Domesticating Mountains in Middle Bronze Age Crete.
Minoan Agricultural Landscaping
in the Agios Nikolaos Region

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Εξημερώνοντας τα Κρητικά Όρη στη Μέση Εποχή του Χαλκού.

Η Μινωική Διαμόρφωση του Τοπίου

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<u>Τριμελης Επιτροπη</u>

Κατερινα Κοπακα

Νενα Γαλανιδου

Ίρις Τσαχιλη

Πρόγραμμα Μεταπτυχιακών Σπουδών
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Κατεύθυνση Προϊστορική Αρχαιολογία

Für meine Familie

\- και για την Κρήτη

Παλάτια δεν εζήλεψα
καλλιά' χω το μιτάτο
κι όλη η ζωή μου να διαβεί
στο γύρο των προβάτω.

Καλλιά στα όρη μοναχός
στο δάσος με τσι πρίνους
παρά σε κήπο με πολλούς
ψεύτικους άσπρους κρίνους.

Από το κρητικό τραγούδι «Ο Μαντρατζής» (Ο Ύμνος Των Βοσκών) του Μύρωνα Σκουλά

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FOREWORD - ACKNOWLEDGEMENTS

One evening in December 2007 I returned from a long day of walking the higher reaches of the study area in the mountains west of Kritsa. Whisps of fog from below let the world around me fade into dusk when I reached my car. Listening to Bach, I navigated contentedly downhill along a rocky, twisty track even my jeep didn't take easily. Turning a bend I suddenly had that well known feeling of having seen something without noticing (like hearing without listening). I stopped and put the car slowly in reverse. The tree in front of me hid something I just couldn't believe: A built structure rising out of a forested part of steep slope, close to the dirt track I had known for years, came into view for about 10 m of the way only some 200 m below (Figure 1).

Figure 1: Finding Site 50. The zoom (right) really shows the Minoan ruin as seen from 200 m above

The sheer possibility of a ca. 4000 year old ruin reaching out of parts of the forest was unbelievable even after having seen quite a lot of similar remains. It turned out to be the highest of the over 330 ruins I saw in the area, with walls over 3 m high (Fig. 2) – and it may be the highest known freestanding Minoan architectural complex[1].

There are still a few hairs rising in the back of my neck when I think of that moment, as I had the distinct feeling someone invisible, something like an "ancient spirit", had given me a hint. This makes me think that the first line of my gratitude should go to the forgotten for eons people who built and used the structures that I am studying here, the Minoans[2].

[1] The region hosts also some of the highest known in altitude Minoan architecture preserved on the surface.

[2] This conventional anthroponymic/etnhic noun and adjective of the Bronze Age inhabitants of Crete, after their legendary King Minos, is so common in archaeology since Arthur Evans that I am going to use it as well, although we still do not know how they called themselves or their kings.

Figure 2: Site 50, main architectural remains

But apart from the "unknown", there are many known people I would like to thank for their help and support.

My warm and sincere thanks go to my supervisor Katerina Kopaka, who believed in this research issue, even when she hardly knew me, mainly because of her valuable experience with ruined wall typologies on Gavdos. Her advice was important to keep it all in shape and her patience was necessary to get a lot of material structured – over a time of nearly six years of study with her.

During the eight years I walked 2000 km of Minoan landscaping, especially my five children have shared many hours of wandering and wondering. The youngest, Lisa, grew up with more hours of tripod legs and *perivoloi* than ballet (Figure 3), my son Johnny measured all kinds of sites and ruins with me, tirelessly climbing over rocks and thorns. They even dared to tackle the measuring of Site 171 with me, which needs more than half an hour of walking through dense macchia to reach and is itself overgrown with heigh thornbushes. And while some of the intricate Minoan ruins and enclosures are actually visible on Google Earth, one can hardly imagine from that how difficult it is sometimes to reach them and study them on the ground.

My best friend and loyal partner in life Christos Galanis taught me all I know about maps and mapping, worked on most maps and refined many files of this thesis. In between, he never refused to discuss every issue that I went through all these years. Also my parents and brother in Germany supported my work from the very beginning. I am grateful for their trust in my ability to complete it, and for their generous funding, without which I would never have completed it. They are the best!

Figure 3: My youngest daughter Elisa “growing up with the Minoans” in every weather (2003-2011)

My friend and example Vance Watrous taught me all I know about Minoan pottery, during the three years of the Galatas survey and the two excavation seasons at Gournia: I feel honoured to participate in his teams. I thank him for reading previous drafts of some chapters of this work, and for greatly useful discussions over the years too. I am also thankful to Joseph Shaw, another example of mine, and one of the genuine pioneers of Minoan architectural studies, who has read several draft chapters of this thesis and gave me precious advice.

I am grateful to: Lynn Foxhall, who gave me some important clues about how to get started; Stefanos Karachalios, geologist of the Lasithi Prefecture in Agios Nikolaos, who discussed the basics of the Tsivi area geology with me and Ioannis Koinakis, geologist of IGME in Crete, who shared the database of some hyetometers of the same region. Anaya Sarpaki always had an open ear when I needed to discuss Bronze Age agriculture in terms of plants, and showed great interest in the old variety of barley still cultivated in the Katharo plain – which I used in my experimental field. I thank Tom Brogan and Eleanor Huffman of the INSTAP SCEC for allowing me to use the Centre’s library; Apostolos Sarris of the Institute of Mediterranean Studies-ITE/FORTH, and Kaiti Sylligardou of the Lasithi Prefecture, for sharing some of their maps with me.

Special thanks are due to the archaeologists of the KD’ Ephoreia of Prehistoric and Classical Antiquities, particularly Villy Apostolakou and Vaso Zografaki, for their longstanding measure of patience over the years of preparation of my thesis, and for spending a lot of time reading my reports and commenting on them with interest; and Chrysa Sofianou too, who discussed all kinds of subjects on Minoan culture with me. Many other specialists in various fields but also non specialists have helped me in various ways, mainly through exchanging ideas on my theme.

Last but not least, my very special gratitude is for the local "keepers" of the Cretan landscape, the men and women in the villages of Kritsa, Kroustas and Tapes who generously spent many hours sharing their everyday life experiences with me. I will only mention a few of them – *pars pro toto*. My oldest informant Zacharias Vardas lived in his *mitato* on Site 172 (!) until he passed away in 2006, aged 86. He still remembered well the old times, when the centre of Pateragiorgis (a sloped region above Kritsa settled since the Bronze Age) was cultivated with barley and vines and many villagers managed to make a living by producing charcoal on the wooded mountain slopes; times when the village pigs were still taken for browsing in the high oak regions by a boy from Kritsa, etc.

A good friend of mine was also Kostis Vardas, born in 1930, who passed away recently, in March 2012 (Figure 5: his old crook was made of *ambelitsia*, the extremely old and now rare tree *Zelkova*, used for the best shepherds' crooks[3]). A shepherd and former mixed agriculturalist, as many others from his clan, he spent most of his life in a small house he had built on Site 62 (!). A fervent discussant on the Minoans –whom he only knew from the advertising figures on his yoghurt bucket before (Figure 5)– he knew how to move big stone blocks by himself: with a lever, time, and patience – and the second course over a ramp of stones and earth, later removed. His wife Zacharenia (and Stavroula Thrapsanioti from Tapes) taught me how to make "dako", the twice-baked local bread, step by step from sowing the seed to baking. There is also Nikos Vardas, whose *mitato* is near Site 198, and who offered me my precious walking stick, used as scale on many photos, which he had made from kermes oak. And Iannis Vardas, a shepherd but also a Cretan lyra solist and poet (Figure 4), with whom I discussed Minoan buildings – and Goethe's Faust! – during a thundery autumn afternoon at one of his *mitata* at an altitude of over 1200 m, not far from Site KR04 and KR01.

From these people, and so many others, I have heard fascinating stories (e.g. that of the famous "Kritsotopoula", who is now honoured with a memorial statue below Lato), and I was taught things that I might never learn on my own. Warm thanks to them all! Their wise approaches to their surrounding world, their care for and closeness to the very soil and stones of Crete, and especially their living interaction with the Minoan remains that I study, gave me the most important insight: that I was not dealing with an overgrown wilderness dotted with dispersed prehistoric ruins, but with a diachronically dynamic human-made landscape which has been hosting and nourishing many people from the distant past until recently and, to a much lesser degree, until today.

[3] *Zelkova abelicea* is a Cretan endemic, among endangered and hence protected species (IUCN Red List of Threatened Species. Version 2011.2), and hence it is now forbidden to make crooks from it.

Figure 4: Iannis Vardas at a structure locally called “sternaki” (possibly a Round Structure? – not far from Site KR01B)

Figure 5: Kostis Vardas at his *mitato* on Site 62

INTRODUCTION

Until the mid-20th century, travellers and scholars visiting Crete, still an "underdeveloped area" by then, attest that "relatively little change has occurred in the agricultural economy and in crop and livestock production since Minoan times" (Allbaugh 1953: 242). This may have been, in many respects, an apt description of the technological level and life standard existing on the island – together with malaria and leprosy – more or less until World War II, if not later.

Since then, Crete has made the quantum leap forward into modernity. Things – including what is going to be the future material/archaeological record – have changed dramatically within hardly more than a generation. While there are still people alive who remember the first car arriving at their village; or who aren't certain that if you flip over a photograph, you cannot see the other side of what is shown on it (Ivanovas 2000). Alas, they are vanishing fast…

This study could not have been done without all those local inhabitants of the studied region who generously shared their knowledge and memories, without any condescending attitude towards the unknown and unknowing person that I was – and I thank them with all my heart for this unique gift. They have made many a mystery of the recent and distant past more understandable for me and gave me thus a tool that archaeologists can rarely find and use nowadays: an impression of life in a region on a technological level akin to the studied ancient one in the same area, with similar resources and similar givens of climate and landscape. They have showed me how manifold the riches of the Cretan mountains can be, if only one knows how to use them.

Their land on the Tsivi mountainous region west of Agios Nikolaos in Crete, at altitudes from 500 to 1400 m (cf. maps in the appendix) is at best "inhospitable and remote" to modern minds (Buxton 1992: 10), and "well above the agricultural zone" (Nowicki 2000: 126). Often it was even seen as warlike, while "the *pax Minoica*, that embraced the civic centres and their immediate surroundings, may not always have extended in an equal degree to the remote mountain fastnesses" (Evans 1928: 79). But this same area has turned out to have a wealth that can hardly be understood by scholars of northern European and US life standards and land use strategies, who were looking for ancient "palaces" and elites and were much less interested in hinterlands – even though the latter must have had an important part in the rise and flourishing of the former.

This study is aiming precisely at an "inside view" of the mountainous hinterland of Bronze Age Crete and its potential social economic structures and practices, with the aid of analogies with pre-industrial strategies, and considering their diversity - in an effort to trace conditions of the past before them, with as few preconceptions as possible from other lands or other altitudes.

a. Subject of the study

When A. Evans first followed his "Mycenaean military road" in this region in 1895, he encountered several "Cyclopean" buildings of "primitive construction" which he called "castles", "forts" or "strongholds" (Evans and Myres 1895, in Brown 2001: 204) and believed to have been parts of a Bronze Age defence system (Figure 1).

Figure 1: Arthur Evans 1895 on the ruins of "Kitten's Cistern" (correct place name *Achladies*[1]) (Brown 2001: 310). Our Site 18

Yet, years later, while excavating and publishing Knossos, he established his insight of a highly sophisticated and placid Cretan Bronze Age society, which prevailed for many years in archaeological approaches of Minoan culture. Towards the last third of the 20th century scholars began to question this peaceful image, especially while returning to a closer study of massive

[1] For the problems with toponymns used by various scholars in the studied region see Appendix G.

Minoan structures, in particular in the far East of Crete (Alexiou 1979; Tzedakis et al. 1989; Chryssoulaki 1999; Schlager 1999, Zielinski 1998, Alusik 2007)[2].

The present work is the outcome of years of exploration (mainly between 2003 and 2009) in the wider region mentioned by Evans. During numerous visits, more than 330 Minoan sites were discovered[3], accompanied by scatters of almost exclusively Protopalatial pottery and lithics (see Ch. II.c). The discovered sites were regularly reported to the Greek Archaeological Service - (ΚΔ' Ephoreia of Prehistoric and Classical Antiquities, Agios Nikolaos, Protocols nos 00706/18-3-2004, 01089/27-4-2004, 01506/27-5-2004, 01925/2-7-2004, 01157/16-5-2005, 6-2006, 1-2007, 3-2007, 12-2007)[4].

Indeed, when leaving the known track, it becomes obvious that these so-called "watchtowers" in "cyclopean" or even "megalithic" style~~,~~ are after all located not only along the road (which Evans probably never left, as all the ruins he recognised are ones close to it), but are more or less evenly spread all over the mountain-side (see Ch. II.b.B). Many of them are situated next to small agricultural plots (some still in use today) and surrounded by typical enclosure walls of the same large-block architecture which shall be named "oncolithic" here (see Ch. II.b.A) and considered characteristic of the Middle Minoan or Protopalatial period.

The studied dwelling ruins (named thus in distinction from other wall remains, cf. Ch. II) are arranged in a peculiar dispersed settlement pattern, isolated but usually not more than 300 m apart from each other, and interconnected by a network of paths/roads that also includes local caves and water sources. Over 50 of them are still preserved up to over 1,5 m, mostly due to the lack of destructive human activities in the area in post-Minoan times.

Here I intend to map, analyse and catalogue systematically the sites that I discovered, in terms of their topography and architecture. Further chapters are dedicated to discussion towards some interpretative suggestions as to their character, functions and wider exploitation patterns (see Ch. II.d.4, Ch. III).

With the help of comparative data derived from the ethnoarchaeological survey that I conducted in the region (see Ch. I.b) I will try to show that these Minoan architectural complexes must have been used as farmsteads for mixed agricultural activities, and that the various kinds of walling they included were intended for animal husbandry. Traditional, i.e. pre-industrial, Cretan mixed farming practices have been (and in some cases still are) taking place in the same area, in more or less the same landscape setting as in the Bronze Age, and often even using the very prehistoric structures. So, the ethnoarchaeological approach is a convenient methodological way

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[2] Interestingly, studies about massive towers of the Greek mainland and some islands show the opposite epistemological trend over time, i.e. a clear "de-militarisation" in existing interpretations (cf. Morris and Papadopoulos 2005: 159).

[3] In 1948, at least ten of them were also known to S. Hood (Brown 2001: 202). Several sites "emerged" after I had closed up my catalogue – hence, their numbers in the text may differ from the catalogued 336 ones, and from those appearing on some earlier charts that were not easy to update. New sites will certainly continue to "emerge", especially in more remote areas investigated less thoroughly than I would have wished.

[4] For further reports on sites not studied here, see also Protocols nos 2111/16-8-2002 and 2342/5-9-2002 (ruins in the mountains south of Malia, some of which are mentioned in Müller-Celka 2004).

to get some glimpses of a functioning version of the local *hinterland* – that must have hosted just as few princes and/or warriors in antiquity as in recent times, but must have contributed a good share, instead, to the supplies needed by the Minoan elite centres in order to reach the cultural peak of the middle of the 2nd millennium BC.

b. Problems and questions

As already mentioned, a main question raised by the studied Protopalatial sites is if they result from a warlike tendency of their times and a need of constant readiness for defense. Is it correct to equal massively built structures with expressions of crises and overall difficulties? After all, most probably the *Pax Minoica* was nothing like that, as recently suggested (Nowicki 2000).

Moreover, local habits and attitudes can be easily misinterpreted by "outsiders". For example, collecting of wild edible herbs and vegetables is ~~still~~ today a popular pastime even of bourgeois women in Crete, and some kinds of *χόρτα* are conceived as delicacies and sold at high prices in the markets. This activity is based on an original practice of securing a diversified diet, but is still sometimes interpreted in the sources as a way of finding food in difficult times (Horden and Purcell 2000: 80/81). Yet, wild vegetables were and still are normal dietary elements/supplements in Crete – and, as a rule, not famine foods.

The interpretation of the massive ruins in the mountainous region west of Agios Nikolaos as parts of a military concept may be a comparable example of a certain scholarly tendency to first suspect "the worst", the most "violent" explanation for many phenomena – and history shows that this is right on many occasions from Mycenaean fortifications to the Berlin Wall. Still, in this study I will adopt the initial standpoint that these sites were structural elements of a "peaceful and mutually beneficial social and economic interaction" in their times – just like the Protopalatial sites in the Kavousi area for which this phrase is meant (Haggis 2005: 71). This certainly does not mean that I deny the possibility of Minoan warfare, but that I suggest that war was not a determinant factor of their constitution, at least on a local level.

But if we accept the agricultural interpretation, instead, a second question would be if this rigidly and complexly structured mountain territory reflects a centralised background, i.e. state planning, financing and administration for the needs of a widely varied mixed farming exploitation; or rather a communal initiative, i.e. of nearby coastal settlements, to cultivate these mountains, e.g. as a result of more or less random environmental or other reasons, like drought, exhausted plain soils etc. Although quite unlikely, the latter cannot be excluded according to the material record at hand, especially when taking into account the well planned road network – after all the centralised planning of roads is often an impossible endeavour still in modern Crete and can hardly be imagined without a well functioning infrastructural management.

If we opt for the interference of a central Minoan authority, where was it situated? Some would include our region in the cultural cycle of the "Malia state" (recently, Betancourt 2007: 209; but cf. Knappett 1999). Yet, why could it not belong to the territory of a still unknown (palatial?) elite, maybe settled for instance at Priniatikos Pyrgos[5] or even hidden under modern Kritsa[6] in the closer neighbourhood of our sites? Furthermore, were the occupants of the studied sites working for subsistence only, or would they produce also a surplus destined for some urban area (see Ch. II.d.4)?

Finally, why did this well established Middle Minoan mountain agricultural economy come to an end, apparently before the Minoan cultural *floruit* of the time of the New Palaces? Related speculations cannot provide any answers to this question. It is wiser to wait until hopefully in the future some of our sites are excavated and give a better sequence of pottery and other finds and data, which would shape a clearer picture of how they were abandoned.

c. Research methods

"We must develop ideas and theories (middle-range theory) regarding the formation processes of the archaeological record. Only through an accurate understanding of such processes can we reliably give meaning to the facts that appear, from the past, in the contemporary era."

Binford 1977: 7[7]

"Ethnographic engagements have to challenge archaeological expectations [...] we have arrived at a point where "material correlates" seem to stand emblematically for ethnoarchaeological knowledge despite the well-established diversity of ethnoarchaeology's practices. [...] The neoevolutionary anthropology from which the New Archaeology emerged believed that societies could be fruitfully compared. Modern societies might then serve as ethnographic analogues for the ancient societies that produced the archaeological record, providing that they shared key attributes such as subsistence strategies or socio-political structures"

Cunningham 2009: 116, 117,118[8]

Archaeological theory has moved on since L. Binford's version of "middle-range theory"[9], past processual and post-processual reasoning. Today, in an expression of theoretical pluralism, archaeologists can and, eventually, have to choose and combine a variety of approaches to always keep archaeology "new".

[5] Where the Irish Institute of Hellenic Studies at Athens is excavating a settlement with a rich Minoan stratigraphical sequence (http://www.iihsa.ie/ppex.html – last accessed 23-12-2011).

[6] Evans (1909: 279) mentions Protopalatial pottery that he bought from a place called (Prodromos) Botzano – which is nowadays close to the central square of Kritsa. Large amounts of MM I to Neopalatial pottery (and probable Early Minoan pieces), some of nice quality, appeared in 2007, during the installation of a telephone cable along the main road through the centre of the village, passing the square. But the absence of Minoan surface pottery in the area slightly further downhill in Kritsa suggests that this site would be of limited size.

[7] Cited in Raab and Goodyear 1984: 260.

[8] The author also gives a concise summary on the differences between a) processual and post-processual archaeologists, and b) ethno-archaeologists, as for the acceptability of ethnoarchaeological data for archaeological "middle range" interpretation as a whole, and provides relevant recent bibliography.

[9] Which did not remain without criticism (e.g. Raab and Goodyear 1984).

In this study, the term "research methods" is taken to mean a) the acts by which archaeological knowledge is gained and classified, and b) "a mechanism which enables us to move from evidence to interpretation" (Cunliff et al. 2009:179)[10].

Archaeological Study

Already during my initial informal walks, mainly between 2003 and 2009, I soon realised that the usual grid based survey systems as used in other Cretan surveys (e.g. Gkiasta 2008) would not be adequate for this human made setting, criss-crossed with long parts of unpredictably shaped ancient enclosure walls, often traceable only by strictly following their track though the landscape. Due to the chronological predominance of all the discovered sites to the Protopalatial period, (very few sites have pottery also dating to LM III and other phases - see Ch. II c 1), the study focused from the beginning exclusively on the former. Thus, no historical "stratigraphy" of the landscape was ever intended, and the approach on the field is not that of a systematic surface survey in any way[11]. During the mapping part of the study, I also realised that it was better to work without the distraction of company (I often had to search again enclosure walls of which I had "lost" track on my first investigation walk with company). It also became clear that several sites with impressive architecture (e.g. Site 8, with a well preserved dwelling ruin) didn't show any traces of pottery (or only very little, cf. Ch. II c 1). This is mainly why architectural typology became crucial for my study, as it was necessary to understand and be able to explain why even without movable finds, a site "looked" – and was – Minoan" and even "Middle Minoan". With time and experience, it became possible to detect also ruins hidden in dense underbrush – e.g. when I understood that the closer to the main building the larger the stones of the enclosure walls became (see below Ch. II.b).

Mapping landscape and architectural features

Landscape analyses and mapping techniques in this work are based on Geographical Information Systems (GIS) in functional interaction with architectural classification or typology (details of the latter in Ch. II.b). Geo-referencing of the studied archaeological features, mainly dwelling ruins, enclosure walls and road-tracks, was an important task that permitted to localise and visualise related data on diverse maps. Over 15.000 photographs were also geo-referenced to show as closely as possible (usually with a precision of ca. 4-5 m) where they were taken.

More specifically, wall structures, identified by their architectural characteristics, were traced with a Global Positioning System (GPS) satellite receiver so as to record their topographical position on digitised maps, aerial and satellite photographs and Digital Elevation

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[10] The terms "methodology" and "method" are mostly used synonymously in English publications (Bell 1994: 15), but have considerably different meanings in Greek and German. For basic differences of *Methodologie* and *Methodik* in German see for instance http://de.wikipedia.org/wiki/Methodologie (last accessed 11-8-2012).

[11] The sparse traces of other phases were recorded no more than *en passant*, and did not play any role for the further study. Still the overall absence of almost any later phases until the middle of the 19th century AD seems certain after my intensive work in the area. For this reason, a future multidisciplinary systematic survey approach (Gkiasta 2008, Ch.2: 3) does not seem very promising.

Models (DEM) for further spatial analysis (map and three-dimensional visualisation, spatial relationships and land use). Especially in cases of poor surface visibility (due to erosion or plant cover), predictions possible through the thus produced maps (mainly on the various types of aerial photographs) provided an important tool for archaeological research: enclosure walls may be visible from above either as thin, well defined light coloured lines (visibility of stones) or as slightly thicker and less well defined dark lines (where the better growth of underbrush along or on top of ancient walling emphasises the original built structure and bearing on the images).

Satellite images with a resolution of 0.6 m/pixel were the most detailed available ones at the time of my study, and a set of Quickbird images (DigitalGlobe) of the study area was acquired[12]. Since ca. 2009, high resolution satellite images (ca. 1 m/pixel) available on the Internet (e.g. Google Earth) produced some additional information. For example, a temporarily available satellite image of our region taken in late November (2003) showed more clearly – through the larger shadows caused by the relatively low position of the sun at this late time of the year – various kinds of wall systems and features (e.g. the round black shade of the Minoan cistern at Site KA20, which was thus first detected on a Google Earth image). The analysis and understanding of features visible on such images certainly need a lot of time and training in order to decipher what they might actually show. Also, all possibly visible rocky features need to be cross-checked *in situ*, as the available resolution (0.6 m/pixel means only stones larger than that have their own pixel/s and can be clearly recognized) often gives no clear indication as to which of the visible lines correspond to natural and which to man-made features. Higher resolutions, now available only for military use, might make in the future a big difference for archaeology.

Digital information (vector and raster data) was processed mainly on two computer programs, namely OZI Explorer (www.oziexplorer.com) and Global Mapper (www.globalmapper.com). Three-dimensional modeling was done where needed with the free program Google Sketchup (www.sketchup.com). Topographical maps 1:5000 (original projection “Hatt”[13]) were kindly provided by the Geological and Technical Departments of the Lasithi District administration[14] or were acquired from the Hellenic Military Geographical Service (GYS, see www.gys.gr). Low resolution DEM maps (90 m[15]) of the study area were available through free download at http://www.usgs.gov. A higher resolution (10 m) DEM map was kindly provided by Dr. A Sarris and the Institute for Mediterranean Studies, Rethymno (Foundation of Research & Technology/ITE). Although the higher resolution is, of course, much more reliable for 3-D modelling, only a detailed DEM based on the map used can produce results for an accurate site analysis. For our region, a DEM based on the 4 m isoheights on the 1:5000

[12] My special thanks go to my parents, Gisela and Gerhard Beckmann who have funded this acquisition.
[13] My deepest thanks are due to my partner in life, Christos Galanis, who re-projected the Hatt-projection maps, which I acquired initially, into the WGS 84 maps generally used today in cartography. He has also produced a detailed hand-made DEM map (where each isoheight is drawn by hand – a herculian task) of parts of the study area.
[14] I thank sincerely the geologist Stefanos Karachalios, also for discussions on various geological issues, and Kaiti Sylligardou, responsible for maps.
[15] I.e. one measure of height is taken every 90 m, and the area in between is interpolated. This minimal precision is of very little use for a landscape profile like the one studied here. A better version has been added to the website recently.

maps, which is at present the only workable method to visualise e.g. dwelling ruins as they actually are on the side of small hills (and not on top of them or in the next valley, as Google Earth related DEMs would show – they are notoriously unreliable for this).

Practical procedure: after recording a walked-over Minoan enclosure wall, a digital track was produced from a GPS-receiver‘s Log file on a map. The original track lines often look untidy because of necessary walking "detours" due to environmental obstacles, e.g. bushes etc. Thus lines on the map usually need to be homogenised to produce an image of the actual enclosures. The use of various colours distinguishes different features, like walls surrounding enclosures or roads. Positions of buildings and other important features (round structures, water sources, caves etc) are entered into the software as waypoints. Hence, for instance, the fact that a cave is also served by the Minoan road network becomes visible. By creating distinct area features, various landscape specifications of a given region can be visualised (e.g. areas with good or medium good soil to determine arability and land use possibilities also for the Bronze Age.) A detailed contour resolution (3-D) gives a clearer impression of spatial interconnections, e.g. of how field areas relate to terrain in valleys (with alluvial soil, good soil) or on terraces (on rockier slopes, medium soil (Figures 2, 3)[16]. See also Ch.II.d.4 and Beckmann 2008.

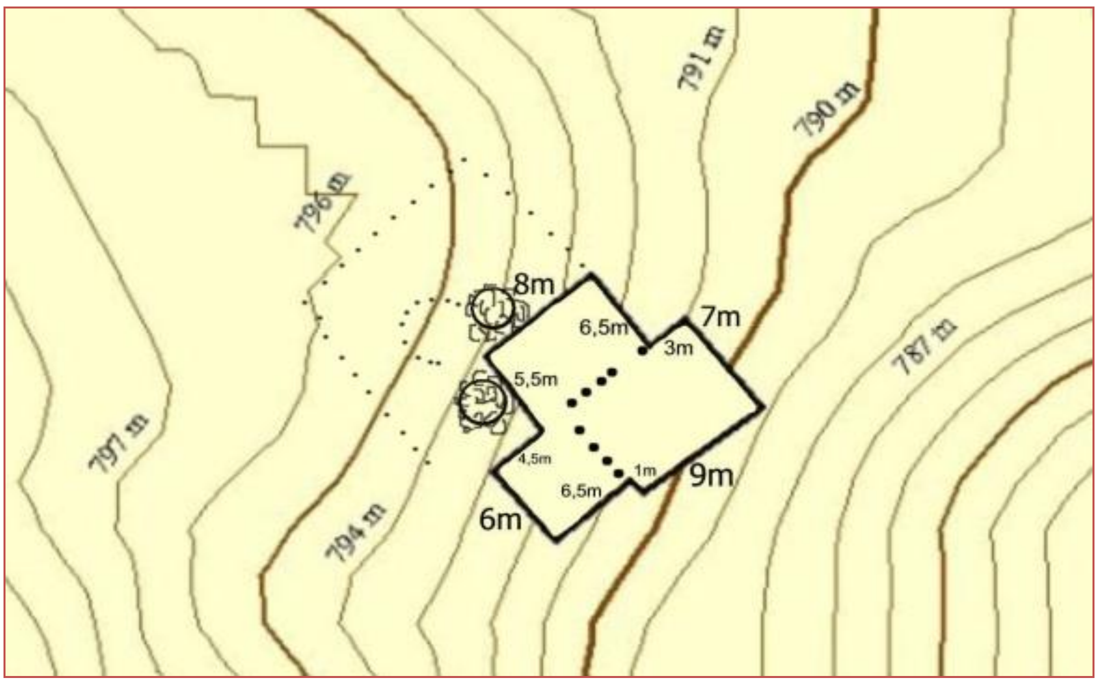

Figure 2: Site 33. Architectural remains, position and features

[16] The interrelation/synopsis of 3-D architectural features within the 3-D data of the landscape needs expensive software, that individual scholars cannot easily afford, and does not add enough useful information to us here. With a much larger financial investment, more precision could be reached – and our methods here are sketchy compared to the immense effort in topographic precision achieved by similar projects elsewhere, (e.g Chrysokamino, Betancourt et al. 1999: 349: "As a result, even tiny man-made features were located and accurately positioned on the maps, so that their topographic relationships can be better understood"). But how necessary is such a high precision for the position of e.g. agricultural terraces?

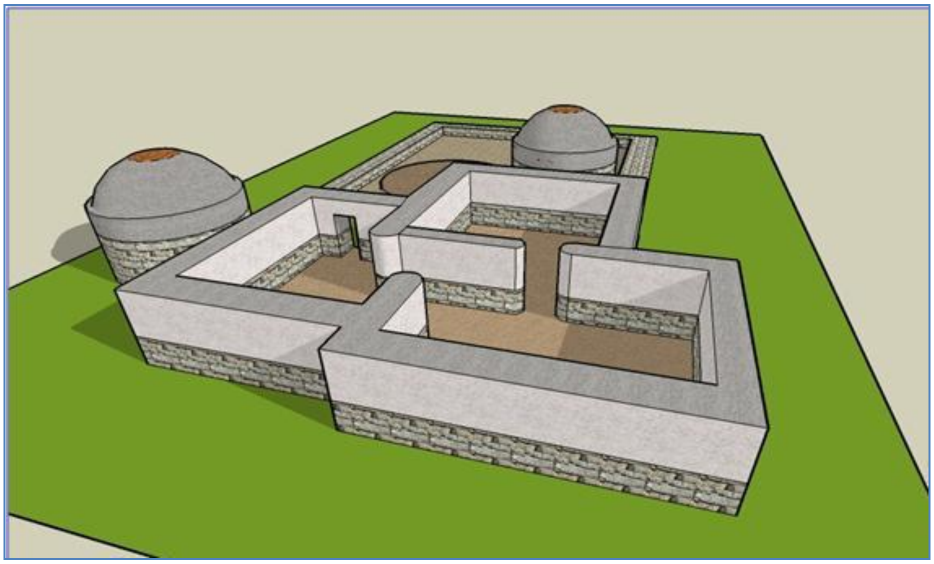

Figure 3. Site 33. Dwelling ruin, 3-D /reconstruction from E (Google Sketchup)

Dating and measuring the sites

The traditional method of dating our sites with the help of surface pottery and other finds, mainly the few typical lithic artefacts, visible in the vicinity of the dwelling ruins, was employed (see Ch. II.c 1-2).

Yet, measuring the site size by the spread and overall density of pottery and other finds cannot be considered fully accurate within clearly sloped areas like those studied. Sometimes, sherds from small dwellings (recognised by their architectural remains) may wander downhill up to 150 m (see e.g. Site 19). Also, different kinds and degrees of erosion and surface visibility in small areas, mainly due to landscape idiosyncrasies like slopes, ledges, dolines, ground cover (e.g. pine needles) show that, in our case, traditional survey methods of pottery analysis for the investigation of site "importance", hierarchy, even function etc can be rather misleading (but cf. Ch. II.c for a possible interpretation of "off-site pottery") Let us illustrate this with only a few out of the many available examples.

a) The small area between Sites 125B and 132 forms a depression. Pottery from both sides would have collected near its lower part (and covered by colluvial soil). Although the surface showed not a single sherd, while opening a dirt road, a bulldozer brought to light plenty of pottery at least on the side of the depression towards Site 132.
b) Site 169 involves an extensive and well preserved dwelling ruin and an inner enclosure wall-system covering an area of ca. 700 sqm. Yet, due to dense ground cover, no more than 2 tiny sherds could be seen – and after a long search.
c) Site 4 lies on a steep slope, but a small natural ledge some 50 m below the dwelling ruin has held large amounts of pottery there – much more than anywhere closer to the construction.
d) Site 110B (not in the site catalogue; discovered quite recently ca. 100 m west of Site 110) has not yielded any pottery, after intensive investigation in the heavily eroded soil below and around it, and a pottery-oriented survey would have to ignore its dating. The slopes below the ruin are

very steep, and the surrounding soil has gullies of washed out topsoil, maybe as a result of recent overgrazing. With time and more winter rains, some sherds may appear in the future (as in the case of Site 8, where I found a few pieces of pottery several years after its initial discovery).

Consequently, in this work, pottery is tentatively conceived as a tool for: a) basic chronological information on the studied sites and b) a very general impression of their status, place in settlement hierarchy and function (e.g. by the presence and prevailing of coarse ware). These prerequisites may change with further study/excavation, they should be seen as no more but first suggestions.

Similarities in architectural features of both the dwelling ruins and their enclosure walls (see Ch. II.b), their shared topographical traits, and their dating as suggested by surface pottery/lithics were combined in order to assign the whole landscaping initiative around the studied settlement region of sites to the same phase of the Middle Bronze Age.

Several databases were created for various kinds of information (see Ch. II) the main parts of which are included in the Appendix. My archive of digital photographs, created over all these years, and the GPS track logs (geo-referencing) are used to document the collected evidence (dwelling ruins, enclosures, roads, moveable finds etc). Some of the photographed monuments have already vanished with time… Detailed GPS data will be deposited with the ΚΔ' Ephoreia at AgiosNikolaos upon completion of this thesis, together with a copy of it.

Ethnoarchaeological approach

In our effort to understand the Bronze Age material remains studied, ethnoarchaeological comparison is used[17]. It should be noted, though, that this is not a case where "behavior that, like the technology, has somehow been perpetuated through time despite modernity's encroachment into other areas of social and cultural life" (Cunningham 2009: 120) as the "somehow" of continuity in perpetuation may easily be illusionary (cf. Beckmann 2012 b). This study shows, instead, that, in pre-industrial technological contexts, it is quite possible to detect cultural analogies and differences as human responses to similar physical and environmental conditions (geography, climate, availability of natural resources…), even without a continuous tradition. Thus I do agree with J. Cunningham:

"Ethnoarchaeology's primary objective is to refine the background knowledge archaeologists use to interpret the past [...] not to avoid becoming entangled in modern cultural complexity, but to revel in those experiences and use them to further archaeological investigations […] acts of translation make ethnoarchaeology uniquely positioned to produce bodies of theory that explain how the structural patterns observed in the archaeological record articulate with the fluidity of daily human practice". *Cunningham 2009: 123, 124*

[17] For the growing archaeological interest in ethnographic data, after a long period of scepticism, see e.g. Efstratiou 1990, contributions in Kardulias & Shutes 1997, Ruschenbusch 1998, Christakis 1999, Cunningham 2009, most of the work of C. Chang, H. Forbes and P. Halstead.

Ethnographic data collection

For the needs of collecting and understanding in depth ethnographic evidence, I created a small relational database resulting from semi-structured interviews (cf. O'Reilly 2005) conducted irregularly during fieldwork with a number of senior locals, i.e. men and women, old enough to remember or even have experienced traditional ways of everyday agricultural and animal husbandry practices (see Ch. I.b.D). The number of suitable informants for my long list of questions was unfortunately small in the end, as people with a clear memory of the 1950s-1960s (and adequate communicability) are extremely rare in the region today, and from many informants I could get no more than some glimpses of what their pre-industrial former, traditional lifestyle was like.

Informants were asked about their personal condition *vis-a-vis* local land use (agriculture and animal husbandry), and about the when, where and how the mountain slopes were exploited by each family/household[18]. Information provided thus fills a serious gap of the available statistical data, which do not consider mountain regions independently but co-evaluate them with those in the lowlands (or highland plains), although these are very different in many aspects, from climate details to soil and plant varieties (horizontal spatial/ecological varieties).

Certainly, oral information on how things were 50-60 years ago is not always reliable and hasto be taken *cum grano salis*. Moreover, for the sake of a good narration, facts may be changed in different ways and to various degrees (see also Ivanovas 2000). For Cretans, "remembering the old years" may become an art in itself. Depending on the personality of the informant, he/she will assume what the interviewer wants to hear and thus "shape" information to make him/her as "happy" as possible with the answers (see also Herzfeld 1985[19]). Hence, when in my interviews/conversations numbers or other data seemed to become too aberrant and the informant's "narrative" tendency too obvious, I would slightly change questioning tactics to give a different idea of my expectations. This would usually lead to a more moderated version of the same account. The database could not show this process, but involves some inconsistencies resulting from it and hence was not reproduced here in detail.

Still the general idea of the state of traditional land use in the studied area became clear enough thanks to these conversations and I learned a lot, from local bee keeping to tool sharpening.

An ethnoarchaeological experiment

For a better understanding of pre-industrial, and, using analogy, possibly also of Bronze Age, agricultural practices on this Cretan mountain zone, I cultivated experimentally a small field

[18] It is interesting to note how gender-specific some information/actions must have been or seem to have been seen. For example, the fields were prepared by men especially if they were large enough for ploughing, whereas the mostly tiny fields in rocky areas were worked with hoes by women and children.

[19] This seems to be more of a male phenomenon. It is interesting to note that M. Herzfeld himself must have fallen victim to this at times during his fieldwork in Crete - still remembered by some of his informants (together with the way they "embellished" their stories) with obvious glee. I learnt of this – now as a narration of a narration – in the 1990ies from locals in one of the villages studied by Herzfeld (Zoniana, called "Glendi" in the book).

(12x12 m) of barley for one season in the area of Pateragiorgis (at ca. 800 masl, near Site 24), following native advice (method and outcomes in Ch. I. b).

Presentation – Text and CD Appendices – Basic conventions

This work consists of the present printed volume with the main text and a CD which includes several Appendices. More specifically:

The Appendix Preamble involves an explanatory chapter for all available files, repeats the established typologies for easy perusal, and includes a general Glossary.

Appendix A includes several general maps of the wider region, plus the Main Map of the whole studied area subdivided into 100 cell grid elements where all of the studied sites (including enclosure walls and roads) can be looked up at various zooms, on a background of isoheights of 10 m (the gridded map was produced by C.Galanis).

Appendices B and C provide drawings of some well preserved site-types – main structures and surroundings, and Appendix F drawings of the grooved ground stone tools from the region.

Appendices D presents the detailed catalogue of all sites in the whole Tsivi South region discovered until December 2011, including where possible details on architecture, topography and related pottery.

Appendix E gives a list of the related Round Structures[20] (circular ruins, cf. Ch. II b).

Appendix G, finally, gives a list of local toponyms and a map with their distribution. Existing confusion in the archaeological bibliography is briefly discussed.

In the text, Greek words transcribed with Latin characters (in italics) follow their pronunciation as closely as possible. These terms are used to convey a meaning that cannot be imparted in English by one term – for example, *perivolos* stands for the Greek περίβολος and connotes, here, both an enclosing wall and/or the space it encloses – in cases of uncertainty, "*perivolos* wall" or "*perivolos* area" are also used (see Glossary in the Appendix preamble for the explanation of the respective terms).

Chronological framework

The studied architectural remains are dated, as a rule, to the Protopalatial or Old Palace period between MM IB-MM IIB (some pottery traces may even be slightly earlier, i.e. MM IA), beginning thus by the first century of the second millennium BC (e.g. given as 2000-1700 BC in Shaw 2006: 11).
In recent years, new methods and finds pushed this chronological framework backwards in absolute chronology. The late Prepalatial period (MM IA) is now seen as starting possibly by 2200 BC (Schoep et al. 2012: xi) while the period of the First Minoan palaces (MM IB-MM II) is considered to reach either 1850 or 1700 BC (ibid.). The following Neopalatial or New Palace

[20] Capital initials are used for the general sites and some structures in them, e.g. Site 50, Round Structure 33.

period (MM III-LM II) started with generalised destructions over the whole island and is thought to last until c. 1460/1410 (ibid.), or, in Knossos, until LM IIIA (1375 BC – see Shaw 2006: 11). The Postpalatial period (LM III or LM II-III according to Shaw) covers the time 1420-1050 or 1470/60-1420/10 BC (Schoep et al. 2012).

As, at present, Minoan absolute dating are apparently re-discussed by specialists, and the surface pottery from our sites does not contribute to chronological refinements, I shall refrain from more specific dating and refer merely to "Prepalatial", "Protopalatial" and "Neopalatial" periods – and LM III where necessary. Any closer chronological detail shall have to await future excavations.

Abbreviations

General
p. – page
Ch. – Chapter
App. – Appendix

Chronological
BA – Bronze Age
EM – Early Minoan
FN – Final Neolithic
LM – Late Minoan
MM – Middle Minoan
NP – Neopalatial
PP – Protopalatial

Measures
cm – centimeter
ha – hectare
m – meter
km – kilometer
sqm – square meter
masl – meters above sea level

Geographical
N – North
S – South
E – East
W – West
NE – North East
NW – North West
SE – South East
SW – South West

Mapping
DEM – Digital Elevation Map
GPS – Global Positioning System
GIS - Geographic Information System
GYS – ΓΥΣ: Hellenic Military Geographical Service – Γεωγραφική Υπηρεσία Στρατού

CHAPTER I. GEO-CULTURAL FRAMEWORK

a. Description of the study area. Geology, landscape, environment

1. Topographical and geological setup of the Tsivi South area

The region studied in this thesis is located in eastern-central Crete on the eastern slopes and foothills of the Dikti massif (see maps in appendix). With its highest peak at an altitude of 2.148 m, it constitutes one of the two central mountain ranges of Crete. The peak dominating the studied area is called Katharo Tsivi or simply Tsivi (1.663 m). Its slopes facing the South and Southeast (hence Tsivi South area) are situated above the villages (N>S) Tapes, Kritsa and Kroustas, at a distance of 400 m to 7 km from each other.

As far as we know today, the region of the Minoan settlement described here covers a high zone area of ca. 35 km^2, between ca. 500 and 1.400 meters above sea level[1] (see map Figure 1). It is bordered and defined: to the East, by the steep rocky fault west and south of Kritsa – our sites reach down to the lowest point above Kroustas at ca. 500-550 m; to the North, by the main slopes of Mount Tsivi and the northern of the two main arms of the upper dry riverbed of Kalos Potamos stream (*cheimaros*), also called Xeropotamos[2], passing from the Kritsa Cypress Forest via Epano Tapes. To the South the border is constituted (S-W of Kroustas) by the southern branch of Xeropotamos – i.e. our main settlement area lies between these two deep torrent valleys; to the west by the mountain range east of the Katharo plain (highest peak: Plateia Korfi, 1.485 m and its continuation to the south-west of the Chalasmeni Korfi, 1.392 m) that is only disrupted by one major passage, at two of our highest Sites KR 01, KR 01B (Stsi Ringous) ca. 1.250 m. The southern tip reaches the Xylosyrtis ridge (ca. 1.000 m high) between the Katharo plain and Kalamavka, immediately west of another steep (fault?) cliff at Site KA 11 – a few more sites are located further downhill, but the continuous settlement with *perivoloi* stops below 800 m. The KA-Sites, on the south-facing slopes above Kalamavka are separated from the main settlement area by the ridge of Xenogiorgos (1.164 m) and communicate by two passages near Sites 168 (950 masl) and KA 08 (970 masl) to the North and South of the watershed.

The northernmost sites are situated along or close to the main path (partly dirt road) and several smaller parallel paths connecting today the village of Tapes to the Katharo plain (Sites 3-10 and 32). Several other paths connecting the eastern lowland and coastal area and the plains of Katharo and beyond Lasithi are also marked by Minoan sites. This distribution shows that the same natural passages were in use at least since Minoan times.

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[1] Altitudes are given in meters above sea level (masl).

[2] Or "Dry River". As this name shows, in recent times this stream provides only rarely some winter water; but it may have been an important source of water in antiquity. The two branches of this stream join to form the-Kalos Potamos ca. 2,5 km E of Kroustas, that reaches the sea at Kalo Chorio/Priniatikos Pyrgos, ca. 4 km to the NE.

The geological structure of the region consists mainly of carbonate rocks and conglomerates, of different quantities and varieties. At places, phyllitic-quartzitic[3] layers appear usually close to springs and/or wells and zones with shallow water table distribution (map Figure 1).

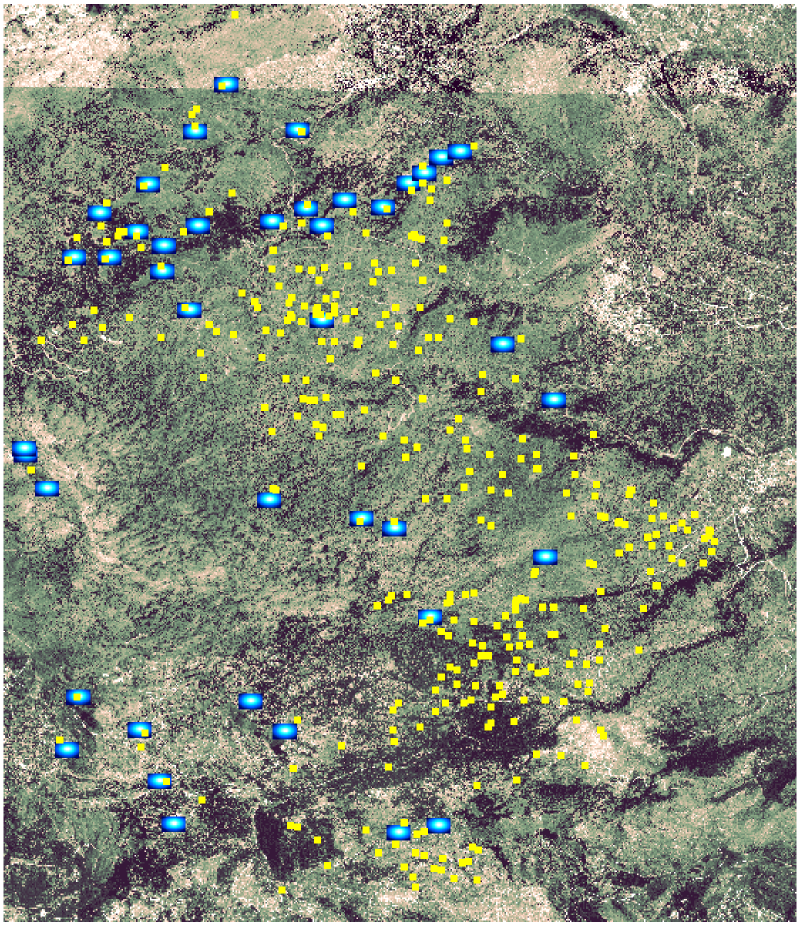

Figure 1. Satellite image map. Minoan sites (yellow) W and S of Kritsa & Kroustas (light plots centre right); water-bearing areas/springs & wells (blue); forest coverage (dark patches: dense, dark spotted: thinned by humans)

Where limestones predominate, landscapes are extremely porous and carstic, involving typical washed-out slopes, dolines and caves. This carstic character also encourages the formation of fertile alluvial and colluvial deposits along runoffs and in doline depressions, constituting thus one of the basic conditions for the agricultural value of this zone. Together with the higher rainfall in Katharo Tsivi's lee (below, Climate) we find here also the cause for the relatively dense natural pine and cypress forest cover (Figure 1 and below, Vegetation). The phenomenon of fertile sediments "wandering" downhill with winter rainfall is also the reason for the ubiquitous terracing of the slopes (below, Terracing). The largest karstic depression close to the studied area is the high polje of Katharo (height ca. 1.000 m, size ca. 9 km^2) west of and below the westernmost of the studied sites. This upland basin is the traditional region for transhumance in summer for several nearby villages (see Ch. I.b). During parts of the Pleistocene this area is supposed to have been a lake leaving behind

[3] Cf. the similarities in the Lasithi plain, Watrous & Blitzer 1982: 6.

its typical lacustrine deposits with fossils of various dwarf mammals characteristic for the Cretan Pleistocene (Lax 1996: 21, 22; Fassoulas 2000: 94), datable to 850 000-375 000 BP (Lax 1996: 22, Reese et al. 1996: 48).

Under the limestone and conglomerate layers of the main rocky substructure, raised near Kritsa at a fault cliff ca. 100 m above the village, lies a strong layer of grano-diorite, especially visible in the area of Agios Ioannis Theologos, between Kritsa and Kroustas. This is similar to the one known at Gournia (e.g. by the church of Panagia, 750 m W of the Minoan town) and at Kalo Chorio/Istron (Hayden 2004: 14, Hayden 2005: 6)[4]. Where exposed to the weather, this layer crumbles easily, and produces a well distinguished sandy sediment in the Xeropotamos below Kritsa, already noted by Raulin (1858: 156)~~.~~ Together with the phyllitic clays available e.g. in areas like Agios Ioannis/Flej (3 km W of Kritsa), this has been used as a temper for local pottery at least since Early Minoan times[5] (for grano-diorite in local pottery see Ch. II.c.1).

The same phyllitic layers (at the water bearing places in the map Figure 1) also contain at places noticeable amounts of steatite: greenish-brown (Agios Ioannis/Flej, the unique source within the studied area) greenish dark (Tapes) and light green (Katharo plain) – the only deposit known in the area (Jones et al. 2007, Y. Bassiakos, pers. comm. 2009). This stone was used mainly for jewellery at least since EM and MM times, as shown by steatite beads and waste pieces on the surface of Minoan sites (see Ch. II.c and Appendix D). It is interesting to note that the greenish steatite here always occurs close to water sources, a connection that may have been important for the choice of this material in terms of its symbolic value.

Apart from these few clayey areas, soils around our Sites consist mostly of terra rossa, the typical Cretan mountain soil, a fertile product of decomposition of limestone (e.g. Wallace 2000) mixed to light to dark brown humous in the forested areas. So, this apparently rocky, arid and rather barren area is nevertheless dotted with many small to tiny colluvial humus-rich soil deposits, which provide a good basis for small scale agriculture.

2. Hydrology

The Tsivi South area is drained mainly by many small torrents that feed the *cheimaros* of the upper Xeropotamos riverbed in its two broadest branches which delimite the larger part of the studied region. Their junction forms Kalos Potamos ("Good River")[6] and meets the sea at Kalo Chorio/Istron/Priniatikos Pyrgos bay, ca. 9 km SE of Kritsa and 7 km of Kroustas[7]. In the Venetian period there was running water at least at its coastal part. Most probably this water originated from

[4] This grano-diorite occurrence around Kritsa is not introduced in the geological maps of the area and is usually not mentioned in the archaeological literature. Yet, the rock is reported as a local temper for the pottery of ancient Lato in Hayden 2004: 32, n. 39, where it is connected to a respective outcrop along the Agios Nikolaos-Kritsa road.

[5] One of the small EM sites in the Agios Ioannis/Flej valley shows on the surface a very characteristic fabric of EM coarse ware with pure grano-diorite temper in rather large, rounded pieces of 1-3 mm in a buff matrix (later and elsewhere grano-diorite temper appears more in much smaller angular pieces).

[6] The fact that Venetians noted rivers starting from the sea in the area (Rackham & Moody 1996: 60) justifies this change of name.

[7] But cf. Moody & Rackham in Hayden 2004: 17, where a different Xeropotamos is mentioned (!) and Kalos Potamos is called Istron River (elsewhere in the text also Kalos Potamos).

the copious spring at Pyrgos, which is still active today and sometimes provides water to the Kalos Potamos riverbed down to the sea until May[8]. Even in the 19th century, Kalos Potamos was still a year-round stream (Spratt 1865: 138)[9].

But today it is only during the winter that several upper branches of this natural drainage do have running water for some weeks, especially after strong rainfall. Humidity plant indicators like oleander (*Nerium oleander*) show that the water table is relatively high there also in the other seasons. The lower branches until the Pyrgos spring remain dry and function only as torrents.

Water sources available for more than two weeks are mainly situated in the phyllitic regions along the borders of the studied area (Map Figure 1). There is only one large central well providing water until ca. September, in the densely occupied in Minoan times Pateragiorgis region W of Kritsa (Sites 21- and 24- and many surrounding ones). There are also several small wells and a small spring close to our KA-Sites in the South, and other small wells and winter springs in the Northern part of the studied area. But no actual water sources, closer than 2,5 km, exist at all in the region of Tafos and the pine forest W of Kroustas, where there are neither visible phyllitic/clayey soils that might suggest water sources in antiquity.

3. Climate, erosion and ecology

[…] This is not human mismanagement of the landscape; it is a return to nature. […] The tendency for modern ecologists to blame humanity for most – if not all – the environmental problems we are facing today, seems to be reverberating in current paleoecological interpretation. *Moody 1997: 66-67*

Crete has a typical Mediterranean climate with humid, cool winters and hot, dry summers, although of decisive importance for the general picture are also regional differences and local microclimates (Betancourt & Farrand 2006: 19), especially differences in precipitation (Riehl 2008: 43, Leontiadis et al. 1988: 124). For instance, in the coastal areas of North-central and NE Crete and especially the region of Kalo Chorio/Istron (and thus the Minoan settlement of Priniatikos Pyrgos) this means hardly any precipitation between the end of May and the beginning of October. Albeit close to this region, the Tsivis South area lies on a much higher zone, and local conditions are amazingly different, rather comparable to those of the Lasithi plain, some 8 km to the West[10] (Watrous & Blitzer 1982: 7; and infra n. 11 precipitation maps): definitely cooler and wetter, with snowfall and frosts in winter and dry and hot summers with cools evenings, thus keeping more humidity.

Despite the fact that in most areas of Crete due to NW winds there is a rain shadow on the S and E mountain sides (Moody 2000), the lee SE slopes of Mount Tsivi (1663 masl) seem to have two advantages. The mountain peak protects the Tsivi South region – and the area of the Minoan settlement – from the prevailing strong and often cold NW winter winds. And there is clearly a higher amount of average rainfall, probably because rain bearing clouds are still in the orographic lift

[8] This occurred e.g. in 2010, when I was told that this happens only very rarely.
[9] "The river from the Kritza valley, south of Olus [modern Lato] flows into this bay [of Kalo Chorio] on the west side of the point [the one with ruins he saw: Nisi Pandeleimon, just east of Priniatikos Pyrgos], and it contains a running stream all the year". But it is unclear in which part of the riverbed Spratt saw the water he describes.
[10] Distances are considered in straight lines (or "as the crow flies").

upwards on the windward side of the higher peak of Mount Lazaros to the South (2084 masl)[11]. The second predominant local wind is a southern, warm to hot one depending on the season, which is often rain bearing in winter. The ridge between our slopes and the Katharo plain both protects the Sites to its NE from the uncomfortable effects of this wind and leaves its rain on the windward side of Mount Tsivi. It contributes thus to the high average precipitation here (see below IGME table: typical rain shadow effect on the mountains' lee and at the lower altitude in the Lakonia region)[12].

This phenomenon is of particular importance during the agriculturally active months in early summer and autumn. Thus sowing usually takes place earlier in autumn, after the first strong rains, and rains continue well into May, and thus the plants' growing period is prolonged, often by several weeks (cf. infra Precipitation table). These differences, as seen in the detailed IGME average precipitation chart (Chart 1) based on data from three local hyetometers – stationed at "Kritsa", close to Site 93 (Pateragiorgis), at "Katharo", close to Site KR1B (Romanos/Stsi Ringous), and near "Lakonia", NE of Kritsa – (Map Figure 2), are amazing: over the last ten years, Lakonia receives ca. 30% less rain than Kritsa which is only ca. 5 km away! (see table below). The IMS' precipitation charts (infra n. 11) show even bigger differences between these three areas, and some more arid regions to the E and S, over several decades.

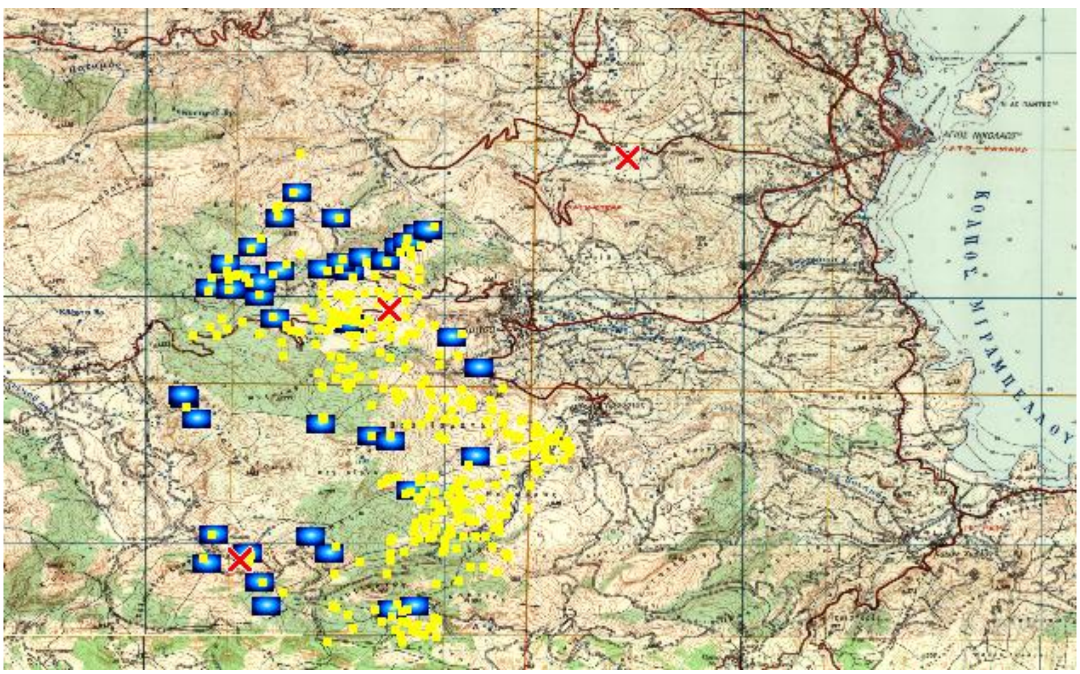

Figure 2: Map of studied area. Minoan sites (yellow); water sources (blue); IGME hyetometers (red crosses) at Lakonia (top) Kritsa and Katharo; Mount Tsivi peak (top left), Kalo Chorio region (bottom right).

[11] This effect seems to be even more pronounced for the high plain of Lasithi. See the charts of the Institute of Mediterranean Studies: http://maps.ims.forth.gr/DigiArchaeoClimate.aspx (last accessed 18/10/2010), which also give a good general overview of the rainfall conditions in Crete between 1930 and 2000.

[12] Cf. Allbaugh 1953: 30 and 45, where it is noted that in some areas of the mid-20th century Cretan countryside there was "insufficient rainfall for fall-sown cereal grains", while important for this purpose was the "effective use of the rough lands of high elevation [... constituting] one-third of the surface of Crete".

ΙΝΣΤΙΤΟΥΤΟ ΓΕΩΛΟΓΙΚΩΝ
ΚΑΙ ΜΕΤΑΛΛΕΥΤΙΚΩΝ ΕΡΕΥΝΩΝ
ΠΕΡΙΦΕΡΕΙΑΚΗ ΜΟΝΑΔΑ ΚΡΗΤΗΣ / ΓΡΑΦΕΙΟ ΑΓΙΟΥ ΝΙΚΟΛΑΟΥ
ΥΠΕΥΘΥΝΟΣ : Κοϊνάκης Γιάννης, γεωλόγος
ΠΑΡΑΤΗΡΗΤΕΣ : Κοκολάκης Αντώνης, Δαβράδος Μιχάλης, εργοδηγοί

ΥΔΡΟΛΟΓΙΚΑ ΣΤΟΙΧΕΙΑ
ΝΟΜΟΥ ΛΑΣΙΘΙΟΥ

ΠΙΝΑΚΑΣ ΜΗΝΙΑΙΩΝ ΒΡΟΧΟΠΤΩΣΕΩΝ
(ΥΨΟΣ ΒΡΟΧΗΣ ΣΕ mm)

ΒΡΟΧΟΜΕΤΡΙΚΟΣ ΣΤΑΘΜΟΣ : ΚΡΙΤΣΑ υψό-μετρο 720 m

ΥΔΡΟΛΟΓΙΚΟ ΕΤΟΣ	ΣΕΠ	ΟΚΤ	ΝΟΕ	ΔΕΚ	ΙΑΝ	ΦΕΒ	ΜΑΡ	ΑΠΡ	ΜΑΪ	ΙΟΥΝ	ΙΟΥΛ	ΑΥΓ	ΣΥΝΟΛΟ
2001-2002	0	13	85	490	182	216	43	9	0	0	0	72	1110
2002-2003	30	132	189	301	114	247	257	57	15	0	0	0	1342
2003-2004	0	0	83	196	331	75	33	35	0	0	0	0	753
2004-2005	0	121	178	203	283	173	62	4	102	0	0	0	1126
2005-2006	0	58	320	78	125	167	82	74	4	0	0	0	908
2006-2007	48	209	131	10	82	334	58	31	73	0	0	0	976
2007-2008	2	256	46	209	102	166	36	119	7	0	0	0	943
2008-2009	26	8	69	319	77	203	42	74	27	0	0	0	845
ΜΗΝΙΑΙΟΣ Μ. Ο.	13,3	99,6	137,6	226	162	198	77	50,4	28,5	0	0	9	
												ΕΤΗΣΙΟΣ Μ.Ο.	1000,38

ΒΡΟΧΟΜΕΤΡΙΚΟΣ ΣΤΑΘΜΟΣ : ΚΑΘΑΡΟ (ΡΩΜΑΝΟΣ) 1230 m

ΥΔΡΟΛΟΓΙΚΟ ΕΤΟ	ΣΕΠ	ΟΚΤ	ΝΟΕ	ΔΕΚ	ΙΑΝ	ΦΕΒ	ΜΑΡ	ΑΠΡ	ΜΑΪ	ΙΟΥΝ	ΙΟΥΛ	ΑΥΓ	ΣΥΝΟΛΟ
2001-2002	0	20	160	601	161	124	53	29	0	0	0	0	1148
2002-2003	44	66	311	349	165	331	192	104	38	0	0	0	1600
2003-2004	0	0	115,9	277	325	57,5	34	0	0	0	0	0	809,6
2004-2005	0	125	155,8	255	133	289	73	0	60,8	0	0	0	1090,6
2005-2006	0	68,4	209	64,6	93,1	148	44	72,2	5,7	0	0	0	704,9
2006-2007	38	172,9	72,2	41,8	60,8	257	36	23,7	44,6	0	0	0	747,4
2007-2008	0	184,3	70,3	139	68,4	238	25	108	13,3	0	0	0	845,5
2008-2009	20,9	0	79,8	452	89,3	181	1,9	85,5	32,3	0	0	0	942,3
ΜΗΝΙΑΙΟΣ Μ. Ο.	12,9	79,6	146,8	272	137	203	57	52,8	24,3	0	0	0	
												ΕΤΗΣΙΟΣ Μ.Ο.	986,04

ΒΡΟΧΟΜΕΤΡΙΚΟΣ ΣΤΑΘΜΟΣ : ΛΑΚΩΝΙΑ 100 m

ΥΔΡΟΛΟΓΙΚΟ ΕΤΟ	ΣΕΠ	ΟΚΤ	ΝΟΕ	ΔΕΚ	ΙΑΝ	ΦΕΒ	ΜΑΡ	ΑΠΡ	ΜΑΪ	ΙΟΥΝ	ΙΟΥΛ	ΑΥΓ	ΣΥΝΟΛΟ
2001-2002	0	0	130	368	185	103	0	35	0	0	0	65	886
2002-2003	26	16,5	58	179	110	201	168	71	12	0	0	0	841,5
2003-2004	0	0	59	237	266	99	8	12	0	0	0	0	681
2004-2005	0	37	158	68	185	95	52	0	33	0	0	0	628
2005-2006	0	50	164	57	90	134	37	54	0	0	0	0	586
2006-2007	20	199	59	3	50	203	41	21	61	0	0	0	657
2007-2008	0	162	50	156	34	149	22	48	6	0	0	0	627
2008-2009	5	7	32	203	17	115	25	44	0	0	0	0	448
ΜΗΝΙΑΙΟΣ Μ. Ο.	6,4	58,9	88,8	159	117,1	137	44	35,6	14	0	0	8,1	
												ΕΤΗΣΙΟΣ Μ.Ο.	669,31

Chart 1: Precipitation at 3 hyetometers in the wider Kritsa area, IGME (Institute of Geology and Mineral Exploration).

Erosion is an especially important and sensitive issue[13]. Relevant discussions are often highly emotional and lack good arguments based on the material record, especially for ancient Crete (Rackham & Moody 1996 passim, Moody 1997: 61, Grove & Rackham 2001, e.g. 289-90). Some see Minoan Crete in the light of an environmental desertification and deforestation with purely hypothetical material evidence ("Ruined Landscape theory": Rackham & Moody 1996: 18, Grove & Rackham 2001 passim); and, earlier, Evans (1928, II: 565 – cited in Rackham & Moody 1996: 126), Pendlebury (1933, 1939: 6)[14]. A similar but more explicit hypothesis of general erosion and depletion expected to have happened since Minoan times is shared by other researchers (e.g. Seymour & Girardet 1986, Rackham & Moody 1996: 18-31, with references) More specific "cumulative erosion episodes" as "imperfectly correlated with specific stages in human impact" (Bintliff 1992: 127), if thoroughly examined, may refer to local phenomena but usually are considered as independent of human activity e.g. by A. Grove and O. Rackham (2001: 307-11).

In the mountains of Tsivi South, despite high average rainfalls, erosion was minimal during the last ten years of my study in the region. Only recently bulldozed and dramatically overgrazed areas showed slight gullying and sheet-erosion respectively after an especially "catastrophic event"[15], a local deluge (but so extremely local that the Lakonia region, only 5 km away to the NE, was not affected)[16]: mainly bulldozed roads, scarps and unconsolidated terraces (recent walls, affected by large herds' movements) were gullied (a road up to 1,5 m deep at one spot, only 10 m away from the ancient road disserving the area, which remained totally undisturbed) and washed away in parts. Yet, Minoan dwelling ruins, enclosure walls and roads did not show any damage (see Ch. II). Strongly overgrazed patches (close to stables vel sim.) suffered some sheet erosion without the protection of surface shrubs. In a functioning landscape of terraces, i.e. with frequent repair works by their users, only sheet erosion occurs, with soil regularly replaced through re-growth/decay in most places. (see Ch. I.b.D and Grove & Rackham 2001: 248). Despite the average gradient of ca. 10 % (10 m ascent per 100 m - but many terraced fields are much steeper), most ancient terracing and overall walling seems little affected by time – a fact that shows how solidly they were built and how little erosion the area has suffered during ca. 4000 years (cf. Van Andel et al. 1997: 47).

The resilience of local plants (shrubs and trees equally) to (re)grow even after heavy stress shows how well adapted to browsing, fire and even to most human interventions (except for bulldozers!) this Cretan mountainscape is. Small losses or gains of soil around our Minoan remains (e.g. Figures 3, 4) also show the environmental stability in terms of erosion. Only ruins situated in the oldest (unburnt) part of the pine forest, where trees have been producing large amounts of needles covering the ground for many years, are partly covered in a top forest layer of soil (Figure 5) that is not eroded even by strong rainfall.

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[13] For various types of erosion, see Rackham & Moody 1996: 18-24.

[14] J. Pendlebury is very probably based on Evans, who observed that timber was replaced by gypsum in the Neopalatial constructions of Knossos and considered it evidence "of timber shortage – a symptom of deforestation" (PM II: 565).

[15] Compare the "Pachyammos Event" witnessed and described in Rackham & Moody 1996: 20-21, Moody 1997, Grove & Rackham 2001:247-8.

[16] A similarly local range of limited severe erosion is described also for the Pachyammos Event, Rackham&Moody 1996: 20-21.

Figure 3: Site 44D. The bulldozer-cleaned NE corner (above stick, length 90 cm). The stone slabs on the uphill outside, obviously intended for levelling the ground, are covered by only 20 cm of colluvium, trapped between ruin and slope

Figure 4: Site 44D. The same bulldozer-cleaned NE corner (left) and the slope above

Figure 5: Site 175 seen from NW nearly covered by pine needles

In areas burnt during the big fire of the Ierapetra-Malles-Kalamafka region in 1994, where the pine needles vanished, the landscape around the Minoan ruins can be seen in a hardly eroded state, even after years of rainfalls, with only some sheet erosion following the fire. The soil has recovered well and shrubs and herbaceous plants prevent the rain from removing much earth – even if the large amount of *Urginea maritima* plants testifies to the overgrazing of the area (Figure 6).

Figure 6: Site 179 from SW, 13 years after the 1994 fire.

On the other hand, disuse of terraces for cultivation and land use for grazing mean disrepair, as the upper parts of retaining walls tumble when dislocated by animals. Also, animals often prefer the easy passage along the top of these walls, and repress thus shrubs growing on or close to the wall edges. Without holding roots, the soil remains loose and can be washed off by sheet erosion more and more each winter. This undermines and gradually dismantles the walls and the slope returns to its natural state and gradient depending on local surface geology (cf. also Rackham & Moody 1996: 163[17]). The best protection against erosion in Cretan mountain landscapes seems to come from the low phrygana: their omnipresent roots hold soil perfectly well against water and wind-erosion. Mosses and lichens have an important protecting function (Rackham & Moody 1996: 22) and are especially abundant in several parts of the studied area (see below, Vegetation). Natural decay produces new layers of soil even here, and not just in the forested areas, and often regions add soil rather than loose them, even on slopes (Grove & Rackham 2001).

4. Ancient climate changes, the 4.2 kiloyear BP aridification event and the Little Ice Age

Between 2200 and 1900 BC an abrupt climatic event, the so-called 4.2 ka BP aridification event, caused intense dryness worldwide, with dramatic consequences in the Eastern Mediterranean basin, and was maybe responsible for the collapse of great empires, from Egypt to Mesopotamia and to the

[17] Still the authors state that they have never seen this “goating” of the landscape leading to major (!) erosion (ibid: 19).

Indus Valley (Kaniewski et al. 2008, Fiorentino et al. 2012, for coastal Northern Syria). Despite little available information from pollen cores about Bronze Age Crete, it seems obvious that this climatic change affected the island, too. Research in West Crete showed that in the Middle Bronze Age, the landscape turned unexpectedly to a *steppe* rather than a *garigue*, i.e. the climate became clearly drier even in the today much more humid western part of the island (Moody 1997: 71). This serious natural event must have influenced Minoan agriculture and should be borne in mind when discussing settlement changes of the time.

The Little Ice Age was a phase of unstable weather conditions (worst in the 16th and 17th centuries AD) with "droughts, harsh winters and terrible rains around the Mediterranean" (Moody 1997: 68, Rackham & Moody 1996 passim). Such weather conditions may have occurred also in other periods (Moody 1997: 68). Although this has been correlated with "activity in the high mountains in Crete" (ibid, citing Watrous 1982, Nixon et al. 1990), the forested region of the Minoan settlement area on the Tsivi South slopes bears very little such traces: only at 5 out of the over 300 sites Venetian/Early Ottoman pottery could be seen (App. D), and all of them were close to water sources. Yet, the evidence of only Minoan and Venetian/Early Ottoman pottery at the same spots and the absence of sherds of any other period (with only a few exceptions – see Ch. II.c.1) could be interpreted similarly, i.e. with mountain activities restricted to times of climatic stress. A clearer impression of this could only (if at all) be gained by intensive survey of the whole area.

5. Vegetation and wildlife

"Mountains can seem hostile and marginal areas; yet they are actually closely integrated into the patterns of production and communication that abut them" *Horden & Purcell 2000: 81*[18]

"ein langes unzugängliches, mit einem vortrefflichen Kieferwalde, pinus chalepensis, geziertes Tal […] wohin auch die an Transportmitteln so arme türkische Zerstörungssucht noch nicht gedrungen ist"

Sieber 1823: 17[19]

The area under study may appear rocky, especially in the summer and due to the intensive use for grazing. But, in reality, it hosts a great amount of vegetation, useful to its inhabitants, from the forest timber to the wild flowers for apiculture, etc (see below Land use) and is therefore for the locals neither hostile nor marginal. Foreign archaeologists visiting the Cretan mountains are too often not enough prepared to realise the (possible or actual, ancient or recent) tight, intricate interweaving of native vegetation and land use which is definitely very different from that on the mountains of other countries.

Characteristic vegetation types and patterns for our region are: phrygana, maquis, mixed forests, mainly of pine (*Pinus brutia* x *halepensis*, πεύκο) and kermes oak (*Quercus coccifera*,

[18] Cf. Walsh et al 2006: 437, for the Alps as an area often seen as "unwelcoming and filled with risk".

[19] "a long, inaccessible valley decorated with a wonderful pine forest of pinus halepensis […] to which the Turkish obsession with destruction hasn't reached yet for their typical lack of means of transportation" (my translation). The passage concerns the forest area on the SE slope of Mount Dikti above Kalamafka, i.e. our KA-sites.

πρίνος) in the area above Kroustas[20] and kermes oak and cypress (*Cupressus sempervirens*, κυπαρίσσι) in the area above Kritsa.

While there are often enough trees to form a forest in every definition, this is not quite as clear a term as it appears to be. Visitors from many forest rich countries may never call a Cretan forest a forest at all compared to their own ones. Even in Mediterranean countries there are problems of definition, sometimes within the same country, (Grove & Rackham 2001: 19). A simple look at the list of protected forest plants of the Greek Forest Service[21] suffices to understand that "forest" (δάσος) is a problematic term in Crete: in this list appear, for instance, also the omnipresent shrub thorny broom (*Calicotome villosa*, ασπάλαθος), and the lentisc (*Pistacia lentiscus*, σχίνος), both not palatable for animals and a pest in nearly every piece of land not constantly dug and weeded. With this point of view "forest" is seemingly what the forest authorities would make believe develops whenever and wherever the Cretan landscape is left untouched by humans and animals. This is certainly true for most of the area that we study, but there are enough regions in Crete where such a hypothesis is more than doubtful.

For the sake of this study, forest is defined as an area larger than 100x100 m with trees higher than 4 m and shady enough to prevent underbrush from being so dense as to make passage impossible for humans. This is the difference between an upcoming forest – after fires or overuse – still in the *maquis* state of dense underbrush, and the final high forest. The density of trees in forests of our studied area varies but may be as open as 10 m between individual trees (Figure 7).

Figure 7: Site 169. Kroustas pine and kermes oak forest and Minoan enclosure wall (the building remains above it are not visible)

[20] The Kroustas forest seems to have a mixed species of pine (Matthaeos Filipakis, Lasithi Forestry Department, pers. com.).

[21] This government agency is feared by mere citizens as nearly almighty, nearly as much as the archaeological service, because of its powers to stop building and cultivation activities. With the necessity to protect Greek forests (and the decision to do so during the last decades) it has achieved an authority often beyond healthy measures.

The main forests covering a large part of our Minoan settlement region consist, as already mentioned, of pines (Kroustas and towards Kalamafka) and cypresses (Kritsa) with various amounts of kermes oaks. Occasional occurrences of other trees include mountain maple (*Acer sempervirens*, ασφένδαμος), wild pear (*Pyrus spinosa*, απιδιά), wild olive (*Olea europaea*, αγρελιά, αργουλίδα) wild almond (*Prunus webbii*, άγρια αμυγδαλιά) and a few terebinths (*Pistacia terebinthus*, τραμιθιά, αντραμυθιά). Olives and pears show sometimes traces of former land use by being grafted. In the region near Kroustas, sweet almond (*Prunus amygdalus*, αμυγδαλιά) is still nearly the only existing and cultivated tree (see below Land use).

Figure 8: Site 201. Building remains (badly preserved) from above with their holm oak tree

On rare occasions one might also meet a holm oak (*Quercus ilex*, αριά, Figure 8)[22] and exceptionally the extremely old and protected endemic *Zelkova cretica (syn. Z. abelicea*, αμπελιτσιά), very appreciated by Cretan shepherds for making the best crooks[23]. Next to torrent beds and near springs one can also sometimes find a fig tree (*Ficus carica*, συκιά).

In heavily overgrazed areas (re)growing trees are often kept for many years in a bush-like state by browsing animals (mainly goats who can climb into larger shrubs and trees, too). Kermes oaks in this state have even a special name, *katsoprini* (κατσοπρίνι or shrunk kermes oak). Trees can thus acquire the most amazing and bizarre shapes, especially with resilient species like kermes oaks and wild olives. Even though this landscape looks like *maquis*, it is basically suppressed forest and can grow to become a full-blown forest within a few years if browsing pressure is reduced (Figures 9,

[22] Only “confined to cliffs” according to Rackham & Moody (1996: 66); but occasionally growing here and there in our area (Figure 9). Another forest of holm oaks exists above Malia, and surrounds an open Minoan settlement similar to ours (!) but maybe with much fewer sites.
[23] And not solely in Western Crete, as Rackham & Moody (1996: 71) believe.

10). This obviously changes through time, following human needs for timber etc (see Ch. I.b Land use).

Figure 9: Intensively browsed kermes oak in bush form (*katsoprini*) and browsing goat. Mountain maple behind

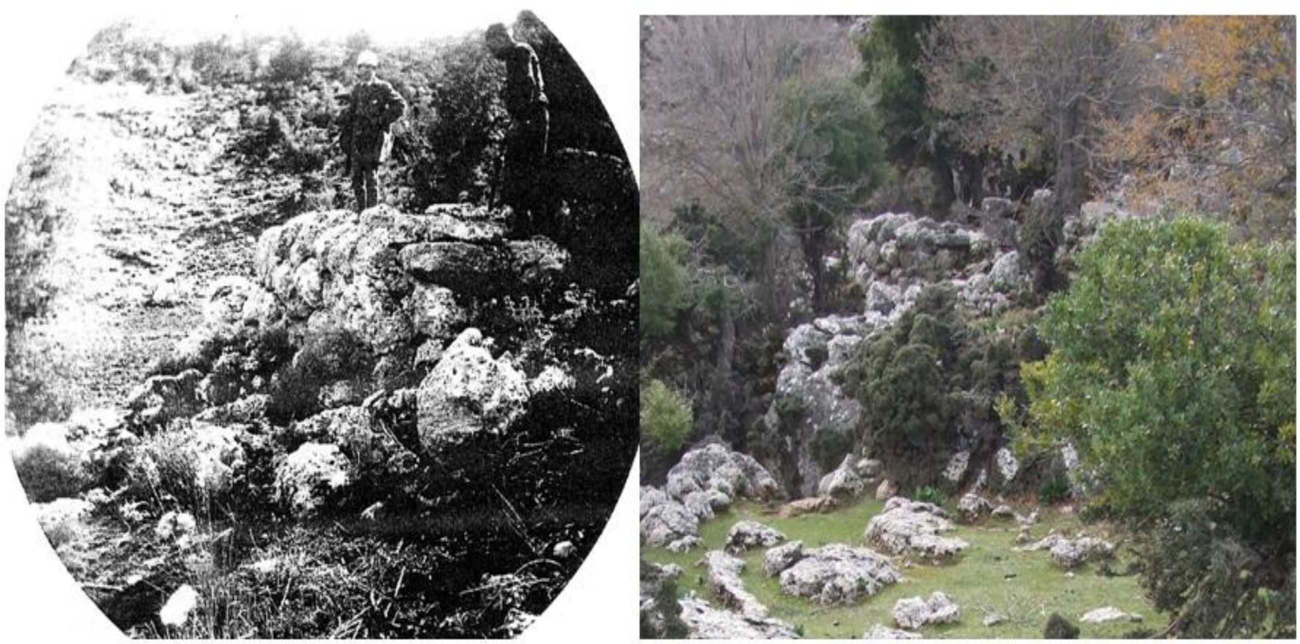

Figure 10: Site 18 (Achladies). Evans, 1895 (Brown 2001: 310) and my photo of the same spot, January 2009. Despite long and heavy grazing and browsing, the difference in the vegetation cover is obvious.

Other plants, covering half height, *maquis*–like areas, are spiny broom (*Calicotome villosa*, ασπάλαθος*)*, lentisc (*Pistacia lentiscus*, σχίνος) and phillyrea (*Phillyrea angustifolia*, φιλύρεα). In the lower regions near the villages, also Mediterranean spurge (*Euphorbia characias*, ατσουμαλλιά) is a characteristic plant of the phrygana, and Jerusalem sage (*Phlomis fruticosa*, φλόμος), mostly a lower shrub elsewhere, sometimes reaches up to 1,2 m of height here. In torrent beds, oleander (*Nerium* *oleander*, πικροδάφνη) can become 3 m high, and in regions with a dung rich fat soil the impressive dragon arum (*Dracunculus vulgaris*, αράπης[24]) with its pervasive carrion smell can often be seen (flowering in May). Near Kroustas and on the slopes closest to Mount Tsivi (region "Boina") one often meets the yellow asphodel (*Asphodeline lutea*, γρύλλος).

The low growing woody cushion shaped shrubs are mostly thorny burnet (*Sarcopoterium spinosum*, αστοιβίδα, growing up to the highest peaks, well beyond the tree line), thyme (*Thymus capitatus*, θυμάρι), mountain savory (*Satureja montana*, θρύμπα, θρούμπι), the endemic small-leaved origanum (*Origanum microphyllum*, καλοκοιμιθιά[25]), spiny spurge (*Euphorbia spinosa*, probably γαλαστοιβίδα), the strongly aromatic rockrose or labdanum[26] (*Cistus creticus,* αλαδανιά), and on some spots sage (*Salvia triloba*, φασκομιλιά). Most of these shrubs have very aromatic flowers and often intensely aromatic leaves and are highly suitable honey plants for bees.

Most of the spiny shrubs give the distinct impression of live barbed wire (e.g. *Sarcopoterium* and *Euphorbia spinosa*). This shows the most spectacular kind of Cretan plant survival strategy (together with hairy leaves, strong aroma and toxicity, the latter especially in leafy herbs) to defy being browsed, certainly developed over millions of years (Rackham & Moody 1996: 57).

Leafy plants grow, as in most non watered areas of Crete, between November and May (some even June). They are the main reason why shepherds bring their sheep to the area, which appears to be barren in summer, but every non-rocky bit is covered in greens in winter (Figures 10, 11) and shows how fertile the mountain soils are. Especially in overgrazed places, grow the unpalatable (extremely bitter and poisonous) species, sometimes with extra thorns, like thorny chicory *Cichoria spinosa*, (σταμναγκάθι), the toxic sea squill (*Urginea maritima*, ασκελοτούρα, καμούτσανο[27]), the mandrake (*Mandragoras autumnalis/vernalis* –not distinguished locally– μανδραγόρας, παιδιά-της-γής[28]) and the very fragrant endemic Cretan cyclamen (*Cyclamen creticum*, κυκλάμινο).

For Minoan archaeologists, the most impressive herbaceous plants are the autumn flowering varieties of crocus (*Crocus oreocreticus*, above ca. 1000 m, and *Crocus laevigatus*, κρόκος[29]), and the dwarf iris (*Iris unguicularis*, *Iris cretica*, ίριδα) - both very famous from their depictions in Minoan art (e.g. Evans 1928-35, Cameron 1968, Chapin 2004, Beckmann 2006, 2012). Another very special herbaceous endemic of Crete (and Rhodes) that grows sumptuously in various parts of the studied area is the white peony (*Paeonia clusii*, ροδαρή – a protected species– Figure 10).

[24] According to locals, the plant is called thus because it is black and it stinks (!) – an example of the politically incorrect naming of plants in the colloquial Greek language.
[25] In Western Crete, *Sideritis syriaca* has this name: Greek names of plants given here are local and need not be the same elsewhere.
[26] Not to be confounded with laudanum, Tincture of Opium.
[27] Would this local name relate to the ancient Greek practice of using the squill flowers as a whip (καμουτσί), to beat e.g. Pan's statue? See Bremmer 1983: 309.
[28] This local name comes from the often human-like shape of the plant's root.
[29] Even specialists sometimes seem to have problems to actually pinpoint the subspecies of Liliaceae and Iridaceae, which the locals – if they know a name at all - only call with the general name κρινάκι (little lily).

Figure 11: North of Site 41. *Paeonia clusii* and tiny *Cyclamen creticum* on the steep slopes (May 2009)

Other plant varieties well visible only in the rainy half of the year are all kinds of grasses, wild legumes and *compositae* too many to enumerate here (see the magnificent Fielding & Turland 2000) that form the main body of palatable fodder for browsing animals. There also exists a notable variety of mosses and lichens, which show passers-by where the most humid patches are, for example in many of the small, deep dolines but also in the more dense forest parts (the higher up the more is the usual rule of thumb). For the various human uses of local plants see below Ch, I. b Land use.

Wild fauna species on our mountain slopes conform mainly to those of most areas of the island, since the Cretan wild goat (*Capra aegagrus creticus*) vanished (Rackham & Moody 1996: 46) and no larger mammal is left[30]. The same goes for smaller mammals, mainly predators like weasels and martens hunting the various birds and rodents, as the very elusive snakes, like the cat snake (*Telescopus fallax*, αγιόφιδο or γατόφιδο)[31], the only Cretan snake carrying poison, but so far back in its mouth that it is nearly impossible to bite a human (a rare photograph in Figure 11). The most dangerous animal to humans in Crete, an insect, is probably the hornet (*Vespa orientalis*), which lives in holes in the ground and is usually easy to avoid.

[30] The largest wild mammal in Crete is the badger (*Meles meles*, άρκαλος – elsewhere in Greece: ασβός), a night active animal, today rare to meet.

[31] E.g. http://reptilesgreece.com/fidia_tis_elados.htm (last accessed 7/11/2010).

Figure 12: Near Site 100. A cat snake in May

The most prominent non-domesticated creatures in the region are the large predatory birds, especially vultures, attracted by carrion that goes with the large local herds of sheep and goats.

b. Historical and recent mixed agriculture in the Cretan mountains

"Analogies, to be sure, prove nothing, but they comfort conjecture."[1]

[...] "upland area shows a high degree of microenvironmental complexity"

Horden & Purcell 2000:82

"Mixed Agriculture" (the combination of crop agriculture and animal husbandry) has in Crete many variations. Even farmers close to lowland urban areas with good arable land, in Crete nearly always set not far from the coast, usually own a few animals for self/family supply. But people farming the mountain regions are forced by their environment to try and make the most diversified use of its total natural potential – for consumption and for trade[2]. This would include: wild plant collection (herbs, vegetables and mushrooms, resin, dye plants); wild animal hunting and collecting (hares/rabbits, snails - Figure 8, small predators for fur); timber cutting, coal and lime burning, and maybe even steatite working in prehistoric times. All this took place in addition to "normal" farming activities *strictu sensu* in our region: cultivating land, mostly for harvesting cereals, and animal husbandry, mainly raising goats, sheep and rarely pigs, for cheese, meat, wool, leather and maybe fertilizer, and bee-keeping[3]. Also some vines (on humid soils), olives and almonds are grown. Depending on each family's conditions and choices, this may mean either a nearly total pastoral occupation (in modern Crete 2000 animals per herd still occur[4]), or a predominant farming occupation with small herds. Sometimes men would tend the herds (including transhumance) while women, children and seniors would tend the fields near the village[5].

This form of mixed agriculture is different from what Skydsgaard (1988: 83) doubted to have existed in Greek antiquity. But his concept seems to attribute the fertile lowland areas to farmers exclusively, who would not have any parallel pastoral activity, as is the case with intensive farming in the lowlands of central and eastern Crete – most of the Pediada and the Mesara, and the coastal regions around Malia, Sitia, Ierapetra etc.

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[1] R. MacMullen, *Roman Social Relations: 50 B.C. to A.D.* 284 (New Haven and London, 1974): 14, cited in Rosivach 1993: 562.

[2] Cretan mountain dwellers are often seen, still today, with their improvised stalls or just some baskets or bags near the central market in Heraklion, offering special collections of mountain herbs, wild vegetables and flowers.

[3] The invention of apiculture (and that of animal husbandry in general) is attributed to the Cretans (Diodorus 5,65,2 – cited in Chaniotis 1991: 101).

[4] But as a rule such large herds are fed on imported fodder.

[5] In central Crete (Psiloritis area) it is only quite recently that women gave up farming and horticultural activities. With their children, they now accompany their husbands during transhumance to the winter browsing areas (χειμαδιά chimadia), when school obligations and drying up of fodder permit it – while most of their animals are fed mainly by imported feed pellets.

1. Land use in the Cretan mountains before and in the Bronze Age and Early Iron Age

Before the Bronze Age

The Cretan mountains seem to have been first settled in the late Neolithic. Some scholars believe that their settlers were pastoralists (e.g. Watrous 1982: 9, Branigan 1999), among other reasons because their surroundings seemed "marginal for grain growing " (Halstead 2008: 248). But respective arguments are weak. V. Watrous (1982: 10) conceives the FN settlement on the Lasithi plateau, located on the edge of the plain, at the base of the slopes, as seasonal and pastoralist[6], because of the small amounts of surface pottery. He supposes that these slopes would have been wooded and the sites close to the plain for good browsing grounds But can the small amounts of surface pottery indicate seasonal use? Would not many years of periodical occupation still produce similar quantities of pottery as permanent sites?

Exclusive (recent) pastoralist sites choose regions where browsing can profit from the best and most nutritive plants, even from tiny good soil patches in between rocks which are too small for cultivation, while colluvial land is preferably used for agriculture, even if there are only small patches (Sieber 1823, and see below). In the Lasithi and Ziros plateaus, ancient sites set around the edges of smaller or larger arable lands thus suggest at least mixed agriculture. P. Halstead (2008) does not take into account that serious climatic change towards aridity occurred only after the Neolithic, and that most of the high regions, including those of Eastern Crete, are still today humid enough for rainfed agriculture – only the coastal fields can be too dry in bad years.

A similarly weak argument for exclusive pastoralism is the lack of surface querns from a region (Branigan 1999: passim). But grain can be consumed in many other forms than milled (e.g. cooked or pounded and cooked, as in the modern Eastern Mediterranean diet; and barley and oats can also be eaten uncooked (see Ch. III.a). A few and small households (K. Branigan mentions ca. 4-5 at Ziros) would have used few querns, if any, and those can hardly be expected to be available for surveyors on the surface[7]. So, the absence of querns can be a taphonomic problem, or connote either differing diet practices, or different patterns of division of labour, within split households – e.g. non-milling men in often seasonal mountain dwellings and bread/flour producing women in the lowlands (see Ch. I. b.4).

All in all, it seems much more plausible to suppose mixed farming already in Final Neolithic times. While it is true that "the response to ecological locations where the biomass can be made available to human needs only by way of animal diet" (Horden & Purcell 2000: 84), there are still no purely pastoralist societies in the

[6] But cf. ibid: 11, where what would be called now mixed farming (e.g. Halstead 1996: 20) is suggested.
[7] Grinding tools are diachronically useful items. The author has seen a large EM quern used as a whetstone in a shepherd's hut, some 100 m from the remains of the prehistoric site of its origin.

Mediterranean, where "the close integration of pastoralism and agriculture [… serves] a very wide range of functions" (ibid: 84). Thus Halstead's (2000: 115, referring to Halstead 1989) statement that "agro-pastoral farming supported most of the archaeologically visible population"[8] can be equally adopted for mountain life strategies in pre-Bronze Age Crete.

The Bronze Age and Early Iron Age

"By the third millennium B.C., therefore, several components of our concept of the "traditional Mediterranean landscape" were in place, albeit in undeveloped form: sheep and goat-dominated pastoralism; upland grazing systems, including ones characterized by seasonal transhumance; plowing with the ox-drawn ard; the use of donkeys for riding and as pack animals; the cultivation of tree crops as well as cereals and legumes; systems of forest management; and perhaps terracing."

Barker (2005: 57 (on the whole Mediterranean area)

Although these words give the impression of well founded knowledge, for the Bronze Age regional economy[9] of the Cretan mountains, there hardly exist any concrete relevant data[10]. And to date, the only Bronze Age shepherd's installations in the Aegean traced archaeologically seem to be those excavated in Santorini (Doumas 2006). Most other statements on Minoan pastoral activities are conjectural. Watrous (1977) suggested, early, that in analogy with modern conditions in the Lasithi plain, the EM settlement of Myrtos Fournou Korifi was not settled year round as assumed by its excavator P. Warren (1972) but must have been a seasonal winter settlement, with its inhabitants moving to the mountains in the summer, in transhumance for instance to the area of Kalamafka – leaving the arid coastal zone (but were Early Bronze Age climatic conditions similar to those of today?). Our closest site to Kalamafka is KA12, 3,5 km to the NE, and belongs to a later period (PP) – I have not seen any EM remains in this region.

P. Betancourt and his team (Betancourt 2006) recently produced a more practical approach for assessing land use at the Chrysokamino Farmhouse. They established three criteria for characterising the surrounding landscape: soil quality, the existence of a pottery scatter (taken as an indication for manure, Betancourt 2006: 242) and the local topography (inclination, amount of rocks, soil amount, ibid). Based on these criteria they defined then patches of land in their intensive survey area as

[8] His conjecture is based on the size and distribution of Early Neolithic human population (2000: 115). He also notes that "specialized pastoralism is dependent on a market economy and so unlikely to have developed in the Aegean in prehistory" (ibid: 123, with references).

[9] The issue discussed here is not the theoretical realm of Bronze Age economies (state-, palace-, or which ever) and administration, but the actual occurrence of pastoral and farming activities and their (possible) traces in the material record. For Mycenaean pastoral economy in the Linear B tablets, see Killen 1964 (and many other of Killen's and others' writings) and recently Greco 2004 (with extensive bibliography). For agricultural products and farming economy from a palace-authority point of view the bibliography is huge since Ventris and Chadwick 1956.

[10] Even though Chaniotis 1991:95 gives the impression that there were many "Feldforschungen" (surveys) dealing with the Cretan mountains, and some of them (like the Lassithi and Sphakia survey) certainly are serious studies.

either gardens (with traces of pottery from manure, ibid: 243), grazing land (terra rossa soil, ibid: 248) or farmland (phyllitic soil, ibid: 250). Here emerges, obviously, a concept of “mixed” agriculture.

A rather general approach in judging probable agricultural land use (computations based on amounts of produce or storage vessel capacities) has been done by discussing the size of storage facilities in Bronze Age settlements, mostly seen as centralised and controlled by palace or elite surplus (Halstead 1989, Halstead & Jones 1989; but cf. Dewolf et. al. 1963, Christakis 1999, 2005). Branigan (2001: 47) accounts for amounts of grain stored in the Knossos and Phaistos "kouloures", (considered as granaries, i.e. also communal storage, of 250 and 75 tons respectively). H. van Effenterre (1980[11]) theoretically established what he called the *domaine* of Malia, meaning the wider area[12], supplying town and palace with agricultural and other products, as compared to modern data. Starting with the hypothesis of a large size of town population, this model, like the former, takes for granted the control of large areas of land producing agricultural surplus for the palaces and their urban domains. Yet, S. Müller-Celka (2003: 466) who surveyed the mountain slopes above Malia, did not recognise the agricultural potential of the area for its Minoan (Protopalatial) inhabitants, because of the lack of large arable plots: “aucune pâture ni terre cultivable n'offrant de quoi subsister à proximité immédiate"[13]. Watrous (1982: 36) stated that the economic roots and especially agricultural produce of the Malia palace and town should be seen in the Lasithi plain in Protopalaltial and Neopalatial times.

Another approach is suggested e.g. by D. Haggis (2005: 72), who sees a possibility for storage as a communal activity within MM settlement clusters of the Kavousi area from where the surrounding fields would have been harvested.

An approach of self-sufficiency for LM IIIC Karfi is suggested by Nowicki (1999), who correctly attributes important dietary elements to rural Crete, such as wild vegetables and snails (ibid: 154) and accounts for small game bones vanishing from the material record by animal activity, e.g. dogs (ibid: 157). He also accounts for a general agricultural production volume from the starting point of suggested family sizes in connection with the number of houses and their storage vessels[14].

S. Wallace (2000, 2003) supposes that the Early Iron Age defensible sites she and Nowicki identified in the wider area (NE of the Lasithi plateau) subsisted on

[11] Citing his previous work (Dewolf et al 1963).

[12] One of his main arguments for considering Sissi and Milatos under Malia’s control, was the absence by then of Minoan finds from there. But since 2007, a Minoan settlement is being excavated at Sissi (Driessen 2009) and extensive Minoan remains, including traces of apparently huge buildings, are visible on the surface at Milatos. This is a good example for the attention with which negative evidence should be employed in the archaeological argumentation.

[13] But it was noted early that the forest (and its arable colluvial areas) above Malia must have existed in the Bronze Age (Dewolf et al. 1963: 32).

[14] Problematic may be his consideration of pulses available to the Karfi dwellers. According to local people, most pulses do not thrive above 300 m, and thus the inhabitants of the LM IIIC settlement would have had to trade them for their own possible surplus products (cheese, meat, wool?) which are not easy to trace in the material record.

mixed agriculture with an emphasis on herding because of the poor soils she analysed in the area of the higher slopes (Wallace 2000)[15]. Although she works mainly on the basis of comparison with recent land use and modern analyses, she does not mention the fact that until the first half of the 20th century even fields on heights up to 1350 m used to be cultivated in barley (see Ch. I.b.4)[16].

2. Land use in the Dikti mountains after the Bronze Age and Early Iron Age

Before Hellenistic times

There seem to be very few traces of land use after the Bronze Age and Early Iron Age in the area of ca. 30 sqkm that is studied here, although naturally an intensive survey could possibly give a clearer idea.

There are some interesting analogies between modern agro-pastoralist practices and those described by Homer in the Odyssey, so I shall mention a few examples. Homer gives only a few hints of the agricultural situation of his time in Ithaca. The poet speaks of the browsing areas of the goatherd Melantheus, equipped with some kind of pen/stable/*stathmos* (Od. XVII 223) and located at the *eschatiai* (wilderness in the border area) although it is not quite clear how far away from Odysseus' palace. Fences for gardens (here Laertes' newly cultivated land) were made out of thorny bushes (Od. XXIV 224), whereas Eumaios built his swine-herding place with heavy stones for the enclosure in the wild forested, rocky landscape also far from the coast (Od. XIV 1 sq.). These examples show, as Skydsgaard (1988: 78) pointed out for some of them, that animal husbandry and agriculture "do not necessarily coexist in the epic". But had e.g. Laertes been occupied with mixed agriculture in his property, he would still have to protect his cultivated fields from the exterior browsed by animals. This practice is still described in a similar way (including the thorny fences) by the last living "mixed farmers" of the Tsivi South area (see Ch. I.b.4).

Melantheus was clearly a dependent overseer for his missing king's herds (or rather for the palace institution, as his obedience to Penelope's suitors shows) who had several other herdsmen as helpers. In Classical and Hellenistic Crete herd ownership could be a citizen's profession within highly regulated geographical boundaries. Transhumant pastoral frontiers were known, pastures were assigned to political regions and damages done by the herds to arable lands were prosecuted in the region of Hierapytna (Chaniotis 1995). This all was legally defined in the isopolity treaties that regulated also other interstate affairs, including fines for animal theft and the payment of customs for herds crossing borders, and shows how important pastoral economy was to the Cretans at least in the Hellenistic period (ibid:

[15] But cf. Watrous 1977, who thinks that Karfi may have been a summer settlement only.
[16] She also usually mentions cereals/legumes together, even though locals insist that legumes were never grown on the high slopes (cf. n. 14) because they needed to be tended regularly; whereas cereals were sown and then left alone for months, as there were no goats/sheep freely ranging the mountains as they are today. Legumes were only cultivated in "lowland" fields close to the villages.

61). Still it seems that settlements were almost exclusively restricted to the lowlands, from where they exploited higher areas[17].

A seasonal movement of herding population similar to modern/recent times is postulated for the Classical and Hellenistic periods (Chaniotis 1988, 1995, 1996a,b, 1999, Skydsgaard 1988, Chandezon 2003 – with intensive discussion on transhumance and its definitions[18]). The economic importance and resulting disputes on land borders especially for Hierapytna[19], the modern Ierapetra, is obvious in the various related treaties (Chaniotis 1988, 1995, 1996b). The extensive apparatus of such treaties makes clear that among shepherds belonging to the lowland city-states surrounding the high mountains, mainly those from Hierapytna used the Dikti range.

Despite this evidence on the mountains above Hierapytna, in the area that we study there don't seem to be any relevant material remains hinting at a dispersed mixed land use including building and actual "living" between Minoan and Roman times (see below) – again, only an intensive survey could give a clear picture. Still its pastoral use is known from the written documents (cf. Skydsgaard 1988: 78 with a similar statement of a missing "mixed agriculture" for the whole of Classical Greece). There are two possible explanations for this: either shepherds' dwellings were too perishable and people too poor to leave any pottery[20]; or that they left the mountains and returned to their settlements for living.

Shepherding work leaves few material traces, Ch. I.b.4), even including cheese making that would have been done in the settlements. The closest nearby archaeological survey in the Vrokastro area showed that the size of the Cretan population was obviously much smaller than in Minoan palatial times (even though settlement nucleation may mask some of the population), especially for the more mountainous areas. Only from middle Roman times a similar to the Bronze Age population density together with a traceable use of mountainous areas can be suggested (Hayden 2004, see esp. the maps after fig. 15). In the Vrokastro area agricultural use seems to be centred mainly on the fertile colluvial valleys and the few areas with springs (ibid. chapter 8).

The continuous use of the Kato Syme sanctuary (ca. 12 km SW of the SW edge of the area studied here, on the S slopes of the Dikti range[21]) from MM III to late Roman times and possibly diachronically (Lebessi in PAE 1972 to 2003, Lebessi &

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[17] As for settlements in the mountains: regions like Anavlochos (where the highest habitation traces of historical periods lie below 500 m, not at 625 m as Chaniotis states (ibid: 96). The site of Vrokastro (270 m) can be hardly called mountainous, as rocky as it may look. All the other (known) settlements mentioned by Chaniotis are situated below 600 m – apart from Hyrtakina at over 800 m (Chaniotis gives 680 m).

[18] According to his criteria, there could not be any real transhumance in Crete, if only because of distance issues and herd sizes. The problem of definition is already mentioned in Skydsgaard 1988: 76.

[19] Hellenistic documents about this city are the most important sources of information on the subject.

[20] For the archaeological "invisibility" of recent pastoral sites in northern Greece see Chang &Tourtelotte 1993.

[21] In this case the actual distance to get from one to the other is much larger, though (ca. 30 km), because of the high and difficult mountainous area in between.

Muhly 1990[22]) may show a certain continuity of mountain land use (centred on herding?) in its own right, insofar as it is set at a spring and thus stresses from a different point of view the importance of fresh water to animal husbandry. Relevant archaeological evidence *strictu sensu* is sparse. Hence of interest is that for Archaic times Lebessi (1989, cited in Chaniotis 1995: 57) sees statues of ram-bearers (found in various sanctuaries on Cretan mountains) as votives of rich flock-owners[23].

The area studied here most probably houses the frontiers (maybe Homer's *eschatiai*) between the city states of Lato (that would have occupied most of the region to the N and E of the Tsivi South region or SW of Lato) and Hierapytna (which must have owned the S part of the region or NW of Hiearpytna: here are mainly our KA-Sites. (For the frontier see Faure 1967, Effenterre & Bougrat 1969[24], Chaniotis 1996 b, Chaniotis 1999)[25]. None of the Minoan sites – and the browsable mountain region housing them – is more than 6 km away from the city states of either Lato or Malla (later belonging to Hierapytna). Hence, most of them could have been reached in a day's walk and back by shepherds living in the nucleated settlements. According to Chaniotis (1995: 62) "the use of the pasture is allowed on condition that the shepherds had to return to the territory of their native city after the grazing". The settlement pattern suggested by Hayden (2004, fig. 22), showing sites of Classical and Hellenistic times mainly close to the fertile valleys, points in the same direction.

It is interesting to note, in the context of the frontier treaties (necessary because of constant wars between the various city states of the region), that a private but slave-worked property is known in the mountains along the frontier (*aphamia* of Exakon) that bordered on old uncultivated land (van Effenterre & Bougrat 1969: 14, cf. also Chaniotis 1999: 187[26]) while the frontier from there goes on to some kind of ruins (*ereipiones*) and then to the "hill above the Hermes" (-sanctuary[27]?). Even if only a hint, this seems to confirm that Hermes was a god omnipresent in this area, not just in the known sanctuaries of Hermes and Aphrodite Sta Lenika (ibid. map opp. p. 16) and Kato Syme above the S coast (see below). Could the ruins mentioned in the description of the frontier (ruined constructions already in the 2nd century BC!) have been the Minoan ones at Kato Kaminaki (our KA-sites)? Then the Hermes sanctuary (Chaniotis 1988: 25, who connects this with another line mentioning a sanctuary of

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[22] For a wider bibliography of the Syme sanctuary cf. the website of the Archaeological Society of Athens at http://www.archetai.gr/site/content.php?artid=373 (last accessed 2/1/2012).

[23] That this may already have been similar in Minoan times shows the obvious "economic and social diversity of the worshipers" with a clear indication of elite participation (Lebessi & Muhly 1990: 335).

[24] The toponyms Fortetsa and Asfendamous on the map fig. 1/p.17 seem to correspond to our exclusively Minoan Sites 46 (Fortezza) and 99A-F (Stous Asfendamous). The other, more southern suggestion running over the higher ridges (watershed) is much more convincing.

[25] Whether parts of the regions had at times belonged to the town of Oleros (modern Meseleri) is unclear, as this became known only after already belonging to Hierapytna (Hayden 2004: 191). Chaniotis (1995: 62) supposes that in Hellenistic times pasturage mentioned in isopolity-treaties was situated on the "common borderland".

[26] Although I do not agree with setting the frontier so far E as they do. Benkasos must have been modern Vrokastro (after the seizing of Istron by Lato).

[27] Cf. also Chaniotis 1996b: 343, "(Kultort des) Hermes".

Hermes Kornisaios) might be somewhere in the region of (or at?) Korakia/Pano Kaminaki, with its unusual Early to Late Roman settlement site at 1100 m[28], which sits partly on top of the Minoan site KA15. In this context, of special interest is Chaniotis' (1988: 26) hypothesis that the sanctuary in the mountains on the frontier between Lato and Hierapytna was located on an area seen as no-man's-land, and was possibly the continuation of a Minoan cult place.

While archaeological evidence seems in general sparse for these phases, at least archaeozoological material is abundant enough to show that raising sheep has been a matter of course for the Cretans continuously after Minoan times (Chaniotis 1999: 189, with references).

Late Hellenistic and Roman times

„Erst nach der Integration der Insel ins Imperium Romanum verbanden sich die auf dem Gebirge verrichteten wirtschaftlichen Aktivitäten mit Handwerk und Handel „

Chaniotis 1991: 98[29]

During Hellenistic times wars were raging between the city-states, often needing arbitration from outside of Crete (Ager 1994). During these difficult times, many a good field was suffering under the "disastrous effects of war on agriculture", fields were left untended, even the drying up of springs was seen as a consequence of the Cretans' bellicose tendencies[30] (Chaniotis 1991: 99, citing Plinius Nat.Hist. 31.53). Only with the integration of Crete into the Roman Empire trade and agriculture began to flourish in various sectors. By then Crete "constituted a political and administrative unity" (Chaniotis 1999: 191), and the fragmentation of the city-states was overcome.

While timber seems to have been exported from Crete, at least for special building projects like temples, already before Roman times, in the Imperial period even stones were traded (Chaniotis 1991: 102, with references). While earlier Cretan piracy made trading difficult, after 67 BC foreign traders could move about freely. While earlier the mountains were part of the city-states' subsistence economy, with the Roman regime they began to produce a surplus in many a merchandise: wine, honey, wax and mainly herbs became Cretan exports par excellence (Chaniotis 1991: 105, with references and an extensive list of Cretan herbs in ancient sources: 108-109). Especially the herbs were famous in the Roman medical world, not only because of their quality, but also because the Cretans did not need to adulterate them (ibid: 106, citing Galen) – an exploitation of the area that would hardly show in the local material record[31].

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[28] My warm thanks are due to Scott Gallimore from Buffalo University for sharing his thoughts on the surface pottery of that settlement area with me.

[29] Only after the integration of Crete into the Imperium Romanum the economic activities carried out in the mountains became connected to crafts and trade.

[30] The fact that in this period springs were dried up in the lowland settlements may hint at a change towards a drier climate, which in turn could explain the interest in the region close to two mountain springs in the following phase.

[31] Ample traces of bee keeping of Hellenistic and Roman times have been found during the Sphakia survey in the White Mountains (Francis 2006).

The relative freedom of movement into and through the Cretan mountains was most important for defining their use or non-use in various periods. This should especially be kept in mind when comparing Minoan and later eras and when trying to answer why the tradition of mountain land use was by no means uninterrupted in Crete (see below, especially the "re-invention" of mountain use with the relaxing of regulations during the last phase of the Ottoman occupation,). This historical example shows that continuity in land use may depend more on political and social conditions than on any other factor, and that options do not change whether it is interrupted or not (Chaniotis 1991), provided that the climate stays the same.

The unexcavated Roman settlement (ca. 1,1 ha) at Pano Kaminaki was partly built on top of – and with the materials – of our Minoan Site KA 15. This does not seem such a very unusual occurrence, although no other Roman settlement is known at such an altitude. In the neighbouring Vrokastro area, "good soil, water, and routes are magnets for settlement, and herding activities may also be manifest through site location" (Hayden 2004: 209), thus it does not come as a surprise that a settlement is found in this special region: Pano Kaminaki/Korakia, even if high up above modern villages and often in the clouds, had two perennial springs close by, and was surrounded by good arable land on the same level and slightly below (now *metochia* at Korakia, see Ch. I.b.4). It was, moreover, situated above the main important route[32] traversing the mountains from Malles (ancient Malla) and Kalamafka (ancient Larissa (?) – van Effenterre & Bougrat 1969: map op. p. 16) to Kritsa (Lato) and Agios Nikolaos (Lato pros Kamara)[33]. This good position near a probable trade route (possibly even starting at Hierapytna further east) may also account for some of the surface pottery seen at the site, including imported ware from Syria and Africa. Could this have been one of the production centres of the Roman-Cretan herb trade?

The only known ancient written document actually originating from the studied area is an inscription dedicated to an unknown god with the epithet "Kyfarissitas" or "Kyfarissifas", maybe Hermes or Pan (Demargne 1900, Dragoumis 1900, Xanthoudidis 1903, Voutiras 1984, Sanders 1982: 141[34]). It was found close to a "metochi appelé Patarachi" (Demargne 1900: 241) is dated to the 1st century BC and thought to be re-used during "l'ère chrétienne" (ibid: 242, for two different parts of the inscription, although the part of the later phase has only a few unconnected letters). Demargne (1900: 242-43) states:

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[32] Interestingly the settlement perches atop a flat ridge above that road, in a seemingly "defensible" position (which nobody would suppose necessary within the conditions of safety during Crete's belonging to the Imperium Romanum).

[33] This road was still used until recently by people from the south coast (Malles and Myrtos areas) to get to the coast and harbour on the gulf of Mirabello and was important especially since Hierapytna's/Ierapetra's harbour was silted up in later Roman times (Scott Gallimore, pers. com.).

[34] Chaniotis (1988: 22, n. 4) supposition that there was an important sanctuary ("bedeutend", "Heiligtum") seems not sufficiently founded by a single small dedicatory inscription on a base (of a statue?) and no other known findings. P. Demargne (1900: 245) would have expected some kind of "chapelle rustique" near the find spot of the inscribed stone.

"distiques contenant une dédicace faite a Kypharissis par un certain Timon, à la suite d'un vœu. Les circonstances de ce vœu restent vagues. Timon, soit qu'il fût malade, soit pour toute autre raison, était malheureux; le dieu lui était apparu une nuit et lui avait fait promettre de lui consacrer une statue, s'il était soulagé."

An inscription to the hero Kypharissis[35], known as a lover of Apollon turned into a cypress tree, could well originate from the region around *Paterakis*[36] in the middle of a clearly ancient cypress forest (see below).

But others read differently. For Dragoumis (1900, in the vol. of the first publication of the inscription) a "Kypharis, fils de Siphas" (ibid. 526) calls to Kyllanios, that is Hermes (interpreted as *Strophaios* (or Hermes of the Door hinge, as the statue is taken to have protected a door). The god appeared to Kypharis in a dream with a prediction that saved his poor hut – a possible warning of theft (by the god, specialist of thieves) or prediction of luck. The hero thus offers to his divine friend: an animal (sheep or goat), a kind of cake, cooked barley. This would fit the situation of a local shepherd who became aware of threatening animal theft in his dreams and could possibly thus avert it[37].

Buckingham (1902: 210, citing Hiller von Gärtringen 1901) refers to Kyfarissifas Kyllanios, i.e the addressed god Hermes of the Cypresses, and the possible occasion of the dedicator to ask for "a successful theft" – a reading that would also fit well to this region[38].

Later, S. Xanthoudidis (1903) changed the reading of the inscribed epithet to Υλοσκόπος Κυπαρισσίτας (*Kyparissitas* the Woodcutter), a local version, he thought, of the god Pan (Kyllenios, son of Hermes) to whom Timon dedicates the statue the god had asked for to provide him luck in life – which he did. This interpretation also conforms to the region very probably used for woodcutting since ancient times – and it can be suggested that Timon chose a dedication place near (or in) the cypress forest.

Guarducci (1935: XVI 7) adopts Xanthoudidis' version for the name but prefers the details in Demargne's reading. Voutiras (1984) takes up the discussion after the discovery of the Kato Syme sanctuary and the inscription to *Hermas Kedritas* (Hermes of the Cedars) and Aphrodite found there[39]. He compares him to *Hermes Kyfarissitas* and suggests an original Minoan forest god of the Dikti range (ibid: 144). Interesting in this context is that "*kedros*" need not refer literally to the tree of the genus *Cedrus* – actual cedars do not grow in Crete and most probably never did; but to various aromatic kinds of juniper, mainly *Juniperus phoenicea* and *macrocarpa* (άρκευθος in ancient Greek), that grow usually up to 300 and rarely 700

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[35] One of the statues that Demargne (1900: 245) attributes to Kyparissos represents a youth holding a (roe?) fawn (cf. the bearers of animals found in Kato Syme).
[36] The stone is only 26x17x13 cm (Demargne 1900) and could have been easily transported from its original find spot.
[37] All this provided the stone hadn't been moved from its original position.
[38] Where, according to the locals, animal theft is still a common practice.
[39] Citing Lembessi 1973: 198, table 205.

m, or in the case of *J. macrocarpa* very close to the sea. Hence, Hermes with this epithet would be more typical for the coastal region.

If all this was a distant remnant of Minoan religion in the mountains, the god on the inscription could be a divinity of resilient vegetation from sea to peak. And if the inscribed object was not the base of a simple statue but that of an herm (Voutiras 1984: 144) it could have had an apotropaic function for a local dwelling – maybe similarly to the modern custom of putting up an impressive ram or billy-goat head to ward off the evil eye from the *mandra* (see Ch. I.b.4).

Today, the *Paterakis* (Πατεράκης)[40] area around our Site 6 partly conforms to Demargne's (1900: 242) description, e.g. the meeting of several old routes etc. On topographical grounds, more convenient to Demargne's description is the region called *Stegi Pezoula* (Shelter Terrace) 360 m WNW of the modern *Paterakis*, where a few Late Roman/Byzantine surface sherds were seen. If this was the spot in question: the coarseware mentioned by the French scholar probably came from the Minoan Site 7B, 50 m further E, where the pottery scatter is more dense. (Stegi Pezoula was long and intensively used by shepherd-farmers, and no ancient architectural remains are left - if they ever existed; Demargne does not mention any either). This is the region of the oldest and most stately cypresses of this forest (the one in Figure 3 grows 300 m N of Site 7B), a very old forest too (mentioned in Spratt 1865: 137), maybe already there in Minoan times.

3. Modern/recent land use in the study region

"Οι Ελληνες είναι κάκιστοι στον προγραμματισμό και άπιαστοι στον αυτοσχεδιασμό. Αυτή την αρετή μάς την δίδαξε το ελληνικό τοπίο. Είμαστε μια κουτσουλιά στον παγκόσμιο χάρτη, με αφάνταστη ποικιλία στο υψόμετρο, στα οικοσυστήματα, στις θερμοκρασίες, στη μορφολογία."

Doumas, Newspaper 'Kathimerini', 5/12/2010, p.30

Since Minoan times the beginning of the 20th century is the first and only phase, it seems, where mountain land use may have been practiced to the same degree as in the Bronze Age for the region south of Agios Nikolaos. Pre-industrial conditions thus seem the best occasion to study the land use possibilities of this area.

A. The use of uncultivated nature

The forests

The area's forests provide a large number of various products that have been collected traditionally. Timber naturally is the best known (apart from firewood), and used here

[40] On the GYS 1:5000 map, it lies 1000 m farther W, but locals assured me no such toponym ever existed there.

in great variation: cypresses and pines for building, oaks for doors and troughs (Figure 1).

Cooking utensils are also a typical timber product (maple, *Acer sempervirens*, or *Pistacia terebinthus*), made by gifted locals (often shepherds) in their spare time (Figure 2).

Figure 1: Old trough made from *prinos* (*Quercus coccifera*), above Katharo plain

Figure 2: Zacharenia Barda with a collection of her husband Kostis' homemade spoons (mountain maple)

The nowadays extremely rare, endangered and protected endemic *Zelkova cretica (syn. Z. abelicea*, αμπελιτσιά) is a tree especially loved by shepherds for making the best crooks (as mentioned above) but has been known since the travels of

Tournefort (1717) and was then still used as timber for beams (Lemery 1721: col. 1) because of its elasticity. It grows above 850 m.

This manyfold timber use is certainly not just a recent development, as the forests here have been known for a long time (cf. above). That the cypress forest of this area, is definitely ancient, is shown by some of some immensely old and thick trees (Figure 3), and can be inferred from the above mentioned inscribed dedication to Kyfarissitas. With past timber use for shipbuilding, the high, straight and elastic cypress trunks would certainly have been much in demand for masts.

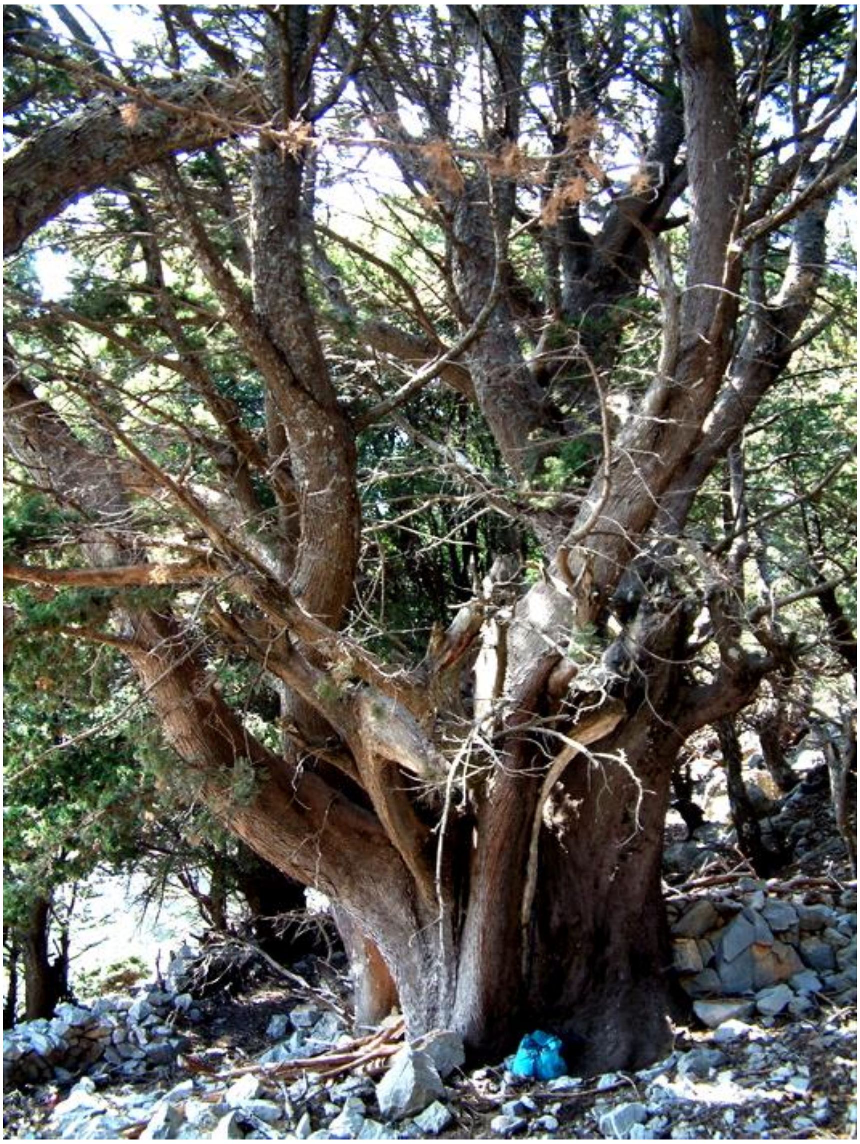

Figure 3: Ancient cypress near Site 8 (backpack ca. 60 cm high)

Other trees yield other products. In pre-industrial Crete, the pine (*Pinus brutia x halepensis*) forest above Kroustas was extensively exploited for resin production, traces of which can still be seen on some of the older trees (Figure 4).

Figure 4: Resin collecting vessel still in situ on pine. Made from sheet metal (recycled American magazine boxes from a World War II calibre 30 machine gun[41])

This resin was mainly sold to the mainland for the production of retsina wine, but was also exported, to be used for artistic and medicinal purposes. Cypress trees must also have yielded (smaller amounts of) resin in the past – they produce a strongly aromatic resin when injured. Cypress resin would have been in great demand in ancient times (Manniche 1999).

Another product of pines of this forest interests beekeepers, as bees collect honeydew from the insect *Marchalina hellenica* from these trees (Figure 5, and Gounari 2006).

Figure 5: Bee collecting honeydew from *Marchalina hellenica* (the insect sits under the masses of whitish waxy secretions)

Collected from kermes oaks (prinos), the insect *Kermes vermilio* was traditionally used to produce a precious and expensive crimson dye – a process known since antiquity[42].

Tree fruit was also much sought after. Wild olives (*Olea europaea* αγρελιά/agrelia, αργουλίδα/argoulida) are often grafted with a cultivated species.

[41] A special version of "swords into ploughshares"!
[42] For instance, in Pliny, Nat. Hist. 16, XII, 32.

Contrary to what is sometimes believed by archaeologists[43], olives can grow up to 1100 m in Crete, e.g. the *Olea europaea* var. *microcarpa* (Κορωνέικη/koroneiki), and close to that (1000 m) the *Olea europaea var. mamilaris* (Τσουνάτη/tsounati)[44]. Tournefort (1717: 50) mentions wild olive trees in June right up to the snow line on the slopes of Mount Dikti – while still seeing flocks of αγρίμια/ *agrimia*/*Capra aegagrus cretensis*– and suggests that the origin of the olive should to be sought here. Walnut trees (*Juglans*) also grow up to great heights and were not only used for their fruit but also as a dye plant (brown to black) for hair and cloth.

Most enduring to climatic variations among the fruit bearing trees are the wild pears (*Pyrus spinosa)*. Although edible when collected very ripe, they are also often grafted with cultivated varieties, mostly the old, half wild one called καράπιδα/*karapida*, which is particularly suitable for drying conservation, like raisins[45]. Today, most of the fruit is consumed by browsing animals.

The region of Kroustas is locally known for its almond production: still today almonds are the villagers' most important traded commodity. Thus, it is with reason that the area of our lower Minoan Sites 139-163 (just above Kroustas) is partly called *Amygdalolakkos*/Αμυγδαλόλακκος (Almond basin). Almond trees are often cultivated in small, originally hand-hoed agricultural plots (Figure 6) used for cereals and vetches (today eaten by sheep *in situ* in late winter and spring[46]).

Figure 6: Small fields among rocks, sown with vetches (*Vicia sativa*) for fodder between almonds and olives

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[43] No Minoan settlement over 400-600 m was known along the south coast in the 1970s, and Warren believed that this related to an "elevational limit for the olive" (Warren 1972: 276). Dewolf (1963: 44) gives 500-600 m (without source) and Watrous (1977) 600-800 m citing Polunin & Huxley (1965) *Flowers of the Mediterranean*. Chaniotis (1996: 258) mentions 700 m as upper limit. But even (non Greek) specialists do not seem to agree on this subject: in Moriondo et al. 2008: 100, 800 masl is the upper limit. This may result from the fact that high areas relatively close to the sea (as typical for Crete) are warmer than those more distant.

[44] See the website of the Olive Growers' Cooperative of Rethymno http://www.easreth.gr/politismos-perivallon/Pikilies_elias.htm (last accessed 28/10/2010).

[45] Personal experience.

[46] The vetches' roots (as typical for legumes) also produce nitrates that function as fertilisers for other plants (McVay et al. 1989).

Many protected dolines and small valleys show traces of former tree cultivation, and the small semi circular terrace structures (cf. Moody & Grove 1990) are constructed within Minoan enclosure walls are probably very ancient (see Ch. II). Some of the typical small rounded terraces have been (re-) used until recently (Figure 7). Locals remember that the person who grafted a wild olive tree in public land was accorded the legal right to harvest it in the future – and exploit the piece of land below it.

Figure 7: Until recently cultivated olive in rounded small terrace near Site 123 (860 m)

Examples for local use of the wild flora and fauna

It would exceed the frame of this study to try and treat the subject of mountain flora and fauna use *in extenso*, thus a few typical examples are given only.

Herbs

As mentioned above, the mountains' aromatic leaf shrubs have been used as medicinal herbs at least since Roman times (Chaniotis 1996:263, 1999: 219 with a list of Cretan herbs known from antiquity) and may have contributed to the region's economy time and again.

One of the rare plants of the area that elder locals still remember as extant but couldn‘t be actually found by the author any more is Cretan dittany (*Origanum dictamnus, δίκταμος/ dictamos* or *έρωντας/erodas*), an endemic praised for its medicinal quality since antiquity that has always been collected for tea by the locals and thus probably vanished, as it grows mainly in hardly browsable steep cliffs and used to be a challenge for young men to collect (and then give to their beloved).

The endemic small-leaved origanum *Origanum microphyllum*, καλοκοιμιθιά/*kalokimithia* ("well-sleeper") was used for filling mattresses, or rather softening bedsteads by covering a thick layer of the aromatic and elastic thin twigs with thick blankets. It was also added to mixed herb teas (like most of the other aromatic local herbs).

A special kind of preparation from aromatic herbs that technically probably predates steam distillation is mentioned here to show the manyfold possibilities of herb preparation, in this case pitch as a predecessor to ethereal oil. In pre-industrial Crete a variation[47] of dry distillation was used as known very similarly in NW Europe since the Middle Ages (the so-called "Doppeltopfverfahren", see e.g. Jankuhn, Beck et. al 1968/73-2007, vol. 22: 540). One of the two vessels was a κουρούπα/*kouroupa*, (jug with medium wide mouth) or a kind of σταμνί/*stamni* (pitcher, usually narrow-necked) with a larger opening than normal. Filled with chips of the resinoferous parts of pinewood (from below the bark, not too deep inside the heartwood) and positioned upside-down on a (not very high) dish, the jug-like vessel was surrounded on the lower half by glowing embers (often with the whole combination set in a low pit). The heat would liquefy the 'juice' (which locals notice is not the same as the resin, technically it would be called pitch) out of the chops. The same procedure could be followed with sage. The "juice" thus collected on the dish was used as remedy against colds[48]. In the area of Vasiliki further East the same procedure was known for *Juniperus phoenicea* κέδρος/*kedros* – this would have yielded the same product as Pliny's "cedrium"[49].

Thyme (*Thymus capitatus*, θυμάρι/*thymari*) and mountain savory (*Satureja montana*, θρύμπα/*thryba*, or θρούμπι/*throubi*), together with other aromatic flowering plants are also especially loved by bee keepers (see bee keeping below) and constitute one of the the main reasons for the many bees of the area in summer as honey collected here from these plants achieves a special aromatic taste.

Wild vegetables, snails

Another main use of wild plants is for vegetables (χόρτα/*chorta*), an important part of the rural population's diet in winter (and still loved by many of the urban population). But what exactly does collecting wild vegetables for food mean?

Often Cretan/Greek peasants' subsistence strategies are misinterpreted by non locals, showing the problem to be a question of perspective. The collection of wild plants for food, still nowadays a popular pastime even of town-women on country walks (many species are sold at high prices on town markets) was easily misunderstood especially in times before the consolidation of the back-to-nature-movement, but often even afterwards (Horden & Purcell 2000: 80/81). While for the locals collecting wild vegetables has always also been a subject of diversification of

[47] A pitch making method using a specially built furnace has already been described in Pliny, *Hist.Nat.* XVI: 21:11 for "cedrium".
[48] My warm thanks to Ioannis Brokos from Kritsa and Katharo for the details!
[49] This is a good indication for the ancient use of the name *kedros* also for non-Lebanese cedar trees.

diet, it is often seen as a method of finding food in difficult times only (ibid.) It seems wiser to see here a method of enriching the people's diet in the green time of the year, as to grow green vegetables during summer requires enough water for irrigation that often couldn't be spared in dry regions[50]. *Chorta* were and are a normal dietary supplement - not a famine food, and their contribution in minerals and vitamins to an otherwise rather monotonous diet (staples: cereals – olives – legumes – wine, i.e. hardly any fresh foodstuffs; see also Allbaugh 1953) must have been important for a healthy diet balance.

The most popular species collected include: *Sonchus ssp.* (sow thistles, young shoots, boiled greens), *Foeniculum vulgare* (wild fennel, mixed cooked greens, also with snails), *Allium ampeloprasum* (wild leek), *Amaranthus ssp.* (amaranth, boiled greens), *Asparagus acutifolius* (wild asparagus young shoots), *Brassica nigra* (black mustard, boiled greens), *Sinapis ssp.* (mustard and charlock, boiled greens), *Raphanus raphanistrum* (wild radish, boiled greens) *Cichorium spp.* (various kinds of chicory greens), *Leontodon spp.* (hawkbits and other dandelion-like plants, boiled greens) *Daucus carota* (Queen Anne's lace, boiled greens), *Rumex ssp.* (sorrel, docks, boiled greens, big leaves filled), *Solanum nigrum* (black nightshade, young leaves, boiled greens). These are all growing during the humid part of the year (Nov.-June), some kinds of amaranth are cultivated over the summer[51]. Wild vegetables, often forgotten as an important part of the Cretan diet, are for that reason also called "Cryptocrops" and are used all around the Mediterranean (Hadjichambis et al. 2007).

Another important fact for the rural population's diet was the scarcity of meat. Even though they did consume some animal products from milk, protein must have been sparse for all but the most affluent. Thus collecting snails is an important protein rich part of the traditional Cretan diet, still extremely popular today (Figure 8) – Snails usually must be stored to "fast" for about ten days after collection – they are cooked only after extensive purging actions especially if collected following the first autumn rains when they are crawling in masses after their summer "hibernation".

[50] Although I doubt that the inhabitants of Bronze Age Karfi had a more important part of wild vegetable diet than those of Malia or Palaikastro as suggested in Nowicki 199: 153-4.

[51] There is also *Portulaca oleracea* (purslane, salad and cooked) that grows in summer only, at moderately humid spots, mostly in the lowlands; black nightshade can also be found in summer at humid spots. These are also browsed by animals – the latter in lesser amounts, as it is poisonous when uncooked.


Figure 8: Closed and open snail stash in the middle of nowhere but near Site 99A

This food-procuring strategy, together with trap-hunting (rabbits, hares, birds), must have been for centuries one of the main protein-producing ones for rural populations in Crete – and is totally non-detectable in the material record[52] (cf. also Nowicki 1999 for a suggestion for vanishing of small animal bones).

As for bird-hunting, birdlime from the local endemic *Viscum creticum* (Cretan mistletoe) growing in Crete only on pines as e.g. in the Kroustas forest, may, at times, also have been a valuable trade product with hunters who for centuries were not allowed weapons.

But there were other products from the mountain slopes, too. Apart from the insect dyes mentioned above, various plants were used for dyeing as well. Locals remember especially the use of lichens for light greens and walnut for browns, but other plants must have been used too.

Black and white work: Coal and lime burning

A forested area naturally attracts activities that need a lot of fuel, as charcoal and lime burning.
All over the mountain slopes charcoal burning spaces can be detected, and many locals remember one or two members of their families earning a small income from this work, although it was generally seen (as in Northern Europe) as a rather humble one. Even though this activity, after some decades, leaves few traces in the landscape, now that about 50 years have passed since the last charcoal burners left, many soil areas covered in fine black coal pieces can still be seen (Figure 9) often using leveled spaces originally installed by the Minoans, provided the built edge around them is low (as e.g. on Site 7D, Figure 10).

[52] As snails by nature hide in shaded hollows, a human snail stash differs only by its function as trap.


Figure 9: Charcoal burning site near Minoan Site 1B


Figure 10: Coal burning space re-using the low frame of the hardly preserved Minoan Site 7D

The large variety of limestone also attracted lime burners, although I was assured that not all kinds of limestone are suitable: favoured are plain, crystalline limestones over mixed varieties like conglomerate, a fact that probably saved many a ruin from being erased as an easy collecting place for stones to be burned. Lime-burning kilns καμίνια/*kaminia* are built with small rubble round structures and originally in a truncated beehive-shape (the upper part is open, hence the name cognate to “chimney”), often with a thick soil layer on its outside (for insulation). The inside of the structure is more detailed: Over a pit the round cylinder-shaped structure is built. While the outer soil wall reaches up to about two or three meters, the stones on the bottom inside form a wide vault with an opening on one side for firing this chamber, beehive shape, closed at the apex by the keystone, the *κλειδί*/*klidi (*key). The firing vault inside is not quite man-high. This vault could carry large loads, and up to 5 m of limestones would have been piled up on top inside and even above the outer walling. Many people in Crete had their own lime kiln, if only a small one for the family's use[53].

Usually the vaulted inner part is not very stable and thus in a ruined kiln only the cylindrical part, filled up with the rubble of the fallen vault, remains standing. Sometimes, low on one side, the fire opening can still be seen.

Lime being ubiquitously used from cementing walls to painting houses and clearing wine, many lime kilns are spread over the Cretan landscape, indicated by the typical surrounding scatter of white, dead-burned stones: While they weren't of use any more as they wouldn't react with carbon dioxide or water any more and thus stay unchanged on the surface with time, the reactive quicklime (Calcium oxide) was collected and sold.

The most interesting lime kiln in the Tsivi South area is situated at Site 44D, where parts of the Minoan walling, possibly an actual round structure, was included in a lime burning site (Figure 11). It seems that first the lime burners tried to use the round ruin as base for their kiln, which then must have gone wrong as only very few white burned stones can be seen in the lower of two kilns the lowest layers of which are partly oncolithic. The burners must have given up this experiment and proceeded to build a new kiln from scratch which is slightly uphill from the first, typically constructed from small rubble which is white burnt on the inside and surrounded by more dead-burned pieces.

Figure 11: Lime kiln below the dwelling ruin at the Minoan Site 44D

[53] My warm thanks go to Kostis Papadakis from Pacheia Ammos for explaining the details and procedure.

B. Mountain built environments and settlement pattern(s) in the study region

"There is nothing in any sense of the word primitive about pastoralism"

Horden & Purcell 2000: 84

Agricultural installations - Pastoral installations

Families using the mountain landscapes usually have at least two dwellings, one in a village and one or more in the mountains (depending on their respective priorities in agricultural and pastoral activities and the way their landholdings are distributed). In the past, a few families had another dwelling at the coast. The villages with the main homes are (from East to West) Kroustas, Kritsa and Tapes. These also had schools and thus during school term (September to May) mothers and children between 7 and 12 would live there at least for a period of six years if they were lucky enough to finish Elementary school. As a rule, men would stay with the herds wandering in a vertical (and mostly short-range) transhumance between the mountainous areas in summer and the coast in winter, where they lived mainly in small stone huts of the field-house style, as during the winter there was hardly any milking and cheese making. When the sheep were to have their lambs in April, the men and herds would move once (or twice in rare cases) up into the mountains where they worked and lived in larger shepherd huts (μιτάτα/*mitata*, see below) containing several rooms or separate buildings, with low stables (optional) and animal pens close to them.

Contrary to the massive beehive-shaped shepherd huts on the N slopes of Mount Ida in Rethymnon (Ivanovas 2000), those on the Dikti range are built on spots with accumulations of stones ready for use. In the Tsivi South area, the foundations of our Minoan buildings (see Ch. II) were very attractive spots for building when the landscape was re-opened for use in the 19th and early 20th centuries. Especially ruins on even level and of low height, with stable-looking foundations, have found interested parties. But builders refrained from (re)using the scattered big blocks for the upper parts of their new walls, and mostly worked with easily manageable rubble, usually stabilised with mud mortar. These rather perishable walls are often reduced to ruins within less than 50 years. Their wooden roof was covered with a layer of clay roof-soil[54] (δωματόχωμα/*domatochoma*) (Figure 12) and decayed easily without constant autumn repairs (Figure 13). Then, the winter rains can wash out the mud mortar and the walls crumble. As a rule, only parts of the Minoan ruins are “reoccupied”, not the whole structures – thus, recent buildings are smaller than those of the Bronze Age – and to the rest of the Bronze Age ruins other functions can be assigned, for instance that of a walling around a small courtyard (Figure 14).

[54] Often strange, obviously dug depressions in the landscape are what is left of a source of domatochoma, recognizable as such by its higher impermeability to water (and thus more green in its surroundings in winter), or even holding water for a while.

Figure 12: Source of "domatochoma" near Site 82. Note the intense green hinting at impermeability on the bottom (walking stick 90 cm).

Figure 13: Tsivi South. Two varieties of roofs, slighty inclined for water runoff. Cypress timber and stone slabs positioned like tiles (left) (1200 masl); timber from various trees bark covered, red "domatochoma", grey gravel (for easy drainage) and stabilising rocks (right).

Figure 14: Site 33B used for a recent (crumbling) *mitato*. Part of the Minoan ruin in the foreground shape a small courtyard

Exclusively agricultural houses (μετόχια/*metochia*) are extremely rare in our area: most dwellings are laid out for mixed agriculture and host also pastoral activities. The few purely agricultural field houses are usually small one-roomed structures with thin rubble walls often built with no mud mortar (Figure 15). Originally used to house the family seasonally, they served later mainly as shelters for the rainy days of the cultivation seasons and sometimes for the storage of tools.

Figure 15: Tafos region above Kroustas. Ruined fieldhouse/*metochi* with small fenced arable land and almond trees

More energy would be spent for dwellings built for half a year of use, either by men when meant for nearly exclusively pastoral activities (see below) or partly by families, when meant for mixed agricultural exploitation. Depending on the water supplies in the vicinity, women and children would often move to the mountains in summer as well, especially from Kroustas where water was often sparse by July. Such family "refuges" near water sources were in the areas of Korakia and Skotomenou above Kroustas (and along the NE edges of the Katharo plain). They differ from the exclusively pastoral dwellings by being surrounded with small gardens (see below) and vineyards, both needing at least some watering in summer. Inhabitants from Kritsa used to move to the Katharo plain and the NW part of the studied area (the slopes along the riverbed of the northern Kritsa *cheimaros* with the cypress forest) and the two water-bearing high valleys of Mikri and Megali Limni and Agios Ioannis/Flej. The Tapes people moved to Katharo (few), Pano Tapes (our Site 32) and Boina (area of our Sites 10-10D). Many of these dwellings had baking ovens, an especially clear indication of female presence, like handmills[55], and very rarely looms. These family dwellings were also larger, usually two-roomed, and have storage facilities.

Various specialized installations

Horticulture

Gardens are thus rather frequent in the Dikti range near springs and wells (Figure 17) – much more popular than on the slopes of Mount Ida. These gardens are mainly used in summer, but sometimes even year round, by families staying on the lower slopes in winter with their animals (Figure 16). They are usually simply fenced today, but used to have small walled enclosures previously (Figure 17).

They are mainly rainfed, planted with winter- and spring-vegetables like leeks (πράσα/*prasa*), lettuces (μαρούλια/*maroulia*), broad beans (κουκιά/*koukia*), chards (γούλα/*goula* or σέσκουλο/*seskoulo*), onions (κρεμμύδια/*kremidia*) artichokes (αγκινάρες/*anginares*) and a local kind of sprouting cabbage (τσιμούλια/*tsimoulia*). They are occasionally watered with the small available excess of amounts of excess or greywater and can house plants that need extra water and/or grow in summer like the garden-varieties of amaranth (βλήτο/*vlito*). Sometimes also local flowers (e.g. narcissi, flowering in winter and thus documenting a winter- or all-year use of the structures) and fruit trees are grown.

[55] These handmills consist of two circular grinding stones (each ca. 10 cm thick) joined with a central stick: the lower is immovable, the upper turns with a stick at its perimeter used as handle. Grain is placed – and ground – between the two. They are often made of hard volcanic stones imported, e.g. from Milos that would suffer less abrasion with use.


Figure 16: Current mountain garden at the *mitato* of Irini and Manolis Lassithiotaki (Kroustas), Tafos.


Figure 17: Megali Limni, garden wall ruins (below the large cistern) last used ca. 25-30 years ago

These gardens were meticulously tended and well fertilized with the family's herd's dung), their position often close to, or a terrace or two downhill from, the sheepfold, where winter rains would wash out well-trampled dung that composted on its way down until it reached the garden walling or fence and could easily be applied.

Bee-enclosures

In many rather inapproachable places (Figure 18) of the mountain landscape there are small to medium sized enclosures, usually independent of other buildings, the μελισσόκιπποι (*melissokippi*, bee gardens). These are built with an extra difficult access to keep animals, and mainly thieves, out, often with tiny openings, to hinder carrying away of the beehives. They used to house mostly horizontal ceramic beehives (Figure 19), although in some regions also vertical hives were used. Nowadays walls are unnecessary and beehives are wooden boxes.

Figure 18: Kritsa gorge, near the entrance. Bee enclosure on nearly vertical cliff at the tiny green nearly horizontal terraces.

Figure 19: Bee enclosure with some horizontal hives still intact (Kroustas area)

Shepherd installations

The buildings/dwellings used as functional bases for shepherds, are rather variable in different regions of the Cretan mountains (Ivanovas 2000 for Mount Ida) – probably because of a missing continuity in architectural tradition (see Ch.1.a). For instance, on Mount Psiloritis builders are centred on beehive-shaped buildings[56] for some 120 years now, in contrast with dwellings on the other mountains which are more house-like.

In villages and towns architecture is agglutinative and household units can hardly be told apartfrom neighbourhoods, while in the countryside isolated vernacular buildings like *mitata* prevail that usually give a better impression of the space used by their inhabitants, which, as already mentioned, may be only men. Built structures and spaces were used as workspace for pastoral work and/or storage, mainly for produce like cheese, items like firewood etc. *Mitata* of the Dikti region are usually quadrangular and have auxiliary structures either attached to them[57] (Figs 19-22) or at a slight distance.

In exclusively pastoral *mitata*, e.g. the Psiloritis ones, often situated hours of walks away from the villages, only men would stay for weeks at a time while herding and cheese making. Thus, less space was needed for storage of family supplies, e.g. in

[56] These are often compared to the Early Minoan (beehive) tholos tombs in the plain of Mesara and elsewhere, but their construction principles are closer to the Mycenaean corbel vaulted funeral monuments. With their diameter up to 7 m and stone slabs wide up to 1,5 m, the Psiloritis *mitata* are impressive, nearly megalithic buildings created to resist the pressure of large masses of snow in winter and keep stored cheese cool in summer. Their huge lower blocks (mostly slabs) are positioned by whole family or clan groups. The oldest known such buildings, their archaic appearance notwithstanding, date only to the end of the 19th century (Syrmakesi 1988).

[57] Each *terminus technicus* used by shepherds may be local only and differ within each region of Crete (Xanthoudidis 1918 for a seminal shepherd terminology, local differences etc).

cereals and oil. Women – if they came to the mountains at all – had their workplaces always in the main residences in the village. Food supplies were taken up to the men on a regular basis by the youngest brothers/men (μαντρατζής/mandratzis, χωριολόγος/choriologos) occasionally (e.g. during shearing) also by women. Cretan bread is typically a kind of biscuit (ντάκο/dako) that keeps for months, and can be stored in sacks in the *mitato.* Together with oil, olives, salt, locally produced cheese and meat they form the simple shepherds' diet, sometimes enriched by collected wild vegetables, and needed only a minimum in storage facilities.

The architectural setup of a *mitato* and *mandra* varies with the local environment, the herd's size and nature (sheep and/or goats) and the shepherd group's needs. Yet, some basic building principles and structures can be noticed (Figures 20-22). The main components are:

1. The house, *mitato* proper (the word can be used for the whole compound). This usually contains the main sheltered cheese-maker's (τυροκόμος/*tyrokomos*) workspace, the cheese-making hearth (εστία/*estia*), and the sleeping space for the shepherd(s) πεζούλι/*pesouli*: Some kind of hightened place like a bench or dais as bed or resting-place, sometimes softened with aromatic shrubs (e.g. *Origanum microphyllum,* καλοκοιμηθιά/*kalokimithia* "well-sleeper") and covered with a traditionally woven woolen κουβέρτα/*kouverta* (blanket).

Figure 20: Recent *mitato* at Site 74 (few remains lower right). The roof is fenced to keep goats from climbing up and destroying the mud/clay cover.

Many *mitata* also have an extra building for cheese storage (τυρόσπιτο/*tyrospito*). In pre-industrial Crete these were built with stronger, thicker walls (especially in the Mt.

Ida area – those were bee-hive shaped as well) because cheese needs to be stored in a cool and dry place (the latter excludes many caves as cheese-storage places, although they are used sometimes).

2: The *mandra* (μάνδρα, the word can be used for the whole compound as *pars pro toto*) or more specifically milking *mandra* (γαλόμανδρα/*galomandra*) and a second, usually larger, *mandra* (στειρόμανδρα/*stiromandra*) for the non-milking part of the herd (στείρα/*stíra* or αστείρα/*astíra*). M*andra* basically designates the whole enclosure structures surrounding the *mitato* (Figures 20-23).

The *galomandra* is always and all over Crete oval or rounded, according to locals to keep animals from being trapped in the corners during milking. Depending on the animals to be milked, its wall height varies from 1,2 (sheep) to at most 1,6 m (goats). These, and especially the latter, can be topped by twigs facing slightly inward to reach the final height (Figures 23, 24) to keep goats from jumping up (Figure 25).

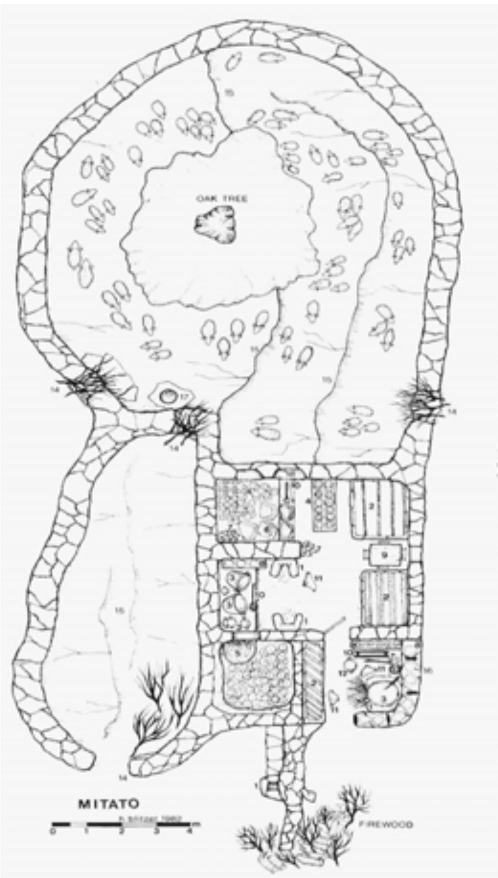

Figure 5 (left). Plan of a mitato (numbers 1-18 on plan) built of limestone. The entrance to the building faces north.

1. *Hearths built of three upright square stone slabs lined with clay*
2. *Stone beds and benches covered with thyme-filled mattresses*
3. *Copper cauldrons for cheese and mizithra preparation*
4. *Cheese wheels aging on wooden and packed earth shelves*
5. *Wheels of cheese in the naturally refrigerated storage area*
6. *Goatskin sacks for the storage of mizithra*
7. *Sheep bells hanging on the walls*
8. *Cheese baskets stored on shelves and the tops of walls*
9. *Table and chairs*
10. *Wooden stirring tool fashioned like a whisk*
11. *Wooden tools for cheese processing: wooden frame and T-shaped stirring tool*
12. *Stools made from tree roots*
13. *Pan of coarse salt*
14. *Entrances to corral with movable prickly shrub closures*
15. *Natural shallow, laminar limestone terraces encircled by the corral walls*
16. *Enclosed porch area of mitato, with raised roof allowing for air circulation*
17. *Stone block with carved cylindrical depression for the milking can*
18. *Shelves built into the walls of the mitato*

Figure 21: H. Blitzer’s (1990: 36) congenial drawing of a shepherd’s installation on Mount Dikti

Figure 22: Kroustas area, ca. 30 m above Site 143. *Mitato* in use

Figure 23: Katsouli Sterna, 50 m E of Site 2. Ruined *mitato*, probably the oldest of Kritsa (some Venetian sherds near 5). 1. Two dwelling rooms 2. Milking *mandra* 3. Small courtyard 4. Large courtyard with threshing floor 5. Enclosed field or big mandra 6. Small terraced enclosure (garden?)

Figure 24: Kroustas Tafos, re-using of Site 47. *Mandra* Lassithiotakis. Milking *mandra*. Small roofed cover for milkers at the exit, low *ypostego* with roof left.

Figure 25: Sheep in *mandra* during shearing (κουρές koures). Note twigs looking inside

A κλαδόμανδρα/*kladomandra* (twig *mandra*) is built only with twigs and is another kind of enclosure which does not belong to the buildings, but keeps animals out of planted areas – today replaced by wire fences (Figure 49).

Mandres can be set on very rocky spots (Figure 26). Even when levelled space is available: no shepherd could give any good reason for this. It is probably because they provide a solid, well-draining (not too muddy in winter apart from recent dung) underground – and because the space also cannot be used for anything else. A typical feature of many *mandres* (especially when they are set on sloping ground) is a sewer opening, always smaller than a grown animal, for the cleaning of dung (Figure 27) – which is often collected from the outside to be used for fertilizing nearby gardens.

Figure 26: Bambakia, Agios Ioannis Tapes/Kritsa (deserted). Rocky *mandra.*

Figure 27: *Mandra* wall from outside with sewer opening. Kroustas area

The "large courtyard" in Figure 23 could also be a *mandra*, (possibly also the *stiromandra*), in this case possibly to keep in animals over night or to keep them out of/away from the agricultural part of the "mixed agricultural" use of the area (indicated by the threshing floor) so as to better control other tasks, especially anything to do with cereal processing.

Other small enclosures may be used as partitions for separating parts of the herd during various tasks like shearing or during winter when ewes with challenged lambs (twins or triplets) need to be watched apart from the herd. The mentioned αστείρα (*astira*, "steriles" meaning non-reproductive), animals who are either male or too young yet to give birth (and kept with the males to be impregnated when the time comes) are in general kept apart of the milked ewes and lambs. For browsing they are led to the less lush regions, as the best are kept for the productive part of the herd (έγγαλα/ *engala*, milk-bearing). On some occasions these different parts of the herd might also need to be kept apart in their own space. The same goes for the lambs once they are to be weaned and ready to be slaughtered, or (for the females and rare males) to be incorporated to the *astira*. In most cases the milking space and overnight keeping space were two different enclosures (Figure 21: The lower, uterus-shaped part is typical for the milking enclosure as mentioned). Some independent smaller enclosures might be used to feed different animals differently (e.g. the gravid ewes), these would then be called *ταΐστρες* /*taistres* (feeders)[58].

On rare occasions one *mitato* can have several milking *mandres*. These were in use by several families or shepherd groups at the same time. In the case of Mesokoúntouro (Figure 28) for instance four families would spend here ca. 6 weeks in late spring between their winter pastures (χειμαδιό/*cheimadio*) near the coast and their summer alpine pastures at the highest browsing grounds on Mt. Tsivi (at ca. 1350 m)[59]. In other cases brothers with separate herds also had separate *mandres* (e.g. at Koutsoura Armi, between Sites 189 and 191), but set in a cloverleaf-like combination (usually brothers manage their sheep as one herd).

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[58] If the interest in wool was greater (which it hasn't been recently for economical reasons as noted above) a special *mandra* for sheep with special wool (e.g. castrated males) would also be a possibility.

[59] My warm thanks to Manolis Thrapsaniotis, Tapes, for this information. His family used to do this transhumant journey until the early post-World War II years. He also told me about the winter 1945, which he spent, 11 years old, on Pseira island with a hired by his family old man as shepherd and ca. 500 sheep (an immensely large flock at the time!). See below for flock sizes.

Figure 28: Mesokoúntouro (on top of Site 31), height 920 m. Fourfold *mandra*

Walling may also have belonged to the υπόστεγο/*ypostego* (low stable), a construction giving some shelter to animals (cf. the roofed part in Figure 20 and 22). These were always built low (often not detectable when ruined) while in some cases ruined constructions are still clearly recognizable as such, even when abandoned for enough years for the originally perishable cover to vanish (Figure 29).

Figure 29: Former *ypostego* ruin near Kroustas Tafos. The short stone column shows about the original height, roofing was perishable

Other small enclosures or small walled spaces may also exist surrounding *mitata*. Smaller enclosures (nowadays usually fenced only) close to the *mitata* may be used as vegetable gardens (Figure 16 above) or chicken pens, and in rare cases even the dog(s) have their own separate space[60].

A very small kind of enclosure is the κούμος /*koumos,* meaning something like rounded hollow). Often a mere hole in between rocks, they are sometimes built like small Iron Age tholos tombs (Figure 30) with an opening on top. Their function is to seperate single sheep, e.g. for slaughtering (typically these were stolen, part of the becoming of age quasi ritual theft[61] for young men, for this cf. also Herzfeld 1985). Normally shepherds when asked will say these sheep (recognizable by their ear-sign σαμία "samia" as foreign, cf. Ivanovas 2000) are to be given back to the rightful owner (which nowadays may actually be true at times).

Figure 30: *Koumos* in a scree high near a *mitato* above Pano Tapes/Boina (opening and space just large enough for one animal)

Another small built structure is the φούρνος/*fournos* (baking oven, Figure 31). Epecially when almost totally gone, it can often still be recognised by the large amount of pottery sherds (in Figure 31 beehive fragments, in other cases pithos sherds) fallen from the original inner lining. Large ovens can have up to 4 m wide outer structures housing the mud mortared inner baking space. The author has seen in

[60] I have seen one small stone building (at a recently deserted *mitato*), with a big rock as one wall, a wooden lintel above a 40 cm broad door and covered with slabs that must have been a dog hut.

[61] There is an interesting similarity of images showing the animal thief (sometimes in old churches among the various "sinners" depicted, cf. Ivanovas 2000: 171) carrying the stolen animal over his shoulders, and the bronze statuettes (ritual dedications) of ram-bearers (e.g. from Kato Syme, Lebessi 1989).

the Kritsa area the leveled ruin of a Medieval to Ottoman oven partly lined with Minoan sherds – from a site only ca. 50 m away.

Such ovens show that women were active at the respective sites. Women from the Kritsa/Kroustas area used to work full-time or part-time as shepherdesses (and some still do). Depending on the age of their children, they would stay in the mountains with the men and help in shepherd work (Figures 32, 33). Still, very few of them actually seem to have had their own ovens in the mountains[62].

Figure 31: Kroustas Tafos area. Recent ruined baking oven with sherds and soil mixture from inner lining of the oven opening (width ca. 3 m)

3. The courtyard αυλή/*avli* is often only the open space in front of the dwelling, used for many outdoor tasks, circulation and communication. It can be walled too and include built-in tables and seats (τραπεζαρία/*trapesaria*). As a rule there are only built benches and moveable seats from perishable material (modern shepherds often use colourful plastic crates). Sometimes a simple cooking space (εστία/*estia*) is integrated in the benches (Figures 34 and 21: no 1). Preferably, yards are shaded by one or more trees, mostly kermes oaks) (Figure 35).

[62] My thanks to Koula Brokou, Zacharenia Barda, Stavroula Thrapsanioti, Sofia Barda, Irini Lassithiotaki, Maria Chorafa, Maria Brokou for sharing their memories and experiences with me! None of these actually owned a baking oven in the mountains they made their bread in their respective villages or on Katharo.

Figure 32: Zacharenia Barda making *mizithra* in her *mitato* (on Site 62)

Figure 33: Lato area. Koula Brokou watching her sheepp in her *cheimadio*.

Figure 34: Cooking space in a *mitato's* outer bench

Figure 35: Kroustas area, ca. 1100 m. *Mitato* courtyard with the bench Figure 31, shaded by kermes oaks

Agricultural installations

Apart from the small houses and gardens mentioned above, there are several other typical built structures belonging to agricultural installations.

1. The threshing floor (αλώνι/aloni). It is usually made up of a single row of stones set in a circle, these stones are often standing upright (rather on their sides than on end). The threshing floor was only rarely close to the *mitato* (if part of it at all, but cf. Figure 20). In cases where mixed agriculture was practiced (and thus cereal production together with animal husbandry), threshing floors were part of the

structures belonging – in the widest sense, as often distant from the dwellings – to the family's mountain compound.

These spaces were always set in a position of optimized wind movement (as this was needed during threshing to separate the grain from the husks[63]). On the other hand this position was mostly avoided for the dwellings. Well planned mixed compounds would be situated so as to include both (Figure 22). Threshing floors often also belonged to several families and were set apart for freedom of workspace, sometimes in groups (as, for instance, next to the recent ruin parts of Sites 21 – 21F, where 3 *alonia* are set aside next to each other). Threshing was done by moving (a) large animal(s) (cows, donkeys, mules) around within the cleaned, flattened, stone circle (hence at least 4 m diameter), trampling the whole grain so as to dehusk it. In the last century threshing was also boosted by a sledge armed by chert pieces[64] (βολόσυρος/volosyros), usually thought to be traditional although it seems that is no indication of it in Crete until the ending 19th century (Beckmann, forthcoming)[65]. Sometimes, modern *alonia* reused Minoan remains (Figure 36), taking advantage of the flattened space of the ruins' fill level.

The earliest *alonia* in the Tsivi South area are probably those nearly hidden from view at more or less inaccessible spots on ridges or behind large rocks, probably to prevent the Turkish occupants from realising that threshing was going on (which would have meant tax payment *in situ*) (Figure 37).

Figure 36: Site KA01 (massive wall left) reused as *aloni*

[63] This – together with the size - is one of the main criteria to judge if one is in doubt of having to do with a threshing floor or not – cf. the subject of the Minoan Round Structures in Ch. II.b.3.C.

[64] Later, by saw-like metal blades.

[65] Oval and/or smaller spaces thus should not be interpreted as threshing floors (as in Betancourt et al. 2005, Site D2, measuring 3x6 m, this would rather fit the shape of a milking *mandra).*


Figure 37: Agios Ioannis Tapes/Kritsa area . Mountain *aloni* hidden on a thin rocky ridge

2. Fenced fields χωράφια/chorafia. The largest kind to be found (and rare in the Tsivi South area) is the walled field, usually built to keep out animals that are browsing freely in very rocky surroundings (Figure 38)[66].

Although in Crete animals were either tended during the day or locked in the *mandres* during the night[67], many mixed agricultural fields were fenced to prevent access for animals, often mainly with thorny bushes lined up along the sensitive fields, creating the mentioned above *kladomandres* up to field size.

[66] For this and other kinds of modern walling see also Moody and Grove 1990.
[67] Modern Mt. Ida shepherds maintain their sheep were always free during the night, but their tendency to identify with everything to do with freedom might have biased their "memories", and the fact that their browsing grounds were also terraced for fields support this view.

Figure 38: Walled field (recent, partly re-using the perivolos of Site 49B) near Site 49/49B (in the background), from East. The better colluvial soil causes different plants to grow inside, hence the (yellowish dried here) lusher vegetation in the area surrounding the tree up to the wall

An example of a small field sowed with oats, wire fenced now, is still in use just below Minoan Site 30 (Figure 39), controlling the *in situ* browsing of the sheep, as herds nowadays are by far too large to be fed by local wild greens[68].

Figure 39: Site 30 (2008). Fields sown with fodder to be browsed *in situ*.

[68] As expensive imports are avoided as much as possible, the *in situ* feeding is becoming more popular every year and has already dramatically changed the landscape e.g. in the Palaikastro/Cavo Sidero area by bulldozing (to clean from surface rocks) large areas to make them machine-ploughable. They now look in winter like golf courses (easily recognizable on Google Earth east of the Toplou monastery region while in the brown, dry state - notice how dramatically these fields have grown between 2003 and 2010!) and grow fodder for large herds.

Terracing ancient and modern

"Man liebt alle kleinen Felder auf Anhöhen, welche mit der Haue bearbeitet werden, weil der Regen zwischen den Steinen liegende fruchtbare Dammerde herabschwemmt und dort liegen läßt. Auf Ebenen geschieht dies nicht, daher sie auch nicht fruchtbar sind, weil nur selten und sehr mühsam der Boden gedüngt wird" [69] *Sieber 1823: 22*

"Wo mögich sind alle Getreidefelder auf Anhöhen, und Abhängen [...] Ueberall trifft man Scarpirungen, Futtermauern eines Feldes, welches oft kaum 2 Quadratklafter [= ca. 7 m²] an Flächeninhalt besitzt. [...] Man liebt diese kleinen Felder höchst wahrscheinlich deshalb, weil der Regen den Humus zwischen den Steinen dahin führt und absetzt"[70]

Sieber 1823: 53

The archaeological bibliography contains various opinions on the age of terracing in the Aegean. While the oldest known dated fieldwalls/terraces in Europe have been found for Neolithic Ireland (cf. e.g. O'Connell & Molloy 2001, dated to the 4th millennium BC), a similar age has been suggested for Crete, although certain dating exists only for periods of the Bronze Age (Bull et al 2001)[71]. On the other hand Nowicki seems to believe that LM III settlers were the first to install terraces after "arriving in virgin mountainous territory" (Nowicki 1999: 168). In general it is said to be known that the technology of terracing goes back at least to Bronze Age times for the Mediterranean (Frederick & Krahtopoulou 2000: 80). While there still seems to be uncertainty about Graeco-Roman terracing with many authors (e.g.Foxhall 1996[72]), Price and Nixon (2005) provide evidence for terracing also of this phase, and Chaniotis (1991: 99) sees deminishing water supplies known from late antiquity (Plinius Nat.Hist 31:53, citing Theophrastus) as consequence of interrupted (through war) cultivation on terraces[73]. Descriptions of various structural techniques of recent terracing can be found in Moody & Grove 1990 and Rackham & Moody 1996.

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[69] "They love all small [built] fields on heights that are cultivated with hoes, as the rain carries down the fertile colluvial soil from inbetween the stones and leaves it there [on the fields]. This doesn't happen on the plains, hence they aren't fertile as the ground is fertilized only rarely and arduously."

[70] "Where possible all fields are installed on heights and slopes […] Everywhere one sees terracing and revetments of a field, which often may be no larger than 7 sqm […] Most probably they love these small fields because the rain takes the good soil from between the stones and produces a colluvium on the fields."

[71] P. 225: "terraces are considered to have increased gradually between the Final Neolithic and Middle Bronze Age; the final terracing of available agricultural land coinciding with a large population increase during the Middle Minoan period (ca. 2050–2000 to 1700–1680 B.C.; Betancourt & Hope-Simpson, 1992)." For the latter reference, see below.

[72] She maintains that intense structuring would have been "done by the rich […who] made use of available surplus labour for generating income" whereas over-population only would make people desperate enough to cultivate sloping lands, p.65

[73] To judge from the longevity of old terraces even after many years of agricultural disuse, this fact seems to be rather improbable, though. Erosion is not as bad as usually believed without the interference of bulldozers, see Ch. I.a. On the other hand disuse of aqueducts (with their usually small diameters, cf. the preserved parts of the Roman aqueduct along the riverbed above the Roman settlement at Gournia) may easily disrupt water supplies dependent on them within a year.

A more concrete approach to Bronze Age terracing was made by Betancourt and Hope Simpson (1992:53) who believe that the terracing in Pseira island goes back to Middle Minoan times and had been first structured "to create level plots of land" (ibid.) (and hence not as a precaution against erosion). That these plots of land were also manured they deduced from small pottery sherds evenly spread on and through the soil of the excavated terraces (ibid. 51). Another kind of manuring they suggest would have come from cleaning out the silt from behind the dams also found in the area and taken to be used for irrigation. This silt must have been spread (to judge by changing soil colours) on the terraced fields at least since the Late Bronze Age, together with manure from animal pens containing the pottery (ibid. 53). For possible manuring in the studied area cf. Ch. II.c.1 Pottery.

Thus it may be stated that terracing has been a vital strategy in Crete for many centuries[74]. The importance of the phenomenon of slope sedimentation for agriculture and its human exploitation as seen from a more recent perspective can already be seen in Sieber's report (cf. citation above from Sieber 1823), who also described in detail the terraces' fertility (and its origin as black earth being washed out from between rocks) as well as their often minute size.

The current, often crumbling, state of mountain terracing is the main factor of what looks like erosion, but is mainly a function of the "return to nature" (see above, erosion, Moody 1997) taking place since the terraces aren't regularly repaired any more[75]. As the slopes of most Cretan mountains are only used for browsing animals and not agriculture any more (since about the 1960ies) the terrace walls built during the late 19th and early 20th centuries aren't repaired any more and sediments trapped behind them return to their natural position on the slope. It is therefore amazing to see that in several places terraces built with large blocks and obviously in Minoan times (see below Ch. II.b) still survive in situ, whereas most of the modern, small-stone constructions either crumble or leave no more than a slight ridge behind, to denote their original position (depending on surrounding soils and slope gradient). Where the surrounding landscape has the tendency to grow over with forest (which is most of the studied area) more of the terracing remains in position wherever overgrazing/goating is not so dramatic as to cause the toppling of the walls before trees have re-grown (see above, Erosion)[76].

[74] For terracing in general cf. most recently Grove and Rackham 2001, Chapter 6.

[75] Note that the time it takes to reduce terraces to no more than slight ridges can be hundreds of years, cf. Grove&Rackham 2001:265, in the studied area this may take longer – and has taken longer where Minoan terraces still remain. Cf. also Shiel 1999: 71 for the fact that abandoned terraces are often a main cause of erosion (or rather what looks like general erosion).

[76] For details on terrace erosion cf. Grove & Rackham 2001 (e.g. 264-265).

C. Life in the Cretan mountains (study area)

Shepherd life - Transhumance

For the question of what should be called transhumance various opinions exist (Chandezon 2003 for the large definition). In the case of Crete, transhumance means the moving of herds from different browsing areas between winter and summer (hence the Greek word χειμαδιό/*cheimadió*, "wintering"), mostly in a short-range vertical way between coast/lowlands and mountains. The longest (rare) transhumance of Cretan pre-industrial times known to the author was from the north-central Mt.Ida slopes to the Siteia area, i.e. some 110 km. While coastal areas were still intensively agriculturally cultivated where possible until the 1960ies, herds needed to find uncultivated coastal areas even at such a distance.

Cretan transhumance is a function of the different growth periods in the mountains and close to the sea: Between the high mountains (e.g. the Tsivi South area) and the shore regions the difference in reaching the same stadia of vegetation can be 4-6 weeks, and as rainfall continues longer in the mountains (see Ch. I.a) the vegetation lasts longer in the mountains, too. Thus without the intense pressure of cultivation at all possible coastal places, many shepherds of the eastern Dikti range would rather have short, horizontal transhumance journeys, at the most between the Katharo plain and the coast between Elounda in the Nort-West and Gournia in the East[77]. To move the herds from summer mountain grazing areas to the coast is especially reasonable when herds a mainly kept for milking (and with that milk products), as below ca. 12-13° C animals produce only half as much milk as when it is warmer (as is mostly the case near the coast in winter). On the other hand one could imagine that if wool production was sought, keeping the animals in cooler surroundings might add to the wool amount per animal to be obtained after the winter. As the interest in wool has been marginal for economical reasons in recent years, no clear information about the subject could be gained locally.

Shepherds' manners and customs

Δεν την πετώ τη βέργα μου, την βούργια δεν την βγάνω
Ορκίστηκα στο κόκαλο τση μάντρας να ποθάνω

I won't part with my shepherd's crook, nor ever take off my knapsack
I swore on the threshold of the mandra to die [if I do]

Ο Μαντρατζής (Myron Skoulas on his CD *Τ'αορείτικα*)

There are many manners and customs, thus here again only three examples of possible interest from an archaeological point of view.

Ritual behaviour (still) has a certain importance within the daily routine of shepherding. The most impressive – and the only possibly visible one in the material

[77] One of the current shepherds of the western Gournia plain comes from Kritsa and only recently gave up transhumance (when imported fodder became a necessity anyway).

record - is the way a ram- or billy-goat head/skull is attached to some well visible point of the *mitato* or *mandra* to ward off the evil eye. The skull is chosen to be of the strongest available animal that dies or has to be slaughtered (usually these big males are leaders or breeding bucks/rams and thus are kept as long as possible.) The animal's strength is seen as a blessing for the herd's general state of fertility and well being (Figure 38).

Figure 40: Kroustas Tafos. Irini and Yannis Lassithiotakis' modern *mitato* sitting on Site 47. Large apotropaic ram's skull at the entrance (backgorund: garden and dwelling).

Another magic or powerful element within the mitato compound is the entrance to the *mandra*, κόκαλο της μάντρας /*kokalo tis mandras* (threshold into the milking *mandra*). The spot where the milking takes place and every sheep/goat has to pass twice a day is seen as especially important for the shepherds. Hence swearing an oath they want to ascertain they really mean (like swearing on the Bible or one's mother's grave elsewhere) has to be connected with the herd's fate, and thus the threshold is chosen as a place of special power. Very official shepherds' oaths (like swearing one has not stolen the other shepherd's sheep) can only take place in a few very holy spots in Crete, as for instance the church of Saint George of Selinari (Vrachasi), that has also a position (at the passage through a tight gorge) similar to a *kokalo tis mandras*[78].

[78] The similarity may or may not play a role in the choice for swearing church.

One of the most openly Christian religious shepherds' "rituals" is the slow drawing of the sign of the cross on the surface of the just set cheese (and similarly on other products, see below, *xinochondro,* with Figure 47) while it is still in the cauldron. This is, I was told, in deference to the moment of metamorphosis that takes place when the milk sets and becomes cheese.

That this may not always have been a Christian "ritual" but possibly follows an older one might be suspected from the fact that one of the tools used in the process of preparing this stage (while the milk is still fluid) is called διόνυσος /*dionysos* or διόλυσος/*diolysos,* Figure 41). It is the stalk of a palm leaf (!), used to stir the milk and loosen any parts that might lead to a burning of the milk.

Figure 41: Cheese cauldron and *diolysos*

Pastoral every day life of interest for archaeological comparison

Pastoralism is "the response to ecological locations where the biomass can be made available to human needs only by way of animal diet"

"Environments whose potential is to be realized only through animal husbandry"

Horden&Purcell 2000: 83,132

Pre-industrial shepherds (before hundreds of meters of black hose[79] crisscrossing the landscape started to bring water to each desired spot) were used to walk their grazing sheep every day to the closest watering place, and although none of them was (on the map) further than ca. 1.5 km from the closest cistern or spring, many would walk 2 hours (plus 2 hours back) for that task only. The water need per sheep depends on the current milking stress: for traditional sheep-keeping (without extra feeding) ca. 1 litre per sheep would be enough (modern times: up to 4 litres). If there are enough water-containing plants for goats (herbs and or bushes, even low trees are browsed) they can be kept άνυδρα/*anidra,* (un-watered). For human drinking water supply, a donkey

[79] For instance Kostis Bardas (his *mitato* sits on Site 62) laid ca. 1.500 m of plastic hose to be able to water his sheep on the spot instead of walking them the 1.500 m every day to the cistern at Megali Limni (at Site 84-84B).

with two narrow-necked jugs (στάμνες/*stamnes*, containing up to 8 litres) would be taken along. These jugs were kept in a wall recess to be as cool as possible[80] (Figure 42).

Figure 42: Kritsa area at 1200 m. *Stamni* in wall recess (*doulapi*) of recently abandoned mitato

The amount of land surface needed as a minimum per head sheep obviously changes with the surroundings, but is given by the locals as somewhere about 3/4 ha in a moderately rocky region (Tafos, Kroustas) if no extra fodder is given (Halstead 2008: 242 gives 1 ha).

To increase the browsing quality of phrygana-emphasized areas, shepherds practice controlled burning (in winter, when the danger of the fire taking over larger areas is small, Figure 43). They either burn single large bushes or small, mostly triangular-looking (from a small beginning downhill to a broader range uphill) patches (cf. also Rackham & Moody 1996: 118). Where the thorny bushes are gone, fresh greens sprout (with extra power from the fertilizing ashes, Figure 43) and provide extra fodder.

[80] Those produced in Kentri (Ierapetras) were especially well known for their water cooling function: The slightly porous pottery let a small amount of water evaporate over the vessel's surface, resulting in a lower temperature of the water inside.

Figure 43: Controlled burning in winter, Kritsa area (below Site 83C)

Figure 44: Pateragiorgis, Kritsa. Burned patch in January. Ash amounts are noticeable.

Cheese making

Cheese making is basically done in the spring and early summer months, once a day after morning milking (with last night's milk as well).

Traditionally, a patch of bench along the inner wall of the mitato was built up on two sides with a space inbetween to become the hearth εστία (*estia* – this one is usually much bigger than the one for cooking), fired mostly with small pieces of wood and underbrush (like the village baking ovens). A cauldron χάλκωμα/*chalkoma* or χάρκωμα/ *charkoma* ("coppery one") [81] made from galvanized copper (blackened outside by long use) is set on the opening (Figure 45), often small gaps on the side are filled with mud or clay to keep smoke as much as possible out of the cheese-making person's face[82].

[81] *Charkoma* or τσιγκλάκι /*tsiglaki* ("zinc coated one") is also the name for the milking bucket which is called πίνακας/*pinakas* on Mt. Ida.

[82] For cheese-making procedures see also Ivanovas 2000.

Apart from the metal cauldron, all the other tools are of perishable material (Figure 46; in Figure 45 even the big ladle is made from a gourd).

Figure 45: Maria Chorafas (Kroustas) making cheese

Figure 46: Jorgos Brokos's cheese making equipment, from cauldron (sitting on a gas-cooking tripod[83]) to cheese shaping baskets

[83] In a more modern phase the hearth was replaced by a tripod gas-cooker, especially interesting in terms of possible use of Minoan tripod-cooking pots for making cheese, see Conclusions. A good collection of terms for herding and cheese-making items in Xanthoudidis 1918.

Xinochondros – ξινόχοντρος

This "sour-thick" Cretan specialty[84] and best example for a product of mixed agriculture was often produced by the shepherds (but also in the villages): Fermented (sour) milk was cooked (in the big cauldron also used for cheese-making, Figure 47) with coarsely ground (by the hand mill described above) wheat, the finished, thickened product laid out on the village roofs in small handful-sized portions to dry, and then consumed over the year. It constitutes the ideal solution for various problems: when sheep and goats reduce their milk-production by summer, only small amounts come from milking (too small for cheese-production) and are added to a big jug with souring/fermenting milk every day. Together with the home-ground wheat a preserve is created that contains a good mixture of proteins and carbohydrates. While eating wheat as such presupposes either long soaking and cooking or baking, this pre-cooking process prepares the cereal for being cooked in a much shorter time. Also the rules for the religious fasting period in summer (before Assumption Day) forbid animal products. Thus by preservation the loss of valuable dietary elements could be prevented.

Figure 47: *Xinochondros* made in a *mitato*, just finished, protected by the cross

Shepherds' knives

Until recently (and with shepherds from Mount Ida still as a matter of course) together with shepherd's crook and satchel a big knife[85] (worn on the belt) was still part of the main shepherd equipment. It was used for many a task, from slaughtering

[84] A similar produce of the mainland is τραχανάς/*trachanas*, although made with not fermented milk.
[85] With modern police/law regulations wearing a knife with a long blade is forbidden (here the possible use as a weapon actually does come into the debate).

animals for the family and cleaning the hide to cutting and shaping sticks for use, and eating it. In any case a knife was seen as indispensable[86].

Mountain agriculture

"The farms averaged 9.2 acres [3.72 ha] in size with nine-tenths of them less than 25 acres [10 ha] in area. On the average these small farms consisted of 13 lots scattered throughout the community, requiring 5 to 90 minutes to reach them." *Allbaugh 1953: 284*

When considering Cretan agriculture and its possibilities, one rather tends to look to the fertile plains than the mountains. Even Allbaugh, who tried to give a good overview, necessarily dealt with Cretan villages for information and was thus more focused in favour of the more fertile areas. Still the small size of the Cretan average farms is interesting to note. There are hardly any large villages either[87].

Contrary to what is usually believed, the seemingly "marginal"[88] area studied here is not (and probably never was) a region in danger of "increased risk of crop failure" (Halstead 2000: 123). To the contrary, while in the lowlands rains may stop from May (see below, experimental barley fields, and above Ch. 1.a for precipitation), humidity in the higher regions lasts longer, and thus the risk of crop failure is much lower. Still it is clear that while lowland fields were large (and rock-less) enough to be ploughed with oxen, highland fields of the Tsivi South area were only rarely big enough to be tilled in a larger style. Ploughing was men's work, the "plough" often drawn by no more than a cow, and actually using an ard[89], not a plough with a ploughshare. Instead, most of the tiny fields (often no more than 2 sqm among rocks – but these were supposed to be the most fruitful ones) were simply hoed, and were seen as women's and children's work (as were large parts of the harvest). These small fields are said to have often been the best (see above, terracing, with Sieber 1823).

This can actually be corroborated by measurable facts, as walls (and similarly the rocks surrounding the small fields) reduce dehydration of the soil and erosion through wind in a distance up to 8 times their height (cf. Krusche et al. 1982).

The basis of agriculture in the Cretan mountains is dry farming – there is no artificial irrigation for fields, but only in small horticultural contexts, usually close to settlements and/or the rare year-round springs. All other fields are watered exclusively by rain and thus tillage farming takes place only during the rainy half of

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86 Wearing a knife on one's belt thus is not necessarily a sign of belligerence/war-like life (as e.g. with Cretan resistance fighters of the 19th century) as is said in interpretations of Minoan male figurines with a knife-like object (dagger/εγχειρίδιο) on their belts (Alexiou 1979: 50). It might e.g. have been part of the equipment of men slaughtering sacrifice animals.

87 But note that Kritsa, just below the studied area, until recently was Crete's largest village.

88 "remote" is also a frequently used word – mainly by people who think in terms of the position of the closest petrol station or hospital. Still the comparatively good connectivity of many of the remote seeming areas with the usual kind of Cretan transportation (per mule/donkey or on foot) should be the main factor to take into consideration if judging a place to be remote or not.

89 Ards or scratch ploughs do not cut and turn the soil to produce furrows, but rather make a deep scratch in the surface, cf. already for ancient Greece Isager and Skydsgaard 1992: 46, citing Hesiod.

the year from November to May. Plants with a shorter growing period are favoured before those with a longer one, hence barley is and was the most popular mountain cereal (while wheat was more popular in the plains as long asgood rainfall was expected), barley also being more resistant to the vagaries of mountain weather. Barley also yields 10% more nutritient energy per square meter (cf. Allbaugh 1953: 125-6) and is more palatable (the grains are soft enough even for eating raw or short cooking, whereas wheat can only be cooked after long soaking or being milled)[90]. Apart from that, barley also needs less labour than wheat[91].

While in traditional Crete animals were still under their shepherds' control, mountain fields would be sown in November and visited afterwards only sporadically before the harvest in June. More work-intensive crops like legumes or flax (they need weeding and hacking) were grown closer to the villages in the lowlands. Even nowadays, after about 50 years of disuse, many of the terraced mountain fields can still be seen on slopes up to great heights (some up to 1400 m) that locals also remember to have cultivated with cereals (Figure 48)[92].

As mentioned above, cereal fields were not manured[93] (~~cf.~~ Ruschenbusch 1998), and the general method might even be described as extensive crop husbandry (of the kind depleting soils very slowly and over decades only). The natural tendency of the region to wash down fresh soils from higher levels would slow that process or even prevent a total depletion.

Figure 48: Boina, Tsivi, region (Tapes, Site 10C) ca. 800 masl. Terraced slope.

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[90] The Cretan (hulled) mountain variety of barley (contrary to other known kinds) can also be raised alone with sourdough for baking in bread, producing the well known specialty of Cretan "dako" (nowadays mostly baked mixed with wheat flour).

[91] Barley: 1,8 man's workdays/stremma/head versus 2 for wheat, plus 0,2 supplementary worker workdays/stremma/head versus 0,6 for wheat, Wagstaff and Gamble (1982): 103, citing Pepelasis and Yotopoulos (1962): 164

[92] The village olive trees were also mostly situated at lower altitudes (most under 700 m height, but some up to 800 m), although as mentioned above they do grow also in greater heights. This may also be a function of practicability for harvest and oil pressing.

[93] Cf. also Bogaard 2004: 29 for the theory that Neolithic fields were not manured.

Tilling fields in the mountains is not the same as tilling fields in the plains. In our study area, only large fields were ploughed. The ploughs – or rather ards – consisted until recently entirely of wood, sometimes with the exception of a small iron ploughshare (no more than a hardened tip). Especially with poor people they were pulled by no more than one cow, often shared by several families, as oxen were too expensive to maintain (in terms of the amount of fodder and water they needed).

Once fields were sown they protected them from foraging animals (with or without inattentive shepherds) usually by perishable fences made from thorny twigs (wild pears, spiny broom) that were lined up along the cultivation border (Figure 49).

Figure 49: Branch fence (*kladomandra*). Originally probably ca. 0,7 m high.

The harvest was done with sickles with half-meter long handles, but as Trevor-Battye noted in 1919 (148): "Where the corn is thick enough it is cut with a sickle; but on many an upland terrace it is too thin for this, and there each stalk of corn must be separately plucked by the fingers." The scythe was unknown in Crete (Hitier 1881: 593).

After the harvest crops were brought to local threshing floors (αλώνια/*alonia*), as mentioned above circular flat spaces with trampled earth on the surface surrounded by a single wall of stones as boundary. Threshing floors had a diameter of at least 5-6 m, as on them threshing was done either with animals walking around on the spread out crop (this makes a certain diameter necessary) or with the animals pulling a flat wooden board studded with cutting flint or iron saw pieces on the underside called *volósyros* /βολόσυρος) on which the person leading the animals rode. The true *volosyros* (literally *sod-puller*) originally was a similar heavy board, but without the cutting flint or iron blades, used for breaking up chunks of soil after ploughing, in function similar to a harrow.

Early travelers in Crete describe threshing the reaped cereals by treading with animals (Sieber 1823: 54), confirming the impression that sledges were not in use here until sometime in the middle of the 19th century (Hitier 1853: 593), when the first descriptions of threshing sledge use in Crete appear. A general use of the *volosyros* is documented from the beginning of the 20th century (e.g. Trevor-Battye 1919, travelling before 1909). As I have tried to show elsewhere (Beckmann forthcoming) the use of flint pieces on a sledge for threshing seems to be a late arrival in Crete, probably together with the first slackening of Turkish oppression some time during the end of the 19th century[94]. Neither excavations nor archaeological surface surveys (Blitzer in Watrous et al. 2004, T. Carter, pers. comm.) seem to have produced convincing examples of older chipped stone tools showing the use-wear typical in tribula (or in sickles). Diamond (1975) believed to have identified some possible threshing flints by use-wear, but later work finds this doubtful (Kardulias & Yerkes 1996: 664).

Nevertheless there seems to be the impression in the scholarly world that something similar to the tribulum must have existed already in Minoan times (Warren 1979: 560). But even though threshing sledges with flints have been used in the Eastern Mediterranean since Neolithic times (Anderson 1999) they probably were not used in early Crete – neither in the Minoan Bronze Age nor later Archaic or Classical times, to judge from the material record, and probably not even in medieval times. Only from the middle of the 19th century was the tool introduced to Crete, presumably from Turkey, but it never became popular enough even to acquire a proper name.

One of the reasons for this (apart from the slow coming of age of Cretan agriculture at the end of Ottoman occupation), is that the finely cut chaff produced in this kind of threshing was not seen as palatable by animals according to some locals (cf. also Halstead 1989 b).

Apart from the late introduction of flint/iron blades for threshing and the optional use of an iron tip on the ard, all other tools used in Cretan pre-industrial agriculture (even more so than in animal husbandry that has copper cettles for cheese making, iron shears and knives) were of perishable material: pitchforks (two- or three-tined) used during threshing, various sieves used to separate cereal from straw and dirt, sacks for transport etc[95]. Only in the villages there would have been the pottery vessels for storage (large jugs, πιθάρια/*pitharia*[96]) or further processing the grains (milling, baking).

As is obvious from modern practices (and as a possibility for antiquity as well – Forbes 1995: 330), the highly variable land forms and conditions in Greece/Crete can be best used by a mixed agricultural and pastoral exploitation. And it is also obvious that varying pieces of land have to be approached with various methods

[94] Hitier (1881: 593) saw them. But from the numbers and details he gives it is obvious that he had his information from the Mesara or other fertile areas in central or western Crete.
[95] Harrison 1903, 1904: for other perishable tools and contemporary Cretan agricultural ones.
[96] A modern Greek word for the same vessels already used for storage in the Bronze Age.

according to the changing of the seasons: cereal fields can be browsed (up to three times, according to locals) during the winter while still in the "grassy" state of their plants, and then again after the harvest to make the best of stubble and have the fields slightly fertilized at the same time by the browsing animals.

Thus often enough even longer straw was left standing, and the fences were opened for an hour or so a day to be browsed by the field owners' animals who would leave some dung while at it – in any case the only fertilization there was for the fields (with the rare exception of burning). The subject of the necessity of having animals for manure, as Gamble noted (1982: 161), is an important point for the rise and fall of effective agriculture, and the poor (in animals) cultivators of pre-industrial Crete were well aware of that.

The diversified economic base reached through locals' landholdings (although the subject of ownership in the mountains is controversial[97]) in the lowlands as well as in the mountains must have been an important measure to reduce the consequences of crop-failure in one region only, e.g. with draught in the lowlands or damages by snow in the mountains.

Experimental archaeology: Cultivating a mountain barley field

While locals often still do remember specific amounts of harvest from a specific field after an especially good year, the numbers given during the interviews were too unreliable for further reference. Thus the author decided to make an experiment in cultivating a mountain field with (local) barley for further information.

After consulting local shepherds and the local Forest Authority[98] a mountain field of twelve by twelve meters was fenced to achieve a clear cultivation area of 100 sqm. The appropriate region was chosen in the (studied in detail for land use possibilities, cf. below Ch. II.d.4) area of Pateragiorgis above Kritsa, in the vicinity (and within the enclosure wall) of Site 24 at a height of 800 m. Although the recent use of the region for agriculture had to have depleted the soil, this was seen as a typical problem that would have been faced at all times during history where farmers didn't have fertilizer at their command. Still, as the area has been intensively browsed during the last decades, the cover by thorny shrubs was light (through still visible by burnt bushes fire cleaning, see above and Figure 50) and the sheep/goats of the region

[97] Cf. ΣΧΕΔΙΟ ΔΙΑΧΕΙΡΙΣΗΣ ΠΕΡΙΟΧΗΣ ΔΙΚΤΗΣ (ΠΡΟΓΡΑΜΜΑ LIFE B4-3200/98/444: ΠΡΟΣΤΑΣΙΑ ΤΟΥ ΓΥΠΑΕΤΟΥ (Gypaetus barbatus) ΣΤΗΝ ΕΛΛΑΔΑ) p.11: „Σύμφωνα με το Ν. 998/79, οι κάτοικοι της Κρήτης και ορισμένων νησιών του Αιγαίου απαλάσσονται της υποχρέωσης να αποδείξουν το «εμπράγματον ή μη δικαίωμα επί των δασών, των δασικών εκτάσεων ή των χορτολιβαδικών εκτάσεων», δηλαδή πρακτικά όπου δεν ορίζεται αλλιώς, οι βοσκότοποι που νέμονται οι κτηνοτρόφοι θεωρούνται ιδιωτικοί. Το πολύπλοκο και ιδιόμορφο ιδιοκτησιακό καθεστώς που διέπει τα δάση και δασικές εκτάσεις της Κρήτης, έχει ως συνέπεια η πλειοψηφία των εκτάσεων αυτών να διακατέχεται από ιδιώτες, χωρίς αυτοί να διαθέτουν τίτλους ιδιοκτησίας, τις οποίες το κράτος θεωρεί ως δημόσιες." Last accessed 20/4/2011 at www.nhmc.uoc.gr/life_gypaetus/documents/DIKTI.pdf

[98] My special thanks to Ioannis Lassithiotakis (Δασαρχείο Αγ. Νικολάου) for his support.

had left a modest amount of dung during grazing (as would have taken place in pre-industrial times).

Figure 50: Region of experimental barley field before clearing

Cultivation started by clearing shrubs and most of the larger stones from the field (the smaller ones are thought to prevent the formation of a surface crust, thus having a similar function to hoeing or otherwise breaking up the surface for less evaporation). Then it was hoed by hand (not too deep, about as the ard would have done) and sown with ca. 1,5-2 kg of a local kind of barley[99] obtained from farmers that still cultivate it in the Katharo plain. The seed was covered by raking the loose soil from hoeing over it. As the sowing time was chosen according to local custom (after the second good rain that left the soil humid enough, i.e. in this case the 28th of October 2007), waiting was the next step (Figure 51).

After a few days, a first check showed the problem of too shallow covering of the seed: ants were transporting kernels in large numbers to their nests (these spots turned to be especially densely grown later, where inside the fence, thus the ants don't seem to be purely destructive).

[99] An obviously old, local variety as it is hulled (A. Sarpaki, pers. comm.).


Figure 51: 28.10 2007 – day of sowing 24.11.2007 – resowing on patchy spots

At the same time a second, not measured (ca. 30 sqm) small field was prepared in the same way on the author's property at Lakonia (180 m asl). The region likewise hasn't been cultivated for ca. 40 years and consists of former terraced slopes.

Both fields were closely followed over the next months (Figures 51-53).


Figure 52: Site 24 (brown arrow) with barley field (blue arrow), 11.07. Right: Snow around 20.2.2008 (experimental field within fence)


Figure 53: 17.3.2008 15.6.2008 Day of harvest

When the barley was ripe, on a dry day in June, we went to harvest it.

After initially trying to use sickles (with two types known in Crete: one has a ca. 60 cm long handle said to be typical for cereal harvest, and one has a 30 cm short handle said to be used for cutting grass/fodder for animals, both have a not dented cutting edge) it turned out that the stalks were too tough for cutting[100].

We then tried breaking the ears only and pulling up the whole plants (obviously the method depends here also on the planned use of straw elsewhere or not). Although it seemed at first gaze that uprooting was the faster method of harvest, it turned out that when added the later steps necessary for cleaning the soil from the uprooted straw[101] (and seeds, eventually) possibly breaking the ears would have been the least labour-intensive method of harvest as a whole (if the straw would only be needed for feeding on the spot[102]).

From 100 sqm we harvested ca. 6,5 kg (seeds only)[103]. That means ca. 65 kg/stremma (not totally comparable as the edges of the field grow differently from the main part) coming from a previously constantly (winter and summer!) grazed for ca. 50 years area. This is close to the lowest range of average amounts in barley harvested from Greek (unfertilized) fields in pre-industrial times: 8-26 kg/year/100 sqm [104]. Still there were big differences in various spots of the field: The worst area, where ants had collected many seeds at spots seeds hadn't been well covered, produced only 40 gr on a sqm, whereas the otherwise poorest area in the field produced 130 gr/sqm with smaller ears. On the best spot there were plants with larger ears and the yield was 210 gr/sqm[105]. There were also a few spots where no seeds had fallen during sowing (or none had grown).

But the most amazing outcome was the comparison with the small (fenced) field in Lakonia: as the winter had no regular rainfall there during spring, the plants grew no more than ca. 25 cm high, hardly developing any ears at all (Figure 54), and most of the existing ears were eaten by wild animals (rodents? Possibly because of the plants' low height?). A family with a field on the Lakonia slopes would have hungered in 2008!

[100] We were later told that traditional harvests would take place in the early morning hours when there was still a small amount of humidity left that might make cutting of the stalks slightly easier.
[101] But cf. Harrison 1904: 250 ("Mr. Bosanquet tells me 'corn is often rooted up to this day in Crete, but, so far as I yet know, without the aid of a hoe"). See also Sieber 1823: 54 for harvesting cereals by uprooting.
[102] I was told, though, that an important part of the straw was needed to feed animals not freely browsing like donkeys and cows.
[103] Invaluable here was the help of my family, namely Christos Galanis, Elisa Ivanovas, and Johnny Ivanovas (with threshing)!
[104] Ηλιος Εγκυκλοπαίδεια, Αθήνα 1941/52. Cf. also Ruschenbusch's data of harvesting 3-4 times the sowed amount from non-fertilised fields in pre-industrial Greece and data including the kg/ha numbers for the Lasithi plateau 1921-1930 (Ruschenbusch 1998: 78, 80) at 7,1 on average (as this must be including the Lasithi plain and other fertile plains the number is probably higher than mountain yields, even though differences between the years were large).
[105] Whole ears weighed.

Figure 54: Barley sown/harvested in 2007/2008. Top mountains (800 m, one plant), bottom: Lakonia (180 m) two plants

Another interesting observation could be made during the experiment: a few grains of wheat had found their way into the seeds used on the mountain field (Figure 55). While the barley was already as good as ripe, the wheat was still in bloom in the end of May.

Figure 55: Wheat still in bloom (forground) while barley is nearly ripe, background (22.5.2008)

This was interesting to note as it means that with the given small amounts of rain in late spring, wheat would have a still smaller probability of ripening in Crete during times of draught[106].

The conclusion of the experiment is that successful barley growing depends on many more factors than good soil and enough rain: sowing density, well-covered

[106] Note that wheat is described as a none profitable product for Crete (Giannaris 1906) because the cost of production and transport was larger than the profit of sales. Giannaris accounts for a medium quality field a production rate of 1:4 of sown to reaped wheat and mentions smaller losses when sowing barley, rye or oats.

seeds, existence of pests (or seed-eating animals) vel sim. It can be influenced/improved by re-sowing (as soon as the non-bearing spots become visible). The occurance of snow on the field (twice for about a week during that winter in the mountains) does not seem to have had any negative consequences on the growth. Wheat could grow but has a much greater risk of crop failure due to lack of rainfall.

All in all, rainfall was the most important, it seems, factor in the amount of barley harvest during the experiment and probably was for harvesting farmers over time on Cretan mountain slopes[107].

Apiculture – Beehives

"Nebst der Viehzucht war die Bienenzucht, nach Diodor (5.65.2; vgl. Colum. 9,4) eine Erfindung (ebenso wie die Viehzucht) der kretischen Kureten, unmittelbar mit den Bergen verbunden"[108] *Chaniotis 1996 a: 258*

The Tsivi South mountain region between 800 and 1100 m, together with the Sellakano-region further S, especially where there is pine forest, is and probably was for a long time, one of the most popular areas for beekeepers in Crete, who bring their bees here from all over the island in spring nowadays. That this area was also an important beekeeping region in pre-industrial Crete can be judged from the numerous dispersed bee enclosures (see above *melissokipoi*)

There are two basic types of traditional beehives used in Crete: one elongated, horizontally placed tube with a smaller back opening for human access and a larger front opening for the bees' access, both closed with a wooden disc, the larger front one with a cutting as flight hole (Figure 56). Within these tubes the bees fixed their combs to the sides, facilitated by the rather rough potter's work traces on their inside.

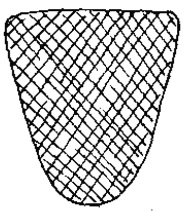
[107] Locals maintained that controlled (!) grazing of the plants in the "grassy" stage would not harm but rather induce the plants to produce several stalks – plus the added advantage of some extra dung.

[108] "Apart from animal husbandry, bee keeping was, according to Diodorus (5,65,2; cf. Colum. 9,4) an invention (like animal husbandry) made by the Kouretes, and connected closely with the mountains".

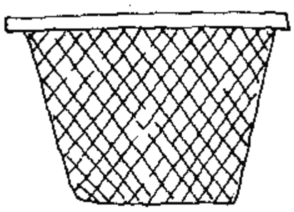
Figure 56: Horizontal traditional beehives (abandoned). Front opening closed by board from pine bark

The other kind was a ceramic bucket-shaped vessel standing upright, mostly with a small hole near the base on the side, covered by a larger than its upper diameter ceramic lid (shaped like a low, flat bowl). The top opening of the vessel was spanned by thin wooden bars longer than the width of the lid which rested on them, thus creating an opening for the bees' free movement between vessel and lid (Figure 57). The bars were used by the bees to fasten their combs, thus creating moveable combs that were much easier to handle than those in the fixed to the pottery horizontal hives (interesting to note that still beekeepers didn't all adopt this seemingly much better solution[109]). A similar kind of beehive is also described by Sieber (1823:102).

"Ideally, the sides of a moveable-comb *hive should slope about 120 degrees. This slope basically follows the curve of naturally built comb; therefore it minimizes comb attachment to the sides of the hive. This makes it easier to remove the combs without breakage.*



Natural comb



Top bar with comb" [110]

The drawing (ibid.) shows how well the bucket-shaped hives conform to the bees' needs.

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[109] Anderson-Stojanović (2002: 373) sees the upright hive as an improvement from the horizontal one already achieved in ancient Greece.

[110] http://www.apiservices.com/articles/us/small_beekeeping/bee_space.htm (last accessed 22.4.2011).

With small differences (inner combing instead of finger grooves or rough surface) these two kinds of beehive types seem to have been very similar from Hellenistic times at least (Jones et al.1973, Anderson-Stojanović 2002[111]) – and maybe from the Bronze Age? (see Ch. II.c.1 for beehive sherds).

Figure 57: Region of Malia. Traditional Cretan vertical clay hive (abandoned)

Although bees are moved between areas for a few months at the time nowadays, this movement must have been much rarer in times when bee enclosures were as remote and inaccessible and beehives as heavy as we know them from pre-industrial times.

Transport

Until the beginning of the 20th century the Cretan roads were not made for wheeled transport, but pack animals were the preferred solution here as in most areas around the Mediterranean "and their versatility is responsible for the complexity of the geography of communications in areas of high relief" (Horden & Purcell 2000: 131).

In 1948 Crete had already 860 miles of surfaced road near the coast – but the others were "mere mountain trails on which the donkey with a basket on either side was the agent of land transport" (Allbaugh 1953: 25). These roads, paved with unworked stones on rough parts of the landscape, are called καλντερίμια (*kalderimia*, cobble stone roads, cf. also Rackham & Moody 1996: 156-7), even though they are not continuously cobbled but may be just well trodden paths in easier parts of the landscape. They are usually at least 1,5 m broad (for one loaded animal), but the main connecting routes were in most parts around 3 m broad so that two loaded animals could pass each other (Figure 58).

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111 The Isthmia pieces, excavated by Anderson-Stojanović and team, were proven to be beehives by chemical analysis (Evershed & Dudd 2003).

Figure 58: Site 92. Nearby passing *kalderimi* of the main route used by Evans in 1894.

Even though this is not obvious, one of the main problems connected with the difficult road situation in Crete was an economic one: Giannaris mentions in 1906 that wheat was no profitable product in the Mesara because the cost of production and transport was larger than the profit of sales (with a detailed cost-benefit calculation, ibid: 33).

In spite of this and the marginal look the studied area has today for modern (and especially town-dwelling) people, it was until recently seen as easily reachable for locals, and through-roads connected the Lasithi Plain and the coast around Myrtos/Malles/Ierapetra with the north coast around modern Agios Nikolaos.

Donkeys transported olive oil (and other fluids or semi fluids, cf. Figure 59) in (goat-) skins (ασκί *aski*) e.g. from the south coast (Malles region) to the market in Agios Nikolaos (in earlier times, i.e. before World War I, Kritsa was the local centre – its proximity to Lato and this ancient town's relocation to the coast shows that this coast-upland oscillation was a condition of long standing).

Figure 59: Pano Tapes. Yorgos Brokos' property An *aski* (whole goat skin, here with hair) with sour mizithra (rubbed regularly with salt to de-hydrate the cheese ripening inside).

Major transportation routes leading through or along the studied region were at least three: One from the Lasithi plain via Tapes to the coast which was used for donkey caravans carrying goods between the two destinations. The second main route between the Lassithi plain and the north coast via the Katharo plain was the one called "Mycenaean Military Road" by Evans (Evans & Myres 1895), which he took because, even at his time, this was part of one of the main road tracks between central and eastern Crete. The third main route was the one in the southern part of the studied area, connecting Malles (and thus also Myrtos-Ierapetra) with the north coast via Kroustas.

All these routes were used for transport of goods to trade in the (at the time only one in the region) harbour town at Agios Nikolaos (the next possibility to the East was, at least during the twenties and until Agios Nikolaos became the more important harbour, in Pacheia Ammos). As trade and "shopping" was until the 60ies still mainly done not in money but in barter trade, the products to be bartered (typically oil, eggs, cheese) had to be transported to the centre in many cases.

CHAPTER II – ARCHAEOLOGICAL DATA

a. Background to the investigation

The kind of ruin studied in this thesis has been heard of in Minoan archaeology from the very beginnings. The main reason for that lay in the big size of blocks used in their masonry, always interpreted as a feature of buildings of strategic function. Hence it is nearly impossible to extract any typological description of big block masonry without also getting the description of the buildings' function as "defensive" or otherwise of strategic importance (i.e. as watchtowers along roads vel sim) for the Cretan Bronze Age.

Joseph Shaw's 1973 "Minoan Architecture: Materials and Techniques" is actually the only reference work not automatically connecting big stones and strategical importance[1]. Although this book is usually seen as standard reference for Minoan masonry in general (justified for Neopalatial, and especially elite-building masonry), there is unfortunately no closer description of masonry built with big unworked blocks. The subject is only superficially touched upon:

Shaw, J. (1973)

> *Subject MM masonry (rubble type):*
> *Roughly coursed walls, often composed of large boulders of hard grey or bluish limestone, sometimes partially hammer-dressed, have been described as "Megalithic" or "Cyclopean" although the latter term is more appropriately applied to the distinct masonry of fortified Mycenaean citadels. (p.80)*
>
> *subject"limestone":*
> *Another type of stone, quite different from "poros", ranges from greyish to dark-blue or even black in color, and is much harder. Two varieties of this stone were used by the Minoans. The first, which I have termed the "boulder" type, is sometimes used as a packing for rubble walls and sometimes, when the stones were very large, for exterior walls, as at the palaces of Zakro and Mallia (figs. 77,78). These walls can be described as Megalithic or "Cyclopean", the latter a term usually applied to Mycenaean fortification walls on the mainland. (p.13)*

In his description of Gournia walls, Shaw uses the term "megalithic" for a kind of rubble masonry (ibid.:81). It seems that terms like "Megalithic" and "Cyclopean" are not clearly differentiated, although "Cyclopean" is rather attributed to mainland Myceanaean walls[2].

A similar tendency to identify the two terms can be seen through the bibliography on Minoan architecture, to be shown in the following overview of some of the descriptions of big block masonry available until now.

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[1] Actually Shaw (1977: 202, n.8) did seem to have his doubts for this stereotype. About a Minoan "cyclopean" built road in the Messara with a Minoan site next to it he writes: "Following Evans' logic, the remains should be attributed to a Minoan "station" guarding the road. In my view, however, the presence of Minoan remains along a natural route for a roadway simply indicates that the Minoans did live here and that they used a road near by."

[2] This is similar in the new edition (Shaw 2010) which still deals mainly with urban and elite architecture.

As so often in Cretan archaeology, Sir Arthur Evans laid the foundation for archaeological interpretation in this context, interestingly when publishing his travels on one of the then main connection routes between the plateau of Lassithi and the north coast, along what is now preserved in parts as "traditional" kalderimi (Evans&Myres 1895, Evans 1896). His judgement of the impressive ruins he saw close to this road as "fort", "watchtower" or "guard-house" and his description of their masonry as "cyclopean" (ibid., cf. Brown 2001: 205,206,218,222) still prove to be more influential than should be expected after so many years.

Minoan archaeology passed afterwards through the long phase of denial of Minoan war-like tendencies, under the epithet "pax minoica" coined also by Evans for the seemingly unfortified Minoan palaces and towns (Evans 1928:79).

This changed slightly with Alexiou's 1979 "Τείχη και ακροπόλεις στη Μινωϊκή Κρήτη", where settlements of the final Prepalatial phases were shown to have been often situated in defensive positions. Also a long wall east of the palace of Malia, dated in parts to MM IA, was tentatively called "enceinte" by the French excavators and declared as fortification wall (Effenterre 1980, I: 267, with earlier bibliography[3]), thus beginning a new era of Minoan archaeology, where Minoan remains were seen in a less idealized light, and attention was paid again to Evans' earlier publications where strategically used sites were still a subject[4]. Some of the massively built ruins of far eastern Crete described by him with strategical terms in the 1890ies brought about titles of new studies like "War regained" (Chryssoulaki 1999, part of the "Minoan Road Project" publications) or "Town of Castles" (the latter re-using Evans' own term for similar ruins in the mountains above Malia: Schlager 1999, from Evans 1896).

Still, ironically, most of these studies have been clinging to Evans' early perception from travelling along what he described as "Mycenaean Military Road" (Evans&Myres 1895), and thus Evans' attitude towards massive masonry (even if only in elements) remains to this very day unchallenged. And even though various students of Minoan massive masonry have undertaken to describe it, they always remained under Evans' impression of connecting structures built from big stones with aggressiveness, even if sometimes reduced to the passive, receiving side of it as "defense" (e.g. Alusik 2007). As the extensive defense constructions from Mycenaean times were known since antiquity (cf. Pausanias: II,16.5; VII,25.6 [5]) as "cyclopean" (only giants like Cyclops could have built such structures), this term has been used for describing big stone masonry since the beginnings of Cretan archaeology. Close studies and descriptions of Mycenaean fortification architecture (Küpper 1996, Loader 1998) rightfully limited (like Shaw)

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[3] Effenterre also utters his belief that this fortification wall had probably never been finished, which would account at least in part for the somehow random looking single long north-south oriented stretch of a big block wall no broader than 1,6m at its base, somewhere in the middle of several parts of the PP settlement documented also as continuing further east than known until earlier by S. Müller-Celka's survey (2002, 2003).

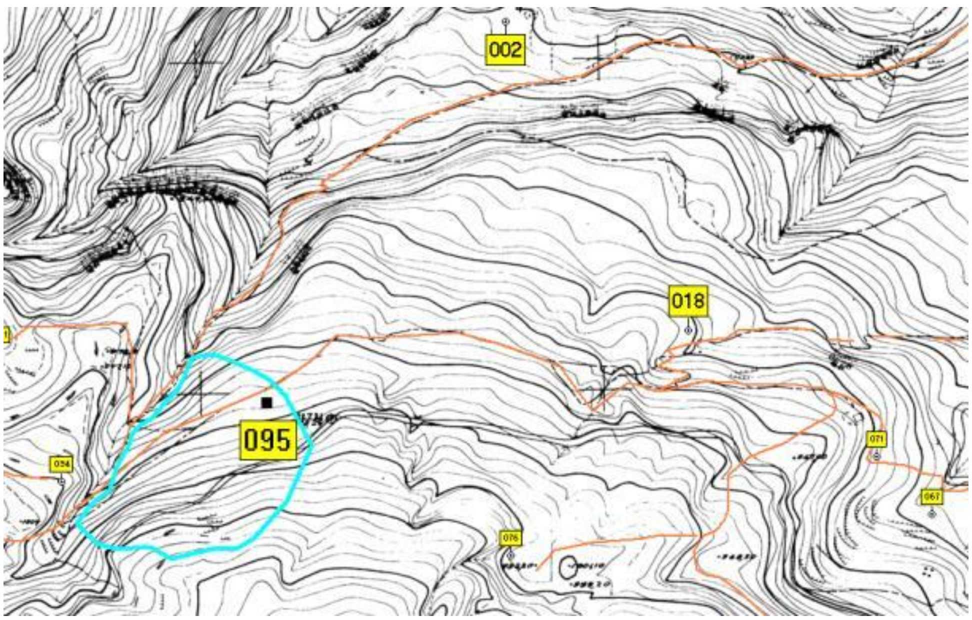
[4] Although Evans had seemingly always kept some doubts about continuous peace in the hinterland: "But the *pax Minoica,* that embraced the civic centres and their immediate surroundings, may not always have extended in an equal degree to the remote mountain fastnesses." On the same page (beginning from p.78: n.3) he has a long citation from The Academy (Evans 1895) describing the Bronze Age constructions at the old *kalderimi* next to Site 95, see below.

[5] Cf. http://www.perseus.tufts.edu/hopper/text?doc=Perseus:text:1999.01.0159 (last accessed on 9/10/2009)

the term "cyclopean" to Mycenaean structures only[6]. Evans' early terms keep re-appearing in this context, as his texts and some descriptions from various studies may show.

Evans and Myres (1895)

> *About twenty minutes from the top of the pass, we observed the remains of a vast primaeval fortification [...] and from the lower end of these, above and below, two other walls branched off at right angles – one climbing down towards the bottom of the ravine, the other ascending the rocky slope above. A breastwork was thus formed some two hundred yards long with a passage for the road, and the upper part of this again made a return for another sixty or seventy yards.[7] [cf. Figure 1] [...] Within this outer enclosure there were also traces of other walls. The walls were about four feet thick, of undressed polygonal blocks; [...] a stupendous work. [...] About fifteen minutes below this the road was commanded by another "Cyclopean" work, this time more of the nature of a castle rising on a rocky knoll. [in the following description of ruin parts he mentions "tower" ,"bastion" "commanding position"][8]. [Then, describing ruins on a road above Kroustas to the south: Here...] the old route is guarded against lowland attack by a series of similar stone strongholds [in the following description again: "bastion", "fort", "watch-tower"][9].* *(Brown 2001: 205-206).*



Map 1: Map of Evans' „fortification" on the „Mycenaean Military Road" (cf. Evans & Myres 1895), ca. 20 min from the top of the pass. They must have seen Ruin 95, and its perivolos (turqoise) crossing the road. Notice how it turns back and closes the circle. Site 18 is "Achladies", Site 2 "Katsouli Sterna".

Evans (1896)

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[6] See below for differences in Mycenaean and Minoan big stone masonry.

[7] This must have been the ruins of house, surrounding walls and perivolos of site 95. Obviously Evans didn't notice that further west (supposing the "return" he mentions here is the enclosure's curve to the W, ca. 5m S of the modern asphalt road) the mentioned wall (Perivolos 95, fig.1) continues and then returns downhill to meet the other leg of the NW-SE part of the perivolos near the bottom of the ravine.

[8] For the chaos of toponyms in the archaeological bibliography since Evans see appendix G under "Toponym Confusion".

[9] These ruins are probably the area around the cave "Tafos" in the forest S of Kroustas. One of them is correctly identified as "Fortezza" by Brown, 2001: 206 (my Site 46). Evans seems to have known that, too, see his sketch in Brown 2001: 159 that gives a fairly correct position for "Fortezza".

> *The largest of these* Phrouria *– perhaps the "mother" stronghold of the settlement – [...] of very massive polygonal blocks [...] a rude approach to horizontal layers [...] the "Town of Castles" itself – this primitive συνοικισμός in fortified dwellings (Brown 2001, 222, also cited in Schlager 1999, 171)*[10]

Likewise Pendlebury (1939) mentions all over his book "forts" and a "watch-tower", but never explains why he applies these terms (possibly they are Evans', as some of them are said to have been seen by him). From what can be said today it seems that they all shared some kind of big block masonry (one of the "forts" is of Ottoman date, p.21).

Tzedakis, Chryssoulaki and the other members of the "Minoan Road" program began from the late 80ies to study the system of "postes de guarde" vel sim. of "cyclopean" structures dated from MM I-II (with multiple later reuses) in the Zakros-Xerokampos area of far eastern Crete. (Tzedakis 1989, 1990, Chryssoulaki 1999).

In their latest (at this moment) public description (from 3/9/2007)[11] it is obvious that they (as was the case from the first publications) interpret the Minoan structures as part of a strategic system. They, too, use both terms (cyclopean and megalithic) to describe masonry of structures dated from the Protopalatial period:

> *Στην κοιλάδα με το τοπωνύμιο «Χοιρόμανδρες», ήδη από την περίοδο των πρώτων ανακτόρων, τον 18 αι. π.Χ., κτίστηκε φυλάκιο ελέγχου του μινωικού οδικού δικτύου. Πρόκειται για ένα μικρό αλλά εντυπωσιακό κτήριο κυκλώπειας τοιχοδομίας, που θεμελιώθηκε πάνω σε φυσικό οχυρό βράχο. Η ανασκαφή του έδειξε ότι το φυλάκιο είναι ένα δημιούργημα της κεντρικής διοίκησης του γειτονικού ανακτόρου και ανήκει στο σύστημα ελέγχου - και πιθανόν άμυνας – του νεοσύστατου κρατικού μηχανισμού. [...] η διερεύνηση των περιβόλων και αναλλημματικών τοίχων της κοιλάδας έδωσε στοιχεία για ένα μεγάλο εγγειοβελτιωτικό έργο των μινωικών χρόνων, που για πρώτη φορά αποκαλύπτεται στο σύνολό του στην Κρήτη. Πρόκειται για σύστημα κανονισμού της ροής των υδάτων, που περιλαμβάνει ένα ανασχετικό φράγμα, καθώς και μεγαλιθικούς τοίχους εκτροπής και ήπιας διάχυσης του νερού στα καλλιεργήσιμα άνδηρα.*

Their most elaborate typology/definition was given in Tzedakis et al 1989:

> *Il faut noter que I'appareil du mur qu'Evans appelle "cyclopean", Academy (4.7.I896), p. 18. est construit sur le type bien connu des maisons de campagne: une série de grands blocs polygonaux taillés à l'extérieur, à l'intérieur des pierres plus petites (p.66, note 73)*

In recent years Haggis (1996: 399) saw "cyclopean masonry" (no further description) as an expression of hierarchy, a possible indicator for higher ranked Protopalatial buildings within settlement clusters. Thus he sees a parallel for earlier times comparable to Rehak&Younger (1998: 110) who believed that in Neopalatial times "megalithic rubble" was "signaling low-level (local) administration".

The PhD thesis of Zielinski (1998) on "cyclopean" architecture has influenced later studies in a similar direction, especially in his understanding of "cyclopean" buildings in Minoan Crete as expression of elite culture and special status (passim). For stone sizes he states that

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[10] The sites mentioned are situated on the mountain slopes above Malia (called "Mavros Dasos" and "Pentekorfes" today – "Omales" is further S). Some see at Müller-Celka (2003).

[11] http://www.yppo.gr/2/g22.jsp?obj_id=11010> Last accessed 13/10/2009

"cyclopean" boulders should be roughly three times the size of rubble in the same masonry (p.54). His general definition for his study is this:

Zielinski (1998)

> *Minoan Cyclopean Masonry is an architectural style distinct from simple rubble masonry and ashlar block masonry. Walls constructed in the cyclopean style are composed of large irregular shaped boulders of local hard stone which are not cut and quarried but are sometimes partially hammer-dressed and are usually acquired in the nearby locality. Wall stones are set roughly into courses without mortar, although often small stones are used as chinking. Cyclopean masonry is found predominately used on the outer faces of the exterior walls of palaces, houses, and defensive constructions. The size of the visible face of the boulders is approximately 70 ^{cmxcm}, and repeated use of exceptionally large boulders, measuring approximately 90 ^{cmxcm}, often denotes fortification construction. Although construction materials, techniques, and boulder sizes vary from site to site and often suggest regional variations, at any given site an average cyclopean masonry wall boulder will be 3 times larger than an average simple rubble masonry wall stone. (p.55)*

Mantzourani & Vavouranakis (2005) have, in part, the same opinion as Zielinski as for the status expression of "cyclopean" masonry (Mantzourani &Vavouranakis 2005: 37 and 47), although Mantzourani et al. (2005) seem to express a different view[12]. They are not quite consistent in their definitions of boulder size for what they call "megalithic masonry":

Mantzourani& Vavouranakis (2005)

> *There is a series of edifices of special character in east Crete during LM I, featuring megalithic masonry. In several of these buildings, such as the guardhouses, this type of masonry is indicative of their function. However, in the case of the "villas", masonry along with architectural design seems to have played a different role. These features are assumed to be indicators of high status and authority. […] it is necessary to define the term "megalithic masonry" for Minoan Crete […:] It is a building practice that utilises very large boulders, i.e. roughly 1m x 0.80 m x 0.60 m or larger. The usual building material is limestone and sandstone of local provenance. These boulders are not necessarily well hewn, but roughly dressed on the outer surface. They are often riveted together with small stone plugs. With this technique the constructed walls measure 1m or even more in width. Megalithic construction is mostly encountered at the exterior walls of the buildings.[13] […]*

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[12] This, as well as the smaller block sizes in the definition, may be connected with the fact that the Klimataria Villa studied in the former paper is not as impressive as other Minoan "villas": "The general impression of the wall construction lacks refinement and falls between the categories of rubble and megalithic." (Mantzourani et al. 2005: 755).

[13] Directly below this passage several monuments supposedly applying this „megalithic masonry" are enumerated. But even though the mentioned Neolithic and Early Middle Minoan structures may have a varying wall thickness from 1-2,5m, none of them has actually the large blocks in its masonry mentioned in this definition. The tholos tombs do use sporadic stone blocks of the mentioned size (especially in Lebena), but none of them is built consequently with "cyclopean" or "megalithic" masonry. The difference between "monumental" architecture (which the tholos tombs certainly do show) and the "cyclopean" or "megalithic" (i.e. built with big blocks) architecture beginning only with Protopalatial times is important. Cf. the defintion of "monumental": relating to a monument, which is "something that by surviving represents or testifies to the greatness or achievement esp. of an individual or an age" Merriam Webster's Third New International Dictionary, Encyclopeadia Britannica Inc., Chicago et al 1976, vol. II, p.1466.

> *In conclusion, each of the examined buildings betrays an individual character. The presence or absence of megalithic masonry was part of this individuality, being combined with other architectural aspects. As a result, the equation between megalithic masonry and status is not linear at all. It has to be understood each time according to the particular context, both archaeological and social. (p.35-36)*

Mantzourani et al. (2005)

> *Megalithic or cyclopean masonry falls between the other two categories, both in elaboration and labor investment. It requires large blocks, at least 0.60 x 0.60 m, sometimes roughly hammered. The blocks do not have to be quarried; they may be the products of collection and detachment from local surface rock layers. [...] megalithic and crude masonries indicate low-quality construction, because they do not require masons specialized in stonecutting and fitting but the large availability of unqualified, inexpensive manpower. This affordable labor force fits a picture of provincial countryside life allowing occasional employment during breaks from farming and pastoral activities. Furthermore, the monumentality of building blocks should always be examined against any possible practical uses they might have had, such as retaining terraces. (p.749-750)*

It should be noted, though, that these studies deal exclusively with Neopalatial buildings[14]. Schlager's findings on the other hand seem to be based on Protopalatial constructions (Schlager 2006: 376). He supposes that these early structures originated from "times of social and political upheaval" (ibid.) and were sometimes re-used or copied later: "When the conflicts had eventually been settled, the usefulness of the new architectural style proved hundred-fold, and could easily be turned from military into purely civilian purposes" (ibid.)

Schlager (2006):

> *"cyclopean" masonry, an expression generally used for describing Mycenaean fortification walls [...] Cretan examples are also dubbed "megalithic" [...] Although both names have non-Cretan associations, until a more appropriate terminology has been developed the term "cyclopean" will here be used. [...] It applies to massively built, stout walls made of large blocks of locally available stone [...] one- or two-faced, using the bigger blocks in their external face, and backfilled with smaller stones, rubble and earth. [...] there may have once existed a superstructure of mudbricks. [... boulders...] measure at least 70cm in length and may be as long as 2m [...] either unworked or brought into form only very superficially, but sometimes they are more carefully shaped and hammer-dressed. [...] Depending on their shape, the large stone blocks are laid out as headers or stretchers in irregular or roughly horizontal courses, with smaller stones used to fill the interstices. [...] The rough and ragged appearance of some boulders does not necessarily show the primitive dressing of the original surface, but may well be due to natural weathering and damage over many centuries, especially since most "cyclopean" walls were never buried.*[15] *(p.368-370)*

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[14] These articles are a summary of Mantzourani's and her research associates' re-study of LM I Minoan Villas in east Crete: "project on the role and character of the "villas" in east Crete" (Mantzourani&Vavouranakis 2005: 35), cf. Mantzourani et al. 2005: 743.

[15] That Schlager is probably right in the last statement can be seen in the big differences between excavated and surface blocks e.g. in the LM I Zou villa, where blocks seem to have been actually quarried (Mantzourani&Vavouranakis 2005: 44-45, figs.14 and 16)

The most recent study of the subject of, in this case called "Defensive Architecture" (Alusik 2007) has not really defined any terms, but just the general approach (Alusik mainly relies on the terms used by other scholars before him).

> Alusik (2007):
> *[...] definition of what exactly belonged (and what did not) to the category of defence architecture. As for (presumed) enclosure walls (and towerlike and guard house type structures), the remains of walls are marked and interpreted as such on the basis of the following four features: 1) their situation/location (on the perimeter of a settlement/building; the dominant position in the landscape; different orientation from other parts of a building or settlement); 2) construction technique (often "megalithic" or "Cyclopean" masonry); 3) width/massiveness (even walls about 1 m wide are considered fortifications) and 4) overall look (quality construction technique, making a good "trimmed" impression, width and/or massiveness are all regarded as proof of "preventive psychological" defence). In the case of guard houses the main definition criteria are a good view of the surroundings, dominant points in the landscape and visual contact with a settlement of another construction of the same type. The most problematic aspect seems to be the definition of so-called guardrooms. To consider a space to be a guardroom its location in the entrance corridor and the absence of finds that clearly indicate the room's function (e.g. a cultic function) are important. The existence of benches is considered a supporting sign. The real defensive and especially military purpose is not very clear either in the case of access modifications, but nevertheless thanks to them it is necessary to take into account a certain increase in the defensibility of the building.[...] It is also necessary to discuss whether to include constructions/construction types with only a secondary (presumed) "non-military" function within the term "defensive architecture". This would apply to towerlike watchtowers/observation posts in the landscape, so called megalithic farmsteads, "guardrooms" or modifications of access systems into buildings that were aimed at limiting the access into them. The author, though, includes all these types in the category discussed and does not distinguish between the primary – military or "combat" - and secondary - e.g. guarding or defensive task (function). (p.15)*

Neither the availability of stones/blocks in the context of their size (except if there was a quarry, as in the case of Cheiromandres, cf. Tzedakis et al.1989,1990) nor any detailed masonry techniques applied for building big blocks are discussed (with the exception of Vokotopoulos 2007). Usually authors seem to see this architecture (cf. already Shaw 1973) as a kind of rubble masonry (and hence probably unstructured or haphazardly piled up).

The currently (4/2012[16]) last publication on the subject of PP big block architecture – and especially for the study region - seems to be by Nowicki (2011), who elaborates further on the subject of defensibility already widely discussed in Nowicki 2000 (although the subject there was LM III settlement, MM sites were often discussed as well). As a whole Nowicki's perspective does not go beyond the subject of defensibility in this publication, as the title suggests ("When the house becomes a fortress")[17].

[16] Not yet published (available by the end of 2011) during the compilation of this study, hence mentioned only here.

[17] Nowicki shows in drawings and photographs sites also mentioned in this study, namely "Katharo Rigous" (p.360) here named Site KR 01, "Kritsa Korakou to Kephali" (p.361), here named Site 28 (the toponym I was given by the locals was Skalia, for its description cf. also Taramelli 1899), "Kritsa Chonaria" (p.361, three ruins given), here named Sites 42 (four ruins suggested), and "Kroustas Fortezza" (p.357), here named Site 46 (Nowicki understands

Nowicki (2011)

"Forts" are particularly common in the vast area of the eastern part of the Lasithi Mountains between Katharo, on the one hand, and Kroustas, Kritsa and Tapes on the other […] Some of the sites were built on the slopes of hills, having visual control of the communication routes, but others were constructed in lakkoi, *hidden between the hills. This latter type usually had a less solid and lower cyclopean platform, if it had one at all. The most intriguing question – why these buildings were constructed of huge boulders – may be answered through analysis of the changes in settlement patterns through the periods preceding and following the phenomenon (MM I and LM I). […] The use of large boulders in the lower parts of buildings may indicate an improvement in construction, stimulated by increasing conflicts between territorial units (during the MM I and II periods) and marked by the occasional destructions and burnings of the predecessors of MM II forts[18]. (p.362)*

As becomes obvious from these quotations, it seems opportunate for a study on this kind of architecture based on a relatively large amount of new data to provide some basic terminology in order to create a solid foundation for further discussion. This is going to be the subject of the following chapter.

the whole walling surrounding the hilltop as dwelling ruin, whereas I suggest there was a small dwelling ruin inside this outer, not well faced, walling which I see as enclosure wall, for all these cf. Site Catalogue).

[18] The latter burnings refer to earlier sites below "cyclopean" ones on the Selena slopes above Malia.

b. Built structures

1. Typology, Morphology - Masonry

A. Stone Block Typology

Figure 1: Site 99A. Mt. Tsivi South slopes ruin with characteristic masonry.

To overcome the problems of too vague definitions and too unclearly used terms that have been confined to other meanings (as mentioned in Ch. II.a), first of all a new term shall be suggested and defined here. I mostly agree with Schlager's definition (Ch. II.a), and shall try, as he suggested, to find a "more appropriate terminology" (Schlager 2006:369) for further discussion of the subject of Minoan Protopalatial masonry with large stones. This term and definition shall be used henceforward in this study.

Definition:
Oncolithic masonry (from Greek όγκος: *volume, bulk, mass*)[1].
The basis for oncolithic masonry is the stone block :
Oncolith: Minimum one side of block: 35cm, minimum second side 1,25 times that much.[2]
Stones smaller than this shall be called rubble in the scope of this thesis.

Oncolithic blocks of the Protopalatial[3] sites studied in this thesis (cf. Figure 1) are unworked and mostly irregular (in very few cases cornerstones might be slightly dressed). Blocks with very even surfaces are the product of local peculiarities, mostly of the closer surroundings. In some cases the chosen blocks appear so regular that at first gaze they seem quarried, but well stratified surface limestone layers in the surroundings are always the only obvious origin for these blocks, and to the author's knowledge no Minoan quarries exist in the area. As Schlager already stated (see also Vokotopoulos 2007: 172 for a similar observation) surface blocks have been exposed to the weather (in this case possibly up to 4000 years) and thus often show an eroded, either smoothed or, to the contrary, ragged surface. This is one more reason why a possible original slight dressing of some blocks' outer faces cannot be ascertained positively.

Usually stones must have remained in their original shape as collected or broken off surface rocks and taken from naturally stratified outcroppings that show natural lines of cleavage and will fracture there. In most cases certainly little consideration was given to choosing stones for aesthetic appearance. Functionality seems to have been the builders' only concern. While infinite amounts of smaller stones were available close to every built structure (and were typically used in all later structures), in Minoan masonry they mainly seem to have played the role of stopgaps in oncolithic foundations and fillers in general (see below, masonry).
Differences in local varieties can be large: Surface weathering is often very variable even within a few hundred meters (Figure 2). Raw material is, as mentioned, always the local limestone, available in various forms: pure (rarely hard)[4], also in conglomerate and breccia (rare) versions. Normally the spots where blocks have been broken off or collected are not findable, although obviously in enclosure wall construction blocks are collected from the closest possible space on both sides of the wall, creating a zone with fewer stones on the surface that is then often used as passage/path by animals (if not actually planned as passage by the Minoans already - see below under "roads").

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[1] Joe and Maria Shaw suggested the spelling "ongolithic" (pers. comm.), which was not approved by the audience of a paper I presented in 2009 in Athens (Workshop "Bronze Age Warfare") where I used this spelling in describing big block masonry. As the majority of the scholars present were Greek, criticizing the "uncorrect" (as only phonetic) spelling, I accept their suggestion of "oncolithic" where the Greek spelling is latinicized/anglicized in the usual manner. The spelling "onkolith" with "k" already exists as a German Geological term (Eng.: oncolite).
[2] Usually a true oncolithic structure in the Tsivi South area has larger blocks, but for the sake of the definition there needs to be a minimum size measure. Note that Vokotopoulos 2007 also uses the word "ογκόλιθος". He calls those stones big that are longer than 0,5m (p.175).
[3] Similar Neopalatial blocks could also be called oncolithic.
[4] Hard limestone is often called "sideropetra" elsewhere, although local specialists explain that real "sideropetra" is rare, very dark, hardly cuttable even with modern machines that have no problem with average limestone and sometimes contains a small amount of "akonopetra", a local kind of very hard layered (silicate) whetstone.

Figure 2: Erosion in oncolithic ruins. Here dwelling sites that are only 1 km apart. Left: Site 16 (blocks heavily eroded on all visible surfaces). Right: Site 33 (blocks with erosions on parts of their surface).

In enclosure wall construction (and exclusively there) sometimes massive upright stone slabs[5] are integrated and produce a very typical and recognizable appearance (more see below under "*perivoloi*").

Variations in block sizes[6] between and even within sites are probably a factor of chance in the available, unworked material. It is, after all, what Fitzsimons calls "rubble masonry writ on a grand scale" (Fitzsimons 2007: 110).

The biggest moved to their position blocks in the Tsivi South area (rare) examples:

Site 33: 1,4x0,6x0,3m = 0,26 m^3 = ca. 680 kg[7]

Site 44: 0,8x0,8x2m = 1,28 m^3 = ca. 3330 kg (a little heavier than e.g. a Range Rover)

Site 46B: 0,4x0,6x1,2 = 0,29 m^3 = ca. 750 kg

Site 53 (similar block at KA 19): 0,9x0,7x0,5m = 0,32 m^3 = ca. 820 kg

Site 87 (trigonal) 0,6x0,6x1,7 = 0,6 m^3 = ca. 800 kg

Site 99A: 2,2x1,0x0,6m = 1,32 m^3 = ca. 3430 kg

Site 108: 2x1,2x0,8-1m = 2 m^3 = ca. 5200 kg (about like a grown elephant)

Site 18 II: 2,5x1x0,6m = 1,5 m^3 = 3900 kg

Usual big size (a popular measurement): 1x0,7x0,3m = 0,05 m^3 =136 kg.

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[5] Prof. J. Shaw, whom I want to thank again here for discussing various points with me, suggested not to use the term "orthostate", as that usually means in Minoan archaeology a very specific kind of high, partly squared upright block (in Kommos actually huge slabs) used as lower course (supporting structures above) in the façade of palace or similar buildings (pers. comm.).

[6] Cf. Zielinsky passim, who ascribes importance and intent on the Minoans' side to block size.

[7] The specific weight of limestone is usually given between 2,5 and 2,7, hence I use here 2,6.

Most oncolithic stones are smaller than that, though. They cannot be compared to Mycenaean Cyclopean blocks as e.g. used in Tiryns, that weigh on average roughly 12 tons[8], although this enourmous size of blocks can be found in fortification walls only, not in dwellings. A comparable difference seems to exist between Cretan and Levantine big masonry blocks. Wright (1985) defines southern Syrian and Palestinian "cyclopean" blocks (mostly in early Middle Bronze Age fortifications) thus:

> "very large units of stone often with a face area of several square meters. The units are thus so massive that they need a company of men and auxilliary earthworks to get them in place. (396)
> [he adds later:] And as for the development of megalithic and related construction virtually nothing is known for certain." (422)

Hence one can safely assume that masonry with Cretan Protopalatial oncolithic blocks is an entirely local development on the island. As mentioned above, pre-forms in Early Minoan masonry do not seem to exist, as most masonry from that period consists of small rubble (and mudbrick, cf. Vasiliki). Only some of the south-central tholos tombs have been built including larger stones that might be called oncolithic. Interestingly, apart from the fact that these stones are mostly thick slabs, they are set in a totally different pattern (mostly headers, hardly stretchers, big blocks in erratic occurrence, cf. Figure 3).

The cause for this kind of masonry lies in the aspired shape of a tholos: To construct a corbelled vault stones in the corbelling part need to reach far enough into the wall thickness so that the corbelling can be achieved and the weight of the higher courses is borne by the lower ones without the stones tipping inward. A similar corbelled vault construction with large slabs is applied in the modern *mitata* of the Mt. Ida region (cf. Syrmakesi 1988)[9]. Whereas the *mitata* have large slabs from the lowest layer (as the corbelling starts from the ground), in tholos tombs often the lower courses' masonry is built with smaller stones (below the corbelled part), where slabs aren't necessary yet (cf. Murphy 1998: 29 fig.2.1)[10].

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[8] Fitzsimons 2007: 111, citing Mylonas, G. E.*Mycenae and the Mycenaean Age* (Princeton 1966) p.12.

[9] Cf. also Mycenaean corbelled constructions, e.g. in Tiryns, South Gallery, Küpper 1996: 294, pl. 20.3 where the Cyclopean blocks start in the height of the beginning of the inward curve; or the Tiryns corbel vaulted chamber in thickness of east wall just N of main gate, shown at http://projectsx.dartmouth.edu/classics/history/bronze_age/lessons/img/21img.html (Last accessed on 3/11/2009), where the breadth of the blocks reaching into the wall is largest at the corbelled part.

[10] Cf. also below: 3 C - Round structures - Ruin Wall types and shapes.

Figure 3: “Kamilari. Tholos. Annexes, Top of Entrance, and Tomb Chamber from E”. (photo from Dartmouth, Classics Department)[11].

As is obvious from comparing the size of oncolithic and Mycenaean Cyclopean blocks, the procurement of stones/blocks is a subject to deal with here. In Mycenaean fortification masonry a centralized authority would have been necessary to organize and actually move construction material. This is not the case (with very few exceptions that would need more sophisticated methods or more help, see large oncolithic blocks above) in the Tsivi South area: Labour for collecting, transporting and setting the blocks could have been managed on a kinship basis (similar in a way to the recent situation in Crete, where members of clans help each other in larger ventures like *mitato* construction, similarly as in recurring events like sheep-shearing). There is no necessity for a centralized authority in this, just the fact that certain labours need to be done in larger groups rather than on a nuclear family level. In this case there is also no "mobilisation of surplus"[12] necessary to finance the venture, as these labours have probably always been executed on a mutual basis and each member of the kinship group in turn would have been assisted by the others in some larger venture.

It also should be noted here that Protopalatial big masonry blocks are, even more than Cyclopean ones, not an expression of "technical proficiency" (Fitzsimons 2007: 110).

From all this follows that consistency should rather be sought in masonry, i.e. wall-building techniques than in block shapes or sizes.

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[11] http://projectsx.dartmouth.edu/classics/history/bronze_age/lessons/img/6img.html last accessed 20-10-2011.

[12] A much used term in recent years, after Halstead, varia.

B. Walls (wall ruins)

Οδύσσεια ιδ' (XIV)
αὐτὰρ ὁ ἐκ λιμένος προσέβη τρηχεῖαν ἀταρπὸν
χῶρον ἀν᾽ ὑλήεντα δι᾽ ἄκριας, ᾗ οἱ Ἀθήνη
πέφραδε δῖον ὑφορβόν, ὅ οἱ βιότοιο μάλιστα
κήδετο οἰκήων, οὓς κτήσατο δῖος Ὀδυσσεύς.
τὸν δ᾽ ἄρ᾽ ἐνὶ προδόμῳ εὗρ᾽ ἥμενον, ἔνθα οἱ αὐλὴ
ὑψηλὴ δέδμητο, περισκέπτῳ ἐνὶ χώρῳ,
καλή τε μεγάλη τε, περίδρομος· ἥν ῥα συβώτης
αὐτὸς δείμαθ᾽ ὕεσσιν ἀποιχομένοιο ἄνακτος,
νόσφιν δεσποίνης καὶ Λαέρταο γέροντος,
ῥυτοῖσιν λάεσσι καὶ ἐθρίγκωσεν ἀχέρδῳ·
σταυροὺς δ᾽ ἐκτὸς ἔλασσε διαμπερὲς ἔνθα καὶ ἔνθα,
πυκνοὺς καὶ θαμέας, τὸ μέλαν δρυὸς ἀμφικεάσσας·
ἔντοσθεν δ᾽ αὐλῆς συφεοὺς δυοκαίδεκα ποίει
πλησίον ἀλλήλων, εὐνὰς συσίν· ἐν δὲ ἑκάστῳ
πεντήκοντα σύες χαμαιευνάδες ἐρχατόωντο,
θήλειαι τοκάδες· τοὶ δ᾽ ἄρσενες ἐκτὸς ἴαυον

But Odysseus fared forth from the haven by the rough track, up the wooded country and through the heights, where Athene had showed him that he should find the goodly swineherd, who cared most for his substance of all the thralls that goodly Odysseus had gotten. Now he found him sitting at the vestibule of the house, where his courtyard was builded high, in a place with wide prospect ; a great court it was and a fair, with free range round it. This the swineherd had builded by himself for the swine of his lord who was afar, and his mistress and the old man Laertes knew not of it. With stones from the quarry[13] had he builded it, and coped it with a fence of white thorn[14], and he had split an oak to the dark core, and without he had driven stakes the whole length thereof on either side, set thick and close; and within the courtyard he made twelve styes hard by one another to be beds for the swine, and in each stye fifty grovelling swine were penned, brood swine; but the boars slept without.

Homer, Odyssey (transl. Butcher&Lang, 1909) XIV: 6-9

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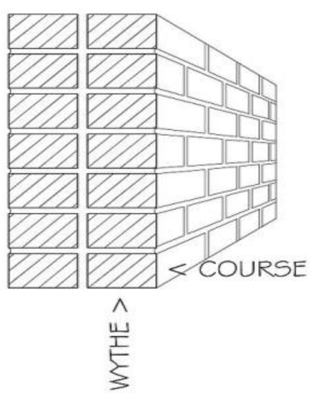
[13] I believe the better translation for the Homeric hapax ῥυτοῖσιν would here be "hauled" stones, not quarried (cf. e.g. also Benseler& Kaegi 1990: 703 ῥυτός "herbeigeschleift"). Certainly that is more adequate for the description of collecting material for building a remote mountain installation for animal and herder than supposing the word meant "quarried" (LSJ for ῥυτοῖσιν λάεσσι at: http://artflx.uchicago.edu/cgi-bin/philologic/getobject.pl?c.66:5:53.LSJ, but cf. also their second meaning "dragged, hauled" for ῥυτός at http://artflx.uchicago.edu/cgi-bin/philologic/getobject.pl?c.66:5:54.LSJ last accessed 26/11/2009).

[14] The plant is elsewhere translated as wild pear. Prickly (or wild) pear, *Pyrus spinosa*, is still a very popular plant for additions to walls. See below and Ch. I b.

This is an interesting description in comparison to the Tsivi South structures, even though Homer doesn't employ a term for "wall" here or actually describe how these "court" walls were built[15]. Still it might be useful to keep in mind the diversity of walls used in this kind of installation.

1. Definitions and descriptions of terms used in this thesis[16], cf. Figure 4 [17]:

Wall: A wall in general is a single or double (with or without filling inbetween) manmade row of stones (even or with setbacks, linear or rounded), sometimes with incorporated bedrock outcroppings.
Stretcher: Longer face of a masonry unit visible on the face of a wall.
Header: Shorter face of a masonry unit visible on the face of a wall.
Diatoni[18]: In ancient masonry band-stones extending through the full thickness of the wall (i.e. visible on both sides even with two-faced walls); through-stones.
Cross Joint: Joint usually at right angles to the face of the wall.
Course: Continuous horizontal section of masonry, one stone block in thickness.
Wythe: Continuous vertical section of masonry, one stone block in thickness.
Isodomic courses: Masonry courses following the same horizontal line (nearly impossible with unworked stones).



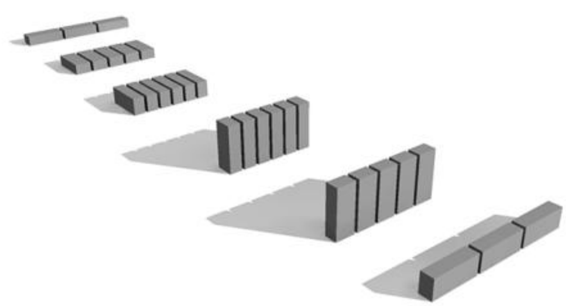


Figure 4: Isodomic wall construction consisting of stretchers only and styles of courses for masonry units. From left to right: Strecher, Header, Rowlock, Soldier, Sailor and Shiner (Wikipedia).

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[15] In Oddyssey IX Homer uses the word "σηκός", translated as "*pen*, *fold*, esp. for rearing lambs, kids, calves" by LSJ (http://www.perseus.tufts.edu/hopper/morph?l=shko%2Fs&la=greek#lexicon , last accessed 26/11/2009), but there is also no description of how this was built. Cf. for a possible LM IA shepherd installation in Thera: Doumas 2006, 82-91, with Homer parallels 90-91.
[16] These terms are evidently - by nature of the unexcavated surface remains studied here - applicable for the visible parts of various ruins and constructed from stones. Thus descriptions do not necessarily apply to the underground parts of walls.
[17] The images show brick constructions, several of which can hardly apply to oncolithic masonry.
[18] Sometimes this term is written according to the Greek "diatonoi", but the usual orthography for the architectural term is "diatoni" (fr. Latin "diatonus").

2 - Middle Bronze Age walls in the Tsivi South area: Typology

General aspect: Larger blocks are set in the lower courses, sparsely supplemented by chinking in between courses. Where available, bedrock is incorporated into the wall construction, most probably for enhanced stability, as it certainly would have been possible to avoid bedrock outcrops. No use of mortar (or plaster or mud) is visible in any case, but well-draining open dry-stone constructions may have been intended in many instances[19]. As oncolithic walls are self supporting by mere mass, no consolidating mortar (and thus no plaster) would have been necessarily needed as is the case in rubble walls[20].

Even though sometimes at first gaze courses in oncolithic walls seem to be tending towards horizontal layers (especially when blocks come from evenly stratified geological strata), isodomic courses do not occur. To the contrary in many cases stretchers are selected and positioned so as to partly reach into lower or upper courses, thus achieving a kind of cross-bracing effect (Figure 5). This is not only useful for load-bearing qualities, but must have been a main asset in cases of earthquake, where the coming apart of courses by shearing forces seems to have been prevented (note the great number of ruins that have been well preserved for over 3000 years of enduring Cretan earthquakes)[21].

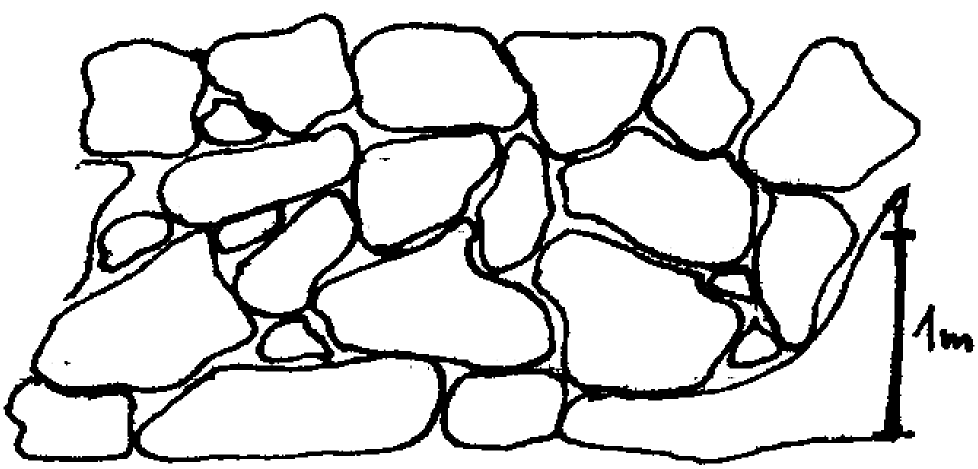

Figure 5: Site 99A. Cross bracing effect in an oncolithic wall

[19] Even for dwelling ruins (see below).
[20] Examples of the fast rate with which unattended rubble walls with mud mortar deteriorate can be seen in most recent Cretan villages, where houses disintegrate to mere heaps of muddy stones (often fast overgrown) within a few years. For details cf. description of modern/recent walls above, Ch. I b.
[21] Wherever visible the same holds true for headers (see below).

Variations in wall wythe construction include:

2.B.1 (Figure 6)
Double row, double faced oncolithic walls with occasional cross joints where tie-stones span both faces of the wall (this has also a horizontal bonding function, stabilizing walls in a sense perpendicular to the stretchers, thus e.g. resisting several directions of shearing forces as occuring in earthquakes, but also in slope pressure). Sometimes spaces between two oncolithic wythes are filled up with smaller stones/rubble. Purely oncolithic walls are usually 0,8 to 1 m wide (in rare cases up to 1,2 m), rubble filled ones may be slightly broader.

Special case a): Mixed double and single row (double faced) constructions with cross-joining through stones (like the later "diatoni").

Special case b): Use of upright, often slab-like stones with an even side constituting the outer face. Obviously always on walls that are not load-bearing[22].

Type 2.B.1 (and 2.B.1 a) - 2.B.1 with rubble - Type 2.B.1 b: top view – vertical section

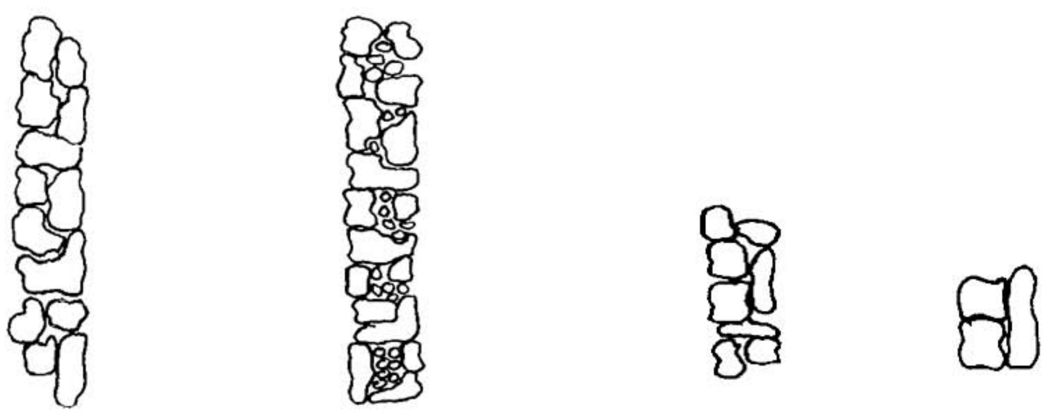

Figure 6: Drawings Wall Type 2.B.1 (top view, 2.B.1 b also side view)

2.B.2 (Figure 7)
Double row walls, oncolithic on one side (mostly discernable as outside, with a well built outer face) with rubble backing on the other side (inside). In many cases it is uncertain if they were originally double faced: The rubble positioning looks always disintegrated, so the existence of an original (inner) face is necessarily conjecture. Some of these walls may have been plastered on the inside, and the rubble originally solidified and held in place by mud mortar.

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[22] There is the single exception of the ruin of Site KA20, where the NW foundation consisted of bedrock (a small ledge's edge), in which a small part remained higher, looking like an upright block, while it is still well connected to the rest of the bedrock and thus probably could also have been load-bearing.

2.B.3 (Figure 7)

Single row, double faced walls (rare[23]). In mostly level surroundings only (e.g. sites 44C, 94, KA03).

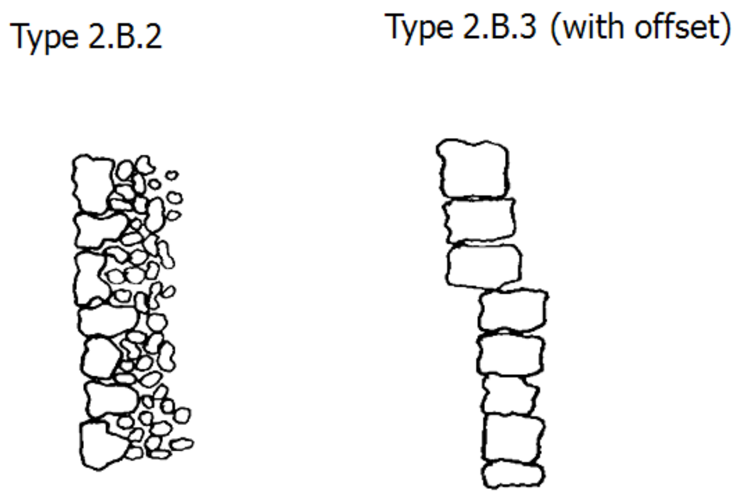

Figure 7: Drawings Type 2.B.2 and 2.B.3 (with offset) – top view

2.B.4 (Figure 8)

Single faced walls. Only one side is well lined up. This occurs in:

a) Single-row walls. A single line of stones, faced in the same direction.
b) Double-row walls: Only one face more or less lined up, the other haphazard or sporadic.

More than two wythes, or rather no discernable wythes. The outer face orderly, but not done with care, the inner side nearly always buried. At destroyed/eroded segments it becomes visible that there were additional inner layers of rubble.

[23] In Malia this type is much more popular in Protopalatial masonry, see e.g. the walls visible north of the north-west corner of the Neopalatial "palace", or oncolithic outer walls of Quartier Mu.

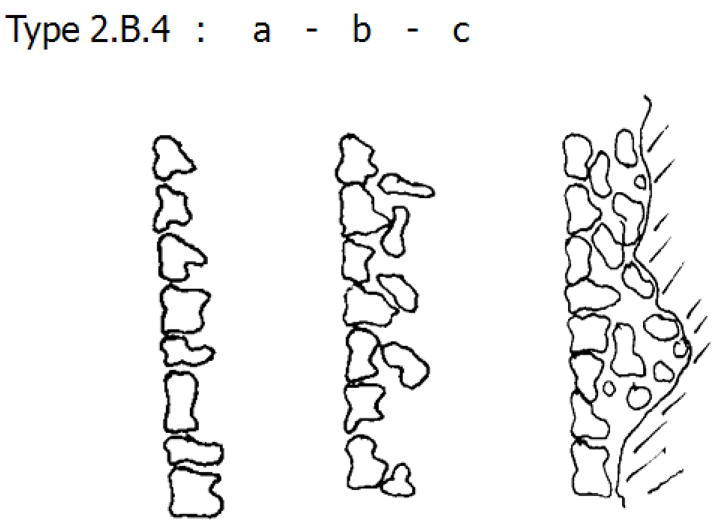

Figure 8: Drawings Type 2.B.4 (hatching symbolizes soil cover)

3 - Wall Identification

Double-row walls (built as Type 2.B.1, Figure 5).

If not building/dwelling ruin walls (see below, part 3) these are either (if untidily assembled, narrow and not visibly faced or only inside/roadside faced) Road Borders (see below part 5) or outer and inner Enclosure or *Perivolos* Walls[24] (see below part 4)[25].

The latter are walls between 0,8 and 1,3 m width. From remaining fallen construction material the original height can be estimated to 1,2 - 1,4 m[26]. Thus one of their main functions may have been the keeping in or out of animals: For sheep usually 1,2 m are enough, goats may have needed a higher wall or an extra layer of thorny twigs on top (cf. the Odyssey-citation above), a height increasing technique still in use today in the area of the Tsivi South sites (see Ch. I b).

The closer to the dwelling, the larger are the blocks used in enclosure construction[27]. Bedrock is often incorporated (probably for economization of construction work). The further away from the dwelling they surround, the less identifiable *perivoloi* become.

Outer *Perivolos*: Long double row wall (370-2150 m long) , enclosing one or several dwellings and by this allocating land areas or plots to sites. Several adjoining enclosures share stretches of

[24] For the use of the term *perivolos* in this context see also Tzedakis et al 1990: passim.
[25] This entry refers only to the masonry of *Perivoloi* – further information on function etc. see below part 4.
[26] Technically a dry stone wall of 0,8 m width also can't be built higher than 1,2 m. Most of the BA enclosure wall ruins studied here are ca. 1m wide at their base, indicating, for a dry stone wall, a maximal height of 1,5 m, cf. Hylton 1984: 487.
[27] In several cases – e.g. Site 73 – the otherwise nearly totally overgrown ruin could be only be detected by very close scrutiny, following the hint of the consecutively increasing block size in *perivolos* construction in that area.

perivolos wall, except if a road/path runs between them. Thus given pieces of *perivolos* wall often can not be attributed to a certain site unambiguously, as they separate one *perivolos* area from the other and thus belong to both. The ruins of some *perivolos* stretches suggest that quite a lot of rubble had been used in their upper layers (e.g. Site 37, Site 65), the construction principles of these can not be determined (Figure 9).

Figure 9: Outer Perivolos NE of Site 65, NW of Site 20, to N. Wall Type 2.B.1

Inner *Perivolos*: Shorter doublesided wall (or walls) of Type 2.B.1 (and Type 2.B.1 a and b) within the outer perivolos, mostly in the vicinity of the dwellings. According to their shapes and position they can sometimes be identified as enclosing yards, gardens or animal pens. Many sites have several inner perivoloi in various shapes (Figure 10).

Figure 10: Site 99F dwelling ruin (background left) and its inner *Perivolos* (foreground and bending to upper right corner) from N

Mixed double and single row (double faced) constructions (built as Type 2.B.1 a): With carefully set faces: see below part 3. Occurs otherwise in *perivolos* wall construction either in areas, where large blocks are easily available, (e.g. Site 138 NE *Perivolos*, see Figure 11) or close to sites, where, as noted above, always larger stones and with this also more sophisticated construction techniques are employed.

Figure 11: Perivolos NE of Site 138 to S, ca 100 m from dwelling ruin

Use of upright, often slab-like stones (built as Type 2.B.1. b): Occurs exclusively in *perivolos* masonry and is thus clearly identifyable[28] (Figure 12). The probable reason is that this kind of standing slab construction would not be load-bearing (in building walls) and also of no use in standing horizontal pressure in terrace walls, always being part of aboveground wall elements. Site 38 has a whole small oval enclosure wall built exclusively of massive upright slabs (Figure 13). An inner *perivolos* of Site KA19B also has a stretch exclusively made of (small) upright slabs, probably for economizing space (inner and outer *perivolos* walls are here rather close to each other and the site). This may here, for space reasons, have functioned as nothing but an orientation line, possibly connected with other, perishable material (similar to modern sporadic stone settings below wire fences, to prevent animals from passing underneath. These stone rows may often remain even after a fence has been removed).

Figure 12: 211 E *perivolos* to SW with upright slab (stick 90cm)

[28] Interesting examples can also be seen outside the Tsivi South area: NE of the fenced area of the Zominthos excavations, several stretches of Minoan *perivolos* walls are clearly identifiable, inter alia, by their use of upright slabs. Vokotopoulos (2007) notes that vertically set big blocks in the Minoan terrace walls studied by him might be seen as under the influence of orthostate masonry (p.187). For the term “orthostate” see above p.10.

Figure 13: 138 *Mandra* with upright slabs

Blocks used in *perivolos* construction may be huge, depending on the available material (e.g. Site 60B *Perivolos* NE - Figure 14). As noted above though, larger blocks are often an indication for the proximity of the site's dwelling[29]. On some occasions differences between *perivolos* and dwelling masonry are negligible[30].

Figure 14: Perivolos NE of Site 60B, upper block size: 2 x 0,6 x 0,4 m.

<u>Double row walls, one wythe oncolithic, one rubble (built as Type 2.B.2)</u>. These walls are always dwelling ruin walls (see below part 3). In some cases eroded *perivolos* walls of Type 2.B.1 that have lost the second oncolithic wythe may be mistaken for Type 2.B.2 walls, but only

[29] This applies not to single large stones, but rather to the general construction.

[30] This probably explains why Zielinski (1998: 313, my Site 51) obviously did not tell apart dwelling and *perivolos* walls: The size of the ruin he mentions (12x12m) must have been measured including parts of the *perivolos*, although actually its shape is an L-form, 8x11m on the long, 8x8 m on the short side.

if the rubble is mostly soil covered, as Type 2.B.2 dwelling walls usually contain a much larger amount of rubble than the filling inbetween wythes of Type 2.B.1 *perivolos* walls.

Single row, double faced walls (built as Type 2.B.3). Nearly always dwelling ruin walls (see below part 3). As in Type 2.B.2 above, occasionally eroded *perivolos* walls of Type 2.B.1 that have only one oncolithic wythe preserved may be mistaken for these, but only very rarely *perivolos* walls have several blocks in a row that seem to have had double facing (in cases of strong surface erosion of the blocks, where determining possible original facing becomes conjecture).

Single face single row walls (built as Type 2.B.4 a). On road borders the inner (looking towards the road) face is well lined up, the outer is either lost (e.g. if the border is part of a *perivolos*) or wasn't intended to exist (Figure 15). Roads, when on even, non sloped ground and not taking up the space between two *perivolos* walls, show two parallel single or narrow mixed single-and double-row walls, sometimes sparsely set. Depending on the road type (see below part 5) the flanking walls are more or less well constructed: The narrower the road the less elements of a flanking construction are detectable, sometimes it seems only paths were cleared and the stones thus moved set on the side, so that no continuous wall is achieved.

Figure 15: S of Site 22. Minoan road border Type 2.B.4 a (left of middle from W)

Field walls, where discernable at all as ancient (similar conditions apply to recent walls) depend in their masonry on the amount of soil existing in the closer surroundings. As the Tsivi South area is mostly sloping, the differences between field- and terrace walls are gradual. The steeper the incline the more massive the construction. Here the difference between ancient and modern walls is rather the stone size than the width of the wall, but as recent rubble walls disintegrate within what seems to be less than a century, Minoan walls or wall parts become visible again eventually even if they had been built upon in recent years as since about WW II fieldwalls aren't tended any more. Also, as in the case of the *perivolos* constructions, the closer to the site the larger the stones are in fieldwalls. Thus ancient field- and terrace walls can sometimes be assumed. Helpful in this can be the links of such walls with certain ancient ones. Re-constructed and re-used (for convenience) ancient walls are often recognizable by the clearly discernable lower, eroded oncolithic and upper rubble masonry showing still harsh, un-eroded surfaces (especially when broken off bedrock and not just collected). Thus field/terrace walls partly built in oncolithic style can often be suggested to have been originally Minoan.

<u>One-faced double-row walls (built as Type 2.B.4 b):</u> Field walls, terrace walls. Looking along the length of what seem to be Bronze Age field walls (especially in eroded areas) sometimes reveals that only one, downhill (outer), face was well lined up, whereas the uphill (inner) face wasn't[31]. But as erosion may have backfilled all kinds of originally raised field walls, it is hardly ever possible to tell from the surface aspect what the structure of partly covered by soil walls may have looked like originally.

In some cases *perivolos* walls, especially on edges of level terrain towards a slope (also when forming a roadside, as e.g. W of Site 18), have an eroded outer (downslope) face and are thus not readily recognizable (e.g. *Perivolos* 38 north, Figure 16). There are also *perivolos* walls where only the oncolithic downslope face is preserved whereas the upslope face is covered by colluvial soil and only traces of the second (inner) row remain visible (e.g. *Perivolos* 51, a case between Type 2.B.4 b and c, cf. Figure 17).

Figure 16: N of Site 38. *Perivolos* (from E), its right side eroded downhill, giving the impression of being one-faced (to left) but still in part double row (the lower layers of the right side)

[31] In recent walls it seems to have been always most important to see to a single, well closed, dense outer face, whereas behind that rarely any structured layers ore wythes can be noted.

Figure 17: N of Site 51. *Perivolos*, downhill (left) side oncolithic, right side uncertain with colluvial soil covering parts but containing a lot of rubble.

A rather unusual case of a one wythe wall-like construction with small slabs perpendicular to the road exists at Site 95 (see also Figure 1 for this site). In the cobbling of the road (only 3 m from the ruin) small slabs are set obviously to lead water running along the road off the dwelling and to the field side[32]. (Figure 18)

Figure 18: Site 95, water channel (vertical) across the road (horizontal), right image detail.

Exception (Special case of type 2.B.2): What sometimes looks like a one-faced oncolithic dwelling wall must have been a two faced outer oncolithic, inner rubble construction where the rubble has eroded away and thus the original rubble layer isn't visible any more (e.g. some parts of 99C). Here only the positive identification of a dwelling ruin can clarify circumstances.

[32] Naturally this can’t be dated with certainty to Minoan times, but probabilities are high as the are of the site doesn’t seem to have been re-used (possibly only the fields) in later times.

More than two wythes/one outside faced wythe and unlayered amounts of stones behind that (built as Type 2.B.4 c): Important or high terrace walls had sometimes several wythes to stabilize the terrace. On destroyed/eroded segments additional inner layers of rubble become visible. Often it can't be determined if there actually were construction wythes or if (as with recent terraces) one faced constructions were backfilled with unstructured rubble.

Special case check dams

In the draining course of former winter run-offs (*cheimaroi*) often check dams were constructed that seem to be Minoan by similarity to other oncolithic walls (Figure 19) and recognizable the better the closer to Minoan sites they are situated by being constructed with larger stones like *perivolos* walls[33]. Another version of Minoan check dam retains soil on the edges of colluvial fields that would otherwise be washed off by stronger rains. It is interesting to note that some of the best fields in the Tsivi South area are still kept intact by Minoan constructions (even though right now they aren't cultivated any more) (Figure 20).

Blocks used in check dams are often large but don't seem to have been placed with wall-"faces" in mind, as surfaces seem totally rough[34]. In at least 5 oncolithic cases the check dams still successfully hold heavy loads of soil (up to 1,5 m high and up to over 10m across) and are nowadays usually planted with olives as the so created terraces provide plenty of soil regularly refreshed in winter, and additionally much more humidity than most surrounding areas[35]. In active (i.e. water bearing in winter) *cheimaroi* traces of similar oncolithic structures can be seen along the course of run-offs in several upper branches of the Kalos Potamos that is eventually reaching the sea next to Priniatikos Pyrgos. They often seem to have been rather current controlling (or even sediment collecting) than dam-like structures, but the erosion disturbing even heavy oncolithic constructions through sometimes torrential water masses in winter make any certain identification impossible[36].

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[33] For excavated and dated examples of check dams from Pseira see Betancourt et al 2004, 257-263.

[34] Cf. Jansen 1997, n.51 about Mycenaean checkdams: "do not require a large infrastructure or labour force to construct."

[35] This may in part answer Moody&Rackham's (2000: 39) questions: "Auf dem Inselchen Psira ist ein minoischer Damm ausgegraben worden. Was sollte er halten - Sedimente oder Wasser - und warum?" Both (for water and soil) and to improve cultivation (for why).

[36] It is interesting to note that Allbaugh 1953: 28 suggests the construction of small dams for the improvement of water conditions in Crete.

Figure 19: 100 m NW of dwelling ruin 56. Oncolithic check dam in winter run-off (fr E)

Figure 20: Near Site 118. Check dam holding soil (dwelling ruin in trees top left).

4- Comparison Protopalatial versus other masonry

The rather detailed description of masonry principles given above that became possible by the large amount of preserved PP wall ruins in the Tsivi South area allow some interesting tentative comparisons.

Closer studies might eventually reveal that there are differences in the way big blocks and chinking are used between Protopalatial and Neopalatial building architecture. A small random comparison with Neopalatial ruin walls excavated e.g. in Achladia (“Villa” in eastern Crete) or Malia (NP walls of the “palace”[37]) shows that in later times often rubble was also used in the lower courses of walls underneath big blocks (Figure 21), while the blocks themselves do seem to have been worked on several faces (Achladia) and courses are much more regular[38]. Probably also the amounts of chinking used are different, this being also a function of trying to achieve more regular courses. Naturally much more chinking is also needed in stretches of walls that were plastered.

Figure 21: Malia, NW facade corner (fr N): Foreground: PP (blue dots), on top (orange dots) NP big blocks on top of rubble/mud layers.

As for the comparison between Minoan and Mycenaean big block masonry, several points can be made. First of all hardly any Mycenaean building ruin seems to have been built with Cyclopean masonry, that is rather limited to fortification and other public architecture walls (e.g. in bridges).

[37] Probably the blocks used in PP buildings were reused in NP buildings of the same area, so this kind of comparison is always problematic. But when looking not just at a small stretch of wall (where differences may chance to be neglectable), longer stretches of walls may reveal differences, as e.g. in Malia.

[38] For Achladia cf. most recently Mantzourani&Vavouranakis 2005; Vokotopoulos 2007:175 notes that the PP ruins studied by him are built of big stones only while smaller ones are used in additional layers in NP to give the stones the right levelling.

Apart from the often much larger blocks mentioned above, Mycenaean fortification walls are also much thicker, with a meticulously built outer face, mostly intended to leave no openings and a façade as straight and smooth as possible (probably to prevent attackers from being able to climb up). The rubble filling behind this Cyclopean outer wythe is massive, producing a wall broad enough to be many meters migh without mortar and to walk on and fight from. Tiryns is seen as the best example by Küpper, following various scholars (Küpper 1996:33 n. 202): Double faced Cyclopean walls, filled with smaller stones, the outer shell faces have larger stones on the outside than the inside, extra large blocks as corner stones. There doesn't seem to have been a systematic use of header/stretcher principles, as emphasis was put rather on achieving the most dense possible masonry (Küpper 1996: 31).

These fortification walls also use mostly unworked in shape stones, apart from the representative areas, where blocks are worked on 5 sides (often nearly ashlar like) and built in nearly isodomic courses. But even in unrepresentative wall stretches, there is a much more obvious tendency to level coursing (Figure 22).

Chinking is also used differently in fortifications, with many more pieces (tiny and rubble)[39] achieving a much more "closed" surface than with PP building ruins (Figure 23), chinking stones were often set in mud to fill openings (Küpper 1996: 33).

Figure 22: Mycenae. Ayios Georgios Bridge. View from Downstream Side (SW). (Photo: Dartmouth, Classics Department, Internet).

[39] Walsh&McDonald 1986: 496 note that chinking increases the later the ruins are (from LH I to LH IIIB).

Figure 23: Mycenae. Fortifications. NE Extension. “Entrance to Underground Water Supply, from SE” (Photo: Dartmouth, Classics Department, Internet, the actual entrace lies to the right of the photo).

In this context it is interesting to note that the example drawing given by McEnroe (McEnroe 1990: 196), type 5 of his Minoan vernacular masonry styles called “megalithic” (ibid.:198) probably shows a rather late (presumably LM III) example with even, nearly isodomic courses and many chinking pieces between blocks probably worked on several surfaces (Figure 24).

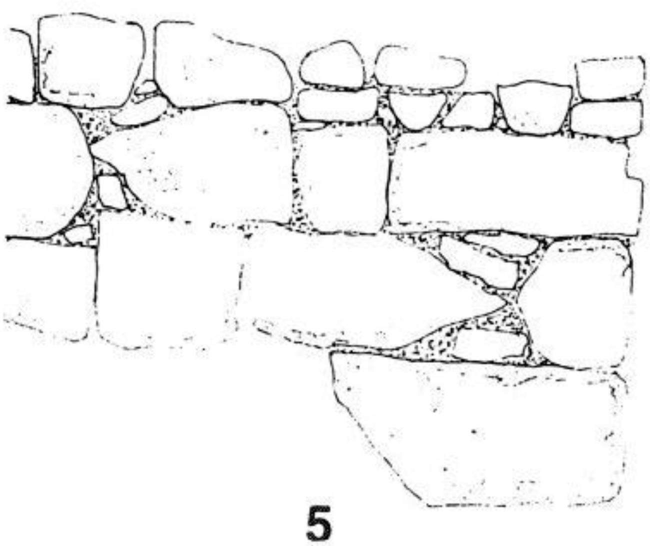

Figure 24: McEnroe 1990: 196. Minoan vernacular “megalithic” masonry

As for the intended impression of the masonry it seems safe to state that Mycenaean Cyclopean masonry obviously was intended to impress the onlooker in its large-scale monumental fortifications[40], whereas this was probably not the case for Minoan oncolithic building, especially in the mountains where it has to be taken into account how remote many of the Tsivi sites are[41]. There also seems to be an interesting difference between the described Protopalatial typology and the Cretan Mycenaean local LM III big block masonry typology (-ies?): Two (exemplary, possibly) agricultural (?) sites with large block masonry, Avgo (E of Kavousi, cf. also Hayden 1997: 202 for chronology, following Boyd-Hawes) and Perdikolakkas (E of Kroustas, unpublished, but known to the KD Eforia Archaiotiton and protected as archaeological site) have nearly “isodomic” courses of blocks reminiscent of Tiryns and Mycenae fortification masonry (Figure 25, Figure 26).

Figure 25: Masonry differences oncolithic PP – Cretan Cyclopean LM III. Left: “Cross-braced” Minoan (Site 99A, N wall). Right: “Isodomic” LMIII (and later) ruin at Kroustas Perdikolakkas (unpublished).

Figure 26: Nearly isodomic big block masonry in retaining wall at Avgo, Kavousi.

[40] This seems still to have been the same in 5th to 3rd cent. “cyclopean” architecture in Latium, cf. Adam 1994: pp.102-106.

[41] Note here: In Malia Protoplatial oncolithic ruin walls were plastered and thus masonry not visible, e.g. in the Crypte Hypostyle in Malia, Amouretti 1970: 12.
One can't help suspecting that in this context archaeologists, impressed by the massive masonry of Late Bronze Age fortifications (Mycenaean, Hittite) transferred the feeling of awe connected with them (Fitzsimons 2007: 110) to similar structures without due differentiation. Still it needs to be emphasized that the skill and workmanship necessary for building oncolithic structures like the Tsivi South ones is in no way comparable with those of ashlar masonry, nor with the more intricate fittings of later Mycenaean masonry.

C - Ruins – Buildings. From wall to house: Shapes and sizes

Definitions:

Building: edifice (a structure that has a roof and walls and stands more or less permanently in one place)[1].
This is not necessarily identical with a permanent habitation (cf. modern Cretan *mitata* used only during parts of the year or fieldhouses used only for certain activities) and is also taken to include non-habitation built structures like granaries, stables. I'll also include the ruins of possible cisterns in the "building" category even though these probably were not roofed.

Dwelling: Building or place of shelter to live in for humans and possibly animals.

Fundament/grounding: Wall base of (oncolithic) stones built into the earth (underground) to prevent upper constructions from being dislodged. Not necessarily whole walls, sometimes piers under corners to support the larger weight of the corner. In the Tsivi South area only visible at Site 44D where the bulldozing of a dirt road has scraped exactly along the outer wall of the dwelling's ruin and below, making parts of the fundament visible[2] (Figure 1).

Special case of foundation (rare):
Krepidoma (Crepidoma): Wall base (or layer of stones outside of the lowest (dwelling-) ruin course), possibly also underground. Only one level course is visible, like a low step or narrow terrace along the base of ruins. It may have been employed to stabilize constructions where the underground didn't seem safe (soft soil, not rock), but may have been a drainage layer or protecting the ground next to the ruin wall from being washed away. Built with rubble (Site 1B, Round Structure 47B K). Also noticed by Schlager (2006: 370 w note 31), and also known from other sites[3] (Figure 2, cf. also Figure 21 in Ch. II b A 2 D, the possible krepidoma in Malia).

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1 From: http://wordnetweb.princeton.edu/perl/webwn?s=building (last accessed: 29/12/2009)
2 It is interesting to note that in the Protopalatial settlement of Monastiraki rubble walls prevail in which a few sporadic large blocks occur in the lowest layers, cf. Como 2006: 173.
3 In Kommos the "krepidoma", e.g. underneath Building J and T, is ashlar-built from large blocks, cf. Shaw 1982: 180, w note 39. In NP Malia there seems to have been something like the krepidoma seen in the area of Tsivi South: See above Part I, Figure 21, the NP wall running diagonally through the photo.

Figure 1: Site 44D. Dwelling ruin, E wall and its foundation (cleaned accidentally by bulldozer).

Offset : Change of wall run direction, the wall continuing parallel to its original line after a small vertical setback (see below Figure 12, and the drawing Figure 7 in Ch. II.b.A.2. B). A similar offset is described as "fruit de mur" in NP architecture (Fotou 1990: 69, fig.24-26).

Figure 2: Site 1B. Dwelling ruin NE wall (right) with its 0,2m high krepidoma (under scale).

1 - Dwellings - Ruin Wall types

In the case of dwelling ruins (here just called "ruins" for simplification, although obviously enclosure walls and round structures also have ruins) several typical wall construction cases may be noted.

General:

All building ruins include at least a few oncolithic blocks (for details and the few older exceptions cf. the Site Catalogue). Ruins situated in level or slightly sloped areas show more rubble use than elsewhere. Building walls differ from *perivolos*- and road- or fieldwalls in that they include a more or less (depending on preservation) clearly defined inner space area. Dwelling or habitation ruins have mostly straight walls with corners (not necessarily 90° ones, though)[4], occasionally include bedrock structures[5] and often have offsets[6]. *Round structures* are roughly circular structures of a maximum 4 m (inner) radius (details see below, C - Round structures).

Typical wall lengths (only rectangular and square ruins, Chart 1):

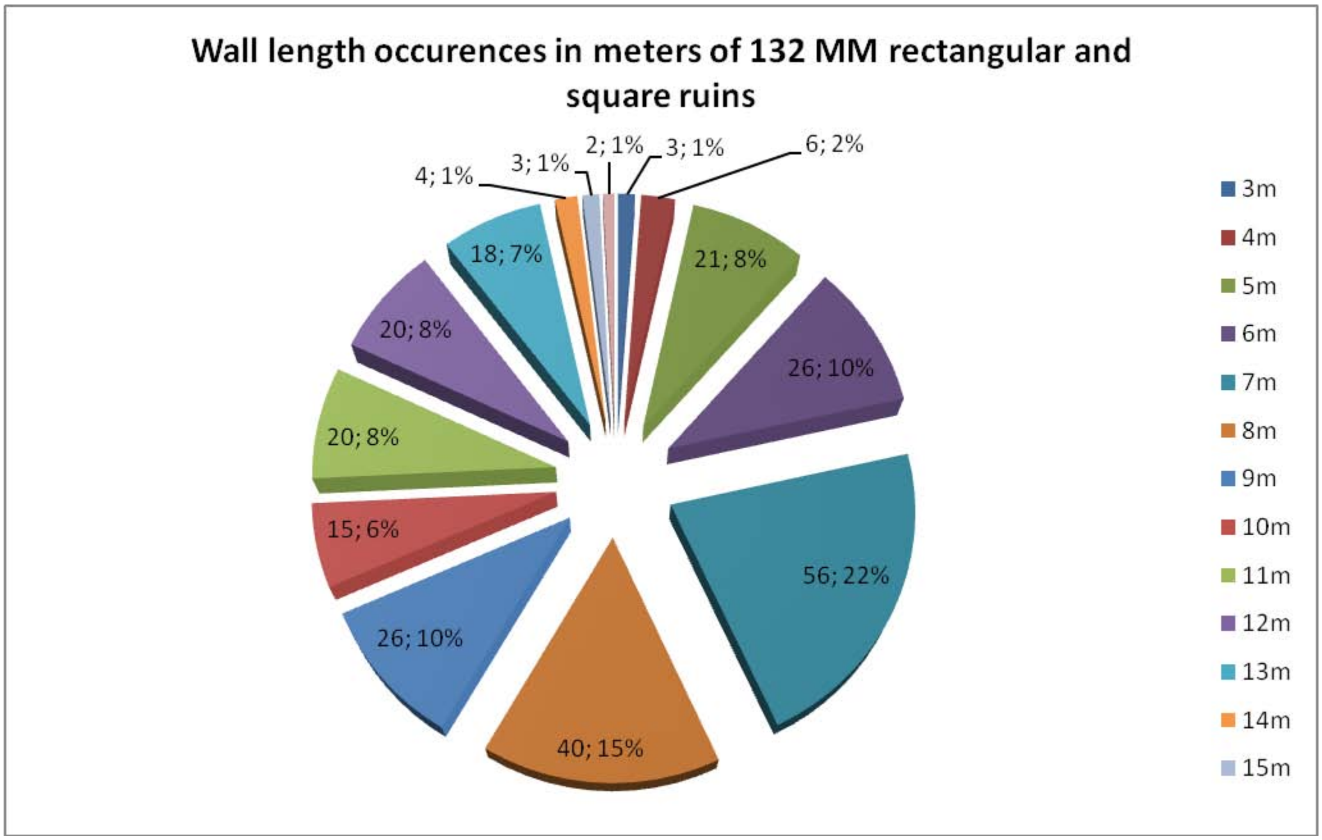

Chart 1

[4] Twelve clearly defined ruins have a trapezoidal shape. In a few cases (Site 53, 83, 189) half round structures are attached or close to the dwelling ruins. Further details on ruin forms see below.

[5] Cf. a similar technique in Gournia: Soles 1979:164, cf. also Hayden 1988:18.

[6] Graham 1960:329 interprets offsets as standard equipment in palaces only, not houses. The function of offsets in Egyptian and Mesopotamian architecture is given by him (p. 333) as traditionally decorative.

Measurements of wall-lengths are always to be understood as giving the external dimensions – due to the often uncertain position of inner wall limits.

As for the level of precision in measurements (cf. Eiteljörg 2002): Visible ruins in the Tsivi South area (built of uncut ogolithic blocks) make any precision under 50cm inadvisable, as through the changes of time many ruin elements have been moved from their original position. Even in the best preserved cases - depending on where one measures, at the longest part that may be just the tip of a block, or at the shortest with an accidental indent - differences are significant enough to justify no more than half meter intervals. Also depending on the respective environment (usually dense overgrowth of thorny and spiky bushes) more than measuring by paces of ca. 1 m was often not possible. Thus numbers in the following should be taken *cum grano salis*.

Wall lengths can be seen in a range between 3 and 16 meters[7] (with wall lengths of 1-2 meters often seen in polygonal ruins). Short walls of rectangular/square/trapezoidal ruins are never longer than 13 m. In long and short walls the most popular wall-length is 7 m (see Chart 1 for all wall lengths).

In none of the ruins the use of mortar can be ascertained, they all seem to have been pure dry stone constructions [8].

Dwelling wall types in detail

Type 2.B.1 Double row, double faced oncolithic walls. This is the most common kind of ruin wall construction (Figure 3, Figure 4). Nearly all visible, oncolithic dwelling walls in the Tsivi South area must have been foundation walls for upper constructions of mudbrick or cobwork. Oncolithic walls that seem to be inner walls probably were originally outer/foundation walls, with extra rooms added later (e.g. Site 53, 87). In other cases what may look like inner oncolithic walls show the actual ruin continuing into walls of a small court (or inner *perivolos* , e.g. Site 51[9], 99A). Depending on the downward gradient the downslope walls not only often show larger stones[10], but stand in many dwelling ruins much higher than the upslope ones[11], the latter often consist of no more than one or two visible courses. Cornerstones are often spanning both wythes for extra stability, if possible even a little more, so as to enable bonding over the corner. This is especially well visible at the dwelling ruin of Site 50, the northeast corner of which still stands nearly 4 m above ground on its downhill side (Figure 5).

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[7] There is one case of a 19 m wall at Site 187, although that is not a continuously freestanding wall as in its middle it is abutted by two, unusually thick for inner constructions, walls. The lengths apply not just in rectangular but also in polygonal ruin walls that were not entered in the data set for Chart 1 because by the polygonality wall lengths can often not be clearly determined. See appendix X: Drawings of ruin shapes.

[8] Different conditions seem to apply to urban circumstances, where, as mentioned above, Protopalatial ruin walls including oncolithic blocks were plastered and thus masonry not visible, e.g. in the Crypte Hypostyle in Malia, Amouretti 1970: 12.

[9] This kind of construction is the reason why Zielinski 1998: 313, (see above note 42) describes the ruin as much larger.

[10] Ruin sides built against the rise of the hill often have smaller stones in masonry also in MM Gournia, cf. Soles 1979:135.

[11] Cf. the similar observation of McEnroe 1990: 198 for Neopalatial buildings in Pseira and Gournia.

The variation with some rubble filling can also be seen (Figure 6), although often it may be not possible to judge if surface rubble was actually part of the built structure or a later intrusion.

Inner walls (Figure 7), are nearly always built of rubble. Where well preserved (rare), they are also mostly double row, double faced, walls, with occasional *diatoni*.

Figure 3: Site 16. Dwelling ruin, E wall seen from N.

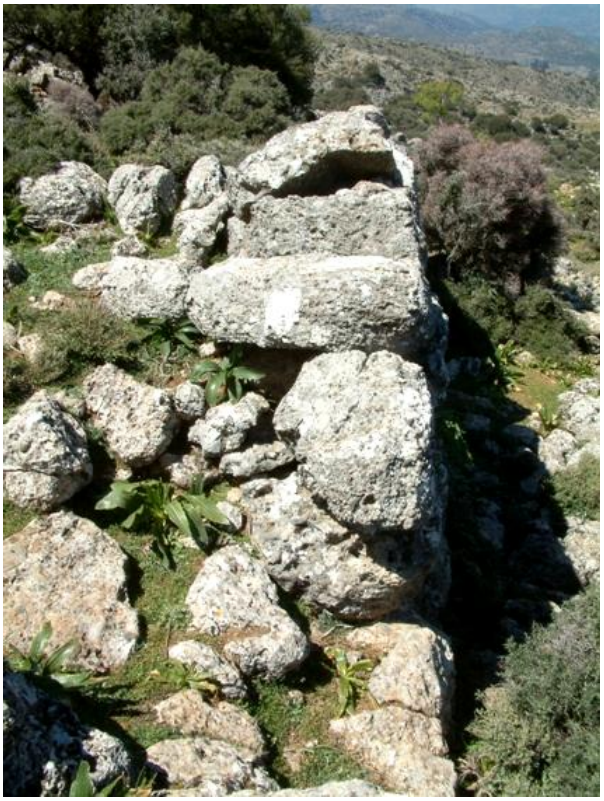


Figure 4: Site 100. Dwelling ruin, E wall seen from S, with *diatoni* (wall width: 0,8m, height: 2,3m)

Figure 5: Site 50. Dwelling ruin seen from SE corner, girl sitting on NE corner.

Figure 6: Site 213. Dwelling ruin, NE wall seen from E with probably original rubble filling.

Figure 7: Site 85. Dwelling ruin inner wall (rubble) remains, seen from outer S wall.

Type 2.B.2 double row, double faced, oncolithic on the outside with rubble backing on the inside walls were, as noted above, possibly plastered on the inside, and the rubble must have been originally solidified by mud mortar to form the second face. This obviously only occurs in dwelling ruins where the space on the inside of the foundations was open and useable (in low foundations, e.g. Site 213; or with extra broad walls, e.g. Site 99C, Figure 8). Cases like this, with – depending of the state of the ruin - indefinite amounts of rubble on the inside, might possibly be confounded with cases of ruins of other types actually filled with rubble, as e.g. the ruin of Site KA13 (Figure 9). Large amounts of rubble in the vicinity of ruins may also be recent artefacts of farming, where fields adjacent to the ruins where cleared of stones that where positioned on or next to the (useless for agriculture) stony ruin areas[12]. In some cases rubble areas next to oncolithic ruins may be eroded krepidomata (e.g. rubble on the west/slightly downhill side of the south wall of ruin 207, rubble on the south/slightly downhill side of ruin KA11, Figure 10Figure 10)[13].

Figure 8: Site 99C. Dwelling ruin, SW wall from NW, SE wall in background partly eroded probably recently. Black scale = 0,5 m.

[12] Usually these rubble heaps contain a less eroded, sharper edged, "newer" looking rubble.
[13] Two cases of rubble backfilled inner *perivolos* walls (Sites 211 and KA04) close to the ruins must have been intended to level the area and show walls of Type 2.B.1 plus rubble.

Figure 9: Site KA13. Dwelling ruin seen from S corner, filled with rubble. As there don't seem to have been any recent fields in the surroundings, the filling is probably ancient.

Figure 10: Site KA11. Dwelling ruin seen from SW with a layer of rubble in front of its S wall.

Type 2.B.3 Single row, double faced walls: No ruin is built exclusively of these. They are preserved only in one course either in level areas or the upslope sides of dwelling ruins, e.g. Site 44C, KA03)[14]. They occur mostly in combination with Type 2.B.1, but as no more than one course remains visible, they might have been backfilled with rubble on the inside (although known walls with rubble backfilling never have an explicit inner face), which only excavation would reveal (Figure 11).

Figure 11: Site 44C. SE wall of dwelling ruin from NE. Type 2.B.3 - Single row double faced

Other features of building ruin walls.

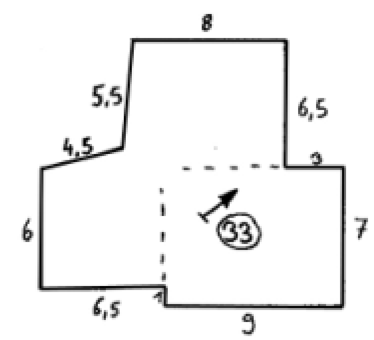
Set-backs/offsets

They were often included in long walls (Sites 33, 82 etc., see Figure 12 with drawing and Appendix C, ruin shapes). They also seem to have helped constructions in coping amazingly well with centuries of earthquakes. Thus an architectural feature long taken to be a characteristic

[14] McEnroe 1990, doesn't seem to have seen this kind of wall in NP architecture. He writes (198) for his Style 5 ("megalithic") of Minoan vernacular masonry: "All of these walls are generally built of two skins, with larger stones on the exterior faces". Judging from his example drawing he might be talking about Mycenaean walls though: It shows a well layered (close to isodomic) masonry of stones hammered at least on three sides with many smaller chinking stones for filling interstices.

feature of Minoan (NP) “Palace” west façades (Graham 1960 *passim*, Graham 1962: 162–4, cf. Wright 2005: 191, cf. also Hayden 1988:18, who notes various kinds of set-backs in LM III[15] ruins[16]) seems to have been rather popular already in vernacular PP architecture. Whereas in the palaces these offsets were interpreted as parts of window substructures, in the PP ruins studied here their sole function seems to have been to statically support long, downslope facing building walls. No indents similar to these were observed in *perivolos* or road walls of the area.

It is interesting to note that in Mycenaean architecture there seem to exist two variations of offsets, one of which is in fortification walls. White (2005:191) defined “offset” thus: “vertical joint that marks a change in the course of a wall, such that one section of the wall is not aligned with its neighbour”. Small wall lengths of extensions in polygonal ruins may have had a similar function.



Dwelling ruin 33, offset in S wall

Figure 12: Site 33. S wall of dwelling ruin (seen from W), with offset ca. 0,7 – 1 m.

[15] The dating of these sites may be questionable as it goes back to ca. 1905 and Hayden did not examine the sites herself to check if there were other chronologies (too) (p.18). See White’s discussion for Mycenaean “offsets”: Here he clearly describes only offsets in fortifications, as on the other hand he also mentions (ibid.) the offsets of the residential building at Glas, although (cf. his Figure 1B) it is obvious that the walls there do keep aligned in spite of having offsets. Thus a definition like the one above would be more adequate for offsets in Mycenaean buildings, too. These can also be seen in walls of the Tiryns citadel, (see White’s Fig.1D).

[16] Tzedakis et al 1989:66 call this technique “architecture minoenne à redents” and note it for Choiromandres dwelling ruin and *perivolos*, although the plan on p.67 doesn’t show offsets in the *perivoloi*.

Doors/windows etc.

The fact that oncolithic walls in dwellings were foundation walls is also supported by the fact that there are hardly any openings that might qualify as doors (and if they exist: Only in low walls on mostly level ground, e.g. Sites 18, KA 19, see Figure 13). Special cases of doors are those entrances constructed "dog-leg" (for Minoan Malia French archaeologists called this "à chicane"[17]) fashion, these also exclusively on low, uphill sides of ruins, where the entering person would have approached parallel to the wall (e.g. led by a second outer wall in 99 C and KR 1B) and entered perpendicular to the approach (Figure 14).
None of the dwelling ruins shows anything like window openings or recesses. This is an additional argument for the studied walls being foundation walls.

In the upslope wall of dwelling ruin 94 there is an inbuilt opening that resembles a recent *doulapa*, a small cupboard opening in fieldhouse and mitato walls (Figure 15Figure 15). The inside of the foundation seems to have been used as room.

Figure 13: Site KA19. Dwelling ruin with possible door opening next to NE corner (with scale).

[17] Cf.for instance Joly 1928:337, where this kind of entry is called typical for small Minoan palace sanctuaries. The Protopalatial Salle Hypostyle treated there also has this kind of entry.

Figure 14: Site KR01B. Dwelling ruin S wall with dog-leg entrance. Scale on left door frame, ruin to right.

Figure 15: Site 94. Dwelling ruin W wall from E inside. The stone above the scale is one piece with a 0,6 x 0,4 m bay like a cupboard.

So-called "Sally Ports"[18]

The so-called sally ports noted in Minoan dwelling ruins in far eastern Crete by the Minoan Road Project[19] seem to be similar to openings occuring in various Tsivi South sites (18, Figure 14; 28; 99A, Figure 17Figure 17). None of the openings seen in the studied sites is higher than 0,6 m, thus they can hardly be called sally ports from a practical point of view. It is suggested here that these openings were – as in similar modern examples (Figure 18) - some kind of waste disposal or drainage opening, as they are always positioned on the downslope side of the ruins. What is called "Sally Port" in Mycenaean fortification walls[20] is always high and broad enough for an adult to pass (cf. also the Tzedakis et al. example). Also sally ports are not set in dwellings, but fortification walls, where such an installation obviously makes much more sense.

Figure 16: Site 18. Dwelling ruin from below the SE (downslope) ruin wall. Opening probably for drainage.

[18] Definition for "Sally Port" in, Webster's Online: "A postern gate, or a passage underground, from the inner to the outer works, to afford free egress for troops in a sortie." http://www.websters-online-dictionary.org/definition/Sally+Port, last accessed 18/1/2010.

[19] In Tzedakis et al 1990: 48: "sortie de secours", cf. Tzedakis et al 1989 fig. 28-29-30: The "sally port" is a built opening in the SE external wall of a paved "court" (leading out – down - of the building via stairs). Evans had interpreted the same opening as "dromos of tholos tomb", Evans 1896:18/Brown 2001:222. Cf. also Tzedakis et al 1989:66, n.71. See also Reid 2007.

[20] Already since Schliemann (cf. Schliemann 1878:5).

Figure 17: Site 99A. Dwelling ruin, S wall from outside, with the largest known (side/downslope) opening.

Figure 18: Next to Site 100. Recent mandra outside, downslope side with waste disposal /drainage opening.

2– Dwellings - Ruin shapes

General

The Protopalatial buildings of the Tsivi South area in general clearly were of a vernacular nature (cf. also McEnroe 1990): Shape and setting of walls or ruins obviously depended not on an "architect's plan" that was executed, but were rather adjusted to the plot's shape and condition, and available material, which suggests a spontaneous rather than a planned architecture, adapting specific local topographical forms (cf. Vokotopoulos 2007:174).

All in all it seems that these installations were far from Zielinsky's idea of "élite"[21], and not "conspicuous buildings". Nor could they be connected with an expression of monumentality of an unknown kind like that of the Neolithic megalithic structures.

Well preserved ruin walls as a rule achieve to create a level, horizontal area on the inside. As mentioned above, often these spaces are obviously intentionally filled in with rubble to create that level area.

Building shapes

In the site catalogue ruins are classified in three basic types (cf. for NP houses McEnroe 1982[22]):

1. Quadrangle (Type 1): Either rectangular, square or trapezoidal shapes with four corners (but not necessarily right angles): 145 ruins (43%).
2. Polygon (Type 2): Composite shape consiting of several to many small quadrangles (again not necessarily in right angles). The most popular shape here is the simple L-form, but highly complicated shapes occur, too: 54 ruins (16%).

Several distinctly apart buildings close to each other (Type 3). This variation is similar to a small hamlet or closely set group of buildings[23] and there are only few certain cases of the first case with large built areas: Sites 100/100B: ca.300sqm, and 108/108B: ca. 400sqm. In spite of their rareness though these sites may be of special importance, not only for their large size, but also for the fact that they may constitute a kind of prototype for the NP "villas". Here also Site 60 might belong where strong erosion hides if there is one building of ca. 80 sqm or possibly two. The same applies to Site KA14 with at least 70 sqm belonging to one central ruin and probably 150 sqm more for several smaller outbuildings. Other sites occupy smaller areas and have 2 distinct ruins:7D, 23, 128 (but in all cases one is clearly the main dwelling). Because of the extremely intricate system of walls surrounding several sites there may be more sites actually belonging in this category[24]. In any case these sites are no more than 2%.

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[21] Several oncolithic sites of the Tsivi South area are, as mentioned above, included in his (1998:passim) catalogue of interpreted as "élite" "cyclopean" sites.

[22] Although McEnroe studied only 29 NP ruins for this typology, that is based mainly on ruin size and simplicity in the small types and additional other criteria in the larger types. His (1982: 13) smallest houses (11 of 29 studied, called Type 3) are ca.125 sqm, less than half the size of Type 2 houses.

[23] Necessarily, depending on the distance between ruins and other parameters (e.g. the existence of a *perivolos* between), sometimes ruins are seen as distinct sites even when very close to each other (e.g. Site 60/60B).

[24] E.g. Site 179 where because of the chaotic conditions after a wildfire no clear impression could be formed of outbuildings; the group of the 42 Sites might also be a special case of this type.

For details of the shapes see Appendix C, ruin shapes (drawings).

The general impression of shapes for well preserved ruins is that they were *irregular*. No ruin exactly resembles any of the others, although some forms seem to have been favoured (see the statisctics). Right angles exist but don't seem to have been important for the architecture: at places where a slightly larger, irregular ledge would allow, a dwelling would rather have been built without a right angle but rather covering the whole area (e.g. Site 118) or using the irregular space given by bedrock (e.g. Site 61). Often what looks like a rectangular or square structure would with closer scrutiny turn out to be rather slightly trapezoidal, but as detailed measurings of angles were not conducted, this is not visible in the drawings (Appendix C).

Statistics[25]

Ruins shapes, wall lengths

Of 336 Sites 289 have recognizable dwelling ruins (some several), 13 have no recognizable ruin (for various reasons), at 34 only traces of ruins could be seen.

Of 346 PP dwelling ruin building remains (some sites with several buildings) in the Tsivi South area, 187 are well enough preserved to see their full size and shape while 159 (46%) have an unclear shape as only parts are preserved on the surface. Of those with discernable structure shapes:

- 107 are rectangular (31%),
- 18 are square (5%)
- 8 are trapezoid (2 %)
- 54 are polygonal (of which 24 simple L-shapes) (15% - 7%).

Wall lengths of rectangular/square/trapezoidal ruins, see Chart 1 above[26].
When summing up all the wall lengths of the rectangular type (the first three varieties in the list above[27]), a "joined" length of over 4000 m is the sum.

Ruin size

When summing up all measurable and approximately judgeable in size dwelling ruin areas only[28], a minimum of over 20.000 sqm of certain house areas were built. When accounting the unclear ruins with an average of 70 sqm (as most popular size when averaging the 200 ruins in the middle range of chart 4) there must have been close to 27.000 sqm of houses built - a huge

[25] *Perivoloi* and Round Structures shall be treated under their own headings.
[26] Because the trapezoidal ruins are clearly discernable as single rectangular buildings in their shape, they are integrated into the rectangular shapes for the charts.
[27] To add the many walls of the polygonal ruins as well would take too much time here, but they would certainly attribute another noticeable amount.
[28] 187 certain ruin sizes, 69 approximate.

undertaking when one thinks e.g. of the fact that the NP "palace" of Knossos covers an area of 13.000 sqm[29], i.e. about half this size.

The quadrangular ruin shapes (rectangular, square, trapezoidal) include as a rule smaller floor spaces than the polygonal ones (Chart 2)[30]. The absolute size of the largest dwellings needs to be in polygonal shapes, as rectangular ones could not be built so large in this landscape if the preferred analogies were as can be seen in this region (Chart 3). Also some of the large and multiple polygonal ruins may have grown from a smaller, simpler in shape nucleus (although clear indications for multiple construction phases were rarely seen, e.g. at Sites 37, 87).

The analogies between long and short rectangular ruin walls are on average 1,46 (details see Chart 3). Only 4 ruins have an extended rectangular shape more than double its width in length (three are 12x5, one 11x5m), which may also turn out as the consequence of add-ons, if excavated.

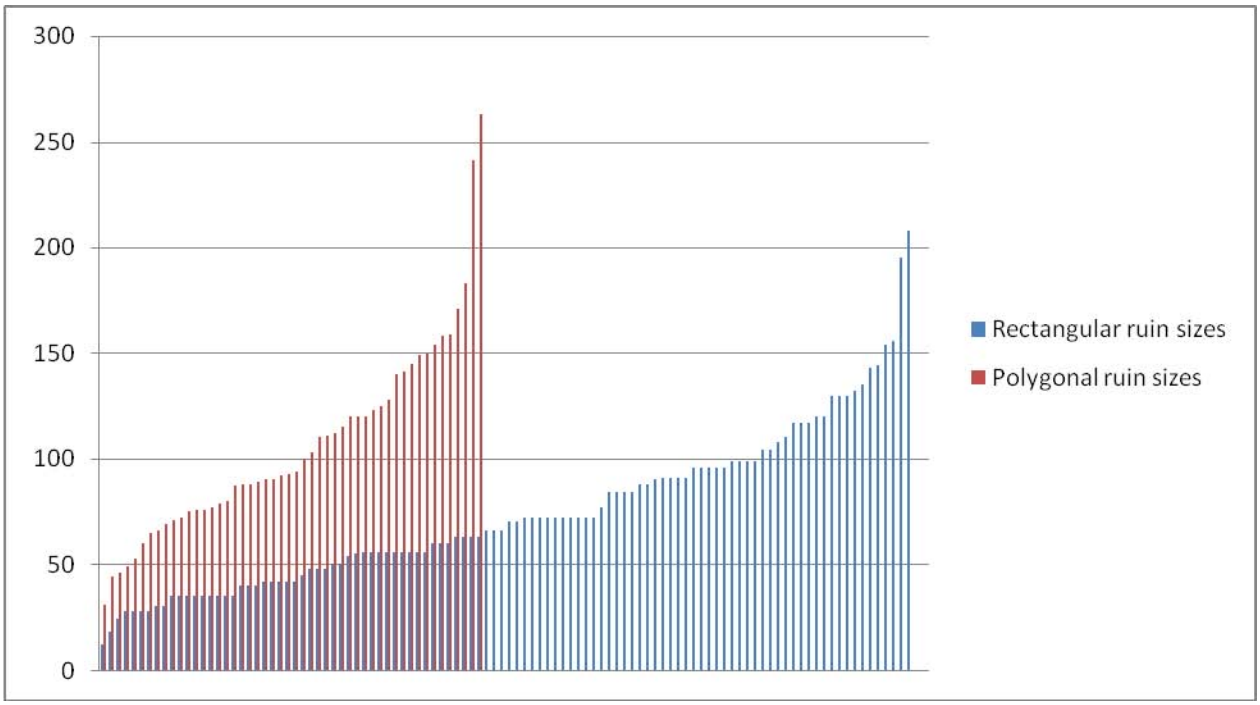

Chart 2: Number of ruins used 189

[29] Cf. http://projectsx.dartmouth.edu/history/bronze_age/lessons/les/12.html (last accessed 18-11-2011).
[30] The average area size of all the certain measurable ruins is 82 sqm, of the 52 certain polygonal ruins only the average is 105 sqm, of the 131 certain rectangular (with square and trapezoidal) ruins 74 sqm. The uncertain (but roughly assessable) ruins have on average 77 sqm. Clearly the polygonal ruins are on a different scale than the others with 105 sqm average, while the most popular site sizes (see chart 4 below) are slightly below 70 sqm. A future detailed pottery analysis might clear if this bears any relation to hierarchy or chronology, which from surface conditions seems doubtful.

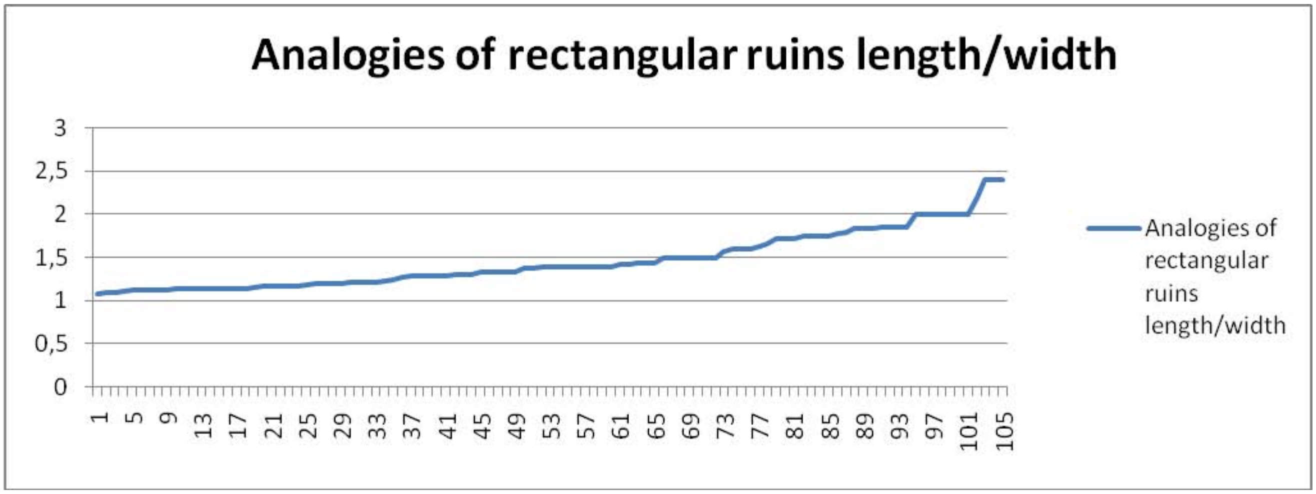

Chart 3

Ruin Size: Comparison with recent houses

Allbaugh (1953:90) gives the average floor space for houses in rural areas as 56 sqm (larger than in towns) and reasons that more storage space is needed there "because of more self-sustaining households" (ibid.). Judging from the fact that PP country ruins (counting all possible data) had an average size of 80 sqm (the simpler rectangular dwellings: 73 sqm), Minoan circumstances obviously were more generous – or needed larger space for individual work and/or storage, spending more times indoors due to a colder climate (especially if the dwellings were used in winter, too), or even larger groups of occupants[31].

Ruin Size: Comparison with NP houses

Judging from the average size of over 140 sqm[32] in NP (mainly town-) houses (Whitelaw 2001, see also Chart 4 below), circumstances were different in that sector (and/or epoch) even more clearly.

A clearer comparison of house sizes becomes possible with Whitelaw's (2001) list of "The Floor Area of 207 Minoan Houses" (these are all known excavated NP town houses plus a few country villas and farmhouses that have either a certain size or an uncertain but well estimatable for Whitelaw size). The numbers given in that list are compared in the following chart (Chart 4) with the certainly measurable 184 ruins (plus added the 69 well estimatable in size but uncertain ruins) of the Tsivi South area. (The given areas always suppose only one story,

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[31] Although recent Cretan life has proven that many people can live in one-room-houses – certainly more than the typical "5-person-household" used for settlement calculations.

[32] Not counting the large structures of over 1000 sqm for a certain amount of comparability. For the discussion of several floors in Minoan Neopalatial houses increasing the accounted for by Whitelaw spaces see Driessen 2010: 36 (where it seems problematic that he compares large Minoan urban house sizes with Allbaugh's small Cretan rural (!) houses – it seems normal that the urban ones are larger).

as in Whitelaw). One should keep in mind here – apart from the chronological difference – that it should be expected that town houses are larger than vernacular ones, and only possible elite country buildings might be similar in size (and facilities/equipment) as town (elite) houses.

Most (185) of the 254 measureable (or estimated) dwellings were smaller than 100 sqm and never larger than 325 sqm, whereas only 82 of the 207 known NP houses are smaller than 100 sqm and several are much larger (although may be the small palaces of Gournia and Petras doubtably belong in this list). It seems clear from this comparison that the inhabitants of the vernacular PP mountain countryside were more humble than their urban successors of the following phase. Thus the fact that the PP houses of the Tsivi South area were mainly simple and small structures seems to be an additional argument for the supposition that their builders were amateurs - as opposed to the building of the "polite" class (town-) houses that needed professionals (cf. McEnroe 1990). Similarly Zoïs (1990:83) envisages the building of NP town structures to have been done by specialists, whereas he supposes the masonry in EM II Vasiliki might have been done by “family” sized groups of non specialists. From the point of view of the size of the PP mountain structures, the case of the latter construction may well have been similar in the following phases as well.

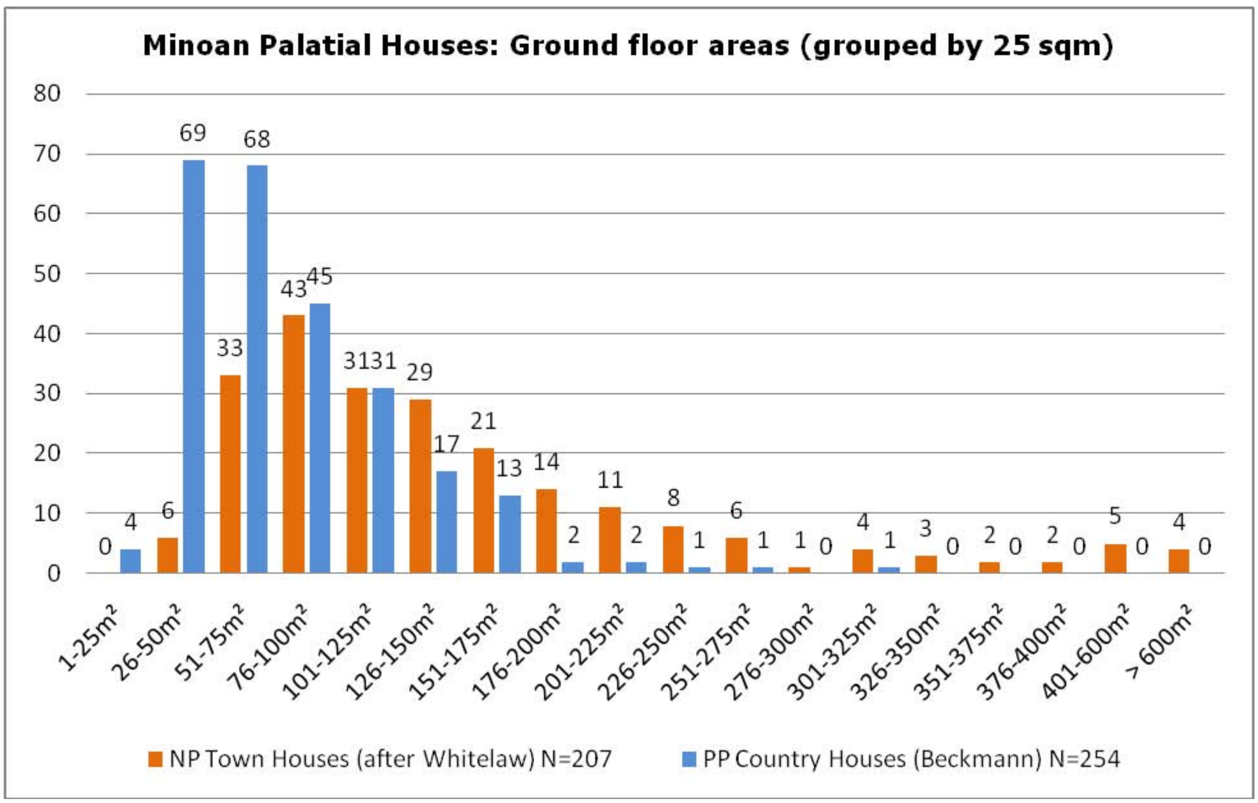

Chart 4

Yards/courts and similar open air structures

Many of the Tsivi South ruins had – to judge from surrounding smaller Inner *Perivolos* walls (see more details below), all kinds of useable open air spaces surrounding the ruins. According to Allbaugh small yards were in traditional Cretan houses "almost a part of the dwelling unit" (1953:91). For an agricultural society in a subtropical area of more than half a year of sunny days this is certainly sensible, and the use of yards for household and industrial activities should be kept in mind.

Columns?

Considering the fact that only 29 of 106 known short walls in rectangular buildings are shorter than 6 m (external dimensions, i.e. estimated 4,5 m of clear width) the question of the necessity of some kind of column for holding up a roof has to be dealt with. According to Joly (1928:338) no beams longer than 5 m had been used for Minoan buildings in Malia (similarly: Amouretti 1970:18) and columns were employed (rarely) since MM I in houses (ibid.). Joly even supposed the beams were imported (op.cit.).

Obviously the masonry of houses in the Tsivi South area would have made some sort of roof-support necessary. And while the situation of inner walls remains mostly unaccounted for because of taphonomical conditions, many ruins seem to have been too large in clear width for their construction to deal with the weight of a roof without some kind of support. A comparison with recent buildings of the area suggests that most of the possible supports might have been perishable (typical struts for roof support are made of gabled oak trunks).

Only one incident of a column base from Site 165 could be seen in the area. It has a diameter of 50cm Ø, height ca. 25 cm, and is rounded on one, flat on the other side. A comparable example from PP Malia (Amouretti 1970:18) had a hammered circle in the flat part of the diameter of the column, the 8cm ring around that was polished (30 cm - 43,5 all Ø), otherwise its shape was very similar to the Tsivi South example. At Site 165 the column base was clearly out of context. It was stacked on top of a recent fieldwall that contained also several oncolithic blocks from the otherwise nearly untraceable ruin. It is quite possible that other column bases like this might exist in situ (Figure 19, Figure 20).

Thus the conjecture that stone column bases were introduced only in MM IB or early MM II and possibly as an outside influence (Schoep 2006:55) should be approached more carefully in the context of Tsivi South area PP ruins[33], and excavation of several of the sites that might shed light on the subject seems advisable.

[33] Prof. J. Shaw kindly tells me that his new book to appear soon shall also deal with the subject.

Figure 19: Site 165 Column base, diameter 50 cm.

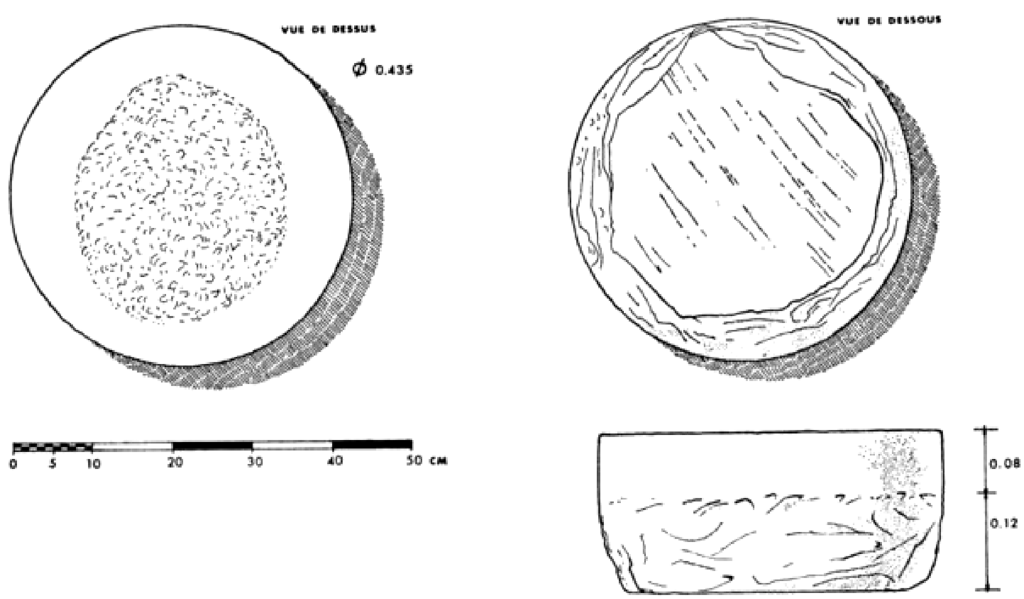

Fig. 1. — Base de colonne. Chambre 1.

Figure 20: Similar column base from the Crypte Hypostyle in Malia, Amouretti 1970:17

As for the length of possible roof-supporting beams, the surrounding forest (oak and cypress) would probably have furnished all kinds of possible lengths of tree trunks for this. The prevailing frequency of the ruins' short wall lengths between 6 and 9 meters (73 of 112, see Chart 5) suggests that beam-lengths of over 5m were common (and might well have been exported to Malia, too, to make imports from outside the island unnecessary).

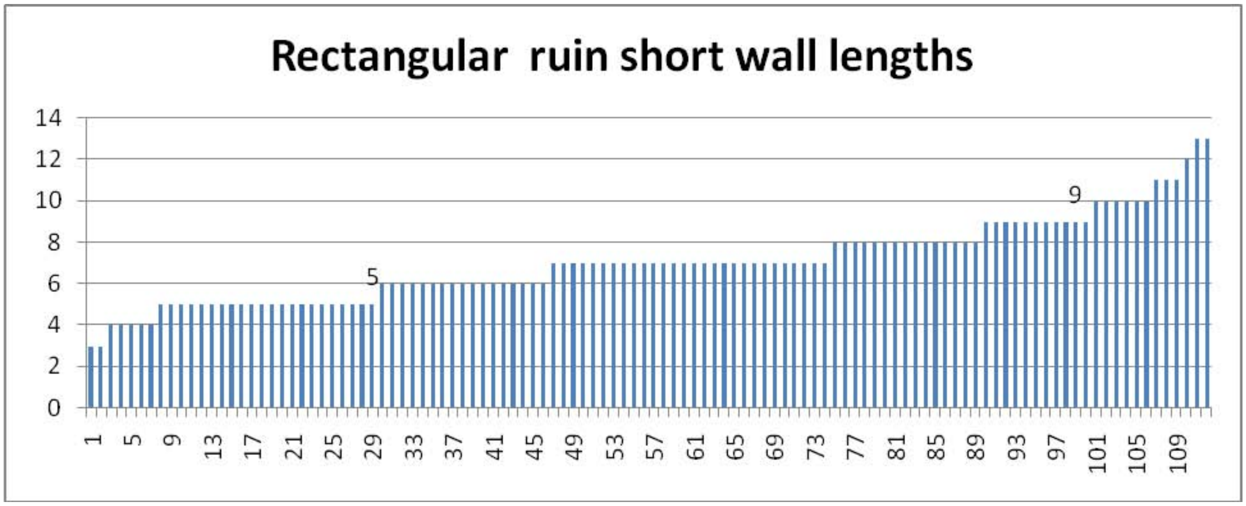

Chart 5

Possible upper structures

As for possible upper structures that must have existed on the (oncolithic) foundations, traces of burnt earth suggest former superstructures of perishable material. If these clay building elements were mudbrick cannot be clearly determined from extant surface remains[34]. Small burnt pieces of clay that clearly belong to the ruin contexts[35] make several points clear:

a) They are very rare (14 occasions of few tiny pieces at over 300 sites), thus no systematic destruction, comparable to that of EM II sites, leaving large amounts of fired clay elements, is to be expected.
b) The built with clay upper structures must have contained thin plant parts (twigs?), still visible as imprints in the burnt pieces (Figure 21). Often there is a clear indication of leaves of some kind of *Poaceae* (grass/cereal, Figure 22 – although note that this site has also Late Prepalatial pottery, the inclusions also seem denserFigure 22)[36].

[34] In any case strong connections dont seem to have existed between superstructures and foundations as none (like holes, notches) are visible in the upper layer of the foundations.
[35] Note that traces of past forest fires sometimes look similar, but can usually be seen out of context of sites.
[36] Note that recent roof constructions do not contain any grassy elements, cf. Ch. Ib.

Figure 21: Site 53. Shapeless piece of burnt clay structure (Ø ca.5 cm) seen next to dwelling ruin. Note the plant imprints.

Figure 22: Site 21: Shapeless pieces of burnt clay with grassy impressions, seen next to dwelling ruin.

Thus there might have been mudbrick architecture employed here (cf. Nowicki 1998:36[37]). Still there is only one example (and that seen at over 100 m from the ruin of 213B) of part of an

[37] Nowicki believes that in this area there were MMI-II "mudbrick sites" as opposed to later MM II-III sites built with "large boulders" (ibid.). With few exceptions I do not agree, as earlier looking sites (without oncolithic masonry and pottery that seems Late Prepalatial) have a different pattern of burnt pieces, with less visible inclusions, more of a grassy kind, cf. Figure 22).

actual brick (Figure 23, note that it doesn't have externally visible plant inclusions)[38]. Usually remaining surface pieces are very small and may rather have been part of pisé or wattle-and-daub constructions. Even though in many cases findings of mud-constructed walls are unclear, they are usually taken to have been traces of bricks (cf. Mantzourani et al 2005:755[39]). Still it is interesting to note that the EB Aegean did know wattle-and-daub constructions (cf. Hood 1986:41; see McEnroe 2010:12-13 for Cretan Neolithic antecedents[40]).

Figure 23: Site 213. 100 m W of dwelling ruin. Traces of a possible former mudbrick (note the different ways of firing in joining pieces). The brick thickness (top) seems to be less than e.g. known from Monastiraki[41].

3- Round structures - Ruin Wall types and shapes

General – (details see Appendix E "Round structures")

"Round Structures" in the context of this thesis is a term used for ruins of a circular shape. In general the Round Structures of the Tsivi South region seem to be similar to what elsewhere in Minoan archaeology is called "kouloura"[42]. The measurements of the known kouloures are:

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[38] It is interesting to note, though, that Monastiraki bricks seem to show traces of straw: "there were walls made of mud bricks. The mud bricks of the walls, probably made nearby, were presumably made by pouring and packing the clay mixture directly from the bank into bottomless moulds placed on the ground upon a bed of straw in order to reduce shrinkage caused by drying" (Como&Marazzi 2006:16)

[39] "Specifically, he noticed a narrow layer of reddish brown soil immediately overlying the surviving parts of the eastern wall of room I-K. He suggested that this layer consisted of decomposed mudbricks." Citing N. Platon's (1954) "Excavation Notebook." Unpublished.

[40] My thanks to J. Shaw for reminding me of the latter reference.

[41] Cf. measurement in Como&Marazzi:17 : "48 x 28 x 15 cm (l x w x h)".

[42] The main article on this subject still seems to be Strasser 1997, but see also Carinci 2001, Cadogan 2007, more references there.

Malia, ca. 4 m (8 similar "kouloures"); Knossos, 5,1 m, 5,8 m, 6,2 m, 6,7 m; Phaistos, ca. 4 m. (there are 5 similar ones, Damiani Indelicato & Chighine 1984: 229; for more detail see Strasser 1997, esp. p.77), Myrtos-Pyrgos, ca. 3,4 and 5,3m (Cadogan 2007:105).

The "kouloures" (also called "walled pit" by Pendlebury & Pendlebury 1928: 53) are usually dated to PP[43], the Knossos ones have a clear *post quem* date to the underlying MM Ia houses, had been paved over (like those in Phaistos) by MM III (Evans 1928/2: 610) and are thus unambiguously PP. Only Aghia Photia (Siteia) seems to have an older "kouloura", datable to MM IA-B (Tsipopoulou 1988)[44]. The Malia "kouloures" seem to have been used in NP times, as well (Béquignon 1930:521). Various (undated) round structures have been noted in the surroundings of Choiromandres, the oldest phase of which is dated to PP (Tzedakis et al 1989, Tzedakis et al 1990). Similarly, a "construction ronde" and three others called "citerne" on the mountain slopes above Malia (between 300 and 900 m asl) have been dated to PP (Müller-Celka 2003: 464, 467)[45].

None of those structures seem to have been built exclusively with large blocks, while few such blocks seem to be present in the Knossos examples, to judge from the photos mainly in the uppermost layer (Evans 1935:62). Malia mountain round structures/cisterns also show the use of oncolithic blocks in their masonry.

The examples from Knossos, Phaistos, Malia mountains and Myrtos-Pyrgos are built belowground (hence "pits" "citerne"), those from Malia Palace, Aghia Photia and Choiromandres aboveground. Only the Malia kouloures seem to have been furnished with a central pillar and showed traces of plaster on the inside[46].

In the Tsivi South area have been discovered all in all 61 Round Structures of two distinctly different kinds, positioned mostly near the dwelling ruins, but sometimes also more than 300 m distant (e.g. 99K 3[47]). Usually they cannot be dated by pottery (absent, with few exceptions, see Appendix E: Round Structures), but as many are situated in a close context to the respective dwelling ruins (with pottery dating) or within a site's enclosure walls, even those outside of context but with similar masonry and/or positioning shall be interpreted as Minoan here for the lack of other evidence.

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[43] The Malia structures' date seems to be debatable, cf. Cadogan 2007: 108, with literature. Original dating to MM Ib/II: Béquignon 1930. Those known from Archanes, Zakro and Tylissos are dated to NP: Cadogan 2007: 103.

[44] Not to be confounded with the two later tholos tombs built on top of the older ruins.

[45] In general the slopes above Malia may reveal a similar settlement pattern with the Tsivi South area – the author has seen several sites not mentioned by Müller-Celka, and some seem to have *perivoloi* , too (albeit they often seem to be rather eroded). There also seems to have been a much more intense re-use of the area in Venetian times.
Two further PP "kouloures" are mentioned for Malia's Maison E: Deshayes and Dessenne 1959:109.

[46] Although it seems risky to call plaster or cement "water-tight" (Strasser 1997: 79) without further analysis. Lime (and gypsum even less) plaster is actually not waterproof (it would be for cistern use, i.e. water being stored inside, cf. Lior Regev cited on "Aegeanet" by Louise Hitchcock, 30.9.2009), if not made with hydraulic lime mixtures containing volcanic material (known since later antiquity only).

[47] This Round Structure, even though closer to the 138 Sites than to the 99 Sites, was named 99 K (3 - there are 2 others in the 99 region) because of its position within a 99 *perivolos*.

Round Structure Type 1

The first kind of round structure (23 certain cases) seems always meant to be level (or nearly level) with the surrounding soil, built with oncolithic blocks at least in part, and dug out as a pit or vertical shaft/well. Wall thicknesses vary between 0,7 and 1,3 m (in rare cases wider: see Figure 28) and inner diameters between 0,7 (well variety) and 3-4 m (pit variety), at Site 100 one round structure even has a 5 m inner diameter (Figure 27). Often (may be always) rubble masses have been used to fill up space on the outer rim, especially on downhill sides (Figure 26). The extant depths vary between openings of ca. 2,5 m (KA 20K, Figure 26) and nearly filled up with colluvial soil and fallen material. The uppermost layer, where obviously well preserved, forms a continuous level surface, by being built with blocks as flat as possible on top. None of these structures shows traces of an inner lining of any kind[48], but where preserved vertical surfaces are especially well fitted to avoid gaps (Figure 24). This special way of construction should be seen as intentional for their function, although any absence of flat surface stones on vertical walls doesn't mean that the structures did not belong to this type once. Round structures Type 1 with small shaft or well sizes are mostly built with headers facing the openings and many of them are still functioning wells (probably most of them re-built at least inside during the last 150 years) (Figure 25). The structures of Type 1 are often positioned in some distance from the dwelling sites or, if close, they are set on the downhill side of them. On various occasions (as the rocky ground of the area doesn't easily allow deep pits to be dug) these structures are integrated partly into the slopes with mostly either bedrock parts included in the lower walls (e.g. 179 K) or generous amounts of rubble outside of them (e.g. Ka 20 K, Figure 26). Six such half underground/half aboveground structures are known to me, they all seem to belong in masonry to this type.

[48] It seems important in this context to keep in mind that Tzedakis et al (1990:46) found a (partly undisturbed) layer of clay inside of one round structure at Choiromandres they interpret as "tourelle". Also Evans (1921: 106) writes in his description of the Hypogaeum (dated to Late Prepalatial, cf. also Cadogan 2007:108 with further bibliography) that it may have been used for the extraction of "potter's clay" without a clearer explanantion.

Figure 24: Site 179. 179K Round Structure with typical Type 1 masonry. Placename: “Glisterni”. The N wall (left) is partly bedrock on the downhill side. Scale on big block centre right.

Figure 25: Site 26. 26K Round Structure of the shaft variety (intact well). Diameter of opening 0,7 m.

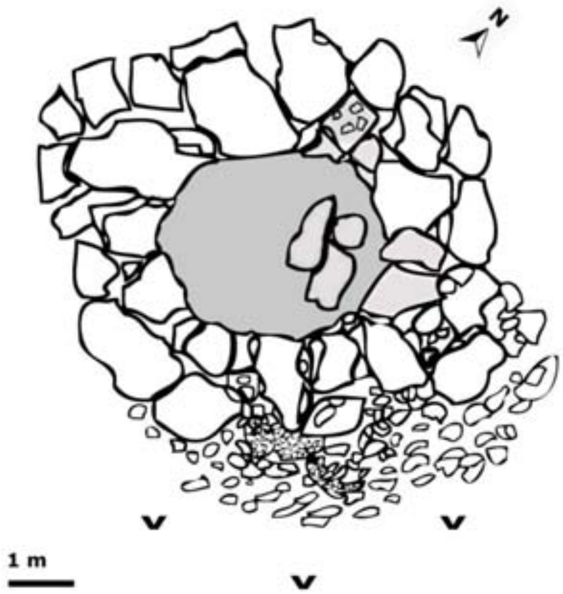

Figure 26: Site KA20. KA20K Round Structure of Type 1 – drawing (gray: lower levels.) The oncolithic fallen blocks inside must have been dislocated intentionally from their positions to the right for animals fallen into the 2,5 m deep pit to be able to get out.

Figure 27: Site 100B. 100K1, the area's largest pit type Round Structure with a diameter of ca. 5 m.

Round Structure Type 2

The second kind of round structure (21 certain cases) is always built aboveground, mostly with rubble or a mixture of a few oncolithic and rubble stones. This, again, as with other built structures of the PP area, often seems to depend on the distance from the dwelling ruin: The closer the setting, the larger the stones. Diameters vary from 1,5 to 4 m, the most popular sizes between 3-4 m, and wall width 0,8-1,2 m (often difficult to judge because of fallen rubble). In general most of these structures are set on slightly raised or rocky surfaces (Figure 28). Many of them are set right next to or close to dwelling ruins. None of them is well enough preserved to allow to see a possible opening/entrance vel sim, but in some cases parts of masonry structures are visible (Figure 29).

Figure 28: Site 189. 189K2 Round Structure Type 2, (seen from W).

Figure 29: Site 189. The same round structure (189 K2), E side seen from S, with wall masonry partly intact.

A special case of this might be the not well preserved probable small Round Structure at Site 128, at the edge of the Inner Perivolos. It is constructed from several big upright slabs and bedrock pieces where presereved (height up to 0,8 m) and might have had an outer diameter of 2,5-3 m.

Round Structure Type 2 – variation

A variation of the second type of (aboveground) round structure in the Tsivi South area can only be hesitantly described because of the rareness of its occurrence (Sites 91,183, three alltogether). It involves aboveground structures of a larger, less well built/less preserved kind, with inner diameters of 5-6 m (Site 91, two cases, Figure 30) and 4 m (Site 183, Figure 31) that have a superficial similarity with an *aloni* (threshing floor), except for their size[49] and the fact that threshing floors are always built level whereas the Minoan ones are too small (183) or sloping (91, both). Many of the stones used are oncolithic. Only the inner faces are (partly) preserved, and show several stones with more or less upright appearance (hence they might belong also to a special kind of enclosure, the only structures using upright stones otherwise, cf. above, masonry 2.B.1-c), which is the reason they resemble modern threshing floors (Figure 32) that are built with an edge of often upright slabs to keep animals and worked material in place. Both cases are

[49] Threshing floors of the kind used since late antiquity need to have a diameter large enough for animals to circle around inside it (with or without a tribulum), i.e. at least 6 m.

situated relatively close to the dwelling ruins (183: 6 m, 91: 30-40 m). There originally may have been an outer face to the walls, too (see figures 30, 31).

Figure 30: Site 91. 91K1 – *aloni*-like Round Structure, diameter ca.6 m.

Figure 31: Site 183. 183 K – *aloni*-like Round Structure, diameter ca. 4 m.

Figure 32: Modern (abandoned) *aloni* re-using (left) a length of the perivolos of Site 70B.

Half Round Structures

Built like round structures but only in half are the additions to several dwelling ruins noted here. As with the rest of the ruins, none of them looks or is positioned exactly like the other, their diameters ranging from 4-6 m (sites 24C, 53, KA9, KA14). It is unclear if they were added later or built together with the angular parts of the ruins, may be they are just not quite successful structures of type 1 or 2. A half round structure that may have been round originally (as it is not directly attached to the visible dwelling ruin – but that may be a taphonomical problem) can be seen at Site 189. (Cf. the drawing of Site 53, Figure 9 in Ch. II b A 4 below).

D. Ruins – Enclosure walls/Perivoloi

1. General

Minoan enclosure walls similar to those studied here have been called *perivoloi* and described as a kind of circuit wall in the vicinity of a Minoan site by Tzedakis et al (1989, 1990). As the term "enclosure" is in archaeology often *per se* seen as part of a fortification system (Parkinson and Duffy 2007) and thus is already assigned more or less to a certain interpretation, here the Greek word *perivolos* shall be used mainly[1]. The term is especially suitable, as *perivoloi* in the Tsivi South area often constitute full peripheries, enclosing areas between 7000 sqm (350 m long, Site 21D) and over 230.000 sqm (2,1 km long, area shared between Site 168 and 179). This kind of circuit wall shall be addressed here as "Outer Perivolos". Several fully preserved (in length, not height) cases surrounding Minoan sites, together with their typical masonry[2] prove their dating to be the same as the dwellings. The way they are juxtaposed not just surrounding sites but also in many cases next to each other in a way as to leave space for paths/roads inbetween adds to the argument that they belong to the Minoan system of structures.

Especially interesting is the fact that in areas where Minoan settlement is most systematic[3], *perivoloi* are like boundary walls with shared use[4] between two neighbouring sites, much like in a honeycomb. Exceptions to this rule are (with few exceptions) only the mentioned cases where Minoan roads (see below) pass between two *perivolos* areas: here the space for the road is left open between two *perivolos* walls (Figure 1), each of which can be attributed to one site only. This feature suggests an amazingly well planned concept of the whole settled area, otherwise functioning access to each site from the through roads would never have been feasible (a well known problem in recent Crete).

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[1] In the sense as it is known in Greek as "wall around a piece of land". Note that Tzedakis et al also give a defensive interpretation to the *perivoloi* they describe (1990 passim).

[2] For detailed perivolos masonry styles see above 2.B.1: Double-row, double faced oncolithic walls with occasional cross joints where tie-stones span both faces of the wall. See also 2.C – Wall Identification.

[3] See example areas Pateragiorgis (Kritsa) and the wider Tafos-Asfendamous area (Kroustas), Ch. II d 4 Land Use.

[4] Which might have meant shared building activity as well.

Figure 1: *Perivoloi* 44C (right) and 44D (left) flanking a Minoan road.

Figure 2: *Perivolos* between sites 20 and 23 with typical fallen material.

Perivolos walls are between 0,7 and 1,2 m broad (Figure 2) - one small part of a base even 1,5 m (Figure 3) - and stand in some places up to 1,2 m (Figure 4). Fallen material in situ (cf. Figure 2) suggests that mainly the bases of the walls were oncolithic, whereas upper layers also used rubble (*perivoloi* are usually built with stones the larger the closer to the dwellings).

Figure 3: *Perivolos* between sites 74 and 59 at its broadest spot (1,5 m)

Figure 4: *Perivolos* 44D south-east, lining a Minoan road, seen from outside (on the Minoan road). Stick 0,9 m.

The original appearance was probably similar to the way *perivoloi* look like when still/again in use (Figure 5). Preserved widths, together with the fallen material, suggest an original height of

1,2-1,5 m[5] . The inclusion of bedrock parts in *perivolos* walls and the way they have been built from the bottom up (visible where they are cut by modern road construction, Figure 6) in combination with the level of the dwellings and roads suggests that neither were their foundations sunk into the earth nor was the surface much different from what it is today. A further suggestion to the same conclusion comes from *perivoloi* passing winter runoff-valleys (*chimaroi*) and colluvial valleys.

Figure 5: *Perivolos* between sites 141 and 142, still in use as boundary between two plots of land. The rubble layers are re-constructed or recent.

[5] Dry stone walls can only be built to a certain height related to their width: A wall of 0,8 m width can't be built higher than 1,2 m (cf. Hylton 1984: 487). Most of the *perivolos* bases are 0,8-1 m broad at their base meaning a maximal height of 1,5 m.

Figure 6: *Perivolos* 132-123 uphill, cut by modern bulldozed cartrack (not visible below). Bedrock parts included.

In the latter case the *perivoloi* have often kept soil from being washed downhill (cf. Figure 7), even though in these cases modern soil levels usually reach the upper preserved layer of walling and thus the walls look like terrace walls. If one deals with a *perivolos* or not in these cases can only be determined by following the *perivolos* on its whole circuit and just mapping its exact course. Especially in longer valleys the view perpendicular to the valley's direction often just shows layers of terraces (of usually indeterminable age), and only following the *perivolos*' course as a whole (by seeing it from walking on top of it) can decide which is which[6].

Apart from the outer circuit walls (Outer Perivoloi) there are also various smaller wall ensembles of various shapes within these, here called Inner Perivoloi (more below). The size of the *perivoloi* varies greatly, but when calculating the available arable land within, most sites fall within the range of a certain minimum amount (more details in Chapter II d 4 Land Use).

[6] Excavation might show a difference: While *perivoloi* are two-faced, probably terrace walls were constructed only with one (downhill) face.

Figure 7: *Perivolos* KA 13 east passing a colluvial valley like a terrace wall, nearly invisible (but note the upright stone in the foreground, typical for *perivolos* construction). Distance from dwelling site: 200m.

2. Outer Perivoloi

For this study ca. 150-200 km of Outer Perivolos wall-length has been walked[7]. The enclosed area of all measured *perivoloi* (those known as full areas, that excludes those only known in part) can be determined as of ca. 7 sqkm. This area of fenced land can be attributed in mostly clearly defined plots to 160 of the known in the area 335 PP sites. Many other *perivoloi* are known at least in part and suggest that probably most or all sites originally were equipped with one. An exception may have been some of the sites on the edges of the settled area (Sites 4, 28, 49 C, 89, 135, 181) which might possibly have taken the outer wall as unnecessary for some reason[8].

Perivoloi surround amazingly different plots of land, from extremely rocky to well arable. Still in most cases a certain minimum of arable land is provided: Even if in some cases a

[7] The actual built amount of *perivolos* wall-meters is difficult to judge because many of the single walls (separating two distinct *perivolos* areas) belong to two sites and are thus accounted for twice. The actual walking distance during my study naturally was much larger as many walls (especially those not too well preserved) had to be walked several times and in several directions to ascertain their position on the map.

[8] E.g. because they installed themselves later than the others (which might be determined by a detailed pottery study).

site's *perivolos* area is much smaller than the neighbours', most sites' arable land is fairly distributed (see example Table 1). On the other hand (with few exceptions that should be borne in mind for any interpretation) neither the amount of arable land nor the dwelling ruin sizes seem to occur in a replicable defined proportion to the *perivolos* sizes (Table 1 and 2).

Several *perivoloi* were seen without a visible dwelling ruin in the surrounded space[9], but with several sites relatively close together in neighbouring areas, e.g. sites 21 - 21B - 21F - 21G – 21H (see Map 1) and the 99-Sites, or several sites densely together in one larger *perivolos* (the 24-Sites, see Map 1). In this case the dwellings seem to have shared in some way several plots of land, while each of the dwellings seems to have held additionally a specific Inner Perivolos, delineating their respective spaces. Also, several sites are positioned in a kind of small "pocket" that looks like a "projection" of their *perivolos* into the neighbouring *perivolos* area (22B, 200[10]). The identifiability of *perivolos* walls is inversely proportional to the distance from the dwelling sites: the further away from the dwelling they surround, the less visible *perivoloi* become, while the closer to the dwelling the larger are the stones [11]. Often they are integrated into recent/modern fieldsystems (mostly as terrace-walls, sometimes covered with layers of recent walling) and wouldn't be recognizable at all if they were not traceable as part of a whole enclosure by following their line from the better preserved to the less preserved parts (Figure 7). It is important to note here that traditional survey methods are ill suited to determine the course of *perivoloi*, especially where they are not well preserved. Even the experienced eye often cannot recognize traces of a *perivolos* if not looking at it from the right angle that can make the slight pattern clearly perceivable. In cases of weathered parts of *perivoloi*, experience and patience are of advantage to detect the continuation of the wall course, as e.g. (depending on the surrounding landscape), *perivolos* traces are sometimes preserved only in the shape of conspicuously non-natural steps in slope-shape, where soil eroding downhill has (nearly) covered all traces of stone construction.

[9] There are also a few examples of "siteless" *perivolos* areas apart from these explainable ones. If they did or did not have a dwelling originally cannot be determined, neither a ruin nor pottery could be seen inside (a very careful intensive survey might change that).

[10] In the latter case the existence of Site 200 B in a more central position of the *perivolos* area might explain why Site 200 dwellers wanted a clear distinction of their own space.

[11] In several cases – e.g. Site 73 – the otherwise nearly totally overgrown ruin could only be detected by very close scrutiny, following the hint of the consecutively increasing block size in *perivolos* construction in that area.

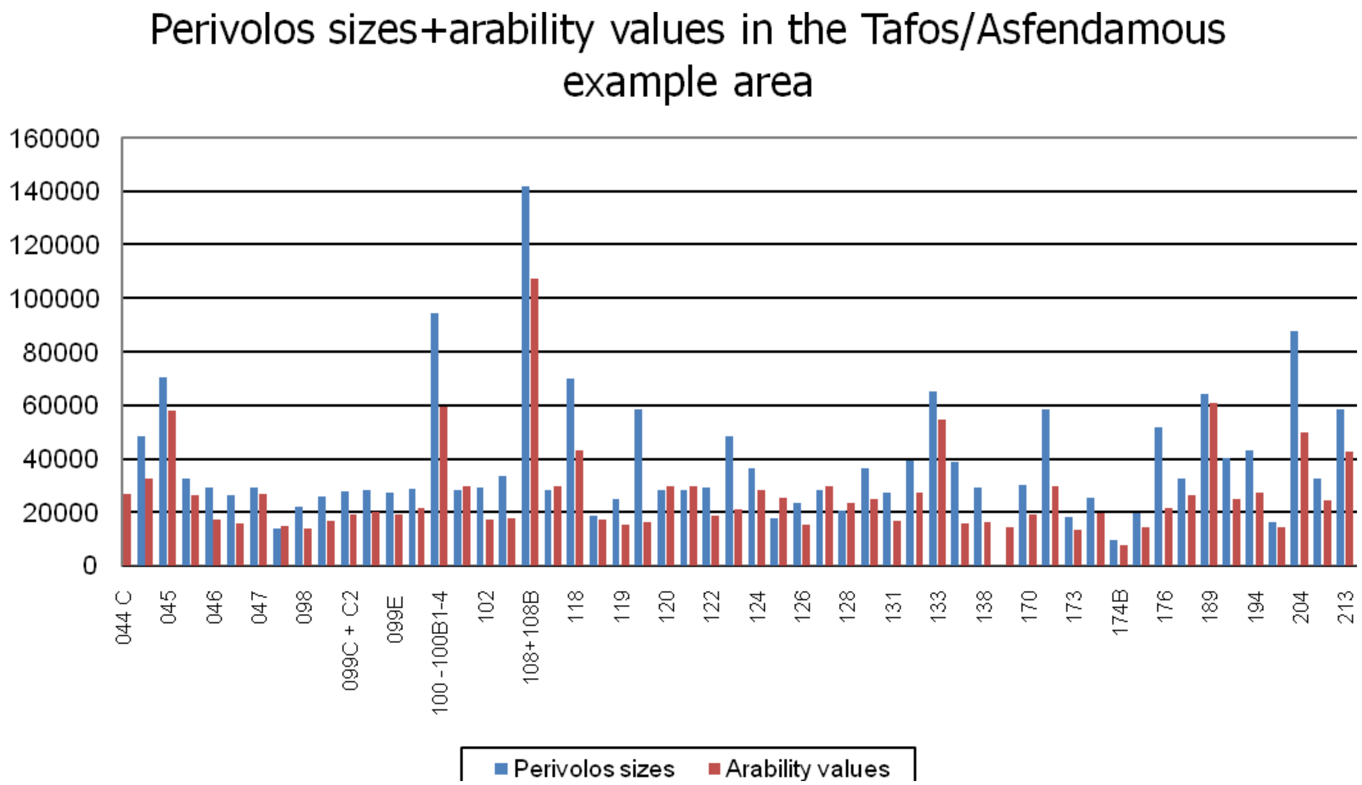
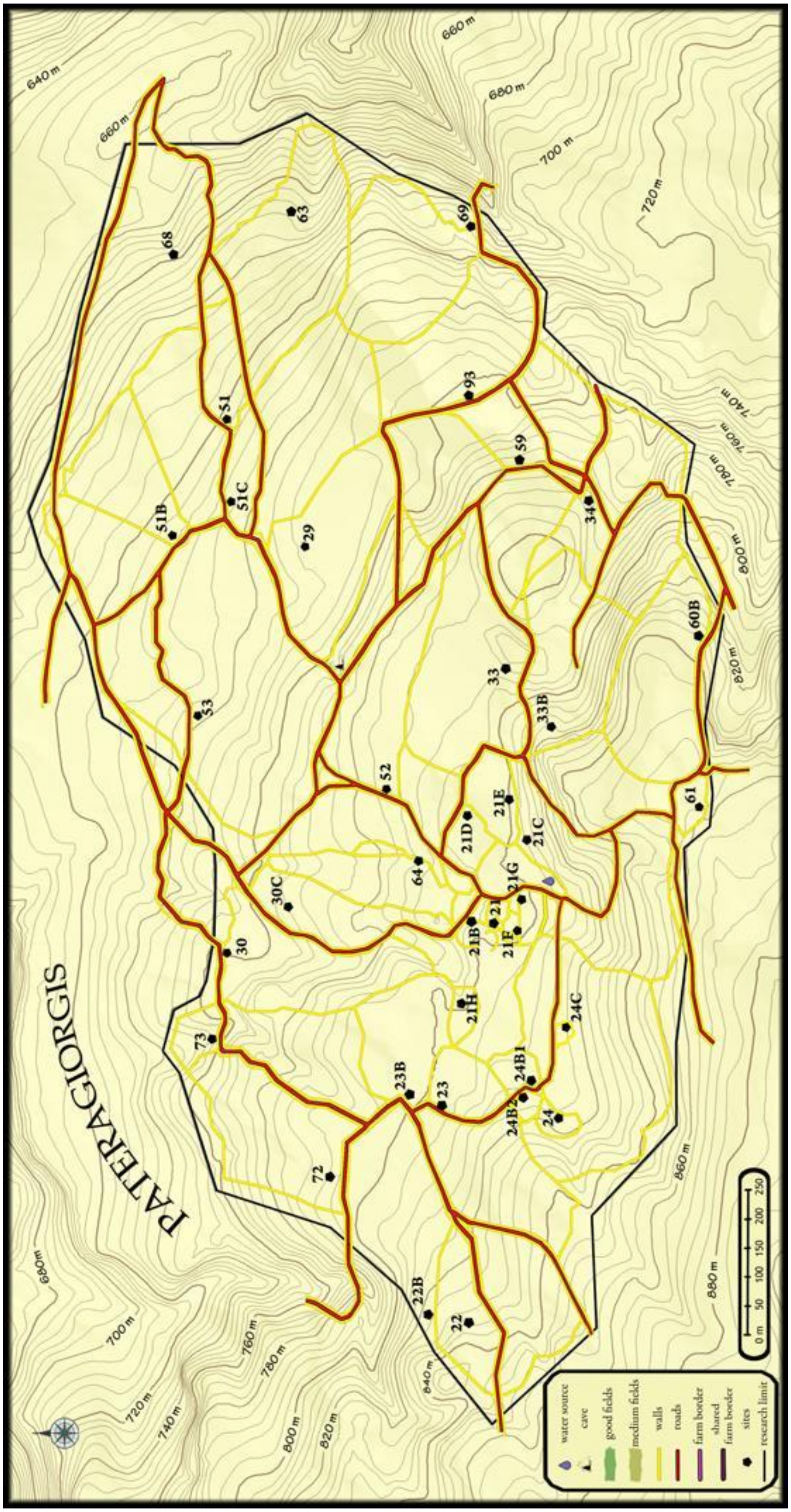


Table 1: Perivolos sizes relative to their arability values (see Chapter II d 4 Land Use for details).

Aerial photographs or satellite images (of high resolution, best under one 1m/pixel) often make traces of *perivolos* walls recognizable, either by showing shadows[12] or the conspicuous dark line of plants growing slightly more pronounced in the protection and better humidity conditions right next to the *perivolos* wall ruins, as next to walls the amount of dew can be three times larger (Krusche et al.1982: 52/53). Also the *perivoloi* protect the soil behind against erosion (cf. Grove & Rackham 2001: 110) – until today successfully, as many recent fields still existing within the BA walls prove.

[12] When the Google Earth image of the study area was changed from a photo taken in summer to a newer one taken at the end of November, the long shadows of this season made an amazingly large number of *perivoloi* visible, cf. Figure 8.



Map 1: Pateragiorgis intensive study area (black border) with all detected BA walls (yellow), and roads (red) where spaces are inbetween. Site areas 21 and 24 lower centre.

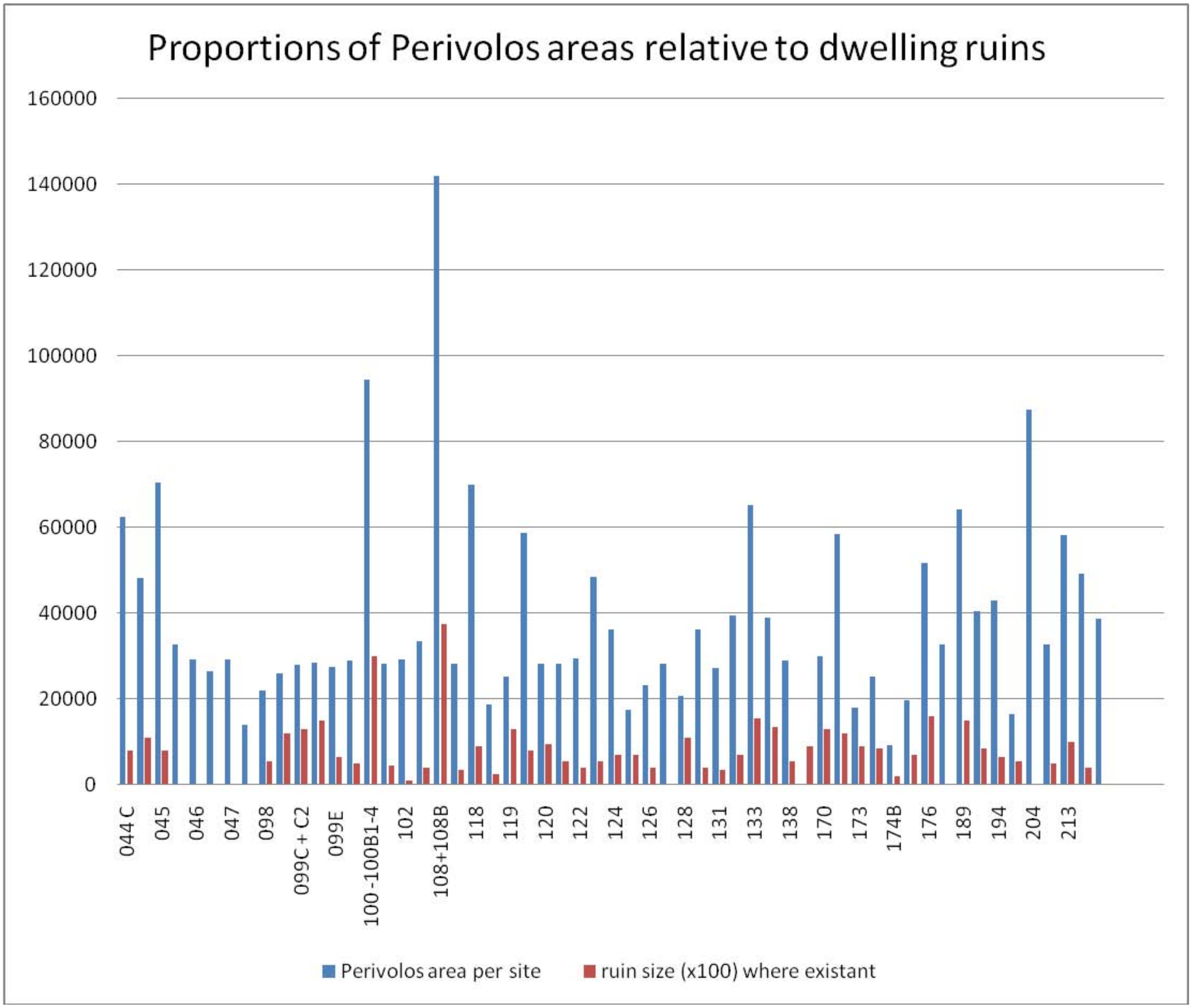


Table 2: Sizes (in sqm) of *perivoloi* in relation to the respective dwelling ruins in the Tafos/Asfendamous example area (ruin sizes multiplied with 100 to make them visible in the graph). Note Site 108's values here and in Table 1.

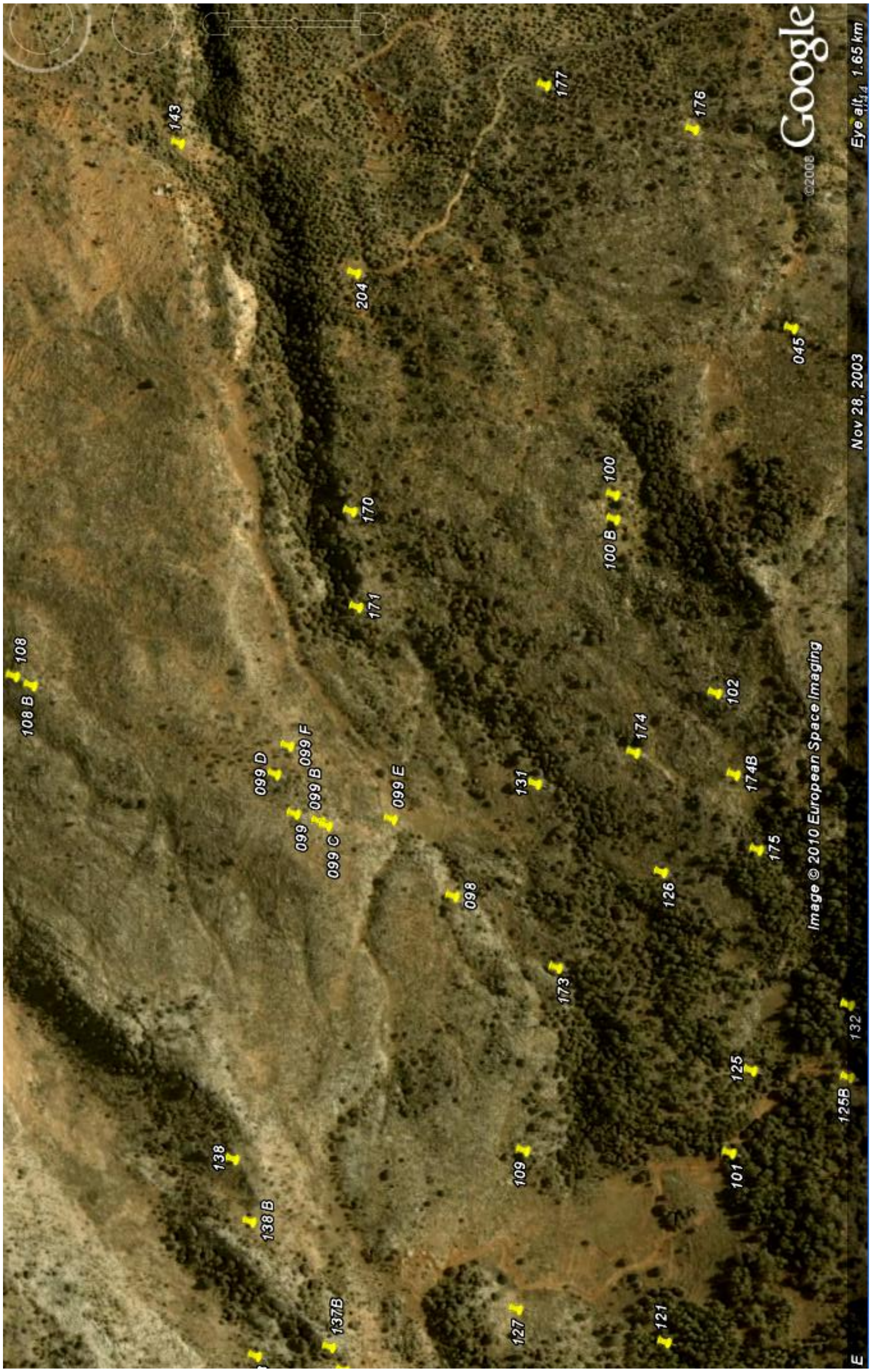


Figure 8: Google Earth image of the Asfendamous area (99 to 108 sites and to west/left of them), marking traces of *perivolos* walls by their shadows. There are no modern walls in this area.

By the amounts of stones of remaining fallen construction material often preserved on both sides of *perivolos* walls, the original height can be estimated to 1,2 - 1,5 m as mentioned above. Thus they must have made it possible to keep animals in or out: For sheep usually 1,2 m are enough, goats may have needed a higher wall or an extra layer of thorny twigs on top (cf. the Odyssey-citation in Chapter II b 1), a technique still in use today in the area of the Tsivi South sites (see Chapter I b D).

All in all Outer Perivoloi could not just form a boundary and hold the soil, but protect fields within from drying out and from strong winds (10% less wind means a 15-20% larger amount of precipitate)[13], as well as keep animals out or in, thus giving their "owners"/holders control over and better conditions for the enclosed area.

3. Inner Perivoloi

Within the Outer Perivoloi can be detected various shapes and sizes of Inner Perivoloi, built with the defined above (2.B.1) masonry walls and obviously belonging to dwelling ruin sites with Minoan pottery. Inner Perivolos parts are not always easily to be told apart from the actual dwelling ruins, because similar masonry would have been used for roofed and unroofed structures. Width and preserved heights are similar to those of the Outer Perivoloi. An Inner Perivolos shall be set apart here from simple or random terrace walls (that need to be perpendicular to the slope, with the ability to hold back soil and often several in parallel lines to be called such, Figure 9: dashed lines with slope signs). Inner Perivoloi show corners or curvatures always either in closed independent shapes (oval, square, mixed, for oval cf. example in Figure 9: Red dotted line) or in some connection to the dwelling ruin (beginning and ending at or near the dwelling, Figure 9: Blue dotted line). A good example is the perfectly preserved Inner Perivolos of Site KA19 (Figure 10), with its various inner compartments including two lengthy oval enclosures, a Round Structure (top right in the image) and various squarish compartments.

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[13] Walls or hedges result in 50% less wind within a distance of 8 times their height (i.e. within over 10m behind a wall of 1,3 m height, Krusche et al 1982: 52/53) – important points in a windy mountain area.

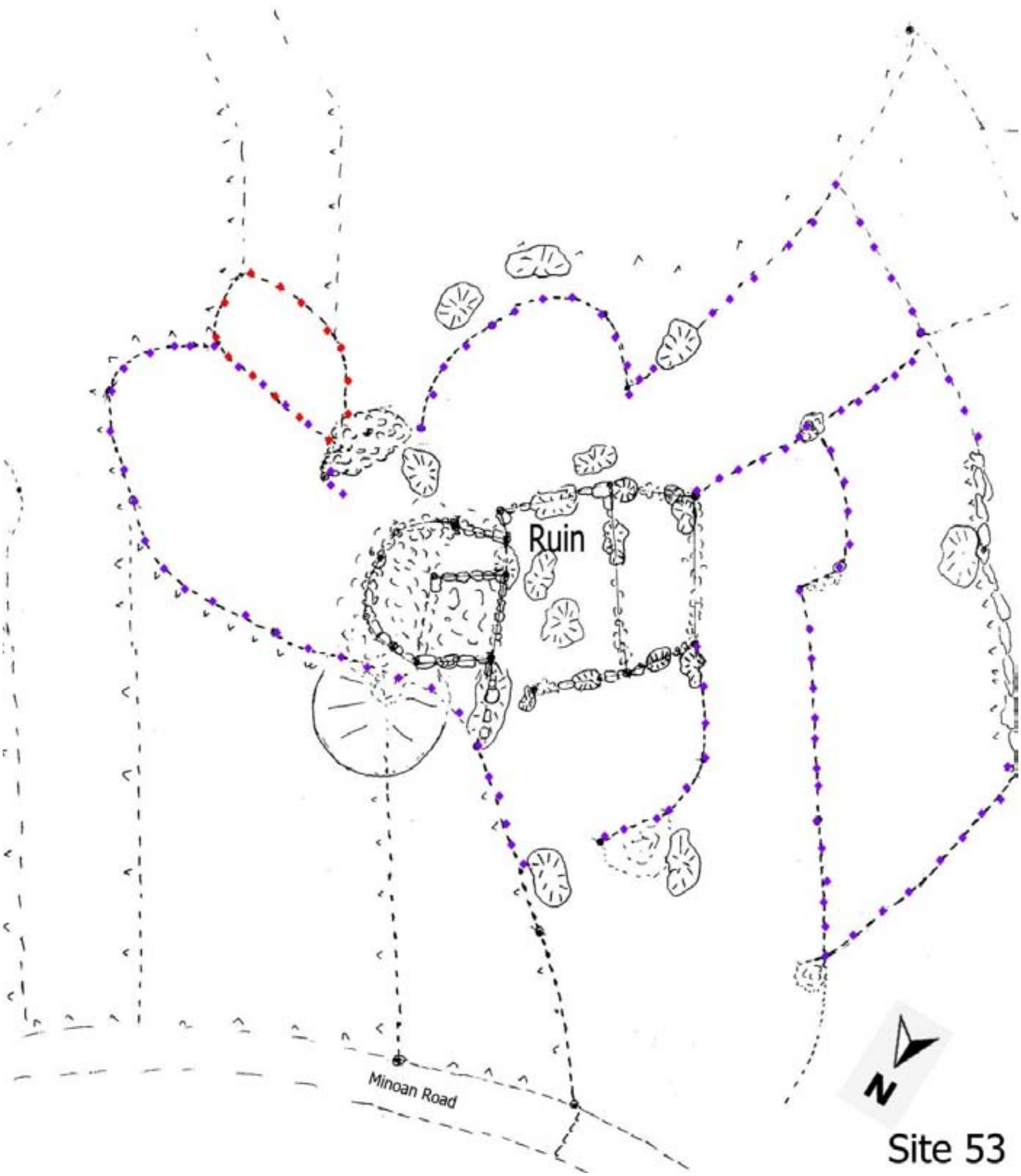

Figure 9: Site 53. Site plan with surrounding walls, road and terraces. red dotted line: closed Inner Perivolos; blue dotted line: connected Inner Perivolos; black dashed lines with slope signs: terrace walls. Note the half round structure on the east side of the angular dwelling ruin ("Ruin").

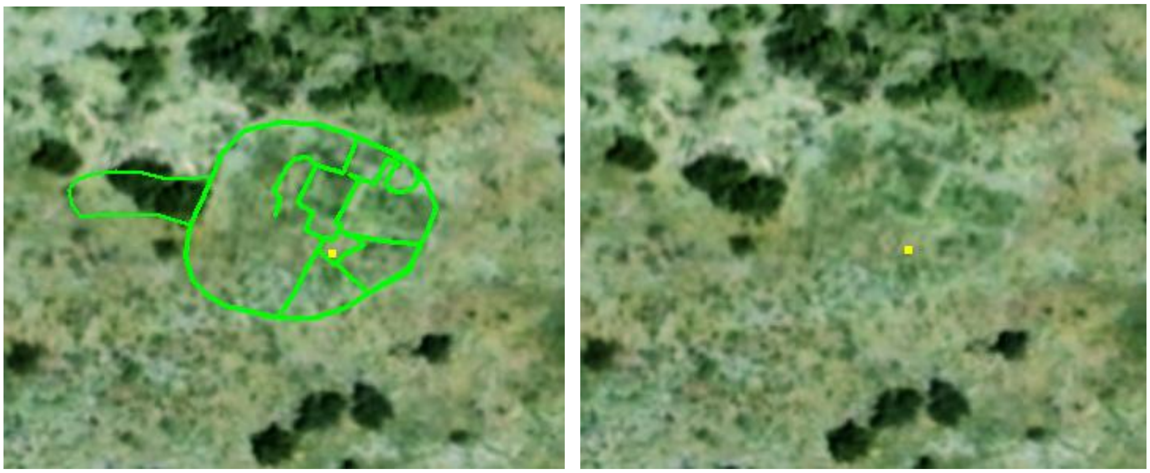

Figure 10: Site KA 19 and the intricate walls within/at the Inner Perivolos (max. diameter of the oval 43 m), drwaing left. The satellite image shows parts of these walls (right). Dwelling ruin in the centre (above the yellow dot).

Most of these are close to the dwelling sites, but may be up to 30 m distant, as in the case of the very unusual oval closed Inner Perivolos built in large parts with upright slabs SW of site 38 (Figure 11)[14].

Figure 11: Site 38 closed Inner Perivolos 30m SW of dwelling ruin built mainly with upright slabs and bedrock, showing the western part of an 8m long, ca. 5 m wide oval.

One peculiar variety of connecting Inner Perivolos are the irregularly coursed ones surrounding the edges of small hilltops or outcroppings with dwelling sites, stabilizing them at the same time at an even height, like a balustrade. Depending on the topography, some of these are still preserved to several courses, e.g. Site 46, 46B, 210, 211 (Figure 12).

[14] But compare above the type 2 special cases of round structures that also contain (much smaller and only sporadically) upright stones.

Figure 12: Site 211 seen from SW, the outcrop with the ruin (under the large pine) surrounded by an Inner Perivolos like a balustrade on the steep side.

One case of an otherwise unknown kind of Inner Perivolos occurs within the *perivolos* area of Site 61, on its far northern end and closer to Site 33B (ca.50 m SW and uphill). It forms an oval built *perivolos* partly passing over the edge of the cliff overlooking the Pateragiorgis plain, with one possible opening (or entrance?) on the eastern side (Figure 13). On the inside of this probably originally double-faced wall (bad preservation of faces) including several patches of bedrock, mostly tiny pieces of Minoan pottery can be seen. At some spots there may have been small rubble based structures like lean-to’s on the inside.

Figure 13: Inner Perivolos in the NE corner of Perivolos 61, seen from south. Blue dots mark the perimeter (ca.18m).

E. Ruins – Roads

1. Background to the investigation

“Όδαί δέν ὑπάρχουν καί ἂν συναντήσετε τοιαύτας, ἐξάπαντος θά ἀνάγωνται καί αὐταί εἰς τήν ἐποχήν τοῦ βασιλέως Μίνωος, ὅπως καί τά ἄλλα ἐρείπια”.[15]

Daily Paper *Empros* 5-4-1910: 3 (about a visit in Knossos)

Minoan roads early on had captured A. Evans’ interest (Evans and Myres 1895), and he returned to the subject in the second volume of the “Palace of Minos” (Evans 1928-1) when he had been looking between Knossos and the south coast for what might have been left of the Minoan trade route over which the many Egyptian artefacts found in Knossos might have been transported (Evans 1928-1:60 and following). He uses the term “road” more or less synonymously with “track”, looking at main natural passes and lines of passage without actually expecting to see archaeological traces of built roads (Evans 1928-1: Paragraph 35: “Transit Road”). When he believes to be certain, e.g. at Archanes, he writes of the “course of a Minoan road-line – the boulders of its outer supporting terrace black with age and exposure […] with traces of steps at intervals” (Evans 1928-1:66, 68), reminding him of the roads he had seen years before in the area of Lasithi and to the east (ibid.). The fact that he passed occasional Minoan sites with pottery along this route confirms his view. Hence to him a Minoan road is basically a track connecting Minoan sites and providing a plausible passage over large areas of land (see the map

[15] „Roads do not exist, and if you see some anyway, they certainly have to be attributed, too, to the period of King Minos, like the other ruins.”

Evans 1928-1:70)[16]. Basic Knossian roads (e.g. under the NP "Viaduct") are dated to the Protopalatial period (ibid. paragraph 36, esp. p.102) and given with typical widths from 3.80 m to 4.30 m (ibid.:71).
A similar hypothetical approach (under the heading of "spatial analysis") to "Potential Minoan transit roads" is still applied with various additional modern geophysical methods used by Siart et al (2008:2923, fig.4)[17].
In other urban contexts, first roads in Gournia (Soles 1979:151, 155) and Malia (Effenterre 1980: 257 sq., given with widths of 0,5-4 m: 258) were also dated to MM I-II.
Roads in a non urban area (the Minoan Roads Project of far east Crete) are described by Tzedakis et al (1989:49-50) thus:

"La route est tracée sur le sol rocheux sans nivellement préalable, à moins que le rocher qui se trouve dans le tracé de la route ne dépasse excessivement le niveau du sol et gêne la marche (en général les parties saillantes de moins de 0,40 m sont laissées mème au milieu du tracé). La route suit la pente du sol de façon égale. Les sections rectilignes de la route alternent en formant des zigzags. Les murs de soutènement sont en même temps les limites de la route. En règle générale, seul le mur extérieur est vraiment appareillé. Pour la limite intrieure, l'amènagement du rocher suffit souvent "

Minoan roads in the Malia area are described by Müller (1991: 545-546):

"Ils consistent essentiellement en deux rangs de pierres parallèles, formant les bordures de la chaussée, conservées sporadiquement le long du trac (fig. 2). La distance entre eux varie entre 1,60 et 2,00 m. Ces bordures apparaissent de deux manières différentes selon les endroits : soit comme une rangée de blocs grossièrement équarris et dressés de chant, soit comme un muret a double parement fait de petits blocs irréguliers, large de 60 cm au maximum (fig.3 et 4). Il n'y a pas trace de pavement, ou kaldérim, entre les bordures. [...] Par endroit, le rocher affleure au milieu de la chaussée."

2. Minoan Roads in the Tsivi South area

The first question to be addressed here is: What is a "road"?
Definition
A road is "an open way (generally public) for travel or transportation"[18].

This "open way", consists here of two basic constituents: The width of the space of the way and its margins boarded by walls (as described above, 2.B).

Various road widths shall be classified here thus:

Road Type 1: ca. 2-3 m (two loaded donkeys can pass each other). This road has nearly always two built shoulders, and is sometimes later re-used as *kalderimi*. These roads are always long through roads, connecting the area to outer regions and many sites with others. Its original older track can sometimes be seen (in short sections) as running parallel or close to the later versions of the road, as e.g. on Pateragiorgis (Figure 14, 15). Often patches of pavement (rubble) seem to have existed, mainly in very rocky areas to level the road surface.

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[16] These are named "grands axes" by Tzedakis et al 1989:49.
[17] Although the effort (and expense?) of these methods don't seem to be warranted for these, as the outcome is very similar to Evans' approach of simple logic. As mountainous regions only have few possibilities for "transit roads" to pass, those that exist have remained along the same tracks since antiquity.
[18] From: http://wordnetweb.princeton.edu/perl/webwn?s=road

Figure 14: Satellite image of part of Pateragiorgis (Google Earth) where the Minoan road (with blue arrows) and the later *kalderimi* run parallel in north and east, then the *kalderimi* turns to west while the Minoan road continues to southwest. Both met again at Site 22 (not visible). The dark lines are the shades of the *perivoloi* flanking the road (image taken end of November with slanting light that emphasizes shades).

Figure 15: Minoan and later (*kalderimi*) roads running parallel near Site 23B (see satellite image above). The Minoan road runs here between two *perivoloi*, where part of the right (north-west) one has been destroyed by using material for the later road to the right (north-west) of it. View to SW.

Road type 2: ca. 1-1,5 m (one loaded donkey can pass a human). This kind of road has sometimes built shoulders, especially in sloping terrain, where the lower shoulder would be built, the upper just cleared. These roads may be through roads, but can be seen mostly connecting sites (Figure 16). Sometimes they seem to be cul-de-sacs (which might be a problem of visibility). Pavement is rarely visible (mostly as small rubble: Figure 17).[19]

Figure 16: Road type 2 connecting the N part of Pateragiorgis (near Sites 30/30B) to the cisterns area (passing Site 52 further S). The wall on the right is a perivolos, also holding soil in the small colluvial valley uphill.

[19] Cf. Müller 1991 for such a road in the Malia area.

Figure 17: Road type 2 (1,2 m broad) SW of Site 54. Rubble paving raises the level of the road above the surrounding terrain.

One also might assume the existence of a Road type 3: 0,5- 1m (one loaded donkey or human can pass), but there is no clear archaeological evidence for this kind of path because there are no shoulders except in terrain where the track would be disrupted following landscape recesses. Thus these smallest roads are hard to pinpoint as they look like mainly just cleaned from rocks tracks used by passing animals. Those conjectured to be Minoan are cul-de-sacs, leading to one dwelling ruin only (Figures 18, 19), but many such paths exist in the area that may not be ancient.

Figure 18: Probable Minoan road type 3 below Site 62 (site still in use as *mitato* and *mandra*)

Figure 19: Probable Minoan road type 3 between Sites 39 and 40, possibly ending at 39.

None of the roads ever strictly follows one type: Type one roads can reach widths of 4 m in places, but even smaller roads become larger in places, and their shoulders more explicitly oncolithic close to sites (Figure 20).

Figure 20: Site 58 B (dwelling ruin bottom right) with the road passing between double oncolithic shoulders.

E.g. next to Site 51 the road (Type 1 to 2 further off-site) runs in a space between two *perivoloi* of even more than 4 m[20]. How broad the actual passage was in this space is unclear, though. Another example can be seen north of Site 52, where three road-branches come together in an open triangle (with a side-length of ca. 45 m) formed by three *perivolos* walls (52 east and west, 53). Where exactly in the open space the road(s) passed is difficult to tell, but probably along the *perivoloi* walls as stones collected for building them would have left the best open space for passage right along the *perivolos* walls (Figure 21).

[20] My warm thanks to Prof. Vance Watrous for sharing his knowledge about this site and its road with me.

Figure 21: Road type 1 (width 3 m) between *perivoloi* 52 and 53, *perivolos* walls in background opening to form a triangle (from W).

A map of part of the Asfendamos/Tafos example area gives a rough impression of the various widths of roads in the landscape (Figure 22). Many of the smaller Minoan roads are preferred passages for animals which keeps them more visible than might be expected in a quasi wilderness.

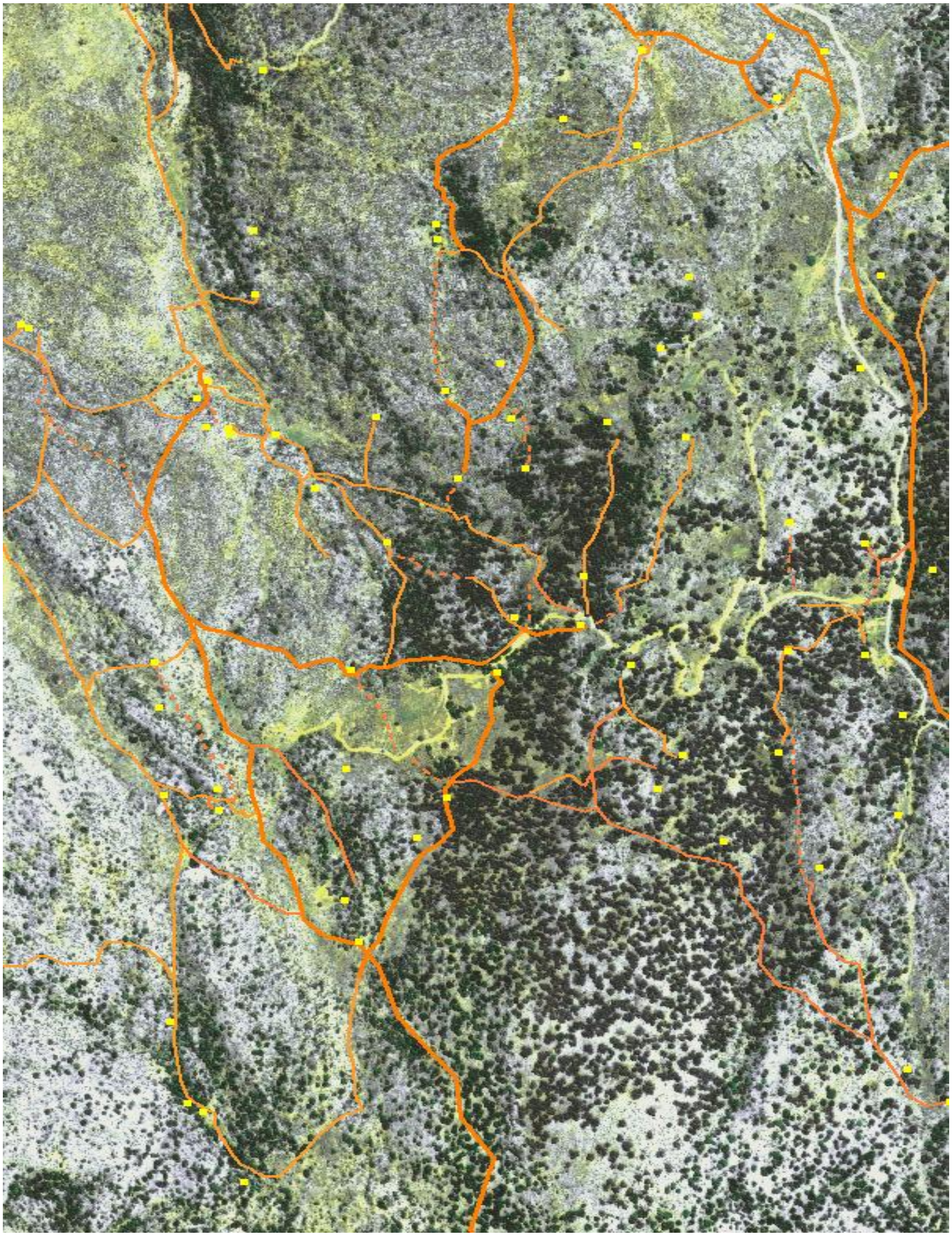

Figure 22: Asfendamous/Tafos area, central part, with various widths of Minoan roads on a Quickbird satellite image. Uncertain parts dotted.

2. Built Structures - Topography

In the survey bibliography of the wider area, descriptions of sites and their local surroundings are treated in various ways. Haggis (2005 : 89 and 90-148) uses in his headings "minimal topographic information" like "foothill", "mountain", "inland plain" and gives details on "topography and architecture" within the text of each entry of his site gazetteer. Hayden (2005, Site catalogue on CD by Hayden, Moody, Rackham, Stallsmith) gives a "brief description of topographical setting and landforms" (Hayden et al. 2005 CD: 2). In the entries for each site details are given, like the point of the compass slopes are facing, the inclination of the slopes at the site (in degrees), and a short variable description of the surroundings including geology, soil and vegetation (Hayden et al. 2005 CD: 3-201). Watrous in his Lasithi site catalogue (1982: 38-66) gives within the text of each site description brief information on the sites' position like "on the top of a low ridge" (55) or "occupies the top and southeast slope" (38) vel sim. For multiple period surveys these approaches are well established (cf. Gkiasta 2008).

While the whole area studied here lies on the south side of the high peak of Mt. Katharo Tsivi (1663 m), the landscape generally slopes to the East and South-East. Because of its karstic character shaped in many small valleys, dolines and troughs there are also all kinds of small north-looking and even a few west-looking slopes. Although there seems to be an endless topographical variability and sites seem to be randomly distributed in the Tsivi South landscape (see settlement pattern, below), Middle Bronze Age people obviously had a limited but clearly distinguishable spectrum of setting choices for building dwellings. *Perivoloi* and roads also show specific settings in the landscape. These choices are necessarily of great importance for any interpretation of site function and thus shall be presented in the range of data to be used for this end (see also Appendix D, Site Catalogue).

In general, topography should not just be seen as the direction buildings are facing or the kind of subfloor they are built upon, but as an integrated kind of mixed artefact, in the "composition" of which humans chose their structures to be set. What comes to mind as possible factors influencing such a decision is mainly an interest in the surrounding land for agriculture and exploitation of natural sources, but also intervisibility of sites with each other, the visibility of known landmarks like the peak-sanctuary of Thylakas[1], the landmark of Pano Kastellos[2], possibly large sites/towns on the coast (e.g. the Minoan centre under excavation by the Irish School of Archaeology at Priniatikos Pyrgos, Kalo Chorio[3]), or even the sea and coast as such. (Details see in the Site Catalogue).

[1] See Ch. 1. Although the main finds were dated after the first exploration of Thylakas to phases between 750-250BC (Reinach 1913, Bates 1914: 97), a close look at surface pottery nowadays shows a small but decisive amount of Minoan PP material, too. The author saw there coarseware, but also the head of a bull figurine made of the same fabric.

[2] Also mentioned at times as possible peak sanctuary (Nowicki 2000, citing Rutkowski 1986 and Nowicki 1987), but finally classified as "defensible settlement or hamlet" (Nowicki 2000:126). A small excavation conducted by Nowicki and Davaras in 1986 revealed on the hilltop only LM III and EIA material (ibid.) and the site is seen as part of a wider defensive system in the area (for the EIA Kastellos cf. also Wallace 2000:80). A second, older scatter (MMI-II) also mentioned by Nowicki seems to belong to a site in Nowicki's "area C" (2000:126 – the one-building visible ruin of which isn't mentioned by Nowicki, it has traces of oncolithic walls) on the lower SW slope of the hilltop.

[3] See http://www.priniatikos.net/ (last accessed: 11/5/2010).

Often factors un-quantifiable from a modern perspective may have been of importance, like the availability of certain plants at the time of settlement (like, e.g., trees for resin production in recent times), as well as aesthetic or even magical/religious criteria[4].
The quantifiable factors given in the site catalogue are several, only a few of which shall be discussed here in detail, as e.g. facts like the intervisibility between sites and other landscape features, closest neighbouring sites or recent buildings don't need further explanation (see Site Catalogue, entries “View/visibility” , “Neighbouring known sites”, “Closest recent buildings”)[5]. These factors were determined by observation and GIS[6].

Especially how site positions have been chosen in relation to landscape formations is of interest, and should always be seen in the context of factors important for Crete and this special area, like prevailing winds (see below). Differences in micro-climate (especially when seen comparatively with coastal areas) caused by the changing amount and direction of sunshine, may also have been of importance. In this area the general incline to the East, together with the height above the sea and thus lower temperatures in general, produce a pronounced difference - especially noticeable in summer - of insulation that results in lesser parching of soils here than in level areas close by like the valleys of Kritsa or Lakonia or the coastal plains.

A. Spatial organization and settlement pattern

Island-wide intensive settlement expansions occurred in the PP period and nucleation seems to have been the main tendency for settlement pattern in urban and non-urban areas (Schoep 2004: 262, citing Watrous et al 1993; Watrous 1994, Müller 1996, Tsipopoulou 1999, Watrous et al 2000, Driessen 2001, Haggis 2001, Watrous et. al. 2004).

That there was also a tendency to dispersal (Haggis 2005:70[7]) probably depends on the explored area, as e.g. Haggis’ dispersed sites are described to be in agricultural catchment surroundings (Haggis 2005: 70, 71), and there as well as in the Vrokastro area sites seem to have been clustered around perennial springs (ibid., Hayden 2004:95). Especially the dispersed PP sites on the high slopes above Malia should be mentioned here (Müller-Celka 2003) that might, at a closer look, have been similarly organized as the Tsivi South sites[8], especially as in both regions springs seem not to have been of the overall importance noted elsewhere and cisterns were often built instead (Müller-Celka 2003:467, for the Tsivi South cisterns see above Ch. II b A 3-C).

[4] Difficult to judge is the often amazing aesthetic quality of site-positions that many times caused the author to think: What a wonderful place! What a great view! *vel sim* - sentiments - as reactions to an also un-quantifiable fine distinction or rather the preference of a spot before others next to it - that are sometimes so intense even hardly traceable sites may make themselves noticed through them.
[5] It should be kept in mind though that factors like “View/visibility” in the Site Catalogue are often only suggestions as modern vegetation (especially in the forests) doesn’t always allow a clear assessment.
[6] Using a Garmin GPS receiver and the mapping softwares “Global Mapper” and “OZI Explorer”, cf. also Beckmann 2008.
[7] Haggis 2005 writes for the region of Kavousi near the coast of “dispersed houses and hamlets” but also of clustered farmsteads "within a roughly half-kilometer radius of a concentration of arable land and usually a permanent water supply […] Buildings were placed so as to minimize direct occupation of potentially cultivable areas" (71).
[8] While visiting the area in 2001 I saw several *perivolos* walls in the vicinity of the oncolithic PP sites described by Müller-Celka, the agricultural potential of which she didn’t recognize (Müller-Celka 2003: 467).

Compared to the sparse traces of settlement in earlier phases that can be observed in the area (in the Tsivi South region similarly as may have been the case in Malia cf. Schoep 2004:262), an obviously rather large group of newcomers settled the mountain slopes, most probably well over 1000 people[9]. Clearly the Minoan PP settlement expansion into the Hinterland known also from other areas of Crete (cf. Watrous 1982, Nowicki 1998, Haggis 1999, Hayden 2004: 93[10], Watrous et al 2004, Haggis 2005, Watrous et al. forthcoming b) took shape in a rather extensive form in this region.

Even though recently Driessen suspected: "it is indeed doubtful that, apart from some highland plateaux, occupation was anything more than sparse in the mountains" [in the Bronze Age] (2002:53)[11], and Rackham and Moody (1996: 93) stated "The upper limit of all-year habitation, with rare exceptions, is only 800 m", the situation in the Tsivi South region was obviously quite different: Over 330 Minoan sites were here installed with an average density of 165 m from each other over an area of at least 30 sqkm. The range between 100 and 200 m distance is the most popular, while distances range all in all between 30 and 500 m[12] (see Figure 1, map Figure 2). This is a clear case of dispersed settlement, with no nucleated centre, where density seemingly depends only on the availability of arable and especially browsable surroundings. While the Vrokastro region PP settlement tendency goes toward hilly areas between 400-700 m asl (Hayden 2004: 82) and the highest known Malia mountain sites lie at ca. 800 m, Tsivi South sites range mostly from 500 to 1000 m (Figure 2), with only a few sites (mainly those close to water sources) in higher areas up to 1400 m. The main demarcation line above which this settlement pattern begins is above and west of the (slightly rising from S to N) steep cliff of the fault edge west of Kritsa and Kroustas (Kritsa lies at its base, Kroustas on top, near the edge), where the landscape shows a sudden altitude difference of 100 m height within an E-W distance of 300 m.

[9] If calculating with moderate 5 persons per household the known dwelling sites would have housed 1600 people.
[10] Although there seems to be a connection of sites with springs in the Vrokastro area (ibid.)
[11] Still, on p.59, he notes that there must have been “a serious pressure on agricultural land in the coastal zones" as "abandoned or semi-abandoned inland areas are mostly re-colonized".
[12] Not counting the rare extremes of 20m and 670m.

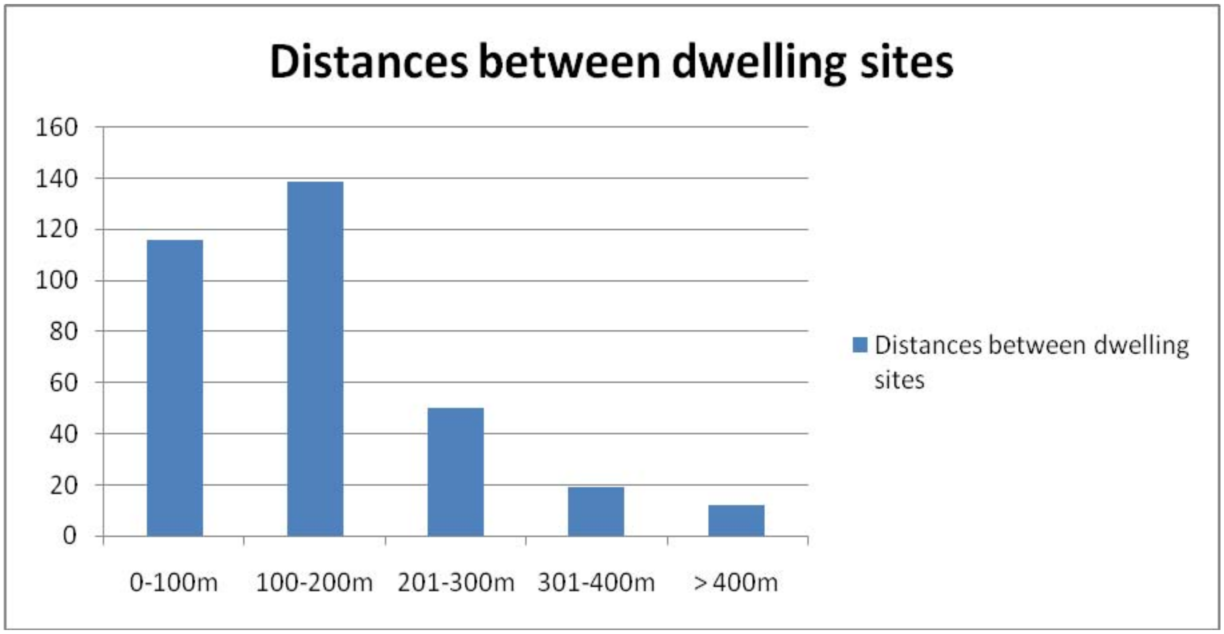

Figure 1: The most popular distances between site dwelling ruins in the Tsivi South area (n=336)

The few small areas where one might speak of a settlement "cluster" have still sites with clear distances of 40 m, surrounded each by built enclosures, and none of these areas resemble an agglutinative village in any way, although Outer Perivoloi seem to be shared here (Pateragiorgis, Stous Asfendamous, for more detail see below Ch. III a, "Land use").

Sites were well connected with each other and with the wider surroundings by roads (see below), the existence of roads and *perivoloi* in a systematic arrangement relative to the sites and each other were obviously extremely well planned and executed[13], probably in the beginning of MM II or even slightly earlier (for the chronology see Ch. II c I, pottery). Similar to the Vrokastro region where "no discernable hierarchy exists for sites" (Hayden 2004:93), in the Tsivi South area only very few sites seem to have been different from the average, either in dwelling size combined with area (within their *perivoloi*) size (e.g. Sites 100/100B and 108/108B), or in *perivolos* size only (e.g. Site 53)[14]. These sites could have been economically more powerful if only in terms of agricultural surplus.

Here, as well as in the Vrokastro and Kavousi regions (Hayden 2004:93) there seems to be no known "primary" centre from whence this expansion into the mountains may have originated, although recent excavations in the Priniatikos Pyrgos area, together with a well traceable route (preserved in parts as recent *kalderimi*) connecting the two regions, suggest the missing centre might be found there with future excavations. It should also be kept in mind here that settlement in the mountains above Malia shows a similar development at the same time (Müller-Celka 2003, 2004). Still it seems highly improbable that Malia could have been the centre for the Mirabello sites (cf. also Hayden 2004:93, 99,100), especially those in the

[13] In modern Crete non-organized building often leads to later problems with connectivity as systematic roadworks are made impossible, and (where extant) systematic road-planning is not respected by those building without permit (less in recent years, but still happening).

[14] These sites also have the relatively largest arable plots. Site 53 has a totally average size dwelling (for details see Site Catalogue and also below Ch. III a, "Land Use").

mountains. The Selena mountain range and the deep valley of Potamies inbetween would make it nearly impossible to control such a large area from a Malia point of dominion. Naturally there is always the possibility that another, until now unknown, "urban" centre existed, e.g. underneath Kritsa.

The dwellings' distance to sources of water (cf. Figure 2) are very variable, but never farther than 1,7 km of a current water source (if one also counts the probable Minoan cisterns, even the site furthest from water would have been at 1,2 km, i.e. much closer than many recent mountain dwellings). The area close to modern Kroustas (at the easternmost and lowest sites) might appear like far from water sources, but the existence of several wells in the village (although locals say they often dry up in summer[15]) could show the prerequisites for water sources (at least as a geological possibility) there also in the Bronze Age[16].

It is interesting to note that settlement density obviously did not depend on the easy availability of water as in Early Minoan times in the wider area (cf. Hayden 2004: 70) nor even, as mentioned above, on the closeness to water sources PP settlements sought in the neighbouring Vrokastro and Kavousi regions (Hayden 2004: 71; Haggis 2005: 70). Notably the earliest visible in this region sites (around Agios Ioannis "Sto Flej" between Kritsa and Tapes: EM I to EM III/MM I) are all situated relatively close to water sources that still have year round water nowadays (in the upper region of the map, Figure 2).

[15] With less intense use of water in the upper mountain regions and a slightly more humid climate, ground water may have been more plentiful in Minoan times also in the lower regions near Kroustas, although apart from the uncertain Round Structure at Site 142 no other could be seen in that area and possible water sources remain only the ones that are situated on top of the seemingly impermeable clayish layers underneath Kroustas.

[16] Otherwise the base of the fault scarp has the springs of the area, as at Theologos, in Kritsa and on another spot along the Kritsa-Kroustas road. Possibly the wells in Kroustas reach down to the top of the impermeable phyllite/clay stratum that reaches the surface further downhill elsewhere.

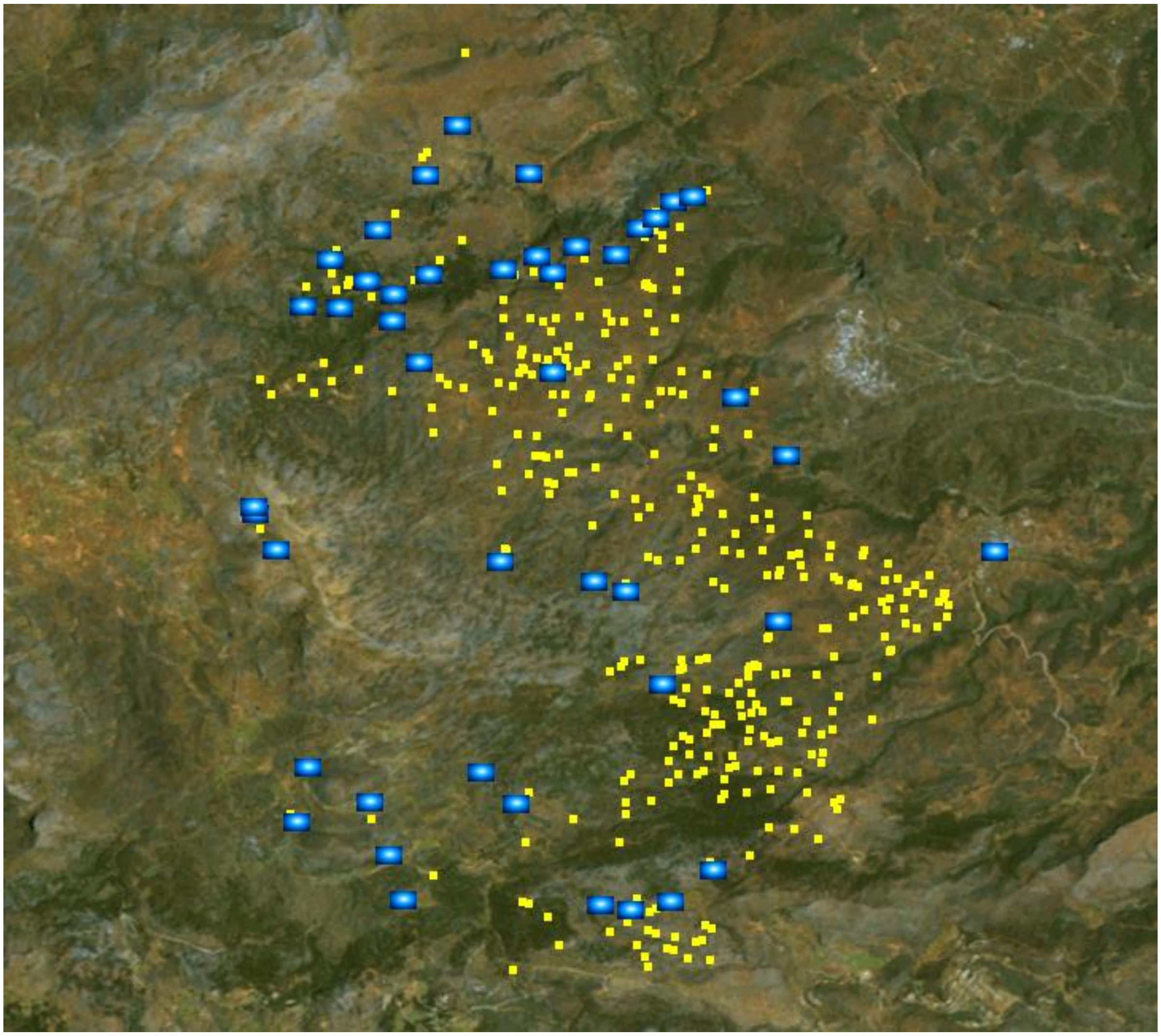

Figure 2: All known Tsivi South sites (yellow) with closest known water sources (blue)

B. Site topography – ruin topography

Analogous to the general eastern incline of the region, most of the 336 studied sites are situated on southeast and east facing slopes (165>49%)[17], followed by those who chose a more northeastern or northern direction (95> 28%). For reasons of simplicity these two positioning kinds are called Type 1 and 2 positioning in the Site Catalogue (Appendix D), whereas the others are given simple descriptive names like "plateau", "*langada*", "ridge-top" (see below for detailed typology and definitions).

In general, sites situated near higher south or south-east facing slopes to the north-west of the area, like those near or on the Katharo Tsivi main south slope (but also the KA sites in the lee

[17] Cf. the Vrokastro region, where 60% of the PP sites are north-facing, linked to the mainly north-facing slopes of the area (Hayden 2004: 94)

of the Xenogiorgos[18]) were notably less susceptible to winds (a fact that must have been of importance for topographical choices). For details see below: "position to wind".

Another interesting factor is the possible strategical position (i.e. position of possible military importance) of sites. As many of the terms chosen in the archaeological bibliography to describe sites with similar architectural features are of a somehow military character (see above, Ch. II.b. A 1), it seems necessary to refer in the topographical notes for each site to the specifics of its suitability as position of a possibly military function. This set of data ("Strategical Position" in the site catalogue) may also be interesting in combination with the sets "Access" and "View/Visibility". Statistically clear is the outcome of this account: 309 (92 %) of 336 Sites are Not Defensible, i.e. situated so that an attack could neither be foreseen nor be deflected easily because of the sites' location. Only 5 of the studied sites could be seen as "Highly Defensible", i.e. situated on a knoll-top or ridge-top with full surround view and difficult approach from all sides. The remaining 22 sites have some defensibility in being situated on a ledge or rocky slope that could be defended by a small group of people and has difficult approach at least from several sides (note that many sites are positioned on rocky ledges/slopes vel sim but still open to a possible attack from several sides).This seems to be a clear statement for the indifference towards defensibility that dominated the topography of the studied sites.

As a general rule dwelling positions were chosen so as to occupy the rockiest part of a plot that allows building upon (often in a slightly raised position), sparing every small patch of soil good enough for exploitation[19]. In rare cases a position of overview over a longer part of a main road could have been intended (e.g. Sites 23B, 32, 59, 95) but if this was for controlling the traffic on the road or e.g. for trade[20] or easier transport of goods or communication (for details see below) cannot be determined, and any naming like "guard station" vel sim. would even in these cases be an over-interpretation[21].

Sometimes the question of a site's agricultural catchment is of special interest. As an example one might mention the region Angastará near Kroustas. With several other sites there are Sites 163 and 165, set below (just protected from winds) the amphitheatrical rim of a large oval doline valley (Φ 100-180 m). Judging by their *perivolos* position it becomes clear that 163's and 165's fields occupied the surrounding terraces, not the colluvial doline bottom below. As a large part of this same colluvial valley bottom cannot be attributed to one particular of the surrounding sites by being included in its *perivolos* (parts belong to 164 and 154) the question arises if there might have been a special (or even shared) use of it in Minoan times (Figure 3). Unfortunately, as this area has been intensely used until today, taphonomical conditions are not as undisturbed as in many cases in the higher mountain areas, so no more detailed suggestions can be made.

[18] For placenames see appendix at the end of this chapter and maps in Appendix A.
[19] For a similar situation in the Kavousi area cf. Haggis 2005: 71, although in the Tsivi South region not only arable but also grazeable land is kept clear of buildings.
[20] Note that Site 32 was where a balance weight was seen, cf. Chapter II c 2, lithic finds.
[21] While for the 5 clearly defensible sites with a good surround-view such a term could be discussed.

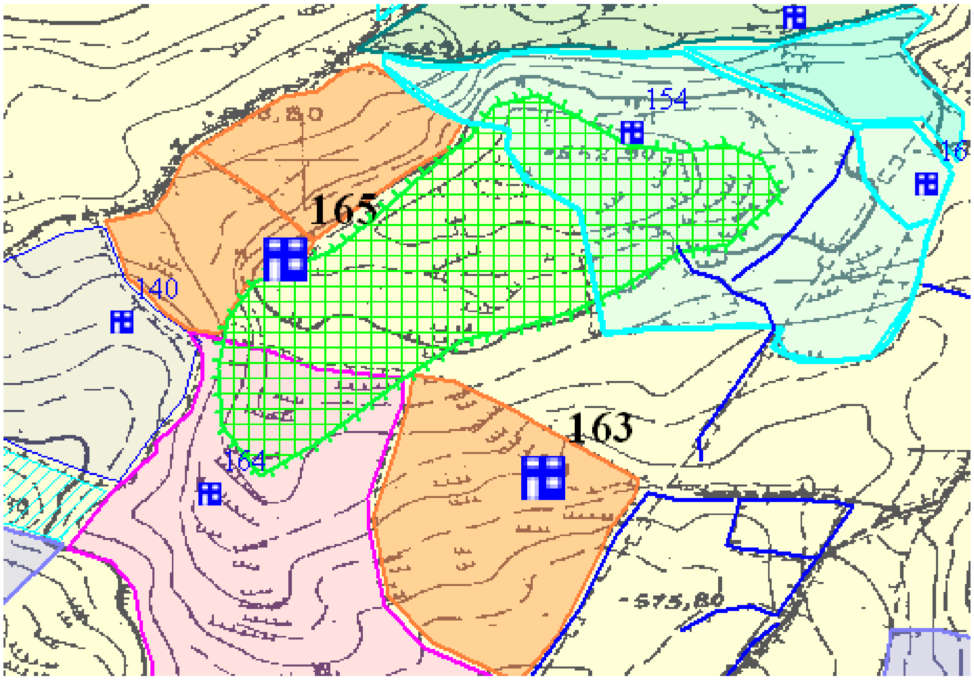

Figure 3: Angastará catchment (Site 163 and 165 *perivoloi* orange, both dwellings are clearly inside those, 165 close to the edge). Colluvial soil green hatch. Isoheights 4 m.

As at Angastará, the situation of the sites in the lower hill area close to Kroustas is generally taphonomically more problematic: Here most ruins are (compared to the often good preservation in the mountains) nearly invisible and *perivoloi* often obliterated with modern (re-)constructions and soil aggradation. It is obvious that sites must have been of a different character, though, especially in terms of denser positioning and much smaller *perivolos* areas (where clearly attributable). Much better agricultural land was attributed to much smaller enclosed areas: 1,2; 1,4; 2,0; 2,1 hectares, as opposed to mountain rocky sites with 3,5 to 6,5 ha. Although it seems that some ruins were originally of oncolithic architecture (this kind of stone does not easily vanish from its vicinity, while often the smaller stones must have been re-used for other walling[22]), the much better[23] arability of the area - the main reason for its continuing use - suggests that land use preferences must have been different from higher mountain areas in the Bronze Age, just as is the case now.

For positions similar to Angastará but with other kinds of catchment attribution, various cases may be mentioned where sites sitting on rims or slopes of colluvial dolines have well enough preserved *perivoloi* and thus can be clearly attributed to these good fields as catchment, for instance Site 128 (Figure 4).

Generally it is clear that due to the existence of the *perivoloi,* catchments can very often be much more clearly (if not to say definitely) attributed to sites than is the case in usual surface surveys. For more detailed information on the possibilities of catchment evaluation see below Ch. II d 4, “Land use”.

[22] Architecture in this region may have been less oncolithic as a whole.
[23] This doesn’t necessarily mean easier, as soil here, too, is often collected in small patches that must have always been tilled with a hoe, not a plough as many of the mountain fields.

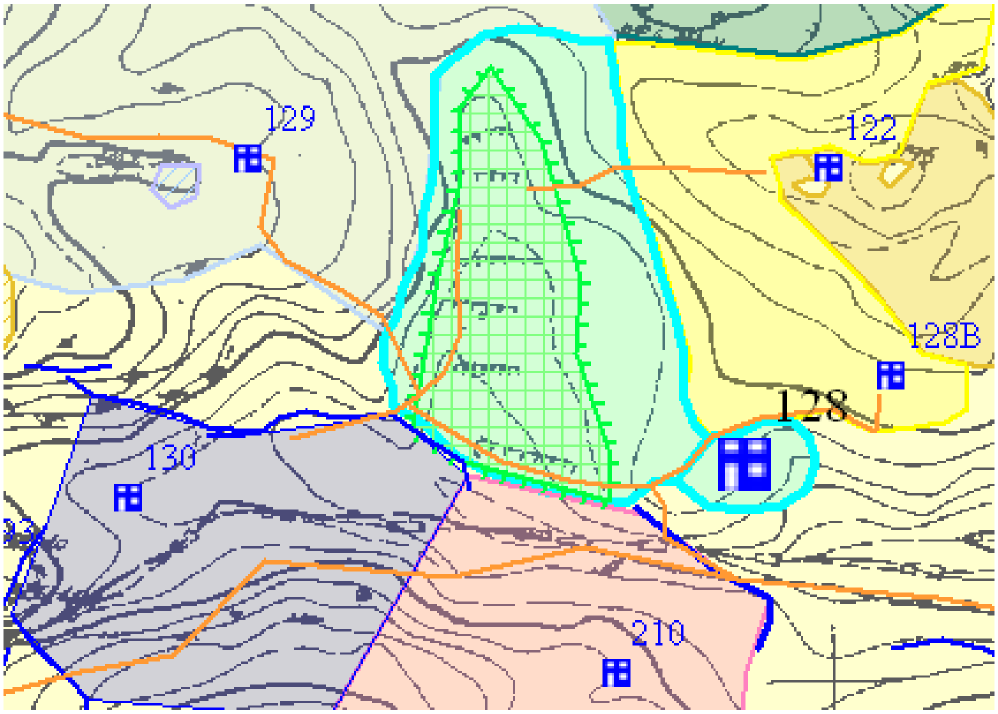

Figure 4: Site 128 (turquoise) catchment. Note that the site's inner *perivolos* sits on the slope with the site, whereas the main *perivolos* encloses the colluvial valley. Orange lines roads.

Additionally it should be mentioned that the Minoan installations of the area rather seem to follow the lines (and protection) of the landscape than any interest in special cardinal points or astronomical directions. Further information on that can be found in the Appendix C "Ruin shapes", where for all ruins with a traceable shape a north arrow is given, too.

Topography typology:

Type 1 (164 of 336 sites – 49%) : On southeast and east facing slopes.
Type 2 (96 of 336 sites – 28%) : On north and northeast facing slopes.
Two sub-types: A) Less than 200 m from a slightly higher rise to N-NW;
B) 200-400 (rarely 500) m from a high slope to the N-NW[24].
At/on a "plateau" (25 of 334 sites – 7%) or "small plateau" (8 of 336 sites – 2 %): Situated in an area with little gradient, usually with less rocky and larger (in sum) arable plots.

In the Tsivi South area these "plateaus" are always small and uneven/ sloping. For instance the largest plateau (central Pateragiorgis) that houses on its "plain" and edges 19 known sites, spans heights between 785 m (Site 52) and 835 m (Site 22) within an E-W distance of ca. 750 m, i.e. a slope of not quite 7% gradient. This is still slope, but compared to the rest of the area it is nearly horizontal overall. The central 500 m E-W with 15 sites (21- 23- and 24-sites in the "Sternes" clusters) lie within 20 m of horizontal difference (cf. Figure 5), even though there are small rises and troughs within that distance.

[24] In rare cases the distance is larger: Several sites on the foot of the high rise of Katharo Tsivi, e.g. Site 54, 70, 70B: ca. 700m. Note that these are protected from strong winds by slight rises on all but the N sides.

Other sites occupy a “small plateau” (i.e. a rather flat area) of their own, e.g. Site 56 (Figure 8) and 93. Only the “small plateau” housing sites 149-150-151-151-152B has (now?) larger amounts of soil aggradation. The region of Pateragiorgis has mainly many smaller pockets of colluvial soil around slightly higher rocky ledges/knolls the sites are built on/at.

Interestingly, in three of the four in the studied area extant larger "plateau" regions, sites situated along the edge or on rocky parts of these "plateaus" show a system of “shared” perivoloi. These are: Pateragiorgis Sternes: 21, 23 and 24 –sites and their *perivoloi* respectively (Figure 5); Koufalotos Lakkos: Sites 101, 109, 120, 121, 127 (120 is situated above the "plateau" in a side-langada[25]) (Figure 6); Sta Chonaria: 42–sites (Figure 7)[26]. Sites occupying a "small plateau" do not show any *perivolos* anomalies.

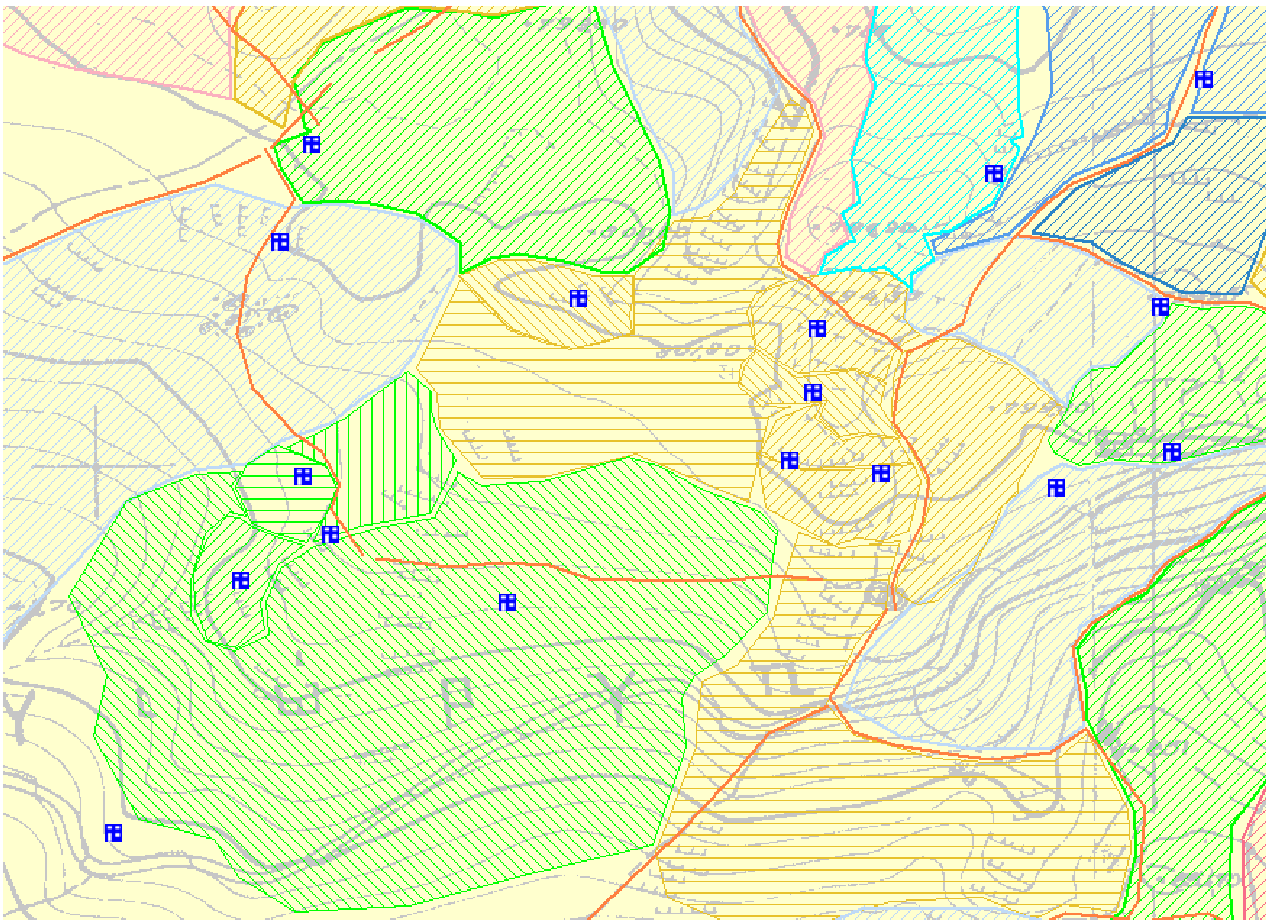

Figure 5: Central Paterogiorgis “plateau” area (“Sternes”). Ochre *perivoloi* are those shared by five of the sites (Site 21, 21B, 21F, 21G, 21H), the large green *perivolos* to the left is shared by four sites (24-24C). Inner *perivoloi* are clearly attributable.

[25] This situation might suggest that the *perivolos* closing off Site 120's *perivolos*-area from the others' (south of the site where the langada opens into the more level area) is buried in colluvial soil, and hence the site does not belong to the “*perivolos* sharing group”.

[26] Although here the perivolos situation cannot be decidedly mapped because of the intense recent re-use of the area, the extant perivolos parts suggest a similar set-up. An interesting situation with a somehow comparable segmentation of siteless land-lots in *perivoloi*, with respective sites at the edge of the adjoining slope are the 99-Sites (see CH. III a “Land Use”). This area is not exactly a “plateau” but much more level than its surroundings.

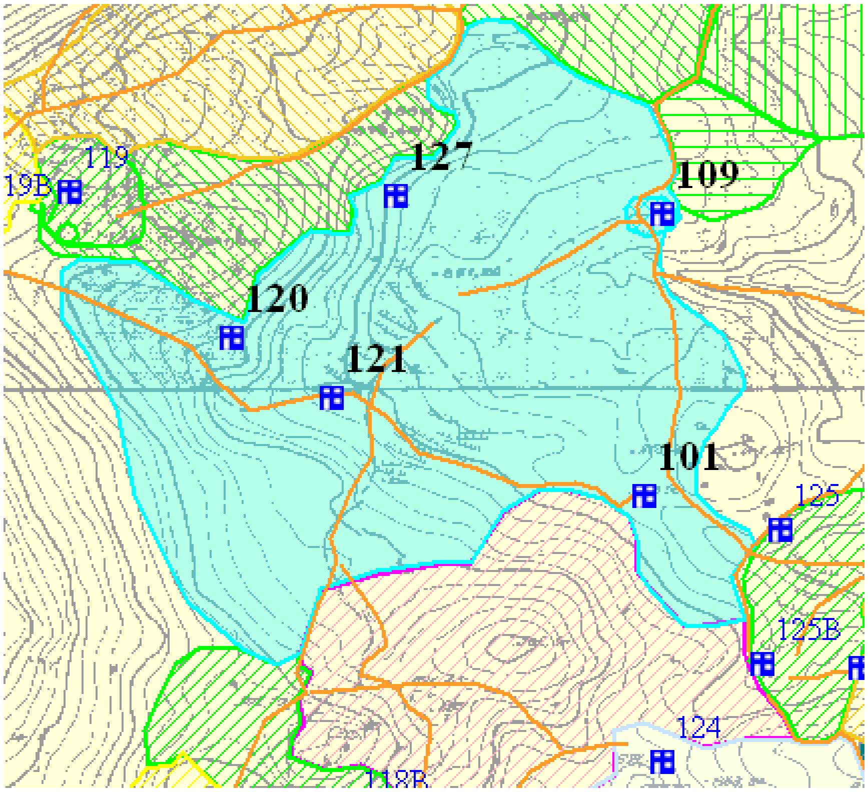

Figure 6: Koufalotos Lakkos "plateau"-area with the large *perivolos* shared by probably 5 sites (turquoise). Of these Site 120, in a small side valley, may have been separate and its southern *perivolos*-wall lost to erosion/aggradation of the valley's SE lowest part.

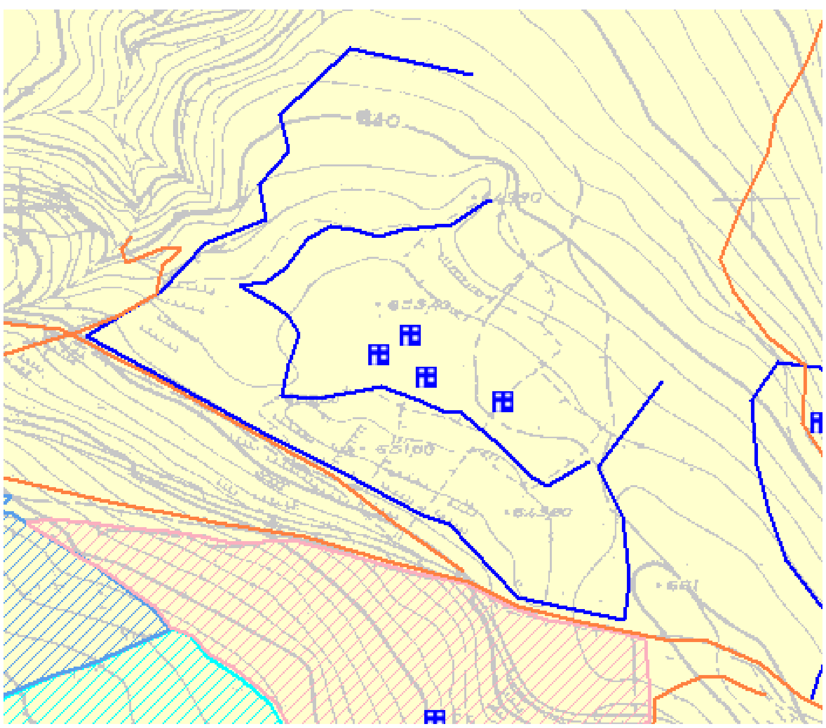

Figure 7: Sta Chonaria "plateau" with the 4–site-cluster and the unclear to the NE *perivolos* situation. Some kind of shared system seems clear, though.

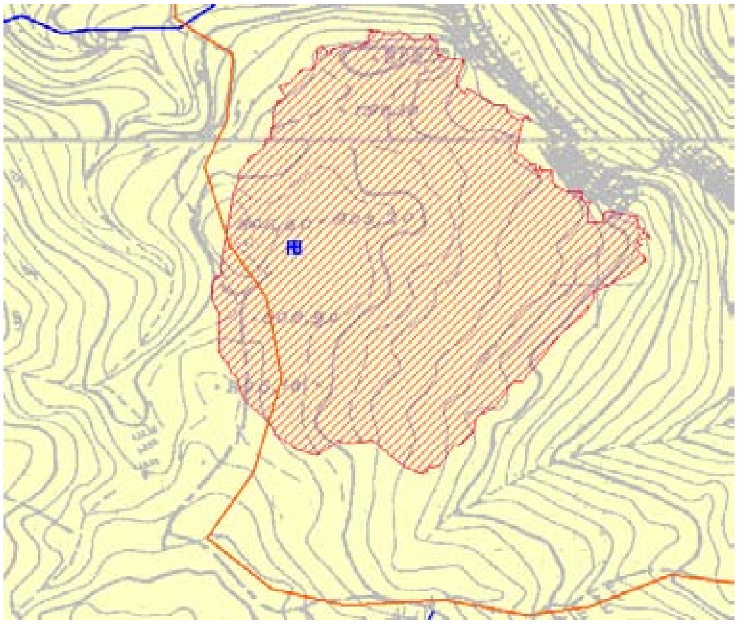

Figure 8: Sti Mpémpeli "small plateau" area with Site 56 (orange: road).

<u>Langada/Lakkos</u> (20 of 336 sites – 6%) : On the steep slopes of small karstic depressions or runoff-valleys (*langades or lakkoi*). Because of the closed-in by steep slopes position these sites are mostly independent of wind-directions. Thus it doesn't seem amazing that several of them face directions that sites in a more exposed region usually avoid (e.g. facing directly towards the main cold-wind-direction N-NW) (Figure 9, Figure 10).

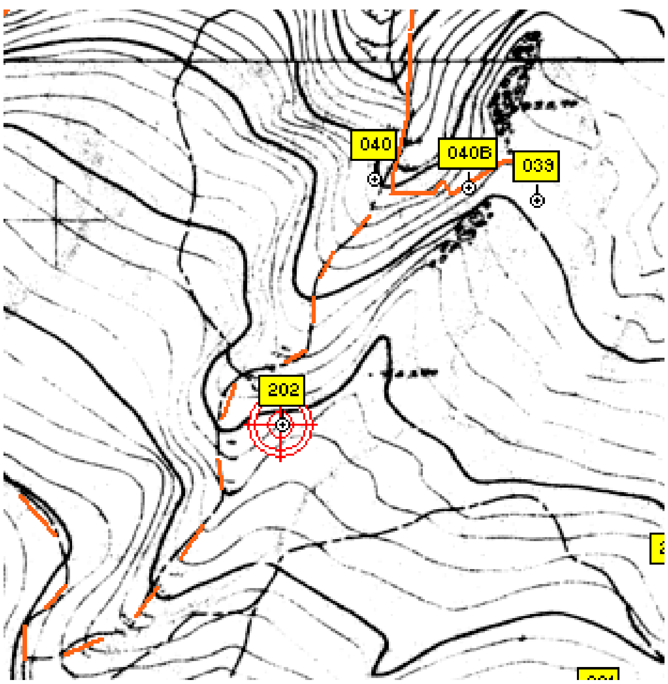

Figure 9: A typical runoff-langada with Site 40 facing N, 40B N-NW and 202 N.

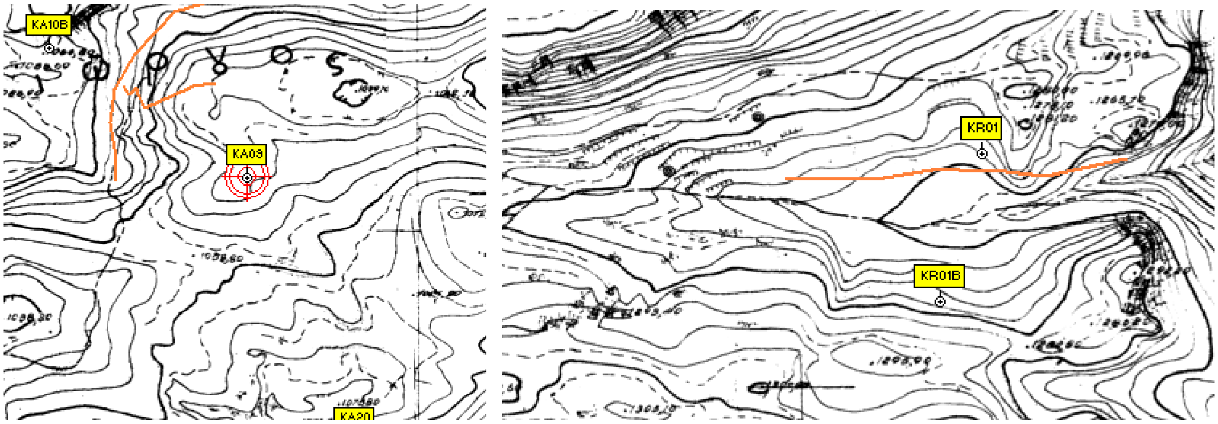

Figure 10: Left: typical doline-lakkos with site KA09 facing N-NW behind a high rise. Right: High mountain langada Stsi Ringous (with intense runoff-erosion) KR01B facing N protected to W and KR01 protected to all sides by close-by slopes.

In a <u>saddle</u> (5 of 336 sites – 1,5%): On or near the lowest point between two higher rising slopes. These positions can obviously be connected with road control: Site 1B (on the connection routes between Tapes- Katharo and Kritsa-Katharo); Site 3 (on the Tapes-Katharo route), Site 43 (on the Tapes-Pateragiorgis route), Site 101 (on the road connecting the Kroustas N and Kroustas S to mountains routes, Figure 11, cf. also Figure 6, SE corner), Site KA08 (on the pass connecting Kroustas forest and Pano Kaminaki areas).

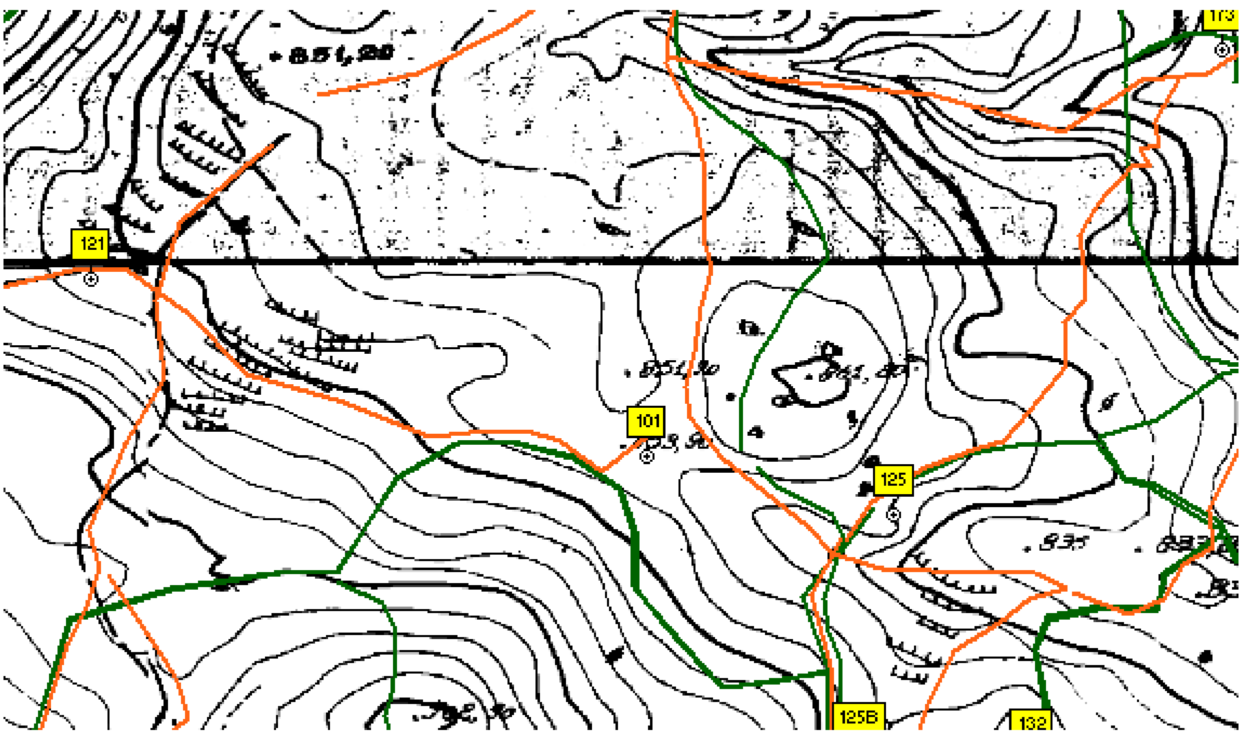

Figure 11: Site 101 in a saddle position at the entrance to Koufalotos Lakkos (green lines *perivoloi*, orange lines roads*)*.

At/on a <u>ridge-top</u> (4 of 336 sites – 1%): On or near the highest point between two opposite downgrade slopes. Only 2 of those sites are actually on top of the ridge and thus see at least part of both sides of the respective ridge (sites KA10 and 180, Figure 12).

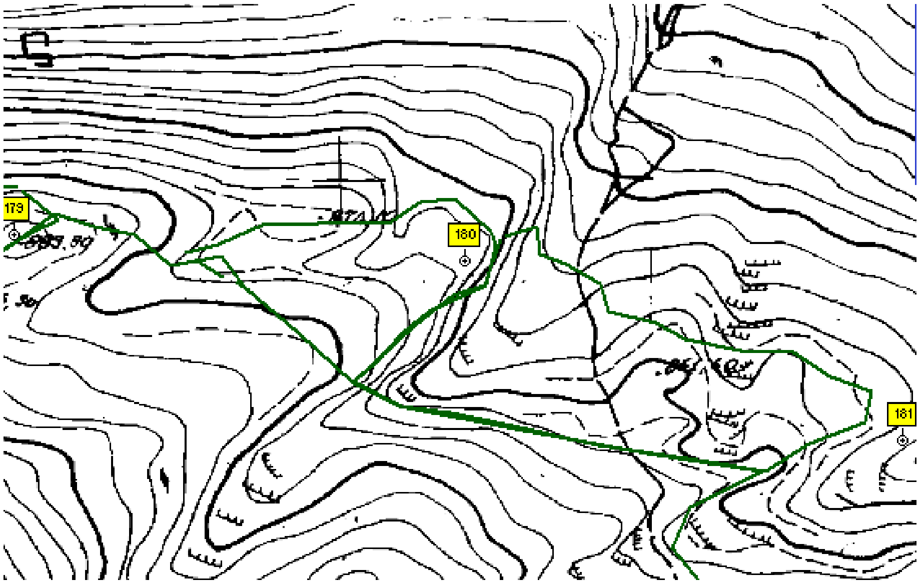

Figure 12: Site 180, positioned on the lengthwise highest part of a ridge (i.e. seeing both slopes to E and W). Green *perivolos* walls.

At/on a knoll-top (4 of 336 sites – 1%): On or near the highest point in all directions. 46 and 46 B (within 100 m of each other, Figure 13) are 10-15 m higher than the surroundings, KA 05 is only ca. 4-6 m higher, like Site 148. (Still in the catalogue under defensibility they have been entered as "high defensibility"). The dwelling buildings were (as far as visible) set slightly to the S-SE of the knolls.

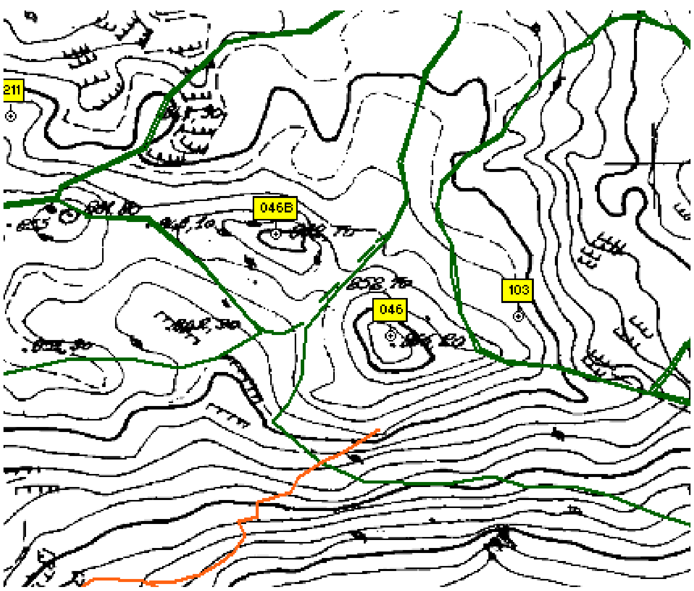

Figure 13: Two of the four extant knoll-top sites, 46 (Fortezza) and 46B (90 m distance).

This small number makes obvious how much all positions on hilltops or heights were actually avoided in the Tsivi South area[27]. Figure 14 gives a three-dimensional example of how sites are typically set, Figure 15 a panoramic view of the way this can actually be seen in the landscape.

[27] Cf. also Hayden 2004:346 about PP sites with massive architecture in the Vrokastro area: "none are in a particularly defensive position".

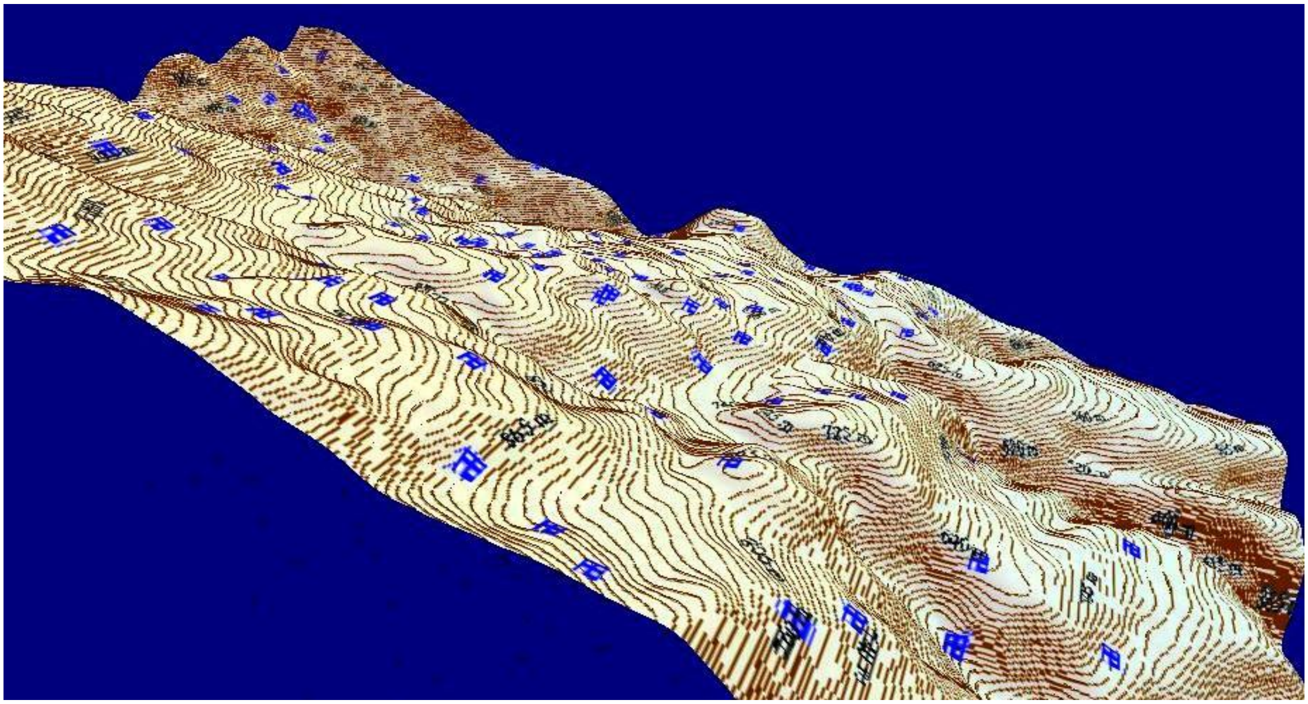

Figure 14: Southern Pateragiorgis and Achlada areas from South-East. Sites avoid hilltops and exposed spots. (Isoheights 4 m, vertical exaggeration x 2).

Figure 15: Pateragiorgis central area with sites in visible range avoiding heights (from South-East).

Naturally there are sites that combine two or more of the aforementioned qualities (e.g. Sites: 132 Type 2A on a slight ridge, 179 on a small knoll on the highest point of a short ridge. The 119 sites are Type 1 on a low ridge with two langades on both sides, see Figure 16). As one of those factors is always clearly more prominent than the other(s), only that shall be mentioned in the catalogue (e.g. Sites 119: "Type 1").

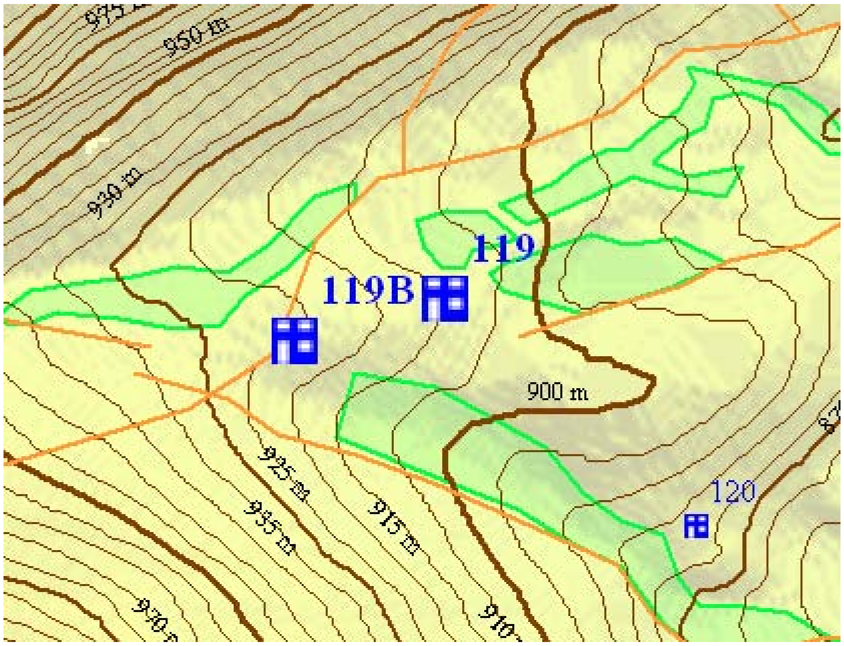

Figure 16: Combined position: 119 sites, Type 1 sites on a low ridge with langades (colluvial fields green) on both sides. (orange lines roads, *perivoloi* not shown)

Neighbouring sites/proximity of dwelling ruins.

Another point for studying the art of positioning mountain sites in Middle Bronze age north-east Crete is the way they are set in relation to each other. Fortunately the number of dwelling ruins with preserved *perivolos* and preserved neighbours' position give a good impression of various ways space was distributed. In terms of the topographical information given in this study, various details may be noted.

In several cases two (or more) dwelling ruins are set so close to each other that they are treated as one site, e.g. in the case of Site 18, Site 128 (see Figure 17), Site 23 (with two building ruins), or Site 100/B or 108/B (with several adjacent ruins or agglutinated structures, see Figure 18)[28]

[28] Here the B-numbers are a relict of my original numbering, and as thousands of photographs and other data have been labelled by this numbering, they remain as they were.

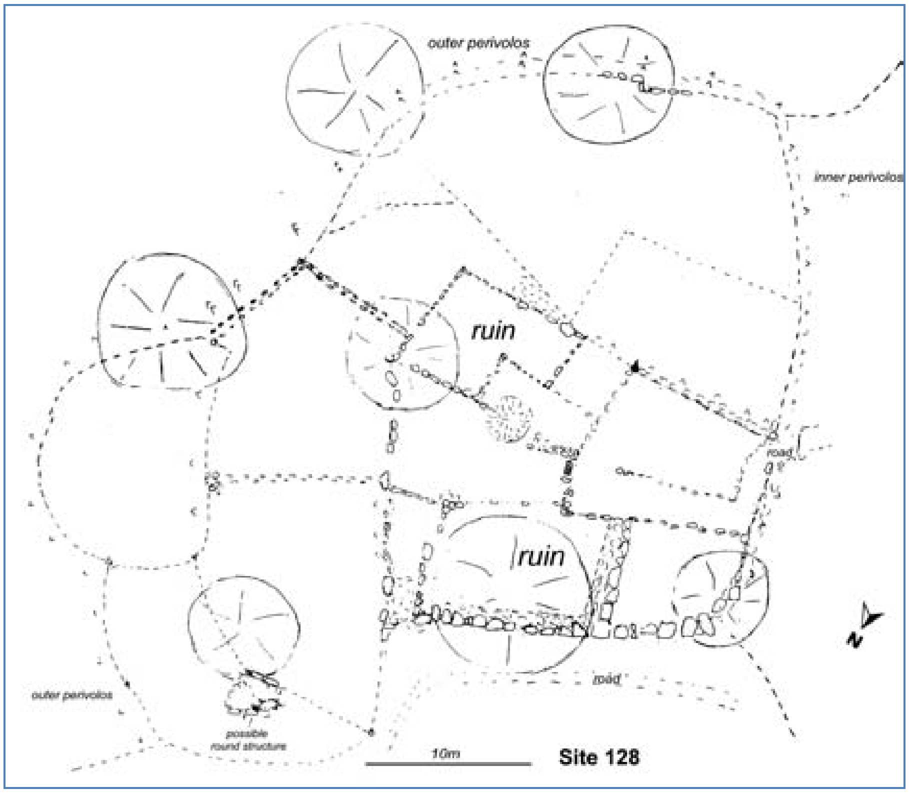

Figure 17: Site 128 with two dwelling (?) ruins within the inner *perivolos* (cf. Figure 4).

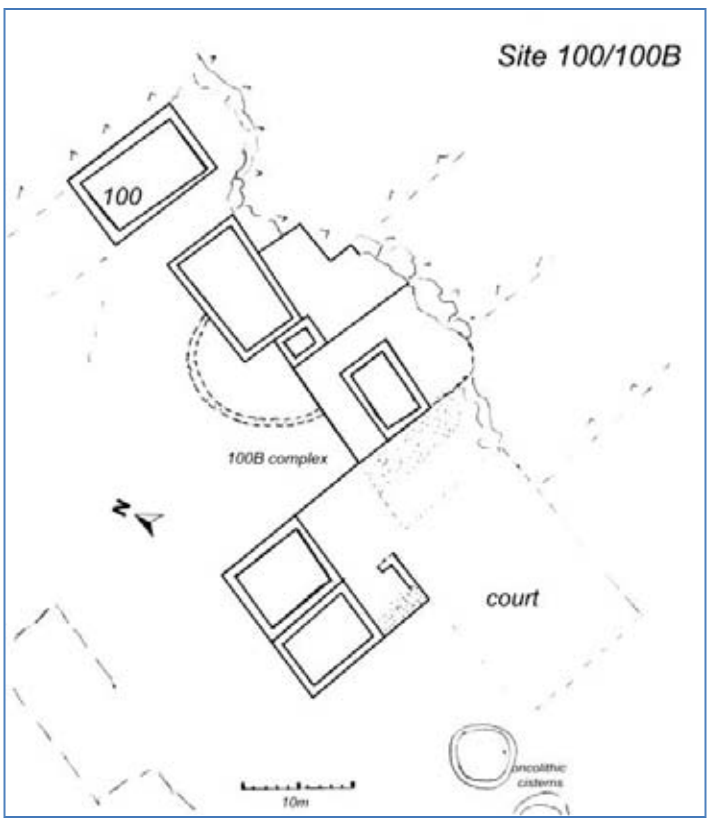

Figure 18: Site 100/100B with a cluster of several partly agglutinated dwelling ruins sitting on a rocky ledge, to E a terraced langada with gradient to NW.

In other cases, similarly close dwelling ruins are treated as two or more different sites, as e.g. in the case of Site 60 and 60B (Figure 19; similar sites 24, 24B1 and B2, 144 and 144B, 152 and 152B). These are only 20-35 m apart (and the pottery of the area is, with a few exceptions, not all clearly attributable), but they each have their own *perivolos*/Inner Perivolos, the dividing walls of which run between the two sites (difficult to discern in the case of 60/60B, as the respective part of the *perivolos* walls separating the sites run over a steep slope and are very eroded at that point, although slightly further to the West well preserved, see Figure 20). These twin (or triplet-)-dwellings obviously still have their own distinct domains. In the case of 152B, where a clear perivolos area couldn't be mapped, and for want of a very distinct ruin, the site might have been some kind of outdoor-kitchen-cum-working space for a lapidary working/living in 152 (the dwelling-ruin of which is only partly preserved).[29]

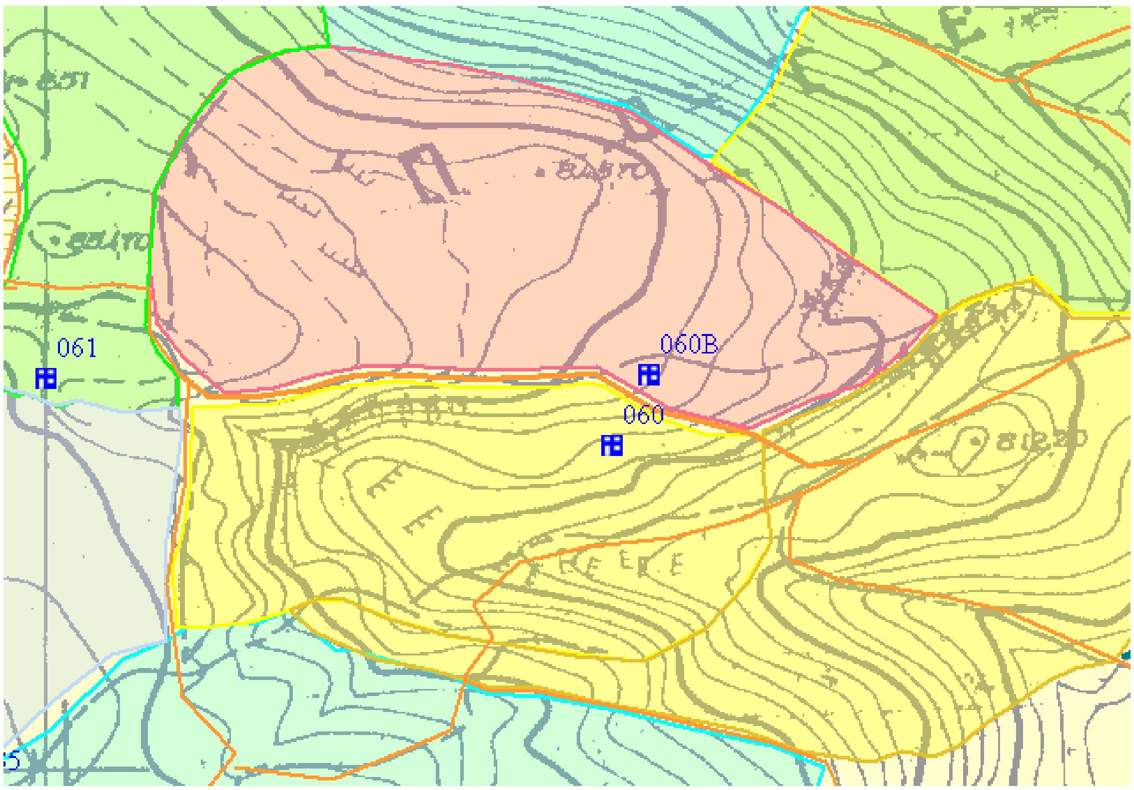

Figure 19: Sites 60 and 60B with their *perivoloi*, distance between ruins 30 m (orange lines roads).

[29] A similar situation as in these cases may have existed with Sites 157/157B, where two dwelling ruins (?) are only a few meters apart but separated by a (possibly only modern) wall. As the ruin of 157B seems to be on a lower level, though, and because of intensive disturbance of the surroundings by a recent bulldozed road, only an excavation might clear if possibly 157B was just another part of one site, which was partly overbuilt if the wall should turn out to be originally BA as well and had thus been built over part of ruin 157.

Figure 20: Site 60 and 60B *Perivoloi* N and W of the dwellings (view to E) with a road in-between.

Other neighbouring ruins are treated as two different sites albeit situated in different parts of the same perivolos as they seem to have had different functions: Site 125 (dwelling) and 125B, where the latter doesn't seem to have any pottery and is built so close to an important road crossing that an independent function seems certain[30]. Another B-site situation can be seen at Site 137 (dwelling) and 137B, where the latter (a pronounced scatter) is situated in the same perivolos but on a tiny, rocky ledge where it has an amazingly good view to the Northeast, East, two (!) coasts (with Priniatikos Pyrgos to the East), and the whole closer area to the East[31]. In the case of Sites 161 and 161B the situation is especially difficult as at 161 only (together with some larger and lots of smaller rubble) a lower layer of some oncolithic blocks remains, stones that might have come as spoils from ruin 161B when the (now also ruined) Venetian/Ottoman building was erected at 161. They are close enough to each other that Minoan pottery at 161 may have drifted to 161B, even though the scatter is not continuous (but at too much ground cover to be certain). Both seem to be set in the area of the same *perivolos* - if the preserved parts can be attributed correctly. Only excavation might possibly solve uncertainties like these[32].

[30] Although there is the possibility that it was a rectangular granary or storage building, viz. because of its raised, filled with rubble structure. Similarly Site 99B (4m from 99C and sharing its inner *perivolos*).

[31] Judging from the pottery and its 40m distance from the dwelling ruin, it might, on the other hand, also have been one of the "distant kitchens" several examples are known of in this area.

[32] Note that due to research process reasons (various changes in numbering procedures over years of research) some numbers do not exist, as e.g. Sites 11, 13, 17, 93 that had only EM pottery, or Site 7 that was a Late Roman site where some Minoan pottery from 7B had drifted.
There is also the group of Sites 27 C, D, E that don't show any trace of oncolithic ruins (nor of mudbrick). There are no discernable *perivoloi* either, and the pottery - although made from similar fabric and with no clearly datable as earlier shapes - has a distinctly "early" feel to it (mostly softer and more heavily eroded, small pieces). Like Site 27F, that has

Defensibility/positioning of possible military importance

Morris & Papadopoulos (2005: 159,162) and Parkinson & Duffy (2007:113) have - each in their field (Attic towers of Classical times and Fortifications and Enclosures in European Prehistory) noted the shifts of archaeologists' interest in impressively looking to modern eyes architectural elements and interpretations from military to rural and/or "cultural identity and group memory" (Parkinson & Duffy 2007: 116) or even as a means for the better integration of groups (ibid. : 123). Hence there was a general "pacification of the past" (ibid.: 114) in post WW II times in several fields of archaeology.

Contrary to that, Aegeanists re-discovered an interest in Minoan "cyclopean" countryside-installations in what they saw as expression of the until then missing in Minoan archaeology war-like attitude of Bronze Age Cretans, who now, after all, could be seen as controlling roads from watchtower-buildings: "l'appareil, les terrasses successives et les murs de la colline, joints au petit nombre d'ouvertures semblent être caractéristiques d'une architecture défensive" (Tzedakis et al 1990: 55). Finally it was appreciated how the Minoans, especially in eastern Crete, had been protecting country roads and mountainsides with a series of forts (Evans 1896, but still Nowicki 1999:193).

In the Tsivi South area, Nowicki (1998:36) was shown by locals some of the sites studied here. He interpreted them as dozens of "strongholds", protecting farms and flocks, although he recognized that Evans may have made a mistake by seeing them as "guard stations" aligned along important connecting roads (ibid.), but still resuming "who was the enemy?" (ibid.).

As shown in Ch.II.b.1, warlike terms have been used in context with oncolithic ruins and their topography since the beginnings of Cretan archaeology. But unfortunately the choice of terms in this context has never been brought into question, although several scholars have been observing that the installations labeled as such may have had other functions than military/defensive (Wroncka 1959: 538, cf. Gkiasta 2008: 213; Dickinson 1994: 159). Thus it seems necessary to address the question in detail here. To be able to classify sites' position as possibly of strategic function, the heading "strategical position" has been entered in the Site Catalogue, and the following shall explain the terms used there.

The most problematic term in this context seems to be "defensible". How or when is a built structure part of a defensive intention?

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traces of a ruin-foundation with a few larger stones, these might at closer inspection/excavation turn out to be late Prepalatial (cf. Nowicki 1998: 36, who mentions for the outer slopes of Mt. Dikte "earlier (MM I-II) mudbrick sites and later (MM II-III) buildings constructed of large boulders".) Site 27B might have both phases (some burnt earth, a greater variety of pottery, some oncolithic blocks and parts of a *perivolos*). The same applies to Sites 9, 17C and 17D where both phases might be present in pottery (no burnt earth, but indistinct ruins with a few larger stones only, no mentionable *perivoloi*) and Site 21 that has large pieces of burnt earth and a few pieces of indistinct pottery with that "earlier feel", but also parts of an oncolithic ruin and *perivolos* (here the intense re-use of the area might also blur the recognizable conditions). As most probably the oncolithic sites also originally had an earthen upper construction, traces of burnt earth (or "mudbrick" - as stated in Ch. II.c.1 none of the seen pieces of "burnt earth" were clearly recognizable as part of an original "brick") give as such no distinction for dating.

Definition:

The word used in this context archaeologically is usually “defensible” (=defensible (capable of being defended), same as defendable). What often seems to be intended is:
Defensive: "intended or appropriate for defending against or deterring aggression or attack"[33]

This definition shows the problem of using any such term in archaeology, as the "intention" for the use of some structure for defense naturally cannot be known with certainty. In the context of this study I shall thus try to abide by the Defensive ="appropriate for defending". When judging a position to be defensible or not, not just the existence of large stones in a built structure shall be taken to be an expression of defensibility, as that would make, for comparison, each modern Cretan shepherd-*mitato* a "fortress" - even though at a closer look many of them would be totally less suitable for that than any of the naturally occurring rocky areas in their surroundings. But even in cases of, on the face of it, entirely "defensible" positions of buildings, as e.g. on rocky knoll-tops, one needs to be careful with fast interpretations: Locals declare e.g. that the positioning of *mitata* on top of knolls has to do with the fact that they are used only in summer (during the mountain-half of the transhumant year), where they can be refreshed by the wind during the hottest months.

Still in this context I shall stay with the purely descriptive possibility of defensive use of any given structure as much as possible - even though this doesn't mean it must have been actually seen as such by their builders.

Thus sites and their positions shall be labeled in the Site Catalogue as:

1. "Highly defensible" (5 of 336 sites -1%): When situated on a knoll-top or ridge-top with full surround view and difficult approach from all sides.
2. "Defensible" (22 of 336 sites - 7%) : When situated on a ledge or rocky slope that could be defended by a small group of people and has difficult approach at least from several sides. (Note that many sites are positioned on rocky ledges/slopes vel sim but still open to a possible attack from several sides.)
3. "Not defensible" (309 of 336 sites - 92%): When situated so that an attack could neither be foreseen nor be deflected easily because of the sites' surroundings.[34] (Figure 21).

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[33] wordnetweb.princeton.edu/perl/webwn - last accessed 17/12/2011.

[34] One might add a category “just missed”: Dwellings that were obviously intentionally built just below/behind defendable hilltops (33, 124), but these are still just “not defensible” - while they are missing the area’s control, too.

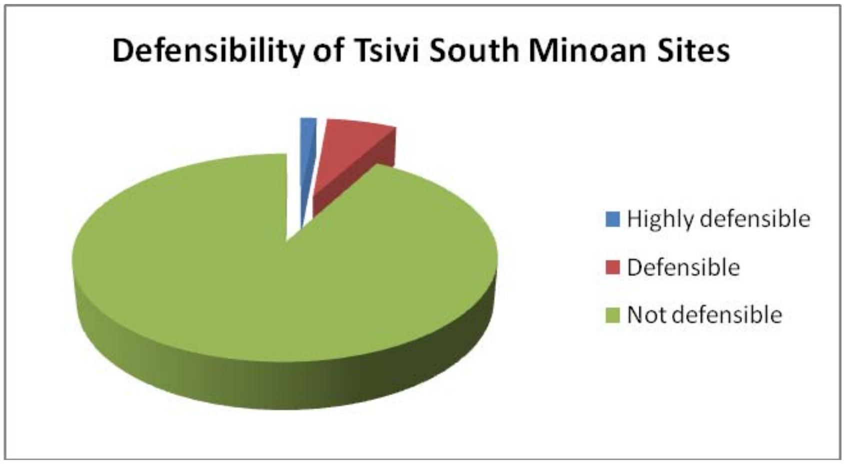

Figure 21: Percentage of "defensibility" in Tsivi South sites

Judging from the fact that there were obviously more than enough highly defensible positions available to build their structures on (see e.g. Figure 14), it seems that the Minoans' interest in the defensibility of their sites' position in general must have been marginal in this region. If those sites that did have a position one could call defensible were used in any way in a strategical/military kind of function cannot be determined on the basis of the material remains neither of the dwelling ruins (that are e.g. in all five cases of highly defensible positions rather infinitesimal), nor of the small finds in their surroundings[35].

The existence of *perivoloi* as such shall not be taken as part of any intention of defensibility (with a few exceptions mentioned below), because they can hardly have been high enough to have any strategical or defensive function (for the discussion of the possible *perivolos* heights see above Ch. II.b.2). Why the amount of work invested in the building of oncolithic structures should have to do with defensibility (Tzedakis et al 1990: 46, note 7) [36] eludes me, as that notion would (to use that example again) prove each Mt. Ida *mitato* to be defensible in function.

[35] The fact that purportedly in 1939 a stamp seal was found on the slopes of Fortezza, Site 46, (the name of which refers to its massive Inner Perivolos surrounding the knoll top the site sits on) also doesn't give any further information in this line (the seal is said to have been sold to an unknown source at the time by a farmer). Traces of tool making/stone working at the dwelling ruin (chips of waste material of greenstone, broken remains of a stone spatula, see Ch. II.c.2) does not give any indication of special military function either as it belongs to the normal pattern of many of the Tsivi South sites.

[36] The perivoloi of Χοιρόμανδρες are interpreted as defensible in character: Tzedakis et al 1990: 46, note 7: "La hauteur conservee de ces murs est inversement proportionnelle à leur largeur. Des fondations aussi puissantes incitent, pourtant à restituer une hauteur plus grande, nécessaire pour assurer un rôle de defense. L'importance du travail — taille, façonnement, transport et pose de blocs aussi volumineux — ne s'explique pas s'il s'agissait de bâtir un mur aussi bas. La seule explication que nous puissions proposer est que ces murs, construits souvent perpendiculairement ou obliquement aux courbes de niveau, sans soutènement particulier, n'ont pas résisté au temps et se sont peu à peu écroulés, ne laissant subsister que les fondations". The prototype for this interpretation was Evans, 1895, (in Brown 2001:205), where what he called "vast primaeval fortification" and especially "breastwork" must have been the wall-constructions surrounding the nearly vanished ruin of Site 95, see above Ch.II.b.1, with note 7, and Figure 1. Still, for the Tsivi region I do not see a similar state of affairs: Taphonomical conditions make it - among over 150 km of existing *perivoloi* - often clear enough, how much stone material had been originally used for the walls - see Ch. II.b.2.

Positioning of buildings in relation to roads

Another aspect of topography is the position of sites on roads (for examples of what is taken to be a military function, see Tzedakis et al. 1989, 1990; Chryssoulaki 1999). Important in this context is mainly the kind of road a site is positioned on or close to, as clearly only through-roads can have been of any further functional importance and not just the way of access to a house (for "road" definitions and typology see Ch. II b A – 5).

Here, again, the most important part of the interpretation depends on the perspective of the onlooker, as the position of a site on or close to a main road may indicate various functions. Apart from the simple function of access these may have to do with:

1. Trade or trade control: Either as private trading installation or as provisioning station/inn for passers-by, comparable to the recent "*chani*" (cf. for a similar idea Wroncka 1959:538)[37]. Even some kind of custom-station would be theoretically possible in such a position when a site is situated on/near the edge of a superior administration - a fact that cannot easily be ascertained for prehistoric vernacular sites[38].
2. Religious function: Buildings like the modern Greek *xoklisia* are often also provided with a road or built on an existing road. In a wider sense belonging to a religious sphere are also buildings like the recent Greek monastery *metochia*, where areas belonging to the monasteries but too far off to be cultivated directly from there are furnished with buildings for farming purposes and are connected to a road for transport and communication.
3. Military function: Checkpoints, "guard stations" vel sim. Which position on a road makes a certain point suitable for any of these strategic functions probably depends on each particular responsible authority's needs and possibilities and remains thus a matter of opinion in archaeology.

Still it should be kept in mind that none of these specialized functions would probably surpass a certain frequency of occurrence per length of road, and e.g. the 28 sites close to 4,5 km of the main road (#1) Kroustas to SW (Katharo, Malles) could hardly all be explained as trade posts or guard stations.

The actual distance between through-roads and sites is also interesting to observe. While most sites are positioned at a moderate distance (between 10 and 50 m) from roads that connect them with other sites or the wider area, some seem to have been rather distant from known/followable roads or paths (46/46B: 150 m, 155: 170 m, 164: at least 200 m). This may have mainly taphonomical reasons: Especially in agriculturally intensely used until today areas (e.g. around 155 and 164), or around Sites 145, 169, 178, positioned in what is today dense forest

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[37] Until recently there existed, for instance, a *chani* of this kind (*Chani tou Tsapinomichalis*) on the route between Lasithi and Heraklion, east of Peza. The owners remember farmers travelling on foot and donkey on the old *kalderimi* to transport their products to market in the capital and stopping over to rest at their *chani* for the night as this was about half the way (*mesostrathia*), important especially in winter when days are short, on their ca. 10 hours travel from the mountains to the coast and back (cf. also Melena 1892: 215-220, and similar kinds of tours in Crete in Kalomenopoulos 1894 and Nouchakis 1903). The site of the *chani* has yielded proof for its continuous use through time since the Middle Bronze Age (Watrous et al., forthcoming).

[38] Although, on a very long shot of hypothesizing, e.g. the stamp seal at Site 46 mentioned above (n. 35) might hint at a special connection to such a superior administration. Thus the imposing position of the site could be taken as symbolic expression for its function as representative of a superior power.

with nearly total thick ground cover, it can't be expected that small connecting roads are still traceable. The case of sites 46/46B is different, though, as they are positioned in comparatively undisturbed areas[39]. While here several small road (#2-3) possibilities can be suggested, none can be actually followed to the sites (although there may have been until recently a small entrance path other than the modern looking one to the hilltop of Site 46, cf. Nowicki 1998:36). Any approach from the next through road seems to have been much more difficult than in nearly all known other cases. This is one of the main reasons (together with the site's high defensibility) to suspect a special function for these sites, the collateral hilltop positions of which is unusual in any case[40].

On the other hand several sites seem to be not just on the side of a road, but in the middle of it, i.e. a road can be followed to the site from two directions, but it is unclear how someone using this road could have passed the site without actually walking through the "back yard" vel sim. Examples are Sites 126, 174 (neighbours with well preserved roads off-site) and Site 132 (in the same wider area), but also Site 190. Here, as with sites where connecting roads obviously end, it seems probable that roads must have been established to serve the sites (and not the other way round, as may sometimes have been the case especially with the important through roads).

Details on site-position in relation to roads for topographical interest can be found under "access" in the site catalogue.

C. Perivolos topography/positioning

Although Moody and Grove (1990) were able to classify typical structures of walling in the modern Cretan landscape, Moody and Rackham still stated in 2000: "Auf Fresken sind ummauerte Bezirke dargestellt, die jedoch nicht ohne weiteres mit der Landwirtschaft verbunden werden können."[41] (Moody and Rackham 2000: 38) and phrased several questions for a future Minoan archaeology related to animal and field management with walls and terraces. For classical antiquity several structures called "outer enclosure wall" were studied by Jones et al (1973) and characterized as having an "irrational meandering course" (p. 370). Hayden (2004: 324), who didn't necessarily agree with Moody and Grove (1990), stated that shapes/styles of terraces are not as easily attributed as the latter scholars seem to show, for instance stepped for vine cultivation, braided for cereals, as she noticed that the uses of terraces changes, and shapes are often rather a factor of topography. She didn't have clear evidence for a Bronze Age date of any terracing, but "boulder-sized field walls at APh3 and SP2 appear to be similar to the Bronze or early Iron Age structure walls at these sites, and may be contemporary." (ibid.)

Perivoloi in the Tsivi South area often show typical ways of positioning in respect to the dwellings and to the landscape, some of which are characteristic enough to be mentioned here.

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[39] Apart from a bulldozed car-track leading to the base of the site hillocks. Compared with the condition seen at other sites, though, the probability that this track has destroyed an ancient road as a whole is very small, as modern tracks follow other needs (mainly passability for cars). If 46/46B had been some kind of refuge site or acropolis, one would expect some kind of well developed access road at least to the base of the neighbouring hillocks.

[40] Here, again, some speculating might suggest that as a local symbol of "power above" – and double in this case – easy access would not be needed.

[41] "Frescoes show walled areas but those cannot easily be connected to agriculture."

As can be seen in Ch.II b A 3 “Outer Perivoloi” (with Table 2), there is no linear relationship between the size of dwelling ruins and their *perivolos* area. In terms of positioning it seems sensible here to repeat that *perivolos* constructions were the more massive the closer to the site (more details in Ch.II b A 3). The relation dwelling-position to *perivolos* walls seems mostly unsystematic and variable, although a certain tendency to place dwellings close to Outer Perivoloi can be noted. The reason for this seems obvious: If the dwelling is positioned in a suitably small distance from the outer *perivolos* wall, this wall can achieve a double function also for structuring the space close to the dwelling, or as part of an Inner Perivolos (in the case of Sites 38 and 38B one wall functions as partition of two sites in a double sense of Inner and Outer Perivolos, see Figure 21). A special case of these *perivoloi* are those where sites are positioned in a kind of pocket of the *perivolos*, reaching either into the neighbouring one, as with sites 22B (map cf. Figure 27), 200 (Figure 22), or being attached to an otherwise evenly shaped *perivolos*, e.g. sites 69 (Figure 23) and 128 (map cf. Figure 4).

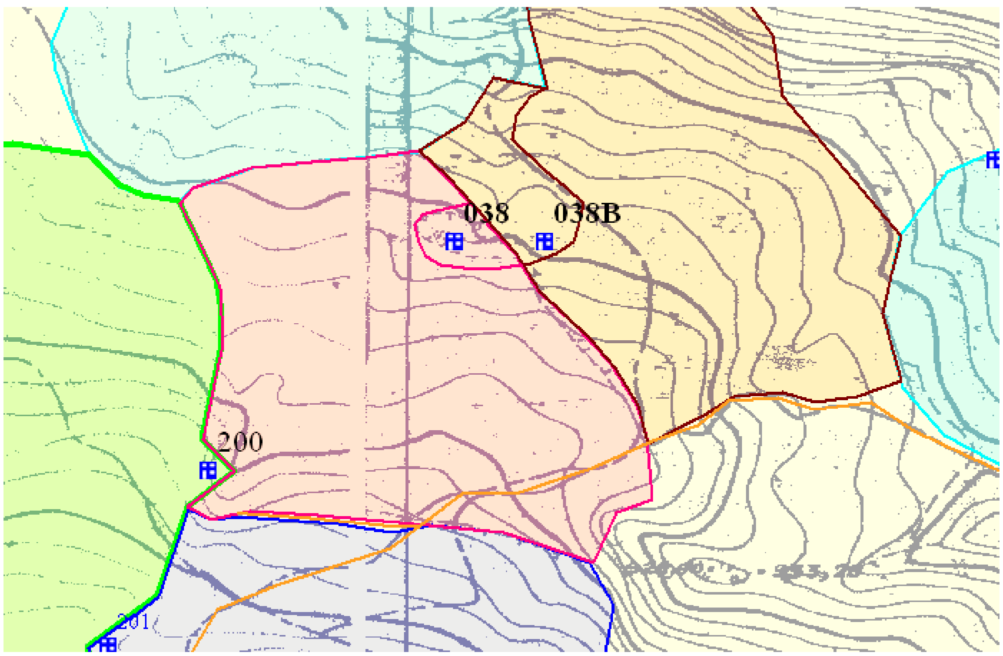

Figure 22: *Perivolos* topography: Using the same wall as Outer and part of the Inner Perivolos for two dwellings (Site 38 in the pink and 38B in the brown *perivolos*) or with the site positioned in a kind of attached “pocket” into the neighbour’s (Site 200, green *perivolos*, reaching into the area of 38).

If *perivolos* walls run in the vicinity of steep drops in the slope, they usually follow the edge just on the edge of the slighter gradient before the drop (e.g. the case of Site 56 NW *perivolos*, cf. the map Figure 8; Figure 23, 24). Thus they often until today protect large areas from soil erosion into the gorges the walls run along (Figure 23).

Figure 23: *Perivolos* wall between Site 10B and 10C, just inside of the top edge of the cliff.

Figure 24: Site 74 *Perivolos* N (seen to SE) along the edge on top of a steep part of slope (left).

If there is a need to connect to other walls, though, *perivoloi* may even run in a perpendicular way into and out of gorges, sometimes at amazingly steep angles (Figure 24,25).

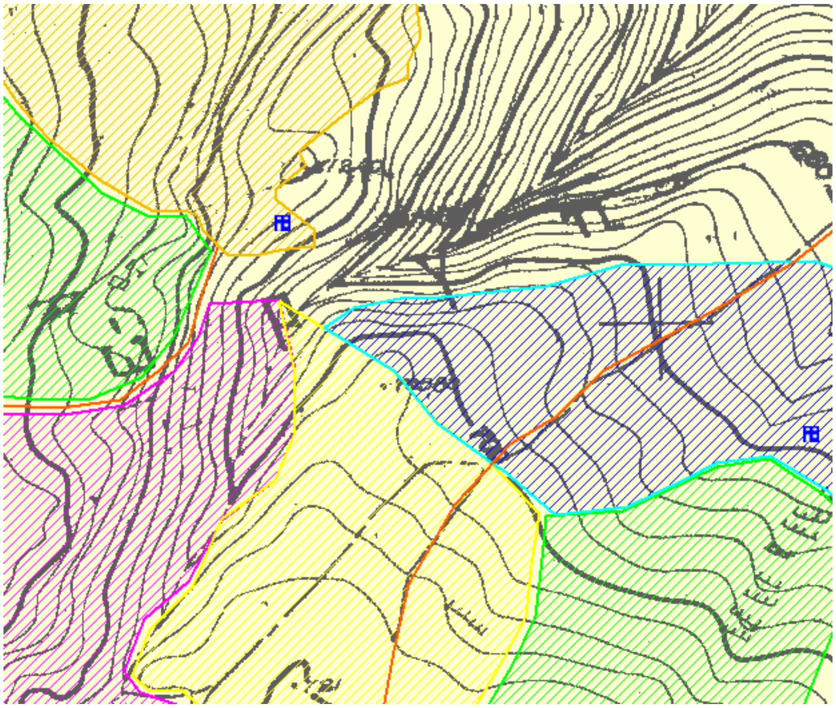

Figure 25: *Perivoloi* running into/along a gorge at steep angles. From top left: Site 69 (brown, pocket *perivolos* part at site), *perivolos* 197 (blue, running along edge), 75B (green), 75C (yellow, steep slope part), 74 (pink, steep slope part), 93 (green, running along edge). The dwellings of the latter are outside of the scope of the map.

Figure 26: Site 16 *perivolos* SE (view to N) running perpendicular to a steep slope into a *langada*.

Soemtimes too steep and rocky (and thus obviously useless) areas are in this manner excluded from the surrounding *perivolos* areas (Figure 25, 27).

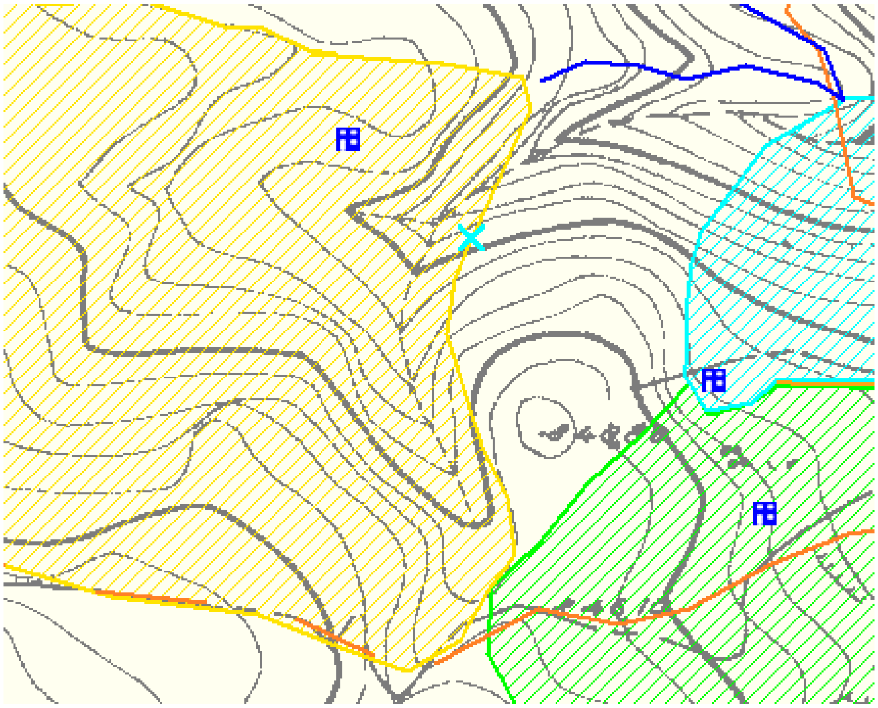

Figure 27: *Perivoloi* excluding steep (and purely rocky: on the central hillock) slopes from their areas. Sites 16 (brown), 22B (turquoise), 22 (green). The photo Figure 26 was taken at the turquoise cross.

Many other *perivoloi* run along the lowest rocky part of a steeper slope above a terraced or colluvial area at the base of the slope, thus excluding not used (or differently used?) areas (Figure 28).

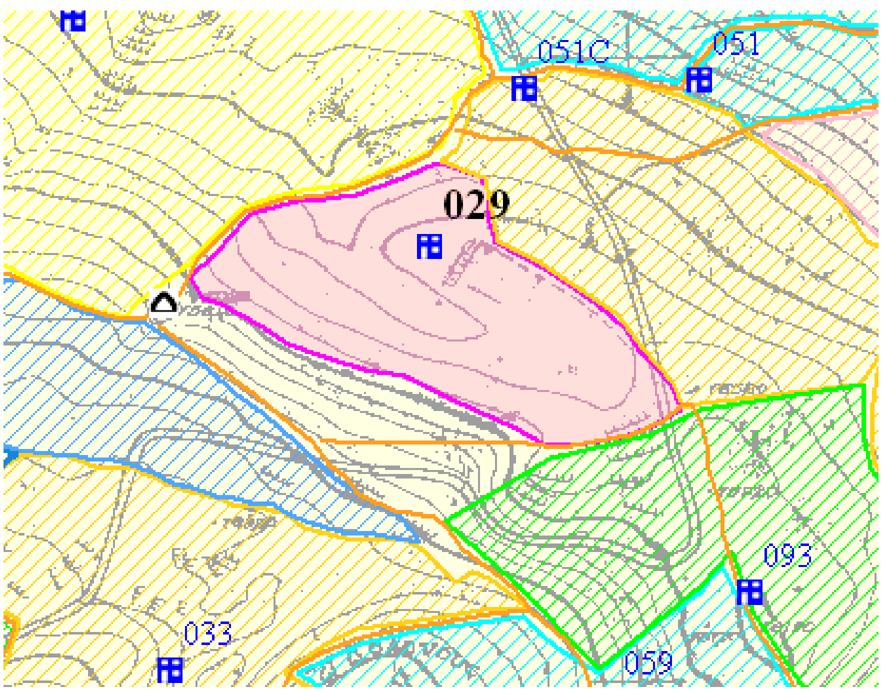

Figure 28: Site 29 *perivolos* (pink) running in the south along the base of the steep slope SE of the Gaidourotrypa cave. On this strewn with big rocks slope, small pocket terraces may have been used (for trees?).

Still in other cases *perivolos* walls run over very rocky slopes without any discernable reason for their precarious position (apart, may be, from the easiest availabilty of stones for building and the fact that animals wouldn't easily jump neither out of nor into an area protected in this way (Figure 29).

Of special interest are the spots were several *perivolos* walls meet. Even though theoretically it should be possible to discern if and how walls were built one after the other[42], I am not aware of any spot where it was actually possible for me to see such a distinction[43]. While obviously a cleaning of several such spaces would help to get more information on this subject, from what is visible now walls seem to have been built together (or possibly an existing wall was dismantled and rebuilt at the meeting point when the necessity for making a connection arose?).

Figure 29: Site 50 Perivolos E (seen from W) passing through the middle of a steep slope.

Thus it seems that all walls were built together (and thus planned together), an undertaking that would certainly be of great interest to know more details about (Figure 30,31).

[42] My thanks to Dr. Jennifer Moody for this suggestion.
[43] As at most well preserved *perivolos*–meeting points aggradation and humidity-preserving conditions are especially good, they are unfortunately nearly always at least in part densely overgrown with impenetrable bushes, while in other cases fallen stones do not allow a clear judgement.

Figure 30: The spot where the *perivoloi* of sites 38, 39B and 200 meet (cf. map Figure 22, top left corner). One wall running parallel with the bottom edge of the image, the other coming from top right.

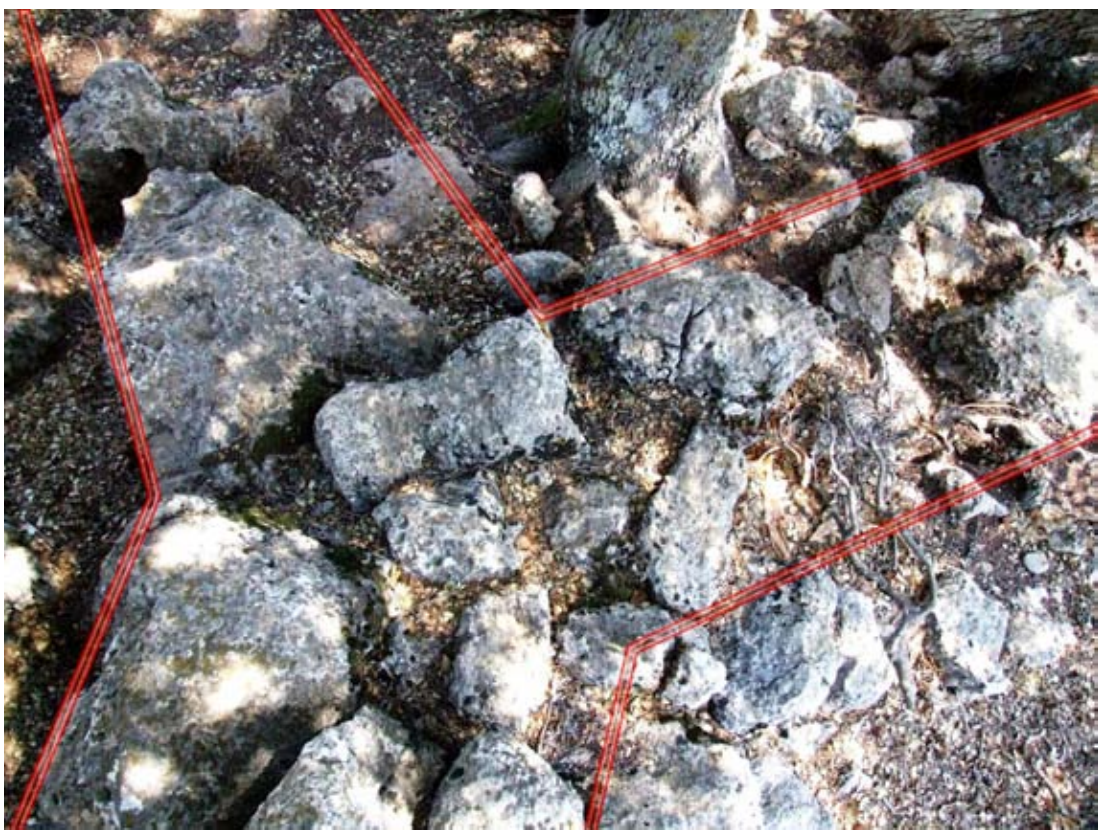

Figure 31: Site 119 E – two *perivolos* walls meeting (seen from S), the N-S running one under walking stick, the E-W running one under measure (top, in May). The same place with lines placed in the photo to show the two *perivolos* parts (below, in August).

D. *Minoan road/route topography*

When Evans passed along the then main road of connection between the coast and the Katharo plain (and behind that the Lasithi plain[44]) he called this road a "Mycenaean Military Road" (1895), an interpretation he reached when noting the sturdy way of road-construction that he saw as similar to the Minoan (then still called Mycenaean) dwelling ruins he saw along that route that he took to be of a military function, too[45].

As noted by Tzedakis et al (1989:49-50) for the Zakros area and by Müller (1991: 545-546) for Malia, Minoan road-builders seem not to have bothered too much with the occasional larger rock in the course of the road (cf. also Chapter II.b.A.5). The same scholars also seem to agree that for their areas Minoan roads showed traces of pavement only in urban surroundings and close to sites (Müller 1991: 546, Tzedakis et al 1989: 50), although at some parts a filling with small stones was noted and interpreted as measure of leveling (Müller 1991: 547). As Müller has also stated, the route (“itinéraire”, Müller 1991:551) of a road should be dated by the age of the sites it serves, while the actual date of “road-building” remains necessarily unclear. It seems reasonable to follow Müller in her ideas for road use:

> Il devient alors raisonnable d‘imaginer que ces habitants devaient pouvoir se déplacer vers d‘autres régions, et le faisaient en suivant les itinéraires les plus rapides et/ou les plus faciles, dictés, bien sûr, par la configuration géographique de la région. (ibid.)

Müller refrains from connecting the Malia roads with any defensive system as was suggested by Tzedakis et al. This kind of approach has already been taken before the beginnings of the “Minoan Road Project” by Joseph Shaw (1977) who wrote about a Minoan "cyclopean" road Evans had described (Evans 1928-1:60 and following) with a Minoan site next to it:

> Following Evans' logic, the remains should be attributed to a Minoan "station" guarding the road. In my view, however, the presence of Minoan remains along a natural route for a roadway simply indicates that the Minoans did live here and that they used a road near by.(Shaw 1977: 202, n. 8, also mentioned by Müller 1991:554, n. 11).

An interesting detail used by Müller to confirm the Minoan date of the road she studied are the Y-shaped crossroads seemingly typical for Minoan road-connections in Malia (Müller 1991: 555) – but obviously not only (see below).

Minoan Roads of the Tsivi South area

While in Chapter II.b.A of this study the actual architectonical remains of Minoan roads in the Tsivi South area were treated, here the topography of routes shall be the main subject. Thus, together with the basic positioning in the landscape, the alignment or positioning relative to sites and/or *perivoloi* is taken to be the most important factor of identification of Minoan roads, even though these are certainly beyond a single dating, as many are still in use (while some may even

[44] In recent times there was (still?) also a second, smaller road, used for the main trade between the coast and Lasithi via Tapes, that locals remember was used with donkey caravans for transport. My thanks to Jorgos Brokos from Tapes for this interesting story.

[45] Evans knew of three or four relatively wide-spaced such ruins along this road, apart from Site 18 probably Sites 22 and 28.

be older than the Middle Bronze Age[46]). In some cases, where there are several parallel tracks preserved (see Chapter II.b.A.5) I would - if typical oncolithic borders are missing – suppose the optically oldest to be the Minoan road construction[47]. Only roads clearly used as connection to/from/by Minoan dwellings shall be treated here (if not mentioned otherwise).

That roads should follow the easiest and/or shortest route from one point to be connected with the other, is not only a necessary prerequisite for a mountainous area, but also part of the process of building (shortest walls/cleanings) and use: more hours are needed for maintenance than for just building roads[48]: "it is very easy to make roads in Crete and difficult to maintain them" (Rackham&Moody 1996: 158). It might not have been quite as easy - until the arrival of dynamite and bulldozers - in karstic areas like the one studied here, and the difficult landscape is certainly the main reason why most modern (and Minoan) "roads" (i.e. paths) are not more than 1,5 m wide. In terms of the actual track or route followed from point X to Y, in many cases there would – whenever in time – have been only one possibility for the passage of a longer road, as the rocky surroundings wouldn't have allowed any other. In other, more passable (i.e. with fewer rocks) areas sometimes several parallel road tracks can be noted (see the N part of the road system in satellite map Figure 34), and which one of those actually may have been the Bronze Age one has to remain indefinite. As many routes would have to negotiate differences of height in various gradients, roads in the area change direction, are often curvy, and also in many places steeper than one might expect would be negotiable e.g. by a mule. Still these animals are much more nimble than their shape suggests, and thus even small and difficult parts of roads could have been passed by a rider (and still are, in rare cases, I was assured by experienced locals). All in all Minoan sites of the area show a complex connectivity among each other enabling communication from many sites in various directions and with various other sites, through-roads and directions. None of the roads leading from the area to more distant destinations seems to be more important than any other one[49] (cf. Figure 34).

Roads in the studied area have several characteristics that are of importance in a wider topographical sense:

1. Steps. At many spots the Minoan (as the later) roads must have had steps, judging from their steep course. Unfortunately only at very few points traces of these steps are preserved on roads that are most likely Minoan only (Figure 32, 33). In any case, the steep course and the steps,

[46] This applies especially for the area of Agios Ioannis or "Flej", were several sites of EM (possibly even traces of FN) date can be noted.

[47] Constructional details (as have been used for Roman roads, cf. Bekker-Nielsen, Tønnes 2004: 21) apart from oncolithic borders don't seem to be reliable as criterium for dating as e.g. similar paving and steps/water runoff ridges seem to have been constructed also in later times.

[48] Senior Cretans still remember times (i.e. possibly even after the military dictatorship of the 70ies) when every citizen had by official decree to spend several days per year with public work (a kind of corvée), mainly road (*kalderimi*)-repairs. (cf. Rackham & Moody (1996: 157) for such compulsory work on roads in the 19th century) Corvee or public service of various kinds has been a well-known practice around the Mediterranean from the Romans' *opera officiales* (and in kind already the λειτουργία) until recent times. Examples from the Levant already exist from the Bronze Age (cf. Naaman 2005:235).

[49] As these roads were/are mostly re-used until recently/today, the actually visible size or seeming importance may not be representative for the BA. Let it be noted that the connecting road between Kroustas and Kalo Chorio (Priniatikos Pyrgos area) seems to have been at least as important as the one connecting the area to Kritsa, which is today the main "owner" of the north-western half of the studied area, while both *kalderimia* are now obsolete due to modern car-tracks crossing and re-crossing them, as the same connections are still of interest for locals.

together with the small width of most Minoan roads make clear that they could never have been used by any kind of wheeled vehicle, neither for travel nor for transportation[50].

Figure 32: Site 18, steps 20 m above (W) dwelling ruin – note that these are not the "staircase" NE of the main ruin that Evans drew in his sketch (cf. Brown 2001: 311).

Figure 33: Step in the Minoan road N of Site 51B (between NE and NW *perivolos* parts, of which only part of one wall is visible here to left).

[50] The very first known cart-ridable road (15 km length) in modern Greece was made by the French army from Pylos to Methoni in 1828 (probably for their own army-movements). Shortly later it was given up and fell into disuse (1878 no trace left) (Passas vol.7, ca. 1952).

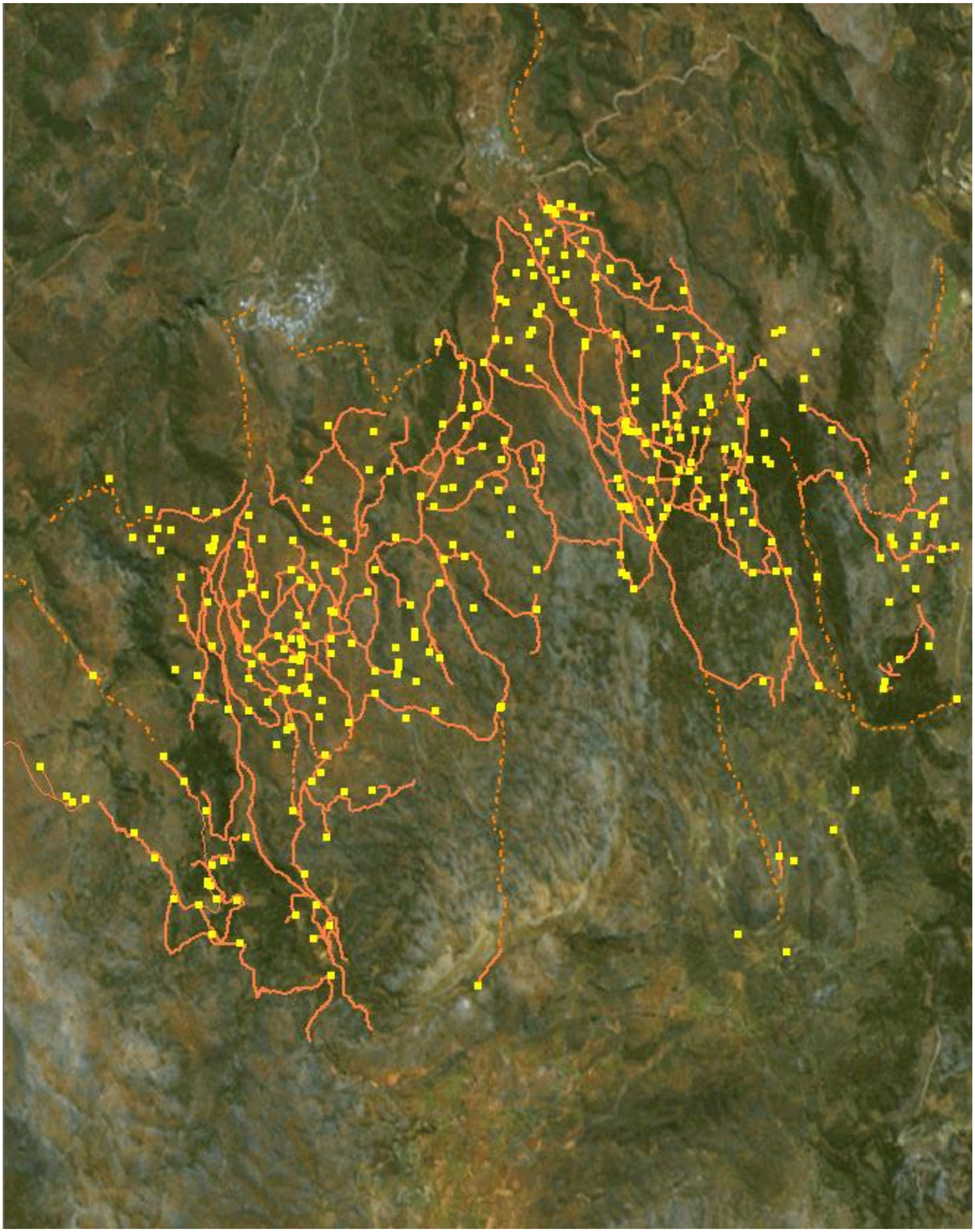

Figure 34: Roads in relation to sites in the Tsivi South area (North to the left!). Dotted routes are suggested routes, as the preserved traces can not be identified as Bronze Age on any part of the visible track (several are connecting routes to other regions and would have continued from the sites). The villages on top of the image are Kritsa (left) and Kroustas (right), the lighter, brown area on the bottom is part of the Katharo plain.

2. Y-shaped crossings. As mentioned above (Müller 1991: 555), a typical feature of Minoan roads seems to be the Y-shaped crossing (Müller relates to those in the urban context of Malia). While T- or Y-shaped crossings may not be unusual in a wider sense, some examples in the Tsivi South area are noteworthy. For instance the crossing north of Site 52, where three roads come together like three Ys connected at their upper ends (Figure 35)[51], enclosing a space of c. 800 sqm.

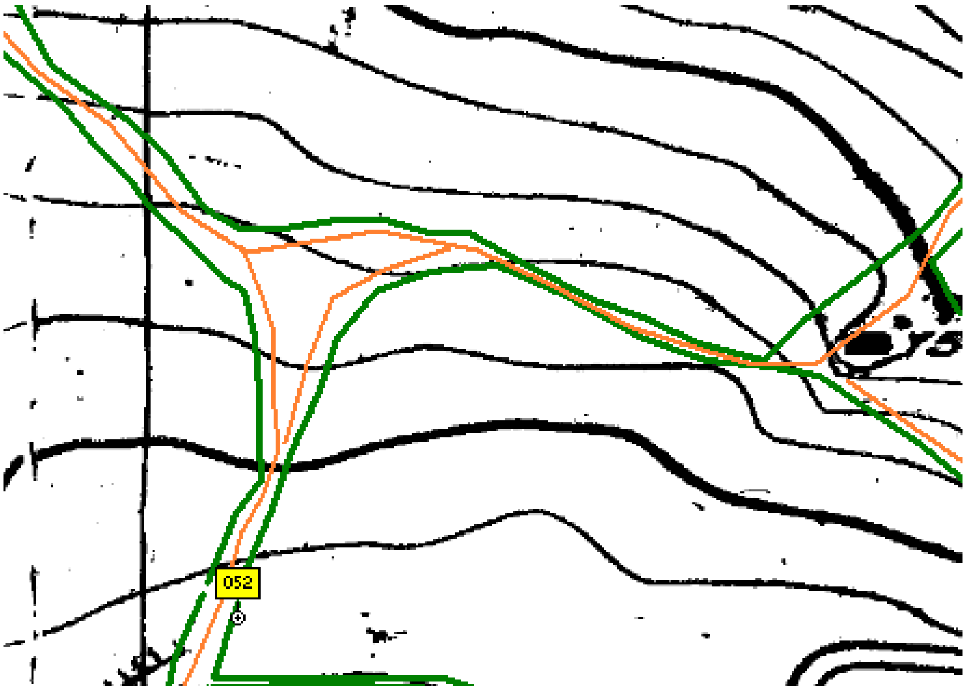

Figure 35: The Y-shaped crossing north of Site 52 (note the closeness to the Gaidourotrypa cave, black dot on the right of the map image). Roads: orange, *perivolos* walls : green.

Road width

As has been noted above (Chapter II.b.A.5), various widths of Minoan road can be seen in the Tsivi South area. Broad roads (#1) are always major through roads continuing from the studied area into other regions. The wide road parts are few and may have reached their visible width often only in recent centuries. The *kalderimi* (on many spots visibly recent, there is an older track framed by *perivolos* walls next to it) connecting Kritsa with the Katharo plain (and from there on to the Lasithi plain) is nearly on all its length so wide[52], whereas its few preserved clearly ancient parts (mostly parallel to the modern track) are medium roads #2. That the Minoan road actually used the same route can be seen by the large number of sites close to it: 14 sites are on this route or directly connected to it by a small side road and not further than 100 m from it. Even 28 sites

[51] It might be wondered if the cave 130m east of this crossing had anything to do with this shape (some kind of ritual function?).

[52] It should be noted here again that this is the road Evans travelled and called a "Mycenaean Military Road" (Evans and Myres 1895, cf. Brown 2001). The sites he knew of are some of the 14 sites in its vicinity mentioned here. That ancient roads were seen as "military" based on various assumptions goes even back to earlier in the 19th century (Steffen 1884, cf. Jansen 1997, 2001), but here the implied roads or "highways" (Jansen) are at least 2,5 m broad, useable by wheeled vehicles and without steep grades (cf. also Zekkos et al. 2005).

are similarly close/related to the *kalderimi* connecting Kroustas with the mountains (from there to the Katharo plain, but also the Malles and Kalamavka areas). This *kalderimi* seems to be similarly recent in its wider parts, whereas in its more mountainous and curvy stretches it rarely reaches a width over 2 meters (see the site catalogue for the kind of road closest to sites). Thus most Minoan “roads” of the Tsivi South area (the whole network comprising as seen on Figure 34 close to 150 km road-length as far as known to me) consists actually only of “lanes” or rather “paths” and should be seen exclusively as that, so that a military function of the kind Evans seems to have had in mind (cf. Evans and Myres 1895) can be nearly excluded for them with a probability bordering on certainty.

E. Other features

The edge of the settled area

There are some interesting remarks to be made for those sites that were sitting on the edge of the settled area. What might seem at first gaze to be a taphonomical problem in an often highly eroded area – the absence or scarcity of *perivoloi,* especially in the northern part of the settlement region – may have been not just that. Some unusual conditions related to sites north of the main *cheimaros* in the Kritsa Cypress Forest, but also concerning the westernmost sites (mainly KR Sites) may be more than incidental. There are hardly any preserved enclosure walls to be seen there, but mostly only bits and pieces of what may have been Bronze Age walls surrounding primarily the best fields in the respective sites’ surroundings. The best example may be Site 32, sitting somewhat offside the densely setteled area on the northern pass between Tapes and the forested slopes. Its ca. 80% preserved *perivolos* encloses an area that seems with ca. 2,7 ha not big, while it includes only very good fields and well terraced slopes, hardly any rocky patches. In recent times walled areas like this functioned as agriculturally used plots when many animals were kept in the surroundings. Other sites on the edge may have been similarly organized when only small pieces of enclosure walls (or only walls towards neighbouring sites, not the outer region, e.g. Site 1, 49C, 82, 181) have remained and none of these seem to constitute parts of the closed Outer Perivoloi typical in the central part of the region (e.g. Sites 4, 5, 8, 14, 19, 43, 44B, 89, 198, 207 to name only the oncolithic ones).

Courts?

Four of the studied sites seem to be situated next to/at an enclosed space similar to a rectangular court[53]. Three of these spaces show traces of lithic production (steatite debris and/or obsidian). These are their sizes and (longer) axes’ positions in relation to the cardinal points:

Site 14 : due north (8x13 m, steatite debris)
Site 100: 23° E of N (14x20 m, steatite debris)
Site 184: 18° W of N (7x17 m, steatite debris and obsidian)

[53] Site 205 also has a large, walled court (ca. 650 sqm, 30 m W of the dwelling ruin, with a pottery scatter next to the court on one side), but that is more or less hexagonal, with one corner looking due north and the longest straight side ca. 20° W of N. The central court of NP Gournia is with not quite 500 sqm clearly smaller.

Site 187: 21° W of N (15x16 m)[54]

As all the court-axes of known "Court centred buildings" (Driessen 2003) are within 20 degrees east or west (Petras, Gournia) of North (only Zakros is at 36° E of N) and the PP "Agora" at Malia similarly faces 8° W of N (Effenterre 1980 I: 256), it is certainly noteworthy that these "working" courts were placed similarly and are in size all larger than the courts at Petras (13x6) and Palaikastro Building 6 (10,7 x 7,3 m) and only slightly smaller than at NP Gournia (25 x 17,5 m) (measures from Rehak and Younger 2001: 395 n. 45). Still only the "court" at Site 100 was partly framed by several dwelling buildings (see above Figure 18), whereas the other sites seem to have had only one building in their vicinity.

F. Sacred/ritual places?

Remains to be asked if there were any sacred or ritual places within the area studied here. It is interesting that Mt. Thylakas (between Agios Nikolaos and the Kritsa and Lakonia plains, 4,5 km east and northeast of the Tsivi South slopes), while sometimes called a peak sanctuary, recently has been clearly disputed (Davaras 2010[55]). After its initial short excavation before WW I (Reinach 1913), the site was re-excavated by Davaras in 1971 (cf. Davaras 2010 for all bibliography to the subject). Reinach only seemed to find remains of much later periods, where the sanctuary must have been related to the town of Lato (Prent 2003), while Sakellarakis (1970) was voting for a BA phase. Davaras insists that he found nothing older than the Iron Age in his re-excavation (cf. Davaras 2010: 80).

While it may be correct that no Bronze Age material existed on the very peak (near the structure called "chapelle" by Reinach), I saw clear traces of Minoan use ca. 50 m (N) below the excavated area(s): typical cooking ware of Type 1 pottery, with ample inclusions of granodiorite. There is also a kind of enclosure (at ca. 50-80 m around the N-E perimeter of the peak – not the small *mandra* on the eastern peak) that I believe has not been mentioned in the bibliography[56]. This "temenos" could be BA or later and should be studied at some time in the future.

The subject of intervisibility is certainly (as Davaras correctly remarks) a very important one here – even if Thylakas was possibly used in a not so intensely "ritual" way as other peaks. To judge from the fact that of over 300 PP Minoan Sites on the south-east facing Tsivi slopes[57], ca. 160 see Mt. Thylakas[58] (Figure 36, 37), it may have had some kind of meaning for the mountain settlers of Middle Bronze Age. Especially the fact that 18 sites saw only just the peak seems amazing, as possibly some sites' position must have been selected due to a point in the

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[54] This „court“ is, as the site below, situated on a heavily eroded/eroding slope, where the Minoan ruins are already reduced to the lowest layer, thus items from a possible earlier/higher surface layer (of lithic debris?) may have been washed downhill.

[55] The statement that "nothing older than LM III has been found in the Kritsa district" (Davaras 2010: 80, citing Tsipopoulou and Vagnetti 2006) clearly cannot be taken as correct any more, after this study.

[56] It is visible, in kind – possibly by the shade – even from Agios Nikolaos (especially in winter). An animal figurine head of a very similar fabric, like a half-fine version of Type 1, was seen at its edge.

[57] All the KA-sites (and some others) face to S-SW and the Kalamafka-Iearpetra region.

[58] These are the sites where I could clearly see the peak – some additional 70 sites may see it when there are no trees. For the amount with probable intervisibility cf. viewshed in Figure 37 – but *cave* the imprecisions of the DEM file(s) used in this kind of demonstrations – see below.

landscape where the peak of Mt. Thylakas (the sanctuary?) was just visible – which it wasn't from other, just as suitable for building, positions within the sites' *perivoloi*.

While specialists usually seem to assume that intervisibility between peak sanctuaries and settlements had to be top-down (Peatfield 1994: 29), the case of Thylakas and the mountain sites studied here could be seen as an indication that it may have been the other way round as well, as even the Tsivi South site situated lowest (Site 149: 531 m) is above the height of Thylakas peak (520 m). The special meaning of the hilltop may have been ritual or otherwise, but topography and on the spot finds suggests it existed.

I would also suggest that the intervisibility between the peak of Mt. Thylakas and other regional sites may have been more important than e.g. Davaras (2010: 80) realized: While Gournia (contra Davaras) and the Priniatikos Pyrgos area are clearly visible, there are also some other landmarks that may have been of interest for Minoan distance communication (and/or ritual life): Towards the South the very peak of Anatoli Stavromenos, recently declared as new peak sanctuary (Nowicki 2007) is just visible (Figure 37, 38), while similarly to the North-West the uppermost peak of Anavlochos can be seen.

Figure 36: Mt. Thylakas seen over the dwelling ruin of Site 51 bottom right (see the white goats to the left for scale). Close to the winter solstice a special phenomenon of topography shows the last rays of the sun on the peak, while the surrounding region (down to Agios Nikolaos) is already in the shade of the Dikti range. The coast near Kavousi and Pseira (background) are still in full light.

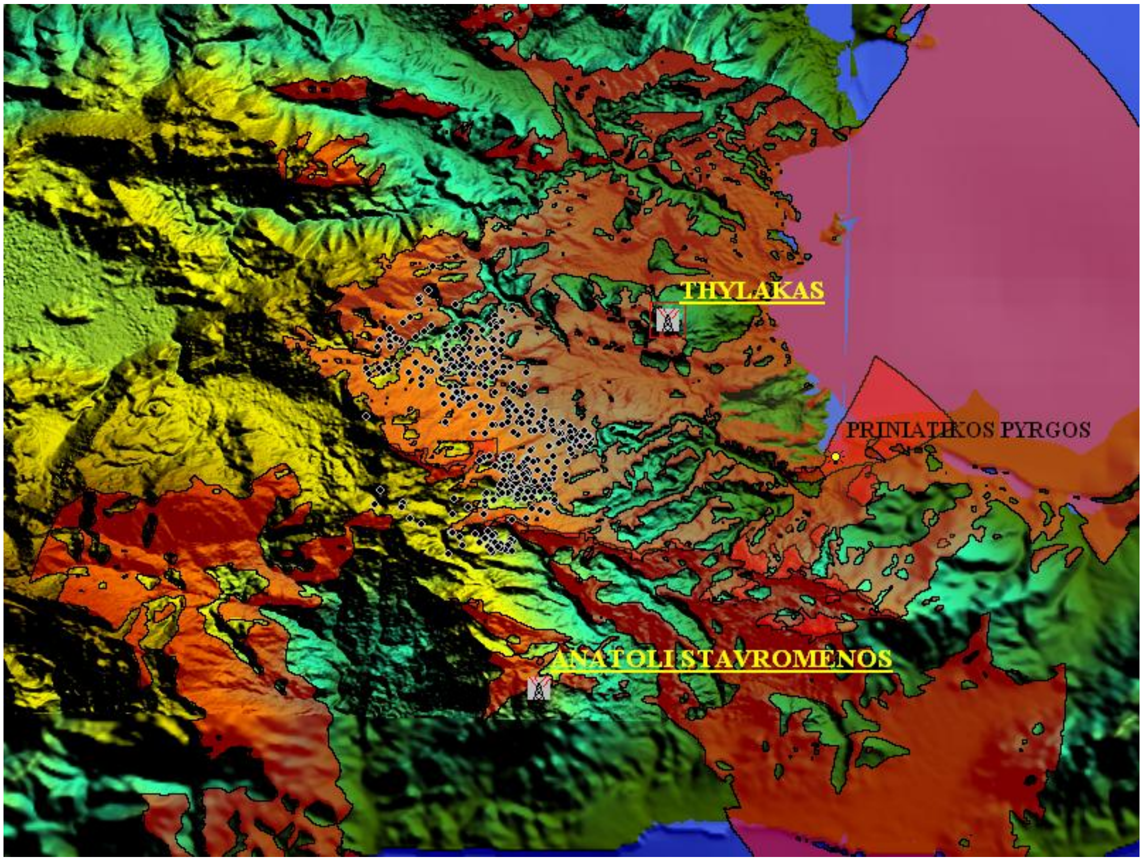

Figure 37: Viewsheds (red, 15 km) for Thylakas and Anatoli Stavromenos, overlapping (bright red) mainly at Priniatikos Pyrgos, i.e. from there both are clearly visible. Tsivi South sites dark dots. Note how few spots (bright red) apart from Priniatikos Pyrgos actually see both peaks.

This is of interest when taking into account that Nowicki (1994: 48) suggested the latter, too, as a possible candidate for a peak sanctuary, referring exactly to the part of the peak visible from Thylakas. He, as well as Driessen and Farnoux (1991) noticed PP pottery there, while the absence of figurines seems to exclude, as in the case of Thylakas, the site to have been a typical peak sanctuary of the kind Davaras (2010) would expect. Another such case of formerly suggested possible peak sanctuary, now seen as refuge site, is Tapes Pano Kastellos (Nowicki 2000, Wallace 2003), also well visible from Thylakas. As in the former cases a small PP site occupies the peak (or in this case rather a spot close to the peak, off wind). Neither figurines nor pebbles (which were detected by Nowicki in the two former spots, Nowicki 2000) could be seen here, and to call the site a settlement seems overstated, as only one small ruin seems to belong to the PP pottery scatter. The intervisibility of these peaks and the respective PP presence might have been needed not for a ritual context, but for communication over a larger distance, an interesting concept which at the moment and with the available GIS data (digital elevation maps - DEMs) of Crete can hardly be tackled digitally, as the intervisibility is often a question of a few height meters more or less which can easily get lost in the rather imprecise elevation data[59]. In any case it is noteworthy that the settlement of Priniatikos Pyrgos sits exactly at the point (one of very few, see viewsheds on Figure 37) where both, Thylakas as well as Anatoli Stavromenos,

[59] This is a typical case where still only classical fieldwork – i.e. walking – can lead to possible success.

peaks can be seen - and it sees Pano Kastellos as well. A very interesting subject – clearly beyond the scope of this study.

Figure 38: The peak of Anatoli Stavromenos as seen from Thylakas peak.

That Mt. Thylakas could have been a ritual place - if rather as a “hilltop shrine” (cf. Watrous 1995) than as a “peak sanctuary”, details may be a matter of perspective - in the MBA is not necessarily connected to its peak alone. As the name shows (and it’s certainly “Thylakas”, not “Phylakas”), the deep, crater-like doline on the mountain’s west side may have been of importance as well. Especially when taking into account that typical peak sanctuaries needed a kind of depression (chasm, bothros, crevice) and/or precipice to function as such, as Nowicki suggested[60]. The deep natural pit west of the Thylakas peak (visible in its upper parts from many of the Tsivi South sites) may also have had a symbolical meaning of some kind for the MBA mountain dwellers of the region[61].

[60] Nowicki 2001: 32: “A precipitous slope on one side and a chasm, being a central and focus point of the sanctuary, may have been such “essential features.”

[61] The surface in the amazingly deep doline does not show any traces of Bronze Age use. This is especially interesting when taking into account that the two other, similar dolines to the West are different: the one right next to the doline closest to Thylakas peak has surface traces of nearly all epochs at first gaze (first and second millennium BC, Roman, and later), the second deep doline from there to the West sits like an impressive deep pit in the centre of the town of *Lato tin Etera*. The fact that the main deity connected to this town was Eileithia could easily have been seen in connection with such a deep depression in the earth. Whatever custom and time attributed to the deepest doline next to Thylakas peak, did not allow any settlement (or other permanent installation, apart from terracing at the easiest parts of the very steep slope) as far as the surface record can tell. May be a taboo of some kind was effective for this “hole in the mountain” – understandable with a deep depression over 200 m below the peak.

Another special feature to be mentioned in this context is the most unusual upright stone near Site 49 with a hole, through which the peak of Mt. Thylakas is visible as if through a scope (Figure 39, 40). It seems hardly possible that this “special effect” is totally accidental, although archaeologists have been known to develop many ideas about baetyl-like stones. That these stones do sometimes have special (and probably some kind of ritual) functions can be shown by the upright, baetyl-like stones in Gournia (Hood 1989, Soles 1991) and recently in Galatas, at the base of which figurines were found[62].

As the block might have been integrated in some kind of wall (enclosure? which in this case unfortunately is not datable due to surface conditions) that may be of BA dating (very eroded, it seems to form a kind of big oval), the whole space might have had a special, even ritual, role. Still without excavation it is impossible to do more than hypothesize about its meaning or function[63].

Figure 39: Vicinity of Site 49. Upright stone with hole and Mt. Thylakas in background.

[62] G. Rethemniotakis, pers.comm. (ca. 2006, during its excavation), cf.also http://chronique.efa.gr/index.php/fiches/voir/785/ (from 3/2010, last accessed 21-11-2011) where it is mentioned as “unpublished field report” (which may have changed now).

[63] If it is or isn‘t correct to call this kind of stone a “baetyl” also can’t be discussed here, but cf. Marinatos 2009.

Figure 40: Vicinity of Site 49. View to Thylakas peak through the hole in the upright stone.

It might be of interest here that not only the rural shrine of Thylakas in the Dikti mountain range area enjoyed some kind of continuity (or re-occupation), as similarly we know from the much more thorough excavations of the Kato Syme Sanctuary, the longevity of a mountain ritual place (here a spring sanctuary, seemingly of special importance for people involved in animal husbandry (Lebessi, varia). Possibly the occupants of Site 87 had originally planned to take the goat or sheep figurine seen there (see Chapter II.c.1), to one of them[64].

The fact that the Syme Sanctuary had an enclosure circling the ritual space and the (holy) spring is certainly interesting here, too, although in the Tsivi South area springs rather seem to have been avoided than sought out as ritual/settlement spaces in the MBA. If the spring region of "To Flej" had possibly achieved a numinous character due to the earlier settlement there, again can't be decided, still it is obvious that even though one would expect the spring area to be settled in MM times as well, only one small site with clearly MM (if early) pottery could be seen there among several wells and half-year running springs. This kind of "avoidance" is noteworthy in any case, as we know similar reactions to formerly settled spaces mainly because of "magical" reasons, like the village Rouma (south of Iraklion, region Alagni, cf. Watrous et al. forthcoming) thought as "στοιχειωμένο" (stigmatized, cf. "Kritiko Panorama", vol. 36.) and never resettled after the plague killed all but one inhabitant.

Another unusual space that might have been of a ritual nature should be mentioned here. At a distance of 125 m from one of the easternmost sites of the known settlement region (toponym "Tafos Kopranes"), a rock near a small but distinct hilltop is surrounded by a tiny pottery scatter

[64] The fine fabric this figurine is made of could – if found e.g. on Thylakas peak – hardly be told apart from any other similar fineware, of a different period, without (may be) comparative analyses.

of clearly MBA date (fabric Type 1, half fine Type 4, fine, mostly from thin or medium sized vessels, but the sherds are too tiny to give more detail).

The rock's surface was shaped lengthy oval with a more or less flat surface (natural?) that showed several small, bowl-like depressions (natural?) connected to each other by slightly erratic channels (natural?), in a row that ended in one deeper hole (natural?) with something like a spillway on one side (natural?). As all this has been sitting on the surface for eons it is impossible to tell how many of the features were natural or manmade (Figure 41).

Figure 41: Possible libation rock E of Site 49C seen from lower end, metal object 12 cm.

If this feature was or wasn't used in any ritual way cannot be determined, but because of the pottery scatter next to it it seems certainly noteworthy.

Another possible natural feature to have been used in some way in the BA is the massive rock near Site 10B ("Monocharakos" = "Single rock"), where parts of the nearly vertical, house-high rock were terraced with oncolithic blocks without there being a clear indication of function for these structures (too small and too difficult to approach for a small field-terrace). There is no pottery visible at this terrace. While in earlier phases in this area, small rocky peaks and ridges seem to have been regularly used (traces of – probably late – Prepalatial pottery, sometimes together with typical chipped stone-working assemblages/debris, can be seen on several sheer rocky heights in the region), it is unclear if this (and possibly other similar) rock features were used – and in which function – in the MBA (Figure 42).

Figure 42: Structures built along rock face (holding the little terrace now) 60 m E of Site 10B.

Since at the base of the high rock near Site 10B (at about the same distance) there can be seen a small EM II/ Late Prepalatial site, here again, no clearer propositions for an MBA use can be made, while the possibility should be kept in mind.

c. Moveable Finds

1. Pottery

A. Description

This study is based on on-site observations[1] of macroscopically recognizable characteristics of mostly coarse pottery visible on the surface in the vicinity of the studied sites[2]. Contrary to usual surface survey pottery studies, observations could be made only depending on what was visible at the time of the author's visiting. Thus this chapter should be seen as no more than a preliminary approach to the study of the area's pottery with due caution for the biases caused by not only taphonomic hazards (see below for more details on this) but also the uncertainties of in-the-field observations[3]. Certainly in a later stage it shall be interesting to study the Tsivi South area pottery in detail, not only in its own right, but as it might possibly shed a new light on long-standing discussions on early state-formation in Crete and the existence or not in this area of a Malia-Lassithi state (Knappett 1997: 207, and bibliography *passim*)[4].

Fortunately "considerable fieldwork and laboratory study" (Haggis & Mook 1993: 271)[5] has been undertaken for Mirabello bay area pottery, and various surface surveys conducted in regions near to the Tsivi South area (mainly on the coast) have produced an abundance of data that are useful for comparison. (Betancourt 2006, Haggis 2005, Hayden 2003-2005). Especially Haggis and Mook's article "The Kavousi Coarse Wares: A Bronze Age Chronology for Survey in the Mirabello Area" (1993) has given data and a good example in how to compile a typology for coarse surface pottery which *in nuce* I am going to follow here.

If only for the taphonomical condition of the Tsivi South region being a vicinity much trodden by herding animals, pottery traces left on the surface are only those that have proven the most resistant to the ravages of time, i.e. mostly tough coarse ware. Fine sherds are, where preserved at all, usually reduced to tiny shapeless pieces devoid of any trace of surface treatment (slip, paint). Thus dating by diagnostic pottery (fineware) shapes and decorations can hardly be applied. With the help of diagnostic coarse ware fabric typologies as set up by Haggis & Mook

[1] The author had no permit for pottery collection. Comparisons were made based on detailed macroscopical observations and photographs of the pottery on the spot.
[2] For the general approach to this kind of pottery study see Haggis & Mook 1993.
[3] For in-depth studies I agree fully with Knappet (2004): "The traditional use of typological and stylistic data is in itself inadequate, and has to be supplemented by, and integrated with, technological and compositional data. In terms of methodology this involves detailed analyses of vessel size and shape, fabric (using thin section petrography), construction technique, surface treatment and decoration." – a methodology that necessarily can only be following excavation.
[4] It is interesting to note that in terms of coarse-ware there doesn't seem to be any correlation between Maliot Minoan Palatial period sherds and Tsivi South material, judging from examples visible on the surface in the area surrounding the "palace" at Malia: Neither colour nor inclusions are closely comparable.
[5] Mentioning especially: Betancourt, P.P. et al.,(1984) *East Cretan White-on-Dark Ware. Studies on a Handmade Pottery of the Early to Middle Minoan Periods*. Philadelphia, and Day,P.M.(1991) *A Petrographic Approach to the Study of Pottery in Neopalatial East Crete* (Diss. Univ. of Cambridge).

(1993), it still seems possible to approach a dating of the sites under study, especially when combined with some other small features and finds that may precise the chronological ranges of the use of local coarse ware types. Still it should be kept in mind (and local pottery prooves this once again) that Early Protopalatial pottery has a "low level of standardization" (Van de Moortel 2006), i.e. a great diversity of possibilities exist, albeit in variation of recognizable basic themes (cf. also Knappett 1997:152: "there is not a strong unifying tradition across the Lasithi region in the sphere of domestic pottery production and consumption").

The shapes

With the help of comparisons to known shape changes in storage and cooking wares ("unmistakably diagnostic rims and feet", Haggis & Mook 1993: 269) over time, a rough dating of coarseware shapes can be approached. In the studied area the variety of tripod leg shapes seem to allow an approximate dating of nearly all studied sites to the Minoan (Proto-) Palatial period, and some may have been in use already before that[6] or were in use until later times. By creating a typology of local fabrics and grouping observed pottery accordingly some information can be gained to help in a rough dating of the studied architectural features (see typology below).

This means in detail that nearly all tripod legs are flat oval to oval in section and cooking ware rims have a rounded or only slightly everted shape[7]. There are many examples of tripod legs with (usually finger-impressed) raised outside ridges[8] or cut grooves: 1-3 ridges (at 13 of 336 sites), 1-12[9] grooves (at 20 of 336 sites[10]). These occur predominantly on flat oval (i.e. early) shapes[11]. Where parts of the cooking pot bases are preserved, the position of the legs was always slightly everted[12]. In three cases vertically positioned round section grooved tripod legs (i.e. LM III) were seen. Further three round section tripod legs without groove (1 of which with typical thumb imprint) were noted[13]. The grooves of the two phases are mostly clearly distinguishable: Earlier grooves are (because of the softer material) more eroded and not as sharply cut as the later variety (if with V-shaped grooves) or were produced by a blunter instrument (producing U-shaped grooves) (Figure 1).

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[6] MM IA in Eastern Crete may have been synchronous with Protopalatial phases of Knossos and Phaistos: Cadogan 1983: 509. Thus possibly earlier looking wares might still point to the settling of the area during the time of the first Minoan palaces. Cf. also Nowicki's (2000) general dating of Minoan mountain sites in the area to Late Prepalatial (as "mudbrick sites", p.36) or Protopalatial (those constructed from "large boulders" ibid.) times.

[7] For the shape of tripod-legs and rims over time see Barnard 2001, Betancourt 1980.

[8] One (site KA05) has a short ridge underneath, connecting base of pot and beginning of leg, thus further stabilizing a rather large pot.

[9] The tripod leg with twelve grooves looks very unusual, the grooves being distributed evenly all around the oval leg.

[10] Sites with grooved pottery: 22 have tripod legs (two are LM III), 3 have grooved handles.

[11] Ridges on flat oval tripod legs dated to MM I-II by Hayden, 2005, pottery catalogue (on CD), e.g. her number 1404 (from VK6/8) fabric GD cooking 1a/b (corresponding roughly with my Type 1), p. 45.

[12] Everted tripod legs as typical for Protopalatial: See Haggis & Mook 1993: 283, fig. 20.

[13] Interestingly these were made in a hard variety of Type 2 (see below) fabric. The comparable Kavousi fabric class IV is dated by Haggis & Mook 1993 to either MM I-II or LM III.

Figure 1: Grooved tripod legs – PP (right) and (rare) LM III (left).

An interesting question is raised by the often large numbers of tripod legs seen per site (cf. Site 142: 12, 143: over 15, 172: over 20). This suggests a possible use not just for cooking but also for cheese-making, as intense surface survey in a mostly agricultural (not herding) region like that of the Galatas Survey shows a usually much smaller amount of tripod legs found per site (in 52 identified Protopalatial farmsteads most produced 1-3 tripod legs, only one had 5)[14].

Four unusual items for the region from Site 17 D (MM II lamp rim), 87 (rump of lying animal figurine) and 151/44D (loom weights) should also be mentioned in this context. The rim (fabric Type 2, see below) has the typical shape of Protopalatial stone lamps like the example from Malia Quartier Mu, Agios Nikolaos museum 13741[15] and may even have been intended with its carefully slipped surface to imitate an actual stone lamp (see figure 2).

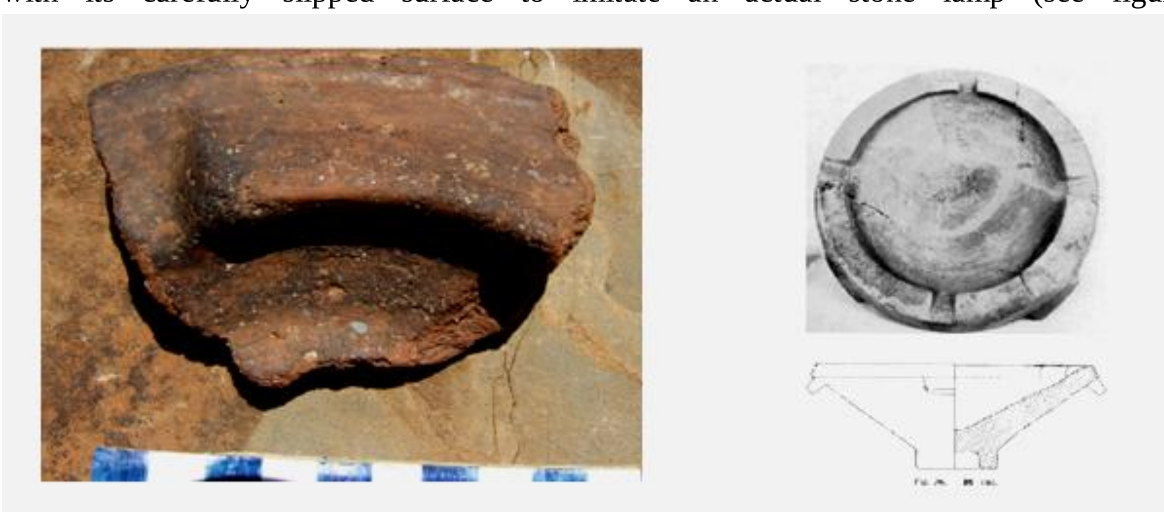

Figure 2: Lamp rim sherd from Site 17D (left) and a PP stone lamp from Quartier Mu (right).

[14] My thanks to prof. Vance Watrous for allowing me to use Galatas survey data. The possibility for various uses of cooking pots was already mentioned by Betancourt 1980: 8; a possible use as braziers is suggested in Pelon 1966: 567.

[15] Published in Detournay and Poursat 1980: 59-60. My thanks to prof. Poursat for this information.

The animal figurine rump from Site 87 (fineware) is broken off at head and tail. Underneath its belly a small ridge of clay remains that seems to suggest it was attached to some kind of other object (possibly a vessel). As site 87 has no similarity with a peak sanctuary, where the finding of such objects would usually be expected, one may only suggest that objects ending up as votive offerings in peak sanctuaries must have started somewhere in other surroundings – here possibly from a potential offering person's home or workspace. But it is just as possible[16] that an object like this had its typical function as part of a household shrine (vel sim.) – judging from the fact that most known animal figurines seem to come from some kind of ritual surroundings. While the position of the legs have no similarity with the popular bull figurines, they do look like belonging to a simplified version of a resting wild goat (*agrimi*) as depicted e.g. in the Late Minoan Zakros (or "Sanctuary"[17]) Rhyton[18]. While site 87 is certainly set in surroundings totally fulfilling archaeologists' dreams of "a thoroughly wild landscape, a mountainside" (M. Shaw 1993: 678, n. 70) it is certainly not "above human habitations" (Huebner 2003[19]) – although arguably until recently archaeologists didn't know much about human habitations of the mountains in Minoan times. Even though the possibility of site 87 being a "hillside shrine" (ibid.) cannot be excluded, it might be necessary to rethink the Minoan relationship with the mountains and their nature since at least Protopalatial times with the data from Tsivi South sites presented here. Let it be noted that the Sanctuary Rhyton shows a scene absolutely convincing for a "normal" (and not hierarchical, as suspected e.g. by Huebner 2003) scene of mountain life, as goats do have the tendency to occupy the highest and most comfortable available spot - manmade or not[20]. Thus the use of a goat as symbol may – certainly for Minoan mountain dwellers' minds - have represented rather fertility and resilience than hierarchy: A typical scene of animal life in difficult surroundings, conveying trust in nature and land – notwithstanding (or even supported by) its possibly wider religious connotations. Thus I would interpret the animal figurine fragment from site 87 as probably a perfectly normal, everyday religious symbol that need not have been connected in any way with an actual superordinate shrine. And short of identifying a goat as anything else than that (e.g. a symbol for a divine being or even "sacred ecstasy" – Huebner 2003) I could well imagine that the use of a rested (i.e. well fed) goat as decoration on an everyday vessel might have been seen as good omen (vel sim.) for the owner's herd and economical well-being[21] .

[16] Especially when remembering how small our knowledge of Minoan non-elite, non-urban households is.
[17] I admit I don't really see the "peak" often connected to that sanctuary (cf. Huebner 2003) – that was probably derived from archaeologists' minds trying to explain the combination of nature and ritual in terms of findings they are familiar with.
[18] Similar goats' positions on seals e.g. from nearby Mochlos, cf. Soles and Davaras 1994: 399.
[19] Citing: Rutkowski, B., "Minoan Sanctuaries: The Topography and Architecture," in R. Laffineur, ed., Annales d' archeologie egeenne de l' Universite de Liege 2 [Aegaeum 2] Liege 1988), 72.
[20] The Sanctuary Rhyton shows a scene imaginable as absolutely normal in surroundings where goats run freely. They would certainly occupy a place like the one shown in such a manner naturally, as the author has had ample occasions to observe in similar surroundings.
[21] Dabney (1995) p.46 believes that periphery people exchanged "their surplus for specialized craft products produced at the center to be dedicated at the sanctuary."

Figure 3: Figurine of resting animal (probably goat) from Site 87.

The fragmentary (half) loom weight from Site 151 is unusual in that it is the only one of its kind seen during the study. Site 151 is one of the lowest sites in the area and situated close to the village of Kroustas. The loomweight is discoid, with one central hole, flat-topped and with a probable original diameter of ca. 9-10 cm (thickness 3 cm at thickest). This kind of loom weight is typical for MM I-II (Evans PM IV, 71 and 83, fig 51-27).

A second, possible loom weight comes from Site 44D, has a (fragmentary) cylindrical/ovoid form with 6,5 cm diameter and an original height of at least 6 cm, with one vertical hole of 0,9 cm in the middle. Similar (in general lines) loom weights are known from PP Malia (Quartier Theta, cf. Effenterre, H. van and M. van Effenterre 1976: 81, foldout 18 – the "Peson sphérique" they show is not as high as the one from 44D).

Both are made from a fabric (Type 1 and 2) locally known (Figure 4 and 5). The rarity of loom weights is an obvious sign that weaving was not one of the main occupations of the Tsivi South mountain Minoans.

Figure 4: Discoid loom weight from Site 151.

Figure 5: Ovoid loom weight from Site 44D (stick in central hole).

The fabrics

One of the main elements of information for the chronological range of coarse ware pottery is the fabric, including colour and the kind of inclusions visible (Haggis & Mook 1993: 270). Fortunately Haggis and Mook could base their typology not only on surface material, but also on comparanda from excavations in the adjacent area[22] and thus reach a rather solid base for dating their coarse wares. Naturally in the present study nothing similar is possible, but their descriptions allow a rather close correlation, even though it seems that coarse wares are mostly locally produced (cf. also Knappett 1997: 196 “noncentralised production mode”) and necessarily show slight differences even in neighbouring areas[23]. This is especially notable when comparing neighbouring Vrokastro-survey pottery types (Moody 2005) with the Tsivi South pottery to the North-West and Kavousi survey pottery to the East: The latter two seem to show more similarities with each other than with the area inbetween (details of similarities/differences see below).

A main feature of the Mirabello area pottery has been recognized as granodiorite inclusions (Figure 6). The subject of this special material has been discussed for Mirabello pottery since the early 1990ies (for more detailed bibliography see Haggis & Mook 1993: 290 and the mentioned survey-publications, also Knappett 1997). In these publications the ubiquitous inclusion material is always mentioned as originating from an area between Kalo Chorio (Istron) and Gournia (Haggis & Mook 1993: 290 n.58; “granodiorite inclusions indicative of a source near Gournia” still in Knappett 1997: 119), and thus a remarkable deposit of granodiorite in the Kritsa area (S of the village) has not been taken into account in Minoan pottery identification[24]. Still it should be kept in mind for this study as otherwise totally distorted conclusions are to be expected. Potters from elsewhere in the Mirabello region may even have been provided with granodiorite from the Kritsa deposit. Thus the "old MM I-II regional production center at Gournia" (Haggis/Mook 1993: 292) might need to be seen as only one of at least three such centres in Protopalatial times (with the Minoan town at Priniatikos Pyrgos and the Kritsa region).

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22 “Thus, it is the exclusive appearance or dominance of certain fabric types in well-stratified and dated deposits that is the basis for the attributed chronological range.” Haggis & Mook 1993: 271.

23 For imported cooking wares in the wider area in Protopalatial times see Knappett 1997, 1999.

24 Hayden 2004: 99 suggested as possible origin also outcrops in the South of the Meseleroi valley and the Lato-Kritsa area.

Site 42 B Site 110

Figure 6: Granodiorite in Mirabello ware pottery at Tsivi South sites.

Apart from fabrics comparable to those known from other regions in the Mirabello region, the mountain area seems to have actually produced its very own typical granodiorite-fabric, here mentioned as **Type 3** or “muesli cookie” ware[25] , combining all of the local inclusion materials (including granodiorite) in one beige to light brown matrix and seemingly unknown in other Mirabello areas[26] (for detailed descriptions see the typology below). It occurs at no less than 37 of 336 sites (Figure 7).

Granodiorite is generally and in various fabrics a very popular inclusion in Tsivi South area pottery and an absolutely local one at that (occuring in at least 205 of 336 sites)[27].

Figure 7: Tsivi South “Muesli Cookie” ware (from Site 38, left) and its name-sake, a real Muesli-cookie (right).

One of the better known fabrics of the wider area is a buff-grounded storage material (possibly Knappett’s “fabric e”: 1997:119, Haggis & Mook’s Type XX: 1993:277-8) that similarly also occurs frequently in the Tsivi South area, with and without visible granodiorite inclusions. Interestingly this seems to have been one of the fabrics also imported to places like Myrtos

[25] This name came along naturally while reading about some of Jenny Moody’s beautiful pottery descriptions/names for the Sphakia survey.
[26] My thanks to Kellee Barnard, Jenny Moody and Krzysztof Nowicki for giving me their opinion on this.
[27] Moody, even though being aware of the Kritsa area granodiorite deposits, still calls the fabrics made with it in the Bronze Age “Mirabello fabric […] probably originating in the Vrokastro-Gournia area”, Moody et al 2003: 67, n.41.

Pyrgos (Knappett 1997: 198) and Malia (ibid. 197) in amphorae and pithoi. As mentioned above it is usually interpreted as coming from the Kalo Chorio/Gournia area.

The popularity of a similar fabric (**Type 4**, see Figure 8, 9) in the Tsivi South area (at no less than 199 of 336 sites), where it might be of local origin, certainly raises new questions as to where exactly the said imports - and goods transported in the vessels - might have come from[28].

Figure 8: Tsivi South Type 4 fabric. Could this have been imported to Malia (Quartier Mu) and Myrtos Pyrgos? Two varieties: Storage vessel Site 21 (left), amphora rim Site 72 (right).

Figure 9: Dense variety (Site 12, pithos rim, left) and medium fine variety (Site 201, right)

Remarkable are the various medium fine varieties (cf. Figure 9, 10) of local coarse fabrics. I call them "medium-fine" instead of the usual "medium coarse" (vel sim.) because they are nearly exclusively used for vessels imitating - intentionally or unintentionally - the finer wares of more "urban" regions. If this was done with the intention of "copying" more urban styles or happened out of necessity naturally can't be decided from the material record visible on the surface, as the rarity of real fineware in general doesn't allow judgement for possible élite implications for the occurence of fineware.

[28] Knappett 1997. p.197: "Most of the semi-coarse and coarse buff fabrics represented in the Quartier Mu assemblage are imported amphorae, lekanai, pithoid jars and pithoi, from the Mirabello area (fabric E), the South Coast (fabric D) and the Mesara (fabrics F1-3, and G)."

The most popular medium fine ware is Type 4[29], probably because it is buff, like real finewares, but it has less and finer inclusions than the storage wares as if the coarse fabric mixture had been sieved before production or much lesser and smaller inclusions used for the same pure clay. Some of these medium fine vessels are also slipped with a buff slip, thus looking even more similar in kind with fineware, and are sometimes decorated with black paint (only traces preserved). A recognizable shape here are e.g. straight-sided cups. The medium fine fabrics occur in at least 110 of 336 sites.

Let it be said, also, that where visible even what looks like "real" fineware at first gaze often contains tiny pieces of the typical for Type 4 reddish siltstone inclusions, with or without granodiorite, and may have been made locally. Fineware occurs at least at 168 of 336 studied sites (Figure 10).

The only preserved polychrome sherd, seen at a recently bulldozed scarp (site KA05).

Medium fine fabrics type 1 (top l), 4 (right), Haggis/Mook Class III (bottom left) (site 190)

Figure 10

B. Typology

Type 1

Like the other most popular fabrics of the Tsivi South sites often including granodiorite inclusions, **Type 1** is a dark orange to brown (rarely dark red) cooking fabric that seems to have great similarities with Haggis & Mook’s Class VI (this is said to have always granodiorite). Occurrence: At least at 299 of 336 sites (Figure 11).

[29] Please note that this judgement is again made from a macroscopic perspective.

Figure 11: Type 1 pottery without obvious granodiorite (Site 26, left), or with granodiorite (Site 27B, right).

Type 2

Type 2 is similar in the varieties of colours it appears in, but always contains a clear amount of phyllitic inclusions, too (occurrence: 285 of 336 sites

Figure 12: Type 2 pottery from Site 77.

Close to the granitic-dioritic outcrops of the area SE of Kritsa there is also a large deposit of phyllite-quartzite (cut by the road SE of Kritsa). Both are situated at less than 1 km distance from the easternmost sites mentioned in this study. Phyllitic inclusions exist also naturally in other local clays.

It should be noted how rarely fabric with pure phyllite inclusions occurs in the Tsivi South area, while it is by far the most popular fabric in Neopalatial times elsewhere in the Mirabello area (Haggis/Mook 1993: 281, Moody 2005: 154, and generally in the Malia area, Müller-Celka pers. comm.) This alone raises doubts if the Tsivi South sites were still used in Neopalatial times. But even the few extant occurences (at 15 of 336 sites) may not be datable that late in the study area: Known Neopalatial (in the Kavousi region exclusively NP) phyllite fabric is durable, smooth and hard (Haggis & Mook 1993: 281), with well imbedded inclusions[30], while Tsivi South examples must be earlier: the material appears soft and erodable, shapes (like flat oval section tripod legs, see figure 13) are early, the surfaces feel rough. None of the sherds seen had phyllite packed as densely as in typical NP fabric. This material looks slightly similar to seemingly Protopalatial sherds (by Mirabello area standards) that can be noted in the Malia region (cf. Figure 14).

Figure 13: Probably PP local phyllitic fabrics. Flat oval tripod leg section with nearly pure phyllite inclusions (Site 114 , left), and detail of extremely flat oval tripod leg Site 120.

Although coarse pottery from the Tsivi South area seems to have similarities with e.g. Kavousi area pottery, its several unique features ("muesli cookie" ware, possibly early eroded phyllite ware, all coarse wares also as medium fine) support the general assumption that pottery is mainly produced on a local basis and with local raw material.

Similarities of regional coarse pottery types

The Tsivi South Type 1 (comparable to Haggis & Mook Class VI) seems to be a very popular fabric in the Protopalatial Mirabello area from E (Kavousi) to W (Kritsa). Still at close scrutiny even without magnification small differences can be noted: Similar fabric on the surface of Priniatikos Pyrgos e.g. often contains more small, sandy inclusions, similar to Protopalatial pottery from Kritsa centre[31], whereas Tsivi South area Type 1 pottery often contains also small dark inclusions and tiny pieces of phyllite. The firing/colour of the Priniatikos Pyrgos material seems to be very similar to the comparable Kritsa centre pieces (intense red), on the other hand those from Tsivi South tend more towards the brownish than the reddish tones and have more

[30] Haggis & Mook 1993, p. 281: "its complete absence on single-period survey sites and in excavation contexts of Early and Middle Minoan date (figs. 17, 19) further supports its LM I date".

[31] This pottery became visible in great quantity when new telephone lines were installed in Kritsa centre, especially in the area near the *plateia*. It is interesting that Evans noted to have bought a Minoan (inscribed) juglet purportedly from a region he called "Prodromos Botzano". The area the pottery came from lies between the church of Ag. Ioannis "o Prodromos" (at the graveyard) and the quarter called "Botsano" not far from the main church and south of the central plateia (Evans 1894: 279).

similarities among each other (even in sites that are further apart from each other like e.g. site 146 and site 168: 3,9 km distance and ca 400 m difference in height) than with Kritsa centre fabric (the origin of which lies 2,8 km from site 146 and at ca.150 m difference in height).

Pottery of the Malia region always seems to contain phyllite, whereas the small oncolithic sites in the region close to Agios Nikolaos town[32] show granodiorite and are reddish in colour. Only the (very little, compared to Iron Age material) Bronze Age pottery from Thylakas peak sanctuary is amazingly similar to Tsivi South pottery and suggests that the oncolithic building mountain dwellers may have used this typical peak visible by many of them as a sanctuary (one bull figurine head and other BA pottery seen by me on Thylakas also showed the same fabric). All in all it seems from the point of view of the pottery that the Tsivi South sites functioned as some kind of common group rather than independent, isolated units (Figure 14).

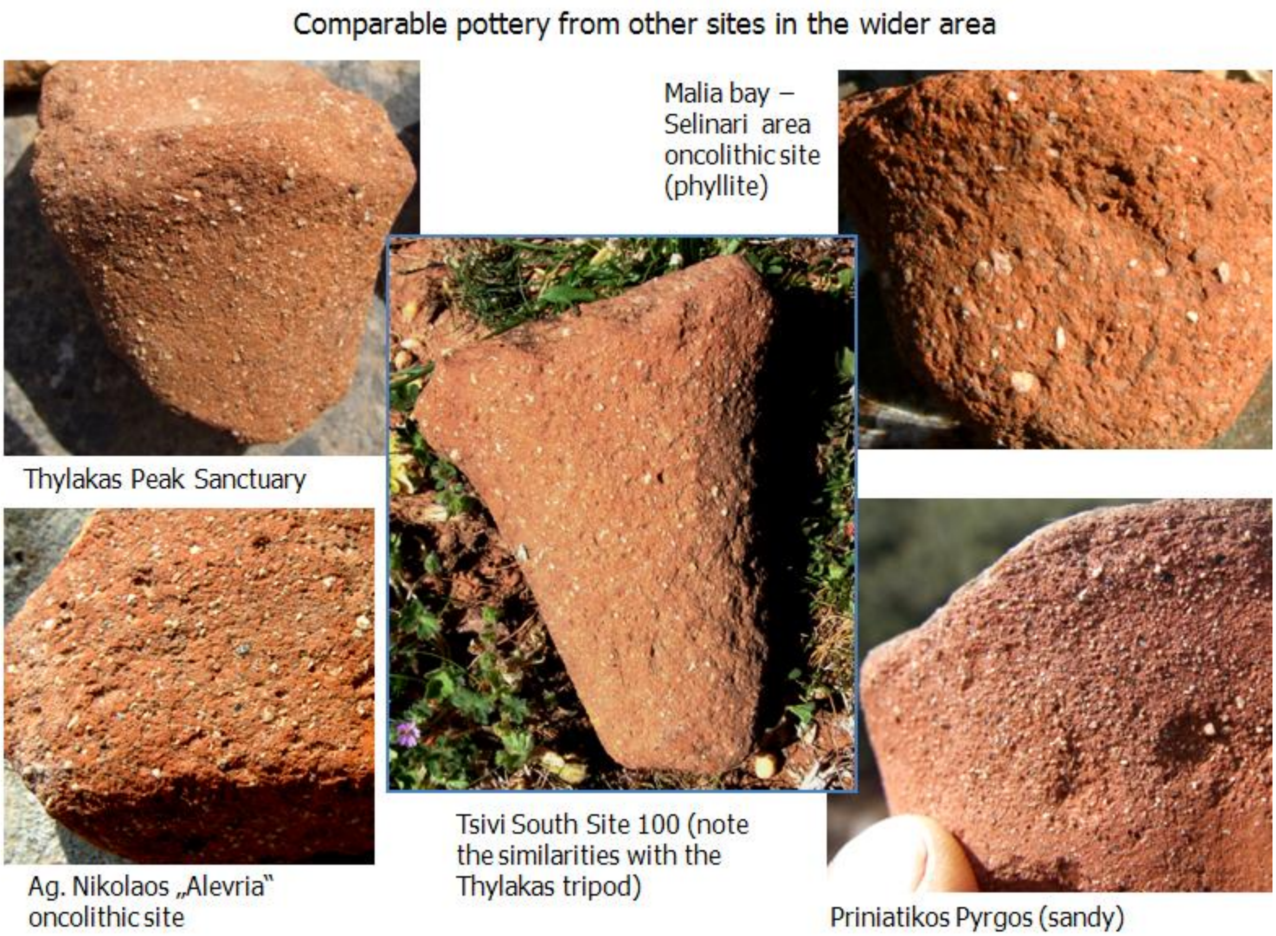

Figure 14

[32] Not published, but several are known to the Archaeological Service, e.g. Almiros and Alevrio.

Distribution

Pottery distribution (Bintliff & Snodgrass 1988: 508) is in the Tsivi South area, as elsewhere (e.g. in Boeotia), not as one would expect from simple logical thinking. An intensive survey of the studied area would show that pottery is mostly but not necessarily concentrated closely around the sites. As the ruins producing the scatters are clearly visible, a fact that could be studied in this area is the actual relationship of habitation or dwelling ruin to pottery distribution: depending on the slope and surface cover (e.g. in the forests) visibility of scatters of the same kind/size of dwelling ruin can vary between very few pieces/none at all (Sites 175, 8, 169), or scatters very close to the dwelling ruin (varia), ruins with large amounts of sherds (Site 77) or thin scatters over several hundred sqms (Site 19, not many pieces) - without necessarily any at first gaze visible reason for these differences but slight terracing, steeper slopes (the case of Site 19) or slight differences in current surface soil erosion.

One of the less obvious reasons in this area for the cases where pottery stayed close to the ruins may be forest cover in the past that began before the pottery could spread much by erosion. If the ground is covered with tree parts like pine needles – this happens within a few years after the regrowth of trees in areas of the pine forest agriculturally used until recently[33] - pottery on the soil surface below will hardly move for hundreds or thousands of years. For instance the KA ruins were seemingly situated in a forest until the late 20th century, where a severe fire erased the trees (and most of the loose soil cover below). They are regrowing after 15 years now visibly - and would be more so without overgrazing[34]. That means that even fire events baring the surface for decades in places, elsewhere wouldn't allow for much weathering-movement by artefacts[35] - only if by human intervention the forest didn't regrow.

As for the fact that surface pottery should have minimal upslope concentration (Bintliff & Snodgrass 1988: 508): whereas most sites of the Tsivi South area show pottery logically spread according to the surrounding landscape (downhill, collecting in depressions below, decreasing in number with distance), several sites show distinctly defined scatters at some distance between 10 and 40 m from the dwelling ruins uphill or parallel to the ruins, where normal erosion and time could not have taken pottery (sites 59, 71, 72, 74, 75, 137, 138/138B, 141, 158, 162, 197 - sites not related in any other way)[36]. Without the certain existence of a ruin this feature would be difficult to note, but in the mentioned cases ruins are clearly discernible. Small but distinct scatters can be seen 20-50 m from (and slightly above or beyond a ridge) the ruins. In each case

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[33] As could be witnessed in the recent years after several fires in the wider region.

[34] It takes a while until all the residue of the fire covering the surface is washed away, and it is notable that fallen burnt trees also reduce erosion (and would have done more so without human intervention, i.e. clearing of fallen wood).

[35] The area – as described in chapter I, is mainly forested, from cypresses in the very East over mixed cypress/kermes oak, kermes oak, mixed kermes oak/pine, nearly pure pine to the West.

[36] Cases with similarities that are not included here are: When two clearly discernable building ruins are close to each other and the scatter is one, the situation is interpreted as one site (sites 23, 100). On the other hand when there is a *perivolos* between the two building ruins clearly defining each as within its own space they are treated as two different sites (23B1/23B2, 60/60B, 157/157B, 213/213B).

the scatters present a similar image of more or less densely packed pottery containing cooking ware, sherds of various medium fine Type 4 vessels and sometimes fine ware (in the case of Sites 72 and 137 the pottery can be seen off-ruin more than anywhere else around the ruin, in the case of Site 197 there is also a pithos base sherd at the offsite-scatter). The positions of the scatters don't show any traces of building or arrangement of their surroundings (Sites 72, 141 and 162 might have a few aligned small stones and a few larger blocks added to bedrock to form a platform). Still they share being positioned on level (albeit rocky) spots, sometimes no more than a narrow ridge (Sites 71, 74, 137).

Figure 15: Typical off-site, not downhill scatter at a distance from the ruins: Site 72 and 75.

The fact that surface pottery undergoes all kinds of "regular stress from natural and human activity" (Bintliff& Snodgrass 1988, 508) as herding, ploughing vel sim. does not explain this kind of displacement. Naturally it is unclear now, how the pottery actually got there, but the possibility for Minoan activities being responsible for this seems probable.The kind of pottery represented might suggest a small storage or food preparation area, even though the positions sometimes seem too far from the ruins to easily explain the scatters as traces of e.g. outlying kitchens vel sim. in the way a modern person would imagine. With Site 59 the scatter appears on the road (road Type 2) near the site, with site 137 on a very prominent rocky ledge at the edge of its *perivolos* where also a lookout (possibly for site 133, 90 m to N, as well, a site that has no visual connection to the wider region) might have made sense[37].

Other background noise outside the logical range of the dwellings seems to have been more or less none-existant (an interesting exception: a bee-hive sherd seen between Site 25 and 26), apart from two (region of Sites 99, 108) clearly offsite areas with more or less evenly spread tiny, very weathered coarse sherds. None of them are diagnostic but most are recognizable as Minoan by fabric. These areas are remarkably flat (like fields) compared to the other surroundings and contain a moderate amount of soil kept from eroding off the edge of the area by *perivolous* and terracing.

[37] Site 207 may show traces of a similar arrangement. Typical Minoan Protopalatial pottery can be seen at a recent mandra ruin some 60 m NE and 2 m below. Pottery eroding along its natural "route" here would have followed the runoff slightly to the E and not ended up at the mandra.

This situation is interpreted here as showing the traces of Bronze age manuring (cf. Bintliff and Snodgrass, 1988: 508, Bull et al, 2001: 227). That Minoans did manure their offsite fields has been proven beyond doubt[38], thus the fact as such is not unusual. On the other hand I am not aware of any publication mentioning similar pottery scatters as signs of Minoan manuring. Although the 99 and 108 sites are adjacent (and both large, probably a condition for the existence of enough waste to produce manure), the existence of these scatters might be incidental and exist elsewhere, too. Still it is interesting to note that both fields are of comparatively (for the areas) good quality and may have been used for special crops. This is corroborated in the case of the 99 field by half-round "pocket" terraces[39] visible only within one small *perivolos* (of several belonging to the 99 sites). Following from their positioning inside of a small Minoan *perivolos* and no later traces of landuse in this region it seems acceptable to take them to be ancient, suggesting that may be some valuable kind of tree was cultivated (and manured) in this area[40].

A special case in the field of pottery are the cases of bee-hive sherds (more details see the small appendix at the end of this chapter). They are parts of basins/lekanai[41] with a diameter between 35 and 45 centimetres, in the Tsivi South area mostly of a slightly finer variety of some local material, fired harder than usual, of a thickness similar to cook-pots. They are usually recognizable as such by their inner hatched or crossed grooves (cf. Knappet 2004: 159). The continuous use of the area for bee-keeping is notable - it produces a large variety of honey plants – and thus Minoan bee-hives should be expected as well.

Main features in Tsivi South coarse pottery fabrics – typology summary:

General remarks: Munsell numbers shall not be used here as (probably due to varying processes of firing) all types come in a variety of colours only generally described. The obvious differences lie mainly in the kind of inclusions.

Type 1:
Colour/inclusions: (Dark) red to orange brown with many white grits (tiny to 0,4 mm) sometimes with granodiorite (contra Haggis/Mook: Always granodiorite), comparable to Haggis/Mook Class VI (MM I-II).
Use: Mostly cooking pots.

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[38] Bull et al 2001: 239: "we propose that a highly organized agricultural strategy, involving deliberate and systematic application of manures, was being applied at Pseira between the Early to Late Minoan I periods". Cf. also Betancourt, ed. 2006: 245 with further literature and comparanda.
[39] This terrace shape is typical for tree-terraces, Moody and Grove 1990: 183-184.
[40] Even though the elevation limit for olives in the Mediterranean is given as 800 m asl (Moriondo et al. 2008: 100) and the two sites lie between 700 and 800 m asl, locally growing wild and/or domesticated olives show that olives could have been a possibility. Warren's limit of 400-600 m asl for olives (Warren 1972: 276), also mentioned in Hayden 2004: 70 is too low in any case for Crete. Cf. also Ch. I on the subject.
[41] Depending on who describes them: basin: Barnard 2001: 348; lekanai: Knappett 2004: 159.

Comes also in a medium fine variety for small vessels and cups[42]. (at 299 sites)

Type 2:

Colour/inclusions: Reddish brown to orange (rarely dark buff), phyllite (and/or siltstones) and many white-grey gritty inclusions. Similar with Haggis/Mook Class IV (MM I-II + LM III, for the latter there exists a tripod leg site 151: LM III round w finger impression). In some areas - especially high in the KR-and KA- site range - nearly pure phyllite versions that are often very soft and eroded and belong to, where recognizable, early shapes.

Use: Cooking pots, storage.[43] (at 285 sites)

Type 3:

Colour/inclusions: "Muesli cookie" material: Ochre to light orange brown, rarely dark red, many different inclusions in various sizes: Granodiorite, grey, black and white grit, small phyllite in various colours, siltstones, microscopic mica (various colours). Not known to other specialists of the Mirabello area, except Nowicki (pers.comm.) who dates it to MM II. (Local variation of Haggis/Mook Type III?).

Use: Cooking pots, storage. (at 37 Sites)

Type 4:

Colour/inclusions: Buff to light orange material with red to brown, sometimes foliated, inclusions from the phyllite series (mostly siltstone) abundant (sometimes very dense) in various sizes (< 5mm). White to light gray and off-white gritty inclusions (various amounts), sometimes also white and black grano-dioritic, small. Sometimes a buff slip is preserved. Comparable to Haggis/Mook 1993 Class XX (MM I-II).

Use: Storage (mostly pithoi, big jars), rarely smaller jars/basins.

A medium fine variety also exists for smaller vessels and cups. With tiny inclusions only, very typical for the "mountain-variety" of not quite fine ware.[44] (177)

In Haggis & Mook 1993 pp.273-274 another class of coarse-ware is described that occurs in the Tsivi South area and shall be mentioned as “Haggis/Mook Class III” in the pottery part of the Site catalogue (Appendix D):

“Type III: MM I-II (fig. 5)

The color of this fabric ranges from light orange to buff (7.5YR 616 reddish-yellow to lOYR 616 brownishyellow), with a pink to orangish-brown core with diffuse edges (2.5YR 516 red to 5YR 516 yellowish-red). Black-and-white granitic-dioritic inclusions are 0.3-3.5 mm in size and abundant. These are the most obvious inclusions in type III, and often protrude beyond the surfaces, giving them a rough

[42] Cf. the Vrokastro „GD 1a cooking“ (Moody, 2005: 153, there compared to Haggis&Mook Class IV, which must be mistakenly given instead of VI, but see the differences in inclusions above). In the Tsivi South area in many cases there are no clearly visible granodiorite inclusions, even though the visible white gritty (quartzy?) inclusions may be the granite parts of granodiorite on occasion; these compare possibly best to the “GD 1c cooking” (ibid., inclusions primarily quartz), dated to Protopalatial and earlier, from the Vrokastro area.

[43] There doesn’t seem to be a comparable fabric in the Vrokastro area.

[44] GD 1a,b and 2 (Moody 2005: 152-3) from the Vrokastro area both have some comparable features, but only in combination with granodiorite inclusions, whereas in the Tsivi South area this fabric often doesn’t show any granodiorite.

texture and a "salt and pepper" appearance. Discrete white to very light gray, angular to subangular, elongate inclusions are 0.3-1.0 mm in size. They are rare and not always apparent. "Gold mica" particles (biotite), microscopic to 0.3 mm in size, are also rare and frequently not visible.” [p.273/4]

C. Chronology – affinities – conclusions

Of all 336 sites the following data can be gained for pottery fabric incidence frequency (Chart1):

299/336 Type 1: at 88% of the sites
285/336 Type 2: at 85% of the sites
37/336 Type 3: at 11% of the sites
199/336 Type 4: at 59% of the sites
168/336 Fineware: at 50% of the sites
110/336 Medium fine: at 33% of the sites
205/336 Granodiorite: at 61% of the sites
15/336 nearly pure phyllite (NP?) at 4% of the sites
9/336 no pottery: at 2% of the sites (see below)
7/336 LM III pottery: at under 2% of the sites
13 of the Minoan dwelling sites show also a possible Venetian re-use in their close vicinity, i.e. 4% of the sites; one has Roman, one Late Roman/Byzantine presence.

No pottery was seen at these sites:

17B: Apart from a few tiny traces of possibly Minoan fabric, only medieval pieces are visible (the church of Agios Ioannis next to the Scatter had a metochi - or small moastery? - few walls of which are left in a dense growth above the scatter)
76: The ruin traces are situated in a slight rise in the middle of a colluvial doline and are nearly covered in field clearing rubble, pottery is probably buried.
84B: Soil overgrown and space re-used intensively until recently. Slope below short ending in a winter runoff - any possible pottery might be washed away.
125B: Unclear ruin. No dwelling.
136: 100% ground cover (forest)
145: 100% ground cover (forest)
175 : 100% ground cover (forest)
KA 10: No recognizable reason, even with strong erosion some small pieces should have remained.
KA 10B: 100% ground cover (see previous).

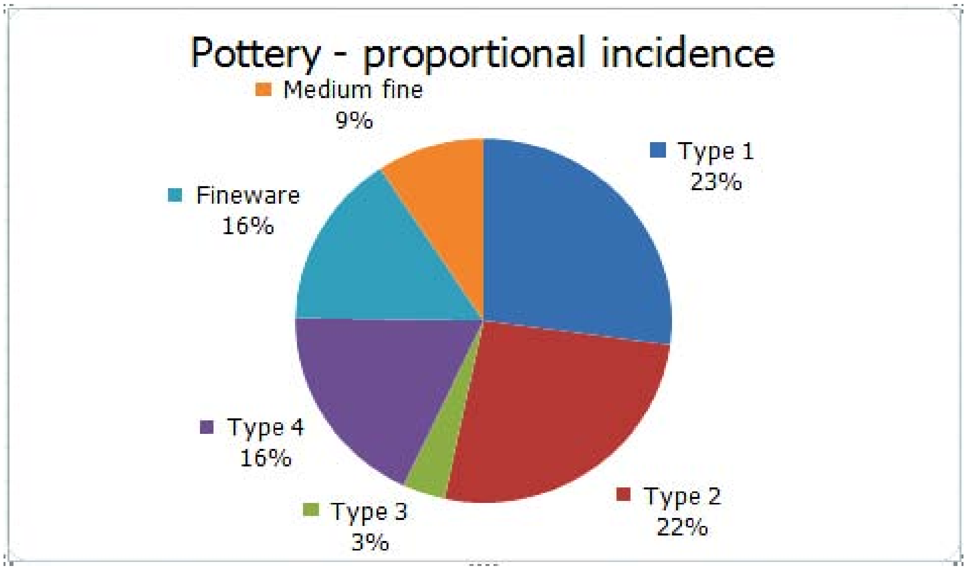


Chart 1

From this it is obvious that visible near the sites pottery can be dated mainly to the Minoan Protopalatial period (with few exceptions, where additional LM III pottery was seen, and, if the phyllite fabric should be Neopalatial after all, about 4% sites that continued in use into the period of the Second Palaces). As it is always possible that among the unrecognized sherds are those that belong to other periods, and as we don't know how much the inhabitants of the area remained faithful to older pottery traditions, the only conclusion here can be that all sites must have been founded (and the oncolithic structures probably built) during the period of the First Palaces.

The use of grano-diorite (known since EM I as temper in the Mirabello region, cf. Hayden 2005: 4, and intensively since EM III, also at Gournia) in the area's pottery shows an affinity of the Tsivi South slopes towards the closest coastal region, i.e. Minoan towns like the one under excavation at Priniatikos Pyrgos (Minoa) and Gournia, whereas there don't seem to be any similarities with pottery from Malia (although stone vessels might have come to both from the same source, cf. next chapter). Noteworthy is also an EM III sherd seen above Site 12 (where also other EM sherds can be seen – but no ruin traces) that shows a decoration of mottled red to dark with parts of the typical light beige striped triangle of exactly that kind of ware known from the North Trench at Gournia[45] (Figure 16).

[45] My warm thanks to Prof. Watrous for allowing me to use the Gournia photo here.

Figure 16: Late Prepalatial sherd on slope SW above Site 12 (light decoration washed off) – left; Late Prepalatial sherd with similar decoration, Gournia excavation (North Trench) 2010 (right, by permission of prof. V. Watrous).

Another sherd (from Site 188) hints to affinities in the Mirabello region as well (Figure 17). It was probably part of an obliquely banded (3 roughly parallel bands) jug like the examples shown in Betancourt and Silverman 1991, no.381 and 382 from Gournia (Palace, room G10 and town, room B19, dated MM I-II).

Figure 17: Banded jug sherd at Site 188.

As for the wider implications of what closer pottery studies from the Tsivi South area might illuminate, I should rather cite a person more apt to comment on pottery studies (just the “area around Gournia” has to be seen with the now known wider limits including the Kritsa and Tsivi South region):

“One area that is a particularly common source of imports, as established through petrographic analyses, is the area around Gournia in the northern part of the Isthmus of Ierapetra. Oval-mouthed amphorae, pithoid jars and pithoi from this area are found in considerable quantities in Quartier Mu, and in lesser amounts at Myrtos Pyrgos.
[…] There is additional evidence compiled in this study to suggest that the distribution of storage and transport vessels in the Mallia-Lasithi region was not controlled by Mallia.
[…] Instead the data point more convincingly to an independent economic pattern, in which goods were exchanged along various routes irrespective of political authority.”

Knappett 1997, p.207/208

Appendix: Bee-hive sherds

Bee-hive basins, as basically described e.g. by Barnard 2001, Knappet 2004, occur in various fabrics and shapes in the Tsivi South area, as described below.
Usual thickness 0,7 - 2 cm.
Sites:
7 D Uncertain ф, piece too small, but not less than 30cm. Fabric Type 4 (hard, fine version), clear cut hatching, not combing (cross-hatch). Outside traces of wheel ridging. Found 20m N of site, close to possibly later square structure (bee-enclosure?). Site 7 with Late Roman pottery 145m above (steep hill).
(cf. late, e.g. Isthmian horizontal hives type 1: different ф, different hatching, cf. Anderson-Stojanović & Jones 2002, *passim*).
7 D (2nd) Uncertain ф, piece too small, but no less than 30 cm. Fabric Type 4 (hard version, but much less fine than the former, many more and larger inclusions (especially white), outside smoother (wiped?), also traces of wheel ridging.
9 Uncertain ф, piece too small, but no less than 30 cm. Fabric Type 2 (pinkish, fine version).
9 (2nd) Uncertain ф, piece too small, but no less than 30 cm. Unknown fabric, similar to Haggis/Mook type III but only dark pieces (diorite?), inside buff slipped ware.
Between 25-26: Uncertain ф, piece too small, but no less than 30 cm. Fabric Type 1 (hard version).
38 Uncertain ф, piece too small, but no less than 30 cm. Fabric Type 4 (very rough but small inclusions).
38 (2nd) Uncertain ф, piece too small, but no less than 30 cm. Fabric also Type 4, but finer, slightly rose coloured, fewer inclusions, looks hard.
44B Uncertain ф, piece too small, but no less than 30 cm. Fabric Type 4 (rough with small inclusions).

53 ф >40cm, rim sherd with fabric Type 4 (looks harder - possibly fired hotter?). Rounded rim with one incision on the outside running around the rim. Cross-hatch on inside beginning right below rim (at ca. 3m)
62 Uncertain ф, piece too small, > 40 cm. Fabric Type 4 (hard, fine version), possibly originally slipped.
164 Body sherd, slightly overfired (inside more than outside), ф 33-34 cm, medium fine fabric Type 3. Hatching Π-shaped.
172 Rim sherd, ф over 40 cm, thick Type 4 fabric, hatching parallel and cross.
179 From vessel wall-thickness 2cm, ф ca. 40cm, outside slightly worn light brown slip, in any case much smoother buff, inside darker and very coarse Type 4 fabric. Clear-cut hatching made by rounded stick vel sim ca. 3mm ф. Seen near the roundish mandra SE of site (bee-enclosure?). 30m from modern bulldozed bee-keeping space (no other traces of bee-keeping).
204 Body sherd ф ca. 40 cm, Type 4 fabric (hard medium fine version, surface treated to flatten inclusions, remaining hatching parallel. (One of two similar sherds seen at site).

2: Lithic objects

Although lithic tools and objects are usually relegated to appendices in archaeological studies (Carter 2008), in recent years they have received more attention than before, not just in archaeological, but also in geoarchaeological terms (Dierckx and Tsikouras 2007). This is especially true for the Mirabello and east Cretan area, where ground stone tool production (or tool raw material acquisition) seems to go back at least to Neolithic times (Strasser 2008)[1].

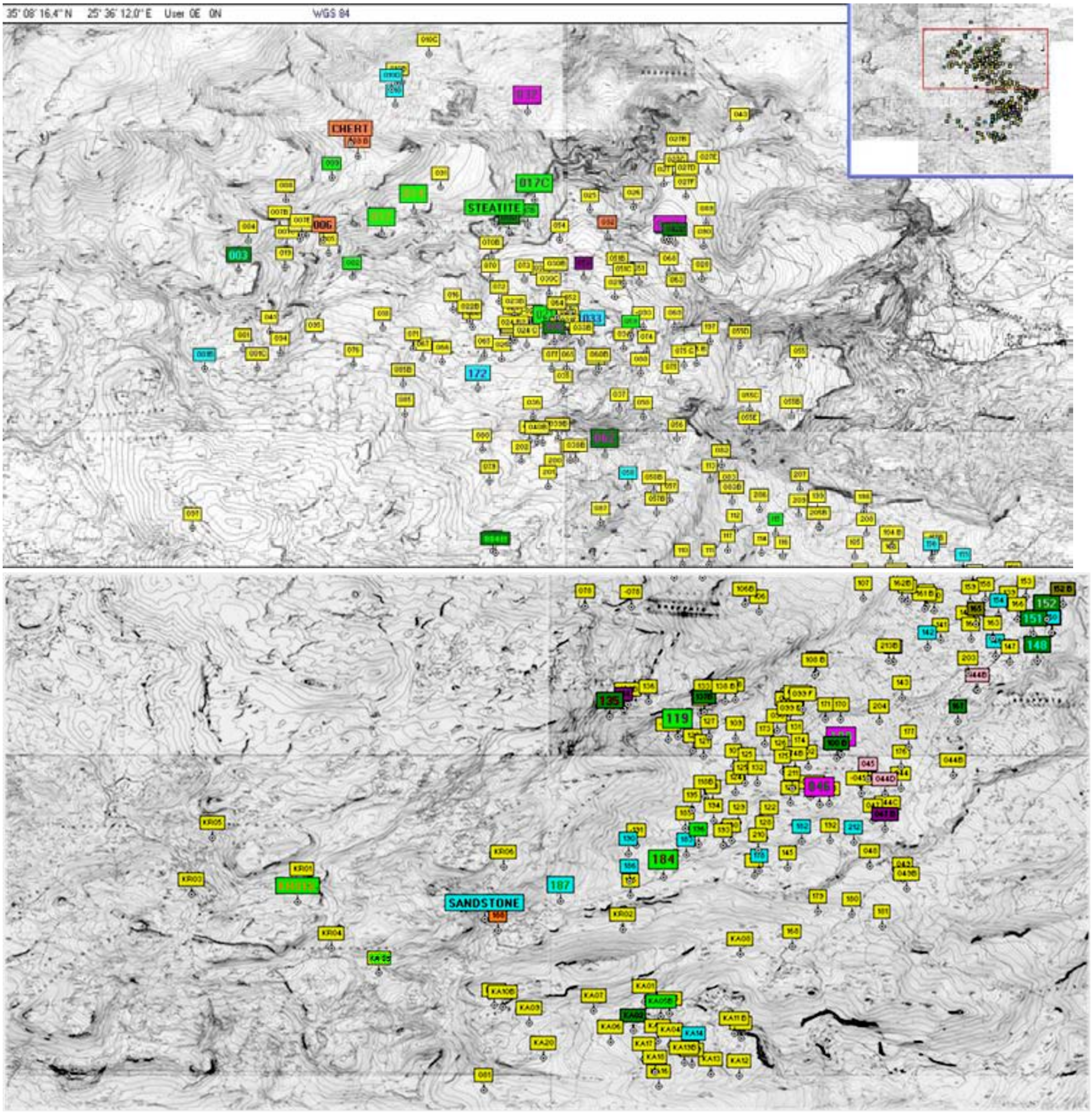
Surveys of the wider Mirabello area show various amounts of lithic finds for Minoan sites. One of the respective difficulties is the natural occurrence of pebbles (from riverbeds and the sea shore) close to the surveyed areas, making the recognition of simple pebble tools uncertain for surface findings, while the same kind of tools can be more easily identified in excavations by their position in the stratigraphy (see for instance the examples from Chrysokamino, Evely 2006).

There often seems to be an "uncertainty as to the correct rock identification of the tools" (Dierckx and Tsikouras 2007:1776[2]), thus comparability is sometimes difficult. To avoid further confusion, only few materials with a clearly possible description shall be identified with names and descriptions here, other materials shall be described by their macroscopically visible/tangible qualities.

In general steatite and chert seem to occur more frequently in the surroundings of their natural deposits (see Map 1), whereas sandstone (mostly as quern parts or whetstones) has spread more evenly down the

[1] As for the Tsivi South area it seems the lithic finds are too meaningful by their presence or absence to be "just" an appendix, thus they are treated in a separate chapter part here.

[2] This comment is coined for the Pseira and Mochlos excavation lithic finds, but can be generalized for other areas, too, especially for the various identifications of hard green tool material with terms like serpentine, greenstone, ophiolite, amphibolite. As the latter seems to be the correctest description for the material seen in the Tsivi South area, this term shall be used here.



Map 1: Map of lithic objects seen in the Tsivi South area. Legend: Yellow Sites: No lithic finds. - Light green: Steatite - Violet: Obsidian - Orange: Chert - Turquoise: Sandstone (whetstones, quern parts, polishers) - Dark Green: Amphibolite (mostly ground stone) - Pink: Limestone objects (tools, mortar) - Olive green: Breccia worked - Fuchsia: Unusual (Balance Weight, palette, worked black marble slab) - Several colours combined: Several kinds of lithic finds at the same site. Image taken from Ozi-Explorer [Note that Site 31 (light green and orange) is situated to the north outside of the map.]

valley towards Kroustas from its closest deposit in the area (the whole of Katharo plain, eastern parts of which are visible on the left central part of the map, contains plenty of material useable for querns/whetstones). Several regions show a clear concentration of lithic material, as at Sites 21-21G, the 42-sites and Sites 151-152. Sites given in pink on the map showed special or unsual lithic objects (see below).

A. Lithic finds according to material[3]

Soft stone: Steatite

Also known as soapstone: A "soft heavy compact variety of talc having a soapy feel"[4].

Published sources concerned with the wider area (Becker 1976, Jones et al 2007) mention only the steatite[5] source on Katharo - exploited after WW II by a German (or French, locals are uncertain about this) company for powdered talc production. From that same region comes a mostly very light green-to-turquoise, whitish material (often visible in the riverbed below as greenish, soft pebbles). On the other hand several otherwise unknown sources within the study area show on the modern surface a mixed olive-green, brown, rarely dark-brown to violet variety: in the Agios Ioannis valley (Map 1: "Steatite", Figure 2). Another source for steatite can be seen near the close by village Tapes (2,5 km NE of the former source), where visible colours are mostly very light green as in Katharo (Figure 1).

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[3] Detailed descriptions of the lithic objects seen at the sites cf. the site catalogue.

[4] http://wordnetweb.princeton.edu/perl/webwn?s=steatite, compare also the rather simlar description at http://projectsx.dartmouth.edu/history/bronze_age/glossary.html .

[5] *Cave* the problematic naming of many Minoan stone vases as "steatite" by just following Evans (Warren 1969:138), although they may not have been made of what is nowadays called steatite/talc/soapstone. This text refers only to material belonging to the latter terms as steatite. Note Becker 1976: 373: "outcroppings of soft stone are considerably more extensive on Crete than archaeologists generally believe and even larger than indicated on older geological maps"

Figure 1: Tapes steatite deposit.

Figure 2: Site 14, chert varieties and possibly chipped quartz (left, green and red; top left, the white piece) and local steatite colour varieties (raw material/waste, right).

Steatite objects seen at sites with PP pottery are rare (e.g. part of a bead at Site 21[6], other worked pieces at sites 9, 12, 84 B; cf. Figure 3), whereas small pieces of raw material, possibly large enough for beads (or waste?), can be seen slightly more often.

Figure 3: Site 21. Part of broken steatite bead in situ (the actual object was not quite as blue as the photo seems to show, rather gray).

While only PP sites are shown on the maps (and are subject of this study), it should be noted that several EM to Late Prepalatial sites[7] in the Agios Ioannis area show on the surface large amounts of steatite waste (in some cases beads and half-worked or broken jewellery pieces like unfinished/broken beads and pendants, cf. Figure 4) together with moderate to large amounts of obsidian and chert chipped pieces (blades, flakes, waste) and raw material (chert only, see below).

Figure 4: Steatite objects seen at a purely EM site of the Flej area (slightly NE of the steatite source in the map).

[6] Note that the burnt pieces of clay/mud brick vel sim near the ruin may hint at a Prepalatial /Late Prepalatial existence of the site not clearly visible in identifiable surface pottery.
[7] Here meaning those with no visible PP component of pottery.

The steatite deposit indicated on Map 1 (Agios Ioannis “Flej”) seems nearly totally exploited now, although traces of fallen material downhill of the seemingly main source area suggest an originally larger deposit (with the respective colours, comparable to the finds in the surrounding sites, see Figure 2, 4, 5) in the BA.

Figure 5: “Flej” Steatite raw material on the slope below the rests of the main deposit.

Experimental bead-making with raw material from Agios Ioannis “Flej” showed that the material is slightly harder the darker its colour. Also no obsidian or other hard tool is necessary (but comes in useful now and then) to make a bead: A small, pointed piece of bone and/or chipped stone for the bore hole and a flat stone with an abrasive surface (e.g. sandstone) for shaping, plus a soft surface (e.g. leather, wool vel sim.[8]) for polishing are enough to make a bead (from a slightly larger piece of steatite) within ca. 25 minutes (Figure 6).

Steatite waste (and chert if extant) was seen several times on flat open areas surrounded by Inner *Perivoloi* next to the ruins, where stone may typically have been worked (e.g. Sites 14, 42, 100, 119, 184).

[8] In the experiment I used the suede leather part of my shoe and my woolen sock.

Figure 6: Experimental steatite bead (ca. 0,5cm) made in 25 minutes, with used tools: Bone and chert chip, abrasive surface (sandstone) and comparable piece of steatite raw material.

2 - Chipped stone:

Chert[9] and quartz

Chert: "variety of silica containing microcrystalline quartz"[10]
Quartz: "a hard glossy mineral consisting of silicon dioxide in crystal form".[11]
As with steatite, several sites with more than one chert piece (blades, flakes, raw material) in the area are either EM or seem at least to have an earlier component. 15 sites with a clear PP dating had (mostly one to three) visible chert pieces in their closer vicinity. The obvious chert source on the slope near the old path from Tapes to Katharo (NE of Site 9, see Map 1) contains red and greenish chert, but grey varieties can also be seen (cf. Figure 2, left side). Some of the sites with chert also seem to have used chipped quartz pieces (e.g. Site 14, 184). At the source site of the area (Site 9 B) no traces of a ruin could be spotted, but worked chert pieces and flakes were seen together with a few small PP pieces of pottery and a few pieces of half worked steatite (Figure

[9] Also sometimes called flint (e.g. Watrous 1994), meaning a local hard microcrystalline, quartzy stone fracturing in conchoidal structures.
[10] http://wordnetweb.princeton.edu/perl/webwn?s=chert , cf. also http://projectsx.dartmouth.edu/history/bronze_age/glossary.html .
[11] http://wordnetweb.princeton.edu/perl/webwn?s=quartz . "It is made up of silicon dioxide (SiO_2), otherwise known as silica". (http://geomaps.wr.usgs.gov/parks/rxmin/mineral.html). Local worked quartz always consists of chips/pieces of white pebbles/cobbles, sometimes with tiny gray inclusions.

7). Only one site had another form of worked gray chert, a seemingly unfinished thick disk, Blitzer Type 15 (Blitzer 1995) at Site 135 (Figure 8). A possible variation of non-local black chert-like material including golden mica chips was seen at Site 42.

Figure 7: Site 9B chert raw material as eroding out of the slope, some chipped pieces and two small half worked steatite pieces (left of measure).

Figure 8: Site 135, unfinished disk-shaped object (with marks of chipping around perimeter) of gray chert, 3-4 cm thick

Obsidian

Obsidian: "acid or granitic glass formed by the rapid cooling of lava without crystallization; usually dark, but transparent in thin pieces".[12]

While at published excavated Palatial sites of the wider area usually obsidian amounts prevail by far over cherts (e.g. in PP Malia Quartier Mu: 97,2% obsidian, 2,8% other, Carter & Kilikoglou 2007:118), in the study area only earlier sites can be seen with mentionable amounts of obsidian. None of the PP sites showed more than three pieces, either blades or flakes, always seemingly products of chipped stone industry elsewhere (no cores or raw material could be seen[13]), and all in all no more than 16 pieces were seen around the ca. 330 PP sites[14]. Obsidian colours varied from slightly dull gray, nearly opaque to highly shiny black/translucent varieties, all of which are similar to those that can be seen at the two sources of the island of Milos, Sta Nychia (Adamas) and Demenegaki (Figure 9, 10).

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[12] http://wordnetweb.princeton.edu/perl/webwn?s=obsidian

[13] This applies for the earlier sites, too.

[14] Compare the similarly scarce finds of chipped stone at Minoan palatial sites in the plain of Lasithi, Watrous 1982. Also Müller-Celka (2003:466) notes the near absence of obsidian and stone tools at MM I-II *Sopata*, a mountainous region south west of Malia with a roughly similar settlement pattern as the Tsivi South area.

Figure 9: Obsidian examples at Sites 119, 134, 53, 32 (the latter with a fragment of a square green flat hard stone object), from top left. Not to scale.

Figure 10: Milos island, area of Demenegaki, obsidian cores and worked pieces.

None of the chipped stone pieces (neither chert nor obsidian) was shaped to be used as an arrowhead nor showed any macroscopically visible sickle gloss, both seemingly a typical lack for Crete that has even been noted for intensely agricultural areas as the Mesara plain (Blitzer 2004: 515).

Ground stone:

Amphibolite

Amphibolite: "a metamorphic rock composed chiefly of amphibole and plagioclase"[15].

This is probably the lithic material with the most variable terms used in archaeological descriptions of ground stone tools. Sometimes, as in the case of the Quartier Mu III publication (Poursat 1996: 120), closer descriptions of colour or material of ground stone tools are avoided altogether (similar: Watrous 1982). Still Bevan (2007: 58) feels confident to identify the material usually employed in groundstone spherical cobbles as those in Malia (with a tubular drill slot) as amphibolite. Carter (2004; 2008:74) also uses the term amphibolite for many of the similar Mochlos ground stone tools. Dierckx, for the Vrokastro survey, where few ground stone tools were noted (Dierckx 2004: 22), names the hard, green kind of ground stone tools "igneous rocks, mostly serpentinized basalt" (ibid.). The most detailed description of the manyfold variations in amphibolites is probably in Dierckx and Tsikouras (2007: 1771-1773), local occurances are also described in Theodorakopoulou et al. (2005)[16]. Often, as in many other regions, the generic term greenstone is used because of the colour of the stone. But as the term is used for the much softer serpentinite/chlorite as well (e.g. employed for stone vases, Warren 1972), further confusion is unavoidable (cf. Rapp 2009).

The tools and raw material pieces occuring in the Tsivi South region are clearly all of the hard, amphibolitic quality, dark to light (sometimes bright olive) green with various amounts of whitish inclusions optically visible either as spots or as veins (see figures below). There are 16 sites in the studied area where amphibolite was seen near the dwelling ruins, either as tools or tool fragments (11 sites), six of which showed drilled tubular slots (see e.g. Figure 11,12; plus one small object at site 32, see below and Figure 9) or as debris material (e.g. 21G, 42, 46, the first two sites also had whole tools, cf. Figure 13).

[15] http://wordnetweb.princeton.edu/perl/webwn?s=amphibolite

[16] After visiting many surrounding regions said to have produced some kind of "greenstone", I would suggest that the best place for procuring pebbles in the right size for tools was "Voulisma beach" just east of Istron. Along the beach all kinds of half worked/broken amphibolite pebbles can be seen, probably the heritage of past centuries of being raw-material source.

Figure 11: Tsivi South amphibolite tools. From top left (clockwise): Site 42, 17D, 62, 151, 148 (not to same scale).

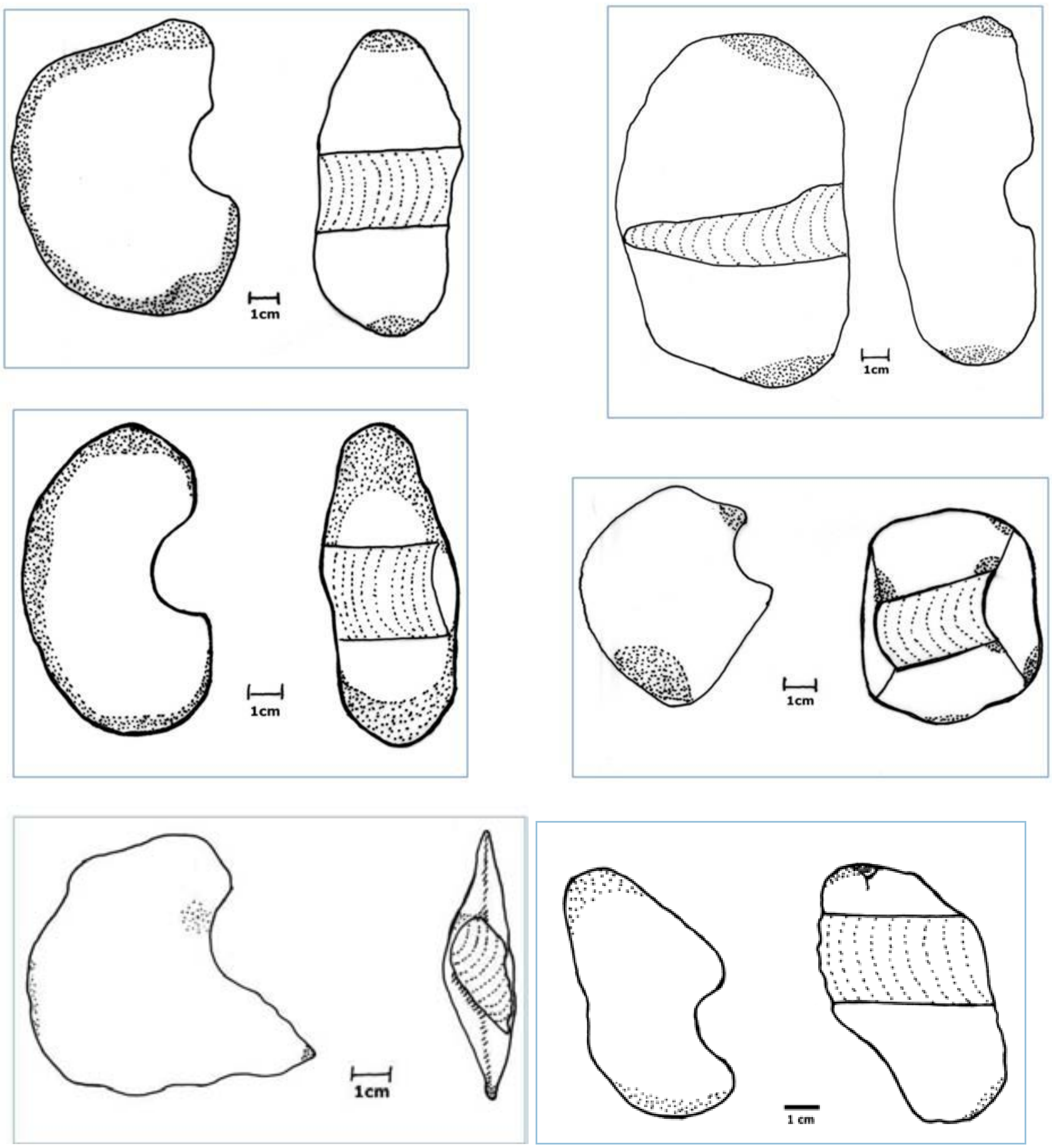

Figure 12: Drawings of tools with drill slots. Top: Site 42 (1), 42 (2), centre: 62, 151, bottom: 167, 83C.

Figure 13: Site 46, discarded amphibolite material.

Limestone

Limestone tools must have been the most popular in the adjacent coastal regions studied in surveys in the recent years (Dierckx 2004 for Vrokastro, Haggis 2005 for the Kavousi area). Still in both cases ground stone tools seem to be generally rare[17]. The Mochlos excavations produced and produce large numbers of limestone tools, it is the most popular material for ground stone tools seen there (Carter 2004, Carter pers. comm.). Chrysokamino produced in the excavation only 23 tools, most of which were "water-worn limestone" (Evely 2006:99), a fact that is explained by their having been collected as natural cobbles (ibid.).

Naturally in a region like the Mirabello area, close to a pebble coast and riverbeds with the natural occurrence of pebbles useful as tools without much modification, this kind of tool as main lithic ground stone object is to be expected.

This may have been different in the Tsivi South area because of its distance from the coast: even though the area consists mainly of limestone bedrock, this occurs in water-worn variations only in sites near the two main riverbeds (*cheimaroi*) framing the study area. At two sites south of the modern village of Kroustas and at Site 12 (all relatively close to riverbeds) limestone tools (pounders and rubber) were seen. The mortar seen at Site 144B is probably a hollowed out local surface block (all in pink on Map 1) (Figure 14).

[17] Dierckx describes 22 ground stone tools for the Vrokastro survey, 8 of which are limestone; Haggis 2005 mentions only one FN-EM site with ground stone tools.

Figure 14: Limestone objects - Site 45 pounder and Site 144B mortar.

Possible whetstones

Of the surveys in the Mirabello area only in the Vrokastro survey whetstones/possible whestones were identified (7 pieces, 5 of which from sites including Protopalatial dating, Dierckx 2004). Onesidedly abraded sandstone objects, especially when fragmented, can rarely be certainly identified as whetstone, quern or even polisher, but as most of those seen in the Tsivi South area have a shape lending itself easiest to a whetstone, they shall be listed as “possible whetstones”.

The sites studied here often seem to have used sandstone for abrading, 31 worked objects were seen. Judging from the closest area where this material is naturally available (see Map 1, in turquoise as also the sites with such objects) it might be the case that closer to this area more sites used it, but on the other hand a close study of the map and landscape conditions reveals that all sites with what looks like a whetstone in their vicinities were situated in areas of good arable land (see site catalogue for more details).

Differences between quern parts and whetstones often cannot be made, some objects even looked like quern-parts re-used as whetstones. Only objects manageable easily enough for sharpening a knife vel sim are seen as a clear whetstone here, especially if several sides had been used for such abrading or if there was an abrading pattern not possible for a quern (see Figure 15, right). In general it should be noted that whetstones like these were still in use until recently (locals say and demonstrate), and it would certainly be interesting to do trace-analyses for the metal (or metals?) used on them.

Figure 15: Sandstone objects. Quern Site 10D (left) and possible whetstone Site KR 02 (right).

B - Unusual lithic objects or accumulations

Several sites (given in pink on Map 1) showed unusual lithic objects and/or accumulations of several of them:

Site 100/100B:

At Site 100 a fragment of a hemispherical stone vase, gray-green dappled with beige serpentinite (cf. Détournay 1980: 65), with a horizontal handle (round section) reaching up to 2 mm below the horizontal, square edged rim of an open vessel (Figure 16) was seen. The original diameter of the vessel must have been ca. 28 cm, its wall-thickness was 1 cm. It belongs to the type “grandes coupes à anses” or Warren 10,B (Détournay 1980: 41), in older Malia publications also called “jatte” and typically (as shape) dated to MM (Chevalier & Detournay 1975: 95). The closest parallel seems to be the basin 68 P 2505 from the “Sondages au Sud-Ouest du palais” in Malia (ibid. and plate 31,6). They are of similar material, size, handle (with the same size and shape, only the semi-circular hole is slightly different) and general shape, as far as comparable from the fragmentary state of the object at the Tsivi South site.

On the site were also seen a polisher and, on a court-like open space framed by the Site 100B ruins on the north and east and a *perivolos* on the other two sides, a piece of steatite raw material with traces of working.

Figure 16: Site 100 rim fragment with handle of stone basin (serpentinite).

<u>Site 32</u>:
At Site 32 a balance weight of red, hard stone, a small dark amphibolite object with drill slot and a piece of a green lid vel sim., also a small obsidian doublesided blade (Figure 9, bottom right, Figure 17) were seen.

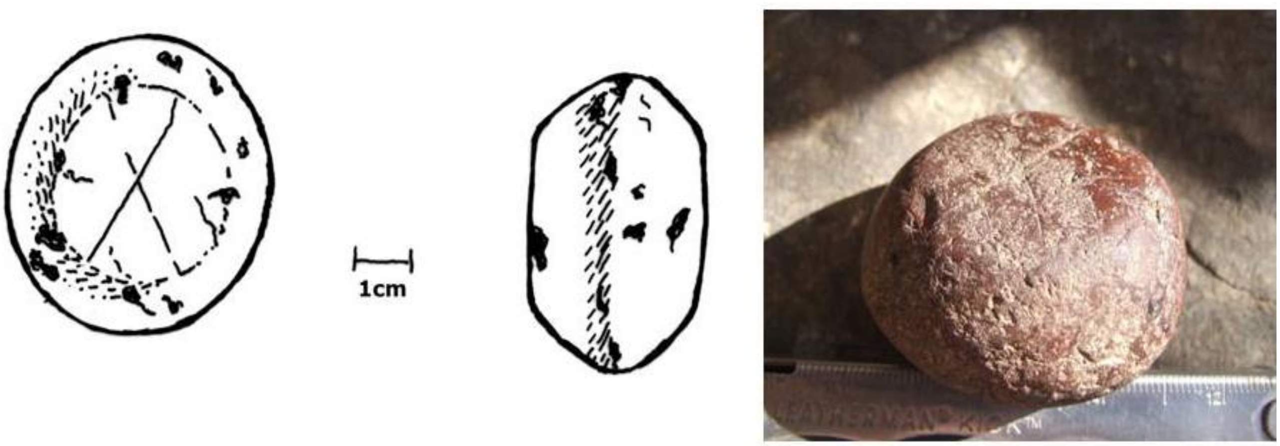

Figure 17: Site 31, stone balance weight, ca.120gr, Ø 4,8 cm.

The balance weight, a slightly biconical spheroid flattened on opposite sides, weighs about 120 gr (in its original state it would have been slightly heavier, see the missing chips) and thus equals ca. ¼ of a Minoan Mina (Petruso 1978:42) or 2 Minoan units of slightly over 60 gr (cf. also Michailidou 2006). The X–like sign engraved in its one flat side is very similar to one from a NP lead weight from Malia (MA09, from house Zeta Beta, Alberti 2000:63-65; compare a similar lead balance weight from Akrotiri, Petruso 1978b: 551, where the four parts of the X are interpreted as meaning 1/4). While the two NP balance weights were made of lead, the Site 32 stone disk as such compares better to the PP disk-shaped (with rounded edges) stone balance weights, e.g. from Quartier MU (these are the oldest balance weights known from Crete: Poursat 1996:123).

Sites 42 area (mainly 42B): A complete "stone vase-makers' tool-kit"[18] plus parts of worked material, raw material and debris were seen at sites 42B-D (Figure 19): Two amphibolite "drill guides" (Carter 2008:73), a smaller one (580 gr) with many light inclusions, a larger one (1030 gr) dark with white veins (cf. drawings Figure 12 top), both with drill grooves of Ø 2,9 cm, were seen at 42 B (several meters apart, Figure 18 and 19). Also close to the ruin of 42 B, on the edges of a small court (inner *perivolos*), lay half a spheroid hand tool (gray-green amphibolite), a fragment of a roughly shaped purple sandstone handaxe with peck-marks at the rounded end and a larger cobble of amphibolite raw material, light green with sparse white inclusions (probably unworked, possibly roughly shaped) (Figure 20). Smaller chipped- off pieces of amphibolite debris were also seen. Slightly further to the East, half way between 42B and 42D, lay a small rectangular even fragment of hard polished marble-like black limestone material with white veins. Bedrock with these qualities was seen 70-100 m north of there, actually several of the outcrops had chipped off pieces around them, in the vicinity lay a fragment of a sub-cuboid pounder or grinder/polisher (dark amphibolite with small, thin veins) (Figure 21).


Figure 18: Site 42B tools. Left: Smaller tool with drill groove on underside, in situ. Right: Larger tool with drill groove on underside, in situ.

[18] "Although both drill-guides and sub-cuboid grinders/polishers have been recovered on their own, there are a number of contexts at Neopalatial Mochlos where sets of these implements have been found together; these are interpreted as the stone vase-makers' tool-kits (Brogan and Carter 2001)". Carter 2008: 73.

Figure 19: Site 42B-D vase makers' "tool kit" plus worked and raw material.

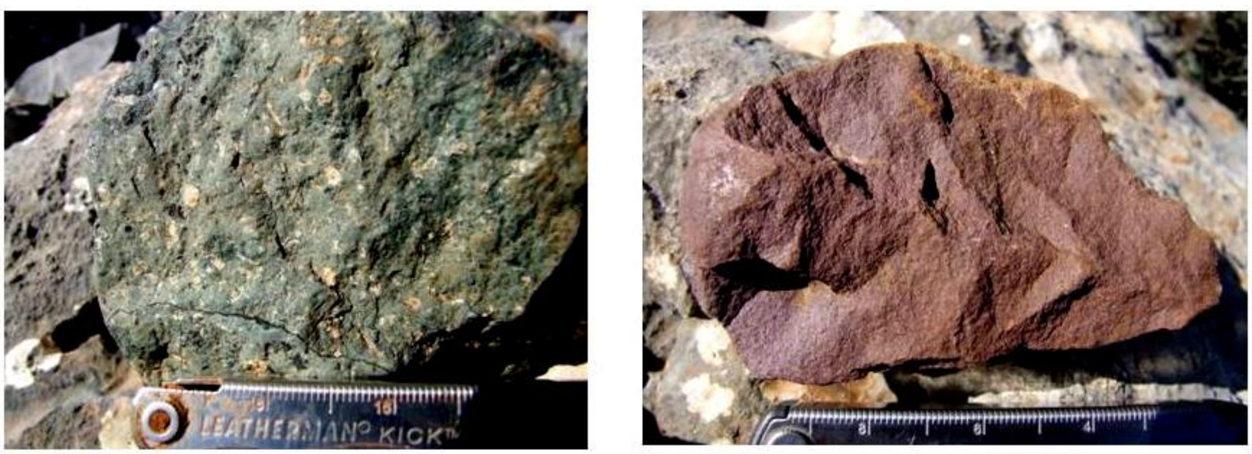

Figure 20: Site 42B amphibolite raw material (left) and sandstone handstone (fragment?) with pecked end (right).

Figure 21: Site 42B-D area. Worked dark veined local material (looking darker for being polished) and worked chips with tool at bedrock (lighter, in the natural form).

Site 46: On the hilltop of Site 46 a palette-like thin rectangular to oval finegrained sandstone object could be tentatively reassembled from many surface fragments (Figure 22). All sides (large and small) were carefully shaped and polished. Some amphibolite debris was also seen at the site, both outside of the dwelling ruin traces in a small court-like space (Figure 13).[19]

[19] Locals report that an "orange coloured" amygdaloid seal stone was found in the thirties slightly below the top of the hill that houses the site. There were "strange signs" engraved on one side, judging by the finder's description probably hieroglyphic signs. Giorgios Lasithiotakis (the finder, born 1929), pers.comm.

Figure 22: Site 46, palette-like sandstone object.

Tools of this shape have been interpreted as potter's spatula (e.g. Hansen Streily 2000: 24, called "Formschiene", but stone not mentioned as material).

Site 62: The existence of a whole amphibolite tool with a drilled tube (Figure 11, bottom right) and the fragment of a dark brown, fine grained stone axe (Figure 23), both in the vicinity of the same site might suggest lapidary or stonecutting activities.

Figure 23: Below Site 62, fragment of brown stone axe in situ (cutting edge preserved for ca. 2,5cm)

A similar situation seems to be given in the area of sites 151-152B (within 50 m of each other), where the unusual density of various lithic objects including an amphibolite tool with drill groove and peck marks, a greenish-black amphibolite fragment like part of a small quern or vase, i.e. polished on its concave side, a dark breccia handtool with peckmarks, a worked marble fragment and sandstone hand tools (151: Figure 11, bottom centre, Figure 12 centre right, 152 B: Figure 24) suggest stoneworking activities.[20]

Figure 24: Site 152B – breccia handtool, marble worked object, whetstones/polishers, sansdtone handtools.

Site 33B:

In front of (below) the dwelling ruin can be seen a worked limestone conglomerate block, a kind of stone "table" with two hollowed out depressions, a larger and a smaller one[21] (Figure 25). The erosion of the surface suggests its BA date (the site has been re-used as *mitato* until recently). Stones like this (or what sounded in descriptions similar) have been interpreted in various ways.

[20] Chert chips/blades, mainly white to light gray (some with a typical for Çakmak greenish tint, Prof. John Whittaker, Grinell Univ., pers. comm.), most with sickle gloss on one side, are often found on or near modern threshing floors and were until recently imported from Turkey (Blitzer 2004:512). They are called "nychia" or "tschakmakopetra" (the Turkish village Çakmak, named after the Turkish word for flint, is often the place of origin, cf. recently Whittaker et al. 2009). Originally parts of threshing sledges, they are likely not older than the middle of the 19th century (Beckmann, forthcoming) and thus not further discussed here, even if seen on Minoan sites re-used as threshing floors (21F, 148, KA01). The same applies to a fragment of a Melian millstone seen near KA15 – the site area was restructured as a Roman settlement, hence the millstone.

[21] The larger depression may be recently re-worked to become useful as "gourna".

They may be comparable to Gournia hollowed stones called "stone pot stand" (Soles 1979: Plate 18, fig.2); Tzachili 1997: 197-198 mentions a stone block with depressions and interpretations by Pelon and Effenterre as loom or spinning bases. In the context of this study no alternatives present themselves.

Figure 25: Stone block at Site 33B with two depressions. Scale 12 cm.

d. Synthesis - Architecture and Function

"The regions or sites without palaces are in the palatial model usually subordinated to the nearest palatial center, but alternatively they might have followed alternative socio-political trajectories which may have been structured in a different way. […] it is becoming more and more clear that Crete did not consist of a handful of large peer polities but of an unknown number of larger and smaller polities. Power and agency, expressed in terms of control over the production, ownership and deployment of material, social and symbolic resources, do not appear to have been concentrated in the Palaces, but were distributed at multiple places in the settlements and the landscape and operated at different levels."

Schoep 2010: 70, 80

[because of the practice of ancestor worship] "Minoan Crete is likely to have enjoyed a more egalitarian society, […] in which the small farms and country villas and town houses that dot the landscape in the Neopalatial period are not so much manifestations of a landed aristocracy as they are evidence for the existence of a large middle class of free, land-owning people.

Soles 2001: 236

[About the cadastrated field system installation of the Chora Chersonisou, Sevastopol, Crimea, Ukraine (Greek colony, 4th cent. B.C.)]:
"This undertaking would have required truly staggering wealth and labor. […] Similar acts elsewhere were connected with major political upheavals."

Carter 2000: 713, 714[1]

What can the data given in Chapter II b above (and in detail in the site catalogue, Appendix D) tell us about Minoan mountain settlement when integrated? As can be seen from the two upper citations above, scholars have recently begun to deconstruct for Protopalatial (Schoep 2010) as for Neopalatial (Soles 2001) Crete what used to be a general assumption: that central authorities residing in the "palaces" (recently rather called "court centred buildings", after Driessen 2001: 55) had the power and authority over a state-wide administration. Driessen suggests to look rather for "a *spatial hierarchy* of settlement" that would have at least four levels in a state: cities, towns, large villages and small villages, even though these settlement levels do not necessarily show similar administration hierarchies (ibid.).

When in the following Driessen gives a summary of site numbers and their development over time from published (by the turn of the millennium) surveys in Crete, the allover number of Middle Minoan sites from about 12 surveys was ca. 430 (ibid.: 56-58).

[1] The area of organized (squared) fields there is about 5 times larger than the one studied here (Crimea: 430 plots of ca. 26 ha, i.e. 100 sq km. The known *perivoloi* of the Tsivi South area are over 220, covering ca. 20 sq km). Note that the size of the large farmhouses there with ca. 400 sqm on average isn't comparable in the least!

Thus it seems that the current study dealing with over 330 sites, unknown until now, has something to say about Protopalatial Minoan non-urban settlement, certainly for north-eastern Crete.

1. Dwelling ruins (including their pottery and other objects)

Even though objects visible on the surface do not prove the existence of "high status artefacts"[2] (Schoep 2010: 71), the architecture in the Tsivi South area is quite elaborate.

And while in most of the mentioned by Driessen (ibid.) surveys sites would consist mainly of pottery scatters, this richness in architectural remains gives a lot of new information to Minoan archaeology. About 250 of the studied here ruins are well enough preserved to give an account for their size (see above Ch. II.b.A.3), while ca. 200 ruins are even well enough preserved to reproduce an approximate plan of their whole shape (see below Appendix C). From this we learn first of all that oncolithic walls, especially in sloped areas, are obviously not easily prone to taphonomic concealment. Pottery in the surroundings of the dwellings allows us to approximately date the sites to the Minoan Protopalatial period. The *perivoloi* surrounding these ruins in a systematic way (Ch. II.b.B.3 and below) show us how associated plots were arranged in juxtaposition with each other, creating a spatially inclusive and comprehensive network of land use units where most fields and browsing spaces are attributable to definite dwellings[3].

From the point of view of the dwellings it seems that the typical "microenvironmental complexity" (Horden and Purcell 2000: 82) of the landscape finds its parallel in the manifold and variable ruin shapes, where apart from the most popular simple rectangles (ca. half of all well preserved ruins) hardly any shape is like the other, as they all seem to have been highly customized to their respective surroundings (and/or their inhabitants' needs), while even the simple rectangle-shaped ruins show an amazing variability (see Appendix B and C). Thus the term "individuality" comes to mind, and although this individuality characterizing the Minoan mountain dwellings may be a pure function of their environment, the fact could be taken as an expression of underlying social conditions: one might expect that any kind of given state-prescribed standard[4] would most probably also have found its equivalent in the buildings' shape(s). Here it seems safe to state that no standard of any recognizable kind seems to have been applied.

From a practical point of view it is noteworthy that most short dwelling walls are more than 6 m in length (Ch. II.b.A). As the region has even nowadays an ample supply of tall trees (oaks, pines and especially cypresses) it seems also safe to assume (contrary to what has been suggested for Minoan houses, Joly 1928:338, Amouretti 1970:18) that they were built generously with local timber beams holding their roofs. And although column bases couldn't be recognized

[2] Which is probably one of the main reasons why the area has remained nearly unknown until today.
[3] Thus within the studied area few PP sites should have escaped notice (but note the existence of enclosures seemingly without sites, below).
[4] E.g. something like building size in sqm per inhabitant, sqm per land size vel sim., or other factors of standardization like those known from Classical Greece cf. Jones et al. 1962: 105-6.

but once in the area, perishable timber columns together with (or even without) simple flat stones for bases may have existed for longer roof spans (Figure 1).

Figure 1: 99C dwelling ruin, inside eroded (through partly fallen eastern wall, in background). An inner partition becomes visible with flagstones possibly used as bases for wooden columns/struts in the centre (ruin size 9x11 m).

Since the scarce amount of fallen material proves the oncolithic part of the ruins to have been bases or foundation walls, and the (rare) traces of burnt clay in the ruins' vicinity hints at mud (either brick or rather some kind of adobe) as building material - whereas rubble collapse debris seems to be mostly absent - we have now a passable idea of what the houses may have looked like: They were variably shaped buildings of medium size based on oncolithic foundations. These - sturdy mainly on the slope side - foundations must have been built upon with a (possibly in cases more than one storey high) cobwork (vel sim.) upper structure and a roof resting on wooden beams – not unlike the example in the image created for the NP country "Villa" of Achladies in Mantzourani and Vavouranakis (2005) (Figure 2 left). As the outer walls would probably have been mud-plastered, the white colour there may be too much of a parallel to recent Aegean houses, while the roofing may have had slight projections to protect the plaster from being washed off by weather as suggested in the NP house model roof reconstruction from Archanes (Figure 2 right). Also it seems that in the oncolithic parts of the Tsivi South ruins there were no windows (cf. Ch. II.b.A). The fact that the up-slope sides of the foundations rarely had more than two courses is one of the reasons -from an architectural point of view - why (most of) the sites were clearly not built with defensibility or military strategies in mind.

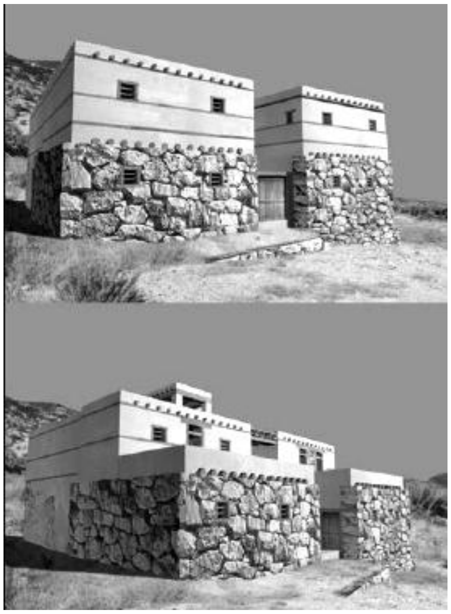

Figure 2: Left: Achladia House A, two possible reconstructions, from Mantzourani and Vavouranakis 2005: 41 (by C. Kanellopoulos). Right: Clay house model from Archanes. (23rd EPCA. Ministry of Culture / Archaeological Receipts Fund. Sakellarakis, Y. and Sapouna-Sakellaraki, E., Archanes, Ekdotike Athenon, Athens 1991, p. 61, ill. 36.)[5]

That dwellings had partitions into rooms and the foundations were seemingly often used as extra (storage?) space[6] are two more details indicating a down to earth, practical setting in everyday life – just as the main kinds of pottery seemingly used at the houses, namely cooking and storage wares.

The obvious architectural resemblance in terms of oncolithic masonry among sites and enclosures remains to be discussed. This resemblance might be interpreted either as plain "fashion of the time" [7] – or as an expression of some kind of "cultural identity and group memory" (Parkinson and Duffy 2007:116)[8]. If the latter, this would have been a kind of affiliation or 'group integration' (cf. ibid.:123) of a more than just local kind (cf. for instance the stylistic similarities with Protopalatial sites from far eastern Crete studied by Tzedakis et al. 1990

[5] © Ministry of Culture, from http://www.ime.gr/chronos/02/crete/en/gallery/house_model.html (last accessed 27-8-2011)

[6] While at times filled with rubble either for added stability or for drainage reasons.

[7] Obviously the availability of large blocks is also of importance, but the fact that recent mountain masonry (built with mud as binder) shows recent builders in the same area preferring rubble (abundantly available as well) - makes this argument defeasible.

[8] Cf. Tsipopoulou 1999: 186, identifying the massive eastern wall at Petras as "expression of an ideology based on plentitude and splendour, but also fear and enforcement", Santillo-Frizell and Santillo, (1984) who see massive architecture as an expression of power and also Schoep (2001: 87) as expression of "centralized mobilization of labour". Cf. also Parkinson&Duffy (2007: 113-114): "Many recent syntheses have stressed the monumental aspects of enclosures and their relationship to group identity, territoriality, and social memory (e.g., [p.114] Bailey 2000; Bradley 1998; Edmonds 1999; Sherratt 1990; Tilley 1996). This emphasis on the symbolic aspects of monumentality is a striking divergence from previous models that used monumental architecture as a proxy for social complexity and as an archaeological indicator for the evolution of chiefly authority (e.g., Renfrew 1974)."

and in detail Vokotopoulos 2007, and other far east Cretan "watchtower" sites studied by Schlager; for the roadsides cf. also Müller 1991)[9].

Zielinski's approach (1998) to what he calls Cyclopean Minoan architecture as expression of the building residents' elite-status cannot be maintained for the Tsivi South area: surface pottery suggests a low status of people living in these buildings. On the other hand any hypothetical "land-owners" (elite-status or not, group or individual person) of the mountain land and/or structures might well have lived elsewhere (see also below, Minoan land use)[10]. All in all, it can be safely stated that the mountain sites do not show any traces of elaborate "palatial" architecture. Remarkable is only the tendency some of the sites show to include a court in their surrounding architecture/landscape structuring[11] - in the case of Site 100 (looking 23° E of N, 14x20 m) it could even be called "central court" within several structures grouped next to it (Figure 3).

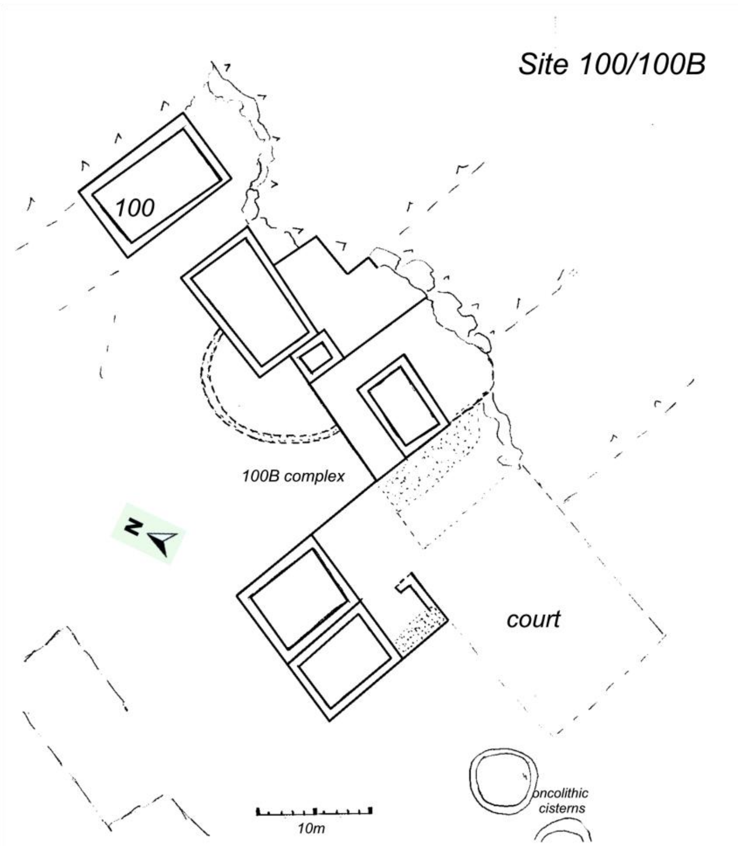

Figure 3: Site 100/100B with the visible on the surface structures. Colluvial soil collection S of the "court" prevents visibility of possible structures there as does intense re-use of the space W of the visible ruins.

[9] On the other hand it might well be possible that many Protopalatial country (or sloped country?) sites with preserved ruins are built in this style, cf. e.g. for the Kavousi and Vrokastro area Haggis 2005 and Hayden 2005, for the Galatas and Gournia regions Watrous et al. forthcoming and forthcoming b.

[10] The later Greek hinterland farms with landowners in the cities, or landowning monasteries, could be seen as a parallel.

[11] Cf. Tsipopoulou 1999: 182 describing the small court at Ag. Photia as "predecessor to the central court of the later palaces". The enclosed court at Site 184 looks 18° W of N and is 7x17 m, while the central court at Petras looks 12° W of N, and is 17,6 x 7,6 (Tsipopoulou 2007: 51).

Apart from the lack of evidence for elite facilities and equipment as compared to other areas, very little social stratification in general seems to exist between the various sites themselves: as mentioned above larger and smaller houses are similarly built and accompanied by the same kind of coarse surface pottery mainly, while fineware (or other "elite" objects) are rather rare (see site catalogue)[12]. And even though houses seem on average much larger than their 20th century counterparts (nearly double, cf. Allbaugh 1953:90, see Ch. II.b.A), they are at the same time clearly smaller than the average NP urban house (Whitelaw 2001), and their overall impression is that of comfortable but humble dwellings of a size that would be well suited to nuclear families (including their animals and storage) in the countryside.

On the other hand it should be kept in mind that typical recent *mitata* are similar in many ways (even though smaller in size on average) and still have nothing to do with a "domestic" or "family" unit (in terms of presence of a typical nuclear family life), being mostly "animal husbandry work stations", to be understood rather as occupational than as accommodation facilities, often clearly male dominated.

In any case, it seems safe to state that Driessen's "*spatial hierarchy"* (2001:55) does not in any way apply to this Protopalatial settlement area, while it might well constitute one of Schoep's "different levels" (Schoep 2010: 80; cf. longer citations above).

Chronology - topography - other findings

Even though the pottery record as for the visible on the surface pieces should be seen as preliminary for a certain chronology, a few remarks for the dating of sites with oncolithic masonry and their setting in the landscape (versus obvious earlier local sites) seem in place. While naturally only a thorough ceramic analysis following excavation could put the impression mentioned here on a solid basis, it seems an interesting working hypothesis for the future to suggest that sites in the area usually near springs and without oncolithic architecture or *perivoloi* are (mostly late) Prepalatial in date (possibly with the exception of Site 21, where older settlement seems to have existed on the same spot before the oncolithic phase[13]), whereas only with the beginning of Protopalatial times oncolithic architecture surrounded by *perivoloi* became the concept of choice for the area and a close proximity to springs wasn't sought any more.

While the existence of oncolithic cisterns (see also "Round Structures" below) at sites far from springs seems to suggest a certain independence of water sources[14] and the regular positioning of dwellings on the lee side of hills off-wind from cold winter weather could suggest an all-year use of the sites, it can't be excluded that they were used only in and slightly after the

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[12] Naturally this is – for movable objects - applicable as far as can be judged from the surrounding surface only. It could, obviously, also be a taphonomical problem that might, in part at least, be illuminated by excavations of some of the sites, but cf. the findings at excavated similar sites in eastern Crete, Tzedakis et al 1989, 1990, Chryssoulaki 1999, Vokotopoulos 2007.

[13] But note its position near the big cistern with water available close to the modern surface.

[14] Cf. Allbaugh 1953: 92, giving the fact that 15% of the Cretan pre-industrial families needed 30-90 min to fetch water. This would be roughly similar to the conditions at most of the Minoan sites.

rainy season (as some of their modern counterparts), i.e. in late autumn, winter and spring (October to May/June). In this case the question would remain, though, where the inhabitants (i.e. ca. 1500 people with their livestock) could have been dwelling during the summer months (Katharo or Lassithi plains?).

The few sites with dwelling ruins in exposed positions on knoll tops (Sites 46, 46B, 148) should also be shortly mentioned here. Especially with Site 46 (Kroustas Fortezza, just 100 m from 46B[15] but better visible from many sites) a viewshed-analysis from the dwelling's position shows how many of the surrounding sites could see it and be seen from there (Figure 4). Hence a function connected to this might be suggested, e.g. some kind of control over or communication with the other sites. Judging from the fact that too many sites are also outside of this viewshed, it seems rather probable that the function had to do with communication of information (alert?), for instance coming from the coast (e.g. the Priniatikos Pyrgos area) that is also visible from Site 46, to be communicated to sites that didn't have optical connectivity to the coast themselves (mainly those in the valley south-west of Site 46), while on the other hand many of the sites not optically connected to Fortezza do see the coast directly. Still, the fact that Site 46 has a *perivolos* like other surrounding sites seems to suggest that the function connected to this position was not its only one, and may have been only occasionally used (when or if needed)[16].

[15] This site seems enigmatic because of its nearly nonexistent pottery traces on the surface, its extra large blocks along the top edge of the knoll and the fact that no clear base for a dwelling seems recognizable. Still its *perivolos* is clearly defined.

[16] Site 148 doesn't seem to have had a similar function, its viewshed is rather insignificant (they did see the coast from there). All sites in the valley west of it without coast-view could also see Site 46. But its position right on the top of the small gorge at the north-east edge of the settled area might connect it also to a possible alert system. An intrusion from the East would be first noted here and could be communicated to Fortezza (and thus most other sites) and the coast easily.

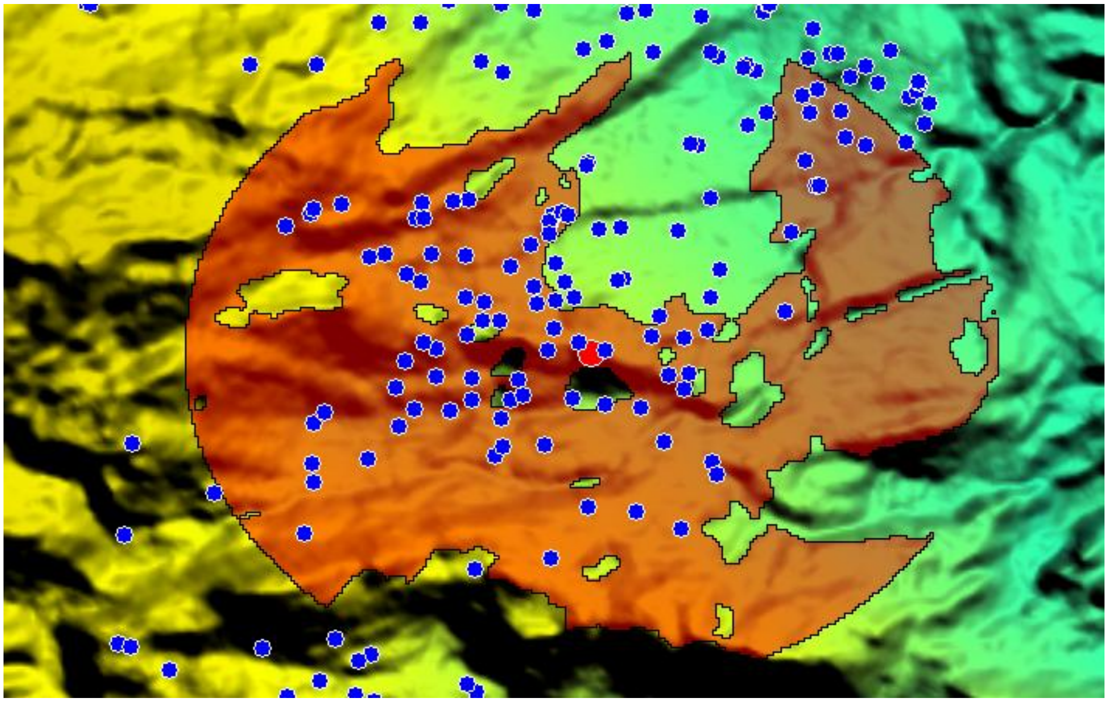

Figure 4: Viewshed analysis from Site 46 (Kroustas Fortezza, red): Blue Minoan sites, brown visible area within 2 km. Most sites without view of 46 to the N can see the coast directly.

To sum up, available evidence seems to prove beyond dispute that oncolithic dwelling architecture in this area[17] can be seen as a Protopalatial introduction, with different choices of positioning and probably different prerequisites for land use from older local sites. The large number of sites newly founded (uniquely constructed) and interlinked in this phase makes certain that some kind of newcomers to the area settled the mountain slopes[18]. If this should be seen as an indication of population explosion on coastal sites of the same phase, a chance result of new choices for settlement pattern or rather a consequence of the climate change forcing settlement into more humid areas together with a change of style in masonry is obviously a matter of further study (if it can be clearly attributed at all). The similarity of pottery fabrics and styles with nearby other regions seems to exclude the newcomers to have been foreigners from outside of Crete.

2. Round structures

"At present, the Myrtos-Pyrgos cisterns remain the earliest cisterns beyond dispute in Crete and are important evidence for social/political – and quite likely military – conditions on the island in the earlier part of the second millennium BC."

Cadogan 2007: 110

[17] And this is not to say that in other regions cases might not be similar.
[18] A similar conclusion for PP mountain settlement was drawn following surveys further east and west (cf. Haggis 1999: 56, Haggis 2005, Hayden 2004, Müller-Celka 2003, 2004).

The question of how the two kinds of ruins in the Tsivi South area built in a circular shape could be interpreted leads first to an exclusion: differences in architecture (style, size, the specific underground construction of the oncolithic kind, lack of fallen stones) make it nearly impossible for them to have been anything like the tholos tombs of the kind otherwise known in any case nearly exclusively from further west in Crete[19]. Also, and with the same arguments, there are no similarities whatsoever with the towers of Classical and later mainland farms[20] (Young 1956, Morris and Papadopoulos 2005 with extensive bibliography). In this case the arguments include the lack of any possibly load-bearing architecture and the positions, which exclude any possibility that the Round Structures might have been part of a tower-like defensive installation accompanying the dwelling sites, neither for public (watchtowers, signal stations, part of a fortress vel sim.) nor for similar private use.

In terms of other possible functions of small round buildings over European (pre-) history, there is an interesting suggestion for underground built pits by Ault (1999): The "kopron" or refuse pit. Although such an installation is not very probable for country sites in general[21] the main question is here: How much (bio-degradable) waste could have been collected from a single house[22]? And while our modern idea of a compost or dung midden implies only bio-degradable material, other household waste (like broken pottery) would have landed in/on the "kopron" in other times[23]. Actually, the tiny contemporary pieces of pottery seen on various fields surrounding the sites studied here have suggested the use of manure from some such kind of midden (see Ch. II.c.1), but the Round Structures clearly were not included in this practice as there are only very rarely traces of pottery visible in their surroundings (see Appendix E).

Carinci's (2001) interpretation of the palace "kouloures" as (ritual) planting pits for trees doesn't seem applicable for the Tsivi South Round Structures, and neither does Yannouri's suggestion (based on interpreting Late Minoan seal motifs as possible representations of round

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[19] For an example of 2 round structures tentatively interpreted (without clear traces of funereal use, it seems) as tombs in eastern Crete see Tsipopoulou 1992. But let it be said again, for the sake of thoroughness, that naturally without excavation of some of the structures mentioned here there cannot be any certainty!

[20] Note that Tzedakis et al 1990: 47 call the round structures extant in the surroundings of Choiromandres tower(s) ("tours" or "tourelle") and extend this interpretation to another round structure found in Zakros (ibid., note 11). A similar interpretation of "towers" detected on a Minoan sealing from Kato Zakros (CMS II 7 No. 218) as "Festung" is given by N. Schlager in Forum Archaeologiae 8/IX/1998 on http://homepage.univie.ac.at/elisabeth.trinkl/forum/forum0998/08agais06.htm (last accessed 20/5/2011).

[21] Urban houses may well have needed such a place, but dung (vel sim.) middens in vernacular settings occur only together with intensive stable husbandry of herds or big animals.

[22] Here „waste" means any refuse that could not or would not be used for feeding animals like dogs or pigs.

[23] One known and studied example for Minoan fertilizing from Pseira is dealt with in Bull et al 2001: „Manure formed from human excrement (there exists no evidence of pig husbandry) and household waste would have been transported from the main site of occupation and spread over agricultural terraces, thereby fertilizing them." (239) and "Analysis of relative epicoprostanol abundance provided insights into the predepositional treatment of manure, indicating the possible long-term accretion of midden heaps in the latter stages of the Minoan period." (240). Still there don't seem to be any known structures possibly housing the rotting material in the settlement, and relatively pure human feces would hardly be stored openly close to dwellings, with or without pits or structures. As for a more recent kind of compost storage (biodegradable material that might elsewhere be fed to pigs) let it be noted that in the dry Cretan climate even 8 years of household collection haven't filled a compost box of 1 cubic metre in my garden yet.

buildings not yet accounted for archaeologically) of a hypothetical Minoan round "hut" with or without ritual function (Yannouli 2009).[24]

Various other round ("corbelled") buildings (pigsties, potato cellars, storage huts) known from different parts of the world and dating to different periods as possible remains of a Bronze Age building tradition have been known (Walton 1969), but these all would logically need an entrance and none of the studied here Round Structures seems to have had one, although ladders might have been used to descend into the underground ones (possible future excavations might enlighten this further for the aboveground examples, where fallen material might mask possible openings).

The most popular interpretations of the known Minoan "kouloures" (see Ch.II.b.A for bibliography) are cisterns and granaries. And even though there is a certain risk of interpreting the Round Structures studied here as anything definite without excavation[25], I shall try here to examine various possibilities for their applicability.

Taking into account the prohibitive reasons for other functions given above (and the details given in Ch.II.b.A), the Tsivi South Round Structures should be seen as part of a "range of storage strategies" (Halstead 1997:106) with various possible implications. That no wall sealing material can be seen on the nowadays (and probably mostly for many centuries) exposed surfaces doesn't mean they could not have existed in the Bronze Age, especially when walls were sealed with clay[26], which would have vanished by now from the surface like any possible mud structures that might have sat on top of them.

So the main question here remains: cistern or granary?

Remarkably the region offers two different kinds of Round Structure, the underground and aboveground ones (for details see Appendix E and Ch. II.b.A), the main difference of which (apart from their position relative to the surface) is the masonry material: underground Round Structures are oncolithically built (and with all their visible height as such) while aboveground Round Structures are built in rubble and exist only as foundations (the fallen material surrounding them doesn't allow for much original height – may be about one meter).

A first approach to an interpretation would be the suggestion that each of the two has a different function – probably either cistern (water storage facility) or granary (dry storage facility). When trying to get closer to a solution, the first obvious remark would be that dry goods are certainly in general[27] better stored aboveground than underground – if these are the two general options. Another point would be the physics of storing liquids versus dry goods in a

[24] Two other possible interpretations: Evans (1935) suggested the Knossos "kouloures" were blind wells to dispose of surface water (as they were not plastered). "Alexiou (1964:140–141) suggested they were depositories for sacred offerings" (Cadogan 2007: 108, who gives in the bibliography Alexiou, S. (1964). Minoikos politismos. Yioi Sp. Alexiou, Iraklio, Greece (in Greek)).

[25] And notwithstanding the fact that unexplainable pits are too often taken to be a storage facility as mysterious objects are taken to be ritual in nature (Strasser 1997: 93).

[26] That ancient cisterns could be sealed with clay is known e.g. from EB III Ai ("Khirbat `Ayy", Palestine, cf. Mazar 1990: 129).

[27] Notwithstanding the fact that it seems already in earlier phases humans were able to store grain – if necessary – in underground storage pits, usually of under 2 m diameter. These storage pits needed anaerobic conditions which wouldn't have been provided easily by either of the studied here Round Structures.

cylindrical storage object (silo), where different pressures apply (Figure 5). This is especially important to know when taking into account any water storage in aboveground structures, the base of which would need to be extremely massive to bear all the pressure, whereas bulk storage exerts pressure much more evenly on the sides, making a less massive wall construction possible. For the pressure on the walls also the specific weight of the content is of importance, for instance water: 1000kg/m^3, wheat: 680-840 kg/ m^3, barley: 450-730 kg/ m^3 .[28]

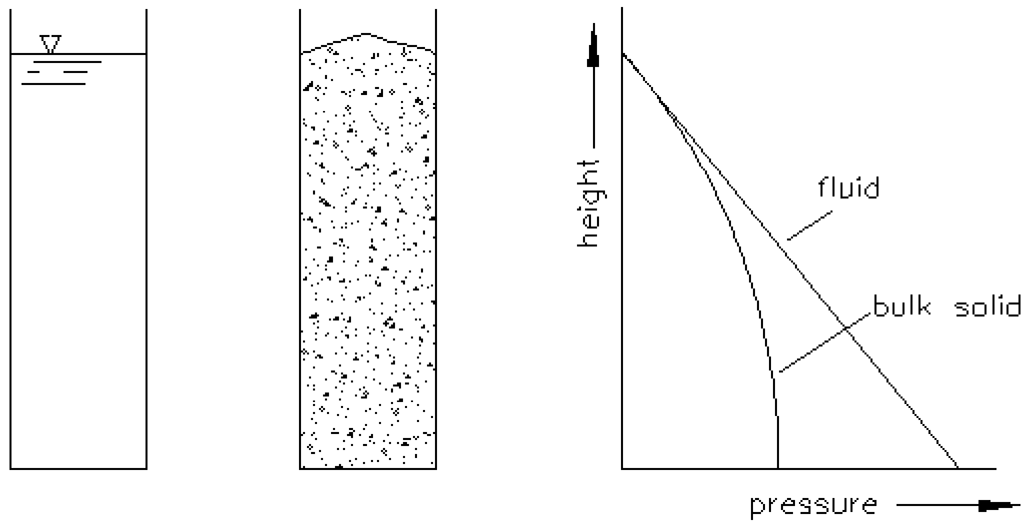

Figure 5: Dietmar Schulze's diagram of pressures in storage cylinders, liquid versus dry goods/bulk[29].

EB III granaries excavated in Beth Yerah (in modern Israel, cf. Borowski 1987, Mazar 1990), Egyptian images of BA granaries (cf. Maspero 1895, fig. 44[30]) and the beehive-shaped granary model (pyxis, Agora P 27668, cf. the discussion in Morris & Papadopoulos 2004) from EIA Athens show a similar approach to grain storage around the early eastern Mediterranean. One even wonders if it is accidental that the upper granary structures (probably originally all mixed clay masonry) have about the shape of the pressure curve bulk material exerts on the sides of a silo (cf. Figure 5). A structure like that might have had – and not needed more than - a rubble base in Minoan Crete, while naturally only very careful excavation might show any possible traces of material from upper structures, inner linings or even the grain (vel sim.) content to ascertain such an interpretation. In any case one might wonder if the NP Zakro sealing No. 130 (CMS II 7 No. 218, found by Hogarth, 1901[31]) and described as showing "five towers" could not be meant to show granaries as well (possibly with a timber-framed masonry, not ashlar masonry, as suggested by the excavator and Schlager, 2000), hence intending not a warlike image of a fortified settlement, but a symbol of prosperity (Figure 6).

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[28] Thanks to my father G. Beckmann, engineer and specialist in tank construction, for help with these data and explaining the general principles.
[29] From: http://www.dietmar-schulze.de/spann.html, (last accessed 5-1-2012).
[30] Available online at http://www.gutenberg.org/files/14400/14400-h/14400-h.htm , (last accessed 6-1-2012).
[31] D. G. Hogarth, "The Zakro Sealings," JHS 22 (1902) 76-93, here cited after Schlager 2000.

Figure 6: CMS II, 7 No. 218[32] Sealing from Zakro showing five cylindrical buildings (granaries?).

As the aboveground Round Structures in question are all set on flat or slightly raised rocky bases (where visible) it is certainly possible that they were granaries, so that I shall interpret them in this study as such.

As for the possible inner linings, at least for the granaries one might expect e.g. something like a mixture of clay, dried olive leaves and oil lees as suggested in Columella, (De re rustica 1.6.12-16) that was supposed to keep away insects from the stored material[33].

This leaves to discuss the underground Round Structures – traditionally a rather typical position for cisterns, not least because the water can enter naturally: some of the underground Round Structures studied here even have a typical flat collection area reaching to their rim, cf. Figure 7 right, on the upper level behind the structure). Another advantage of the underground position are the cooler storage conditions that keep the contained water fresher/healthier and evaporation as low as possible (especially with a cover, for instance made of wood).

From the technical point of view, the high pressure of fluids on the base of a container (Figure 5) would explain: 1. Why the underground Round Structures were built with oncolithic masonry, and 2. Why they are underground in the first place. The oncolithic blocks may have reduced also the risk of water loss through the many more openings that would have had to be closed with clay (vel sim.) to waterproof a rubble cistern.

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[32] Image from: IDAI images, Arachne (CMS online), CMS-II7-218-Pla1_160585,01.jpg at http://arachne.uni-koeln.de/arachne/index.php?view[layout]=marbilder_item&search[constraints][marbilder][searchSeriennummer]=3192003 (last accessed 6-1-2012)

[33] Any possible excavation would have to keep this in mind when finding traces of olive products in the residues!

Here it is interesting to note that where parts of the structures are close to the surface (by being set in the slope) the oncolithic inner masonry is supported on the outside by a thick layer of rubble (possibly even originally sloping as it is now – where preserved, cf. Figure 7 – possibly as an extra counterbalance the water pressure).

Figure 7: Site KA20. Underground Round Structure KA20K seen from SW on top of the rim (left) and from below (right) with the sloping rubble shoring on the outside. Ø 3,5m inside, 7,5m outside. As it is the structure has a content of ca. 28 cubic meters.

Another point in case for the underground Round Structures to have been cisterns (as which they are going to be interpreted in this study) is their relative position in the landscape. Even though most probably quite a few such structures existed that have been covered by soil and thus are not visible right now, those that do exist on the surface occur significantly more densely in regions without water sources like Sopata Bourdounospastis (82-Sites) and Tou Tzortzi o Prinos (83-Sites , see the central eastern part of the map Figure 8). Here water sources are not just distant in a horizontal, but also in a vertical sense, as one would have had to walk 300 m downhill and uphill or uphill and downhill in both directions for bringing water to the sites – a fact that isn't visible on the map.

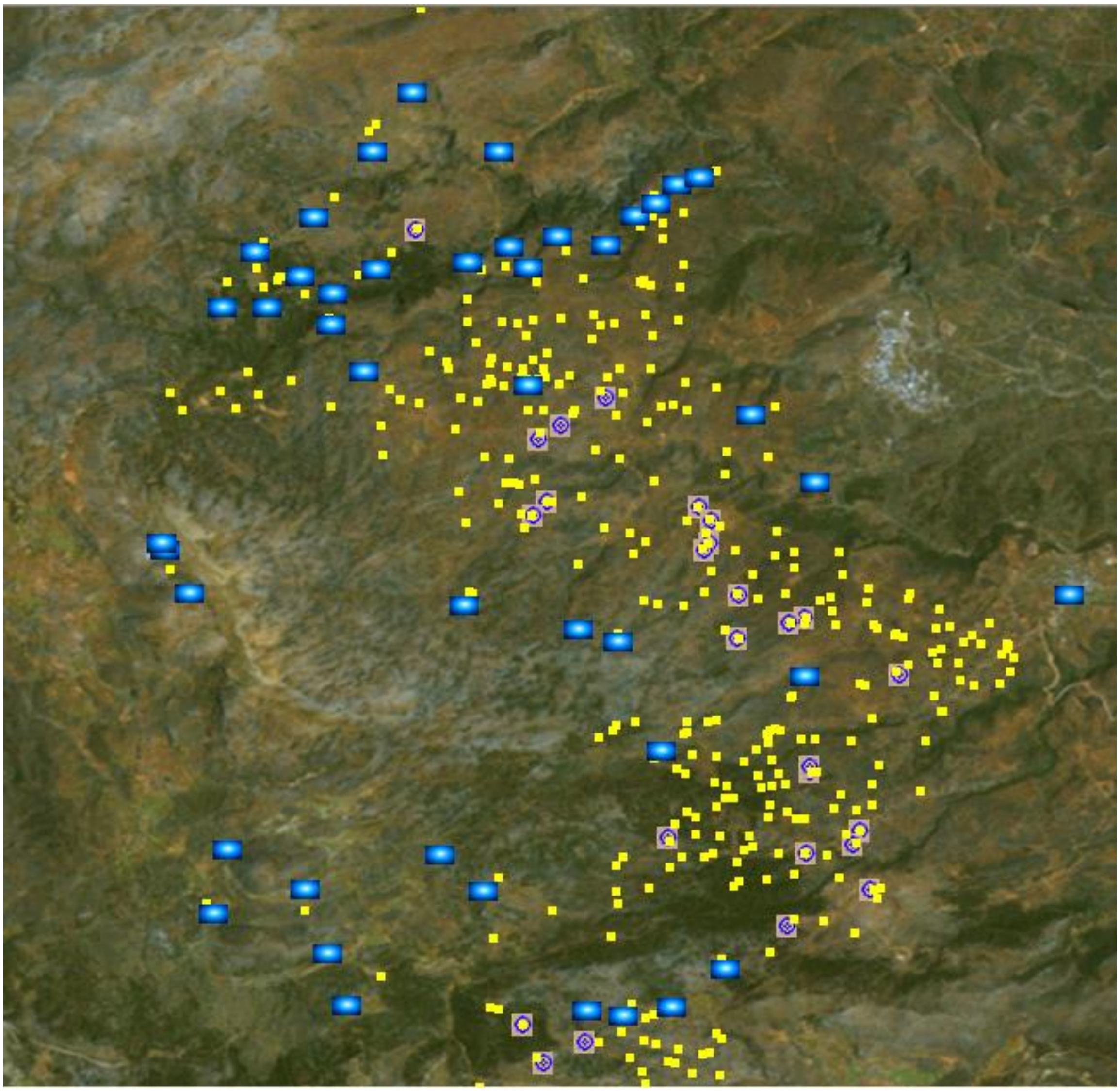

Figure 8: The studied sites with water sources (blue rectangles) and suggested cisterns (underground oncolithic Round Structures, grey and blue squares).

Thus it can be summarily stated that Round Structures of the Tsivi South region are most probably to be seen as storage installations for storing water and dry goods depending on their position underground or aboveground.

In this context , the humble pottery (if at all) in the Round Structures' surroundings – and thus their probably humble status – should be remembered again (for details see Appendix E[34]). And while the general idea might be of interest, one might wonder if it is correct to suppose that land ownership follows from storage space (Schoep 2010: 71), as the land's owners need not be living in the same spatial context as the storage facilities they own – and especially if the stored product(s) are not to be consumed/handled by the owner(s) himself.

[34] As many of the structures are set close to the dwelling sites, naturally pottery in their surroundings does not give any indication for their use.

For the way the Round Structures can help in the evaluation of Minoan mountain land use, see below.

3. Enclosure walls

That enclosure walls - called "périboles" already in Tzedakis et. al. 1990 - existed in the area of the far eastern massive masonry sites has been known since then. These *perivoloi* were expressly seen as part of a fortification system: because of them the site they surrounded was not to be identified as "autonome, comme ce serait le cas d'une ferme, d'une bergerie, d'un moulin [!] ou d'un autre bâtiment comparable" (Tzedakis et al 1990: 48) and "ce réseau de barrières rappelle, par sa disposition, les murs de soutènement des fortifications des acropoles étéocrétoises"[35] (ibid.).

Another, much more down to earth interpretation for the enclosures existing in the vicinity of the sites studied by Tzedakis et al. as "corrals for livestock" was suggested by Dickinson (1994: 159), an approach generally similar to Wroncka's (1959: 538) who had seen the sites (without expressly mentioning the enclosures) as a kind of agricultural waystations ("haltes d'étape", ibid.) for the transport of goods from the hinterland to Zakros. While this practical approach does not necessarily indicate "her different perception of Minoan society as of a peaceful one" (Gkiasta 2008: 213), the two concepts probably show how wide the variety of interpretations has been.

Apart from the aforementioned identification of enclosures at Zakros hinterland sites as defensive installations, a term "sacred enclosure"[36] has also been discussed in the bibliography (e.g. Brown and Peatfield 1987 passim) that should be mentioned here for the sake of completeness. Unfortunately this term has been used for all kinds of seemingly ritual places[37] and thus rightfully called "all-encompassing" at times (ibid.: 31), especially as in many cases there don't seem to have been any actual enclosures identified with the "so-called 'sacred enclosures' " (ibid.: 32[38]).

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[35] The citation given here to Tzedakis et al 1989, p.72 n.77 is *non sequitur* (it just gives the reference to Hayden 1988), and it remains unexplained why an agricultural building should be "autonome".

[36] Usually used in the same sense (and often interchangeably) with "temenos".

[37] In this context scholars should make a clearer difference between sites seen as ritual places *sui generis* without the "enclosure" – except if such walls actually exist. And while they do in the case of Jouchtas (Anemospilia and the peak sanctuary) and Kato Syme, the differences between the size and masonry of those three is notable (cf. Sakellarakis and Sakellaraki vol. I. 272, Karetsou 1981 and Lebessi and Muhly 1990) and the question will remain if they had the same function. It seems notable, though, that the Jouchtas peak perivolos is very similar in masonry to the enclosures dealt with in this study, and while the dating of the Jouchtas enclosure seems still uncertain due to the multiple period character of the site's use (Karetsou 1981), this similarity might be seen as an argument to date the Jouchtas enclosure as Protopalatial. The combination of sanctuary building and enclosure or "temenos" at Anemospilia and Kato Syme (this especially) justify the usual comparison of the installations shown on the so-called "Peak Sanctuary Rhyton" from Zakros and the cult places (cf. Shaw, J. 1978, also discussed in Hitchcock and Preziosi 1999: 140-141).

[38] The authors accept only three actually existing „sacred enclosures": Anemospilia, Kato Syme Viannou and Piskokephalo, ibid. n. 30, even though the latter doesn't seem to have had an actual enclosure, only obvious ritual findings (ibid: 33, with bibliography).

While other regional studies do not mention specific BA enclosure walls, during visits to various areas of Crete I noted that many wall systems might actually be ancient as they look like typical Minoan *perivoloi* as studied in this thesis. Apart from the PP Malia mountain sites (Müller-Celka) that show clear parallels in their surroundings, there is also a similar wall near one of the Minoan sites east of the settlement at Malia/Agia Barbara (the site see ibid.)[39]. Another rather typical *perivolos* (length 1,6 km) can be seen below the “Chrysokamino Farmstead” (for the site see Betancourt 2006, the wall isn’t mentioned there), surrounding the large colluvial field of “Lakkos Ambeliou” (for the place ibid. p.12, Haggis 2005) and followable along nearly the whole length. The four Minoan sites to the S, SE and SW of this wall are all datable (among other phases) to MM I-II (Haggis 2005: 119-120), but although an undated “field wall” (ibid.) was partly noted for the area, neither Haggis nor Betancourt (et.al.) seem to have taken into account the possibility that this wall was originally Minoan. There also seems to have been a more complicated system of enclosures around and below Haggis’ Site 68 (for the site see Haggis 2005), although the overgrown steep slope didn’t allow me at a short visit to follow more than a few parts (some of them along the old path from Kavousi towards the region of Azoria and Avgo). Even north of the “Villa” at Zominthos (Mt. Ida) I saw a few parts of walls that may turn out to be Minoan (some looked typical including upright stones[40]). Some walls surrounding Minoan sites in the Galatas region also looked like typical *perivoloi* (Watrous et al. forthcoming). All in all it seems possible that Minoan enclosures are much more common than is known until now.

For the Tsivi South area the *perivoloi* are the most unusual and the most siginificant feature of the typical landnam of the Protopalatial phase. Some 150 km total length of walls (with an overall built volume of probably more than 200.000 cubic meters nearly as substantial as a smaller Egyptian Pyramid[41]) constitute an impressive work effort invested into the landscaping process – and that is without counting the necessary terrace walls that would have been built at the same time or the dwelling buildings themselves. Still, before jumping to the conclusion that an effort like that must have been connected to slave work, one might consider a wise old shepherd’s comment on the Minoan walls he has lived with for many years while wondering how they came about: “Just as all shepherds in summer they may have had nothing better to do and spent their free time building stout fences…”[42]

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[39] It also seems that part of the long wall connecting the Villa Alpha and Gamma might belong to *perivoloi* of their phase (the masonry suggests that other parts could have been (re-)built in LM III).

[40] As the known ruins at Zominthos seem to be NP, one might wonder if there was a PP part somewhere in the region that could have been responsible for the *perivolos* walls.

[41] E.g. the pyramid of Menkaure at Gizah, cf. http://en.wikipedia.org/wiki/List_of_Egyptian_pyramids, last accessed 28.8.2011 .

[42] My warm thanks to Kostis Bardas (he lived on a Minoan site for 50 years and re-built unknowingly parts of it) from Kroustas for this „edifying“ remark! Cf. also Allbaugh 1953: 33: farmers work "an average of only 160" 8h days/year, which means they actually might have had some spare time for building (note though that Cretan farmers at that time produced only part of their own cereal needs!).

Outer Perivoloi

While the enclosure walls' masonry and their juxtaposition around neighbouring sites allows to date them roughly to the same building phase as the dwellings (Protopalatial), the question remains if they were actually constructed together with the houses (and thus necessarily part of a larger plan), or if they were built when the (or some of the) houses were already there, in a kind of endeavour to organize the surrounding space subsequently.

A look at a map of one of the densest settlement regions in the study area (Pateragiorgis) might enlighten us to more detail (Figure 9 and 10).

Figure 9: The area of Kritsa Pateragiorgis showing Minoan walls (green lines), road tracks (between double green lines) and sites (black dots). Only the central *perivoloi* are shown to give a clearer impression.

When wondering about the possibility of walls having been built by one enclosure at a time, a map like figure 9 can be helpful that just shows all detected walls in their position relative to the sites. If there had been one site in the area to have built the first of all enclosures, one would expect the respective wall to be built without corners or sharp angles and with none of its walls continuing into the surrounding landscape.

Figure 10: The same part of the map with *perivolos* areas as attributed here to the sites by colour (dark blue lines unclear or untraceable in large parts *perivoloi*).

On the other hand those enclosures built later would be abutting this earlier one (where not continuing some line of the older wall) at an angle – as is the case in most of the *perivoloi* seen here. Only the *perivolos* of Site 53 (top centre of the map) does not show any walls continuing into other enclosure walls. But as it is abutted on three sides by roads (some of which may have existed before, see below) and only the NW wall is shared by the neighbour, it shall remain unclear if Site 53 might have been (slightly, the pottery doesn't look different) earlier than the other Pateragiorgis sites.

Judging from the fact how all other *perivolos* walls of the study area (not just this region) seem to have been built together and continue into each other, together with the fact that neighbouring sites share one wall between them (cf. the Greek concept of μεσότοιχος mesotoichos, shared – by two owners - wall [43]) they should be seen as a simultaneously built large landscaping venture. This is corroborated by the way meeting walls (where the meeting spots are clearly visible) seem to have been constructed together, not one after the other (Figure 11)[44].

[43] "Μεσότοιχος είναι ο εξωτερικός τοίχος κτιρίου ή ο τοίχος περιφράγματος που βρίσκεται κατά μήκος και πάνω στο κοινό όριο ομόρων οικοπέδων και καταλαμβάνει χώρο και από τα δύο οικόπεδα." Cf. ΓΕΝΙΚΟΙ ΚΑΝΟΝΕΣ ΔΟΜΗΣΗΣ - Κτιριοδομικός κανονισμός. - 'Αρθρο 353 at http://www.minenv.gr/1/13/131/13108/g13108353.html (last accessed 29-8-2011).

[44] My thanks to Prof. Jenny Moody for suggesting to follow this line.

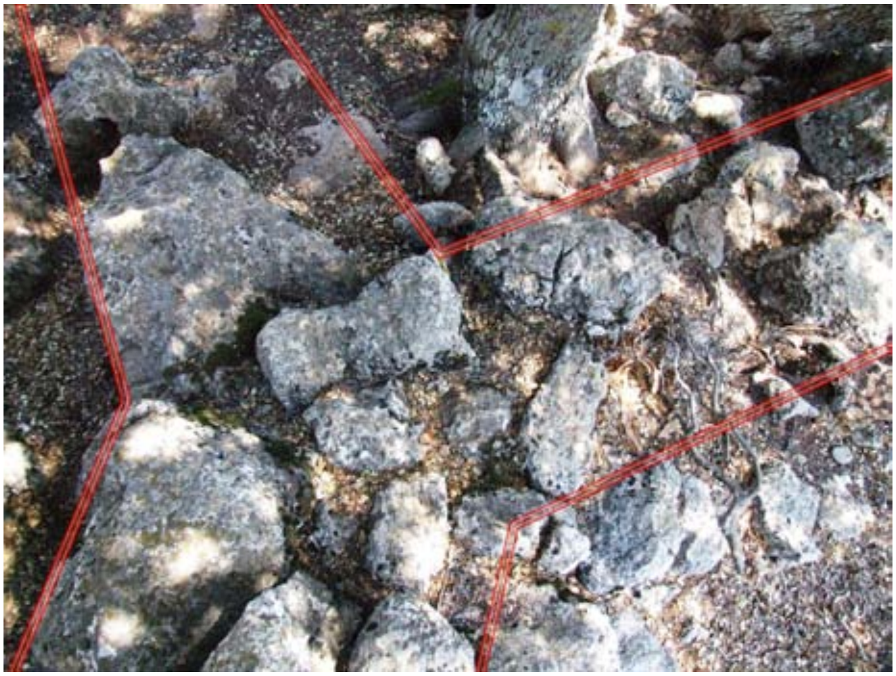

Figure 11: Two perivolos walls meeting (near Site 119) – red dots show the two directions the walls run.

The few exceptions to this remain enigmatic, e.g. the spots where two *perivoloi* actually do run parallel (*contra* the otherwise used shared wall) for a certain length and without obviously leaving just the space for a through road– even though e.g. in the case of the *perivoloi* between Site 34 and 59 some of the space might have been meant to make a passage from the West/Site 34 towards Site 74 (Figure 12, 13).

Figure 12: SW of Pateragiorgis – the *perivoloi* of Site 59 (turquoise, top) and 34 (yellow) run next to each other EW in the direction of Site 74 (right, in pink perivolos) – leaving more space than necessary for a passage.

The actual space in this case is much wider than usual for a road inbetween (Figure 13).

Figure 13: Roughly parallel *perivoloi* (59 S left, 34 NE right) E of Site 34, seen to East (space between ca 6 m)

Another look at figure 9 (map of Pateragiorgis with only Minoan walls and sites) shows at first glance that not quite all sites are surrounded in some kind by an enclosure wall each that can attribute a clearly definable area to the respective dwellings (see the same part of the map in fig. 6 showing possible attributions in colours). Figure 9 shows (slightly SW of the centre) an area with sites surrounded by small (inner) *perivoloi* only, whereas the outer, larger walled areas do not enclose space with a site inside. This is interpreted here as a probable second kind of *perivolos*/site relationship where surrounding enclosed areas are shared (for the way this might be interpreted in detail see land use below) by several sites which are in all cases positioned rather close to each other and only separated by small enclosures (here called Inner Perivoloi[45]). Still, the shape of the "site-less" surrounding enclosures doesn't suggest this to have been a "nuclear" kind of region either (which might have been suggested as Site 21 - in the centre of this area - shows earlier traces: burnt mudbrick, steatite working, some possibly late Prepalatial pottery).

As will be seen in the land use study below (Ch. II.d.4), the arable shared land divided by the number of enclosed sites leads to a good average size of arable land for all involved sites. The most extreme of such cases is the region of the 99 Sites ("Stous Asfendamous"), where "siteless perivoloi" are preserved in the full length of the walls.

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[45] Please note that many sites with a clearly attributable *Outer Perivolos* have an *Inner Perivolos* as well. For details, photos and more maps see above Ch. II b.

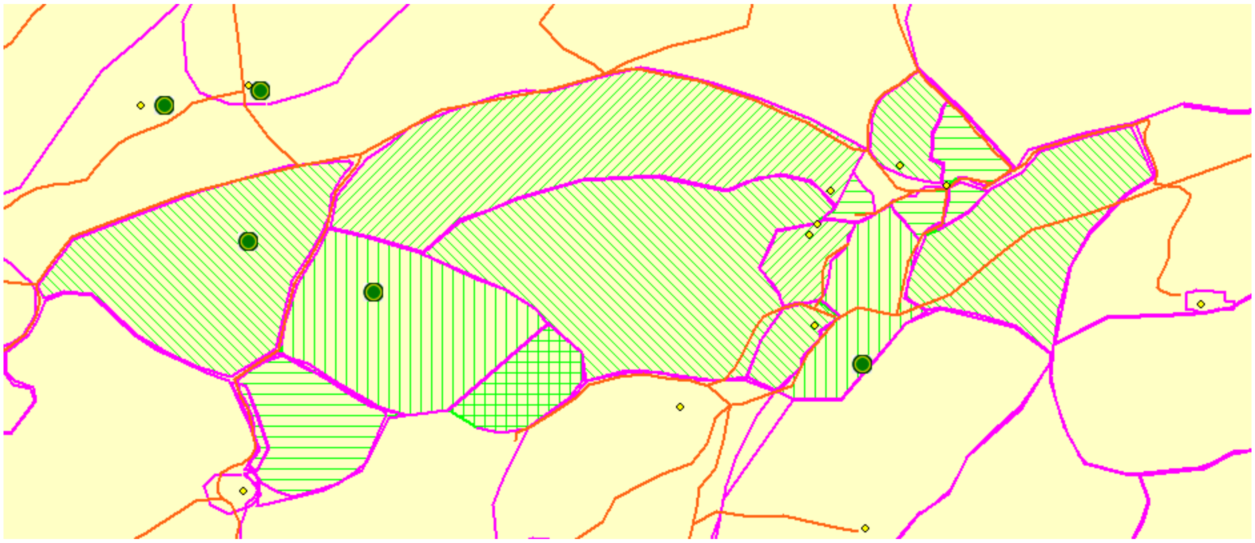

Figure 14: Stous Asfendamous, area of the 99 Sites, with "siteless" *perivoloi* tentatively attributed to the closely set 99 sites (green small diamonds in green areas 99-dwelling sites, green circles Round Structures, probable granaries).

These *perivoloi* are notable not only because of their unusually good preservation (followable in their whole length without missing/eroded parts), but also because some of them seem to have had a specialized function (Figures 14, 15, 16).

Figure 15: Western *perivoloi* at 99 Sites seen from SW – long stretches of walls discernable (the dwelling ruins are situated at the trees forming a diagonal line under the upper right corner).

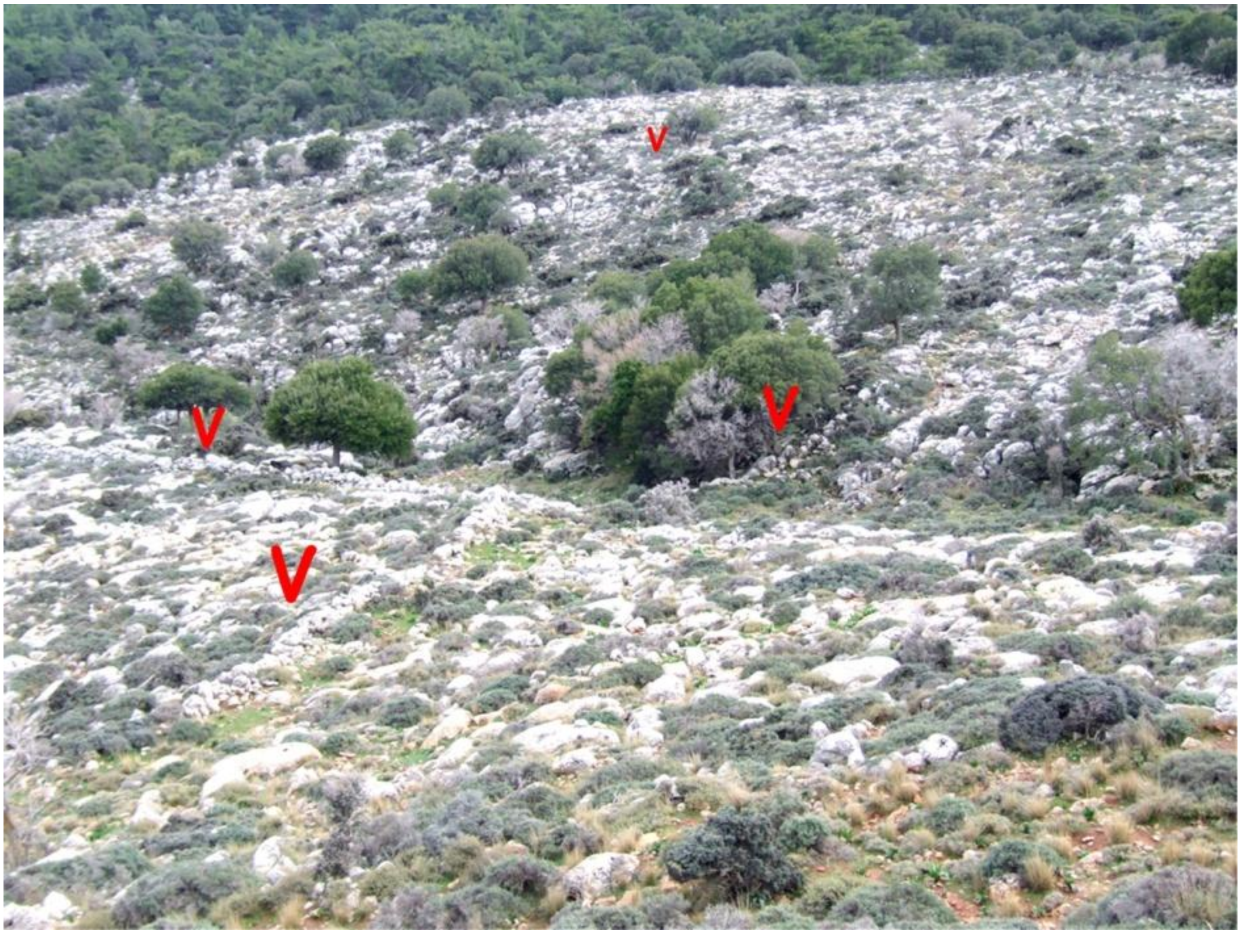

Figure 16: Closer view of the same area (from NE), various *perivolos* walls at red arrows.

The specialized function suggested for one of the "external" or off-site *perivoloi* (hatched on Figure 14) is based not on the *perivolos* wall or area itself but on the recognizable small half round terrace walls (cf. Figure 17) within its area, surrounded by traces of tiny worn pottery pieces (suggested to be Minoan by their fabric) that are probably a sign of ancient fertilizing (for details cf. Ch II.c.1). The half round terrace walls are typical for surrounding small plots of land for planting trees (cf. also Moody&Grove 1990), nowadays mostly olives (although this region is today above the typical olive growing region – with a slightly different climate this may have been otherwise). In a fruit orchard like that fertilizing would make sense, too.

A similar kind of dissociated from the site *perivolos* area with half round terraces and traces of fertilizing can also be seen NE of the 108 sites[46] (as in Figure 17, Figure 18).

[46] E of the 42 Sites (and N of Site 28) is also an area with half round terraces, but its definite position within a clearly defined enclosure cannot be corroborated (important parts of *perivolos* walls eroded and not traceable). The fact that this seems to occur in the cases of the 99 and 108 slightly more "nucleated" site areas suggest that this "orchard" might have belonged to the "quasi-nucleated" 42 Sites.

Figure 17: Half round terrace in *perivolos* area W of the 99 sites.

Figure 18: Traces of worn off-site pottery (fertilizing?) within a *perivolos* at Site 108 containing also half round small terracing (as in Figure 17).

In very few cases there also seem to be sites surrounded/abutted by several more or less equivalent, independent *perivoloi* , a phenomenon most obvious in the north-east part of Pateragiorgis, with Sites 51, 51B and 52[47] (blue and turquoise in Figure 19). While with Site 51 and 52 one might see the road passing between two parts of *perivolos* as reason for this, in the case of Site 51B clearly no road between the two parts is responsible for the division, and none of the two can be called inner or outer *perivolos*. While obviously here the roads were there before the *perivoloi* had to be adapted in shape to them (see especially the eastern corner of *perivolos* 51, between two roads), in the case of Site 51B only land/herd management choices seem to be a plausible explanation (Figure 19).

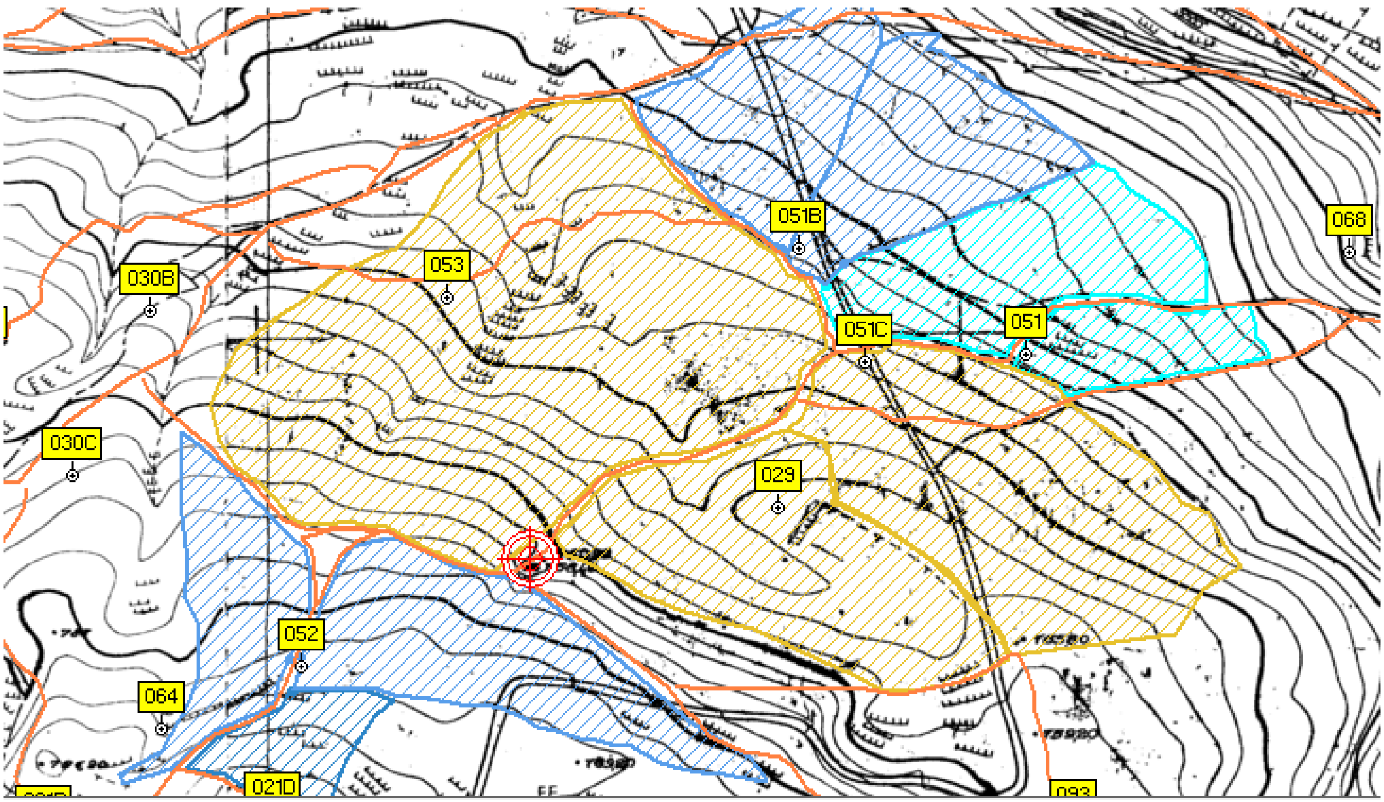

Figure 19: Pateragiorgis NE – several *perivoloi* belonging to the same site (51, 51B, 52 blue//turquoise), single *perivoloi* belonging to other sites (29, 53, brown). Other surrounding *perivolos* areas not coloured; Gaidourotrypa cave at red sign, orange lines Minoan roads.

In general *perivoloi* contain variously sized patches of arable and rocky land, which shall be closer analyzed in the land use section below.

Inner Perivoloi

Inner *perivoloi* are in their shapes and sizes just as variable as the house ruins, although certain characteristics can be noted that might shed a light on their function. One may assume that their

[47] The small *perivolos* south of Site 52 might also have belonged to Site 21D, but has here been attributed to Site 52 for its downslope position towards Site 52, while Site 21D lies beyond a slight ridge to the South.

original height (together with that of the outer *perivoloi*) must have been ca. 1,3 – 1,4 m to judge from fallen material (Figure 20) and the fact that dry stone walls can only be built to a certain height related to their width: a wall of 0,8 m width can't be built higher than 1,2 m (Hylton 1984: 487). As most of the *perivolos* walls are ca. 0,8 - 1 m broad at their base[48] that means a maximal height of 1,4 m, as mentioned above (Ch. I.b) just right to keep animals like sheep and goats in or out (especially for goats an extra layer of twigs might have been added). So one main function can be ascertained to have been connected with (inner and outer) *perivoloi*: the management of herds.

Figure 20: Perivolos with well visible undispersed fallen material, Pateragiorgis.

Especially some of the inner *perivoloi* might have been even more specialized in function. For example there is a group of walls (often as one of various shapes surrounding a site, cf. Figure 22, Figure 21 red dotted line) built in a curious, lengthy oval way with an opening at the smallest point. Comparison with modern wall constructions show that these may have been milking pens, the shape of which need to be like this (rounded corners, best lengthy oval), locals insist, because during the milking process - while sheep/goats leave the mandra one by one after having been

[48] Their base must have been very similar in its relative position to the soil surface in the Bronze Age as several *perivolos* walls cut by modern road construction show (e.g. *perivoloi* of Sites 20, 32, 33, 92, 132).

milked - animals might try to hide in corners and are then difficult for the dogs or helpers to be moved towards the milkers (for the shape of a recent milking *mandra* see Figure 23).

Figure 21: Plan of Site 53 with surrounding walls, road and terraces. Red dotted line: Closed Inner Perivolos; blue dotted line: Connected Inner Perivolos; black dashed lines with slope signs: Terrace walls.

Figure 22: Site 174. Oval Inner Perivolos on the east side of dwelling ruin 174 (the latter right of and under the tree), with opening at upright stone in background.

Figure 23: Recent milking *mandra* with a typical lengthy oval shape (near Sites 84, Megali Limni, Kritsa).

The possible interpretation of other smaller walled spaces surrounding Minoan mountain sites should be expected to have been more animal management spaces[49], but also gardens and outdoor working areas.

Special cases of Inner Perivoloi

There are few examples of small enclosures that do not seem to fit into the aforementioned categories, namely the structures with upright stones some of which might also be special cases of Round Structures (small diameters, Sites 128, 183; the upright stones stand no higher than ca. 30-40 cm), while the largest known one (25 m SW of Site 38, ca. 8x4 m) stands high enough to even be used as pen for small animals (Figure 24).

Figure 24: S of Site 38. Peculiar oval structure with upright stones (height 0,8-1 m)

[49] Note that at the recent *mitato* of Mesokoúntouro (Site 31) there are 4 milking *mandres* next to each other (and in shape adapted to the surroundings, but with rounded walls), used at times by four families using the *mitato* simultaneously for 4-6 weeks after *cheimadio* and before climbing up to the highest summer browsing grounds. My warm thanks to Manolis Thrapsaniotis from Tapes for this and a lot of other information regarding pre-industrial conditions in the Tapes mountain area.

An otherwise unknown kind of Inner Perivolos occurs within the *perivolos* area of Site 61: While other Inner Perivoloi are positioned close to the sites, or actually enclose them, this (while within the outer *perivolos*) lies at a remarkable distance from the respective site (200 m) and all in all gives the impression to be detached from any site by its position close to a cliff (partly at 3 m from the edge). It is comparatively large (diameter ca. 40 m) and roughly oval in shape (Figure 25, 26).

At a closer look there seem to be traces of one (or two?) small, may be originally house-like compartment(s) (cf. bottom right on Figure 25) near the inside of the *perivolos* wall. In one small area traces of (Minoan) pottery also occur (mainly pieces of medium coarse fabric, small vessels, cups). Naturally the exact function of such a feature cannot be guessed, although it is suggested here that this recalls some kind of graveyard (possibly enclosing house-tombs?) for the surrounding sites (over 30 within 1000 m).

Figure 25: Oval Inner Perivolos north of Site 61 (from SW edge at cliff), with view to sea and Thylakas.

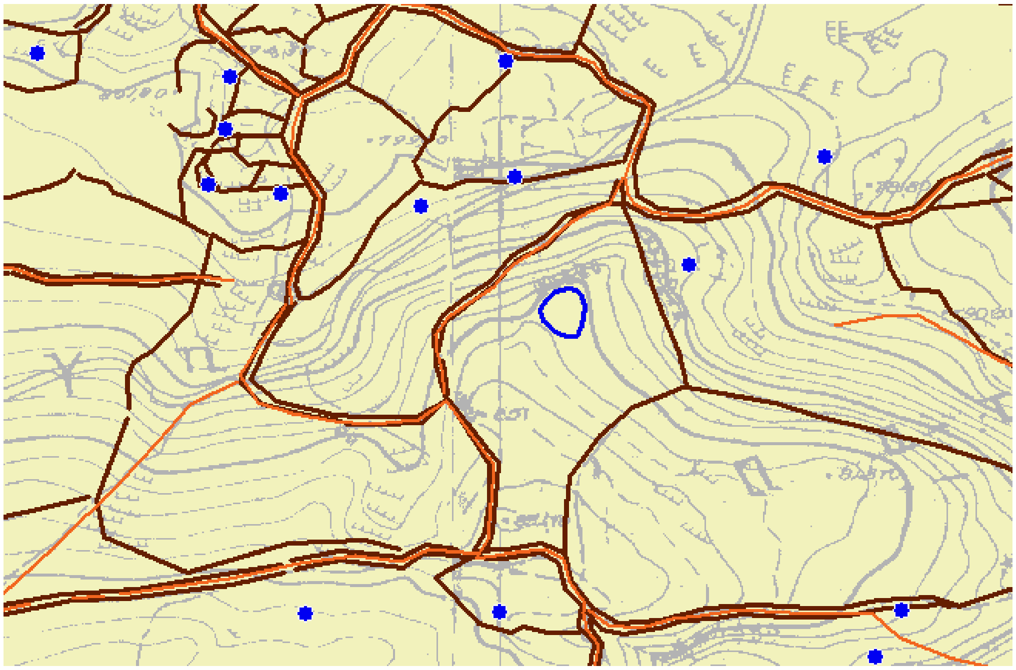

Figure 26: South Pateragiorgis area (width of map ca. 600 m) with the oval Inner Perivolos (blue) within the *perivolos* of Site 61 (brown, with all other walls, roads orange, sites blue dots, Site 61 bottom centre)

Another – and unique – case of unusual Inner Perivolos is situated near Site 49 (ca. 40 m NW of dwelling ruin): a not too well preserved low, roughly circular wall, “enclosing” (with several lacunae making this uncertain) an area of ca. 15 m diameter is furnished at its best preserved side (east) with a very interesting upright stone roughly recalling the “baetyls” of Gournia and Galatas (cf. Ch. II.b.B.6). In its centre is a – probably natural - irregular hole (ca. 25 cm) looking through which the gaze is directed exclusively to the peak top of Mt. Thylakas that houses a possible Minoan (and certain Classical-Hellenistic, cf. Reinach 1913) peak sanctuary (Figure 27, 28). Excavation could possibly show if this is a chance occurrence of nature or an intentionally erected structure, possibly with ritual significance.

Figure 27: Upright stone near Site 49 (from W) with hole and view to Thylakas (right: Thylakas peak as seen through hole).

Figure 28: Upright stone like baetyl near Site 49, position in landscape from E (left); right the stone seen from S: traces of Inner Perivolos the stone is part of in front.

4: Synopsis: Bronze Age Land Use in the Tsivi South area

"In der Tat wissen wir nahezu nichts über die minoische Felderwirtschaft. Auf Fresken sind ummauerte Bezirke dargestellt, die jedoch nicht ohne weiteres mit der Landwirtschaft verbunden werden können. [...] Wie wurde das Vieh angesichts des Fehlens von Felderumfassungen von den Feldern und Weinbergen ferngehalten?" *Moody&Rackham (2000: 38)*[1]

“Communities living in marginal ecological niches, which according to subsistence availability would have been estimated as unable or at least expected to be organized on a non permanent basis, are proved to be sedentary.” *Efstratiou (1990:36)*

[…]”evidence for pastoralism in antiquity being associated primarily with the estates of the wealthy emphasizes the importance of its wealth-generating, rather than its subsistence, function. “

Forbes (1995:332)

In this chapter I shall suggest some basic calculations on the possible carrying capability of Minoan fields. My approach is a very general - and necessarily imperfect - one to reach an assessment of the possible yield or the size of population that the Minoan mountain fields might have sustained (cf. Foxhall & Forbes 1982 passim for necessary reservations). These calculations shall be based on grain production, which obviously means disregarding other sources of energy/nutrition[2] possibly available at the time from elsewhere (meat, oil, wine, legumes, fruit, honey, wild vegetables – some of which might have been local, too - etc. to be mentioned below - cf. Allbaugh 1953 for details of pre-industrial Cretan diet and nutrition, cf. Nowicki 1999 for his accounts of a possible early Iron Age mountain diet). Such an approach means to ignore, for the time being, each possible local and temporal variability (Horden & Purcell 2000: 47) by using modern production variables (that have luckily a large span of possibilities). This is supported by my own experimental data for computations[3]. The possible re-use of the same area with the same methods/strategies as in the Bronze Age is already supported by climate and geology. In the recent Tsivi South area we can most probably witness a re-use of a human made landscape offering ready sub-structures created in the Bronze Age so lastingly that Cretans of the 19th century needed hardly more than just cleaning and probably some slight re-building of fallen fieldwalls.

The first fact that can be stated for the Minoan land use organization is that as in other areas of Crete “Buildings were placed so as to minimize direct occupation of potentially cultivable areas” (Haggis 2005:71). But while in the Kavousi region “spaces between houses in a cluster could have been tilled for small gardens and used to keep household livestock”

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[1] “Indeed we know close to nothing about Minoan field management. Frescoes show walled areas but those cannot easily be connected to agriculture.[…] How did they keep animals away from [cultivated] fields and vineyards without enclosures?”

[2] One should keep in mind that the amount of energy needed per person over time is certainly more variable than modern standards suggest (cf. Allbough: 1953 for Cretan low-calory needs of the 40ies).

[3] As the latter - due to decades of overgrazing of the area - produced a minimal yield (see above for details), Minoan yields must necessarily have been better because with the new landnam the soil must have been still fresh and rich in nutrients. In this I'm trying not to overstress the historical ecological approach (cf. Horden&Purcell 2000 II/5: 45-49), but to use it as a tool for judging the possibilities of self-sufficiency or even surplus of the area in Minoan times.

(ibid.), the Tsivi South area spaces between houses are much larger and obviously have room for more than household livestock, while, as has been shown above, various wall structures surrounding many dwellings also suggest an additional management of larger herds.

As recent land use shows this doesn't mean an absence of agricultural activities in the area. So in this assessment of the possible Minoan use of arable patches in the enclosures, a husbandry similar to recent practices is assumed where walls and fences were used to manage herds in a way so as to keep animals out of reach of the cultivated plots during the growing period of cereals (November-early June[4]).

Practical approach

The arable plots in the studied area are usually too small to be cultivated by plough and most of them were traditionally cultivated by hoe. To be able to estimate the actual arable surface in the Minoan sites' enclosed catchments, two regions were chosen where *perivoloi* are in a good enough preservation state to allow detailed attribution (Pateragiorgis and Stous Asfendamous regions, Kritsa and Kroustas slopes). GIS maps were drawn up and arable plots within the landuse-study areas were plotted on the maps according to their quality as visible in the modern landscape[5]. For these plots three categories of arability were established:

1. Good fields: mostly alluvial/colluvial plots in little valleys or *'langades'* with 85% and more arable soil surface and – because of their position – necessarily very good soil. They are given in green on the maps. (Figure 4)
2. Medium fields: often plots on slopes, mostly terraced even in areas with very little gradient, with no less than 50% arable surface. They are given in khaki on the maps.
3. Non arable spaces: with more than 60% rocky surfaces, often on steep slopes or rocky outcrops. They are not coloured on the maps but might have been used as space for keeping animals that could graze – as they do today – even on the small amounts of wild herbs between the rocks. That these areas are not necessarily exclusively 'non-arable' is proven by the fact that some of them (e.g. the tiny soil patches of 2 - 10 sqm just W of ruin 33) were agriculturally used as hoed 'fields' (for barley), as locals report.

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[4] As mentioned above (Ch. I) even when the cereal plants are small in winter animals might still be led to browse on them (and leave some dung while at it). That many enclosures of sites sitting on the edge of the settled area seem to be open towards the outer reaches might have had several reasons: either *perivoloi* mainly protected the land from domesticated animals – or these settlers came later than the others and didn't bother to enclose "their" land in the same way – obviously this question could be solved only (if at all) by detailed pottery studies.

[5] It seems necessary to mention here that in detail and for the Cretan landscapes that are not big plains (like the Messara, parts of Pediada etc.) such a land use study is not possible by a purely satellite-photography (i.e. Google Earth) approach with the currently available resolutions. At a minimum (i.e. best quality on the market apart from military uses) of 0,6 m per pixel (Google Earth has at best 1 m per pixel) stone blocks of ca. 1 m (!) size and bigger can be distinguished, whereas visible growth inbetween not visible in detail dense smaller rocks may be no more than a browsable piece of land without making it arable in any way. On the other hand small arable plots may not be recognizable as such. For the small, hoe-able by hand only fields also taken into account here, only the actual physical presence of the student allows him/her to get a clear picture. Hence while using mapping programs for the computations in this study, the actual classification of land areas for agricultural potential was done in the field.

While many soil-holding retaining walls bordering these plots[6] (where important) seem to have been built already in Minoan times, the distribution of arable fields must have been at least as it is now, or may be slightly towards better quality because of erosion through wind in recent years as a consequence of overgrazing (EU subsidised by head of animals). Spots where erosion by water might have occurred are always barred by strong Minoan walls (see the position of *perivoloi* in relation to run-offs or sloping colluvial *langades* on maps Figure 4 and 5: they always pass them horizontally in a retaining function).

It is interesting to note that the special positioning of these retaining walls in run-offs can be used to prove the fact that the climate cannot have changed very much (or rather never had a significantly larger amount of rainfall) since Minoan times. (For details see special example A at the end of the chapter).

According to the clearly defined modern distribution of arable plots (see map Figure 4) a chart (landuse-distribution chart, see graph Figure 7 below) was created, into which each site was entered with the size of its *perivolos.* The arable plots inside the respective *perivoloi* were computed into an index number for arability, where good field surfaces were counted multiplied by three as an expression of their especially good quality (see Figure 1, illustrating a good field example at dwelling ruin 30 in modern use). Medium field surfaces were multiplied by ½ because of their much smaller actual amount of arable soil.

Figure 1: The still cultivated alluvial fields at Site 30 (dwelling ruin in front of big tree top left).

[6] Some are preserved as *perivoloi* and/or roadside walls, others as check dams vel sim., and even some of the terrace walls probably go back to the Bronze Age.

These multiplicators include two factors:
1 - the actual amount in surface sqm of arable land.
2 - the fact that on good fields the yield of barley can be expected to have been somewhere over 80 kg/stremma, as Allbaugh (1953: 379) refers to an average yield of ca. 58 okades (ca. 74 kg) per stremma[7].

Thus when showing the "arability index" in the charts below (Figure 7 and Figure 10) not the actual size of fields in square meters is visible, but the quality of arable land belonging to a site, as a large medium field would have produced much less yield than a much smaller good one because of the different amount of stones on their surface. Hence with some sites (those with many good fields) it becomes possible that the "arability index" seems larger than the *perivolos* area itself.

Another reason for multiplying the good fields by three is not only soil that would have been regularly renewed by erosion from neighbouring slopes[8] (even without extra fertilizing), but also that they had the best amount of humidity possible in the area (being mostly situated in former run-offs). Judging from the fact that locals[9] remember that e.g. the central good field (ca. 850 sqm) of Site 23 produced at best 3 sacks (i.e. ca. 110 kg) on a field planted for may be a century without any fertilizing, even there a multiplicator of 2 would still apply. As the area doesn't seem to have been agriculturally exploited before PP times, a larger yield could have been expected on fresh, untired soil on good fields (especially if animals browsed and thus slightly manured fields after harvest).

For medium fields the actual size is only counted by half because of their actual arable soil surface between 20 and 50 %, the rest being rocky (and here usually not moveable rocks are the problem but the amount of bedrock reaching the surface.)

A third area, the sites closest to, and west of, Kroustas, was originally taken into consideration as a possible third close study region, but as through intense recent re-use[10] many walls have been obliterated or re-structured, not enough certain *perivoloi* areas could be attributed to produce a satisfactory result. Still as a general notice it is interesting that the sites' *perivoloi* were much smaller and distances between the dwellings were shorter. If these two facts were connected with a better arability, too, cannot be stated with certainty, but a more detailed study of this area – and thus better judgement of actual *perivoloi* [11] might give a better base of data. (for a tentative map see Figure 2).

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[7] Ilios gives for the whole of Greece slightly more optimistic yields between 60-200 (ca. 80-260 kg) okades/stremma, (Ilios vol. 11: 551, lemma >κριθή<), that is between a simple amount and its triple in the best case. My experimental field in Site 24's good field area still produced the minimum amount under the worst conditions (non-specialist farmer//methods, the soil worked after having been exposed to overgrazing for many years and thus rather eroded, absolutely no improving of field quality by any fertilization, no influencing of the rain-fed irrigation conditions by channels, vel sim).

[8] And it stands to reason that the Minoans would have tried to optimize all the improving effects of the landscape at the least by terracing, possibly also by controlling the rainwater flow (by channels, walls). For NP undertakings of this kind see the recent work of Chrysoulaki and her team at Choiromandres at http://www.hydriaproject.net/en/cases/crete/zakros/importance.html (last accessed 7-1-2012).

[9] Many warm thanks to Katherina Afordakou from Kritsa.

[10] Most dwelling ruins are only preserved in traces of a few oncolithic stones (where these could be integrated in recent fieldwalls/terracing), many originally smaller oncolithic /large rubble blocks (the latter seem to have been more popular here) were rebuilt into recent walls surrounding the pottery scatters.

[11] The dense modern use also implies a dense net of fences in the area that could only be overcome by a possible detailed future study with the cooperation of the respective owners.

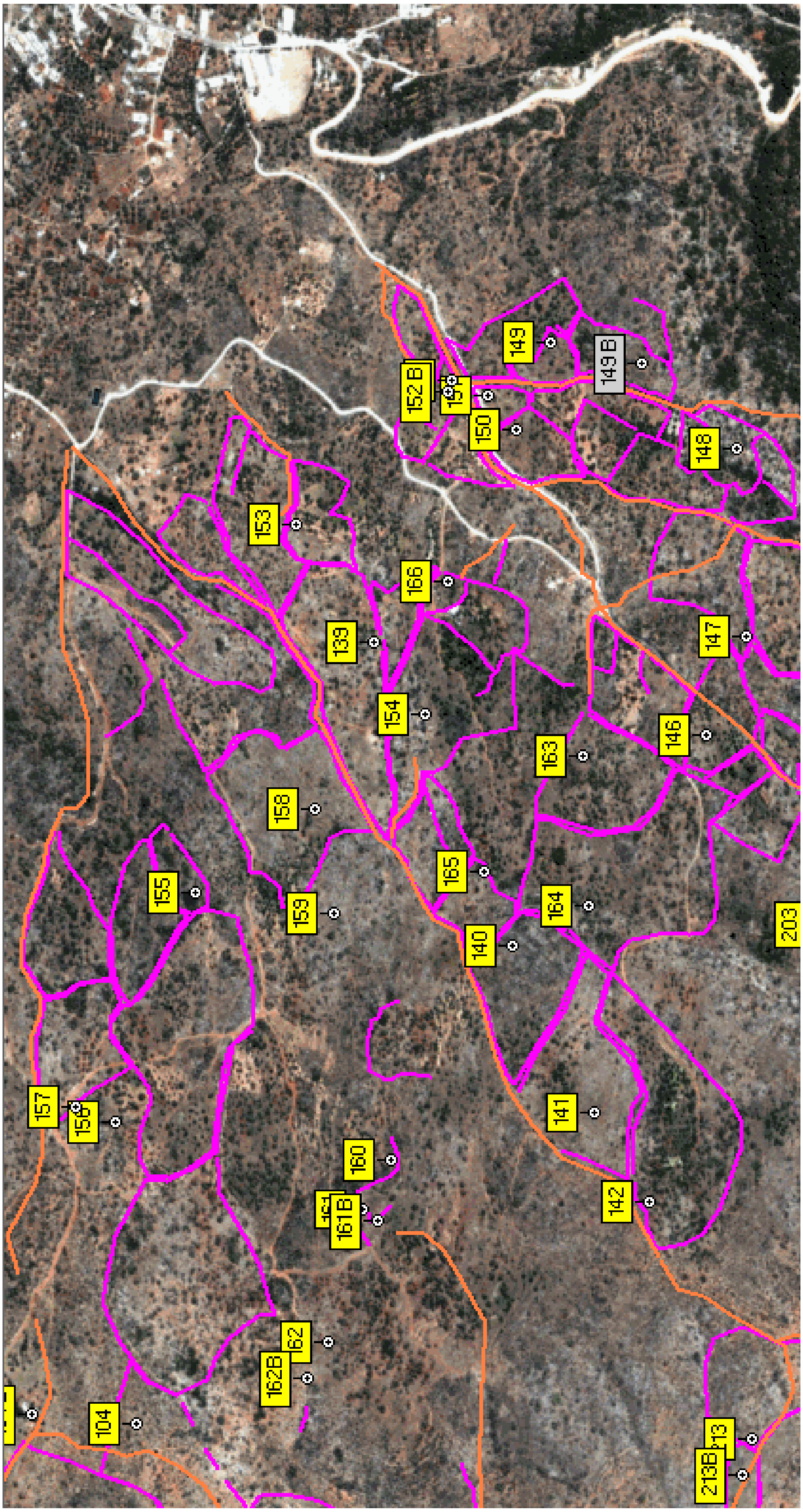

Figure 2: Minoan Sites west of Kroustas (edge of village top left) with tentative walls/*perivoloi* (pink). Distance between sites on average much less than elsewhere, ca. 150 m (North left).

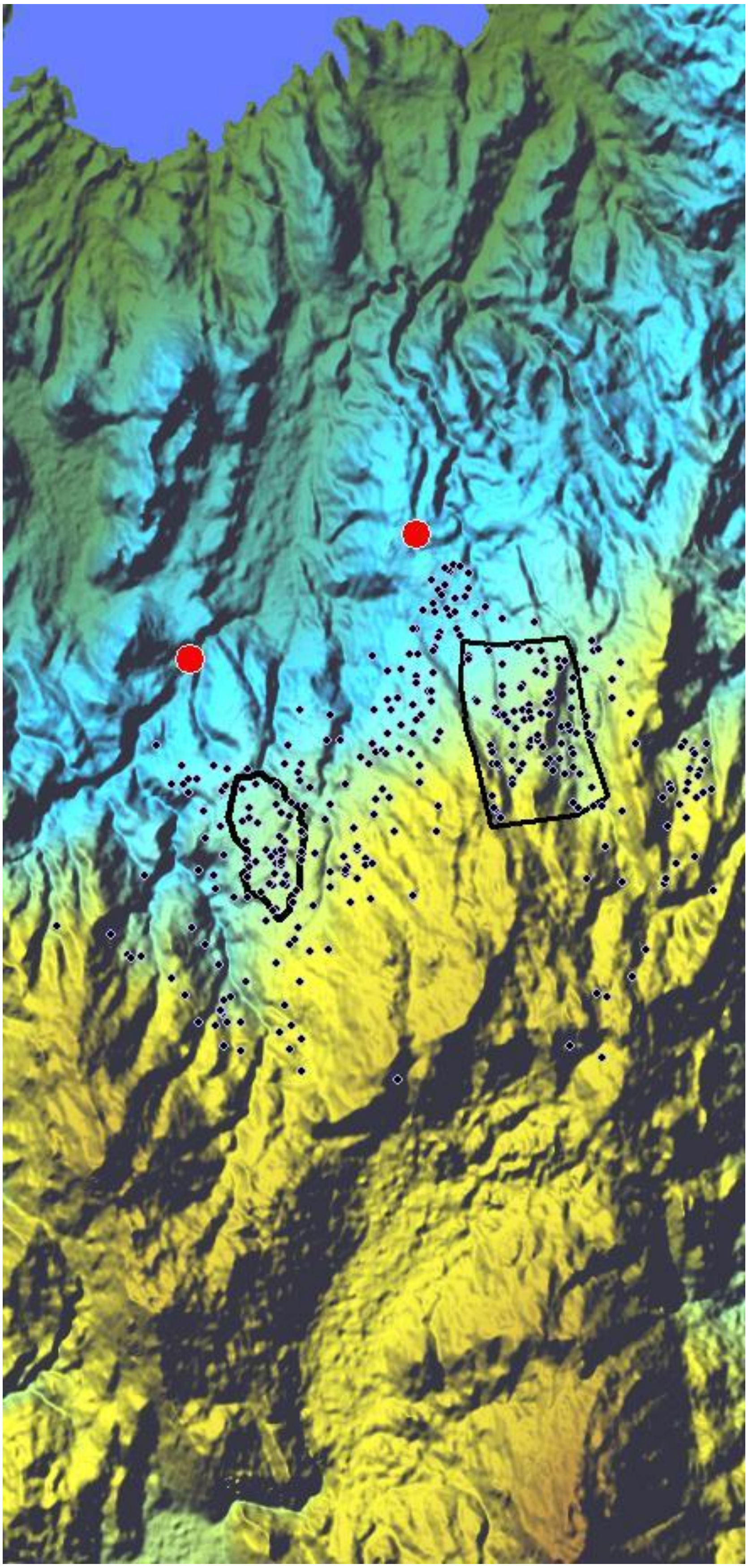

Figure 3: Special land use study areas on relief map (within black lines) seen from W. Pateragiorgis (to N, left) and Stous Asfendamous (to S, right). Red dots Kritsa and Kroustas. (Minoan sites black dots). Areas in yellow over 800 m (North left).

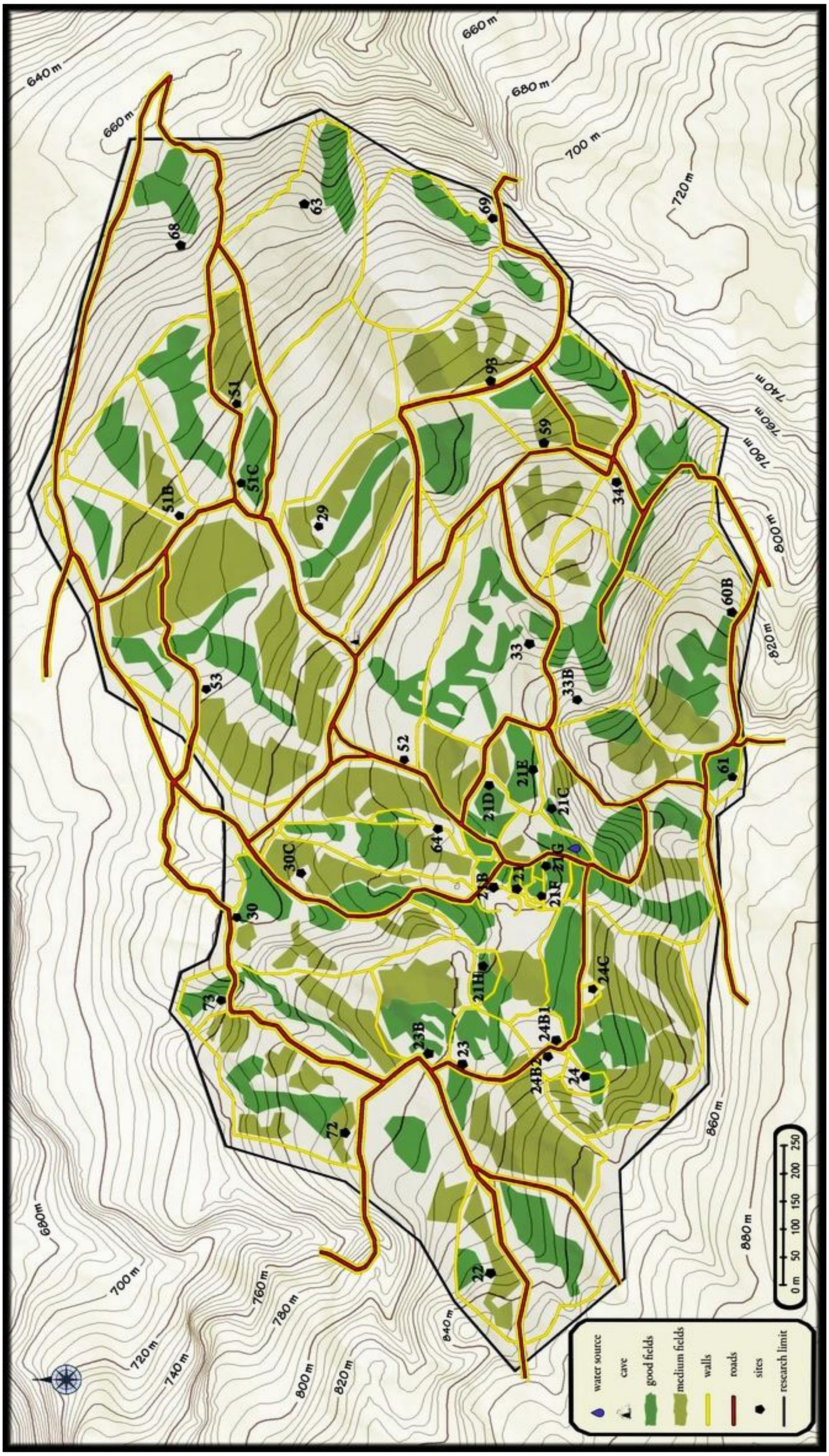

Figure 4: Pateragiorgis land use map 1: All walls (yellow) and roads (orange). Good field areas green, medium field areas khaki.[12].

[12] Special thanks to Christos Galanis for creating these beautiful map images.

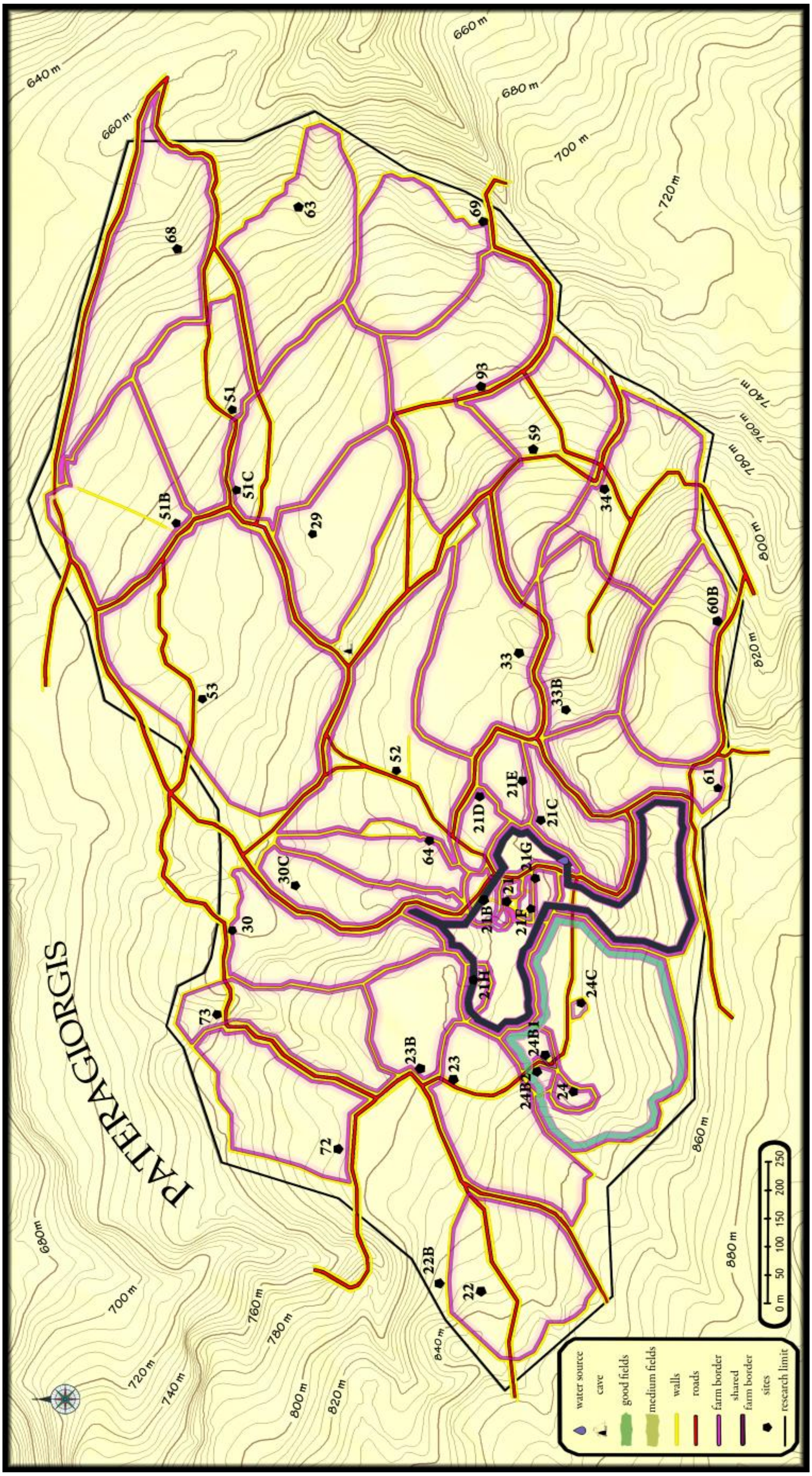

Figure 5: Pateragiorgis map 2 with all walls (purple) and shared perivoloi (blue and violet)

A. Pars pro toto: The Pateragiorgis land use area

Pateragiorgis is the name of a region (sized ca. 1,4 sqkm) above Kritsa along the road to the Katharo plain, between ca. 680 and 850 m. Large parts of this special study region have been cultivated with cereals and vines until ca. 50 years ago and a small *metochi* sat on a slight rise in its centre near one of the few water sources of the region. Recent agricultural activity has necessarily obliterated a lot of information and nearly totally destroyed several dwelling ruins[13], but still the choice of this as study area for site catchment analysis[14] is (as in Stous Asfendamous) based on the best preserved and documentable *perivoloi* within the area that could be reconstructed on the map with enough precision as a continuous territory of Minoan use, including also the roads and other features (water source, Gaidourotrypa cave).

The large recent double well/cistern giving the eponymous place name of "Sternes" to the closer region[15] at the densest settlement area around Sites 21, together with roads/paths connecting the surrounding sites with the cistern space, suggests that a water source already existed here in Minoan times. The cave remains unexplored[16], still it was obviously also included in the Minoan road system.

The Pateragiorgis land use-area contains 37 Minoan sites, which apart from two (24B2 and 64 exist only as pottery scatter) all have at least traces of oncolithic dwelling ruins, some of which still stand up to 2,2 m (Site 33) (for the distribution of sites see maps Figure 5,6). *Perivolos* walls here have lengths between 200 and 1200 m. In most cases each ruin has its own large, outer *perivolos* wall of at least 600 m length. Only the *perivolos* walls of Sites 21D and 21E are not longer than 370 and 340 m each. Still if one takes into account the land use-quality of their enclosed fields (Figure 8, cf. map Figure 5) they can be seen as just lower average in terms of overall arable land (as they have hardly any rocky patches in their acreage compared to other sites).

In the central region near the water source many sites have a (often well preserved) inner *perivolos*. These sites (21 and 24 sites) seem to share their outer *perivoloi*[17] in two different but characteristic ways (for details see the end of the chapter, special example B) that also occur similarly in the Stous Asfendamous area (see below).

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[13] E.g. at Site 24B2 where the ruin must have been – apart from an intense Minoan scatter - lost in the pre-industrial activities around a recent mixed agricultural installation (*mitato, mandres, aloni*), or at Site 21F where only two oncolithic stones in a row are still visible in the edge of a recent *aloni* with a scatter next to them.

[14] A less continuous (and often less well preserved for *perivoloi*) pattern of sites has been noted in the wider surroundings. The special study area is marked with a black line in the detailed maps above, sites outside are not shown.

[15] This was a *metochi* inhabited in summer in pre-industrial times (one house ruin sits next to Site 21 on the S end of the small central ridge), and before in the middle ages: few pottery pieces (possibly Venetian) are visible and traces of a large ruin sit on top of Site 21 B (on the N end of the small central ridge). The cistern sits 120 (150) m S of them.

[16] Cistern and cave are marked in blue and black on the maps.

[17] Due to the geological conditions (clayey phyllitic soil) around the water source, fields here may also have had better yields or been planted with more exclusive plants that needed humidity.

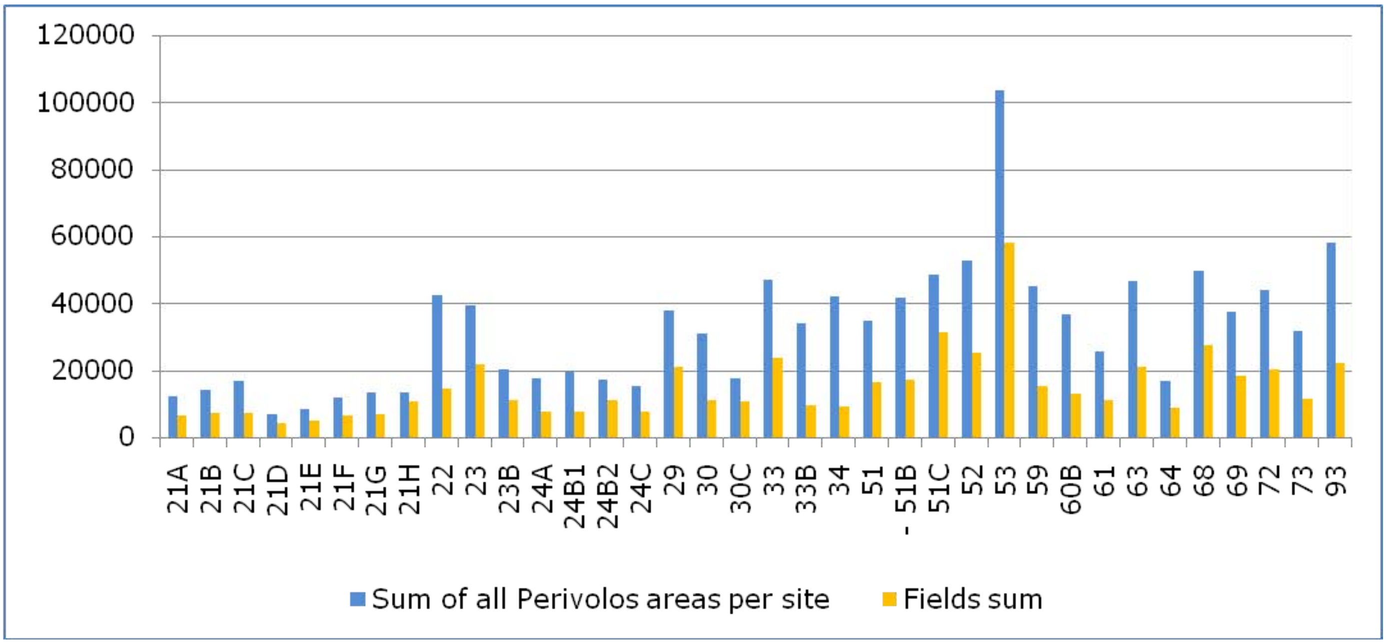

Figure 6: Chart showing complete perivolos areas in 1000 sqm (blue) and arable field areas within (orange, combined good and medium quality). The larger the difference the more non-arable space is in the perivolos. Note the difference between actual arable space in sqm (orange) and arability index (green on Figure7).

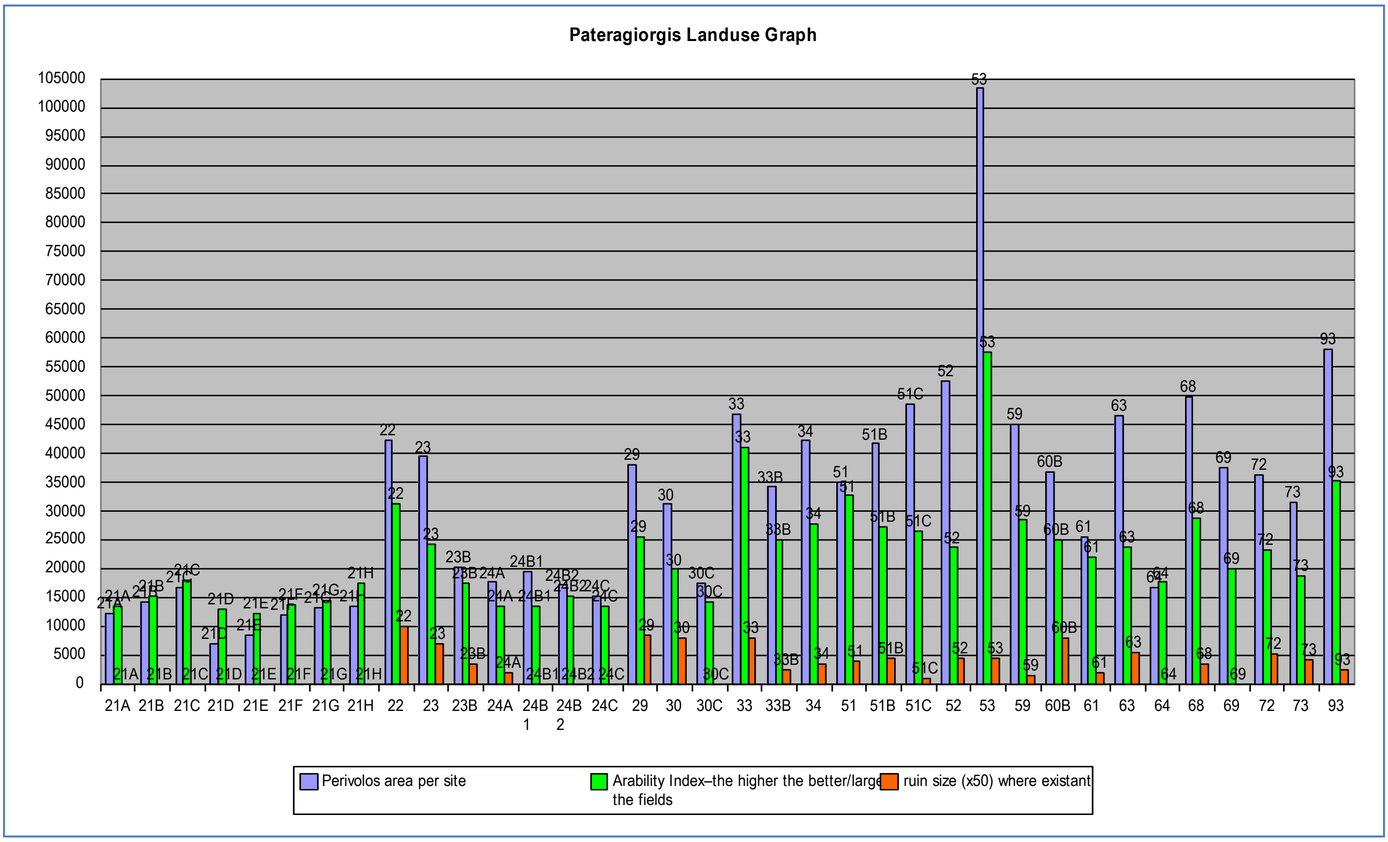

Figure 7: Landuse graph (blue: perivolos area size in 1000 sqm, green: arability index, red: dwelling size x 50 in sqm).

The chart in Figure 6 shows the actual sizes of *perivoloi* areas (blue) in relation to the respective actual arable plots (good and medium fields combined, both in sqm). The large spaces within the *perivoloi* with no arability are nearly exclusively useable as browsing land only.

The chart Figure 7 makes obvious that even though there may be large differences in the sizes of *perivoloi* (blue), the "arability index" per site (green, derived from good fields x 3, medium fields x ½) is much closer to a general average amount (table 1 and 2 below), i.e. by the choice of plot allocation small *perivolos* sizes were often compensated.

Average ruin size	Average Perivolos size	Average Good field size	Average Medium fields	Average field Size (all)	Average arability index
83 sqm	26.200 sqm	5.180 sqm	6.800 sqm	13.400 sqm	19.400

Table 1: Average field data for Pateragiorgis (not counting Site 53)

Site	Ruin size	Perivolos size	Good fields	Medium fields	All fields	Arability Index
21E	Ca. 40 sqm (traces)	8.500 sqm	3.890 sqm	1.240 sqm	5.130 sqm	12.290
53	Ca. 88 sqm	103.580 sqm	11.370 sqm	46.800 sqm	58.170 sqm	57.510

Table 2: The smallest and largest sites in Pateragiorgis and their field data.

The tables show that even site 21E with its very small *perivolos* has arable land (good+medium) of over 5000 sqm, thus still reaching an acceptable arability index not too far away from the other sites' average.

On the other hand the upper limit of the spectrum can be seen in Site 53. Its arability index is 1/3 larger than that of the next in size site, 33[18], and more than 4 times as large as that of the smallest site 21E. The inhabitants of Site 53 obviously managed a much larger expanse of arable fields than everybody else in the Pateragiorgis landuse study-area. Thus it isn't very amazing to note that the surface at Site 53 shows more pithos-sherds (i.e. storage vessels) than elsewhere, together with a few hints of finer pottery (more than at other sites of the area[19]). The evidence of the storage vessels on the slope below might additionally shed a light on the possible function of the half-round structure that seems to have extended the square part of the dwelling ruin (see topographic plan Figure 8) to the North-East: it could have been some kind of storage area or granary (as is suggested also for the aboveground round structures[20]).

[18] Cf. in Figure 7 that in actual field plot size the difference is larger as Site 33 has relatively more good soil fields.

[19] Still the overall numbers of fineware visible on the surface is extremely small in general, at many sites I could see none, at Site 53 a few, one of which showed traces of black slip (for more details cf. Ch. II c 1, pottery.

[20] Although these – if granaries - must have been used without ceramic storage containers as the surface around none of them shows traces of (storage) pottery, as mentioned above.

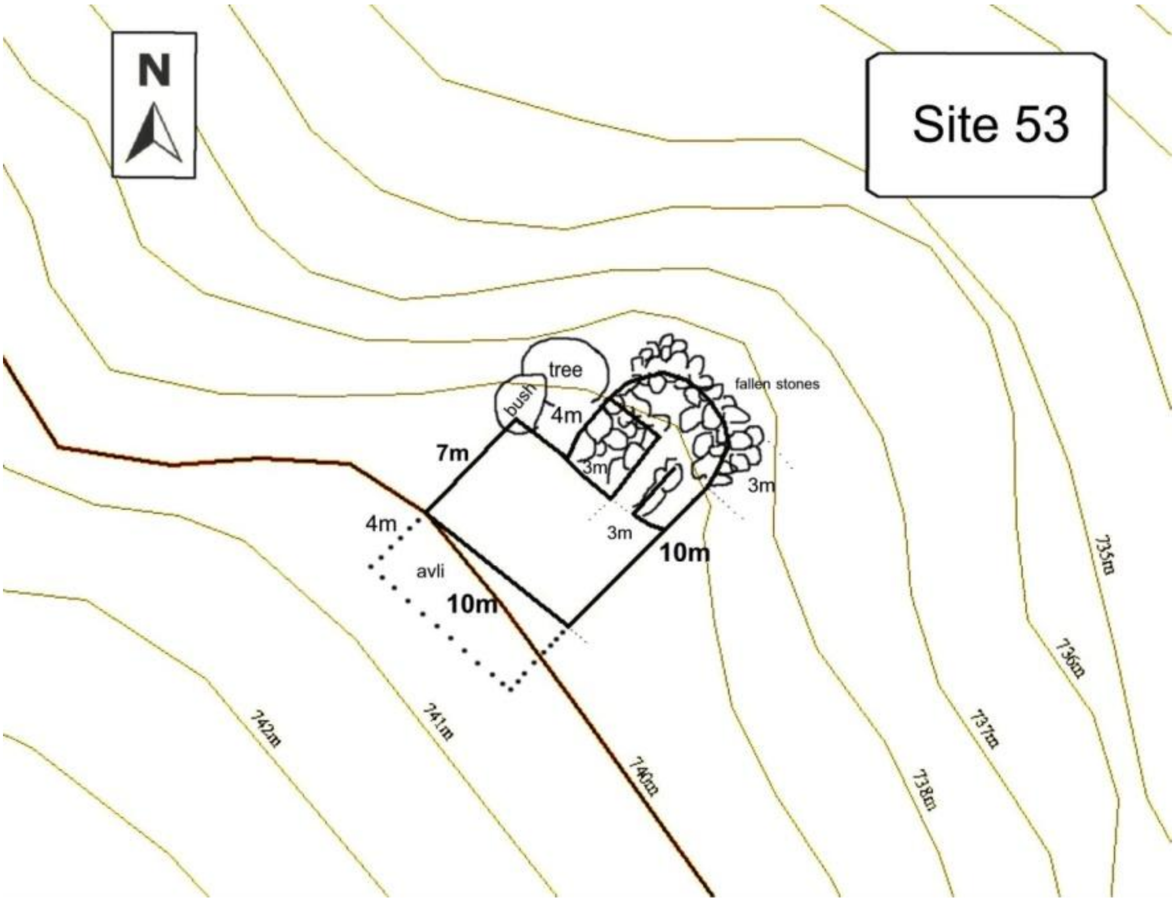

Figure 8: Topographic plan of the dwelling ruin of Site 53.

Still not only the arability of Site 53's land was the best, its *perivolos*, too, is by far the largest in the area (see maps, tables and Figure 9[21]), allowing thus for a larger space for keeping (browsing) sheep/goats as well.

On the other hand the size of the ruins (where preserved, see Figure 7: red data[22] and tables) obviously bears no recognizable relationship to the field sizes, which is here taken to mean that there existed no relationship between family size/inhabitant number or indeed their wealthiness or status and the arable plot or *perivolos* size.

[21] The possible garden spaces N and E of the ruin are not included in the "good fields".

[22] Please note that the red indices for ruin size in Figure 7 does not mean the dwellings were actually as large as they appear on the x-axe of the graph – ruin sizes have been multiplied by 50 to make them visible on the chart. The indices are only meant to illustrate their relative size differences.

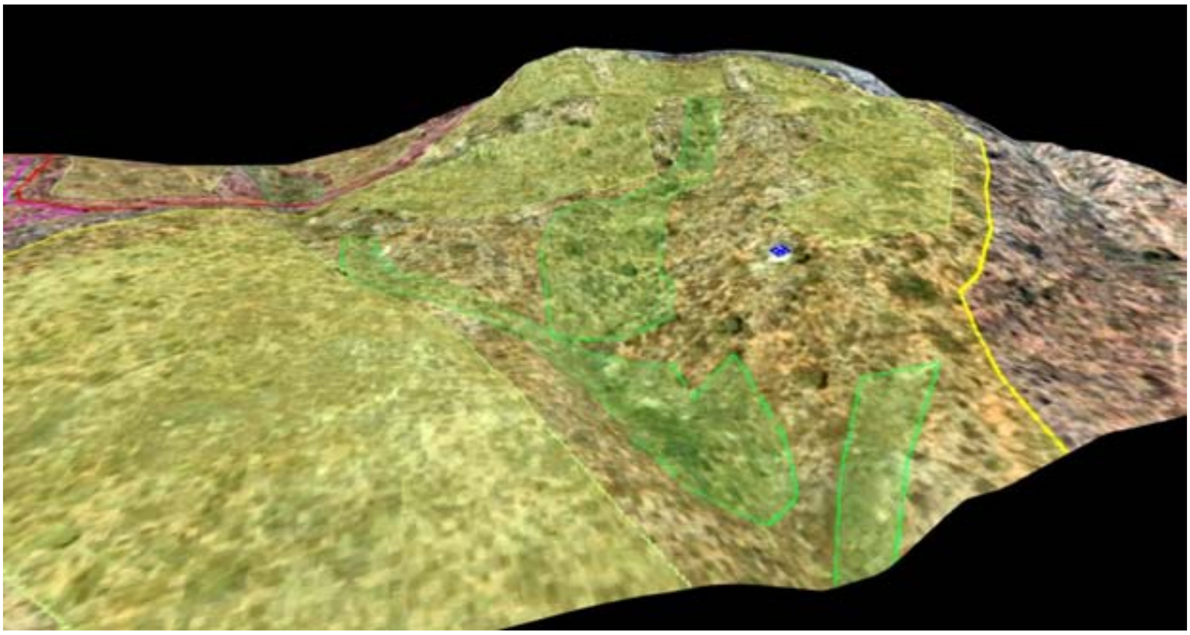

Figure 9: 3D rendering of the perivolos area and part of its wall (yellow, with good fields green, medium fields khaki) around Site 53 (blue dot). Distance from the dwelling ruin to valley bottom ca. 75 m. Seen from NE, with NE part of area missing.

Were the Minoan mountain dwellers of Pateragiorgis self-subsistent?

An interesting subject to be studied in this context is the question of a possible self-subsistence of the Minoan mountain sites. This can be more easily judged now with having a general idea of the arability and size of their fields. But apart from the possible yields one needs to deal with the probable caloric intake per person first to be able to give an account of the relationship between field production rates and the number of persons that could be fed from them - in approximate numbers at least[23].

For an average household of 5 persons[24] Foxhall/Forbes' (1982: 49)[25] mention an average amount of 15.000 calories/day, i.e. 3.000 per person. This is much too high when compared with pre-industrial caloric intake as described in Allbaugh (1953: 507), where the mean per person is given as a little over 2.500 (which means that many lived with less). This high amount shall be used here in any case for safety reasons.

[23] This calculation ignores the fact that probably fields were cultivated not only in cereals. It is only employed to judge if caloric amounts adding up to self sufficiency could be achieved. Also the possibility of fallowing (not practiced in the Tsivi South pre-industrial agriculture) is ignored as the existence of this kind of husbandry for the BA is unknown and extrapolations to this kind only complicate the subject (cf. for ancient agricultural practices and comparisons with modern data Halstead 1987, with bibliography).

[24] These are given as a young couple, two children and an old woman, using FAO data, in Foxhall and Forbes 1982: 46.

[25] This article takes as many uncertainties and possible data varieties concerning the subject into account as one could wish, still they emphasize that all their data can only yield approximate numbers. Cf. also Christakis (1999).

About 40% of these 15.000, i.e. 6000 calories/day and 2.190.000 calories/year would have been constituted by cereals[26], supposing the Minoans' overall calory-intake was reached in a similar way as in pre-industrial Crete[27]. Judging from the data provided by Ilios (1941/52, vol. 11: 551, lemma >κριθή<), a stremma (1000 sqm) of Greek field (before the time of artificial fertilizers) could have produced between 60-200 okades of barley per year, i.e. ca 80-260 kg[28].

With these numbers it is now feasible to make some suppositional yield calculations. As the sites with the smallest arable plots would have had the greatest problem of self subsistence, they are going to provide the first examples. Sites 21D and 21E, the smallest Pateragiorgis sites (in terms of arability, see charts above) could have produced 330-1100 kg/year and 350-1150 kg/year of barley in the worst/best case[29]. That means between 990.000 and 2.657.000 calories[30] and thus – if not in the worst case, but from the mean value upward – could have covered the need of the above mentioned 5 person household in cereal calories[31].

Based on Allbaugh's data (1953: 107), who measured an actual average need of 128 kg of cereals per person (i.e. 640 for the whole family) per year in a household[32], from 2 to 8 persons could live with the possible amounts of barley produced on sites 21D and E[33]. As on Pateragiorgis fruit trees (e.g. pears) and vines could have been planted on the non-arable parts of the *perivoloi*, families living on sites 21D and E would have been poor, but probably could have just managed to survive on their plots of land[34].

Sites having larger plots at their disposal could have lived easily off their land while having extra space for raising animals, planting gardens, etc. The by far largest area of Site 53, to use an example of the maximum side of the range, with (good and medium) arable land

[26] Foxhall/Forbes ibid.: 66. Christakis' (1999: 11) amount of 65-70% of cereals may be too high. Cf. also Allbaugh 1953 for Cretan pre-industrial diet and nutrition in general.

[27] Note that there is an important element of uncertainty in these computations, as e.g. Allbaugh 1953: 131, mentions also 29% of the overall calorie-intake in olive-oil. This, as well as the legumes omnipresent in modern Cretan diet, would in recent years not be produced in large parts of the Tsivi South mountain region as it is supposed to be situated too high for most of the olive species to bring optimal yield, while legumes were only grown in the lowlands because they needed more (and constant) tending than cereals that were sown on mountain slopes by village dwellers and left to ripen on their own.

[28] The Greek *oka* is given in Ilios at 1,28 kg, the amount is here rounded.

[29] Yield amounts calculated based on Ilios' (ibid.) minimum-maximum amounts per sqm of good fields plus half of the amount per sqm of medium field.

[30] Foxhall/Forbes (1982: 46) state that the nutritive value of 60-70% of extraction barley meal made from hulled barley has ca 3300 calories/kg (30-40% loss in bran sieved out after milling the hulled grain). As local Cretan barley has a loss of ca. 30 vol/% of bran (personal experiment) the lower loss of 30% has been used in the calculation here, even though the typical local twice baked barley bread *dako* is made even without sieving out all the bran.

[31] In a realistic calculation, one would also have to subtract 10-20% of seed for the following year, but with the wide margins employed this is dispensed with in this study.

[32] Kritsa locals recently assumed they needed 166 kg, probably with a certain safety margin included

[33] Foxhall/Forbes (1982: 68) mention Forbes' Methana study (unpublished) that produced data similar to Allbaugh's from Crete: 150-200 kg/person/year (before milling), based on the locals' estimates, not measured consumption; thus actual consumption was probably less.

[34] Locals remember the vines that grew on Pateragiorgis in pre-industrial times. Note – as an example for recent extra revenue of the poor - also the local custom to graft wild olives (σηκωματαριά ελιά „adopted olive tree") wherever they were found in the wilderness (i.e. on public land). He who had grafted the tree became its owner and had the legal right to collect its olives and use the land below its crown as he saw fit.

of nearly 6 hectars could have produced 2800-9100 kg[35], i.e. a cereal surplus for 4 -14 families[36].

Interestingly, even though the dwelling ruin 53 (not taking into account the half-round extension, cf. Figure 10) very much resembles the simple rectangular McEnroe Type 3 Minoan Neopalatial house (McEnroe 1982), the site's production capacity, judging from the possible revenue from its plot of arable land, could have exceeded the storage capacity of the much larger McEnroe Type 2 Neopalatial house type that "does not exceed ca. 3,000 litres" (Christakis 1999: 10) and possibly even fall into the storage capacity range of McEnroe Type 1 Neopalatial houses of 5000-14.400 litres[37]. Here we certainly deal with a serious possible surplus.

Now the relatively large, half-round structure on the NE side of 53's dwelling ruin can be more confidently interpreted as a probable storage area: Its ca 20 sqm of surface area would have had enough room to store the barley produced on its fields (cf. Christakis 1999:7, recent Cretan houses with storage capacities from 4000-8000 litres would have had 10-25 large pithoi). The mentioned above sherds from several different large pithoi on the surface below the half round structure of dwelling ruin 53 do give more weight to this.

Another case in detail from the high end of land owning sites (Site 33 and its possible granaries) can be found at the end of the chapter – special example C.

B. Pars pro toto: The Stous Asfendamous Land use area

The second part of the Tsivi South region (2,6 sqkm) exemplarily used for studying Minoan land use patterns is situated between the regions Tafos/Kroustas in the South and Stous Asfendamous in the North and comprises 68 sites (for the general setting cf. map Figure 3). 20 of the respective dwelling ruins are still at least in one corner preserved to 1,5 m height. Here *perivolos* walls are mostly in a better state of preservation than at Pateragiorgis, and because of the landscape's more drastically changing relief recent land use wasn't quite as detrimental for Minoan ruins as there[38]. The largest part of the study area is naturally covered in a mixed pine and oak forest which in several cases produces a rather poor surface visibility and various sites were detected by their position and architecture without more than a few pieces of pottery visible even after thorough searching.

The land use patterns already described for Pateragiorgis were similar in this region, including the variable kinds of *perivolos* sharing[39] or accumulation (Sites 100, 108, cf. special example B and D for details). Field quality was also plotted on a GIS map according to the respective *perivoloi* (Figure 11), and after calculating the arability indices (good fields x 3, medium fields x ½) a chart was produced (Figure 10).

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[35] Again using Ilios (ibid.).

[36] I.e. ca 1900-6100 litres, using the local Cretan barley for measure that weighs 0,67 kg/litre.

[37] These "houses" would otherwise be called "villa".

[38] One of the reasons for this must have been the fact that Patergiorgis had a water source, which the Asfendamous area does not have.

[39] Especially the six 99 sites sharing 5 *perivoloi*, Sites 101-109-120-121-127 all in one big *perivolos*, and probably similarly also Sites 124 and 129, although because of the massive bulldozing for a dirt road not certainly assignable. Still in this case it seems clear which catchment/arable plots belonged to which site, so there exist no „shared fields" here.

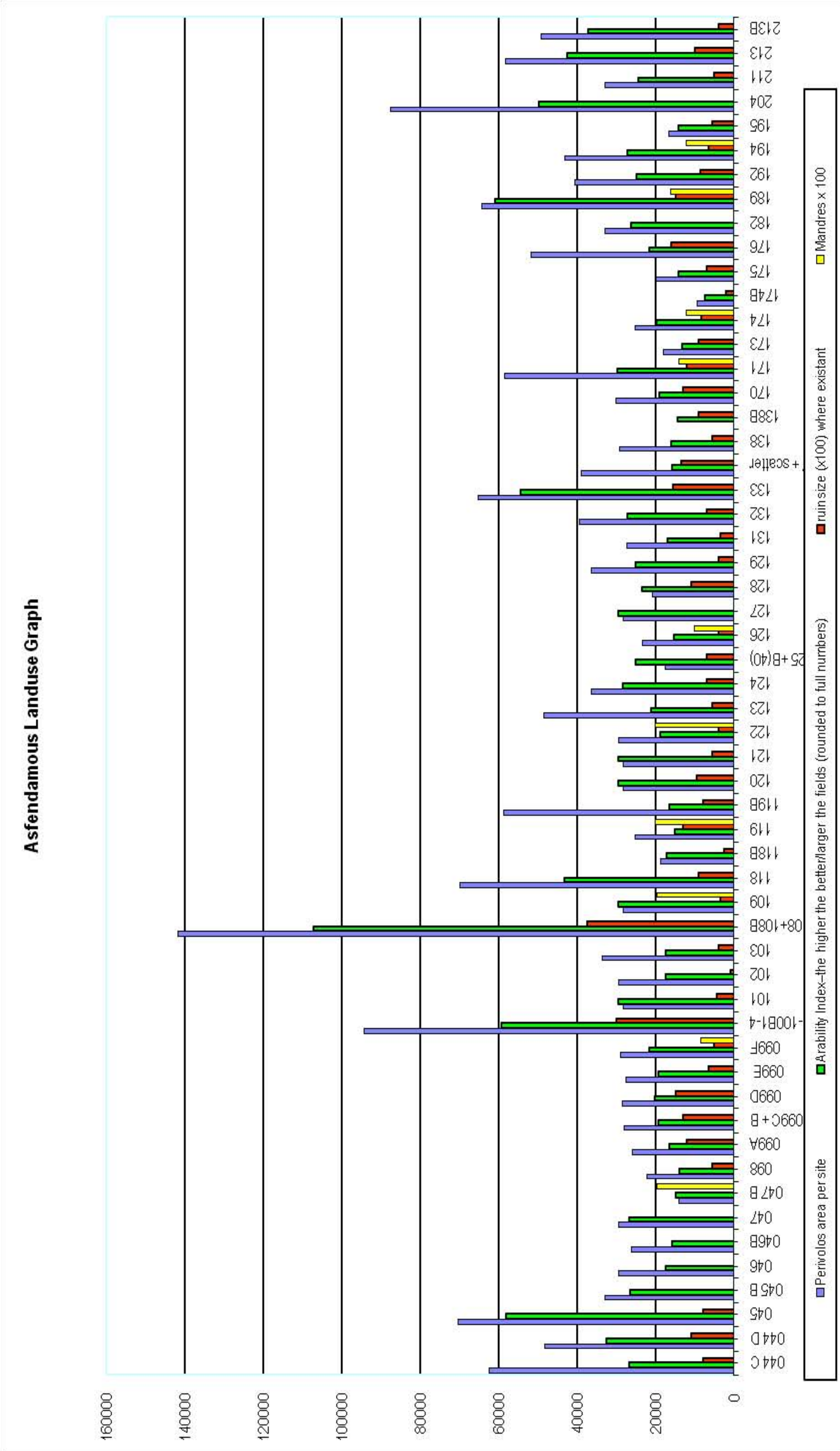

Figure 10: Land use chart Stous Asfendamous area. Yellow: probable animal “mandres” (actual size x 100 for visibility).

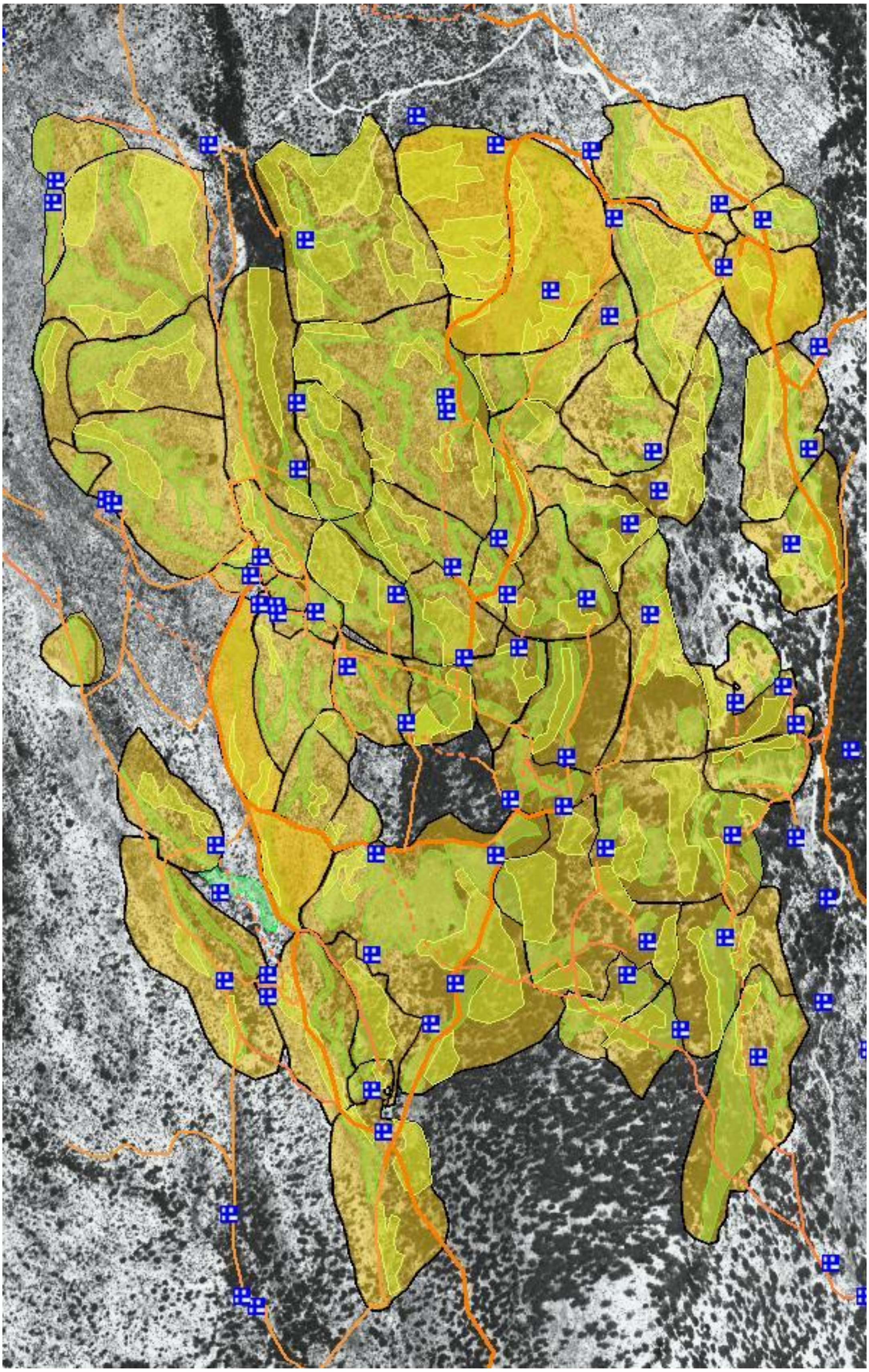

Figure 11: Stous Asfendamous-Tafos Minoan land use region on aerial photo. (blue: dwelling sites, light orange with black edge: enclosures, orange: roads, green: good field plots, khaki: medium field plots. North to the left.

The chart shows that, similar to the case of Pateragiorgis, most sites' arability index[40] ranges at a similar scope, here an average of 25.000. One might wonder why this average at Pateragiorgis is only at ca. 20.000[41]. Two possible explanations are the fact that there is no known water source in the Asfendamous region (and no comparable region with high water table around it), and the fact that the surface at the Pateragiorgis area is much more even (hardly any steep slopes[42]) – both factors that might have led to a generally better yield in the Pateragiorgis area and thus a smaller necessary average plot size/arability index.

Still, at Asfendamous several sites (Sites 99, 100, 108[43]) show dramatically larger sizes than any average – especially Site 108 (several dwelling ruins, in this case these are also larger than with other sites, but also *perivolos* areas).

Interestingly, here as with Pateragiorgis (apart from one exception) all sites with smaller *perivoloi* still had sufficient arable land plots at their disposal to be subsistent, i.e. – as we know from Pateragiorgis - in smaller *perivoloi* the relative amount of (good) arable land is relatively larger.

The one clearly not self supporting site should be mentioned here as unusual in more detail: Site 174B not only had a very small *perivolos* (less than 10.000 sqm), also its dwelling ruin (badly preserved, mostly rubble, not larger than 20 sqm), was set not on a slope side or else 'at the edge'[44] as would be expected, but in the centre of the best soil patch, close to the passing road. This suggests a function possibly different from the surrounding sites – may be in some way including the passing road. Whatever the inhabitants did there, the arable plot is not large enough to be self-sufficient (possibly with a one-person household?)[45].

Just as exceptional are the overly large sites, 100 and 108. Both also had more than one dwelling building, or, if the ruins really belonged to one household only, several outbuildings[46]. In both cases the *perivoloi* areas are huge. Site 108 seems to have managed several independent enclosures (one of which had small half round terrace walls with traces of fertilizing indicated by the typical tiny pottery scatter, i.e. could have been an orchard), while Site 100 included two huge oncolithic cisterns – a fact that, together with its one large but rather rocky *perivolos*, might suggest a functional focus on animal husbandry. Compare also tables 3 and 4.

For the case of Site 100/100B and their cisterns see the end of the chapter, special example D.

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[40] Arability index reached as above: Size of good fields x 3 plus size of medium fields x ½ .

[41] Not counting the three largest and smallest.

[42] Difference of height above sea level between the lowest and highest sites at Pateragiorgis ca. 170 m, at Asfendamous ca. 260 m.

[43] The possible explanation that they are some kind of "central" elite just doesn't seem to fit the fact of their relative proximity to each other (ca. 750 m) with just two other, smaller sites inbetween. Also the dwelling and *perivolos* ruins of the 99 sites, in this area as well, seem to be more impressively built – all in all a situation discouraging any simple apples-to-apples comparison.

[44] That means at the rockiest spot within the *perivolos*. The dwelling also doesn't seem to have had any inner land managing structures. Still the spot it sits on is slightly more rocky than the small good field surrounding it.

[45] While the enclosure walls are so well preserved there can be no doubt in their position, the house ruin might not have been a dwelling at all. Unfortunately pottery traces are sparse enough to make it impossible to give any more detailed suggestion based on them (cooking ware, some medium fine sherds, one sherd of fineware). Still this site is enigmatic enough to make it one of the first of interest for excavation – if only to find out, if possible, some more about its function.

[46] Ruin sizes all in all 300 and 375 sqm.

Average ruin size	Average Perivolos size	Average Good field size	Average Medium fields	Average field Size (all)	Average arability index
77 sqm	39.000 sqm	6.800 sqm	8.800 sqm	15.600 sqm	27.000

Table 3: Average field data for Stous Asfendamous (counting all sites)

Site	Ruin size	Perivolos size	Good fields	Medium fields	All fields	Arability Index
174 B	Ca. 20 sqm (traces)	9.360 sqm	2.350 sqm	1.000 sqm	3.350 sqm	7.550
108	Ca. 375 sqm	141.900 sqm	33.000 sqm	16.500 sqm	49.500 sqm	107.200

Table 4: The smallest and largest sites in Stous Asfendamous and their field data.

Possible granaries in the Stous Asfendamous area

In this context it should also be of interest to see the relative spread in the landscape of what seem to have been granaries[47] (Figure 12).

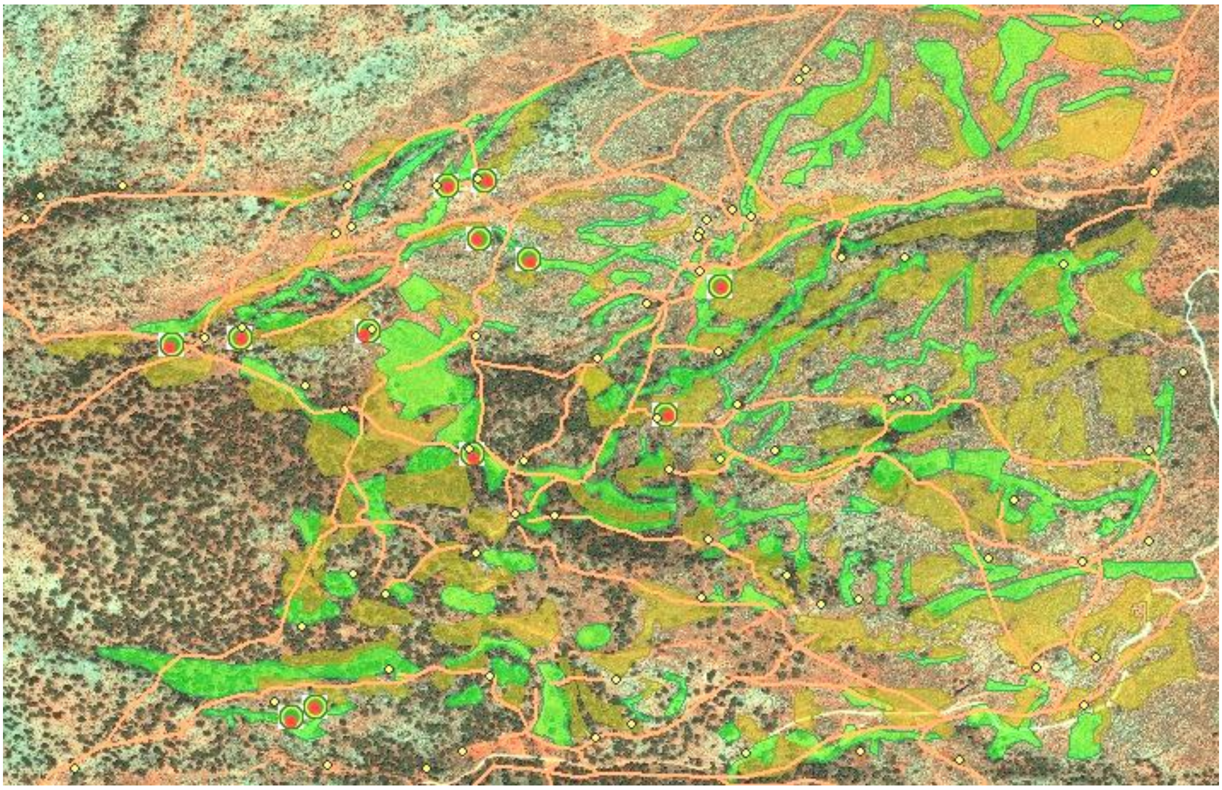

Figure 12: The Stous Asfendamous land use region with field qualities (green and khaki for good and medium) and possible granaries (red dots). Sites yellow dots, Minoan roads orange lines

[47] Aboveground round structures, see Ch. II.b.A, Ch. II.d.2.

Obviously there may have been more (and not just round) granaries in the area, but still even with those round structures suggested here as possible granaries their distribution over the landscape in relative proximity to larger arable plots is one of the reasons why they are interpreted as such.

Possible Bronze Age sheep pens

"The wool, leather, and other animal products from the Lasithi Plain would have helped provide some of the surplus necessary for the Cretan side of this exchange network. "

Betancourt 2007:217 (on overseas trade from MM IIA and Malia's domination of Lasithi)

Another interesting land use feature to suggest by the rounded shape of inner *perivoloi* is the case of sites with *mandres* (yellow in the chart Figure10) that could be interpreted as milking pens[48]. It is not unusual that the same sites owning possible animal managing pens also had a comparatively small arability index: For them production might have been centred more around animal husbandry than agriculture. Not surprisingly these same sites are also either set close to the edge of the region with the dense agricultural pattern and/or have a good and short access to the outer, probably uncultivated mountain slopes (cf. Figure 13), where animals could have browsed without disturbing agricultural land.

Naturally the other sites may also have had (and most probably did, after all the whole region is surrounded by large amounts of browsing land) small herds, but those seemingly equipped with a "milking pen" would have been especially well provided by enclosures to facilitate animal management also of larger herds.

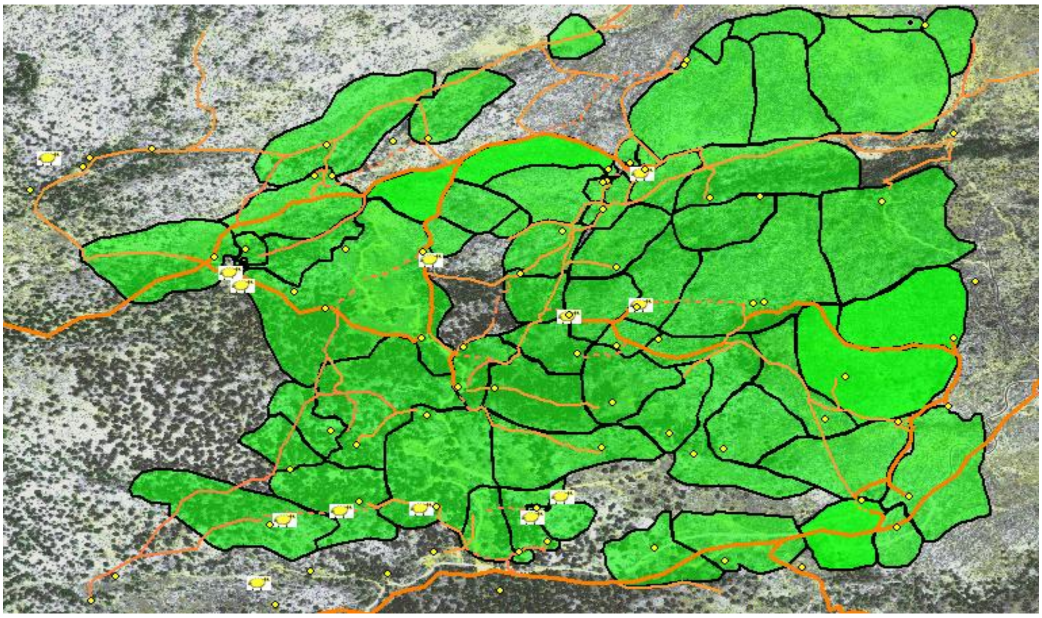

Figure 13: The *Stous Asfendamous* land use study area with its juxtaposed *perivoloi* (green with black enclosure walls), roads (orange) and sheep icons to indicate sites owning an Inner Perivolos typical for a sheep/goat milking pen in shape. The central plot without green does not contain a site and is very steep and rocky, not arable – it might have been common (grazing) land or belonged to any of the surrounding sites.

[48] Note that more sites than those given in the graph may have had this kind of *mandra* if their preservation on the surface would make their detailed shape more clearly recognizable. Especially in recently re-used sites (e.g. 100, where many surrounding inner *perivoloi* can only be seen in parts) wall cleaning or shallow excavation might clarify conditions already.

As mentioned in Ch. I.b sheep intended mainly for milk production are better kept near the coast (transhumant) in winter (the milk production falls to half under 10° C). On the other hand it may be expected that wool sheep produce more wool by keeping them in cooler surroundings. When looking at the amount of dwelling sites protected by their topography from cold winter winds (mainly Type 1: south/south-east facing: 49%, plus some other types protected by other features) one may suggest that these dwellings were intended for winter use (as well as the usual in the mountains summer use). These facts together suggest that Minoan animal husbandry was directed mainly at wool production. While modern Merino sheep can produce up to 11 kg of wool/ram (6 kg/ewe)[49], sheep races like the modern Chios sheep have a fleece weight of 1,2-2,5 kg[50]. Herds of pre-industrial mixed agriculturalists in the area (who had to rely on the natural amount of fodder available in the region) had no more than 30-80 animals per herd with ca. one head of sheep per hectar browsing land (goats manage with a little less). If those numbers are used for comparison in the Minoan sites, the hypothetical local 5-person families would have managed – for instance as owners of ca. 30 animals – with no more than 3-4 km of the land surrounding all the known sites, while at the same time being able to cultivate the mentioned fields (cf. Figure 14).

A larger area of browsing ground, as would have been clearly available in their landscape, would even have allowed for slightly larger herds[51]. So Minoan herds of 50 animals would by comparison be a logical mean value for an account for wool production of the region: With ca. 330 households à 50 sheep, 16.500 sheep would have been kept on the Tsivi South slopes – and thus between ca. 20.000 – 180.000 kg wool (using the modern minimum-maximum yield data above) could have been produced theoretically[52]. Amortization of investments in building may have come within 10-20 years of the beginning of the project, even if part of the barley was used for animal fodder.

[49]Cf. http://www.ansi.okstate.edu/breeds/sheep/delainemerino/index.htm (last accessed 17-1-2012).

[50] http://www.ansi.okstate.edu/breeds/sheep/chios/index.htm (last accessed 17-1-2012). Unfortunately I could find no information on the suggested Minoan sheep races, but the wool yield would probably be somewhere inbetween these two amounts (the Chios and modern Cretan sheep races are kept more for their milk than for wool). General Greek good milk-sheep pre-WWII yields are 1,5-2 kg/sheep (Helios 1949-1952, tom.8, lemma ἔριον – data of 1948 at the latest).

[51] Shepherds in pre-industrial times drove their herds to distances of up to 5 km from their *mitata*, mainly during trips to springs in the dryer part of the year.

[52] With a current (washed, carded, unspun) wool price from ca. 5$/kg (Internet, wholesale price), this would have earned a max. profit of up to 1 Million $ per year for wool (by 1-2012) – a lot, while these are certainly dumping prices.

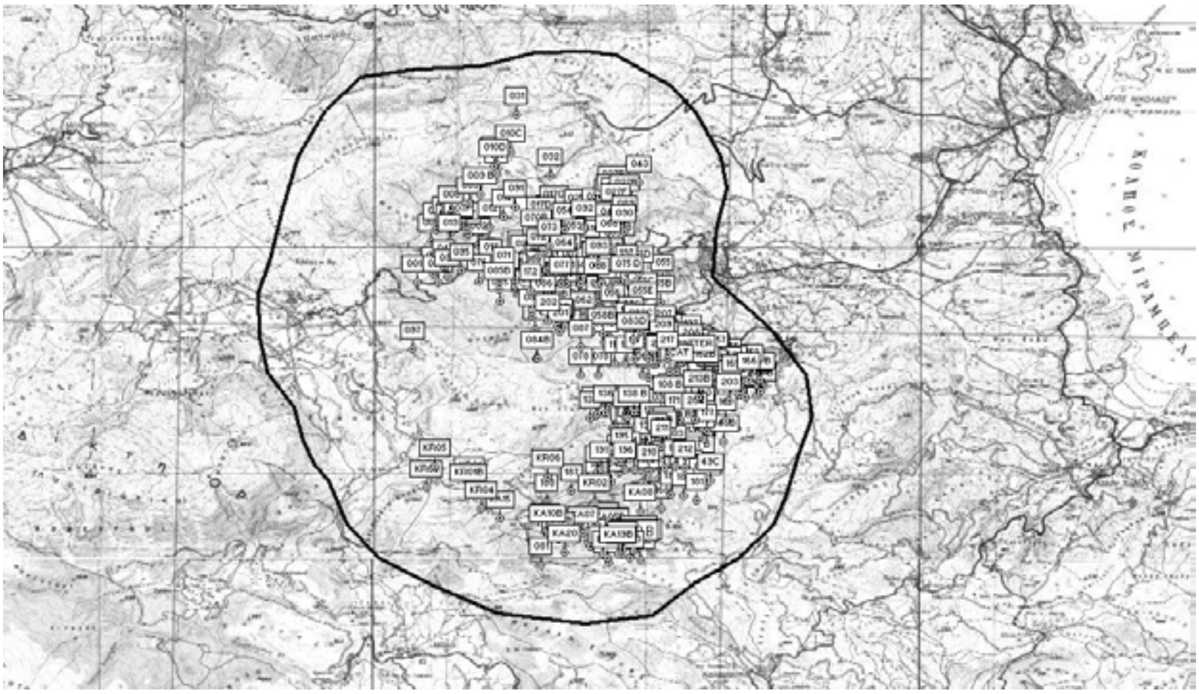

Figure 14: Map of the study area with the range of browsing that would have been necessary for 30 animals *per* farmstead (black line). It would easily be extendable to the West and Southeast to feed slightly larger herds. (Plains to the East contain arable land that would not have been used for browsing).

Bronze Age land use in the Tsivi South area in general

While the region is absolutely not suitable for raising cattle (too rocky, not enough grass or other browsing for large animals), some of the sites may have raised pigs, especially those close enough to water sources: Possibly the modern region of Site 187 doesn't have its name "Χοιρομίτατα – Chiromitata: Swine-herding place" without reason[53] and shows the suitability of that region for raising pigs.

Similarly, modern land use as well as some chance finds of bee-hive sherds (Figure 15) suggest that bee keeping was one of the agricultural processes practiced here by the Minoans as well[54]. This would be consistent with the findings of the Malia survey that detected traces of apiculture for MM I-II in the mountainous region called "Sopata" south-west of Malia (Müller-Celka 2003: 433). Probably it was not accidental that ancient mythology attributes the invention of apiculture to the Cretan Curetes, mountain dwellers *per se*, who are also credited with developing the art of sheep husbandry (cf. Diodorus Siculus, Library of History 5. 65. 1-4)[55].

[53] Although locals do not know of any such reason for the name. Still the oak forest of the wider Kritsa mountain region used to be browsed (for acorns) by the collective village pigs, herded by one boy in pre-industrial times.

[54] The number of seen sherds is certainly not representative for the number of sites engaged in bee keeping – especially if bees were not kept close to dwelling sites, the visibility of bee hive pottery on the surface is probably much lower than their actual occurrence and might show better in an intensive survey of the area.

[55] Note that in the ancient description of the southern frontier of Lato (that must have been somewhere in the region of Tsivi South) the Curetes are mentioned as people of the area (or place name), cf. Effenterre and Bougrat (1969), Faure (1967).

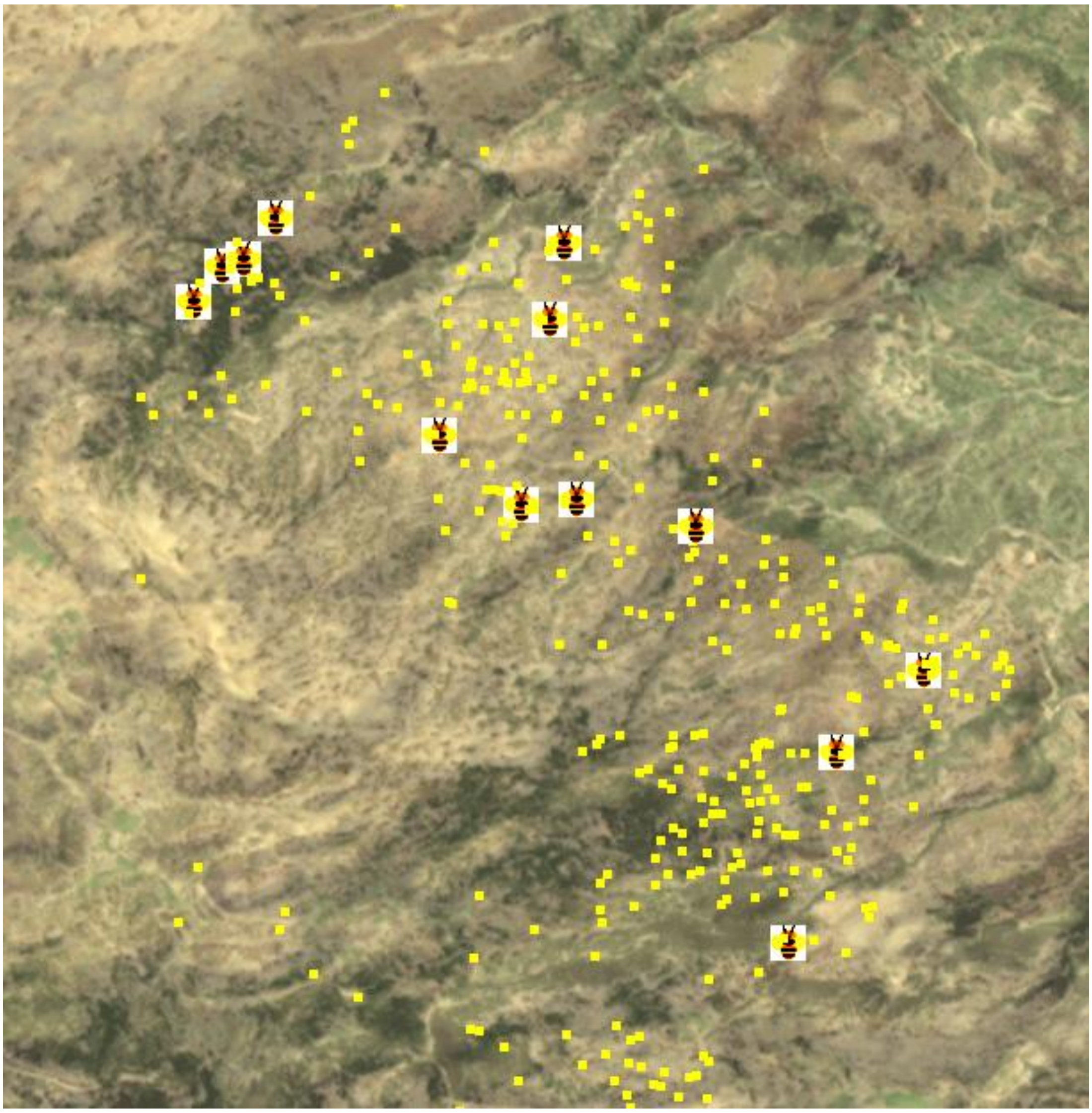

Figure 15: Distribution of Minoan beehive sherds seen in all the Tsivi South area.

The mentioning of the Curetes and their inventions also reminds us of another important human practice in the mountain context for the benefit of food acquisition (together with other associated products like leather and horns): hunting. Until the 19th century the wild Cretan goat still roamed the high mountains above the Katharo plain (Sieber 1823) and the fact that an obvious Agrimi-horn is part of the Linear B ideogram collection (*151) shows that horn was a sought after in the Bronze Age animal product. Deer – now long extinct - was also hunted in Minoan times (Rackham & Moody1996: 48, with bibliography), and the still plentiful hares and Chukar partridge would have put more venison on Minoan tables.

Other local products that may have been not just used in the region but also traded with or delivered to the coastal regions must have been timber (see above for probable use and length of timber applied in the dwellings), and there could have been other local plant specialties like herbs or resin. The chapter on lithic finds (II.c.2) shows that (at least partly local) stones were also worked in the area.

Farm sizes over time – "Norms and Variability"

"When modern peasant farmers are questioned about average yields or labour requirements, they are often unwilling, even unable to give a straight answer. Though frustrating for the amateur ethnographer, this experience can also be instructive." *Halstead 1987:84*

As can be deduced from what has been said until now about the PP Minoan fields in the Agios Nikolaos area, their (probable) sizes cannot be easily compared to any lowland fields of near to 100% arability because of the broken relief of the landscape they are set in and the rockiness of the soil even in the best case. Especially when trying to calculate an average enclosure size, the somehow inconspicuous number of 3,9 ha (in the Asfendamous region[56]) is misleading, as it is reached by *perivolos* areas between 14 and 0,9 ha and thus does not have much value as "average". By eliminating the two largest and two smallest *perivoloi* from the account, a slightly more realistic number of 3,7 ha average *perivolos* (not field!) size can be noted.

But, as has been seen above already, the size of the enclosed plots doesn't have anything to do with its arability or the size and quality of the enclosed fields. Even in pre-industrial (mostly lowland) Crete the difference given by Allbaugh (1953: 265-266) is noteable: the average Cretan farmer had ca. 3,7 ha (9,9 acres) of land, ca. 2,7 ha (6,6 acres) of which were cultivated (ca. 0,8 in cereals)[57]. Hence, although the acreage of land held seems to be the same, I do not believe that this fact is of any significance.

The large range of yields possible on Greek pre-industrial fields (e.g. for barley, see above) mainly provides a great *caveat* for definite sizes of fields "needed" to feed a family, and large differences were also noted for antiquity: "as little as 7-8 jugera (c. 2 ha) worked by hand could feed a family, but 20 jugera (c. 5 ha) would be needed if work animals were kept" (Halstead 1987: 84, with bibliography, for Roman agriculture[58]).

Hence it doesn't seem to be necessary to go into more detail as for comparison with other regions, when the "in situ" data of pre-industrial and experimental yields and conditions probably give a more precise range of possible production amounts and variability than any other information could provide.

Still it should be noted that – within the range of local possibilities[59] – at some of the sites apart from stone carvings and/or stone vases and steatite objects, intensive cultivation of vines, almonds, wild fruit (Figure 16), timber, (Figure 17), or even unusual items/products

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[56] 2,7 ha in Pateragiorgis.

[57] That this land was – and is – often spread over large geographical regions is another fact that should make us cautious with too direct comparisons in statistical data.

[58] Note that, as mentioned by Halstead, hoe cultivation made much better use of any available "human labour force" (ibid.) – pre-industrially experienced locals also insist that no ploughing "team" was ever used – only one cow (not ox!) for drawing a plough in the few ploughable fields - and that often shared among several families. Oxen just would have needed too much fodder in a region poor in grassland. This is a good point to state that a certain size of family – if possible – was desirable if only for economical/practical reasons, and possibly (as in pre-industrial Crete and similar societies) families would (must?) have been larger than 5 persons. Note also Halstead's comments on the better seed:yield ratios in hoed agriculture (ibid.).

[59] Naturally the amounts and preferences in terms of production may have changed time and again as they did during the last 80 years. Cf. Lehmann 1939: 212: Die Räume bleiben konstant, aber ihre Bedeutung wechselt mit der geschichtlichen Situation (spaces remain the same, but their meaning changes with the historical situation).

like beeswax, cypress resin, tree lichens for dyeing or even local saffron[60], etc. may have made their very special and unpredictable attribute to a highly variable local land use and economy.

Figure 16: Huge wild pear tree, south-west of Kroustas, near Site 164.

Figure 17: Recent timber use: wooden trough from whole tree trunk, near Site 172.

[60] See the balance weight from Site 32, typical in its weight for gold and saffron (Ch.II.c.2).

Special examples

Example A: How it is visible that the climate probably hardly changed

A very good example in the Pateragiorgis area is this: a clearly discernable Minoan road leads from the region of sites 30, 30B, 30C to SE. At about 100 m south of Site 30B it passes through a well defined, broad run-off (right next to the northern tip of Site 64's perivolos), held by a strong retaining wall on the down-hill side (under the olive-tree in Figure 18, this might have also been part of 30B's *perivolos* wall, unfortunately mostly too unclear to follow) and by a second wall on the uphill-side (its upper layers look recent, the lower course belongs to the northernmost edge of 30 C's *perivolos* wall). The whole run-off is well structured by retaining walls/check dams at right angles to the sloping valley, producing an area of alluvial/colluvial good fields in the N of Site 64's perivolos (see map Figure 4,5). Thus it becomes obvious that at least since Minoan times the run-off didn't function as such any more but had been converted into a strip of arable land[61].

Figure 18: Minoan road E of Site 30 passing former run-off (to upper right). In it small fields produced by more retaining walls.

Example B: Shared *perivoloi* – shared land

Apart from the most usual case of one large *perivolos* enclosing one site, two other categories of site-*perivolos* relationship exist: in the first a single site is surrounded by several seemingly equivalent in size *perivoloi* (i.e. none of them could be classified as clearly inner *perivolos*),

[61] For more details on check-dams see above Ch.II.b.4.

which are either seperated by a road (cf. sites 51, 51C, 52[62], on Figure 19) or just by a *perivolos* wall (51B, - Figure 19 top centre - and the east of the road part of 52's *perivoloi* - Figure 19 bottom left). In these cases it is not always possible to attribute each single *perivolos* with certainty to a site, like for instance in the case of the perivolos between 52 and 21D: because of the sites' position in the landscape relative to the enclosure (the plot is visible from 52, not from 21D), this comparatively small *perivolos* area is here attributed to Site 52, but it might as well have belonged to Site 21D. These several seemingly equivalent enclosures may have had several different (permanent) kinds of crop (as e.g. the 21D-52 area used to be partly cultivated in vines until recently), or they may have been partly used for animals, partly for cultivation.

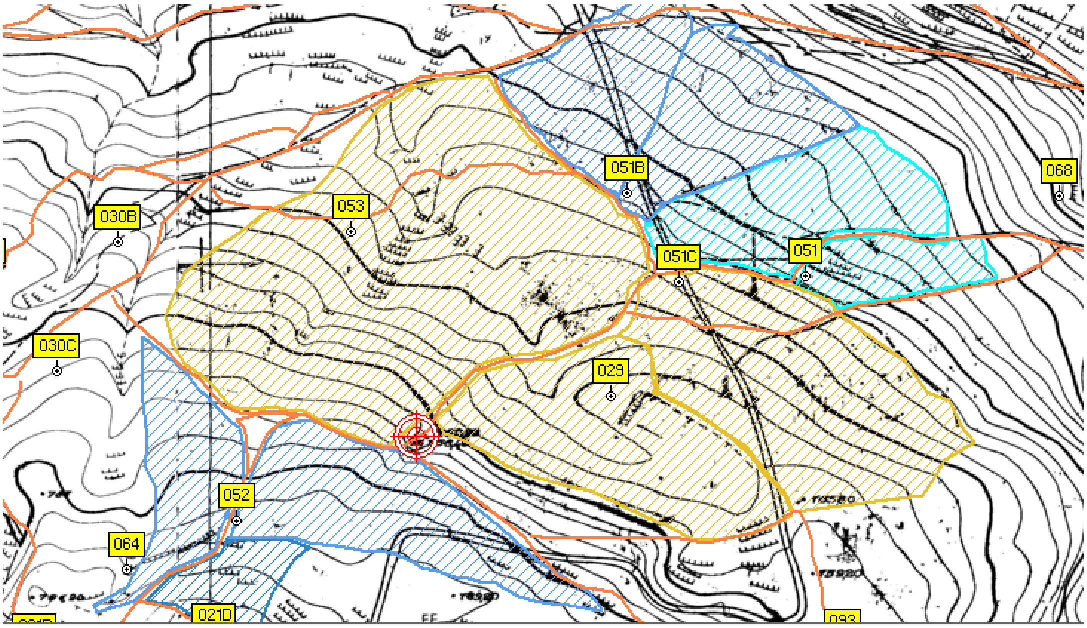

Figure 19: Sites with probable use of several *perivolos* areas (blue and turquoise).

As shown in the map (Figure 5) above, there also exists the case of „shared *perivoloi*". Sites 21 A,B,F,G,H (and 24 A,B1,B2,C) are only actually enclosed by a small Inner Perivolos each that is thus clearly attributable. In addition the respective site groups are surrounded by 3 (1 in the case of 24) large (otherwise siteless) *perivoloi* (indicated by the dark violet and blue lines on Figure 5). Naturally it is possible that all these belonged to only one or several of the site(s), which would mean though that the respective site(s) would totally fall out of the average range of *perivolos*- and arable field-plots in comparison and leave some inhabitants landless.

Thus it seems necessary to ask in which way the *perivoloi* may have been shared. A simple mathematical process is the first that comes to mind with the question after the possibility of the sites' subsistence: by adding the sum of arable land within in the outer (siteless) *perivoloi* surrounding the sites and dividing it by the number of sharing sites (e.g. in the case of the 21-sites 5 - A, B, F, G, H – as 21 C, D and E have their own *perivolos*) one arrives at an equal share of land per site (see table 5 below). This needs to be added to the small, clearly attributable inner enclosures. At the end of this calculation it turns out that the

[62] This case has already been mentioned above, Ch.II.d.3.

arable acreage of all the 21 sites falls into the average range of those surrounding sites which have a single, clearly attributable *perivolos*. These relationships are given in the chart, Figure 7[63]. The whole shared area may also have been divided into crops per enclosure which were then "shared" (in consumption and/or tribute) by the thus connected sites. Their combined sizes show the sharing sites to have been reasonably self-subsistent.

A similar process helps to clear the situation of the 24 sites (4), that are all (including their respective Inner Perivoloi) surrounded by one large *perivolos* wall. Following a similar way of calculation, the divided by 4 area shows these sites, too, to be within the average range of arable land belonging to Minoan sites in the region. Here it cannot be suggested how the fields may have been shared.

Site	*Shared* Perivolos area sum all sites	*Shared* Perivoloi (by sites)	*Shared* Perivoloi per site (sqm)	Inner Perivolos area sqm/site	Sum of Perivolos areas per site	*Good fields each in Inner Perivolos*	*Shared good fields per site*	Good fields sum sqm per site	Medium fields sum sqm per site	Arability Index (NOT sqm)	All Fields (good + medium) sum
21A	52.250	5 (21 A-B-F-G-H)	1/5 of 52.250 = 10.450	1800	12.250	*810*	*3250*	**4060**	1700	13.030	**5760**
21B	52.250	5 (21 A-B-F-G-H)	1/5 of 52.250 = 10.450	3720	14.170	*1450*	*3250*	**4700**	1700	14.950	**6400**
21F	52.250	5 (21 A-B-F-G-H)	1/5 of 52.250 = 10.450	1430	11.880	*890*	*3250*	**4140**	1700	13.270	**5840**
21G	52.250	5 (21 A-B-F-G-H)	1/5 of 52.250 = 10.450	2770	13.220	*1200*	*3250*	**4450**	1700	14.200	**6150**
21H	52.250	5 (21 A-B-F-G-H)	1/5 of 52.250 = 10.450	3000	13.450	*1590*	*3250*	**4840**	2250	15.650	**7090**
24A	61.120	1 (24 A, B1-B2, C)	1/4 of 61.120 = 15.280	2330	17.610			**3740**	3850	13.145	**7590**
24B1	61.120	1 (24 A, B1-B2, C)	1/4 of 61.120 = 15.280	4200	19.480			**3740**	3980	13.210	**8620**
24B2	61.120	1 (24 A, B1-B2, C)	1/4 of 61.120 = 15.280	1810	17.090			**3740**	3850	13.145	**7590**
24C	61.120	1 (24 A, B1-B2, C)	1/4 of 61.120 = 15.280	unclear parts	15.280			**3740**	3850	13.145	**7590**

Table 5: Land use data of *perivolos*-sharing sites on Pateragiorgis

[63] Hence "shared" *perivolos* . Ruin sizes were multiplied by 50 to be visible in the graph.

Example C: Site 33 and its land, estimated storage and subsistence data

An example from the possible high end of production potential on Pateragiorgis is Site 33, with traces of two round structures (cf. Figure 20) marked by a moderate amount of rubble next to the oncolithic dwelling ruin. An inner enclosure wall surrounded an uneven court with a rounded, level area inside (cf. Figure 21: dotted lines; Figure 22).

Figure 20: Site 33. Traces of the southernmost of two rubble Round Structures (two oncolithic blocks of the dwelling ruin centre left), seen from the North. Outer diameter ca. 3,5-4 m.

Figure 21: Topographic map of the Site 33 ruins. The round structure on Figure 20 is the lower one. Dotted line outside dwelling ruin Inner Perivolos.

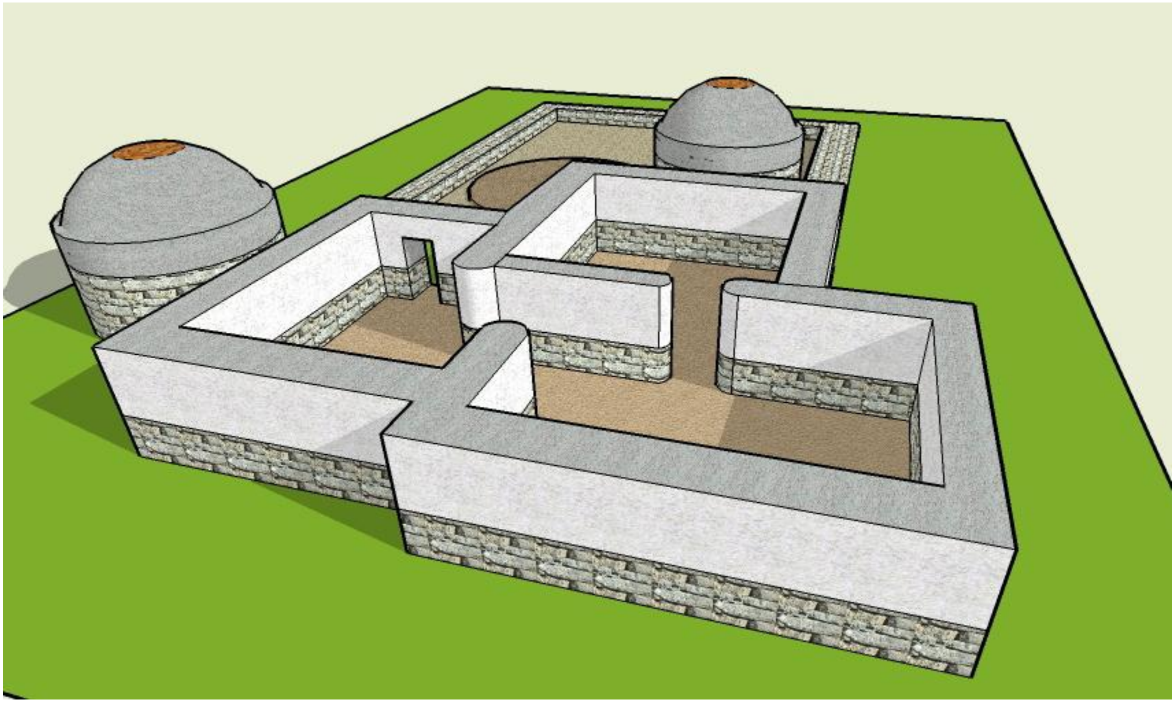

Figure 22: Site 33 ruins as 3-D image (drawn with Google Sketchup) based on the map drawing above (not set in contoured landscape). Seen from South-East[64].

[64] The hypothetical uper parts of the Round Structures are drawn following BA examples (height = width x 1,5 or 2) from the south-eastern Mediterranean as e.g. in Mazar 1990: 129 (Tel Bet Yerah/Khirbet el-Kerak, Palestine, EBA), or Egypt like those in the terracotta model from Gebelein, Middle Kingdom (19th-18th BCE) in the Museo Egizio Torino (Inv. S. 15802), cf. Schulz and Seidel 1998: 375, Figure 76 and http://www.artres.com/c/htm/CSearchZ.aspx?o=&Total=39&FP=5430685&E=22SIJM5KSI8SC&SID=JMGEJNBADTFOX&Pic=13&SubE=2UNTWAHI0L2Q (last accessed 17-9-2011).

The arable areas within the sites' enclosure wall include 11.700 sqm of good and 12.000 sqm of medium quality fields. Following the same calculations and sources as above, the site could produce from 1.400 to 4.600 kg barley/year. Discounting the average household need of 640 kg, a surplus of up to 4.000 kg/year (with 0,6 kg/l of Cretan hulled barley that would be nearly 7 m^3) could have been produced at this site - a good reason for the existence of two granaries.

Example D: Site 100 and its oncolithic cisterns

The two large cisterns at Site 100 (Stous Asfendamous area) would – at a hypothetic depth of 3 and 4 m[65] – have held at least 120 cubic meters (80 and 40 cubic meters each). When calculating ca. 7 l/sheep/week [66] and 20 weeks without rain (acording to modern climate), one would need 140 l/summer/sheep. If only the larger cistern (at least 80 cubic meters with a hypothetical original depth of 4 m, cf. Figure 23) was used for sheep, and one allowed 10 cubic meters of evaporation (learned guess[67]) the remaining water would be enough for 500 sheep[68]. As at ca. 1 animal/ha (cf. Halstead 2008: 242, locals give a little less for goats) Site 100's *perivolos* area of 9,4 ha would have been good enough for feeding some 10 animals only, the cistern at Site 100 could have watered animals of many a neighbour as well – or a larger herd could have been kept when browsing it outside of the cultivated region (that would have meant a walk of 1 – 1,5 km, a not unusual distance to reach one's browsing grounds in pre-industrial times). On the other hand if the 16 families that could be drinking from the smaller cistern (cf. note 57) shared the 500 animals, the resulting herd size of ca. 30 per household would correspond to pre-industrial local conditions.

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[65] They are now between 1,5-3 m deep and have diameters of 4 and 5 m.

[66] According to Schmidt-Nielsen (1964), 1,5 l/sheep every second day are sufficient (in a desert), cited after Miller (1983: 337). Modern local shepherds say that the amount depends on the milking stress: In their opinion for traditional sheep-keeping without extra feeding and with non-industrial age milking ca. 1l per sheep/day would be enough (modern times: up to 4l/sheep/day) Goats need less, in sufficiently forested areas they can live without extra water. These "unwatered" goats are called άνυδρα (anydra) and often realize high prices for their meat because of its aromatic qualities.

[67] Taking into account the cistern's surface of ca. 20 sqm and a loss of 1 inch per week (cf.: "Without a cover, an average pool of 18 feet x 36 feet loses about 1 inch of water per week in the peak of summer." (for California) At http://www.marinwater.org/controller?action=menuclick&id=268 (last accessed 17/9/2011) that would be 8 cubic meters in 20 weeks of summer.

[68] In this case the second cistern with its 40 cubic meters would have been for human use: at 3l/day for 5 humans in 20 weeks = 2100 l per summer per family the cistern would have (at a surface loss of 5 cubic meters) had enough water for 16 families. Pre-industrial mountain Cretans told me about a consumption of 3 l/day/person in summer (to be fetched at well or spring by jug).

Figure 23: Site 100, large oncolithic cistern (my friend Andrea stands 1,7 m high).

CHAPTER III – THE MINOAN MOUNTAIN LANDSCAPE

"Such political structures cannot form without the investment of energy in some form. While initially there are often significant returns to be had on investment, over time these returns diminish […] If means are not found to overcome diminishing returns […] the political complexity is compromised and collapse may ensue." *Knappett 2012: 389-90*

a. The Minoan Mountain Landscape as Human Artefact

One of the most obvious features to be stated in the context of this study is that in the Minoan Protopalatial installations of the Tsivi South region we can see an immense human engagement with the landscape. Even earlier, similar exploitation of the same environment did exist on a small scale. But from the beginning of the Protopalatial period someone engaged in the serious intervention (and investment) into the landscape that is described in this study – whether individuals or groups, be they of palatial authority sending dependent workers or even slaves, or be they independent "elite agents" (Schoep 2006) from whichever Minoan urban area[1], remains unknown. It cannot even be stated with certainty if this was a bottom-up or top-down venture. The lack of similarities of surface coarse pottery with that of Malia can suggest that the Tsivi South settlements began before any possible "Malia-Lasithi state" came into being (Knappett 2012, Knappett 1999, Betancourt 2007). It should be emphasised, again, that only close pottery studies (preferably with excavated material) would permit to fully integrate the study area into the "macro-scale" level (ibid: 395) of Minoan Crete.

Few dispersed sites sometimes built with oncolithic features have been noted in adjacent or neighbouring surveyed areas (for Kavousi, Haggis 2005; for the Vrokastro region, Hayden 2003-2005; for the Malia area, Müller-Celka 2004; for Lasithi/Katharo, Watrous 1982 – for Protopalatial times)[2]. These are sometimes described as making an "intense use of the landscape [… where] the carrying capacity may have been pressed to near limits" (Hayden 2004: 379). But for none of them features like the Tsivi South *perivoloi* are described, and none of them seems to have been part of a large landscaping "project" like the one described here. Still, at my visits to some of these sites (Kavousi Ampelolakkos, Malia Omales and Agia Barbara) I noticed wall structures that had a close similarity to Tsivi South *perivoloi*. Some *perivoloi* are also described for Neopalatial Choiromandres (Tzedakis et al. 1990, http://www.hydriaproject.net/en/cases/crete/zakros/timeline.html – last accessed 12-3-2012) and it seems probable that this kind of fencing did exist there from Protopalatial times, if not on the same scale and consequence as in our studied region.

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[1] A most probable candidate could be the Minoan town excavated now at Priniatikos Pyrgos (Hayden et al. 2006, http://www.priniatikos.net).

[2] Those described for the Katharo plain (Watrous 1982, sites 33, 36) continue into Neopalatial times. Similar observations on architectural features , mainly foundations of terraces and other buildings using large stones, is made for the island of Gavdos, where they also very probably belong to the mid-2nd millennium BC (Kopaka pers. comm.; a short reference in Kopaka 2011, 27-28, fig. 12).

In cultural ecological terms, the Tsivi South network of sites, previously unknown to Minoan archaeology, shows a highly developed system of human-to-environment relations and an intricate and powerful interaction of Minoan Protopalatial (master-?) minds and work forces with their surroundings, which resulted in a certain “domestication” of the local mountains. This is reflected in the installation of a productive area of mixed farming and diverse land use on formerly randomly settled and forested slopes, at altitudes from 500-1400 m, which thereafter produced various returns at least for a few centuries.

Concepts like "experiential modes of knowledge" are increasingly used to describe human interaction with Minoan landscapes (Jusseret et al., forthcoming, Wallace 2007). Indeed, developing for the first time a mountainous region like the Tsivi South slopes must have been one of those practical and emotional experiences leaving deep cultural imprints. This brings important additional archaeological knowledge on Bronze Age Crete, completely unsuspected until recently (*contra* e.g. Driessen 2002: 53 – "it is indeed doubtful that, apart from some highland plateaux, occupation was anything more than sparse in the mountains")[3].

Unfortunately, from the perspective of the surface material record the symbolic value of the studied architectural remains cannot be extrapolated to more than hypotheses and impressions. This mountain natural setting provides abundant resources (e.g. an unlimited supply of timber and large boulders for building) but also offers certain numinous experiences related to its manifold physical and mental bounties. A feeling of "power" prevails here – as in other rocky landscapes in far Eastern Crete. Scholars have conceived of this as part of a military or “strategic” concept (see Ch. II.a). To me, this results from a dynamic interaction of men with these mountains; it is an expression of their coming to terms with them, “taming” and employing their forces in the best possible ways.

This would imply great awareness of the harsh, sometimes destructive powers of the Cretan mountainscapes; but also a deep knowledge of the amazingly simple and even delicate forms that life can assume in them, and the rich, diversified resources that they provide (Figure 1).

Figure 1: Wild saffron crocus growing from a tiny amount of soil in a flat rock at 900 m

[3] Cf. also Niess 2008: 8-9: “Eventuell war es gar ein Tabu, die Berge zu besiedeln“ (it may even have been taboo to settle the mountains).

Thus it may not have been entirely by chance that from the Protopalatial period on, Minoan images of nature included elements that allude to this "power of the mountain", as expressed e.g. by crocus representations[4] – which archaeologists and anthropologists understand in various ways (Marinatos 1984, Chapin 2004, and many others; see also Beckmann 2006, 2012).

That mountains and/or rocky landscapes were often seen as liminal places of reverence is reflected in several wall paintings and other artefacts, like the Zakros rhyton. It can also be deduced from the fact that – at the latest (cf. Nowicki 2001) from PP times - some mountaintops qualified in the eyes of the Minoans to become fully developed ritual places (the "peak sanctuaries"), where this liminality could be seen as strongest, where mindscape seemed best expressed in landscape[5].

Similarly, by re-creating an optical synopsis (a simultaneous image of all seasons – Beckmann 2006, 2012) of a mountainous landscape on the walls of the House of Frescoes at Knossos, this building would have been consecrated as a symbolic substitute far from the actual liminal space in the countryside. The wall paintings could thus form the all-encompassing scenery for rituals that earlier/initially may have been performed within real mountaiscapes, without the existence of closed buildings (Lebessi 1973, Peatfield 1990, Chryssoulaki 2001).

It does not seem too farfetched then to assume that mountain settings were conceived as liminal zones of intense experiential quality. If the Minoans had, as Herva (2006) suggests, a special, animistic, relationship with some elements of the landscape, e.g. stones and rocks – possibly associated to spiritual objects like baetyls[6] – then building within a mountainous landscape with large rocks might have been an expression of their particular relationship with these inanimate "social entities" (ibid).

Describing her understanding of the relationship between architecture and landscape in BA Crete, Hitchcock (2007:97) writes: “Minoan architecture was not simply integrated into the landscape: instead the landscape was integrated into it, in a process of social transformation whereby authority was constructed, and social behaviour was institutionalised and manipulated”. This is absolutely true in the case of our Protopalatial mountain complexes. Their architecture and masonry show such an amazing integration into the landscape, and assimilation of the landscape into their structures, that one wonders how much of what is today’s landscape is actually a consequence of the Minoan architectural intervention. Whether our builders intentionally constructed a “liminal space” and manipulated relevant ideologies vel sim., or whether they merely adjusted themselves to practicalities cannot be easily deduced from the material evidence.

Translating these theoretical insights using my own perceptions (themselves not quite free of animistic tendencies), I would suggest that the feeling of safety and

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[4] See, for example, the crocus flowers on: MM II pottery, MM III Knossos wall paintings, LM IA Cretan and Thera frescoes, seals and sealings, stone rhyta –above all, of course, the Zakros rhyton– that depict the flower within the whole mountainous landscape.

[5] Independent of the question if any specific "gods" where venerated there or not – and independent of the fact that other mindscape-landscapes existed as well, e.g. caves.

[6] Remember also the impressive baetyl-like stone near our Site 49 (Ch. II.b.B.6), with its hole viewing directly to the peak sanctuary of Thylakas.

connectedness with the earth and the land at the Tsivis South sites give an overall different emphasis to building with oncolithic masonry. Linked to a powerful entity of nature – and often built on spots in the landscape that have their own "breathtaking" atmosphere – the studied sites seem to communicate an expression of connectedness with the land, of being built to stand the test of time[7] (Figure 2). Thus the significance of oncolithic masonry might be conceived not as just of the straightforward kind of kinship symbolism, e.g. among humans, but rather of a kinship with the land, an expression of closeness with and belonging to mountain and forest[8].

Figure 2: Parts of Sites 99B and 99C with view to the E and Priniatikos Pyrgos

What Herva (2006: 594) calls the "special identity of certain landscape elements" might in this region also have been part of an animistic conception of some particular features of the Minoan mountain world. For instance, at Boina (close to Site 10B) and at Kato Kaminaki (close to Site KA1)[9] unusual "rock features" seem to have been of interest for the Bronze Age settlers. Small, indistinct BA pottery scatters at their base (or top, in the earlier examples)[10], and in the former case also part of a sustaining wall that can not have belonged to a building (see Ch. II.b.B.6) were perhaps the focus of some kind of interaction that would rather fit Herva's cultural ecological concept than a more religious background. Even though, in the Minoan world, there may have been various physical entities (trees, boulders, other plants – Beckmann 2006, 2012) that were conceived as between religious and social/secular beings (Herva: ibid) (Figure 5).

[7] This kind of 'communication' could be understood as "defensive" by some, especially in more warlike times like those of Evans.
[8] As for instance many of the inhabitants of Kroustas nowadays seem to have a very special relationship with "their" forest – a feeling that lies between the forest area belonging to them and they belonging to It (here written with a capital I to denote the strong "personality" It seems to have.
[9] Similar traces exist already since late Prepalatial times at the cypress forest of Kritsa.
[10] These scatters are very small and sit on extremely rocky tips and outcrops, difficult to reach, above a riverbed with hardly any flat space available; no similarities with peak sanctuaries that I know.

Figure 3: Kato Kaminaki. SW of Site KA1 (180 m) & N of Site KA2. Animal shaped (?) rock (from NE). Traces of modern use as bee-garden (leftovers of ceramic and wooden beehives)

The hypothesis of some kind of religious authority ruling over the settled mountain area could be thought of here – as conceived in a distant relation to Christian monasteries owning large ranges of land also at distant places, including small agricultural settlements (metochia). But this is too wide a subject to be further discussed here. A form of MM "land ownership" certainly emerges from our evidence but one can only speculate on its specific social nature, political, religious or other.

b. Negative Evidence

Archaeological survey is skewed towards certain sorts of recognizable material, and the sites which it identifies are not always easy to reconstruct in imagination as functioning social landscape. *Horden & Purcell 2000: 77*

Athough archaeological surface evidence is always a problematic point of departure for further interpretive reasoning, some interesting suggestions result from the fact that certain findings one might have expected to see in a settled area of this kind are not or are hardly present.

In this direction, remarkable is the absence of "elite" architectural features and artifacts from the studied sites (see Ch. II.c). The two fragments of stone vessels found at Sites 100 and 213 can point rather to stone manufacture workshops, also attested elsewhere (see Ch. II.c.2) than to ownership. This could mean that there was no direct local profit from any economic surplus generated in the area. The absence of conspicuous urban buildings similarly constructed in their whole as ours[11], as well as elite architectural elements (e.g. ashlar masonry) in our sites, and the fact that no pottery "imported" from any known lowland settlement has been seen in the mountains, allow no clear connection between them. Our remains thus cannot verify the statement that: "strategies would be devised to enhance the link between the

[11] But the Crypte Hypostyle at Malia does have a few oncolithic blocks; the same with some Protopalatial parts of the palace and the Quartier Mu.

[urban] physical places and the surrounding landscape in which the buildings – both funerary and residential – served as a localising hub for a spatial and social network" (Jusseret et al. forthcoming: 21). Knappett's (2012) suggestion that the so-called "Malia-Lasithi state" (cf. Cadogan 1990, Knappett 1999, Betancourt 2007) did not exist before MM IIB, seems to be supported by the sites studied here.

Yet, more similarities in the construction techniques exist between the Tsivi South sites and architectural remains at Zakros than between here and any of the closer urban settlements with known Protopalatial occupation – mainly Malia, Priniatikos Pyrgos and Gournia. If there were any (kinship?) ties between our mountain/hinterland people and the population of these lowland/coastal settlements, these are not reflected, at present, in neither clear architectural affinities nor obvious pottery exchange[12]. Until further survey and excavation evidence is available, let us suggest that Protopalatial oncolithic foundation masonry was a kind of conspicuous vernacular "group-identifier" in some parts of Eastern (but also of central and even further?) Crete – a possibility that would need more detailed studies.

Of interest are also a few unusual details "missing" from the sites that we study. One of them is the definite scarcity of "female" tools among surface finds (just a fragment of loomweight was found at one of the lowest sites near Kroustas (Site 151) and a possible spindle whorl (Site 44D). The same with grinding tools: hardly any of them were found (one quern at Site 10 D, and a possible part of a quern at Site 142). This information is important for the sites' possible functions and the kind of "specialised" agricultural/pastoral activities they hosted, and seems to show that cloth was produced and cereals were processed mostly elsewhere.

Even if we were to admit that women could spin and weave with perishable, e.g. wooden, tools only, the virtual absence of querns remains intriguing[13]. Yet, the same can be noticed in modern installations in the study area and is due to its inhabitants' clear division of tasks between their village houses and mountain dwellings (see Ch. I.b). Thus the lack of female tools does not necessarily translate into the absence of women from the mountain slopes, although a spatial division between male and female working areas in upland versus lowland regions can occur. These diachronic analogies –and their reasons– within the same landscape are certainly worth mentioning, at least as an archaeological *caveat*.

While the studied region could have been used for subsistence in terms of agricultural yield (see Ch. II.d.4), negative evidence rather seems to favour an interpretation towards a more important role played by animal husbandry. Still, the absence of querns, combined to the probable presence of granaries, could mean several things:

a) A mountain diet without grain processing.

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[12] This is not to say there cannot have been (kinship or other) close links between town and country, but any hypothetical "corporate group" in a known town clearly did not apply/impose similarities in conspicuous masonry as means to demonstrate their ownership of the mountain structures.

[13] The high density of querns as a rule found during surveys in the vicinity of Minoan sites makes the picture dramatically different. For the area of Galatas, see Watrous et al. forthcoming; for Gavdos, Katerina Kopaka pers. comm.

b) Cereals grown were not destined for (local) milled consumption, but either for the production of other goods (e.g. beer[14], power-feeding animals), or for temporary storage to be processed and/or consumed elsewhere (e.g. in a lowland settlement, urban centre etc).

c) The women at the studied mountain sites were not occupied with "typical" female tasks or the sites hosted only male dwellers while in any case provisions in cloth and milled cereals-were not produced in situ.

The scarcity of chipped stone, the lack of sickle shine on the few pieces extant, and the relatively frequent whetstones could suggest that, while cereals may have been harvested by pulling out the whole plants, or with metal tools, which are rarely expected as surface finds, or (see Ch. I), while other cutting activities must have been done with metal tools. Archaeometric trace ware analysis of some whetstones could show their former use for sharpening bronze objects, (while a possible (re-) use for iron would indicate a later dating).

Negative evidence further includes the absence of pottery from the following architectural complexes, which are dated by their masonry to the Bronze Age:

Site 17B. Few tiny sherds of possibly Minoan fabric. But scatter of Medieval pottery close to the church of Agios Ioannis and its ruined *metochi* or small monastery (?) A number of (mostly) chipped stones (mainly chert), including a few small blades: perhaps a refuse deposit of an EM (?) stone working place associated to neighbouring settlement traces and pottery.

Site 76. Traces of a dwelling ruin in the middle of a colluvial bowl-shaped doline. Almost completely covered by field clearing rubble, so pottery could be buried under rubble and soil. Especially impressive and massive *perivoloi* in the surroundings.

Site 84B. At least one well distinguished oncolithic dwelling ruin. Partly overbuilt with a modern mitato, used intensively until recently as summer habitation. Surrounding soil is mostly overgrown by closely cropped grass and the short slope below ends in a nearby winter runoff: so, pottery could be buried or washed away. Traces of worked steatite enhance the (early) MBA date of the site.

Site 125B. Small rectangular structure in BA masonry (Figure 4), close to a road-crossing and *perivolos*. Probably not a dwelling but a storage facility vel sim. (?).

Sites 136, 145, 175. All within the pine forest, 100% ground cover: pottery could be buried under it (Figure 5). Extensive architectural remains in all three, clearly of BA date. Site 145: probable building/dwelling or just structures for animals. Site 175: parts of inner and nearly whole outer *perivolos*.

Site KA10: Very well and wholly preserved (Figure 6). Rather exposed to winds at ca. 1100 m. Masonry leaves no doubt of its BA dating. Relatively little ground cover. No

[14] My thanks are due to François Sigaut, technical and agricultural historian and ethnographer, who reminded me that some processing of cereals e.g. to make beer, could have occurred locally (pers. comm.)

recognisable reason for the absence of pottery – even with strong erosion a few small pieces should have remained. Built but never used?

Figure 4: Site 125B. Built rectangular structure (from SE). *Perivolos* and road behind

Figure 5: Site 175. Building remains (NW corner) with thick cover of forest plant

Figure 6: Site KA10. Building remains (standing up to 2,2 m). W wall from W

Site KA10B. Small structure – some kind of facility related to nearby KA10 (?). In the forest, 100% ground cover: pottery could be buried under it.

c. Open Questions

"The language of 'core' and 'periphery' may suggest an active role for the former and a passive one for the latter; yet the relation between them was creative and dialectical. If cores create peripheries, peripheries also create cores: this conception is radically different from simplistic diffusionism" *Sheratt A. & S. 1998: 337*

A study like this leaves, of course, many open questions, especially as the region presented and its monuments were previously almost completely "invisible" in the archaeological research for the Bronze Age. The material resulting from this study hints at a concerted planning and large scale building endeavor –a "project" as we call it here. But was this really the case? Or are there any arguments pointing to a different, e.g. haphazard, venture?

Most important are dating questions. Suggested chronology takes into consideration surface pottery that I only saw on the spot and did not collect nor study in detail – a first task to be tackled in any future study. At present, to judge from the clay fabrics mainly, the network of sites on the Tsivi South mountain slopes was put in place in Protopalatial times and lived solely within the framework of this very period. Few possible Neopalatial sherds show a rather random presence in the area. Finally, a few dwelling sites have also been re-settled or used otherwise in LM III.

Of interest is also the time that the sites ceased to exist – were abandoned, since there is no evidence of violent destruction; and, of course, the reason(s) for their abandonment. What happened to the probably over 1000 people of this region? This is an extremely difficult question to answer on the basis of the material evidence. Maybe, economic and social-political reasons could be relevant, namely different regional orientations and strategies of exploitation of the hinterland brought about by the Neopalatial system of administration[15], but further studies should investigate the possibility of earthquakes, probable layers of volcanic ash etc.

A partly answered question relates to the function of the Minoan Round Structures, above and below ground. Careful excavation would be necessary here, in search of any traces of inner layering, organic remains, pottery and other possible finds. Answers concerning the public/state or domestic character of storing in them would be of particular interest and worth further discussion.

Inherent remains the need to learn more on the form(s) of authority that conceived, installed, organized and controlled the Tsivi South settlement. Local population definitely produced valuable and even prestige items and goods – in different scales – usually destined for Cretan "palatial" economies and social elites. Among the former are mainly stone vessels, to judge from the Pateragiorgis stone

[15] For a similar argumentation concerning the also exclusively Protopalatial mountain settlement at Malia, see Müller-Celka & Coqueugniot (2010: 49).

carver's toolkit, and the amazing number of grooved tools for vase making all over the area (see Ch. II.c.2)[16].

Other products of the region would have included animals and plants from mixed agriculture and their sub-products. These are frequently also traced in (later) written records as palatial staples, together with aromatic and medicinal substances etc. Such commodities would certainly interest any central authority/ies; especially in a period of important processes of political development that could account for the Tsivi South settlement "project" itself.

Naturally inherent also in the aforementioned questions would be the need to learn if any traces of a particular superior power/controlling elite can be attested in the sites' material record. While the whole "project" in itself could be interpreted as an expression of a state formation process, one would expect a developed administration of some kind to execute such a multifaceted architectural planning and landscaping venture from a remote centre. The question here would be how such an administration might be documented in the material record of this distant hinterland. Several possibilities come to mind. If, as Knappett (2012) suggests, a Malia-Lasithi state - and if such a state really included the area studied here - was in function by MM IIB, some kind of influence on Tsivi South pottery should be traceable at a closer study. On the other hand, if, as proximity and access routes suggest, the elusive administration expected for the area was situated closer by, namely in the Priniatikos Pyrgos area some 10 km to the North-East, it will be necessary to wait until further excavations there shall give a clearer image of the PP settlement, its size, administration and facilities, before any possible influences could be taken into consideration.

As for the oncolithic masonry of the studied sites, further questions are: were there any prototypes, any predecessors of it in Crete and/or beyond? How did this massive architectural forms and construction techniques emerge – out of nowhere or as a result of older tendencies and ways of building?

The question also remains as for the character of the upper, perishable, structures. This could probably be solved through excavation, The same might be the case for any additional architectural features, like column-bases, inner walling and plaster lining, information about which would throw a clearer light on the studied buildings' forms and functions. Interesting further research could also focus on the open spaces or "courts" that appear in several complexes. Were they spaces for work, communication and other everyday activities? Could they also have hosted ritual actions of any kind?

As for possible ritual activities, additional studies are definitely needed, e.g. around the baetyl-like stone seemingly targeting Thylakas peak sanctuary (near Site 49), and the possible Pateragiorgis "cemetery" within the *perivolos* of Site 61. Similarly interesting would be systematic exploration of local caves, including the

[16] These tools can certainly support Michailidou's (1999: 97) "decentralization of workshops" for the Protopalatial period.

two small ones near Agios Ioannis–Flej[17], and especially “Gaidourotrypa”, also on Pateragiorgis, and “Tafos” in the Kroustas forest[18].

A last set of questions of great importance is: was the impressive Tsivi South “project” – and its results – unique within the framework of Protopalatial Crete – and maybe beyond? Or are there more mountain installations of the kind still to be discovered elsewhere? Here the answer is, I think, yes – if not necessarily for an entire comparable “project”, but at least for smaller individual sites. Following specific architectural features and especially “wall typologies” as described in this study, focused future research will definitely reveal and/or confirm the existence of similar structures in other mountainous – and perhaps not only – parts of Crete[19], and change dramatically our knowledge and understanding of the Minoan process of “domesticating the mountains” and social and cultural interactions between lowland and upland settlements in the Protopalatial period.

d – Conclusions

“Le seul véritable voyage, le seul bain de Jouvence, ce ne serait pas d'aller vers de nouveaux paysages, mais d'avoir d'autres yeux, de voir l'univers avec les yeux d'un autre, de cent autres”
Marcel Proust, Á la recherche du temps perdu (Vol. 5, 1923)

Jusseret (et al. 2011: 11) wrote recently, that “the continuing use of the Cretan landscape makes it unlikely that larger scale, undisturbed Bronze Age situations remain to be discovered”. But it is obvious that the region and the monuments we are dealing with respond exactly to this challenge.

In this study, we present 336 such largely undisturbed MBA “situations”, in their vast majority newly discovered[20]. The added built space of the dwellings of these nearly adds up to twice the size of the Neopalatial complex at Knossos (see Ch. II.b.A).

The architectural units on the Tsivi South slopes include dwellings, mostly moderately sized between 50-120 sqm, with several rooms, sometimes comprising an open space or court, and often having auxiliary structures, for storage and animal husbandry. They were also equipped with impressive enclosure walls or *perivoloi* of a total length of over 150 km, which correspond to a minimum of 150.000 cubic meters of stonework. They were interconnected *via* a network of roads and paths over 140 km long[21]. Within the same area existed 61 stone lined round structures

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[17] Below one of which I saw a piece of a conical cup.

[18] Hood and Townsend saw tripod cooking pot legs on their visit to “Tafos” in 1989 (Brown 2001: 202). When I visited the cave, I saw little Minoan pottery near the bottom southern part; but mainly, on the NE side of the cave, an area with sherds probably of the late 1st millennium BC.

[19] Maybe, already: the architectural remains of enclosures that I observed in the mountainous zone above Malia, none of which have been described by Müller-Celka (2003) who did notice several of the respective dwelling ruins. As this was only a preliminary report, he final publication of the Malia survey in the future might already shed more light on this.

[20] For the few already known sites see Ch. II.a.

[21] *Contra* Jusseret et al. 2011: 12: "Moreover, the Minoan sense of environment seems to suggest that, rather than imposing artificial boundaries upon the land, the inhabitants tended to follow its natural constraints” (referring to Betancourt 2006b).

("kouloures"): those clearly attributable in position consist of at least 18 aboveground ones, interpreted as granaries of an estimated capacity of over 600 cubic meters of grain; and 22 underground ones, interpreted as cisterns with an estimated capacity of 460 cubic meters of water.

In the architectural analysis, I propose the terms "oncolithic masonry" to describe the typical building technique which makes use of big unhewn local stone blocks (for details cf. Ch. II b I) apparently for the foundation- and retaining walls of the structures, the upper parts of which must have been built of perishable material. Surface pottery in the vicinity of oncolithic buildings is nearly exclusively datable to the Middle Bronze Age – with rare cases of re-use in LM III – suggesting that these can be attributed to the same period. The position of the similarly constructed oncolithic enclosure walls, which are juxtaposed around sites often leaving intermediary free spaces for roads and paths, show that these are contemporary too. This particular type of large block masonry can be considered as a Protopalatial architectural feature, characteristic probably not only in the studied region but also elsewhere, especially in other areas of Eastern Crete.

Ethnoarchaeological analogies with traditional forms of land use in the same region suggest ancient mixed farming activities, and can shed a light on probable yields of the "domesticated" within clearly defined enclosures mountain fields and pastoral spaces. Recent land use strategies also suggest manifold other products, like timber, honey, herbs and resin, acquired from exploitation of the "wild" mountain slopes (see Chs I.b and II.d.4). Approximately 50 sheep and goats could constitute the livestock per site; and most of the enclosed fields could support households of 5-8 persons – which gives a total of about 1500-2700 people for the studied area of ca. 25 sqkm. Our accounts for the possible amount of barley cultivated inside the *perivoloi* (see Ch. II.d) show that households would have been self sufficient, and some of them even must have produced a surplus – possibly stored in the round structures set aboveground. Recent pastoral activities suggest related functions of many of the wall structures surrounding the dwelling ruins.

To judge from surface finds and architectural remains, none of the studied sites fall into the category of "elite" structures. Sites do not show signs of hierarchy or social stratification, e.g. larger dwellings, better quality of pottery in complexes where fair revenue can be assumed. As a rule, the size of the main dwelling ruins is not proportional to other features, namely the extent of arable land and storage facilities and thus the size of groups inhabiting the sites may not have been related to the amount of its arable land. These findings stand in contrast to the immense investment in workforce, time and effort necessary for the studied structures' first erection.

The installations of the Tsivi South area do not seem to have been small independent farmhouses as those in far Eastern Crete (Vokotopoulos 2007[22]). The combination –especially when pooled– of enterprises that can be attributed to the Protopalatial inhabitants (certain: stone cutting; inferred: products of animal

[22] Vokotopoulos is dealing with slightly different conditions as the sites studied by him had their main period of use in Neopalatial times, although many of them have MM II origins.

husbandry including honey and agriculture, timber, herbs vel sim.) can be seen as an easy parallel to the farming ventures for which later Minoan Neopalatial “country houses” or “villas” were known (e.g. Watrous 1984, Mantzourani et al. 2005). As for stone cutting workshops often believed to be characteristic for palatial sites, conditions in the Tsivi South area do not confirm this; and support Schoep’s (2010: 68) suggestion that “designations such as >high-quality< and >luxury goods< should not be considered as synonyms for >palatial production or palatial workshops<”. Still, while at present no immediate influence of any known “palatial unit” is evidenced in our sites, the mountain workshops could possibly be seen as long-distance supply manufactures for one or more urban units (possibly to be correlated by future excavations?).

In a similar direction of thought, the rarity of surface chipped stone tools and the presence of many whetstones led to the suggestion that metal tools (possibly provided by elite centres) were probably used for agricultural activities. It could also be suggested that while scarce grinding and weaving tools do not exclude the presence of women at the studied sites, finds point to a range of functions not focussing on typical female tasks.

As for the reasons for such an insistent large scale settling in this mountain landscape in the first part of the Middle Bronze Age, a connection with the recently traced climatic aridification is suggested. The uncertainty of production and yields with the change of climate after the 4.2 kiloyear event must have asked for new strategies to cope with probable lowland crop failures, so as to optimize land use within the climatic and geographical differences between lowland and mountains. The well attested general expansion of settlement in this period all over the island (Driessen 2001)[23] is usually seen as an indication of “peaceful and mutually beneficial social and economic interaction" (Haggis 2005: 71). But it often occurs in places dotted with water sources (Hayden 2004: 82) and could also be a reaction to a drier climate.

In the Tsivi South region, olives would have been sparse – not enough to respond to local needs in oil, especially in terms of calories. Some sites could also have produce wine, vegetables and greens, the latter two possibly in their own gardens. Meat, from domestic animals and game, would have been abundant and could have been used in exchange for oil and other basic subsistence items. Wool, probably unprocessed, would have been a central product, and the frequent occurrence of fragments of tripod cooking pots suggests cheese making. And beekeeping and honey producing is evidenced by evenly spread beehive sherds over the whole region (see Ch. II.a). Further produce, mostly invisible in the archaeological record, would include wood and timber, animal horns and skins, aromatic, medicinal and other plants and their sub products.

Such specialised items of consumption would be a great asset for any urban "palatial" or “elite” society. Especially where economic structures were also profiting

[23] See also Haggis 2005: 69, where a "fourfold increase in the number of sites" in the Kavousi area is proposed. But absolute numbers in the wider region are usually much smaller than those in the Tsivi South area (e.g. 5 to 15 sites in the uplands of the Vrokastro survey area – Hayden 2004: 82).

from export and exchange of prestige manufacture and crops, as was the case in Minoan economy. Highly appreciated would also have been various mountain animal products that the Tsivi South region could provide, from wild or domesticated animals, and unprocessed or refined in the respective mountain settlement. After all, the quantities of wool needed, for example, for the looms implied by at least 700 loomweights at Quartier Mu in Malia (Poursat 2010: 262) must have been produced somewhere.

All in all, the Tsivi South slopes, west of Agios Nikolaos in Crete, reveal an extremely well planned dispersed settlement pattern, an organised system of allocation of fields and land use, dating back to the Protopalatial period, in the first half of the 2nd millennium BC. People who lived and worked there, most probably permanently, have not left traces of any social stratification in the material record. They were mainly farmers and associated with an elite or elites established elsewhere, and their settling on these highlands was probably the result of some kind of a central project aiming to install a “secondary centre” and to “domesticate” the mountain landscapes and exploit their multiple and often highly valued resources.

Yet, this is only one hypothesis, based on existing data and “rational” reasoning in Minoan archaeology, for this pattern of Protopalatial implantation only too recently discovered in the Tsivi mountains. Other interpretive possibilities and alternative readings could exist as well – and will certainly be elaborated in the future. Let us keep in mind Schoep’s (2010: 70) suggestion that “regions or sites without palaces are in the palatial model usually subordinated to the nearest palatial center, but alternatively they might have followed alternative socio-political trajectories which may have been structured in a different way”.

Even though it is not possible to entirely reconstruct just how far Minoan intervention modified the landscape, it certainly transformed it into an area providing self-sufficiency (with probably even some surplus), where an amazingly large number of structures still fulfilled their purpose in recent mixed farming. The Minoans built their structures to last, and left us thus a big new field to study in the future. But for the time being, this first relevant approach has to be content with raising more intriguing questions than it is able to answer. Hopefully, future 're-searchers of lost time' may give us new answers, with a hundred new eyes.

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