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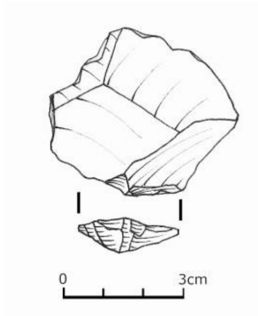

Pleistocene sea-crossings and submerged terrestrial routes

A view from the Inner Ionian Archipelago

by Christina Papoulia

A dissertation submitted to the Department of History & Archaeology of the University of Crete in fulfillment of the requirements for the degree of Doctor of Philosophy (PhD).

Supervisor:
Dr Nena Galanidou, University of Crete

Advisors:
Prof Nikos Efstratiou, Aristotle University of Thessaloniki
Dr Tristan Carter, McMaster University

Oral defense committee members:
Prof Katerina Kopaka, University of Crete
Dr Dimitris Bosnakis, University of Crete
Dr Dimitris Sakellariou, Hellenic Centre for Marine Research
Dr Vassilis Lykousis, Hellenic Centre for Marine Research

Frontpage figures:

(Upper row) Flake with a prepared platform made on chert from Atokos (drawing: Christina Papoulia)

(Middle row) View of Kythros from the south end of Meganissi. In the background the islands of Atokos, Kefalonia, Ithaki and Arkoudi (©IISAP photographic archive)

(Lower row, left to right) Pseudo-Levallois point made on flint from Arkoudi (©IISAP photographic archive) and a prepared core made on chert from Kythros (photo: Christina Papoulia)

Πανεπιστήμιο Κρήτης
Φιλοσοφική Σχολή
Τμήμα Ιστορίας και Αρχαιολογίας
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Διάπλοι και καταβυθισμένα χερσαία περάσματα κατά το Πλειστόκαινο

Η περίπτωση του Εσωτερικού Αρχιπελάγους του Ιονίου

Χριστίνα Παπούλια

i. Extended Greek abstract

Η διδακτορική διατριβή υπό τον τίτλο «Διάπλοι και καταβυθισμένα χερσαία περάσματα κατά το Πλειστόκαινο: Η περίπτωση του Εσωτερικού Αρχιπελάγους του Ιονίου» (απόδοση στα ελληνικά), χρησιμοποιεί ως μελέτη περίπτωσης το Εσωτερικό Αρχιπέλαγος του Ιονίου προκειμένου να εξετάσει το ενδεχόμενο θαλάσσιων μετακινήσεων κατά το Πλειστόκαινο καθώς και τα, καταβυθισμένα σήμερα, χερσαία περάσματα που θα υπήρχαν στη διάθεση του ανθρώπου για τη διασπορά του στη βορειοανατολική Μεσόγειο, πιο συγκεκριμένα στη νότια Βαλκανική χερσόνησο και στα νησιά του Αιγαίου και του Ιονίου Πελάγους. Η εργασία είναι αποτέλεσμα πρωτογενούς έρευνας στο πεδίο και στο εργαστήριο και δευτερογενούς, βιβλιογραφικής έρευνας.

Στόχοι της διατριβής είναι:
α) να μελετηθούν και να ερμηνευθούν τα νέα δεδομένα από τα νησιά του Εσωτερικού Αρχιπελάγους του Ιονίου
β) να αξιολογηθούν τα ήδη δημοσιευμένα ευρήματα από νησιά του Ιονίου και του Αιγαίου Πελάγους και να επανεξεταστούν τα επιχειρήματα της δια θαλάσσης μετακίνησης κατά το Πλειστόκαινο στην περιοχή
γ) να εξαχθούν συμπεράσματα σχετικά με τις υδάτινες και τις χερσαίες καταβυθισμένες διαδρομές
δ) να ενταχθούν τα νέα στοιχεία στη συζήτηση σχετικά με τις τεχνικές, γνωστικές και κοινωνικές δεξιότητες των ανθρώπων της Μέσης Παλαιολιθικής περιόδου.

Το πρωτογενές υλικό, που συλλέχθηκε στο πλαίσιο της επιφανειακής έρευνας του τμήματος Ιστορίας και Αρχαιολογίας του Πανεπιστημίου Κρήτης σε συνεργασία με το Υπουργείο Πολιτισμού, προέρχεται από νησιά και νησίδες του Εσωτερικού Αρχιπελάγους του Ιονίου και αποτελεί τον κορμό της μελέτης. Πρόκειται για λίθινα τέχνεργα που αποδίδονται στην Παλαιολιθική περίοδο και αποτελούν τα μόνα αρχαιολογικά τεκμήρια ανθρώπινης παρουσίας στα νησιά της περιοχής κατά το Πλειστόκαινο. Η πλειοψηφία των εργαλείων αυτών φέρει τεχνολογικά και τυπολογικά χαρακτηριστικά που συνάδουν με τις τεχνικές κατασκευής και τα μορφολογικά χαρακτηριστικά των εργαλείων της Μέσης Παλαιολιθικής περιόδου, μιας περιόδου που στον Ελλαδικό χώρο ταυτίζεται, προς το παρόν αποκλειστικά, με τον άνθρωπο του Νεάντερταλ και τοποθετείται χρονολογικά μεταξύ του 40.000 και του 250.000 πριν από το παρόν.

Σύμφωνα με τις πλέον πρόσφατες γεωαρχαιολογικές μελέτες ανασύστασης της παλαιογεωγραφίας της περιοχής, τα περισσότερα από τα υπό μελέτη νησιά ήταν ενωμένα με τις σημερινές ακτές της Ακαρνανίας, ωστόσο τα νοτιότερα εξ αυτών, το Αρκούδι και η Άτοκος, ήταν ήδη νησιά κατά τη Μέση Παλαιολιθική περίοδο. Το ίδιο έχει προταθεί και για τα δύο νοτιότερα νησιά του Ιονίου Πελάγους, την Κεφαλονιά και τη Ζάκυνθο. Δημοσιευμένα λίθινα εργαλεία τόσο από την Κεφαλονιά όσο και από τη

Ζάκυνθο έχουν αποδοθεί από τους μελετητές τους στην Κατώτερη ή/και στη Μέση Παλαιολιθική περίοδο. Λαμβάνοντας υπ' όψιν τα ευρήματα αυτά, σε συνδυασμό με τα νέα δεδομένα από την επιφανειακή έρευνα στο Αρκούδι και την Άτοκο και την προτεινόμενη ανασύσταση της παλαιογεωγραφίας, υποθέτουμε πως ο διάπλους μεταξύ των νησιών αυτών και της χέρσου θα ήταν, τουλάχιστον για ορισμένες περιόδους του Πλειστοκαίνου, εφικτός. Η υπόθεση αυτή αποδίδει στον άνθρωπο της Μέσης Παλαιολιθικής περιόδου έναν βαθμό εξοικείωσης με το υδάτινο στοιχείο και αντίστοιχες δεξιότητες που σχετίζονται με την ικανότητα προσαρμογής του στις περιβαλλοντικές συνθήκες καθώς και την ικανότητα ανάληψης ρίσκου και αντιμετώπισης ενδεχόμενου κινδύνου.

Το νέο υλικό από το Εσωτερικό Αρχιπέλαγος του Ιονίου προσφέρεται για τη διερεύνηση της υπόθεσης εργασίας, απαντά σε συγκεκριμένα ερωτήματα και θέτει νέα. Οι περιορισμοί που τίθενται λόγω της φύσης του υπό μελέτη υλικού προκύπτουν από την έλλειψη στρωματογραφικής συνάφειας και αφορούν κυρίως την ακριβή χρονολόγηση των ευρημάτων. Επίσης, απουσία παλαιοανθρωπολογικών καταλοίπων, η συσχέτιση με τα αντίστοιχα είδη του ανθρώπινου γένους προτείνεται εμμέσως με βάση την τεχνολογία. Πιο συγκεκριμένα, το πρωτογενές υλικό απαντά σε ερωτήματα που αφορούν: α) τις πρώτες ύλες, τις τεχνικές κατασκευής, τους τύπους και τη χωρική διασπορά των εργαλείων, β) τη συσχέτιση με αντίστοιχες θέσεις από νησιά και περιοχές της ηπειρωτικής Ελλάδας, γ) τις δραστηριότητες και τις στρατηγικές επιβίωσης του ανθρώπου του Νεάντερταλ στη ΒΑ Μεσόγειο. Η κριτική επανεξέταση των ήδη δημοσιευμένων συνόλων αναγνωρίζει προβλήματα τεκμηρίωσης και ερμηνείας των δεδομένων, εντοπίζει παραλείψεις και προτείνει ερμηνείες. Μέσω της σύνθεσης των νέων και παλαιότερων δεδομένων προκύπτει ο χώρος δράσης και γίνεται κατανοητή η παρουσία του ανθρώπου τόσο στα νησιά όσο και στα καταβυθισμένα τοπία της Μέσης Παλαιολιθικής περιόδου, ενώ προτείνονται, επίσης, οι θαλάσσιες και χερσαίες ρότες. Η συζήτηση εστιάζει στο ζήτημα της καινοτομίας (innovation) ως προσαρμογής (adaptation) τόσο με αφορμή τα νέα δεδομένα από τη ΒΑ Μεσόγειο αλλά και με βάση τα συμπεράσματα από έρευνες σχετικές με τον άνθρωπο του Νεάντερταλ σε θέσεις της υπόλοιπης Ευρασίας. Η εργασία ολοκληρώνεται με προτάσεις σχετικά με τις μελλοντικές προοπτικές της έρευνας.

Εν συντομία, στο πρώτο κεφάλαιο παρέχεται μία εισαγωγή στο ερευνητικό ζήτημα (1.1), τίθενται τα ερωτήματα και οι περιορισμοί της έρευνας (1.2) και γίνεται μια σύντομη αναφορά στην ιστορία της έρευνας και σε συγκεκριμένα επιστημολογικά ζητήματα (1.3-1.4). Παρουσιάζεται το αντικείμενο και η μεθοδολογία έρευνας (1.5) και μία σύντομη επισκόπηση των κεφαλαίων (1.6).

Αντικείμενο του δεύτερου κεφαλαίου είναι το ερευνητικό πλαίσιο από παγκόσμια σκοπιά. Ξεκινώντας με μια σύντομη επισκόπηση των κλάδων της Αρχαιολογίας (Νησιωτική, Ενάλια, Ναυτική Αρχαιολογία και Αρχαιολογία των καταβυθισμένων τοπίων) που ασχολούνται με τη σχέση του ανθρώπου με τη θάλασσα (2.1) Στο τρίτο κεφάλαιο παρουσιάζεται η ΒΑ Μεσόγειος κατά το Πλειστόκαινο από τη σκοπιά του παλαιοπεριβάλλοντος και της γεωμορφολογικής διαμόρφωσης των παλαιοακτών (3.3-3.4) και γίνεται διάκριση μεταξύ «ωκεάνιων» και «ηπειρωτικών» νησιών (3.5). Η σύνθεση των παλαιοντολογικών (3.6) παλαιοανθρωπολογικών (3.7) και αρχαιολογικών δεδομένων (3.8) από τη ΒΑ Μεσόγειο παρέχει το απαραίτητο υπόβαθρο για την ένταξη των νέων δεδομένων στη συζήτηση των χερσαίων και υδάτινων διαδρομών στην περιοχή κατά το Πλειστόκαινο.

Αντικείμενο του τέταρτου κεφαλαίου είναι η ανάλυση και η ερμηνεία των νέων δεδομένων από το Εσωτερικό Αρχιπέλαγος του Ιονίου. Έπειτα από μια σύντομη εισαγωγή στη γεωγραφία και τη γεωλογία της περιοχής (4.1) περιγράφονται οι μέθοδοι έρευνας πεδίου, συλλογής και καταγραφής δεδομένων (4.2-4.3) και η μεθοδολογία ανάλυσης των λίθινων συνόλων (4.4). Τα νέα ευρήματα παρουσιάζονται αναλυτικά με ποιοτικές και ποσοτικές πληροφορίες, πίνακες, γραφήματα, σχέδια και φωτογραφίες για κάθε νησί ξεχωριστά και στο τέλος παρατίθενται τα συμπεράσματα σχετικά με την τεχνολογία, τη χωρική κατανομή και τη χρονολόγηση των ευρημάτων (4.5). Το κεφάλαιο κλείνει με μία συζήτηση σχετικά με τις διαθέσιμες διαδρομές (χερσαίες και υδάτινες) όπως αυτές προτείνονται από τα γεωλογικά δεδομένα (4.6-4.7).

Το πέμπτο κεφάλαιο αποτελεί μία κριτική επανεξέταση των ήδη δημοσιευμένων λίθινων συλλογών από νησιά του Ιονίου (5.1) και του Αιγαίου Πελάγους (5.2) και διασαφηνίζει τα προβλήματα και τα όρια ερμηνείας των δεδομένων που έχουμε στη διάθεσή μας σχετικά με το ζήτημα των δια θαλάσσης μετακινήσεων κατά το Πλειστόκαινο (5.3).

Η διατριβή ολοκληρώνεται με την παρουσίαση των γενικών συμπερασμάτων στο τελευταίο κεφάλαιο (6), το οποίο συζητάει τις δύο μορφές διασποράς στη ΒΑ Μεσόγειο (χερσαία και θαλάσσια, εκούσια και μη) και τις προϋποθέσεις (τεχνικές, γνωστικές, κοινωνικές) για έναν επιτυχημένο διάπλου κατά το Πλειστόκαινο και προτείνει τις πιθανές διαδρομές στο Ιόνιο και το Αιγαίο. Το κεφάλαιο κλείνει με προτάσεις για μελλοντικές έρευνες (α), τονίζει την αναγκαιότητα για ανασκαφές σε θέσεις με αδιατάρακτη στρωματογραφική αλληλουχία, ώστε να καταστεί εφικτή η απόλυτη χρονολόγηση των ευρημάτων (β), συνδυασμού χερσαίων και ενάλιων ερευνών (γ), ακρίβειας στην ανασύσταση του παλαιοπεριβάλλοντος (δ), κοινής «γραμματικής» στην καταγραφή και ανάλυση των λίθινων εργαλειακών συνόλων, τόσο από τα νησιά όσο και από τις θέσεις της υπόλοιπης Ελλάδας (ε), και απαγκίστρωσης από το «σύμπλεγμα ανωτερότητας του Σύγχρονου Ανθρώπου» (κατά Villa and Roebroeks, 2014)[1] στην ερμηνεία των δεδομένων του Πλειστοκαίνου (στ).

Η παρούσα διατριβή είναι μια σημαντική συμβολή στην αρχαιολογία των νησιών της ΒΑ Μεσογείου αλλά και στην ιστορία των θαλάσσιων μετακινήσεων παγκοσμίως.

[1] Villa, P., Roebroeks, W., 2014. Neandertal Demise: An Archaeological Analysis of the Modern Human Superiority Complex. PLoS ONE 9, e96424.

Είναι η πρώτη εργασία που ερευνά το ζήτημα των χερσαίων και υδάτινων διαδρομών στη λεκάνη του Αιγαίου κατά το Πλειστόκαινο με αφορμή ένα κλειστό σύμπλεγμα νησιών και νησίδων. Η προσφορά της έγκειται (α) στην ανάλυση και ερμηνεία πρωτογενούς υλικού από περιοχές που για πρώτη φορά αποδίδουν ευρήματα της Μέσης Παλαιολιθικής περιόδου, (β) στην ένταξη του υλικού αυτού στον χάρτη της Παλαιολιθικής Ελλάδας και της ΒΑ Μεσογείου, (γ) στην ανάδειξη των προβλημάτων της έρευνας από πλευράς τεκμηρίωσης και ερμηνείας και της αναγκαιότητας για διεπιστημονικές προσεγγίσεις, (δ) στη συζήτηση των χερσαίων καταβυθισμένων περασμάτων και των υδάτινων διαδρομών τόσο από τοπική όσο και από παγκόσμια σκοπιά.

ii. Acknowledgements

This thesis explores the origins of sea crossings in the NE Mediterranean. It concludes, among other things, with the hypothesis that some of the first crossings, i.e. acts that clearly involved a great amount of risk, were instigated by chance. Similarly, the decision to pursue a PhD in Greece, in the middle of the economic crisis, in the particular topic, was to a certain degree risky. Also, the very beginning of my personal journey within the field of Greek Palaeolithic Archaeology was to a large degree coincidental. It happened that I got into the Department of History & Archaeology of the University of Crete (UoC) at a time when this was the only Department in Greece with a prehistoric archaeologist specialising in the Palaeolithic. This was Dr Nena Galanidou, teaching her second semester in Crete.

Obviously, my acknowledgments will start by thanking my PhD supervisor, Dr Galanidou for entrusting me with the analysis of the lithic collection from the Inner Ionian Sea Archipelago project, upon which this thesis is primarily based. By this opportunity I would like to thank her for a number of things, including the encouragement to study the lithic collection of an open-air site in Epirus in 2008, when I was an MA student getting to grips with lithic analysis, and the chance to familiarise with lithic assemblages from several sites in Greece by inviting me to draw them or collaborate in their study. Most importantly, she was the one who introduced me to the study of Human Origins, from the first lecture I ever attended as an undergraduate student on a Monday evening in October 2001. That particular lecture, through Dr Galanidou's enthusiasm, opened a brand new and very captivating window. Above all I want to thank Dr Galanidou for believing in me when this might have been more difficult, in the very beginning.

Yet "smooth seas never made skilled sailors", so of course this lengthy project which began in 2010, and took me, literally and metaphorically, to a number of –often isolated– places, would have been impossible without the advice and support of colleagues, friends and family. Firstly, I appreciate the help of my two advisors, Prof Nikos Efstratiou and Dr Tristan Carter for reading through the text and providing useful suggestions and valuable comments. Special thanks to Tristan, for happily accepting the role of advisor towards the very end of this trip. I cannot forget that even though my first contact with the field of Human Origins was made at the UoC, it was the year spent at the University of Southampton, through the lectures of Dr John McNabb and Dr William Davies, which really got me involved in Palaeolithic Archaeology. Will, my MA supervisor, was a constant encouragement and support during my first steps in the discipline providing as much help as a student would need. Mac, was the one who introduced me to the analysis and interpretation of lithics, the one who would call me "mate" and treat me as such, and whose valuable advice to not be afraid of taking risks I have kept in mind since.

The lithic assemblages studied for this PhD were collected as part of the UoC's field training programme. Vivian Staikou was the person who first spotted the lithics at Meganissi and offered the reason for a thorough investigation. Three geologists, Dr Giorgos Iliopoulos, Ilias Koussis and Petros Chatzimpaloglou, have helped me understand the archipelago's geology. I thank Giorgos and Petros for discussions upon the raw materials and Ilias for providing useful references. The archipelago was, without doubt, an ideal setting for fieldwork and I feel fortunate to have been part of it. I am of course indebted to all undergraduate and postgraduate students who were involved in the field and the laboratory between 2010 and 2013, both for the hard work and the fun times, with special thanks to Nikos Gkiokas for his patience and support. There are not enough words to express my gratitude to my friends and colleagues Popi Koukouraki and Panos Zervoudakis. The times spent together at Palairos' storeroom during the summer seasons of 2012 and 2013 would have been unbearable without them. Thanassis Kyrkos, guard from the Ministry of Culture, was often the only person to keep me company during long days of data processing. I would like to thank him for that.

At Kefalonia, it was Dr Christina Souyoudtzoglou-Haywood, director of the Livatho Valley Survey, who invited me to go through the lithics. Her hospitality and the ideal working conditions she offered during my fleet visits to Argostoli in June 2014 and July 2015 as well as the pleasant talks we shared during the evenings are much appreciated. The late Klaus Randsborg kindly allowed me to photograph the collection of lithics from the survey he directed in Kefalonia more than a decade ago. Dr Antonios Vassilakis and Dr Andreas Sotiriou provided valuable information and access to material during my visits to the island in 2011 and 2015.

Throughout these years I visited museums, storerooms and sites all over Greece. Having to deal with surface material there was always the need to see and grasp as many artefacts as possible. For this I want to thank Dr Galanidou for inviting me to study the Palaeolithic assemblages from Lefkas and for including me in the first small team who conducted fieldwork at Rodafnidia in 2010, Prof Efstratiou and Dr Galanidou for inviting me to see the impressive Middle Palaeolithic assemblages from Grevena (2012) and Prof Katerina Kopaka and Dr Christos Matzanas for discussions upon the Palaeolithic material from Gavdos (2012). I also thank Katerina for making me part of the Gavdos survey, excavation and study team since 2005 and of the small teams who surveyed the islets of Dia (2010) and Gavdopoula (2011). Above all it was because of her survey and excavation programme that I had the chance to explore the so-called "southern end of Europe". Few instances have offered better relaxation than the evenings just before the sunset on Sarakiniko beach with the feet in the sand and the eyes looking towards the southern coasts of Crete. I would also like to thank Dr Vangelis Tourloukis and Prof Katerina Harvati for the chance to participate in the PaGE project. Vangelis' invitation in 2012 came at a time when the horizon seemed particularly gloomy to me, yet fieldwork at Megalopolis (2012-2013) and Katharo (2013) offered me good times of Palaeolithic research in a balanced combination of tsipouro and raki respectively. This is when I also met Nicholas Thompson. I thank Nick for the multiple discussions upon radiolarite, flint and quartz, the good times we shared both at Megalopolis and Crete (Katharo & Plakias) and for a strong friendship since. Dr Thomas Strasser, director of the Plakias Stone Age Project is also warmly thanked for his sincere hospitality at Plakias in 2013 and for the profitable discussions.

Invaluable was my participation in the Submerged Prehistoric Landscapes Summer School, in August 2015, directed by Dr Julian Beck and Dr Dimitris Sakellariou, including lectures by Prof Kurt Lambeck and Prof Geoff Bailey. Through the SPLASCHOS network I got the chance to receive important feedback from Dr Anders Fischer and Prof Geoff Bailey. I would also like to thank Prof Albert Ammerman for providing (then unpublished) papers on the issue of early voyaging and for his useful comments on my work. Participating in international conferences was the only way to communicate and receive feedback from many colleagues from around the world. Although logistics were always an obstacle, it was absolutely worth it. Within these venues I met new colleagues, two of which I would particularly like to thank for the invitation to present my work in their Institutions, i.e. Dr Andreas Nymark Jensen (McDonald Institute for Archaeological Research, University of Cambridge) and Dr Trine Kellberg Nielsen (Neanderthal Museum, Mettmann).

Writing down the acknowledgments made me realise that there were quite a few Danes around. Heartfelt thanks to my favourite one, Katerina Tsalapatis, who was the first to show me how to dig a skeleton back in 2003, and because no matter how far, she is always so close. A 15year old friendship, common interest in submerged landscapes, roadtrips in Crete and Sardinia, and endless laughs are only some of the things we have shared with Dr Tatiana Fragkopoulou. Dr Margarita Nazou has since 2012 been an oasis of discussions and encouragement and the always useful stance from the Neolithic viewpoint. I also thank my colleagues from Crete, Dr Stefanos Ligkovanlis, with whom I have shared quite a lot of stressful hours in storerooms and many constructive discussions since we first met in 2008, and Eleni Chreiazomenou who has since 2012 shared her expertise in lithic use wear analysis, has become a valued research partner and, most importantly, because we have shared some of the most memorable moments. Despoina Markaki and Prof Nikos Efstratiou are also thanked for the tips on Alonnissos. Last but not least, many thanks to my non-archaeologist friends, Katerina, Elpida, Despoina, Antonis, Sotiris, Vassiliki and of course Marikaiti, whose subtle yet enduring support was invaluable, and to Nikos Oikonomou for his unwavering willingness to accompany my need to look for the Palaeolithic all around Greece and for his genuine interest in visiting museums and archaeological sites worldwide. Thank you!

All lithics were drawn by the author. Authorship of photographs is indicated in each caption. For the use of photos from the IISAP photographic archive I would like to thank the IISAP director, Dr Galanidou.

This project was partly funded (2012-2014) by the UoC's special research account (KA3632). Financial support was also provided by the French School of Athens (2014). Finally, I express my gratitude to the Irish Institute of Hellenic Studies at Athens for hosting me as its Assistant Director since March 2016, especially to its Director, Dr Christina Souyoudzoglou-Haywood.

The journey took longer than expected and throughout the way I lost family members and friends, loved ones who cannot be replaced. Yet new friends were made and babies were born. In a semiotic rather than religious point of view, Saint Nicholas, traditionally regarded as the protector of the sailors, seems to have been present throughout the process, providing the calm I needed at times of heavy seas.

This thesis is dedicated to the memory of my grandfather, who had always indulged in the view of sailing boats. Acting both as a grandfather and a father to me for a bit less than 30 years, I owe him most of what I have become. Life is different since March 2013; and again since March 2018, when I also lost my father. Both might have been less interested in the thesis itself but would have definitely been prouder than anyone upon its completion. Finally, I am sure that my mom deeply knows my profound appreciation of all she has been unconditionally offering to me for the last 34 years. Thank you for your trust and confidence, I couldn't ask for anything more. Looking forward to celebrating together the end of this trip, very soon, at the beautiful island of Crete!

Time to leave yet another shore.

Στον Ιωάννη Μ. Αντωνίου

So it returns.
Think you're escaping and run into yourself.
Longest way round is the shortest way home.

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1. Introduction

1.1. Introduction to the research problem

"Theories, like islands, are often reached by stepping stones"

(MacArthur and Wilson, 1967, p. 8)

The act of *seafaring* has diachronically been surrounded by a prestigious aura and its origins have fascinated both the academic community and the public. The open sea tends to provoke both awe and fear even to the most skilled mariners. From the first attempts in a human's life to swim to the most demanding transatlantic voyages, confronting the sea is never an easy task. Therefore, how plausible can it be for us today to conceive our early ancestors' attempts to confront and navigate the sea? People today, as well as in the past, have been inspired by the *unknown*, the *other*, and stimulated by the idea of getting the dominion over the *wild,* the *untamed*. The most celebrated example comes with the legendary "Neolithic revolution", as defined by Childe (1936) during the first decades of the previous century, i.e. with the first large-scale domestication of plants and animals. Far from a real "revolution", farming was much more like a gradual and long-term process. The same is being argued here for the establishment of *seafaring*. Going out to the open sea can, in a sense, be regarded as another attempt to experience the *unknown* and get the dominion over the feral and unrestrained nature of the sea. It is well documented that the Neolithic was accompanied by highly sophisticated maritime networks, while the Mesolithic is also known for a wide exploitation of marine resources, occupation of insular sites and transportation of people, animals and goods (Chapter 2). Can the birth of maritime activity be regarded as an instant "revolution" or rather as a result of gradual adaptation with the sea, its resources, its perils and its conundrums? When did the first attempts to cross the sea occur in our evolutionary history? Where we, *Homo sapiens*, the first and only species of our genus who tried to confront and navigate the sea? Have other species tried but perhaps failed, and which may have been the reasons for the possible unsuccessful endeavours?

The critical role of early hominin adaptations to coastal environments (Bicho et al., 2011) has recently been further elaborated by implications for seafaring activities by the hominins occupying the NE part of the Mediterranean before the arrival of *Homo sapiens.*

Challenging archaeological and geological data published in the last decade argue for Pleistocene seafaring in the central Ionian Sea (Ferentinos et al., 2012) and the southern Aegean Sea (Kopaka and Matzanas, 2009; Mortensen, 2008; Runnels et al., 2014a, 2014b, Strasser et al., 2011, 2010). These papers have reinforced attention to the NE Mediterranean Sea making it a principal arena for the study of early hominin dispersals; be it an obstacle or a crossing point.

In view of the total lack of direct evidence for Pleistocene sea-crossings, such as organic remains of boats, the search for the earliest sea-crossings in the NE Mediterranean focuses on indirect evidence, i.e. the archaeology found on islands. However, the geological history of the area as well as the climatic and sea-level fluctuations complicate the picture in the sense that not all present-day islands were indeed islands during the Pleistocene. Land bridges emerging during times of low sea level stand allowed for terrestrial rather than marine dispersals, a fact observed in several cases worldwide (Chapter 2).

In consideration of these aspects, the thesis at hand approaches the subject of seafaring by looking for its origins, i.e. the earliest attempts to confront the sea, as these may be preserved in the archaeological record of the NE Mediterranean. It focuses on a small archipelago, situated in the enclosed Inner Ionian Sea, consisting of Meganissi and several larger or smaller isles and islets (Figure 1). With the Inner Ionian Sea Archipelago (IISA) as a case study and by taking into account the differences in the palaeogeography of the region, corroborated by the contextual evidence in terms of palaeoanthropological and palaeontological remains from this part of the Mediterranean (Chapter 3), the aim is (a) to critically reassess the available archaeological indications for the Pleistocene sea-crossings, (b) to test the hypothesis for Pleistocene sea-crossings in an enclosed sea, such as the one encountered at the IISA, (c) to identify both the marine but also the terrestrial routes which are today submerged, (d) to re-evaluate the technical, behavioural and cognitive capacities of the species involved under this new prism and (e) to propose the way forward in terms of research agendas for the future.

Since palaeoanthropological remains are almost totally absent from the NE Mediterranean islands and chronostratigraphic data are only rarely provided (Cubuk, 1976a; Strasser et al., 2011), and can often be of debatable nature (Darlas, 2007; Galanidou, 2014a; Phoca-

Cosmetatou and Rabett, 2014a; Tourloukis, 2010), the lithic collections are the main datasets available to us.

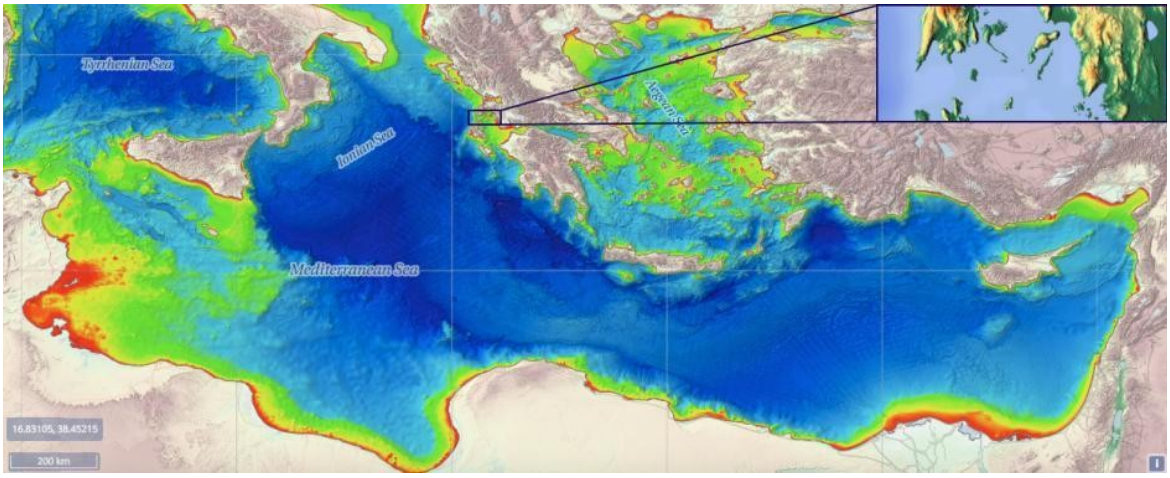


Figure 1: Map of the NE Mediterranean (**http://www.emodnet-bathymetry.eu**) with the location of the Inner Ionian Sea Archipelago (insertrt) annotated.

The Inner Ionian Sea Archipelago (IISA) consists of several isles and islets, the majority of which were, during most of the Pleistocene, connected to the western shores of the southern Balkans peninsula. However, two of the under study islands were, according to the latest geological reports (Ferentinos et al., 2012; Zavitsanou et al., 2015), insular throughout the period of interest to our research questions. The new, unpublished lithic material were collected in the course of the Inner Ionian Sea Archipelago Project (IISAP), conducted by the University of Crete in collaboration with the Greek Ministry of Culture (35^{th} and 36^{th} EPKA) between 2010-2013 under the direction of Dr Nena Galanidou (Galanidou, 2015, 2014b, 2011a). The lithic assemblages from the IISA islands are being analysed in terms of their technological, typological and morphometric attributes and interpreted within their spatial and temporal framework (Chapter 4). Additionally, a small number of artefacts collected from SW Kefalonia in the course of the Livatho Valley Survey (LVS), conducted by the Irish Institute of Hellenic Studies at Athens in collaboration with the Greek Ministry of Culture (35^{th} EPKA) between 2003-2013, under the direction of Dr Christina Haywood-Souyoudzoglou, are presented here for the first time, adding to the already published material from the island (Chapter 5.1.2). A thorough and systematic re-evaluation of the already published lithic collections is a fundamental step towards the comprehension of the Pleistocene record and forms an integral part of this thesis (Chapter 5).

Based on the available reconstructions of the Pleistocene sea levels for the central Ionian Sea (Ferentinos et al., 2012; Zavitsanou et al., 2015), particular hypotheses are formed in terms of terrestrial and marine crossings and their recounted technical, cognitive and behavioural patterns (Chapter 6). What will be proved is the usual pattern of such intense debates: that they tend to become polarised to the extent that the "truth" lies somewhere in the middle (Erlandson, 2001; Erlandson and Braje, 2015).

1.2. Research questions and limitations

In order to approach the research problem, a number of questions need to be addressed. Some of them can be answered through the study of finds alone, but traditional archaeological methodologies cannot always detect the answers to particular questions; interdisciplinary research is the key. For instance, without the geological inferences regarding the palaeogeomorphology of the present day islands, we would be unable to draw any significant conclusion concerning the insularity or not of the present-day islands during the Pleistocene; thus whether early hominins had to cross the sea, walk over a land bridge or just wander inside a valley in order to reach the areas which are today insular. In specific, the questions that are being addressed in terms of the palaeogeography of the NE Mediterranean during the Pleistocene are the following:

- Which present-day islands were insular, which were connected to larger island clusters and which to the mainland at different parts of the Pleistocene?
- How reliable are the up to date palaeogeographic reconstructions? Can we be confident for each and every island and for the entire chronological span?

The most important issue for the interpretation of the insular archaeological record is the chronological attributions of the assemblages; be these lithics or other types of archaeological finds. Both absolute and relative dating techniques have been employed in order to classify the finds; thus it is legitimate to question:

- What kinds of relative or absolute dating techniques have been employed in order to date the archaeological sites and assemblages?
- How reliable are these methods?
- Are the proposed dates valid and consistent?

The palaeoenvironment and the behavioural patterns of the other large mammal species, which occupied this part of the Mediterranean, may provide significant help in approximating the matter. Asking the adequate questions may provide insights into the skills required and the techniques involved in the conception of the initial idea, the planning of the trip and the construction of a watercraft.

- What are the cognitive, social and technological prerequisites for a sea-crossing to be successful? Which hominins are possible candidates?
- What are the environmental conditions which would allow or not a sea-crossing?
- Can we tell if there were enough faunal, floral, aquatic and raw material resources available on the Pleistocene islands? In other words, do we have enough information in terms of the biogeography of the Pleistocene islands?
- Which animal species arrived on the islands, which are the possible sea routes, where did each crossing event originate from and how did these species manage to successfully cross the sea?
- What is the observable impact of isolation for the large mammals (including hominins) and the smaller faunal species?

Since lithic assemblages collected from unstratified contexts are the most commonly found evidence for the Pleistocene, the most pertinent research tool that is available to us is the analysis of the lithics. This may provide answers to questions regarding the techniques employed for the construction of the tools, the preferences and behavioural repertoire of their artisans as well as cultural traditions and chronological attributions. Aspects examined during the analysis of the lithic collections include the following:

- What kinds of raw materials have been used for each assemblage? Are these made from local or allochthonous (exotic) materials? In the latter case, how far away have the exotic raw materials come from?
- What are the technological/typological/metrical characteristics of the lithic assemblages encountered on each site and on every island?
- Are there possible affinities with their contemporary sites on the mainland?
- What kinds of activities are implied by the production and use of the particular tools?
- Can we identify the spatio-temporal distribution of the lithic industries?
- To what degree are we able to identify individual chronological categories based on the lithics collected from the surface?

Based on the lithic analysis of the artefacts and in view of the total absence of palaeoanthropological remains we are only able to speculate on the hominin species which may have produced and utilised the particular tools, thus occupied this part of the Mediterranean during the Pleistocene. According to the spatial distribution of the finds in association with the available palaeogeographic reconstructions, particular questions are posed:

- Which of the present-day islands were reached via marine and which via terrestrial crossings?
- Which were the routes employed for the crossings?
- How many independent crossing events might have occurred?
- Are we able to speculate on the hominin species that occupied each one of the islands? How many species might have crossed the NE Mediterranean Sea during the Pleistocene?

Lastly, particular propositions in terms of future research agendas need to be proposed. Namely, what should be the aim of future geoarchaeological investigations; where should we look for next? Which methods need to be employed and to what degree is it feasible to answer in full the question of early seafaring?

A number of limitations in the interpretation of the available archaeological record are both associated with epistemological matters and the particular methodologies employed within the discipline itself (Chapter 1.3-1.4) as well as with a lack of the necessary datasets from other disciplines (geology, palaeoanthropology, palaeontology).

The first issue is what has often been stated, that the absence of evidence should not always be regarded as evidence of absence; a statement that is particularly evident in the search for the earliest sea-crossings. Of particular significance here are the implications from the terms used by archaeologists who investigate the broader issue of human *seagoing*, *seafaring*, *voyaging* etc. (Chapter 1.3). Clearly, the majority of the evidence is gone due to taphonomic issues and the significant impact of tectonic and erosional processes (Tourloukis, 2010; Tourloukis and Karkanas, 2012). What is left from the earlier phases of human prehistory is only a small percentage of what actually took place during the Palaeolithic, most of which probably still remains to be discovered.

Secondly, although an increasing number of geological studies are now available to us, palaeogeographic reconstructions of the eastern Mediterranean before the LGM are rare (Ferentinos et al., 2012; Lykousis, 2009; Perissoratis and Mitropoulos, 1989; Sakellariou and Galanidou, 2017, 2016; Zavitsanou, 2016; Zavitsanou et al., 2015) and most of them should be treated with caution. Combined geomorphological and stratigraphic studies (that is sedimentological and biological data) are needed in order for a complete picture of the sea-level changes to be formed. Palaeogeographic reconstructions need to associate the eustatic and isostatic changes together with the tectonic influences, especially in tectonically active regions such as the Aegean (Kapsimalis et al., 2009; Lambeck, 1996; Lambeck and Purcell, 2005; Sakellariou and Galanidou, 2017, 2016; Shackleton et al., 1984; Tourloukis and Karkanas, 2012; van Andel and Shackleton, 1982). Relative rather than absolute sea-level indications might be deceptive in some cases, as it will be discussed in Chapter 3.4.

Thirdly, a key issue is the almost total lack of palaeoanthropological remains from the islands (Chapter 3). This is a twofold setback, since when present, such fossil remains may allow more specific chronological attributions by narrowing the margin error and when found in the same context can provide direct associations between the stone tools and a particular hominin species.

Furthermore, relative rather than absolute dates are in most cases only available to us. In particular, the majority of the lithic assemblages are part of surface collections. These were either found by chance, or in the course of organized field surveys which could rarely be assisted by excavation methods, not even test trenches, in most cases due to legislation limitations. In order to date the finds, archaeologists have mainly conducted preliminary lithic analyses, with the detailed publications of the technological, typological and metrical characteristics of the artefacts usually pending. In most cases an attempt to associate the finds with their geological context has been made in lesser or greater extent, whereas artefacts in secure stratigraphic contexts are hardly ever found. Chronological deductions based on out of context lithic artefacts can often be misleading. The problems of dating a whole assemblage by the presence of a few artefacts categorized as type-fossils are discussed in greater detail in Chapters 4 and 5.

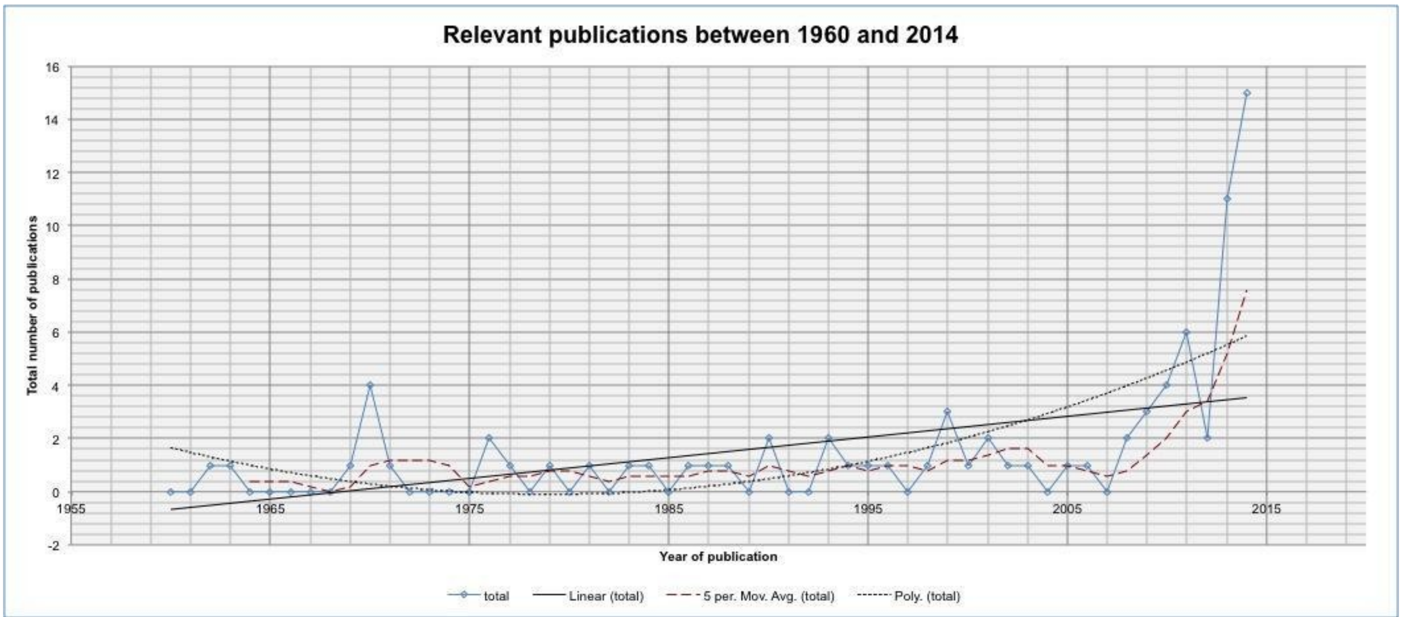
Lastly, the history of Palaeolithic research in the NE Mediterranean is indicative of the concentrated emphasis on the mainland, on a particular number of caves and the plenty open-air sites with the characteristic *terra-rossa* formations (Galanidou, 2014c). Apart from a couple of exceptions (Cubuk, 1976a, 1976b; Kavvadias, 1984; Sordinas, 1970a, 1970b, 1969), the countless islands of the Ionian and the Aegean Sea were up until the onset of the 21st century overlooked in terms of early Palaeolithic remains. Undoubtedly, one more reason was the premise that our ancestors were either incapable of or unwilling to cross the sea before the dawn of the Holocene (Papoulia, 2013). Consequently, since a number of theories were constructed on this premise, any attempt to challenge such conceptions is bound to be confronted with scepticism.

1.3. History of research and epistemological aspects

The last decade has witnessed a cumulative interest in the prehistory of seafaring with a particular focus on the islands of the Aegean (Graph 1). Each year of research witnessed vigorous debates over freshly published data and an intensification of field projects focusing on this matter. Before the submission of the present PhD proposal to the University of Crete in 2010 two papers, by Mortensen (2008) and Kopaka and Matzanas (2009), both published in Antiquity's Project Gallery, argued for Palaeolithic artefacts on Crete and Gavdos respectively. Within the next few months, the first paper by Strasser et al. (2010), entitled "Stone Age Seafaring in the Mediterranean: Evidence from the Plakias Region for Lower Palaeolithic and Mesolithic Habitation of Crete", was published. This study presented data from a survey conducted in the southwest (SW) coasts of Crete where a number of sites were attributed to the Early Holocene but also to the Pleistocene. The team working at the broader area of Plakias had previously presented orally the preliminary results of their survey both in the US and in Greece.[2] The assertion that the island of Crete was inhabited during the Mesolithic was novel, yet not as challenging as the suggestion for the presence of Lower Palaeolithic hominins on the same island. Although the two other papers had already dealt with the issue of early hominin presence at the islands of Crete (Mortensen, 2008) and Gavdos (Kopaka and Matzanas, 2009), it was both the eager

[2] In 2010, Dr Thomas Strasser together with Dr Eleni Panagopoulou presented a talk organised by the Archaeological Service and the Municipality of Rehymnon and Prof Curtis Runnels was invited to show some of the artefacts to students of the University of Crete in Rethymnon. A public talk was also organised by the American School of Classical Studies in Athens.

presentation of these new finds together with the even more enthusiastic reception by the press that perhaps brought the issue of "Stone Age seafaring in the Mediterranean" at the centre of the research agenda of a broader group of prehistoric archaeologists, not only the ones specializing in the Palaeolithic period.



Graph 1: Linear chart of the total number and trend-lines of the most relevant publications on insular sites and sea-crossings between 1960 and 2014. For a complete list of references see Appendix 1 (Papoulia, 2017, fig. 2). [3]

The finds from Plakias featured in the list of the 'top 10' discoveries of 2010 in Archaeology Magazine published by the Archaeological Institute of America, together with the decoding of the Neanderthal DNA which revealed that there was indeed interbreeding between Modern Humans and Neanderthals (https://archive.archaeology.org/1101/topten/%20). The international appeal of the discovery gave birth to another project, the experimental voyage from Kythera to Crete with a reed raft during the early summer of 2014 (First Mariners Expedition, 2014). As expected, the Plakias finds caught the attention of prehistorians who had in the past argued for a total absence of humans on Crete before the Neolithic, since such theories (Broodbank, 2000; Cherry, 1990, 1981; Evans, 1977) were now being challenged. The arguments were heavily criticised both by Broodbank (2014), who questioned the finds and their chronological attributions, and by Cherry and Leppard (2015) who focused on the very limited scientific base of the experimental voyage. Substantial arguments against a Lower Palaeolithic attribution of the Plakias evidence,

[3] In 2015 a postgraduate MA dissertation on Palaeolithic Crete was also defended at the University of Crete by Panagiotis Zervoudakis (2015).

were formed on the basis of biogeographic implications (Leppard, 2014a), on the loose association of the finds and the geological layers (Ammerman, 2013a; Galanidou, 2014c; Phoca-Cosmetatou and Rabett, 2014a) and on the cultural affinities of the lithics (Galanidou, 2014c, 2014a). Yet, at the same time, the finds from Plakias thrust a number of specialists to have a more open mind in the interpretation of lithic artefacts from surface collections,[4] with the possibility of a Palaeolithic signature being present on islands where such a prospect would have until recently been out of the question. Apart from Crete, a small number of publications had in the past dealt with lithic assemblages from sites on present-day islands (see Chapter 5 for a detailed analysis of the finds). These assemblages come both from islands of the Aegean Sea (Milos, Alonnissos, Ayios Petros) as well as from islands of the Ionian Sea (Kerkyra, Lefkas, Kefalonia, and Zakynthos). So why did the Cretan finds attract so much attention both from the academic community and the press, and why were the other islands generally overlooked before?

Firstly, a key element for the interpretation of the Pleistocene and Early Holocene record is the appreciation of the palaeogeography, which in our case rests predominantly on the sea level and palaeoshoreline reconstructions. Sea level fluctuations have caused submergence or ascendance of the landmasses forming either islands or connecting land bridges (Lambeck, 1996; Lambeck and Purcell, 2005; Lykousis, 2009; Shackleton et al., 1984). Therefore, the discovery of archaeological remains on present-day islands does not necessarily imply sea-crossings. For instance, the rich Palaeolithic material from Lefkas ought to be treated as part of the archaeological record of NW mainland Greece since during the Pleistocene Lefkas would have been connected to the Aetoloakarnanian coast (Dousougli, 1999; Galanidou, 2016; Galanidou et al., 2016a). Another example is the island of Kerkyra, situated at the northern borders of the Ionian Sea and at a very short distance from the closest continental coast. Archaeological investigations on the island have resulted in the identification of a number of sites with Middle Palaeolithic, Upper Palaeolithic and Mesolithic material (Sordinas, 1970a, 1969). Yet while the Mesolithic and Late Upper Palaeolithic sites testify marine crossings, the evidence for Middle Palaeolithic occupation on Kerkyra implies activities on the former Epirotic coasts of which Kerkyra

[4] Even Runnels himself proposed a Pleistocene date for the lithics from Milos after his initial Mesolithic scenario (see Chapter 5).

would have been part (van Andel & Shackleton 1982; Sordinas 1983; Papagianni 2000). Thus, although lithic assemblages attributed to the Pleistocene have since the 1960s been collected from islands of the Ionian Sea, i.e. Kerkyra (Sordinas, 1970a, 1969), Lefkas (Dousougli, 1999; Dousougli and Zachos, 1994), Kefalonia (Cubuk, 1976b, 1976a; Kavvadias, 1984; Randsborg, 2002), Zakynthos (Kourtessi-Philippakis, 1999, 1993; Kourtessi-Philippakis and Sorel, 1996; Sordinas, 1970b) and later on from the Aegean Sea as well, i.e. Alonnissos (Panagopoulou et al., 2001a; Theocharis, 1971, 1970), Kyra Panayia (Efstratiou, 1985; Moundrea-Agrafioti, 1992) and Milos (Chelidonio, 2001), not all of the aforementioned assemblages can qualify as arguments for Pleistocene sea-crossings, since not all were actually islands at that time. They may, on the other hand, be indications of terrestrial crossings conducted via the presently submerged land bridges.

Secondly, it was not until the onset of the 1980s that the issue of pre-Neolithic seafaring in the Aegean was essentially settled. The recovery of obsidian artefacts at the Mesolithic and Late Upper Palaeolithic layers of Franchthi Cave, Argolid could not but imply direct or indirect sea-crossings to and from the island of Milos (Perlès, 1979; Renfrew and Aspinall, 1990). Yet academics were still reluctant in accepting that the earliest sea-crossings in the Aegean could have occurred any time before the Neolithic (e.g. Cherry, 1990, 1981). Today, a number of open-air (Maroulas, Kerame 1) and cave sites (Cyclops Cave) from the Aegean Islands have been radiocarbon dated to the Mesolithic (Sampson et al., 2012, 2010, 2002) and the presence of obsidian from Milos at the same sites and at one more cave site in Attica provide additional evidence for marine navigation during the final parts of the Late Pleistocene and the onset of the Holocene (Laskaris et al., 2011). Yet for the southern Aegean islands of Crete (Strasser et al., 2010) and Gavdos (Kopaka and Matzanas, 2009), the arguments for early Holocene occupation were published as part of the arguments for Pleistocene occupation on both islands. Thus the strong critique against the Pleistocene attributions obscured any attempts for a thorough evaluation of the evidence for the early Holocene attributions. Since then, more open-air sites with Mesolithic affinities have been reported from the eastern part of Crete (Carter et al., 2016; Galanidou, 2011b), and the obsidian found at Damnoni has been added to the discussion of its circulation within the Aegean Mesolithic (Carter et al., 2018). The particularly enthusiastic announcements for an "Early Stone Age Seafaring" based predominantly on surface finds as well as the hasty and in a sense preliminary analysis of the lithics from Crete prompted rigorous replies (Ammerman, 2013a; Broodbank, 2014; Galanidou, 2014a; Leppard, 2014a; Phoca-Cosmetatou and Rabett, 2014a). These did not differ much from critiques framed in the past contra other claims about an insular Pleistocene or early Holocene archaeology in the Mediterranean (e.g. Ammerman and Noller, 2005; Cherry, 1990, 1981) which resulted "in a 'loss of innocence' for Island Archaeology" as well portrayed by Phoca-Cosmetatou and Rabbet (2014b, p. 87). It was in this context that old lithic collections were used in order to either support (Runnels, 2014a, 2014b) or reject (Galanidou, 2014a) the arguments for a pre- *Homo sapiens* presence on Plakias, Crete, based on the published lithics from the aforementioned survey. Yet, regardless of the frequency of references to the already published collections, a detailed re-evaluation of the lithic evidence had until now (Papoulia, 2017) not been attempted.

Thirdly, it is a fact that while the history of Palaeolithic research in Greece presents a slow but gradual progress since its dawn during the 1960s, the earliest parts of prehistory have always fascinated the amateurs (Galanidou, 2014c, 1996). Thus, it is no coincidence that a number of works dealing with lithic collections from sites on islands were either published by non-lithic specialists or had significant classification errors. Subsequently, the particular publications, more often than not, lack important strands of evidence by providing only limited valuable information. Their importance, however, lies on the attention driven to the specific sites and islands and should not be overlooked. To give an example, the inadequately published collections were one of the reasons why insular sites such as Fiskardo (Kefalonia) and Loutro (Crete) were only rarely referred to by other academics.

A fourth issue is the existing "consensus" on the earliest seagoing in the Mediterranean and worldwide. Established narratives for the prehistory of the Mediterranean islands have for about a century argued that it was not before the Neolithic that the majority of the small and large islands were *colonised* (Broodbank, 2013, 2000, Cherry, 1990, 1981; Dawson, 2013; Evans, 1977; Phoca-Cosmetatou, 2011). However, increasing evidence from SE Asia and Australia argue for Late Pleistocene seaward dispersals since at least 45,000±5,000BP, if not by 60ka BP (e.g. Balme, 2013; Balme et al., 2009; Barker et al., 2007; Davidson, 2010; Mellars, 2006; O'Connell et al., 2018, 2010; Summerhayes et al., 2010). Claims for even older sea-crossings, dating back to about 1mya have been built on the basis of the fossil remains found on Flores Island (Brown et al., 2004; Brumm et al., 2010a; Morwood et al., 2004). The epistemological saga about *Homo floresiensis* is an indication of the intricate nature of such extraordinary discoveries (Balzeau and Charlier, 2016; Brown, 2012; Brown et al., 2004; Brumm et al., 2010b, 2010a, 2006; Dennell et al., 2014; Morwood et al., 2005, 2004, 1998; O'Sullivan et al., 2001; Obendorf et al., 2008; Sondaar et al., 1994; St Pierre et al., 2013; e.g. Van Den Bergh, 1999; Van Den Bergh et al., 2001). While the crossing to Flores was most probably conducted by a species older than our own, those to Australia are associated with the dispersal of *Homo sapiens* and have also encountered criticism, mainly in terms of the intentionality of the crossing. Thus, since intentional sea-crossings by our own species during the Late Pleistocene can still be contentious, it is evident that arguments for sea-crossings potentially conducted by older species of our genus are compelled to be confronted by rigorous criticism sturdily built upon the equivocal nature of the archaeological record. Secure stratigraphic associations and absolute dates, which are unfortunately usually missing, is the only way to refute such kind of criticism.

Lastly, if we are to scrutinise the *origins* of seafaring, then all other types of relationship with the sea that do not qualify as "seafaring" yet might have been the triggering reasons for its birth need to be utterly considered. Less organised and perhaps less successful attempts to confront the sea may be expressed by different terms. Seafaring usually accompanies the other habitually used term that marked the Neolithic expansion, i.e. *colonisation*. Yet colonisation is defined by permanent occupations on islands and requires a large number of individuals in order for them to become established at the novel territories (e.g. Dawson, 2013; Leppard, 2014b). Environmental impacts, including faunal extinctions, as a consequence of human colonisation, have been well-documented for the Indonesian islands (Dennell et al., 2014), and may also be valid for the Mediterranean ones (Leppard, 2014a; Sondaar and Van der Geer, 2005). On the other hand, a *sea-crossing* may be conducted by a small number of individuals or groups and may result in non-permanent occupation -or "ephemeral colonisation" as defined by Leppard (2014a)- or rapid abandonments and/or extinctions. Sea-crossings may include both intentional and serendipitous crossings, even due to natural hazards. Yet, the later ones are unlikely to allow a series of reproductions in order for a population to become established at an insular landscape. Consequently, the material culture would be restricted in just a few lithic artefacts, which either travelled along with the individuals who made them or were produced and subsequently discarded shortly after their arrival. Archaeological visibility would then be minimum or even non-existent.

1.4. A short history of Palaeolithic research in the Ionian Islands

In the late 19th century and during the first decades of the 20th century, the tectonic activity of the Ionian Islands attracted the attention of a number of geologists. In some instances, in the course of their geological investigations they out of chance spotted a few lithic artefacts at the island of Zakynthos (Issel & Agamennone 1894; Jamet 1982; Sorel 1989) and Kerkyra (Marinos and Sakellariou-Mane, 1964). The British archaeologist Sylvia Benton (1932) conducted surveys and excavations on the islands of Zakynthos and Kefalonia and was one of the first archaeologists who paid attention to the lithics. The first organised collection of lithic assemblages from the Greek islands was conducted during the early 1960s, at a time when the Greek Palaeolithic was almost totally unknown. Although in 1962, Spiridon Marinatos, Professor of Archaeology at the National and Kapodistrian University of Athens and Head of Archaeology at the Greek Ministry of Culture who was also born in Kefalonia, published a brief report about a number of stone tools found at Korkos, SE Kefalonia (Marinatos, 1962), it was the pioneering work of Eric Higgs with his team from the Department of Archaeology and Anthropology of the University of Cambridge that turned the attention of the international community to the numerous open-air, red soil Pleistocene formations of the Epirotic landscape with the rich lithic assemblages (Dakaris et al., 1964; Higgs, 1964; Higgs and Vita-Finzi, 1966). The observation made by Higgs' team during the 1962 survey that such red soil "*terra rossa*" deposits were usually associated with large numbers of lithic artefacts attributed mainly to the Middle Palaeolithic made it easier for them and for the succeeding researchers to spot even more Palaeolithic sites in NW Greece (e.g. Runnels et al., 1999; Runnels and van Andel, 2003; Van Andel and Runnels, 2005). Similar geological formations occur in other parts of Greece, including parts of the Ionian Islands. It was Augoustos Sordinas, a Greek archaeologist with studies at the University of Harvard, who first identified and collected lithic artefacts from similar red soil formations on Kerkyra (Corfu) and from the smaller adjacent islets of Ereikoussa and Diaplo between 1964-1966 (1970a, 1969). For the finds from Diaplo, Sordinas proposed a late Mesolithic/early Neolithic date with "Campignian" affinities (Gabel, 1957; Nougier, 1950) mainly due to the differences in the angle of percussion between these artefacts and the ones from Corfu, which were classified as Levallois-Mousterian (Sordinas, 1969). Sordinas was the first to report the presence of open-air Palaeolithic sites on the island of Zakynthos which he also identified in the course of his PhD research during the mid 1960s (Sordinas, 1970b). He also reported the discovery of Middle Palaeolithic and terminal Upper Palaeolithic material on the island of Lefkas (Sordinas, 1983).

Ten years later, it was G. Cubuk (1976a; 1976b) who claimed to have found lithic artefacts at the site of Nea Skala on the island of Kefalonia. Between 1976 and 1977, Georgios Kavvadias, a Greek Professor of Sociology at the National and Kapodistrian University of Athens and a former student of André Leroi-Gourhan, collected a number of artefacts, together with a number of what seem to be geofacts (see discussion in 5.3.1), from the site of Fiskardo, NE Kefalonia, which were published the subsequent decade (Kavvadias, 1984). While Sordinas attributed his oldest artefacts to the Middle Palaeolithic, Cubuk and Kavvadias proposed even older dates for some of the artefacts from Kefalonia by assigning them a Lower Palaeolithic age. A Lower Palaeolithic age was also proposed for a chopping tool coming from Korrisia, Kerkyra (Kourtessi-Philippakis, 1999).

In the 1990s Angelika Dousougli and Kostas Zachos (Dousougli, 1999; Dousougli and Zachos, 1994; Zachos and Dousougli, 2003) identified five sites with diagnostic Middle Palaeolithic artefacts on the island of Lefkas, most of which, are situated in *terra rossa* contexs (Galanidou et al., 2016a; Galanidou et al. , 2017a). During the same decade, a survey by a Danish research team focused on the diachronic history and archaeology of Kefalonia (Randsborg, 2002) yielding significant amounts of lithics (5.1.2). An interdisciplinary survey took place during the first decade of the 21st century by archaeologists and geologists from Dutch universities on Zakynthos (Gouma et al., 2011; van Wijngaarden et al., 2013) and by the Irish Institute of Hellenic Studies at the Livatho Valley, NW Kefalonia (Souyoudzoglou-Haywood, 2008).

The islands of Kerkyra, Zakynthos and Kefalonia, are today situated very close to the shores of western mainland Greece. The non-insular nature of Kerkyra during most of the Pleistocene is today indisputable. However, the insularity of Kefalonia and Zakynthos has been a matter of a long-held debate. According to the latest geological evidence (Ferentinos et al., 2012), it seems that isolation from the shores of the mainland during most of the time that corresponds with the presence of Pleistocene hominins in the region is the likeliest scenario (see discussion in 3.4 and 4.6).

The Inner Ionian Sea Archipelago project is the first research survey project conducted by a Greek University on the islands of an archipelago (Galanidou et al., 2017b; Galanidou, 2015, 2014b) as well as at its sea bottom (Zavitsanou et al., 2015) with a specific aim in identifying the Palaeolithic signature of the islands and their significance in terms of hominin technology, behaviour and dispersal patterns (see 4.2).

1.5. Materials and methods

This research is the result of a series of studies combining fieldwork and laboratory methods. Literature review was conducted in order to appreciate the palaoenvironmental, palaeogeographic, palaeontological, palaeoanthropological and archaeological context. In terms of the arguments for Pleistocene sea-crossings, a bibliographical re-examination of all published lithic assemblages collected from insular sites was conducted in order to test the already proposed hypotheses. Bibliographical research was corroborated by fieldwork consisting of direct observations of known sites at the islands of Alonnissos, Crete, Gavdos (Crete), Kerkyra, Lefkas, Kefalonia. Identification of new sites on several isles and islets of the IISA, on and between Meganissi and the Aetoloakarnanian coasts, was made possible in the course of the Inner Ionian Sea Archipelago project conducted by the University of Crete in collaboration with the Greek Ministry of Culture (Galanidou et al., 2017; Galanidou, 2015, 2014b, 2011a). The material collected during the survey at the isles and islets of the IISA (for a detailed description of the survey project and the methodology employed see Chapter 4.2-4.3) form the core of the thesis since the archipelago served as a case study in order to test both the sea-crossing and the submerged terrestrial routes hypotheses at this part of the NE Mediterranean. Its geological history allows for a combined study of the "seafaring" scenario as well as the identification of the land bridges, which today can be found below the current sea level.

The unpublished lithic collections were macroscopically analysed, catalogued, photographed and illustrated in accordance with the usual archaeological conventions (Inizan et al., 1999). Although the survey at the IISA yielded a large number of artefacts belonging to different sub-periods of prehistory, the aim was to study in detail only those artefacts that can be securely attributed to particular cultural traditions. Diagnostic tool types and technological schemes provide hints for chronological attributions in the cases of unstratified surface collections. This means, for instance, that artefacts produced by the *Levallois* technique are usually attributed to the Middle Palaeolithic, a period which in Greece has traditionally been associated with the Neanderthals (Galanidou, 2004; Harvati et al., 2009). Since artefacts with Upper Palaeolithic affiliations are rare in the islands of the IISA, the emphasis is placed on the older material. This has been predominantly attributed to the Middle Palaeolithic and has been classified based on the standard typologies provided by Bordes (1980, 1979, 1961a) and modified by Debénath and Dibble (1994). On a technological basis, Boëda's (1994) principles of classification in terms of Levallois and Discoid reduction sequences were consulted, and new approaches have been taken into account (e.g. Eren and Lycett, 2012). Since the standardisation offered by typology manuals is never sufficient to account for the variation observed in lithic collections (Papagianni, 2000; Papoulia, 2011), adjustments of the European typelists and technological schemes to the local variations are offered by Papaconstantinou (1988), Papaconstantinou and Vassilopoulou (1997) and Papagianni (2000) for Epirus, Greece and by Kuhn (1995) for central Italy. The artefacts' attributes were stored and managed in Excel, where a number of graphs was produced in order to facilitate the interpretation of the data. A detailed presentation of the data analysis methodology is further discoursed in Chapter 4.

A re-examination of the already published material from sites on Zakynthos (Kourtessi-Philippakis, 1993; Kourtessi-Philippakis and Sorel, 1996; van Wijngaarden et al., 2013) and Kefalonia (Cubuk, 1976a, 1976b, Foss, 2002a, 2002b; Kavvadias, 1984) together with the study of new assemblages from the LVS allowed for a comprehensive scrutiny of the issue of Pleistocene sea-crossings in the central Ionian Sea (Chapter 5). Furthermore, the detailed re-examination of the published lithic collections from the Aegean islands of Alonnissos (Panagopoulou et al., 2001a), Kyra Panagia (Moundrea-Agrafioti, 1992), Ayios Efstratios (Kaczanowska and Kozlowski, 2014), Naxos (Carter et al., 2017, 2014), Crete (Mortensen, 2008; Runnels et al., 2014b, 2014a; Strasser et al., 2010) and Gavdos (Kopaka and Matzanas, 2011, 2009) allows for a meticulous and exhaustive approach of the subject matter and an appreciation of the state-of-the-art in terms of Pleistocene sea-crossings in a local scale (the NE Mediterranean) but with significant repercussions for the discipline in a global scale.

The study includes a number of tables and graphs as well as drawings of artefacts, photographs of sites and artefacts and site distribution maps, either modified already published ones or produced with ArcGIS. Appendix I includes the full references used for extrapolating Graph 1 and Appendix II is a short report on the obsidian artefacts collected in the course of the IISAP. Appendix III includes extra graphs regarding the material from the Plakias survey.

1.6. Thesis outline

This thesis has begun (Chapter 1) by identifying the research problem (1.1), the questions formed as well as the limitations imposed by the available datasets (1.2). It has provided a brief description of the history of research and the epistemological issues attached to it (1.3-1.4) and, finally, the materials and methods employed (1.5) in order to provide systematic answers to the questions posed.

The next chapter (Chapter 2) will further contextualise the problem in terms of its research background from a world perspective. A discussion of the archaeological sub-disciplines focusing on the matter (i.e. Coastal, Island, Wetland and Underwater Archaeology, Maritime and Continental Shelf Archaeology) as well as the terminology used to describe different aspects of the relationship between our genus and the sea is being clarified. Particular examples from the North Sea (2.2.1), the Messina Strait (2.2.2) and the North Adriatic Sea (2.2.3) are manifestations of Pleistocene terrestrial routes, now submerged. The available types of evidence for the earliest sea-crossings, i.e. direct or indirect, are discussed in a global context grouped into the Mediterranean (2.3.1.1), the Baltic and the North Sea (2.3.1.2) and SE Asia – Oceania (2.3.1.3). Additional information gained from the ethnoarchaeological record and important insights provided by experimental projects allow for a comprehensive approach on the issue of prehistoric water vessel construction (2.3.2).

The third chapter (Chapter 3) concentrates in the Pleistocene NE Mediterranean. It defines the chronological framework (3.2), the palaeoenvironment, i.e. the climatic conditions that our ancestors would have encountered in the NE Mediterranean during the glacials and interglacials (3.3), and the proposed palaeo-geomorphologic configuration which provide the foundation for the discussion on the marine or terrestrial crossings (3.4). In this context, it then briefly discusses the palaeontological record and its implications for Pleistocene hominin dispersals (3.6). Finally, it presents an overview of the palaeoanthropological record (3.7) and gives a general picture of the Middle and Late Pleistocene archaeological record from the Greek peninsula (3.8).

Chapter 4 presents the recently collected, unpublished lithic assemblages from the islands of the IISA. The description of the geography and environment of the archipelago (4.1) follows an introduction to the survey project (4.2). A comprehensive presentation of the survey methodology (4.3) and data analysis methodology (4.4) are an essential introduction to the detailed analysis of the lithic evidence. The assemblages from Meganissi (4.5.1), Kythros (4.5.2), Thilia (4.5.3), Tsokari (4.5.4), Arkoudi (4.5.5) and Atokos (4.5.6) are analysed in terms of their technological, typological and morphometric attributes, separated, when appropriate, in smaller geographic units (e.g. NE Meganissi, SW Meganissi etc.). The last part of the chapter (4.5.7) is a synthesis of the results and a thorough interpretation of the evidence in terms of the activities taking place in the area and the behaviour of the hominins who occupied the IISA during the Pleistocene. The insularity of the islands is discussed in accordance to the available palaeogeographic reconstructions. Based on the available geological and archaeological evidence, Pleistocene sea-crossings are implied for some of the sites under consideration.

Chapter 5 presents and critically re-evaluates the available lithic collections that have been used as arguments for Pleistocene sea-crossings in the NE Mediterranean. It is a synthesis and profound assessment of the evidence from the Ionian Islands (5.1) and the Aegean Islands (5.2). The discussion at the end of the chapter (5.3) summarises the current state of knowledge and stresses the problems regarding particular claims for sites whose insularity is not certain and for assemblages whose chronological attributions are unsubstantiated.

In conclusion, Chapter 6 provides a brief synopsis of the state-of-the-art in terms of Pleistocene marine and terrestrial crossings in the NE Mediterranean, it stresses the identified and the unidentified facets of the subject matter and provides, based both on the already published data, as well as on the new evidence from the enclosed Inner Ionian Archipelago (6.1-6.2). According to the evidence stipulated in Chapters 3, 4 and 5, Chapter 6 discusses the possible marine and/or terrestrial crossing routes for each of the islands discussed in the previous two chapters (6.3). In view of the challenging arguments for pre-LGM sea-crossings in the NE Mediterranean and worldwide, either by our own or other species of our genus, Chapter 6 provides a brief re-examination of the technical, social and cognitive prerequisites for a successful sea-crossing and examines the likelihood of any one of the species occupying the NE Mediterranean in the Pleistocene, i.e. *Homo sapiens*, *Homo neanderthalensis*, *Homo heidelbergensis* and perhaps also *Homo erectus*, to have, intentionally or not, crossed parts of the NE Mediterranean Sea. It discusses the notion of "innovation" as "adaptation" in order to look for the origins of seafaring in acts instigated by the need to adapt to different kinds of natural or anthropogenic stress (6.4). Finally it examines the future prospects in this direction and pinpoints the need for both on-land and underwater investigations (6.5). Irrefutably, there is still much work to be done towards the identification and documentation of the archaeological evidence for the earliest sea-crossings not only in the NE Mediterranean but worldwide. What becomes apparent, though, is that future archaeological investigations aiming to explore the earliest attempts of the human lineage to confront and navigate the sea may need to be sustained in the sea.

2. Research background: a world perspective

"What is still missing is archaeology of the sea to match that of the land"
(Broodbank, 2000, p. 34)

On questions regarding coastal settlements and human activity on the Pleistocene seashores, as well as the relationship between human agents and the sea, the deployment of a broad array of datasets from a variety of disciplinary fields is necessary. The archaeological record has traditionally been developed from terrestrial surveys and excavations, while theoretical frameworks provide the background for the interpretation of the evidence. Yet for reasons discussed in detail in the next chapter (3), the majority of the information from Pleistocene coastal settlements rests today below the current sea level. The particular problem has lately been addressed by conducting systematic underwater investigations on the continental shelf.

This chapter discusses the formation of the disciplinary fields and the methods employed in order to coherently approximate the under scrutiny matter (2.1). In particular, in order to examine the submerged terrestrial routes of the NE Mediterranean it is vital to appreciate the state-of-the-art in respect of the investigation of the submerged prehistoric landscapes (2.2). Accordingly, in order to investigate the nature of the sea-crossings that possibly took place in the area during the Pleistocene, it is necessary to consider the archaeological marks of sea-crossings worldwide (2.3). The direct and indirect evidence (2.3.1) from three different parts of the world, i.e. the Mediterranean (2.3.1.1), the Baltic and the North Sea (2.3.1.2), as well as SE Asia and Oceania (2.3.1.3) provide the essential framework for the interpretation of the lately discovered evidence coming from the NE Mediterranean (Chapters 4-5) and for a stimulating discussion on this matter (Chapter 6). The archaeological evidence discussed in detail in Chapter 2.4 proves that the archaeological record of sea navigation technology is considerably impoverished for the earliest parts of human history worldwide, with actual sea vessels dating not before 9ka years ago. Yet, a significant antithesis is stressed due to the archaeology found on insular sites testifying to early open sea-crossings many thousands of years earlier, at least since 60ka BP. For this reason, important information obtained from the fields of Ethnoarchaeology and Experimental Archaeology (2.3.2) lead to valuable suggestions in terms of the different types of vessels that might have been used in order to successfully cross parts of the Mediterranean Sea during the Pleistocene.

2.1. Human agents and the sea: the disciplinary spectrum

2.1.1. Island Archaeology

Island Archaeology has mainly focused on answering questions relating to insularity and connectivity, settlement and adaptation, isolation, marginality and cultural diversification, human-environment interaction, domestication, social and cultural networks, colonisation and abandonment (Dawson, 2013), size, distance and configuration (Cherry, 2004), marine dispersals and the development of seafaring (Broodbank, 2006, 2000). Terms such as the *seascape* (Gosden and Pavlides, 1994)*,* in juxtaposition to the *landscape,* or the *islandscape,* which focuses on the cultural aspects of connectivity and the dynamics of maritime culture (Broodbank, 2000, p. 34), were subsequently adapted.

According to Broodbank (2000, p. 22), “in island archaeology, the identification of the island as the primary unit is simply an imposed view: the most obvious unit that *we* can pick out”. Indeed, cultural isolation is not the typical scenario when dealing with the material record from islands, especially in the not so remote islands of the Mediterranean Sea and in periods of developed seafaring activities (i.e. from the Mesolithic onwards). Moreover, the relationship between people and the sea in communities living away from the shore, or in great elevations, may be of a significantly different character than the one expected for the typical islander (Fitzpatrick, 2007, p. 232). The supposed structural similarities between the islands and their catholic divergence from the mainland, has often proved to be superficial (Boomert and Bright, 2007; Broodbank, 2000; Fitzpatrick, 2004; Rainbird, 2007). Instead, it has been argued that “isolation is a cultural phenomenon related to the construction of identity as much as to insularity” (Barrowclough, 2010, p. 27).

According to Rainbird (2007, p. 45), the story of maritime communities is not merely a story of islands, but a rather more complex one. His phenomenological approach attempted to cast greater emphasis on the sea and less on isolation, a need already partially expressed by Broodbank (2000, p. 34). For Renfrew (2004, p. 276) the polarity between isolation, i.e. “islands as laboratories” (Evans, 1973), and interaction, i.e. “islands as reticulate networks”, is the “fundamental paradox” of Island Archaeology (Knapp, 2013).

2.1.2. Underwater Archaeology

Underwater Archaeology, as a sub-discipline of archaeology concentrating in the sea rather than on land, has traditionally been focusing on shipwrecks and submerged settlements. The NE Mediterranean in particular has provided a number of impressive archaeological finds, mainly from the historical times, including two elaborate Bronze Age wrecks situated off the SW coasts of Turkey, i.e. Cape Gelidonya and Uluburun. Yet while the majority of the finds were until the middle of the 20th century a result of chance discoveries, usually by sponge divers, the excavation of Cape Gelidonya in the 1960s marked the beginning of Underwater Archaeology as an academic discipline. The site was initially discovered in 1959[5] by Peter Throckmorton, a photojournalist, Honor Frost, a pioneer in the field of Maritime Archaeology, together with diver Mustafa Kapkin. The next year an archaeology student, George Bass, became the director of the first systematic excavation of a prehistoric site conducted underwater. Bass, employed the revolutionary techniques provided by Jacques Yves Cousteau and Emile Gagnon who developed the *aqualung*, a modern form of self-contained underwater breathing apparatus, while following the proper scientific methods of recording and recovering archaeological material. The discovery and scientifically excavated site of Cape Gelidonya proved, among other things, that (a) there is good reason why archaeologists should be able to submerge themselves rather than interpret out of context artefacts given to them by divers, (b) it is indeed possible to apply on the seabed the usual methodologies used on land, albeit with certain modifications, and, most importantly, (c) investigations under water are the only way to provide answers to particular research questions (Bass, 1966).

A number of publications during the 1960s and 1970s postulated the foundations for this new sub-field.[6] The analytic and scientific methodological framework of *New Archaeology* resulted in the development of new recording, excavation and conservation standards.[7] Subsequently, site formation processes were scrutinised (Muckelroy, 1976), and, as

[5] The *Advisory Council on Underwater Archaeology (ACUA)* was formed the same year.
[6] The *International Journal of Nautical Archaeology* was also established in 1972.
[7] In 1969 the use of *Polyethyleneglycol* (PEG) becomes a standard approach for the long-term conservation of waterlogged wooden material.

underwater excavations became common in several parts of Europe, the field of *Maritime Archaeology* formally emerged (Muckelroy, 1978).

2.1.3. Maritime Archaeology

Maritime Archaeology was defined by Muckelroy (1978) as including both *Nautical Archaeology* and *Underwater Archaeology.* Maritime cultural landscapes that can be found on land were later added to its scope (McGrail, 1984; Westerdahl, 1992, 1986). *Maritime Cultural Landscapes* as opposed to *Natural Landscapes* are defined as "the whole network of sailing routes, old as well as new, with ports and harbours along the coast, and its related constructions and remains of human activity, underwater as well as terrestrial" (Westerdahl, 1992, p. 6). According to Westerdahl's definition, in addition to the physical remains underwater and along the coasts, *"*cognitive aspects of the landscape, including the so-called 'mental map' and place names, are also necessary to understand a maritime culture and its relation to the physical landscape" (Westerdahl, 2008, p. 213). Theoretical approaches have since the 1990s incorporated Westerdahl's ideas in the social theories of Structuration and Actor-Network Theory, widely used by post-processual archaeologists (Firth, 1995; Tuddenham, 2010).

2.1.4. Continental Shelf Archaeology

Lately the paradigm in underwater archaeology has shifted towards the investigation not only of historical or prehistoric wreck sites but also of all aspects of human activity, which is hidden below the current sea level, not as a result of a shipwreck but due to geological processes (e.g. Bailey and Flemming, 2008; e.g. Bailey and Sakellariou, 2012; Evans et al., 2014; Flemming et al., 2014). Taking into account the relatively recent formalisation of Maritime Archaeology as an academic sub-discipline, it is not odd that the prehistoric archaeology focusing on the continental shelf is still a nascent, yet very promising, part of the discipline; one that has been introduced as a major avenue of research emerging in the 21st century (Bailey, 2011; Bailey et al., 2017; Bailey and Flemming, 2008; Bailey and Sakellariou, 2012; Benjamin, 2010; Benjamin et al., 2011b; Benjamin and Hale, 2012; Evans et al., 2014; Flemming et al., 2014; Harff et al., 2015; Tizzard et al., 2011). Prehistoric coastal sites are often inundated today. Yet, since the turn of attention towards the investigation of the *littoral* [8] and *sublittoral* zone, [9] a large number of submerged sites due to land subsidence or rise of the sea level has been discovered (Bailey et al., 2017; e.g. Benjamin et al., 2011b; Flemming et al., 2014). *Submerged landscapes* include any share of land that has been inundated, be this part of a lake, a river system, land bridges, coastlines or even whole islands. The *continental shelf* defines the area that would have been above the sea level during parts of our prehistory (Figure 2).

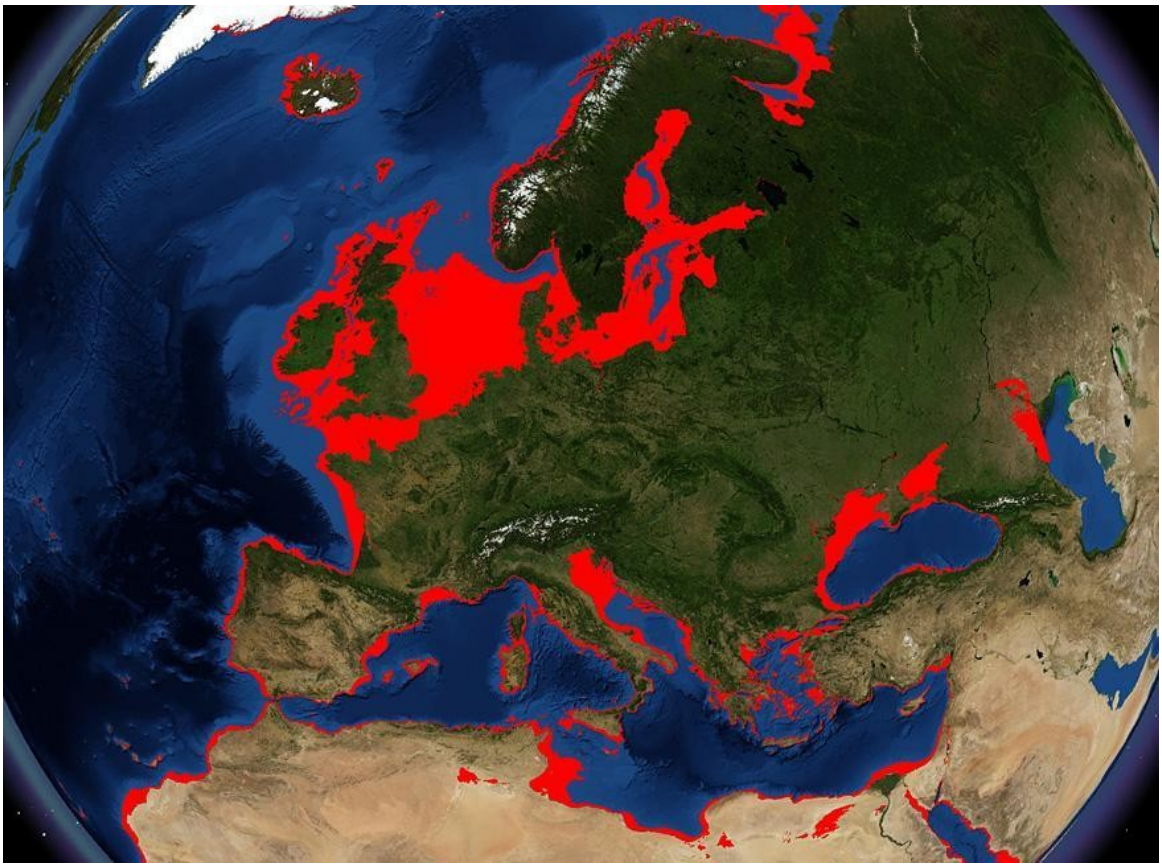


Figure 2: The continental shelf at maximum sea level regression during the LGM (Bailey & Sakellariou 2012: fig. 1).

In the investigation of an inundated archaeological site a marine geophysical survey usually comes first in order to define the site's particular characteristics, by employing techniques from military applications, commercial geological prospection, deep-ocean exploration and

[8] Intertidal zone between the highest and lower water marks.
[9] Subtidal zone between the lower water mark and the continental shelf break (c. 200m).

seafloor mapping. A vessel with sidescan *sonar*[10] and a *sub-bottom profiler* (boomer)[11] creates a model of the seabed corroborated by data from *single beam* or *multi beam (swath) bathymetry*. [12] As in terrestrial surveys, cores allow for an appreciation of the context of the site (primary or secondary) and the attainment of geological information for the reconstruction of the submerged landscape (Figure 3).

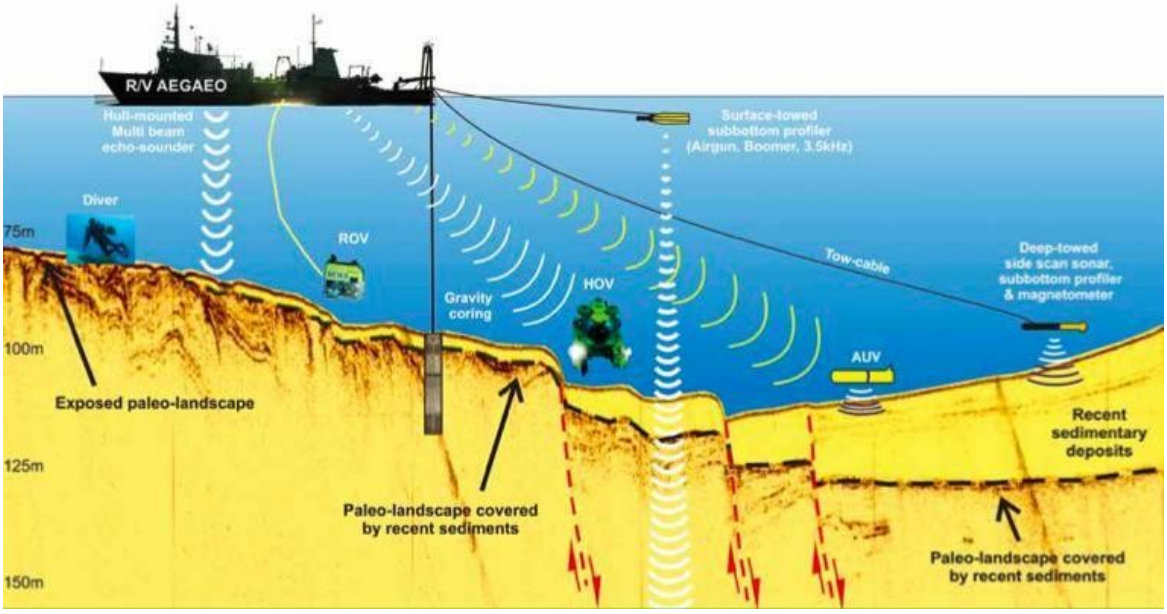


Figure 3: Illustration of the different methods used for the recording of the seabed. Courtesy of D. Sakellariou / HCMR (Flemming et al. 2014, Box 6.2).

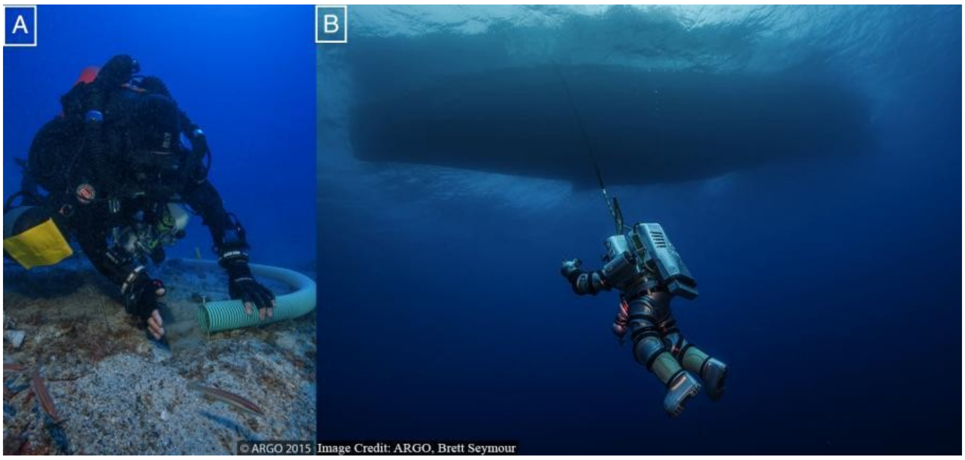


Figure 4: An underwater archaeologist excavating an inundated site with the help of an airlift (A) and the exosuit, which allows archaeologists to submerge at greater depths (B). (http://antikythera.whoi.edu/technology/exosuit/)

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10 This is an acoustic device that creates an image of the seabed and provides information in regards of the sediments and the possible human-made features (e.g. shipwrecks, walls etc.).

11 Seismic-acoustic systems able to detect and create an image of the buried structures. The *Boomer* provides better results for coarse sediments, while the *Pinger* and the *Chirp* are more appropriate for fine sediments.

12 Single and multi bean echo sounders are attached to the vessel and measure the water depth and provide an image of the seabed along its track (single-) or across a larger area (multi-).

New techniques have allowed for an amendment of underwater excavations. In shallow waters underwater archaeologists currently use *airlifts* or *dredges* in order to remove the sediments (Figure 4A). Diving in even greater depths has now been made possible with the *exosuit*, an apparatus launched in 2014 at the underwater excavation off the island of Antikythera (Figure 4B).

Table 1: Simplified diagram of the techniques applied and the technologies involved in the investigation of the continental shelf. After Flemming et al. 2014, p. 98.

Method	Technique	Type of data	Technology
Remote Sensing	Acoustic	Seafloor map	Side scan sonar, multibeam echosounder
	Acoustic	Sub-seafloor image (2D)	Sub-bottom profilers
		Sub-seafloor image (3D)	3D Chirp, SES-2000, Quattro
	LiDAR	Seafloor topography	Airborne LiDAR Bathymetry
	(Electro-)magnetic	Seafloor and sub-seafloor magnetic/resistivity map	EM profilers, gradiometers
Direct Investigation	Coring and sampling	Sedimentological/environmental	Grabs (van Veen, Shipek) Boxcore, vibrocore, gravity core, piston core
	Dive surveys	Sedimentological/archaeological	Swim dive (corridor/jackstay/circular)
Underwater platforms	Submersibles (manned/unmanned)	Wide spectrum of data (acoustic maps, water/sediment samples, cores, video etc.)	HOV, ROV, AUV
Photographic	Photo, video, stereo	Exposed seafloor	Digital 2D/3D cameras, photo/video-mosaicing, video microscope

The discovery of a number of prehistoric sites underwater worldwide proves that archaeological and palaeontological finds may be able to survive several episodes of marine transgression / regression (Bailey and Sakellariou, 2012; Flemming et al., 2014). Apart from the recovery, the concern in respect of the preservation and protection of the underwater archaeological sites was established by the UNESCO convention for the Protection of the Underwater Heritage, adopted in 2001 and ratified in 2009. This aspect together with the radical archaeological methods and recording techniques available today (Table 1) offer the impetus for the elaboration of this newly developed field.

2.2. Submerged terrestrial routes

Hominin activity on the Pleistocene coasts is only minimally represented in the archaeological record when compared to inland activity. Coastal and aquatic adaptations from terrestrial projects are difficult to inspect since, although uplifted shorelines associated with former interglacials may be encountered in a few parts of the world, the coasts of the glacial periods are rarely above the sea level today (Erlandson, 2001; Chapter 3). The few coastal sites preserved on land include the famous Middle Pleistocene site of Terra Amata, situated today at 26masl on the French Mediterranean coast (Figure 5).

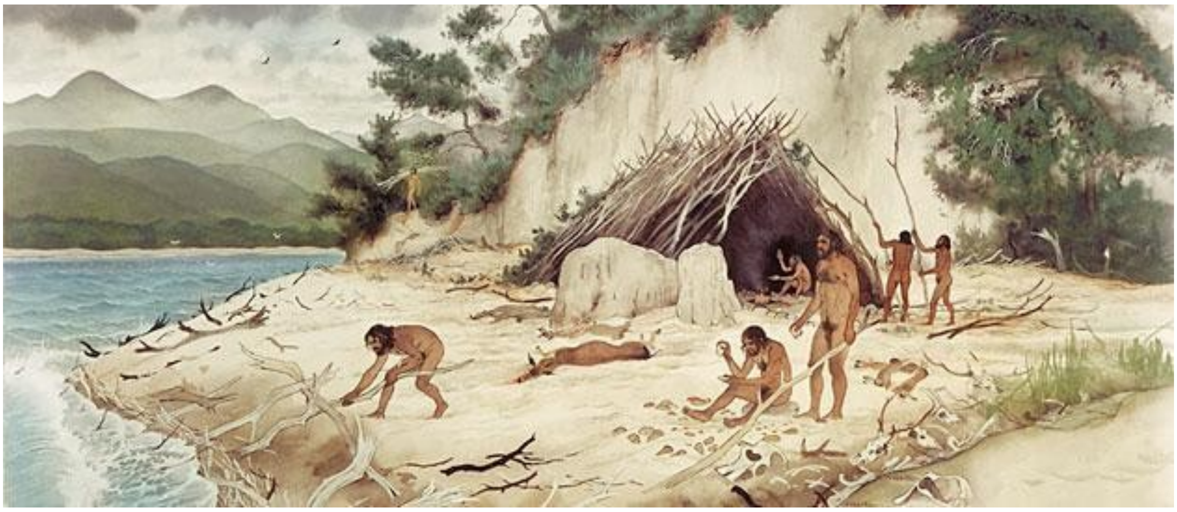


Figure 5: Artistic reconstruction of the coastal Middle Pleistocene site of Terra Amata, Nice, France. After http://www.hominides.com/html/lieux/terra-amata-site-prehistorique.php.

On the contrary, the investigation of inundated sites has managed to alter the archaeological narratives in terms of coast- and sea- related hominin adaptations, provided answers to long-held questions and given birth to new ones. It has proved that there is much to learn from the investigation of submerged landscapes, that the required technology is here (See 2.1.4 above) and that the aquatic environments may preserve artefacts that are rarely found in terrestrial contexts, such as wooden vessels, paddles, fishhooks or fish traps (See 2.3.1.2). In the investigation of Pleistocene dispersal routes, the study of former land bridges is crucial and needs to be corroborated by both terrestrial and underwater geoarchaeological surveys. This section presents examples of submerged landscapes from parts of the North Sea and parts of the Central Mediterranean that have acted as land bridges during the Pleistocene.

2.2.1. The North Sea

An extensive reconstruction of a submerged archaeological landscape through geophysical data is the so-called *Doggerland.* During the Pleistocene, a land bridge used to connect the area of the southern North Sea between Britain and NW continental Europe allowing for terrestrial migrations and settlements. Doggerland is the inundated land which used to connect the two banks and was systematically excavated in the late 1990s (Coles, 1998). A rise of the sea level since c. 18ka BP altered the landscape by gradually creating an archipelago comprised by the former peaks of the mountains (the Dogger Hills) and eventually the seascape as we know it today. The area has yielded a great amount of Holocene artefacts attributed to the late Upper Palaeolithic and the Mesolithic. During the final parts of the Pleistocene and the beginnings of the Holocene, Doggerland, apart from hosting a range of activities, also acted as a terrestrial corridor between NW continental Europe and the British Isles.

Pleistocene finds, including both lithics and faunal remains, from the seabed of the North Sea have been reported since the 1930s (Coles, 1998; de Wilde, 2006; Flemming, 2002; Glimmerveen et al., 2004; Godwin and Godwin, 1933; Long et al., 1986; Mol et al., 2006; van Kolfschoten and Laban, 1995). A decade ago, the oldest archaeological material was recovered from *Area 240*, situated 11km off the eastern coasts of England (Tizzard et al., 2011). A total of 88 flint artefacts, including a large number of handaxes attributed to the Lower Palaeolithic, as well as faunal remains, including woolly mammoth, woolly rhinoceros, bison, reindeer and horse, were discovered in the stockpiles of gravel extracted from Area 240 by the dredging industry (Figure 6). Area 240 extends between 16.7 and 33.5mbsl. A re-evaluation of the site in 2010 proved that the deposits include anthropogenic material (flint flakes) and both terrestrial (bovine or cervid) and marine (fish and aquatic mammal, possibly dolphin) faunal remains (Tizzard et al., 2011).
Further seabed sampling and dredge monitoring activities raised the total amount of lithics to 124 (Tizzard et al., 2014). OSL dates indicate an MIS 8-7 (ca. 250 ka) age for the main sediment unit (Bicket and Tizzard, 2015; Tizzard et al., 2014). A reconstruction of the palaeogeography of the region during the early Middle Palaeolithic, ca. 300-200ka (MIS 9-7), shows the limits of the valleys, the extent of the MIS 12 glaciation, the drainage systems as well as important sites with Levallois products and handaxes (Figure 7).

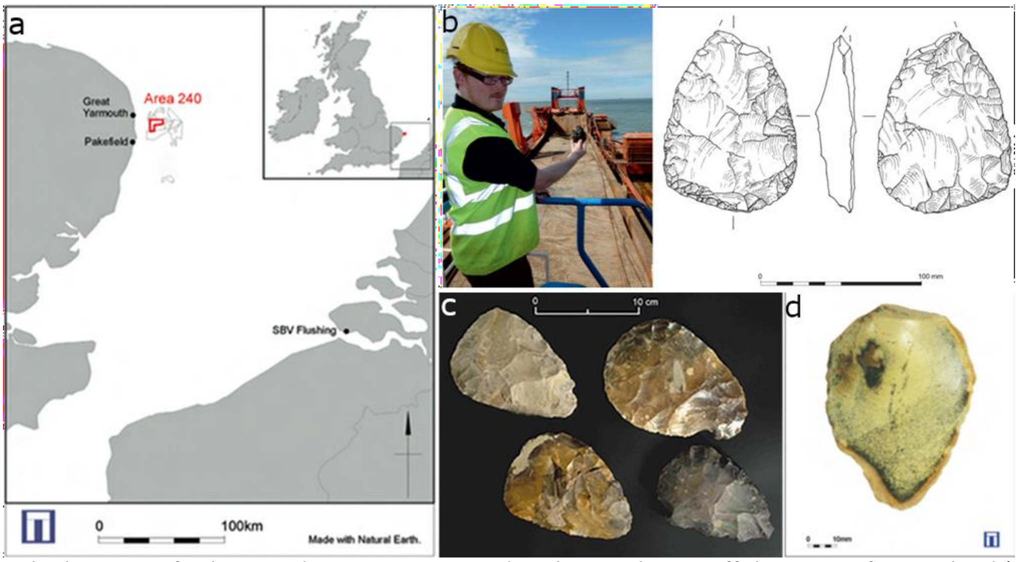


Figure 6: The location of submerged Area 240, situated at the North Sea, off the coast of SE England (a), a handaxe found during the investigation of the aggregate material on board the dredging vessel (b), handaxes found within the gravel stockpiles at the Flushing wharf in Vlissingen, Netherlands (C) and a flake recovered in situ from the excavation of the inundated site (d). Modified after Tizzard et al. 2011, fig. 1, 5; Bailey and Sakellariou 2012, fig. 8; Tizzard et al. 2014, fig. 8.

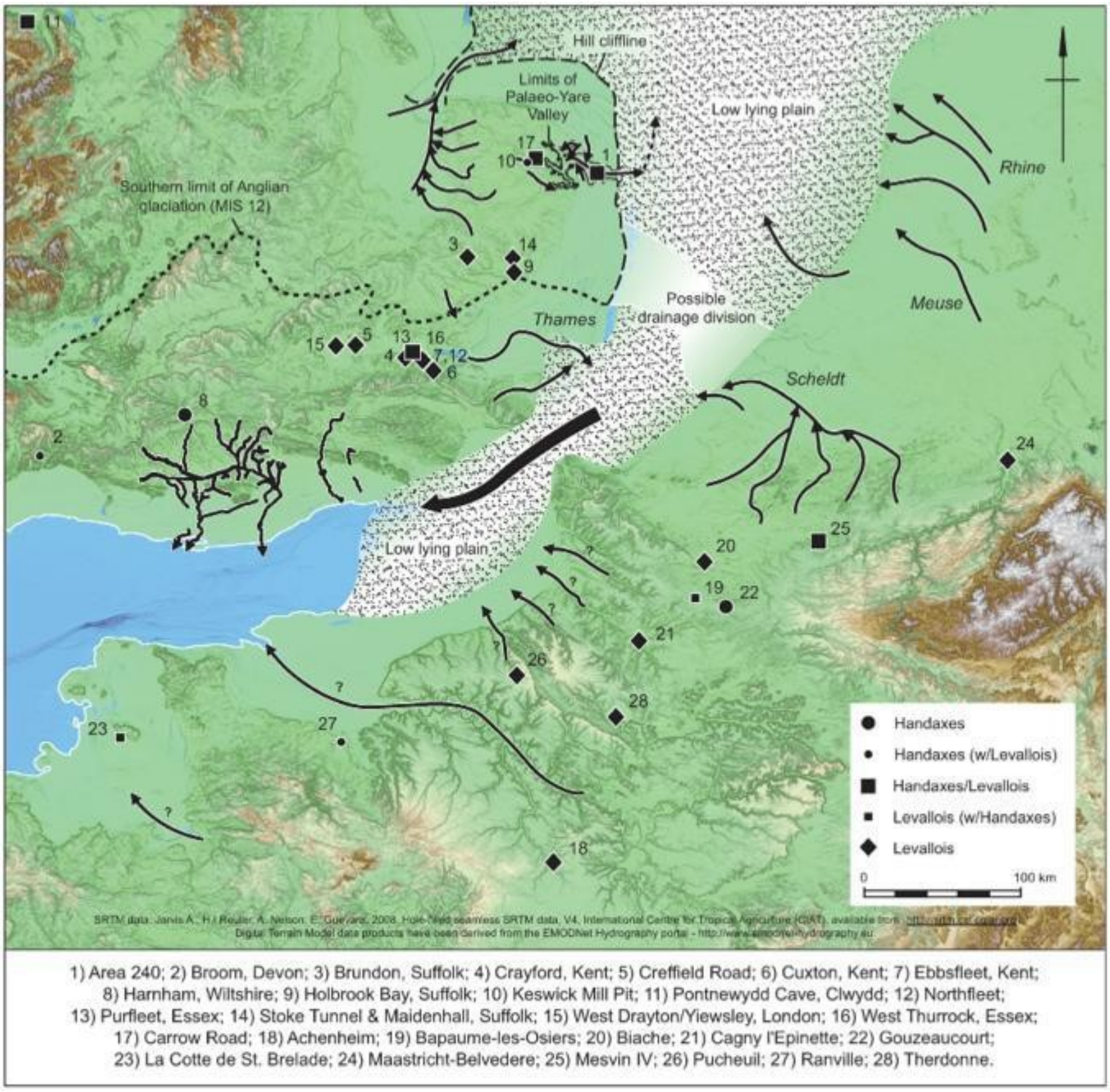


Figure 7: Reconstruction of the SW North Sea during MIS 9-7 (Tizzard et al. 2014, fig. 9).

In 2013, hominin footprints were found in estuarine sediments at Happisburgh site 3, situated at the eastern coast of England, further to the NW of the submerged Area 240 (Figure 8). The sediments are believed to be part of the Hill House Formation (HHF), thus they belong to the Early Pleistocene, ranging between 1 and 0.78 mya (Ashton et al., 2014). The only fossil remains from this time range in Western Europe belong to *Homo antecessor* (Carbonell et al., 2008, 2005). The authors propose that the hominins from Happisburgh may also belong to the same species, especially since their foot index (mean=39) and estimated stature (<1.73m) are in accordance with the fossil evidence of *Homo antecessor*, although the estimated stature falls within the range of the fossil evidence of *Homo heidelbergensis* and early *Homo neanderthalensis* (Ashton et al., 2014). These finds testify to the utilization of the present coasts by archaic hominins and the great antiquity of the terrestrial crossings between NW continental Europe and SE Britain, and allows for speculation as to the degree of the information that may be hidden below the current sea level.

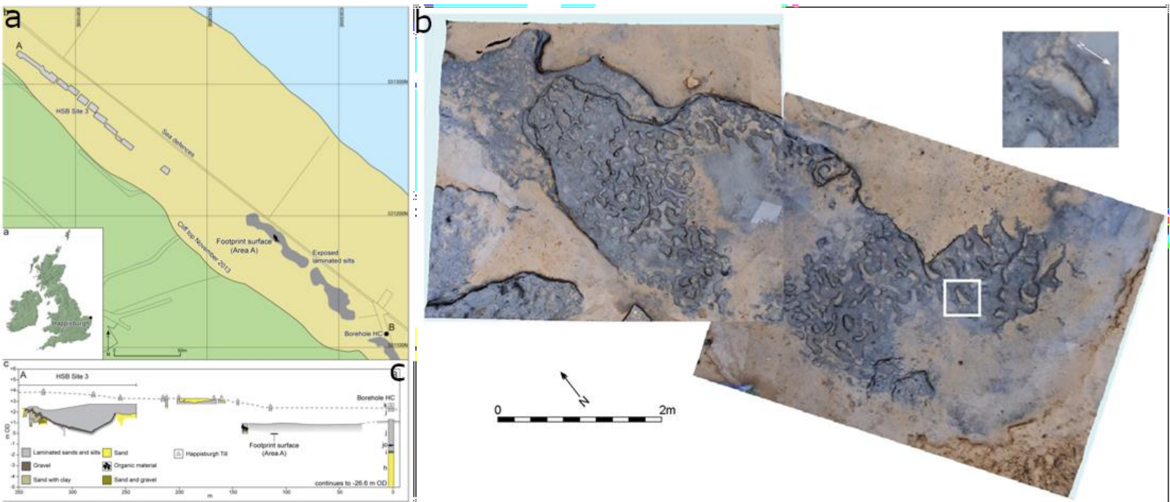


Figure 8: Location (a), vertical plan (b) and schematic cross-section (c) of Happisburgh site 3 (left) and photo mosaic of the footprints from area A (right). Modified after Ashton et al. 2014, fig. 1 and 7.

2.2.2. The Messina Strait

During parts of the Pleistocene the Messina Strait was separating continental Italy from Sicily, yet at times of low sea level a land bridge was connecting the two banks permitting terrestrial crossings (Antonioli et al., 2016, 2012; Petruso et al., 2011). Based on recent palaeogeographic reconstructions combined with palaeoanthropological and palaeontological data from sites on Sicily, it appears that around the LGM Sicily was connected with Calabria (Figure 9; (Bonfiglio et al., 2008; Mangano, 2011; Mannino et al., 2011; Mannino and Thomas, 2007; Palombo, 2009). The minimum duration of the land bridge emergence would be between 21.5 and 20ka BP and the maximum between 25 and 17ka BP (Antonioli et al., 2016), yet it is possible that more episodes of low sea level stands might have produced a connection between Calabria and Sicily throughout the Pleistocene (Antonioli, 2012; Marra, 2009).

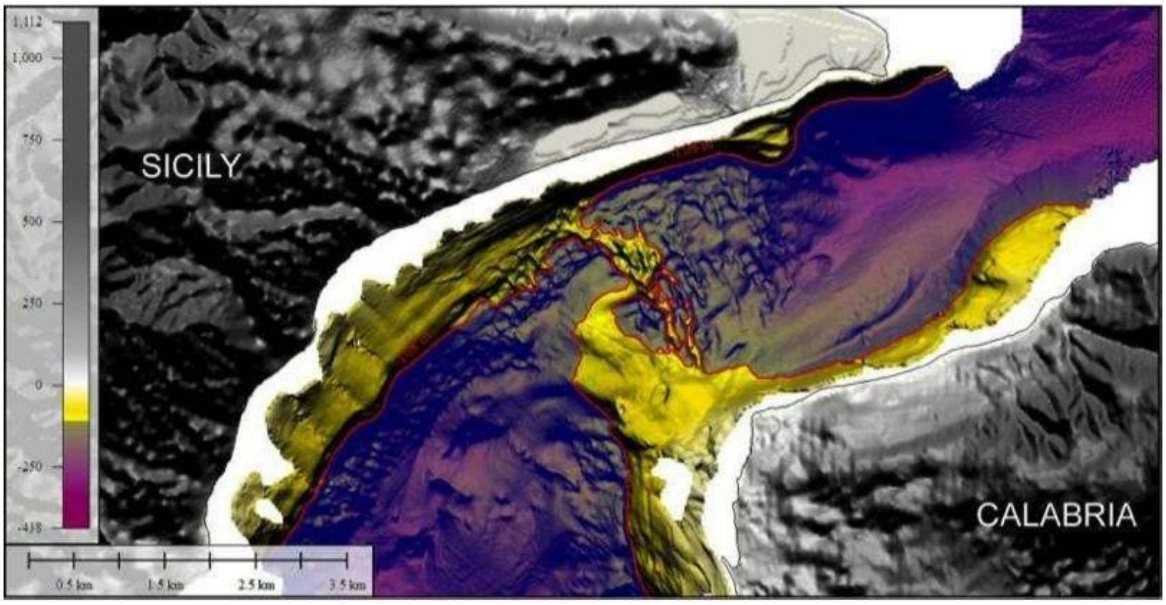


Figure 9: A multibeam image of the 'Sill' in the Messina Strait showing the connection between Calabria and Sicily during the LGM, at 108mbsl (Antonioli et al., 2012, fig. 1).

According to the faunal evidence, the dispersal of *Microtus (Terricola) Savii* to Sicily, perhaps in two different episodes, implies the presence of a land bridge between the late Middle Pleistocene and the Late Pleistocene (Masini et al., 2008; Petruso et al., 2011). Furthermore, the presence of an *Equus hydruntinus* specimen at St Teodoro Cave, a species unable to swim, has been dated to between 23ka and 21ka BP (Antonioli et al., 2012; Mannino, 2012; Mannino et al., 2012). The turnovers of the Late Pleistocene fauna, which are identified on both sides of the Messina Strait, have been partially associated with human predators (e.g. Masini et al., 2008). Given that the earliest human fossils have been dated to 20ka BP (Sineo et al., 2002), the presence of humans on Sicily before the LGM (Chilardi et al., 1996; Leighton, 1999; Mussi, 2001; Mussi et al., 2006), if this is to be used as evidence for sea crossings, needs to be treated with caution. Either as an island or not, Sicily can be an important place for future investigations on Pleistocene human crossings, both marine and terrestrial ones.

2.2.3. The Adriatic Sea

The northern parts of the Adriatic Sea were, during most of the Pleistocene, part of extensive plains and drainage systems. Similarly, the numerous Adriatic islands would have been part of the mainland (Markovic-Marjanovic, 1971), thus former terrestrial landscapes are now fragmented (Figure 2). Palaeolithic finds from the Adriatic islands were first published in the late 1960s (Malez, 1967). Given that amateur archaeologists were the first to identify the majority of the sites, a number of systematic surveys and re-examinations of old collections have recently been undertaken (Vujević, 2009), with the investigations continuing underwater (Karavanić et al., 2014; Karavanic and Patou-Mathis, 2009; Figure 10).

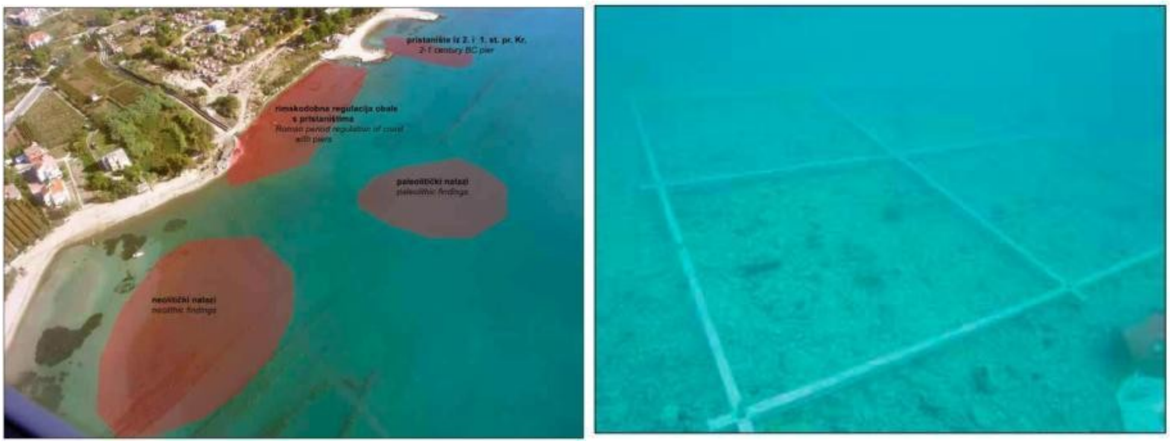


Figure 10: Arial view (A) and photograph of the underwater excavation (B) of the Kaštel Štailić – Resnik site in Croatia. Marked in red are the submerged underwater finds spanning the Palaeolithic to the Roman period (Karavanic et al. 2014, fig. 19-20).

A plethora of Middle Palaeolithic artefacts attest to the dense Neanderthal presence in the area (Karavanić, 2004, 1995, Karavanić et al., 2014, 2007; Karavanic and Patou-Mathis, 2009; Karavanić and Smith, 1998; Vujević, 2009). A significant amount of Late Pleistocene/Early Holocene finds were also found at several caves and open-air sites on the present coast and the mainland, as well as on the islands and the continental shelf of the Zadar Archipelago (Benjamin et al., 2011a; Karavanic and Patou-Mathis, 2009). In this case, while the Neolithic, Mesolithic and late Upper Palaeolithic finds are evidence of sea-crossings, the Middle Palaeolithic material confirms the terrestrial dispersals which took place in the former Adriatic plain, by Neanderthal populations.

2.3. Pleistocene sea-crossings and the origins of seafaring

"The singular fact of global colonisation by modern humans was due to the fact they had purpose"
(Gamble, 1997, p. 145)

According to Irwin (1992) the colonisation process of modern humans is characterised by *intention* and *rationality*. These two have been regarded as the most critical elements for the successful colonisation of even the most remote and inhospitable parts of the earth. An examination of the dispersal patterns of our own species, as well as older species of our genus, as manifested in the material record demonstrates significant differences as well as similarities.

The term *colonisation* is used to define a sustained presence of a particular group in a novel territory to the degree that the archaeological record may verify it. In the case of *island colonisation*, at least one sea-crossing of a significant number of individuals, of both sexes and of fertile age, is an essential precondition. Simulation models and archaeological evidence from Oceania disclose that usually more than one sea-crossing needs to take place in order for a colonisation to be successful (Allen and O 'Connell, 2008; Balme, 2013). Thus, sea-crossings might not always result in the colonisation of an insular territory in the sense that not all expected criteria are fulfilled in order for a species to become established on an island. Instead particular individuals who crossed the sea might have either abandoned the island or died out soon enough before producing any significant archaeological record. Thus some of the cases with diminutive archaeological evidence for sea-crossings might either be construed as a result of our flawed interpretation of the archaeological record, or as a result of sea-crossings conducted by a small amount of individuals with no permanent occupation, rapid abandonment and/or extinction (Papoulia, 2017, 2016).

Yet while intentionality is usually essential in order for a species to colonise an insular landscape, *chance dispersals* have also resulted in the colonisation of islands both by faunal as well as hominin species. A prominent example is the island of Flores in Indonesia (See 2.3.1.3.1). There, an archaic hominin (*Homo erectus*) dispersed, most probably by chance, possibly due to environmental conditions (e.g. tsunami). An adequate number of individuals successfully made the crossing, since a new species, *Homo floresiensis*, also known as the 'Hobbit', survived for several thousands of years on Flores (Dennell et al., 2014).

Maritime activity has been considered, within the archaeological literature, as a proxy for human behavioural complexity (Davidson, 2010; Davidson and Noble, 1992; O'Connell et al., 2010), not least due to its concomitant economic and demographic effects (Broodbank, 2013, 2006). The search for the origins of seafaring is unequivocally linked with the technological, social and cognitive capacities of the unit scrutinised, be this an individual, a group, a hominin species or our whole genus. Archaeological evidence provide substantial clues for the comprehension of the diverse mechanisms involved in the evolutionary process which resulted in the formulation of marine cultures as we know them today. In the next chapter I aim to detail both the direct and the indirect archaeological evidence for sea-crossings drawing from case studies from around the world in order to reveal the different degrees of certitude implied by the different types of evidence. This fact will ultimately contribute to the appreciation of the available record from the NE Mediterranean islands (Chapters 4 and 5) and allow for a discussion on the technical, cognitive and social capacities of the pre-modern human species that occupied this part of the world during the Pleistocene, a subject which I will return to in Chapter 6.

2.3.1. Archaeological evidence for sea-crossings

Both *direct* and *indirect* types of evidence are available when it comes to prehistoric marine navigation. Direct evidence consists of all archaeological findings that are clearly associated with seafaring, such as wrecks, boat remains, paddles, etc. The second category comprises all of the other evidence that only indirectly indicates the construction and use of seagoing vessels. This may include models of boats as well as iconographic evidence, such as engravings with depictions of boats. Artistic depictions of aquatic animals certainly imply a degree of familiarity with the aquatic environments and perhaps also seafaring activities. Such depictions are often found in a number of Upper Palaeolithic European sites (e.g. Cleyet-Merle and Madelaine, 1995; Clottes and Courtin, 1995). According to isotopic studies, which are able to trace types of food regularly consumed, fish was part of the diet of Upper Palaeolithic *Homo sapiens*, but not of the Neanderthals (Bocherens, 2011; Richards and Trinkaus, 2009). Yet, isotopic analysis particularly on coastal Neanderthal bones has yet to be performed (Stringer et al., 2008) and the presence of marine (even pelagic) fish remains in a number of Pleistocene sites across the Mediterranean should not be disregarded. The exploitation of freshwater fish dates back to the earliest hominin occupation of Olduvai Gorge, ca. 1.9mya to 800k BP (Broadhurst et al., 1998; Erlandson, 2010; Stewart, 1994). The oldest barbed bone harpoon found worldwide dates to c. 80ka and comes from the MSA sites of Katanda, Zaire (Brooks et al., 1995; Yellen, 1998, 1995), whereas systematic exploitation of shell middens is testified in Indonesia at least since ca. 31ka (Glover, 1981; see also 2.4.3.5). Due to taphonomic issues and context-less assemblages, the comprehension of the exact role that aquatic resources played in early hominin societies is complicated. However, the existence of marine faunal remains and fishing equipment in prehistoric settlements may, in some cases, imply the use of boats for inshore or offshore fishing. Other types of indirect evidence include structures, artefacts, materials or even animal species (domesticates and small non-avian terrestrial mammals that are unable to swim), whose mere presence on islands can only be explained by hominin sea-crossings.

2.3.1.1. The Mediterranean

2.3.1.1.1. Direct Evidence

The Mediterranean Sea, an almost completely enclosed sea, covers c. 2.5million km^2 and is separated from the Atlantic Ocean by the 14km narrow Strait of Gibraltar in southern Iberia, formulated during the early Pliocene. With an average depth of 1.5km, its deepest point, 'Calypso Deep' is situated in the Ionian Sea and measures c. 5.3km. The eastern part of the Mediterranean Basin is characterised by greater evaporation and salinity levels.

Since direct evidence of boats dated to the Pleistocene is completely absent from the entire Mediterranean region, the oldest boat remains in the Mediterranean come from lacustrine environments and belong to the Neolithic (Chourmouziadis, 1996; Fugazzola Delpino and Mineo, 1995; Marangou, 2003), while no shipwreck recovered from the Aegean basin predates the Bronze Age. A wooden vessel from Italy was recovered from the submerged Neolithic settlement of 'La Marmota' at lake Bracciano, situated NW of Rome (Fugazzola Delpino and Mineo, 1995). It is a 10.5m long x 1.08m wide extended logboat made of an oak tree trunk radiocarbon dated to 6,565±64 BP (Figure 11).[13] It has been argued that during the occupation of the site, the lake would have been connected to the sea, some

[13] More logboats were found in the lake, dated to later periods.

30km away, thus the vessel could have also been used for seafaring. Experimental voyages following the discovery have proved the seaworthiness of such a vessel in certain parts of the Mediterranean Sea (See 2.3.2.2.2).

Figure 11: The logboat found underwater at 'La Marmota', a Neolithic site in Lake Bracciano, Italy. Copyright: Museo Nazionale Preistorico Etnografico "Luigi Pigorini".

In Greece, the Neolithic lakeside settlement of Dispilio at Kastoria, northern Greece, yielded two outlines of logboats ('monoxyla') and an outline of a wider vessel (either a dugout or a hide boat) belonging to the end of the Neolithic, ca. 7ka BP, (Figure 12). Yet indirect evidence in the form of boat models comes from the site's older layers radiocarbon-dated to 7,760-7,860 cal BP and correspond with the transition between the Middle to Late Neolithic (Marangou, 2003).

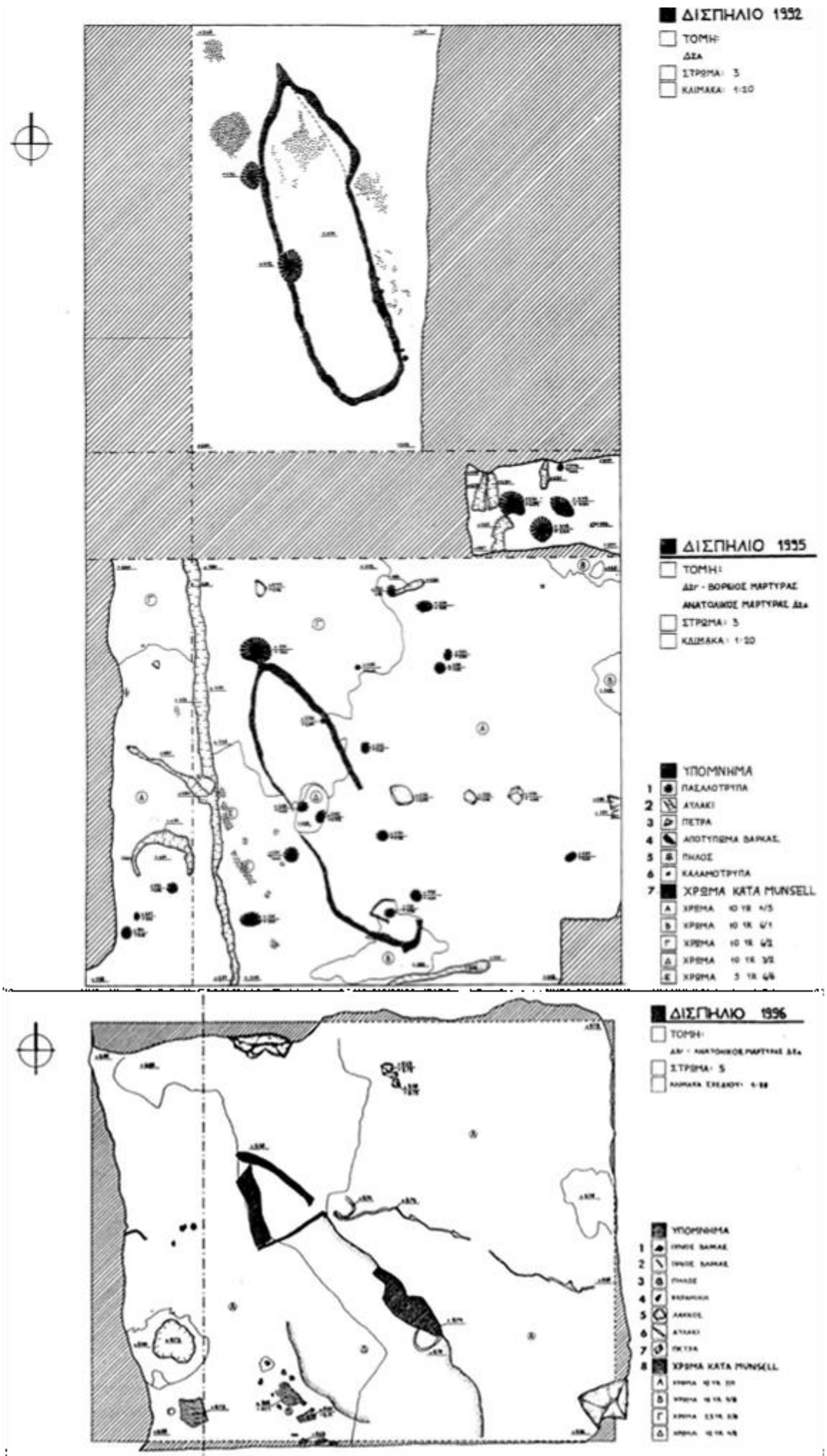


Figure 12: Drawings of the three boat outlines from Dispilio, Kastoria, NW Greece (Marangou 2003, fig. 1-2).

2.3.1.1.2. Indirect Evidence

Obsidian procurement networks

Obsidian characterisation studies have since the 1960s (e.g. Renfrew et al., 1965) provided a great tool in archaeological interpretations of global significance (Carter, 2014; Moutsiou, 2011). Obsidian raw material sources in the Aegean Basin are restricted to the islands of Milos, Antiparos and Yali, and thus direct or indirect marine transportation from these islands to the sites of discovery is irrefutable. Franchthi Cave, today situated on the coast of the Argolid, has yielded the oldest evidence of obsidian transportation in the Aegean and the Mediterranean islands in general (Figure 13). Its late Upper Palaeolithic and Mesolithic levels include a small number of artefacts made of obsidian from Milos, dated as back as c. 14ka BP (Laskaris et al., 2011; Perlès, 1999, 1979; Renfrew and Aspinall, 1990). More evidence of Pleistocene obsidian transportation comes from the slightly younger late Upper Palaeolithic layers of Anonymous Cave at Schisto, Attica and from insular Mesolithic sites of the Aegean Sea, i.e. the open-air sites of Maroulas on Kythnos (Cyclades) and Kerame 1 on Ikaria (SE Aegean Sea) as well as the Cave of Cyclopes on Youra (Northern Sporades).

Figure 13: Franchthi Cave, Argolis (photo: C. Papoulia, August 2015).

Marine resources

A number of Upper Palaeolithic sites in the north Mediterranean coasts and inland cave sites in France and Spain have provided faunal remains of marine mammals, fish and birds (Burov, 1995; Cleyet-Merle, 1990; Cleyet-Merle and Madelaine, 1995; D'Errico, 1994). Although some may be caught in estuaries and rivers (e.g. seals) or even on the seashore (e.g. tuna may approach the shores during breading periods), particular species such as the great auk had to be caught in the sea. Depictions of auks are known from Cosquer Cave situated underwater at the Mediterranean coasts of France (Figure 14).

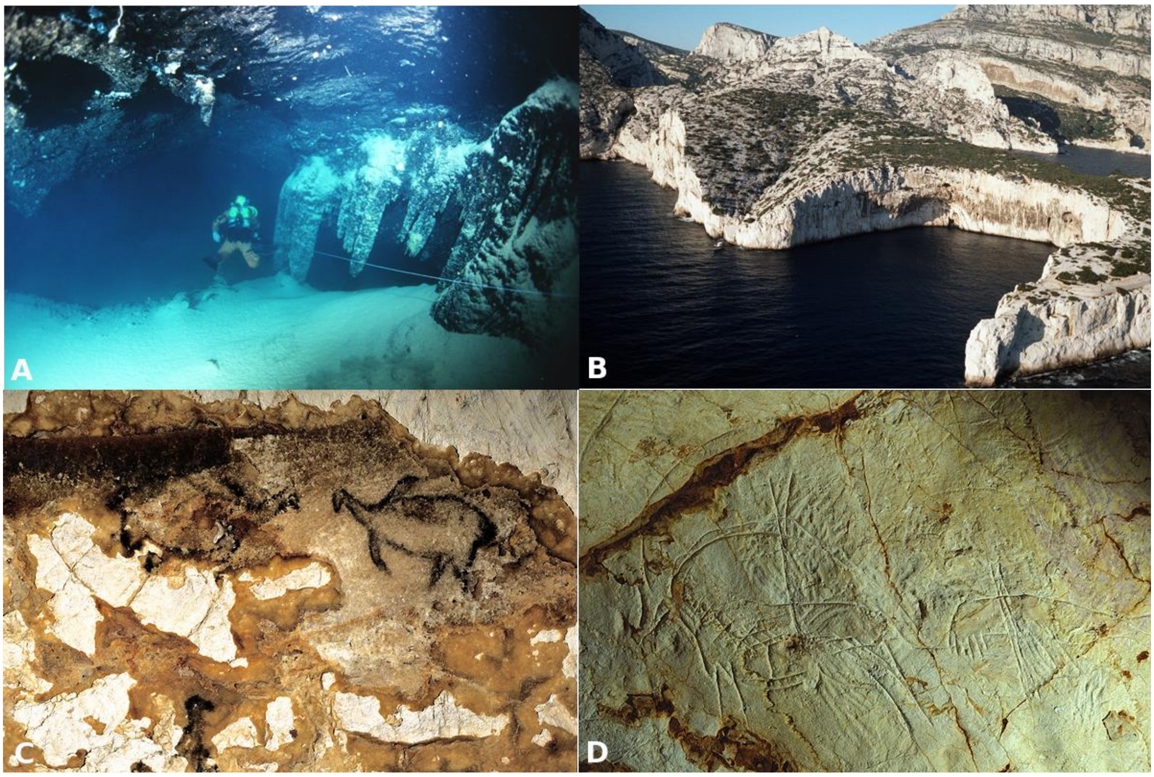


Figure 14: Photographs from the submerged cave of Cosquer, situated at the Mediterranean coasts of France (A-B). Its rich parietal art consists of paintings and engravings of animals, anthropomorphic figures (D) and hand stencils. Among the animal species there are also marine species such as seals, auks (C) and fish. Photos by Luc Vanrell (A-C) and Jean Clottes (D) (http://www.bradshawfoundation.com/cosquer/).

The submerged cave of Cosquer, found in the early 1990s by a diver who gave his name to the cave, is famous because of its rich parietal art. A total of 177, mostly engraved but also painted, animal figures belong to 11 different species including both terrestrial (n=138) and marine (n=16) animals (Clottes and Courtin, 1996, 1995). Terrestrial mammals include horses (n=63), bisons and aurochs (n=24), ibex, red deer (stags and does; n=28), chamois (n=4), megaloceros deer (n=2), saiga antelope (n=1), and felines (n=1), and marine species include seals (n=9), fish (n=4) and auks (n=3). To this may be added an anthropomorphic figure with a seal's head. Other types of parietal art include 44 black hand stencils and

21 red hand stencils, 216 geometric signs, 20 indeterminate animal figures, 3 hybrids and 7 others (like traces, holes in the walls, etc). The occupation of the cave seems to have begun in the Gravettian (25-20ka BP) with particular animal figures produced before the hand stencils at about 26-28ka BP. Although hand stencils and terrestrial mammals are commonly found in the European Palaeolithic parietal art, seals are rare (Serangeli, 2001). Other known examples come from the caves of La Pileta (Dams, 1978) and Nerja in Andalusia, Spain (Aura et al., 1998; Clottes and Courtin, 1996). Nerja cave, in particular, is one of the very few caves that yielded both parietal art and bone remains of seals (Figure 15). Bosinski (1981) suggested that seals are also depicted in engravings from the Magdalenean site of Gönnersdorf, Germany, where a large number of ornaments made of seashells was also found (Strauch and Tembrock, 1978). The bone remains and artistic representations of the great auk, however, are delimited in just a few coastal sites, in the central Mediterranean and the Iberian coasts (Figure 16).

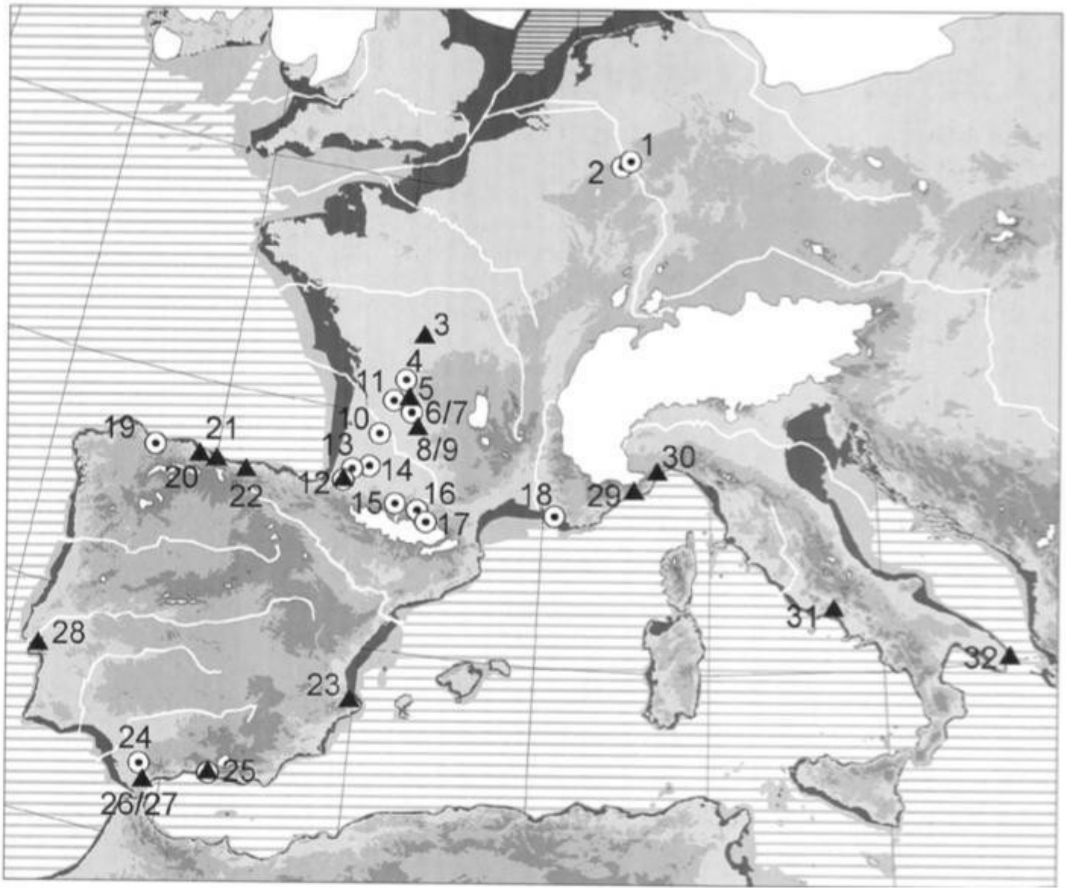


Figure 15: Sites with osteological remains (triangle) and parietal art representations (circle) of seals. 1: Gönnersdorf, 2: Andernach, 3: La Marcher, 4: Mège, 5: Raymonden, 6: La Madeleine, 7: Lachaud, 8: Castanet, 9: Lartet, 10: Le Morin, 11: Montgaudier, 12: Isturitz, 13: Duruthy, 14: Brassempouy, 15: Gourdan, 16: Enlène, 17: La Vache, 18: Cosquer, 19: Pena del Candamo, 20: Tito Bustillo, 21: La Riera, 22: Altamira, 23: Les Cendres, 24: La Pileta, 25: Nerja, 26: Gorham's Cave, 27: Devil's Tower, 28: Figuiera Brava, 29: Grimaldi, 30: Arene Candide, 31: Grotta di S. Agostino, 32: Romanelli (Serangeli 2001, fig. 1).

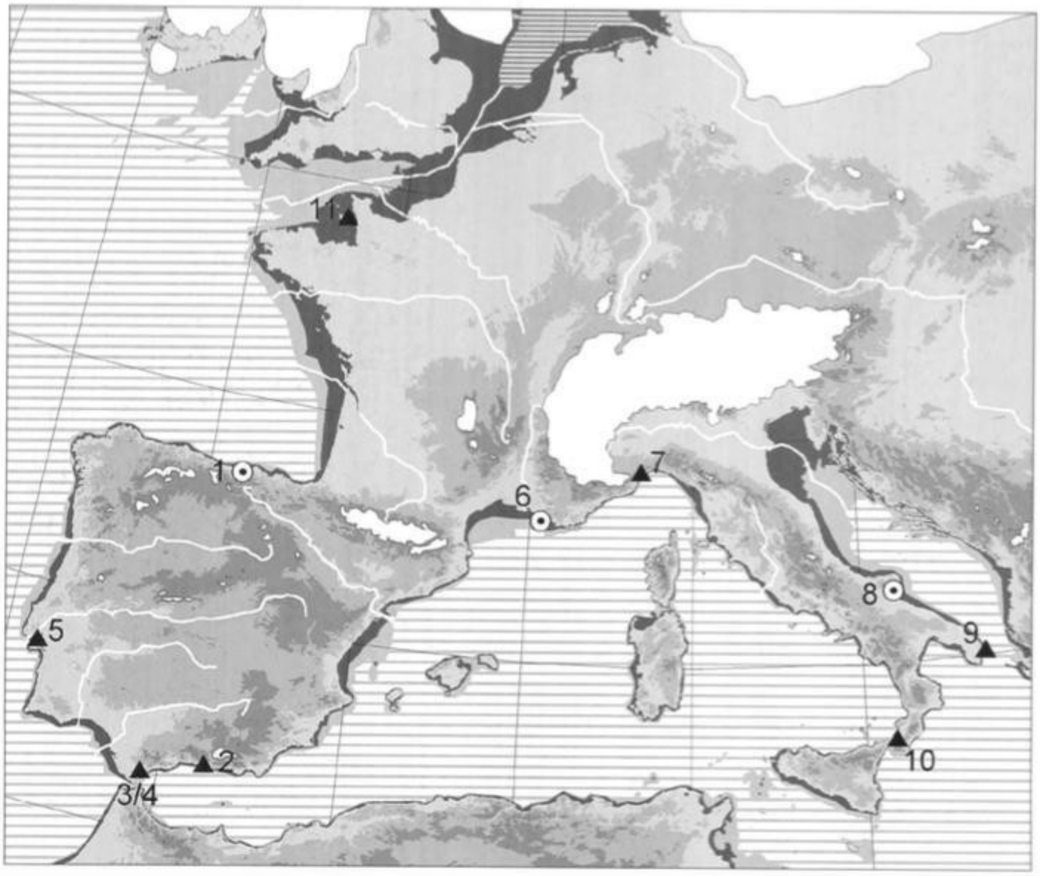


Figure 16: Sites with osteological remains (triangle) and parietal art representations (circle) of great auks. 1: El Pendo, 2: Nerja, 3: Gorham's Cave, 4: Devil's Tower, 5: Figueira Brava, 6: Cosquer, 7: Arene Candide, 8: Paglicci, 9: Romanelli, 10: Archi, 11: Cotte de St. Brelade (Serangeli 2001, fig. 3).

The number of seal bones collected from the Middle Palaeolithic layers of Vanguard and Gorham's caves, Gibraltar (Stringer et al., 2008) and Sant' Agostino, Italy (Stiner, 1994) may be a few, yet the cut marks on some of the bones point to hominin exploitation. According to Stringer et al. (2008, p. 14323) "the coastal exploitation of resources by Neanderthals was not a sporadic and isolated occurrence but one that required a knowledge of the life history of prey and its seasonality".

Ornaments made of seashells collected from the Mediterranean and Atlantic coasts are commonly found in coastal and inland Magdalenian (15-10ka BP) sites in Europe, while even earlier evidence for the use of marine resources as ornaments or tools (e.g. scrapers) can be traced in the Middle Palaeolithic coastal sites of Gibraltar (Cortés-Sánchez et al., 2011), in Mousterian and Uluzzian sites in Italy (Borzatti von Lowenstern, 1971, 1966; Campetti, 1986; Dantoni, 1980; Palma di Censola, 1989, 1967, 1965; Vicino, 1974; VItagliano, 1984) and in a Middle Palaeolithic coastal site in Greece (Darlas, 2007; Darlas and de Lumley, 1995) (Figure 17-Figure 18).

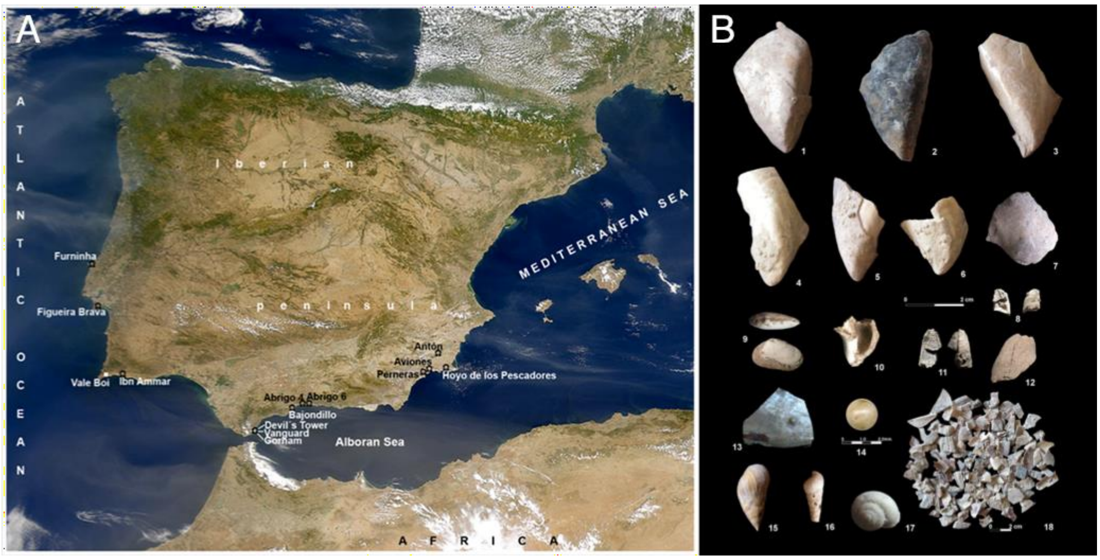


Figure 17: Map (A) of Middle Palaeolithic sites in the southern Iberian peninsula with marine mollusks and barnacles (B). Modified after Cortés-Sánchez et al. 2011, fig.1, 4.

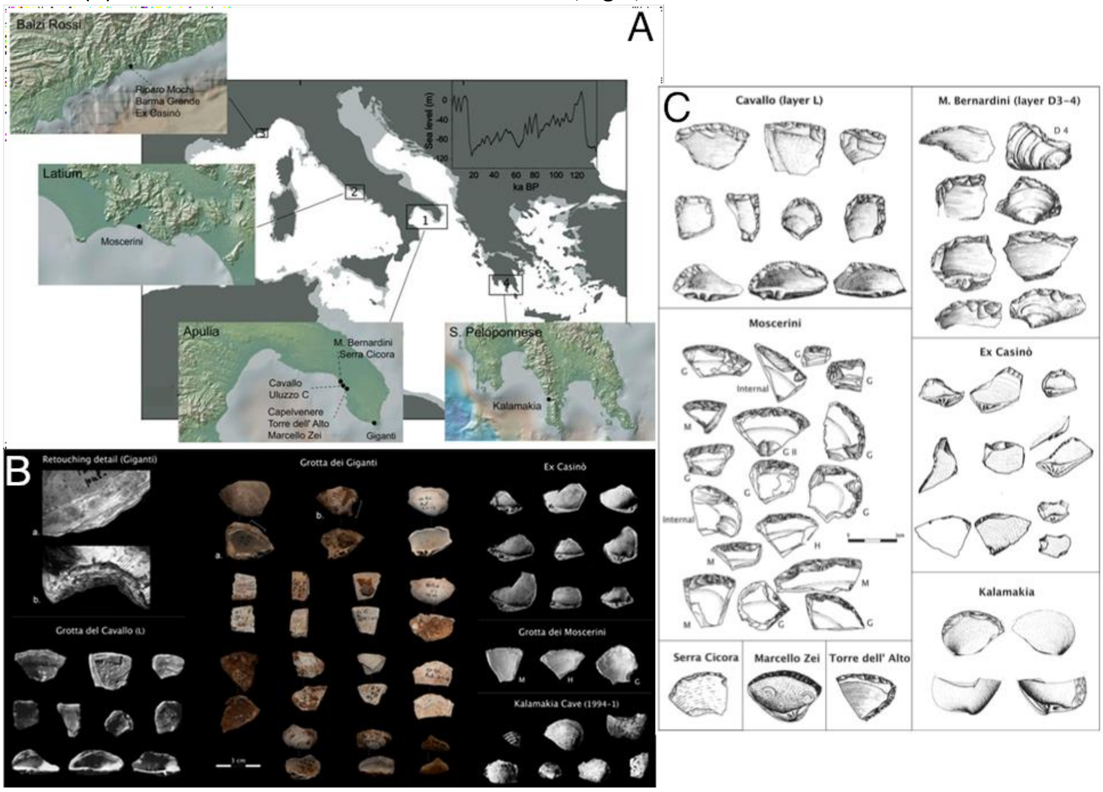


Figure 18: Mousterian sites in Italy and Greece producing evidence of scrapers made of Callista chione shells. Map of the sites (A), photographs (B) and drawings (C) of the artefacts. Sea level reconstruction is based on the -100m isobath. Modified after Douka & Spinapolice 2012, fig. 1, 4-5.

Marine mollusc exploitation in the Mediterranean dates back to at least the Last Interglacial (130-115ka BP), and it might have even started in the Lower Palaeolithic, at about 300ka BP, if the marine molluscs found at Terra Amata (Villa, 1983) and Lazaret (de Lumley et al., 2004) were indeed anthropogenic imports for consumption (Colonese et al., 2011). Marine molluscs, either as food or as raw material, have been found in about 20 Middle Palaeolithic sites associated with the Neanderthals in the Iberian peninsula (Bicho and Haws, 2008; Bicho, 2004; Zilhão et al., 2010), with the oldest find dated to 160ka BP from Bajondillo cave, Spain (Colonese et al., 2011). Finds of comparable age (135-35ka) are also associated with early *Homo sapiens* in Es-Skhūl, Israel, Oued Djebbana, Algeria and Taforalt, Morocco (Bouzouggar et al., 2007; Vanhaeren et al., 2006).

Yet although the consumption of marine molluscs and the production of seashell ornaments may, among other things, imply adaptability and a good familiarisation with marine resources (Douka and Spinapolice, 2012) they can only very tentatively act as evidence for seagoing. To this end, it is important to note that the recovery bias from areas characterized by wide continental shelves (such as the North Adriatic or the Aegean Basin), may provide a diminished picture of the actual significance of marine molluscs due to the geology and climatic history of the particular regions (Bailey and Flemming, 2008; Colonese et al., 2011). As for deep-sea fishing, the mere presence of pelagic fish bones does not imply that such an activity took place (Anderson, 2013). Archaeological indications of deep-sea fishing are scarce and, in Spain for instance, appear towards the terminal Upper Palaeolithic (Late Glacial – Upper/Final Magdalenian, ca. 14-10.5ka) (Morales et al., 1998). An osseous harpoon from Taforalt cave, Marocco, associated with the Iberomaurusian cultural phase and dated to ca. 11ka BP, has raised arguments in terms of cultural connections between NW Africa and Iberia through the crossing of the Gibraltar Strait (Straus, 2001). These are based on morphological associations and on the absence of similar artefacts in areas that would connote a terrestrial dispersal (e.g. NE Africa etc.).

2.3.1.2. The Baltic and the North Sea

2.3.1.2.1. Direct Evidence

The Baltic Sea is the largest brackish water sea worldwide. It is characterized by low salinity levels (on average 0.6% as opposed to c. 3% in the oceans). The incoming water from the Atlantic Ocean with its higher salinity levels is heavier, usually staying at least below 40m depth, while the lighter brackish water remains on the upper layers. The mixture of seawater and freshwater and the low salinity levels aids the preservation of organic materials such as the wooden vessels. This factor, together with the land uplift of the region, is the key reason why a number of early Holocene (Mesolithic and Neolithic) boats are often found in the western Baltic region. They are made from hollowed out large tree trunks, can be up to 10m long and may have been used for small sea-crossings, fishing and sealing. The wood trunks most often used are of soft trees, such as alder or lime, which are lighter, can be more easily worked and have a less tendency to split compared to other wood species (e.g. Christensen, 1997; Klooss and Lübke, 2009; Lübke, 2005).

The oldest dugout ever found was discovered in 1955 at Pesse, Netherlands (Van Zeist, 1957) and has been radiocarbon dated to 8760±145BP (Figure 19B).[14] It is made of a pine trunk and measures a bit less than 3m (Niekus et al., 1997). It has been argued that knapped stone axes found at Landeland, vicinity of Groningen (e.g. Figure 19A), were already being utilised when the Pesse canoe was constructed. Their dates (8750±50BP, 8770±50BP and 8800±50BP) indicate that they are synchronous to the particular canoe and could have potentially been part of the dugout construction tool-kits (Beuker and Niekus, 1997; Niekus et al., 1997).

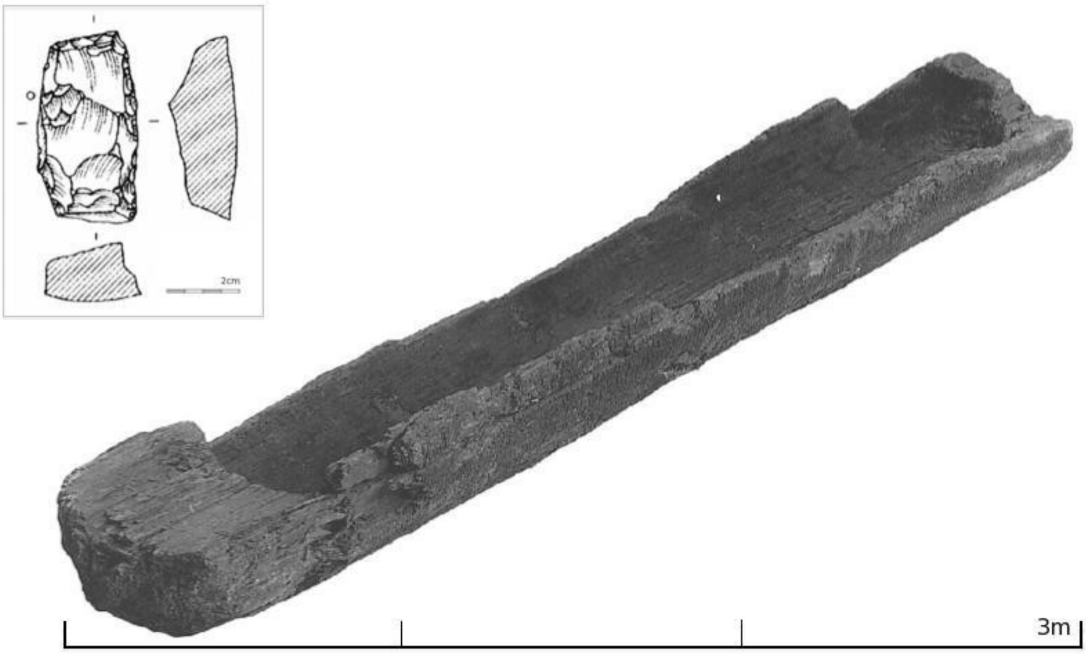


Figure 19: An axe from a Mesolithic site in Lageland, dated to 8750±50BP (A) and the dugout from Pesse, radiocarbon dated to 8760±145 BP (B). Both are situated near Groningen, Netherlands. Modified after Beuker and Niekus 1997, fig. 1-2 and Niekus, de Roever and Smit 1997, fig. 2.

A number of logboats belonging to the Mesolithic Ertebølle culture have been unearthed from coastal and submerged sites in Denmark. The oldest logboat is Lystrup II, from Aarhus (Table 2; Figure 20). Slightly younger are the dugout canoes excavated at the submerged settlement of Tybrind Vig, c. 200m off the west coast of the island of Fyn, at a depth of

[14] This is the weighted average of the two dates 8270±275BP (GrN-486) and 8825±100BP (GrN-6257) coming from the same piece of wood(Lanting and Van Der Plicht, 1997/1998, p. 154).

approximately 2-3m (Andersen, 2011, 1987, 1985). The better preserved one, Tybrind I, measures c. 10m in length and 50-65cm in width (Figure 20). Its sides are c. 30cm high and the hull's thickness ranged between 2-3cm. Its carrying capacity has been estimated to about 6-8 individuals plus 500-600kg of cargo (Andersen, 2011, 1987). All Tybrind Vig dugouts were made of long, strait lime trunks (*Tilia* sp.) and shaped with the use of flint or greenstone adzes, as the oblique chopping and splitting marks imply; yet there is no indication of fire use during the production process (Andersen, 2011). A series of eight depressions were identified on the stern, thus, although not preserved, a bulkhead was probably attached to the vessel (Figure 21A). An oval hearth made from a mixture of clay and sand (Figure 21B) is often preserved on the vessels from several Ertebølle sites.

Table 2: Water vessels from Denmark from the Late Mesolithic Ertebølle cultural levels. After Christensen 1997, Table 1.

Name and geographical location	Laboratory number	C14 years before 1950	Calibrated, ± 1 standard deviation
Lystrup II, Århus	K-6012	6550 ± 105	5570–5340 BC
Margrethes Næs I, Halsskov	K-5599	6530 ± 105	5570–5330 BC
Korshavn/Mejlø N, Hindsholm	K-5040	6260 ± 95	5280–5070 BC
Margrethes Næs II, Halsskov	K-5597	6140 ± 105	5220–4930 BC
Yderhede, Frederikshavn	AAR-2463	6210 ± 65	5240–5060 BC
Lystrup I, Århus	K-5730	6110 ± 100	5210–4910 BC
Margrethes Næs III, Halsskov	K-5596	6070 ± 105	5200–4840 BC
Horsekær II, Halsskov	K-5314	6040 ± 100	5040–4840 BC
Horsekær I, Halsskov	K-5313	6020 ± 100	5050–4790 BC
Møllegabet/Dejrø, Ærø	K-5640	5910 ± 75	4900–4720 BC
Maglemosegårds Vænge I, Vedbæk	K-2722	5720 ± 75	4680–4470 BC
Maglemosegårds Vænge II, Vedbæk	K-4336	5420 ± 90	4350–4150 BC
Tybrind Vig II, Middelfart	K-4149	5370 ± 95	4340–4040 BC
Tybrind Vig I, Middelfart	K-3557	5260 ± 95	4230–3970 BC
Horsekær III, Halsskov			
Vig, Halsskov			
Lindholm I, Nyborg			
Maglemosegårds Vænge Nord, Vedbæk			
Agernæs, Nordfyn			
Flynderhage, Norsminde			
Præstelyngen, St. Åmose			

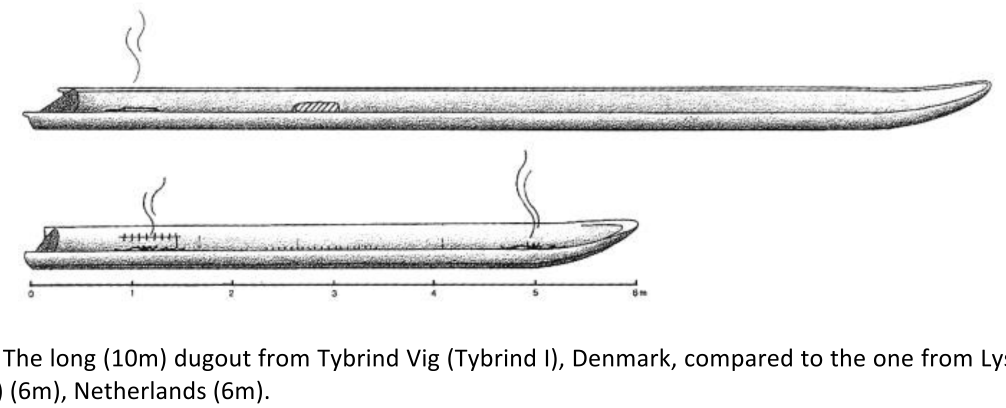


Figure 20: The long (10m) dugout from Tybrind Vig (Tybrind I), Denmark, compared to the one from Lystrup (Lystrup II) (6m), Netherlands (6m).

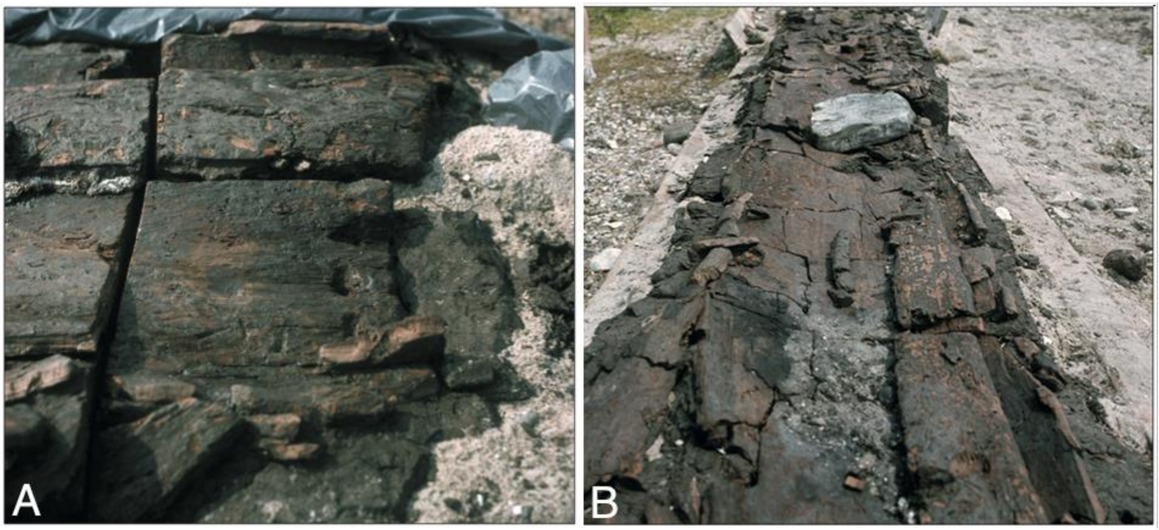


Figure 21: Depressions on the stern (A) and traces of a hearth (B) on Tybrind I logboat, Tybrind Vig, Denmark (Andersen 2011, fig.1.13).

Phase I of Hardinxveld-De Bruin, Netherlands, has yielded a complete dugout and several fragments dated to 5500-5300 cal. BC which in the Low Countries corresponds with the end of the Mesolithic (Louwe Kooijmans et al., 2001, fig. 455ff). This one is made of a lime trunk and measures 5.55m in length and 50cm in width (Figure 22A). It has two rectangular bows and a very regular wall thickness of 2cm. Traces of burning inside, yet out of the central axis, have been interpreted as a result of its construction procedure (Louwe Kooijmans and Verhart, 2007). Due to differences in shape and construction from the typical Danish logboats, the Hardinxveld vessel has been interpreted as of having certain southern cultural affinities, also reflected in the use of particular raw material sources (Arnold, 1995-1996; Louwe Kooijmans et al., 2001; Louwe Kooijmans and Verhart, 2007). Due to the presence of heavy blocks of a particular type of exotic flint, as well as quartz and quartzite blocks, the use of other types of vessels such as bark canoes and rafts (as well as sledges) has been regarded as possible (Louwe Kooijmans and Verhart, 2007), yet has not been confirmed by the archaeological record.

Figure 22: Dugout canoes from Hardinxveld-De Bruin (A) and Lystrup (B), Netherlands. Modified after Louwe Kooijmans & Verhart 2007, fig. 4.

Broken canoes have also been found as evidence of secondary uses. At Bergschenhoek (6,700 cal BP), a dugout made of alder was found broken in boards (Louwe Kooijmans, 1987). Nine of the larger boars (max dimensions: 150x20x4cm) and a few small ones were used together with small tree trunks, reed bundles and remains of a fish trap in order to stabilize the campsite on the soft peaty subsoil (Louwe Kooijmans and Verhart, 2007). Both in Denmark and in the Netherlands, the wood preference during the Mesolithic and the early Neolithic phases included softwood types such as lime, alder and poplar, while oak trees were mainly used in later phases of the Neolithic.

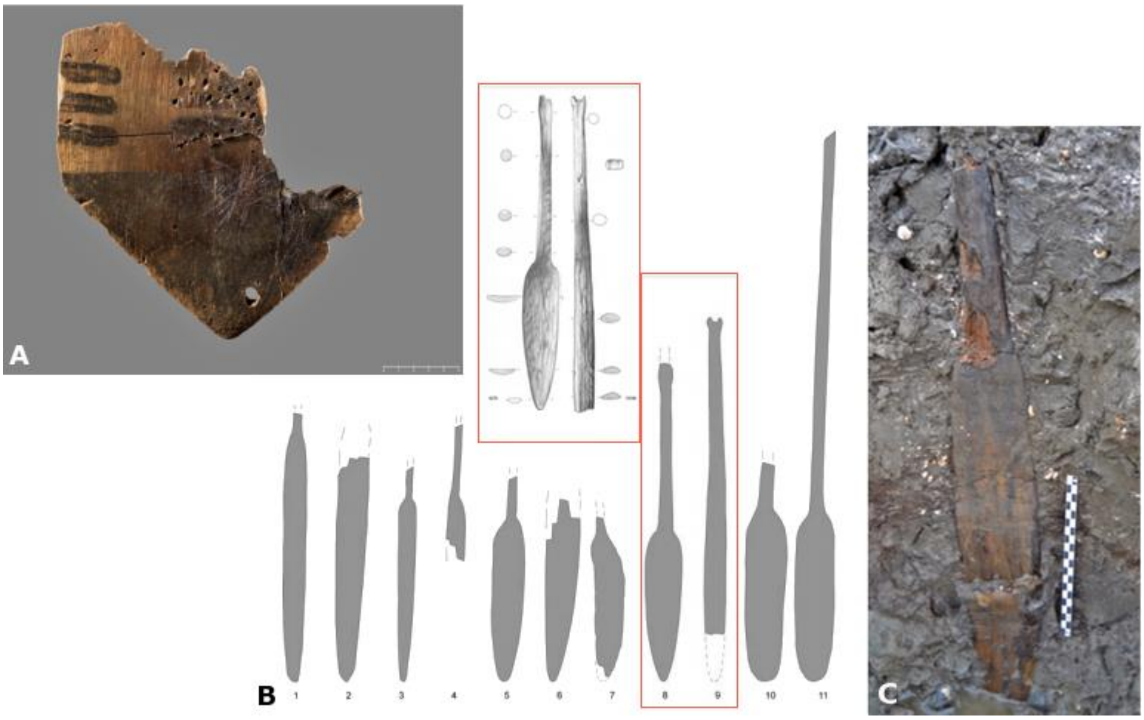


Figure 23: Paddles from NW Europe. A: Wooden paddle fragment found underwater off the island of Hjarnø, Horsens Bay, Denmark. B: Types of paddles found at a number of Mesolithic and Neolithic sites in the Netherlands, C: Paddle fragment as found in situ at a Mesolithic site in Denmark. Modified after Bailey & Sakellariou 2012, fig. 2; Louwe Kooijmans and Verhart 2007, figs. 5-6.

The variation in the shapes of paddles found in NW Europe and the motifs often depicted on them may demonstrate chronological and cultural differentiations (Figure 23). Visual signalling of individual and/or collective identity must have been one of the triggering reasons for the production of the elaborate ornamentation of the paddles at Tybrind Vig, for instance (Figure 24), some of which have been interpreted as potentially resembling human faces or masks (Andersen, 2011; Nash, 1998).

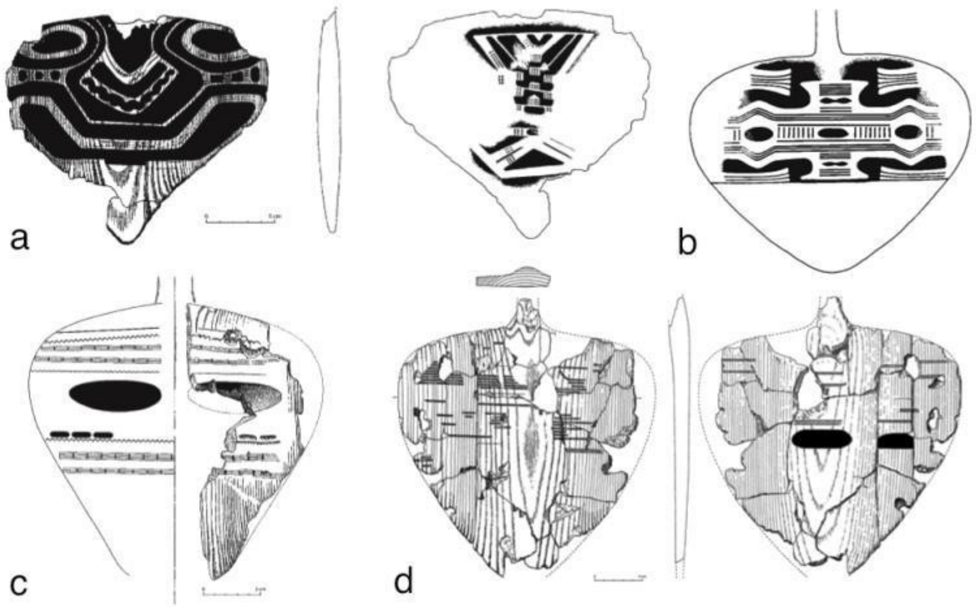


Figure 24: Ornamented paddles from the Late Mesolithic site of Tybrind Vig, Denmark (Andersen 2011, figs. 1.5-1.8).

2.3.1.2.2. Indirect Evidence

Apart from the dugout canoes, for which we have direct archaeological evidence, hide-covered vessels, although not yet found, were most probably used since the Late Palaeolithic, as the engraving on a reindeer antler from Husumer Hafenschleuse (Germany) indicates (Fischer, 1996). Rock paintings and petroglyphs of boats come from a number of sites in Scandinavia (Fischer, 1996; Gjessing, 1932; Hesjedal, 1993; Stölting, 1997). All post-date the Younger Dryas and are widely distributed from the coasts of the NW European plain to the northern extremes of Norway. Such examples of Mesolithic petroglyphs portraying water vessels come from Slettnes, a coastal site in NW Norway (Hesjedal, 1993). These were found beneath marine gravel whose deposition has been dated to c. 6ka BP. Apart from the vessels, they also depict a number of marine and terrestrial animals, footprints and a human figure (Figure 25).

In contrast to the Mediterranean, the melting of the ice sheets resulted in the rise of the land surface in the north. According to Fischer (1996), the coastal settlements of the Ahrensburgians, an Upper Palaeolithic culture of the Late Glacial (c. 13-12.5ka BP) found mainly in the western coasts of Sweden and Norway, may not be an exception in the inland-focused settlement patterns of the period, but rather an exceptionally preserved example due to the favourable geological and taphonomic conditions of the region. More evidence may be missing due to the submergence of the seashores.

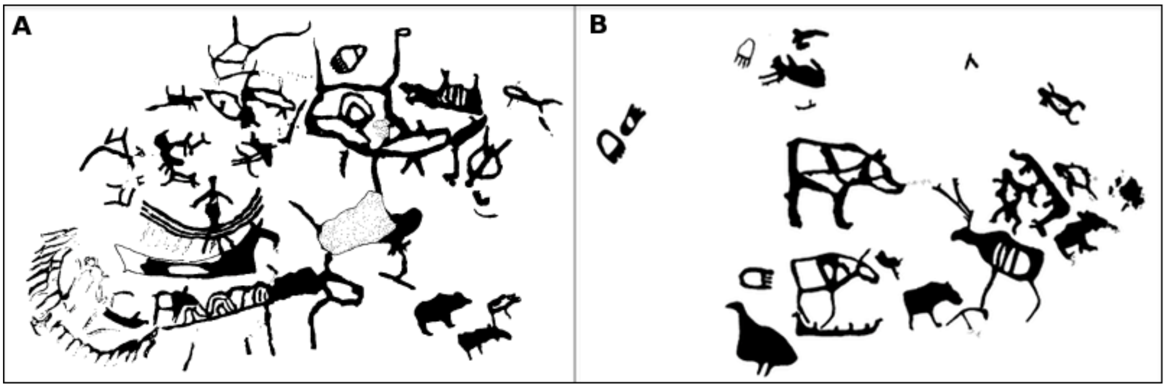


Figure 25: Mesolithic petroglyphs from Slettnes, Norway portraying, among others, four boats (A and B) and a human figure (A) (Stölting 1997, fig.2-3).

2.3.1.3. SE Asia – Oceania

This part focuses on the SE part of the world, in particular the islands of Indonesia, Melanesia and Australia (including Tasmania). During the Pleistocene, Sunda was separated from Sahul by the Wallacea archipelago (Figure 26). Sahul was a large landmass including Australia, New Guinea and Tasmania up until ca. 7ka and 14ka respectively when the islands became detached.

Figure 26: The Wallacea Archipelago, separating Sunda from Sahul. Sea level reconstruction at c. 22ka BP (Balter, 2007, fig. 2).

2.3.1.3.1. Flores, Indonesia

The oldest uncontested evidence for sea-crossings worldwide comes from the island of Flores, Indonesia. These crossings are associated with archaic hominins and have been interpreted as unintentional crossings, a result of the tsunamis often occurring in the region (Dennell et al., 2014). Although the area is tectonically active, the present consensus is that small straits of sea were throughout the Pleistocene separating the island from the Asian mainland (Gaubert and Antunes, 2005; Morwood et al., 1998; Sondaar et al., 1994). According to Morwood et al. (1998) three deep straits needed to be crossed in order to reach Flores, none of which exceeded 20km, with the Bali-Lombok strait (Wallace's line) being the largest one.

The evidence consists both of artefacts and palaeoanthropological remains. The only area with *Homo floresiensis* fossil remains is the Liang Bua cave system (Brown et al., 2004; Morwood et al., 2004). Although there have been arguments against the distinctiveness of the species from Flores, based on an interpretation according to which the fossils from Liang Bua represent *Homo sapiens* individuals with myxoedematous endemic (ME) cretinism (Obendorf et al., 2008), such arguments have been proved incorrect (Brown, 2012). A large number of lithic artefacts and faunal remains were also found at the site, including the faunal remains of *Stegodon*. The oldest dates from Liang Bua have been determined at ca. 95ka BP. The layer of black volcanic sandy silt and coarse silty sand on top of the archaeological horizon is associated with a massive volcanic eruption taking place at ca. 17ka BP and was probably the reason for the extinction of both *Stegodon* and *Homo floresiensis* (Brown et al., 2004; Brumm et al., 2010b, 2006, Morwood et al., 2005, 2004; Morwood and Jungers, 2009).

Early Pleistocene hominin presence on Flores was confirmed by the discovery of stone tools from Mata Menge, found *in situ* between tuff horizons and dated by zircon fission-track to between 0.88 ± 0.07Ma and 0.80 ± 0.07Ma (Morwood et al., 1998; O'Sullivan et al., 2001; Sondaar et al., 1994). Even older lithic material was recovered *in situ* from Wolo Sege, in the Soa Basin (Figure 27). A date of 1.02 ± 0.02Ma was produced using $^{40}Ar/^{39}Ar$ for the eruption of an ignimbrite overlying the lithic assemblages from the site (Brumm et al., 2010b).

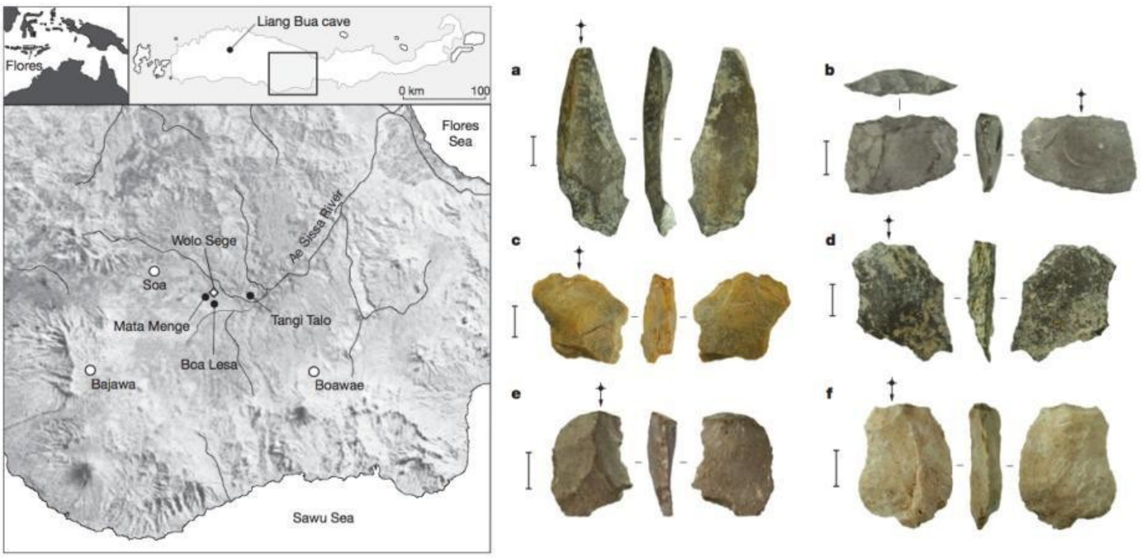


Figure 27: Location of the Soa Basin sites and Liang Bua cave site which yielded the Homo floresiensis fossils (left), and lithic artefacts from Wolo Sege (right), Flores (Brumm et al. 2010, fig. 1, 3).

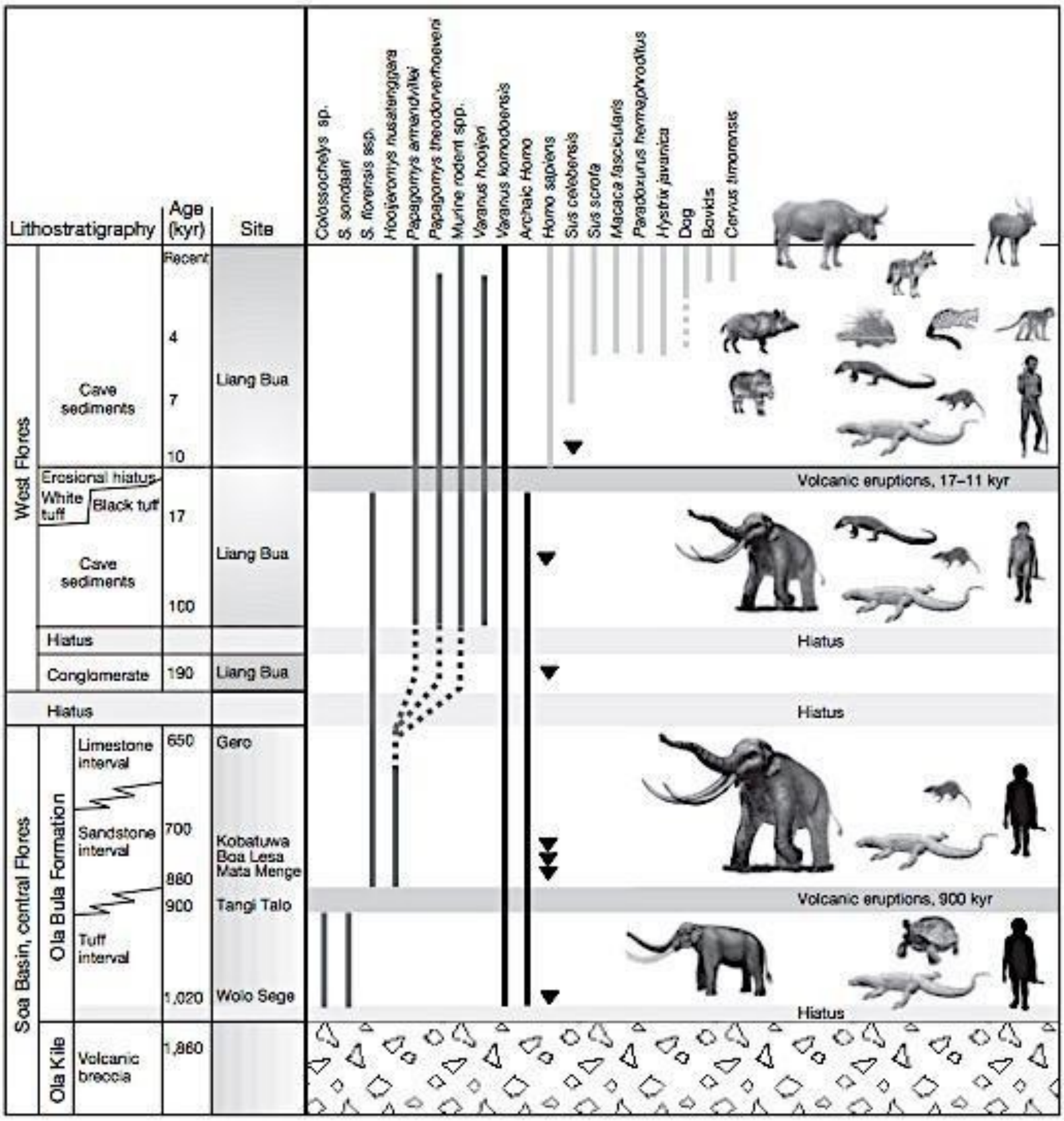


Figure 28: The faunal sequence on Flores Island (Brumm et al. 2010, fig. 4). The black triangles denote the presence of lithic artefacts, thus implying hominin presence.

According to Dennell et al. (2014, p. 105): “Flores is one of the last places where one would expect to find continuous occupation, given that it is volcanically highly active, and lies in a region frequently afflicted by earthquakes, tsunamis and cyclones”. However, the persistence of *Homo floresiensis* on the island for more than 1M years proves the opposite (Figure 28).

2.3.1.3.2. Sulawesi, Indonesia

Stone tools associated with Pleistocene fossil faunal remains have since the 1940s been recovered from the Walanae Basin, situated at the southern part of the island of Sulawesi (Celebes) (Bartstra et al., 1991; Van Heekeren, 1949). The so-called *Cabenge Industry* consists of cores, core-tools (choppers) and flakes (Van Heekeren, 1958, 1949), yet all artefacts, with the exception of some excavated fossils (Van Den Bergh, 1999), were surface finds lacking stratigraphic context. The oldest dated evidence of human presence on the islands during the Pleistocene was until recently the cave art from Maros, SW Sulawesi, discovered back in the 1950s (Figure 29) (Van Heekeren, 1952). The Uranium-series dating of the coralloid speleothems directly associated with 12 hand stencils and two animal figures from seven sites provided a minimum date of 39.9ka BP (Aubert et al., 2014). Such a date implies the presence of modern humans on the island at least 10ka years later than their presence in Australia. Yet, excavations at Talepu, NE of Maros, between 2007-2012, revealed *in situ* lithics associated with fossil megafauna remains (*Bubalus* sp., *Stegodon*, *Celebochoerus*) dated via a number of methods to between 100-200ka (van den Bergh et al., 2016).

Two trenches (T2 and T4) provided an 18.7m long stratigraphic section exposing five sedimentary units (A-E). T2 yielded 270 lithics and a bovid lower molar fragment from the high-energy fluvial gravel deposits of Unit A (Figure 30b; Figure 31t), while T4 yielded 41 lithics *in situ* in the exposed older strata, within the silt of Unit E2 from the topsoil and colluvium, and four artefacts made of silicified limestone (Figure 30c; Figure 31j-m). Below these, eight *Celebochoerus* dental fragments, a *Stegodon* milk molar and a dermal scute of a crocodile were also recovered (Figure 31) and dated via combined uranium-series indicating that the fossil samples are older than c. 200ka BP (van den Bergh et al., 2016, p. 209). Although a soil sample from T4 yielded a minimum age of c. 195ka BP, the oldest securely dated evidence for the construction of stone tools ranges between 118-194ka BP (van den Bergh et al., 2016, p. 210).

Based on the aforementioned evidence, the authors rightly hypothesise that it is plausible for modern humans to have dispersed out of Africa soon after their emergence, spread to Sunda and crossed over to Sulawesi by c. 120ka BP, especially since palaeoanthropological remains from the Levant and perhaps also from SE Asia have been dated to the same period (van den Bergh et al., 2016). Yet the late Middle Pleistocene dates of Talepu imply that hominins arrived at much earlier dates, as it is also the case with Flores. Three species of archaic hominins, i.e. *Homo floresiensis*, *Homo erectus* and the Denisovans, are possible candidates for the initial colonisation of Sulawesi. Borneo to the west and the Philippines to the north have been proposed as the possible points of origin due to the "predominantly southerly flowing currents of the Indonesian through-flow" (van den Bergh et al., 2016, p. 210).

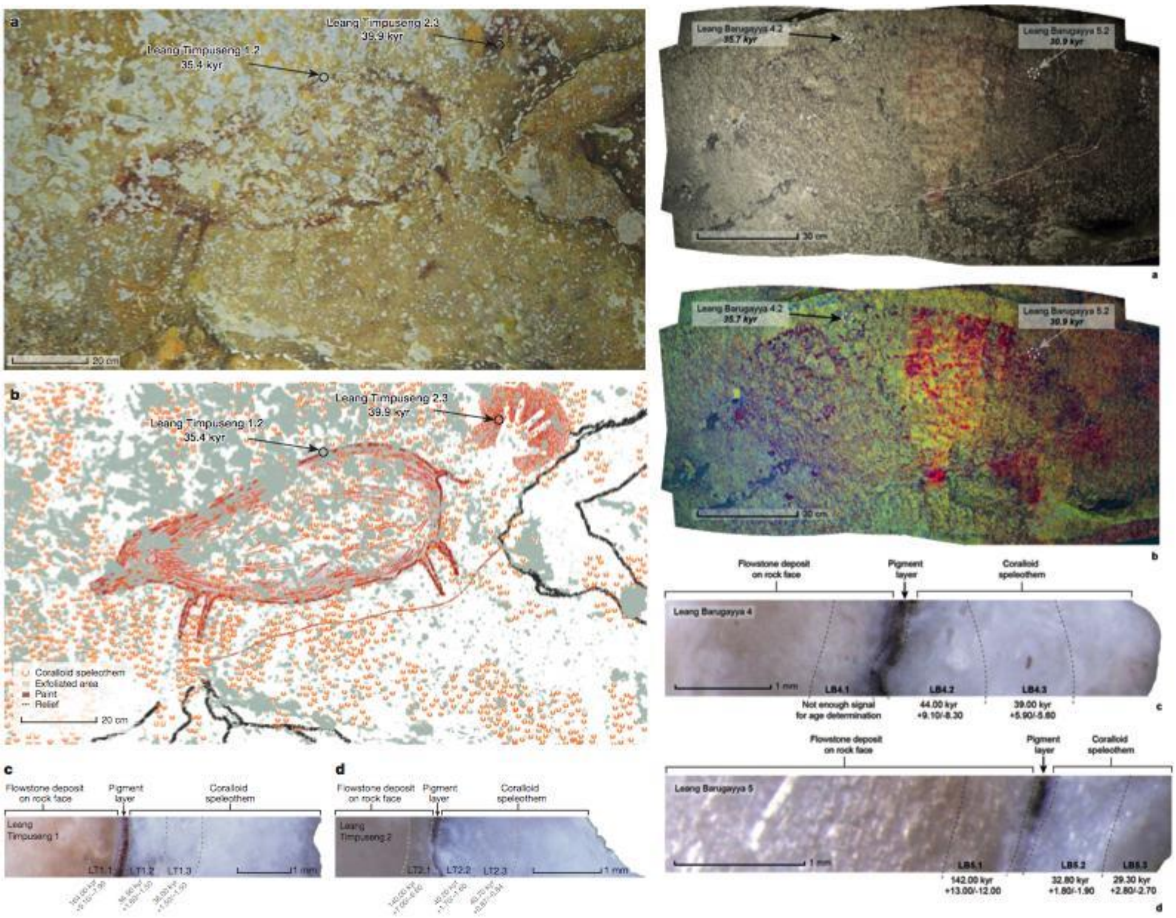


Figure 29: Dated rock paintings from Leand Timpuseng (left) and Leang Barugayya 2 (right). A hand stencil and a large naturalistic depiction of an animal figure interpreted as a female babirusa, shown in profile (left) and profile of a large land mammal, probably a pig (a babirusa or Sus celebensis), with the head facing right and the hindquarters at the left (right) (Aubert et al. 2014, fig. 2 and ED fig.6).

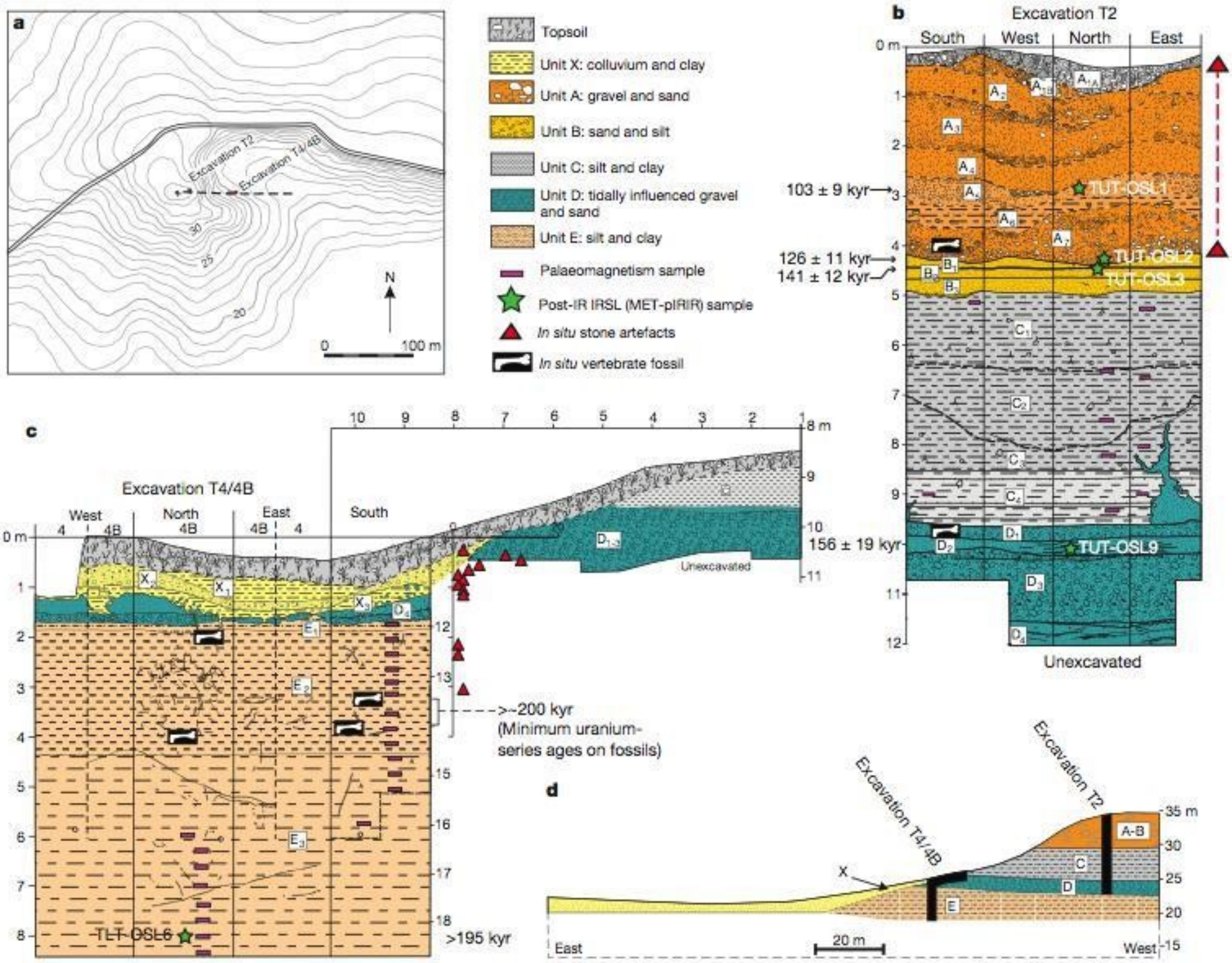


Figure 30: Talepu, Sulawesi Island, T2 and T4 excavation: Site map (a) with the profile (d) indicated in dotted line, stratigraphy, finds, sampling horizons and dates for T2 (b) and T4 (c). After van den Bergh et al. 2016, fig. 2.

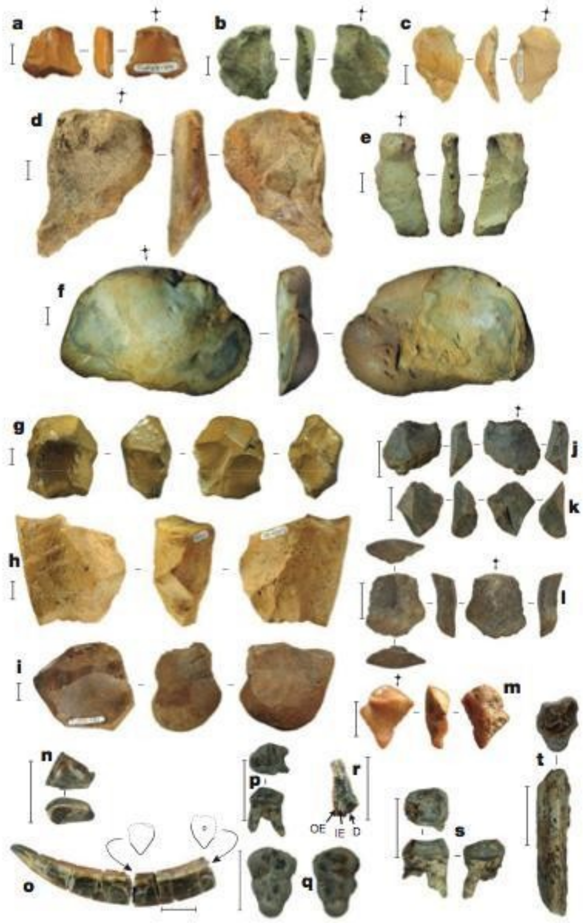


Figure 31: Finds from T2 (a-f, g-i, t) and T4 (j-s) excavations at Talepu. Lithic artefacts consist of flakes (a-f, j-m), core (h) and radial core (g). Fossils consist of a Celebochoerus sp. upper left incisor (n), a lower left canine (o), an upper right third premolar (p), an upper right and upper left third molar (q) and an upper left fourth premolar (s), a Stegodon molar ridge fragment (r) and a Bovidae, cf. Bubalus sp., lower left third molar fragment. After van den Bergh et al. 2016, fig. 3.

2.3.1.3.3. Timor, Indonesia

A total of 38,000 fish bones from 23 different taxa, including tuna and parrotfish that are usually found in deep waters, were collected from Jerimalai Cave, East Timor, and the oldest ones have been radiocarbon-dated to ca. 42-38ka BP (O'Connor et al., 2011). Although the quantity of fish bones is limited in the earliest occupational phase (I) of the site, at least 15 different taxa were identified, both inshore and pelagic species (Table 3) (O'Connor et al., 2011, p. 2). These finds led the authors to the conclusion that East Timor provides the oldest evidence for pelagic fishing.

Table 3**:** the MNI and NISP of the identified fish taxa from the 1x1m excavation, square B, Jerimalai, East Timor. After O'Connor et al., 2011, Table 3.

Cultural phase		I		II		III		IV		Total	
Age (cal yr B.P.)		42,000–38,000		17,000–9000		6500–5500		5500–modern			
	Genus/ species	MNI (NISP)	%	MNI (NISP)	%	MNI (NISP)	%	MNI (NISP)	%	MNI (NISP)	%
					Inshore fish						
Scaridae		10 (13)	18.9	12 (19)	13.5	44 (183)	13.6	47 (247)	14.2	113 (462)	14.2
Balistidae		0 (0)	0	10 (15)	11.2	53 (107)	16.4	45 (99)	13.6	108 (221)	13.6
Serranidae		4 (5)	7.5	9 (12)	10.1	39 (98)	12.0	46 (122)	13.9	98 (237)	12.3
Acanthuridae		4 (4)	7.5	1 (1)	1.1	20 (24)	6.2	49 (54)	14.8	74 (83)	9.3
Lethrinidae	*Lethrinus* sp.	1 (1)	1.9	3 (3)	3.4	17 (24)	5.2	17 (38)	5.2	38 (66)	4.8
	Monotaxis sp.	1 (1)	1.9	1 (1)	1.1	2 (2)	0.6	6 (6)	1.8	10 (10)	1.3
Lutjanidae		2 (3)	3.8	3 (3)	3.4	8(9)	2.5	11 (14)	3.3	24 (29)	3.0
Labridae		1 (1)	1.9	3 (3)	3.4	8 (19)	2.5	9 (12)	2.7	21 (35)	2.6
Muraenidae		1 (1)	1.9	1 (2)	1.1	5 (5)	1.5	5 (5)	1.5	12 (13)	1.5
Siganidae		0 (0)	0	0 (0)	0	0 (0)	0	7 (9)	2.1	7 (9)	0.9
Diodontidae		1 (1)	1.9	0 (0)	0	3 (3)	0.9	3 (3)	0.9	7 (7)	0.9
Tetradontidae		1 (1)	1.9	0 (0)	0	6 (9)	1.9	0 (0)	0	7 (10)	0.9
Platycephalidae		0 (0)	0	2 (2)	2.2	3 (3)	0.9	1 (1)	0.3	6 (6)	0.8
Lobotidae?		1 (1)	1.9	2 (2)	2.2	2 (2)	0.6	0 (0)	0	5 (5	0.6
Scorpanidae		0 (0)	0	0 (0)	0	2 (2)	0.6	0 (0)	0	2 (2)	0.3
Kyophosidae		0 (0)	0	1 (1)	1.1	0 (0)	0	0 (0)	0	1 (1)	0.1
Ostraciidae		0 (0)	0	0 (0)	0	1 (1)	0.3	0 (0)	0	1 (1)	0.1
Subtotal		27 (32)	51	48 (64)	54	213 (491)	66	246 (610)	76	534 (1197)	67
					Pelagic fish						
Scombridae		18 (62)	33.9	23 (181)	25.8	52 (716)	16.0	39 (299)	11.2	132 (1258)	16.6
Carangidae		4 (5)	7.5	16 (35)	17.9	56 (213)	17.2	42 (101)	12.1	118 (354)	14.8
Caracharhinidae		2 (2)	3.6	1 (1)	1.1	3 (3)	0.9	3 (3)	0.8	9 (9)	1.1
Sphyraenidae		1 (1)	1.8	1 (1)	1.1	0 (0)	0	0 (0)	0	2 (2)	0.3
Belonidae		1 (2)	1.8	0 (0)	0	0 (0)	0	0 (0)	0	1 (2)	0.1
Subtotal		26 (72)	49.0	41 (218)	46.0	111 (932)	34.0	84 (403)	24.0	262 (1625)	33
Total		53 (104)		89 (282)		324 (1423)		330 (1013)		796 (2822)	

Besides the marine faunal remains the excavators found a number of fishhooks made of *Trochus* marine shells, dated to the final part of the late Pleistocene and the Holocene occupation of the site (O'Connor et al., 2011). One of them is a broken piece of a fishhook, which has been dated between 16-23ka BP, thus it is the oldest example found worldwide (Figure 32). According to the authors this type of single-piece baited hook made of *Trochus* shell is inadequate for pelagic fishing. Bone points, on the other hand, appear in the subsequent phase (II) and increase dramatically during the Holocene occupation of the site (phases III and IV). Developed fishing skills and high dependence upon marine resources are implied by the limited range of vertebrates available (i.e. small quantities of murid rodents, bats, birds and reptiles) which seem to have been exploited in an opportunistic manner.

Figure 32: Photograph of a broken fishhook made of marine shell (*Trochus*) from Jerimalai, East Timor, dated between c. 16-23ka BP. After O 'Connell et al. 2011: Fig. 3.

2.3.1.3.4. Luzon, Philippine islands

Stone tools and mega-faunal remains have been unearthed from the Philippines since the middle of the previous century (Pawlik, 2004; von Koenigswald, 1958). Within the last decade, a human metatarsal found in Callao Cave, situated at the northern part of Luzon island, has been directly dated to 66.7±1.0ka BP (Mijares et al., 2010). Yet, in the past months, arguments for an even older hominin presence on the island was put forward by Ingicco et al. (2018). After a survey at the Cagayan Valley, the site of Kalinga is being excavated since 2014 and has yielded 57 stone tools associated with faunal remains (Figure 33-Figure 34). These included an almost-complete disarticulated skeleton of a *Rhinoceros philippinensis,* which according to the authors “shows clear signs of butchery” (Ingicco et al., 2018, fig. 233). More faunal remains were attributed to stegodon, Philipine brown bear, freshwater turtle and monitor lizard. The clay-rich sediments incorporating the abovementioned finds are dated via electron-spin resonance methods, applied to tooth enamel and fluvial quartz, to between 777ka and 631ka BP. Since Luzon was an island even during periods of low sea level (Voris, 2000), the Middle Pleistocene hominins who reached the island had to cross at least one sea barrier, either from Borneo through Palawan, or from China and Taiwan, which at times would have been connected to mainland Asia (Ingicco et al., 2018).

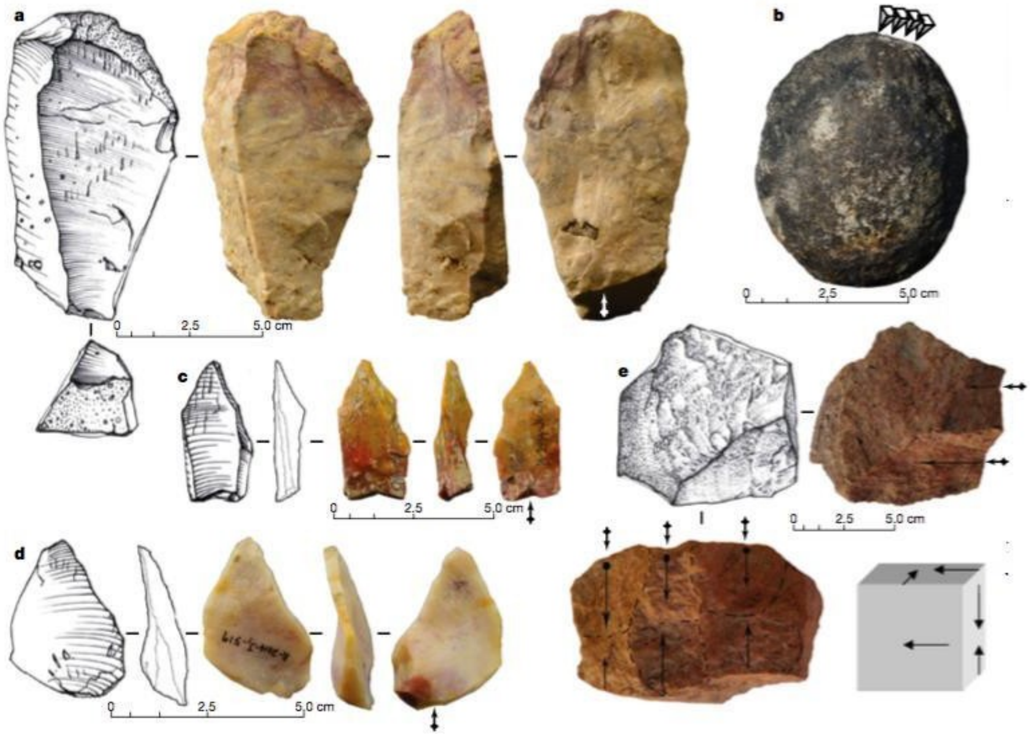


Figure 33: Lithic artefacts from Kalinga, Luzon (a) chert cortical flake, (b) possible hammerstone on dacite, (c) jasper siret Kombewa flake, (d) flint double-backed flake and (e) quartz core (Ingicco et al., 2018, fig. 2).

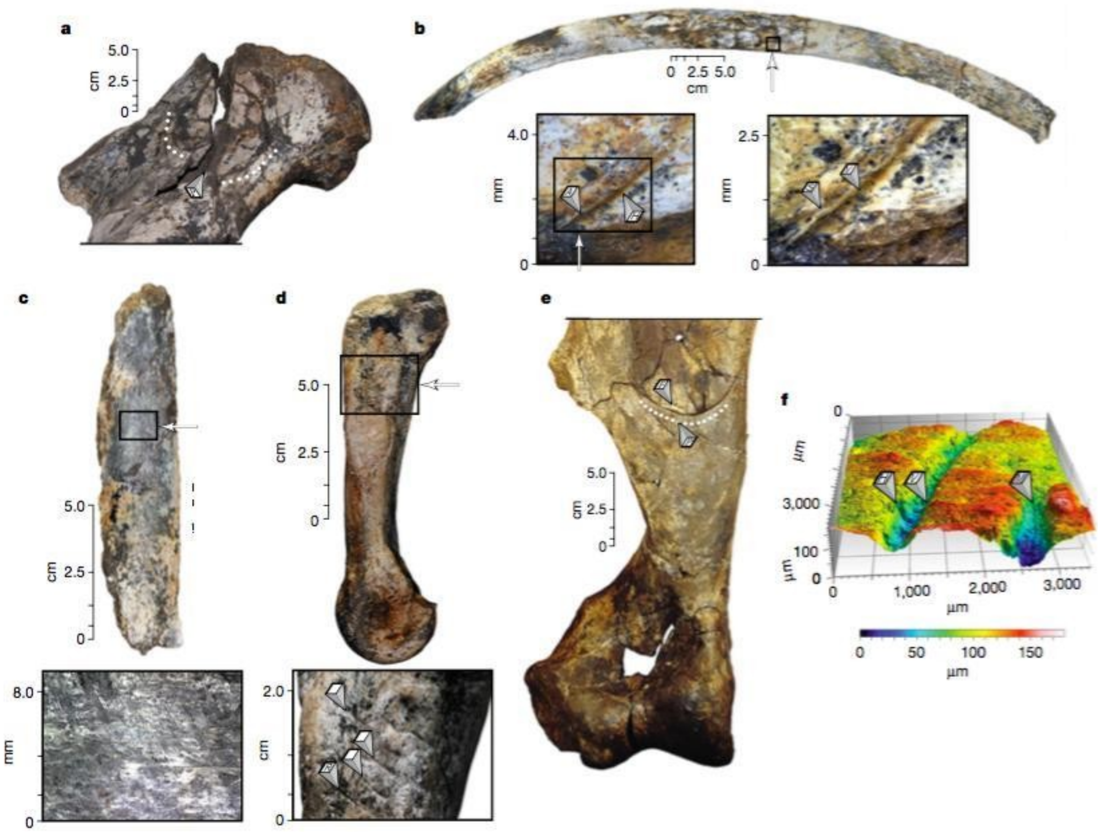


Figure 34: Bones with different types of anthropogenic cut marks (Ingicco et al., 2018, fig. 3).

2.3.1.3.5. Australia

Since it is incontrovertible that Australia was separated from SE Asia throughout the Pleistocene, any kind of archaeological find from the island is categorical evidence of sea-crossing. The oldest indication of human presence on Australia is dated between 50ka and 60ka and has been associated with our own species, *Homo sapiens*. Colonization of Australia by Modern Humans required several small-scale crossings, including larger ones of less than 70km (Irwin, 1992). Cogently, the northern part of Australia provides the oldest dates. A number of sites are 40ka or older, with excavations at Malakunanja II rockshelter in Arnhem Land yielding dates of ca. 55ka to 50ka BP. By 30ka, the whole island was colonized, including its arid central part, as far south as Tasmania (Balme et al., 2009). It is of course reasonable to hypothesize that the coastal sites, today submerged, might have been the earliest ones to be occupied.

Apart from the numerous lithic artefacts, the use of mineral pigments, i.e. ochre, is affirmed since the earliest occupation of the island, at ca. 55ka BP (Bowler et al., 2003; Morse, 1993; Smith et al., 1998, 1997). Painted rock fragments radiocarbon-dated to 42ka BP were found at Carpenter's Gap, Kimberley (O'Connor and Fankhauser, 2001). The oldest palaeoanthropological remains, 'Lake Mungo III', come from the Late Pleistocene burials of Lake Mungo, SW New South Wales and have been dated by OSL to between 42ka and 38ka BP (Bowler et al., 2003). The Lake Mungo burials provide evidence of cremation and fragmentation, as well as the use of sprinkled ochre (Bowler and Thorne, 1976; Bowler et al., 2003; Olley et al., 2006). Although today a desert, Lake Mungo was during the Pleistocene part of the Willandra Lakes system and seems to have provided an ideal setting for its first settlers, since there is evidence for continuous occupation between ca. 45ka to 20ka BP. The material culture of the first settlers involves body ornaments, i.e. shell beads, as well as edge-ground and waisted stone axes (Groube et al., 1986; Morwood and Trezise, 1989; O'Connor, 1999; Schrire, 1982) and bone tools (Barker et al., 2007; Webb and Allen, 1990).

Figure 35: Map of Sunda, Sahul and Wallacea during the Pleistocene. Sites older than 40ka and possible crossing routes are noted. Modified after Balme 2013, fig. 1.

Table 4: Australia and Papua New Guinea separated into zones with key sites and archaeological evidence implicit of innovative behaviour. After Habgood & Franklin 2010, Table 1a-b.

Region	Key Sites	Characteristics
Papua New Guinea 	Buang Merabak Matenkupkum Bobangara Kosipe	Long-distance transport and/or exchange networks – c. 40,000BP Shark tooth pendant – c. 39,500BP Early exploitation of marine resources Obsidian transport/exchange -- late Pleistocene
Northern 	Carpenter' s Gap Widgingarri 1 Miriwun Riwi Cave Nawamoyn Malangangerr Nauwalabila Malakunanja Early Man	Long-distance transport and/or exchange networks – c. 40,000BP Shell beads -- c. 40,000BP Ground stone hatchets and waisted axes -- possibly c.40,000BP Grindstones -- c. 22,000BP Pigment processing and ochre – c. 42,000BP Rock art -- c. 42,000BP
Central Western 	Mandu Mandu Creek Noala Cave Gum Tree Valley	Long-distance transport and/or exchange networks -- c. 25,000BP Shell beads -- c. 32,000BP Ochre -- c. 20,000BP Rock art -- c. 18,500BP Possible early marine exploitation – c. 22,000BP
Southwestern 	Devil's Lair	Ochre -- c. 31,000 Bone points -- c. 26,000 Notational pieces -- c. 25,000 Bone beads and other personal ornaments -- c. 20,000
Central 	Puritjarra Puntutjarpa Koonalda Cave	Long-distance transport and/or exchange networks – c. 32,000 Flint mining – c. 24,000 Ochre -- c. 32,000 Rock art – c. 20,000
Murray-Darling 	Willandra Lakes Roonka Cuddie Springs Kow Swamp	Long-distance transport and/or exchange networks -- c. 40,000 Ochre -- c. 40,000 Ritual burials -- c. 40,000 Grindstones -- c. 35,000 (but disputed) Exploitation of freshwater shellfish – c. 40,000
Tasmania 	Kutikina Bone Cave WargataMina Warreen Cave Cave Bay Cave Mannalargenna	Long-distance transport and/or exchange networks -- c. 35,000 Bone points – c. 29,000 Ochre -- c. 22,000 Rock art -- possibly c. 35,000 Intensive exploitation of resources (Bennett's wallaby) -- c. 30,000

It seems that Australia was intensively and systematically colonised during the Late Pleistocene (Figure 35) because of the speed with which its distant parts as well as diverse habitats seem to have been occupied (Allen and O 'Connell, 2008; Balme, 2013). The Pleistocene archaeological record of Australia is a manifestation of innovative behaviour (Table 4), from the production of personal ornamentation, burials and the consumption of marine resources, to the use of water vessels and the act of colonisation itself. The construction and maintenance of social networks and information exchange systems have been regarded as essential prerequisites for long distance transportation of materials, individuals and ideas (Balme et al., 2009; Davidson, 2010; Davidson and Noble, 1992).

Rafts made out of bamboo reeds were initially proposed as the type of water craft used for the crossing from Sunda to Sahul (Anderson, 2000, pp. 13–19) because they can be easily constructed, they are buoyant, light and fast when traversed, and could be easily propelled by the wind without the use of a sail. Arguments against the bamboo rafts for a crossing via the southern route have been placed by in terms of the present bamboo distribution (Birdsell, 1977). Although their Pleistocene distribution might have been even narrower, the likelihood of their expansion beyond their natural distribution due to human use has also been hypothesised (Allen and O 'Connell, 2008).

2.3.1.3.6. Melanesia

The steep local geography of the Bishmarck Archipelago and Solomon Islands allowed for relatively limited effects on the shoreline configuration thus a good coastal Pleistocene record has been preserved (Erlandson, 2001). The fact that there is an abundance of fish and marine shellfish remains in the saltwater shell middens of these islands implies that sea-crossings took place between 35-15ka (Allen et al., 1989; Allen and Kershaw, 1996; Wickler and Spriggs, 1988). Of special interest is a shark's tooth interpreted as a pendant, from Buang Merabak, New Ireland, with an age of between 39.5ka and 28ka (Leavesley, 2007).

Less than 100km of sea would need to be crossed in order to reach Melanesia from Australia, yet the colonization of Buka, dated at ca. 30ka cal BP, would require a crossing of at least 140km (Irwin, 1992; Spriggs, 2001). Even more interesting is the fact that by 15ka sea voyages included distances of 200km or more in order to reach Manus (Wickler and Spriggs, 1988), an island which would have probably been an out of sight land (Irwin, 1992).

2.3.1.3.7. Japan

It has been argued that although Japan would have been connected to continental Asia during most of the Pleistocene, the presence of modern human remains as well as evidence of particular technologies (blade and edge-grinding) which were introduced c. 30ka, are potential evidence of sea-crossings (Fagan, 1990; Matsu'ura, 1996). After 26ka, archaeological evidence suggests human presence on the islands of Okinawa, Miyako and the smaller Ryukyu islands some of which would have required crossings of 75-150km (Matsu'ura, 1996). Obsidian procurement networks imply marine crossings in the area since c. 20ka (Oda, 1990).

2.3.2. Boat types for crossing the sea

In order to examine the possibility of Pleistocene hominins to have attempted to cross the Mediterranean Sea, we need to first examine the types of vessels that they might have utilised. It has already been demonstrated that no organic remains of Palaeolithic watercraft is preserved. Thus, the vessels used during later prehistoric periods (Mesolithic and Neolithic) as well as important information from ethnographic studies can be used to provide hints in terms of the buoyancy of each vessel. Notwithstanding the limitations of any present-day reconstructions of prehistoric sea travels with "archaic" vessels, particular data from experimental trips provide answers to the appropriate questions.

2.3.2.1. Ethnoarchaeological record

A rich ethnographic record provides information on the sea-worthiness of several boat types and their diachronic use worldwide. Simple hide crafts such as *curraghs* or *coracles*, made of sewn animal hides covering a simple wooden or bone frame, were used in NW Europe until recently (Figure 36-Figure 37A); while the more specialised *kayaks* and *umiaqs* were used by the Eskimos (Greenhill and Morrison, 1995; McGrail, 1987).

Figure 36: Two *curraghs* in Ireland, 1913 (© Musée Albert-Kahn - Département des Hauts-de-Seine)

Reeds are still being used for the production of simple rafts, especially in SE Asia (Figure 37B). Specifically in the Aegean, a type of simple reed bundle boat, known as *papyrella* (Figure 37C), was used for fishing and lobster trapping until the 20th century in the shallow waters around the island of Kerkyra, Ionian Sea (Sordinas, 1969). Dugouts similar to the Neolithic example from Dispilio were until recently used in the lakes of Kastoria (Marangou, 2001a, 2001b). It has been argued that due to the low gunwale, the simple logboat (Figure

37D) lacks stability and is difficult to control, attributes which meant that it was not safe for use in the open sea. However, the addition of external fittings increased the stability of the original vessel (McGrail, 1987). Propelled by paddles or poles, extended dugouts were used until the 20th century in inland waters of Albania but were also used in the North Aegean Sea during the 16th century (Marangou, 1991). Thus, in contrast to the simple dugouts, which may have been more appropriate for inland waters (McGrail, 2010), paired logboats (Figure 37E) have also proven to be seaworthy.

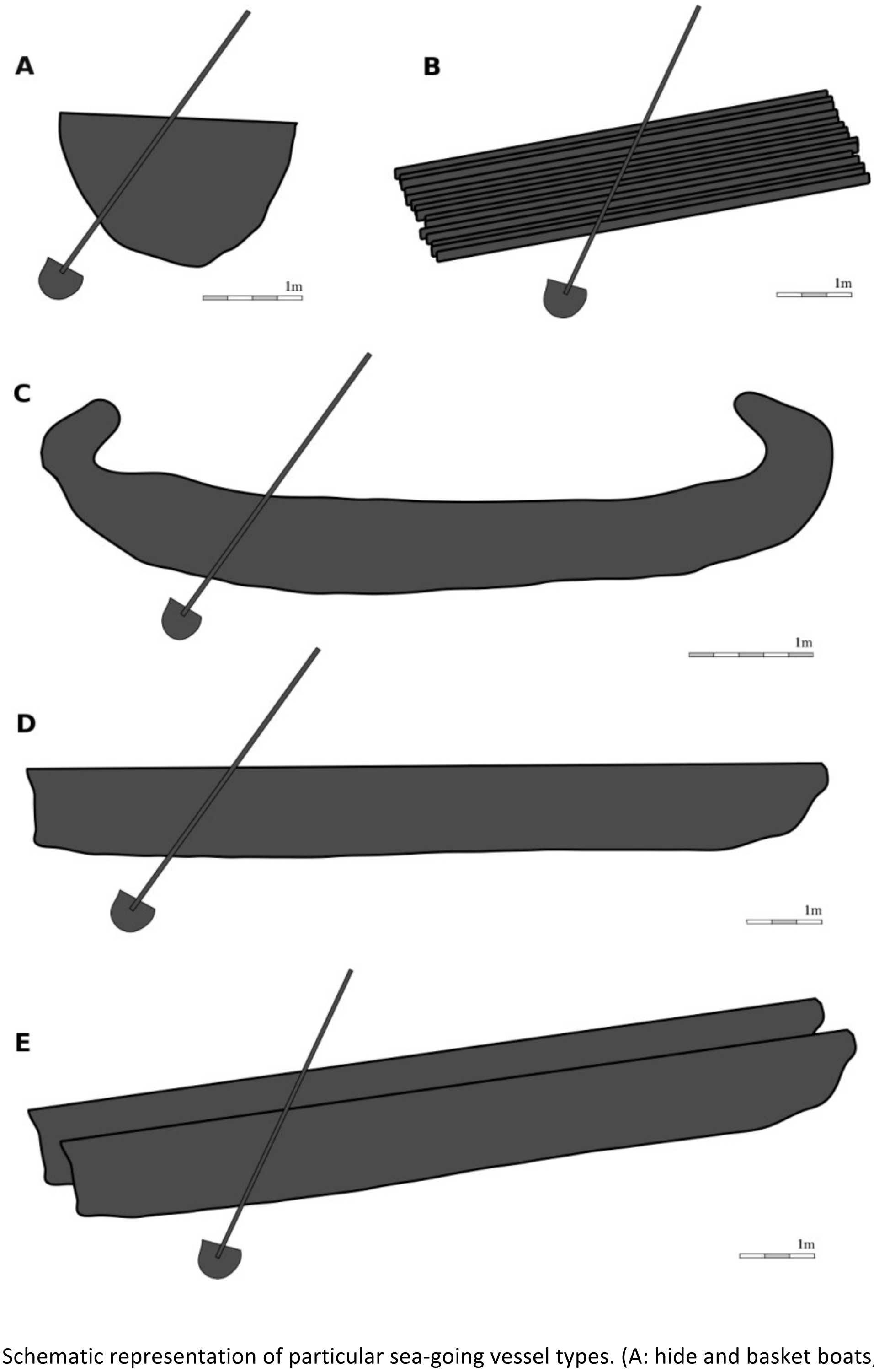


Figure 37: Schematic representation of particular sea-going vessel types. (A: hide and basket boats, B: raft, C: papyrella-type reed-bundle boat, D: dugout, logboat, monoxylon, E: double logboat) (Papoulia, 2016, fig. 2).

2.3.2.2. Experimental voyages

2.3.2.2.1. Papyrella (1988)

Based on the ethnographic use of *papyrella*, in 1988 Tzalas and collaborators tested the potential use of reed-bundle boats to navigate the Aegean between Milos and Franchthi Cave (Tzalas, 1995). Their experimental voyage proved that a combination of land (Argolid to Attica) and sea (Lavrion to Milos) voyages was faster and safer than a direct crossing from the coasts of the Argolid to Milos via a circumnavigation of the Saronic Gulf (Figure 38). Heavy winds of 7-8 on the Beaufort scale were challenging and delayed their arrival at Milos; however, the reed craft proved to be adequate for mild weather conditions and shallow anchorages such as those usually found on the Cycladic islands.

Figure 38: The routes of the four experimental voyages in the Mediterranean (Papoulia, 2016, fig. 3).

2.3.2.2.2. Monoxylon I and II (1995 and 1998)

Although all of the archaeological boat remains from the central and eastern Mediterranean pre-dating the Bronze Age were found in inland waters, this does not preclude their use at sea. The seaworthiness of the long and relatively narrow boats, such as the *logboat,* was tested by two expeditions in 1995 and 1998 (Tichý, 2002, 1999). Two dugouts (Monoxylon I and II) were constructed based on the archaeological find at La Marmota, in Central West Italy (Fugazzola Delpino and Mineo, 1995). Both were made using wood from oak trees found in Valdice, East Bohemia (Figure 39). The first dugout travelled the Aegean Sea between Samos, Ikaria, Mykonos, Tinos, Andros and Evia, covering a distance of 300 km (Figure 40). The second travelled approximately 800 km along the coasts of the Central and Western Mediterranean. The vessel was constructed using both stone and metal tools; however, the team estimated that the construction of such a boat solely using stone tools would require about 300 hours. Both trips were made at an average speed of 4 km per hour and proved that the wind was the main constraint. Sea currents mainly affected the Strait of Sicily, whereas the Cycladic voyage was mainly affected by strong winds. The team managed to paddle the boat through up to 2-m-high waves and in winds of 9 on the Beaufort scale. A cargo (consisting of obsidian, wheat, water and the crew) of more than one tonne in weight was regarded as both feasible and safe. The second trip followed parts of the western Mediterranean coasts, including the southern Atlantic facade of Portugal. The largest strait of sea crossed was the 31km strait between Milazzo in Sicily and the Vulcan Islands, which took the crew 8hours to cross. The maximum distance covered was 290 km along the coast between San Remo (Italy) and Portiragnes (France).

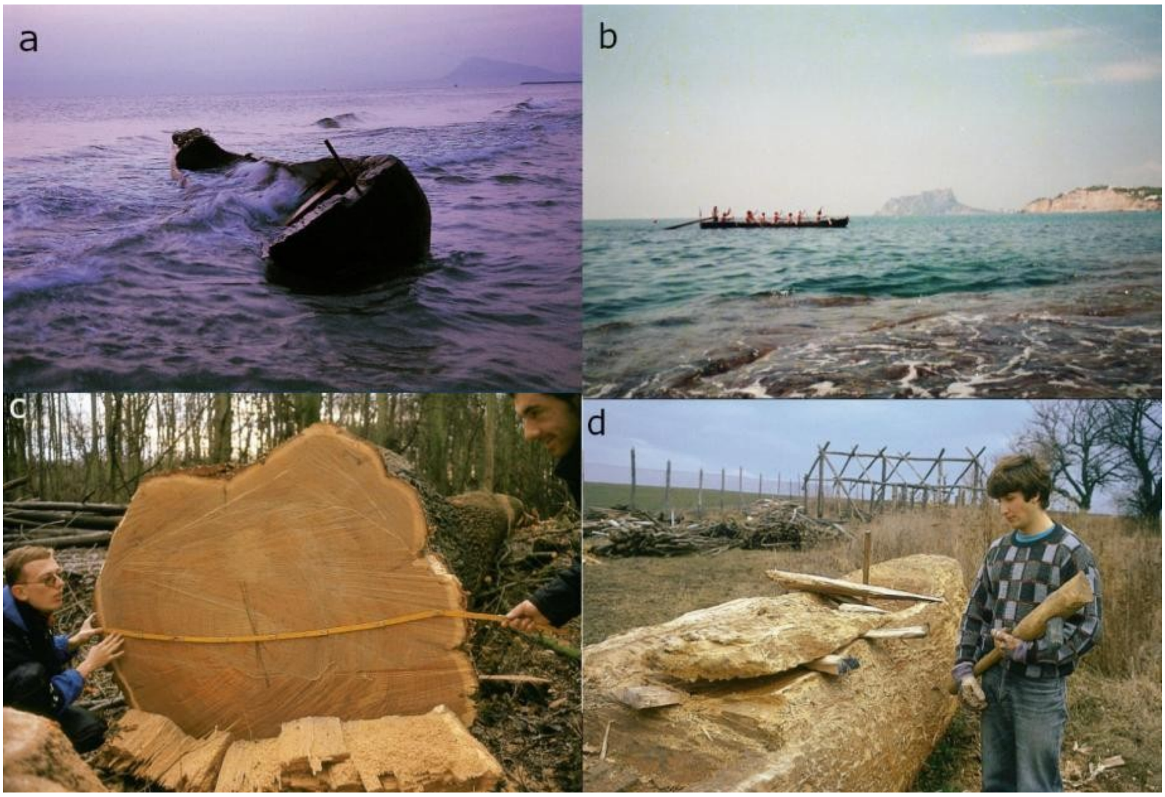


Figure 39: Monoxylon II (a-b), the oak tree wood used (c) and the logboat under construction (d) (**http://www.monoxylon.com/**).

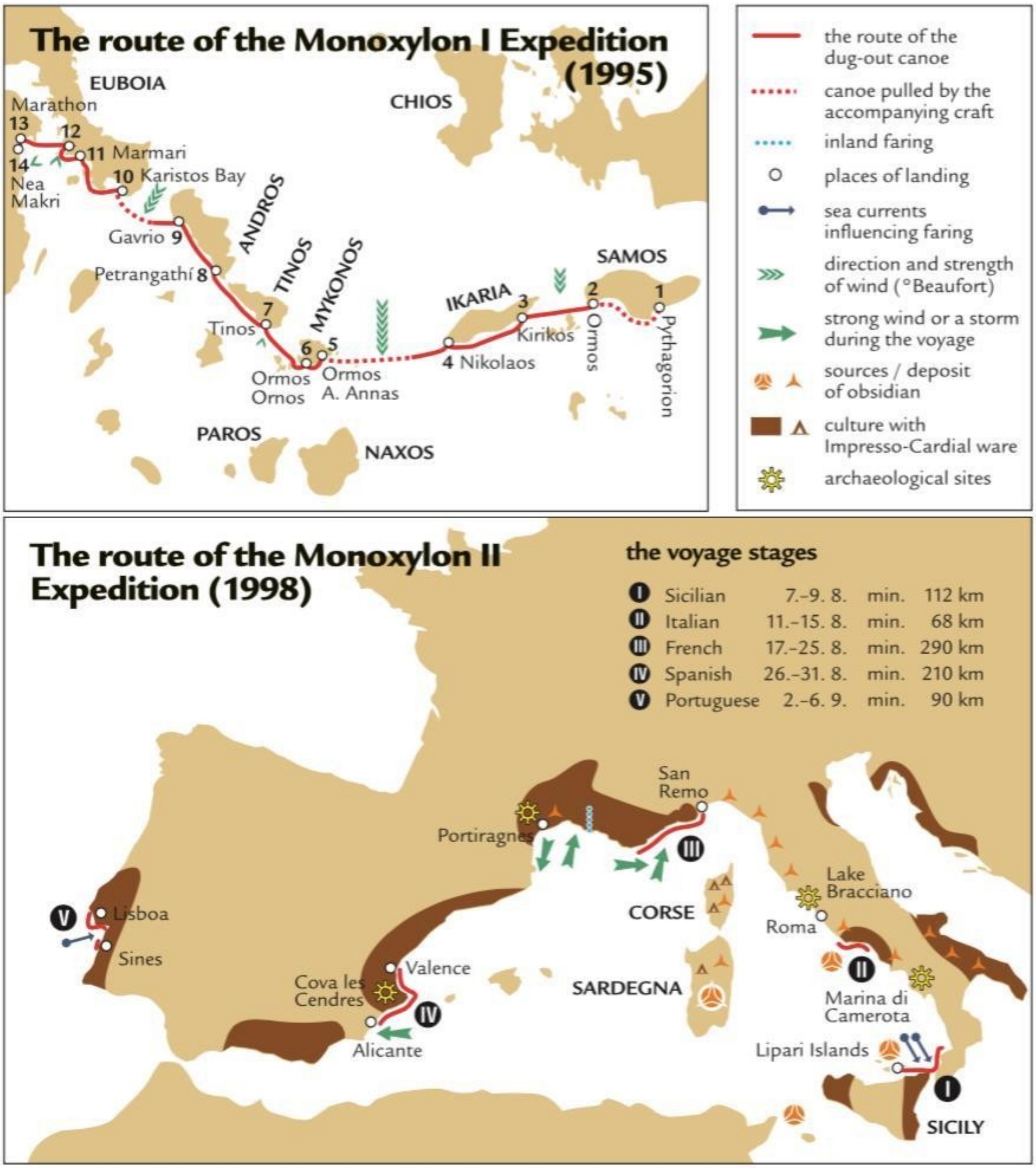


Figure 40: The routes of Monoxylon I and II (Tichý, 2016, fig. 1)

2.3.2.2.3. Melinda (2014)

Another experimental trip was recently made in the Aegean, between Kythera Island and NW Crete (Figure 38). The crew paddled a sailed raft called ‘Melinda’ which they made out of locally sourced reeds (*Arundo donax*) (First Mariners Expedition, 2014). The team mainly used metal tools to construct the craft and the paddles, and commercial sisal in order to bind the reeds. They needed three days to reach Chania and proved that a trip with such a vessel was possible under calm weather conditions.

Figure 41: "Melinda" paddled without the sail (a, c), preparation of the sail (b) and view of Crete from Kythera (d) (**https://www.thefirstmarinersexpeditions.com/kythira-to-crete-galleryPage**).

2.3.2.3. Archaeological Inference

Regarding the usefulness of the information gained from these ethnoarchaeological experiments, caution is necessary both in terms of the accuracy of the reconstructions (Cherry and Leppard, 2015) and because of the sea level fluctuations and the subsequent alterations in the palaeolandscapes, which had a different effect on the coastlines of the Central and Eastern Mediterranean (Lambeck, 1996; Lambeck and Purcell, 2005; Lykousis, 2009; Sakellariou and Galanidou, 2016; Shackleton et al., 1984; van Andel and Shackleton, 1982). In other words, although the current sea-corridors between the Cycladic islands might have not changed significantly since the Mesolithic (Kapsimalis et al., 2009), the seascape was completely different prior to the Last Glacial Maximum (Lykousis, 2009). Thus, while general inferences regarding the seaworthiness of the particular types of vessels may be made, it is impossible to simulate the exact routes.

Additionally, although the present consensus is that the use of a sail post-dates the Neolithic, it is important to note that the distance between Kythera and Crete covered in 2014 was longer than that which would have been confronted during the Pleistocene, when looking out from the now-submerged southern parts of the Peloponnese towards the NW coasts of Crete (Lykousis, 2009); it is certain that land at both ends would have been visible at that time, as it is also today (Figure 41d). Overcoming the local winds and currents would have been a significant challenge for the inexperienced, yet on the other hand climate may have been one of the factors triggering chance dispersals to Crete.

2.4. Conclusions

A very brief yet comprehensive review of the state-of-the-art in terms of marine and submerged terrestrial crossings in three different parts of the world sought to convey that:

a. The archaeological discipline was, since the early years of the previous century, forced to expand and broaden its horizons both above, but also below the current sea level in order to provide answers to different types of questions.
b. Multidisciplinary and interdisciplinary collaboration is the only way to approximate issues concerned with past natural and cultural landscapes.
c. Palaeogeographic reconstructions form the basis for any archaeological interpretation of the material record since Pleistocene land bridges may today be covered by sea, and present archipelagos may have, during the Pleistocene, been extensive plains.
d. The origins of seafaring have for long stimulated the interest of archaeological scrutiny; yet several questions remain unanswered and new data constantly alter the existing narratives.
e. Intentionality and serendipity may both produce evidence of marine crossings, albeit by inscribing different marks in the archaeological record.
f. Different types of evidence may provide different degrees of certitude.
g. Different taphonomic conditions may either protect or destroy direct types of evidence for sea-crossings.
h. Up to date, the oldest water vessel unearthed is 9000 years old and comes from the Netherlands. In the Mediterranean, only two examples are known, both are about 7000 years old and were part of Neolithic lakeside settlements.
i. Although in NW Europe the oldest direct evidence of sea-crossings consists of organic remains of logboats, the mere presence of hominin species on islands such as Australia and Flores, as testified by different types of material cultural remains, affirms the antiquity of sea-crossings, both intentional and accidental, ca. 50-60ka and 0.8Ma respectively.

j. Ethnographic and experimental studies may provide insights into boat construction procedures and marine navigation itself, yet caution is warranted in terms of archaeological interpretations and the perils of generalisations.

Most importantly, what this chapter vividly shows is a fundamental contrast between an extremely impoverished archaeological record of Pleistocene maritime technology, i.e. direct evidence of seafaring, and an ever-growing record of indirect archaeological evidence testifying to smaller or larger sea-crossings dating as back as the Lower Pleistocene (Table 5). The particular matter will be readdressed later on with the addition of the new evidence from the Inner Ionian Archipelago (Chapter 4) and the reassessment of the indirect evidence coming from islands of the central Ionian Sea and the Aegean Sea (Chapter 5). The next chapter (3) focuses on the natural and cultural landscape of the NE Mediterranean during the Pleistocene. It discusses the palaeoenvironmental, palaeogeographic, palaeontological and palaeoanthropological record in order to contextualise the archaeology of the Middle and Late Pleistocene.

Table 5: Types of archaeological evidence (direct and indirect) for sea-crossings

Evidence for sea-crossings		**Mediterranean**				**NW Europe**				**SE Asia / Oceania**			
		pre-LGM	UP	Meso	Neo	pre-LGM	UP	Meso	Neo	pre-LGM	UP	Meso	Neo
Indirect	lithics	x	x	x	x		x	x	x	x	x	x	x
	exotic raw materials		x	x	x		x	?	x		x	x	x
	marine resources		x	x	x		x	x	x	x	x	x	x
	structures			x	x		x	x	x	x	x	x	x
	iconography / boat models				x			x	x			?	x
Direct	boats				x			x	x				
	human remains			x	x		x	x	x	x	x	x	x

3. The NE Mediterranean in the Pleistocene

"In one sense, trying to reconstruct environmental changes from terrestrial evidence is like trying to assemble a jigsaw puzzle and then make sense of the picture when more than 90 per cent of the pieces are missing."
(Lowe and Walker, 1997, p. 7)

3.1. Introduction

The natural environment, the climate and the geomorphological configuration are factors that have diachronically shaped and affected the cultural expression and expansion of hominin groups. The NE Mediterranean has gone through substantial geological and climatic changes in the past million years. These changes at times facilitated and at times complicated the subsistence of our genus. Particular species proved to be more capable of adapting to the constantly changing environmental conditions, or to migrate to new territories. This chapter provides the chronological (3.2) and environmental framework (3.3) within which the archaeology presented and analysed in the next two chapters (4 and 5) may be placed.

Largely tied to the climate, the eustatic and isostatic changes occurring in the Aegean region have been altering its geomorphological configuration, at times connecting separate bits of land via the development of terrestrial bridges and at times separating the land through the formation of sea straits, or fragmenting it into smaller islands (3.4). The NE Mediterranean consists of *oceanic*, *oceanic-like* islands and *continental* ones (3.5). The difference in the geologic formation history between these types of islands implies differentiations in the accessibility and ease of both animal and human species' diaspora. Both geological and palaeontological studies have contributed to the production of palaeogeographic reconstructions that are essential in any attempt of archaeological interpretations. In order to apprehend the terrestrial and marine crossings in the NE Mediterranean during the Pleistocene, the examination of the large mammals' dispersal patterns is fundamental (3.6). A concise synthesis of the palaeoanthropological evidence from the Greek peninsula (3.7) and a succinct discussion of the archaeology associated with the oldest hominin activity in the region (3.8) provide the context for the introduction of the new evidence coming from the Inner Ionian Sea Archipelago (Chapter 4). As it will be seen, the present record (archaeological, palaeoanthropological, palaeontological, palaeoenvironmental) is highly fragmentary, yet informative enough to provide answers to particular questions.

3.2. Chronological framework

The beginning of the Quaternary corresponds with the *Pliocene-Pleistocene boundary* which coincides with a major shift in the earth's climatic rhythm and has been dated at about 2.6Ma BP (Pillans, 2004; Shackleton et al., 1990). The periodic glacier activity with the formation of major continental ice-sheets and the expansion of mountain glaciers during the cold stages (*glacials*), interspersed with the high temperatures and the melting of the ice-sheets during the warm intervals (*interglacials*), are the most distinctive features of the Quaternary (Lowe and Walker, 2014). The *Pleistocene* or the 'Glacial Epoch' ends around 11.7ka BP, to be followed by the *Holocene*, or the 'Postglacial', the warm interval within which we live today (Figure 42left). Further subdivisions into *stadial* and *interstadial* episodes within the aforementioned stages denote specific, more localised environmental conditions; yet these terms hold different nuances for each geographic region. Although fluctuations between cold and temperate stages occur throughout the Cenozoic (i.e. 65Ma BP to present; Figure 42right) the frequency and high amplitude of these oscillations, together with the intensity of the cold stages, are the climatic characteristics of the Quaternary (Lowe and Walker, 2014).

3.3. The Palaeoenvironment

In order to apprehend, analyse and reconstruct past environments different strands of evidence need to be correlated. The integration process of the different types of evidence are combined into a palaeoenvironmental synthesis that goes through four major stages (Lowe and Walker, 2014):

a. The development of a geological framework through the establishment of the stratigraphy of the site
b. The extraction of palaeoenvironmental information from the analysis of proxy records
c. The development of a chronological framework
d. The correlation of individual sequences from different sites

The causes of global environmental change and climatic fluctuations have been the core of investigations since the 19th century with the 'Astronomical Theory' (see below) the most famous and widely recognised theoretical framework.

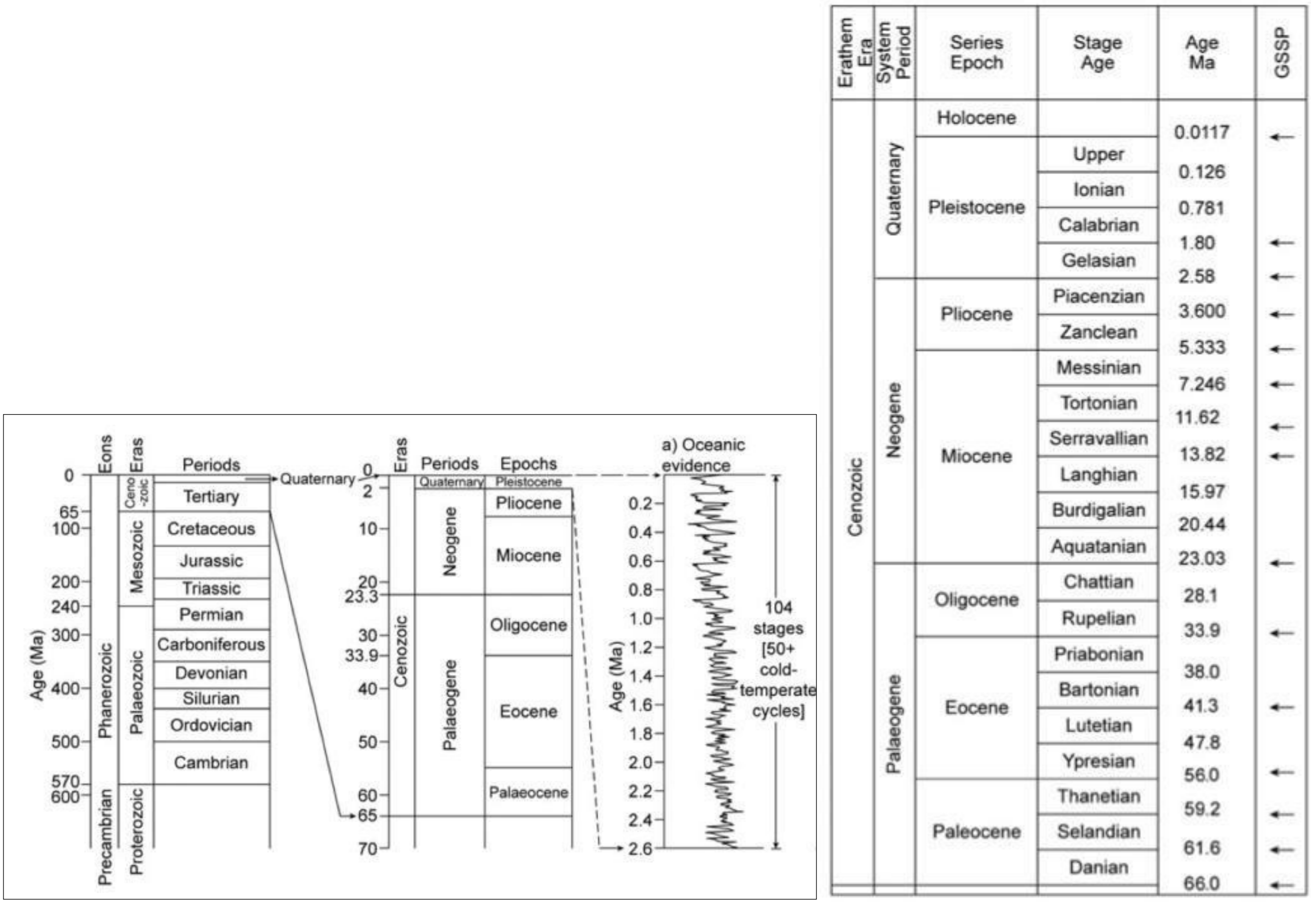


Figure 42: The geological timescale (left) and the Cenozoic timescale. Arrows show the stages/ages ratified by the GSSP in 2014 (right) (Lowe and Walker, 2014, fig. 1.1-1.2).

3.3.1. The Astronomical Theory

Joseph Alphonse Adhémar, a French mathematician and James Croll, a Scottish physicist and astronomer, were the first to develop astronomical hypotheses in the 19th century. Adhémar, back in 1842, suggested that the Ice Ages were controlled by astronomical forces in the sense that glaciations occur when winters are anomalously long, and this happens when they coincide with aphelion, i.e. the point of the Earth's orbit that is farthest from the Sun. Two decades later, Croll agreed that glaciation occurs when winters coincide with aphelion but explained that this is not due to the duration of the winters but because of the weaker intensity of solar radiation at this point (Raymo and Huybers, 2008). Later on, these arguments were further elaborated by Milutin Milankovitch (1930) who formed the Astronomical Theory which rationalized the climatic fluctuations in a global scale.

According to it, the global temperatures depend on (a) the eccentricity of the earth's orbit, (b) the obliquity of the ecliptic plane and (c) the precession of the equinoxes (Figure 43). In particular, the earth's orbit changes periodically from circular to elliptical, every 96,000 years. Secondly, the tilt of the earth's axis varies between 21°39' and 24°36' in a period of 42,000 years, thus forming an oblique angle in relation to the ecliptic plane (i.e. the earth's elliptical path around the sun). Thirdly, the gravitational attraction of the sun and the moon results in the precession of the equinoxes or solstices, which need about 21,000 years for a full circle (Lowe and Walker, 2014, p. 13). The amount of solar radiation received by the earth is highly based on the eccentricity of the orbit, but the way this is distributed to each latitude depends on the other two factors.

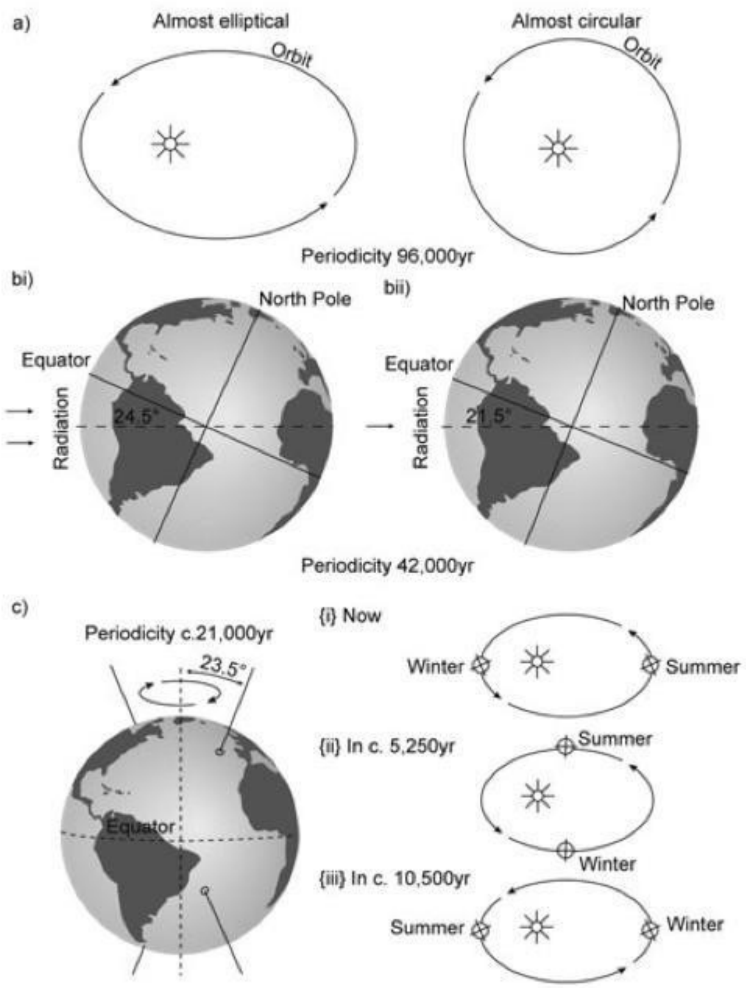


Figure 43: The Astronomical Theory components: eccentricity of the orbit (a), obliquity of the ecliptic (b) and precession of the equinoxes (c) (Lowe and Walker, 2014, fig. 1.8).

Although the aforementioned model explains rather intelligibly the global climatic changes, additional elements need to be studied in order to produce a more precise palaeoclimatic record (Denton, 2000; Rea et al., 1998; Ruddiman, 2003; W. F. Ruddiman, 2006; William F. Ruddiman, 2006). These factors include (Lowe and Walker, 2014):

i. changes in the disposition of the continental landmasses
ii. tectonic activity
iii. feedback mechanisms caused by oceanic circulation
iv. changes in the extent of the ice cover
v. the composition of the atmosphere (such as CO_2, CH_4 and aeolian dust particles)

In sum, the Astronomical Theory has proved that orbital forcing is the major cause of climate change; however other factors have also contributed to the global climatic oscillations of the Quaternary. For instance, the onset of the Northern Hemisphere glaciation at around 2.7Ma and the shift in climatic phasing around 780ka, known as "Mid-Pleistocene Transition", cannot be adequately explained by the orbital forcing (Lowe and Walker, 2014, p. 15). Long-term cooling trends may have as well been influenced by factors such as tectonic activity (e.g. Ruddiman and Kutzbach, 1990) and significant changes in the geomorphology or oceanography, such as the closing of the Panama Isthmus at c. 2.75Ma (Schneider and Schmittner, 2006) or the restriction of the Indonesian Seaway at c. 3–4Ma (Cane and Molnar, 2001). Additionally, the *thermohaline circulation* may be another driving factor of short-term centennial or millennial events, i.e. the salt density variations, together with chemical changes from biological activity. Decadal to millennial scale events also include greenhouse gases, variation in solar output and in the intensity of the solar wind as well as volcanic eruptions (Lowe and Walker, 2014, p. 16).

3.3.2. Oxygen Isotope Stages

While the "Milankovitch cycles" is the theoretical explanation of the glaciation cycles, the application of marine oxygen isotope analysis to deep-ocean sediments provides actual indices of global environmental change. The shells of the *foraminifera* (i.e. small marine organisms), which are embedded in the deep-sea sediments, are composed by the oxygen contained in the water. Thus, their chemical composition reflects the combined influences of circulation, nutrient supply and water temperature, i.e. the chemistry of the oceans at the time of their lives. The variation in the oxygen isotope ratios in the shells provide indirect indications of the size of the glaciers, thus of global climate, at the time of the microorganisms' death. Through cores of deep-sea sediments, a continuous record of the past glacial-interglacial cycles, thus climate change, can be inferred by the marine oxygen isotope curve, which is divided in several *Marine Oxygen Isotope Stages (MIS)* that are the fundamental elements of Quaternary stratigraphy (Figure 44). Odd numbers are allocated for the interglacial stages with the warmer climate (lighter $\delta^{18}O$ values) while even numbers are allocated for the glacial stages with the colder climate (heavier $\delta^{18}O$ values). MIS 1 represents the Holocene and MIS 2 – MIS 103 the Pleistocene Epoch (Gibbard et al., 2010; Head and Gibbard, 2015).

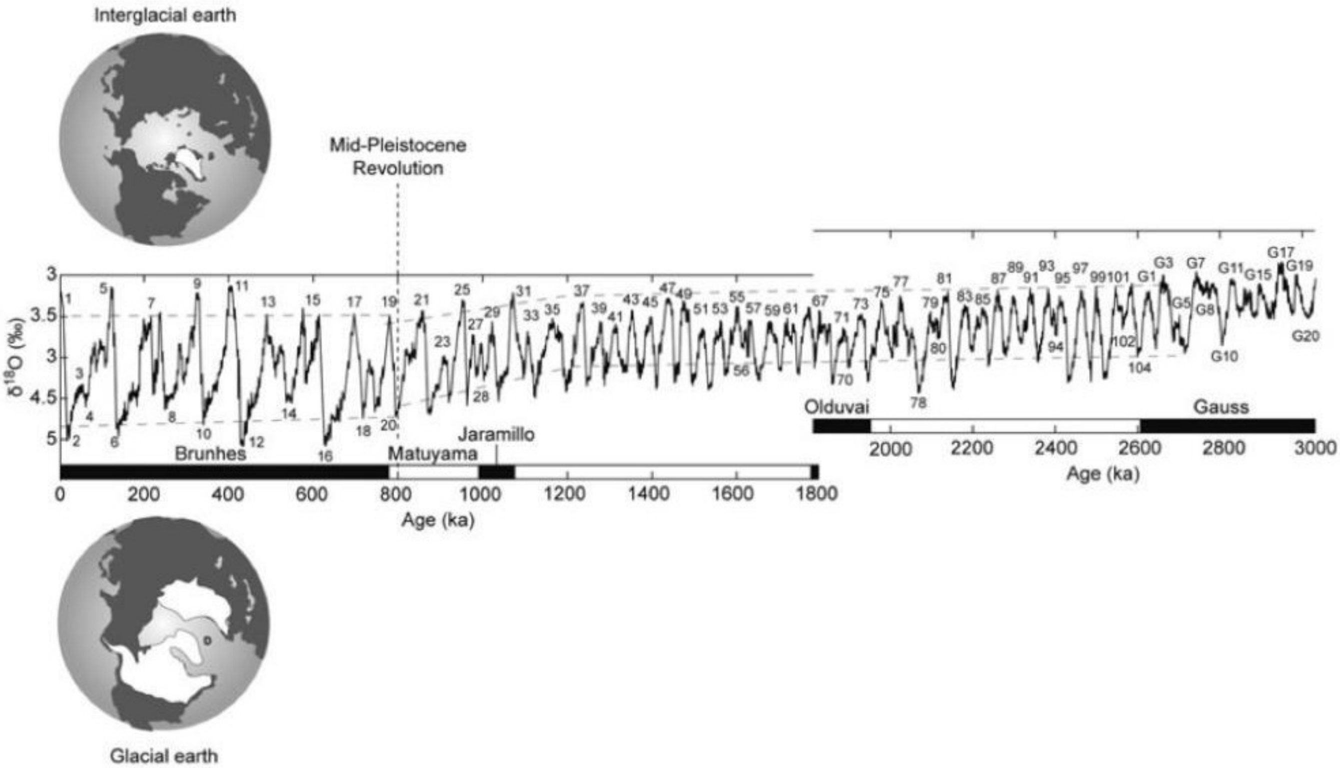


Figure 44: The marine oxygen isotope signal for the climatic trends since 3Ma. The isotopic trace forms a proxy climate record for the glacial and interglacial stages. Since the Mid-Pleistocene Revolution at c. 780ka, climatic extremes increased the ice sheets of the Northern Hemisphere reached their greater extents (Lowe and Walker, 2014, fig. 1.5).

The sedimentary sequence in the deep ocean is relatively undisturbed and the oxygen isotope signal obtained from the microfossils is geographically consistent, thus it is a climatic signal of global significance. Finally, by correlating terrestrial and marine signals it has been confirmed that the MIS framework is also adequate for the analysis of the terrestrial record (Tzedakis et al., 2001).

3.3.3. Palaeoenvironmental Implications

In high latitudes major glaciations have provided a chronological scheme named after the river valleys relating to the Alps (i.e. Gunz, Mindel, Riss, Wurm). However, the low latitudes were never cold enough to experience glaciations; instead the local climate was dry and arid during glacial stages, with extended deserts and diminished tropical rain forests, interspersed with periods of wet climatic conditions during the interglacials. Depending on the climate, hominins, animals and plants migrated, evolved or became extinct according to their ecological needs. The diachronic changes in the faunal and floral record are reflected in the fossiliferous deposits, which are often used as a way of stratigraphic dating known as *biostratigraphy*.

The Mediterranean basin, situated between subtropical and mid-latitude atmospheric patterns, can be affected from both large- and small- scale changes in the general circulation (Berger, 1986). The NE Mediterranean, in particular, is affected predominantly by the South Asian monsoon and the Siberian High Pressure System (Xoplaki et al., 2003) and the Greek peninsula is characterized by warm/dry summers and mild/humid winters. Precipitation patterns designate an east/west and south/north increase of rainfall with a summer drought increase in the SE (Figure 45) (Allen, 2001; Macklin et al., 1995).

During the Pleistocene, the Mediterranean climate, characterised by seasonal precipitation and a predominance of sclerophyllous vegetation, would have defined the interglacials – with a maximum extension during boreal summer insolation maxima – yet such conditions would not continue in the glacial stages (Tzedakis, 2007). During the glacial stages, the Mediterranean acted as a refugium for several faunal and floral species. Insights into the character of *plant refugia*, i.e. areas where temperate tree species survived during the glacial stages (Magri, 2010), are to a certain degree provided by palynological studies. For instance, during the LGM, pollen records from the circum-Mediterranean region suggest that conifers characterized the northern parts, while thermophilous elements thrived at its southern parts (Figure 46). A great taxonomic diversity is noted at mid-altitude sites, while the low-altitude ones are characterized by sclerophyllous elements (Tzedakis, 2009).

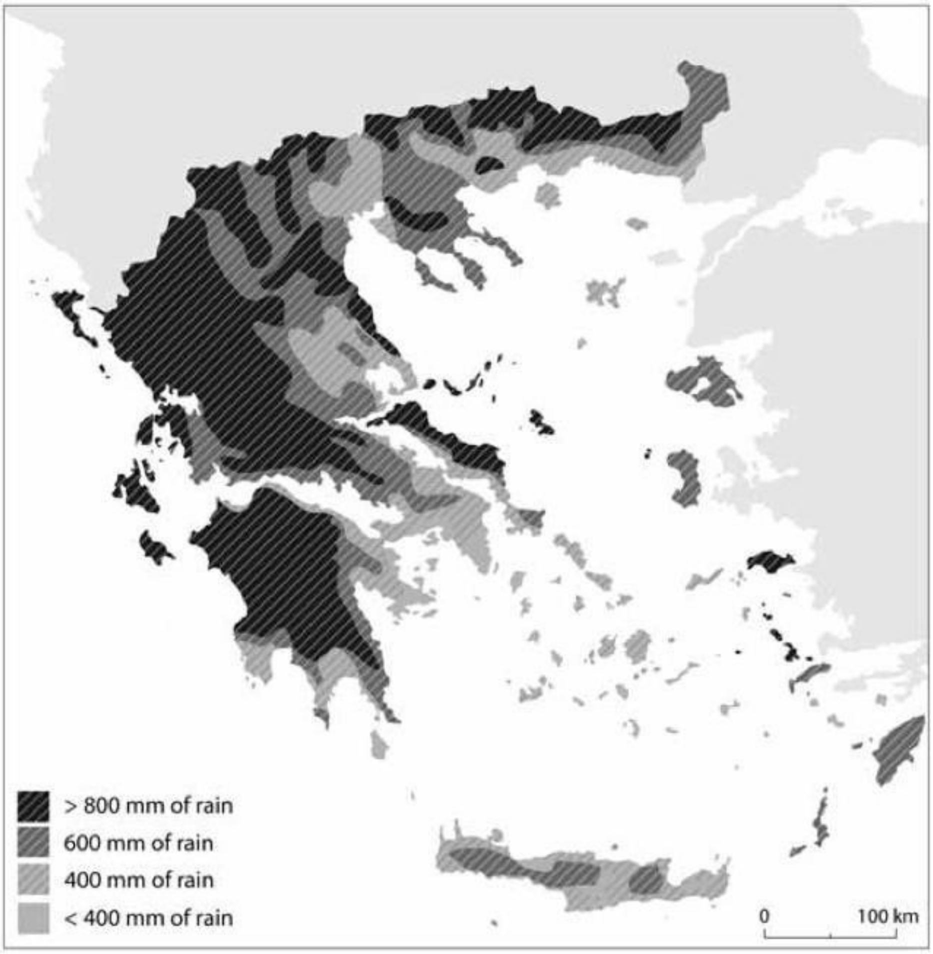


Figure 45: Annual precipitation in Greece (Tourloukis, 2010, fig. 6.1).

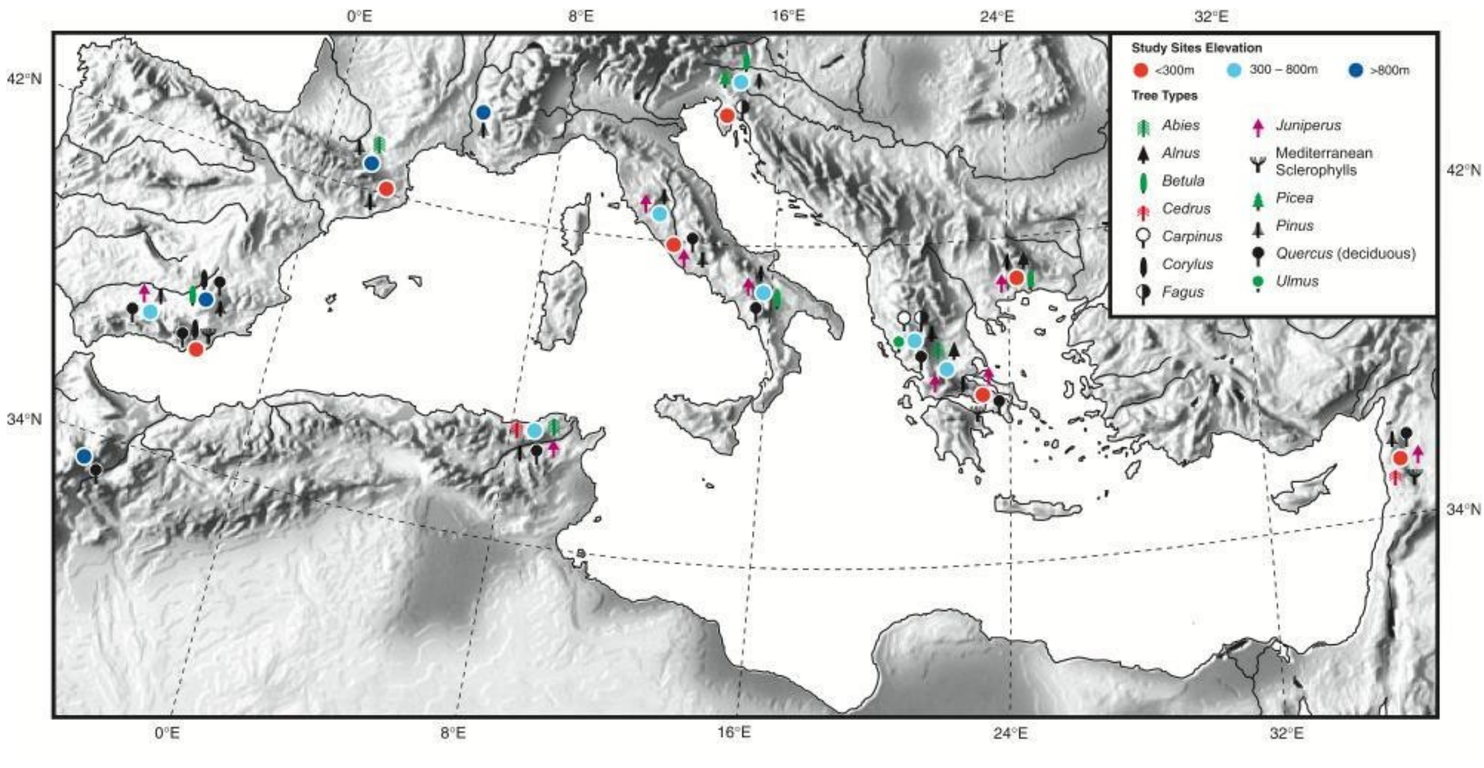


Figure 46**:** Pollen records from circum-Mediterranean wetland sites with inferred refugial populations of the main tree taxa (Tzedakis, 2009, fig. 1).

Based on pollen records from Southern European sites the following scheme presents the broad vegetation patterns during a glacial/interglacial cycle whose most important driving force was the changes in precipitation (Tzedakis, 2007; Woodward et al., 1995):

a. Pre-temperate: open woodland with pioneer taxa, i.e. *Juniperus*, *Pinus*, *Betula* and *Quercus*
b. Temperate: Mediterranean forest/scrub communities for the warm and dry conditions, deciduous forest for the warm and wet conditions and montane/coniferous forest for the onset of the cold phase
c. Post-temperate: open woodland for the initial cooling and drying and glacial steppe vegetation for the cold and dry conditions.

Interestingly, pollen records from the Greek sites indicate that the Pindus Mountain range designates different biogeographical patterns between the east and the west. The tree populations of the arid and exposed lowlands east of Pindus (i.e. Tenaghi Phillippon and Kopais) would significantly decrease during glacials and stadials, whereas the mid-altitude sites of western Greece (i.e. Ioannina) would act as refugia evading the complete elimination of trees (Tzedakis, 2005; Tzedakis et al., 2004, 2002). Additionally, during climate extremes of dry conditions, periglacial phenomena (e.g. rock glaciers and debris accumulation) would prevail, while glaciers advanced on the Pindus peaks during intermediate, cold and moist conditions and decayed during stadials and interstadials (Hughes et al., 2003; Hughes et al., 2006; Woodward et al., 2008).

Tymphi and Smolikas at the Pindus mountain range, show evidence of the presence of rock glaciers, a phenomenon which implicates permafrost (Hughes et al., 2006). A periglacial environment would have been encountered by the hominins of the Last Glacial at Samarina, Macedonia, as the frost crack polygons imply (Karkanas, 2010, fig. 47), yet the extreme climate of the Last Glacial Maximum was probably the reason for the absence of early Modern Human remains in the regions. At Theopetra Cave, Thessaly, human presence has been identified in layers superimposed by sterile ones exhibiting evidence of frost, a fact which demonstrates the use of the cave during the warmer episodes of the Last Glacial and the lack of use at periods of extreme glaciation (Karkanas, 2001).

Based on the palynological data from northern and central Greece, which seem to be in agreement with the marine isotopic curves and the Chinese loess stratigraphic deposits, indicate that during MIS 6, 12 and 16 (i.e. 200-140ka, 430-480ka and 620-660ka), the climate was significantly cold and dry, while during MIS 7, 11, 13 and 15 (250-200ka, 430-380ka, 540-480ka and 620-560ka), the conditions were milder (Tzedakis, 1999, 1993). The most extensive glaciations occurred during MIS 12 and MIS 6 at the Pindus mountain range (Hughes et al., 2007; Hughes et al., 2006; Hughes et al., 2006). On the other hand, MIS 11 (430-400ka) and MIS 5e (127-112ka)[15] were the warmest interglacial periods in the Greek peninsula, with MIS 9 (332-336ka) and MIS 7e (245-239ka) being less warm (Okuda et al., 2001; Tzedakis and Bennett, 1995). Wild olive was present both at MIS 11 and MIS 5e, a fact which indicates particularly warm and dry conditions (Okuda et al., 2001). Most of the present-day deciduous trees were also present during MIS 5e, while thermophile animals such as hippos and rhinos were found both in Greece and in northern Europe. Temperature and rainfall was similar to the present levels, as was the global sea level. The stages succeeding MIS 5e, i.e. MIS 5a-d (115-75ka), were part of the last glacial (115-10ka). MIS 5a and MIS 5c were warmer while MIS 5b and MIS 5d were colder episodes. MIS 4 (75-60ka) was a severe pleniglacial, resulting to the gradual disappearance of forests and the prevalence of a steppe environment. MIS 3 interpleniglacial was in general warmer than the preceding pleniglacial, yet instable, with frequent climatic fluctuations, which were capped by the Last Glacial Maximum of MIS 2 (Karkanas, 2010).

The close link between Quaternary vertebrates and climatic regimes has long been recognised (Blois and Hardy, 2009) and palaeoclimatic information are often derived from the fossil vertebrates' record (Figure 47). Ecological niche models were constructed based on the thermal preferences of vertebrate faunal species, typical of cold, warm and temperate climates (Polly and Eronen, 2011). Although such inferences are not straightforward since, apart from climate change a number of other factors contribute to the diffusion patterns (Stewart et al., 2010), Milankovitch-driven climatic oscillations had an effect on the development of animal guilds (Lowe and Walker, 2014). The evolutionary trend known as *orbitally forced species range dynamics* (Dynesius and Jansson, 2000) is a result of a successive environmental turmoil, which forced the faunal species towards rapid diffusion and enhanced environmental adaptability.

[15] MIS 5e in Europe corresponds with 130-115ka, yet particularly for Greece the duration is 15.000 years, extending between 127-112ka (Tzedakis, 2003).

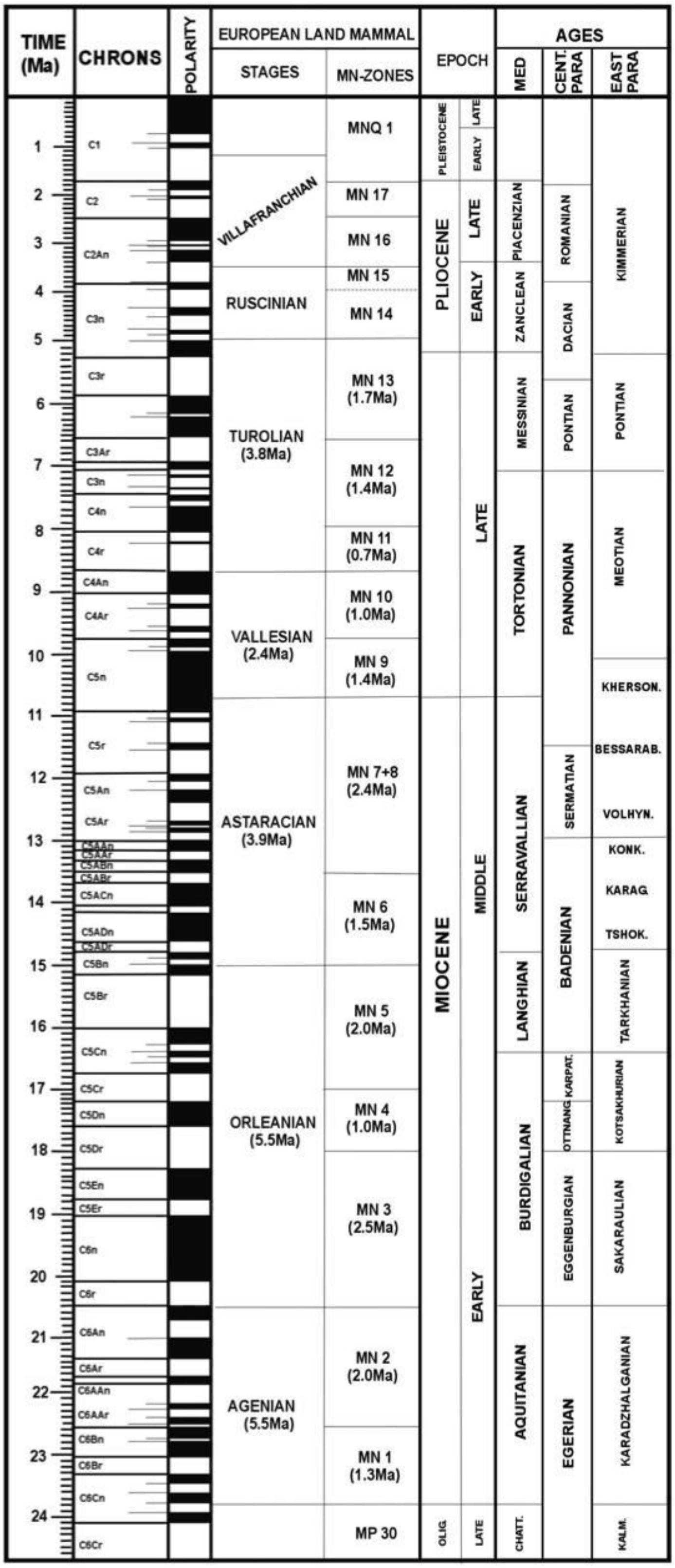


Figure 47: Chronological table for Neogene/Quaternary with the European land mammal stages. According to Mein (1990), Steininger *et al.* (1990) and Steininger (1999) (Koufos et al., 2005, fig. 1).

3.4. Sea level change and geomorphological configuration

3.4.1. Eustatism, Isostasy and tectonism

During the Pleistocene, the biogeographic characteristics of the islands were much different than today. In particular, the size and distance from the mainland depended on the sea level oscillations, which either connected or disconnected the islands from each other or from the mainland. Sea level is controlled by eustatism, isostasy and tectonism.

On a global scale, the fluctuations in the volume of the oceans' water result in *eustatic* changes. On a local scale, the vertical movements of the sea, the land or both can influence the *relative sea level*, i.e. the change in the position of the sea in relation to the land (subsidence or uplift). Local gravitational effects influence the extent of eustatic changes (Milne and Mitrovica, 2008), while another factor of sea level changes is tectonic activity, both of local and global effect. *Isostatic* changes are horizontal movements associated with the migration of the great lithospheric plates but also with more localized phenomena of shorter duration which affect the balance within the earth's crust (Teixell et al., 2009). In other words, isostasy restores the earth's equilibrium. Glacio- and hydro- isostatic *absolute* as opposed to *relative sea level* is easier to reconstruct in areas of low tectonic activity. On the other hand, at tectonically active areas such as the NE Mediterranean, a variety of different arrays of evidence need to be combined in order to provide a reliable model.

Up until the Quaternary, the sea level was at much higher levels (Figure 48). For instance, while the warmer temperature of the Pliocene resulted in less polar ice and an estimated sea level of between 10-25m higher than today (Haywood and Valdes, 2004), by the end of the Pleistocene the lowering of the global sea level during glacial stages reached a maximum of 130-135m below present sea level, with significant fluctuation between glacials and interglacials (Yokoyama et al., 2000).

The *glacio-eustatic changes* are reflected in the oxygen isotope curves from which the long-term eustatic record is regulated (Shackleton, 1987). Direct dating of shoreline features, such as coral reefs, or speleothems from submerged caves contribute to the chronology of sea level changes (Antonioli et al., 2004; Surić et al., 2009).

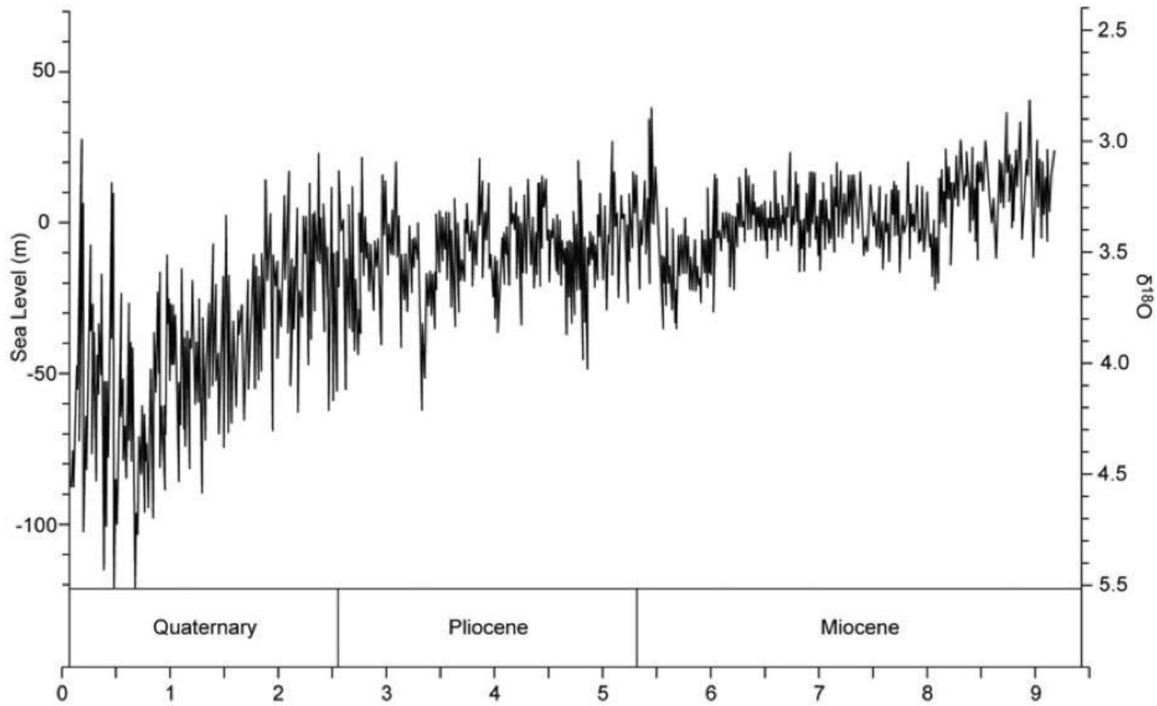


Figure 48: The global eustatic sea-level variations curve since 9.5Ma based on marine oxygen isotope measurements. After Lowe and Walker, 2014, fig. 2.31 as modified from Miller et al., 2005.

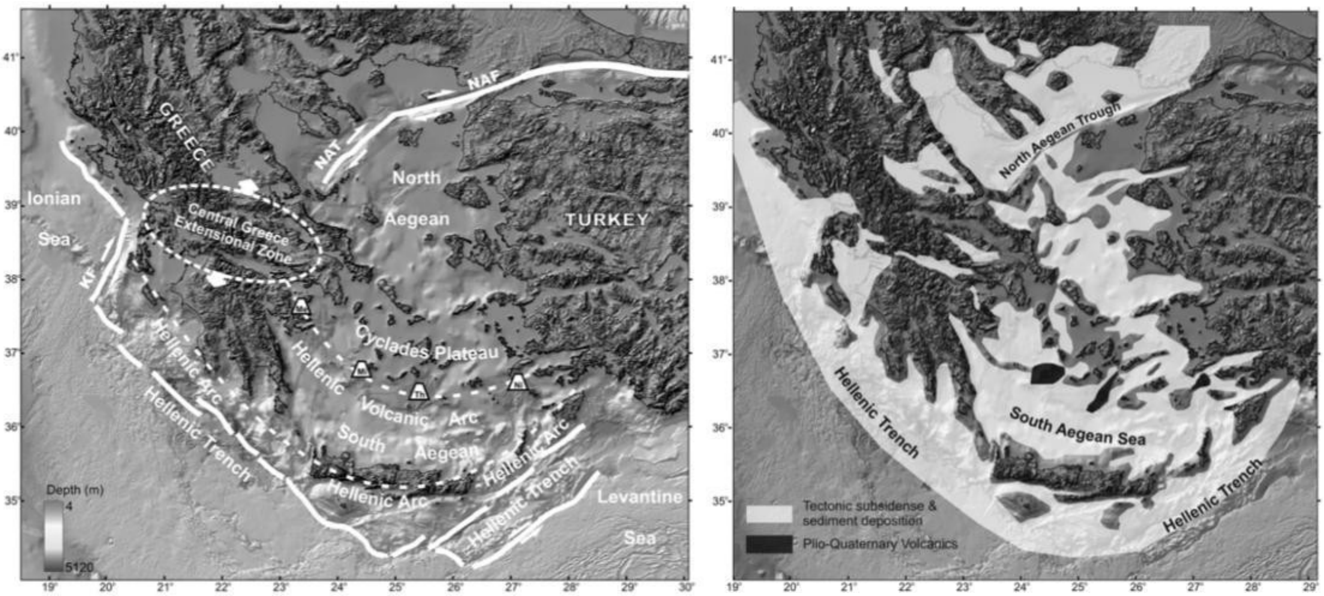


Figure 49: Main geotectonic features of the NE Mediterranean [KF=Kephallinia Transform Fault, NAT=North Aegean Trough, NAF=North Anatolian Fault, Me=Methana, Mi=Milos, Th=Thera, Ni=Nisyros] (a) and the areas of Pleistocene tectonic subsidenceand sediment deposition (b) (Sakellariou and Galanidou, 2016, figs. 3, 6)

The occurrence of raised marine terraces in the Mediterranean may indicate eustatic sea level highstands or episodic tectonic uplift. Tectonic processes often result in shoreline displacement and deformation. *Tectonism* and *volcanism*, today as well as in the past may significantly alter the landscape (Figure 49a), while erosion and sedimentation (Figure 49b) have also considerably affected the accumulation and preservation of the archaeological material (Tourloukis, 2010) and all make the land-sea interface “a dynamically changing boundary” (Sakellariou and Galanidou, 2016).

For these reasons, collaboration between geology and archaeology is the necessary foundation for any attempt to reconstruct past behaviours within their prehistoric landscapes. The strategic need to better understand and manage submerged landscape archaeology, from the Palaeolithic onwards (Bailey et al., 2017; Flemming et al., 2014; Harff et al., 2015), as well as the critical importance of the eastern Mediterranean (the connecting point between Africa and Eurasia) for integrated studies of landscape evolution and archaeology and its high research potential towards our understanding of diachronic human dispersals, both through terrestrial and maritime routes, has already been emphasized (e.g. Benjamin et al., 2017; Papoulia, 2013; Sakellariou and Galanidou, 2017, 2016).

The first step towards the appreciation of past seascapes and (presently submerged) landscapes is the construction of accurate, high-resolution bathymetric maps for the respective spatial and temporal unit under study.

3.4.2. Reconstructing submerged palaeolandscapes

Several studies on sea-level and palaeolandscape reconstructions have been published from around the world as well as from the Mediterranean region (Antonioli, 2012; Lambeck, 1996; Lambeck and Bard, 2000; Lambeck and Purcell, 2005; Lykousis, 2009; Perissoratis and Conispoliatis, 2003; Pirazzoli, 1996; Shackleton et al., 1984; van Andel, 1989). Yet, due to the incomplete record, i.e. a detailed history of ice-volume changes in the Mediterranean goes back to a maximum of 35ka (Lambeck et al., 2014) and geophysical models of the sea-level evolution before the LGM are rarely available (Lambeck et al., 2011), the global eustatic curve and data from other regions have regularly been applied to the Mediterranean (e.g. Bard et al., 1996; Rohling et al., 2008; Waelbroeck et al., 2002).

For these reasons and due to the variety of parameters that need to be taken into account for a reconstruction to accurately convey the particular geomorphological characteristics and the history of sea-level fluctuations of each sub-region, the majority of the available sea-level reconstructions from the NE Mediterranean focus on the Holocene, or the final part of the Pleistocene (after the LGM). The relative sea level indicators used for reconstructing past palaeoshorelines consist of two categories (Benjamin et al., 2017):

- natural, non anthropogenic
    - i. depositional (estuarine or deltaic brackish sediments, salt marshes, coastal lagoons, beach deposits and beach rocks etc.)
    - ii. biological (encrustations by marine organisms)
    - iii. erosional (abrasion platforms and marine notches)
- anthropogenic, i.e. archaeological

Based on these, a number of studies have investigated the palaeoshorelines and the effects of seismicity on subsidence for parts of the Aegean and the Ionian islands' coastal zone (Evelpidou et al., 2017, e.g. 2014, 2012), including Meganissi Island (Figure 50) yet for a time-period which is, unfortunately, younger than the one of our study.

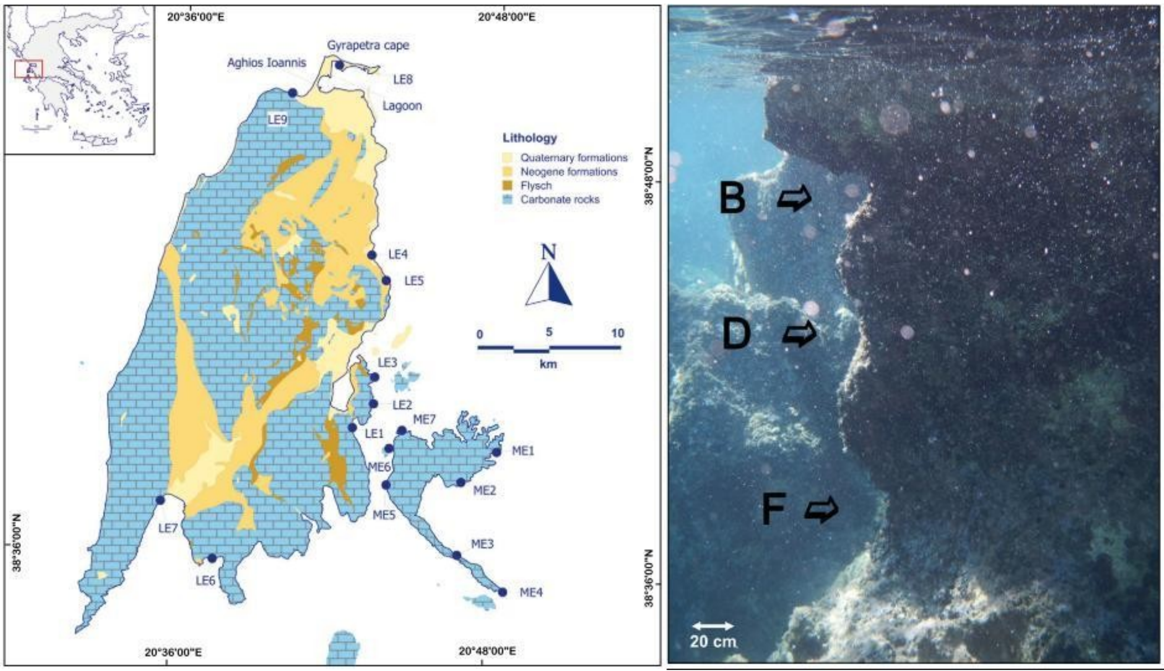


Figure 50: Map with the lithology of Lefkas and Meganissi, and the location of the tidal notches studied (left), and an underwater photograph of the tidal notches at ME1 (Evelpidou et al., 2017, figs. 2, 5).

The few studies contemplating earlier periods do not always take into account the tectonic aspect, which is locally controlled. Notwithstanding, although a lot of work on sea-level reconstructions before the LGM still needs to be carried out, a number of studies pertinent to the Middle Palaeolithic archaeology of the region are today available to us and provide the framework for archaeological interpretations and sea crossing hypotheses to be formed.

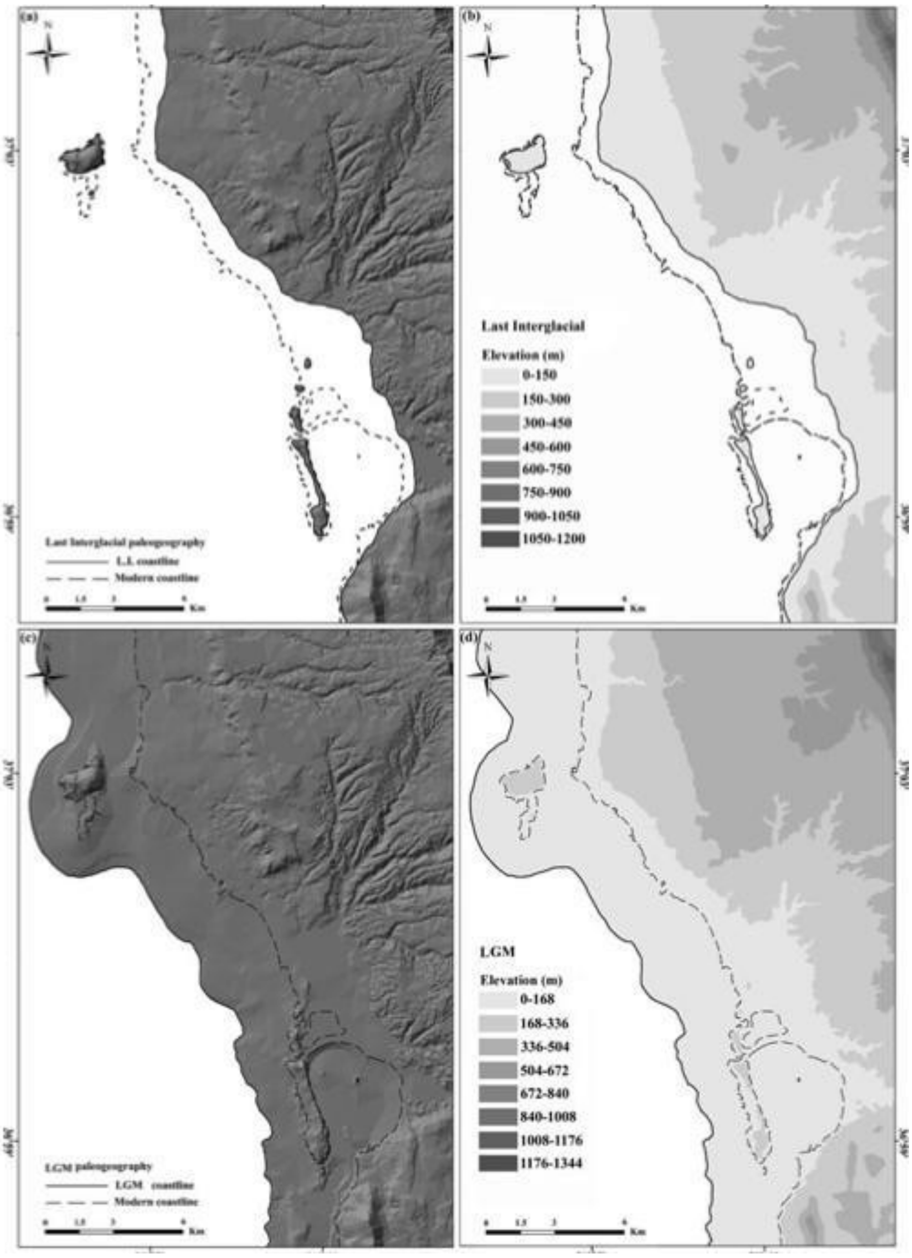


Figure 51: Reconstruction of the palaeoshoreline configuration of the greater Navarino area during the Last Interglacial (a-b) and during the LGM (c-d) (Athanassas et al., 2012, fig. 12).

In particular, reconstructions of the Middle Palaeolithic coastal landscapes of the SW part of the Peloponnese (Figure 51), based on extrapolated data from published records, allow for a better idea of how the landscape would have looked like in the particular period (Athanassas et al., 2012). Particularly important to the study of past seascapes is the most broad reconstruction of the Aegean Basin yet available, proposed by Lykousis (2009). According to it, the NE Mediterranean, and particularly the Aegean Sea, would have been a terrestrial wetland, a place where early hominins could both seek refugium (Tourloukis and Karkanas, 2012) and use as a bridge to cross over westwise and/or eastwise, as would the large mammals do, depending on the environmental conditions (Figure 52).

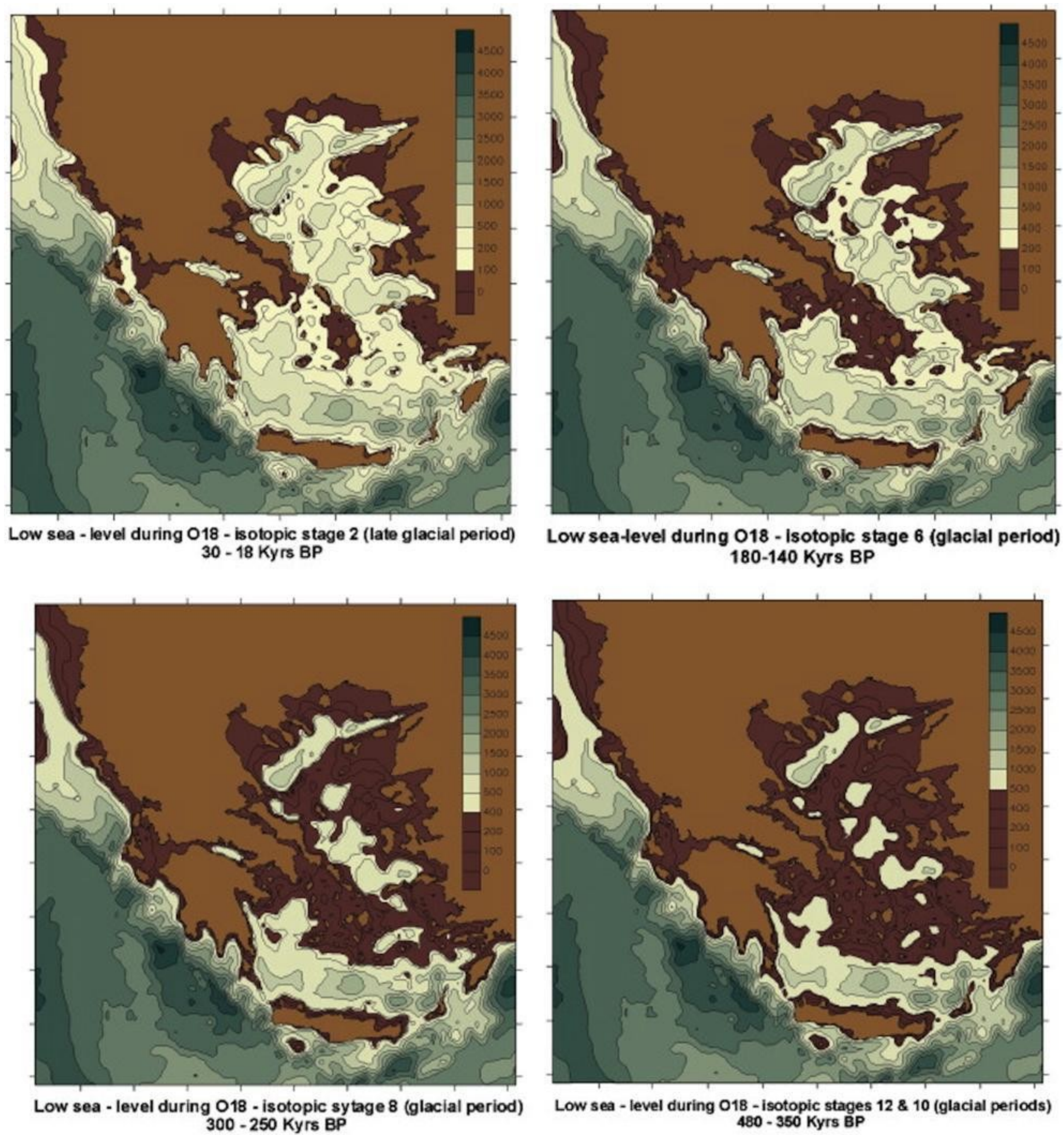


Figure 52: The proposed palaeogeographic reconstruction by Lykousis 2009, fig.9.

The southernmost islands of Crete and Gavdos, however, seem to have been separated from the adjacent coasts since at least 450ka. Similarly, the easternmost island of the Mediterranean, Cyprus, was never connected to Turkey throughout the history of hominin migrations in the region.

As for the area of the central Ionian Sea, geoarchaeological studies that took place in the region within the last six years, argue for the insularity of the islands of Kefalonia and Zakynthos (Figure 53-Figure 54) during parts of the Late Pleistocene (Ferentinos et al., 2012). More recently, detailed palaeogeographic reconstructions founded on sea-bed mapping, with a particular aim to bridge the island archaeology to the changing Pleistocene landscape of the Inner Ionian Sea Archipelago, provided new data on the insularity of the islands (Zavitsanou et al., 2015; http://honorfrostfoundation.org/exploring-the-submerged-caves-and-prehistoric-landscapes-of-the-inner-ionian-sea-archipelago/). A discussion upon the new geoarchaeological data from the Inner Ionian Sea Archipelago and their significance for Pleistocene hominin dispersals is part of the next chapter.

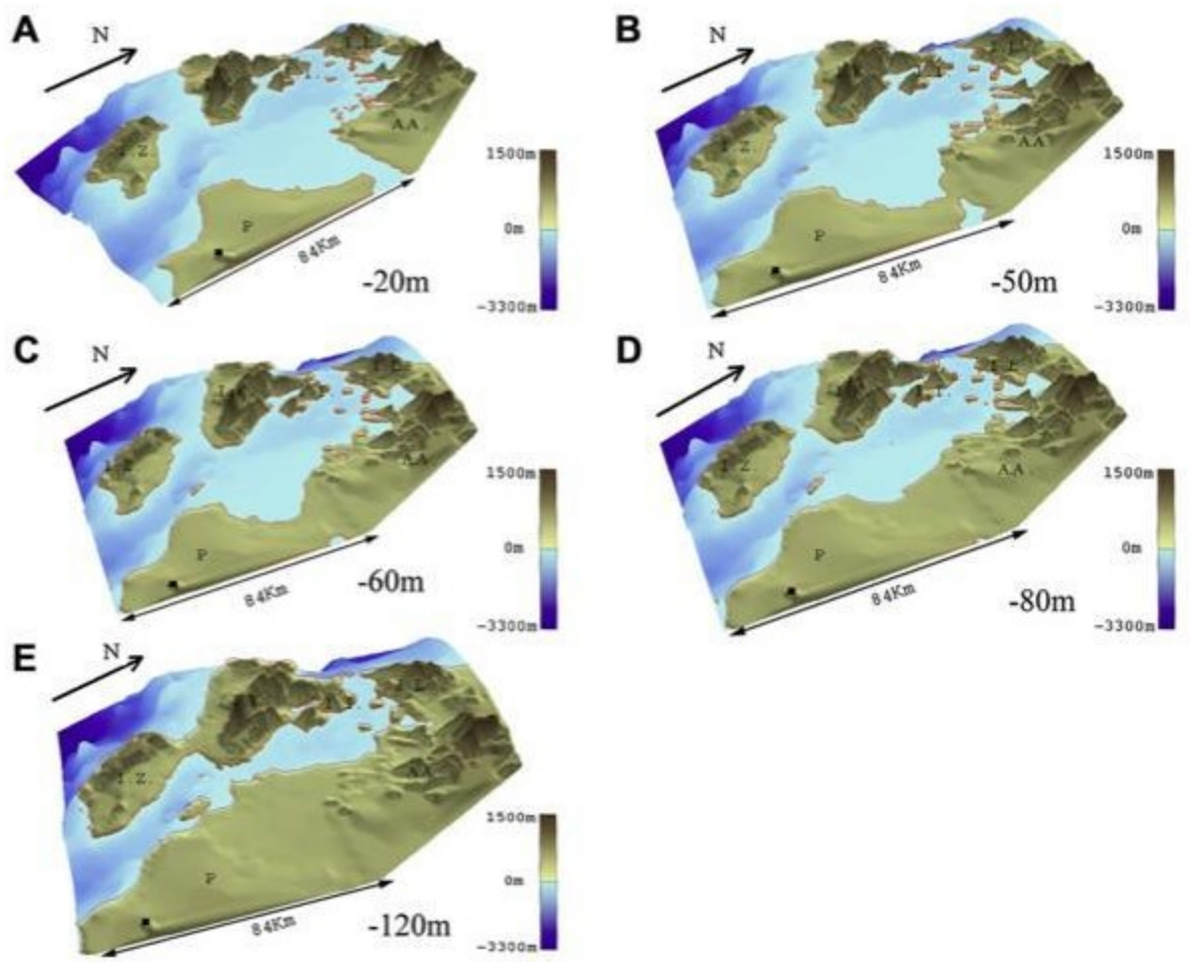


Figure 53: 3D models of the palaeoshoreline configuration of the central Ionian islands at particular sea level drops (Ferentinos et al., 2012, fig. 7).

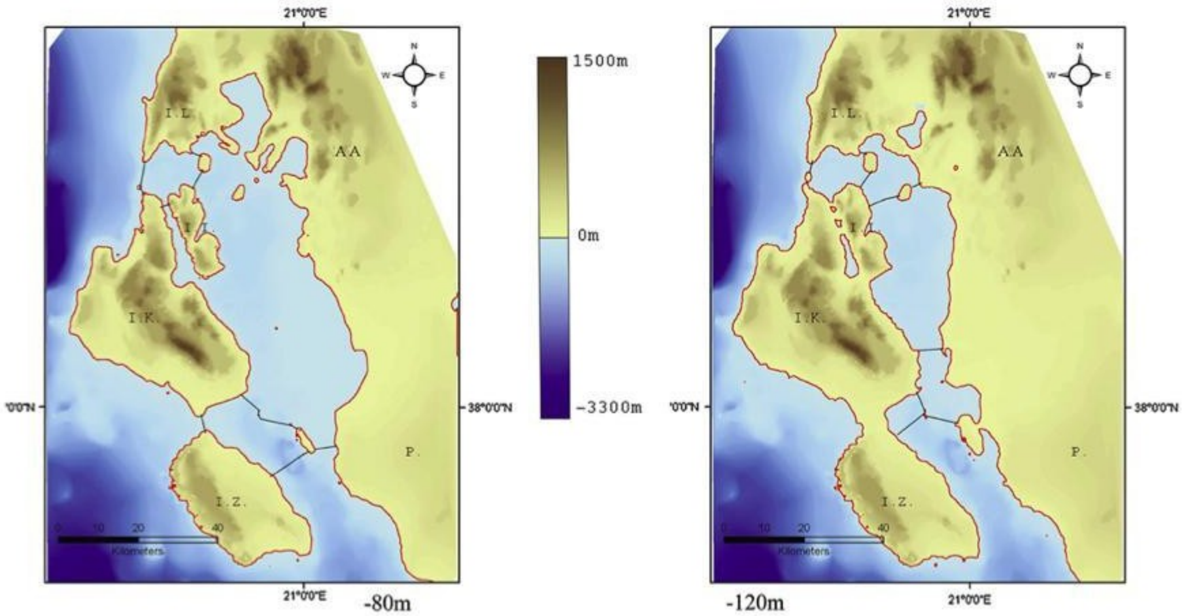


Figure 54: Reconstructions of the palaeoshoreline configuration at 80mbsl and 120mbsl (Ferentinos et al., 2012, fig. 8).

3.5. ***Oceanic*, *oceanic-like* and *continental* islands**

A distinction between *oceanic* and *continental* islands is often used in arguments for or against island “colonization” by hominin or other mammal species. Continental islands, as their name connotes, formed part of the mainland (or of the continental shelf), at some point in the recent or distant past. These islands were either separated from the mainland due to a rise in the sea level or were detached when continental blocks rifted. Oceanic islands, on the other hand, were never part of the continent or the continental shelf and were usually formed as a result of volcanic activity, or a combination of volcanoes and corral reefs (Darlington, 1975). Such distinctions are particularly useful in extrapolating zoogeographic patterns of dispersals (e.g. Palombo, 2006). Based on studies of the origin of insular faunal communities, a third type of island was proposed, the *oceanic-like* island (Alcover et al., 1998). These islands were at some point in the distant past connected to the mainland, but then separated from it by a persistent, wide sea barrier. This third category is important to us since Crete and a few more islands of the Aegean Basin (see 3.6) may be described as such. Another name used in the literature for this type of islands in the Aegean Sea is *continental fragments* (Sfenthourakis and Triantis, 2017). Most of the other islands discussed in the next two chapters fall into the category of the continental islands.

In particular, up until the Late Miocene (9mya), *Crete* was connected to mainland Turkey, as demonstrated by fossil remains of mainland fauna (van der Geer et al., 2006). In the Early Pliocene, although separated from the continent, Crete formed more than six smaller islands that correspond to its present-day mountain tips (Figure 55). Throughout the Pliocene, periodic connections between Crete, the Peloponnese and the SW Anatolian coasts might have occurred. After several sea-level changes and tectonic uplifts, Crete became a single island and its current morphology does not differ significantly from the Pleistocene onwards (Dermitzakis, 1990; Angelier et al., 1982; Bartole et al., 1983; Dermitzakis and Sondaar, 1978; Leite and Mascle, 1982; Meulenkamp et al., 1988; Schüle, 1993). However, there are also some arguments against a continuous insularity of the island during the Pleistocene, which are also based on palaeontological evidence (Malatesta, 1980; Mazza, 2014). According to this view, the hippos found on the island would have been incapable of crossing the sea, thus a land bridge has to have connected the island with mainland Greece. Yet this hypothesis is not widely accepted (Van der Geer et al., 2014).

Further to the south, the island of *Gavdos* was much larger than today yet separated from Crete throughout the Quaternary, as a 1000-3000m deep trench separates the two islands (Sakellariou and Galanidou, 2016). *Kythera and Antikythera* had been connected to the southern ends of the Peloponnese during the Early and Middle Miocene. The area southwest of Antikythera was probably submerged during the Late Miocene thus producing a marine channel between Antikythera and Crete (Dermitzakis and de Vos, 1987). In the Late Pliocene the island of Antikythera became isolated from the mainland while Kythera is still connected to the Peloponnese. A marine channel between Kythera and the Peloponnese was constructed at about 1.5Mya. However, during the Middle Pleistocene, both Kythera and Antikythera as a single island reconnected with the southern ends of mainland Greece (Dermitzakis, 1990). According to Lykousis' reconstruction these two islands remain connected to each other and to the mainland at least until 250ka (Figure 52c).

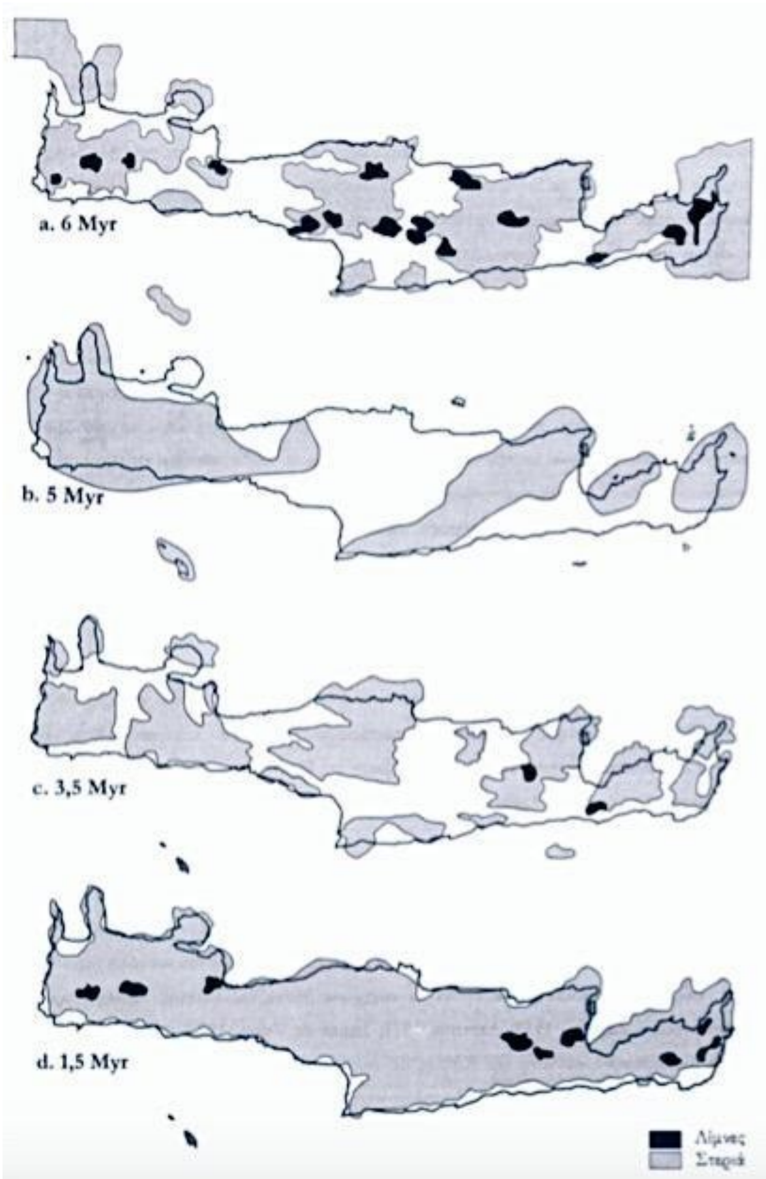


Figure 55: The gradual palaeogeographic evolution of Crete (Chatzaki, 2003).

The eastern Dodecanese islands were during the Pliocene and for most parts of the Pleistocene connected to the western coasts of Turkey. The islands of *Samos, Patmos, Leipsi, Leros* and *Kalymnos* were probably not separated before 14ka to 15ka. According to the palaeontological data *Kos* seems to have been connected to Turkey until very recently, some 11.5ka as was *Chios* and *Lesvos* (Dermitzakis, 1990). Limnos was also connected to Turkey until the early Holocene (Higgins and Higgins, 1996). *Psara, Ikaria* and *Nisiros* seem to have been separated at earlier dates, perhaps during MIS 2 (Figure 52a) while *Tilos* may have been insular since MIS 6 (Figure 52b). The palaeontology of Tilos as well as of *Chalki* and *Rhodes* imply a similarly early detachment from the mainland.

Kassos and *Karpathos* were during the Early and Middle Miocene part of the mainland. During the Early Pliocene Karpathos was still connected to Rhodes and the Anatolian coasts and remained connected until the Late Pliocene when it was completely submerged. Kassos was also partially submerged during the Late Pliocene. Since the Pleistocene, Karpathos and Kassos have been either a single or two isolated islands with deep straits separating them from Rhodes to the east and Crete to the west (Figure 52a-d).

The Cycladic Plateau is a “marginal platform” with complex geomorphology (Dermitzakis and Papanikolaou, 1981). Until 800ka the *Cyclades* as a single mass were connected to the Anatolian coasts and certain of the Dodecanese islands between Patmos and Amorgos. The main Cycladic landmass was probably constructed in the late Middle Pleistocene and became detached from mainland Greece before the LGM. The separation between the north and south Cyclades occurred by 12ka (Kapsimalis et al., 2009), yet the western islands (*Kythnos, Serifos, Apollonia, Folegandros* and *Milos* together with *Kimolos, Polyaigos* and probably *Antimilos*) seem to have been separated from the eastern island cluster during the Late Glacial of MIS 2 (Figure 52a). *Anafi* and *Astypalaia* have a significantly longer history of insularity, being separated from the Cycladic landmass by MIS 6 (Figure 52b).

Further to the north, the islands of the “northern Sporades”, *Alonnissos, Skopelos* and *Skiathos* formed a single entity until relatively recent, yet the most distant island, *Skyros*, was probably separated since MIS 6 (Figure 52b). By MIS 2, although Skopelos and Skiathos remained connected to Thessaly, the island of Alonnissos may have been insular. During MIS 2 *Ai Stratis* was the northernmost island of the Aegean Sea (Figure 52a).

At the Ionian Sea, the northernmost islands (*Kerkyra, Paxoi, Antipaxoi, Lefkas*) were connected to western Greece throughout the Pleistocene (Sordinas, 1983). Yet, as already discussed, *Kefalonia* and *Zakynthos***,** as well as *Ithaki***,** have been insular either as a single or as separate islands before MIS 2 (Figure 52a-Figure 54) and at least since 100ka (Ferentinos et al., 2012).

3.6. Palaeontological record

The Eastern Mediterranean is a geographic area that has witnessed the migration of mammals (including early hominins) between Africa and Eurasia. The palaeogeographic reconstructions are essential in order to infer both hominin and faunal migration waves and turnovers (Koufos et al., 2005). Although the fossil record is relatively scarce and only few sites have been successfully dated, several attempts to reconstruct the palaeobiogeography have been made. Regional palaeogeography (i.e. geographic barriers such as sea channels and mountains) and climatic conditions affect the migration patterns and routes during the Pleistocene.

The large number of islands and islets in the Aegean has favoured the evolution of island endemic mammals (Sondaar et al., 1986). The decrease in the size of macromammals (e.g. proboscideans and artiodactyls) and the increase in the size of micromammals (e.g. soricomorphs and rodents) is the most diagnostic characteristic of endemism. Such modifications are a result of (Masseti, 2012; Masseti and Mazza, 1996):

i. genetic isolation
ii. quantitative and qualitative reduction in food supply
iii. alteration of intraspecific competition
iv. absence of large carnivores endothermic adaptation (for the micromammals)

Proboscideans of the genus *Elephas (Palaeodoxon)* dated to the Middle and Late Pleistocene have been found on a large number of Aegean islands (Figure 56), i.e. Evia, Crete, Kythera, Kassos Rhodes, Tilos, Kos, Kalymnos, Samos, Ikaria, Chios, Psara, Imvros, Kythnos, Seriphos, Milos, Delos, Naxos, Astypalaia and Imvros (Herridge, 2010; Kuss, 1975; Poulakakis et al., 2002; Sen et al., 2014; Symeonides et al., 2001; Van der Geer et al., 2014).

The dwarf *Mammuthus creticus* found at Cape Maleka, Chania (Figure 57) has not been directly dated, yet it is very probable that it did not have any herbivore mammal competitors on the island, in contrast to the larger-sized *Palaeodoxon antiquus creutzburgi,* which post-dates *M. creticus* and seems to have shared the island with dwarf hippos and deer (Herridge, 2010).

Remains of *Hippopotamus creutzburgi* (Boekschoten and Sondaar, 1966) have been found only on Crete. Specimens from Katharo Basin have been dated via several methods and returned a number of results between 12,135 ± 485 BP (Theodorou and Dermitzakis, 1991) and over 800ka (Herridge, 2010; Marra, 2005; Poulakakis et al., 2006, 2002a).

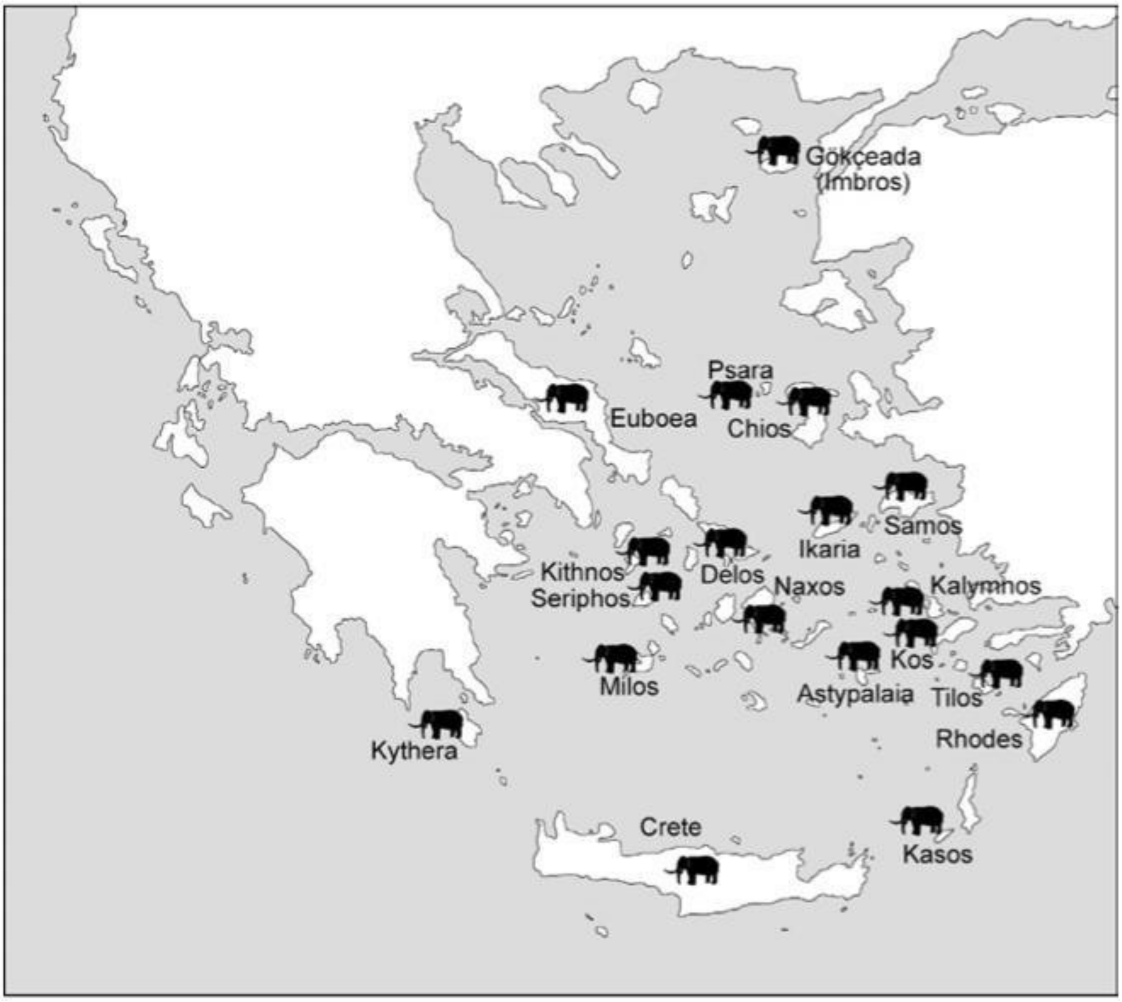


Figure 56: Spatial distribution of *Elephas* fossils in the Aegean Basin (Masseti, 2012, fig. 8)

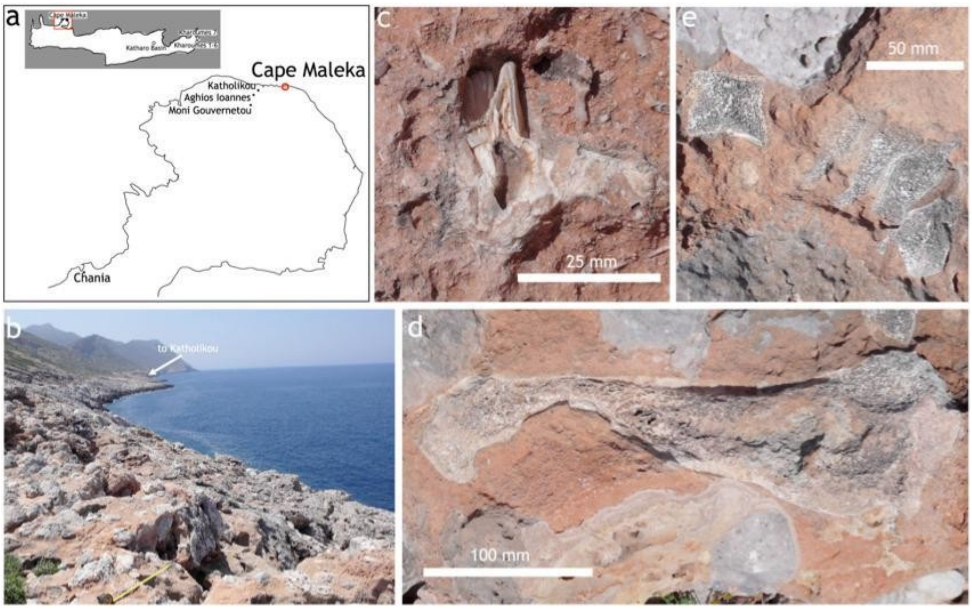


Figure 57: Cape Maleka in NW Crete (a-b) where *M. creticus* was first identified by (Bate, 1907) and fossil fragments of a dwarf proboscidean identified in 2007 by Herridge (2010, fig. A1.9).

Late Pleistocene deer of reduced size have been reported from Crete, Kassos, Karpathos, Rhodes and Amorgos (Dermitzakis and Sondaar, 1978; Kotsakis, 1990; Kotsakis et al., 1979;

Kuss, 1975; Sondaar et al., 1986). The latter is the only evidence of a Pleistocene cervid probably endemic to the Cyclades (Anastasakis and Dermitzakis, 1990). Remains of an endemic deer from Tilos have been dated to 140,000 ± 11,400 / 10,200 BP (Theodorou, 1988).

Endemic murid remains have been found at Naxos, Tilos and Karpathos (Masseti, 2012; Van der Geer et al., 2014). Most of the endemic species of the Aegean islands became extinct before the end of the Pleistocene. It was only the Cretan white-toothed shrew (*Crocidura zimmermanni*), the dwarf elephant of Tilos and a large endemic cricetid (*Mesocricetus rathgeberi*) that persisted into the Holocene (Figure 58).

Thus, in terms of palaeontology, the Aegean islands of Kythnos, Amorgos, Delos, Naxos, Melos, Serifos, Crete, Kassos, Karpathos, Armathia, Rhodes and Tilos are regarded as *oceanic-like* islands as opposed to the *continental* islands (Ghigi, 1950; Masseti, 2012, p. 12). The same applies to Cyprus, where the Late Pleistocene terrestrial mammalian fauna was, however, restricted to four or five endemic species (Simmons, 1999): mouse (*Mus cypriacus*; Cucchi et al., 2006), genet (*Genetta plesictoides*), dwarf elephant (*Elephas cypriotes;* Bate, 1903), dwarf hippopotamus (*Phanourios minutus*) and perhaps a shrew, of which only the mouse is still living in Cyprus today (Vigne et al., 2012).

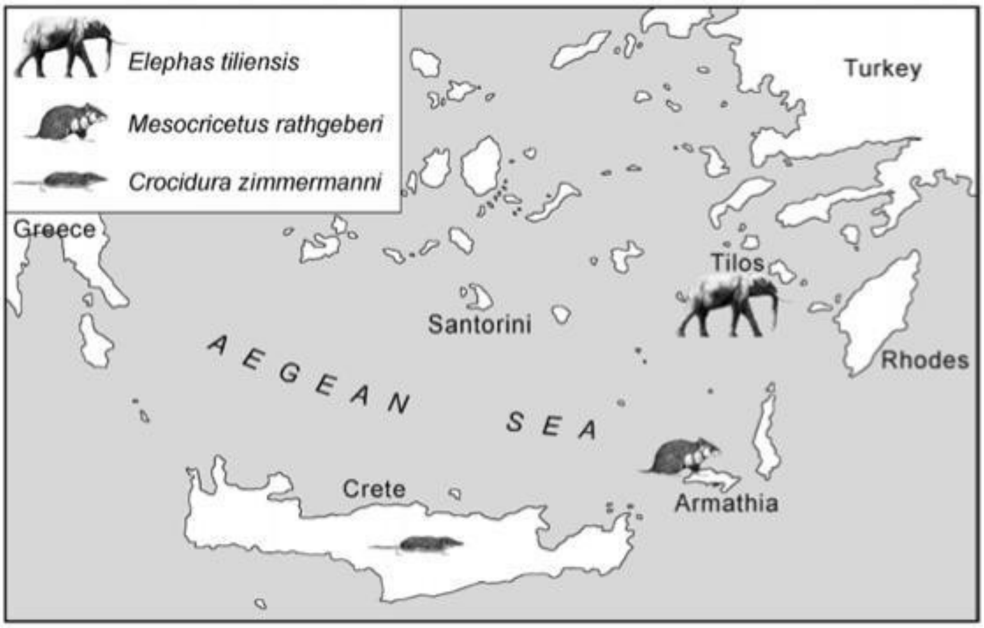


Figure 58: The Holocene endemic mammals of the South Aegean Basin (Masseti, 2012, fig. 16)

On the other hand, the Ionian Sea consists mainly of *continental* islands, "the remains of the stable continental platform now considered as the Pre-Apulian zone which outcrops in the western parts of Lefkas, Kefalonia and Zakynthos” (Masseti, 2012, p. 10). The recent terrestrial fauna of the Ionian Islands have continental characteristics, probably originated from the southern parts of the Balkan peninsula and migrated during the LGM. Non-insular faunal species such as wild boar, deer and carnivores of the Late Pleistocene have been recorded at Kerkyra and these do not differ from their continental counterparts (Caloi et al., 1986; Kotsakis, 1990). The only hippopotamus from Kefalonia (Psarianos, 1953) does not have any pigmy characteristics, as the island rule would connote if it were for an insular individual (Masseti, 2012).

In seeking answers regarding Pleistocene hominin migrations, the data provided by the palaeontological record are of great value not only for the reconstruction of the palaeogeography of the region (e.g. Dermitzakis and Sondaar, 1978), but also for the interpretation of the archaeological record itself. Any archaeological interpretation of early human sea crossings should take into account the migration patterns of large and medium-sized ungulates, such as elephants, hippos and deer (Koufos et al., 2005; Reyment, 1983). It has been proved that hippos (*Hippopotamus*) and, to a lesser degree, elephants (*Elephas*, *Mammuthus*) are good swimmers, with the latter ones capable of crossing up to 50km of sea at a speed of 2.70km/h by using their trunks as snorkels (Johnson, 1980). Deer, such as *Cervus* (Figure 59) and *Megaloceros,* and in rare cases, even bovids (*Bison*) and boars (*Sus*) could cross smaller distances of up to 10 or 20km (Schüle, 1993).

Figure 59: A group of red deer individuals (Cervus elaphus) crossing the open sea. The particular species cannot survive a crossing of more than a few miles of open sea. (Masseti, 2012, fig. 12).

Dispersal patterns can depend on several factors including the island’s size, its distance from other shores, the local climatic conditions, temperature, wind and sea currents, as well as the natural resources of the islands (i.e. springs, flora, fauna and lithic raw material sources), and only by correlating the archaeological and palaeontological evidence are we able to provide solid and cohesive corollaries.

By examining the two big islands of the central Mediterranean, Corsica and Sardinia, as case studies, we see that until the Early Pleistocene these were a single, *continental* island (Palombo, 2006; Sondaar, 2000; Sondaar and van der Geer, 2002). The presence of hyaenids and bovids, species that according to some researchers are unable to swim such a distance, has ruled out the possibility of an overseas colonisation during the Pliocene and Early Pleistocene. Later on, however, during certain periods of the Middle and the Late Pleistocene, Corsardinia as a single island exhibited oceanic characteristics (e.g. Masseti, 2008). At that time, the ancestors of three subtaxa of Lutrinae (*Megalenhydris barbaricina*, *Sardolustra ichnusae* and *Algarolutra majori*) and *Mammuthus lamarmorai* reached the island via sea-routes in periods of lower sea-level (Palombo, 2006). In the case of Sardinia, the arguments for the faunal turnovers of the Late Pleistocene and the early Holocene due to human presence are not widely accepted (e.g. Mannino, 2012; Vigne, 1990). A number of archaeological (Martini, 2009 and references therein), palaeoanthropological and palaeontological (Sondaar et al., 1995, 1986; Spoor and Sondaar, 1986; Spoor, 1999) evidence have been used to support arguments regarding the Pleistocene human presence on Sardinia, yet these remain controversial. Corsica's early prehistory has likewise been a matter of debate (Dawson, 2013 and references therein). Today, the only widely accepted evidence indicates Late Pleistocene sea crossings to the single island of 'Corsardinia' after the LGM (Mussi, 2001; Mussi and Melis, 2002). A crossing of about 15km via the Tuscan Archipelago would be necessary at times of low sea level in order for hominins and faunal species to inhabit Corsardinia; yet strong anti-clockwise currents could make such a crossing a relatively demanding task (Bonifay et al., 1998). The shared biography in terms of the epistemological problems associated with the study of the earliest human occupation of the big islands of the central and eastern Mediterranean is remarkable.

3.7. Palaeoanthropological record

The scarce palaeoanthropological record from Greece consists of a single *Homo heidelbergensis* cranium from Petralona Cave, Macedonia and a small number of *Homo neanderthalensis* fossil remains from the southern parts of the Peloponnese (Table 6). Two crania were found at the caves of Apidima (Pitsios, 1999) and a small number of teeth and cranial and post-cranial bone fragments were during the last decade recovered from Kalamakia Cave (Harvati et al., 2013) and Lakonis rockshelter (Harvati et al., 2003). All are younger than 350ka (Galanidou, 2004; Harvati, 2017; Harvati et al., 2009). It has been argued that the oldest specimen from the Greek mainland might be a single upper third molar from Megalopolis Basin (Sickenberg, 1975; Xirotiris, 1979). An attribution to the Early/Middle Pleistocene and a tentative age of between 300 and 900ka has been proposed for the specimen, however phylogenetic classification is pending (Harvati et al., n.d.; Tourloukis, 2010).

Table 6: The human fossil record from the Greek peninsula (Harvati, 2017, Table 1)

Site	Hominins	Taxon	Age (ka)	Method	Assoc. Lithics
Megalopolis (Peloponnese)	Isolated LUM3	*Homo* sp.	Possibly Early/ Middle Pleistocene	Faunal, Paleomagnetism	–
Petralona Cave (Macedonia)	Petralona cranium	*H. heidelbergensis*	>240 ka	ESR/ U/Th, Faunal	–
Apidima Cave A (Mani)	LAO 1/S1 and LAO 1/S2 partial crania	*H. heidelbergensis*— *H. neanderthalensis*	Late Middle- Early Late Pleistocene	Geomorphology	–
Lakonis Site 1 (Mani)	LKH1, isolated LLM3	*H. neanderthalensis*	42–48 ka (cal)	AMS ^{14}C on charcoal	Initial Upper Paleolithic
Kalamakia Cave (Mani)	KAL1-KAL14 Isolated teeth: LUP3, LUM3, L?UP4, LLP4, RUM2, RLP4, RUI2, LUI1, LUdi2, L?Udi1; occipital fragment; right fibula shaft fragment; subadult lumbar vertebra; left navicular bone	*H. neanderthalensis*	>40–100 ka	AMS ^{14}C on charcoal, U/Th on marine shell	Mousterian
Apidima Cave Γ (Mani)	Partial skeleton LAO 1/S3	*H. sapiens*	Late Pleistocene	–	Possibly Aurignacian

3.7.1. Petralona, Macedonia

An exceptionally well preserved cranium was found in 1959 at the Petralona cavern, situated on the NW end of Chalkidiki peninsula, northern Greece (Kokkoros and Kanellis, 1960; Stringer, 1974; Stringer et al., 1979). A few years later, test trenches were conducted by physical anthropologist A. Poulianos (1980, 1983), who claimed to have found postcranial bones, associated faunal remains and stone tools. A number of issues related to the recovery and publication of the material obscure the stratigraphic correlation and the chronological attribution of the finds (Grün, 1996; Hemmer, 1975; Henning et al., 1982;

Liritzis, 1982; Stringer, 1983; Wintle and Jacobs, 1982). First, the exact spot of discovery is unknown and the calcite encrustation which covers the cranium most probably implies a secondary deposition (A Darlas, 1995; Grün, 1996). Second, the postcranial specimens reported by Poulianos were not identified as such by any of the anthropologists and palaeontologists who examined the collection (Stringer, 1983; Tsoukala, 1991). Thirdly, there has been a long-lasting debate in terms of the age and the phylogenetic attributions of the cranium (Wintle and Jacobs, 1982), yet it has now become widely accepted as part of the *Homo heidelbergensis* lineage, dated between 150 and 350ka (Galanidou, 2004; Grün, 1996; Harvati et al., 2009; Latham and Schwarcz, 1992) most probably older than 240ka (Harvati, 2017). Quartz artefacts reported from the cave have, again, been insufficiently published, yet the long-awaited re-examination of the cave by the Greek Ministry of Culture is about to commence and hopefully several of the issues may be resolved by systematic excavation of the deposits.

3.7.2. Megalopolis, Peloponnese

Geological research at Megalopolis Basin during the 1960s revealed the geological history of the basin and the antiquity of its palaeontological record (Melentis, 1961; Okuda et al., 2002; Siavalas et al., 2009; van Vugh et al., 2000; Vinken, 1965), where Th. Skouphos had already in the beginning of the 20th century spotted the presence of giant and dwarf proboscidean fauna (Skouphos, 1905). The locality, today a lignite mine, was during the Pleistocene a large lake (Vinken, 1965). Fossil specimens belonging to 11 different mammal species were identified by Sickenberg (1975) and, even though these were not found *in situ*, their Early/Middle Pleistocene attribution is supported by palaeomagnetic and ESR studies (Okuda et al., 2002; van Vugh et al., 2000) and their stratigraphic provenance is considered to be secure (Tourloukis, 2010, pp. 111–112). Amongst the faunal specimens, a hominin upper third molar was also identified (Sickenberg, 1975) and examined by means of microscopic and comparative odontometric analysis (Xirotiris, 1979), yet its phylogenetic classification remains unpublished (Harvati et al., n.d.).

3.7.3. Apidima, Peloponnese

Apidima cave complex consists of four caves excavated by the Greek Ministry of Culture between 1978 and 1985 (Pitsios, 1999). Two hominin crania were found at close proximity, the first one *in situ* (Apidima I, LAO 1/S1) and the second one (Apidima II, LAO 1/S2) within the breccia block which was extracted for laboratory cleaning (Harvati and Delson, 1999), both younger than 200ka, probably between *c*. 115ka and 105ka (Coutselinis et al., 1991; Harvati et al., 2011; Pitsios, 1999). Apidima II, the better preserved cranium of the two, was initially classified as archaic *Homo sapiens* by the excavator but later on Harvati et al. (2009), based on multivariate statistical analysis between *Homo heidelbergensis*, *Homo neanderthalensis* and early *Homo sapiens* specimens, proposed that it should better be classified as an early European Neanderthal (Middle Pleistocene). Detailed publications of the excavation and the phylogenetic attributions of the crania as well as radiometric dates are pending and the presence of stone artefacts and faunal remains cannot be securely associated with the hominin remains (Harvati and Delson, 1999; Tsoukala, 1999).

3.7.4. Kalamakia, Peloponnese

A small number of Neanderthal cranial (vault fragment) and post-cranial (a lumbar vertebra, a fibular shaft and a left navicular) bone fragments, including 10 teeth, have been dated at between *c*. 100ka and 39 ka (Darlas and de Lumley, 2004; Harvati et al., 2013). The remains belong to a maximum of 14 and a minimum of eight individuals. The vertebra belongs to a juvenile (6-18 years of age) and the two deciduous teeth (incisors) belong to one or two 6 years old children. As for the adult individuals, the finds represent a number of individuals in their third, fourth and fifth decades of life. Some of them exhibit anthropogenic and carnivore modifications. The latter occurs on the navicular bone and is a result either of a hyaenid or a wolf, both species represented in the faunal database of the cave. Possible rodent gnaw marks have been identified on the fibular fragment. The potential use of toothpicks is testified by the anthropogenic modifications in the form of large grooves on two specimens (KAL5 and KAL8) (Harvati et al. 2013).

3.7.5. Lakonis, Peloponnese

A lower left molar with slight taurodontism, has been found within the Initial Upper Palaeolithic layers, radiocarbon dated to ca. 38-44 C^{14} ka (Elefanti et al., 2009; Harvati et al., 2003; Panagopoulou et al., n.d.). Taurodontism is a common Neanderthal feature (Stringer and Gamble, 1993) (Tattersal 1995; Klein 1999) and only rarely found among modern human populations. This feature together with other metric and non-metric traits argue for a Neanderthal identification for the Lakonis molar (LKH1) (Harvati et al., 2003).

Strontium isotope analysis performed on the LKH1 proved that the particular individual moved within a range of at least 20km during their lifetime (Richards et al., 2008).

3.7.6. Chania, Crete

Despite its rich palaeontological record, the island of Crete has not yielded any palaeoanthropological remains, apart from a single problematic case from a cave site at Chania where specimens attributed to our own species were reported by Simonelli (1897). Consisting of a cranium and a few postcranial fragments the specimens were found cemented in a calcareous breccia. Although the breccia has been dated to about 50ka, the association with the fossils is not clear (Strasser et al., 2010, p. 150).

3.8. Archaeology

A thorough review of the Pleistocene archaeology of the Greek peninsula is out of the scope of this chapter; however a brief synthesis of the major archaeological sites and finds is crucial in order to put the new evidence from the Inner Ionian Archipelago in context.

3.8.1. Middle Pleistocene

Archaeological evidence dating to the Middle Pleistocene is scarce. This consists predominantly of palaeontological remains and a small number of lithic assemblages or isolated finds, often equivocal in terms of their chronological attributions. The first category of evidence includes the Petralona cranium and the tooth from the Megalopolis Basin (see 3.7.1 and 3.7.2). The second category includes lithic assemblages from excavated open-air sites, such as Marathousa, Megalopolis (Panagopoulou et al., 2015) and Rodafnidia at the island of Lesvos with a minimum age of 476,000 ± 62,000 (pIRIR), i.e. MIS13 (Galanidou et al., 2017c, 2013), as well as surface finds from mainland and insular open-air sites (Figure 60). The latter consist of small lithic assemblages or isolated finds which have been attributed to the Middle Pleistocene mainly on typological grounds. Apart from a single stratified biface from the open-air site of Kokkinopilos, Epirus, whose context has been radiometrically dated to about 250ka (Tourloukis et al., 2015), the rest are all unstratified and have been interpreted by various researchers as belonging to either Middle or Late Pleistocene assemblages. These include two more bifaces from Kokkinopilos (Runnels and van Andel, 1993a; Tourloukis, 2009), the single trachyte handaxe from Palaeokastro (Higgs, 1964), the few as yet purely published artefacts from Nea Artaki, Evia (Sarantea-Micha, 1986), a small number of finds from Gavdos island (Kopaka and Matzanas, 2011, 2009) and the recently discovered assemblages from Plakias and Mochlos on Crete (Runnels et al., 2014a, 2014b; Strasser et al., 2010). The geological context of some of the finds from Plakias, in particular, has been dated to the Middle/Late Pleistocene boundary (Strasser et al., 2011). Finally, a recent re-evaluation of the lithic assemblage from Triadon Bay, Milos (Chelidonio, 2001), argued for a Middle Pleistocene attribution (Runnels, 2014a, 2014b), while the newly discovered material from Stelida, Naxos are thought to also include a small number of artefacts with Lower Palaeolithic affinities (Carter et al., 2017; Runnels, 2014b).[16]

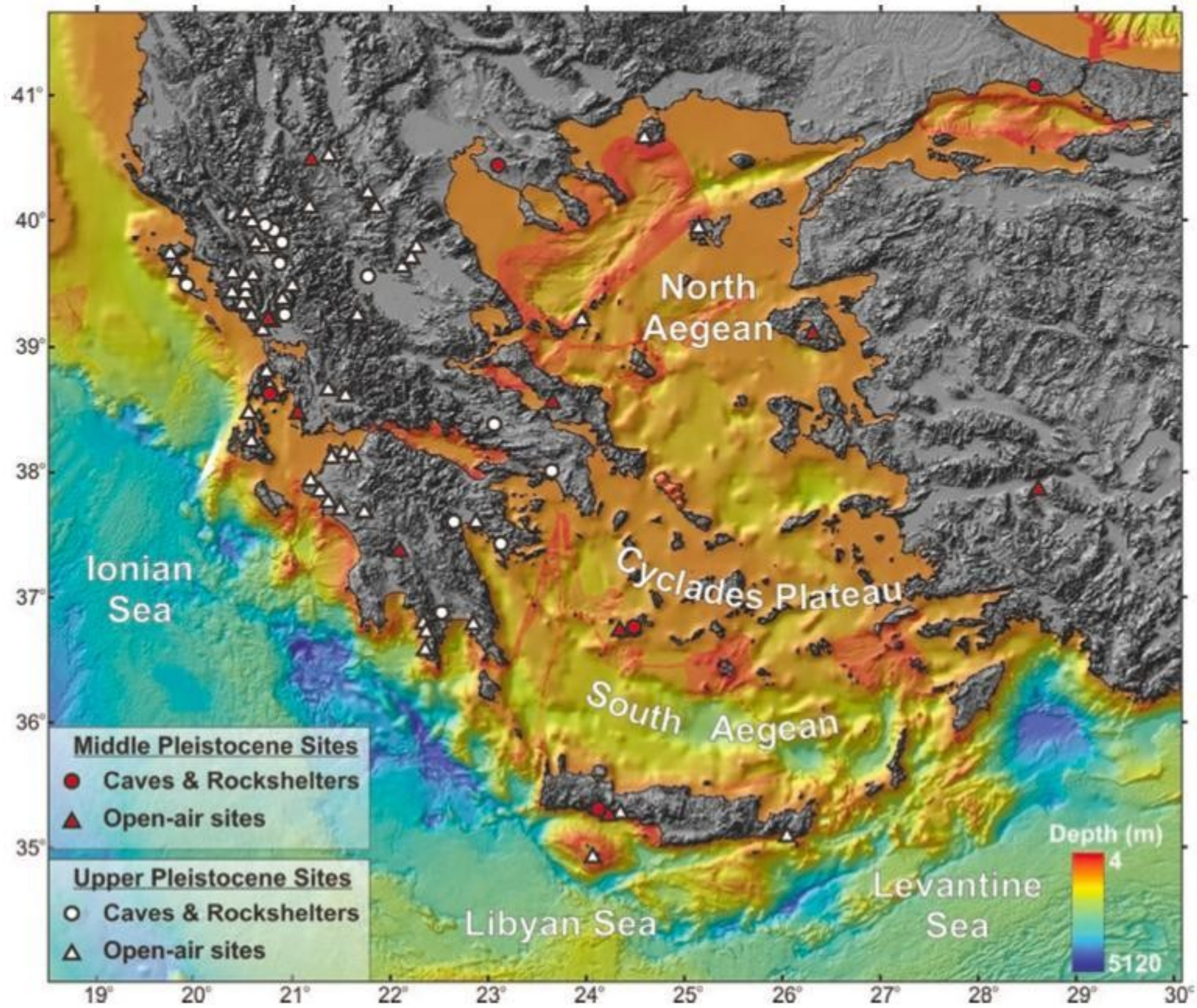


Figure 60: Middle and Late (Upper) Pleistocene excavated sites and surface finds (Sakellariou and Galanidou, 2017, fig. 22.1).

3.8.1.1. Spatial distribution

Based on the limited available information, not much can be said about the spatial distribution of artefacts, sites and hominin groups of the Middle Pleistocene. Taking into account the only palaeoanthropological signals of Middle Pleistocene activity in the region (i.e. the hominin remains from Petralona and the yet to be more precisely classified fossil from Megalopolis), the excavated and radiometrically dated sites (Marathousa and Rodafnidia) as well as the radiometrically dated biface from Kokkinopilos, we may conclude that Middle Pleistocene hominins occupied parts of the Greek peninsula from the northern (Macedonia and Epirus) and the northeastern parts (Lesvos) up to the central Peloponnese

[16] A detailed analysis and critical evaluation of the published material from Crete, Gavdos, Plakias, Milos and Naxos is presented in Chapter 5.

(Megalopolis) (Galanidou et al., 2017c; Higgs, 1964; Panagopoulou et al., 2015; Tourloukis et al., 2015). The Middle Pleistocene map may potentially extend further to the southernmost island of Gavdos, to Naxos in the SE and Palaeokastro in the NW, if on-going and future investigations are able to confirm the arguments for a Lower Palaeolithic presence on those sites (Figure 60).

3.8.1.2. Technology and behaviour

The type-fossil tool of the Lower Palaeolithic, the handaxe, has traditionally been used as an indication for Middle Pleistocene activity at the sites found. In Greece, up until recently, handaxes, and in the broader term, bifaces, were limited in numbers and heteroclite in typological terms, yet they formed the most persuasive and often the only indication for a Lower Palaeolithic age (Galanidou et al., 2016b; Tourloukis, 2010). However, targeted excavation projects in two different parts of mainland (Megalopolis) and today insular (Lesvos) Greece have unearthed assemblages attributed to the Middle Pleistocene, yet of totally different technological choices. This means that while at Rodafnidia, Lesvos, the presence of Large Cutting Tools (LCTs), i.e. handaxes, cleavers and trihedrals (Galanidou et al., 2017c, 2013), accords with the stereotypical morphotypes of the period, the total lack of such tools and the presence of small-sized ("microlithic") artefacts at the excavated layers of Marathousa, Megalopolis (Panagopoulou et al., 2015; Tourloukis et al., 2018), defines the range of the technological and typological repertoires expected to be found at Middle Pleistocene sites in Greece (Papoulia, 2017).

Based on these two sites, another aspect emerges, the strong link with major water resources, i.e., large lakes, at Marathousa and at Rodafnidia, where the presence of hot springs is evident even today (Galanidou, 2014c; Galanidou et al., 2013). Although *Homo heidelbergensis* was, according to the Petralona cranium, one of the species present in the region during the Middle Pleistocene (see 3.7.1), the most enigmatic issue remains the association of the lithic assemblages with specific hominin species.

Based predominantly on the typological and technological affinities of the artefacts, but also on the preliminary dates available, an archaic hominin species, i.e. *Homo heidelbergensis*, *Homo antecessor* or *Homo erectus* has been proposed for the Rodafnidia assemblages' artisans (Galanidou et al., 2013). A similar hypothesis arose from the early dates provided by the Marathousa excavation (Panagopoulou et al., 2015). The biface from

Kokkinopilos has been described as having Lower Palaeolithic typological affinities, thus an archaic hominin lineage was probably implied for its artisan. Yet, an alternative interpretation according to which the Neanderthals may have been the artisans of the particular tool may also be valid (Galanidou et al., 2016b). The persistence of archaic tool types into the Late Pleistocene and even the Holocene is a facet that accompanies the argumentation throughout the present thesis and will be discussed in greater detail in the next chapters.

3.8.2. Late Pleistocene (>LGM)

In contrast to the very limited archaeological dataset for the Middle Pleistocene, that for the Late Pleistocene is strikingly rich. A wealth of archaeological finds and widely distributed sites argue for an intense and persistent occupation by Late Pleistocene hominins. To these, a significant number of palaeoanthropological remains from three sheltered sites situated at the southernmost extreme of mainland Greece unravels the hominin question (See 3.7.3-3.7.5). The Neanderthals are up to date the only hominin species firmly associated with Middle Palaeolithic technology in the region, while a Neanderthal tooth was also found embedded in the same layer with lithic artefacts attributed to an Initial Upper Palaeolithic technocomplex (see 3.7.5).

The sheltered sites of Asprochaliko in Epirus (Bailey et al., 1992, 1983; Dakaris et al., 1964; Higgs and Vita-Finzi, 1966; Huxtable et al., 1992), Theopetra in Thessaly (Facorellis et al., 2013; Panagopoulou, 1999; Valladas et al., 2007), Klissoura (Sitlivy et al., 2009, 2008), Kalamakia (Darlas and de Lumley, 2004, 1999, 1995), and Lakonis (Elefanti et al., 2009; Panagopoulou et al., 2002-2004) in the Peloponnese have all provided Late Pleistocene dates (Table 7). Theopetra, in particular, extends back to *c*. 130ka, thus its Middle Palaeolithic assemblages are as yet the oldest securely dated ones. Footprints, found within the Middle Palaeolithic layers of the cave have been interpreted as belonging to a pre-adult Neanderthal individual (Manolis et al., 2000). The shape of the imprint may hint towards the use of some kind of footwear (Figure 61).

Table 7: Absolute dates from Late Pleistocene cave sites in Greece.

Site	Stratum /Level	Dating Method	Date (BP)	Cultural Dating	Reference
Asprochaliko	18	TL	102,000±14,000, 96,000±11,000	MP	Huxtable et al. 1992
	14	C14	>39,000	MP	Bailey et al. 1983
	10	C14	26,100±900	UP (Gravettian)	Bailey et al. 1983
Theopetra	II2	TL	124,000±16,000	MP	Valladas et al. 2007
	II4	TL	129,000±13,000	MP	Valladas et al. 2007
	II11	TL	57,000±6000	MP	Valladas et al. 2007
	II11	C14-AMS (A-BOX)	45,750±750	MP	Facorellis et al. 2013
Klissoura 1	XXc	C14-AMS (A-BOX)	60,250±2700	MP	Kuhn et al. 2010
	XVII	C14-AMS (A-BOX)	62,290±3930, 56,140±1450	MP	Kuhn et al. 2010
	VII	C14-AMS (A-BOX)	48,990±1770	MP	Kuhn et al. 2010
	V	C14, C14-AMS (A-BOX, ABA)	40,100±740, 29,660±360	Early UP (Uluzzian)	Kuhn et al. 2010
	IV-IIIg	C14, C14-AMS (A-BOX)	33,150±120 - 30,925±420	Early UP (Aurignacian)	Kuhn et al. 2010
Kalamakia	II	U/Th	109,000+14,000/-13,000	MP	de Lumley et al. 1994
	IV	C14-AMS	≥39,000	MP	Harvati et al. 2013
Lakonis	IV	TL, U-series	120,000-130,000	MP	Panagopoulou et al. 2002-2004
	Ib	C14	39,640±1000	MP	Elefanti et al. 2009
	Ib	C14-AMS	43,335±1800, 43,150±1790	MP	Elefanti et al. 2009
	Ia	AMS (charcoal)	44,450±2330, 38,240±1160, 42,800±1700 (48,000 – 42,000 calBP)	Initial UP	Elefanti et al. 2009
Franchthi	Q	C14-AMS (A-BOX, ORAU)	34,960±220 - 29,780±160	Early UP (Aurignacian)	Douka et al. 2011
	R	C14-AMS (ORAU)	41,080±390 - 23,150±90	Early UP (Aurignacian)	Douka et al. 2011
Skoini 3		AMS (charcoal)	25,560±190	UP (Gravettian)	Darlas and Psathi 2008
Skoini 4		AMS (charcoal)	26,240±200	UP (Gravettian)	Darlas and Psathi 2008
Kolominitsa	6	AMS (charcoal)	33,870±550 (40,390 - 37,180 calBP)	Early UP (Aurignacian)	Darlas and Psathi 2008, Darlas and Psathi 2017
	11	AMS (burnt bone)	34,320±250 (40,040 – 38,730 calBP)	Early UP (Aurignacian)	Darlas and Psathi 2017
	16	AMS (charcoal)	37,840±300 (42,800 – 42,020 calBP)	Early UP (Aurignacian)	Darlas and Psathi 2017
	18	AMS (charcoal)	34,150±280 (39,650 – 38,610 calBP)	Early UP (Aurignacian)	Darlas and Psathi 2017

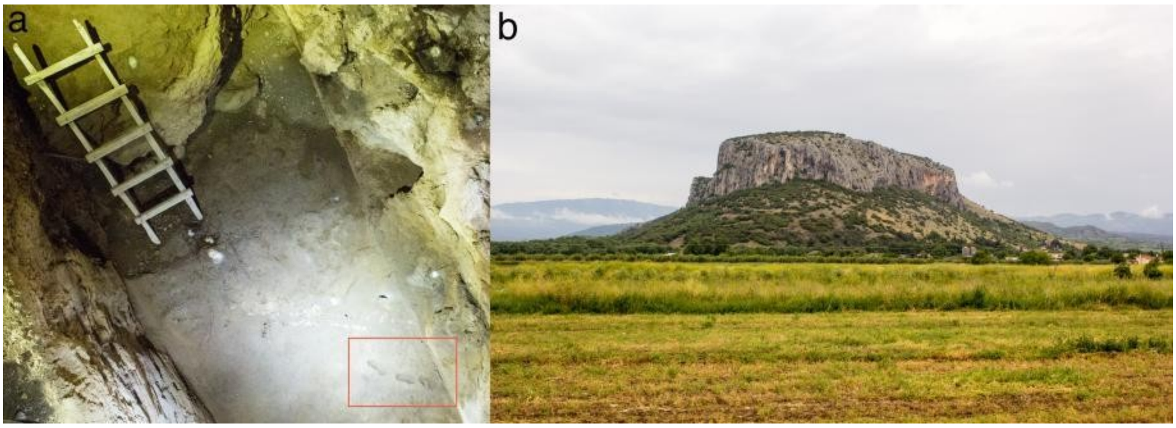


Figure 61: Footprints (a) from the Middle Palaeolithic layers of Theopetra Cave, Thessaly (b) (photos: C. Papoulia, April 2016).

Finally, the identification of Aurignacian assemblages in limited cave and open-air sites in the Greek mainland speak for the first appearance of Modern Humans in Epirus and the Peloponnese, after c. 40ka BP (Darlas and Psathi, 2017, 2008; Douka et al., 2011; Kuhn et al., 2010). In the absence of well-dated stratified assemblages, the carinated endscraper is often used as an index type for the attribution of an assemblage to the Aurignacian (e.g. Carter et al., 2017; Darlas, 1999; Forsén et al., 2016; Ligkovanlis, 2011; Runnels et al., 2003). Nonetheless, it has to be stressed that the particular "culture" as well as its artisans in the context of the Greek Early Upper Palaeolithic are not that well understood yet. Furthermore, the Uluzzian, an early Upper Palaeolithic technocomplex, well documented in Italy (Palma di Censola, 1965; Riel-Salvatore and Barton, 2004), is yet to be more precisely defined in Greece, where technological features attributed to the particular industry (arched backed blades) are almost exclusively found in layer V of Klissoura cave 1 (Koumouzelis et al., 2001; Kuhn et al., 2010; Sitlivy et al., 2008).

3.8.2.1. Spatial distribution

A striking difference in the available datasets between the Middle and the Late Pleistocene spatial distribution of sites is evident (Figure 56). There is a pronounced concentration west of the Pindus mountains with numerous open-air *terra rossa* sites situated in NW Greece, from Epirus (Galanidou et al., 2016b; Ligkovanlis, 2011; Papaconstantinou and Vasilopoulou, 1997; Papagianni, 2000; Papoulia, 2011) to Achaia in the Peloponnese (Andreas Darlas, 1995; Darlas, 1999). Open-air sites on the mainland (Plastiras Lake sites, Aliakmon River sites) and on present-day islands, which would during the Middle Pleistocene be part of the mainland, such as Kerkyra and Lefkas, add to the abundance of evidence in NW Greece (Apostolikas and Kyparissi-Apostolika, 2008; Dousougli, 1999;

Galanidou, 2016; Galanidou et al., 2016a; Harvati et al., 2008; Papagianni, 2000; Sordinas, 1969). Another area rich in Middle Palaeolithic finds is the Mani peninsula (Darlas and de Lumley, 2004; Harvati et al., 2013; Panagopoulou et al., 2002-2004; Tourloukis et al., 2016). Caves, rockshelters and open-air sites have yielded material remains, including lithics, fossils, faunal and floral remains. Isolated cave sites around mainland Greece, from Thrace (Maara), to Thessaly (Theopetra), Epirus (Asprochaliko) and the Peloponnese (Klissoura Cave 1) provide important information in terms of Late Pleistocene technology and behaviour and broaden the occupation and activity network (Trantalidou and Ntarlas, 1995; Darlas, 2007; Huxtable et al., 1992; Manolis et al., 2000; Panagopoulou, 1999; Papaconstantinou, 1988; Sitlivy et al., 2009, 2008; Starkovich, 2012; Valladas et al., 2007).

3.8.2.2. Technology and behaviour

Earlier interpretations of Neanderthal adaptations envisioned them confined to lowland sites, either coastal or mainland ones. However, the presence of diagnostic lithic assemblages on higher altitudes (800masl) such as the Plastiras Lake (Apostolikas and Kyparissi-Apostolika, 2008) or at the alpine environments (1400-1900masl) of the Pindus mountain range (Efstratiou et al., 2011, 2006; Galanidou and Efstratiou, 2014) expands their spatial distribution map in upland locations and is principally a testimony of their adaptability to diverse environments. The mobile lifestyle of the Neanderthals is further implied by the use of non-local raw materials and testified by the strontium isotope analysis of the LKH1 tooth (see 3.7.5).

Direct evidence of Neanderthal fossils indicate that they lived in sheltered dwellings, today situated in the southernmost extremes of the mainland, i.e. Mani peninsula (Harvati et al., 2013, 2003), they produced the well-known Mousterian flake tools, they made use of the Levallois prepared core technique (Darlas, 2007; Papagianni, 2000), and they utilised a variety of raw material sources, predominantly local but also non-local ones. They survived in these locations at least until *c*. 40ka, they made use of marine resources as blanks for scrapers (Darlas and de Lumley, 2004, 1999; Douka and Spinapolice, 2012) and seem to have produced stone tools with Upper Palaeolithic characteristics as well (Elefanti et al., 2009; Panagopoulou et al., 2002-2004.).

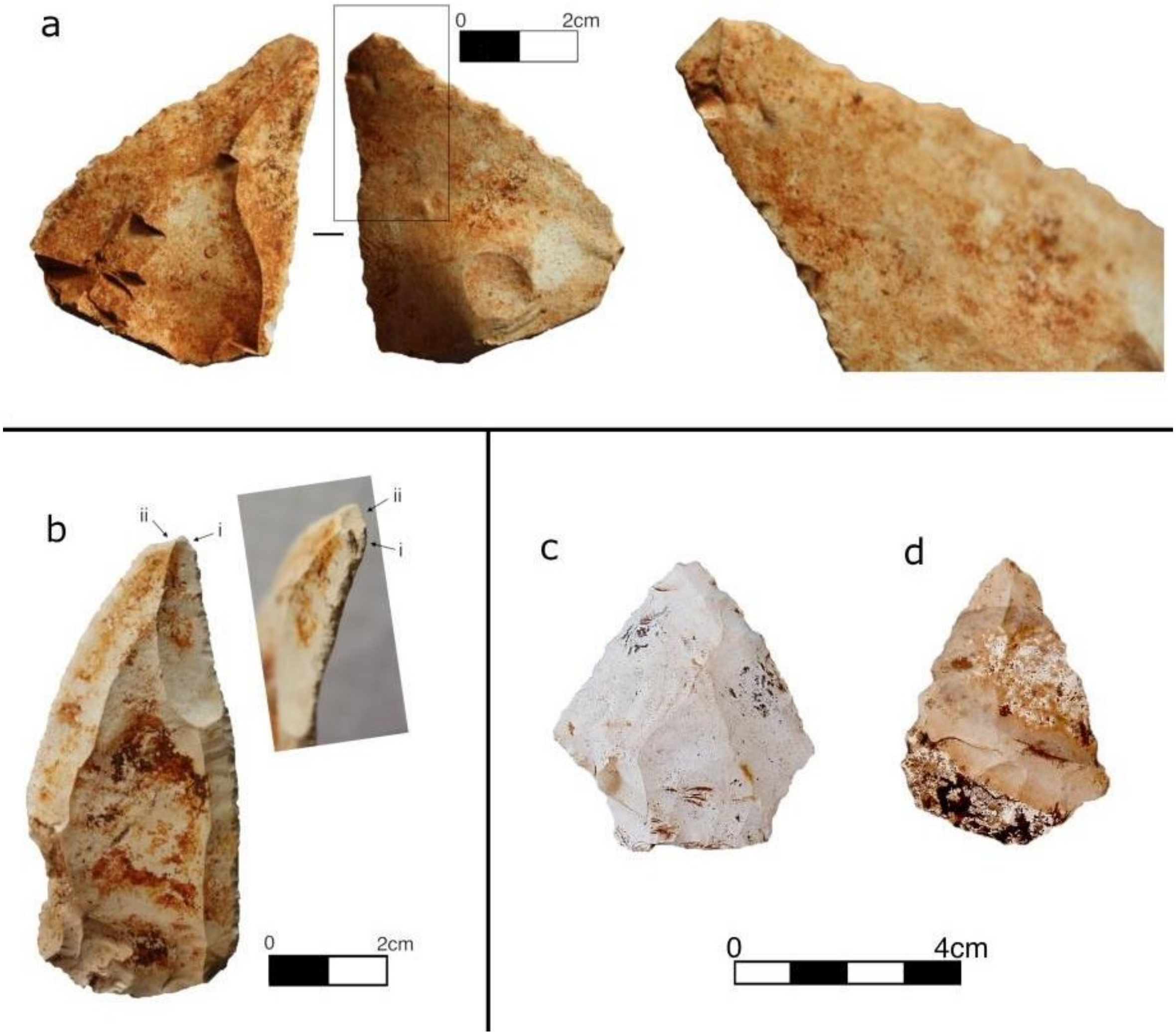


Figure 62: A pseudo-Levallois point (a) and a Levallois point (b) with macroscopically visible fractures at their distal ends, on the inverse and dorsal face respectively, a tanged Mousterian point (c) and a Levallois point (d) with proximal modification/thinning. All are heavily patinated surface finds from the open-air Middle Palaeolithic site of Mikro Karvounari, Epirus, NW Greece (Photos: C. Papoulia, modified after Papoulia, 2018a, figs. 2–4).

The lithic assemblages from the Aegean Basin sites conform to the technological schemes and tool repertoires of several Middle Palaeolithic sites in Europe and the Levant (e.g. Darlas, 2007; Papagianni, 2000; Tourloukis et al., 2016). Although there is no evidence of organic material used as adhesive for hafting and no microscopic use-wear studies on points have yet been published, in all probability, the presence of numerous pointed tools in several Middle Palaeolithic sites in Greece imply spear-hunting. The identification of macroscopically visible fractures, possible impact scars (Figure 62a-b), on certain of these artefacts further validates such assumptions, and the presence of proximal modification (Figure 62c-d) may often be a hint for the hafting of the stone tip on a shaft (Papoulia, 2018a; Papoulia, 2011).

Strong social bonds and cooperation is one of the prerequisites for successful hunting of large mammals. The presence of hearths in caves and rockshelters, where faunal remains are also quite often burnt (Darlas & De Lumley 1999; Panagopoulou et al. 2002-2004; Sitlivy et al. 2009; Starkovich 2012; Tourloukis et al. 2016), imply communal activities and social interaction within the groups of Middle Palaeolithic hominins.

3.8.3. Final Late Pleistocene (<LGM) / Early Holocene

The final part of the Late Pleistocene is exclusively associated with our own species, *Homo sapiens*. A number of cave sites and a few yet enlightening open-air sites document the final parts of the Late Pleistocene, i.e. after the LGM, in the archaeological record of Greece. The cave sites of Epirus (Kastritsa, Klithi, Boila), and the Peloponnese (Franchthi, Klissoura 1, Kephalari, Melitzia, Tripsana, Skoini) provide valuable information about the Upper Palaeolithic lifestyle in these two regions (Adam, 2007, 1989; Bailey, 1997; Bailey et al., 1983; Darlas and Psathi, 2017, 2008; Douka et al., 2011; Galanidou, 1997; Jacobsen, 1981; Jacobsen and Farrand, 1987; Kotjabopoulou et al., 1999; Kotjabopoulou and Adam, 2004; Koumouzelis et al., 2001; Sitlivy et al., 2008).

A marked spatial diffusion took place during the end of the Late Pleistocene and into the early Holocene, one that included high mountaintops and distant islands. Organised travels crossing the open-sea began during this period. Primarily caves but also open-air sites seem to have been occupied during this period when the palaeogeographic configuration was much more similar to the present day one, spanning the whole area of the Aegean region, from Kerkyra to the islands of the NE Aegean Sea and from Macedonia to Crete and Gavdos (Kopaka and Matzanas, 2011; Carter et al., 2018, 2016, 2014, Efstratiou et al., 2014, 2013; Galanidou, 2011b; Galanidou and Papoulia, 2016; Kaczanowska and Kozlowski, 2008b, 2014, 2008a; Panagopoulou et al., 2001a; Runnels and van Andel, 2003; Sampson et al., 2012, 2010, 2002, Sordinas, 2003, 1970a; Starkovich, 2014; Strasser et al., 2015, 2010; Tourloukis and Palli, 2009).

The recently excavated cave at Schisto, Attica, has, among other things, offered one of the oldest evidence of obsidian transportation in the Aegean, together with Franchthi Cave, Argolis (Laskaris et al., 2011). The case of obsidian circulation, thus of late Upper Palaeolithic seafaring, remains the strongest amongst the academic community. Architectural remains (stone structures of ellipsoidal and circular shape) found at the open-air site of Maroulas, on the island of Kythnos, undoubtedly testify the occupation of islands since the Mesolithic (Sampson et al., 2010). Mesolithic burials have been found at the open-air site of Maroulas, and at two cave sites, at Theopetra, Thessaly, and Franchthi, Argolid (Cullen, 1995; Manolis and Stavropodi, 2003; Sampson et al., 2010). These remain the oldest burials yet found in the Greek peninsula. Finally, as expected, marine resources (fish and molluscs) were part of the dietary life of the Mesolithic inhabitants of the Aegean (Mylona, 2014).

3.9. Conclusions

Chapter 3 has provided the palaeoenvironmental, palaeontological, palaeoanthropological and archaeological framework so that the evidence coming from the Inner Ionian Sea Archipelago (IISA) may be placed in the appropriate environmental and cultural context. Chapter 4 presents the new lithic collections collected from the isles and islets of the IISA between 2010 – 2011. It provides a detailed analysis of their macroscopically observed morphological and technological characteristics in order to identify the occupational and behavioral patterns and discuss the possible hominin (terrestrial and marine) dispersal scenarios to and from each island of the IISA during the Pleistocene.

4. The Inner Ionian Sea Archipelago (IISA) as a case study

4.1. The Inner Ionian Sea Archipelago (IISA)

4.1.1. Geography and environment

The Inner Ionian Sea Archipelago (IISA) covers an area of approximately 1,021km^2 (IndiSeas, n.d.) and consists of seven islands (Meganissi, Kalakos, Kassos, Atokos, Arkoudi, Scorpios, Kythros) and several smaller isles and islets (including Tsokari, Cheloni, Maduri, Sparti, Petalou, Megali Formikoula, Mikri Formikoula, Thilia). Further to the SE, at the borders of the archipelago and very close to Astakos, 20 isles and islets form a separate island cluster, called Echinades. The archipelago is delimited by Lefkas Island on the northwest, the western coasts of Central Greece (Aetoloakarnania) to the east, and the northern tips of Kefalonia and Ithaki islands to the SW, all together forming a semi-enclosed, relatively "protected" seascape (Figure 63).

Figure 63 (left): The Inner Ionian Sea Archipelago (IndiSeas, n.d.).
Figure 64 (right): Posidonia beds (IndiSeas, n.d.).

The Inner Ionian Sea, itself, is quite shallow, ranging in depth between 100 – 200m. The sea floor at a depth between 1 and 30m is covered by sea-grass meadows, i.e. *Posidonia oceanica* and *Cymodocea nodosa* (Figure 64) (Haritonidis and Tsekos, 1976; Zenetos et al., 1997). An area covering 883.3327 km^2 (longitude: 20.836944, latitude: 38.579444) was proposed by the Hellenic Ministry of the Environment (1996) and accepted (2006) as a site of community importance (SCI) and designated as Special Area of Conservation (SAC) in the NATURA 2000 Network under the European Commission Habitats Directive with code number GR2220003 (Figure 65).

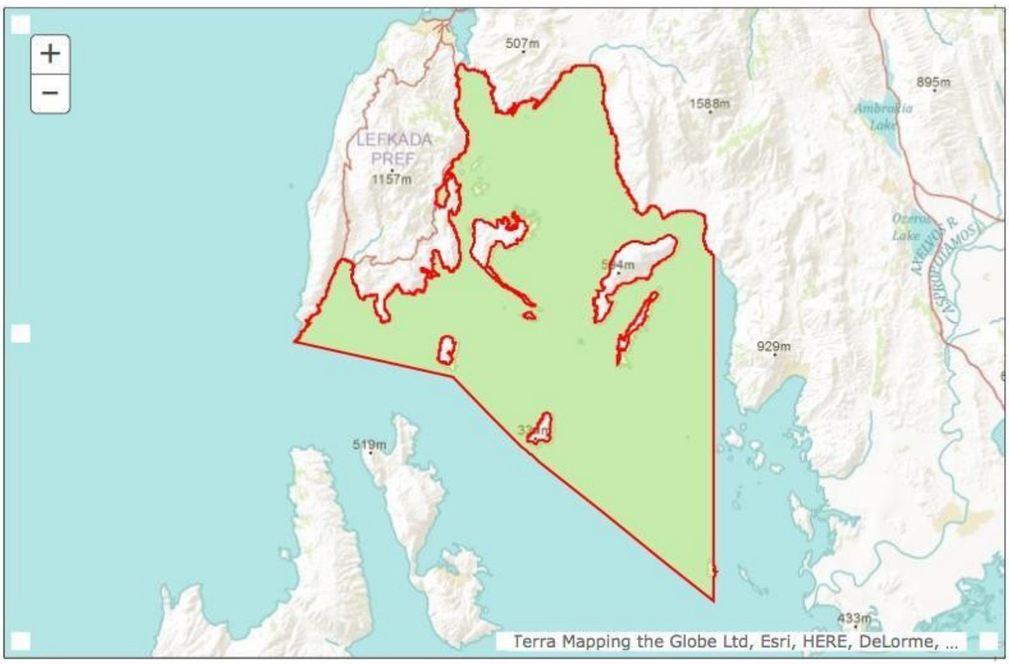


Figure 65: The area of the Inner Ionian Archipelago included in the NATURA 2000 Network (Natura, 2000).

According to the ecological assessments by NATURA 2000 the archipelago consists of six types of habitats:

1. *Posidonia* beds (*Posidonion oceanicae*) [Habitat code: 1120]
2. Coastal lagoons [Habitat code: 1150]
3. Reefs [Habitat code: 1170]
4. Coastal dunes with *Juniperus* spp. [Habitat code: 2250]
5. *Sarcopoterium spinosum phryganas* [Habitat code: 5420]
6. Submerged or partially submerged sea caves [Habitat code: 8330]

The archipelago is today influenced by 4 main water masses: the North Atlantic Water (NAW), the Ionian Surface Water (ISW), the Levantine Intermediate Water (LIW) and the Deep Water (DW). The NAW and the ISW extend from the surface to about 60 m but while NAW consists mainly of water saturated in oxygen, low in salinity and poor in nutrients, ISW is saltier and warmer and flows in the area only in the summer time. The LIW occupies subsurface layers (80–150m) and is characterized by higher salinities and nutrients, while the DW is colder and more uniform water that extends from the lower part of the LIW down to the bottom (Bousoulenga et al., 1990; Malanotte-Rizzoli et al., 1998; Psyllidou-Giouranovits et al., 1994; Ramfos et al., 2006). The area is also influenced by cyclonic and anticyclonic gyres (IndiSeas, n.d.; Souvermetzoglou et al., 1992).

The islands surveyed range from significantly or moderately mountainous (e.g. Meganissi, Atokos), to totally flat (e.g. Petalou). The most mountainous island of the survey region is Atokos, while the biggest one is Meganissi (Figure 66).[17] Meganissi is of an overall C shape, with a quite steep NW coast ending in smooth, denticulated bays to the NE of the island. This part of the island is also associated with lagoons and wetlands, as is also the case with the NE part of the neighbouring larger island of Lefkas (Galanidou et al., 2016a). A characteristic feature of Meganissi is its "foot", en elongated, narrow strip of land extending NW-SE from about the central part of the island to its southern ends. Just off the SE coast of Meganissi and at a very close distance from it, lays the much smaller island of Kythros. The two southernmost islands of Arkoudi and Atokos are similar in size, while all other isles and islets are significantly smaller. The main ecological habitats on the islands consist of maquis shrublands, ponds surrounded by maquis, olive groves and grazing land (Tzortzakaki, 2012).

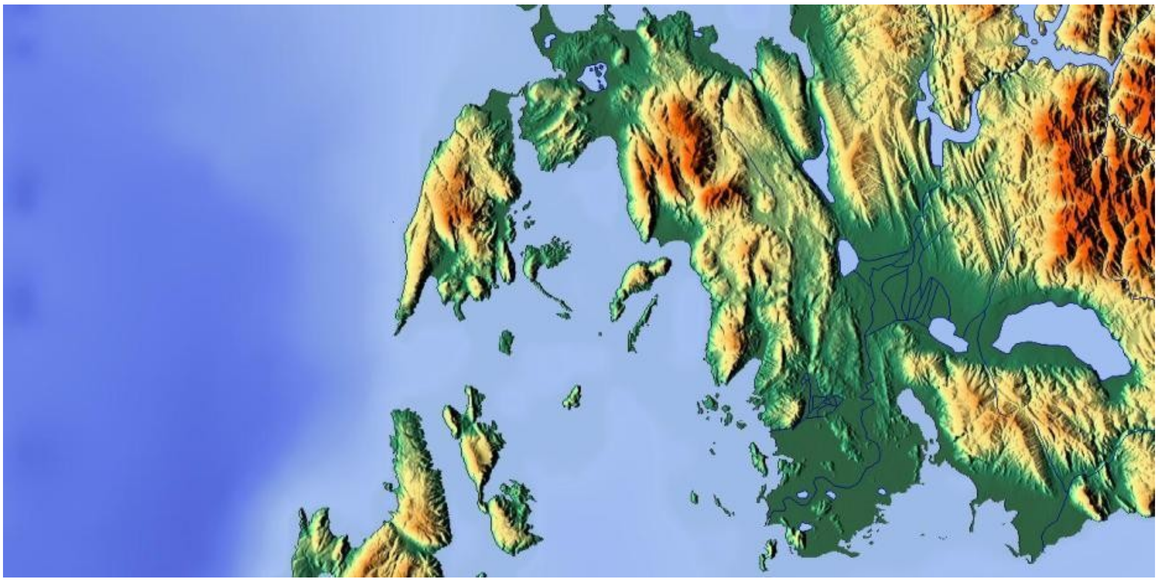


Figure 66: The IISA islands, situated between the SE of Lefkas, the NE of Ithaki and the west coasts of Akarnania. Atokos and Meganissi are the most mountainous islands of the archipelago.

4.1.2. Geology

The IISA, situated at the western border of the active Hellenic Arc, is part of the most tectonically active region of the NE Mediterranean (Figure 67). The African plate, the Adriatic microplate and the Aegean microplate form different types of boundaries, by collision, subduction, transform faulting and spreading. This multiple plate junction to the

[17] Although the initial aim was to include the two easternmost islands of Kalamos and Kastos, due to time limitations these were ultimately not included in the survey project (Galanidou, 2015, 2014b).

west of the Ionian islands is the major controlling factor for the geological and tectonic evolution of the region (Sachpazi et al., 2000; Sakellariou and Galanidou, 2016; Vött, 2007).

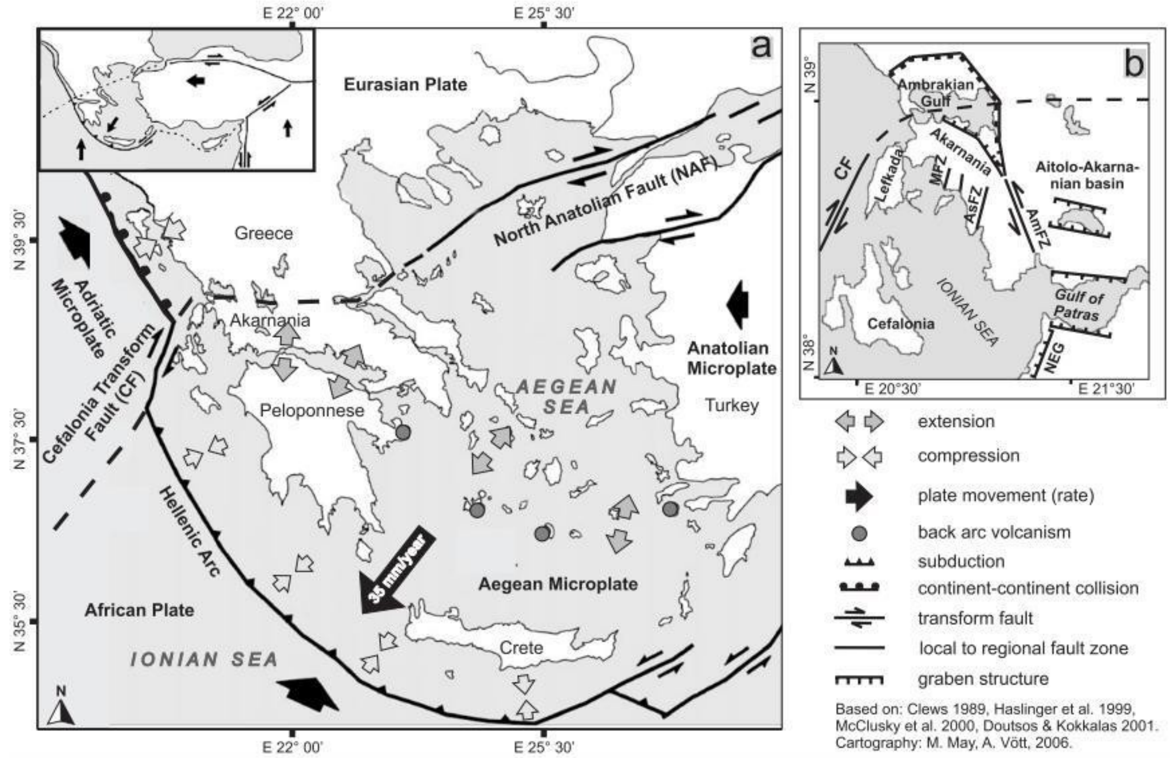


Figure 67: Plate boundaries and geodynamic pattern of the Aegean region. CF=Cefalonia Transform Fault, AmFZ=Amfilochia Fault Zone, AsFZ=Astakos Fault Zone, MFZ=Mytikas Fault Zone, NEG=Northern Elis Graben (Vött, 2007, fig. 2)

The archipelago constitutes part of the Ionian Margin. Its stratigraphic sequence starts with basal Triassic evaporites (up to 3.5 km thick), followed by dolomites and limestones (3km thick) formed on top of large carbonate platforms during the Triassic and the Tertiary. Over the course of the Eocene, the environment changed into a deep oceanic trough, where 2km of clastic sediments of the Western Hellenic Flysch, mostly clay, silt and sand, were deposited. At the Akarnanian coast, the flysch unit is mostly made up of fine grained marly sediments (Jacobshagen 1986 as cited in Vött, 2007). At the interface of the Mesozoic limestones with the Eocene-Oligocene flysch and the Mio-Pliocene clastic formations, numerous karstic springs occur. Large underwater springs have been identified at the western coasts of Akarnania, as well as further south, at the east coasts of Kefalonia (Figure 68). The calcareous composition of the sedimentary rocks of the Ionian Margin, and the dissolution of limestones in particular, also favours the formation of karstic caves (Sakellariou and Galanidou, 2016). This is why a large number of coastal or, now, submerged caves are encountered around the coasts of many of the islands of the archipelago (Figure 69).

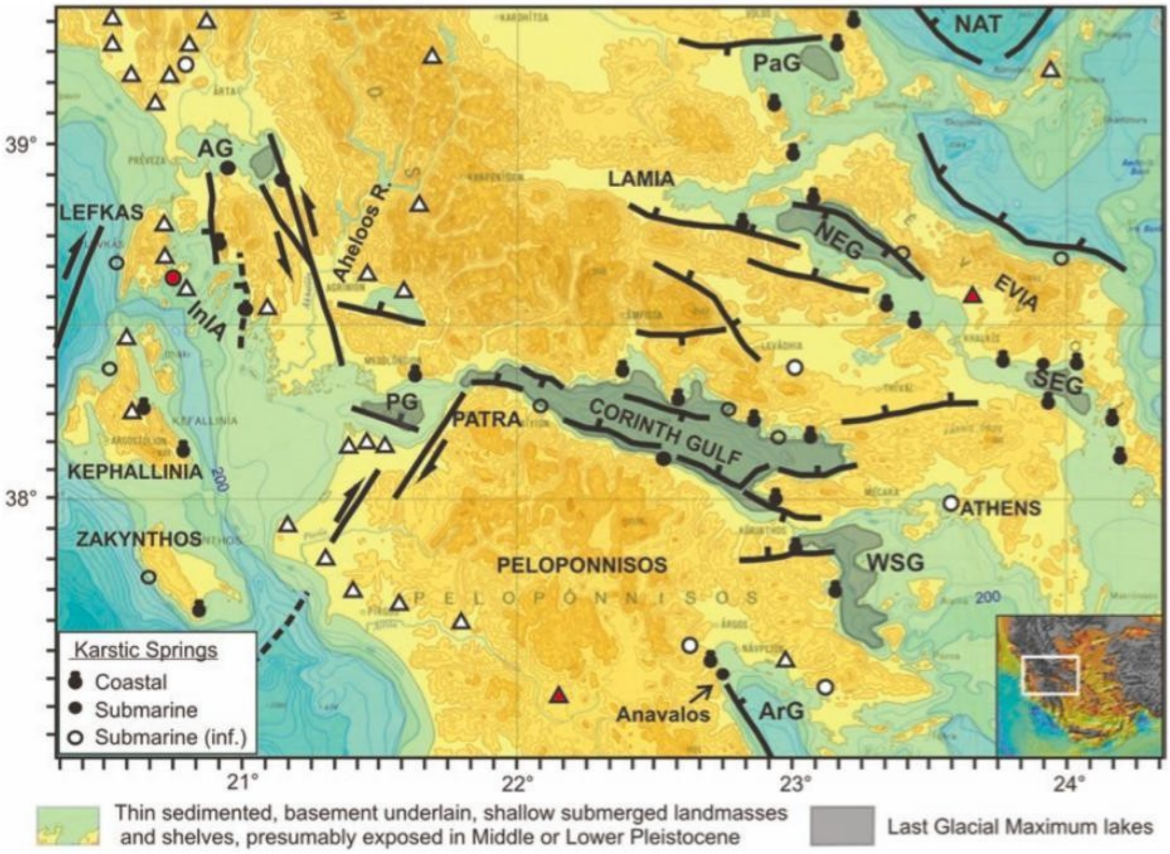


Figure 68: Bathymetry and morphology of Central Greece (IOC 1981) with major faults, Palaeolithic sites (triangles=open-air sites, white circles=caves), coastal and submarine springs, and LGM lakes (grey areas). AG=Ambrakikos Gulf, InIA=Inner Ionian Archipelago, PG=Patras Gulf, NAT=North Aegean Trough, PaG=Pagasitikos Gulf, NEG=North Evia Gulf, SEG=South Evia Gulf, WSG=West Saronic Gulf, ArG=Argolikos Gulf (Sakellariou and Galanidou, 2017, fig. 22.7).

As it has already been discussed (see Chapter 3) during times of glacial maxima, the climate was extremely cold and arid and the sea-level dropped significantly lower (up to a maximum of about -120m). Thus, the archipelago which is today flecked with isles and islets would have been largely a coastal area connecting Akarnania and Lefkas. Yet, according to the latest results of bathymetric, coastal and sea bottom geomorphology studies (Ferentinos et al., 2012; Zavitsanou, 2016; Zavitsanou et al., 2015), two of the islands surveyed were indeed insular during particular time spans within the chronological framework which interests us. This issue, due to its major significance in terms of the hominin dispersal patterns in the region, is being further discussed towards the end of the chapter (4.6).

Figure 69: «Papanikolis» partially submerged cave, Meganissi. Photos: C. Papoulia, July 2010.

4.2. Introduction to the Survey Project

The Inner Ionian Sea Archipelago Project is an interdisciplinary survey project that seeks to investigate the diachronic human presence on the islands of the Inner Ionian Sea Archipelago and the connections between these islands, the island of Lefkas and the western coasts of Aetoloakarnania. The first pilot visit to the islands of Meganissi, Kythros and Formikoula was conducted in 2009 by the archaeologists of the 36th EPCA of the Greek Ministry of Culture, Vivian Staikou, Varvara Giza and Katerina Leontariti together with Dr Nena Galanidou (project director) and the author from the University of Crete. An extensive field survey was conducted in the course of two field seasons during the summers of 2010 and 2011 on Meganissi and its satellite islands, namely Thilia, Kythros, Tsokari, Petalou, Nisopoula, Formikoula, Sparti, Alafonissi, Skorpidi as well as on Atokos and Arkoudi, two islands situated at the SW part of the IISA and closer to the larger island of Ithaki (Figure 70). During the second field season (2011) two test trenches were excavated on Kythros and in 2013 two more trenches were excavated at the site of Kefali, situated at the southern part of Meganissi Island. Since 2015, as part of a separate University of Crete project, an excavation of a collapsed cave at the northern part of Kythros is underway (Galanidou, 2018).

Figure 70: The isles and islets of the Inner Ionian Sea Archipelago (IISA) are enclosed by the islands of Lefkas (NW), Kalamos and Kastos (E), Ithaki and Kefalonia (SW) (Galanidou, 2014b, fig. 1).

The interdisciplinary project included archaeological, palaeogeographic, historical and anthropological research. A large number of students participated in the field-walking and the data processing within the IISA project, which also forms part of the field-training program of the Department of History and Archaeology of the University of Crete (Galanidou, 2015, 2014b, 2018; Galanidou et al. 2017b).

According to the portable finds, the majority of the islands of the archipelago were occupied since the Middle Palaeolithic period up to modern times. Most finds collected are lithic artefacts attributed to the Palaeolithic, the Mesolithic, the Neolithic and the Bronze

Age (Galanidou et al., 2017b; Galanidou, 2015, 2014b, 2011b, 2011a, 2018). Apart from the large number of lithics, a significantly smaller amount of pottery dated to the Final Neolithic, the Bronze Age, the Classical, Hellenistic and Late Roman periods (Morgan and Forsén *in preparation;* Galanidou et al., 2017b) and a large quantity of Medieval and post-medieval as well as modern wares were also recorded (Vroom and Veikou *in preparation;* Galanidou et al., 2017b).

According to the preliminary analysis of the evidence, four types of archaeological sites have been identified on the islands of the IISA (see Galanidou, 2011a, 2018). These are:

i) Palimpsests of large (in number and extent) concentrations of industries of knapped stone lacking pottery
ii) Concentrations of pottery sherds, either associated with architectural remains or not
iii) Megalithic tomb monuments
iv) Sites with modern remains (cisterns, threshing floors, windmills etc.).

In the course of the interdisciplinary study of the first type of the aforementioned sites, i.e. the ones consisting of large amounts of lithic finds, the collaboration with a number of geologists allowed further refinement of the archaeological record. In particular, a lithological study of the raw material sources for the production of stone tools constituted the core of an MSc thesis conducted at the Department of Geology of the National and Kapodistrian University of Athens (Chatzimpaloglou, 2014). Chatzimpaloglou (2014; see also Magganas et al., in press) concluded that the specimens he studied derive from the cherts of Malm – Turonian and Eocene, found at the island of Meganissi (Figure 71). Beyond relative dating of the finds, sediments from Pleistocene and Early Holocene sites on Kythros and Thileia were sampled for OSL dating in collaboration with the NCSR Demokritos (Galanidou, 2015, 2014b, 2011a, 2018).

In a larger scale, geological, geomorphological and stratigraphic studies were conducted in parallel with field walking, covering both the wider landscape and the major archaeological sites. Locales of geological interest (geosites) such as folds, flint sources, rock formations, caves and other karstic features were mapped (Koussis, 2013; Magganas et al., in press). The islands' flora, fauna and wetlands were also documented, emphasising the extent of biodiversity (Tzortzakaki, 2012).

The many modern agricultural remains still observable on the islands were the focus of ethnoarchaeological studies (Kapetanios, in preparation; Koutsoumpos and Galanidou, 2015), while an anthropological approach (Nazou *in preparation*) combined archival research and interviews with the inhabitants of Meganissi in order to address the manifold changes in the behavioural patterns caused by the relatively recent shift from an agricultural lifestyle to an economy based on tourism. The aim was to identify "the impact of these changes on values and perceptions of the land, norms of landholding, and the agricultural identity of the place and its inhabitants" (Galanidou, 2011a).

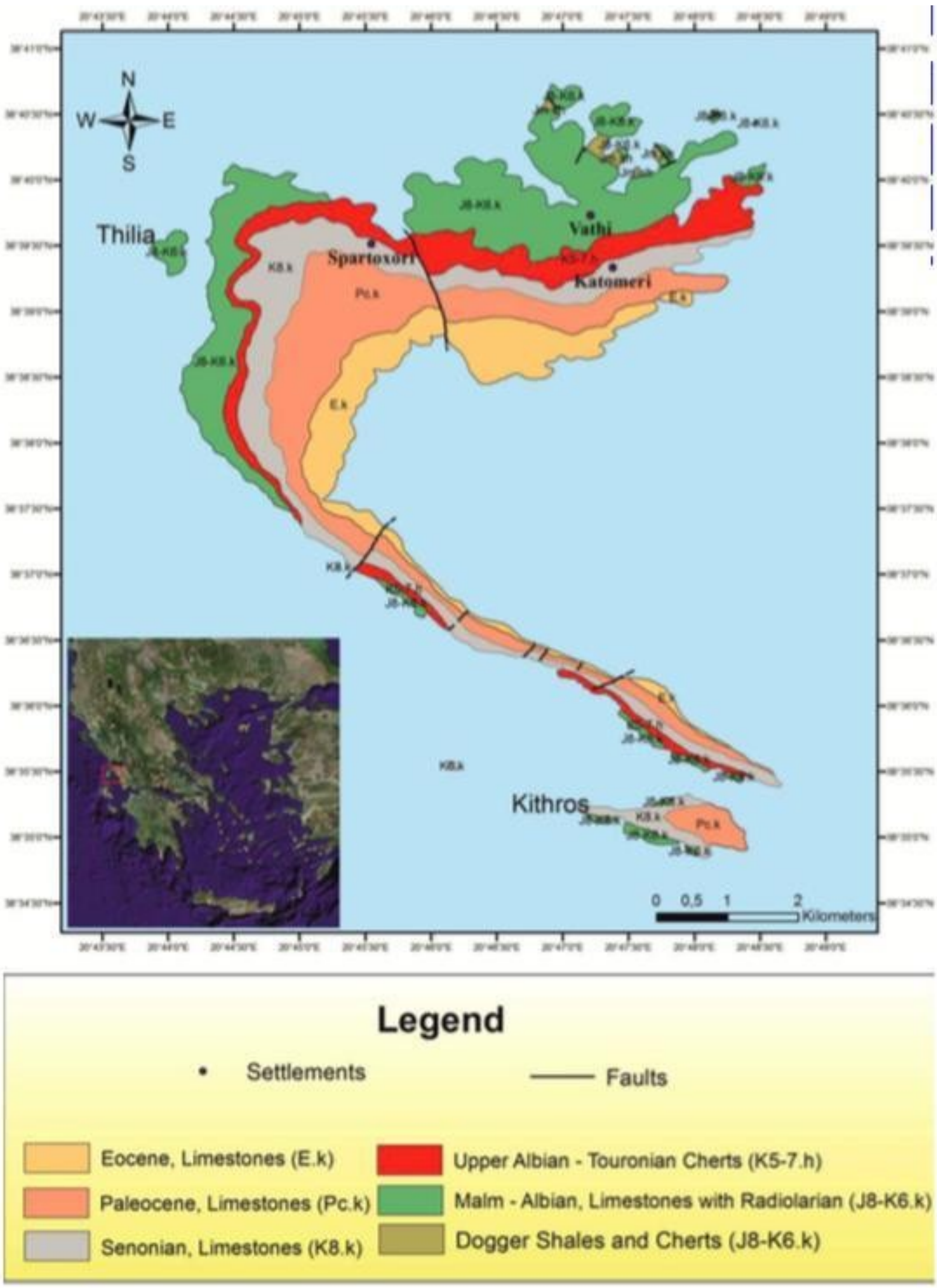


Figure 71: Geological map of Meganissi, Kythros and Thilia (Chatzimpaloglou, 2014, fig. 5)

Lastly, a collaboration between the University of Crete and the Hellenic Centre for Marine Research (HCMR) was able to provide an up-to-date palaeogeographic reconstruction of the marine area between the IISA and the NE parts of Kefalonia and Ithaki (Zavitsanou, 2016; Zavitsanou et al., 2015). This is an essential precondition for a valid archaeological interpretation of the lithic finds from the archipelago (see 4.6).

4.3. Survey methodology

4.3.1. Field methods

Using ArcGIS 9.3 an area of 600m^2 was divided in 100m orthogonal transects with a numeric designation. These parallelograms (tracts) were defined on Meganissi, Thileia and Kythros and covered by a number of field-walkers walking in parallel, equally spaced paths (lines). The remaining isles and islets were, because of their small size, treated as individual entities and walked as a single tract. Five team members spaced at 12m intervals usually surveyed the tracts with a responsibility to scan the immediate area to their left and right (Galanidou et al., 2017b; Galanidou, 2014b). Depending on the total number of people on each team the number of lines walked at times could vary, between four and six, so were the spaces between them (Figure 72). Each line was named after a letter of the Greek alphabet, i.e. A, B, Γ, Δ, E, never exceeding number six (i.e. ΣT). For publication purposes these are replaced by letters of the Latin alphabet (Figure 73)

Figure 72: Team members lined up at Kythros (Photo: C. Papoulia, June 2010)

Each team leader had a portable GPS with ArcPAD 8 software, a compass and a printed map with which he/she guided the walkers to follow an imaginary line. Each walker collected the finds in a separate bag, labelled with the number of the tract followed by the letter of the line, e.g. 1Γ. In some cases, when for example the transects were situated on very steep slopes, the tract could not be covered on its total surface, thus the same or smaller number of people from each group would only cover the accessible part of the tract. There were also instances where the tracts were covered by a team in a relatively random manner, i.e. without following strict lines. These were usually tracts with impenetrable vegetation and very low visibility precluding any possibility of walking in a straight path. In these cases, finds collected by each team member were all fused in a single bag labelled with the number of the tract followed by the letters 'Τ.Δ.' These letters stand for 'Τυχαία Δειγματοληψία', which in Greek means 'random sampling'. There were also instances where a team would be lined up and collect finds in separate bags (A-E) while at the same time the transect would be walked by the team leader or a lithic specialist who would collect additional finds in a Τ.Δ. bag. This strategy was usually followed the first days of the project due to the limited familiarization of the students as well as later on at transects which provided large quantities of diagnostic artefacts. In rare cases, when particular tracts were for various reasons revisited a small number of diagnostic artefacts would be added to the already collected material via a Τ.Δ. bag.

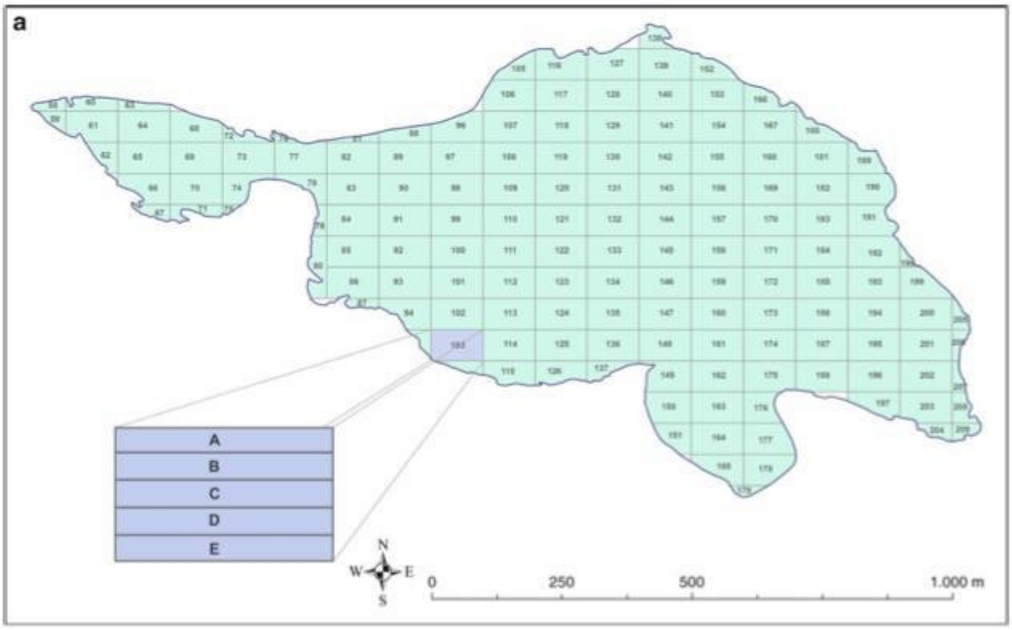


Figure 73: Example of the use of grid and paths (A, B, C, D, E) within transects (e.g. 103) on Kythros (Galanidou, 2014b, fig. 4a).

4.3.2. Data collection and recording

The sampling methodology took into account both the aims of the project and the quantities of the different finds observed in the field. Since the project focuses on the diachronic human presence on the islands of the archipelago, students were asked to record all types of portable and non-portable categories of finds. Modern agricultural structures as well as ancient architectural remains were recorded, measured, photographed and roughly drawn. Some of these were during the second field season (2011) revisited in order to be redrawn according to architectural conventions.

Printed forms were used to register information for each tract, both in the field and at the laboratory. In the field, the team leaders filled out a form for each tract in order to record aspects such as accessibility, visibility, flora, architectural remains, modern structures and other interesting features (e.g. presence of raw material sources etc.). Accessibility was often restricted due to steep relief and eroded surfaces as well as thick and thorny vegetation, yet visibility was at times aided by the paths created by grazing animals or water erosion.

In terms of the collection strategy for the lithic finds, the team members were instructed to collect all lithic artefacts encountered. At the end of each tract or during the breaks, the team leaders would rapidly go through the material collected and exclude ecofacts and highly undiagnostic specimens. These were left at the site, usually under a tree. Such a method was employed in the majority of the areas since lithics were most often abundant. Only rarely, at the tracts where lithics were less often encountered, all artefacts were collected and brought back to the laboratory. As for the raw materials, although during the first days in the field a sample of raw material specimens was collected mostly in order to familiarize with their availability as well as for educational purposes, these were not generally collected. The presence of raw material nodules was indicated in the field diaries instead. In terms of the ceramics, special attention was given to any possible prehistoric or early historical sherds, while due to the abundance of pottery dated to the Middle Ages and Modern times only a sample of these were collected from each tract. The aim was to record their presence in order to reconstruct their spatial distribution but not to collect each one of them. Team members were in these cases initiated to collect diagnostic parts of pots such as bases, handles and lips.

All collected finds were stored at the project's laboratory, i.e. a school classroom at Spartochori village where they were daily washed. Afterwards, the lithics specialists would go through the finds and further exclude any unmodified or heavily shattered fragments, which were afterwards returned to the field. After the final sampling, another form was used in order to record information such as total numbers and categories of finds. This form included a list of the collected finds that was subsequently imported in the GIS software.

During the second season (2011) the form was enriched with a second page where more detailed information in terms of chronological attributions of the diagnostic finds could be recorded. During the study season of 2012 the additional information of these tables was added accordingly for the finds recorded in 2010 as well.

These forms were a first attempt to catalogue the finds and extract preliminary results particularly in terms of spatial and temporal distribution. Although such preliminary recording of the material allowed for coarse-grained conclusions to be drawn during the first stages of the project, the detailed analysis methodologies followed by each specialist during the subsequent study seasons naturally cause particular differentiations in the final outcomes.

4.3.3. Geographic Information Systems (GIS)

An area of 7km^2 was covered in the two field seasons (2010-2011) and approximately 20,000 portable finds were collected (Galanidou, 2017b; Galanidou, 2015, 2014b, 2011a, 2018). All data recorded in the portable GPS devices and the forms were daily entered into a database produced in ArcGIS 9.3 software, in order to be mapped (Figure 74). The several layers with the different information categories incorporated in the GIS software, i.e. topographic, geological, historical maps and satellite images, provided the necessary geographic foundation. Elements such as the elevation, the trigonometric spots, the coastline, the torrents, the wetlands, the caves, the settlements, the road network and the place names were organized in discrete thematic layers as shapefiles. The database consists of two classes of polygons, one for the geographic information data for each square (visibility, vegetation, accessibility, architectural structures etc.) and the other for the finds quantities in each tract. The information from the database was incorporated in the portable GPS devises using ArcPAD 8 and provided a median accuracy of 3m (PDOP) (Galanidou et al., 2017b).

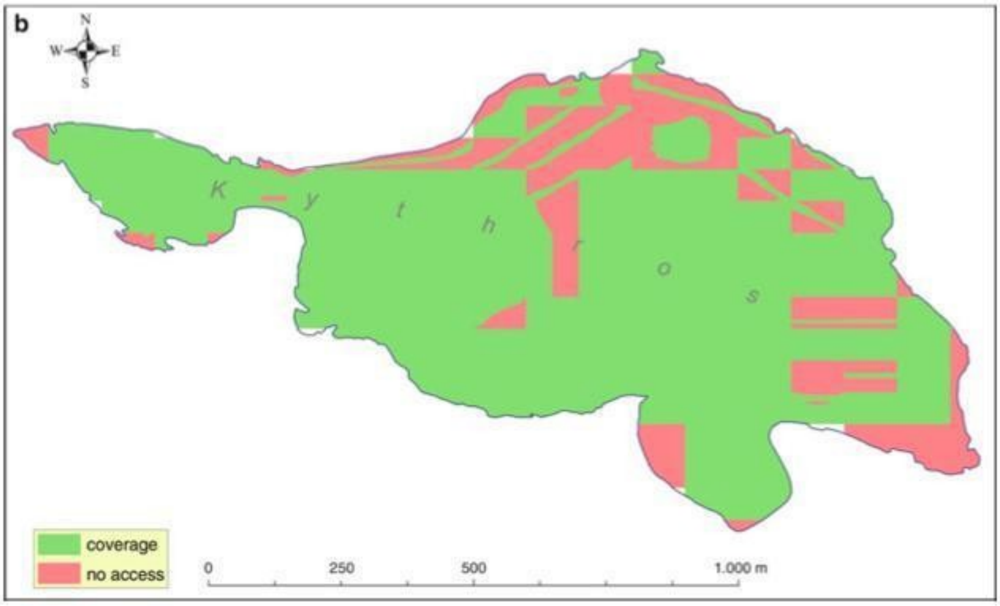


Figure 74: Total coverage of Kythros (Galanidou, 2014b, fig. 4b).

4.4. Lithic analysis methodology

4.4.1. Raw materials

The raw materials utilized at the region under survey were almost exclusively sedimentary siliceous rocks of the type usually referred as *chert* in the international bibliography. Different chert varieties such as *flint*, *radiolarite*, *jasper*, *porcelanite* or *chalcedony* are repeatedly used in archaeological reports in order to more precisely define the different qualities observed in the lithic collections. These terms have often caused misunderstandings since they are quite often employed by archaeologists in order to describe macroscopically observed differences in the raw materials in terms of grain, colour or knapping quality. Yet in strict geological terms, the different types of chert imply differences in their formation and in most of the cases microscopic methods are necessary in order to extract rigid signals on the structure of the sedimentary rocks.[18] For instance, *flint* occurs within chalk or marl formations, while *radiolarite* or *jasper* can usually be observed within thin beds. The latter can often be of a red colour, a result of iron oxides. Bedded formations as well as pebbles of a dark red colour were encountered at the IISA (Figure 75). Albeit being fine-grained, their quality in terms of knapping was medium to bad. Green/olive is also encountered among both the lithic assemblages and the raw materials available at the archipelago. The green colour is associated with iron oxides, yet in the opposite way. An abundance of fine-grained light-brown colour raw material nodules of different sizes were encountered at the rocky beach situated at the south coasts of Atokos (Figure 76). Their cortex is very chalky. Another variety commonly used for the production of stone tools is *chalcedony,* which may be of white, grey, greyish-blue or brownish colours. While many chert varieties are usually opaque, chalcedony can be translucent.

[18] Microcrystaline or cryptocrystalline varieties contain small quartz crystals or microcrystals and can be identified through the examination of thin sections under the microscope. Many cherts contain both microsrystaline and microfibrous quartz (e.g. chalcedony).


Figure 75: Red-colour siliceous raw materials within limestone formations at the SW coast of Kythros (Photo: C. Papoulia, June 2010)

Figure 76: Light brown-colour siliceous raw material nodules found as pebbles within limestone formations on the beach of the south coast of Atokos (Photo: C. Papoulia, July 2011)

The preservation of the lithic artefacts (see 4.4.3) does not allow many observations in terms of the initial colour of the specimens, thus it is rarely possible to tell which of the raw material sources were used for stone tool production during the Pleistocene. The only exceptions are lithics with relatively recent breaks because the alterations on their surfaces are minimal, thus the initial colour and perhaps its opaque or transparent nature can be observed. Since the identification of the initial colour on the artefacts and the use of a microscope in order to test each specimen were impossible, a detailed classification of the different types of 'flints' as discussed above was not applied.

The majority of the lithic artefacts were made on relatively fine- to coarse- grained siliceous rocks. Some of them had macroscopically observable medium- to large-sized inclusions, which when heavily desilicified they leave an empty space in their place. This might explain the presence of a few highly porous specimens among the material from the IISA and might also be an indication of greater age. A distinction could at times be very easily made between these fine- (or medium-) grained materials and other relatively more coarse-grained materials. In the latter case the term 'chert' was employed in order to classify the very coarse-grained raw materials, which were employed less frequently. The term 'flint' is used for all other less coarse-grained materials. A distinction between 'fine-grained' and 'coarse-grained' flint was used in order to describe the slight differences in terms of grain size, yet 'coarse-grained flint' is still fine-grained when compared to 'chert'. In brief, three raw material categories were used in order to record the siliceous artefacts collected:

- Fine-grained flint
- Coarse-grained flint
- Chert

Apart from the abovementioned siliceous materials, obsidian, a vitreous igneous rock was also employed by the prehistoric artisans of the IISA. Its presence is restricted at the island of Arkoudi (see 4.5.5 and Appendix II) and only one specimen was collected from a test trench excavated at Kythros. Yet none of these can be attributed to the Pleistocene since their technological characteristics place them, most probably, at the Bronze Age, and unquestionably not before the final parts of the Neolithic. Quartz (of mediocre knapping quality) is another type of raw material available in certain parts of the IISA, yet it was not employed for the production of lithic artefacts.

4.4.2. Lithic technology - basic terms and concepts

All lithics described in the present chapter are knapped stone artefacts. Such artefacts are created by initiating a fracture in a raw material nodule with the use of a hammerstone (Figure 77). Flakes or blades are then detached from the nodule (which, once worked, is turned into a core) and if these remain unretouched, they form part of the debitage, i.e. the unmodified end products of an assemblage. Throughout the reduction of a core, undiagnostic and usually small pieces of stone may break in an unpredicted way comprising waste products, called debris. Some detached pieces with particular characteristics are able to provide technological information on the technique according to which a core was exploited. These are called technical pieces, and in our case these are mainly *débordant* fakes (i.e. flakes from the periphery of cores) and core rejuvenation flakes or core tablets.

Flake/blade tools are flake/blade blanks further retouched by means of contiguous and overlapping clusters of small flake removals (retouch). Contrary to the traditional view, any fragment of stone may as well have served as a «tool», even if its edges exhibit scarce and discontinuous (informal) scar patterns. In some cases, the use of an artefact may have left no macroscopically visible scars. Also, formal tool types classified as scrapers or points, may have served as tools for totally different types of activities. Experimental archaeology and the application of microscopic use-wear analysis on artefacts provide clues on the use of each artefact as well as general patterns of use for particular artefact categories (Keeley, 1980; Pawlik and Thissen, 2011; Rios-Garaizar, 2016; Rots, 2013, 2009, 2005; Rots et al., 2011; Shea, 1992). However, since no microscopic analysis of the assemblage has yet been performed, any tool type designations are based only on morphological attributes.

An important thing to consider is that typological as well as technological analysis are methodologies that produce “classes” of artefacts and techniques that allow for further scrutiny based on a common “grammar”. Although the *chaine opératoire* approach has been widely accepted as a more appropriate method for the analysis of lithic assemblages, when examining stray and isolated finds or context-less assemblages lacking refits, technological classifications may easily become another form of typology (Bar-Yosef and Van Peer, 2009) from which “we cannot, in fact, escape” (Monnier, 2009, p. 122).

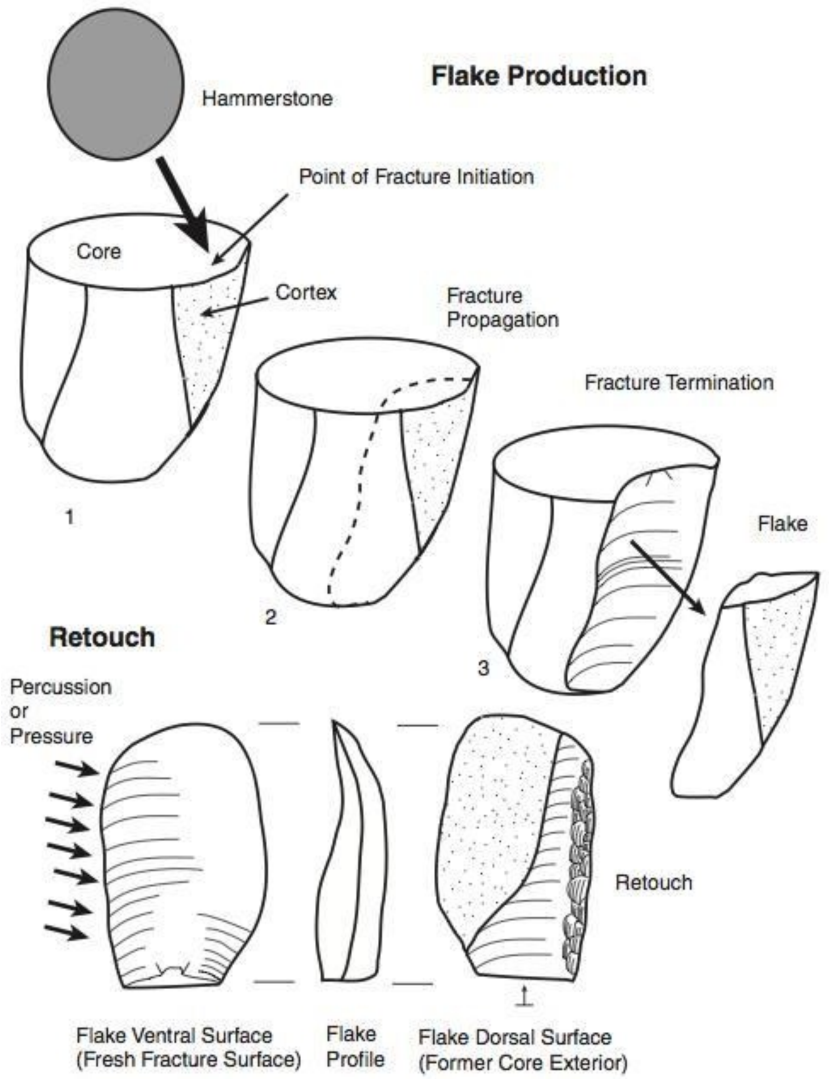


Figure 77: Schematic representation of a flake production and the production of a flake tool (Shea, 2013, fig. 2.3).

The assemblages studied here are predominated by flake tools, yet there is also a small number of core tools, i.e. nodular or core blanks which macroscopically seem to have use-related retouch or wear scars on some part of their circumference. In most cases, these have initially served as cores for the extraction of flakes. The classification of tool types followed the descriptions of the typelists by Bordes (1961b) and Debénath and Dibble (1994). In terms of technology, the assemblages under study fall within the usual categories encountered in the Middle Palaeolithic, i.e. the Levallois and discoid techniques. Additionally, a consideration of early prepared core techniques encountered in late Lower Palaeolithic and early Middle Palaeolithic sites proved to be useful for the lithics from the IISA (Adler et al., 2014; Boëda, 1993; Bordes, 1980; Di Modica and Pirson, 2016; Eren and Lycett, 2012; Ortega et al., 2013; White and Ashton, 2003).

4.4.3. Preservation - surface alterations

Five types of surface alterations were observed on the lithic artefacts from the IISA. These are:

(a) Patina

(b) Edge damage

(c) Weathering

(d) Thermal shattering / frost

(e) Organic residues

4.4.3.1. Patina

Patina on flint artefacts is defined as an alteration of the initial colour of the raw material (discolouration) and a production of a rind (encrustation) on the surface in thin or thick layers that gradually become similar to cortex (natural rinds formed on unmodified surfaces). This is a result of geochemical weathering, i.e. dissolution, hydration, oxidation, leaching as well as chemical and mechanical disaggregation (Schmaltz, 1960). It has been often argued that taphonomy rather than sub-aerial exposure is primarily responsible for the patination process. Glauberman and Thorson (2012, p. 40) explain:

> *'In taphonomic terms, once a flint nodule is removed by humans from its context of procurement, fractured in the act of knapping, and after artefacts are discarded and enter a depositional context, 'fresh' surfaces are subject to dynamic physiochemical microenvironments. If micro-environmental conditions are conducive, surfaces in contact with depositional matrix begin to undergo renewed silica/quartz dissolution, hydration, and re-precipitation. The intensity, localization, and duration of these processes are related to the internal structure of the raw material, its interaction with the geochemically dynamic surrounding matrix, and archaeological site setting and formation processes.'*

In this study, a five-grade scale (1-5) was employed in order to define the different degrees of surface alterations due to patina.

The majority of heavily patinated artefacts exhibit a white colour alteration throughout their surface. Through the study of lithic assemblages coming from a number of sites in NW Greece, both in the Ionian Islands and Epirus, it has been observed that the light pink patina (Figure 78) is usually encountered on artefacts made on dark red flint (Papoulia, 2011).

Another distinct type of surface alteration was detected in some of the artefacts, particularly the ones coming from the islands of Kythros and Arkoudi, but also from the southern part of Meganissi. This was the presence of a dark brown patina (Figure 79). The particular type of patina is a result of surface alteration due to heat/fire and those artefacts were also characterised by a rolled, non-chalky cortex and, at times, some of their surfaces exhibited very intense desilicification.

Figure 78: Different types of red/pink patina on the surface of lithic artefacts from South Meganissi (left) and a recently broken artefact with thick pink patina made on dark red flint, from the Middle Palaeolithic site of Mikro Karvounari, Thesprotia, Epirus, NW Greece (right) (Photos: C. Papoulia).

Figure 79: Artefacts with brown patina from Arkoudi (left) and Kefali, Meganissi (right) (Photos: C. Papoulia).

4.4.3.2. Edge damage

Edge damage is a result of post-depositional processes and can either be in the form of small, discontinuous, often less patinated breaks, usually due to trampling, (Figure 80left) or in the form of rounded edges due to rolling and long-term contact with water and pebbles (Figure 80right). These features were recorded as present or absent.

Figure 80: Edge damage on lithic artefacts from Atokos (left, ©IISA photographic archive) and Meganissi (right, photo: C. Papoulia).

4.4.3.3. Weathering

A significant number of specimens are distinguished from the rest due to their heavy surface alterations not in terms of patination alone, but also because of their severe desilicification (Figure 81). This observation is an indicator of weathering due to various environmental and taphonomic causes and a most likely implication of greater age, especially when compared to the mint condition of artefacts found at the same spot.

Figure 81: Artefacts from Arkoudi with edge damage and extreme surface alterations due to severe desilicification (weathering) (©IISA photographic archive).

4.4.3.4. Thermal shattering / frost

The signs of fire and frost are evident on the surfaces of lithic artefacts by means of natural fractures which alter their regularity, either as hollow marks (potlids) or cracks (Figure 82-

Figure 83). Such fractures are produced gradually with temperature alterations, i.e. when a fragment is heated up and then cools down. Identification of thermal fractures is easy due to the fact that the break starts in the middle of the nodule causing multiple concentric negative scars, like rings, in contrast to the intentional fractures caused by percussion.

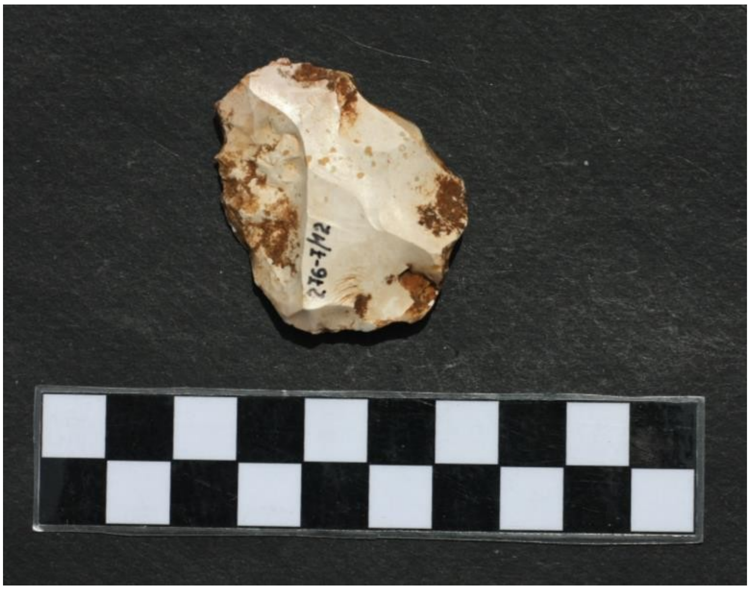


Figure 82: Artefact from Apsidia, Meganissi with the characteristic potlids on its dorsal face (Photo: C. Papoulia).

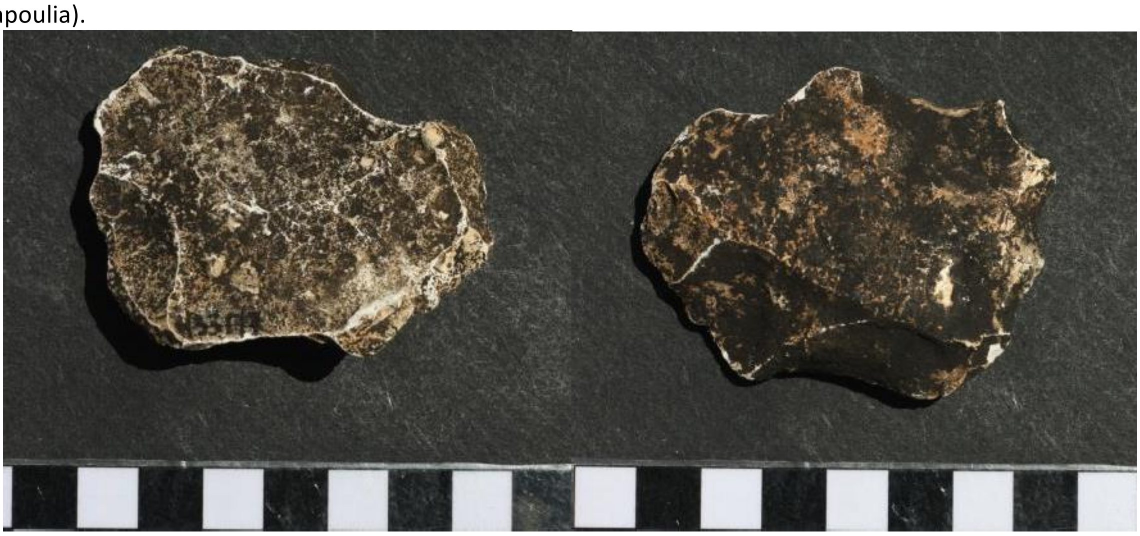


Figure 83: Artefact 433Γ/7 from Meganissi exhibiting thermal fractures on its dorsal face and organic residues covering both surfaces (Photo: C. Papoulia).

4.4.3.5. Organic residues

Organic residues are sometimes attached to the surface of stone tools. Concretions in the form of encrusted clumps or conglomerates created by the natural elements around the artefact are impossible to remove without appropriate conservation. The IISA assemblages include a small number of artefacts with such surface alterations which were found at particular sites indicating similar taphonomic / environmental conditions (Figure 84).

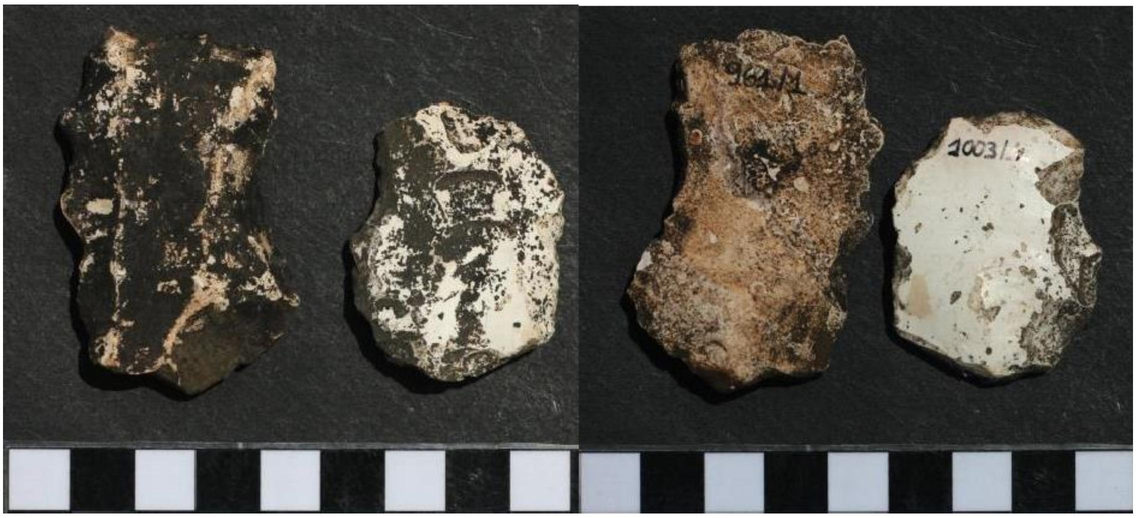


Figure 84: Organic residues attached to the dorsal face of lithic artefacts from Schiza (Photo: C. Papoulia).

4.4.4. Cortex coverage

A scale of 0% to 100% with intermediate grades of 5%, 25%, 50% and 75% is used in order to record the amount of cortex preserved on the lithics. For the flakes, technical pieces and flake tools the percentage of cortex coverage is counted on their dorsal face, while for the cores and core tools the whole artefact is taken into account.

4.5. The lithic assemblages

4.5.1. Meganissi (N=611)

Meganissi is the largest island of the IISA and the only one with permanent inhabitants. Its shape designates its habitation patterns, with the two major villages and their associated ports situated at the north part of the island (Figure 85). According to the lithic artefacts the occupation of the island began in the Pleistocene, since a number of sites have produced diagnostic Palaeolithic tools, most of which are attributed to the Middle Palaeolithic period, and continued to the early Holocene up until the Bronze Age. The island must have acted as a place of memory during the Bronze Age, as the characteristic tombs situated mainly at the central and south parts of the island indicate (Vikatou, 2018; Galanidou, 2018).

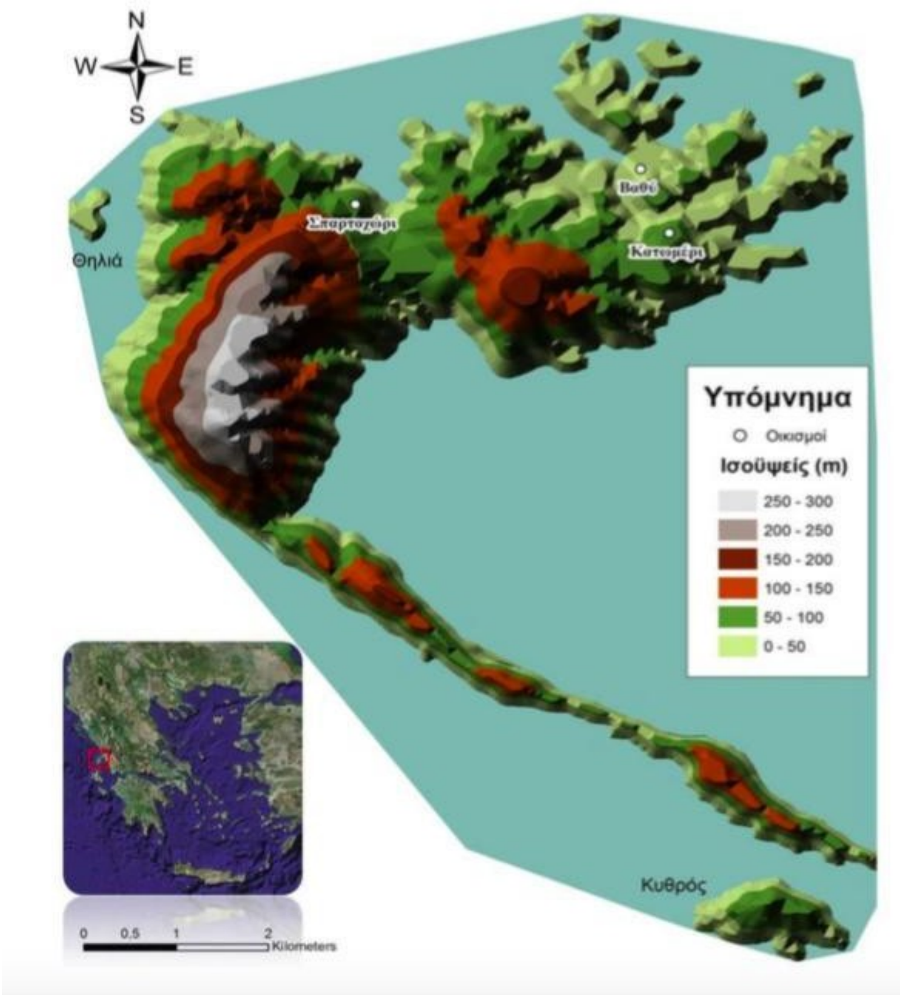


Figure 85: The island of Meganissi. Elevation map with main villages annotated (Chatzimpaloglou, 2014, fig. 1).

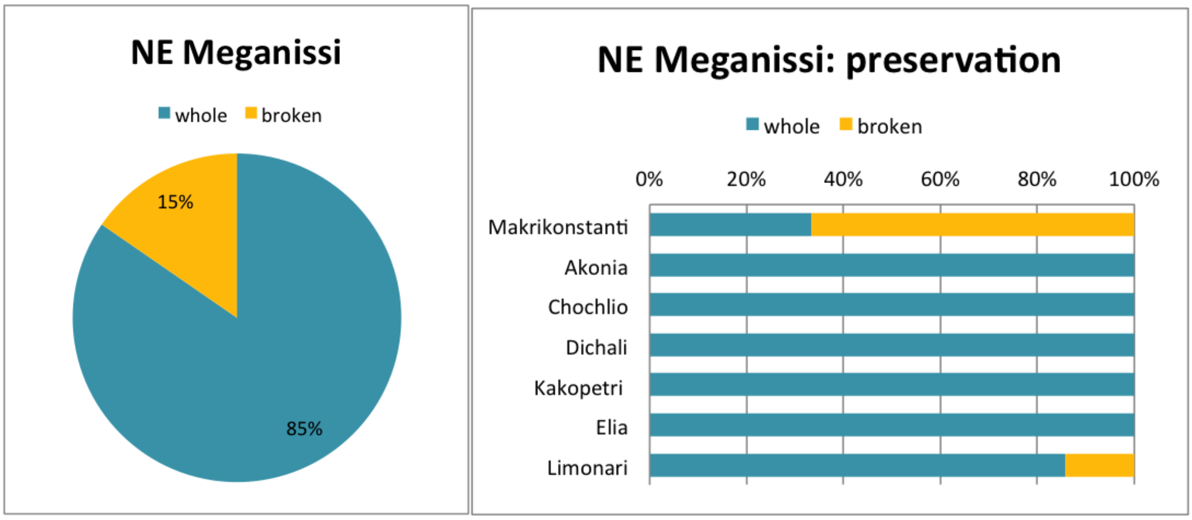
Due to the large number of artefacts, the analysis of the islands' lithic assemblages is separated according to geography in four parts: NE Meganissi, NW Meganissi, Central Meganissi and South Meganissi. A large number of artefacts were catalogued as tract finds while particular sites were designated based on a number of characteristics (e.g. total number of finds compared to area). Most of the sites described here correspond to Pleistocene sites, however, there are also Bronze Age sites (ascribed as such due to the presence of burials, e.g. Mesogi 4), with a limited presence of a Pleistocene component. Thus, although for practical reasons the Pleistocene lithic finds are described here following the overall site categorisation of the project, the interpretation and spatial distribution patterns of the particular finds does not always follow such categorisation (see discussion after each part and 4.5.7.1.3).

4.5.1.1. NE Meganissi (N=20)

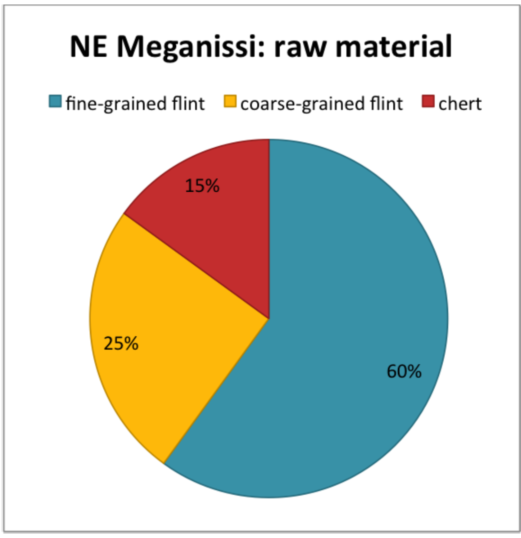
The NE part of Meganissi Island was the humblest one in total numbers of lithics found but also in the ones that could be attributed to the Pleistocene (Table 8). All were collected as tract finds. Most of the artefacts studied are intact while 15% of the sample is broken (Graph 2a), most of which come from Makrikonstanti (Graph 2b). An 85% is made on fine-grained and coarse-grained flint, while the rest 15% is made on chert (Graph 3). All artefacts, apart from one flake tool from Limonari, possess the maximum degree of patina (5) on their surfaces (Graph 4).

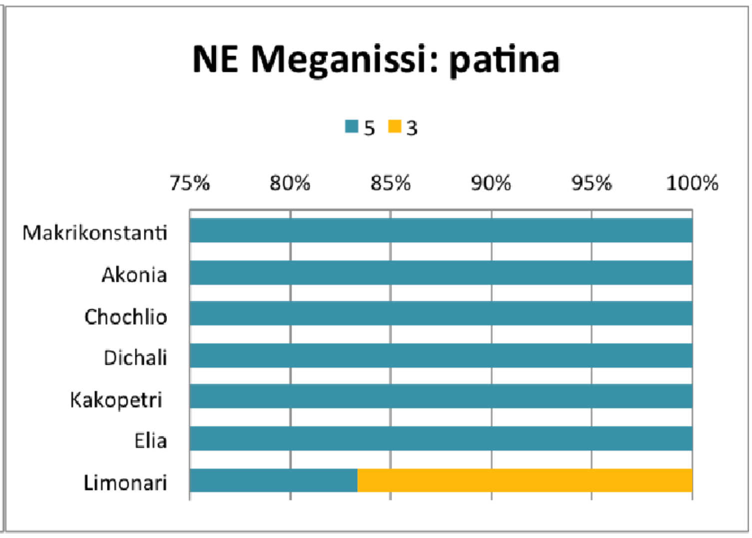
Table 8: NE Meganissi inventory

NE Meganissi	Cores		Debitage		Technical pieces		Flake tools		Core tools		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Makrikonstanti	0	0	2	28,6	0	0	1	10	0	0	3	15
Akonia	0	0	1	14,3	0	0	0	0	0	0	1	5
Chochlio	0	0	2	28,6	0	0	1	10	0	0	3	15
Dichali	1	33,3	1	14,3	0	0	1	10	0	0	3	15
Kakopetri	1	33,3	0	0	0	0	1	10	0	0	2	10
Elia	0	0	0	0	0	0	1	10	0	0	1	5
Limonari	1	33,3	1	14,3	0	0	5	50	0	0	7	35
Total	3	100	7	100	0	0	10	100	0	0	20	100
Total (%)	15		35		0		50		0		100	



Graph 2a-b: Percentage of broken and intact artefacts from NE Meganissi





Graph 3 (left): Percentage of the different raw materials used for the production of lithic artefacts at NE Meganissi.
Graph 4 (right): Percentage of patina on the artefacts from the seven regions of NE Meganissi

4.5.1.1.1. Makrikonstanti tracts (N=3)

Two flakes and a broken retouched laminar flake from tracts 559 and 561 can be attributed to the Pleistocene (Table 9). They are all made on coarse-grained flint and exhibit high degrees of patina (5). Both debitage specimens preserve part of their cortex in lesser (25%) or greater (50%) amounts and their platforms are flat (Figure 86).

Table 9: Assemblage structure at Makrikonstanti.

Makrikonstanti		**Coarse-grained flint**	
		N	%
Debitage	flake	2	66,7
Flake tools	retouched flake	1	33,3
Total		3	100

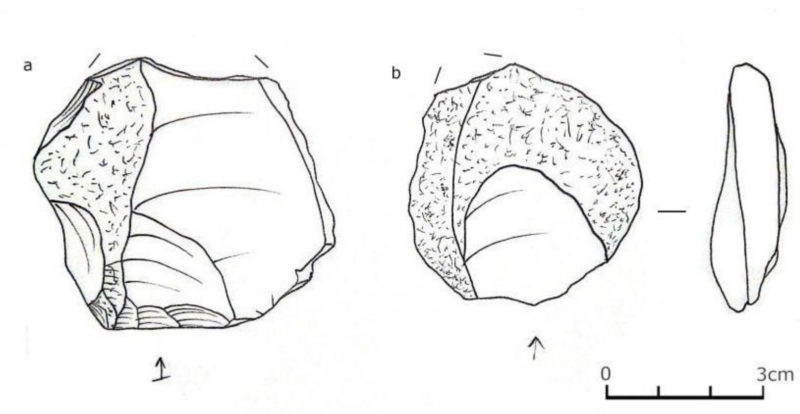


Figure 86 a-b: Flakes (559/1 and 561/2) from Makrikonstanti.

4.5.1.1.2. Akonia tracts (N=1)

The only Levallois flake from NE Meganissi comes from Akonia, tract 671 (Table 10). It is a heavily weathered specimen made on fine-grained flint with high degrees of alteration due to patina (5) and edge damage (Figure 87). It measures 32×27×9mm and its platform can be described as of the characteristic *chapeau de gendarme* type.

Table 10: Assemblage structure at Akonia

Akonia		**Fine-grained flint**	
		N	%
Debitage	Levallois flake	1	100
Total		1	100

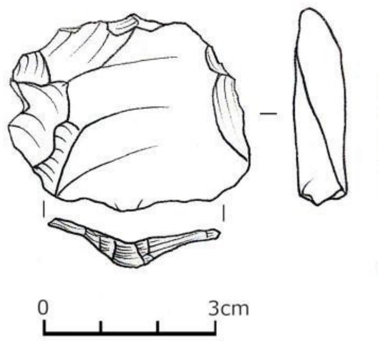


Figure 87: Levallois flake with a *chapeau de gendarme* platform (671/1) from Akonia.

4.5.1.1.3. Chochlio tracts (N=3)

Three artefacts from Chochlio, tract 1573, seem to be part of the Middle Palaeolithic component of the area (Table 11). All are made on fine-grained flint. These are a double scraper made on a (cleaver-shaped) flake by means of short, bilateral, direct (left) and alternating (right) retouch of a semi-abrupt angle (Figure 88a) and two flakes with prepared, facetted platforms, measuring 42×42×11mm and 28×35×9mm respectively (Figure 88b-c).

Table 11: Assemblage structure at Chochlio

Chochlio		**Fine-grained flint**	
		N	%
Debitage	flake	2	66,7
Flake tools	scraper	1	33,3
Total		3	100

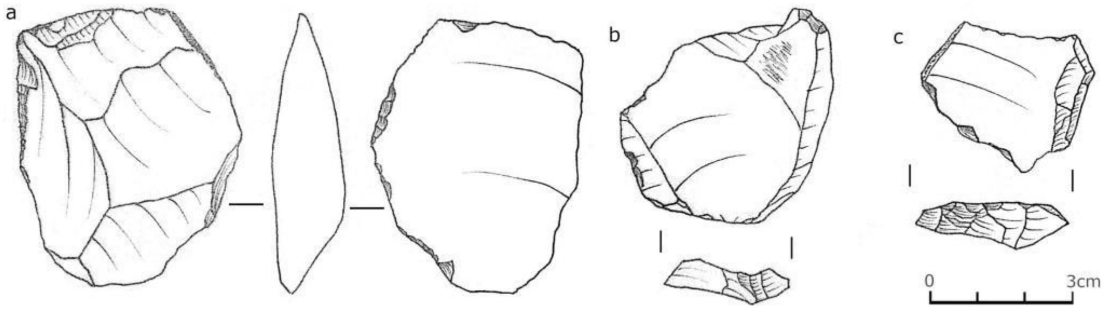


Figure 88: Double scraper (a) and flakes with facetted platforms (b) from Chochlio.

4.5.1.1.4. Dichali tracts (N=3)

Three artefacts from tracts 341 and 342 of Dichali, i.e. a core, a flake and a scraper may be attributed to the Pleistocene (Table 12). The core is a unipolar recurrent Levallois flake core made on coarse-grained flint (Figure 89a). It measures 62×51×26mm and does not preserve any cortex. The flake and flake tool are both relatively large and thick measuring 61×69×11mm and 84×79×35mm respectively (Figure 89b-c). The first one is made on chert while the latter one is of fine-grained flint. Both preserve part of their cortex.

Table 12: Assemblage structure from Dichali

Dichali		**Fine-grained flint**		**Coarse-grained flint**		**Chert**		**Total**	
		N	%	N	%	N	%	N	%
Debitage	flake	0	0	0	0	1	100	1	33,3
Cores	flake core	0	0	1	100	0	0	1	33,3
	scraper	1	100	0	0	0	0	1	33,3
Total		1	100	1	100	1	100	3	100
Total (%)		33,3		33,3		33,3		100	

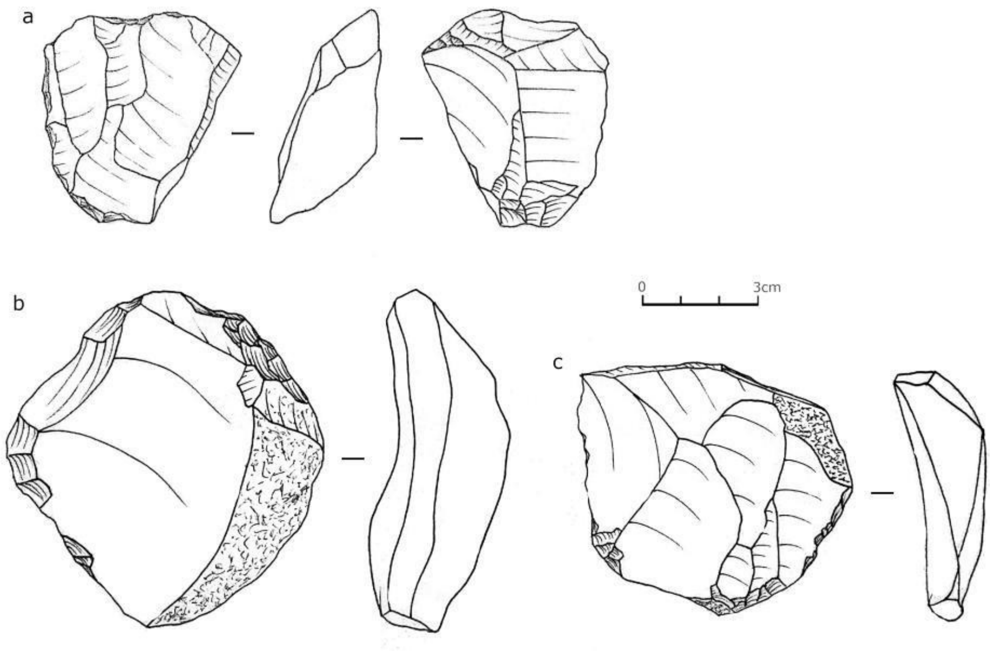


Figure 89: Levallois core (a), scraper (b) and flake (c) from Dichali.

4.6.1.1.5. Kakopetri tracts (N=2)

A flake core and a large flake tool from Kakopetri tracts 1115 and 1133 are part of the Pleistocene component of the area (Table 13). The core is made on fine-grained flint preserving about 50% of its cortex with unipolar negative scars, measuring 43×41×15mm (Figure 90a). The heavy-duty scraper is made on a large and thick chert flake blank (74×72×35mm) with a flat platform. It preserves less than 5% of its cortex on its left lateral. The retouch scars are long, of an abrupt angle and of a stepped and scaled morphology (Figure 90b).

Table 13: Kakopetri assemblage structure

Kakopetri		**Fine-grained flint**		**Chert**		**Total**	
		N	%	N	%	N	%
Cores	flake core	1	100	0	0	1	50
Flake tools	scraper	0	0	1	100	1	50
Total		1	100	1	100	2	100
Total (%)		50		50		100	

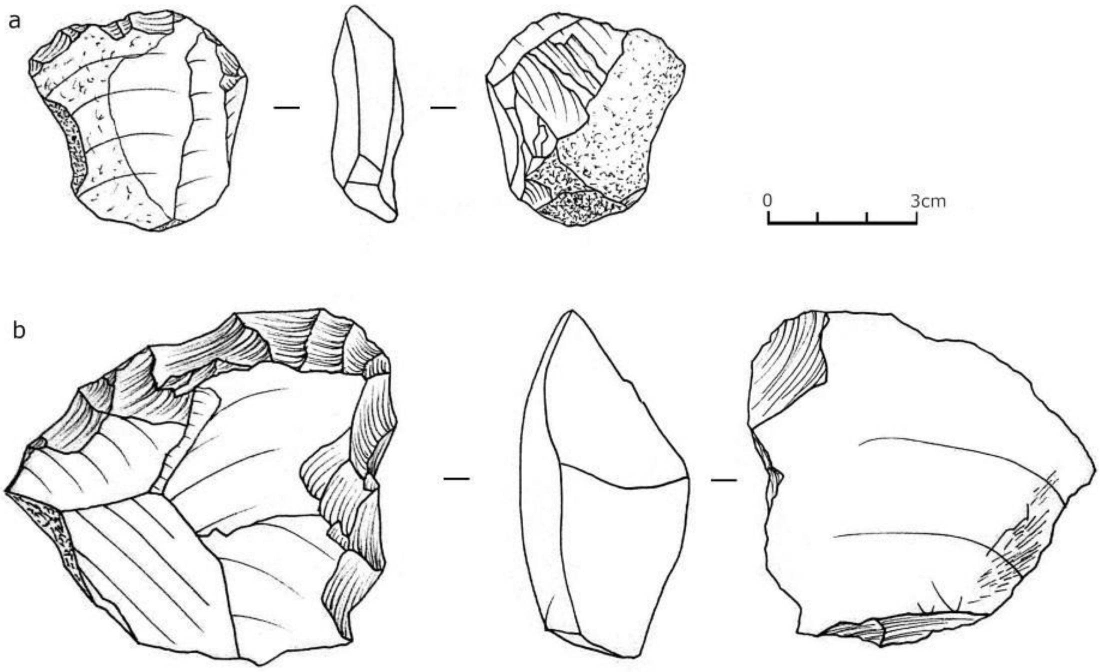


Figure 90: Flake core (a) and heavy-duty scraper (b) from Kakopetri.

4.5.1.1.6. Elia tracts (N=1)

A single flake tool from tract 335 can be attributed to the Pleistocene (Table 14). This is a flake made on chert with alternating retouch on its left lateral and two inverse splintered flake scars on its distal part (Figure 91). It has a winged platform, preserves about 5% of its cortex and measures 32×34×10mm.

Table 14: Elia assemblage structure

Elia		**Chert**	
		N	%
Flake tools	retouched flake	1	100
Total		1	100

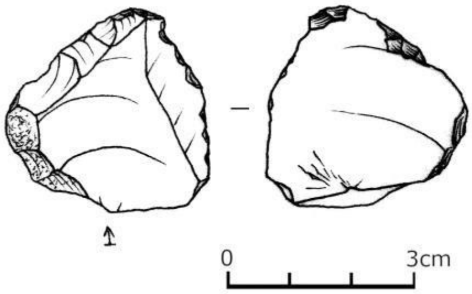


Figure 91: Retouched flake (335/2) from Elia.

4.5.1.1.7. Limonari (N=7)

A total of seven artefacts from Limonari have been attributed to the Middle Palaeolithic. The assemblage consists of a flake core and five flake tools made on fine-grained flint and a relatively large flake made on coarse-grained flint (327/1) (Table 15). An interesting feature of Limonari's assemblage is that the artefacts collected near the beach exhibit rolled, rounded edges, indicating contact with water and pebbles Figure 92. Two flake blanks collected from the same tract (323) are of almost identical size and have been further retouched. One of them has sharp edges and exhibits high degree of white patina (5) and some oxidized stains (Figure 93d). The second one is less heavily patinated (3), revealing the initial olive colour of the flint used, and has rounded edges (Figure 93e). Other artefacts with rounded edges are the only flake core, i.e. a lineal Levallois core (Figure 93c), a pseudo-Levallois point (Figure 93f), and a scraper with direct, abrupt retouch on its right lateral edge (Figure 93g).

Table 15: Limonari assemblage structure

Limonari		**Fine-grained flint**		**Coarse-grained flint**		**Total**	
		N	%	N	%	N	%
Debitage	flake	0	0	1	100	1	14,3
Cores	flake core	1	16,7	0	0	1	14,3
Flake tools	pseudo-Levallois point	1	16,7	0	0	1	14,3
	notch	1	16,7	0	0	1	14,3
	retouched flake	1	16,7	0	0	1	14,3
	scraper	2	33,3	0	0	2	28,6
Total		6	100	1	100	7	100
Total (%)		85,7		14,3		100	

Figure 92: Artefacts from Limonari, NE Meganissi (photo: C. Papoulia).

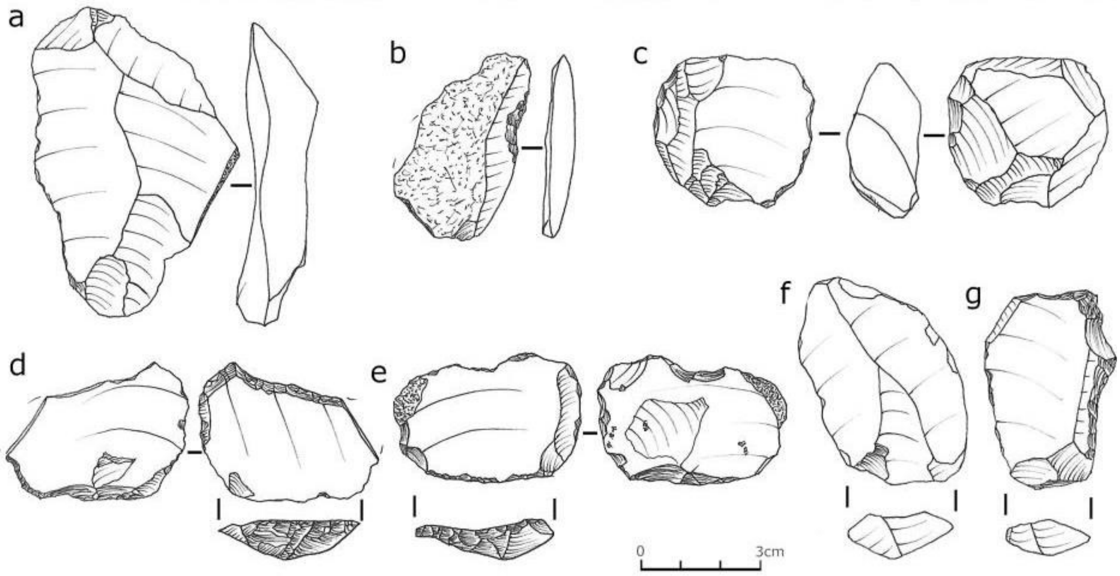
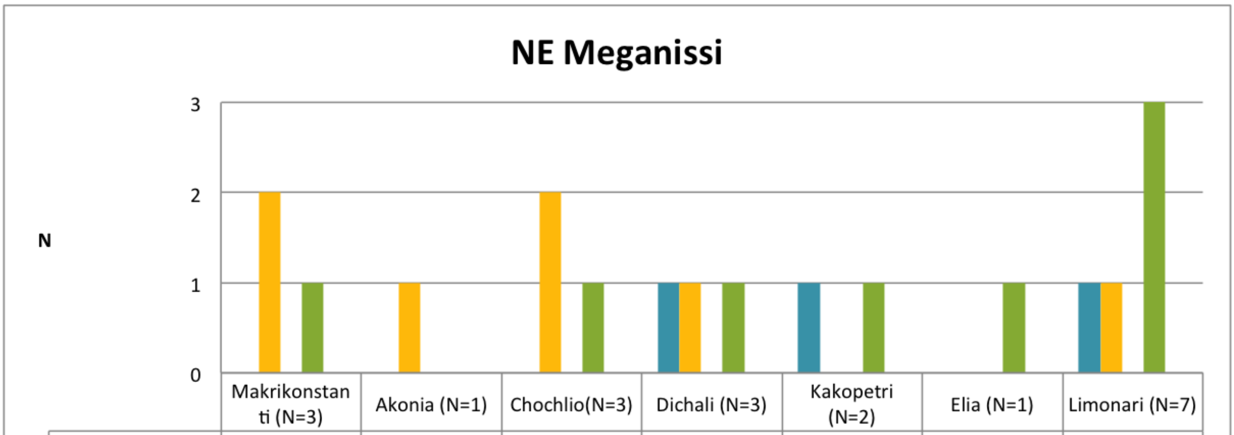


Figure 93: Artefacts with sharp (a-b, d) and rounded (c, e-g) edges from Limonari.

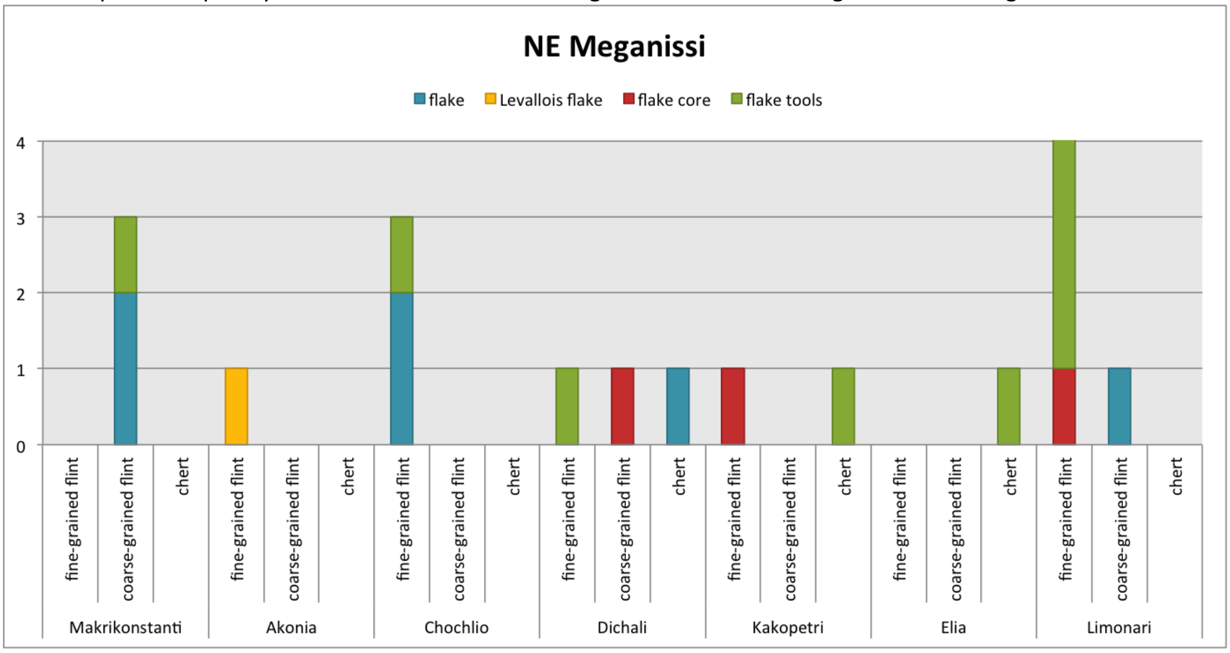
4.5.1.1.8. Discussion

The lithics from NE Meganissi are only a few, come from seven findspots (Graph 5) and are mainly made on flint, while only three flake tools, i.e. two scrapers, one from Kakopetri and one from Dichali as well as a retouched flake from Elia, are made on chert (Graph 6). Of the unmodified debitage, the only Levallois flake is made on fine-grained flint, while plain flakes are also made on coarse-grained flint (Graph 7). Most of the artefacts preserve less than 50% of their cortex, while a 39% of the lithics does not preserve any cortex at all (Graph 8). Only a flake from Makrikonstanti and the flake core from Kakopetri preserve half of their cortex (Graph 9). Although chert products (i.e. the flake from Dichali and the heavy duty scraper from Kakopetri) are expectedly of relatively large dimensions, the double scraper from Dichali and the flake from Limonari prove that the flint raw material nodules available were also of significant size (Graph 10). Most of the flake tools (80%) are made on flake blanks with only one exception made on a laminar flake (Graph 11). The majority of the blanks have unprepared platforms (i.e. flat), yet, among the debitage, there are also a few flakes with prepared (i.e. facetted and *chapeau de gendarme*) platforms (Graph 12).

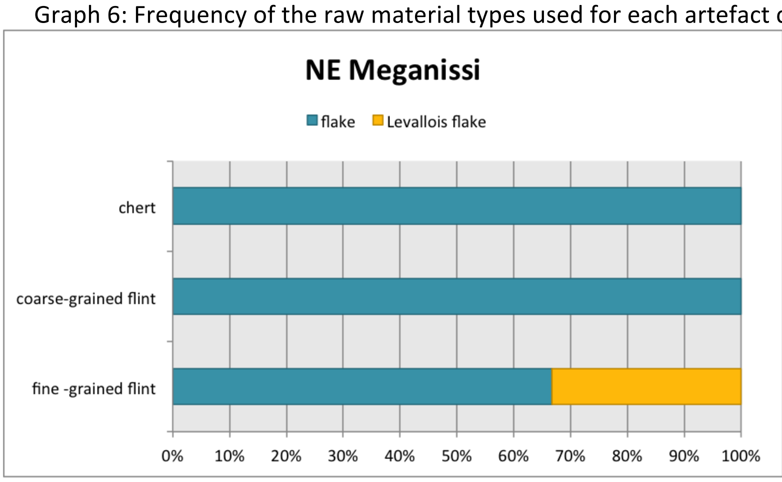


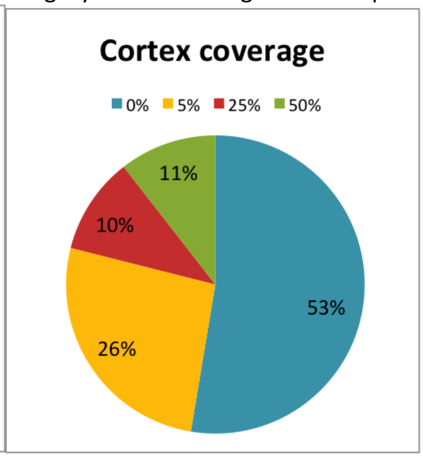
	Makrikonstanti (N=3)	Akonia (N=1)	Chochlio(N=3)	Dichali (N=3)	Kakopetri (N=2)	Elia (N=1)	Limonari (N=7)
Cores	0	0	0	1	1	0	1
Debitage	2	1	2	1	0	0	1
Technical pieces	0	0	0	0	0	0	0
Flake tools	1	0	1	1	1	1	5
Core tools	0	0	0	0	0	0	0

Graph 5: Frequency of the different artefact categories at the assemblages from NE Meganissi tracts

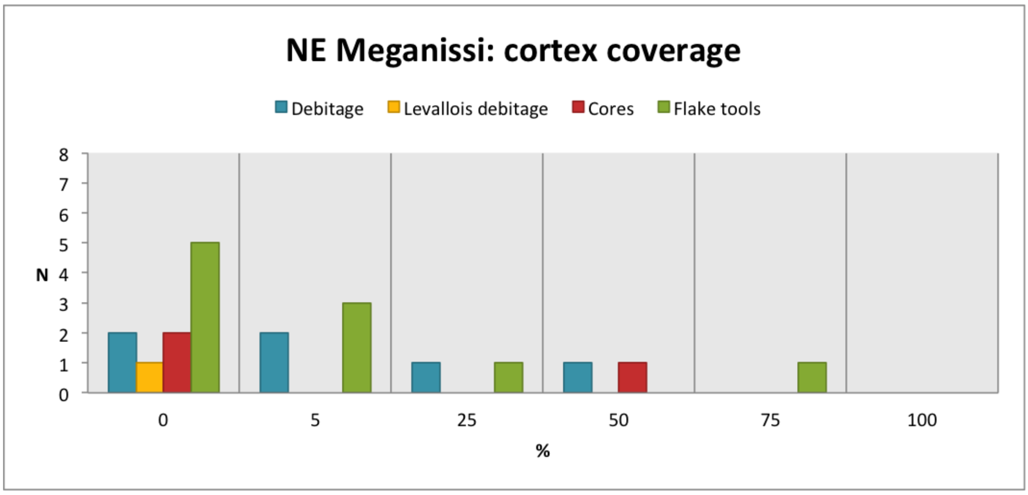


Graph 6: Frequency of the raw material types used for each artefact category at the NE Meganissi findspots.

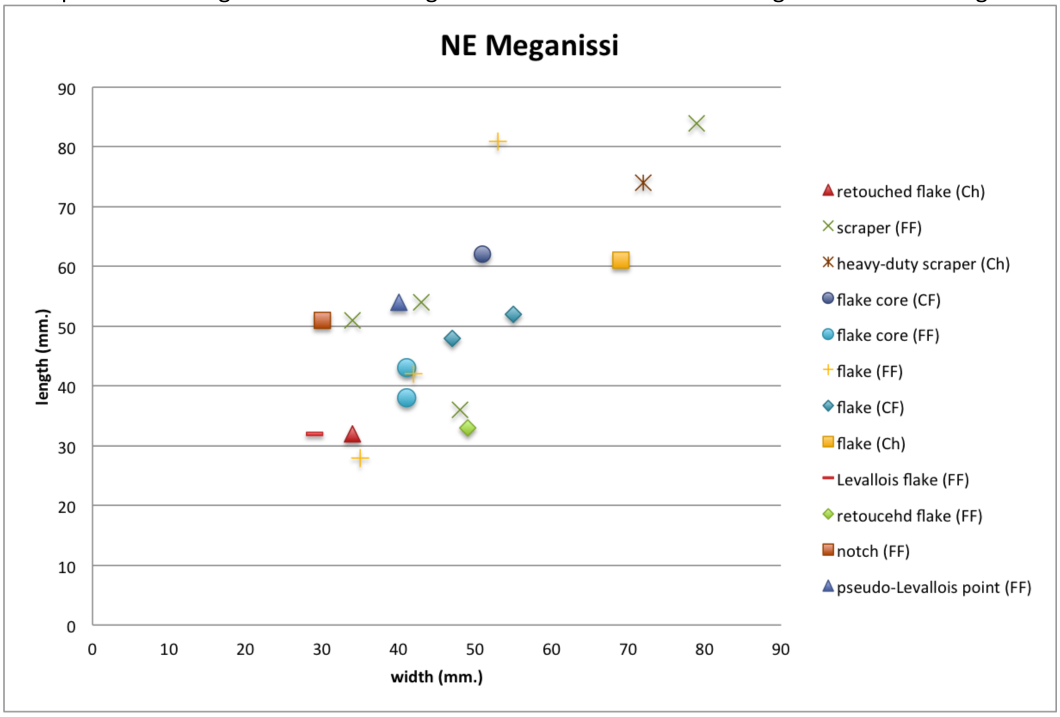




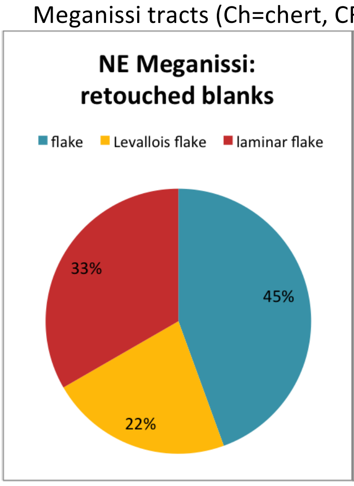
Graph 7 (left): Stacked column chart of the different raw material types with the debitage categories.
Graph 8 (right): Percentage of cortex coverage on all artefacts from NE Meganissi

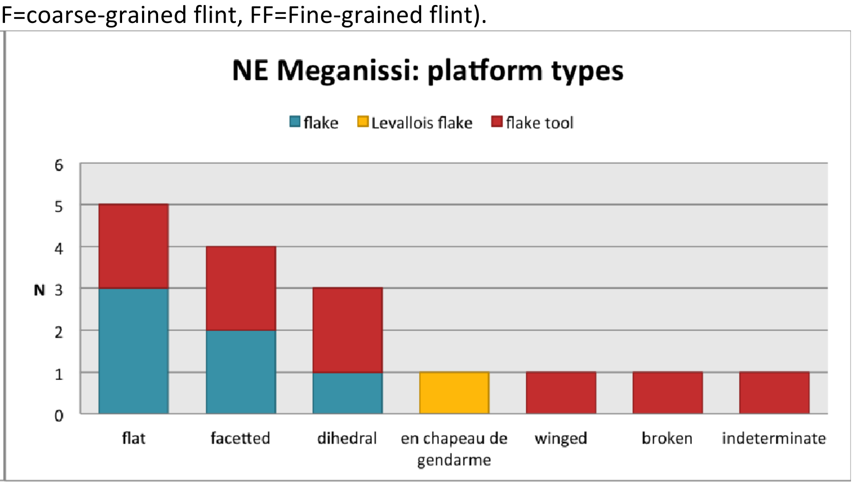


Graph 9: Percentage of cortex coverage on the different artefact categories from NE Meganissi



Graph 10: Scatter plot with the dimensions (length and width) of the cores, debitage and flake tools from NE Meganissi tracts (Ch=chert, CF=coarse-grained flint, FF=Fine-grained flint).





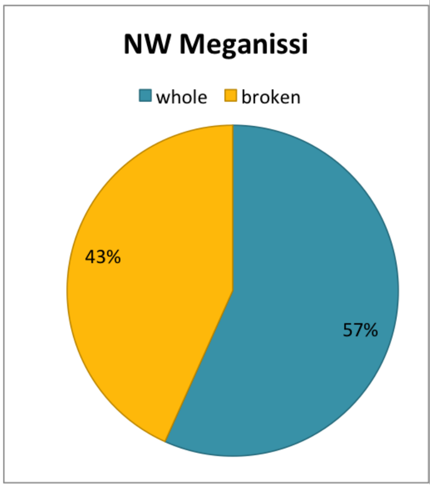
Graph 11 (left): Frequency of blank types used for retouch at the NE Meganissi findspots.
Graph 12 (right): Frequency of the different platform types on the debitage (flakes and Levallois flakes) and flake tools (retouched flakes and scrapers) from NE Meganissi.

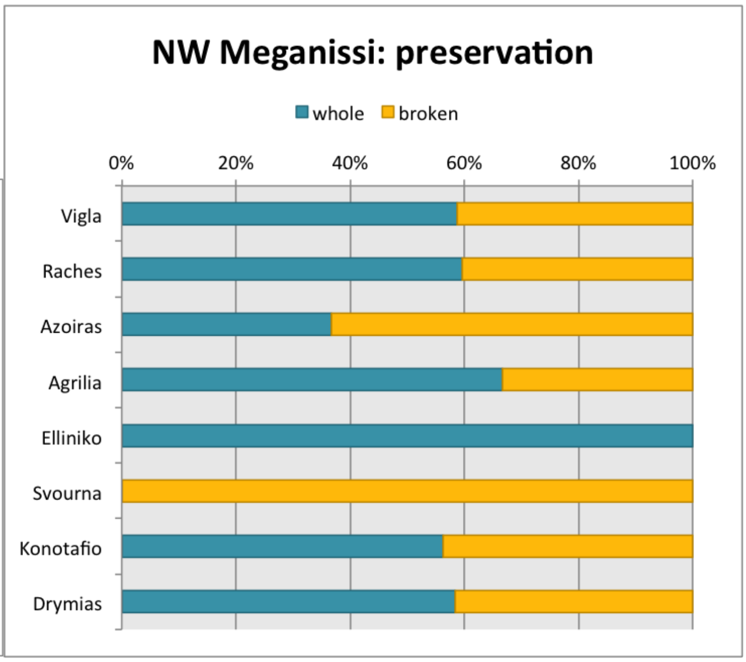
4.5.1.2. NW Meganissi (N=230)

The area NW of Meganissi returned a significant number of lithics that can be attributed to the Pleistocene (Table 16). Most of the artefacts are intact (Graph 13a), with the exception of Azoiras, where more than 60% of the artefacts are broken (Graph 13b). Apart from a 4% made on chert, the rest is made on flint, with the majority made on fine-grained flint (Graph 14). Most of the artefacts possess the maximum degree of patina (5) on their surfaces while a 22% is less heavily patinated (4) (Graph 15).

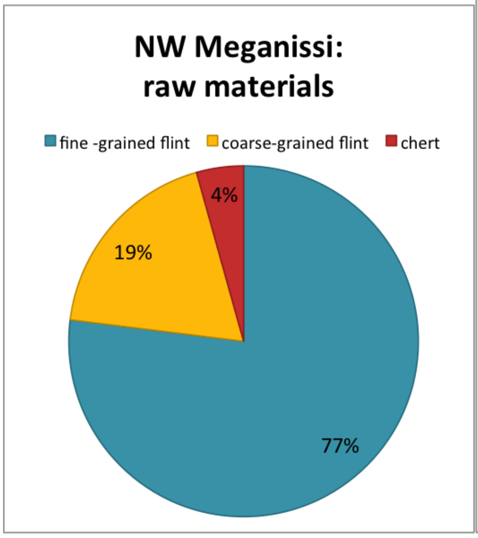
Table 16: NW Meganissi inventory

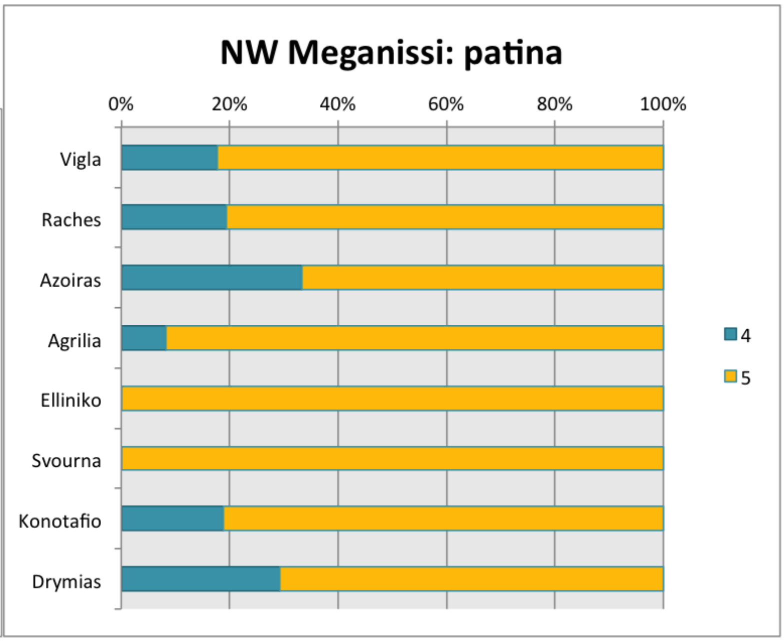
NW Meganissi	Cores		Debitage		Technical pieces		Flake tools		Core tools		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Vigla	0	0	11	13,9	0	0	6	5,1	0	0	17	7,4
Raches	22	64,7	44	55,7	4	80	58	49,6	1	100	129	55,8
Azoiras	4	11,8	8	10,1	1	20	17	14,5	0	0	30	13
Agrilia	3	8,8	4	5,1	0	0	5	4,3	0	0	12	5,2
Elliniko	0	0	0	0	0	0	1	0,9	0	0	1	0,4
Svourna	0	0	0	0	0	0	1	0,9	0	0	1	0,4
Konotafio	0	0	3	3,8	0	0	13	11,1	0	0	16	6,9
Drymias	5	14,7	3	3,8	0	0	16	13,7	0	0	24	10,4
Total	34	100	73	100	5	100	117	100	1	100	230	100
Total %	14,8		31,7		2,2		50,9		0,4		100	





Graph 13a-b: Percentage of broken and intact artefacts for NW Meganissi as a whole (a) and for each area separately (b).





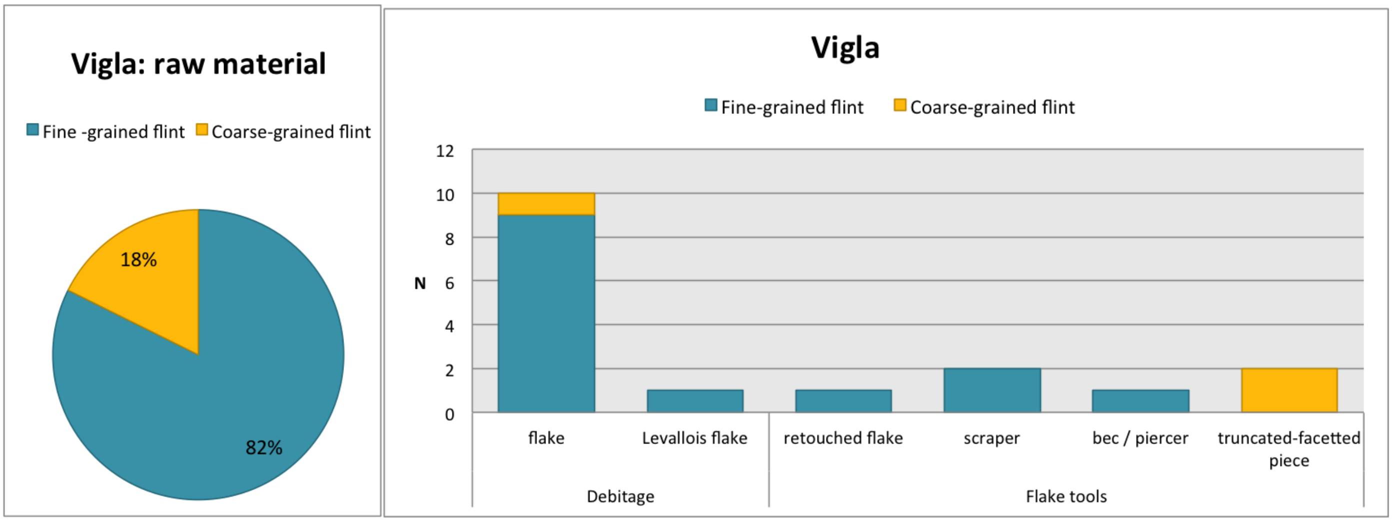
Graph 14 (left): Percentage of raw materials used at NW Meganissi
Graph 15 (right): Percentage of patina observed on the artefacts from NW Meganissi.

4.5.1.2.1. Vigla (N=17)

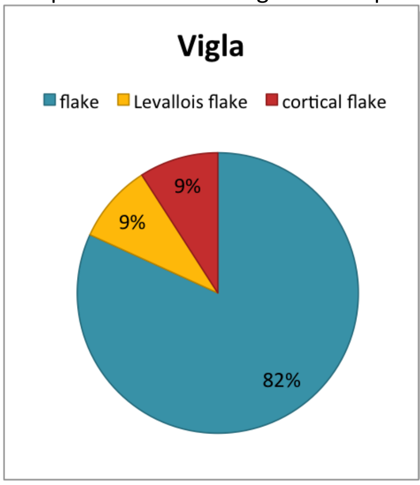
Vigla is an area situated at the NW of Meganissi and, as its name connotes, has a nice overview of the archipelago between Meganissi and Lefkas. A total of 17 artefacts collected from the area as tract finds have been attributed to the Pleistocene component of the island. These include 11 flakes and 6 flake tools, i.e. 2 truncated-facetted pieces, 2 scrapers, an awl and a retouched flake, most of which (82%) are made on fine-grained flint and the rest on coarse-grained flint (Table 17; Graph 16).

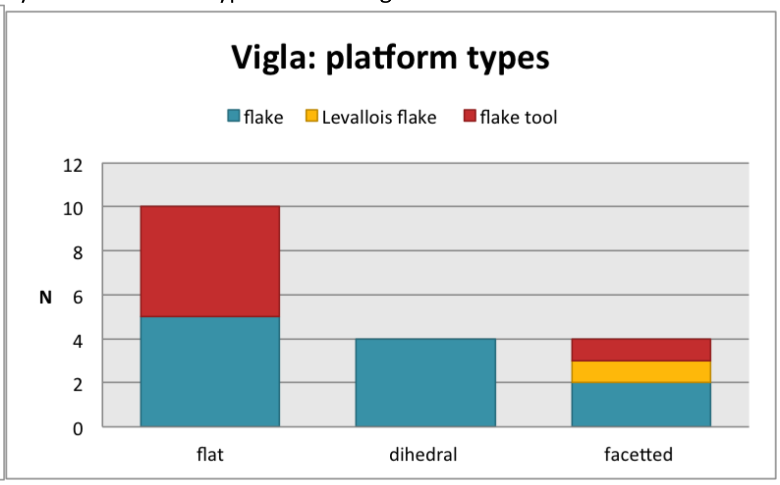
Table 17: Vigla assemblage structure

Vigla		Fine-grained flint		Coarse-grained flint		Total	
		N	%	N	%	N	%
Debitage	flake	9	64,3	1	33,3	10	58,8
	Levallois flake	1	7,1	0	0	1	5,9
Flake tools	retouched flake	1	7,1	0	0	1	5,9
	scraper	2	14,3	0	0	2	11,8
	bec / piercer / awl	1	7,1	0	0	1	5,9
	truncated-facetted piece	0	0	2	66,7	2	11,8
Total		14	100	3	100	17	100
Total (%)		82		18		100	



Graph 16a-b: Percentage and frequency of raw material types used at Vigla





Graph 17 (left): Percentage of blank types
Graph 18 (right): Platform types on debitage and flake tool blanks from Vigla.

The debitage includes a cortical flake (Figure 94h), nine plain flakes, five of which with flat and five with prepared platforms (Graph 18), and a Levallois flake with a facetted platform (Figure 94f). Flake tools include two truncated facetted pieces with flat butts made on coarse-grained flint (Figure 94j), and four other flake tools made on fine-grained flint, i.e. a retouched flake with a facetted platform (1662/1), an awl made on a flake with a flat butt (1698/3), an endscraper on a partially cortical flake (Figure 94k) and a single scraper with semi-abrupt, scaled retouch on its right lateral (Figure 94i). 85% of the blanks used for retouch are plain flakes, followed by Levallois and laminar flakes (Graph 17).

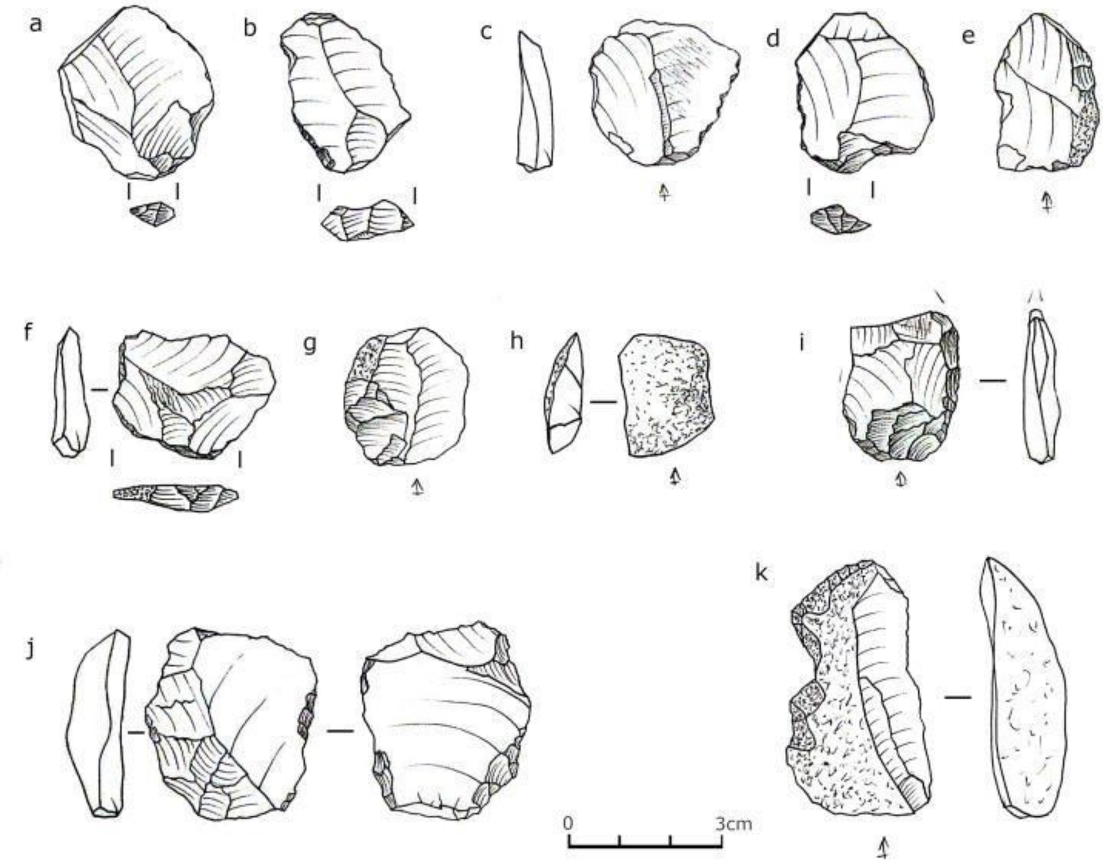


Figure 94: Flakes (a-h) and flake tools (i-k) from Vigla.

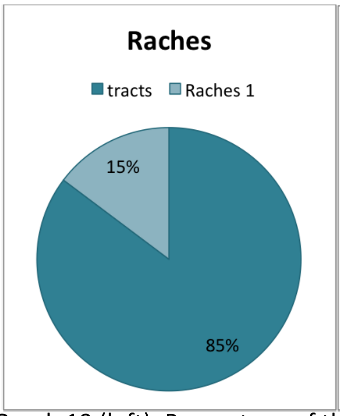
4.5.1.2.2. Raches (N=129)

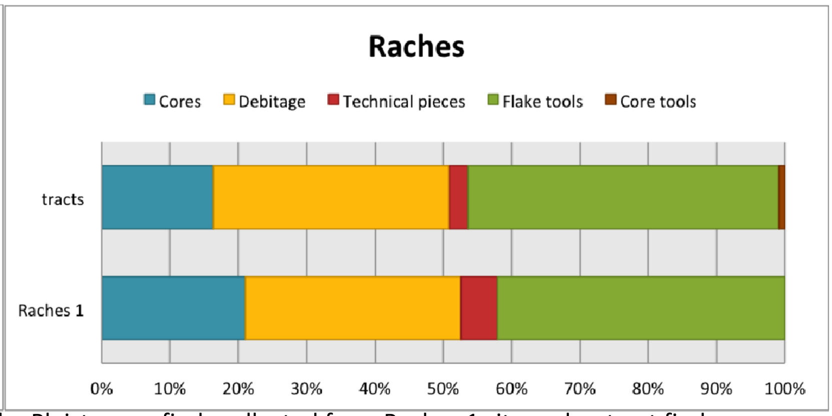
A total of 129 artefacts attributed to the Pleistocene were collected from Raches, both as tract finds and as part of a site, most of which (75,2%) are made on fine-grained flint, while only a 3,9% is made on chert (Table 18). Most of the Pleistocene artefacts from Raches are tract finds, while only 15% were part of Raches 1 site (Graph 19). However the ratio between the different artefact categories is quite similar between the tracts and the site (Graph 20).

Table 18: Raches assemblage structure

Raches		Fine-grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Debitage	flake	25	25,8	8	29,6	3	60	36	27,9
	laminar flake	2	2,1	1	3,7	0	0	3	2,3
	Levallois flake	3	3,1	1	3,7	0	0	4	3,1
	janus flake	1	1	0	0	0	0	1	0,8
Technical pieces	*débordant* flake	3	3,1	0	0	0	0	3	2,3

	crested flake	1	1	0	0	0	0	1	0,8
Cores	flake core	17	17,5	5	18,5	0	0	22	17,1
Flake tools	naturally-backed knife	1	1	1	3,7	0	0	2	1,6
	notch	1	1	0	0	0	0	1	0,8
	denticulate	1	1	0	0	0	0	1	0,8
	pseudo-Levallois point	1	1	1	3,7	0	0	2	1,6
	retouched flake	25	25,8	1	3,7	1	20	27	20,9
	scraper	8	8,2	7	25,9	0	0	15	11,6
	bifacially worked piece	1	1	0	0	0	0	1	0,8
	bec / piercer / awl	4	4,1	1	3,7	1	20	6	4,7
	splintered piece	3	3,1	0	0	0	0	3	2,3
Core tools	heavy-duty scraper	0	0	1	3,7	0	0	1	0,8
Total		97	100	27	100	5	100	129	100
Total (%)		75,2		20,9		3,9		100	





Graph 19 (left): Percentage of the Pleistocene finds collected from Raches 1 site and as tract finds.
Graph 20 (right): Artefact categories percentages from Raches tracts and Raches 1.

4.5.1.2.2.1. Raches tracts (N=110)

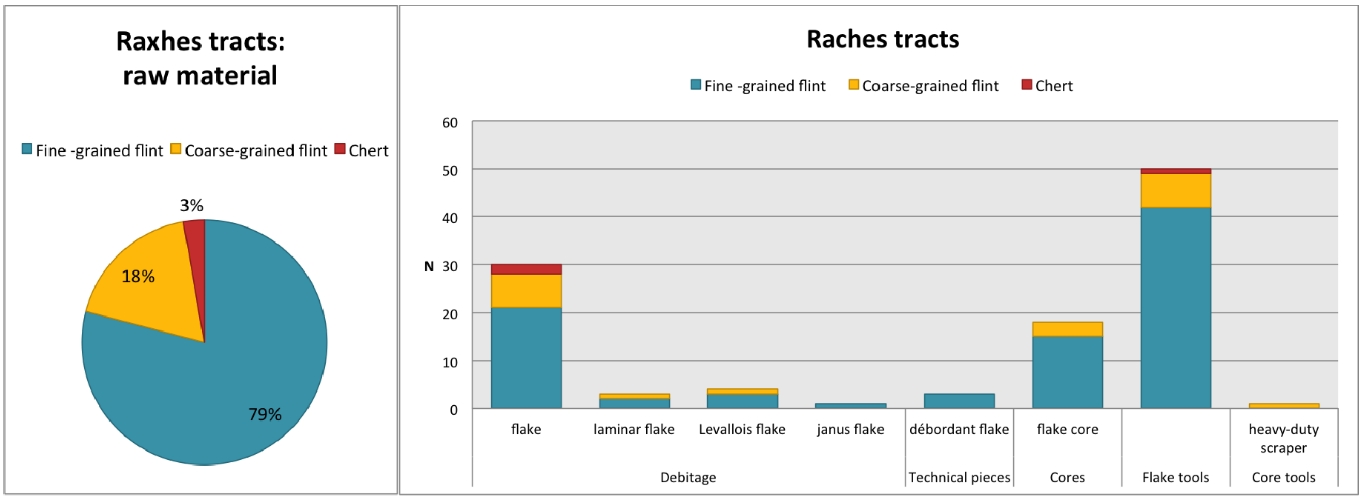
The Pleistocene component of Raches tracts includes 18 flake cores, 38 debitage specimens, 3 technical pieces, 50 flake tools and a core tool (Table 19). The core tool is a heavy-duty scraper (69x48x57mm) made on coarse-grained flint, the three *débordant* flakes are made on fine-grained flint and all other artefact categories include specimens made on fine- and coarse-grained flint, while only two flakes and a splintered piece (1326/1) are made on chert (Graph 21).

Table 19: Inventory of the Raches 1 and Raches tracts assemblages

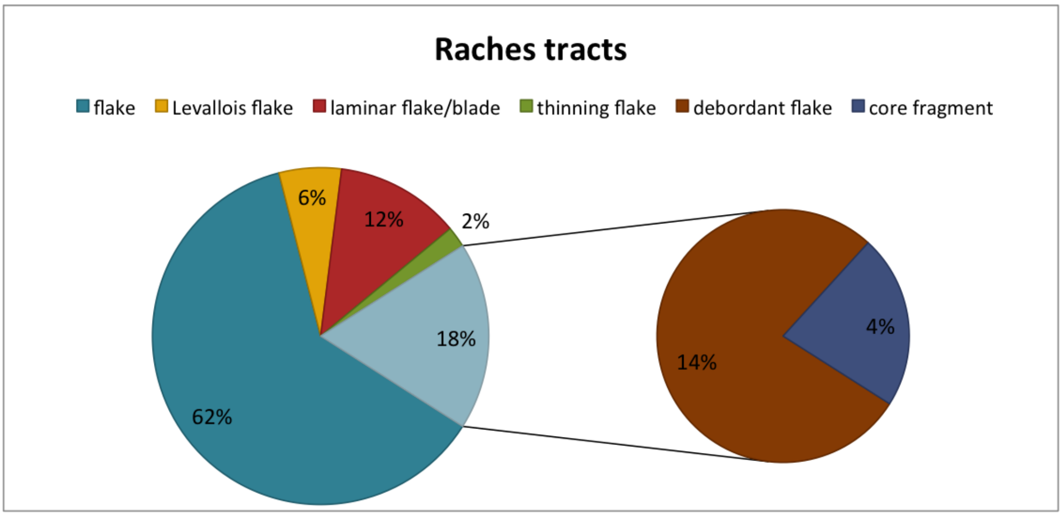
Raches	Cores		Debitage		Technical pieces		Flake tools		Core tools		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Raches 1	4	18,2	6	13,6	1	25	8	13,8	0	0	19	15
tracts	18	81,8	38	86,4	3	75	50	86,2	1	100	110	85
Total	22	100	44	100	4	100	58	100	1	100	129	100
Total (%)	17,1		34,1		3,1		45		0,8		100	

Table 20: Raches tracts assemblage structure

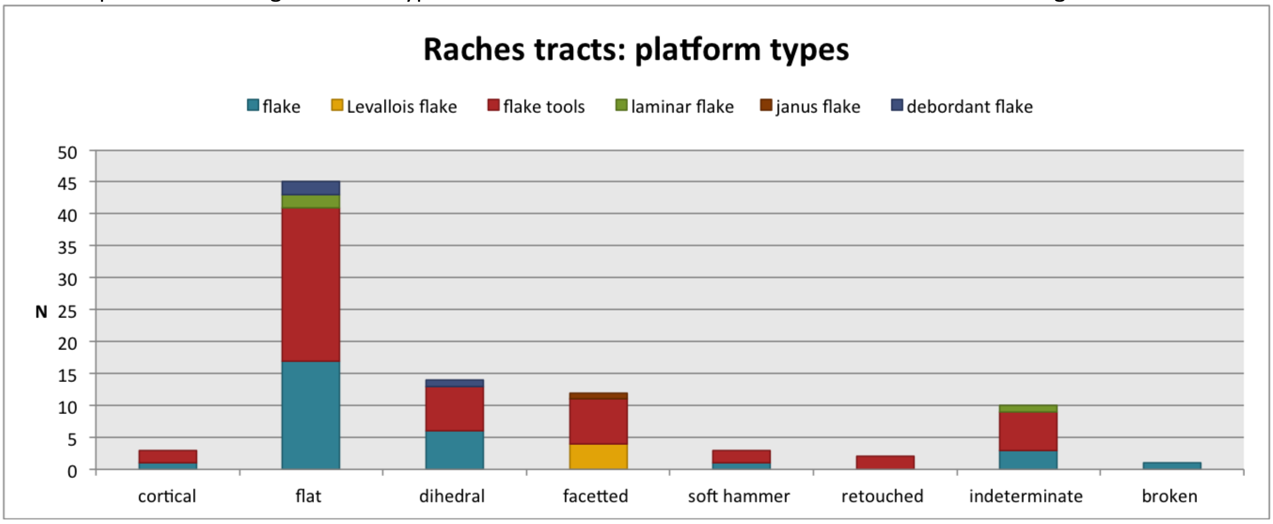
Raches tracts		**Fine -grained flint**		**Coarse-grained flint**		**Chert**		**Total**	
		N	%	N	%	N	%	N	%
Debitage	flake	21	24,1	7	35	2	66,7	30	27,3
	laminar flake	2	2,3	1	5	0	0	3	2,7
	Levallois flake	3	3,4	1	5	0	0	5	3,6
	janus flake	1	1,1	0	0	0	0	1	0,9
Technical pieces	*débordant* flake	3	3,4	0	0	0	0	3	2,7
Cores	flake core	15	17,2	3	15	0	0	18	16,4
Flake tools	naturally-backed knife	1	1,1	1	5	0	0	2	1,8
	notch	1	1,1	0	0	0	0	1	0,9
	denticulate	1	1,1	0	0	0	0	1	0,9
	pseudo-Levallois point	1	1,1	1	5	0	0	2	1,8
	retouched flake	24	27,6	1	5	0	0	25	22,7
	scraper	7	8	3	15	0	0	10	9,1
	bifacially worked piece	1	1,1	0	0	0	0	1	0,9
	bec / piercer	3	3,4	1	5	1	33,3	5	4,5
	splintered piece	3	3,4	0	0	0	0	3	2,7
Core tools	heavy-duty scraper	0	0	1	5	0	0	1	0,9
Total		87	100	20	100	3	100	110	100
Total (%)		79		18		3		100	



Graph 21a-b: Percentage and frequency of raw material types used for the Raches tracts assemblage



Graph 22: Percentage of blank types used for retouched tools at the Raches tracts assemblage



Graph 23: Frequency of the different platform types on the debitage, technical pieces (débordant flakes) and flake tools from Raches tracts

The prepared core technique is attested by the presence of a number of Levallois cores (Figure 95) and blanks. Although most platforms are flat (Graph 23), a significant number of prepared platforms, i.e. facetted and dihedral, are encountered on flakes (1136/4, 1137Δ/2, 1188Δ/2) and flake tools (1188B/1, 1167/1) (Figure 96). *Débordant* flakes have in some cases been used as blanks for tools (Graph 22; Figure 97). The assemblage also includes seven elongated artefacts, three unmodified laminar flakes and four retouched ones, all with flat (or indeterminate) platforms. Most of these come from the same tract, i.e. 1160 (Figure 98).

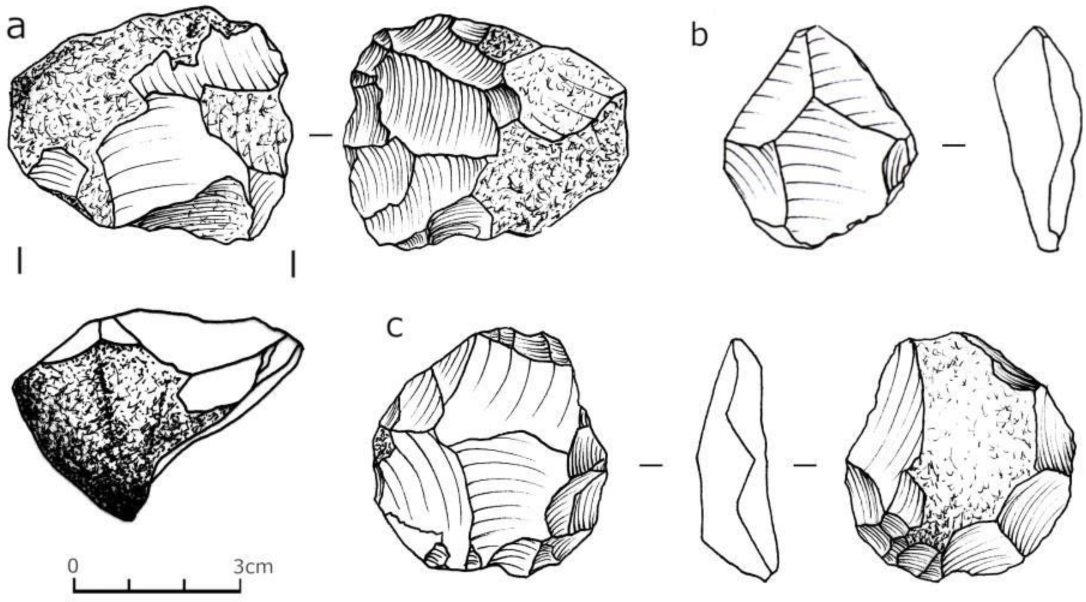


Figure 95: Flake cores from Raches tracts.

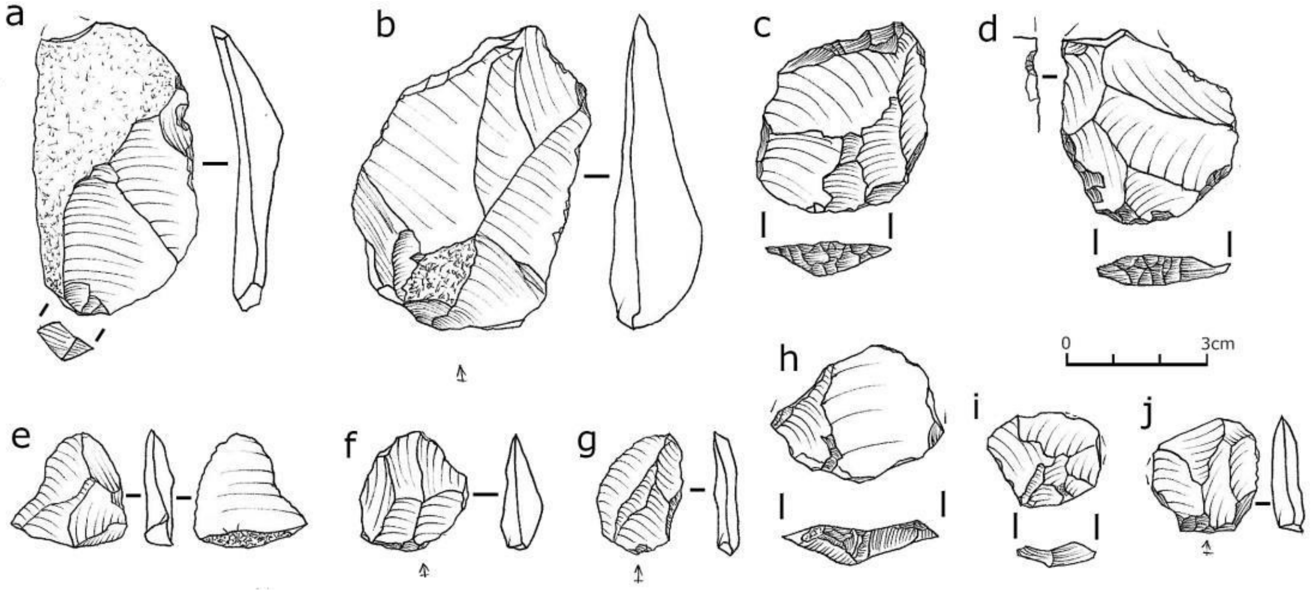


Figure 96: Flakes (a-b, e-j) and flake tools (c-d) from Raches tracts.

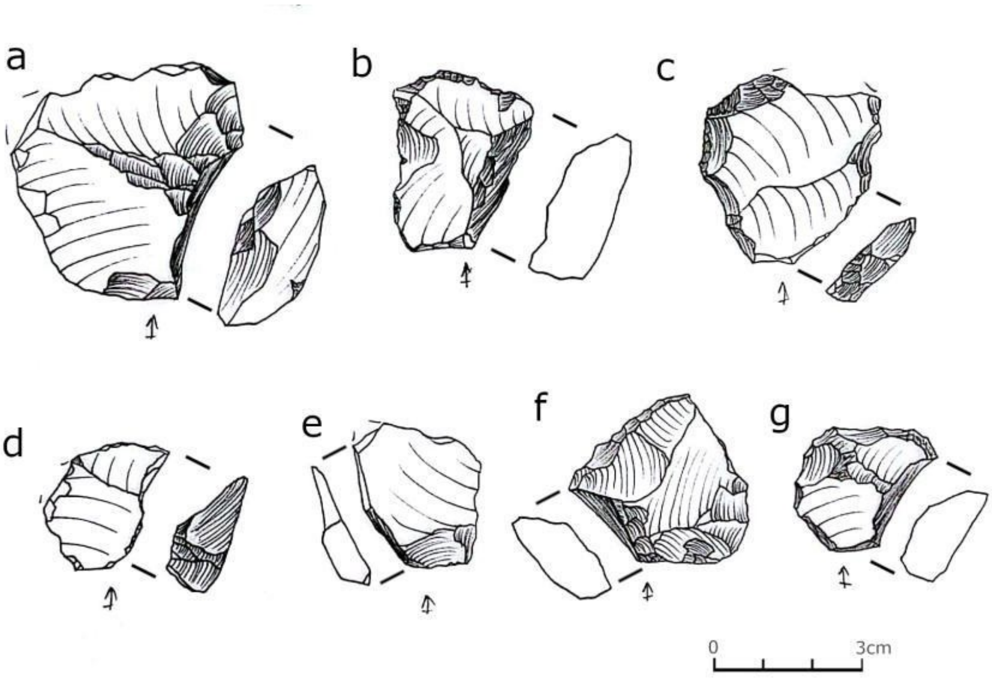


Figure 97: Débordant flakes, both unmodified (a, d-e) and retouched (b-c, f-g) from Raches tracts.

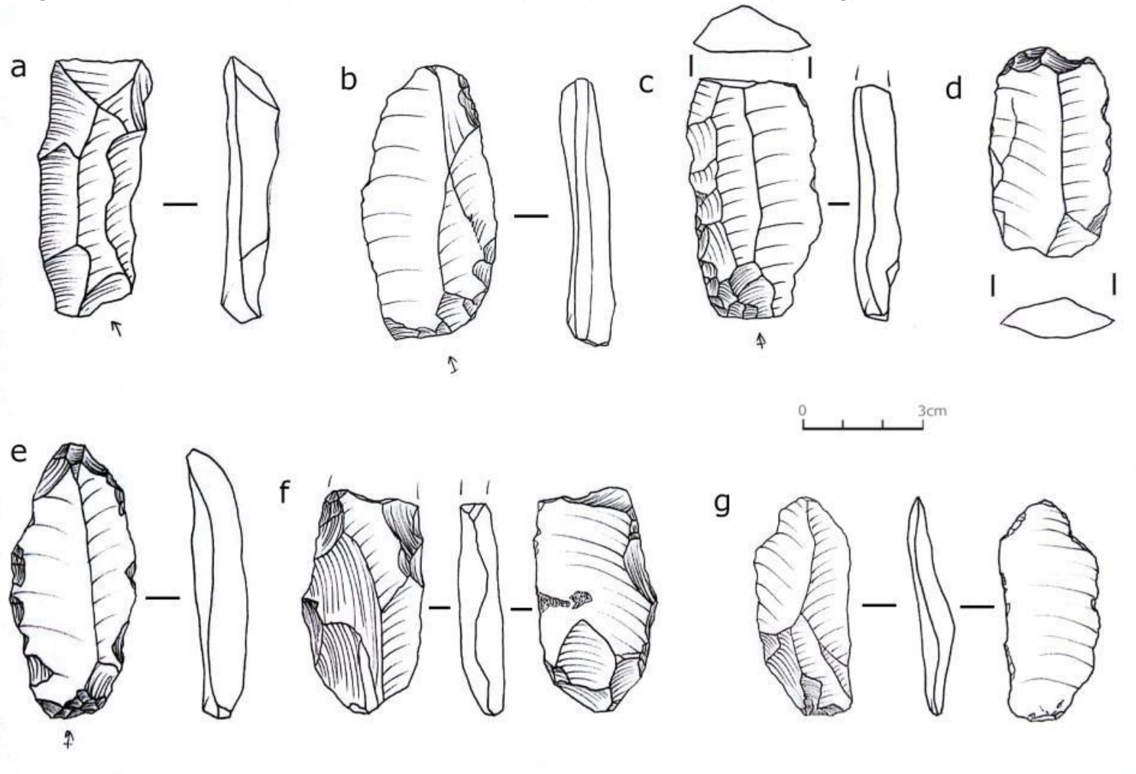


Figure 98a-g: Elongated artefacts from Raches tracts.

Formal tool types include a pseudo-Levallois point made on coarse-grained flint and a broken retouched pseudo-Levallois point (Figure 99a-b), five perforators/becs and ten scrapers (Table 20). There is also a heavily patinated (5) bifacially worked tool which resembles a leafpoint (Figure 99d). The retouch is of a continuous distribution, covering on the dorsal face and invasive on the ventral face, of a low angle on both faces with a semi-abrupt angle on its right lateral. Of interest are the splintering scars on one of the flakes (Figure 99e).

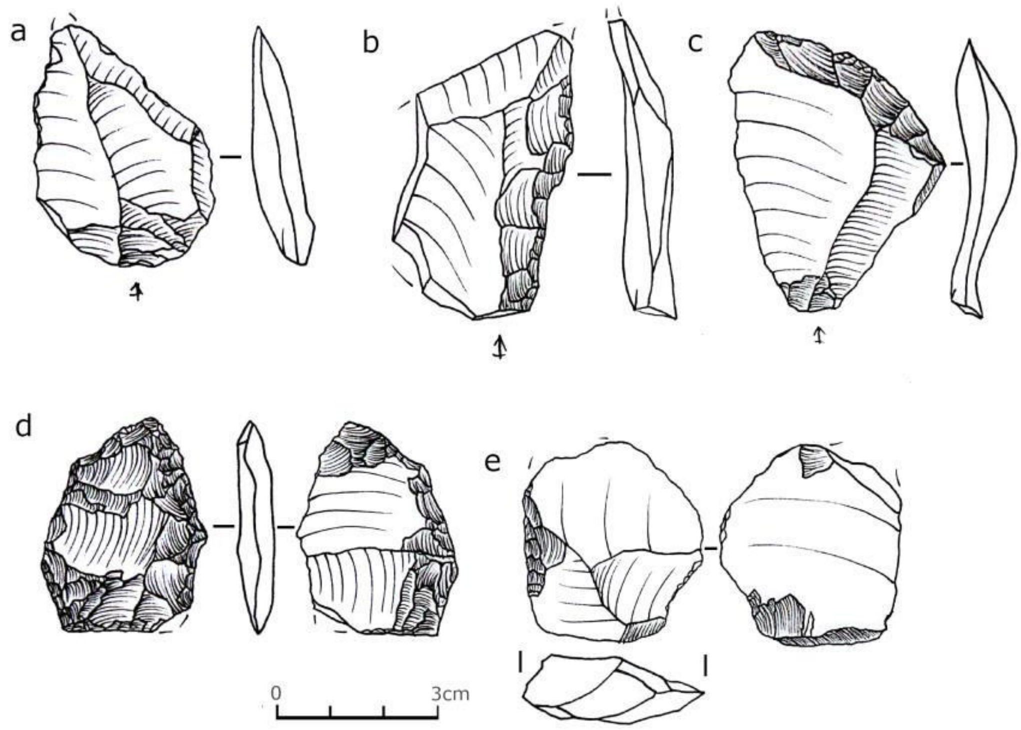


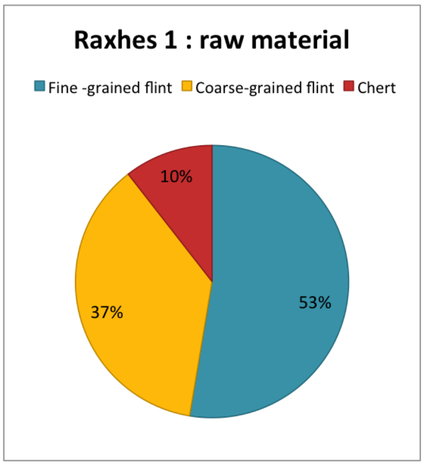
Figure 99: Formal tools from Raches tracts.

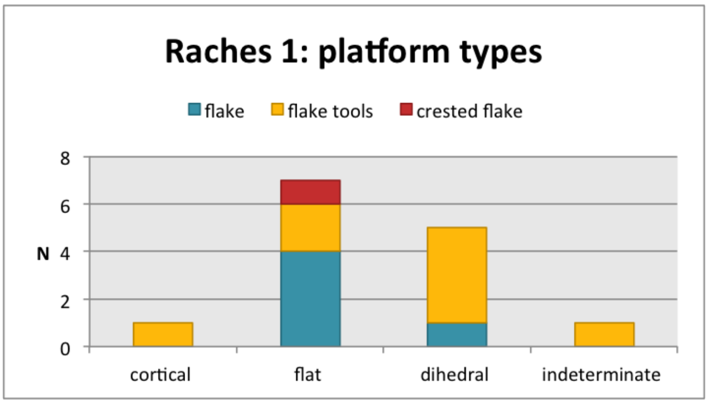
4.5.1.2.2.2. Raches 1 (N=19)

A total of 19 artefacts were collected from Raches 1. Most of the artefacts are made on fine-grained (52,6%) and coarse-grained (36,8%) flint, while only a flake and a retouched flake are made on chert (Graph 24). The assemblage consists mainly of flake tools and unmodified flakes (Table 21; Graph 26). There are also four cores: two disc cores, a lineal Levallois core (Figure 100a) and a heavily weathered thick flake turned into a flake core which has also produced a Janus flake (Figure 100b). In terms of platform preparation, only dihedral butts have been recorded, on an unmodified flake and on four flake tools (Graph 26). Formal tool types encountered at Raches 1 include mainly scrapers (26.3%) and two perforators (5.3%), all made on plain flake blanks. All other flake tools are retouched flakes (Table 21; Figure 101).

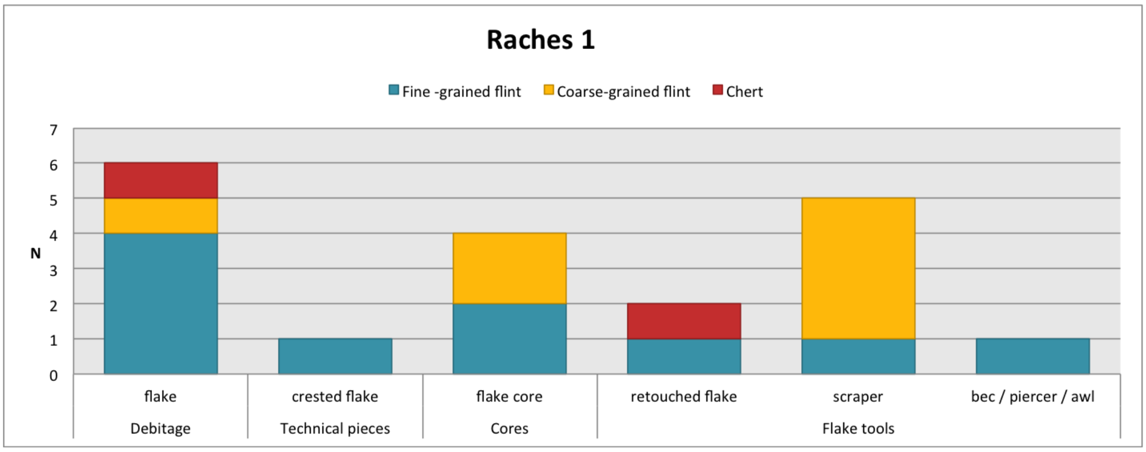
Table 21: Raches 1 assemblage structure

Raches 1		Fine -grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Debitage	flake	4	40	1	14,3	1	50	6	31,6
Technical pieces	crested flake	1	10	0	0	0	0	1	5,3
Cores	flake core	2	20	2	28,6	0	0	4	21,1
Flake tools	retouched flake	1	10	0	0	1	50	2	10,5
	scraper	1	10	4	57,1	0	0	5	26,3
	bec / piercer / awl	1	10	0	0	0	0	1	5,3
Total		10	100	7	100	2	100	19	100
Total (%)		53		37		10		100	





Graph 24 (left): Percentage and frequency of the raw material types used at Raches 1
Graph 25 (right): Frequency of the different platform types on the debitage, technical piece and flake tools from Raches 1



Graph 26 : Frequency of the raw material types used for the diffrerent artefact categories at Raches 1

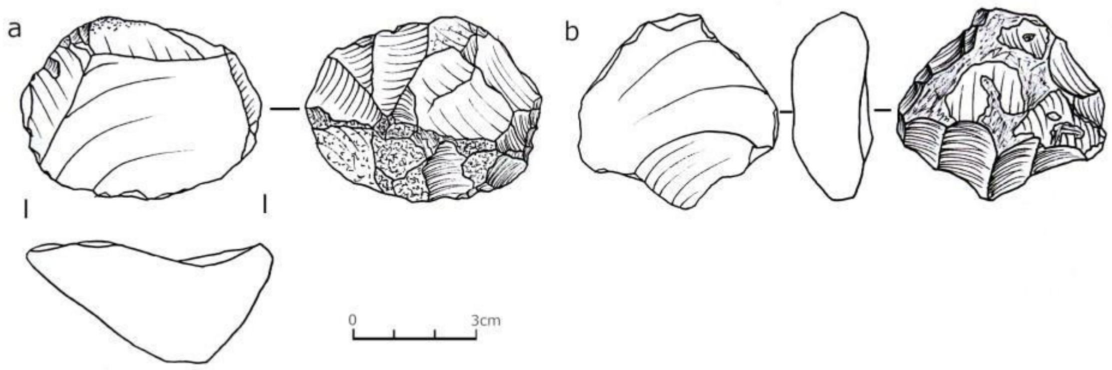


Figure 100: Flake cores from Raches 1.

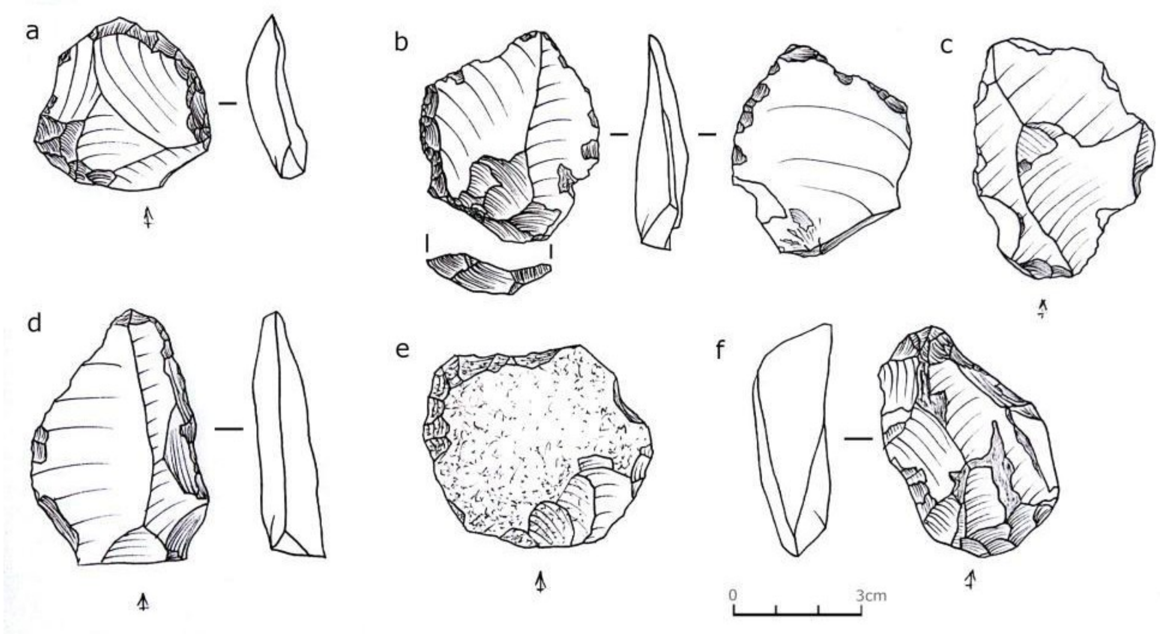


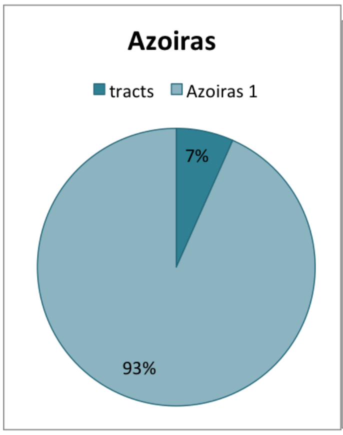
Figure 101: Flake (c) and flake tools (a-b, d-f) from Raches 1.

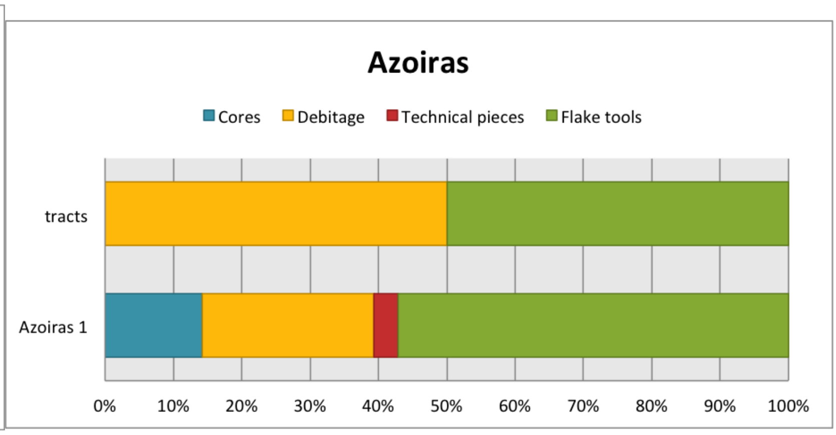
4.5.1.2.3. Azoiras (N=30)

A total of 30 Pleistocene artefacts from the area of Azoiras were collected mainly as part of Azoiras 1 site, with only a 7% collected from the tracts (Graph 27). Most artefacts are made on fine-grained flint (80%), followed by coarse-grained flint and only a scraper is made on chert (Table 22). While Azoiras 1 includes mainly flake tools but also debitage, cores and a technical piece (Graph 28), the tract finds consist only of a debitage specimen and a flake tool (Table 23).

Table 22: Azoiras assemblage structure

Azoiras		Fine -grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Debitage	flake	6	25	0	0	0	0	6	20
	Levallois flake	2	8,3	0	0	0	0	2	6,7
Technical pieces	*débordant* flake	1	4,2	0	0	0	0	1	3,3
Cores	flake core	2	8,3	2	40	0	0	4	13,3
Flake tools	naturally-backed knife	1	4,2	0	0	0	0	1	3,3
	retouched flake	8	33,3	2	40	0	0	10	33,3
	scraper	2	8,3	0	0	1	100	3	10
	bec / piercer / awl	1	4,2	1	20	0	0	2	6,7
	splintered piece	1	4,2	0	0	0	0	1	3,3
Total		24	100	5	100	1	100	30	100
Total (%)		80		16,7		3,3		100	





Graph 27 (left): Percentage of the Pleistocene finds collected from Azoiras 1 site and as tract finds
Graph 28 (right): Artefact categories from Azoiras 1 and Azoiras tracts.

Table 23: Assemblage structure at Azoiras 1 and Azoiras tracts

Azoiras	Cores		Debitage		Technical pieces		Flake tools		Total	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Azoiras 1	4	100	7	87,5	1	100	16	94,1	28	93
tracts	0	0	1	12,5	0	0	1	5,9	2	7
Total	4	100	8	100	1	100	17	100	30	100
Total (%)	13,3		26,7		3,3		56,7		100	

4.5.1.2.3.1. Azoiras tracts (N=2)

A broken Levallois flake (358/2) and a heavily weathered scraper with inverse retouch (358/1), both made on fine-grained flint blanks with a dihedral platform (Figure 102), were the only artefacts collected from the Azoiras tracts that can be attributed to the Middle Palaeolithic (Table 24).

Table 24: Azoiras tracts assemblage structure

Azoiras tracts		Fine -grained flint	
		N	%
Debitage	Levallois flake	1	50,0
Flake tools	scraper	1	50
Total		2	100

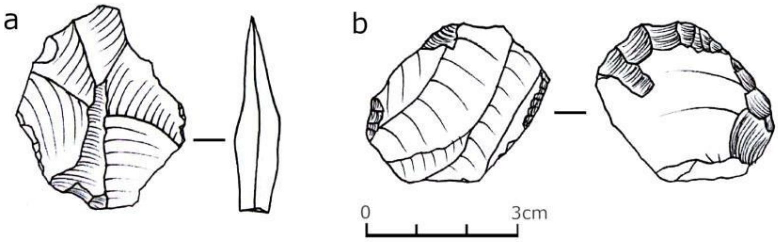


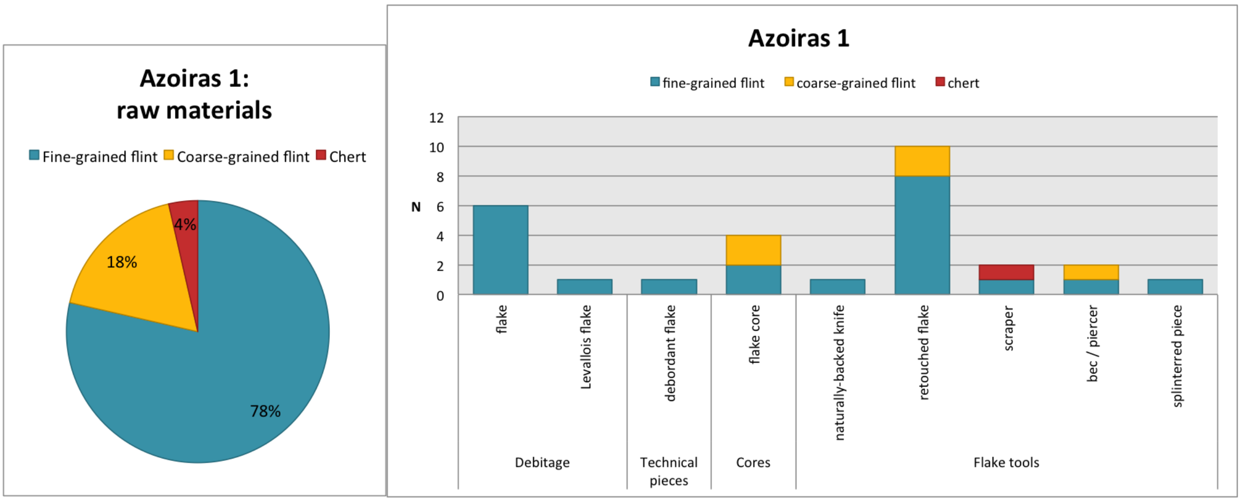
Figure 102: A Levallois flake (a) and a scraper (b) from Azoiras tracts.

4.5.1.2.3.2. Azoiras 1 (N=28)

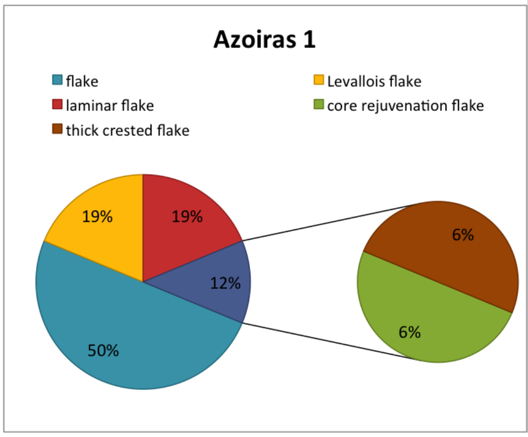
Azoiras 1, on the other hand, returned 28 artefacts that may be attributed to the Middle Palaeolithic. These are mainly flake tools (N=16), followed by debitage (N=7), cores (N=4) and a technical piece, i.e. a *débordant* flake (328/10) (Table 25). Apart from a single scraper with direct, denticulated stepped and scaled retouch of an abrupt angle on its left lateral made on a thick crested chert blank (59x54x25mm), all other artefacts are made on flint, predominantly fine-grained one (Graph 29). The four flake cores include a lineal Levallois (306E/1) and a recurrent Levallois core (306E/2). The first one is made on coarse-grained flint and measures 51x66x36mm (Figure 103). The second one is made on fine-grained flint and it is partially broken and burnt. These parts are of a red colour while the rest of the surface is covered by pink patina.

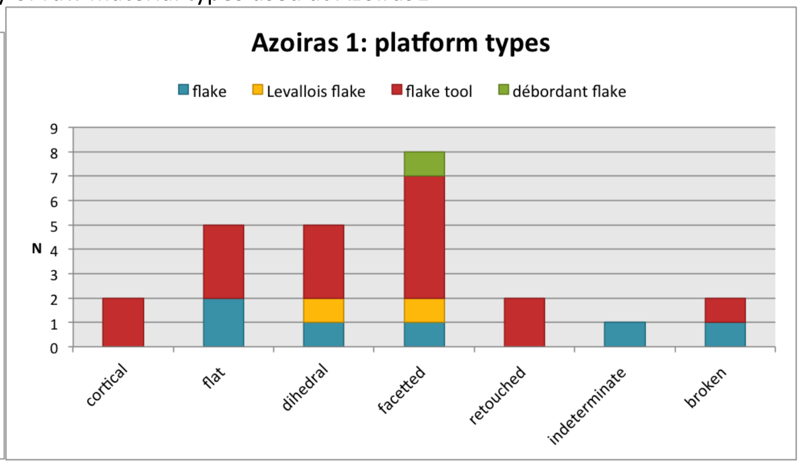
Table 25: Azoiras 1 assemblage structure

Azoiras 1		Fine -grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Debitage	flake	6	27,3	0	0	0	0	6	21,4
	Levallois flake	1	4,5	0	0	0	0	1	3,6
Technical pieces	*débordant* flake	1	4,5	0	0	0	0	1	3,6
Cores	flake core	2	9,1	2	40	0	0	4	14,3
Flake tools	naturally-backed knife	1	4,5	0	0	0	0	1	3,6
	retouched flake	8	36,4	2	40	0	0	10	35,7
	scraper	1	4,5	0	0	1	100	2	7,1
	bec / piercer / awl	1	4,5	1	20	0	0	2	7,1
	splintered piece	1	4,5	0	0	0	0	1	3,6
Total		22	100	5	100	1	100	28	100
Total (%)		78,6		17,9		3,6		100	



Graph 29a-b: Percentage and frequency of raw material types used at Azoiras 1





Graph 30 (left): Percentage of blank types used for retouched tools at Azoiras 1
Graph 31 (right): Frequency of platform types on debitage, technical pieces and flake tools at Azoiras 1

The flake tools include two becs, one made on a fine-grained flint flake with a flat butt and the second on a coarse-grained flint flake with a cortical butt, an endscraper made on a laminar flake (Figure 103a), a naturally backed knife, a splintered piece probably used as a wedge (Figure 103c) and several retouched flakes, two of which are on Levallois flake blanks with facetted platforms. Artefact 328/12 has a short, continuous retouch along its edges while the distal part of artefact 305Γ/3 was mainly utilized since apart from the direct retouch scars there is also an inverse burin blow, probably a result of its use (Figure 103b). Half of the retouched blanks are plain flakes, followed by Levallois and laminar flakes, and two of the flake tools are made on technical pieces (Graph 30). A number of different types of platforms are encountered on both debitage and flake tools, most of which are prepared, either facetted or dihedral. The only débordant flake has a facetted platform, as well (Graph 31).

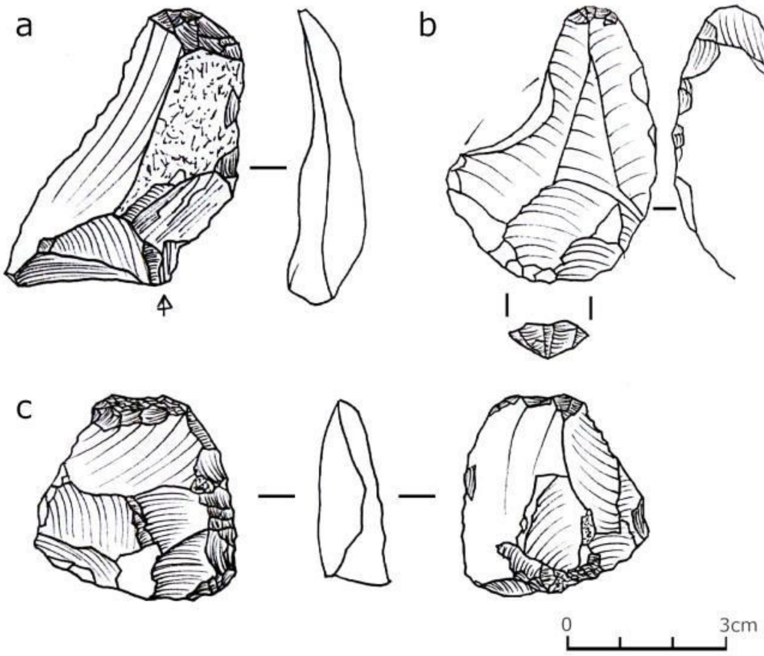


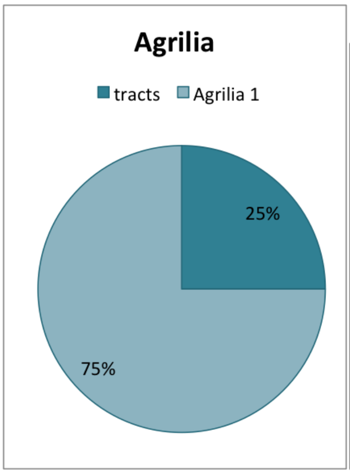
Figure 103: Flake tools from Azoiras 1.

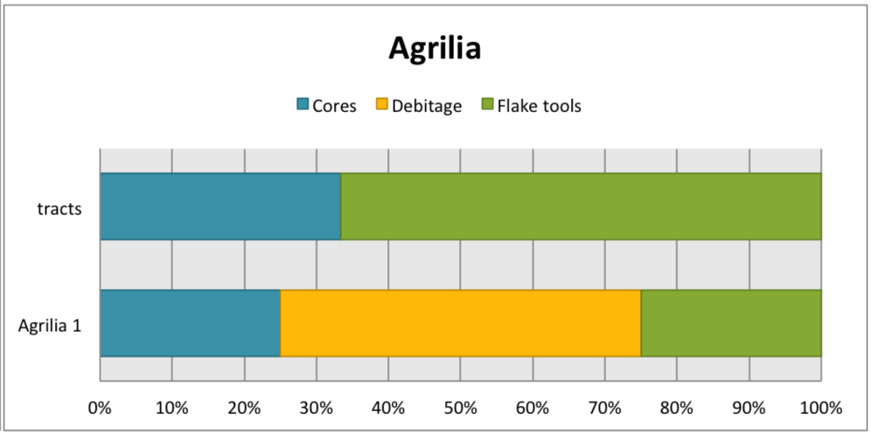
4.5.1.2.4. Agrilia (N=11)

Three cores, four debitage pieces and four flake tools from Agrilia, all made on fine-grained flint (Table 26), have been attributed to the Middle Palaeolithic, 75% of which are tract finds (Graph 32). Artefact categories represented in the Agrilia tracts are only cores and flake tools, while at Agrilia 1 there are also debitage pieces (Graph 33, Table 27).

Table 26: Agrilia assemblage structure

Agrilia		**fine-grained flint**	
		N	%
Debitage	flake	3	27
	Levallois flake	1	9
Cores	flake core	3	27
Flake tools	point	1	9
	retouched flake	2	18
	bec / piercer / awl	1	9
Total		11	100





Graph 32 (left): Percentage of the Pleistocene finds collected from Agrilia tracts and Agrilia 1
Graph 33 (right): Artefact categories from Agrilia tracts and Agrilia 1

Table 27: Assemblage sdtructure at Agrilia 1 and Agrilia tracts

Agrilia	Cores		Debitage		Flake tools		Total	
	N	%	N	%	N	%	N	%
Agrilia 1	2	67	4	100	2	66,7	8	73
tracts	1	33	0	0	2	33,3	3	27
Total	3	100	4	100	4	100	11	100
Total (%)	27,3		36,4		36,4		100	

4.5.1.2.4.1. Agrilia tracts (N=3)

Three artefacts collected as tract finds have been attributed to the Middle Palaeolithic. These are a prepared flake core and two flake tools, both made on fine-grained flint (Table 28). The flake core is a bifacially worked, lineal Levallois core (Figure 104a). The point's butt is facetted, yet unpatinated, a fact which implies that it was probably further retouched at a later stage. It bears direct, partial, denticulated retouch at its left lateral (Figure 104b). The retouched flake has a facetted butt and continuous, long, regular retouch on its right lateral (Figure 104c).

Table 28: Agrilia tracts assemblage structure

Agrilia tracts		Fine -grained flint	
		N	%
Cores	flake core	1	33
Flake tools	retouched flake	1	33
	point	1	33
Total		3	100

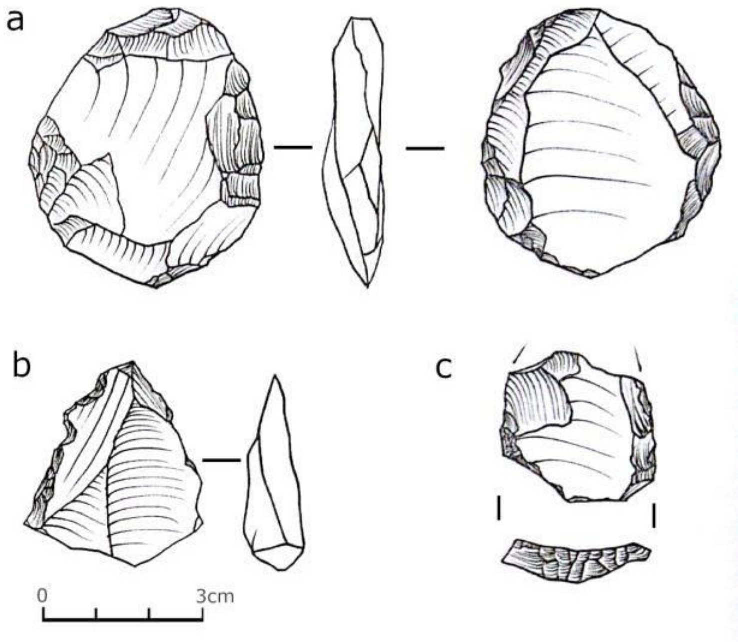


Figure 104: Flake core (a) and flake tools (b-c) from Agrilia tracts

4.5.1.2.4.2. Agrilia 1 (N=8)

The Agrilia 1 lithic assemblage attributed to the Middle Palaeolithic includes three flakes, a Levallois flake (1353/8), two flake tools and two flake cores, all made on fine-grained flint (Table 29). Both cores have centripetal negative scars and preserve part of their cortex. The largest one (74x73x28mm) can be described as a disc core, while the smaller one (51x58x19mm) is a lineal Levallois core (Figure 105). Apart from the Levallois flake, however, no other flake or flake tool from Agrilia 1 has a prepared platform. The only formal tool type is a bec made on a small flake with a flat platform (23x25x7mm). It has alternating, continuous retouch on its right lateral (1349/2). The second flake tool from Agrilia 1 is a flake of relatively larger dimensions (52x63x16mm) with alternating, irregular retouch on its distal and right lateral (1353/1) (Figure 106).

Table 29: Agrilia 1 assemblage structure

Agrilia 1		**Fine -grained flint**	
		N	%
Debitage	flake	3	38
	Levallois flake	1	13
Cores	flake core	2	25
Flake tools	retouched flake	1	13
	bec / piercer / awl	1	13
Total		8	100

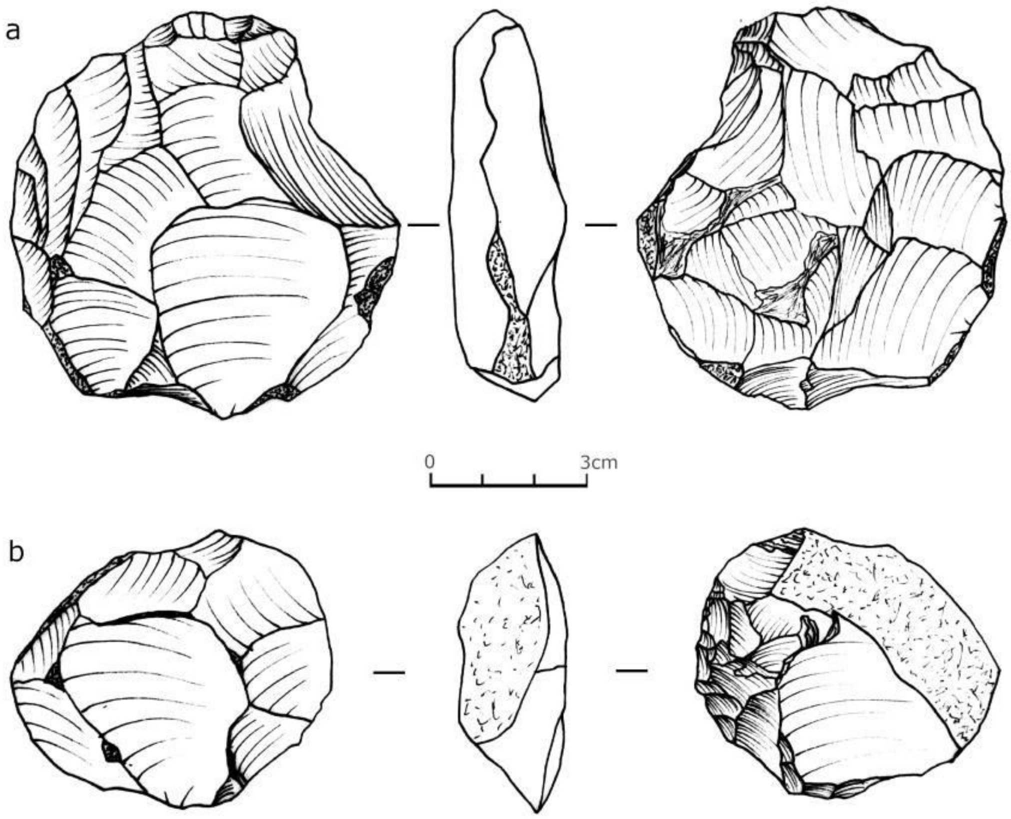


Figure 105: Flake cores from Agrilia 1.

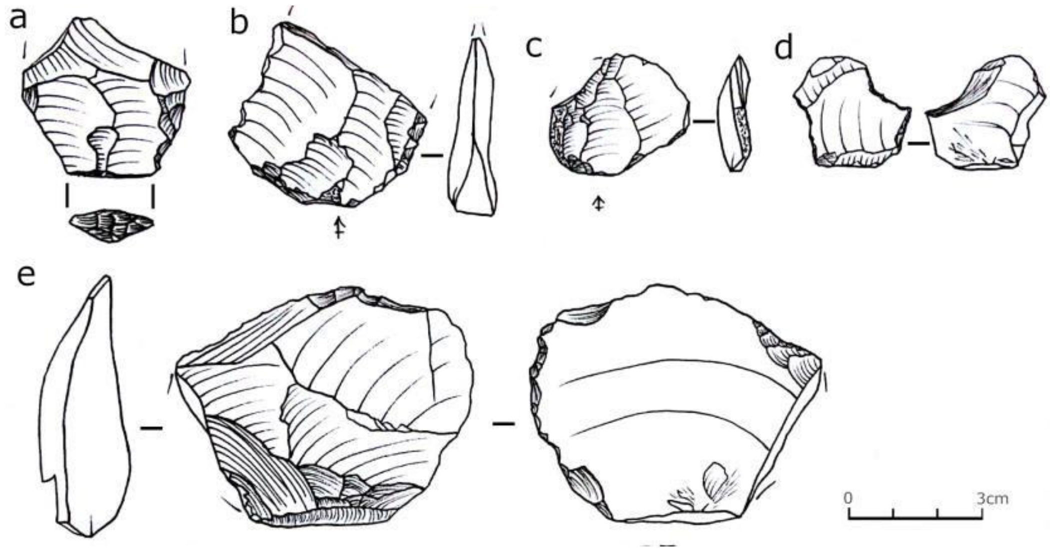


Figure 106: Flakes (a-c) and flake tools (d-e) from Agrilia 1.

4.5.1.2.5. Elliniko (N=1)

A transverse scraper from Elliniko made on a fine-grained flint flake is attributed to the Middle Palaeolithic of NW Meganissi (Table 30). It has long, irregular, stepped retouch of an abrupt angle resembling a truncation, and measures 40x32x11mm (Figure 107a).

Table 30: Elliniko assemblage structure

Elliniko		Fine -grained flint	
		N	%
Flake tool	scraper	1	100

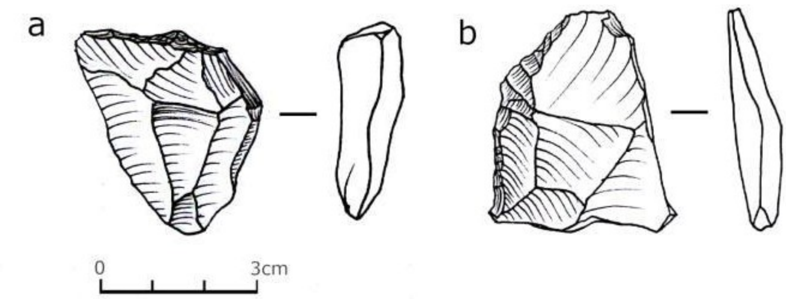


Figure 107: The scraper (a) from Elliniko (XA.1) and the retouched flake (b) from Svourna (280/1).

4.5.1.2.6. Svourna (N=1)

A retouched Levallois flake from Svourna with a broken butt is the only Middle Palaeolithic artefact from the area (Table 31; Figure 107b).

Table 31: Svourna assemblage structure

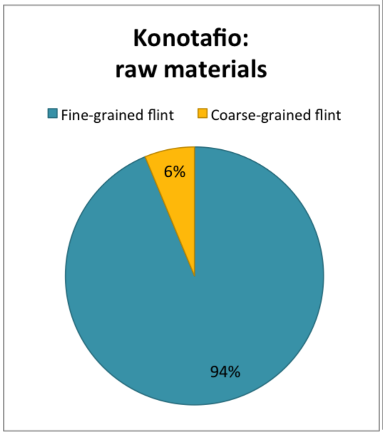
Svourna		Fine -grained flint	
		N	%
Flake tool	retouched flake	1	100

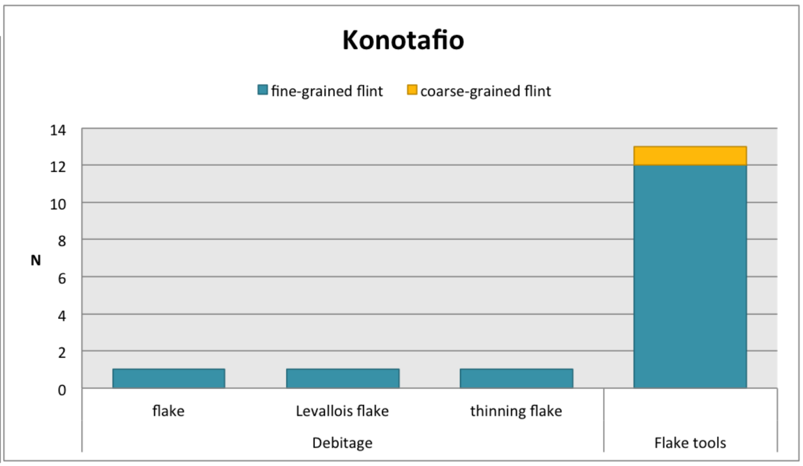
4.5.1.2.7. Konotafio (N=16)

A total of 16 artefacts from Konotafio have been attributed to the Middle Palaeolithic. These are three debitage pieces and 13 flake tools, all made on fine-grained flint, apart from a backed-knife made on coarse-grained flint (Table 32; Graph 34). The retouched artefacts are made on flakes and Levallois flakes (Graph 35). Prepared platforms are the most common platform types and are encountered both on flakes and flake tools (Graph 36).

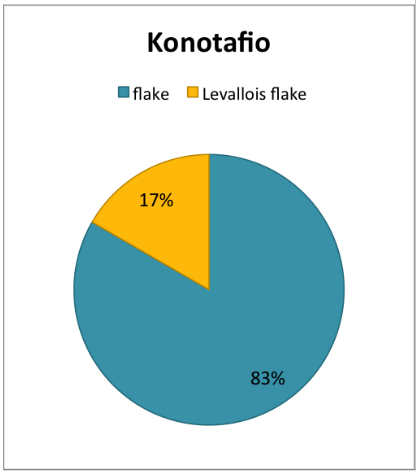
Table 32: Konotafio assemblage structure

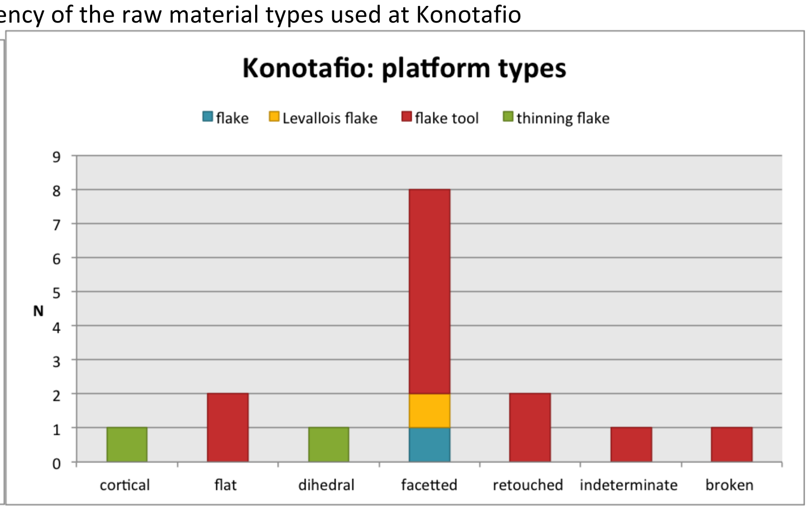
Konotafio 1		**Fine-grained flint**		**Coarse-grained flint**		**Total**	
		N	%	N	%	N	%
Debitage	flake	1	6,7	0	0	1	6,3
	Levallois flake	1	6,7	0	0	1	6,3
	thinning flake	1	6,7	0	0	1	6,3
Flake tools	naturally-backed knife	2	13,3	0	0	2	12,5
	retouched flake	5	33,3	0	0	5	31,3
	scraper	2	13,3	0	0	2	12,5
	bifacially worked piece	1	6,7	0	0	1	6,3
	bec / piercer / awl	1	6,7	0	0	1	6,3
	truncated-facetted piece	1	6,7	0	0	1	6,3
	backed knife	0	0	1	100	1	6,3
Total		15	100	1	100	16	100
Total (%)		93,8		6,25		100	





Graph 34a-b: Percentage and frequency of the raw material types used at Konotafio





Graph 35 (left): Percentage of blank types used for retouched tools at Konotafio
Graph 36 (right): Frequency of the different platform types on the debitage and flake tools from Konotafio

Debitage pieces from Konotafio consist of a broken Levallois flake (1860/5) and two thinning flakes (1860/6-7). There is also a flake turned into a core with an inverse flake removal (1854B/1, Figure 108d). No proper cores attributed to the Middle Palaeolithic were collected from the site. Formal tool types include backed and naturally-backed knives, scrapers (e.g. Figure 108f), a bec formed by a partial truncation (1854B/3, Figure 108e), a truncated-facetted piece and a bifacially worked artefact (Figure 109). The latter is a broken and heavily weathered small biface made on a fine-grained flint flake measuring 81x57x21mm (1859B/1). The retouch is concentrated on its right lateral and it is invasive, continuous, of a semi-abrupt angle. It is a unique find from the area under scrutiny.

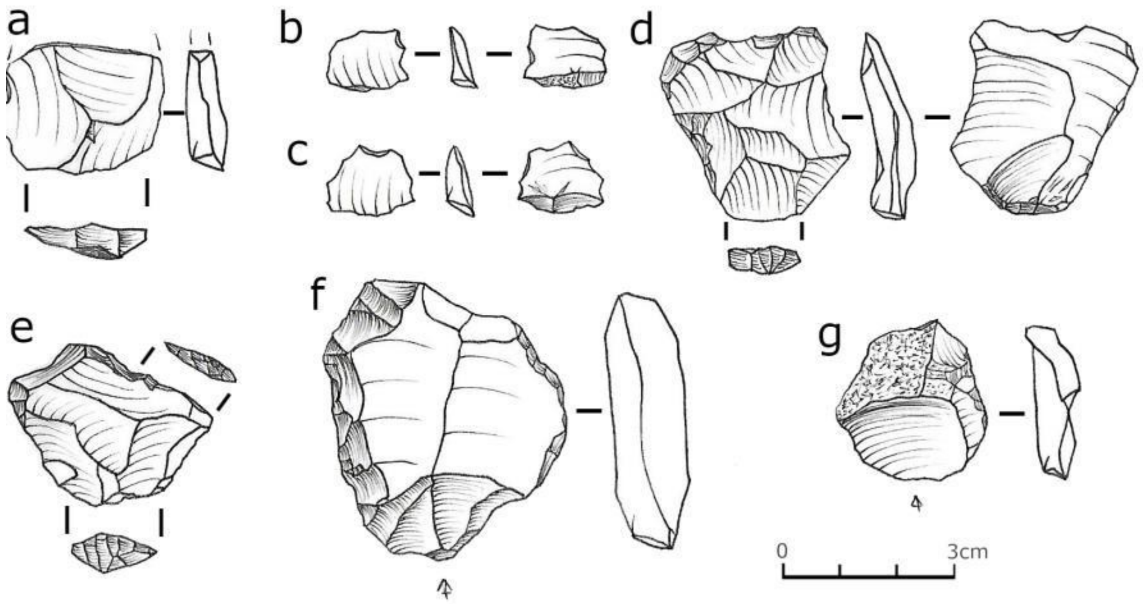


Figure 108: Flakes (a-c, g) and flake tools (d-f) from Konotafio 1

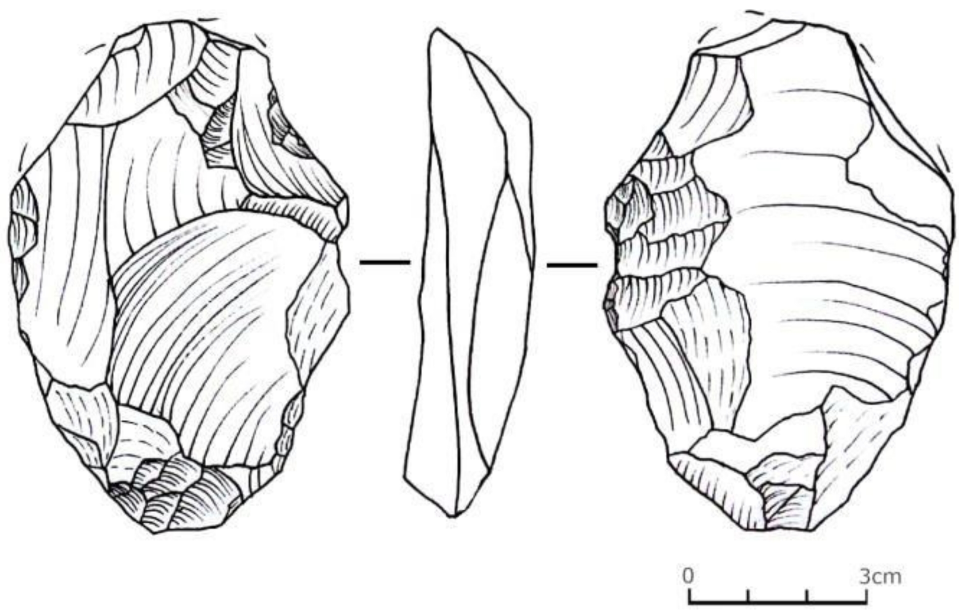


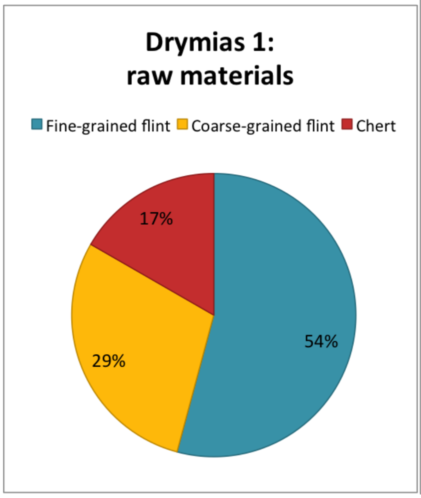
Figure 109: The bifacially worked tool from Konotafio 1 (1859B/1).

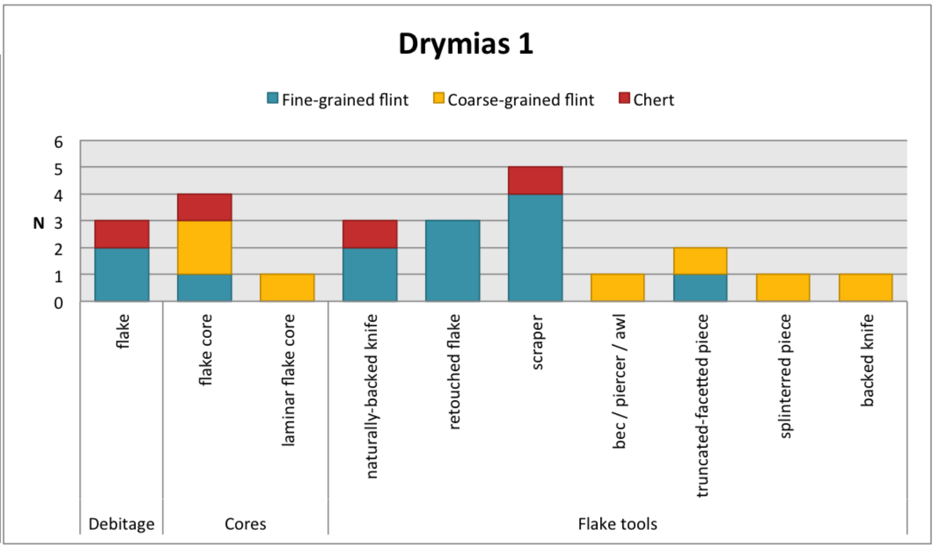
4.5.1.2.8. Drymias 1 (N=24)

All artefacts from Drymias attributed to the Middle Palaeolithic come from Drymias 1 site. The assemblage consists predominantly of flake tools (N=16), yet there are also a few cores (N=4) and flakes (N=2) (Table 33). The majority is made of fine-grained (54%) and coarse-grained flint (29%), yet there are also four artefacts (17%) made of chert (Graph 37). Although most platforms on flakes and flake tools are flat, there is a significant number of dihedral platforms as well **(**Graph 39**)**.

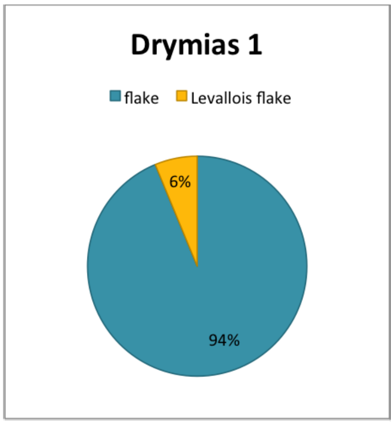
Table 33: Drymias assemblage structure

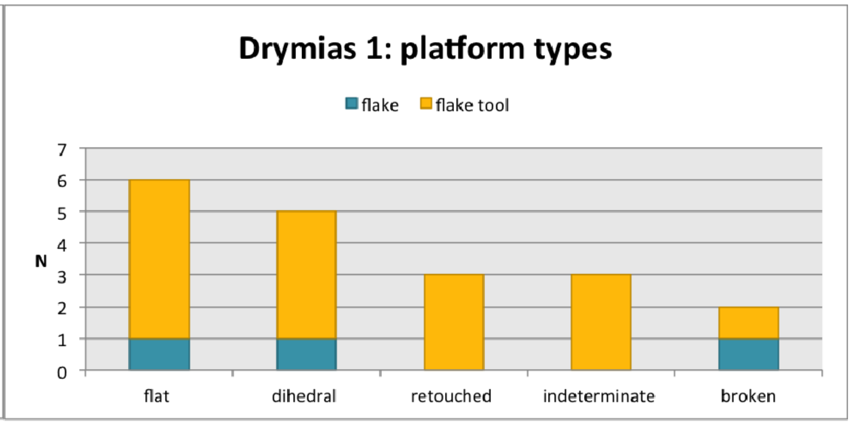
Drymias 1		**Fine-grained flint**		**Coarse-grained flint**		**Chert**		**Total**	
		N	%	N	%	N	%	N	%
Debitage	flake	2	15,4	0	0	1	25	3	12,5
Cores	flake core	1	7,7	2	28,6	1	25	4	16,7
	laminar flake core	0	0	1	14,3	0	0	1	4,2
Flake tools	naturally-backed knife	2	15,4	0	0	1	25	3	12,5
	retouched flake	3	23,1	0	0	0	0	3	12,5
	scraper	4	30,8	0	0	1	25	5	20,8
	bec / piercer / awl	0	0	1	14,3	0	0	1	4,2
	truncated-facetted piece	1	7,7	1	14,3	0	0	2	8,3
	splintered piece	0	0	1	14,3	0	0	1	4,2
	backed knife	0	0	1	14,3	0	0	1	4,2
Total		13	100	7	100	4	100	24	100
Total (%)		54		29		17		100	





Graph 37a-b: Percentage and frequency of raw material types used at Drymias 1





Graph 38 (left): Percentage of blank types used for the retouched tools at Drymias 1
Graph 39 (right): Frequency of the different platform types on the flakes and flake tools from Drymias 1.

Four out of five cores have produced flakes, while the fifth one is a unipolar laminar flake core with one prepared platform (47x53x27mm). It is made on coarse-grained flint and is a bit less patinated (4) that the majority of the artefacts. The same degrees of patina are encountered on a discoid core with a semi-fixed perimeter made on coarse-grained flint flake (49x43x33mm). The other three cores are all prepared ones with centripetal or sub-centripetal negative scars and could be regarded as Levallois lineal cores (Figure 110). One is made on a coarse-grained flint flake (313/2), another one is made on fine-grained flint and is heavily weathered to the degree that it has become extremely light and chalky (313/1) and the last one is made on chert and exhibits gloss on particular flake scars which perhaps signify heat treatment of the core during its preparation (311/3). The most common formal tool types are scrapers and naturally-backed knives, while there is also a bec, a splintered piece and a couple of truncated-facetted pieces (Table 33; Figure 111). Apart from a single Levallois flake, plain flakes are the main blank types used for retouch (Graph 38).

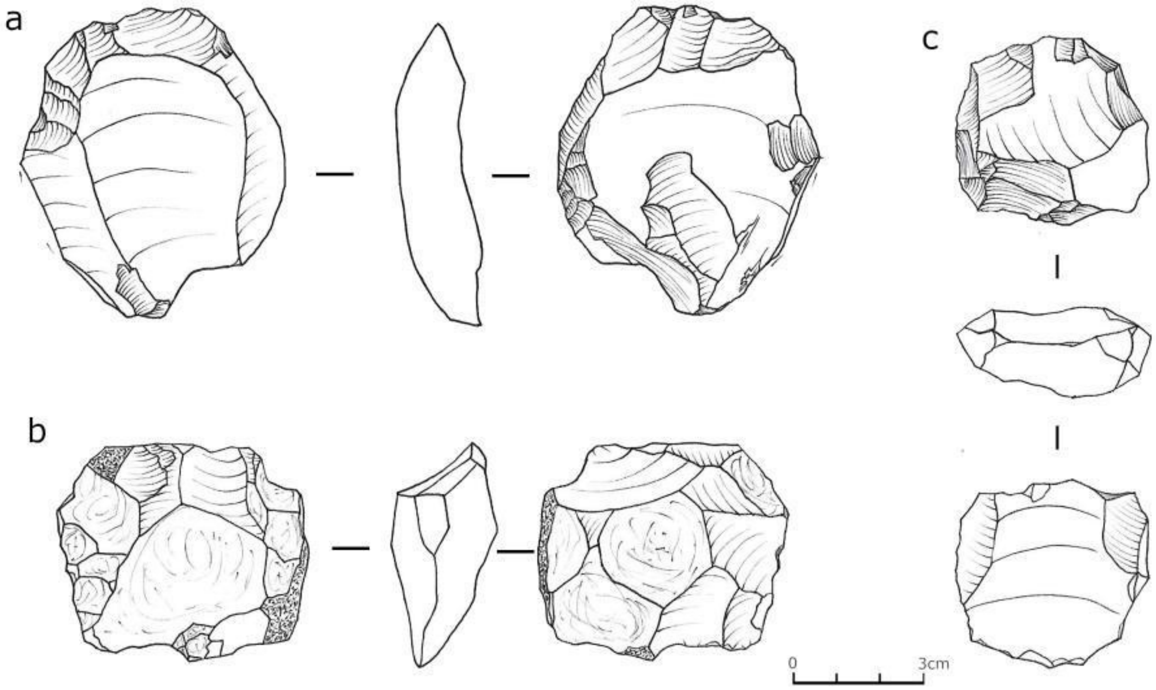


Figure 110: Flake cores from Drymias 1.

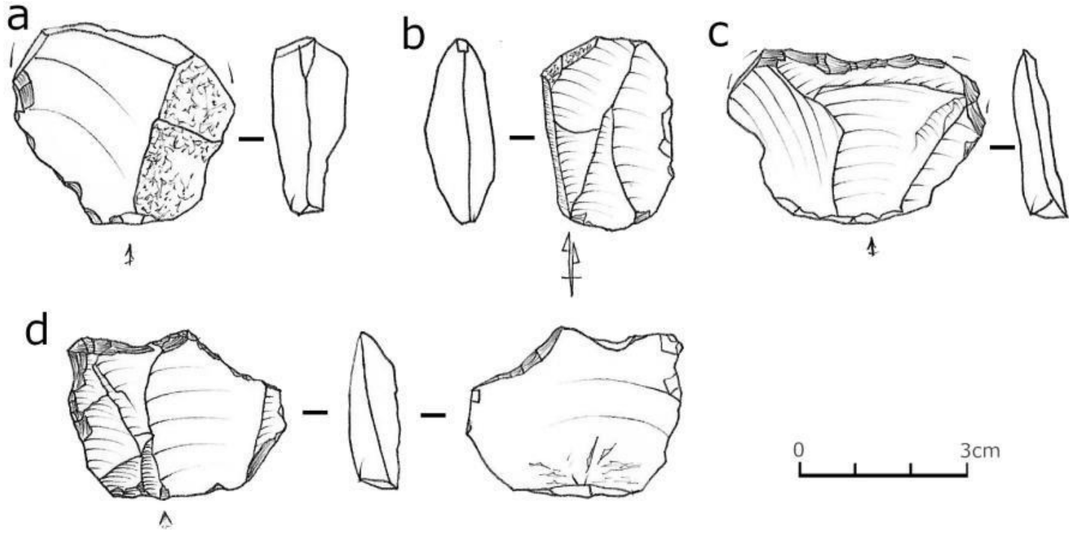
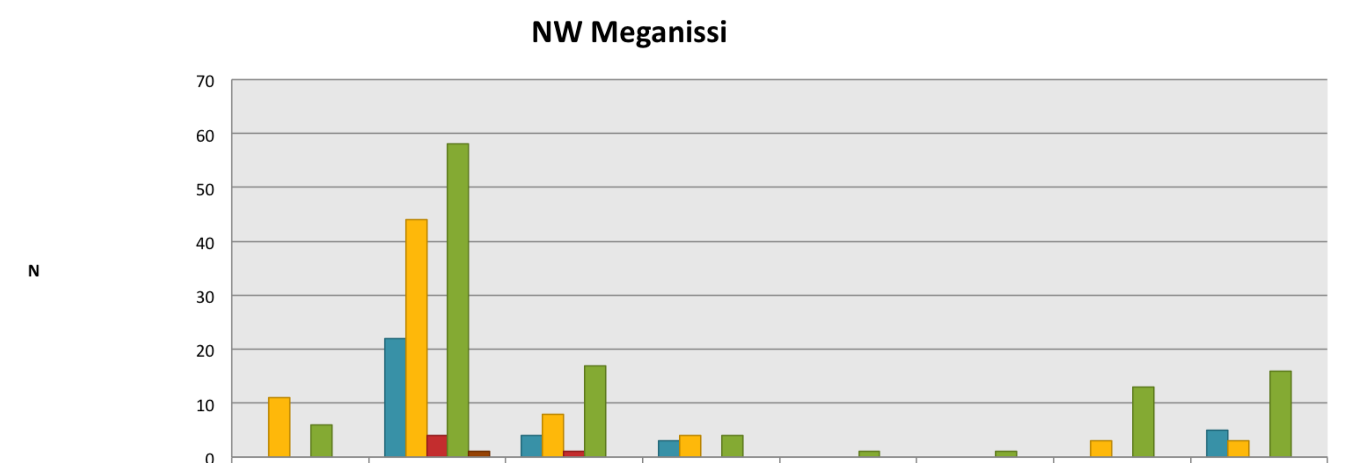


Figure 111: Flake tools from Drymias 1.

4.5.1.2.9. Discussion

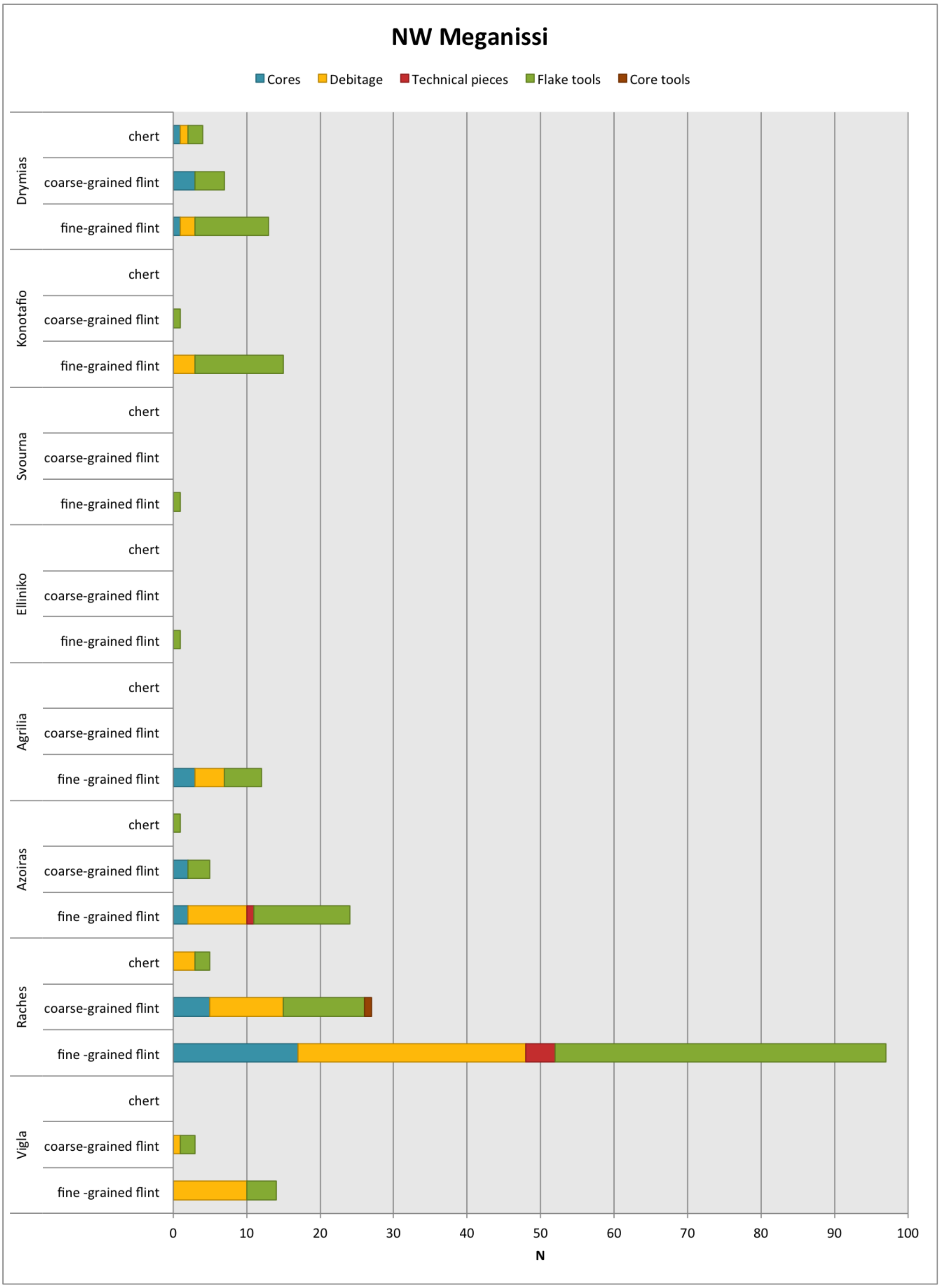
Lithic artefacts collected from NW Meganissi reveal a relatively moderate Middle Palaeolithic presence on this part of the island with a significant concentration at Raches, where all artefact categories are present, including a core tool (Graph 40). In terms of raw materials, fine-grained flint nodules were the most frequently utilised material (Graph 14) and in some cases the only (e.g. Agrilia, Elliniko, Svourna), while coarse-grained flints were used in fewer quantities and cherts in rare cases at Raches, Azoiras and Drymias (Graph

41). Laminar flakes, as well as Levallois flakes and blades (both modified and unmodified) have not been produced on chert, there are, however some made on coarse-grained flint (Graph 42). The majority of the artefacts (both cores and their products) do not retain any cortex at all (Graph 43). As expected, Levallois flakes and blades do not retain any cortex on their dorsal, while the only core tool retains 25% of its cortex and all cores have a maximum of 50% cortical surfaces (Graph 44). The blanks which have been further retouched are mainly plain flakes (71%), with an 11% of Levallois blanks turned into flake tools (Graph 45). The preparation of the striking platforms is evident in the presence of facetted and dihedral butts on almost all artefact categories (Graph 46).

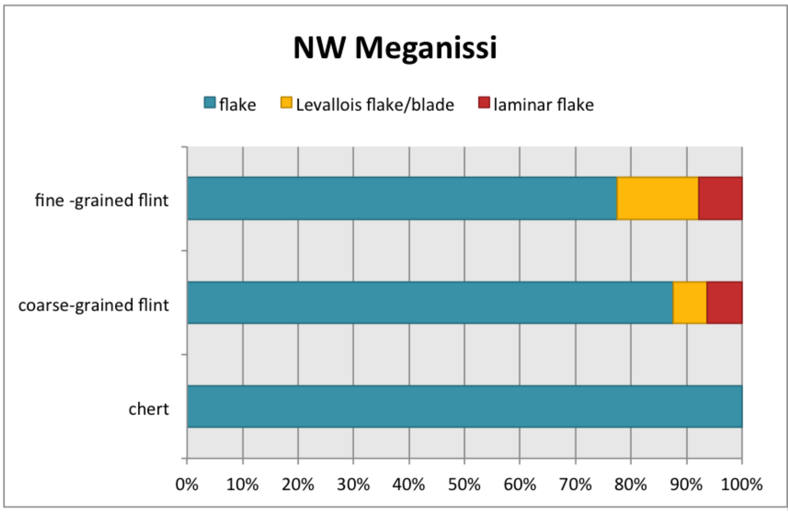


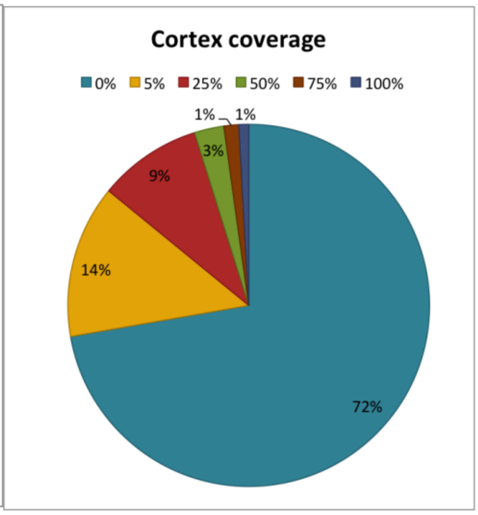
	Vigla (N=17)	Raches (N=129)	Azoiras (N=30)	Agrilia (N=11)	Elliniko (N=1)	Svourna (N=1)	Konotafio (N=16)	Drymias (N=24)
Cores (N=34)	0	22	4	3	0	0	0	5
Debitage (N=73)	11	44	8	4	0	0	3	3
Technical pieces (N=5)	0	4	1	0	0	0	0	0
Flake tools (N=116)	6	58	17	4	1	1	13	16
Core tools (N=1)	0	1	0	0	0	0	0	0

Graph 40: Frequency of the different artefact categories at the assemblages from the NW Meganissi sites and tracts

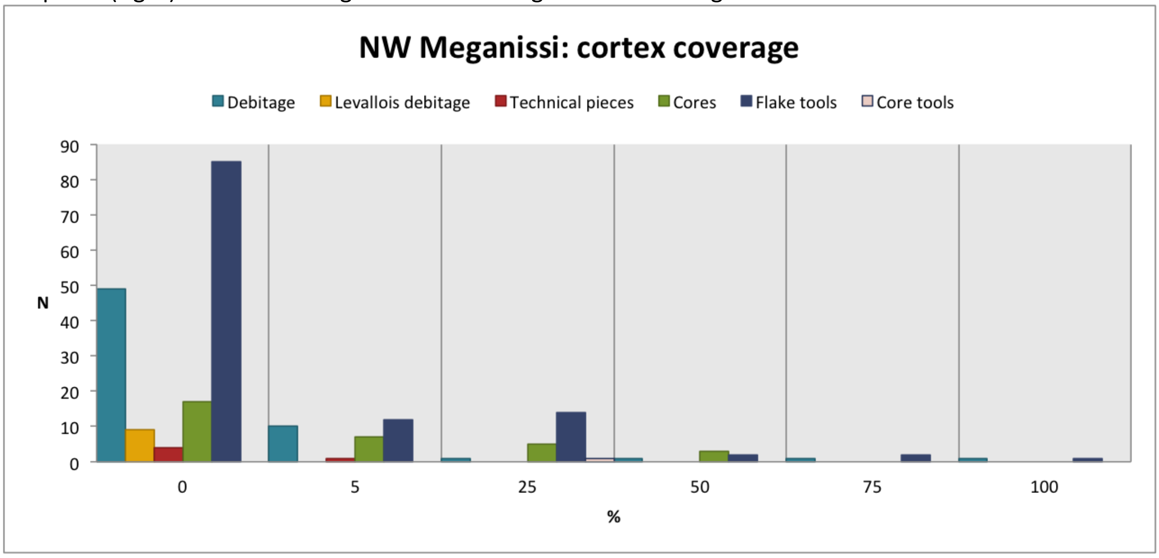


Graph 41: Frequency of the raw material types used for each artefact category at the NW Meganissi sites and tracts

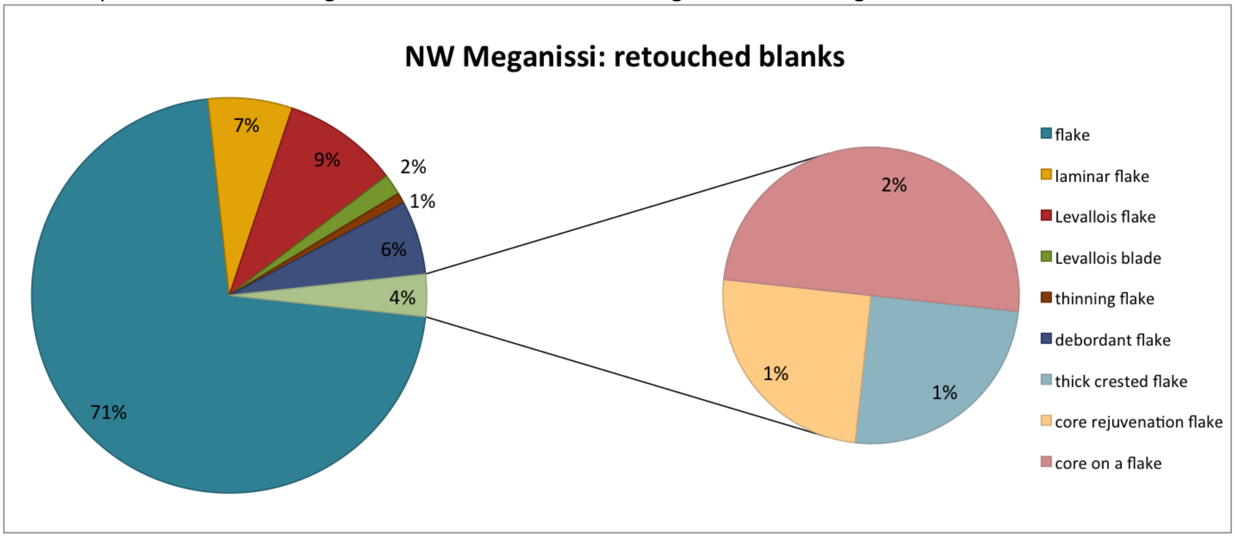




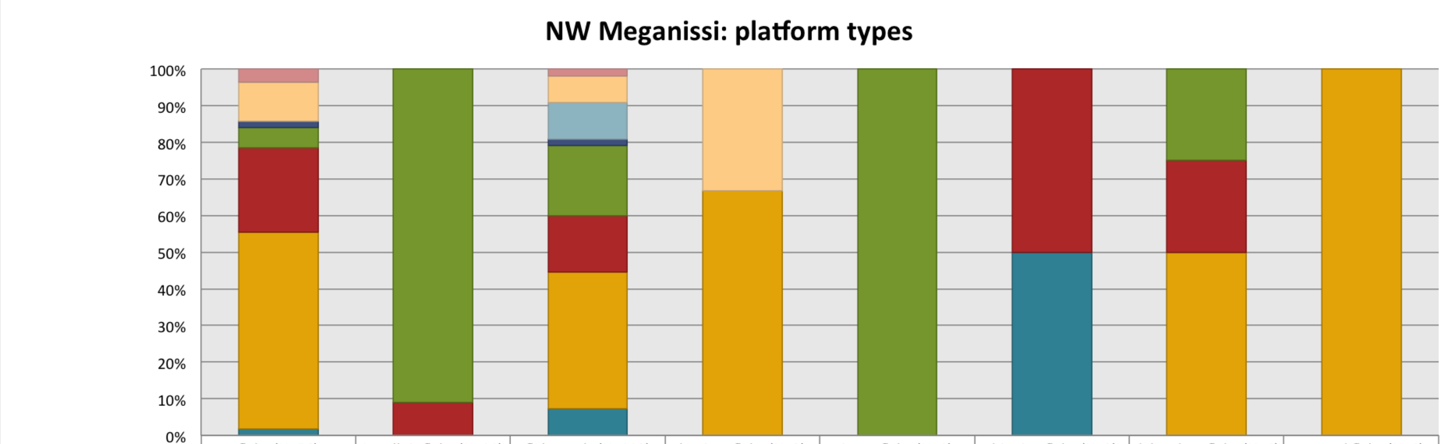
Graph 42 (left): Stacked collumn chart of the raw material types used for each unmodified debitage category
Graph 43 (right): Cortex coverage on the NW Meganissi assemblages



Graph 44: Cortex coverage on the different artefact categories at NW Meganissi sites and tracts



Graph 45: Frequency of blank types used for retouch at NW Meganissi



	flake (N=56)	Levallois flake (N=11)	flake tools (N=110)	laminar flake (N=3)	janus flake (N=1)	thinning flake (N=2)	debordant flake (N=4)	crested flake (N=1)
broken (N=4)	2	0	2	0	0	0	0	0
indeterminate (N=15)	6	0	8	1	0	0	0	0
retouched (N=11)	0	0	11	0	0	0	0	0
soft hammer (N=3)	1	0	2	0	0	0	0	0
facetted (N=36)	3	10	21	0	1	0	1	0
dihedral (N=33)	13	1	17	0	0	1	1	0
flat (N=76)	30	0	41	2	0	0	2	1
cortical (N=10)	1	0	8	0	0	1	0	0

Graph 46: Stacked column chart of the different platform types on each artefact category

4.5.1.3. Central Meganissi (n=116)

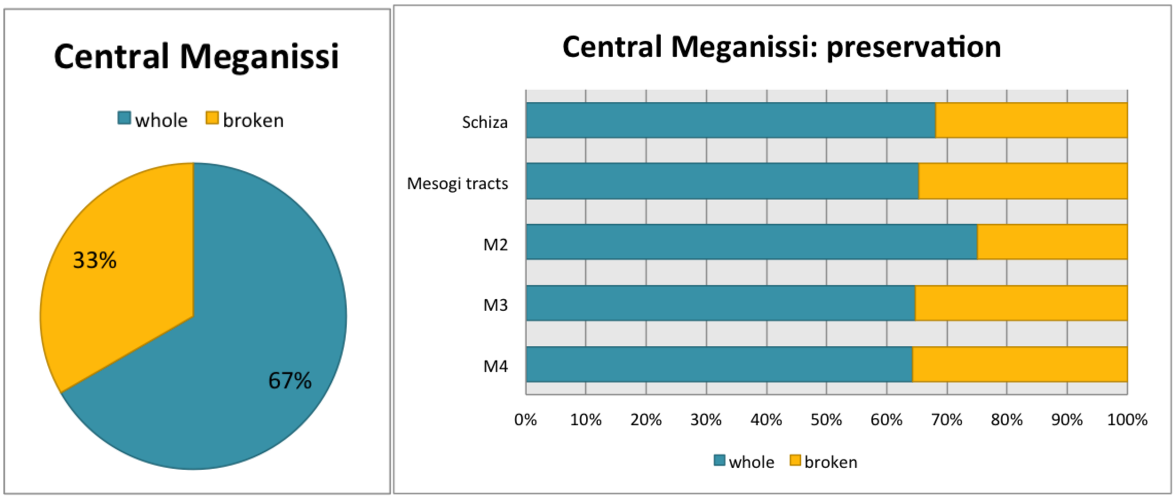
Central Meganissi involves two areas of interest in terms of the Pleistocene occupation of the island. The area that yielded the most significant number of lithics is Mesogi (in Greek *μέσο*=centre, *γη*=earth), a place of low altitude and diachronic use, as the presence of lithics, pottery, a burial site of the historical periods and many modern agricultural remains and contemporary residences testify. Field walking was at times challenging due to vegetation or the many fenced plots. Due to Mesogi's specific taphonomic conditions, several of the artefacts exhibit surface alterations due to organic residues which cannot be taken away with simple water wash (Figure 112). The Middle Palaeolithic component of Central Meganissi consists predominantly of tract finds from Mesogi (41.9%) and Schiza (18.8%), while smaller amounts of artefacts with Middle Palaeolithic characteristics come from three sites: Mesogi 2 (M2), Mesogi 3 (M3) and Mesogi 4 (M4) (Table 34). About 1/3 of the lithics are broken (Graph 47) and the majority exhibits the highest degree of patina (5) on their surfaces (Graph 49).[19] The majority is made on fine-grained flint (64%) followed by coarse-grained flint (19%) and chert (17%).

Figure 112: a pseudo-Levallois point with edge damage, weathering, high degrees of patina and organic residues on its dorsal face (Photo: C. Papoulia, July 2010).

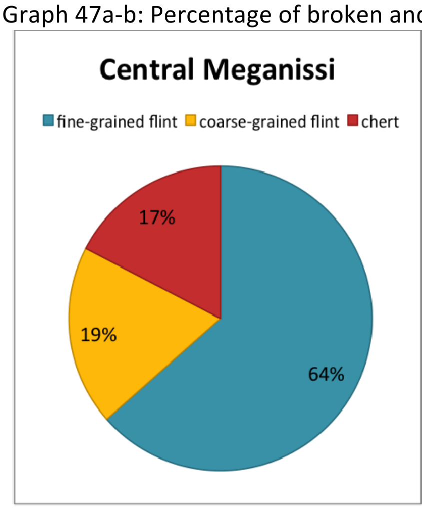
[19] Mesogi 3 being an exception, since about 40% of the lithics have high (4), yet not the highest (5) degree of patina. However, this might be due to the different patterns/characteristics of patina on flint and chert, which might be misleading. i.e. the chalky texture of the highly desilicified flint artefacts is not encountered on the chert artefacts, where desilicification is more evident by means of cavities on the surface.

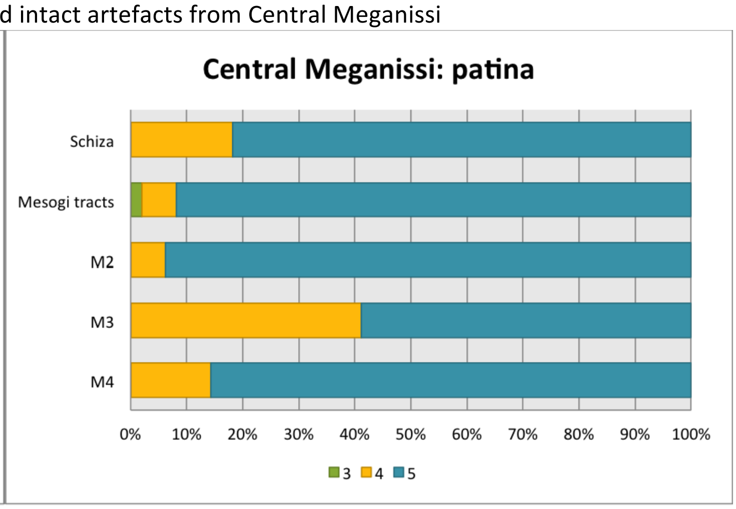
Table 34: Central Meganissi sites and tracts inventory.

Central Meganissi	Cores		Debitage		Technical pieces		Flake tools		Core tools		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Schiza	0	0	8	25	1	50	12	24	1	25	22	18,8
Mesogi tracts	11	52,4	21	65,6	0	0	17	34	0	0	49	41,9
M2	6	28,6	5	15,6	0	0	5	10	0	0	16	13,7
M3	2	9,5	2	6,3	0	0	9	18	3	75	16	13,7
M4	2	9,5	4	12,5	1	50	7	14	0	0	14	12
Total	21	100	40	125	2	100	50	100	4	100	117	100
Total (%)	17,9		34,2		1,7		42,7		3,4		100	



Graph 47a-b: Percentage of broken and intact artefacts from Central Meganissi





Graph 48 (left): Percentage of raw material types used at Central Meganissi.
Graph 49 (right): Percentage of patina on the artefacts from Schiza and Mesogi (tracts and sites), Central Meganissi

4.5.1.3.1. Schiza tracts (n=22)

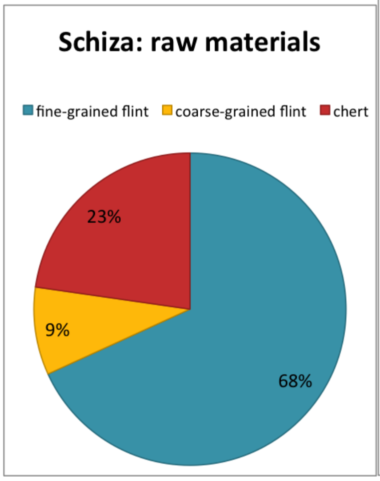
Schiza is one of the few findspots that returned diagnostic artefacts (points and sickle elements) of the later prehistoric periods, i.e. Neolithic/Bronze Age. It is, however, a place at the central part of Meganissi where a number of Palaeolithic artefacts were also collected. The Pleistocene assemblage attributed to the Middle Palaeolithic consists of five Levallois flakes, three plain flakes, a débordant flake, 12 flake tools and a core tool (Table 35).

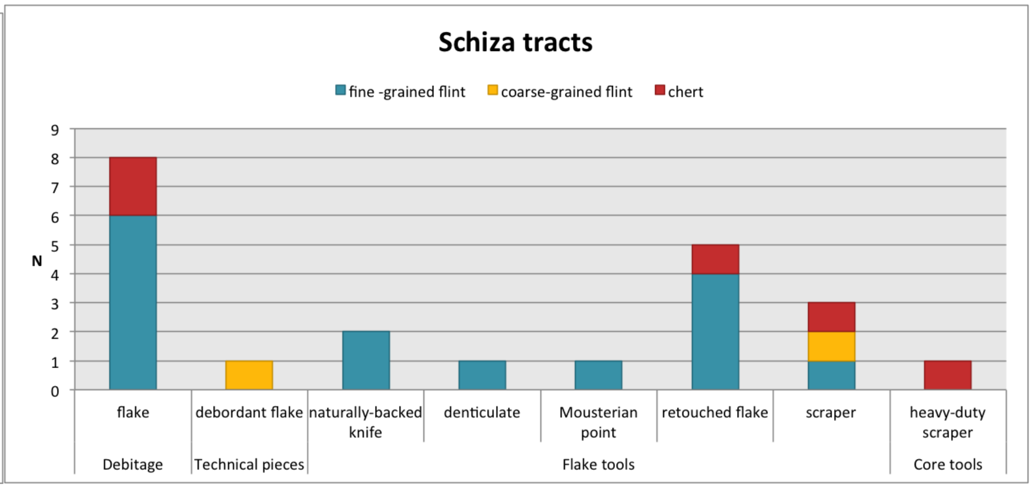
Table 35: Schiza assemblage structure

Schiza		**Fine -grained flint**		**Coarse-grained flint**		**Chert**		**Total**	
		N	%	N	%	N	%	N	%
Debitage	flake	6	40	0	0	2	40	8	36,4
Technical pieces	débordant flake	0	0	1	50	0	0	1	4,5
Flake tools	naturally-backed knife	2	13,3	0	0	0	0	2	9,1
	denticulate	1	6,7	0	0	0	0	1	4,5
	Mousterian point	1	6,7	0	0	0	0	1	4,5
	retouched flake	4	26,7	0	0	1	20	5	22,7
	scraper	1	6,7	1	50	1	20	3	13,6
Core tools	heavy-duty scraper	0	0	0	0	1	20	1	4,5
Total		15	100	2	100	5	100	22	100
Total (%)		68		9		23		100	

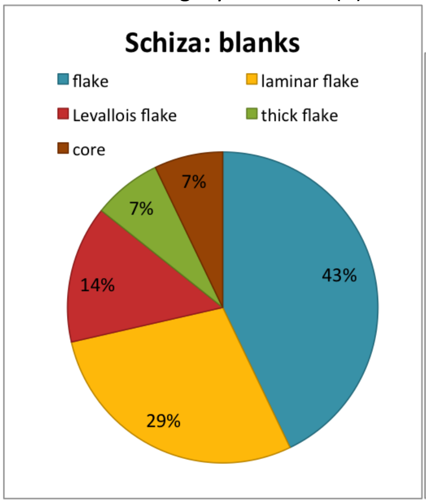
The artefacts made on chert comprise 23% of the Schiza assemblage, more than the mean (17%) from the whole area of Central Meganissi. Yet, as usual, the raw material most frequently utilised in all artefact categories is the fine-grained flint (Graph 50a). Exceptions are, the only technical piece (a *débordant* flake), made on coarse-grained flint, and the core tool (a heavy-duty scraper), made on chert (Graph 50b).

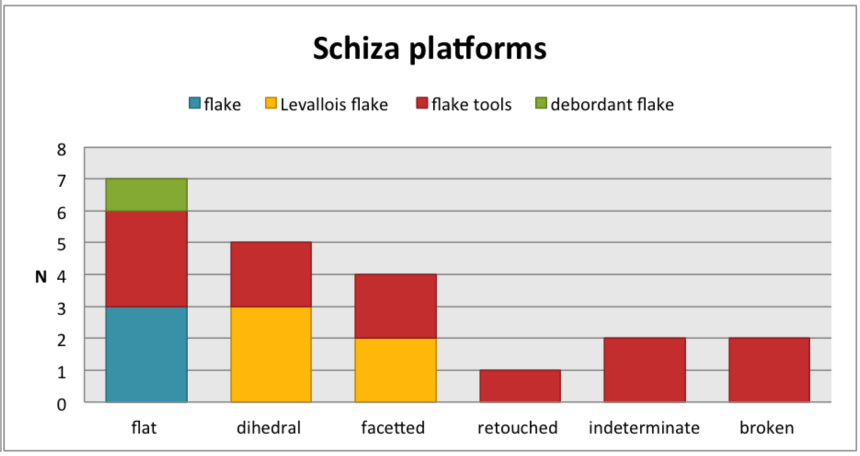
The flake tools are mainly flake, Levallois flake or laminar flake blanks with facetted (n=2), dihedral (n=1) or broken platforms, retouched by means of irregular, discontinuous retouch (Graph 51-Graph 52). There are also two naturally backed knives made on laminar flakes with broken platforms, a denticulate (947/1), a denticulated scraper made on a coarse-grained flint flake with a dihedral butt (989B/1), an endscraper made on a fine-grained flint flake with a retouched butt (Figure 113) and an unfinished tanged point with a flat butt, still preserving about 50% of its dorsal cortex (Figure 114). Its patina is not uniform, with the main negative scars being white (5) and the few, small scars on its proximal end forming the tang having a less intense patina (4). It is important to note that Schiza includes a later prehistoric component and it is possible that this tool could be part of that. However, the more diagnostic artefacts of the later component (i.e. a sickle element and a bifacially worked point – unfinished arrowhead) exhibit much less degrees of patina.





Graph 50a-b: Percentage of raw material types used (a) and frequency of raw material types used for each artefact category at Schiza (b).





Graph 51 (left): Percentage of blank types used for retouch at Schiza.
Graph 52 (right): Frequency of platform types on debitage, technical pieces and flake tools at Schiza.

Figure 113: Flakes and flake tools from Schiza (photo: C. Papoulia)

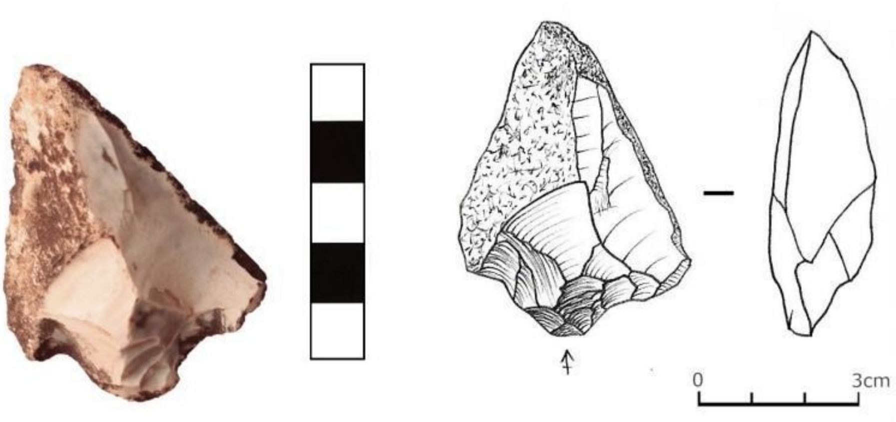


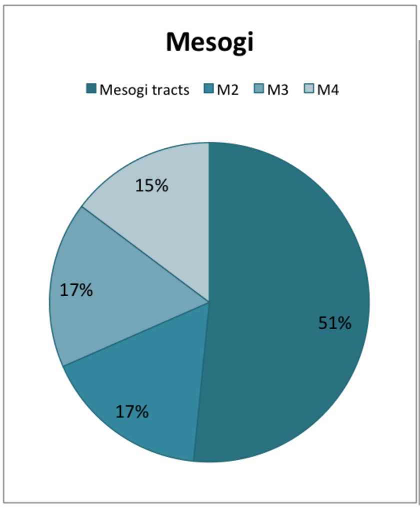
Figure 114: Unfinished tanged point from Schiza (photo: C. Papoulia)

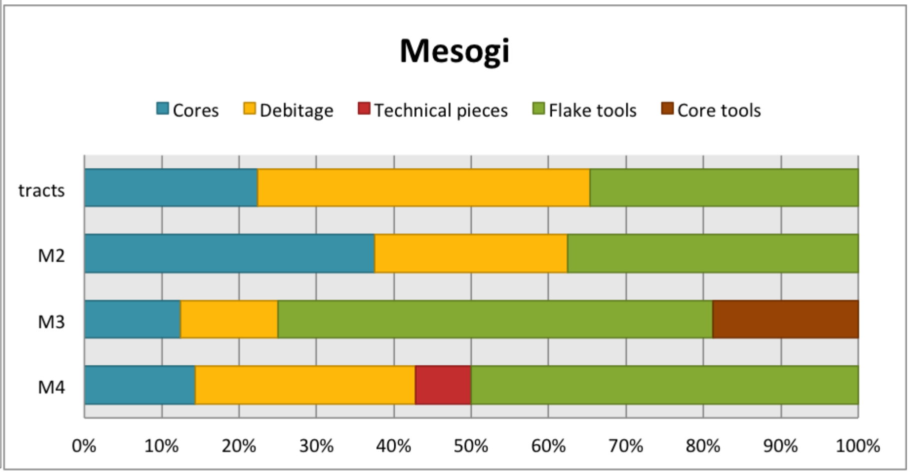
Finally, there is a large (141x93x65mm) heavy-duty scraper made on a thick chert flake (991/1) and a denticulated heavy-duty scraper made on a split pebble/core preserving 50% of its cortex (1006/2) (Figure 115). In typological terms, similar heavy-duty tools are often encountered in Lower Palaeolithic contexts and could indicate such a component for Schiza. Alternatively, these “tools” may have been nothing more than cores which were discarded at an early stage of reduction, and could hypothetically be part of a diachronic use of the site, even though heavy degree of patina is observed on their surfaces (5). However, a co-evaluation with the material collected from the sites and tracts of Mesogi points to a pattern according to which Central Meganissi was a place where large nodules were marginally modified into core-tools. A pattern not encountered at the other parts of the island.

Figure 115: Heavy-duty scrapers made on a chert flake (left) and split nodule (right) (Photos C. Papoulia)

4.5.1.3.2. Mesogi (N=95)

A total of 95 artefacts attributed to the Pleistocene were collected from Mesogi, both as tract finds (51%) and as part of three different sites (Graph 53). The lithics collected from Mesogi are characterised by the presence of diagnostic Middle Palaeolithic cores, debitage and flake tools, as well as of an important number of core tools. Not all core tools have been attributed to the Pleistocene component of the site, however. This is due to the fact that “heavy-duty” tools such as core tools (or cores) can be part of various cultural assemblages, diachronically. Due to the fact that we are dealing with surface finds, particular caution was employed on the sampling and attribution of such finds to the Pleistocene component of Mesogi. Characteristics such as surface alterations (weathering, patina, desilicification) were taken into account. For instance, artefacts with particularly sharp edges were not included in the study. Yet it must be stressed that more core tools, excluded from detailed analysis but collected during the survey, might also be part of Mesogi’s early component, thus potentially differentiating the assemblage structures as shown in Graph 54.





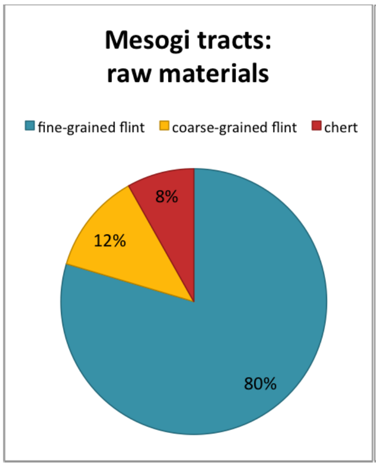
Graph 53 (left): Percentage of the Pleistocene finds collected from Mesogi tracts and sites (M2, M3, M4)
Graph 54 (right): Artefact categories percentages from Mesogi tracts and sites (M2, M3, M4)

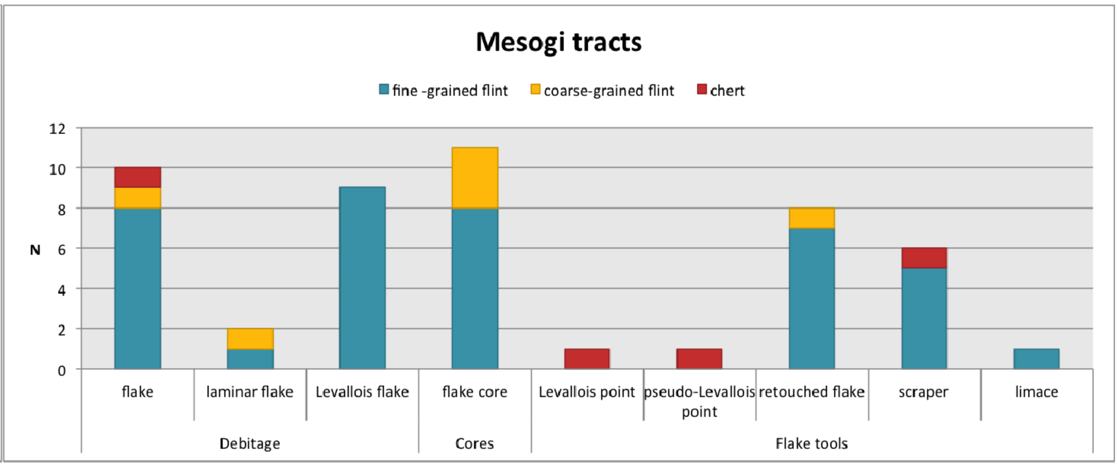
4.5.1.3.2.1. Mesogi tracts (n=49)

The Middle Palaeolithic tract finds from Mesogi consist of plain and Levallois debitage (n=21) followed by flake tools (n=17) and cores (n=11). The majority is made on fine-grained flint (80%), followed by coarse-grained flint (12%) and chert (8%) (Table 36 Graph 55). Out of 21, there are nine Levallois flakes with facetted (n=7) and dihedral (n=2) butts, two laminar flakes with flat butts, one of which is made on coarse-grained flint, and the rest are plain flakes, only one of which (705B/1) is made on chert (Figure 116).

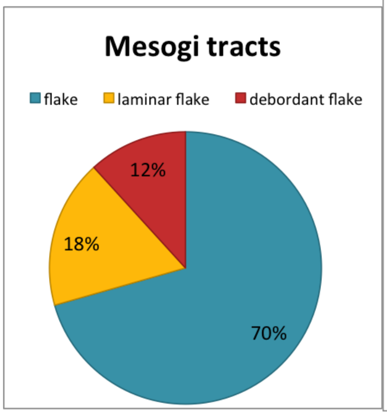
Table 36: Assemblage structure from Mesogi tracts

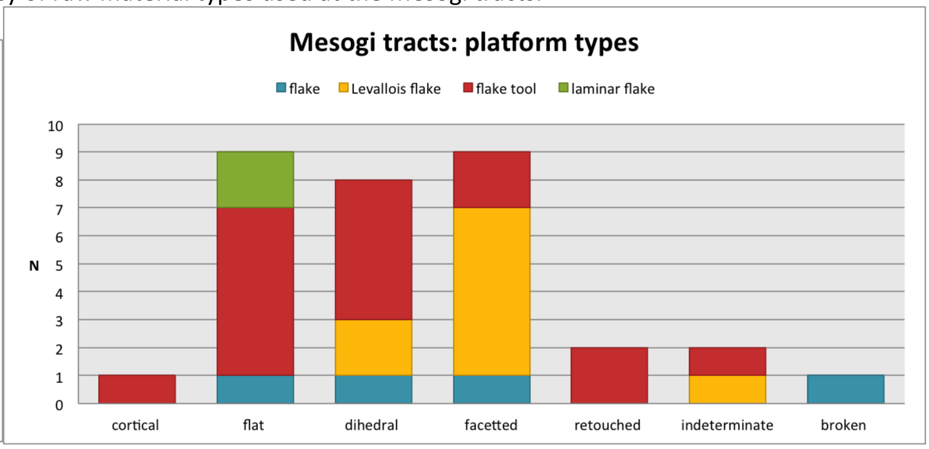
Mesogi tracts		**Fine -grained flint**		**Coarse-grained flint**		**Chert**		**Total**	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Debitage	flake	9	23,1	1	16,7	1	25	11	22,4
	laminar flake	1	2,6	1	16,7	0	0	2	4,1
	Levallois flake	8	20,5	0	0	0	0	8	16,3
Cores	flake core	8	20,5	3	50	0	0	11	22,4
Flake tools	Levallois point	0	0	0	0	1	25	1	2
	pseudo-Levallois point	0	0	0	0	1	25	1	2
	retouched flake	7	17,9	1	16,7	0	0	8	16,3
	scraper	5	12,8	0	0	1	25	6	12,2
	limace	1	2,6	0	0	0	0	1	2
Total		39	100	6	100	4	100	49	100
Total (%)		80		12		8		100	





Graph 55a-b: Frequency of raw material types used at the Mesogi tracts.





Graph 56 (left): Frequency of blank types used for retouched tools at the Mesogi tracts.

Graph 57 (right): Frequency of the different platform types on the debitage and flake tools from Mesogi tracts

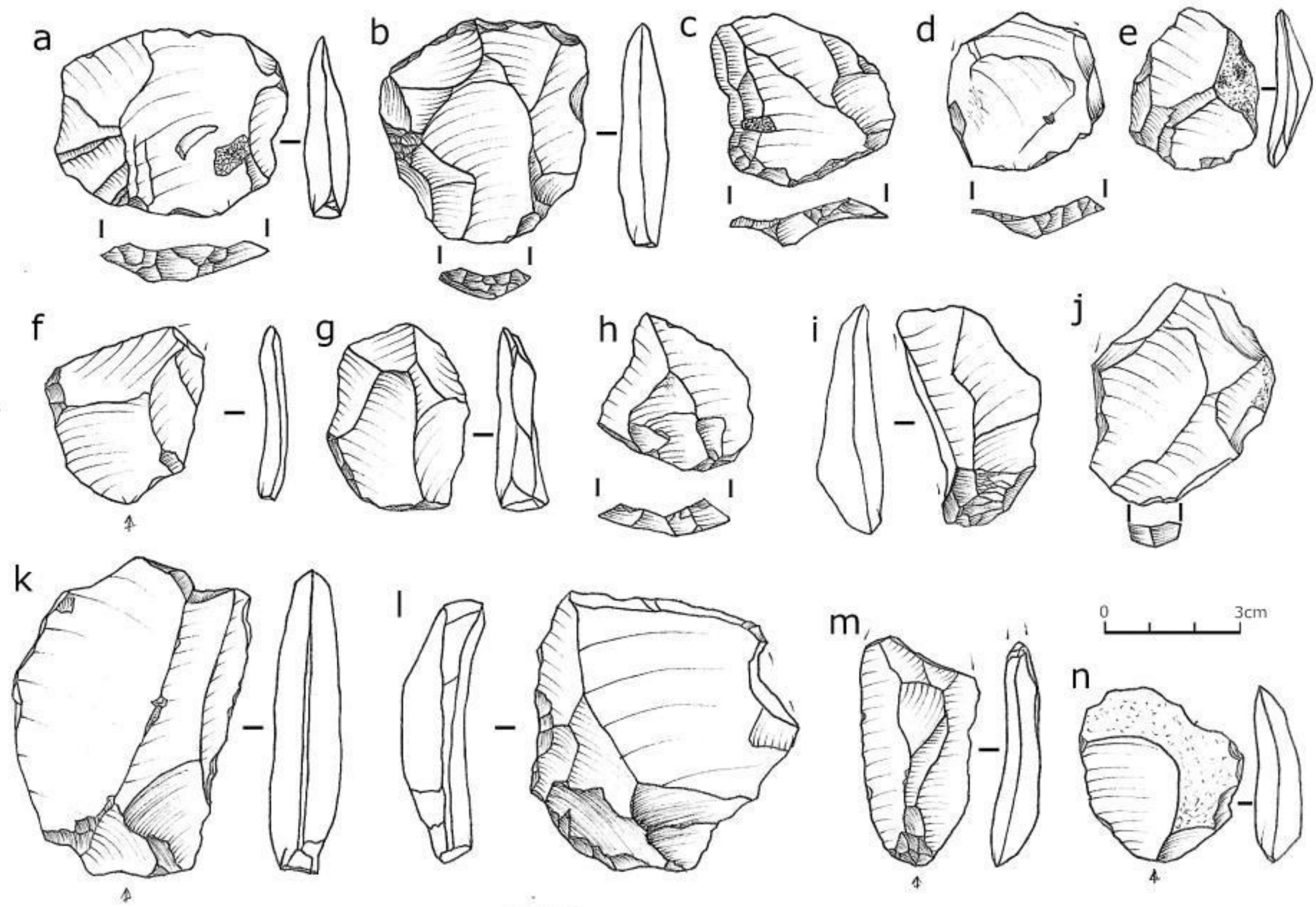


Figure 116: Flakes, Levallois flakes and laminar flakes from Mesogi tracts.

Most of the flake tools are made on plain flakes (70%) followed by laminar flakes and *débordant* flakes (Graph 56). The majority of platforms, on both unmodified flakes and flake tools, exhibit some kind of preparation, being either facetted (n=9) or dihedral (n=8), followed by flat ones (Graph 57). Most of the flake tools are retouched flakes (n=5) and retouched laminar flake (n=3). Formal tool types include a tanged Levallois point and a pseudo-Levallois point (Figure 117a-b), both made on chert, as well as a limace made on a fine-grained flint flake (Figure 117e). There are different types of scrapers (Figure 117d, f-g, i-j), among which an endscraper (Figure 117h) and a bifacial, Quina-type scraper (Figure 117c). The cores from the tracts consist mainly of Levallois (n=5) and disc cores (n=3). Three of these (Figure 118c, Figure 119a-b) are made on coarse-grained flint, while all the rest are made on fine-grained flint. There are also two discoid cores on flakes, both made on fine-grained flint.

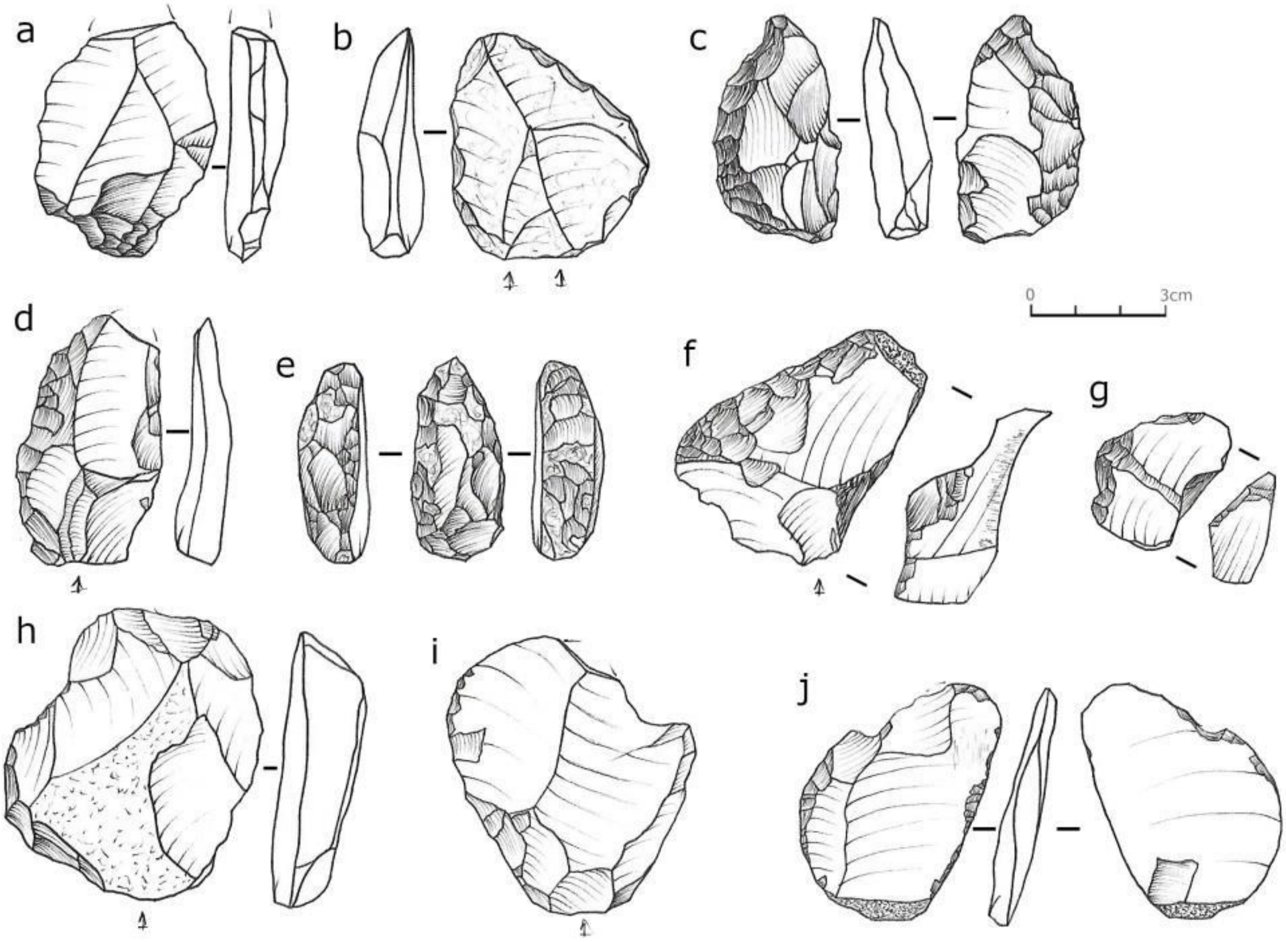


Figure 117: Flake tools from Mesogi tracts

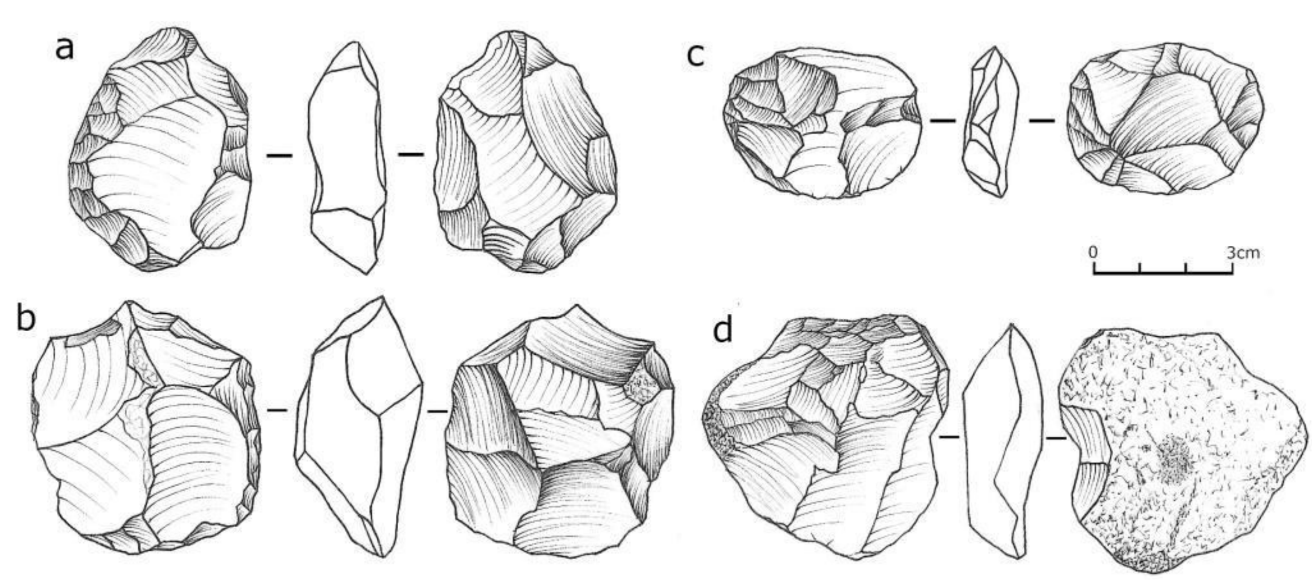


Figure 118: Levallois cores from Mesogi tracts

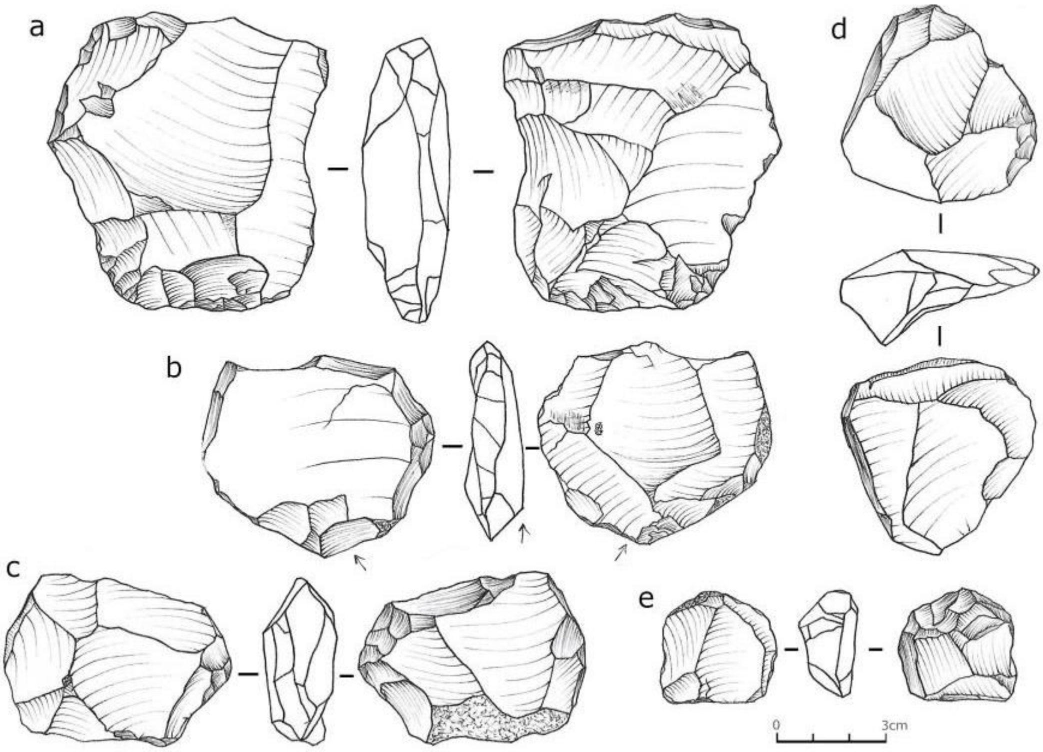


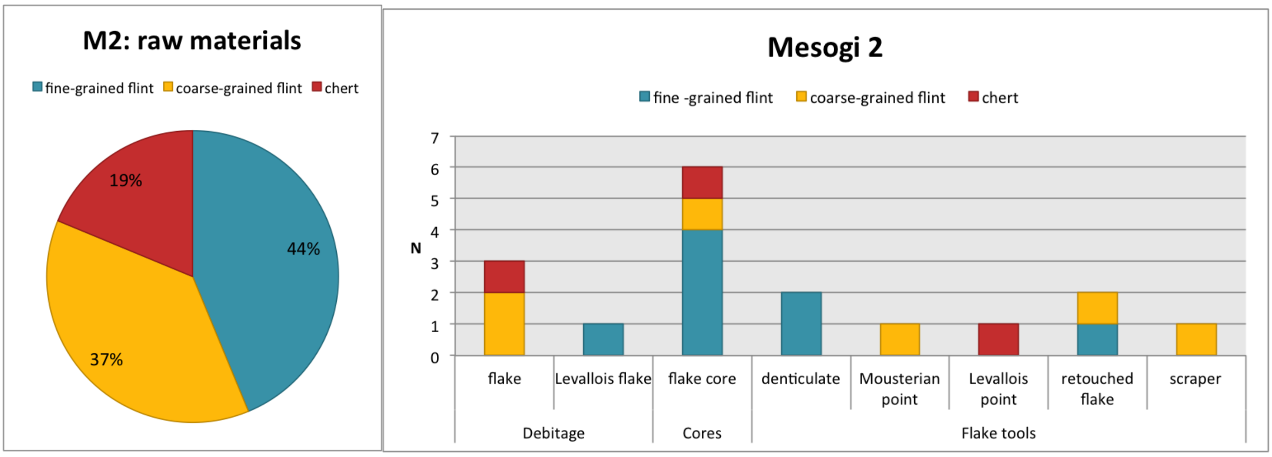
Figure 119: Levallois, disc and discoid cores from Mesogi tracts.

4.5.1.3.2.2. Mesogi 2 (n=16)

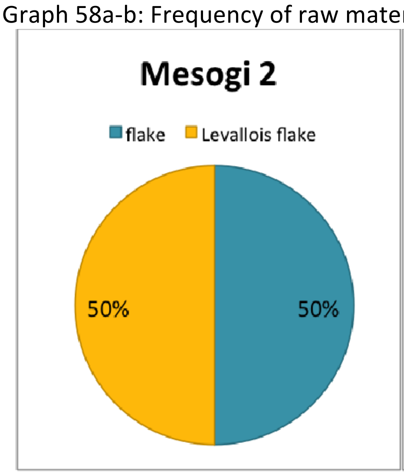
The Middle Palaeolithic assemblage from Mesogi 2 consists of flakes (n=4), one of which is a Levallois flake, flake tools (n=6) and flake cores (n=6). The raw material used is predominantly fine-grained (44%) and coarse-grained flint (37%), while chert artefacts comprise 19% of the assemblage (Graph 58), i.e. a flake a core and a Levallois point (Table 37). The Levallois flake is made on fine-grained flint, it has a dihedral butt and it is preserved broken, with significant edge damage (Figure 120d). Edge damage is also observed on the single chert flake (50-56/1).

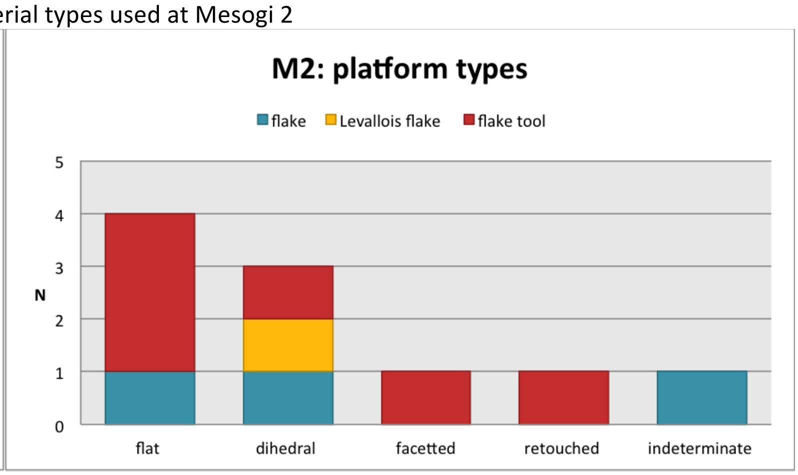
Table 37: Assemblage structure at Mesogi 2

M2		Fine - grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Debitage	flake	0	0	2	33,3	1	33,3	3	18,8
	Levallois flake	1	14,3	0	0	0	0	1	6,3
Cores	flake core	4	57,1	1	16,7	1	33,3	6	37,5
Flake tools	denticulate	1	14,3	0	0	0	0	1	6,3
	Mousterian point	0	0	1	16,7	0	0	1	6,3
	Levallois point	1	14,3	0	0	1	33,3	2	12,5
	retouched flake	0	0	1	16,7	0	0	1	6,3
	scraper	0	0	1	16,7	0	0	1	6,3
Total		7	100	6	100	3	100	16	100
Total (%)		43,8		37,5		18,8		100	



Graph 58a-b: Frequency of raw material types used at Mesogi 2





Graph 59 (left): Frequency of blank types used for retouched tools at Mesogi 2.
Graph 60 (right): Frequency of the different platform types on the debitage and flake tools from Mesogi 2

Flake tools are made both on flakes and Levallois flakes (Graph 59) and consist of a denticulate made on a fine-grained flint flake with a flat butt, preserving 25% of its cortex (27x35x11mm), an endscraper on a Levallois flake (54x58x28mm), a retouched flake (40x37x11mm) and a Mousterian point made on coarse-grained flint (724B/2). There is also a Levallois point made on chert (Figure 120b) and a retouched Levallois point made on fine-grained flint (Figure 120a). Platforms are mainly flat and dihedral followed by facetted and retouched (Graph 60).

As for the cores, there are two disc cores of similar dimensions (46x46x14 and 47x45x13mm) with cortical lower faces, both exhibiting extreme wear due to thermal shattering, or probably frost, one on the upper (Figure 120e) and the other on the lower face (Figure 120f). There is also a recurrent Levallois core made on coarse-grained flint, worked bifacially with two different platforms (Figure 120g) and a core on a flake with few organic residues on its surface (60x44x17mm). The two larger cores of the assemblage are a unipolar core made on fine-grained flint, preserving 50% of its cortex (85x68x49mm) and a 75% cortical flake core made on chert, (72x26x58mm), both of which in typological terms could be part of an early Middle Palaeolithic component of the site.

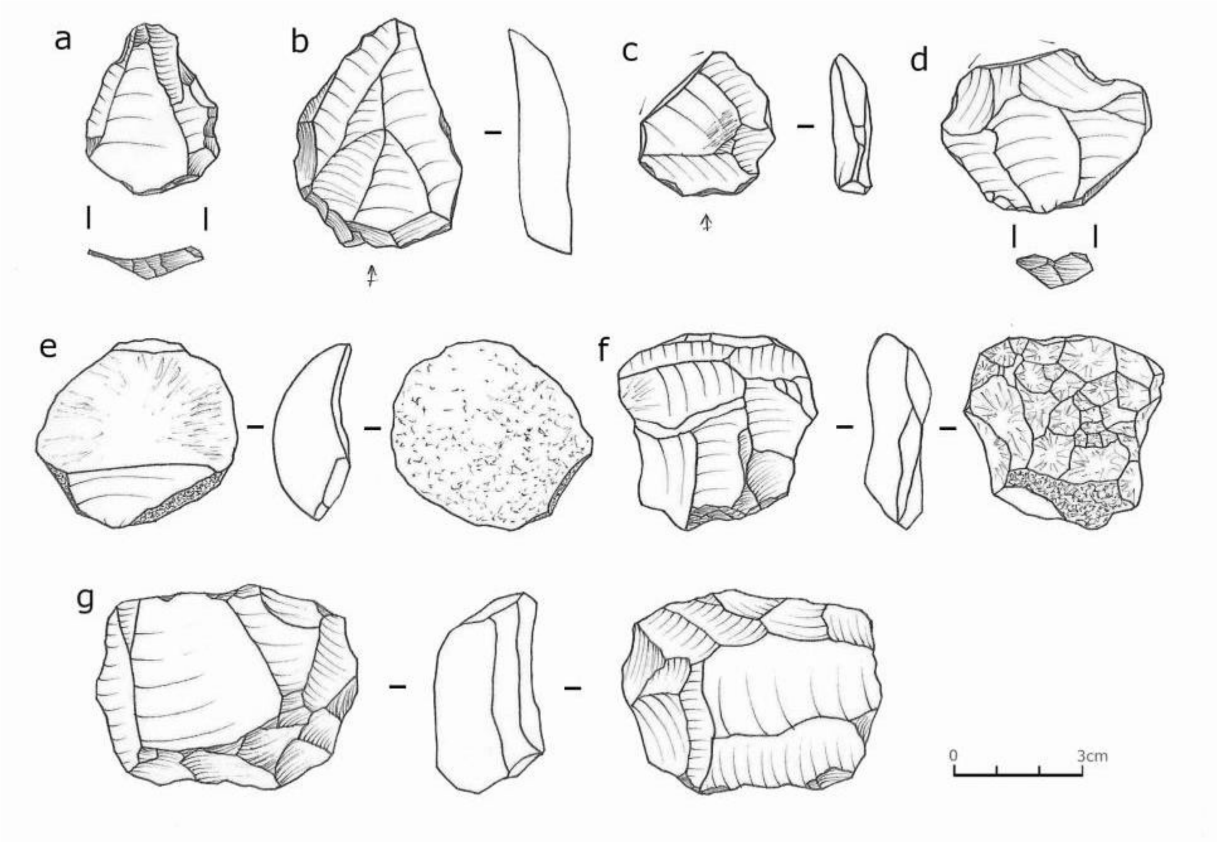


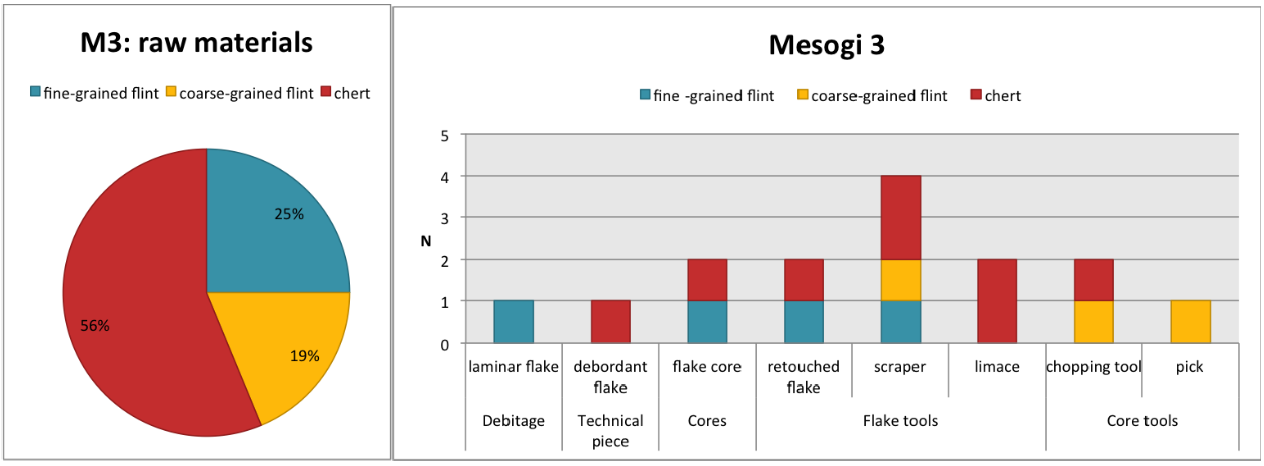
Figure 120: Points (a-b), flakes (c-d) and flake cores (e-g) from Mesogi 2.

4.5.1.3.2.3. Mesogi 3 (n=16)

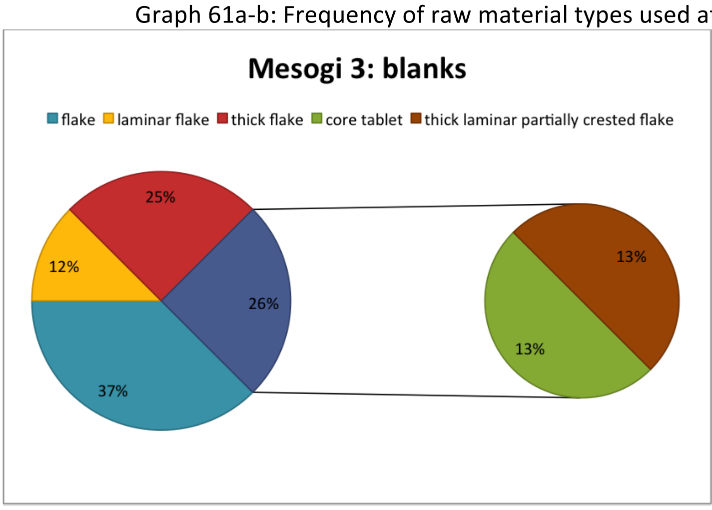
A total of 16 artefacts from Mesogi 3 is attributed to the Middle Palaeolithic. In contrast to the usual pattern, the majority (56.3%) is made on chert (Graph 61a). The assemblage includes mainly flake tools (n=9). There is also a laminar flake, a *débordant* flake, two flake cores and a three core tools (Table 38). The laminar flake is made on fine-grained flint, it has a facetted platform and its distal end is broken (45ΣT/4). The *débordant* flake (44E/1) has a flat platform and is made on chert (Graph 61b). A discoid core with centripetal reduction sequence is also made on chert, preserves none of its cortex and exhibits two different degrees of surface alteration due to patina, i.e. a white (5) and a gray/beige (4). It measures 59x68x47mm. The second core is a smaller (43x43x18mm), Levallois core preserving cortex at its lower face (Figure 121a).

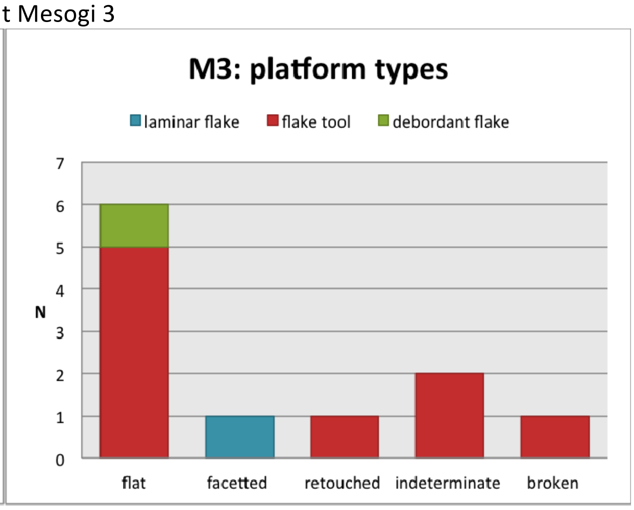
Table 38: Assemblage structure at Mesogi 3

M3		**Fine -grained flint**		**Coarse-grained flint**		**Chert**		**Total**	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Debitage	laminar flake	1	25	0	0	0	0	1	6,3
Technical pieces	débordant flake	0	0	0	0	1	11,1	1	6,3
Cores	flake core	1	25	0	0	1	11,1	2	12,5
Flake tools	retouched flake	1	25	0	0	1	11,1	2	12,5
	scraper	1	25	1	33,3	2	22,2	4	25
	limace	0	0	0	0	3	33,3	3	18,8
Core tools	chopping tool	0	0	1	33,3	1	11,1	2	12,5
	pick	0	0	1	33,3	0	0	1	6,3
Total		4	100	3	100	9	100	16	100
Total (%)		25		19		56		100	



Graph 61a-b: Frequency of raw material types used at Mesogi 3





Graph 62 (left): Frequency of blank types used for retouched tools at Mesogi 3
Graph 63 (right): Frequency of the different platform types used on debitage, technical pieces and flake tools at M3

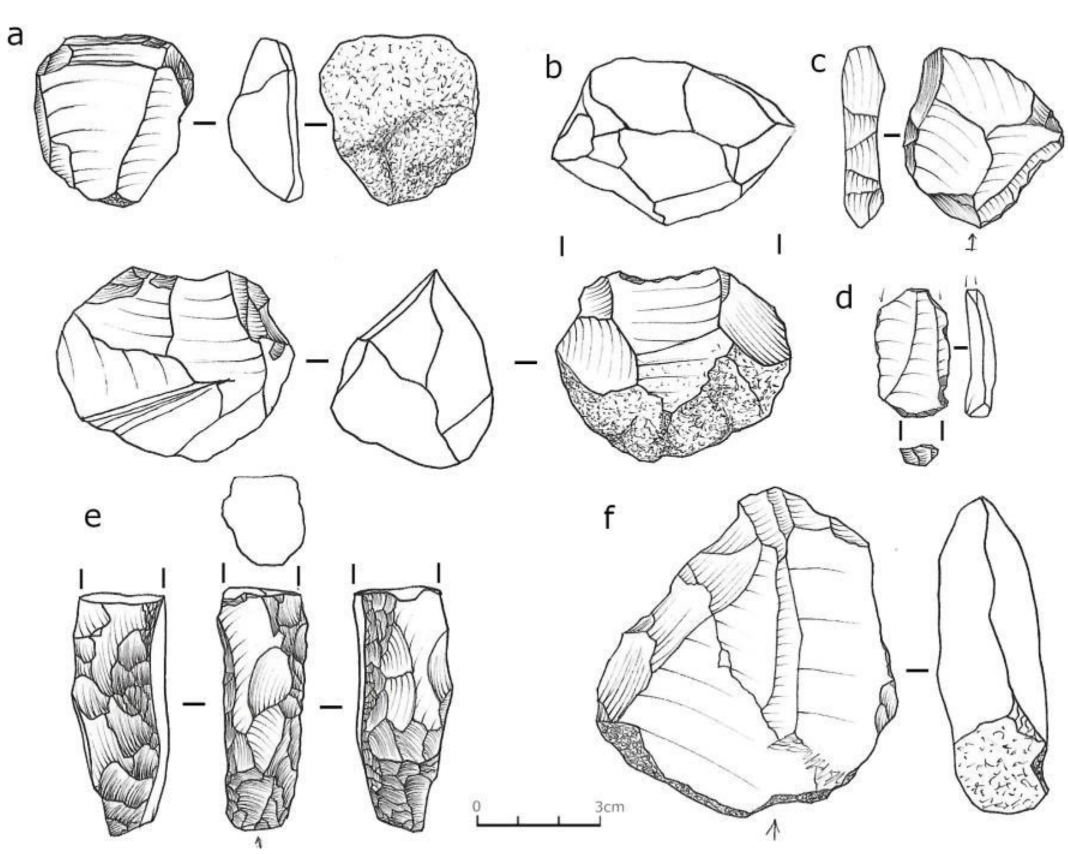


Figure 121: Flake core (a), core tool (b), débordant flake (c), laminar flake (d), limace (e) and scraper (f) from Mesogi 3.

In terms of the retouched artefacts, the assemblage consists mainly of scrapers (n=4). These are a lateral scraper made on a large and thick coarse-grained flint flake, with direct, long, continuous retouch of a semi-abrupt angle (Figure 121f), a nosed endscraper on a fine-grained flint flake with a flat butt (45B/1), two more endscrapers made on chert flakes, one with long and the other with invasive retouch extent, measuring 27x56x29mm and 36x44x22mm respectively. Apart from the scrapers, there are also two retouched flakes, one of which is made on fine-grained flint (44ΣT/1), and three limaces, all made on chert. The largest one is made on a thick flake with a retouched butt and measures 77x47x39mm (44ΣT/3). The other two are broken, of identical dimensions (60x22x24mm and 60x23x24mm) made on thick laminar flakes with flat butts (Figure 121e).

The core tools from Mesogi 3 consist of a large pick/chopping tool made on a coarse-grained flint nodule, preserving 25% of its cortex and measuring 61x67x38mm (44B/1). The largest one is a chopping tool made on a chert nodule, measuring 109x120x94mm (Figure 122), while the smallest one is made on a coarse-grained flint nodule, preserving 50% of its cortex and measuring 48x56x41mm (Figure 121b).

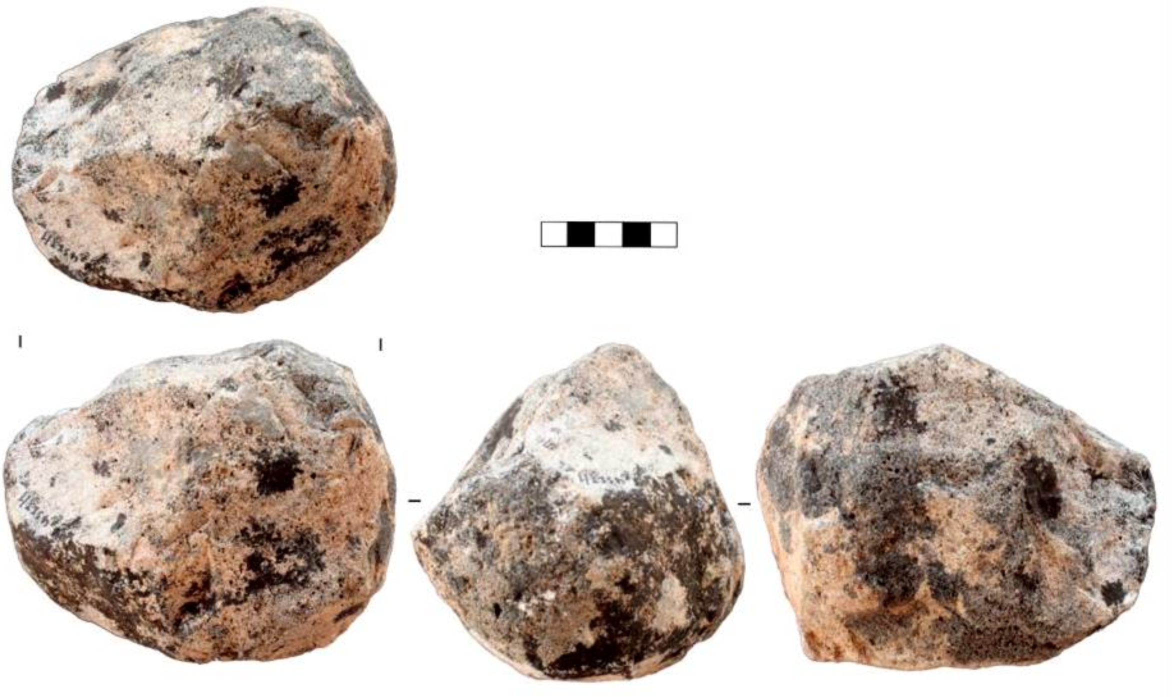


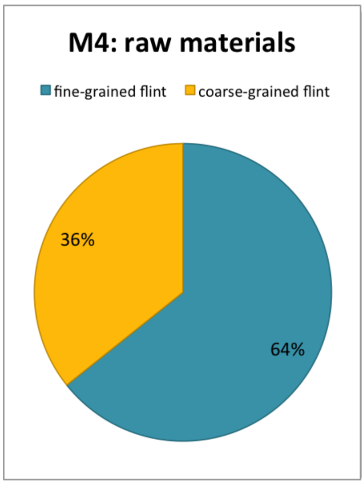
Figure 122: Large chopping tool from Mesogi 3 (photo: C. Papoulia).

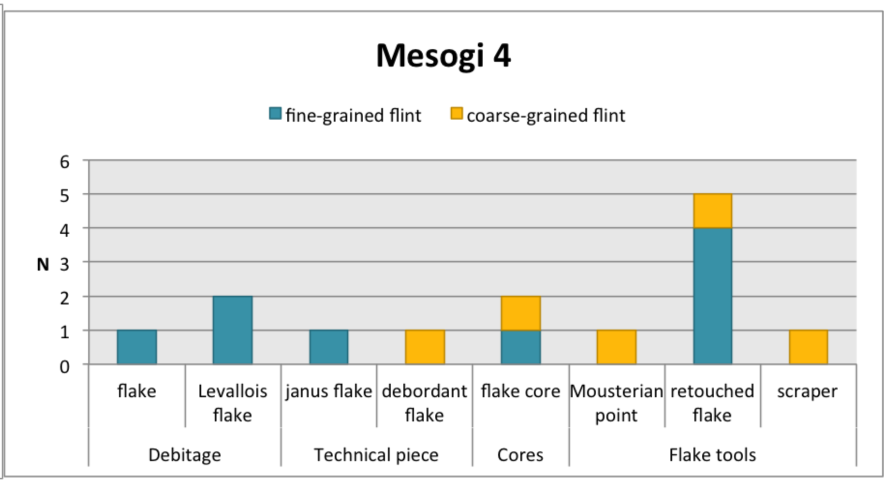
4.5.1.3.2.4. Mesogi 4 (n=14)

Mesogi 4 was designated as a site due to the presence of a burial at “Kallinikato”. Its Pleistocene component, although small, consists of 14 artefacts (Table 41). All artefacts are made on flint, most of which is fine-grained, but a significant amount (36%) is made on coarse-grained flint (Graph 64). Three flakes, two of which are made by means of the Levallois technique, a Janus flake and a *débordant* flake are the only unmodified pieces (Figure 123a-d, Figure 124c). Among the retouched artefacts, there is a Mousterian point made on a coarse-grained flint flake (Figure 123i), a scraper and five retouched flakes. While laminar, Levallois and *débordant* flakes have been occasionally further retouched, plain flakes are the main blanks used for the production of retouched tools (Graph 65). There are also two flake cores, one made on a large fine-grained flint flake and an elongated Levallois flake core made on coarse-grained flint (Figure 124a-b).

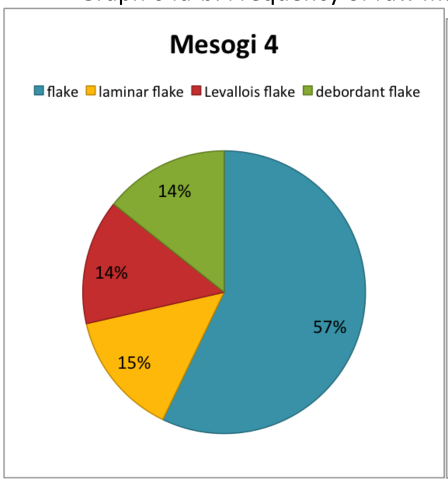
Table 39: Assemblage structure at Mesogi 4

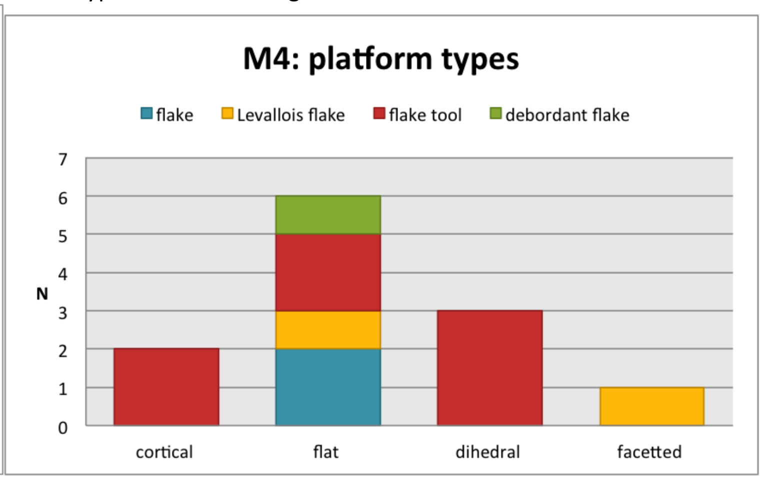
M4		Fine – grained flint		Coarse- grained flint		Total	
		N	%	N	%	N	%
Debitage	flake	1	11,1	0	0	1	7,1
	Levallois flake	2	22,2	0	0	2	14,3
	Janus flake	1	11,1	0	0	1	7,1
Technical pieces	*débordant* flake	0	0	1	20	1	7,1
Cores	flake core	1	11,1	1	20	2	14,3
Flake tools	Mousterian point	0	0	1	20	1	7,1
	retouched flake	4	44,4	1	20	5	35,7
	scraper	0	0	1	20	1	7,1
Total		9	100	5	100	14	100
Total (%)		64,3		35,7		100	





Graph 64a-b: Frequency of raw material types used at Mesogi 4





Graph 65 (left): Frequency of blank types used for retouched tools at Mesogi 4.
Graph 66 (right): Frequency of the different platform types on the debitage, technical pieces and flake tools from Mesogi 4

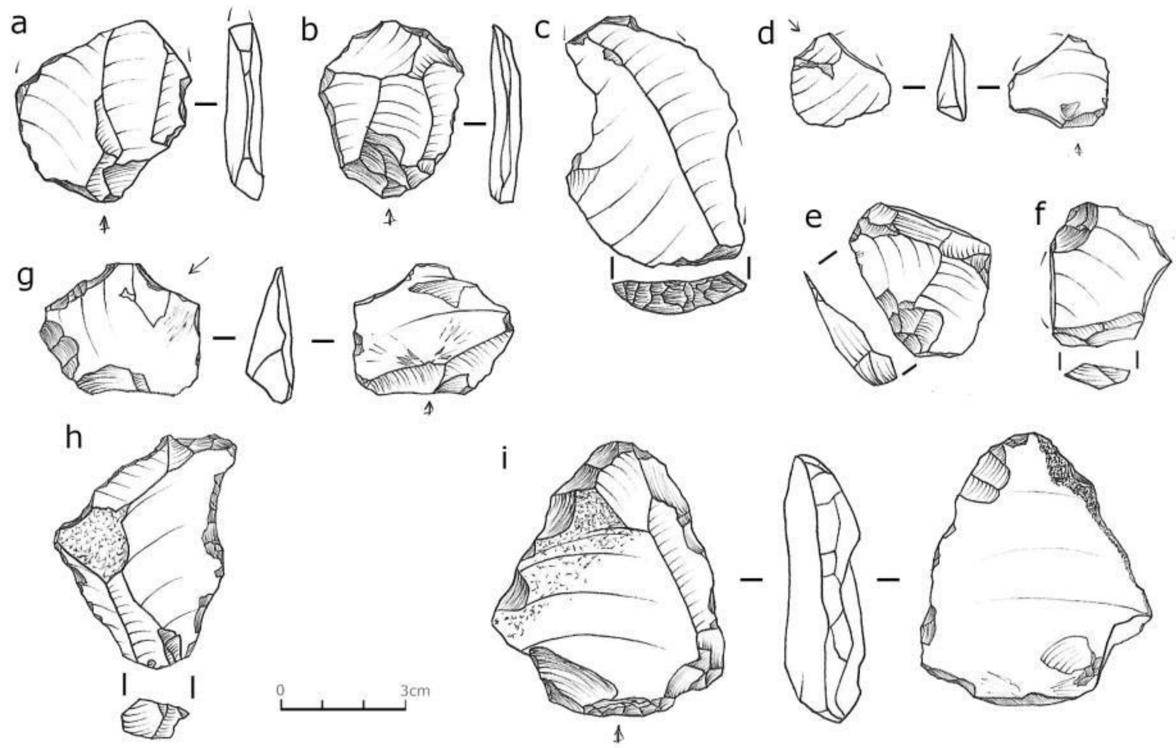


Figure 123: Unmodified flakes (a-c) and Janus flake (d), and flake tools (e-i) from Mesogi 4.

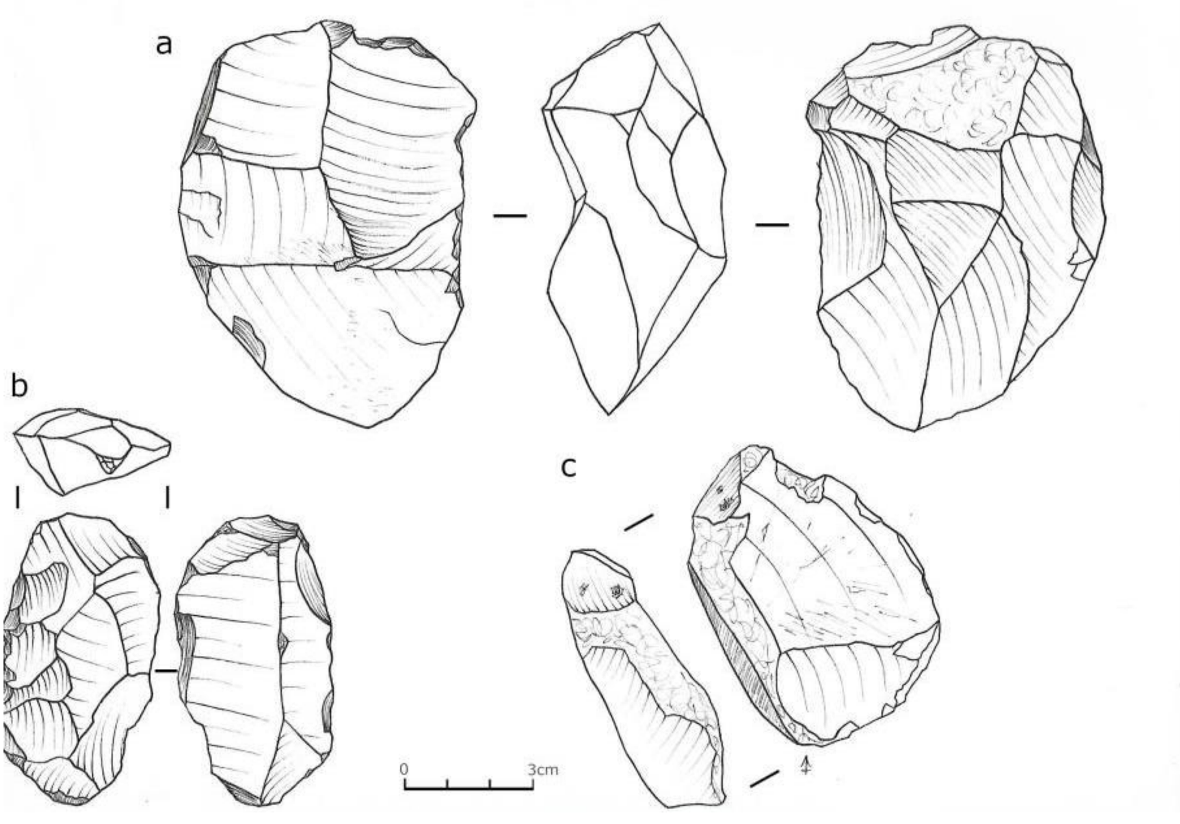
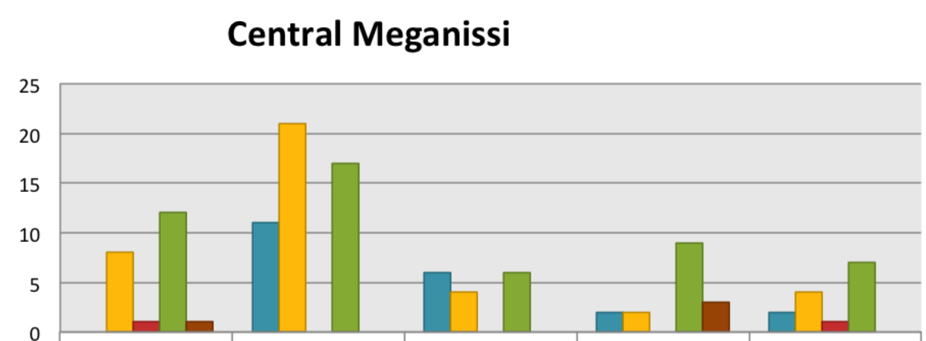


Figure 124: Flake cores (a-b) and a heavily weathered débordant flake (c) from Mesogi 4.

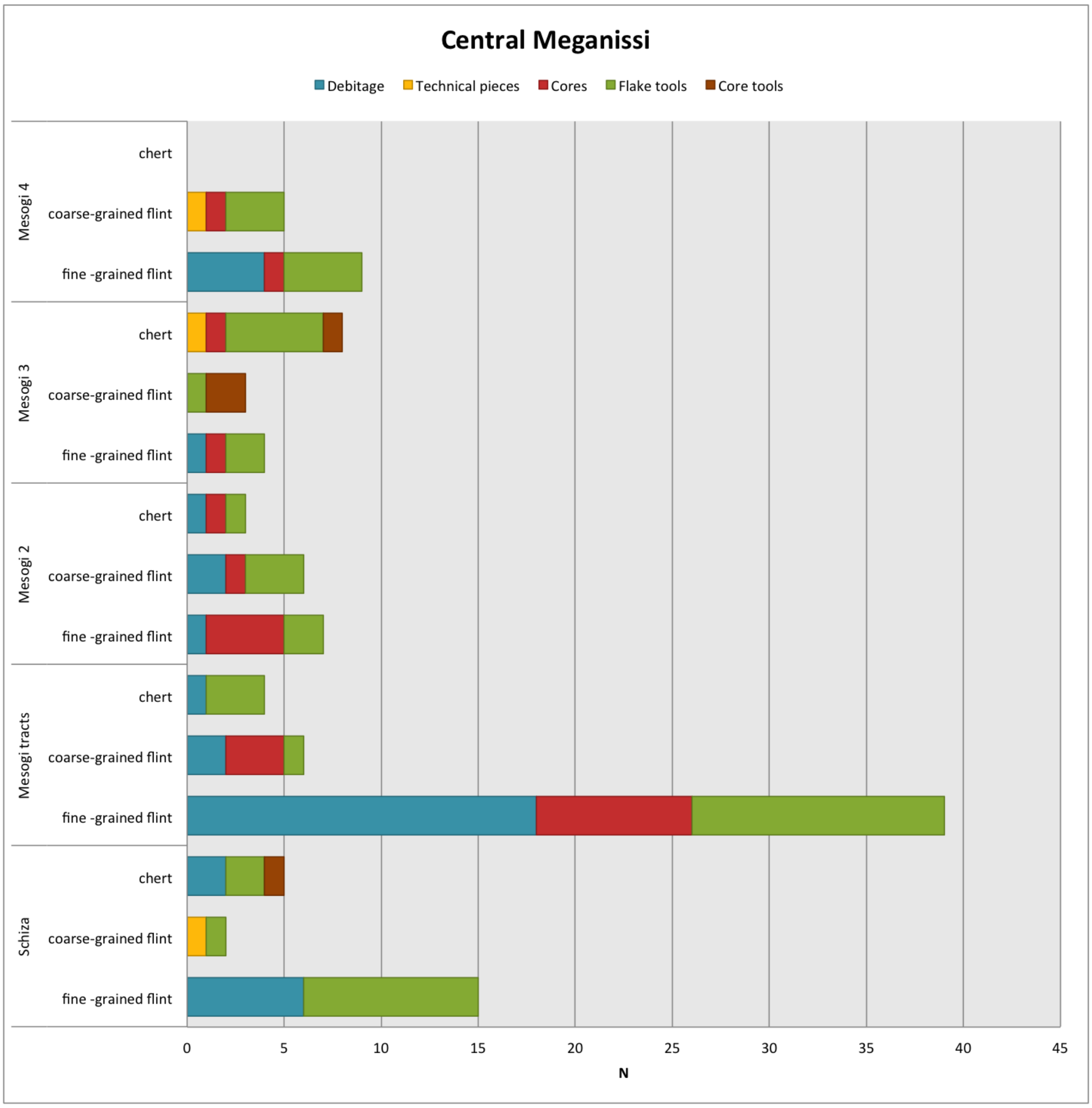
4.5.1.3.3. Discussion

Central Meganissi returned a significant amount of artefacts attributed to the Pleistocene from two main areas, lowland Mesogi and upland Schiza. Most of them were collected as tract finds from Mesogi (Graph 67). Two important observations need to be addressed for the assemblages from the central part of Meganissi, (a) the presence of core tools and (b) the frequent use of chert (Graph 68). Unmodified pieces include about 40% of Levallois debitage made on fine-grained flint, less than 10% of fine-grained laminar flakes and about 25% of coarse-grained laminar flakes. All unmodified debitage made on chert are plain flakes (Graph 69). As usual, the majority in all artefact categories (72%) does not retain any cortex at all (Graph 70). The majority of cores, debitage and all technical pieces do not retain cortex, as do all Levallois blanks with only one exception (Graph 71). About half of the blanks that have been further retouched are plain flakes (56%), followed by laminar flakes (20%). There is a significant amount of artefact made on (large) thick flakes (9%), technical pieces (8%) and Levallois flakes (7%) (Graph 72). About 30% of prepared platforms on flakes and Levallois flakes and about 20% on flake tools are dihedral, while facetted platforms are the majority on Levallois flakes and comprise about 10% of the platforms on plain flakes and flake tools (Graph 73).

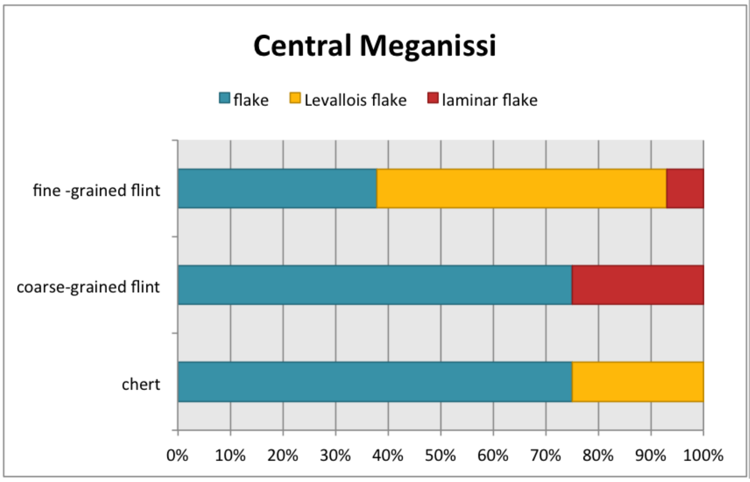


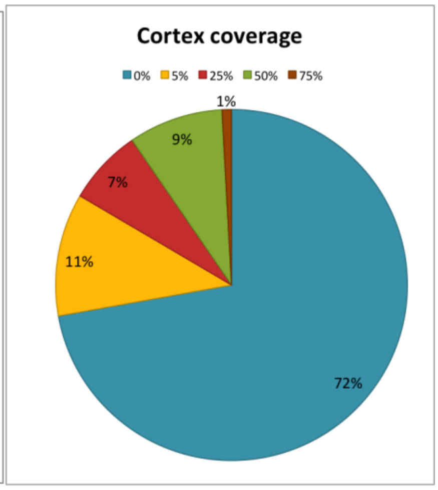
	Schiza (N=22)	Mesogi tracts (N=49)	M2 (N=16)	M3 (N=16)	M4 (N=14)
Cores (N=21)	0	11	6	2	2
Debitage (N=39)	8	21	4	2	4
Tachnical pieces (N=2)	1	0	0	0	1
Flake tools (N=51)	12	17	6	9	7
Core tools (N=4)	1	0	0	3	0

Graph 67: Frequency of the different artefact categories at the Central Meganissi assemblages



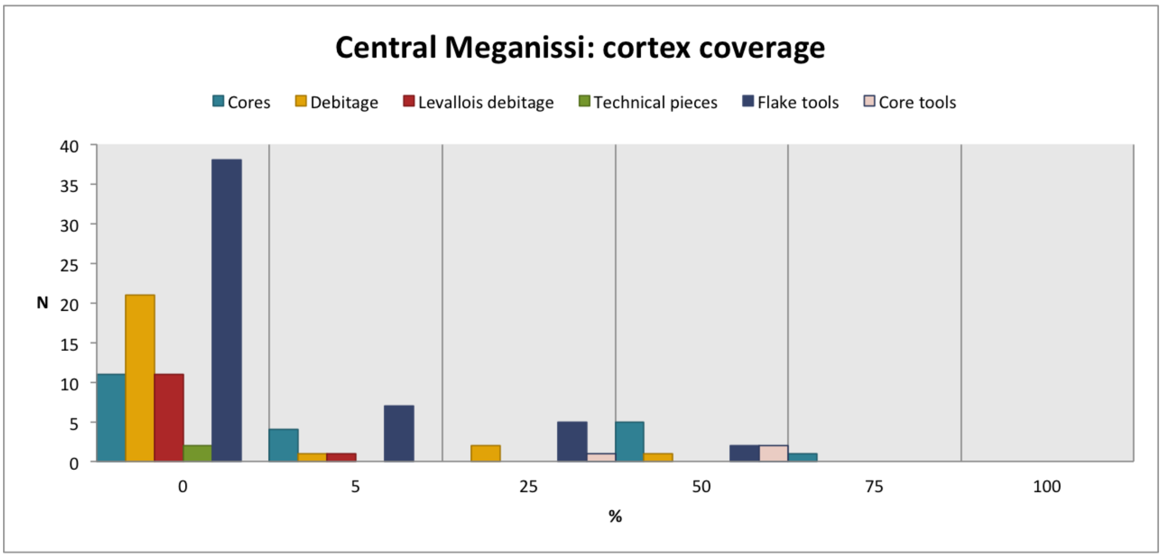
Graph 68: Frequency of the raw material types used for each artefact category at the sites (Mesogi 2,3,4) and tracts (Schiza and Mesogi) of Central Meganissi.



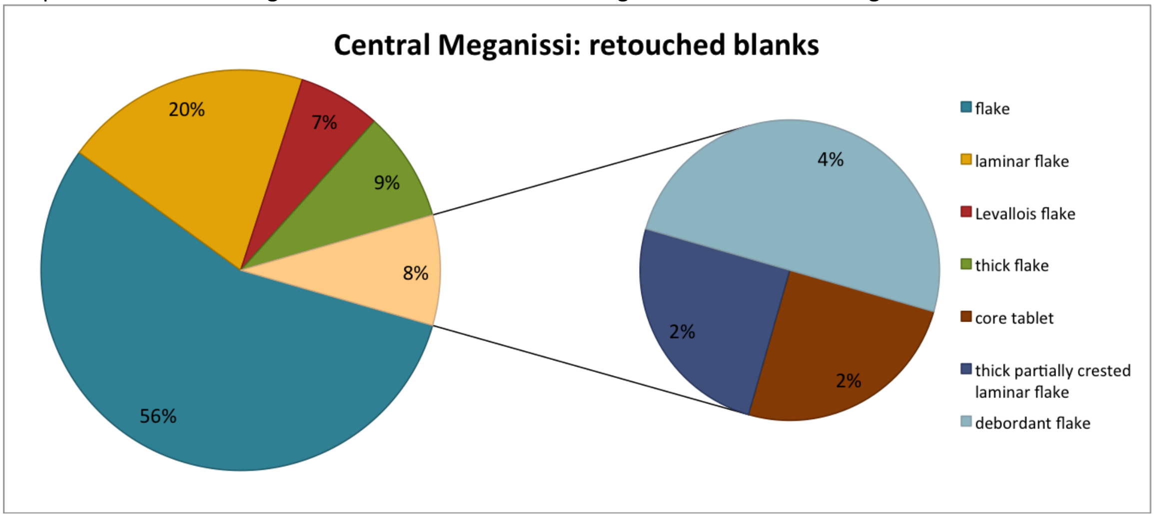


Graph 69 (left): Association of the unmodified flakes, Levallois flakes and laminar flakes with the raw materials used at Central Meganissi

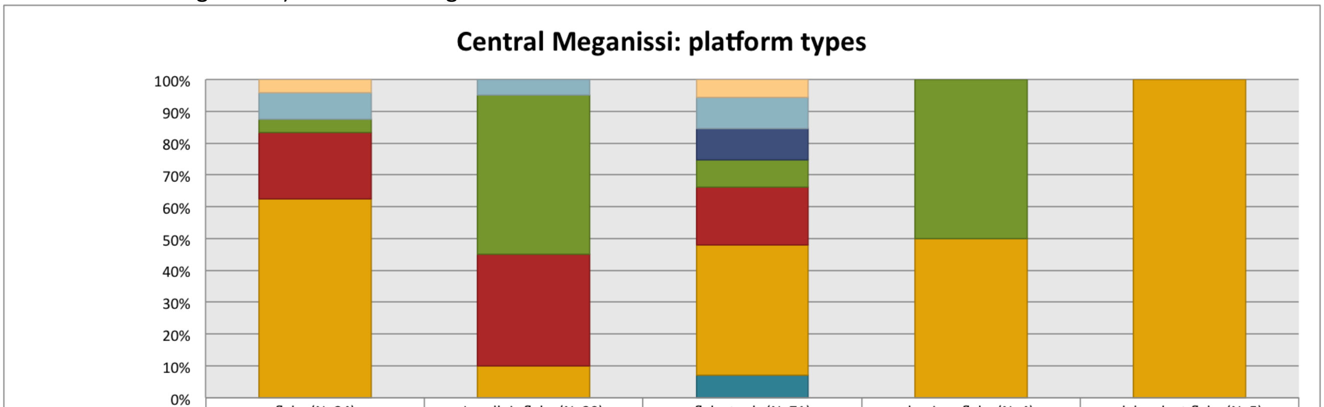
Graph 70 (right): Cortex coverage on all artefacts from Central Meganissi



Graph 71: Cortex coverage for the different artefact categories from Central Meganissi.



Graph 72: Frequency of the blank types used for retouch at the sites (Mesogi 2,3,4) and findspots (Schiza and Mesogi tracts) of Central Meganissi.



	flake (N=24)	Levallois flake (N=20)	flake tools (N=71)	laminar flake (N=4)	debordant flake (N=5)
broken (N=5)	1	0	4	0	0
indeterminate (N=10)	2	1	7	0	0
retouched (N=7)	0	0	7	0	0
facetted (N=19)	1	10	6	2	0
dihedral (N=25)	5	7	13	0	0
flat (N=53)	15	2	29	2	5
cortical (N=5)	0	0	5	0	0

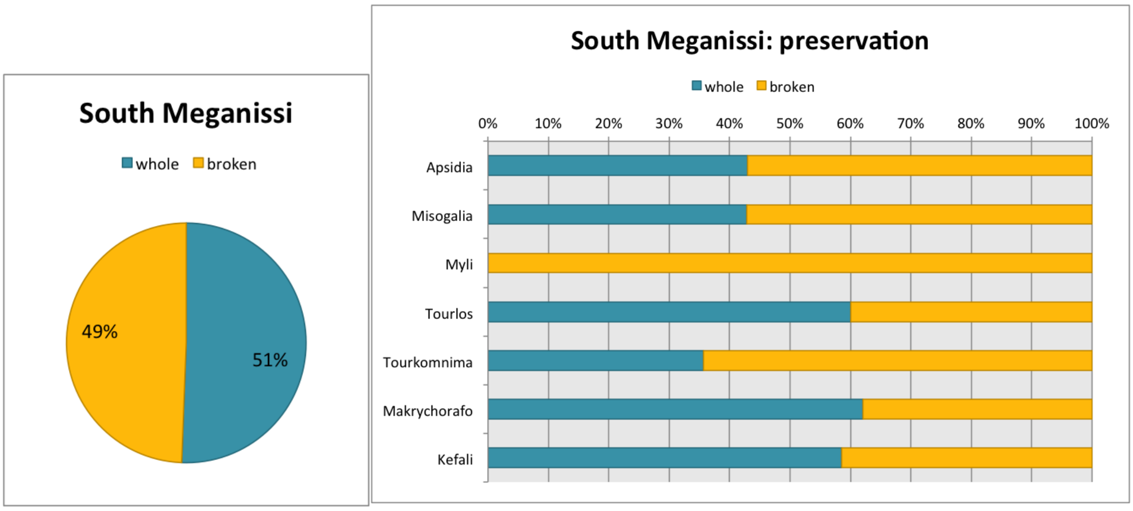
Graph 73: Stacked column chart with the different platform types on the unmodified and modified blanks from Central Meganissi.

4.5.1.4. *South Meganissi* (N=245)

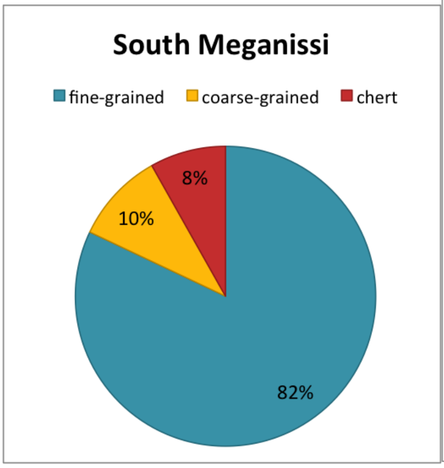
South Meganissi is an elongated piece of land characterised by particularly steep terrain that was only recently (2011) connected with the rest of the island by an asphalt road. It includes three Pleistocene sites (Apsidia 1, Makrychorafo 1 and Kefali 1) and a number of tract finds from the whole surveyed area, some of which were part of sites with Bronze Age or early Iron Age architectural remains (e.g. Tourkomnima, Myli, Tourlos). A total of 245 artefacts comprise the Middle Palaeolithic assemblages from the southern part of the island. Most of the artefacts come from Apsidia (38%), Makrychorafo (23,7%) and Kefali (21,6%). The most diagnostic artefacts are flake tools (46,5%) and debitage (36,3%), followed by cores (10,6%), technical pieces (6,1%) and a core tool (Table 40). In terms of preservation, almost half of the artefacts collected were broken (Graph 74) and the majority is heavily patinated (Graph 75).

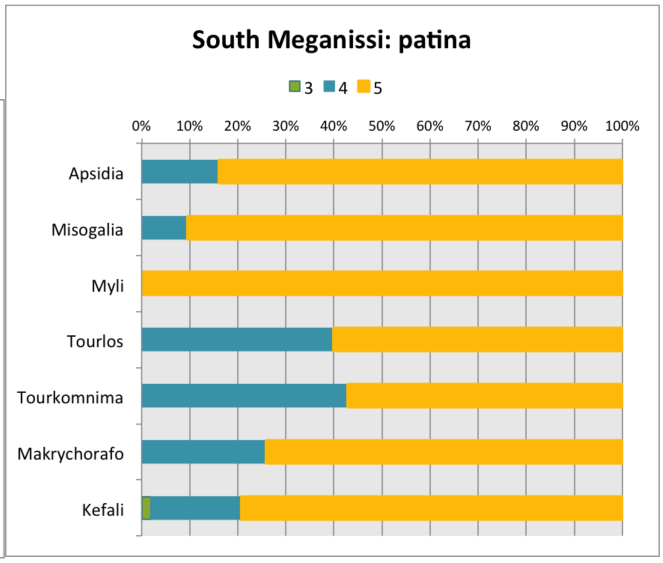
Table 40: South Meganissi inventory

South Meganissi	Cores		Debitage		Technical pieces		Flake tools		Core tools		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Apsidia	11	42,3	30	33,7	7	46,7	45	39,5	0	0	93	38
Misogalia	5	19,2	8	9	0	0	8	7	0	0	21	8,6
Myli	0	0	1	1,1	0	0	0	0	0	0	1	0,4
Tourlos	0	0	4	4,5	0	0	1	0,9	0	0	5	2
Tourkomnima	0	0	3	3,4	0	0	11	9,6	0	0	14	5,7
Makrychorafo	6	23,1	23	25,8	2	13,3	26	22,8	1	100	58	23,7
Kefali	4	15,4	20	22,5	6	40	23	20,2	1	0	53	21,6
Total	26	100	89	100	15	100	113	100	1	100	245	100
Total (%)	10,6		36,3		6,1		46,5		0,4		100	



Graph 74a-b: Percentage of broken and intact artefacts from South Meganissi

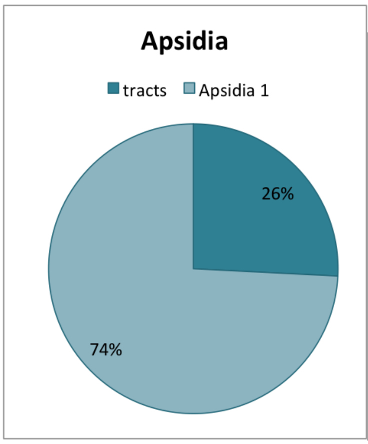


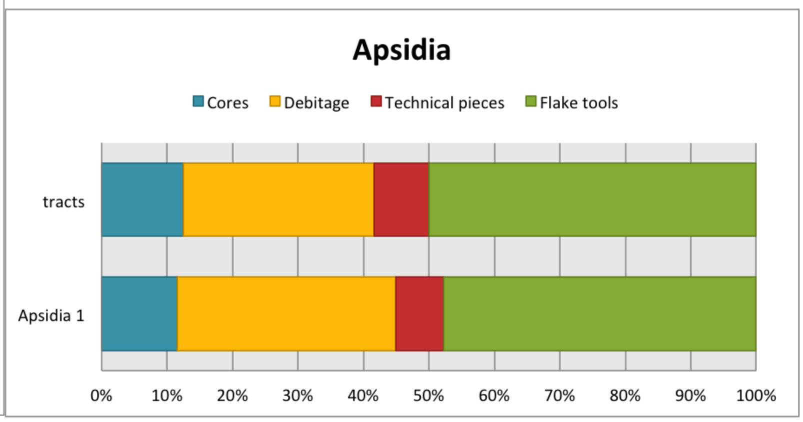


Graph 75 (left): Percentage of the different raw materials used for the production of lithic artefacts at South Meganissi.
Graph 76 (right): Percentage of patina on the artefacts from the seven regions of South Meganissi.

4.5.1.4.1. Apsidia (N=93)

The majority of the lithic artefacts from Apsidia that belong to the Middle Palaeolithic are part of Apsidia 1 site (Graph 77). In terms of assemblage structure, the picture between Apsidia tracts and Apsidia 1 is almost identical (Graph 78), with the most frequent artefact category being the flake tools (47,3%), followed by the debitage (32,3%) (Table 41). More than 90% of the artefacts are made on fine-grained flint with the rest made both on coarse-grained flint and chert (Table 42).





Graph 77 (left): Percentage of the Pleistocene finds from Apsidia tracts and Apsidia 1
Graph 78 (right): Percentage of artefact categories from Apsidia tracts and Apsidia 1

Table 41: Apsidia 1 and Apsidia tracts inventory

Apsidia	Cores		Debitage		Technical pieces		Flake tools		Core tools		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Apsidia 1	8	72,7	23	76,7	5	71,4	32	72,7	1	100	69	74,2
tracts	3	27,3	7	23,3	2	28,6	12	27,3	0	0	24	25,8
Total	11	100	30	100	7	100	44	100	1	100	93	100
Total (%)	11,8		32,3		7,5		47,3		1,1		100	

Table 42: Assemblage structure at Apsidia 1 and Apsidia tracts

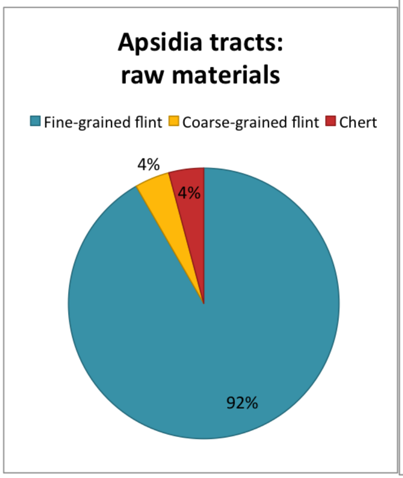
Apsidia		Fine-grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Debitage	flake	18	21,2	0	0	1	25	19	20,4
	laminar flake	4	4,7	0	0	0	0	4	4,3
	Levallois flake	5	5,9	1	33,3	0	0	6	6,5
	blade	1	1,2	0	0	0	0	1	1,1
Technical pieces	*débordant* flake	5	5,9	0	0	0	0	5	5,4
	core tablet	2	2,4	0	0	0	0	2	2,2
Cores	flake core	10	11,8	0	0	1	25	11	11,8
Flake tools	naturally-backed knife	1	1,2	0	0	0	0	1	1,1
	Levallois point	1	1,2	0	0	0	0	1	1,1
	pseudo-Levallois point	1	1,2	0	0	0	0	1	1,1
	tanged point	1	1,2	0	0	0	0	1	1,1
	retouched flake	18	21,2	0	0	1	25	19	21,5
	scraper	12	14,1	1	33,3	1	25	14	15,1
	bifacially worked piece	1	1,2	1	33,3	0	0	2	2,2
	burin	1	1,2	0	0	0	0	1	1,1
	bec / piercer / awl	2	2,4	0	0	0	0	2	2,2
	splintered piece	1	1,2	0	0	0	0	1	1,1
	pick	1	1,2	0	0	0	0	1	1,1
Total		86	100	3	100	4	100	93	100
Total (%)		92,5		3,2		4,3		100	

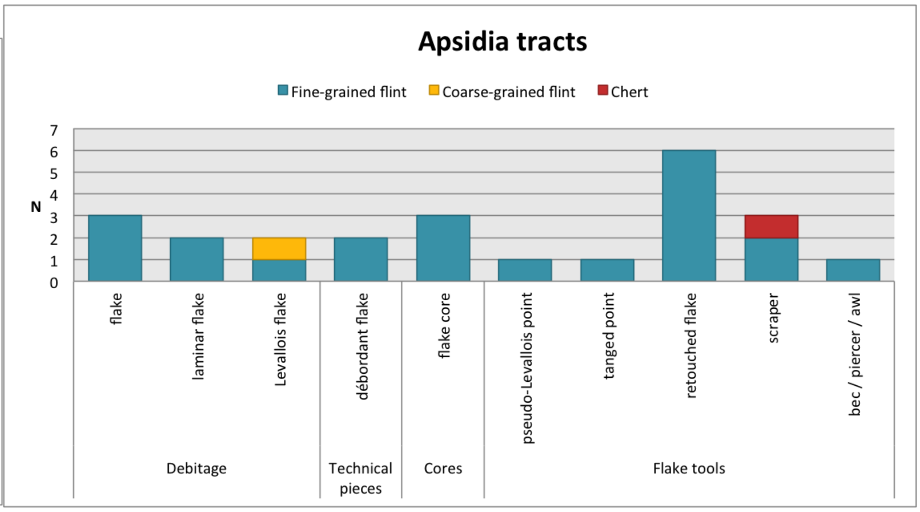
4.5.1.4.1.1. Apsidia tracts (N=24)

Apart from a Levallois flake made on coarse-grained flint and a scraper made on chert, all other 22 artefacts from Apsidia tracts are made on fine-grained flint (Table 43; Graph 79). The assemblage structure includes flakes, laminar flakes, Levallois flakes and flake cores, two *débordant* flakes and 11 flake tools. A 75% of the flake tools are made on plain flakes, followed by laminar, Levallois and débordant flakes (Graph 80). Platforms on both unmodified and modified blanks are mainly facetted and flat, followed by cortical and dihedral (Graph 81).

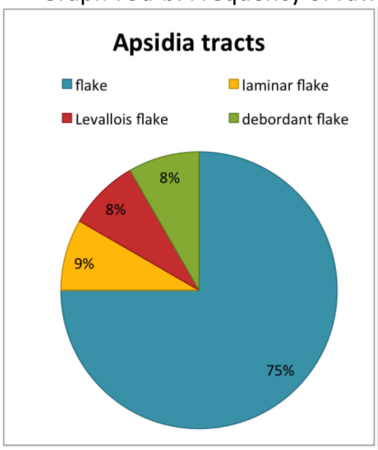
Table 43: Apsidia tracts assemblage structure

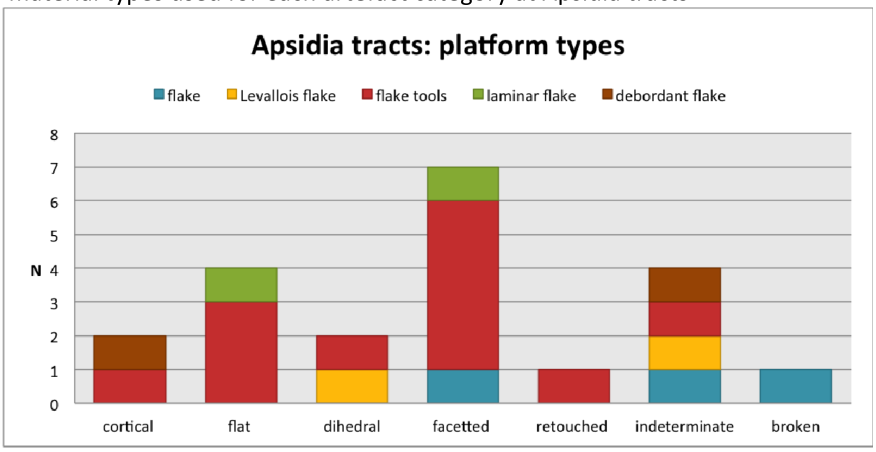
Apsidia tracts		Fine-grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Debitage	flake	3	13,6	0	0	0	0	3	13
	laminar flake	2	9,1	0	0	0	0	2	8
	Levallois flake	1	4,5	1	100	0	0	2	8
Technical pieces	*débordant* flake	2	9,1	0	0	0	0	2	8
Cores	flake core	3	13,6	0	0	0	0	3	13
Flake tools	pseudo-Levallois point	1	4,5	0	0	0	0	1	4
	tanged point	1	4,5	0	0	0	0	1	4
	retouched flake	6	27,3	0	0	0	0	5	25
	scraper	2	9,1	0	0	1	100	3	13
	bec / piercer / awl	1	4,5	0	0	0	0	1	4
Total		22	100	1	100	1	100	24	100
Total (%)		91,7		4,2		4,2		100	





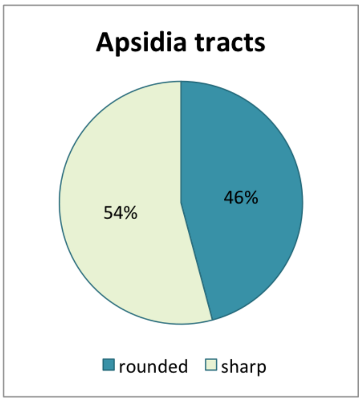
Graph 79a-b: Frequency of raw material types used for each artefact category at Apsidia tracts





Graph 80 (left): Frequency of the blank types used for the retouched tools at Apsidia tracts
Graph 81: (right): Frequency of the different platform types on the debitage, technical pieces and flake tools from Apsidia tracts

Apsidia tracts consist of a large number of artefacts collected from Apsidia beach (N=11; 46%, Graph 82). These have rounded edges due to their relatively long-term contact with water and pebbles and have probably ended up on the beach due to the erosional processes of the site (Figure 125). The particular group of artefacts, nevertheless, includes diagnostic MP pieces such as a lineal Levallois core (Figure 126i), a pseudo-Levallois point (Figure 126d) and *débordant* flakes (433A/2) (Figure 126f-g). There are also two laminar flakes (Figure 126a-b) and a particularly elongated laminar flake (96x35x18mm) preserving 50% of its cortex. The latter one exhibits bilateral scars which are both retouch and/or use scars but also a result of trampling; typologically it can be compared to Aurignacian blades (Figure 126h).



Graph 82 (left): Percentage of the artefacts with sharp and rounded edges from Apsidia tracts.
Figure 125 (right): Artefacts with rounded edges collected from Apsidia beach (photo: C. Papoulia).

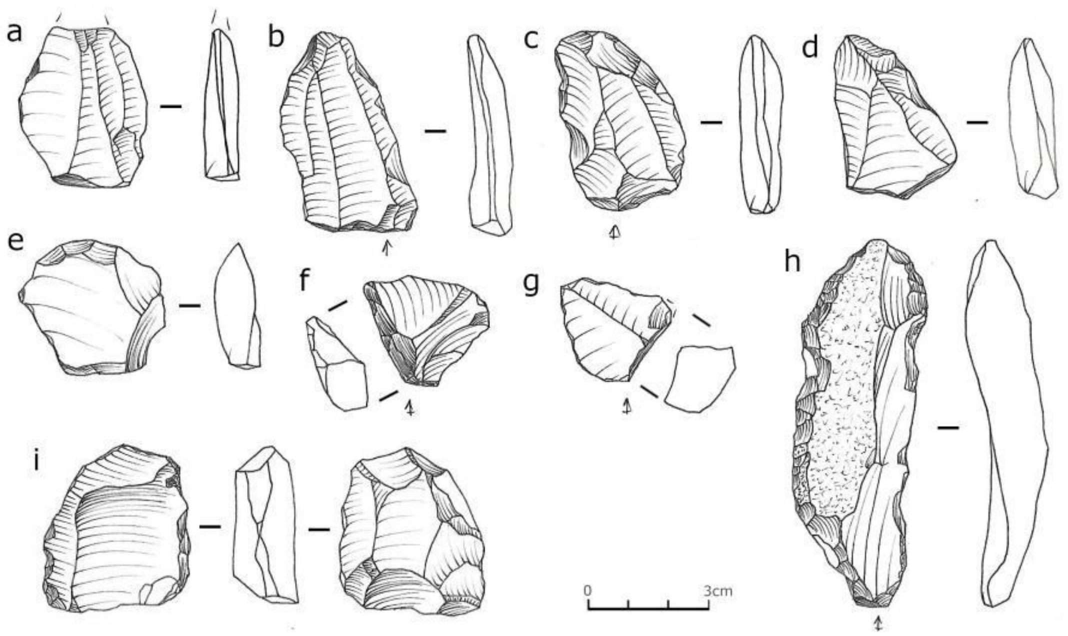


Figure 126: Apsidia tract finds with rounded edges

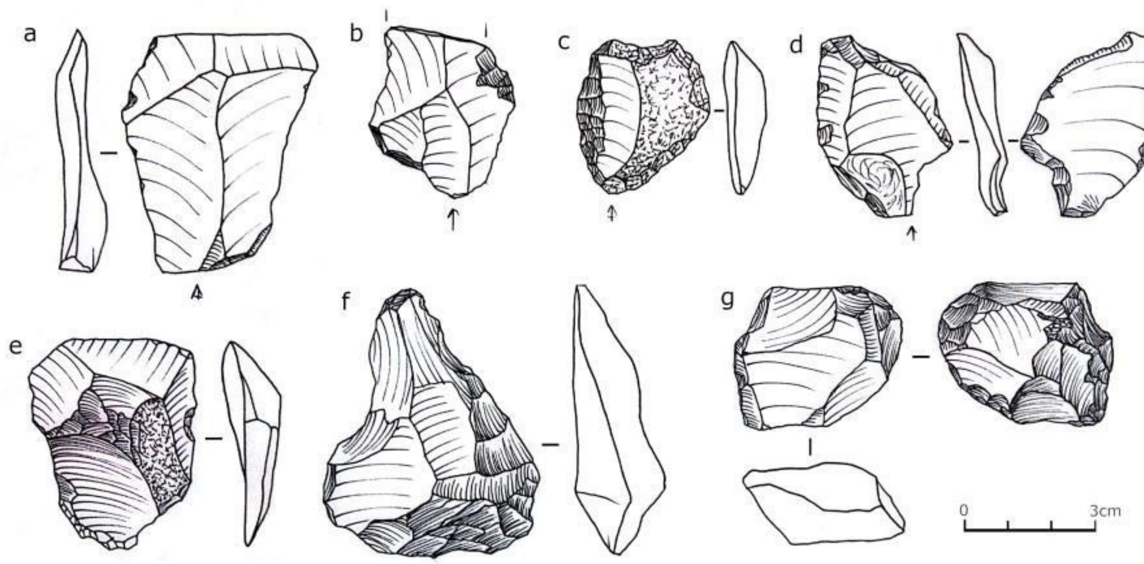


Figure 127: Apsidia tract finds with slightly rolled (a, e) and sharp (b-d, f-g) edges

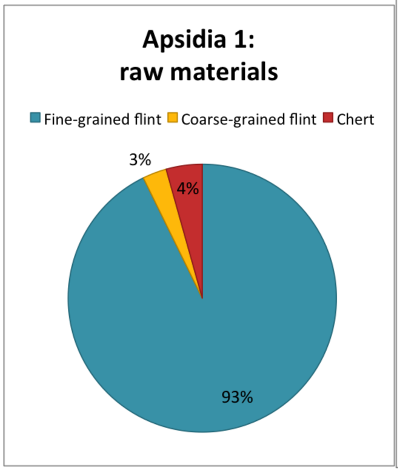
Other than these, the tract finds from Apsidia include a discoid core (Figure 127g), a core on a flake, a flake and two Levallois flakes – one of which is made on coarse-grained flint and has a dihedral butt (Figure 127a)– two scrapers (Figure 127c, f), a tanged point (Figure 127d) and several retouched flakes.

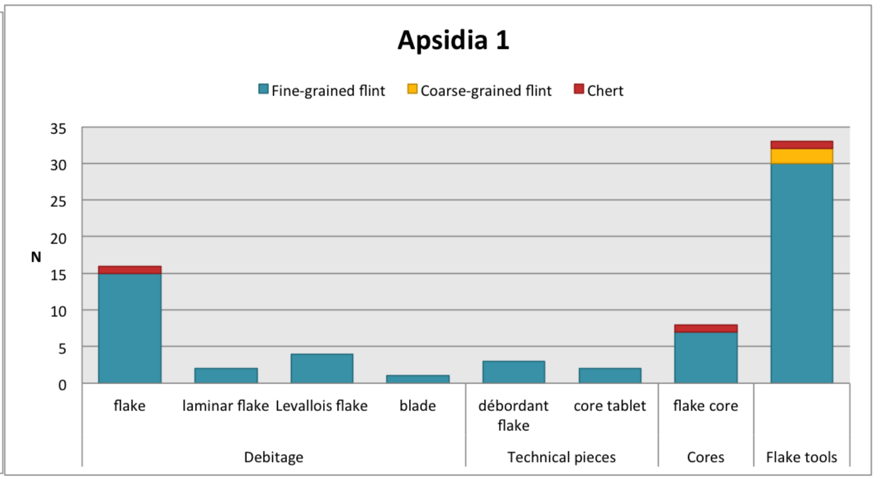
4.5.1.4.1.2. Apsidia 1 (N=69)

Apsidia 1 provided the largest amount of Middle Palaeolithic artefacts from south Meganissi. Like the tract finds from Apsidia, the artefacts collected from the site also include diagnostic Middle Palaeolithic tool types and Levallois debitage, most of which are made on fine-grained flint with the exception of two flake tools made on coarse-grained flint, and three artefacts (a flake core, a flake and a retouched flake) made on chert (Table 44). The same pattern in terms of raw material preferences is observed at Apsidia 1 and Apsidia tracts, since in both cases, a 92-93% of the artefacts are made on fine-grained flint Graph 83). Plain flakes (61%), Levallois flakes (24%) and laminar flakes (15%) are further retouched into flake tools (Graph 84). Preserved platforms are mainly facetted, flat, dihedral or retouched, while there is also a soft hammer butt with the characteristic lip (Graph 85).

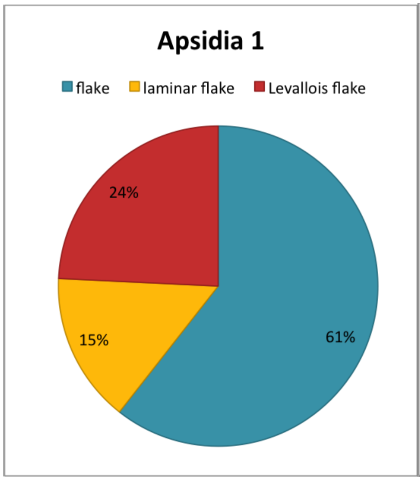
Table 44: Apsidia 1 assemblage structure

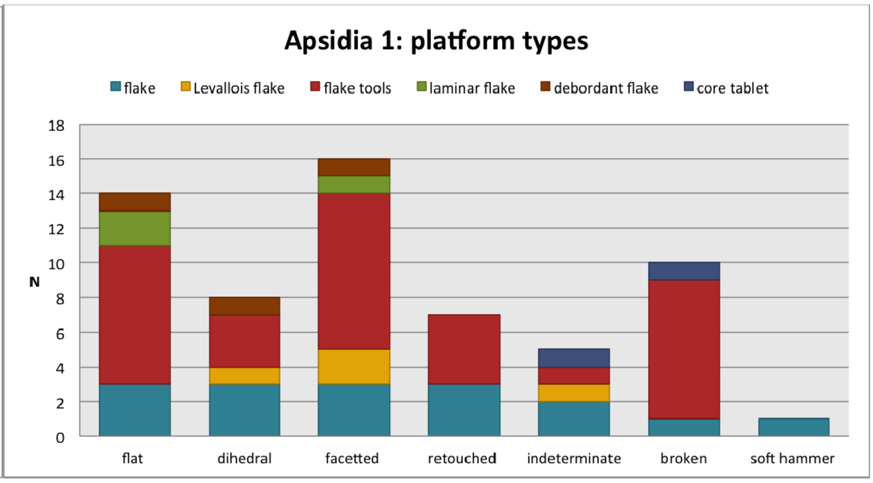
Apsidia 1		Fine-grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Debitage	flake	15	23,4	0	0	1	33,3	16	23,2
	laminar flake	2	3,1	0	0	0	0	2	2,9
	Levallois flake	4	6,3	0	0	0	0	4	5,8
	blade	1	1,6	0	0	0	0	1	1,4
Technical pieces	*débordant* flake	3	4,7	0	0	0	0	3	4,3
	core tablet	2	3,1	0	0	0	0	2	2,9
Cores	flake core	7	10,9	0	0	1	33,3	8	11,6
Flake tools	naturally-backed knife	1	1,6	0	0	0	0	1	1,4
	Levallois point	1	1,6	0	0	0	0	1	1,4
	retouched flake	13	20,3	0	0	1	33,3	14	20,3
	scraper	10	15,6	1	50	0	0	11	15,9
	bifacially worked piece	1	1,6	1	50	0	0	2	2,9
	burin	1	1,6	0	0	0	0	1	1,4
	bec / piercer / awl	1	1,6	0	0	0	0	1	1,4
	splintered piece	1	1,6	0	0	0	0	1	1,4
	pick	1	1,6	0	0	0	0	1	1,4
Total		64	100	2	100	3	100	69	100
Total (%)		92,8		2,9		4,3		100	





Graph 83a-b: Percentages and frequency of the raw material types used at Apsidia 1





Graph 84 (left): Frequency of blank types used for the retouched tools at Apsidia 1
Graph 85 (right): Frequency of the different platform types on the debitage, technical pieces and flake tools at Apsidia1

Technical pieces include two flake core tablets (Figure 128a-b) and three *débordant* flakes (Figure 128c-d). Flake cores are mainly thin, bifacially worked disc cores (Figure 128f-g) and discoid cores (Figure 128e). The latter one has a Levallois aspect in the sense that it exhibits preparation and a slight preferential upper face. There is also a globular-shaped flake core with a single platform and a semi-fixed perimeter with centripetal negative scars on both faces (51x44x20mm, Figure 129) and a flake core with a straight distal plane resembling a chopping tool, made on fine-grained flint, preserving 25% of its cortex (56x50x36mm, Figure 130). A number of hinged flake scars on both faces should either be interpreted as knapping accidents or as an intention to produce a thin edge while retaining a thick cortical base.

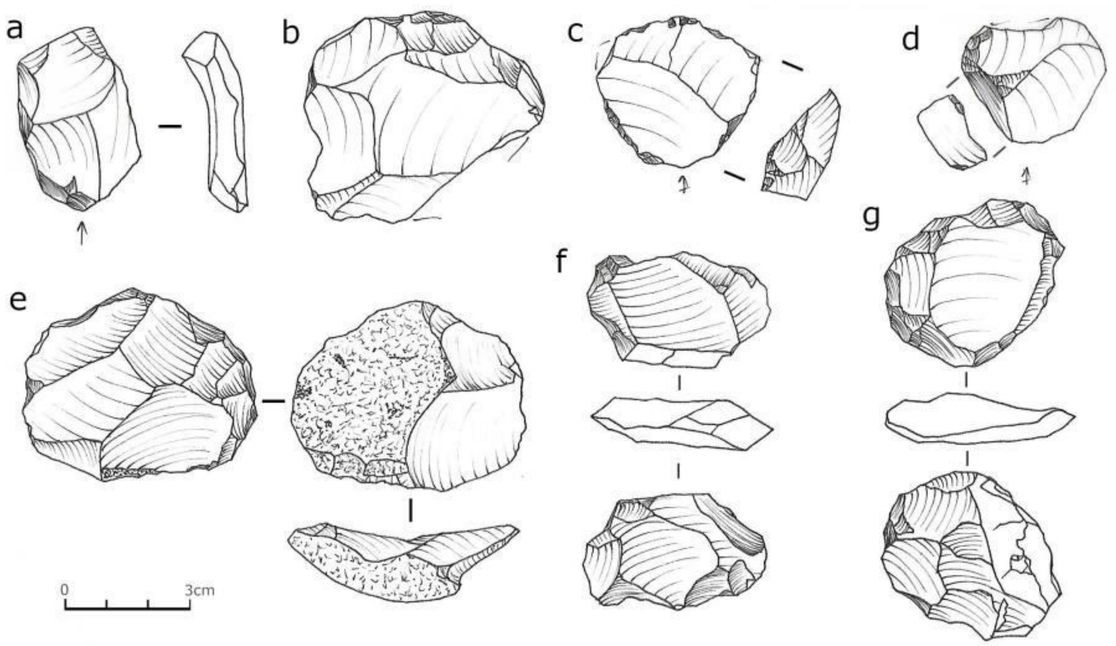


Figure 128: Technical pieces (a-d) and flake cores (e-g) and from Apsidia 1.

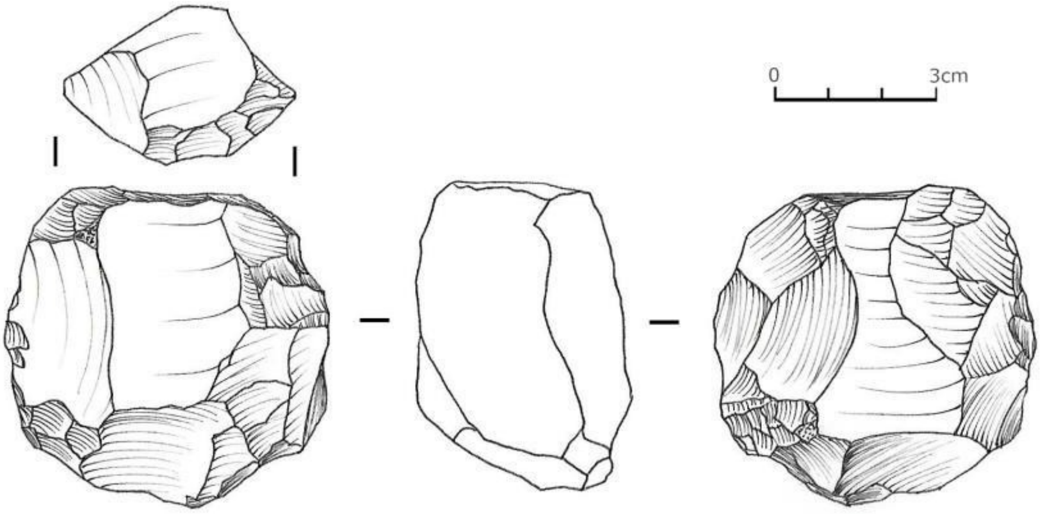


Figure 129: Globular-shaped centripetal flake core from Apsidia 1 (277B2/1).

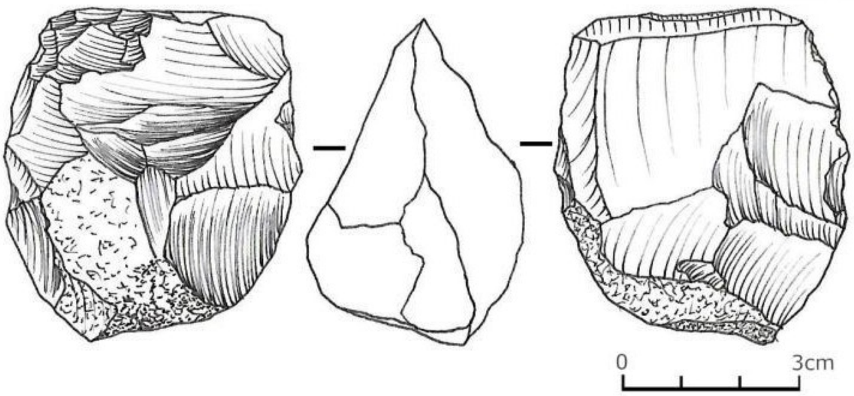


Figure 130: A flake core, which could also be classified as a chopping tool, from Apsidia 1 (277B2/6).

As for the retouched artefacts, these include a number of points, i.e. a retouched Levallois point (Figure 131b) measuring 39x21x8mm, a second Levallois point turned into an endscraper made on coarse-grained flint (48x30x9mm, Figure 131a), a bifacially worked leafpoint produced on a fine-grained flint flake by means of direct covering and inverse invasive retouch measuring 56x36x10mm (Figure 131d). There are also four single and three double scrapers (Figure 132e, k-l), three endscrapers (Figure 132j), a denticulated scraper, a naturally backed-knife with a facetted platform (Figure 132g), a bec made on a laminar flake (Figure 132m), a burin made on a heavily patinated fine-grained flint flake, yet with a less patinated burin scar that could indicate a slightly later date for this artefact. There is also a broken flake with a facetted platform turned into a splintered piece (Figure 132h) and a large number of retouched flakes, only one of which is made on chert. Lastly, there is a retouched artefact made on a large and thick fine-grained flint flake (90x58x28mm) which could be regarded as a pick (Figure 131c) and a bifacially worked piece of a triangular shape made on a coarse-grained flint flake (59x72x19mm) that could be the broken tip of a biface (Figure 133).

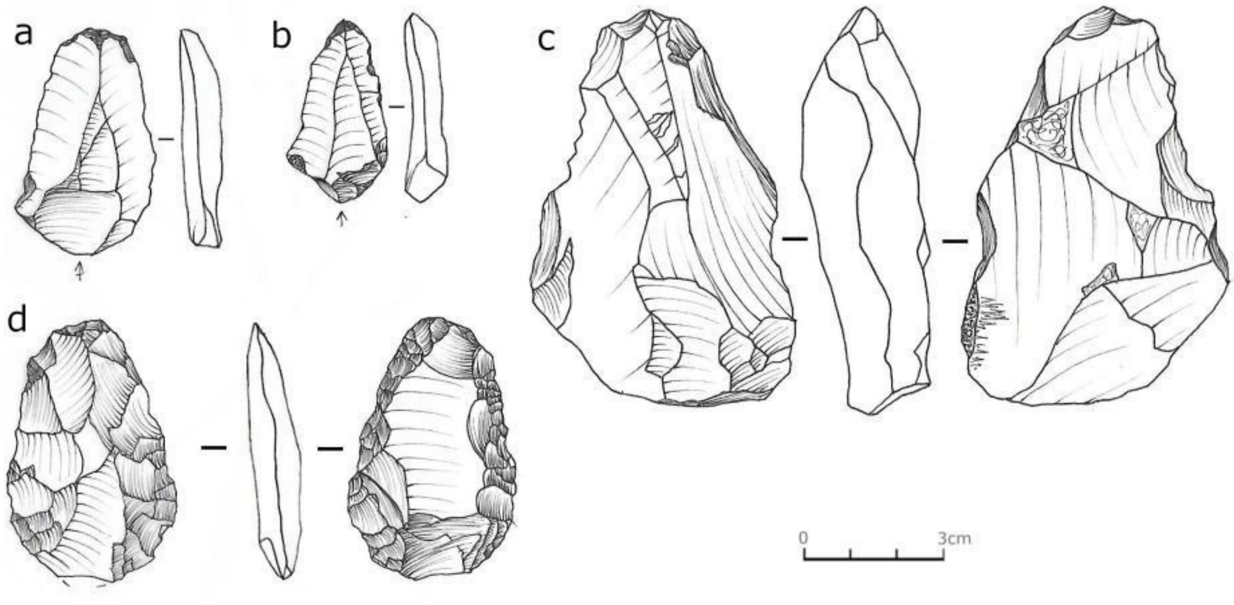


Figure 131: Unifacially worked points (a-b), a bifacially worked piece (c) and a leaf-shaped point (d) from Apsidia 1

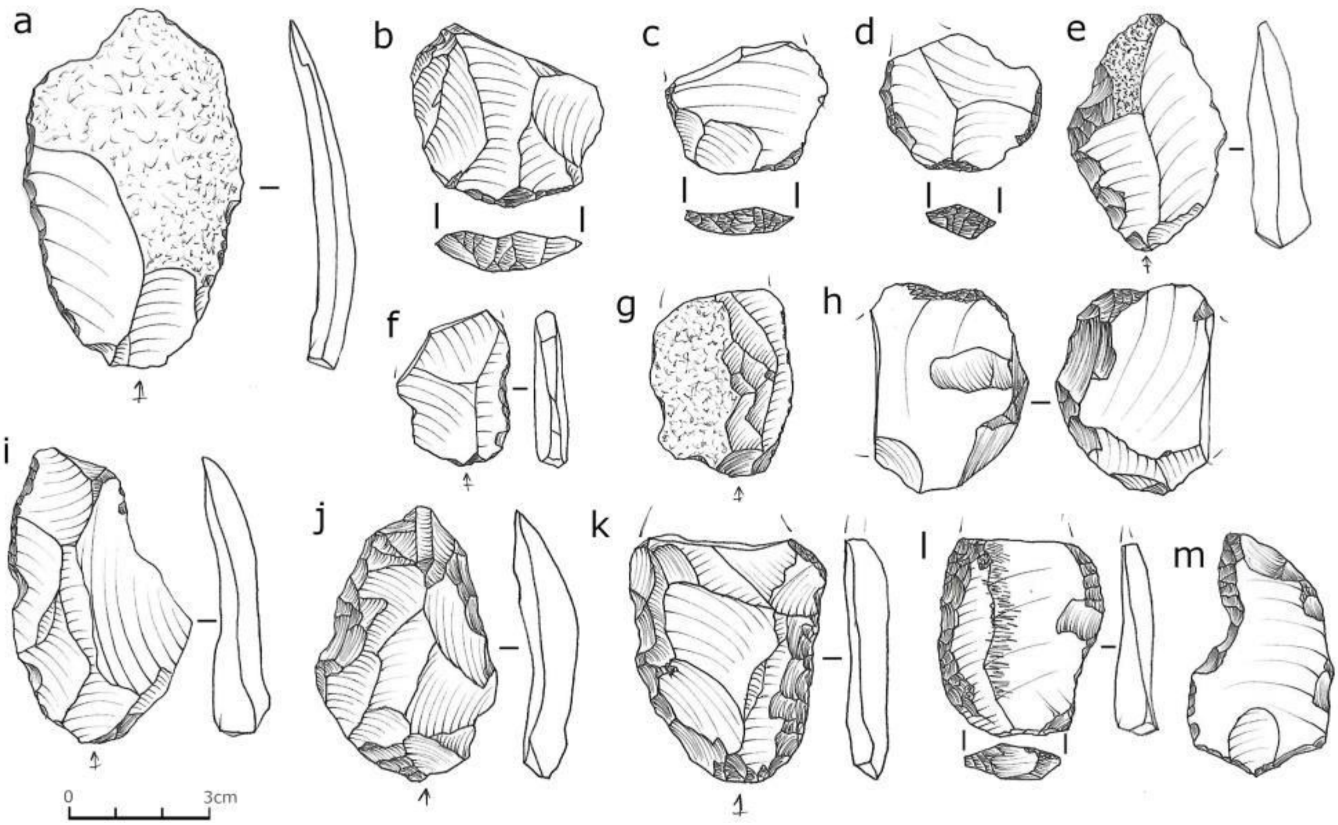


Figure 132: Flakes (b-c, f) and flake tools (a, d-e, g-m) from Apsidia 1

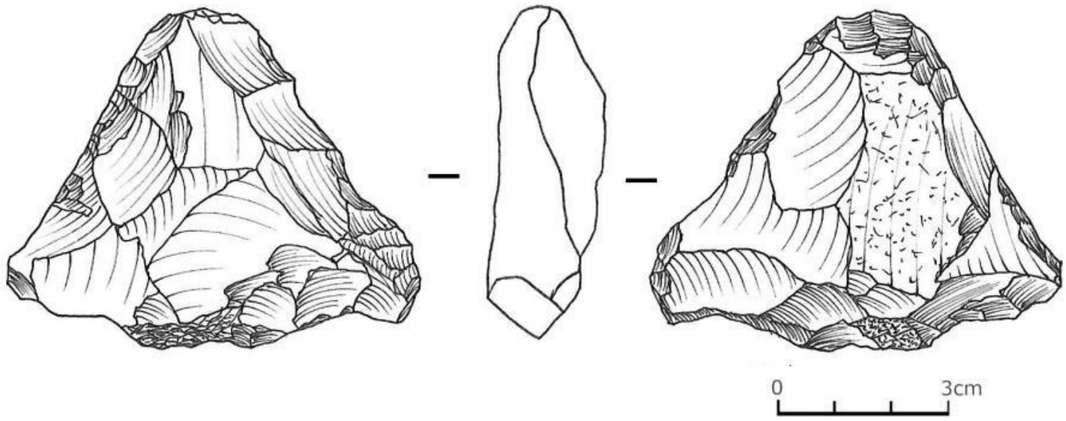


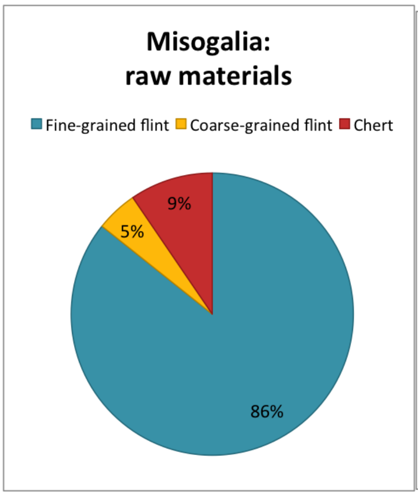
Figure 133: Bifacially worked triangular piece from Apsidia 1 (276-7/33).

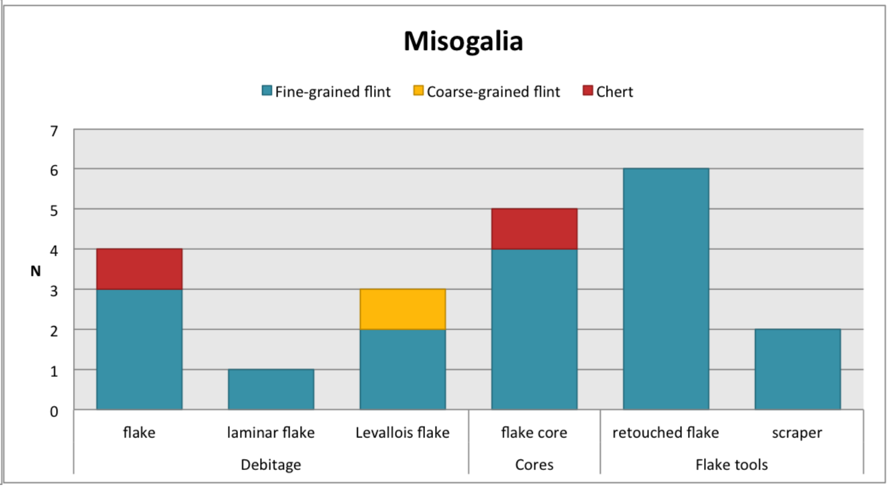
4.5.1.4.2. Misogalia (N=21)

The assemblage from Misogalia is a small but diagnostic Middle Palaeolithic one. It includes a significant Levallois aspect, i.e. three Levallois flakes (Figure 134a, d), a recurrent Levallois core (Figure 135a) and three retouched Levallois flakes (Figure 134c, e, g). There is also a laminar Levallois flake with a facetted platform (Figure 134b) and a laminar flake tool (Figure 134f). Most of the artefacts are made on fine-grained flint (85%), a Levallois flake is made on coarse-grained flint while two artefacts, a flake and a flake core, are made on chert (Table 45; Graph 86).

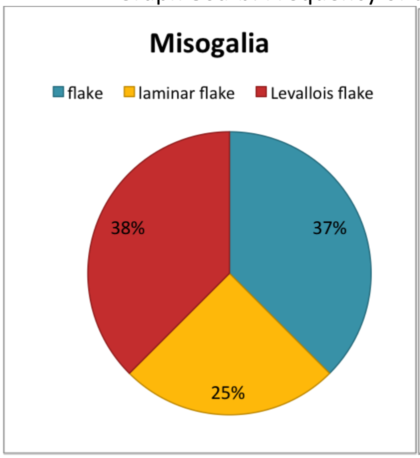
Table 45: Assemblage structure at Misogalia

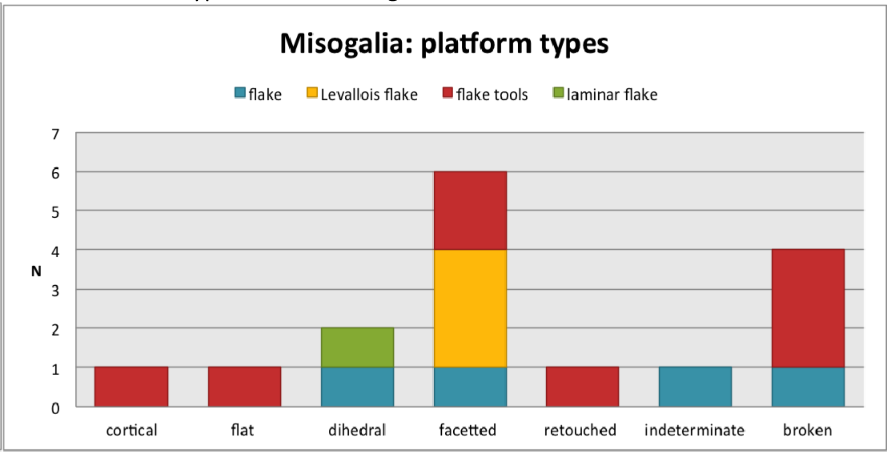
Misogalia		Fine-grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Debitage	flake	3	16,7	0	0	1	50	4	19,0
	laminar flake	1	5,6	0	0	0	0	1	4,8
	Levallois flake	2	11,1	1	100	0	0	3	14,3
Cores	flake core	4	22,2	0	0	1	50	5	23,8
Flake tools	retouched flake	6	33,3	0	0	0	0	6	28,6
	scraper	2	11,1	0	0	0	0	2	9,5
Total		18	100	1	100	2	100	21	100
Total (%)		86		5		9		100	





Graph 86a-b: Frequency of the raw material types used at Misogalia





Graph 87 (left): Percentage of blank types used for retouched tools at Misogalia
Graph 88 (right): Frequency of the different platform types on the debitage, technical pieces and flake tools at Misogalia

Apart from the recurrent Levallois (Figure 135a), other core types include a discoid core with a semi-fixed perimeter that exhibits extremely weathered surfaces and could also be classified as a chopping tool (Figure 135c), a disc core (Figure 135b), an amorphous core made on chert preserving 50% of its cortex (40x37x22mm) and a core on a flake, which at the same time is the largest core of the particular assemblage (66x63x30mm). Retouched tools are almost equally made on plain flakes, Levallois and laminar flake blanks (Graph 87). In terms of platforms, apart from the significant number of broken ones, the majority are prepared, either facetted or dihedral (Graph 88).

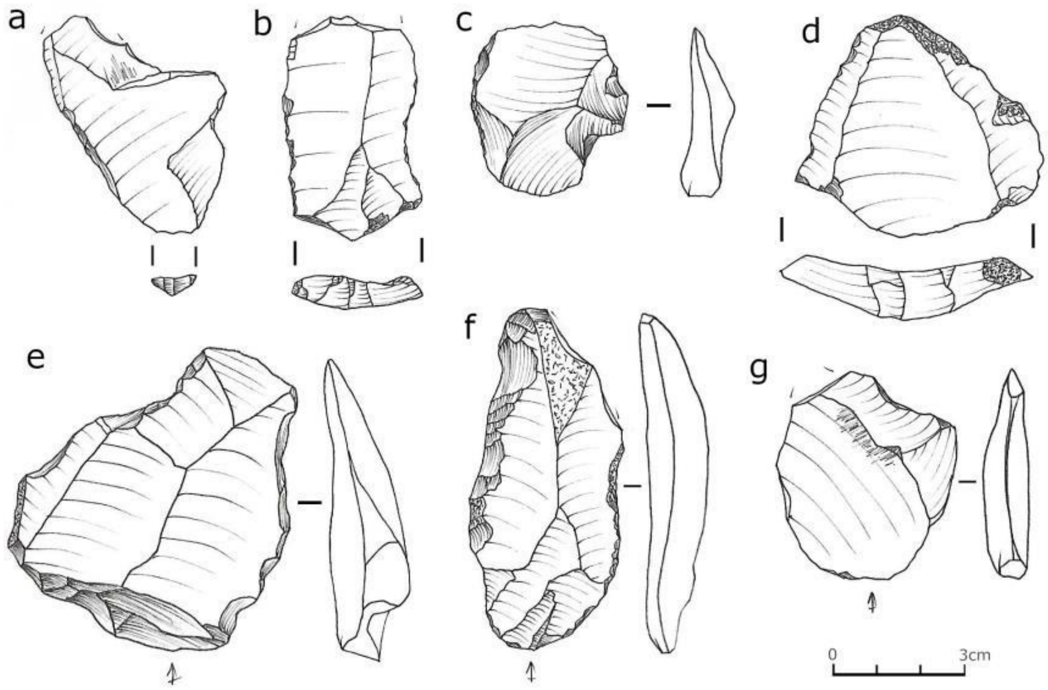


Figure 134: Flakes (a, c, g), a laminar flake (b) and flake tools (e-f) from Misogalia

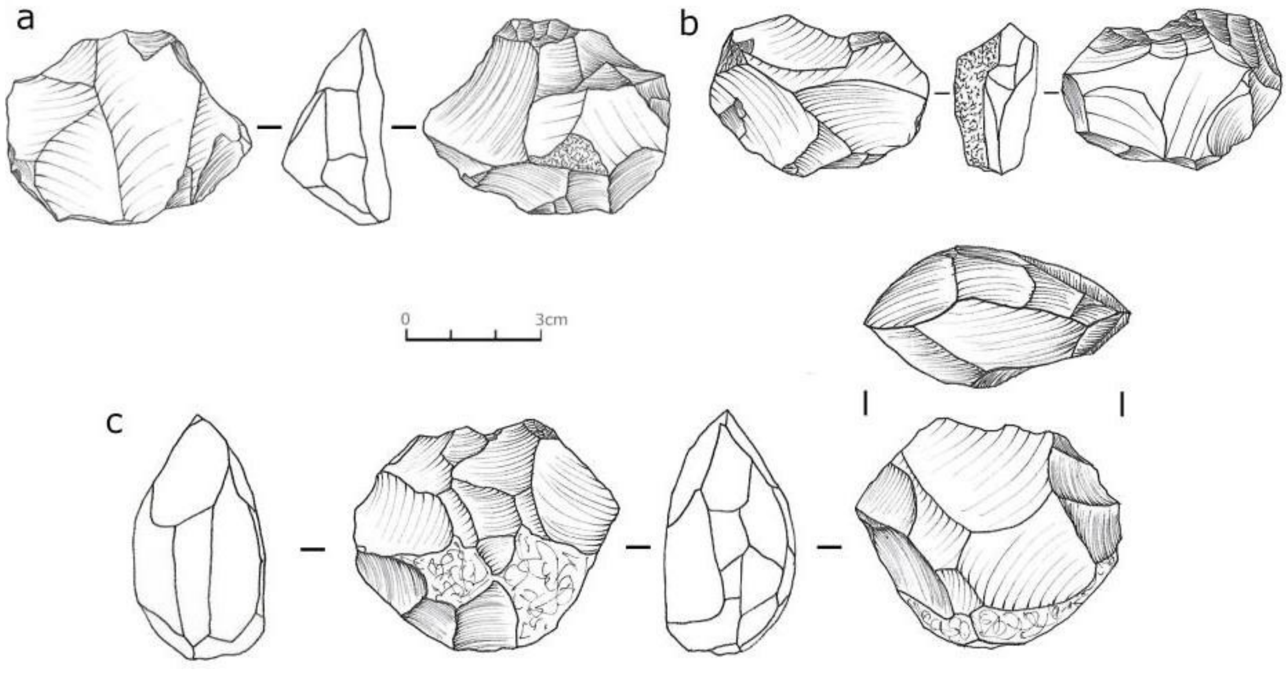


Figure 135: Flake cores from Misogalia

4.5.1.4.3. Myli (N=1)

A broken flake made on fine-grained flint is the only artefact that may be attributed to the Pleistocene component of Myli (Table 46). It is heavily patinated (5) with macroscopically observed bilateral scars that are probably due to its use (Figure 136).

Table 46: Myli assemblage structure

Myli		Fine -grained flint	
		N	%
Debitage	flake	1	100

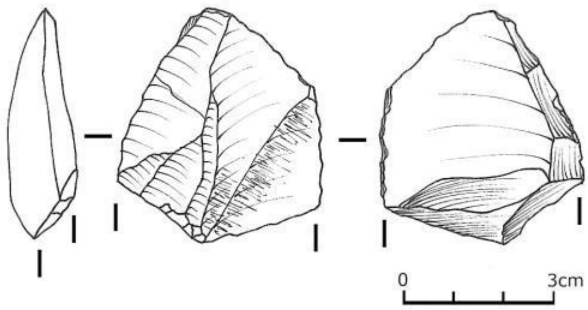


Figure 136: Flake 265/1 from Myli.

4.5.1.4.4. Tourlos (N=5)

Four flakes and a flake tool are the only Middle Palaeolithic artefacts from Tourlos (Table 47). Contrary to the usual pattern, only one artefact is made on fine-grained flint, while the rest (80%) is equally made on coarse-grained flint (40%) and chert (40%). The flake tool is a splintered piece made on a chert flake with a dihedral platform. It retains 5% of its cortex and measures 45x35x12mm (Figure 137).

Table 47: Tourlos assemblage structure

Tourlos		Fine-grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Debitage	flake	1	100	2	100	1	50	4	80
Flake tools	splintered piece	0	0	0	0	1	50	1	20
Total		1	100	2	100	2	100	5	100
Total (%)		20		40		40		100	

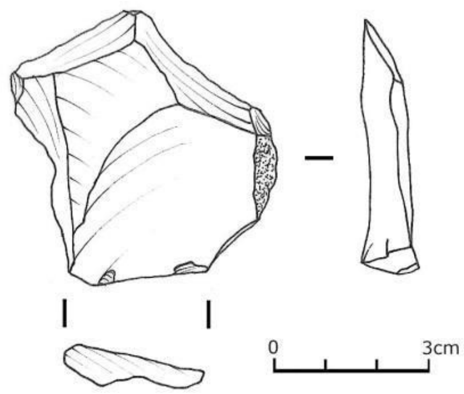
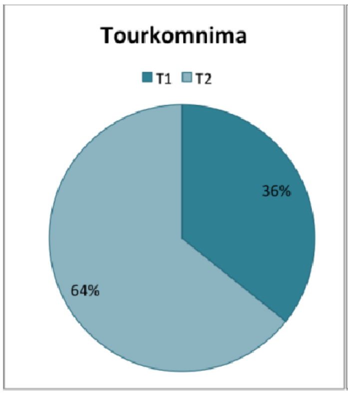
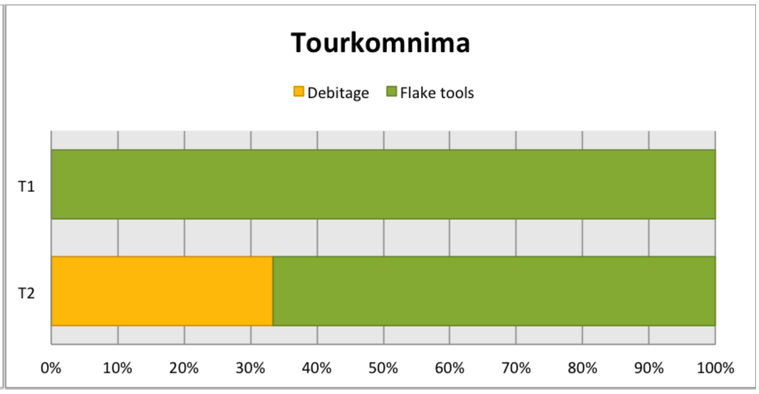


Figure 137: Middle Palaeolithic artefact from Tourlos.

4.5.1.4.5. Tourkomnima (N=14)

A total of 14 artefacts found at the two Holocene sites at Tourkomnima, i.e. T1 and T2, can be regarded as part of to the Pleistocene component of the area, most of which come from T2 (Graph 89). A 64.3% of these were found broken while some of the flake tools were almost intact. All artefacts exhibit high degrees of surface alterations due to patina (Graph 75). The colour of the patina observed on one retouched artefact (i.e. burin) from T1 as well as on two retouched artefacts (i.e. a retouched flake and a scraper) from T2 is pink. In the latter case, the retouch scars are less patinated than the blank itself. A reddish patina can be observed on a retouched flake from T2. T1 consists only of flake tools, while T2 consists of both debitage and flake tools (Graph 90).





Graph 89 (left): Percentage of the Pleistocene finds collected from Tourkomnima 1 and Tourkomnima 2
Graph 90 (right): Artefact categories percentages from Tourkomnima 1 and Tourkomnima 2

Table 48: Assemblage structure at Tourkomnima 1 and Tourkomnima 2 sites

Tourkomnima		**Fine-grained flint**		**Coarse-grained flint**		**Chert**		**Total**	
		N	%	N	%	N	%	N	%
Debitage	flake	3	27,3	0	0	0	0	3	21,4
Flake tools	naturally-backed knife	0	0	1	100	0	0	1	7,1
	retouched flake	6	54,5	0	0	2	100	8	57,1
	scraper	1	9,1	0	0	0	0	1	7,1
	burin	1	9,1	0	0	0	0	1	7,1
Total		11	100	1	100	2	100	14	100
Total (%)		78,6		7,1		14,3		100	

4.5.1.4.5.1. Tourkomnima 1 (N=5)

A total of five retouched artefacts collected from T1 may be attributed to a Pleistocene component of this late prehistoric site (Figure 139). These include three retouched laminar flakes, a naturally backed knife and a dihedral multiple burin, both made on laminar blanks (Figure 138a-e). The majority is made on fine-grained flint (Table 49) and all, but one (239/3), preserve some of their cortex. Two retouched flakes (237Δ/1, 238B/1), and the burin (239/4) have a dihedral butt, while the third retouched flake (239/3) and the naturally-backed knife (238Γ/1) have flat butts.

Table 49: Assemblage structure at T1

Tourkomnima 1		Fine-grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Flake tools	naturally-backed knife	0	0	1	100	0	0	1	20
	retouched flake	2	66,7	0	0	1	100	3	60
	burin	1	33,3	0	0	0	0	1	20
Total		3	100	1	100	1	100	5	100
Total (%)		60		20		20		100	

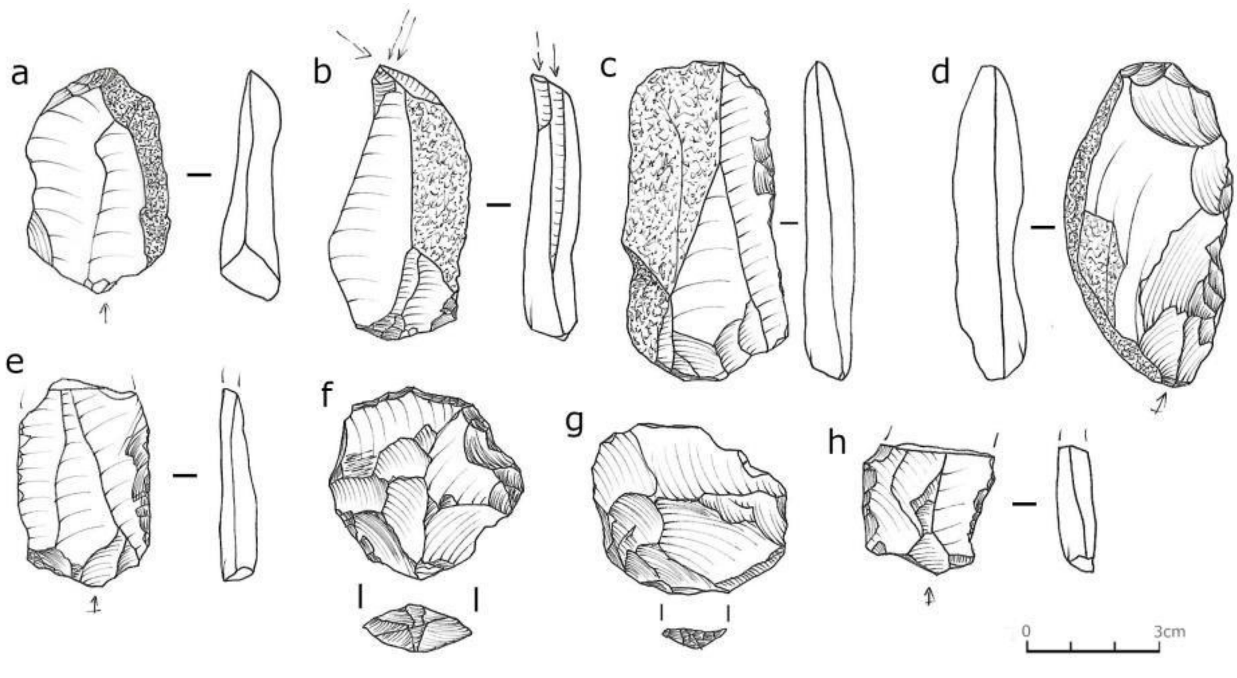


Figure 138: Flakes and flake tools from Tourkomnima 1 (a-e) and Tourkomnima 2 (f-h).

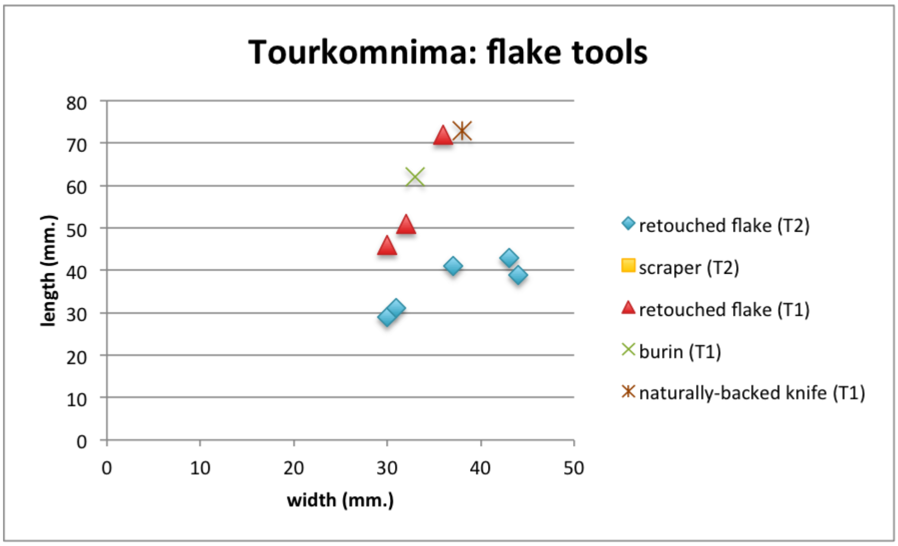
Figure 139 a-b: laminar flake tools (a: dorsal face, b: ventral face) from Tourkomnima 1 (photos: C. Papoulia).

4.5.1.4.5.2. Tourkomnima 2 (N=9)

A total of nine artefacts collected from T2 may be attributed to a Pleistocene component. These include three flakes, five retouched flakes and a scraper. All are made on fine-grained flint apart from one retouched flake made on chert (Table 50). A hinge and a siret fracture are observed on two of the unmodified flakes. The scraper and one of the retouched flakes are made on Levallois blanks with facetted platforms (Figure 138f-g). Two more retouched flakes have facetted butts and the other two flake tools, one of which made on the only laminar flake blank from T2 (Figure 138h), have dihedral butts. The significant elongation observed on the T1 artefacts is evident when compared to the flake tools from T2 (Graph 91).

Table 50: Assemblage structure at T2

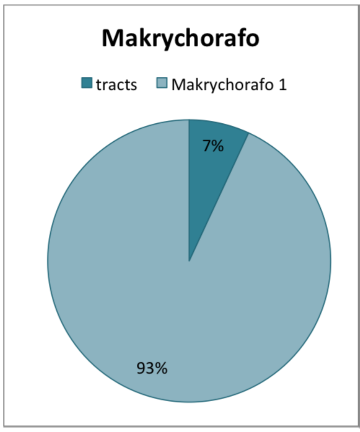
Tourkomnima 2		Fine-grained flint		Chert		Total	
		N	%	N	%	N	%
Debitage	flake	3	37,5	0	0	3	33,3
Flake tools	retouched flake	4	50	1	100	5	55,6
	scraper	1	12,5	0	0	1	11,1
Total		8	100	1	100	9	100
Total (%)		88,9		11,1		100,0	

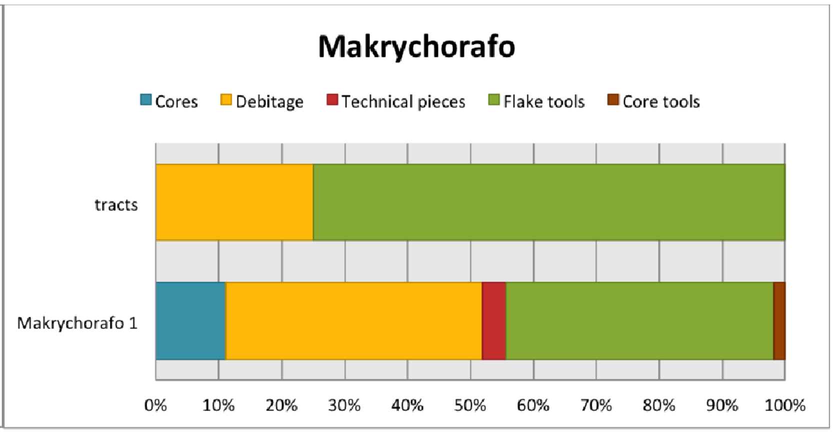


Graph 91: Scatter plot with the dimensions of the retouched artefacts from T1 and T2.

4.5.1.4.6. Makrychorafo (N=58)

A 93% of the artefacts attributed to the Pleistocene component of Makrychorafo come from Makrychorafo 1 site (Graph 92). All artefact categories are represented at the site, including a core tool, while the tract finds are only flake and flake tools (Graph 93). Most of the artefacts are made on fine-grained flint (67,2%), yet a significant number is also made on coarse-grained flint (20,7%) and chert (12%) (Table 51).





Graph 92 (left): Percentage of the Pleistocene finds collected from Makrychorafo 1 and as tract finds
Graph 93 (right): Artefact categories percentages at Makrychorafo 1 and Makrychorafo tracts

Table 51: Makrychorafo assemblage structure

Makrychorafo		**Fine-grained flint**		**Coarse-grained flint**		**Chert**		**Total**	
		N	%	N	%	N	%	N	%
Debitage	flake	13	33,3	6	50	2	28,6	21	36
	laminar flake	1	2,6	0	0	0	0	1	2
	blade	0	0	1	8,3	0	0	1	2
Technical pieces	*débordant* flake	2	5,1	0	0	0	0	2	3
Cores	flake core	3	7,7	2	16,7	1	14,3	6	10
Flake tools	denticulate	2	5,1	0	0	0	0	2	3
	Levallois point	1	2,6	0	0	0	0	1	2
	retouched flake	7	17,9	1	8,3	2	28,6	10	17
	scraper	5	12,8	2	16,7	1	14,3	8	14
	limace	1	2,6	0	0	0	0	1	2
	burin	1	2,6	0	0	1	14,3	2	3
	bec / piercer / awl	2	5,1	0	0	0	0	2	3
Core tool	pick	1	2,6	0	0	0	0	1	2
Total		39	100	12	100	7	100	58	100
Total (%)		67,2		20,7		12		100	

4.5.1.4.6.1. Makrychorafo tracts (N=4)

Only four artefacts, a flake and three flake tools, collected as tract finds are part of the Middle Palaeolithic component of Makrychorafo, all made of fine-grained flint (Table 52). These are a flake with a flat platform and a step fracture measuring 25x35x28mm (230/5), a retouched Levallois flake with a dihedral butt (230/1) and two scrapers, i.e. a carinated scraper (230/2) and a déjeté scraper made on a Levallois flake with a facetted platform (230Γ/1) (Figure 140).

Table 52: Makrychorafo tracts assemblage structure

Makrychorafo tracts		Fine-grained flint	
		N	%
Debitage	flake	1	25
Flake tools	retouched flake	1	25
	scraper	2	50
Total		4	100

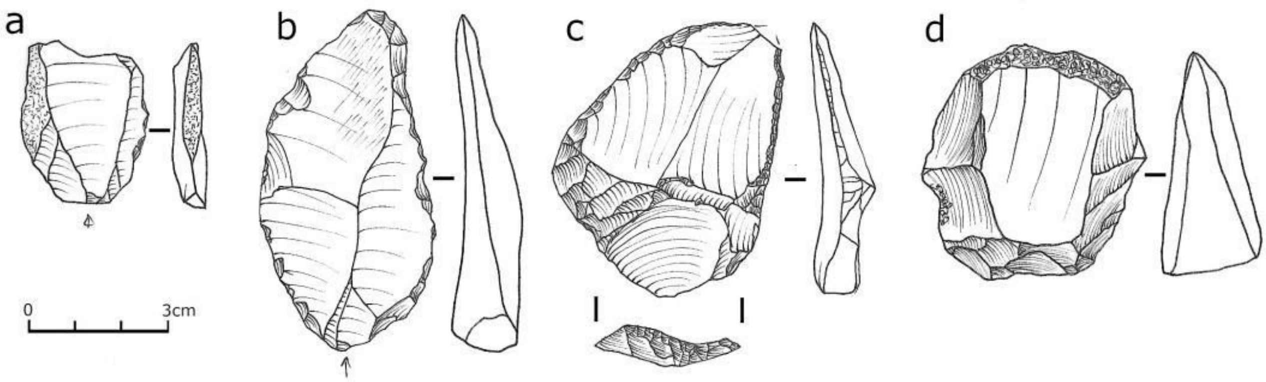


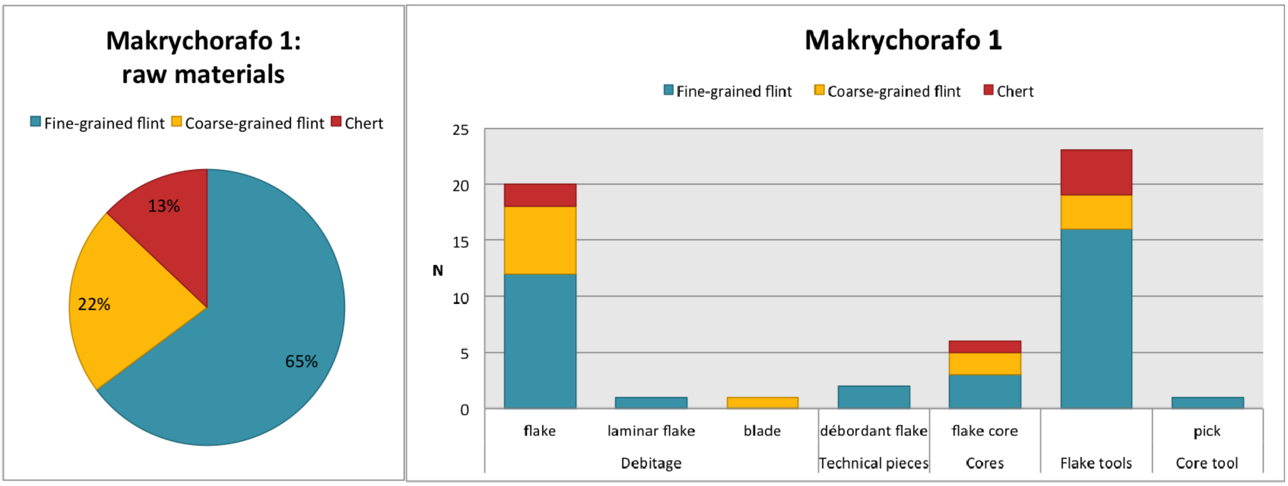
Figure 140: Artefacts from Makrychorafo tracts: flake (a) and flake tools (b-d).

4.5.1.4.6.2. Makrychorafo 1 (N=54)

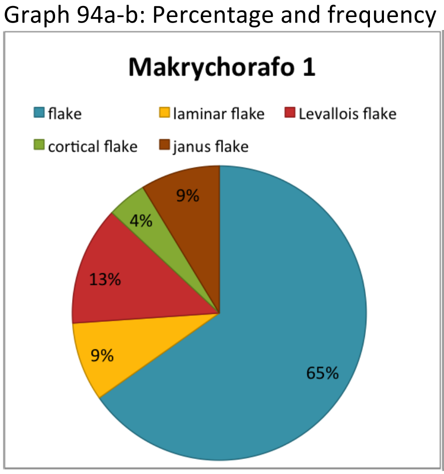
Most of the diagnostic Middle Palaeolithic artefacts from Makrychorafo come from the site. There are 54 lithics in total, most of which are made on fine-grained flint (64,8%), with quite a few made on coarse-grained flint (22,2%) and a 13% made on chert (Table 53; Graph 94). Among the numerous debitage specimens, there is no characteristic Levallois flake or blade, however a preparation of the striking platform is evident in the many facetted and dihedral butts recorded (Graph 96). Plain flakes are mainly used as blanks for retouch (65%), a significant number of tools is made on Levallois flakes (13%), while 9% of tools are made on laminar flakes and 9% on Janus flakes (Graph 95).

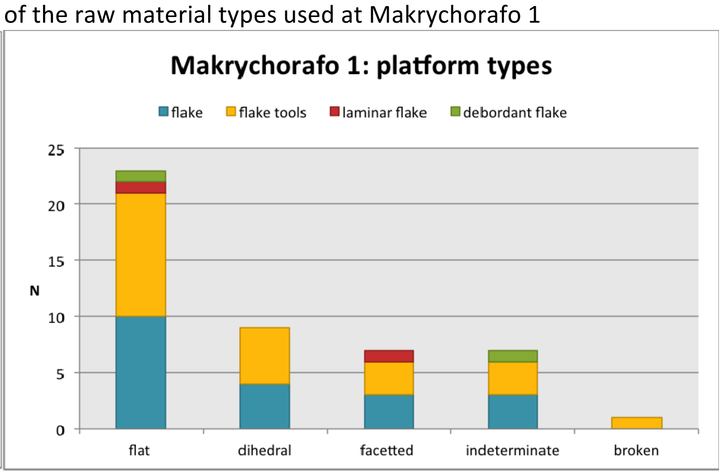
Table 53: Makrychorafo 1 assemblage structure

Makrychorafo 1		**Fine-grained flint**		**Coarse-grained flint**		**Chert**		**Total**	
		N	%	N	%	N	%	N	%
Debitage	flake	12	34,3	6	50	2	28,6	20	37
	laminar flake	1	2,9	0	0	0	0	1	1,9
	blade	0	0	1	8,3	0	0	1	1,9
Technical pieces	*débordant* flake	2	5,7	0	0	0	0	2	3,7
Cores	flake core	3	8,6	2	16,7	1	14,3	6	11,1
Flake tools	denticulate	2	5,7	0	0	0	0	2	3,7
	Levallois point	1	2,9	0	0	0	0	1	1,9
	retouched flake	6	17,1	1	8,3	2	28,6	9	16,7
	scraper	3	8,6	2	16,7	1	14,3	6	11,1
	limace	1	2,9	0	0	0	0	1	1,9
	burin	1	2,9	0	0	1	14,3	2	3,7
	bec / piercer / awl	2	5,7	0	0	0	0	2	3,7
Core tool	pick	1	2,9	0	0	0	0	1	1,9
Total		35	100	12	100	7	100	54	100
Total (%)		64,8		22,2		13		100	



Graph 94a-b: Percentage and frequency of the raw material types used at Makrychorafo 1





Graph 95 (left): Percentage of blank types used for retouched tools at Makrychorafo 1
Graph 96 (right): Frequency of the different platform types on debitage, technical pieces and flake tools at Makrychorafo 1

Among the cores, two are classified as lineal Levallois; both are of a relatively thin, disc shape preserving 25% and 5% of their cortex respectively (Figure 141a-b). The larger one (49x59x21mm) is made on coarse-grained flint, and the smaller one (34x39x13mm) on fine-grained flint. There are also two discoid cores (Figure 142a), a globular core preserving 25% of its cortex and a core on a flake made on chert (Figure 141c). One more flake has acted as a core since it has two small flake removals on its ventral face (Figure 141d).

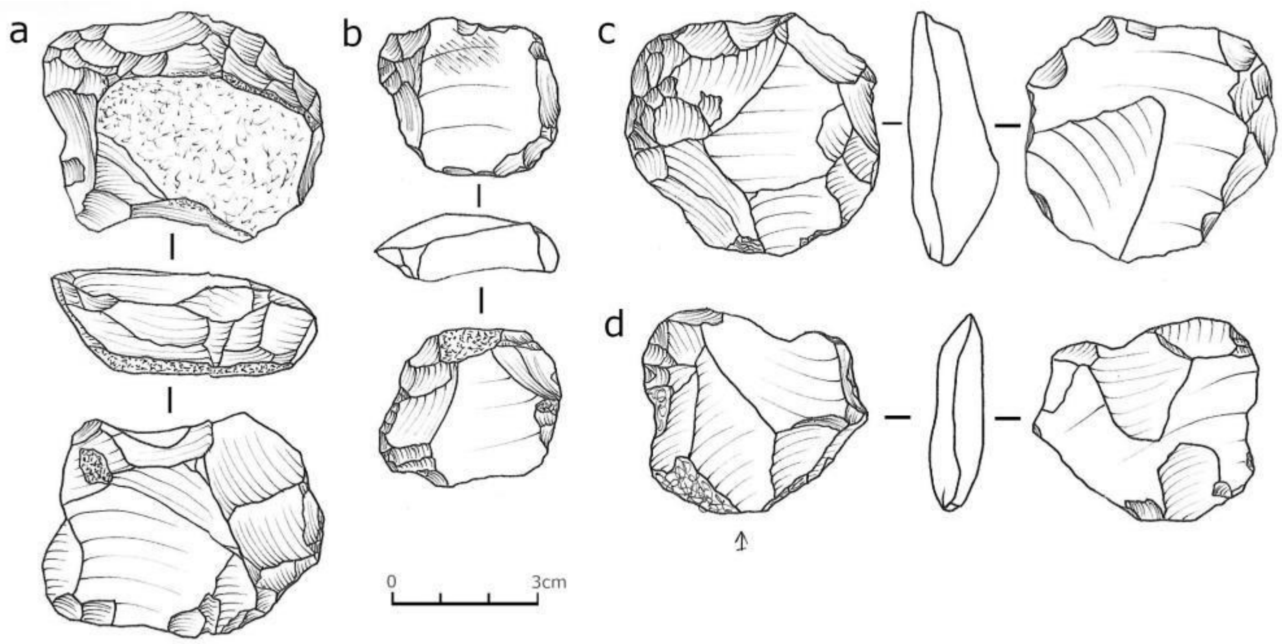


Figure 141: Flake cores from Makrychorafo 1.

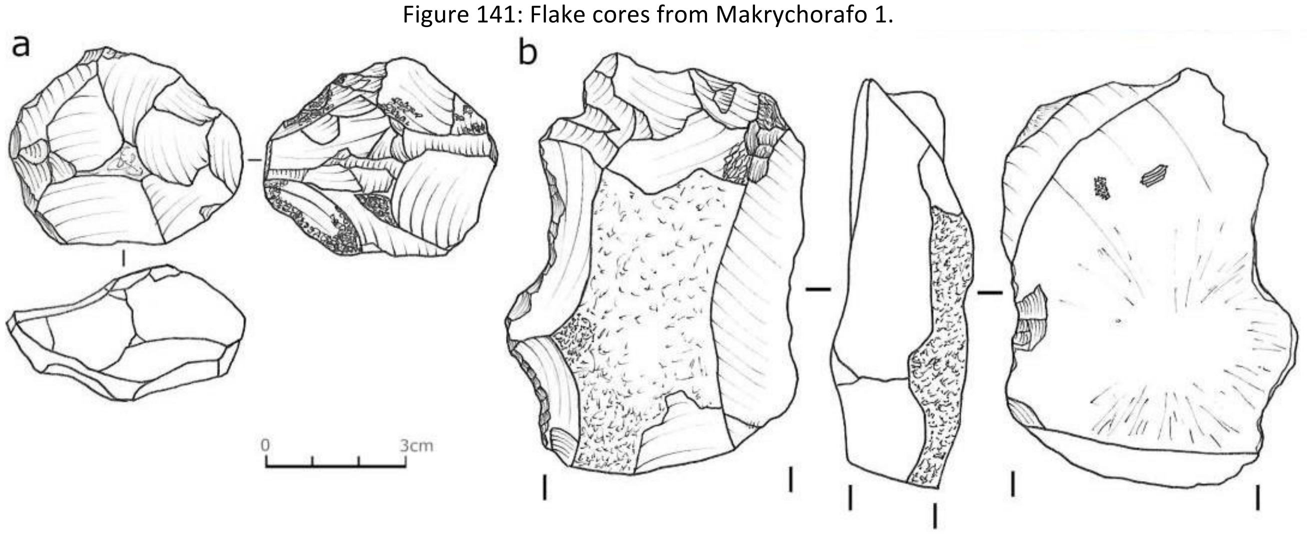


Figure 142: Discoid core and large denticulate with fossil inclusions from Makrychorafo 1.

Six out of 20 flakes are made on coarse-grained flint (Figure 143e-g) and two on chert. The two technical pieces are *débordant* flakes both made on fine-grained flint (Figure 143d). Formal tool types include several types of scrapers, i.e. single scrapers, double scrapers with inverse, steep retouch (Figure 144e) and two endscrapers (Figure 144a), one of which is a carinated endscraper made on a large and thick (71x50x24mm) coarse-grained flint flake (Figure 144f). Of relatively similar size is the limace (78x39x30mm) which is made on a fine-grained flint flake and its surfaces are heavily weathered (Figure 144g). There are also two denticulates, one of which is made on a Janus flake (35x30x15mm). The larger one (91x62x25) is made on a flake which exhibits surface alterations due to frost on its ventral face. A fossil inclusion is also evident on the particular surface (Figure 142b). Two becs, two burins and several retouched flakes and laminar flakes complete the assemblage. One of the becs is made on a Janus flake measuring 61x36xx9mm. The burins are a single burin made on a chert flake (45x49x14mm) and a dihedral burin made on a fine-grained flint flake with a dihedral platform.

An early Upper Palaeolithic component might also be hidden in the assemblage from Makrychorafo 1 due to the presence of particular Upper Palaeolithic tool types, such as the carinated endscrapers (Figure 144f-g) and burins.

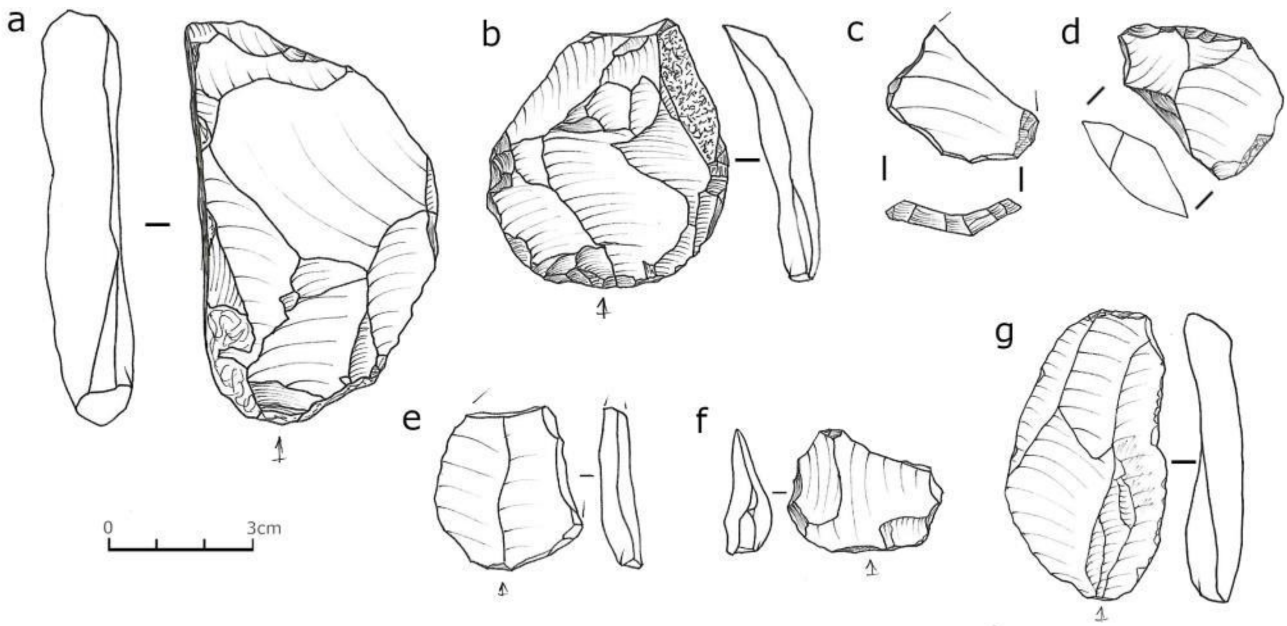


Figure 143: Flakes (a-c, e-f), a laminar flake (g) and a débordant flake (d) from Makrychorafo **1.**

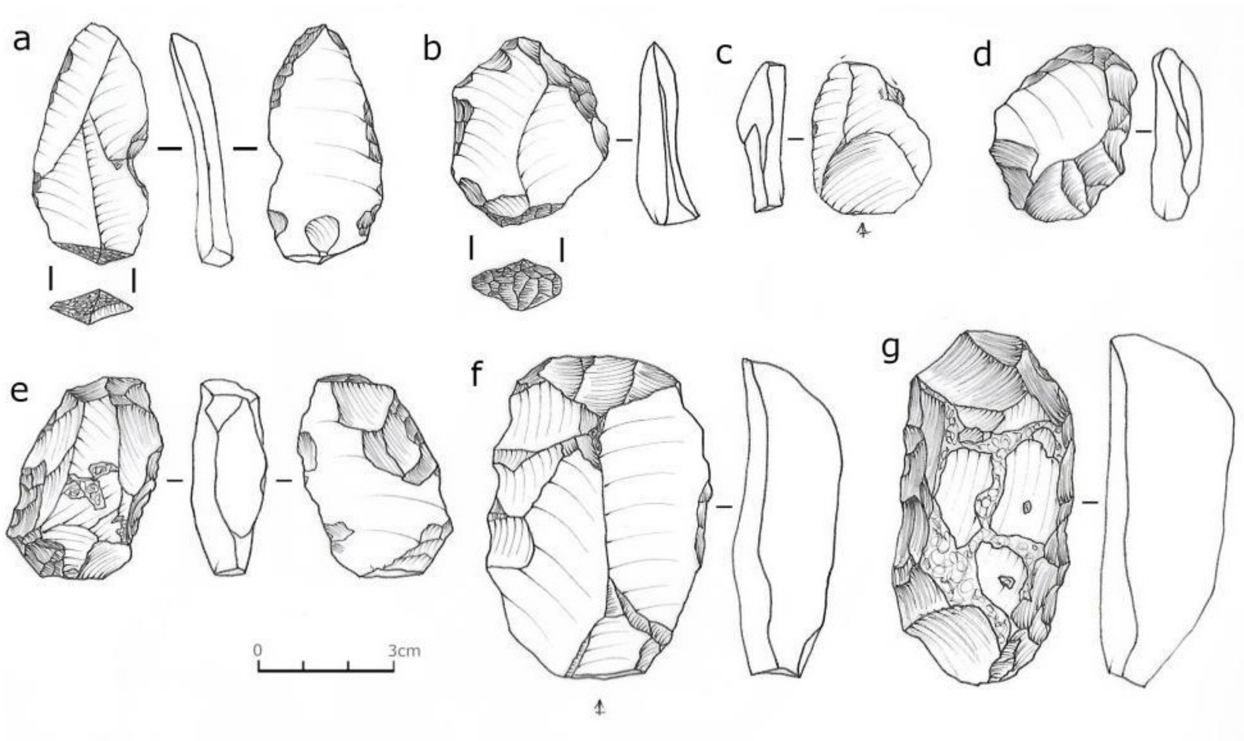
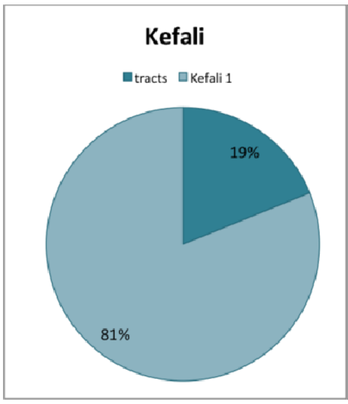
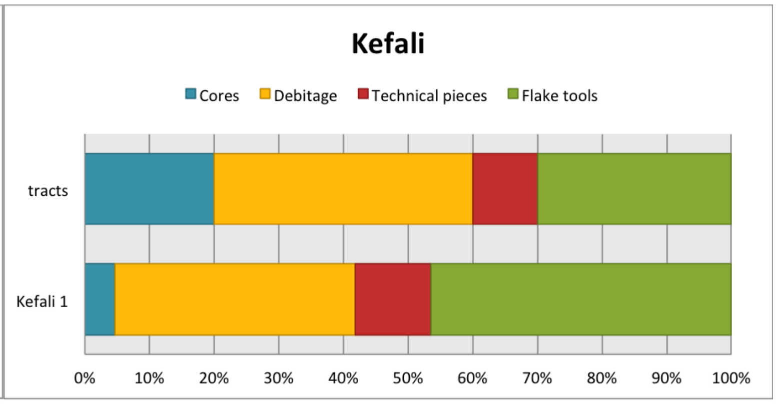


Figure 144: Flake tools from Makrychorafo 1.

4.5.1.4.7. Kefali (N=53)

Kefali is one of the areas on Meganissi where lithic artefacts of different chronological periods are present in relatively high concentrations. Good visibility due to the plateau with the red soil was certainly one of the aspects for the collection of a significant number of diagnostic artefacts. Most of the artefacts were collected as part of Kefali 1 site (Graph 97). The ratio of the debitage and technical pieces between Kefali 1 and Kefali tracts is relatively similar, while cores comprise a larger percentage of the tracts' assemblage and diagnostic flake tools comprise a largest percentage of the Kefali 1 assemblage (Graph 98). The interesting aspect of the finds from Kefali is the presence of typical Levallois cores and products, plus characteristic tool types, e.g. Quina scraper. Almost 85% of the artefacts are made on fine-grained flint, yet a 9,4% is made on coarse-grained flint and 5,7% on chert (Table 54).





Graph 97: Percentage of the Pleistocene finds collected from Kefali 1 and as tract finds.
Graph 98: Artefact categories percentages from Kefali 1 and Kefali tracts.

Table 54: Kefali assemblage structure

Kefali		**Fine-grained flint**		**Coarse-grained flint**		**Chert**		**Total**	
		N	%	N	%	N	%	N	%
Debitage	flake	11	24,4	1	20	0	0	12	22,6
	laminar flake	1	2,2	0	0	0	0	1	1,9
	Levallois flake	4	8,9	0	0	1	33,3	5	9,4
	Levallois laminar flake	1	2,2	0	0	0	0	1	1,9
	janus flake	1	2,2	0	0	0	0	1	1,9
Technical pieces	*débordant* flake	4	8,9	1	20	0	0	5	9,4
	core tablet	1	2,2	0	0	0	0	1	1,9
Cores	flake core	2	4,4	2	40	0	0	4	7,5
Flake tools	naturally-backed knife	1	2,2	0	0	0	0	1	1,9
	notch	1	2,2	0	0	0	0	1	1,9
	retouched flake	8	17,8	0	0	1	33,3	9	17,0
	scraper	9	20	0	0	0	0	9	17,0
	bifacially worked piece	0	0	1	20	0	0	1	1,9
	cleaver	1	2,2	0	0	0	0	1	1,9
	heavy-duty scraper	0	0	0	0	1	33,3	1	1,9
Total		45	100	5	100	3	100	53	100
Total (%)		84,9		9,4		5,7		100	

4.5.1.4.7.1. Kefali tracts (N=10)

A total of 10 artefacts were collected as tract finds from Kefali and attributed to the Middle Palaeolithic. These are flakes, an elongated cortical laminar flake (Figure 146a), a core tablet (Figure 145c), two Levallois flake cores and three flake tools. All apart from a core are made of fine-grained flint (Table 55).

Table 55: Kefali tracts assemblage structure

Kefali tracts		Fine-grained flint		Coarse-grained flint		Total	
		N	%	N	%	N	%
Debitage	flake	3	33,3	0	0	3	30
	laminar flake	1	11,1	0	0	1	10
Technical pieces	core tablet	1	11,1	0	0	1	10
Cores	flake core	1	11,1	1	100	2	20
Flake tools	retouched flake	1	11,1	0	0	1	10
	scraper	2	22,2	0	0	2	20
Total		9	100	1	100	10	100
Total (%)		90		10		100	

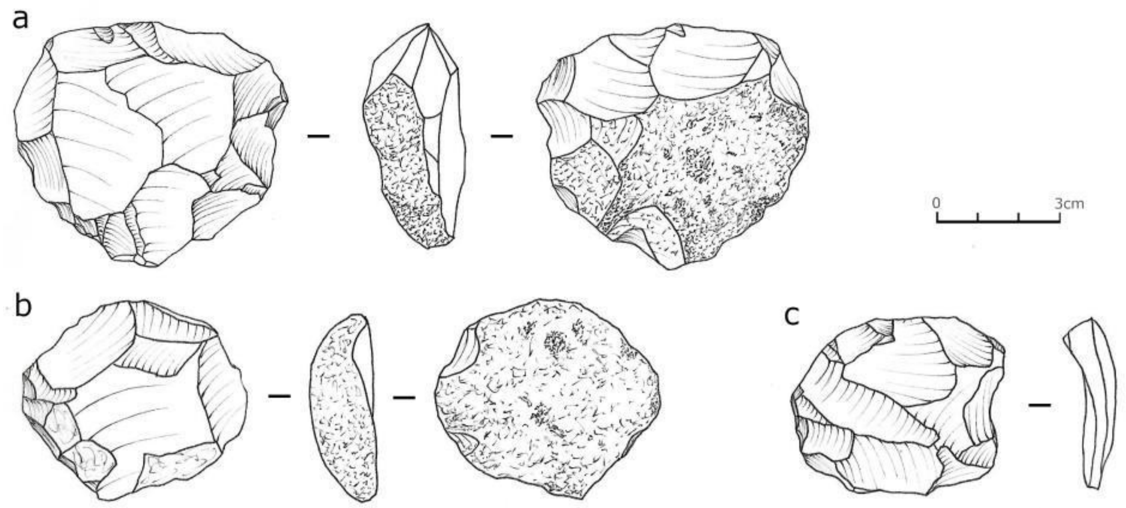


Figure 145: Levallois cores (a-b) and core tablet/overshot Levallois flake (c) from Kefali tracts.

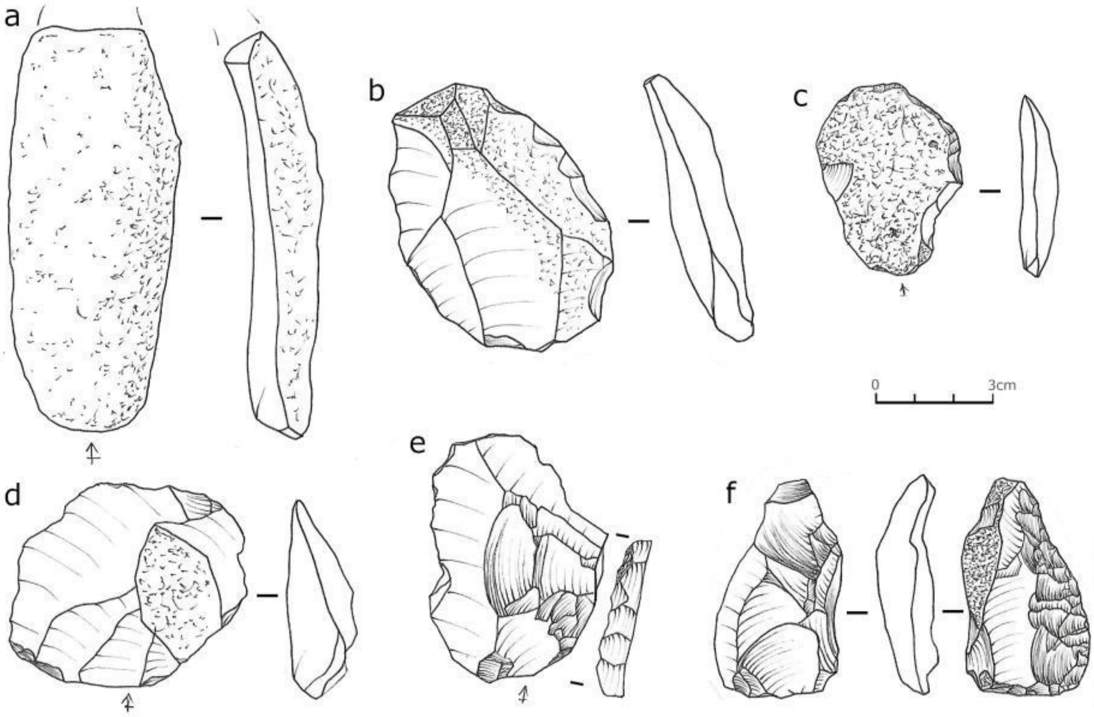


Figure 146: Flakes (a-b, d), a débordant flake (e) and flake tools (c, f) from Kefali tracts.

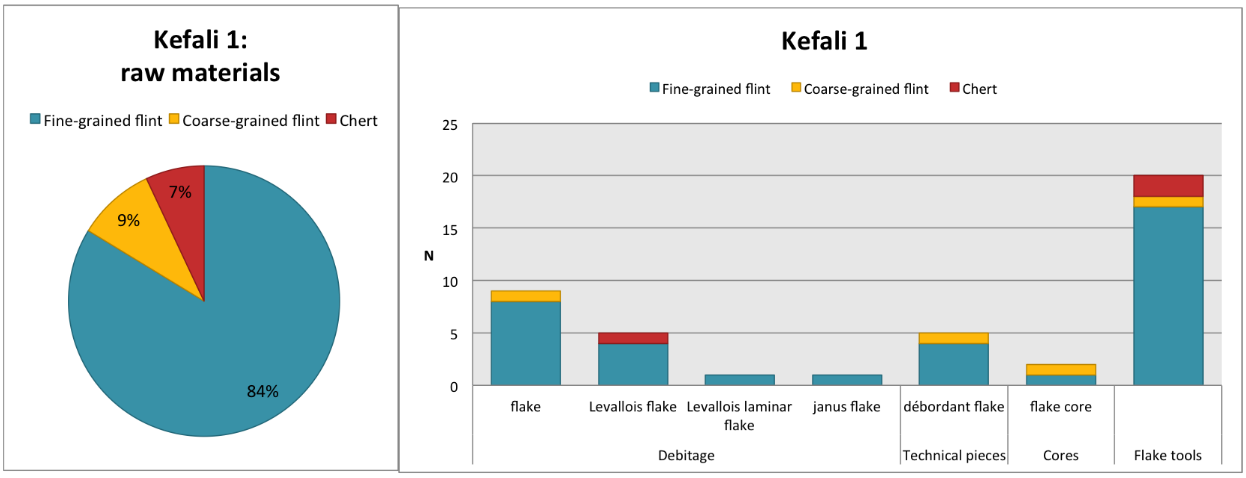
The flake core made on coarse-grained flint is a recurrent Levallois core preserving 25% of its cortex and measuring 61x68x26mm (Figure 145a). The second core is a lineal Levallois core preserving 50% of its cortex and measuring 46x53x16mm (Figure 145b). The tool repertoire includes a Quina scraper measuring 57x32x14mm (Figure 146f), a single scraper made on a cortical flake with a dihedral butt and a broken retouched flake made on a *débordant* flake with a facetted platform (445/1).

4.5.1.4.7.2. Kefali 1 (N=43)

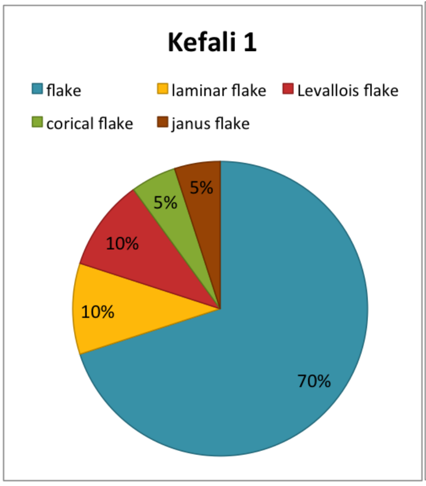
Similar to the tract finds from Kefali, the lithic assemblage from Kefali 1 includes particularly diagnostic Middle Palaeolithic artefacts and a significant Levallois aspect, i.e. five Levallois flakes (Figure 147a-b, d), one of which is made on chert (Figure 147c) and a Levallois laminar flake (Figure 147e). Two more Levallois flakes have been further retouched (e.g. Figure 147f). Most of the artefacts from Kefali 1 are made on fine-grained flint (83,7%), yet a significant percentage is made on coarse-grained flint (9,3%) and chert (7%) (Table 56; Graph 99).

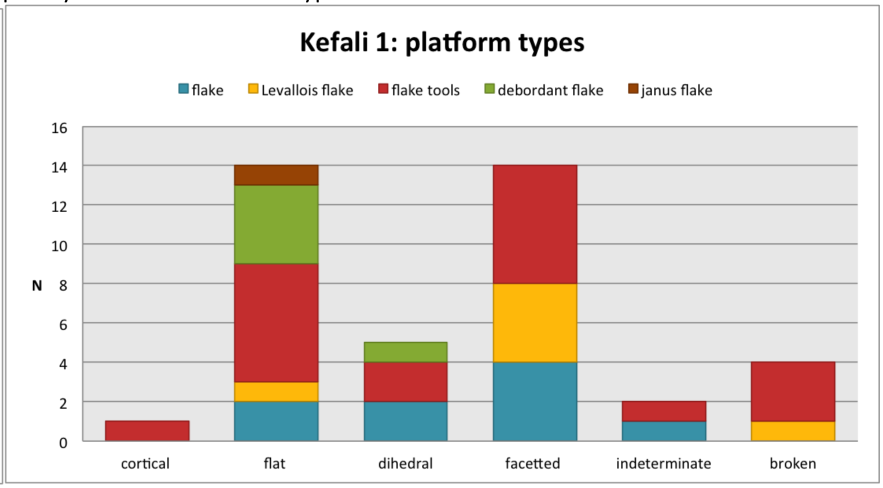
Table 56: Kefali 1 assembage structure

Kefali 1		**Fine-grained flint**		**Coarse-grained flint**		**Chert**		**Total**	
		N	%	N	%	N	%	N	%
Debitage	flake	8	22,2	1	25	0	0	9	20,9
	Levallois flake	4	11,1	0	0	1	33,3	5	11,6
	Levallois laminar flake	1	2,8	0	0	0	0	1	2,3
	janus flake	1	2,8	0	0	0	0	1	2,3
Technical pieces	*débordant* flake	4	11,1	1	25	0	0	5	11,6
Cores	flake core	1	2,8	1	25	0	0	2	4,7
Flake tools	naturally-backed knife	1	2,8	0	0	0	0	1	2,3
	notch	1	2,8	0	0	0	0	1	2,3
	retouched flake	7	19,4	0	0	1	33,3	8	18,6
	scraper	7	19,4	0	0	0	0	7	16,3
	bifacially worked piece	0	0	1	25	0	0	1	2,3
	cleaver	1	2,8	0	0	0	0	1	2,3
	heavy-duty scraper	0	0	0	0	1	33,3	1	2,3
Total		36	100	4	100	3	100	43	100
Total (%)		83,7		9,3		7		100	



Graph 99a-b: Percentage and frequency of the raw material types used at Kefali 1





Graph 100 (left): Percentage of blank types used for retouched tools at Kefali 1
Graph 101 (right): Frequency of the different platform types on the debitage, technical pieces and flake tools from Kefali 1.

The two flake cores are a discoid core made on coarse-grained flint, measuring 48x49x24mm (Figure 147k) and a small bipolar parallel core measuring 39x39x18mm (Figure 147j). Apart from the discoid core, five *débordant* flakes testify the discoid lithic production at the site (Figure 147g-i). Most of the flake tools are made on plain flakes (70%), while there are also a few laminar, Levallois, cortical and Janus flakes further retouched into tools (Graph 100). Platforms on both modified and unmodified flakes are mainly facetted, followed by flat and dihedral ones (Graph 101).

In terms of formal tool types, these are mainly scrapers (Figure 148a-c, f), one of which is made on a Janus flake (Figure 148g). There is also a naturally backed knife (Figure 148d), a notch, a tip of a bifacial leafpoint made on coarse-grained flint (Figure 148e), a cleaver (84x79x21mm) and a heavy-duty scraper made on chert (88x101x40mm) (Figure 149).

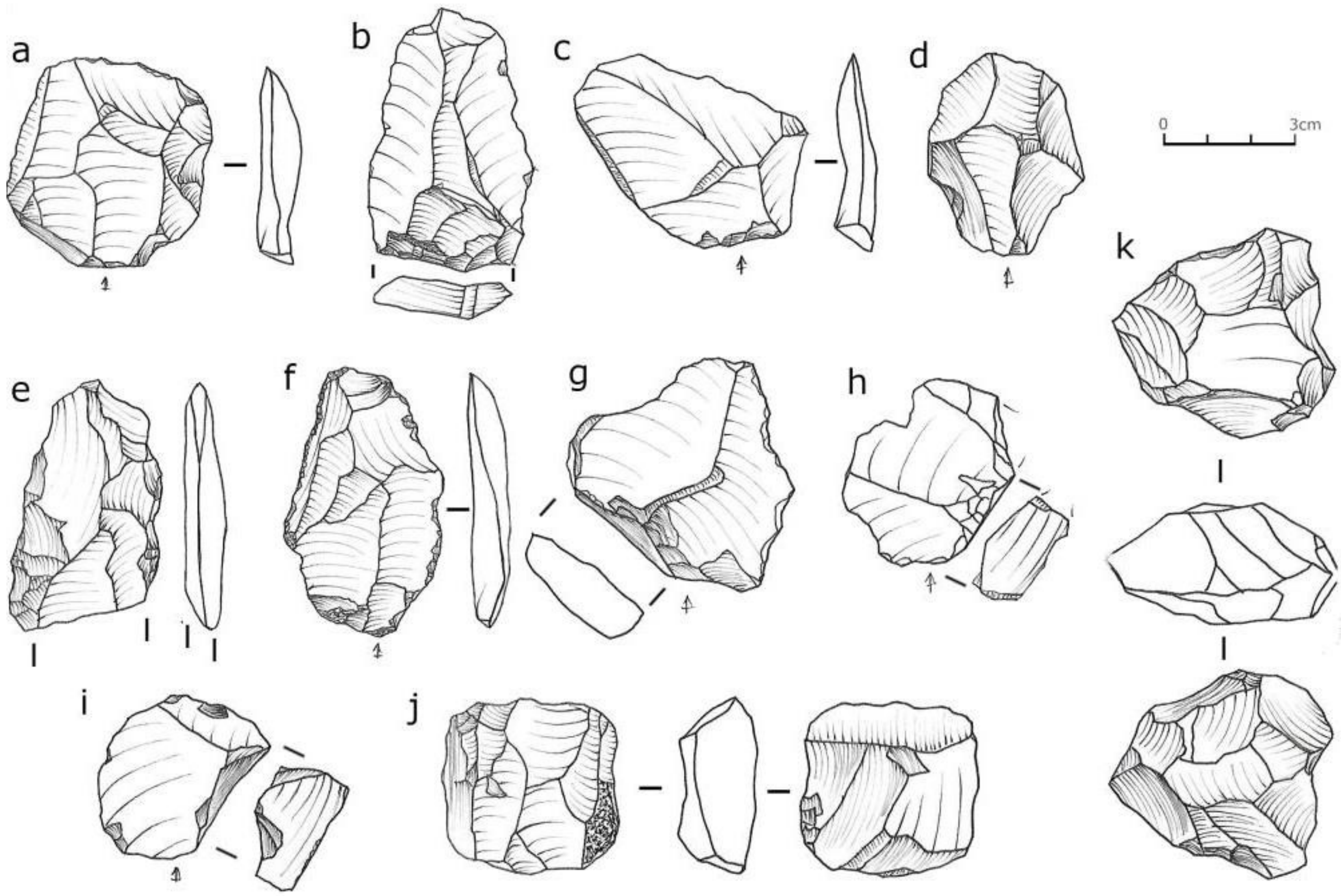


Figure 147: Levallois flakes (a-f), *débordant* flakes (g-i) and flake cores (j-k) from Kefali 1.

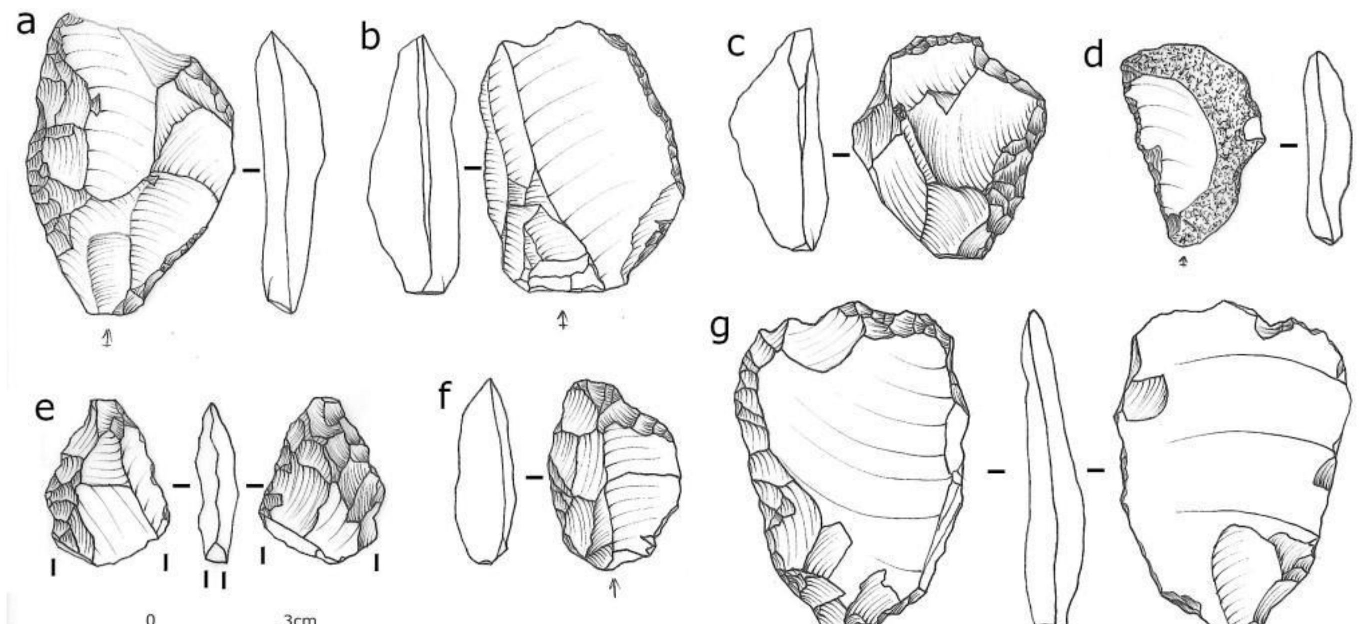
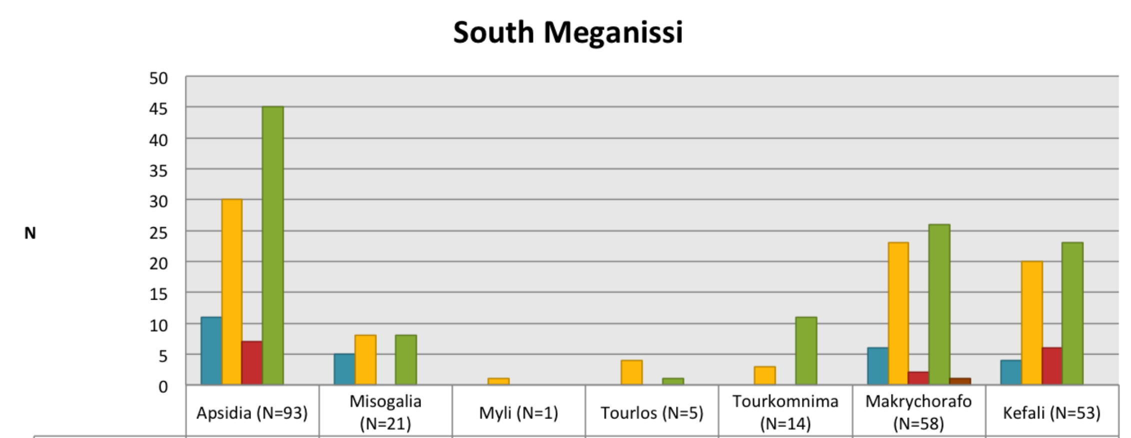


Figure 148: Flake tools from Kefali 1

Figure 149: Cleaver and heavy-duty scraper from Kefali 1 (photos: C. Papoulia).

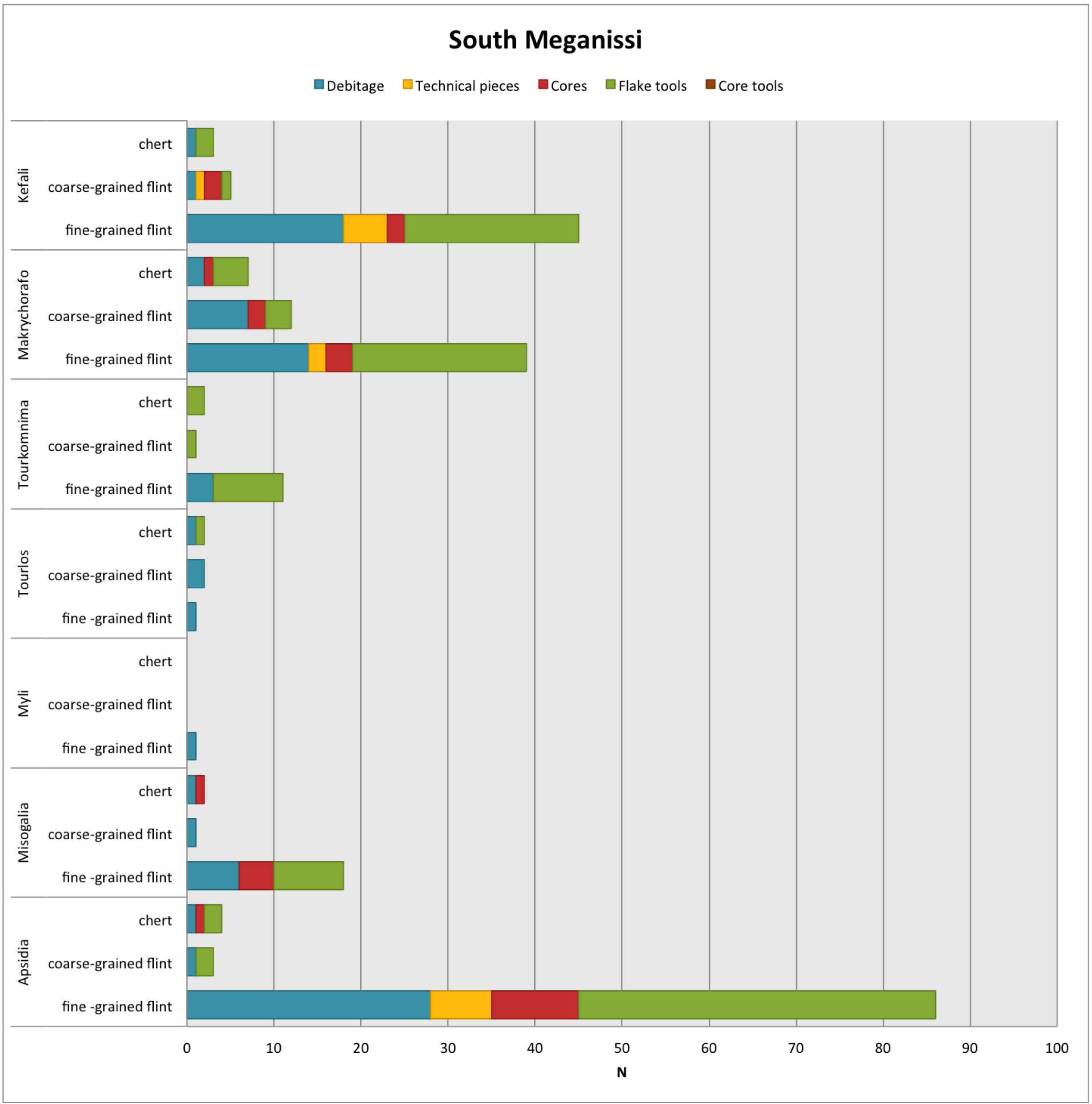
4.5.1.4.8. Discussion

The south part of Meganissi is scattered by sites and findspots rich in diagnostic Middle Palaeolithic artefacts. The largest assemblage comes from Apsidia (Graph 102). Makrychorafo yielded a significant amount of lithics, with a possible Aurignacian element, and the red-soil plateau of Kefali, initially accessed only by sea (2010), yielded some diagnostic Levallois cores and scrapers with Quina-type retouch. In terms of raw materials, there is a significant preference in the use of fine-grained flint for all artefact categories, a fact mainly demonstrated at Apsidia (Graph 103-Graph 104). The majority of the artefacts do not retain any cortex (76%) (Graph 105), yet there are a few cores, flakes and flake tools preserving a 25-50% of their cortex (Graph 106). Plain flakes (61%), Levallois (19%) and laminar flakes (16%) are the main blank types used for retouch, with the technical pieces comprising 4% of the flake tools (Graph 107). The majority of platforms are prepared, mainly facetted but also dihedral, and the flakes and flake tools exhibit a variety of butt types (Graph 108).

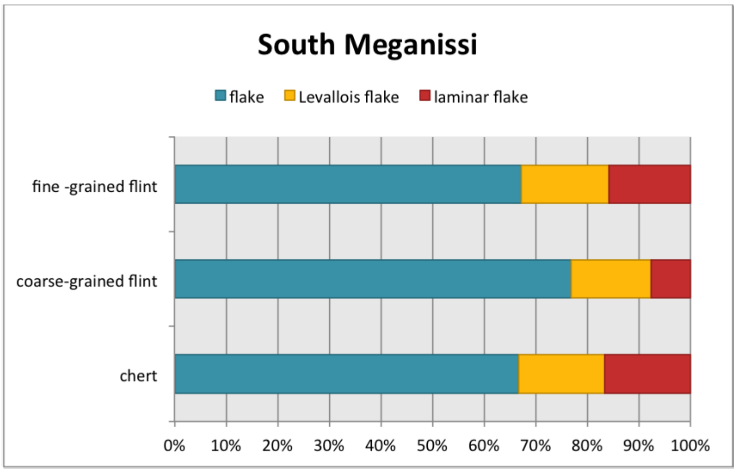


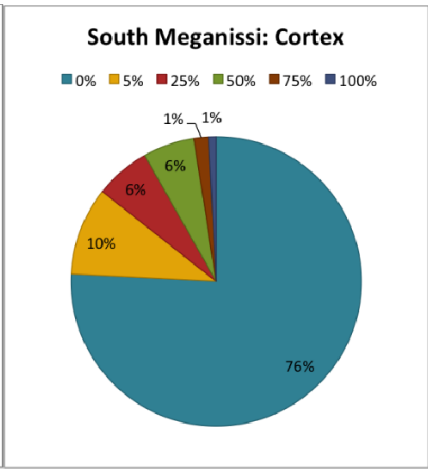
	Apsidia (N=93)	Misogalia (N=21)	Myli (N=1)	Tourlos (N=5)	Tourkomnima (N=14)	Makrychorafo (N=58)	Kefali (N=53)
Cores	11	5	0	0	0	6	4
Debitage	30	8	1	4	3	23	20
Technical pieces	7	0	0	0	0	2	6
Flake tools	45	8	0	1	11	26	23
Core tools	0	0	0	0	0	1	0

Graph 102: Frequency of the artefact categories found at the seven regions of South Meganissi.



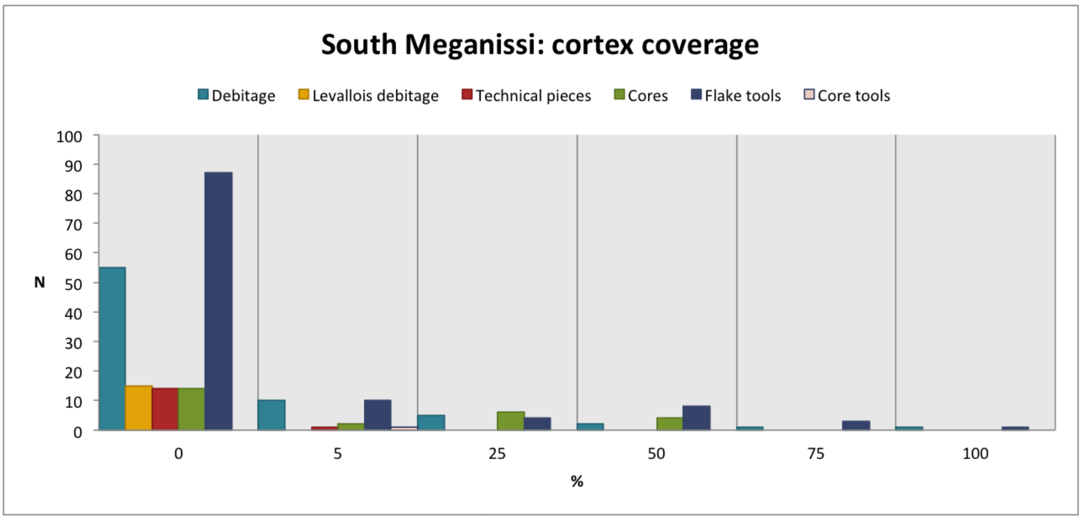
Graph 103: Frequency of the raw material types used for each artefact category at the South Meganissi sites and tracts



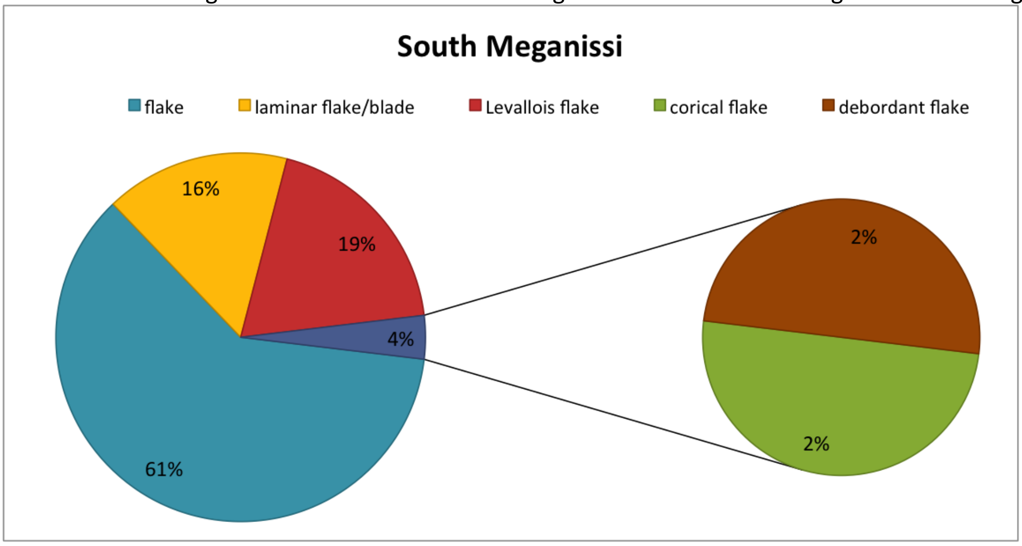


Graph 104 (left): Association of the unmodified flakes, Levallois flakes and laminar flakes with the raw materials used

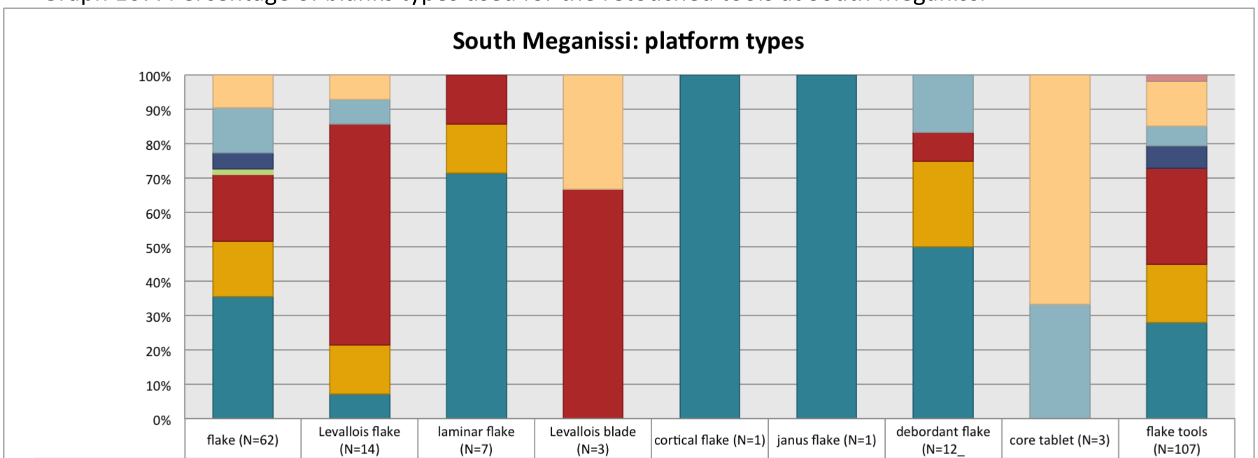
Graph 105 (right): Percentage of cortex coverage on all artefacts from South Meganissi



Graph 106: Cortex coverage on the different artefact categories from the South Meganissi assemblages



Graph 107: Percentage of blanks types used for the retouched tools at South Meganissi



	flake (N=62)	Levallois flake (N=14)	laminar flake (N=7)	Levallois blade (N=3)	cortical flake (N=1)	janus flake (N=1)	debordant flake (N=12_	core tablet (N=3)	flake tools (N=107)
cortical (N=2)	0	0	0	0	0	0	0	0	2
broken/burnt (N=24)	6	1	0	1	0	0	0	2	14
indeterminate (N=18)	8	1	0	0	0	0	2	1	6
retouched (N=10)	3	0	0	0	0	0	0	0	7
soft hammer (N=1)	1	0	0	0	0	0	0	0	0
facetted (N=55)	12	9	1	2	0	0	1	0	30
dihedral (N=34)	10	2	1	0	0	0	3	0	18
flat (N=66)	22	1	5	0	1	1	6	0	30

Graph 108: stacked collumn chart with the different platform types on unmodified and modified blanks from South Meganissi

4.5.2. Kythros (N= 284)

The islet of Kythros is situated off the southern coast of Meganissi, at a close distance from it. Due to the long-term grazing of its land and the several combustions that have occurred, its present landscape with the thick vegetation, mainly the *Phlomis fruticosa* bushes, made it particularly challenging in terms of field walking and visibility (Figure 150).

Figure 150: Thick vegetation, dominated by *Phlomis fruticosa*, at the north part of Kythros looking towards Meganissi (right) and Lefkas (left) (Photo: C. Papoulia, June 2010).

Nevertheless, Kythros proved to be an important place for the study of Middle Palaeolithic occupation at the Inner Ionian Archipelago, with a total of 284 artefacts attributed to the Middle Palaeolithic. More than half (56,7%) of these were collected as tract finds (Graph 109). The rest come from three sites (K2, K3, K4) with the majority of the diagnostic finds (37%) belonging to Kythros 2, a red-soil plateau towards the centre of the island (Figure 151). It is important to note here that Kythros 3 was designated as a site during the 2013 preliminary study of the material and consists of the tract finds collected in 2010 from tracts 111-112 and 122 plus the finds from a test trench excavated in 2011 at the SW part of tract 112.[20] Since the excavated material comprise an independent study, only the tract finds are included in the present analysis of the material from Kythros 3.[21] Kythros 4 was designated as a site due to the presence, in tract 154, of a semi-circular structure (3x3m), which was also excavated but yielded no finds. It should also be noted that Kythros 1, a Pleistocene site on the north coast of the island, was identified as a site during the 2010 survey because

[20] A 2x2 text trench was excavated to a maximum depth of 1,50m. A sample for OSL analysis was also collected.

[21] According to the preliminary analysis of the excavated material, the majority of the artefacts coming from the test trench are smaller in size than the ones encountered on the surface and on the upper, layers of the trench. In technological and typological terms, and with only a handful of exceptions coming from the upper layers, the majority is part of a later component of the site. The assemblage from the test trench includes a single specimen made on obsidian and three pottery fragments measuring less than 1x1cm.

of the discovery of fossil mammalian skeletal remains and lithic artefacts embedded within the sediments in front of a small rockshelter. Due to the particular nature of the site, i.e. the fact that both artefacts and fossils, together with limestone and chert clasts, are contained within the brecciated red clay deposit with calcitic matrix (Sakellariou and Galanidou, 2017, p. 349), no artefact could be collected during the survey. Kythros 1 is being excavated by the University of Crete, since 2015, as part of a separate project (Galanidou, 2018). While a full dating program is underway, the preliminary results have yielded two dates that place the upper units of the collapsed cave at about 200ka, that is at the margins between the end of the Middle Pleistocene and the beginning of the Late Pleistocene, (Sakellariou and Galanidou, 2017, p. 349).

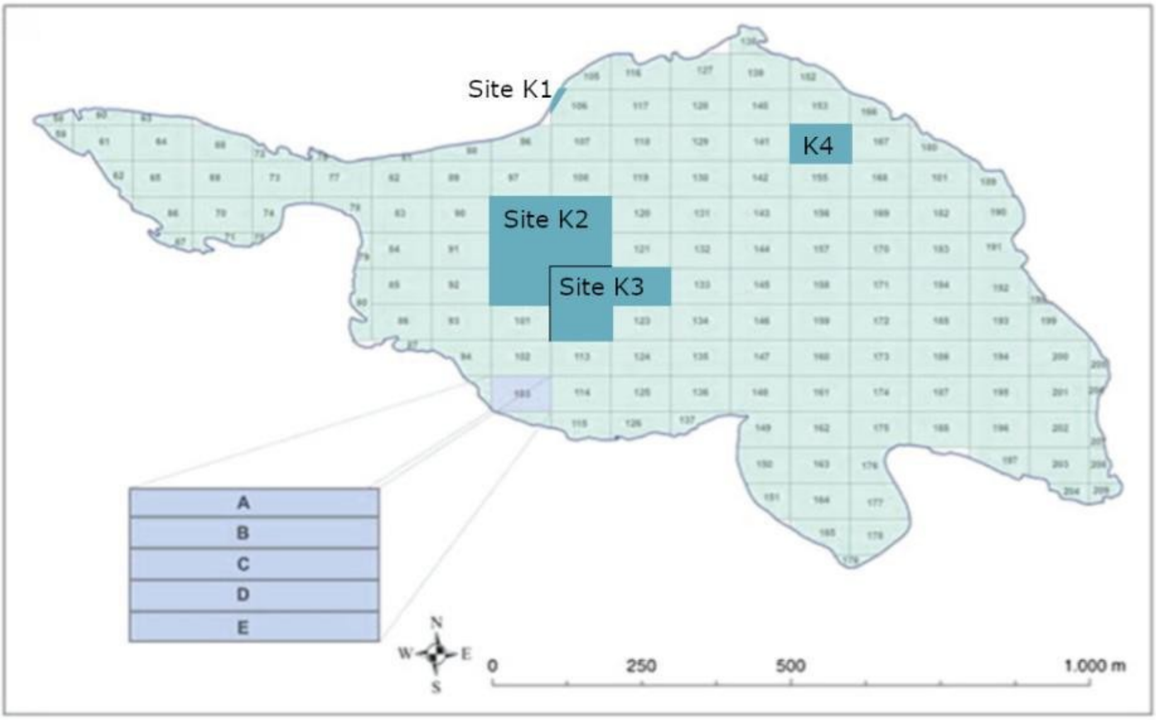
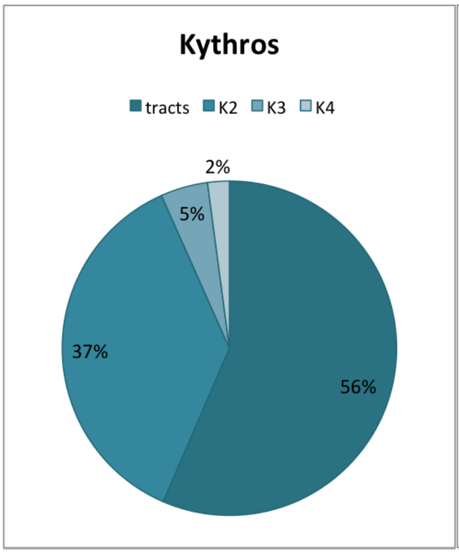
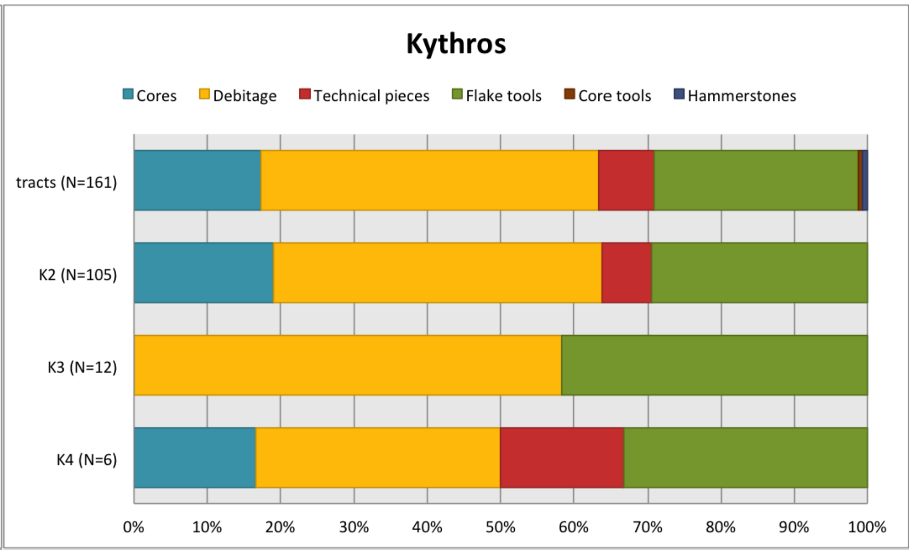


Figure 151: Kythros map with the four sites (K1, K2, K3, K4) annotated (modified after Galanidou, 2015, fig. 14.4a).

Kythros 2 and the assemblage from the tracts are of the same structure, with the latter including a core tool and a hammerstone (Graph 110). Debitage (45.8%) and flake tools (29.2%) are the most diagnostic artefacts followed by cores (17.3%) and technical pieces (7%) (Table 57).



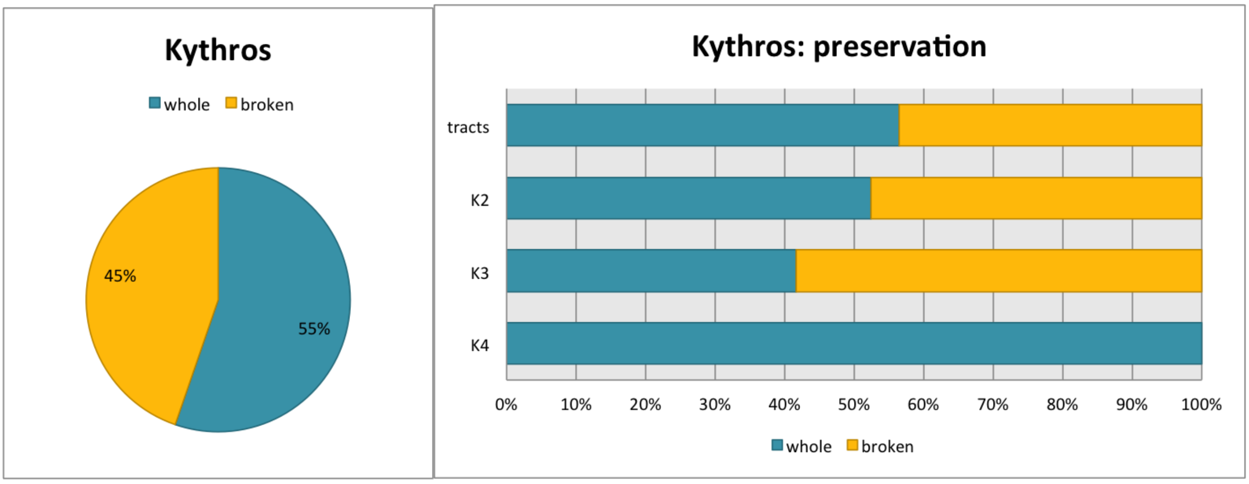


Graph 109 (left): Percentage of the Pleistocene lithics collected form Kythros tracts and sites (K2, K3, K4)
Graph 110 (right): Assemblage structure at Kythros tracts and sites (K2, K3, K4)

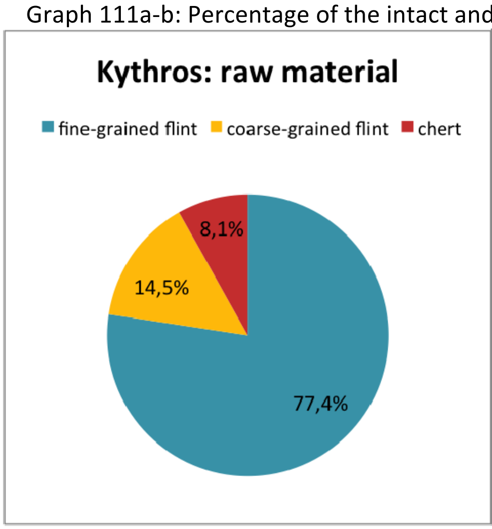
Table 57: Kythros sites and tracts inventory

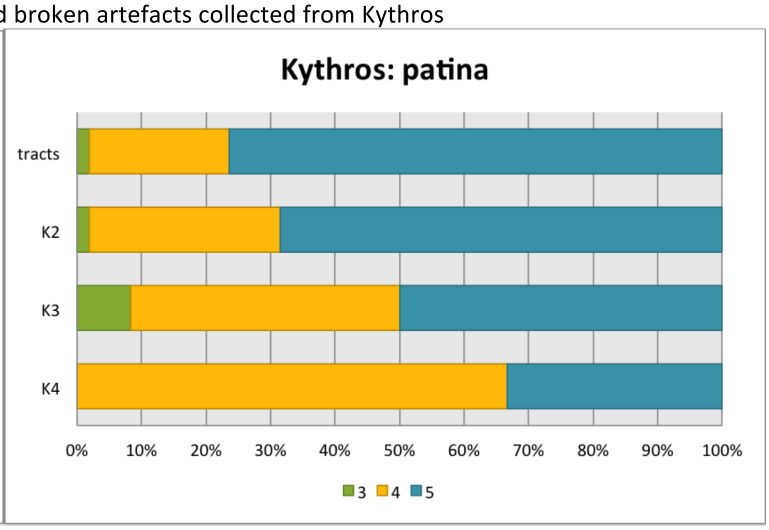
Kythros	**Cores**		**Debitage**		**Technical pieces**		**Flake tools**		**Core tools**		**Hammerstone**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
K2	20	40,8	47	36,2	7	35	31	37,3	0	0	0	0	105	37
K3	0	0	7	5,4	0	0	5	6	0	0	0	0	12	4,2
K4	1	2	2	1,5	1	5	2	2,4	0	0	0	0	6	2,1
tracts	28	57,1	74	56,9	12	60	45	54,2	1	100	1	100	161	56,7
Total	49	100	130	100	20	100	83	100	1	100	1	100	284	100
Total %	17,3		45,8		7,0		29,2		0,4		0,4		100	

About 43-58% of the artefacts from K2, K3 and the tracts are preserved broken, while all artefacts from K4 are intact (Graph 111). The raw material most frequently used is by far the fine-grained flint (77.4%), followed by coarse-grained flint and chert (Graph 112). The majority of the artefacts, both from the sites and tracts, exhibit high degrees (4-5) of patina (Graph 113), yet the surface alterations on the ones from the tracts and K2 are significantly heavier with about 69-76% having the highest degree of patina (5).



Graph 111a-b: Percentage of the intact and broken artefacts collected from Kythros

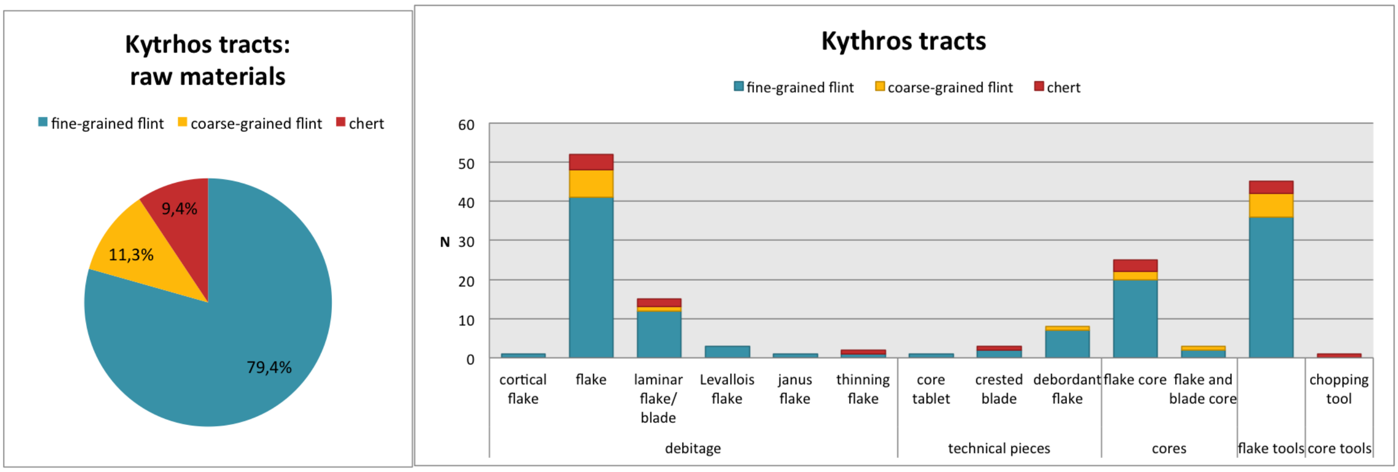




Graph 112 (left): Percentage of raw material types used at Kythros
Graph 113 (right): Percentage of surface alterations due to patina on the assemblages from Kythros tracts and sites

4.5.2.1. *Kythros tracts* (N=161)

The majority of the Middle Palaeolithic artefacts from Kythros (n=161) were collected as tract finds. The fine-grained flint which would be locally available is the main raw material type used (78,9%), followed by coarse-grained flint (11,2%) and chert (9,9%) (Graph 114). The assemblage from the tracts includes Levallois products, all made on fine-grained flint, a variety of flake tools made on all three types of raw materials, as well as a cleaver, a core tool and a hammerstone made on chert (Table 58).



Graph 114a-b: Frequency of raw material types used at the Kythros tracts

Table 58: Assemblage structure at the Kythros tracts assemblage

Kythros tracts		Fine-grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Debitage	cortical flake	1	0,8	0	0	0	0	1	0,6
	flake	41	32,3	7	38,9	4	25	52	32,3
	laminar flake	8	6,3	1	5,6	2	13	11	6,8
	Levallois flake	3	2,4	0	0	0	0	3	1,9
	Levallois blade	4	3,1	0	0	0	0	4	2,5
	janus flake	1	0,8	0	0	0	0	1	0,6
	thinning flake	1	0,8	0	0	1	6	2	1,2
Technical pieces	core tablet	1	0,8	0	0	0	0	1	0,6
	crested blade	2	1,6	0	0	1	6	3	1,9
	débordant flake	7	5,5	1	5,6	0	0	8	5,0
Cores	flake core	20	15,7	2	11,1	3	19	25	15,5
	flake and blade core	2	1,6	1	5,6	0	0	3	1,9
Flake tools	retouched flake	23	18,1	3	16,7	0	0	26	16,1
	scraper	10	7,9	2	11,1	1	6	13	8,1
	bec / piercer / awl	1	0,8	0	0	0	0	1	0,6
	truncated-facetted piece	1	0,8	0	0	0	0	1	0,6
	partial truncation	0	0	1	5,6	0	0	1	0,6
	partially backed knife	1	0,8	0	0	0	0	1	0,6
	burin	0	0	0	0	1	6,3	1	0,6
	cleaver	0	0	0	0	1	6,3	1	0,6
Core tools	chopping tool	0	0	0	0	1	6,3	1	0,6
Hammerstone		0	0	0	0	1	6,3	1	0,6
Total		127	100	18	100	16	100	161	100
Total (%)		78,9		11,2		9,9		100	

Although the Middle Palaeolithic component of Kythros is one of the clearest among the whole survey region, Levallois debitage products are not abundant. However, the most characteristic lineal Levallois core and one of the first found during the initial exploration of the island comes from this island (Figure 152f). It is made on fine-grained flint and exhibits a heavy white patina. A few more Levallois cores are collected as tract finds (Figure 152a-b). The assemblage from the tracts includes a few single platform flake or laminar flake cores, several discoid cores (Figure 153), some cores on flakes (Figure 154a-b), and quite a few *débordant* flakes (Figure 154-f). Of particular interest is the largest core of the assemblage, a prepared core made on a large chert flake (Figure 155). The presence of this core raises questions in terms of an early Middle Palaeolithic occupation of the island, especially when associated with two mores "early-looking" artefacts from Kythros tracts, a cleaver (Figure 156) and a large chopping tool (Figure 157), all made on chert. Such a hypothesis for an early Middle Palaeolithic presence on Kythros is further affirmed by the preliminary reports on the dating results of the collapsed cave at Kythros 1 (Galanidou, 2018).

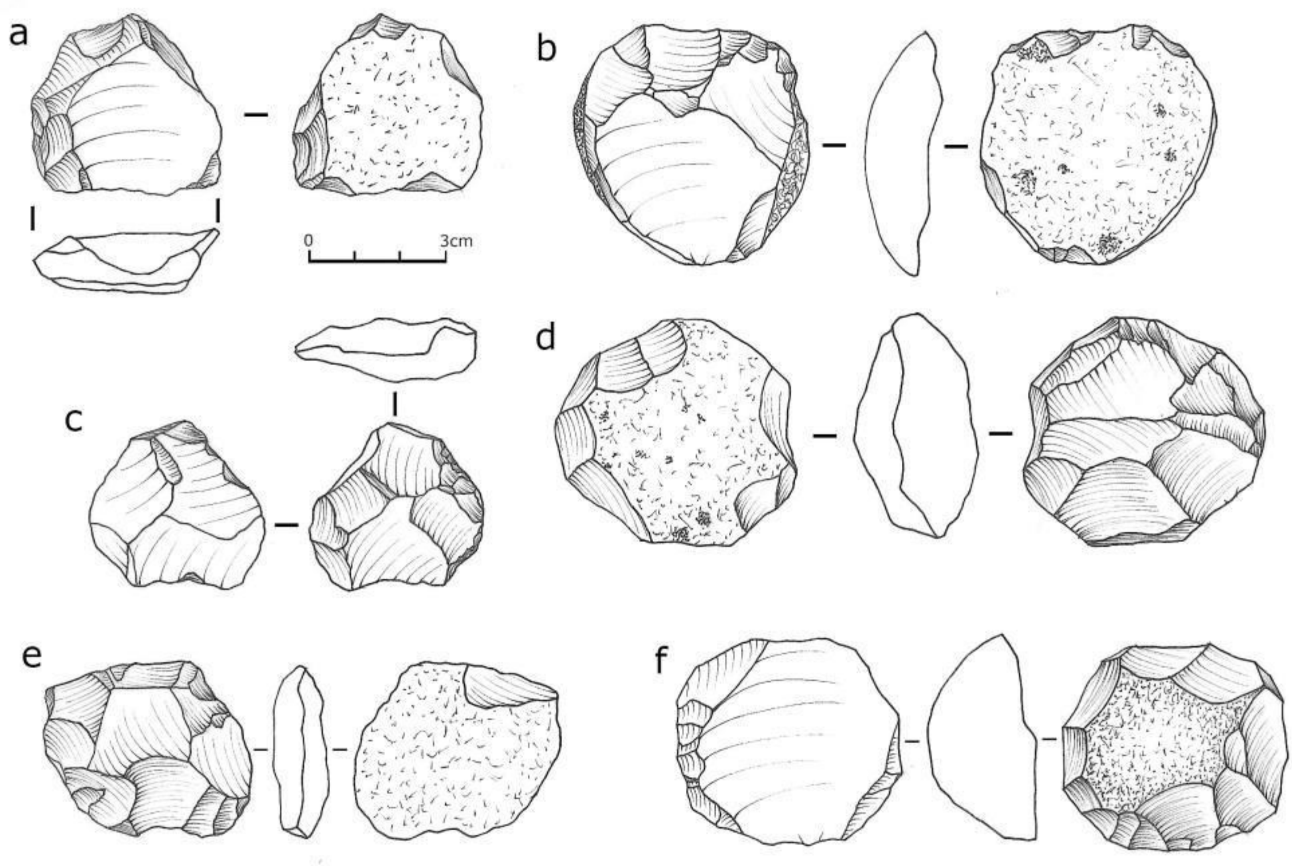


Figure 152: Levallois cores from Kythros tracts

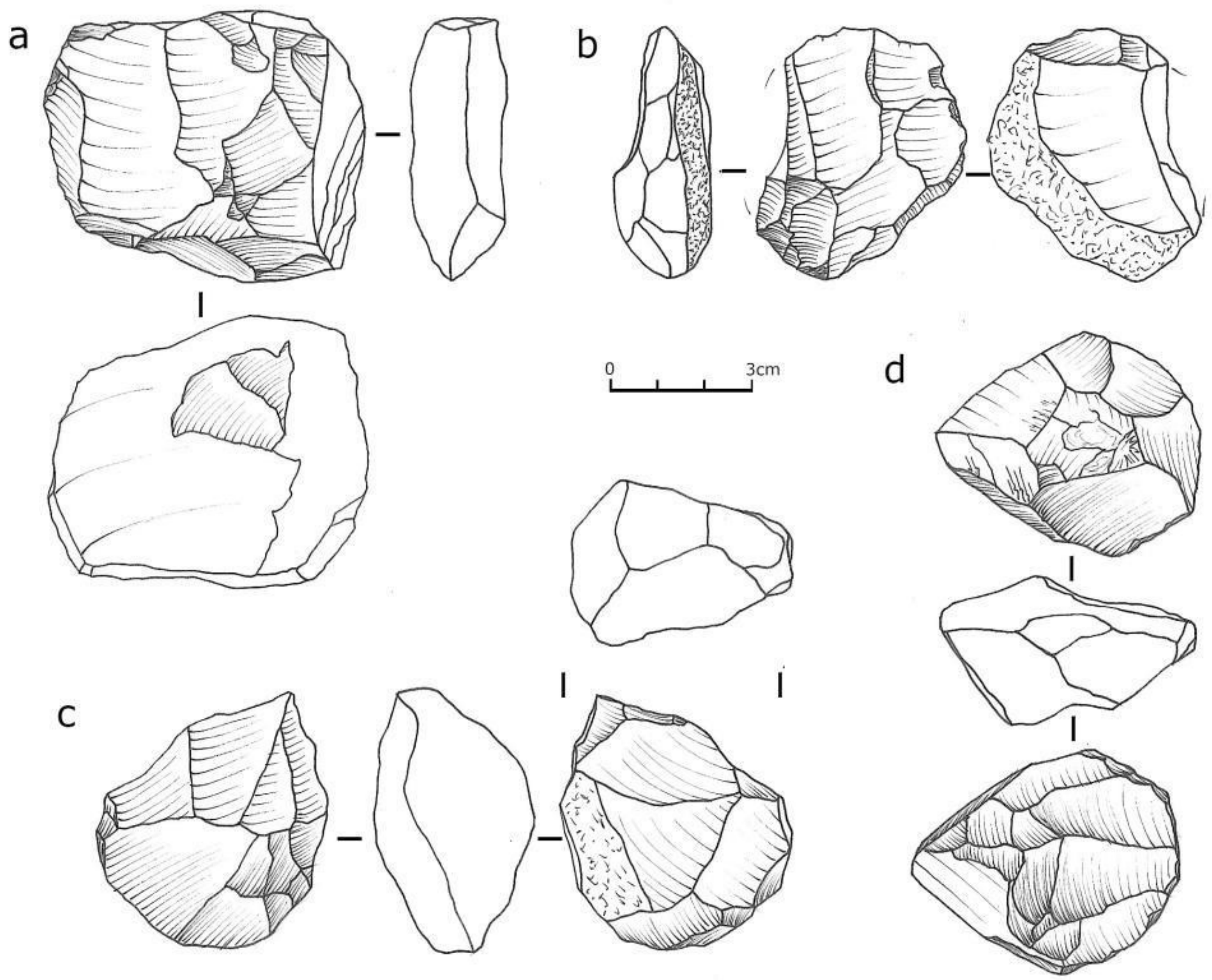


Figure 153: Single platform (a-b) and discoid cores (c-d) from Kythros tracts

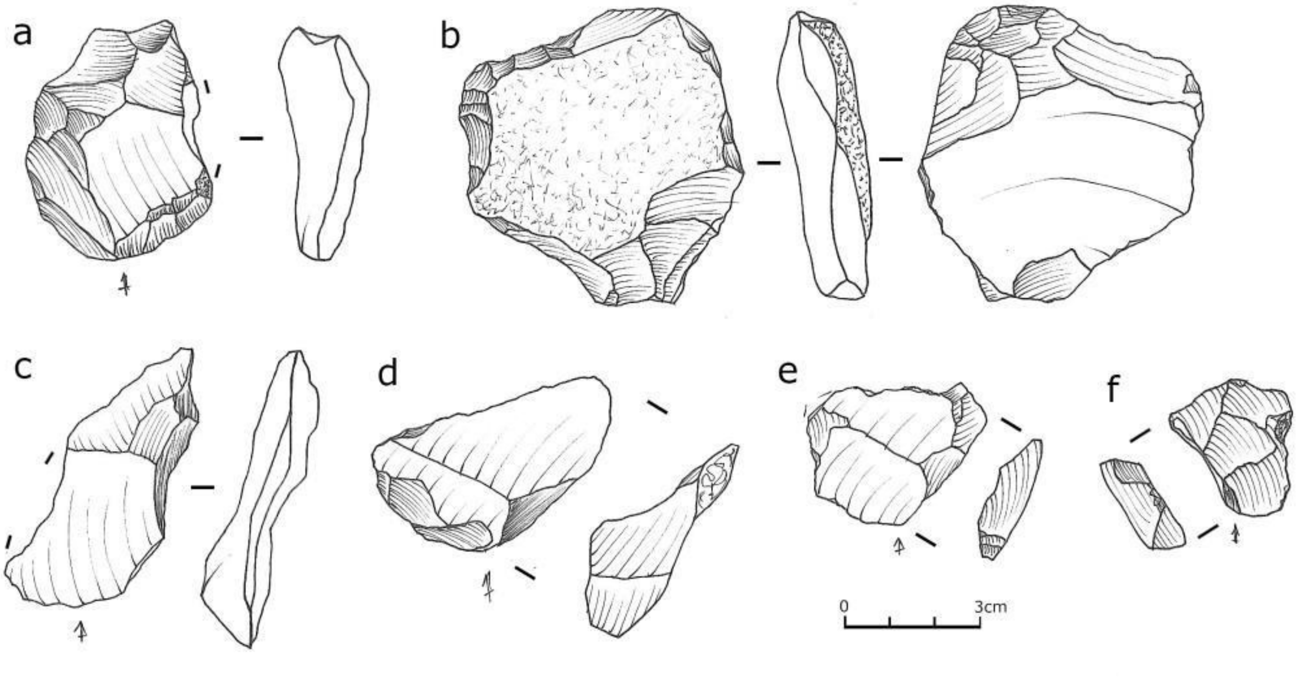


Figure 154: Cores on flakes (a-b) and *débordant* flakes (c-f) from Kythros tracts

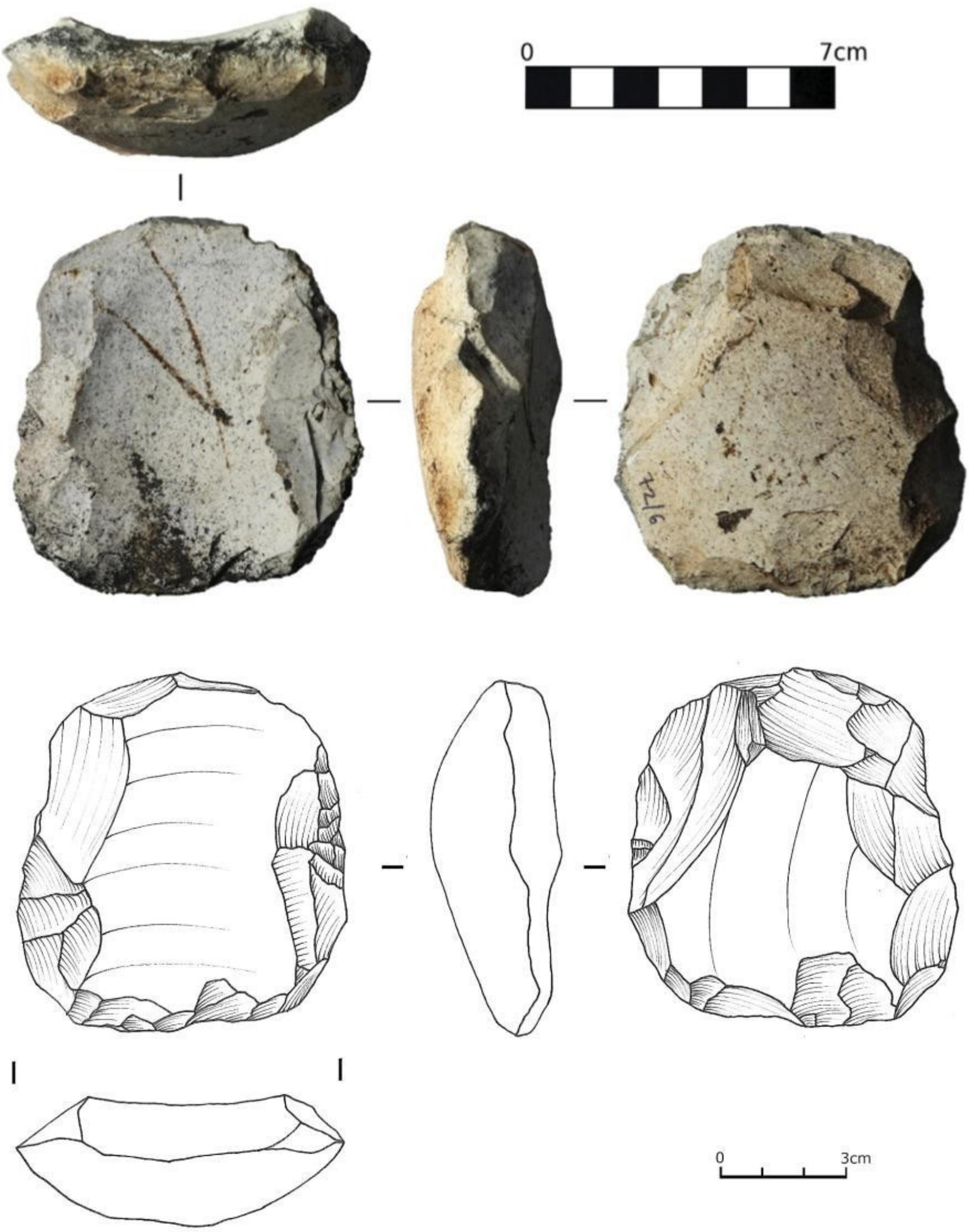


Figure 155: A prepared core made on a large chert flake from Kythros tracts (72/6) (photo: C. Papoulia).

In terms of formal tool types, retouched artefacts are predominantly scrapers, while there is only one example of each other tool type category, i.e. a perforator, a burin, a truncated-facetted piece, a partial truncation and a partially backed knife (Figure 158). Almost half of the retouched artefacts are made on flakes (52.2%), while a significant number is made on Levallois (15.2%) and laminar flakes (17.4%). Other blank types include blades, cortical flakes, technical pieces and raw material nodules (Graph 115). Platforms are mainly flat, followed by dihedral, facetted and retouched (Graph 116).

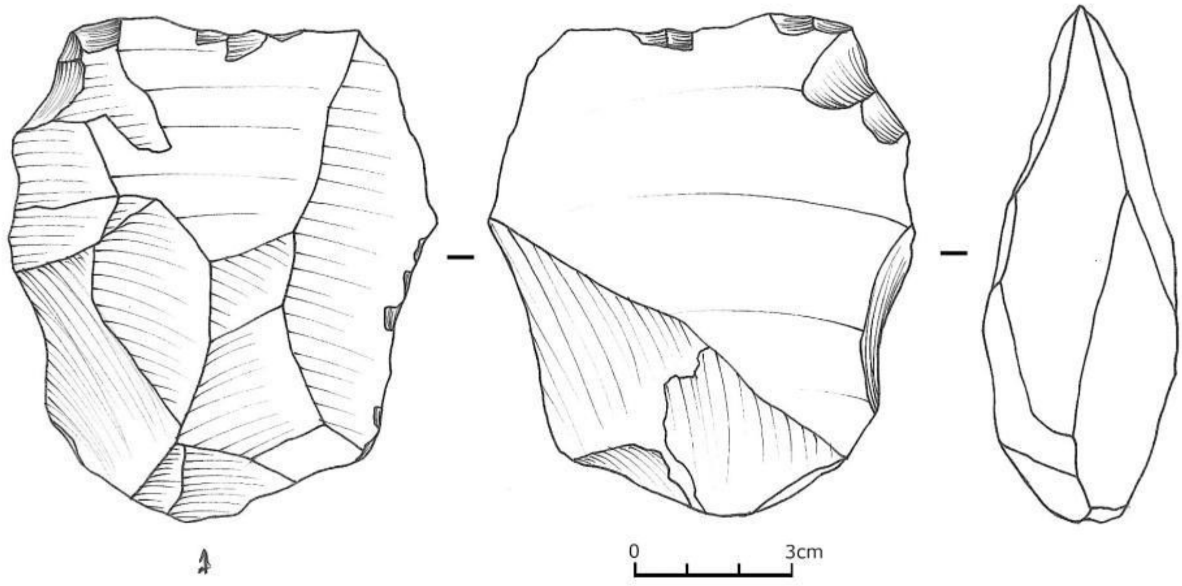


Figure 156: Cleaver made on a chert flake (66E/1) from Kythros tracts.

Figure 157: Large chopping tool made on a chert nodule from Kythros tracts (Photo: C. Papoulia).

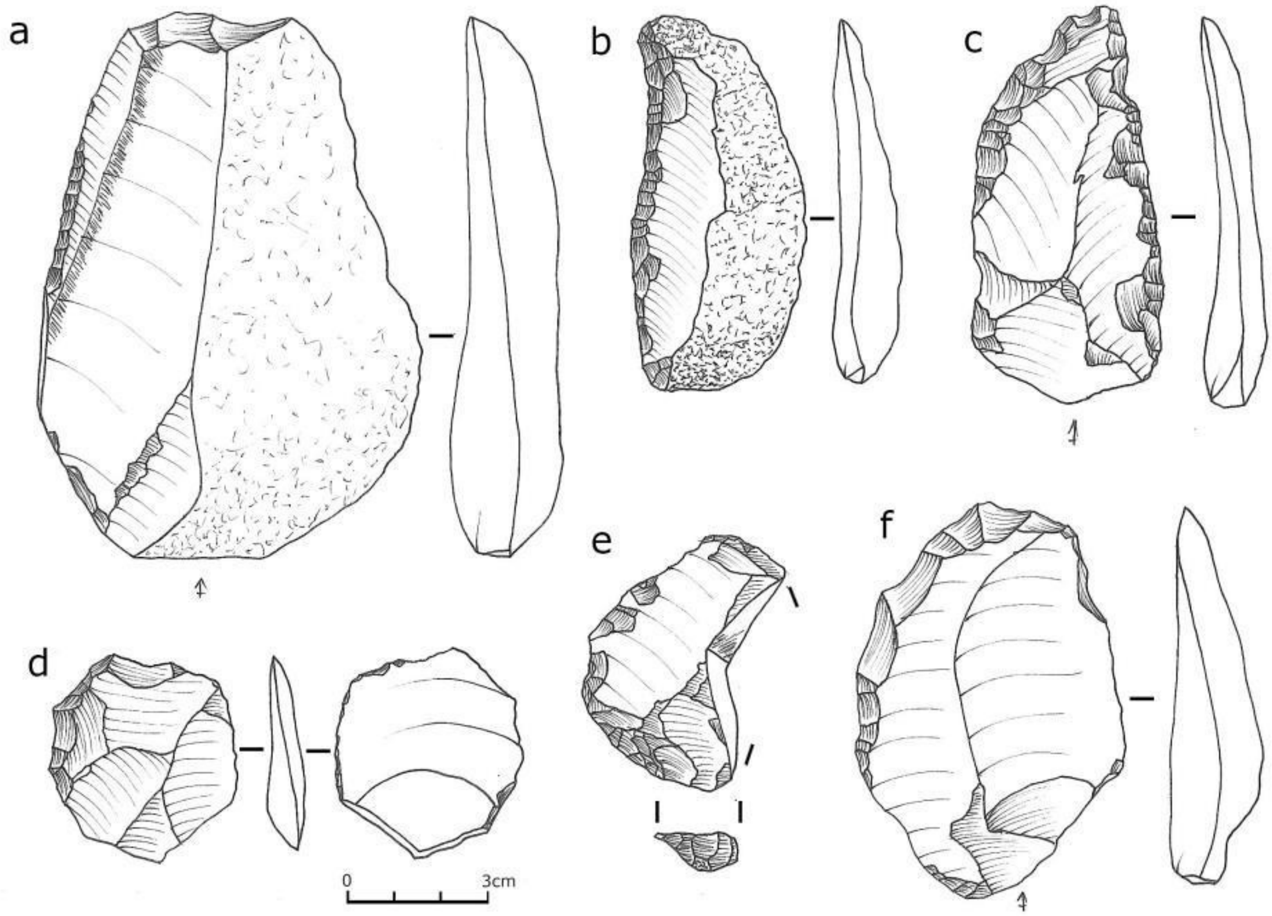
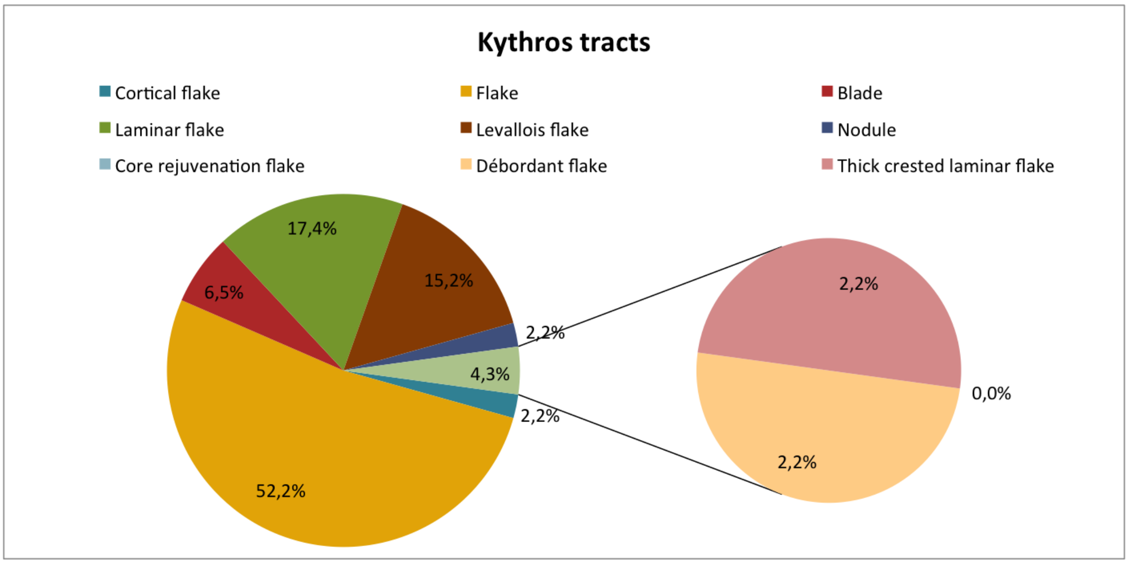
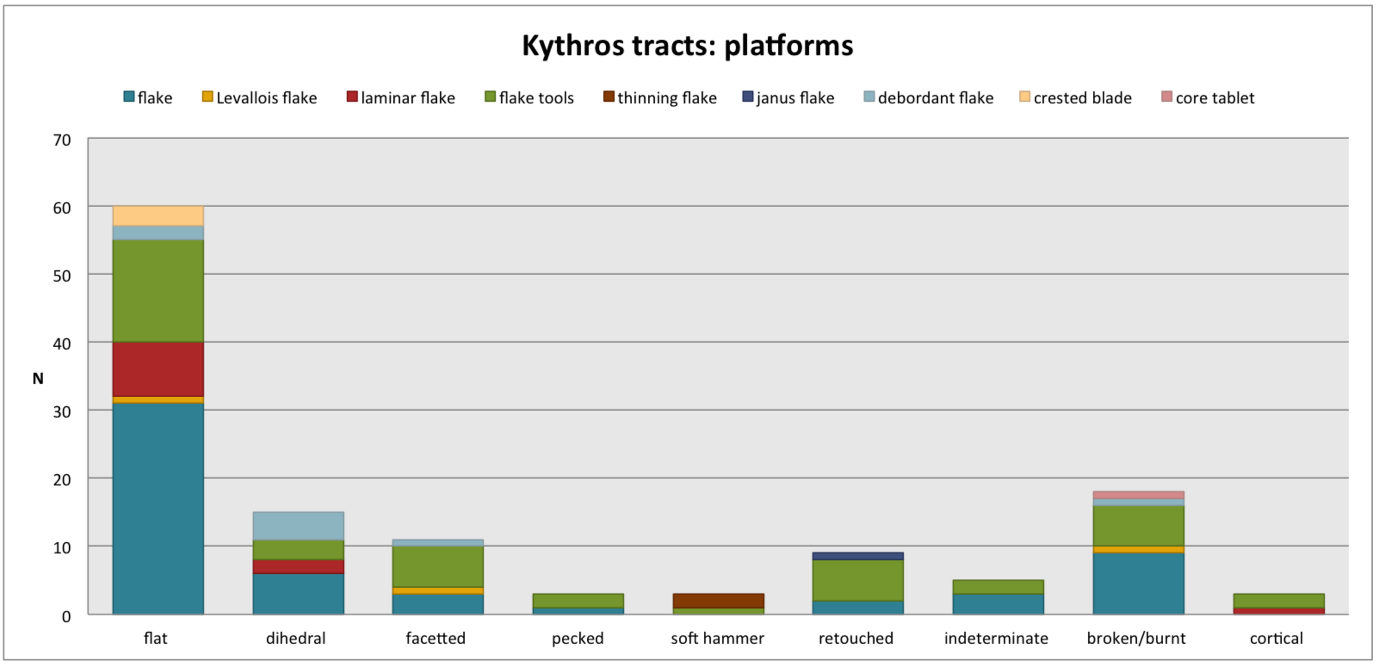


Figure 158: Flake tools from Kythros tracts



Graph 115: Frequency of blank types used at the Kythros tracts.



Graph 116: Frequency of the different platform types on the debitage, technical pieces and flake tools of Kythros tracts

4.5.2.2. *Kythros 2* (N=105)

Kythros 2 yielded the second largest collection of artefacts from the island. The assemblage consists of unmodified pieces, mainly flakes (31,4%) with a significant number of flake cores (19%). The vast majority of artefacts is made on fine-grained flint (76,2%), followed by coarse-grained flint (18,1%), while only six artefacts (5,7%) are made on chert (Table 59, Graph 117). Apart from two lineal Levallois cores, the majority of the flake cores are either discoid or thin discs, one of which can be classified as a Mousterian disc. There are also six single platform cores of which four are made on coarse-grained flint, one on fine-grained flint and one on chert. On the contrary, one out of seven discoid cores is made on coarse-grained flint, while the rest are made on fine-grained flint.

Among the retouched tools, the majority are scrapers and retouched flakes made mostly on flake and laminar flake blanks (Graph 118; Figure 159a, c). There are also a couple of broken bifacially worked pieces made on fine-grained flint fakes of similar dimensions (36x29x13mm and 36x33x9mm), one of which has the characteristic brown patina. Two pointy flakes, one made on coarse-grained flint and the other on fine-grained flint with bilateral, alternate retouch scars, have been classified as (atypical) points. Unmodified and modified *débordant* flakes are also present (Figure 159e-g).

Table 59: Assemblage structure at K2

Kythros 2		**Fine-grained flint**		**Coarse-grained flint**		**Chert**		**Total**	
		N	%	N	%	N	%	N	%
Debitage	cortical flake	1	1,3	0	0	0	0	1	1
	flake	23	28,8	7	36,8	3	50	33	31,4
	laminar flake	3	3,8	0	0	0	0	3	2,9
	Levallois flake	6	7,5	0	0	0	0	6	5,7
	Levallois blade	3	3,8	0	0	0	0	3	2,9
	janus flake	1	1,3	0	0	0	0	1	1
Technical pieces	core tablet	0	0,0	1	5,3	0	0	1	1
	crested blade	2	2,5	0	0	0	0	2	1,9
	débordant flake	3	3,8	1	5,3	0	0	4	3,8
Cores	flake core	13	16,3	6	31,6	1	16,7	20	19
Flake tools	naturally-backed knife	1	1,3	0	0	0	0	1	1
	notch	1	1,3	0	0	0	0	1	1
	point	1	1,3	1	5,3	0	0	2	1,9
	retouched flake	7	8,8	2	10,5	1	16,7	10	9,5
	scraper	9	11,3	1	5,3	1	16,7	11	10,5
	bifacially worked piece	2	2,5	0	0	0	0	2	1,9
	bec / piercer / awl	2	2,5	0	0	0	0	2	1,9
	truncated-facetted piece	1	1,3	0	0	0	0	1	1
	composite tool	1	1,3	0	0	0	0	1	1
Total		80	100	19	100	6	100	105	100
Total (%)		76,2		18,1		5,7		100	

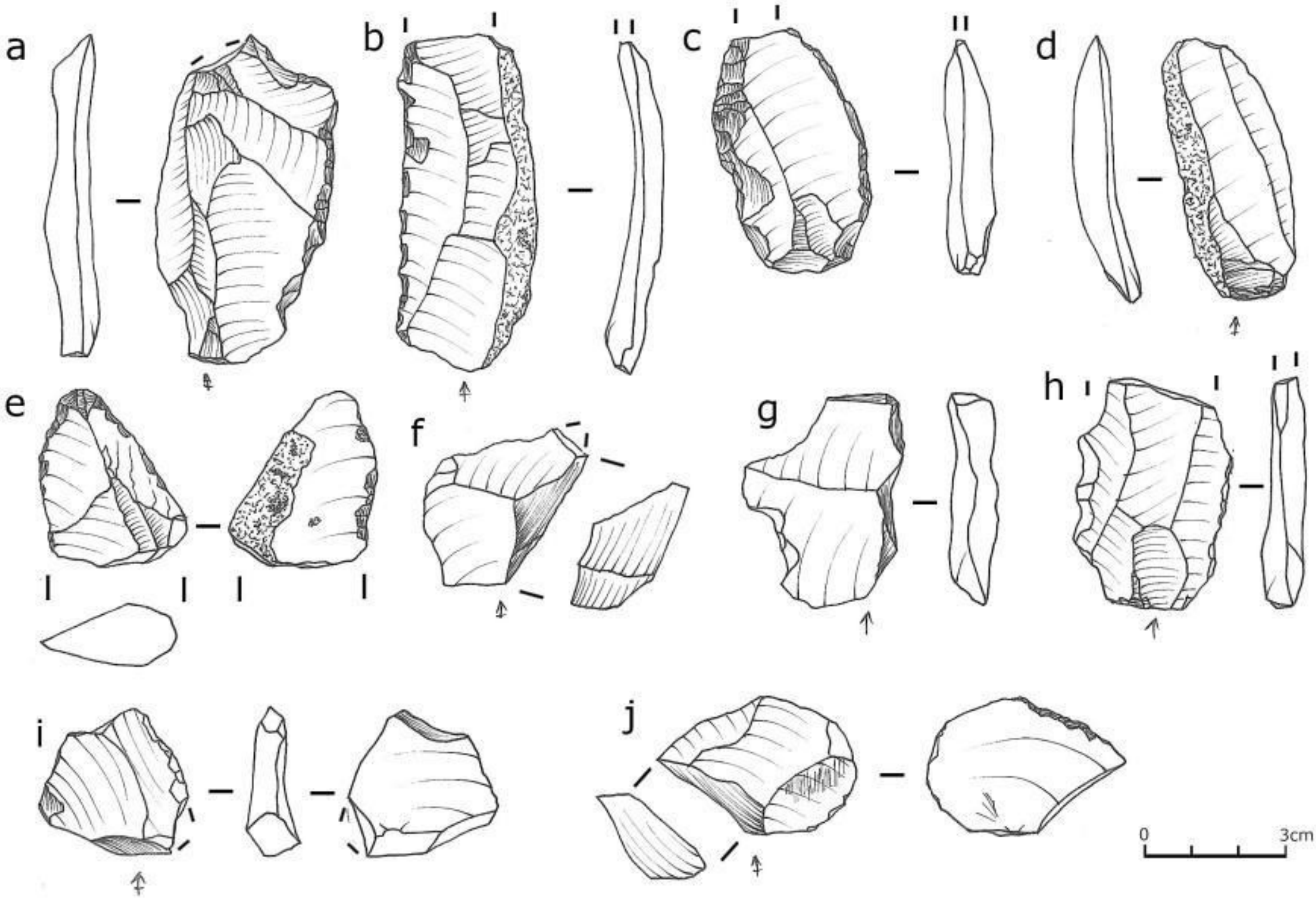
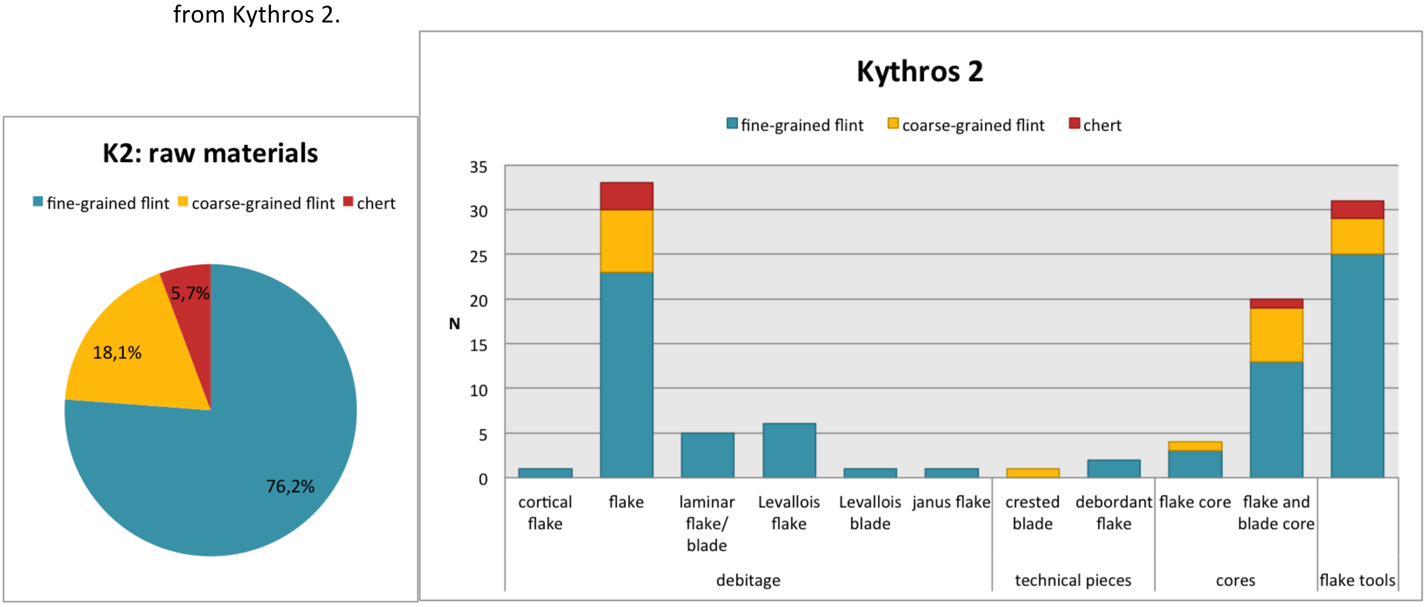
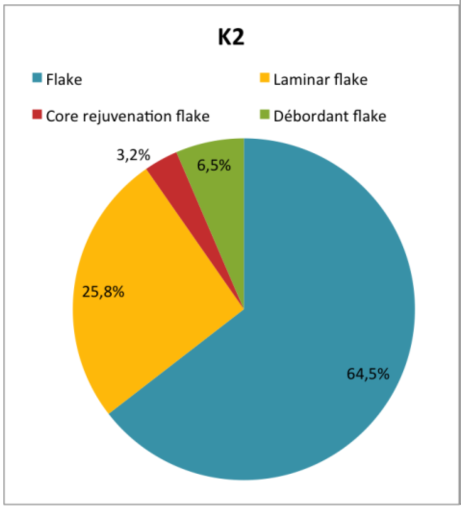
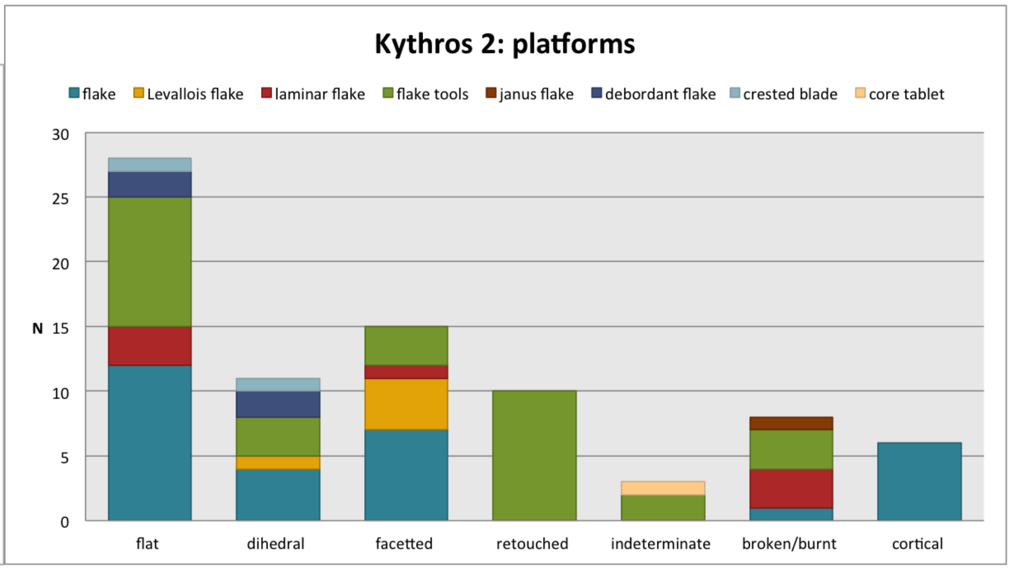


Figure 159: Laminar flake tools (a-c, e), laminar flakes/blades (d, h), *débordant* flakes (f-g) and flake tools (i-j) from Kythros 2.



Graph 117a-b: Percentage and frequency of raw material types used at K2





Graph 118 (left): Percentage of blank types used for retouched tools at K2.
Graph 119 (right): Frequency of the different platform types on the debitage, technical pieces and flake tools from K2

Blanks used for retouch are predominantly flakes (64.5%), followed by a significant amount of laminar flakes (25.8%) and a few technical pieces (Graph 118). Platforms on both unmodified and modified blanks are mainly flat or prepared (facetted and dihedral) while a large number of flake tools have retouched butts (Graph 119).

4.5.2.3. *Kythros 3* (N=12)

Site K3 consists of 12 lithic artefacts, i.e. seven debitage pieces and five flake tools. The unretouched blanks are predominantly flakes (N=5), yet there is also a laminar flake and a Levallois flake. The type of raw material most frequently used (66,7%) is a fine-grained flint, equally followed by coarse-grained flint and chert. The chert group consists of two flakes, while the coarse-grained flint was employed for the production of a flake and a notch. The laminar and Levallois flake as well as all other retouched tools are made on fine-grained flint (Table 60). Apart from the notch, which is made on a chert laminar flake, flake tools include a retouched flake and a retouched Levallois flake with a facetted platform, as well as two scrapers: a single scraper made on a *débordant* flake with a flat butt and a double scraper made on a laminar flake with a thinned platform.

Table 60: Assemblage structure at K3

Kythros 3		Fine-grained flint		Coarse-grained flint		Chert		Total	
		N	%	N	%	N	%	N	%
Debitage	flake	2	25	1	50	2	100	5	41,7
	laminar flake	1	12,5	0	0	0	0	1	8,3
	Levallois flake	1	12,5	0	0	0	0	1	8,3
Flake tools	notch	0	0	1	50	0	0	1	8,3
	retouched flake	2	25	0	0	0	0	2	16,7
	scraper	2	25	0	0	0	0	2	16,7
Total		8	100	2	100	2	100	12	100
Total (%)		66,7		16,7		16,7		100	

4.5.2.4. *Kythros 4* (N=6)

Only six specimens coming from Kythros 4 have been attributed to the Middle Palaeolithic. These are two laminar flakes, a *débordant* flake, a flake core and two flake tools, i.e. a scraper and a retouched flake. An 80% of the artefacts is made on fine-grained flint and none made on chert (Table 61). The only core is a core on a coarse-grained flint flake, measuring 66x69x41mm, preserving none of its initial cortex (141/1). The only formal tool type is a *déjeté* scraper made on a coarse-grained flint flake whose platform is burnt (Figure 160). It is bifacially worked with retouch scars of continuous distribution and long extent on its distal part (30x39x11mm). The scraper and one of the laminar flakes are heavily patinated (5), while the rest have slightly less degrees of patina (4). The platforms on both modified and unmodified blanks are either flat or broken/burnt.

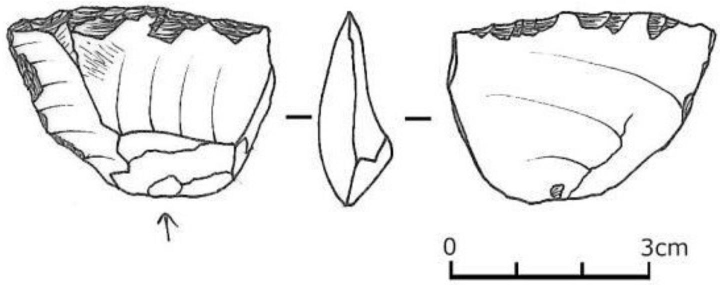


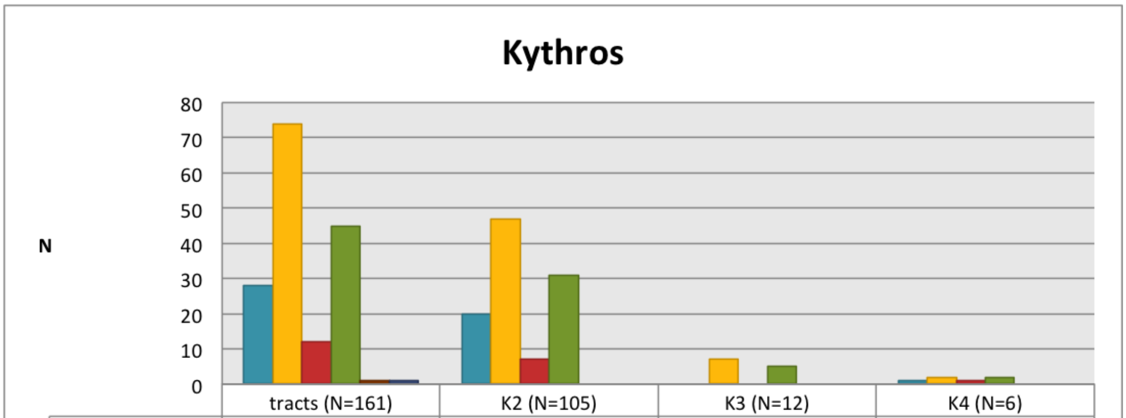
Figure 160: A déjeté scraper (114/11) from Kythros 4.

Table 61: Assemblage structure at K4

Kythros 4		Fine-grained flint		Coarse-grained flint		Total	
		N	%	N	%	N	%
Debitage	laminar flake	2	50	0	0	2	33,3
Technical pieces	*débordant* flake	1	25	0	0	1	16,7
Cores	flake core	0	0	1	50	1	16,7
Flake tools	retouched flake	1	25	0	0	1	16,7
	scraper	0	0	1	50	1	16,7
Total		4	100	2	100	6	100
Total (%)		80		20		100	

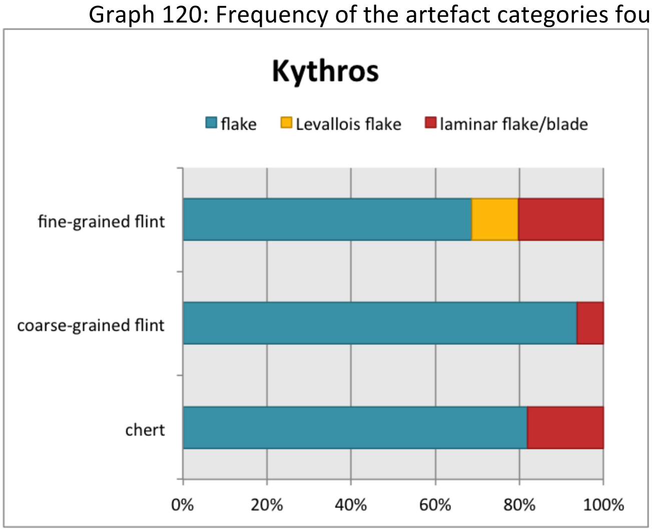
4.5.2.5. Discussion

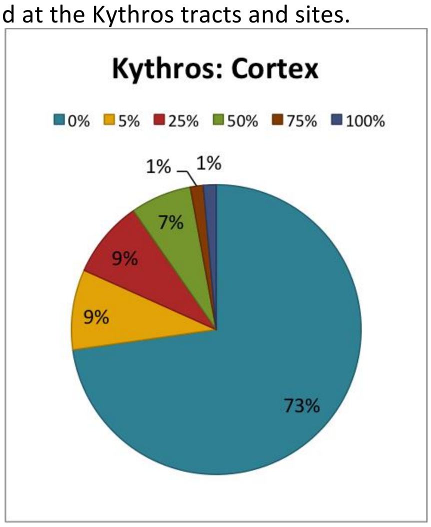
Kythros islet returned a significant amount of diagnostic Middle Palaeolithic artefacts, the majority of which come from the tracts and from Kythros 2 site. Both assemblages, from Kythros 2 and from the tracts, have a similar structure (Graph 120). As usual, fine-grained flint is the predominant raw material type used. All Levallois debitage is made on fine-grained flint, while laminar flakes and blades are also made on coarse-grained flint and chert (Graph 121). 73% of all artefacts from Kythros preserve no cortex at all, 18% have between 5-25% cortical surfaces and the rest 9% have more than half of their cortex preserved (Graph 122). All Levallois debitage and technical pieces and the majority of flakes and flake tools have no cortex at all. Yet, there are a few cortical flakes and tools made on cortical flakes, i.e. flakes with 100% cortical dorsal face (Graph 123). The retouched tools from Kythros were usually made on flakes (54.8%) and laminar flakes (21.4%) followed by Levallois flakes (10.7%) and technical pieces (7.2%), i.e. core rejuvenation flake, *débordant* flake, crested flake (Graph 124). Although the vast majority of platform types at Kythros are flat, prepared platforms – either facetted or dihedral – are encountered on almost all artefact categories (debitage, technical pieces and flake tools).



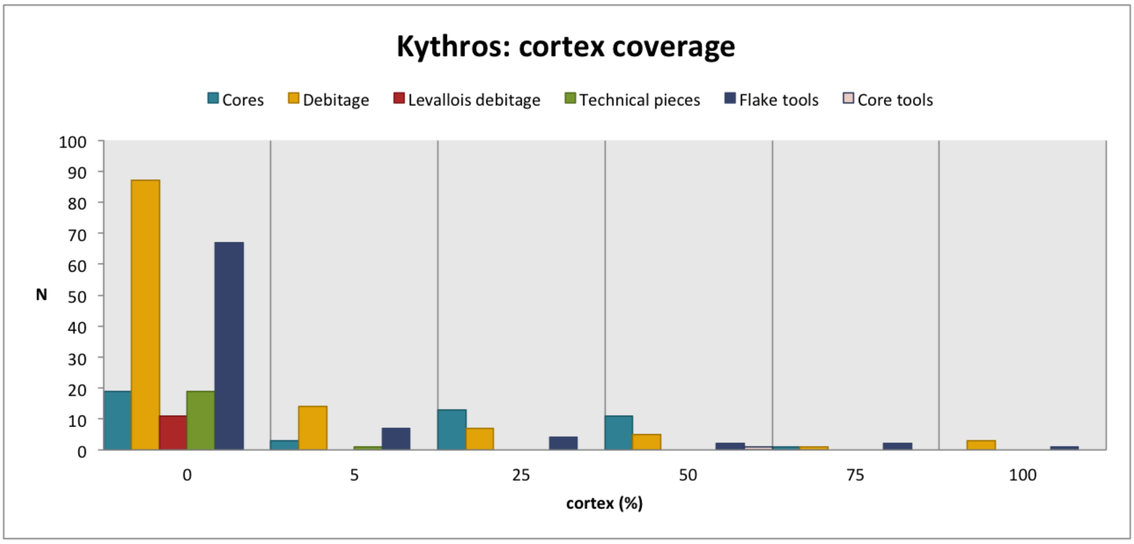
	tracts (N=161)	K2 (N=105)	K3 (N=12)	K4 (N=6)
Cores	28	20	0	1
Debitage	74	47	7	2
Technical pieces	12	7	0	1
Flake tools	45	31	5	2
Core tools	1	0	0	0
Hammerstones	1	0	0	0

Graph 120: Frequency of the artefact categories found at the Kythros tracts and sites.

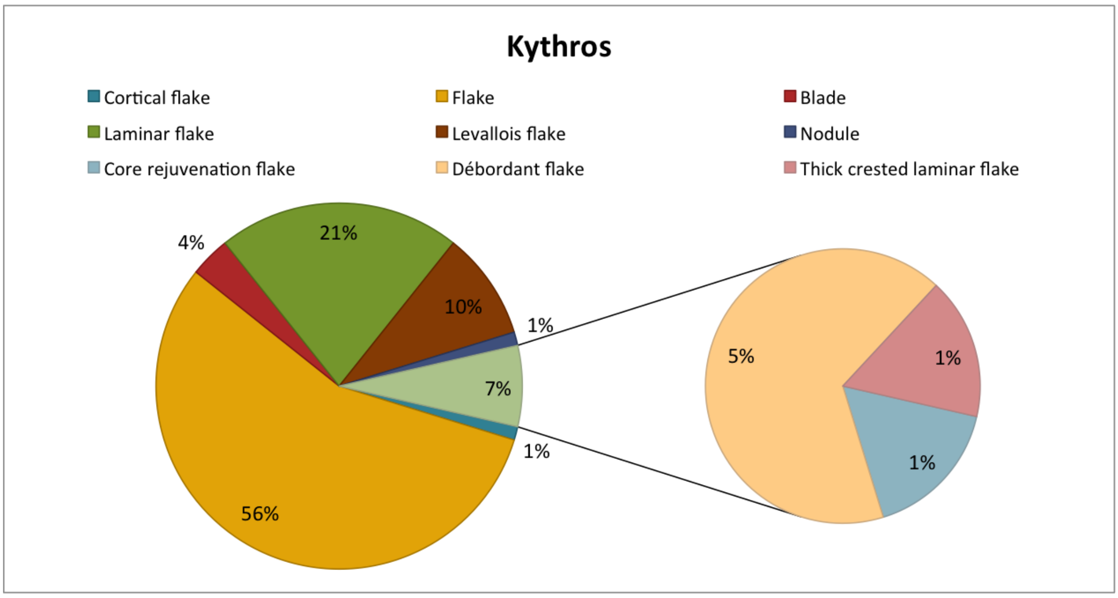




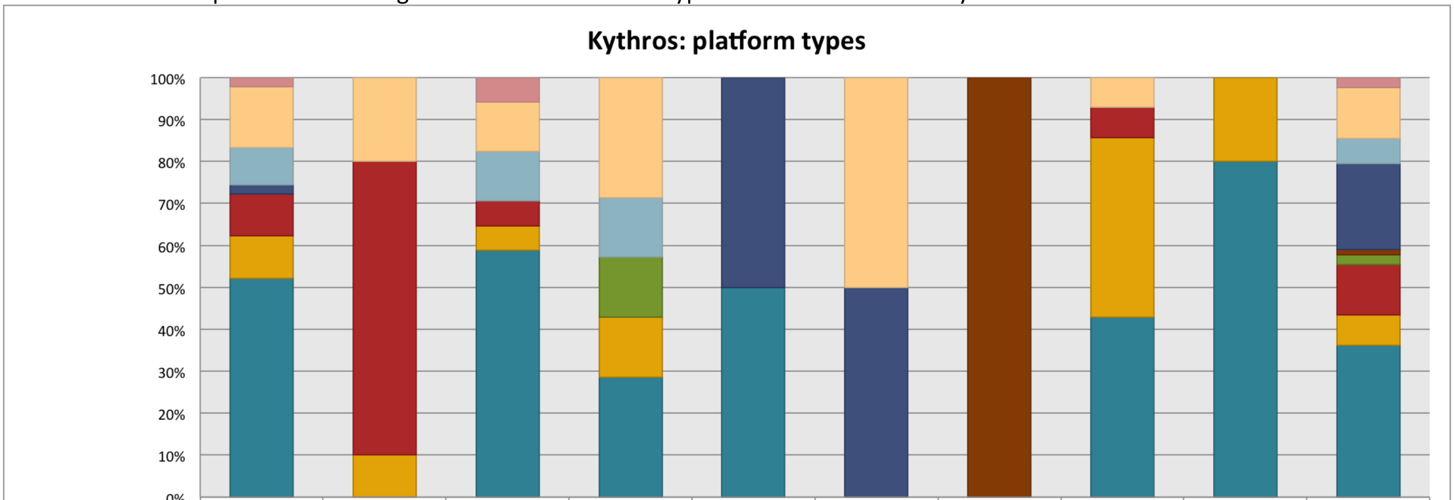
Graph 121 (left): Association of the raw material types with the different debitage categories at Kythros
Graph 122 (right): Percentage of cortex coverage (0-100%) on all artefacts from Kythros



Graph 123: Frequency of cortex coverage (0-100%) on each artefact category at Kythros



Graph 124: Percentage of the different blank types used for retouch at Kythros



	flake (N=90)	Levallois flake (N=10)	laminar flake (N=17)	blade (N=7)	cortical flake (N=2)	janus flake (N=2)	thinning flake (N=2)	debordant flake (N=14)	crested blade (N=5)	flake tools (N=83)
cortical (N=5)	2	0	1	0	0	0	0	0	0	2
broken/burnt (N=31)	13	2	2	2	0	1	0	1	0	10
indeterminate (N=16)	8	0	2	1	0	0	0	0	0	5
retouched (N=21)	2	0	0	0	1	1	0	0	0	17
soft hammer (N=3)	0	0	0	0	0	0	2	0	0	1
pecked (N=3)	0	0	0	1	0	0	0	0	0	2
facetted (N=28)	9	7	1	0	0	0	0	1	0	10
dihedral (N=25)	9	1	1	1	0	0	0	6	1	6
flat (N=100)	47	0	10	2	1	0	0	6	4	30

Graph 125: Stacked collumn chart with the different platform types on the debitage, technical pieces and flake tools from Kythros

4.5.3. Thilia (N=6)

The island of Thilia, situated east of Lefkas and west of Meganissi is today an uninhabited island used only occasionally for agricultural activities by the people who leave permanently on the island of Meganissi. During the survey, a significant amount of lithics was collected from the island, the northern part of which was impossible to walk due to heavy vegetation (Figure 161a).

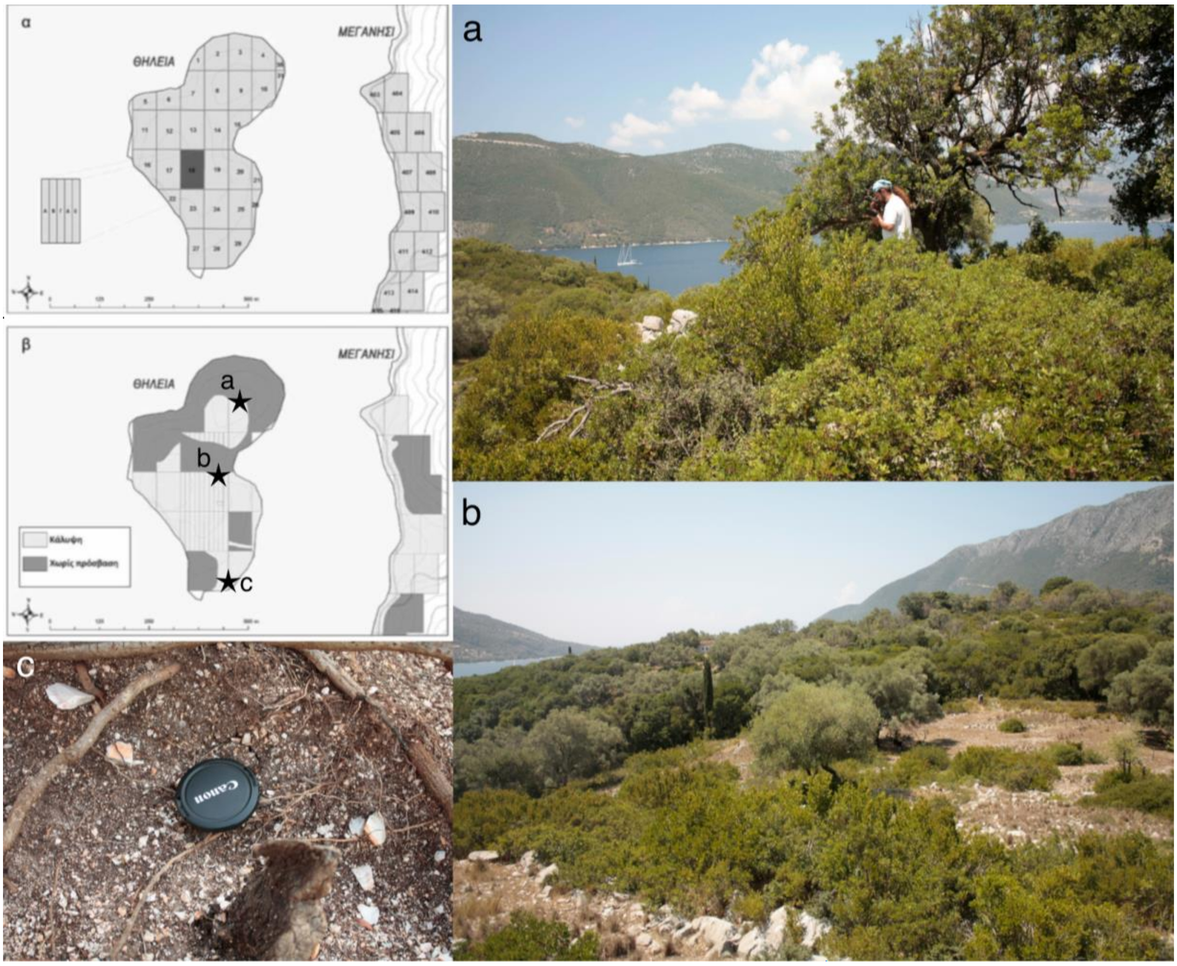


Figure 161: Map of Thilia island with the squares attributed (α) and the areas walked in light grey and the ones not walked in dark grey (b) and photos of parts of the island: a. view to the east towards Meganissi, b. view to the south with the mountains of Lefkas seen to the right and Meganissi to the left, c. Thilia 1 early Holocene site (map modified after Galanidou et al., 2017b, fig. 3 all photos are by C. Papoulia, July 2010).

Of the artefacts collected only a few are diagnostic in terms of technological and typological characteristics. The general picture is of a small-sized industry, made predominately on the medium- to small-sized fine-grained flint pebbles still available on the island (Figure 162). Notwithstanding, a number of larger flakes, flake tools and cores are also present, yet in lesser amounts. Chert artefacts count only a handful of the material.

Figure 162: Photo of the few flint raw material nodules of large size found towards the northern part of Thilia and might have arrived at the island as constructing material, and (insert) two of the very small-sized, rounded flint pebbles collected from Thilia 1 (Photos: C. Papoulia, July 2010).

A concentration of lithics was observed at Thilia 1, a site situated at the SE part of the island (Figure 161c). A test trench was excavated in the summer of 2011 in order to obtain soil samples for OSL dating. The initial hypothesis, based on the 'microlithic' character of the specimens and the absence of particularly diagnostic tool types, was that the particular site might be dated to the Mesolithic (Galanidou, 2011b). Such a scenario remains plausible, especially if we take into account the highly undiagnostic character of the Greek Mesolithic assemblages (Carter et al., 2017, 2016, 2014, Galanidou, 2014c, 2011b; Galanidou and Papoulia, 2016; Kaczanowska and Kozlowski, 2014; Perlès, 1987; Runnels et al., 1999; Sampson et al., 2010, 2012; Sordinas, 2003; Strasser et al., 2010). Interestingly, the OSL results propose an early Holocene date for the particular samples (Athanassas & Bassiakos interim report). Later on, a detailed analysis of the material proved that, although a few, diagnostic Holocene tool types do exist; yet these might also be part of a Neolithic toolkit (Figure 163). It seems that the site represents either a palimpsest of both Neolithic and Mesolithic presence or an early Neolithic site with no pottery. A similar pattern emerges from the Kokytos river valley in Thesprotia, Epirus (for a discussion on this see Galanidou and Papoulia, 2016; Forsén et al., 2016).

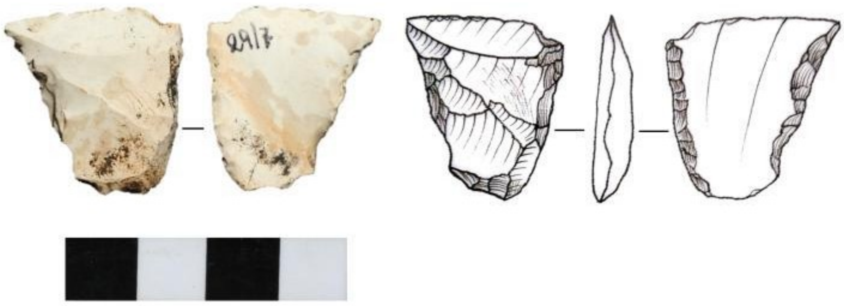


Figure 163: Transverse arrowhead from Thilia 1 (Photo: C. Papoulia).

For our discussion in regards of the Pleistocene occupation of the IISA islands, only a few of the artefacts collected from Thilia provide reasons to talk about the possibility of a Middle Palaeolithic presence on the island. In short, taking into account the following aspects: (a) the presence of diagnostic Holocene tool types, (b) the preservation of the artefacts and (c) their technological characteristics, only a handful of flakes and flake tools could be regarded as part of the Pleistocene component of Thilia (Table 62). These are three heavily weathered flakes and a flake with a dihedral platform from the tracts (Figure 164a-d), a broken retouched point and a scraper from Thilia 1 (Figure 164e-f). All artefacts apart from one flake (Figure 164d) have flat butts, thus no particular preparation of the striking platforms was observed. One of the heavily weathered flakes was probably used or retouched transversely, yet its bad preservation does not allow for further postulations. Its overall shape and size is very similar to the only formal tool from Kythros 4, a *déjeté* scraper (141/11; Figure 160).

Table 62: Lithics inventory at Thilia 1 and Thilia tracts

Thilia	**Debitage**		**Flake tools**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**
Thilia 1	1	25	2	100	3	50
tracts	3	75	0	0	3	50
Total	4	100	2	100	6	100
Total %	80		40		100	

Table 63: Assemblage structure at Thilia

Thilia		**fine-grained flint**	
		N	**%**
Debitage	flake	4	66,7
Flake tools	point	1	16,7
	scraper	1	16,7
Total		6	100

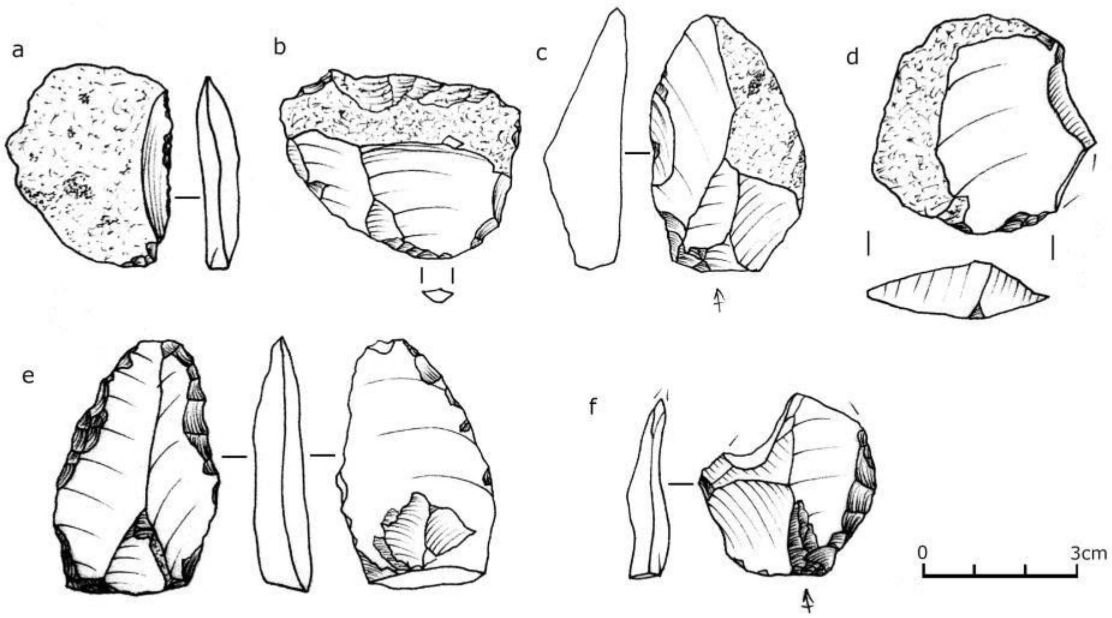


Figure 164: Flakes from the tracts (a-d) and flake tools (28A/1, 28Δ/3) from Thilia 1 (c-d).

Apart from the flakes and flake tools, a number of cores provide information regarding the reduction sequences, thus the techniques employed by the knappers. The cores from Thilia 1 are particularly small (Table 64), a fact which can be easily interpreted as a result of the size of the available raw materials. Their reduction sequences seem relatively simple, lacking an effort to produce prepared platforms for the extraction of predetermined products, as one would expect if it were for a "typical" Middle Palaeolithic assemblage. Similarities between the Middle Palaeolithic assemblages from the Ionian islands studied by Kourtessi-Phillipakis (1999) have been traced in the Pontinian Mousterian of Italy (Kuhn, 1995). This may tentatively be suggested for the Middle Palaeolithic component of Thilia island, yet again, since we are dealing with a surface collection, the presence of the particular types of cores may as well be part of a later prehistoric industry.

Table 64**:** Dimensions of all cores (N=33) from Thilia 1. Measurements are in mm.

Thilia 1 cores	**length**	**width**	**thickness**
MIN	12	19	12
MEDIAN	29	39	28
MAX	57	57	46

4.5.4. Tsokari (N=1)

Tsokari is a small islet off the north coast of Skorpios. Due to the thick vegetation, only a very small part of the islet of Tsokari was accessible (Figure 165-Figure 166a). Of the limited number of artefacts collected (N=6), one has been attributed to the Middle Palaeolithic due to its technological characteristics. This is a *débordant* flake with centripetal negative scars and a facetted platform, made on coarse-grained flint, and measuring 46x47x14mm (Figure 167).

Figure 165: Tsokari islet as it was approached by boat (Photo: C. Papoulia, July 2010).

Figure 166: Archaeologist V. Staikou holding an artefact while walking at the very edge of Tsokari's shore (a) and flint/chert specimens with a reddish patina spotted underwater, just off the shore (b) (Photos C. Papoulia, July 2010).

The rest of the lithics collected are undiagnostic cores, i.e. two globular cores with heavy white patina and chalky cortex, and three nodule fragments with rolled surfaces and multicolour patina (reddish/yellow), probably a result of contact with organic materials (vegetation) and water. More specimens seem to have ended in the sea just off the islet's coast, apparently as a result of erosional processes (Figure 166b).

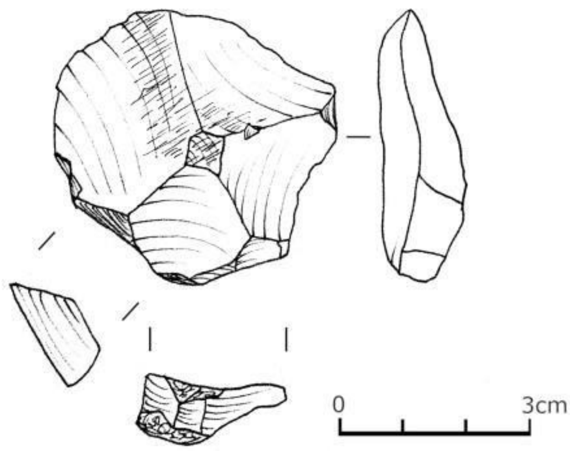


Figure 167: *Débordant* flake with centripetal negative scars from Tsokari (570/1).

4.5.5. Arkoudi (N=50)

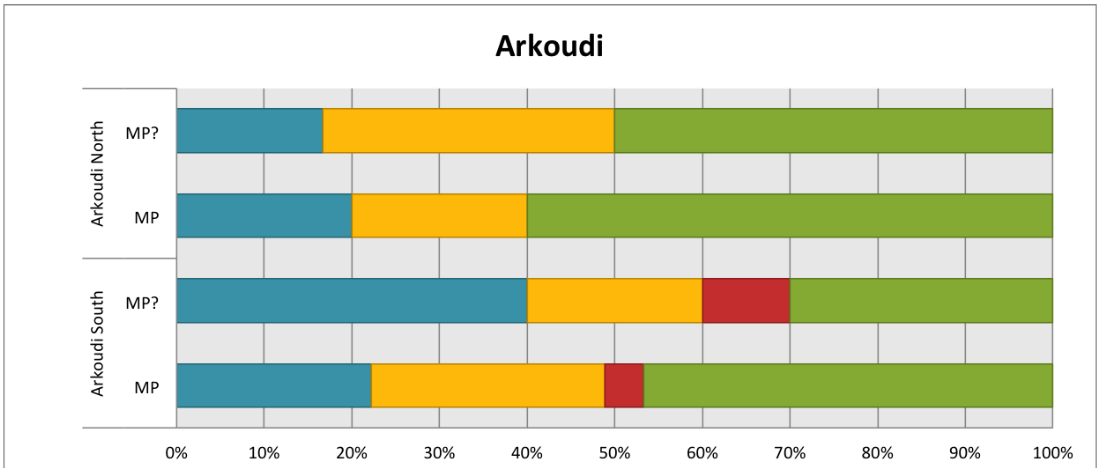
Further to the south and closer to the southeastern parts of Lefkas, the westernmost island of the archipelago, Arkoudi, consists of lithic assemblages with significantly diagnostic tool types belonging to several cultural periods of prehistory. While a large number of Arkoudi's assemblages belong to the final part of the Late Pleistocene, as well as the early Holocene, there is an important amount of artefacts with Middle Palaeolithic characteristics that can be attributed to the earlier phases of the archipelago's habitation. The material collected comes from two sites: Arkoudi North and Arkoudi South. Both sites are eroded *terra rossa* formations. The Pleistocene component is much more robust at Arkoudi South, while the most diagnostic examples of typical Neolithic artefacts (ovates, slugs, points etc.) from the whole surveyed region come from Arkoudi North. Furthermore, Arkoudi North yielded an obsidian assemblage consisting of 15 artefacts that can confidently be attributed to the Bronze Age, or the final part of the Neolithic, because of the technological characteristics (parallel ridges and edges) observed on the blades and bladelets (Figure 168). Apart from a single specimen from Arkoudi South and another one coming from a test trench excavated in 2011 at Kythros, this is the only site throughout the survey region were obsidian artefacts were found, adding to the importance of the island during the aforementioned periods (see Appendix II).

Figure 168: Obsidian assemblage from Arkoudi North (©IISAP photographic archive).

In terms of the lithic artefacts attributed to the Pleistocene, a total of 50 specimens can be attributed to the Middle Palaeolithic (Table 65), made almost exclusively (92%) on fine-grained flint (Graph 128). While a minimum of 16 artefacts (6 from Arkoudi North and at least 10 from Arkoudi South) of a less diagnostic nature may also be part of the Middle Palaeolithic component of the island, these are not included in the detailed analysis of the material. The artefacts from Arkoudi North include mainly flake tools, a few flakes and flake cores, while in the assemblage from Arkoudi South there are also some technical pieces (Graph 126). Several of the artefacts are preserved broken (Graph 127a), i.e. a 40% from Arkoudi North and a 64% from Arkoudi South (Graph 127b). A 54% of the artefacts from both sites exhibit the highest degree of patina (5), yet an interesting feature of the Arkoudi South assemblage is the predominance of the characteristic brown patina on most of the artefacts (60%) attributed to the Pleistocene (Graph 129).

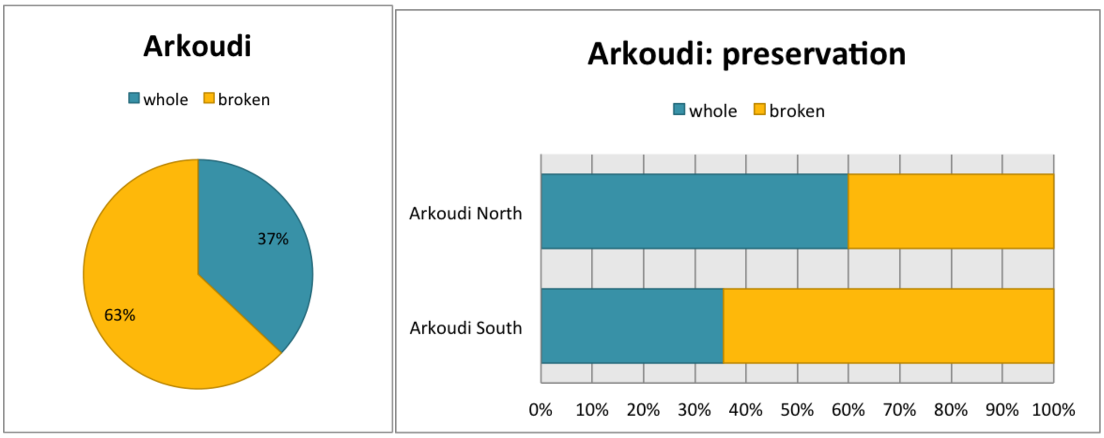
Table 65: Assemblage structure at Arkoudi North and Arkoudi South

Arkoudi	Cores		Debitage		Technical pieces		Flake tools		Total	
	N	%	N	%	N	%	N	%	N	%
Arkoudi South	10	90,9	12	92,3	2	100	21	87,5	45	90
Arkoudi North	1	9,1	1	7,7	0	0	3	12,5	5	10
Total	11	100	13	100	2	100	24	100	50	100
Total (%)	22		26		4		48		100	

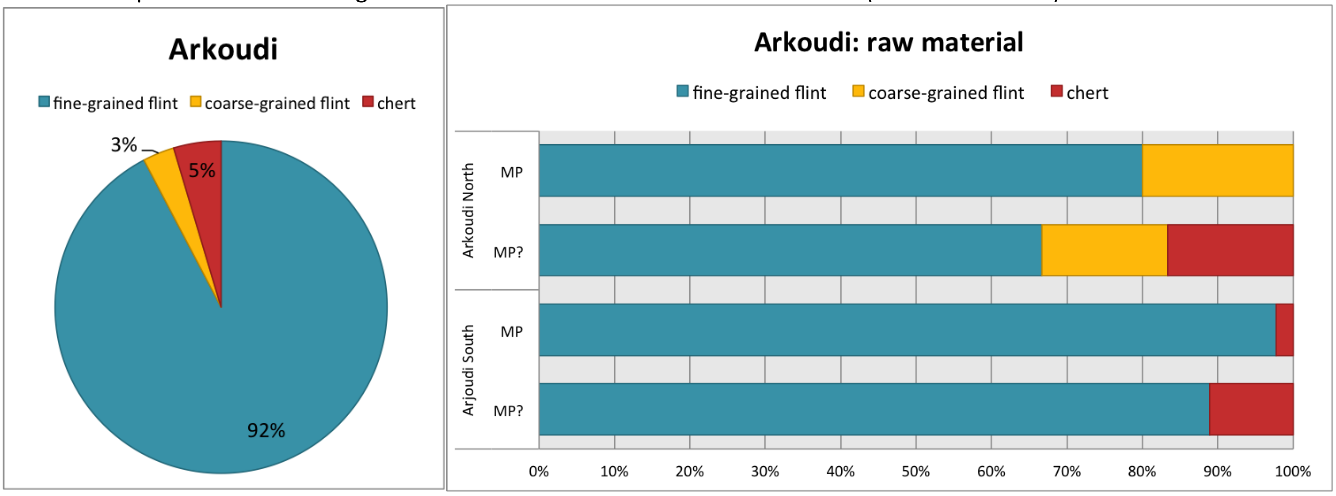


	Arkoudi South MP	Arkoudi South MP?	Arkoudi North MP	Arkoudi North MP?
Cores	10	4	1	1
Debitage	12	2	1	2
Technical pieces	2	1	0	0
Flake tools	21	3	3	3

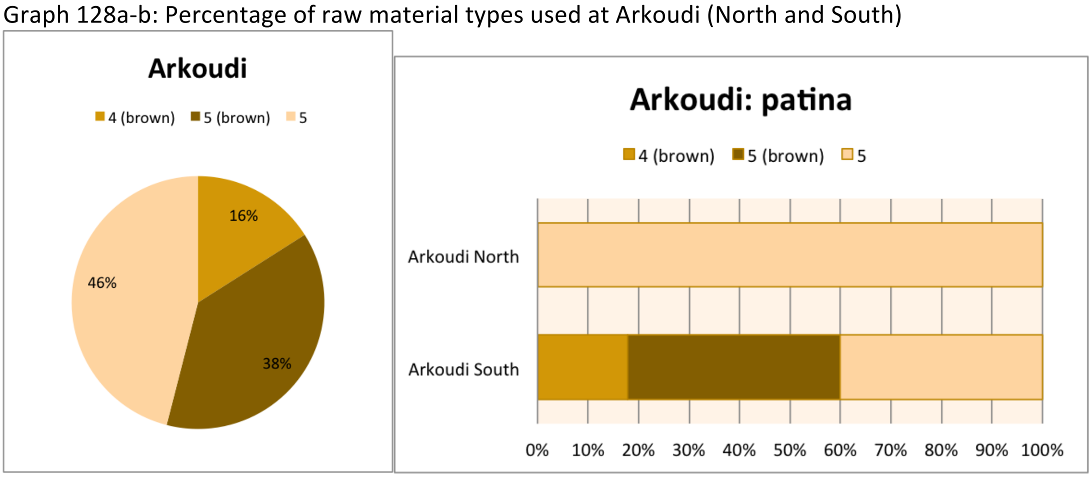
Graph 126: Stacked collumn chart with the diagnostic (MP) and the less diagnostic (MP?) artefacts attributed to the Middle Palaeolithic from Arkoudi.



Graph 127a-b: Percentage of broken and intact artefacts from Arkoudi (North and South)



Graph 128a-b: Percentage of raw material types used at Arkoudi (North and South)



Graph 129a-b: Percentage of the different degrees and types of patina on the artefacts from Arkoudi

4.5.5.1. Arkoudi North (N= 5)

Five artefacts from Arkoudi North can be attributed to the Middle Palaeolithic due to their technological and typological characteristics. These were collected from squares 6026, 6027 at the northeastern part of the site and square 6058 at its southern end (Figure 169).

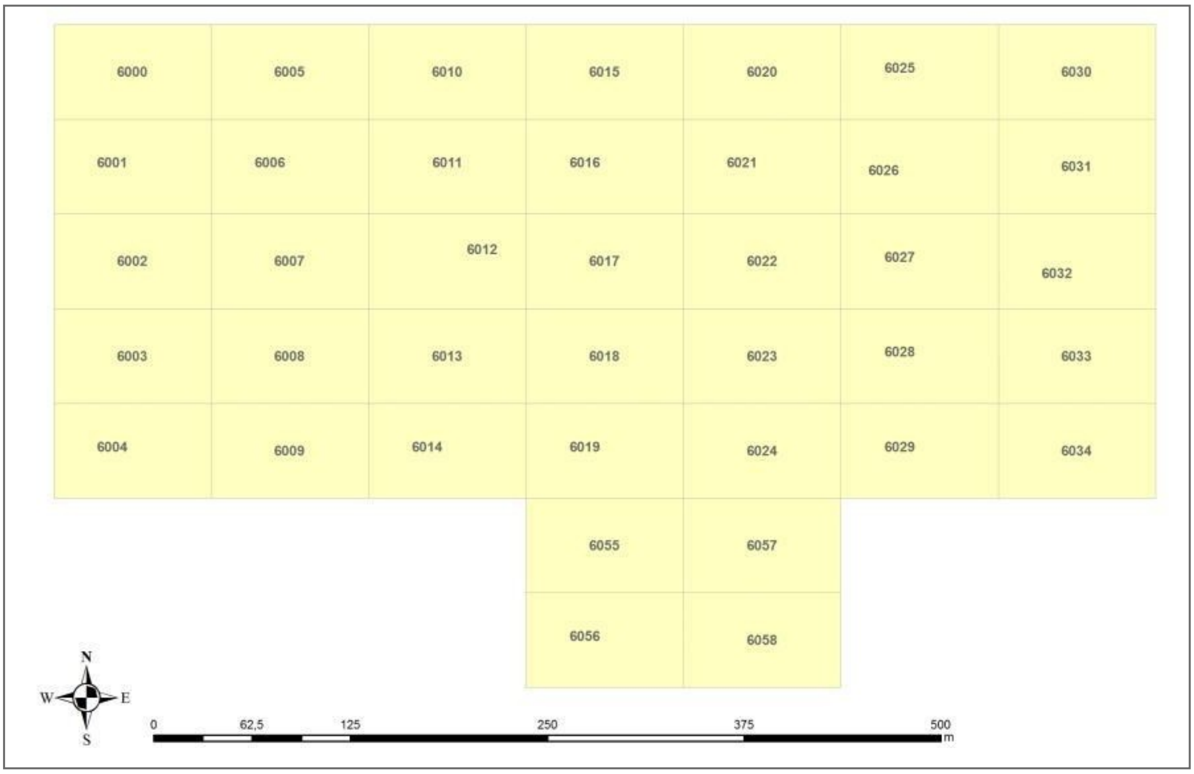


Figure 169: Arkoudi North GIS squares

The most diagnostic Middle Palaeolithic artefacts are a Levallois point made on coarse-grained flint with a dihedral butt and its tip broken (53x31x11mm). All other artefacts are made on fine-grained flint (Table 66). These are two flake tools, i.e. a déjeté scraper with a dihedral butt (33x36x13mm) and a convergent scraper made on a laminar flake (52x25x9mm) (Figure 170), a flake with a facetted platform (6027/39) and a Mousterian disc (6027/38). The latter two exhibit significant edge damage and extreme weathering/desilicification. More artefacts, made on fine-grained flint and chert, whose surfaces exhibit significant alterations due to weathering, are most probably also part of the oldest component of the site, i.e. the Middle Palaeolithic (Figure 171).

Table 66: Assemblage structure at Arkoudi North

Arkoudi North		Fine-grained flint		Coarse-grained flint		Total	
		N	%	N	%	N	%
Debitage	flakes	1	25	0	0	1	20
Cores	flake cores	1	25	0	0	1	20
Flake tools	Levallois point	0	0	1	100	1	20
	scraper	2	50	0	0	2	60
Total		4	100	1	100	5	100
Total %		80		20		100	

Figure 170: Déjeté scraper 6058/8 and convergent scraper 6058/9 (left) and broken Levallois point 6026/32 (right) from Arkoudi North (©IISAP photographic archive).

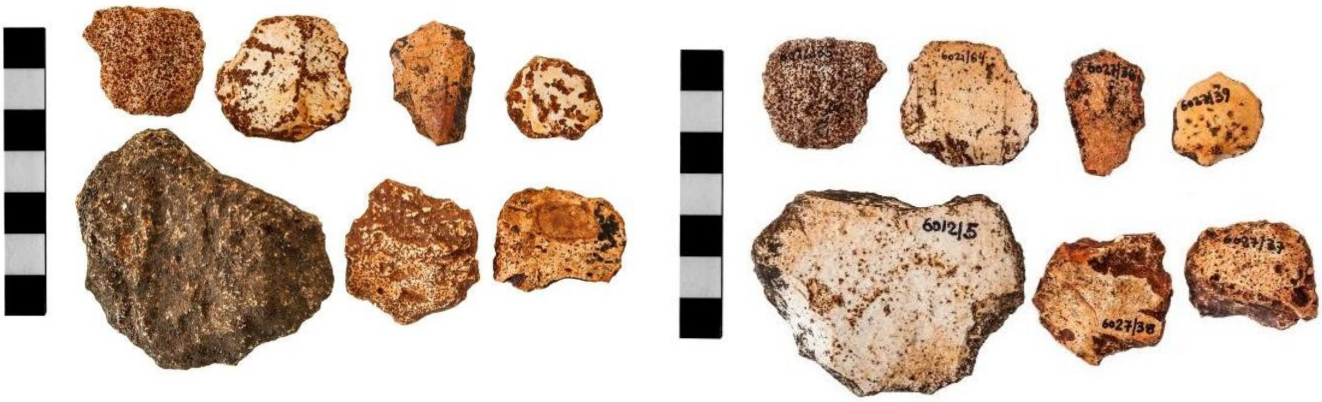


Figure 171: Dorsal (left) and ventral (right) face of a group of artefacts with extreme surface alterations – weathering from Arkoudi North. Top right is artefact 6027/39 and the middle one in the lower row is 6027/38 (©IISAP photographic archive).

4.5.5.2. Arkoudi South (N= 45)

A total of 45 artefacts collected from Arkoudi South, a relatively small red soil formation, can confidently be attributed to the Middle Palaeolithic in terms of their technology and tool-types. Most of the diagnostic ones come from square 6052 (Figure 172). The lithic assemblage from Arkoudi South consists of a number of flakes and Levallois flakes (Figure 175), a few cores and technical pieces, while half of the assemblage is comprised by flake tools, including an important amount of points (Table 67).

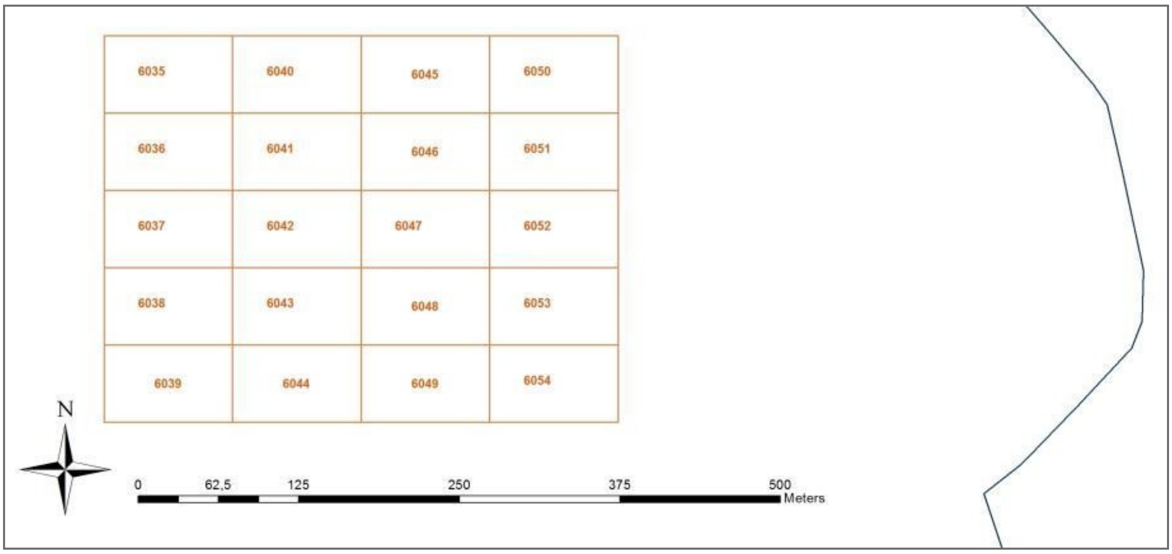


Figure 172: Arkoudi South GIS squares

Table 67: Assemblage structure at Arkoudi South

Arkoudi South		fine-grained flint		chert		Total	
		N	%	N	%	N	%
Debitage	flake	8	18,2	1	100	9	20
	Levallois flake	3	6,8	0	0	3	6,7
Technical pieces	*débordant* flake	1	2,3	0	0	1	2,2
	core rejuvenation flake	1	2,3	0	0	1	2,2
Cores	flake core	10	22,7	0	0	10	22,2
Flake tools	naturally-backed knife	1	2,3	0	0	1	2,2
	Levallois point	2	4,5	0	0	2	4,4
	pseudo-Levallois point	1	2,3	0	0	1	2,2
	retouched point	3	6,8	0	0	3	6,7
	retouched flake	2	4,5	0	0	2	4,4
	scraper	5	11,4	0	0	5	11,1
	bifacially worked piece	2	4,5	0	0	2	4,4
	burin	2	4,5	0	0	2	4,4
	bec / perforator	2	4,5	0	0	2	4,4
	truncated-facetted piece	1	2,3	0	0	1	2,2
Total		44	100	1	100	45	100
Total %		97,8		2,2		100	

The cores are lineal and recurrent Levallois flake cores, thin lineal Levallois disc cores and Mousterian discs. There are also small discoid cores (6052/7, 6052/171, 6052/172) and a unipolar core which has produced laminar flakes (6052/176), all made on fine-grained flint with the characteristic brown patina (Figure 173-Figure 174).

Figure 173: Upper and lower face of Middle Palaeolithic cores from Arkoudi South (©IISAP photographic archive).

Figure 174: Discoid cores from Arkoudi (©IISAP photographic archive).

The tool types encountered at Arkoudi South that can be attributed to the Middle Palaeolithic include Levallois and pseudo-Levallois points (Figure 176a-b, Figure 177b), scrapers with stepped and scaled retouch (Figure 176e, h-i) and tools with bifacial retouch (Figure 176f-g). Of particular interest is an elongated point or *déjeté* scraper, the largest one found in the course of the survey (Figure 177a, Figure 178), which is made on fine-grained flint and exhibits surface alterations in the form of brown patina, like the majority of the artefacts from 6052 this also probably belongs to the Pleistocene component of the site. It is retouched by means of direct, bilateral, continuous and denticulated retouch. A diagnostic product of a discoid reduction sequence is the pseudo-Levallois point which also exhibits fractures bifacially on its distal end (Figure 179).

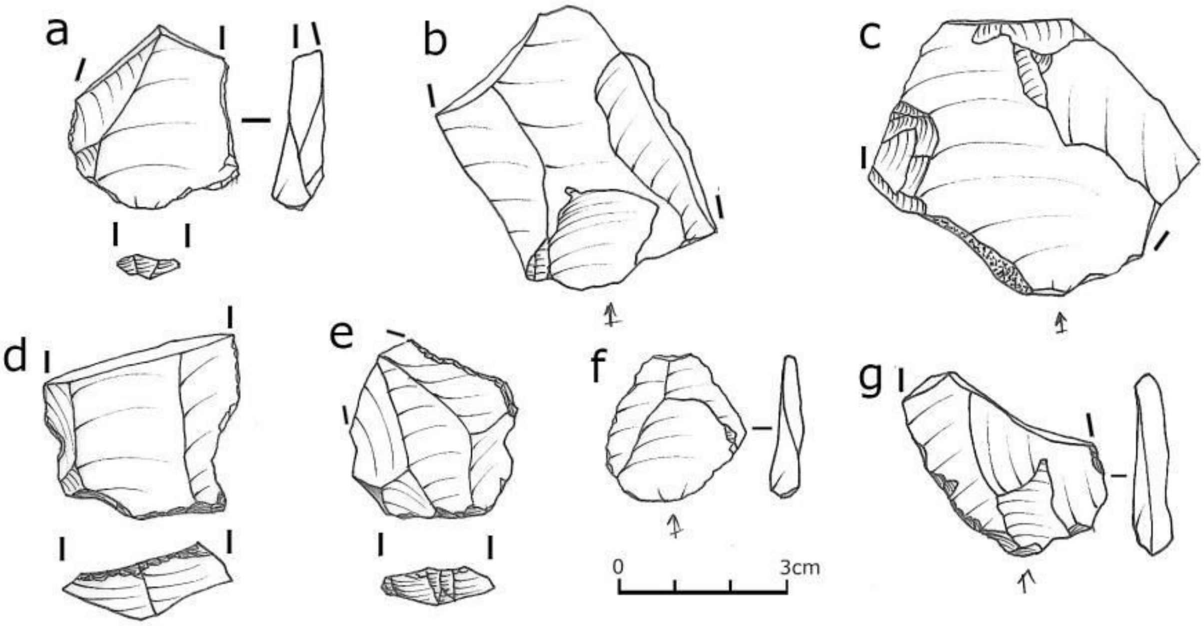


Figure 175: Flakes from Arkoudi South

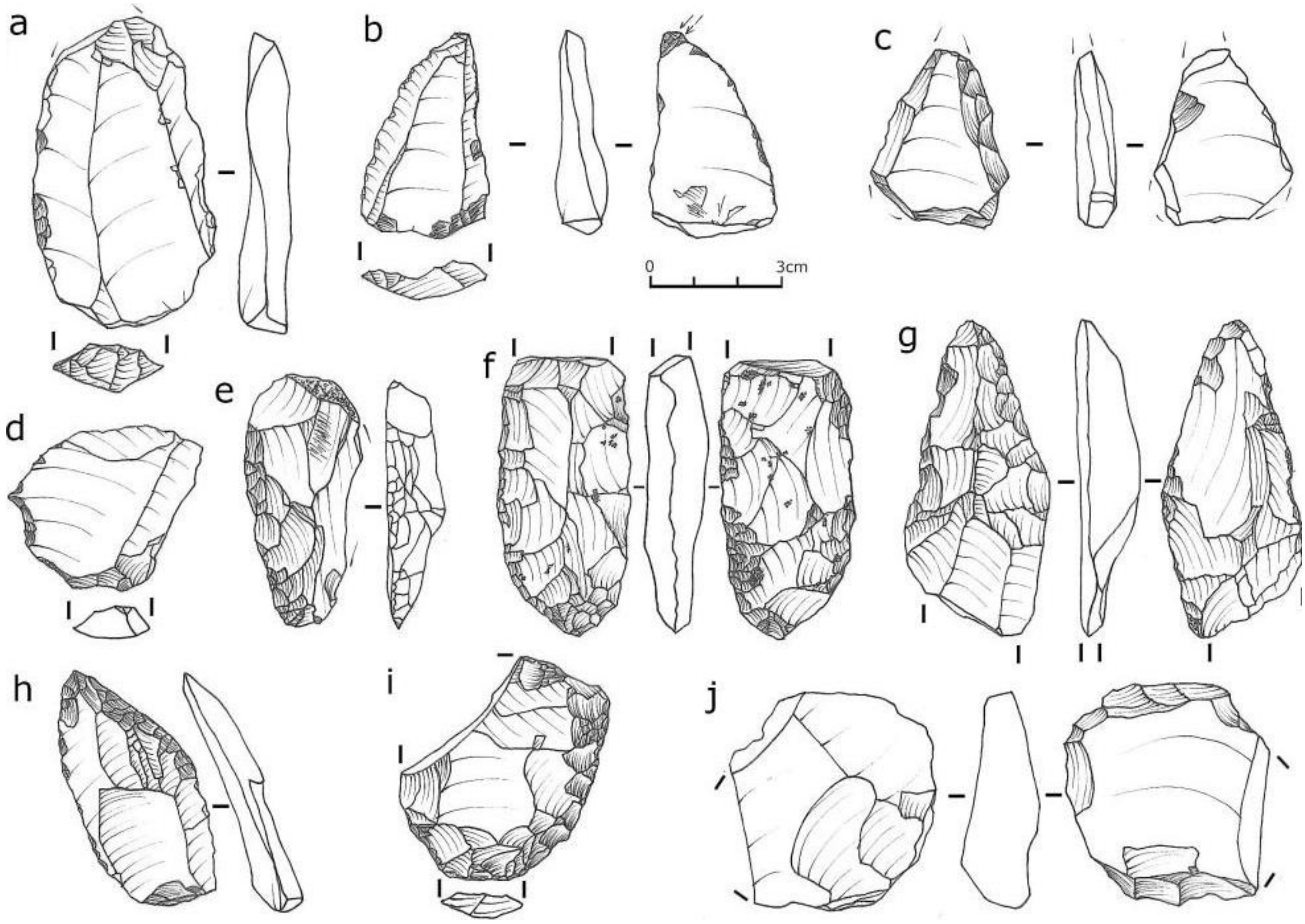


Figure 176: Flake tools from Arkoudi South

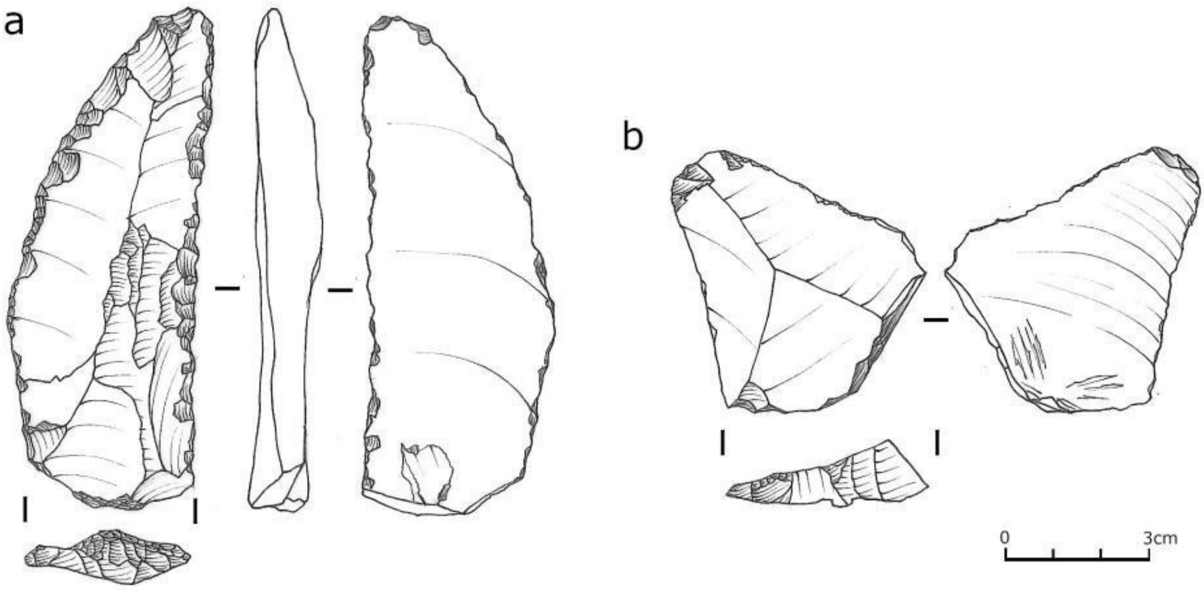
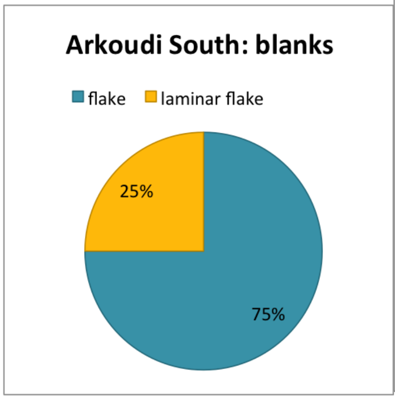


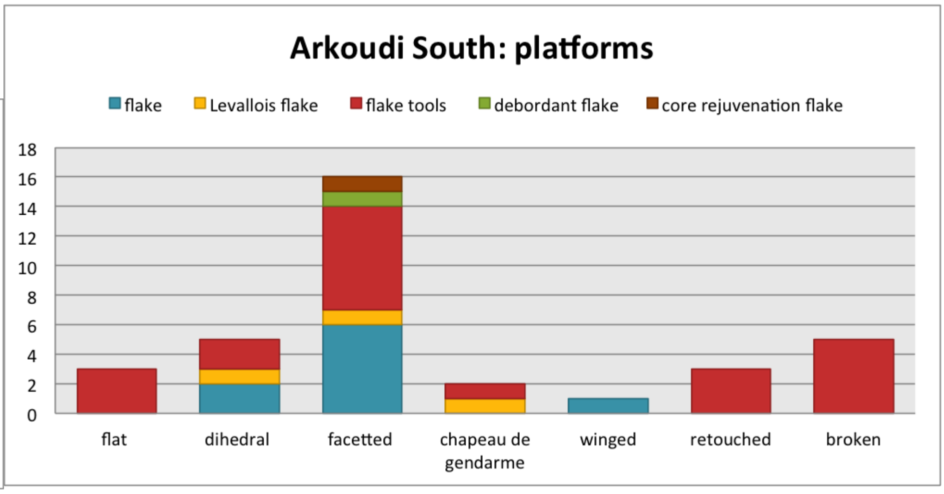
Figure 177: elongated point / déjeté scraper (a) and pseudo-Levallois point (b) from Arkoudi South

Figure 178: elongated point / déjeté scraper from Arkoudi South (6052/29) (©IISAP photographic archive).

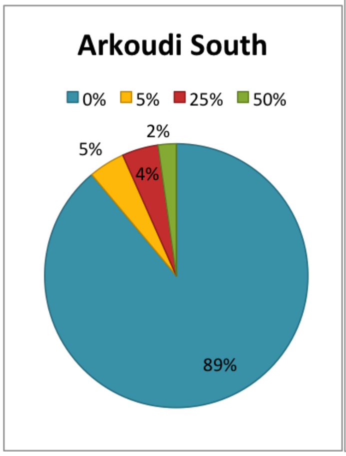
Figure 179: pseudo-Levallois point from Arkoudi South (6052/28) (©IISAP photographic archive).

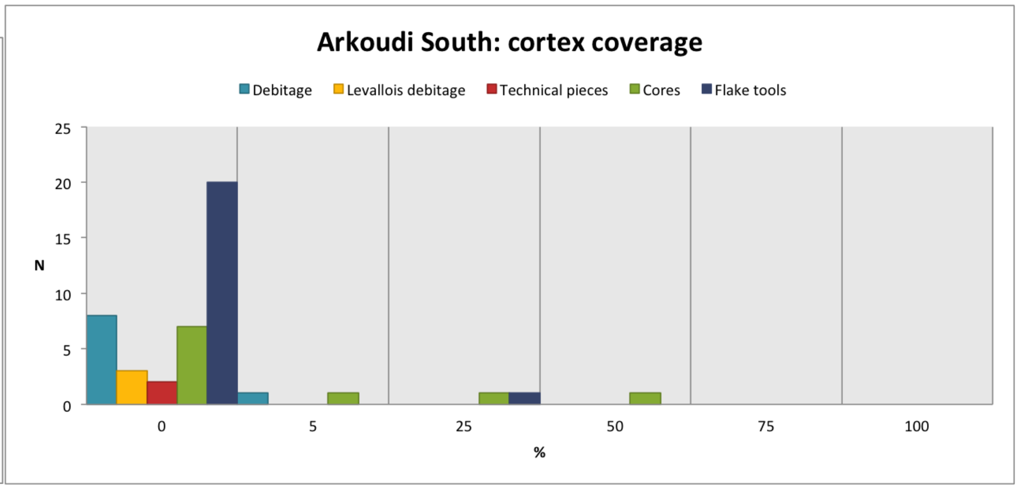
A 75% of the blanks further retouched are plain flakes, followed by laminar flakes (Graph 130). Platform types on both unmodified and modified blanks are mainly facetted, dihedral or flat. There is also a Levallois flake and a flake tool with a prepared platform of the *chapeau de gendarme* type (Graph 131). The vast majority of the artefacts (89%), including all technical pieces and Levallois debitage, do not preserve any cortex at all, while only a few cores and flake tools preserve between 5-50% of cortex on their surfaces (Graph 132).





Graph 130 (left): Percentage of blank types used at Arkoudi South
Graph 131 (right): Frequency of the different platform types on the debitage, technical pieces and flake tools from Arkoudi South





Graph 132a-b: Cortex coverage on the artefacts from Arkoudi South

4.5.6. Atokos (N=13)

The island of Atokos looms over the southernmost end of the survey area due to its high altitude (Figure 180). The first thing one notices when getting off at its SE coast is the impressive limestone formations and the abundance of raw material sources suitable for the production of stone tools (Figure 181). These are found both in the form of bedded cherts and nodules within the limestone.

Figure 180: Atokos as seen from the North (©IISAP photographic archive).

Figure 181: Limestone formation with cherts/flints on the beach of the south part of Atokos (Photo: C. Papoulia, July 2011).

Atokos yielded a significant amount of lithic artefacts from a single plateau on one of its high picks (Figure 182). Of these, only a very small number can be attributed to the Middle Palaeolithic, all of which come from the central and northeast parts of the site, i.e. squares 5002, 5003, 5005, 5007, 5008, 5009, 6059 (Figure 183). A total of 13 artefacts exhibit certain technological or typological characteristics which allow for such an attribution, yet again with a particular degree of tentativeness. These include a few Levallois and pseudo-Levallois artefacts, two flakes made on chert and coarse-grained flint, as well as a flake with a dihedral platform made on fine-grained flint (Table 68). An extra 26 artefacts might as well be part of the Middle Palaeolithic component of the site, yet with greater degrees of uncertainty, due to their less diagnostic nature (Graph 133). The raw material most frequently used is the fine-grained flint, although chert and coarse-grained flint are also occasionally used (Graph 134). Platforms on both unmodified and modified blanks are either flat or dihedral, with the only Levallois flake having a facetted platform (Graph 135a). A similar pattern is observed on the unmodified and modified blanks from the possible Middle Palaeolithic (MP?) assemblage from Atokos, although instead of a Levallois flake, there is a *débordant* flake with a facetted platform (Graph 135b). In terms of cortex coverage, 85% of the artefacts preserves no cortex at all (Graph 136a), while the dorsal face of a flake and a flake tool are about 5% cortical (Graph 136b).

Figure 182: Atokos plateau, July 2011 (©IISAP photographic archive).

Table 68: Assemblage structure at Atokos

Atokos MP		**fine-grained flint**		**coarse-grained flint**		**chert**		**Total**	
		N	%	N	%	N	%	N	%
Debitage	flake	1	11,1	1	100	1	33,3	3	23,1
	Levallois flake	0	0	0	0	1	33,3	1	7,7
Cores	flake core	4	44,4	0	0	0	0	4	30,8
Flake tools	Levallois point	2	22,2	0	0	0	0	2	15,4
	pseudo-Levallois point	2	22,2	0	0	0	0	2	15,4
	heavy-duty scraper	0	0	0	0	1	33,3	1	7,7
Total		9	100	1	100	3	100	13	100
Total %		69,2		7,7		23,1		100	

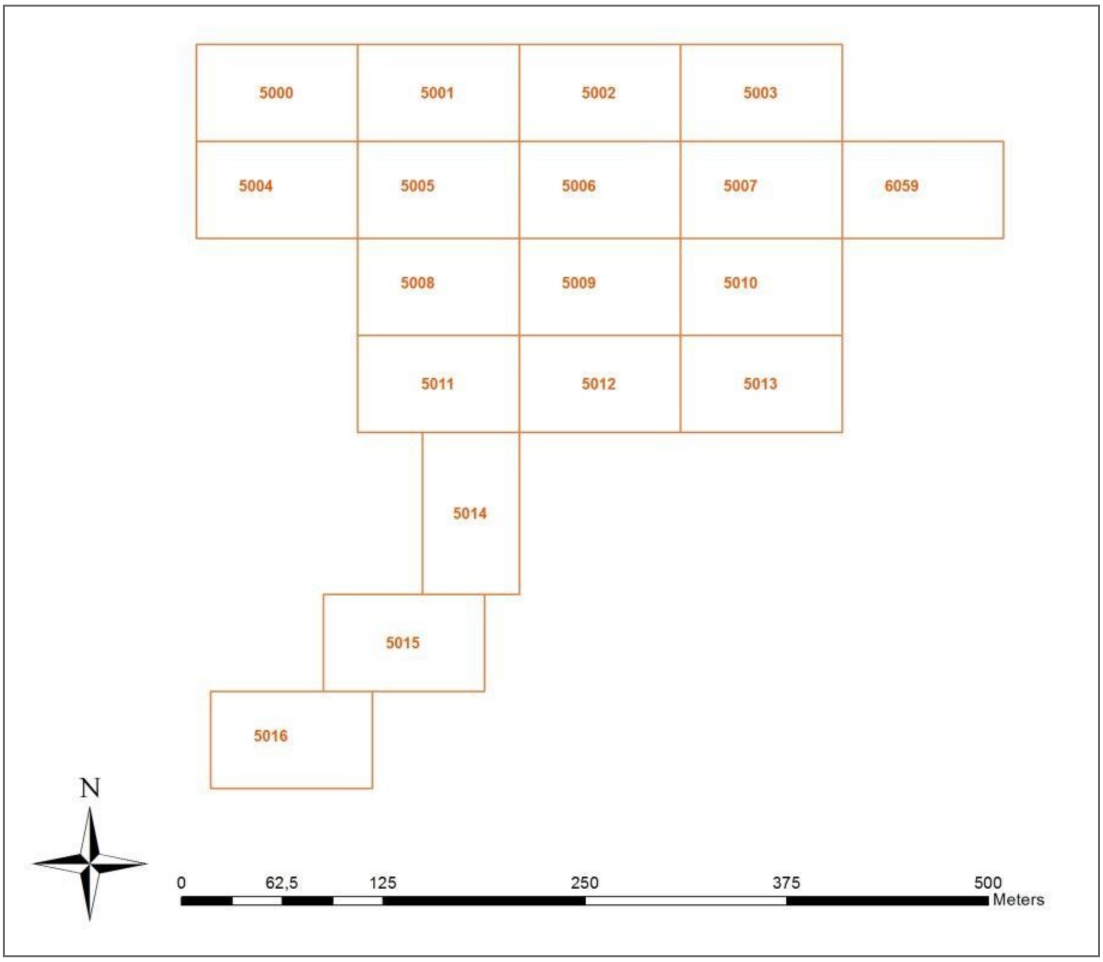
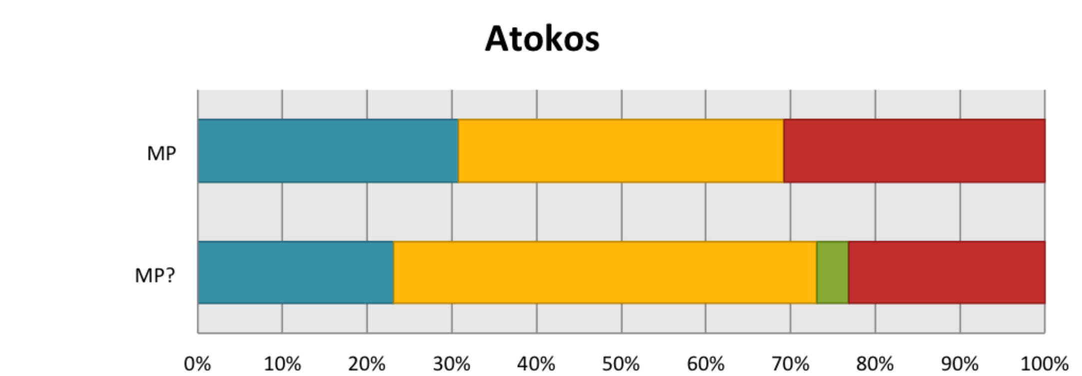
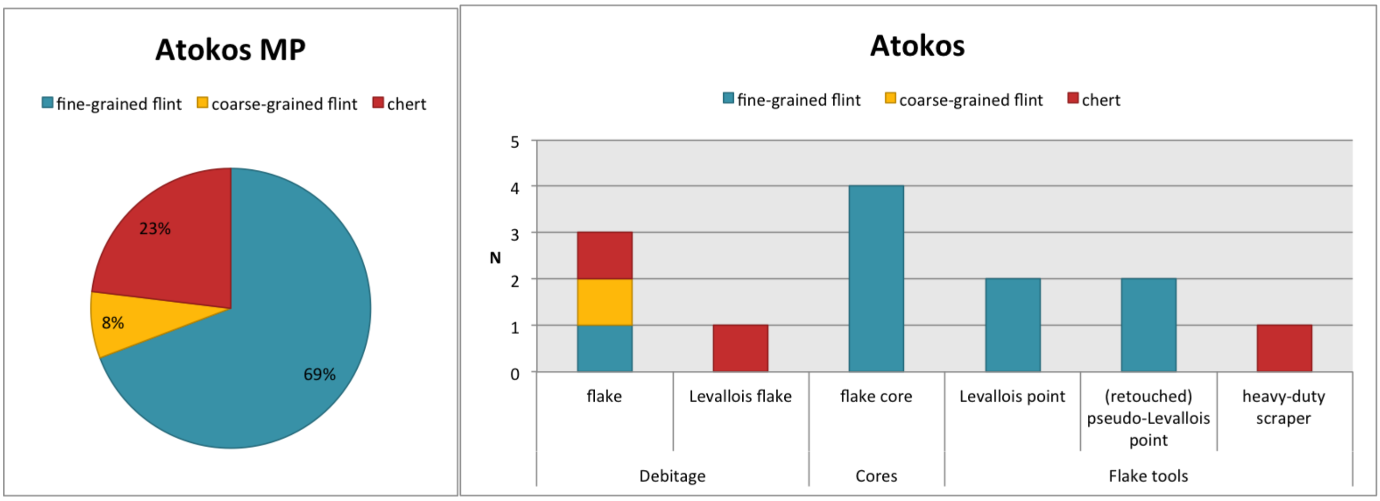


Figure 183: Atokos GIS squares

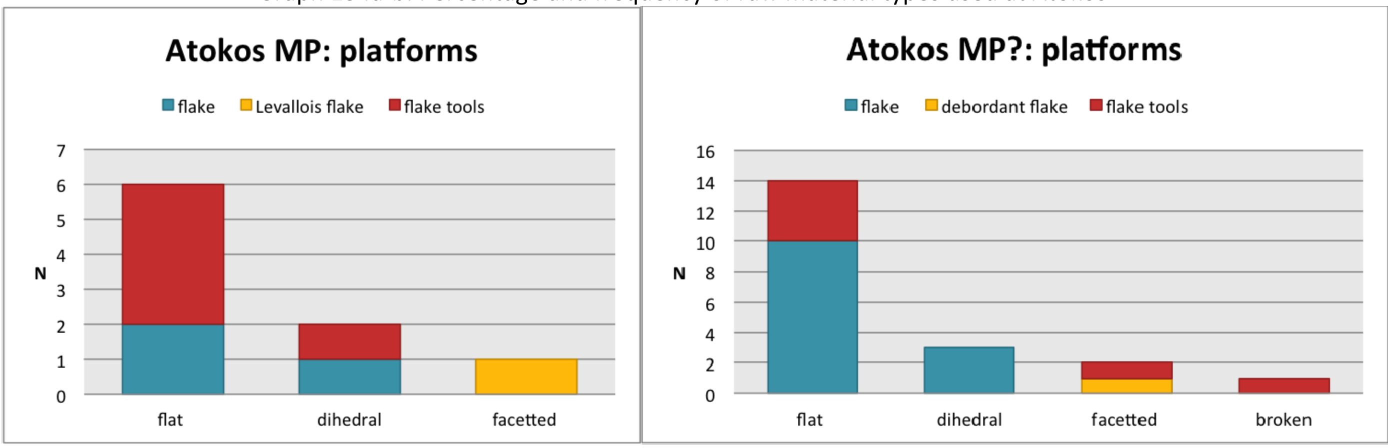


	MP?	MP
Cores	6	4
Debitage	13	5
Technical pieces	1	0
Flake tools	6	4

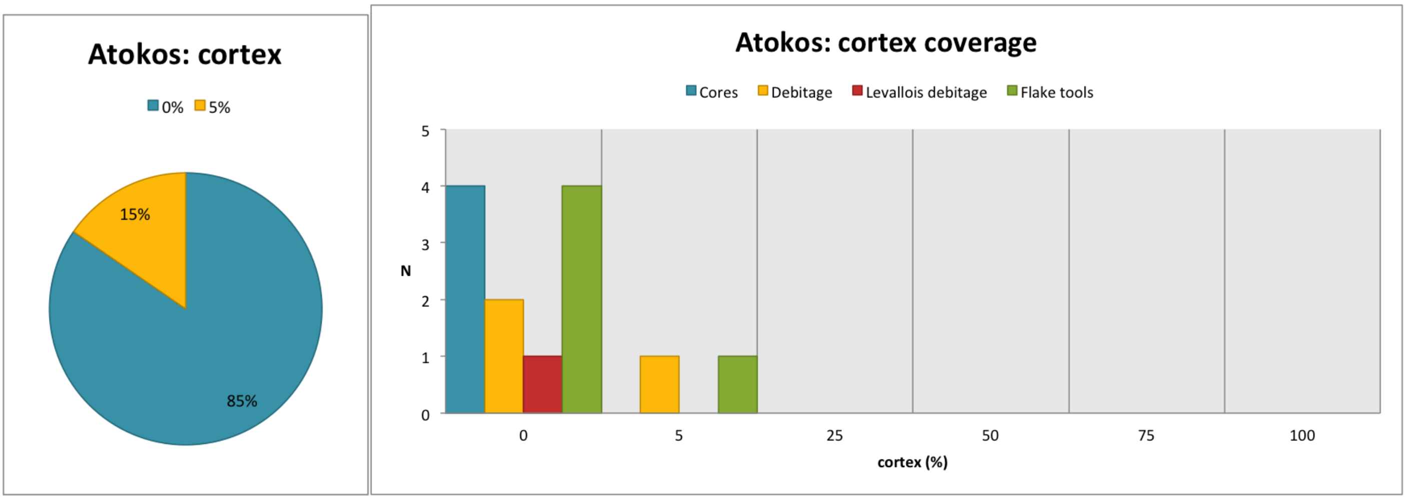
Graph 133: Stacked column chart with the artefact categories attributed to the Middle Palaeolithic (MP) and those of a less diagnostic nature that may also be part of the same component of the site (MP?)



Graph 134a-b: Percentage and frequency of raw material types used at Atokos



Graph 135a-b: Frequency of the different platform types on the debitage, technical pieces and flake tools from Atokos



Graph 136a-b: Cortex coverage on all artefacts (a) and on each artefact category (b) from Atokos

Figure 184: Levallois flake made on chert, with edge damage and surface alterations (patina & few organic residues), from Atokos (5005/1) (photos: ©IISAP photographic archive).

Apart from the Levallois flake made on chert (Figure 184), diagnostic artefacts include two Levallois points made on fine-grained flint (Figure 185, Figure 186a-b) and a broken Levallois core (Figure 187a). One more prepared flake core (5002/2) has been attributed to the Middle Palaeolithic component of the island (Figure 187b), while a few more (Figure 187c-f) may possibly be part of the same component. A heavy-duty tool made on a large and thick chert flake (Figure 188) as well as a discoid core with a semi-fixed perimeter, also made on chert, which in typological terms could also be classified as a chopping tool (Figure 189), have been attributed to the earliest component of the island.

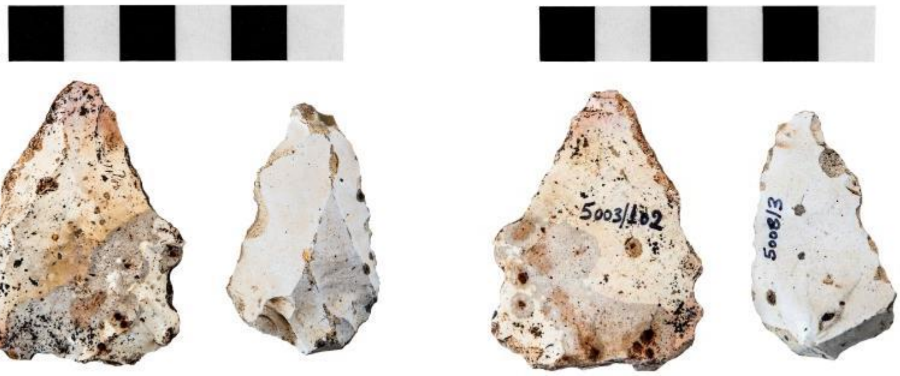


Figure 185: Levallois points from Atokos (Galanidou, 2018, fig. 10)

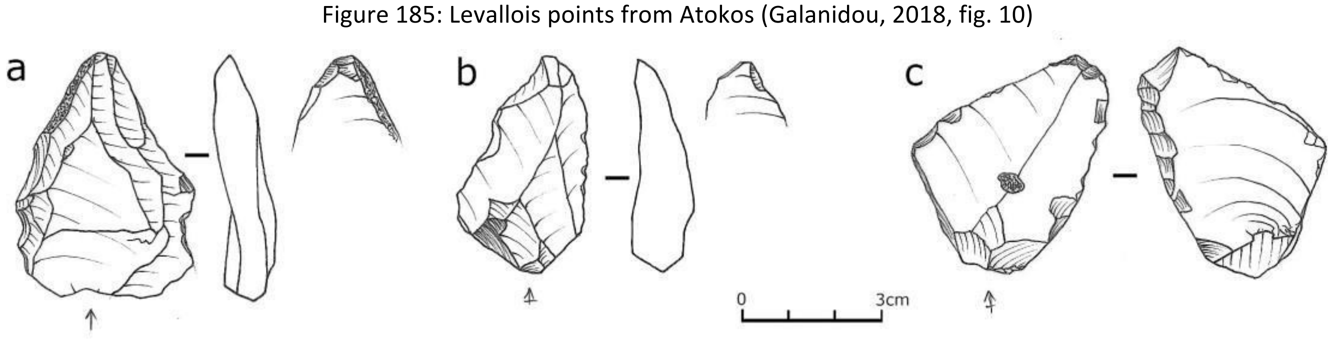


Figure 186: Levallois (a-b) and pseudo-Levallois (c) points from Atokos.

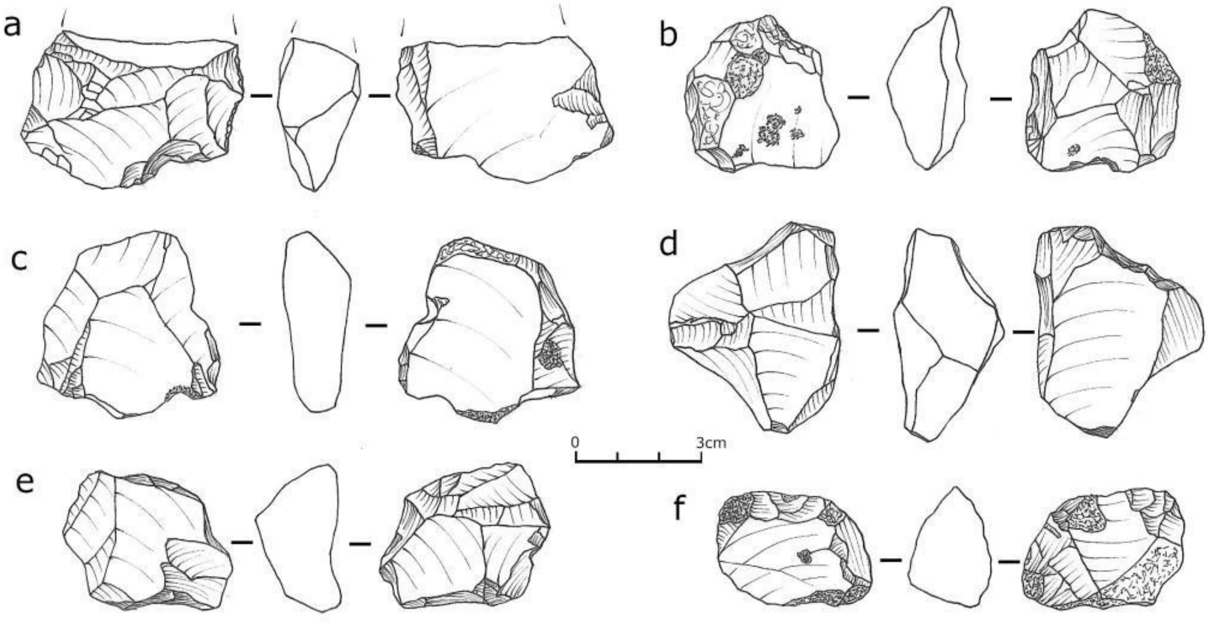


Figure 187: Prepared cores from Atokos

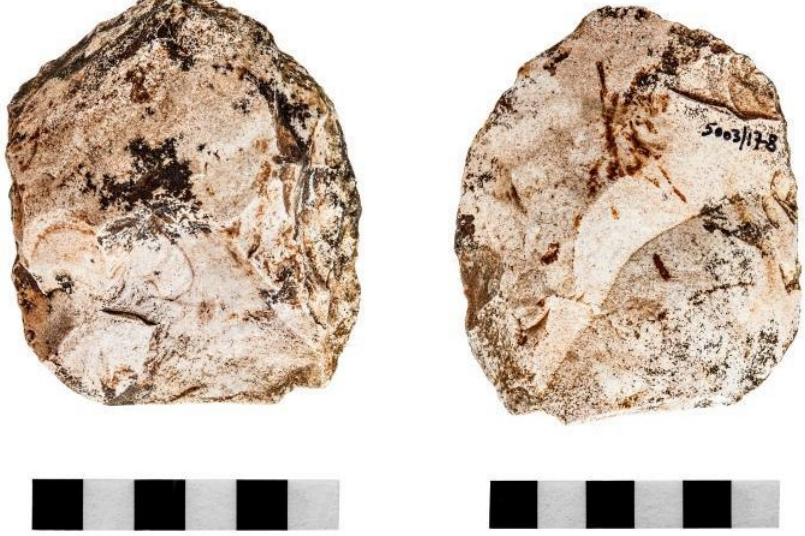


Figure 188: Heavy-duty tool made on chert, from Atokos (5003/178) (©IISAP photographic archive).

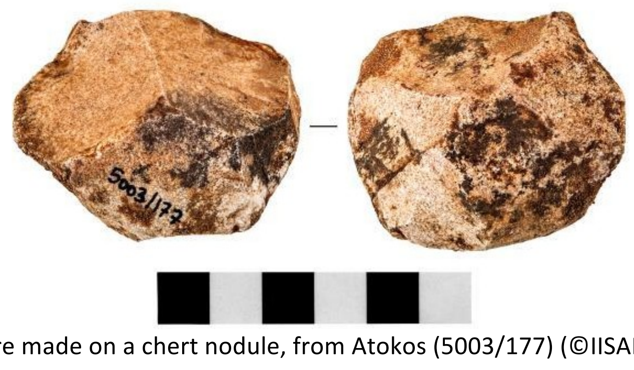


Figure 189: Discoid core made on a chert nodule, from Atokos (5003/177) (©IISAP photographic archive).

Flakes and laminar flakes made on fine- and coarse-grained flint as well as chert, with centripetal, convergent or parallel scars and various degrees of surface alterations, including a heavy white patina (and in one case light pink 5002/70), extreme weathering and desilicification, have thick, albeit usually flat butts (Figure 190-Figure 191). A double bulb is observed on one of the chert flakes (Figure 192d) and on the largest and desilicified flake made on coarse-grained flint (Figure 192a). The few dihedral platforms are observed both on the chert (Figure 192c) and flint (Figure 193d) artefacts. Possible but less diagnostic Middle Palaeolithic artefacts include flakes and retouched flakes, as well as small discoid cores (Figure 194).

Figure 190: MP and MP? artefacts from Atokos made on fine-grained flint (a-i, l-n, r), coarse-grained flint (p-q) and chert (j-k, o, s-t) (©IISAP photographic archive).

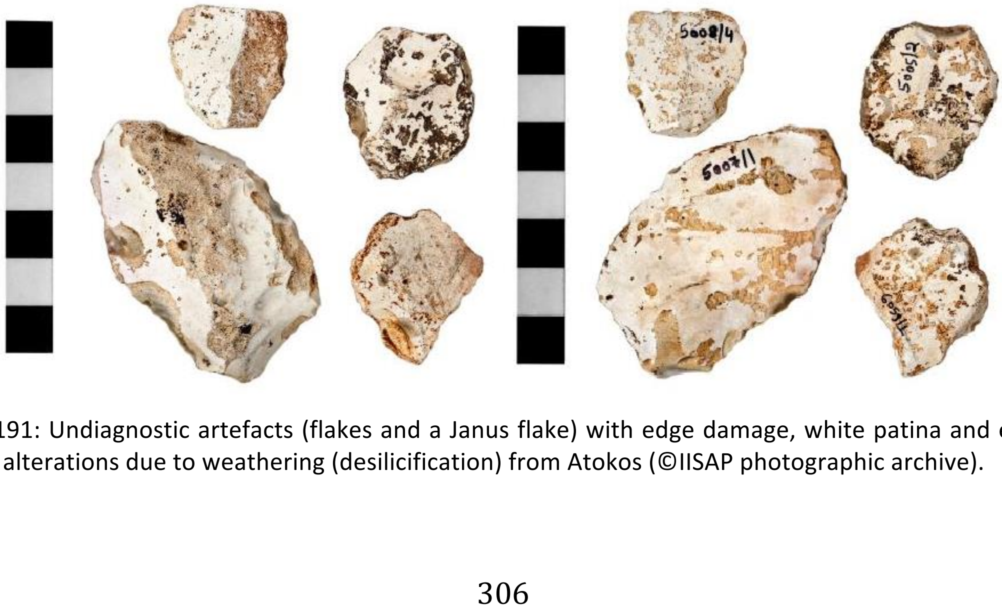


Figure 191: Undiagnostic artefacts (flakes and a Janus flake) with edge damage, white patina and extreme surface alterations due to weathering (desilicification) from Atokos (©IISAP photographic archive).

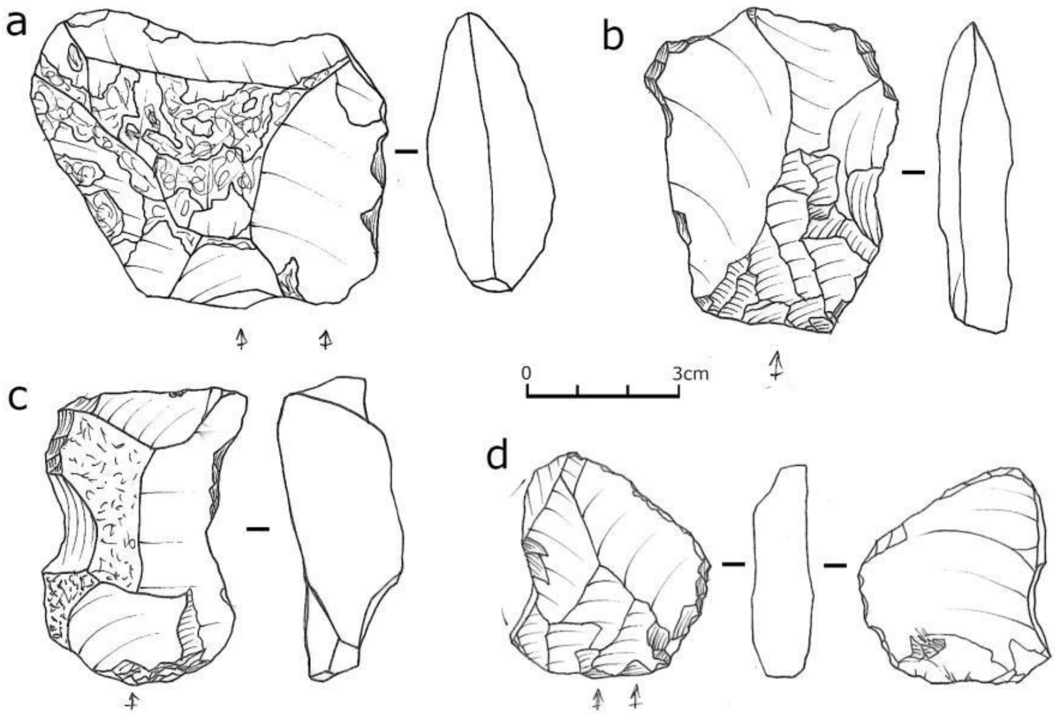


Figure 192: Flakes with flat (a-b, d) or dihedral (c) butts, all made on chert, from Atokos.

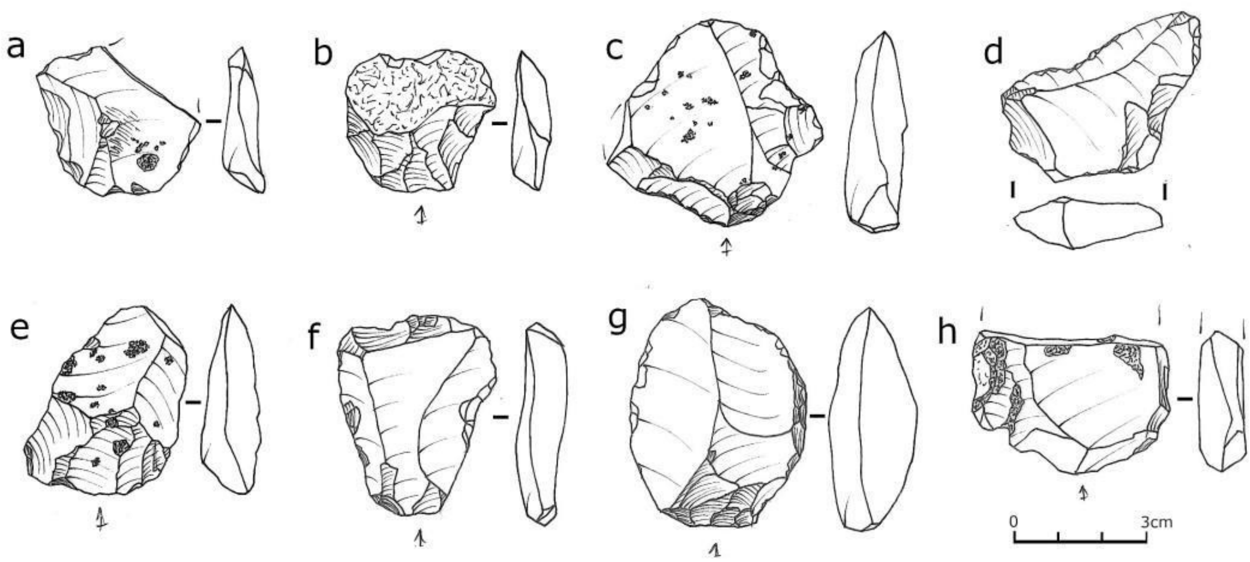


Figure 193: Flakes made on fine-grained flint, from Atokos.

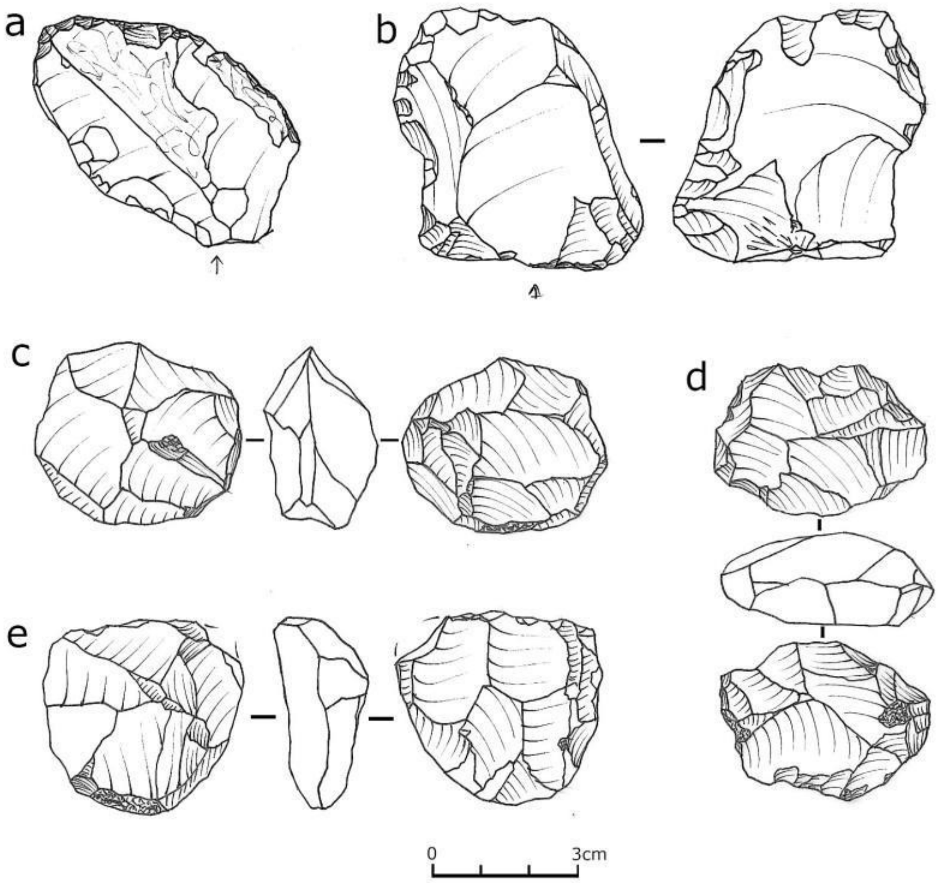


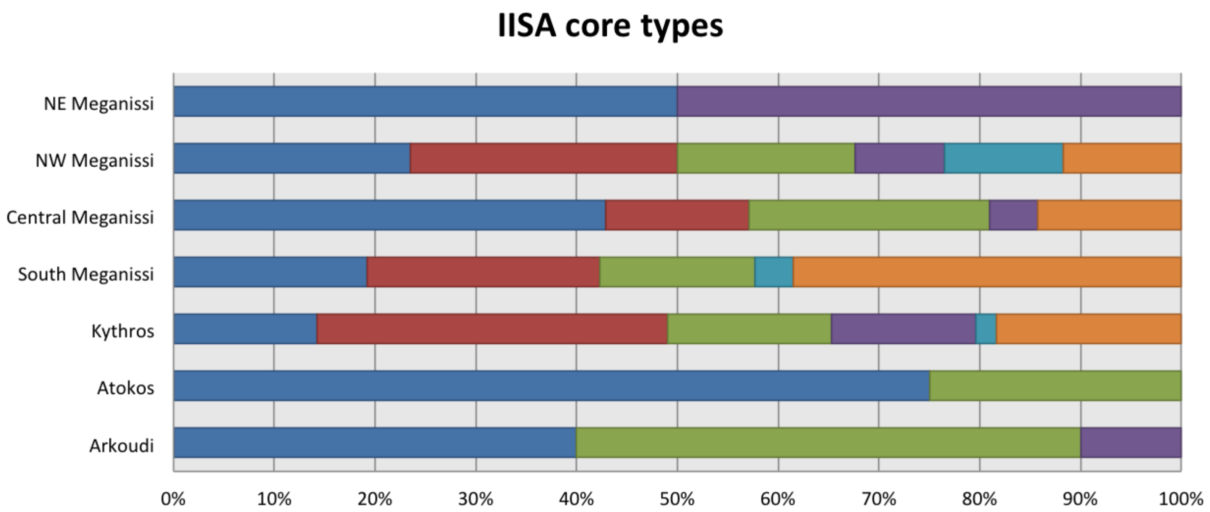
Figure 194: A heavily weathered flake (a), an inversely retouched flake (b) and discoid cores from Atokos.

4.5.7. Synthesis and Interpretation

4.5.7.1. Technology – Behaviour

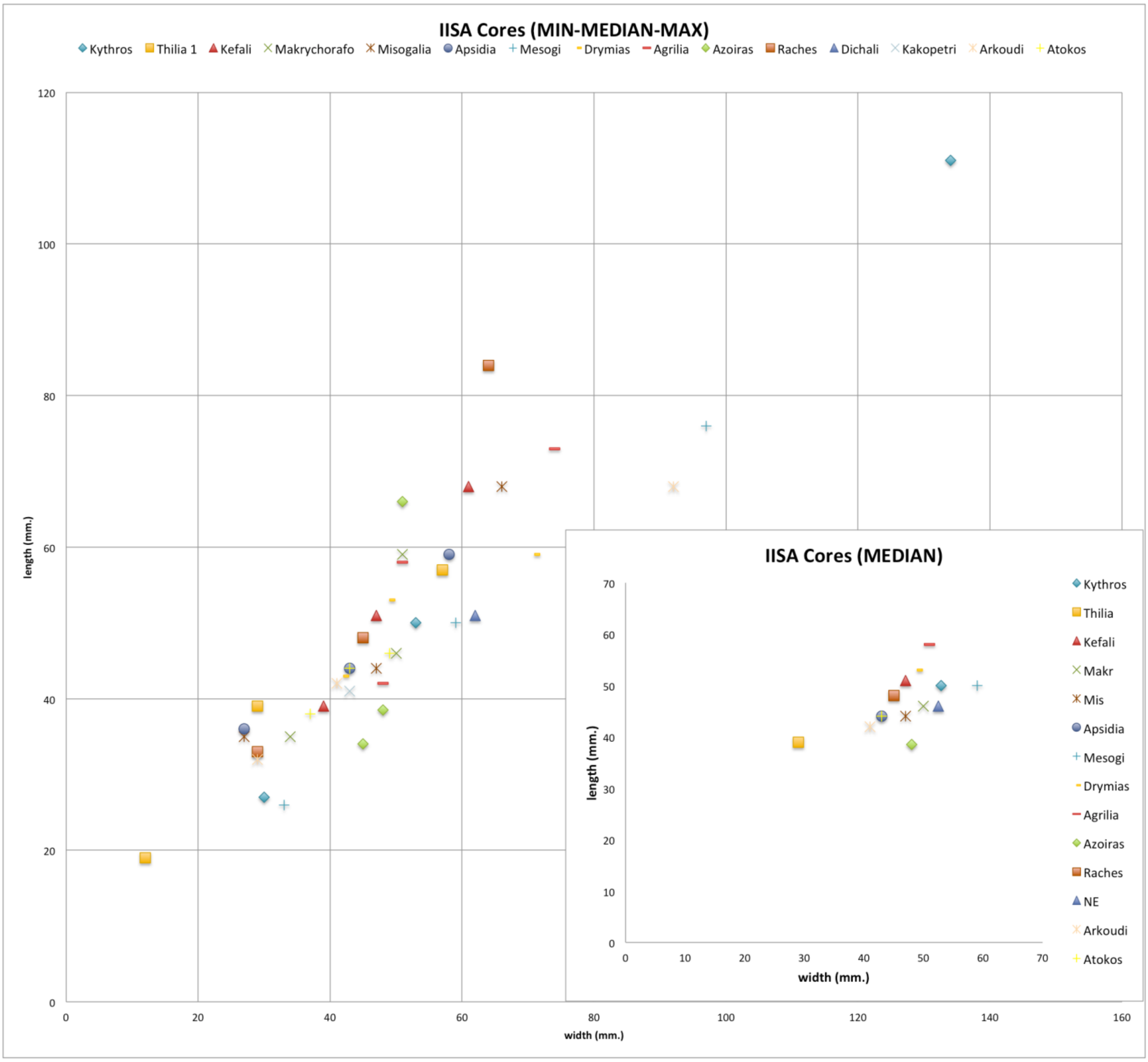
4.5.7.1.1. Core reduction sequences

Fine-grained and coarse-grained flint nodules, procured from the local raw material sources which are still observed on the present day islands, were reduced by means of the prepared core technique (lineal/recurrent/convergent Levallois), or by producing a fixed (or semi-fixed) perimeter around the core and extracting flakes centripetally (discoid). Sometimes centripetal reduction is observed on very thin cores (discs) which are either reduced bifacially or preserve their natural surface, usually cortex, on the lower face (Mousterian discs). Cores with one or two prepared platforms producing laminar flakes/blades are also present, yet the majority of the cores found are flake cores. Levallois cores and small disc cores were collected from most survey regions (apart from NE Meganissi for the disc cores, Thilia and Tsokari for both core types). Discoid cores were also found at Atokos and Arkoudi, yet their atypical morphology precluded us from including them in their Middle Palaeolithic component, since these could as well be part of a later prehistoric component of the islands (Graph 137).



	Arkoudi	Atokos	Kythros	South Meganissi	Central Meganissi	NW Meganissi	NE Meganissi
Levallois	4	3	7	5	9	8	1
Discoid	0	0	17	6	3	9	0
Disc	5	1	8	4	5	6	0
unipolar	1	0	7	0	1	3	1
bipolar	0	0	1	1	0	4	0
other	0	0	9	10	3	4	0

Graph 137: Types of cores encountered at the different IISA regions

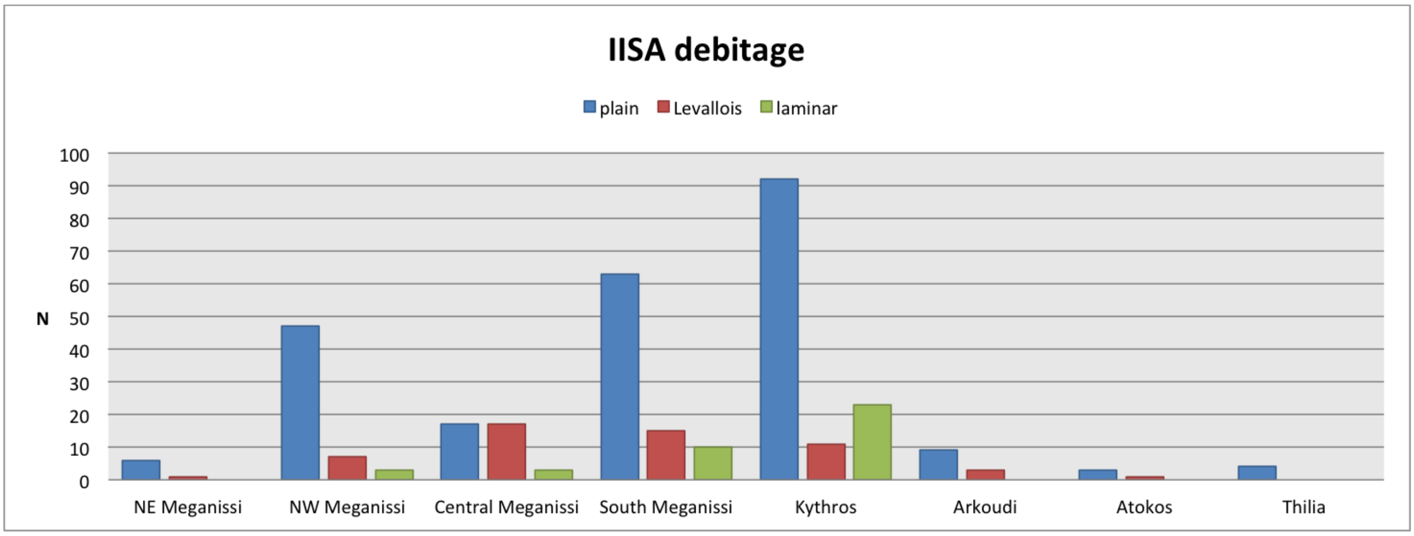


Graph 138: Scatter plot with the dimensions of cores from the IISA regions. All cores included are attributed to the Middle Palaeolithic component of each site, apart from Thilia 1.

A great range of core sizes are observed at Kythros, where the smallest and the biggest core of the survey project were collected from (Graph 138).[22] Median dimensions of cores (length and width) are between about 40-60mm. On average, the longest cores come from NE Meganissi (Agrilia and Drymias) and the widest ones from Central Meganissi (Mesogi). The median size of cores from Atokos and Apsidia are almost identical and slightly larger than

[22] Thilia 1 is included in the chart only for comparative reasons, since its assemblage has been attribute to the early Holocene (Mesolithic/Neolithic).

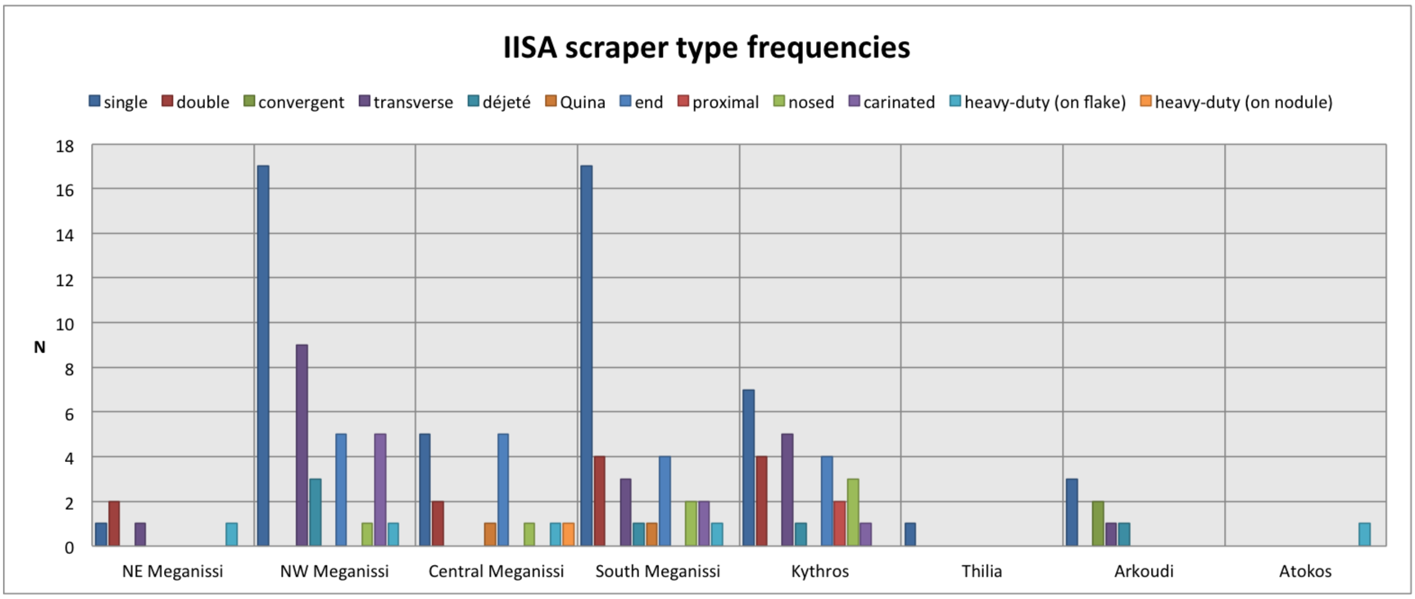
the ones from Arkoudi. The debitage is generally dominated by plain flakes, followed by Levallois and laminar flakes (Graph 139). Laminar flakes that can be attributed to the Middle Palaeolithic are not reported from NE Meganissi and from the islands of Arkoudi, Atokos and Thilia. The biggest Levallois proportion is encountered at Central Meganissi, in particular at Mesogi.



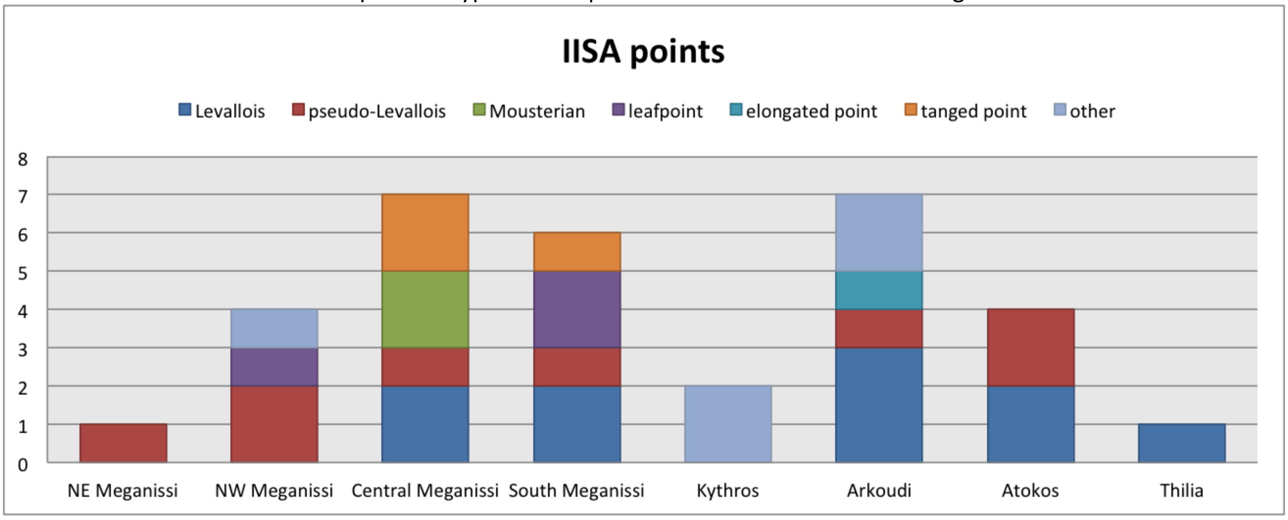
Graph 139: Percentage of the types of debitage found at the IISA. Levallois debitage includes the Levallois laminar flakes.

4.5.7.1.2. Tool kits

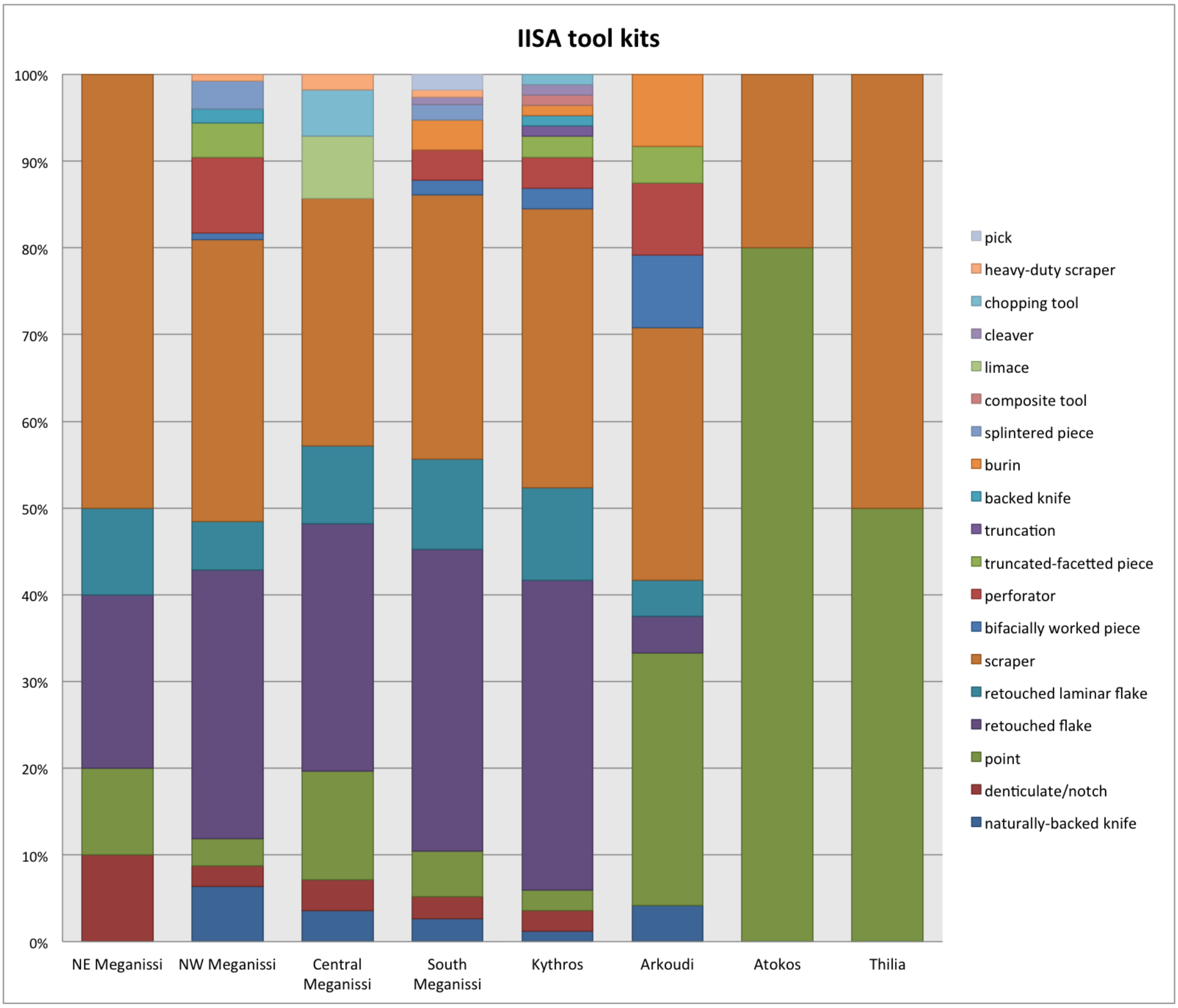
The predominant tool type in all isles and islets is the scraper. Variations include single, double, transverse, *déjeté*, end-scraper and nosed scraper (Graph 140). Points are occasionally encountered, mainly at the central and south parts of Meganissi, as well as on Arkoudi. These are mostly Levallois, pseudo-Levallois or Mousterian points, yet there are also a few bifacially worked points and several “atypical” points (Graph 141). Tool kits in all regions are predominated by scrapers and retouched flakes (Graph 142). Other tool types include naturally-backed knives, denticulated tools, perforating tools (piercers, awls, becs), and just a few burins. Larger assemblages include a larger variation of tool types. Heavy-duty tools, i.e. chopping tools, thick scrapers and cleavers were found at places like Mesogi and Kythros, where large lithic assemblages include all types of artefact categories as well as a great variety of formal tool types. Such a heavy-duty tool was also found on Atokos (Figure 188).



Graph 140: Types of scrapers found at the different IISA regions



Graph 141: Types of points found at the different IISA regions



Graph 142: Tool kits at the different IISA regions

4.5.7.1.3. Behavioural inferences and spatial distribution

In terms of behavioural inferences based on the types of tools found, there seems to be no particularly discernible pattern, e.g. concentration of points implying a hunting stand, or a significant presence of cores/debitage combined with an absence of formal tool types that could imply the use of a particular place as an artefact production site. A hypothesis is that either all types of activities were taking place at the sites discussed, or that the erosional processes and tectonic activity have altered the initial character of the sites, providing an obscured picture of (a) the initial place of discard, (b) the geographic boundaries of the actual Pleistocene sites and (c) what was originally happening in each one of the sites. The homogeneous carpets of lithics found, particularly at places like Kythros or Mesogi, might as well be totally insignificant if we are looking to interpret potential *in situ* activities and associated behavioural inferences.[23] Contrary, these may be totally «new» sites, in the sense that stone assemblages in many cases have followed the natural processes of gravity and erosion, travelling – together with the sediments incorporating them – to lower, flat areas or small basins and plateaus or follow the water streams and the paths produced by animals' activity. When looking at the spatial distribution map of the Middle Palaeolithic and the Upper Palaeolithic, we do not see significant differences (Figure 195). The Middle Palaeolithic distribution map includes a few more sites, yet in reality, the total numbers of the artefacts attributed to the Middle Palaeolithic by far exceed the limited and sporadic presence of diagnostic Upper Palaeolithic tool types. These consist primarily of tools with early Upper Palaeolithic traits, often attributed to the Aurignacian.

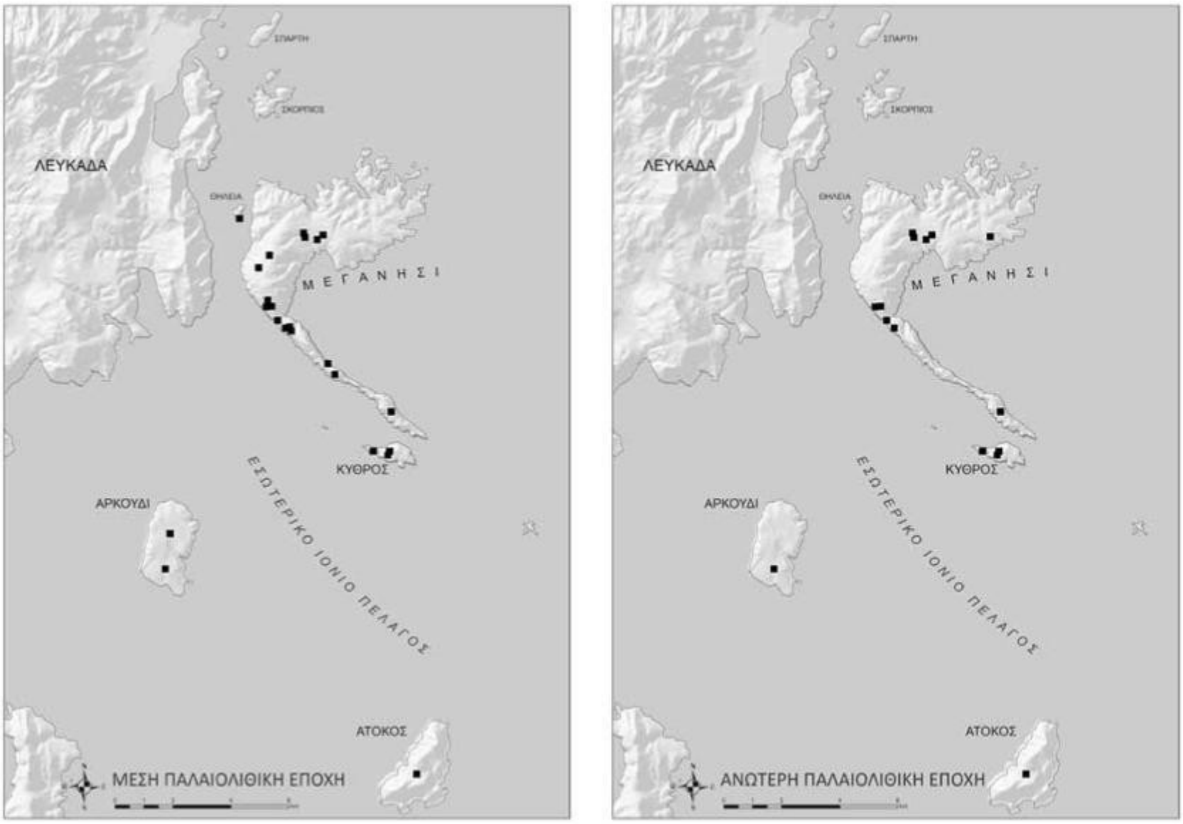


Figure 195: Spatial distribution of the Middle Palaeolithic (left) and the Upper Palaeolithic (right) sites at the IISA islands (Galanidou et al. 2017b, fig. 7).

The Aurignacian technocomplex appears in Europe before the significant climatic oscillations which developed into the Last Glacial Maximum. Thus, the geomorphological changes occurring in the late Middle Palaeolithic and the early Upper Palaeolithic

[23] The only exception being the collapsed cave site at Kythros 1, which is not part of this study.

(Aurignacian) would be minimal, when compared to the later phases. This is, perhaps, one of the reasons why the two spatial distribution maps exhibit similar patterns.

In sum, the picture we face today is basically a result of the erosional, post-depositional processes occurring diachronically and altering the character of the sites together with the boundaries of the sites themselves and any potentially significant spatial distribution patterns. Yet, in the macroscale, the presence or absence of diagnostic Middle Palaeolithic artefacts on each one of the present-day islands provide information on broader aspects of spatial distribution, including dispersal patterns, and associated behaviour (see 4.7).

4.5.7.2. Industrial and chronological attributions

No absolute dates are yet available from any of the sites mentioned in this chapter, apart from the interim report for Thilia 1, which yielded an early Holocene date, and the Kythros 1 collapsed cave site, which returned two luminescence dates placing the upper unit at the end of the Middle Pleistocene at around 200 ka BP (Sakellariou and Galanidou, 2017). More samples coming from the collapsed Pleistocene cave at Kythros island are expected to be published in the near future, yet, until then, and since no organic remains were recovered from the survey, the only available source of chronological attributions rests on the technological and typological attributes of the lithic assemblages.

The numerous unstratified lithic finds from open-air sites are usually classified as Middle Palaeolithic when particular technological and typological criteria are met. The prepared core technique has generally been regarded as the most distinctive trait that differentiates the Middle from the Lower Palaeolithic period in terms of lithic technology. Although rudimentary prepared core techniques are present in Lower Palaeolithic sites in Europe and Africa, the Levallois is considered the prepared core technique *par excellence* and the most diagnostic element of the Middle Palaeolithic (Adler et al., 2014; Foley and Lahr, 1997; White and Ashton, 2003). Prepared core techniques produced by early *Homo sapiens* coexist in temporal and sometimes spatial terms with the typical Levallois products fashioned by the Neanderthals. The Nubian prepared cores of NE Africa and Arabia (Osypiński and Osypińska, 2015; Usik et al., 2013; e.g. Van Peer et al., 2010), for instance, are associated with our own species, while the Levallois technique in the Levant seems to have been produced both by the Neanderthals and early *Homo sapiens* (Shea, 2003; Hershkovitz et al., 2018).

Although the use of the Levallois is not restricted to a particular type of raw material, in Greece it is most frequently identified on fine-grained siliceous rocks such as flint and chert, while the discoid technique is found on both fine- and coarse- grained materials (e.g. Ligkovanlis, 2011; Panagopoulou, 1999; Papaconstantinou, 1988; Papagianni, 2000; Papoulia, 2011; Runnels and van Andel, 2003, 1993b). Discoid cores are, however, produced diachronically, i.e. from the Early Pleistocene to the Holocene; thus in the cases of unstratified surface collections with no other diagnostic elements the chronological attribution of discoid products may be problematic (Papoulia, 2017).

The presence of diagnostic tool types as well as technological characteristics such as core reduction techniques indicate a clear Middle Palaeolithic presence on most of the islands of the IISA. In particular, Meganissi and Kythros provided the most abundant examples of Middle Palaeolithic artefacts, while there were only a handful of diagnostic artefacts on Thilia, a single artefact with Middle Palaeolithic attributes on the smaller islet of Tsokari and a limited presence of possible Middle Palaeolithic artefacts on the southernmost island of the archipelago, Atokos. The island of Arkoudi, situated at the southwest part of the IISA, yielded an important amount of artefacts with technological characteristics typically associated with the Middle Palaeolithic period (Mousterian tool-types, Levallois & discoid reduction techniques). Yet, some of them could be described as of exhibiting late Middle Palaeolithic/early Upper Palaeolithic affinities. These finds indicate the extent of the Middle Palaeolithic territory and, when placed within their palaeogeographic context (4.6), are manifestations of the land use as well as the terrestrial and marine journeys (4.7) which took place during the period under investigation.

Diagnostic Middle Palaeolithic tool types include several types of scrapers (e.g. single, double, transverse, Quina etc.) and points (e.g. Levallois, Mousterian). However, more frequently significant are the blanks used for the production of formal and non-formal tool types. Tools made on Levallois blanks or pseudo-Levallois points for instance, are strong indications of a Middle Palaeolithic industrial and chronological attribution.

As it has already been discussed (4.5.7.1), in terms of core reduction sequences, there is strong evidence for the use of the Levallois technique, supplemented by the use of the discoid technique. Such a pattern is evident in a number of Middle Palaeolithic sites all over the Greek peninsula, both in sheltered sites and in the open-air. The sporadic presence of

Upper Palaeolithic tool types (e.g. endscraper, burin) and heavy-duty Lower Palaeolithic tool types (e.g. cleaver, chopping tool) may either indicate a co-existence of different industrial and chronological categories – thus a diachronic use of the sites, or an incorporation of the particular tool types within an early or late Middle Palaeolithic industry. Upper Palaeolithic tool types (*sensu* Debenath & Dibble 1994) are commonly found within Middle Palaeolithic assemblages. Similarly, it has long been demonstrated that Lower Palaeolithic tools types such as bifaces, chopping tools and cleavers, can in several cases coexist with the use of the Levallois technique and characteristic Mousterian tool types (Bordes, 1961b). Such tools have been found in stratified contexts in NW Greece, both in the open-air (Kokkinopilos), and in cave sites (Theopetra). More examples come from unstratified open-air Middle Palaeolithic sites from the wider area of western Greece (for a discussion on the presence of bifaces within MP contexts in Greece see Galanidou et al., 2016b; Papoulia, 2017). At the IISA, an early Middle Palaeolithic aspect rather than a Lower Palaeolithic one can be proposed for the limited presence of large cutting or chopping tools at Kythros (Figure 156-Figure 157), especially when associated with the presence of the large prepared core made on a chert flake (Figure 155) and with the preliminary results from the collapsed cave at Kythros 1. Similarly, it is possible that the "early-looking" artefacts from the central part of Meganissi, i.e. Mesogi and Schiza, are also snapshots of such an early Middle Palaeolithic presence in the region. The limited, yet significant, presence of a large Levallois core and a large cutting tool made on chert from Karyotes, a site situated at the NE part of Lefkas island (Galanidou et al., 2016a, fig. 8; 12) and similar artefacts from the islands of Kefalonia and Zakynthos, situated further to the south of the Ionian Sea (see Chapter 5), all contribute to the consolidation of such a hypothesis. Notwithstanding, the possibility of a Lower Palaeolithic component to remain hidden within a more diagnostic Middle Palaeolithic one, should not be totally ruled out, especially since both islands, i.e. Meganissi and Kythros, would have been part of the mainland and the aforementioned sites would be easily approached via terrestrial routes.

4.6. Palaeoshoreline reconstructions

Information about the geographic configuration of the IISA can be obtained from the recent palaeogeographic reconstruction of the central Ionian Islands by Ferentinos et al. (2012) but also from the results of the seabed exploration by the Hellenic Centre for Marine

Research (HCMR) in collaboration with the UoC's terrestrial geoarchaeological project at the region (Zavitsanou, 2016; Zavitsanou et al., 2015). Based on the sea-level reconstructions by the team from the University of Patras, the majority of the islands were connected to the mainland during most of the Pleistocene, the only exception being Atokos and Arkoudi (Figure 196). The particular study includes reconstructions for 100ka, 60ka, 30ka, 18ka, 10ka and 8ka BP yet it does not take into account the 'tectonically driven modification of the seafloor' (Ferentinos et al., 2012, p. 2172). The most recent results by Zavitsanou et al. (2015) provide two reconstructions, one at 60ka and one at the LGM (at about 20ka BP). While the first one agrees with the previous models, the later one depicts the islands of Arkoudi and Atokos connected to the shores of Lefkada and Akarnania respectively (Figure 197).

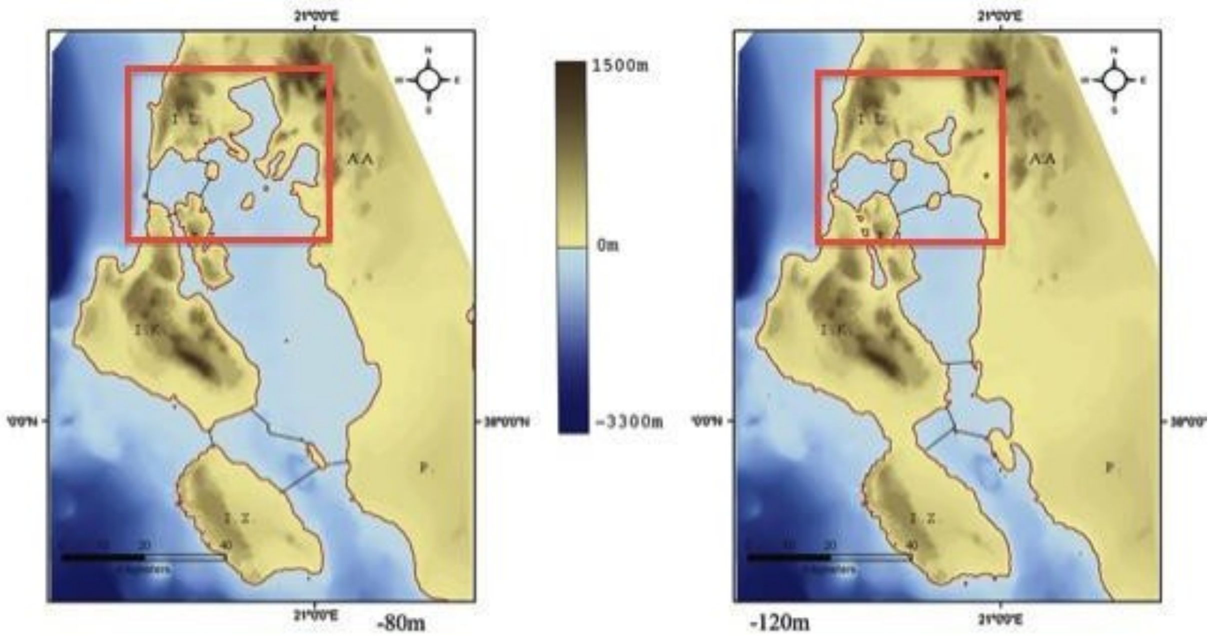


Figure 196: Reconstructions of the central Ionian Islands at 60ka and at 18ka BP. Red box portrays the broader area of the IISA which was also presented in the reconstructions by Zavitsanou et al. 2015 (modified after Ferentinos et al., 2012, fig. 8).

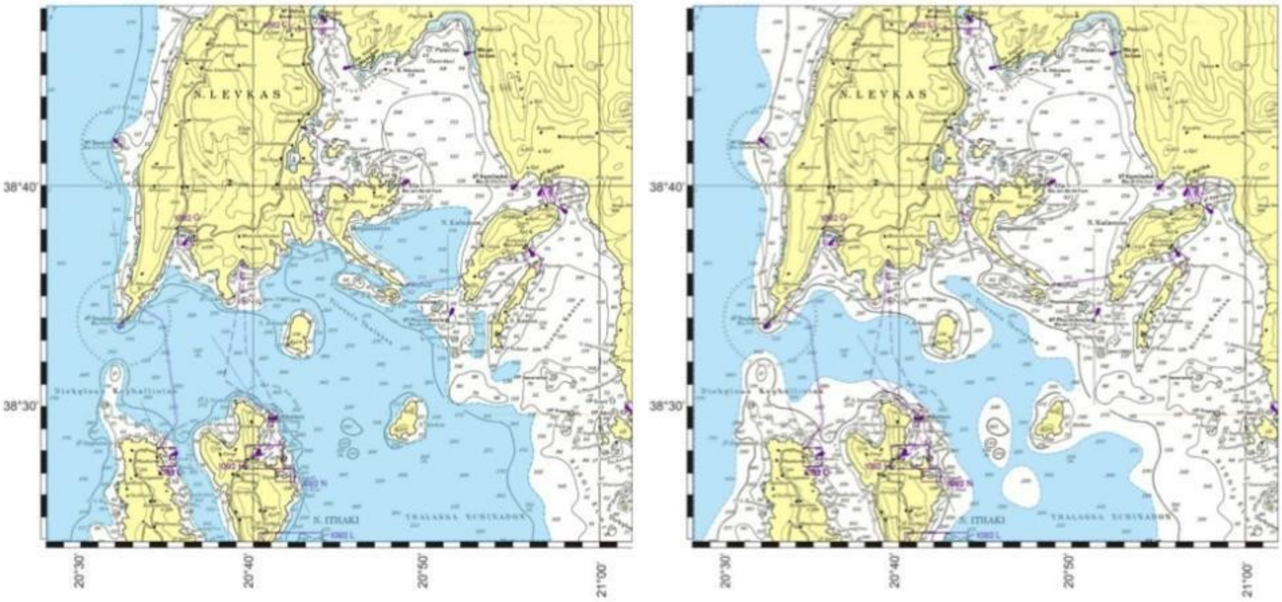


Figure 197: Reconstructions of the IISA at 60ka BP and at the LGM (c. 20,000BP) (after Zavitsanou et al., 2015, fig. 4).

In view of the available reconstructions the presence of a land bridge between Meganissi, together with its satellite isles and islets, and the shores of Lefkas is incontestable at least between the Late Pleistocene and the LGM, i.e. from approximately 100ka to about 20ka.[24] As for the southern islands of Atokos and Arkoudi, it seems that their insularity has been demonstrated for most part of the Late Pleistocene even if these might have not been insular during the LGM. The importance of both studies is that they reveal that during MIS 2, MIS 4 and MIS 6, the islands of Kefalonia, Zakynthos, Ithaki, Atokos and Arkoudi were indeed separated from the mainland, thus, any lithic finds attributed to the Middle Palaeolithic are indications of marine rather than terrestrial crossings.

4.7. Dispersal patterns

The area of the IISA is an ideal case study for both terrestrial and marine crossings since the present palaeogeographic configuration differed significantly during the Pleistocene. As discussed above, during the Middle Palaeolithic, all islands apart from Atokos and Arkoudi were connected to the mainland. Thus, any lithic evidence coming from them is an indication of terrestrial crossings via the land bridges which are now submerged. On the other hand the evidence from Atokos and Arkoudi are potential manifestations of small-scale sea crossings in the enclosed Pleistocene sea of the IISA (Figure 198). These two

[24] LGM=between 19ka and 23ka.

islands, apart from being the ultimate places of arrival, they would have also certainly played the role of stepping-stones in order for Pleistocene hominins to reach the larger islands of Ithaki, Kefalonia and eventually Zakynthos, on their way from Lefkas or the Akarnanian coasts (Papoulia, 2018a; Papoulia, 2017, 2016). Since the end of the Middle Palaeolithic occupation in Greece has been dated to c. 40ka and because Atokos and Arkoudi would have been surrounded by sea throughout most (if not all) of the period, the few but important artefacts from these southernmost islands, presented in paragraphs 4.5.5 and 4.5.6, need to be treated as part of the bigger discussion in terms of marine dispersals during the Pleistocene.

Figure 198: View from Kefali, Meganissi towards the SW. Island names and arrows added on a photo taken by photographer Costas Zissis, September 2013 (©IISA photographic archive).

The sea-crossing scenario during the Middle (and the Lower) Palaeolithic is a new and controversial issue in Palaeolithic Archaeology and one that has raised significant questions related to the nature of the evidence and the extent of the interpretative potency. The next chapter (Chapter 5) examines the available evidence for sea-crossings in the NE Mediterranean by providing a thorough and exhaustive evaluation of the already published material from islands of the Ionian and the Aegean Sea, and their related arguments, in view of the latest palaeoshoreline reconstructions. The last and concluding chapter (Chapter 6) discusses the incorporation of the new data to the existing record of archaeological evidence for terrestrial routes that are now submerged and for the sea-crossings that seem to have taken place during the Late Pleistocene, but before the LGM.

5. Lithics from the islands: synthesis and evaluation of the current state of knowledge

5.1. The Ionian Islands

5.1.1. Zakynthos (Zante)[25]

The first report about Palaeolithic artefacts from the island of Zakynthos comes from the late 19th century. During their geological survey in 1893, Issel and Agamennoni spotted a small number of siliceous artefacts, in a plain near Cape Yerakas, SE Zakynthos (Figure 199). The presence of chipped stone artefacts together with flint pebbles and other geological formations (i.e. limonite and manganese) was interpreted as a result of the eroded Pliocene and Miocene deposits of the area (Issel and Agamennone, 1894). According to the Italian geologists, the sample included scrapers and knives, which were attributed to the Palaeolithic both due to their technological characteristics and their state of preservation (i.e. degrees of patina).[26] Since then, more geological studies provided information about the peninsula of Vassilikos, where a number of sites are situated (see 5.1.1.1).

Later on, the Netherlands Institute in Athens conducted further fieldwork on the island, with a pilot survey in 2005 (van Wijngaarden et al., 2005) and a systematic one, called the *Zakynthos Archaeology Project (ZAP)* between 2006 and 2012 (2013, 2010, 2009, 2008, 2006). In the course of these investigations, under the direction of Dr Gert Jan van Wijngaarden, in collaboration with archaeologists from the Greek Ministry of Culture, i.e. Xeni Arapogianni[27] in 2005, and since 2006 Andreas Sotiriou,[28] a large number of lithic artefacts were collected. According to the annual reports of the project, 10,000 lithic artefacts from three areas (A, B and C) of the SE part of the island were collected (van Wijngaarden et al., 2013).

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[25] Names in brackets are different versions for the same island as encountered in the literature

[26] Issel & Agamennoni 1984, p. 15: "*Presso la riva situata a mezzogiorno de Batelli, in vicinanza del Capo Geraca, si trova un territorio pianeggiante, il quale risulta precipuamente di arena commista a ciottoli silicei e ad innumerevoli pisoliti limonitiche e manganesifere. Siffatti materiali provengono tutti dallo sfacelo e dalla erosione dei prossimi colli pliocenici e miocenici. In questo territorio si trovato pure numerose selci scheggiate, cioe schegge informi, raschiatoi e coltellini, che credo dover ascrivere alla fase paleolithica, tanto pei tipi cui appartengono, quanto per la patina onde sono coperti. Si tratta pero di manufatti riferibili ai tempi meno antichi di detta fase, che io denominai altra volta miolitici.*"

[27] 7th EPCA

[28] 35th EPCA

As part of the same project, Vangelis Tourloukis, then a PhD student at Leiden University, conducted geoarchaeological fieldwork in the course of his studies between 2005 and 2009 (Tourloukis, 2010). His observations are of great significance to the interpretation of the assemblages from the island of Zakynthos and need to be taken into account when interpreting the Pleistocene archaeology of the rest of the Ionian Islands as well.

Figure 199: Map of the Central Ionian Islands with important Pleistocene sites annotated. Map produced with ArcGIS.

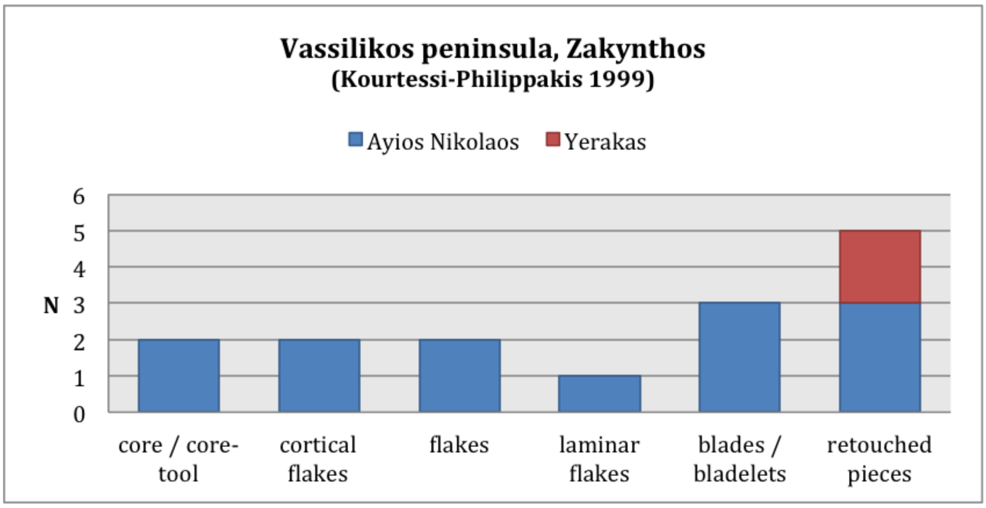
5.1.1.1. Vassilikos Peninsula

5.1.1.1.1. Yerakas

Assemblages consisting of flakes, flake tools and pebble tools were collected from sites formed of sediments of marine origin (Dermitzakis et al., 1979), situated on the SE part of the peninsula of Vassilikos, between 1990-1991 in the course of geological fieldwork by D. Sorel (Kourtessi-Philippakis, 1999; Kourtessi-Philippakis and Sorel, 1996). Although the geologists located several sites, two of these have attracted the attention of the archaeologists and were briefly discussed in the preliminary report by Kourtessi-Philippakis (1999), i.e. the site of Yerakas, situated on Yerakas beach and Ayios Nikolaos, situated on a bay by the Cape of Ayios Nikolaos. In that first introductory study of the material, only two specimens from Yerakas were included, i.e. a sidescraper and a Mousterian point (Figure 200.13-14) and associated with the "Moustero-Levalloisian" industries (Kourtessi-Philippakis, 1999, p. 286), while more information can be derived for the site of Ayios Nikolaos.

5.1.1.1.2. Ayios Nikolaos

The lithics from Ayios Nikolaos consist of small pebble tools, flakes and flake tools with a few blades and blade tools also present (Kourtessi-Philippakis 1999). A total of 13 artefacts are illustrated in the preliminary report (Figure 200.1-12; Graph 143). The raw material used for the majority of the artefacts from the site, i.e. the small flint pebbles, can still be found in the marine terrace. Based on the preliminary analysis of the material, it has been proposed that this area would have acted as a secondary raw material source where the small flint pebbles would have been procured and knapped *in situ*, as the presence of cortical flakes, flakes with natural backs and cores at initial stages of preparation indicate (Kourtessi-Philippakis, 1999). The sharp edges and ridges and the absence of surface alterations (Kourtessi-Philippakis, 1999) indicates that the particular assemblage did not undergo severe geological transportation; in other words, these tools did not travel far from the place of their initial discard.



Graph 143: Frequency of Middle Palaeolithic artefact categories from Vassilikos peninsula (total N=15 artefacts, 13 from Ayios Nikolaos and two from Yerakas). The artefacts in the chart have been classified by the author based on the illustrations provided by Kourtessi-Philippakis, 1999, fig. 25.4.

An unknown number of artefacts that are in a different state of preservation, exhibiting "*surface alteration, red coloration, considerable desilification of the pieces and potlids due to thermal activity*" (Kourtessi-Philippakis, 1999, p.286) have been interpreted as belonging to a separate assemblage. Due to the above-illustrated state of preservation there was no attempt of typological classification of the retouched specimens but it has been suggested that the debitage is a flake-oriented one, and the raw material used would have been of larger size, thus the technological products are of larger scale.

Comparanda for the material from Ayios Nikolaos have been traced in the alluvial plain of Elis, which is adjacent in geographical terms since it is situated in the northwestern part of Peloponnese, Nea Skala, situated in SE Kefalonia and Latium, Southern Italy (Kourtessi-Philippakis, 1999). More specifically, affinities with the Pontinian Mousterian of the caves of Guattari, Fosselione, Sant'Agostini and Moscerini (Kuhn, 1995) have been proposed by Kourtessi-Philippakis (1999) not only for the assemblages from Ayios Nikolaos on Zakynthos, but also for the material from Nea Skala on Kefalonia (see 5.1.2.2).

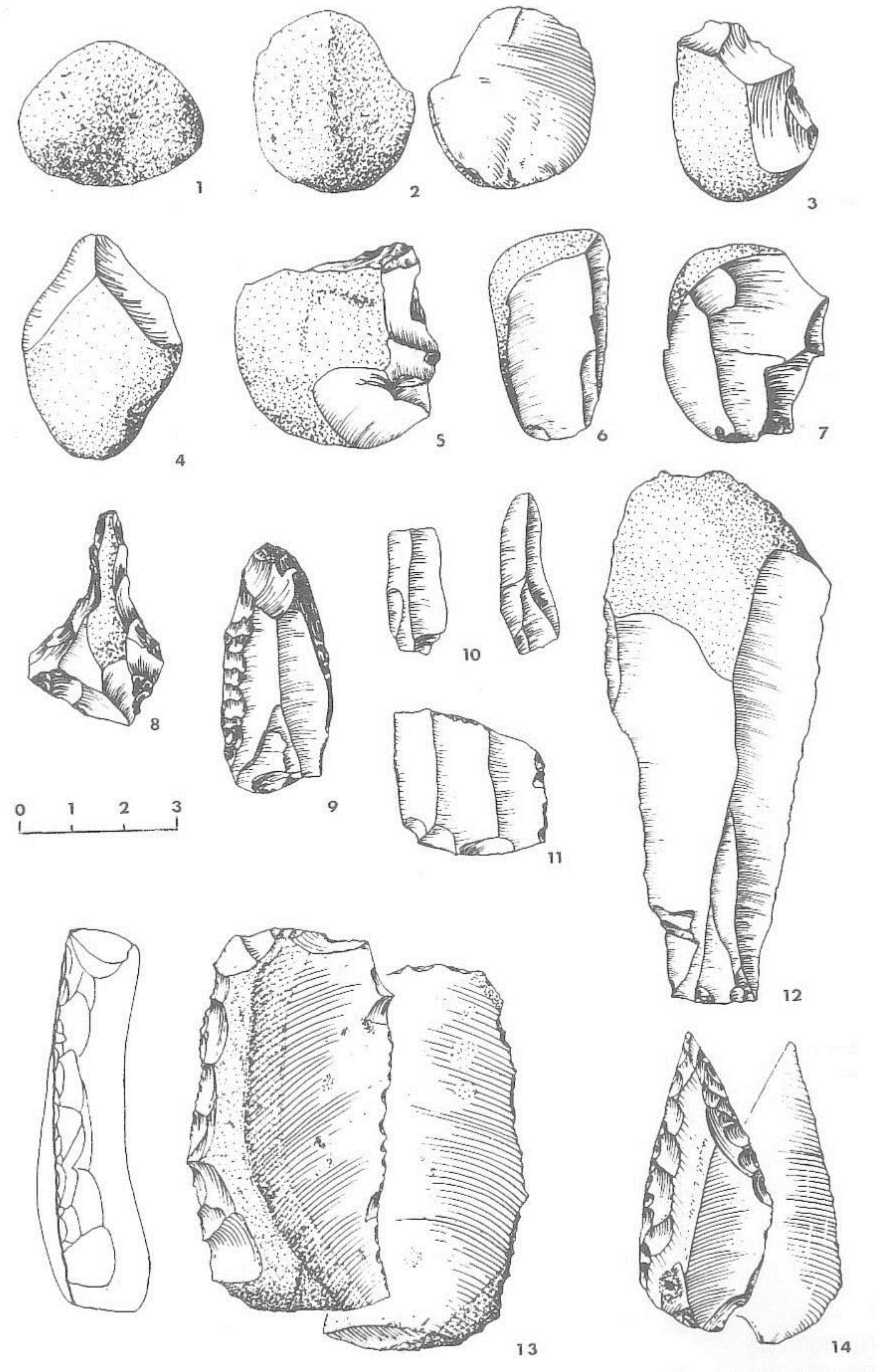


Figure 200: Middle Palaeolithic artefacts from Agios Nikolaos (1-12) and Yerakas (13-14) (Kourtessi-Philippakis, 1999, fig. 25.4)

5.1.1.1.3. Other findspots

Based on the annual preliminary reports of the ZAP, six more findspots at the peninsula of Vassilikos (Area C), other than Yerakas and Ayios Nikolaos, were identified. Amongst the many Palaeolithic artefacts, a few diagnostic Neolithic and/or BA tools (e.g. tracts 2006 and 3006-3009 at the peninsula of Yerakas) and pottery sherds were also reported (van Wijngaarden et al., 2006, p.36-37; 2010, p.49-51; 2013, p.133). Lastly, artefacts with "*remains of old patina that might be dated to the Middle Palaeolithic period"* as well as a number of pebble tools similar to the ones from Ayios Nikolaos have been reported from Cape Kaloyeros (von Stein and van Wijngaarden, 2012, p. 71), though no further details are yet provided. Apart from the artefact categories, which might be of a Palaeolithic date, there are also three blades that are possibly Neolithic (ibid.). However, caution in necessary in this case, since the area has yielded large quantities of Bronze Age pottery, thus it is highly likely that undiagnostic lithic artefacts, perhaps debitage pieces, might equally be of a BA date.

The Dutch team acknowledged the differences in the lithic assemblages between the three survey areas. According to these, the distinct characteristic of the assemblages from area C is the production of pebble tools. Two of the pebble tools published in the project's preliminary reports are interesting in terms of their preservation. Both are made on small pebbles with rolled cortex, yet although the one is unpatinated (or lightly patinated) with the initial olive colour of the flint still clearly observable and has very sharp edges, the other is heavily patinated to a degree that it is impossible to tell its initial colour and its edges seem relatively abraded (Figure 201). The predominance of pebble tools at the peninsula of Vassilikos was first noted by Sordinas (1970b) who observed affinities with pebble tools found at Sidari (Sordinas, 1970a) and Kyllini (Chavaillon et al., 1969; Leroi-Gourhan, 1964), dated to the Mesolithic and the Middle Palaeolithic respectively. It has already been mentioned that Middle Palaeolithic affinities were proposed by Kourtessi-Philippakis (1999) for the old assemblage from Ayios Nikolaos.

Figure 201: Pebble tools from the peninsula of Vassilikos, SE Zakynthos (van Wijngaarden et al. 2013, fig.5-6).

5.1.1.2. Machairado

Further to the west, the area south of the town of Machairado (Area B) has yielded the largest amount of lithics collected in the course of the ZAP (van Wijngaarden et al., 2013). The area consists of parts of the Vrachionas Mountains where natural flints are embedded in primary deposition in the limestone formations (Figure 202) (van Wijngaarden et al., 2013, 2008; Zelilidis et al., 1998). Several findspots were recorded in these mountains, most of which are in secondary deposition, since these were found on the very unstable slopes of the mountains. The only exception is an exposed palaeosol (probably due to the recent heavy bulldozing of the area) with a concentration of about 300 lithic artefacts situated in a flat plateau above the Achiouri Valley.

5.1.1.2.1. Kiliomenos

Soil samples for OSL dating were taken from an exposed palaeosol at the site of Kiliomenos in order to define whether the palaeosol is of a Pleistocene age (van Wijngaarden et al., 2008). The eastern slopes, the foothills and the area between the mountains and central plain have extensive Holocene deposits (van Wijngaarden et al., 2013). According to the 2013 report, OSL dating of one of the artefact-bearing deposits on the west slopes of the Vrachionas hills provided a date of 800BC, thus, evidently, the particular lithics could not be regarded as found *in situ* (van Wijngaarden et al., 2013). The lower parts of Area B yielded significant concentrations of lithics.

5.1.1.2.2. Mouzaki-Brouma

A total of 48 artefacts were collected from Mouzaki-Brouma (Site 21) in the pilot survey of 2005 and about 760 artefacts were added in 2008 when the site was reinvestigated as part of the ZAP survey. According to the geological study of the site, "*no substantial anthropogenic soil movements have taken place*" thus the lithics might as well be considered *in situ*; a hypothesis which needs to be confirmed by further geoarchaeological investigations (van Wijngaarden et al., 2008). The site had previously been mentioned by Kourtessi-Philippakis as site M1 (1993, p. 39) and the lithics were tentatively attributed to the Middle Palaeolithic with a few Neolithic specimens being present as well (van Wijngaarden et al., 2008; 2013).

Figure 202: A large flint nodule embedded in the limestone of the Vrachionas Mountains near Palaiokastro, Machairado (left) and lithic finds from Mouzaki-Brouma, tract 3369 (right) (van Wijngaarden et al. 2013, p.132, fig. 3-4).

5.1.1.2.3. Palaiokastro

The hill of Palaiokastro and particularly tract 4003 yielded a number of patinated lithic artefacts (Figure 203), which have been attributed to the Middle Palaeolithic and were associated with a palaeosol. Other than these, the geological formations of the east slopes of the hills are of a Holocene date. Sordinas (1970b, p. 128) had previously referred to a number of lithic finds from Palaiokastro, which he attributed to the EBA. At the same time, concentrations of lithic material were spotted at the Holocene deposits of the eastern slopes of the mountains with similarities with the Mouzaki-Brouma assemblages (van Wijngaarden et al., 2005, p.68-69; 2008, p.74; 2013, p.132). The presence of Middle Palaeolithic artefacts in Holocene deposits was interpreted as a result of post-depositional erosional processes and sedimentation (van Wijngaarden et al., 2013).

Figure 203: Lithic specimens from the palaeosol in tract 4003. Photograph adapted from van Wijngaarden et al. 2008, online report.

5.1.1.3. Keriou Lake

5.1.1.3.1. Kastello

In the late 1930s, H. Zapfe was the first to identify lithics associated with pottery sherds at the hill of Kastelli, north of Keriou Lake (Kourtessi-Philippakis, 1993; Sordinas, 1970b; van Wijngaarden et al., 2013; Zapfe, 1937). In the ZAP sites catalogue, Kastello-Keriou was first recorded as a Neolithic and Venetian site (van Wijngaarden et al., 2009) but later on as a Palaeolithic, Neolithic and Venetian one (van Wijngaarden et al., 2013, p. 158), yet no further details were provided.

5.1.1.3.2. Perlakia

Perlakia, a site situated NW of Keriou Lake have yielded large amounts of lithic artefacts (van Wijngaarden et al. 2009) with different types and degrees of patina (van Wijngaarden et al. 2013). The majority of the artefacts are made of grey flint with "*heavy reddish patina*" and are characterised by the production of flake blanks (Figure 204). The presence of radial dorsal scars on several of these flakes and the use of the discoid technique (van Wijngaarden et al., 2013, p. 135) might be a hint for a Palaeolithic age, yet in the preliminary reports this hypothesis has been vaguely implied rather than spelled out. Sordinas (1970b) had already reported that the Levallois technique is absent, a fact that has been verified by

ZAP (van Wijngaarden et al., 2013, p. 135). The presence of a group of artefacts with a blade technology and a different type of patina, i.e. white, as well as two small (or fragmented?) obsidian artefacts (ibid.) somewhat complicate the picture. Additionally, the exact association with the pottery found in the broader area needs to be further clarified.

Figure 204: Lithic finds and pottery sherds from Perlakia (van Wijngaarden et al. 2009, online report). If the three dark patinated artefacts in the right part of the picture are the ones described as having heavy reddish patina then this type of patina is what in the IISA we have called as dark brown (see Chapter 4).

5.1.1.4. Overview

The island of Zakynthos has been at the centre of attention since the end of the 19th century, yet its archaeology in terms of the earliest phases of human occupation is underrepresented due to the absence of thorough studies of the lithic material. Based on the few preliminary reports we may extract significant information predominantly in terms of the quantity rather than the quality and the technological characteristics of the lithics. The spatial distribution of the sites that might potentially be attributed to the Palaeolithic has been made possible mainly due to the survey conducted by ZAP. The detailed analysis of the Middle Palaeolithic collection from the survey is under preparation (S. Ligkovanlis pers. comm. 2014). What is important to note here is the presence of diagnostic Middle

Palaeolithic artefacts among the ZAP lithic collections (e.g. Levallois cores).[29] These together with a number of isolated finds already published, such as the Mousterian point from Yerakas (Figure 200.14), and the presence of radial scars on several of the blanks, particularly from Perlakia (Figure 204) point to a clear yet confined Middle Palaeolithic presence on the island. The limited number of absolutely diagnostic Middle Palaeolithic artefacts might be either a real pattern, i.e. limited archaeological remains, thus limited periods of occupation by Middle Palaeolithic hominins, or a result of the as yet insufficiently presented data. In the latter case, the forthcoming publication of the material collected by the ZAP will be able to confirm or not such a hypothesis.

[29] The particular information was kindly provided to the author in December 2014 by Dr. Stephanos Ligkovanlis, who is undertaking the technological analysis of the material after an invitation by Prof. Georgia Kourtessi-Philippakis who is coordinating for the study of the lithics.

5.1.2. Kefalonia (Cephalonia, Kephalonia)

Besides occasional references to chipped stone artefacts dated to the Holocene (Ankel, 1970; Benton, 1932; Marinatos, 1962) it was not until the 1970s when the first accounts referring to Palaeolithic artefacts from the island were published (Ankel, 1973; Cubuk, 1976b, 1976a; Kavvadias, 1984). The proclaimed Pleistocene sites and findspots on Kefalonia count a total of nine. Of these, two were identified by chance, and eight new sites were recorded in the course of a systematic survey during the 1990s. The first systematic survey focusing on the island of Kefalonia, was organised by the Danish School between 1992 and 1994, provided new evidence on the prehistory of the island by increasing the number both of the sites and of the lithic artefacts dated to the Palaeolithic (Randsborg, 2002). Although the primary aim of the survey was the investigation of the ancient Greek *poleis* in their diachronic history, all periods represented in the area were investigated, with all "significant finds" such as pottery sherds, loom weights, roof tiles and lithics collected (Foss, 2002a, p. 81); yet although for the small sites and units all debitage and retouched pieces were collected, for the larger sites, such as Fiskardo, "several hundred pieces were left behind" (Foss, 2002a, p. 83). The survey methodology followed the local topographic characteristics, the "structures and contours of the landscape, occasionally concentrating on smaller areas (usually with find concentration)" (Foss, 2002a, p. 80). Survey areas and units of varying size and shape were scanned by teams of four or five participants walking at intervals of 10-20m.

Besides lacking a geologist, the survey team tried to locate the local raw material sources that would have been exploited by the prehistoric knappers. Flint nodules of a dark reddish or dark orange colour were found embedded in the limestone at Ayia Efemia (Site 332). At the peninsula of Fiskardo (Site 352), the flint nodules are described as of a dull, yellowish colour and at Sami valley (Site 225) the nodules are large, of a dull, light brownish colour with yellow cortex. In all three locations the type of flint is of good knapping quality whereas at Poros valley, all flint encountered is "of a rather poor quality" (Foss, 2002a, p. 82). Imported flint has been identified only among the Holocene assemblages, namely in a few specimens attributed to the Neolithic and the Bronze Age (Foss, 2002a).

5.1.2.1. Fiskardo (Phiscardo)

The site with the largest quantity of published artefacts is Fiskardo, situated at the long and narrow peninsula of Erissos, which is the northern tip of the island. As described by Foss (Foss, 2002a, p. 128):

> *"the site is situated on a headland protruding to the southeast from Erissos, at the point where the East coast meets with the North coast. The township of Phiscardo is situated just of the headland at a naturally protected harbour with a short beach. The headland itself is low – not above 40m – and rocky but has centrally two flat plateaus."*

The site is very near a Byzantine church and has provided a large number of lithic artefacts made of flint, and probably also chert, which in their majority have been dated to the Middle Palaeolithic (Kavvadias, 1984). Kavvadias, the Greek sociologist who collected more than 200 artefacts from the site in 1976, proposed than among the material there are also Lower Palaeolithic, i.e. "Middle and Upper Acheulean", and Early Upper Palaeolithic, i.e. Aurignacian artefacts, however he noted that these could equally be part of the same cultural tradition, i.e. the Middle Palaeolithic. Although his monograph was published in Greek about 30 years ago, a detailed study of the material is unfortunately still pending. In his publication, he talks of core-tools such as bifaces, choppers, levers, cleavers and flake tools such as points, scrapers, burins, awls and a smaller number of blade tools. The material had until recently received only minor attention not only because the publication is in Greek but also due to its problematic presentation (cf. Foss, 2002a). Adam (1989) has questioned the dating proposed by Kavvadias due to poor standards of publication, i.e. bad photographs, absence of technical illustrations, limited sample. Indeed the total absence of Illustrations and the orientation of the artefacts in the photographs indicate an amateur approach. Similarly, judging by the photographs, the classification of the specimens (Table 69) is rarely in tune with the types and technological categories proposed. To mention a few of the problematic cases, there is a large amount of specimens (n=52) classified as 'points' (types include Mousterian which can be large, medium and small, triangular or retouched ones, Levallois, '*lanceolé'* and shouldered), yet only a handful of these might indeed be regarded as such (Kavvadias, 1984, figs. 14–23). Similarly, a couple of thick notched flakes and fragments with cresting scars have been classified as 'large elongated scrapers' (Kavvadias, 1984, fig. 30), flakes with edge damage and/or less patinated discontinuous scars due to recent breakage have also been classified as scrapers (Kavvadias, 1984, figs. 32–34). Overall it seems that there is minor, if any, appreciation of the post-depositional effects on material coming from the surface. The collection includes nine 'bifaces' and nine '*hacheureaux*' (as opposed to 'handaxes') (Kavvadias, 1984, p. 112) yet none of these is convincing in typological terms (Kavvadias, 1984, pp. 7–9).

Table 69: Assemblage structure from Fiskardo as classified by Kavvadias (1984)

Fiskardo	N	%
Pick	1	0
Bifaces	9	3
Hachereaux	9	3
Mousterian cores	2	1
Levallois core	1	0
Prismatic core	1	0
Triangular points	36	13
Retouched points	2	1
Elongated Levallois points	3	1
Mousterian points	3	1
Shouldered points	8	3
Backed knives	29	11
Wedges	28	10
Scrapers	42	15
Notches/scrapers	31	11
Small circular scrapers	8	3
Burins	29	11
Perforators	33	12
Total	275	100

After a number of re-visits both to the site (catalogued by the Danish team as Site 352) and to the entire peninsula by the Danish team during the 1990s, the number of artefacts collected is astonishingly small. Foss reports 36 specimens, 62% of which are flakes and flake tools (Foss, 2002a, p. 72; 2002b, p. 129). Three of 36 specimens (i.e. a burin and two retouched blades) are illustrated in the 2002 publication (Foss, 2002a, p. 117, Pl. A VI. 12,15-16). The small number of artefacts was interpreted as both a result of (a) a thorough collection made by Kavvadias in 1976, and (b) a less intense Palaeolithic occupation than the one he had proposed (Foss, 2002a). Although, according to Foss (2002a), there are no diagnostic tools in the Danish collection, she proposed particular affiliations with the blade tools from Kokkinopilos (Dakaris et al., 1964, p. 239, fig. 21.71). The blades have in general been described as broad and thick, yet "well fabricated" (Foss, 2002a, p. 130) with most of them exhibiting pronounced bulbs due to direct percussion with a hard hammer.

Figure 205: The site of Fiskardo, NE Kefalonia, and a couple of artefacts encountered on the surface in July 2011 (photos: C. Papoulia & N. Gkiokas).

A fleet visit to Fiskardo in July 2011 allowed me to appreciate the nature of the site, the quantity and the quality of the artefacts that are still lying in significant numbers on the red-soil surfaces (Figure 205). As reported by the previous surveys the densest concentration is visible at the northwest of the church and very close to it. The impression I got by this visit was that Fiskardo is indeed a multicomponent site in the sense that there are both blade/bladelet blanks and tools which could be part of a late Pleistocene / early Holocene industry, i.e. Upper Palaeolithic, Mesolithic and probably also a Neolithic one, although no diagnostic Neolithic tools (e.g. projectile points, sickle elements etc.) were neither identified by me nor reported by any other researcher. Such an inference might of course be altered by a detailed analysis of Kavvadias' collection. At the same time, a large number of flake blanks and tools could easily be attributed to the Middle Palaeolithic, yet a textbook example is absent. Again, it is more than possible, that the initial collection by Kavvadias includes diagnostic pieces, which still need to be illustrated and properly published. Additionally, a future intensive geoarchaeological survey at the site will certainly be able to define the technological character of the assemblages that were discarded at Fiskardo during prehistoric times and perhaps also be able to define a chronological threshold. Phoca-Cosmetatou and Rabbet (2014b, 2014a) are pessimistic in terms of *in situ* recovery of material from the highly disturbed deposits due to modern construction works, yet note that the particular formations might be dated to MIS 5a, 5c or MIS 4 due to affinities with similar deposits in Epirus (cf. Runnels and van Andel, 2003) and Mounta, SE Kefalonia, although, they rightly emphasise that such a date should not be taken at face value for the dating of the artefacts collected from their surface.

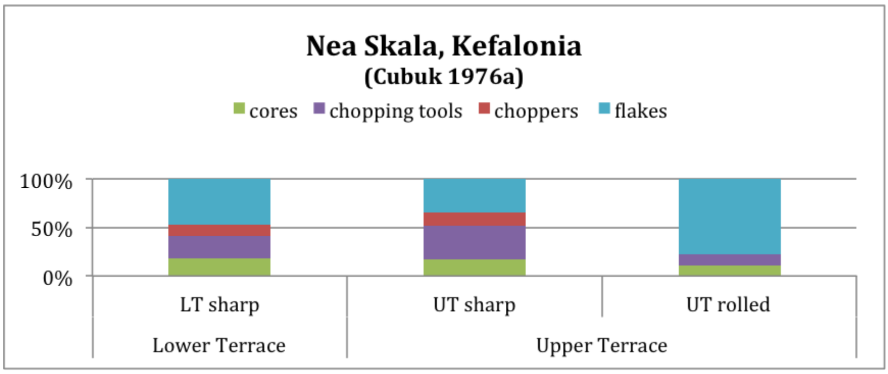
5.1.2.2. Skala

5.1.2.2.1. Nea Skala

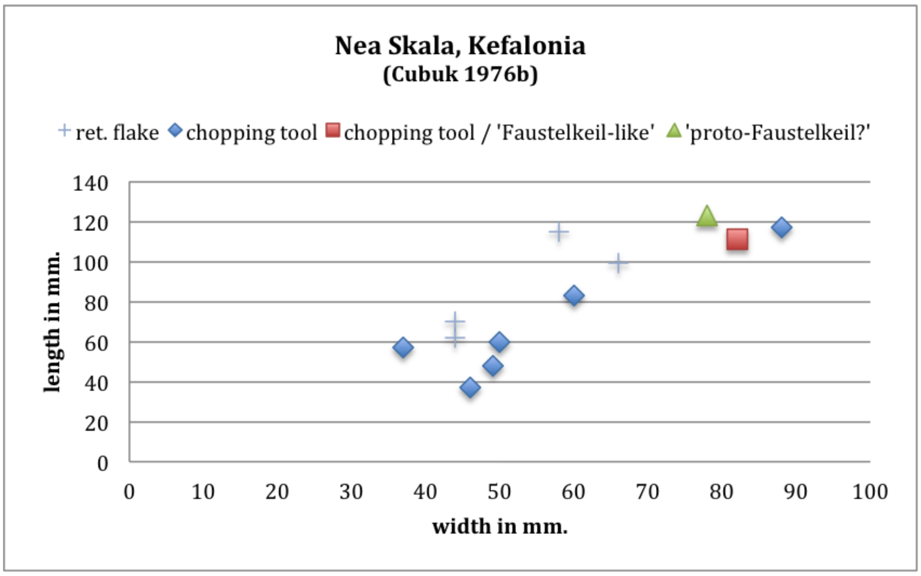
Another site, situated at the southern part of the island, Nea Skala, which is situated about 1.5km north of Skala, has yielded an assemblage consisting of flakes, cores, choppers and chopping tools which were attributed by Cubuk (1976a, 1976b) to the Lower and Middle Palaeolithic based both on their typo-technological characteristics and on their geological context. He identified three different terraces, one at 20masl, which contained the Middle Palaeolithic artefacts, and two at 75masl and 85masl respectively, which contained the Lower Palaeolithic artefacts. According to Cubuk, the terrace containing the Middle Palaeolithic artefacts was deposited in the Last Interglacial and the other two are fossil raised beaches, which were deposited on tertiary limestone during Interglacials, i.e. either during the Gunz-Mindel (c. 620-410ka) or the Mindel-Riss (c. 380-200ka) Interglacials. These terraces were at the time of discovery situated at a distance of 400m from the seacoast, whereas the Middle Palaeolithic findspot was situated 300m away from the Lower Palaeolithic findspots and 100m away from the coast. Unfortunately none of the artefacts attributed to the Middle Palaeolithic have been further described or illustrated on any of the two reports. On the other hand, the ones attributed to the Lower Palaeolithic have been described in more detail. In particular, of a total of 85 artefacts from these two terraces, 41 belong to the upper terrace (85masl) and 44 to the lower terrace (75masl). All artefacts from the second terrace (n=44) and 23 from the first have sharp edges whereas 18 exhibit rolled edges. Both assemblages include similar numbers of cores, chopping tools, choppers and flakes (Table 70) with the flakes comprising the largest category from both terraces (Graph 144).

Table 70: Inventory of the lithic assemblages from the two terraces from Nea Skala, attributed by Cubuk (1976a, p.176-177) to the Lower Palaeolithic

Nea Skala LP assemblages	Lower Terrace (75masl)				Upper Terrace (85masl)				Total	
	LT sharp		LT rolled		UT sharp		UT rolled			
	N	%	N	%	N	%	N	%	N	%
Cores	8	18	0	0	4	17	2	11	14	16
Chopping tools	10	23	0	0	8	35	2	11	20	24
Choppers on flakes	5	11	0	0	3	13	0	0	8	9
Flakes	21	48	0	0	8	35	14	78	43	51
Total	44	100	0	0	23	100	18	100	85	100
Total (%)	52		0		27		21		100	



Graph 144: Chart based on the publication by Cubuk (1976a). It includes all the artefacts from both lower terrace (LT) and upper terrace (UT), with the latter subdivided to two categories of artefacts, those with sharp edges (UT sharp) and those with rounded/rolled edges (UT rolled).



Graph 145: Scatter plot of the dimensions (length and width) of particular artefacts (n=12) from Nea Skala as described by Cubuk (1976b).

In one of his publications, Cubuk (1976b) described certain of the artefacts coming from the upper terrace (85masl) and provided detailed information on their raw material, preservation, and dimensions. Amongst the artefacts there are two specimens of specific interest, included in the "chopping tool" category and described as possible *Faustelkeil-like* (catalogue no 8) or *proto*-Faustelkeil (catalogue no 4). Together with one more chopping tool (catalogue no 1), these artefacts are among the largest ones presented being bigger than 111x78x35mm (Graph 145).

The large number of pebble tools has been interpreted as of early Palaeolithic age, thus affiliations with the Lower Palaeolithic pebble industries of Europe were proposed. To support his argument, Cubuk compared the assemblages from Nea Skala with Acheulean industries from Syria, Italy and Yugoslavia (Cubuk, 1976a). His interpretation comes in straight contrast to Kourtessi-Philippakis' analysis (Kourtessi-Philippakis, 1999), which associates the lithics from Nea Skala with the ones from Ayios Nikolaos, Zakynthos and both of them with the Pontinian Mousterian assemblages from Latium, Italy. Reservations about the age of the assemblages have also been expressed by Reisch (1982), while Darlas (1994) expressed doubts about the dating of the terraces themselves and stressed the problematic case of associating pebble tools with Lower Palaeolithic industries in general. Foss (2002b, p.78) was also reluctant in accepting Cubuk's argument for a Lower Palaeolithic date because, as she states, even if the terraces can indeed be of the specific date Cubuk proposes, the artefacts are not directly associated with a particular geological layer. Furthermore, the attribution of the site of Nea Skala to the Lower Palaeolithic has also been challenged by Tourloukis' geoarchaeological approach. Tourloukis draws attention to the weak argument attained by Cubuk in terms of the altitude of the terraces (Tourloukis, 2010, p. 57-58).

The Danish team attempted to relocate the site in 1996, but the exact spot could not be identified. They examined the coastal area between Skala and the archaic temple (Sites 33 and 53) and they found several terraces with natural and worked flint pieces. From all the terraces surveyed, only one, situated on a plateau south of Vlychos, north of Site 33, contained an acceptable amount of artefacts in order to potentially describe it as a "site". Although Foss (2002b, p.75) suggests that it is not impossible for this terrace to correspond with Cubuk's site, she also mentions that the terraces where the original site was found might not exist anymore due to the construction works that have taken place since 1976. Another possibility is that Site 53 corresponds with Cubuk's site (see description below in 5.1.2.2.3), however the descriptions do not seem to fit. What is important to note is that none of the artefacts they encountered in the broader area and at these two sites could be classified as of a Lower Palaeolithic age.

5.1.2.2.2. Site 33

At the coast north of Skala, which is in general characterised by "flat plateaus cut by deep ravines" (Foss, 2002a, p. 98) the Danish survey identified another Middle Palaeolithic site, Site 33 (Table 71). This is situated on the northernmost plateau at about 90masl, 1km north of Skala. It is described as of about ¼ km^2, with "*large patches of open soil between formations of limestone rock*" (Foss, 2002a, p. 99). It also has an excellent view of the coast eastwards and of the flat land southwards.

A total of 77 artefacts were collected from the site, most of which are patinated but "*otherwise in fresh condition*" (Foss, 2002a, p. 99). As for the raw material used, Foss notes that both fine-grained and coarse-grained flints, as well as both small and large pebbles have been employed. Although small pebbles were spotted on the plateau, the larger nodules were thought to have been procured from the nearby Site 53, where large nodules of light grey and light reddish to dark red colour flint were recorded. Apart from the above-mentioned raw material categories, all shades of grey and brown as well as yellowish coloured flints were encountered at about the same percentages (Foss 2002a).

The assemblage is described as a "*uniform industry producing flakes and squat blades or blade-like flakes*" (Foss, 2002a, p. 100). It is similar to the Middle Palaeolithic component of Mounta (Site 13:2-3) and has been compared with Kokkinopilos. Quite a few artefacts were illustrated, including a core on flake (Randsborg, 2002 Pl. A III. 5), flake tools (Randsborg, 2002 Pl. A III. 2-4, 6-10, 11-16), blade tools (Randsborg, 2002 Pl. A IV. 1-7) and a piercer which has been described as made on a small pebble (Randsborg, 2002 Pl. A III. 11). Foss (2002a) proposes an age of between 75ka to 50ka for the site based on the similarities with the assemblages from Mounta and Kokkinopilos and on the dates proposed for the upper horizon of Kokkinopilos (Higgs and Vita-Finzi, 1966).

Table 71: Lithic inventory from Site 33, attributed by Foss (2002b, p. 64) to the Middle Palaeolithic

Site 33	**N**	**%**
Flakes	25	32
Blades	11	14
Retouched / notched flakes	18	23
Notched blades	2	3
Retouched blades	2	3
Round scraper	1	1
Scrapers on flakes	5	6
Burins	4	5
Rhomboid tools	2	3
Piercer	1	1
Point	1	1
Drills	2	3
Retouched point	1	1
Rejuvenation flake	1	1
Flake core	1	1
Total	**77**	**100**

5.1.2.2.3. Site 53

Site 53 is situated at a very narrow part (about 500m) between the coast and the Vlychos Mountains. Flint and obsidian artefacts were collected from the area around the remains of an archaic temple (Table 72). It has been argued that the soil and gravels containing the obsidian pieces (n=5) might have been transported to the site in order to level the area during the construction of the parking space. Apart from the attribution of the obsidian to the Late Neolithic and / or the Bronze Age, some of the flint artefacts have also been attributed to the same industry, i.e. three blades, a burin and a core which is the only flint specimen illustrated (Foss, 2002a, p. 115; Randsborg, 2002 Pl. A IV. 11). The particular core is of a triangular, longitudinal cross-section and has produced both flakes and blades with parallel ridges. A Late Neolithic age has been proposed due to affinities with cores from contemporaneous sites in the Cyclades (Foss, 2002a, p. 104).

A second industry was also identified on the same site, one producing "coarse flakes with large parts of cortex and a few retouched flakes that cannot be dated" (Foss, 2002a, p. 104). In the catalogue of the lithic finds, however, the detailed inventory of the site includes a "worked flint pebble" which together with some of the coarse flakes "possibly belong to the Palaeolithic" (Foss, 2002b, p. 64). Site 53 is one of the two possible locations that according to the Danish team could correspond with Cubuk's site (Foss, 2002b, p. 64).

Table 72: Inventory of the flint and obsidian assemblages from Site 53 Only some of the flint artefacts, i.e. the worked pebble tool and some of the coarse-grained flint flakes were tentatively attributed by Foss (2002a, p.64) to the Palaeolithic.[30]

Site 53 (flint)	N	%	Site 53 (obsidian)	N	%
Flakes	36	80	Flake	1	20
Blades	3	7	Blade	1	20
Retouched / notched flakes	2	4	Retouched flake	1	20
Worked pebble	1	2	Rejuvenation flake	1	20
Naturally split pebble	1	2	Slightly worked lump	1	20
Burin	1	2	**Total**	**5**	**100**
Flake core	1	2			
Total	**45**	**100**			

[30] A precise number of the ones attributed to the Palaeolithic is not provided. The obsidian assemblage has been dated to the Early Bronze Age.

5.1.2.3. Poros

C. Ankel reported a Middle Palaeolithic site in 1973 as a result of a systematic survey conducted in the area around Poros, between 1965 and 1972 (Ankel, 1973). The artefacts were reported as "embedded in red earth on some terraces at Kraneias above Poros" (Foss, 2002b, p. 78). The assemblage was described as possibly a "Micro-Mousterian" industry that consists of retouched flakes, blades, some triangular points, two or three convex scrapers and a denticulated piece (Foss, 2002b, p. 78).[31] She also spotted a "flint mine" exposed during construction works but does not provide any further information (Ankel, 1973). According to the finds collected by the Danish team, all artefacts post-date the Pleistocene while there is only a blade and a scraper that might be considered older than the Neolithic (Foss, 2002b, p. 117).

Today, we know of Drakaina cave in the area, with several Neolithic projectile points (Stratouli and Metaxas, 2009). It would be interesting to test whether the "triangular points" from Ankel's site are indeed Middle Palaeolithic or perhaps Neolithic ones. The area also includes an Acropolis above Poros and a Tholos Tomb dated to the Mycenaean period.

5.1.2.4. Mounta

5.1.2.4.1. Site 13:2-3

Site 13:2-3 was identified by the Danish team in 1992 at the southernmost tip of Kefalonia, the promontory of Mounta, which is a flat and sandy area. This site might correspond to the "obsidian factory" site mentioned by Benton (1932), Marinatos (1962) and Ankel (1973). It is equally possible, however, that we might be dealing with a totally different site. The area was first surveyed in 1992 and revisited in 1995. The site is "confined to the sandy area around a geodetic point marking the highest point (45m) and situated centrally in the area, 650m from the tip of the headland" (Foss, 2002a, p. 85), with the densest concentration in an area of 50x100m parallel to the gravel road. An aeolian red-soil deposit, only minimally visible during the first visit, was exposed to a much greater extent due to erosion towards the southwestern part of the gravel path at the time of the second visit, when some of the cores and pebble tools were collected (Foss, 2002a, p. 94). Sites 14, 15

[31] These artefacts were reported by Foss (2002a, p. 78) as being then part of a private collection.

and 16[32] that have yielded much smaller amounts of artefacts, indicate the southern borders of the activity area and 150m to the north of the site a drained river forms its natural border (Foss, 2002a).

The particular site provided the largest amount of obsidian artefacts (n=67) from the island (Table 73; Figure 206). The obsidian assemblage has been attributed to the Early Bronze Age based on a characteristic ovate (Randsborg, 2002 Pl. A I.10) and on the dimensions of the blades which would have been struck from the three blade cores illustrated (Randsborg, 2002 Pl. A I. 1-3). It should also be noted that Foss refers to Marinatos' suggestion of a Mesolithic date for a number of obsidian artefacts he collected from the region of Skala (Marinatos, 1962) with an intention neither to confirm nor to disprove his insinuation since she was unable to study the collection (Foss, 2002a, p. 93). On the other hand, for Benton's obsidian collection (1932), judging from her illustrations, she recognises similarities with the obsidian assemblage from Site 13:2-3, namely the prismatic blade cores and parallel-sided blades. Based on the photographs of blades provided by Marinatos (1962) it has to be noted that it seems unlikely that the particular artefacts can be of a Mesolithic age.

Table 73: Composition of the flint and obsidian assemblages from Site 13:2-3, Kefalonia as described by Foss (2002a, p. 61-63)

Mounta (obsidian)	N	%	Mounta (flint)	N	%
Blade cores	3	4	Primary & secondary flakes	140	27
Ovate	1	1	Tertiary flakes	231	44
Burin	1	1	Large flakes	2	0
Retouched flakes	2	3	Notched flakes	5	1
Retouched blades	2	3	Blades	73	14
Flakes	31	46	Retouched flakes	6	1
Blades	16	24	Serrated blade	1	0
Chips	6	9	Scrapers on flakes	4	1
Technical pieces	5	7	Scraper on blade	1	0
Total	**67**	**100**	Retouched point / scraper	1	0
			Burins	3	1
			Piercer on blade	1	0

32 Site 14 is not included in this chapter since none of the 10 artefacts collected is diagnostic. It should be noted that the artefacts from Site 16 are not made on the "*grey and light greyish flint of good quality*" which was the preferred raw material in the Neolithic and Bronze Age (Foss, 2002a, p. 98), but this argument is not strong enough to support a more precise chronological association. The single tool described as a burin is also impossible to be treated as a proxy. In Foss 2002a, p. 63, the site is described as of uncertain date, possibly including both Middle Palaeolithic and Neolithic artefacts but no further details are provided. For these reasons, Site 16 is also excluded from further discussion here.

	Piercers/drills on flakes	3	1
	Slug	1	0
	Crested flake	1	0
	Rejuvenation flakes	8	2
	Core rejuvenation flakes	3	1
	Cores	24	5
	Blade core fragment	1	0
	Pebble tools	2	0
	"Chopper-like" piece	1	0
	Handaxe	1	0
	Retouched pieces	4	1
	Natural / unmodified pieces	9	2
	Total	**526**	**100**

As for the flint assemblage, a total of 525 artefacts has been recorded[33] some of which made from the large pebbles or smaller nodules available in the area, but others made from the non-local grey or light greyish colour flint. Surface alterations include white or yellowish patina, polished surfaces and "slightly smoothed" ridges "due to the sandy soil and the wind" (Foss, 2002a, p. 91).

Figure 206: Obsidian artefacts from Mounta (Site 13:2-3). Note the first two artefacts, i.e. pressure bladelet cores, on the left of the second row from the bottom (photo: C. Papoulia).

[33] The total count here is based on the detailed classification provided by Foss 2002b, p.62 where she counts a total of either 525 or 526. This is because the number under category "retouched flakes" is 6, however in the parenthesis the description explains "*3 complete, 4 incomplete*", thus the total of retouched flakes is either 6 or 7. Furthermore, in Foss 2002b, p.85 and 91, the total amount of flint arefacts is 509. Assuming that the 9 unworked pieces mentioned in Foss 2002b, p.62 might have been excluded from the total of 525 (or 526), it is still impossible to reach the number of 509.

Foss believes that the more than 500 pieces from the site belong to several different industries yet due to the limited number of diagnostic artefacts it was impossible to attribute each artefact to clear-cut chronological categories. Certain groups of artefacts, such as the 36 blades that were collected in the same part as the obsidian artefacts, have been attributed to the Neolithic due to their dimensions and by comparison with other sites of the Aegean (Foss, 2002a, p. 92). Late and Final Neolithic age has been proposed for three endscrapers (Randsborg, 2002 Pl. A I. 12-13, 19), a Late Neolithic/Early Bronze Age is implied by the presence of a slug (Randsborg, 2002 Pl. A I. 16) and an Early Bronze Age date is suggested for the prismatic blade core (Randsborg, 2002 Pl. A I. 4), which is produced with a technique similar to the obsidian cores from the same site mentioned above (Figure 207).

At the same time, a number of artefacts from the flint assemblage have been attributed to the Middle Palaeolithic in terms of typological and technological similarities with others sites in Greece and adjacent areas. This group counts a minimum of 18 artefacts since more potentially Palaeolithic flakes and flake tools, as well as globular cores, if added to this category could increase the total (Table 73). In particular, 12 artefacts, five of which have also been illustrated (Randsborg, 2002 Pl. A II. 8-12), were classified as discoid flake cores which "*have a broad flat base and have flakes struck radially along the perimeter giving a trapezoid and occasionally triangular cross-section*" (Foss, 2002a, p. 95). Foss also notes that most of them are small, exhausted cores which preserve part of their cortex. A Middle Palaeolithic age was proposed for this category due to the regular presence of discoid cores in Mousterian assemblages not only in Greece but also in several Middle Palaeolithic sites in Europe. Based on the classification by Mellars of the Kokkinopilos assemblages, Foss described the majority of the discoid cores from Mounta as of Type A since they have "flakes struck from more than half of the perimeter" (Foss, 2002a, p. 95), one as of Type B (Randsborg, 2002 Pl. A II. 11) and most of the globular cores as either Type A or Type B. However, based both on the illustrations published and on personal examination (2015) of the material from Mounta, the particular comparison does not seem valid, because these cores have a single prepared platform instead of a perimeter from which the flakes were extracted and their overall morphology does not agree with a "discoid" classification (Figure 208). Instead, these might perhaps find better parallels at Sidari, Kerkyra, particularly in the "partial cores turned into thick scrapers" from the layers dated by Sordinas (1969, fig. 5.4) to the Mesolithic.

Figure 207: Artefacts of the flint assemblage from Mounta (Site 13:2-3) that have been attributed to the Holocene, i.e. the Neolithic and the Bronze Age (photo: C. Papoulia).

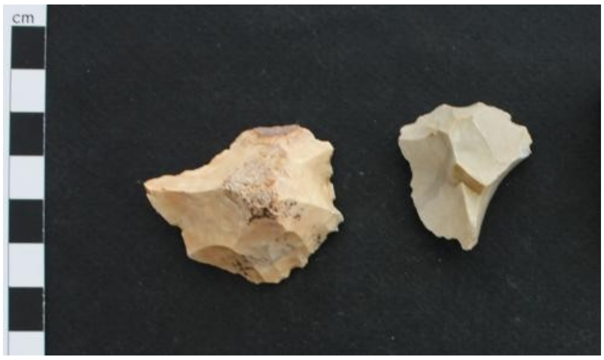


Figure 208: Two of the 12 flint artefacts from Mounta (Site 13:2-3) classified as "discoid cores" by Foss (2002a, p. 113) which may, however, be better classified as "thick scrapers" (photo C. Papoulia).

Apart from the cores, a scraper, (Randsborg, 2002 Pl. A II. 6), a "point" (Randsborg, 2002 Pl. A II. 7), a "chopper-like" piece (Randsborg, 2002 Pl. A II. 14), two pebble tools (Randsborg, 2002 Pl. A II. 13, 15) and a "handaxe" (Randsborg, 2002 Pl. A III. 1), comprise the Middle Palaeolithic component of Mounta. The artefact classified as a point is not a Levallois one, yet Foss (2002a, p. 94) suggests that it shares similarities with Type C points from Kokkinopilos in the sense that it is offset, made on a thick flake with irregular retouch. Of the aforementioned artefacts, the "handaxe", as defined by Foss, is the most interesting one (Figure 209). It measures 90x57x28mm with a width of 11mm at the tip which is however broken and its maximum length is estimated at about 105mm (Foss 2002a, p. 98). Quoting Foss, the biface is

> "*made on a nodule of light grey, gritty flint and it retains about ¼ of the cortex at the base. It is multidirectionally worked, the working covering the entire surface on one face, and c. two thirds on the other. It is triangular in shape with a rounded base and straight edges, and it is slightly asymmetrical with the axis of the axe being a little offset from the central axis. There are traces of usage as the right edge is abraded and the tip is broken in Prehistoric time.*"

Figure 209: The handaxe from Mounta (Site 13:2-3) (Photo: C. Papoulia).

Foss notes that triangular and sub-triangular handaxes from NW Europe are common tool types in the Mousterian of Acheulean tradition (MTA) Type A and Type B, yet she correctly stresses that it is impossible to ascribe either one of these types to the particular biface from Mounta since it comes from an unstratified context. She instead proposes a broad date "to the first half of the glacial period" (Foss, 2002a, p. 96).

As for the "a chopper-like" tool, it measures 60x84x32mm and is made on a thick, oval, cortical flake. According to the description by Foss (2002a, p. 96) "a series of parallel blows struck from the ventral surface has created a steep, serrated edge". The raw material used for this piece was a large light grey flint nodule. Regarding the two pebble tools, Foss notes that the first one (Figure 210right) is made on a large pebble, with bi-directional flake removals which have left about 1/3 of the original cortical surface unworked creating like this “a trapezoid piece with a concave, notched edge and rectangular cross-section” (Foss, 2002a, p. 96). The second one (Figure 210left) is made on a smaller pebble of a gritty, light, yellowish flint, with thin cortex. It has multidirectional flake removals in ½ of its surface creating a “semi-oval piece with broad serrated edge” (Foss, 2002b, p.96). Foss seems to agree with the observation that pebble tools are not restricted in Lower Palaeolithic industries and based on affiliations with Middle Palaeolithic assemblages from sites in western Greece, i.e. Lakopetra and Amalias, NW Peloponnese, and Kokkinopilos, Epirus, she proposes a date between 75ka–50ka for the early component of Site 13:2-3 (Foss, 2002a, p. 97).

Figure 210: The two “pebble-tools” from Mounta (Site 13:2-3) (Photo: C. Papoulia).

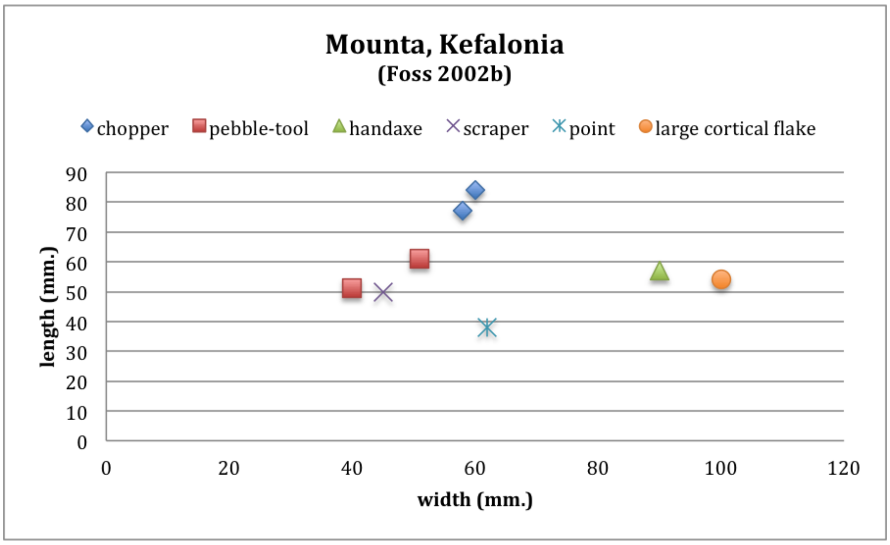


Figure 211: Scatter plot of the dimensions (length and width) of particular artefacts (n=8) from Mounta sites (13:2-3 and 15) as described by Foss (2002b). The smaller of the two choppers and the large cortical flake belong to site 15.

5.1.2.4.2. Site 15

Site 15 is situated at the northern borders of Site 13:2-3, about 150m NW of the geodetic point and very close to the drained river. It includes only 12 artefacts (Table 74), namely seven cortical flakes, four smaller non-cortical flakes, and a "chopper-like" piece (Randsborg, 2002 Pl. AII. 16). The chopper is made on an oval split pebble and measures 58x77x42mm. According to Foss (2002a, p. 98): "a number of heavy, parallel blows struck from the ventral side have created a notched, convex edge of 5.6 cm opposite the platform. In cross-section it is triangular with a rounded base". She associates the particular tool with the other two pebble tools and the "chopper-like" tool from Site 13:2-3, thus attributes it to the Middle Palaeolithic. All artefacts from the site have either white, yellow or reddish colour patina.

The artefacts collected from Site 15 were probably found in association with their geological context yet the story is somewhat unfortunate, since the exact spot identified in 1992 could not be relocated in 1995. Thus no detailed description of the geological context are provided apart from the fact that the artefacts were found next to "a ditch of approximately ½ metre in depth" which had been dug in the area due to construction works. The team reported that "the lithics were lying on the surface next to the ditch but had obviously come up with the filling as earth was still adhering to them" (Foss, 2002a, p. 98).

Table 74 Assemblage composition from Site 15, Kefalonia, as described by Foss (2002b, p. 63)

Site 15	**N**	**%**
Flakes	11	92
Chopper-like tool	1	8
Total	**12**	**100**

5.1.2.5. Katelios

5.1.2.5.1. Site 25

At about 3km west of Mounta, in a valley named after the village Katelios Site 25 was identified by the Danish team in 1992 and was revisited several times during the survey project. The valley of Katelios is rather flat with two streams and a sandy beach looking south bordered by steep mountains in the north and smaller ones in the west and east ends. Site 25 is situated on a hill at the northern part of the valley with good view of the valley and mountains. The lithic assemblage consists of 42 artefacts and 10 pieces of unmodified flints. [34] Had it not been for the "thick and thorny shrubbery" the team believes they would have probably collected a larger number of lithics, although it has been noted that flint was not abundant even in the open areas (Foss, 2002a, p. 105). In regards of the raw material types, Foss reports a wide colour spectrum, from dark to light yellow with white spots, light to dark grey, a pinkish with darker stripes and light brown with white spots. [35] She also notes that a similar variety of raw materials was recorded for Site 33, yet according to her observations, the flint at that site was in general of a better knapping quality. Small lumps and pebbles were spotted around the hill yet a number of artefacts, among which the long blades would need larger flint nodules than the ones available on site (Foss, 2002a, p. 106).

The fact that the assemblage is dominated by flakes, flake tools and flake cores has intrigued Foss who rightly notes that further analysis of a larger sample is needed in order to decide whether such a preference mirrors deliberate choice or technological adaptation to the available raw material sources. Supposing that the first case is true, and by comparisons with the material from Kokkinopilos, the tool types described and illustrated in Foss' analysis have been dated to the Middle Palaeolithic (Foss, 2002a, p. 106-107). Two "scrapers" (Randsborg, 2002 Pl. A IV. 8, 17), two blade tools (Randsborg, 2002 Pl. A IV. 15, 21), a "denticulate" (Randsborg, 2002 Pl. A IV. 12) and a "naturally pointed flake" (Randsborg, 2002 Pl. A IV. 13) have been used by Foss to support her argument (Foss, 2002a, p. 106-107). Yet, judging by the illustrations, none of these tools is particularly diagnostic in typological terms.

5.1.2.5.2. Site 9

Site 9 is situated halfway up the southern slopes of mount Goulaki at an altitude of about 160m. It consists of only 13 flint artefacts, one natural flint nodule and five fossilized shells, which imply that the site is a raised seabed. The unworked nodule is of an orange colour and splits in perpendicular facets. Foss notes that this type of flint was encountered embedded in limestone at Site 322:1-2, near Agia Efemia. The largest flake of the

[34] In Foss 2002a, p. 105 the unmodified pieces are 9 yet in Foss 2002b, p. 63 the number is 10. The correct one is probably the latter since the total need to be 52.

[35] "White spots" have been used by Foss to describe a particular colour variety (2002b, p.106), yet according to personal observations in several surface lithic assemblages from the Ionian Islands and NW Greece, these might perhaps indicate early stages of surface alterations due to patina.

assemblage weights 135g, and its size makes Foss believe that it was also brought to the site. All flakes are described as large and crude and most of them are cortical. By comparing the Neolithic and Bronze Age artefacts collected from other parts of the island with the "inferior technology" (Foss, 2002a, p. 108) encountered at Site 9 and due to the presence of Site 25 nearby, Foss suggested the assemblage might possibly be of a Palaeolithic age, yet admitted that "to take this any further is untenable" (Foss, 2002a, p. 108).

Table 75: Assemblage composition from Site 9, Kefalonia, as described by Foss (2002b, p. 61)

Site 9	N	%
Flake	8	57
Retouched flakes	4	29
Notched blade	1	7
Unmodified piece	1	7
Total	**14**	**100**

5.1.2.6. Sami

The valley of Sami is situated at the centre of the eastern part of Kefalonia. A protected bay to the north forms an excellent natural harbour with a view towards the SW part of the island of Ithaki. Caves and rockshelters have been identified in the limestone formations of the valley. Some were utilized during prehistoric and historical periods. For instance, Mellisani cave, with its famous subterranean lake, that was occupied during the Hellenistic period, Phytidi cave at Vlachata, identified by I. Petrocheilos and the well-known Drakaina cave occupied since the Neolithic period (Stratouli et al., 2014, 1998; Stratouli and Melfos, 2008; Stratouli and Metaxas, 2009). Reports about prehistoric activity at the rockshelters of Chaliotata and Poulata (Petrocheilos, 1959) (Figure 212) were not confirmed by the Danish survey (Site 227), which only yielded 5 undiagnostic flakes (Foss 2002a, p. 119; Foss 2002b, p. 69).

Both Ankel (1973) and Sotiriou (Foss 2002a) have questioned the Upper Palaeolithic date of the paintings on the limestone walls of Phytidi cave, where faunal remains of *Cervus elaphus* and *Ursus spelaeus* were also supposedly found. Darlas (1994) refers to a Middle Palaeolithic site in the region of Sami but no further details are provided.

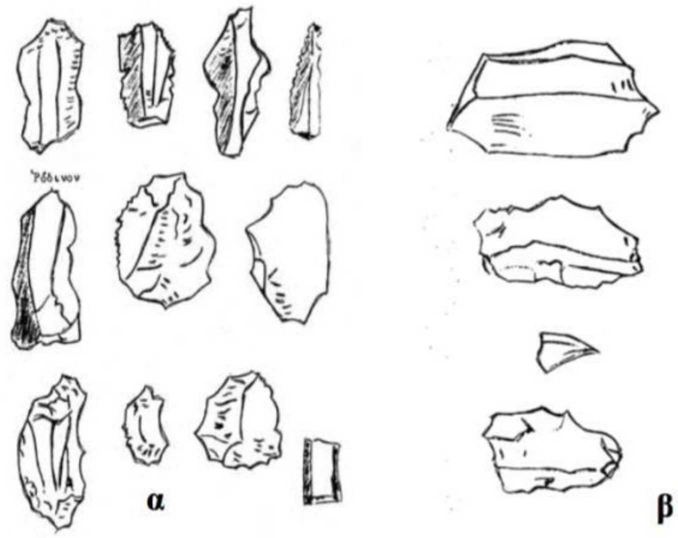


Figure 212: Drawings of lithics published by Petrocheilos in 1959 and attributed to the Palaeolithic and the Mesolithic from (α) the Agioi Theodoroi cave at Poulata and (β) the road from Sami to Grouspa (Efthimiatou-Katsouni, 2012, fig. 25).

5.1.2.6.1. Site 225

Site 225 is situated at the centre of the southern valley of Sami at an altitude of about 80-120m and is characterized by red-soil terraces with large amounts of flint artefacts and raw material nodules. Due to time and space limitations the Danish team collected only a very small sample of 134 artefacts. The types of raw materials encountered varied both in colour and quality. More often found at the site were large nodules of a light yellow and brownish or a greyish with fine-grained cortex of a medium knapping quality. Smaller nodules of light reddish to dark red and aubergine colour were also found locally but seem to have been utilized in smaller numbers. Tabular flint pieces of purple or chocolate colour were probably not utilized at all. All artefacts are in fresh condition apart from the surface alterations due to patina that either in white, yellow or red colour is present in the majority of the artefacts. Some pieces have also several degrees of patina implying either recycling or accidental breaking at later stages (Foss, 2002a, p. 120-121).

The site has been interpreted by Foss (2002a, p.121) as a “flint quarry and processing site” due to the large amounts of natural flint nodules, primary and secondary flakes and the small amounts of retouched tools. This is also supported by the presence of large cores, which have been discarded after only minor flake extraction. As for the dating of the site, Foss (2002a, p.122) was rather reluctant to propose firm chronological categorizations but suggests that the Middle Palaeolithic, the Neolithic and the Bronze Age are represented at the same site. In respect of the Middle Palaeolithic, Foss (2002a, p.122) reports that the period is represented “though not well documented”. She describes a radial discoid flake core of a trapezoid cross-section, which was found in 1996 but was not illustrated nor collected. She compares it with the Type A cores from Kokkinopilos implying a date between 100ka and 50ka. Furthermore, she refers to a few retouched artefacts to which she ascribes a broad Palaeolithic age due to their atypical and “un-paralleled” nature (Randsborg, 2002 Pl. A V. 27, 28; A 3-4, 7-8, 13). However, judging by the illustrations, only three of these (Randsborg, 2002 Pl. A VI. 4-5, 9), could be part of a Middle Palaeolithic inventory.

Table 76: Table of the sites and artefact categories from Kefalonia attributed by Foss (2002a; 2002b) to the Palaeolithic

Kefalonia lithic assemblages (Foss, 2002a, 2002b)	Mounta				Katelios				Skala				Sami		Fiskardo		Total	
	Site 13:2-3		Site 15		Site 25		Site 9		Site 33		Site 53		Site 225		Site 352			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
flakes	?	?	11	91	21	50	8	62	25	32	?	?	0	0	17	49	82	38
blades	0	0	0	0	3	7	1	8	11	14	0	0	2	18	3	9	20	9
flake tools	2	11	0	0	13	31	4	31	32	42	0	0	6	55	6	17	63	29
blade tools	0	0	0	0	3	7	0	0	6	8	0	0	2	18	7	20	18	8
technical pieces	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
pebble tools	2	11	0	0	0	0	0	0	1	1	1	100	0	0	0	0	4	2
chopper-like tools	1	6	1	8	0	0	0	0	0	0	0	0	0	0	0	0	2	1
handaxes	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
flake cores	12	67	0	0	2	5	0	0	1	1	0	0	1	9	0	0	22	10
blade cores	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6	2	1
Total	18	100	12	100	42	100	13	100	77	100	1	100	11	100	35	100	215	100
Total (%)	8,4		5,6		19,5		6,0		35,8		0,5		5,1		16,3		100	

5.1.2.7. Livatho Valley

Since 2002, the Livatho Valley Survey (LVS) took place on the NW part of the island, at the Livatho Valley, by the Irish Institute of Hellenic Studies at Athens (Souyoudzoglou-Haywood, 2008). The lithic collection from this survey is currently under study. The assemblages are of a highly undiagnostic nature. However, apart from the clear late prehistoric presence (Neolithic/Bronze Age), a very limited number of artefacts may potentially be attributed to a Pleistocene component (personal observations, 2015). These include a couple of prepared flake cores (Levallois) and a few flakes/flake tools with prepared platforms, made on both flint and chert (Figure 213).

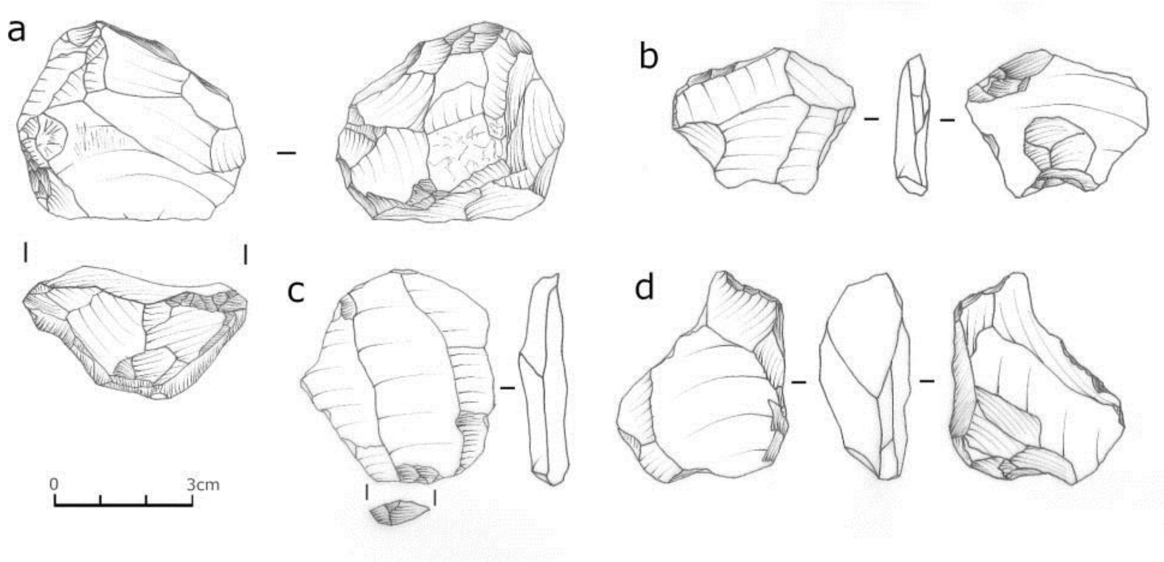


Figure 213: Prepared flake cores (a, d), flake (c) and flake tool (b) from the LVS.

5.2. The Aegean Islands

5.2.1. Northern Sporades

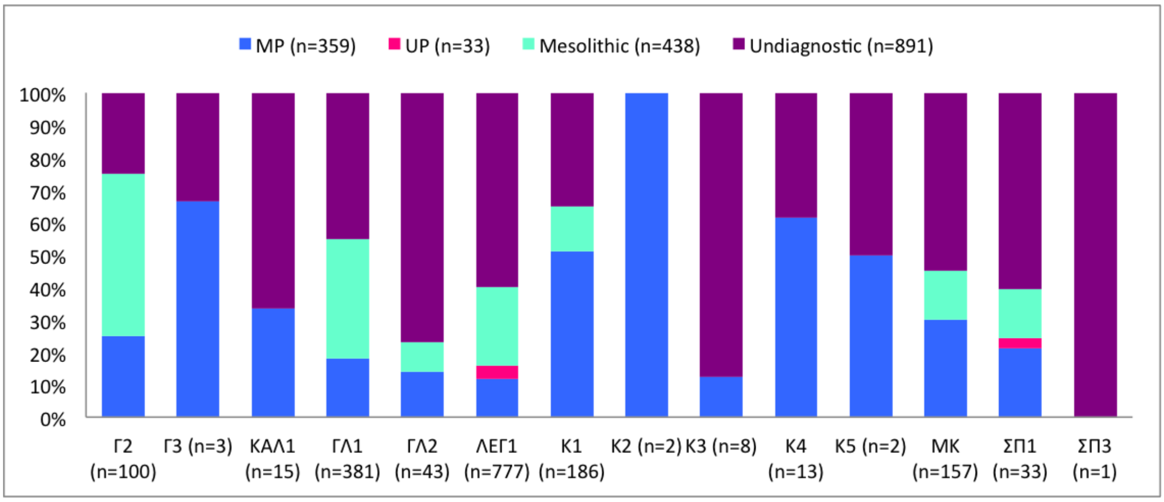
5.2.1.1. Alonnissos

After a brief report on the presence of Palaeolithic finds at Alonnissos (Theocharis, 1971, 1970), on land surveys conducted by the Greek Ministry of Culture between 1994-1996 yielded a total of 1721 artefacts from 14 sites and findspots (Panagopoulou et al., 2001b). Although most of the artefacts are undiagnostic (51.8%), thus not attributable to any particular technocomplex, the majority of the datable ones (49,1%) have been assigned a Mesolithic date, yet the ones attributed to the MP are of an equally significant number (40,3%). On the other hand, only a 10,6% of the datable artefacts has been regarded as of an UP age, the totality of which (with only one exception) was collected from the same site (Table 77).

Table 77: Number of diagnostic and undiagnostic artefacts from the sites and findspots of Alonnissos, as described by Panagopoulou et al. (2001)

Alonnissos industries (Panagopoulou et al., 2001)	Findspot	MP	UP	Mesolithic	Undiagnostic	Total
Yerakas (n= 103)	Γ2	25	0	50	25	100
	Γ3	2	0	0	1	3
Kalamakia (n= 15)	ΚΑΛ1	5	0	0	10	15
Glyfa (n= 424)	ΓΛ1	69	0	140	172	381
	ΓΛ2	6	0	4	33	43
Leptos Yalos (n= 777)	ΛΕΓ1	91	32	189	465	777
Kokkinokastro (n= 221)	Κ1	95	0	26	65	186
	Κ2	2	0	0	0	2
	Κ3	1	0	0	7	8
	Κ4	8	0	0	5	13
	Κ5	1	0	0	1	2
Mikro Kokkinokastro (n= 157)	ΜΚ	47	0	24	86	157
Spartines (n= 34)	ΣΠ1	7	1	5	20	33
	ΣΠ3	0	0	0	1	1
Total		359	33	438	891	1721

The preliminary report by Panagopoulou et al. (2001) notes that the raw material used in all 14 sites is mainly a brownish chert of the type known as porcelanite. Artefacts made of fine-grained quartz of a good knapping quality are also reported for the totality of the sites. Both raw material types are locally found in primary and secondary sources. The authors rightly note that assemblages with "Mesolithic characteristics" might as well belong to earlier or later phases of prehistoric activity. Thus, in their preliminary analysis apart from the technological and typological attributes, they also took into account the preservation, the surface alterations and the geological context of each site (Panagopoulou et al., 2001, p. 128). In particular, the assemblages from Yerakas, Kalamakia, Glyfa, Leptos Yalos, Kokkinokastro and Spartines (Figure 214) include in lesser or greater amounts diagnostic MP artefacts, while only Leptos Yalos and Spartines yielded artefacts attributed to the UP (Graph 146).



Graph 146: The percentages of artefacts attributed to the MP, the UP and the Mesolithic as well as of the undiagnostic artefacts from the sites at Alonnissos. Yerakas includes Γ2 and Γ3, Kalamakia is ΚΑΛ1, Glyfa includes ΓΛ1 and ΓΛ2, Leptos Yalos is ΛΕΓ1, Kokkinokastro includes K1-5, Mikro Kokkinokastro is MK, Spartines include ΣΠ1 and ΣΠ3. Data inferred from Panagopoulou et al., 2001.

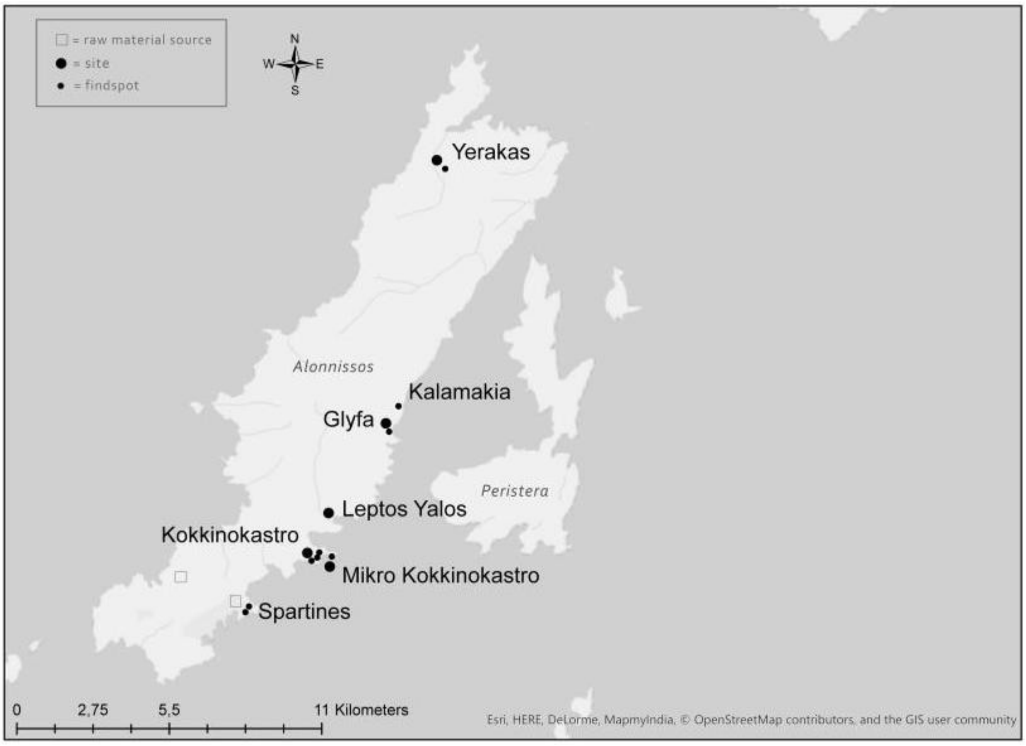


Figure 214: Map of Alonnissos Island with the Pleistocene sites, findspots and raw material sources of the island annotated. Map produced with ArcGIS.

The MP components of Yerakas, Glyfa, Leptos Yalos and Kokkinokastro include cores and blanks made by the use of the Levallois (lineal, recurrent, convergent) and discoid techniques. A pronounced presence of the Levallois technique in all stages of the reduction sequence is reported for Glyfa (ΓΛ1) and Kokkinokastro (K1) (Figure 215).

Figure 215: The south profile of the peninsula of Kokkinokastro, Alonnissos Island, and the islet of Mikro Kokkinokastro, which was part of the peninsula. View from Kokkinokastro Bay towards the SE. A Middle Palaeolithic site has been identified and excavated by the Greek Ministry of Culture on the islet and a few more findspots surveyed on the peninsula and bay (photo: C. Papoulia, July 2014).

Illustrations of Levallois cores (Panagopoulou et al., 2001, fig. 2.1, 2.3, 4.1), Levallois flakes (Panagopoulou et al., 2001, fig. 2.2, 3.1, 3.4) and of a small Levallois point (Panagopoulou et al., 2001, fig. 3.3) support the MP character attributed to the particular assemblages. The report includes small amounts of Kombewa flakes and blanks produced by the use of the *Quina* technique, one of which is also illustrated (Panagopoulou et al., 2001, fig. 4.3), as are a couple of transverse scrapers (Panagopoulou et al., 2001, fig. 3.5, 5.2). Judging by the illustration, the one from Leptos Yalos has inverse, long, stepped retouch and is made on a partially cortical flake with a facetted platform. Technical pieces, *entame* and *débordant* flakes, naturally backed knives, pseudo-Levallois points as well as notches and denticulates are also part of the MP assemblages from Glyfa. The site at Kalamakia includes only a few scrapers and flakes, while the sites at Spartines, due to the abundance of raw material sources (Figure 216), is predominated by cores and flakes from the initial stages of the reduction sequence and would have perhaps acted as a procurement site diachronically.

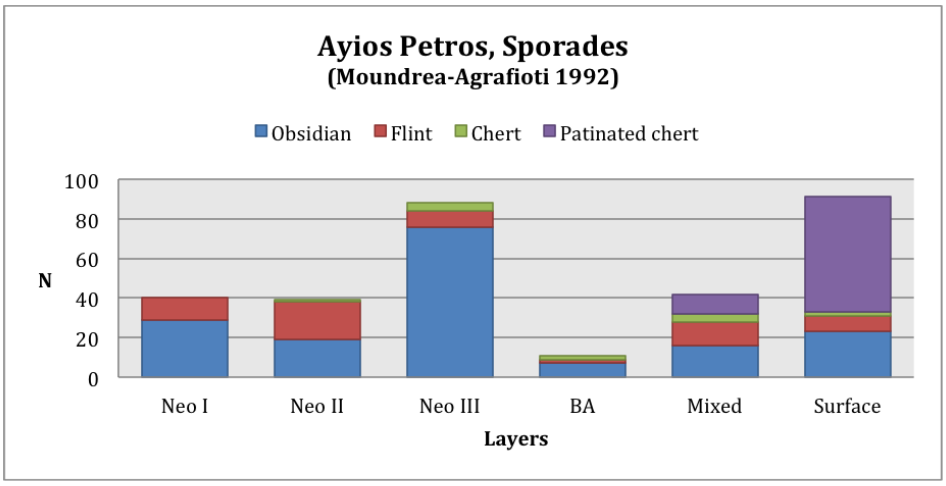
Thus, the MP presence on Alonnissos is adequately supported by the technological and typological characteristics of the assemblages, seconded by the illustrations. On the contrary, artefacts belonging to the UP are very few and rarely diagnostic. A bladelet core and a carinated endscraper on a blade are the only artefacts illustrated (Panagopoulou et al., 2001, fig. 5.3, 5.4), while the presence of one more carinated endscraper, a few technical pieces (i.e. core rejuvenation flakes and crested blades) and some broken parts of tools on bladelets are also accounted. Although the potential of encountering MP sites in situ is believed to be low, the opposite is expected to be true for the preservation of sites dated to the final part of the Late Pleistocene as well as to the early Holocene (Panagopoulou et al., 2001, p. 136), yet again the absence of diagnostic UP artefacts has been partially explained by the now submerged coastal parts of the island which might have been occupied during the LGM.

Figure 216: The beach at Spartines with different types of siliceous raw material sources (both primary and secondary) (Photos: C. Papoulia, July 2014).

5.2.1.2. Ayios Petros (Agios Petros)

A few MP artefacts have also been reported from Ayios Petros, an islet once part of Kyra Panayia, another isle situated NE of Alonnissos (Efstratiou, 1985; Moundrea-Agrafioti, 1992). The excavations at the Holocene site of Ayios Petros yielded remains of a Neolithic occupation (Layers I, II, III) on top of which there was a Bronze Age deposit and a Byzantine burial. A total of 133 artifacts were collected from the surface (N=101) and the initial, disturbed (N=32) layers of the site. The material attributed to the Palaeolithic, because of their technological characteristics and their heavily weathered surfaces, counts a total of 68 specimens and comes from the surface and from the mixed top layer of the site of (Graph 147). According to Moundrea-Agrafioti (1992, p. 193) artefacts with the same characteristics were not found in the undisturbed Neolithic layers (I-III) and hypothesises that the Palaeolithic material were found on the surface due to the erosional processes. She notes that the artefacts are heavily weathered and are made of the same siliceous raw material as the ones from Alonnissos, here described as flint and chert.[36] The assemblage consists of small discoid and polyhedral cores, small and wide flake blanks with centripetal dorsal negative scars and dihedral or facetted platforms. The small size of the artefacts was interpreted as a result of the small size of the raw material nodules (Moundrea-Agrafioti, 1992, p. 194), yet a re-evaluation by Panagopoulou et al. (2001) proved that the particular size range is not uncommon in the MP record. The tool *repertoire* lacks the characteristic Levallois points and MP scrapers. Instead the blanks have rarely been retouched and the reduction of the cores is not exhaustive. The centripetal reduction sequences of the cores urged Moundrea-Agrafioti (1992) to classify them as discoid cores. Although there are no Levallois points or typical MP scrapers, judging by the illustrations, the cores, two of which (Moundrea-Agrafioti, 1992, pl. 33a.1, 3) could be regarded as recurrent centripetal and lineal Levallois respectively, together with the prepared platform flakes (Moundrea-Agrafioti, 1992, pl. 33a.4-6) lend support to the proposed MP cultural attribution.

[36] At the time of publication (1992) the survey by Panagopoulou et al. (2001) had not taken place, thus Moundrea-Agrafioti refers to the material collected by Theocharis (1970) from the sites of Glyfa and Mikro Kokkinokastro.



Graph 147: Frequency of raw material categories in the lithic assemblages of each layer excavated at Ayios Petros as described by Moundrea-Agrafioti (1992).

5.2.1.3. Ayios Efstratios or "Ai Stratis" (Agios Ephstratios)

The site of Alonitsi, situated at about 30masl (Figure 217), discovered by Sampson's investigations on the island of Ayios Efstratios, has yielded a lithic industry made of various raw materials such as flint and radiolarite, siliceous hydrothermal rocks, andesite and quartz. According to a reference by Kaczanowska and Kozlowski (2014) the industry includes notched and denticulated tools (Figure 218.6-9), double-platform (Figure 218.2-3) and -less often- Levallois preferential core techniques (Figure 218.1), only a few illustrations of which have been published (Kaczanowska and Kozlowski, 2014, fig. 2). Of these, the small Levallois core forms the strongest argument for a MP presence at the site, while the tools with the denticulated retouch can hardly be regarded as artefacts diagnostic enough to support such a chronological attribution.[37]

Figure 217: View of the site of Alonitsi (black arrow), Ayios Efstratios Island (Kaczanowska and Kozlowski 2014).

37 A recently published paper provides more details on the site and its context (Sampson et al., 2018).

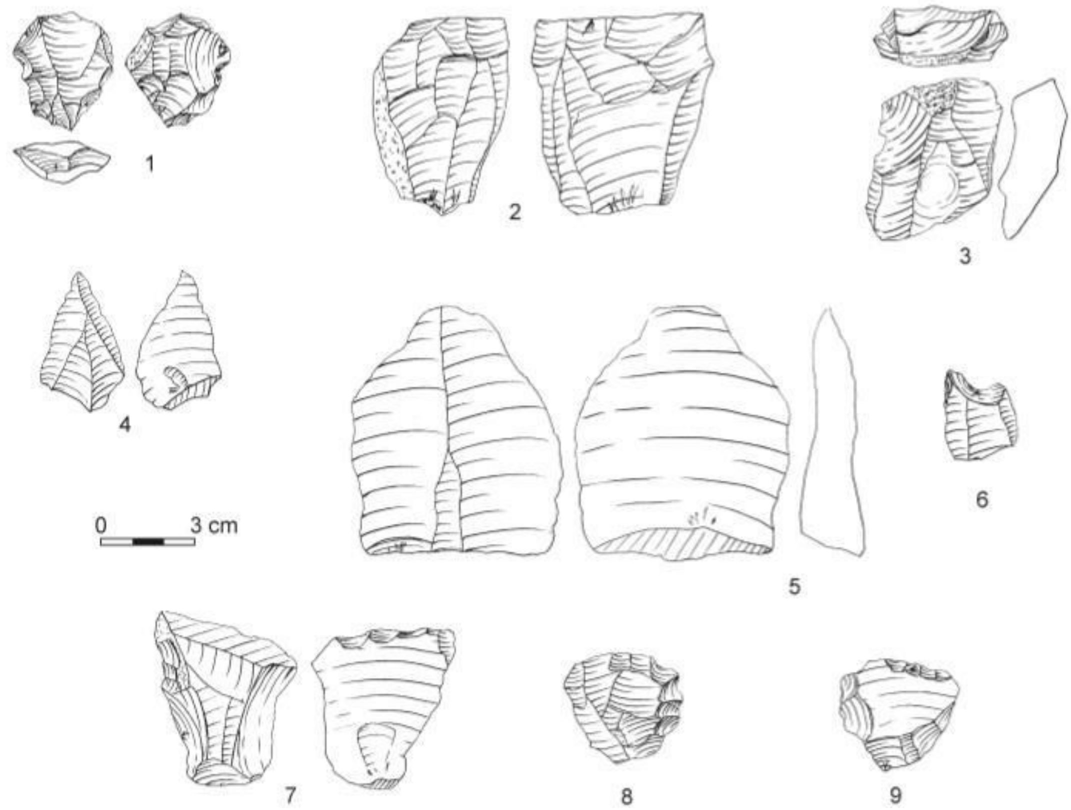


Figure 218: The lithic artefacts from Alonitsi, Ayios Efstratios (1= Levallois core, 2-3= double-platform cores, 4-5= triangular flakes, 6-9= notched/denticulated tools), which have been attributed to the Middle Palaeolithic by Kaczanowska and Kozlowski (2014).

5.2.2. Cyclades

5.2.2.1. Milos

In 1991, the Italian archaeologist Giorgio Chelidonio collected 136 lithic artefacts from a survey conducted at the western coast of the Cycladic island of Milos by the Institute of Mediterranean Research "Atlantis" (Chelidonio, 2001). Core and flake tools made primarily of a coarse-grained volcanic rock (rhyolite) were recovered from three different findspots situated in the marine terrace along Triadon Bay (Triades, Figure 219):

i. Cape Zefiros / Triadon North (TN, loc. A)
ii. Triadon South (TS, loc. B)
iii. Triadon (loc. C)

Figure 219: a. The marine terrace at Triadon Bay, b. Pebbles in an eroded surface collection area, c. Strata with faulted volcanic rocks (Chelidonio, 2001, figs. 1–2, 5).

Chelidonio published a preliminary report in an Italian journal at a time when the discussion on the subject of Pleistocene sea-crossings in the Mediterranean did not practically exist. It was only a year later when the detailed conclusions from the Danish survey at Kefalonia got published. In his report he describes in detail 13 "tools and cores"[38] (Chelidonio, 2001, pp. 125–126), the majority of which are also illustrated.

In particular, he mentions a "Tayac-like" point[39] with inverse, scaled retouch made on a cortical flake (Chelidonio, 2001, Pl. 7.2), a backed knife[40] made on a thick laminar flake (Chelidonio, 2001, Pl. 8.2), a flake with inverse retouch, two convergent scrapers with scaled and stepped retouch (Chelidonio, 2001, Pl. 9.4), one of which has a thick triangular cross-section (Chelidonio, 2001, Pl. 10.1), two thick scrapers made on pebbles (Figure 220;

[38] *Strumenti e masse nucleiformi (*Chelidonio 2001, p.125*)*
[39] *1 punta "taiacoide"* (Chelidonio 2001, p.125).
[40] *1 "dorso" atypico* (Chelidonio 2001, p.125).

Chelidonio, 2001, Pl. 3), two thick scrapers made on cores by means of denticulated retouch. One of them preserves traces of intense battering on the right edge of its dorsal face, which are probably due to previous uses as a hard hammer or an anvil.

Figure 220: Pebble tools classified by Chelidonio as «thick scrapers made on pebbles» (Chelidonio, 2001, fig. 3).

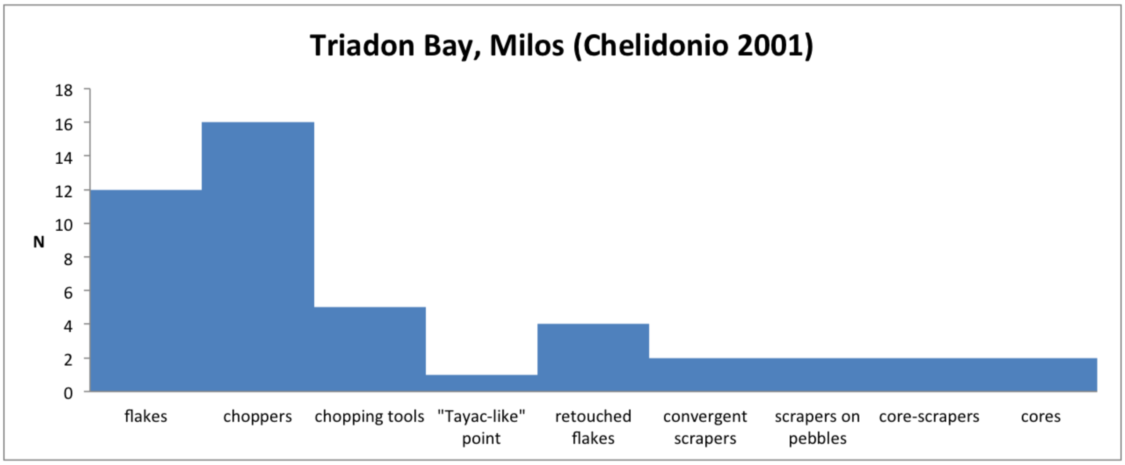
There is also an artefact with invasive, semi-abrupt retouch (Chelidonio, 2001, Pl. 4.2), a thick retouched flake with notched retouch at its proximal and left lateral and scaled retouch (mixed with notches) at its distal (Chelidonio, 2001, Pl. 12.2). Lastly, he describes a core with laminar removals and a large prepared platform. He notes that it retains a large lateral scar that has truncated the dorsal scars in order to change the orientation of the removals. Among the collection there is only one bifacially worked discoid core made of black, opaque obsidian with brownish shades (Figure 221). It is described as "*laviforme*" and the negative scars are all short, uni/bidirectional, with smooth planes. He believes it is probably a core preform rather than an atypical biface (Chelidonio, 2001, Pl. 4.4, 11).

Figure 221: Artefacts from Triadon Bay. Artefacts (a)-(c) are made of rhyolite and (d) of obsidian (Chelidonio, 2001, fig. 4).

He also refers to 12 cortical flakes, 16 choppers and five chopping-tools and while some of these are probably included in the illustrations, there is no direct reference in the text. Table 78 and Graph 148 present the categories described in the text. More retouched tools have been illustrated though not included in the text.

Table 78: Number and percentage of artefact types for the sample (n=46) from the Triadon Bay assemblage as described in Chelidonio 2001.

Triadon Bay (Chelidonio, 2001)	**N**	**%**
Flakes	12	26
Choppers	16	35
Chopping tools	5	11
"Tayac-like" point	1	2
Retouched flakes	4	9
Convergent scrapers	2	4
Scrapers on pebbles	2	4
Core-scrapers	2	4
Cores	2	4
Total	46	100



Graph 148: Column chart of the frequency of the different artefact types for the sample (n=46) from Triadon Bay which has been described in Chelidonio 2001.

According to his descriptions, 50% of the *choppers* have four removals, 32% have three, 12% have two and only one of the 16 has six flake removals. The majority has either a very wide-angle retouch of 70°-80° (43,75%) or an angle of 60° (37,5%). A 6,25% has an angle of 50° and the rest 12,5% have been knapped in a rather acute angle of 30°-40°. Four of the choppers are fan-shaped and two can marginally be classified as choppers due to their morphology, meaning that the first has a core-like aspect and the second could be also described as a wedge, due to probable use of an anvil, with minor retouch of the type an endscraper would have (Chelidonio, 2001, p. 128).

The five *chopping-tools* have been produced by bifacial flake removals of the following morphology:

i. Single removal with four removals on the opposite face (1+4)
ii. Single removal with two on the opposite face (1+2)
iii. Four removals with three on the opposite face (4+3).

According to Chelidonio (2001, p. 128) these artefacts reflect an opportunistic technology that rarely produces "tool-types", but its multidirectional knapping process produces either sub-discoidal cores or pebble-core tools and he correctly notes that such expedient tools are present in several sites dated both to the Lower and the Middle Palaeolithic.

Chelidonio was cautious in attributing the stone tools from Triadon Bay to the early Palaeolithic due to the unstratified context. Although he thinks that a Middle Palaeolithic date might be more probable than a Lower Palaeolithic one, he also notes the possibility of a Mesolithic date. Chelidonio (2001, p. 42) reports that the Mesolithic scenario was positively accepted by Runnels back in 2001, when the discussion of even earlier sea-crossings in the Aegean was still out of the question. In his review of the evidence from the Aegean islands 13 years later, Runnels (2014) describes the artefacts from Triadon Bay as of a Lower Palaeolithic type and mentions his own observation of bifaces made of non-obsidian volcanic rock found at Sta Nychia back in 1977. While his initial interpretation associated these tools with obsidian-working activities (Runnels, 1981; Torrence, 1986, p. 182) he now considers the potential of a Palaeolithic date in accordance with the tools from Triadon Bay (Runnels, 2014a, p. 217). As it will be further discussed in the evaluative synthesis of the Aegean data later on, the published photographs from Milos portay lithic artefacts with technological and typological affinities that could clearly associate them with both Lower and the Middle Palaeolithic industries. Could these artefacts, however, be part of later prehistoric industries whose main toolkit consisted of obsidian flake and blade tools accompanied by a few "heavy-duty" artefacts made on different raw materials, such as rhyolite?

5.2.2.2. Naxos

Another Cycladic island, Naxos, situated at the eastern part of the island cluster was in 2012 reported as of having been visited during the Palaeolithic due to rescue excavations conducted by the Greek Ministry of Culture at Stelida, NW Naxos (Legaki, 2012). The following two years, the *Stelida Naxos Archaeological Project (SNAP)* conducted intensive survey in this part of the island. During this two-year geoarchaeological project the aim was to identify the raw material sources and the associated knapping floors (Carter et al., 2014). The team surveyed the Stelida promontory with transects and grids and identified the chert outcrops at the two peaks of the hill, at an altitude of 118masl. The siliceous raw materials are mainly pervasively silicified shale and some silicified sandstones and conglomerates (Skarpelis et al., 2017). The colour is white with an occasional honey hue. The best raw material sources and the largest concentrations, with lithics (ca. 30.000 specimens) attributed to the Palaeolithic and the Mesolithic, were found at the southern peak (Figure 222). Between the two peaks and nearly at the top of the southern peak there are two small rockshelters. Since 2015 the project in collaboration with the Greek Ministry of Culture, focuses on excavating the site with the aim to locate undisturbed stratified deposits in order to be able to generate absolute dates (Carter et al., 2017).

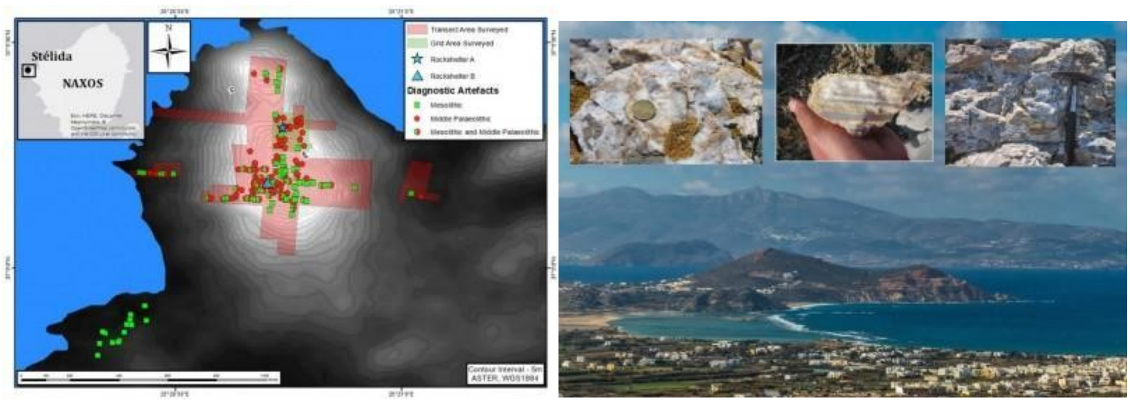


Figure 222: a. GIS map with the Middle Palaeolithic (red dots) and the Mesolithic (green dots) artefacts collected in 2013 from Stelida, b. View of the promontory of Stelida seen from the west with the chert raw materials found at the top of the hill. The rockshelters are annotated by a star and a triangle (Carter et al. 2014).

According to the preliminary reports, the Middle Palaeolithic material from Stelida consists of blanks produced from discoidal cores and Levallois products, i.e. flakes and blades with both unidirectional and bidirectional dorsal scars. Denticulates and notches dominate the tool repertoire, which also includes different types of scrapers and only a few Levallois and pseudo-Levallois points. By typological comparisons, the lithics from Stelida have been broadly placed between 250,000 and 40,000 BP (Carter et al., 2014).

The preliminary publication of the surface material includes a number of drawings of lithics ascribed both to the Mesolithic (Carter et al. 2014, fig. 4: 1-18) and the Middle Palaeolithic (Carter et al. 2014, fig. 4: 19-20; Fig. 5). A few more drawings of Middle Palaeolithic artefacts were published in their second paper (Carter et al., 2017) where they also discussed part of the excavated material (Figure 223e-f). Taking into account the preliminary nature of the results it is difficult to evaluate the reading of the lithic material at this stage. Judging by the illustrations it seems that there is evidence of platform preparation in some of the blanks (e.g. Figure 223c, e-f; Figure 224.4, 14). The two cores attributed to the Middle Palaeolithic have been described as Levallois blade core and Levallois flake core (Figure 223a-b) respectively. The flakes and flake tools drawn include a Levallois point (Figure 223d and Figure 224.1 depict the same artefact), Levallois flakes (Figure 224.2-4) and blades (Figure 224.5-7), backed flakes (Figure 224.8-10), *déjeté* scrapers (Figure 224.11, 13), a *déjeté* flake (Figure 224.12), a pointed tool (Figure 224.14), an inverse scraper (Figure 224.15) and two pseudo-Levallois points (Figure 223f, Figure 224.16).

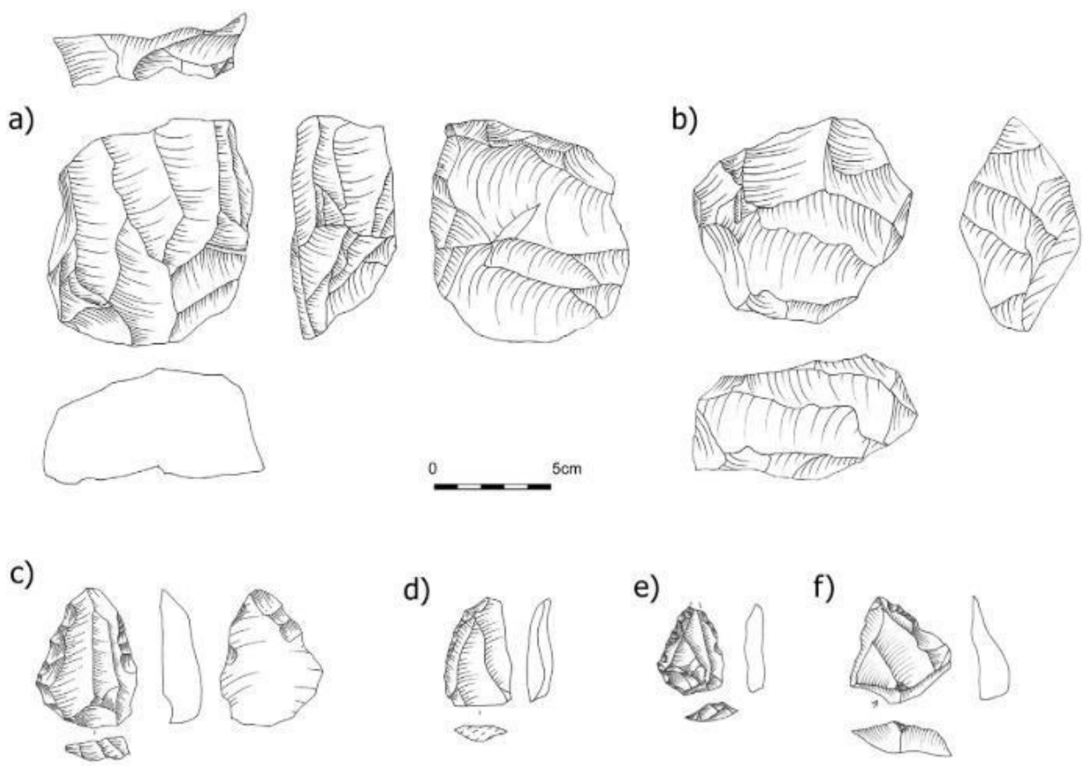


Figure 223: Levallois blade core (a), Levallois flake core (b), Mousterian points (c, e), Levallois point (d), pseudo-Levallois point (f) (Carter et al., 2017, fig. 6).

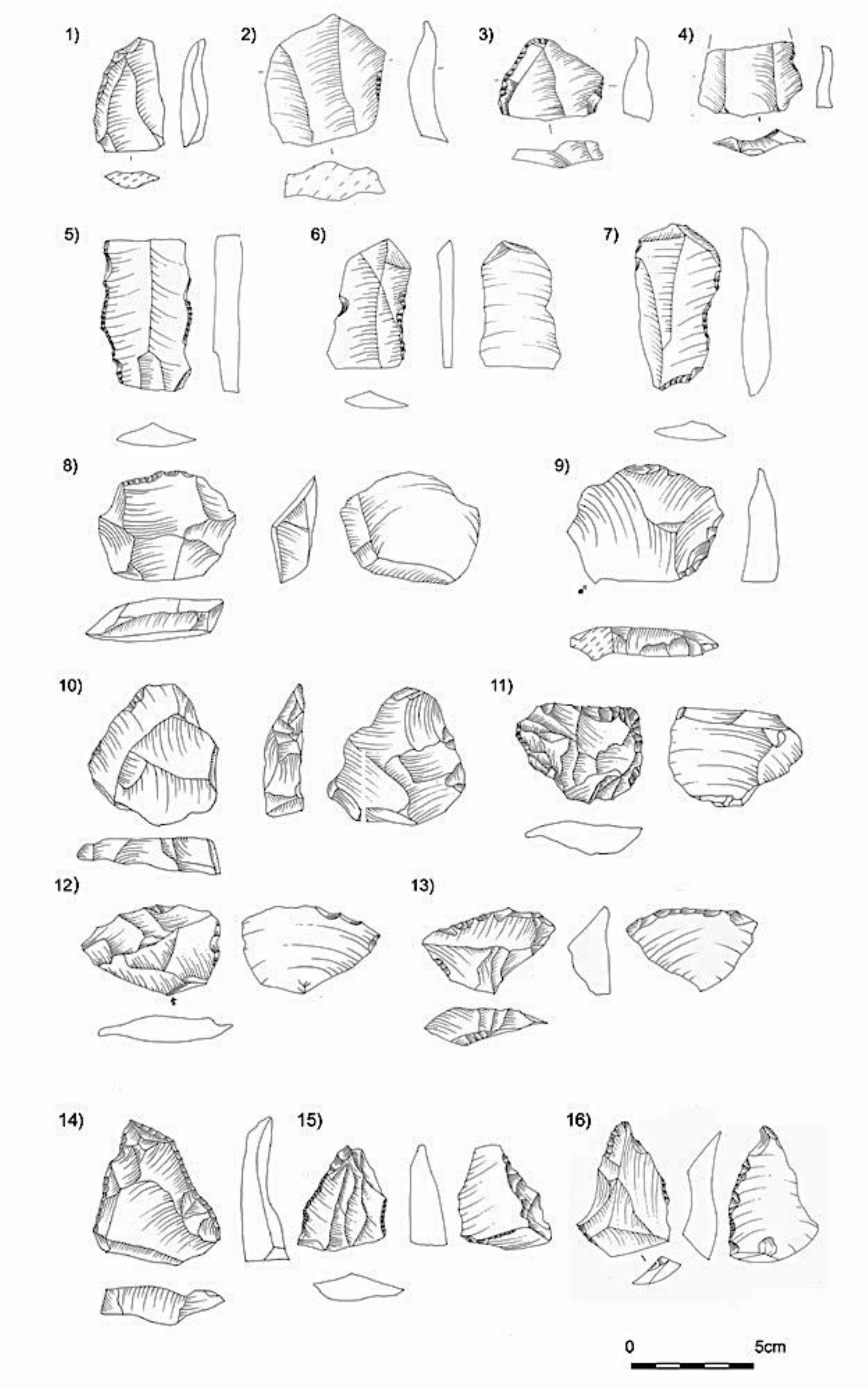


Figure 224: Drawings of the lithic artefacts from Stelida attributed to the Middle Palaeolithic by Carter et al. 2014, fig. 5.

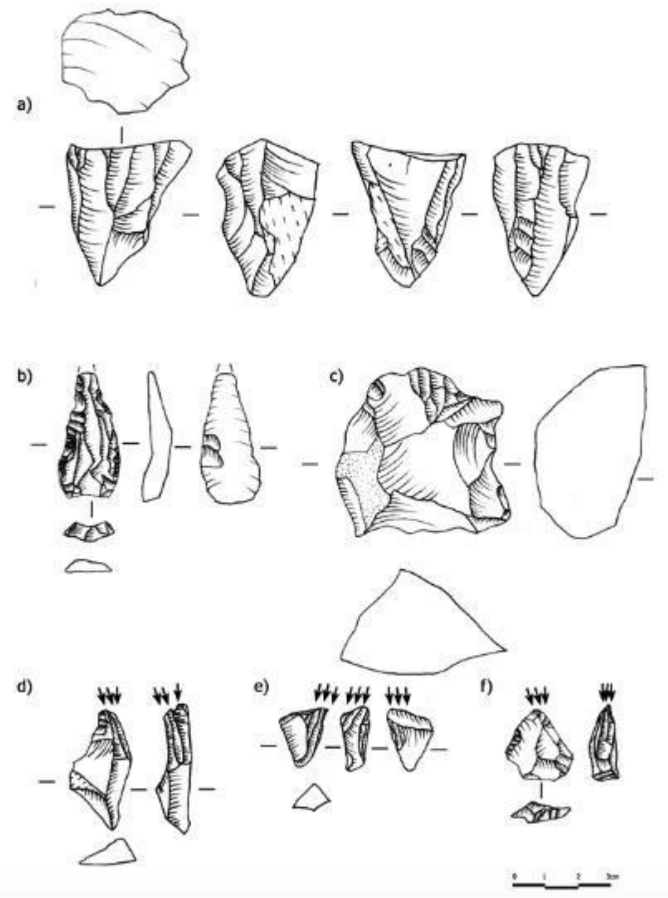


Figure 225: Upper Palaeolithic artefacts from Stelida: unipolar blade core with lateral preparation (a), unipolar retouched blade (b), combined tool end-scraper and denticulate on flake (c), multiple burins on flakes (d-f) (Carter et al., 2017, fig. 5).

However some of the classifications do not seem well supported by the illustrations provided. For instance, in accordance with Boëda's definition of Levallois vs. discoid technique (Boëda, 1993), the second core described as a "Levallois flake core" should most probably be classified as a discoid one, with a semi-fixed perimeter rather than a recurrent centripetal Levallois one. The "pseudo-Levallois point" would be better classified as a perforator (piercer/bec) and one of the backed flakes (i.e. Figure 224.10) seems to be a bifacially worked piece with negative scars of flake removals covering both the dorsal and ventral faces. Judging by the illustrations of the blades (Carter et al., 2014, fig. 5.5-7) at first it was thought legitimate to wonder about the particular criteria for the proposed Middle Palaeolithic attribution (Papoulia, 2017), especially since (a) their platforms are broken, (b) broad and quite thick blades can also be part of early Upper Palaeolithic and even Neolithic assemblages and (c) being a raw material source site, Stelida would had diachronically attracted flint-knappers. The excavation provided answers in this respect, since an Upper

Palaeolithic component was recounted for in the team's second report (Carter et al., 2017). According to the authors, this consists of blades and tools with early Upper Palaeolithic (Aurignacian) and Epigravettian affinities (Figure 225). What is more, the survey yielded artefacts with Lower Palaeolithic affinities (Figure 226), "including handaxes and other bifaces (some made of emery from elsewhere on Naxos), a cleaver, as well as large flake tools such as denticulates and scrapers", comparanda of which are believed to be found at Middle Pleistocene quarry sites in the Levant (Carter et al., 2017, p. 81).

It is suspected that within the very large collection sample (ca. 30.000 artefacts only from the survey) more diagnostic examples of Middle Palaeolithic artefacts are hidden, waiting to be fully published. Yet, as the excavators rightly note (Carter et al., 2017), because of the idiosyncratic nature of the site, being it a quarry, the expectation should not be to find a "typical" Mousterian tool-type (a point or a scraper for instance) as one would expect to find in other types of Middle Palaeolithic sites, but large amounts of specimens from the initial stages of the *chaine opératoire*.

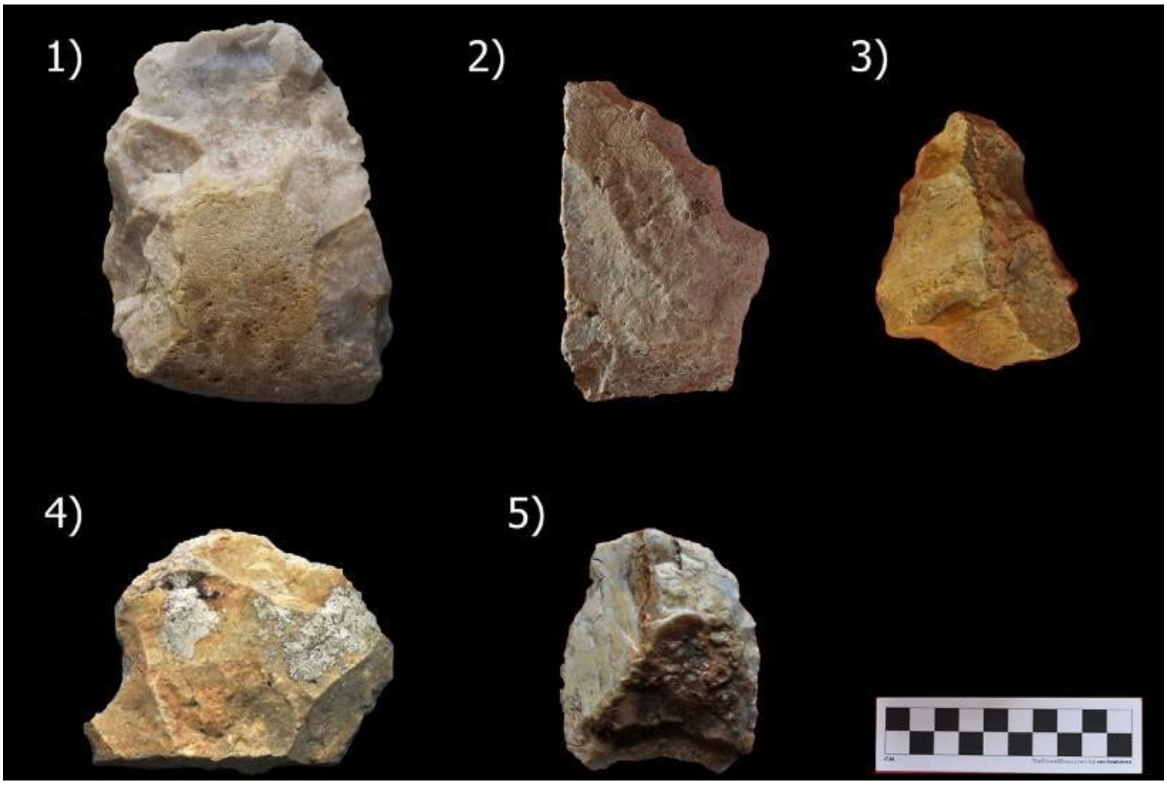


Figure 226: Artefacts attributed to the Lower Palaeolithic component of Stelida, Naxos (Skarpelis et al., 2017, fig. 7).

5.2.3. Crete

Nine sites at the area of Plakias (Strasser et al., 2010) and one more site at Loutro (Mortensen, 2008), both situated in SW Crete, have raised arguments of a Pleistocene presence on the islands, predominantly of a Lower Palaeolithic age. Two more sites from Mochlos, NE Crete, have only recently been added to the Pleistocene map of the island (Runnels et al., 2014b).

5.2.3.1. Loutro

The first article with implications for Lower and Middle Palaeolithic presence on Crete was published by a Danish archaeologist within the last decade (Mortensen, 2008). In the summer of 2003, Mortensen collected 22 artefacts from a gully at the area of Loutro, west of Sfakia, SW Crete. The artefacts were laying on an eroded surface at an altitude of 180-220masl that has been described as of a “grey to reddish-brown soil, possibly washed down from terraces deposited earlier on top of the gully” (Mortensen, 2008).

The majority of the lithics are made of a local, coarse, white to reddish-brown chert and some of limestone. The local cherts are of bad knapping quality; a fact which according to Mortensen (2008) is reflected in the artefacts and might have also been the reason for no previously identified Palaeolithic artefacts on the island. All artefacts are worn and heavily patinated. The “blurred” surfaces have in some cases made it difficult for Mortensen to distinguish the intentionality of the knapping scars yet he argues that the presence of particular traits on a number of specimens prove that these are not the products of trampling or accidental impact. These traits include (a) the flaking/retouch and crushing scars in restricted areas instead of scars covering all the edges of each specimen, (b) the pronounced bulbs of percussion and (c) the probable preparation of the platforms.

After explaining why he regards the particular sample as artefacts rather than geofacts, Mortensen describes in relative detail the 22 pieces he collected, including their measurements (Figure 227), though he does not provide any photographs. These include an unmodified flake, a retouched cortical flake and a retouched flake with a “probable” prepared platform (Mortensen, 2008, fig. 3c), five artefacts described as “points” made mostly on “natural” flakes or cores (Mortensen, 2008, fig. 4b-c), a scraper with alternating retouch made on a “natural flake” (Mortensen, 2008, fig. 3d) and a scraper made on a core (Mortensen, 2008, fig. 4a). There is also an artefact described as a “handaxe made from a core, the lower part of which consists of a thick lump of limestone" while "the upper part is of chert that has been bifacially modified by flaking" (Mortensen, 2008, fig. 2a).

Apart from the handaxe there are three "picks", two of which are described as triangular, all made on "natural" flakes, cores or lumps of chert (Mortensen, 2008, fig. 2b-c). The handaxe and one of the picks (catalogue number 2 in Mortensen, 2008) are the most elongated ones from the 12 in total LCTs from Loutro as described by Mortensen (Graph 149). Lastly, there are eight chopping-tools which are made on "natural flakes" (n=1), "thick natural flakes" (n=3), flakes (n=2) and cores (n=2) (Mortensen, 2008, fig. 3a). Mortensen notes crushing marks and use/retouch traces on five of these tools.

Table 79 Assemblage composition from Loutro, Crete, as described by Mortensen (2008)

Loutro	N	%
Flake	1	5
Retouched flake	2	9
Pick	3	14
Handaxe	1	5
Chopping tool	8	36
Scraper	2	9
Point	5	23
Total	**22**	**100**

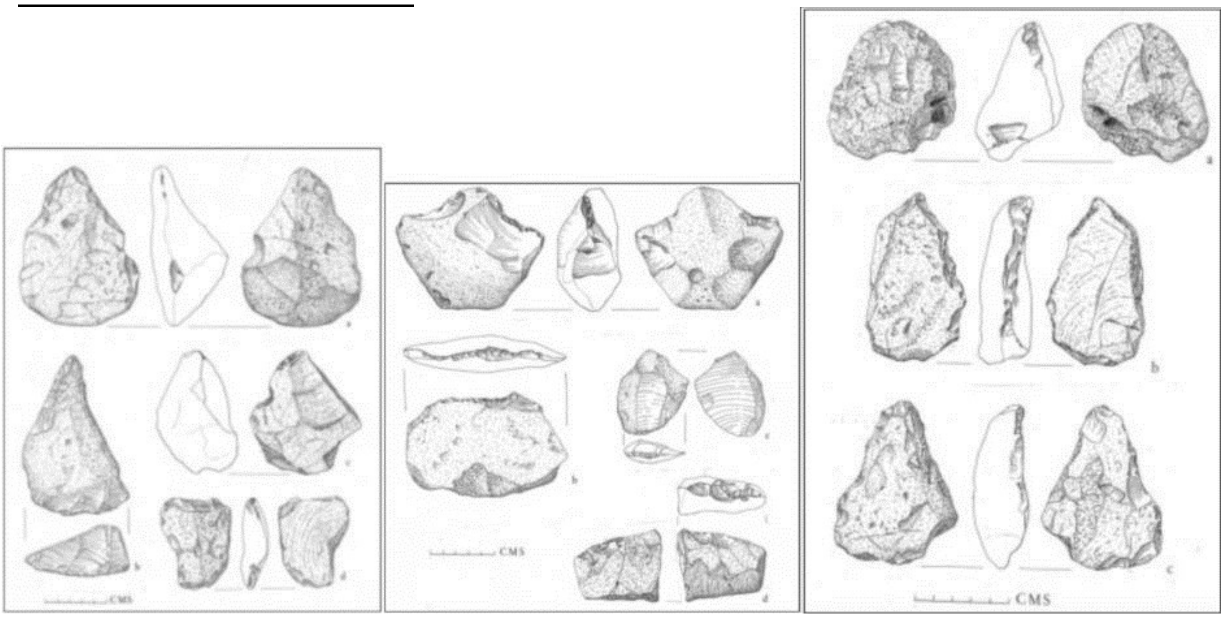
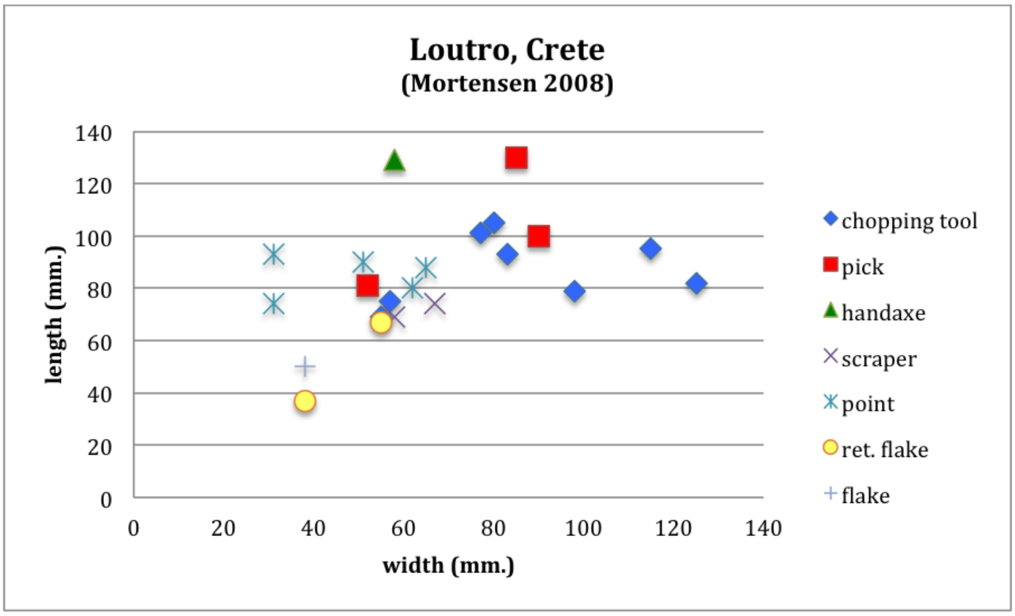


Figure 227: Specimens from Loutro attributed to the Lower Palaeolithic by Mortensen (2008, figs. 2–4)

Based on the tool composition (Table 79), he proposed a late Lower Palaeolithic and early Middle Palaeolithic date for the assemblage. He also proposed possible contemporaneity with the artefacts collected from Gavdos, the small island situated SW of Crete and suggested that a sea-crossing directly from Libya might be a possible scenario for the arrival of the "first humans". However, an evaluation of the finds based on this preliminary report is rather problematic due to the absence of photographs. Doubts about the artefactual nature of the specimens have been expressed by Runnels who examined the finds as part of the Plakias survey team (Runnels, 2014a, p. 218; Strasser et al., 2010). Based on the illustrations, which by definition include a large amount of interpretation, it is here impossible to agree or disagree with Runnel's claim. It is true, though, that at least a couple of them (Mortensen, 2008, figs. 2a, 4c), i.e. artefact no. 1 classified as a "handaxe" and artefact no. 17 classified as a "point" bear close resemblance to the *pseudo-outils* as illustrated by Bordes (1979, fig. 41); yet this cannot be said for artefact no. 13 which clearly exhibits negative scars of previous removals on its dorsal face, even if the preparation of the platform is followed by a question mark (Mortensen, 2008, fig. 3c). Of interest is the distinction of the blanks into "flake" vs. "natural flake" or "core" vs. "natural core", with the word "natural" apparently implying an unintentional, ecofactual blank that was then further retouched/utilized?



Graph 149: Scatter chart of the dimensions (length and width) of the artefacts from Loutro as described by Mortensen (2008).

5.2.3.2. Plakias

Between 2008 and 2009, an American team under the auspices of the Greek Ministry of Culture conducted a survey in southwestern Crete at the broader area of Plakias, especially its former and present wetlands, in order to identify possible remains of Mesolithic activity on the island (Strasser et al., 2010). According to the archaeologists involved, the survey yielded both Mesolithic and Palaeolithic artefacts (Strasser et al., 2010). In the initial publication of the material (Strasser et al., 2010), a Palaeolithic age was ascribed to a total of 555 artefacts from nine sites from the area between Preveli Gorge and Kotsifos Gorge, i.e. Preveli 2, Preveli 3, Preveli 7, Preveli 8, Kotsifos 1, Timios Stavros 1, Timios Stavros 4, Gianniou 1 and Schinaria 5 (Figure 228).

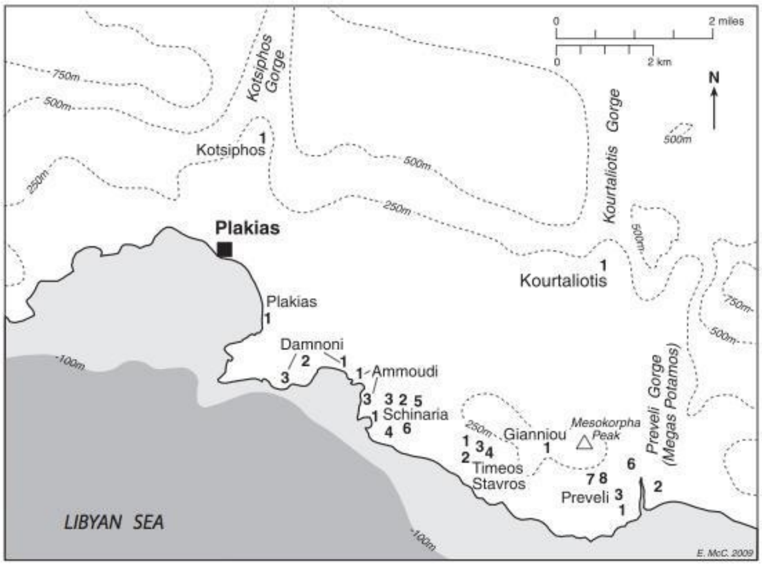


Figure 228: Map with the sites identified by the Plakias Survey team in 2008-2009. The sites that yielded Palaeolithic artefacts are Preveli 2,3,7 and 8, Kotsifos (Kotsiphos) 1, Timios (Timeos) Stavros 1 and 4, Gianniou 1 and Schinaria 5. The -100m isobath indicates the approximate extent of the Pleistocene coastal plain (Strasser et al., 2010, fig. 2).

After re-evaluation, the Lower Palaeolithic assemblages, counting a total of 211 artefacts, were separated from the overall sample of the Palaeolithic material and were discussed independently (Runnels et al., 2014a). The latter publication includes eight, instead of nine, sites excluding Schinaria 5. Since there has been no indication of an Upper Palaeolithic signature in any of the sites, it is plausible to assume that the nine artefacts collected from Schinaria 5 were either attributed to the Middle Palaeolithic or are totally undiagnostic. There is also a chance that, after the re-evaluation, the particular site might have been attributed to the Mesolithic instead of the Palaeolithic. Five more sites from the area of Schinaria (i.e. Schinaria 1,2,3,4 and 6) have been attributed to the Mesolithic (Strasser et al., 2010; Table 80).

Table 80: Chronology of the sites from the Plakias survey (Strasser et al. 2010, Table 1)

Plakias sites	Palaeolithic	Mesolithic	Other
Damnoni 1		x	
Damnoni 2		x	
Damnoni 3		x	
Ammoudi 1		x	
Ammoudi 3		x	
Ayios Pavlos 1		x	
Ayios Pavlos 2		x	
Ayios Pavlos 3		x	
Schinaria 1		x	
Schinaria 2		x	
Schinaria 3		x	
Schinaria 4		x	
Schinaria 5	x		
Schinaria 6		x	
Preveli 1		x	
Preveli 2	x	x	
Preveli 3	x	x	
Preveli 6		x	
Preveli 7	x		
Preveli 8	x	x	
Kourtaliotis 1			x
Kotsifos 1	x		
Plakias 1			x
Timios Stavros 1	x		
Timios Stavros 2		x	
Timios Stavros 3		x	
Timios Stavros 4	x		x
Gianniou 1	x		

At first, quartz and quartzite core and flake tools were attributed predominantly to the Lower Palaeolithic in terms of technology, typology and associated geological context (Strasser et al., 2011, 2010), however the presence of more than one Palaeolithic industries including the Middle Palaeolithic was regarded as likely (Strasser et al., 2010, pp. 178, 184). In 2010, they stated that most of the material "resembles the Acheulean *sensu lato*" while some retouched tools "resemble Middle Palaeolithic artefacts in terms of preparation technique, form or retouch" (Strasser et al., 2010, p. 184). Four years later, the attribution to the Acheulean is more straightforward and there is no further discussion of the Middle Palaeolithic component of the sites (Runnels, 2014b; Runnels et al., 2014a) more information for which might perhaps remain hidden among the 344 artefact which were included in the Palaeolithic component in the 2010 publication but excluded from the Lower Palaeolithic component in the 2014 publication. In particular, in their latter publication, the authors declare that "the artefacts from the eight findspots discovered so far can be taken together as belonging to the Acheulean Industrial tradition" (Runnels et al., 2014a, p. 130), and refer to the "Plakias Acheulean" (Runnels et al., 2014a, pp. 130, 139) or the "Cretan Acheulean" (Runnels et al., 2014a, pp. 129, 148).

As for the reduction strategy, large flakes and, on occasion, thick blades were produced by the use of direct hard hammer percussion. The cores have often been centripetally or bifacially worked and exhibit minimal degrees of preparation. Their size ranges from 50mm to more than 200mm. Flakes produced by the aforementioned cores count from 80mm to 150mm in length and their platform are thick and wide up to 40mm, and can be either flat or dihedral (Strasser et al., 2010).

Three of the Palaeolithic sites, i.e. Preveli 2, Preveli 3 and Preveli 7, have also been dated to the Pleistocene based on marine terrace chronology and pedogenic maturity levels as well as OSL dating of the alluvial fan sediments (Runnels et al., 2014a; Strasser et al., 2011).[41]

5.2.3.2.1. Preveli 2

At the eastern flank of Preveli Gorge, on an uplifted limestone block lays Preveli 2 (Figure 229), a site which has yielded lithic finds associated with geological formations which allowed a chronological determination. Lithic artefacts made of quartz and quartzite (Strasser et al., 2010, p. 172-173) were found "as lag on the marine terraces, but a small number of artefacts (four flakes and a biface) were observed as indurated clasts in the beach deposits at 59 and 96masl and on a planation surface at 125masl" (Strasser et al., 2011, p. 554-555). Although photographs of a biface, a cleaver and a large flake from the surfaces of these terraces were provided (Figure 230-Figure 231), as well as a number of illustrations (Figure 232-Figure 233), no further details regarding the artefacts which were part of these indurated clasts are available. Larger amounts of finds were encountered in

[41] See Appendix III for the stacked column charts with the assemblage structures form each site as described in the 2010 and the 2014 publications.

sediment pockets among the limestone outcrops on the erosional planation surfaces or below the conglomerates (Strasser et al., 2010, p. 173).

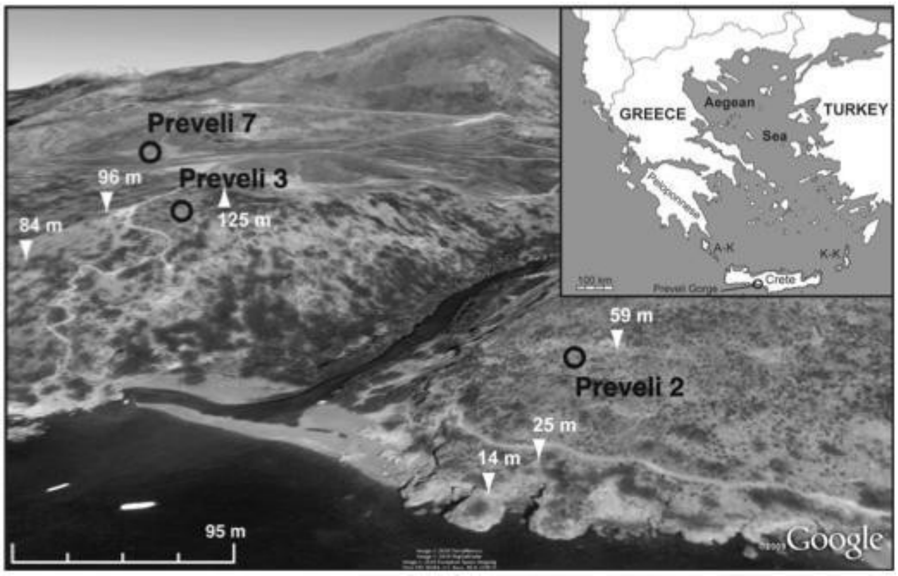


Figure 229: Location of the three sites (i.e. Preveli 2, 3 and 7) near Preveli Gorge which have been dated to the Pleistocene by the Plakias Survey team (Strasser et al. 2011, fig. 1).

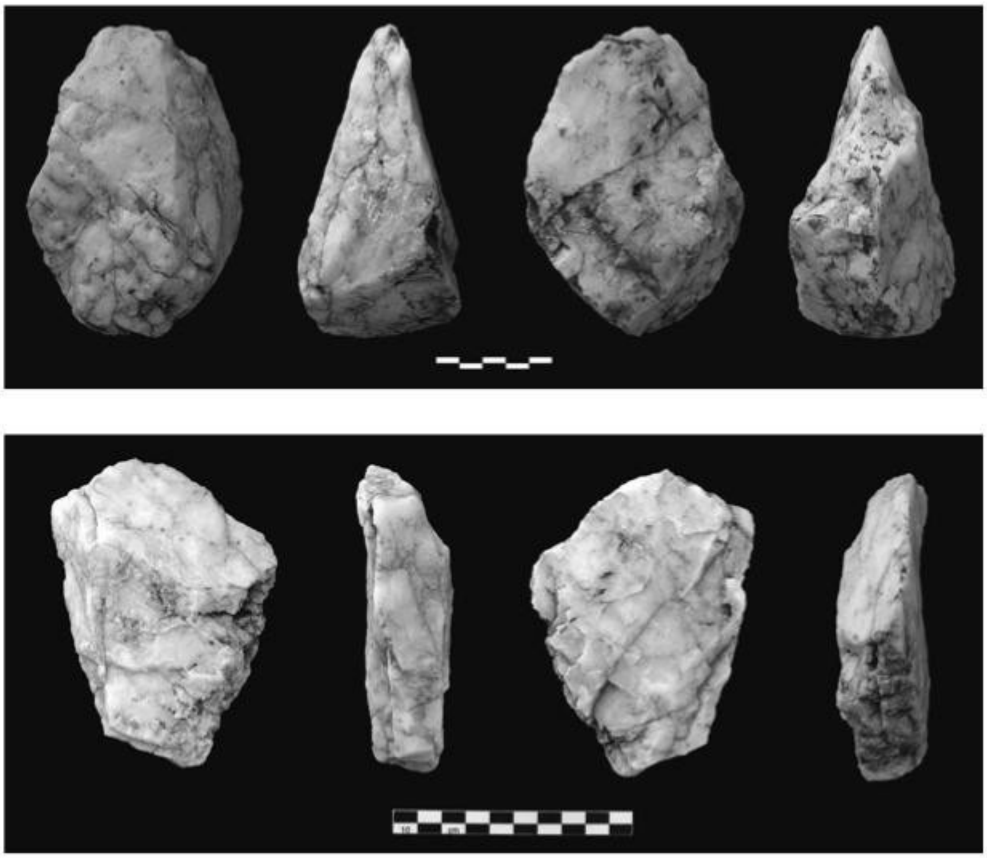


Figure 230: Photographs of a biface (also shown in Figure 232a and Figure 233i) and a cleaver (also shown in Figure 233d) from Preveli 2, Crete. Both are made of quartz and were found on the 59masl terrace and on the 96masl terrace respectively (Strasser et al., 2010, figs. 34-35).

Figure 231: Photograph of a large quartz flake (left) from the 59masl marine terrace (right) at Preveli 2, Crete (Strasser et al., 2010, figs. 25-26).

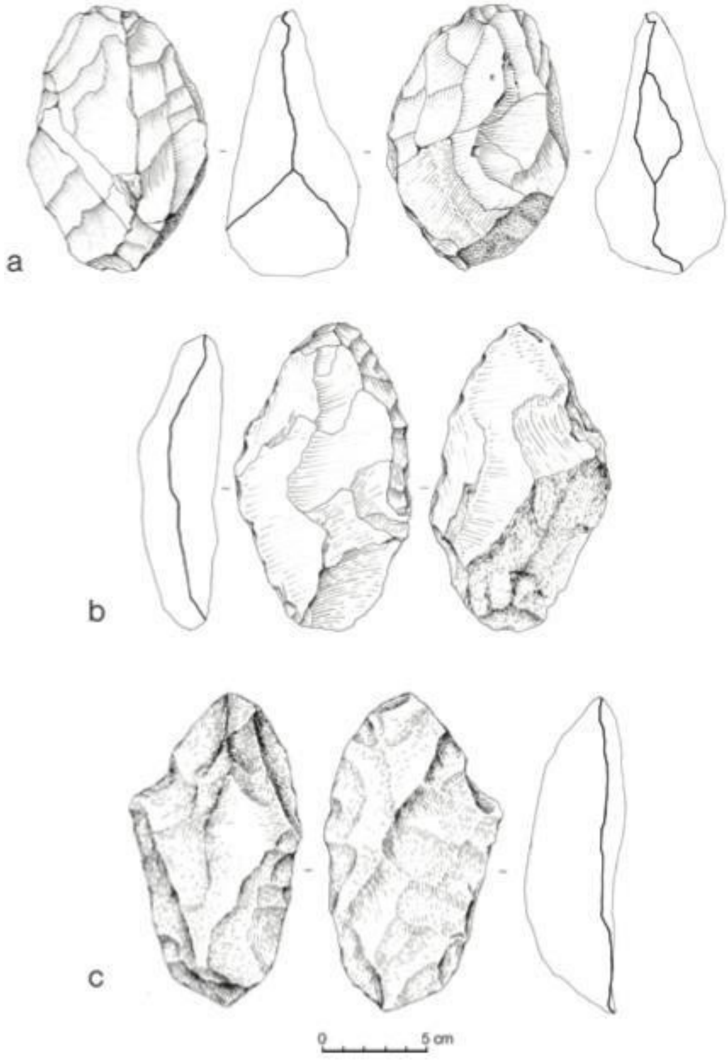


Figure 232: Lower Palaeolithic LCTs (a-b: quartz bifaces, c: quartzite trihedral pick) from Preveli 2, Crete. Runnels et al., 2014a, fig. 5.

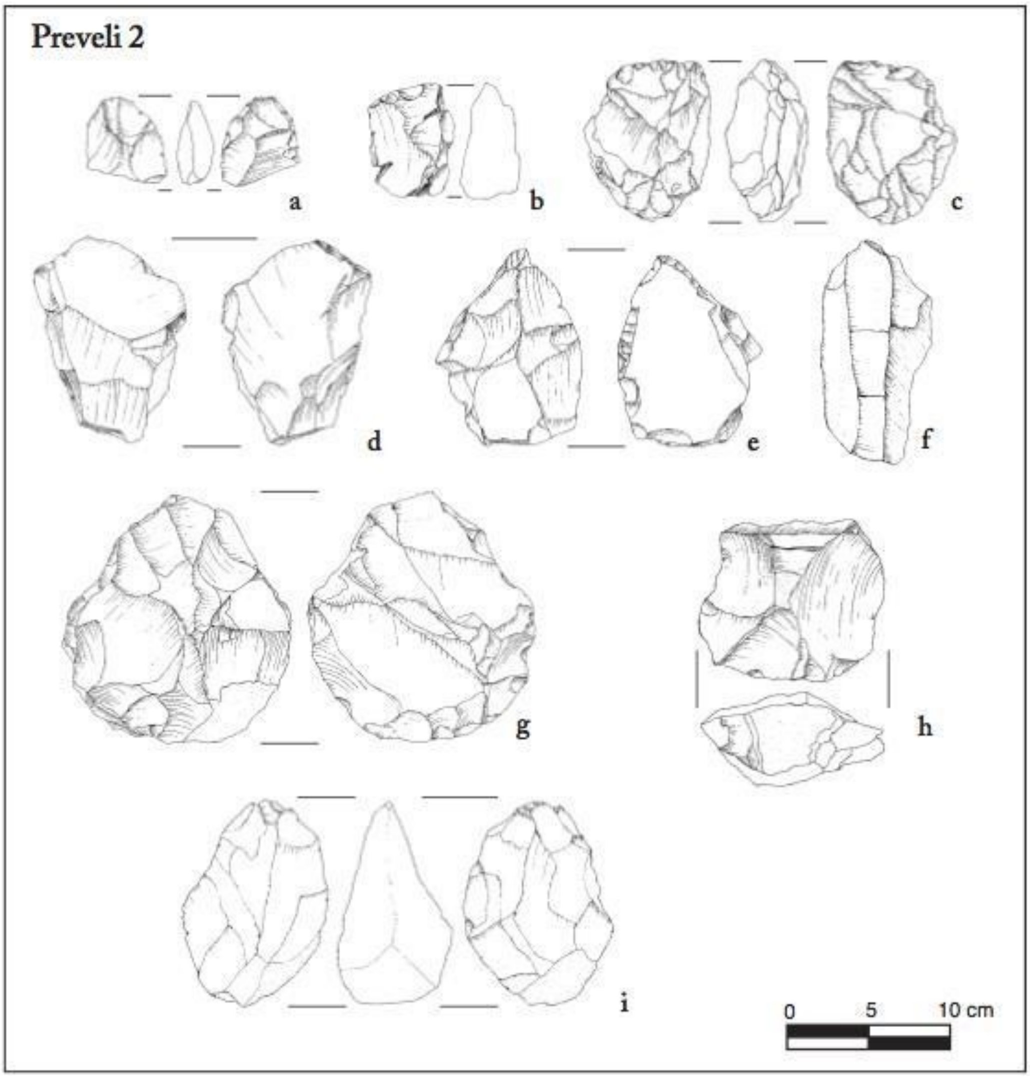
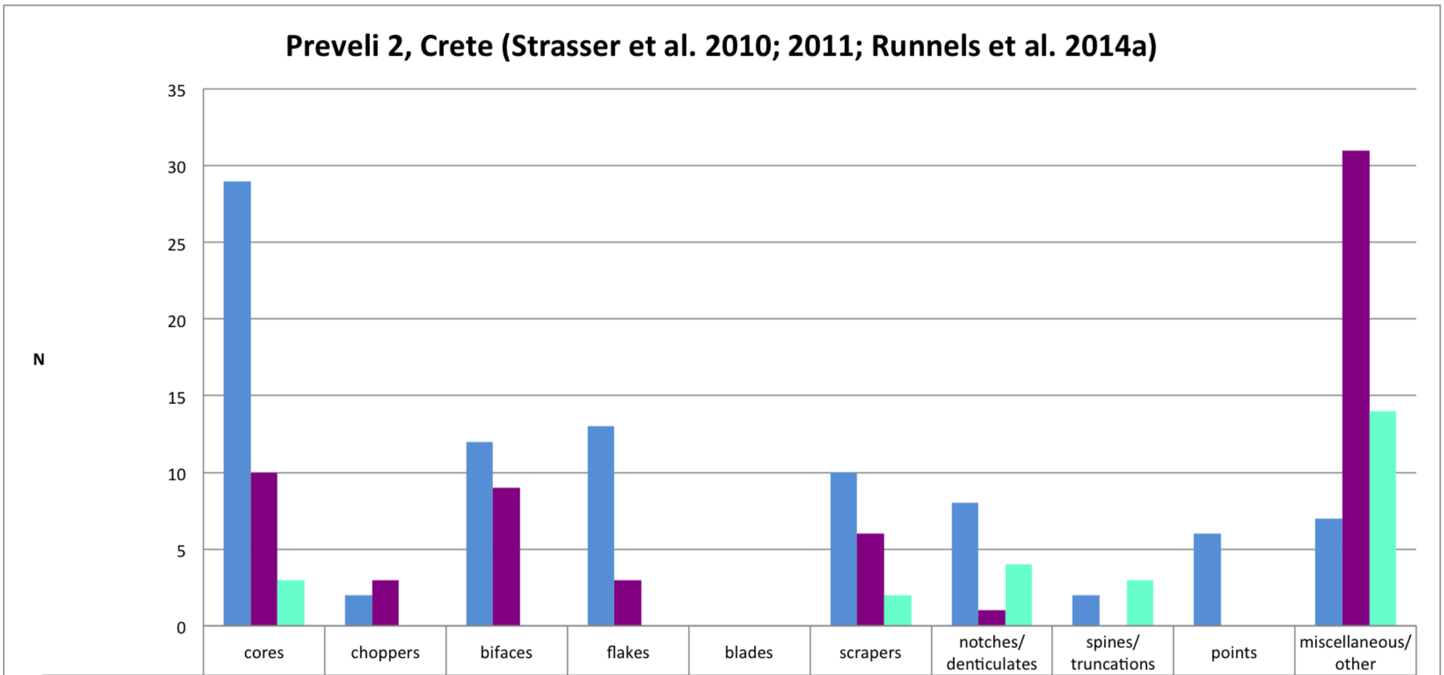


Figure 233: Illustrations of the Palaeolithic artefacts (a: tip of biface, b-c: biface cleaver, d: cleaver, e: biface, f: blade core, g, i: biface, h: core) from Preveli 2, Crete as classified in the 2010 publication. All artefacts are made of quartz except (a) which is made of quartzite (Strasser et al., 2010, fig. 32).

According to the authors, Preveli 2 contains an "early" component that corresponds to the Palaeolithic and counts a total of 89 artefacts and a "late" component that corresponds to the Mesolithic and counts a total of 24 artefacts (Strasser et al., 2010). The early component contains a Lower Palaeolithic assemblage counting 63 artefacts (Runnels et al., 2014a) (Graph 150).[42]

[42] Although Preveli 2, Preveli 3 and Preveli 8 have been recorded as both a Palaeolithic and a Mesolithic components (Strasser et al., 2010, p. 148, Table 1), Preveli 2 is the only site which was divided in two components, an "early" and a "late" one in the detailed table of the assemblage composition (Strasser et al, 2010, p. 163, Table 2).



	cores	choppers	bifaces	flakes	blades	scrapers	notches/ denticulates	spines/ truncations	points	miscellaneous/ other
Early [2010/2011]	29	2	12	13	0	10	8	2	6	7
LP [2014]	10	3	9	3	0	6	1	0	0	31
Late [2010/2011]	3	0	0	0	0	2	4	3	0	14

Graph 150: Column chart of the assemblage composition of the different chronological components of Preveli 2. Columns indicate the Palaeolithic (early) and the Mesolithic (late) component of the site as described in the 2010 and 2011 publications, to which the Lower Palaeolithic (LP) component of the site as described in the 2014 publication has been added. Retouched tools other than scrapers, notches and denticulates attributed to the Lower Palaeolithic have been included in the Miscellaneous/Other category here. For detailed categorization of the retouched tools see Graph III.157. Data inferred from Strasser et al., 2010, p. 163, Table 2; Strasser et al., 2011, p. 554, Table 1; Runnels et al., 2014a, p. 131, Table 1.

5.2.3.2.2. Preveli 3

At the opposite flank of the Preveli Gorge, Preveli 3 (Figure 229) was identified on a small limestone plateau on top of which there are red-soil deposits, which are either part of preserved primary *terra rossa* or of a heavily eroded alluvial fan. Although lithics were spotted in such outcrops at the entrance of the parking lot shown in Figure 234 to a depth of up to 2m below the surface, the ones collected come from the "now-soilless limestone plateau below and to the south of these outcrops" (Strasser et al., 2010, p. 174) "are found on the planation surface above the highest marine terrace as a lag deposit on the karstic surface at 125masl" (Strasser et al., 2011, p. 555). Photographs and drawings of artefacts are provided (Figure 235-Figure 236), yet again details about which was found where are missing. The team dated the site based on the uplifted marine terraces and proposed that the particular artefacts now collected as lag had been part of an *in situ terra rossa* deposit formed on the karstic surface through pedogenesis. The preserved *terra rossa* is described as highly mature, certainly of a Pleistocene age similar to others along SW Crete (Nemec and Postma, 1993; Pope et al., 2008), yet it is undated and has been severely disturbed in modern times (Strasser et al., 2011, p. 555).

Figure 234: View of the red-soil formation above the parking lot at Preveli 3 (Strasser et al., 2010, fig. 14).

Figure 235: Photographs of quartz artefacts from Preveli 3, Crete classified as a scraper (left) and double convergent denticulates (right) (Strasser et al., 2010, p. 182, fig. 37-38).

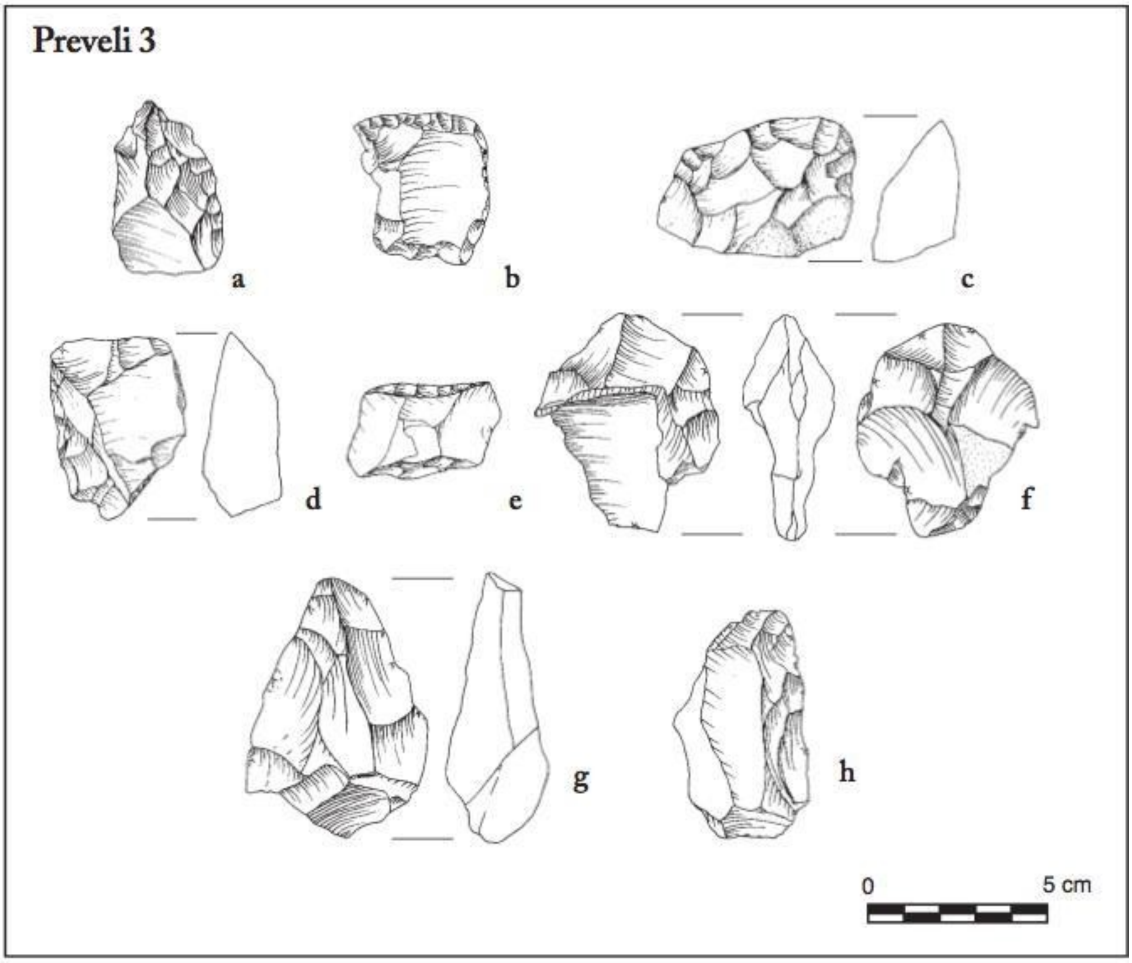


Figure 236: Illustrations of the Palaeolithic artefacts (a-d, h: scrapers, e: double truncation, f: biface tip, g: double convergent denticulate) from Preveli 3, Crete as classified in the 2010 publication. All artefacts are made of quartz (Strasser et al., 2010, p. 181, fig. 36).

5.2.3.2.3. Preveli 7

Preveli 7 is situated at ca. 120masl (Figure 237) and has provided artefacts found on the surface but also within an eroding palaeosol Bt horizon, cemented within it as clasts. Two flakes and two bifaces were, according to the authors, found *in situ* (Strasser et al., 2011, p. 556). The palaeosol is highly mature (Maturity Stage 6) and is formed in an alluvial fan on a planation surface above the highest marine terrace correlated to the 123,000±2,000 years (OIS 5e) glacial sea level highstand (Strasser et al., 2010, 2011). The artefacts found on the surface of the eroded palaeosol have been interpreted as deriving from it due to the recent erosion, because of the red stains and soil usually adhering to them. At an elevation of ca. 300masl, 50m to the north of the palaeosol, the team observed a limestone outcrop with traces of small caves and indications of the existence of fossil springs (Strasser et al., 2010). Two samples of sandy silt lenses from the alluvial fan were extracted from an exposed 4m profile in order to date the site using OSL. Two stratigraphically reversed dates, one above and one below the artefacts baring horizon were obtained (Figure 238). Bt3 and Bt5 horizons yielded an age of 113,600±10,300 and 93,800±8,900 years respectively (Runnels et al., 2014a, pp. 131–133). These dates have been interpreted as minimum estimates of the timing of the sedimentation of the alluvial fan and the authors have proposed a date older than 126,000 years for the production of the lithic artefacts.

Figure 237: View of Preveli 7 (Strasser et al., 2010, fig. 28).

The Lower Palaeolithic component of the site counts a total of 49 tools (Runnels et al., 2014a), among which there are 19 retouched tools and five LCTs (Figure 239). Two bifaces, a bifacial scraper, a denticulate and an unretouched blade have also been illustrated (Figure 240). Since the total count from Preveli 7 in the 2010 publication was 47 (Strasser et al., 2010, p. 163, table 2), it is plausible to assume that no artefacts from the particular site were regarded as of a different technological tradition i.e. Middle Palaeolithic.

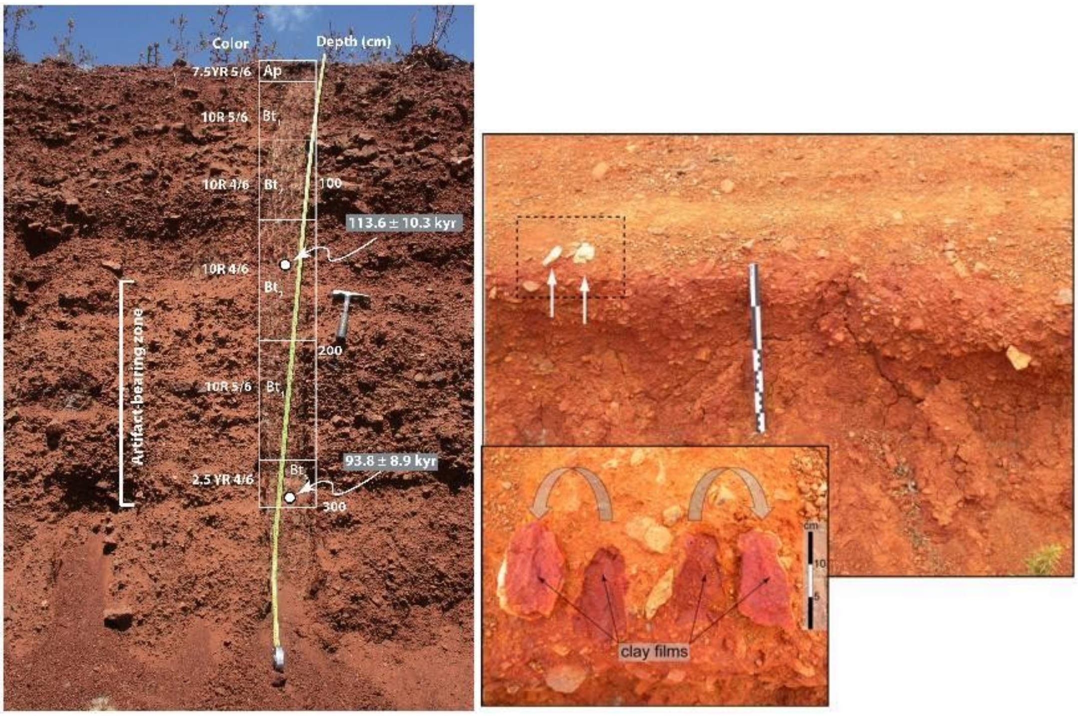


Figure 238: The palaeosol outcrop at Preveli 7 at ca. 130masl (left), and the Bt profile with the *in situ* artefacts (right) (Runnels et al., 2014a, fig. 2; Strasser et al., 2011, fig. 5)

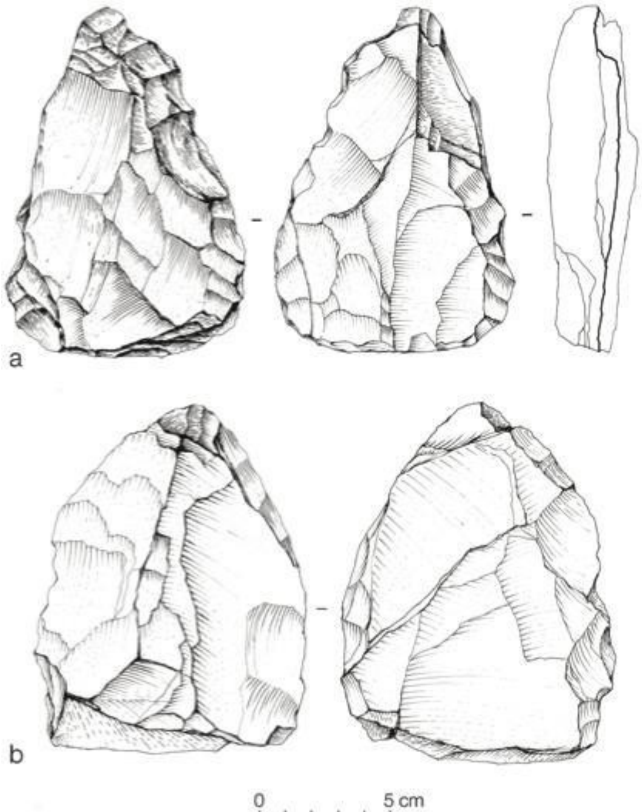


Figure 239: Illustrations of two Lower Palaeolithic quartz LCTs (bifaces) from Preveli 7, Crete as classified and redrawn for the 2014 publication (Runnels et al., 2014a, fig. 6).

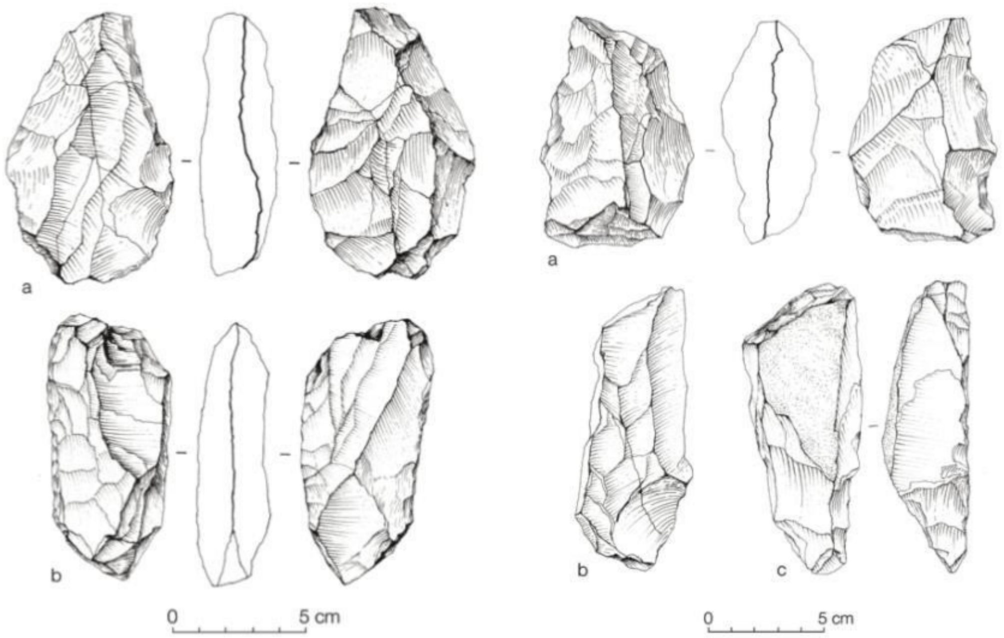


Figure 240: Illustrations of quartz artefacts from Preveli 7, Timios Stavros 1 and 4, Crete as classified and redrawn for the 2014 publication. Left: bifacial scrapers from Preveli 7 (a)and Timios Stavros 4 (b); Right: denticulate (a) and blade (b) from Preveli 7 and convergent scraper (c) from Timios Stavros 1 (Runnels et al. 2014a, p. 139-140, fig. 7-8).

5.2.3.2.4. Preveli 8

Preveli 8 is a site with only minor reference in the publications by the Plakias Survey team. Judging by the map in their initial publication (Strasser et al., 2010, p. 147, fig. 2a) the site is situated to the east of Preveli 7 and very close to it. A total of 17 artefacts were collected from the site (Strasser et al., 2010, p. 163, table 2), which has been described as containing both Palaeolithic and Mesolithic artefacts (Strasser et al., 2010, p. 146). Nine of them were later on classified as belonging to the Lower Palaeolithic (Runnels et al., 2014a) including a biface, a trihedral pick (Figure 241), a chopper/chopping tool and five scrapers.

Figure 241: Photograph of a quartz trihedral pick from Preveli 8, Crete, as classified in the 2014 publication. Modified after Runnels et al., 2014a, fig. 3.

5.2.3.2.5. Kotsifos 1

The only site situated at the SE end of the Kotsifos Gorge yielded a total of 10 artefacts initially dated to the Palaeolithic based on morphological affinities with the assemblages from the Preveli Gorge sites. All artefacts were collected from "the upper slopes to the bottom of the gorge" and were thought to be remnants of a totally destroyed Pleistocene site (Strasser et al., 2010, p. 178). In the subsequent publication, seven of them were classified as part of a Lower Palaeolithic assemblage and a significant difference can be inspected in the LCTs category (Graph 153). In particular, although seven artefacts were initially classified as bifaces (Strasser et al., 2010, p. 163, table 2), after the re-evaluation, only one biface has been reported (Runnels et al., 2014a, p. 131, table 1; p. 135, table 3). There are no published illustrations or photographs from the Kotsifos 1 artefacts.

5.2.3.2.6. Timios Stavros 1

An exposed alluvial fan outcrop (up to 2m thick) is situated on the slopes of Timios Stavros hill at an altitude of ca. 200masl (Figure 242). Timios Stavros 1 yielded a total of 31 weathered and transported artefacts coming both from the outcrop and from the surface of the fan (Strasser et al. 2010, p. 177). The outcrop itself has been included in the category of palaeosols, such as Preveli 3, 7 and Schinaria 5, described as of Maturity Stage 6, consequently dated to MIS 6 (Strasser et al. 2010, p. 186). From the 31 artefacts published in 2010, 26 have been included in the 2014 publication. No LCTs have been recorded, while there are 17 retouched tools with a predominance (76.5%) of scrapers (Figure 243b-c).

5.2.3.2.7. Timios Stavros 4

Timios Stavros 4 has been described as "a debris flow preserved in a field below a limestone fault scrap" (Strasser et al., 2010, p. 177). A total of 21 artefacts, 16 of which have been ascribed a Lower Palaeolithic age (Runnels et al., 2014a, p. 131, table 1) were found together with angular pieces of limestone and travertine in an area of 40x90m. The authors' hypothesis is that these artefacts must have derived from the caves and rockshelters situated upslope (Strasser et al., 2010). In the 2010 publication, illustrations include an artefact classified as a Levallois core (Figure 244c), thus probably attributed to the Middle Palaeolithic. Perhaps this particular core is the one also excluded from the 2014 publications (Graph 153).

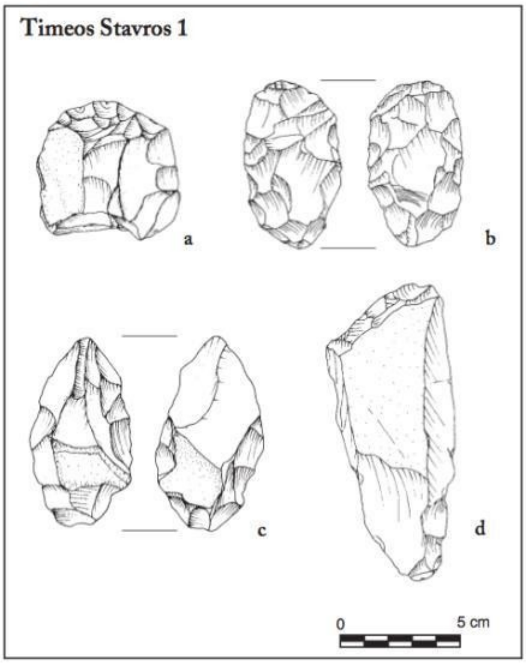
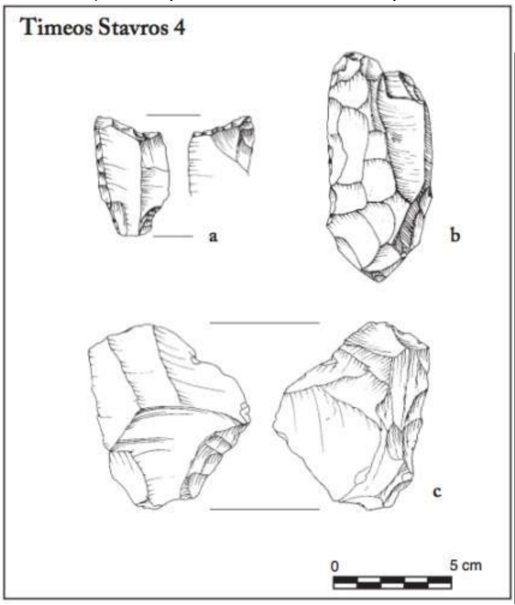


Figure 242(left): View of Timios Stavros 1, Crete, from the west (Strasser et al., 2010, fig. 30).
Figure 243(right): Illustrations of quartz artefacts from Timios Stavros 1, Crete, as classified in the 2010 publication (a: scraper, b-c: bifacial scrapers or small bifaces, d: blade) (Strasser et al., 2010, fig. 41).



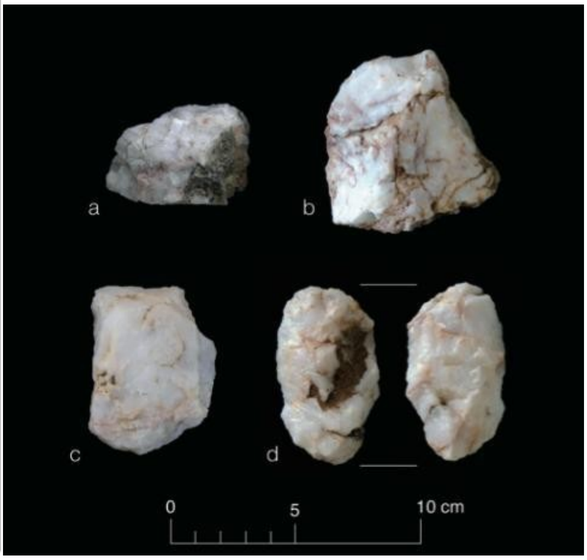


Figure 244(left): Illustrations of quartz artefacts from Timios Stavros 4, Crete, as classified in the 2010 publication (a: truncated retouched blade with a proximal notch, b: scraper, c: Levallois core (Strasser et al., 2010, fig. 42).
Figure 245(right): Photographs of quartz artefacts from Preveli 2 (a), Preveli 3 (b), Timios Stavros 1 (c) and Timios Stavros 4 (d) as classified in the 2014 publication (a-b: simple convex scrapers, c: transverse scraper, d: bifacial scraper) (Runnels et al., 2014a, fig. 4).

5.2.3.2.8. Gianniou 1

Gianniou 1 is a small site situated on an eroded narrow saddle west of Mesokorfa Peak ca. 1 km NW of Preveli 7. A total of 44 artefacts were collected from the surface where large quartz boulders were also present. Since some of the boulders exhibited large flake removals, the team regarded flint-knapping as the most plausible activity which took place at site (Strasser et al., 2010, p. 175). Eight retouched tools (i.e. seven scrapers and a burin) as well as two picks were attributed to the Lower Palaeolithic (Runnels et al., 2014a), yet no illustrations or photographs have been published.

5.2.3.2.9. Schinaria 5

Situated ca. 1km west of Timios Stavros, Schinaria 5 is part of an alluvial fan with palaeosol outcrops about 2m deep. At an elevation between 85masl and 96masl artefacts were exposed, nine of which were collected and were attributed to the Palaeolithic. It has already been mentioned that the palaeosol at Schinaria 5 was regarded as similar to the ones from Preveli 3, Preveli 7 and Timios Stavros 1 in terms of pedogenic maturity, indicating similar ages, i.e. MIS 6 (Strasser et al., 2010, p. 177). Schinaria 5 is excluded from the 2014 publication, implying that the material was not diagnostic enough to be considered as of a Lower Palaeolithic age. No photographs or illustrations of artefacts have been published from this site.[43]

[43] Appendix III includes graphs with the detailed assemblage composition of each site from the Plakias survey, based on the 2010 and 2014 publications.

5.2.3.3. Mochlos

A preliminary publication which came out in December 2014 reported the discovery of five bifacially worked tools and cores together with an unspecified number of large (>100mm) flakes in stratified context near Mochlos, NE Crete (Runnels et al., 2014b). All artefacts are made of quartz, a raw material that can be found locally, and are a result of chance discoveries in the course of a geological study of a Quaternary alluvial fan sequence at Mochlos. The fan sequence, which has not been dated yet, extends 4km east of Mochlos village, 600m inwards and terminates at the present shore by means of steep wave-cut scarps (ibid.). The artefacts which have been characterized as of a "Lower and/or Middle Palaeolithic type" come from two different fans at 2km and 1km east of Mochlos village respectively, i.e. Mavroseli and Loutres.

5.2.3.3.1. Mavroseli

The first fan, Mavroseli, is characterized by about 15m deep cut banks which expose a sequence of 2-3m thick layers of cobbles and boulders (Figure 246). Two artefacts, i.e. an "amygdaloid/ovate biface (handaxe)" with its tip broken (Figure 247) and a "bifacial core or protobiface" were the only quartz clasts in the section observed *in situ* at a depth of about 9m. The raw material is described as milky vein quartz and the artefacts as produced by direct hard hammer percussion, measuring between 100 and 120mm in length. The angular shape of the artefacts was interpreted by the authors as a result of minimal pre-depositional transport.

Figure 246: The Mavroseli fan cut bank (left) and the biface from Mavroseli as found *in situ* (right) (Runnels et al., 2014b, figs. 2–3).

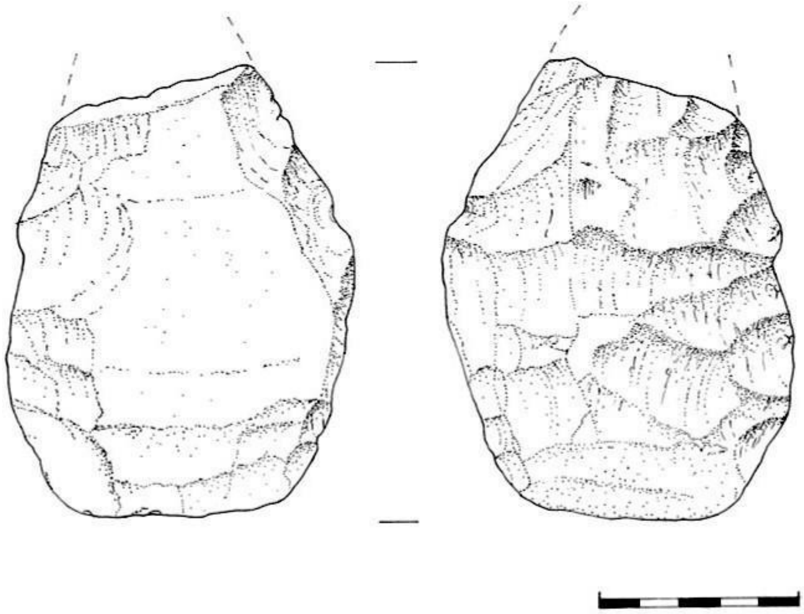


Figure 247: The quartz biface from Mavroseli fan, Mochlos, NE Crete (Runnels et al., 2014b, fig. 4).

5.2.3.3.2. Loutres

The second fan, Loutres, is closer to Mochlos village and has a different depositional history. A palaeochannel filled with cemented conglomerate is topped by a "Bt horizon of a palaeosol about 3m thick with discontinuous stringers of gravel interrupted by small stream channels filled with debris flow materials" (Runnels et al., 2014b). By comparisons between this palaeosol and similar palaeosols from the area of Plakias, the authors notice similarities in the level of their pedogenic maturity. In the case of Plakias the particular palaeosols were dated to about 114,000 BP by OSL and pedogenic maturity (Runnels, 2014a; Strasser et al., 2011).

A number of large flakes together with "a sub-triangular biface and a cleaver on a flake" were found within the aforementioned palaeosol, about 3m below a 0.5m thick overbank deposit which is capping the palaeosol (Figure 248). The bifaces are 100mm and 110mm long respectively. Another 1-2m thick palaeosol would have capped the overbank yet has now almost totally eroded away. Possible Middle Palaeolithic artefacts such as a *preferential flake core of Levallois type* measuring 85mm in length were observed in a lag deposit on top of the overbank deposit and, according to the authors, may presumably have derived from the latter palaeosol (Runnels et al., 2014b).

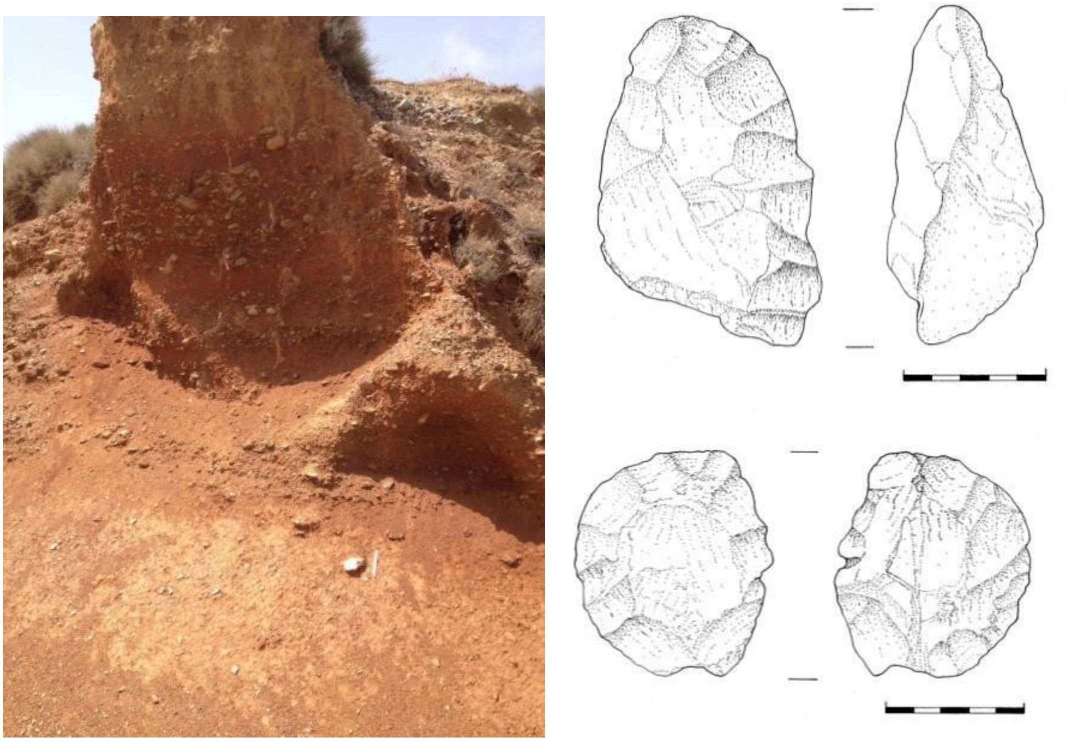


Figure 248: a) A flake embedded in the lower Bt horizon of Loutres fan, b) A biface and a preferential flake core from the lag deposit of Loutres fan (Runnels et al., 2014b, figs. 5–6).

Both findspots from Mochlos, NE Crete although yielded a very limited number of artefacts (Table 81), were, however, associated with geological deposits dated to the Pleistocene, by means of macroscopic observations of the pedogenic maturity of the palaeosols and their comparison with similar OSL-dated ones from the island. This fact opens a window for future geoarchaeological investigations in the Pleistocene component of the particular area of Crete.

Table 81: The composition of the lithic sample collected from the two fans at Mochlos, Crete as described by Runnels, et al. 2014b.[44]

Mochlos	Mavroseli	Loutres	Total
Biface	1	1	**2**
Core	1	1	**2**
Cleaver	0	1	**1**
Flakes	0	?	**?**
Total	**2**	**3+**	**5+**

[44] The sample from Loutres includes an unspecified number of flakes.

5.2.4. Gavdos

The island of Gavdos has been systematically surveyed by the University of Crete since 1994 (Kopaka et al., 1994-1996). Large amounts of prehistoric pottery and lithic artefacts were collected from several sites on the island. Among the collection there is a great number of stone artefacts attributed to the whole range of the Palaeolithic and the Mesolithic. Seven sites on the island have been attributed to the Pleistocene (Figure 249), with five more attributed to the final UP and/or the Mesolithic, yet a detailed publication of the material is still pending.

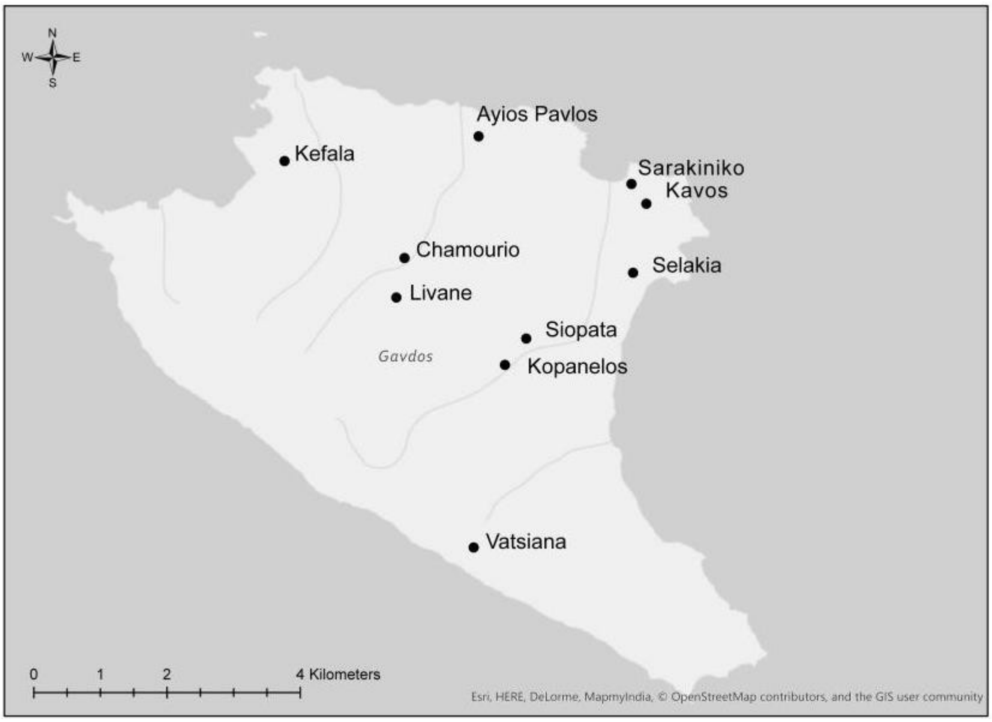


Figure 249: Map of Gavdos with the Pleistocene sites annotated. Map produced using ArcGIS.

Kopaka and Matzanas (2011; 2009) in their preliminary publications have identified seven chronological phases of Pleistocene occupation on the island. Ayios Pavlos, situated near the northern coast of Gavdos, yielded the majority of the chipped stone artefacts and formed the basis for the chronological categorization (Table 82). A “core-like chopping tool” (Figure 250c), a limestone “sub-cordiform handaxe” (Figure 250b), a “large handaxe-cleaver, partially shaped on an ultramafic or granodiorite pebble” (Figure 250a) (Kopaka and Matzanas, 2009), some core-like chopping tools made on grey chert and a large discoid core made of sandstone represent the oldest phase attributed to the LP (>120kya).

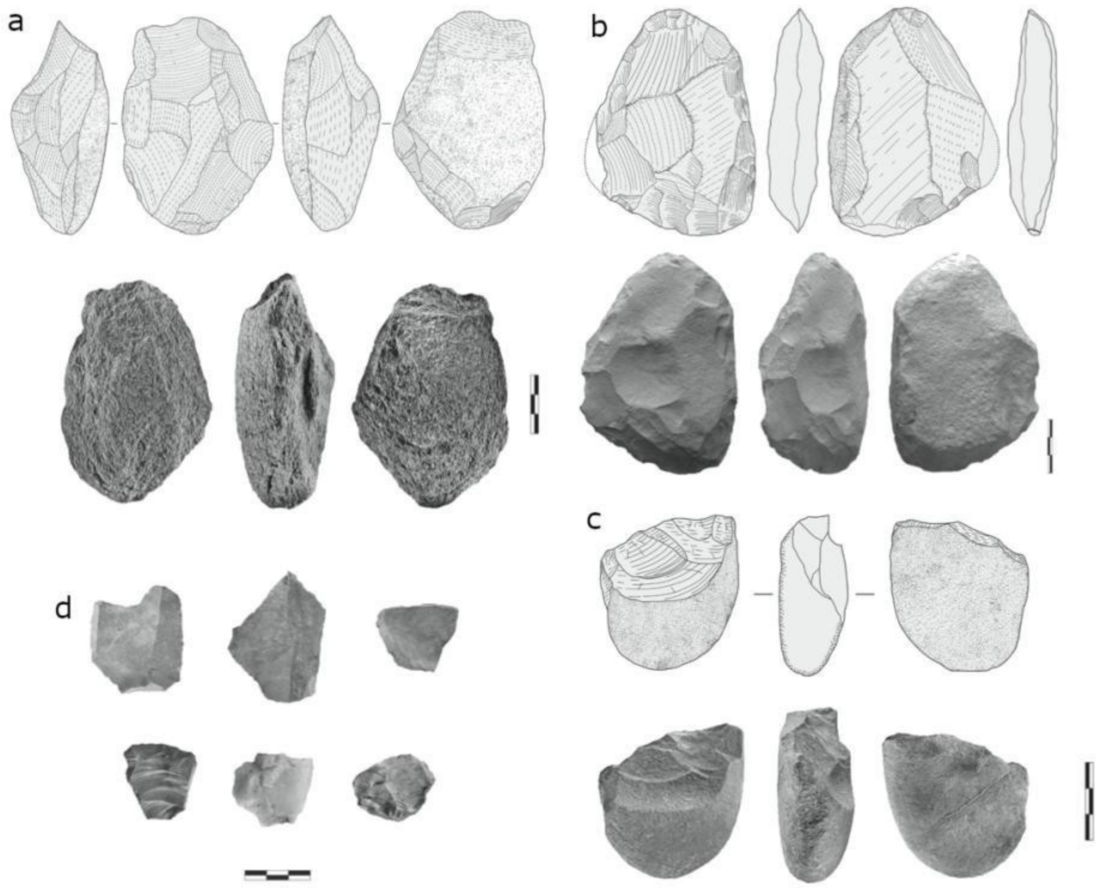


Figure 250: Artefacts attributed to the Lower and the Middle Palaeolithic from Gavdos (Modified after Kopaka and Matzanas, 2011, figs. 2α-β, 3α, 3β, 5β)

The authors declare that the biface from Sarakiniko is a characteristic example of the "Developed Acheulean" (Kopaka and Matzanas, 2011, p. 17). The second group consists of core and flake tools with a few "Mousterian types" (i.e. sidescrapers) attributed to the Last Interglacial (c. 128-118ka) or the "pre-Mousterian" phase as described by Darlas (1994). The majority of the lithics from Gavdos belong to the third and fourth group associated with the Middle Palaeolithic and are made predominantly on local and perhaps also imported flints (Figure 250d). Scrapers, denticulates, Levallois flakes and laminar debitage are part of the "proto-Mousterian" assemblage associated with the early Middle Palaeolithic (c. 120-75ka). Implements attributed to later Middle Palaeolithic periods (c. 75-35ka) include *Quina* (or *demi-Quina*), *déjeté* scrapers, convergent scrapers, points, Levallois blanks and small-sized cores. A total of 34 artefacts including scrapers, denticulates, a "micro-chopper", and a "small triangular *Faustelkeil*" attributed to the Mousterian of Acheulean Tradition (MTA) are made of quartz. Finally, the Upper Palaeolithic period in Gavdos is mainly represented by hunting equipment (i.e. projectile points) and has been separated into the early Upper Palaeolithic (c. 40-35ka) and the late Upper Palaeolithic (c. 20-14ka) with Aurignacian and Gravettian/Epigravettian affinities respectively. Lastly, there is a group of artefacts regarded as of a Final Upper Palaeolithic and/or Mesolithic age (c. 14-8ka), including artefacts made on obsidian.

In sum, although less profoundly presented by illustrations and photographs, it seems that the Middle Palaeolithic by means of the Levallois technique as testified both by cores and blanks, as well as tool-types (*Quina* scrapers, *Faustelkeil*) is the amplest represented group on the island. The presence of pebble-tools and thick scrapers with bifacial *Quina*-type retouch was also testified by personal observations in the field (2010-2011), yet one would expect a better documentation (i.e. illustrations, photographs) of the Levallois aspect, since, according to the descriptions, it forms a large part of the Middle Palaeolithic component of the island.

Table 82: Cultural categories of the lithic industries from Gavdos as described by Kopaka and Matzanas (2011)

Gavdos industries		Site	Raw material	Surface alterations	Assemblage structure	Tool types	Cultural dating
LP	1	Ayios Pavlos (26E), Sarakiniko (64A), Kopanelos (62A), Livane (33), Kavos (27)	local (limestone, granodiorite?, chert, sandstone)	thick white patina, extreme weathering	mainly debitage and cores, rarely tools	handaxe, cleaver, chopping tools	>120kya
	2	Ayios Pavlos, Kavos (27), Siopata (44B), Vatsiana (14Γ)	local (mainly black fine-grained flint, rarely brown)	yellowish/red patina	mainly debitage and cores, some tools	choppers/chopping tools, denticulates, few 'Mousterian types'	*pre-Mousterian* c.128-118kya
MP	3	Ayios Pavlos (26E), Vatsiana (14Γ), Kavos (27)	mainly local (black fine-grained flint), possibly also imported (flint)	yellowish/white patina	debitage, cores and tools, *Levallois* flakes and blades	scrapers, denticulates	*proto-Mousterian* c.120-75kya
	4a	Ayios Pavlos (26E), Vatsiana (27)	local (black fine-grained flint)	white patina	laminar blanks, *Levallois* blanks	?	*typical Mousterian* c.70-50kya
	4b	Ayios Pavlos (26E), Vatsiana (27)	local (black fine-grained flint)	light white patina	*Levallois* blanks, small-sized cores, tools	*Quina* and *déjeté* scrapers, composite tool (scraper& piercer)	*Micro-Mousterian* c.50-20kya
	4c	Ayios Pavlos (26E), Vatsiana (27)	local (quartz)	moderate weathering	?	small choppers, denticulates, scrapers, Faustelkeil	c.75-35kya
UP	5	Ayios Pavlos (26E) and other sites	local (black fine-grained flint)	light white patina	?	carinated endscraper, sidescraper on a thick blank	*Aurignacian* 40/35-20kya
	6	Vatsiana (14Γ), Kavos (27), Kefala (58)	local (black fine-grained flint)	light white patina	projectile points	backed blades/bladelets, shouldered points	*Gravettian* and *Epigravetian* c.20-14kya
FUP/Meso	7	Ayios Pavlos (26E), Siopata (100Δ), Kopanelos (62A), Chamourio (78), Selakia (41A), Padouraki, Ayios Panteleimonas	local (black and grey fine-grained flint) and imported (obsidian)	light or no patina	conical-prismatic bladelet cores, miniscule discoid cores, polyhedral cores, tools	microliths (crescents), UP tool types with silica gloss	Final UP / *Epipalaeolithic* - Mesolithic c.14-8kya

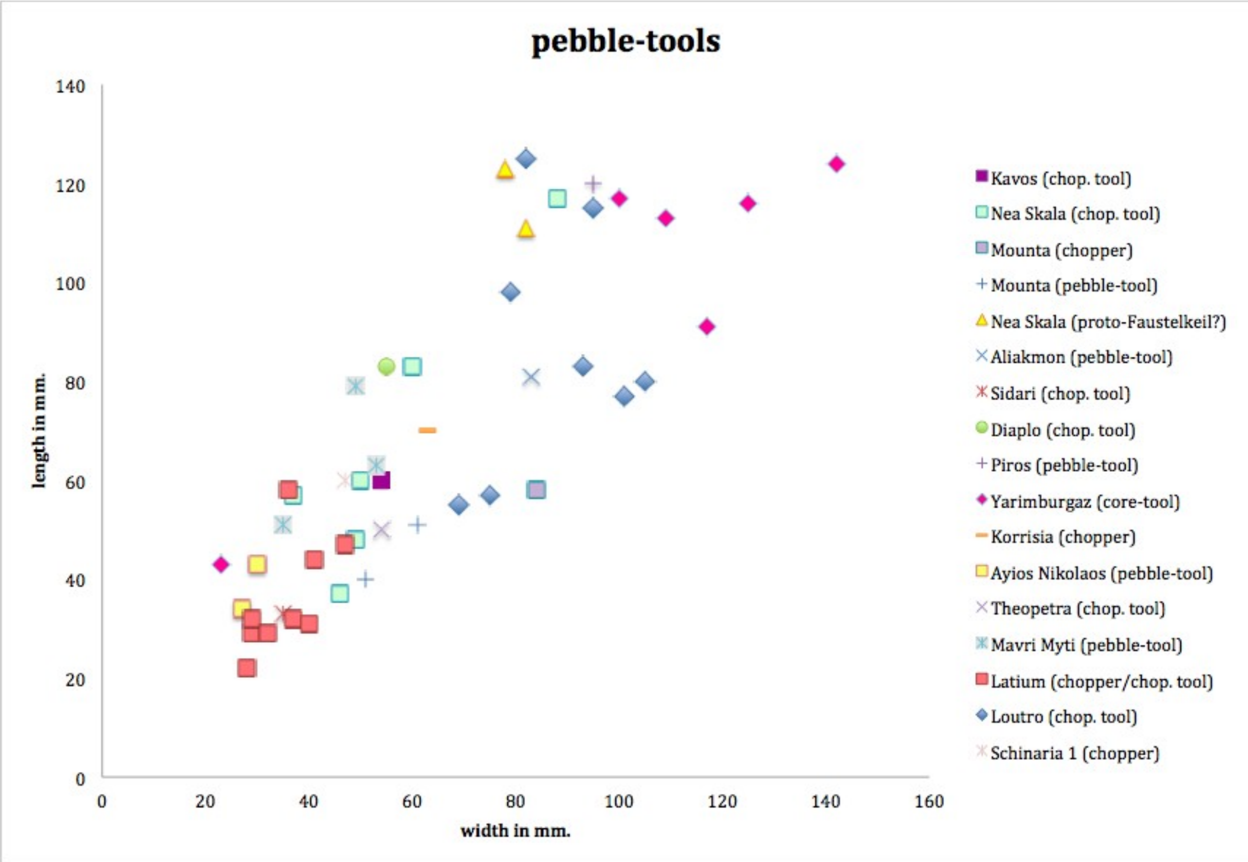
5.3. Interpreting the current evidence

The main constrains of the interpretative process are three, (a) the lack of chronostratigraphic data, (b) the preliminary form of the publications and (c) the lack of a reference collection from dated contexts. Due to the preliminary form of the majority of the publications the lack of high quality photographs and/or drawings limits any attempts of coherent evaluation. It is true that all aspects, both of analysis but also of the presentation of the evidence, incorporate a subjective element. For this reason it is by all means essential, especially for high debatable issues such as the one we are dealing with, to present as much information as possible given the restrictions in each case. For instance the high quality photographs provided at the publication by Chelidonio in 2001 are great tools in the interpretation of the finds, although more views (i.e. profiles and ventral faces) would have been even more helpful. High quality photographs taken by archaeologist Nick Thompson were also provided by the Plakias team (Runnels et al., 2014a; Strasser et al., 2010), however, in their case, the nature of the particular raw materials does not always do justice to their interpretations. For these reasons, drawings are always expected. Yet, drawings involve a great amount of interpretation and should not be taken at face value without an examination of good photographs or, even better, the artefacts themselves.

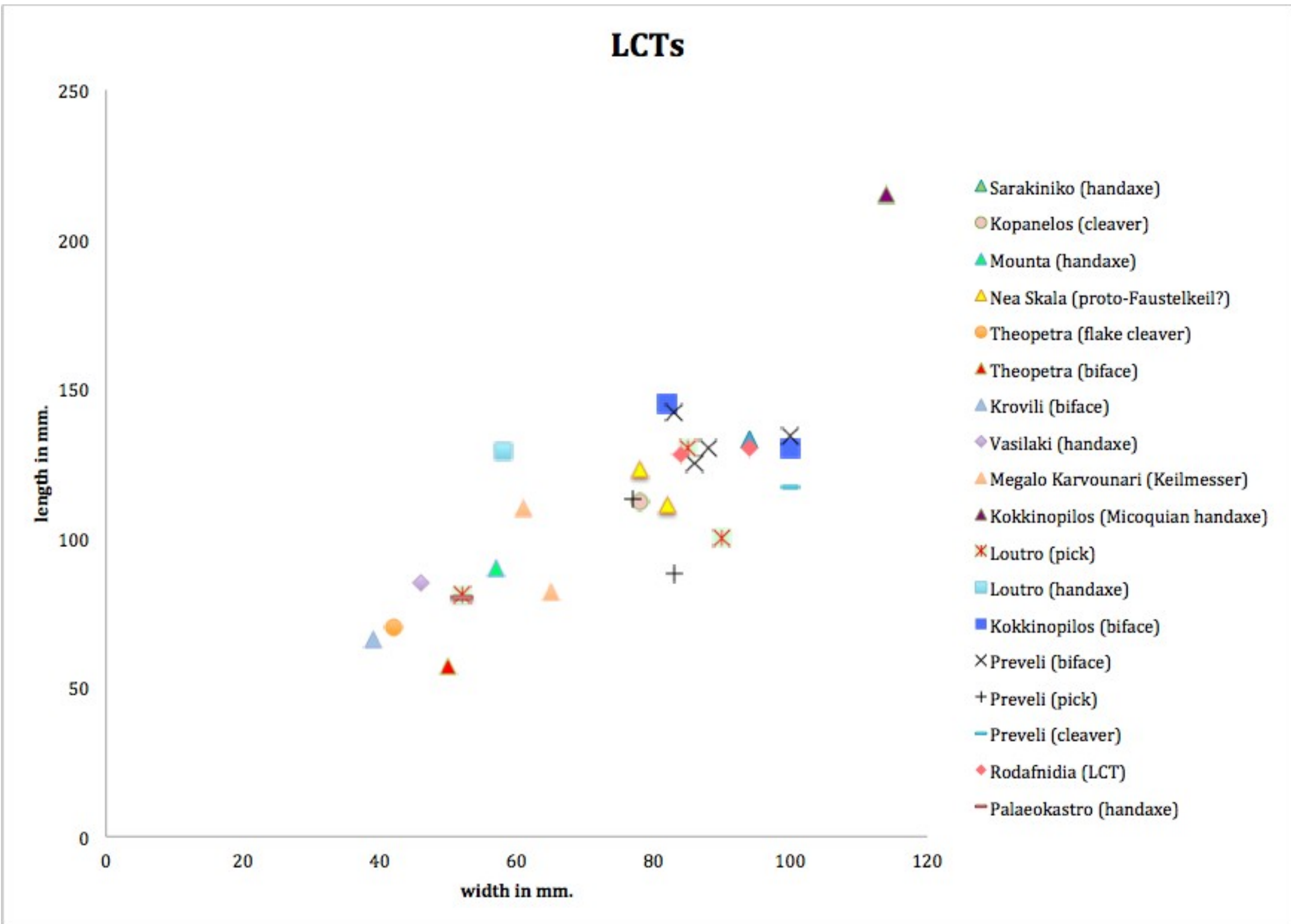
5.3.1. The Ionian Islands

The earliest collections of stone tools associated with the Pleistocene come from the islands of the Ionian Sea, yet detailed publications of the material, with the exception of the assemblages collected by the Danish team from Kefalonia, are mostly lacking. Apart from a small number of artefacts which can securely be attributed to the Middle Palaeolithic in terms of typological and/or technological associations the vast majority of the lithics are undiagnostic, potentially Palaeolithic. In the absence of diagnostic specimens, often the preservation of the artefacts can hint to their biography, meaning that the ones exhibiting extreme wear on their surfaces cannot be very recent. On the contrary, artefacts with very sharp edges and ridges, when found on the surface, cannot be regarded as very old unless they had just come out of an undisturbed section. Yet, the fact that both unpatinated pebble-tools with sharp edges and ridges (e.g. van Wijngaarden et al., 2013, fig.5) as well as patinated, relatively weathered ones (e.g. van Wijngaarden et al., 2013, fig.6) are part of the new collection from Vassilikos peninsula, Zakynthos, could either denote discreet taphonomic histories or chronological differences. If the latter is true, then similar types of core-tools were utilized diachronically in the area. Pebble-tools reported from Cape Kaloyeros coexist with three possibly Neolithic blades and large quantities of Bronze Age pottery (von Stein and van Wijngaarden, 2012), a fact which urges us to treat the particular assemblages with caution in terms of chronological attributions. Among the artefacts from Mouzaki-Brouma (Site 21) the occasional Neolithic artefacts are present as well (van Wijngaarden et al., 2013, 2008).

The fact that small sized pebble-tools are found in Middle Palaeolithic assemblages made Kourtessi-Philippakis (1999) to seek affinities with the Pontinian Mousterian from Italy. She proposed that the particular choppers and chopping tools from Zakynthos like the ones from Kefalonia should be attributed to the Middle Palaeolithic, as have some of the artefacts from the Preveza (SW Epirus) and Elis (NW Peloponnese). Choppers, chopping tools and cores that might often be classified as “pebble-tools” are indeed part of Middle Palaeolithic assemblages from open-air sites (Chavaillon et al., 1969, 1967; Andreas Darlas, 1995; Darlas, 1999; Runnels et al., 1999; Runnels and van Andel, 2003), caves (Panagopoulou, 1999) and rock-shelters (Panagopoulou et al., 2002-2004) in mainland Greece. Although the majority is made of different types of flints and cherts, some made of quartzite are also reported from the Peloponnese (Reisch, 1982). Even though the majority of the open-air sites suffer from a lack of stratigraphic context, the assemblage from Mavri Myti, NW Peloponnese is of particular interest since it was found in a thin layer of silts on the surface of a marine terrace and was considered to be *in situ*, dated to MIS 5e or to the beginning of MIS 4 (Andreas Darlas, 1995; Darlas, 1999). On the other hand, the claims of retrieving Lower Palaeolithic pebble-tools from stratified contexts at Rodia, Thessaly (Runnels and van Andel, 1993b) and Korrisia, Kerkyra (Kourtessi-Philippakis, 1999), have been questioned in terms of stratigraphic associations (Darlas, 2007; Tourloukis, 2010; Tourloukis and Karkanas, 2012). It has already been proposed that the pebble-tools from the central Ionian Islands are probably part of MP industries (Darlas, 2007, 1994; Kourtessi-Philippakis, 1999) and comparisons with the Pontinian Mousterian have been made predominantly due to their size similarities (see Graph 151). Likewise, although a few, bifaces found amongst MP collections in NW Greece might in many cases also be part of Middle Palaeolithic industries (for a discussion see Galanidou et al., 2016b and references therein). Thus for the only documented biface from Kefalonia, Foss' ascription to the MP seems valid. Another partially supportive element of a Middle Palaeolithic age could be its size, which according to the available evidence is relatively closer to the Middle Palaeolithic bifaces from Theopetra, Vasilaki, Krovili and Megalo Karvounari rather than the larger LCTs from Kokkinopilos and Rodafnidia that have been dated to the Middle Pleistocene (Graph 152). Yet again, size may or may not matter in our case. It could be indicative, but the sporadic nature of such finds all over the Greek peninsula does not allow for firm conclusions in that direction.



Graph 151: Scatter plot with the dimensions (length and width in mm.) of pebble tools from insular and non-insular sites from Greece, i.e. Kavos on Gavdos (Kopaka and Matzanas, 2009, 2011), Schinaria 1 at Plakias (Strasser et al., 2010) and Loutro on Crete (Mortensen, 2008), Nea Skala and Mounta on Kefalonia (Cubuk, 1976a, 1976b; Foss, 2002b), Ayios Nikolaos on Zakynthos (Kourtessi-Philippakis, 1999), Korrisia (Kourtessi-Philippakis, 1999) and Sidari on Kerkyra, Diaplo islet (Sordinas, 1970a, 1969), Mavri Myti and Piros Valley in the Peloponnese (Darlas, 1999), Aliakmon (Harvati et al., 2008) and Theopetra MP Cave in Northern Greece (Panagopoulou, 1999), Turkey, i.e. Yarimburgaz LP cave site (Arsebük and Özbaşaran, 1999) and Italy, i.e. Pontinian Mousterian cave sites from Latium (Kuhn, 1995). In cases where exact dimensions are not published, measurements were taken based on the illustrations provided.



Graph 152: Scatter plot with the dimensions (length and width in mm.) of LCTs - including the two possible Faustkeils from Nea Skala, Kefalonia (Cubuk, 1976a, 1976b) - from insular sites, i.e. Sarakiniko and Kopanelos on Gavdos (Kopaka and Matzanas, 2009, 2011), Mounta on Kefalonia (Foss, 2002b), Loutro and Preveli on Crete (Mortensen, 2008; Strasser et al., 2010) and non-insular sites in Greece, i.e. Theopetra MP Cave in Thessaly (Panagopoulou, 1999), Krovili in Thrace (Ammerman et al., 1999), Palaeokastro in Macedonia (Dakaris et al., 1964), Kokkinopilos (Runnels and Van Andel, 1993b; Tourloukis, 2009, 2010) and Megalo Karvounari (Galanidou et al., 2016) in Epirus, Vasilaki in the Peloponnese (Reisch, 1982), Rodafnidia on Lesvos (Galanidou et al., 2017c). In cases where exact dimensions are not published, measurements were taken based on the illustrations or photographs provided.

Overall, it seems that the Pleistocene artefacts from the islands of Kefalonia and Zakynthos are predominantly Middle Palaeolithic. Any attribution to the Lower Palaeolithic (i.e. the Acheulean) remains tenuous since such an ascription would be based on (i) weak geological interpretations and (ii) the arguable assumption that pebble tools (and bifaces) are strictly associated with Lower Palaeolithic industries. At the same time, this does not preclude the possibility for a future investigation in the region to provide new, more diagnostic of the Lower Palaeolithic period assemblages.

5.3.2. The Aegean Islands

Apart from Alonnissos where the MP presence is adequately supported (see 5.2.1.1), the assemblages from the Aegean Islands are more complicated. Although the arguments for a Middle Palaeolithic age often imply the use of the Levallois technique, this is rarely manifested, whereas discoid cores predominate in all of the assemblages. Yet these can hardly be strong cultural signifiers, especially since the categorizations are rarely in tune with all the criteria proposed by Boëda (1993). When found together with typical Mousterian artefacts and/or Levallois products, it can be assumed that they belong to the same industry. However, in the cases where the discoid is the only technique employed for flake production, it is almost impossible to extract significant chronological corollaries since discoid (or "discoidal" and "discoid-like") cores can be found diachronically from the Lower Pleistocene to the early Holocene.

For the material from Milos, It has to be stressed, that most of the choppers and chopping tools from Triadon Bay seem fairly convincing on morphological grounds (cf. Runnels, 2014a), and had these come from a more "secure" geoarchaeological context they would have probably not allowed many hesitations about an early Palaeolithic attribution (Papoulia, 2017, 2014). Unfortunately, though, the problematic interpretations from the ascription of an early date to unstratified pebble tools apply in this case as well. Taking as an example the double scraper with direct stepped and scalar retouch made on a large flake (Chelidonio, 2001, fig. 12.1), a Middle Palaeolithic age for the assemblage seems possible. Artefacts with similar retouch type, blank size and/or reduction patterns have been found in several sites of the Greek mainland (e.g. Dakaris et al., 1964, fig. 20.47-49; Darlas, 2007, fig. 7.10; Papoulia, 2011, fig. 22.a; Van Andel and Runnels, 2005, fig. 8.5). The same can be said for one more illustrated scraper with direct stepped retouch on its left lateral and alternating scaled retouch on its right lateral edge (Chelidonio, 2001, fig. 17.2). The particular type of retouch (stepped) when found on scrapers is usually referred to as *Quina* type retouch and can be either unifacial or bifacial. In our case, although the typological associations need to be taken into account, another parameter might perhaps explain the stepped morphology of the retouch flake scars on each artefact, and this might be its use. It is apparent that the majority of the tools illustrated have direct, inverse, or bifacial stepped (and often scaled) retouch of a relatively abrupt or semi-abrupt angle. The latter of course has to do with the thick blanks usually utilized. In accordance to the usual presence of pebble-tools in Middle Palaeolithic assemblages as discussed in 5.4.2, a Middle Palaeolithic age seems possible, yet judging both by the photographs and the illustrations provided by Chelidonio (2001, fig. 3, 4, 6, 7.1, 7.3–4, 8.1, 9, 12.3, 13.1, 14–15, 16.1), on morphological grounds and only, the particular tools could quite amply support a Lower Palaeolithic attribution as well.

Thus, unless we prove that the assemblage is associated with diagnostic Holocene tool-types, prehistoric pottery, or any other kind of activity that might explain their presence at Triadon Bay, [45] we will have to agree with Chelidonio's initial inference that a Middle Palaeolithic age seems as the most credible scenario, while the possibility of a Lower Palaeolithic age should not be excluded. However, it should not be overlooked that choppers and chopping tools, especially of small size (see Chelidonio, 2001, fig. 18), can also be part of late Pleistocene and Holocene assemblages. Taking into consideration the quarrying activities, which would have certainly taken place on the island during vast periods in prehistory, it would be useful to be able to identify the tools for the particular activities and the broad chronological spectrum within which these would have been utilized. Thus, in the absence of stratified context, the particular artefacts remain highly promising indications yet not solid evidence for Pleistocene marine or terrestrial crossings to Milos.

According to Runnels (2014a, p. 217) the material from Stelida, Naxos, bears resemblance to the Triadon Bay assemblage (see 5.2.2 and 5.2.2.2), yet in view of the limited published evidence from Naxos (i.e. absence of choppers/chopping tools, presence of a cleaver) such a claim is still difficult to evaluate, especially if Stelida has indeed two Pleistocene components, a Middle Palaeolithic and a Lower Palaeolithic one. It is, beyond doubt, very fortunate that, while these words are being written, an on-going excavation is taking place at the site, especially since Stelida is one of the present day insular sites that might possibly hold clues to the issue of Pleistocene marine (and/or terrestrial) crossings.

Further to the south, at the island of Gavdos, the fact that all artefacts attributed to the Lower Palaeolithic are made on coarse-grained raw materials, although might indeed imply

[45] Galanidou (2014c) has noted that she observed architectural remains near the site.

a “preference” for the particular materials during the earlier parts of the Pleistocene, it might as well indicate that different raw materials were employed for different purposes. For instance, the available raw materials on the island as observed between 2009-2012 included only small sized pebbles of the fine-grained brown and black flints, whereas other, coarse-grained siliceous raw materials were available in medium and large sized nodules (Figure 251).

Figure 251: Siliceous, coarse-grained raw material nodules observed at the stream leading to Korfos beach (Photo: C. Papoulia, August 2009).

At Klissoura 1, a cave site in eastern Peloponnese, the raw materials mainly used in all Middle Palaeolithic layers are the radiolarites and flints, yet other materials have also been used at a frequency of 1-2% never exceeding 4% (Sitlivy et al., 2009, 2008). Limestone and quartz artefacts occur more frequently in the middle and lowermost layers of the cave, whereas chalcedony seems to be more frequently used during the later parts of the occupation.

In the absence of fine-grained materials, artefacts made of quartz predominate at the cave sites of Maara and Petralona in NE Greece. At Maara Cave, Thrace, 38 lithic artefacts were the only finds recovered from the test pit, the majority of which is made of quartz

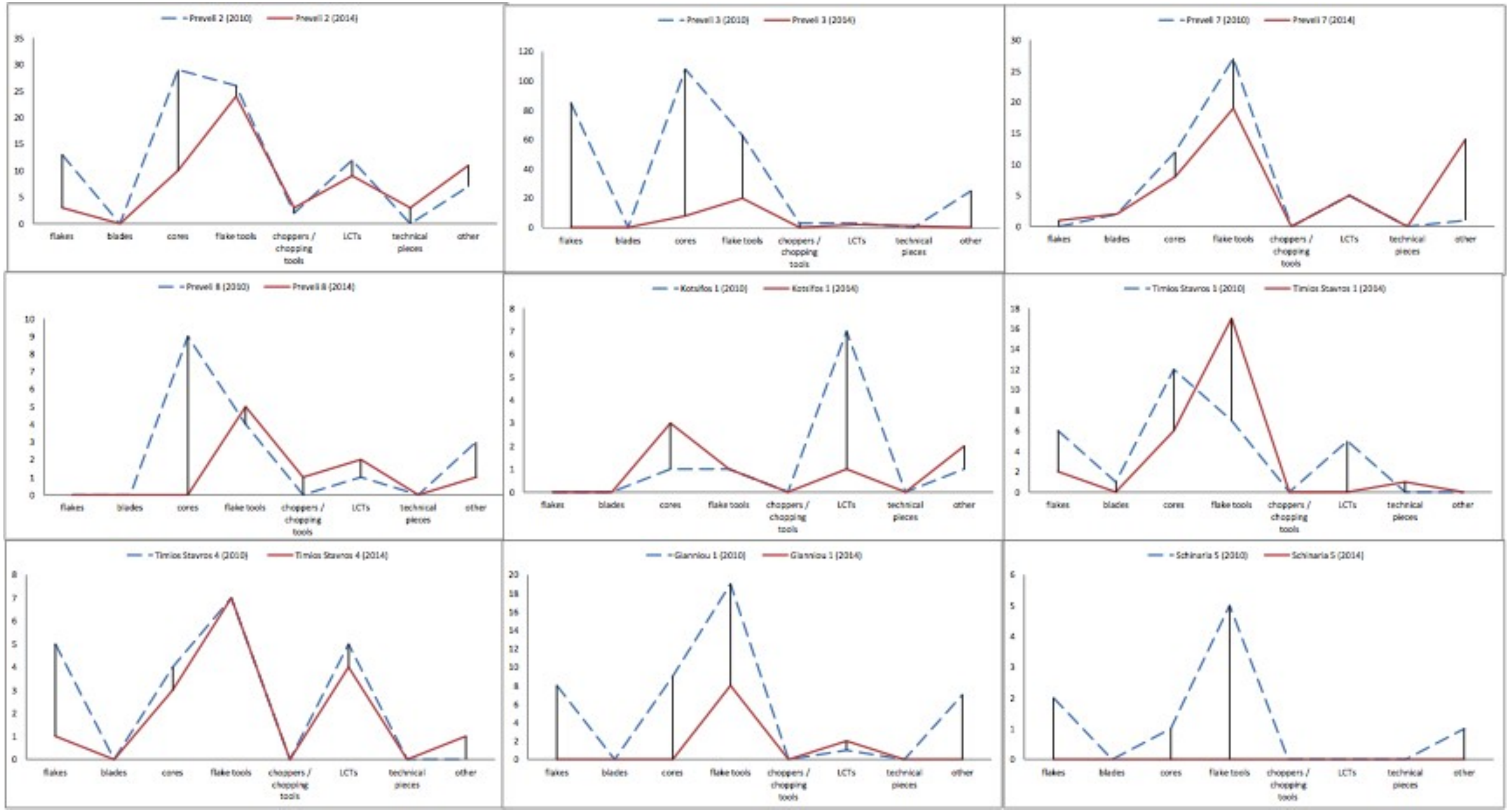
(Trantalidou and Ntarlas, 1995). While the Petralona artefacts have been poorly published and may belong to a Lower Palaeolithic industry, all artefacts from Maara are attributed to the Middle Palaeolithic and have been described as “typical Mousterian”. However, the Levallois technique is represented only by a single flake made of flint (Trantalidou and Ntarlas, 1995). Likewise, at particular parts of the Mani Peninsula raw material sources of metamorphic tuffs and andesitic lavas of mediocre knapping quality predominate, while fine-grained flints are less frequently found. The local ‘krokeatis lithos’, a green andesite from Krokees, was the main raw material (80%) upon which Pleistocene hominins produced their tools at Lakonis (Panagopoulou et al., 2002-2004). Other types of rocks utilised include quartz and schist. At a distance of approximately 30km, Kalamakia, demonstrates the use of the green andesite from Krokees as well as a variety of raw materials including quartz, quartzite and flint, whose raw material sources could be approached at a smaller distance of *c*. 10-15km, (Darlas and de Lumley, 2004; Harvati et al., 2013). Of particular interest is the discovery of scrapers made of seashells (*Callista chione*) at the coastal cave of Kalamakia (Darlas, 2007; Darlas and de Lumley, 2004). The same practice has been identified at Middle Palaeolithic sites of southern Italy and was interpreted as an adaptive response to raw material shortage (Douka and Spinapolice, 2012; Spinapolice, 2009).

For the *Faustelkeil* from Ayios Pavlos, Gavdos, Kopaka and Matzanas (2011; 2009) propose an association with the MTA. Even though such tools are most frequently encountered in the *Keilmessergruppe* assemblages of NW, Central and Eastern Europe (see Galanidou et al., 2016b), the important thing to remember here is that, apart from the fine Middle Palaeolithic leafpoints, thicker and larger tools with bifacial retouch should not be axiomatically attributed to the Lower Palaeolithic. In this sense, the bifacially backed knives from Megalo Karvounari, Epirus (Galanidou et al., 2016b), the ones classified as possible *Faustelkeils* from Nea Skala, Kefalonia (Cubuk, 1976b) and the quartz *Faustelkeil* from Gavdos (Kopaka and Matzanas, 2011, 2009) might tentatively be regarded as of having certain cultural, yet not straightforward chronological affinities. Additionally, the stepped *Quina* retouch (unifacial or bifacial) observed at Gavdos and Milos, unless it can be related with a particular use, it has to be regarded as a diagnostic element of the Middle Palaeolithic. Yet to claim that these tools could be associated with the particular sub-culture of the French prehistory might be driving the argument too far. *Quina* scarpers have also been found in limited Middle Palaeolithic sites on the mainland (Galanidou et al., 2016b and references therein).

The material from Plakias, has been described as consisting both of Lower Palaeolithic and Middle Palaeolithic artefacts (Strasser et al., 2010), yet the emphasis has been put on the oldest component which was revised and republished with a few alterations in the initial tool categories (Graph 153), accompanied by new illustrations (Runnels et al., 2014a). In some cases, there are significant differences between the assemblage structures and the tool repertoires as published in 2010 and 2014. Apart from the fact that the undiagnostic nature of the material has obviously puzzled the authors as well, it may also be assumed that a large part -if not all- of the artefacts excluded from the 2014 publication, yet included in the 2010 one, are either totally undiagnostic or part of the Middle Palaeolithic component of the particular sites. This is supported by the fact that there has been no indication of diagnostic Upper Palaeolithic artefacts.

The rather “atypical” nature of the so-called *bifaces* (Strasser et al., 2010) or *LCTs* (Runnels et al., 2014a) has been interpreted as a result of the “unpredictable flaking quality of the opaque, dull and blocky” type of quartz used, and of an unsystematic, expedient and opportunistic knapping technique (Runnels et al., 2014a, p. 138; Strasser et al., 2010, p. 181). Apart from their similar dimensions (Graph 152), little affinities can be traced between them and the ones from the mainland, including Lesvos (cf. Galanidou et al., 2013), an island which would have been connected to the western coasts of Turkey, thus would be easily accessible from the east via terrestrial routes. Unfortunately, the technological schemes are underrepresented in the existing publications. The only flake core illustrated is a discoid one from Preveli 2 (Strasser et al., 2010, fig.32.h), which could perhaps be part of the Middle Palaeolithic component of the site (it has been excluded from the 2014 publication). In the absence of textbook examples or “fossil-types”, a more detailed documentation of the cores would have helped towards the identification of the reduction sequences, thus perhaps also their cultural and chronological associations.

Graph 153 (next page): Line charts with the assemblage structures of the lithic collections from Plakias, Crete. Blue line corresponds to the Palaeolithic assemblages as classified in the 2010 publication and red lines correspond to the Lower Palaeolithic assemblages as classified in the 2014 publication. Data inferred from Strasser et al., 2010; Runnels et al., 2014a.


Prevell 2 (2010)
Prevell 2 (2014)
Prevell 3 (2010)
Prevell 3 (2014)
Prevell 7 (2010)
Prevell 7 (2014)
Prevell 8 (2010)
Prevell 8 (2014)
Kotsifos 1 (2010)
Kotsifos 1 (2014)
Timios Stavros 1 (2010)
Timios Stavros 1 (2014)
Timios Stavros 4 (2010)
Timios Stavros 4 (2014)
Giannlou 1 (2010)
Giannlou 1 (2014)
Schinaria 5 (2010)
Schinaria 5 (2014)
flakes
blades
cores
flake tools
choppers / chopping tools
LCTs
technical pieces
other

The industry from Plakias was initially described as of an "Acheulean *sensu lato"* (Strasser et al., 2010) character which later on became the "Cretan Acheulean" (Runnels et al., 2014a). In strict typological terms, none of the LCTs illustrated could be part of an Acheulean *sensu strico* assemblage and this fact seems to have been appreciated by the use of the aforementioned terms. Actually, cultural associations are arduous, a fact that might only in part be explained by the bad knapping quality of the raw material used. The question that naturally occurs is if they are not part of a Lower Palaeolithic industry then to which industry should the lithics from Plakias be attributed? Traditional narratives on the Cretan prehistory indicate that the island was uninhabited throughout the Pleistocene and, according to some scholars, even until the Neolithic. Acting as the Devil's advocate, an "unsystematic, expedient and opportunistic knapping technique" may be employed diachronically; thus equally associated with later parts of the Pleistocene and, why not, even the Holocene. Quartz artefacts were indeed utilized during the Holocene, even though this aspect has hitherto not been adequately documented for the Greek sites (cf. Palli, 2014). Additionally, it has been experimentally proven that, although quartz artefacts can break in an unpredicted manner and relatively easier than other raw materials, their resistance increases in relation to their thickness (Tallavaara et al., 2010). Thus, perhaps the expedient character of the LCTs from the Preveli sites could be explained as a combination of a breakage-resistance size in addition to the good availability of quartz as raw material. However, in the absence of archaeologically visible traits that could imply a post-Pleistocene date for the surface collections from Plakias, such a scenario has to be disregarded. An alternative interpretation was suggested by Galanidou (2014a) who partly accepts the dates of the artefacts and their southwards origin but not the attribution to the Acheulean; instead, she proposed affinities with the core-axe Sangoan and Lupemban industries of the African MSA associated with early *Homo sapiens.*

The team identified both Palaeolithic and Mesolithic sites in the course of their survey and decided to excavate one of those believed to be of an early Holocene date, i.e. Damnoni 3. Judging by the production of bladelets from small, prepared cores and the presence of fine retouch on microlithic tools at the nearby Damnoni 3 it can be assumed that, unless the particular assemblages were made of a different type of quartz, morphological restrictions were not implicit by the quality of the raw material. Additionally, the presence of imported flint/chert types has been observed at Damnoni 3 (Carter et al., 2018; Strasser et al., 2015) but was not reported for any of the Preveli sites. Such differences can either be interpreted as chronological/cultural signifiers, as a difference in the use of sites, i.e. investing different amounts of time and energy and employing different raw materials/techniques in each case, or both.

The presence of a pebble-tool classified as a "chopper" among the assemblage from Schinaria 1 (Strasser et al., 2010, fig. 16o), a site attributed to the Mesolithic, can be used to raise another point. It is of course reasonable to wonder about the criteria of attribution of the particular tool to the Mesolithic when identical artefacts have in other cases been part either of Lower Palaeolithic or of Middle Palaeolithic assemblages. The answer probably lies in the geological context of the particular site and the overall "microlithic" character of the assemblage. Generally, apart from the geological context, the different traits between the Plakias Palaeolithic and Mesolithic assemblages seem to be (a) the presence or absence of LCTs, (b) the raw materials (i.e. predominance of quartz, presence or absence of chert and obsidian and (c) the overall size of the artefacts.

A "microlithic" character has been identified in several surface collections all over Greece, which are habitually attributed to the Mesolithic. The nature of the Greek Mesolithic, which often lacks diagnostic elements does not refine the picture (cf. Galanidou, 2011b). In many cases the small size of specimens encountered on the surface prevents specialists from attributions to the Pleistocene, yet small-sized artefacts can also be part of Middle Palaeolithic and Lower Palaeolithic industries. This fact is testified in several sites worldwide, while the presence of small sized artefacts in stratified Middle Pleistocene deposits of Marathousa 1 in Megalopolis, Peloponnese (Panagopoulou et al., 2015; Tourloukis et al., 2018) proves that this might also be the case in Greece. It is highly unlikely that similar finds if found unstratified would have been regarded as of a LP date. The "Micro-Mousterian" from Asprochaliko, Epirus, is an example of relatively small-sized artefacts coming from Middle Palaeolithic stratified cave deposits (Papaconstantinou, 1988). Although the "microlithic" character of the assemblages proved to have been somewhat overemphasized, it is still useful to keep it in mind. Small-sized artefacts are also reported from Kalamakia Cave, southern Peloponnese, where the Levallois technique is represented mainly by flakes with centripetal and unipolar negative scars while cores are extremely few and exhausted (Harvati et al., 2013) as well as Klissoura 1, eastern Peloponnese (Sitlivy et al., 2009, 2008). Assemblages rich in microlithic elements and sidescrapers, yet poor in *Quina* and Levallois products, as well as miniscule lineal and recurrent Levallois cores of less than 30x30mm come from the Middle Palaeolithic layers of the cave. Another recurrent Levallois core of similar dimensions comes from Kokkinopilos (Dakaris et al., 1964, fig. 24.124), whereas one more small-sized Levallois core has been reported from the island of Ayios Efstatios (5.2.1.3).

To reverse the argument, larger artefacts, which might as well be part of Mesolithic assemblages (e.g. Kaczanowska and Kozlowski, 2008a, fig. 8.1.L9, 8.1.L16-17), could likewise be regarded as of a Lower Palaeolithic or a Middle Palaeolithic age. Sordinas (1970) had referred to the presence of *galets aménagés* as parts of Mesolithic industries and has provided illustrations from Sidari, Kerkyra (Sordinas, 1969, fig. 5.4) and Diaplo, an islet NW of Kerkyra (Sordinas, 1970a, fig. 7.1). Following Sordinas' observation, Galanidou (2014c) believes that certain of the pebble-tools from Gavdos should be regarded as *galets aménagés* rather than Lower Palaeolithic choppers/chopping tools. Indeed the limestone chopping-tool from Kavos, Gavdos and the quartz chopper from Schinaria 1 are of similar dimensions. Yet again, stratified flint chopping-tools from Theopetra and the Italian caves of Latium are even smaller (Figure 151). Of similar dimensions are the surface finds from Kefalonia (Ayios Nikolaos, Nea Skala, Mounta) and Mavri Myti, Peloponnese. This aspect partly illustrates the *recovery biases* due to the absence of Mesolithic diagnostics and the diverse datasets available (cf. Galanidou, 2011b, p. 234) as well as the limited available information and our subsequent incomplete appreciation of the Greek Lower Palaeolithic record (cf. Tourloukis, 2010).

5.4. Conclusions

In conclusion, this chapter demonstrates that lithic assemblages with Middle Palaeolithic affinities have been found on sites that were insular (a) throughout the Pleistocene, i.e. Crete, Gavdos and (b) during parts of it, i.e. Kefalonia, Zakynthos (Ionian Sea), Alonnissos, Agios Petros, Ai Stratis (North Aegean Sea), Naxos and Milos (Cyclades). At the same time, arguments for Acheulean (Lower Palaeolithic) affinities based on the present data are less convincing. The main constraint is that we are mainly dealing with surface collections, usually coming from palimpsest sites. Any attributions are mainly based on typological affinities yet the majority of the lithic material is undiagnostic.

That being said, more conclusive evidence for a Middle Palaeolithic presence comes from the southern Ionian Islands, whose insularity is also supported by the recent palaeoshoreline reconstructions. These islands have produced larger collections and more diagnostic finds and the rich regional Middle Palaeolithic record from NW mainland Greece (Epirus and NW Peloponnese) that are also usually produced on similar, fine-grained raw materials permits an enhanced, comparative assessment of the evidence. As for the North Aegean Islands, Middle Palaeolithic assemblages have been well documented on Alonnissos and Agios Petros. However, refined sea-level reconstructions are necessary in order to evaluate any marine- or terrestrial- crossing scenario. The central Aegean sites, such as Stelida on Naxos and Triadon Bay on Milos, have both yielded core tools with Lower Palaeolithic affinities and a number of artefacts that could equally be attributed to the Middle Palaeolithic. The fact that Stelida is the first and only excavated site on an island that might have perhaps been an island at the time of its occupation is extremely important and has already provided promising results. Again, refined sea-level reconstructions are essential if we are to appreciate how Palaeolithic individuals and groups reached these two islands. As for the South Aegean sites on Crete and Gavdos, further investigation are vital in order to better appreciate the geological association and chronological attributions of the finds. At present any Lower Palaeolithic attributions are equivocal, and while Middle Palaeolithic affinities might be easier to accept (mainly due to the rich Middle Palaeolithic record from the mainland), we should not disregard the likelihood of certain "archaic-looking" artefacts to be a result of particular techniques persisting through later prehistoric periods of the Holocene.

In a nutshell, the available datasets suffer from (a) a lack of absolute dates, (b) limited diagnostics, (c) the predominance of preliminary reports, (d) inadequate documentation with no or bad quality photographs and drawings, (e) lack of comparative material from stratified contexts (especially for the Lower Palaeolithic) and (f) a number of epistemological and methodological aspects that complicate things. For instance, it is not rare for lithic artefacts to be classified based on obsolete criteria for classification according to which, for instance, pebble tools and bifaces are part of Lower Palaeolithic industries, prepared core techniques are only part of Middle Palaeolithic technological schemes and blade technology signifies an Upper Palaeolithic presence. Other usual assumptions is that coarse-grained materials were used in the Lower Palaeolithic, while fine-grained material were part of later industries. Similarly, larger artefacts are assumed to be produced in the Pleistocene, while microlithic industries are thought to be a result of the technological advancement of the Holocene. These are only some coarse-grained but indicative examples of the impact that solid and inflexible categorisations may have on context-less collections. This, by no means, suggests that surface material is totally inadequate for extrapolating important data about the Palaeolithic. On the contrary, the abundance of open-air unstratified sites in Epirus, for example, has been a huge source of information for the Greek Middle Palaeolithic (e.g. Papagianni, 2000). It is true, thought, that well-dated early Middle Palaeolithic (>130ka) and Lower Palaeoltihic sites are either totally missing or under investigation. Future studies will surely provide answers to several of the questions currently posed. Until then, our aim should be to examine all possible scerarios with an open mind about the cognitive capacities of other members of the human lineage, while being suitably cautious in terms of the interpretative limitations of the available data.

6. Conclusions and discussion

6.1. Islands and submerged landscapes of the Pleistocene NE Mediterranean

The particular thesis aimed at investigating the marine crossings that took place during the Pleistocene and the presently submerged landscapes at the NE Mediterranean. In order to do so, it first discussed the state-of-the-art in terms of the discipline's research tools and methods available and the evidence archaeologist should expect to find, from a global perspective (Chapter 2). This showed (a) the significant contrast between the direct evidence of sea crossings during the Pleistocene, i.e. remains of boats, and the ever-increasing indirect evidence for early marine navigation, and (b) the great potential of the newly established field of Continental Shelf Archaeology in our attempts to reconstruct past behaviours within their landscapes and seascapes.

The environmental context as well as the palaeontological, palaeoanthropological and archaeological record was briefly discussed in order for the new data to be incorporated in the already published array of evidence (Chapter 3). Based on the latest palaeogeographic reconstruction of the Aegean Basin, few are the present day islands that can contribute to the debate of marine crossings, while most of them are able to answer questions pertinent to patterns of terrestrial dispersals during the Pleistocene.

By taking as a case study the Inner Ionian Sea Archipelago (Chapter 4), we managed to provide new evidence from this part of the NE Mediterranean and to investigate both marine and terrestrial types of dispersals (see 6.2 below). Furthermore, the re-evaluation of the already published lithic collections used in the past as arguments for sea crossings allowed for a better appreciation of the available record in terms of this type of human dispersal (Chapter 5).

Based on the combined results from archaeological and geological studies, Table 83 summarizes the evidence divided to three categories, the finds attributed to the Pleistocene before the LGM, the late Upper Palaeolithic finds (post LGM) and the Mesolithic. A degree of uncertainty is present not only for the cultural attributions but also on the insularity of several of the islands in the different time-periods within the Pleistocene.

Table 83: Association of cultural remains (pre-LGM= before the Last Glacial Maximum, ca. 20,000BP, LUP= Late Upper Palaeolithic, Meso = Mesolithic) and insularity for the islands of the Aegean with indirect evidence for sea-crossings [×✓ archaeological remains on insular sites, × = archaeological remains on non-insular sites, ×? = archaeological remains on sites whose insularity is not confirmed]. Based on the sea level reconstructions provided by Lykousis (2009); Kapsimalis et al. (2009) and Ferentinos et al. (2012) (After Papoulia, 2016, Table 2).

	Island	Cultural dating / Insularity			References
		pre-LGM	LUP	Meso	
Ionian Sea	Kerkyra	×	×	×✓	Sordinas, 1969
	Diaplo			×✓	Sordinas, 1969
	Kefalonia	×✓	×✓		Cubuk 1976; Kavvadias, 1984; Randsborg, 2002
	Zakynthos	×✓	×✓		Kourtessi-Philippakis, 1999
Aegean Sea	Alonnissos	×?	×✓	×✓	Panagopoulou *et al.*, 2002
	Kyra Panayia	×?			Efstratiou, 1984
	Youra			×✓	Sampson, 2010
	Ai-Stratis	×?		×✓	Kaczanowska and Kozlowski, 2014
	Lemnos		×		Efstratiou *et al.*, 2013
	Lesvos	×			Galanidou *et al.*, 2013
	Ikaria			×✓	Sampson *et al.*, 2012
	Yali			×✓	Sampson *et al.*, 2012
	Kythnos			×✓	Sampson *et al.*, 2010
	Naxos	×?		×✓	Carter *et al.*, 2014; Sampson, 2006 and 2010
	Melos	×?	×✓	×✓	Chelidonio, 2001; Laskaris *et al.*, 2011
	Crete	×✓		×✓	Strasser *et al.*, 2010 and 2011; Runnels *et al.*, 2014
	Gavdos	×✓	×✓	×✓	Kopaka and Matzanas, 2009 and 2011

Islands such as Kerkyra (Corfu) and Lefkas, in the Ionian Sea are clear markers of terrestrial dispersals for all Palaeolithic activity taking place before the LGM. Lefkas, in particular, is still in a way connected to mainland Greece, while Kerkyra was probably disconnected during the sea-level rise that took place after the LGM (Sordinas, 1983). Both islands have plenty of sites with diagnostic assemblages attributed to the Middle and/or the Upper Palaeolithic (Adam, 2007; Dousougli, 1999; Galanidou, 2016; Galanidou et al., 2016a; Papagianni, 2000; Sordinas, 1969). Equally diagnostic material are now available from sites on the islands of Meganissi and Kythros, situated at the Inner Ionian Archipelago, SE of Lefkas (see Chapter 4). On the other hand, the insularity of Kefalonia and Zakynthos during most parts of the Pleistocene has lately been suggested (Ferentinos et al., 2012). The lithic assemblages from these two islands have been re-evaluated in Chapter 5, and more unpublished material are expected to provide in the near future new insights into the question of Middle Palaeolithic occupation on both islands of the southern part of the Ionian Sea. To this end, the new material collected in the course of the IISAP, from the island of Arkoudi and Atokos offer a few more hints in terms of Late Pleistocene sea-crossings in the Ionian Sea (Chapter 4).

On the other side of the southern Balkan Peninsula, the island of Lesvos, today situated at a very close distance from the west coast of the Asian continent would have been a terrestrial extension of it during the Pleistocene. Its rich Palaeolithic mark, extends back to the Middle Pleistocene and is a testimony of activities and terrestrial dispersals spanning the Lower and Middle Palaeolithic (Galanidou et al., 2017c, 2013). Limnos, another island situated at the NE part of the Aegean Sea, has yielded important signals of a Late Upper Palaeolithic (post-LGM) open-air occupation at Ouriakos. Although Ouriakos is a much younger site than Rodafnidia on Lesvos, the presence of the characteristic lunates on the island of Limnos most probably also connote terrestrial rather than marine dispersals as well (Efstratiou et al., 2014, 2013). In both cases, comparanda have been sought at similar sites of the same temporal and cultural context in the western costs of the Asian continent. In the first case, similarities have been identified, for example, between the Rodafnidia LCTs and similar finds from Acheulean sites in Israel, and in the latter case between the hunting equipment found at Ouriakos and Epigravetial sites in west Turkey (ibid.). In the central Aegean Sea, the large island of Evia, situated at a very close distance from the east coasts of central Greece has yielded a few promising suggestions for a possible Lower Palaeolithic presence (Sarantea, 1986), yet a systematic publication of the material is pending.

Since the coastal configuration of the NE Mediterranean islands was during the Mesolithic quite similar to the present day one, Mesolithic marine dispersals between the mainland and several islands of the Ionian and the Aegean Seas, have now been well documented, not least because of the robust signature of the obsidian circulation networks, while new sites are increasingly reported (e.g. Carter et al., 2018, 2017, 2016, 2014; Galanidou, 2011b; Kaczanowska and Kozlowski, 2014; Laskaris et al., 2011; Panagopoulou et al., 2001b; Perlès, 1987; Renfrew and Aspinall, 1990; Sampson, 2006; Sampson et al., 2012, 2010, 2002, Sordinas, 2003, 1970a, 1969, Strasser et al., 2015, 2010).

However, what remains to be clarified is the insularity (or not) of particular islands of the Aegean Sea that carry signals of Pleistocene activity, such as the North Aegean islands of Alonnissos, Kyra Panayia and Ai-Stratis, and the Cycladic islands of Naxos and Milos. Unless detailed sea-level studies provide refined palaeogeographic maps of the seascapes during each and every part of the deep prehistory of the Aegean Basin, we cannot but restrict our archaeological interpretations to hypotheses in terms of either marine or terrestrial crossings to and from the particular present day islands. Based on the available reconstructions, it is only the evidence from the southernmost Aegean Sea islands of Crete (Mortensen, 2008; Runnels et al., 2014b; Strasser et al., 2011, 2010) and Gavdos (Kopaka and Matzanas, 2011, 2009) that can be more clearly used as arguments for or against Pleistocene sea-crossings (Chapter 5).

6.2. Insights from an enclosed archipelago

The analysis of the new lithic collection from the Inner Ionian Sea Archipelago (Chapter 4) has offered the great chance to study two types of dispersals; terrestrial and marine. The islands of Meganissi and Kythros have returned large assemblages of diagnostic Middle Palaeolithic artefacts with clear affinities with their synchronous sites found in several Middle Palaeolithic open-air and cave sites in mainland Greece. This fact, apart from widening the territory of the Middle Palaeolithic occupation in the region, urges us to envision the landscapes that are now hidden below the current sea level but would have been part of the terrestrial landscapes available for the Pleistocene foragers to exploit. The anticipated types of adaptation to the natural environment, its terrain and its resources, are extrapolated by the detailed study of the tool types and their spatial distribution, notwithstanding the effects of erosion and post-depositional processes on the current distribution of the finds.

A different type of adaptation to the natural environment, the local climatic conditions or even the social stress that might have occurred during parts of the Pleistocene, is demonstrated by the lithic finds from the two southernmost islands of Arkoudi and Atokos. These two islands, being detached from the mainland during the period under study, were able to provide the context for the study of the possible marine crossings that took place between the isles and islets of the archipelago during the Late Pleistocene.

Arkoudi, the island situated closer to Lefkas, provided a larger sample of diagnostic artefacts with Middle Palaeolithic affinities, but also a few hints for an early Upper Palaeolithic cultural attribution. This fact needs to be further investigated in accordance to the limited yet informative sites with early Upper Palaeolithic characteristics across the southern Balkan Peninsula. To this end, the full publication of the only, as yet recorded, assemblage of an Initial Upper Palaeolithic character from Lakonis (Elefanti et al., 2009), at the Mani peninsula, is well awaited.

Atokos, on the other hand, has a particularly small assemblage of artefacts that have been attributed to the Middle Palaeolithic due to their technological and typological attributes (e.g. Levallois products). The fact that they are present, no matter how few, does open a window for a discussion of marine crossings to it during the Middle Palaeolithic period. The limited presence of diagnostic artefacts may be interpreted in many ways, including a real gap in occupation, or a limited, serendipitous presence of Middle Palaeolithic hominins on the island.

A question remaining unanswered is how many hominins might have attempted and successfully managed to cross the sea of the Inner Ionian Sea Archipelago? In the southern Balkans peninsula, including Greece, Middle Palaeolithic assemblages are directly associated with Neanderthal remains (Galanidou, 2014c, 2004, Harvati et al., 2013, 2009; Tourloukis and Harvati, 2018) and all Middle Palaeolithic assemblages from sites on the mainland have been hypothesized to be a product of the Neanderthals. Based on the association between the Neanderthals and Middle Palaeolithic technology, the presence of the respective technological category on Arkoudi and Atokos points to the Neanderthals as the most probable candidates. Nevertheless, it is necessary to consider the likelihood that particular tool types and techniques (e.g. Levallois) might not be associated exclusively with the Neanderthals, as is the case in certain sites of the eastern Mediterranean coast (e.g. Shea, 2003). Yet, there is not enough evidence to support such a hypothesis for the Greek data, at least for the time being. If such a case is confirmed, the time of arrival becomes another tantalizing issue, especially in respect of the proposed interpretation for the Plakias finds by Galanidou (2014a, 2014c) and her hypothesis of an early arrival of *Homo sapiens* from Africa to Crete.

6.3. Sea routes (>LGM)

6.3.1. Ionian Sea

Sea-crossings between the central Ionian Islands may have been a less demanding task than the one proposed for the southern Aegean, both because of the smaller distances between the islands and the mainland, and perhaps also due to a more protected seascape in terms of winds and currents, at least for parts of the Inner Ionian Sea. The “regional palaeo-shoreline configuration” was the element that according to Ferentinos et al. (2012, p. 2174) provoked such inter island – mainland crossings.

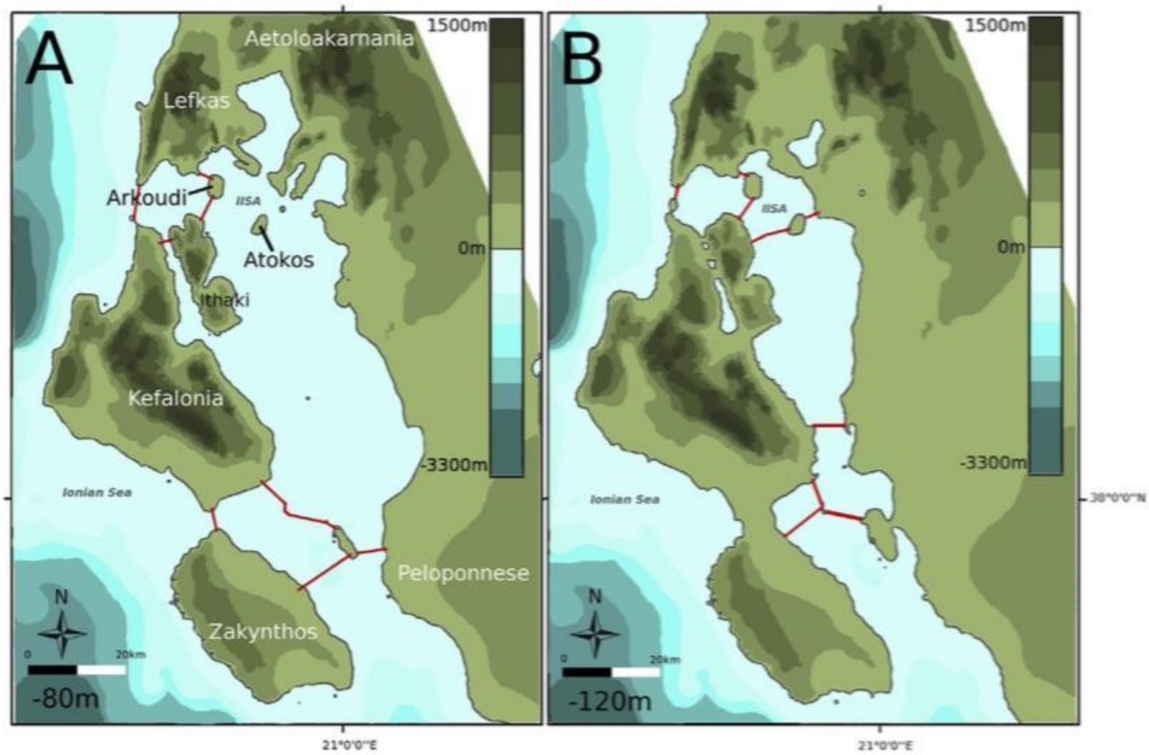


Figure 252: Reconstruction of the central Ionian Sea at about 60ka BP when the sea level would have been approximately 80mbsl (A) and during the LGM when the sea level subsidence would have reached 120 m (B) (Papoulia, 2017, fig. 4 as modified after Ferentinos et al., 2012, Fig. 8).

Based on the recent reconstructions (Figure 252.A), it seems that at about 60ka BP, when the sea level would have been approximately 80mbsl, the closest distance to be crossed would be via the SW promontory of Lefkas, i.e. Cape Doukato, towards the northern coast of Kefalonia. Large amounts of artifacts have been collected from the red-soil formation at Cape Doukato (Dousougli, 1999; Dousougli and Zachos, 1994; Zachos and Dousougli, 2003). The collection includes numerous diagnostic MP tools such as Levallois points and various types of scrapers (Galanidou et al., 2016a). The point of arrival, in this case, would have been near Fiskardo (for its Middle Palaeolithic component see Chapter 4). An alternative route, and perhaps more “protected” in terms of winds and currents, is the one originating from the SE end of Lefkas towards the NW part of the isle of Arkoudi, which could have acted as a stepping stone in order to arrive to the NE coast of Ithaki. The new data from the IISAP support the particular route between Lefkas and Arkoudi, since an assemblage of at least 50 artefacts with Middle Palaeolithic affinities have now been identified on the latter (see 4.5.5), even if their artisans did not cross over to Kefalonia. In any case, during that time, one more crossing would be necessary in order to reach Zakynthos from the now submerged coasts of the southern part of Kefalonia. The distance is estimated to have been about 5 km. Another option could be through a southern route originating from the Peloponnese, approximately where the Kyllini peninsula lays today, crossing over to an islet that is now submerged in order to reach the eastern coast of Zakynthos.

Zavitsanou et al. (2015) propose than during MIS 6 (c. 140ka) Arkoudi and Atokos were connected to the mainland, thus distances between the coasts were much smaller. At about 100ka the shoreline would have been approximately 20mbsl, thus the sea intervals much larger. Although the same distances would need to be crossed at about 8ka, the navigation abilities of our own species, especially at that time, are rarely questioned. While a crossing by Middle Palaeolithic hominins at 100ka would have been far more challenging than at 60ka, a crossing attempted at about 30ka might have perhaps been less complicated, since the sea-level would be about 60 m lower than today (see Figure 53 in 3.4.2); yet at that time it would have probably been modern humans crossing the sea.

As a single island, Kefalonia, Ithaki and Zakynthos, would have been at the peak of its accessibility during the LGM (Figure 252.B) not only because of the proximity between Lefkas and Kefalonia, but also due to the significantly more "protected" waters of the Inner Ionian Sea. These might have perhaps allowed "safer" crossings via the southern routes, i.e. between the now submerged NW parts of the Peloponnese and the SE parts of Kefalonia or the NE parts of Zakynthos. Such low sea levels would have certainly allowed more frequent crossings between the island and the mainland.

In sum, in the hypothetical scenario that Middle Palaeolithic hominins crossed the sea at about 60ka, based on the available reconstructions (Figure 252.A), they could have arrived at the islands of Kefalonia and Zakynthos via three possible ways, with the first two considered more likely:

i. SW Lefkas – small islet – N Kefalonia (1 crossing of about 7 km and 1 crossing of about 1 km)
ii. SE Lefkas – NW Arkoudi, SE Arkoudi – NE Ithaki, NW Ithaki – NE Kefalonia (1 crossing of about 5 km and 2 crossings of less than 5 km)

iii. NW Peloponnese e stepping stone islet – E Zakynthos (1 crossing of about 5 km and 1 crossing of about 12 km)

Such a crossing during the LGM, at about 20ka, when land-bridges connected Ithaki, Kefalonia and Zakynthos (Figure 252.B), would follow one of the following possible routes:

i. SW Lefkas – N Kefalonia (1 crossing of less than 5 km)
ii. SE Lefkas – NW Arkoudi, SE Arkoudi – NE Ithaki (1 crossing of about 1 km and 1 crossing of less than 5 km)
iii. Aetoloakarnanian coast – NE Atokos, SW Atokos – NE Ithaki (1 crossing of about 3 km and 1 crossing of about 7 km)
iv. SW Aetoloakarnanian coast – SE Kefalonia (1 crossing of less than 7 km)
v. NW Peloponnesian coast – stepping stone islet – SE Kefalonia or NE Zakynthos (2 crossings of less than 7 km)

6.3.1. Aegean Sea

The Cyclades have been described as inter-visible and inter-accessible islands (Kapsimalis et al., 2009, p. 186), a fact which would provide several options of island hoping between them after the LGM, when most of them would be separated from the large Cycladic mass existing during most of the Pleistocene.

Based on the reconstruction provided by Lykousis (2009), we may assume that the initial crossing from mainland Greece to these islands could be achieved either from Kea to Kythnos or from Cape Kafireas, Evia, to Andros (Figure 253.A). The distance at 20ka BP would be a minimum of 6 km yet not without challenges in terms of climatic conditions. The strong currents of the deep channel below the Kafireas strait and the rocky coasts of Andros have been cerebrated as rather challenging conditions for prehistoric navigation (Kapsimalis et al., 2009, p. 186).

Further to the south, a direct crossing from Africa to Crete has been implied as the possible explanation of the presence of the artifacts at the south coast of Crete (Mortensen, 2008; Strasser et al., 2010, p. 186) yet the fact that the distance between Libya and Crete is long enough (today c. 260 km) not to allow any visibility (not today, nor in the past) of the opposite coast is perhaps the most important argument against such a crossing, at least during the Pleistocene (Papoulia 2017, 2016, 2013).

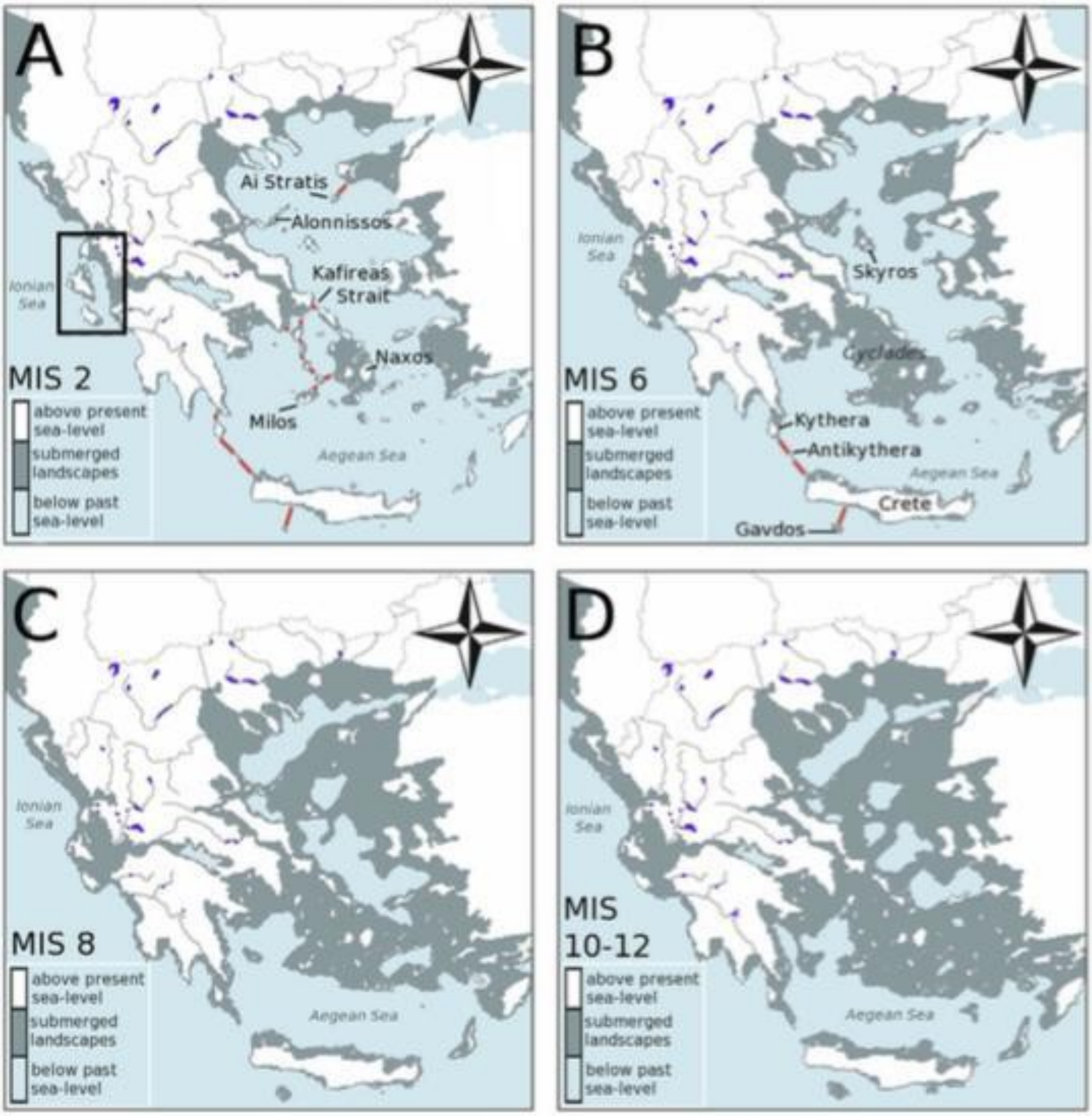


Figure 253: Reconstruction of the NE Mediterranean during the glacial periods of MIS 2, MIS 6 MIS 8 and MIS 10/12 which correspond with c. 18-30 ka BP (A), 140-180 ka BP (B), 250-300 ka BP (C) and 350-480 ka BP (D). (Papoulia, 2017, fig. 3 as modified after Lykousis 2009, Fig. 5 and Tourloukis & Karkanas 2012, Fig. 7).

Instead, crossings from SW Turkey to NE Crete via island hopping between Rhodes, Karpathos and Kassos, or most probably from the southern ends of the Peloponnese to the NW part of Crete seem to be the most plausible scenarios for the arrival of Pleistocene hominins to the island. The latter route is also implied by the palaeontological, palaeoanthropological and archaeological evidence. The southern coasts of the Peloponnese are full of caves and rock-shelters yielding material remains associated both with the Neanderthals and modern humans (Darlas and de Lumley, 2004, 1999, 1995; Elefanti et al., 2009; Garefalakis et al., 2017; Harvati et al., 2013, 2003; Panagopoulou et al., n.d.; Tourloukis et al., 2016). If Galanidou's (2014a, 2014c) hypothesis is confirmed, i.e. if the artisans of the Plakias Palaeolithic are *Homo sapiens* originating from NE Africa, thus, if a trip directly or, most probably, via coastal routes did indeed occur between Africa and Crete before 100ka, then subsequent crossings further northwards to the Peloponnese and then to Zakynthos, Kefalonia and Arkoudi would have been much easier tasks. A SE-NW route for the dispersal of modern humans has also been proposed by Ferentinos et al. (2014) yet for the early Upper Palaeolithic, on the basis of the available Aurignacian assemblages from the mainland. An E-W route is also proposed by Phoca-Cosmetatou and Rabbet (2014b) based on their tied-biome model. This route may have also been favoured by the sea currents and gyres (Figure 254).

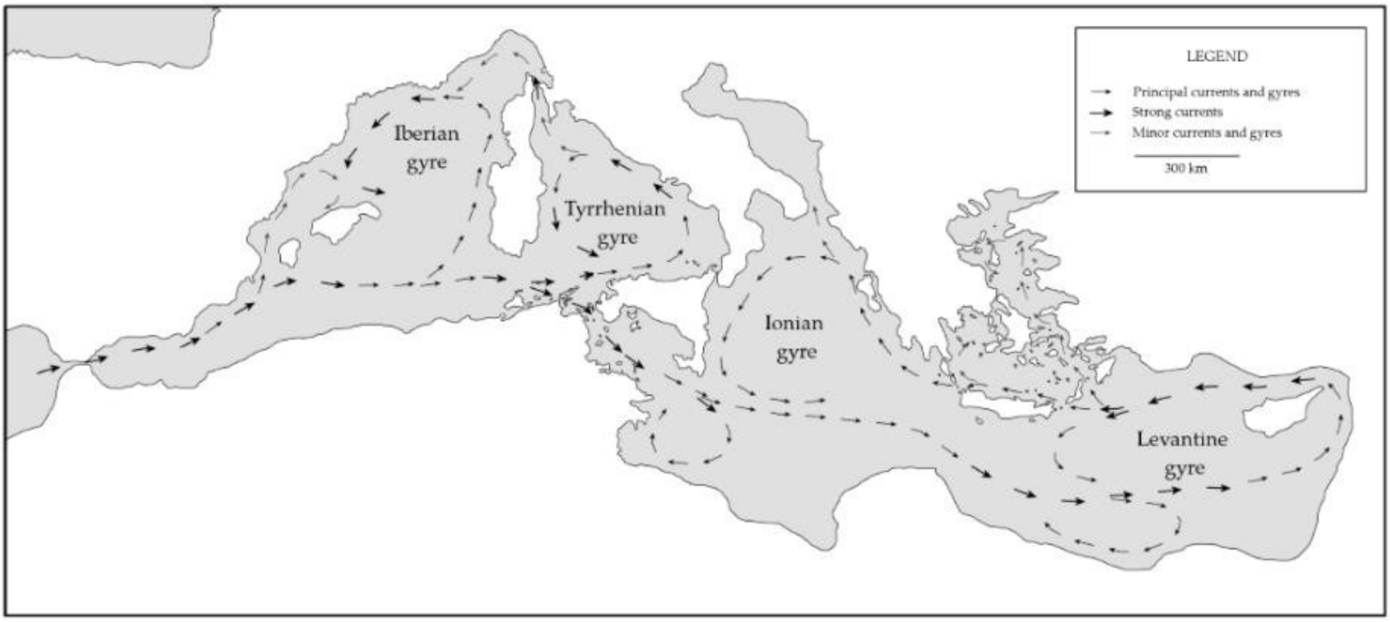


Figure 254: LGM coastal configuration and predicted major currents for the Mediterranean Sea (Phoca-Cosmetatou and Rabett, 2014b, fig. 6.4)

Based on the available reconstructions, a crossing towards Crete at times of low sea-levels would be a little less than 30 km plus another 30 km or less towards Gavdos, with the distances being significantly smaller (up to 1/3) for the time period before 250ka. These seem quite a lot compared to the distances required to be crossed in the Cyclades or at the Ionian Sea. However the earliest uncontested dispersal to Australia (at least at ca. 50ka) required a sea crossing two times larger (ca. 60 km). Of course the particular crossings are associated with our own species, as are the earliest widely accepted crossings to Cyprus.

The latter are dated to the final part of the Pleistocene (ca. 12ka) and the distance to be crossed in this case would be of about 40 km (Ammerman, 2014, 2013a; Simmons, 1999). None of these occurred in a "protected" archipelago, although the time-lapse between them cannot be disregarded, yet nor can the ever-increasing arguments of Pleistocene presence on islands. Arguments for a possible Palaeolithic occupation on the island of Cyprus have been further proposed by Strasser et al. (2016) based on a reexamination of an artefact collected in the course of a survey project conducted back in 1983 (Fox, 1987). However, both the photograph of a "handaxe" published on Antiquity Project Gallery in 2016 as well as the few drawings of artefacts published many decades ago by Vita Finzi are not adequate to support such a hypothesis for the time being since, as the author well portrays it, "they are not demonstrably Palaeolithic" (Vita-Finzi, 1973, p. 453). However, their geological context promped him to publish the material in order for future investigations to explore such a possibility. Up to now there is no convincing evidence to argue for a Palaeolithic (pre-LGM) presence on Cyprus. The possibility, though has to be further investigated since such a fact would unquestionably imply sea-crossings.

To this end, the unique case of Flores needs to be added to the discussion. The presence of archaic hominins on Flores dated to ca. 800ka proves that, albeit the scanty evidence, the successful crossing of straits did occur very early in the history of humankind, notwithstanding in very rare occasions, certainly under favorable conditions and, in this case, most probably "by accidental drifting rather than from purposeful navigation" (Dennell et al., 2014, p. 105).

6.4. Innovations as adaptations

It is common ground that innovation is more directly linked with social rather than anatomical characteristics. Seafaring as an innovative act would have been an extremely complex and demanding task in various levels, from its conception to its enactment. Advance technical skills and knowledge of the means required to cross the sea, as well as familiarity with the environment and the numerous risks involved are essential for a seafaring act to be successful.

6.4.1. Technical prerequisites

A detailed review of the earliest archaeological examples of sea crafts in the demonstrated that the oldest vessels recovered both from the Mediterranean and the Baltic are the simple dugouts (Chapter 2). Apart from the dugouts, hide and basket boats as well as rafts might have other possible vessels that are no longer preservd in the archaeological record (Fischer and Papoulia, 2018). Such boats, made of a light frame covered by hides or fabrics, provide superior control and safety than the simple raft. Both ethnographic (Greenhill and Morrison, 1995) and archaeological (Carter, 2006) examples suggest that organic residues such as bitumen or birch bark tar, and in some cases also clay, were used in order to render the vessel waterproof. Since the Upper Palaeolithic, sewing implements such as bone needles were being used extensively, while spun, dyed, and knotted flax fibres date back to 30ka BP (Kvavadze et al., 2009). Bitumen and tar were used as adhesives for the production of composite tools since the Middle Palaeolithic (Wragg-Sykes, 2015), whereas stone tools suitable for wood and hide working were produced by the genus *Homo* since the earliest of times. Strictly from a technical perspective, the construction of a dugout or a hide vessel could be achieved by any hominin species occupying the NE Mediterranean during the Late Pleistocene, i.e. *Homo sapiens, Homo neanderthalensis* or *Homo heidelbergensis*. Yet unfortunately only via proxies are we able to hypothesise how likely it may have been for any of these groups to produce such an idea, have the motivation, and make the effort to attempt a sea-crossing.

6.4.2. Cognitive and social prerequisites

Apart from the technical skills required, strong social bonds, communication and exchange of ideas between individuals are essential prerequisites for such kind of projects (Farr, 2006). The fundamental question is whether early hominins were capable of coming up with such an innovative idea, of organising and successfully performing such a technically, cognitively and socially demanding task. Sufficient archaeological evidence has now been available to prove that, especially late Neanderthals were capable of abstract reasoning, innovative thinking, multitasking, cooperation, planning ahead and constructing complex technological means in order to survive. Although we most probably will never be sure whether Neanderthals possessed language (even if we agree on what language *is*), they must have been able to verbally communicate, even without proper syntax (Wynn and

Coolidge, 2011). And, while “language has proven to be a particularly intractable topic for archaeologists” (Wynn, 2009, p. 9545), other aspects that can be traced in the archaeological record are eligible to provide clues on the technical, cognitive and social capacities of Palaeolithic individuals and groups. Hafting is an activity with complex cognitive prerequisites that can easily be observed in the archaeological record since the Middle Pleistocene. The procedures required for the production of the hafts cannot but imply multitasking and abstract thought (Wadley et al., 2009; Wynn, 2009, fig. 7). Although the use of wooden spears is an innovation attributed to *Homo heidelbergensis*, the production of a composite tool consisting of a wooden shaft and a stone tip, which can easily be replaced when broken, is most probably a Neanderthal innovation and a very successful one. While cooperative hunting and meat-sharing existed since the Lower Palaeolithic (e.g. Stiner et al., 2009), late Neanderthals in France were technically and cognitively capable not only of planning their hunt but also of storing surplus for future needs (Rendu et al., 2012). At the same time, in certain palaeoenvironments, a varied subsistence existing since approximately 250ka has been attested by a broad-based diet including the consumption of fish and starchy plants by Neanderthal groups (Hardy, 2010; Hardy et al., 2013; Hardy and Moncel, 2011).

As far as the Greek record in concerned, lithic evidence from Epirotic sites in NW Greece also suggests that Neanderthal individuals apart from being efficient tool-makers, they were also sophisticated hunters, and had profound knowledge of their environment as well as their preys' behavior (Papoulia, 2018a; Papoulia, 2011). Although they seemed to have preferred coastal/lowland environments, certain individuals and groups were either attracted or forced to and capable of adapting to upland regions of the Pindus mountains of northern Greece (Efstratiou et al., 2011, 2006; Galanidou and Efstratiou, 2014). Furthermore, evidence from the southern Peloponnese suggests that they made use of marine shells as blanks for tools (i.e. scrapers) as a response to poor lithic raw materials (Douka and Spinapolice, 2012).

On social grounds, the controlled use of fire and the subsequent communal gatherings would allow for the transmission of knowledge and interchange of new ideas. High-risk activities, such as hunting large mammals or evading predators and natural hazards, require sufficient communication skills and a certain degree of vigilance to avoid detrimental outcomes – characteristics potentially useful for undertaking sea-crossings. They may not, however, have been sufficient for the strategic organisation and successful implementation of a sea voyage.

A great array of evidence from Eurasia are now challenging traditional notions of “behavioural modernity” as a uniquely Modern Human characteristic have lately been challenged by various cases in Europe. To mention just a few examples, Late Neanderthals in Gibraltar used pigments in order to transform a surface, possibly also to transform their own bodies by colour tattoos. Personal ornamentation such as perforated marine shells coming from the Iberian peninsula and dated to approximately 50ka have been used as a proxy for symbolic expression (Zilhão et al., 2010). Bird feathers might have also been used for personal ornamentation and perhaps also for the negotiation of personal and/or social identity (Finlayson et al., 2012). Lastly, it is now widely accepted that some Neanderthal individuals intentionally buried certain of their dead (Pettitt, 2011 and references therein). Whether these burial practices incorporate “symbolic” expression or not is of minor importance here, although a rudimentary “aesthetic” aspect in the negotiation of the individual’s identity within such a multisensory arena may be proposed (Papoulia, 2012). According to Gamble (2011, 2007), Neanderthal societies were based predominantly on “instrument dominated” rather than “container dominated” technology. The idea of constructing a “container” for the body of the deceased is an innovation not commonly found in the early Palaeolithic record and perhaps not far from the idea of the construction of other containers for the body such as a “home” or a “boat”. From the data at hand, it appears that certain Neanderthal individuals or groups had acted in a more innovative –or “revolutionary”– way, some snapshots of which we are seldom allowed to witness in the Palaeolithic record (Papoulia, 2017). On top of that, the recent claims for Neanderthal “artistic" expression (Hoffmann et al., 2018; Rodríguez-Vidal et al., 2014) have raised even more questions as to the degree of “modernity” that the particular species may have achieved, and shortened the distance between *them* and *us*.

6.4.3. Ready-made artefacts and natural rafts

Even though technological progress was a key element for the development of seafaring, the lack of advanced sea vessels is not always a deterrent for crossing the sea. It has been proved that any object able to float can potentially serve as a flotation aid (McGrail, 2010;

Ruxton and Wilkinson, 2012); hence it becomes an artefact. Today, there are several reported cases where due to natural disasters animals and people were transported by means of natural rafts, i.e. tree logs, vegetal bulks, or plastic and other floating anthropogenic debris. Indicative and particularly revealing is the longest transoceanic dispersal of hundreds of living coastal marine species who survived for 6 years on nonbiodegradable objects that travelled by rafting thousands of kilometres across the Pacific Ocean to the shores of North America and Hawaii due to the 2011 East Japan tsunami (Carlton et al., 2017). More pertinent to our study are several examples of tsunami and hurricane men and women survivors, including a pregnant woman surviving on floating vegetation for seven days drifting 100km offshore after the December 2002 Indonesian tsunami, and five men drifting 2400km over 70 days surviving on floating coconuts, flying fish and rainwater (Ruxton and Wilkinson, 2012). According to computer stimulations in demography, a group of four or five people of both sexes comprise a viable unit for the development of a self-sustained population in areas with often mild conditions such as the Pacific (Irwin, 1990).

Although it is clear that simple boats as well as rafts can carry people, objects and animals, the use of such vessels is dependent on water temperature and wind conditions (McGrail, 2010), and thus they may have been used for short voyages and only under favourable weather conditions. Given the availability of suitable trees, hollowed-out tree trunks, *i.e.* simple dugouts, were probably an innovation developed independently in different parts of the world, as were a number of other innovations such as the production of stone tools, the controlled use of fire and the utilisation of natural materials as “ready-made” artefacts (Papoulia, 2016). Such innovations may as well be interpreted as part of their adaptive resonse to natural and/or anthropogenic stress. In other words, it is proposed that, if the initial crossings are perceived as *ad hoc* responses to natural hazards or external threats, then any kind of expedient vessel may be interpreted as an artefact, a tool used as part of a subsistence strategy. With this in mind it is possible to envisage that species other than our own witnessed some of the earliest serendipitous sea-crossings, which would then gradually have given way to more organised voyages.

In theory, Neanderthals seem that had most –if not all– of the cognitive prerequisites for coming up with such an innovative idea and, most probably, the technical capacity for constructing some kind of sea-crossing means. Did they have the will, though, and were they successful? Both the geological and archaeological evidence at hand, as described in Chapters 4 and 5, support the assumption that they most probably *did* successfully cross the Inner Ionian Sea Archipelago in order to reach the islands of Arkoudi, Atokos, Kefalonia and Zakynthos. Where these initial crossings, as implied by the limited amount of evidence available, intentional or not?

The eastern Mediterranean is a geographic area prone to earthquakes and tsunamis (Salamon et al. 2007). Earthquakes and tsunamis have often been regarded as catastrophic for past civilizations, yet they may also become triggers for diverse adaptations. [46] According to Morhange et al. (2014, p. 34) "seismic activity is strongly linked to these[47] tectonic features, and because earthquakes often generate tsunamis, it is logical that the distribution of palaeo-tsunami sources mimics the seismotectonic trend" (Figure 255). Thus, in view of the tectonic history of the central Ionian Sea it is valid to consider the possibility that such natural phenomena may have indeed caused chance dispersals during the Pleistocene. Obviously, the amount of surviving individuals in the course of such extreme phenomena would be minimal (if any) but taking into account the very broad temporal range and the short distances between the Pleistocene shores at the Inner Ionian Archipelago, it is not improbable that certain individuals managed to cross the sea via natural rafts. Any such limited yet successful chance dispersal could potentially instigate deliberate, organized crossings that would involve the construction of watercraft and a very specific plan, for which the Neanderthals seem to have been capable of (Papoulia, 2017, 2016).

[46]Morhange et al. (2014, p. 45) conclude: "*Despite the popular paradigm, which directly associates natural catastrophes with past human disasters (e.g. climate aridification and the collapse of civilizations) (Weiss - Bradley 2001), closer examination of speculated palaeotsunamis often reveals a different story. It illustrates the complex nature of the relationship between coastal societies and high-energy processes and suggests that catastrophes may sometimes act as a stimulus rather than a hindrance to cultural development (Morhange and Marriner 2010; Stefanakis 2010; Leroy 2013).*"

[47] Referring to the Hellenic and Cyprus arcs subduction system.

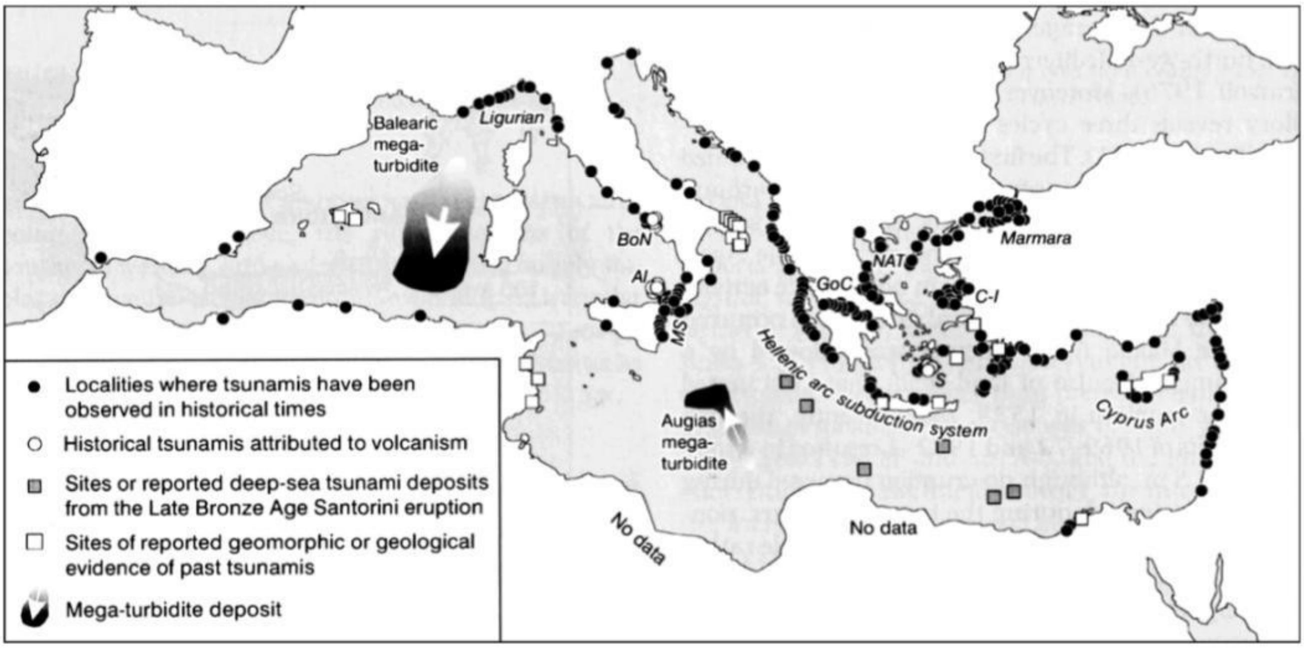


Figure 255: Tsunami activity and plate tectonics in the Mediterranean Sea (Morhange et al., 2014, fig. 1)

For the *Homo erectus* arrival on the Indonesian islands, Ruxton and Wilkinson (2012, 510) conclude that:

> *"It is important to distinguish between highly improbable and impossible events. If* H. erectus *lacked the required social and technological sophistication to build substantial watercraft, then deliberate seafaring by them would not have been highly improbable but impossible, while accidental arrival on an island would be merely improbable (for any particular island in any particular year). But given the large number of islands, tsunamis and river flood events, such colonisation might be quite likely to happen to at least some islands over a time period of archaeological interest."*

As for the pre-modern humans in the Mediterranean, the evidence is generally scarce and debated. However, the re-evaluation of the already published material from the Ionian islands of Kefalonia and Zakynthos (Chapter 5), together with the new unpublished material from the smaller islands of Atokos and Arkoudi, Inner Ionian Sea Archipelago (Chapter 4) suggest that small-scale sea-crossings (of at least 5km) must have taken place in the area during the Middle Palaeolithic, a period so far exclusively associated with the Neanderthals in the particular region. The indices of cognitive complexity and innovation as discussed above imply that the Neanderthals were probably capable of coming up with the idea, producing an adequate watercraft, planning the trip and taking the risk of attempting such a crossing. The archaeological and palaeoanthropological record from the Aegean Basin does not allow for a similar hypothesis for other pre-modern human species such as *Homo heidelbergensis* or *Homo erectus*. This, however, remains an open question for future investigations to answer. In the second chapter it became clear that "intentionality and serendipity may both produce evidence of marine crossings, albeit by inscribing different marks in the archaeological record" (p. 103). A "colonisation" by all three species is not supported by the available data, not for the Aegean nor for any island of the Mediterranean Sea. Furthermore, "seafaring" as an organised, recurrent activity that presupposes adequate watercraft, is not an accurate term to describe the activity implied by the archaeological evidence from the islands of the Pleistocene NE Mediterranean. On the other hand, the evidence may support the hypotheses of chance dispersals or intentional crossings by few Neanderthal individuals, perhaps due to natural or anthropogenic stress. Also, as discussed earlier, it might also be valid to consider the possibility that lithic assemblages with Middle Palaeolithic affinities from the Aegean and Ionian islands may not be a result of the Neandertals, but of modern humans, as is often the case with several sites of the SE Mediterranean coasts; yet at present this can only remain a speculation worth to be further scrutinised by future investigations. That being said, we need to also bear in mind that the fact that any interpretation of pre-modern human evidence for sea-crossing as a serendipitous, unintentional act is much more likely to be widely accepted as true may have also something to say about our own epistemological bias.

6.5. Future research considerations and prospects

In terms of marine crossings, it is increasingly appreciated that their prehistory goes much further back in time than was previously thought. Interdisciplinary investigations on the islands and the available geoarchaeological record have made clear that not all present day islands were indeed islands in the past. The insular character of each and every island needs to be investigated with the aid of meticulous palaeogeographic reconstructions, based on detailed geological studies that take into account the local tectonic history inter alia. Furthermore, it is evident that the discovery of direct evidence of the earliest Pleistocene sea-crossings in the Aegean is highly unlikely. This can be better appreciated when we consider the evidence from the Holocene record. Even though seafaring formed an integral part of both Mesolithic and Neolithic lifestyles, only two cases of archaeological vessels have been recorded from the entire Mediterranean region and both date no earlier than the Neolithic (see Chapter 2). It is important to acknowledge that while the maritime character of late Prehistoric societies (Neolithic and Bronze Age) can be studied in a considerable amount of detail, and corroborated by a small amount of direct and much indirect evidence for seafaring activities such as fishing, trading, or colonization, there is still a high degree of uncertainty regarding the oldest sea-crossings. Although we may assume that the technological capacity for constructing simple vessels, such as dugouts, hide vessels and reed-bundle rafts, was present at least since the Middle Palaeolithic (see Chapter 6.4), a number of questions remain to be answered by future geoarchaeological investigations. This is because the controversy regarding the interpretation of the available indirect evidence for the pre-LGM marine crossings lies at the heart of the issue regarding the intentionality of the crossings, if not the feasibility of the crossings themselves. It is highly likely that events such as sea-crossings made by a very small number of individuals have left only minor if *any* archaeological evidence at all. Thus in order to resolve this issue, meticulous investigation at sites where stratigraphic sequences permit absolute dating of the archaeological context is required.

Furthermore, it is possible that evidence for the occupation of the Pleistocene Aegean coasts remains hidden at depths well below current sea level (Papoulia, 2013; Sakellariou and Galanidou, 2016; Tourloukis, 2010). Thus the submerged palaeo-landscapes between the islands and the Eurasian mainland can no longer be neglected, since these were either the coastal parts of the present-day islands or the connecting terrestrial bridges between the landmasses. Therefore, it is clear that future surveys seeking to answer questions regarding the earliest attempts of hominins to confront and navigate the sea need to be pursued in the sea (Fischer and Papoulia, 2018; Papoulia, 2016, 2013). Although such projects will prove to be particularly demanding in terms of practical and financial aspects, new techniques are now available "providing the momentum for a rapidly expanding field of investigation" (Bailey and Flemming, 2008, p. 2153).

In the eastern part of the Mediterranean, pioneering underwater investigations aiming particularly at the exploration of the early prehistory of Cyprus have already started at the Late Pleistocene sites of Aspros and Nissi Beach off the southwest coasts of the island (Ammerman, 2013b; Ammerman et al., 2011). In the Central Mediterranean, the potential of the Istrian and Dalmatian coasts of the northeastern Adriatic, especially the Zadar archipelago, has been outlined (Benjamin et al., 2011a) and in some cases also proved by underwater investigations, which identified Pleistocene artefacts a few metres off the Croatian coasts. Kaštel Štafilić is one of the sites, which only recently drew the attention towards the Pleistocene submerged archaeology of the region due to Middle Palaeolithic artefacts found below the sea-level, at a depth of 3.5m (Karavanić et al., 2014, 2009). A number of archaeological and palaeontological studies from Pleistocene Croatian sites (e.g. Miracle et al., 2010 and references therein) provide the context for such research objectives.

On the other hand, the first documented palaeolithic artefact from the Greek continental shelf was discovered back in the 1980s in the Ionian Sea, about 200m away from the shores of Kerkyra (Flemming, 1985). However, since then, the totality of the proclaimed lithic artefacts recovered from underwater surveys dates to the Neolithic or later stages of prehistory. Nonetheless, it certainly will not be long before much more lithic artefacts will be recorded from underwater sites or spots, either lying on eroded surfaces or embedded in sediments.

In conclusion, future investigations that will aim at providing a combination of an unequivocal temporal context for the archaeological finds, corroborated by detailed regional sea level reconstructions, will be able to test the Pleistocene seaward or terrestrial dispersal hypothesis. In most cases, a combined on-shore and off-shore investigation is anticipated in order to reconstruct past behaviours within the (today submerged) landscapes. A “common grammar” in the analysis and evaluation of lithic collections that come from the islands but also from the mainland will certainly prove to be a useful step towards a better understanding of the different Pleistocene “cultures” that have left their marks in the Aegean Basin. Finally, a disentanglement from the “Modern Human superiority complex” (*sensu* Villa and Roebroeks, 2014), especially in view of the recent genetic evidence for interbreeding is more that essential for any researcher trying to better understand the *other*, be it a Neanderthal, an early Modern Human or a species yet to be defined.

APPENDIX I: References for Graph 1

Year	Total N	Publication details
1960	0	-
1961	0	-
1962	1	Marinatos, 1962
1963	1	Ankel, 1963
1964	0	-
1965	0	-
1966	0	-
1967	0	-
1968	0	-
1969	1	Sordinas, 1969
1970	5	Ankel, 1970; Schüle, 1970; Sordinas, 1970a, 1970b; Theocharis, 1970
1971	1	Theocharis, 1971
1972	0	-
1973	0	-
1974	0	-
1975	0	-
1976	2	Cubuk, 1976a, 1976b
1977	1	Evans, 1977
1978	0	-
1979	1	Perlès, 1979
1980	0	-
1981	1	Cherry, 1981
1982	0	-
1983	1	Sordinas, 1983
1984	1	Kavvadias, 1984
1985	0	-
1986	1	Sarantea-Micha, 1986
1987	1	Perlès, 1987
1988	1	Simmons, 1988
1989	0	-
1990	2	Cherry, 1990; Renfrew and Aspinall, 1990
1991	0	-
1992	0	-
1993	2	Kourtessi-Philippakis, 1993; Schüle, 1993
1994	1	Dousougli and Zachos, 1994
1995	1	Tzalas, 1995
1996	2	Kourtessi-Philippakis and Sorel, 1996, Lambeck, 1996
1997	0	-
1998	1	Flemming, 1998
1999	3	Dousougli, 1999; Kourtessi-Philippakis, 1999; Simmons, 1999
2000	2	Papagianni, 2000; Broodbank, 2000
2001	2	Chelidonio, 2001; Panagopoulou et al., 2001
2002	1	Foss, 2002a and 2002b (counted as one)
2003	1	Zachos and Dousougli, 2003
2004	0	-
2005	1	Lambeck and Purcell, 2005
2006	1	Broodbank, 2006
2007	0	-
2008	2	Mortensen, 2008; Rackhman, 2008
2009	3	Kapsimalis et al., 2009; Kopaka and Matzanas, 2009; Lykousis, 2009
2010	4	Ammerman, 2010; Knapp, 2010; Strasser et al., 2010; Tourloukis, 2010
2011	6	Ammerman et al., 2011; Kopaka and Matzanas, 2011; Laskaris et al., 2011; Phoca-Cosmetatou, 2011; Simmons, 2011; Strasser et al., 2011
2012	2	Ferentinos et al., 2012; Tourloukis and Karkanas, 2012
2013	11	Ammerman, 2013a, 2013b; Broodbank, 2013; Dawson, 2013; Efstratiou et al., 2013; Galanidou et al., 2013; Knapp, 2013; Papoulia, 2013; Simmons, 2013; van Wijngaarden et al., 2013; Vigne, 2013
2014	17	Ammerman, 2014; Broodbank, 2014; Carter et al., 2014; Efstratiou et al., 2014; Ferentinos et al., 2014; Flemming et al., 2014; Galanidou, 2014a, 2014b, 2014c; Kaczanowska and Kozlowski, 2014; Leppard, 2014; Papoulia, 2014; Phoca-Cosmetatou and Rabett, 2014a, 2014b; Runnels, 2014; Runnels et al., 2014a, 2014b
Total	**84**	

APPENDIX II: The obsidian assemblage from Arkoudi

Introduction

A total of 15 obsidian artefacts were collected from squares 6021, 6027 and 6031 of Arkoudi North site. These three squares are situated at the northeast part of the site and very close to each other. All artefacts exhibit some sort of surface alterations (brownish patina) due to the red soil within which they were deposited. The different degrees of patination upon the same specimen indicate that some of the artefacts were re-cycled and re-utilized by consecutive artisans who visited the site. One more obsidian artefact was collected from square 6052 of Arkoudi South site.

Cultural and chronological attributions

Based on the technological characteristics of the obsidian finds from Arkoudi a Holocene age can clearly be proposed. The pressure blades and bladelets are manifestations of a technique used in the Aegean not before the end of the Neolithic, and are usually part of Bronze Age toolkits. The transportation of obsidian artefacts to the southern Ionian Islands during the Bronze Age is a fact supported by investigations on the bigger islands of Kefalonia and Zakynthos.

Raw material characteristics – Obsidian procurement network

Obsidian raw material sources in the NE Mediterranean are limited in a few sites in the Aegean, all on islands, i.e. Milos, Antiparos and Yali (Laskaris et al. 2011; Sampson et al. 2010; Kaczanowska & Kozlowski 2008; Sampson et al. 2012). Obsidian sources are also found on islands of the Central Mediterranean, i.e. Sardinia, Palmarola, Lipari and Pantelleria (Figure IIa). Yet these are rarely transported to the Aegean region. On the other hand, few instances of transportation of obsidian specimens from the Cappadocian and the Carpathian sources are manifested in the later prehistoric periods.

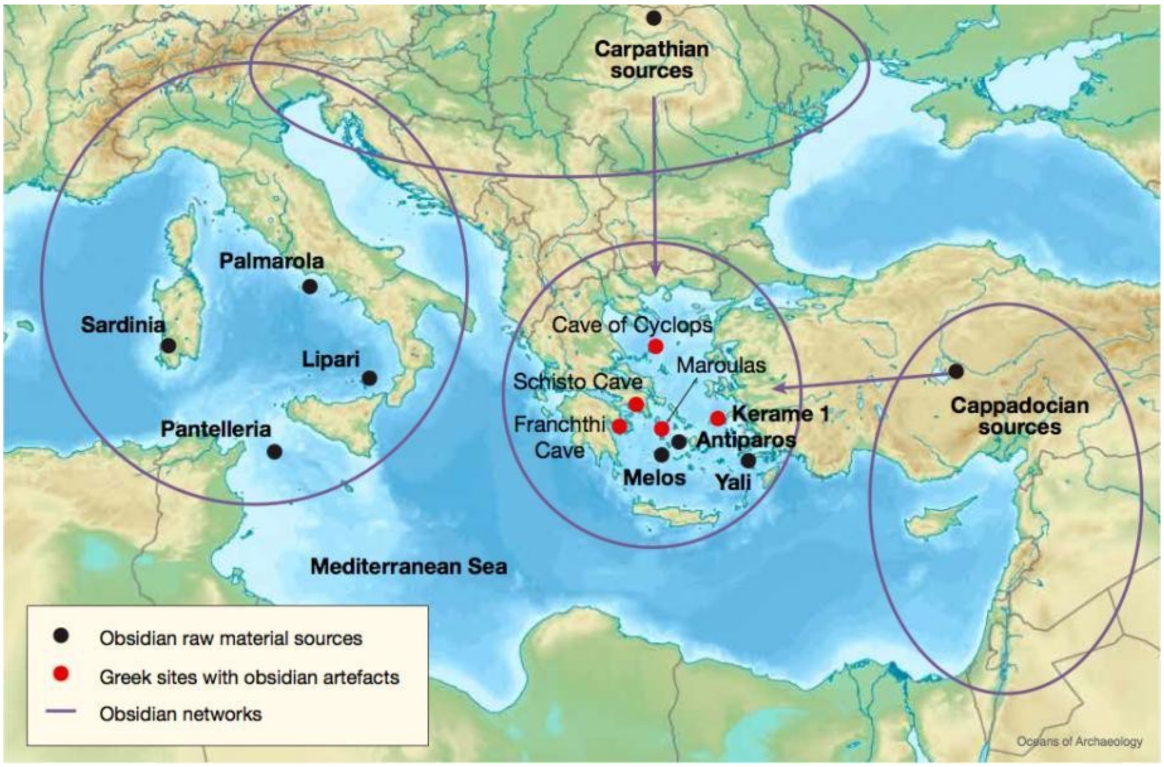


Figure **II**a: Obsidian raw material sources and networks in the Central and Eastern Mediterranean. Red circles indicate the Aegean sites with the oldest dated evidence of obsidian procurement networks: Franchthi Cave & Schisto Cave (Late Upper Palaeolithic), Cave of Cyclops, Maroulas and Kerame 1 (Mesolithic) (Papoulia, 2018b, fig.2).

Although, macroscopically it is difficult to extract rigorous inferences regarding its procurement, some sources have to be excluded. Obsidian from Yali is characterised by the presence of white spherulites of a radiate fibrous structure, yet these are absent from the IISA specimens. On the contrary, all artefacts are of a typical black colour, which occasionally exhibit colourless transparent lines. Obsidian from Milos, being translucent, hard and brittle, it usually travelled to other islands of the Aegean and less frequently to NW Greece and the Ionian islands, yet not before c. 14,000BP (Laskaris et al. 2011). Another island with obsidian raw material sources of similar characteristics is Antiparos, yet the very small size of the nodules has probably been the reason for its limited use beyond the local communities. Macroscopically it is impossible to further define the provenance of the IIAS obsidian specimens. The possibility for a trans-Adriatic procurement network cannot be excluded; however, among the obsidian surface finds from Arkoudi, there is no macroscopic feature that could support such a hypothesis.

Catalogue of finds

6021/1: mesial part of a pressure bladelet with a lower face languette (15x7x2mm)

6021/2: distal part of a bladelet (14x9x3mm)

6021/3: mesial part of a pressure bladelet (13x10x2mm)

6021/4: proximal part of a bladelet with a flat platform (16x11x3mm)

6021/5: mesial part of a blade (18x14x4mm)

6021/6: mesial part of a blade (14x17x2mm)

6021/7: proximal part of a flake with a facetted platform and lip (14x16x4mm)

6021/8: proximal part of a bladelet with a linear platform (23x10x8mm)

6021/9: proximal part of a flake with a flat platform, preserving less than 5% of its cortex (11x7x6mm)

6021/10: partially retouched blade by means of direct, bilateral, long retouched of a notched delineation and a semi-abrupt angle (34x13x7mm).

6021/11: splintered piece on a flake with bipolar, bifacial long and covering negative scars (18x14x5mm)

6021/12: notched flake with a punctiform platform, with inverse, short retouch on its left lateral and partial backing on its right lateral part (24x23x6mm).

6027/44: mesial part of a blade (23x12x4mm)

6027/45: fragment of a mesial part of a blade (7x12x3mm)

6031/6: mesial part of a pressure blade with inverse, bipolar splintering scars (18x13x3mm)

6052/178: mesial part of a bladelet (13x8x4mm)

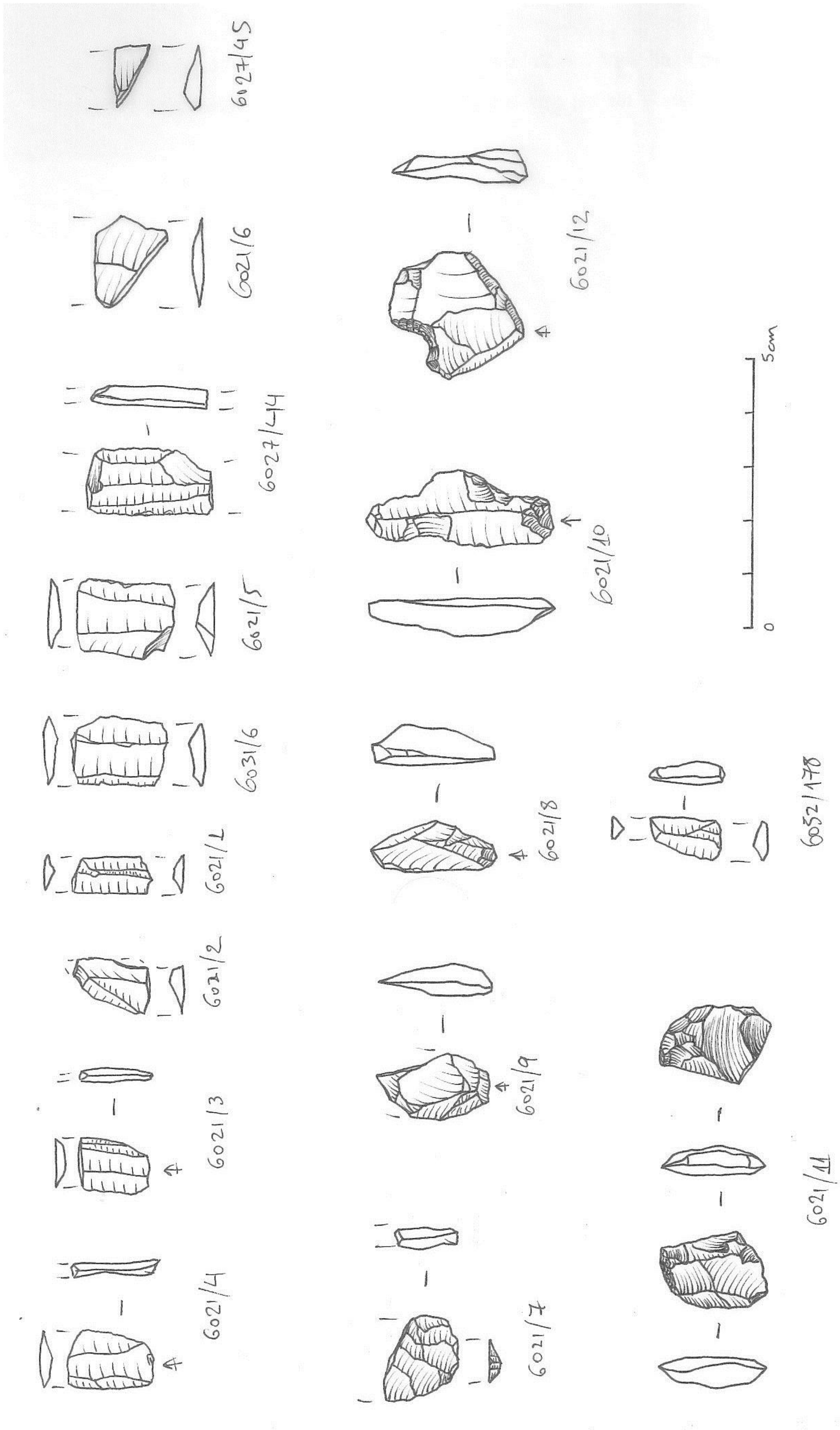
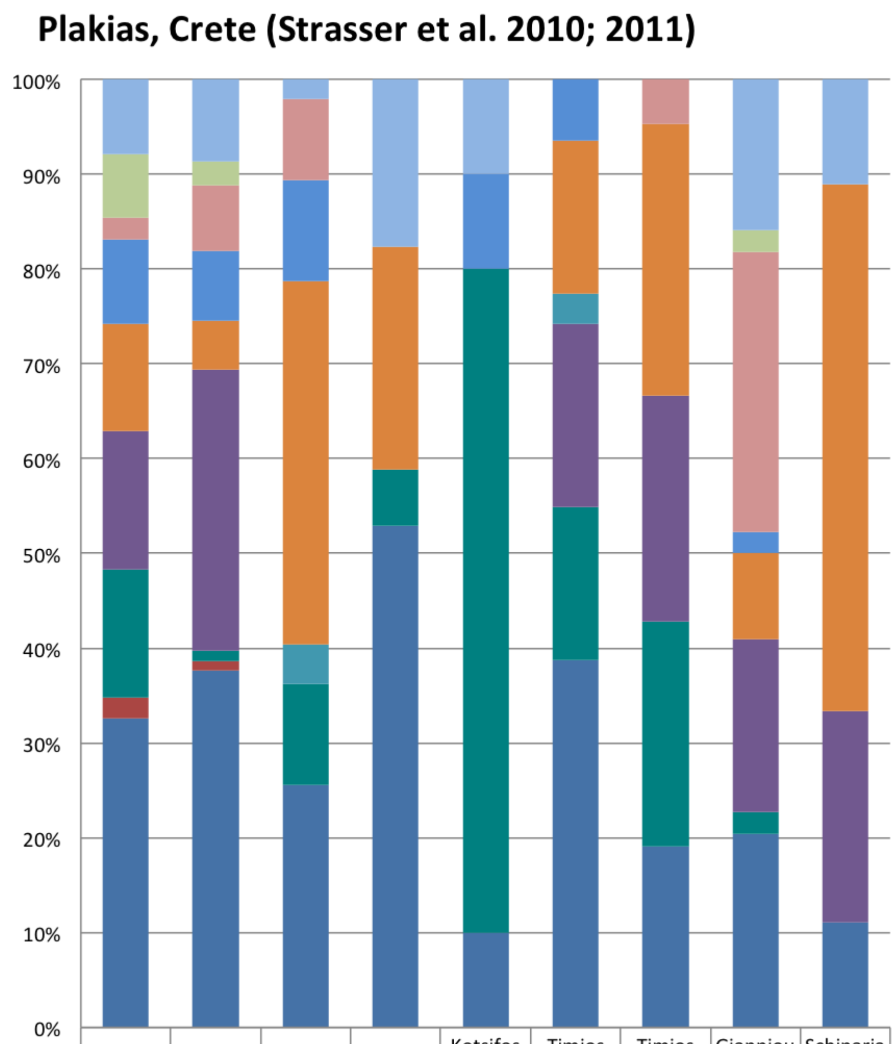


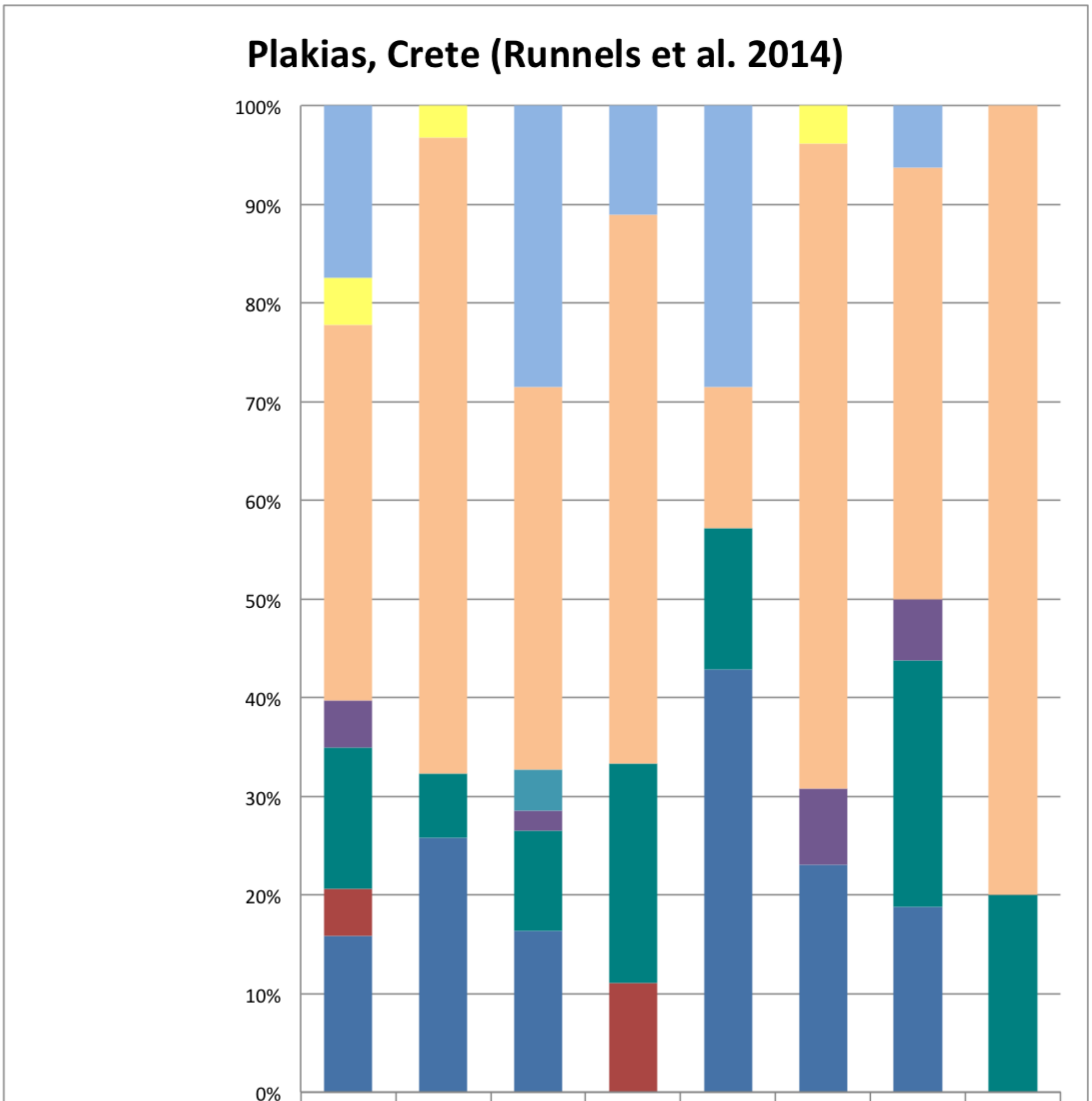
Figure **IIb**: The obsidian artefacs from Arkoudi

APPENDIX III: Stacked column charts with the assemblage structures from the Plakias Survey



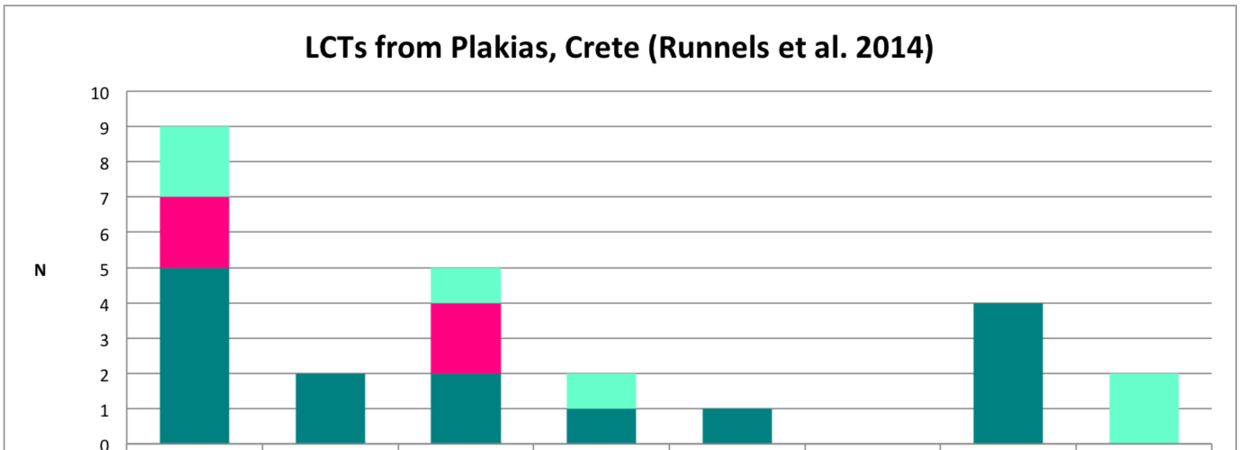
	Preveli 2	Preveli 3	Preveli 7	Preveli 8	Kotsifos 1	Timios Stavros 1	Timios Stavros 4	Gianniou 1	Schinaria 5
miscellaneous/other	7	25	1	3	1	0	0	7	1
points	6	7	0	0	0	0	0	1	0
spines/truncations	2	20	4	0	0	0	1	13	0
notches/denticulates	8	21	5	0	1	2	0	1	0
scrapers	10	15	18	4	0	5	6	4	5
blades	0	0	2	0	0	1	0	0	0
flakes	13	85	0	0	0	6	5	8	2
bifaces	12	3	5	1	7	5	5	1	0
choppers	2	3	0	0	0	0	0	0	0
cores	29	108	12	9	1	12	4	9	1

Graph III.154: Stacked column chart demonstrating the composition of the Palaeolithic assemblages from the Plakias sites as classified in the first two publications. "Retouched pieces" are included in the "Miscellaneous/other" category. Data inferred from Strasser et al., 2010, p. 163, Table 2; 2011, p. 554, Table 1.



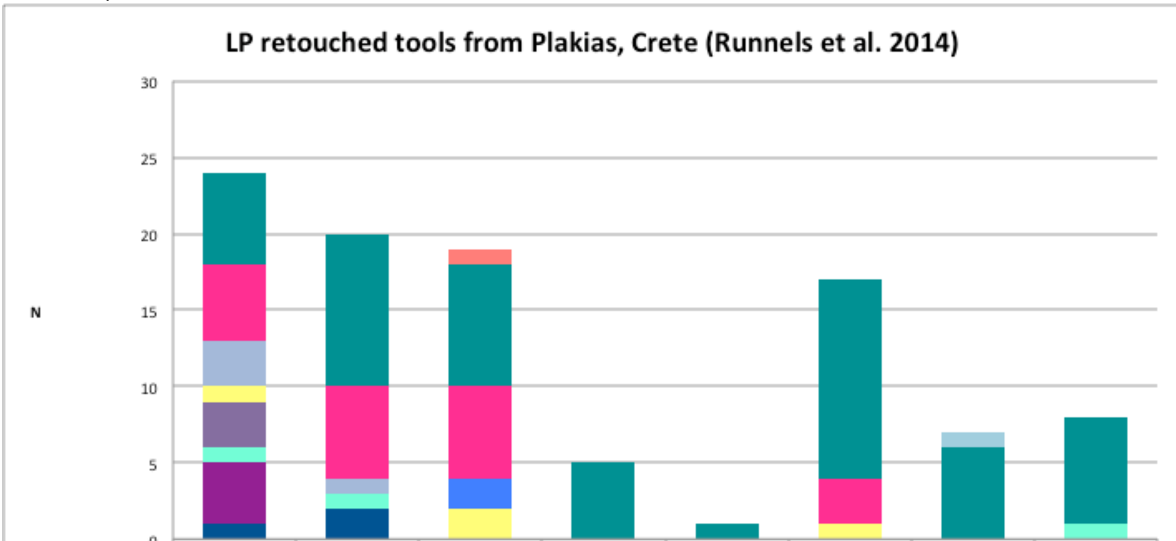
	Preveli 2	Preveli 3	Preveli 7	Preveli 8	Kotsifos 1	Timios Stavros 1	Timios Stavros 4	Gianniou 1
other	11	0	14	1	2	0	1	0
technical pieces	3	1	0	0	0	1	0	0
tools	24	20	19	5	1	17	7	8
blades	0	0	2	0	0	0	0	0
flakes	3	0	1	0	0	2	1	0
LCTs	9	2	5	2	1	0	4	2
choppers / chopping tools	3	0	0	1	0	0	0	0
cores	10	8	8	0	3	6	3	0

Graph III.155: Stacked column chart demonstrating the composition of the Lower Palaeolithic assemblages from the Plakias sites as classified in the 2014 publication. Data inferred from Runnels et al., 2014a, p. 131, Table 1.



	Preveli 2	Preveli 3	Preveli 7	Preveli 8	Kotsifos 1	Timios Stavros 1	Timios Stavros 4	Gianniou 1
pick	2	0	1	1	0	0	0	2
cleaver	2	0	2	0	0	0	0	0
biface	5	2	2	1	1	0	4	0

Graph III.156: Stacked column chart with the frequencies of the different LCT categories from each site of the Plakias survey attributed by Runnels et al. to the Lower Palaeolithic (n=25). Data inferred from Runnels et al., 2014a, p. 135, Table 3.



	Preveli 2	Preveli 3	Preveli 7	Preveli 8	Kotsifos 1	Timios Stavros 1	Timios Stavros 4	Gianniou 1
backed piece	0	0	0	0	0	0	1	0
truncation	0	0	1	0	0	0	0	0
scraper	6	10	8	5	1	13	6	7
retouched piece	5	6	6	0	0	3	0	0
rabot	3	1	0	0	0	0	0	0
notch	0	0	2	0	0	0	0	0
denticulate	1	0	2	0	0	1	0	0
core tool	3	0	0	0	0	0	0	0
burin	1	1	0	0	0	0	0	1
bifacial piece	4	0	0	0	0	0	0	0
bec	1	2	0	0	0	0	0	0

Graph III.157: Stacked column chart with the sites and retouched tools categories from the Plakias survey attributed by Runnels et al. to the Lower Palaeolithic (n=101). Data inferred from Runnels et al. 2014a, p. 141, Table 4.

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