The Distribution Of Obsidian In The Eastern Mediterranean As Indication Of Early Seafaring Practices In The Area

A Thesis
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Acknowledgments

This paper represents the official completion of a circle, I hope successfully, definitely constructively. The writing of a Master Thesis turned out that there is not an easy task at all. Right from the beginning with the effort to find the appropriate topic for your thesis until the completion stage and the time of delivery, you got to manage with multiple issues regarding the integrated presentation of your topic while all the time and until the last minute you are constantly wondering if you handled correctly and whether you should have done this or not to do it the other. So, I hope this Master this to fulfill the requirements of the topic as best as possible.

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INTRODUCTION

Obsidian is a volcanic raw material with a characteristic shiny and usually black colour. Obsidian was used from the early prehistory for the manufacture of sharp and resistant stone implements. One of the main properties of obsidian is that due to its particular chemical configuration leaves a unique "fingerprint", that when obsidian analyzed with the suitable archaeometrical techniques, the source of the raw material and the age can be determined with accuracy. The sources of obsidian in Eastern Mediterranean are very restricted and specific. In this basis, when for example an obsidian tool discovered on an island, which does not have obsidian sources, the only possible way that the raw material could have arrived there is by the sea transport. Thus, the study of obsidian finds in the various archaeological sites of Eastern Mediterranean is one of the most reliable tools that can provide secure evidences for the seafaring and maritime activities during the period of early prehistory. The findings of obsidian in combination with the various archaeometric methods and techniques of analysis as well as the recent developments and data that are relating with seafaring and maritime activities during the Early Prehistory in the area of eastern Mediterranean is the main scope of this paper.

CHAPTER 1

TIMEFRAME AND GEOGRAPHICAL CONTEXTS

The Mediterranean Sea, which is located among three continents, Europe, Africa and Asia, is a very interesting and rich area in many aspects: geomorphologically, culturally and archaeologically. The Mediterranean Sea appeared during the period of Miocene, about 30 million years ago. It was at the end of this period that the formation of Mediterranean Sea started and lasted during the whole period of Pleistocene. The following period, the period of Holocene, the Mediterranean Sea took its current form, with smaller or bigger alterations.

The Eastern part of Mediterranean Sea is an area of exceptional variety regarding geomorphology, climate, ecology, culture, as it is composed of several microenvironments with their own special features, which were more obvious in prehistory than they are today. As for culture, in the Eastern part of the Mediterranean great civilizations were born, flourished and declined and in earlier

eras this area leaded global events, important for the whole humanity, such as the neolithisation in the field of evolution, which took place there. It also played a key role for the dispersal of hominids from Africa in the rest of the world.

The area of the Eastern part of the Mediterranean Sea consists of Greece, Turkey, Syria, Lebanon, Jordan, Israel, Palestine, Egypt and Cyprus and numerous smaller islands and islets, especially in the Aegean Sea. The Aegean Sea has smaller subdivisions: the Thracian Sea, the Myrtoan Sea, the Sea of Crete and the Icarian Sea. Other seas that the Eastern Mediterranean area includes are the Libyan Sea, the Cilician Sea and the Levantine Sea, the easternmost part of the Mediterranean Sea. All these subdivisions of the Eastern Mediterranean have their own special features. The specific geography of each of these subdivisions enriched in total and individually the Mediterranean. Also, it affected and shaped the area and still is, in various aspects. [1]

Divisions of the Stone Age

The division of the Stone Age is based on the type of stone tools and includes Palaeolithic, Mesolithic and Neolithic Age. Each period is divided into other subdivisions and is accompanied with transitions in other cultural aspects, mainly in the Mesolithic and even more in the Neolithic Age.[2]

Palaeolithic

The geomorphology of Eastern Mediterranean was completely different during the period of Pleistocene (2 million years ago – 12. 000 BC). In this period the climate conditions were characterized by alternations of warm and cold periods (Glacial Period- Interglacial Period). It was also then when the human species evolved. The dispersal of hominids from Africa, where the oldest human fossils appeared, is of great importance for science.[3] There are various theories suggesting that the ancestor of modern human (*Homo sapiens sapiens)* is not related to *Homo sapiens neanderthalensis* and that this ancestor has migrated from Africa in 100.000 BC, which is quite recently, considering the age of the planet.

[1] http://cordis.europa.eu/search/index.cfm?fuseaction=result.document&RS_LANG=IT&RS_RCN=11489403
[2] Trigger B., 1989, 114-129. Also, see: http://en.wikipedia.org/wiki/Three-age_system
[3] Bar-Yosef, O., and A. Belfer-Cohen 2001, pp. 19-28.

The geomorphology of the world during Pleistocene was dramatically different.[4] Particularly, in the area of Eastern Mediterranean the sea level was lower, for example in the Aegean Sea the sea level was 120 m lower than it is today. Moreover, the land territory covered larger extent since many islands were united either to each other (like the islands of Cyclades) or to the mainland (like the islands of Sporades).[5]

Culturally, the Palaeolithic Period is represented by different lithic technologies. More specifically, the Lower Palaeolithic stone tools followed the Acheulean tradition. In the Middle Palaeolithic there was mainly the Mousterian technology. Finally the Upper Palaeolithic is dominated mainly by bladelets, made not only from stone but also from bone and antler. [6]

The area of Aegean Archipelago met drastic changes during the period of Late Glacial Period (Wuerm) of Pleistocene, around 13.000/15.0000, when the maximum increase of ice occurred around 18.000 years BP to the begging of the last Interglacial Period of Holocene around 10.000 BP, which continues until today. The changes concerned the climate conditions prevailing in the area, with temperature increase, reconfiguration of the shoreline by cleavage of the mainland in smaller zones and loss of the plains connecting the western coasts with the Italian Peninsula and the Eastern with Asia Minor, the sea level rise as well as diversification in the flora and fauna, with the appearance of new species. In this period the Aegean Sea took more or less its current form.

The Pleistocene is beginning in 1,6 million years and lasted until 10.000 years BP when begins the period of Holocene. The Pleistocene is divided into three phases, based on the various diversification on the flora and fauna of each phase, from which the first is called the Lower and spans from 1,6 million years to 730.000 years BP, The Middle 730.000 to 130.000 years BP and the Upper Pleistocene from 130.000 to 10.000 years BP. In the phase of Upper Pleistocene occurred the activities of Human species of Homo Neanderthals and Homo sapiens, which corresponds to the archaeological period of Middle and Upper Paleolithic respectively.

During the Late Glacial Period (Upper Palaeolithic 30.000-10.000 years BP) in Europe and in Mediterranean occurred cold and dry climatic conditions with

[4] Hughes D. Ph. and Woodward C. J., 2008, pp. 575-588
[5] Lambeck K., 1995, pp.1022 -1044
[6] Anton, S. C. et al, 2004, pp. 271–296.

minimal rainfall. The basic characteristic of this period is of course the ices, which spread from the Atlantic to the Mediterranean, resulting in the reduction of sea level which arises 120 meters below present sea level. This has resulted in the emergence of landmasses in Europe and Asia. This correspondingly resulted in many inland parts be joined to each other. Regarding the vegetation the main characteristic was steppe and decline of forests. These conditions of ice domination and cold climate arrived in the peak around 18.000 years BP when the phenomenon gradually began to recede.

Mesolithic / Epipalaeolithic

The following period of Holocene (Mesolithic 10.000 years BP) began the retreat of these phenomena. The temperature was raised gradually resulting in the ice melting. Ice melting affected drastically the geomorphology of Eurasia. Firstly, areas that were situated at higher levels eroded by the creation –due to the ice melting – of torrents and rivers which carried large amounts of soils that covered the lower areas and secondly the rising of the sea level plunged land sections that connected islands and terrestrial parts. This last, led to the grown up of the distance between the various islands and landmasses, with everything this entails for seafaring and maritime activities.

The impact of climate changes in the area of Aegean Sea varied according to each region, however, the consequences were apparent in the field of economy, where these changes led to the adoption of new ways of exploitation and of a different management of the environment in the period that these changes occurred, the period of Mesolithic.

The geological period of Pleistocene spanned from 1, 6 million years BP to 10.000 years Bp. During Pleistocene Glacial and Interglacial Periods were interchanged. Glacial Periods were characterized by cold and dry climate, where glaciers formed and the sea level was lower while during interglacial periods the climate was warmer and the ice melting resulted in the sea level rise. It should be mentioned that the time scale of such transitions varies from as season up to hundreds or thousands of years.

Medium or short term, these alterations had drastic impacts on all levels affecting the geomorphology of land and seascapes, the composition of plant and

animal world and of course human beings, since altered rapidly and drastically the living conditions and organization.

The alterations of Glacial and Interglacial periods had great impact in Mediterranean Sea level and thus in Mediterranean shoreline. During Glacial Periods the ices resulted in the reduction of sea level and the appearance of pieces of land which during the warmer phases of Interglacial periods were covered by the sea.

According to the scientists, the area of Mediterranean, during the maximum growth of the ices around 18.000years BP, the lower sea level was 120 meters with regional variations of course depending from other factors too, tectonic phenomena occurred in each region. The beginning of the next period of Holocene with the melioration of climate signaled the sea level rise and arrived in 60 meters approximately while around 9.000 years BP arrived in around 20 meters.

Mesolithic covers the Lower and Middle Holocene as well as Neolithic and Bronze Age. During Holocene, which is lasted until today, the climatic condition ameliorated (postglacial period) and the sea level levitated. The amelioration of the climatic conditions had great impact in the cultural aspects.

The transition from the Upper Palaeolitic to the Mesolithic is not occur simultaneously even in same regions. For example in Greece, in the eastern part of the Greek territory occur earlier sites than in the western part of the territory.

During the Mesolithic the economy enriched with other activities mainly relating to the sea, like fishing and navigation not only due to the fishing in the open sea but also for searching raw materials -obsidian- for the manufacture of stone tools. Finally, during the Mesolithic period there are evidences (Franchthi Cave) indicating tendency for installations in a permanent basis. This detection in combination with others factors, puts in a new basis the theories for the transition from hunter-gatherers- fishermen to the agriculture (Neolithic).

Neolithic

Neolithic is the period of time where humanity abandons hunting and gathering and passes in agriculture. Neolithic Revolution, as known the transition from hunter gatherers to the agriculture, accompanied with alterations in all aspects of human culture. The transition to the Neolithic did not happen simultaneously and varied in the various areas.

Neolithisation is an issue of great importance. It is considered as the first time that humans do not just survive but they intervene into their environment so as to succeed better survival conditions. Apart from the food production in Neolithic occurred other developments that signified the transition in a completely new era for the humanity relating to architecture (permanent settlements, storages and emergence of new cult symbols).

The transition first occurs in the Near East, where the earlier sites have been detected that has developed the domestication of plants and animals. The transition first occurred in the area of the Near East, around 9.000 years BP, where the suitable conditions that prevailed in the area favoured the initiation of this process.

The geomorphology during the Neolithic was different from today. Around 11.000 BP is the end of the Glacial Period which continued into the whole Neolithic. This has resulted in the rise of sea level. Land parts divided from the mainland in various areas and became islands or islets.[7]

On the other hand in other regions the sea level was lower than today and the development of coastal settlements favoured.[8]

The climatic conditions were not very different from today. According to palynological analysis climate was characterized by colder and rainier winters. Also, by drier and warmer summers than today. Vegetation, as expected, was also affected by the changes occurred in climate and geomorphology. Forests were not preferred. Humans preferred areas with bushy vegetation because there was easier the new practices and technologies to be developed.

Earlier than 9.000 BP in Near and Middle East were existed the Natufian societies where occurred already some of the new elements of the transition. Archaeological finds indicates that Natufians collected crops in their wild form and it is considered as very possible the fact to cultivate them in their wild form, without alter their morphology. Other significant aspects of the Natufian Cultures are the presence of more permanent settlements including storages. Changes also occurred in the symbolic aspects of their culture.

The domestication of plants is certified by finding carbonized botanical residues, bearing the morphological characteristics of domestication. The first

[7] Hamann et al, 2008, pp. 97 -114. Also see: Weninger B. et *al*, 2009,pp.7-59
[8] Lambeck K., 1996, pp.588 -611

cereals that have ever been domesticated were emmer wheat, monocoque and barley. The first residues have been found in Aswad (Syria), Jericho, Netiv Hgdud (Israel). The domestication of animals is a bit later and appeared in archaeological data during the Pre Pottery Neolithic B.

There are various theories for the beginning of Neolithisation in Near East. The various theories are emphasizing either in ecology and geomorphology or in demic diffusion or in social structure. Neolithic economy spreads in Europe through Greece (around seventh millennium) and then in the rest of the Balkan and in Europe.

There are various theories for the neolithisation of Aegean Sea. According to those the Neolithic introduced in the Aegean from Minor Asia, where there has already been introduced through contacts (cultural diffusion) or through human expansions (demic diffusion) or the transition is indigenous with in situ domestication.[9]

The consequences of the new conditions

During 18.000 BP, when the great peak of the glaciers occurred, many of the present Greek islands were joined with the Greek mainland by the large steppe areas that stretched on the coasts of many regions of the Greek mainland like Euboea and Peloponnese. For example, Corfu in the Ionian Sea was united with the Epirus; the south part of Euboea was united with the land parts of Attica, the central part with Boeotia and the north part with Thessaly. Many of the present Cycladic Islands like Andros, Kea, Naxos etc. in the Aegean Sea were joined together in one terrestrial formation. The islands of Northern Sporades Skopelos, Allonissos and Skiathos were united to Thessaly. In Peloponnese plains were stretched in the south of Argolis, surrounding the upland areas of the mainland. A large plain was extended north of Asia Minor and united its north coast with the islands of Limnos and Thasos, extending as far as the Thermaikos Gulf in the North Greece. Another large plain was extended from the west part of Greece along the Adriatic and connected the south part of Italy with the western coasts of Yugoslavia and reached the Albanian coast.

The shifts of climatic condition signaled the reversal of these conditions that started in around 15.000 years BP and continue through 10.000 years BP, in

[9] Cauvin J, 2004

which the lowlands precipitated out and the islands were gradually separated from the mainland. Until Early Holocene (10.000 years BP) the gradual shift of the shoreline towards the interior resulted in settlements and caves that were previously located in the hinterland to be turned into coastal. For example, the sea level rise led to the separation of the islands of the Saronic Gulf (Dokos, Spetses, Hydra etc.) from the mainland and the precipitation of plains extending from Methana to Attica. This affected the Franchthi Cave which during Palaeolithic was located away from the sea and with these alterations approached the coast.

Parallel changes occurred in other areas of the Aegean Sea and many areas that were lying in the coasts of the mainland were gradually found underwater.

These changes did not affect only the geomorphology of the Aegean but also the flora and the fauna of the area not only the affected areas which either emerged either sunk but also the areas which remained stable. This changing world affected humans of course, influencing decisively the ways of living and the movements of the population.

The dramatic changes that were occurred during the end of Pleistocene in the climate and the landscape affected drastically the way of life of the Palaeolithic hunters-gatherers. The rise of temperature that caused the ice melting and the rise of sea elevation correspondingly resulted in the precipitation of coastal plains and the separation of large peninsula and the formation of smaller islands created primarily a gap and an insecurity regarding the securing of the necessary for the survival natural resources, that these areas used to guarantee and provide. Therefore, this gap was a matter of survival to be replenished.

During the last glacial phase (around 18.000BP), the activities of hunting and gathering were taking place mainly in the extensive lowlands of the coastal areas of the mainland, where there were water resources and wild fruits while herds of wild animals were attracted. The ice melting and the sea level rise occurred in the following phase 13.000 to 10.000 BP) sunk many of these plains and forced the humans to seek new ways of exploitation of the natural resources of their environment.

The strategies that were developed each time varied by location and affected by the special conditions prevailing in each area.

In Epirus for example the hunters after the gradual retreat of the ices, around 16.000 BP and after, explored the mountainous hinterland and exploited

ecosystems which previously because of the prevailing ices were not possible to explore and exploit. They use rock shelters like those that were discovered in Kleidi and Kastritsa as seasonal camps and as bases for the hunting migratory animals. In contrast, based on archaeological finds, their interesting in the collection of fruits was almost nonexistent.

The diverse topography of Thessaly with basic characteristic of the lowlands has resulted so as the hunters-gatherers to use as basis the Theopetra Cave for the exploitation of the surrounding area, which consisting the collection of fruits and the hunting of small animals. Also, based on archaeological finds hunting activities occurred along Pinios River, the most important river in Thessaly and the most basic source of water for humans and animals.

For the area of Peloponnese the majority of the information derived from the site of Franchthi Cave, in Argolis. During the excavations of the cave were unearthed layers, spanning from the last glacial to the period of Neolithic. Around 18.000 years BP, during the last glacial period the sea level in the area was around 120 meters below the present. The present islants of the Saronic Gulf: Dokos, Hydra and Spetses were united to the mainland of Argolis, which has resulted in the emergence of extensive plains, stretching up to the present areas of Methana and Attica. Franchthi Cave was then situated in a distance of around 6 km from the coast. The prehistoric humans used as a basis the Franchthi Cave for hunting wild animals for food and the use of their bones for the tool manufacture, that were living in these plains because of the existence of water resources. The presence of camp sites between the plain of Argolis and the basin of Prosymna like the rock shelters in the gorge of Kleisoura suggest that that hunters used to move in order to expand the zone of exploitation and ensure their food and other supplies. Here there are no indications so far to suggest that humans used to collect fruits from the surrounding area.

The following period with the ice melting and the corresponding sea level rise the islands were separated from the mainland and the plains were gradually sunk. The Franchthi Cave was now closer to the coast. These have resulted in the decrease of the animals that were living in these biotopes and forced the hunters to seek new ways of natural exploitation for the supply of food and other resources. Humans were begun to turn their interest in the collection of fruits and

fishing. In the same time the hunting activities of migratory animals were continued.

The new conditions led the hunters-gatherers in a more extensive exploitation of the natural environment near and around of their caves or camps including fruit collection and fishing various fish species, primarily at least from the coast. During this challenging period seemed that some humans sought for new sources of exploitation, now in the area not of the near and secure mainland but in the unknown and vast sea. The partition of the land on the one hand would make difficult their endeavor because this made the sea distances greater but on the other hand the emergence of numerous of small islands and islets, especially in the area of Aegean Sea would be helpful during a sea voyage. However, in any case for an attempt like this would be necessary an autonomous seaworthy watercraft and great experience and knowledge regarding on the one hand the sea passages and on the other winds, currents, constellations etc. for the travelling in the open sea.

Such a shift which involved a more extensive exploitation of the surrounding micro ecosystems that containing primarily fruits gathering and fishing altered the way of life of hunters, who now restrict their systematic and periodical movements and made more permanent installations in cave-camps, even on a seasonal basis. Also, this turn led to the sea, meaning that led to the exploration of new marine areas, aiming the exploitation of the vital area of these new environments or even the establishment of a settlement, seasonal or not.

The alterations that begun in the period of Pleistocene continued and integrated into the following period of the Mesolithic, spanning from 10.000 to 7.000 years BP. During the Holocene the climatic conditions were warmer and the sea level rise up to 35 meters from the current sea level. In general, the sea level with small changes was stabilized and arrived into its present levels. Also, the period of Holocene the precipitation of plains was completed as well as the dismemberment of the mainland in smaller islands and islets.

Regarding the flora and fauna, the new conditions favored the increasing of forests and arboreal vegetation while the smaller animals prevailed, which they were considered as ideal for hunting like the red deer and wild boar.

The new conditions and the ecosystems that have arisen pushed humans to look for alternative ways of living and seeking for food and other supplies. The

archaeological data that derived from the various archaeological sites suggest that the new activities consisted of fruit collection, (like fruits, wild grains and pulses), hunting of small animals, (like deer, wild boar and wild goat) and fishing. Evidences from coastal sites and caves situated near the shoreline like the Franchthi Cave in Peloponnese and the Cave of Cyclops in the island of Youra in Northern Sporades suggest that the activities of fishing and the collection of marine shells and snails becomes particular important and humans begun to seek new places and spots appropriate for developing their new activities.

During the last Glacial period (around 18.000BP) the sea level was around 120 m below from present sea level. The impacts from this were apparent strongly in the geomorphology of the areas. In Greece for example the low sea level resulted in the revealing of big parts of lands in the coastal sites and the islands. In this period many islands were connected with the mainland. Argolis in Peloponnese was connected to the islands of Spetses, Hydra and Doko. Many of the present Cycladic islands were connected to a big island while the north part of Euboea, Thessaly and the big islands of Northern Sporades: Skiathos, Skopelos and Alonnisos composed a single peninsula. In this basis the discovery of Palaeolithic tools for example in North Sporades does not suggest maritime activity but was the result of human movements for hunting or finding other recourses in these areas by land. However, the discovery of Palaeolithic tools in the islands of Northern Sporades that were not connected to the mainland but they were in a close distance or they were connected by land straits. This indicates maritime activity.

Thus, the hunters of Palaeolithic used to travel and explore areas that were in a short distance between them or they were connected by terrestrial straits. The exploration of these areas was possible through sea passages and was not necessary highly developed means of navigation. In a trip like this, it is assumed that melian obsidian was discovered by the Palaeolithic hunters and transferred by the sea in the Cave of Franchthi. The Cycladic island of Melos would be accessible from Attica through small sea passages, measured 2 to 5 km., through the Cycladic islands of Andros and Siphnos, from which would be visible, during their journey.

However, any movement by the sea, simple or more complex, near or distant requires at least elementary means of navigation perhaps from reeds or tree trunk

and satisfactory knowledge about sea currents, weather and orientation with the help of stars.

The discovery of lithic tools dating in the following period of Mesolithic from stratified sequences of sites that are locating in distant islands or in areas, where the passage of the sea is necessary, it is really impressive. The Mesolithic period the separation of the islands has been completed while the distances between them and between the islands and the mainland have grown, the discovery that human groups used to travel systematically, in a seasonal basis though show that humans had the knowledge and skills, the experience and the appropriate means for attaining such an endeavor: to travel in the open sea.

The purposes for travelling in the open sea could be exploratory, in order to discover other new usable areas for exploitation or to find and supply food and other recourses like obsidian. Or it could be just curiosity for what there is beyond their field of vision.

The visits in Mesolithic sites like the Sidari in Corfu, Franchthi Cave in Argolis, Youra in North Sporades, the site of Maroulas at the island of Kythnos perhaps were organized movements of population from the mainland to the islands and reverse, in order to explore the limits, the potentials and the dynamics of their living space. The excavator of the island of Youra, A. Sampson considers that the human presence in this island was from organized movements of specialized groups, perhaps fishermen who used to visit the fishing spots of northeastern Aegean on a seasonal basis, in order to fish for example tuna when they were passing through the area. These groups probably came from either the mainland or other big islands.

According to other researchers, like C. Runnels these visits and by extension the Mesolithic installations that have been discovered in various sites, is the result of a broader trend of the population of this period for moving and migration from the Near East and the Eastern coasts of the Aegean towards the western Aegean coasts. If this hypothesis proved and the Mesolithic sites of Youra and Kythnos are parts of these movements, then the role of the islands of North Sporades and Cyclades would be extremely important for the communication and contact with the coast of Asia Minor. A possible scenario could be that the seaway with direction from east to the west passed from Youra and perhaps through Limnos and Agios Efstratios.

The site of Franchthi Cave provides evidences that the hunters-gatherers-fishers used to travel during the Mesolithic in order to find raw materials like obsidian for the tool manufacture or to fish in the open sea. The island of Melos was detached from the other Cycladic islands in the Palaeolithic and as s mentioned above the period of Mesolithic the dismemberment of the Cycladic islands has been completed and thus the distances between the islands for the destination of Melos and Franchthi were longer. In this basis, such a trip required further knowledge and skills and organization regarding sea currents, climatic conditions and orientation, comparing to the respective sea ventures of the past.

Archaeological data suggest that there was an immigration wave that looked forward to find new areas for exploitation on the western part of Aegean. The discoveries from the site of Franchthi Cave and Kleisoura in Argolis, dating to the Lower Mesolithic suggest that there was an immigration wave that seek for new areas initially on the southern tip of the Greek mainland while later in the Upper Mesolithic towards the northwest, based on the discoveries of the archaeological sites in the Sidari of Corfu and open sites in the area of Preveza in Epirus. The similarities in the techniques of the lithic industries that have been found in the island of Youra in Northern Sporades with those derived from the southwest Asia Minor indicate close contacts and communication between the two parts of Aegean Sea. These populations visited some Palaeolithic sites like Theopetra and Franchthi that Paleolithic hunters- gatherers used to use. However, the gaps in habitation that have been traced in the stratigraphy between the two periods, for example in Franchthi 300-600 years, suggest that these populations they were not connected with the previous users of these sites. They were probably new groups of people that reused and re-exploited these same sites in order to ensure their food with the collection of fruits, fishing and hunting of small animals.

The hypothesis of migration of new populations during the Mesolithic is derived from the theories that support the allogeneic origin of the the productive economy (the domestication of plants and animals, agriculture, permanent settlement) in Greece and by extension the lack of any relation or relevance with the period of Mesolithic. The main argument of this theory is on the one hand the scarce and discontinuous distribution of the Greek Mesolithic sites, where many areas remained uninhabited, a fact that indicates that there is rapture with the previous period of Palaeolithic rather than continuity. On the other hand in the various

Mesolithic sites there are no evidences of continuous occupation or domestication of wild plants and animals, a fact that suggest a rapture with the following period of the Neolithic.

The radical changes in the climate and the geomorphology of the landscape occurred in the transition from the Pleistocene to Holocene brought significant changes in the sense not only of the alterations in the geographic space that humans used to live and move but also regarding the social aspect of the space that people used to move, live and interact. These changes concerned the way that people were perceived and organized into their world. The old sites like caves and rock shelters around which the various activities of Palaeolithic hunters were organized could not respond anymore to the new needs and data and humans sought for new landscapes that could respond to the new circumstances and could cover their needs in food and other supplies.

The remote groups of hunters-gatherers used to use caves and rock shelters as their base during the exploration of an often unknown and unfamiliar for them world. Evidences from the Palaeolithic Epirus show that the use of caves and rock shelters could be worked either as strategic points for the monitoring and control inaccessible mountain areas, so as to be possible the optimal exploitation of the resources of an area, like the Kleidi rock shelter or the cave of Kastritsa or could work as key points for the contact of different ecosystems, like the rock shelter Boila. Thus, caves and rock shelters were of great importance for the Palaeolithic hunters-gatherers and a familiar reference point in a changing world.

Hunters-gatherers used to move seasonally in big distances for hunting, taking advantage of the vast coastal plains or the mountainous volumes. The changes that occurred to this period the space that hunters used to search for their food reduced and they lost the sense of familiar with their surrounding space. Now they had to seek the necessary goods in smaller ecological zones and ecosystems that were located in the immediate vicinity of their each seasonal base. In the same time the restriction of their vital space in combination with the partition of the numerous islands in the Aegean Sea mainly, pushed them to seek for new alternatives ways of life in alternative ecosystems and ecological zones. This led them not only to the fishing in the open sea but additionally and most important led them to the sea and the sea travel. This by extension led these mobile populations in the creation of new channels of communication and contacts. In

this new way of organization of the wider social space that inaugurated in the Mesolithic based the following most organized of course, polycentric networks of communication of the Neolithic.

CHAPTER 2

OBSIDIAN: DEFINITION, CHARACTERISTICS AND PROPERTIES

Obsidian belongs to the volcanic glass, in the category of rhyolite. It is a hard and glassy volcanic rock that was used widely during prehistory as raw material, for the tool manufacture. This was a very reasonable and not accidental choice, considering the properties of this material. More specifically, it is a usually black volcanic glass, suitable for the manufacture of sharp and resistant tools.[10]

The term obsidian in Ancient Literature is reported in Pliny the elder's Natural History (Historia Naturalis) around 77 A.D. and derives from the Latin obsidianus. The term is also reported in the ancient source of Anabasis Alexandri by Arrian (around 200 A.D.).

Its characteristic colour is usually a shiny black but it could also be grey, red or green, depending on the particular conditions prevailing in the area where obsidian is formed. On this basis, the colour of obsidian varies from translucent to black, depending on the special chemical composition of obsidian. For example hematite gives a reddish colour or iron gives obsidian a greenish colour. In general these differentiations and variations in the colour of obsidian are related to the oxidation of the trace elements contained in the chemical configuration of obsidian.[11]

The chemical composition of obsidian is SiO_2 (circa 70-75 %), Al_2O_3 (circa 10-15%), Na_2O (3-5%), K_2O (2-5%), Fe_2O_3, trace elements and water (maximum 5%). [12]

The main property of obsidian is that it is a very homogeneous material due to its chemical composition. As basic features of obsidian its hardness and the fact that it is in general a very solid material should be mentioned. However, the most useful feature of obsidian for the tool manufacture, due to all of the features

[10] Pollard A. M and Heron C.,2008, pp.75
[11] Pollard A. M and Heron C.,2008, pp.75. See also Laskaris N.,2010,
[12] Glascock D. M. et al, 1998, pp.18

mentioned above, is that the formation of very sharp and durable edges was possible through percussion. [13]

Obsidian was used for the tool manufacture from the Palaeolithic, around 12000 years BC, until the Bronze Age. In some cases it was used until more recently, for example in places such as Mexico, Easter Islands or Chile.[14] Finally it is worth mentioning that obsidian is used until nowadays for the manufacture of surgical tools, since it is considered to give "cleaner cuts".[15]

Obsidian is considered as an ideal material for tool manufacture, especially for knapping, since it is homogeneous, without fissures or cracks and frangible, thus it was easier for the prehistoric knappers to give obsidian the desired form.[16]

The main production techniques and shapes that are relating with obsidian are depicted in the table below ((Andrefsky 2000: XXI-XXVII):

[13] Glascock D. M. et al, 1998, pp.16
[14] Laskaris N.,2010, pp. 11
[15] Pollard A. M and Heron C.,2008, pp.76
[16] Andrefsky W. Jr, 1998, pp. 24

Bevelled:	Usually referring to a tool edge that has been modified by the removal of a series of flakes to produce a desired edge angle.
Biface:	Biface a tool that has two surfaces (faces) that meet to form a single edge that circumscribes the tool. Both faces usually contain flake scars that travel at least half-way across the face.
Bifacial thinning flake:	A flake that is removed during biface trimming and often contains a striking platform, that is rounded or ground, indicating preparation. It is usually thin related to width, with a feathered termination.
Bipolar flake:	A detached piece that is formed as a result of compression forces. Bipolar flakes often show signs of impact on opposing ends and have compression rings moving in two directions toward one another.
Bipolar technology:	A technique of resting the objective piece on an anvil and striking it with a hammer to split or remove a detached piece.
Blank:	A blank is a detached piece potentially modifiable into a specific tool form.
Collateral flaking:	The process of removing expanding flakes removed from the lateral margins of an objective piece at right angles to the longitudinal axis.
Conchoidal fracture:	The production of smooth convexities or concavities, similar to those of a clamshell, after fractured.
Conchoidal flake:	A conchoidal flake having the properties of conchoidal fracture. These flakes have a dorsal and ventral surface and often bulb of force.
Core:	Nucleus or mass of rock shows signs of detached piece removal. A core is often considering an objective piece that function primarily as a source for detached pieces.
Core tool:	A core used for chopping, cutting or some activity other than as a source of detached pieces.
Debitage:	Detached pieces which are discarded during the reduction process.
Detached piece:	Detached pieces that are discarded during the reduction process.
Diagonal parallel flaking:	This is similar to parallel flaking except that the flakes are removed at an oblique angle to the objective piece edge.
Microlith:	A microlith is a very small blade usually geometric in form used in composite tools.
Parallel flaking:	Flake scars are parallel to each other and leave a sharp edge on the objective piece. These flakes are removed in a serial fashion by following the ridge created by the previously removed flake.
Pressure flaking:	The removal of a detached piece from an objective piece by pressing rather than by percussion.
Percussion flaking:	A method of striking with a percussor to detach flakes from an objective piece. Different methods of percussion flaking using different kinds of percussors tend to produce distinctive detached pieces.

SOURCES OF OBSIDIAN

Obsidian originates exclusively in areas with a relatively recent volcanic activity and was created through the rapid cooling of the volcanic magma. Obsidian is the result of this process, where the components of magma did not have the required time to be normally crystallized. The crystallization of obsidian is repeated through time so not all of the obsidians are considered to be appropriate for exploitation. The most recent deposits are considered to be of better quality and thus proper for exploitation and tool manufacture. For example the deposits of North America and in the case of this study, the deposits of Eastern Mediterranean are considered to be of the highest quality, formed in both cases during the last fifteen and ten million years correspondingly.[17]

The sources of obsidian are divided in primary and secondary; the first are located around the volcanic cones while the secondary sit in talus slopes and stream beds as the result of various geologic activities which transport the material from the primary sources. Usually prehistoric quarries were located near the primary sources for practical reasons though often obsidian was extracted from secondary deposits, as the erosion of the original source made the mining of the raw material easier. Obsidian was extracted either from quarries near the primary sources or from the secondary sources like talus slopes and stream beds. The material was extracted easier because of the erosion of the primary source. [18]

As mentioned above, obsidian deposits occur in areas of recent geological – volcanic activity and can be created under special circumstances, thus, they occur in limited areas around the world and in specific parts in each country. These sources are known to the scientists and it would be very surprising and unexpected for totally unknown obsidian sources to be discovered nowadays. This restriction of obsidian sources in very limited areas around the world makes practicable and traceable the possibility to identify and locate the exact source of obsidian that is found away from the original sources of the volcanic glass.[19]

In general, as mentioned above, obsidian deposits around the world are very limited and they are for example in America (Arizona, Hawaii, New Mexico, Ecuador, Mexico), Africa (Ethiopia, Kenya), Asia (Japan), Western Europe

[17] Malainey E. M. A, 2011, pp275-276
[18] Glascock D. M. et al, 1998, pp.16
[19] Pollard A. M and Heron C.,2008, pp. 81

(Hungary, Iceland, Italy,) Eastern Europe (Greece, Turkey) and Eurasia (Armenia-Caucasian sources)

In the area of Eastern Mediterranean obsidian sources are in the Aegean Sea in Greece, where there was recent volcanic activity. Also, there are in the neighboring Turkey. In Greece all obsidian sources are identified in the Aegean Sea, where the geologic activity was very intense.

The most important source is in the Cycladic island of Melos, which according to archaeological data is one of the most important exploitation sites. Melian obsidian was used since Upper Paleolithic and was of very good quality, because of its hardness. The deposits are located in the area of Nychia or Adamas and Demenegaki.[20] According to an archaeometrical analysis between the two Melian obsidian sources it was found that they have almost homogeneous chemical composition with slight difference in the presence of a chemical element (Zr).[21]

Obsidian sources also occur in the islet of Yali of Nisyros. The quality of obsidian of Yali is considered to be of lower compared to Melian obsidian because it was fragile and not suitable for fine processing, which requires the manufacture of lithic tools, due to its chemical configuration (it contains white spherulites) and was used mainly for the manufacture of stone vessels in Bronze Age. The last year obsidian originating from Yali has been discovered in the archaeological sites of the island of Ikaria (Mesolithic and Neolithic sites)[22] and in the island of Crete in Malia (Bronze Age).[23] Finally, minor deposits of obsidian exist in the islet of Antiparos in the Aegean Sea but according to archaeological data most likely they were not being exploited during prehistory.[24]

The main obsidian sources in Anatolia are located in the same manner in areas with volcanic activity: In Eastern Anatolia, in the area of Lake Van and in south central Anatolia, in Cappadocia. Colin Renfrew dealt extensively with the study of obsidian in Eastern Anatolia and he also classified Anatolian obsidian sources in four district groups depending on their composition and concentration. Also, he

[20] Shelford P. et al, 1982,pp.182-192. See also, Renfrew et al, 1965, pp.225-247 and Renfrew et al, 1971, pp.242-245
[21] Liritzis I., 2007, pp. 399-406
[22] Georgiadis M., 2008, pp. 101-117.
[23] Carter T. & Kilikoglou V., 2007,pp.115-143
[24] Shelford P. et al, 1982,pp.182-192. See also, Renfrew et al, 1965, pp.225-247 and Renfrew et al, 1971, pp.242-245

attempted to analyze and interpret the socio-economic extension leads of the issue. [25]

Obsidian sources in Turkey are located in North Western Anatolia, in the North and North West of Ankara. Also in Central Anatolia they are located in the area of Cappadocia, in Eastern Anatolia in the Area of Van Lake (South Eastern Anatolia) and in the area of Kars (North Eastern Anatolia). Regarding the deposits in the area of Ankara only two sources were used during Neolithic while other sources were not used at all because of their low quality for the tool manufacture. The deposits of Central Anatolia were used more, especially from the area of Acigol. In the deposits of one area there are of course variations: for example the quality of the deposits in the area of Acigol was better than that in the area of Gollu Dag, where obsidian cracked easily. The deposits of obsidian in the area of Lake Van were used widely during Neolithic while the sources in the area of Kars were exploited mainly during Chalcolithic and Bronze Age.[26]

Despite the abundance of obsidian in the area of Anatolia, according to the excavations and archaeological data, obsidian sources in Turkey were used widely mainly in the period of Neolithic. The oldest appearance of obsidian transferred by sea in archaeological data until now comes from the island of Melos, in the Aegean Sea, in Greece. Obsidian was found in a destination of 160 km in the Cave of Franghthi in Argolida and was dating το Upper Palaeolithic. [27]

ARCHAEOMETRICAL APPLICATIONS

As mentioned above, obsidian deposits occur in areas of recent geological – volcanic activity and can be created under special circumstances, thus, they occur in limited areas around the world and in specific parts in each country. These sources are known to the scientists and it would be very surprising and unexpected for totally unknown obsidian sources to be discovered nowadays. This restriction of obsidian sources in very limited areas around the world makes practicable and traceable the possibility to identify and locate the exact source of obsidian that is found away from the original sources of the volcanic glass.[28]

[25] Renfrew C. et al, 1966,pp 30-72. See also, Renfrew et al, 1968, pp.319-331
[26] Renfrew C. et al, 1966, pp 30-72. See also, Renfrew et al, 1968, pp.319-331
[27] Renfrew C. and Aspinall A. ,1990, pp. 183-202
[28] Pollard A. M and Heron C.,2008, pp. 81

The conditions in which obsidian deposits were formed - due to the rapid cooling of volcanic magma- give obsidian a special fingerprint, which can provide the necessary information, in order to link the source with the artefact. This happens because after a volcanic eruption the multiple lava flows have a characteristic and unique fingerprint due to their quick formation. This fingerprint is traceable through the analysis of trace elements (zinc, rubidium, strontium, barium) of lava flows. The identifiable difference is in the quantity of trace elements in lava flows: different lava flows contain different quantity of those elements.[29]

The find of obsidian in prehistoric excavations is not surprising, especially in the under exploration area of the Eastern Mediterranean, an area where intense volcanic activity occurred through time. The fact that obsidian can be originated only from few specific areas help archaeologists and other researchers to understand the contacts and transactions that prehistoric people and groups had either by land or by sea.

The substantial development of the Natural Sciences and the ongoing collaboration with archaeology contributed decisively to the development of obsidian studies and the increasing understanding of issues related to them. Natural Sciences are now considered to be an indispensable part of archaeology and their contribution to the better understanding of the past is undisputable and extremely important.

The appearance of the material was one of the first methods of analysis and studying of obsidian. Its colour both in general and under certain circumstances, like when the light is transmitted or reflected, its brightness, opacity, refraction or internal structure are some of the visual criteria that archaeologists use to evaluate a sample regarding its origin. However all these criteria are not objective and they cannot be reliable.

The study of obsidian with archaeometrical techniques is a relatively recent scientific issue. The study of the origin of obsidian which can be identified with specific scientific methods is a relative new scientific issue that begun to concern scientists the last decades. On this, was contributed the rapid development of technology and scientific methods of research and analysis in Natural Sciences as well as the new scientific developments in the field of archaeology and the

[29] Robert L. K. and Thomas H. Th.2012, pp. 272

intensification of archaeological research helped this study. Archaeological research has resulted in the increase of obsidian finds and of archaeological sites related to obsidian studies. The cooperation between archaeology and Natural sciences in the field of obsidian studies was inevitable and has been instrumental on the progress achieved on this scientific topic in recent years.

The first attempts in the study of obsidian tools for the definition of the origin of obsidian source and the linking between sources and artefacts comprised macroscopic observations, density measurements and mass spectrometry. During 1960s and 1970s obsidian studies moved forward with the introduction of X-Ray X-ray fluorescence spectrometers (XRF) and Neutron Activation Analysis (NAA). Since 1980s the application of those methods in obsidian studies and the introduction of new techniques have been intensified and continue to be enriched until today, so that the results are as far as valid and reliable. [30]

Other techniques that used to be applied in the souring of obsidian but were abandoned because of their low reliability were density measurements, thermo luminescence, Mossbauer Spectroscopy. This technique was named after the physicist Rudolph Mössbauer, who employed it. This technique uses the differences of the energy to detect data from a sample:[31] Fission-track analysis, measurement of magnetic properties, and measurement of natural radioactivity. The main disadvantage of those techniques are their low reliability and weak prospects of evolution,[32]although some of those succeeded in tracing differences between the sources.

Various geochemical techniques are applied nowadays for the analysis of obsidian.These techniques differ from each other both in the implementation and the method of analysis and in the type of information they provide. The available source data and the quality of equipment are factors that affect the validity of results. The basic information that obsidian can provide and the two main points in the analysis of obsidian is the source origin and the dating of the raw material. [33]

The basic techniques analyses of obsidian sourcing are the followings:

X-RAY Fluorescence spectrometry (XRF) is one of the most widely used for obsidian analysis. X –rays penetrate the surface of the lithic sample and evaluate

[30] Shackley S. M., 2008, pp. 198- 199
[31] Malainey E. M. A, 2011, pp.499.
[32] Glascock D. M. et al, 1998, pp.18
[33] Shackley S. M., 2008, pp.199

it. The technique of X-Ray fluorescence spectrometry (XRF) is usually applied on the surface of the samples and sometimes the samples are pulverized, so that a whole sample can be analysed. This method is based on the irradiation of the sample by X beam during the X-Ray Fluorescence scanning, which excites electrons. Subsequently electrons emit a secondary of X-Ray Fluorescence and by measuring the intensity of X-Ray the concentration of different elements in the surface of the sample can be evaluated, which is the key element for the definition of obsidian fingerprint, which differs among obsidians from different sources. [34]

The PIXIE technique is similar to this method. The Particle Included X-Ray Emission analysis is based on the application of an X-Ray beam in a small area of the surface of the sample's surface. In this technique, the surface of the sample must have been polished before any application, in order to give valid results. However, this practice may harm and damage the sample. [35]

Electron Microprobe Analysis (EMPA) is again similar to the XRF technique and it is based on the scanning of the sample by electron beams and then on the emission of secondary X-Rays. This technique is usually applied on artefacts or sample of artefacts, since it not at all destructive. [36]

The NAA (neutron activation analysis) was the first technique that succeeded in dealing with the problem of older techniques: the problem of overlapping of different sources.

By the technique Instrumental neutron activation analysis (INAA) the sample is irradiated and specific isotopes are likely to be traced.[37] Instrumental Neutron Activation Analysis (INAA) is considered as a non destructive and of a high accuracy technique but it is not very applicable for a large sample. This technique is based on the irradiation of the sample by neutrons in a nuclear reactor.[38]

Inductively coupled plasma-mass spectrometry (ICP-MS) also evaluates the sample with the use of laser adaptation (LA-ICP MS). ICP or Inductively Coupled Plasma emission spectroscopy is a technique that requires a very small solution of the sample (oo.3 g), which is heated in very high temperatures (around 6000 degrees) in order to be transformed into plasma. After the injection of argon the

[34] Malainey E. M. A, 2011, pp.478. See also, Andrefsky W., 1998,pp.42
[35] Andrefsky W., 1998,pp.43
[36] Andrefsky W., 1998,pp.43
[37] Malainey E. M. A, 2011, pp.427
[38] Andrefsky W., 1998,pp.43-44

plasma is warmed in a RF (Radiofrequency) coil. The analysis of emission spectrum allows the trace elements and their differentiations to be detected.[39]

Atomic absorption spectroscopy: with this technique the determination of a sample is possible by the detection of the presence of specific elements.[40] In the technique of Atomic Absorption Spectrometry or AAS the obsidian sample is smashed and then placed on a solute and with the help of a flame spray the atoms are separated from the compounds. The identification of the elements and the concentration of each one of them are based on the evaluation of the colour of the flames. [41]

The source analysis methods of obsidian are based on the identification and measurement of trace elements. In the same manner, obsidian hydration dating is based on the measurement of the hydration layer of obsidian. The technique was first employed during 1960s by Friedman and Smith, who noticed this hydration layer of obsidian.[42] The technique is based on the measurement of obsidian's hydration rind, which is created by the exposure of a "fresh" surface of obsidian and it can determine the duration of the sample's exposure.[43] Recent developments have shown that OHD in combination with Secondary Ion Mass Spectrometry (SIMS) can give more accurate data.[44] Then other scientists were involved with this innovative technique.[45]

Obsidian, as mentioned above, contains water 0.1-0.3 %, the minimum quantity comparing to other volcanic glasses. The hydration layer is created when obsidian is fractured, for example during tool manufacture and tool knapping. The exposure to air results in the creation of atmospheric water which begins to diffuse into the glass because of its attraction to the surface. As a result, this water creates a hydration rind, which increases as time passes.[46]

In their first attempts, Friedman and Smith used optical microscope for their measurements[47]. Despite its wide use, this method is no longer considered

[39] Andrefsky W., 1998,pp.44
[40] Malainey E. M. A, 2011, pp 443
[41] Andrefsky W., 1998,pp.44
[42] Friedman I. and Smith R. A., 1960,pp.476-522
[43] Malainey E. M. A, 2011, pp 147
[44] Malainey E. M. A, 2011, pp 285
[45] Anovitz et al,1999, pp735-752, Liritzis I. and Diakostamatiou M.,2002,pp.93-109.

[46] Pollard A. M and Heron C.,2008, pp.79
[47] Friedman I. and Smith R. A., 1960,pp.476-522

reliable. [48] In 2002 this technique advanced with the contribution of professor I. Liritzis and his team.[49] I.Liritzis and his team invented and implemented a new method for obsidian's dating which combined Obsidian Hydration Dating with SIMS-SS. This method is considered to be even more accurate for the dating of obsidian.[50] The application of this method is based on the distribution of the water (see above about hydration rind) into obsidian and the detection of a saturation point which is very close to the surface.[51]

This method is considered to be accurate, as well as it is not limited to the measure of hydration rind but it is based on the diffusion modeling.[52] Also, it is not time consuming.[53]

The analysis of hydration rind can be done with various techniques:

Analysis with SIPS or Sputter-Induced Photon Spectrometry: This technique was presented during 1980s but has never been developed. Nuclear Reaction Analysis (NRA): this technique is considered to have some imperfections and not to be that accurate.[54]

Infrared- Photoacoustic Spectrometry or IR-PASS: The techniques of spectroscopy FTIR and IR-PASS begun to develop during 1980s. Fourier Transform Infrared Spectroscopy measures the quantity of interior water while Photoacoustic-Infrafed Spectrometry measures the distribution of water in the surface of the material. This technique is considered the most secure and not destructive for the specimen.[55]

The most recent method is SIMS (Secondary Ion Mass Spectrometry). Nowadays this technique is considered not destructive and the most accurate method for the measurement of hydration rim of the sample, especially in combination with other techniques (see below). The first attempts to employ this method failed. But the next attempts by Stevenson et al (2001), LIritzis and Diakostamatiou (2002), Anovitz et al (1999,) succeeded. With an accuracy of 0.05μm, this method is considered to be the most valid at present.[56]

[48] Laskaris N.,2010, pp. 22-23
[49] Liritzis I. and Diakostamatiou M.,2002,pp.93-109
[50] Liritzis I. and Diakostamatiou M.,2002,pp.93-109. Also see, Liritzis I. and Laskaris N. 2012
[51] Laskaris N.,2010, pp. 31-32
[52] Laskaris N.,2010, pp. 225-228
[53] Laskaris N.,2010, pp. 79
[54] Laskaris N.,2010, pp. 18-20
[55] Laskaris N.,2010, pp. 18-19
[56] Laskaris N.,2010, pp. 20-21

In this method the sample is just mounted on a holder and the hydration rind is measured with depth profiling use of Secondary Ion Mass Spectrometry. The technique advanced by a Greek scientific team of Professor I. Liritzis and was presented in 2002 (SIMS-SS).It is based on the detection and analysis of layer saturation very close to the surface, hence the name: SIMS-SS, where SS means Saturation Surface approach. This technique provides accurate and thoroughly measurement of the water infiltration in the sample, thus can detect all the changes that have been made through time.[57]

Another dating technique is Radiogenic Argon Isotope or $^{40}AR/^{39}$ AR Dating: the method was first employed forty years ago and is based on the potassium (K) - argon (Ar) isotopic dating technique with the calculation of the result of the radioactive decay of an isotope of potassium into argon.[58] The problem of this method is that regarding the case study of glasses, the hydration of obsidian decreases radiogenic argon, thus affects the result of measured K/Ar ages. On this basis, the technique could work in fresh –thus anhydrated- obsidian samples.[59]

Finally, the Fission track dating technique is used for the determination of the geological age of a sample. This technique is based on its uranium content and specifically on the damage that trails or tracks produced by uranium fission fragments for the establishing of the age of the sample. The polished surface of the sample is etched with acid in order to reveal the damage by the fission of uranium nucleus.[60]

The techniques mentioned above are applied for the analysis of obsidian and are considered to provide reliable and comparable data. Scientists have their preferences in the choice of an analysis technique. In Europe for example they usually exploit emission spectroscopy, atomic absorption spectroscopy, XRF, NAA, diffraction spectroscopy. Laboratories in America, mainly North and Asia, Japan and China show also the same preference to the techniques mentioned above.[61]

However, the last thirty years all of these techniques have been exploited over time. Thus, Atomic Absorption Spectroscopy (AAS) has been exploited for the characterization of obsidian from Alaska, PIXE (Particle induced X-Ray emission Spectroscopy) has been used for the analysis of New Zealand. Neutron Activation

[57] Liritzis I. and Diakostamatiou M.,2002,pp.93-109. Also see, Liritzis I. and Laskaris N. 2012
[58] McDougall I. and Harrison M.T., 1999, pp. 9
[59] McDougall I. and Harrison M.T., 1999, pp. 35
[60] Pollard A. M and Heron C.,2008, pp.86
[61] Garrison G. E.,2003, pp.209

Analysis (NAA)is used for the study of obsidian from Guatemala. XRF is used for the analysis of obsidian from Northern California while Inductively –Coupled Plasma Emission spectroscopy for the analysis of obsidian- from New Mexico. One of the first techniques exploited for the study of Mediterranean obsidian's origin was optical emission Spectroscopy (OES)[62].

Regarding the dating techniques, the most recent achievement comes from the method of Obsidian Hydration dating with SIMS-SS. Scientists combined the traditional method of Obsidian Hydration Dating with the new technique of secondary ion mass spectrometry of surface saturation (SIMS-SS) and proved that obsidian tools originate from Melos, and were manufactured even earlier than it was believed until recently.[63]

[62] Glascock D. M. et al, 1998, pp.19
[63] Laskaris et al, 2011, pp. 2475-2479

CHAPTER 3

THE SITES OF EARLY PREHISTORY IN THE EASTERN MEDITERANNEAN BASIN

Franchthi Cave, Argolis of Peloponnesus

Franchthi Cave is situated in Southern Greece. It is located in Southern Argolis of Peloponnesus. It is considered to be one of the most important sites in Palaeolithic Greece and the Mediterranean in general. The cave is situated in the sea shore of the Gulf of Koiladas. During Pleistocene it was lying in a distance of seven kilometers away from the sea while during Holocene, because of the various changes occurring on that period, the entrance of the cave lay just one kilometer from the coastline. At present the entrance of the cave is located in an altitude of 12 meters above sea level.[64]

The excavations of the site under the directions of Thomas Jacobsen were initiated in 1960s, in 1967 by the Indiana University, the University of Pennsylvania, the American School of Classical studies in Athens (ASCSA) and the Greek Ephorate of Prehistoric and Classical Archaeology and lasted until 1976.[65]

In the period of 1979-1983 followed a systematic archaeological survey under the supervision of M. Jameson, T. van Andel and C. Runnels. The objective of "The Southern Argolid Project" was the investigation of the geomorphology of the area and the study of the submerged areas.

The stratigraphic sequence in the cave of Franchthi spans from the Palaeolithic to the Neolithic, with some gaps between 18.000 to 13.000 BP. After the end of Palaeolithic, a gap of 300-600 years is observed in the stratigraphy. The layers of the Mesolithic are dating the Lower Mesolithic in the 9.500-9.000 BP and the Upper in 9.000-8.000. A third phase, the Final Mesolithic added later by C. Perles, that resulted by the study of stone industry. In general the Mesolithic finds consist of seeds, animal bones, sea shells, stone tool and of course obsidian.

The fact that humans used to travel from such an early stage and under such difficult conditions it is really exciting. In a changing world and in a period where the means of navigation were shabby such a venture cannot considered easy at all. The conditions of a journey in the open sea are extremely difficult, more over

[64] Jacobsen, T. W., 1969, pp. 343-381
[65] Jacobsen, T. W., 1969, pp. 343-381

when the available means are restricted in very simple means and perishable, thus easier vulnerable materials like reeds and papyrus or tree trunk. However, the indications derived from obsidian finds discovered in Franchthi and now in other sites too in combination with the human presence in remote islands, even nowadays or in islands that were not connected that period of time to any mainland, leaves no doubts that humans used to travel in the sea and developed seafaring and other maritime activities from a very early stage.

The cave is very important for the Greek Palaeolithic. Its stratigraphy extends from the Palaeolithic to the Neolithic. The site was inhabited since Upper Palaeolithic, around 40.000 BP until 3000 B. C. Thus it was in use during all of the phases of Stone Age (Palaeolithic- Mesolithic and Neolithic) with an interruption during 18000-13000 and 11000-9500 BC. Another reason for its importance is that up until very recently it belonged in the category of the very rare sites providing information about the Mesolithic; a very controversial period of time up until lately. However, the cave of Franchthi is of great importance for another reason. The oldest appearance of obsidian in archaeological data regarding seafaring trade comes from Franchthi. In Franchthi Cave there is the earliest established data for maritime trade activity during the Palaeolithic. [66]

The excavating area is very limited compared to the size of the cave. Only a small part of the cave has been excavated. Regarding the types of the findings, they are stone tools of various types, pottery (in the Neolithic deposits of the Cave) shells, animal bones, burials.[67]

The cave was probably created during the Miocene period and is made of crystalline limestone. It is considered to be a big cave with depth more than 150 m and an opening mouth of about 30 m. The cave covers the need for fresh water, since inside the cave there is a small lake, while around it, along the coast, there are several springs.[68] (Jacobsen 1967)

The first period excavations were in a small area in front of the cave and in a restricted depth (around 20-40 m) because of the cave's surface configuration:

Pit A later Mesolithic to Neolithic

Pit B 2,50 m. x 5m.

Pit C 1m x1,5 m

[66] Jacobsen, T. W., 1969, pp. 343-381. Also, see: Jacobsen, T. W., 1973a, pp. 45-88 and 1973b, pp. 253-283

[67] Jacobsen, T. W., 1969, pp. 343-381

[68] Jacobsen, T. W., 1969, pp. 343-381. Also, see Van Andel Tj., & Sutton S. B. 1987,

Pit D 1m x 1,5

Pit E 4x 4,5

Pit F/F1 3m. x 3m. Later Mesolithic to Neolithic

Pit G/G1 3m. x 3 m. the pit was divided into 2 different parts, which penetrated into the deepest deposits of the excavation: Stratified layers from Mesolithic through Neolithic with a hiatus at the end of Mesolithic.

Pit H (season 1968) 4x 4 (excavated area with deep deposits of Mesolithic strata. Also layers from the Neolithic period). During excavations (with a depth of 3, 5 m) the excavated area was reduced (1,8 x 2, 5) while in deeper layers (about 5 m.) it was divided and the one part reached 6 m above sea level [69]

The overall depth of the pits arrived in a maximum depth of 5 m above sea level. The excavation unearthed uninterrupted deposits extending from later Mesolithic to Neolithic.

The Neolithic fauna consists of sheep (ovis) and goats (capra) with the assemblages of sheep bones to be more than the goat ones. It also includes pigs (sus), bovid (bos), red deer (cervus elaphus), hares (lepus), foxes (vulpes), canid (canis), bones of birds and fragments of tortoise carapace (testudo) in smaller quantities. Finally fish bones of large fish have been found. The assemblages are 5-10% of the total sample [70].

The findings are considered to be common in the Neolithic Greece (Early and Middle). The economy was based on domesticated animals, especially sheep and goats.

Below Neolithic strata the findings are different. The predominant species is the red deer and there is no appearance of goats or sheep.

The Mesolithic fauna is dominated by red deer (cervus elaphus). In smaller quantities there are foxes (vulpes), pigs (sus), bovids (bos or bison), hare (lepus), a small felid (felis) a large canid (canis lupus). Finally, fish bones of large fishes have been found in abundance.

The Pleistocene fauna found mainly on the Pit H consists of deer (probably cervus elaphus) and equid (probably Equus hydruntinus). Bovids (bos or bison), caprines (probably capra ibex), hares (lepus) and pigs (sus) have been found in

[69] Jacobsen, T. W., 1969, pp. 348

[70] Jacobsen, T. W., 1969, pp. 343-381

smaller quantities. Pleistocene fauna resembles faunas found in Kastritsa, in Epirosa and in Romanelli in South Italy.

Mesolithic flaked stone industries[71]

Artefacts come mainly from lower deposits of Pit G (which were excavated from deeper layers) and in a small number of Pit H. The number of the artefacts exceeded the number of 5000 pieces. An amount of 912 retouched specimens is included in this quantity.

The material varies from red and grey flint (in the majority of the artefacts) to grey or gray-green chert. Variations are met even among the same material and colours. This raw material probably originated from local sources.

Obsidian was documented in the pre-Neolithic levels. The use of obsidian is asserted in Mesolithic deposits. More specifically, 96 pieces of obsidian have been found in the layers of Pit G-1 from the units 22-45. Isolated fragments came from the unit 49, 51, 52. Regarding the types of obsidian tools, they include four microlithic "trapeze" forms, which are very typical for the period.

The excavator recognized the importance of obsidian as the first oldest occurrence in the Aegean Sea. Obsidian in combination with the amount of fish bones of large size will need further examination. Finally the excavator declares that the source of obsidian is unknown.

The main characteristic of the retouched pieces is that they have one or more notches and are denticulate. In general, there is the sense of uniformity with the Mesolithic succession. (?1967 355) Other groups are the flakes with sharp edge, one or more with clear marks of utilization , cutting or sawing. The characteristic scrapers and burins of the Late Palaeolithic and the Mesolithic have also been found. (Three or four scrapers and one burin are from G-1. Also, splintered blades and finally tools of microlithic form (15 from G-1) have been found. Among some pieces which can be categorized, a "triangle", a "crescent", 3 "obliquely-blunted points", 4 "rods retouched along a single edge", 6 "rods or points retouched on two edges" outstand. All of the microliths were made of flint and not of obsidian.

Regarding the techniques, only one or maximum two specimens suggest that blade production was known during the Mesolithic. In the same manner, only

[71] Perles, C., 1990, 183-202, 257-70. Also, see: Perles, C., 1999, pp.311-318 and Perles, C., 2003, pp. 79–88,

three or four from the 160 cores that were found must have been for blade production. The majority of the cores (irregular form) show evidence of flaking from different directions. Finally, in G-1 two artefacts – a flake and a typical "discoid" core that were found are probably of Mousterian style thus dating at least back to the Middle Palaeolithic.[72]

From Pit H a smaller number of stone implement was found, 74 pieces in overall, some of which bore one or more notches.

During the site's excavations four burials have been discovered. They are four inhumation burials. Only the three of them can be securely dated back to the prehistoric period. The two burials of two children in tightly contracted positions have been found during the 1967 campaign and date back to the Neolithic period. The most important find was unearthed during the season of 1968 and is the complete skeleton of a male dating back to the Mesolithic. The burial was found in Pit G/G-1. The skeleton is the oldest complete skeleton ever found in Greece and the oldest burial, dating back to the Mesolithic, in the area of the Aegean.

In all of the burials offerings were not detected. The forth burial was found below the modern surface. It was an adult burial and seemed to belong in the modern period.

Regarding obsidian finds, after the study of lithic assemblage, the fact that obsidian dated back to the end of the Upper Paleolithic and of the Mesolithic was certified. The quantities of obsidian dating back to the Upper Palaeolithic are too small and represent the 1% of the lithic material. During the Mesolithic the quantity increased rapidly but is still considered as small quantity since it represents about 3% of the total lithic assemblages. [73]

Archaeological data in relation to the use of obsidian during the Palaeolithic suggest that its exploitation as a raw material was not that common and concerned sporadic and occasional collection. Only a very small quantity of obsidian was found, and after archaeometrical analysis it was ascertained that it originates from Melos, a Cycladic Island in the Aegean Sea.[74] Melos has never been united to the mainland, thus the only way for the obsidian to be transported to Franchthi was by sea. The quantity that has been found was very small and

[72] Jacobsen, T. W., 1969, pp. 356-358
[73] Perles, C., 1990, 183-202, 257-70
[74] Renfrew, C., J.R. Cann, and J.E. Dixon, 1965, pp. 225–47. Also, see: Renfrew C&Aspinalli A., 1990, pp.257-270

according to contemporary archaeological data there was not an intense respective activity. [75]

However, the data concerning the period of the Mesolithic have been differentiated. Some years ago, researchers believed that obsidian trade existed during this period but still without being that intense, even though it was more intense than during the Palaeolithic period. The only site that obsidian has been found in and indicated obsidian transfer by the sea was again Franchthi Cave. Mesolithic deposits gave larger quantities of obsidian tools, originating again from Melos, even though compared to the rest of the stone tools they were small. However, the existence at the same time of fish bones of large fish that lived in the open sea -tuna- strengthened the conviction that people during the Mesolithic exploited the sea in any possible way: in order to get food and find raw materials.[76]

The progress in archaeology and archaeometry and the intensification of excavations brought to light more Mesolithic sites with many similarities to Mesolithic Franchthi Cave.

The site of Maroulas at Kythnos

The site of Maroulas at Kythnos is a site contemporary to Franchthi Cave. The site was first excavated by A. Sampson and is the only island of the Aegean Sea that has provided dwellings and burials, thus there is evidence of occupation during the Mesolithic Period. Over the last years, Mesolithic finds have increased substantially due to the intensification of the research. However, the site of Kythnos in Maroulas remains the only Mesolithic site which has provided evidence of occupation.[77]

Three circular stone paved floors and three also stone paved constructions of ellipsoid irregular form have been unearthed there among the finds. The floors have a diameter of 3 m. Moreover, nine burials have been found. The majority of them was not well preserved or has been destroyed due to the sea erosion. The two best preserved burials consist of one of an adult, found under the surface of the circular floor, and another of a child with a dog. Probably families lived for a

[75] Renfrew, C., J.R. Cann, and J.E. Dixon, 1965, pp. 225–47,
[76] Perles, C., 1990, 183-202, 257-70. See, also Shackleton, J.C., 1989
[77] Sampson, A. et al, 2002, pp.45–67

specific period of time or seasonally or they used to move in seasonal travels in order to renew their resources at the site of Maroulas.[78]

Melian obsidian has been found on the site of Maroulas. The quantity of obsidian finds is 16, 87 % of the total stone assemblages. The obsidian amount is much more in quantity comparing to the quantities found at Franchthi Cave, (3, 15 %). Obsidian finished tools (36, 36) were found at Maroulas, but cores as well, which suggests that apart from the importation of finished tools obsidian was imported and worked on the site.[79]

The case of Maroulas can shed light in the case of Franchthi. Kythnos is part of a transport route which ends in Argolida and Franchthi Cave. In this route the island of Melos, which is the source point, is considered to be the starting point and part of the western group of Cycladic Islands: Kimolos, Siphnos, Seriphos, Kythnos, Keos, which continues in Attica (Cave of Schistos, see below) and finally ends up in Argolis of Peloponnesus.[80]

North Sporades

Traces of human appearance are dating from the period of Palaeolithic. However, the following period of the Mesolithic indicates that humans who lived or moved around and in this area used to fish systematically. The finds from the Cave of Cyclops in the islet of Youra , which is located 20 km northeast to the island of Alonissos suggest that the maritime area was of great importance and that here were developed fishing and navigational methods by the Mesolithic people.

The site of Cyclops Cave at Youra, Northern Sporades

Another island that is considered to belong at the same time frame and where obsidian finds have been traced is the site of Cyclops Cave on Youra, in the Northern parts of the Aegean Sea. Youra belongs to the deserted islands of the Northern Sporades. The others are Kyra Panagia and Psathoura.[81] In the Cave of Cyclops fifteen obsidian artefacts were found. Seven of them belong to the

[78] Sampson, A. et al, 2002, pp.45–67. See also Sampson A. et al 2010b
[79] Sampson, A. et al, 2002, pp.45–67. See also Sampson A. et al 2010b
[80] Sampson A., 1996, pp.46-51. Also, see: Sampson A., 2010a
[81] Sampson A., 1996a, pp. 51-56. Also, see: Sampson A., 1996c, pp.507-520

category of microlith tools. The absence of cores and the appearance of finished tools suggest that the tools were imported finished unlike the case of Maroulas.[82]

The cave of Cyclops is situated at an altitude of 120 m. The Mesolithic traces are dating around 6.445-6.375 BC. The site had seasonal character. The Mesolithic finds are very abundant and include of fish bones and animal bones, snails and shells, lithic and bone tools as well as an important number of an unique type of bone hooks.

According to the excavator, A. Sampson, the site is very important because it presents intense fishing activity and not individual efforts. The discoveries of the amount and type of fish hooks in combination with the quantities of the fish bones indicate that the site would probably worked as a seasonal base for populations of fishermen that who used to live in other bigger islands or even the mainland and used to visit the area of northeastern Aegean on a seasonal basis. However, in any case the human presence in the island which dating an era that sea level was higher and the parts of sea that used to united islands with the mainland had already immersed, thus the distances were bigger, show significant progress in maritime activities. Mesolithic population used to travel in the open sea and that they had the necessary knowledge, experiences and skills for such a venture. The hunters of Palaeolithic arrived in some islands on foot without the use of any floatable because of the lower sea level. For example the islands Skiathos, Skopelos and Alonissos used to be united with the Thessaly and the North Euboea, forming a big peninsula during the Palaeolithic.

Regarding the finds of obsidian, the same form of obsidian microliths found on Youra is also known from sites in Anatolia: in the Antalyan area and in the Cave of Okuzini on the Cilician coast. Also, similar tools have been found in Central Anatolia, in Belbidi and Pinarbasi. These similarities suggest connections of the island with Anatolia. However, these finds cannot be translated as direct contacts but those finds in conjunction with the location of the islands of the Northern Sporades as a natural bridge to the Western Anatolia, indicate contacts among these Mesolithic groups of humans living in these areas.[83]

[82] Sampson A., 1996c, pp.507-520. See, also: Sampson A. 1996b, pp.58-59 and Sampson A. et al, 2003, pp 123-130,
[83] Sampson A. et al, 2003, pp 123-130. Also, see: Sampson A., 2011,

What is more, the fact that among the lithic assemblages there are some artefacts made of siliceous rock found in the Mainland should be mentioned. This suggests contacts with the Greek mainland.[84]

The sites of Ikaria Island

The last years archaeologists unearthed prehistoric sites dating back to the Palaeolithic or the Mesolithic. The surprising is that the majority of these new sites are located on islands. This has resulted in the reevaluation of the role of islands in Prehistory.

The island of Ikaria is located in the Eastern Aegean Sea. It is a large island (255 m^2), compared to the other islands of the Aegean Sea. The archaeological investigation of the island was very scarce until rather recently. Excavations or even researches on the island have been conducted only over the last years. Surface surveys have been being conducted since 2003, when new prehistoric sites were found, while in 2006 the high school teacher Mr. Katsaros, collected stone axes and obsidian by surface investigations. Systematic survey of the island started in 2004 by the University of the Aegean. This survey located more than 20 sites on the island. The number of the sites seems noteworthy, considering the limited size of the island.[85]

The majority of the sites were located in the western and eastern side of the island. The most important of them were detected in the area located between Agios Kirikos and Faros. The sites (with the exception of the site at Glaredo, near Agios Kirikos) are located near to the coastline while the sea is protected and isolated by the "shelter" which Ikaria, Samos and Fourni create. In this area five sites that could date back to pre-Neolithic periods have been located. This is concluded through the preliminary study of lithic assemblages found on the sites in combination with the absence of pottery. This discovery is fascinating, since pre Neolothic sites have never been detected in the Eastern Aegean (despite its proximity to Anatolia) or even on the coast of Asia Minor so far. [86]

[84] Sampson A., 2011
[85] Sampson A. et al, 2008, pp. 321-329.
[86] Sampson A. et al, 2008, pp. 321-329. Also see: Sampson A. et al, 2012

The sites found on Ikaria date back to the Mesolithic and the Neolithic. This suggests that the Island was not used incidentally but that there was a network of sites. [87]

In Nyfi there is a part of a Late Neolithic settlement, where remains of a rectangular building are preserved.

Other Neolithic sites have been located in the Northeast coast of the sea. These sites have been detected in eroded today's capes. The Mesolithic site of Nyfi 2 is located in the sea very close to Nyfi.[88]

According to the lithic assemblages, five sites dating back to the Mesolithic have been identified so far. Kerame 1 dates back to the Mesolithic period and is considered to be a large site, as it is reckoned by the erosion of the peninsula. The site extends 80 m along the sloping edge of the cliff and has a width of more than 40 m. A large part of the edge of the cliff has retreated and so has the part of the site which was situated on it because of erosion. The site is located near the town of Agios Kyriakos, 8 km, in the northeastern part of the island. The research was conducted by the University of the Aegean Sea and the University of Athens in 2007 and 2008 and lasted for a few weeks. In overall were investigated eleven trenches were investigated, and regarding the stratigraphy, three layers were identified:[89]

1. Pure brown loamy soil
2. Light brown sandy-loamy-clayey sediment with stones of small and large size
3. Gravel

During the excavations not any prehistoric structures like dwellings, floors or any burial were found. The only structure that was unearthed is a semicircular stone structure with a diameter of approximately one meter that may have been a hearth or stone ring surrounding dwellings or other structures.

Concerning the excavations finds these include lithic tools: high end scraper from white-patinated flint, denticulated-notched tools from Melian obsidian and from white-patinated flint, a broken quartz pebble with use wears, flakes of beige and white patinated flint and obsidian chips.

[87] Kaczanowska M. & Kozlowski J.K., 2009, p.p 357-384
[88] Sampson A. et al, 2012
[89] Sampson A. et al, 2012

Moreover, land shells were found (Helix-Helix licorum and Helicopsis-Helicopsis smyrnocretica),[90]

The Mesolithic industry of the site was made of three different raw materials:

Obsidian, which was grey, dark grey or almost black in colour, possibly coming from the Cycladic island of Melos.

The beige and white patinated flint, which is probably a local material.

The black transparent obsidian with the characteristic white spherulites, originating probably from Yali of Nisyros. [91]

Finally, local quartz or rhyolite was used but their role in lithic assemblage is not important.

Melian obsidian was supplied by sea. The destination between the two islands is around 170 km. The excavator considers that is a matter of time to also find obsidian originating from Antiparos, which is of high quality and on a closer destination, approximately 120 km away. Obsidian from Antiparos appeared in small concretions (maximum with a diameter of 5 cm) but enough for the lithic industry of Kerame 1. In archaeological data obsidian from Antiparos is known only from the Late Neolithic.

Macroscopically the differences among the obsidians that have been found in the site are apparent. Small parts of specimens have been analyzed with archaeometric techniques until now. All of the analyzed obsidian originated from Melos.

Yali is located in the southeast of Ikaria. Obsidian originating from Yali is considered of lower quality and treatment properties (poorer cleavage). Obsidian from Yali is attested only macroscopically because it is easily recognizable due to its characteristic colour and its white spherulites. It represents 15 % of the total of lithic assemblage.The raw material was transferred by sea and the excavator suggests that the easiest way was by the existence of a chain of islands which connected the obsidian suppliers (Melos and Yali) with Ikaria.[92]

Melian obsidian is more abundant in the total lithic industry. But the dominant raw material is the white patinated flint. It is probably a local raw material. However, the nature of this material does not allow to trace its exact sources objectively and with certainty. The source could have been located in the central

[90] Sampson A. et al, 2012
[91] Georgiadis M., 2008, pp. 101-117
[92] Georgiadis M., 2008, pp. 101-117

part of the island, where Mesozoic formations exist or on the Eastern and South Eastern coast, thus very approximate to Keramos 1. However, Melian obsidian is the second most popular raw material while the assemblages of obsidian from Yali are of significant quantity and compared to other raw materials it constitutes the third most popular one, after white patinated flint and Melian obsidian.[93]

Regarding the typology of lithic assemblages, the majority are flakes, chip chunks and retouched tools. Also, there are splintered pieces, blades, cores and unrefined nodules.

Obsidian was used mainly for the production of splintered pieces. Melian obsidian was used for 102 pieces (88,5 %). Regarding cores from the 157 specimens, 13 specimens were made of Melian obsidian and 15 specimens from obsidian originating from Yali Islet. Flakes are most abundant compared to other artefacts. In a total of 1116 pieces, 195 (17,4%) are of Melian obsidian and 80 (7,1%) of Yali obsidian.

Chips from Melian obsidian are 47, 2 %(387 specimens) and consist the most numerous group. Chips made of obsidian from Yali are less, counting 128 specimens in a percentage of 15, 6 %.

Among the 121 blades found on the site some of them were dating back to the Neolithic (probably those with lateral edges and straight ridges). 53 of them were made of Melian obsidian. Two of them probably date back to the Neolithic period. 10 specimens of Blades made of obsidian from Yali were found. At this point the fact that the techniques of blades production have various differentiations should be mentioned.

Chunks and waste items coming from various raw materials were found on the site. Regarding obsidian chunks, the majority of them come from Yali obsidian. The quality of this raw material resulted in the left-over of large quantities of waste while it was being processed.

In the site of Keramos 1, 297 retouched stone tools were found. The typology consists of end scarpers (5 from Melian obsidian and 3 from Yali. Also one end scarper on flake made of Melian obsidian), burins, becs and perforators (one specimen made of Melian obsidian and a trihedral perforator made from obsidian sourcing from Gyali), retouched truncations whose seven specimens were made of Melian obsidian, backed pieces where 9 specimen were made of Melian obsidian

[93] Sampson A. et al, 2012

and 6 from Yali obsidian., retouched flakes (14 specimen made of Melian and 2 from Yali obsidian), raclettes, which consist of three made of Melian raw material., denticulated notched tools (17 pieces of Melian and 3 from Yali obsidian), bladelets with impact fractures, which were three in total, and made of Melian obsidian , two bladelets with a proximal notch, both made of Melian obsidian. All of the unidentified chipped tools were made of white-patinated flint; processed pebbles: three specimens were found, no one made of obsidian.[94]

On the surface of the site few Neolithic artefacts were found. In this category a small flake from surface retouch was found. The tool was made of Melian obsidian. Also, a fragment of a regular blade, with lateral semi steep retouch and another fragment of a blade with flat, lateral retouch made from Melian obsidian were found.

It is not possible to form a picture regarding the economy of the site due to the absence of organic remains. The only find was two types of few land snail shells. No marine shells have been traced contrary to other Mesolithic sites.

During the surveys in the island of Ikaria, other Mesolithic sites have been identified. The sites are located very close to Kerame 1, within a distance of one to three kilometers.

The site of Panagia is the closest to Kerame 1 and is located on a small plateau near a Monastery of Panagia. The finds were collected in open areas from shrubs and include artefacts made of flint and obsidian, originating from Yali.

The site Nyfi 2 is located near Nyfi, within a distance of 40 km from the Neolithic settlement. The site is a small plateau, preserving thick sediments. During surface survey flint and obsidian artefacts were collected. In this case obsidian originated from Melos.

The site Nyfi 3 is a low plateau which preserves thin sediments. The site lies very close to the site Nyfi 2 in a distance of approximately 500 m. In surface investigations flint and obsidian artefacts have been collected. Obsidian was originating from both sources: Melos and Yali.

The site of Sykies lies on the west of Nyfi 1 in a distance of one kilometer. No obsidian artefacts have been collected apart from few, made of flint.

During Early Holocene the sea level was probably 30-35 meters lower, thus the Mesolithic sites mentioned above were located further away from the seashore.

[94] Sampson A. et al, 2012

The environment was dry while the combination with the absence of any flora remains and the presence of few land snails, occurred with artefacts in two layers, indicates that the vegetation was sparse. [95]

Archaeometrical analyses using the method of Obsidian Hydration Dating (OHD) with SIMS-SS were carried out only on few specimens found in Kerame 1 and were dating back to the Mesolithic period, 10600+-1830 BC. Regarding the obsidian sources archaeometrical analyses showed Melian origin. However, the examining sample was very small at present, compared to the number of obsidians that were found, according to the excavator. The properties of obsidian originating from Yali can be identified macroscopically while the proximity of Ikaria to Antiparos and the preference of its habitants in this raw material which made them travel to Melos to exploit it, could suggest that it is very possible that among the specimens obsidian originating from the sources of Antiparos exists.[96]

Comparison among Mesolithic Aegean sites[97]

The comparison of lithic industry from the site Keramos 1 to other Mesolithic sites, locating in Aegean Sea, shows enough similarities. The comparison with the Mesolithic site on Maroulas of Kythnos Island shows similarities in the production of cores, by reduction processes. Regarding the differences, these are traced in the raw materials. Apart from the presence of Melian obsidian in higher amounts in the site of Maroulas, where the use of Melian obsidian is up to 31% in the overall lithic assemblages, the dominant raw material in the site of Maroulas is quartz while in Keramos 1 is the white patinated flint. Regarding the typology of stone industries Keramos 1 and Maroulas present similar types. The most numerous types in both sites are retouched flakes (Kerame 1: 22, 2 % and Maroulas: 16, 9%) and denticulated notched tools (Kerame 1: 19, 5% and Maroulas: 25, 9%)

The relation of stone industry of Mesolithic Kerame 1 to the Mesolithic layers of the cave Cyclops in Youra Island is not possible because the Mesolithic stone assemblages found in Youra are very small. The comparison is restricted only in a few types made of flint tools. Obsidian tools found in Cave of Cyclops in Youra Island cannot be attributed with certainty to Mesolithic deposits.

[95] Papanikolaou D., 1978, pp. 321-329,
[96] Sampson A. et al, 2012
[97] Sampson A. et al, 2012

Other Mesolithic sites in the Aegean have been detected in the islands of Naxos and Chalki correspondingly. The two sites were found during surveys conducted over the recent years by the professor of the Aegean university Adamantios Sampson. Both sites have provided enough artefacts.

In Naxos tens of artifacts were found. The dominant raw material was Melian obsidian while some of them have been made of flint.

In the small island of Chalki more than a hundred artefacts have been collected. The artefacts of Chalki were also made of Melian obsidian and from Obsidian originating from Yali and a few were made of brown flint.

Regarding the typology of artefacts, these consist of becs, hypermicrolithic end scrarpers, short blade-end scrapers, denticulated notched tools, retouched flakes. All of these types are also found in Mesolithic Aegean sites of Kerame 1 and Maroulas of Kythnos Island. The main difference of the finds collected in Naxos and Chalki is that in both inventories regular bladelets have been isolated. The presence of regular bladelets in combination with the presence of typical trapezes perhaps indicates that those two sites are younger compared to the other Aegean Mesolithic sites. However, there are no archaeometric analyses to confirm this case objectively undoubtedly.

Regarding the chronological frame of the Aegean Mesolithic sites, radiometric analyses of obsidian specimens indicate that the site of Kerame 1 in Ikaria, the site of Maroulas in Kythno and probably the lower deposits of the Cave of Cyclops in Youra may be contemporaneous. Concerning the Mesolithic sites situated on the islands of Naxos and Chalki the lithic assemblages indicate posterior chronology than Kerame 1 and the same chronology as the Mesolithic sites of Kythnos and Youra.

The Cave of Schisto at Keratsini, Attica

The cave of Schisto at Keratsini in Attica is situated on the southwestern foothills of Aigaleo Mountain. The Cave was first investigated in 2000. Systematic researches started in 2006 and are still in progress. The investigations are conducted by the Ephorate of Paleoanthropology-Speleology of Southern Greece with the contribution of scientists from various countries. [98]

[98] F. Mavridis, 2006

The entrance of the cave is at an altitude of 251 m with sea view. It consists of a main room and an underground low area formed after the fall of boulders. The oldest finds of the cave date from 11000 to 7000 BC according to the excavators of the site. Prehistoric tools, bones artefacts, flora and fauna remains have been some of the findings so far. [99]

According to flora and fauna remains, the inhabitants of the cave had a rich diet consisting of deer, hares, birds, fish and marine shells as well as a kind of a horse that has now been extincted. Palaeobotany studies have shown the presence of various plants in their wild form such as cereals, legumes, fruits and nuts.

The lithic assemblages were made mainly of flint and obsidian. A bone implement reminiscent of hook has been found. However this implement could date back to the Neolithic phase of the cave. Pottery has been found in the Neolithic deposits of the cave.

The stratigraphy of the Cave seems to cover the period from the Mesolithic to the Bronze Era and to the historical period. According to archaeometrical analyses (Radiocarbon 14) the oldest deposits of the Cave date back to the eleventh millennium BC, making the Cave the oldest of all and unique for the area of Attica.[100]

The Island of Gavdos

Another site where the transfer of obsidian by sea is tested is Gavdos Island. Gavdos is a small island located in the south part of Crete and is considered as the southernmost part of Greece and Europe at the same time. At the edge of Greece and Europe and between Greece and Africa Gavdos could be regarded as isolated or as a nodal point. These characteristics make the case of Gavdos an exceptional one for the study of various issues regarding prehistory. [101]

Researches were conducted and are still in progress by the Department of History and Archaeology of the University of Crete and the Greek Ephorate of Prehistoric and Classical Archaeology. The director of the excavations is Professor K. Kopaka.

[99] F. Mavridis, 2006
[100] Laskaris N. et al, 2011, pp. 2475-2479. Also, see: F. Mavridis, 2012
[101] K. Kopaka & C. Matzanas, 2009. Also, see: Kopaka & C. Matzanas, 2011, pp. 43-82,

The finds are dating from the Palaeolithic to 7000 BC. The Palaeolithic tools that were found are dating from 200.000 to 12.000 BC. These datings are particularly high and change the prehistoric data and the role that this island and Greece in general played during Prehistory. At this point the other very important finds of prehistoric stone tools from the area of Plakias in the neighboring to Gavdos island of Crete, which according to the researchers also date back to the Lower Palaeolithic should be mentioned. [102]

A Paleolithic hand axe, made of local limestone, found in the beach of Sarakinikos, has all the characteristics of Achelaia stonework and could be dated back to the Lower Plaeolithic.

The other very important find is the presence of Melian obsidian back dating to the final Palaeolithic- Mesolithic period, in the eleventh millennium. In addition, in the location of Agios Pavlos an early "workshop" of tools was located. Further investigations on the area will enlighten this discovery and its role.[103]

The Neolithic Period of Greece[104]

Obsidian was used for the tool manufacture during all of the phases of the Neolithic period (around 7000 BC to 3200 BC). The raw material was not mined by a group of people permanently settled in the places of the sources but by specialized groups, that in order to extract the raw material from the quarries, travelled from their installations to the place where obsidian existed.

During the Early and Middle Neolithic, around 6800-5300 BC, obsidian was prepared at the site while during the Late and Final Neolithic, 5300-3200 BC, obsidian was transferred in the form of nodules, which were roughly manufactured. In general, during the Neolithic the exchange and transfer of obsidian was intensified greatly and the movement of obsidian diversified and joined the more and more increasingly complex trade networks that have been created in the area of the Eastern Mediterranean.

Lithic inventories made of obsidian, (dominated by Melian obsidian so far) and dating back to the various phases of the Neolithic have been found in almost all of Greece, which indicates an extensive exchange network. Correspondingly in

[102] K. Kopaka & C. Matzanas, 2009. Also, see: Kopaka & C. Matzanas, 2011, pp. 43-82,
[103] Kopaka & C. Matzanas, 2011, pp. 43-82,
[104] Perles C., 2001

Neolithic Greek sites obsidian which is not originating from Greek sources has been found, or in other Neolithic sites situated in other parts of the Eastern Mediterranean Melian obsidian or other obsidian, which is not originating from the same part has been found.

The origins of this date back to the Mesolithic Era, where obsidian trade was also more extensive than it was thought until recently. The discovery of obsidian assemblages is typical for Neolithic excavations and probably indicates the degree of dependence of Neolithic economies from these exchanges. At this point it should be mentioned that during the Final Neolithic the metal trade of copper, silver and lead from the mines of Laurium and Sifnos was involved in the extensive obsidian network (in the case of Greece).

The Greek Neolithic period is subdivided into the following phases:

Aceramic: 6800-6500 BC. Evidence from human habitation from pre pottery Neolithic period exists in Franchthi and Knossos in south Greece. Argissa is in Thessaly and Youra is in the North Aegean Sea.

Early Neolithic: 6500-5800 BC. There are sites again in Franchthi, Sesklo in Thessaly, Knossos in Crete, Agios Petros in Western Makedonia, Youra in Northern Sporades.

Middle Neolithic: 5800-5300 BC. Various sites have been located dating back to this period: Sesklo I-III, Chaeronia in Central Greece, Knossos V-VII, Servia in Kozani.

Late Neolithic: 5300-4500 BC. This phase is subdivided into two more phases: the Late Neolithic I (5300-4800 BC) which consists of the sites of Knossos III and IV in South Greece, Saliagos in Cyclades, Emporio IX-X in the North Aegean. Abundant sites have been located in Makedonia and Thrace: SitagriII, Dikili Tash I, Makrigialos I, Parademe III, Dispilio, Makri, Vasilika I-II.

Late Neolithic II (4800-4500 BC). From this period the following sites have been located: classic Dimini, Otzaki and Agia Sofia in Thessaly, Nea Makri, Korykeion Cave and Diros in Central and South Greece, Paros, Naxos, Saliagos in Cyclades and Knossos I-II in Crete, Emporio VIII in Northern Aegean. Also, the majority of the sites so far investigated in the area of Macedonia and Thrace are the followings: SitagriIIIA, Dikili Tash IIB-C, Makrigialos II, Parademe IV, Dispilio, Makri, Vasilika III-IV, Olynthus 1-3.

Final Neolithic or Chalcolithic: 4500-3200 BC. Archaeological sites dating back to the last phase of Neolithic are Rahmani. Pefkakia and Petromagoula in the area of Thessaly. Kephala and Diros in Central Greece, Poliohni I and Emporio VI-VII in the North Aegean and Mandalo I-II, Kritsana, Sitagroi IIIB-C and Makri in Macedonia and Thrace. [105]

CRETE

The question of the initiation of the Early prehistory in Crete was until recently a very controversial issue among the researchers. On the one hand the advantageous location of the island on hominids way for their dispersal from Africa into Europe and on the other the excellent conditions that are prevailing on the island. The geomorphology of the island could be described as ideal for the needs of prehistoric hominids and humans with fresh water sources, raw materials for the tool manufacture and variety in flora and fauna.

However, the oldest archaeological stratified data were derived from the site of Knossos and they were dating in the seventh millennium. Another problematic point was the almost total absent of any remain that would be dated in the Early Prehistory. The only exception was the discovery of a hippo bone that dated by radiocarbon at 12.135 +/-485 BP. The discoveries in the other Mediterranean island of Cyprus in the site of Aetokremnos altered the researchers' point of view. There hunters-gatherers used to visit the island between the 12^{th} – 10^{th} millennium and they were responsible for the extinction of some kinds of the fauna of the island. Researchers start considering that something like that could be the reason that there have not been discovered in any Cretan settlement contexts any prehistoric animals remains with the exception that mentioned above.

Finally, it was only matter of time remains that are dating in Early prehistory to be discovered. And indeed, the discoveries from Plakias exceeded all the expectations. The researches have been conducted in the region by the American School of Classical Studies under the supervion of Th. Strasser and E. Panagopoulou with the contribution of C. Runnels.[106]

[105] Perles C., 2001
[106] Strasser F.Th. et al, 2010, pp. 145-190

The discoveries of Palaelithic lithic assemblages indicate that humans or hominids visited the island as early as 700.00years BP to 130.000 years BP. In the same time, Mesolithic sites have been discovered in the island of Crete. The Mesolithic finds have been traced along the Palaeolithic discoveries in the region of Plakias. The sites are located in the western area around Plakias and the Eastern area around Ayios Pavlos and are listed chronologically on the table:

TABLE 1. CHRONOLOGY OF THE SITES

Sites	*Palaeolithic*	*Mesolithic*	*Other*
Damnoni 1	—	×	—
Damnoni 2	—	×	—
Damnoni 3	—	×	—
Ammoudi 1	—	×	—
Ammoudi 3	—	×	—
Ayios Pavlos 1	—	×	—
Ayios Pavlos 2	—	×	×
Ayios Pavlos 3	—	×	—
Schinaria 1	—	×	—
Schinaria 2	—	×	—
Schinaria 3	—	×	—
Schinaria 4	—	×	×
Schinaria 5	×	—	—
Schinaria 6	—	×	—
Preveli 1	—	×	—
Preveli 2	×	×	—
Preveli 3	×	×	—
Preveli 6	—	×	—
Preveli 7	×	—	—
Preveli 8	×	×	—
Kourtaliotis 1	—	—	×
Kotsiphos 1	×	—	—
Plakias 1	—	—	×
Timeos Stavros 1	×	—	—
Timeos Stavros 2	—	×	—
Timeos Stavros 3	—	×	—
Timeos Stavros 4	×	—	×
Gianniou 1	×	—	—

(Strasser et al, 2010,p.148)

The lithic industries that discovered in the sites indicate similarities with the contemporaneous findings in the Aegean Sea and the Greek Mainland. Also, these discoveries show strong evidences that hominids and humans used to cross the sea from a very early stage. The potential discovery of similar finds in other islands will completely altered the current knowledge and beliefs regarding early human migration.[107]

The Neolithic settlement of Knossos is one of the oldest in the Aegean and according to the scientists this is not a coincidence. The island of Crete could provide in the Neolithic settlers the essentials and these conditions favored the permanent settlement. The settlers probably came from Anatolia and brought the new way of Neolithic life on the island.

[107] Strasser F.Th. et al, 2010, pp. 145-190

However the various analyses of the material culture of the Early Neolithic II-Middle Neolithic suggest that the new settlers did not manage to assimilate their new environment so as the increase and spread of population to be favored. This perhaps explains the "Neolithic poverty" that characterizes the island of Crete. The known Early Neolithic sites in Crete that have been examined adequately are restricted and apart from the Neolithic settlement of Knossos are the Cave of Gerani (west of Rethymno) and the Lera Cave (west of Chania).

The Neolithic settlement of Katsmabas is dating in the Early Neolithic I and II. In the site only one piece of obsidian have been discovered. [108]

During the Final Neolithic, the Neolithic settlements appeared an important increase. Sites that have been identified in Crete and are dating in the Final Neolithic based on Moody's survey are traced in the area of Akrotiri of Chania. Also, in the highlands of Sfakia, when the area first inhabited. Additionally, in the area of West Messara, where one site (Kannia) is dating in the Middle Neolithic and nine more, that they were open settlements, caves in the coast of Messara, in the centra plain, in the Asterousia Mountain and the Mount Ida. Also, in the Istron area, in northeastern Crete three coastal sites of the Final Neolithic have been discovered. The small islet of Pseira was first inhabited during this period. The recent discoveries of the Final Neolithic site of the Kephala, Petras at Siteia enriched our knowledge in the Cretan Final Neolithic. During the excavations of the site important quantities of obsidian have been discovered. The quantity of about 1376 pieces of obsidian has been unearthed. The 1235 pieces are probably assigned in the Final Neolithic IV and Early Minoan I. based on preliminary macroscopic analysis the majority of the quantity of obsidian that has been discovered on the site is originating from the melian sources Sta Nychia and lesser from Demeneghaki (a quantity of 15 %). Some undiagnosed pieces perhaps derived from the sources of Yali. Also, it cannot be excluded an Anatolian origin for some of the undiagnosed pieces of obsidian. However, an archaeometrical analysis will shed more lights on these hypotheses.[109]

All of these sites mentioned above (even though they may used to have a seasonal character) they presented alterations in their size. For example the Neolithic settlement of Knossos, in the Early Neolithic was 3ha and in Final

[108] Galanidou N. & Manteli K., 2008, pp. 172-183
[109] D'Annibale Cesare, 2008, pp.191-200

expanded in around 5ha. The same was for the Final Neolithic of Phaistos,[110] where the settlement was around 5.6 ha. This fact suggests that there was a significant increase in the number of the population of the island during this period.

The archaeological data from the Final Neolithhic like pottery, figurines and of course obsidian show contacts and relationships with the islands of East Aegean, the Peloponnese and the "Attic-Kephala" culture and Cyprus. Overseas contacts and relationships seemed that were a general trend in the area of the Aegean and the Near East of the Final Neolithic. This trend is going to be culminated in the following period in the area of Eastern Mediterranean.

ANATOLIAN SITES

The peninsula of Anatolia is situated at the meeting point of the continents of Asia and Europe while is neighboring with Aegean Sea from the West and the Mediterranean Sea from the south.

The geology of Anatolia presents intense complexity. The presence of volcanism is resulted in the formation of rich sources of raw materials. One of the most important and the main subject of this paper is the sources of obsidian. The main obsidian sources in Anatolia that exploited during prehistory are located on Central Anatolia, the Cappadocian sources, and the others on the North central Anatolia. In the area of Anatolia obsidian was exploited since Epipalaeolithic.

Climate

In Anatolia climate conditions turned to be more stable comparing to the prevailing climate during Pleistocene, when rapid alterations there were and dry and cold conditions.

The archaeology of the Near East and the spread of neolithisation often is related with the 8.2 KA event as called.

It is a fact that the location of Near East in the crossroad of various climatic systems has affected the climatic conditions in the region of Anatolia. Before the beginning of Holocene, Younger Dryas, caused cold conditions while regarding the vegetation, like in the rest of Mediterranean there were steppe. The following period, in Early Holocene between 9.000 and 6.000 BP, the climatic conditions improved and turned to be stable and milder, than the current climate of the

[110] Vagneti L., 1972/1973 , pp. 115 "L'insediamento neolitico di Festos", AS Atene34/35, 1972/1973, pp.7-138

region. Like in the rest of the area of Eastern Mediterranean the transition from the Pleistocene to the Holocene was not mild.

The sea level changes had great impacts in the geomorphology of Anatolia. During the period of Late Glacial in Pleistocene around 25.000-18.000 BP the sea level was 100-130 below the present. The conditions that occurred in the Late Pleistocene and Early Holocene resulted in the ice melting and the sea level rise. The shorelines affected more from these alterations while another factor that caused the elevation or the precipitation in various areas was the movement of the tectonic plates. However, the stabilization of the conditions led to the corresponding stabilization in the geomorphology of the area with few exceptions that continue to have alterations but this is not a subject for the scope of this paper.

The southern coastline of Anatolia is characterized by mountains that are rising from the sea and the impacts of the sea level rise were impalpable. Impacts there were in the area of Antalya in the south coastline and in the area of Cilicia in the southeast, where the sea level rise with the combination of other factors like the alluvial have resulted on the one hand in the preservation of the prehistoric sites of the area with either their sinking or their burying under deltaic formations and on the other in an overall impact in the landscape of the region. The coastline of the Asia Minor used to extended westwards during the Late Glacial Maximum and was united with islands of Northern Aegean and the northern part of the Dodecanese islands in the Aegean Sea. The period of Late Glacial and Early Holocene the sea level rise has resulted in the precipitation of these parts of lands and the coastline of Asia Minor took its current form.

The Epipalaeolithic is used to characterize the hunters-gatherers in the area of Anatolia. In the area of the Near East settlements of hunters-gatherers-fishers have been discovered in the Natufian Culture for examples in the area of the Southern Levant but the majority is dating at the last millennia of the Pleistocene.

Obsidian in the area of Anatolia was used widely and was traded mainly by land in the areas of Near East. There are few evidences that Anatolian obsidian was also traded by the sea. The transfer of obsidian by land occurred in a very early stage – from Epipalaeolithic- from the Anatolian Plateau to the Northern Levant, in a period when sedentism did not exist in Anatolia but existed in the Natufian Levant. The contacts between the two areas could play a key role in the

formation of communities in the Anatolian Plateau. The transfer of obsidian in the Levant maybe was the impetus for the creation of a network between the south and east areas in order to ensure the transfer of the material. So this could bring the areas closer and led them in the creation of the first communities.

The transfer of obsidian occurred from the Late Epipalaeolithic (Pinarbasi) to the Neolithic. Based on archaeological data there was an interaction and an exchange in ideas, techniques and materials, like obsidian. The obsidian implements that produced in the obsidian workshop of kaletepe , in the area of the sources of Gollu Dag, seems that promoted in the areas of Levant, Euphrates and Cyprus and not in the surroundings areas, perhaps with few exceptions. The people that were involved in the transfer of obsidian perhaps brought with them the domestication of plants and the herding of animals and contributed in this way in the spread of the new way of life. This theory is different from the present theories regarding the spread of agriculture. However, it is clear that in such a case would contribute other more complex factors too.

The Cappadocian sources at Gollu Dag, Nenezida and Acigol and those at Sakaeli, Yaglar and Galatia-X in the Galatean Massif considered that were the most important during prehistory.[111] As mentioned above the obsidian transfer in Anatolia occurred mainly on land. There are however few examples that indicate that obsidian transfer by the sea co-existed, though in a smaller scale. Anatolian obsidian has been found in the island of Cyprus and in few sites in Greece. Conversely, melian obsidian has been traced in few sites of Anatolia, Morali and Aphrodisias locating in the Asia Minor.

Obsidian sourcing from Gollu Dag has been traced in sites of the Levant, such as Mureybet, Abu Hureyra, Ain Mallaha while the following period of the Pre Pottery Neolithic A (9500-8700BC) has been found in Jericho, Tell Aswad, Netiv Hagdud, Mureybet and Jerf el Ahmar. The subsequent period of Early and Middle Pre Pottery Neolithic B (8.700- 7.500 BC) the transfer of obsidian is more intense and occurred so by land like the discoveries in the sites of Abu Hureyra, Tell Halula, Ras Shamra, Nahal Lavan as by the sea in the site of Shillourakampos in the island of Cyprus[112]. During the Late Pre Pottery Neolithic B and into the sixth and fifth millennium the transfer of mainly Cappadocian obsidian continues

[111] During S.B., 2011, pp.53

[112] Briois, F. et al, 1997, pp. 95-112

especially in the Fertile Crescent.[113] Also obsidian originating from Gollu Dag has been identified in another Cypriot site, in Neolithic Khirokhitia (around 7.700 BC)[114]

Anatolian obsidian sources were exploited extensively and the raw material was transferred notably long distances mainly by land and less by sea. Anatolian obsidian was used and transferred from the Palaeolithic. The earliest evidence for obsidian transfer by land in Anatolia dates back to the period of Upper Palaeolithic. The raw material was transferred in a distance of about 400km by land from the sources of Lake Van to Shanidar Cave in Zagros Mountains of Kurdistan in Iraq.

Raw material originating from the Cappadocia sources was also transferred in a distance of 350 km to the southwest Anatolian coast, in Antalya. However, all of these transports were made by land. The material continues to be transferred in long distances by land during the Mesolithic. Archaeological data also came from Jericho where obsidian has been found and dated back to 8000 BC.

The site of Catal hoyuk (6300-5500 BC) indicates that in the seventh millennium the transport of obsidian was intensified to a great extent. At the site evidence of specialization due to the large amounts of the raw material that was found on it was first detected. It is evident that the material was extracted by experts or by others, who travelled a distance of 200 km in order to extract the raw material and then transfer it and trade, having their own "profit" as a primary goal.

Indications for Anatolian obsidian transferred by sea appeared in archaeological data from the seventh to the sixth millennium. In Cyprus findings of obsidian in Neolithic Khirokitia suggests contacts by sea.

Anatolian obsidian transferred by sea has also been found in sites located on the Levantine Coast. The adoption of a new life style by the Neolithic communities seems to have broaden all of their economic and social aspects. On this basis obsidian has been found in Mersina and Byblos dating from the sixth millennium BC. Other sites are Ras Shamra (6410 BC), at Tabbat al-Hammam (6000 BC).

[113] During S.B., 2011, pp.53-55

[114] Chataigner, C. et al, 1998, pp. 517-537. Also, see: Renfrew, C. et al, 1968, pp. 319-331.

Despite the existence of obsidian sources in Aegean, Anatolian obsidian has been found in Greek sites. Obsidian originating from Anatolia has been found in stratigraphic deposits of Knossos, in Crete, dating in Bronze Age.

The prehistory of Cyprus

Cyprus is the third larger island of the Mediterranean Sea and is situated in the easternmost part of the Mediterranean Sea. The island's coastline is characterized by alteration of rocky beaches, promontories and coves. The interior landscape is formed by extensive plains, interrupted by hills of various shapes and forms and mountains covered by forests. The mountains of Pentadaktylos extend along the northern coastal plain of the island of Cyprus while on the south there are the Troodos Mountains and between them the fertile plain of Messaoria lies.

Cyprus was always an island. Alterations from that era occurred of course in the final shaping and the geomorphology of Cyprus, mainly during the Glacial Periods in the Pleistocene, however it has been always surrounded by sea since the beginning of its creation, around ten million years ago. There are no obsidian sources in the island of Cyprus. Thus, the only possible way obsidian to exist in the island is to have been transferred by sea.

Over the last decades a significant number of prehistoric sites have been unearthed on the island of Cyprus, and have altered both the picture of the islands' prehistory and the prehistory of the Eastern Mediterranean in general.

The site of Shillourokampos is situated in southern Cyprus, in the east of Limassol (Lemesos), near Parekklisia. Shillourokampos is a settlement of PPNB aceramic Neolithic period. During the site's excavations, four phases beginning with the site's occupation around the end of the ninth millennium and which lasted until almost the second half of the eighth millennium have been discovered. Among the lithic tools found and dating back to the earliest phase were bladelets made from obsidian originating from Anatolia. (vivlio 90) About 500 small pieces of obsidian were found and mainly dated back to early phases A and B. Obsidian as a raw material holds the two per cent of the total amount of chipped stone industries and comes from the Cappadocia sources, from Gollu Dag. A controversial issue regarding the obsidian finds in Shillourokampos is whether obsidian was transferred to the island as a raw material (cores) and was processed at the site or as finished tools. Regarding the typology of these

obsidian tools, the majority of the bladelets were produced by the pressure technique and could be transferred all together in one way while obsidian finds belonging to middle and later phases are lesser in quantity and have been replaced by local stones, like chert for the tool manufacture. This differentiation in the use of obsidian for the tool manufacture at the site of Shillourokampos between the early phases and their subsequent ones could be explained. [115]

Mylouthkia is located in the north of Kissonerga, which lies in the south west part of the island. Obsidian has been discovered in the site of Mylouthkia, where twenty one pieces of Period IA and one piece from Period IB correspondingly have been discovered. These obsidian pieces are mainly waste material that has been reprocessed and consists of chips, shatter fragments, bladelets and narrow blade segments. Regarding the acquainted tool types of five pieces four of them are *pièces esquillées* (scaled pieces) and one of them is a large retouched blade. As in the case of Shillourokampos, after obsidian analysis with laser ablation ICP-MS analysis, it was identified that obsidian found in Mylouthkia originated from the sources of Central Anatolia and Cappadocian Gollu Dag. More or less this pattern concerns the finds of obsidian found in Southern Levant and dating back to PPNB.[116]

Comparing obsidian finds from the sites of Sillourokampos and those from Mylouthkia, some observations can be reported. The obsidian quantities that have been found in Mylouthkia from the Period IA is 12 % and from Sillourokampos from Early Phases A and B is 2% of the total amount of lithic assemblages and consitute the only non local material used in the chipped stone assemblages that have been found in both sites. Regarding the artifact types there are similarities among them: narrow blades, bladelet segments with a certain retouch, *piéces esquillées* and quantity of debris of small size. Obsidian during the early stages of the Aceramic Neolithic at those two sites doesn't seem to be considered as an exotic raw material. This realization regarding the use and meaning of obsidian is different from the one that existed in the area of the Levant in the period of the Late Aceramic Neolithic.

The excavation data from the sites of Sillourokampos and Mylouthkia have altered drastically the way that Cypriot prehistory was viewed and the role that

[115] Guilaine J. &Briois F., 2007,pp.159-175. Also, see: Guilaine J. et al, 2011,
[116] Peltenburg E., 2003, .Also, see: Peltenburg E., 2001, pp. 61-63

the island played in the Neolithic transition which was occurring simultaneously in the areas of Anatolia and Levant. The inhabitants of Sillourokampos and Mylouthkia were involved in various economic activities relating to crops cultivation and exploitation of animals according to the faunal and floral remains found at the sites, exploitation of marine resources and obtaining obsidian through maritime routes for the manufacture of lithic tools during the late 9th millennium BC. All these mentioned above, in combination with the wells and pits found on Mylouthkia, suggest that there was a permanent agriculture settlement about a thousand years afterwards.

Kalavasos Tenta: the site of Tenta is situated on the top of a small natural hill in the Valley of Vasilikos River, in the south central part of Cyprus and within a distance of about 3 km from the coast. The site is favored on the one hand by its proximity to the main east-west passage through the area and on the other hand by its easy accessibility to the resources of Troodos Mountains and to the sea. At the site Early Aceramic Neolithic residues have been traced extending with the current state of research to 0.25-0.30 ha apart from the scattered Neolithic material which spread over 2.5 ha. According to estimations structures at the site could be 40-45 ha. In the area of Tenta and in the area of the nearby village Kalavasos at least four other sites of the Aceramic Neolithic Period have been traced.[117]

The site is surrounded by an outer stone wall and a ditch cut in the bedrock. Regarding the chronology, the excavator of the site identified five periods, the four of which are related to the Early Aceramic Neolithic. The stratigraphy of the site was a little complicated because of the three different areas where separate architectural levels have been traced. On this basis, the correlation of each area to each level and by extension the correlation of each level to the other was not easy.

The inhabitants of Tenta could be descendents of early colonizers, like those who have been detected in the site of Aetokremnos. They could also be related to the Early Aceramic Neolithic immigrants who arrived in the island later, during the Levantine PPNA. Evidence from the sites of Mylouthkia and Sillourokampos suggests that the inhabitants of the site could be related to the earliest seafaring

[117] Todd A. I., 2001, pp. 95-97

visitors of the island of Cyprus and that they do not represent a single colonization but on the contrary their presence is the result of a gradual process. (106)

According to McCourtney and to the radiocarbon dating which compares the chipped stone assemblages found on the sites Paleokamina, Kelaidoni, Asrokremnos to those found on the sites of Sillourokampos and Mylouthkia they are considered as "contemporary", of an equivalent period of the Levantine PPNA and thus they can work as a basis for the understanding of the permanent settlement in the earliest prehistory of Cyprus. Over the last years the archaeological data regarding the earliest prehistory of Cyprus are continuously enriched while the surprises come the one after the other. This, combined with the fact that some new data from the sites of Asprokremmos, Ais Giorkis and Arkosyko have not been fully published yet results in the possible alteration of the various interpretations. In any case, scientists are still not in position to answer the question whether the island of Cyprus was continuously occupied between the Late Epipalaeolithic and Early Aceramic Neolithic or not.

Ais Giorkis(7900-7500 Cal. BC): The site of Ais Giorkis is an Early Pre Pottery Neolithic site and is situated in the foothill of Troodos Mountain in Western Cyprus, Paphos district. The site dates back to the Pre Pottery Neolithic B, between the later 9th and the end of the 8th millennium Calibrated BC. It is revealed that the site is unique, with some of the earliest directly dated domesticated animals in the Near East, with a unique and unusual architecture and evidence for trade and feasting activities. Based on the more than twenty radiocarbon datings that have been obtained from faunal (animal bones) and botanical remains found at the site, its primary occupation is placed around the middle of the 8th millennium (Middle to Late Cypriot – Pre Pottery Neolithic B). Excavations have not revealed buildings so far, but finds such as pits and circular platforms constructed of small cobbles have been traced, while at least the two of them bearing plaster on their top, constitute unique architectural features. Fauna remains are very abundant both in terms of quantity and of variety of species including fallow deer (53%), pigs (28 %), sheep and goats (17%), cattle (2% -up until recently it was believed that these animals were introduced in Cyprus in a later era) while smaller quantities of dogs, cats, fish, birds and foxes have been discovered. [118]

[118] Simmons A. H., 2012, pp.86-103

A huge quantity of chipped stone assemblages, about 200,000 pieces, has been discovered at the site. After examination and analysis of chipped stone material, a few parallels with the Neolithic of Near East have been identified in some cases. According to the director of the excavation, Alan H. Simmons, the characteristics that have been traced in the site, such as the architectural features and the presence of a variation in economic assemblages like the not that common cattle, the prestige items and obsidian, suggest that the site was not a permanent settlement but its character was more seasonal for activities like hunting, trade and feasting and seems to have worked as a station for refueling raw materials and other resources. What is more, the circular platforms suggest that the site could be allocated to communal feasting activities according to the excavator.

The chipped stone industries found in Ais Giorkis are estimated in 200,000 pieces and have been made mainly from Lefkara cherts. Among them 42 obsidian bladelets have been recovered. One of them was a burin while another one that has been collected by the Canadian Palaipaphos Survey Project was originally located in Ais Giorkis. Obsidian found at the site originates from the area of Ciftlic in Anatolia. Also, obsidian found in the site of Tenta originates from the Ciftlic sources in Anatolia as well. The village-site of Ais Giorkis is located in uplands; therefore the recovery of obsidian, even in a small quantity, in this non coastal site, makes it even more important and indicates the use of this raw material in the Early Aceramic Neolithic period. In general, the combination of the findings in the site of Ais Giorkis that includes faunal remains, cattle bones, obsidian and prominent points suggest strong similarities to Levantine PPNB period style.

According to Alan H. Simmons, director of the excavations at the site of Ais Giorkis, the Neolithic Revolution started independently in different places, however the oldest data come from the Near East, beginning around 11,000 years ago. The adjacent areas of Mediterranean delayed in adopting the new way of life. Neolithisation delayed to arrive in the neighboring region of the Eastern Mediterranean. However, the data regarding island colonization have been altered in the light of new researches. The role of Cyprus in this is fundamental. The recent discoveries have shown that the island of Cyprus had a Pre-Neolithic occupation and a very early Neolithic occupation with both Pre Pottery Neolithic A and B, that are so early as those of the mainland and begin around 10,500 years

ago and is now documented by a handful of village sites , the majority of which so far are coastal with the exception of Ais Giorkis which is located in the upland margins of the west part of the island of Cyprus.

Khirokitia Culture: The occupation of the settlement of Khirokitia began in the aceramic Neolithic period and according to the excavation data it was a well organized society with various activities. The main activities of the inhabitants of the settlement were farming, mainly of cereal crops, hunting and herding. The animal species that have been identified were deer, goats and sheep. The inhabitants of the site also used to collect fruits (like pistachio nuts, figs, olives, prunes) from the wild trees of the surrounding area. The site is situated in Maroni Valley, on the slopes of a hill, about 6km from the southern coast of the island, in the district of Larnaca. The foundation of the settlement dates back to the seventh millennium and after abandonment for unknown reasons it was reoccupied in the 5th millennium around 4.500 until 3800 BC in the Late Neolithic period and then permanently deserted. Also, other sites of the island were suddenly abandoned in the mid of the sixth millennium and reoccupied after a thousand years, in the ceramic Neolithic period. The site was excavated by P. Dikaios during the period 1936-1946. In 1977, new excavations have been started at the site by A. Le Brun. The Aceramic Neolithic village covered maximum 1, 5 hectares. Among the architectural remains is a thick mud wall with a stone facing and was used for the defense of the settlement. When the village was extended to the west another defensive wall was built. A staircase (preserved height 2, 50 m) with an impressive architectural complex gave access to this part of the village, existing in the top of the hill.[119]

Other architectural remains include houses, that were constructed without foundation, directly to the ground and which are separated from each other with narrow passages. These houses were circular and have been made of stone and mud brick. Their roof was flat, constructed by branches and earth. Their size varied in diameter which ranged from 1, 4 to 4, 8 m. The houses, equipped with hearths and basins were grouped around an open area where domestic activities took place. Other finds include aceramic Neolithic stone vessels with carved decoration and stone figurines which include one made of unbaked clay (anthropomorphic figurine). The site was protected from all sides apart from the

[119] Knapp B. , 2013, PP.120-150

west one, by the River Maroni and by steep slopes. From the west side the site was surrounded by successive walls. The site was occupied from the seventh to the fifth millennium. The complex architectural system that has been discovered in Khirokitia is considered to constitute a collective effort indicative of a structured social organization for large scales works. This is extremely important and there are a few known parallels in the region of the Near East. Other finds are flint and bone tools, stone vessels, animal and plant remains (early forms of wheat, barley, lentils). Regarding burial practices according to excavation data, dead were buried in pits beneath the rammed earthen floor of the houses.

The remains of the Neolithic period of the site are less monumental especially regarding architectural remains. However, apart from the characteristic pottery, new forms of plant and animal remains suggesting that life was based again on agriculture and domestication of animals have been unearthed during the excavations. The site was abandoned in the early fourth millennium.

According to research data so far, Cyprus was always an island, separated from the mainland. Cyprus location is very important for human prehistory since it is in the middle of an area which is considered to be a cradle of human evolution according to research data so far. Cyprus faces the south coast of Anatolia and that of Lebanon and Syria. Only from the geography of the island one could consider that Cyprus must have played a key role in earliest prehistory. However, archaeological data were very poor until recently. Only over the last years Cyprus plays a leading role in the archaeology of prehistory due to the discoveries of very important early prehistory remains.

A study about Cypriot Neolithic lithic tools and raw materials demonstrated that the tool types found on these sites are related to domestic activities rather than hunting activities. Regarding raw materials, the use of obsidian for the manufacture of stone tools is considered to be not very common but at least not absent at all. Obsidian finds have been found at Khirokitia, Cape Andreas Kastros and Kholetria Ortos. The obsidians are originating from Gollu Dag, in Anatolia. Despite the fact that obsidian was an exotic material, since there was not in the island of Cyprus and it must have been transferred by sea from other places, it does not seem to have any special treatment or difference compared to other raw materials found on the sites. The only evidence possibly showing that this raw material was considered to be special came from a retouched pointed tang of fine

pressure found on Khirokitia. In any case, the presence of obsidian (50 pieces at Khirokitia), even in small quantity indicates that maritime contacts throughout the Late Aceramic Neolithic, continue to exist, though less intensively, on a basis of trinket exchange or just as an effort for long distance contacts for the finding of raw materials to be maintained. The possibility that the obsidian found in Late Aceramic Neolithic sites, at least in small quantities was recovered from the sites of Early Aceramic Neolithic, where obsidian was more abundant, should not be excluded. (p. 133-134 and 151)

Obsidian as raw material for the tool manufacture, despite its presence (around 100 pieces, p.151) is considered to be less common in the Late Aceramic Neolithic than it was in the Early Aceramic Neolithic. Even in this case there is no evidence that obsidian was considered to be a prestige item, although it was an exotic, imported raw material transferred by sea. The fact that the use of obsidian is abundant in the early phases of the Aceramic Neolithic (see above the site of Sillourokampos) and its use was reduced during the Later phases perhaps makes sense on the basis that the settlers must have had more often contacts with homeland during the earliest stages of their settlement. The transport of goods was a good way for these contacts to be kept. The reduction in the use of obsidian since even the Final Aceramic Neolithic may shows that the inhabitants tried to meet their needs from the existing raw materials in the island and in a lesser degree from imported raw materials like obsidian.

Still, maritime contacts for obsidian transport did not stop. According to obsidian finds, they continue to exist in the later periods but they are not that often. The use of obsidian in this period occurred but it was not that common. The decline in the use of obsidian during the later stages of Aceramic Neolithic is observed not only in Cyprus but also in the area of southern Levant. In this basis, it cannot be attributed to a possible isolation of the island in that period, since this decline is observed in other regions too. The most probable is that this reduction is due to the general decline in the use of obsidian as a raw material for the manufacture of stone tools and its replacement by other kinds of raw materials. According to excavation data, interconnections continue to exist of course with the transport of other raw materials such as the 106 engraved pebbles found in Khirokitia and the 51 ones found in Kholetria Ortos , indicating contacts among Cyprus contemporary sites in the central and southern Levant during the Late

Aceramic Neolithic. Another possible explanation could be the reenlistment of obsidian trade routes existing in the early phases of the Aceramic Neolithic. In general, the evidence suggest that between Cyprus and the Levant contacts with the exchange of goods as well as ideas have been developed not in an intensive way but in a rather loose way. These contacts were carried out independently by the various communities.[120]

In the Ceramic Neolithic of Cyprus obsidian continues to be used for the manufacture of stone implements but rather seldom. The finds are extremely rare and include one nugget from Vrysi and two blades and one bladelet from Kokkinoyia. McCartney suggests that these contacts of apparently low intensity for the supply of small quantities of obsidian are under what she calls "infrequent trinket trade". This situation can be compared to the corresponding one in the southern Levant after the collapse of the existing-as it termed- interaction sphere during the Pre Pottery Aceramic Neolithic. (186)

In the Ceramic Neolithic the decline of obsidian in imports is not the only new element in this period in Cyprus. Innovations occurred in the typology of tools with the appearance of new woodworking tools such as adzes, chisels, flaked tools as well as the use of low quality chert for the manufacture of long blades for example. Researchers like McCartney suggest that the fact that some features were met in the southern Levant is an indication that Cyprus probably belonged to an interaction sphere, extending from Lebanon, the area around Byblos to southern coastal Israel, Esdraelon Plain. According to researchers (see Clarke) similar links have been identified in these areas in the period of the Ceramic Neolithic like the Syrian site of Arjoune, near the Orontes River in the Central Levant.[121]

The earliest human presence in the island of Cyprus has been identified in the site of Aetokremnos and corresponds to the period of Younger Dryas climate episode (Late Epipalaeolithic). Thus, the exploitation of the island on the one hand seems to begin in a period when climatic conditions were difficult, but the warmer and wetter climatic conditions that followed made the island of Cyprus an attractive origin for hunting and foraging for aspiring settlers in order to develop permanent occupations in the island in the following period of the Early Aceramic

[120] Knapp B. , 2013, PP.152-153
[121] Knapp B. , 2013, PP.186-187

Neolithic, in the begging of Cypro-PPNA and EAN I. Albert J. Ammerman use the antithesis between intensification and "extensification" in order to give an explanation. According to his hypothesis, the challenging period of Younger Dryas may have worked as a driving force for the adoption of two different adjustments in the area of the Eastern Mediterranean. The first is intensification of the available existing animals and plants in the occupied area, which leads to agriculture, and the second is "extensification" by using more input that leads to seafaring and foraging.[122]

Despite the fact that seafaring activities have been attested, it cannot be known exactly when and under what conditions seafaring activities were intensified and to what extent. During the period of Younger Dryas, are the climate conditions cooler and arid and is the sea level more stable. Thus, did the Younger Dryas predate or are the prevailing conditions especially the effects in the sea level associated with it, and did they motivate fishers, foragers and hunters? At this moment these questions cannot be answered, since apart from the evidence there are no established data from this period (the Late Epipalaeolithic), like the discovery either of a floatable or of domesticated plants and animals or obsidian that could provide information regarding the size of the means of transport or how often that transport occured. However, humans developed early seafaring activities in the period of Younger Dryas, perhaps as a response to an increasingly changing world. These activities that benefited them and helped them react to these new conditions more than other activities could have done, since they helped them find environments buffered from the fluctuations of Younger Dryas .

The humans who arrived in the coastal sites of Cyprus left clear evidence of their presence, especially in periods when the developing of seafaring seems to be favored. Coastal sites like Aetokremnos have revealed a varied range in quantity and species of marine resources: about 70,000 resources including crabs, sea urchins, limpets and topshells. Corresponding evidence of marine exploitation there is in sites like Nissi Beach and Akamas, dating back to the Late Epipalaeolithic and the Early Aceramic Neolithic, in combination with the obsidian finds originating from Melos unearthed in the Lithic Phace VI of Franchthi Cave in Peloponnese. All these, are indicative of early seafaring activities for purposes of

[122] Knapp B. , 2013, PP.71

raw material exploitation like obsidian or marine resources like fishes, s, shellfish, seashells and salt.[123]

It is apparent that the special climatic conditions emerging during Younger Dryas in the Late Epipalaeolithic favored and pushed humans to broaden their horizons in the searching of food supplies and raw materials for the manufacture of tools and implements which were essential for their survival or because they just have been reliant on them and used to them.(73) According to researchers, there is a change in the point of view that humans react and interact with the sea. Foragers, fishers and hunters take the risk to perform risky ventures, for which navigational experience and knowledge are required, both for exploiting the sea and for travelling. [124] Whatever the reason was, the fact is that hunters, fishers and foragers took the risk and responded to a changing world by performing seafaring and maritime activities that resulted in the emergence of networks interacting the one with the other and extending from Aegean through the Anatolian plateau to the Amanus, Taurus and Zagros mountains. It is what Sherrat calls "forager climax" or Baker "foraging seascape" where humans began to seek to cross the sea of the Mediterranean, aware of the sea's special characteristics which are essential for this endeavor: winds, currents and tides.

The hypotheses regarding the early visitors and seafarers in Cyprus during the period of the Late Epipalaeolithic suggest that they may have initiated their travel from Anatolia or Levantine mainland. However, it should be mentioned that it is not possible at this moment these kind of questions to be answered in a definite way. Based on the stone lithic assemblages, there are similarities with the site of Okuzini Cave in Anatolia (14.500- 11,000 BC). Ofer Bar Yosef supports the hypothesis that perhaps the visitors of Aetokremnos started their journey from that area of Anatolia. Regarding the area of the Levant, researchers suggest that due to the resource depletion, it is possible that people were in bigger mobility in order to cope with this and to discover new sources areas during the Late Natufian Period However, other researchers such as McCartney, suggest that it is not possible to trace the origin of these visitors. He also suggests that these visits should not be faced as a single "colonization" event. On the contrary, according to Ammerman et al it is more likely that they are a mobile population whose way of

[123] Knapp B. , 2013, PP.71-72
[124] Broodbank C., 2006, pp. 199-230

life was based to an extent which is impossible with the current data to be known, on seafaring. [125].

Archaeological data from the Cypriot site of Aetokremnos (marine invertebrates found in stratum 2, or from the seasonal visits to Nissi Beach, the Akamas peninsula, the uplands or the foothills of western and east central Troodos correspondingly in which people were complementing their diets by marine activities such as fishing or the exploitation of other marine resources, suggest that people of the Late Epipalaeolithic in the area of the Eastern Mediterranean were forced to change themselves and their habits as well in order to survive. In this period some animals and plant species were reduced or became extinct while the climate became dryer and colder and the resources dwindled. On this basis people became more mobile in the beginning because they had to and because this transformation seemed inevitable.[126]

Cyprus in the beginning of the Early Aceramic Neolithic provides the earliest evidence (which is continually increasing), for foraging and early farming and of course seafaring in the region of the Eastern Mediterranean. The paradox and the risk of insular living which entails isolation, restricted resources, food and raw material, especially world rather unstable, does not seem to be considered to be a problem for prehistoric humans. Instead, they seem to have responded in the best way to these new challenges by adopting and developing new activities such as seafaring, fishing and marine exploitation.

Insularity affects all the aspects of organization and activities of a group and of a society. On the other hand, this is visible in the way that people deal with insularity. Insularity can motivate economic developments or drive in political changes and differentiated social structure. It also entails mobility, communication, exchange and trade that in another point of view can modify island identities and bring together people and things from different islands or mainland. The phenomenon of the sense of common identity is common in island communities. Despite the fact that insularity has specific advantages and opportunities and provides benefits it also entails risks and involves certain restrictions. The important factor is the way that people deal with it and handle

[125] Ammerman et al, 2011, pp.26
[126] Bunimovitz S. & Barkai R., 1996, pp.85-96.

insularity in their own special way in order to overcome the restrictions and be benefited by the advantages that an island can provide.

CHAPTER 4

SHIPS AND EARLY SEAFARING

Winds, Currents and navigational techniques

The transition from the Pleistocene to the Holocene was not smooth. During the Late Glacial period the climate in the area of Eastern Mediterranean was dry and cold and the sea level was around 120-130 below the current sea level. This has resulted in many islands locating into the Mediterranean Sea to be united in a single formation or to be connected on the mainland. The prevailing conditions during the transition into the Holocene (12.000-8.000 years BC) when the climatic condition ameliorated, the geomorphology of the Mediterranean induced important alterations. The rise of sea level caused the immersion of land masses and the isolation of the islands. It is assumed that the Mediterranean shoreline took its current form during the 8th millennia BC. The following period of the seventh into the fourth millennium the sea level continues to rise, though its rate decreased notably. Between the seventh and sixth millennium BC the sea level was around 5.5 meter below the present while the temperature continue to increase and into the 3rd millennium after a period of hotter and drier summers and wetter winters, followed a decrease in the temperature and the climate began to stabilize in the present conditions approximately with few alterations.[127]

In the last 5.000 thousand years the climatic condition and by extension winds, currents and the geomorphology of coastlines have not altered drastically, thus the early seafaring conditions is assumed that would be very similar with those of present era.[128]

In general terms the Mediterranean Sea is characterized as a tideless sea with the exceptions of few points (Strait of Messina in Italy, between Sicily and Calabria, Strait of Evripou, in Greece, between Euboea and Central Greece and the head of Adriatic-Gulf of Gabbes. Also into the Aegean Sea the tides have a maximum rate comparing to the rest of Mediterranean.[129]

Generally the climate of Mediterranean basin is mild with hot and dry conditions during the summers and mild winter, though during the winter months it is often the occurrence of storm and winds. These were not the best conditions

[127] McGrail S., 2001, pp. 88-89
[128] McGrail S., 2001, pp. 88-89
[129] McGrail S., 2001, pp. 89-92

for travelling during the winter, when the probability of a shipwreck was high. Another problem during the winter is the clouds. Especially during some winter nights it is not possible for someone to see the sky and observe the stars, a very important issue in the early seafaring. The best sailing season in the area of Mediterranean is considered the period between June and September.[130]

The winds in the field of maritime activities are another aspect of great importance. During the summer the winds in the Aegean Sea and the area of Eastern Mediterranean are north- west and north- east or between west and north. However there are always local winds which are depending from the special topographical characteristics of an area. Also, how the winds affect the sail always depend from the route. In this basis winds they could either help or worked as a restraining factor and eventually be a disadvantage.[131]

There are various overseas passages in the area of Mediterranean. The northern routes along the length of the Mediterranean Sea have such topographical characteristics that provide good visibility from a watercraft and by extension conditions of easy navigation. The existence of many islands works as mark points. Also there are places that can provide a safe shelter for the vessels or points for refueling fresh water and perhaps other goods. Finally, the existence of economic center points allowed communication and other activities, like trade. On the disadvantages should be mentioned the existence of numerous of straits, where the prevailing winds could cause delays or other problems. [132]

The southern routes along the length of the Mediterranean Sea differ notably from the corresponding northern routes. They are characterized by more wind and lots of reefs and shoals. The safe points for the watercraft were few. However, during the summer months the voyages on the open sea eastwards were possible while westwards they were more difficult because of the fact that they were against the wind. Generally speaking, the special characteristics and the prevailing conditions in the northern shores of the Mediterranean Sea were considered better and safer for seafaring and other maritime activities. [133]

The formation of the Mediterranean Sea is such that lot of the islands could be seen either from the mainland or from in-between mainland and island. Thus, a

[130] McGrail S., 2001, pp. 92-93
[131] McGrail S., 2001, pp. 93-95
[132] McGrail S., 2001, pp. 95-97
[133] McGrail S., 2001, pp. 95-97

remarkable number of these islands could be found by using pilotage methods.[134] The earliest evidences for overseas exploration in the area of Eastern Mediterranean in the Mesolithic period are derived from the Cave of Franchthi in Argolis. The route that was followed would probably be indirect, over islands. The recent discoveries on Cyprus suggest that groups of hunters-gatherers used to visit the island from as early as 12.000 BP. (the previous perception assumed that the island was settled around 9.000 years BC.) Also, the discoveries from Crete suggest that the first visitors of the island arrived as early as 110.000 years BP.[135]

The majority of the Aegean islands first colonized during the Neolithic period, around 7.000 BC and onwards. The crossings should have had to include space for people of course but also for the domesticated plants and animals that people brought with them. The overseas passages should not exceed the 46 to 83 km in length. However, that was not the rule since few number of islands in the Aegean Sea first settled even in a seasonally basis in the Mesolithic and even the Paleolithic period.[136]

Early crafts would probably be propelled by paddles or oars perhaps. They probably could travel within daylight hours or at least from twilight to twilight. Early navigational techniques they are not based on instrumental techniques. The navigational methods during the early prehistory would probably base on personal experience or inherited traditions or probably both. The only known material aid- in case of bad conditions like low visibility or other hazards- was the sounding lead or sounding pole. Regarding direction the role of the stars was crucial. Orientation would probably achieved by either navigating with the help of the star –for this reason a sky without clouds was of great importance- or by the features of the prevailing winds. The distances of a trip were usually measured in "days sail".[137]

Early Ships

Seafaring during prehistory is a very controversial issue not only regarding the exact period of time in which humans start seafaring but also concerning what

[134] McGrail S., 2001, pp. 98-99
[135] McGrail S., 2001, pp. 99
[136] McGrail S., 2001, pp. 100
[137] McGrail S., 2001, pp. 100-102

kind of sea craft the prehistoric humans used to use. The above issues entail of course other parameters about the navigational skills of prehistoric humans and their ability to built seaworthy watercrafts.

The new archaeological data from the area of Mediterranean Sea suggest that humans "plowed" the sea earlier than it was previously thought: Until recently the earliest seafaring activity was considered to be from Franchthi Cave. However, new researches and archaeological data suggest that humans used to travel earlier and sail in the Mediterranean Sea. Archaeological data from Crete, Cyprus and Ionian Islands in Greece suggest that humans used to travel as early as Paleolithic age in order to find food and other raw materials.

However, the find of obsidian in Franchthi Cave suggests the oldest maritime activity of trade in Mediterranean. Archaeological data of Franchthi Cave indicate that humans used to use sea for developing maritime activities such as obsidian transfer and fishing in deep open sea. The site of Franchthi is not the only site that supports this view.

The earliest evidence for maritime trade activity in the area of Eastern Mediterranean and in Mediterranean in general came from Franchthi Cave in Argolis of Peloponnese. The obsidian finds in the cave originating from Melos Island within a distance of 150 km, dating back to Upper Paleolithic, is the oldest indicator in the area of Eastern Mediterranean that humans used to travel in the open sea.

Other contemporaneous sites that have been found especially in Greek Islands indicate that people used to reside the islands earlier than it was considered in the past and exploit all the possible sources that islands offered, including the exploitation of the sea. For the first time, archaeological data in the Mediterranean Basin show that the Sea did not constitute a barrier but a bridge for the prehistoric humans.

The seafaring is a practice that, according to last excavating data (see above), had already been developed in the Pleistocene. According to these data humans or hominids used to travel in the open sea in order to find either a new place or food supplies.

All of the finds indicate that people used to travel in open sea from a very early stage.

These new data show that prehistoric people were more complicated and developed a more complex behavior, since special skills and knowledge are required in order to build a watercraft seaworthy in open see. More complex social relations and data are also required.

In spite of this evidence mentioned above, a prehistoric watercraft has never been found. The only data came from later eras and experimental archaeology. However, the data from Bronze Era (see for example Minoans in Crete or Ancient Egypt) show that there was a long tradition in maritime activities in the region of Eastern Mediterranean. This is a fact that up until recently scientists only suspected, but they can be more confident nowadays.

A very controversial issue is what kind of water craft these first mariners used for their maritime activity. The fact that there are neither boats or other relevant remains to help understand what kind of watercraft they used or how prehistoric humans built those from Paleolithic or Mesolithic period, nor indirect sources like depictions or written sources, make the issue even more complicated. Objectively archaeologists and other researchers can be based only on hypothesis. These hypotheses were based on indirect information, speculations and ethnoarchaeology. However, during late Neolithic and mainly Early Bronze Age, various representations and depictions of ships have been found mainly originating from the area of Aegean. These representations provide a clear impression of what kind of watercraft was used in the prehistoric Mediterranean.

The oldest representations came from Ancient Egypt. Ancient Egypt developed innovative shipbuilding techniques from a very early stage. Moreover, people developed techniques for the construction of boats in Mesopotamia and in the coast of Levant as well.

In the Mediterranean Sea, especially in the area of the Eastern Mediterranean, great civilizations were born, flourished and declined. The interactions among them were inevitable. Unsurprisingly, the various shipbuilding techniques were shared by the inhabitants of this closed sea. Perhaps a difference can be traced in the timing of these techniques were applied. An innovation for example could be applied earlier in Egypt and a bit later in the Eastern Mediterranean. In a few words, in the area of Eastern Mediterranean there was not isolation but coexistence and meddling of techniques.

The only positive indication for early seafaring comes from Franchthi Cave. Obsidian was transferred in the Aegean Sea from Melos to the coast of East Peloponnese in Franchthi Cave, sailing within a distance of 75 to 150 nautical miles, depending on the travel routes. In any case, even the minimum distance of 75 nautical miles is quite big for hunter-gatherer human, at least regarding the picture that scientists have for hunter gatherer until nowadays. This effort would need naval knowledge and capability.[138]

According to the new archaeological data, maritime activities consisting of obsidian transfer and fishing in the open sea in the area of Eastern Mediterranean were not unprecedented. The specific part of Mediterranean, especially the Aegean Sea, is a closed Archipelago with numerous islands, islets and skerries at a short distance between them which facilitate travelling even with a vestigial watercraft. In general, the coasts are characterized by the alteration of bays, coves and promontories. These characteristics in combination with good weather conditions (mild climate) and clear atmosphere for most of the year are characteristics which favor maritime mobility and sea activities.

In an effort to understanding and get an idea on how prehistoric humans used to travel and transfer obsidian 11000 years ago, a program of experimental archaeology was conducted in Greece in 1989. The main objective of this effort was to understand the seaway of obsidian that connected Melos (Greek Islands) to Franchthi Cave (Greek Hinterland).[139]

There are various issues regarding the building of a watercraft during prehistory such as what type of materials or lithic tools they used or what skills and knowledge humans or pre humans had.

The attempt to built a prehistoric boat was not easy and lasted few years so that the proper materials could be found. The limited variety of tools during the Mesolithic period and the weather conditions in the Aegean Sea, in the area of Cyclades, was another factor which affected the program. For the transfer of obsidian, rafts made of logs and monoxyle were excluded since they were not considered sufficient for the transfer of obsidian.

Ethnographic research detected a primitive craft in the island of Corfu in the Ionian Sea. [140]This craft has probably been being made for millennia; however it

[138] Renfrew C. et al, 1965, pp.225-247. Also, see:Renfrew C. & Aspinall A.,1990, pp. 183-202
[139] Tzalas C., 1989,pp.11-19
[140] Sordinas A., 2003, pp. 89-97

has almost disappeared nowadays. The attempt of making a prehistoric vessel was based on this type of primitive craft called "Papyrella". The constructor of Papyrella copied and built an identical craft which travelled in the autumn of 1989 following the obsidian route, based on the obsidian findings in Franchthi Cave. The oared vessel was 6 m. long and travelled from the southernmost point of Attica, Lavreotiki, towards Melos. The crew consisted of six persons which paddled during the day, moving from island to island with an average speed of two knots. The trip lasted six days.

It is not possible to know if obsidian transfer was made by rafts built of papyrus. However, the objective of this attempt was to investigate whether a trip in a simple boat built by papyrus and by the use of simple stone tools, available in that period of time, could be made.

Archaeological data regarding Neolithic period exist but they are severely limited. In the prehistoric lakeside settlement of Dispilio in Kastoria, Greece, the imprint of a monoxyle was found in 1992. It is a lake boat with a length of 3, 30 m, preserved in a good condition in the mud of the Lake of Kastoria, where it was found. The boat is dating back to the end of the Middle Neolithic or the Late Neolithic. The recent discovery of a sunken vessel bearing obsidian discovered off Capri. Unfortunately the author could not find any other information about this significant discovery. [141]Simultaneously, at least ten clay models of monoxyle were among the findings of the excavations. The majority of them was found fragmented. However, one of them was found almost entire and had a length of around 20-50 cm and dating from the end of Middle Neolithic.

Other finds regarding Neolithic period are mainly rock paintings depicting ship representations. In the Island of Naxos, in Cyclades of Aegean Sea, in the site Korfi Aroni, two rock paintings with ship representations were found. The first depicts a watercraft on which two human types are standing. The second one, dating from the Late Neolithic, shows a well made boat with high bow or stern with two domesticated animals, a goat and a cow, and a human boarding on it. The stability and the size of this boat in the last mentioned representation present the possibility of the transfer of domesticated animals by sea with the right watercraft.[142]

[141141141] http://www.lagazzettadelmezzogiorno.it/english/sunken-vessel-bearing-obsidian-discovered-off-capri-no543735/

[142]Waschman Sh., 1998, pp. 69-82

The depictions of ships increased the next period of Bronze Age. The majority of the ship depictions of Early Bronze Age period have been found in the Cycladic Islands and Crete. Ship representations have been found in frying pans dating from 2800 to 2300 BC. They are clay pots of circular shape with a low rim. The exact use of these utensils has not yet been ascertained. The engraved on the pans ships are long and with a large number of oars. A clay ship model from Crete (Mochlos) and a representation from Boeotia (Orchomenos) date from the same period.

The Minoan Thalassocracy was reinforced from the depictions of ships in seals and rings of sacred character, frescos and clay models from Crete dating back to the 2nd millennium.

The most important find relating to ships and naval architecture during the Bronze Age was found in the Cycladic Island of Santorini, in the site of Akrotiri. The so-called "procession of ships" was found in the West House of the site Akrotiri in Thira (Santorini) and dating from about 1600 BC. The date is very close to the eruption of the volcano of Santorini, which destroyed and buried the site under the volcanic ash and altered the geomorphology of the island. The scene depicts eleven vessels: seven large, three smaller and an oared boat. In the fresco presented all the types of means of propulsion are presened: sail, oars and free rowing.

In conclusion, in the area of the Eastern Mediterranean no boat remains dating back to the period of Palaeolithic and Mesolithic have been found so far. Things change a bit in the period of Neolithic. Archaeological data dating back to the Neolithic period are very limited, apart from the findings of Naxos and Dispilio, mentioned above. However, data change rapidly from the end of the third millennium and onwards and ship representations show a high level of shipbuilding practices and techniques.

Archaeological data concerning ships, such as rock paintings during Neolithic might exist but still have not been found or have been lost because, for example, of the sea level changes: during the Mesolithic Period sea level was even 100 m lower. The rising sea level during Holocene might have expunged information like rock carvings.

The majority and the most interesting of clay models of ships dating back to the 2nd and 1st millennium were found in the island of Cyprus either during land

excavations or by fishermen. The number of Cypriot clay ship models is bigger than the total number of ship models found in Greek Mainland and Islands and in Asia Minor. Few of these models are large in size and full of human figures. The largest and most detailed carried about nine persons. These representations have been suggested to show ritual scenes or just a captain and its crew.[143]

The excavations (in 2011) at the Neolithic settlement at Strophila of Andros, a Cycladic island of the Aegean Sea, broaden the horizons not only of Prehistory in the area of Aegean Sea but also of iconography. The excavations have revealed an extensive settlement of Final Neolithic (around 4500-3200 BC) in the West coast of Andros. The location of the island is very close to the mainland, (Lavreotiki, Attica) and was an important intermediate point due to its location at the sea routes for the transport of goods, including obsidian, during the Neolithic Period.

One of the main characteristics of the settlement according to the excavator, Christina Televantou, is the extensive use of rock art decorative and pictorial. The extensive use of the ship as iconographic theme in public places like in sanctuaries, walls (perivolos), and an area on the north of the wall, with perhaps more than a hundred ship representations on them, show a distinctively naval character regarding shipbuilding, navigation and trade in this settlements. Iconography includes ships and ships procession, the oldest so far in the area. A remarkable number of ships have been found so far, more than seventy either in groups or individually in a variety of sizes. It is worth mentioned that one of those looks bearing something like a flag. This is the fifth of such symbols that is found, perhaps showing organization in the functioning and role of the ships and is related to the social structures of the settlement. The excavation has revealed a very well organized settlement with proto-urban elements and is in general characterized by power and wealth. The intense appearance of ship in the structures of the settlement in combination with other finds relating to maritime activities, like obsidian artefacts, suggest that this wealth and power was deriving from trade and other maritime activities.[144]

Close to the outer face of a wall, in a rock in an area of about 70 square meters a representation that probably was visible from the wall but also from the ground was detected. It depicted at least twelve ships in various types and sizes,

[143] Waschman Sh., 1998, pp. 61-68
[144] Televantou, Ch. A.,2008, pp.43-53

many animals and one large fish. One of the ships had a length of around 50 cm as well as a steering wheel and a component on the bow resembling a hook. A symbol before it is perhaps an indication of divine protection. There were other smaller vessels that they seemed like they were in a cove. One of them had a load of two goats and the other one of a dog.

The blocks of the wall have a ship as a dominant motif. More than twenty ships are illustrated there either individually or in groups. According to the excavator the majority of them seem to be towards the entrance and perhaps they work as guides to the entrance of the settlement.

Other Neolithic sites in the Island of Andros are in Mikrogiali, Vriokastro and Plaka. The last mentioned, according to the archaeological finds, is considered to date back to the begging of the Early Bronze Age. Also, in the site of Plaka extensive rock paintings were found, presenting the same features as those found in Strofilas. Among them there are ship representations and a radial disc that may indicates the sun.

The recent finds in Andros and Astypalea in combination with older finds in the area of the Aegean Sea are indicative of the indisputable importance of the role of the sea in the life of the habitants of the Aegean Sea since that period and suggest that the great achievements followed in shipbuilding and maritime activities in the area of Aegean Sea are the natural continuance that has been initiated long before.

The discovery of rock carvings depicting ships in the area Vathi of Astypalea is another recent find relevant to this topic. The prehistoric rock art was found in the surface of limestones and is dating to the third millennium BC. The rock paintings of ships have a length of around 70 cm and their typology is considered to be protocycladic. The ships are oared while three of them have fishes and other various themes on their bow or on their stem. These representations from Astypalea of Dodecanese seem to be completely corresponding and relevant to the depictions in the frying pans, mentioned above. According to the researchers the discovery of these finds expands the geography extent of Protocycladic civilization and indicates interaction and unity in the area of Aegean much earlier than it was thought at a first place.[145]

[145] http://www.imerisia.gr/article.asp?catid=26513&subid=2&pubid=113046885

The rock carvings of Andros could be considered as ancestors of frescoes found on the island of Thera, since they seem to belong in a tradition that has been developed and cultivated in the area long time ago.

Recent archaeological investigations have shown that the area of the Eastern Mediterranean was a vital area of maritime activity from a very early stage. The new archaeological data from Crete suggests that humans used to cross the sea during Palaeolithic. The evidences from Aegean (Francthi Cave, Maroulas Kythnos, Ikaria, Cave of Cyclops in Youra of Northern Sporades, Lemnos) and from Cyprus (Aetokremnos, Nissi Beach)dating back to the Mesolithic Period suggest that seafaring and fishing in open sea was developed to a significant extent.

From that period and on, to an even greater extent during the Neolithic Period, humans developed maritime activities in order to find food, raw materials or perhaps to seek knowledge and experiences. During this period humans set the first solid bases which led to the gradual evolution of navigation even from the Neolithic Period which was very obvious till the next periods in the Eastern Mediterranean's area.

The claim of Bednaric that stone tools found in Crete are indicative of seafaring during Pleistocene by early humans is now a theory greatly reinforced by the recent discoveries in the Plakias of Crete. However, the earliest established evidence for seafaring are the finds relating to obsidian, with the obsidian finds in Franchthi Cave, dating back to the end of the Upper Palaeolithic, as the earliest ones.

Despite the fact that in the area of the Eastern Mediterranean there are enough indications of early seafaring, archaeologists and other researchers are not in position to know when exactly the inhabitants of the area started building ships. Moreover, they cannot know with great certainty what kind of watercraft early humans used for these maritime activities. The use of very simple and rudimentary floatables like dugouts and reed craft is the most likely. These hypotheses are based on the building materials and various types of lithic tools available to them. It is also based on later depictions and representations.

These depictions and representations are very valuable for the ships study, since not any prehistoric vessel has ever been found so far. On the other hand, this task is not an easy one, since on these artistic representations the details of construction are very hard to be identified. The representations are found on rock

carvings, frescoes, clay models, seals etc. The best way for someone to understand a vessel is the study of the vessel itself.

Archaeological finds of vessel remains are very restricted and date back to the subsequent period. However they are the oldest hull remains from the studying area and thus they are the best evidence about the shipbuilding techniques developed in those early stages of human cultures.

The oldest boat remains in the area of the Eastern Mediterranean have been found in Egypt. It is very probable that Egyptians have developed the building of simple rafts in order to navigate the Nile. The oldest boat remains in archaeological context are two predynastic boat models dating back to 4000 BC, which followed the simple technique of rafts. However, Egyptians (around mid-fourth millennium BC) used wood for the construction of boats and employed the technique of plank –built boat at a very early stage. [146]

In the beginning of the dynastic period boat depictions are presented in funerary monuments while according to excavating data, boat remains relating to these tombs have been discovered. In 1991 fourteen wooden boats remains have been discovered in Abydos. The Early dynastic tombs were boat-shaped and the boat remains were buried in the mud bricks. These finds are considered to be the earliest planked watercraft in the world that has ever been discovered until now.

The characteristics of the boats that have been examined so far indicate that they bore the characteristics and typology that symbolic and religious items have. The only boat that has been examined until now was made probably by tamarisk and its main characteristics are: a crescent shaped hull, shallow and narrow with round ends. The thick planks of the hull were lashed down together with woven straps. The boat has a flat bottom and angulated sides. The characteristic of the boats suggest that it belongs to a tradition that continues in later periods and is considered to be ancestors of this kind of boats, funerary, that have been discovered and dating back to later periods. The studying and publication of the rest of the boats will shed light on issues like this.

Khufu boat (discovered in 1954) is the most magnificent boat of the type of funerary boats that has ever been found. It belongs to a later era, in Fourth Dynasty and has been found at the foot of the Great Pyramid of Giza in Egypt. It is made of Lebanese cedar and has a length of 43 m, a flat bottom and angulated

[146] Waschman Sh., 1998, pp. 9-38. Also, see: Casson L., 1995, pp. 11-22

sides. However, the function of the ship is a controversial issue among the researchers. It is not known if it has ever been sailed or it was just for ritual purposes. The absence of rigging and paddling reinforces this belief. Nevertheless, whatever the function of Khufu boat was, it can provide information regarding the developing shipbuilding techniques of that period of time.[147]

Another category for extracting information about boats and ships in prehistory is the funerary boats that have been found in Egypt.

In 1894, four more funerary boats were discovered at Dashur. They are dating back to the Twelfth Dynasty and were buried in the pyramid of Senwosret III. They are 10 and 2 m in length and width correspondingly with crescent shaped hulls. They were built mainly of imported cedar and recycled material coming from other larger boats. In general, they were smaller and beamier compared to the Abydos boats and Khufu boat.

More than ninety timbers (local tamarisk and acacia) have been discovered at Lisht which probably derived from boats that have been disintegrated and their timbers were used as construction material. However, since they came from working vessels, they can provide information regarding shipbuilding techniques. The study of this timbers showed they were bearing additional joinery of mortise and tenon joints and thus they probably originated from utilitarian boats that they were used for heavy loads.

In the Levantine coast there have been detected seagoing ships dating back to the fifth Dynasty of old Kingdom at the funerary temple of Sahure, Abusir and at the causeway of Unas at Saqqara. Dating back to the New Kingdom, the depictions of seagoing vessels were presented at the mortuary temple at Deir el Bahri. The construction characteristics in both cases present similar features.

Excavations at Wadi Gawasis and Ayn Sokhna confirm the practice of the reuse and recycling of ship timbers, as mentioned above for Dashur boats (recycling timbers for the hull construction) and Lisht (construction material -like Wadi Gawasis-). These data suggest a well-organized industry of shipbuilding and emphasize the important role of boats and ships in the various economic, social and symbolic-religion aspects in the specific society.

The Tomb of Kenamum at Thebes dating back to the eighth Dynasty presents a detailed depiction of ships. The ships, eleven in number, are presented very

[147] Polzer E. M.,2011,pp. 349-378

similar to the description of the ships mentioned above: with crescent-shaped hull and vertical ends. The constructive elements on this representation from Thebes are restricted on the presence of a line which goes through beam ends and projects from the sides of the hull. The interpretation of this feature is problematic. However, it is probably just an artistic detail attributable to the creator of the paintings and does not represent a shipbuilding technique for real ships. [148]

Archaeological data regarding ships and seafaring are very few in the area of Near East and the majority of them are dating back to a later period than those originated from ancient Egypt, mentioned above. The last King of the seventeenth Dynasty in Thebes, Kamose, made the earliest mentions regarding Syro-Canaanite ships, which are referred in his account regarding the capture of Hyksos vessels. These vessels were loaded with various cargoes because of the conflict that has arisen about them. Apart from Thebes and Egypt there are others cities which are documented in texts in the area of Eastern Mediterranean.

Ship remains in the area of Anatolia have been found outside the coast of Turkey. They are two shipwrecks dating back to the last period of Bronze Age. The oldest one is dating back to 1320 BC +-15 years and was discovered on southwestern Anatolia coast of Turkey, near Kas. The shipwreck was discovered in 1982 and the excavations lasted from 1984 until 1994. The ship was made with the first shell technique and was bearing a mortise and tenon joints. According to measurements and the cargo, it should be of 15 to 16 m in length and it was made of Lebanese cedar and oak (tenons). One of the most interesting finds was the cargo of the vessel. Copper and tin ingots, jars that are known from Greece, Cyprus, Syro-Palestine, Egypt, weapons, tools and fishing equipment, gold and silver ornaments, glass and other various exotic raw materials like ivory and hippopotamus horns , tortoise upper shells, ostrich eggshells, quartz, amber as well as olives, almonds, figs, grapes and other food residues. The origin and the route of the vessel was a rather controversial issue. According to the information extracting from the cargo, the abundance and the luxury of the materials of the ship, it is assumed that Uluburun ship was from one of the ports of North Carmel

[148] Polzer E. M.,2011,pp. 349-378

coast (perhaps at Tel Abu Hawam) and the final destination was somewhere in the Aegean sea in a port related to Mycenaean Palaces.[149]

The other shipwreck that has been found in the area of Eastern Mediterranean in the Near East is the shipwreck of Cape Gelidonya, named after the homonymous Cape off the southern coast of Turkey. The shipwreck is also dating back to the Late Bronze era. The remains of the wreck are very scarce. However, the discovery of a piece of a half tenon which is drilled, suggests by its thickness that the ship would be built with the same technique of pegged edge joinery. The ship is considered to be Cypriot or Syro-Canaanite.

According to the excavator of the prehistoric site of Akrotiri S. Marinatos, the ship depictions are the most detailed representations of a Minoan Ship.

Actual ships remains as well as depictions and representations of ships in the area of the Eastern Mediterranean indicate that the civilasations that have been developed and flourished in this area of the world were closely related to the sea and that they used extensively watercraft for seafaring from a very old time.

A reliable watercraft should be able to safely transfer people, animals, objects, raw materials and various other commodities. The construction of the first floatables would be probably based on the observation of the various phenomena in their environment. The humans in prehistory would have probably observed in nature that a piece of wood or even a log can float in the water and maybe somehow this is how the idea of the first watercrafts of completely simple design and construction like rafts and dugouts emerged. The experience and the knowledge that humans gained by their contact and activity concerning the sea are apparent in the development and progress in the types and forms of the watercrafts that were built over time.

Actual ship remains and other archaeological data from the area of Eastern Mediterranean, where the oldest ship remains and representations of vessels emerged, suggest that the common element of shipbuilders' technique for the construction of a floatable was first the construction of the shell of planks fastened with the use of a type of joinery and then the strengthening of the construction with internal structure. Thereafter different needs and problems led each civilization develop in the area of the Eastern Mediterranean, so as to seek its own solutions. However, the amalgamation and the interaction were inevitable.

[149] Pulak, C., 1998, pp. 188–224.

Although materials, tools and techniques were common factors in the shipbuilding in the area of the Eastern Mediterranean, the specific socio-economic conditions and needs of a civilization and more over the experience and the creativity of a shipbuilder made the detailed difference and was the determining factor in the whole process of shipbuilding.

There are no actual ship remains and the most probable is that the first mariners used shabby and simple materials like reed and papyrus depending on the availability of the material in their environment for the construction of their floatable.

It is not possible to be known when humans or pre-humans crossed the sea for the first time and by extension when exactly the first use of a floatable occurred. However, the findings of the latest years really confirm what once the scientists assumed. The recent discovery of Palaeolithic lithic assemblages in various locations of the southwest coast of Crete in the area of Plakias indicates that hominids arrived at the island much earlier than it was first believed. The oldest archaeological remains and strata in the island were dating back to the Neolithic and have been found in Knossos. These new finds, according to the research team, 130.000 years old and some of them could be even earlier. The fact that the island of Crete is not united to some solid ground within the last 5 million years affirms that the only way to get someone there was only by sea. And despite the fact that such an old watercraft has never been found, this evidence is an indication which can assure that seafaring during the Early Pleistocene was a fact.

The incentives for a trip like this, including so many difficulties, can only be assumed. Perhaps the motivations were practical reasons such as search for food or raw materials or new places for residence or simply were curiosity of human nature and the quest of knowledge and experiences. In the case of obsidian carriers the motives were clearer.

The most potent and indisputable evidence about seafaring in early prehistory is provided by the obsidian finds.

According to recent excavation data humans arrived in the islands of Eastern Mediterranean by crossing the sea earlier than the beginning of the Neolithic period. The discovery of stone tools and animal bones in the islands of Crete,

Cyprus and the Ionian Islands indicates that before the Neolithic farmers reached these islands the Plaeolithic and Mesolithic hunters-foragers had done so.

At the site of Aetokremnos in Cyprus, archaeological finds suggest that humans first arrived at the island 3000 years earlier, around 12000 B.C, than it was previously was. The site of Aetokremnos is a rock shelter on the southern coast of Cyprus. According to the excavator, a group of hunter-gatherers visited seasonally the island of Cyprus. The excavator believes that they were individuals and there is no evidence for the presence of women or children. The site was not large enough even for one person to live, much less for a group of people. On the other hand, the distance from the closest land indicates that the trip could not have been daily. Nevertheless, a seasonal base with more adequate living conditions has not been found near the site Aetokremnos so far.

Archaeological finds of burned animal bones, the majority of whom belonged to the species of pigmy hippos and a few to dwarf elephants, birds and other animals, indicates that the activities of these bands were responsible for the extinction of pigmy hippos in the island of Cyprus. [150]

The study of stone tools assemblages found on the site of Aetokremnos suggest that the origin of the visitors could be from the coastal areas of Turkey or from the Levant. Sites of Paleolithic and Mesolithic occupation have been found in both areas. Of course, the alternative is that it was not only one specific group that visited the island but various groups from different locations. In any case, according to A. Simmons, the site's excavator, these visitors did not stay permanently on the island and their descendants do not have any involvement in the Neolithic Period of the island.

The discovery of two others Mesolithic sites of Nissi Beach in Ayia Nappa and Aspros in the island of Cyprus dating back to around 10.000 and 9.000 BC suggest that the visitors of the islands on a seasonal basis were not that rare and that contacts were maintained between the island and the mainland. These campsites were used basically for seasonally visitations in the island of Cyprus and were not appropriate for permanent living. (It should be mentioned that, according to the researchers, there must be more suchlike sites submerged in the area because of the changes occurred during the last Ice Age, and are still waiting to be investigated.) However, these Cypriot sites which are contemporary with the

[150] Simmons A.H., 2001, pp.

Franchthi Cave in the Aegean Sea indicate that an early seafaring activity occurred on a regular basis in the area of the Eastern Mediterranean.

Sites dating back to the Middle and Upper Paleolithic, in the Ionian Islands of Greece Keffalinia and Zakynthos which were not connected to the mainland at that period of time,indicate that humans used to cross the sea from a very early stage. Lithic assemblages that have been found are dating from 110.000 and 30.000 BC. Geoarchaeological surveys showed that the islands of Keffalinia and Zakynthos were insular during Palaeolithic. However, the distance between those islands and the Greek mainland was about 5 to 10 km, thus visible and easily accessible with a rudimentary floating.

Also, in the Ionian Islands evidence that suggest seafaring activities in the period of Mesolithic has been identified. The finds were detected on the island of Corfu and dating back to the end of the seventh and the beginning of the sixth millennium. The study of stone assemblages shows that there are not much analogies to the stone tools found on Greek Mainland. The excavator of the site suggests that when at the end of Palaeolithic the island was separated from the mainland humans crossed the sea and had contacts with the civilizations of the Italian Mainland. Sordinas, the site's excavator, said that the most probable watercraft must have been a small reed boat similar to those that were used during 1960s by lobster fishermen of the island of Corfu. He also suggests that this type of vessel must have been the means that was used to cross the sea by the carriers of obsidian from Melos found in Franchthi Cave. The creation of a shell midden suggests that these visitors lived on shellfish. The settlers of the island during the Mesolithic period don't seem to be connected with those in the Neolithic. [151]

All these finds mentioned above suggest that the area of the Eastern Mediterranean with this particular landscape especially observable in the Aegean Sea of Greece with the scattered islands, islets and atolls seem to have favored seafaring activities from a very early period and was an important area of experimentation for the prehistoric people who gained experiences and developed navigation skills that led to the achievements of the next period: the creation of magnificent civilizations closely related to the sea like Ancient Egypt and Minoans.

[151] A. Sordinas , 2003, pp. 89-97

These recent finds have raised very important issues regarding the skills of humans.

Cargo finds in the seabed dating back to the Bronze Age and indicating the existence of a shipwreck have been found in the Aegean Sea. In these finds not any wooden parts of the ship have been preserved. The remains of an Early Helladic wreck, dating back to around 2200 BC was discovered on the seabed at Dokos, a small island in the Saronic Gulf, in Southern Greece. The shipwreck was investigated between 1989 and 1992 by the Hellenic Institute of Maritime Archaeology (HIMA).

There are no wood remains of the ship apart from some scrap of timbers probably originating from the hull of the ship. However, the bulk of its cargo has been saved. Large quantities of pottery, lithic tools and two stone anchors have been detected. The pottery includes amphoras, amphoriskoi, bowls and handled cups. Whole vessels and large quantity of shards have been found as well. Also, it should be mentioned that among the finds there was a part of a Cycladic frying pan. With regard to stone assemblages obsidian finds (block and blades) are included among them, originating from the island of Melos. Regarding the two stone anchors, they are stone slabs each one having a hole in it. The millstones found on the cargo without use traces indicate the commercial character of the ship according to the researchers.

There are two small coastal Early Helladic settlements on the island of Dokos, Myti Kommeni and Ledeza and others on the islands of Saronic Gulf, like Agia Marina in Spetses. The ship of Dokos must have been a small commercial ship, according to the bulk of its cargo and the characteristics (size, weight) of the stone anchors, which served the maritime trade network of the region, for the distribution in smaller coastal settlements and stations in the area, which perhaps work as an intermediary station for the trade form the Cyclades and the large Early Helladic centers that existed in the area: Tiryns and Lerna in Argolis and Aegina in Saronic Gulf.

The wreck of Point Iria, off the southern coast of Argolis in Greece, was detected in 1962 and was investigated systematically in four periods from 1991 to 1994. According to excavations data the ship must have been built with the first shell technique and its length was estimated at 10 m. The ship was loaded with pithoi and amphorae for the transport of wine and olive oil. The pottery originated

from Cyprus, Crete and Peloponnese and shows the maritime network and trade relations between Cyprus and the Aegean. It is dating back to 1200 BC. The merchant vessel probably followed a route from Cyprus to Argolis, with Crete or perhaps another Aegean island as intermediary.

Other shipwreck finds dating from the Early Bronze have been found in the area of the Eastern Mediterranean. Despite the fact that from these shipwrecks wooden remains of the ship have not been discovered, thus they cannot provide data regarding shipbuilding techniques, they can provide important information regarding maritime network and trade connections during prehistory and indirect information concerning the ship itself, such as type or size.

Another shipwreck dating back to the 12th century BC was found in the islet of Modi (also named Liontari which means lion, because of its characteristic shape), on the southeast of the island Poros, in the Saronic Gulf of Aegean Sea. The survey of the ship started in 2003 and lasted until 2007 with some intermission, but the systematically excavation of the ship is still in progress. According to preliminary estimations the load of the wreck consisted mainly of big transport jars like pithoi and amphoras and is dating back to the 12th century BC, a crucial period for the Mycenaean world, because of the following decline and abandonment of Mycenaean Palaces.

Another wreck which is dating back to the Bronze Age is the Seytan Deresi wreck found on Turkey, on the east of Bodrum. The wreck was investigated in 1975. Not any timber remains of the vessel have been preserved. The finds were mainly pottery, the majority utilitarian vessels either for trade or some of them for the needs of the crew. According to the excavator, based on the study of pottery, the wreck was dating back to late Middle Bronze Age. The wreck and its cargo indicate the connections of Minoans either with the islands of Eastern Aegean or with Anatolian coasts. According to the excavator, because of the absence of any hull remains, the fact that this vessel of a probably small size have not been made of wood but of skin could be considered as possible. However, other wreck finds dating back to the Bronze Age suggest that the dominant material of that era for building seagoing trading vessels was the timber. Still, this assumption cannot be excluded because a well-made skin boat could be seaworthy and large enough to carry even a ton of load.

According to experimental archaeology, a skin boat of small dimensions with a length of 6 m and 1,4 m maximum beam could be seaworthy containing more than a metric ton of load while larger could carry up to 4 or 5 tons of cargo.

The cargo of a Minoan shipwreck was identified in the islet of Pseira, in the North-West coast of Crete, in the Gulf of Mirabello. The islet is known for the remains of a Bronze Age harbor. The finds consist of Minoan pottery and probably were from Eastern Crete. The shipwreck is dating from 1900 to 1700 BC (MMIIB). Based on the finds of the ship, it is believed that it was a small coastal vessel which was trading locally. It should be mentioned that in the islet of Pseira a stone seal with the representation of a ship has been found. The Minoan ship is depicted with a rostral-shaped prow and a high stern. A single mast is connected to the vessel by ropes. The seal is dating between 1800-1675 BC.

The earliest fragments relating to ships have been found in Arabian Gulf. In Kuwait, in the site As-Sabiyah fragments which according to the excavators of the site are related to sea going boats have been found. The site which is dating back to the Mesopotamian Ubaid Period 2/3 (according to radiocarbons the occupation started between 5500-5000BC) and indicates that sailing in the area was known from the Ubaid period. The more than fifty pieces of bituminous amalgam the majority of which were bearing parallel reed impressions or/and barnacle encrustations that were discovered, were interpreted as fragments of a seagoing watercraft. Bitumen was used for the caulking of reed and wood boats. These pieces are probably originating from the waterproof caulking of a reed bundle hull of a vessel. These pieces removed from the hull of the boats possibly either for recycling or for repairs.

Another finding related to ships in the site of As –Sabiyah is a clay model of a boat (15cm in length), bearing incised parallel lines. It was considered to represent schematically a reed bundle boat. There is also a painted ceramic disc which depicts a sailing boat.

The first watercrafts must have been simple, such as dugouts, canoes or rafts made of wood, papyrus or reed.

Important evidence about the leaps made in the shipbuilding in the area of the Eastern Mediterranean provide the depictions and representations of ships dating back to the third millennium BC in cave paintings, carvings on the crockery and seals. These depictions cannot be described as primitive but they are considered

to represent the results of an evolution that culminated in the mid second millennium BC with the discovery of the frescoes in the site of Akrotiri, in the Cycladic Island of Aegean Sea, Santorini. The frescoes had the representation of "fleet" in the West House, and dated back to approximately 1500 BC. In this representation all the types of means of propulsion for a watercraft are depicted: sail, oar and paddle.

The new data suggest that homo Neanderthals or early ancestors of homo sapiens used to travel by sea and were experienced navigators since the performance of such journeys in smaller or bigger scales demanded abilities and skills to build a seaworthy floatable on the one hand, and knowledge and experience relating with sea routes, weather and currents on the other.

According to the researchers' evidence –the discovery of human residues and the fact that these areas have never been connected to any mainland- it was indicated that seafaring was first introduced in the island complexes of Southeast Asia and Australia, where humans crossed these sea passages 50.000 years ago.

The new archaeological data from the area of the Eastern Mediterranean suggest that humans and hominids used to travel even earlier. Even though, especially in the case of Ionian Islands, the trips where shorter, they show in any case that humans from attempt to exploit the vast sea at very early stage and that gives them abilities and skills that until recently were considered to be an exclusive prerogative of homo sapiens.

DISCUSSION – EVALUATION

Until relatively recently the strongest evidence for seafaring and maritime activities was the transfer of Melian obsidian in the Cave of franchthi in Peloponnese. Since then, the data have altered drastically. New evidences from Cyprus, Crete, Gavdos and Ionian Islands indicate that humans used to travel in the area of Eastern Mediterranean much earlier than until recently were thought. The new data change what scientists believed not only regarding seafaring and maritime activities but also about Homo Neanderthals, who had the skills to build a floatable and moved by the sea.

Perhaps, the characterization as "sea nomads" could be the best expression to describe their motives and the way that they were moving in the sea: in correspondence to the hunters- gatherers that they were in the land, humans in the Palaeolithic and Mesolithic forced them to move nomadically by the sea in the fragmented sea area of the Eastern Mediterranean in order to find food or other resources in a very remote world.

However, the new discoveries of obsidian finds in the area of Eastern Mediterranean lead the issue a step further. The discovery of more sites that are also dating in the period of Mesolithic like Maroulas of Kythnos, Gavdos, Ikaria, the cave of Cyclops and the sites in Cyprus and bearing obsidian finds, marine shells and fishes from the open sea, show that people not only developed seafaring from a very early period but also that they exploited all the possible aspects in their favor for the finding of food and other recourses. In a nutshell, Mesolithic people were not adrifts of their remote environment but they adapted the new conditions of their world and tried to control it and exploited it. The achievement to sail across the sea and the exploitation of the aspects of the sea could be considered just as rebel as the achievement of the control of their land environment with plant and animal domestication.

Another aspect of the obsidian discoveries is that obsidian because of its characteristics and properties was considered as an ideal raw material for the manufacture of resistant and sharp stone tools and this is the reason the

popularity of this raw material. The transfer of obsidian in the area of Eastern Mediterranean seems that was circular (with starting point the obsidian sources in the Eastern Anatolia): from Melos in the Greek mainland and the islands, the Anatolia and Cyprus and vice versa. Thus, there was a cyclical circulation in the transport of obsidian.

The transfer/trade of obsidian suggest that in this period the first network of obsidian transport created that will culminate the subsequent period of the Neolithic by the creation and the establishment an extensive network for the transport of obsidian and other goods.

FUTURE PROSPECTS

The future prospects regarding obsidian studies and seafaring and maritime activities in the area of Eastern Mediterranean are very challenging.

The further study of the transfer of obsidian by the sea it will shed light not only in the interconnections and relationships between the humans and the communities of Early Prehistory but also in the role of the sea in the life of Early humans and their transformation and subsequent evolution. The further study of obsidian and the overseas relationships is crucial because perhaps here there are further answers relating the dispersal of hominids and the Neolithic Revolution, events that were determined decisively the human evolution.

It is almost certain that there are other Palaeolithic and Mesolithic sites that are waiting to be discovered. The sea level changes that occurred in the end of Pleistocene and the beginning of Holocene has resulted in many Palaeolithic and Mesolithic sites nowadays to lie submerged. Even though the present data suggest that humans developed a closer relation with the sea mainly during the Mesolithic, however the poor data from Franchthi Cave suggest that humans used to exploit obsidian earlier though in a very small quantities. Few years the only evidence was from Franchthi Cave but now there other evidences too. The ever earlier evidences from the discoveries of Crete, Gavdos and Ionian islands indicate that the relationship between the sea and humans started in a very early stage.

On the one hand there are still many gaps regarding the Mesolithic period itself and the relation between the previous period of the Palaeolithic and the subsequent of the Neolithic. What was the role of the Mesolithic –if there was any finally- in the transition to the Neolithic and the role of the transfer of obsidian in the spread and the adoption of the Neolithic way.

The discoveries from Crete, Gavdos and Ionian Island need definitely further investigation as there are many unanswered issues such as if simultaneously with the land dispersal there was and a maritime dispersal or what skills had finally the Homo Neanderthals etc.

Finally, there are many gaps regarding prehistoric watercraft. Still there are no satisfactory and definite answers on this issue.

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APPENDIX

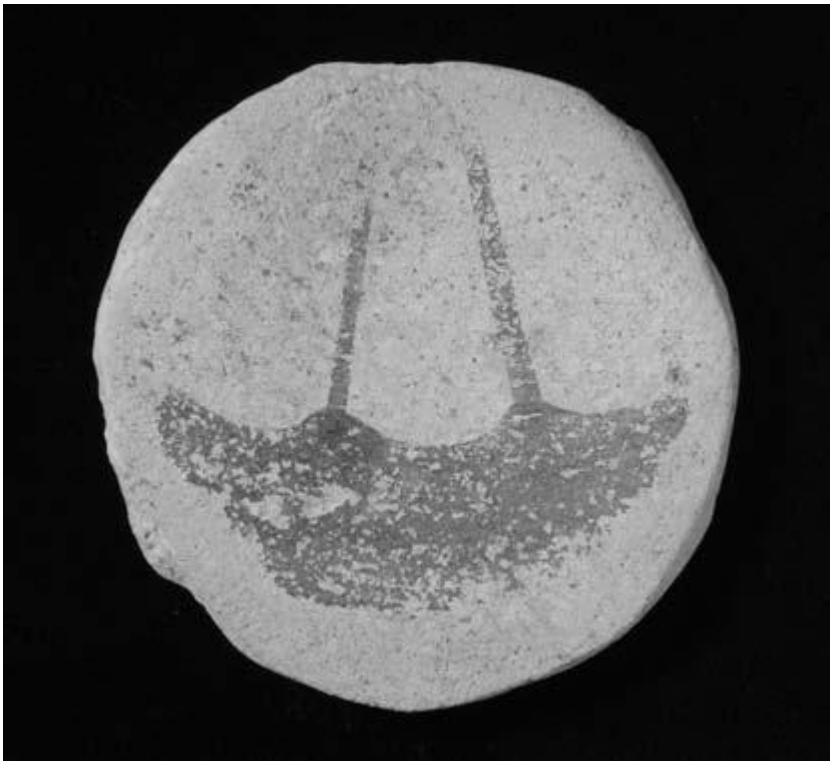

Figure 1. Painted ceramic disc depicting boat with two-footed mast. Robert Carter 2006

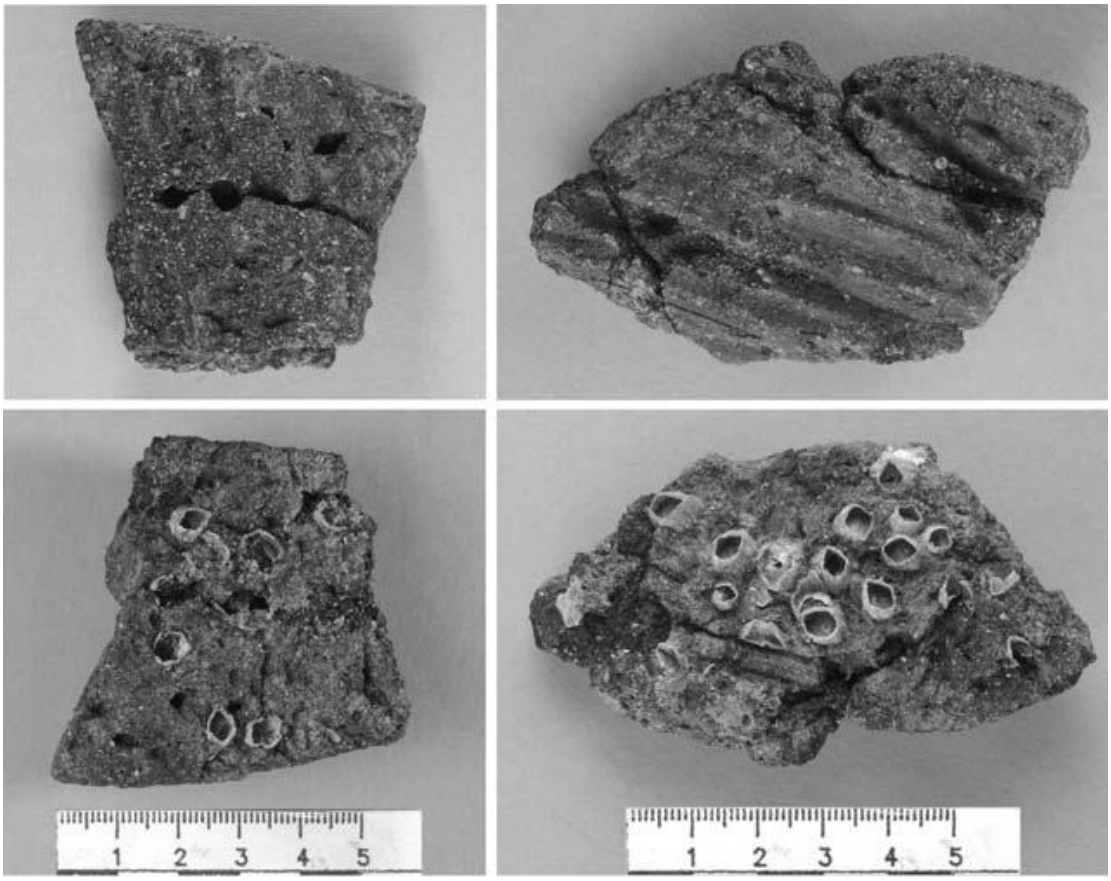

Figure 2. Bitumen with reed impressions and barnacles. Robert Carter 2006

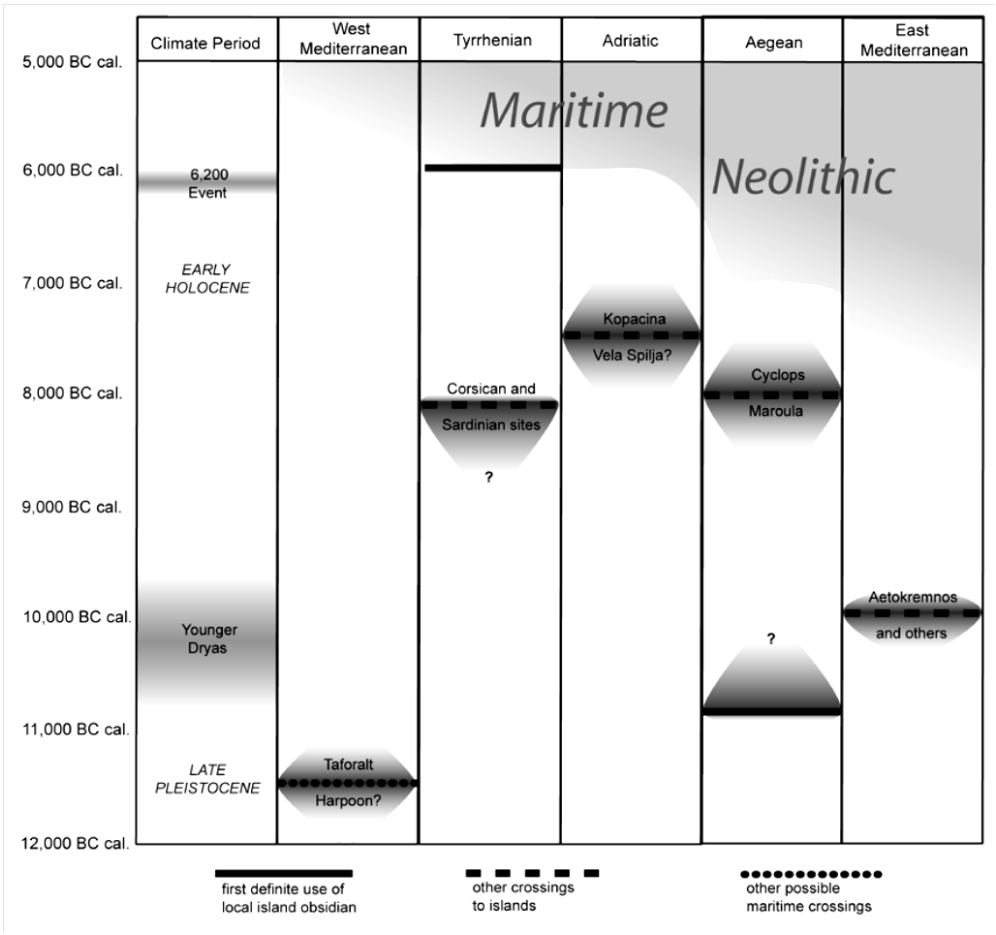

Figure 3. The chronology of sea-crossings and insular presence in the Mediterranean from shortly before the Younger Dryas until c. 5500 bc. Cyprian Broodbank 2006

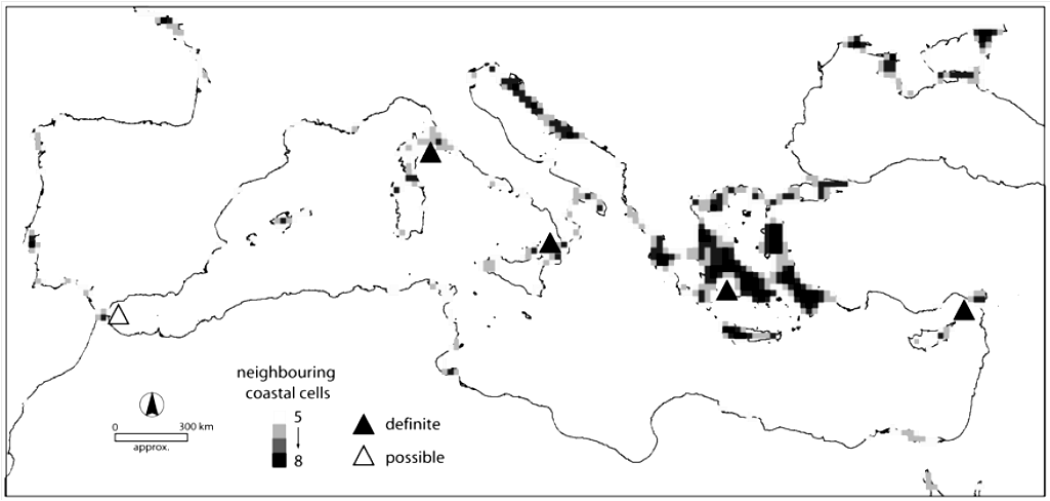

Figure 4. The incidence of early maritime activity in the Mediterranean during the Upper Palaeolithic up to the end of the Younger Dryas, mapped onto areas of favourable coastal configuration (the latter adapted from McEvedy 1967, using squares 25 km across; increasingly dark shading indicates coastal squares with five or more adjacent squares also coastal). Note that where crossings to islands are involved, the likeliest crossing-point, rather than the terrestrial evidence on the island itself, is indicated. Cyprian Broodbank 2006

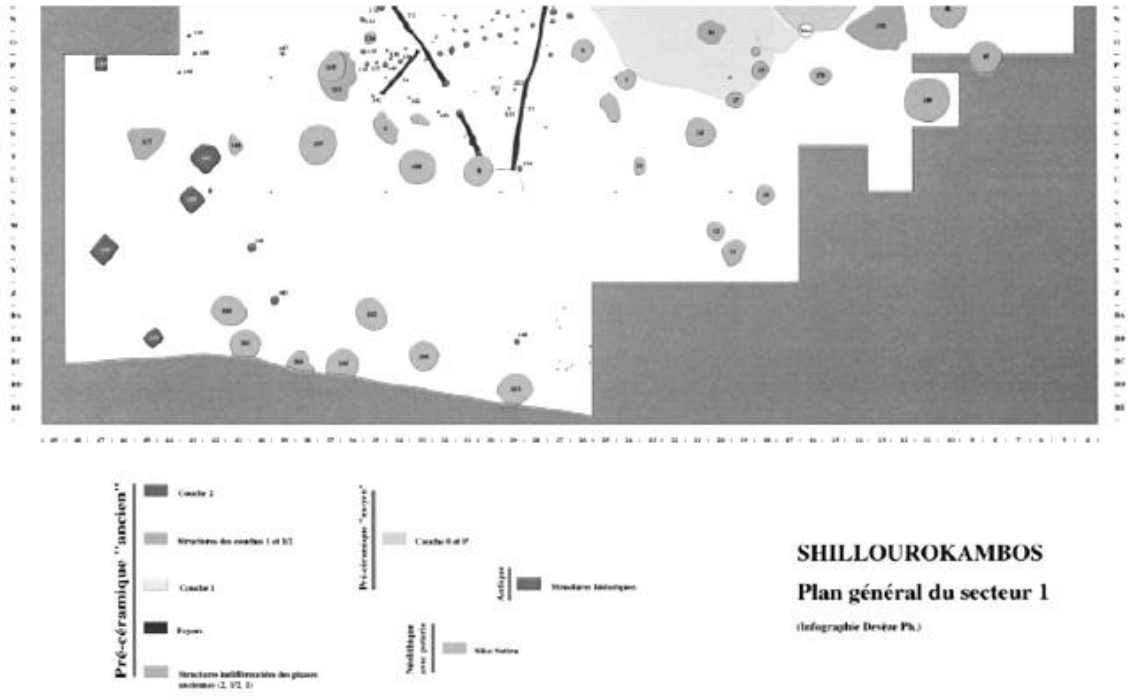

Figure 5 Site plan of Parekklishia Shillourokambos. Stuart Swiny 2001

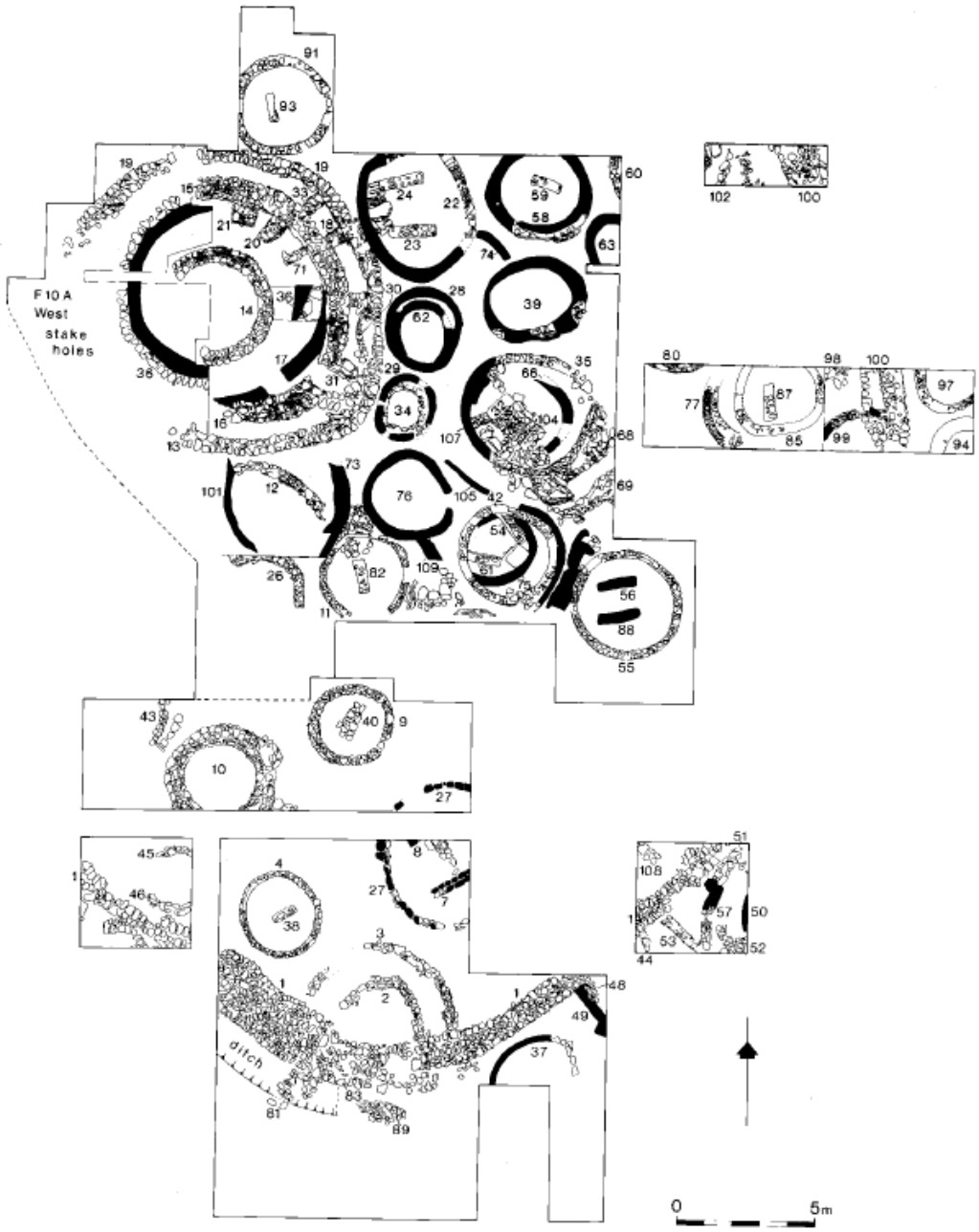

Figure 6 Plan of major architectural and features at Tenta. Mud-brick walls are show in solid black. Stuart Swiny 2001

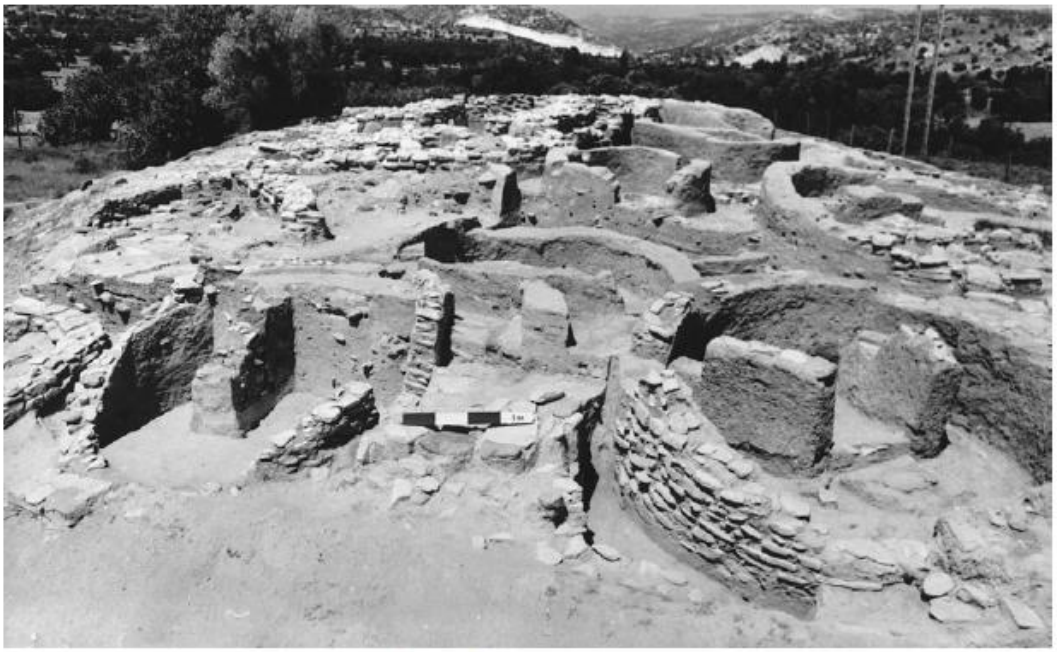

Figure 7 General view of upper part of Tenta with Structures 11 and 42 in foreground, from the southsoutheast. Stuart Swiny 2001

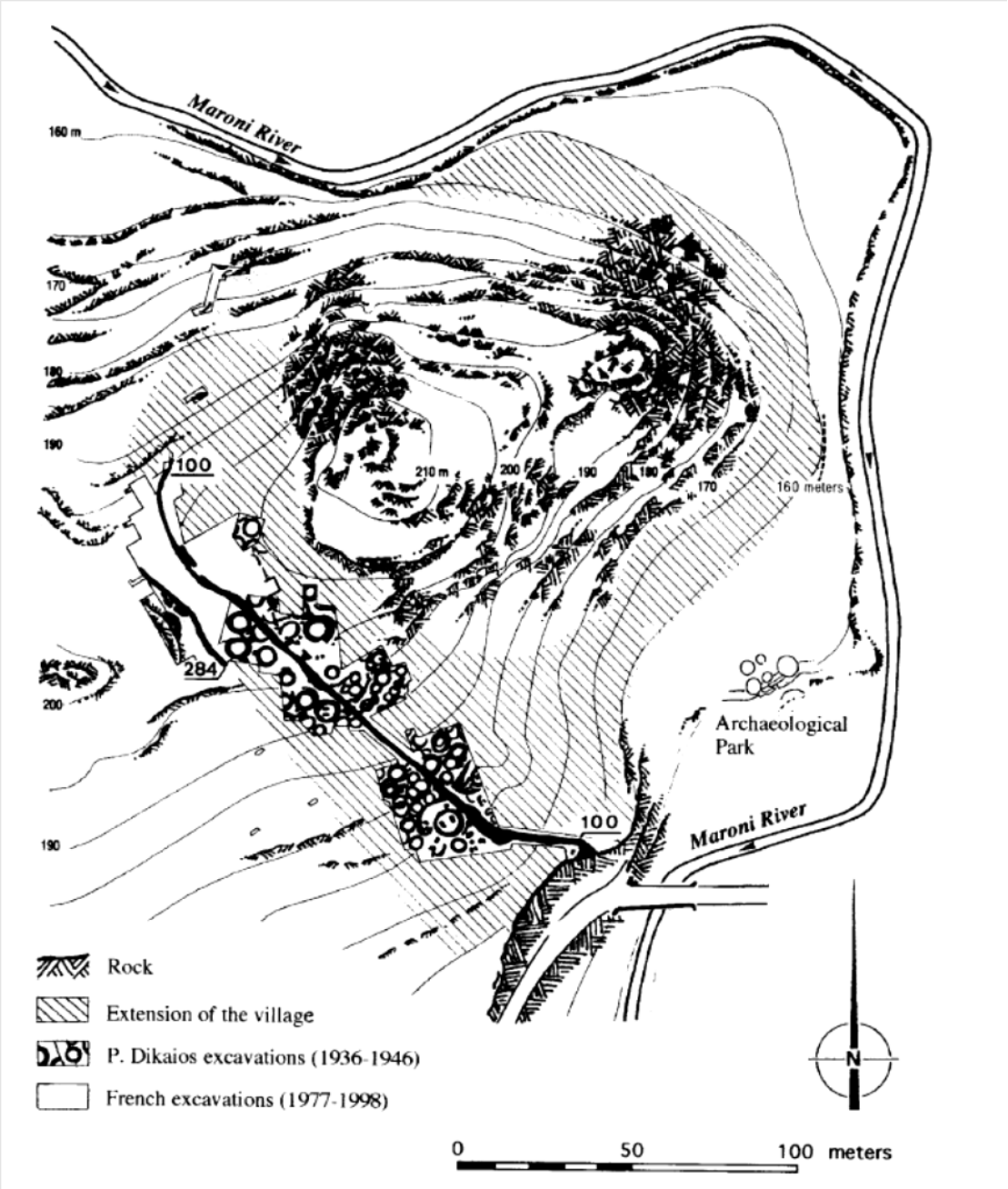

Figure 8 Khirokitia. General plan of the site. Stuart Swiny 2001

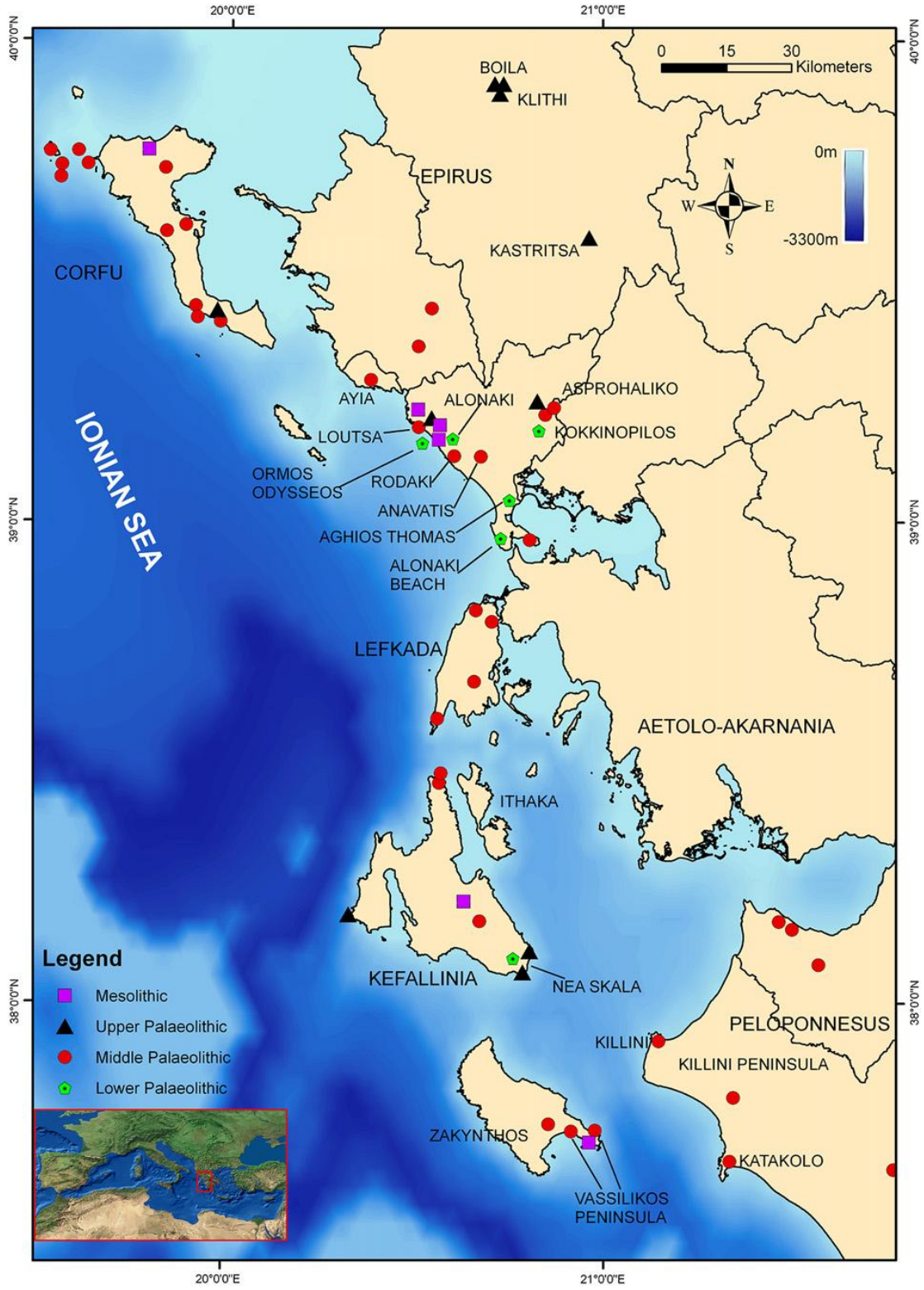

Figure 9 Lower Palaeolithic to Mesolithic sites in the Ionian Islands and Greek mainland. Inset: Map of the Mediterranean Sea showing the study area. Ferentinos, G. 2012

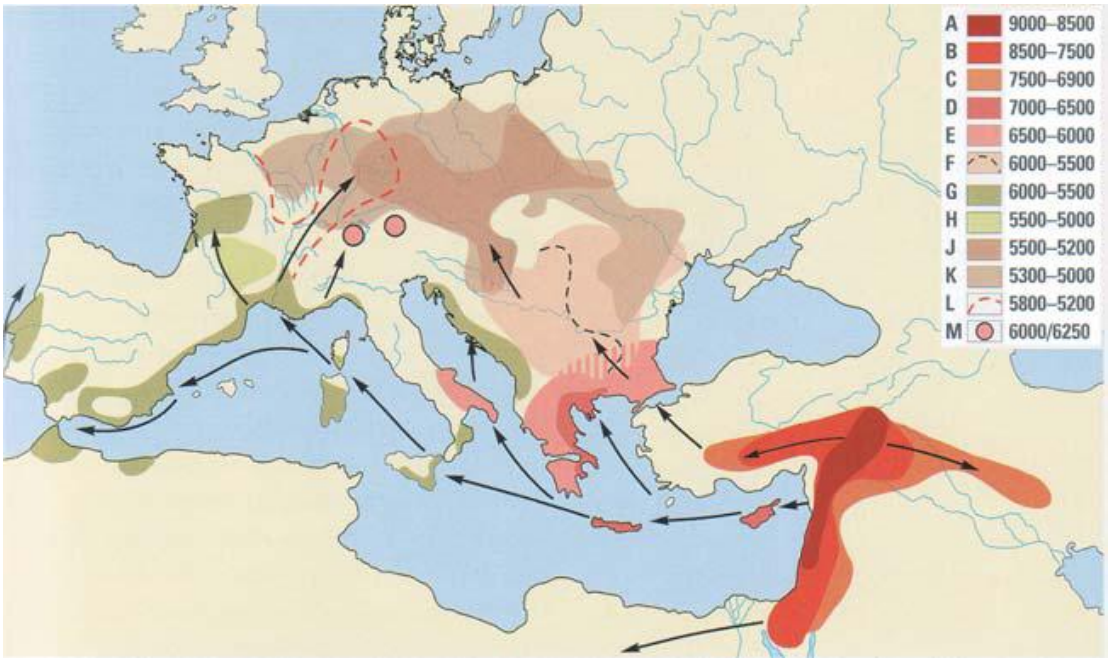

Figure 10 Neolithisation model according to Luning. Agathe Reingruber 2011

Figure 11 Neolithisation model according to Ozdogan. Agathe Reingruber 2011

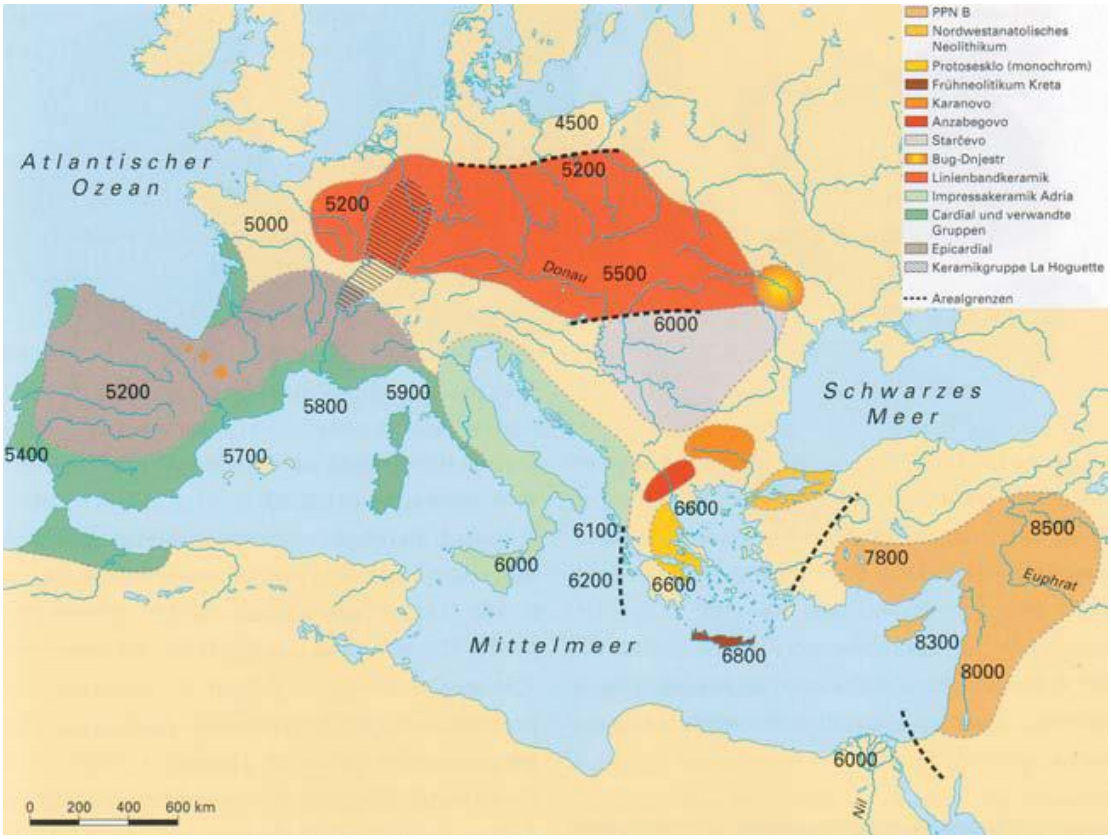

Figure 12 Neolithisation model according to Guilaine. Agathe Reingruber 2011

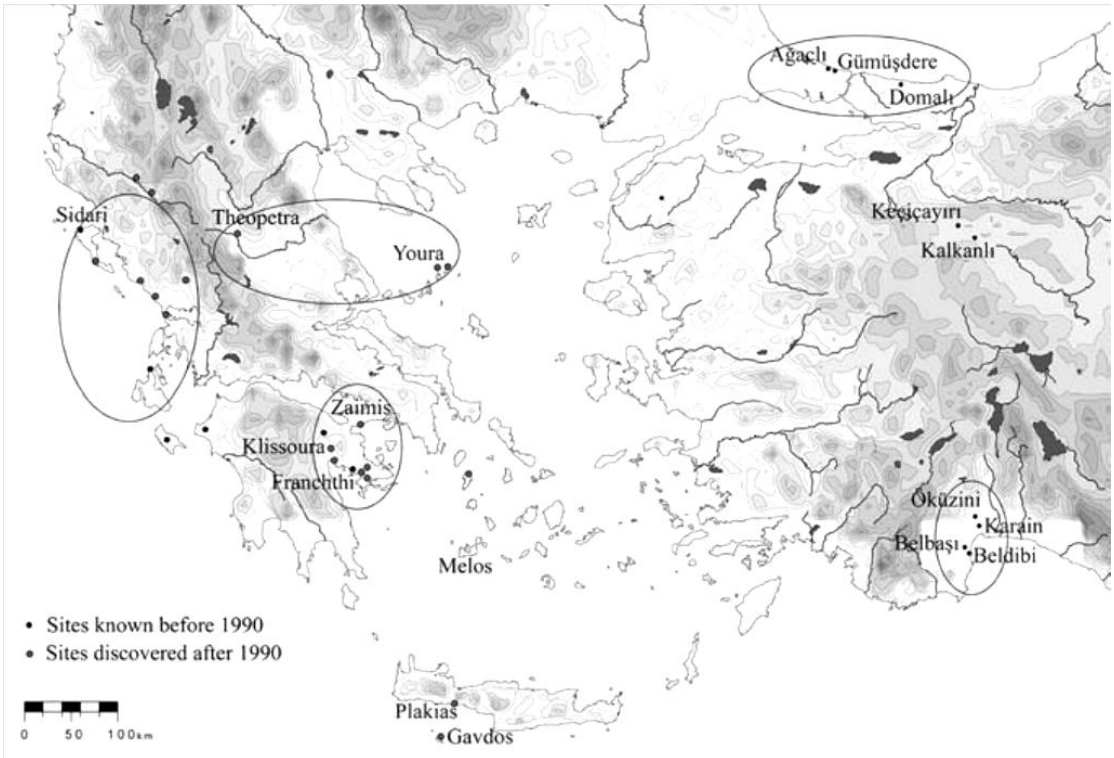

Figure 13 Mesolithic sites in the Aegean (after Reingruber 2008.Map 1). Agathe Reingruber 2011

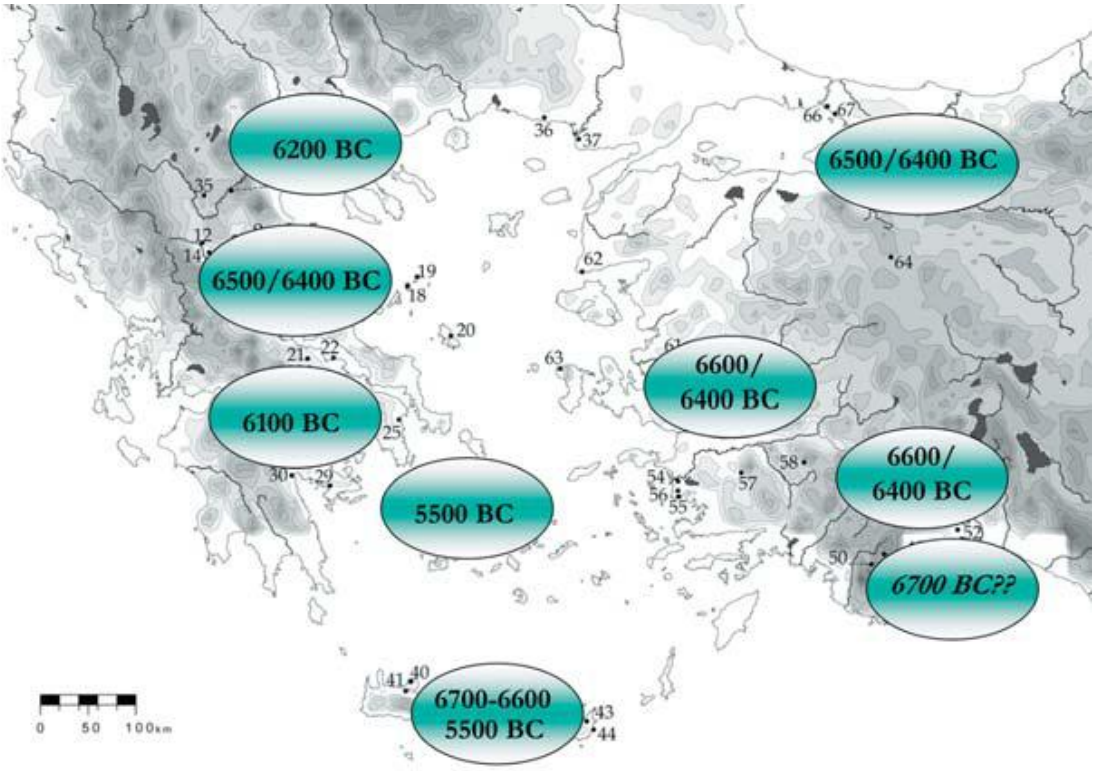

Figure 14 First appearance of Neolithic sites in the Aegean. Agathe Reingruber 2011

Figure 15 Distribution of obsidian from the island of Melos in the Mesolithic. Agathe Reingruber 2011

Figure 16 Distribution of obsidian from the island of Melos in the Neolithic**.**. Agathe Reingruber 2011

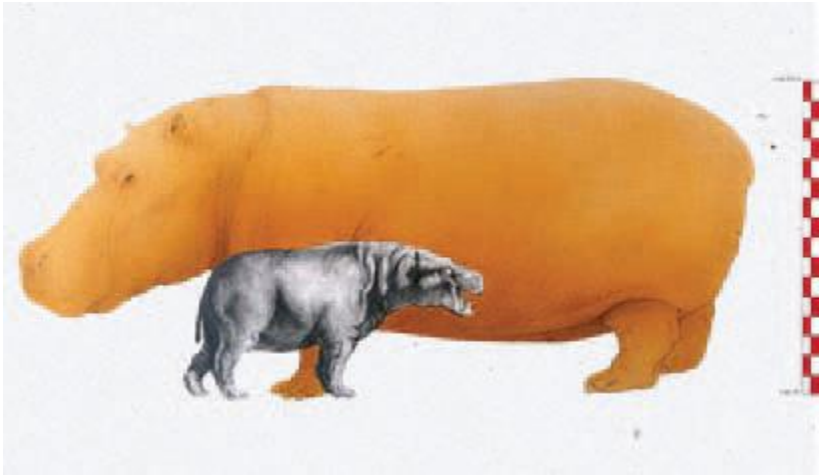

Figure 17 Artist's reconstruction of the extinct pygmy hippopotamus Phanorious minor (Desmarest, 1822) of Late Pleistocene Cyprus, adapted from the specimen in the London Natural History Museum and compared to the size of the extant Hippopotamus amphibius. Marco Masseti 2008

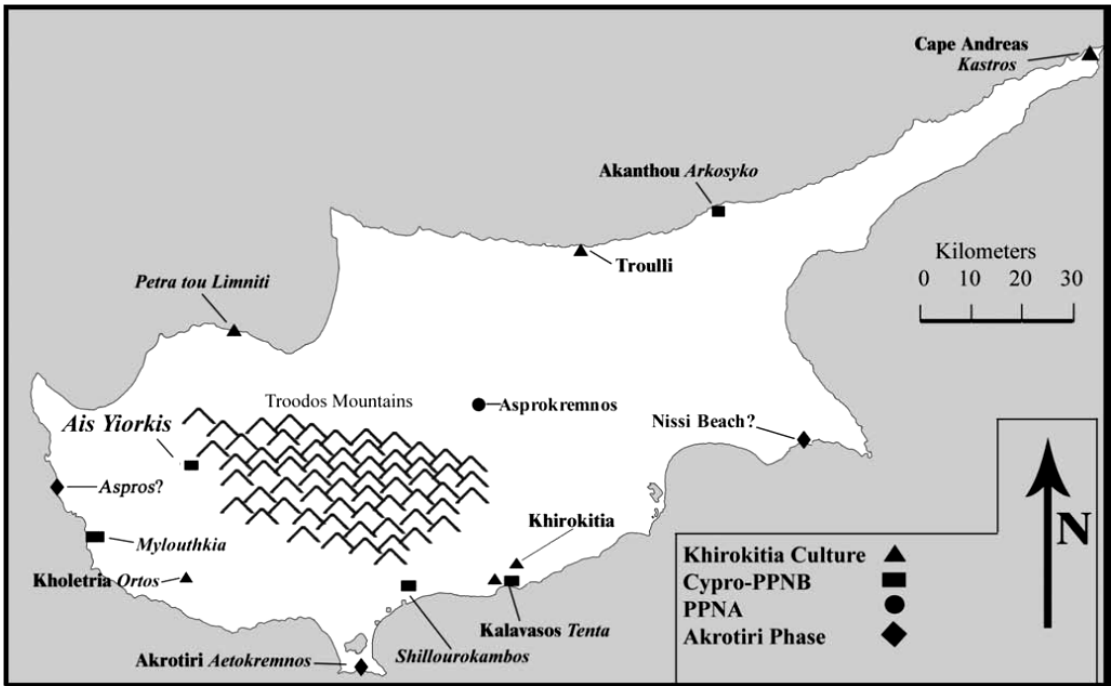

Figure 18 Map of some of the sites mentioned in the text**.** Nellie Phoca-Cosmetatou 2011

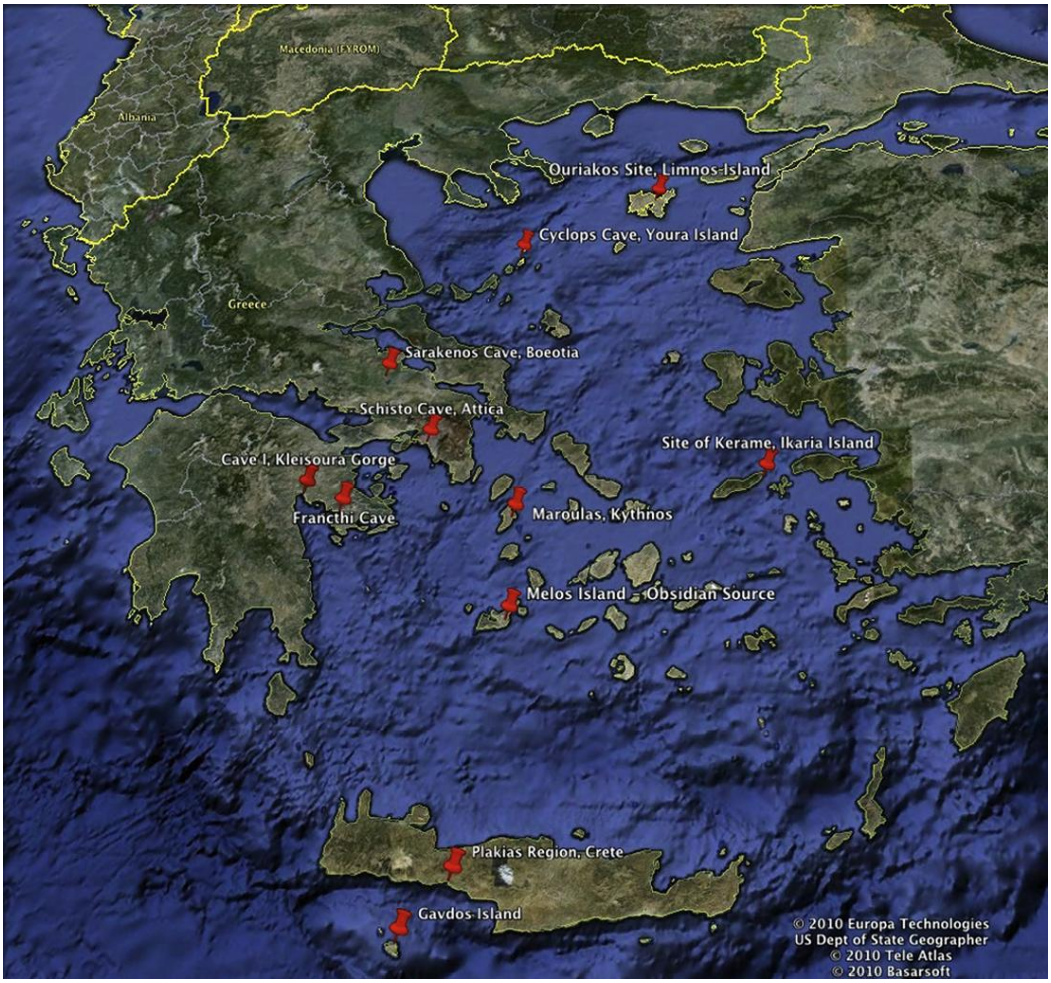

Figure 19 Sites mentioned in the text. N. Laskaris et al 2011

Figure 20 Painted ceramic disc depicting boat with two-footed mast. Robert Carter 2006

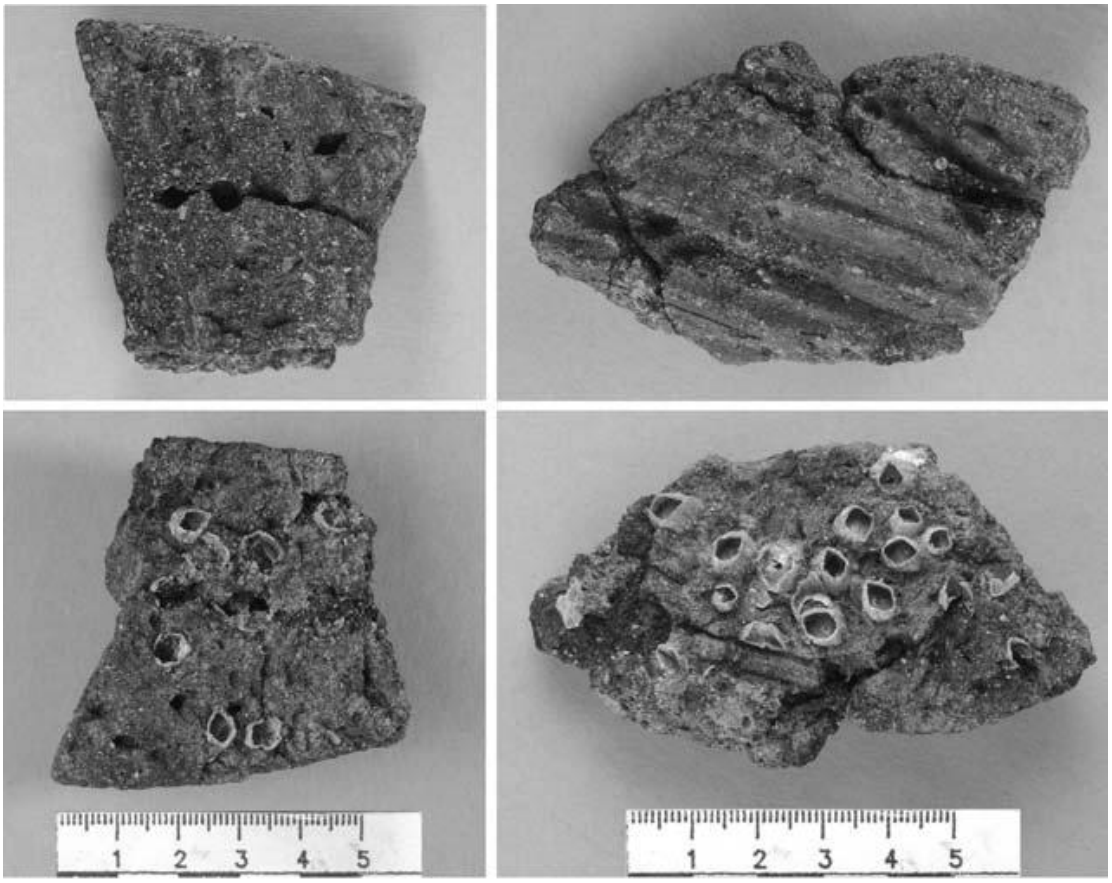

Figure 21 Bitumen with reed impressions and barnacles.. Robert Carter 2006

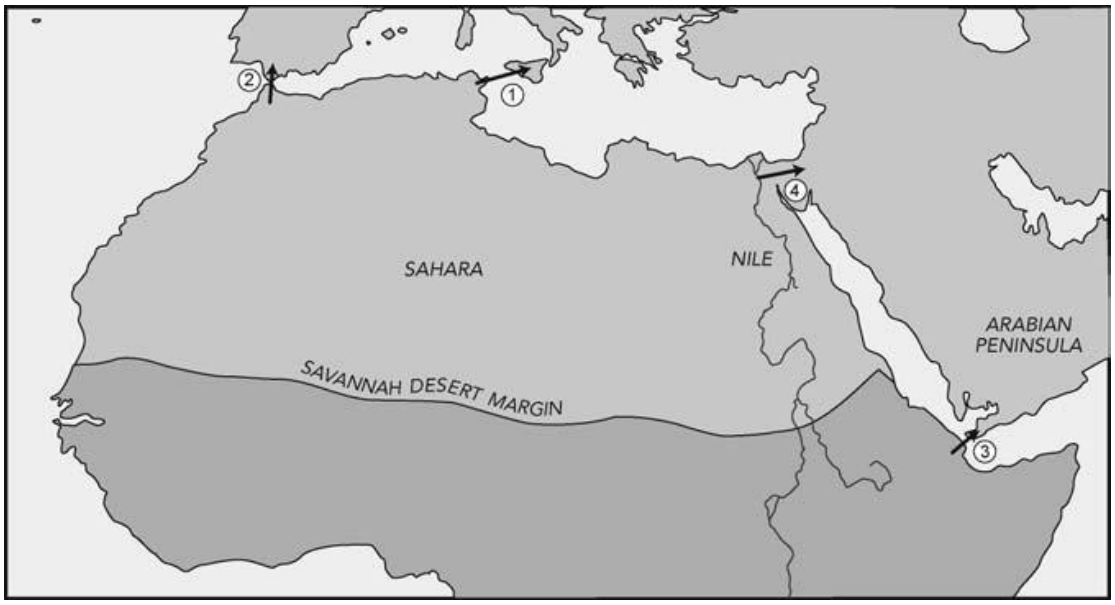

Figure 22 Northern Africa and possible migration routes. 1 Sicilian Channel. 2 Strait of Gibraltar. 3 Babel-Mandab. 4 Sinai Peninsula Robin Derricourt 2006

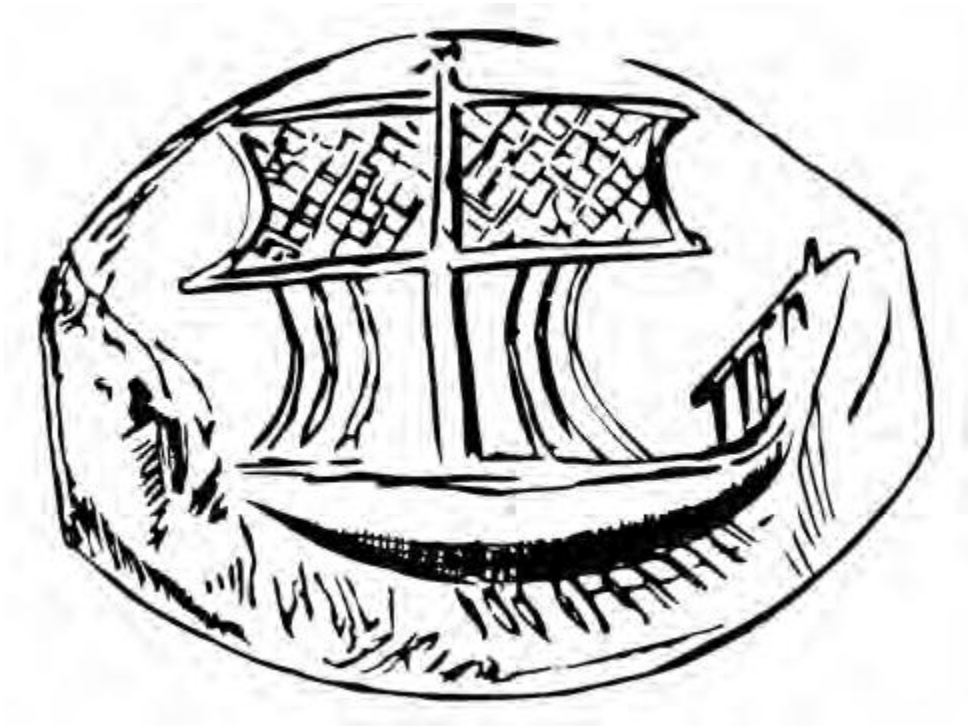

Figure 23 Late Minoan seal depicting a vessel under sail. The hatches below the boat probably indicate oars. Giorgos Vavouranakis 2011

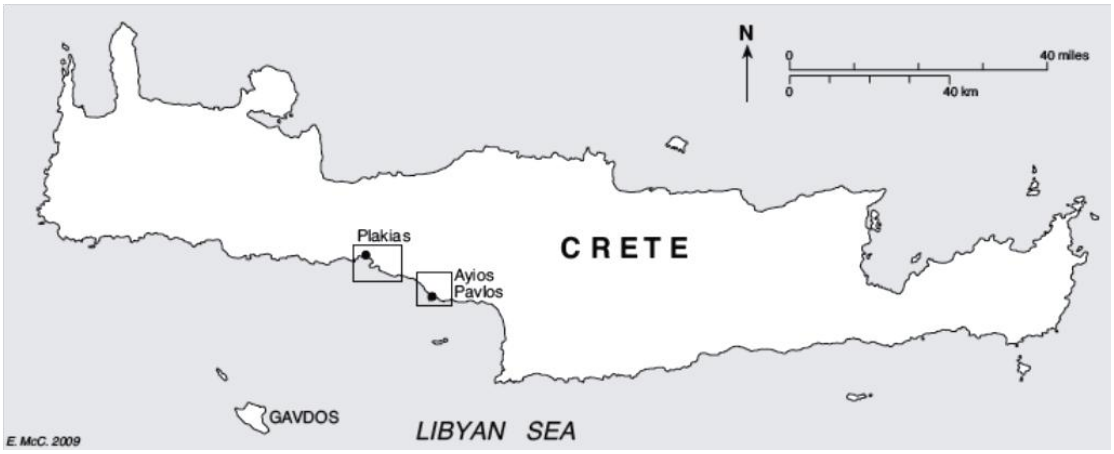

Figure 24 Map of Crete showing areas surveyed by the Plakias Survey. Thomas F. Strasser Et. Al 2010

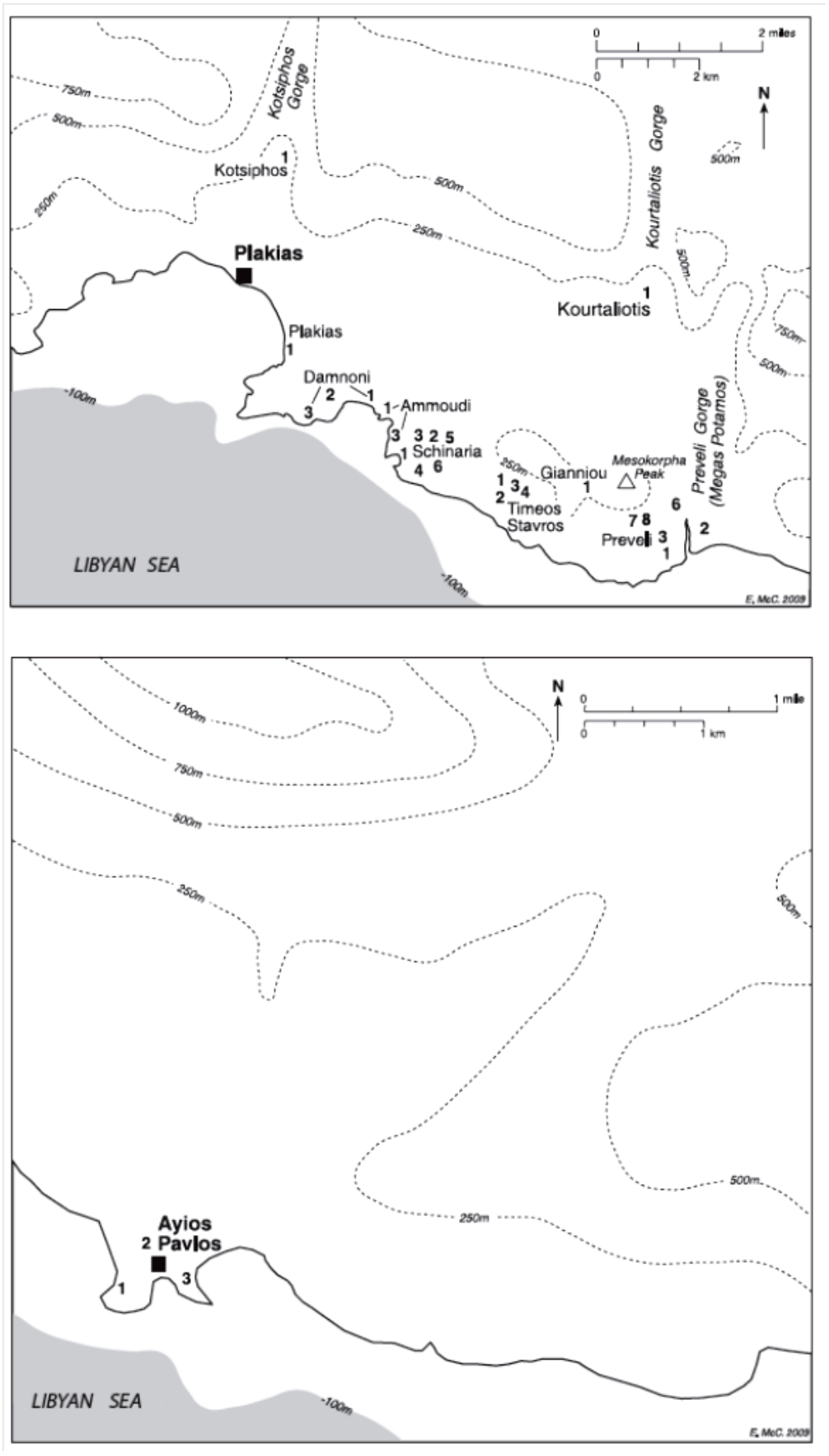

Figure 25 Details of the survey areas shown in Figure 1, with approximate locations of sites: (a) western area around Plakias (b) eastern area around Ayios Pavlos. Thomas F. Strasser Et. Al 2010

Figure 26 Mesolithic artefacts from Damnoni 1. Thomas F. Strasser Et. Al 2010

Figure 27 Kerkyraiki papyrella. Chari Tzala

Figure 28 Papyrella at sea. Chari Tzala

Figure 29 The inner part of the cave. Zacharias N. 2012

Figure 30 Final Neolithic blades from Petras Kephala. Cesare D'Annibale 2008

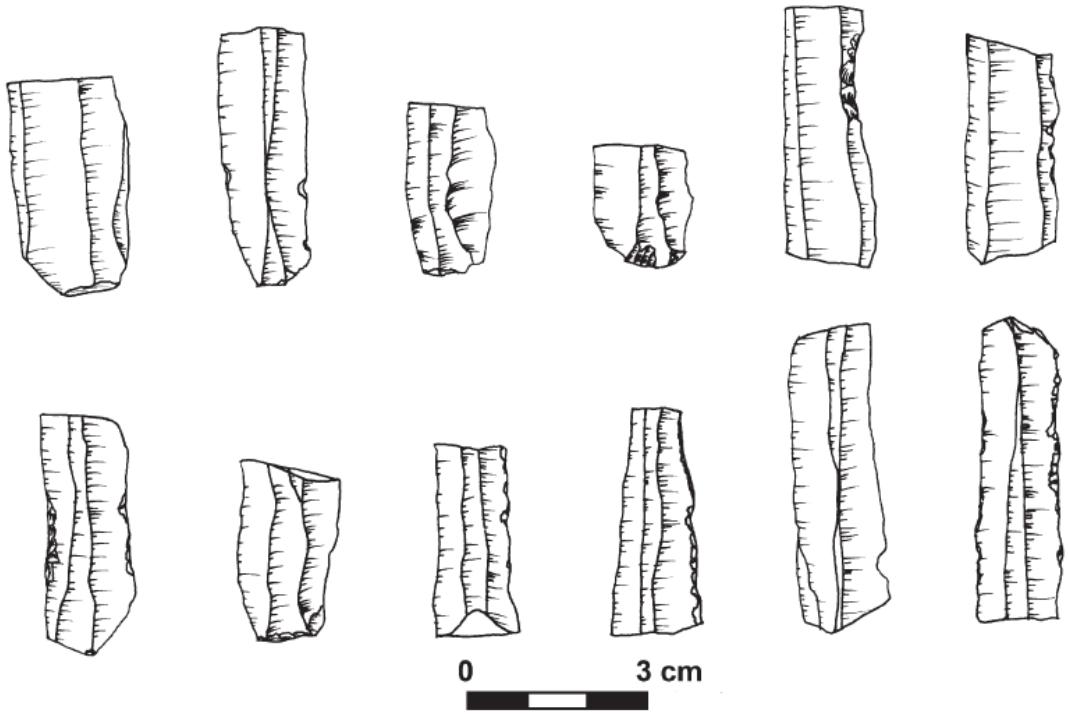

Figure 31 Large blades from Petras Kephala: Final Neolithic IV (top row) and Early Minoan I (bottom row). Cesare D'Annibale 2008

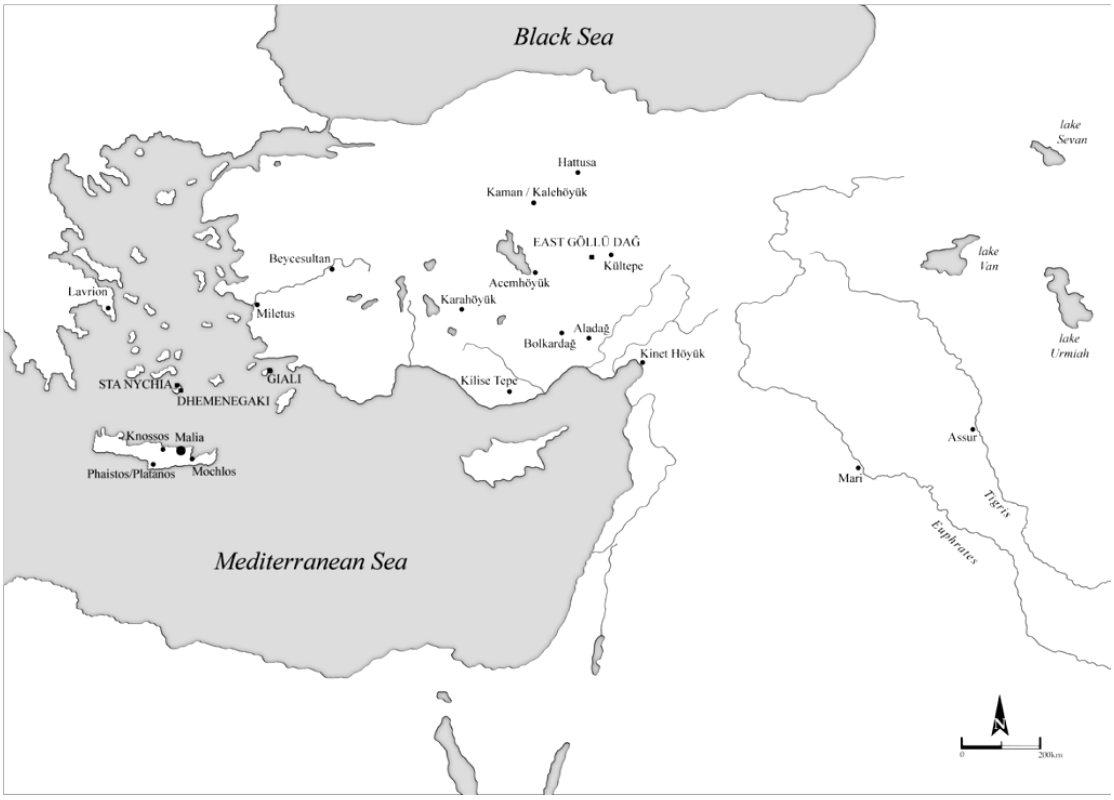

Figure 32 Map of the Aegean and Anatolia showing main sites. Tristan Carter and Vassilis Kilikoglou 2008

Figure 33 Artifacts made of obsidian sourced to Giali and East Gollu Dag. Tristan Carter and Vassilis Kilikoglou 2008

Figure 34 Map showing Crete and Gavdos. Katerina Kopaka and Christos Matzanas 2011

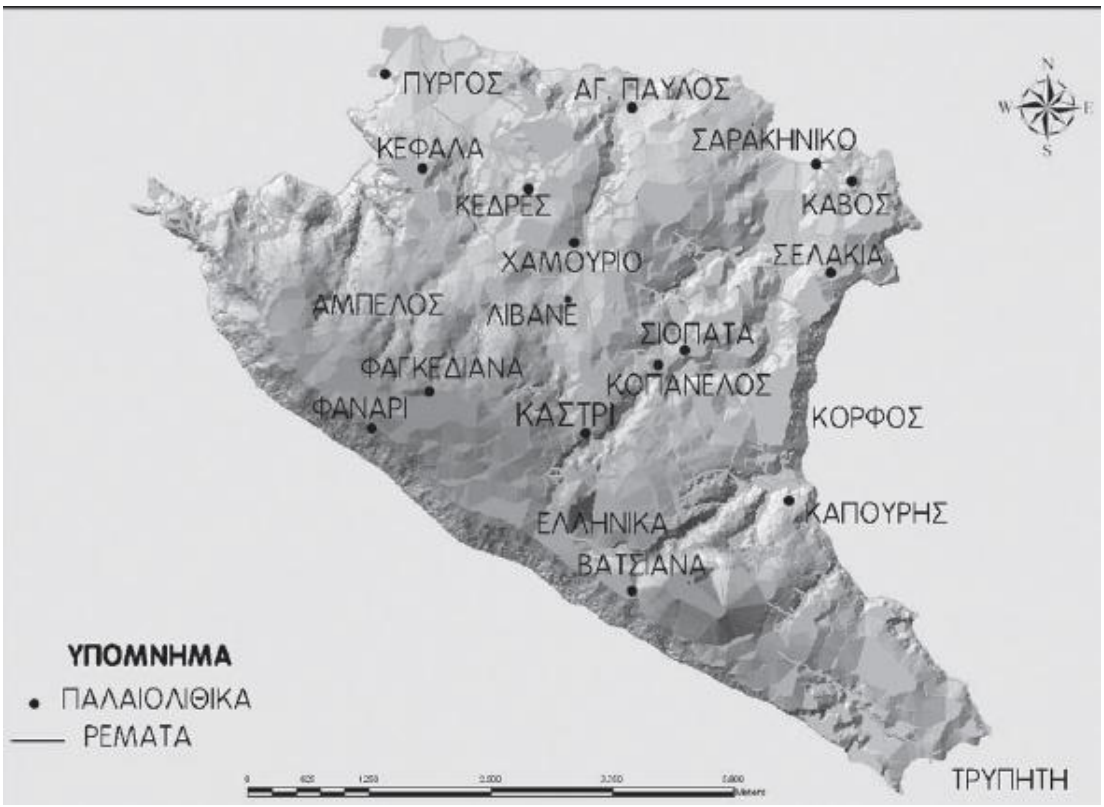

Figure 35 Map showing Gavdos. Katerina Kopaka and Christos Matzanas 2011

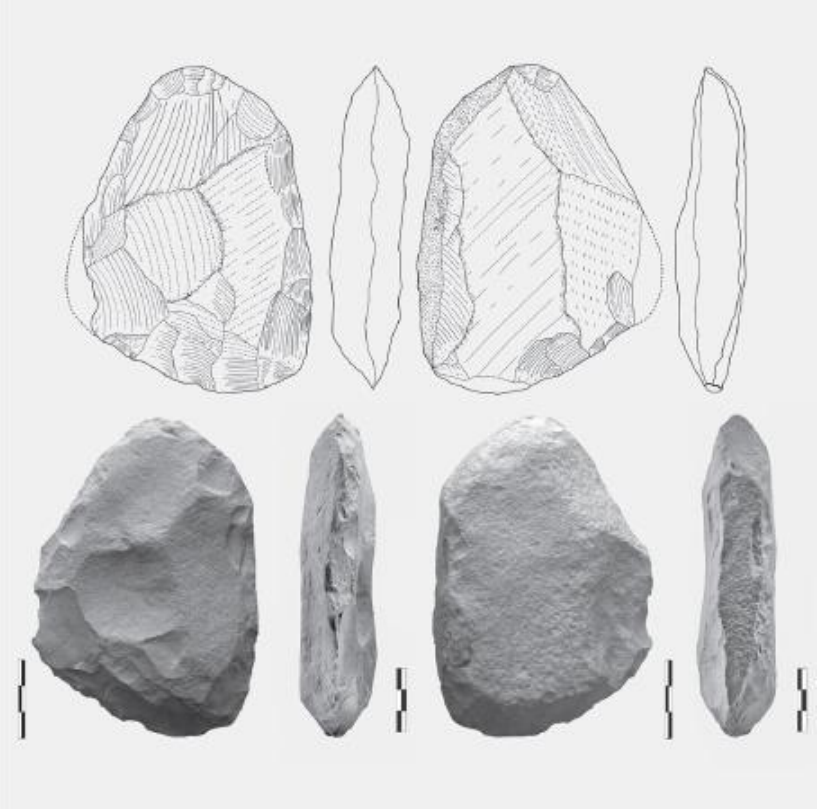

Figure 36 Hand-axe. Katerina Kopaka and Christos Matzanas 2011

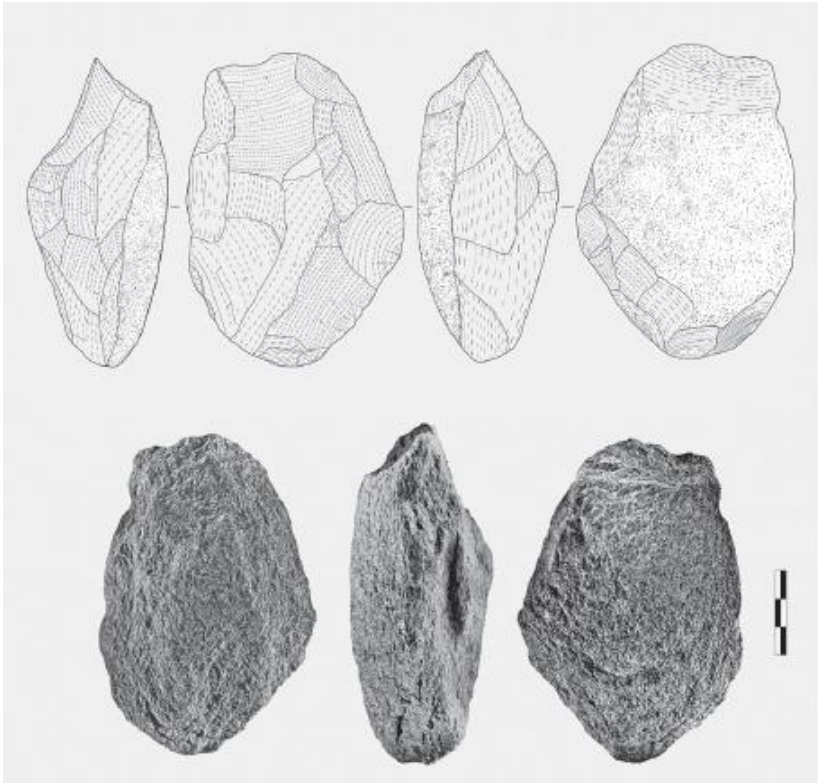

Figure 37 Hand-axe. Katerina Kopaka and Christos Matzanas 2011

Figure 38 Melian obsidian. Katerina Kopaka and Christos Matzanas 2011

Figure 39 Feature 1—Platform after excavation. Ais Giorkis 2012

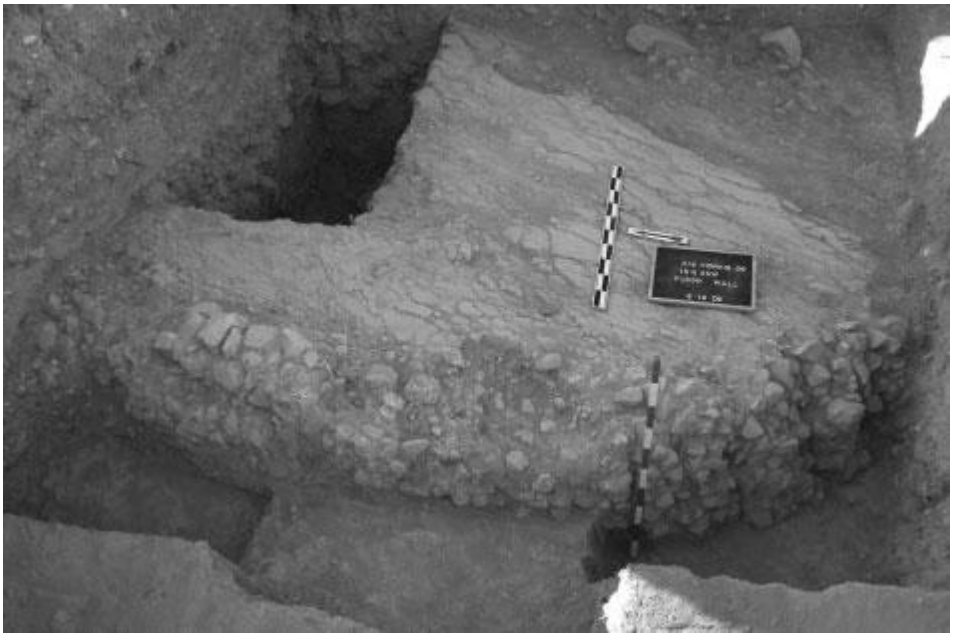

Figure 40 Feature 17—Platform after excavation. Ais Giorkis 2012

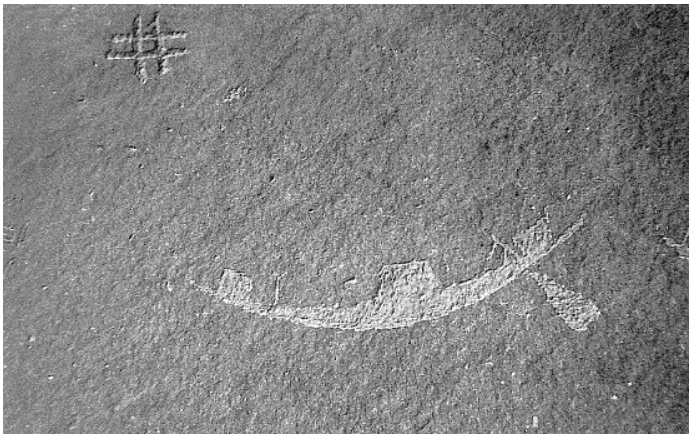

Figure 41 Ship graffito no12. Shelley Wachsmann 1998

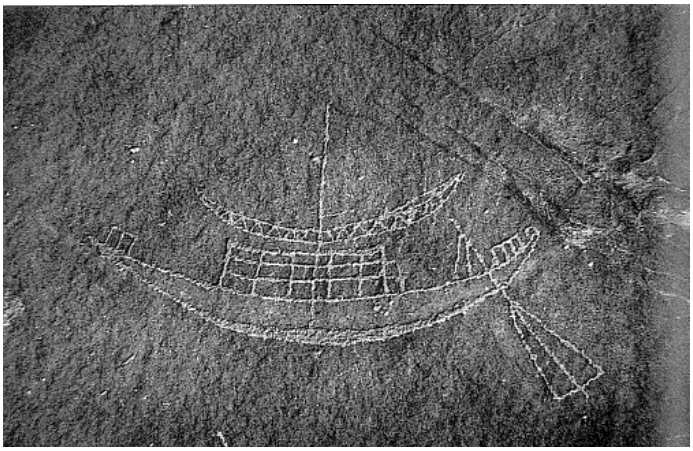

Figure 42 Ship graffito no13. Shelley Wachsmann 1998

Figure 43 Ship on a Syrian cylinder seal from Tell el Daba. Shelley Wachsmann 1998

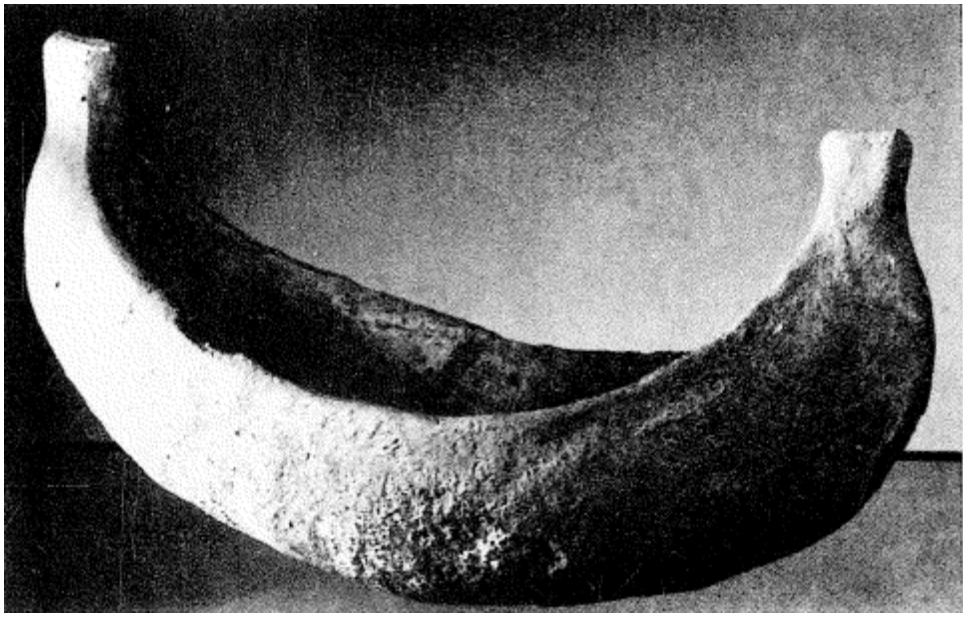

Figure 44 Terra-cotta ship model from Enkomi. Shelley Wachsmann 1998

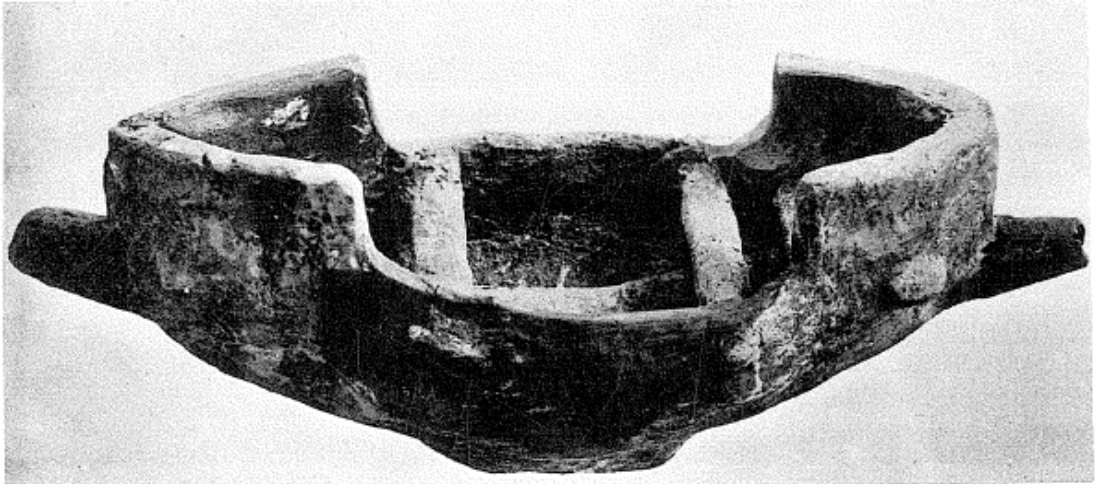

Figure 45 Terra-cotta ship model found in the excavation at Byblos. Shelley Wachsmann 1998

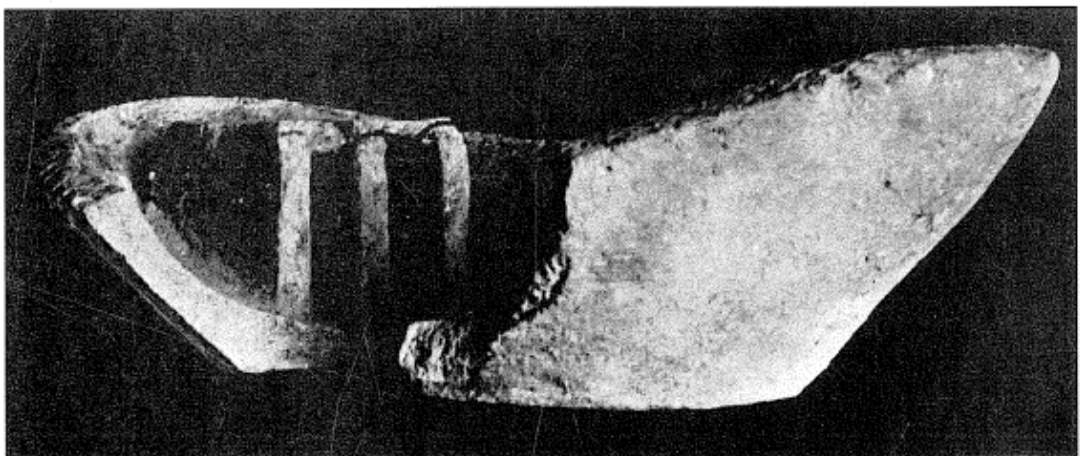

Figure 46 Terra-cotta ship model found at Byblos. Shelley Wachsmann 1998

Figure 47 Terra-cotta ship model of unknown provenance. Shelley Wachsmann 1998

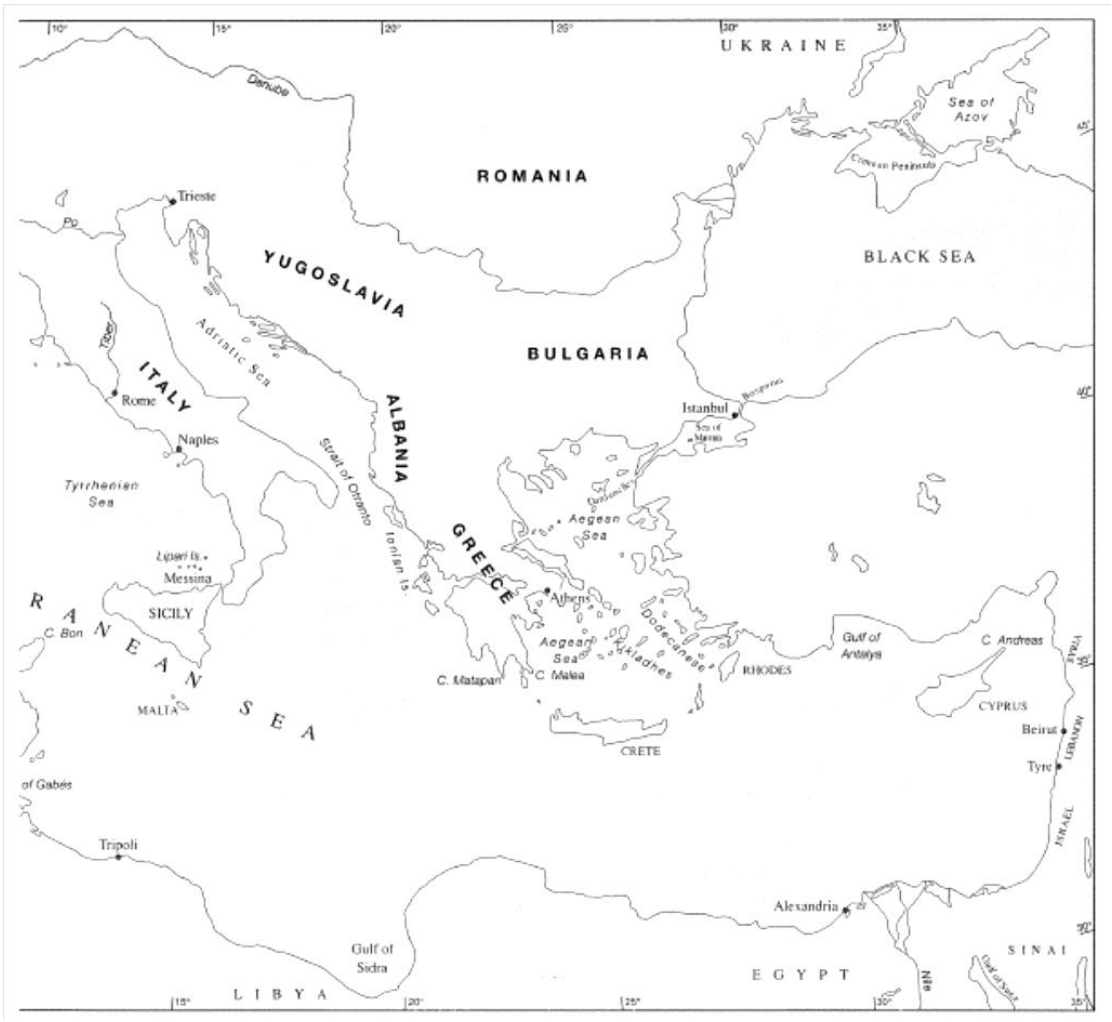

Figure 48 Map of the Mediterranean region. Sean McGrail 2001

Figure 49 A possible bundle raft depicted on a gold ring from Monchols, Crete. Sean McGrail 2001

Figure 50 A lead model boat of third millennium BC from Naxos, Greece. Sean McGrail 2001

Figure 51 A terracotta boat model of third millennium BC from Palaikastro, Greece. Sean McGrail 2001

Figure 52 A terracotta boat model of third millennium BC from Machlos, Crete. Sean McGrail 2001

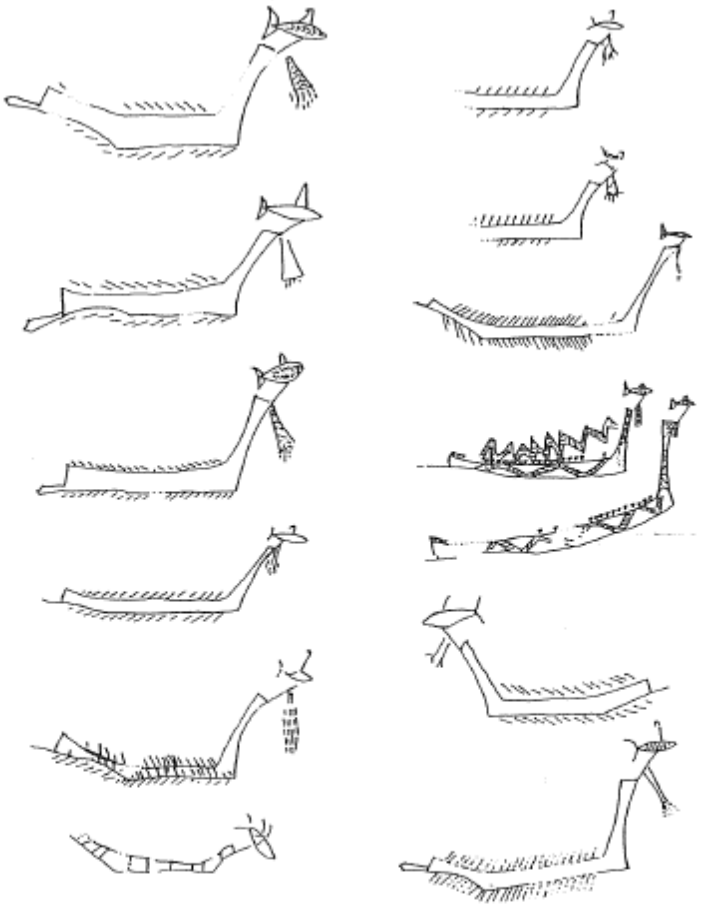

Figure 53 Incised decoration on Cyvladic terracottas – "frying pans". Sean McGrail 2001

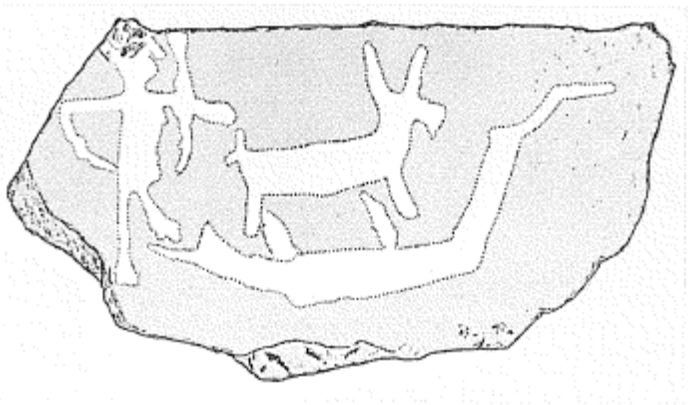

Figure 54 Engraving on a stone from Naxos, Greece. Sean McGrail 2001

Figure 55 Sailing ship on a Minoan seal of c.2000 BC. Sean McGrail 2001

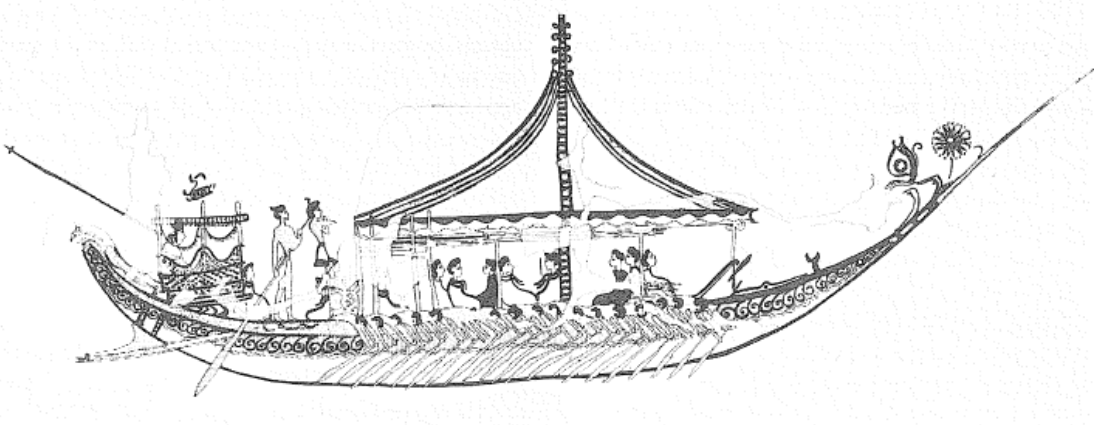

Figure 56 The Thera "flagship" restored. Sean McGrail 2001

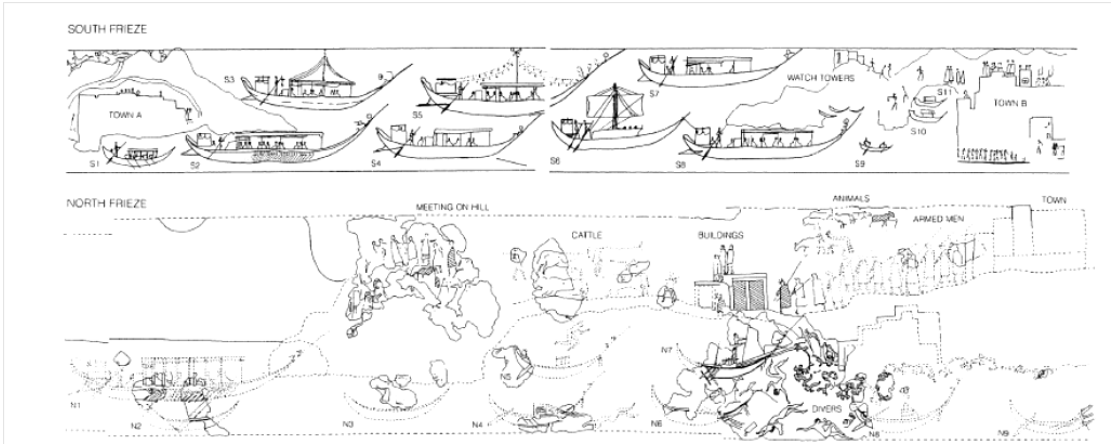

Figure 57 Diagrammatic representations of the Thera south and north friezes as restored. Sean McGrail 2001