Archaeological and Archaeometrical Research at Yali, Nissiros

Yali (Nissiros) da Arkeolojik ve Arkeometrik Araştırmalar

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Keywords: Yali tephras,Radioisotopes,Neolithic, Metallurgy,Ethnoarchaeology
Anahtar sözcükler: Yali tefraları,Radioisotoplar, Neolitik Devir,Madencilik,Etnoarkeoloji

Yali adası Kos ile Nissiros arasında yer alır ve jeolojik olarak bu bölgedeki değişik volkanik merkezlerden kaynaklanan volkan katmanlarından oluşmuştur. Burada yapılan sistemli yüzey araştırmaları ve kazılar adanın güney batı kesiminde yoğun Neolitik yerleşmelerin varlığını ortaya çıkarmıştır. Aynı zamanda yürütülen etnoarkeolojik araştırmalar adanın güney doğusunda sürdürülmüştür. Arkeometrik araştırmalar M.Ö. 2.binin ortalarında Yali - Nissiros volkan merkezinin etkin olduğunu ve tefraların civardaki adalarda biriktiğini kanıtlamıştır (Kos, Rodos, Tilos).Volkanik kalıntıların TL (termoluminesans) tarihlemesi Yali'de en son volkan patlamasının M.Ö. 2. bin süresinde meydana geldiğini kanıtlamıştır.

The island of Yali (Fig. 1), meaning "glass" in modern greek, owes its name to the volcanic deposits of obsidian occuring in its NE part. Yali is situated south of Kos and not far from Nissiros, the main volcanic centre of the area[1]. It consists of two mountain masses joined by a long and narrow sandy isthmus of alluvial coast deposits which probably was related to a shallow sea in the prehistoric period. The NE part of the island consists mainly of perlite, while obsidian is found either in thin layers within the perlites or in limited massive deposits (Fig. 2). It is possible that all these ryoliths of the NE part are due to the activity of one or more volcanic centres, existing today in the marine area between Yali and Nissiros[2] and between Yali and Kos[3]. The obsidian deposits of Yali are also attributed to small eruptions of more than one unknown volcanic centres by the volcanologist R. Brousse (pers. communication). He ascribed the material to a quite recent age.

In the NE sector Hellenistic pottery was collected from many surface spots[4]. However, to date no prehistoric remains have been located, with the exception of one site on the east side. The existence on Yali's NE sector of a dense assemblage of farming and herding constructions (about 300) dated to the 19th c. diverted the orientation of Yali Project for a few years towards an ethnoarchaeological study of the area and the

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The name of the island occurs in literature also as Giali and Ghiali.

search for the type of subsistence strategies which the modern population from Nissiros had adapted to exploit the land of Yali[5]. Between 1990-1995 a team of archaeologists and topographers effectuated the location, mapping and typological separation of the structures (Fig. 3) ranging from habitation constructions, storerooms and food-preparation huts to pens, cisterns, wells and threshing floors. Problems like seasonality, island trunshumance, extent of private properties and variety of land use raised in the course of the research revealted the socioeconomical idiosyncrasies of the area. The pattern implied can be used as an explanatory parallel for the type of the neolithic occupation of Yali.

The SW part of the island holds great geological interest. The complexity of the geological events has attracted the attention of many specialists; but no thorough study has so far been made to relate the geological formations to human occupation in prehistory. However, the data so far allow us to make a first approach to the palaeogeography of Yali.

The SW part of the mountain massif consists basically of a uniform deposit of pure pumice more than 160 m. high. This has been exploited by a mining company for the last two decades (Fig. 4). This geological unit containing xenoliths from Kos was deposited in a shallow marine environment and is dated to 145 ka[6]. Pumice is overlaid by a deposit of calcareous sandstone, 2 -3 m. thick, containing typical fossils of sea molluscs (Fig. 4) which have been assigned to the Tyrrhenian age (125 or 85 ka old)[7]. However, the lack of Strombus Bubonius, the characteristic species of the Tyrrhenian in the Mediterrenean, shows that these sediments cannot be assigned to the above period, and that their date rather ranges between 145 and 31ka BP.

Above the sandstone one can observe a layer of argil, 0.30-0.60 m. thick (palaeosol 1), probably formed during a glacial period. This deposit is dated by Pentarakis[8] by ^{14}C of sea shells to 55450 ± 230 BP, and by Wagner[9] to ca. 24000 BP. This layer is overlaid by a aphiric pumice deposit 1,5 to 2 m. thick and corresponds to an explosive event from a volcanic centre probably between Yali and Kos. Based on deep sea core sediments, the age of this deposit is dated about 31 ka[10] . Furthermore, a land uplift brought the marine sediments and the upper pumice to a height of 165 m., while a set of NW-trending normal faults[11] caused the lowering of the relief on the north side of the SW part and on the isthmus, where all this stratigraphic sequence is visible just a few metres above sea level.

Also a second argilic layer (palaeosol 2) is found on top of this sequence. Finally the younger palaeosol is covered by pumice of variable thickness, reaching several metres in some cases. A major part of this is due to small volcano eruptions and deposits of pyroclastic material in a round movement ("serge"). However, some of it likely due to aeolic displacement and seems to be of a post-neolithic date.

Radioisotope analysis of ten well stratified tephra and pumice samples (Fig. 5) from the top pumice deposit of the SW sector of Yali had for the first time connected Yali deposits with similar layers in Kos and Rhodes by producing overlapping radionuclide signatures (Fig. 6). On the island of Kos two sites were sampled: Kephalos on the island's West, which falls within the same isotopic characteristics as Yali, and the city of Kos on the East, the latter however pointing towards a Santorini provenance. Concerning Rhodes, most samples correlate with the Santorini group, except for one sample coming from the Minoan settlement of Trianta. This closely resembles a single Yali sample. It is noteworthy that distinct differences observed even within Yali samples are likely to be due to different eruptions[12]. The analyses together with more measurements effectuated in an earlier stage, imply no trace of Santorini tephra at Yali.

The Yali Archaeological Project was initiated in the SW part of the island in 1986. This area was divided into sections and was systematically surveyed in squares (Fig. 7-8) yielding abundant neolithic pottery and stone tools. The prehistoric material lay all over the surface of the peak, between the upper palaeosol 2 and the lower surface pumice deposit[13]. The almost flat area around the top is more likely to have been used for cultivation or herding rather than residence, although some sporadic structures or huts of poor materials cannot beruled out.

To the north, parts of neolithic buildings were excavated on a slope protected from the south and north-east winds. The layers of aeolian pumice and argil were completely eroded in that area, and the calcareous sandstone was exposed to the surface, offering building material in abundance. Because of the inclined bedrock, the constructions were erected on terraces supported by walls. However, the corrosion and the later hellenistic occupation of the area caused major damage to the neolithic structures.

The sole neolithic building with good preservation came to light on a small plateau, and constitutes a complete specimen of neolithic architecture, the best so far known in the Aegean (Fig. 9). The building 17 m. long and 7.5 m., wide consists of three areas; the two major rooms are divided by a sturdy wall on a NE-SW axis. This was used to support the roof, possibly of an Å shape. A long-narrow room is attached along the north part and was used as a kitchen or storing place, as implied by the remains of fire and the abundance of coarse cooking vases such as cheese-pots and pithoids. An irregular area, detached from the main room, ends in an apsidal wall ,on the west side. This was interpreted as a yard or a shelter for animals. The architectural type of the building is unusual and the division in two unequal areas appears for the first time in a neolithic house of the Aegean. As for the apsidal walls there are many parallels in Saliagos[14], Emporio Chios[15], Sitagroi in Thrace and Thessaly[16]. One more parallel coming from the Dodecanese is an apsidal building on the small island of Alimnia near Rhodes, excavated in 1980[17].

The pottery dates the building to a late neolithic phase (Late Aegean Neolithic 4) which corresponds to Late Chalcolithic 4 of Anatolia[18]. The same neolithic stage also includes the site in Alimnia, the settlement at Partheni in Leros, as well as many other unexcavated sites in the Dodecanese. More stratified remains of this phase have been found in the caves of Koumelo and Agia Georgios in Rhodes[19]. Although Yali pottery has close affinities with the Beycesultan sequence, many particularities exist, such as the large variation of a coarse open basin known as cheese-pot. The large quantities of this vase in the Dodecanesian sites possibly suggest a local origin of the shape[20]. The spread of this form to the rest of the Aegean, mainland Greece and Asia Minor seems to be limited.

A large ceramic sample of Yali ware was measured by the Magnetic Susceptibility (X) method suggesting seven ceramic groups (A-F), according to clays of different origin (Fig. 10a,b). At least one of this group was local, as far as is implied by the local clay magnetic rates.

Not far from the neolithic building, together with characteristic neolithic pottery, two ceramic vases with remains of copper were identified as melting pots (Fig. 11). Both bear holes to accomodate wooden handles. These rare examples are compared with similar pots found in Kephala on Keos[21] and Sitagroi[22]. Copper in general is scarce in the Neolithic, although it is found in most neolithic sites in minor quantities (Sesklo, Pefkakia[23] in Thessaly, Alepotrypa in the Peloponnese, Tharrounia[24] (Euboea), cave of Kitsos[25] (Attica), cave of Zas (Naxos), Kephala[26](Keos), Ftelia[27] in Myconos. All samples are supposed to come from copper sources a short distance away, such as the mines of Lavrion in Attica. In the Dodecanese copper artifacts were found in the cave of Agia Georgios in Rhodes[28]. Given the proximity of the Dodecanese to the coast of Asia Minor it was logical to expect that copper artifacts found in neolithic levels would originate from sources of Anatolia. Recent isotopic analysis in the Osotrace Laboratory of the University of Oxford showed surprisingly that the copper residues found inside the two above melting pots from Yali came from Lavrion deposits in Attica (pers. comm.V. Maxwell-McGeehan and N. Gale).

More buildings and about seventy graves of the same date were excavated from inside pumice further to the South of the Yali SW sector. No grave offerings were found since most of the graves seem to have been pluntered in the past, while all human bones were totally destroyed by pumice's chemical acidity. The existence of a cemetery of the Neolithic period on Yali suggests dense population and intense occupation, which is striking for such a small island. It seems that the neolithic communities of Yali were orientated to productive activities such as cultivation and herding. The big quantity of millstones everywhere testifies to the cultivation of cereals, as well as to an intensive occupation on a permanent basis. Seasonality cannot be excluded however, and the island transhumance pattern revealed by ethnographic analogy for the 19th c. communities of Yali provides us with a good implication for prehistoric seasonality.

After long archaeological research on Yali, including systematic surveys of the island, it is certain that Yali obsidian sources were very indifferently exploited, because of the inferior quality of the local material. The presence of white spots in the outcrop does not facilitate specialised knapping and sharpening of the material to create points (Fig. 12). Nowhere in the Dodecanese blades made of Yali obsidian have been found, whereas the obsidian from Melos[29] (Fig. 13) is strongly present in all the islands, even in Yali. This fact clearly indicates that Yali sources were unable to provide the proper material for the production of tools. It is likely that some unshaped flakes were usable, but it is also possible that Yali obsidian found in the SW sector of the island was not transported there on purpose, but was produced by recent volcano euprtions (R. Torrence[30] and Buchholz[31]). They visited the island also noticed the non-existence of tools from local material. Nevertheless, the thick pumice deposits of the SW sector contain several outcrops of pure, high-quality, obsidian, produced by older volcano eruptions of the area. Samples of all those different materials have been analysed by neutron activation. Trace elements confirm the local origin and that they derive from different eruptions. The absence of tools from this material is due to the small quantity of the raw material.

The use of Yali obsidian for madeing stone vases or jewellery is a well known activity in the Late Minoan period[32]. During this era habitation exists in many Dodecanesian islands (Rhodes, Kos, Telos, Karpathos). In Yali the flourishing neolithic period is succeeded by a poor Bronze Age habitation, probably because of a critical change in the economic conditions of this area. Very recently ceramics of Late Minoan A were excavated from within the pumice on the west side of the isthmus joining Yali's two sector. The most diagnostic among them is an eye-beaked jug bearing polychrome mattpainted decoration (Fig. 14), and some sherds with white-on-red patterns[33]. Typological studies and clay measurements on the pottery of a contemporaneous site at Seraglio in Kos, not far from Yali, suggests that Kos could have been the production centre of this type of pottery, and moreover one of the sources from which vases of this type were imported to Akrotiri[34] and, presumably, to Yali.

Of particular importance is the new dating produced by thermoluminescence on four surface ejecta eruption samples, taken from Kamara, in the east side of the NE sector of the island (Fig. 2, 15). The mean age was 1460±460 years B.C., which is a significant date concerning the volcanic activity in the Aegean during the 2nd millenium B.C. because of the Santorini eruption occuring about the same age[35]. The new result is of considerable significance, because it proves that volcanic centres on Yali and/or Nissiros were active until about three millenia ago. Moreover the obsidian outcrops in Kamara are dated to about the same time, as the Belgian volcanologist R. Brousse has suggested. Unfortunately no pottery or other finds have been located in the area of Kamara. The stratigraphy of Kamara, to the NE of Yali, has a similar sequence to that of the top (SWsector) and the neck, where the Minoan pottery was found. This dates all tephra layers to the same age. The correlation provides a safe indirect way to date the most recent eruptions which took place in Yali.

Concerning the Late Minoan period, ceramic evidence of that age was found inside a tephra layer from the excavations of Kos (T. Marketou, pers. comm.). Also to early Late Minoan are dated the conical cups excavated inside a tephra layer on the island of Telos[36]. Tephra analysis of two samples from this site by alpha-particle spectrometry[37] indicates a different volcanic origin than tephras from Rhodes and Kos, but similar to Nissiros isotopic data. Although no Santorinian tephras were analysed for comparison, taking into account the radioisotope analyses[38] suggesting Santorini as the provenance of most tephras in Rhodes, we may assume that Telos tephras come from the same eruption that deposited pumice on Yali.

Recently, a volcanic layer (sulphuric sediment and cemented tephra) has been revealed in excavations at Methana (northeast Peloponnese), another well known volcanic centre. This layer covers a Late Mycenean settlement and a sanctuary of the same period (Konsolakis, pers. comm. 1995). This event indicates a chain of volcanic eruptions in the Aegean, around the Hellenic volcanic arc, during the 2nd mill. B.C. Possibly this timing suggests an inter relationship of magma chambers of those volcanos occuring as a result of a triggering effect.

Up to this time, the Santorini volcanic eruption was the major and unique event in the Aegean that took place in 1620-1660 B.C. (1624 B.C. according to tree-rings, 1645±20 according to ice-cores, and between 1700-1400 on the evidence of pottery) and that was considered as the cause for the demise of the Minoan civilisation. As a result, every tephra deposit covering Minoan settlements has been attributed to the Santorini volcano[39]. Recent investigations imply that such attributions and the associated analyses have to be reconsidered, reanalysing older and newly found tephras from Minoan settlements of Crete, Telos, Rhodes, Kos, Karpathos and other Aegean islands, employing the uranium, thorium, and potassium radioisotope analysis corroborated with other methods[40]. It is worth mentioning that analysis of the tephra layer fron Nile Delta has shown a different origin than that at Santorini[41], implying volcanic eruption in the Aegean.

In conclusion, the role of volcanic activity in the Aegean during the second half of the 2nd millenium B.C. at the time of thedestruction of Minoan settlements and the eventual demise of Minoan civilisation, has to be reassessed in the light of the recent archaeometric analyses from Yali and other Aegean islands.

NOTES

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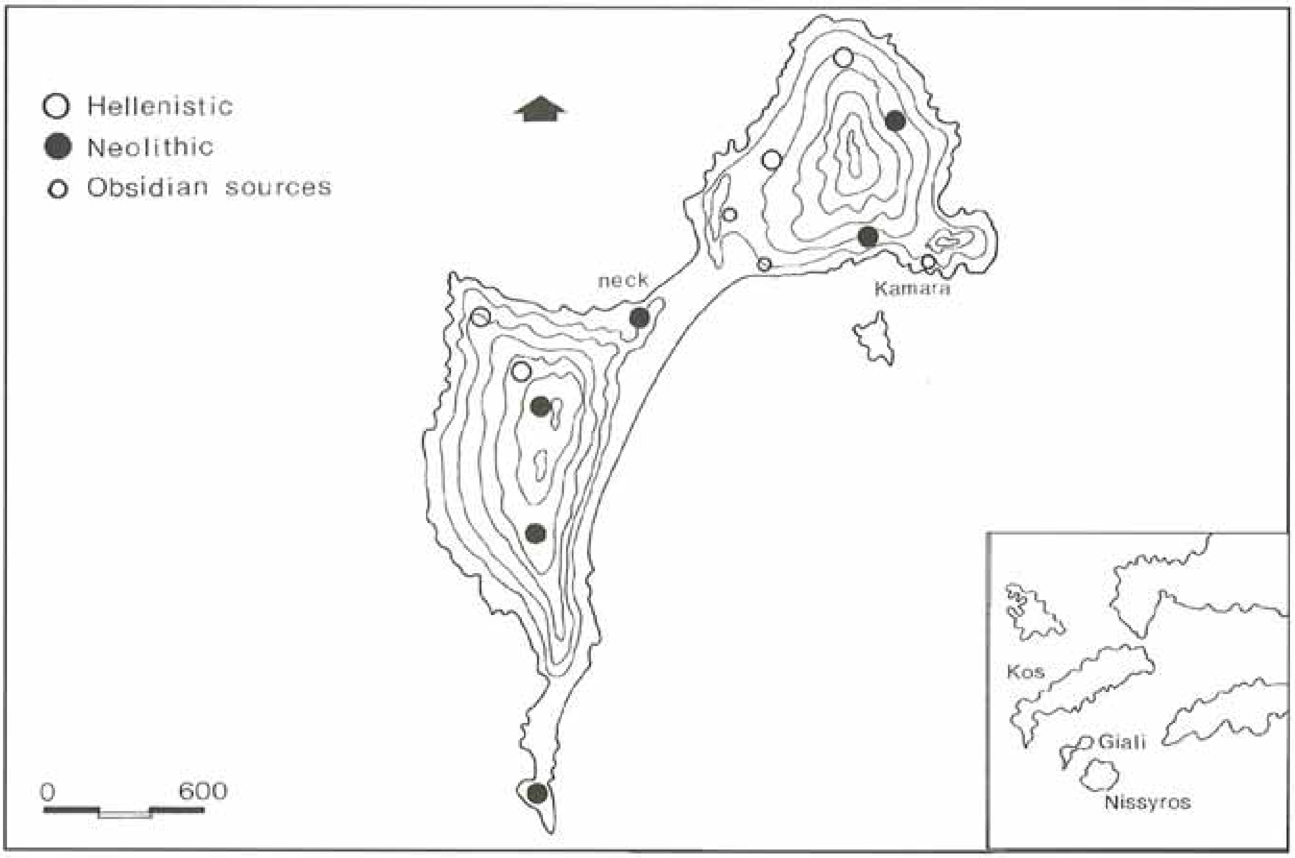

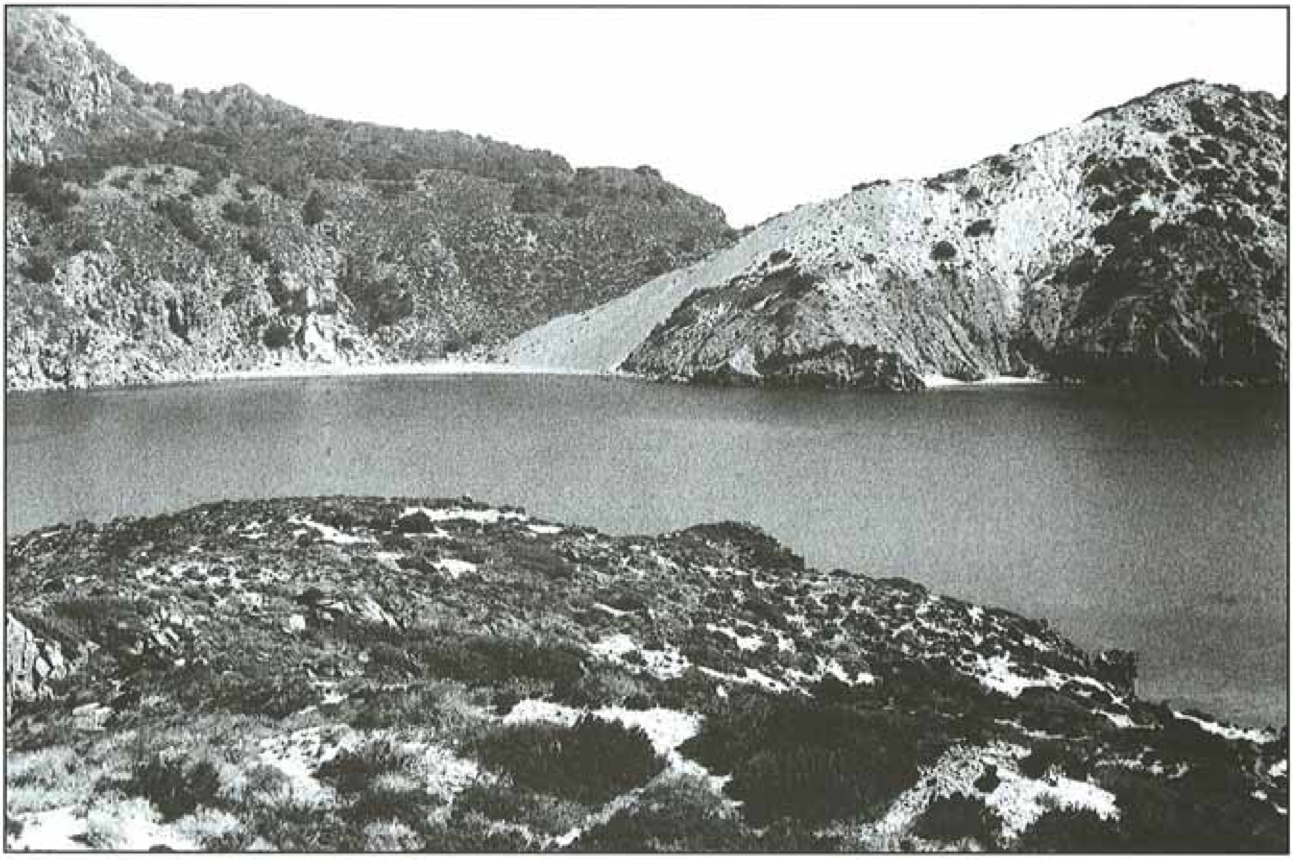

Figure 2: The site of Kamara in the NE part of Yali.

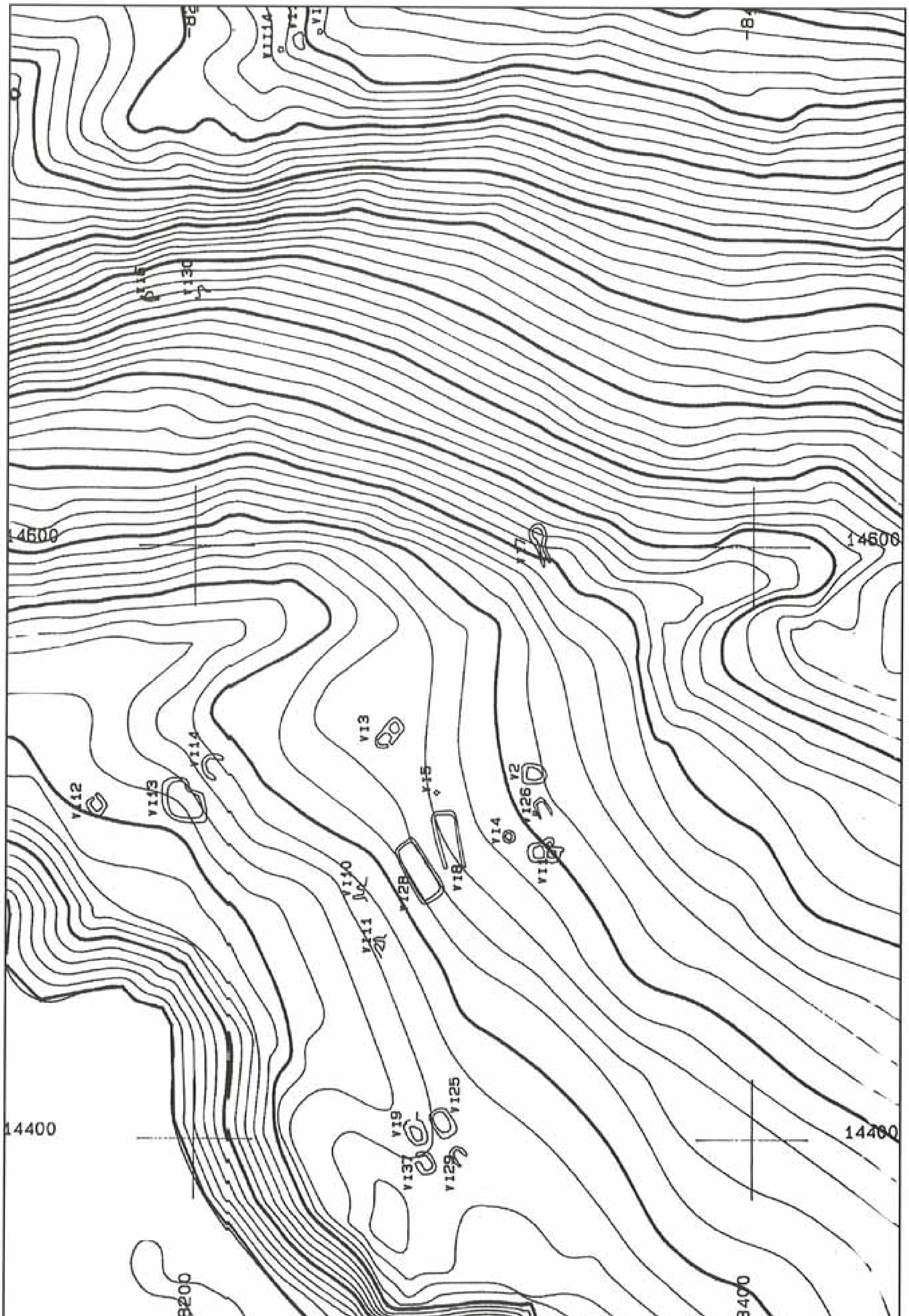

Figure 3: Various structures in the NE part of Yali.

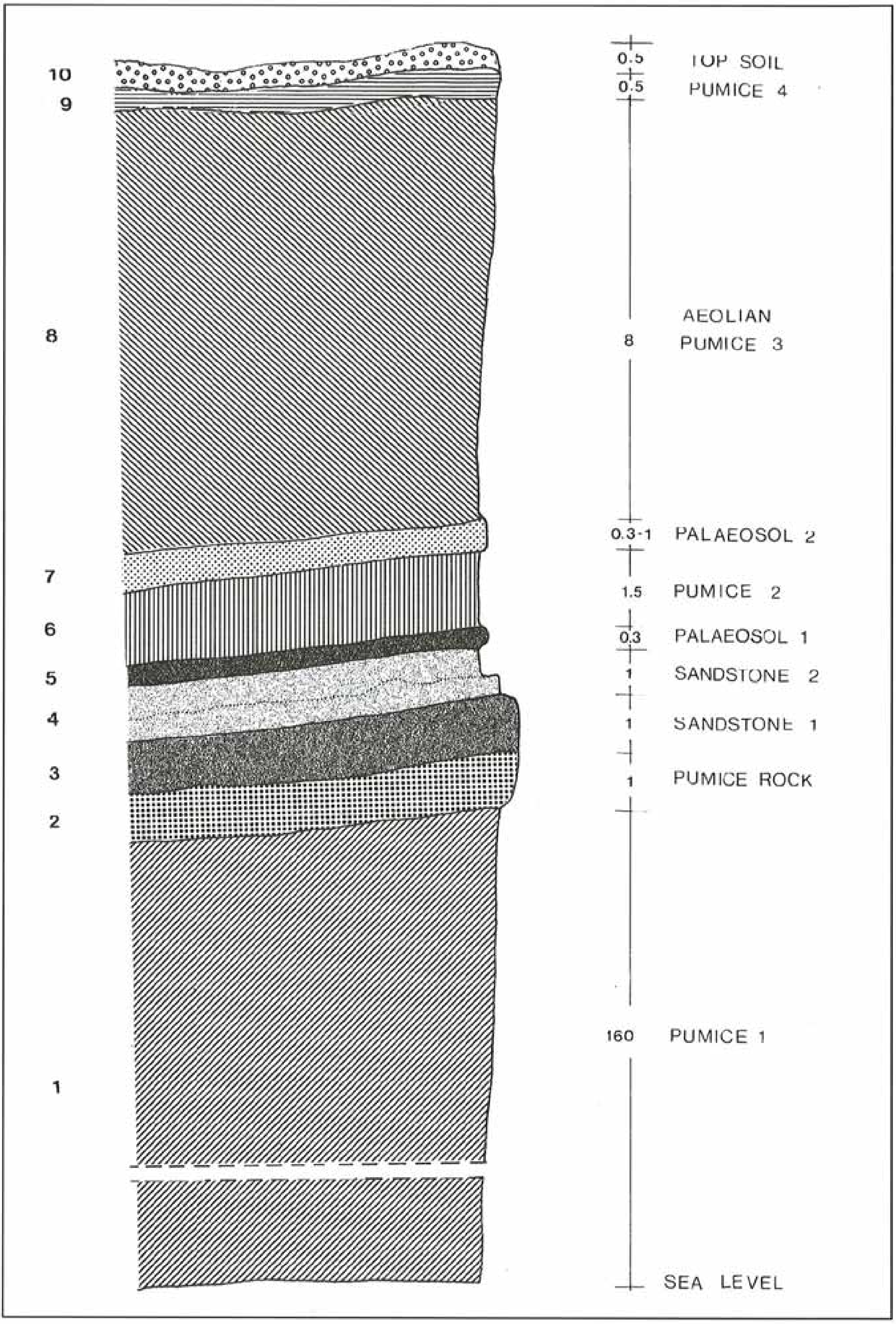

Figure 4: Geological stratigraphy of the SW part of Yali.

Figure 5: Layers of tephras at Yali.

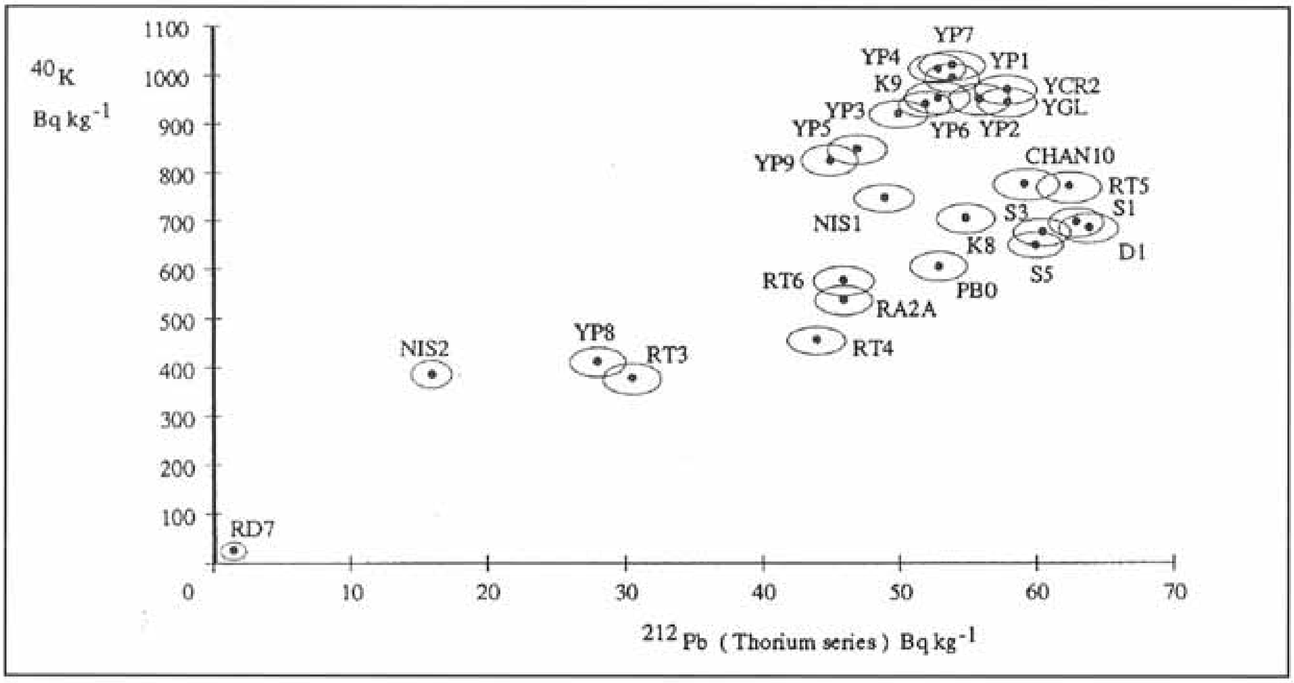

Figure 6: The 40K specific activity plotted against the 212Pb specific activity of the samples from Yali, Rhodes, Kos, Nissiros and Chania Crete. The elipses around each point represent the standard deviation in the measurements. Each point is identified by the sample code of YP4, YCR and YGL for Yali, K for Kos, R for Rhodes, N. for Nissiros, S and PBO for Santorini. Note the significant groupings around Yali and Santorini where K9 from Kephalos Kos belongs to Yali group.

Figure 7: View of the SW part of the island.

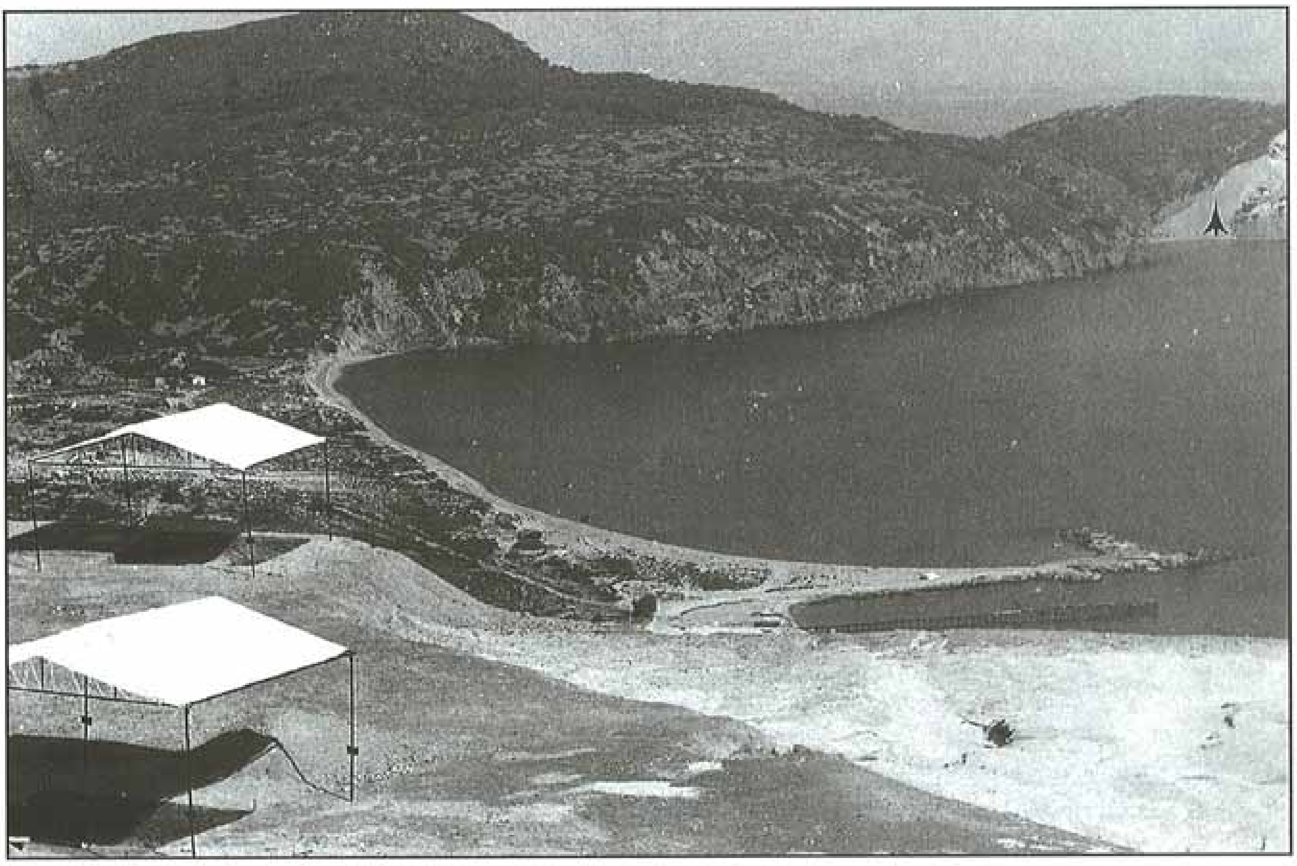

Figure 8: Excavation trenches in the SW part of Yali. In the backround, Kamara and the NE sector.

Figure 9: The neolithic building at Yali.

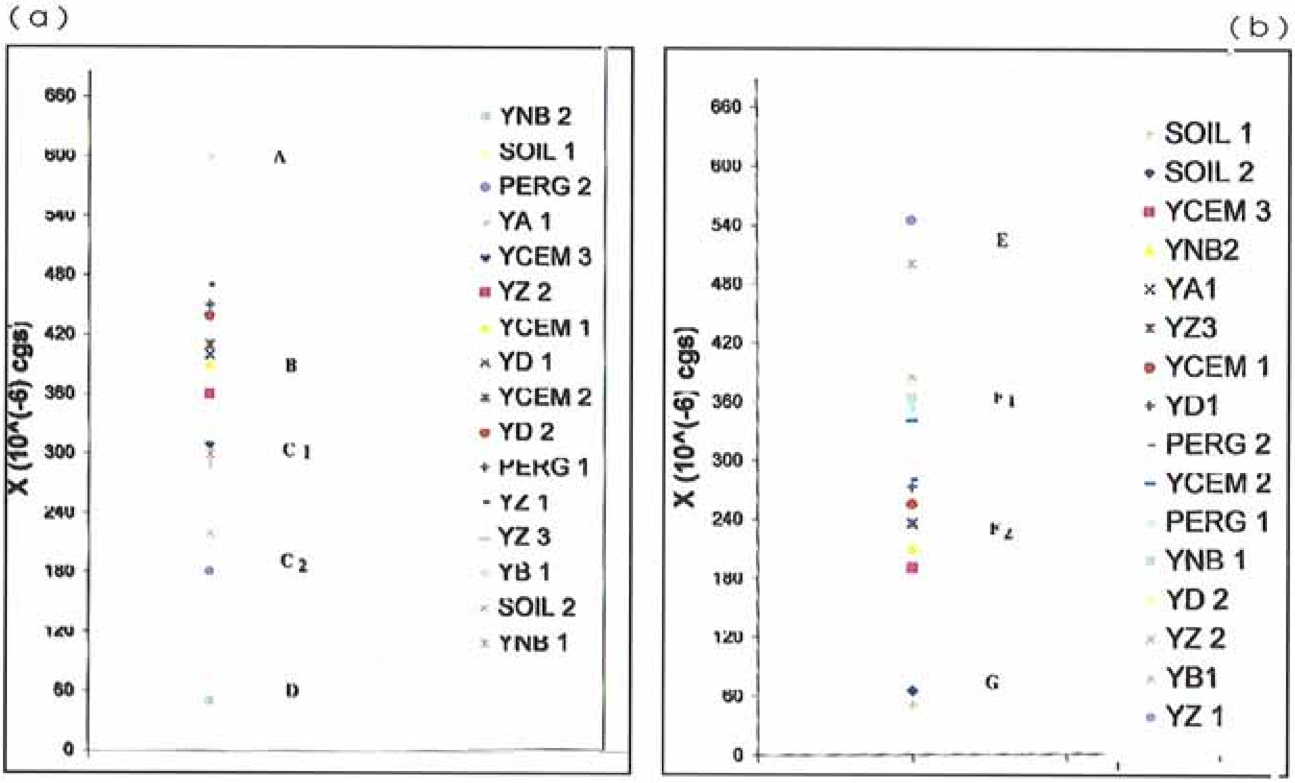

Figure 10: Magnetic susceptibility (X) values from Yali neolithic pottery. a) X- values for low field and b) X-values expressed as: XDF%=XLF-XHF % where XLF= X-values for low field and XHF= X-values for high field. Both diagrams are different means of expressing the magnetic susceptibility for the same samples. Both corroborate each other.

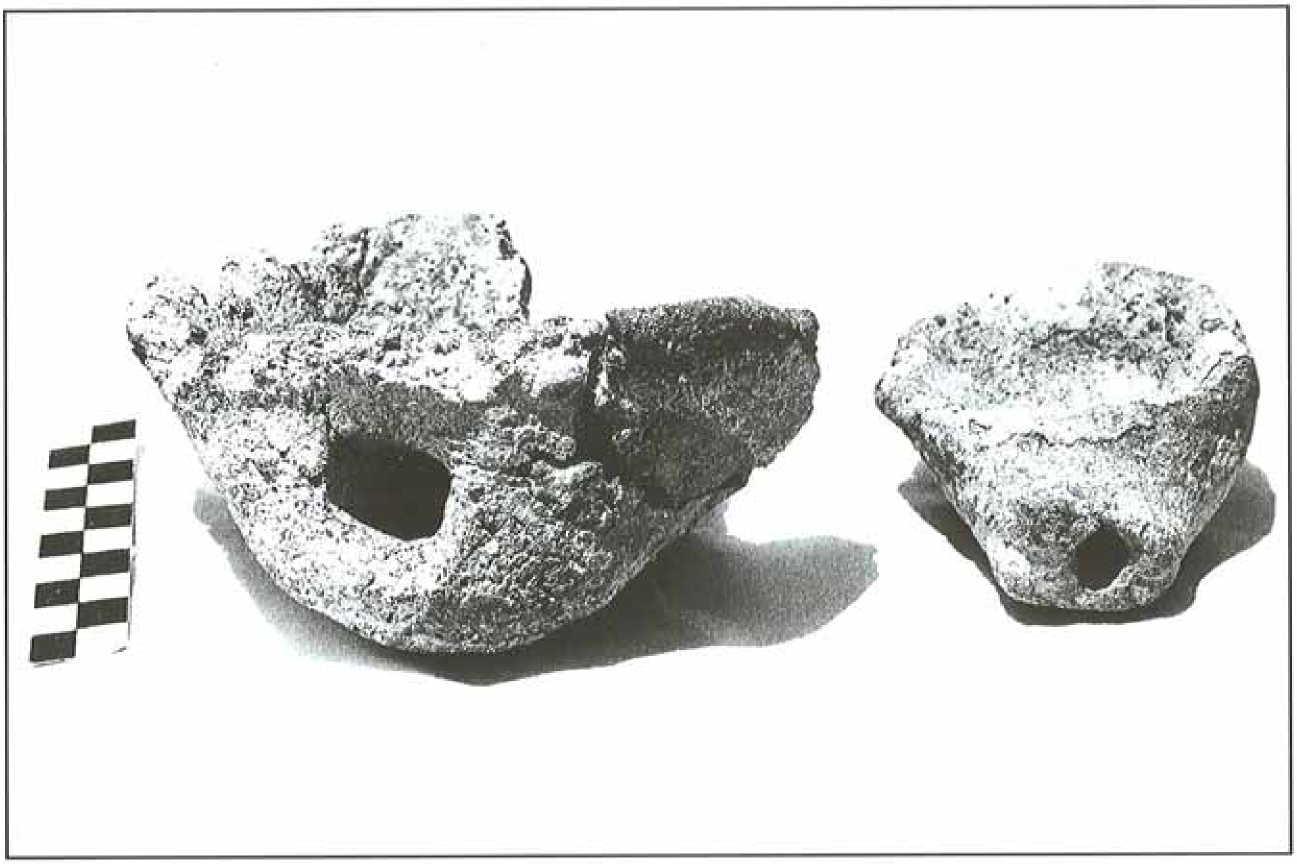

Figure 11: Neolithic melting pots from Yali.

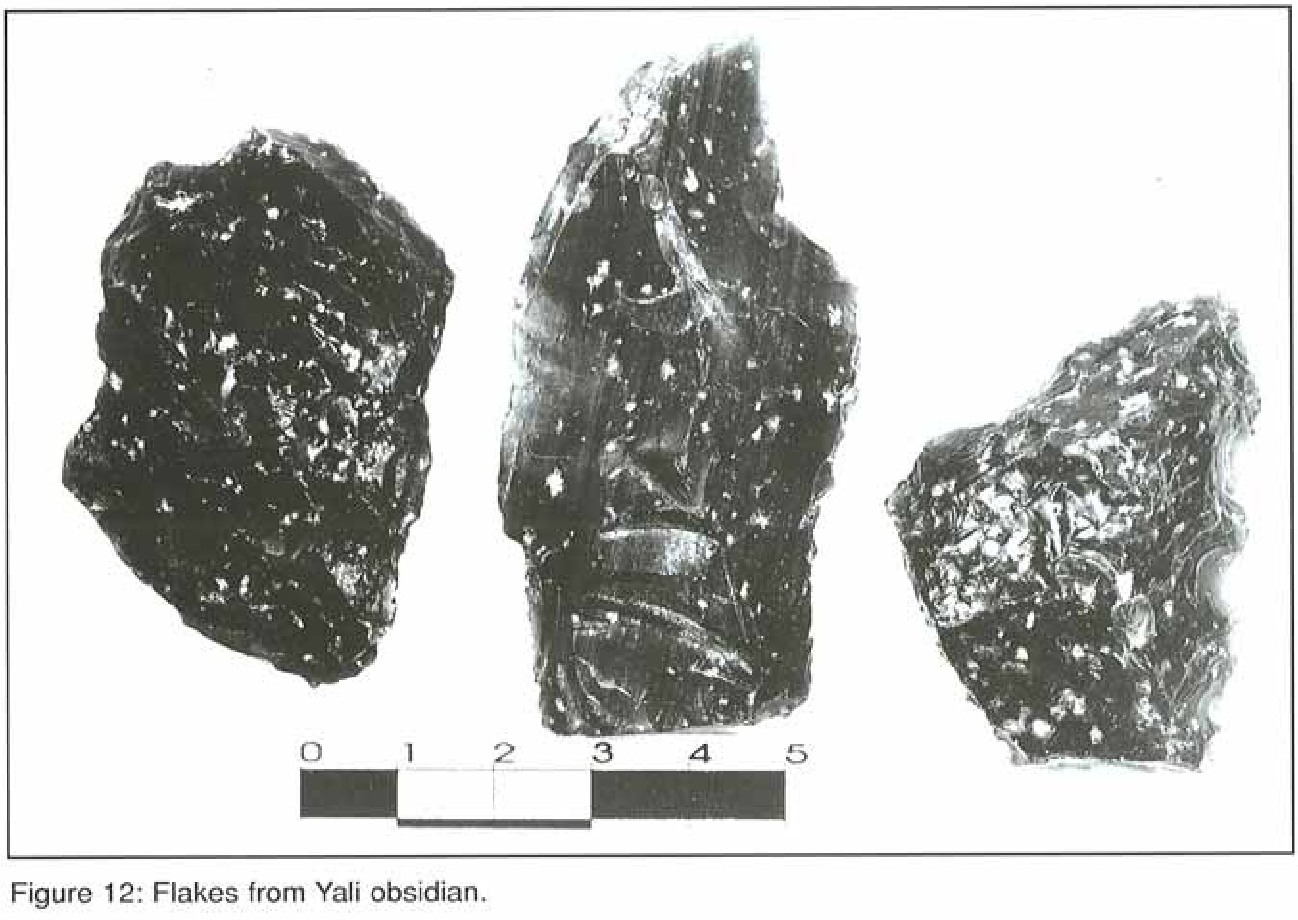

Figure 12: Flakes from Yali obsidian.