



MARIOLAKOS, I., ZAGORCHEV, I., FOUNTOULIS, I., IVANOV, M. (2004). "Neotectonic Transect Moesia Apulia", *Field Trip Guide Book – B26, 32nd International Geological Congress, Pre-Congress Field Trip B26*, 72p. + B26 GREEK ROUTE -APPENDIX 25p.



Field Trip Guide Book - B26

Florence - Italy
August 20-28, 2004

Volume n° 2 - from B16 to B33

32nd INTERNATIONAL GEOLOGICAL CONGRESS

NEOTECTONIC TRANSECT MOESIA-APULIA



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GREEK ROUTE - APPENDIX

Pre-Congress

B26

Dear participant,

The Greek leaders (Ilias Mariolakos and Ioannis Fountoulis) welcome you in Greece and wish you to have a very nice field trip in Northern Greece. The period is not the more favorable as on 13th of August 2004 is the opening ceremony of the Olympic games in Athens, and the 15th of August is a holy day for the Greek Orthodoxes and everybody is in holiday.

In this field trip we will try to transfer to you our way of thinking, our philosophy of approaching the geological problems concerning the neotectonic deformation and to discuss with you about these problems. We want your reaction.

For these purposes we prepared some more notes in order to help you. Furthermore, we observed that some Figures we had prepared for the Field Trip guide Book were omitted although we had marked it before printing.

In the next pages you can find the following:

1. Figures omitted to be print in the Field Trip guide Book
2. Some more information for specific stops and
3. We finally decided to include a new Stop in Nekyomanteion (Lower Acheron Basin), which is very interesting for many reasons.

More specifically:

Stop 6.3: Mavropigi (Ptolemais)

We provide to you new information deriving from very recent studies in the area.

Stop 6.4: Aliakmon terraces

Omitted Figure 45b.

Stop 6.6: Pramoritsa River

Omitted Figure 46a.

Stop 7.5: Meteora

Omitted photo (Figure 50a).

Stop 7.6: Theopetra

We provide to you new information deriving from very recent studies in the area.

Stop 9.2a: Nekyomanteion (Lower Acheron River Basin)

New stop, information deriving from very recent studies in the area.

Stop 9.2: Arillas

Omitted photo (Figure 53).

Stop 6.3: Mavropigi (Ptolemais)

Mavropigi is located at the western margin of the NW-SE striking Ptolemais-Kozani tectonic graben, filled in with 1 km in thickness post-orogenic continental sediments, (**Figure 44a**). The observed geological formations in the western margin are dissociated in the basement, including the pre-Cretaceous Pelagonian metamorphic outcrops and the sedimentary fill in of Plio-Quaternary age. The sedimentary fill contains lacustrine and continental sediments, which constitute the upper members of the sedimentary sequence of Ptolemais-Kozani graben. The present-day structural view of the sedimentary fill is characterized by the influence of recent and strong brittle-type deformation with planar and listric (gravity) normal faults as well as a large number of reverse faults constitutes an important structural feature.

The fault analysis of the western marginal-Mavropigi fault zone revealed that it constitutes a composite shear zone reactivated in the recent geological times. The Mavropigi fault zone strikes NW-SE near Agios Markos hill in Mavropigi-Pontokomi settlements, with an apparent false throw more than 300m going 2km basinwards. The set of the fault surfaces constitute a left- and right-stepping en echelon arrangement, cutting the Plio-Quaternary sediments. At least, two set of striations can be observed, the first and the dominant one shows an oblique-slip normal movement, which is combined with a left-lateral strike-slip component of movement and also a vertical set of striations of a clear normal displacement. The aforementioned en echelon arrangement of the fault surfaces in combination with the strong westwards tilting of the sedimentary fill indicate the action of anti-clockwise horizontal rotational axis, parallel to the direction of Ptolemais-Kozani basin.

The analysis of 580 drillings of PPC in combination with field observations in the surrounding area made visible the recent action of ductile-brittle deformation of the study area. The 3D representation of the morphology of the present-day surface, of the top and of the bottom of the lignite sequence and of the pre-Cretaceous metamorphic basement have led us to determine a clear mega-flexure (folding) in the macroscale as schematically **Figure 44b** represents. Its geometrical configuration is accompanied by the creation of two 3rd order tectonic grabens, showing the simultaneous occurrence of brittle deformation within this macrostructure. In parallel, this recent ductile-brittle deformation is also imprinted in the minor structures of the metamorphic sequences of the western margin, following the general geometry of the sedimentary fill.

The analysis of the sub-surface tectonic structure made comprehensive the formation of 3rd order macrostructures of the pre-Cretaceous metamorphic rocks with the geometrical development of tectonic horsts and grabens. In this framework, the basic Pliocene unconformity of the sedimentary fill above the basement constitutes the basic element of the calculation of the displacement in the sub-surface fault zones. Regarding to the Mavropigi shear zone, it became clear its fluctuated false throw along the borderline and it was defined its detailed sub-surface arrangement, which essentially coincides with the geographical axis Mavropigi-Pontokomi settlements. The general sub-surface structure of the western borderline is also outlined, either by the significant occurrence of brittle structures with more than 300m false throws or by the action of strong syn-sedimentary structural conditions, showing that the progressive subsidence of the western borderline was achieved through many evolutionary stages. In **Figure 44c**, it is illustrated the tectonic structure of the western borderline in Mavropigi settlement, showing clearly the location of the Mavropigi Lignite Field with reference to the complex geometry of the post-orogenic sediments and also the strong faulted sub-surface structure of the basement.

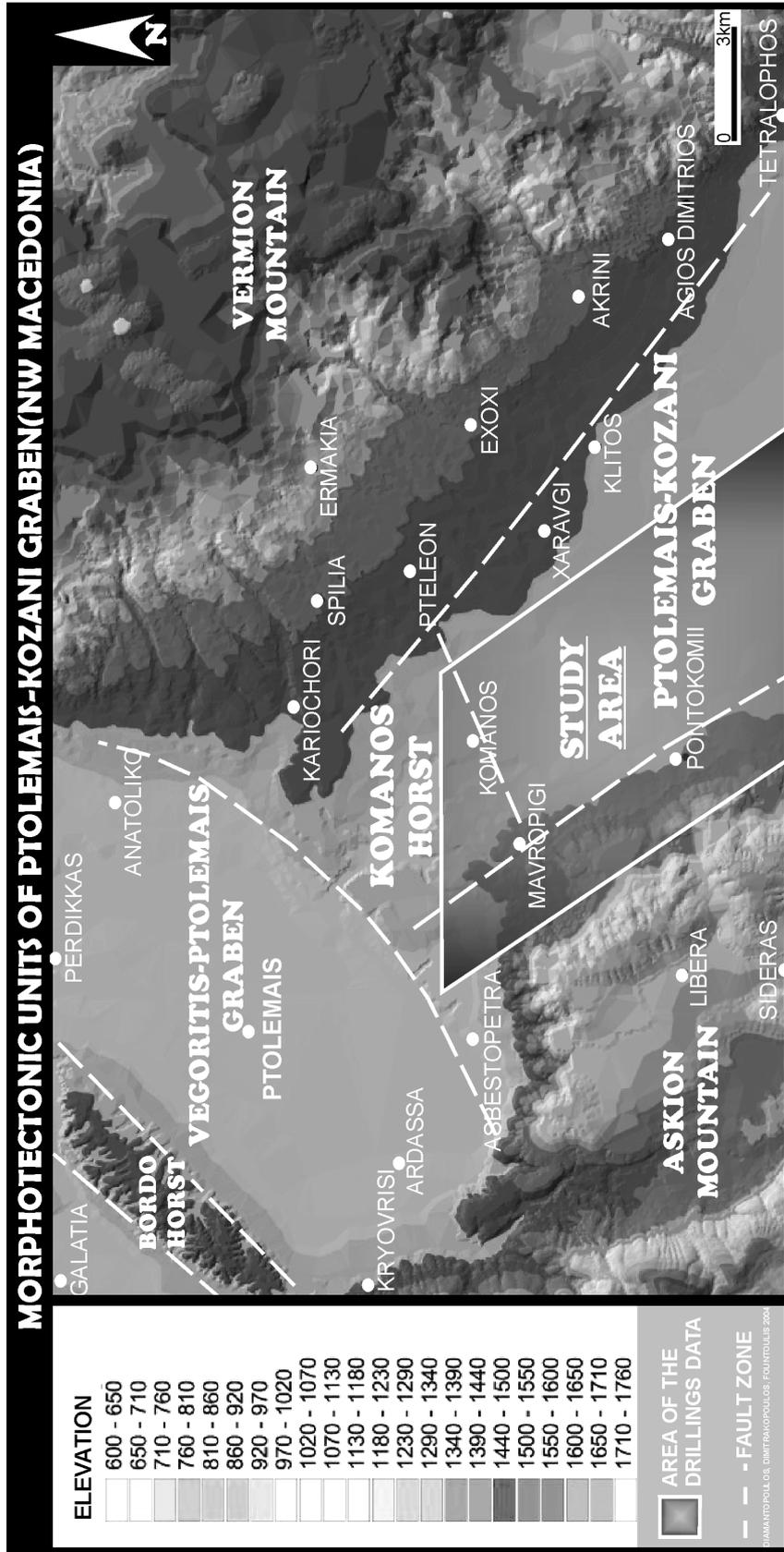


Figure 44a. D.E.M. of Ptolemais-Kozani graben, including the major morphotectonic units and the fault zones. It is remarkable that in the internal parts of the graben, it is arranged a sub-surface mega-anticline macrostructure of the pre-Tertiary basement, creating two individual and perpendicularly directed morphological basins (Vegoritiss-Ptolemais and Ptolemais-Kozani grabens). The southern graben constitutes a very well defined morphological basin, filled by 1 km in thickness post-orogenic sediments. This morphotectonic configuration is based on geological-drillings-geophysical-hydrogeological data of PPC (after DIAMANTOPOULOS et al., 2004).

From all the aforementioned, it is concluded that the Quaternary deformation of the western margin of Ptolemais-Kozani graben is complicated as in the same period are developed normal faults (with or not strike-slip component), reverse faults (with or not strike-slip component) and a mega-anticline macrostructure of the described surfaces (relief morphology, lignite sequence and basement) and of the already formed alpine structures geometry as well. Consequently, the deformation in the western margin of Ptolemais-Kozani graben is expressed by brittle structures of normal and reverse character and also at the same time by ductile-brittle in-type macrostructures.

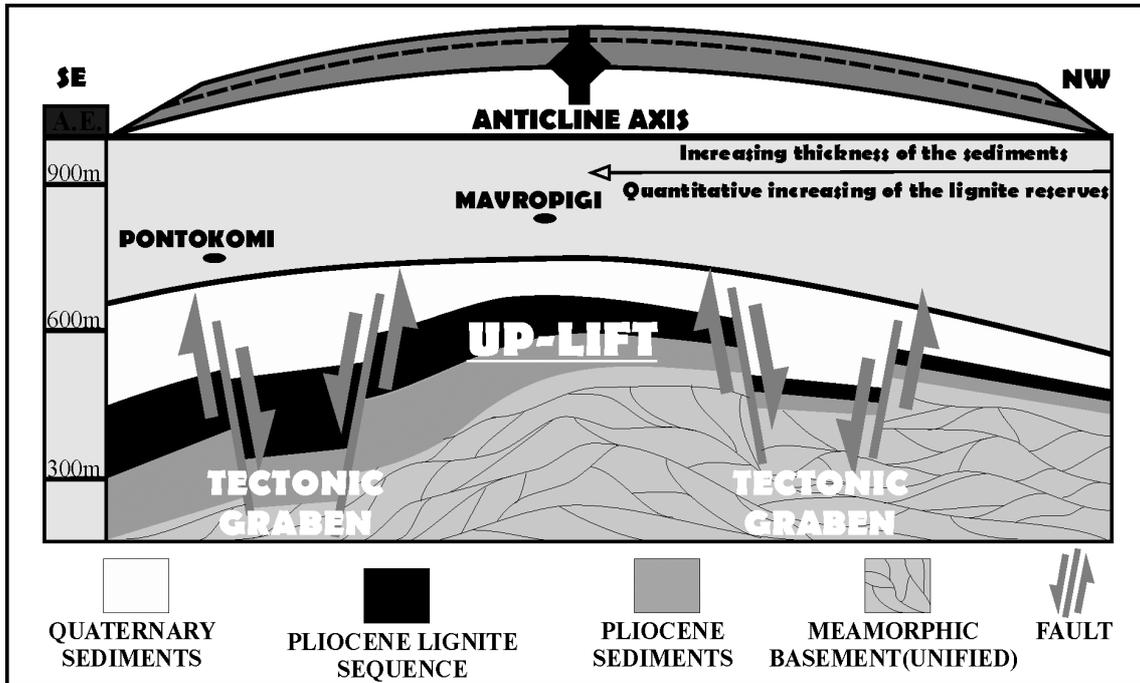


Figure 44b. Ductile-brittle macrostructure of the western borderline of Ptolemais-Kozani graben (after DIAMANTOPOULOS et al., 2004).

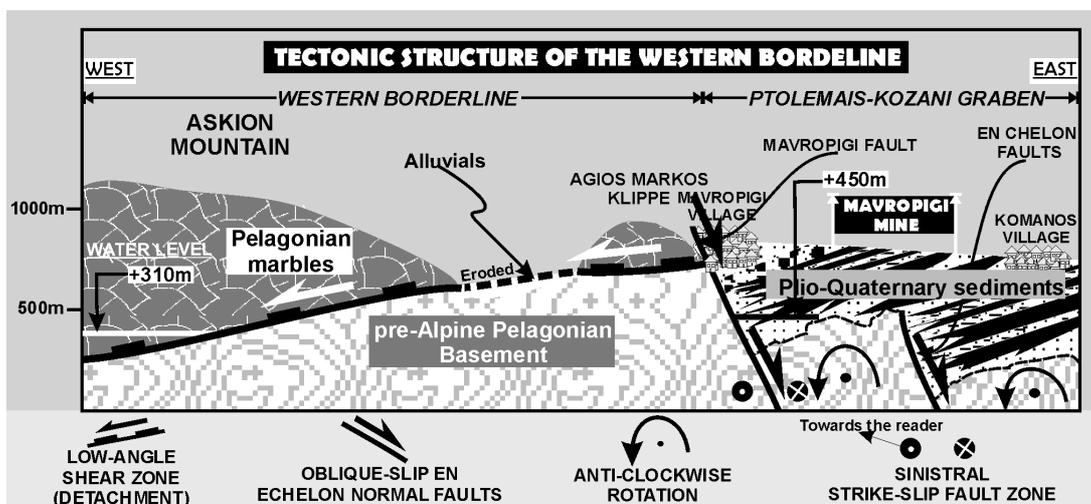


Figure 44c. Schematic geological cross-section along the western borderline (after DIAMANTOPOULOS et al., 2004)

Bearing in mind, the complicated geometry and the peculiar tectono-sedimentary processes of the post-orogenic sediments (ductile-brittle deformation), the arrangement of reverse faults as well as the strike-slip kinematic character of the Mavropigi shear zone, it is concluded the action of a complicated deformational pattern, a rotational couple-type stress field in Quaternary period. These new structural data reveal and also corroborate the great importance of the back-arc compressional intra-plate deformation in Western Macedonia, which has also been outlined by recent GPS data and field observations.

REFERENCES

DIAMANTOPOULOS, A., DIMITRAKOPOULOS, D. & FOUNTOULIS I. (2004). Quaternary deformation of the Mavropigi Lignite field (Western margin of Ptolemais - Kozani graben, NW Macedonia, Greece). *Extended Abstracts 10th International Congress Geological Society Greece*, p.378-379, Thessaloniki.

Stop 6.4:
Aliakmon terraces

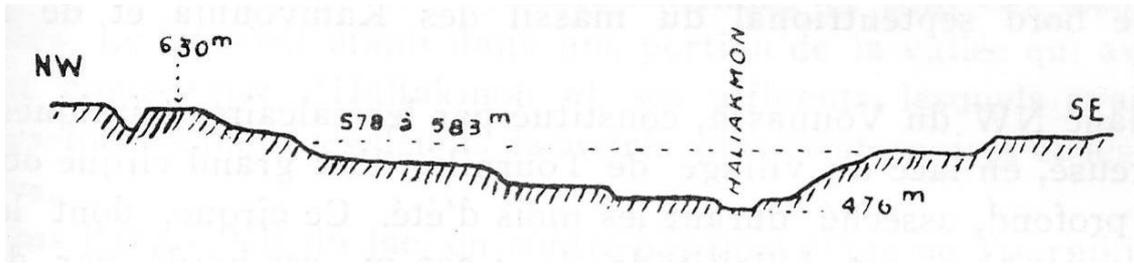


Figure 45b. Sketch cross-section at the Asprokampos area depicting the Aliakmon river terraces (after BRUNN, 1956).

Stop 6.6:
Pramoritsa river

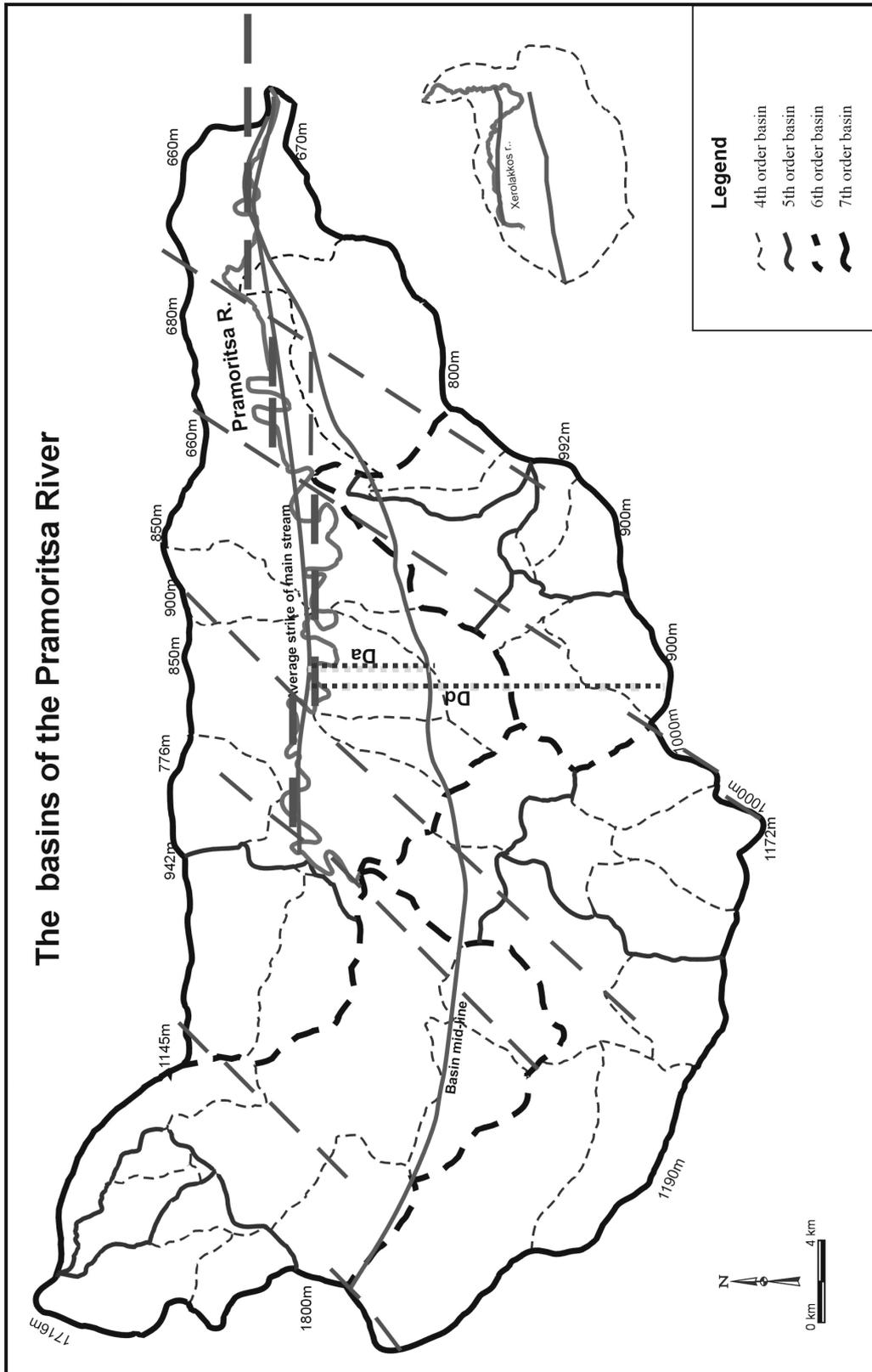


Figure 46a. The Pramoritsa drainage basin and the occurring fault zones (after FOUNTOULIS & BAKOPOULOU, 1999).

**Stop 7.5:
 Meteora**

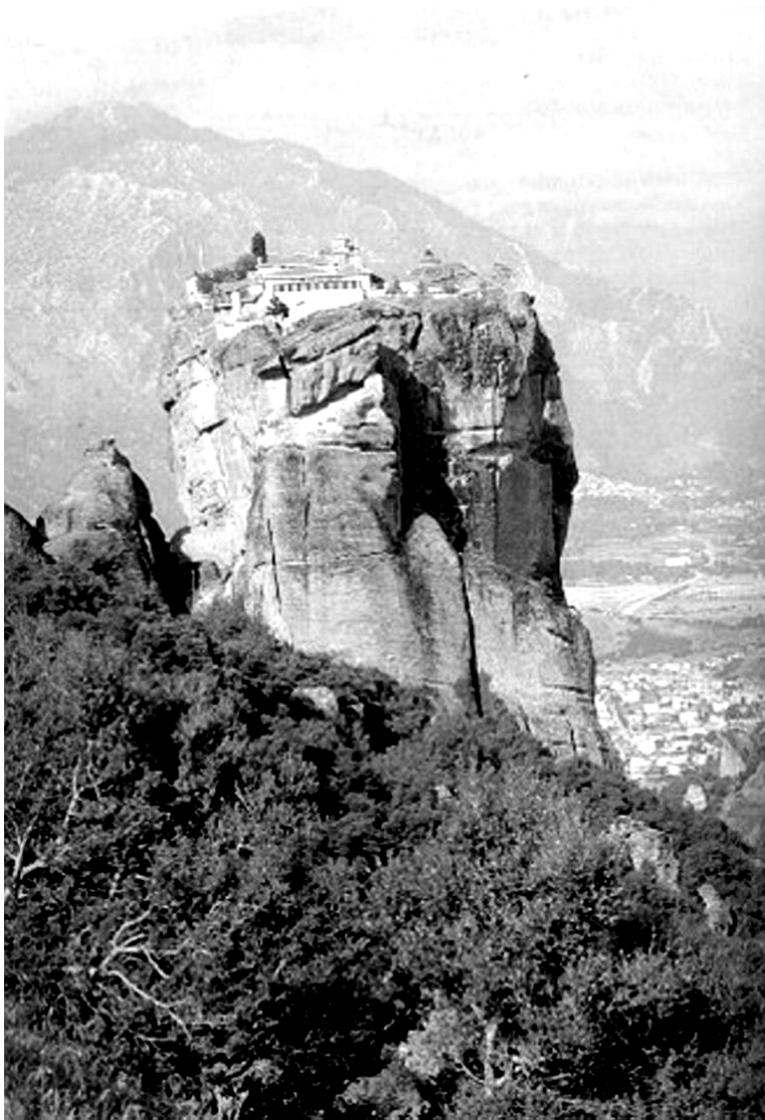


Figure 50a. Meteora .

Stop 7.6:
Theopetra

Key reference: N. Kyparissi-Apostolika 1998

The Theopetra Cave is situated at the right side of the route leading from Trikala to Kalambaka, 3km away from the latter, on a height of 300m above sea level and 100m above the plain, at the north side of the limestone mound that overhangs the town Basilike of the homonymic municipality/deme. River Lithaios, tributary of Peneios that crosses the town of Trikala, flows nearby. The Cave is of quadrilateral shape with small niches (karstic grooves) at its periphery and it measures about 500m². The entrance is apsidal with dimensions 17X3m that allows the natural daylight to come into the inner part of the cave. It is the westernmost prehistoric site of Thessaly and as it neighbours with the thessalian plain and the range of Pindus, mountain Koziaca, it combines characteristically these two environs.

The Cave is being excavated since 1987 by the Ephorate of Speleology and Anthropology under the direction of Dr. N. Kyparissi-Apostolika and it's being studied with the co-operation of a great scientific team. It is the only, so far, prehistoric excavation conducted in Greece that presents such a stratigraphic sequence that covers the Middle and Upper Paleolithic, the Mesolithic and Neolithic period (ca 75.000-3.500 BC., while recently new dates based on the method of thermoluminescence, gave us a much older chronology 110-135.000). Beyond any dispute, that was expressed at the bibliography in the past few years, the continuity of the culture in the Greek area before the Neolithic period has been proved. Paleolithic finds had also been traced sporadically, during the decades of 50s and 60s, at terraces of Peneios . But the lack of relevant excavations that could attest the habitation of people in Thessaly during these periods, led some foreign scientists (Runnels) to the conclusion that these finds came from the sporadic movements of Paleolithic hunters from other areas. For example, they could have come from eastern Peloponnese where the Frachthi Cave has been traced since 1970, presenting occupation of Upper Paleolithic-Mesolithic and Neolithic period (but not of Middle Paleolithic). Formerly it had been stressed the total lack of Mesolithic period- that connects the Paleolithic with the Neolithic period, the Pleistocene with Holocene- in Thessaly, a region that is considered to be the birth place of the Neolithic culture in Greece. Furthermore, no cultural background was recognized to it as it was considered that the knowledge that made the difference between the previous prehistoric stages (farming and ceramic technology) could be rendered to the migration of population coming from the Middle East and impartment of the relevant experiences.

The excavations at the Theopetra Cave came to confirm the unbreakable continuity of Neolithic culture with the presence of Mesolithic period for the first time in Thessaly but also the connection of the latter with former stages, the Upper and Middle Paleolithic period, and moreover to prove through the relevant finds that the institution of farming and the ceramic technology were the result of millennia of effort that altered the wild to cultivated and the clay to pots. During all these millennia, it is very possible that even the human type lived in the area was changed, since it is known from other sites in Europe that the human Homo Sapiens neanderthalensis was disappeared after about 40.000 years and the modern human Homo Sapiens sapiens is appeared. At Theopetra we had the great opportunity to find three human skeletons, one of the Upper Paleolithic and two of the Mesolithic period. These finds are extremely rare in Greek area and we hope them to contribute towards the study of human presence and development in Greece. The repeated climatic changes, that took place, have left their traces at the cave, the unique witness, until now, of these phenomena in Greece. Furthermore, is the southernmost site of Europe that the characteristics of the glacial periods have been survived (Karkanas). The completion of the search at the

Theopetra Cave, beyond the excavation itself that requires small scale works, involves the study-analysis of the recovered material.



Figure 50b. The Theopetra area

Visiting the cave

Entering the cave the visitors can have a general view to the excavated trenches. Starting the visit from the west side of the cave (at the right hand) the visitors can see the trenches (sq. Γ9, Γ10) with Mesolithic hearths and fires of the end of the Upper Paleolithic period (see the section plan). Going on southwards to the deeper area of the cave, they can see at their left hand the sq. Z11, H11, Θ11, I11 the preserved hearths of 25.000 years BP. These finds represent a period of better climate during the last glacial period (28.000-16.000 BP) that led to an increase of population and of the human activity in the cave.

Turning left eastwards the visitor can see the burnt surface where human footsteps have been preserved on, in squares Z10, H10, Θ10, I 10 (see section plan). The radiocarbon analysis gave them a date of 46.330 ± 1590 BP, whilst the method of thermoluminescence gave of 110-135.000 years BP. They are the second older footsteps ever recovered in Europe, after those found in Terra Amata in France (380.000 BP). Some others found in caves of France and Italy, have been dated below 20.000 years BP. At the easternmost side of the cave the visitor can see the axis Λ of the trenches, where the limestone substructure of the cave has been found in depth 3,00 to 3,30m. In this horizon animal bones of Middle Paleolithic period have been traced very well preserved coming from cave bear, hyena, red deer, goat, wolf and other smaller species.

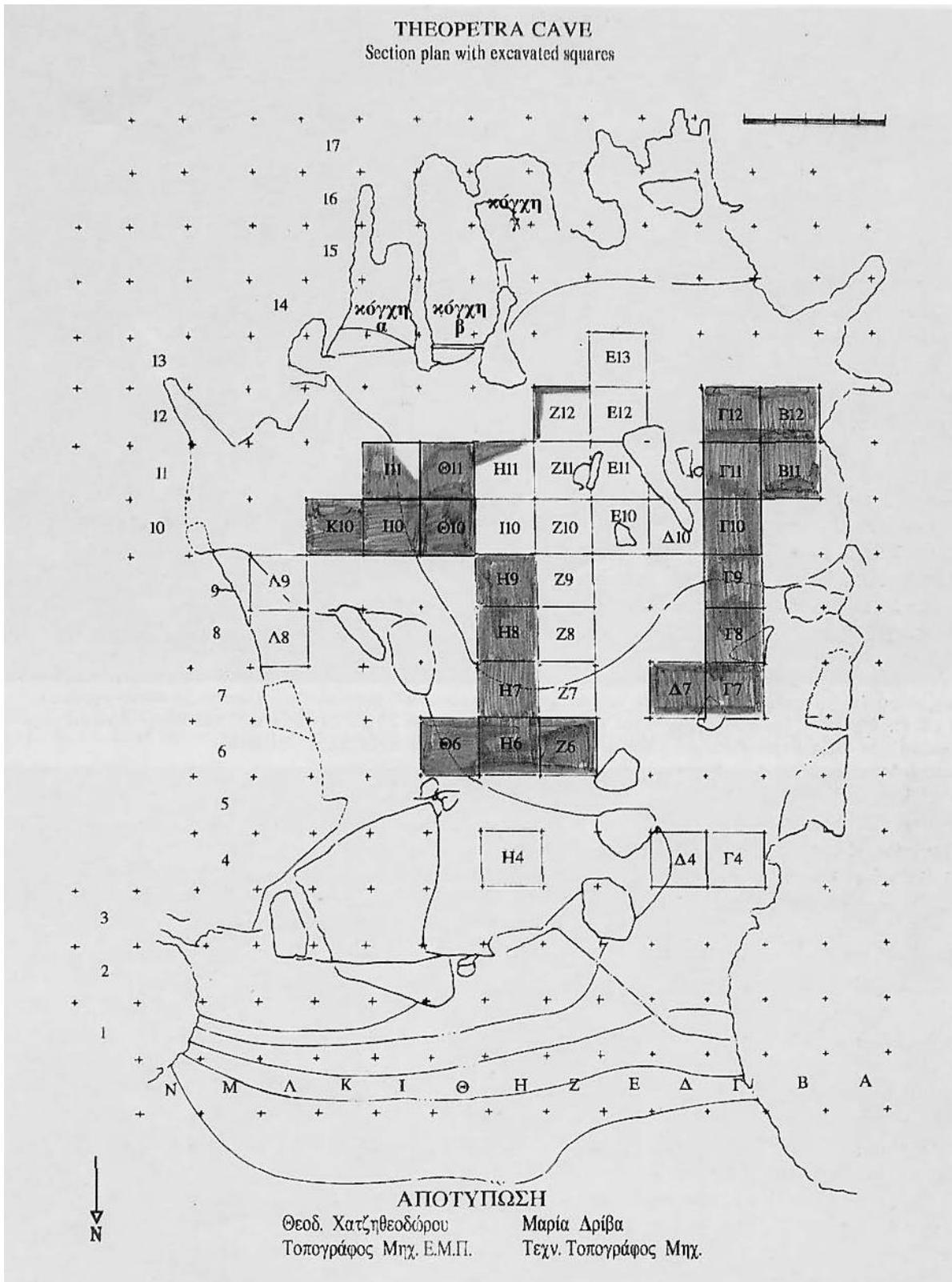


Figure 50c. Section plan of the cave and the excavated squares. In color is marked the area with the Mesolithic deposits (after KYPARIISSI-APOSTOLIKA 1998).

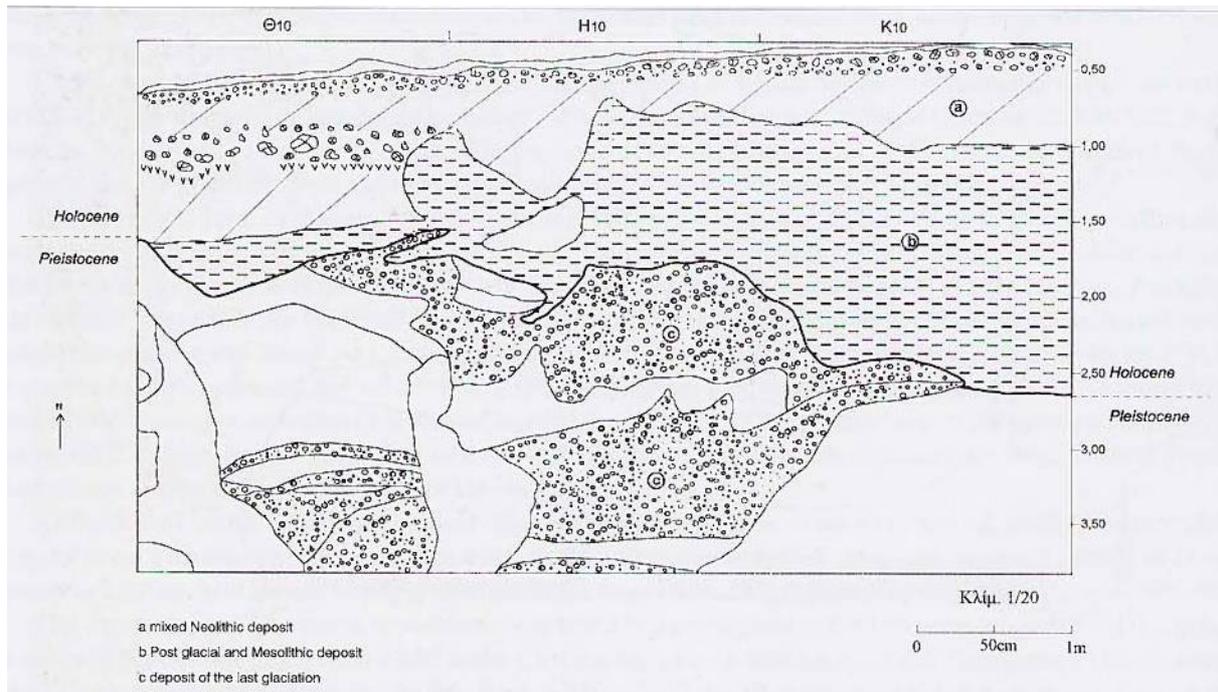


Figure 50d. Stratigraphic section of the northern profile of squares Θ10 I10 K10 where the mixed neolith deposit (a), the mesolithic and the post glacial deposit (b) and the sediment of the last glaciation (c) are seen (after KYPARIISSI-APOSTOLIKA 1998).

The presence of these bones is very important as in general the bones are lacking in Theopetra Cave except the east part of the cave because of the diagenesis, characteristic mainly of the central area of the cave near the exit of the carstic aquifers, from which big quantities of water invaded the cave repeatedly and caused dissolution of the bones. Going on northwards, directing to the entrance of the cave, one can see at the Mesolithic strata part of a clay floor (sq. I9), similar of which also exists in some other places of the cave.

At our left hand we see the western profile of the trenches of the axis Z (sq. Z7, Z8, Z9) where the climatic changes (glacial maximum) occurred during the Pleistocene period have left their traces. In the same trenches (see the section plan) are observed the oldest sediments with traces of fire. From this point also the visitor can have a general view of the excavation on his way to the exit of the cave.

REFERENCES

KYPARIISSI-APOSTOLIKA, N. (1998) The excavations IN Theopetra Cave. *Proc. International Conference, 6-7 November 1998*, p. 17-36 (in Greek) Trikala, Greece

Stop 9.2a: Nekyiomanteion Lower Acheron River Basin

Numerous ancient authors beginning with Homer in the **8th century BC** make reference to the Lower Acheron Valley in Epirus, Greece and indicate a landscape configuration that is significantly different than at present. According to Bezonen 1997 three notable discrepancies between the ancient landscape and modern landscape exist:

1. The size of the Glykys Limen (modern Phanari Bay), which at present is very small, but was much larger in ancient times according to the descriptions of the ancient accounts.
2. The evolution of the no longer extant Acherousian Lake, which ancient sources indicate was a conspicuous feature in the valley.
3. The course of the Acheron River which today flows to the south of the Kastri hill, but was located to the north of that site according to ancient sources.

Geologic evidence from 28 gouge auger sediment cores taken at various locations in the valley indicates that significant geomorphic change in the valley has occurred during the last 4,000 years. It appears that the discrepancies between the accounts of ancient authors and the modern landscape can be explained by a natural sequence of geomorphic evolution in the valley.

The Glykys Limen

According to Bezonen 1997 the shoreline of the Glykys Limen has prograded nearly 6 km in the last 4000 years doing so at varying rates.

In the 3200 years from 2100 BC to AD 1100, the shoreline prograded just 2km and the sea coverage of the Glykys Limen was reduced 9 km². (**Figures 1, 1, 3, 4, 5, and 6**).

However, nearly 3.5 km of shoreline progradation occurred in the 900 years from AD 1100 to the present (**Figures 5, 6 and 7, 8**) and the sea coverage of the Glykys Limen was reduced 11 km².

The difference in the rates of shoreline progradation may be due to several factors, an important one probably being the formation of the Acherousian lake, which served as an efficient sediment trap and moderated the quantity of sediment delivered to the shore of the Glykys Limen. The noted changes in rates of shoreline progradation may also be related to the normal infill sequence of a basin, or the amount of sediment delivered to the fluvial system, which is dependent on natural climatic variability and anthropogenic activities among other considerations.

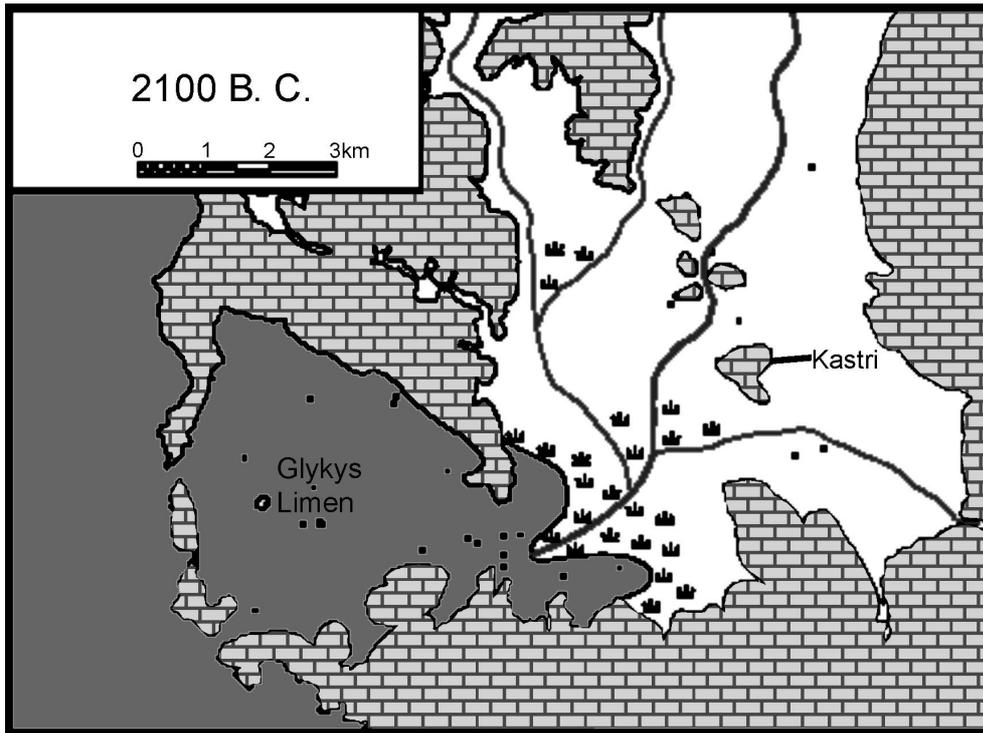


Figure 1 Paleogeographic reconstruction for 2100 BC (after BESONEN 1997) (The small black squares in this diagram mark core locations)

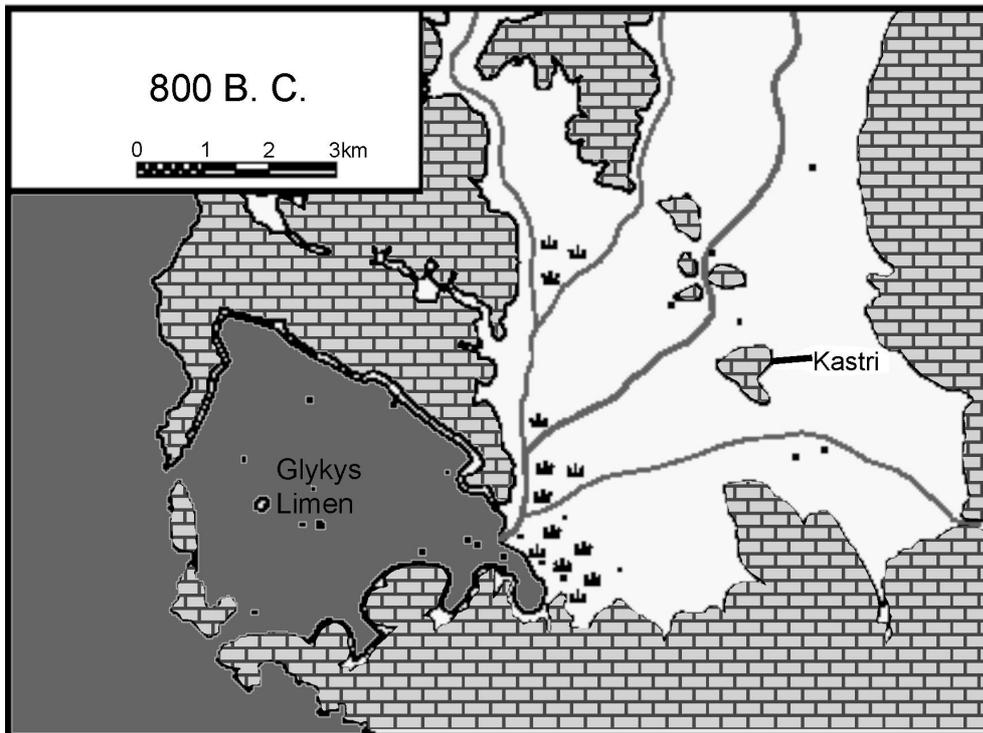


Figure 2 Paleogeographic reconstruction for 800 BC (after BESONEN 1997) (The small black squares in this diagram mark core locations)

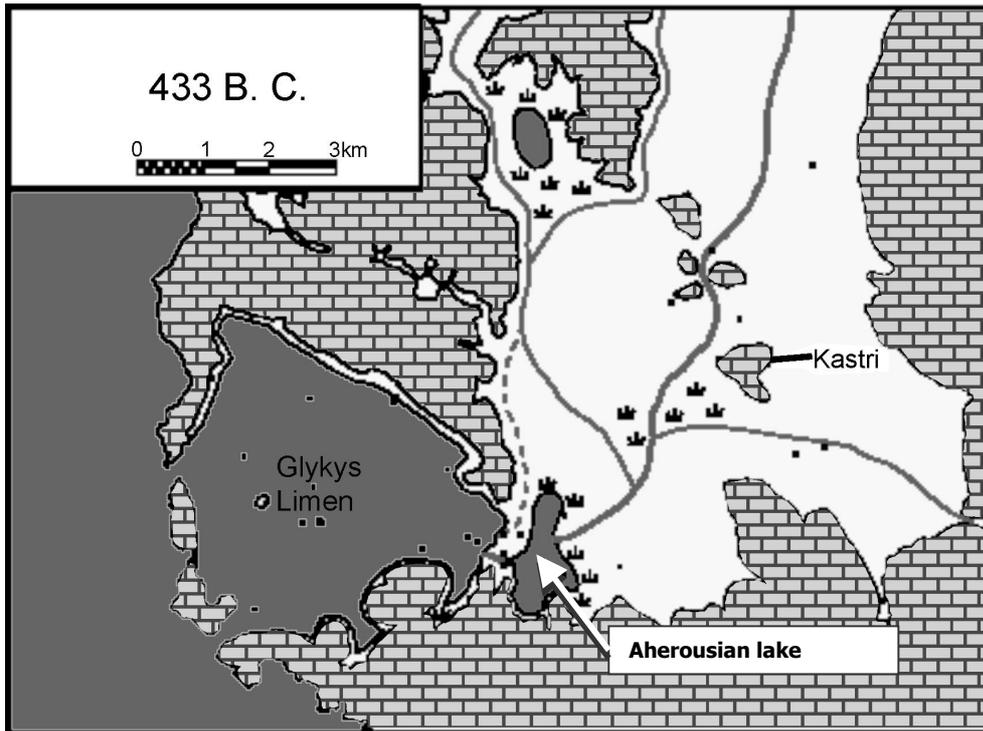


Figure 3 Paleogeographic reconstruction for 433 BC (after BESONEN 1997) (The dashed line indicates alternative course for the Vouvos River. The small black squares in this diagram mark core locations)

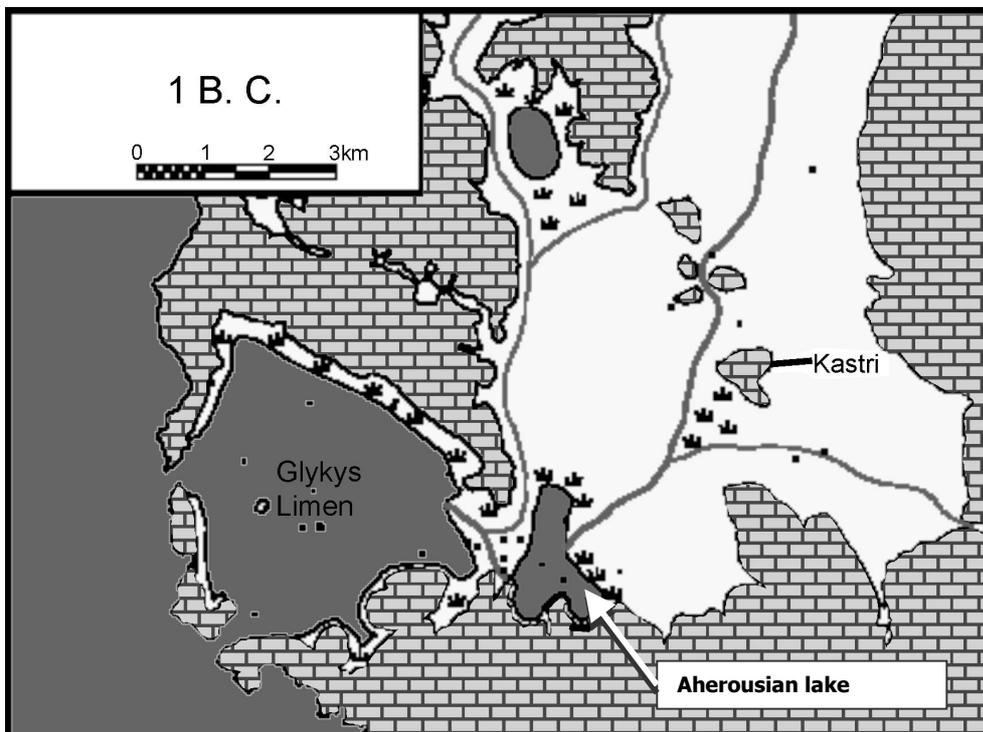


Figure 4 Paleogeographic reconstruction for 1 BC (after BESONEN 1997) (The small black squares in this diagram mark core locations)

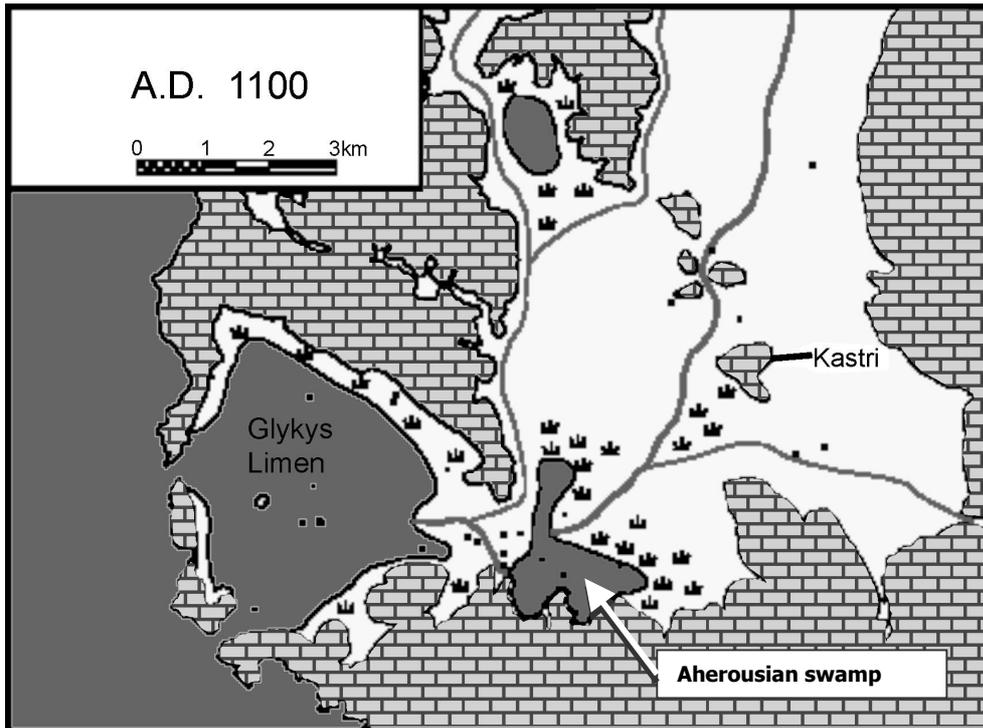


Figure 5 Paleogeographic reconstruction for 1100 AD (after BESONEN 1997) (The small black squares in this diagram mark core locations)

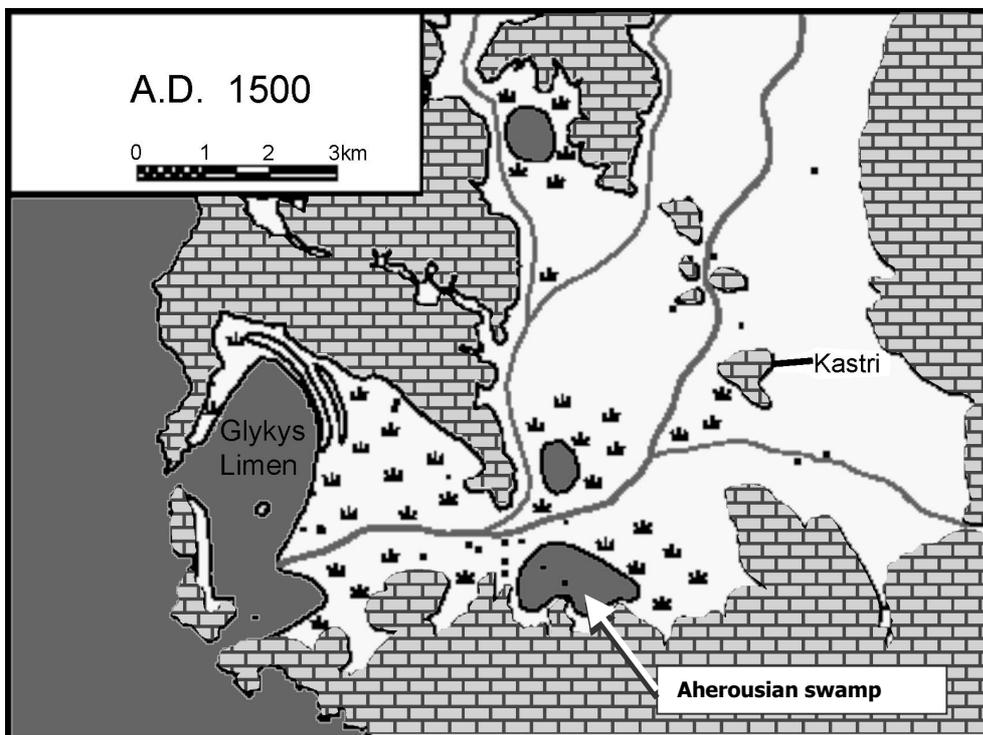


Figure 6 Paleogeographic reconstruction for 1500 AD (after BESONEN 1997) (The small black squares in this diagram mark core locations)

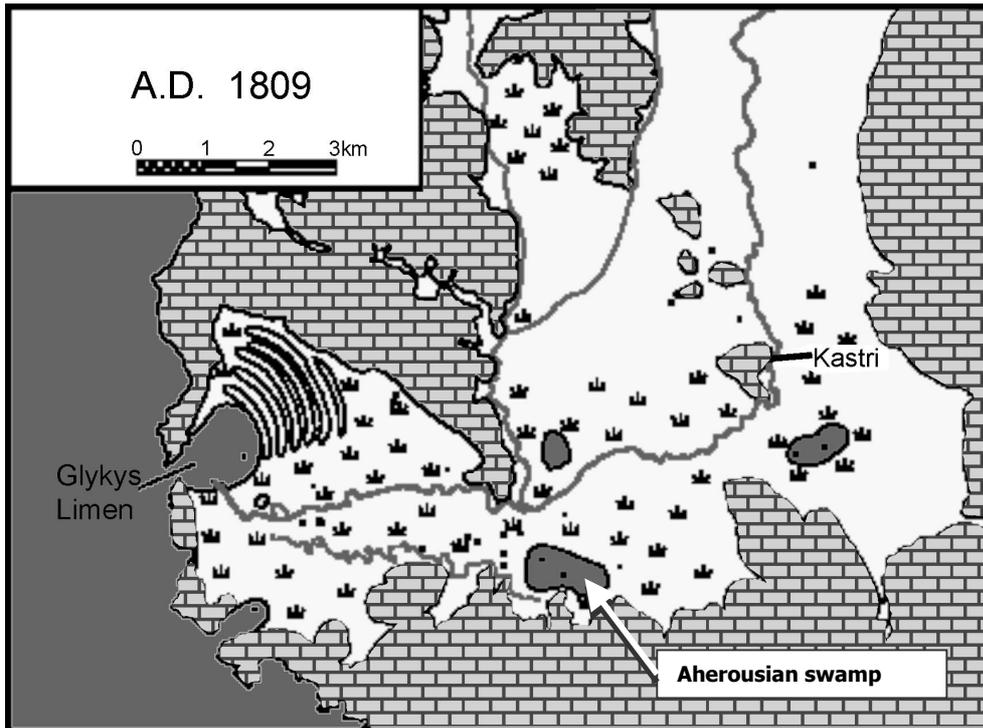


Figure 7 Paleogeographic reconstruction for 1809 AD (after BESONEN 1997) (The small black squares in this diagram mark core locations)

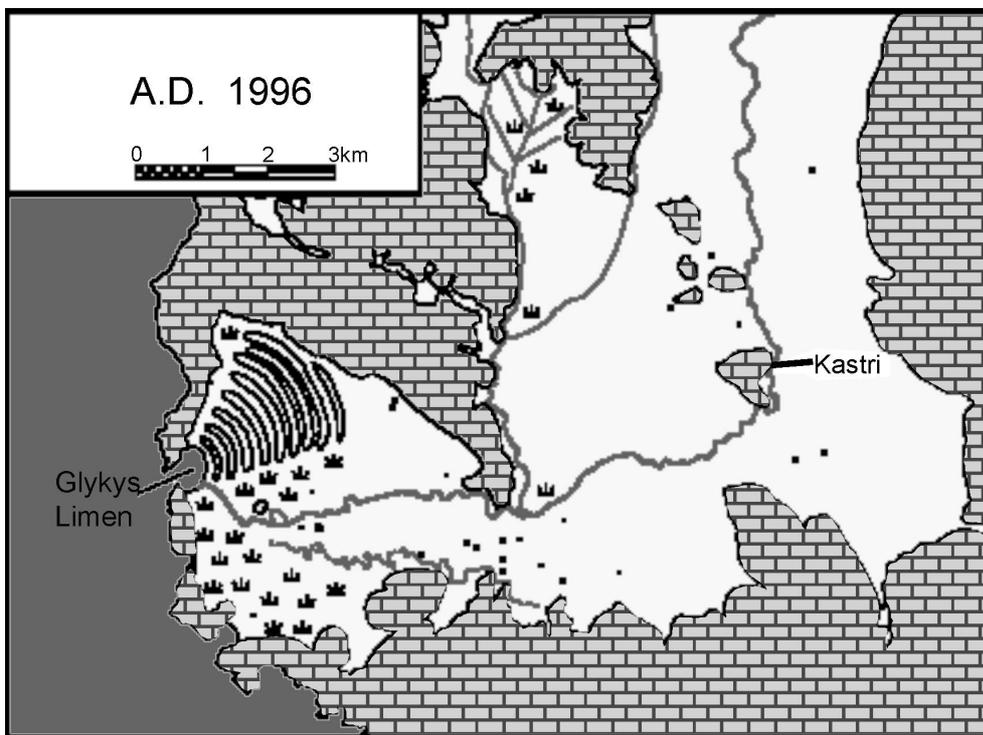


Figure 8 Paleogeographic reconstruction for modern landscape (after BESONEN 1997) (The small black squares in this diagram mark core locations)

The Acherousian Lake

According to Besonen 1997, the Acherousian Lake appears to have developed relatively late in the Holocene, definitively between 2100 and 433 BC, but probably between 800 and 433 BC. The lake came into existence by a sedimentary process, which appears to be a very effective agent of geomorphic change in the valley; because the valley is so narrow, migrating river channel and levee systems frequently impinge against the bedrock valley walls pinching off shallow closed depressions upvalley of the impingement point. Because of this, the Acherousian lake did not experience a normal lacustrine infill sequence becoming shallower and aerially less-expansive through time. Instead, the river channel and levee system, which served as the lake spillway aggraded continuously causing a consequent rise in lake surface elevation. Infilling by fluvial sediment, subsidence of the lake bottom, and sediment compaction were occurring simultaneously with the rising lake level. The balance between these parameters allowed the lake to maintain a shallow marshy profile, but grow continuously larger spreading upvalley through time. By Turkish times, the lacustrine delta built into the lake by the Acheron River breached the spillway thus allowing its sediment supply to return to the coast. Subsequent to this, normal lacustrine infill processes dominated the swampy, marshy remnants of the lake.

The Course of the Acheron River

Regarding the course of the Acheron River, a pottery fragment and an AMS radiocarbon date from two significant river channels north of Kastri suggest that the river course followed a northerly route around the hillock during Classical times. The river course appears to have migrated to the south of the hill very recently, probably between AD 1500 and 1809.

Discussion

Concerning the results presented, and especially 11 km² reduce of the Glykys Limen sea coverage in the last 900 years, it has to be mentioned that to the south of this area, the Byzantine temple (1100 AD) of Panagia Mavrika is covered (only the roof is visible) from the coarse grained deposits (conglomerates) of Ermitsa torrent (MARIOLAKOS *et al.*, 2004). Furthermore, a sample of organic material from the depth of 19,33m of a sampling drilling near the coastline of the Dioni Bay (Acheloo River), in a small distance from the mouth of the river, gave an age of 710±40 yrs BP. That is about 1300 AD (MARIOLAKOS *et al.*, 2004).

In the diagram (**Figure 9**) is shown the relationship between the sea coverage reduction of the Glykys Limen and the continental sedimentation rate for the last 5000 years. Two periods of high sea coverage reduction can be observed, the first between 3000 and 2000 years and the second 1100 up to modern times. It seems that the last 300 years the of the sea coverage reduction is not so high.

In the diagram (**Figure 10**) is shown the relationship between the temperature change and the sedimentation rate for the last 5000 years. We can observe that in case the temperature change is not abrupt the sedimentation rate follow more or less these changes (approx. parallel curves). In cases the temperature changes are very abrupt the sedimentation rate does not follow the changes.

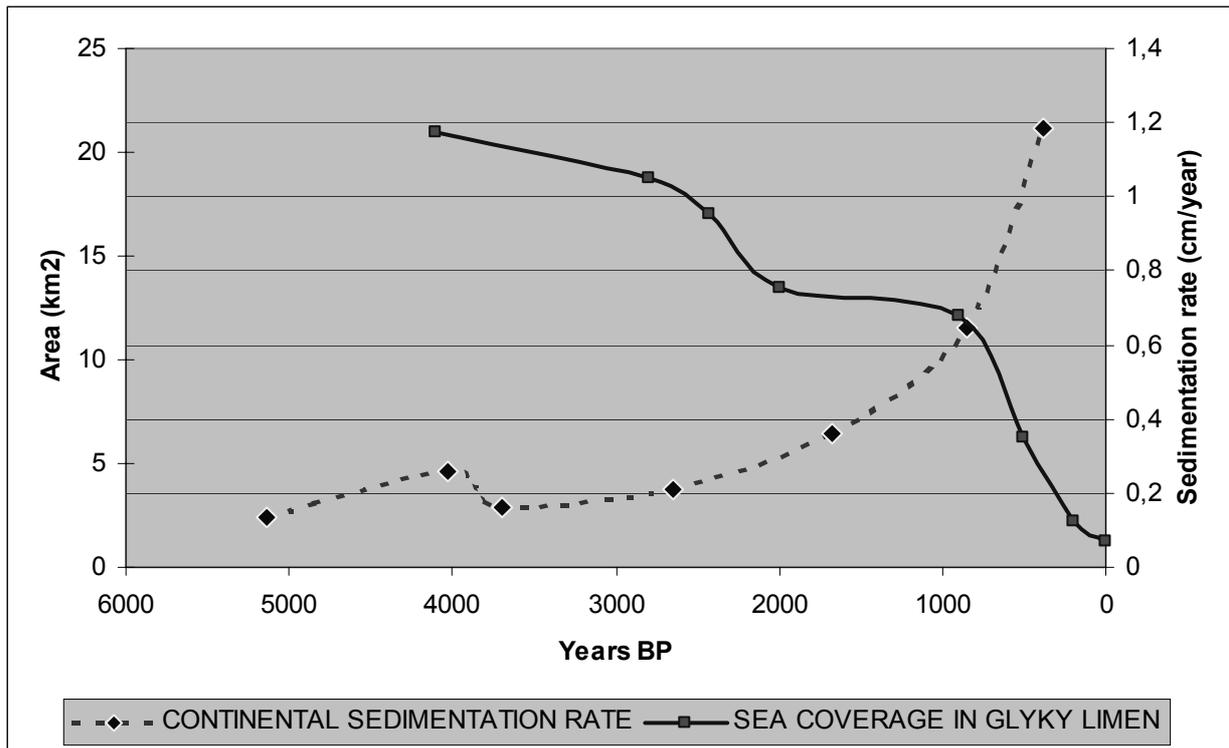


Figure 9 Comparison of continental sedimentation rate and Sea coverage reduction in Glykys Limen in the last 5000 years (From drilling and dating data in BESONEN 1997).

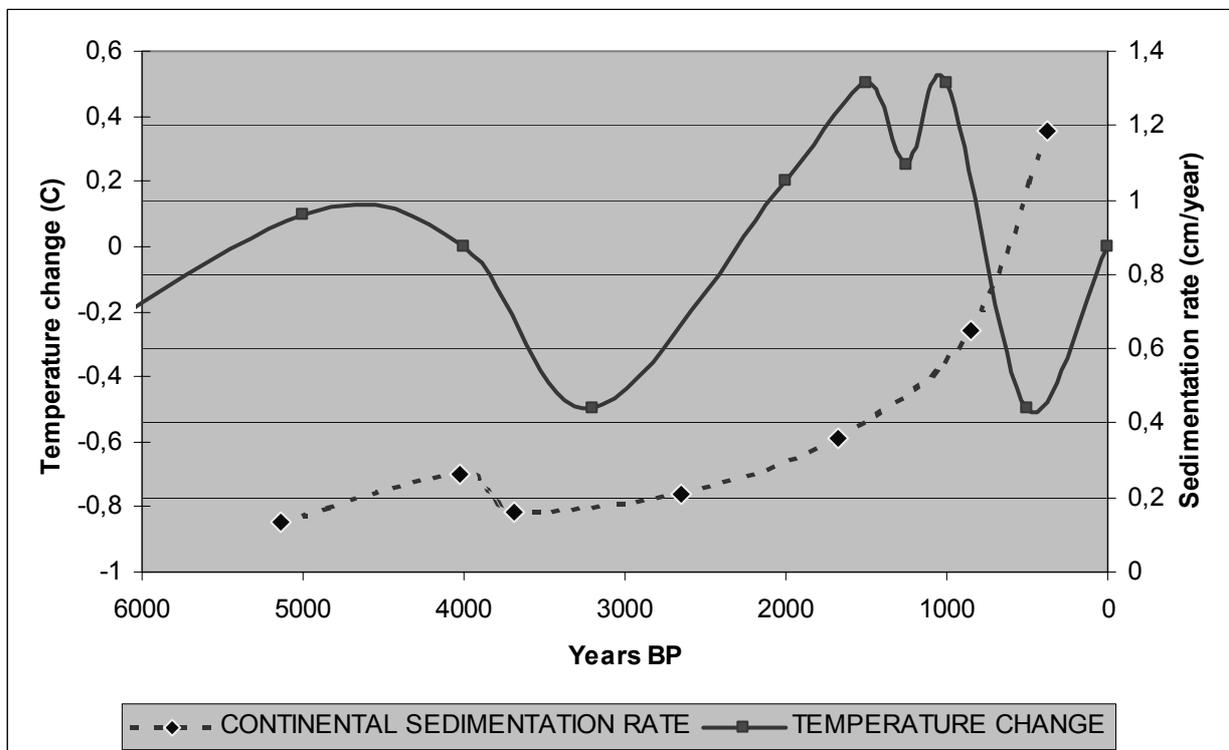


Figure 10 Comparison of continental sedimentation rate and global temperature change in Glykys Limen in the last 5000 years.

We present you these diagrams because it is well known that the sedimentation rates could be connected with two major factors: tectonics and climate. In this case, as we are in a

tectonically active area, the increase of sedimentation rate could not be connected to tectonic activity. The fact that we have not observed a tectonic event affecting the area the last 900 years, as we have in many areas of Greece with different tectonic setting, we think that the main factor is climatic change (**Figure 11**). The main climatic change of this period is the Little Ice Age (approx. 700 years BP).

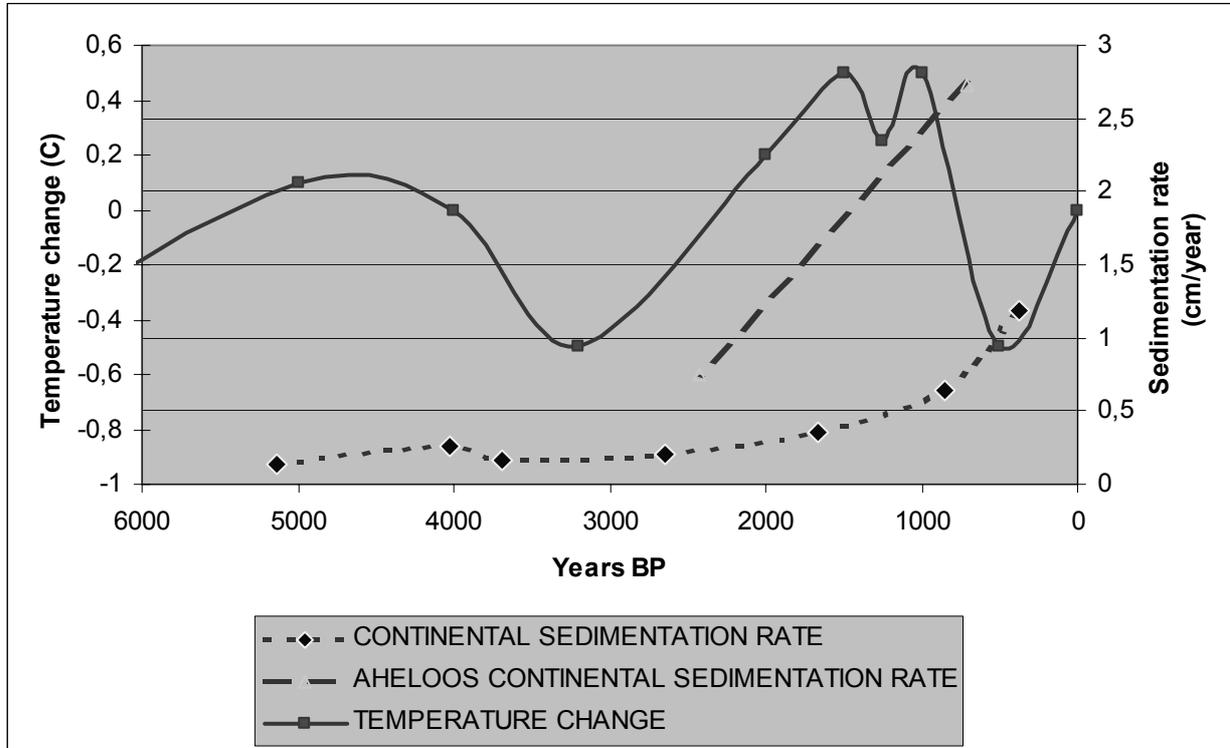


Figure 11 Comparison of continental sedimentation rates in Aheron and Aheloos river mouths and global temperature change in the last 5000 years.

The disciplines of geology and archaeology find a natural interface in the Lower Acheron River basin, both contributing to, and benefiting from one another. Indeed, the profound geomorphic evolution noted in the Acheron Valley during the last 4,000 years of relatively stable eustatic sea level (**Figure 9**) reaffirms the need for multidisciplinary archaeological investigations that strive for a broad understanding of the dynamic physical environment in which the material remains they study were generated.

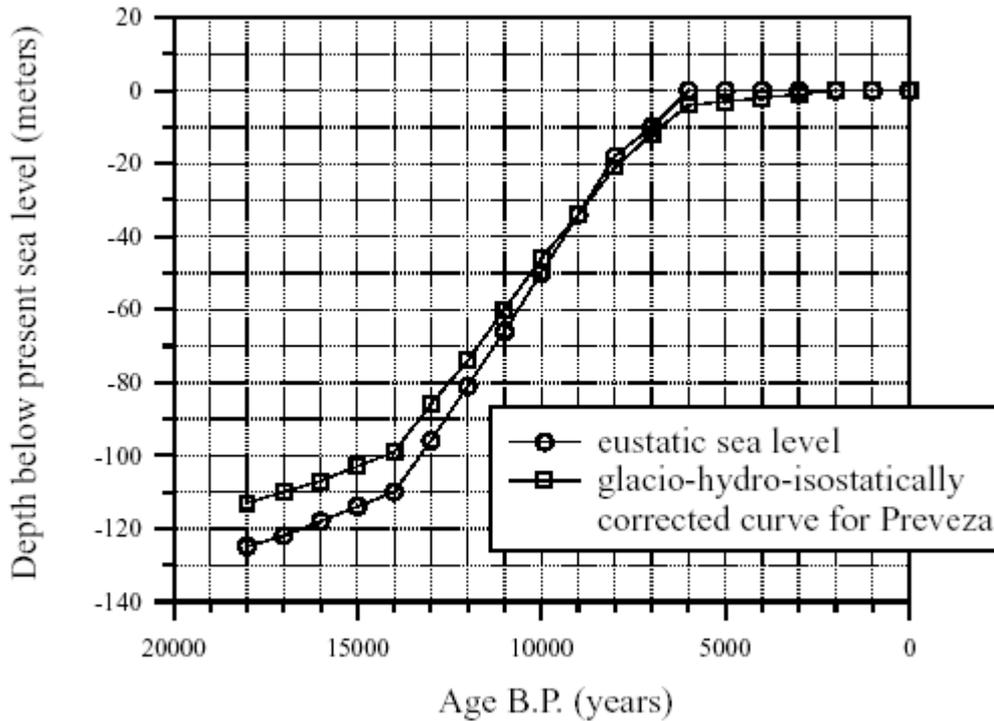


Figure 12 Glacio-hydro-isostatically corrected relative sea level curve for the Preveza area (after BESONEN 1997)

REFERENCES

BESONEN M. .R. (1997) *The Middle and Late Holocene Geology and Landscape Evolution of the Lower Acheron River valley, Epirus, Greece*. Msc Thesis, University of Minnesota, Faculty of the Graduate School, 176p.

MARIOLAKOS, I., MARIOLAKOS, D., FOUNTOULIS, I., TZIOVARA, A., CHAMPILOMATI, A., ANAGNOSTOU, CH., and SAKELLARIOU, D. (2004) Shallow Sampling drillings in the Acheloos delta area: preliminary results and radiocarbon dating. *Extended Abstracts 10th International Congress Geological Society Greece*, p.496-497, Thessaloniki.

**Stop 9.2:
Arillas**



Figure 53. Arillas area: thrusting of the Ionian unit over the Pliocene marine deposits.

Epirus Morphotectonic setting

In Epirus region we can distinguish the following main River Basins:

1. The Sarantaporos River Basin
2. The Thyamis River Basin
3. The Ioannina closed basin
4. The Acheron River Basin
5. The Louros River basin
6. The Arachthos River basin and some other minor order basins

The watersheds of the above mentioned basins in most cases are located close or coincide with active fault zones. Numerous of thrusts can be observed in the Sarantaporos and Acheron basins, whereas in Thyamis and Ioannina basins can be observed only few of them. During this field trip we will cross the first four basins, whose main characteristics are:

Sarantaporos River Basin

The Sarantaporos River is a trans-boundary river starting from Greece and flows out in Albania. In the Greek region we can distinguish 3 main tributaries, the Sarantaporos, the Aios and the Voidomatis. These main tributaries present flow direction from SE to NW and from NE to SW. In the area SE of Konitsa (Tymphi Mt. 2497m) the main flow direction is from SE to NW forming, in combination with neotectonics, gigantesque gorge the famous Vikos gorge.

Thyamis River Basin

The main tributaries of the Thyamis River Basin present an X shape. They converge from north and south towards a central area located closer to the southern watershed, and then it flows out in the Ionian sea. The drainage network presents an asymmetry to the south, that is the main river-bed is located closer to the southern watershed than the northern one. The main flow directions are from NW to SE or from SE to NW and only when it reaches the sea it flows towards west.

Ioannina closed basin

The Ioannina basin is located at the central eastern part of Epirus region at an elevation above 500 m forming a closed basin, as there is not communication with the sea. All the tributaries of the basin converge to the lower elevated area the Ioannina (or Pamvotis) Lake. The basin presents an ellipsoid shape with the long axis striking NW-SE, and has common watershed with all the main river basins of Epirus.

Acheron River Basin

This river basin presents a typical asymmetry to the south as all the main tributaries flow from NNW to SSE and finally they change direction to west (Ionian sea). At the south southwestern part of the basin historically were two lakes that have drained and nowadays only at the western part a swampy area exist.

The purpose of this sort morphotectonic description is to show that:

1. The area consisting of the Ioannia and Thyamis basins separates the whole area into two parts. The northern part, which discharge towards NNW, and the southern one that discharge towards SSW.
2. Large fault zones directly influence all basins.
3. As is shown on the Maps the fault zones present a strike slip character.
4. The asymmetry of the drainage network is due to tilting of the blocks bounded by the strike slip fault zones. The rotational axes are almost horizontal and have an E-W direction for the Acheron block, and WSW-ENE direction for the Voidomatis-Aoos block.

