Marine mollusk fauna and Holocene stratigraphy of the marsh of Agia Paraskevi, (Lamia, Fthiotida) Greece.

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ABSTRACT

This research deals with the analysis of the mollusk fauna and the stratigraphy of the Agia Paraskevi marsh. This marsh is situated 5 km eastwards of Lamia city and 5.5 km from the present coastline of Malian Gulf on the northern margins of Sperchios basin. The area was highly influenced by the sea transgression and the sedimentation of Sperchios River during the Holocene. The site area was investigated with 6 inspecting trenches (T-1,2,3,4,5,6), and 7 vibracores (PAR-1,2,3,4,5, MAG-1,2), up to 4m and 10m depth respectively. Selective samples of the vibracores were analyzed, and two types of marine mollusk faunas were recognized. The first type includes marine mollusks (*Alvania, Epitonium*, *Cerithium vulgatum, Bittium, Murex, Triforis, Retusa, Turbonila, Cythara, Nassa, Nassa semistriata, Cyclope neritea, Nucula, Mytilus / Modiolus, Chlamys, Abra, Tapes, Venus gallina, Plagiocardium, Donax, Tellina, Gastrana fragilis, Corbula gibba, Spisula, Loripes lacteus*) indicative of a protected marine environment with silty- sandy bottom. The second type includes mollusks of a lagoonal environment (*Cerastoderma glaucum, Abra, Cerithium vulgatum, Bittium reticulatum, Loripes lacteus, Hydrobia*). The stratigraphical and the palaeontological analysis of the vibracoring data allowed the distinction of the penetrated strata into seven (7) Stratigraphic Units - Depositional Facies a) Anthropogenic Facies, b) Alluvial Facies, c) Temporal marshy Facies, d) Marshy Facies, e) Lagoonal Facies, f) shallow marine Facies, g) marine shoreline Facies.

The existence of a marine environment with palaeoshore sediments in the periphery accompanied with shallow marine fine grained silty sands was confirmed in the deeper part of the stratigraphy. The end of the marine environment is signalled by a sandy bed with numerous *Cerastoderma, Abra, Hydrobia,* shells reflecting a lagoonal environment. Finally, above the marine and lagoonal sediments a marshy environment was created and loamy sediments were deposited. While sands & gravels at the SW edge of the site area indicates lateral alluviation.

Keywords: Sperchios,

1. INTRODUCTION

Agia Paraskevi village is situated 5 km east of Lamia city, between the northern margins of the Sperchios plain and the south foothills of Mount Othrys consisting of karstified Mesozoic limestones. South of the village a marsh dominated the area since the middle of the 20th century when the area was reclaimed. Today the area is located 5.5 km away from the sea, but ~8,000 years ago the sea was extended up to the margins of the hilly terrain forming a marine bay south of the village (Vouvalidis et. all., in press). The area was gradually silted up and a marsh was formed in the former bay the last ~3,000 years. The main reason for the alluviation of the area is the Sperchios River delta prolongation seawards, due to high sedimentation rates and rapid delta progradation (Zamani & Maroukian, 1980, Poulos et al., 1997, Psomiadis et al, 2004, 2005**)**. The site area is also affected by the Sperchios basin tectonic deformation (Pavlides et al., 2004) with an uplift rate >1mm/yr (Vouvalidis et. all., in press).

The area was inhabited by the man since the prehistoric times probably due to the proximity to the sea and presence of fresh water springs (Vouvalidis et. all., in press).

ΘΑΛΑΣΣΙΑ ΠΑΝΙΔΑ ΚΑΙ ΟΛΟΚΑΝΙΚΗ ΣΤΡΩΜΑΤΟΓΡΑΦΙΑ ΤΟΥ ΕΛΟΥΣ ΤΗΣ ΑΓΙΑΣ ΠΑΡΑΣΚΕΥΗΣ, (ΛΑΜΙΑ, ΦΘΙΩΤΙΔΑ) ΕΛΛΑΔΑ.

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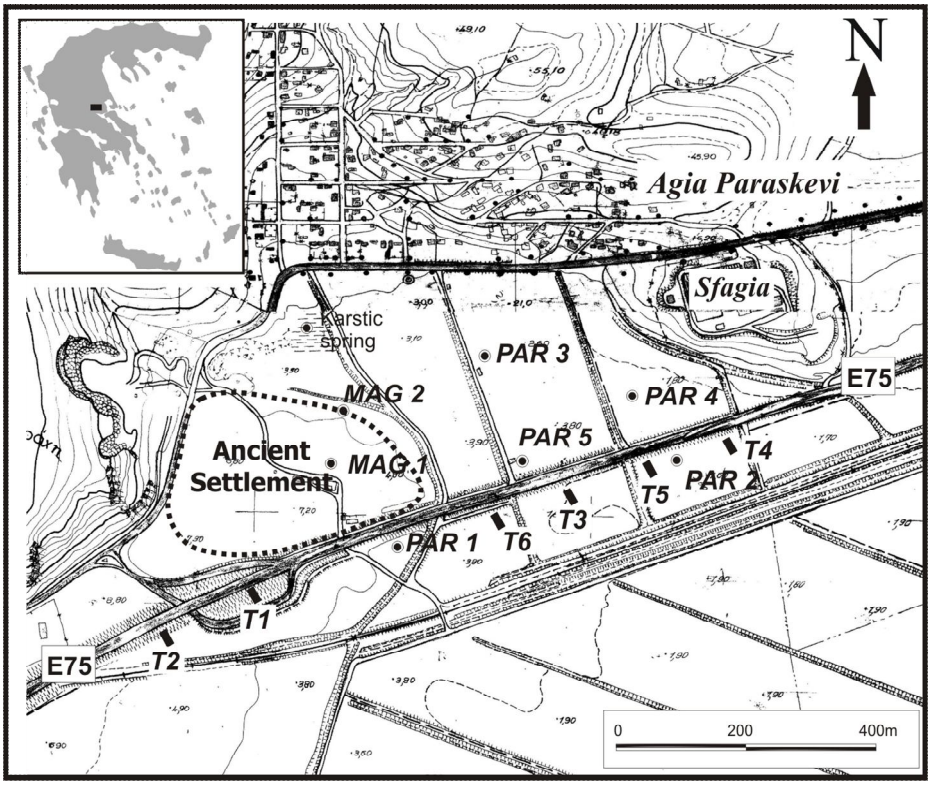


Fig. 1: Site map of Agia Paraskevi with the inspection Trenches and the borehole locations. (*E75 is the Athens-Thessaloniki national highway*).

An important prehistoric settlement is situated close to the Agia Paraskevi village (Fig. 1), (Papakonstantinou, 2006, 2007, 2008). The so far collected data from the geoarchaeological research, indicate a coastal settlement and the presence of a marine bay between the prehistoric settlement and the Sfagia hill southern of Agia Paraskevi village, that gradually silted up and evolved into marsh (Vouvalidis et. all., in press). In this paper, is attempted to be presented in detail the Holocene Stratigraphy and the marine mollusk fauna derived from 5 inspection trenches and 7 vibracores realized into the area of the marsh of Agia Paraskevi.

2. MATERIALS AND METHODS

Both Vibracoring and inspection trench digging were used for the present study to investigate the Holocene Stratigraphy.

Six (6) inspecting trenches (T-1,2,3,4,5,6), were opened up to 4.5m depth with a digger machine, south of the E75 national road (Fig. 1). Advantage of trench digging is the rapid and direct observation in the field of the subsurface stratigraphy up to 3-4m depth. In our case a shallow ground water level guide to rapid floods with water of the trenches and subsequent side collapse. As a result time for precise record of the Stratigraphy was short, and supported with the photographic record. Direct sampling from the trench sides was not possible (too risky and dangerous), and it was realized on samples from the excavated sediments into the bucket of the digger machine. Never the less trench digging gave enough information for a more efficient planning and drilling of the vibracores.

Seven (7) vibracores (PAR-1, 2, 3, 4, 5 & MAG-1, 2) (Fig. 1), were drilled in the area. The sediment cores were obtained by using an Atlas Copco vibracoring device (Cobra MK 1). The corer used (1m in length) was equipped with a 40mm in diameter core cutter and basket type

core catcher. The inner sampling was achieved through the use of plastic PVC tubes (with a 40mm outer diameter) sealed, marked and stored properly for further analysis. The maximum recovery depth for the drilling procedure in Agia Paraskevi was 10 m below surface (m b.s.).

All the samples were opened in the laboratory for analysis. After cutting the plastic tubes and carefully splitting the cores were divided into two halves, an archive and a working. Detail photographic recording, with a digital camera, using an mm scale of every sediment core was realized, followed by stratigraphical and lithological descriptions. A Munshell Soil Color Charts was used for precise colour determination.

Selective samples containing mollusks were taken from the vibracores. They were treated with water containing diluted ~10% hydrogene peroxide and washed into a series of 4 stainless steel sieves with 2, 1, 0.5, & 0.064mm wire mesh. Washing removed silt and clay (< 0.064mm), while fossils, sand (0.064-2mm) and gravel (>2mm) fractions remained into the sieves (sieves 1, and 0.5mm used for better washing and sorting of the residue). Residue was dried up and mollusc shells and fragments were hand selected for further palaeontological study. The weighting of the samples before and, after washing allow weight separation into gravel, sand, silt+clay fractions, and semiquantitative estimation of the mean grain size for each sample. The scarcity of the shells with the small size of the cores (38mm in diameter) guided to selective sampling of the visible shells, and qualitative elaboration of the results.

In the other hand samples from the inspecting trenches was large enough and contained many fossils; but uncertainty in depth of sampling and possible contamination – mixing due to the procedure of digging allow only qualitative approach and a general good look to the mollusk fauna.

3. RESULTS

3.1. Lithostratigraphy

Trench profiles

Six (6) inspecting trenches (T-1,2,3,4,5,6), were opened up to 4.5m depth with a digger machine, south of the E75 national road (Fig. 1).

Trench T1, (+4.5m asl, 3.5m depth) it was opened south of the national road, at the old exit to Lamia.

- 0.00-0.80m Brown sandy gravely loamy soil.
- 0.80-1.00m Brown loam.
- 1.00-2.00m Sand and gravel.
- 2.00-2.70m Olive gray sand.
- 2.70-2.90m Brownish sandy loam

All the layers in this trench indicate terrigenous sediments; mainly coarse sand and gravels intercalated with more sandy or gravely layers. Gravel is of fluvial origin with rounded grains, many of them consist of dark red-brownish chert. Two layers of thin bedded brown silty loam are intercalated at 0.8-1.0m and at 2.7-2.9m depth. At the base of the trench (3.0-3.5m depth) the profile shows coarse sand with gravel. It is an aquiferous layer and rapidly floods the trench.

Trench T2, (+5.0m asl, 4.5m depth)

The westernmost trench in the area, consisting entirely of fluvial sediments, and was quickly flooded also.

- 0.00-0.50m Brown sandy loamy soil.
- 0.50-1.00m Brownish sand.
- 1.00-1.70m Sand and gravel.
- 1.70-2.00m Olive gray sand
- 2.00-2.30m gravel.
- 2.30-3.00m Brownish sandy loam and gravel.
- 2.70-2.90m sand with gravel.

Trench T3, (+1.5m, 4.5m depth)

Situated at the east of the area

- 0.00-1.50m Brown loam
- 1.50-2.50m Dark gray greenish loam
- 2.50-2.90m olive gray fossiliferous sand
- 2.90-4.50m Greenish gray fossiliferous silty-clayey sand.

Profile shows marine sediments at the lower part, overlain by loamy sediments in the upper part. The uppermost part of marine sediments (2.50-2.90m) is fossiliferous sand with numerous

mollusc shells (*Cerastoderma, Abra, Cerithium, Bittium, Loripes*).

Trench T4, (+1.5m, 4.5m depth)

- 0.00-1.60m Brown loam
- 1.60-2.50m Dark gray greenish loam
- 2.50-2.90m olive gray fossiliferous sand
- 2.90-4.50m Greenish gray fossiliferous silty-clayey sand.

Trench T5, (+1.5m, 3.5m depth)

- 0.00-1.50m Brown loam
- 1.50-2.50m Dark gray greenish loam
- 2.50-2.90m olive gray fossiliferous sand
- 2.90-4.50m Greenish gray fossiliferous silty-clayey sand.

Stratigraphy of T4 and T5 is almost identical to T3, with no considerable differentiation. The most characteristic in all three of them is that the contact between the top of the marine sediments and the above loam is situated at 2.5m depth (Fig. 3).

Vibracore Profiles

Seven vibracore profiles were retrieved from the area of Agia Paraskevi. Five of them (PAR-1,2,3,4,5) were drilled in the flat plain area south of the village (Fig. 1) in order to investigate the Holocene stratigraphy. The other two (MAG-1,2) were taken on the prehistoric settlement. MAG-1 traced the thickness of archaeological strata in the centre of the settlement, while MAG-2 in the north margin investigates the interface between anthropogenic and natural strata.

Lithology profiles are described downwards from surface:

Vibracore profile PAR-1 (+3.08m a.s.l., 6.50m depth)

It is located ~150m SSE from the margins of the prehistoric settlement (Fig. 1), at the south side of the National road.

- 0.00-0.50m Dark grayish brown loam, with few gravel grains
- 0.50-1.40m Yellowish brown to brown silty loam with dark spots. More sandy between 1.20-1.40m
- 1.40-1.58m Dark brown sand, more coarse and few gravel grains at the base
- 1.58- 3.30m Brown loam, sand and gravel increases downwards.
- 3.30-3.60m Dark brown sand with gravel.
- 3.60-3.85m Dark grayish brown silty loam with horizontal bedding, and some scattered dark spots of carbonized plant remnants.
- 3.85-4.62m Greenish gray to dark greenish gray silty sand with scattered fragments of thin shelled bivalves. At 3.95m Abra valves were found.
- 4.62-4.82m Greenish gray silty sand with many fragments of thin shelled bivalves. At the top (4.62m) a pottery fragment appears.
- 4.82-5.48m Greenish gray silty coarse sand with a lot of gravel up to 2 cm. Contains many eroded small fragments of marine molluscs.
- 5.48-5.88m Dark greenish gray silty fine sand with horizontal bedding.
- 5.88-6.50m Dark greenish gray coarse sand with gravel, Contains many eroded small fragments of marine molluscs.

Vibracore profile PAR-2 (+1.32m a.s.l., 7.00m depth)

It is located ~150m SSW from the hill of Sfagia (Fig. 1) at the south margin of the National road.

- 0.00-0.40m Blackish loamy soil with plant remnants.
- 0.40-1.15m Brown massive loam with calcareous concretions at 0.80m.
- 1.15-1.30m Brown to gray bedded loam
- 1.30-2.42m Greenish gray laminated silt-very fine sand with multicolour bedding.
- 2.42-2.80m Olive gray to greenish gray fossiliferous silty sand (*Cerastoderma, Abra, Cerithium, Bittium, Loripes*)
- 2.80-5.15m Greenish gray silty-clayey fine sand with laminated bedding. Scatter appearance of thin shelled fossil fragments (4.25m *Dosinia* valve, 4.33m *Abra* valve, a carbonised root at 4.26-4.33m)
- 5.15-5.40m Greenish gray fossiliferous fine sand with many thin shelled molluscs

(*Loripes, Dosinia, Chlamys, Modiolus, Tellina, Cerithium, Venus, Donax, Alvania,* etc.)

- 5.40-7.00m 15m Greenish gray silty-clayey fine sand with laminated bedding. Scatter appearance of thin shelled (mainly *Abra*) fossil fragments.

Vibracore profile PAR-3 (+2.25m a.s.l., 10.00m depth)

It is located in the middle distance between prehistoric settlement and Sfagia hill (Fig. 1) ~150m S from Agia Paraskevi village.

- 0.00-0.30m Very dark brown loamy soil.
- 0.30-2.20m Brown massive loam with calcitic concretions and multicolour spots. A more fine sand layer at 1.70-1.75m.
- 2.20-2.54m Dark grey massive loam with many plant remnants.
- 2.54-2.95m Brown massive loam with calcitic concretions
- 2.95-3.14m Dark grey-blackish massive loam with charcoal small fragments and many plant remnants.
- 3.14-3.30m Greenish gray silty fine sand with mica scales.
- 3.30-3.80m Greenish gray fossiliferous silty-clayey sand. Contains many thin shelled molluscs. At the upper part articulated valves of *Loripes* and *Solen* are found (Fig. 4F).
- 3.80-3.95m Greenish gray silty fine sand with mica scales.
- 3.95-4.56m Dark greenish gray silty-clayey sand with scattered thin shelled fossils (*Abra, Bittium*).
- 4.56-5.28m Dark greenish gray laminated clayey silt. At the top contains carbonized plant remnants.
- 5.28-5.60m Dark greenish gray silty-clayey sand-coarse sand with scattered thin shelled fossils. At the base contain gravel and several eroded mollusc fragments (*Cerithium*).
- 5.60-6.00m Dark greenish gray laminated silty-clayey fine sand.
- 6.00-6.75m Dark greenish gray silty sand. Mollusk shells appear at the upper part, at 6.29m articulated *Cerastoderma glaucum* (Fig. 4E).
- 6.75-8.27m Dark greenish gray thin bedded silty-clayey fine sand with very few scattered thin shelled molluscs (*Abra, Bittium*) and some roots at 7.30m.
- 8.27-8.45m Dark greenish gray silty sand with few pebbles (up to 3cm) and thin shelled fossil fragments (*Loripes*, *Abra, Bittium*).
- 8.45-9.05m Dark greenish gray laminated silty-clayey fine sand with few scattered thin shells (*Abra* mainly). At 8.56m *Cyclope neritea*.
- 9.05-9.30m Dark greenish gray silty sand with few gravel grains and articulated *Abra* shells at 9.20-9.25m.
- 9.30-9.53m Dark greenish gray silty sand with scattered charcoal and a few pebbles
- 9.53-10.00m Dark greenish gray laminated silty sand, more sandy at the top. A *Cyclope neritea* shell at 9.69m.

Vibracore profile PAR-4 (+1.91m a.s.l., 10.00m depth)

It is located 60m SW of Sfagia hill (Fig. 1, 2) ~100m N from the National road.

- 0.00-0.50m Dark brown sandy loamy soil.
- 0.50-1.20m Olive brown gravely silty sand
- 1.20-1.70m Brown sandy loam with large fragments of Mesozoic limestone.
- 1.70-2.10m Brown coarse sand and gravel.
- 2.10-2.60m Dark greenish gray laminated silty-clayey fine sand. At the base small thin shelled fragments of *Cerastoderma glaucum*.
- 2.60-3.00m Dark greenish gray coarse sand with gravel. Contains many eroded small fragments of marine molluscs
- 3.00-3.95m Dark greenish gray silty sand with articulated valves of *Abra* and *Solen,* at the top (Fig…).
- 3.95-4.50m Dark greenish gray coarse sand with gravel and many eroded small

fragments of marine molluscs (*Cerithium*, Veneridae ind.)

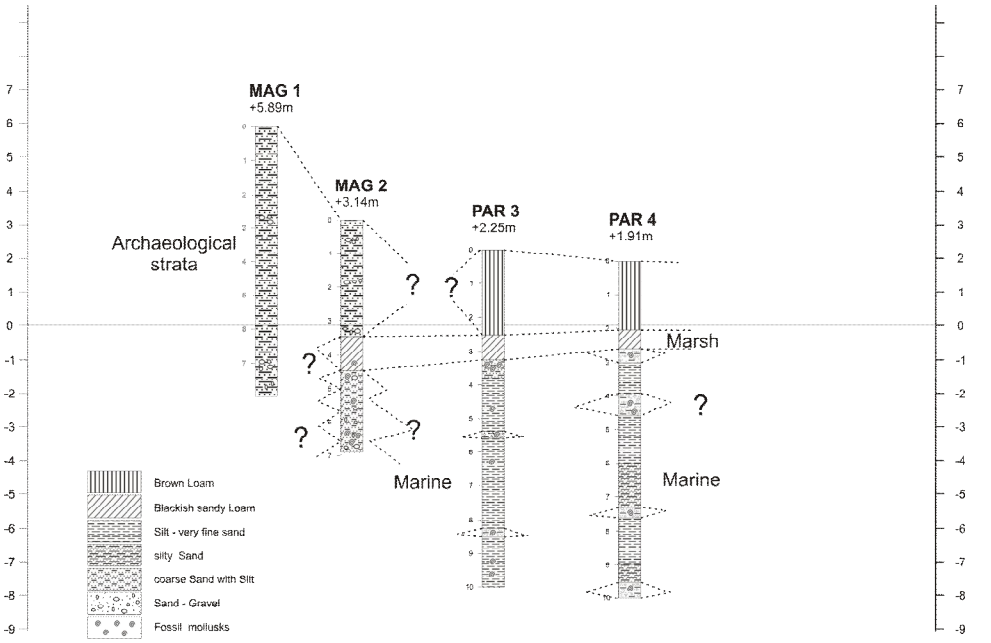


Fig. 2: Lithostratigraphic correlation of the boreholes drilled between Agia Paraskevi village and the national road.

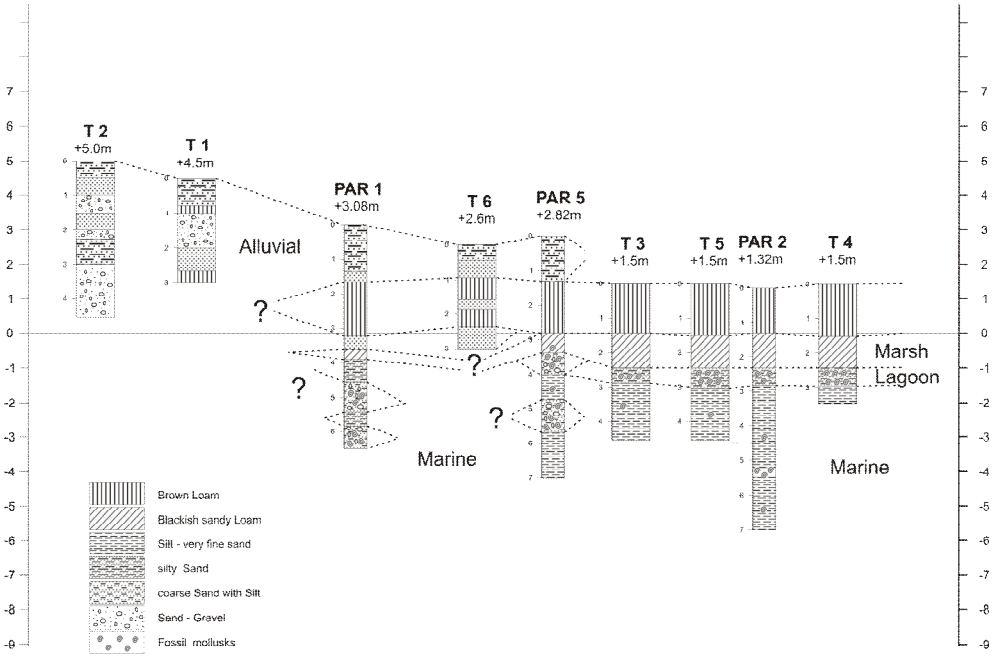


Fig. 3: Lithostratigraphic correlation of Trenches and boreholes along the national road.

- 4.50-6.00m Dark greenish gray laminated silty sand with scattered small *Abra* shells.
- 6.00-7.60m Dark greenish gray sand with gravel and many small fragments of marine shells (*Cerithium Bittium* Veneridae ind., *Cladocora*), many *Bittium* at the lower part.
- 7.60-9.00m Dark greenish gray silty sand with few thin shelled fossils (*Abra, Bittium, Cerastoderma*) at the upper part (7.60-8.00m). More laminated below 8.20m.
- 9.00-9.70m Dark greenish gray silty sand with several thin shelled fragments (*Abra, Bittium*, Veneridae ind.).
- 9.70-10.00m Dark greenish gray sand with gravel and pebbles (up to 3cm). Contain many eroded small fragments of marine shells (*Cerithium* Veneridae ind.).

Vibracore profile PAR-5 (+2.82m a.s.l., 7.00m depth)

It is located in the middle distance between prehistoric settlement and Sfagia hill (Fig. 1) at the north margin of the National road.

- 0.00-0.30m Dark brown sandy soil.
- 0.30- 1.00m Brown sandy loam with calcitic concretions.
- 1.00-1.20m Olive brown sandy loam.
- 1.20-1.35m Brown sandy loam with gravel.
- 1.35-1.55m Brown silty loam with multicolour spots.
- 1.55-1.68m Brown sandy loam with gravel.
- 1.68-2.55m Brown silty loam with thin bedding.
- 2.55-2.80m Dark grayish brown to olive brown sandy loam.
- 2.80-3.25m Olive brown fine sand with thin bedding.
- 3.25-3.45m Alternations of reddish brown laminated silty-clayey loam with olive brown silty loam and sand. At 3.36m the reddish brown loam contains shells of *Planorbis planorbis*.
- 3.45-3.95m Dark greenish gray coarse sand with gravel and many eroded small fragments of marine molluscs (*Cerithium*, Trochidae, Veneridae ind.). at 3.70m a small (~1.5cm) pebble with Clionid boring.
- 3.95-4.20m Dark greenish gray silty sand.
- 4.20-4.50m Dark greenish gray to blackish silty sand with black laminas of organic matter at the top. Thin shelled mollusc fragments at 4.23m.
- 4.50-4.65m Dark greenish gray silty sand with thin shelled mollusc fragments. At 4.50m fragment of *Tapes*.
- 4.65-4.74m Dark greenish gray thin bedded silty fine sand.
- 4.74-5.70m Dark greenish gray sand with gravel and many eroded small fragments of marine molluscs (*Cerithium*, Trochidae, Veneridae ind.). At 5.54m a small (~1cm) pebble with Clionid boring.
- 5.70-7.00m Dark greenish gray silty sand with few scattered small *Abra.*

Vibracore profile MAG-1 (+5.89m a.s.l., 8.00m depth)

It is located in the centre of the prehistoric settlement (Fig. 1, 2) only anthropogenic strata are found along 8 m drilling.

Vibracore profile MAG -2 (+3.14m a.s.l., 6.90m depth) is located at the north margins of the prehistoric settlement (Fig. 2).

- 0.00-0.35m Light brown sandy soil.
- 0.35-0.85m Dark brown sandy loam with pottery fragments and angular pebbles.
- 0.85-2.30m Olive brown sandy loam.
- 2.30-2.65m Olive brown loam with multicolour bedding.
- 2.65-3.30m Dark olive brown sandy loam.
- 3.30-3.45m Large cobbles (broken due to drilling).
- 3.45-4.00m Dark olive brown loamy sand, contains prehistoric human litter (pottery, bones, shells, charcoal).
- 4.00-4.20m Dark olive brown sandy loam with small charcoal fragments.
- 4.20-4.32m Dark gray to blackish loamy sand with organic matter. At 4.26m *Planorbis planorbis* shell.
- 4.32-4.45m Dark gray silty sand with small charcoal fragments, and various mixed mol-

lusc fragments. At 4.33m intact *Planorbis planorbis,* at 4.35m intact small (~5mm) land snail.

- 4.45-5.14m Dark gray sand with pebbles and eroded small fragments of marine molluscs. Contain several rounded small pottery Fragments. At 4.70m calcareous pebble (~3cm) with Clionid borings (Fig. 4A, B.).
- 5.14-5.90m Dark gray silty sand with few gravel, and many small charcoal fragments.
- 5.90-6.35m Dark gray coarse silty sand with gravel, and small eroded mollusc fragments.
- 6.35-6.90m Olive gray loamy sand intermixed with coarse sand, gravel, and pebbles. Many eroded small mollusc fragments, and several eroded worked pottery fragments.

The above described columns were arrayed into two, parallel each other, longitude profiles for further Lithostratigraphic correlation. The first profile passed from the prehistoric settlement towards the Sfagia hill is situated between the village and the national road (Fig. 2), while the other is situated along the south side of the road, (Fig. 3). The first profile represents a cross-section through the ancient marine bay, and the second is situated outside along the coast and the mouth of this bay.

3.1. Mollusk Fauna

Distribution of mollusk fossils into the various strata is not uniform, but differs due to the depositional palaeoenvironment and subsequent lithology. Analysis was realized on selective samples from the boreholes since depth of samples was well documented. Samples from the inspection trenches were not included in analysis because of depth uncertainty and possible mixing. Never the less, trenches confirm the stratigraphy of the nearby boreholes, the continuity of the various beds and especially for the fossiliferous beds the large samples from the trenches allow a general outline of the fauna.

In TABLE I data from selected samples of all vibracores are compiled showing the mollusc fauna (gastropods, bivalves, etc.) in relation to sampling depth. Additional information on vertical grain size distribution for each vibracore profile is given. The determined fauna includes exclusively marine species. The only exception is two samples with small (<1cm) shells of *Planorbis planorbis* from boreholes PAR 5 (3.36m) and MAG 2 (4.32m) indicating fresh water environment and few land snails (Helicidae ind.) from MAG 2.

The marine fauna originates from two different types of beds:

Beds of mixed coarse sands with rounded gravels, representing the marine palaeo-shore.

Bedded sands and silty – clayey sands deposited in a shallow marine environment.

In the first type fossil mollusks are the remnants of dead empty shells washed, on shore, and worn by the waves. They consist of badly preserved small rounded fragments, quite problematic in determination. Since they are “sedimentary grains” their fauna is mixed. Never the less presence of pebbles with Clionid borings (PAR1 6.45m, PAR4 4.20m, PAR5 3.70m, MAG2 4.70-4.80m) (Fig. 4A, B) indicates palaeoshore.

In the second type fossils originate from well bedded layers and their faunal synthesis is indicative for the palaeoenvironment. Several articulated bivalves (Fig. 4C to F) are found in living position, representing “in situ” palaeoenvironmental indicators. Although the mollusk shells are a few and scattered into the marine beds, in some places appear shell lenses. From such a lens (PAR2 5.15-5.40m) the following fauna was recognized: Gastropoda: *Alvania, Epitonium*, Trochidae ind., *Cerithium vulgatum, Bittium, Murex, Triforis, Retusa, Turbonila, Cythara, Nassa, Nassa semistriata, Cyclope neritea.* Bivalvia: *Nucula, Mytilus / Modiolus, Chlamys, Abra, Tapes, Venus gallina,* Veneridae ind., *Plagiocardium, Donax, Tellina, Gastrana fragilis, Corbula gibba, Spisula, Loripes lacteus,* Scaphopoda: *Dentalium,* Vermes: *Serpulae,* Bryozoa, Foraminifera: *Elphidium, Nonion, Triloculina*, Echinoids (Regular & Iregular): spines and test fragments, Ichofossils: Naticoid boring on shells.

TABLE I. Fossil fauna from selected samples of Agia Paraskevi boreholes. (*) = articulated bivalves

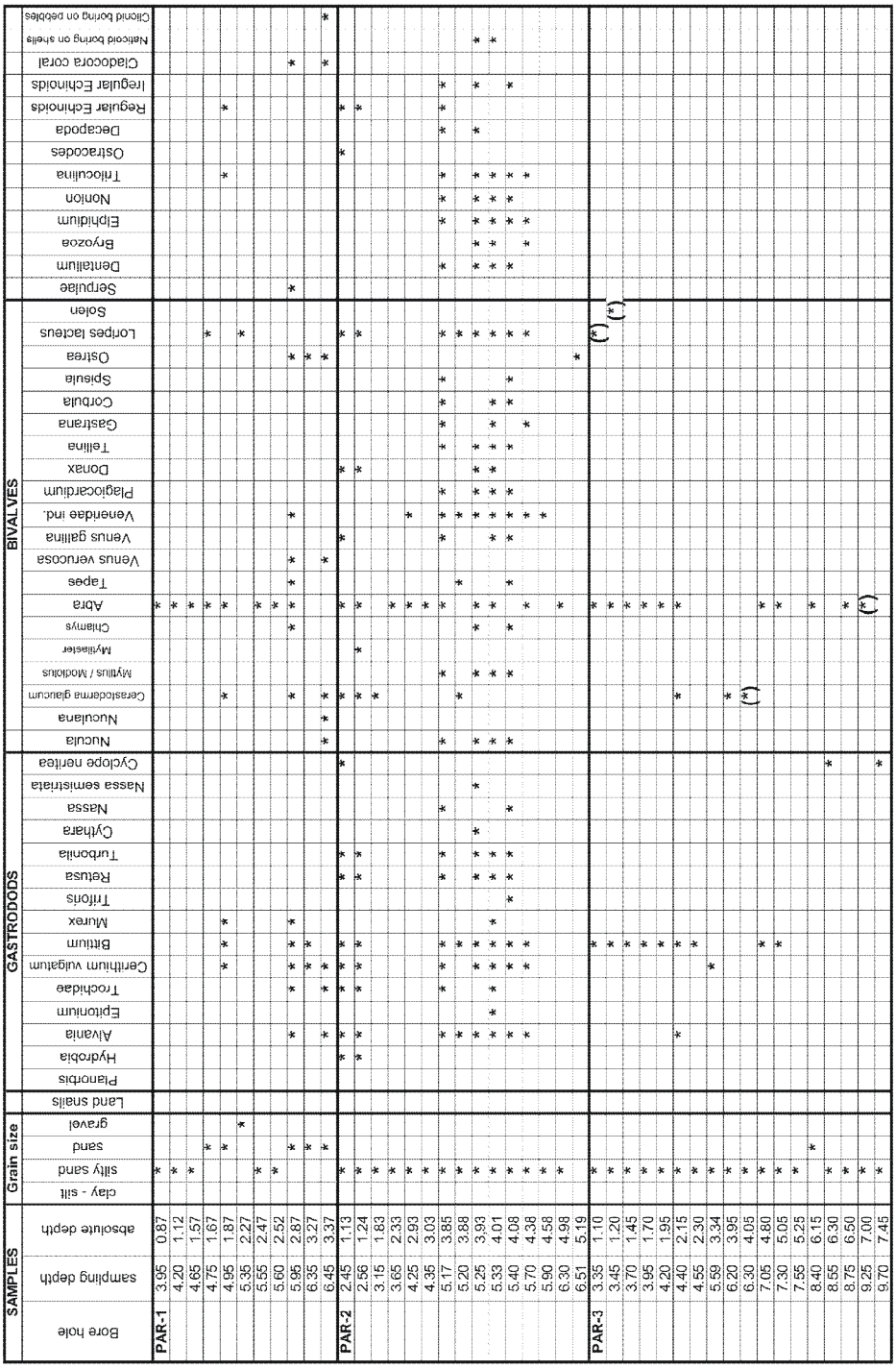
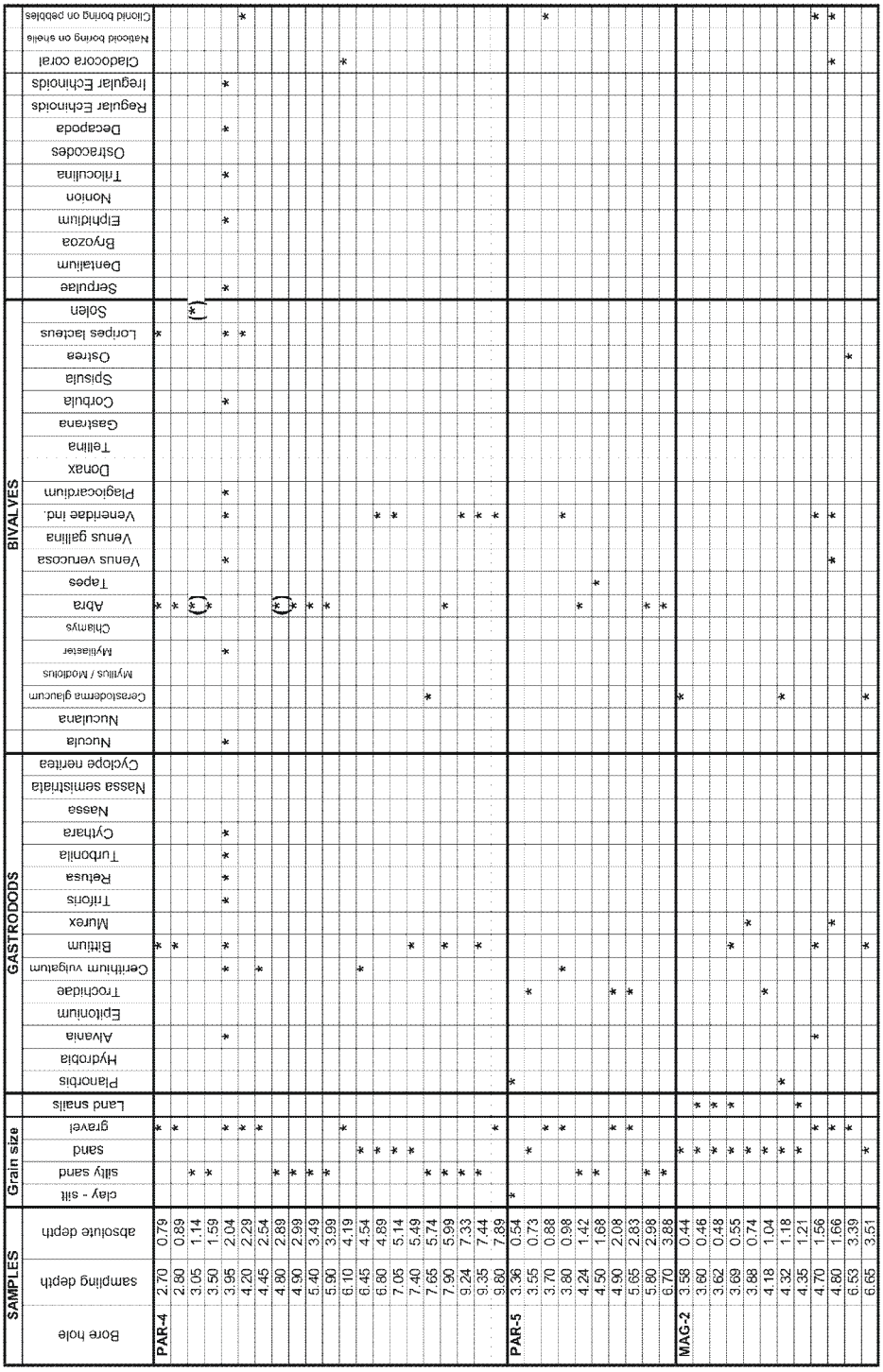


TABLE I. (continued)



It is a typical marine fauna that characterises silty- sandy substrates. The few remnants of regular echinoids (spines and test fragments) indicate proximal rocky shore or submerged rocks, this looks realistic for the shore along Sfagia hill.

In the upper part of marine strata (PAR2, T3, T4, T5, ~2.5-3m depth) appears a sandy bed with *Cerastoderma* valves. Fauna includes *Cerastoderma glaucum, Abra, Cerithium vulgatum, Bittium reticulatum, Loripes lacteus, Hydrobia*. The assemblage of *Hydrobia, Cerastoderma glaucum, Abra,* indicates a lagoonal mollusc association and the existence of a lagoonal palaeoenvironment. They also reported as a common association from the present lagoons around Mediterranean (Zaouali, 1975; Vatova, 1981; Nicolaidou *et al.,* 1988; Kevrekidis *et al*., 1996). *Cerastoderma glaucum* is abundant in many lagoons and especially those with the best contact with the sea (Kevrekidis *et al*., 1996), it also prefers relatively sheltered areas because it is unable to tolerate even a small amount of wave action (Boyden & Russel, 1972). It lives on all types of soft substrate, but it is more abundant in very well sorted fine sand and in low energy environments (Kevrekidis et al., 1996). *Abra* is a very common species in Mediterranean lagoons and estuaries, and has been found in muddy, silty to sandy-silty substrates (Vatova, 1981; Bourgoutzani and Zenetos, 1983; Nicolaidou and Karlou, 1983).

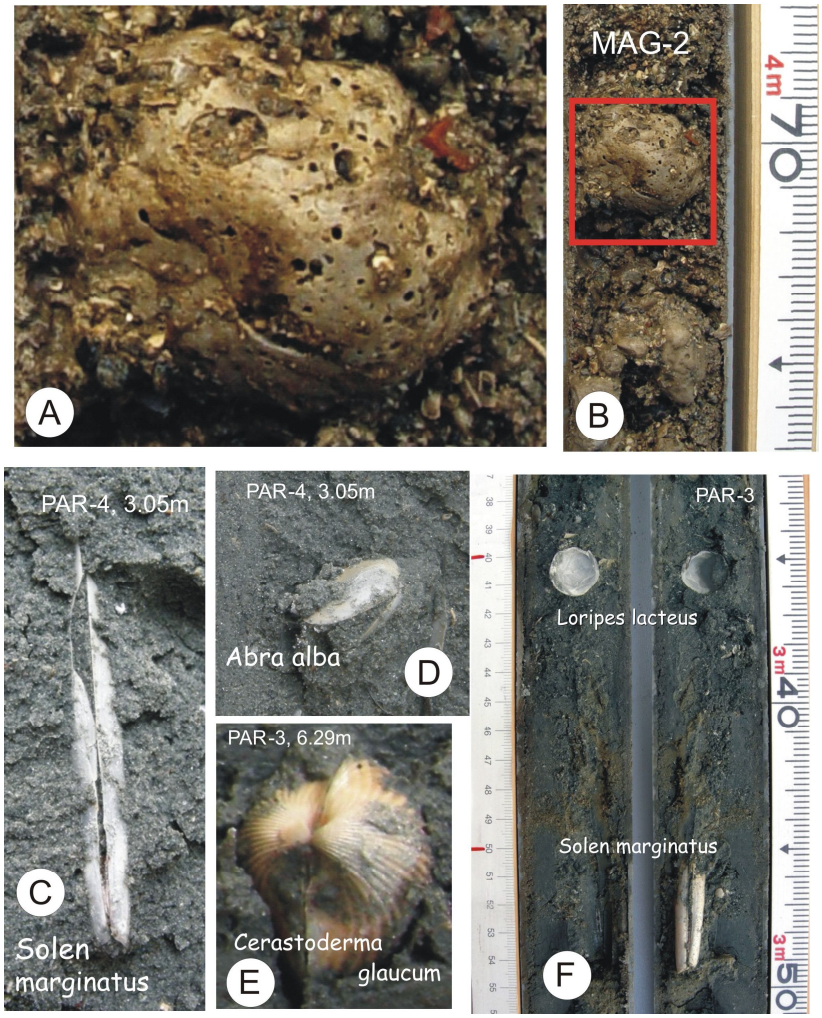


Fig. 4: A&B) Beach gravel, limestone pebble with clionid boring, from MAG 2, 4.70m depth. C to F) Articulated bivalves ("*in situ*"), in living position.

4. SYNTHESIS

Elaboration of the stratigraphic data with the mollusc fauna allows the distribution of the penetrated strata into the following informal Stratigraphic Units - Depositional Facies:

- Anthropogenic Facies. Archaeological sediments of the prehistoric settlement. Brownish sandy – loamy sediments containing rocks, human litter, pottery shards. Thickness more than 8m. Appear only on the settlement, the upper part interfingers with the Brown Loam eastwards, while the lower part is marginal to Grey-blackish Loam and Beach Bed (MAG 2) (Fig. 5).
- Sands & Gravels - Alluvial Facies. Alternating beds of sands and gravels of fluviotorrent origin. Appears south of the settlement, and is more than 4.5m thick (T2) at the western part of the studied area (Fig. 5) diminishing gradually eastwards (PAR5). This indicates feeding of alluvial material from west.
- Brown Loam – Temporal marshy Facies. Beds (~ 2m thick) of mainly fine bedded brown loam but locally massive and mixed

with sand and scattered small gravel. In many places reveal multicolour spots and small holes possibly from grassy vegetation. It represents a palaeoenvironment of shallow fresh water temporal marsh with fine grained sedimentation that covered all the low altitude area. Colour of the sediments indicates presence of oxygen.

- Blackish Loam – Marshy Facies. Beds up to 1m thick, consisting of grey to blackish silty- sandy loam. Locally reveals fine bedding (PAR 1, 2, 3) indicative of calm water environment. Presence of *Planorbis planorbis,* a fresh water gastropod, in PAR 5 and MAG 2 indicates the existence of a fresh water sluggish environment. Blackish colour and plant remnants indicate anoxic conditions. This bed edges at the margins of the settlement (MAG 2) as massive and sandy loam containing land snails and pottery shards.
- *Cerastoderma* Bed – Lagoonal Facies. A bed of silty sand that contains numerous fossils of a lagoonal mollusc association (*Cerastoderma glaucum, Abra, Cerithium vulgatum, Bittium reticulatum, Loripes lacteus, Hydrobia*). This bed was located only in borehole PAR 2, and trenches T 3, 4, 5 (Fig. 3, 5). Possibly it reflects a lagoonal environment that established only along this area (the mouth of the bay) since it was not traced yet else where.
- Grey-greenish Beds – shallow marine Facies. The deepest beds traced by boreholes (up to 10m depth). They consist of grey greenish thin bedded silty-clayey sands containing scattered thin shelled molluscs, mainly small *Abra* shells. Locally contain fossiliferous lenses with typical marine mollusc fauna indicating a calm marine environment, possibly a shallow area sheltered from the waves.
- Beach Bed – marine shoreline Facies Coarse clastic sediments consisting of well rounded pebbles and sand. They contain worn and rounded fragments of marine shells, as well as pebbles with clionid borings. They represent the clastic sediments from marine palaeoshore. Sediments of this facies are found in the lower parts of PAR 1 and MAG 2 (Fig. 5) indicating the location of the marine palaeoshore. Some scattered lenses of similar fossiliferous coarse grained sediments found in different depths (PAR 3, 4, 5) indicate diachronic existence of proximal palaeoshores

Deployment of the above described sedimentary facies into the subsurface of the area and their relative positions is presented into Figure 5.

5. CONCLUSIONS

Holocene stratigraphy and the relevant sedimentary facies were reconstructed for Agia Paraskevi area after determination of mollusc faunas.

Natural sediments of Fluvial, Marshy, and Marine Palaeoenvironments were deposited diachronically and frame the Antropogenic sediments of a prehistoric settlement.

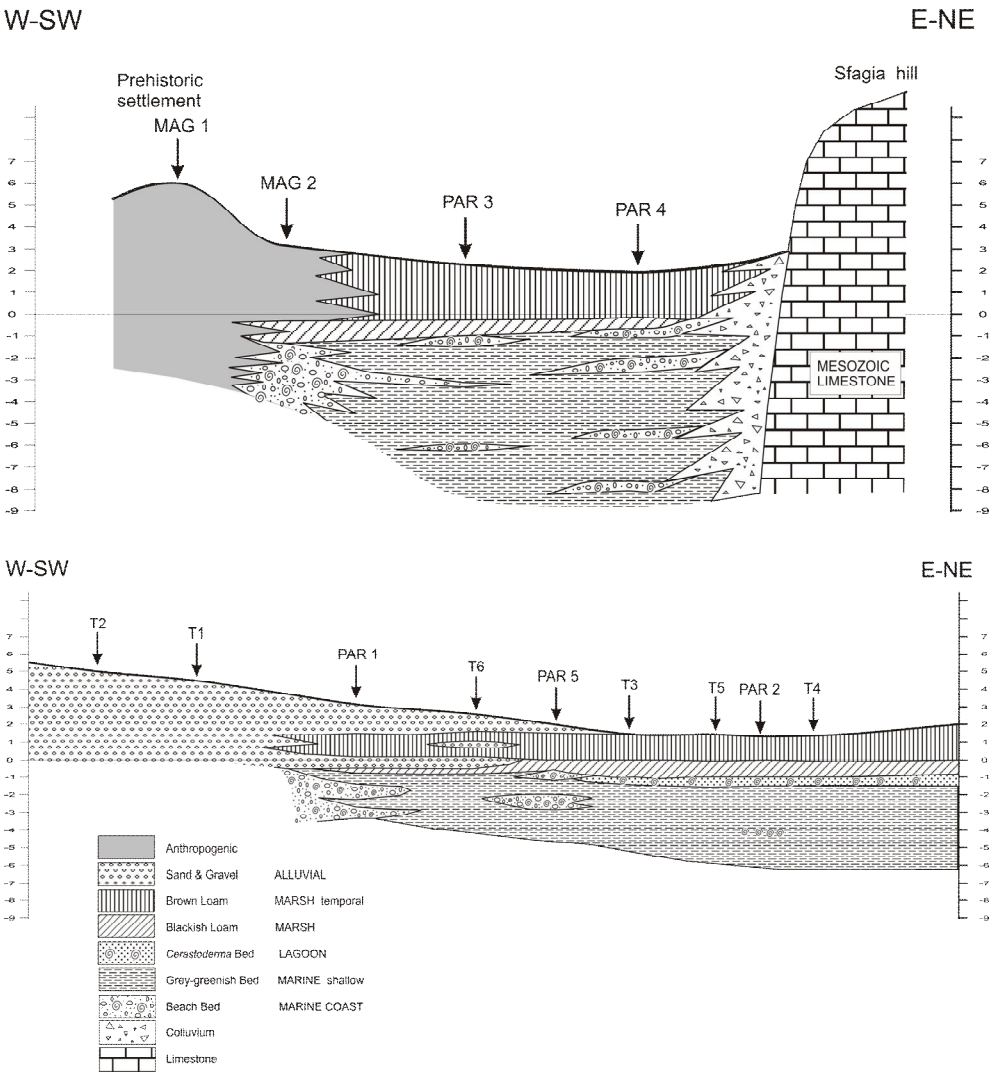


Fig. 5: Distribution of the sedimentary facies into the profiles

Existence of marine palaeoshore sediments was confirmed into the former marine bay along the north side of prehistoric settlement, the south-west side of the Sfagia hill as well as outside the bay along the south margins of the settlement. In the same time a shallow marine environment with fossiliferous bedded silty sands (Grey-greenish Bed) domain the area inside and outside the bay. The end of the marine environment is signalled by a sandy bed with numerous *Cerastoderma, Abra, Hydrobia,* shells (*Cerastoderma* Bed), reflecting a lagoonal environment. This bed is traced along the "mouth" of the bay and possibly represents a lagoon that formed here after the extensive alluviation and silting up of the area. Above the marine and lagoonal sediments a marshy environment was created. At the base Blackish loam with few *Planorbis* indicates fresh water marsh with organic matter, while upwards is transformed into a temporal marsh (brown loam). Presence of alluvial sands & gravels at the SW side of studied area indi-

cates an Alluvial Facies that influences laterally the area from west.

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