RESPONSE OF BENTHIC FORAMINIFERAL ASSEMBLAGES TO THE EARLY LATE MIOCENE TECTONO-SEDIMENTARY EVOLUTION OF THE PRE-APULIAN ZONE, LEVKAS ISLAND, IONIAN SEA

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INTRODUCTION

Levkas island belongs to the Ionian Islands which are located in the west segment of the Hellenic Arc, the most active plate margin of the Mediterranean region. The tectonic setting of the wider area is determined by the continental collision between northwestern Greece in the east and the Apulian platform in the west.

The island is built up mainly by Alpine Mesozoic-Cenozoic sedimentary rocks belonging to the external units of Hellenides, the Pre-Apulian (Paxos) zone and the Ionian zone (Bornovas 1964, Fig. 1). Early Tortonian is considered very crucial for Levkas island as it marks the transition from carbonate to clastic sedimentation in western Greece and a phase of compression which affected the external Ionian zone and the pre-Apulian zone .This shortening is related to the overriding of the pre-Apulian zone by the Ionian zone.

The purpose of this study is to reconstruct the paleoenvironmental setting of the early Tortonian pre-Apulian zone using quantitative benthic foraminiferal data which provide direct indications on water depth, oxygenation and trophic conditions.

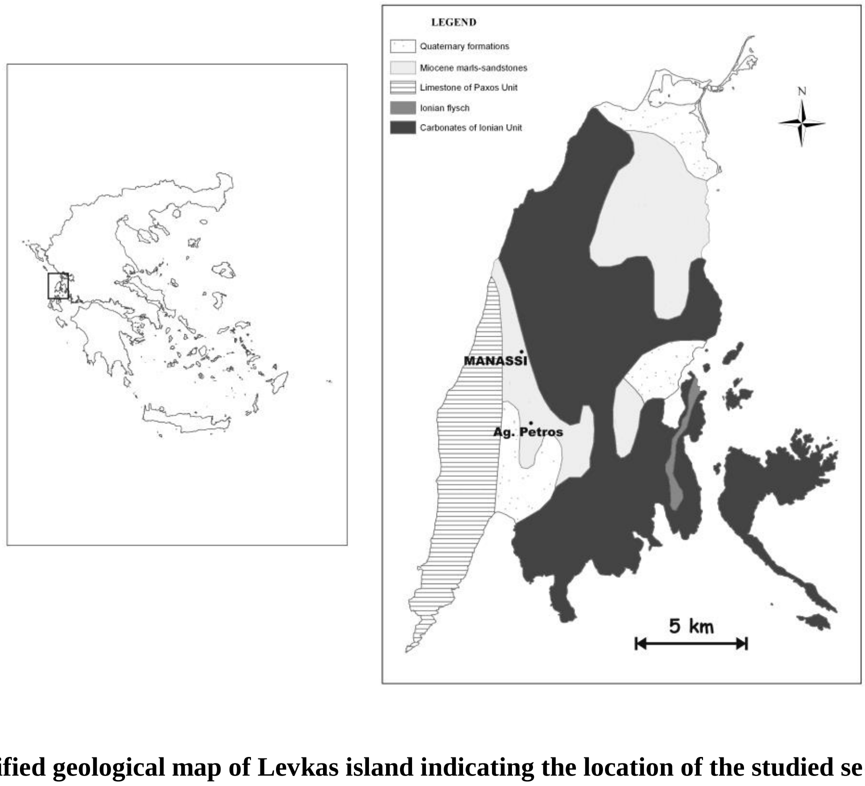

Fig. 1. Simplified geological map of Levkas island indicating the location of the studied section

THE STUDY AREA

The Manassi section belongs to the Pre-Apulian (Paxos) zone, the most external domain of the Hellenic realm. Its Early Tortonian (*Paragloborotalia siakensis* planktonic foraminiferal zone, 11.54-

11.2 Ma) contains a rich foraminiferal fauna dominated, in numbers of individuals, by planktic species. Its benthic foraminiferal assemblage is characterized by a high number of taxa with low numbers of individuals.

According to Drinia et al. (2007), the succession represents deposition in upper to lower bathyal depths during a period of intense tectonic activity. The micropaleontological and paleobathymetrical analyses of the studied sediments indicate that these correspond to distal atypical flysch deposited in the foredeep depozone of the most external domain (Pre-Apulian zone) of the Hellenide foreland basin.

The studied succession consists of blue grey marls and clays with some fine grained sandstone interbeds (Fig. 2). The intercalations of these thin, clastic beds and especially of positively graded sandstones in the studied succession reflect the influence of density currents, which supplied coarser material from a distant hinterland (de Mulder, 1975).

MANASSI SECTION

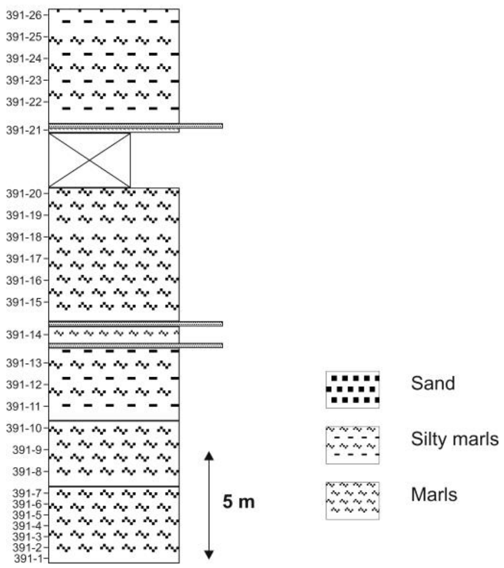

Fig. 2. Lithostratigraphical column of the studied section.

METHODOLOGY

The 25 m thick section was measured and sampled at 0.5 to 1 m intervals. For the faunal analysis 26 samples were taken. Counts of benthic foraminiferal species were made on splits from the 125 μm fraction. Between 200 and 300 specimens of benthic foraminifera were picked per sample, mounted on Chapman slides, identified and counted. The results of quantitative analysis were processed using a statistical program (SPSS13.0) in order to perform the hierarchical clustering (Q-mode Cluster Analysis-CA) and the Principal Component Analysis. In order to simplify the matrix, some species with homogeneous environmental significance were grouped on the basis of their taxonomy, so that only species or groups more abundant than 2% in at least one sample were considered for statistical analysis.

RESULTS

Of the 26 samples, only one was barren of benthic foraminifera and could not be used in the present study. The most abundant species recovered from the section were *Siphonina reticulata, Cibicidoides kullenbergi, Melonis barleeanum, C. italicus.* These taxa abundantly and persistently occur throughout the section along with *Globocassidulina subglobosa, Gyroidinoides neosoldanii* and *Uvigerina semiornata rutila.* In the upper part of the record, allochthonous taxa include any shallow water taxa that occur alongside abundant, and clearly autochthonous deeper water taxa. In these cases it can be clearly inferred that the shallow water taxa have dislodged downslope into deeper waters, through transport or turbidity activity (Fig. 3).

Two main clusters were distinguished by the Q-mode CA. On the basis of the paleoecological information provided by the taxa present in the clusters, clusters Cluster A represents a mixed fauna composed of allochthonous taxa (*Elphidium* spp., *A. planorbis*) alongside abundant and clearly autochthonous deeper water taxa (*Cibicidoides* spp., *Melonis* sp.*).* This fauna may represent the bedload transport of (turbidity) currents, sweeping material off the shelf into bathyal depths. Therefore, this specific assemblage, dominated by almost epibenthic species, is discussed as a possible current indicator. Cluster B, composed of deep-water species, shows the highest frequencies in the Manassi section.

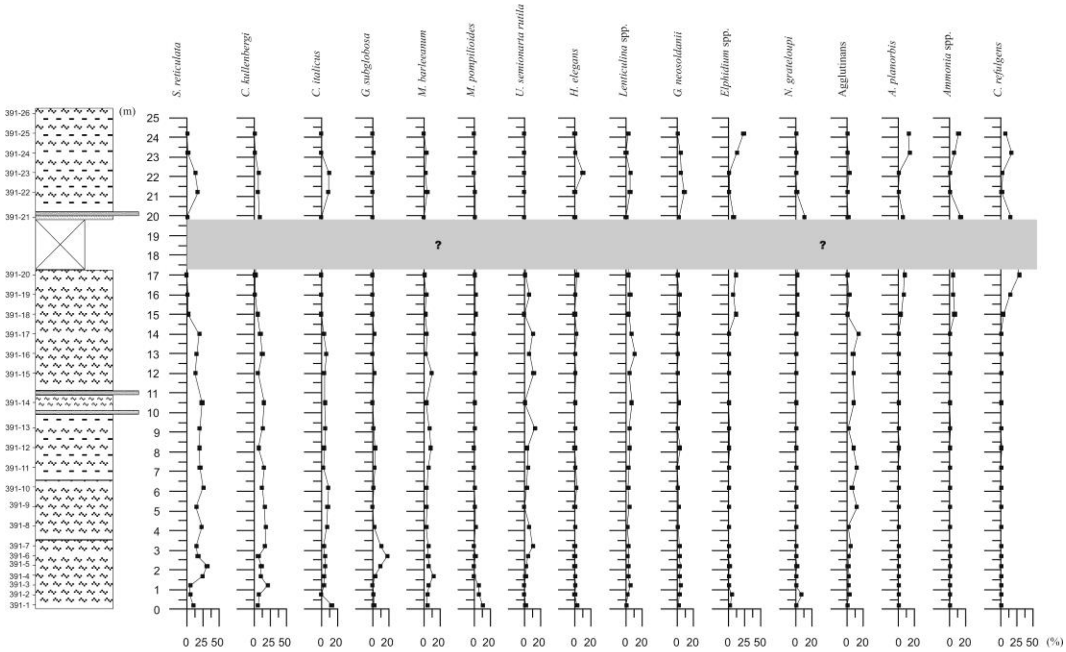

Fig. 3. Distributional pattern of the most significant benthic foraminifera species identified in the studied section.

A standardised PCA was performed on the same data set. The first factor explains 24.84% of the variance. The other factors are not considered because they are too low.

Factor 1 (Fig. 4) is loaded positively by *A. planorbis-Elphidium* spp. assemblage and negatively by *Cibicidoides* assemblage. As a result the first factor is loaded positively by shallow water taxa and negatively by taxa typical of deep water environments.

DISCUSSION

Benthic foraminiferal assemblages in Manassi sediments are characterized by a *Cibicidoides* assemblage with the accessory species *G. subglobosa* which is related to the intensification of bottom currents and a *Asterigerinata planorbis* assemblage which is interpreted to be reworked form shallower adjacent areas.

Benthic foraminifera distribution indicates that sedimentation was primarily in situ, with periods of increased downslope transport of shallow-water material. This is further supported by Factor 1 which is characterized by high abundances of transported, shallow water taxa (dominated by *Asterigerinata planorbis* and *Elphidium* spp.). The faunal distribution that characterize this factor show that low numbers of shallow-water specimens were transported and deposited at Manassi section, punctuated by periods of increased downslope transport.

The varied faunal pattern responses mentioned before are not random, but provide the key to unlocking the broader question as to whether the depositional patterns within the Pre-Apulian zone were driven by tectonic or climatic (eustatic) change.

Part of the signal may result from a climatic effect. Tectonic readjustments, as well as changes in the geometry of the basin might have induced changes in the water masses circulation pattern. It remains difficult however to adduce evidence whether the benthic foraminiferal faunal pattern corresponds to climatic signal or is an independent response to local tectonics and paleoceanography.

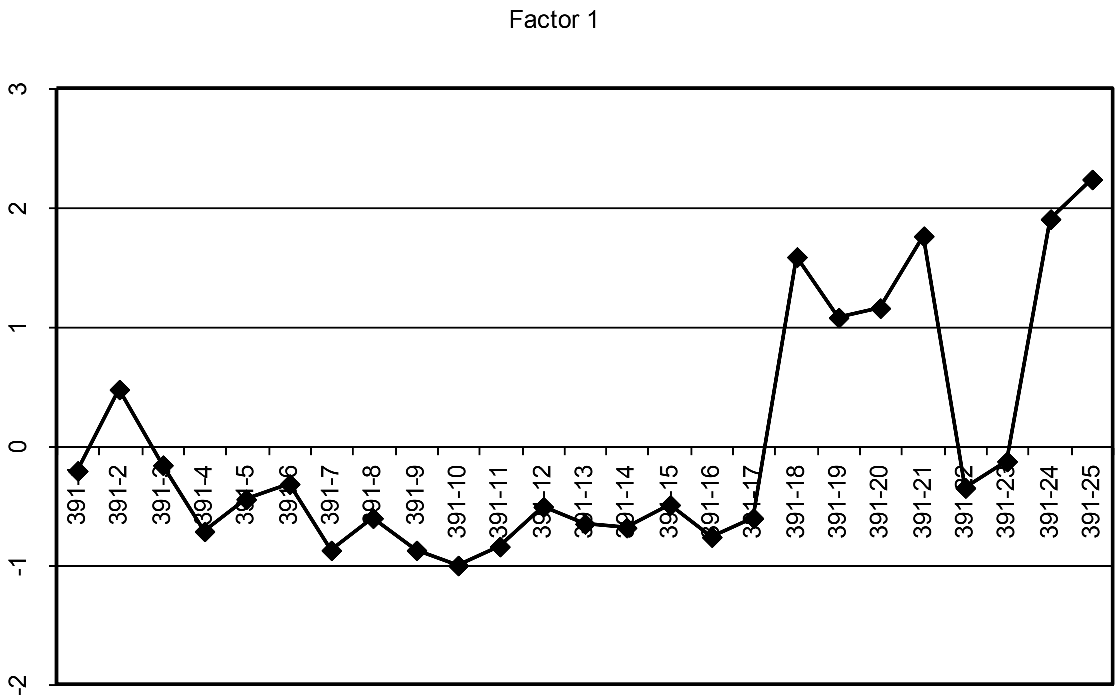

Fig. 4. Factor scores extracted from the PCA analysis.

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