FORAMINIFERAL RECORD OF ENVIRONMENTAL CHANGES: PRE-EVAPORITIC DIATOMACEOUS SEDIMENTS FROM GAVDOS ISLAND, SOUTHERN GREECE.

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ABSTRACT

It is well documented that during the Messinian at ca. 6.7-6.8 Ma a wide shift in lithologies in Mediterranean took place. In western Mediterranean basin this time marks the onset of sapropel deposition (Sierro et al., 2001), whereas at the same time in the eastern Mediterranean sapropels became siliceous and were replaced by diatomites (Hilgen & Krijgsman, 1999).

These changes could presumably be related to changes in basin-wide circulation patterns. The Messinian pre-evaporitic sedimentary cycles in Eastern Mediterranean are mainly tripartite and are composed of a sapropel at the base, followed by a prominent diatomite and a homogeneous layer on top (Hilgen & Krijgsman, 1999)

The purpose of this study is to reconstruct the environmental changes leading to the MSC during the transition from the Tortonian open marine conditions to the Messinian evaporitic environments, in the Eastern Mediterranean basin. The succession of paleoenvironments and foraminifera assemblages is analyzed from the time period before the Messinian evaporitic deposition in Gavdos Island, Metochia section.

The objectives of this study are to quantitatively examine the benthic foraminiferal response to changing bottom-water conditions, to study foraminiferal biofacies and biofacies shifts related to environmental changes and to determine which combination of environmental factors are the main influences on the distributional patterns of benthic and planktonic foraminiferal species.

The paleoenvironmental interpretations are based on the knowledge of the ecological affinities of the still-extant species (strategies of life-infaunal, epifaunal, epiphytic, oxic, dysoxic, anoxic, bathymetrical distribution, temperature, salinity) and on the ecomorphological characteristics associated with the morphogroups analyses.

The studied sequence comprises the uppermost part of the Metochia section of Gavdos island and is dominated by finely laminated diatomaceous sediments which are cyclically alternating with marls and white limestone beds. The abrupt transition from diatomites to carbonates occurs at the same time as evaporite deposition was initiated in western Mediterranean (Krijgsman et al., 1999). The well-developed cyclicity observed on the diatomaceous deposits is similar to that of the pre-Messinian marl sediments. Climatic oscillations due to the precession-driven insolation variations are the origin of these cycles (Hilgen & Krijgsman, 1999).

In order to gain a detailed reconstruction of paleoenvironmental trends and events preceding the Messinian Salinity Crisis, we carried out quantitative and statistical analysis on benthic and planktonic foraminifera assemblages. We selected 45 samples, which were processed with standard techniques, and about 300-500 foraminifera specimens were picked from one split per fraction from each sample, identified and counted.

Measures obtained from the database included abundance of species and species groups and percentage abundance were plotted.

Taxa at the species or genus level that amounted to <2% averaged across the data set were removed from the data matrix so that statistical analyses of the data were based on the common and abundant taxa. We measured P/B ratios, which can be regarded variously as a measure of depth of deposition, a paleoproductivity index or as index or as a measure of preferential loss of planktonics by dissolution.

Various diversity indices were estimated. Species diversity can be viewed as a gross measure the effect of environmental stresses on benthic foraminiferal communities. Richness of species

were measured by applying the a index of Fisher et al. (1943), which shows the relationship between the number of species and the number of individuals in an assemblage. The index of heterogeneity H(S) is calculated using the Shannon-Weaver formulation. In order to evaluate the preferred microhabitat, species of total assemblages were divided in two groups –infauna and epifauna- (Jorissen et al., 1992; Murray, 1991; Barmawidjaja et al., 1992) that are used as indicators of paleoproduvctivity and upwelling.

Planktonic foraminifera distribution patterns were also plotted as the warm-oligotrophic/cold eutrophic ratios in order to estimate paleoproductivity and climatic changes.

The most important benthic constituents are biconvex *Cibicides, Bulimina, Bolivina* and *Oridorsallis umbonatus*, which represent a typical deep-sea mud dwelling assemblage.

The benthic assemblage has been divided into two major ecological categories, infauna and epifauna, based on habitat preferences known for their recent representatives. A calculation of their relative abundances shows the infaunal component dominating the benthic community. Among the infauna, species of *Bolivina* and *Bulimina* are the most common. Representatives of these infaunal species are indicating adaptation to high organic carbon and low oxygen of the deep infaunal microhabitat.

It is well documented that infaunal foraminifera prefer nutrient-rich, low oxygen, muddy environments and their high abundances usually signal eutrophication in the water column. These conditions are more typical of colder or deeper waters. Other mechanisms, which may produce a similar effect, include large-scale runoff that produces a brackish water lid and ultimately a high nutrient level.

The quantified profile of the spinose *Globigerina bulloides* is indicative of upwelling signal especially in the upper part of the section where it is more abundant. This species occurs predominantly in subpolar waters and in upwelling areas, and in the Mediterranean Sea, it is particularly abundant during winter under conditions of high fertility.

Therefore, the increase in Bolivinidae -Buliminidae abundances in the upper part of the section together with the peak occurrences of the *G. bulloides* may that small upwelling cell affected the biotic assemblages in this part of the section.

Our results suggest that two environmental parameters are the most important factors that control the community structure of the benthic foraminiferal fauna: the food availability and oxygen concentration. In addition, local upwelling phenomena evidenced by signals from the benthic foraminifera and the distribution pattern of the planktonic *G. bulloides* may have played a role in the faunal density and composition.

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