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Late Miocene benthic Foraminifera adaptation to changing bottom water conditions: a case friom Gavdos island, Eastern Mediterranean

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Two sections (Ah-Giannis and Bo sections) from the Early Tortonian of Gavdos Island, Greece, have been investigated with respect to foraminiferal assemblages. The main objective was to analyze qualitatively and quantitatively and to interpret paleoecologically the benthic foraminiferal fauna of these sections in order to increase our knowledge of how benthic foraminiferal assemblages develop under fluctuating bottom water oxygen.

The concept, which has been adopted, is that species fitness is primarily affected by changes in nutrient abundance (Altenbach, 1988; Altenbach & Sarnthein, 1989; Herguera & Berger, 1991). Foraminiferal abundance and biomass are closely related to food availability. Foraminifera flourish where food is plentiful, but in order to gain access to food they must endure the oxygen depletion that often accompanies an abundance of organic matter. Oxygen concentrations in the sediment pore water become a limiting ecological factor in these environments and foraminiferal assemblages are composed largely of low-oxygen tolerant species (Sen Gupta & Machain-Castillo, 1993). Since the ability of foraminifera to withstand oxygen deficiency varies among major taxa and species (e.g. Bernhard et al., 1997), reduced oxygen concentrations will influence both the taxonomic composition and species diversity of foraminiferal assemblages by eliminating the less tolerant species, generally those which exhibit epifaunal adaptations (de Stigter, 1996).

The occupation of different microhabitats is governed by a more local interplay of nutrient availability, oxygen supply and seasonality. Benthic foraminifera represent one of the most sensitive indicators of dissolved oxygen levels and can therefore be used to interpret ancient sediments. Criteria to estimate oxygenation are based on foraminiferal morphology, test size, wall thickness or indicative taxa. Therefore, according to these criteria the determined benthic foraminifera have been grouped into three catergories: oxic indicators, suboxic indicators and dysoxic indicators. The Benthic Foraminiferal Oxygen Index (BFOI) of Kaiho (1991; 1994) based on foraminiferal characteristics reflects aspects of these processes. The two sections are characterized by high percentage values of the representatives of the Dysoxic and Suboxic group. Oxic indicators are of minor importance. Microfaunas adapted to these low-oxygen conditions indicate temporal sluggish bottom-water circulation, which can be associated with high fresh water fluxes.

The two sections represent a shallowing upward sequence from outer shelf blue-gray clays at the bottom of the sequence, deposited below the storm wave base, to shallow inner shelf deposits affected by storm waves at the top.

The foraminiferal assemblage at the bottom of the sequence is dominated by Bolivinidae/Buliminidae and Uvigerinidae, a microfossil assemblage corresponding to the deepest deposits formed under dysoxic sea-floor conditions. Foraminiferal assemblages of the middle part of the section are highly diversified whereas the top of the section is mainly characterized by *A. planorbis, C. lobatulus, A. beccarii* and *Elphidium* sp., a typically epiphytic foraminiferal assemblage which can be correlated with the presence of an algal covered sea-bottom.

Within this general environmental trend, minor shallowing cycles can be differentiated. The boundaries of these cycles can be inferred, based on a substantial microfossil assemblage

change and on the coincidence of species diversity maximum and a planktonic/benthic (P/P+B) ratio peak. Nonetheless, upwelling currents and/or over-abundance of nutrients due to continental outflow could also contribute to increased diversity and P/P+B ratio.

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