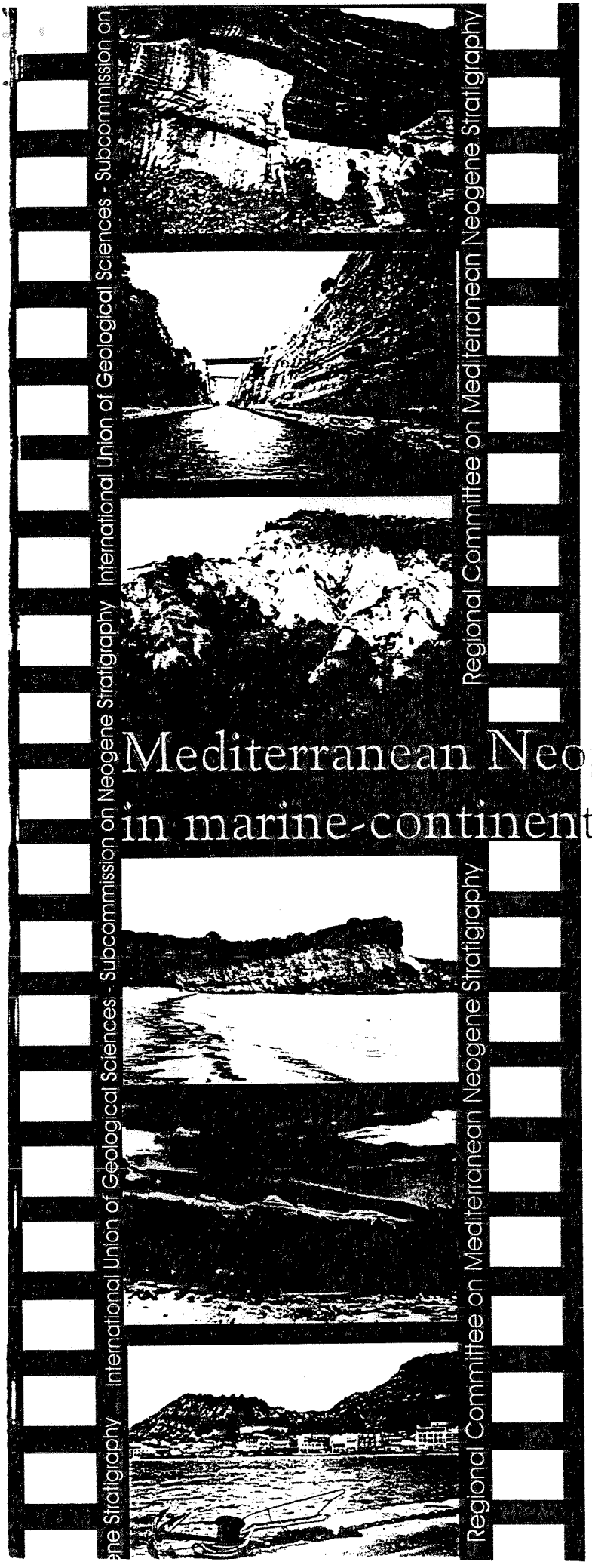

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Study of the Late Miocene fauna of Faneromeni section, eastern Crete. Biostratigraphical implications and cyclostratigraphic patterns

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Abstract. Planktonic foraminifera and mollusc associations have been studied in order to define the biostratigraphical and chronostratigraphical position of a cyclic sequence of marly Neogene sediments in Faneromeni (eastern Crete), extended the previous studied section of Krijgsman et al. (1994).

The integrated analysis indicates for these sediments a Late Miocene age. The section displays cyclic alternations of homogeneous marly beds and sapropels and can be correlated on the basis of their cyclic patterns with the other already studied section.

Key-Words: Miocene, Cyclicity, Planktonic foraminifera, Molluscs.

Introduction

The studied section is located along the coast of Faneromeni Gulf, which is found west of the city of Sitia (Fig. 1).

Gradstein (1973) gives the general lithostratigraphy of Faneromeni Gulf. In addition, Marcopoulou-Diacantoni (1974) has studied the Neogene megafauna of the area. Langereis (1984) worked on the magneto-stratigraphy of the area while Krijgsman et al. (1994) gave the biostratigraphy and cyclo-stratigraphy.

The main objective of this study is to define the biostratigraphic and cyclostrati-graphic correlation of a section found eastwards of Faneromeni section studied by Langereis (1984) and also to correlate plan-ktonic foraminifera, and mollusc biozones on the basis of an integrated analysis.

In this study, we aim in combining the two sections by counting the number of cyclic alternations and the planktonic foraminiferal and mollusc bioevents.

Lithostratigraphy

The studied section has a thickness of about 30m and is excellently exposed (Fig. 2,3). It consists of an undisturbed and complete succession of alternations of homo-geneous marly beds and laminated beige marls and organo-clastic limestones which are composed of algal crusts, mollusc remains, echinids, serpulids, etc.

The lower part (about 15m from the basement) of the section consists of open-marine sediments that show cyclic alterna-tions of beige-coloured carbonate-rich and grey-coloured carbonate-poor marls. These homogeneous grey-beds are indurated containing sponge spicules, bivalves and mollusc remains. The main species prevailed and determined by Marcopoulou-Diacantoni (1974), are cited on Fig. 4.

The upper part of the section is characterized by alternations of the laminated and non - laminated marls and brownish -

coloured beds termed sapropels, which start to occur within, or completely substitute, grey beds.

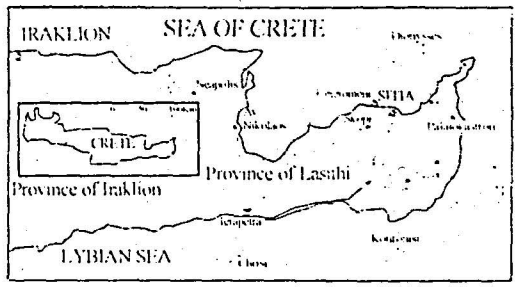

Fig. 1. Location map of Faneromeni Gulf

The transition from open-marine marls to shallow-marine carbonates marks the uppermost part of the studied section, consisting of 4-5m limestones, with Pectinidae, *Schizaster* and *Pericosmus*. The limestones (building stones) can be subdivided in a more marly lower part and a more calcareous, indurated upper part. Quarries are situated at this stratigraphic level, which is the uppermost part of Faneromeni Formation.

Biostratigraphy & Chronostratigraphy

The studied section was sampled in detail, in order to establish its biostratigraphic position and to correlate with other studied sections. We focused our investigation on a qualitative analysis of the planktonic foraminiferal assemblages and of the assemblages of molluses and echinids. We tried to correlate our associations with the planktonic "standard" zones of Blow (1969), and with the biozonal scheme of Dermitzakis & Georgiades-Dikeoulia (1987) as it is presented in Steininger et al. (1987).

The homogeneous marly beds are characterized by the presence of *Clypeaster*, Pectinidae and *Ostrea*. The presence of *Clypeaster partschi, C. campanulatus, C. intermedious, C. portentosus, C. scilla., C. altus, C. insignis, C. lambertis, C. crassus* indicates a Tortonian age and corresponds to the *Gryphaea (Crassostrea) gryphoides crassissima* assemblage zone of Dermitzakis & Georgiades-Dikeoulia (1987). This zone is also found in Achladia section (in Sitia district) (Dermitzakis et al., 1978) and covers the biostratigraphic interval N16. *Neogloboquadrina acostaensis* Zone (Tortonian).

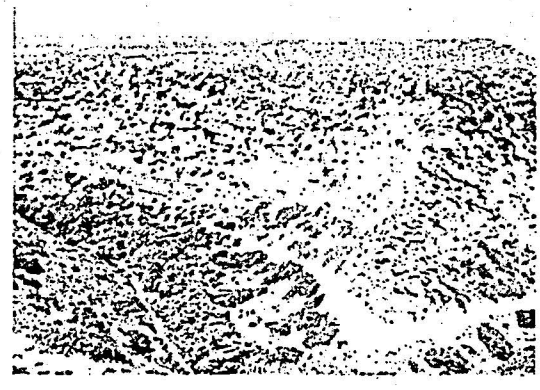

Fig. 2. General view of the studied section

The remaining fauna is not confined to this zone but is characteristic for the middle upper Miocene including *Clypeaster zumoffeni, C. ibericus, C. brevior, C. tauricus, Ostrea cohlear, Echinolampas hemisphaericus, Conolampas oranensis*.

A rich planktonic and benthic foraminiferal fauna characterizes the section. The biostratigraphic planktonic foraminiferal correlation is based on the following bioevents: the occurrence of *Globorotalia menardii* form 5 (Zachariasse, 1975), and the First Occurrence Datum of *Globorotalia conomiozea* (Zachariasse, 1979). The FOD of *G. conomiozea* points to the Tortonian/Messinian boundary (at about 7,24 Ma) (Langereis et al. 1984, Sierro et al. 1993, Krijgsman et al. 1994) and determines the *Globorotalia conomiozea* Zone of Zachariasse (1975) and the N17 zone of Blow (1969) (Fig. 5).

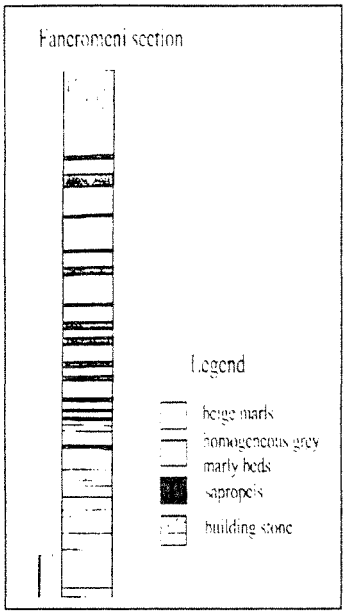

Fig. 3. Lithostratigraphical column of the studied section

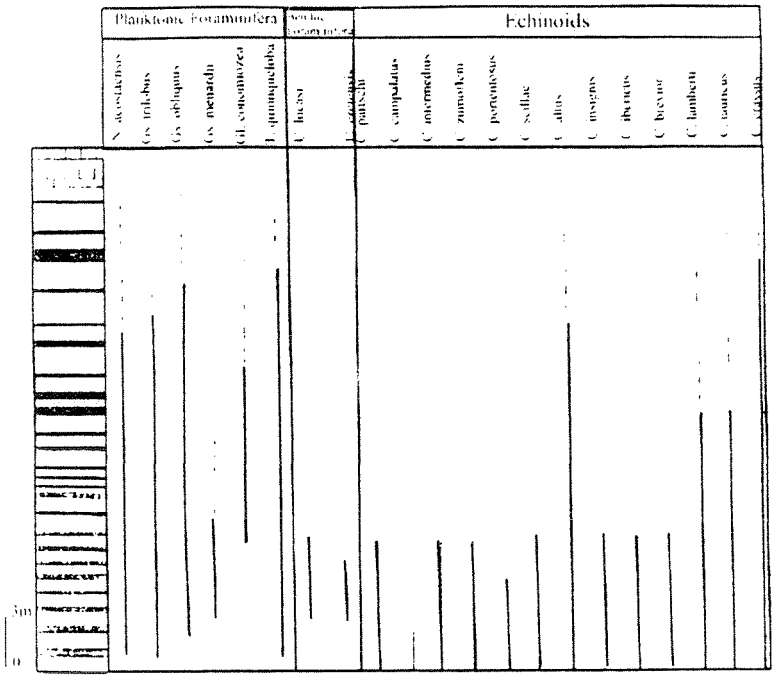

Fig. 4. Distribution of planktonic and benthic foraminifera and echinids

Globorotalia conomiozea belongs to a Late Miocene group of keeled globorotaliids characterized by a sinistral coiling and a reniform chamber outline in spiral view (Zachariasse, 1979). The Late Miocene *G. conomiozea* group lived at the mid- to high latitudes of both hemispheres (Berggren, 1984) and invaded the Mediterranean near the Tortonian/Messinian boundary in response to increased climatic cooling (Zachariasse & Spaak, 1983, Sierro et al., 1993).

The first regular occurrence of *G. conomiozea* is used to define the T/M boundary because this bioevent reflects the most pronounced change in the Late Miocene globorotaliids.

The lower part of the section, which is characterized by the occurrence of *Globorotalia menardii* form 5, contains also *Neogloboquadrina acostaensis*, *Globorotalia scitula*, *Globigerinoides obliquus*, *Turborotalita quinqueloba*, and *Globigerinoides trilobus* typical association for the Tortonian. This result coincides with the previous one made by the study of the megafauna association found in the same stratigraphic level (Fig. 5).

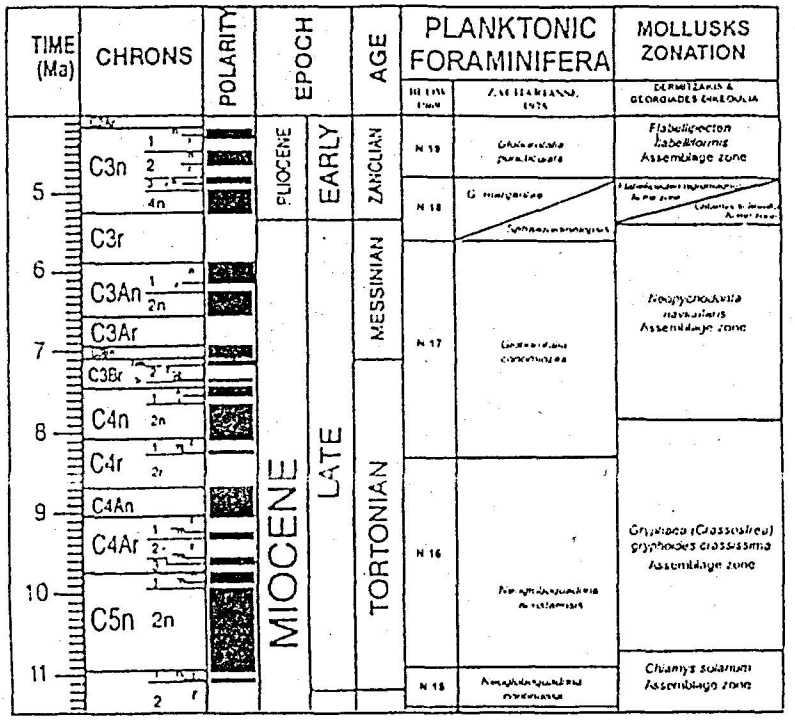

Fig. 5. Correlation chart of planktonic foraminifera zones of Blow (1969) and Zachariasse (1975) with the molluscs zonation of Dermitzakis & Georgiades-Dikeoulia (1987).

Discussion

All over Crete, a transition from sandy littoral deposits to open marine marls is observed in the Tortonian. Generally, the marls are overlain by shallow-marine beige to whitish marls and limestones of Messinian age.

Planktonic foraminiferal biostratigraphy plays an essential role in order to correlate the studied section with the already studied section of Faneromeni Formation.

On the other hand, the sapropels reveal characteristic patterns and allow us to correlate the sections (Fig. 6) (it is very well documented that sapropels in particular display characteristic cyclic patterns). The number of cycles corresponds perfectly to the cycles counted in the already studied section. Although it was difficult to distinguish the sapropel pattern in large or small scale clusters (so the correlation would have been easier even in the field), we identify three small-scale clusters of the already studied section.

The occurrence of *Globorotalia menardii* form 5 and the first regular occurrence of *Globorotalia conomiozea* give the exact chronostratigraphic interval of the section and the correlation to CK95. According to this correlation the studied succession starts in the chron C3Br (7,4 Ma) and ends at C3An (about the 6.6 Ma).

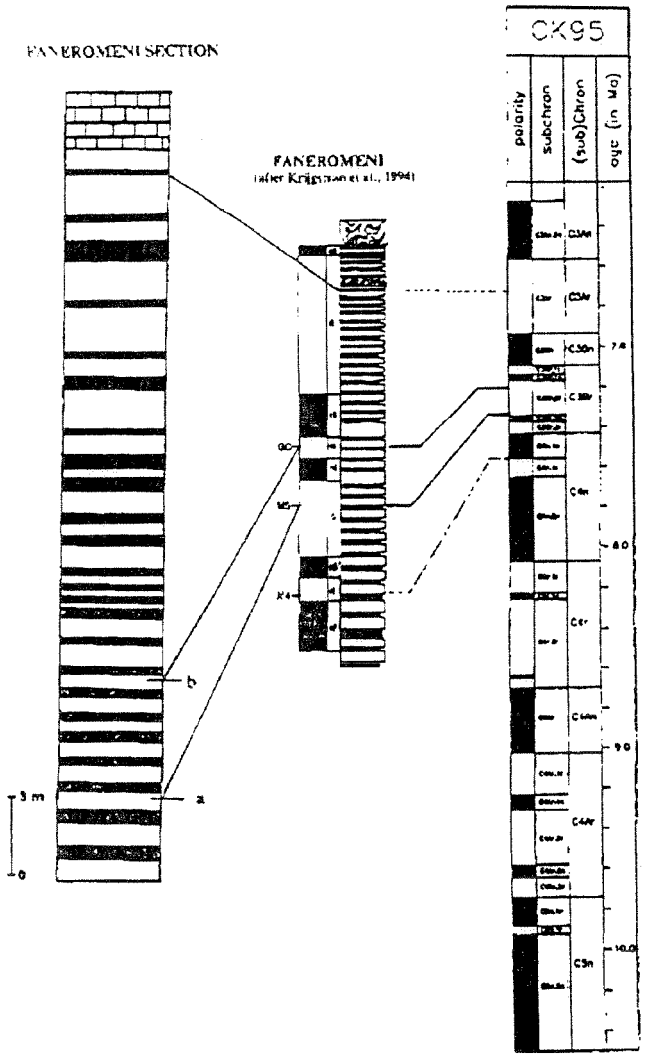

Fig. 6. Stratigraphical correlation of the studied section with the Faneromeni section and the geomagnetic polarity time scale of Cande & Kent (1995). Cyclostratigraphic correlations are based on sedimentary cycle pattern and biostratigraphic data.
M5, a: FOD of *Globorotalia menardii* 5, **GC, b**: FOD of *Globorotalia conomiozea*, **M4**: LOD of *Globorotalia menardii* form 4.

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