PLIOCENE SAPROPELS FROM THE EASTERN MEDITERRANEAN BASIN (LEG 160, HOLES 969E, 967C AND 966D) : IMPLICATIONS OF SEDIMENTOLOGICAL DATA

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Abstract

Pliocene sapropels located just below the last common occurrence (LCO) of *Discoaster tamalis* can be correlated across the Eastern Mediterranean Basin, from Sicily to Cyprus. The deposition of these sapropels is mainly related to climatic control but sedimentation patterns show that local factors such as bathymetry and post-depositional processes may play an important role. Total organic values (TOC) can be very high. Organic matter (OM) is mainly amorphous and corresponds to high marine productivity, at least pro-parte from marine planktonic diatoms that are preserved within some sapropels.

Key-words : Mineralogy, Organic matter, Diatoms

Introduction

Middle Pliocene sediments from Sicily and Calabria (Italy) show periodical variations of the $CaCO_3$ content classically related to climatic control [1, 2, 3]. Sediments of the same age were recovered in the Eastern Mediterranean, during ODP-Leg 160, with numerous organic-rich layers (sapropels). We analysed a bundle of sapropels, along a transect from the South of Crete to the South of Cyprus in order to investigate the relative influence of the climate and of local factors such as bathymetry, post-depositional processes, etc. Hole 969E is located South of Crete, on the Mediterranean ridge (2201 m water depth), whereas the two other holes are located in the Eratosthenes Seamount (ESM) region : one toward the northern edge of the ESM plateau (Hole 966D, 926 m water depth), the other (Hole 967C, 2553 m water depth) on the lower northern slope of the northern flank of the ESM (fig.1).

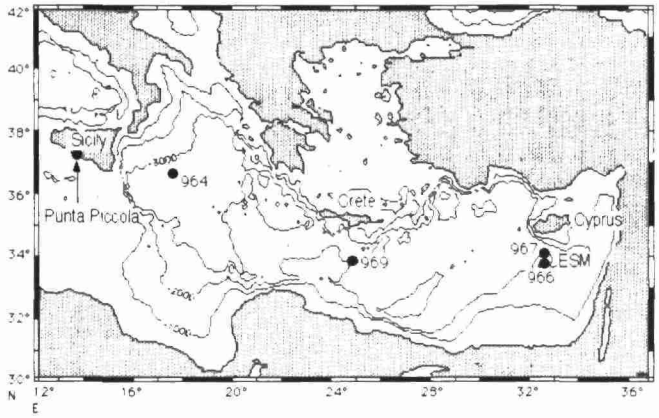

Fig. 1 - Location map.

Methods

The studied cycles were selected from preliminary biostratigraphic data acquired on board the Joides Resolution [4, 5, 6]. The stratigraphic correlations were refined by comparing the holes series with the classical succession of Punta Piccola (Sicily), using the abundance curves of *Discoaster tamalis* [7, 8, 9]. Mineralogical (carbonatometry, X-Ray diffraction, smear-slides, SEM & TEM) and geochemical studies (Rock-Eval pyrolysis) were also performed.

Results

Correlations, using *D. tamalis* curves and other sedimentological data, show that the sapropels studied correspond to the basis of Hilgen cycles numbered 102 to 110 in the Punta Piccola section of Sicily ([2] & fig. 2). Previous studies of the Sicily sections [1, 2, 3] showed that cycles 102 to 108 are controlled by earth-precession (# 22-kyr periodicity), whereas cycles 109 to 111 are influenced by obliquity (# 41-kyr periodicity) ([1] & Tab. 1). In the Ionian Basin (Hole 964A) and on the Mediterranean Ridge (Hole 969E), the control is similar (fig. 2). But, further east, in the ESM region, two sapropels are present in the inferred obliquity-controlled cycles 109 and 110, showing the influence of the precessional signal from Hilgen cycle 102 to 110.

Calcium carbonate, mainly corresponding to the calcareous nannoplankton, represents the most important mineralogical phase of the series. South of Crete (Hole 969E) carbonate values show large cyclic variations (fig. 3) as in the Ionian Basin (Hole 964A) [9]: they vary between 0 and 20 % in the sapropels and around 60 % elsewhere. In the ESM region, carbonate cycles are less differentiated, well developed in cycles 106 to 108 of Hole 967C, but absent or poorly marked in Hole 966D (located on top the ESM) where sapropels contain less organic-matter (OM) and are more bioturbated : bioturbation is inferred to disturb the OM and carbonate signals.

Table 1 : Time estimation of studied sapropels (from [1]); age refers to the mid-points of the sapropels.

Hilgen cycle number	Sapropel age (Ma)	time (Ka) between 2 sapropels
111	2.828	36
110	2.871	43
109	2.900	29
108	2.921	21
107	2.943	22
106	2.965	22
105	2.989	24

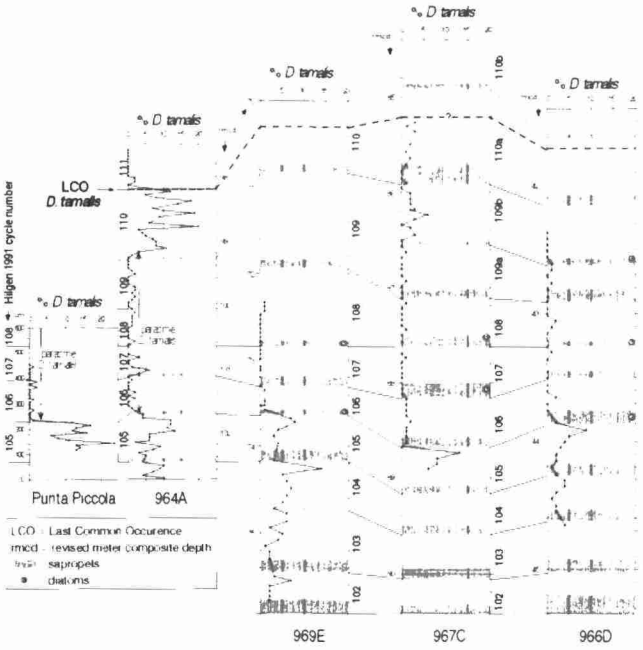

Fig. 2 - Correlation between cycles across the eastern Mediterranean, from Punta Piccola (Sicily) and Hole 964A [9] to Holes 969E, 967C, and 966D, using the fluctuation abundance curves of *D. tamalis*.

Total Organic Carbon values (TOC), in the studied sapropels can be very high (fig. 3), especially in the deep-water settings : up to 30 % in Hole 969E, 12 % in Hole 967C and 5 % in Hole 966D. The Hydrogen Index values (HI) and the HI/Tmax diagram (fig. 4) indicate a partial oxidation of the primary marine (type II) OM and/or an admixture with OM of terrigenous provenance. A general trend of co-variation between HI and TOC (fig. 5), and biomarkers data [10] show the importance of