Identification and correlation of stagnation layers in cores from the Eastern Mediterranean Sea

by

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Abstract

Stagnation layers are an important tool for the stratigraphy of Eastern Mediterranean deep-sea sediments. They occur often as prominent black sapropelic layers. However, locally they are only discernable by slight gray colours.

Closely spaced organic carbon analysis of sapropelic parts of stagnation layers from Ionian deep-sea showed that each of the different layers within one core exhibits a specific internal distribution of organic carbon. However, identical layers within other cores show the same distribution in a given layer. With the help of these characteristic distribution curves sapropelic layers of previously unknown stratigraphic position can be identified and correlated. In addition, sedimentation gaps and other changes in the sedimentation can be detected.

Résumé

Des couches de stagnation sont un instrument important de la stratigraphie des sédiments de la Méditerranée orientale. Elles se manifestent souvent sous forme de couches sapropéliques noires proéminentes. Par endroits, elles ne sont discernables que par leur couleur grisonnante.

L'échantillonage serré des parties sapropéliques des couches de stagnation provenant de carottes de la mer Ionienne en vue d'analyser leur teneur en carbone organique montrait que chacune des différentes couches d'une carotte fait apparaître une distribution interne spécifique de carbone organique. Cependant, des couches identiques dans d'autres carottes montrent la même distribution dans une couche donnée. A l'aide de ces courbes caractéristiques de distribution, des couches sapropéliques d'une position inconnue auparavant peuvent être identifiées et mises en corrélation. De plus, des omissions de sédimentation et d'autres différences dans la sédimentation sont détectables.

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Deep-sea cores from the eastern Mediterranean usually contain a sequence of prominent black sapropelic layers. As to their origin, most workers agree that their formation was caused by hydrographic stagnation : density stratification by an increasing influx of less dense surface water due to climatic changes interrupted the thermohaline circulation leading to oxygen depletion in the bottom water [for references see RYAN 1970]. As a result, organic matter accumulated at the sea bottom and reduction of sulfate by anaerobic bacterias took place causing the formation of black Fe-sulfides as Marcasite.

Pinpointing the paleoclimatic significance of the sapropelic muds, they have been widely used for the correlation of eastern Mediterranean deep-sea cores. While the uppermost sapropelic layer deposited at the beginning of the Atlantic period (7000 - 9000 years B.P.) can be dated by C-14 analysis, this method fails in the sapropels deposited earlier. Local differences in sedimentation and exposure to the stagnant water body, sedimentation gaps and different rates of sedimentation have led to some substantial confusion when stratigraphic sequences were compared.

Rapp. Comm. int. Mer Médit., **23**, 4a, pp. 277-279, 2 figs., (1975).

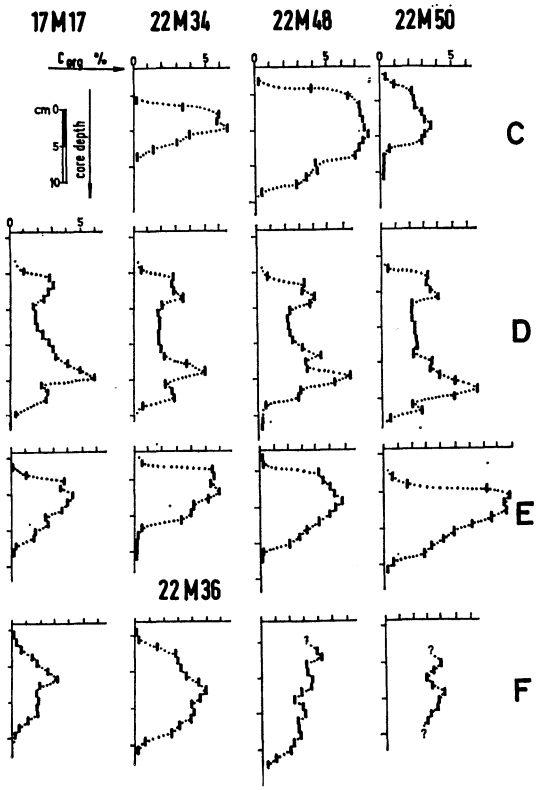
We therefore looked for a criterion to distinguish and identify the different layers within our cores from the Ionian Sea which were taken during the cruises 17 (1969) and 22 (1971) of R.V. *Meteor*.

When analysing the organic carbon content of the sapropelic layers at very close intervals (1.0 cm), we found that each layer within one core has a characteristic (vertical) distribution, but identical layers within other cores show the same distribution in a given layer. Figure 1 shows the internal distribution of organic carbon within the sapropelic layers C, D, E, and F of five cores which were taken in a maximal distance of about 200 km (see situation map on fig. 2). The consistency of the distribution curves in layers of the same age is obvious. It proves that stagnation periods are going off uniformly within a great area.

In figure 2 the stratigraphy and correlation of these so far investigated cores is given. The single sapropelic layer of core 22 M 36 was identified by the similarity of its C_{org}-distribution curve to that of layer F in core 17 M 17 (see fig. 1). The correlation given in fig. 2 is confirmed by the boundary of the nannofossil zones NN 20/21 in the investigated cores which has been fixed by C. MUELLER *(personal communication)*.

The sepropelic layers A (Holocene) and B, being either absent or disturbed in these cores, have been omitted so far from our investigation.

Although, this preliminary study was restricted to Ionian deep-sea cores, we think that an extension of this method to cores of the whole eastern Mediterranean Sea will prove more reliability of the Quaternary stratigraphy in this area.



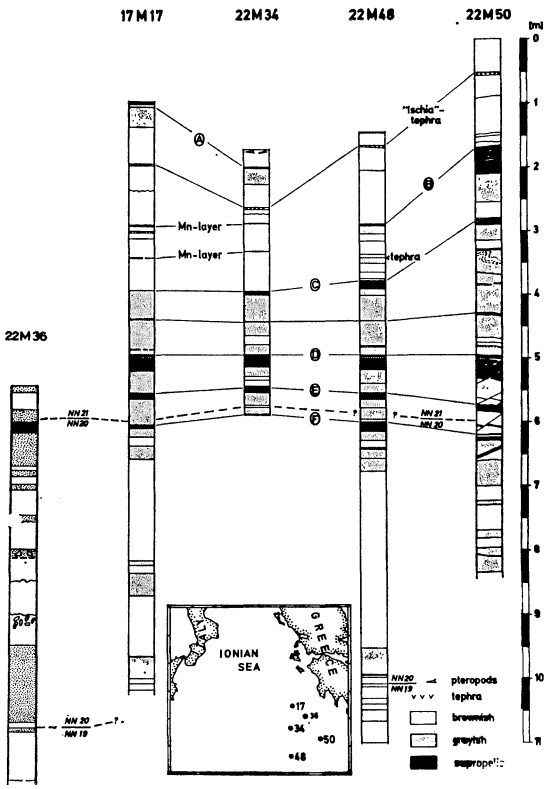


FIG. 1. — Distribution of organic carbon in sapropelic layers (C-F) of five Ionian deep-sea cores. Layers of the same age show comparable distribution curves.

FIG. 2. — Correlation of sapropelic layers (A-F) in five cores from the Ionian Sea. (adapted from HIEKE *et al.* 1973). Position of boundaries of nannofossil zones 19/20[21 after C. MUELLER (*pers. communication*).

References

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HIEKE (W.), SIGL (W.) & FABRICIUS (F.), 1973. — Morphological and structural aspects of the Mediterranean ridge SW off the Peloponnesus (Ionian Sea). — *Bull. Geol. Soc. of Greece*, **10**, 1, pp. 109-126.

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Interventions

R. Sartori. — I would like to know something more about the content of magnesian calcite within the sapropelitic layers.

Réponse — The carbonate fraction of the sapropelitic layers analysed so far consists entirely of calcite with occasional admixtures of dolomite.

G.B. Griggs — If the cores you discussed were collected on the Mediterranean Ridge, how do you explain the stagnation?

Réponse — All our cores from the Mediterranean Ridge in the Ionian Sea which were taken in water depths of more than 2500 m contain a sequence of sapropelitic layers.

As shown by VAN STRAATEN [1972] and MCCOY [1974], the limit between the aerobic and the anaerobic (stagnant) water body during the formation of the postglacial sapropelitic layer was situated in a water depth of about 600 m. Similar conditions can be assumed for the Pleistocene stagnation periods.

H. Closs — Did you make also organic and inorganic geochemistry for the characterisation of the stagnation layers?

Réponse — They are in process.

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Discussion

Closs : Did you make also organic and inorganic geochemistry for the characterization of the stagnation layer?

Answer : They are in process.

Sartori : I would like to know something more about the content of magnesian calcite within the sapropelithyc layers.

Réponse : Very low.

Griggs : If the cores you discussed were collected on the Mediterranean ridge, how do you explain the stagnation?

Réponse : Very deep $\pm$ 3.000 m.