Inorganic geochemistry of organic-rich sediments: paleoceanographic evidence from the eastern mediterranean and Sea of Japan

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Introduction

In the Neogene sedimentological record, organic-rich sediments, termed sapropels when they have greater than 2% by weight organic carbon (Kidd *et al.*, 1978), have been recovered from a number of marginal seas and basins including the Mediterranean and Japan Seas, and have been compared with the black shale facies from the geological record. Detailed research has failed to fully comprehend the significance of these sediments. Clearly they represent abrupt changes in paleoceanography and are essential components for the reconstruction of paleoclimates and considerations of global changes.

Methods

Geochemical evidence from the eastern Mediterranean is based on a 3.6m Kastenlot core recovered from 800m water depth upon the

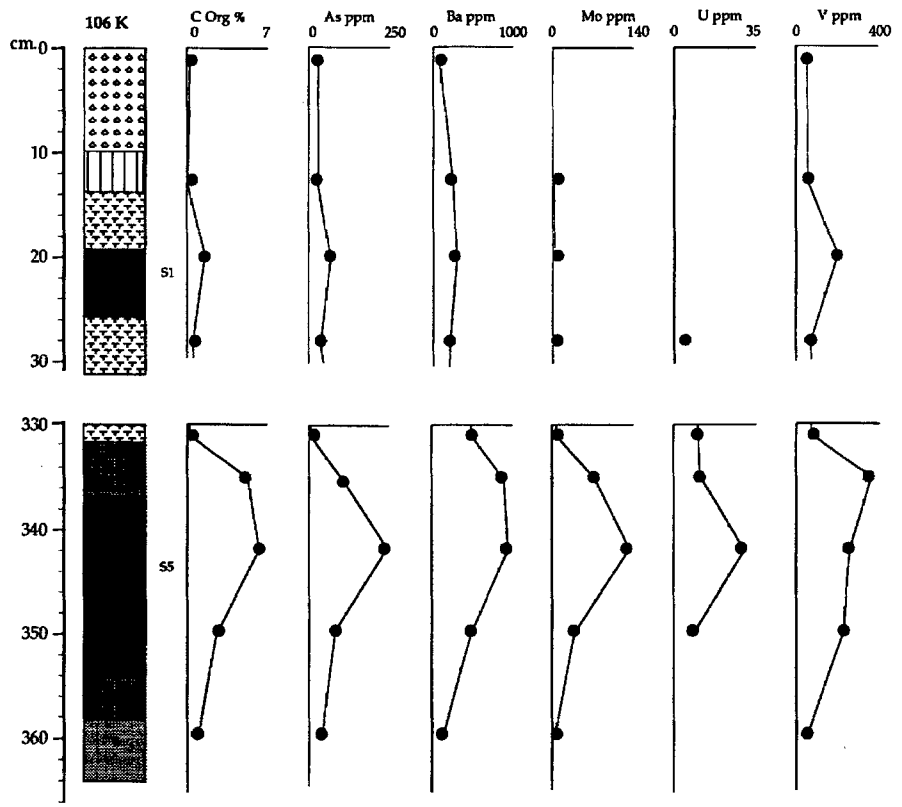

FIG. 1. The vertical distribution of selected elements through the S1 and S5 sapropels from Eratosthenes Seamount.

summit of the Eratosthenes Seamount during the 1993 TREDMAR cruise aboard the R/V Gelendzhik. Geochemical evidence from the Sea of Japan is based on samples from cores recovered by the Ocean Drilling Program Legs 127 and 128 from the Sea of Japan in the summer and autumn of 1989. Major and minor element geochemical analyses were carried out on a Phillips PW 1400 X-ray fluorescence spectrophotometer. Minor elements and major oxides for Sea of Japan samples were all determined on fused glass beads, as were major oxides from the eastern Mediterranean. Minor elements on eastern Mediterranean sediments were determined on pressed powder pellets. Organic carbon determinations were carried out by the titration method of Gaudette *et al.* (1974) and by a CHNS analyzer. Biogenic silica was determined using the sequential leach extraction method of DeMaster (1981) analysed on a Perkin Elmer UV-VIS spectrophotometer using a modified method of Stickland and Parsons (1972). Salt determinations were effected by $AgNO_3$ titrations.

Results

The sediments from the Eratosthenes Seamount in the eastern Mediterranean have shown that the organic-rich layers have complex and distinct geochemical signatures as compared to the intercalated calcareous oozes. Furthermore the different organic-rich layers exhibit differing geochemical signatures suggesting different modes of genesis (Fig. 1).

The geochemical signature of S_1 suggests increased productivity with oxic bottom waters during deposition. This casts doubt on the traditional model that organic-rich sediments accumulate purely as a result of enhanced preservation of organic carbon in anoxic bottom waters and suggests that the organic-rich sediments accumulated as a consequence of enhanced photic zone productivity in a fully oxic water column. In contrast another organic-rich layer, S_5, has a geochemical signature that suggests the presence of bottom water anoxia, supporting the anoxia hypothesis. Sea of Japan sediments display similar patterns.

Conclusions

Geochemical signatures such as these indicate that the conditions of genesis of these organic-rich sediments are far more complex than has previously been thought. In order to fully comprehend the significance of organic-rich sediments it needs to be appreciated that there is not necessarily one model that accounts for their formation.

References

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