Geophysical Research Abstracts, Vol. 9, 02349, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02349

Amino acids, δ 15N and other biogeochemical proxies in surface sediments and cores from the eastern Mediterranean Sea

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Sediment cores from the eastern Mediterranean Sea contain series of sapropel layers (cm to m thick) that are rich in organic carbon and were deposited during periods when the deep waters were anoxic. Deep-water anoxia in the eastern Mediterranean Sea is unambiguously linked to climate, as evidenced by the close correlation of sapropel intervals with maxima of insolation on the Northern Hemisphere and periods of decreasing ice volume.

In the framework of EUROCORES-EUROCLIMATE, Project MERF (Marine Ecosystem Response to Fertilisation) investigates the biogeochemical processes that caused the rise in marine productivity, which must have been a response to natural fertilization of the Mediterranean Sea during sapropel events. Our specific project aims to quantify the relationship between present-day nutrient and productivity regimes of the Mediterranean Sea with geochemical (organic carbon and phosphorus accumulation rates, composition of amino acids) and isotopic (15N/14N of sedimentary nitrogen) proxies in surface sediments. We then proceed to investigate gradients in productivity and in nutrient regime during isochronous time periods of enhanced productivity in the past.

The uppermost and youngest sapropel (S1) consists of an upper part that has been oxidized after deposition (burn down zone) and a lower part that is the remaining original sapropel.

We analyzed organic carbon, total nitrogen, δ 15N, amino acid composition and barium concentrations of a S1 sequence to elucidate the relationships between productivity (indicated by Ba concentrations) and diagenesis. Our particular interest was to trace diagenetic biases on δ 15N.

The barium curve as an indicator of productivity outlines the original extent of the sapropel. δ 15N and the amino-acid-derived Degradation Index (DI) show higher 15N (4.1 to 4.7 ‰) and strong degradation (-1.2 to -1.7) in the burn-down zone, but low 15N (0.7 to 2.2 ‰) values and good preservation (DI = 0.4 to 0.9) of organic matter in the remaining sapropel. The strongest degradation is found at the top of the burn down zone - in a layer rich in manganese. Generally the DI and the δ 15N show a diverging behaviour which suggests nitrogen isotope fractionation during amino acid degradation in the oxic sediment.

We also compared the δ 15N and the DI in more than 60 surface sediments samples of the Mediterranean Sea. No obvious trends emerged between these two variables, nor between these and satellite-generated productivity data. This implies that the general pattern of δ 15N in Mediterranean surface sediments is neither a result of decay nor of the production intensitiy. This suggests that modern Mediterranean Sea surface sediments reflect the source signal of δ 15N , whereas δ 15N in older sediments could be affected by diagenesis.