ALLOGENIC URANIUM IN IONIAN-SEA SAPROPELS

Augusto Mangini[+] and Walter Sigl[++]

+ Inst. f. Umweltphysik, Univ. Heidelberg, Im Neuenheimer Feld 366, 6900 Heidelberg

++ Lehrst. f. Geologie, Techn. Univ. München, Arcisstr. 21, 8000 München

Uranium- and Thorium-isotope analyses on quaternary sediments from the Ionian-Sea show the allogenic origin of Uranium in the sapropel-layers C,D,E and F.

L'analyse des isotopes du U et du Th effectuée sur sédiments quaternaires (Mer Ionienne) indique que l'Uranium dans les couches sapropéliques est d'origine allogènique.

Sapropel-layers with extremely high content of organic matter are a common feature of Plio-Quaternary strata in cores from the Eastern Mediterranean (1). They serve as stratigraphical markers and are used for core correlation (2). Very much differing formation age estimates for sapropels older than the range of the C-14 method were, however, reported (3).

In order to determine the absolute age of sapropels, alpha-spectrometric analyses of U and Th isotopes were carried out on piston cores from the Ionian-Sea. In the studied cores 22M21, 22M45, 22M48 and 22M50 six different sapropel-layers (A-F) occur. In sapropels C,D,E and F Uranium was incorporated in a manner different from what is normally assumed for anaerobic sediments. This implies a new, interesting aspect for sapropel formation.

Anaerobic sediments with high organic matter (C_{org}) content are enriched in U (up to 50 ppm (4)), whereas in aerobic sediments the U content is similar to the average for sedimentary rocks (1-3 ppm). This enrichment generally is ascribed to authigenic U-deposition from sea-water. U dissolved in sea-water is not in radioactive equilibrium with its daughters (Act. ratio U^{234}/U^{238} (=AU) =1,15; $Th^{230}/U^{234} \leq 5.10^{-4}$ (5)). Thus dating of U-enriched anaerobic sediments is possible because after U-deposition, Th^{230} grows into equilibrium with U^{234}, while the U^{234}-excess decays with the halflife of U^{234} ($T\frac{1}{2}$ Th^{230}:75.000y.; U^{234}:250.000y.).

In layers A(Holocene) and B(upper Pleistocene), AU exceeds unity indicating the presence of authigenic U (Fig.1). If the detritic component comes up to about 1-3 ppm, the age of layer B can be estimated to range between 40.000 and 60.000 years. In layers C,D,E and F (Pleistocene), however, the process of authigenic U-deposition cannot be responsible for the U-enrichment, because the U here is already in radioactive equilibrium. This suggests an apparent age of $\geq$ 700.000 years which strongly contradicts to previous chronological interpretations of these cores (3) and comparable ones from other expeditions (2).

The high U-content in sapropel-layers C to F can alternatively be explained by a supply of "old" allogenic material in which U was already in radioactive equilibrium. In layer C of core 22M48, the allogenic U-component then is estimated to be 80%.

The radioactive equlibrium of Ra^{226} with Th^{230}, found in layers C and D of core 22M48 (Fig.1), indicates that no appreciable diffusion of the easily mobile Ra took place in the former reducing environment. Rather, a particularly stable incorporation of Radium can be assumed.

The fact that in the sapropels under study a large amount of the U appears to be of allogenic origin and that a broad correlation between the U and the C_{org}-content was found, finally suggests the former existence and remobilization also of a huge store of organic material.

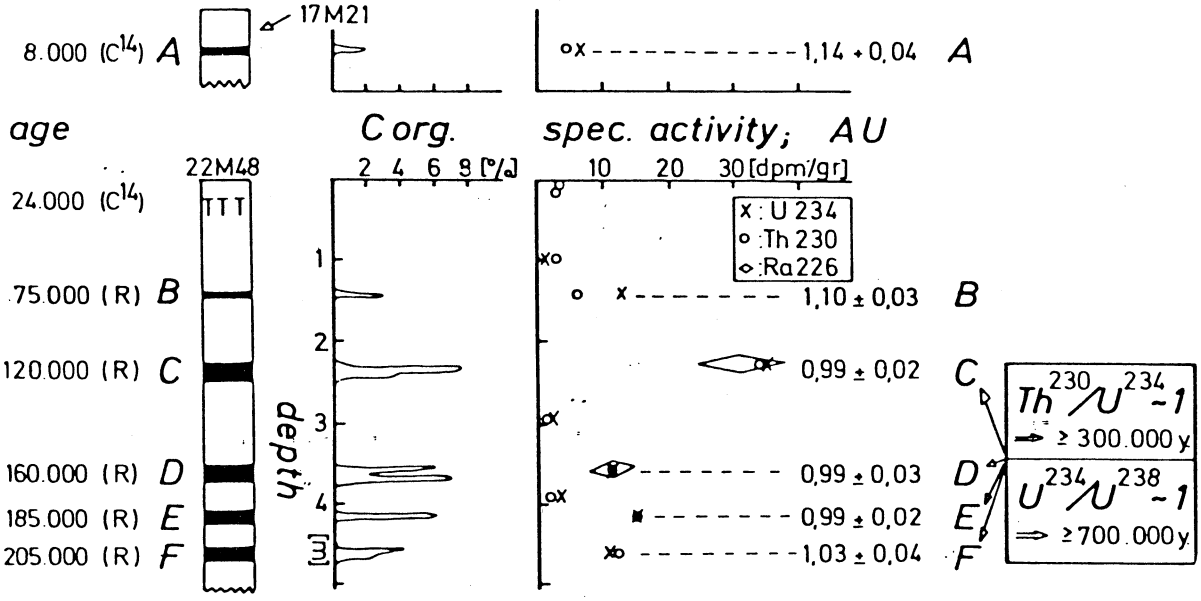

Fig.1: U^{234}-,Th^{230}-,Ra^{226}- and C_{org}-distribution in cores 22M48 and 17M21 (layer A) from the Ionian-Sea. AU= Activity ratio U^{234}/U^{238}. (1 dpm/g U^{238} $\hat{=}$ 1,36 ppm Uranium). C^{14}, paleomagnetic and paleontologic (R) ages, on the left side are from Ryan (2).

References:

1) SIGL W. et al., 1977: Sedimentology and Environmental Conditions of Sapropels. In HSÜ K.J., MONTADERT L.C. et al., Initial Reports Deep-Sea Drill. Proj.,Vol. 42 A.
2) RYAN W.B.F., 1972: Stratigraphy of Late Quaternary Sediments in the Eastern Mediterranean. In: STANLEY D.J. (ed): The Mediterranean Sea, Stroudsburg, Pa.
3) HIEKE W.,1976: Problems of Eastern Mediterranean Late Quaternary Stratigraphy- A Critical Evaluation of Literature-. "Meteor" Forsch. Erg. Reihe C, 68-88.
4) VEEH H.H. 1967: Deposition of U from the Ocean. Earth. Planet. Sci. Lett. Vol. 3, 145-150
5) MOORE W.S. and SACKETT W.M.,1964: U and Th-Series Inequilibrium in Sea-Water J. Geophys. Res., Vol.69, 4293.