Acceleration of Sedimentation Rate in the Black Sea Revealed in Radiometricaly Dated by 210Pb Sediment Cores

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Introduction: Radiometric dating of the sediment cores using the set of radionuclides 210Pb, 137Cs and 241Am show broad applicability and credibility to the results owing to robust calculation of the key parameters of the sediment dynamics, e.g. variation of sediment accumulation rate over the last 150 year. This was evidently exhibited in the Black Sea, unique natural euxinic marine environment, with permanent anoxic conditions in the sea body below 200m and absence of the mechanical mixing and bioturbation on its bed, thus making virtually intact sediment as an ideal archive of the records of sinking particles flux from the water column to the sea bottom.

Methods: Sediment cores from continental slope and deep-sea plain of the Western and Eastern Black Sea were collected during several international cruises in the framework of the IAEA and UNOPS-GEF BSERP Projects using a MARK II-400 multi-corer (Bowers & Connelly). After slicing with a resolution of 0.2 1cm (further confirmed to represent 5-10 year timespan in each subsample) the sediment cores were subjected for detailed radiometric analysis. The 210Pb, 226Ra, 137Cs and 241Am were measured using low-background gamma – spectrometry [1].
Chronostratigraphic analysis and sediment age calculation have been done by application of advanced CRS dating models to unsupported 210Pb (excess) activity profiles which were calculated by subtracting 226Ra activity from the total 210Pb [2]. Alongside the sediment age calculation, a number of other key parameters of sediment dynamics were estimated, e.g. radionuclide inventories, fluxes and sediment accumulation rates.

Results: It was revealed that in the deep-sea sediment cores of the Black Sea accumulation of the sunk material over the 150 years is recorded in the upper ca. 10-12 cm. This was further corroborated by the well resolved 137Cs activity profiles showing two clear peaks formed after the Nuclear Weapons test (maximum in 1963) and Chernobyl fallout. In some sediment cores refractory radionuclides 241Am and 154,155Eu originated from nuclear fuel component of the Chernobyl fallout were also found in statistically significant quantities. Observed offset in time suggested by the 210Pb chronology and that one inferred by position of the 137Cs/241Am peaks (ca. 3-7 years), is likely caused by the different source terms for natural (210Pb) and artificial radionuclides accounted for in the aggregation of the deposited material on the deep sea bed. Significant amount of unsupported 210Pb (up to 70%) is produced in-situ in water column below the halocline by decay of grandmother 226Ra being scavenged much faster to the sea bottom than contemporary artificial radionuclides which reside in the upper mixed layer of the sea for a while time. Calculated mass accumulation rates (MAR) vary in a range 40-150 gm-2y-1 over the last 150 years and indicate statistically significant increase of particulate flux to the sea bottom over the last century [3]. Mass accumulation rates variations, for carbonate-bearing and non-carbonate material separately, showed distinct temporal changes of biogenic carbonate supply to sediment. This increased flux of the biogenic carbonates is linked to the development of intensive algae (*coccolitho-phorid E.huxlei*) bloom what became evident in the 80-90s of the 20th century when the problem of eutrophication of the Black Sea was highlighted on the global level. At the same time another evidences of the rapid changes in thermochaline, circulation and chemistry structures for the Black Sea have been reported elsewhere for the same period of time [4].

Discussion: The revealed evidence of the increase in sedimentation rate in anoxic deep Black Sea need further elaboration in order to understand which factor, climatic (natural) or anthropogenic, play more crucial role in controlling changes in biogeochemical system of the Black Sea in recent few decades thus affecting its ecological status.

References: [1] Appleby, P.G. et al. (1986) *Hydrobiologia*, 141:21-27., [2] Appleby, P.G. & F.Oldfield (1978). *Catena*, 5:1-8, [3] Yücel M. et al. (2012). *Deep Sea Research Part I* 66, 103-113, [4] Gulin, S.B. (2000) *Marine Environmental Research*, 49: 319 328.