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Distribution of natural radionuclides and ¹³⁷Cs in the sediments of a Mediterranean fjord-like embayment, Amvrakikos Gulf, Greece

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Five small sediment cores were collected from the seafloor of the Amvrakikos Gulf for the study of the spatial and downcore distribution of natural radionuclides and ¹³⁷Cs in the sediments. Amvrakikos Gulf is a shallow (< 65m) marine embayment lying on the west coast of Greece having a surface of some 405 km² and a coastline length of 256 km. It is separated from the open Ionian Sea by a beach barrier complex and is connected to the open sea through a narrow channel, 600 m wide and less than 8 m deep. Amvrakikos Gulf receives the freshwater inputs of the Arachthos (2202 x10⁶ m³ yr⁻¹) and Louros (609x10⁶ m³ yr⁻¹) rivers at its northern shoreline. The Gulf is characterized by a general two-layer type of stratification in the water column and is considered as the only Mediterranean fjord. Sediment samples were analysed for specific activities of ²³⁸U, ²³²Th, ²²⁶Ra, ²³²Th, ⁴⁰K and ¹³⁷Cs together with grain size and Corg.

²³⁸U and ²²⁶Ra concentrations range from 37.2 to 124.0 and 8.5 to 27.2 Bq kg⁻¹ with an average value of 62.1 and 17.9 Bq kg⁻¹ respectively. The concentrations of ²³²Th and ⁴⁰K range from 11.2 to 46.5 Bq kg⁻¹ and 238 to 892 Bq kg⁻¹ with an average value of 36.6 and 710 Bq kg⁻¹, respectively. The activities of ²³²Th and ⁴⁰K reported in the present study are comparable to those of the world average as reported by UNSCEAR, 2000. On the contrary the reported ²³⁸U activities are significantly higher than those of the world average (UNSCEAR, 2000).

The value of the ²²⁶Ra/²³⁸U ratio ranges from 0.09 to 0.66 with an average value of 0.35 showing disequilibrium between the two radionuclides in all sediment samples. The disequilibrium can be ascribed to the weathering of phosphorites of Epirus (at the northern margin of Amvrakikos Gulf) as well as to the high phosphate fertilizers inputs due to the intensive application of fertilizers in the surrounding agriculture areas. It is well known that phosphorites and phosphate fertilizers are characterized by high ²³⁸U concentrations. The spatial distribution of ²³⁸U, ²²⁶Ra, ²³²Th and ⁴⁰K, in the surface sediments of the Amvrakikos Gulf shows a clear increasing eastward trend. Maximum activities were observed at the eastern deep basin, while minimum values were found at the western basin of the Gulf.

The man-made radionuclide ¹³⁷Cs was found in measurable concentrations (5.2-20.2 Bq kg⁻¹) in all surface sediments (0-5 cm). The higher specific activities of ¹³⁷Cs were found in the deeper sediment layers (8-44 cm) than in the surface layer. The high content of the clay minerals and organic matter found in the sediments of the Amvrakikos Gulf play very important role in the high level of ¹³⁷Cs. Moreover, the elevated specific activities of ¹³⁷Cs in the deeper sediment layers (44cm) suggest a high sedimentation rate for the Amvrakikos Gulf.

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