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Gamma Emitters in IAEA's SD-A-1 Marine Sediment Intercomparison Sample

Iolanda OSVATH

Environmental Radioactivity Research Laboratory, Institute of Meteorology and Hydrology, Bucharest (Romania)

SD-A-1 is a deep-sea sediment sample, collected in 1985 from the Atlantic floor (between 46° - 48°30′ N and 18° - 22° E, depth greater than 4000 m), (IAEA, 1988). A box corer was used for sampling. The top 15 cm of the resulting sample having been removed, the remaining material was assumed to have artificial radionuclide concentrations at or below detection limits. The intercomparison run, organized by the International Laboratory of Marine Radioactivity during 1986-1987, certified the values of some natural radionuclide concentrations in the sample, which thus became reference material, also recommended as a blank for artificial radionuclides. Results for K-40 and Ra-226 are synthesized in Fig. 1, respectively Fig. 2.

In our laboratory, we have analysed an aliquot of 100g of the sample, using high resolution, low-background gamma spectrometrical equipment. Three measurements were performed, with the counting time ranging between 30 and 61 hours. Data were processed according to ILMR requests.

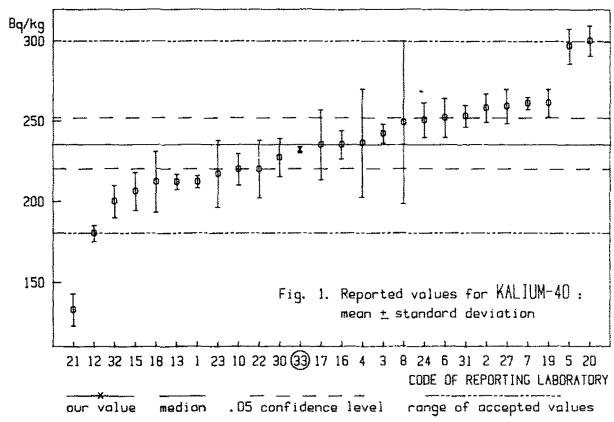
Two problems regarding data interpretation ask for attention, leading to conclusions of interest for the gamma spectrometrical analysis of sediment samples.

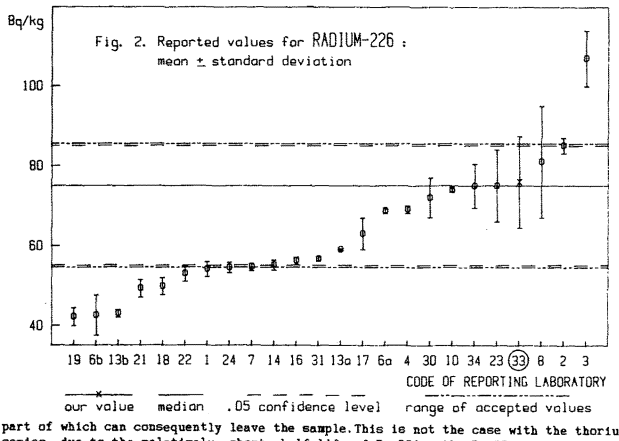
1. Among the Ra-226 concentration values reported by the participants, the ones obtained through gamma spectrometrical analyses were assesed by two methods:

a. directly, from the 186 keV photopeak, and

b. indirectly, from Pb-214 - Bi-214, assuming them to be at equilibrium with Ra-226.

Under normal sealing conditions (sample in closed plexiglass beaker), even at times much longer than needed for equilibrium to be attained among Ra-226 daughters , a dis-equilibrium factor of 1.3-4 persists. It is due to the great diffusivity of Ra-222,





part of which can consequently leave the sample. This is not the case with the thorium series, due to the relatively short half-life of Ra-220, the Ra-228(Ac-228)/Pb-212 activity ratio being very close to unity. These statements are based on a large amount of measurement data resulting from marine as well as river and lake sediments.

The conclusion can be drawn that the activity concentration of the Ra-226 in the sample cannot be assimilated to the Pb-214 - Bi-214 activity concentration.

2. Activity concentrations are reported for Tl-208, which appear to be calculated using different values for the yield of its gamma line at 583.1 keV. According to the disintegration schema of the thorium series (GUSEV and DMITRIEV, 1978), when equilibrium is reached in a closed sample, as pointed out in pp. 1, the Pb-212 - Bi-212/Tl-208 activity ratio approximates the branching ratio (BR=0.36).

This BR has to be considered when calculating the Tl-208 activity concentration from its 583.1 keV line.

The same explanation also accounts for the large scatter in Tl-208 data reported in the IAEA-306 Baltic Sea sediment intercomparison run (IAEA, 1989): they obviously group around two values, which differ from one another by a factor which closely approximates the BR.

Regarding U-235, although itself was one order of magnitude below our detection limit, the sample spectra showed clearly the presence of its gamma emiting daughters, like Th-227, Ra-223 and Bi-211. Most of the important gamma lines of the daughters are usually shielded by those of radionuclides in the U-238 and Th-232 series.

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