

TOTAL ALPHA AND BETA RADIOACTIVITY AND GAMMA SPECTROMETRICAL ANALYSES  
IN BLACK SEA SEDIMENT, WATER, FLORA AND FAUNA BETWEEN 1984-1985

Constantin DOVLETE<sup>o</sup> and Alexandru S. BOLOGA<sup>o\*</sup>

- <sup>o</sup> Institute of Meteorology and Hydrology, P.O.B. 11-2, Afumati-Bucharest (Romania)  
<sup>o\*</sup> Romanian Marine Research Institute, P.O.B. 53, Constantza (Romania)

*Abstract*

Results are presented for total alpha and beta radioactivity and gamma radionuclides in samples of sediment, water, macrophytes and fish collected from the Black Sea during the period 1984-1985.

*Résumé*

Les données concernant la radioactivité alpha et bêta totale et les analyses par spectrométrie gamma d'échantillons de sédiment, d'eau et de certains macrophytes et poissons, collectés en mer Noire, pendant la période 1984-1985 sont présentées dans ce travail.

The monitoring of natural and artificial radioactivity along the Romanian Black Sea shore, by means of alpha and beta total, and gamma spectrometrical analyses, was continued between 1984-1985.

MATERIAL AND METHODS

Sediment, sea water, macrophytes and fish samples were collected nearshore between Constantza (44°10'N) and Jupiter (43°50'N). Sea water samples were also collected offshore the Danube Delta (Portitza), and at Constantza and Tuzla (upto 30 nautical miles offshore) for comparative purposes.

The samples were counted for total alpha activity at least 40 min. each, using a RFT 72015 type probe with a VAZ-520 proportional detector connected to a ST6 Nuclear Enterprises Counter. Total beta measurements were performed using a low-background anti-coincidence system, consisting of Mullard Geiger-Müller detectors and a SR5 Nuclear Enterprises counter. Each sample was counted for at least 50 min. Gamma-spectrometry measurements were carried out with a Quanta computer-based multichannel analysis system consisting of Canberra Ge (Li) detectors, associated modular electronics and 8100 MCA, with counting times ranging between 50,000 and 300,000 s/sample. Spectra were analyzed with a PDP11/04 computer, using improved SPECTRAN III codes written in CLASS.

In total, 136 samples were analyzed. The activity due to <sup>40</sup>K was not subtracted from the measured values.

RESULTS AND DISCUSSION

The data on marine radioactivity indicate, in general, a lower level of contamination as compared to 1981 (ALEXANDRESCU *et al.*, 1982). Thus, the tendency for lower concentrations of fission radionuclides reported between 1982-1983 (BOLOGA *et al.*, 1985) has continued. The absence of atmospheric nuclear tests in the northern hemisphere between 1982-1985 led to a depletion of the fission radionuclide stratospheric reservoir. Furthermore, no important nuclear events occurred which could have resulted in a significant increase of marine environmental artificial radioactivity levels.

Specific alpha-total activity of the samples was below the lower detection limit associated with the measurements; only in *Bryopsis plumosa* the value of 6 pCi (222 mBq) g<sup>-1</sup> fresh weight or 234 pCi (8.6 Bq) g<sup>-1</sup> ash was due to the presence of alpha emitters from the natural series of U-Ra and Th (<sup>226</sup>Ra, <sup>218</sup>Po, <sup>216</sup>Po, <sup>214</sup>Bi, etc.).

With regard to total-beta activity, the highest value of 30 pCi g<sup>-1</sup> f.w. or 1,168 pCi g<sup>-1</sup> ash, also in *B. plumosa* in 1984, was due to beta emitters from the U-Ra, Th and K series (<sup>214</sup>Pb, <sup>212</sup>Pb, <sup>208</sup>Tl, etc.). However, because of the prevalence of radionuclides from the natural series U-Ra and Th in this sample, the calibration with <sup>40</sup>K seems in this case unjustified. Compared to the level of <sup>40</sup>K of only 1.5 pCi g<sup>-1</sup> f.w., if calibrated with a source of <sup>90</sup>Sr-<sup>90</sup>Y (or equivalent), the total beta activity in this sample increases to 11 pCi g<sup>-1</sup> f.w.

The following radionuclides were assayed by gamma-spectrometric analysis: <sup>7</sup>Be, <sup>40</sup>K, <sup>226</sup>Ra, <sup>228</sup>Ac, <sup>54</sup>Mn, <sup>60</sup>Co, <sup>106</sup>Ru, <sup>125</sup>Sb, <sup>137</sup>Cs and <sup>144</sup>Ce. <sup>40</sup>K is permanently much over the detection limits (upto 1.3 pCi g<sup>-1</sup> sediment, 236 pCi l<sup>-1</sup> in sea water, 12.1 pCi g<sup>-1</sup> f.w. or 384 pCi g<sup>-1</sup> in macrophytes, and 5.9 pCi g<sup>-1</sup> f.w. or 211 pCi g<sup>-1</sup> ash in fish. <sup>7</sup>Be, <sup>106</sup>Ru, <sup>137</sup>Cs, <sup>54</sup>Mn and <sup>60</sup>Co do not significantly exceed the detection limit. Among the marine organisms analyzed, higher values of <sup>106</sup>Ru and <sup>144</sup>Ce were found in *Ceramium elegans*, *Zostera nana* and *Gobius melanostomus*.

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DISTRIBUTION OF Cs<sup>137</sup> AND Pu<sup>239-240</sup> IN THE MARINE AREA  
IN FRONT OF THE PO DELTA (NORTHERN ADRIATIC SEA)

L. TASSI PELATI, C. TRIULZI, S. ALBERTAZZI and L. SCARPINA  
Istituto di Zoologia, Università, Parma (Italia)

ABSTRACT:

This research is connected with the preliminary one whose results were presented at the Cannes CIESM Congress (1982) "Radionuclides present in North Adriatic Sea in front of the Po delta (1979-81)". From that moment onward the research was carried out by thoroughly studying the aspects of distributions of radioactive isotopes of caesium and plutonium and also considering samples collected subsequently up to 1984. Significant samples of sea-water zooplankton and benthic and pelagic organisms were processed for the sequence determination of Cs<sup>137</sup> and Pu<sup>239-240</sup>. We report herein the results about the concentrations of these radionuclides in sea water and organisms. We also report their distributions in the surface layers of the sea-bottom.

Vertical profiles of Cs<sup>137</sup> were obtained in several points of the considered area in front of the Po delta; in particularly significant points, we also obtained several data concerning Pu<sup>239-240</sup>. These data enabled us to value the rate of sedimentation in some points of the considered area.