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Long-term environmental radioactive contamination of Europe due to the Chernobyl accident - Results of the ICPDR Joint Danube Survey 2013 radioactivity measurements

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Content

This paper was carried out within the scope of the Joint Danube Survey 3 (JDS3), co-ordinated by the International Commission for the Protection of the Danube River (ICPDR) was the world's biggest river research expedition of its kind in 2013, the UN International Year of Water Cooperation. A Joint Danube Survey is carried out only once every six years – JDS1 was held in 2001 and JDS2 in 2007. JDS3 completed the sampling in 2013 to enter an extensive ecological, biological, chemical and radiometrical analysis stage [1]. The Joint Danube Survey pursued three main objectives: 1) To collect information on parameters not covered in the ongoing monitoring, 2) to have data that is readily comparable for the entire river because it comes from a single source and 3) to promote the work of the ICPDR and raise awareness for water management. Carrying out JDS3, for six weeks between 13 August and 26 September 2013, the JDS3 ships travel 2375 km downstream the Danube River, through 10 countries, to the Danube Delta. An international Core Team of 20 scientists was responsible for sampling, sample processing, on-board analyses and all survey activities. 68 sites were sampled by the JDS3 Core Team along a 2581 km stretch of the Danube, 15 of which were located in the mouths of tributaries or side arms. Samples from the first two stations in Germany were collected using cars, the remaining 2354 km were sampled by ships.

The specific activities of artificial and natural gamma-ray emitting radionuclides and β-particle mitting 90Sr in bottom sediment samples from the 68 locations along the Danube river were determined by gamma-ray spectrometry and radiochemical analysis. The bottom sediment samples were taken from the left and right banks of the Danube river by surface bottom sediment sampling with 1-1.5 m water depth with a sampling net. This was followed by on-board homogenisation and grain size fractioning with wet sieving in order to get the less than 63 µm grain size fraction for radiometrical analysis in the laboratory. Before analysis, the sediment samples had been dried in the laboratory at 105 °C. All results are given for dried samples ($< 63\ \mu$m fraction, 105 °C). The yield of strontium extracted from the geological matrix was determined by total reflection X-ray fluorescence (TXRF). The 90Sr was then processed radiochemically, separated with strontium-selective resins and quantified by liquid scintillation counting (LSC).

27 years after the environmental contamination due to the Chernobyl accident the 90Sr contamination level of the Danube bottom sediment is low and did not exceed 10 Bq/kg with a few exceptions. 137Cs and 40K have been radiometrically analysed by low-level gamma-ray spectrometry in the Low-Level Counting Laboratory Arsenal, Vienna. Generally the 137Cs activity concentrations of the bottom sediment are below 100 Bq/kg. A significant decrease in specific activity in sediment along the river was observed.

This set of observations is of great importance since it is the first one of this type of radiometrical analysis done for the whole Danube river. The radiometrical results of the JDS3 survey have not been published so far.

[1] ICPDR, JDS3 Final Scientific Report, Joint Danube Survey 3. A Comprehensive Analysis of Danube Water Quality. ISBN: 978-3-200-03795-3, Vienna, 2015.

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