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ASSESSMENT OF RADIONUCLIDE INPUT INTO THE CURONIAN LAGOON BY SUSPENDED MATTER

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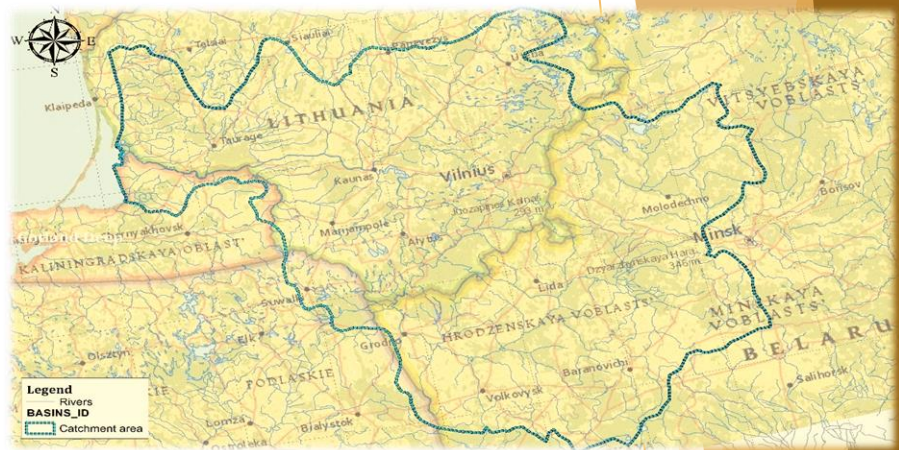
INTRODUCTION

The Curonian Lagoon is a semi closed area (1584 km^2) in the south-eastern part of the Baltic Sea. The main sources of radionuclides in this area are global fallout from nuclear explosions and fallout of radionuclides from the Chernobyl accident (*Aarkrog, 1988*). Even after decades, particle-bound radionuclides still enter the Curonian Lagoon from contaminated catchments.

Baltic Sea

Curonian Lagoon



Catchment area of the Neman river

The aim of this study was to estimate the input of radionuclides through the suspended solids of the Neman River.

MATERIALS AND METHODS

During the sampling campaign, suspended sediment samples were collected *in situ* by filtering a large volume of water (~1000 L) through 0.2 µm, 1 µm, 25 µm sediment filter cartridges (US Filter Plymouth Products). After sampling, the filters were dried at 25°C for one week. Gamma-emitting radionuclides were measured using an ORTEC gamma-ray spectrometer with an ORTEC gamma-ray spectrometer with an HPGe GWL-120-15-LB-AWT detector (resolution 2.25 keV at 1.33 MeV) . After the gamma measurements, the ash samples were dissolved in strong acids (HNO_3, HCl, HF, and $HClO_4$). TOPO/cyclohexane extraction and radiochemical purification with TEVA resins (100–150 µm) were used to separate Pu isotopes. Pu isotopes were electroplated on stainless steel discs and measured using an alpha-spectrometry system with passivated implanted planar silicon (PIPS) detectors with an active area of 450 mm^2 (AMETEK, Oak Ridge, Tennessee, USA) (*Lujaniene et al., 2022*).

RESULTS AND DISCUSSION

The activities of radionuclides in the suspended sediment were estimated to be 1.2 Bq/m^3, (^{7}Be), 1.9 Bq/m^3 (^{40}K), 0.1 Bq/m^3 (^{137}Cs), 0.4 Bq/m^3 (^{210}Pb), 17.6 Bq/m^3 (^{239,240}Pu).

The contribution of radionuclides to the Curonian Lagoon was estimated from measured activities in suspended sediment, assuming a suspended matter concentration of 12 mg/L and an average annual sediments input of 4.844 x 10^8 ± 3.790 x 10^8 kg/years, reported by *Mežine et al. (2019)*.

The calculated average annual contribution of radionuclides with riverine suspended matter is 76 GBq ^{40}K, 4 GBq ^{137}Cs, 16 GBq ^{210}Pb, 0.1 GBq ^{239,240}Pu.

The average plutonium input was also estimated using a different approach that considers the plutonium input from the 100 458 km^2 catchment (*Gasiūnaitė et al., 2008*) due to soil erosion.

Taking into account the published data for the conservative assessment, it was assumed that the average plutonium deposition in the catchment is uniform and does not exceed 39 Bq/m^2. Plutonium enters the water flow gradually through soil erosion with an average residence time in the catchment of 3000 years according to the approach described by *Wang, (2021)*. The average annual contribution of the river to the plutonium budget of the Curonian Lagoon was estimated to be 0.9 GBq/year. The calculated values differ significantly by a factor of 9, which may be related to the fluctuations of the plutonium concentration in the suspended sediments during a year.

CONCLUSIONS

Taking into account that about 60% of the sediments are trapped annually in the lagoon the annual amount of ^{40}K, ^{137}Cs, and ^{210}Pb that accumulate in the lagoon was estimated at 60 GBq. The calculations of the plutonium input (239,210) from the river show that the accumulation rate in the lagoon is about 0.54 Gb/year (60% of 0.9 GBq/y). Considering the long half-life of plutonium, it can be assumed that the plutonium concentration in the lagoon will increase in the near future.

REFERENCES

- ARKROG, A. "Worldwide data on fluxes of 239,240 Pu and 238Pu, inventories of selected radionuclides in the oceans." IAEA International Atomic Energy Agency, TECDOC-481, Vienna 103 (1988).
- G. Lujanienė, B. Šilobritienė, D. Tracevičienė, S. Šemčuk, V. Romanenko, G. Garnaga-Budrė, J. Kaizer, P.P. Povinec, Distribution of 241Am and Pu isotopes in the Curonian Lagoon and the south-eastern Baltic Sea seawater, suspended particles, sediments and biota, J. Environ. Radioact. 249 (2022) 106892. https://doi.org/10.1016/j.jenvrad.2022.106892.
- Mežine, J., Ferrarin, C., Vaičiute, D., Idzelyte, R., Zemlys, P., Umgiesser, G., 2019. Sediment transport mechanisms in a lagoon with high river discharge and sediment loading. Water (Switzerland) 11, 1970. https://doi.org/10.3390/w11101970.
- Gasiūnaitė, Zita Rasuolė, et al. "The curonian lagoon." Ecology of Baltic coastal waters. Springer, Berlin, Heidelberg, (2008). 197-215.
- Wang, J., Du, J., Qu, J., Bi, Q., 2021. Distribution of Pu isotopes and 210Pb in the Bohai Sea and Yellow Sea: Implications for provenance and transportation. Chemosphere 263, 127896. https://doi.org/10.1016/j.chemosphere.2020.127896

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