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Radon as a natural tracer for underwater cave exploration and hypogenic cave formation

Katalin Csondor (1), Anita Erőss (1), Ákos Horváth (2), and Dénes Szieberth (3)

(1) József & Erzsébet Tóth Endowed Hydrogeology Chair, Eötvös Loránd University, Budapest, Hungary (kacc91@gmail.com), (2) Department of Atomic Physics, Institute of Physics, Eötvös Loránd University, Budapest, Hungary , (3) Department of Inorganic and Analytical Chemistry, Budapest University of Technology and Economics, Budapest, Hungary

Using 222Rn as a natural tracer is a novel approach in underwater cave exploration and in the research of active hypogenic caves. The research area, the Molnár János cave is one of the largest caves of an unique hypogenic karst system, the Buda Thermal Karst (Budapest, Hungary). The cave system is mainly characterized by water-filled passages. The cave is located at one of the main discharge areas of the Buda Thermal Karst and the major outflow point of the waters of the cave system is the Boltív spring, which feeds the artificial Malom Lake. Previous complex hydrogeological studies and radon measurements in the cave system and in the spring established the highest radon concentration (71 Bq/L, where the average is 44 Bq/L) in the springwater. The origin of radon was identified in the form of iron-hydroxide containing biofilms, which form by mixing of waters and efficiently adsorb radium from the thermal water component and cause local radon anomalies. Since mixing of waters is responsible for the formation of the cave as well, these iron-hydroxide containing biofilms and consequently high radon concentrations mark the active cave forming zones. The aim of the study was to use the radon as a natural tracer to locate active mixing and cave forming zones. Based on previous radon measurements it is supposed that the active mixing and cave forming zone has to be close to the spring, since the highest radon concentration was measured there. Therefore, the radon activity concentration mapping was carried out with the help of divers and involving that part of the cave which closest to the spring. Based on our measurements the highest radon concentration (84 Bq/L) ever was achieved in the springwater. Based on the radon concentration distribution direct connection and active karst conduit was established between the spring and the deepest room of the researched part of the cave, which was verified by artificial tracer as well. However, the distribution of radon in the cave passages shows lower concentrations (18-46 Bq/L) compared to the spring, therefore an addition deep inflow from a hitherto unknown cave passages is assumed, from which waters with high radon content arrive to the spring. These passages are supposed to be in the active cave formation (mixing) zone.

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