Abstract

In the presented work the suitability of the naturally occurring radioactive noble gas isotope radon-222 (^{222}Rn) for qualitative and quantitative description of groundwater discharge into lakes was studied.

Basis of these investigations was the development of two innovative techniques for the on-site determination of radon in water. One method allows the detection of radon outside the water body involved (ex-situ), the other within the said body (in-situ). In the ex-situ radon measurement procedure, water from the source concerned is taken up in an exchange cell used for this purpose. Inside this cell, the radon dissolved in water is transferred via diffusion into a closed counter-flow of air and subsequently detected by a radon-in-air monitor. Where the in-situ radon determination is concerned, a module composed of a semipermeable membrane is introduced into a water column. Subsequently, the radon dissolved in the water body diffuses through the membrane into the corresponding air flow, by means of which it is transferred into a radon-in-air monitor and is detected.

For verification purposes, both procedures were compared with conventional standard methods for the measurement of radon in water. All methods used show very good consistency in terms of their efficiency and the time required for the detection of radon-222.

Combination of the developed mobile radon extraction techniques with a suitable and portable radon monitor allow the detection of radon-222 with sufficient accuracy (2σ-error: ≤ 20 %) in groundwater as well as in surface waters, i.e., within a broad range of concentrations.

Radon-222 was subsequently used to characterize groundwater discharge into a meromictic and a dimictic lake, i.e., two types of lake basically distinct from each other with respect to their water circulation properties were investigated. Underlying basis of the description of groundwater discharge into lakes using radon-222 as a geochemical tracer is the balancing of all sources and sinks of the noble gas with reference to the water column of the respective surface water body. It could be shown at both investigation sites that it is possible to reveal a qualitative effect of groundwater on the lake water as well as a quantitative estimation of the groundwater discharge rates based

on the detection of radon-222.

In generally it can be stated that the use of the noble gas isotope radon-222 as a geochemical tracer makes the application of on-site detection techniques possible and that this in turn permits a rapid, reliable, and cost-effective assessment of groundwater discharge rates into lake water bodies.