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A comparative study for the determination of uranium and uranium isotopes in granitic groundwater

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The determination of uranium and uranium isotopes in groundwater is very important in the context of the safety of the deep geological disposal of radioactive wastes. The effects of groundwater-rock interaction on the migration of radionuclides can be evaluated using naturally occurring radionuclides as analogues of radioactive waste disposal in a deep geological repository. In this study, the uranium concentration was determined using different analytical methods such as alpha-spectrometry, a liquid scintillation counter (LSC), and inductively coupled plasma mass spectrometry (ICP-MS). The groundwater was sampled from a small underground research facility called KURT (KAERI Underground Research Tunnel) located in Daejeon city, in the center of Korea. Groundwater samples were taken from 6 different depths down to 300 m from a borehole where a multi-packer system is installed. The dissolved U concentrations in the 6 groundwater samples determined by 3 different methods widely ranged from 0.3 to 854 µg/L. The results from the 3 different methods showed a good agreement with each other. An anomaly showing a high U concentration was observed at a relatively shallow region (92 ~ 200 m depth). The ARs of U-234/U-238 analyzed by alpha-spectrometry and LSC showed AR values between 1.149 and 2.384 depending on the depth and analytical method. These ARs indicate that the uranium isotopes are out of secular equilibrium owing to an increased water-rock interaction and different origins of the sampled groundwaters.

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