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Age dating of the hot spring waters in Korea using natural radionuclides

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The use of radioactive isotopes as a groundwater-dating tool plays an important role in assessing the dynamics of groundwater systems, essential for the characterization of water resources and planning its exploitation. In hydrogeological studies the application of radioisotopes with a short half-life (below 100 year) is limited in dating old groundwater. However, they can be extremely helpful in solving another type of question such as the identification of mixing between old and young groundwater systems. Within the environmental radioisotopes, 3H cannot be detected in waters more than approximately 50–60 years old due to the short half-life (t1/2=12.32 year). Among the radioactive isotopes with a half-life greater than 1 ka, 14C (t1/2 = 5730 year) represents the most important tool in groundwater dating. This radioisotope is present in the atmosphere, soil, aquifer matrix, etc.
Using these two radioisotopes, the age of the hot spring waters in Korea were estimated. And also, some other natural radioisotopes, Ra and U, were analyzed to know the characteristics of the hot spring waters.
Most hot spring waters are founded in granite region in Korea and the Mesozoic granites at the southern part in the Korean Peninsula are divided into two groups, Jurassic Daebo-granite and Cretaceous Bulguksa granite. High temperature hot springs more than 40℃ occur in the above granite areas. Therefore, fifteen hot spring waters were collected and the contents of 3H, 14C and other radionuclides were determined. Tritium concentration in hot spring waters were very low, therefore, they were concentrated using the Ni-Ni electrolytic enrichment method. And it was analyzed using low background liquid scintillation counter. Dissolved carbonate was precipitated with BaNO3 to BaCO3 form and it was reacted with phosphoric acid to produce CO2. Finally, CO2 was converted graphite. After then, it was analyzed using AMS.
Tritium in the most hot spring samples could not detected and it was ranged <0.5-1.31 TU. And 14C contents were ranged 2.62-94.13 pMC(%). From the 3H and 14C analysis, we found some hot springs are mixed with recent groundwater and hot spring water aged from 490 years to 33680 years.

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