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Development on groundwater dating method

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On the safety assessment of radioactive waste disposal, it is important to evaluate a groundwater scenario. In the groundwater scenario, groundwater velocity is one of the important indexes. However, it is expected that groundwater velocity at candidate site of radioactive waste disposal is very slow, direct measurements of groundwater velocity is difficult. For this reason, a groundwater dating using radioactive isotopes naturally existing is one of the most promising methods.

We have been conducting research and development for the groundwater dating focusing on very old groundwater, which ranges from ten thousands to millions year. In this project, we have been studying for helium-4, carbon-14 and Chlorine-36, which is suitable for very old groundwater. We proposed a method for rock core as well as water to enhance applicability of these methods. The validity of proposal methods was verified by applying these methods to aquifer and aquitard in Australia Great Artesian Basin.

Moreover, we have been conducting the in-situ investigation in Horonobe and Mizunami, study site in order to check the applicability to Japanese geological condition.

In Horonobe study site, we applied proposed methods to drilling core. Helium concentration is equivalent to millions year accumulation of helium in-situ, and Chlorine-36 is reach to in-situ equilibrium. It indicates that the groundwater stay in geological formation more than 5 times half-lives. These results show that groundwater in Wakkanai Formation was stable from sedimentation time.

In Mizunami study site, we sampled water from borehole, and analyzed helium and carbon-14. Helium age and Carbon-14 age increase from recharge area to discharge area. These ages has correlation, and increasing rates are equivalent each other. Therefore, it was proved that these ages reflect the site scale groundwater flow and range from ten thousands year.

We will conduct another method and integrate the sampling and measurement method to check the validity of groundwater age in the future.

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Keywords: groundwater, radioactive isotope, chlorine-36, carbon-14, noble gas, helium-4