Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SCG084-P12 会場:コンベンションホール 時間: 5月25日17:15-18:45

幌延地域における地下水年代測定法の適用

Application of groundwater dating in Horonobe area, Hokkaido, Japan

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Knowledge on groundwater flow property around disposal site is essential for safety assessment of radioactive waste disposal. Central Research Institute of Electric Power Industry (CRIEPI) has investigated groundwater dating methods such as ^{4}He accumulation method and ^{36}Cl method that enable estimation of very long residence time.
The ^{4}He accumulation method can estimate residence time based on increment of ^{4}He concentration in groundwater and generation rate of ^{4}He in rock. ^{36}Cl is a radioisotope whose half-life period is 301 thousand years, and the ^{36}Cl method is based on concentration change resulted from ^{36}Cl decay in groundwater. Applicability of these methods was confirmed in previous works carried out in the Great Artesian Basin, Australia.
Research using these methods was conducted in Horonobe, Hokkaido, Japan, to consider the applicability of the methods and to adapt them to geological environment in Japan. Neogene sedimentary formations, Wakkanai and Koitoi formations are thickly distributed around the area, and the groundwater dating was carried out with cores and groundwater collected from the formations.
^{4}He concentration in the samples was in the range of 10^{-6}-10^{-5} cc_{STP}/g_{w}. Equilibrium concentration of ^{4}He in atmosphere is 4.8 x 10^{-8} cc_{STP}/g_{w} and generation rate of ^{4}He in situ is 1-2 x 10^{-12} $cc_{STP}/g_{w}y$ and thus residence time of groundwater was calculated as several million years. However, ^{3}He/^{4}He ratio of He in groundwater was in the range of 10^{-7}-10^{-6} and slightly high relative to the ^{4}He concentration. This may imply the inflow of He from external origin.
^{36}Cl/Cl of the samples was in the range of 10^{-15}-10^{-14}. The origin of deep groundwater in Horonobe area is considered to be seawater trapped when the formations were formed. Averaged ^{36}Cl/Cl of present seawater obtained in previous works was 1.0 x 10^{-15}, and the ^{36}Cl/Cl values of groundwater was higher. This means that ^{36}Cl/Cl in groundwater increased by radioactivation in the formations. Considering the half-life period of ^{36}Cl, residence time was estimated as larger than 1.5 million years. The residence time obtained from the two methods showed that groundwater flow in this area is not active.

Acknowledgements
This research entitled 'Research and development on groundwater dating technique' was carried out under contracts awarded by the Japanese Ministry of Economy, Trade and Industry (METI) to CRIEPI. In-situ investigations in Horonobe study site have been conducted as joint research with Japan Atomic Energy Agency.

キーワード:地下水,滞留時間,堆積岩,地下水年代測定

Keywords: groundwater, residence time, sedimentary rock, groudwater dating