An evaluation of Helium flux using profile of Helium in Great Artesian Basin

Kotaro Nakata[1]; Takuma Hasegawa[1]; Takahiro Oyama[1]; Tomohiro Higashihara[2]; Yasunori Mahara[1]; Hirohisa Kobayashi[3]

[1] CRIEPI; [2] none; [3] Sumiko Consultants Co., Ltd.

For the safety disposal of high-level radioactive waste in deep geological formations, it is very important to estimate flow rate of groundwater near the disposal site. However, it is sometimes very difficult to estimate very slow flow rate (a few cm/y) by mechanical way. We can obtain information on such very slow flow rate by residence time of ground water. Some previous studies indicated that the concentration and isotope ratio of helium (He) in groundwater can provide information on such residence time of ground water because of their inertness and increasing concentration in subsurface. However, it is not easy to estimate the residence time of groundwater precisely by using only He concentration, because estimation of its accumulation rate is not easy. Sometimes, origins of sources of He are not simple to determine. The He accumulation rate is affected not only by radiogenic He in host rock, but also by external sources.

The Great Artesian Basin (GAB) in Australia is considered as one of the most suitable site to verify the ground water dating methodology because geological and geohydrogical structure of GAB is very simple. In some previous studies, possibility of exitence of He flux in GAB from deeper geological formation to aquifer has been indicated, because accumulation rate of He in aquifer were sometimes 10 times or more greater than that expected from U and Th concentration in aquifer in GAB. Even though the possibility of existence of He flux at GAB has been indicated, no clear evidence has been shown at this present.

In this study, drilling to aquifer at GAB was carried out at 2 sites (Richmond and Marree) to investigate depth profile of He concentration and isotope ratio. In our previous study, sampling, extraction and measurement method for noble gas in pore water of rock core (drilling core) was established. This method was applied to drilling core of GAB to estimate He concentration and isotope ratio of pore water in drilling core.

The depth profile of He concentration and isotope ratio in Marree drilling site was shown in Figure-1 and 2, individually. As shown in figure-1, in the upper part of aquitard (50-172m in depth) concentration of He increased with increase of depth. In the deeper part of aquitard (deeper than 181m), concentration of He also increased with depth. However, the gradient of He concentration in depth profile of He concentration is completely different between upper and deeper parts of aquitard. Big gradient showed in deeper aquitard indicate a large amount of He is in deeper geological formation and such He in deep geological formation flows into aquifer by diffusion. Smaller gradient in upper aquitard compared with deeper one, indicate that most He come from deep geological formation accumulate in aquifer and a little fraction of accumulated He lost from aquifer by diffusion to upper aquitaed. Isotope ratio of He is stable at depth of 50 to 200m. This is because depth profile of He is mainly controlled by He flux from deep

geological formation or source of He of He flux is same as aquifer and upper aquitard, that is, radiogenic He in host rock. Thus, clear evidence of existence of He flux in GAB is showed for the first time by this study.

This study was done under contracts awarded from METI (Ministry of Economy, Trade and Industry).

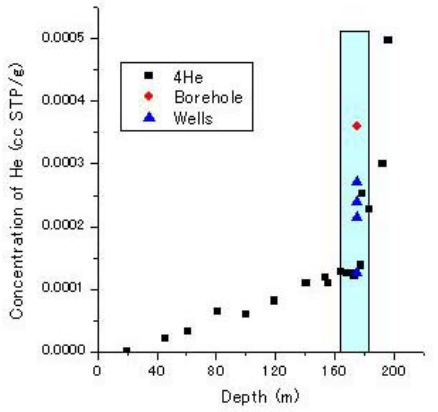

Figure-1 Depth profile of He concentration

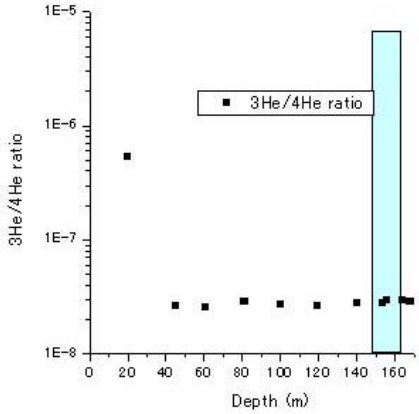

Figure-2 Depth profile of He isotope ratio