Groundwater study using drill holes in Abukuma granitic province 2: the multi-isotopic approach to evaluate crack water stability

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Little is known on the quantification on stability and mean residence time of crack water. As the step to reach the goal of investigation, we conducted the multi-isotopic approach for the study of groundwater in cracks by drilling two bore holes in Abukuma granitic province, Fukushima, northeast Japan.

Chemical type of groundwater changes along the depth from Ca-HCO3-type to Na-HCO3-type. The d13C values of total dissolved carbon from two sites, Shirasawa and Miharu, show different profiles vertically. The d13C profiles indicate that carbon at the Shirasawa site is derived from biogenic source, but that at the Miharu site is influenced from other sources, such as crustal fluid upwelling from a deep geologic environment. The contribution of crustal fluid can be canceled using the carbon isotopic mass balance, and the d14C value of crack water excluding deep source contribution was evaluated. The apparent age calculated using the evaluated d14C value is getting older to deeper depth at both sites.

At the Miharu site, the tritium is detected even at depth of 180m, indicating that relatively young water has mixed in the crack water. As the vertical profiles of dD and d18O show the very small change, implying the vertical mixing of crack water, shallow surface water and deep crustal fluid. However, the result beyond the 10000 yrBP in the apparent 14C age suggests that the carbon mixing does not frequently occurred.

As for the Shirasawa site, vertical profiles of dD and d18O show large changes. The deeper the crack water, the lower the dD and d18O values are represented. The lowest dD value is 20 per-mil lower than the present shallow water, suggesting the water recharged in glacial period. The apparent 14C age also show that the older age of carbon in the crack water than 10000 or 20000 yrBP. The evidence shows that crack water can be trapped for a very long period even at shallow depth (80-180m).