

# Geochemistry of drilled weathered granite and Sr isotopes of groundwater in the Kanamaru district (Niigata Prefecture, Japan)

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The evaluation of radioactive wastes repository safety requires detailed numerical data of all aspects of the host geological system and its evolution. For numerical analysis, the environmental features of the natural barrier must be clearly understood. Within this framework, we are studying the geological characteristics of an underground system and to numerically evaluate the rock characteristics.

The field of studies is situated in the Kanamaru district at the border between the Niigata and Yamagata prefectures. It consists of a Cretaceous granitic basement overlain by Neogene sedimentary rocks where drilling and field survey were carried out. The granitic rocks are mainly composed of porphyritic biotite granodiorite. The sedimentary cover is 10 to 35 m thick and consists mainly of fine grain sandstones and conglomerates. In this paper, we report the numerical estimations of the alteration of the granitic basement inferred from the rock chemistry. In addition, preliminary Sr isotope analyses of groundwater to determine the origin of Sr are introduced.

The drilling samples of basement granitic rocks show wide chemical variations on a Harker diagram compared with those of fresh samples, collected by field survey. The concentrations of LILEs indicate larger variations than those of HFSEs. Moreover, the drilling samples show large depletion of Na<sub>2</sub>O and CaO contents compared to unaltered samples. These chemical features cannot be explained by petrogenetic variations of the granitic body. Therefore, it is suggested that the chemical changes of the granitic basement reflect the influence of secondary weathering.

Kamei et al. (2004) reported the Degree of Chemical Weathering(DCW) index for granitic rocks. This index is based on a bivariate plot of the chemical variation(CV) in a granitoid body and the chemical dissolution rate(CDR) during rock weathering. The chemical data of drilling samples suggest that the alteration lead to preferential release of Na and Ca. As a further step, we have used the CIW(Harnois, 1988) and the CIA(Nesbitt and Young, 1980) for the CDR in the model. SiO<sub>2</sub> content is used as the CV. In the bivariate diagram, the magmatic trend of a given granitic pluton is established by plotting the chemical compositions of fresh rocks. Then, a weathered rock is plotted on the diagram. The DCW is defined as the distance between the intercept on the CDR-axis of the magmatic trend and the projected intercept of the sample.

In this study, three drillings, Br.3-1, Br.3-3, and Br.4 are used. The degrees of weathering of both Br.3-1 and Br.3-3 show rapid decrease with depth. On the other hand, the weathering degree of Br.4 is still large over GL-50m. Consequently, we assume the following geological interpretations. The profiles of both Br.3-1 and Br.3-3 show that the upper part of the granitic rocks had already been weathered before the Neogene sedimentation, whereas the profile of Br.4 shows that thick weathering granite had existed.

Recently, we started the study of Sr isotopes of underground water to get insights and further constraints on the origins and pathways of groundwater within the Kanamaru system. The <sup>87</sup>Sr/<sup>86</sup>Sr isotopic ratio of the groundwater in several bore holes was measured. Packers were not set and water sample may have been perturbed during sample collection. The groundwater in deep granitic rocks has Sr isotopic ratios in the range 0.7092-0.7093 (Sr content: 38 ppb and more), whereas the groundwater in the sedimentary cover ranges from 0.7100 to 0.7106 (Sr content: less than 38ppb). Variations of the Sr isotopic composition in groundwater seem to reflect the release of Sr from isotopically distinct sources, namely a radiogenic source (Neogene sedimentary cover) and a less radiogenic source (cretaceous granitic basement). Also, the Sr isotopic ratios slightly change according to the values of pH, dissolved oxygen fugacity and conductivity of groundwater. These changes are being examined now.