Evaluation of a method to determine the radionuclide retardation in bedrocks - the Kanamaru uranium mineralization area, Niigata

Atsushi Kamei[1]; Natsumu Shirasaki[1]; Kazuki Naito[2]; Yoshio Watanabe[2]; Regis Bros[2]; Sayaka Takamura[1]; Yoji Seki[3]; Koichi Okuzawa[2]

[1] Department of Geoscience, Shimane Univ.; [2] Research Center for Deep Geological Environments, AIST; [3] Research Center for Deep Geologigal Environments, AIST

We have investigated a method which consists to evaluate the retardation of radionuclides by using the chemical composition of whole rocks. The whole-rock geochemistry can be performed in various fields, and a great number of samples can be easily processed. The field of studies is the Kanamaru district which is located 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 basement is mainly composed of porphyritic biotite granite. The sedimentary cover is 10 to 35 m thick and mainly consists of detrital sedimentary rocks, fine grain sandstones and mudstones deposited under continental and fluviatile conditions and originating from the granitic basement. A low-grade uranium mineralization (several hundreds ppm) has been identified in the sedimentary cover.

The major process of radionuclides retardation is widely recognized as surface sorption onto clays and altered minerals rather than primary phases such as plagioclase and K-feldspar. High value of the indices would therefore result from high contents of clays and altered minerals in a rock (e.g. Nesbitt and Young, 1980). In this study, the CIA (Chemical Index of Alteration, Nesbitt and Young (1980): Al2O3/(Al2O3+CaO+Na2O+K2O) molar ratio) and PIA (Plagioclase Index of Alteration, Fedo et al. (1995): (Al2O3-K2O)/(Al2O3+CaO+Na2O-K2O) molar ratio) methods are evaluated. The following two signatures are applied to the bedrock of Kanamaru area using whole-rock geochemistry assuming the following: 1) U content of the granitic basement is lower than 10 ppm, and 2) the source rock of the sedimentary cover is mainly the granitic basement, and 3) there is no significant amounts of U-bearing minerals (e.g. zircon) during sedimentation. It is suggested that the U-rich layer in sedimentary rocks was produced by precipitation of U from groundwater. By comparing the U content of sedimentary rocks with the values of chemical weathering degree based on whole-rock chemistry, we deduce that U-rich layers show high degree of chemical weathering. The stability of U in the mineralized horizon closely depends on the redox potential of the environment. Although we cannot conclude in a simple way that U is uptaken by highly weathered rocks, the U content in a rocks is related to its chemical weathering degree in the Kanamaru area. Therefore the chemical weathering indices are considered as potential candidates to estimate the factor of radionuclide retardation.