The evaluation of the compositional variation in a single rock suite revealed by grid sampling toward improving the accuracy of geoneutrino flux

*Minami Kazuki[1], Kenta Ueki[2], Tsuyoshi Iizuka[3], Sanshiro Enomoto[4], Hiroyuki K.M. Tanaka[1]

1. Earthquake Research Institute, the University of Tokyo, 2. Japan Agency for Marine-Earth Science and Technology, 3. University of Tokyo, 4. University of Washington

Geoneutrino, which is emitted in decay of radioactive elements in the earth, was firstly observed on the KamLAND (Kamioka Liquid Scintillator Anti-Neutrino Detector) in 2005 (Araki et al., 2005). In the past decade, the KamLAND has enough observed data to estimate the U-Th abundances in the core or mantle (The KamLAND Collaboration, 2011). Previous estimates of U-Th abundances in the earth were derived based on the refractory element abundances in the chondrites. On the other hand, geoneutrino enables us to conduct direct estimation of the U-Th abundances in the earth. In order to obtain the U-Th abundances with high accuracy based on the geoneutrino data, it is important to estimate the U-Th distributions in the crust near the KamLAND (Enomoto et al., 2007). Takeuchi et al. (in review) showed U-Th distributions in the Japanese crust using the new method, which combines the three-dimensional lithology model inferred from seismic velocity structure and the rock composition model.

The new compositional model enables us to infer the geoneutrino flux from the Japanese crust. However, calculated geoneutrino flux from the Japanese crust has large uncertainties of 70%. One reason of the uncertainty is derived from wide compositional variations of the U-Th concentrations in one geological unit. These wide compositional variations of the U-Th concentrations make it difficult to estimate the uncertainty of the typical U-Th concentration values in one geological unit, which leads to the large uncertainty of geoneutrino flux. If the U-Th distributions in a single rock suite is known, the large uncertainties on geoneutrino flux from the Japanese crust can be reduced to 30% at a maximum.

In order to understand the distributions of element concentrations in a single rock suite or the relationship between sample size and the U-Th concentrations, rock samples were collected in a single rock site. We sampled granitic rocks from Inada granite, Kasama city, Ibaraki prefecture. Inada granite is 60Ma (Arakawa and Takahashi, 1988) medium-grained granite (Takahashi et al., 2011) in the Ryoke Belt (Ishihara, 1977). We conducted grid sampling in two stone quarries. Precise locations were obtained by a high-precision GNSS receiver. Several 2-centimeter cube were cut from one rock sample and each cube was analyzed by XRF utilizing fused glass beads. Compositional variations of rock samples in the single rock suite and the precise sampling points obtained by a high-precision GNSS receiver with the accuracy of 1m degree reveal the relationship between the distance of one sampling point to another and chemical concentration variations. This relationship enables us to constrain on the geoneutrino flux derived from the single rock suite.

