Quantitative evaluation of the geochemical correlation length within the single granitic body, toward the error estimation of geoneutrino flux from the Japanese crust

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Geoneutrino observation at anti-neutrino observatory "KamLAND" (Kamioka, Hida City, Gifu Prefecture) allows us to estimate the total abundance of Uranium and Thorium in the deep Earth. By subtracting the crustal contribution from the KamLAND observation, it is possible to estimate the flux of mantle-derived geoneutrino. As ~50% of the observed geoneutrino flux at KamLAND is derived from the nearby Japan crust, precise estimations of geoneutrino flux from the Japan crust and its error are essential to estimate the flux of mantle-derived geoneutrino accurately. For this purpose, we have established a stochastic estimation method for crustal chemical composition. Based on the stochastic compositional model, we have calculated the geoneutrino flux from the Japan crust. At present, the estimated values of geoneutrino flux from the Japanese crust exhibit a considerable uncertainty because of the difficulty in handling spatial correlations (in other words, compositional similarities within each geological unit).
In this study, dense sampling was performed in a single granite body (Inada granite, Kasama City, Ibaraki prefecture) to quantitatively understand the spatial correlation of rock chemical composition. By analyzing the compositional differences between samples at various distances, the spatial correlation length of the compositions was evaluated. Based on the analysis, the "typical composition of a km-scale rock body," which excludes small (cm-m) spatial-scale composition variations, was estimated with an uncertainty. Under this proper correlation modeling, geoneutrino flux estimation errors from the Japan crust would be reduced. We also discuss the magmatic processes that derived the geochemical variations of granite, based on the differences in spatial correlation depending on the elemental species.

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