Geoneutrino Flux Estimation based on Probabilistic Lithology and Compositional Models

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Geoneutrino observation with the KamLAND detector at Kamioka, Gifu, is expected to bring unique knowledge on the interior of the earth. However, due to a large contribution of the nearby crust to the total geoneutrino flux at Kamioka, detailed understanding of the Uranium and Thorium distributions in Japanese crust is crucial. For this purpose, we have been developing a lithology model by seismic tomography, rock composition models based on evaluated vast samples, and a method to properly propagate all the probabilistic information to an estimation of the geoneutrino flux at Kamioka.

Geoneutrino observations are statistical, therefore results from the observations, such as the total heat budget in the mantle, are described with probability distributions. In order to properly do this, the nearby crustal model must be described in the language of probabilities, where estimation of uncertainties, not just the central value, has essential importance. In spite of this, no geoneutrino flux model with objective uncertainty estimation has never been constructed, presumably due to lack of input information and methodological difficulty of doing it.

At this presentation our effort on developing the method of estimating the geoneutrino flux based on probabilistic input models will be discussed. Currently our major difficulty is description and evaluation of correlations among values in the input models, such as quantitative description of regional lithological similarities and modeling of compositional variations / similarities among rocks classified as same rock type. In parallel to the effort of constructing the best optimal models, we evaluated a conservative uncertainty by assuming the maximum correlations among everything.

Although the estimated conservative uncertainty, 60~70%, is too large to be meaningful in geophysics, this is the first objective estimation of the uncertainty on the regional geoneutrino flux. We will also discuss the future prospects to further improve the estimation. In addition, some other interesting side-products, such as a heat-source distribution map of the 3-D Japan crust, will be presented.

Keywords: geoneutrino, BSE, thermal evolution, crustal composition