Possible link between East-west mantle geochemical hemispheres and Geoneutrino

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There has been an extensive debate concerning the compositional structure of the mantle: e.g., two-layered mantle model, stratified/zoned mantle model, plum-pudding mantle model, and marble-cake mantle model (e.g., Tackley, 2008; Iwamori, 2016, for review). The compositional structure is important as it reflects the flow pattern of mantle convection and differentiation processes during material cycling, yet poorly constrained at present. An geochemical end-member model argues that the mantle convection chaotically stirs geochemical heterogeneity brought by plate subduction, resulting in ubiquitously heterogeneous mantle (e.g., plum-pudding or marble-cake mantle, Zindler et al., 1984; Allègre and Turcotte, 1986). At the same time, a large-scale heterogeneity has been argued to exist, e.g., Dupal-anomaly in the southern hemisphere (Dupré and Allègre, 1983; Hart, 1984), or East-west geochemical hemispheres in terms of hydrophilic components (Iwamori and Nakamura, 2012; 2015).
Distributions and abundances of the radiogenic isotopes such as uranium (U) -238, -235 and thorium (Th) -232 in the mantle are key to constrain cooling history and mode of mantle convection of the Earth (e.g., McKenzie et al., 1974; Davies, 1999; Korenaga, 2013), because of the radiogenic heating. However, detailed information of distributions and abundances of such radiogenic elements in the Earth's interior are not well constrained. Recently, Kamioka Liquid-Scintillator Antineutrino Detector measured the geoneutrino flux from decay of U-238 and Th-232. The observations indicate that the heat from radioactive isotopes might account for about a half of Earth's total heat flux (The KamLAND Collaboration, 2011). In addition, Tanaka and Watanabe (2014) proposed Li-loaded directionally sensitive detector for possible geo-neutrinographic imaging. Based on these on-going measurements and new methods, the fundamental questions concerning the mantle compositional structures described above could be addressed.
East-west geochemical hemispheres of the mantle have been proposed based on statistical analysis (Independent Component Analysis) of the global isotopic data set of young basalts (Iwamori and Nakamura, 2012; 2015), suggesting that the eastern hemisphere is enriched in "anciently subducted fluid component". If this is the case, we expect a systematic hemispherical difference in elemental abundances and ratios, including U and Th. Although the absolute abundances of these elements in the mantle are not readily constrained by the basalt data (unless the degrees of partial melting of basalts are tightly determined), by combining the geochemical analyses and geoneutrino measurements, we might be able to constrain the distribution and abundances of crucial elements, which will lead us to evaluate Geoneutrino.

Keywords: Mantle composition, Geoneutrino

