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Multi-scale heterogeneity of abyssal peridotite

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Petrological studies of peridotite have increasingly revealed the origin of magma as well as materials and processes of Earth interior. Although we now only access to the interior indirectly, we can obtain the mantle-derived material brought by magma transporter or by large tectonic reconstruction of the earth surface. At the ocean floor near the mid-ocean ridge spreading center, where the deep seated rock is exposed along spreading axis or fracture zone, abyssal peridotite is collected. The abyssal peridotite studies significantly contribute not only to understanding of the formation of oceanic lithosphere but also to development of analytical way for the mantle material. In mineralogical and geochemical approaches, chromian spinel is a good indicator for the origin; for example, the spinel Cr# reflects a partial melting degree of the upper mantle material (e.g., Dick and Bullen, 1984; Arai, 1987). Trace-element compositions of clinopyroxene allow us to discuss the melting process quantitatively (e.g., Johnson et al., 1990). Recently, further discussions can be available by using ultra-trace elements and PGE isotopes (e.g., Harvey et al., 2006; Ishikawa, 2012).

Several petrological studies of abyssal peridotite samples have demonstrated ”regional-scale” heterogeneity of the upper mantle along Mid-Atlantic Ridge based on their spinel Cr# (e.g., Dick et al, 1984; Michael and Bonatti, 1985). In ”Global-scopic” differences between Atlantic, Indian and Pacific oceans, Niu and Hekinian (1997) proposed that the spinel Cr# of abyssal peridotite is dependent on spreading rate. Contrasting to such a heterogeneity, Ghose et al. (1996) and Dick et al. (2010) showed that the compositional variation of the abyssal peridotite is controlled by local structures at the mid-ocean ridge: for example, spreading axis, fracture zone, abyssal plane and oceanic core complex. Geochemical heterogeneity of each abyssal peridotite sample is recently discussed in aspects of magmatic event during or after partial melting stage (Tamura et al., 2008; Warren and Shimizu, 2010).

In our presentation, to review petrological characteristics of abyssal peridotite, we will demonstrate our compiling data set focused on relationship between their spinel Cr# and sample localities, such as ocean floor structures at the mid-ocean ridge. The example of abyssal peridotite sample heterogeneity are also discussed. Then, we would like to discuss the factor and significance of compositional variation of abyssal peridotite.

Keywords: abyssal peridotite, spinel, ocean floor