# Small-scale variations in abyssal peridotites collected from Atlantis Bank of the slow-spreading Southwest Indian Ridge

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Understanding of the formation processes of oceanic lithosphere is a major issue in the Earth Sciences. Petrology and geochemistry of abyssal peridotites provide direct information on mantle melting, melt extraction and post-melting processes beneath ocean floors. Although many studies on abyssal peridotites were conducted based on local averages, less attentions have been paid to local variations in modal and chemical compositions in peridotites. Field-work like close-spaced observation and sampling on a wall of Atlantis Bank along the Atlantis II Fracture Zone in the slow-spreading Southwest Indian Ridge (14 mm/year full spreading rate) were conducted by submersible SHINKAI 6500 of the Japan Marine Science Technology Center. We succeeded a cross-sectional observation of an outcrop where layered gabbros are directly underlain by granular peridotites (gabbro/peridotite boundary hereafter). Nineteen of 20 samples are plagioclase-free spinel lherzolite with Cr number of spinel 0.2-0.35, mainly concentrated around 0.2. Chondrite-normalized REE patterns of clinopyroxene in these peridotites have LREE-depleted signatures and systematically decrease in LREE with increasing of the Cr number of spinel, and are compatible with mantle residue of a low-degree of partial melting predicted for slow-spreading ridges (Dick and Bullen, 1989, Arai, 1994). Clinopyroxene compositions are not equilibrium with mid-ocean ridge basalt in terms of REE concentrations as suggested by Johnson et al. (1990). Strong LREE depleted signatures in residual clinopyroxene were interpreted mantle residues after nearly fractional melting (Johnson et al., 1990). The dunite sample (6K643R15) was at the first time recovered from outcrop at about 40 m below the gabbro/peridotite boundary. It occurs as a dike (20cm in thickness) highly oblique to the gabbro/peridotite boundary. The dunite is accompanied with dunitic lherzolite (olivine-rich rock with high cpx/opx ratio) at the edge of the sample and is intruded by gabbro vein (2cm in thickness) (Morishita et al., 2004). The Cr number of spinel in the dunite (0.3) is similar to those in the SWIR MORB far from hot spots (Le Roex et al., 1983). REE concentrations of calculated melt equilibrated with dunite clinopyroxene show a flat to weak LREE-enriched patterns, which are similar to those in the SWIR MORB formed by low-degree of partial melting. These data indicate that the dunite acts as melt conduit even in a slow-spreading ridge. Clinopyroxene in the dunitic lherzolite occurs as porphyroclast, interstitial grain between olivine matrix and rarely rimming of orthopyroxene. Chondrite-normalized REE patterns of clinopyroxene in the dunitic lherzolite are variable corresponding to the occurrences above, LREE-depleted, LREE-enriched and high-concentrations of REEs with negative Eu anomaly, respectively. These suggest that some clinopyroxene formed from interstitial melts. The dunitic lherzolite is therefore interpreted to be residue of high-degree of partial melting, even in a slow-spreading ridge. Since the computed bulk compositions of the Hole 735B is too evolved to be in equilibrium with mantle peridotites, there must be a significant mass of missing primitive cumulates (such as high-Mg dunite and trocotlite) in the lower crust or in the mantle section around the studied area (Dick et al., 2000, 2002, Niu et al., 2002). Our results suggest that large quantities of melt were trapped in the upper mantle rather than bleeding upward to solidify in the crust if magmatic activity is low. We are grateful to Captain Ishida and the crew of the Yokosuka as well as the Shinkai team who contributed to the success of the cruise. LA-ICPMS works were supported from the 21st Century COE project of Kanazawa University (led by Hayakawa).