Petrological and geochemical diversity of mantle section revealed by comparison between northern and southern Oman ophiolite

*Eiichi TAKAZAWA[1,2], Keisuke ISHII[3], Yuki Nomoto[3], Yoshihiko Tamura[2]

1. Department of Geology, Faculty of Science, Niigata University, 2. R&D Center for ODS, JAMSTEC, 3. Graduate School of Science and Technology, Niigata University

The Oman ophiolite is a former oceanic lithosphere formed at Neo-Tethyan oceanic ridge about 95 million years ago and is now distributed along the eastern border of Arabian peninsula over 500 km length. It is suitable for studying formation of oceanic lithosphere at spreading ridge and arc-related magmatism initiated by thrusting of oceanic lithosphere (Lippard et al., 1986; Nicolas, 1989). The volcanic rocks in the crustal section in the northern part of the Oman ophiolite record an evolution in tectonic setting from spreading ridge (N-MORB) to convergent margin (arc tholeiite and boninite) (Alabaster et al., 1982; Ishikawa et al., 2002; Kusano et al., 2013, 2014, 2016). The harzburgites and dunites in the mantle section of northern Oman ophiolite (Salahi and Fizh massifs) are highly refractory indicated by high Cr# (=Cr/[Cr+Al] atomic ratio) of spinel (Cr# >0.6) (Arai et al., 2006; Kanke et al., 2014). The spinel Cr# of harzburgites and dunites show positive correlation with the Ce/Yb ratio of clinopyroxenes. The increase of spinel Cr# accompanies the increase of Ce/Yb ratio of clinopyroxenes. In general, during partial melting of harzburgite in a closed system spinel Cr# increases with increasing the degree of melting (Dick and Bullen, 1984; Arai, 1994). At the same time the Ce/Yb ratio of residual clinopyroxene decreases (Johnson et al., 1990). On the other hand, when melt/rock ratio increase by reaction between exotic fluid/melt and harzburgite in an open system, the Cr# of spinel may forms a positive correlation with the Ce/Yb ratio of clinopyroxene. The plots of harzburgites and dunites produce the same positive trend although the Cr# of spinel and Ce/Yb ratio of clinopyroxene in dunites are greater than harzburgites. The dunites may have reacted with some fluid/melt with high Cr# spinel and clinopyroxene with high Ce/Yb ratio such as boninite. The reaction of harzburgite with boninitic melt may have produced dunites with high Cr# (>0.7) spinel and precipitated clinopyroxene with high Ce/Yb ratio. Although peridotite with high Cr# spinel is common in the northern massifs they are rare in the southern massifs such as Wadi Tayin massif in the southern Oman ophiolite. Similar to the northern massifs, the Cr# of spinel in the Wadi Tayin massif forms a positive correlation with the Ce/Yb ratio of clinopyroxene. Also the range of spinel Cr# for dunites tend to be greater than those of harzburgites. Thus in the Wadi Tayin massif the reaction of harzburgite with a light REE enriched fluid/melt increased melt mass resulted in the formation of dunite with high Cr# of spinel and high Ce/Yb ration of clinopyroxne. However, in the spinel Cr# vs Ce/Yb diagram the trend for the Wadi Tayin massif is sifted to lower Cr# side relative to that for the northern massifs. The high Cr# end of the trend for the Wadi Tayin massif does not coincide with boninite. Alternatively a possible end member is MORB or arc tholeiite that were active before boninite in the northern Oman ophiolite. Chondrite-normalized pattern for clinopyroxenes in the dunite with the highest Cr# of spinel and the highest Ce/Yb ratio of clinopyroxene is characterized by negative anomaly in the high field strength elements such as Nb, Ta, Zr and Hf. This may indicate that arc tholeiite is responsible for the formation of positive trend in the spinel Cr# vs Ce/Yb diagram for the peridotites from the Wadi Tayin massif in the southern Oman ophiolite. Further investigation is required to prove this hypothesis.

Keywords: Oman ophiolite, mantle, peridotite, oceanic lithosphere, subduction zone, mantle wedge

