Mantle-melt reaction recorded in the ICDP Oman Drilling Project Hole CM2B in Wadi Tayin massif of the Samail ophiolite

*Eiichi TAKAZAWA[1,2], Natsuki Oyanagi[1], Sayantani Chatterjee[1], Fatma Kourim[3], Katsuyoshi Michibayashi[4], Oman Drilling Project Phase 2 Science Party

1. Department of Geology, Faculty of Science, Niigata University, 2. VERC, IMG, JAMSTEC, 3. Institute of Earth Sciences, Academia Sinica, 4. Graduate School of Environmental Studies, Nagoya University

At the crust - mantle boundary of the Oman ophiolite, there is a dunite dominant layer of dozens to hundreds of meters in thickness called the crust-mantle transition zone (MTZ) [1]. The formation of MTZ dunite can be attributed to the accumulation of olivine crystallized from MORB melt [2] and the reaction of orthpyroxene-undersaturated MORB melt with harzburgite [3-6], and the involvement of fluid [7-10]. The ICDP Oman Drilling Project carried out onshore drilling of the crustal-mantle boundary of the Oman ophiolite in order to clarify the formation process of the MTZ and its relation to the oceanic Mohorovicic discontinuity.

The drilling site is located in the Wadi Zeeb of Wadi Tayin massif in the southern Oman ophiolite. Hole CM1A (UTM: 40Q 637000E, 2533870N) and Hole CM2B (UTM: 40Q 637000E, 2534270N) were drilled, and 404.15m and 300.00m cores were collected at 100% recovery rate, respectively. In the summer of 2018, the detailed core description was carried out on the deep-sea science drilling vessel "Chikyu", and measurements of chemical and physical properties of the cores were performed using various instruments.

In this study we report the downhole variations of whole rock major and trace element compositions in Hole CM2B with special attention to the boundary between MTZ dunite and mantle harzburgite. Across this boundary orthopyroxene (Opx) disappears in the MTZ dunite. Whole rock CaO wt% decreases from 0.7-0.9 wt% in the harzburgite to 0.3-0.6 wt% in the dunites of the lower part of MTZ to less than 0.2 wt% in the dunites of the upper part of MTZ. The existence of intermediate dunite in the lower part of MTZ, often with thin layers of gabbro and plagioclase wehrlite, may impose constraints on the origin of the MTZ dunite.

In the chondrite-normalized pattern of rare earth elements (REEs) in whole rock, most of the harzburgites show a spoon-shaped pattern depleted in middle rare earth elements, while the harzburgite at the contact to the MTZ dunite shows a convex upward pattern with enrichment in middle to heavy rare earth elements. A similar tendency is also observed in the clinopyroxenes in dunite and harzburgite. Clinopyroxenes in the harzburgites near the boundary between MTZ dunite and mantle harzburgite are most enriched in incompatible elements including REE.

The harzburgites and dunites at the boundary between MTZ dunite and mantle harzburgite are most strongly influenced by the reaction with the melt that formed MTZ dunite by the dissolution of opx and precipitation of olivine [3]. The top of the mantle harzburgite is thought to have been a reaction front where harzburgite reacts with the melt and converts it to dunite. It is considered that the MTZ became thicker as the reaction front moved deeper. In the process of dissolving Opx and crystallizing olivine, it is possible that a similar mechanism to zone melting was activated at the reaction front, causing the concentration of incompatible elements in the melt. The equilibrium with such a melt has made peridotites enriched in incompatible elements at the boundary.

[1] Boudier and Nicolas (1995) *J. Petrol.*, **36**, 777-796.
[2] Pallister and Hopson, 1981, *J. Geophys. Res.*, **86**, 2593-2644.
[3] Kelemen et al., 1995, *Nature*, **375**, 747-753.
[4] Korenaga and Kelemen, 1997, *J. Geophys. Res.*, **102**, 27729-27749.
[5] Collier and Kelemen, 2010, *J. Petrol.*, **51**., 1913-1940.
[6] Abily and Ceuleneer, 2013, *Geol.*, **41**, 67-70.
[7] Koga et al., 2001, *G-cubed*, **2**, 2000GC000132.
[8] Rospabé et al., 2017, *Geol.*, 2017139.
[9] Rospabé et al., 2018, *Geochem. Cosmochim. Acta*, **234**, 1-23.
[10] Rospabé et al., 2019, *Earth Planet. Sci. Lett.*, **516**, 108-121.

Keywords: Oman ophiolite, mantle section, mantle-melt reaction, crust-mantle transition zone, Mohorovicic discontinuity