Drilling of crust-mantle transition zone in Wadi Tayin massif, the Oman ophiolite

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At the boundary between the crustal section and the mantle section of the Oman ophiolite there are several tens to hundreds of meters thick, mainly composed of dunite called the crust-mantle transition zone (MTZ) (Boudier and Nicolas, 1995). Since it often accompanies thin veins or clots of plagioclase and clinopyroxene and several centimeters to meters thick gabbro sills, it leaves traces of magma activity right under the ridge. The origin of dunite in MTZ is the accumulation of olivine crystallized from melt (Pallister and Hopson, 1981), or the reaction of harzburgite with pyroxene-undersatulated melt (Kelemen et al., 1995), or both (Abily and Ceuleneer, 2013). Recently, the presence of water at the time of formation has also been pointed out (Rospabé et al., 2017). To clarify the origin of MTZ, more detailed research by continuous core through MTZ is necessary. From 15th November to 5th January 2017 MTZ of Wadi Zeeb in Wadi Tayin massif was drilled by the ICDP Oman Drilling Project (Kelemen et al., 2013). Geological mapping on ground associated with information from the recovered cores the thickness of the MTZ is estimated as about 150 m. The upper and lower boundaries of the MTZ has a strike in the east-west direction, and it is inclined 30 degrees south. In the summer of 2018, the drilled cores are expected to be carefully described by scientists on the deep-sea drilling vessel "CHIKYU". The results at each drill hole are summarized below.

Hole CM1A (UTM: 40Q 637000E, 2533870N) is an inclined hole, 60 degrees northward. The cores of 404.15 m in length was recovered. The top 160 m of the borehole is mainly composed of layered gabbro and is locally interlayered with melanocratic layers rich in olivine. The middle part from 160 to 310 m is mainly composed of massive dunite, accompanied by a small amount of gabbro and wehrlite. The top of the MTZ is located at 160 m where rock lithology dramatically changes. Several ten’ s centimeters thick fracture zones with fault gouges often develop in the upper part of MTZ, and the peridotite is severely serpentinized. The lower part of the MTZ of 150 m in thickness seems less serpentinized because the equigranular texture of olivine is more visible and crystals are reflective. Furthermore, the first harzburgite appeared at 310 m reaching the bottom of MTZ. The deeper part corresponds to the mantle section. Even after the appearance of harzburgite, dunite dominates harzburgite from 310 m to 362 m. Hole CM1 B is a vertical rotary borehole of 237 m deep, located 3 m south of Hole CM1A. Geophysical logging has been scheduled using this borehole. The comparison with the oceanic Moho and integrated analysis of core and logging will be done.

Hole CM2A (UTM: 40 Q 637000 E, 2534270 N) is a vertical hole located 400 m north from Hole CM1A, and a core of 300 m in length was recovered. Drilling started from the upper part of the MTZ, the first harzburgite appeared at 140 m and reached the mantle section. From 140 to 300 m the cores consist mainly of harzburgite and dunite with a small amount of gabbro. It is stratigraphically comparable with Hole CM1A with a marker at the lower boundary of MTZ defined by the first appearance of harzburgite. Hole CM2B is drilled parallel to Hole CM2A and geophysical logging has been scheduled.

Keywords: ophiolite, ICDP, Oman Drilling Project, upper mantle, lower crust, Moho discontinuity

