Physical properties of the Moho TZ: Implications from ICDP Oman Drilling Project Phase I & II on-board measurements

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We report physical property measurements of core samples from the Samail ophiolite in Oman, drilled by the ICDP Oman Drilling Project. Onboard core logging was conducted on D/V Chikyu for 4 months in total in the summers of 2017 and 2018. We analyzed 4 holes (GT1A, GT2A, GT3A and BT1B) in 2017, and 5 holes (CM1A, CM2B, BA1B, BA3A and BA4A) in 2018. The total core length of those 9 holes is about 3200 m. Cores from Holes GT1A and GT2A in the lower crust section of the ophiolite are mainly composed of gabbros (gabbro and olivine gabbro), with small amounts of ultramafic rocks (wehrlite and dunite), whereas those from Hole GT3A at the boundary between the sheeted dikes and gabbro are mainly composed of basalt and diabase, followed by gabbros (gabbro, olivine gabbro and oxide gabbro). Minor felsic trondhjemite and tonalite dikes intrude the mafic rocks. In contrast, Hole BT1B penetrated from mantle section through the basal thrust and into the metamorphic sole. The CM holes were drilled through the crust-mantle transition, from gabbroic lower crust, through dunite with minor gabbros, and in to residual mantle harzburgite. BA holes were taken from the mantle section and are composed of dunite and harzburgite intruded by minor gabbroic and pyroxenite dikes. Ultramafic rocks at both sites were extensively serpentinized, but the names of igneous protoliths are used here.

Whole-round data, including X-ray CT images, natural gamma radiation (NGR), gamma ray attenuation (GRA) density, magnetic susceptibility (MS), P-wave velocity (Vp) and noncontact electrical resistivity were obtained. Split core color spectroscopy data were also collected. Magnetic susceptibility, electrical resistivity under both nominally dry and brine-saturated conditions, P-wave velocity, bulk/grain density, porosity and thermal conductivity were measured in discrete samples. Nearly 100% core recovery allowed us to take a large data set of petrophysical data on the cores from Oman ophiolite including fault zones and highly altered intervals.

Generally, gabbroic rock types have higher density, P-wave velocity, and electrical resistivity, and lower porosity than ultramafic lithologies. Serpentinized dunite have lower density, P-wave velocity and electrical resistivity, and higher porosity than serpentinized harzburgite, and these physical properties are correlated with magnetic susceptibility, probably due to crystallization of magnetite during alteration. Average X-ray CT values are also correlated with many other physical properties in most lithologies. Those physical property data and the lithological characteristics of the Moho transition zone in the Oman ophiolite revealed apparent difference and similarities with the oceanic data, especially in the seismic profiles from the oceanic plate. In this paper, we would like to compare the data from ocean drilling, Oman Drilling and seismic profiles.

Keywords: ICDP, Oman Drilling Project, ophiolite, Moho TZ, Oceanic crust

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