Physical property of the fossilized crust-mantle transition zone from ICDP Oman Drilling Project Hole CM1A and CM2B measured onboard D/V Chikyu

*Keishi Okazaki[1], Natsue Abe[1], Kohei Hatakeyama[2], Yuya Akamatsu[2], Ikuo Katayama[2], Eiichi TAKAZAWA[3], Damon A H Teagle[4], Peter B Kelemen[5], Jude Coggon[4], The Oman Drilling Project Phase 2 Science Party

1. Japan Agency for Marine-Earth Science and Technology, 2. Hiroshima University, 3. Niigata University, 4. University of Southampton, 5. Columbia University

To understand physical properties of the oceanic crust and the mantle is fundamentally important to reveal the dynamics of plate tectonics, and the global circulations of H_2O and CO_2 fluids. We report results on physical property measurements of core samples from Oman Drilling Project (OmanDP) Holes CM1A and CM2B, which drilled from the lower igneous crust into the upper mantle in the Samail Ophiolite, Sultanate of Oman.

X-ray CT, bulk/grain density, porosity, magnetic susceptibility, P-wave velocity, electrical resistivity and thermal conductivity were measured onboard D/V Chikyu using whole-round cores and discrete samples for core sections from CM1A and CM2B.

The paleo-Moho in CM1A may not preserve the original structure due to minor faulting, possibly during obduction. The gabbro-dunite transition (paleo-Moho) in Hole CM1A is characterized by a sharp change in physical property data. For example, P-wave velocity decreases from ~6.7 km/s in the layered gabbro sequence to ~4.9 km/s in the MTZ. Low P-wave velocity and density (~2.6 g/cm^3) in serpentinized dunites reflect the fact that olivine in the dunites is almost completely serpentinized. Serpentinization could have occurred during hydrothermal alteration near the spreading ridge axis, during subduction of 100’s of km of oceanic crust and sediment beneath the ophiolite, during obduction onto the Arabian continental margin, and/or during present-day weathering. In contrast to the paleo-Moho, the boundary between the Crust-Mantle Transition (CMT) sequences (i.e., dunites and dunites with gabbro lenses) and the underlying, residual mantle harzburgites is somewhat gradual. P-wave velocity gradually increases from ~4.9 km/s for dunite in the CMT to ~5.5 km/s for harzburgite in the mantle sequence. The thickness of the CMT is 50–70 m in Holes CM1A and CM2B. We also report on correlations between physical properties, especially electrical conductivity and magnetic susceptibility, and the fault intensity and alteration intensity from the core descriptions.

Keywords: ophiolite, mantle, oceanic crust, moho

