Petrography and geochemistry of lower crustal gabbros at Oman ophiolite: Insight from Oman Drilling Project Phase 1 & 2

*Sayantani Chatterjee[1], Eiichi Takazawa[1,2], Katsuyoshi Michibayashi[3], Oman Drilling Project Science Party

1. Department of Geology, Faculty of Science, Niigata University, 2. Volcanoes and Earth's Interior Research Center, Research Institute for Marine Geodynamics, JAMSTEC , 3. Department of Earth and Environmental Sciences, Nagoya University, Japan

Ophiolites are the fragments of the ancient oceanic lithosphere that are exposed (mostly as dismembered) on the land surface. Magmatic processes responsible for accretion of the lower oceanic crust remain one of the least-restrained components of the global seafloor spreading system. Lack of sufficient exposures regarding the systematic representation of the oceanic lithosphere is another major hindrance in deciphering crust-mantle differentiation. In order to achieve this goal lower oceanic crust thought to be a crucial lithomember which turns out to be pretty rare in a global context to observe spatial variations in magmatic flow within in situ lower crust. In this contribution, we report recovered lower crust from Oman drilling Project Phase 1, which was drilled into Wadi Gideah of Wadi Tayin massif and Phase 2, which was drilled into Wadi Zeeb of Wadi Tayin massif in Samail Ophiolite, Oman.

In Phase 1, Hole GT1A drilled the lower crustal section (recovered 401.52 m of total cores) and Hole GT2A was mainly concentrated to recover through the transition between lower crustal foliated and layered gabbro (total depth of 406.77m). Phase 2 concentrated to drill lower crust to the mantle transition zone. Hole CM1A drilled base of crust to the mantle transition zone (total depth of 404.15 m) and CM2B drilled the mantle transition zone to the mantle (total depth of 300 m).

Petrographic observation of representative samples from both phases, we found two dominant rock types: Gabbbro and Olivine gabbro, where later dominates the lower part of the drill hole. Interlayered Troctolites in association with gabbroic rock are also noted in Phase 1 samples.

Gabbroic lithologies represented by anhedral olivine with tabular to elongate shaped. Clinopyroxenes are tabular to subequant in habit. Some thin film of orthopyroxene is present as a corona around olivine. Most of the samples have undergone alteration and obscured the igneous origin. Gabbros contain plagioclase and clinopyroxene (showing poikilitic texture) as primary minerals associated with few amounts of oxides. Clinopyroxenes are often replaced by brown amphibole along cleavages or at the rim. In olivine gabbros, olivine grains are present as subhedral to skeletal in nature. Magmatic foliation is often demarked by laths of plagioclase followed by elongated clinopyroxenes. Also, symplectitic intergrowth is present between spinel and orthopyroxene. All lithologies from different holes show the different textural relationships, which will be included in this discussion.

Downhole variations of major mineral compositions and trace element compositions in both phases indicate several cycles of crystallization history. Detailed petrographic, microstructural and geochemical studies of all the representative samples will be presented. We have also attempted to determine the oxygen fugacity of the system using oxide minerals to show the range of temperature and pressure. Oxygen fugacity provides a clue to determine the thermal evolution of the lower crust and the rate of cooling to understand the accretion process.

Our data will be used to ascertain the hypotheses on accretion process of lower crust formation by 'The gabbro glacier' model (Nicolas et al., 1988), 'Sheeted sill' model (Kelemen et al., 1997) and maybe a hybrid model (Lissenberg et al., 2013) of both and its role to modification of composition of MORB. Moreover, assimilation-fractional crystallization and the percentage of trapped melt estimation will give the total scenario of the formation of lower crustal gabbros.

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