Lower crustal accretion processes revealed from the study of gabbroic cores in Holes GT1A and GT2A, the ICDP Oman Drilling Project

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Transition between middle crustal foliated and to lower crustal layered gabbros of Oman ophiolite was drilled at Hole GT2A and GT1A in Wadi Gideah of Wadi Tayin massif (22˚51.793'E/58˚31.198'N and 22˚53.535'/58˚30.904' respectively) during Phase 1 of Oman drilling project. With total depth of 406.77m long Hole GT2A core samples the middle foliated to layered gabbro. Hole GT1A drilled the lower crustal section in the southern Oman ophiolite and recovered 401.52 m of total cores (99.6% recovery). Petrographic observation of representative samples from GT2A and GT1A, we found two dominant rock types: gabbbro and olivine gabbro, where later dominates the lower part of the drill hole.

The layered structure is mainly controlled by the variable grain size and modal composition of minerals. 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. Olivine gabbros are constituted of plagioclase, clinopyroxene, olivine, some orthopyroxene and oxide minerals. Texturally, olivine grains are present as subhedral to skeletal in nature. Magmatic foliation is often demarcated by laths of plagioclase followed by elongated clinopyroxene. The contact between olivine and plagioclase frequently marked by presence of symplectitic intergrowth between spinel and orthopyroxenewhich suggests, olivine was reacting with late stage liquid and produce simultaneous coprecipitation of magnetite and orthopyroxene. Downhole evolution present from bottom to top for both in gabbro and olivine gabbro samples in terms of Mg#,TiO2, and Cr2O3 in clinopyroxene, olivine and plagioclase, particularly at 270mt and 130mt Mg# increase (influx of primitive melts at several intervals). TiO2 and Cr2O3 correspond with Mg#, and eventually follow fractionation trend. Data from rare earth elements implies that ol-gabbros are crystallized from different parent melts (at least two types) supported by the evidence from evolution with depth profile.

Gabbroic lithologies in GT1A represented by anhedral olivine with tabular to elongate shape. Plagioclase are partly or totally enclosed by large clinopyroxene. Clinopyroxenes are tabular to subequant in habit. Some thin films of orthopyroxene present as corona around olivine. Most of the samples have undergone alteration and obscured the igneous origin. In case of Hole GT2A, gabbros are much less affected by alteration compared to GT1A. Downhole variation in mineral composition (in-situ composition) can be correlated with several cycles of crystallization history. Detailed petrographic, microstructural and geochemical study of all the representative samples will be presented. We have also attempted to determine the oxygen fugacity, where (fO2 vs.T plot) oxide pairs are plotted within FMQ field (fO2 vs. T plot). Temperature estimation ranges from 600-800˚C (shallow level gabbro to deeper gabbro) cover total range of temperature from high to low and also have a clue to determine the thermal evolution by rate of cooling.

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