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Petrogenesis of the axis stage and late stage felsic rocks in the Oman ophiolite

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The presence of felsic rocks in ohiolite suites has been reported by numerous authors, and are called plagiogranite (Coleman and Peterman, 1975). Lippard et al. (1986) classified the felsic rocks in the Oman ophiolite into three stages; High-level intrusives (axis stage), Late intrusives, and younger granites associated with emplacement. Rollinson (2009) described similar classification of the felsic rocks in the Oman ophiolite, and discussed petrogenesis of these felsic rocks. This paper describes field occurrences, petrography, and petrochemistry of the felsic rocks in early (axis stage) intrusive rocks and late (associated with detachment) intrusive rocks. In this study, we investigate felsic rocks from the Lasail complex as an example of late intrusive rocks.

Lasail complex, dimension of 4.7 x 3.8 km, consists of gabbroic and tonalitic rocks. The gabbroic rocks are composed of layered gabbro and massive gabbro. The layered gabbro is intruded by the massive gabbro, and often occurs as large blocks in the massive gabbro. The layered gabbro is composed mainly of gabbronorite and leucogabbronorite associated with dunite, lherzolite, websterite, olivine gabbronorite. The massive gabbro consists of hornblende gabbronorite, hornblende gabbro, and hornblende diorite. These gabbroic rocks are intruded by small intrusions of hornblende diorite to hornblende tonalite. The quartz diorite consists of hornblende diorite to hornblende tonalite, and intrudes into the gabbroic rocks.

We also investigate felsic rocks associated with the sheeted dike complex from eastern margin of the Lasail complex and Wadi Barghah, and those associated with upper gabbro from Wadi Rajimi (Rollinson, 2009) as examples of early intrusive rocks. Sheeted dike complex is intruded by upper gabbroic rocks in eastern margin of the Lasail complex and Wadi Barghah, and upper gabbro includes sheeted dikes as large blocks less than 10 m in Wadi Rajimi. These sheeted dikes are infiltrated by quartz dioitic vein networks. In some places, sheeted dike complex is composed of hornblende and pyroxene hornfels cut by quarts dioritic vein networks. These occurrences resemble to the anatectic migmatites of axial magma chamber roof exposed in the Troodos ophiolite, Cyprus, described by Gillis and Coogan (2002).

Bulk chemical compositions of the felsic rocks from the late intrusive rocks are characterized by extreme depletion in incompatible elements compared with the early intrusive rocks; K2O, P2O5, TiO2, and REEs. In the case of REEs, felsic rocks from the early intrusive rocks are clearly richer in REE contents than those from the late intrusive rocks. Rollinson (2009) explains that early felsic rocks were produced by the partial melting of hornblende gabbros (cumulate gabbros) in the roof zone of an axial magma chamber, facilitated by the influx of seawater. He also describes that late gabbro-trondjhemite complex, which formed from a mafic magma by the remelting of previously depleted mantle harzburgite followed by fractional crystallization. Explanation of Rollinson (2009), however, is inconsistent with the occurrence interpreted as anatexis of sheeted dike complex.

Gillis and Coogan (2009) describes disequilibrium melting models to explain relatively lower REE concentrations in early felsic rocks. Disequilibrium melting models assume that the concentration of an element in a melt is simply controlled by its concentration in the constituent minerals and the relative proportions in which they dissolve into the melt (e.g., Bea, 1996). This paper will discuss the possibility of disequilibrium melting by using the newly collected samples of the early felsic rocks, and detailed petrogenesis of the late felsic rocks.

Keywords: Oman ophiolite, plagiogranite, oceanic crust, petrochemistry