Contribution of slab-derived fluids and sediment melt in the incipient arc magma of the Oman Ophiolite

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Ophiolite gives us a great opportunity to observe the peridotite-crust sequence as an integration of magmatism during the subduction initiation. Since metamorphic rocks beneath the peridotites are considered to be a remnant of subducted slab, there is a chance to understand developing process of wedge mantle. However, less exposure and severe secondary alteration in the volcanic rocks had prevent studying whole volcanism of the incipient arc. In the Oman Ophiolite, Sultanate of Oman, a type volcanostratigraphy of the incipient arc stage (V2) has been reconstructed [1]. We present how the arc magma was produced during the subduction initiation.

The V2 magmatism occurred at 96–94 Ma. It is subdivided into the lower arc tholeiite (LV2) and upper boninite (UV2). The fresh UV2 glass has higher LILE and lower HREE content than the LV2 glass. The compositional change with age may result from source depletion with increasing slab-derived fluid. In spite of similar εHf to the LV2, low εNd of the UV2 illustrates that contribution of slab-derived fluid and sediment melt is necessary to form the UV2 magma. We conducted simple partial melting model to form the V2 magmas by using metamorphic rock compositions. Slab-derived fluid composition is estimated as in equilibrium with amphibolites [2]. Sediment melt is assumed to be bulk metachert which intercalated with amphibolites. The source mantle composition is estimated as a residue of pre-subduction (V1) stage basalt [3]. The LV2 is modeled by partial melting of the V1 residue with addition of 1.5% amphibolite-derived fluid. Compositional variation of the primitive UV2 magma would be explained by different contribution of amphibolite-derived fluid and metachert.

[1] Kusano, Y. et al. (2014) GSL Spec. Publ., 392, 177–193. [2] Ishikawa, T. et al. (2005) EPSL, 240, 355–377. [3] Kusano, Y. et al. (2016) Chem. Geol. Submitted.