Transition from MORB through intermediate type to IAT magmatism in the northern Oman ophiolite

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Wadi Rajmi area in the northern Oman ophiolite had been recognized as an "anomalous" crustal section in the Oman ophiolite, including the dike swarms crosscutting sheeted dike complex and large occurrence of gabbronorite (e.g. MacLeod & Rothery, 1992). In this area, the crustal section shows over 7km thick sequence consisting of layered gabbro, layered wehrlite, heterogeneous gabbronorite, isotropic diorite-tonalite, foliated gabbro, isotropic and pegmatitic gabbro, sheeted dike complex and pillow lava, from bottom to top. Besides three boninitic dike swarms are found from this area, and they are intruding into lower crust to pillow lava. Layered wehrlite, heterogeneous gabbronorite and isotropic diorite-tonalite are regarded as the late intrusive complex intruding into layered gabbro and foliated gabbro. Layered gabbro blocks rarely appear in heterogeneous gabbronorite. The boninitic dike swarms crosscut all earlier plutonic rocks including the late intrusive complex and dikes.

Based on mineral and bulk chemistry, we could distinguish three types of magma products (MORB, IAT and intermediate type) in the crustal sequence of Wadi Rajmi area. Trace element and REE contents of the boninitic dike swarms indicate a very low-Ti (TiO_2= 0.14-0.61 wt.%) and a depleted spoon-like chondrite-normalized REE pattern (La_N/Sm_N= 0.63-1.67). These characteristics indicate that the boninitic dike swarms have IAT affinities and some of these have high-Ca boninite affinities. Clinopyroxenes from the boninitic dike swarms are a very low TiO_2 (<0.33 wt.%) in consistent with the bulk rock characteristics. Clinopyroxenes from gabbronorite indicate slightly lower TiO_2 content (0.05-0.74 wt.%) than those of layered gabbro and foliated gabbro (TiO2=0.18–0.91 wt.%; corresponding to MOR gabbro). Clinopyoroxenes from layered wehrlite have a vely low TiO_2 content (0-0.15 wt.%) and REE patterns witch are comparable with those of boninite dike swarms. These mineral chemistry of the late intrusive complex indicate that these rocks crystallized from intermediate type magma between MORB and IAT.

The occurrence of three types of magma suggests that the tectonic setting of the Oman ophiolite was changed from accretion stage of MORB oceanic crust at mid-ocean ridge through reconstruction stage of oceanic crust by intrusion of intermediate type magma to IAT magmatism stage (subduction related magmatism).

Reference

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2.7 Ga Re-Os age for C-rich slate of the Joy Lake sequence, western Wawa subprovince, Minnesota

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Re-Os dating of carbonaceous rocks using H_2SO_4-CrO_3 dissolution [1] provides a powerful new geochronologic tool for application in Archean terranes. Using this method, we determined ages of ~2.7 Ga for C-rich slates in the Joy Lake sequence, the oldest Re-Os ages yet reported for C-rich sedimentary rocks. The Joy Lake supracrustal sequence (western Wawa subprovince, Superior province, north-central Minnesota) consists of volcanic and sedimentary strata with intercalated mafic tuff lenses, intruded by layered peridotite-pyroxenite-gabbro sills of the Deer Lake complex. Poor exposure and lack of geochronologic data for this sequence hinder construction of a geologic framework for the Wawa supracrustal rocks, compromising correlation with other sedimentary sections in the Superior province.

Carbonaceous slates of the Joy Lake sequence have well-developed cleavage subparallel to bedding and contain nodules, disseminations, and bedding-parallel stringers of pyrite [2]. Samples from two drill holes (DH26503 and DH26506) yield isochron ages of 2695±14 Ma and 2684±16 Ma and initial $^{187}Os/^{188}Os$ (Os_i) of 0.15±0.16 and -0.29±0.20, respectively. The ages, identical within uncertainty, are consistent with ages for Timiskaming-type sequences in the Wawa (~2688 to 2695 Ma) and Abitibi subprovinces (~2677 to 2680 Ma) [3,4], that represent late-orogenic deposits and likely postdate the Joy Lake sequence.

A chondritic Os_i (0.109 at 2.69 Ga) is expected in Archean shales [5], but the negative Os_i for DH26506 requires explanation. Re may have been released from intercalated high Re/Os mafic tuffs during recent exposure and local oxidation. The C-rich rocks are a ready sink for mobile Re. This could shift isochron data points to higher $^{187}Re/^{188}Os$ with minimal slope change, increasing scatter and uncertainty for the Os_i. This would shift the isochron to the right, producing a spuriously low or negative Os_i intercept. If the Re addition is recent, the age is not affected. Notably, the shales in DH26506 are in direct contact with pyroxenite [2].

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