Geochemical evaluation of Haybi volcanic rocks as a protolith of amphibolites in the metamorphic sole of Oman ophiolite

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We conducted geochemical analysis of the Haybi volcanics and amphibolites of metamorphic sole from the Sumeini Window in the northern Oman ophiolite to understand the protolith of amphibolites and their genetic relationship to the Haybi volcanics.

In the Sumeini Window the metamorphic sole consists of amphibolite, greenshist and quartzite. They have been thermally metamorphosed during thrusting of ophiolite mantle section. The metamorphic sole occurs tectonically above the Haybi Complex that includes metachart, limestone and volcanic rocks so that the protolith of metamorphic sole is considered as Haybi Complex. Haybi volcanics are alternations of pillow lava and lava sheet. Some pillow lavas occur as blocks enclosed in metachart.

By examination of whole rock compositions using discrimination diagrams and C1 chondrite-normalized patterns of rare earth elements (REE) Haybi volcanics can be divided into either OIB or E-MORB type. OIB-type basalts are pillow lava and lava sheet of alkali basalt to bsasanite and is stratifically located beneath E-MORB type that is blocks of trachyandesite to dacite enclosed in metachart. On the other hand, amphibolites can be divided into N-MORB to E-MORB type. Amphibolites with E-MORB affinity are geochemically similar to E-MORB type volcanic rocks. There is no systematic distribution of N- and E-MORB types along a wadi in the Sumaini Window. Both N- and E-MORB types occur near the contact between metamorphic sole and mantle section.

Whole rock Nd isotope ratio and La/Yb ratio show a broadly negative correlation that are similar to those of volcanic rocks from Kerguelen islands. These variations can be explained by mixing between MORB source mantle and isotopically enriched mantle associated with various degrees of melting. Our results show that N-MORB, E-MORB and OIB type volcanic rocks were distributed on the oceanic crust prior to the thrusting of Oman ophiolite. Then, N-MORB and E-MORB were subducted beneath ophiolite so that they were metamorphosed to amphibolite by thermal metamorphism and accreted to the base of the ophiolite. On the other hand, OIB-type volcanic rocks that are free from thermal metamorphism accreted beneath metamorphic sole after N-MORB and E-MORB at relatively lower temperature and formed Haybi Complex.

Keywords: Oman ophiolite, metamorphic sole, Haybi volcanics, OIB, N-MORB, E-MORB

