Geochemistry and tectonic significance of basalts from Central Iran: Evidence from Nain and Ashin ophiolites

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The Nain-Ashin ophiolites belong to the highly dismembered Mesozoic ophiolitic complexes bordering the central-east Iranian microplate (CEIM) and therefore represent a key area for reconstructing the tectono-magmatic and geodynamic evolution of central Iran. These ophiolites are mainly represented by mantle peridotites, though minor pillow lavas and sheeted dykes in Nain, and pillow lavas in Ashin can be found. In this contribution, we present new geochemical data on pillow lavas from these ophiolites with the aim of assessing the tectono-magmatic processes that characterized the western border of the CEIM during Cretaceous times.

The studied volcanics consist mainly of basalts and minor ferrobasalts and basaltic andesites, all showing a clear subalkaline nature (e.g., Nb/Y=0.03-0.21). Two samples from the Nain ophiolite are characterized by N-MORB normalized incompatible element patterns showing marked Th positive and Ta, Nb, Ti negative anomalies. Chondrite-normalized REE patterns show LREE/HREE enrichment, with La_N/Yb_N= 3.2-4.3. These rocks are chemically similar to the calc-alkaline basalts (CAB). All other samples display a wide range of chemical compositions. However, the relatively less fractionated basalts are characterized by low TiO_2 (0.60-1 wt%), P_2O_5 (0.03-0.08 wt%), Zr (23-75 ppm) and Y (9-27 ppm) contents. Cr (38-619 ppm) and Ni (22-220 ppm) contents show a wide range of variations. N-MORB normalized incompatible element patterns show rather flat trends and a general depletion (0.4-0.8 times N-MORB) coupled with a slight Th enrichment (1-3 times N-MORB). REE patterns are generally flat and are characterized by a slight depletion/enrichment in LREE, compared to HREE (La_N/Yb_N=0.7-1.2). These chemical features resemble those of island arc tholeiites from ophiolites. The depletion in incompatible elements, compared to N-MORB, indicates that these rocks were derived from partial melting of a depleted mantle source. Our data suggests that the ophiolites formed in a subduction-related tectonic setting. The chemistry of the rocks is compatible with those from transition zones, either from forearc to arc or from arc to backarc.