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Research Article

Petrography, mineralogy, and geochemistry of the Hemrin Basalt, Northern Iraq: Implications for petrogenesis and geotectonics

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ABSTRACT

The studied Hemrin Basalt (HB) was previously mis-identified and called burnt hills. The HB is studied petrographically and geochemically as constraints for its provenance and geotectonics. The immobile trace element plot of Zr/TiO_2–Nb/Y as well as mineralogy, textures and hand specimen appearance indicate that the studied rocks are basalts. This basalt occurs as surficial thin layer capping few hills along a NW/SE oriented direction within the Injana Formation in the Low-Folded Tectonic Zone, which is not related and far from the ophiolites of northeastern Iraq. It consists dominantly of diopside, labradorite and volcanic glass, and many accessory and secondary vesicle-filling minerals (amygdules). The basalt is very fine-grained with a massive and vesicular/amygdaloidal structures, and sub-ophitic as well as very rare and unusual textures, called firework and feathery in this study which are very similar to those of lunar basalts. The large ion lithophile elements (LILE) are enriched 4.8 times relative to the high field strength elements (HFSE), indicated from the MORB-normalized diagram for major and trace elements. The average content of rare earth elements (REE) in HB is 140 ppm with 10.6 times enrichment of LREE relative to HREE which is reflected in their chondrite-normalized diagram having a negative slope of 7.6 and a small Eu-anomaly of 0.7. The $(La/Yb)_n$–La plot showed that the source magma was fractionally crystallized; whereas, the immobile trace element ratios and elemental values such as Nb/U, Ce/Pb, Nb/La, LREE/HREE, LILE/HFSE, Zr, Hf, Nb, and Ta indicated that source magma for HB was contaminated while rising through the Arabian continental crust. Many major, immobile trace and REE element discriminating diagrams showed that the studied rocks are high-K calc-alkaline basalts formed as a continental volcanic arc under orogenic convergent tectonic conditions because of the continent-continent collision between the Arabian and Turkish/Iranian plates. The surficial HB and the surrounding calc-alkaline tuffs are probably related and formed by the same volcanic eruption during Quaternary period, <0.5 Ma ago. The source of HB is most probably a hot spot volcano erupted in the area close to the studied hills, ejecting large amounts of volcanic ash which deposited the tuff beds and the associated bentonites in the surroundings, and culminated by a basaltic flow which formed the HB.