

Geochemistry and petrogenesis of Jurassic volcanic rocks in Central Alborz, Iran

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Summary

The Central Alborz structural zone of Iran has been the focus of magmatism from the Permian to Tertiary. This study focuses on Jurassic volcanism that outcrops in the eastern part of Damavand city, Central Alborz. Petrographic examination of samples collected as part of this study, identified a continuous spectrum of compositions from alkali-olivine basalt to trachybasalt. An observed gradual decrease in size and abundance of olivine and pyroxene phenocrysts, from the lower part of the sequence upwards, contrasts to that of feldspar phenocrysts, especially microliths, that became more abundant at higher levels. This suggests that magma may have cooled in several stages, or under changing conditions during ascent and emplacement (i.e., temporary storage and crystal fractionation having occurred prior to eruption). Determined compositions for pyroxene, find this typically is augite, whereas most plagioclase is albitic. Whole-rock geochemistry confirms our basalt to alkali basalt petrographic assignment, as do plots of immobile trace elements for these samples. A variety of discriminant diagrams, including Th vs. Co and Zr vs. Ti/Zr found affinity to calc-alkaline rocks and to a back-arc environment. Correlations between Ni, V and Cr suggest that the primary magma to the basalts likely experienced varying degrees of mainly clinopyroxene fractionation. On chondrite-normalised REE patterns, the investigated rocks show enrichment of LREE relative to HREE, suggesting that garnet may have been stable in the source. Fractionation is also evident in these patterns, though a lack of anomalous Eu suggests that plagioclase was not an important fractionating phase. Multi-element-normalised patterns show enrichment in a range of trace elements (Th and LREE), and depletion in Nb and Ta, elements which might suggest contamination with upper continental crust or through fluids derived during subduction processes. The observed trace element patterns are similar to those of ocean island basalt (OIB) and an enriched mid-ocean ridge basalt (E-MORB/P-MORB), whereas La/Sm and Sm/Yb ratio plots suggest enriched mantle compositions, and that the Damavand area basalts formed by low degree partial melting of a garnet- + spinel-bearing lherzolite mantle, which contained a greater proportion of garnet than spinel. The determined characteristics of Jurassic basaltic magmatism is similar to that of other magmas erupted across Central Alborz during the Permian, Triassic, Cretaceous, and Tertiary, which reflect an extensional setting, and the involvement of lithospheric and asthenospheric mantle sources where the asthenosphere contributed to magma genesis. Generally, these rocks are thought to relate to a back arc tectonic setting.