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Syn-collision Pliocene-Quaternary volcanism in NE Iran: mantle melting on the periphery of the Turkish-Iranian Plateau

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NE Iran is part of the Turkish-Iranian Plateau, but lies up to 1000 km from the Zagros suture zone. The Plateau formed during the Late Cenozoic, as part of the Arabia-Eurasia collision zone. Collision began at ∼30 Ma, and is still active. There has probably been break-off of the Tethyan oceanic slab under the Plateau at some stage, but the constraints are not precise. Many recent mafic, mantle-derived volcanic centres in NW Iran, E Turkey and Armenia post-date the initial collision and are derived from subduction-modified lithospheric mantle sources. These centres can be attributed individually to slab break-off, lithospheric thickening, and small-scale lithospheric delamination close to the suture.

The few studies of mafic magmatism in E and NE Iran indicate largely ocean island basalt (OIB)-like sources. Volcanic rocks from the Faruj area within the Binaloud Range fall into two distinct categories: Pliocene-Quaternary mafic alkaline rocks and more felsic samples with adakite-like affinities of uncertain age. We present new major, trace element and radiogenic isotope results focussing in particular on the mafic rocks from Faruj as a guide to the nature of the upper mantle beneath the region and its relationship to Mesozoic-Cenozoic collision processes.

The mafic rocks are trachybasalts with ∼48 wt.% SiO_2, moderate MgO (Mg# = 54-59), high Ni (<160 ppm), Cr (<190 ppm), TiO_2 (∼2.2 wt.%), and extreme enrichment in Nb (60-80 ppm). Overall trace element patterns are LREE-enriched and HREE-depleted, indicative of small-degree partial melting of peridotite containing residual garnet. Samples are moderately depleted in fluid-mobile elements and contain no evidence for interaction with a subduction zone. Analysed felsic rocks have some affinities with high-silica adakites (SiO_2 ∼ 68 wt.%; MgO <1.2 wt.%, Sr/Y ∼ 70, La/Yb ∼ 60) but also contain up to 90 ppm Ni and 30 ppm Cr suggesting derivation from mafic melts or interaction with peridotite mantle.

Like the OIB-like rocks elsewhere in E Iran, the mafic Faruj samples formed by melting of upwelling asthenosphere. The region was the site of subduction-related magmatism during the Mesozoic to Early Cenozoic. The region also lies to the north of the shallow-angle Makran slab. Therefore significant pre-existing lithospheric topography, lithospheric thickening during Arabia-Eurasia collision, and mantle flow induced by Makran subduction may have all contributed to recent small-scale upwelling and melting of asthenosphere. The origin of the adakite-like rocks remains uncertain until a definitive age is obtained.