Petrogenesis of post-collisional volcanism in the Greater Caucasus

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The Caucasus lie between the Alpine and Himalayan orogens and are characterised by intense post-collisional volcanism in marked contrast to its neighbouring orogenic belts. Following the onset of collision, triggered by the Oligocene closure of Tethys, there was a major rearrangement of tectonic regime, related to the closure of the Greater Caucasus bark-arc basin, and a major phase of uplift at 5Ma. The thickened crust (>50km) has been intruded by Pliocene-Quaternary volcanism, the source of which is poorly understood. We present the first comprehensive study of bulk-rock major and trace elements, and Sr-Nd-Pb isotopes, that constrain the role of asthenosphere, lithosphere and crust in the Greater Caucasus and help unravel the complexity of the Arabia-Eurasia collision.

Rock types range from baslatic andesites to dacites, although high Mg# (>80) cores of olivine and clinopyroxene phenocrysts suggest more mafic melts exist at depth, hence requiring significant fractionation from a more primitive source. Enrichment in large-ion lithophiles and negative Ti and Nb-Ta anomalies are indicative of a source enriched by subduction related fluids. A relatively low degree of shallow partial melting (2-5%) is required, with a small input from deeper melts ($(Dy/Yb)_N$ = 1.2-1.65) to explain variations in trace elements. Middle rare-earth patterns show that amphibole fractionation played a significant role and may be the result of an evolved hydrated source region. Variations in radiogenic isotopic compositions (Sr, Nd, Pb) require interaction with the local Variscan crust.

Our results are consistent with subduction of the back-arc crust prior to collision, and support a shallow, lithospheric source, metasomatised by slab-derived fluids. Melting may have been triggered by an influx of heat from the asthenosphere, the result of a slab breakoff event. Further investigation will allow sources and petrologic evolution of post-collisional volcanism across the Caucasus to be better constrained and compared with those from the wider Arabia-Eurasia collision zone, and hence integrated into a post-collisional tectonic model for the region.