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A Comparison of Recent Post-Collisional Volcanism in the Lesser and Greater Caucasus

Samuel Bewick (1), Nigel Harris (1), Ian Parkinson (2), Sam Hammond (1), Shota Adamia (3), and Nino Sadradze (3)

(1) Department of Environment, Earth and Ecosystems, Open University, Milton Keynes, UK, MK7 6AA, (2) School of Earth Science, University of Bristol, Queens Road, Bristol, UK, BS8 1RJ, (3) Tbilisi State University, Institute of Geophysics, 1/1M. Alexidze St. 0171, Tbilisi, Georgia

The southern margin of the Eurasian plate is a well studied region of continental collision. The Caucasus lie in the centre of the Alpine-Himalayan orogenic belt, and differ from their better studied neighbours by the presence of intense post-collisional volcanism. The Lesser Caucasus (LC) represent a Jurassic-Cretaceous-early Palaeogene arc formed from the northward subduction of the Neotethys Ocean. The back-arc basins that opened behind this arc closed during the Oligocene Arabia-Eurasian collision, forming the Greater Caucasus (GC). Late Miocene-Quaternary volcanism has erupted through the thickened crust (45-60km), tens of millions of years following continental collision. The source of magmatism in this region of significantly thickened crust is poorly constrained. We present bulk rock major and trace element, and Sr-Nd-Pb isotope data to unravel the complexity of the orogenic zone and assess the role of asthenosphere, lithosphere and crust in the contemporaneous Greater and Lesser Caucasus volcanism.

Rock types from the LC cover a wide range of compositions from basalts to dacites (50-70 wt% SiO_2). Those from the GC range from andesites to rhyolites, although high Mg# (up to 85) cores of olivines and clinopyroxenes, suggest more mafic melts exist that have not been recognised at the surface. Significant fractionation from a primitive source is required to produce the range of compositions measured. Enrichment in large-ion lithophiles and negative Ti and Nb-Ta anomalies are indicative of a source enriched by subduction related fluids. Flat heavy rare earths patterns ((Dy/Yb)N = 1.14-1.42) require shallow (<70km) melting for the LC magmas, while the GC volcanics ((Dy/Yb)N = 1.2-1.65) require a small input from deeper melts. Middle rare earth patterns show amphibole fractionation played a significant role in LC magmatism. Variations in radiogenic isotopic compositions (Sr, Nd, Pb, Hf) require interaction with local GC and LC crust.

Our results are consistent with subduction of Tethyan crust prior to collision. Our data do not support a crustal origin for these melts, but the shallow depth of melting requires a mantle lithosphere source, close to the base of the thickened crust. Melting may have been triggered by an influx of heat from the asthenosphere, either from slab breakoff, or a delamination event. The former possibility is consistent with recent geophysical studies of lithospheric structure beneath the Caucasus. Assimilation-fractional-crystallisation processes must have occurred during melt ascent to the surface. Further investigation will allow sources of post-collisional volcanism across the Caucasus to be better constrained. The petrologic evolution of the magma will be compared with those from the wider Arabia-Eurasia collision zone, and hence integrated into a post-collisional tectonic model for the region.