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What olivine and clinopyroxene mineral chemistry and melt inclusion study can tell us about magmatic processes in a post-collisional setting. Examples from the Miocene-Quaternary East Carpathian volcanic chain, Romania

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Calc-alkaline magmatism occurred along the easternmost margin of Tisia-Dacia at the contact with East European Platform forming the Călimani-Gurghiu- Harghita volcanic chain. Its northern part represented by Călimani-Gurghiu-North Harghita (CGNH hereafter) is showing a diminishing age and volume southwards at 10-3.9 Ma. This marks the end of subduction-related magmatism along the post-collision front of the European convergent plate margin. Magma generation was associated with progressive break-off of a subducted slab and asthenosphere uprise. Fractionation and crustal assimilation were typical CGNH volcanic chain. The rocks show homogeneous 87Sr/86Sr, but a linear trend of Th/Y vs Nb/Y that reflects a common mantle source considered to be the metasomatized lithospheric mantle wedge. Fractionation and/or assimilation-fractional crystallization are characteristic for each main volcanic area, suggestive of lower to middle crust magma chamber processes.
The South Harghita (SH) volcanic area represents direct continuation of the CGNH volcanic chain. Here at ca. 3 Ma following a time-gap, magma compositions changed to adakite-like calc-alkaline and continued until recent times (< 0.03 Ma). This volcanism was interrupted at $\sim$1.6-1.8 Ma by simultaneous generation of Na- and K-alkalic varieties in nearby areas, suggestive of various sources and melting mechanisms, closely related to the hanging block beneath Vrancea seismic zone. The specific geochemistry is revealed by higher Nb/Y and Th/Y ratios and lower 87Sr/86Sr as compared to the CGNH chain.
Identification of primitive magmas has been difficult despite the fact that this volcanic area contains more basalts than any other in the Carpathian-Pannonian region. Since the most primitive rocks represent the best opportunity to identify the trace element composition of the mantle source beneath the East Carpathian volcanic chain we use mineral and melt inclusions in olivine and composition of the most primitive clinopyroxene to estimate the source composition. The results show extremely diverse olivine compositions (Fo90-65) in single rocks indicative of extensive mixing and back-mixing processes during fractionation. The most forsteritic olivines (Fo80-90) contain either $Al2O_3$ rich spinels (30-40%), with low Cr/(Cr+Al) ratio (0.2-0.4), or low $Al2O_3$ spinels (30-40%), but with high Cr/(Cr+Al) ratio (0.6-0.8).
Trace element concentrations of melt inclusions, using laser-ablation technique, in the most forsteritic olivines give a snapshot of early and hence primitive magma chemistry. Our results suggest that whole rocks geochemistry does not define exactly the source region as being an average of various melt components and further fractionation processes. In the East Carpathians there are two distinct mantle components: variably subduction-modified lithospheric mantle and slightly modified asthenosphere which support slab breakoff (CGNH) and slab-pull and tearing models (SH).
The study offers an inside understanding on source melting during post-collisional processes suggesting an anomalous mantle, potentially a subduction-modified source due to asthenospheric upwelling.
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