Geochemical fingerprints in Siberian mantle xenoliths reveal progressive erosion of an Archean lithospheric root

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Mantle xenoliths from a picrobasalt quarry in Miocene (14 Ma) and Holocene (~0.65 Ma) basalts of the Bulykhta Riverside and Kandidushka volcanoes in the Vitim volcanic plateau, SE Siberia, are dominantly spinel-, garnet-, or garnet–spinel-bearing lherzolites with minor pyroxenites. Equilibrium temperatures and pressures of garnet-bearing lherzolites in the Miocene basalts range from 1110 to 1250 °C and 22 to 28 kbar, whereas those in Holocene basalts have similar temperatures (1110–1180 °C) but lower pressures (20 - 21 kbar). The latter thus yield a hotter geotherm than the former. The Fo contents of olivine in these lherzolites range from 89.1 to 90.6, with most from 89.8 to 90.2. Trace-element patterns of clinopyroxenes (cpx) in the lherzolites can be divided into three types: depleted, enriched and intermediate. The depleted patterns are typical of unmetasomatised, refractory lithospheric mantle. The enriched and intermediate ones provide fingerprints of different metasomatic episodes. Some lherzolites contain amphibole and/or apatite as evidence of modal metasomatism. Whole-rock and cpx Sr–Nd isotopic ratios of lherzolites in Miocene basalts are more radiogenic ($^{87}Sr/^{86}Sr$=0.70225-0.70561 and $^{143}Nd/^{144}Nd$=0.51288-0.51303) than those in Holocene basalts ($^{87}Sr/^{86}Sr$=0.70244-0.70374 and $^{143}Nd/^{144}Nd$=0.51300-0.51329). It indicates the material sampled from the SCLM beneath the Vitim region in Holocene time is more depleted than that sampled in the Miocene. Os isotope compositions of sulfides display simiar temporal variation; the lherzolites in the younger basalts have more radiogenic ratios ($^{187}Os/^{188}Os$=0.1066-0.1318) than those in the older basalts ($^{187}Os/^{188}Os$=0.1168-0.1350). Both T_{MA} ages from the least-disturbed sulfides ($^{187}Re/^{188}Os$<0.07) and T_{RD} ages from higher-Re/Os sulfides yield model ages ranging from 0.5 to 3.2 Ga, with peaks around 1.4, 1.1, 0.9 and 0.5 Ga. The Miocene basalts sampled a deeper, more refertilised part of the Archean root, compared to the shallower part sampled by the Holocene basalts.

Compositional variation in apatites from carbonatites and associated alkaline silicate rocks: A case study of the Kaiserstuhl complex, Germany

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In the present study, we investigate textural and chemical signatures of apatites from a series of carbonatites, related alkaline silicate rocks, an unusual carbonate-bearing melilitic dyke rock (bergalite) and a diatreme breccia of the Miocene Kaiserstuhl Volcanic Complex, South Germany.

Significant chemical differences between apatite from carbonatites and associated alkaline silicate rocks exist for Sr, Fe, Mn, Th, U, Nb, Si, S, As, Cl and Br. These differences can be attributed to different partition coefficients, melt compositions, substitution mechanisms and redox conditions.

A systematic and sharp core-mantle-rim zonation is present in apatites from the bergalite sample. The core and mantle zones are compositionally similar to apatites from silicate rocks, whereas the rim compositions correspond to that of carbonatitic apatites. These observations imply that bergalititic apatites initially nucleated in a siliate melt and continued crystallizing from a melt with carbonatitic affinity during later stages. This late-stage carbonatitic melt was interpreted as the protracted fractionation product of the carbonate-bearing nephelinitic melt [1].

Apatites from a diatreme breccia (containing carbonatitic and silicate rock components) comprise three textural and compositional populations: (1) similar to apatites from silicate rocks, (2) similar to apatites from carbonatites, and (3) resembling apatite population (1) partially replaced by population (2). We infer that apatite population (1) derived from silicate rock fragments and apatites (2) crystallized from the later intruding carbonatitic melt causing the formation of the breccia. During ascend of the carbonatitic melt, metasomatic overprint caused the observed replacement textures in apatite population (3).

[1] Keller (1997) *Geol.Ass./Mineral.Ass. Annual Meeting*. **Abstract**, A77.

www.minersoc.org
DOI:10.1180/minmag.2013.077.5.23