



Trace (including light) element systematics in a suite of upper mantle xenoliths from Marsabit (Kenya rift): indications for subduction-related metasomatism?

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Li, Be and B concentrations were measured in upper mantle-derived spl lherzolites, hosted by quaternary alkali basalts and basanites from the Marsabit volcanic field (Kenya rift). The analyses were performed in-situ by secondary ion mass spectrometry (SIMS) on samples previously analysed for major elements (electron microprobe) and trace elements (laser ablation ICPMS). Two types of samples were distinguished. One is a porphyroclastic former garnet (now spinel-bearing) lherzolite of relatively fertile composition (e.g. Fo content in olivine ~ 89 , Na₂O ~ 2.0 wt% and mg numbers of ~ 92.5 in clinopyroxene). Cores of clinopyroxene retained a garnet signature [low heavy rare earth element (HREE) contents]. Light REE's (LREE) in clinopyroxene are relatively depleted. Ti pargasite testifies to a metasomatic overprint. However, light elements (Li, Be, B) were not enriched during this event, as minerals show values similar to those of many non-metasomatic spl peridotites reported from other localities.

The second type of samples comprises porphyroclastic spl lherzolites and harzburgites. Major elements in minerals indicate a more 'depleted' character (higher modal olivine with Fo contents between 90 and 92; mg-numbers in clinopyroxene up to 94). In contrast many trace elements are enriched (especially LREE, U and Th). In addition, high amounts of modal amphibole (Ti-poor katophorite) and phlogopite (with up to 2.5 wt% Na₂O) evidence a strong modal metasomatic overprint with addition of incompatible elements. In this case, also the light elements are highly enriched, showing the following concentrations: orthopyroxene (Li: 1.53-4.05 $\mu\text{g/g}$; Be: 0.02-0.26

$\mu\text{g/g}$; B: 0.05-0.73 $\mu\text{g/g}$), clinopyroxene (Li: 0.85-1.98 $\mu\text{g/g}$; Be: 0.14-0.40 $\mu\text{g/g}$ B: 0.19-0.53 $\mu\text{g/g}$) olivine (Li: 4.10-8.13 $\mu\text{g/g}$; Be: \sim 0.02 $\mu\text{g/g}$; B: 0.05-1.00 $\mu\text{g/g}$), amphibole (Li: 2.47-5.17 $\mu\text{g/g}$; Be: 1.29-4.72 $\mu\text{g/g}$; B: 1.52-6.02 $\mu\text{g/g}$), phlogopite (Li: 0.63-5.14 $\mu\text{g/g}$; Be: 1.17-1.51 $\mu\text{g/g}$; B: 1.17-1.59 $\mu\text{g/g}$).

A common feature is that parallel to the light element enrichment in these samples, high field strength elements (HFSE) like Nb, Ta, Hf, Zr and Ti are strongly depleted. In former studies, low abundances for these elements in upper mantle peridotites were explained by two models: (1) metasomatism by a 'carbonatitic' melt, where these elements are shown to be low, or (2) metasomatism by subduction related fluids with low HFSE solubility. The geodynamic evolution of the upper mantle represented by our samples allows in principle for both models. Ancient subduction processes and related rocks of Pan-African age are present in the near Mozambique mobile belt. At the same time intrusive and extrusive carbonatites are known along the East African Rift, as well as mantle xenoliths metasomatised by carbonatite melts (e.g. Tanzania; Rudnick et al., 1993).

Light elements, on the other hand, are known to be enriched in hydrothermally altered oceanic crust and may then be carried to the lithospheric mantle of the upper plate by slab-derived fluids in a subduction setting. In our case, the observed enrichment in Li, Be and B, together with low HFSE abundances in the investigated minerals rather favours metasomatism by a subduction-related agent. The studied rocks could represent part of the subcontinental mantle beneath eastern Africa metasomatised by slab-derived agents during multiple accretion and subduction events.

Nevertheless, a carbonatitic nature of the metasomatising agent cannot be completely excluded because the behaviour of light elements in carbonatites is only poorly understood.

Rudnick, R.L., McDonough, W.F. and Chappell, B.W. (1993): Carbonatite metasomatism in the northern Tanzanian mantle: petrographic and geochemical characteristics; *Earth Planet. Sci. Lett.*, 114: 463-475.