



Implications of mineral reactions and disequilibrium processes for trace element signatures (Li, Be, B and REE) in peridotite minerals: a case study on xenoliths from Marsabit (Kenya)

Benjamin Kaeser (1), Angelika Kalt (1), Thomas Ludwig (2) and Thomas Pettke (3)

(1) Institut de Géologie et d'Hydrogéologie, Université de Neuchâtel, Switzerland, (2) Mineralogisches Institut, Universität Heidelberg, Germany, (3) Isotope Geochemistry and Mineral Resources, ETH Zürich, Switzerland (benjamin.kaeser@unine.ch / Phone: +41327182680)

Light lithophile elements (LLE; Li, Be, B) in combination with rare earth element (REE) abundances in mantle minerals are typically used to distinguish intraplate and subduction-related mantle metasomatism (Ottolini et al., 2004). Here, we present a new data set of LLE (analysed by SIMS) and REE (analysed by LA-ICPMS) in minerals from upper mantle peridotite xenoliths from Marsabit, northern Kenya, which highlights the importance of mineral reactions and disequilibrium processes for the interpretation of LLE and REE signatures in mantle rocks.

Two groups of peridotite xenoliths have been studied. The first, former grt lherzolites are relatively fertile (olivine ~Fo89) and experienced deformation, cooling and decompression associated with grt to spl transition in the context of continental rifting (Kaeser et al., 2006). The second, metasomatic spl harzburgites mainly contain amphibole and phlogopite that replaced primary cpx and spl. Later, melt pockets consisting of silicate glass + cpx + ol + chromite + Mg-calcite formed at the expense of amphibole, shortly before the xenoliths were entrained by the host magma.

The LLE and light REE (LREE) abundances in cpx of former grt lherzolite are similar to cpx compositions from fertile un-metasomatised sub-continental lithospheric mantle (Eggins et al., 1998; Ottolini et al., 2004). Within single cpx grains Li shows only little variation (0.59-1.05 $\mu\text{g/g}$), whereas heavy REE (HREE) concentrations increase

strongly from cores to rims (0.06-6.83 $\mu\text{g/g}$). The range of Li/Yb ratios in cpx (0.20-4.93) thus mainly results from Yb variation, which most likely reflects the sub-solidus re-partitioning of HREE following decompression-induced garnet breakdown, and not a metasomatic feature.

Compared to former grt lherzolites, minerals from metasomatic spl harzburgites are LREE- and LLE-enriched, with Li, Be and B concentration levels similar to those reported from mantle rocks metasomatized by melts and fluids released from subducting slabs. However, detailed investigation of textures and chemical zoning shows that the LLE systematics were considerably modified during late-stage formation of melt pockets, which resulted in disequilibrium partitioning of LLE between different minerals. Mass balance calculations show that the bulk melt pockets mostly inherited the REE, Be and B budget of the precursor amphibole, while Li concentrations increased by about a factor 2.

LLE/REE ratios (i.e., Ce/B, Li/Yb and B/Be ratios) of metasomatic phases prior to late melting (preserved in mineral cores) may be explained to result from metasomatism by a melt/fluid carrying a signature from a subducting slab. Alternatively, simple modelling of metasomatic processes (i.e., melt-rock reaction and amphibole crystallisation) shows that residual liquids derived from basaltic (OIB-like) melt-peridotite interaction can produce a wide range of LLE/REE ratios including 'slab-like' signatures. These results indicate that assuming subduction-related metasomatism solely based on LLE systematics in minerals can be ambiguous.

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Ottolini, L., B. Le Fèvre, and R. Vannucci (2004), Direct assessment of mantle boron and lithium contents and distribution by SIMS analyses of peridotite minerals, *Earth and Planetary Science Letters*, 228, 19-36.

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