Trace-element variations and melt percolation within mantle xenoliths from Algeria

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The western Oranie (Algeria) is located at the northern margin of the African plate. Mantle xenoliths occur in important plio-quaternary alkali volcanic extrusions. The volcanism changed in composition during the Neogene from calc-alkali at the Miocene to alkali at the Plio-Quaternary. Type I mantle tectonites are porphyroclastic to equigranular lherzolites and protogranular harzburgites. Both types reequilibrated in the spinel and/or plagioclase stability field. Type II basaltic cumulates are wehrlites, pyroxenites and hornblendites. Rare composite xenoliths are also present. Both type I tectonites and type II cumulates display interstitial glass patches in foliation plans underlined by spinel alignments.

Among mantle tectonites, some clinopyroxenes with trace-element compositions depleted in LREE relative to HREE ($(La/Yb)_N$=0.21-0.33) attest of small degree of partial melting that affected only LREE. Clinopyroxenes having various degrees of enrichments in LREE are related to different stages of incomplete reequilibration during melt-rock reaction processes with an alkaline melt. Clinopyroxenes in cumulates or composite xenoliths have concave trace-element patterns with enrichments in MREE relative to LREE, characteristic of a nearly complete reequilibration with deep alkali segregates. In some of the highly metasomatized type I xenoliths, clinopyroxenes have compositions similar to werhlitic or pyroxenitic cumulates. Preliminary results on glass patches associated with highly metasomatized samples exhibit silicic (SiO_2= 54-62 wt.%) and high alkaline contents (Na_2O= 2.5-6.1 wt.%, K_2O= 3.4-6.5 wt.%). Its trace-element composition shows enrichments in LREE (La/Yb_N=22.4-23.6) and Nb, Ta without significant other enrichment or depletion in other HFSE. The glass major and trace-element compositions are either distinct from the trace-element composition of the alkaline host lava or with the calc-alkaline lavas in the area. The composition of the glass seems to results from infiltration of an alkali basalt and further complex reaction-crystallisation processes with the peridotitic matrix that produced silicic and incompatible trace-element enriched glasses.

Geochemical evidence for metasomatic clinopyroxenes in Lesotho peridotites

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Introduction

Since the First International Kimberlite Conference in 1973, many studies were made advocating the case for mantle metasomatism as a mechanism for promoting chemical change in the upper mantle. Although Erlank et al. (1987) demonstrated the role of metasomatism in the clinopyroxene formation in the Lesotho peridotites, mantle geothermo-barometers are still based on the primary origin of the clinopyroxene in equilibrium with orthopyroxene, olivine and garnet.

Observations and results

Secondary metasomatic nature of clinopyroxene is confirmed on new peridotite samples from Thaba Putsoa and Letseng. In garnet harzburgites, we observe clinopyroxene with phlogopite and spinel within symplectite (in relation with or without garnet) and closed microfractures. LA-ICP-MS analyses demonstrate all these clinopyroxenes have similar trace element patterns (REE, Sr, Zr, ….).

We have also in Letseng peridotites spinel lherzolites with typical tabular texture of olivine. They display clinopyroxenes showing totally different trace element signatures with concave upward REE patterns.

Conclusion

Our results imply several secondary equilibria between the mantle peridotites and various melts that will be discussed. Whatever the origin of secondary pyroxenes, our results impose a revision of the thermobarometric strategy that should rely on mineral phases less subdued to secondary processes as orthopyroxene or olivine.

Erlank A. M. Waters F.G., Hawkesworth C.J., Haggerty S.E., Allsopp H.L., Rickard R.S. and Menzies M.(1987), Mantle metasomatism, Acad. Press. Geol. Series, 221-311