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Geochemical evidence of strongly alkaline-carbonated HIMU metasomatism in mantle xenoliths from the Manzaz-Atakor District (Hoggar, Algeria)

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Major and trace element analyses on bulk rocks and constituent minerals, and Sr-Nd-Pb isotopic analyses on clinopyroxene separates have been carried out on mantle xenoliths included in Pliocene-Quaternary alkaline volcanics from the Manzaz-Atakor District (Hoggar, Algeria). Most of the xenoliths are protogranular-textured spinel-lherzolites (modal cpx 10 - 14 %) with superimposed pyrometamorphic textures consisting of fine grained narrow zones of secondary phases and/or re-crystallized clinopyroxene around orthopyroxene. Moreover, millimetric spinel-olivine-clinopyroxenite veinlets are sometimes observed within the peridotite xenoliths.

Chondrite-normalized REE patterns in lherzolites show flat HREE (1.0 – 2.6 * Ch) and variable LREE distribution from overall LREE depletion (with the exception of La, Ce_N/Yb_N down to 0.15) to LREE enrichment (Ce_N/Yb_N up to 5.84).

Chondrite-normalized REE patterns of clinopyroxenes mimic those of whole rocks showing flat HREE patterns (6.3 – 12.8 * Ch) and LREE distributions varying from depleted (Ce_N/Yb_N down to 0.04) to enriched (Ce_N/Yb_N up to 9.58). LREE enrichment in clinopyroxenes is coupled with remarkable Ti-Zr negative anomalies, resembling those of secondary clinopyroxenes related to carbonatite mantle metasomatism (Coltorti et al., 1999).

Isotopic data on clinopyroxene separates have the following compositional ranges: $^{143}Nd/^{144}Nd$ 0.5129 – 0.5137, $^{87}Sr/^{86}Sr$ 0.7022 – 0.7032, $^{206}Pb/^{204}Pb$ 19.52 – 20.18.

These variations may correspond to long term depleted lithospheric mantle subsequently metasomatized to a various extent by HIMU-like components. Coherently, extremely radiogenic Nd isotopic composition (up to 0,5137) are recorded by samples which appear scarcely affected by metasomatism (Ce/Yb of cpx $\leq$ 1), whereas the most LREE enriched clinopyroxenes perfectly fit the HIMU isotopic signature ($^{143}Nd/^{144}Nd$ 0.5129 – 0.5130, $^{87}Sr/^{86}Sr$ 0.7031 – 0.7032, $^{206}Pb/^{204}Pb$ 19.93 – 20.18).

The overall geochemical characteristics suggests that the metasomatic enrichment could have been related to strongly alkaline-carbonated melts similar to the basanites/nephelinites occurring in the Hoggar volcanic districts. Analogous metasomatic processes have been proposed for other mantle xenoliths occurrences in the Hoggar region (Dautria et al., 1992).

Compared to what is generally observed for mantle xenoliths from the African lithosphere, mantle metasomatism beneath the Hoggar swell appears to be characterized by distinctly more alkaline-carbonated metasomatizing melts.

References

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