ARMALCOLITE-BEARING, TI-RICH METASOMATIC ASSEMBLAGES IN HARZBURGITIC XENOLITHS FROM THE KERGUELEN ARCHIPELAGO (INDIAN OCEAN): IMPLICATIONS FOR THE MANTLE BUDGET OF HIGH-FIELD STRENGTH ELEMENTS

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ABSTRACT

Some mantle clinopyroxene- and spinel- harzburgite xenoliths from the Kerguelen Islands contain an unusual metasomatic mineral association consisting of feldspar, olivine II, chromite II and Ti-oxides (rutile, ilmenite and armalcolite). The metasomatic minerals occur in veins along the grain boundaries of the olivine, orthopyroxene and clinopyroxene but may cut across these anhydrous silicates as well as across pre-existing amphibole and the phlogopite.

To our knowledge, it is the first time that such a mineral association representing a distinctive type of mantle metasomatism has been reported from peridotite samples in the oceanic mantle. This assemblage is distinct from those commonly attributed to potassium-rich hydrous fluids in cratonic mantle lithosphere or to carbonated Fe-Ti-rich silicate melts in non-cratonic mantle lithosphere. A similar mineral association has been recently described in off-cratonic continental mantle xenolith from southern Siberia (Russia, Ionov et al., 1999).

The vein-forming minerals are inferred from experimental and compositional constraints to have crystallized at a minimum pressure of about 1.3 GPa and 1150-1200 °C from a strongly alkaline magma with low water activity buffered by the wall-rock harzburgites. The oxygen fugacity is well-constrained at NNO - 2.5 to - 3.0 log units.

The event that formed these Ti-rich oxide veins was very recent as the veins crosscut metasomatic assemblages inferred to have formed in two previous metasomatic episodes that produced firstly anhydrous dunites and secondly Mg-augite ± phlogopite ± amphibole-bearing peridotites. In addition, the persistence of the high-energy skeletal crystal forms indicates that mantle residence time was short.

Exchange reactions of the parental melt with the peridotite wall-rock released silica (from opx), chromium (from cpx and original Cr-Al spinel) and magnesium (from opx and cpx); this element exchange was essential to forming the armalcolite paragenesis. Such Ti-rich veins result in strong local enrichment in some incompatible trace elements (figure 1), including LILE that are largely concentrated in feldspar (eg Ba, Sr, LREE) and HFSE (Ti, Nb, Zr) in rutile and armalcolite, if they comprise just 0.05 wt% of the rock (Grégoire et al., 1999). At such low modal abundances, such veins could be easily overlooked or misidentified during conventional microscopic study.

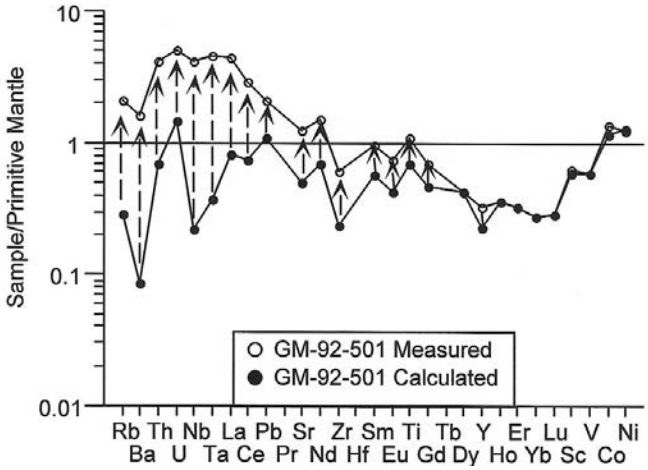

Fig. 1 - Comparison between primitive mantle-normalized incompatible trace element patterns of measured and calculated (using calculated modal abundance and trace element contents of constituants minerals: olivine, opx, cpx, spinel) bulk rock compositions of Kerguelen poikilitic harzburgite GM-92-501. Arrows indicate the higher content of incompatible trace elements in measured bulk rocks due to the presence of Ti-rich oxides- and feldspar-bearing veinlets.

REFERENCES

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