Ofioliti, 1999, 24 (1a), 132

AMPHIBOLE-PHLOGOPITE MANTLE XENOLITHS FROM THE KERGUELEN ARCHIPELAGO: EVIDENCE OF A MAJOR METASOMATIC EVENT BY ALKALINE SILICATE AND CARBONATE-RICH MELTS

Bertrand N. Moine*,, Michel Grégoire**, Jean-Yves Cottin*, Suzanne Y. O'Reilly** and Simon M.F. Sheppard*****

** Département de Géologie-Pétrologie-Géochimie, UMR-CNRS 6524, Université Jean Monnet, 23 Rue P.Michelon, 42023 Saint-Etienne cedex 02, France.*

*** GEMOC National Key Centre, Department of Earth and Planetary Sciences, Macquarie University, NSW 2109, Australia.*

**** Département des Sciences de la Terre, UMR-CNRS , Ecole Normale Supérieure de Lyon, 46 Allée d'Italie, 69366 Lyon cedex 07, France.*

ABSTRACT

Alkali basaltic rocks from the Kerguelen Islands have entrained numerous phlogopite- and/or amphibole-bearing ultramafic to mafic xenoliths. The xenoliths can be subdivided into mantle wall-rocks (harzburgites, dunites, Type I xenoliths) and high pressure magmatic segregates (clinopyroxenites, hornblendites, glimmerites; type II xenoliths) that generally form composite xenoliths with mantle wall-rocks. A phlogopite megacryst-bearing lava was also incorporated in this study.

Chemical compositions of amphiboles and phlogopites from both xenolith groups are characterized by high titanium contents and are similar to those recognized in many ultramafic and mafic volatile-bearing xenoliths from kimberlites, alkali basalts and in peridotites or pyroxenites from orogenic lherzolite massifs.

Phlogopite shows homogeneous trace element compositions and important incompatible trace element fractionation processes characterized by strong enrichment in Rb, Ba, Nb, Ta, Pb, Sr, Ti and slightly in Zr, Hf. Amphibole displays compositional variation between samples but they are commonly high in LIL element and show systematic negative Zr, Hf, Pb and Sr anomalies.

Hornblendite dykelets from composite xenolith display major and trace element compositions closely similar with Kerguelen lamprophyric lavas.

Clinopyroxenes from type I, type II and composite hydrous Kerguelen xenoliths display tight similarities in their trace element contents (Fig. 1). These later display an enrichment in LREE $(La/Yb)_N$=10 with large negative anomalies in Rb, Ba, Pb, Sr, Ti, Zr and Y. They are also similar to poikilitic harzburgite (anhydrous) clinopyroxene. The calculated liquids in equilibrium with clinopyroxene may be compared with ultramafic and alkaline lamprophyric melts. One sample of phlogopite-bearing dunite displays clinopyroxene with very large anomalies in Rb, Ba, Nb, Ta, Zr, Hf, Pb, Sr and Ti which is characteristic of an interaction with a carbonatitic melt.

The δD value of -86 to -70‰ vs SMOW for mica and amphibole of both types of Kerguelen xenoliths and of the phlogopite megacrysts are very homogeneous and within the common mantle range. These data are in agreement with neon isotopic data that indicate homogeneous and relatively primitive compositions of the volatile sources.

The phlogopite- and/or amphibole-bearing ultramafic to mafic xenoliths from Kerguelen Islands may be all related to the circulation of highly alkaline mafic silicate melts into the upper mantle. Interstitial amphibole and phlogopite of harzburgites and dunites formed by a diffuse percolation of such melts within the upper mantle (porous flow). Evidence from composite xenoliths indicates channellized circulation of similar melts propagated by hydraulic fracture resulting in a network of dykes in the Kerguelen upper mantle. The high pressure magmatic xenoliths are evidenced of the cristallisation of highly alkaline magmas into the upper mantle and the lower crust. The mica-bearing lavas ("lamprophyres") are the surface expression of this highly alkaline magmatic activity. The ubiquity of the volatile-rich high alkaline magmatic activity and its isotopic homogeneity is inferred to be the latest and largest metasomatic event related to the late intraplate activity of the Kerguelen mantle plume.

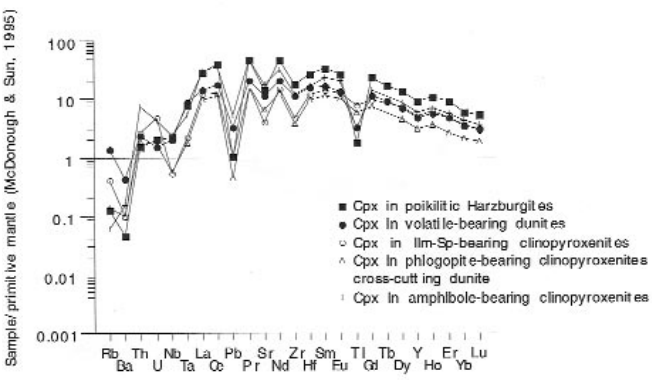

Fig: 1 - Trace element diagrams of clinopyroxene (Cpx) trace element composition from Kerguelen xenoliths.