Recrystallisation and shorted-lived lattice disruptions along mantle fluid pathways

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Mantle-derived xenoliths brought to the surface are often the witnesses of deep-seated processes that cannot be observed on outcropping ultramafic bodies because of preservation issues (e.g. metamorphic overprint, alteration) or simply due to sampling bias during emplacement. We present electron backscatter diffraction (EBSD) and in situ Sr isotopes data obtained on a composite eclogite xenolith from the Roberts Victor kimberlite, South Africa.

This rare sample consists, in one part of a large megacrystic clinopyroxene (~ 4 cm) associated with a small number of unaltered garnets. The second part is made of a more canonical bimineralic eclogite with garnets and clinopyroxenes displaying a "cloudy" appearance. Previous work [1] showed that the two domains are charaterised by distinct major and trace element compositions, but also differ in terms of accesory minerals (none for megacrystic vs. calcite + sulfide + phlogopite + rutile).

In situ $^{87}Sr/^{86}Sr$ ratios of the clinopyroxenes were obtained using LA-MC-ICPMS techniques. The megacrystic clinopyroxene has a Depleted Mantle like $^{87}Sr/^{86}Sr$ ratio of 0.7025 ± 0.0004 (n=8). In contrary, the clinopyroxenes in the bimineralic eclogites have a more radiogenic $^{87}Sr/^{86}Sr$ ratio of 0.7074 ± 0.0005 (n=9), which can be ascribed to an enriched metasomatic fluid percolating through.

EBSD analysis revealed a similar trend with a transition from a relatively undisturbed megacrystic domain to a rather complex bimineralic eclogite. In the latter, normalisation of lattice misorientation to the grain mean orientation highlights very unusual patterns in both garnet and cpx. These fine scale disruptions (~ 10 μm) of the lattice are pervasive and have not been described before. Quenching during the rapid ascent, uniquely preserved these features, which can be seen as snapchots of recrystallisation during mantle metasomatism.

[1] Gréau et al. (2011) *Geochim. Cosmochim. Ac.* **75**, 6927-6954