# SPATIAL RELATIONSHIPS OF COMPOSITIONAL VARIATION IN POLYMICT PERIDOTITES FROM KIMBERLITES

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## ABSTRACT

## INTRODUCTION

Polymict peridotites are a complex suite of mantle xenoliths recovered from kimberlites in Kimberley in South Africa. They are unlike other mantle xenoliths having breccia-like characteristics and containing rock and mineral fragments of lherzolites, harzburgites, eclogites and the megacryst association. These fragments are embedded in a matrix rich in ilmenite and phlogopite together with rutile and sulphides. Polymicts are not only distinct from other mantle xenoliths but can also be texturally distinct from each other.

## PETROGRAPHY

Typically, polymict peridotites include the presence of all or some of the phases garnet, olivine, orthopyroxene, clinopyroxene, phlogopite, ilmenite, rutile and sulphides. Texturally large single crystals (up to 7 mm) are seen embedded in a finer grained matrix. The large crystals are often extensively deformed and recrystallised. This is particularly true of JJG 1414 which contains olivine, garnet, orthopyroxene and opaque minerals within a sea of olivine neoblasts. Commonly the clasts of orthopyroxene and phlogopite within polymicts have distinct petrographic rims. The areas of matrix consist of intergrown fine grained orthopyroxene, phlogopite, opaques and occasionally olivine. These areas are found in nodules JJG 2115, DB3 and UNCAT. No such matrix area is seen in JJG 1414. Clinopyroxene-orthopyroxene intergrowths are found in JJG 1414, JJG 2115, and UNCAT. The only large single clinopyroxene is seen in DB3.

## MAJOR ELEMENT DATA

Electron probe analysis has revealed a wide compositional variety in each of the polymicts. Fig. 1 plots Ca, Mg and total Fe compositions for all the phases in seven different polymicts.

More specifically, electron probe analyses were performed on the rims and cores of individual phases within the polymicts. Fig. 2 show the results of orthopyroxene and phlogopite analyses in two nodules. These minerals indicate clear core-rim variations. In each nodule orthopyroxene clasts have variable core compositions whereas the rims show a common Fe/(Fe+Mg) value of approximately 0.1 - 0.11. In Fig. 2a, orthopyroxene compositions from the clinopyroxene-orthopyroxene intergrowth in UNCAT are also plotted. These show compositions comparable to the rims of the single clasts. In JJG 1414 individual orthopyroxenes show two rim compositions - an inner rim with higher Fe/(Fe+Mg) values and an outermost rim of slightly lower Fe/(Fe+Mg) values. The phlogopite clasts also show variable core compositions and similar rim compositions of between 0.9 - 0.11 Fe/(Fe+Mg). Phlogopites in JJG 2115 show two distinct rim compositions- both of higher Fe/(Fe+Mg) values than the cores (Fig. 2b). With respect to other elements, the phlogopite rims are consistently higher in Na, Cr, Al and Ti than the cores. This is not true of the orthopyroxene clasts. Analysis of olivine clasts in these four nodules reveal similar core-rim variations although a wider spread of Fe/(Fe+Mg) values in the rims is seen between nodules. All garnets which have been analysed to date have been homogeneous.

Matrix minerals have also been analysed for major element compositions. Generally these data plot in close conjunction to the rim compositions of the clasts - especially with respect to Fe/(Fe+Mg) value. This is shown in Fig. 2.

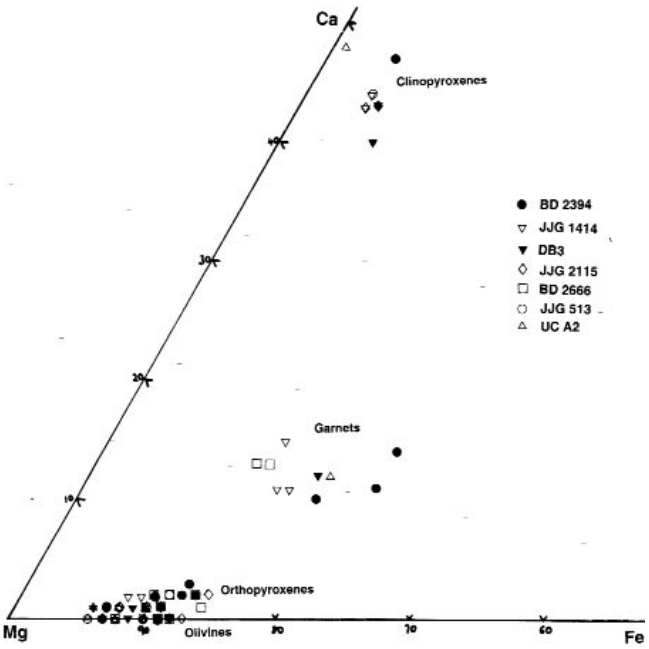


Fig 1 - Ca-Mg-Fe (total) (cation %) plot for olivines, orthopyroxenes, garnets and clinopyroxenes within seven different polymicts.

## DISCUSSION

These features are suggestive of metasomatic processes operating on clasts derived from a variety of sources. Due to the close association of the rim compositions and the matrix mineral data, it is thought that the fluid which was responsi-

ble for this metasomatism was also crystallising the matrix minerals. Preliminary interpretations involve the possibility of more than one pulse of a metasomatising fluid which has resulted in the heterogeneous rim compositions in some of the nodules.

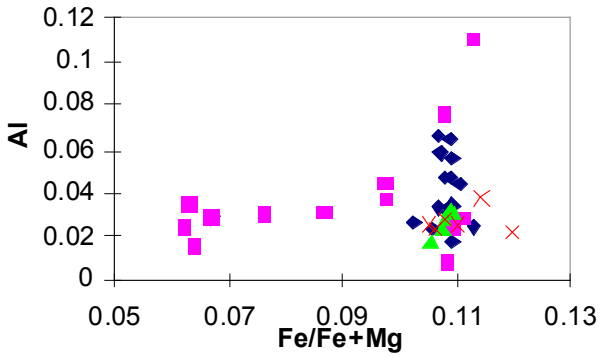


Fig. 2a - Core-rim variations within orthopyroxenes in nodules UNCAT. Squares represent core values, diamonds represent rim values, triangles represent matrix values and intergrowth orthopyroxenes are shown as crosses.

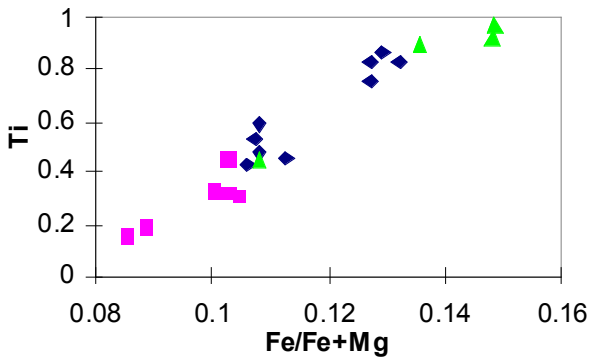


Fig. 2b - Core-rim variations within phlogopites in nodule JJG 2115. Squares represent core values, diamonds represent rim values and triangles represent matrix values.