

PYROXENITE XENOLITHS FROM THE KIMBERLITE OF  
JAGERSFONTEIN MINE

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Two xenoliths from the Williams' collection are referred to as diallage rock and pyroxenite respectively (1). Hand and petrographic examination suggests, however, that they are both varieties of a pyroxenite that has suffered variable degrees of deformation, exsolution, alteration, and recrystallisation.

The diallage consists of coarse, lamellar diopside crystals > 10cm long that have kinked and broken every 4 - 5cm. Thin sections cut parallel to the (001) plane of the clinopyroxene show exsolution lamellae of enstatite which is almost totally altered to serpentine. Small crystals of pyrope garnet are also aligned along the lamellae. Sections cut along (010) planes of the pyroxene show more interesting features than those cut parallel to (001). In particular they demonstrate that stress has produced a parting plane in the pyroxene that is slightly oblique to the plane of exsolution, and slip has occurred along this parting plane. Tension cracks have developed along the length of the pyroxene lamellae at right angles to the apparent direction of the parting plane; occasionally the tension cracks have a near-sigmoidal shape, and they also appear to have acted as channels for serpentinising solutions. In this orientation, the garnet is seen frequently to lie along the parting plane as elongate crystals, which suggests that it formed at a late stage under stress conditions, and not during the initial stages of pyroxene unmixing.

In the kink bands of the xenolith there has been recrystallisation of the pyroxene to give large, irregularly shaped grains which contain scattered, small grains of garnet. Garnet is also present in the form of stringers of grains along the grain boundaries of the recrystallised pyroxene. Considerable serpentinisation of the pyroxene has occurred in the kink bands and randomly oriented grains of secondary phlogopite are also abundant. Except for small grains in some highly serpentinised areas of the lamellar pyroxene, the phlogopite appears to be restricted to the kink bands.

The pyroxenite xenolith also consists of lamellar pyroxene, but the lamellar texture has been distorted by crushing and is partly replaced by a finely granular pyroxene mosaic. In coarser grains, deformation twin lamellae appear to be present but they have not been verified as such. Phlogopite and serpentine are generally absent.

Mineral compositions were determined by electron microprobe

analysis, using the method described by Borley et al. (2). Compositionally (Table 1) the diopside has the higher Mg:Fe of the two pyroxenes, as might be expected, but both pyroxenes are poor in Al, Ti and Mn.

Table 1

Mineral analyses

	<u>Diopside</u>	<u>Enstatite</u>	<u>Pyrope</u>
SiO <sub>2</sub>	54.7	57.7	41.5
TiO <sub>2</sub>	0.02	0.02	-
Al <sub>2</sub> O <sub>3</sub>	0.79	0.37	22.0
FeO	1.93	6.9	11.7
MnO	0.04	0.12	0.69
MgO	17.1	34.8	17.8
CaO	23.4	0.31	5.03
Na <sub>2</sub> O	0.65	-	-
Cr <sub>2</sub> O <sub>3</sub>	0.33	0.03	0.93
NiO	0.12	0.15	-
V <sub>2</sub> O <sub>5</sub>	0.08	0.02	0.04
Totals	<u>99.16</u>	<u>100.40</u>	<u>99.69</u>

Substitution of Al for Si and the entry of Cr into the diopside lattice has probably been responsible for the entry of Na to maintain charge balance, though in part the entry of Na must have been determined by the presence of the large M2 site in the clinopyroxene. In the initial absence of olivine, Ni has entered the pyroxene and the partition of this element is now approximately equal between diopside and enstatite. Partition of Cr is pyrope > diopside > enstatite. Compared with many reported analyses of diopside from xenoliths in kimberlite, the diopside of these xenoliths is low in Cr. The phlogopite is a low iron variety.

The origin of these nodules is uncertain. They would appear to have formed, perhaps as settling phases, at high temperature (the diopside-enstatite equilibrium is temperature rather than pressure controlled), and have been deformed and altered during decreasing temperature, possibly under directional stress.

References

- Williams, A.F. 1932. The Genesis of the Diamond. Vol. 2. E. Benn, London.

Borley, G.D., Suddaby, P., and Scott, P.W. 1971. Contr.  
Mineral. Petrol. v.31, p102-114.