TEXTURES AND FABRICS OF PERIDOTITE NODULES FROM KIMBERLITE AT MOTHAE, THABA PUTSOA AND KIMBERLEY

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INTRODUCTION

The present report is the result of a preliminary examination of 25 ultramafic xenoliths, brought up by the kimberlite intrusions Thaba Putsoa and Mothae(Lesotho) and Kimberley(Republic of South Africa). The rocks studied, viz., harzburgites, garnet-harzburgites, lherzolites, garnet and/or spinel-lherzolites are often serpentinized. It is a complement of the data of Mercier (1972), Nicolas et al. (1971) on the peridotite xenoliths in basalts and on Alpine-type peridotite massifs both of which probably originated in more superficial levels of the upper-mantle. On the basis of texture and fabric of olivine and enstatite, the samples have been grouped in a provisional classification providing a clue to the textures of the layers of the mantle where these xenoliths originated. Some textural types can be readily interpreted in terms of flow processes in view of recent theoritical and experimental research (Ave Lallemant, Carter, 1970; Carter et al., 1972; Nicolas et al., 1971, 1972 in press; Mercier, 1972).

MAIN TEXTURES

1- The "coarse-grained" texture is characterized by:
- a single generation of coarse-grained crystals(6mm);
- neither foliation nor lineation;
- straight or curved mineral boundaries;
- a weak orthorhombic olivine fabric, even weaker in enstatite;(fig 1)

2- The "tabular olivine and enstatite" texture is characterized by:
- a single generation of generally undeformed crystals;
- a medium grain size and a good foliation defined by tabular olivine and enstatite crystals(L/W = 5/2 mm);
- a strong olivine fabric and a weaker but unusual enstatite fabric (Xen normal to the foliation).(fig 2)

3- The porphyroclastic texture is characterized by:
- two generations of crystals: strongly deformed large porphyroclasts and undeformed smaller neoblasts;
- an excellent foliation and a good lineation;
- a characteristic olivine fabric and enstatite fabric;(fig 3)

4- The "mosaïc" texture is characterized by:
- a single generation of small olivine neoblasts(0.3mm) constrating with two generations of enstatite porphyroclasts locally recrystallizing into neoblasts;
- a good foliation and an excellent lineation;
- an insignificant olivine fabric, but strong local subfabric pointing to the former existence of large porphyroclasts.(fig 4)

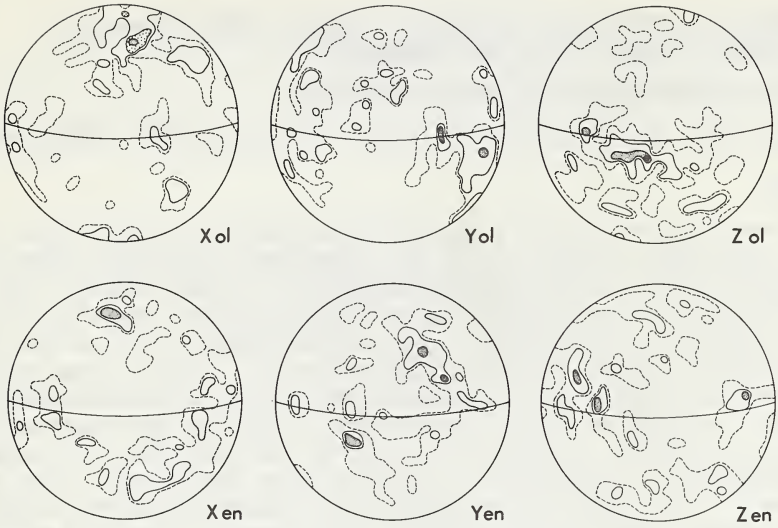

Fig 1 Fabric of the "coarse-grained" texture
Ol = Olivine En = Enstatite
line : measured plane of crystals flattening

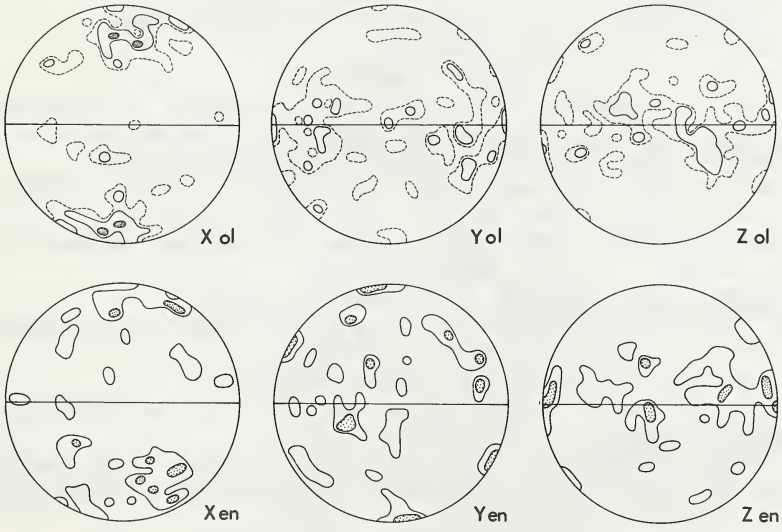

Fig 2 Fabric of the "tabular olivine and enstatite" texture
Ol = Olivine En = Enstatite
line : foliation plane observed on sample.

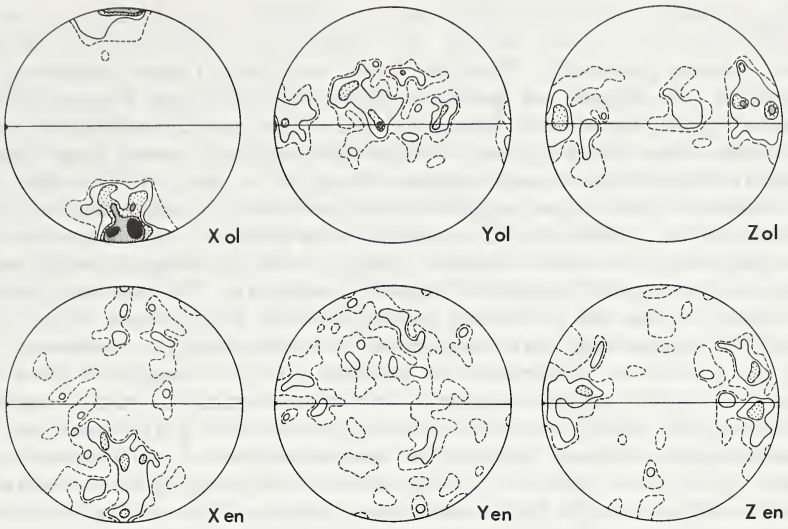

Fig 3 Fabric of the porphyroclastic texture
Ol : olivine porphyroclasts; En : enstatite porphyroclasts.
Horizontal line and point : respectively foliation and mineral lineation observed on sample

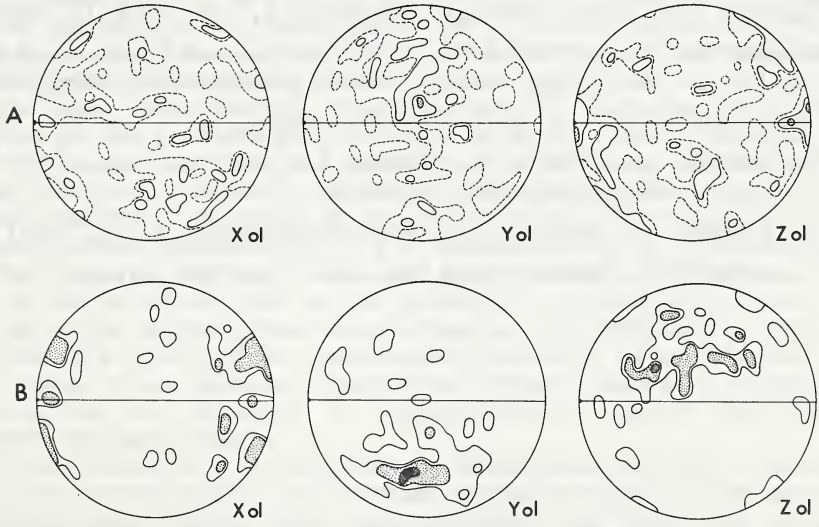

Fig 4 Fabric of the "mosaïc" texture
A- olivine general fabric
B- olivine local subfabric
Horizontal line and point : respectively foliation and mineral lineation observed on sample.

DISCUSSION

The "coarse-grained", "tabular" and porphyroclastic textural groups correspond to the "granular group" defined by Boyd and Nixon (1972) and our "mosaïc" group to their "sheared" one. The porphyroclastic and mosaïc textures have already been described in basalt xenoliths (Mercier, 1972) and in Alpine type peridotites (Nicolas et al., 1971, 1972). They were interpreted, with the support of experimental comparisons (Avé Lallemant and Carter, 1970; Nicolas et al., in press), as formed by plastic flow (porphyroclastic texture) with progressive passage to syntectonic and annealing recrystallization (mosaïc texture). The coarse-grained texture can be compared with the protogranular texture of basalt xenoliths, but no equivalent has been found for the tabular texture.

The existence of intermediate textural facies suggests that the coarse-grained and tabular textures are transformed to porphyroclastic and ultimately to mosaïc textures through increasing deformation. The discrepancy between their respective temperatures of equilibration (Boyd and Nixon, 1972) is tentatively explained admitting that the mosaïc textured lherzolites result from mechanical mixing of formerly interlayered pyroxenites and harzburgites with a coarse-grained texture.

REFERENCES

AVE LALLEMANT H.G.,CARTER N.L. (1970)-Geol. Soc. Am. Bull., 81, 2203-2220.

BOYD F.R.,NIXON P.H. (1972)-Carnegie Institution, Year Book 71, 362-373.

CARTER N.L.,BAKER D.W., GEORGE R.P. (1972)-In Flow and Fracture of Rocks-The Griggs volume - A.G.U., WASHINGTON, 167-190.

MERCIER J.C. (1972)-Thèse 3° cycle, NANTES, 229 p.

NICOLAS A.,BOUCHEZ J.L.,BOUDIER F.,MERCIER J.C. (1971) Tectonophysics, 12, 55-86.

NICOLAS A.,BOUCHEZ J.L.,BOUDIER F. (1972)-Tectonophysics, 14, 143-171.

NICOLAS A.,BOUDIER F., BOULLIER A.M.-Am. Jour. Sc. (In press).