

ORIGIN OF PYROXENE AND SILICA EXOLUTIONS IN ANORTHITE  
FROM 60016,95 POLISHED THIN SECTION, Z.Johan, National Geological  
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The polished thin section 60016,95 was cut from a polymict breccia whose matrix contains numerous lithic fragments of re-crystallized breccias of doleritic and poikilitic texture and some rare glass, accompanied by large feldspathic fragments (an anorthositic clast of 8 by 6 mm, an anorthite crystal of 3 mm and another of 1.5 mm).

The anorthositic clast shows evidence of shock metamorphism (mosaic structure, twin lamellae after the albite law displaced by fractures). The anorthite crystal of 3 mm exhibits a polysynthetic twinning after the albite law. The anorthite of these two clasts has been analyzed on Cameca microanalyzer (table 1). The results show a composition range from  $An_{96}$  to  $An_{98}$  with Fe and Mg contents corresponding to those of non mare rocks (1). Plagioclase clast of 3 mm contains silica and pyroxene inclusions arranged as follows:

1. needles of 1-2 microns width, parallel to the albite twin plane and situated either directly on the twin walls or else still within the narrow twin layers (twin lamellae A) but always remaining parallel to the twin plane.

2. vermicules probably located in the twin plane pericline and formed exclusively by silica.

3. small crystals showing their own birefringence and consequently considered as quartz, accompanied by isometric grains of pyroxene. They are accumulated in certain particular zones (fracture or strength zones ?).

A detailed study has been made on inclusions having taken place within narrow twin lamellae A of anorthite. No regular alternation of silica and pyroxene has been observed.

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The Na, Fe and Mg microprobe analyses (long time counting) have revealed systematic variations in the content of these elements (fig.1). Indeed Fe and Mg diminish as one approaches twin lamellae A. Thus, a depression crest is formed whose summit corresponds to the pyroxene exsolutions ("pumping" effect due to diffusion in the solid state). The case is the same for  $\text{Na}_2\text{O}$  whose content also diminishes within twin lamellae A (0.13%), whilst the average in twin lamellae B (wide) is 0.19%. Thus, the plagioclase of twin lamellae A has a chemical composition clearly different from that of twin lamellae B. It is difficult to explain this by the mechanism of crystal growth, supposing that pyroxene and silica inclusions are magmatic droplets trapped by the anorthite crystal (2). We suggest that these inclusions are exsolutions whose formation is due to the lowering of  $\text{Na}_2\text{O}$  content in twin lamellae A. The reasons for this sodium variation are difficult to interpret (consequence of structural transition; heating and recrystallization?). We consider that these variations have led to a chemical disequilibrium concerning Fe, Mg. A trend to rebalance the distribution of these elements in the crystal was hindered by the impossibility of fixing Fe and Mg in the lattice of a less sodic plagioclase which gave rise to exsolutions of pyroxene. The silica exsolutions are a consequence of stoichiometric readjustment. The final explanation of this phenomenon can only be given by a combined chemical and X-ray study.

(1) STEELE I.M. and SMITH J.V. (1973) *Geochim. Cosmochim. Acta*, 37, 1075-1077.

(2) HARGRAVES R.B. and HOLLISTER L.S. (1972) *Science*, 175, 430-431.

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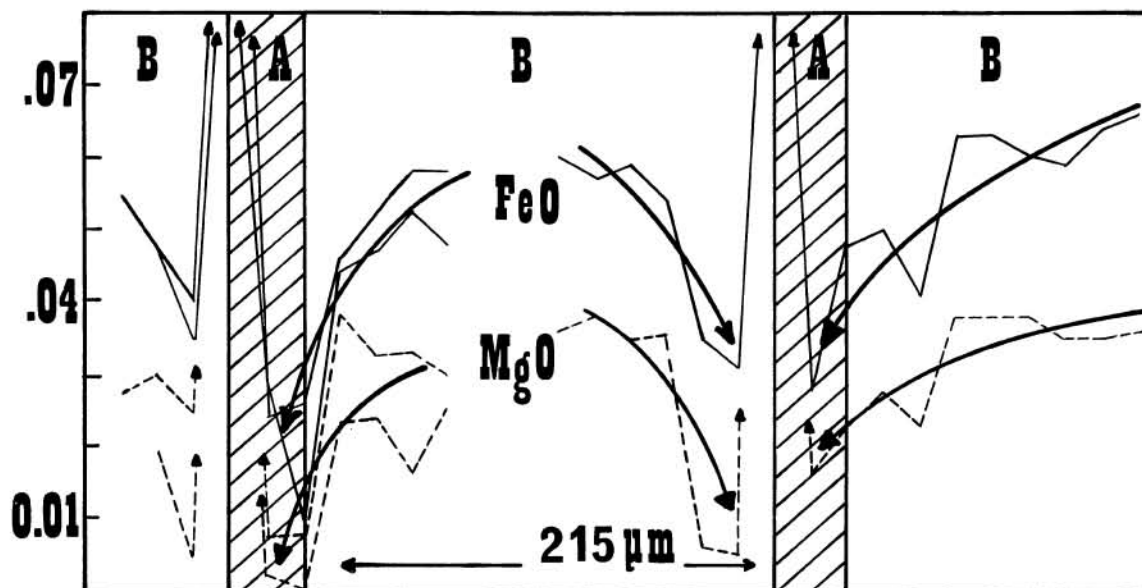


Fig. 1. Variations in MgO and FeO contents across an albite twinned plagioclase crystal from 60016,95 (twin lamellae A and B). The "pumping" effect is clearly visible.

Table 1. Electron microprobe analyses of plagioclases from breccia 60016,95.

SiO <sub>2</sub>	44.24	45.53	44.46
Al <sub>2</sub> O <sub>3</sub>	35.21	33.20	35.64
MgO	0.06	0.06	0.06
FeO	0.13	0.10	0.07
CaO	19.90	19.71	20.32
Na <sub>2</sub> O	0.24	0.42	0.19
K <sub>2</sub> O	0.00	0.00	0.01
Totals	99.78	99.02	100.75