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Grandidierite of contact-metamorphic origin from Maratakka, northwest Surinam

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Abstract

Grandidierite has been found in pyroxene-hornfels-facies xenoliths in a gabbroic intrusion at Maratakka, northwest Surinam.

Introduction

Grandidierite, a very rare Mg-Al borosilicate hitherto known mainly from aplites and pegmatites, occurs in small metasedimentary hornfels xenoliths in a gabbroic body at Maratakka (5°11′37″ N, 56°54′16″ W). It was first found by R. Suringa (unpublished data) in drill-hole samples.

Mineralogy

Only a few tens of crystals of grandidierite, 0.5 mm or less in length, are present in a thin section. They are slender prismatic to fibrous or locally poikiloblastic, and occur as sheaf-like aggregates in or near cordierite, as intergrowths with biotite, and as rims on magnetite and spinel. Only a poor {100} cleavage is present.

Refringence is moderate, birefringence very strong (0.030–0.040). The absorption scheme is X blue-green, Y colorless and Z light bluish green. The axial angle is $2V_x \sim 20°$, with dispersion $r<v$ and the axial plane parallel to (001). Extinction is straight. The elongation of the sections is almost exclusively positive. The combination of tourmaline-like pleochroism and very strong birefringence is uniquely characteristic of grandidierite.

The microprobe analysis (B not analyzed; for methods of analysis see de Roever *et al.*, 1976) confirms the optical identification. As observed previously by McKie (1965) and Black (1970), sodium is absent so that the simple formula, $(Mg,Fe)Al_3SiBO_9$, pertains.

Occurrence

At Maratakka the sand-covered Precambrian basement is not exposed. Drilling showed the basement to consist of a mafic body, a few kilometers in size, surrounded by granite, presumably with metasedimentary enclaves (Bosma *et al.*, 1975). The mafic body consists of quartz gabbro-norite and biotite-quartz diorite, and is cut locally by granite veins.

The metasedimentary hornfels xenoliths in the gabbroic body contain, in addition to grandidierite, antiperthitic andesine, perthite, cordierite, biotite, spinel, magnetite, and minor corundum, apatite, zircon, and ilmenite. Biotite forms poikiloblasts of random orientation in a fine-grained granoblastic matrix of andesine, perthite, and cordierite. Magnetite and dark green spinel occur as small, euhedral crystals, partly enclosed in biotite, as aggregates in feldspar, and as irregular poikiloblastic masses.

Other xenoliths, without grandidierite, contain additional sillimanite (with or without quartz) and locally some andalusite. In one sample a grandidierite-bearing hornfels occurs together with a hornfels of fine-grained, granoblastic andesine and poikiloblastic hypersthene.

Conditions of formation

Grandidierite is usually found in aplites and pegmatites (Madagascar and South Africa, see McKie, 1965; USSR, Zav'yalova *et al.*, 1975) and is thought there to be of deuteric origin, or to have crystallized

TABLE 1. Microprobe analysis of grandidierite

	Weight %	Atomic ratios		
SiO_2	19.6^5	$.98^5$		Simplified formula,
Al_2O_3	50.5^5	2.99^5		calculated on a basis of O_9
(B_2O_3*	11.3)	.98		$(Mg,Fe)Al_3SiBO_9$
FeO	5.7	.24)		
MnO	$.1^5$	$.00^5$)	1.05^5	
MgO	10.8^5	.81)		Ti, K, Na, Ca below .01 %
Total	98.2			

* *B not analysed; for calculation, using the constants of Albee and Ray (1970), the average literature value was taken.*

from a boron-enriched contaminated magma instead of sillimanite (McKie, 1965). The Maratakka grandidierite, which forms intergrowths with biotite and also rims magnetite and spinel, occurs in the assemblage andesine–perthite–cordierite–biotite–spinel–magnetite–corundum. This assemblage, as well as the hypersthene-bearing assemblage in other xenoliths, is characteristic of the pyroxene hornfels facies. Grandidierite of contact-metamorphic origin has also been found in pyroxene hornfelses near a diorite intrusion in New Zealand (Black, 1970).

Near the latter occurrence, substantial boron metasomatism has been observed, but its relation to the occurrence of grandidierite is uncertain (Black, 1970). At Maratakka the only evidence of boron metasomatism might be found in the local presence of a few grains of tourmaline in the granite veins cutting the gabbroic body. In the drill-cores no granite veins have been found within 10 m of the grandidierite-bearing xenoliths. Moreover, the granite veins postdate the gabbroic intrusion and the contact-metamorphism of the xenoliths. As to the source of the boron, the sediments parental to the xenoliths may have had a small boron content—perhaps as tourmaline, a common accessory in metasediments in northwest Surinam. Such a content is sufficient to form the sparse amounts of grandidierite observed without aid from boron metasomatism.

From the presence of hypersthene, perthite, sillimanite, and corundum + alkali feldspar, metamorphic temperatures around 700°C or higher may be deduced for the xenoliths (Hyndman, 1972; Turner, 1968). The abundant magnetite and spinel (especially the poikiloblastic masses), together with cordierite and alkali feldspar suggest the break-down of biotite (*cf* Turner, 1968, p. 228, 229). The aluminous, silica-deficient composition of the hornfelses (with corundum and spinel), probably resulting from partial anatexis, corresponds to the composition of the borosilicate grandidierite itself.

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