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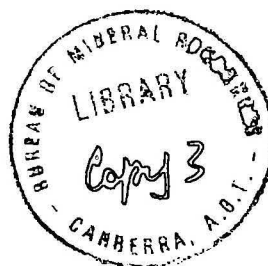
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CORONA STRUCTURES FORMED BY NEAR-ISOCHEMICAL REACTION BETWEEN OLIVINE
AND PLAGIOCLASE IN A PARTLY METAMORPHOSED DOLERITE

by

R.N. ENGLAND

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SUMMARY

Magnetite-hypersthene-cummingtonite-hornblende-garnet coronas have formed between olivine and plagioclase in a dolerite which underwent upper greenschist or lower amphibolite facies metamorphism. The composition of the corona material, calculated from microprobe analyses of the corona phases, is very close to that of the original olivine + plagioclase. It is concluded that the corona structures formed by near-isochemical reaction between olivine and plagioclase.

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In the Pottoyu Hills, immediately south of the Petermann Ranges in the extreme southwest of the Northern Territory, Australia, Precambrian granitic rocks are intruded by basic dykes ranging from a few metres to about 100 m across. Both the granite and the basic dykes have undergone upper greenschist or lower amphibolite facies metamorphism. At 25°07'S, 129°16'E one of the largest of the basic bodies shows typical alteration to biotite-chlorite amphibolite at its margins, but, unlike the smaller bodies, retains a coarse subophitic texture at the centre. Augite and lath-shaped plagioclase are largely unaltered, but relict olivine is separated from plagioclase by well developed coronas (Fig. 1). Immediately surrounding olivine is a rim (discontinuous in places) of fine-grained magnetite which is itself surrounded by a continuous zone of cummingtonite prisms radiating from the olivine-magnetite core. Scattered anhedral grains of hypersthene occur within the cummingtonite zone. The outermost zone (in contact with plagioclase) is a continuous rim of pale blue-green, Ti-poor pargasitic hornblende containing a few small euhedral garnet crystals. Very fine flakes of biotite are scattered through the inner part of some of the hornblende rims, but probably make up less than one percent of the corona material.

Microprobe analyses of hornblende, hypersthene, cummingtonite, and garnet were made at a number of different points, and their averages appear in Table 1. These were combined with a point-count analysis of the corona material to obtain its average composition, which is then expressed as a CIPW

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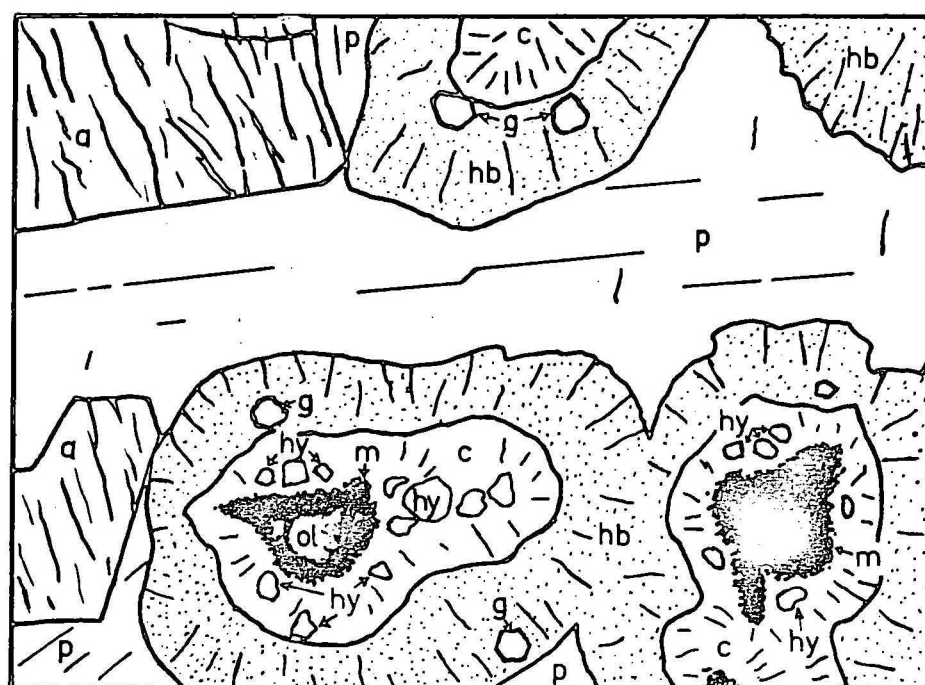


Figure 1. Coronas formed between olivine and plagioclase.
 ol=olivine, m=magnetite, c=cummingtonite
 hy=hypersthene, g=garnet, hb=hornblende,
 p=plagioclase, a=augite.

TABLE I. Microprobe analyses: numbers of ions on the basis
of an assumed number of oxygens

	Hornblende (average of 14 points)	Hypersthene (average of 3 points)	Cummingtonite (average of 3 points)	Garnet (average of 3 points)	Olivine (average of 4 points)
Si	5.88	0.99	7.91	-	
Al ^{IV}	2.12	0.01	0.08	none	
Al ^{VI}	1.22	0.00	0.00		
Ti	0.00	-	0.00	-	
Fe (all Fe as Fe ²⁺)	1.99	0.44	2.62	1.98	1.12
Mn	0.01	-	0.03	0.09	-
Mg	2.07	0.56	4.33	0.60	0.88 (calc.)
Ca	1.71	0.00	0.08	0.30	-
Na	0.81	-	0.05	-	-
K	0.09	-	0.01	-	-
O (assumed)	23	3	23	12	4

norm (Table II). Molar volumes (Table II) used in the calculation were estimated from the data of Robie, Bethke & Beardsley (1967). Fe^{3+} from magnetite was recalculated as Fe^{2+} .

Olivine (45.5 mol. percent Fo) and plagioclase (65 mol. percent An) make up 97 percent of the normative constituents of the corona material. Microprobe analyses of the primary igneous olivine and plagioclase yield average values Fo_{44} and An_{59} , respectively. The plagioclase laths are normally zoned from An_{53} to An_{64} , but a few small more sodic grains near the coronas were detected by electron probe and found to range in composition from An_{23} to An_{45} . It is possible that the more sodic grains and even some of the zoning are products of the corona-forming reactions - which could account at least partly for low normative Ab in the rest of the corona material. Whitney & McLelland (1973) report depletion of plagioclase in An component during formation of garnet-bearing coronas in metamorphosed anorthosites from the Adirondak Mountains.

The present results indicate that the coronas formed by near-isochemical reaction between olivine and plagioclase. Only small amounts of H_2O and O, and a very small amount of K (for biotite), need to have been introduced. The occurrence of hypersthene-bearing coronas is unusual in a terrain where epidote and chlorite-bearing assemblages predominate in other basic rocks. Most coronites - for example, those from the Adirondak Mountains, U.S.A. (Whitney & McLelland, 1973), Norway (Griffin, 1971; Mason, 1967), and India (Murthy, 1958) - occur in granulite or upper amphibolite facies terrains. It is possible that the corona structures described here are relics of an early high-grade event which have survived the relatively low-grade regional metamorphism. However, no independent evidence of an earlier high-grade event has been found in the area. Thus it seems probable that the corona-structures developed during upper green-schist to lower amphibolite facies regional metamorphism under almost dry conditions in the central part of the basic body.

TABLE II. Composition of reaction rim
material and related data

	Vol. % in corona structures	Estd nolar volume (cm ³)	Mol. %	CIPW norm of corona mat- erial
Hornblende	55.8	275	24.3	Ilm 0.02
				Ab 12.6)
Hypersthene	12.8	32.2	47.6	An 27.3) 41.3
				Or 1.5)
Cummingtonite	18.7	272	8.2	Di 1.3)
				Hd 1.9) 3.2
Garnet	8.7	115	9.1	Fo 20.2)
				Fa 35.1) 55.3
Magnetite	4.1	44.5	11.0	Ne 0.2

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