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Garnet-pyroxene-plagioclase granulite xenoliths from a lamprophyre dyke, south-east King Island.

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Abstract

Two xenoliths of high-grade metamorphic rocks were recovered from a lamprophyre dyke near Cumberland Creek, south-east King Island. These xenoliths indicate that part of the basement to King Island is of a higher metamorphic grade than any rocks so far found cropping out on King Island or on the island of Tasmania.

INTRODUCTION

During mapping of the country around City Of Melbourne Bay, south-east King Island, which resulted in the paper *Geological setting and petrochemistry of Eocambrian–Cambrian volcano-sedimentary rock sequences from south-east King Island* [WALDRON, H. M.; BROWN, A. V.; KEAYS R. R. (under review). *Aust. J. Earth Sci.*], a thin lamprophyre dyke was found cutting the picritic lava sequence on the shore platform to the south of Cumberland Creek (fig. 1) [BR549712]. Two xenoliths recovered from the dyke are of high-grade metamorphic origin.

FIELD RELATIONSHIPS

The lamprophyre dyke is exposed across the shore platform. The dyke has chilled margins and for most of its outcrop is 520 mm wide, vertical and striking to 055°. Two metres before outcrop is lost on the inland side the dyke bifurcates into smaller dykes, one 250 mm wide and the other 150 mm wide. The main dyke intrudes a sequence of dominantly picritic pillow lavas, which have a regional dip of 50° to 100°.

PETROGRAPHY

In thin section the lamprophyre consists of large, fractured olivine phenocrysts (Fo_{86-92}), surrounded by haloes of magnetite granules; kinked, mica 'books' (up to 8mm long and 3–4mm thick; analysis 2 Table 2); elliptical, black, clinopyroxene xenocrysts (up to 10×5 mm, but generally 5×2 mm; analysis 1 Table 2), with prominent reaction rims; and minor, 15–20 mm diameter, granulite xenoliths in a groundmass of diopsidic augite, biotite, alkali feldspar and carbonate. Accessory amounts of spinel (analysis 3 Table 2) apatite, tremolite, pyrite and chalcopyrite are present.

AGE

McDougall and Leggo (1965) obtained a K-Ar date on biotite from a biotite lamprophyre dyke which, from the location description, may have been the dyke under discussion here. If not, the dated dyke would only be tens of metres away. Recalculation of their data (using revised constants) by Gleadow and Duddy (1980) gave an age of 143±3 Ma.

Waterhouse (1916) recorded the occurrence of biotite-bearing lamprophyre intruding granitic and layered sedimentary rocks in other areas along the east coast of King Island. Dykes of similar composition and mineralogy have also been described from western Tasmania (Sutherland and Corbett, 1974) and from Cape Portland (Jennings and Sutherland, 1969).

XENOLITHS

Both of the xenoliths (samples K35 and K62) obtained are garnet-clinopyroxene-plagioclase granulite. Chemical analyses of the component minerals are listed in Table 2 (K35: 1–3; K62: 4–6), together with the compositions of the alteration (hydrated garnet; analysis 4 Table 2) around the rims of the garnet grains.

Petrographically, the samples consist of anhedral grains of plagioclase, garnet, clinopyroxene and minor biotite with a granular mosaic texture. The plagioclase grains are up to 2 mm long, garnet grains are approximately 1 mm in diameter, and the clinopyroxene grains 0.5 mm in diameter.

PRESSURE-TEMPERATURE CONDITIONS OF FORMATION OF THE GRANULITE XENOLITHS

Using the garnet-clinopyroxene geothermometer of Ellis and Green (1979) and the clionpyroxene-plagioclase geobarometer of Ellis (1980), Sutherland *et al.*, (under review) obtained the following P-T values for the formation of the granulite xenoliths:

- K35—807°C at 12.0 Kb, which is 155°C below the South-Eastern Australian Geotherm.
- K62—860°C at 13.3 Kb, which is 140°C below the South-Eastern Australian Geotherm.

REFERENCES

ELLIS, D. J.; GREEN, D. H. 1979. An experimental study of the effect of Ca upon garnet–clinopyroxene Fe–Mg exchange equilibrium. *Contrib. Mineral. Petrol.* 71:13–22.

ELLIS, D. J. 1980. Osumitite-sapphirine-quartz granulites from Endoby Land, Antarctica: P–T conditions of metamorphism, implications for garnet–cordierite equilibrium and the evolution of the deep crust. *Contrib. Mineral Petrol.* 74:201–210.

GLEADOW, A. J. W.; DUDDY, I. R. 1980. Early Cretaceous volcanism and the early breakup history of southeastern Australia: Evidence from fission track dating of volcaniclastic sediments, *in:* CRESWELL, M. M.; VELLA, P.

(ed.). *Gondwana Five*. 295–300. Proceedings International Gondwana Symposium

JENNINGS, D. J.; SUTHERLAND, F. L. 1969. Geology of the Cape Portland area, with special reference to the Mesozoic(?) appinitic rocks. *Tech. Rep. Dep. Mines Tasm.* 13:45-82.

MCDOUGALL, I.; LEGGO, P. J. 1965. Isotopic age determinations on granitic rocks from Tasmania. *J. geol. Soc. Aust.* 12:295-332.

SUTHERLAND, F. L.; CORBETT, E. B. 1974. The extent of Upper Mesozoic igneous activity in relation to lamprophyric intrusions in Tasmania. *Pap. Proc. R. Soc. Tasm.* 107:175-190.

SUTHERLAND, F. L., RAYNOR, L. R.; POGSON, R. E. *Under review*. The garnet/spinel mantle transition in eastern Australia, in relation to apparent palaeogeotherms. *Contr. Mineral. Petrol.*

WATERHOUSE, L. L. 1916. Tungsten and molybdenum. Part III. King Island. *Miner. Resour. geol. Surv. Tasm.*

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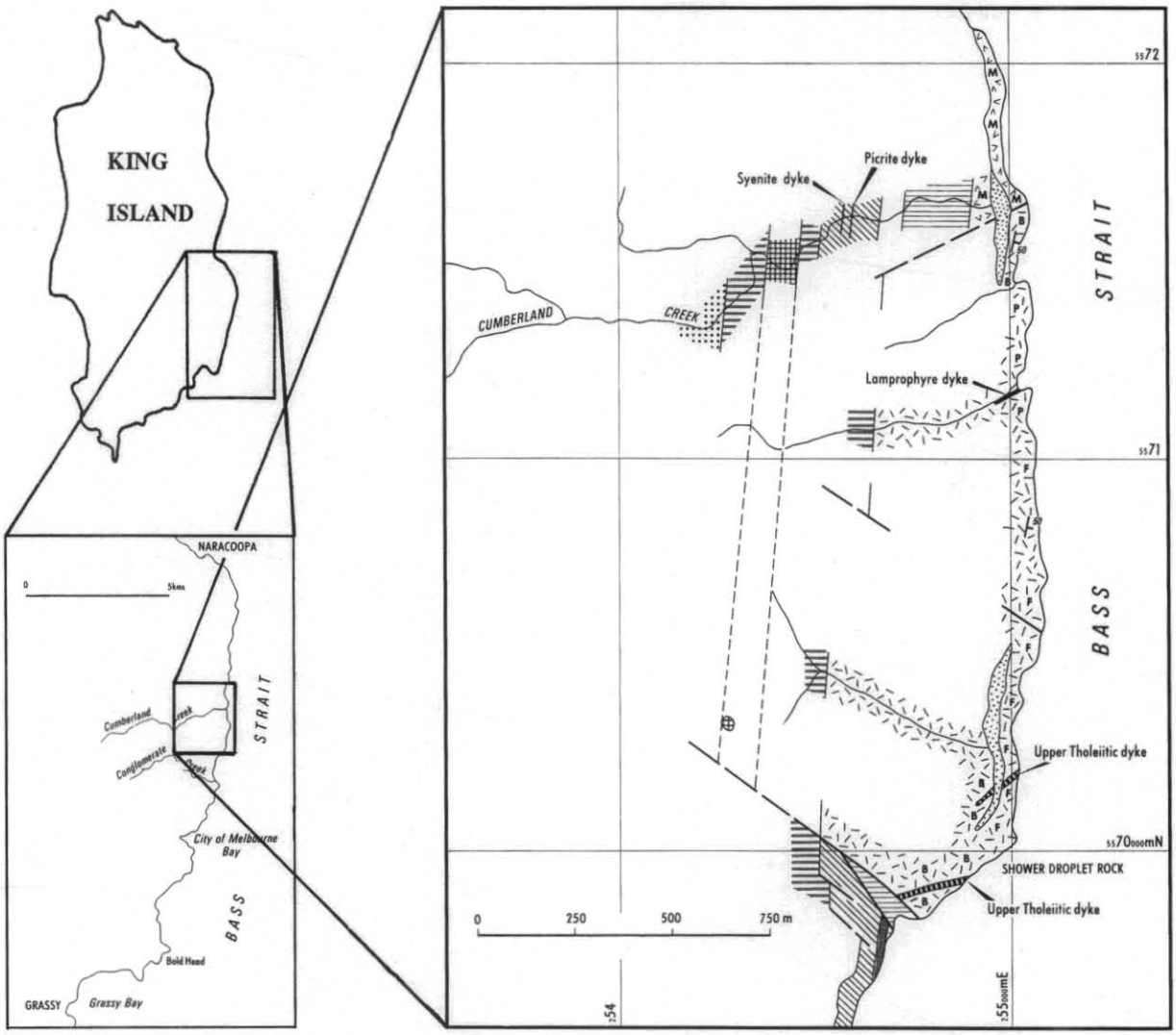

LEGEND

Siltstone and tuff with tholeiite flows

Dolomite

Mixtite

Laminated siltstone

Siliceous sandstone

Fault

Inferred fault

44 Dip and strike

Pebble and sand beaches and alluvial cover

Upper tholeiites Interbedded porphyritic and non–porphyritic flows, conglomerate and chert

Picrites

P Predominantly pillow lavas

P Predominantly thick flows

B Predominantly thin flows, breccias and hyaloclastites

Undifferentiated

Dykes

Lamprophyre dyke

Syenite dyke

Tholeiite dykes

Picrite dyke

Figure 1. *Location map and geology of Cumberland Creek area.*

5 cm

Table 1. *Electron microprobe analyses of xenolith minerals*

	1	2	3	4	5	6	7
SiO_2	40.11	53.04	55.50	37.82	39.21	51.48	60.75
TiO_2	-	0.28	-	5.62	-	0.52	-
Al_2O_3	22.84	3.48	28.16	16.23	22.38	5.04	24.89
FeO	18.93	5.49	-	9.41	22.98	9.69	-
MnO	0.26	-	-	-	0.26	-	-
MgO	11.75	14.94	-	17.53	8.10	11.84	-
CaO	5.86	22.63	10.15	-	7.03	20.32	6.35
Na_2O	-	0.39	4.89	0.42	-	1.50	7.06
K_2O	-	-	0.78	7.74	-	-	0.69
Total	99.75	100.25	99.48	95.77	99.96	100.38	99.74
Si	2.9998	1.9389	2.5097	5.9414	2.9962	1.9111	2.7060
Ti	-	0.0077	-	0.6640	-	0.0145	-
Al	2.0138	0.1500	1.5012	3.0059	2.0161	0.2206	1.3070
Fe	1.1840	0.1678	-	1.2363	1.4686	0.3005	-
Mn	0.0165	-	-	-	0.0168	-	-
Mg	1.3096	0.8139	-	4.1042	0.9224	0.6551	-
Ca	0.4696	0.8864	0.4918	-	0.5756	0.8083	0.3031
Na	-	0.0276	0.4288	0.1279	-	0.1080	0.6097
K	-	-	0.0450	1.7517	-	-	0.0392
Total	7.9933	3.9923	4.9765	16.8315	7.9958	4.0181	4.9650
Mg#	52.5	82.9	-	76.9	38.6	68.5	-
Ca	15.8	47.4	-	-	19.4	45.8	-
Mg	44.2	43.6	-	-	31.1	37.1	-
Fe	40.0	9.0	-	-	49.5	17.0	-
Ca	-	-	50.9	-	-	-	31.8
Na	-	-	44.4	-	-	-	64.0
K	-	-	4.7	-	-	-	4.1

Analyses

1—Garnet, K35
2—Clinopyroxene, K35
3—Plagioclase, K35
4—Biotite, K35

5—Garnet, K62
6—Clinopyroxene, K62
7—Plagioclase, K62

Table 2. *Electron microprobe and XRF analyses.*

	1	2	3	4		5
SiO_2	52.38	37.81	-	38.77	SiO_2	34.90
TiO_2	0.53	6.46	0.37	-	TiO	2.01
Al_2O_3	4.98	14.79	30.71	23.44	Al_2O_3	7.94
Cr_2O_3	0.36	-	37.77	-	Fe_2O_3	11.17
FeO	5.13	9.01	15.06	20.38	FeO	-
MnO	-	-	-	0.24	MnO	0.19
MgO	16.13	17.28	16.44	6.56	MgO	13.06
CaO	18.66	-	-	7.28	CaO	12.97
Na_2O	1.40	0.32	-	-	Na_2O	1.52
K_2O	-	9.49	-	-	K_2O	3.41
					P_2O_5	1.90
					SO_3	0.41
					LOI	9.34
Total	99.57	95.16	100.35	96.67	Total	99.72
Si	1.9108	6.0038	-	3.0247	Cr	516
Ti	0.0145	0.7715	0.0646	-	Ni	435
Al	0.2142	2.7687	8.4001	2.1559	Co	63
Cr	0.0104	-	6.9284	-	Sc	17
Fe^{3+}	-	-	0.6069	-		
Fe	0.1565	1.1965	2.3154	1.3297	Rb	100
Mn	-	-	-	0.0159	Ba	2520
Mg	0.8770	4.0893	5.6846	0.7627	Sr	1641
Ca	0.7294	-	-	0.6086		
Na	0.0990	0.0985	-	-	Zr	260
K	-	1.9225	-	-	Y	29
Total	4.0118	16.8509	24.0000	7.8974		
Mg#	84.9	77.4	71.1	36.5		
Cr#	-	-	45.2			
Ca	41.4	-	-	22.5		
Mg	49.7	77.4	-	28.2		
Fe	8.9	22.6	-	49.2		
Ca	-	-	-	-		
Na	-	4.9	-	-		
K	-	95.1	-	-		

Sample

1—Clinopyroxene xenocryst
2—Biotite xenocryst
3—Spinel xenocryst
4—Rim alteration of garnet, K62
5—Whole rock analysis of lamprophyre