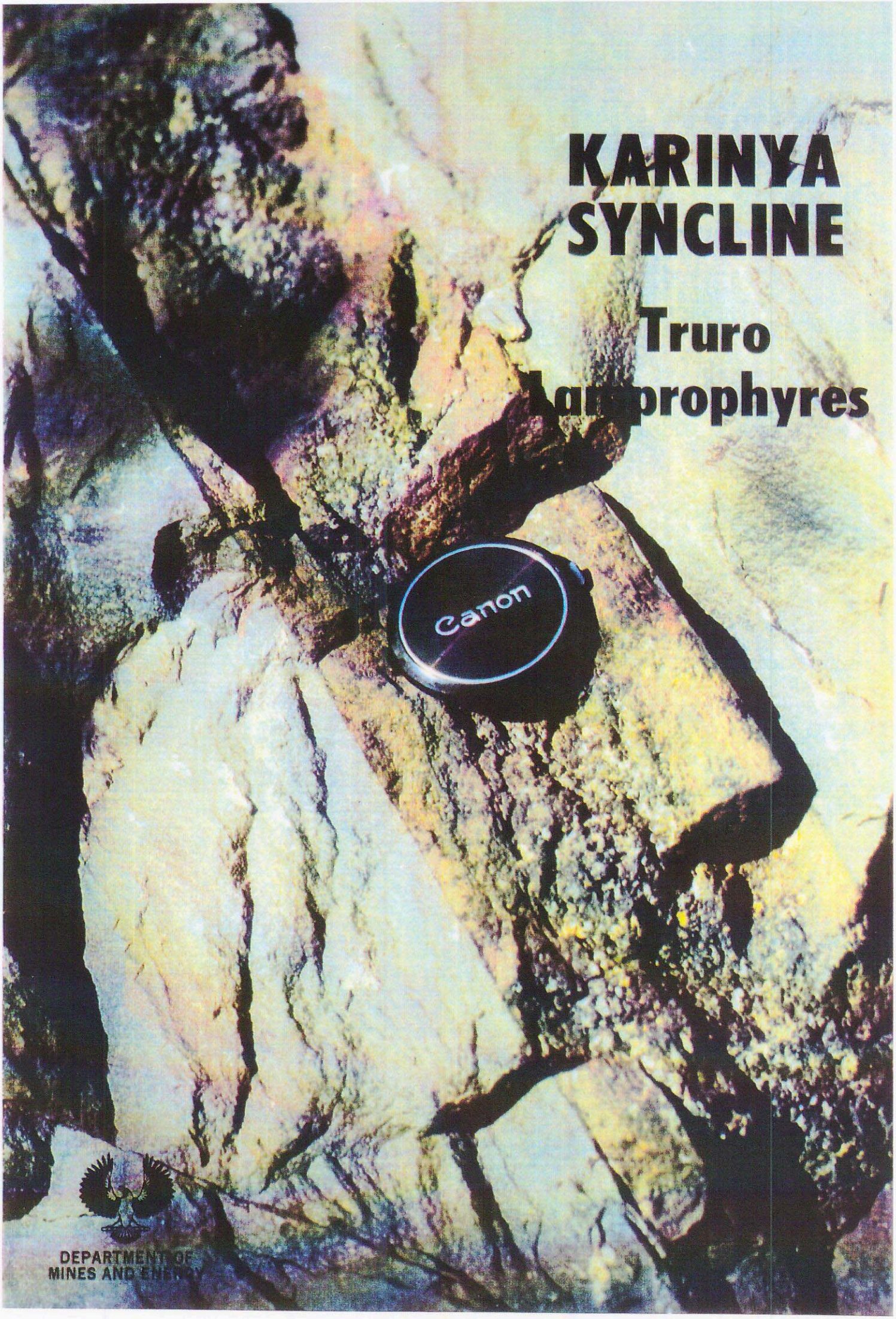
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DEPARTMENT OF
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DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT. BK. NO. 91/29

KANMANTOO TROUGH GEOLOGICAL INVESTIGATIONS
KARINYA SYNCLINE
TRURO LAMPROPHYRES

GEOLOGICAL SURVEY

BY

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DME 56/88

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FIGURES

Front Cover: Lamprophyre dyke intruding joint plane, note fine grained chilled margins. (Photo No. 39276)

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT BK. NO. 92/29
DME NO. 56/88
G02493

KANMANTOO TROUGH GEOLOGICAL INVESTIGATIONS
KARINYA SYNCLINE
TRURO LAMPROPHYRES

ABSTRACT

A lamprophyre province has been identified in the Truro area comprising numerous dykes and at least one diatreme. The regional extent of the province has not been determined. The lamprophyre dykes, of the calc-alkaline suite and classed as minette, generally intrude joint planes of Cambrian meta-sediments of the Karinya Syncline. An age of about 480 Ma has been determined by K-Ar geochronology indicating a genetic association with the Ordovician granite and norite intrusions to the southeast. A possible diatreme with multi-phase dolerite-lamprophyre core, fluidised pebble breccia margin and the talc-asbestos-tourmaline alteration of carbonate host rock has been located near Dutton. Deep seated crustal weakness is indicated by the association of many of the dykes with Landsat lineaments, consequently the region is considered prospective for diamonds, gold and base metal mineralisation.

INTRODUCTION

During the course of base metal investigations of the Karinya Syncline, between February 1989 and September 1990, numerous lamprophyre dykes and a possible lamprophyric diatreme have been

identified. All occurrences were recorded and samples collected for petrology, whole rock silicate and trace metal analysis and geochronology.

Preparation of thin sections and routine petrological descriptions were mainly completed by Pontifex and Associates Pty Ltd (A. Purvis, petrologist) and several by Amdel Ltd (F. Radke, petrologist). SADME petrologist, M. Farrand (1990 a, b, c and d) has reported in detail on most thin sections. Potassium-argon dating of three samples was determined by Amdel Ltd. Whole rock silicate and trace metal analysis were completed by ANALABS Laboratories.

LOCATION

The general area of investigation is approximately 80 km northeast of Adelaide via the Sturt Highway (Fig. 1), and covers part of the Karinya Syncline between Truro and Frankton (Fig. 2).

GEOLOGY

The geology of the Karinya Syncline, at the northern end of the Cambrian Kanmantoo Trough (Fig. 1), is shown on Truro 1:63 360 (Coates, 1959) and ADELAIDE 1:250 000 (Thomson, 1969) and presented on figure 2. A stratigraphic column of Cambrian

sedimentation is shown on Table 1. The region has experienced four folding episodes and faulting during the Cambrian-Ordovician Delamerian Orogeny (Mills, 1964). The north-south trending syncline was generated during the initial D^1 deformation along with a slaty cleavage (Cooper, 1989).

East-northeasterly and northwesterly trending Landsat linear corridors, apparent on Landsat MSS and TM imagery, cross the region and are contained within and near the eastern margin of O'Driscoll's (1985) north-northeasterly trending G2 structural corridor (Fig. 1 and 2). The Landsat linear corridors intersect near Stonefield, where coincident magnetic high and gravity low anomalies may represent a plutonic centre (Gerdes and Hough, 1991), and Frankton, where there is a concentration of lamprophyrye dykes. A study of Landsat and aerial photography over the Karinya Syncline has been prepared by Dubowski (1991).

Lamprophyre dykes are widespread in the region and many are associated with Landsat linear corridors. The dykes, 0.1 to 1.5 m wide, generally intrude along joint planes with no alteration of the country rock and characteristically have fine grained chilled margins about 30 mm wide. A possible lamprophyric diatreme with fluidised pebble breccia around the margins and alteration of the carbonate host rock to talc, asbestos and tourmaline has been located 3 km north of Truro.

TABLE 1

Stratigraphic Column

SOUTHERN KANMANTOO TROUGH		KARINYA SYNCLINE	
Top not exposed MIDDLETON SANDSTONE			
PETREL COVE FORMATION			
BALQUHIDDER FORMATION			
TUNKALILLA FORMATION			
TAPANAPPA FORMATION (with pyrite beds)		Top not exposed TAPANAPPA FORMATION	
TALISKER CALC-SILTSTONE (includes Nairne Pyrite member)		KARINYA SHALE	
BACKSTAIRS PASSAGE FORMATION		BACKSTAIRS PASSAGE FORMATION	
	CAMPANA CREEK MBR		CAMPANA CREEK MBR
CARRICKALINGA HEAD FORMATION	BLOWHOLE CREEK SILTSTONE (B.C.S.) MBR	CARRICKALINGA HEAD FORMATION	B.C.S. MEMBER (includes Milendella Limestone Member)
	MADIGAN INLET MBR		MADIGAN INLET MBR (equivalent)
NORMANVILLE GROUP		NORMANVILLE GROUP	

LAMPROPHYRE OCCURRENCES

The localities of all known lamprophyres in the region are shown on figures 2 and 3, a summary of samples collected is shown on Table 2 and petrological descriptions are included in Appendix A.

The first recorded lamprophyre was reported by Hossfeld (1935) and identified as a minette (locality 20, Fig. 2). A sample submitted by B.P. Thomson in 1971, for K-Ar geochronology, from locality 1 (Fig. 2) was described as a minette and dated at 450 Ma. In 1983 CRA Exploration Ltd located several lamprophyre dykes at locality 13 which were described as minettes (Bubner, 1983). In 1989 C. G. Gatehouse of SADME Regional Geology Branch found lamprophyre dykes at localities 5 and 13 and then during the course of base metal exploration members of the Mineral Resources Branch mapped and sampled many lamprophyre occurrences that are widespread through the region.

TABLE 2

Summary Of Lamprophyre Occurrences
(Localities shown on figures 2 and 3)

Locality Number	Petrological* Sample No.	Geochemical Sample No.	Rock Name	Strike	Dip
1	P241/71,RS1507	RS 1506	minette	020-060	40-70 SE
2		RS 2606		155	20E
3	CRA 953048	RS 1505	minette	020	85E
4	RS 3739	RS 3739	minette	065	40°SE
5	RS 1508	RS 1502	altered minette	075	26N
6	RS 3028	RS 3033	lamprophyre	140	20NE
7	RS 3026	RS 3029	meta-dolerite?	345	85W
	RS 3027	RS 3032	meta-dolerite?		
8	RS 3742	RS 3742	minette	170	40W
	RS 3743	RS 3743	minette		
9	RS 3745	RS 3745	minette	060	vert.
	RS 3746	RS 3746	minette	060	45NW
10	RS 3294	RS 3031	minette	050?	
11	RS 3024	RS 3030	lamprophyre	050	
12	RS 2599		altered dolerite	Diatreme	
	RS 2600		gabbro	"	
	RS 2601		altered dolerite	"	
	RS 2602		altered dolerite	"	
	RS 2603	RS 2604	altered dolerite?	"	
	RS 3297		carbonatite?		
	RS 3342	RS 3342	minette	"	
13		RS 2608		090	30S
		RS 2609		065	30S
14	RS 3296	RS 3302	minette/micro-syenite	070?	
	RS 3295	RS 3301	minette		
15	RS 1509		degraded minette		
	RS 3292	RS 3304	minette	060	60SE
16	RS 1510		minette		
17	RS 3293	RS 3300	minette	000	
18		RS 2605		120	45N
19	RS 3273	RS 3273	lamprophyre	315	?
20			minette	060	20SE
21			dolerite?		
22			Truro volcanic?		
23			minette?	060?	
24	6730RS47	6730RS47	minette?		
	6730RS48	6730RS48	dolerite		
	6730RS49	6730RS49	dolerite		
	6730RS50	6730RS50	dolerite		
25	6730RS51	6730RS51	altered minette		
Frankton No. 1	RS3258	RS3303	minette		
Frankton No. 2	RS3287	RS3298	minette		
	RS3289		minette		
	RS3290	RS3299	minette		

* All RS numbers prefixed by 6729 unless otherwise indicated

The geological setting of each lamprophyre occurrence is briefly described as follows:

Locality 1 Seven dykes, from 10 cm to 60 cm wide strike from 020° to 060° and dip 40° to 70° east, are well exposed in an abandoned aggregate quarry. The dykes intrude along joint planes in meta-sandstone and siltstone of Backstairs Passage Formation that strike 170° and dip 80°W. The dykes are described as flow foliated minettes with fine grained chilled margins (Plate 1).

Locality 2 A weathered lamprophyre dyke 50 cm to 70 cm wide, striking 155° and dipping 20°E is exposed in an abandoned aggregate quarry intruding a joint plane in saccharoidal marble of Milendella Limestone Member, that strikes 170° and dips 40°W. Phlogopite phenocrysts are aligned to a flow foliation and the marble contact surfaces are corroded by dissolution and abrasion by the lamprophyre magma.

Locality 3 In the bank of Pine Creek CRA Exploration Ltd have mapped several lamprophyre dykes 20 cm to 30 cm wide that strike about 020° and dip steeply east and intrude black shale along bedding planes. The site is on the eastern margin of the Karinya Syncline adjacent to the north-south trending Palmer Fault Zone. The dykes are described as flow textured minettes.

Locality 4 In the bank of Pine Creek a lamprophyre dyke 25 cm wide, striking 065° and dipping 40°SE, intrudes a joint plane in Karinya Shale that strikes 175° and dips 35°E (Plate 2). The dyke is described as a flow textured minette with segregations of quartz syenite.

Locality 5 Two highly weathered dykes 10 cm to 20 cm wide, striking 075° and dipping 26°N, are exposed in a road cutting and cross cut meta-siltstone and shale of Carrickalinga Head Formation that strikes 160° and dips 75°W. The dykes are described as minettes that have been altered to a quartz-muscovite assemblage.

Locality 6 A 1 m wide weathered dyke, striking 140° and dipping 20°N, is exposed in a road cutting and railway cutting intruding a joint plane in blue-grey siltstone of Normanville Group that strikes 180° and dips 83°E. The dyke is described as a biotite rich lamprophyre (minette or kersantite).

Locality 7 Two weathered dykes up to 3 m wide, striking 350° and dipping 85°W, are exposed in a road cutting intruding joint planes in blue-grey siltstone and shale of Normanville Group that is near vertical and strikes north-south. The host rock is altered for up to 1 m from the contact with bleaching, tourmalinisation and silicification. The dykes are described as weathered meta-dolerite or basalt.

Locality 8 A weathered 1 m wide dyke, striking 170° and dipping 40°W, is exposed in a road cutting (RS3743) and fresher material is exposed in a pit about 50m to the south (RS 3742). The dyke intrudes meta-siltstone of Normanville Group along a bedding plane. Several parallel dykes, 5 cm to 20 cm wide, are also exposed in the road cutting. The dykes are described as minettes.

Locality 9 Two dykes are exposed along the banks of Middle Creek and intrude meta-siltstone of Normanville Group that strikes 160° and dips 50°W. One dyke (RS 3745) on the southern bank is 30 cm wide, vertical and strikes 060° and

is described as a phlogopite rich minette. The other dyke (RS 3746) on the northern bank is 40 cm wide, strikes 060°, dips 45°NW and is described as an oxide rich (after magnetite) minette with possible emulsion textures.

Locality 10 A poorly exposed weathered dyke is adjacent to a 1 m to 2 m wide ferruginised fault zone that is vertical and strikes 050°. The dyke appears to parallel the fault and is described as a weathered minette. Host rock is meta-siltstone of Normanville Group that strikes 345° and dips 65°W.

Locality 11 A poorly exposed weathered dyke occurs on a hillside within meta-siltstone of Normanville Group that strikes 345° and dips 65°W. The dyke, described as a weathered silicified, albitised, lamprophyre, possibly strikes 050° and parallels an adjacent fault zone. This dyke may be the same one as at locality 10.

Locality 12 A road cutting exposes an interpreted diatreme 90m by at least 25m (Fig. 4). Its extent to the east and west is untested. The central part of the diatreme (plate 3) is a multi-phase basic intrusion with dolerite, minette and gabbro being identified. At the margins is a pebble breccia containing rounded to angular autolithic xenoliths of basic rock and heterolithic xenoliths of marble (plates 4 and 5). The xenoliths are generally ovoid and up to about 10 cm in size. The breccia is thought to result from a fluidised gas charged intrusion. The host rock is Angaston Marble of Normanville Group and marginal to the diatreme is altered to talc schist and crocidolite. The basic intrusives have been enriched with potassium and sodium, leading to the development of phlogopite and albite. Late stage boron metasomatism is indicated by tourmaline veining.

Locality 13 Two dykes are exposed in a creek: one being 30 cm to 50 cm wide, strikes 090° and dips 30°S; the other is 10 cm wide, strikes 065° and dips 30°S. Both dykes intrude north-south trending siltstone and shale of Carrickalinga Head Formation. The dykes appear to be highly weathered lamprophyre but there has been no petrological verification.

Locality 14 Rock float in soil indicates the presence of two dykes: one (RS3296) appears to strike about 070° and is described as patches of minette in spherulitic microsyenite; the other is described as a flow textured minette (RS 3295).

Locality 15 An outcrop of lamprophyre about 1 m wide, striking 060° and dipping 60°SE, occurs near Franklton No. 1 diamond drill hole and intrudes north-south trending Karinya Shale. The dyke is described as a flow textured minette.

Locality 16 Rock float in soil indicates the presence of lamprophyre in a paddock. The sample is described as a fine grained minette.

Locality 17 Along the bank of Levi Creek a dyke occurs as irregular scattered outcrop intruding north-south trending meta-sandstone of Backstairs Passage Formation. The dyke is described as a flow textured minette.

Locality 18 A lamprophyre dyke, 1 m to 1.5 m wide, striking 120° and dipping 45°N is traceable for about 500m and intrudes north-south trending Karinya Shale. The dyke has flow orientated phlogopite phenocrysts but has not been petrologically examined.

Locality 19 A dyke, 20 cm to 30 cm wide and striking about 315° is exposed in a creek intruding Adelaidean sediments. The dyke is described as a lamprophyre.

Locality 20 A 40 cm wide dyke, striking 060° and dipping 20°SE, is exposed along the southern bank of Ram Station Creek. Along strike the dyke divides into two 30 cm to 50 cm wide dykes, 30 cm apart, that intrude joint planes in laminated siltstone of Backstairs Passage Formation. The dyke is described as a biotite minette (Hossfeld, 1935).

Locality 21 Exposed in a road cutting are patches of dolerite? surrounded by talc, asbestos and tourmaline from the alteration of Angaston Marble of Normanville Group. No samples have been collected from this locality.

Locality 22 Hossfeld (1935) describes the occurrence of a dense dark blue basic rock, possibly basalt, that contains about 3% titanium, has amygdales of quartz and feldspar and intrudes marble. He also describes an amphibolite dyke along with graphic quartz and tourmaline in the area. A field check showed the area to be mainly soil covered but an area of float of fine grained basic rock with amygdales of quartz and feldspar was located. The rock is considered to be related to the Lower Cambrian Truro Volcanics (Fig. 2) rather than the lamprophyric intrusives.

Locality 23 Hossfeld (1935) mapped the occurrence of an unclassified basic intrusion. A field check revealed two small weathered sub-outcrops of lamprophyre and an extensive area of lamprophyre float in the soil, traceable for about 300 m. There appears to be at least two dykes that strike about 060° and intrude blue-grey siltstone and shale of Normanville Group that strikes 150° and dips 60°W.

Locality 24 The abandoned Blue Hole Crocidolite Quarry (Fig. 3) consists of asbestos, talc and tourmaline alteration of Adelaidean Burra Group dolomite associated with a dolerite-minette intrusion. Wymond and Wilson (1951) concluded that the crocidolite is associated with late magmatic, soda-metasomatised intrusion which shows doleritic texture.

Locality 25 There are several scattered pits and small open cuts (Fig. 3) showing minette-dolerite intrusions with associated asbestos and talc alteration.

Frankton No. 1 This diamond drill hole, reported separately (Morris, 1991), cut a lamprophyre dyke between 7 m and 11 m depth. The dyke is the same as exposed nearby (locality 15) and is described as a flow textured minette. A 1 cm wide lamprophyre dyke was also intersected at 63.8 m depth.

Frankton No. 2 This diamond drill hole, reported separately (Morris, 1991) cut several lamprophyre dykes:

- a 30 cm dyke at 55.4 m depth is described as a phlogopite-apatite porphyritic minette (RS 3287)
- a 2 cm dyke at 120.5 m depth is described as a flow textured phlogopite-apatite minette (RS 3289).
- a 90 cm dyke at 125.2 m depth is described as a flow textured carbonate rich minette veined by leucocratic microsyenite (RS 3290).
- a 6 cm lamprophyre dyke at 171 m depth was not petrologically described.

PETROLOGY AND GEOCHEMISTRY

Detailed petrological descriptions are included in Appendix A and silicate and trace metal analysis are shown on tables 3 and 4.

The lamprophyres are of the calc-alkaline suite and are termed minettes. They are predominantly porphyritic with phlogopite-biotite phenocrysts, to about 4 mm, aligned to a flow foliation. The phlogopite-biotite phenocrysts have battlemented ends and narrow dark (?iron rich) margins. Apatite is usually present as needles and prisms 0.1 mm to 1 mm long. The groundmass mainly comprises fine mica and orthoclase (often with spherulitic texture), accessories include apatite, albite, quartz, magnetite, leucoxene, carbonate, rutile, epidote and pyrite. Some minette dykes are veined by a microsyenite phase which is dominated by spherulites of orthoclase with minor leucoxene, magnetite, quartz, apatite and phlogopite. Ferro-magnesian minerals are generally lacking from the minettes, although the dolerite-lamprophyre samples at localities 7, 12 (diatreme), 24 and 25 contain alkali amphibole.

The minette dykes have not caused any obvious alteration to the host rock but the dolerite-lamprophyre intrusions have caused significant alteration of calcareous host rock to talc and asbestos. Purvis (1990) (Appendix A) describes samples from the diatreme (locality 12) as showing potassium and sodium enrichment and suggests that alkali metasomatism may be a form of fenitisation that could indicate the nearby presence of members of kimberlite, lamproite or carbonatite suites. There is also baron metasomatism accompanied by sodium and potassium, resulting in a tourmaline-albite-alkali feldspar rock.

Whole rock silicate and trace metal analysis of samples from most locations are presented on Table 3 and an average of all samples along with the average composition of minette (Rock, 1984) is shown on Table 4. The composition of the Truro lamprophyres, with the exception of Nb, is similar to that for average minettes which typically have high contents of K, P, Ba, Sr, Rb, Zr and Nb plus V, Cr and Ni contents ranging between basic and ultrabasic rocks (Rock, 1986).

TABLE 3

Silicate and Trace Metal Analysis

%	1 RS1506	2 RS2606	3 RS1505	4 RS3739	5 RS1502	6 RS3033	7 RS3029	7 RS3032	8 RS3742	8 RS3743	9 RS3745	9 RS3746	10 RS3031	11 RS3030	12 RS2604	12 RS3342	- locality number - sample number
SiO_2	56.4	52.6	58.6	56.0	68.8	55.5	49.0	50.5	56.3	61.5	49.1	57.3	63.4	48.4	39.6	35.4	
Al_2O_3	12.2	11.9	12.0	12.1	15.4	12.1	17.5	16.8	12.29	13.97	13.60	13.16	16.4	14.5	10.5	11.5	
Fe_2O_3	7.93	8.56	8.98	8.50	3.68	8.74	11.95	11.21	9.59	5.05	11.55	9.69	8.28	23.40	15.80	14.39	
MnO	0.10	0.07	0.09	0.06	0.01	0.02	1.32	0.10	0.02	0.01	0.31	0.02	0.01	0.02	0.13	0.09	
MgO	8.50	8.67	2.50	6.70	1.00	4.49	5.07	5.98	4.83	1.15	4.97	2.82	1.12	0.98	16.10	21.03	
CaO	1.50	2.69	2.88	2.08	0.05	0.33	0.97	1.33	0.40	3.59	4.95	0.99	0.07	0.04	2.48	1.09	
Na_2O	2.37	1.44	2.49	1.42	0.15	1.04	2.37	2.40	0.30	1.91	2.10	0.22	0.08	0.07	1.78	1.54	
K_2O	5.71	5.32	5.02	7.55	5.23	5.69	1.86	2.34	9.10	3.63	3.86	9.79	3.99	2.64	1.23	0.51	
TiO_2	1.49	1.55	1.94	1.86	2.23	1.80	1.58	1.65	2.02	2.13	1.80	2.01	1.49	1.49	1.82	1.85	
P_2O_5	1.070	1.400	2.110	1.600	0.067	0.377	0.193	0.108	0.482	2.711	1.845	0.937	0.275	0.932	0.284	0.563	
LOI	2.42	5.60	2.99	2.13	3.05	7.57	8.40	7.45	3.98	4.12	5.46	2.99	4.94	7.72	10.20	11.90	
TOTAL	99.69	99.80	99.60	100.00	99.67	97.66	100.21	99.87	99.31	99.77	99.55	99.93	100.06	100.19	99.92	99.86	
ppm																	
Cu	130	245	220	35	20	340	60	75	160	100	105	35	35	120	60	280	
Pb	30	50	50	60	20	25	5	<5	5	5	5	10	<5	<5	5	<5	
Zn	170	125	60	205	5	80	135	150	90	25	235	95	85	110	170	220	
Ag	<0.5	0.5	0.5	<0.5	0.5	0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	0.5	
Au	0.012	<0.005	0.003	0.004	0.001	<0.005	<0.005	<0.005	0.012	0.030	0.004	0.028	<0.005	<0.005	<0.005	0.003	
Co	90	55	30	40	<5	15	100	50	10	5	75	10	5	10	60	60	
Ni	360	190	165	265	35	125	140	90	120	40	240	100	90	105	330	395	
Be	8	5	4	7	6	6	4	6	10	9	7	9	7	14	2	1	
Li	50	47	39	123	64	30	59	43	62	41	50	120	26	70	80	131	
Nb	21	<20	12	19	23	14	<10	<10	14	<10	20	22	23	10	29	40	
Zr	452	164	170	301	909	758	34	39	819	109	569	884	453	593	79	97	
Ba	1 321	1 983	1 473	2 023	737	1 600	370	323	2 442	235	2 592	2 026	423	665	120	59	
V	442	450	525	544	704	615	265	284	587	699	495	694	445	755	311	210	
Cr	160	75	145	105	20	70	55	45	70	50	60	80	25	70	130	155	
Sc	21	23	18	17	33	22	36	36	20	21	18	19	20	23	38	27	
Y	22	27	38	54	35	79	30	39	59	36	45	41	69	113	7	24	
Sm	<5	10	8	10	6	33	<5	<5	13	10	13	16	19	37	<5	6	
La	37	70	59	62	60	133	13	21	72	73	97	108	140	275	20	54	
Sr	379	621	417	504	41	446	250	244	761	992	1 526	434	170	143	48	35	
As				14					12	7	9	7				2	
B				<10		<10	11	10	<10	58	<10	<10	83	32		15	
Pt		<0.005		0.002		<0.005	<0.005	<0.005	0.002	0.002	0.002	0.001	<0.005	<0.005	<0.005	0.0009	
Pd		0.003		0.009		0.007	<0.001	0.004	0.013	0.018	0.006	0.011	0.004	0.004	<0.001	0.0007	

Note: all RS numbers prefixed by 6729; Total Fe as Fe_2O_3

TABLE 3 continued

Silicate and Trace Metal Analysis

	13	13	14	14	15	17	18	19	24	24	24	24	25	F'ton1	F'ton2	F'ton2 - locality number
									6730	6730	6730	6730	6730			
%	RS2608	RS2609	RS3302	RS3301	RS3304	RS3300	RS2605	RS3273	RS47	RS48	RS49	RS50	RS51	RS3303	RS3298	RS3299 - sample number
SiO_2	67.5	67.0	60.2	59.8	61.9	56.5	59.8	61.60	49.3	49.6	47.5	53.0	42.0	63.1	57.0	48.0
Al_2O_3	16.0	14.1	12.8	14.0	12.6	12.2	12.1	12.60	10.12	13.68	13.96	14.36	6.90	13.1	10.8	9.5
Fe_2O_3	4.13	5.01	6.22	6.62	4.69	7.66	5.87	7.89	11.04	7.96	14.49	7.95	13.33	4.84	7.77	9.81
MnO	0.01	0.01	0.04	0.10	0.01	0.20	0.02	0.02	0.01	0.01	0.01	<0.01	<0.01	0.29	0.15	0.25
MgO	1.40	1.34	3.55	4.70	3.05	3.40	4.18	4.82	15.97	10.89	8.14	6.60	15.70	3.60	5.05	6.20
CaO	0.03	0.68	1.78	0.60	2.12	4.12	1.51	0.64	0.45	0.58	0.50	0.53	0.92	0.07	3.16	6.68
Na_2O	0.16	0.15	1.23	2.24	0.88	1.91	0.58	3.72	0.73	0.65	0.85	0.88	2.29	0.28	0.20	0.39
K_2O	4.83	4.27	8.93	7.11	9.25	7.52	9.81	3.43	0.91	9.45	6.53	12.21	0.79	9.68	8.99	7.69
TiO_2	2.68	2.66	2.13	1.38	2.16	1.33	2.12	1.93	1.65	2.09	2.13	2.23	9.62	2.36	1.97	1.75
P_2O_5	0.050	0.048	1.440	0.370	1.450	1.390	1.200	0.12	0.298	0.458	0.373	0.428	0.298	0.20	2.20	1.80
LOI	4.01	4.75	1.29	2.53	1.64	3.88	2.59	3.21	8.47	4.82	2.39	2.13	8.17	1.98	2.30	6.57
TOTAL	100.75	100.02	99.61	99.45	99.75	100.11	99.78	99.98	98.95	100.19	96.87	100.32	100.02	99.50	99.59	98.64
ppm																
Cu	60	45	50	105	50	150	145	35	760	460	130	70	5	185	380	300
Pb	5	15	10	20	20	15	70	5	<5	<5	<5	<5	<5	30	395	155
Zn	25	35	125	90	80	65	95	80	30	25	5	15	85	210	625	155
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	0.5	<0.5	<0.5	<0.5	0.5	<0.5	2.5	3.0
Au	<0.005	<0.005	0.006	0.002	0.005	<0.001	<0.005	0.003	0.002	0.002	0.002	0.009	0.002	0.002	0.007	0.023
Co	<5	5	35	25	20	50	30	25	95	25	5	40	30	130	30	25
Ni	40	30	175	120	150	140	185	220	30	35	20	35	130	240	200	185
Be	9	6	4	5	4	5	4	6	1	2	1	1	2	6	6	6
Li	212	102	69	52	126	38	54	71	146	82	31	55	151	103	<20	43
Nb	<20	20	<10	18	<10	23	27	<10	<20	<20	<20	<20	64	14	<10	10
Zr	1 010	1 154	88	376	176	450	76	77	100	114	89	134	207	1 058	12	164
Ba	1 734	1 169	2 572	4 704	2 064	2 994	2 286	1 067	27	129	155	261	153	2 564	3 200	2 404
V	777	788	488	359	546	415	358	308	347	258	932	248	731	542	519	502
Cr	15	20	85	45	160	95	220	80	5	5	5	5	125	95	130	100
Sc	30	30	18	16	17	14	17	22	30	17	61	5	38	19	15	16
Y	39	56	38	34	47	21	78	42	27	40	37	38	9	67	36	24
Sm	8	9	7	7	13	<5	21	12	<5	6	5	6	<5	15	9	10
La	65	74	52	73	134	36	122	196	20	21	17	22	14	148	74	102
Sr	92	75	574	936	861	478	797	522	40	17	147	13	104	474	609	761
As			13	3	3	5		3	1	1	1	1	3	7	3	3
B			<10	<10	<10	<10		<5	3 430	484	9 832	276	43	<10	<10	<10
Pt	<0.005	<0.005	0.005	0.004	0.005	0.008	<0.005	0.002	0.007	0.006	0.007	0.009	0.001	0.010	0.009	0.019
Pd	0.001	0.001	0.009	0.002	0.009	0.005	0.005	0.004	0.014	0.006	0.010	0.012	0.001	0.010	0.035	0.049

Note: unless otherwise indicated all RS numbers prefixed by 6729; Total Fe as Fe_2O_3

TABLE 4

Average Silicate and Trace Metal Analysis, Minette

	Truro Lamprophyres %	Rock (1984) %
SiO_2	55.1	51.4
Al_2O_3	12.96	12.65
Fe_2O_3	9.1	7.14
MnO	0.11	0.14
MgO	6.08	7.27
CaO	1.56	6.37
Na_2O	1.21	1.91
K_2O	5.77	6.08
TiO_2	2.15	1.46
P_2O_5	0.85	1.08
LOI	4.74	4.35
	ppm	ppm
Cu	155	9-329
Zn	116	75-113
Co	38	12-58
Ni	148	60-575
Nb	16	127-1645
Zr	366	10-674
Ba	1 434	483-9129
V	504	115-270
Cr	78	60-1757
Sc	24	14-23
Sr	422	32-3521

GEOCHRONOLOGY

Three relatively fresh samples, two from Frankton No. 2 diamond drill hole (RS3287 and Rs3289) and a third from locality 4 (RS3739) were submitted for K-Ar age determinations of mica phenocrysts. The ages ranged from 478±3 Ma to 480±3 Ma (Appendix B). A sample from locality 1 was dated by the same method in 1971, giving an age of 450 Ma (Appendix B) which recalculates on modern constants to 458 Ma.

The ages obtained equate to the waning stages of the Delamerian Orogeny and are of similar age, but possibly younger, to the Palmer Granite (about 485-514 Ma) and Black Hill Norite (about 487 Ma) intrusions (Milnes et al., 1977) to the south and east of this region (Fig. 1). Thus the Truro cal-alkaline lamprophyres may be associated with granite plutonism and if so may result from a crustal modification of primary lamproitic or leucititic magma (Rock, 1984).

LAMPROPHYRE MINERAL ASSOCIATIONS

The Truro lamprophyres are of the calc-alkaline variety and although they may have a depth of origin within the diamond stability field, Rock (1986) considers that this variety, in association with granite plutonism, have probably undergone crustal interaction and are unlikely to be diamondiferous. However diamond is known to be associated with three of the five branches of the lamprophyre clan (Table 5) and from an exploration viewpoint all lamprophyres should be considered prospective, either directly for diamonds or as an indicator of diamondiferous lamprophyre varieties in the region. Alluvial diamonds have been found in Tertiary gravels at Echunga (Gommers, 1988) and the Truro lamprophyre province lying some 85 km to the northeast is a possible source area.

TABLE 5

Lamprophyre Classification (*Diamondiferous)

Alkaline* lamprophyre branch	Cal-alkaline lamprophyre branch	Lamproite* branch			Kimberlite* branch		Ultramafic lamprophyre branch
		Phlogopite lamproite family	Madupite lamproite family	Olivine-lamproite family	Mica -rich family: Group 2	Mica -poor family: Group 1	
CAMPTONITE	MINETTE	ORENDITE	MADUPITE	OLIVINE-			ALNOITE
MONCHIQUITE	VOGESITE	FITZROYITE	JUMILLITE	LAMPROITE	'KIMBERLITES'		AILLIKITE
SANNAITE	SPESSARTITE	VERITE	WOLDIDITE				POLZENITE
	KERSANTITE	CEDRICITE					CUACHIITE

Lamphrophyres are known to have a spatial relationship to gold mineralisation and are common in the goldfield regions of Tennant Creek, the Yilgarn Block and Bendigo. The Truro lamprophyres contain up to 30 ppb Au which is comparable to levels recorded in lamprophyres associated with gold mineralization. Rock and Groves (1988) suggest that there is a widespread space-time association between mesothermal gold deposits and calc-alkaline lamprophyres and mention that at Woods Point (Victoria) 95% of gold production is from reefs within lamprophyres of 380 Ma. A spatial relationship between gold mineralisation and lamprophyre around part of the Nackara Arc near Terowie, has been recognised by Morris and Horn (1990).

Other styles of mineralization known to be associated with lamprophyres are Zn±Pb±Ag, Cu-Mo and V (Rock, 1986).

CONCLUSIONS AND RECOMMENDATIONS

During base metal investigations of the Karinya Syncline lamprophyre dykes were found to be widespread and represent a new lamprophyre province.

A possible diatreme with a multi-phase dolerite-lamprophyre core, fluidized pebble breccia margin and talc-asbestos-tourmaline alteration of host rock has been located.

Dolerite and lamprophyre are associated with asbestos-talc-tourmaline alteration at several localities near Robertstown and may represent diatremes.

The regional extent of the lamprophyre province has not been determined.

The lamprophyres are of the calc-alkaline suite and classed as minettes of Ordovician age and probably related to Ordovician granite and norite to the southeast.

The calc-alkaline lamprophyres are not generally considered to be diamondiferous. However in association with lineaments they indicate deep seated fracturing with the potential for diamondiferous bearing lamprophyres in the region.

The Truro lamprophyre province is a possible source area for Tertiary alluvial diamonds at Echunga.

The lamprophyre dykes contain up to 30 ppb Au and may indicate significant Au and base metal mineralization in the area.

The lamprophyres are depleted in ferro-magnesian minerals and traditional diamond exploration by sampling for indicator minerals is unlikely to be successful. Bulk sampling for micro-diamonds is considered to be the most useful method of determining the diamond potential of the area.

Further exploration for lamprophyre intrusions is recommended for the region. Landsat lineament and aeromagnetic studies may be useful guides in determining prospective areas. The Stonefield

area where two Landsat linear corridors intersect with coincident gravity low and magnetic high anomalies is recommended as a possible target.

Auger drilling to determine the extent of the Dutton diatreme is recommended along with bulk sampling for diamonds.

BRIAN J. MORRIS
SENIOR GEOLOGIST
MINERAL RESOURCES BRANCH

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APPENDIX A

(Petrological Reports)

Pontifex & Assoc. Pty. Ltd. Mineralogical Rept. 4052
(from SADME Env. 4596, CRA EL 947)

953048 :(locality 3) flow textured lamprophyre of minette type; abundant accessory apatite, fine disseminated magnetite, rare scattered quartz.

Abundant strongly oriented pale phlogopite crystals (40%) occur throughout a groundmass of diffuse-microcrystalline K-spar (50%), apparently orthoclase.

The phlogopite crystals have "battlemented" ends and narrow darker (? iron rich) margins. The alkali felspar is mainly granular but is euhedral when projecting into patches of minor, late-magmatic quartz (3%).

Apatite is abundant (5 - 7%) as needles and prisms 0.1 - 1 mm long, and very fine euhedral crystals of oxidised magnetite are disseminated.

Patches of clay-stained limonite are common.

Analabs Rept. 1000 0 07 1270

Sample RS 3273 (locality 19)

Rock specimen "lamprophyre"

Thin section

Biotite	major
Quartz	major
Plagioclase	major
K feldspar	accessory
Limonite	accessory

The samples consists of about 50% biotite of a yellow brown polarizing colour as poorly oriented flakes from under 0.2 to a mm in length, set in a quartz feldspar matrix. The larger flakes tend to be narrow and rather curved. The principal fabric of the feldspar part of the matrix is as part spherulites, the rest being quartz. Staining for K feldspar was positive. See discussion.

Pontifex & Associates Pty. Ltd.

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P.O. BOX 91, NORWOOD
SOUTH AUSTRALIA 5067

MINERALOGICAL REPORT NO. 5722
by A.C. Purvis, PhD.

September 24th, 1990

TO : Mr Ric Horn
Mineral Resources Section
SA Department of Mines and Energy
PO Box 151
EASTWOOD SA 5063

YOUR REFERENCE : EX 1046
12/03/419

MATERIAL : Rock sample.

IDENTIFICATION : 6729 RS 3739

WORK REQUESTED : Thin section preparation, and description, with comments as specified.

SAMPLES AND SECTIONS : Returned to you with this report.

Ian R. Pontifex
PONTIFEX & ASSOCIATES PTY LTD

SUMMARY AND COMMENTS

This is a quite fresh minette and could be used for K-Ar dating to test the Jurassic age suggested in your notes. The Jurassic period was one of widespread within-plate activity within South-Eastern Australia (Tasmanian dolerites, and alkali basalt-trachyte-phonolite suites in New South Wales and Victoria), but lamprophyres in Western Tasmania have been dated at 137 Ma, close to the Jurassic-Cretaceous boundary (McDougall & Leggo, 1965). These minettes were considered by Sutherland (1973) to form part of a 137-90 Ma old shoshonitic association in Tasmania, extending northwards to New South Wales (Mt. Dromedary) and Queensland (Noosa, Rockhampton), [90-120 Ma ages.]

Minettes with a sperulitic groundmass (as in this sample) occur rarely within the 94-100 Ma old Mt Dromedary Complex (A.C. Purvis unpublished observations), so that a Cretaceous age is equally possible for these rocks.

This minette sample described has a strong flow foliation with some signs of magmatic shear, and has small syenitic segregations. The orthoclase is mostly spherulitic suggesting that it crystallised after the magma had ceased to flow. The distribution of apatite crystals suggests some degree of in-situ fractionation, possibly including some early concentration by flow differentiation.

The amount of apatite suggests that this is a relatively unfractionated minette, as discussed in Pontifex Mineralogical Report No. 5682 (20/7/90). The minettes described in that report showed increasingly iron-rich biotite together with a progressive decrease in apatite content. The high initial phosphorous content of the hydrous shoshonitic minette parental magma would ensure early crystallisation of apatite, even in a relatively alkaline liquid in which apatite would be more soluble than in a less alkaline liquid.

The rock 3739 described in this report has a mixture of characteristics compared with the previous minettes of Report 5682. It is phlogopite-rich but not distinctly porphyritic, and apatite rich, and therefore probably relatively primitive. However, it contains syenitic segregations, more common in relatively fractionated (iron-rich, apatite-poor) minettes as described previously. This again suggests in-situ fractionation.

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DESCRIPTION

RS 3739 (locality 4). Flow textured minette with segregations of quartz syenite.

Phlogopite	35%
Orthoclase	50-55%
Opaque oxide	5%
Apatite	5%
Quartz	2%
Dendrites?	<1%

The texture of this rock is dominated by strongly flow oriented flakes of phlogopite, locally turbulent or disturbed by zones of magmatic shear, or flowing around phlogopite-poor lenses of spherulitic microsyenites.

The phlogopite shows a wide range of grain sizes, with flakes from 0.2 to 4mm long, but the size range cannot be subdivided into phenocrysts and groundmass. Battlemented ends are typical on the larger flakes and both normal (to more iron rick, darker rims) and oscillatory zoning is present. Rare small radioactive inclusions occur in some of the flakes, and some of the larger flakes show partial resorption and pseudo-inclusions of orthoclase and opaque oxide grains.

The interstitial areas are occupied by typically fibrous to spherulitic orthoclase with abundant apatite crystals to 0.5mm long. The apatite is distributed rather unevenly, possibly concentrated into irregular lenses during flow. Fine opaque oxide crystals, mostly smaller than 0.05mm, are also common, and small unidentified linear to branched dendrites occur widely.

The syenitic segregations are irregualr to crudely elliptical in outline, and up to 10mm long. They consist of fans and spherulites of orthoclase 2-4mm diameter, with minor phlogopite, opaque oxides and dendrites, but have very little apatite. Minor quartz is present in the margins of the spherulites and between the spherulites.

Fig 1 Sample No. 3739 scale : 10mm = 0.36mm

Plane polarised light, relatively low magnification (x37.5) mainly to show the common flow alignment of most of the abundant lath-like flakes of yellow-tan phlogopite; within a weakly clouded matrix of fine k-spar.

Fig 2 3739 scale : 1mm = 0.09mm

PPL, higher magnification (x150); shows detail of fig 1; similarly aligned flakes of yellow-tan phlogopite; within a matrix of weakly clouded k-spar. Note several (clearer) apatite crystals (examples circled), also disseminated fine opaque oxides.

Fig 3 3739 scale : 10mm = 0.09mm

Crossed nicols photo of fig 2; to highlight the diffuse spherulitic nature of the k-spar matrix (very pale to mid-grey).

Fig 4 3739 scale : 10mm = 0.36mm

PPL, x37.5; large pale, but clouded patch is one of the small poorly defined segregations of syenitic composition described in the text.

Fig 5 3739 scale : 10mm = 0.36mm

Crossed nicols photo of fig 4, to highlight the microspherulitic nature of the k-spar which dominates the syenitic segregations.

Fig.1

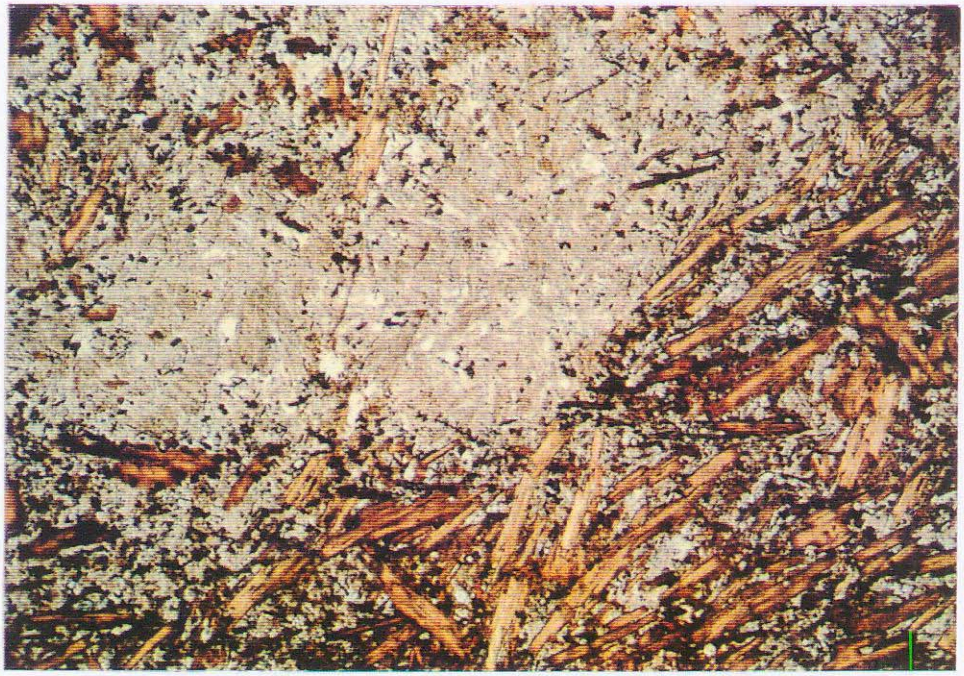

Fig. 4

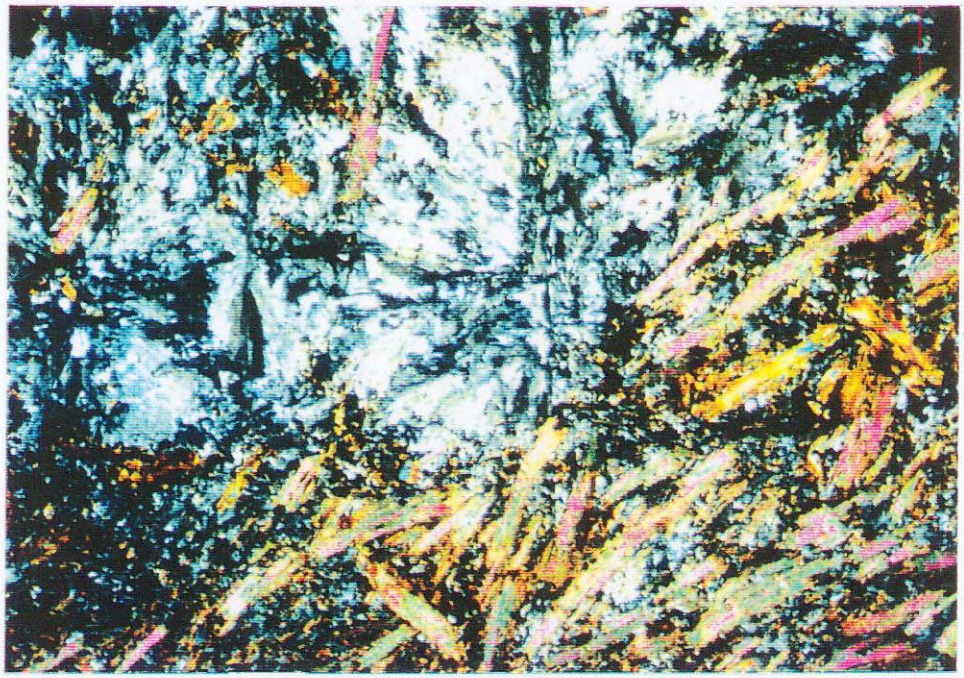

Fig. 5

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15 November 1989

South Australian Department of Mines & Energy
PO Box 151
EASTWOOD SA 5063

ATT: B J MORRIS, MINERAL RESOURCES

REPORT G 8285/90

YOUR REFERENCE:	EX-908; 12/03/351 (Debit No. 88-000-T02-402-005)
IDENTIFICATION:	6729 RS1507-10; 5836 RS739-41
MATERIAL:	7 rock samples
LOCATION:	Kanmantoo Trough and Gawler Craton, S.A.
DATE RECEIVED:	25 October 1989
WORK REQUIRED:	Petrography (7 Code PET1.1.1)

Investigation and Report by: Frank Radke

Keith Henley

Dr Keith J Henley
Manager
Geological Services Section

bp

Pontifex & Associates Pty. Ltd.

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MINERALOGICAL REPORT NO. 5764
by A.C. Purvis, PhD

November 23rd 1990

TO : Mr B.J. Morris
SA Dept of Mines and Energy
191 Greenhill Rd
PARKSIDE SA 5063

YOUR REFERENCE : EX 1067
(2/03/426)

MATERIAL : Rock samples

IDENTIFICATION : 6729 RS 3742 to 6729 RS 1510
(six in all)

WORK REQUESTED : Thin section preparation and petrological report.

SAMPLES & SECTIONS : Returned to you with this report.

Ian R. Pontifex
PONTIFEX & ASSOCIATES PTY LTD

INDIVIDUAL DESCRIPTIONS

6729 RS 3742 (locality 8) Weathered biotite-rich minette with leached out apatite crystals.

This is a porphyritic phlogopite-rich minette from which the formerly abundant apatite crystals have been leached. Much of the phlogopite has been altered to clays ± limonite, although this serves to some extent to emphasise the zoning. The phlogopite phenocrysts are from 1 to 4mm long and the apatite crystals were up to 2mm long.

The groundmass is rich in granular to fibrous alkali felspar with minor phlogopite and very minor quartz. Small opaque oxides are present together with dendritic crystals which are too small for precise identification. A small amount of secondary porosity is present.

6729 RS 3743 (locality 3) Sericitised sparsely porphyritic minette with patches of quartz, albite and possible adularia and abundant rutile.

Somewhat sparsely distributed sericite-leucoxene pseudomorphs after phlogopite phenocrysts are scattered through this rock, most of which has been altered to sericite and fine grained rutile. Irregular patches contain elongate crystals of possible adularia (biaxial negative with a $2V<10°$) or clouded by rutile, or quartz and albite, with or without rutile. A minor secondary porosity is present, however.

6729 RS 3746 (locality 9)

Oxide rich minette with a possible emulsion texture and lenses of oxidised opaque oxide + (leached) apatite.

This rock has a curiously mottled texture in hand specimen caused by the presence of what appear to be coalesced droplets of minette 2-5mm in diameter, with interstitial areas of oxidised and leucoxenised oxides, quartz and partly to completely leached apatite grains. The mineralogy is :

Phlogopite	35%
Felspar	60-65%
Oxides	10%
Apatite	2-3%
Quartz	3-5%

The phlogopite occurs as phenocrysts 1-4mm long, generally zoned, and as flakes 0.1 to 0.5mm long in the groundmass. Felspar is abundant with orthoclase possibly dominant but there may be some secondary albite. Fine oxidised magnetite grains are abundant in the groundmass but occur predominantly in lenses between the elliptical patches of minette. Prisms of quartz and partly to completely leached apatite grains are present in these lenses.

Veins of quartz are present, follwoing or connecting the oxide lenses. There are also irregular patches of adularia. Small spherulities of potassium felspar are locally present in the oxide lenses, but their origin is obscure.

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MINERALOGICAL REPORT NO. 5613

By A.C. Purvis PhD.

March 21st, 1990

TO : Mr B.J. Morris
Mineral Resources Section
S.A. Department of Mines and Energy
191 Greenhill Rd
PARKSIDE SA 5063

YOUR REFERENCE : EX-949
12/03/376

MATERIAL & IDENTIFICATION : Rock Samples, prefix 6729
R.S. 2599, 2601, 2602, 2603

WORK REQUESTED : Thin section preparation and description; also to identify opaque minerals in 2599.

SAMPLES & SECTIONS : Returned to you with this report.

Ian R. Pontifex
PONTIFEX & ASSOCIATES PTY LTD

Summary Comments cont :

Proof of a dolerite precursor for all of these rocks is based at least partly on a preservation of the oxide and apatite content, (particularly of ilmenite identified in reflected light in 2599). This could be tested profitably by immobile element chemistry for Ti, Zr, Y, Nb and/or V, for example. The identity of the alkali amphibole could be checked by electron microprobe or SEM analysis, although the petrogenetic implications of its presence would not be significantly dependent on the precise composition.

The small hexagonal crystals in RS 2599 could also be identified by probe or SEM techniques if this is considered useful, but again, this is not essential in terms of petrogenesis.

RS 2600 (Locality 12)

Poikilitic felspar-rich hornblende gabbro, possibly a pegmatoidal phase in a basic intrusion; advanced alteration to actinolite, albite, epidote minor sphene.

Albite + epidote	40%
Actinolite (+ trace clinopyroxene)	50%
Brown hornblende	7%
Sphene ± ilmenite	3%
Apatite	<1%

The texture of this rock is unusual in that the albite ± epidote-altered plagioclase, occurs as large poikilitic grains 4-10 mm in maximum dimension, commonly enclosing abundant actinolite and residual brown hornblende.

The actinolite has replaced unoriented prisms of clinopyroxene from 1 to 3 mm long, with small patches of residual or recyrstallised pyroxene commonly retained, and minor sphene as small droplets, indicating a small finite titanium content in the pyroxene.

Brown titan-pargasite occurred as flecks within the pyroxene, and as separate prismatic to poikilitic grains to 2 mm long. Fine oxides have been exsolved possibly during alteration and some veining by actinolite is seen. Oxide inclusions in the brown hornblende are partly altered to sphene and locally enclosed in patches of probable smectite or vermiculite. The oxide grains elsewhere have been largely altered to sphene. Rare apatite occurs as prisms and as more irregular very small grains, pssibly reflecting crystallisation within a fluid-rich environment. Radiating fans of elongate thin albite crystals are present, possibly reflecting the same environment.

Minor late stage components include chlorite (replacing actinolite) and sericite (replacing felspar). Thin fractures locally contain carbonate and there is a trace of limonite.

RS 2602 (Locality 12) Altered dolerite, with albite, altered phlogopite, tourmaline, fresh to oxidised opaque oxides, rutile and sericite.

Albite	45%
Altered phlogopite	40%
Tourmaline	4%
oxides	7%
Rutile	2%
Sericite	2%
Apatite	<1%

This is a porous massive aggregate of alteration phases, manifest as albite laths to 4 mm long, enclosing and separated by random aggregates of possibly hydrated or vermiculite-altered phlogopite, and generally dusted by sericite.

Minor irregular patches of bluish to greenish torumaline are present and represent a transition towards RS 2599.

Original skeletal to granular oxides, characteristic of a dolerite, appear to be represented by partly fesh ilmenite (or hematite?) plus oxidised magnetite (?martite) and minor rutile. This is minor apatite.

Clay filled fractures are common; and the considerable porosity (3-5%) may indicate a phase which has been selectively removed by weathering.

Pontifex & Associates Pty. Ltd.

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SOUTH AUSTRALIA

P.O. BOX 91, NORWOOD
SOUTH AUSTRALIA 5067

MINERALOGICAL REPORT NO. 5637
by A.C. Purvis, PhD.

May 8th, 1990

TO :	Mr B.J. Morris S.A. Department of Mines and Energy 191 Greenhill Rd PARKSIDE SA 5063
YOUR REFERENCE :	Order No. EX-969
MATERIAL :	Rock Samples, Kanmantoo Trough, Truro Area
IDENTIFICATION :	RS 1752, RS 3024 to RS 3028
WORK REQUESTED :	Thin section preparation, petrographic description.
SAMPLES & SECTIONS :	Returned to you (Mineral Resources Div., 3rd Floor) with this report.

Ian R. Pontifex
PONTIFEX & ASSOCIATES PTY LTD

RS 3024 (Locality 11)

Weathered, quartz-rich (probably silicified), and albitised, biotite-rich lamprophyre. (cf. RS 3028)

This is a weathered (limonitised) and probably silicified equivalent of the fresher sample RS 3028 in this suite. The distinctive characteristic of both rocks is the abundant (at least 50%) biotite with a mostly decussate texture, in a matrix of quartz and albite. The quartz appears to be secondary.

Limonite and sericite have replaced the biotite in this sample, and accessory, disseminated opaque oxides have been altered to limonite and fine fibrous goethite.

More detail concerning the original rock type is presented in the description of the fresher equivalent RS 3028.

RS 3026 (Locality 7)

Schistose, (limonite-clay), quartz, sericite, scapolite, biotite rock with very fine disseminated opaque oxide grains (?ilmenite). Interpreted as a weathered quartz-biotite-scapolite-plagioclase ?amphibole rock with disseminated ilmenite, probably a meta-dolerite.

The only fresh prograde minerals in this rock are biotite (10-15%, largely altered to clays), scattered scapolite (7%), quartz (5%), and disseminated very fine probable ilmenite (3%).

Pale brownish clays have replaced poikiloblastic grains which, by comparison with similar but fresher rocks elsewhere in the region were probably an amphibole (hornblende most probably). Fine sericite has replaced abundant plagioclase, with rare albitised grains, to 0.5 mm as relicts.

Much of the biotite is schistose, also biotite occurs in clots with limonite and clays after probable amphibole. The fine disseminated ilmenite is fresh and its abundance is consistent with a former dolerite or basalt, [especially as metadolerites with scapolite are known from this area.] However, apatite (another indicator of a doleritic precursor)is very rare.

RS 3027 (Locality 7)

Weathered schist, with biotite, quartz, scapolite, sericite, limonitic clays and very fine disseminated ilmenite. Probably a quartz-biotite-plagioclase-hornblende-scapolite-ilmenite schist, derived from a dolerite or basalt, (cf. RS 3026).

This is a more biotite-rich variant of RS 3026, with the biotite uniformly distributed and defining a strong foliation. Brownish limonitic clays have replaced poikiloblastic to prismatic grains to 3 mm long, probably pre-existing hornblende as in RS 3026.

Felspar crystals to 2 mm may have been phenocrysts in the original rock, but these have been completely silicified. Smaller altered felspar grains are abundant in the matrix. Fine granular and patchy quartz, partly sericitised highly poikiloblastic scapolite-grains (5-7%) occur sporadically through the matrix.

Very fine grains of ilmenite, individually about 0.03 mm are disseminated, but also locally clustered in small lenses more or less along the schistosity. Trace equally fine apatite is present.

The gross mineralogy indicates an original dolerite (or basalt), which has been metasomatised as well as metamorphosed.

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P.O. BOX 91, NORWOOD
SOUTH AUSTRALIA 5067

MINERALOGICAL REPORT NO. 5707
by A.C. Purvis, PhD.

August 27th, 1990

TO : The Director
SA Dept of Mines and Energy
PO Box 51
EASTWOOD SA 5063

Attention : Mr B.J. Morris

YOUR REFERENCE : Order No. EX1024

MATERIAL : 7 Rock Samples, Kanmantoo Trough

IDENTIFICATION : 6729RS 3342 abd 3252
6730Rs 47, 48, 49, 50, 51

WORK REQUESTED : Thin section preparation and description.

SAMPLES & SECTIONS : Returned to you with this report.

Ian R. Pontifex
PONTIFEX & ASSOCIATES PTY LTD

The close links between alkali amphibole and tourmaline in this suite is difficult to reconcile with typical fentisation around carbonatite bodies, but may reflect alkali and boron-rich intrastratal fluids or some other kind of (per-alkaline?) igneous source for the fluids. The fenitisation appears to have been at least partly at lower temperatures than the formation of biotite, as indicated in sample 6730 RS49 by an assemblage including; albite, phlogopite, hematite, magnesioriebeckite and muscovite, which may be controlled by the reaction :

$2NaAlSi_3O_8$ + $K(MgFe)_3AlSi_3O_{10}(OH)_2$ + Fe_2O_3 + H_2O + SiO_2

albite — phlogopite — hematite — quartz

= $Na_2(MgFe)_3Fe_2Si_8O_{22}(OH)_2$ + $KAl_3Si_3O_{10}(OH)_2$

magnesioriebeckite — muscovite

However, the ultimate source of these alkali-rich fluids which have affected these rocks remains obscure.

INDIVIDUAL DESCRIPTIONS

6729 RS3342 (Locality 12) — Magnesioriebeckite-phlogopitic rock with minor magnetite, apatite, rutile and limonite after pyrite.

The bulk of this rock consists of bright mustard yellow, possibly oxidised phlogopite crystals (elongate normal to their basalt cleavages or equidimensional) 0.3 to 1mm in size, with some finer grained patches. The main other mineral is a blue, commonly zoned amphibole probably for the most part magnesioriebeckite but locally zoned towards magnesiorichterite or magnesiokataphorite (extinction angles up to 40° or more). The amphibole make up about 7% of the rock.

Apatite crystals to 1mm long are scattered (2-3%) and there are small crystals of magnetite, probably oxidised to maghemite, and small patches of rutile. Two patches of limonite, probably after pyrite, were noted.

The precursor for this rock is not certain due to to its rather complete reconstitution.

6730 RS49 (Locality 24)

Albite-tourmaline-alkali amphibole-(phlogopite-muscovite-hematite-Kspar-rutile) altered probably dolerite.

Albite	45%
Tourmaline	35%
Alkali amphibole	10%
Phlogopite	5%
Muscovite	5%
Hematite, rutile, K-spar, Apatite, quartz	accessories

The albitised plagioclase laths in this rock are up to 2mm long and are similar to those commonly seen in dolerites. The tourmaline has a bronze to almost black colour and may be rich in ferric iron and/or titanium. It occurs as prismatic to almost ophitic grains to 2mm long and may have, to some extent, taken the place of ophitic pyroxene grains in the original rock. The alkali amphibole occurs as very fibrous patches, mostly pleochroic from a pale beige-bronze colour to a greenish blue, but locally included less fibrous amphibole with a deep inky blue - indigo colour, pleochroic to pale yellow. These may be in the magnesioriebechite-magnesiorichterite field but may include more riebeckite or even crossitic composition.

Decussate muscovite is scattered as patches to 2mm in diameter and there is minor phlogopite oxides present including primary hematite plates 1-3mm long oxidised magnetite grains and minor rutile. There is also minor apatite and k-spar occurring within some of the tourmaline patches.

6730 RS51 (Locality 25)

Phlogopite-magnesioriebeckite-rutile altered minette.

Primary biotite	40%
Secondary mica	50%
Alkali amphibole	5%
Apatite	2%
Rutile	2%
Quartz	1-2%

The primary biotite in this rock occurs as unoriented laths about 1mm long, and are dark brown as in the more fractionated, less apatite rich minettes described in Pontifex Mineralogical Report No. 5682 (20/7/90). These flakes have been expanded and the opening , parallel to the cleavage, filled in by quartz. The interstitial felspathic areas in the minette have been altered to a fine grained pale yellow mica, possibly oxidised phlogopite, less probably a phengitic muscovite.

Apatite crystals to 1mm are common and are similar to those in No. 6729 RS3342, suggesting that that rock may also have been a minette, or a related rock type. Patches of alkali amphibole commonly have the ink-blue/ indigo to sky blue pleochrism seen in 6730 RS50, and may be magnesioriebeckite. Some zoning is visible, however, in both extinction angle and pleochroic scheme.

Minor rutile is scattered through this rock as patches to 0.5mm diameter.

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SOUTH AUSTRALIA 5067

MINERALOGICAL REPORT NO. 5682
by A.C. Purvis, PhD.

July 20th, 1990

TO : Mr B.J. Morris
S.A. Dept of Mines & Energy
PO Box 151
EASTWOOD SA 5063

YOUR REFERENCE : Order No. EX 999

MATERIAL : 16 samples, Kanmantoo Trough

IDENTIFICATION : 6729 RS 3254 to 6729 RS 3258 inclusive
6729 RS 3287 to 6729 RS 3297 inclusive

WORK REQUESTED : Preparation of normal thin sections and petrographic description.

SAMPLES & SECTIONS : Returned to you with this report.

Ian R. Pontifex
PONTIFEX & ASSOCIATES PTY LTD

6729 RS 3289 (Frankton No. 2)

Flow textured phlogopite-apatite porphyritic fine grained minette with abundant carbonate, minor quartz and accessory pyrite.

Field Note : Lamprophyric vein, minor sulphide

Phlogopite	20%
Apatite	5%
Orthoclase	40-45%
Carbonate	20%
Quartz	5%
Opaque oxide + leucoxene	7%
Pyrite	1%

This rock has similarities with both 3258 and 3287. As in 3258, the phlogopite flakes have a strong flow orientation, but as in 3287, these phenocrysts are accompanied by strongly oriented needle like, locally hollow, crystals of apatite. The phenocrysts have a dominant orientation and a second less common orientation at 20°-40° to the dominant orientation. The second orientation is more commonly followed by fine groundmass phlogopite flakes, however.

The apatite crystals appear to be smaller than those in No. 3287 but commonly have their C-axes at a high angle to the plane of the thin section, suggesting that the thin section was cut at a high angle to the direction of flow.

Patches of granular carbonate 0.5 - 2mm in size are common, but the groundmass is mostly fine grained orthoclase with finely dispersed oxidised or leucoxenised oxide grains. Rare pyrite occurs as crystals in the carbonate and minor secondary quartz is present mostly in the carbonate lenses.

Thick veins of carbonate ± quartz are present.

6729 RS 3292 (Locality 15) Flow textured quartz bearing minette cf. No. 3258.

Field Note : Lamprophyre dyke (surface sample) equivalent to RS 3258 in drill hole

Biotite	25%
Orthoclase	60-65%
Magnetite	3%
Leucoxene	5%
Quartz	2-3%
Clays	~1%
Apatite	~1%

This rock is similar to RS 3258, but is richer in biotite and poorer in quartz. The biotite flakes are 0.2-1mm long with a strong flow texture but the orthoclase is unoriented and granular to prismatic locally in subradiating bundles, with prisms to 1.5mm long. Fine oxidised and leucoxenised oxides are common and there is minor quartz and apatite.

6729 **RS** 3295 (Locality 14) Flow textured porphyritic minette with secondary quartz.

Phlogopite	25%
Orthoclase + clay	60-65%
Quartz	5%
Magnetite + leucoxene	5-7%
Limonite	2-3%
Apatite	?<1%

The flow-oriented phlogopite flakes in this rock are from 0.4 to 2mm long, in a fine grained orthoclase rich groundmass with rare spherulites to 1.5mm diameter. Leucoxenised fine oxides are much more abundant than oxidised grains and a fine secondary porosity appears to represent leached out apatite grains. Patches of fine granular secondary quartz are common and there are diffuse patches of limonite.

6729 RS 3297 (Locality 12)

Inequigranular (?porphyritic)? phlogopite-dolomite-calcite rock, possibly a carbonatite, with secondary quartz and limonite.

Field Note : Carbonate xenolith within dolerite plug.

In this rock sparse elongate kinked plates of uniaxial negative colourless phyllosilicate to 5mm long are possibly nearly pure Mg-phlogopite. They are set in a matrix with rounded grains (?phenocrysts) of ferroan dolomite, to 1.5mm diameter, set in calcite. Secondary quartz has to some extent selectively replaced the dolomite and there is some limonite staining, mostly of the dolomite.

This rock has no diagnostic carbonatite minerals but could be either hydrothermal carbonate or a carbonatite.

APPENDIX B

(Geochronology Reports)

amdel

Amdel Limited
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14 December 1990

SA Department of Mines and Energy
191 Greenhill Road
PARKSIDE SA 5063

ATTENTION: Mr B J Morris

REPORT G 8861/91

YOUR REFERENCE:	EX-1055
IDENTIFICATION:	6729RS 3287, 3289, 3739
MATERIAL:	Rock and drill core
DATE RECEIVED:	16 October 1990
WORK REQUIRED:	K-Ar geochronology.

Investigation and Report by: Dr Alan Webb.

for Dr Keith J Henley
Manager, Geological Services

zb

amdel

TABLE 1: POTASSIUM-ARGON ANALYSES

Sample	%K	$^{40}Ar^{*}$ ($x10^{-10}$moles/g)	$^{40}Ar^{*}/^{40}Ar_{Total}$	Age^{+}
6729 RS 3287 Biotite (Frankton No. 2)	8.296 8.304	79.414	0.995	481±3
6729 RS 3289 Biotite (Frankton No.2)	8.157 8.142	77.411	0.983	478±3
6729 RS 3739 Biotite (Locality 4)	7.836 7.842	74.417	0.991	478±3

* Denotes radiogenice ^{40}Ar.

$^{+}$ Age in Ma with error limits given for the analytical uncertainty at one standard deviation.

Constants : ^{40}K = 0.01167 atom %

λ_{β} = $4.962 \times 10^{-10}y^{-1}$

λ_{ϵ} = $0.581 \times 10^{-10}y^{-1}$

T

Dr Webb

amdel

The Australian Mineral Development Laboratories

Flemington Street, Frewville, South Australia 5063
Phone 79 1662, telex AA82520

G. G. LOWDER

Please address all correspondence to the Director
In reply quote: MP 1/1/126

20 September 1971

The Director
SA Department of Mines
Box 38, Rundle Street PO
ADELAIDE SA 5000

THE GEOCHRONOLOGY OF STRATIGRAPHICALLY SIGNIFICANT ROCKS FROM SOUTH AUSTRALIA.

PROGRESS REPORT NO. 5

Investigation and Report by: Dr A. W. Webb and Dr G. G. Lowder

Officer in Charge, Mineralogy/Petrology Section: Dr K. J. Henley

K J Henley

for F. R. Hartley
Director

The groundmass of the rock is very feldspar-rich, although quartz is also common. The feldspar includes some plagioclase but is mostly potash feldspar, at least some of which is sanidine. The groundmass also contains very numerous though small (0.01 mm) granules of opaque matter and fine dark needles. The needles may be rutile, or perhaps sphene, but they are too small for optical identification. Apatite is also quite common in the groundmass.

The rock is a lamprophyre of the minette variety, although it seems to have more quartz than normal for a minette and it lacks the pyroxene usually found in minette.

Geochronology:

Alteration of biotite is slight and it should be possible to obtain a satisfactory sample for K/Ar age determination.

Note: The xenolith observed in hand specimen is a very fine sandstone, quite rich in plagioclase.

Plate 1. Lamprophyre dyke intruded along joint plane at locality 1. Note fine grained chilled margins. Photo No. 39276.

Plate 2. Lamprophyre dyke intruded along joint plane within Karinya Shale at locality 4. Photo No. 39291.

Plate 3. Diatreme exposed in road cutting at locality 12. Dolerite-lamprophyre-gabbro intrusives to right and pebble breccia to left. Photo No. 39292.

Plate 4. Pebble breccia, note rounded fragments of marble, dolerite and lamprophyre. Photo No. 39293.

Plate 5. Pebble breccia, note rounded to angular fragments of dolerite, lamprophyre and marble. Photo No. 39294.

Plate 1.

Plate 2.

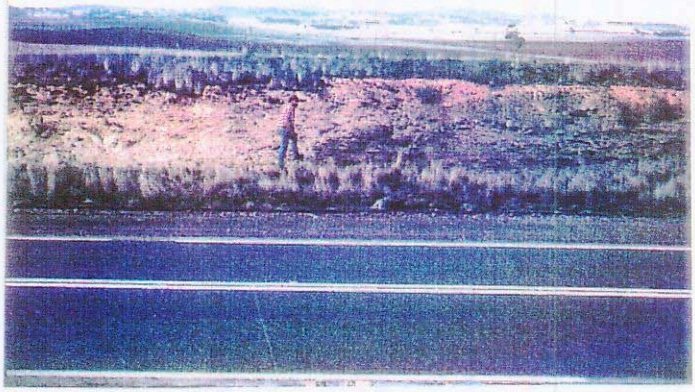


Plate 3.

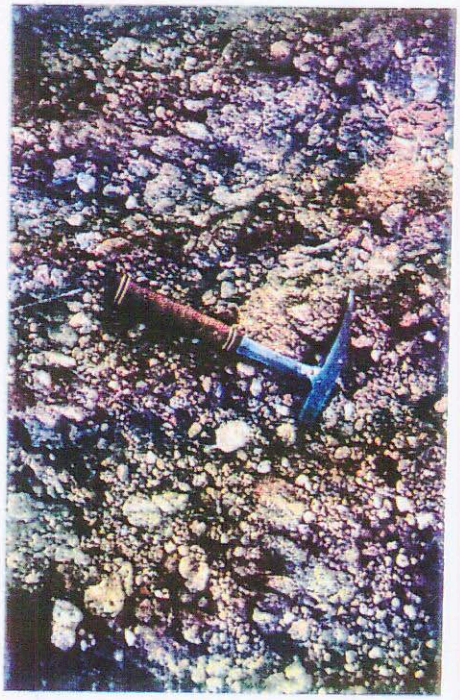


Plate 4.

Plate 5.

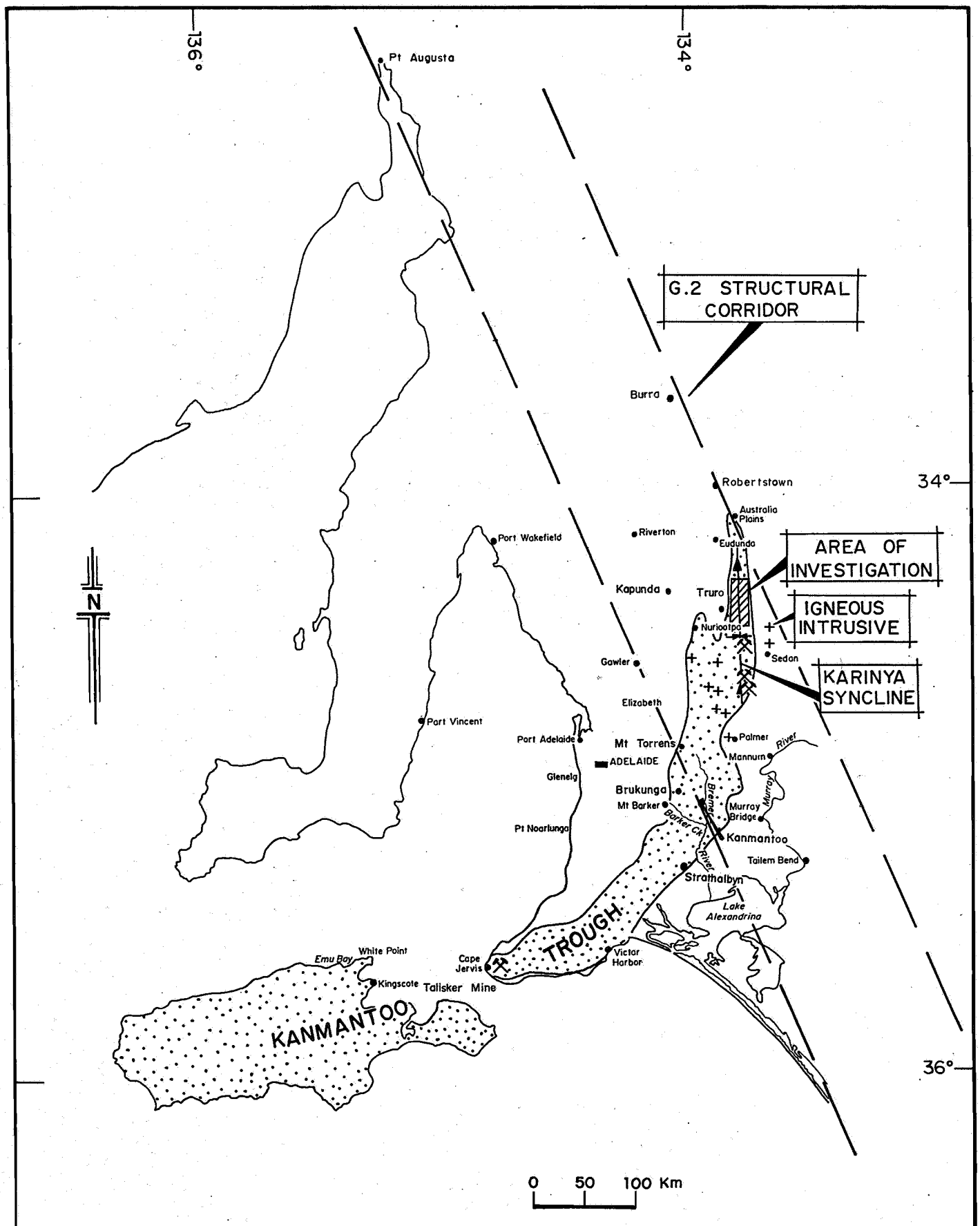


Figure. 1

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED B. Morris	C.D.O.	26·11·90 DATE
KANMANTOO TROUGH GEOLOGICAL INVESTIGATIONS KARINYA SYNCLINE LOCALITY PLAN	DRAWN D. Simpson	SCALE 1 : 2 000 000	
	DATE Aug 1990	PLAN NUMBER S21671	
	CHECKED		

5080

139°10'

139°15'

34°20'

34°25'

Landsat Linear Corridor

N

FRANKTON PROSPECT

THE GAP PROSPECT

ACCOMODATION HILL PROSPECT

STONEFIELD

MURRAY BASIN

Synclinal axis

Karinya Syncline

Dutton

TRURO

Diatreme

HIGHWAY

STURT

TO BLANCHETOWN

Ag,Pb

Cu

Coincident magnetic high and gravity low anomalies

1 0 1 2 3 4 5

KILOMETRES

CAMBRIAN

KANMANTOO GROUP

Tapanappa Formation: grey siltstone and fine meta-sandstone

Karinya Shale (Talisker Calc-siltstone): carbonaceous shale and grey calcareous meta-siltstone

Backstairs Passage Formation: cross bedded medium to coarse feldspathic meta-sandstone.

Carrickalinga Head Formation: siltstone and sandstone with grey-pink saccharoidal marble (Milendella Limestone Member)

NORMANVILLE GROUP

Blue-black carbonaceous shale, siltstone quartzite and marble.

Truro Volcanics

ADELAIDEAN

Undifferentiated

20 X Lamprophyre occurrences.

Note: Geology after Coats (1959)

Figure. 2

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

KANMANTOO TROUGH – GEOLOGICAL INVESTIGATIONS
KARINYA SYNCLINE

GEOLOGICAL PLAN AND LAMPROPHYRE OCCURRENCES

COMPILED	B.J. Morris
DRAWN	D. Simpson
DATE	July 1990
CHECKED	
C.D.O. DATE	26 11 90
SCALE	as above
PLAN NUMBER	91-162

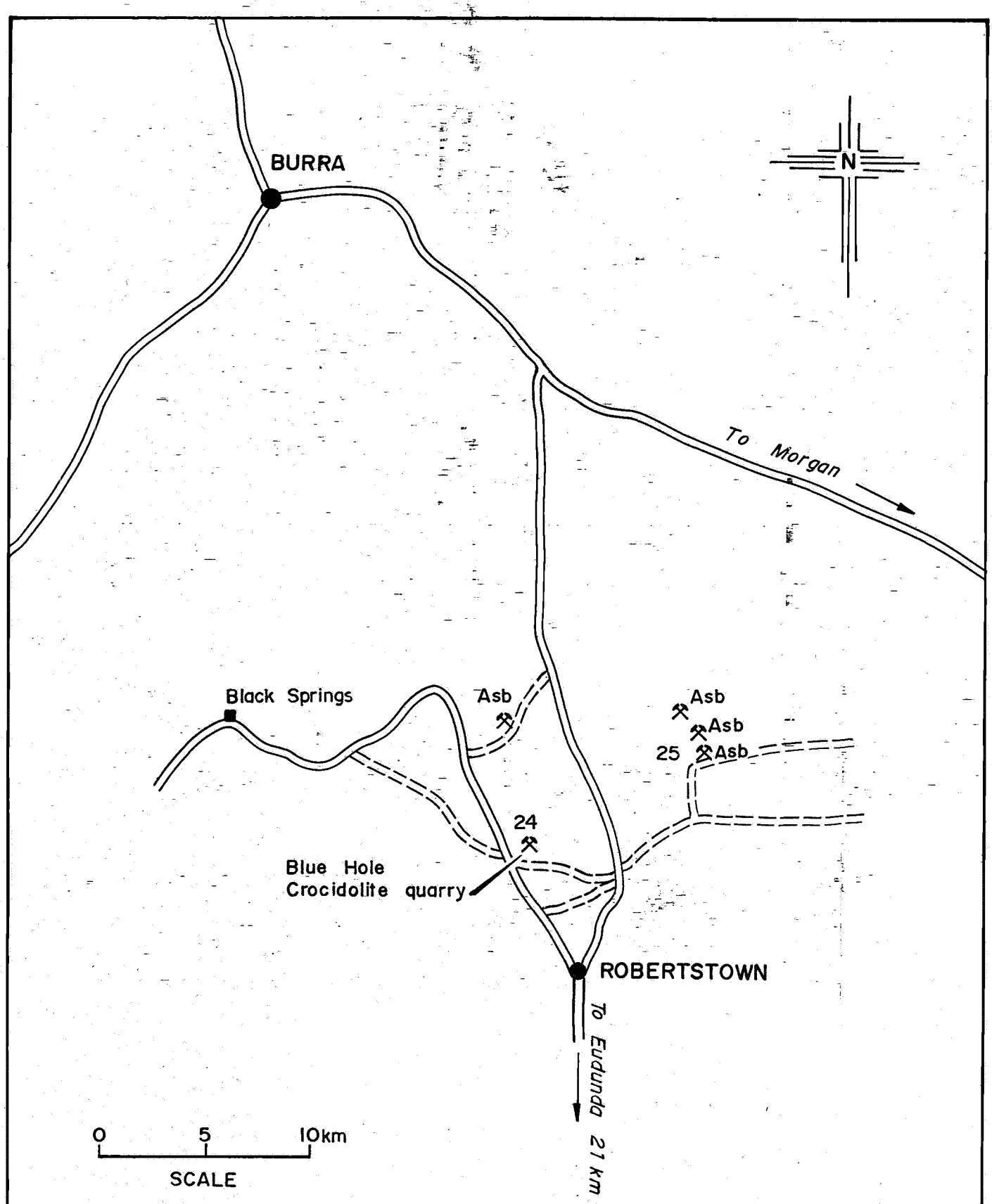


Figure. 3

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED B. Morris	CDO 18·2·91 DATE
DRAWN D.Simpson	SCALE 1:250 000
DATE Feb. 1991	PLAN NUMBER S 21950
CHECKED	

KANMANTOO TROUGH GEOLOGICAL INVESTIGATIONS
KARINYA SYNCLINE
ASBESTOS DEPOSITS, ROBERTSTOWN

5022

N

RS2601

Height of batter approx. 3m

RS3297

Tourmaline and tale

RS2599

RS3342

RS2600

RS2603, 2604

RS2602

Tourmaline and iron oxide cubes

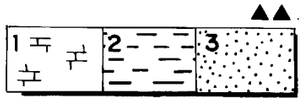
Tourmaline and iron oxide cubes

Height of batter approx. 5m

vvvv..... Undifferentiated dolerite and lamprophyre

+..... Gabbro

▲▲..... Pebble breccia



Angaston marble
1. Marble 2. Calc-shale 3. Calc-sandstone

TT..... Talc and talc schist

..... Amorphous tourmaline

xx..... Asbestos (crocidolite)

..... Calcareous soil and scree

..... Grass and soil

RS 3297 ..... Rock sample location and number

NOTE : All RS numbers prefixed by 6729

TYPE OF SAMPLE	
PETROLOGY	GEOCHEMISTRY
RS 2599	RS 2604
RS 2600	RS 3342
RS 2601	
RS 2602	
RS 2603	
RS 3297	
RS 3342	

0 5 10m

SCALE

KANMANTOO TROUGH
GEOLOGICAL INVESTIGATIONS

KARINYA SYNCLINE
PLAN VIEW OF DUTTON DIATREME

SADME 91-161

FIG. 4