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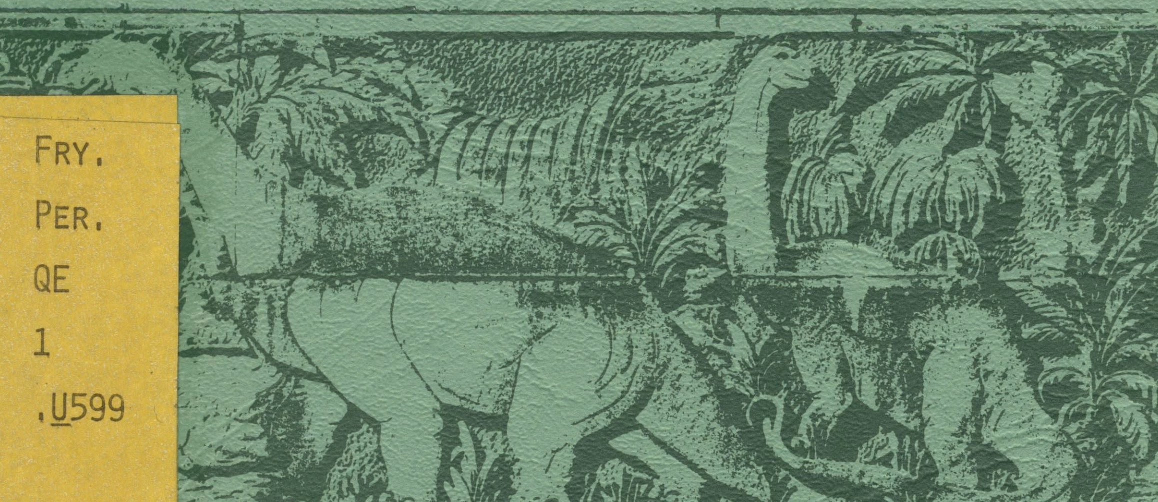

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CAINOZOIC VOLCANIC ROCKS IN THE BUNDABERG — GIN GIN — PIALBA AREA, QUEENSLAND

by **A.D. Robertson**

ABSTRACT. Six periods of volcanic activity have been recognized during the Cainozoic Era in the southern portion of the Bundaberg and the northern part of the Maryborough 1:250 000 sheet areas. Most have been short lived (less than 15 to 2 Ma) and all are of limited areal extent. The composition of the lavas vary with successive eruptive periods. The Palaeocene to early Eocene volcanics (Gin Gin and Pemberton Grange Basalts) are dominantly theoleiitic in composition. By the mid-Miocene, alkali basalt was being extruded. Moderately to strongly undersaturated lavas (Tararan and Maroondan Melanephelinites) were extruded during the Pliocene, and by the Pleistocene the magma composition had changed back towards the alkali basalt – hawaiite field. The late Pleistocene Berrembea Basalt exhibits a range of composition from moderately undersaturated to lava having tholeiitic affinities.

The Tararan Melanephelinite with its entrained upper mantle – lower crustal xenoliths implies magma generation in the upper mantle with a direct passage through the crust. Two distinct pyroxenite xenolith types have been recognised together with banded mafic granulite and sphene-bearing hornblendite. The presence of hornblendite xenoliths and kaersutite megacrysts in the lavas suggests a volatile-rich and hydrous mantle below the Tararan region.

INTRODUCTION

Until in 1978 when the presence of olivine nephelinite was recognised at Hill End southwest of Bundaberg (Robertson & Murray 1978), the volcanics cropping out to the west of Bundaberg were all considered to be basalt. Previous geological work in the area had identified two distinct periods of volcanic activity but the discovery of nephelinite indicated the complexity of volcanic activity in the region.

As a result, further geological mapping in the southern part of the Bundaberg 1:250 000 sheet (SG 56-02) and the northern party of the Maryborough 1:250 000 sheet (SG 56-06) was initiated. This paper gives a brief resume of the results achieved to date. Further work is in progress.

PREVIOUS INVESTIGATIONS

Basic volcanic rocks have been reported from the Gin Gin – Bundaberg area by Dunlop (1952), McTaggart (1960), Ridley (1960), Ellis (1968), Ellis and Whitaker (1976), Robertson (1979, 1980 a & 1980 b) and Day, Whitaker, Murray, Wilson, and Grimes (1983). Andrews (1965) noted the presence of basalt remnants on the sea floor east of Burnett Heads. Robertson and Murray (1978) were the first to report the presence of olivine nephelinite southwest of Bundaberg.

Pap. Dep. Geol. Univ. Qd., 11(3): 72–92, July, 1985.

The lateritised volcanics in the vicinity of Childers and Goodwood (text fig. 1) have been recorded by Ball (1902), McTaggart (1960), Mitchell (1966), Ellis (1968) and Muller (1979). The basalt in the vicinity of Dundowran has been described by Barnbaum (1976). The late Pleistocene Barambah Basalt that erupted from vents in the Coalstoun Lakes area has been studied by Stevens (1961), Ellis (1968), and Stevens & Bell (1977).

Potassium-argon dating of the Hummock and Barambah Basalts have been carried out by Wellman (1978). Barnbaum (1976) dated two volcanic flows near Dundowran.

TECTONIC EVOLUTION OF THE REGION

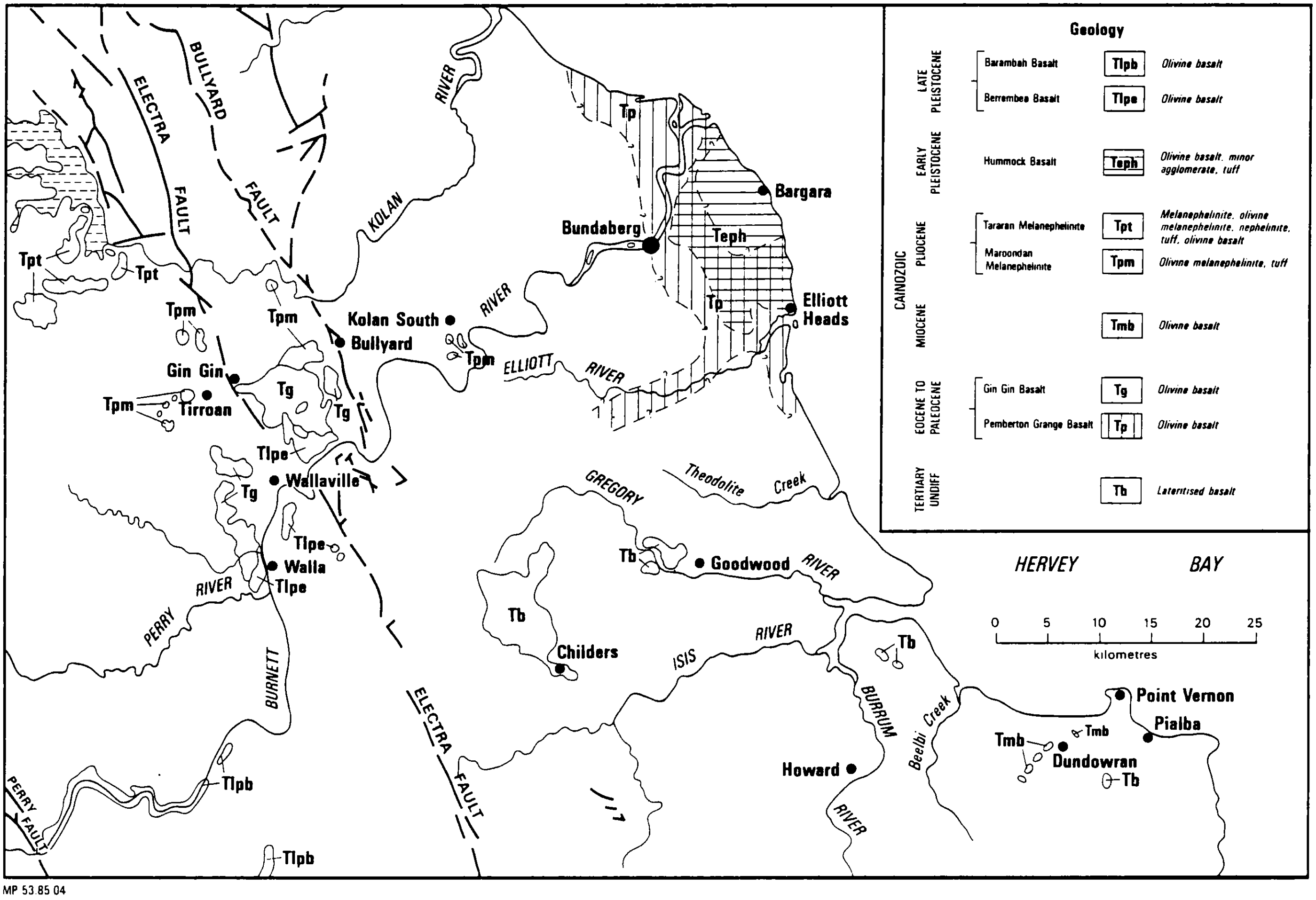
The majority of the basic volcanic units in the Bundaberg-Gin Gin-Pialba area (see text fig. 1) have been extruded from a series of vents emplaced adjacent to the western margin of the Maryborough Basin either within the late Triassic to mid-Cretaceous basin or within the Permian to early Triassic Gympie Block. In the vicinity of Gin Gin, the controlling influence of the Electra and Bullyard Fault Systems on the emplacement is most pronounced.

Grimes, Searle, and Palmieri (1984) maintain that the geological evolution of the region can be explained in terms of the current plate tectonic models. Until the late Cretaceous, the Australian and Antarctic Plates were considered as a single entity that had begun to drift away from the Lord Howe and Pacific Plates with resultant sea-floor spreading in the position of the Tasman Sea and propagating northwards. This sea-floor spreading continued until the end of the Palaeocene to the east of the eastern margin of the Maryborough Basin as a result of the separation of the Australian and Antarctic Plates and the northward movement of the Australian Plate (Mutter 1977; Branson 1978; Weissel & Watts 1979; Mutter & Karner 1980; Falvey & Mutter 1981; Grimes 1980; Day *et al.* 1983).

Falvey (1974) and Falvey & Mutter (1981) have put forward the hypothesis of a rising thermal anomaly to explain uplift and rifting in the late Cretaceous. Grimes *et al.* (1984) suggest the uplift and folding of the Maryborough Basin in the late Cretaceous (Ellis 1968) may be related to this thermal anomaly. The Bundaberg Trough (Robertson 1979) was developed in the late Cretaceous – early Palaeocene as a result of tensional forces. The Gin Gin Basalt and the Pemberton Grange Basalt were extruded immediately following this period, the Pemberton Grange Basalt occupying the basal section of the Bundaberg Trough.

By the end of the Eocene, the active phase had begun to abate and its place was taken by an erosional and depositional period resulting in a planation surface. During the Oligocene, laterite and ferricrete developed on this surface.

Epeirogenic earth movements in eastern Queensland during the late Oligocene to early Miocene, caused by the interaction of the Australian and Pacific Plates, resulted in large scale eruptions of plateau basalts (Grimes 1980) that continued into the Miocene in northern and southern Queensland (Wellman & McDougall 1974; Stephenson, Griffin & Sutherland 1980; Webb,



Text fig. 1: Tertiary volcanics in Bundaberg-Gin Gin-Pialba area

Stevens & McDougall 1967). In the Wide Bay-Burnett District, mid-Miocene basaltic outpourings occurred near Dundowran (Barbaum 1976).

By late Miocene, a period of quiescence again prevailed and lateritisation in eastern Queensland was widespread. The basaltic outpourings near Dundowran bracket a mid-Miocene weathering event in that area. The oldest basalt overlies the main (Oligocene?) laterite, the younger basalt has not been subjected to deep weathering.

Renewed earth movements in the Pliocene resulted in epeirogenic uplift, the destruction of most of the middle and late Tertiary laterite (Grimes 1980; Day *et al.* 1983) and the extrusion of mafic lavas in the Gin Gin area. Periodic earth movements continued into the Quaternary with readjustment on major fault systems and the eruption of olivine basalt from Sloping Hummock, east of Bundaberg, from a vent near Berrembea, northeast of Wallaville, and from vents in the vicinity of Coalstoun Lakes, southwest of Biggenden (not shown in text fig. 1).

AGE DETERMINATIONS

The use of traditional stratigraphic methods for determining the age of volcanic sequences poses considerable difficulties because of the rarity of associated fossiliferous sedimentary material, and the limited usefulness of preserved Cainozoic faunas and floras. The more accurate age determinations have been obtained using K/Ar radiometric techniques on the volcanic rocks themselves. However, the possibility of error through argon leakage should be recognised and where possible it is vitally important to establish relative ages wherever successive volcanism has occurred. The ages assigned to the remaining volcanic units have been based either on stratigraphic correlation or on the basis of physiography and extent of weathering suffered by the unit.

No K/Ar dating has been attempted on material recovered from the Pemberton Grange Basalt, Gin Gin Basalt, Berrembea Basalt, the volcanics around Childers, or the other vents extruding nephelinite-melanephelinite lavas as suitable material for dating has yet to be recovered.

The Maroondan Melanephelinite along with the nepheline bearing lavas extruded to the west and northwest of Gin Gin and north of Maroondan have been assigned a Pliocene age on the basis of morphology of the vent structures, the weathering of the lava flows and the similarities in lava types to those associated with the Tararan melanephelinite and the olivine nephelinite extruded at Hill End (to the south of the settlement of Kolan South).

PALAEOCENE TO EARLY EOCENE VOLCANICITY

The earliest Tertiary volcanics recorded in the Bundaberg-Gin Gin area are Paleocene to early Eocene lavas belonging to the Gin Gin Basalt (McTaggart 1960) and the Pemberton Grange Basalt (Robertson 1979). The Gin Gin Basalt outcropping to the west of Bullyard unconformably overlies Permian to Cretaceous strata and is overlain by late Eocene Elliott Formation, Pliocene Maroondan Melanephelinite and Pleistocene Berrembea Basalt.

To the east, in the Bundaberg Trough (Robertson 1979), the Pemberton Grange Basalt unconformably overlies sediments of the Cretaceous Burrum Coal Measures and is disconformably overlain by sediments of the Fairymead beds and the lateritised sediments of the Elliott Formation. The Pemberton Grange Basalt is a subsurface unit not known to crop out at the surface. McTaggart (1960) was the first to recognise the presence of this volcanic sequence and tentatively equated it in age to the deeply weathered and lateritised volcanics (Gin Gin Basalt) west of the Bullyard Fault.

The basaltic lavas of the Gin Gin Basalt are poorly exposed due to deep weathering and laterisation. Where moderately fresh material can be recovered the lavas appear to range in composition from olivine alkali basalts to tholeiitic basalts containing up to 30% volcanic glass. The chemical analyses of the Palaeocene volcanics as well as other Cainozoic lavas are given in Table 1 and the Grid References of the analysed samples are given in Appendix 1. Microporphyritic, fine grained olivine basalt (olivine 15%, augite 40%, plagioclase 25%, glass 15%, opaques 5%) is restricted in the sequence. Much of the observed sequence appears to be composed of fine to medium grained, tholeiitic basalt (plagioclase 40–60%, augite 10–40%, glass 15–30%, opaques 2–10%). Alteration of the granular to ophitic clinopyroxene is widespread. To the west of Wallaville, the volcanics contain calcite-filled vesicles, near Maroondan numerous sperulitic structures can be observed in the lavas.

The known sequence of the Pemberton Grange Basalt consists entirely of microporphyritic, fine grained olivine basalt (olivine 10%, labradorite feldspar 50%, augite 15%, volcanic glass 20%, opaques 5%). The volcanic glass occurs in two forms in the groundmass. One is a dark brown glass crowded with small opaque grains that make the glass almost opaque. The second type is now devitrified and occurs as concentrically banded brown chlorite and colourless chalcedonic silica. The second form of volcanic glass is prevalent in the Gin Gin Basalt.

Several flows are thought to have made up the total sequence of the Pemberton Grange Basalt. In the Fairymead NS1 drillhole (Robertson 1979) several zones of vesicular basalt, separated by massive basalt, have been recorded. Similar structures have been noted in the CB26 hole drilled in the Coonarr area southwest of Bundaberg (Robertson 1983). The olivine basalt of the Pemberton Grange Basalt is thought to be equivalent to the olivine basalt of the Gin Gin Basalt.

The maximum intersection recorded for the Pemberton Grange Basalt is 45 m in Fairymead NS1 drillhole. McTaggart (1960) proposes a thickness of approximately 60 m for the Gin Gin Basalt east of Gin Gin.

OLIGOCENE TO EARLY MIOCENE VOLCANICS

Ball (1902), McTaggart (1960), Ridley (1960), and Ellis (1968) have recorded the presence of lateritised and deeply weathered basaltic material in the vicinity of Childers and Goodwood. In most instances outcrop is poor and fresh volcanic material is almost non-existent. Muller (1979) states the surface expression of the volcanics is mainly mottled red, brown, yellow or grey clays.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
SiO_2	44.80	48.30	48.60	49.40	50.70	55.60	56.30	47.40	50.40	50.30	48.90	50.30	49.70	47.00	48.60	48.20	47.30	47.20	45.00	39.90	43.20
TiO_2	2.10	1.70	1.80	1.80	2.20	2.10	2.10	1.80	1.70	1.60	1.60	1.50	1.40	1.50	1.70	1.60	1.70	1.50	1.30	1.40	1.40
Al_2O_3	13.60	14.70	14.50	14.60	19.30	17.70	17.20	15.70	16.40	15.20	15.20	14.60	14.30	14.80	15.50	15.40	15.20	14.70	14.10	15.00	13.40
Fe_2O_3	3.10	4.30	4.30	3.80	6.10	3.30	2.40	8.96	5.10	5.70	5.70	3.80	4.40	4.90	5.10	4.70	4.60	5.50	8.60	10.40	10.60
FeO	8.20	5.30	5.30	6.00	0.40	2.10	2.80	1.30	3.90	4.10	4.50	5.20	4.80	6.20	5.30	5.90	6.30	5.60	2.40	1.60	1.60
Mno	0.19	0.13	0.16	0.12	0.02	0.04	0.07	0.19	0.17	0.14	0.18	0.17	0.13	0.14	0.15	0.17	0.21	0.15	0.18	0.20	0.21
MgO	11.20	8.10	7.90	8.10	1.60	2.10	2.60	4.00	3.50	5.50	6.20	7.80	8.20	7.40	6.00	6.70	6.80	8.60	3.50	3.60	4.30
CaO	9.70	7.30	7.70	7.80	5.50	6.40	8.00	9.40	8.70	8.40	7.50	7.70	7.40	6.30	7.60	7.00	7.50	6.50	7.30	7.30	8.20
Na_2O	3.50	3.10	3.20	3.00	3.40	3.30	3.80	3.50	3.40	3.20	2.90	3.00	2.00	3.30	3.30	3.30	3.20	2.90	2.50	2.00	2.70
K_2O	1.40	0.60	0.60	0.60	0.10	0.10	0.50	0.30	0.20	0.30	0.30	0.20	0.20	0.90	0.90	0.80	0.80	0.40	1.70	0.14	0.61
H_2O^+	0.51	5.59	4.69	4.40	10.54	7.11	3.58	5.99	5.59	4.91	5.65	4.82	5.48	6.90	5.03	5.29	5.43	6.36	9.28	15.92	4.51
P_2O_5	0.70	0.20	0.20	0.10	-	-	0.10	0.16	0.20	0.20	0.20	0.20	0.20	0.30	0.30	0.30	0.30	0.20	1.50	1.70	1.70
CO_2	1.50	1.00	1.50	<0.50	<0.50	<0.50	<0.50	1.50	0.50	<0.50	1.00	<0.50	0.50	<0.50	<0.50	<0.50	0.50	<0.50	2.00	<0.50	0.50
Total	100.50	100.32	100.45	99.72	99.86	99.85	99.45	100.20	99.76	99.55	99.83	99.29	99.71	99.64	99.48	99.36	99.84	99.61	99.36	99.16	99.93
C.I.P.W. NORM																					
Qtz	-	-	0.40	-	14.31	17.54	12.25	1.78	5.85	3.25	4.31	2.50	2.35	-	-	-	-	-	7.23	5.53	2.04
C	-	-	-	-	3.60	0.53	-	-	-	-	-	-	-	-	-	-	-	-	3.10	2.36	-
Or	8.27	3.55	3.55	3.55	0.59	0.59	2.96	1.77	1.18	1.77	1.77	1.18	1.18	5.32	5.32	4.73	4.73	2.36	10.05	0.83	3.61
Ab	18.92	26.23	27.07	25.38	28.77	27.92	32.15	29.61	28.77	27.07	24.54	25.38	25.38	27.92	27.92	27.92	27.07	24.54	21.15	16.92	22.84
An	17.27	24.43	23.43	24.60	27.29	31.75	28.40	26.25	28.90	26.23	27.58	25.79	24.97	22.92	24.83	24.85	24.75	25.92	13.77	25.11	22.65
Ne	5.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Di	13.55	3.37	3.22	10.89	-	-	8.63	8.17	8.12	11.59	1.64	8.99	5.89	5.21	8.95	6.48	6.00	4.09	-	-	-
Hy	-	28.12	28.07	22.92	8.50	8.82	5.78	16.19	13.89	18.34	25.59	24.78	27.56	15.00	17.49	18.54	17.67	24.76	20.87	22.12	22.56
Ol	24.11	0.35	-	1.60	-	-	-	-	-	-	-	-	-	9.69	3.04	4.82	6.05	5.09	-	-	-
Mt	2.95	2.46	2.46	2.53	1.58	1.36	1.33	2.51	2.28	2.48	2.59	2.31.	2.35	2.85	2.66	2.72	2.80	2.83	2.72	2.94	2.99
Ie	3.99	3.23	3.42	3.42	4.18	3.99	3.99	3.42	3.23	3.04	3.04	2.85	2.66	2.85	3.23	3.04	3.23	2.85	2.47	2.66	2.66
Ap	1.65	0.47	0.47	0.24	-	-	0.24	0.38	0.47	0.47	0.47	0.47	0.47	0.71	0.71	0.71	0.71	0.71	3.54	4.01	4.01
Cc	3.41	2.27	3.41	-	-	-	-	3.41	1.14	-	2.27	-	1.14	-	-	-	1.14	-	4.55	-	1.14

Sample No. 1-8, Gin Gin Basalt; 9-18, Pemberton Grange Basalt; 19-21, Tararan Melanephelinite:

TABLE 1: Chemical Analyses and CIPW Norms of the GinGin Basalt, Pemberton Grange Basalt, Tararan Melanephelinite, Maroondan Melanephelinite, Berrembea Basalt and Hummock Basalt.

	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
SiO_2	44.60	43.10	42.80	44.80	42.60	42.60	41.90	45.40	43.60	44.20	44.30	46.00	50.90	52.70	53.80	43.90	44.90	45.80	43.00	43.30	47.00
TiO_2	1.30	2.20	2.10	1.50	2.00	1.60	2.90	2.10	2.90	2.90	2.90	2.80	2.40	1.90	2.00	2.30	2.50	2.50	2.20	2.20	2.20
Al_2O_3	13.40	13.40	13.50	14.40	13.00	13.80	13.20	14.40	14.00	13.90	14.20	13.90	20.10	15.00	17.00	13.10	13.90	14.00	13.50	23.60	14.40
Fe_2O_3	9.20	11.00	11.50	7.50	11.40	9.80	3.80	2.50	7.30	7.30	7.00	7.20	6.30	1.50	3.00	4.40	6.90	6.60	3.50	3.40	3.30
FeO	2.00	2.80	2.40	4.60	1.80	3.50	8.20	9.00	5.00	5.00	5.20	4.70	0.80	7.10	3.50	7.50	5.20	5.60	8.00	8.10	7.60
MnO	0.18	0.19	0.20	0.20	0.21	0.23	0.16	0.18	0.15	0.15	0.15	0.12	0.03	0.16	0.08	0.17	0.16	0.17	0.19	0.18	0.16
MgO	3.40	6.70	6.10	4.60	5.70	5.70	8.50	10.30	7.30	7.60	7.30	6.50	1.70	5.70	3.20	10.90	6.70	6.20	10.60	10.20	8.70
CaO	7.80	8.90	9.00	8.50	9.00	10.10	10.30	9.20	4.00	9.10	9.00	8.30	5.50	8.30	8.50	9.90	9.40	9.30	10.40	10.40	8.90
Na_2O	3.00	4.80	4.40	5.10	3.60	2.10	4.90	3.40	4.10	4.90	5.00	1.90	3.70	3.60	3.90	3.90	4.60	4.50	2.30	2.30	3.00
K_2O	1.30	1.60	1.80	2.10	0.50	0.90	0.90	1.50	0.70	0.53	0.78	0.80	0.10	0.30	0.10	1.60	0.72	1.00	1.60	1.80	1.00
H_2O^+	11.42	3.91	4.27	5.51	7.50	8.55	3.51	1.70	3.96	3.76	3.13	5.32	6.59	2.99	4.09	0.53	3.54	3.32	3.60	3.51	3.06
P_2O_5	1.60	1.10	1.20	1.10	1.10	1.00	0.80	0.60	0.80	0.74	0.76	0.80	<0.10	0.20	0.10	0.80	0.74	0.80	0.60	0.50	0.40
CO_2	0.50	1.00	1.00	0.50	1.00	<0.50	1.00	-	1.00	<0.50	<0.50	2.00	2.00	<0.50	1.00	1.50	<0.50	0.50	<0.50	<0.50	<0.50
Total	99.70	100.00	100.00	100.41	99.41	99.88	99.07	100.28	99.81	100.08	99.72	100.34	100.12	99.45	100.27	100.50	99.29	100.29	99.49	99.49	99.72

C.I.P.W. NORM

	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Qtz	1.91	-	-	-	-	-	-	-	-	-	-	7.12	17.63	4.34	9.73	-	-	-	-	-	-
C	-	-	-	-	-	-	-	-	-	-	-	1.37	8.54	-	-	-	-	-	-	-	-
Or	7.68	9.46	10.64	12.41	2.96	5.32	5.32	8.87	4.14	3.13	4.61	4.73	0.59	1.77	0.59	9.46	4.26	5.91	9.46	10.64	5.91
Ab	25.38	18.33	18.31	19.54	30.46	17.77	13.00	15.14	26.82	21.37	20.14	16.08	31.31	30.46	33.00	14.58	22.58	26.23	8.66	7.90	25.38
An	19.26	10.30	11.77	10.20	17.84	25.57	11.37	19.60	17.73	14.37	14.01	23.31	14.64	23.89	28.59	13.52	15.16	15.05	21.79	21.47	22.88
Ne	-	12.07	10.25	12.79	-	-	15.42	7.38	4.26	10.88	21.01	-	-	-	-	9.98	8.85	6.42	5.85	6.26	-
Di	4.88	16.73	15.46	17.99	10.99	14.91	22.87	17.89	12.53	21.12	20.93	-	-	13.02	-	16.87	21.80	18.63	20.91	21.72	15.13
Hy	18.36	-	-	-	1.38	9.34	-	-	-	-	-	27.18	9.74	16.64	10.72	-	-	-	-	-	2.75
Ol	-	16.61	16.19	11.84	15.50	9.00	15.66	21.15	17.11	14.60	14.06	-	-	-	-	22.63	13.07	13.45	20.52	19.52	16.54
Mt	2.76	3.41	3.42	3.05	3.24	3.31	3.12	3.02	3.11	3.11	3.09	3.00	1.74	2.27	1.66	3.08	2.06	3.10	2.99	2.00	2.84
Ie	2.47	4.18	3.99	2.85	3.80	3.04	5.51	3.99	5.51	5.51	5.51	5.32	4.56	3.61	3.80	4.37	4.75	4.75	4.18	4.18	4.18
Ap	3.77	2.60	2.83	2.60	2.60	2.36	1.89	1.42	1.89	1.75	1.79	1.89	-	0.47	0.24	1.89	1.75	1.89	1.42	1.18	0.94
Cc	1.14	2.27	2.27	1.14	2.27	-	2.27	-	2.27	-	-	4.55	4.55	-	2.27	3.41	-	1.14	-	-	-

Sample No. 22-29, Tararan Melanephelinite; 30-39, Maroondan Melanephelinite; 40-42, Berrembea Basalt:

TABLE 1 Continued

	43	44	45	46	C.I.P.W. NORM				
SiO_2	43.50	51.70	46.50	51.70	Qtz	-	4.36	-	-
TiO_2	2.30	1.50	2.20	2.20	C	-	-	-	-
Al_2O_3	13.50	14.90	12.70	14.50	Or	7.09	0.59	9.46	8.27
Fe_2O_3	3.50	4.40	2.50	3.60	Ab	10.88	26.33	19.52	35.54
FeO	8.20	5.50	8.30	6.60	An	19.83	26.45	16.02	16.58
MnO	0.19	0.16	0.14	0.11	Ne	7.85	-	3.63	-
MgO	10.60	6.60	10.60	6.76	Di	22.10	10.27	20.05	12.65
CaO	10.30	8.00	8.90	7.00	Hy	-	22.27	-	8.88
Na_2O	3.00	3.10	3.10	4.20	Ol	20.19	-	20.14	8.56
K_2O	1.20	0.10	1.60	1.40	Mt	3.05	2.54	2.83	2.64
H_2O	2.62	3.85	2.43	1.26	Ie	4.37	2.85	4.18	4.18
P_2O_5	0.60	0.10	0.50	0.40	Ap	1.42	0.24	1.18	0.94
CO_2	<0.50	<0.50	<0.50	<0.50	Cc	-	-	-	-
Total	99.51	99.91	99.47	99.67					

Sample No. 43-44, Berrembea Basalt

45-46 Hummock Basalt:

TABLE 1 Continued

Material when only moderately altered suggests that the volcanics were originally a fine grained, amygdaloidal olivine basalt. Muller suspects that several flows exist because both massive and vesicular varieties have been intersected in water bores.

The volcanics in the vicinity of Childers unconformably overlie the Cretaceous Grahams Creek Formation, the Maryborough Formation, and the Burrum Coal Measures. They also overlie deeply weathered and lateritised Tertiary sediments that are similar to those described by Robertson (1979) as being part of the late early Eocene Fairymead beds.

Day *et al.* (1983) have given a tentative age of Oligocene to early Miocene for the Childers volcanics. Two basalt flows, one weathered, the other unweathered, cropping out to the west of Dundowran have been dated by Barnbaum (1976) as 12 and 18.6 Ma. The 18.6 Ma lateritised flow overlies laterite considered to be of Oligocene age. On the basis of Barnbaum's results, it appears that the volcanics in the vicinity of Childers could be no younger than 18.6 Ma.

Several specimens of moderately weathered volcanics have been recovered from the northern end of the Childers occurrence. The mineralogy and texture of these specimens indicate that some of the lava is andesitic in composition and exhibits some similarities to the more siliceous members of the Gin Gin Basalt.

Deeply weathered volcanics crop out near the Gregory River, west of Goodwood. Little is known of the petrology because of the intense weathering suffered by the volcanics. On the basis of soil types developed on the weathered volcanics, it appears that the lava to the west of Goodwood and that in the vicinity of Childers were of similar composition.

Mitchell (1966) estimated a maximum thickness of approximately 16 m for the volcanics near Goodwood. Both McTaggart (1960) and Ellis (1968) gave a thickness of approximately 65 m for the sequence around Childers. Underground water investigations in the vicinity of Childers (Muller 1979) indicate the thickness of the basalt can vary from 5.8 m to possibly in excess of 23 m.

MIOCENE VOLCANICS

Hawthorne (1960) recorded the presence of a small area of basalt near Dundowran. Ellis (1968) referred to the volcanics as a "small flow" southwest of Point Vernon; Stephens (1971) informally named the unit the Dundowran basalt and gave the 15 m exposure in the then face of the Dundowran quarry as the type section. Ellis considered the flow to have a maximum thickness of 45 m.

Barnbaum (1976) was the first to describe in detail the basalt that covered an area of 3 km^2, "in the form of two elongate outliers arranged end to end (total length 5 km) individually 0.4 – 0.6 km wide". He considered the base of the volcanics to be at approximately 15 m above sea level. The basalt unconformably overlies lateritised Cretaceous Maryborough Formation.

Barnbaum recognised two texturally and chemically different flows making up the volcanic sequence west of Dundowran. Both flows are composed of fine-grained olivine basalt in which "micro-phenocrysts of olivine, magnetite, and clinopyroxene are set in a holocrystalline groundmass of plagioclase, olivine, pyroxene, and opaque minerals".

Dating of the volcanics by the K/Ar method (Barnbaum 1976) gave ages of 12 Ma and 18.6 Ma. The younger basalt is relatively fresh while the older basalt has suffered a period of deep weathering (Barnbaum 1976; Day *et al.* 1983).

PLIOCENE VOLCANICS

Small, flat-lying outliers of "olivine basalt" have been reported by Ellis and Whitaker (1976) to occur in the southern part of the Bundaberg 1:250 000 sheet area. Several were recorded as being near the Bruce Highway approximately 20 km northwest of Gin Gin, whereas the remainder were in the vicinity of Gin Gin, Bullyard, and South Kolan (Hill End). McTaggart (1960) had recognised a younger volcanic unit overlying the lateritised Elliott Formation near Kolan South.

During geological mapping in the vicinity of Kolan South, the black volcanic rock at Hill End was recognised to be olivine nephelinite (Robertson & Murray 1978). Further geological mapping in the southern part of the Bundaberg 1:250 000 sheet area (Robertson, unpublished data) has shown that the small flat-lying outliers of "olivine basalt" belong to a nephelinite-melanephelinite sequence of volcanic activity.

The nephelinite-melanephelinite lavas have been extruded from eight vents in an area extending from Lake Monduran to Tirroan, west of Gin Gin, to Kolan South in the east. The largest outpouring, the Tararan Melanephelinite, is derived from three vents located to the west and south of Lake Monduran and adjacent to the Bruce Highway. The largest vent in the area, the Tararan vent, is a well developed tuff-lava cone with well bedded tuff making up a large part of the cone structure.

Melanephelinitic lavas (Maroondan Melanephelinite) accompanied by basic tuffs and basanite were erupted from a cone vent adjacent to the Bundaberg-Gin Gin road west of Bullyard. Minor eruptions of melanephelinite have occurred from vents at Pinnacle, northwest of Gin Gin, and near Tirroan. In the vicinity of the Kolan River, northwest of Bullyard a small outpouring of melanephelinite, nephelinite and minor basanite has occured. The vent at Hill End, south of Kolan South, appears to have produced only olivine nephelinite throughout its entire period of activity.

The classification of the mafic extrusive rocks in the Gin Gin area is based on that proposed by LeBas (1977).

The Tararan Melanephelinite is composed mainly of melanephelinite with minor olivine nephelinite, melilite nephelinite, and olivine basalt. The Tararan vent consists mainly of bedded tuff and "agglomerate". The "agglomerate" contains a wide variety of fragments, both volcanic and metasedimentary, set in a matrix of nephelinitic tuff.

The melanephelinites are microporphyritic, dark green to greenish grey rocks with pyroxene, opaques, olivine and rare apatite occurring as the microphenocrysts (5 – 20%). Olivine tends to appear as phenocrysts only towards the end of the eruptive sequence where it displaces the pyroxene as phenocrysts. Olivine appears as phenocrysts earlier in the eruptive sequence from the other two vents where from one, olivine basalt was extruded. The groundmass of the melanephelinite consists of colourless to lilac granular pyroxene (40 – 70%), opaques (up to 10%), nepheline, and glass. Apatite and calcite occur as minor accessories with phlogopitic biotite, corroded green and brown spinel and fragmental brown hornblende. Nepheline in the groundmass may be pseudomorphed by zeolites. Olivine when present as phenocrysts is usually pseudomorphed by iddingsite and hematite.

Numerous xenoliths of upper mantle-lower crustal origin as well as megacrysts of anorthoclase and titanium-rich amphibole occur in the earliest melanephelinite flows emanating from the Tararan vent.

Olivine nephelinite and olivine-rich melanephelinite are not well developed in the lava extruded from the Tararan vent. They appear to form a larger part of the lavas extruded from the other two vents. The olivine nephelinites are grey-green to black microporphyritic lavas with phenocrysts of olivine, nepheline, occasional pyroxene and opaques and rare apatite. The groundmass contains subhedral to anhedral nepheline, granular pyroxene, opaques and glass with apatite and calcite as minor accessories. In some flows, the groundmass nepheline is partly replaced by analcime and calcite.

Melilite-bearing nephelinite has been recorded from one flow only. This rock type is similar in texture to olivine-nephelinite except the percentage of pyroxene in the groundmass has increased at the expense of nepheline to the point where the rock is transitional between olivine-nephelinite and olivine-melanephelinite. Olivine basalt has been recorded as an extrusive from the vent adjacent to the Lake Monduran turnoff and appears to be the final product of eruption. Phenocrysts of olivine are set in a groundmass of plagioclase, titanaugite, ore, and glass. The pyroxene has a tendency to form clusters interstitial to the plagioclase. Although basanite has not been found, it is suspected to be present in the Tararan Melanephelinite sequence.

Potassium-argon dating of anorthoclase from the Tararan vent gave a Pliocene (2.99 – 2.69 Ma) age for the volcanic sequence.

Melanephelinites similar to those described from Tararan occur in the Maroondan Melanephelinite. This sequence of mafic lavas has been extruded from a well developed breached vent adjacent to the north side of the Bundaberg-Gin Gin road west of Bullyard. The initial ejecta were nephelinitic tuffs followed by a flow composed of euhedral olivine set in a red-brown glass. Moderately undersaturated to transitional tholeiitic lavas followed the glassy flow. This sequence quickly gave way to melanephelinitic lavas. Towards the end of the eruption basanitic lavas again made their appearance. Both the melanephelinite and basanite flows contain spinel and fragmental clinopyroxene as inclusions. No xenoliths or megacrysts similar to those found in the basal flows from the Tararan vent have been found in the Maroondan Melanephelinite.

Dunlop (1952) briefly described the basalt as "normal olivine-augite-plagioclase basalt". McTaggart (1960), Ellis & Whitaker (1976) and Robertson (1979) record at least three flows emanating from the vent at Sloping Hummock. The basalt is well exposed in coastal headlands between Burnett Heads and Elliott Heads. Remnants of aa and block lava, formed on broad pressure ridges developed as a result of resistance to flow, occur to the west and northwest of Elliott Heads. In the same area, the remnant flow ends of the upper and middle flows can still be recognised.

The Hummock Basalt consists almost entirely of olivine basalt usually containing olivine microphenocrysts set in a fine-grained groundmass of labradorite laths, augite, titanomagnetite, and zeolite. In the basal flow, zeolite in the groundmass is rare or absent but occurs in vesicles together with calcite and aragonite.

Wellman (1978) has dated the Hummock Basalt as Pleistocene (1.1 – 0.9 Ma).

Barambah Basalt

Upper Cainozoic volcanism in the Coalstoun Lakes – Ban Ban Springs area was first noted by Broun (1894; 1895) who named Mount Le Brun, an extinct cone with two crater lakes. He also recognised the origin of the lava along the valley of Barambah Creek (Stevens 1961; Ellis 1968). The vents and flows were mapped by Stevens (1961) who proposed the name Barambah Basalt for the volcanic sequence.

Apart from Mount Le Brun, two other eruptive centres, presumably of similar age, occur a few kilometres to the northwest and to the southwest of Mount Le Brun. Basalt flowed from all three vents, spreading out over a valley 3 to 5 km wide to the south of the vents, following the valley down to the confluence with Barambah Creek and thence into the Burnett River. This flow travelled a considerable distance down the Burnett River (Stevens 1961; Ellis 1968). Ellis has mapped basalt as flowing northwards from the vents towards Degilbo.

Mount Le Brun is a composite cone formed of fragments of vesicular and flow banded basalt, commonly with a ropy surface. Numerous spheroidal, volcanic bombs ranging from 10 – 60 cm in diameter have been found (Stevens & Bell 1977). Harvey's Knob, two kilometres northwest of Mount Le Brun, is composed of basalt agglomerate whereas the third vent, locally known as Hunters Volcano, is composed of vesicular basalt. All three vents have rims that are highest on the southwest side indicating that northeast winds prevailed at the time of eruption (Stevens & Bell 1977).

At least one lava tube is known to occur beneath the basalt surface 1.6 km southwest of Dundurrah (Wilmott 1976). Ellis (1968) suggests that lava tunnels were probably instrumental in maintaining the supply of fluid lava over the distance travelled by the Barambah Basalt. Remnants of an extensive lava tunnel system have yet to be found.

Stevens & Bell (1977) describe the Barambah Basalt as "an olivine basalt, usually with olivine as microphenocrysts in a very fine groundmass of labrador-

Little is known of the petrology or composition of the mafic volcanics emanating from the Pinnacle vent, northwest of Gin Gin, or the Tirroan vent, west of Gin Gin. The Pinnacle vent is made up of agglomerate, splatter products and glassy lava containing well developed, small (up to 2 mm) augite crystals. The main flow is an olivine-augite nephelinite transitional to a melanephelinite. Euhedral olivine (15%) and titan-augite (20%) occur as phenocrysts set in a fine-grained groundmass of clinopyroxene, olivine, opaques, and nephelinite. Spinel and apatite occur as accessory minerals. Basanitic lavas appear to be the final product of eruption from the Pinnacle vent.

The nephelinitic lavas extruded from the vent adjacent to the Kolan River include olivine and augite melanephelinite, olivine nephelinite, and basanite. Olivine basalt appears to be the final product of eruption from this vent. A notable characteristic of the melanephelinites associated with this eruptive sequence is the number of feldspar-rich volcanic rock xenoliths present. This xenolith type is the only one present. Occasional megacrysts of clinopyroxene and amphibole have been recorded.

The mafic volcanics in the vicinity of Hill End (south of the settlement of Kolan South) are the only sequence in which melanephelinite has yet to be identified. Of the rock types studied, all are olivine nephelinites. The petrology and chemistry have been discussed by Robertson & Murray (1978).

Core drilling at Hill End has indicated that the olivine nephelinite overlies a thin sequence of tuff containing acicular crystals of aragonite. The maximum thickness recorded during drilling (Robertson 1979) was 16.62 m. Potassium-argon dating of material recovered from the drill core gave a minimum age of 5.1 Ma. Because of the presence of glass in the material submitted from Hill End, the 5.1 Ma age should be taken as a minimum age that is possibly close to the true age of eruption. The calculated ages for the Tararan eruption (2.99 – 2.69 Ma) were determined from anorthoclases taken from the bottom and top of the eruptive sequence. These ages are considered to be reliable dates.

PLEISTOCENE VOLCANIC ACTIVITY

During the Pleistocene, basaltic magma was erupted from a single vent at Sloping Hummock (Hummock Basalt) east of Bundaberg and from a series of vents (Barambah Basalt) adjacent to the Perry Fault in the vicinity of Coalstoun Lakes. Magma derived from a single vent near Berrembea (Berrembea Basalt) east of Wallaville has been tentatively assigned a late Pleistocene age.

Hummock Basalt

The name Hummock Basalt was first used in a map legend by Ridley (1960) for a sequence of volcanic flows cropping out over an area of approximately 215 km^2 (Robertson 1982) between the Burnett and Elliott Rivers on the mainland and extending an unknown distance offshore. Geophysical investigations (Andrews 1965) indicate the existence of basalt remnants on the seafloor within 3 km of Burnett Heads.

ite laths, augite, and iron oxide. Some are more even grained and slightly coarser, others are ophitic and contain titanaugite, interstitial zeolite and glass." Wellman (1978) has dated the Barambah Basalt as late Pleistocene ca. 600 000 years.

Berrembea Basalt

The Berrembea Basalt is a new name proposed for a sequence of volcanic flows emanating from a single ill-defined vent situated north of the old Berrembea railway siding, east of Wallaville. These basalt flows were included in the Gin Gin Basalt sequence by McTaggart (1960) and were referred to as Tertiary basalt by Ellis (1968).

To the east and north of Berrembea, the flows are well preserved and easily traced usually ending in steep scarp-like features. The flows to the south and southwest have been partly removed by the Burnett River. A low conical hill adjacent to the Bruce Highway, south of Wallaville, may be a point of extrusion for the basalt. A similar structure has been mapped on Burnett Camp Creek to the east of Walla. The volcanic flow along the Burnett River to the west of Walla was considered by Ellis (1968) to be the furthermost position reached by the Barambah Basalt as it flowed down the Burnett River. This basalt is now considered to be part of the Berrembea Basalt.

The Berrembea Basalt is predominantly an olivine basalt with microphenocrysts of olivine set in a fine grained groundmass of plagioclase laths, augite, and iron oxides. Some of the flows have an extremely fine grained groundmass in which the augite occurs as granules, plagioclase is weakly developed and nephline is present.In at least one flow, phenocrysts of plagioclase are set in a groundmass of plagioclase, olivine, subophitic augite, and iron oxide while in another flow xenocrysts of plagioclase fledspar have been noted.

Potassium-argon age dating has yet to be carried out on material from the Berrembea Basalt. Comparing the degree of weathering suffered by the Hummock Basalt and Barambah Basalt and the well preserved flows in the Berrembea Basalt, a tentative age of late Pleistocene has been assigned to the Berrembea Basalt.

XENOLITHS AND MEGACRYSTS

Xenoliths and megacrysts are common in the early flows originating from the Tararan vent but appear to have restricted distribution in the other Pliocene mafic volcanics. They have not been recorded from the less mafic volcanics in the Bundaberg-Gin Gin-Childers-Pialba area.

Xenoliths

Xenoliths of country rock can be found in the tuffs and agglomerates forming part of the Tararan vent but become less common in the flows. Rare xenoliths of country rock have been found in the flow emanating from the Pinnacle vent and feldspar-rich volcanic rocks have been recorded as xenoliths in lava associated with the vent adjacent to the Kolan River, nothwest of Bullyard.

Lherzolites (1 to 5 cm diameter) of the Cr-diopside ultramafic xenolith association can be found in most of the mafic flows but are not abundant. These xenoliths are generally considered to represent mantle material after previous magma extraction.

Numerous xenoliths occur in the early melanephelinitic flows from the Tararan vent. The majority of these xenoliths belong to the Al-Ti-Augite group that include pyroxenites and amphibole-bearing pyroxenites. They consist of the assemblage Cpx + Opx + amphibole with or without ileminite or titanomagnetite, spinel, feldspar, apatite, garnet, and sulphide. Several textural variations have been noted in the pyroxenite xenolith assemblage.

The most common type of pyroxenite exhibits the original igneous texture masked by and in some instances almost entirely obliterated by secondary processes. The pyroxenes have undergone extensive subsolidus re-equilibration, as shown by exsolution textures expressed either as thin lamellae along (100) planes or as coarse-grained blebs of pyroxene within the host phase. As shown by Ellis (1976), the greater the extent of unmixing, the less structural control exerted by the host upon the orientation of the exsolved phase (see also Best 1970; Irving 1974).

A number of pyroxenite xenoliths have equigranular metamorphic textures, with well developed triple point grain boundaries. This group of xenoliths compares with Ellis' (1976) Group 3 pyroxenites from the Newer Volcanics of Victoria whereas the pyroxenites exhibiting extensive subsolidus re-equilibrium in the pyroxenes correspond to his Group 2 pyroxenites.

Amphibole-bearing pyroxenites resemble cumulates that have suffered modification. The pyroxene exhibits all stages of replacement by Ti-rich amphibole. Garnet occasionally accompanies the amphibole in the pyroxenites. The complete replacement of pyroxene by hornblende (in the pyroxenites) results in the development of hornblendites. Several varieties of hornblendite have been recorded from the Tararan vent. Garnet-diopside hornblendite and apatite-diopside hornblendite are most common. Rare sphene and apatite-bearing varieties have been encountered. The apatite in the apatite-bearing hornblendite is high in iron content. Mafic and felsic granulites, some exhibiting banding, contain garnet, apatite, spinel, and occasional Ti-rich mica.

The Al-Ti-Augite group of xenoliths have generally been considered to represent fragments of igneous material formed from an older basaltic melt, by accumulation or segregation of early crystals, under upper mantle – lower crustal conditions.

Megacrysts

Megacrysts are relatively abundant at the Tararan vent and have been found over a wide area in the Tararan Melanephelinite. They occasionally occur in the lavas extruded from the Pinnacle vent, the vent adjacent to the Kolan River and the Maroondan vent. They are rare in the olivine nephelinite from Hill End. Megacrysts are yet to be found in the remainder of the volcanics in the Bundaberg-Gin Gin-Childers-Pialba area.

The following minerals have been recorded either as megacrysts or as xenocrysts: anorthoclase, titaniferous pargasite and kaersutite, titanomagnetite and ilmenite, plagioclase feldspar, titaniferous biotite, garnet, and spinel. No corundum or zircon have been observed although anorthoclase megacrysts are elsewhere companions of the rare corundum and zircon as are ultramafic nodules in other volcanic associations.

The anorthoclase megacrysts are problematical. Their occurrence at the Tararan vent is common and specimens of 12 cm or more diameter are plentiful. Irving (1974) considers anorthoclase formed as large crystals precipitating from hydrous basaltic magma under near-solidus conditions where water pressure is high. However Griffin (1977) has suggested an alternative mode of formation involving anorthoclase growth close to the liquidus in felsic melts derived from mantle-derived phonolite magma.

Bahat (1979) on the other hand has proposed that anorthoclase megacrysts can crystallise in shallow magmatic reservoirs in hydrous residual magmas enriched in volatiles of Na, Sr, and Ba and brought to the surface by later magma.

As megacrysts have generally been accepted as high pressure phases developed by slow growth in their host magma and transported to the surface by direct eruption, the association of anorthoclase with other high pressure phases and xenoliths in Tararan vent needs clarification.

DISCUSSION AND CONCLUSIONS

The Tertiary volcanic rocks of the Bundaberg-Gin Gin-Pialba region can be grouped into six periods of volcanic activity. All have been short lived periods of eruption and all are of limited areal extent. This most probably reflects the mode of emplacement, considered to be the result of diapiric upwelling of magma in response to periods of tectonic instability. This is supported by the close correlation between the periods of eruption and the known periods of tectonic instability.

The observed variation in the overall composition of the extruded lava with progressive periods of volcanic activity defines a trend from tholeiitic for the older lavas, to alkali strongly undersaturated for the Pliocene eruptions back to akali basalt transitional to tholeiite for the younger lavas. The absence of xenoliths and megacrysts in all but the Pliocene volcanics hinders any attempts at estimating depths of magma generation.

The presence of kaersutite-clinopyroxene-garnet-magnetite bearing xenoliths in the Tararan Melanephelinite suggests an upper mantle origin (Yagi *et al.* 1975). This tends to be supported by the low TiO_2 content (0.59%) and the rich Mg-Tschermak's molecule in the co-existing clinopyroxene (Robertson, unpublished data). However, the co-existing garnet is not as rich in the pyrope molecule as would be expected. The presence of Ti-rich amphibole megacrysts as well as spinel bearing lherzolite is also consistent with an upper mantle origin as indicated by the kaersutite bearing xenoliths (Boettcher *et al.* 1975). Sphene bearing hornblendite is also known to occur as xenoliths. Hellman & Green (1979) show that sphene is stable over a pressure range of 10 – 18 kb and to temperatures of 1020°C. At higher pressures rutile becomes the important Ti-bearing phase in an hydrous mafic environment. As the hornblendite contains primary sphene and no rutile, the sphene bearing hornblendite may have been derived at depths of less than 45 km (Hellman & Green 1979).

All the evidence to date suggests that at least the Tararan Melanephelinite was generated in the upper mantle and captured xenoliths from the upper mantle and lower crust during its direct ascent towards the surface. Ferguson & Sheraton (1979) consider that both olivine nephelinite and kimberlite magmas may be derived directly by small degrees of melting of four-phase lherzolite, possibly phlogopite-bearing, in the mantle although rocks of chemistry generally similar to olivine nephelinite may be derived by fractionation of kimberlite magma (Ferguson *et al.* 1975). They maintain that the observed fractionation trend would depend upon the depth at which melting would begin. This in turn would be dependent upon the geothermal gradient.

They consider the presence of a high geothermal gradient in eastern Australia during the Cainozoic would result in the initial melt being of the olivine nephelinite-melanephelinite type. The Tararan and Maroondan lavas are considered to have been generated as a result of this high geothermal gradient. Whether they were derived from the partial melting of four-phase lherzolite or fractionation of kimberlite magma is yet to be determined. As the intersection of the diamond/graphite inversion curve by the geothermal gradient is at a much greater temperature and pressure than that suggested by the xenoliths in the Tararan sequence, it is therefore unlikely that diamonds will be found in the Bundaberg and Gin Gin areas.

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APPENDIX 1

Grid References of analysed samples given in Table 1

Sample Number	Volcanic Unit	Sheet Area+	Grid Reference
1	Gin Gin Basalt	Rosedale	981366
2	Gin Gin Basalt	Rosedale	981366
3	Gin Gin Basalt	Rosedale	981366
4	Gin Gin Basalt	Bundaberg	998370
5	Gin Gin Basalt	Rosedale	987352
6	Gin Gin Basalt	Bundaberg	002380
7	Gin Gin Basalt	Bundaberg	002381
8	Gin Gin Basalt	Mount Perry	936244
9*	Pemberton Grange Basalt	Bundaberg	354620
10*	Pemberton Grange Basalt	Bundaberg	354620
11*	Pemberton Grange Basalt	Bundaberg	354620
12*	Pemberton Grange Basalt	Bundaberg	354620
13*	Pemberton Grange Basalt	Bundaberg	354620
14**	Pemberton Grange Basalt	Bundaberg	486361
15**	Pemberton Grange Basalt	Bundaberg	486361
16**	Pemberton Grange Basalt	Bundaberg	486361
17**	Pemberton Grange Basalt	Bundaberg	486361
18**	Pemberton Grange Basalt	Bundaberg	486361
19	Tararan Melanephelinite	Rosedale	776483
20	Tararan Melanephelinite	Rosedale	776483
21	Tararan Melanephelinite	Rosedale	776483
22	Tararan Melanephelinite	Rosedale	776483
23	Tararan Melanephelinite	Rosedale	779483
24	Tararan Melanephelinite	Rosedale	776483
25	Tararan Melanephelinite	Rosedale	776483
26	Tararan Melanephelinite	Rosedale	776483
27	Tararan Melanephelinite	Rosedale	781476
28	Tararan Melanephelinite	Rosedale	763496
29	Tararan Melanephelinite	Rosedale	816454
30	Maroondan Melanephelinite	Bundaberg	014394
31	Maroondan Melanephelinite	Bundaberg	014394
32	Maroondan Melanephelinite	Bundaberg	014394
33	Maroondan Melanephelinite	Bundaberg	027399
34	Maroondan Melanephelinite	Bundaberg	024397
35	Maroondan Melanephelinite	Bundaberg	024397
36	Maroondan Melanephelinite	Bundaberg	014394
37	Maroondan Melanephelinite	Rosedale	976454
38	Maroondan Melanephelinite	Rosedale	976454
39	Maroondan Melanephelinite	Rosedale	976454
40	Berrembea Basalt	Childers	062195
41	Berrembea Basalt	Childers	063200
42	Berrembea Basalt	Childers	998238
43	Berrembea Basalt	Childers	994337
44	Berrembea Basalt	Childers	028307
45	Hummock Basalt	Bundaberg	463502
46	Hummock Basalt	Bundaberg	463502

+ Grid References have been derived from the following 1:100 000 sheet areas: Bundaberg (9348), Childers (9347), Mount Perry (9247), and Rosedale (9248).

* Samples taken from drill hole Fairymead N.S.1 from the following depths: 9 = 80.5 m; 10 = 88.27 m; 11 = 98.7 m; 12 = 106.4 m; 13 = 108.67 m.

** Samples taken from drill hole CB26 Coonarr Creek from the following depths: 14 = 22 m; 15 = 29.3 m; 16 = 30 m; 17 = 36.3 m; 18 = 38 m.

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A.D. Robertson
Geological Survey of Queensland
P.O. Box 194
Brisbane
Queensland, 4001

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