1983/58. The Parmeener Super-Group at Musselroe Bay : Drilling results and possible Permian volcanic rocks.

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Abstract

A greatly attenuated but complete sequence of the Lower Parmeener Super-Group is present in the Musselroe Bay area of far north-eastern Tasmania.

Drilling has revealed the presence within the Permian succession of intrusive and possible extrusive rocks that belong to the Shoshonite Association. Although chemically similar to the Cretaceous shoshonites that occur in the Cape Portland area, it is possible that the volcanic rocks at Musselroe Bay are Permian in age.

INTRODUCTION

Rocks of the Parmeener Super-Group (Banks, 1973) crop out sporadically between Cape Portland and Gladstone in far north-eastern Tasmania. These rocks rest unconformably on a basement of folded Mathinna Beds sedimentary rocks which have been intruded by Late Devonian granitoids. Although greatly attenuated, a complete sequence of the Lower Parmeener Super-Group underlies paddocks east of The Quakers [EQ884810] and west of Great Musselroe Bay [EQ960820].

Because of the very poor outcrop in this area (mapping was based almost entirely on rock fragments within the soil) a drilling programme was undertaken in 1982 to determine the Parmeener Super-Group stratigraphy. The drilling confirmed the distribution of the rock units as determined by mapping, but also revealed the presence of some enigmatic volcanic rocks that may be Permian in age.

STRATIGRAPHY

Figure 1 is a geological map of The Quakers/Great Musselroe Bay area with the Parmeener Super-Group rocks divided into three units.

Lower Marine Sequence

The base of the sequence is exposed in the vicinity of Mexican Hill [EQ922797] where richly fossiliferous bryozoal siltstone and sandstone overlies Devonian adamellite. The siltstone is thinly bedded and contains abundant stenoporids and fenestellids together with *Eurydesma cordatum* Morris, *Eurydesma hobartensis hobartensis* (Johnston), *Deltopecten illawarensis* (Morris), *Strebloteria* sp., *Stutchburia* sp. and *Trigonotreta stokesi* Koenig. The fauna indicates a Tamarian Zone 2 age (M.J. Clarke, pers. comm.).

The sandstone varies greatly in lithology from coarse pebbly quartz sandstone, well-sorted quartz sandstone, to occasional pebbly siltstone. The pebbles appear to be dropstones and are composed dominantly of quartz and quartzite, although schist, slate and granite also occur. The presence of schist and foliated quartzite implies derivation from a westerly source.

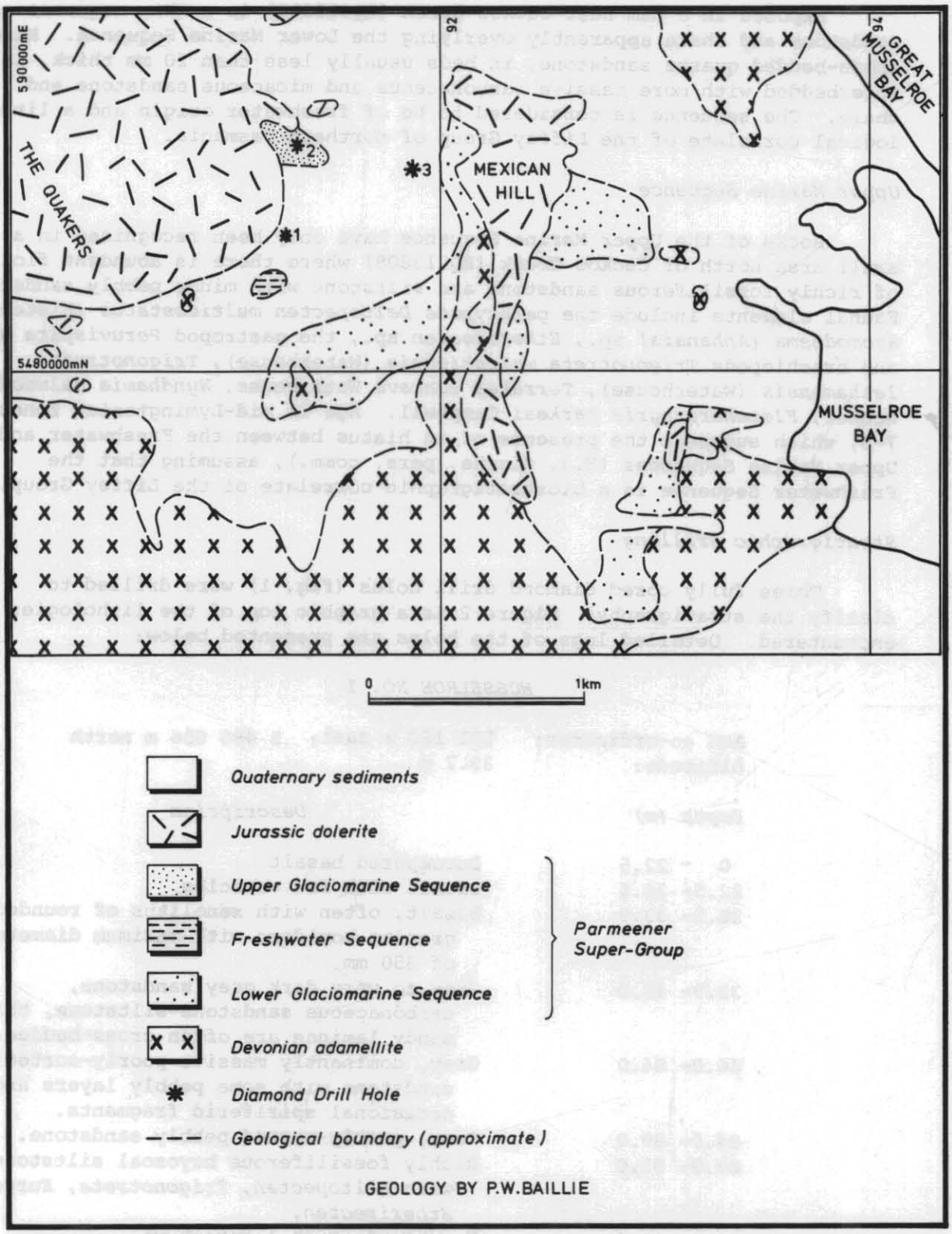

Figure 1. *Geological map of Musselroe Bay/The Quakers area*

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Freshwater Sequence

Exposed in a dam near Cuckoo Creek [EQ912805] is a thin sequence of sandstone and shale apparently overlying the Lower Marine Sequence. Minor cross-bedded quartz sandstone, in beds usually less than 20 mm thick, is interbedded with more massive carbonaceous and micaceous sandstone and shale. The sequence is considered to be of freshwater origin and a lithological correlate of the Liffey Group of northern Tasmania.

Upper Marine Sequence

Rocks of the Upper Marine Sequence have only been recognised in a small area north of Cuckoo Creek [EQ913808] where there is abundant float of richly fossiliferous sandstone and siltstone with minor pebbly sandstone. Faunal elements include the pelecypods *Deltopecten multicostatus* (Fletcher), *Atomodesma (Aphanaia)* sp., *Etheripecten* sp., the gastropod *Peruvispira* sp., and brachiopods *Trigonotreta wairakiensis* (Waterhouse), *Trigonotreta lethamensis* (Waterhouse), *Terrakea concava* Waterhouse, *Wyndhamia dalwoodensis* Booker, *Fletcherithyris parkesi* Campbell. Age is mid-Lymingtonian Zones 7-8, which suggests the presence of an hiatus between the Freshwater and Upper Marine Sequences (M.J. Clarke, pers. comm.), assuming that the Freshwater Sequence is a biostratigraphic correlate of the Liffey Group.

Stratigraphic drilling

Three fully cored diamond drill holes (fig. 1) were drilled to clarify the stratigraphy. Figure 2 is a graphic log of the lithologies encountered. Detailed logs of the holes are presented below:

MUSSELROE NO. 1

AMG co-ordinates: 591 180 m east; 5 480 656 m north
Altitude: 33.7 m

Depth (m)	*Description*
0 - 22.5	Decomposed basalt
22.5- 26.5	Basalt with few vesicles
26.5- 33.9	Basalt, often with xenoliths of rounded granite boulders with maximum diameter of 350 mm.
33.9- 46.0	Grey to very dark grey sandstone, carbonaceous sandstone-siltstone, thin sandy laminae are often cross-bedded.
46.0- 84.0	Grey, dominantly massive poorly-sorted sandstone with some pebbly layers and occasional spiriferid fragments.
84.0- 89.9	Grey, poorly-sorted pebbly sandstone.
89.9- 91.0	Richly fossiliferous bryozoal siltstone with *Deltopecten, Trigonotreta, Eurydesma, Etheripecten*.
91.0- 92.8	Hornblende-rich lamprophyre.
92.8- 96.0	Bryozoal siltstone; last 0.5 m becoming increasingly arkosic and less fossiliferous.
96.0-100.0	Granite.

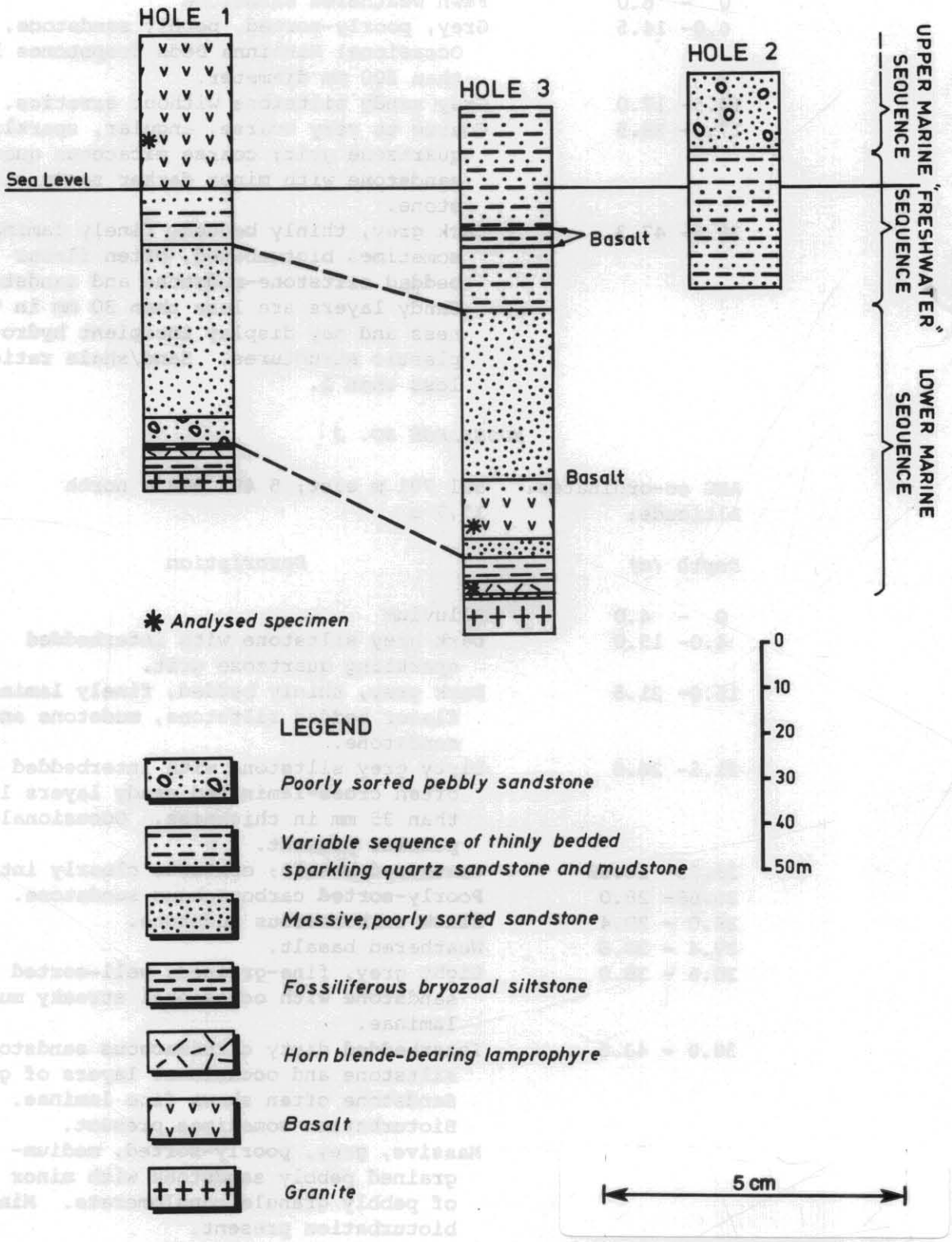

Figure 2. *Graphic logs of stratigraphic drilling*

MUSSELROE NO. 2

AMG co-ordinates: 591 212 m east; 5 481 204 m north
Altitude: 25.7 m

Depth (m)	*Description*
0 - 6.0	Fawn weathered sandstone
6.0- 14.5	Grey, poorly-sorted, pebbly sandstone. Occasional Mathinna Beds dropstones less than 200 mm diameter.
14.5- 17.0	Grey sandy siltstone without erratics.
17.0- 38.5	Coarse to very coarse, angular, sparkling quartzose grit; coarse micaceous quartz sandstone with minor darker sandy siltstone.
38.5- 47.3	Dark grey, thinly bedded, finely laminated, sometimes bioturbated, often flaser bedded siltstone-mudstone and sandstone. Sandy layers are less than 30 mm in thickness and may display incipient hydroplastic structures. Sand/shale ratio less than 1.

MUSSELROE NO. 3

AMG co-ordinates: 591 791 m east; 5 481 098 m north
Altitude: 17.7 m

Depth (m)	*Description*
0 - 4.0	Alluvium
4.0- 15.0	Dark grey siltstone with interbedded sparkling quartzose grit.
15.0- 21.5	Dark grey, thinly bedded, finely laminated, flaser bedded siltstone, mudstone and sandstone.
21.5- 26.6	Dirty grey siltstone with interbedded thin, often cross-laminated sandy layers less than 35 mm in thickness. Occasional pebbles present.
26.65- 26.88	Weathered basalt; contacts clearly intrusive.
26.88- 28.0	Poorly-sorted carbonaceous sandstone.
28.0 - 29.4	Black carbonaceous mudstone.
29.4 - 30.6	Weathered basalt.
30.6 - 38.0	Light grey, fine-grained, well-sorted sandstone with occasional streaky muddy laminae.
38.0 - 43.5	Interbedded dirty carbonaceous sandstone, siltstone and occasional layers of grit. Sandstone often shows fine laminae. Bioturbation sometimes present.
43.5 - 76.5	Massive, grey, poorly-sorted, medium-grained pebbly sandstone with minor pods of pebbly granule conglomerate. Minor bioturbation present.
76.5 - 81.6	Hornfelsed sandstone as above.
81.6 - 81.7	Basalt.
81.7 - 85.6	Hornfelsed sandstone as above.

Musselroe No. 3 (continued)

Depth (m)	*Description*
85.6- 94.5	Basalt; 200 mm granite xenolith present at 94.2 m.
94.5- 97.9	Poorly-sorted, erratic-rich sandstone with few shell fragments.
97.9-104.0	Richly fossiliferous bryozoal siltstone.
104.0-107.2	Hornblende-rich lamprophyre.
107.2-107.7	Arkose.
107.7-115.0	Granite.

The presence of flaser bedding and bioturbation in correlates of the Liffey Group indicates that conditions were at least partially tidal during this time interval in the Musselroe Bay area.

IGNEOUS GEOLOGY

The basaltic rocks encountered in Holes 1 and 3 have no surface expression and their presence was not anticipated prior to drilling. The rocks are invariably altered and it is difficult to obtain fresh specimens. In thin section, a specimen from 23 m (Hole 1) consists of phenocrysts of zoned calcic plagioclase (<1.5 mm) in a felted groundmass, consisting of laths of plagioclase (<0.6 mm), iron oxides and altered glassy material. Electron microprobe analysis (Table 1) shows that the phenocrysts are composed of bytownite (An_{77-86}) while the groundmass plagioclase is labradorite (An_{59-68}).

The presence of vesicles in this rock and the absence of significant thermal metamorphism of the underlying rocks suggests that this rock may be a lava.

Basalt also occurs in Musselroe Hole 3 where all bodies were clearly intrusive and non-vesicular. In thin section, a specimen from 91.8 m consisted of euhedral phenocrysts of augite (<4 mm) in a felted groundmass of augite, labradorite, biotite, iron oxides, and apatite.

Distinct from the basalt, and occurring at 91 m in Musselroe No. 1 and 104 m in Musselroe No. 3, is hornblende-lamprophyre. This rock is similar to the Cretaceous lamprophyres of the Cape Portland area which are always hornblende-phyric and have been radiometrically dated as having an absolute age of 101 Ma (McDougall and Green; Appendix 3 *in* McClenaghan *et al.*, 1982).

Geochemistry

Basalt samples from Holes 1 and 3 and a sample of lamprophyre from Hole 3 were submitted to the Department of Mines Launceston Laboratories for analysis. Results of these analyses and calculated CIPW Norms are shown in Table 2.

The results clearly show that the two basalts are related, and probably derived from the same magma source, but that there are significant differences when the basalts are compared with the lamprophyre. The K_2O/NaO ratio is >1 and indicates that all three samples belong to the Shoshonite Association (Joplin, 1968). There is a close fit between the three samples and the trends noted by Sutherland (1973) in a study of the Upper Mesozoic shoshonites of Tasmania. Comparison of the three samples

with major oxide analyses from Cape Portland (Jennings and Sutherland, 1969) reveals striking similarities. Unfortunately no trace element data is available for the Cape Portland rocks at the present time.

Discussion

The greater degree of alteration of the basalts, the significant differences in trace element geochemistry, and stratigraphic relationships suggest that the basalts are possibly older than the lamprophyre (and so older than the Cape Portland rocks despite the notable similarities in major oxide analyses) and may be Permian in age.

Similar shoshonitic rocks (Gerringong Volcanics) occur on the south coast of New South Wales where intrusive and extrusive latites have given a radiometric age of 238-251 Ma (Facer and Carr, 1979). The N.S.W. lavas belong to the Shoshonite Association and are almost identical in composition to the Mt Dromedary Complex which crops out some 150 km to the south and is of Cretaceous age (Joplin, 1968). A QAPF Diagram comparing the Musselroe Bay samples, Cape Portland rocks, the Permian Gerringong Volcanics of N.S.W., and the Cretaceous Mt Dromedary Complex is shown as Figure 3.

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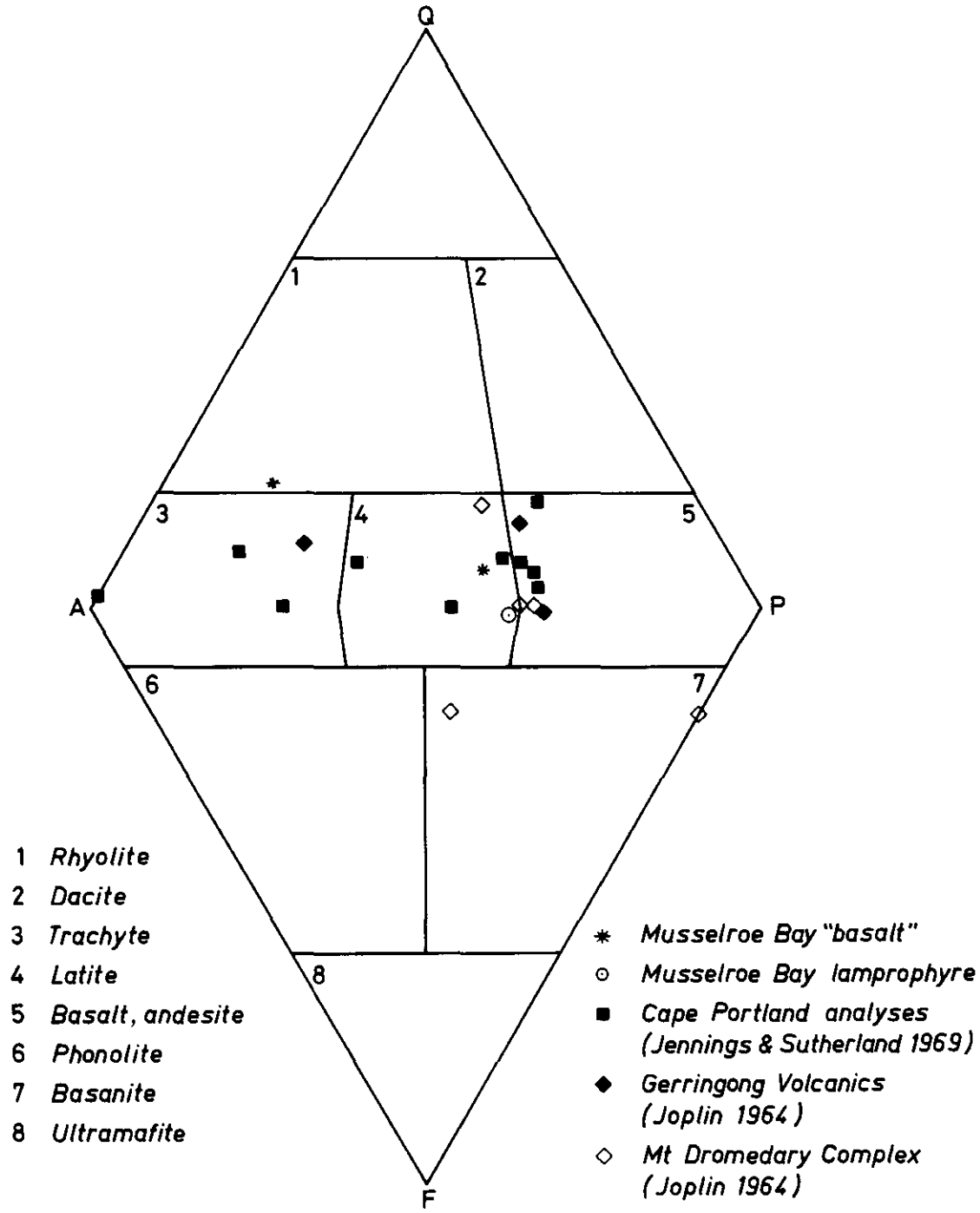

Figure 3. *QAPF diagram of shoshonitic rocks from Musselroe Bay and Cape Portland (Tasmania); Gerringong Volcanics and Mt Dromedary Complex (N.S.W.). Calculated from Rittman Norms.*

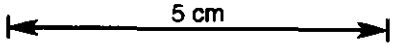

Table 1. ELECTRON MICROPROBE ANALYSES OF PLAGIOCLASE FROM 23 m, MUSSELROE HOLE 1.

	Phenocrysts					Groundmass	
	1	2	3	4	5	6	7
SiO_2	48.07	47.68	49.84	47.90	47.79	52.03	52.54
Al_2O_3	33.48	33.58	32.14	33.18	33.56	30.29	29.48
CaO	16.69	17.13	15.39	16.93	17.08	13.59	12.91
Na_2O	1.74	1.62	2.37	1.71	1.56	3.29	3.45
K_2O			0.25			0.35	0.42
FeO				0.27		0.45	1.20
Structural formulae							
Si	8.793	8.737	9.090	8.784	8.752	9.461	9.572
Al	7.219	7.252	6.909	7.172	7.224	6.493	6.330
Σ	16.012	15.989	15.999	15.956	15.976	15.954	15.902
Ca	3.272	3.362	3.008	3.327	3.352	2.647	2.521
Na	0.617	0.575	0.839	0.609	0.555	1.160	1.219
K			0.059			0.081	0.098
Σ	3.889	3.937	3.886	3.936	3.907	3.889	3.838
Total	19.901	19.926	19.905	19.993	19.903	19.910	19.922
%An	84	85	77	85	86	68	56

Table 2. ANALYSES AND CIPW NORMS, MUSSELROE BAY

Field Name	Basalt	Basalt	Lamprophyre
Field No.	Hole 1/23.5	Hole 3/93.5	Hole 3/106.5
Analysis No.	830787	830788	830789
Oxides			
SiO_2	50.87	48.43	47.85
TiO_2	1.28	1.21	1.14
Al_2O_3	17.19	16.10	12.41
Fe_2O_3	3.21	1.95	3.03
FeO	6.40	7.70	6.87
MnO	0.16	0.24	0.17
MgO	2.97	4.39	7.35
CaO	6.62	4.43	10.85
Na_2O	2.38	1.30	1.83
K_2O	3.08	2.89	2.36
P_2O_5	0.90	0.84	0.46
H_2O+	1.80	5.14	2.50
H_2O-	2.17	3.04	1.88
CO_2	0.30	1.72	1.31
Total	99.15	99.38	100.01
Trace elements (ppm)			
Sr	830	310	500
Rb	110	105	82
Y	30	29	22
Zr	150	150	105
Nb	10	11	6
Ni	<3	<3	55
Ba	910	770	610
Cr	<5	<5	180
V	145	130	280
Sc	15	12	34
Pb	6	6	<4
As	<10	<10	<10
Zn	120	125	89
Cu	11	14	32
Co	15	45	58
CIPW Norms			
Q	6.11	11.14	-
C	0.06	4.79	-
Or	18.20	17.08	13.95
Ab	20.14	11.00	15.48
An	26.96	16.49	18.68
Di	-	-	25.98
Hy	14.23	21.91	8.19
Mt	4.65	2.83	4.39
Il	2.43	2.30	2.16
Hap	2.12	1.98	1.09
Ol	-	-	4.42
Diff. Index	44.48	39.22	29.43
M-value	35	45	58
K_2O/Na_2O	1.29	2.22	1.29