THE SHELL COMPANY OF AUSTRALIA LIMITED
(Incorporated in Victoria)

and

INDUSTRIAL AND MINING INVESTIGATIONS PTY. LIMITED
(Incorporated in the A.C.T.)

EXPLORATION LICENCE E.L. 5/61 (AREA 2)
TASMANIA

GEOLOGY AND COAL RESOURCE OF MOUNT PETER AND MOUNT PAUL, FREYCINET PENINSULA, TASMANIA

By

R.M.D. FORD

CEPR 25/82

OCTOBER, 1982

TCD:RP1:D:1

CONTENTS

CONTENTS (Cont'd)

SUMMARY

The Mt Peter and Mt Paul prospect occupies 45 km² on the eastern coast of Tasmania to the north of the Freycinet Peninsula. It comprises a separate block (Area 2) of E.L. 5/61 which is held jointly by The Shell Company of Australia Ltd. (60%) and Industrial and Mining Investigations Pty. Ltd. (40%).

The area contains Upper Triassic coal measures which are confined to a narrow north-south trending graben bounded by normal faults. A seam 2.97m thick has been excavated at the south end of the graben, on the south side of Mt Paul. A small adit was driven north, from the outcrop 140m down dip on a grade of 1:15 (4°) during the early 1920s. Analyses carried out in this period suggest that the insitu coal is a high volatile bituminous type with high ash content. The southern extent of the seam is limited by subcrop whilst the northern limit of the seam and coal measures is unknown.

There are three possible structural interpretations of the coal measures:

Interpretation 1 - Assumes that the coal measures have a constant dip of 4° to the north. It implies that the coal seam may extend to the south end of Mt Peter, embracing an area of up to 4 km².

Interpretation 2 - Assumes that the coal measures have a constant dip (4°) and the base of coal measures subcrops on the north side of Mt Peter at an elevation 40m a.s.l. The assumptions are reconciled by postulating an east-west striking fault. The size of coal deposit would depend on the position of the fault.

Interpretation 3 - Assumes that the 4° dip is a local feature and the base of the coal measures subcrops on the north side of Mt Peter at an elevation of 40m a.s.l. as in 2. The coal measures occupy a broad syncline and the coal seams are confined to a small area of Mt Paul.

Preliminary reserve calculations indicate that the area is prospective and under interpretations 1 and 2 may contain a small deposit of coal, of up to 18 million tonnes.

1. INTRODUCTION

1.1 Scope

The purpose of this report is to review the geological evidence and to examine the possibility that a significant coal deposit may exist in a subsidiary block (Area 2) of Exploration Licence (E.L.) 5/61, eastern Tasmania.

This report is based largely on work by Hills et. al. (1922) and Leclercq (1976), and supplemented by field mapping undertaken by students employed by the Shell Company of Australia during the 1981 and 1982 exploration programme (Hill and Woodmansee, (1982)).

1.2 Location, Tenure, Access and Local Communities

The licence area occupies 45 km^2 adjoining the northern end of Freycinet Peninsula between Moulting Lagoon and the Tasman Sea (Fig. 1). The licence is held jointly by The Shell Company of Australia Ltd. (SCOA)-(60%) and Industrial and Mining Investigations Pty. Ltd. (I.M.I.)-(40%).

Bicheno, the nearest town, is situated 22 km to the north and has a limited range of community facilities; Post Office, motels and shops and a school. An unsealed road passes down the west side of Freycinet Peninsula and connects a small fishing and tourist settlement at Coles Bay with the coastal Tasman Highway. Unsealed tracks provide access to the north, east and central parts of the prospect.

The cental and eastern portions of the prospect are covered by freehold title. The remaining area comprises uncommitted or leased Crown Land and Crown Reserve administered by the Lands Department (Fig. 2).

1.3 Topography, Climate and Vegetation

The local topography consists of two prominent hills - Mt Peter (280m a.s.l.) and Mt Paul (270m a.s.l.) bordered by a flat coastal plain. A wide low lying saddle separates the hills and the area is drained by a number of small ephemeral streams (Fig. 2).

The climate is mild and temperate; the mean annual temperature ranges from a maximum 21°C in January to a minimum 6°C, in June. The east coast region receives 15 hours of daylight in summer which decreases to 9 hours in winter. Total annual average rainfall is 700mm with highest falls during the autumn and winter months (MacKinnon et. al. 1980).

The hillsides are covered in a dry sclerophyll forest with patches of dense scrub in sheltered gullies. Low heath communities cover the plain.

1.4 Previous Investigations

The first geological description of the area is contained in the report 'Coal Resources of Tasmania' by Hills et. al.. The authors visited a small adit operating on the southern slopes of Mt Paul, collected a channel sample, and recorded a detailed seam section. They recognized that coal measures were confined to a north-south trending graben overlain by remnants of a formerly extensive dolerite sheet, and calculated a reserve of about 5 million tonnes. A revised interpretation of the area by D.J. Jennings (Department of Mines), was incorporated into the 1:250,000 geological map - Oatlands (Forsyth and Gulline, 1979). On this map, the coal measures are shown occupying a smaller area in a fault angle depression; the fault defining the western limit of the coal measures which was mapped by Hills was replaced by unconformable contact on granite.

Leclercq, as part of a detailed sedimentological and biostratigraphic study of the Permian sediments, mapped the area at a scale of 1:20,000. With the use of good biostratigraphic and lithostratigraphic control he was able to show that the coal measures were confined to a narrow graben, and that the faulting in the region was more complex than had previously been thought. An early appraisal of the area for SCOA by Brunton (1978) does not include Leclercq's work and is essentially a summary of Hills.

The Department of Mines drilled two boreholes on the eastern side of Mt Peter, to investigate a deposit of Permian limestone (Jennings, (1979)).

The area was included in a regional gravity survey of the east coast coal fields (Leaman and Richardson, 1981). No significant Residual Bouguer anomalies were observed over the coal measures, but the local effects may have been masked by a strong gradient between the granite at Freycinet Peninsula and a large negative anomaly at Moulting Lagoon.

Two students employed by SCOA mapped Mt Paul and Mt Peter during the 1981-82 exploration programme. The results of their mapping is similar to Leclercq (1976) but differs in some details over the distribution of the coal measures and dolerite scree, and the position of faults. Hill and Woodmansee did not trace out individual beds nor did they rely on numerous paleontological control points. However their interpretation of the distribution of talus and the dolerite sill is considered to be more accurate than that of Leclercq's.

For the purposes of this report, mapping by Leclercq was used but modified to agree with the changes in stratigraphic nomenclature proposed by Forsyth et. al. (1973), and incorporates the mapping of talus and dolerite distribution by Hill and Woodmansee.

2. GEOLOGY OF MOUNT PETER AND MOUNT PAUL

2.1 Regional Setting

Over the eastern side of Tasmania, there is a widespread flat-lying sequence of sediments which were deposited in the shallow Tasmania Basin from the Late Carboniferous to the Late Triassic, which is collectively called the Parmeener Supergroup (Hale, (1962) - Clarke and Banks, 1975)-(Fig. 1)). The unit has been formally subdivided into two broad lithofacies; a lower division comprised predominantly of glaciomarine sediments, and an upper division comprised of fluviatile sediments which include the coal measures. The Parmeener Super Group rests unconformably on an uneven basement consisting of steeply dipping Middle Paleozoic quartzites, sandstones and mudstones and Late Devonian granitic rocks (Leaman and Richardson, (1981)). In the Middle Jurassic, tholeiitic dolerite was intruded as slightly discordant sheets into the youngest sediments of the Tasmania Basin.

Tensional faulting along a north-south trend accompanied the intrusives and reoccurred during the Late Cretaceous and Early Tertiary (Forsyth and Gulline, (1979)). Subsequent erosion has exhumed the dolerite sheet and it now forms an undulating plateau obscuring the underlying sediments.

During the Quaternary periglacial activity has produced extensive deposits of talus below the dolerite escarpments.

2.2 Stratigraphy

2.2.1 Granites and Permian Sediments

The oldest rocks are sub-porphyritic red adamellites, of probable Late Devonian age, which are found in the west and south-east portions of the licence area. Unconformably resting on the adamellite are fluviatile and glacio-marine Permian sediments which belong to the lower division of the Parmeener Super Group. They occupy mostly the eastern half of the licence area but small outliers occur on the adamellite, west of the coal measures.

The lower division sediments consist of sandstones, siltstones, limestones and conglomerate which Leclercq was able to subdivide into 17 units. The maximum thickness of the lower division cannot be accurately determined as faulting has caused repetition of the sequence. However a Department of Mines drillhole, situated about 60m below the top of the unit, intersected 228m of Permian sediments (Enclosure 1).

2.2.2 Coal Measures

The Upper Triassic coal measures consist of massive sandstones often crossbedded, coal and minor conglomerate (Hills, Hill and Woodmansee). All previous workers (e.g. Leclercq) have been unable to subdivide the coal measures into individual units presumably because of poor exposure and rapid lateral variation within the sediments. Detailed mapping by Bacon (1979) in the Llandaff region suggests that four types of sandstones may be encountered in the prospect area;

- coarse grained, poorly sorted quartz arenites;
- fine grained, well sorted quartz arenites;
- quartz rich lithic arenites comprised of quartz (30-50%) and rock fragments (quartz, mudstone, siltstone, coal, metamorphic and tuffs).
- lithic arenites (rock fragments 60-80% and quartz 30%) interbedded with siltstone, coal, rare conglomerate beds and tuffs.

The minimum thickness of the coal measures at the southern end of Mt Paul was estimated using graphical techniques and assuming a 4° dip to the north.

TABLE 1

Thickness of Coal Measures

Southern end of Mt. Paul	SCOA GY8 (Llandaff)	Dept. of Mines 986/620 (Apsley River)
220m	214.5m	291m

Table 1 shows that the sequence at Mt Paul is of comparable thickness to measured sections from drillholes in the southern part of E.L. 5/61 (Area 1) and suggests that the estimate is broadly correct.

2.2.3 Dolerite

Two remnants of the Mid Jurassic dolerite sheet cap Mt Peter and Mt Paul. Hills suggested that the dolerite was the remains of a sill. However, Leclercq mapped the dolerite at Mt Peter as a strongly discordant intrusion which was complicated by faulting. More recent work by Hill and Woodmansee indicates that Leclercq had confused the lower contact of the intrusive dolerite with the dolerite talus, and in Enclosure 1 the dolerite is shown as a small outlier about 80m thick.

2.2.4 Talus and Unconsolidated Sediments

The upper slopes of both Mt Peter and Mt Paul are covered by talus comprising dolerite fragments which is probably set in a clay matrix. The distribution of the talus is uncertain but mapping by Leclercq and by Hill and Woodmansee show that in some parts, e.g. Coles Bay road, it nearly reaches sea level.

Recent beach and estuarine sediments are confined to the coastal plain and Moulting Lagoon.

2.3 Structure

The broad structure of the licence area consists of a central graben containing the coal measures bounded to the west by adamellite with small outliers of lower division sediments, and to the east by lower division sediments containing small outliers of coal measures (Enclosure 1).

Regional dip varies between 4°and 5° to the north which is in the opposite sense to coal measures elsewhere in the east coast region (Forsyth and Gulline (1979)). In the Mt Paul adit the coal seam had an average grade 1 in 15 over a distance of 140m. Locally steep dips can occur and these are believed to be caused by drag folding adjacent to faults.

Faulting in the region is complex but generally occurs along a north-south trend. In the eastern half, the lower division sediments and adamellite are disrupted by a series of steeply dipping normal faults downthrown to the east, and block faulting. The displacement of units in the two Department of Mines drillholes show that one fault has a throw of about 45m.

Most of the coal measures are contained within the graben. The western boundary is defined by a curved fault whose southern extent is obscured by Recent sediments. The east side is bounded by an en echelon fault system which was not traced north of Mt Peter.

The northern extent of the graben is obscured by Recent sediments whilst the southern limit lies outside the licence area. The rest of the coal measures under Mt Peter are limited by subcrop and faulting. Because there are no marker horizons it was not possible to estimate the amount of throw on the boundary faults.

The detailed structure of the coal measures within the graben may be interpreted in several ways, depending on the assumptions made about the regional dip, and the elevation of the base of the coal measures at the north end of the graben. Three possible interpretations are shown in Enclosure 2.

Interpretation 1 is the simplest case. It assumes that the 4° dip measured at the Mt Paul adit is constant within the graben, and that the eastern boundary fault extends north of Mt Peter. This interpretation implies that the area north of Mt Paul may contain an accessible coal deposit.

Interpretation 2 is a combination of versions 1 and 3. It assumes that the coal measures have a constant dip of 4° and that the base of coal measures on the north side of Mt Peter is situated at an elevation of 40m a.s.l. To reconcile these two assumptions, an east-west striking fault is postulated, located in the saddle and downthrown about 300m to the south. The distribution of the coal reserves would be similar to Interpretation 1 but the size of the deposit would depend on the position of the fault. The occurence of steeper dips indicates the possibility of further faulting.

Interpretation 3 is similar to the version proposed by Hills. The base of the coal measures at the north end of the graben is assumed to be continuous with the mapped contact, (i.e. situated at an elevation of 40m a.s.l.) and the measured dip at Mt Paul reflects local steepening of the coal measures. In this version it can be seen that the coal measures occupy a broad asymmetric syncline. The coal seam consists of a small area under Mt Paul about 1 km^2 and a remnant of much small size under Mt Peter.

3. COAL RESOURCE

Within the licence area coal outcrops are rare. Hills recorded "one poor outcrop" from Mt Peter, and two outcrops on Mt Paul at elevations of 143 and 183m. Their detailed seam section and channel samples were taken from the Mt Paul adit. During recent mapping by Hill and Woodmansee (1982) no coal outcrops were found. The adit was visited but as the entrance had collapsed no samples were collected or lithotype descriptions recorded.

The detailed seam section is shown in Fig. 3 and the original description and analyses are contained in the Appendix. The coal seam is 2.93m thick. Most of the coal was described as undifferentiated; one 0.27m band described as bright coal occurs near the top of the seam and another, 0.14m thick is found 1.0m from the top. Three thin carbonaceous mudstone beds are found in the upper part of the seam and a mudstone band, 0.15 metres thick occurs about 1.0 metres above the base. The seam possesses a sandstone roof and mudstone floor.

Unfortunately, few conclusions can be drawn from the two analyses of the raw coal recorded by Hills. Both channel samples were selectively mined and intended to represent a typical mined product of that period. The sampling was based on subjective opinion of what constitutes a working face; all ash bands greater than 6mm thick were removed and it is not clear whether carbonaceous mudstone bands were analysed or whether any record was kept of the weight and nature of the reject. Two proximate analyses representing, presumably the same section, show considerable differences in their raw ash (± 7%) and the volatile matter (± 5%). The results suggest that the insitu coal is a high ash and high volatile bituminous coal.

The analysis of the geological structure suggests that the area may contain a small but accessible coal deposit. Conservative reserve estimates based on Interpretations 1 and 3 are presented in Table 2, and they are intended to indicate the possible upper and lower limits to the deposit. Interpretation 2 is essentially similar to 1 but the size of the reserve will depend on the position of the east-west fault.

For the purposes of the calculation the following assumptions were used:

- Interpretation 1 : area of coal was defined by the graben faults, the base of the dolerite talus on the south side of Mt Peter, and the subcrop of the seam dipping at 4° on the south side of Mt Paul.

- Interpretation 3 : assumes that the coal seam occurs under Mt Paul and dips to the north, at 1°-2°.

- Relative Density (R.D.) : A value of 1.55 was used which corresponds to a raw ash of approximately 30% (Wollff et. al. 1981 Fig.12)

- Seam Thickness - 2.90m.

The area of coal was measured on a 1:20,000 map (Enclosure 1) with a CALCOMP 660 Digitizer.

TABLE 2

Insitu Coal Reserves - Mt Peter and Mt Paul

	Interpretation 1	Interpretation 3
Area of coal (ha)	400	130
Seam thickness (m)	2.9	2.9
Volume of coal m^3 ($\times 10^6$)	11.6	3.8
R.D.	1.55	1.55
Tonnes ($\times 10^6$)	18.0	5.8
or say	18×10^6 tonnes	6×10^6 tonnes

In view of the uncertainties in the geological information the estimated reserves in Table 2 should not be classified.

4. REFERENCES

BACON, C.A. 1979
Regional Geology of the Apsley River area, north-east Tasmania. Part A of an unpublished B.Sc. Honours thesis, University of Tasmania: Hobart.

BRUNTON, J.S. 1978
Mt. Paul Area in A Preliminary review of the Geology and Coal Resources of Exploration Licences 5/61 Gray and 18/77 Avoca. Unpublished S.C.O.A. report CEPR 16/78: Melbourne.

CLARKE, M.J.; BANKS, M.R. 1975
The stratigraphy of the (Permo-Carboniferous) parts of the Parmeener Super-Group, Tasmania in Campbell, K.S.W. (ed.). Gondwana geology: 454-467. A.N.U. Press: Canberra

FORSYTH, S.M. et. al. 1974
Status and Subdivision of the Parmeener Super-Group. Paper and Proceedings of Royal Society of Tasmania 108: 107-109.

FORSYTH, S.M.: GULLINE, A.B. 1979
Oatlands, explanatory report. 1:250,000 Geological Atlas Series Sheet SK 5/6. Dept. of Mines: Hobart

HALE, G.E., 1962
Triassic System in Spry. A; Banks M.R. (eds). Geology of Tasmania. Journal of the Geological Society of Australia 9(2):

HILLS, L. et. al. 1922
Coal Resources of Tasmania. Geological Survey of Tasmania, Mineral Resources No.7

HILL, S.R.; WOODMANSEE, M.B. 1982
The Geology and Coal Resources of the Mt. Paul area. Unpublished report to SCOA 9pP.

4. REFERENCES (Cont'd)

JENNINGS, D.J. 1979

Limestone at Saltwater Lagoon: Friendly beaches Coles Bay Peninsula.
Unpublished Technical Reports No. 13: 11-19 Department of Mines Hobart.

LEAMAN, D.E.: RICHARDSON, R.G., 1981

Gravity Survey of the East Coast Coalfields. Geological Survey Bulletin 60, 77pp. Dept. of Mines: Tasmania.

LECLERCQ, F., 1976

The Permian: Friendly Beaches, eastern Tasmania, Australia. Unpublished Ph.d thesis. 2 volumes. University of Lille: France.

MacKINNON, K. et. al. 1980

Northern: Region 3, Climatic Survey, Tasmania 64pp. Bureau of Meteorology, Dept. of Science and the Environment: Canberra.

WOLLFF, I.M. et. al, 1981

An assessment of the Mount Nicholas Coal Deposit. Volume 1.
Unpublished SCOA report CEPR 11/81.

APPENDIX - Detailed Seam Section and Analyses, Mt Paul Adit

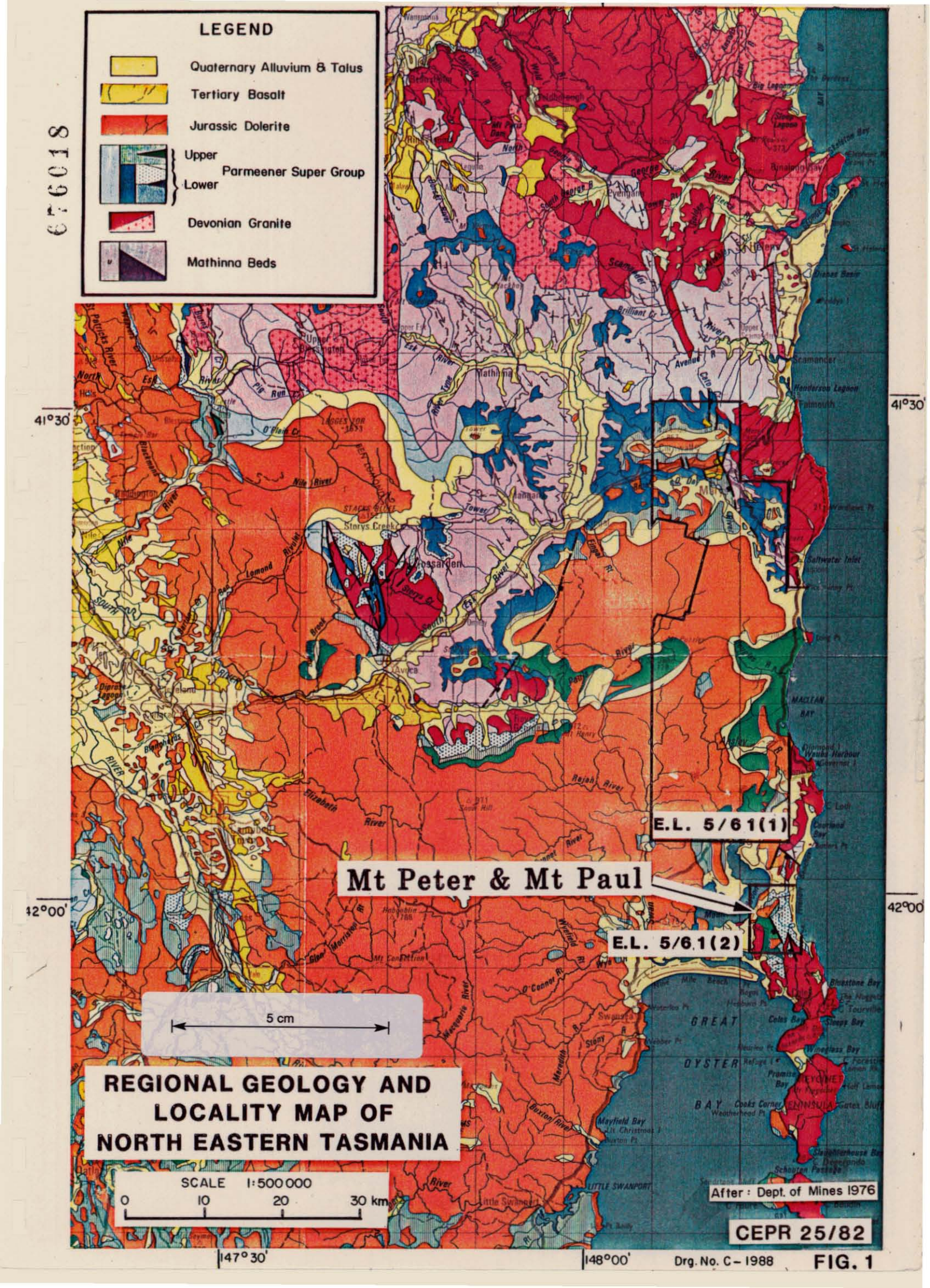
SANDSTONE ROOF

15.24 cm	Stony Coal
6.35	Bright Coal
1.27	Blackstone Band
20.32	Bright Coal
10.16	Dull Coal
1.27	Blackstone Band
0.64	Coal
1.27	Blackstone Band
25.4	Coal, with One Penny Band
0.64	Blackstone Band
16.51	Coal, with One Penny Band
13.97	Bright Coal
0.64	Band
50.80	Poor Coal
1.27	Band
31.12	Coal
15.24	Shale Band
81.28	Coal
292.74 cm	

SHALE FLOOR.

	PROXIMATE			ULTIMATE					HEAT VALUES			
Moisture at 105 C %	Volatile Matter %	Fixed carbon %	Ash %	Sulphur %	Hydrogen %	Carbon %	Oxygen %	Nitrogen %	Calories/lb	British Thermal Units/lb	Evaporative Power	Specific Gravity
1.58	15.32	49.32	33.78	0.37	-	-	-	-	-	-	-	-
1.00	20.80	51.74	26.46	0.44	4.06	56.51	11.60	0.93	5535	9963	10.30	1.36

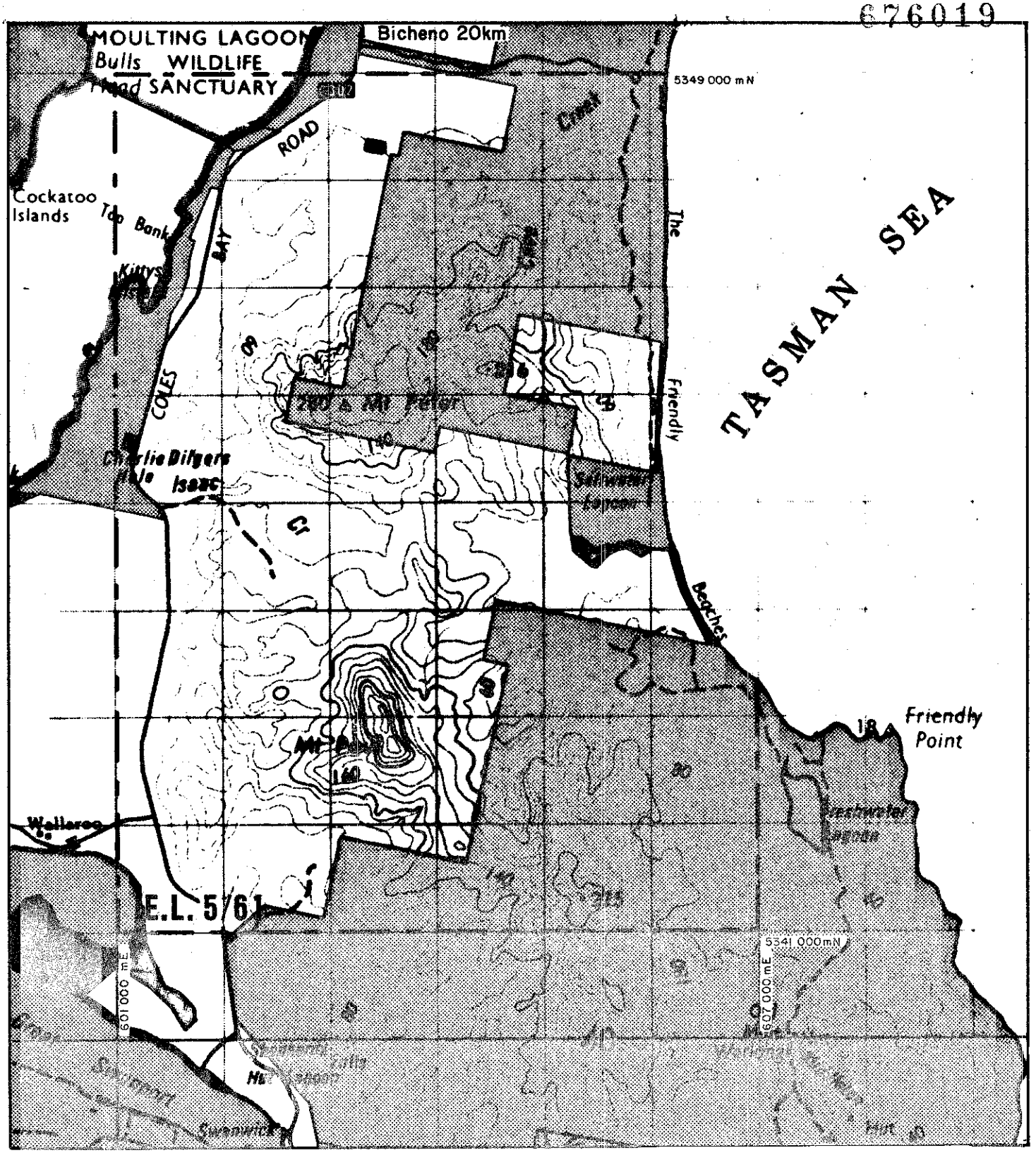
SOURCE: Hills et. al. 1922


LEGEND
Quaternary Alluvium & Talus
Tertiary Basalt
Jurassic Dolerite
Upper
Parmeener Super Group
Lower
Devonian Granite
Mathinna Beds
E.L. 5/61(1)
Mt Peter & Mt Paul
E.L. 5/61(2)
5 cm
REGIONAL GEOLOGY AND LOCALITY MAP OF NORTH EASTERN TASMANIA
SCALE 1:500000
0 10 20 30 km
After : Dept. of Mines 1976
CEPR 25/82
41°30'
42°00'
147°30'
148°00'
Drg. No. C-1988
FIG. 1

TASMANIA - GRAY E.L. 5/61
MT PETER and MT PAUL AREA

TOPOGRAPHY and LAND TENURE

676019



LEGEND

- Private Freehold Land
- Crown Reserve
- Leased or Uncommitted Crown Land
- Adit

5 cm

SCALE 1:50 000

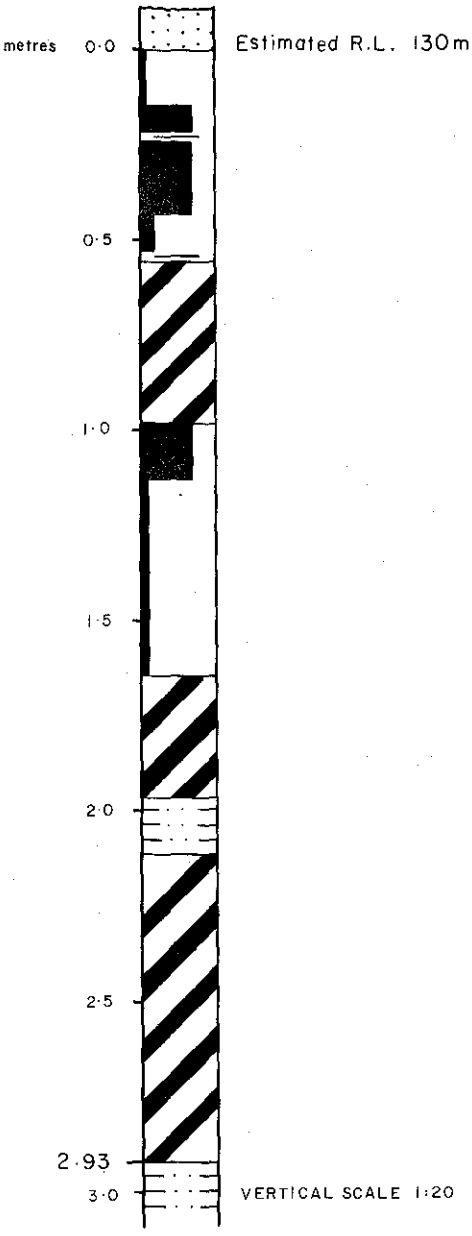
0 1 2 3 km.

Author: R. Ford	Date: October 1982	Fig. 2
Report No: CEPR 25/82	Drawing No: 2674	

TASMANIA - GRAY E.L. 5/61
MT PETER and MT PAUL AREA

676020

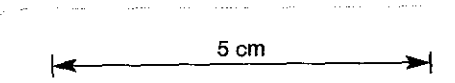
DETAILED SEAM SECTION - MT. PAUL ADIT



LEGEND

- *Sandstone*
- *Mudstone*
- *Carbonaceous Mudstone*
- *Bright Coal*
- *Dull Coal*
- *Heavy Coal*
- *Coal – Undifferentiated*

(SOURCE : Hills et. al. 1922)



Author R. Ford		Date October 1982	Fig. 3
Report No. CEPR 25/82		Drawing No. 2665	

THE FRIENDLY BEACHES

STRATIGRAPHY

GROUP	SYSTEM	
Recent	QUATERNARY	UNDIFFERENTIATED
		DUNES, BEACH SANDS, ALLUVIUM
		TALUS
	JURASSIC	DOLERITE
Upper Division	UPPER TRIASSIC	SANDSTONE, COAL
Lower Division / Parameener Supergroup	PERMIAN	SILTSTONE
		CHERTIFIED UNIT
		GLAUCONITIC SANDSTONE
		PETER LIMESTONE
		BRYOZOAN SILTSTONE
		WORM-CAST SANDSTONE
		CROSS-BEDDED SANDSTONE & MICROCONGLOMERATE
		PACHYDERMAL SANDSTONE
		PLANT - BEARING SILTSTONE
		IRON-RICH SANDSTONE
		MEGADESMUS NOBILISSIMUS SANDSTONE
		FOSSILIFEROUS SILTSTONE
		ISAACS CONGLOMERATE
		ARKOSIC SANDSTONE
		CROSS-LAMINATED SANDSTONE
		WASPS NEST-LIKE SANDSTONE
		ARKOSEC
	EARLY ORDOVICIAN to EARLY DEVONIAN	MATHINNA BEDS (SILURO-DEVONIAN)
	LATE DEVONIAN	GRANITE DEVONIAN

Moulting Lagoon

ISAACS POINT

BULLS HEAD SANCTUARY

ROAD

BAY

TOP BANK

KITTYS MISTAKE

Mt Peter

Mt Paul

SALT WATER LAGOON

FRESHWATER LAGOON

FRIENDLY POINT

The Boot

A — A'

E.L. 5/61 (2)

5349000mE

6102000mE

5342000mN

6109000mE

N

Ng Nm 11° DECLINATION MAGNETIC

Km 0 1

Contour interval = 20metres

- Geological contact - observed
- Geological contact - approx. position
- Fault Post-Jurassic observed
- Fault Post-Jurassic - approx. position
- Fossil locality
- Dept. of Mines Drillhole
- Downthrown side
- Dip (from Hill and Woodmansee 1982)
- Adit
- Road
- Sealed Road
- Track
- Stream
- Marsh
- Boundary of E.L.5/61

Launceston, Hobart

LEVE ET DESSINE EN 1975 PAR F.LECLERCQ

82-1869

076021

5 cm

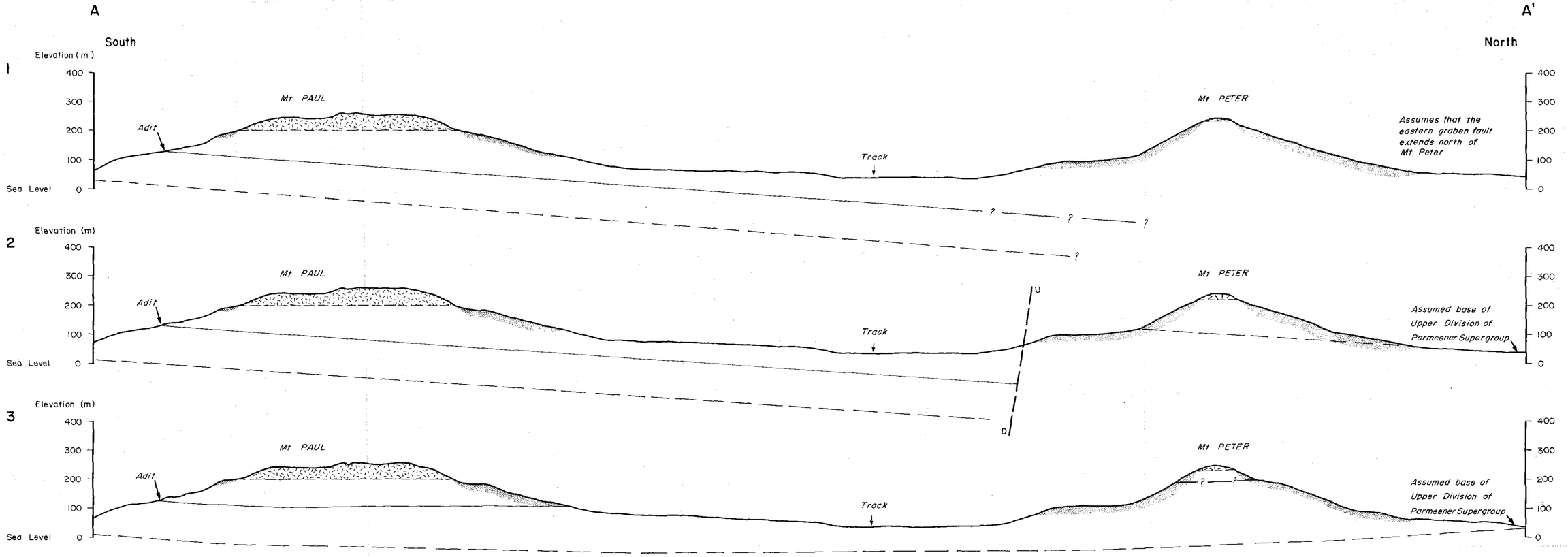
THE SHELL COMPANY OF AUSTRALIA LTD.

TASMANIA - GRAY E.L. 5/61
MT PETER / MT PAUL AREA

GEOLOGICAL MAP

Modified from F.Leclercq 1976
Scale 1:20 000

Author: R. Ford	Date: Oct. 1982	Encl. 1
Report No: CEPR 25/82	Drawing No: 2675	



LEGEND

- Dolerite
- Coal Seam
- Estimated Base of Coal Measures
- Talus (thickness exaggerated)

See Encl. 1 for location of section

676022

82-1869

THE SHELL COMPANY OF AUSTRALIA LTD.

TASMANIA - GRAY E.L. 5/61

MT PETER / MT PAUL AREA

ALTERNATIVE INTERPRETATIONS OF THE STRUCTURE OF THE COAL MEASURES

No Vertical Exaggeration

Scale 1 : 10000

Author : R. Ford	Date : Oct. 1982	Encl. 2
Report No: CEPR 25/82	Drawing No: 2666	