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Takone Project

**First Annual Report for EL73/2007
for the Period 16 June 2008 to 15 June 2009**

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GEOLOGY**

SUMMARY OF ACTIVITIES FOR THE Takone PROJECT
for the Period 16 June 2008 to 15 June 2009

- Compile previous work
- Interpret remote airborne geophysical and other digital datasets
- Assess prospectivity

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KEYWORDS

Geology/Mineralisation:

Permian Lower and Upper Parmeener Supergroup, coal, oil shale, tasmanites

Minerals/ Commodities:

Coal; Oil Shale; Tasmanites

Deposits/Occurrences:

Preolenna Coalfield

Oonah oil shale

Exploration:

Data review, prospectivity

COORDINATES

All lat/long co-ordinates in this report refer to the AGD66 Datum

All AMG co-ordinates in this report refer to the AGD66 Datum - Zone55

1.0 Introduction/ Abstract

This report covers the exploration activities conducted by Geotech International Pty Ltd within EL73/2007 at Takone (The 'Tenement'), for the period 16 June 2008 to 15 June 2009.

The Tenement includes areas with known coal and oil shale deposits, which were Geotech's exploration targets.

During the period all available previous work was evaluated and the prospectivity was appraised.

The area is very accessible with many roads and tracks, and is close to the port of Burnie. Potential resources lie in non-sterilised working forest areas.

The black coal potential of the Preolenna area is limited because of the faulted narrow dipping seams, but very high oil yields are reported from the contained cannel coal/oil shale horizons, so further investigation is recommended.

The Oonah oil shale area is poorly investigated but is large and holds potential for open pittable specialized tasmanite deposits, so further work is recommended.

Exploration Philosophy and Objectives:

The vision is to find and develop oil shale deposits by using the best available techniques.

The philosophy is to favour oil shale deposits amenable to rapid evaluation.

The primary exploration aim for the area is to locate near-surface open-pittable oil shale resources.

There are known deposits present, previously thought uneconomic to develop. The recent increases of oil price and new technologies are favourable factors which may reverse that situation.

A secondary aim is to locate open-pittable coal resources.

2.0 Tenement Details

Tenement details are shown in Table 1.

Table 1 – Takone Project Tenement Details

Tenement	Holder	Date Applied	Date Granted	Area	Two Year Expenditure Commitment
EL73/2009	Geotech International Pty Ltd	Mar 2008	16 June 2008	202km ²	\$61 000

3.0 Location and Access

The Tenement surrounds the locality of Takone in NW Tasmania, as shown on Fig 1.

The area is very accessible with many roads and tracks, and is about 25km from the port of Burnie. Potential resources lie in non-sterilised working forest areas.

4.0 Geology and Coal/Oil Shales

Coal seams and an oil shale unit have been found here in two stratigraphic intervals within the Permian parts of the Lower and Upper Divisions of the Parmeener Supergroup within the Tasmania Basin. The Parmeener Supergroup is up to two kilometres thick, and has been subdivided into two divisions; the Lower Division, being predominantly marine; and the Upper Division, being wholly of freshwater origin.

The oil shale unit occurs towards the base of the Lower Parmeener Supergroup above tillites in a restricted marine environment.

The Preolenna Coal Measures occur at the base of the Upper Parmeener Supergroup, as shown on the stratigraphic column on Fig 3.

The two main areas of the tenement containing coal and oil shale are shown on Fig 2. These are at Preolenna and at Oonah.

Oil Shale at Oonah

The oil shale, near the base of the Lower Parmeener Supergroup, is the variety Tasmanite, which occurs in only a few places world-wide. The kerogen of tasmanite occurs as particulate amber-colored discs (in reality, flattened sacs), having a distinct structure and clearly defined cell walls. The oil shale is thought to have formed in a quiet ecosystem of shallow bays, inlets and river estuaries in which the alga was free to multiply. The kerogen resulted from prodigious algae blooms when conditions were favourable for completion of the life cycle and "spore" build-up in the marginal marine waters.

The target stratigraphy is shown on Fig 4. The unit is flat lying and is a window in a larger area of Tertiary basalt, with an intrusive Jurassic dolerite sill to the north.

Oil shale at Preolenna

Here, at a higher stratigraphic level than at Oonah, there are bands of 'cannel coal' or torbanite within the thin seams of black coal. These are stated to have been caused by concentrations of the alga *Reinschia*. These bands are very rich in volatiles, and have been called 'oil shale' by some authors.

The bands are lenticular and from 23 to 60cm thick. Very high oil yields are reported by Rogers (1934):- he reports 130 gallons per ton, which is 590litres/t!

Coal at Preolenna

Bacon (1991) has reviewed this coalfield, correlated with the Mersey Coal Measures further east. The seams are thin, from 220-600 mm thick, discontinuous, dislocated by faulting, and dip steeply at 14-25°. Four seams of coal crop out on the north-western bank of the Jessie Gorge near Preolenna, and also crop out in the Flowerdale River valley south of Preolenna over a distance of three kilometers. Mining activity has taken place in both the Jessie Gorge (Preolenna Coal Mine) and in the Flowerdale River valley (Torbanhill or Meunna Coal Mine). Coal outcrops are also recorded from near Relapse Creek, south-west of Preolenna, and west of West Takone.

Oil shale occurrence on Cam River

MRT maps show an oil shale occurrence on the Cam River near Tewkesbury in the east portion of the tenement. No information on this could be located.

5.0 Previous Exploration

A summary of previous exploration activities, for oil shale and coal only, is presented in Table 2.

Table 2 – Takone Project Previous Exploration Summary

Year/Company	REPORT No	Activities
Pre 1990 Tas Geol Survey	Bacon, 1991	Summary of all past work for Preolenna coals
1923 Tas Geol Survey	URMISCA_011-13	Discovery of Oonah oil shale by Reid in 1923 recorded in Mercury Newspaper. "Reserves" of 6M tons are quoted.
1924 Tas Geol Survey	UR1924_242-243	Quotes reserves of Tasmanite at Oonah
1928 Tas Geol Survey	UR1928B_081-86	Quotes reserves of Tasmanite at Oonah
1944 Tas Geol Survey	UR1944_043-45	Sampling and oil analyses
1980-1982 Petroquest Pty Ltd	80-1429 80-1449 82-1788	Geological review Drilling Down-hole geophysical logging
1984 CRA	84-2169 84-2172 84-2173	Geological appraisal

The work done in the Preolenna area is amply summarized by Bacon (1991), the relevant extract of which is reproduced in Appendix 1.

She concludes that "Because of the thin, lenticular nature of the seams, which dip steeply at 14-25°, and are dislocated by faulting, the potential of this coalfield for further exploration is limited. The inferred in-situ reserves of black coal are very small."

The Oonah oil shale was discovered by Reid in 1923 as recorded in the Mercury Newspaper. The report is reproduced in Appendix 2. The "reserves" were quoted as 6 million tons. This reserve was repeated by Reid in 1924, here reproduced in Appendix 2, and also repeated by Blake in 1928, here reproduced as Appendix 3. No basis for the reserve calculation was stated.

In 1944 Henderson conducted field sampling of the outcropping oil shale. His report is reproduced in Appendix 4. Oil yields up to 95litres/t were reported from outcrop but follow-up work, poorly documented by a so-called extension officer, reported narrow widths of the seams in trenches and pits, and Henderson concluded that no reserves existed and there was no potential for commercial deposits.

The only modern field work which has been done was by Petroquest, from 1980 to 1982. CRA held part of the area in 1984 but merely carried out a semi academic review of the prospectivity for coal, but oil shale was not reviewed.

Petroquest carried out a desktop review of prospectivity of northern Tasmania, including the Oonah area, and generated maps showing target stratigraphy. They followed this with an unclear poorly documented amount of field work. Ultimately they drilled several areas including at Oonah. The Oonah drilling data is reproduced in Appendix 5. The location of their Oonah drilling is plotted on their map of target stratigraphy and topography on Fig 5.

The Petroquest map in the Oonah area shows that the target stratigraphy occurs over an area roughly 6 x 5km.

The drilling project has not supplied definitive results. It is not stated but I assume that the holes are open-hole-percussion. The holes were geologically logged but detailed data was not reported to MRT. Hole 13 intersected two 0.5m thick tasmanite layers and hole 15 intersected 1.0m of tasmanite, though the geophysical logs suggest that more extensive tasmanite layers exist. The holes were geophysically logged (density and gamma surveys) but only a discussion of results is recorded. A mismatch of geological logs and geophysical logs occurs in a number of holes and the geophysical consultant recommended holes be re geologically logged. No descriptions nor analyses of the intersected tasmanite are recorded.

There is no documented MRT drilling in the Oonah area. There are drill holes documented in the Preolenna area but these are not reviewed here.

No University studies such as theses have been located for the area.

6.0 Work Carried Out During the Period

Work during the period has consisted of office based:

- Compile all past company exploration data, government reports, drill data.
- Process drill data on previous maps and on Google imagery and
- Assess prospectivity for coal and for oil shale.

7.0 Prospectivity

7.1 General

Prospectivity for only coal and oil shale was examined. No other commodities were reviewed. The prospectivity for coalbed methane was not evaluated, (coalbed methane rights are not held).

7.2 Oonah Oil Shale

A large prospective area, about 6 x 5km, contains a flat lying tasmanite unit(s), which are potentially open pitable. High oil yields of greater than 95litres/t are recorded for surface samples. The known thickness of the oil shale from drilling and trenching is 0.3 to 1.0m.

The area is readily accessible, with numerous roads and tracks traversing the predominantly working forest area, Fig 5. A number of active coupes are visible on Google Earth imagery, Fig 6.

Tasmanite is potentially more valuable than “traditional” types of oil shale because the entire oil shale need not be retorted. The tasmanite spores can be recovered by flotation, thereby producing a higher yielding product, and potentially substantially lowering operating costs.

The tasmanite unit was poorly tested and documented in the Petroquest drill program; the maximum value of the program appears to be merely confirming the presence of tasmanite. A new program is recommended, with emphasis on careful RL measurement of holes and careful geological logging and sampling.

7.3 Preolenna Coal

The review by Baker (1991) is definitive so far as black coal is concerned and her conclusions are

" Because of the thin, lenticular nature of the seams, which dip steeply at 14-25°, and are dislocated by faulting, the potential of this coalfield for further exploration is limited. The inferred in-situ reserves of **black coal** are very small."

Nevertheless the coal measures of the area hold potential for the oil shale as discussed below. There is also potential for coalbed methane but no assessment has been made in the past.

7.4 Preolenna Oil shale

The available literature suggests that the oil shales are cannel coals, which are formed in terrestrial environments, as are the surrounding coal measures. However the extraordinarily high oil yields exceeding 500litres/t suggest that the oil shale's original algal content may have been marine. Perhaps a marginal marine environment occurs here, and thus restricted lenses in an original marshy estuarine setting could exist. It is recommended that the next phase be collection of such material if possible from old mining areas or outcrops to confirm its high oil yields and to conduct petrological examination to determine the coal type and origin. A suitable follow up exploration program could be designed to test the extent and quality of high oil yielding units.

8.0 SELECTED REFERENCES

Bacon, C. A., 1991, The Coal Resources of Tasmania. *Bull. Geol. Surv. Tasmania* 64.

Reid, C.M.; Burrett, C.F., 2004, The geology and hydrocarbon potential of the glaciomarine Lower Parmeener Supergroup, Tasmania Basin. *In* Petroleum Exploration Society of Australia Special Publication, Vol.2, p.265-275; PESA Eastern Australasian basins symposium II, Adelaide, South Aust., Australia, Sept. 19-22, 2004, edited by P.J. Boulton, D.R. Johns and S.C. Lang. Publisher: Petroleum Exploration Society of Australia, Sydney, N.S.W., Australia.

Rogers, L.I. 1934. Preolenna cannel coal. Unpublished MRT Report TCR34-057.

Other references are tabulated in Table 2

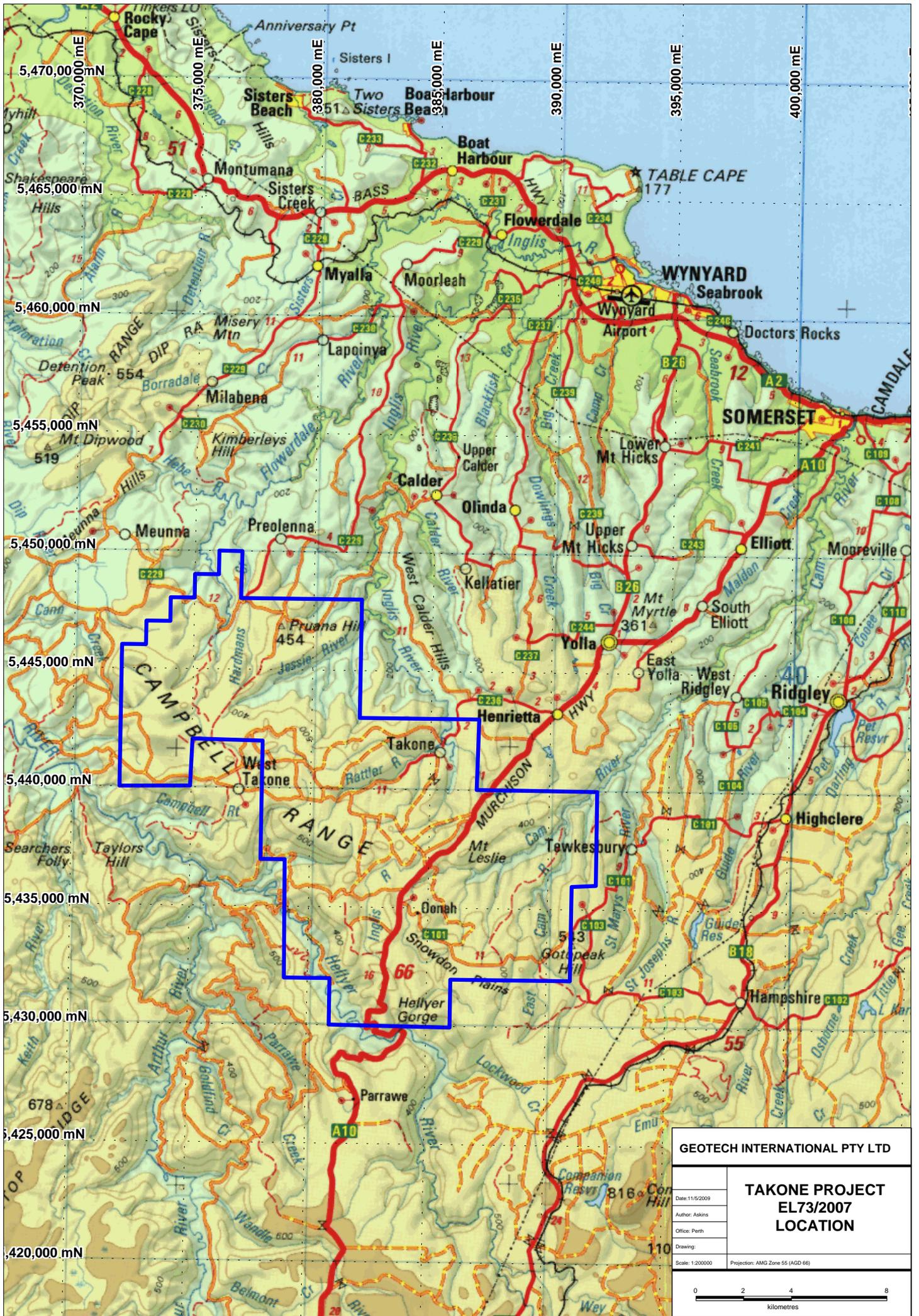


FIG 1

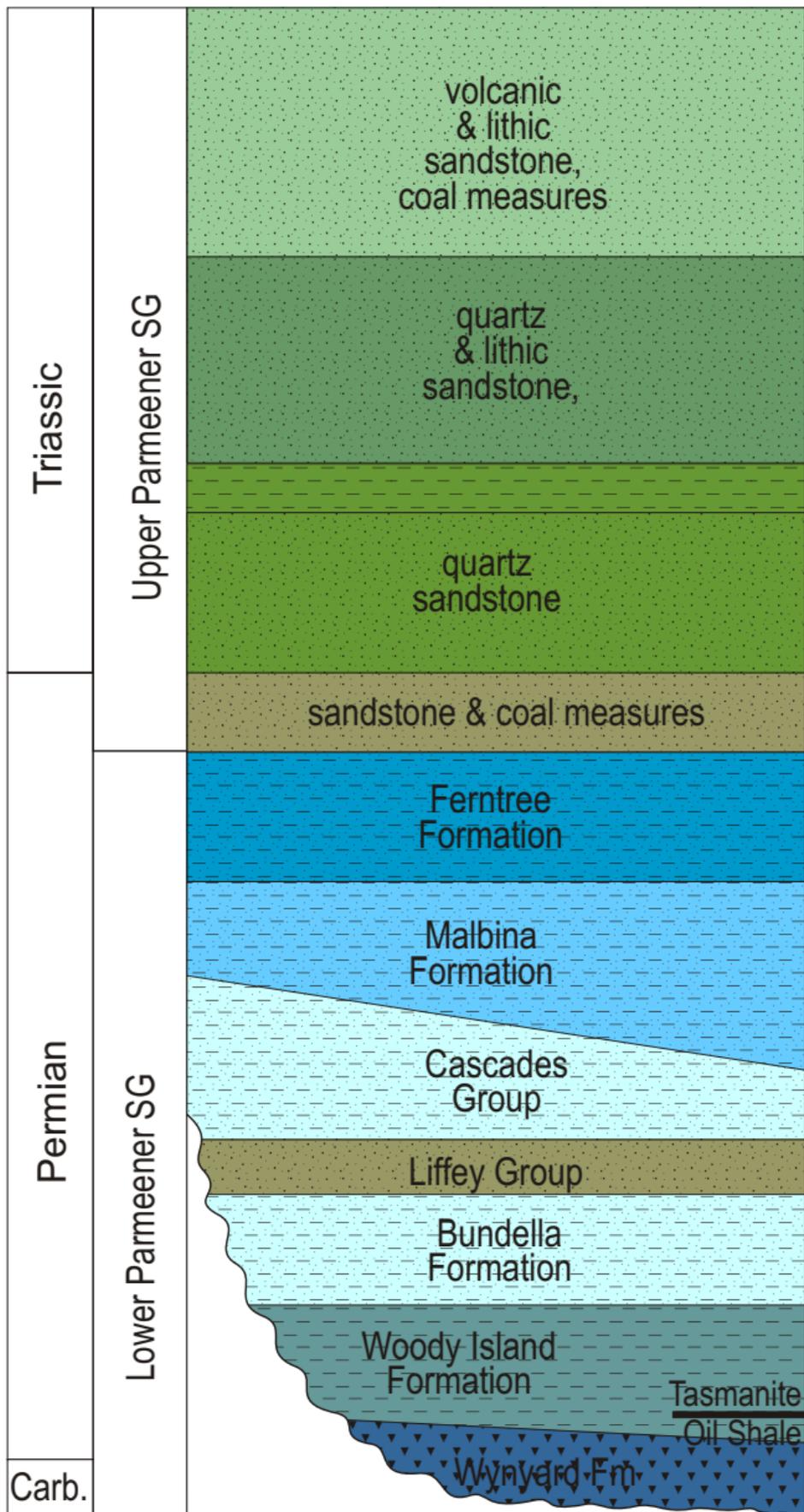
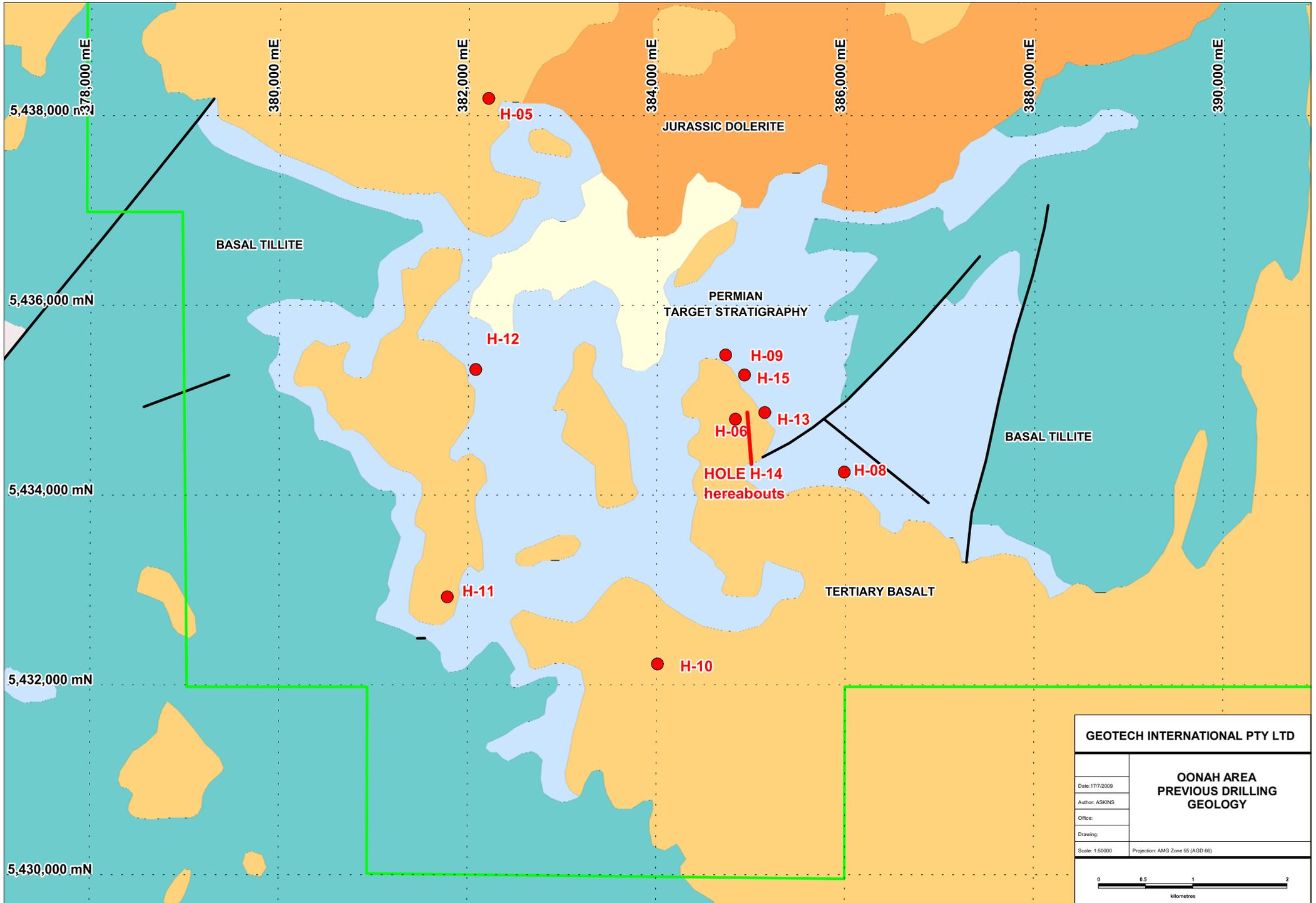


Figure 3. A generalised stratigraphic column and nomenclature for the Parmeener Supergroup. The Lower Parmeener Supergroup is divided into many local units (see Clarke, 1989), but is simplified here to broad units recognisable basin wide. The Upper Parmeener Supergroup nomenclature follows Forsyth (1989). FROM Reid & Burrett, (2004).



GEOTECH INTERNATIONAL PTY LTD	
Date: 17/7/2009	OONAH AREA PREVIOUS DRILLING GEOLOGY
Author: ASKINS	
Office:	
Drawing:	
Scale: 1:50000	Projection: AMG Zone 55 (AGD 66)

FIG 4

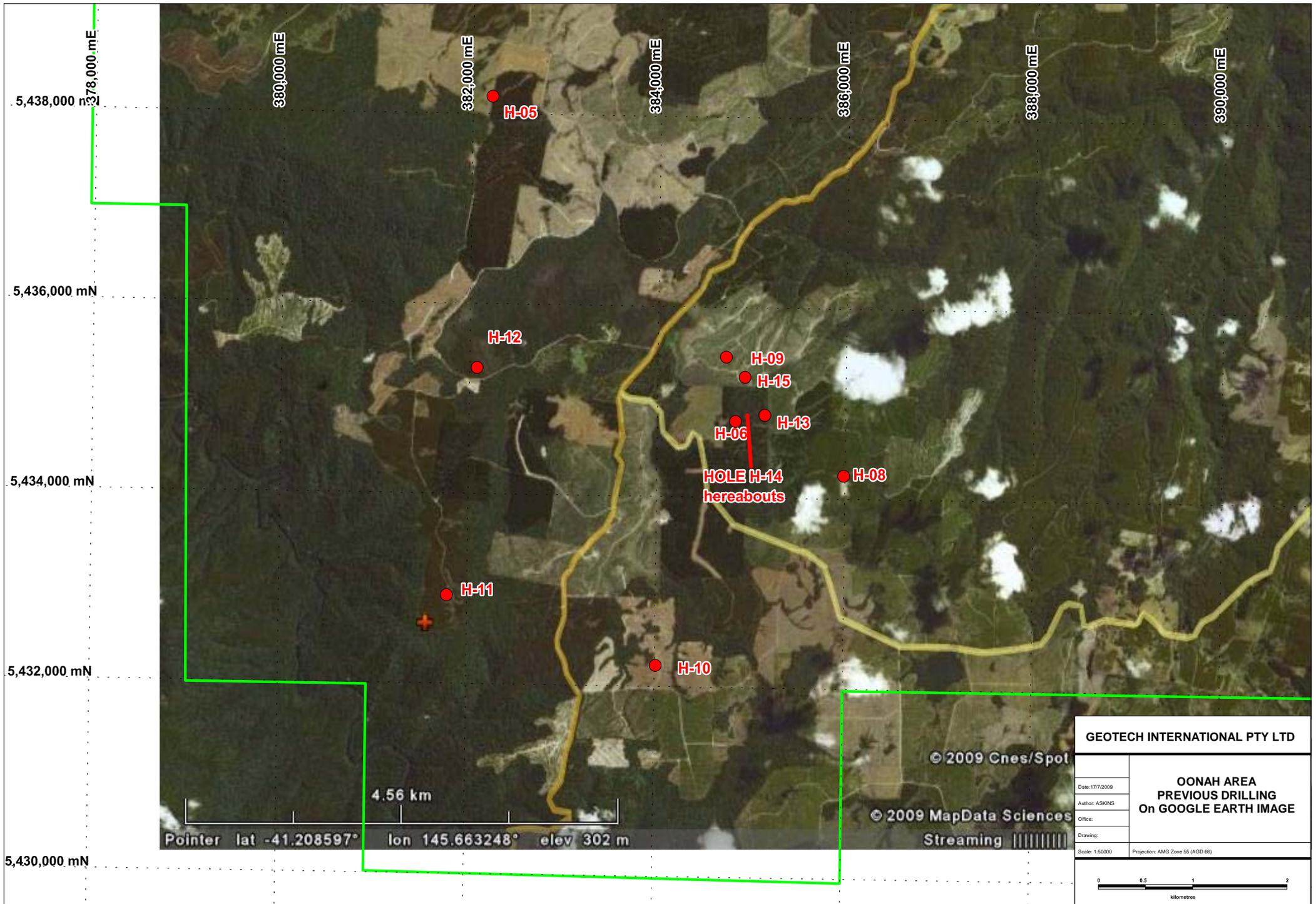


FIG 6

APPENDIX 1

Extract from Bacon (1991)

Table 41. Analyses of coal samples, Mersey-Don coalfield.

	1	2	3	4	5	6
Moisture (%)	8.12	10.42	6.38	8.6	13.58	13.42
Ash (%)	5.28	4.00	5.50	7.08	4.84	4.64
Volatile matter (%)	42.56	43.02	43.18	42.92	36.28	35.06
Fixed carbon (%)	44.04	42.56	44.94	41.40	45.30	46.88
Sulphur (%)	4.56	3.48	3.52	4.81	4.39	4.04
Spec. energy (MJ/kg)	29.0	28.7	30.0	28.7	25.6	24.8

1. Whole seam sample from Aberdeen Colliery, October 1943 (Department of Mines correspondence files).
2. Whole seam sample from Coventry Colliery, October 1943 (Department of Mines correspondence files).
3. Whole seam samples from Black Beauty Colliery, October 1943 (Department of Mines correspondence files).
4. Whole seam sample from Illamatha (No. 1) Colliery, October 1943 (Department of Mines correspondence files).
5. Run of mine coal from Illamatha (No. 1) Colliery, 1922 (Hills *et al.*, 1922).
6. Run of mine coal from Spreyton (No. 1) Colliery, 1922 (Hills *et al.*, 1922).

exclusively used by the cement works at Railton. Local industry, such as the Ovaltine factory and various brickworks, consumed the remainder of the production.

RECENT EXPLORATION

Since the last colliery to work in the field closed in 1961, the area has been examined briefly by various companies, with some interest being shown in the oil shale potential of the area.

POTENTIAL FOR FUTURE EXPLORATION

Whilst the quality of the coal is quite good, the sulphur content is very high and the seams extremely thin. Faulting caused problems in most of the collieries. The area is of limited interest for further exploration.

The Preolenna Coalfield

SUMMARY

The Preolenna Coalfield, located 20 km south-west of Wynyard, is of minor economic importance. The Preolenna Coal Measures are of Early Permian age and are correlated with the Mersey Coal Measures further east. The seams are thin, from 220–600 mm thick, discontinuous, dislocated by faulting, and dip steeply at 14–25°. The inferred reserves of coal are very small and the potential for further exploration is limited.

LOCATION AND ACCESS

The Preolenna Coalfield is located 20 km south-west of Wynyard in north-western Tasmania. Access to part of the field is gained by unsealed roads and rough bush tracks, although much of the area is accessible only on foot. A railway from Flowerdale to Preolenna was opened in 1917 and extended a further 7.6 km to Maweena in 1924 to provide transport for coal and timber products. The railway was closed in November 1931 and dismantled.

GENERAL GEOLOGY

The oldest rocks exposed in the Preolenna Coalfield are mudstone and diamictite of the Wynyard Tillite. As the base of this unit is not exposed at Preolenna the thickness is not known. Overlying the Wynyard Tillite is a 135 m thick sequence called the Inglis Siltstone, which is in turn overlain by the Preolenna Coal Measures. In the Jessie Gorge area, the coal measures are overlain by the Flowerdale Sandstone.

Dolerite has intruded and dislocated the Permian sequence. Areas of higher ground, such as Diabase Hill, are now capped with dolerite. Tertiary basalt flows cover extensive tracts of land south of Preolenna (Bravo *in* Gee, 1977).

The Wynyard Tillite is composed dominantly of a conglomeratic bouldery mudstone or diamictite, with rhythmic deposits being recorded at several horizons. The transition from the tillite to the Inglis Siltstone is rapid. Lenticular beds of *Tasmanites*-bearing oil shale up to 0.6 m thick occur towards the base of this unit. The Inglis Siltstone becomes more fossiliferous towards the top with a variety of molluscs, brachiopods, bryozoans and crinoid debris occurring in fossiliferous pyritic siltstone beds towards the top of the unit.

The Preolenna Coal Measures, which overlies the Inglis Siltstone, consists of interbedded white, clean, quartzose sandstone, micaceous sandstone, shale and thin laminations of carbonaceous material. The sandstone is fine to medium-grained, well sorted, and usually massively bedded. *Glossopteris* leaves are occasionally found.

Four seams of coal crop out on the north-western bank of the Jessie Gorge near Preolenna (Bravo *in* Gee, 1977). Seams also crop out in the Flowerdale River valley south of Preolenna over a distance of three kilometres (Threader *in* Gee, 1977). The seams in both areas vary in thickness from 0.2–0.6 metres. Mining activity has taken place in both the Jessie Gorge (Preolenna Coal Mine) and in the Flowerdale River valley (Torbanhill or Meunna Coal Mine). Coal outcrops are also recorded from near Relapse Creek, south-west of Preolenna, and west of West Takone (Hughes, 1962). The coal seams exposed near Preolenna dip at 14–25° to the west (Hills *et al.*, 1922), although Bravo (*in* Gee, 1977) recorded one outcrop of coal dipping at 40°.

Bands of 'cannel coal' or torbanite exist within the thin seams of black coal. These are caused by concentrations of the alga *Reinschia*. These bands are very rich in volatiles, and have been called 'oil shale' by some authors. Selective sampling of these torbanite bands accounts for some of the very volatile-rich analyses from the Preolenna area.

The seams, which are part of the Preolenna Coal Measures, may be correlated with the Mersey Coal Measures of Latrobe and so are Sakmarian / Artinskian in age. Previously these seams have been correlated with the Great Coal Measures in New South Wales, which are Artinskian in age, and so in fact are younger than the Preolenna and Mersey Coal Measures (Clarke and Banks, 1975).

The Preolenna Coal Measures are overlain by the Flowerdale Sandstone, a 215 m thick unit which has been subdivided into four lithologies. The basal part of this unit is composed of pebbly sandstone with a fossiliferous horizon, which is overlain by a dirty 'greywacke' sandstone. The third lithology is an interbedded sequence of fine-grained sandstone and siltstone which grades upwards into a white, argillaceous, coarse quartz sandstone (Bravo *in* Gee, 1977).

The geology of the area is shown in Figure 59.

PREVIOUS MINING HISTORY

In 1869 a Mr T. Stephens exhibited to the Royal Society of Tasmania a pebble of "kerosene shale" found near the mouth of the Inglis River. Stephens stated that further pieces had been found at the junction of the Inglis and Calder Rivers.

Montgomery (1896) noted that pebbles of coal had been found on beaches near Wynyard, and "high up in the Inglis River and Seabrook Creek", although no seams had been located in outcrop.

Outcrops of coal were discovered by Messrs Lowrie and Harris whilst cutting a track from the Calder Road to the Arthur River (Twelvetrees, 1903b).

Waller (1902) inspected the newly discovered outcrops, some 22–24 km from the coast. Three outcrops were inspected, with the upper seam being the only one Waller considered to be of economic importance, being 500–560 mm thick. The coal was described as being brownish-black to black in colour, with a resinous to dull lustre and a conchoidal fracture. Shortly after this inspection was made, the North West Coal and Shale Company was formed and took out mining leases in the area between the Flowerdale and Jessie Rivers.

Outcrops on these leases were examined and sampled by Twelvetrees (1903b) and Hills (1913). Twelvetrees inspected one adit driven for four metres on a seam of coal 500 mm thick. The adit was driven in a south-westerly direction at a dip of 10°, and was called the "Shale Tunnel". This adit, on an outcrop of coal in the south fork of Fenestella Creek, was also inspected by Hills (1913), although no further work had been done since Twelvetrees' visit. A second adit, named the "Cliff Tunnel", was described by Hills (1913). This adit was six metres long and was driven in on a seam cropping out on the spur between Spirifer and Fenestella Creeks. The seam was 600 mm thick and dipped to the west at 25°. In total the North West Coast and Shale Company drove three short tunnels from 4.8–6.0 m in length on outcrops of coal before abandoning the field.

By 1913 the new lease holders, Weston and Graue, had dug a tunnel 1.8 × 1.4 m for a distance of 62 m on an outcrop in Preolenna Creek. A 1.8 × 1.3 m shaft was sunk to intersect the tunnel. Four seams were intersected in the tunnel and two in the shaft. None of the seams were more than 600 mm thick. Coal bins were erected at the tunnel mouth and a wooden

tramway laid to the end of the road. Coal was mined from two of the seams, then hauled by horse-drawn tram some 120 m up a grade of 1 in 4, then transported 30 km by bullock wagon to Wynyard. The mining operation was not a success. Production statistics indicate that mining in this area lasted from 1918 to 1924.

By 1921, the leases covering the Preolenna coalfield had been taken over by the Preolenna Coal Company. The adit dug previously in Preolenna Creek by Weston and Graue was extended to 67 m, and another adit 2.1 × 1.7 m was driven in for 120 m close to the first adit. Further south, a tunnel 3.0 × 1.7 m, carrying a double tramline, had been driven for 180 m (Hills *et al.*, 1922). A number of seams were cut in each of these tunnels, although none of the seams was more than 600 mm thick.

In 1925 the Meunna Coal Mining Syndicate was formed and took out mining leases in the Flowerdale River valley, three kilometres north-west of the Preolenna coalfield leases. This was probably the same occurrence of coal found "two miles from the Preolenna terminus" in 1919 and called "The Great Fitzroy Coal Mine". The syndicate undertook some initial exploration work, discovering three seams by means of trenching, and dug a dip adit for 18 m before asking the Government for financial assistance to continue with their exploration. In response to this request, an inspection of the area was made. Reid (1925a, b) records that three seams, 450–600 mm thick, were exposed on the eastern bank of the Flowerdale River and could be traced for 800 metres. The dip adit had advanced to 36 metres. A further inspection was made of the Meunna Coal Mine in 1926 when up to 100 t of coal was being produced per week (Reid, 1926). In 1928 a dip tunnel advanced to 25 m was inspected, but mining had ceased (Scott, 1928). Production statistics indicate that mining started in 1926 (10 t) with 53 t being produced in 1928 (the year of Scott's visit). Mining ceased in 1931 although small tonnages were won in 1935 and 1936 (two and six tonnes respectively).

COAL QUALITY

Analyses available for coal from the Preolenna Coalfield are largely of an historical nature. Twelvetrees (1903b) and Hills (1913) collected samples from all available outcrops and had analyses made. A selection of these results are given in Table 42.

Table 42. Analyses of coal samples, Preolenna coalfield.

	1	2	3	4	5	6	7	8
Moisture (%)	0.5	1.1	0.7	0.7	0.5	1.17	0.5	1.27
Ash (%)	2.3	4.1	6.5	6.6	2.0	7.58	6.0	4.82
Volatile matter (%)	76.2	71.6	45.9	48.3	75.5	40.46	47.3	42.45
Fixed carbon (%)	21.0	23.2	46.9	44.4	21.0	50.79	46.2	51.46
Sulphur					1.0		4.4	2.26

1. Sample from Tunnel seam (Twelvetrees, 1903b) in Fenestella Creek.
2. Sample from outcrop in cliff 60 m from Tunnel seam (Twelvetrees, 1903b).
3. Sample from 500 mm thick seam in Fenestella Creek (Twelvetrees, 1903b).
4. Sample from 450 mm thick seam in Camp Creek (Twelvetrees, 1903b).
5. Richest kerosene shale, Preolenna from Tunnel seam in Fenestella Creek (Hills, 1913).
6. Average of eleven samples of black cannel coal, Preolenna (Hills, 1913).
7. Bright coal from seam in adit in Preolenna Creek (Hills, 1913).
8. Bright coal from Tunnel seam in Fenestella Creek (Hills, 1913).

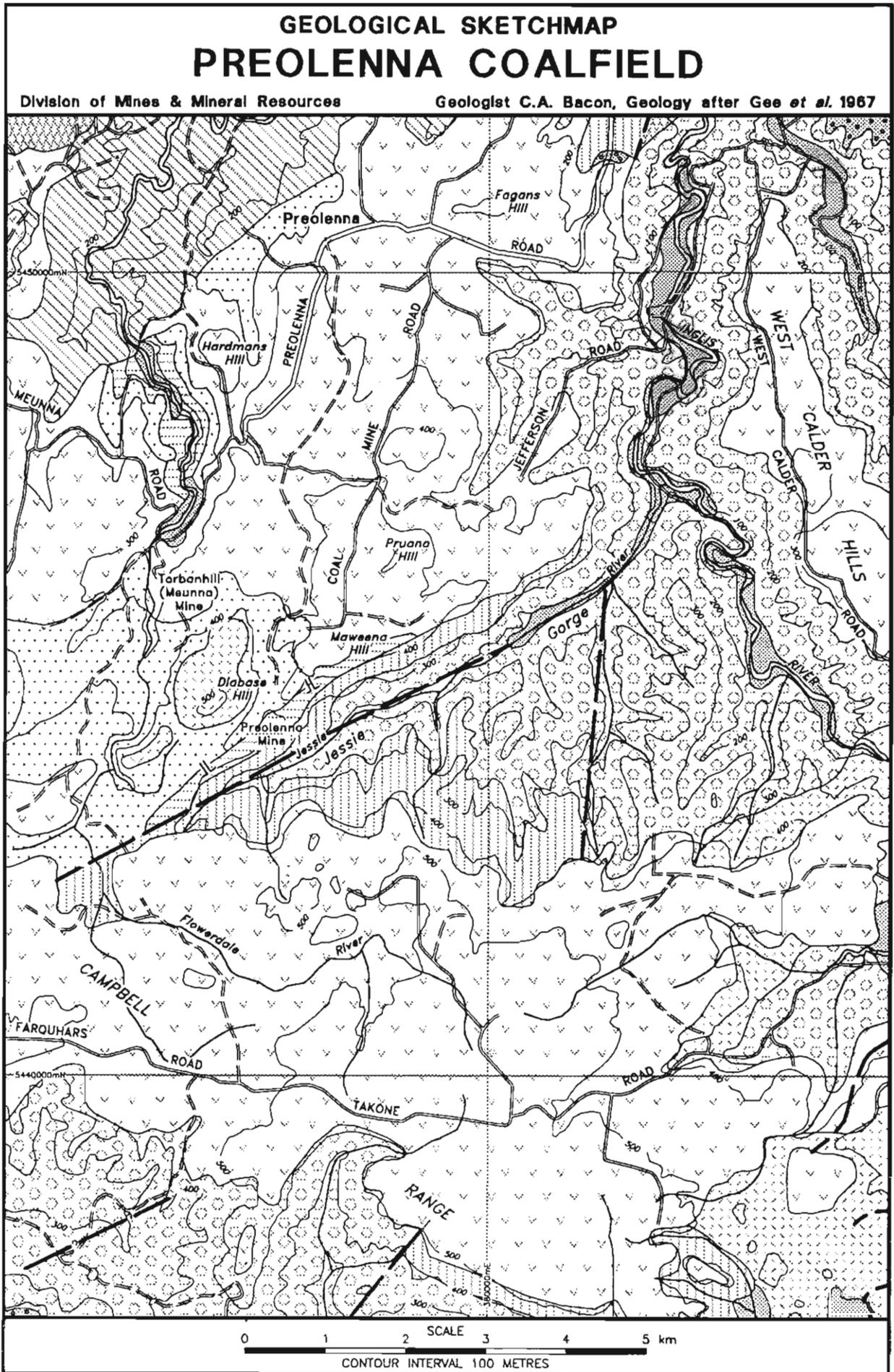
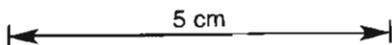
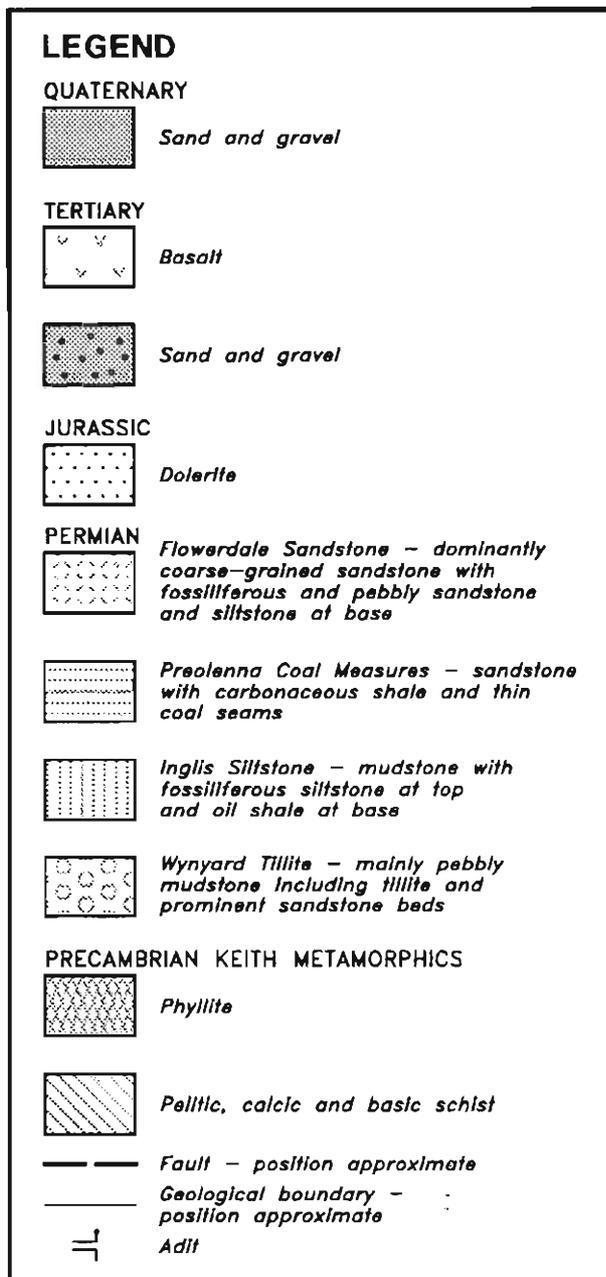


Figure 59.





Interest was shown at one stage in determining the oil yield from the cannel coal, but the venture was deemed to be an uneconomic proposition (Rogers, 1934).

In 1951 a 22 kg sample of coal was collected from one of the seams in one of the adits in Preolenna Creek (Hughes, 1951). However the results of analyses of this coal are not available.

A coal seam 300 mm thick cropping out in a tributary of Relapse Creek south-west of the main Preolenna coalfield was sampled by Hughes (1962). The seam dipped to the north (340–360°) at 11°. This and another nearby (300 mm thick) outcrop in Lowrie Creek were sampled in 1971 (Nye, 1971a, b). Part of the sample collected in Relapse Creek was tested for coking purposes but was reported as having no useful coking properties (Nye, 1971b).

A one kilogram spot sample was collected from the entrance of one of the three main adits in Preolenna Creek in 1970 (Smith, 1971). The analyses of these samples are given in Table 43.

RECENT EXPLORATION

Two holes were drilled in late 1929–early 1930 in the vicinity of the Meunna (Torbanhill) Mine (Department of Mines Annual Reports; 1929, 1930).

A study of the possibility of distilling various fuels and oils from the coal was made by Rogers (1934).

A one kilogram sample was collected in 1971 by Mining Systems Ltd, from the portal of an old adit (presumably the adit in Jessie Gorge). A 40 kilogram sample was collected for 'washability tests' but no results from this are available (Smith, 1971).

A sample of coal from an outcrop in a tributary of Relapse Creek was also taken in 1971, the seam being 12–14 inches (0.3 m) thick. Additional outcrops were found in Lowrie Creek (Nye, 1971a, b).

In 1982 four shallow holes were drilled along Coal Mine Road and three very shallow holes at Meunna, by a Tasman Shale and Coal Company Pty Ltd and Mineral Holdings of Australia Pty Ltd joint venture (EL 43/70). The Meunna holes (all less than 19 m deep) all terminated in basalt, and

Table 43. Analyses of samples from Preolenna Creek, Lowrie Creek and Relapse Creek, Preolenna coalfield.

	1	2	3	4	5	6	7
Moisture (%)	0.9§	0.9	4.3‡	9.3	8.3	11.1	0.36
Ash (%)	5.0	8.4	7.3	20.4	14.8	13.7	5.00
Volatile matter (%)	45.4	40.8	35.8	22.3	28.8	39.4	40.00
Fixed carbon (%)	48.7	50.8	52.6	48.0	48.1	35.8	54.64
Total sulphur (%)	1.74	4.06	1.5	0.14	0.43	0.40	3.30
Crucible swelling number	5.5						
Specific energy (MJ/kg)	33.8	32.5	29.1	19.7	23.1	20.9	
Specific gravity (g/cm ³)	-	1.25	-				

§ air dried moisture

‡ internal moisture

1. Spot sample from entrance of one of the adits in Preolenna Creek (Smith, 1971).
2. Sample taken from outcrop of seam 300 mm thick west of West Takone, in tributary of Relapse Creek (Hughes, 1962).
3. Sample taken from same outcrop (Nye, 1971a).
- 4,5,6. Sample taken from outcrop 300 mm thick in or near Lowrie Creek (Nye, 1971b).
7. Sample from seam 1.0 m thick from hole drilled near Meunna Mine in 1929.

the four Coal Mine Road holes (all less than 50 m deep) terminated in the Flowerdale Sandstone.

POTENTIAL FOR FUTURE EXPLORATION

Because of the thin, lenticular nature of the seams, which dip steeply at 14–25°, and are dislocated by faulting, the potential of this coalfield for further exploration is limited. The inferred *in situ* reserves of black coal are very small.

The Barn Bluff–Mt Pelion Coalfield

SUMMARY

Two small areas, around Barn Bluff and near Mt Pelion, have been of interest to prospectors. Very small quantities of coal were mined from trenches at Barn Bluff and adits at Mt Pelion in the late 1890s. The two areas do not contain sufficient coal to be of any economic importance. The area of the prospecting activity is scenically beautiful and quite remote, and now falls within the Cradle Mountain–Lake St Clair National Park, and so is exempt from the provisions of the Mining Act, 1929.

LOCATION AND ACCESS

The areas in which coal has been found are: on the lower slopes of Barn Bluff; on the spur connecting Barn Bluff with Cradle Mountain; and on the slopes of the Pelion group of mountains to the south of Barn Bluff. Access to all of these places was formerly by pack-horse, but now is by foot only.

GENERAL GEOLOGY

Geological descriptions of the Barn Bluff–Mt Pelion area may be found in Montgomery (1893*b*), Waller (1901*b*), Reid (1919), Hills *et al.* (1922) and briefly in MacLeod *et al.* (1961).

The coal at Barn Bluff belongs to the Early Permian Mersey Coal Measures and equivalents. Parts of the coal are formed from concentrations of the alga *Rienschia*, so this coal is classified as a torbanite or sapropelic coal.

In the Pelion area, the Cygnet Coal Measures crop out across the northern slope of the Pelion Range, between Mt Pelion West, Mt Thetis and Mt Pelion East. The coal seams prospected in this area are Late Permian in age.

PREVIOUS MINING HISTORY

The coal discoveries at Barn Bluff and Mt Pelion were examined by Montgomery (1893*b*), who noted that the coal had been found by members of the Mole Creek and Zeehan Mineral Prospecting and Exploration Company. The discovery of coal at Barn Bluff is credited by Reid (1919) to F. Holmes and W. Hart, who received Reward Claims of 320 acres (130 ha) each for their finds. Hills *et al.* (1922) credit I. Will with finding the Barn Bluff coal in 1892. Will was engaged in prospecting activity in the Barn Bluff and Pelion areas in 1893, and while in the Barn Bluff area he did find some copper-bearing lodes on the western bank of Lake Windermere (Reid, 1919).

The Barn Bluff coal was found as large pieces in a moraine on the south-eastern spur of Barn Bluff. Trenches were dug into the moraine and some coal extracted. From the thickness of the slabs of coal the seam was judged to be around eight inches (200 mm) thick. The trenching was inspected by Montgomery (1893*b*), Reid (1919), and Hills *et al.* (1922). A twelve inch (300 mm) thick seam exposed on the saddle between Barn Bluff and Cradle Mountain was examined by Montgomery (1893*b*) and Reid (1919). This seam lies just above the Permian basal conglomerate, and is part of the equivalents of the Mersey Coal Measures of Early Permian age. A variety of sapropelic coal called 'pelionite', formed largely of the alga *Rienschia*, occurs in the Barn Bluff coal.

At the time of Hills' 1922 visit, the Tasman Oil and Products Company were gouging coal from fragments in the moraine on the slopes of Barn Bluff, and the Great Pelionite Petroleum Oil and Products syndicate held leases in the Barn Bluff area.

In the Pelion area, prospecting activities on Mt Pelion East are mentioned by Montgomery (1893*b*) and examined in detail by Waller (1901*b*), Reid (1919) and Hills *et al.* (1922).

Waller (1901*b*) noted an exploratory adit 20 feet (6 m) long on the east slope of Mt Pelion West, driven in on a seam 17 inches (430 mm) thick. A second seam exposed in the Ossa–Thetis Saddle is described by Waller (1901*b*) and Reid (1919). The seam here was 760 mm thick, and had been traced by trenching around to the western slopes of Mt Pelion East (Reid, 1919).

The Mt Pelion coals are contained in a sequence of sandstone and carbonaceous shale belonging to the Cygnet Coal Measures and equivalents, being Late Permian in age. At the time of Hills' (1922) inspection the Adelaide Oil Exploration Company Ltd held leases for coal in the Pelion area, but no mining was in progress.

COAL QUALITY

The following analyses have been recorded from coal from the Pelion area:

	1	2
Moisture (%)	0.8	2.1
Ash (%)	17.1	20.2
Fixed carbon (%)	52.0	54.6
Volatile matter (%)	19.6	22.5
Sulphur (%)	10.5	0.6

1. Seam exposed in trenches on eastern slopes of Mt Pelion West, seam being 17 inches (430 mm) thick (Waller, 1901*b*).
2. Seam exposed in trenches on northern slopes of Mt Pelion (Waller, 1901*b*).

POTENTIAL FOR FUTURE EXPLORATION

The small quantity of coal available, the thin nature of the seams, and the very poor quality of the coal indicate that the coalfield is of no economic significance and has no potential for future exploration.

APPENDIX 2

Oonah oil shale discovery
MRT unpublished report URMISCA_011-13

0 4

Donal Field

OIL IN TASMANIA.

(Extract taken from "Mercury", Tuesday, August 21st, 1923).

Bulletin No. 24 published this year by the Commonwealth Institute of Science and Industry on "The production of liquid fuels from oil-shale and coal in Australia" in dealing with the oil-shale deposits of Tasmania, says :- "Assuming a reserve in the field of 12,000,000 tons, and an average crude oil yield of 40 gallons per ton, the total recoverable oil will be about 480,000,000 gallons. This represents a six to seven years' supply for Australia, based on present consumption".

RECENT DISCOVERIES.

In making the above computation the author of the bulletin took for his basis the late Mr. W. H. Twelvetrees' estimate of the amount of oil-shale in reserve in Tasmania in 1912, or eleven years ago. It is a pity his figures were not brought more up-to-date, and Tasmania given credit for the extensive additions which discoveries of the last few years have made to our oil-shale reserves. The 12,000,000 ton estimate related to the Mersey Valley district alone, but this has lately been more than doubled by finds of shale in outlying parts of this area, while entirely new areas have also been discovered, which still further increase what may be termed the positive reserves, while the probable reserves may be looked upon as very much greater still, for the geological conditions are such that there is every likelihood of the shale deposits being found over a very much wider area than ^{has} at present been proved.

The Government Geologist, Mr. A. McIntosh Reid, who for some months past has been energetically engaged in the investigation of our oil resources, has made a number of important discoveries, which not only add to the extent of previously known fields, but give at least one new field of magnitude and richness to the State. His work has brought the positive reserves of oil-shale up to the fine aggregate of 42,000,000 tons, spread over what at present are five

separate fields. They are :-

	<u>TONS.</u>
Latrobe-Railton-Kimberley Area.....	30,000,000
Beulah Area.....	3,000,000
Quamby Bluff Area.....	3,000,000
Hook Area.....	800,000
Oonah (recently discovered by Mr. Reid) area.....	6,000,000

The crude oil contents of the shale vary somewhat, but if averaged at 40 gallons per ton, which is really a very low figure, the recoverable oil is shown to be 1,680,000,000 gallons, or instead of a six or seven years' supply for the Commonwealth enough to last from 21 to 25 years. A recent experiment in distillation returned 68 gallons of oil to the ton of shale.

THE OONAH FIELD.

This, the newest of our oil-shale areas, was discovered by Mr. A. McIntosh Reid only about three months ago. Mr. Reid went out to investigate an occurrence of shale that was known to exist on the property of Mr. Wm. Cross in the valley of the Cam River, about two miles north of Oonah. Examinations of the neighbourhood led to the discovery of another and much larger deposit, five miles to the S.W. of Cross's, on land charted in the names of E. Hodgetts, J. Martin, A.L. Green, Jas. McNab, H.E. Miles, and C.C. Jubb. This area is easily accessible from the Mount Hicks-road, which is only $1\frac{1}{2}$ miles away. There is every probability of a very large extension of this area for the permo-carboniferous rocks, with which the oil-shale deposits are closely connected, extend southwards to the Helleyer River, and very likely further, westward through Takone to Preolenna, and eastward right into the "Emu Bay" block of the Van Diemen's Land Co's ground.

Unfortunately, through stress of other engagements,

Mr. Reid was not able to spend more than 10 days on his investigations here, and it is proposed that he shall visit the district in the summer, and make complete investigation of the whole area. In the meantime the Mines Department, being strongly impressed with the value of the oil-shale deposits, Mr. Reid will be engaged upon the production of part 1 of "The Oil Shale Resources of Tasmania" dealing with the Latrobe-Bailton-Kimberley, The Nook, Beulah and Quamby Bluff areas, and what is known of other places. The results of further investigations will be recorded as part 2.

APPENDIX 3

Reid , UR1924_242-243

OIL SHALES

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Extensive deposits of oil-producing shales occur in the northern and north-western part of Tasmania as beds on the horizon of the Greta coal measures of the Carboniferous system. Tasmanite forms the greater part of these deposits, a recent estimate of the reserve at the localities being:-

Latrobe-Railton-Kimberley Area	30,000,000 tons
Beulah Area	3,000,000 tons
Quamby Bluff Area	3,000,000 tons
Nook Area	800,000 tons
Oonah Area	6,000,000 tons
	<hr/>
	42,800,000 tons
	<hr/> <hr/>

The average yield of crude oil from these shales is estimated at 40 gallons per ton, the oil reserve, therefore, amounts to 1,771,200,000 gallons.

The known deposits are situated in two widely separated fields associated with cannal coal and Kerosene shale. The more important is that extending from Latrobe to Quamby Bluff. Along this belt, 27 miles in length, Tasmanite has been proved to extend 14 miles, and in the section intervening Quamby Bluff and Kimberley it probably occurs as well. Outliers of the main body are found at Beulah and Nook on the west side and at Parramatta on the east. Aside from the known deposits it is considered likely that Tasmanite will be found in neighbouring areas.

The facilities for the development of the oil shale industry in the Latrobe-Railton field are not present at Oonah, which is situated 26 miles from the Coast line and is accessible only by roads of heavy grades. Two companies are erecting distillation works, one at Latrobe, the other at Railton. The process of distillation is comparatively simple as the kerosene from which the oil is derived is encased in arenaceous shale and the ammonia content is negligible.

Kerosene shales and cannal coals occur at Preolenna, Mt. Pelion, and Barn Bluff, but the reserve of these shales is small compared with that of tasmanite.

COAL

Coal seams occur in strata belonging to the Permo-Carboniferous from the lower coal measures and are well developed at Preolenna, Barn Bluff, Mt. Pelion and Mersey Fields in the north, and at Cygnet and Bruny Island in the south. These seams do not exceed two feet six inches in thickness. The Trias-Jura coal measures are extensively developed in the eastern midland and south-eastern portion of Tasmania.

These seams constitute the most important coal resources of Tasmania and vary in thickness from three to sixteen feet the most important having an average thickness of twelve feet.

The Tertiary strata also contain important seams, but their extent has not yet been investigated.

The following statement explains the variation in character and composition of the coal found in the several systems:-

Permo-Carboniferous-

Greta Coal Measures : Kerogenites and Humic-Kerogenites
Tomago " " : Sub-anthracites and non-caking humic

Trias-Jura

Sub-anthracites and non-caking humic

Tertiary

Brown Coal and Lignite

The total production of coal is somewhat in excess of 2,000,000 tons with a value of approximately £1,600,000. The present annual production is 69,238 tons valued at £61,016. Development has been greatest in the Mt. Nicholas field where the Cornwall and Mt. Nicholas companies are operating on Trias-Jura Coals. The Preolenna Coal Company has lately become an active producer, and for many years coal has been mined in Mersey River valley.

The coal reserve calculated on the basis of existing economic conditions amount to 134,398,000 tons. On the basis adopted by the International Geological Congress the "actual" reserve is 124,980,000 tons, and the "probable" additional reserve is 123,013,000 tons, with a still further unknown "possible" reserve.

The following figures indicate the composition, evaporative power and calorific value of the average Trias-Jura coal:-

Moisture	4.35 per cent
Volatile hydrocarbons	21.27 per cent
Fixed carbon	51.84 per cent
Ash	22.64 per cent
Sulphur	0.60 per cent
Evaporative power	10.49
Calorific Value	(5636 calories (10145 B.T.U.)

(Signed) A. McIntosh Reid
GOVERNMENT GEOLOGIST.

MINES DEPARTMENT
HOBART. 9th January, 1924.

APPENDIX 4

Blake, UR1928B_081-86

INTRODUCTION -

Petroleum has become an indispensable commodity of civilisation. Australia, at present, is wholly dependent on other countries for supplies of natural petroleum. The necessity for the provision of adequate supplies, from within our own boundaries, both for war and industrial purposes, has long been realised. In recognition of this fact, and in an endeavour to encourage oil exploration, the Commonwealth Government offered a large reward for the discovery of a commercially important reservoir, and a substantial bounty for oil distilled from shale. The principle of a reward was not considered the best means of assisting in the search for oil, and assistance in drilling is granted instead. Several companies have been formed during recent years for the purpose of exploring our resources of natural petroleum, but their operations have not been productive of important results. However, immediate requirements may be supplied in part from extensive deposits of Oil Shale, some of which occur in Tasmania.

Local shales are of two kinds:

- (1) The tasmanite shale of the northern and north-western districts, and
- (2) The so called kerosene shale or torbanites of Preolenna and Barn Bluff.

GEOGRAPHICAL DISTRIBUTION -

(1) Tasmanite shale has been found in the northern portion only of the Island, and is confined within an area fronting the coast thirty miles wide and extending from Tamar River to Stanley. The arbitrary boundaries enclose not only the several known isolated occurrences, but also all other areas that are considered likely to contain important deposits. The known deposits encompass comparatively small areas, and have been definitely delimited. They are situated in two widely separated fields associated with basins of kerogenite and humic-kerogenite coals.

(2) Kerosene shales or torbanites are distributed over two areas widely separated. Those at Preolenna are contained within a coalfield lying thirteen miles south of Wynyard, on the North-west coast. The second area lies some 35 miles to the south-east, and is situated on the extreme north-western end of the Central Plateau of Tasmania.

GEOLOGY OF THE SHALE BEDS -

(1) The tasmanite beds are contained within the Permian-Carboniferous formation, the strata of which were laid down in regional synclinalia developed in older rock formations. The formation generally consists of basal conglomerate and sandstone, limestone, Upper and Lower Marine mudstones with intercalated coal measure sandstones, shales, and grits. Apparently the bed of shale corresponds in position to the coal measure series between the Lower and Upper Marine members of the formation. The coal measures are correlated with the Greta of New South Wales, and are replete with similar flora.

Tasmanite occurs in a three to 6 foot seam at or about the horizon of the coal bed in contiguous area. Only one seam of tasmanite and only one seam of workable coal is known in the district. In some places the coal ends abruptly where the shale begins, but as there is no evidence of mergence one into the other their geographical relation may be due to faulting. However in one place the coal seam recurs on the other side of the narrow shale belt, indicating a close correspondence in time of formation. There is no evidence to show that tasmanite and coal occur mutually superimposed in any part of the district; on the contrary, it is found that where coal occurs, it is futile to search for tasmanite, and where tasmanite occurs, for coal. This knowledge facilitates exploration considerably by the elimination of all coal areas from examination. It has been established that tasmanite fringes the shore-lines of Permo-Carboniferous seams from which it follows that where the upper mudstones abut early Palaeozoic or Proterozoic rocks (conglomerates, slates, schists &c.) the presence of tasmanite may be anticipated. A striking feature is that there is no appreciable thinning of the seam as the shore line is approached. Probably this is due to the steepness of the Permo-Carboniferous shore-line.

(2) The coal seams, in which the oil shales of the Preolenna are confined, were laid down in the Permo-Carboniferous Period. Of this system there are visible in the coalfield itself the following series in descending order:-

- The Tomago coal measures
- The Upper Marine mudstone
- The Greta coal measures
- The Lower Marine mudstones

This shows that the coal occurs at two horizons, namely, the Greta coal measures and the Tomago horizon. The seams in the Greta measures number four. The number in the Tomago has not been ascertained. A number of outcrops occur, but these could quite possibly be the one seam faulted into various positions.

The coal seams vary in thickness from 9 inches to 24 inches, and are characterised by the fact that without exception they belong to the kerogenites or humic kerogenites. Several of the coal seams show at various places the occurrence of high-grade kerosene shale, and it is specially noteworthy that this shale is not confined to any one seam, but makes and disappears in the various seams in a manner totally characteristic of this class of coal.

(3) There is only one coal seam in the Barn Bluff area. This occurs in the Greta coal measures of the Permo-Carboniferous Period. This coal seam is of the humic-kerogenite type, and, as quite characteristic of this type of coal, may consist of the variety pelionite in one part, and of a totally different type of cannel coal in another.

The high grade pelionite, which has been found in the glacial moraine at the eastern foot of Barn Bluff in slabs up to 8 inches in thickness, represents this seam varied to the extent of consisting of practically wholly of the substance to which the name of "pelionite" has been given, which is, in fact, a special variety of the kerogenites and humic kerogenites. The part of the seam from which these fragments have come has not yet been disclosed.

NATURE OF OIL SHALES. -

(a) Tasmanite, like cannel coal and kerosene shale, is not so oil bearing, but an oil-producing substance, that requires heat for the generation of oil. The source of the oil is an organic substance called "kerogen" with which the shale is impregnated. This material, so adapted to the generation of artificial petroleum by distillation, consists of innumerable minute disc-like spore cases set in a fine-grained arenaceous sediment. The amber-coloured discs or sacs are about half a millimetre in diameter, and, where not deformed, are nearly circular in outline. The sacs have been preserved by a decay-resistant waxy or resinous substance forming the outer skin, but the spore cases have decayed, and their remains are generally almost indistinguishable. These waxy or resinous products of the plant are hydrogen-rich and oxygen-poor substances. They are strangely, almost unaffected by the ordinary solvents of waxes and resins.

(b) As compared with the Barn Bluff occurrence of cannel coal, the Preolenna kerosene shale is distinguished by the absence of the marked amorphous unlaminated character and well developed conchoidal fracture of the former. There is a notable difference in the lustre of the two minerals, also, the pelionite (Barn Bluff) having more the appearance of vulcanite, as contrasted with the pitch-like aspect of the kerosene shale. The streak of the former mineral is black, whereas the latter has a tendency towards a brown streak; pelionite also exhibits marked sectility. In the matter of chemical composition, also, there is a distinct difference, for whereas the rates of volatile constituents to fixed carbon is 2.7 in Preolenna kerosene shale, it is only 1.24 in pelionite.

SHALE FIELDS. -

1. The more important tasmanite shale field extends from Latrobe in a south-easterly direction to Quamby Brook. From Latrobe the seam has been traced without serious interruption, under the broad flood-plain and valley sides of Mersey River, to a point three miles south-east of Kimberly. Beyond that point through Dunerlan and Delorain the Permo-Carboniferous do not outcrop, but they reappear a mile south of Deloraine, and, in the valley of Quamby Brook tasmanite is exposed at intervals over two miles. Along this 27 mile belt the shale has been proved to extend thirteen miles, and in the section intervening Kimberly and Quamby Bluff exploration has lately revealed its occurrence. At Latrobe and Railton the seam outcrops, and in no part of those areas is it far below the surface. At Native Plain it is from 300 to 900 feet below river level. Outliers of the main body are known at Beulah and Nook on the west and at Paramatta on the east side. Far removed from these is the Cam River tasmanite field, situated near Oonah, 22 miles south of Wynyard. It consists of two areas - one near the point of confluence of the eastern branch with the main stream; the other and larger one four miles west of it. Aside from the known deposits it is considered likely that tasmanite will be found in the vicinity of Preolenna, near Newhaven, and on the Emu Bay block of the Van Dieman's land Company.

II. The Preolenna kerosene shale field is situated on the northern slopes of the Campbell range. The more important

outcrops occur on the western side of the deep precipitous gorge of Messie River, which drains part of the northern fall of the Campbell Range and flows into the Inglis River at a point about three miles distant from the present mine workings. The extent of the field has not been definitely determined, but there occur in the eastern portion of the shale-bearing areas approximately 1000 acres, which are shale-bearing. In the western portion of the area there is in the vicinity of 1000 acres, but the exact area has not been determined, as the western limit has not been delineated.

III. Barn Bluff shale bearing area lies beneath the approximately conical mass of Barn Bluff, and extends northward under the spur which connects that mountain with Cradle Mountain. The shale horizon outcrops on the eastern side of the steep-sided gorge of the Fury River, and on the eastern side at the heads of the valleys of the various branches of the Brown River.

The potential shale-bearing area is, approximately, seven square miles.

CHEMICAL COMPOSITION -

Oils cannot be extracted from Tasmanite by solvents nor by subjecting the mineral to high pressure, but oils can be formed from it by the application of heat under certain conditions. When the shale is placed in a retort and heated the organic component "kerogen" is progressively decomposed into permanent gases and oil vapours of various kinds, the latter of which can be easily condensed into crude shale oil. The richness of the shale is in proportion to the amount of kerogen it contains. Information regarding the chemical composition of the kerogen of tasmanite is meagre. It is doubtful whether the kerogen can be expressed as a definite chemical compound. The nitrogen and sulphur constituents occur in combinations with the hydrocarbon and in fairly constant proportions. The composition and the properties of the oil distilled from tasmanite differ greatly from the oil of other shales.

Ultimate Analysis of the Crude Oil - Nitrogen, 0.31; carbon 79.34; hydrogen, 10.41; oxygen, 4.93; sulphur, 4.93. The calorific power of the crude oil has been estimated at 21,625 B.T.U., and at 21,336 B.T.U.; the flash point is from 235° to 260° and the specific gravity is 0.931 to 0.956. Laboratory tests show varying results owing to different conditions of operation.

The following gives the proximate analysis of the tasmanite shale from several localities, as determined in the Government laboratories:-

Locality	Moisture	Volatile Matter	Fixed Carbon	Sulphur	Ash
Latrobe	0.80	30.84	5.86	2.56	62.50
Railton	1.00	30.00	6.20	1.92	62.80
Nook	1.90	16.28	8.50	1.26	73.32
Barnett Creek	1.30	22.86	5.84	1.65	70.00

The yield of oil from average samples of tasmanite is given in the subjoined table:-

<u>Locality</u>	<u>Yield in Gallons</u>
Latrobe	44.12
Barnett Creek (outcrop shale)	29.07
Great Bend	65
Railton	40.98

The analyses reveal the variation in the content of oil in shale occurring in the several areas. The crude oil is of an extremely dark colour and viscid character. Tests of the crude oil show that it consists of 64% lubricating oils, 25% lighting oil, and 11% benzine. The proportion of vaseline and mineral waxes is very small.

RESERVES

Tasmanite forms the greater part of the oil shale deposits and a recent estimate of the reserves of this shale is as follows:-

	<u>Tons</u>
Latrobe-Railton-Kimberley area	30,000,000
Beulah area	3,000,000
Quamby Bluff area	3,000,000
Nook area	800,000
Conah area	<u>6,000,000</u>
TOTAL	<u>42,800,000</u>

The average yield of crude oil from these shales is estimated at 40 gallons per ton, and the oil reserve therefore amounts to 1,712,000,000 gallons.

No reserves have as yet been calculated for the oil shales of the Proelenna and Barn Bluff field, and in the present stage of their development, it can only be said that the reserves are small.

TREATMENT -

About 1910 the Tasmanian Shale and Oil Company constructed works for retorting tasmanite shale on the banks of the River Mersey at a point $2\frac{1}{2}$ miles south of Latrobe. An endless steam-driven rope haulage conveyed the shale in trucks on a wooden tramway from the tunnel mouth to the top of the hill, a distance of half a mile. Thence the trucks ran down a self-acting incline to the rock-breaker, in which the stuff was broken into small pieces (2 or 3 inches size). From this the latter was carried by a conveyor to the top of the retorts.

Four of these retorts were built and each of them was supposed to treat daily four or five tons of shale, which was subjected to slow distillation, during which process the gas from the retorted shale passed into a cooler and through the condenser, and the crude oil finally flowed into the stock tanks. The lighter oil and spirit having been extracted by distillation, the remainder constituted residual, or fuel, oil. The spent shale was stacked for sale for manurial purposes. The operations of this company were suspended soon after starting owing to insufficiency of capital.

Of late years two companies have carried out experiments and have erected plants for the distillation of oil from tasmanite in the Latrobe district.

During last year one of these companies, the Australian Shale Oil Company, opened their mine and continued the erection of works, but ran out of capital. Two trials of their retorts were made, with, it is claimed, satisfactory results, and about 60,000 gallons of oil were produced. The power kerosene obtained therefrom found a ready market in nearby centres. A local market is available for each of the products.

The other company, the Southern Cross Motor Fuels Ltd., continued their researches and experiments and as a result have designed a retort which they claim is superior to any other. Large scale trials gave credence to their statements.

CONCLUSION -

There is as yet no oil shale industry in Tasmania. Since the nineties a considerable amount of work has been performed on oil shale, and although it cannot be said that oil has been produced on a commercial scale, the pioneers of this industry have as a result of their works given us a great amount of valuable information relating to the peculiarities of these shales, and the nature of their products. It has been found that the problem is not merely the producing of oil; it is the producing of a uniformly good oil as a continuous operation. The establishment of the industry has been delayed because of a lack of appreciation of the problems confronting investigators a tendency to make light of difficulties, and not make provision for overcoming them, as a result we have two idle retorting plants. However, it now appears that as a result of recent researches and experiments the chief difficulties have been overcome. It has been found:-

1. That emulsification of crude oil and water can be prevented by preliminary drying of the shale,
2. That the drawing of dust into the condensers can be reduced to a minimum by the use of two or more outlets below the surface of the charge
3. That carbonisation of the walls of the retorts can be prevented by the introduction of inert gases, such as carbon monoxide and carbon dioxide, into the retort
4. That greater efficiency is obtained by the use of a large number of small retorts instead of a few large retorts.

Those were the main causes of the early failures.

(signed)

F. Blake
ASSISTANT GOVERNMENT GEOLOGIST

Mines Department,
Hobart,
8th May, 1928

APPENDIX 5

Henderson UR1944_043-45

THE OONAH TASMANITE OIL-SHALE FIELD.Introduction -

As no specific data regarding the commercial possibilities of the unprospected Oonah Tasmanite area, discovered in 1923, were available in Departmental records, it was decided that a preliminary examination of the deposit be made in order to assess the amount of prospecting required to establish the extent, seam thickness and oil yield.

Mr. D.M. Dickinson, Extension Officer, and the writer were engaged upon the preliminary investigation from the 14th to 16th September, 1944, inclusive, and obtained outcrop samples which, upon analysis in the Departmental laboratory, Launceston, indicated that the oil yield would be at least of the order of the general average of the Latrobe shale (26 gallons per ton). As it was not possible to obtain reliable information regarding seam thickness and grade, owing to the complete lack of any developmental work and the paucity of outcrops, it was further decided that shaft sinking in the vicinity of the known outcrops was necessary.

The only reference to this area contained in official publications of the Geological Survey is in "Report of the Tasmanian Shale Oil Investigation Committee" Mineral Resources No. 8, Vol. 11, p.103, Area XIV (Oonah).

Location and Access -

This shale area is situated in the Oonah district, 15 miles south of Wynyard and approximately one mile north-east of the Oonah State School.

With the exception of a small area of crown land, all the known shale area occurs on private land charted in the following names - William Cross 79 acres; E. Hodgetts 198 acres; J. Martin 150 acres; W. Chawns 65 acres; Agricultural Bank 95 acres; H. F. Miles 157 acres; portion of P.R.C. Hays 263 acres; and 130 acres of crownland (previously charted in the name of H.H. Lennox). Apart from Hodgetts' property the area has been abandoned as a farming centre and is fast returning to wilderness. These blocks with the exception of that of William Cross comprise a tract of country near Oonah, while that of William Cross forms a small outlying area in the valley of the Cam River near the Eastern Branch of the river, some three miles to the north-east.

The area is one of high relief, being portion of the deeply dissected, basalt covered upland of the north-west. Many destructional forms exist in the shape of fault scarps, with a general east-west trend, one at least 400 feet high.

Access to the actual shale area is provided by Hodgetts' access road which turns north from the Oonah State School and drops down a steep grade nearly six hundred feet to Jackson's boundary where the metalled road ends. All other access roads are overgrown and practically impassable for motor traffic.

General Geology -

The Tasmanite shale seam is interbedded with the rocks of the Permo-Carboniferous and occurs at a horizon between the Lower and Upper Marine Series. Generally, this horizon is represented by fresh water sediments containing seams of coal or carbonaceous shale, but the Tasmanite seams occur under marine conditions.

As a result of large intrusions of dolerite, with associated faulting, combined with subsequent denudation of the overlying rocks and sometimes the shale seam, the Permo-Carboniferous rocks occur in a number of more or less separate blocks at different altitudes, the blocks being separated and bounded by dolerite intrusions and faults respectively.

Although the Mesozoic dolerites do not outcrop in the immediate vicinity of the shale outcrops, they can be observed on the main Waratah Highway about one mile south of the Oonah settlement.

There is an exposed thickness of approximately 400 feet of pebbly mudstone overlain by at least 300 feet of basalt. It is apparent from the disposition of the known outcrops that considerable block faulting has taken place so that no idea of the stratigraphical thickness exposed can be obtained without detailed mapping.

The highest shale outcrop occurs about 250 feet below the base of the basalt, and the most northerly another 100 feet lower,

The deep soil cover and heavy growth of bracken render the matter of tracing the shale outcrop very difficult particularly in the vicinity of the edge of the basalt where large slump areas have developed.

Although it has been established that the shale horizon occurs about 600 feet above the basal conglomerate series in the Latrobe area, the relative position of the seam in relation to the basal conglomerate series so well developed in the Hellyer Gorge just south of the Oonah area was not established during the preliminary investigation and owing to the disappointing results obtained in shaft sinking, the matter of the southerly extension of the shale below the basalt was not investigated further.

Economic Geology -

The shale seam outcrops in a small creek flowing in a northerly direction through the above land blocks. Dip readings suggest a southerly dip of about eight degrees; therefore, if the shale seam persists in a northerly direction without serious faulting then a considerable area of the seam would be denuded away, but it is known that some block faulting has taken place although the actual amount of displacement is unknown.

Four grab samples taken from outcrop material, No. 1 sample being the only one actually broken from an outcrop, during the preliminary investigation, indicated that oil-shale of average grade could be anticipated. The following results show the indicated oil yield obtained when the samples were examined in the Department of Mines Laboratory, Launceston:

<u>Sample No.</u>	<u>Registered No.</u>	<u>Ash</u>	<u>Oil Yield</u>	<u>Remarks</u>
1.	403	81.4 per cent	equivalent to 21 gals. per ton	Outcrop material
2.	404	91.4 " "	equivalent to 5 gals. per ton	loose matter
3.	405	82.7 " "	equivalent to 19 gals. per ton	loose matter
4.	406	86.5 " "	equivalent to 13 gals. per ton	loose matter

The Extension Officer, Mr. D.R. Dickinson advises that the following results were obtained when the shale seam was prospected for the purpose of obtaining reliable figures of seam thickness and oil yield.

"The outcrops were explored with the object of determining the thickness of the seam.

The first trench revealed a lens of shale ten feet long with a maximum thickness of 12 inches. This was sampled with the following result - No. 412. Ash 91.2% equivalent to 6 gallons of oil per ton. Another cut showed 18 inches of shale and a shaft a similar amount of shale assaying, No. 413. Ash 84.5% equivalent to 16 gallons of oil per ton.

It is, therefore, evident that the seam exposed at the known outcrops is too thin and too poor to be of commercial importance. It is underlain by from one to two feet of oil spore mudstone, under which is the basal blue pebbly mudstone.

It is possible that another band of shale could occur above the one investigated but there is no outcrop evidence of this. There has not been sufficient exploration over the whole area for any definite statement to be made in the matter, but in the portion that has been closely examined, there is little continuity in the outcrop and it is quite probable that only one thin seam is represented".

Conclusions

The limits of this basin are very indefinite, and in view of the paucity of information no attempt should be made to indicate possible reserves.

As it had not been demonstrated that the Oonah oil-shale field did not possess features that might render its commercial possibilities more attractive than any other known Tasmanite oil-shale field some prospecting was justified, but the results of the recent prospecting operations have proved beyond doubt that the oil-shale seam is too thin and the oil-yield too low to anticipate any productive possibility on a commercial scale.

(Q.J. Henderson)
FIELD GEOLOGIST.

Department of Mines,
HOBART

1st November, 1944.

APPENDIX 6

Oonah drilling, Petroquest 1982.
Extracts of open file report 82-1788

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MITRE GEOPHYSICS PTY LTD

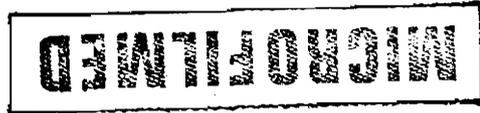
MINERAL EXPLORATION AND ENGINEERING CONSULTANTS

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A REPORT ON GEOPHYSICAL WELL-LOGS

FOR OIL-SHALE, TASMANIA



for

GENERAL GEOLOGICAL SERVICES



by

Dr. J.R. BISHOP

GGG/MG81/08

July, 1981

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(scale 1:500,000)

In Separate Volume

- Vol 2 { Hellyer
H01, H05, H06, H08, H09, H10, H11, H12, H13, H14, H15
- { Preolenna
 P01, P02
- Vol 3 { Latrobe
L01, L03, L04, L06, L08
- { Golden Valley
 G03, G04, G07, G08, G09, G10, G12
- { Beaconsfield (Bacala)
 B01, B02, B05a, B05b.

Transparencies Held



SUMMARY

Mitre Geophysics undertook the responsibility for the production and interpretation of the geophysical well-logging which formed part of an exploration program for oil-shale carried out by General Geological Services on behalf of Petro-Quest Pty. Ltd.

The area explored was covered by four EL's (EL's 17/79, 18/79, 19/79 and 21/79) located in northern and north-western Tasmania. Oil-shale (tasmanites) has been known in the area since the 19th century and it occurs in the Lower Permian above a Permian-Carboniferous tillite. A total of forty one holes was drilled of which twenty seven were logged. Four more holes were drilled for coal near Preolenna to the west of EL 17/79; two of these were logged and the results are included in this report (but not summarised). The holes were logged for single point resistance, self potential, gamma and density using a SIE T450 hand operated logger. Ten holes were later relogged for density plus hole diameter (with an electrically operated T450). A few holes show small discrepancies between the electric and nuclear logs. These have mostly occurred early in the project, where a slightly different datum was used for a second logging of the hole (the density log was not available at the beginning of the project).

The bulk of this report is a detailed description of the responses of the various logs in each hole. This makes rather tedious reading and a summary of the results from each area is given here. It is emphasised that only the holes geophysically logged are discussed here and holes not logged may have intersected oil-shale, although no significant intersections were made.

Hellyer:

H01 - H15: Holes H02 and H03 were not drilled, H04 and H07 collapsed before they could be logged; thus eleven holes were logged. Tasmanites was recognised in two holes, H13 and H15. These were detected by the density log which showed two zones at 15 and 16m. in H13 and one at 8.3m. in H15, all less than half a metre thick. However similar



responses were recognised in the density logs from several other holes. These are indicated in Table 1 and discussed below.

H01 shows up to ten zones of interest, whereas other holes have usually shown a maximum of two or three. There is no caliper log to show the hole diameter, but since the density tool has stuck in this hole on more than one occasion, diameter changes are likely. H01 has very questionable potential zones.

H02 and H03 were not drilled, H04 collapsed before it was logged.

H05 drilled 25.75m. (total depth) of basalt.

H06. Three major density responses at 7, 11 and 13.5m., up to 1m. wide, occur with lesser zones at 8.7, 10 and 16.3m. A caliper log confirms that they are not responses to changes in hole diameter. The zones would appear to be too high in the sequence since the hole was continued to 87m. without reaching basement. These zones are above the cored section of the hole.

H07 was bulldozed over during road repairs before logging was attempted.

H08 reached basement (tillite) at 30m. The density log extended to 27m. without detecting any possible oil-shale zones. Since the hole was cored from 26.5m. to 35.6m. (in sandstones and tillite), it may be considered devoid of interest.

H09 intersected basement (tillite) at 56.3m. The hole was cored from 9.2 to 56.3m. and although no tasmanites was recorded, the density log has defined zones of interest at 7 and 15.7m. The caliper log confirms the interest. The responses are less than half a metre thick and suggest only low concentrations of tasmanites. A re-examination of the core from 12 to 18m. is recommended.

H10 intersected basement at 49.2m. The density log extended to 47m. The intervening distance was part of the cored section (45 to 50.5m.). No prospective zones were detected.



H11 reached a basaltic basement at 37.5m.; presumably a sill, and hence the possibility of Permian sediments continuing below the basalt. The density log extended to 34.3m. A zone of apparently lower density at 16.5m. probably correlates with a response on the electric logs at 17.3m. (incorrect zeroing of one of the probes); the less resistive, and positive SP responses are more likely to indicate a zone of increased permeability than oil-shale, however the grab samples around 17m. could be re-examined.

H12, the deepest hole in the project, had not intersected basement at 75.6m. Two minor responses at 63 and 64m. and an even weaker one at 37.6m. are the only possible zones of interest. At best, only low concentrations of tasmanites are indicated.

H13. Tasmanites was recognised in the core at 15 and 17m. The density log shows a strong response at 15m., with a weaker one at 16m. Both zones are less than half a metre thick.

H14 was cored for its total length of 21.5m. in shale (1m.) and then mudstone. The density log shows a large response over the last two metres of the log from 16 to 18m. It is unlikely that such a large response could be due to tasmanites which has gone unnoticed in the core and it probably is due to wash out at the end of the casing which ran to 17.5m. In the absence of a caliper log, the zone is considered to be 'of interest', particularly since the hole may correlate with H15 in which tasmanites was recognised. Thus re-examination of the core is recommended.

H15. Tasmanites was observed in the core between 8 and 9m. A strong density response was recorded at 8.3m. with a weaker one at 9.3m. These zones correlate well with those in H13.

The observed tasmanites (in H13 and H15) and those more confidently predicted from the density logs (H06, H09, H14) all came from holes drilled in the Oonah area, the only area on the Burnie 1 mile geological sheet (which covers all holes except H10) where oil-shale is indicated. All zones were less than 1m. thick.



a caliper log is run, which measures (continuously) the hole diameter. Regretably this tool was not available until the end of the project and so only a few holes were caliper logged (immediately after re-logging them with the density probe).

The T450 logging system allowed calibration of the resistance and SP by switches on the recorder which placed standard resistors and voltages across the inputs. Natural gamma and density logs were checked by a weak radioactive source. The caliper log was calibrated using a standard 80mm. inside diameter tube.

Geophysical well logs are essential for open-hole drilling and are useful for correlation and confirmation in cored holes. Further, the density log may be used to define prospective zones for oil-shale; and, in an evaluation program, to determine the likely yield.

WELL LOG DESCRIPTIONS

The results of each log have been traced on to one sheet for each hole. In many cases the drafted log is a composite of more than one run. At some holes, logs of differing scales were run and these have been differentiated by using a solid line for the more sensitive scale and a dotted line for the coarser scale.

The logs are discussed area by area, starting from the north west.

Hellyer:

Nearly all of the Hellyer EL is situated within the area covered by the Burnie 1 mile series geology sheet, and all holes, except one (H10), are within the area. The map indicates that the oil-shale occurs at the base of the Permian 'Inglis Siltstone' (a mudstone with fossiliferous siltstone at top), above the Permian-Carboniferous 'Wynyard Tillite'. Near Oonah, where many of the holes were placed, three outcrops of oil-shale are indicated. The explanatory notes for the Burnie sheet (Gee, 1977) state "Small deposits of Tasmanites oil-shale occur near Oonah (643227). Henderson (1944) described the occurrence as being too small and of too low a yield to be of economic importance". More specifically, Gee (1977, p. 47) states



"The transition from Wynyard Tillite to Inglis Siltstone is rapid ... in a marked change of environment over about 5m. ... Lenticular beds of Tasmanite Oil Shale up to 0.6m. thick occur in silty mudstone from 6 to 20m. above the base of the siltstone. Tasmanites is dispersed through adjacent beds over approximately one metre".

The Hellyer holes are numbered from 01 to 15: holes H02 and H03 were not drilled and H04 and H07 collapsed before logging was attempted. Table 1 gives a list of the coverage of the various logs as well as noting the total depth and geology of the drilled section. Also noted is whether the density log shows zone(s) prospective for oil-shale (absence of a 'P' may be because the density log did not extend the whole length of the log), and whether the geological log recorded oil-shale (tasmanites) and/or basement (usually a tillite). Figure 1 shows the location of all holes drilled at a scale of 1:500,000.

H01 (TD 43.24m.)

This hole was sited within the Inglis Siltstone, but apparently did not reach its base. Resistance, SP, natural gamma and density were logged: the first three to just over 35m., and density to just under 30m. The geological log shows mudstone grading to siltstone down the hole. The electric logs show little deflection: the resistance log suggests minor variations in sandiness from 25 - 30m., although the SP is in poor agreement. The SP log has a generally characterless but sloping line; this gradual increase to the positive side of the log is due to thermal gradients down the hole. The gamma log shows only minor fluctuations. The density log in contrast shows considerable variation. The log was repeated down to 8m. (and the original log shifted to the left). The agreement is generally good, but unfortunately no caliper log was run in this hole; so it is not possible to judge to what extent the density log variations are due to changes in hole diameter (the bit diameter was changed from 4½ inches to 3⅞ inches at 21m: the density log shows the decrease in diameter at 20m). The rather rapid variations, of the order of 1m. or less, suggest a lithological cause and thus the density log may be indicating thin, less-dense bands within the top fifteen metres of the hole, with two thicker bands at 25 and 27m. Inspection of hole H15 where tasmanites was found shows that the responses on the



log for H01 are not dissimilar. However, to restate the above, more definite statements cannot be made without a caliper log. This hole was not logged by caliper (and relogged with density) since the density probe had stuck badly during the original logging of the hole and it was decided not to risk this tool again (regulations in all states demand that radioactive sources have to be retrieved).

H05 (TD 25.75m.)

This hole was presumably placed on the edge of the (indicated) basalt to allow as great a thickness as possible of Inglis siltstone to be intersected, however the hole was abandoned after nearly 26m. of basalt. The logging results are therefore of little relevance. Nevertheless the logs are examined here for comparison with responses from other holes. All logs (except caliper) were carried out to a depth of about 17m. Despite a good grounding for the earth electrode, resistance was in excess of 1000 ohms, which suggests a fairly fresh rock. The rapid excursions at 13.3m. and 14.3m. with corresponding deflections in the SP log indicate narrow joints or fractures. The sharp decrease in resistance above 5.5m., again with a corresponding shift in the SP log, suggests a change from fresh to weathered rock. This is supported by the density log which shows a decrease in density above 5.5m. (however a wider drilling bit was used above 6m.). The natural gamma ray activity is very low, less than 10 cps.

H06 (TD 56.98m.)

This hole was drilled in the Oonah area, near the known occurrences of oil-shale. All logs, including caliper, were run in this hole. SP and density were repeated. The electric and gamma logs went within 1.5m. of the hole's total depth of 57m., the density and caliper to within 6m. The repeated density log (solid line) shows that the later density probe (owned by GGS) has better shielding, giving a lower background count of direct gamma rays. The hole diameter according to the caliper log is 175mm. (6.89 ins.) which is quite different to the 98mm. (3.88 ins.) stated in the geologist's log. The caliper shows a clean hole, which was apparently not reamed out. It seems likely that the caliper log was incorrectly calibrated and that it shows the true variations in hole diameter, but with a 75mm. (3 ins.) bias.



There are two zones within this hole which have caused responses in all four logs. The zones are at 20.5m. and 24.5m. The zones are thin (less than .5m.), resistive, dense and have a low gamma ray activity (cherty bands?). Similar but less well developed responses occur at 46m. and 48.3m.

Of more interest are a series of narrow bands of lower density above 20m. The caliper log shows only minor variations, perhaps enough to confirm a weaker rock type, coincident with the density lows on the logs. Major bands occur at 7m. (about 1m. wide), 11m. (about .3m. wide) and 13.5m. (about .8m. wide); lesser zones occur at 8.7, 10 and 16.3m. From the description of Gee (1977), such bands are too high in the sequence to be oil-shales, however such density lows, with no changes on the other logs, are not inconsistent with bands of oil-shale. A further deflection at 46.3m. may also be included in the zones of possible interest.

Casing is recorded as being to a depth of 3m., however the caliper log clearly shows it to a depth of 2m., suggesting that a different reference level was used. The SP log shows the drift that was noted in H01, and again a thermal gradient down the hole is the suspected cause.

H08 (TD 35.59m.)

All logs except caliper were run in this hole: electric and gamma to within half a metre of the end of hole, but density short some 8.5m. This hole is about 2km. south east of H06 and as estimated from the 1:50,000 scale map, with 20m. contours, it is collared about 40m. lower than H06 (at approx. 440m. asl). No section of this hole is directly correlatable with any part of H06 but the logs are similar in character. The narrow zones are again evident in this log, more numerous and probably thinner (the geological log records an increased amount of siltstone in this region).

The gamma log shows a slight increase coincident with the shale at 26m., but shows no significant decrease within the 3m. of sandstone below this. The contact with the tillite is not evident on either the resistance



or gamma logs (the density log did not extend this far), however the SP does show a change from the 'shale-line' to a 'sand-line' over a 5m. interval.

The density log shows two distinct zones; a change at 12m. (lower density above, higher below), which is coincident with a change in bit size. There is no evidence of the narrow, less-dense bands of H06.

H09 (TD 56.31m.)

All logs were run in this hole, including caliper: all started less than a metre from the bottom of the hole, except for the density log at about 1.5m. However the water table was down to about 31m. (above which electrical logs cannot be used). The gamma log was repeated and the discrepancies illustrate the magnitude of the statistical scatter.

H09 is among the Oonah group of holes, about half a km. north of H06, and, like H08, about 40m. lower. Tasmanites outcrops in a pit 100 to 200m. east of H09, and less than 10 or 20m. (?) below the collar height.

The resistance log shows large deflections at 36.3m. and 51m., the former with a corresponding SP response. The gamma log shows only minor changes, proved real where the repeated log is in agreement, however none are of sufficient size to warrant comment. The zone at 36.5m. has a small corresponding drop in density indicated. Thus these thin, resistive zones may be similar in character to those observed in H06 and H08, but here they are relatively less dense.

The density was relogged, with the caliper tool, about two months after the initial logging. The sudden apparent change in density at about 23m. is due to the water table (the first density logged shows a similar deflection, but at about 31m., the water table level indicated on the electric logs).

There are two minor zones of decreased density; one at 7m., the other at 15.7m. Both zones are less than half a metre thick and while they do not indicate high concentrations of oil-shale, they are zones of



The SP log again shows drift suggesting temperature variations in the bore hole column of fluid.

H10 (TD 50.47m.)

H10 is about 3km. south of Oonah. With an estimated altitude of 500m. asl, this hole is some tens of metres higher than those at Oonah.

All properties were logged on this hole, and all extended to depths between 46 and 47m. This hole has passed through a wider range of rock types than those described above and at least one of the logs has responded to each lithological change.

Both the density and gamma logs show increases below the alluvium (large excursions in the density log signify variations within the overburden). The peat layer at 21m. is characterised by decreases in both the density and level of gamma ray activity. Their responses suggest a thickness of 1.5 to 2m. and at a slightly shallower depth than indicated on the geological log.

The resistance and SP logs suggest that the clay (22m. to 35.6m.) is uniform only from 27m., there being minor variations in the electric and gamma logs above this level. The contact between the clay and siltstone is reflected on all logs (and at the same level as the geological log) - the gamma and density logs both showing a marked increase. None of the logs extended to the contact with the tillite (the granite indicated on the log has a thickness of 14cm., and is presumably a boulder within the tillite).

Apart from the peat (?), the density log shows no zones of lower density which may be of potential interest.

H11 (TD 37.81m.)

H11 is about 3km. south west of Oonah, with an estimated collar height of 480m. asl. The electric and gamma logs extend to 37m., and the density log to 34.4m.

020



All logs show little change, reflecting the uniform mudstone sequence with variable percentages of siltstone. There are minor exceptions in the electric logs; the most notable being at 17.5m. where there is a less than 1m. thick conductive zone.

The gamma log shows mainly statistical fluctuations below the water table (9m.), but above this it shows variable clay content in the near-surface mudstone and in the weathered zone. The density shows a count decrease going below the water table and a further decrease at the change in drill bit size at 14m. (recorded on the geological log at 15m.).

The basalt at the bottom of the hole was not reached by any of the logs, however the decrease in the gamma count at the end of the log may be an indication of the less radioactive formation.

The density log shows a less-dense zone, less than 1m. thick, at about 16.5m.; the deflection is, however, only slight.

H12 (TD 75.55m.)

This hole is 3km. (approx.) west of Oonah, and is the deepest hole in the oil-shale project (all other holes being less than 60m.).

The electric logs went to the end of the hole, the density to about 1m. short and the gamma log 1m. over (!). The SP curve has been drafted up from two logs.

The geological log shows a series of mudstones with two shaley patches at 4 to 12m. and 23 to 27m.; the geophysical logs reflect this uniformity, showing little change. The electric logs show two sharp, narrow deflections, about 5m. apart, near the 50m. mark. These sandier zones are slightly denser and have a lower gamma activity. These zones are similar to two markers on the electric logs of H06 about 4.5m. apart near 23m. and thus a tentative correlation can be made between these two holes which are approximately the same height above sea level. However the less-dense zones which occur above these markers in H06 are not in evidence in H12.

The gamma has responded to variations in shale content near the surface,



but shows little other change, apart from the two zones described above. The step in density at 26m. agrees with the change in bit size, recorded in the geological log at 26.9m. Two minor variations in the density log at 63 and 64m., and an even smaller one at 37.6m. are the only possible zones of interest. Unfortunately a caliper log is not available to confirm that these zones are of a lower density.

H13 (TD 46.07m.)

This hole is among the 'Oonah holes', being about $\frac{1}{2}$ km. from H06. All properties were logged; the electric logs to 44.2m., the gamma to 43.3m., one density to 43m., a repeat run to 40m., and the caliper to 43m.

The geological log shows a monotonous sequence of mudstones throughout the hole, with the exception of about 1m. of shale near the surface. The gamma log, which might be expected to respond to the shale, shows an increased count about 1m. shallower. Further down the hole there are similar mismatches between aligned responses on the gamma and density logs and responses on the electric logs. These features occur between 20 and 30m., and are similar to those noted in holes H06 and H12. That is, thin (≈ 20 cm.) resistive and dense bands with a strong SP response and with a lower gamma ray activity. On the electric logs, these bands occur at 21.2m., 24.3m., 25.7m., 27m. Similar electrical responses occur below this, but they do not have the associated nuclear log responses. At 38.7m., the electric logs show a contact zone, with a sandier zone below (higher resistance and a more negative SP). The gamma log also defines the contact (at about 38m.), and a slightly lower activity reinforces the interpretation of a sandier zone.

However it is in the density log that most interest occurs, since tasmanites was recognised in the core at 15m. and 17m. The density log shows a narrow (about .5m.) band of (much) less dense rock at 15m. and a second, poorer band at 16m.; the response at 17m. is within the background level. The higher band is also very resistive (given the .7m. mismatch between these logs). The later density probe (run with the caliper log) shows a more sensitive response to changes in formational density than the earlier probe with its higher background count level. The caliper log shows a remarkably uniform hole diameter below about 5m., confirming that the variations in the density log are due to changes in



The mismatch of about .7m. between the electric and nuclear logs suggests that one of the sets of logs was incorrectly zeroed at the drill-hole collar. The top section of the SP log was repeated due to thermally-caused drift. The lack of repetition suggests that there was still a considerable amount of electrochemical activity in the hole.

H14 (TD 21.45m.)

This hole is in the Onah area; it was abandoned at 21.5m. due to drilling problems. The hole was dry and only gamma and density were logged.

The gamma log shows an atypical narrow band of markedly decreased radioactivity at 7m. The corresponding density deflection shows it to be more dense. The hole was cored and no different lithology was noted. Presumably the geophysical logs have responded to a sandier, more compact layer within the mudstone.

At 15.5m. the density logs show a strong increase in counts; this may be due to wash out at the end of the casing, but the possibility of tasmanites cannot be discounted. A dense, low gamma zone at 5.5m. in drill hole H15 occurs above tasmanites and although in H14 this zone is more marked and further from the density decrease, the similarities with H15 suggest that the two holes may be correlatable, and that therefore the density decrease is due to a concentration of tasmanites (unfortunately the altitude of H14 is not known).

H15 (TD 39.33m.)

All properties were logged in this hole; electric and gamma logs to 36.5m., the two density logs to 29 and 36.8m., and the caliper to 29.5m.

Tasmanites was observed in the core between 8 and 9m. The density log shows a strong response at 8.3m., with a weaker one below. The stronger zone has a corresponding resistance response and this band of tasmanites clearly correlates with that defined in drill hole H13. Also correlatable are the narrow, resistive and dense bands of low gamma activity that occur at 18m., 21m. and 27.8m. in H15.



Matching the electric logs of H13 and H15 with the resistive tasmanites responses opposite each other (there are also characteristic 'lobes' on both logs), it can be seen that there is not an exact correspondence between the narrow zones mentioned above, but the resistive layer below 39m. in H13 closely agrees with a similar response below 29.5m. in H15 (unlike H14, there is no SP response to this zone).

H13 and H15 are about .5km. apart and it appears that the band of tasmanites, the narrow dense, resistive zones and the sandier layer within the mudstone may all be correlated from one hole to the other. The difference in depths below the surface being 8 to 10m., i.e. 10m. on H15 correlates approximately with 20m. on H13.

TABLE 1

WELL-LOGS OF THE HELLYER AREA

BORE HOLE	G E O P H Y S I C A L M E T H O D S (intervals logged in metres)					TOTAL DEPTH (m)	PROSPECTIVE ZONES INTERPRETED	GEOLOGY ^{t,b}	APPROXIMATE LOCATION (AMG)
	Single Point Resistance	Self Potential	Natural Gamma	Density	Caliper				
H01	2.0 - 35.4	2.0 - 35.3	0.5 - 35.4	2.1 - 29.9		43.24	P (?)	Inglis Sltst.	381,600mE 5,452,000mN
H02		not drilled							
H03		not drilled							
H04		collapsed before logging attempted							376,400mE 5,441,400mN
H05	0.0 - 17.2	0.0 - 17.3	0.7 - 17.2	1.2 - 17.0		25.75		Basalt	382,200mE 5,438,200mN
H06	1.7 - 55.6	2.1 - 55.5	0.4 - 55.8	0.5 - 48.9	0.8 - 49.6	56.98	P	Inglis Sltst.	384,800mE 5,434,800mN
H07		collapsed before logging attempted							385,600mE 5,434,800mN
H08	3.0 - 35.0	3.0 - 34.9	0.4 - 35.0	3.0 - 27.0		35.59		Inglis ^b Sltst.	386,000mE 5,434,300mN
H09	31.1 - 56.0	31.4 - 56.0	0.4 - 55.5	0.7 - 54.9	0.8 - 55.8	56.31	P	Inglis ^b Sltst.	384,700mE 5,435,500mN
H10	6.7 - 47.0	0.0 - 47.0	0.3 - 46.6	0.5 - 46.6	0.8 - 47.0	50.47		Inglis ^b Sltst.	384,000mE 5,432,200mN
H11	8.9 - 37.0	5.6 - 37.0	0.3 - 37.0	0.3 - 34.4		37.81	P (?)	Inglis ^b Sltst.	381,800mE 5,432,900mN
H12	7.6 - 75.5	7.7 - 75.2	0.4 - 76.5	7.6 - 74.5		75.55	P	Inglis Sltst.	382,100mE 5,435,500mN
H13	2.4 - 44.2	2.1 - 44.1	0.6 - 43.3	2.0 - 43.0	0.8 - 43.1	46.07	P	Inglis ^t Sltst.	385,100mE 5,434,900mN
H14	dry	dry	0.2 - 19.0	0.2 - 18.0		21.45	P	Inglis Sltst.	385,---mE 5,434,---mN (?)
H15	0.2 - 36.5	0.2 - 36.3	0.5 - 36.4	1.3 - 36.8	0.7 - 29.5	39.33 488.56	P	Inglis ^t Sltst.	384,900mE 5,435,300mN

^t : indicates that 'tasmanites' was recorded in the geological log

^b : indicates that basement was reached

