TASMANIA DEVELOPMENT AND RESOURCES

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The search for petroleum, onshore Tasmania

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INTRODUCTION

Traces of petroleum hydrocarbons have been found in a number of rock types in Tasmania for over a century, and this has led to some flamboyant and energetic efforts in the search for economic oil deposits onshore. A number of shallow holes have been drilled without encountering confirmed, properly documented, or reproducible oil or gas shows. Many seeps of oil and gas have been reported, although subsequent investigation has usually shown that the reported observations are not indicative of petroleum hydrocarbons. Pieces of transported asphaltum have been found at various localities around the Tasmanian coastline.

Petroleum has never been produced in Tasmania, with definite evidence of reservoired oil and gas being currently restricted to the offshore Bass Basin. Exploration offshore commenced in 1961 and continues today at modest levels. Shows of hydrocarbons were first noted in the third well drilled in the Bass Basin (Bass 3) drilled in 1967. To date 36 deep exploration wells have been drilled offshore, with oil and/or gas recorded in ten of these (Appendix 2).

A substantial resource of gas and some light oil was indicated by the results from the Yolla 1 well, drilled in 1985. In 1988 the Bureau of Mineral Resources (BMR) calculated *in situ* volumes of 145 bcf raw gas and 41 million barrels of oil in the proven and probable categories, and 340 bcf gas in the possible category (Morrison *et al.*, 1989).

Now, some 34 years after the first well was drilled in the Bass Basin, the economic viability of any oil or gas field remains to be established.

Small deposits of Late Carboniferous oil shale in northern Tasmania have been investigated on several occasions as a potential source of hydrocarbons or road bitumen, and the shale has been mined intermittently since the 1860s. During the 1930s a number of experimental retorts were used by different companies to produce a variety of fuels and fuel products, although none of the retorts operated as a commercial success. The oil in the shale is derived from microfossil algal cysts or algal bodies, which release hydrocarbons when heated. Recent exploration has indicated *in situ* resources of 40 million tonnes of oil shale, although no commercial application exists for the products which can be produced. A detailed history of the search for oil shale is given in Bacon (1986*a*), and photographs of various distilling works are shown in Plates 1 to 7.

Given an appropriate thermal history, many rocks may eventually yield some petroleum hydrocarbons. Traces of oil have been reported in a number of Tasmanian rocks such as Gordon Group limestone, the Woody Island Siltstone and the *Tasmanites* oil shale, which sometimes smells petroliferous when pieces are freshly broken.

There is, however, no essential link between recognition of trace quantities of petroleum hydrocarbons in a rock and establishing a commercially viable oil/gas field. Many factors must first be assessed and confirmed.

This report reviews the historical reports of occurrences of oil and gas onshore and compares the hydrocarbon content, chemistry and thermal maturity of spot samples from various potential source rocks. Some explanations are offered for the various historical observations.

SEEPS AND GAS SHOWS: HISTORICAL SIGNIFICANCE

The existence of petroleum deposits has been noticed in many places by individuals first finding petroleum or gas oozing from the earth as a 'seep'. Natural seeps have been used as a source of bituminous materials for building purposes, medicine and lighting for millennia[1].

Ancient peoples referred to the products from oil seeps as bitumen, slime or pitch. The Bible records that the Vale of Siddim was full of slime pits (i.e. bitumen deposits) and that the Kings of Sodom and Gomorrah fled and fell there (*Genesis* 14:10). The basket in which Moses lay among the bulrushes was waterproofed with bitumen (*Exodus* 2:3), as was Noah's Ark which was "pitched within and without" (*Genesis* 6:14). Centuries later Columbus waterproofed his ships with pitch from Trinidad. The crew of the *Beagle* used finds of bitumen to waterproof their ship in 1839, after finding fragments of bitumen while drilling for water in the tidal reaches of the Victoria River, Northern Territory[2].

The famous Greek historian Herodutus (circa 484–424 BC)[3], known as the 'Father of History', recorded the existence of oil pits near Babylon. Even earlier, the Pharaoh Thothmes III exacted a tribute of bitumen from cities in Mesopotamia. Around 500 BC Alexander the Great was welcomed to Persia by people lighting oil in the street[4].

The epic poet Homer (circa 850 BC) described in the *Illiad* how "the Trojans cast up upon the swift ship unwearied fire, over her forthwith with streamed a flame that might not be quenched". The Greek historian Diodor wrote of the presence of bitumen: "whereas many incredible miracles occur in Babylonian country there is none such as the great quantity of asphalt found therein"[5].

Pliny, the Greek naturalist (circa 100 AD), described the pharmaceutical value of bitumen in glowing terms. The substance was thought to check bleeding, heal wounds, treat cataracts, relieve shortness of breath, cure diarrhoea, relieve rheumatism and fever, could be used to join severed muscles, served as a liniment for gout, and was also used for "straightening the eyelashes which inconvenience the eyes"![6] This list of wonder cures was echoed centuries later in other countries.

The ancient Chinese used natural gas from seeps to heat pans of brine and so produce salt, and also used oil for heating. Marco Polo, the famous Venetian traveller (1256–1323 AD) recorded oil at Baku on the Caspian Sea (now a major oil province), noting that "the oil was not good to use with food but it is good to burn" and that it also cured camels of the mange. Gas from seeps at Baku fuelled "Eternal Fires". Thousands of pilgrims flocked to worship at temples built around these fires[7].

In the 7th century the Byzantines used 'Greek Fire' (*oleum incendiarum*) which was a mixture of bitumen of petroleum and lime, which could be ignited by wetting. The Byzantines used the mixture on the tip of flaming arrows, in crude grenades, and tossed lumps into attacking ships. The composition was a closely guarded secret and the material was considered to be more powerful than gunpowder[8].

The Peruvians used natural bitumen as a mortar, as did the builders of Babylon and Jericho. The Mexicans made chewing gum from it, and the North American Indians use it as a medicine. The Indians collected bitumen from pools, where it was found floating on water, by lowering blankets carefully into the pools and then squeezing the oil out into bowls. This oil was called 'Seneca Oil' after the local Indian tribe, who supposedly revealed the curative secrets of the oil to white man. The oil was supposed to cure headache, toothache, deafness, worms, rheumatism and dropsy, and to heal wounds on the backs of horses and mules[9, 10]. Oil found during a water boring operation in 1848 in Pennsylvania was sold as a medicine by Samuel Kier[11].

The earliest mechanical extraction of oil from the Earth was made around 300 AD by the Chinese, who sometimes found oil when drilling for salt water with a crude drilling rig. This consisted of a chisel-shaped metal tool hung from a platform of poles, taking the rope attached to the tool over a roller. The tool was jolted up and down by means of a spring board, and the rope on the roller gradually released as the tool dug into the earth. By this means wells of up to 2000 feet deep were dug [12]. This technology was imported into Europe around 1830[13].

REPORTS OF OIL AND GAS SEEPS IN TASMANIA

An oil seep is an outcropping deposit of oil, representing either a breached seal to a trapped accumulation of oil or a migration conduit truncated by the Earth's surface. After seeping to the surface, petroleum begins to change in composition. The more volatile fractions of hydrocarbons evaporate; water soluble compounds of oxygen, nitrogen, sulphur and some of the lighter aromatics may be leached out; the oil will be eaten by bacteria and suffer microbial degradation; and exposure to sunlight will cause formation of oxidised polymers (Hunt, 1979). Although seeps often work ephemerally due to seismic re-activation of faults, evidence of a genuine seep can be easily found, sampled and confirmed. Such features are not transient; they are seen periodically or continuously.

Traditional petroleum seeps are classified as either:

1. Active (live) seeps of gas, oil, or mounds of sticky black asphalt;

2. Inactive seeps, represented by piles of asphalt or bitumen; no liquid oil present.

Materials which have been mistaken for an oil seep, but which are shown to have no connection with accumulations of petroleum, are known as false seeps.

There are no known examples in Tasmania where phenomena matching these descriptions of traditional active, or inactive, oil seeps have been found. Occurrences of bitumens are, however, known from Ordovician limestone and in one case bitumen occurs in fractures in dolerite. Traces of genuine petroleum hydrocarbons have been found in a number of rock types, and in water samples from several places. There are also innumerable examples of 'false seeps', phenomena which have, upon inspection, been shown to be unconnected to any accumulation of petroleum hydrocarbons.

Reports of oil and gas seeps made to the Tasmania Department of Mines (and its successors) have been summarised and are shown in Appendix 1. The results of any investigation, where known, is included, together with reference to the relevant correspondence. The location of these sites are shown in Figure 1.

To date, the Department has received 139 reports of oil and gas seeps. On inspection the majority of the suspected oil seeps have been shown to be caused by agents other than natural petroleum sources. The observed phenomena have been explained as:

iron oxide films on water;

water in clay soil;

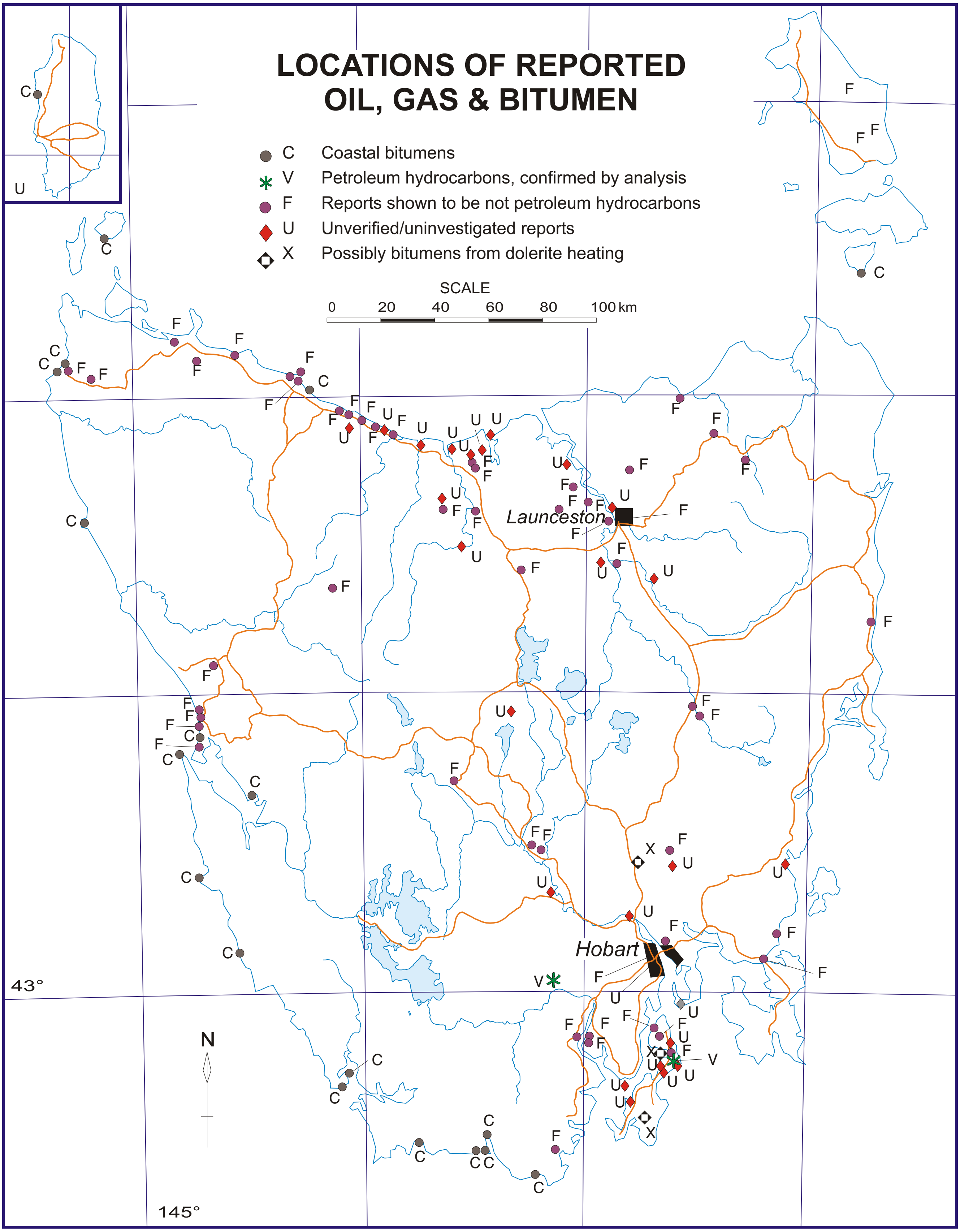
cannel coal (Pelionite);

heavy minerals (ilmenite) swirling in the sea;

bat guano;

seepage from toilets;

road bitumen;



LOCATIONS OF REPORTED OIL, GAS & BITUMEN
C Coastal bitumens
V Petroleum hydrocarbons, confirmed by analysis
F Reports shown to be not petroleum hydrocarbons
U Unverified/uninvestigated reports
X Possibly bitumens from dolerite heating
SCALE
0 20 40 60 80 100 km
Launceston
Hobart
N
43°
145°

Figure 1

decomposing vegetable matter;

a well polluted by nearby storage of petroleum oils;

puddles discoloured by mud;

Tertiary lignite, peat;

deposit of coorongite (peat-like material);

seepage from a pile of eucalypt bark;

manganese oxide;

smectite clay and other minerals;

beach strandings of bitumen;

creosote washed ashore from a shipwreck;

fuel oil from ships at sea, washed up onto the coastline;

resin from Grass Trees or Blackboys; *Xanthorrhoea sp.*;

algal scum on dams or ponds or pools of water;

sounds heard while digging a water well.

Of the 139 reports, one has been confirmed by modern analysis as being a result of petroleum hydrocarbons being generated (Lonnavale, where bitumen derived from *Tasmanites* has been found). Of the other reports:

Ten were reports of traces of petroleum hydrocarbons, which may be expected from rocks having a suitable composition and appropriate thermal history, or from water which has been in contact with such rocks.

Twenty-four reports relate to coastal bitumens, washed up by tides.

Sixty-six reports have been shown to be not related to petroleum.

Some 38 reports remain 'unverified' by either not being investigated or because there is no real evidence to either support or disprove the idea that the reported observations may be due to petroleum hydrocarbons.

Bendall (1990) lists "107 reported indications of petroleum, 127 exploration licences and the sinking of 135 drill holes (which) mark the oil exploration history of Tasmania". In later reports, such as Bendall *et al*. (1991), mention is made of "270 historical hydrocarbon occurrences", given elsewhere in the paper as ". . . reports for 35 drill holes, 127 oil leases and 120 other signs of either oil, tar or gas". Adding together the number of licences and leases ever held for oil exploration, the number of holes drilled and the number of reported sightings does **not** constitute a reasonable estimate of the number of reported hydrocarbon seeps in Tasmania. Brief accounts of reported seeps are given in Appendix 1 of this report, a list of holes drilled for oil and the results obtained are given in Appendix 2, and a list of tenements held is given in Appendix 4.

The mineralogist W. F. Petterd recorded an occurrence of a bitumen-like material near Chudleigh, in northern Tasmania, in his 1910 *Catalogue of the Minerals of Tasmania*. This deposit was never seen by Petterd and was described by Hills (1921*a*) as "doubtful".

Dr Arthur Wade was requested to examine alleged oil seeps on Bruny Island in 1915. He was unable to verify the existence of the reported occurrences of bitumen seeping from the ground (Wade, 1915), even though claims had been made in a company prospectus that liquid bitumen had been known to exude from two places for more than 50 years.

In 1917, W. H. Twelvetrees produced a small booklet entitled *The Search for Petroleum in Tasmania* to be given to interested members of the public. Twelvetrees documented the finds of bitumen on the south and west coasts, and outlined the nature and origin of petroleum, and the relationship of oil fields to structural geology. Twelvetrees noted that in Tasmania "unequivocal indications of any native oil are so far not apparent", and recommended that prospecting schemes be based on signs and evidences at the surface, followed by "geologically correct drilling" (Twelvetrees, 1917).

In the early 1920s Loftus Hills engaged in a fairly energetic campaign to stop the never-ending flow of enthusiastic press articles relating to the search for petroleum in Tasmania. Hills was particularly irritated at what he saw as a misrepresentation of geological facts by enthusiastic and even unscrupulous entrepreneurs. This controversy is detailed in Bacon (1996).

Hills wrote to the Minister for Mines in December 1921 commenting on proposals put to the Government by J. T. Moate and the Adelaide Oil Exploration Company Ltd; in particular Hills was scathing of the request for the Geological Survey to carry out geological surveys searching for oil. Hills argued that this would repeat work already done, and stated;

> ". . . it must be remembered that we already possess very definite knowledge in regard to the salient geological features in Tasmania controlling the occurrence of oil. We possess this to such an extent that it can be definitely stated, and is now so stated by me, that 21,000 square miles of Tasmania has no possibility of containing liquid oil. Of the remaining 5000 square miles which is country of which we know very little, the greater part, we have

evidence I believe, is most unlikely from the point of view of the occurrence of oil."

Hills went on to illustrate some of the "mistaken and unbalanced conclusions" reached by speculators looking for oil, including pelionite (a coal) being mistaken for the mineral albertite (dried up petroleum). In April of the following year Hills addressed the Royal Society of Tasmania on the topic 'Tasmania's Liquid Oil Possibilities — Not Worth Investigation'.

In January 1923, an enquiry was held 'In connection with alleged friction in the Mines Department'. Correspondence was produced to show that Hills had managed to have disagreements with almost everyone in the Department — the former Secretary Wallace, the current Secretary Pretyman, the Inspectors, the Minister, and most of the Survey staff. The Commissioner heard the staff reel off lists of grievances, and Pretyman had an enormous store of petty and trivial incidents involving Hills about which he complained at length. The main problem seems to have been that (in Pretyman's words) "He (Hills) does not seem to have the tact, and he seems to have a domineering spirit" (Bacon, 1996).

Hills was relieved of his duties as Director while the Commissioner considered the case, and would have been reinstated had the Survey staff (the two Reids, Bath, Edwards the draftsman, Nye and Manson) not written to the Minister stating that "his reinstatement would lead to constant friction in the Geological Survey and other branches of the Mines Department". So although Hills was not found to have done any wrong, the Commissioner resolved the issue by abolishing the position of Director, Geological Survey and recommending that the Launceston office be moved to Hobart (Bacon, 1996).

In July 1923 Hill's position was abolished, and he was out of a job. His successor, McIntosh Reid, wasted no time writing a report which he "designed to lend encouragement to the companies engaged in oil exploration in areas where the conditions are favourable". Reid conceded that ". . . the work of some of the companies has not been well advised" and overall the report was not greatly encouraging, but the writing was a great deal more tactful than the work of Hills (Reid, 1923*a*).

Significantly, Reid did consider some of the sightings of oil to be genuine. These were:

globules rising to surface when bedrock struck at Johnson's well on Bruny Island (Reid, 1929);

an oily scum on a backwater in Miles Creek, Bruny Island (Reid, 1929);

a thick scum of oil on water in 10' (3 m) deep shaft dug next to Ray Creek, Nook. The shaft was sited next to a fault cutting Parmeener Supergroup sediments, a seam of coal being exposed on one side of the fault and a four foot (1.2 m) thick seam of *Tasmanites* oil shale on the other (Reid, 1923*a*);

another seep noted downstream from the above (Reid, 1923*a*);

oil seeping from Tertiary strata where tree stumps had been removed by fire on Rockcliffe's land, Mersey Valley (Reid, 1923*b*);

on the property of P. Roche, Sassafras, only active after heavy rainfall (Reid, 1923*a*).

Reid suspected that the oil seen at Nook had been produced by local heating of sediments by dolerite (Reid, 1923*a*). Unfortunately none of these sightings were confirmed by analysis, and none have been reported again to the Department.

After Reid's encouragement, drilling in the in the Permo-Carboniferous beds in the Mersey Valley stopped, and attention was directed at the Tertiary strata.

Reid was the only Government Geologist to consider any of these reported sightings of oil to be genuine. In March 1935, the Secretary of the Geological Advisory Committee of the Commonwealth Oil Refineries Ltd wrote to the Secretary for Mines asking, rather pointedly, "if anyone other than Reid" had verified the existence of the seepages, in view of the negative results from all the drilling in the Mersey Valley[14]. Reids' 1929 report on Bruny Island was made "as a result of prospecting under the superintendence of Mr A. G. Black, undertaken for a syndicate formed in Hobart"[15], so it is possible that it was couched in the most positive terms.

Reid may also have been the only geologist interested in oil exploration. He did not produce any positive reports while Hills was Director — and as Hills was of the view that oil exploration in Tasmania was a waste of time, this is not surprising. On Hills' departure, Reid started writing his more positive, but still cautious, reports. Reid did note that some of the phenomena he saw were definitely not due to petroleum hydrocarbons — thus indicating that Reid did try to be objective, at least some of the time.

Yet another summary of the geology and structure of Tasmania and the possibilities of finding liquid oil was produced by Nye in 1924. Nye made no comment on the probability of finding oil, and confined himself to a brief description of work already completed. With the dismissal of Hills fresh in everyone's mind, Nye may well not have wanted to 'rock the boat' by proffering any of his own opinions, if indeed he had any. Nye had already had a taste of having to do without help, Hills having made him map the Midlands on a bicycle, without a promised car for transport. He had been admonished for losing a geological hammer, and for forgetting to pack appropriate sample jars, and was narked at not being given enough credit by Hills for his part of the coal bulletin, produced in 1922 — although the draftsman and typist were both thanked.

By 1929 Nye did have an opinion on this matter, writing that "As far as our present knowledge extends, the geological conditions are not favourable for the occurrences of oil". This view was in conflict with the hopeful and positive reports written by Reid, but by 1929 Reid's tenure was becoming shaky and his authority over the staff may have waned.

The New River area was assessed in 1929 by H. S. Lyne and the district found to be "occupied by Lower Palaeozoic rocks and to be unfavourable for the occurrence of oil". This private inspection followed the finding of bitumen strandings on the coast[16].

Reid was also on friendly terms with J. T. Moate, Chairman of the Adelaide Oil Exploration Company, the entrepreneur with whom Loftus Hills had a very public and bitter disagreement due to Moate's claims relating to oil in Tasmania (documented in Bacon, 1994). Moate wrote to Reid[17] in January 1930;

> ". . . I understood . . . that you had certain information which you were willing to impart to us, and naturally it did not then occur to me that your government would interfere with your movements to the extent mentioned in your letter. Can anything be done by Mr Darling approaching your Minister for Mines . . . It is hardly conceivable that he should wish to withhold information regarding the discovery of oil within the Commonwealth . .".

Reid replied[18] that permission to him (Reid) to travel to South Australia and furnish a confidential report to the Adelaide Oil Exploration Company had been refused, so further representations would be futile. Enigmatically, Reid hints at the possibility of finding an oil field;

> ". . . In making my investigations I found quite early that the surface revealed little, and in order to decipher subsurface structure I started the investigation of the history of geological development. That supplied the key and gave me an insight into the hidden recesses. I feel quite sure that my evidence cannot be refuted".

Reid was sacked in 1930, following an enquiry during which witnesses alleged Reid (who was Director of Mines at the time) undertook commissions to do private work for companies whilst still being employed by the Government. Although Reid denied the charge, he did admit to giving advice, but had accepted only sufficient funds to cover expenses[19].

The unhappiness generated by the persistent squabbling, both within the Geological Survey and between members of the Survey and others (entrepreneurs, ministers, members of the public), resulted in a climate where the topic of oil exploration was not discussed for many years. Whilst there are very few, if any, encouraging signs which would be of interest to the petroleum industry in general, there are some opportunities for high-risk grass-roots exploration work to fill in the knowledge database, which is still incomplete.

A kerosene substitute was retorted from oil shale during the 1930s. A full account of this activity is given in Bacon (1986*a*).

A précis of previous attempts to explore for oil in Tasmania was compiled by S. Warren Carey in 1946 at the request of the *Oil Weekly* of Texas, USA. Carey wrote that there had been "no large scale co-ordinated search for oil in Tasmania, Government or private, because prospects have not been considered sufficiently attractive to warrant such a programme". Since then there have been no further summaries of oil exploration produced by the Department of Mines until now.

A piece of bitumen was picked up by Dr D. Leaman at Barnes Bay in 1988; the sample was found oozing from dolerite joints, well above high tide mark. Analysis showed the material to be a highly differentiated tar, with much of the volatile fraction missing. The sample was not treated well after collection, being left in a parked car on a sunny day prior to analysis. The origin of the sample has not been determined.

Another occurrence of bitumen and petroleum hydrocarbons was noted by Mineral Resources Tasmania's petrologist Mr R. Bottrill at a location six kilometres northwest of Lonnavale in late 1995. The bitumen occurred in a recently used Forestry Tasmania quarry on Russell Road, at approximately 482 700 mE, 5 247 800 mN. The quarry is located in fine-grained Jurassic dolerite, close to a contact with fossiliferous Permian mudstone, which is well exposed in a small, older quarry about 300 m to the southeast. The contact is probably faulted, and Lonna Creek, striking northeast on the northwest side of the quarry, may be related to this fault.

Laboratory analysis showed that the bitumen and a liquid sample (swabbed off freshly broken dolerite) were derived from a *Tasmanites* source (Revill, 1996). No *Tasmanites* oil shale is known in southern Tasmania, but disseminated *Tasmanites* were found in the Woody Island Siltstone at Maydena (BHP, 1982*a*). While the bitumen and 'swab' samples are thought to have been derived from the same parent material, there are differences between the two in terms of maturity, with the bitumen being the more mature of the two. This may mean that either:

there have been two phases of hydrocarbon generation; or

the bitumen may represent a biodegraded fraction of one generating event; or

dolerite intrusion may have caused generation of hydrocarbons of differing maturity with distance from the intrusion (Revill, 1996).

The hydrocarbons may have been generated by the Jurassic dolerite intruding into the Permian section. Feeder complexes and complex structural features in this particular area (D. E. Leaman, pers. comm.) are likely to have contributed to the generation of hydrocarbons from a *Tasmanites* source, and facilitated migration through the now zeolite-filled fractures in the dolerite.

Suggestions have been made that oil seeps have been seen primarily after periods of intense seismic activity (Bendall *et al.*, 1991), indicating that the seeps are linked to such activity. As described in Appendix 1, most reported seeps are not indicative of petroleum hydrocarbons. The number of 'seeps' reported in any one year is more likely to be a function of the number of people looking for such phenomena.

Some rock samples taken from various places around Tasmania do show traces of petroleum hydrocarbons when subject to field inspection and/or chemical analysis. There is nothing unique or unusual about this; in fact many rocks will contain traces of petroleum hydrocarbons, given suitable composition and an appropriate thermal history. However, traces of petroleum hydrocarbons in a rock do not constitute a seep.

Most of the reported gas seeps have been either explained as, or shown to be, marsh gas produced by rotting vegetation. In recent years, gas samples have been collected from seeps at:

Kimberley (a thermal spring);

Marion Bay (gas seeping through sand in the intertidal zone);

Johnson's Well (where a stick poked into the bottom of a water-filled hole produced bubbles);

Douglas River (drill hole);

the Saw Pit, Bruny Island (bubbles seen in a water-filled pit).

The gas collected from each of these localities has been shown to be of biogenic origin, and not related to any petroleum source. The laboratory results are shown in Table 1, and the locations of the sites are shown in Figure 2.

Isotope data are used to aid the general understanding of the process of oil and gas

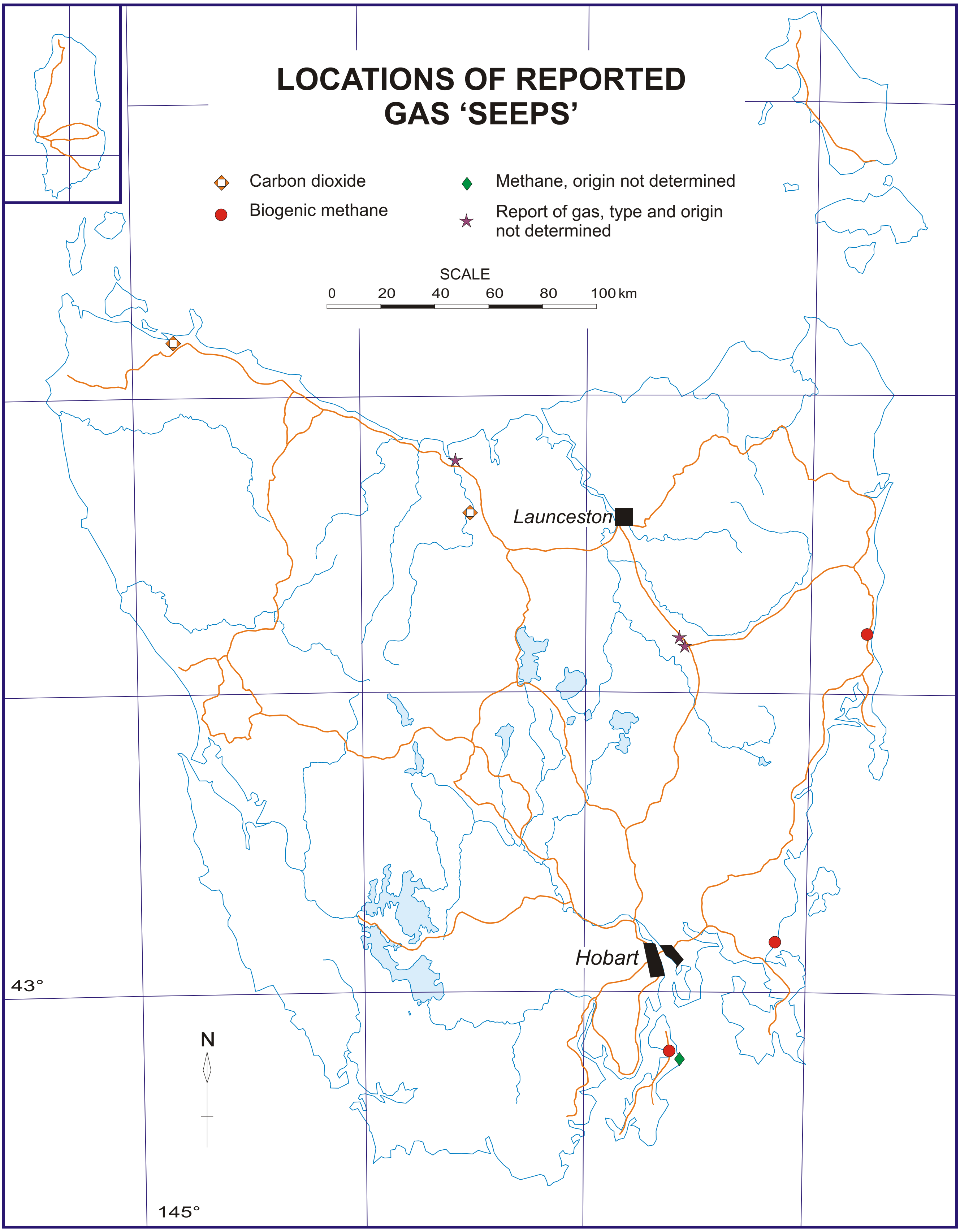
Table 1

Analyses of various gas samples

	Smithton	Kimberley	Marion Bay	Douglas River (1)	Douglas River (2)	Johnson's Well	Saw Pit	Shittim 1 (80 m)	Gilgal 1 (50 m)
Chemical analyses									
methane	0.07%	19.8 ppm	63%	68.1%	81%	70.3%	54.3%	nd	nd
carbon dioxide	59.8%	1.2%	36%	0.1%	0.1%	7.8%	7.1%	2.7%	0.4%
oxygen	8.7%	10.9%		3.2%	0%	2.4%	1.1%	16.7%	21.8%
nitrogen	31.5%	87.9%		28.6%	19%	19.4%	37.5%	80.6%	77.8%
hydrogen sulphide			1%						
ethane			possibly trace						
propane			possibly trace						
Isotopic analyses									
methane ^{13}C (‰)	-32.3 PDB	-77.4 PDB	-45.5 PDB	-66.3PDB		-55.2	-56.1		
methane ^{13}D (‰)			-348 SMOW						
CO_2 ^{13}C (‰)	-4.0 PDB	-18.2 PDB	-10.4 PDB						
CO_2 ^{18}O (‰) (3)			+27 SMOW						
CO_2 ^{18}O (‰) (3)	-4.9 PDB	-5.9 PDB							
Conclusion	CO_2 probable geothermal origin	bacterial origin	biogenic origin	biogenic origin		biogenic origin	biogenic origin		
Reference	Baillie (1992)	Baillie (1992)	Baillie (1990)	Revill and Volkman (1993) Summons (1993)		Revill and Volkman (1994)	Revill and Volkman (1994)	Revill and Volkman (1994)	Revill and Volkman (1994)

(1) Raw data (2) Data re-normalised after removing air contamination

(3) To interconvert between the PDB (International Standard Peedee Belemite) and SMOW (Standard Mean Ocean Water) scales use the equation ^{18}O SMOW = 1.03086* ^{18}O PDB + 30.86



LOCATIONS OF REPORTED
GAS 'SEEPS'
Carbon dioxide
Biogenic methane
Methane, origin not determined
Report of gas, type and origin not determined
SCALE
0
20
40
60
80
100 km
Launceston
Hobart
43°
145°
N

Figure 2

formation. The origin of petroleum (from lipid fractions of organisms) and coal (from higher plants) can be demonstrated by the use of ^{13}C data (Silverman, 1963, 1967 *in* Fuex, 1977). Isotope data can also be used to assess the origin and migration of specific hydrocarbon occurrences (Fuex, 1977). The range of ^{13}C content is a useful measure in such studies.

Methane has the largest ^{13}C range of any naturally occurring material (from –90‰ to about –13‰ PDB). Different categories of methane have distinct ^{13}C ranges (Fuex, 1977). The ranges of ^{13}C values of methane analyses from a variety of materials (from Schoell, 1983) are shown in Figure 3.

Bacteria are capable of producing methane which has been depleted in ^{13}C, a fact proved by laboratory experiments and from analyses of methane of bacterial origin (Fuex, 1977). The ^{13}C range for bacterial methane is large, and the values are evenly spread out over the range for this type of gas.

There is an overlap in ^{13}C values between –50‰ and –60‰ between methane of thermogenic origin and biogenic origin. Some very highly mature gases of thermogenic origin, such as the Ellenberger gas in the Delaware–Val Verole Basin of West Texas, may show similar chemical and isotopic analyses to gases of biogenic origin (Fuex, 1977).

In addition to the overlap between end members of different gas types, mixtures of bacterial and thermogenic gases are sometimes found. An interpretation of the origin of a gas can only be made after the isotopic, chemical and geological evidence has all been considered (Fuex, 1977).

Also included in Table 1 are the analysis results from a sample taken of gas bubbling into puddles in a paddock near Smithton. This gas was found to be carbon dioxide, with trace amounts of methane. The heavy isotopic signature of the methane (-32.3‰, Table 1) suggests a thermogenic origin (fig. 3).

A recent exploration program on Bruny Island involved the drilling of a fully-cored diamond drillhole (Shittim 1) (Plate 14). BQ coring commenced at 1020.5 m in dark grey to black organic carbon-rich shale. From 1020.5 to 1055.6 m a liberated gas level of 6–12 gas units was noted (1% methane in air gives 100 units) (Higgins, 1986).

Four samples of a trip gas were taken from the drillhole at 1528 m and analysed by GC-MS by the University of Tasmania. These samples contained methane (0.5–0.95%), hydrogen (0.007–0.06%) and ethane 2–4 ppm) (Davies, 1996). A carbon isotope value of -50.1‰ PDB has been obtained for this gas (Burrett, 1996). The analyses are shown in Table 2.

Table 2

Analysis of Shittim 1B trip gas — 1528 metres

Sample	1	2	3	4
Nitrogen (%)	78.6	78.6	78.7	78.7
Oxygen (%)	19.4	19.6	19.8	19.4
Argon (%)	0.95	0.94	0.94	0.95
Carbon dioxide (%)	0.13	0.12	0.15	0.14
Hydrogen (%)	0.007	0.05	0.06	0.06
Methane (%)	0.925	0.58	0.55	0.95
Ethane (ppm)	~4	~2	~2	~4

Analyses by Dr N. Davies, Central Science Laboratory, University of Tasmania

INLAND BITUMENS

A number of reports have been made of apparent tar or bitumen finds inland, well away from any tidal influence. One of these samples was identified as bat guano, collected from the floor of a cave, and others have been explained as burnt remains of refined petroleum products.

Local heating by dolerite of coal, shale or similar material has, in some cases, produced samples of bitumen, sometimes grading to protographite.

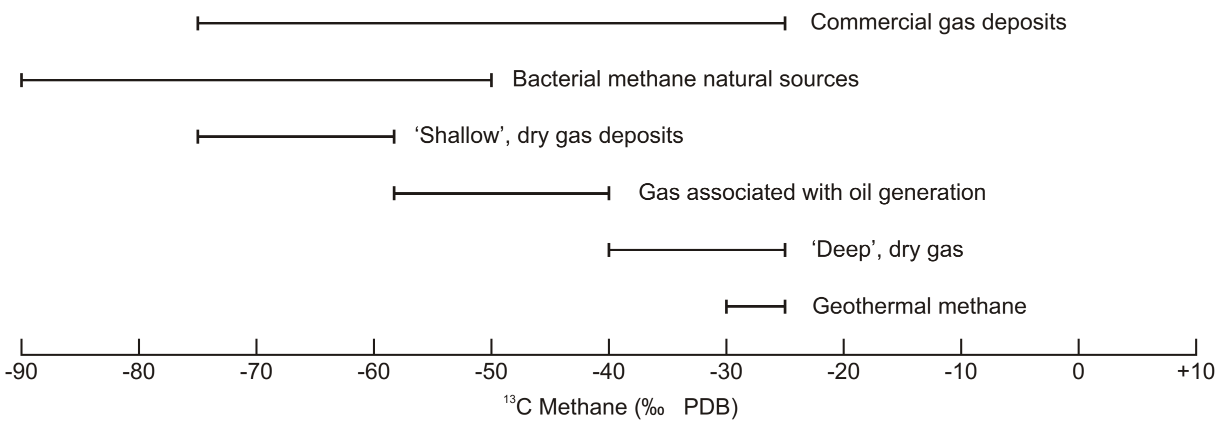


Figure 3

Carbon isotope distribution, methane gas of biogenic and thermogenic origins (from Fuex, 1983)

Bushfires can also cause tar and bitumen-like material to be produced by surface heating of organic-rich shale and burning of coal seams (see Appendix 1).

An occurrence of bitumen and oil is known from Lonnavale on Bruny Island, where the material is lodged in fractures in dolerite.

Pyrobitumens have been noted in a number of Tasmanian rocks — primarily limestone, where the rock has been heated and the contained organic matter has been 'cooked'. Pyrobitumens have been recorded from limestone collected from Benders quarry at Ida Bay, and from the Smelters quarry at Queenstown (Volkman, 1988), and can be seen in core of the Gordon Limestone from a hole drilled at Grieves Siding, near Zeehan.

These occurrences show that petroleum has been generated from these rocks at some stage, although only well-cooked traces are apparent today. The Gordon Group comprises warm-water limestone, shale and sand deposited on a continental shelf, with lagoonal mud facies, abundant algal mats and pellet beds, all common features in rocks which could be expected to have generated some petroleum at maturity temperatures.

COASTAL BITUMEN STRANDINGS

The occurrence of lumps of bitumen at various places around the southeast Australian coastline has been reported by a number of observers, one of the first being a Mr Honchim who noted that "loose pieces of a pitch like substance" had been found on the shores of Kangaroo Island off the coast of South Australia as early as 1844 (Twelvetrees, 1915). Reported findings of stranded bitumens from Tasmania are listed in Appendix 1.

These bitumens have all been found near high water mark, between "normal and storm tide levels", and have varied in weight between an "ounce or two and a hundredweight" (Twelvetrees, 1917).

Hills (1914) noted that pieces varied in size from 3 feet long by 2 feet wide (900 600 mm) down to small fragments a few inches in diameter. One fragment found on King Island was 7 feet long, 1 foot wide and 1 foot thick (2.1 0.3 0.3 m) and had not been on the granite boulders where it was found some nine weeks earlier (Pritchard, 1927).

Hills (1914) observed that some blocks were quite plastic, while other fragments were hard and brittle. The fact that the material changed on exposure to the elements was noted, as the asphaltum, when fresh, was "slightly plastic" and the "plasticity diminishes with exposure, excepting under the burning rays of the sun" (Twelvetrees, 1915).

The Government Analyst, Ward, noted that the samples tested in 1917 were slightly denser than sea water, with specific gravity values ranging from 1.0313 to 1.0459, with sea water having a specific gravity of 1.030. Twelvetrees (1917) suggested that whilst these fragments would not float in stationary sea water, they would certainly do so in moving water. The possibility exists that the stranded lumps may have lost some of the more volatile fraction on being exposed to the air. After collecting the 1915 samples Twelvetrees wrote "In the course of drying the substance it no doubt loses some of its buoyancy". Fresh exudations were thought to float and be carried along by ocean currents. Hills (1914) noted "it will just float on sea water".

The strandings of bitumen were not found every year. Twelvetrees only found three pieces of the material in 1915 although "the beaches were thoroughly and repeatedly searched". Taylor (1966) interviewed Melaleuca resident Mr Deny King, who was familiar with the bitumen strandings and told Taylor they occurred after a high tide. Taylor found none on his 1966 visit, noting that this was probably due to the fact that the last extremely high tide was in May 1964.

The asphaltum (bitumen) pieces were found resting on a wide variety of substrates — granite, limestone, conglomerate and quartzite. Twelvetrees (1915) commented that the pieces "were not actually derived from these beds respectively, but had a common origin", and that "the parent beds are not at an excessive distance (offshore). By this it is meant that they are not separated from Tasmania by thousands of miles of ocean. On the other hand the comparative rarity of specimens indicates that the beds of origin are not close in to shore, where every tide or storm would bring in fresh pieces". Hills (1914) referred to a map produced by Ward, which showed the distribution of a trend of ocean currents in the southern ocean which "will explain the known distribution of asphaltum if we assume them to be from a point in the southern ocean".

Taylor (1966) records that the local Port Davey resident Deny King had found pieces of a South American *Nothofagus* washed up, along with large pieces of pumice thought to have come from a volcanic eruption in the South Sandwich Islands in 1962, and postulated a South American origin for the bitumens.

Modern chemistry has shown that these strandings are "derived from a non-waxy crude of marine origin" (Volkman *et al.*, 1992). The chemical analyses proved that the bitumens were not derived from oils of the Bass, Gippsland or Otway basins, or from the *Tasmanites* oil shale, and were not derived from a carbonate source. These coastal bitumens are now thought to be derived from Mesozoic or Cainozoic offshore sediments (Volkman *et al.*, 1992) and there have been suggestions that the bitumens may be derived from sources in Indonesia (Volkman, pers. comm.).

EXPLORATION HISTORY

The finding of bitumen as beach strandings, or the sighting of some material thought to be oil, has been enough to encourage many individuals to establish either syndicates or companies to raise capital to exploit the supposed oil 'find'.

To date, thirty-eight shallow holes have been drilled in onshore Tasmania for the purpose of exploring for oil or gas. Of these, gas was noted at one drill hole, and 'oily water' was reported from another. No oil or petroleum was reported from the other 36 holes. Details of the various drill holes are given in Appendix 2, with locations shown in Figure 4.

The beach strandings of bitumen on the south coast led to the formation of the Asphaltum Glance and Oil Syndicate in 1915. One prospecting permit of 640 acres (260 ha) was taken out at Recherche Bay, with a further four of 320 acres (130 ha) each being taken out near New River. The men who formed the syndicate, Messrs Herbert Smith, Adams and Harry Glover, found a piece of asphaltum, estimated to weigh 'a hundredweight' (50 kg), on the New River beach. The syndicate reported seeing oil floating on the sea in the vicinity of the bitumen finds at New River and Rocky Boat Harbour (Twelvetrees, 1915).

Several patches of calm water were pointed out to Twelvetrees by the prospectors, who viewed these patches as indicating the presence of oil and water, but Twelvetrees thought the patches more likely represented masses of seaweed, or were an artefact of mixing fresh water and sea water at the mouth of New River. No petroleum odour was apparent, despite the prevalence of the 'oil' patches. Around this time, a large piece of bitumen was brought to Hobart by the Davey River Oil and Mineral Exploration Company, after being found near the mouth of Deep Creek, Port Davey.

The Bruni Island Petroleum Company NL was floated in 1915 for the purpose of raising funds to explore for oil on North Bruny Island. Six Licences to Search of 320 acres each were taken out, and several shallow holes were drilled. The funds raised by the float supported the development of some expensive and elaborate infrastructure — as seen in Plates 9 and 10. The company was very hopeful of finding oil, stating in the prospectus "The discoveries of bitumen which have been made within certain localities absolutely prohibit the possibility of its having been deposited there by any outside agency, such as the ocean. This assures us of the fact that petroleum is underlying the island of Tasmania, and we confidently predict that the day is not far distant when Tasmania will take place amongst the oil producing countries of the world"[20]. The company set up a 30 horsepower Jameson portable boiler and a 25 horsepower oil well supply engine[21].

The Minister for Mines asked Wade to report on the possibility of finding oil or bitumen on Bruny Island. Wade (1915) could not verify any petroleum seeps on the island and considered conditions for finding any such material to be unfavourable.

However, the Bruni Island company pressed ahead, drilling Andrew's Bore to a depth of 430' (131 m) [the log is given in Twelvetrees (1917) and Reid (1929)]. Despite the hopes, no oil was found, and the operation ceased after one hole had been drilled and £5000 had been spent[22].

In January 1920, the Commonwealth Government stimulated the search for liquid oil by announcing a reward of £10,000 for the discovery of a payable oil deposit anywhere in Australia[23]. This had the effect of encouraging explorers and entrepreneurs to turn their attention to oil exploration.

A flurry of activity resulted in a plethora of small companies springing onto the scene, all jostling for acreage, especially in the Mersey Valley. A number of bores searching for oil were put down in this area in the early 1920s, firstly in the Permo-Carboniferous strata but later in the Tertiary sediments. When this exploration proved to be unsuccessful, attention turned to oil-bearing substances such as oil shale and a coal, pelionite.

The Adelaide Oil Exploration Company Ltd and the Mersey Valley Oil Company drilled a number of holes in the Mersey Valley region in the search for liquid oil during the 1920s. These two companies, along with many others, also spent much time and effort searching for oil shale, and then for 'rich in oil' material (see Appendices 2 and 4 and Figure 5).

Gas was reported at 1100' (335 m) in Bore 8 drilled by the Adelaide Oil Exploration Company (Iles Bore) near Sassafras. Reid (1924) considered the report of gas to be genuine; drilling apparently ceased due to an 'inrush of sand' when the bore intersected a bed of sand containing natural gas. Gas was also reported from two holes drilled near Conara (one drilled by the Department of Mines and another by a landowner; both were drilled primarily to search for water). The three holes from which gas has been reported were all drilled into Tertiary sediments. One explanation for the observed phenomena is that the bores have intersected bands of decomposing vegetable matter (peat, lignite) in which gas (methane) has become trapped.

Gas was also reported from Douglas River DDH 10, drilled by the Department of Mines as a stratigraphic hole during a gravity survey of the East Coast Coalfields. The hole was drilled through Upper and Lower Parmeener Supergroup sediments, and did intersect an oil shale horizon (the *Tasmanites* oil shale found in northern Tasmania, primarily around Latrobe). Gas was noted by the presence of bubbles in water filling the hole on

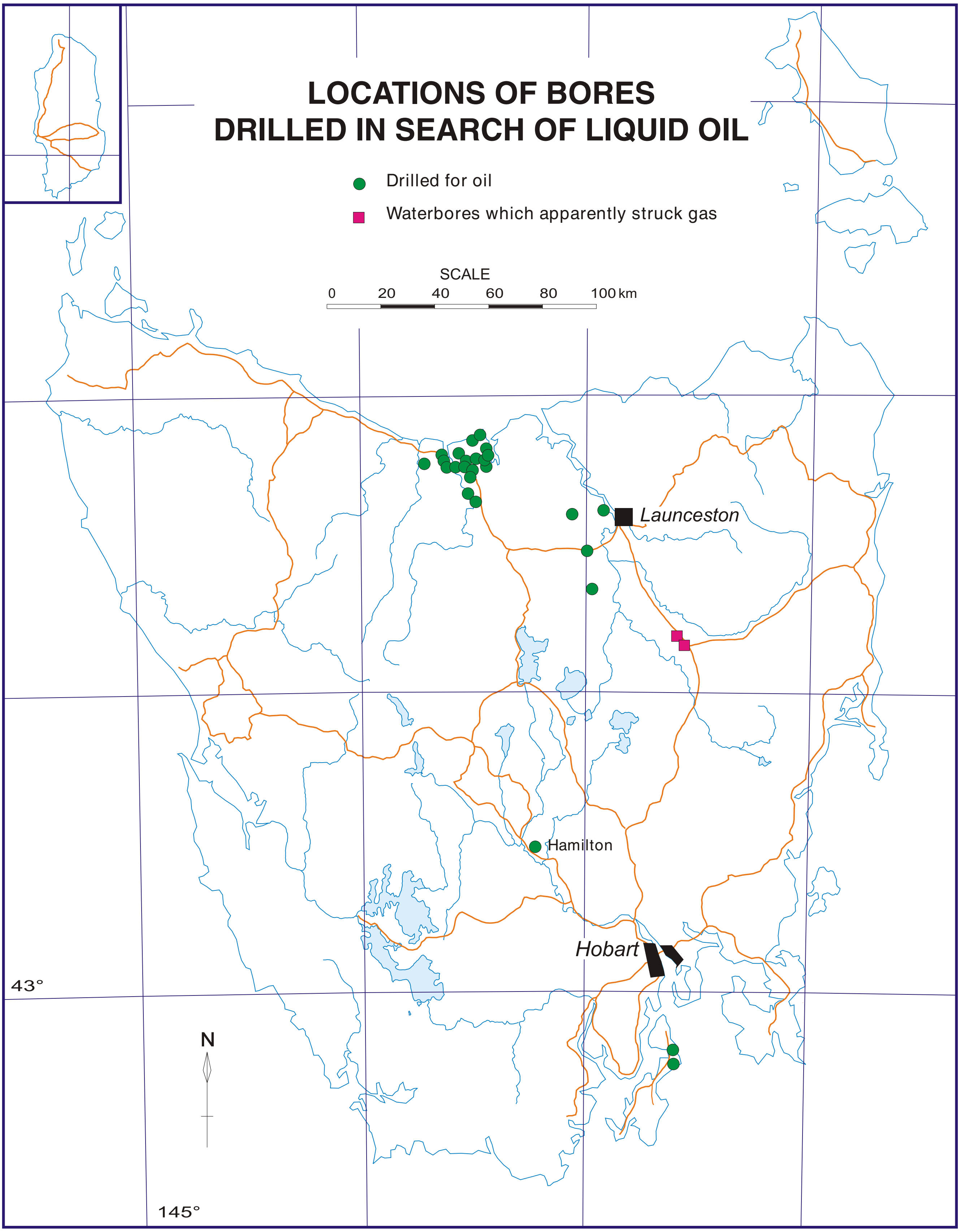

LOCATIONS OF BORES
DRILLED IN SEARCH OF LIQUID OIL
Drilled for oil
Waterbores which apparently struck gas
SCALE
0
20
40
60
80
100 km
Launceston
Hamilton
Hobart
43°
145°
N

Figure 4

completion of drilling (D. E. Leaman, pers. comm.), but a gas sample taken for analysis was shown to be methane of biogenic (bacterial) origin, and not from any petroleum source (see Table 1).

Alfred George Black (who had had run-ins with Loftus Hills) and Frederick Boddy each took out Licences to Search over parts of North Bruny Island in 1929. These two, together with five others, registered the Tasmanian Oil Exploration Company in April 1929. The company drilled several shallow holes "all without success" (Carey, 1946), including one hole near Johnson's well.

An anecdotal report of 'oily water' being struck at a depth of about 90 feet (27 m) in Johnson's well during the 1929/30 drilling was made in 1987 by an individual who had visited the site as a child; he remembered bringing containers from the family orchard to collect the oily water (Morrison, 1988). Curiously, a report of oily water being struck in Johnson's well is not recorded in the Department of Mines Annual Reports for 1929 or 1930 (or for any other year), or in the correspondence files for this time. Reid visited Bruny Island in 1929 but made no mention of the bore at Johnson's well, or even of any plans to drill such a hole. The log attached to Reid's (1929) report is that of Andrew's bore (drilled in 1915). Another anecdotal source claims that the hole was 'salted', and that after collecting money ostensibly to drill deeper, the entrepreneur, Black, disappeared with the funds, after telling locals he was off to Hobart to buy spare parts for the rig (Morrison, 1988). Locals 'still remember' the debts accrued by the project[24].

In 1936 the Austral Oil Drilling Syndicate began investigation of large areas in the vicinity of Lady Barron on Flinders Island, after the finding of an oil-bearing corky substance (coorongite), derived from the algae *Elaeophyton coorongiana*. The syndicate was impressed by the high oil yield which could be obtained by distillation of the material (73–85 gallons/ton) but disregarded Nye's advice that the algae deposit had nothing to do with an occurrence of natural petroleum (Carey, 1945).

The syndicate were no doubt encouraged by the occurrence of oily films on 'paludal waters' near Lady Barron, and two smoky fires in the region, one in 1913 which burnt 'for years' and another around 1936 (Cane, 1966).

A shallow hole was drilled at Danbury Park, a property owned by George Luck on the west bank of the River Tamar, in 1939 (see Plate 11). The site was chosen by a 'patent oil finding device', under the guidance of Max Steinbuchel, who agreed 'no oil, no pay'. The drilling was funded by Producers Oilwell Supplies Ltd. An argument erupted between the (then) Minister for Mines, Major Davies, and Producers Oilwell Supplies Ltd when the Minister stated in Parliament that the company did not hold a permit to explore for oil. The General Manager, Mr Richmond, had obtained a permit to search over a quarter of an acre (0.1 ha) for minerals (but not oil), in his own name. The saga was played out in the press, complete with demands for the Minister to apologise, something he refused to do[25–45].

Producers Oilwell Supplies Ltd held a meeting in the Cygnet Town Hall in December 1939 (*Huon and Derwent Times*, 7 December 1939) outlining the company's plans to test an area near Cradoc for oil. The meeting was told that material from the property of the Armstrong Brothers had been sent for analysis and 'the report was favourable to the possibility of the presence of oil'. Nye (1931) was dispatched to view this reported occurrence of oil, and examined a 'brownish sand' at the top of a shaft 3–4' (0.9–1.2 m) deep, thought to be an indication of oil. The sand tested nil for liquid petroleum, and nil for a yield of crude oil after distillation. Gas bubbles in water in the bottom of the shaft were deemed to be marsh gas. Dr Leaman checked the same area in 1965 after receiving reports of oil seeps from locals and found only iron oxide scums on farm dams.

In 1944 the Government gave a grant of £300 to Mr H. E. Evenden and his party for the purpose of prospecting for the source of the bitumen which had been found from time to time on nearby foreshores (Keid, 1944). The prospecting activities were observed by Keid, who reported that there had been no discovery of bitumen *in situ*, and that the geological evidence was "definitely against the occurrence of bitumen at Port Davey" (Keid, 1944). The prospecting party found one 4 ounce (120 g) piece of bitumen during their investigations.

Samuel Adams registered the Bass Strait Oil Company NL in May 1962, and took out Licences to Search over parts of northern Tasmania. Adams had previously lived on King Island, and in 1927 he and his mother had been very taken with the beach strandings of bitumen[46]. Mrs Adams applied to the Department for a Reward Lease, which was not granted, but mining lease 10103/M of 588 acres was taken out and held until 1929. The initial discovery was examined by Dr Pritchard, an 'oil geologist' (see Pritchard, 1927) and Mr Moate of the Adelaide Oil Exploration Company[47].

In 1955 Mrs Adams approached the Department indicating she had found signs of oil inland. Whilst initially requesting exploration rights for oil for the whole of King Island, Mr S. Adams and Mrs A. J. Adams–Smith (Ulverstone) and Mr J. Adams (Melbourne) decided to apply for exploration licences over areas of interest, although further requests were made to the Minister[48] for such rights, which could not be granted under the existing provisions of the *Mining Act 1929*[49, 50].

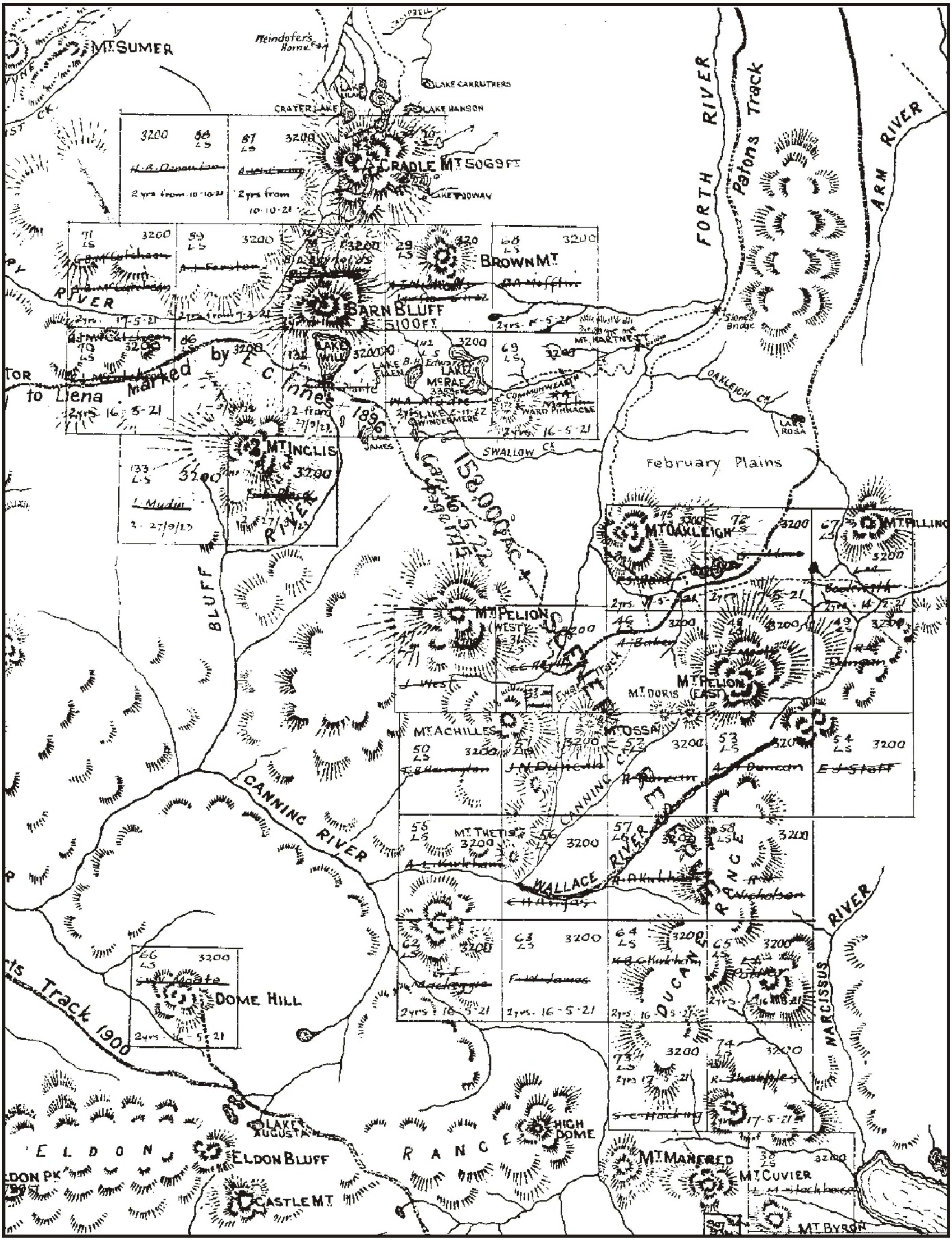


Figure 5

Map showing coverages of Licences to Search, Cradle Mt–Mt Pelion areas

In 1968, Adams claimed "if only he and his mother had been able to convince the Mines Department that oil indications on King Island Tasmania . . . could have been a major figure in the oil business". The need to actually have a commercial oil field seems to have escaped Adams, who continued "Geologists from Canberra were quite excited by the find but the Tasmanian Mines Department put the kybosh on it"[51]. The Commonwealth did write to the State following a visit by Mr Adams to Canberra in 1960[52], asking for the matter to be investigated. Arrangements were made for Mr Stinear (Bureau of Mineral Resources) and Mr T. Hughes (Department of Mines) to visit King Island and investigate the occurrence[53, 54]. The previous reports on the area were forwarded to Canberra and from then on the subject was not mentioned again in correspondence between the two Departments. The Department of Mines was convinced that the sightings were of asphaltum washed up by the sea.

Mr C. G. Sulzberger imported a drilling rig from Gippsland in 1966. The rig, which arrived in pieces, stood 100' (30 m) high when assembled and was said to need nine men to operate it (*The Examiner*, 22 September 1966). At the time of importation the rig was the largest to operate in Tasmania. Mr Sulzberger and his company, Nudec Petroleum Exploration Pty Ltd, drilled a number of holes in the Westbury–Longford and Port Sorell–Sassafras areas with the aim of finding oil and gas. The sites of the drill holes were chosen by Mr Sulzberger with the aid of a divining rod, which allegedly flicked upwards to indicate the presence of gold and downwards to indicate water or metals. Possible petroleum sources were marked by a rapid 'wriggling' of the divining rod. Several samples of lignite were submitted to the Department for analysis. The drilling rig roused much local interest, and several photos of the drilling operation appeared in the press (see Plates 12, 13 and 14). No hydrocarbons were discovered by this exploration programme.

In 1974 the Amoco Australian Petroleum Company examined the hydrocarbon prospectivity of areas to the north and south of Macquarie Harbour on the west coast (the 'Macquarie Harbour graben'). The company relinquished the ground in 1975, concluding the area was non-prospective for hydrocarbons (Womer, 1983). The rock sequence was deemed to be 'much too thin to have thermally generated hydrocarbon'.

An area near Cranbrook, on the east coast, was examined by Meekatharra Minerals Ltd in 1981. Interpretation of seismic data collected indicated that the gravity lows found by the company's initial work could be explained by variations of less than 300 m of Tertiary sediment thickness. The Company concluded that 'these thicknesses are insufficient to provide maturity of any basal Tertiary sequences' (Shaw, 1985).

In 1981, Victor Petroleum and Resources Ltd, in partnership with the Northwest Bay Co. Pty Ltd, held exploration licences covering a large part of the Midlands for coal and oil. A preliminary report on the petroleum potential of onshore Tasmania was made (Summons, 1981) and twelve rock samples were sent for assessment of their kerogen content. Some of these samples showed that the host rock had been, at one time, through the oil window, with a TAI of 2–4. One example of Woody Island Siltstone contained 1.2% carbon.

More recently, exploration licences covering much of southern and central Tasmania have been held by Conga Oil Pty Ltd. Several reviews have been made of the geology of the State, a number of rock, sediment and water samples have been analysed, and a line of seismic shot on Bruny Island. The results of the literature reviews and chemical analyses are contained in various reports on EL 1/88 held by Mineral Resources Tasmania.

Initially work concentrated on oil generation from Ordovician Gordon Group limestone, but in later years Permian-aged source rocks, including the *Tasmanites* oil shale, have been considered as possible source rocks.

The concept of the *Tasmanites* oil shale being prospective as both a source and a reservoir for oil, by analogy with the Spraberry Formation in Texas, was developed by exploration companies in the 1980s. The Spraberry Formation is a 300 m thick package of black shale, siltstone, limestone and dolomite, with oil production from siltstone reservoirs at an average depth of 2200 metres. These siltstones have a primary porosity of 8% and a permeability of 0.5 millidarcies (Wilkinson, 1953), so fracture stimulation and pumping are required to enable oil to be produced from the formation.

However, the Permian *Tasmanites* oil shale is only about two metres thick, and is presently at depths of between 300 to 500 metres. Maximum burial depths would probably have been in excess of one kilometre. It is unusual to find an uplifted shallow hydrocarbon accumulation without seeps, and to date none are known in the onshore Tasmania Basin. The effective permeability of the rock is very low, as evaporating oil shows in fracture porosity are revealed only by breaking outcrop, which means the oil shale is not likely to be an adequate reservoir, even if substantial amounts of oil were generated.

Altogether 203 exploration permits have been held in Tasmania to search for oil (see Appendix 4), not counting the 'permits to enter' held over private property in the Mersey Valley in the 1920s, and permits held solely to search for oil shale. Some 63% of the oil exploration permits were issued between

1920 and 1925, no doubt in response to the Commonwealth offer of a reward of £10,000 for the discovery of a payable oil deposit anywhere in Australia.

Exploration licences for oil exploration over parts of onshore Tasmania are currently held by Great Southland Minerals Pty Ltd.

SOURCE ROCKS

The act of hydrocarbon generation from sedimentary organic matter revolves around a hydrogen deficient budget (Boreham and Powell, 1994). Optical measurements have been used as an indirect measure of hydrogen content and rely on a classification of the organic component of rocks in terms of proportions of the three main organic building blocks (termed macerals), which are liptinite, vitrinite and inertinite. These macerals have strong affinities with structural components of plants and algae (e.g. vitrinite is associated with lignitic woody tissue of plants) and as such the macerals show a cursory relationship to chemical composition. Thus liptinitic components are generally hydrogen-rich and are associated with Type I and Type II organic matter, while vitrinite commonly has a lower hydrogen content and is associated with Type III. Inertinite can have hydrogen contents approaching those of vitrinite but is usually more depleted in hydrogen and is considered to have little to no hydrocarbon generative potential (Tissot and Welte, 1984).

A more direct method used to assess the oil and gas potential relies on a quantitative analysis of the adsorbed organics (bitumen) and those hydrocarbons released on artificial pyrolysis of the organic matter using the Rock Eval method. A classification of source rock parameters based on this approach is shown in Table 3. Here, the S1 parameter represents the amount of free bitumen that is thermally desorbed from the rock at low temperatures, and is similar to the bitumen yields that can be obtained on extraction from the rock with organic solvents. S2 and S3 are the yields of hydrocarbons and carbon dioxide respectively, released on pyrolysis of the bulk of organic matter. The Hydrogen Index (S2 yield normalised to the organic carbon content; HI = 100*S2/TOC) and Oxygen Index (S3 yield normalised to the organic carbon content; OI = 100*S3/TOC) are directly related to the atomic hydrogen and oxygen content, respectively. Table 3 shows that different rock types can have the same source rock potential (S2) but with different organic carbon contents. For example, carbonate source rocks generally contain marine algal organic matter which is predisposed to

Table 3

Classification of Source Rock Parameters

*Guidelines for interpreting source rock potential**

Quantity	TOC (%)	Rock Eval S2 (mg HC/g rock)	EOM Wt %	HC (ppm)
Poor	<0.5	<2.5	<0.05	<200
Fair	0.5–1	2.5–5	0.05–0.1	200–500
Good	1–2	5–10	0.1–0.2	500–1200
Very good	>2	>10	>0.2	>1200

*Guidelines for interpreting type of petroleum generated from immature sediments (R_0 <0.6%)**

Type	Hydrogen Index (mg HC/g TOC)	Rock Eval S2/S3	Extract Yield (mg HC/gTOC)§	Atomic H/C
Gas	50–200	1–5	<20	0.6–0.9
Gas and oil	200–300	5–10	20–50	0.9–1.1
Oil	>300	>10	50–200	>1.1

Guidelines for interpreting degree of thermal maturation

Maturation Level	Production Index (PI)	T_{max} for Type I	T_{max} for Type II	T_{max} for Type III
Immature	<0.15	<445	<435	<440
Mature	0.15–0.4	445–455	435–460	440–470
Overmature	>0.4	>455	>460	>470

* Modified after Peters (1986) and Espitalié and Bordenave (1993).
§ mature samples

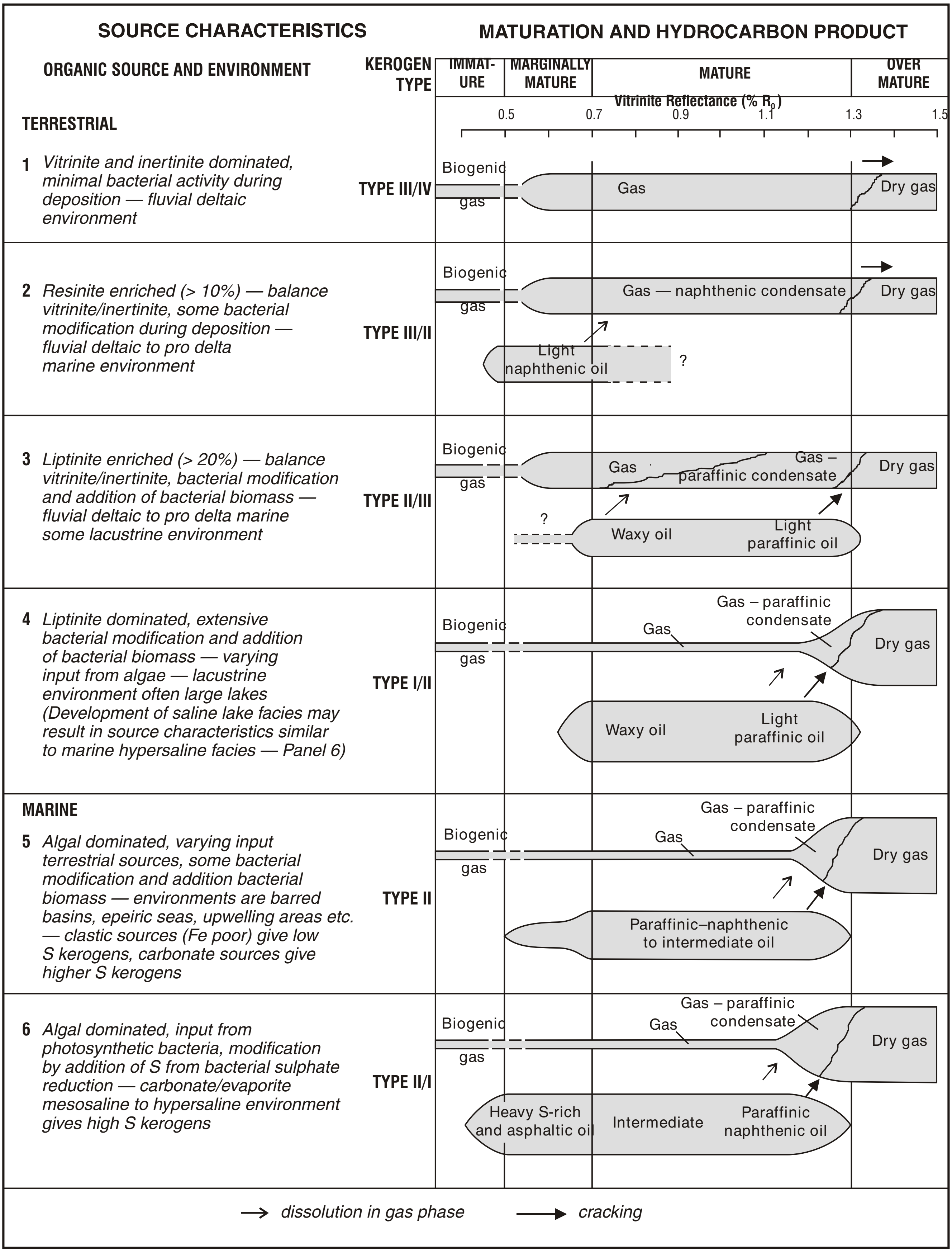


Figure 6

Source characteristics — maturation and hydrocarbon product (from Powell, 1985; reproduced with permission) moderate hydrogen contents (Type II) and therefore require a lower initial organic carbon content to generate the same quantities of petroleum compared with a siliciclastic sediment containing Type III organic matter.

Largely in response to an increase in thermal stress, organic matter in buried sediments evolves through the immature, mature ('oil window'), and overmature stages of petroleum generation (Tissot and Welte, 1984). The values in Table 3 show that maturity levels for the 'oil window' depend on the type of organic matter, and encompass a vitrinite reflectance range of R_0 0.5–1.3% and pyrolysis T_{max} temperatures (temperature at maximum rate of hydrocarbon generation during S2 evolution) of 430–470°C. The pyrolysis Production Index (PI = S1/S1 + S2) is another measure of maturity, with values ranging from 0.15 to 0.4 normally associated with oil generation. Higher values usually reflect allocthanous bitumen associated with staining from migrating hydrocarbons within the section.

Snowdon and Powell (1982) and Powell (1985) developed a detailed relationship between kerogen type, maturity and hydrocarbon type (fig. 6). Their work shows that the onset of peak generation for paraffinic oils from Type I and Type II kerogens requires R_0 0.7%, but that in siliciclastic sequences, Type II and resinite-rich (a specific liptinite maceral) Type III kerogens will produce naphthenic oils at R_0 0.5%. Likewise in carbonates, algal-derived Types II and I kerogen will generate asphaltic oils at R_0 0.5%.

At maturity, an effective source rock must have sufficient hydrocarbon saturation to overcome the absorption threshold of the remaining carbon in the rock matrix, thus permitting expulsion and migration to a reservoir. For this reason many coals are ineffective source rocks, despite their high TOC.

POTENTIAL SOURCE ROCKS — ONSHORE TASMANIA

The regional geology of the onshore sedimentary basins is sufficiently known to conclude that unmetamorphosed organic-rich facies with potential to constitute source rocks do exist in rocks ranging from Ordovician to Tertiary in age.

Unfortunately only a very small amount of patchy and mainly incompatible data are available to assess source quality and maturity levels. No systematic basin-scale study of source potential has been undertaken to date.

Burrett (1992) used regional-scale conodont geothermometry to define an area in southern and southwestern Tasmania where limestone and shale of the Gordon Group are within the oil window (fig. 7; Table 4). Pyrobitumen with reflectance (R_0%) ranging from 2–11% has been noted in the Gordon Limestone near Zeehan. Burial history studies show that the Gordon Limestone was driven through peak oil generation and fluid drive in the Devonian, prior to the Tabberabberan Orogeny and granite emplacement (Taylor and Morris, 1995). While the presence of modest amounts of pyrobitumen indicated the presence of precursor oil, significant hydrocarbon source rocks have not yet been identified within the Gordon Limestone (Taylor and Morris, 1995).

In the Carboniferous–Triassic Tasmania Basin and the small shallow Tertiary basins, maturity data from coal and organic-rich shale (Tables 5 and 6) show that the Tertiary has never been deeply buried, and that maturity in the Parmeener Supergroup varies dramatically because of the prevalence of intrusive Jurassic dolerite. Some of the Upper Triassic coal measures are mature but the inertinite dominance of their maceral composition (see fig. 8) and the low ratio of hydrocarbons to TOC (i.e. high internal adsorption) precludes them from being significant oil producers or effective source rocks.

Intrusive Jurassic dolerite could easily have produced petroleum hydrocarbons at sites of local heating. In a number of cases, vitrinite reflectance values of R_{0max} 3% and greater indicate extreme baking of sediments by such intrusions. The geographical distribution of sites having vitrinite reflectance values of R_{0max} above 0.60% is shown in Figure 7. If hydrocarbons have been generated at any of these sites, there is the difficulty of determining what precisely is the result of local heating by dolerite, and what values may be derived from deep burial.

At Lonnavale on Bruny Island, the bitumen and oil found in cracks in dolerite may have been derived from heating of the *Tasmanites*-bearing sediments by dolerite. The maximum burial of the Permo–Triassic section would have been immediately following the Jurassic dolerite intrusion, following which the rates of erosion of the section exceeded sediment accumulation.

The heat pulse accompanying the intrusion may have lasted as long as 100 million years (D. E. Leaman, pers. comm.), although there have been other subsequent heat pulses which may have adequately heated the sedimentary section. The existence of bitumen at Lonnavale indicates that hydrocarbons have been generated, however small or localised, and that migration pathways exist.

Appendix 5 contains the available source rock pyrolysis data held within the Australian Geological Survey Organisation's ORGCHEM relational database for spot outcrop and borehole samples analysed by AGSO's Isotope and Organic Geochemistry laboratory. The source

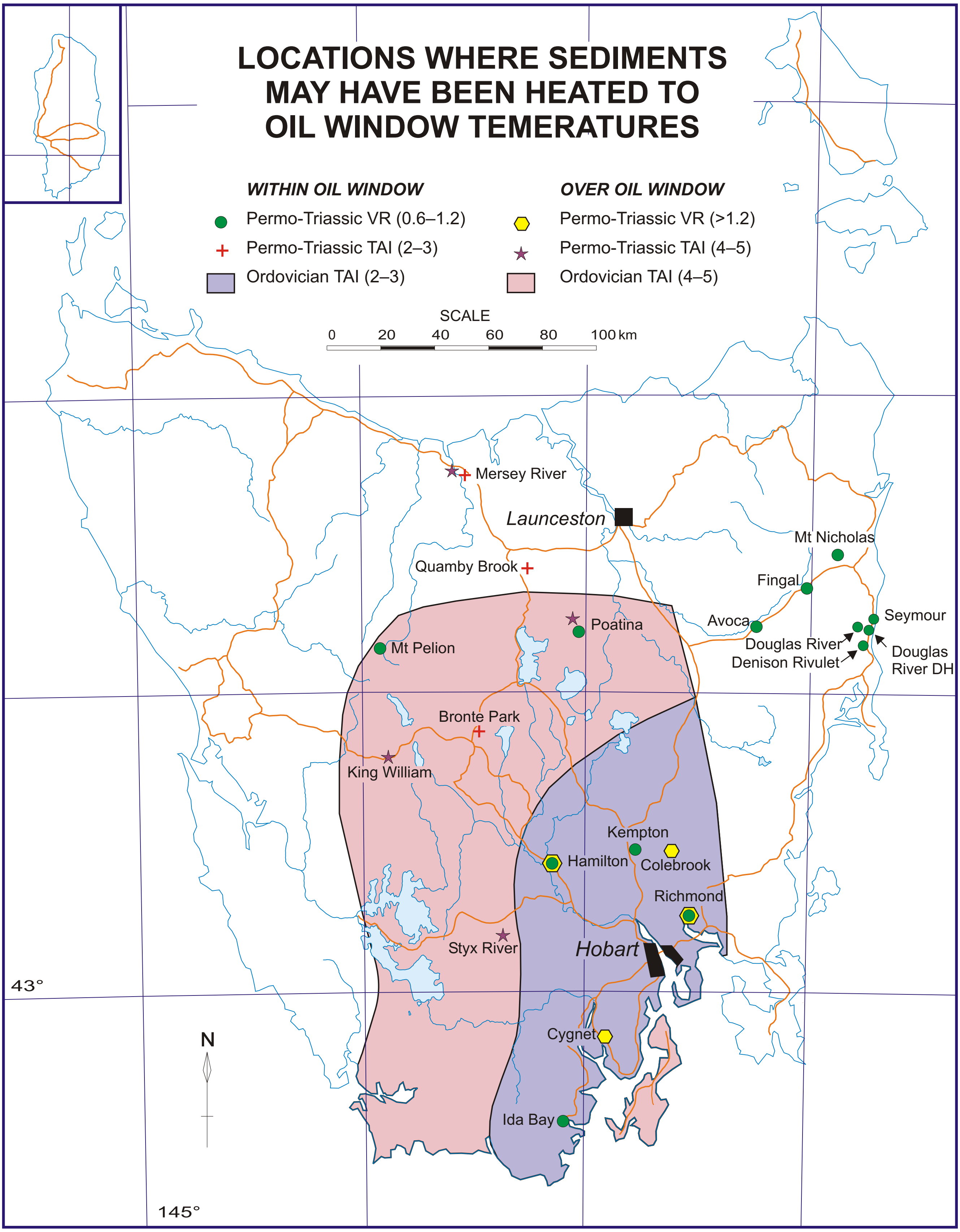

LOCATIONS WHERE SEDIMENTS MAY HAVE BEEN HEATED TO OIL WINDOW TEMERATURES
WITHIN OIL WINDOW
Permo-Triassic VR (0.6–1.2)
Permo-Triassic TAI (2–3)
Ordovician TAI (2–3)
OVER OIL WINDOW
Permo-Triassic VR (>1.2)
Permo-Triassic TAI (4–5)
Ordovician TAI (4–5)
SCALE
0 20 40 60 80 100 km
Mersey River
Launceston
Quamby Brook
Mt Nicholas
Fingal
Avoca
Seymour
Douglas River
Denison Rivulet
Douglas River DH
Poatina
Mt Pelion
Bronte Park
King William
Kempton
Hamilton
Colebrook
Richmond
Styx River
Hobart
Cygnet
Ida Bay
N
43°
145°

Figure 7

Table 4

Thermal maturity — Conodont colour (from Burrett, 1992)

Locality	Grid Reference	CAI*	Age and Unit
Andrew River	CP940131	5	Middle Ordovician, Gordon Group
Bubs Hill	CP985361	5	Middle–Lower Ordovician, Gordon Group
Claude Creek	DQ293068	5	Middle Ordovician, Gordon Group
Duck Creek	CP381749	5	Middle–Lower Ordovician, Gordon Group
Eugenana	DQ422349	5	Middle Ordovician, Gordon Group
Everlasting Hills	DP200154	4	Middle Ordovician, Gordon Group
Florentine Valley	DN560820	3+	Middle–Lower Ordovician, Gordon Group
Flowery Gully	DQ848312	5	Middle Ordovician, Gordon Group
Franklin River	CN990910	5	Middle Ordovician, Gordon Group
Gunns Plains	DQ190297	5	Middle–Lower Ordovician, Gordon Group
Huskisson Syncline	CP658743	5	Middle–Lower Ordovician, Gordon Group
Isle Du Golfe	DM615755	4	Middle–Lower Ordovician, Gordon Group
Judds Cavern	DN662107	4	Middle Ordovician, Gordon Group
Lake Sydney	DN682069	6	Lower Ordovician–Early Silurian, Eldon?/Gordon Groups
Liena	DP359996	5	Middle–Lower Ordovician, Gordon Group
Loongana	DQ120150	5	Middle–Lower Ordovician, Gordon Group
Lower Gordon River	CN911865	5	Lower Silurian–Early Devonian Eldon Group
Lower Gordon River	CN990740	5	Middle–Lower Ordovician, Gordon Group
Lune River/Ida Bay	DM891921	3+	Middle–Lower Ordovician, Gordon Group
Melrose/Paloona	DQ401339	5	Middle Ordovician, Gordon Group
Moina	DQ223067	5	Middle Ordovician, Gordon Group
Mole Creek area	DP505990	5	Middle–Lower Ordovician, Gordon Group
Olga River	CN000701	5	Middle–Lower Ordovician, Gordon Group
Picton River	DN739140	3+	Middle–Lower Ordovician, Gordon Group
Point Cecil	DM673738	3+	Middle–Lower Ordovician, Gordon Group
Point Hibbs	CN575804	1–5	Middle Ordovician–Middle Devonian
Precipitous Bluff	DM677880	5	Middle–Lower Ordovician, Gordon Group
Queenstown	CP800400	5	Middle–Lower Ordovician, Gordon Group
Railton	DQ516225	5	Middle Ordovician, Gordon Group
Salisbury River	DM680969	5	Middle–Lower Ordovician, Gordon Group
Sophia River	CP900744	5	Middle–Lower Ordovician, Gordon Group
Surprise Bay	DM716736	3+	Middle–Lower Ordovician, Gordon Group
Vale of Belvoir	DQ076010	5	Middle–Lower Ordovician, Gordon Group
Vanishing Falls	DM704954	1.5–2+	Middle–Lower Ordovician, Gordon Group
Wilson River	CP646763	5	Middle–Lower Ordovician, Gordon Group
Zeehan	CP617614	5	Middle–Lower Ordovician, Gordon Group

* Conodont Alteration Index (CAI) values of between 1 and 3 show that the rock has, at one time, been within the oil window.

\+ Within oil window.

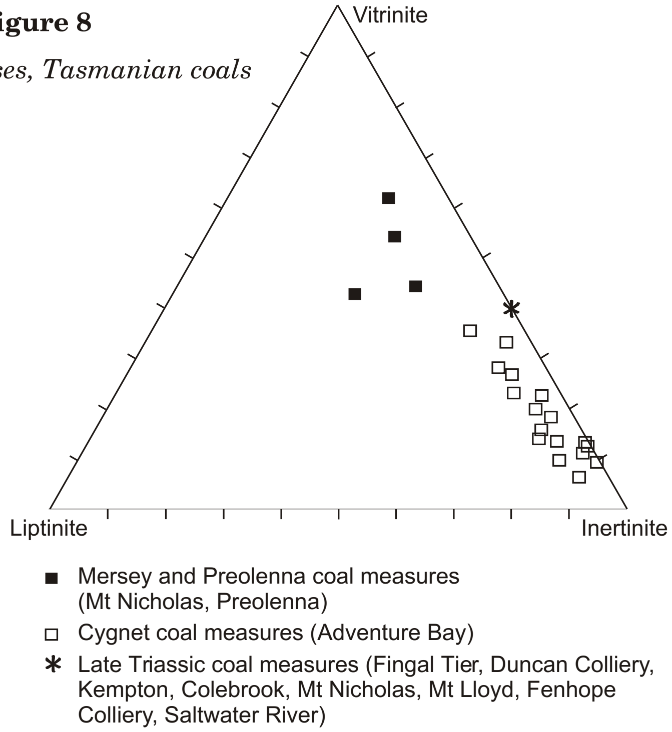
Table 5

Thermal maturity data — Kerogens (from Harris, 1981)

Sample	Location	TOM	TAI	Total carbon %
1	Permian limestone — Hobart	Nil		0.44
2	Road above Quamby Brook	Low	2+	0.72
3	Poatina Station, 720 feet above sea level	Low	4+	0.62
4	Mersey River petroliferous siltstone	Low	4	0.79
5	Mersey River middle	Low	3+	0.92
6	Mersey River lowest sample 4.12.1980			0.52
7	Bronte, Serpentine Creek road cut	Low	3+	0.52
8	Hole 5021, 91 feet	?	2+	0.87
9	Hole 5021, 795 feet	Low	3	0.57
10	Hole 5024, 287 feet			0.45
11	King William Saddle	Moderate	4+	0.84
12	Styx River, 2.12.1980, petroliferous siltstone	Moderate	4	1.19

Figure 8

Maceral analyses, Tasmanian coals



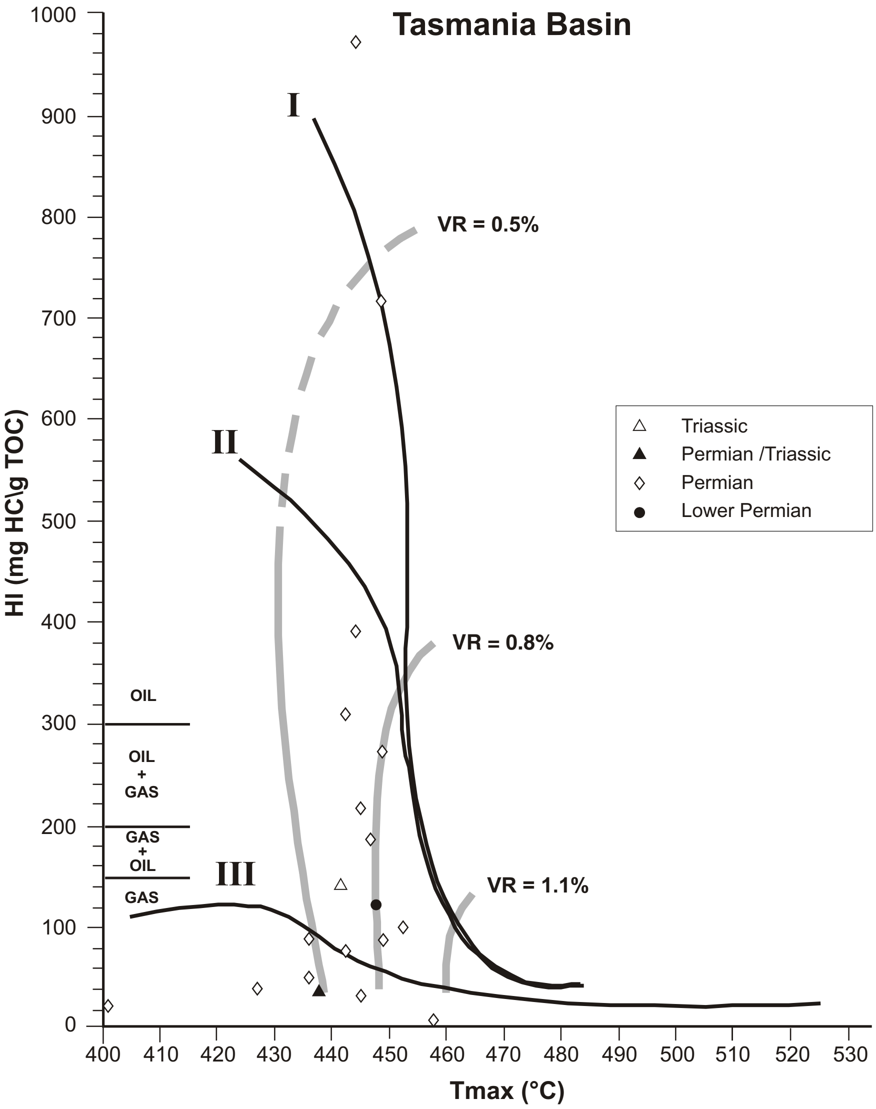


Figure 9

Graph of HI versus T_{max}°C, Tasmania Basin samples

quality-maturity plot is shown in Figure 9 and presents all data with S2 >0.1 (below this value T_{max} is considered unreliable). A summary of stratigraphic position and a history of heating events is given in Figure 10.

The Tertiary sample (AGSO 8479) from Zeehan has a fair organic carbon content of 1.24% (Appendix 5), but no hydrocarbons could be generated during pyrolysis, suggesting that this sample has already been subjected to extreme temperatures. The Late Permian to Triassic Upper Parmeener Supergroup contains gas-prone organic matter, consistent with the high inertinite content of Triassic coals (fig. 8), although the sample (AGSO 8476) is still immature for hydrocarbon generation.

Good to excellent hydrocarbon potential (oil and gas) exists in the Permian sediments, especially the oil shale and the Preolenna Coal Measures. Low Production Indices (PI <0.1) and T_{max} values (T_{max} = <445°C) for the Preolenna Coal Measures suggest that these samples (AGSO 2002–2004) are marginally mature. The high T_{max} values for the oil shale (440–450°C) is a consequence of the samples (BMR 1995, 1996, 5800, in Appendix 5) containing almost pure remains of the *Tasmanites* algae, and highlights the insensitivity of T_{max} to maturity for Type I organic matter (Table 1). The high T_{max} >450°C and PI >0.2 (Appendix 5) for a wide range of the Permian sediments, albeit with lowered source potential, infers that these sediments are currently at peak hydrocarbon generation.

The Ordovician and Neoproterozoic sediments analysed show no source potential, having only maximum TOC and S2 contents of 0.18% and 0.02 mg hydrocarbons/g rock, respectively. Although no source rock units have as yet been identified, maturity indicators based on conodont reflectance (CAI) suggest that the Gordon Limestone is in the oil window (Burrett, 1992). The Rock Eval parameters for the Black

Period	Age (Ma)	Samples	Heating Event
Quaternary			
Tertiary		Lignite	Basalt
	65		
Cretaceous			Syenite
	141		
Jurassic		Dolerite	Dolerite
	205		
Triassic		Upper Parmeener Supergroup coal measures	
	251		
Permian		Berriedale Limestone Preolenna Coal Measures { Tasmanites Oil Shale Woody Island Siltstone	
	298		
Carboniferous		Quamby Mudstone Wynyard Tillite }	
	354		
Devonian		Bell Shale	Granite
	410		
Silurian			
	434		
Ordovician		Gordon Limestone	
	490		
Cambrian			
	545		
Proterozoic		Crimson Creek Formation Kannunah Sub-Group Black River Dolomite	

Figure 10

Stratigraphic chart, onshore Tasmania samples

River Dolomite (AGSO 7050) show a high PI consistent with staining by mobile hydrocarbons in the Precambrian sediment.

Additional pyrolysis and compositional data for various oil shales and associated sediments are listed in Appendix 5. These samples of Late Carboniferous oil shale from three locations contain up to 63% TOC. The high HI values (675–972) attest to the high conversion of the organic carbon in the algal kerogen to hydrocarbons, and are consistent with the high liquid yields reported from the early retorting plants. The low PI and extract yields indicate the immaturity of the sediments. On the basis of the available outcrop data, the oil shale can be considered as prolific oil source rocks, although this will be tempered by their typical unit thickness of only two metres. Mature sediments definitely occur at Tunbridge, Golden Valley and Woody Island, as suggested by their high PI and high A_{lis}/A_{ros} ratio, and in the case of Tunbridge a T_{max} value of 458°C is unmistakably mature (see Figure 11).

Table 6

Thermal maturity data — Vitrinite reflectance

	Location	Age	Mean Maximum Reflectance ($R_{0\ max}$)	Oil/gas Window†	Reference
Endurance tin mine (outcrop of lignite)	South Mt Cameron	Early Miocene	0.12	Under	Banks (unpublished data)
Strahan (outcrop of lignite)	Strahan	Palaeocene	0.21	Under	Banks (unpublished data)
Strahan (outcrop)	Strahan	Palaeocene	0.25	Under	Banks (unpublished data)
Jubilee Colliery	Mt Nicholas	Late Triassic	0.59	Under	Banks (unpublished data)
Mt Nicholas Colliery	Mt Nicholas	Late Triassic	0.52	Under	Banks (unpublished data)
Blue Upper Seam (mine)	Mt Nicholas	Late Triassic	0.55*	Under	Bacon (1985*a*)
DDH GY34 L1 (core)	Mt Nicholas	Late Triassic	0.55	Under	Wollff *et al.* (1981)
DDH GY34 M2 (core)	Mt Nicholas	Late Triassic	0.55	Under	Wollff *et al.* (1981)
DDH GY123 M1 (core)	Mt Nicholas	Late Triassic	0.61	In	Wollff *et al.* (1981)
DDH GY43 1 Seam (core)	Mt Nicholas	Late Triassic	0.67#	In	Wollff *et al.* (1981)
Duncan Seam (mine)	Fingal	Late Triassic	0.56	Under	Banks (unpublished data)
Duncan Seam (mine)	Fingal	Late Triassic	0.61	In	Banks (unpublished data)
Duncan Seam (mine)	Fingal	Late Triassic	0.66	In	Banks (unpublished data)
Duncan Seam (mine)	Fingal	Late Triassic	0.67	In	Joint Coal Board, 1978
Duncan Seam (mine)	Fingal	Late Triassic	0.61	In	Smyth (1980)
Duncan Seam (mine)	Fingal	Late Triassic	0.54*	Under	Bacon (1985*a*)
Duncan Seam DDH 43	Fingal	Late Triassic	0.58*	Under	Smyth and Ledsam (1980)
Unnamed seam DDH 42	Fingal	Late Triassic	0.59*	Under	Smyth and Ledsam (1980)
East Fingal Seam DDH 43	Fingal	Late Triassic	0.58*	Under	Smyth and Ledsam (1980)
Merrywood Seam (mine)	Merrywood	Late Triassic	0.57*	Under	Bacon (1985*a*)
Seymour	Seymour	Late Triassic	0.54	Under	Banks (unpublished data)
Seymour	Seymour	Late Triassic	0.60	In	Banks (unpublished data)
Fenhope Colliery (mine)	Avoca	Late Triassic	0.74	In	Bacon (1986*b*)
Stanhope (outcrop)	Avoca	Late Triassic	0.82	In	Banks (unpublished data)
Stanhope (mine)	Avoca	Late Triassic	0.72	In	Banks (unpublished data)
Bona Vista (abandoned adit)	Avoca	Late Triassic	0.69	In	Banks (unpublished data)
Kempton (Mt Vernon DDH 1)	Kempton	Late Triassic	0.69	In	Banks (unpublished data)
HEC DDH 5083, 941'	Poatina	Late Triassic	0.61	In	Banks (unpublished data)
HEC DDH 5148, 290'	Poatina	Late Triassic	4.05	Over	Banks (unpublished data)
HEC DDH 5156, 306'	Poatina	Late Triassic	3.20	Over	Banks (unpublished data)
HEC DDH 5156, 309'	Poatina	Late Triassic	-		Banks (unpublished data)
HEC DDH 5191, 21'	Poatina	Late Triassic	1.91, 1.61	Over	Banks (unpublished data)
HEC DDH 5191, 23'	Poatina	Late Triassic	1.62	Over	Banks (unpublished data)
HEC DDH 5191, 24'	Poatina	Late Triassic	1.70	Over	Banks (unpublished data)
Richmond (abandoned mine)	Richmond	Late Triassic	1.84	Over	Banks (unpublished data)
Richmond (abandoned mine)	Richmond	Late Triassic	1.62	Over	Banks (unpublished data)
Richmond (abandoned mine)	Richmond	Late Triassic	1.23	In	Banks (unpublished data)
Colebrook, east bank Coalmine Creek	Colebrook	Late Triassic	0.55	Under	Banks (unpublished data)
Colebrook (abandoned mine)	Colebrook	Late Triassic	0.54	Under	Banks (unpublished data)
Colebrook (former dumps)	Colebrook	Late Triassic	0.26	Under	Banks (unpublished data)
Colebrook (former dumps)	Colebrook	Late Triassic	0.38	Under	Banks (unpublished data)
Colebrook (outcrop)	Colebrook	Late Triassic	3.37	Over	MRT unpublished data

Table 6 *(continued)*

	Location	Age	Mean Maximum Reflectance (R_O Max)	Oil/gas Window+	Reference
Saltwater River (abandoned mine)	Saltwater River	Late Triassic	2.08	Over	MRT unpublished data
Saltwater River (abandoned mine)	Saltwater River	Late Triassic	1.92	Over	MRT unpublished data
Ida Bay (abandoned mine)	Ida Bay	Late Triassic	0.64	In	Banks (unpublished data)
Poatina (outcrop of Brady Formation)	Poatina	Late Triassic	0.57	Under	Banks (unpublished data)
Langloh 100m from dolerite	Langloh	Late Triassic	0.60	In	Banks (unpublished data)
Woodbury	Woodbury	Late Triassic	1.23	Over	Banks (unpublished data)
Denison Rivulet (outcrop, seam B2)	Denison Rivulet	Late Triassic	1.61	Over	Banks (unpublished data)
Douglas River DOM DDH 10, 20 m	Douglas River	Late Triassic	0.66	In	Banks (unpublished data)
Douglas River adit	Douglas River	Late Triassic	0.64	In	Ford and Bos (1984)
Langloh (open cut)	Langloh	Late Triassic	3.6	Over	Banks (unpublished data)
Langloh 100m from dolerite	Langloh	Late Triassic	0.60	In	Banks (unpublished data)
Langloh (open cut) (1986)	Langloh	Late Triassic	3.6	Over	Morrison and Bacon
Langloh (open cut) (1986)	Langloh	Late Triassic	0.57	Under	Morrison and Bacon
Douglas River DOM DDH 10, 65 m: core	Douglas River	Early Triassic	0.63	Under	Banks (unpublished data)
Douglas River DOM DDH 10, 65 m: core	Douglas River	Early Triassic	0.77	In	Banks (unpublished data)
Batchelors Road (outcrop)	Cygnet	Late Permian	2.15	Over	Banks (unpublished data)
Batchelors Road (outcrop)	Cygnet	Late Permian	1.76	Over	Banks (unpublished data)
Batchelors Road (outcrop)	Cygnet	Late Permian	1.61	Over	Banks (unpublished data)
Mt Pelion	Mt Pelion	Late Permian	0.76	In	Banks (unpublished data)
Douglas River DDH 10, 121m	Douglas River	Late Permian	0.59	Under	Banks (unpublished data)
Wynyard	Inglis River	Early Permian	0.52	Under/In	Banks (unpublished data)
Barn Bluff	Barn Bluff	Early Permian	0.49	Under	Banks (unpublished data)
Cato Creek Upper Seam (outcrop)	Mt Nicholas	Early Permian	0.53	Under	MRT unpublished data
Cato Creek Lower Seam (outcrop)	Mt Nicholas	Early Permian	0.43	Under	MRT unpublished data
Huntsmans Creek (outcrop)	Mt Nicholas	Early Permian	0.48	Under	MRT unpublished data
Huntsmans Creek (outcrop)	Mt Nicholas	Early Permian	0.47	Under	MRT unpublished data
Douglas River DDH 10, 268 m	Douglas River	Early Permian	0.44	Under	MRT unpublished data
Douglas River DDH 10, 268 m	Douglas River	Early Permian	0.48	Under	MRT unpublished data
Spreyton (abandoned mine)	Spreyton	Early Permian	0.31	Under	MRT unpublished data
HEC DDH 5039, 285'	Poatina	Early Permian	0.50	Under	Banks (unpublished data)
HEC DDH 5096, 241'	Poatina	Early Permian	0.58	Under/In	Banks (unpublished data)

An additional reflectance mode of 1.18 probably indicative of the igneous intrusion intersected at level L2 seam in drillhole.

* Mean random vitrinite reflectance.

† The oil/wet gas peak generation window taken as R_0 0.6–1.3.

CONCLUSIONS

A dolerite quarry near Lonnavale is the only known place in Tasmania where hand sample-sized pieces of naturally occurring *in situ* bitumen may be viewed. Of the many reports of oil and gas seeps made to the Department of Mines, most have been proved to have been caused by phenomena other than petroleum hydrocarbons. The six seeps considered genuine by A. M. Reid have not since been reported by anyone, and we have no evidence as to whether they may be regarded as authentic seeps or not.

Many examples of coastal bitumen have been documented, and some of the material has been profitably used by collectors. These bitumens are probably derived from Indonesian oil sources, and have been washed up onto the Australian coastline by tides.

A number of rock types in Tasmania contain trace quantities of petroleum hydrocarbons. As rocks of appropriate chemical composition have undergone a suitable thermal history, the generation of small quantities of petroleum hydrocarbons is to be expected. Some occurrences of bitumen, sometimes grading to protographite, can be found in metasediments in many areas of Tasmania. Such occurrences undoubtedly result from the metamorphism of organic-rich sediments by some igneous heat source. To date, none of the analysed occurrences of such phenomena constitute a petroleum seep as would be recognised by the petroleum industry.

Nonetheless, some rocks which may be considered potential source rocks do exist in the pre-Devonian Gordon Group, and they definitely occur in the Carboniferous–Permian oil shales containing marine algae and the terrestrial sediments such as the Preolenna Coal Measures. It is encouraging that some of these latter sediments have entered, or are still within the 'oil window', although to date there is no tangible evidence that significant quantities of oil have been produced.

A fortuitous combination of source rock, reservoir and trap leads to the development of a play concept — and some hope that commercial accumulations of petroleum hydrocarbons can be found. Plays can be readily found with the information available for offshore Tasmania, but the same studies have not been completed onshore.

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Dr C. J. Boreham co-authored this report with the permission of the Executive Director, Australian Geological Survey Organisation.

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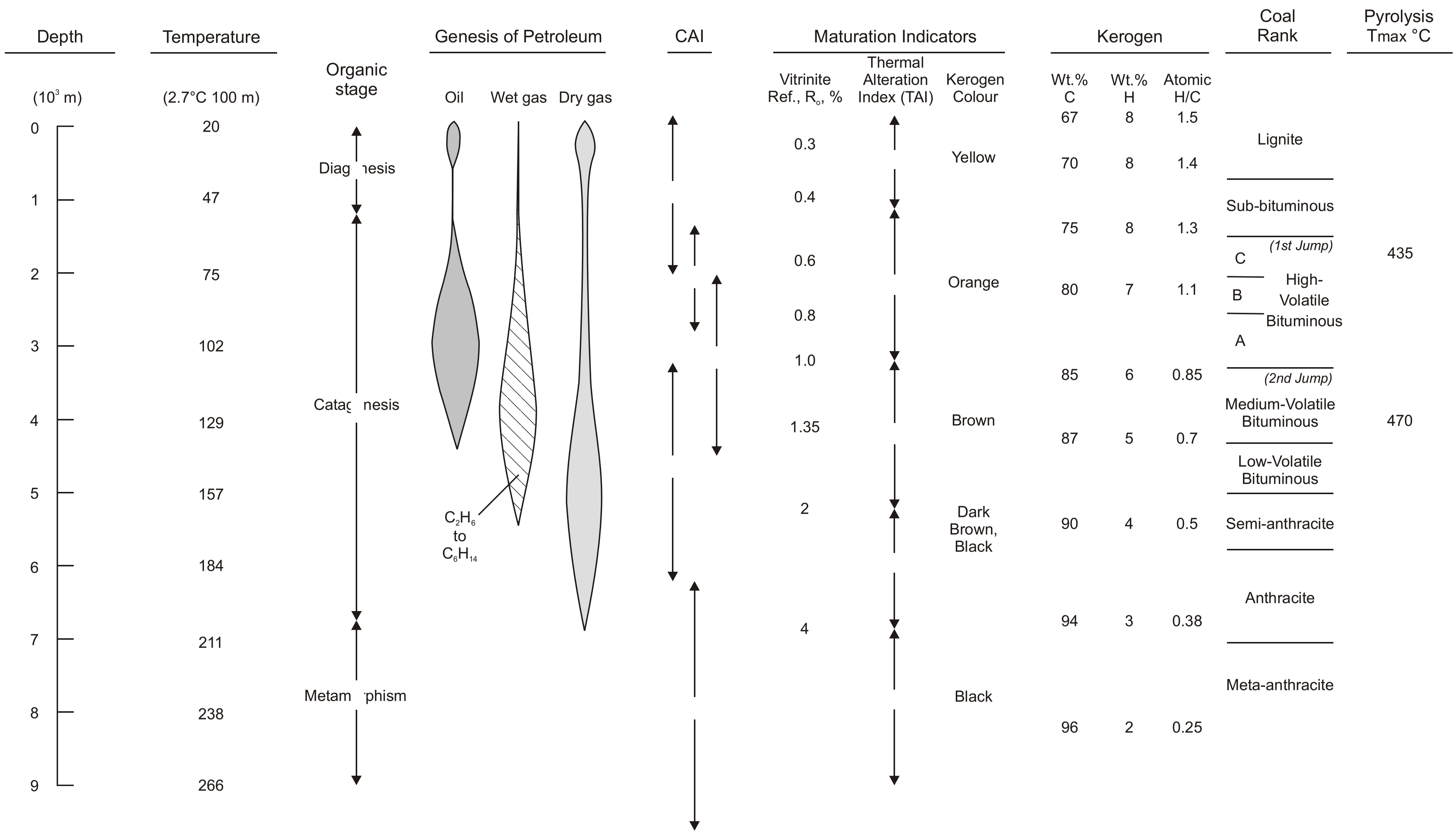

Figure 11. *Comparative techniques for oil maturity assessment (modified from Hunt, 1979)*

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[28 November 1996]

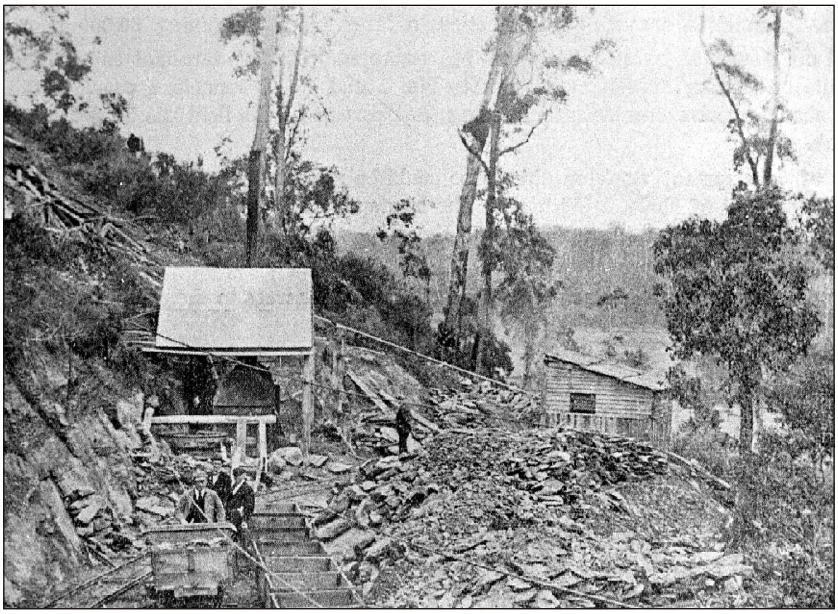
Plate 1

Opening day at the shale works on the eastern side of the Mersey River, 1912

(Latrobe Museum Historical Collection)

Plate 2

Southern Cross Motor Fuels Ltd oil shale mine near Latrobe, 1923



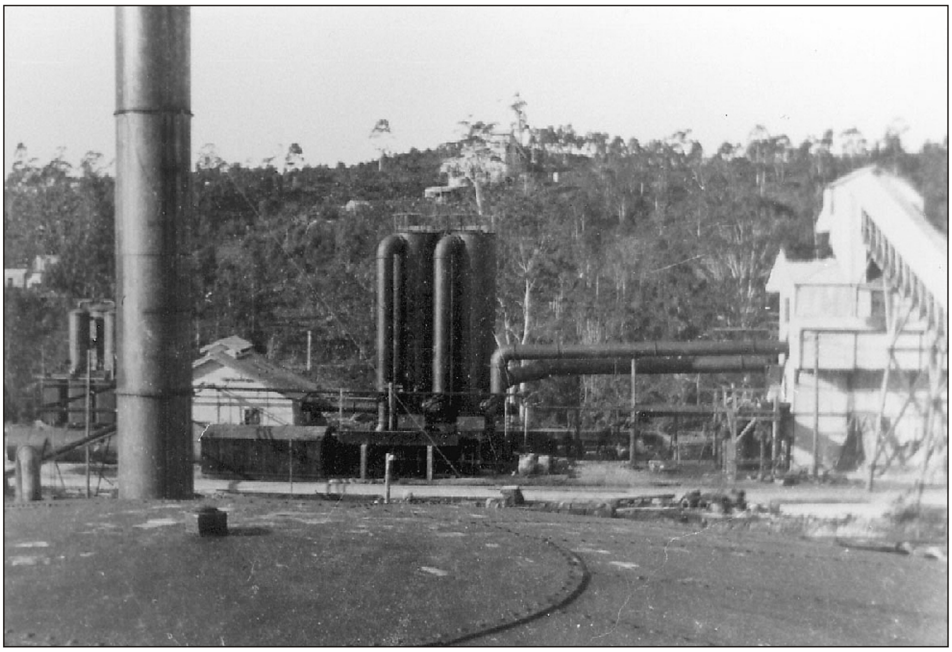


Plate 3

Australian Shale Oil Company plant, showing retort, condenser and storage tank (ca. 1926–1931)

(Latrobe Museum Historical Collection)

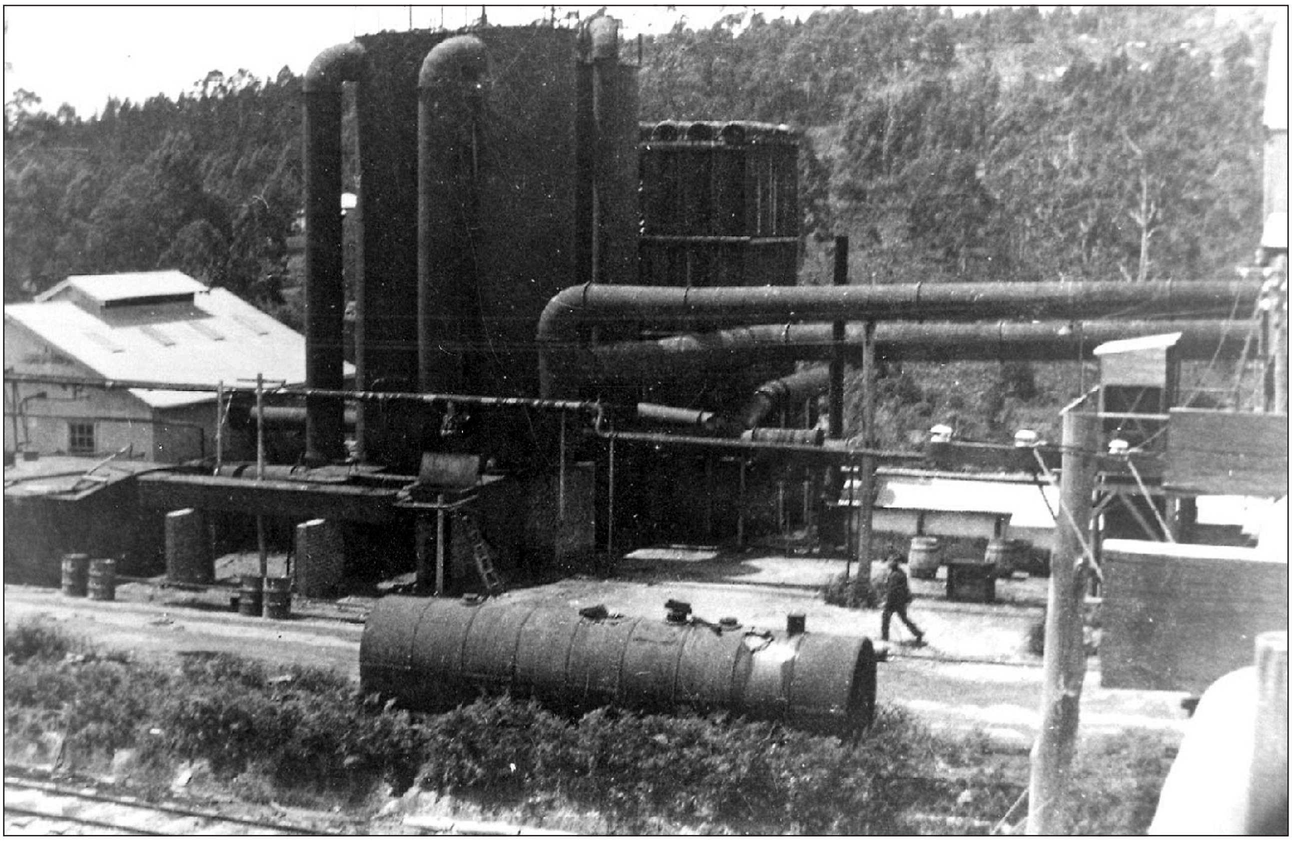


Plate 4

Australian Shale Oil Company condensing plant (ca. 1926–1931)
(Latrobe Museum Historical Collection)

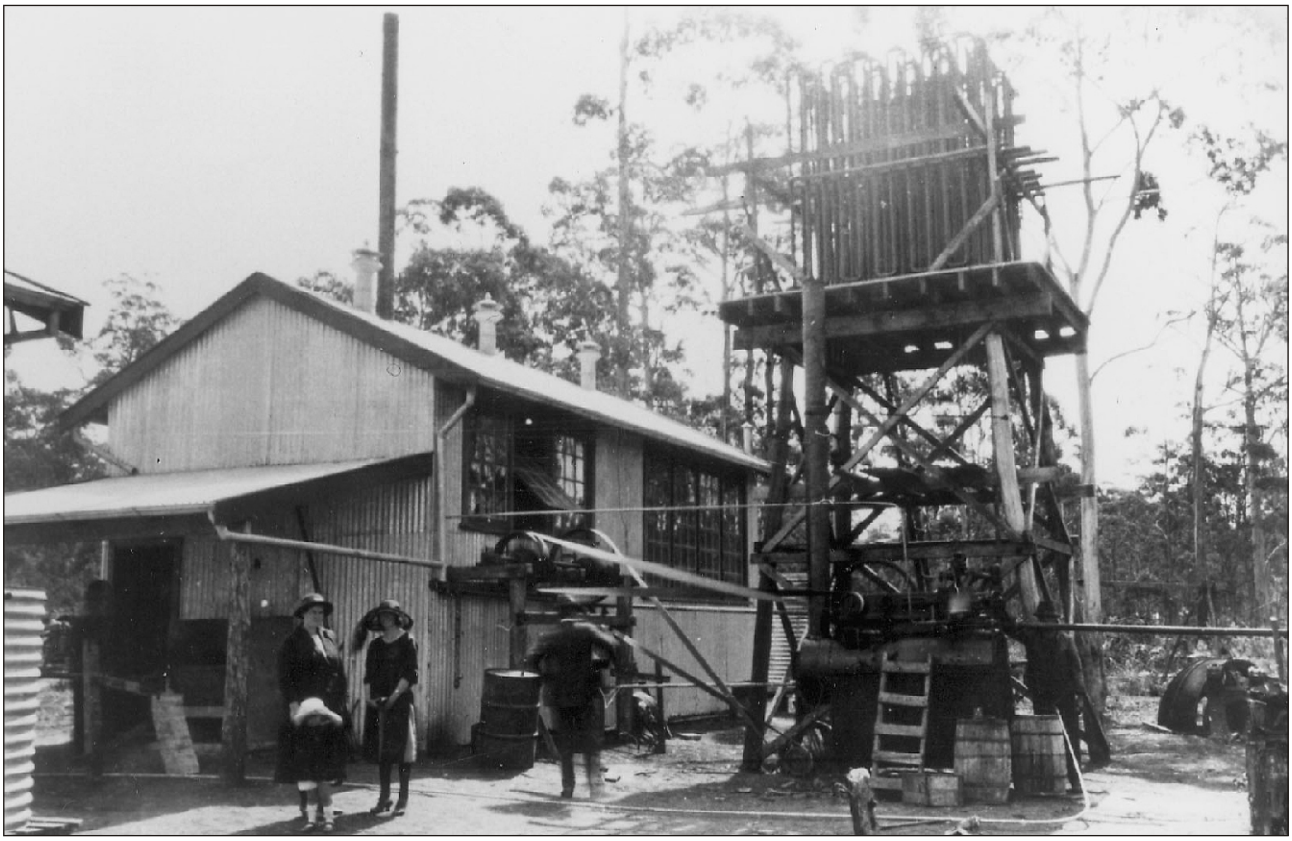


Plate 5

Condensing plant near Mersey River, date unknown
(Latrobe Museum Historical Collection)

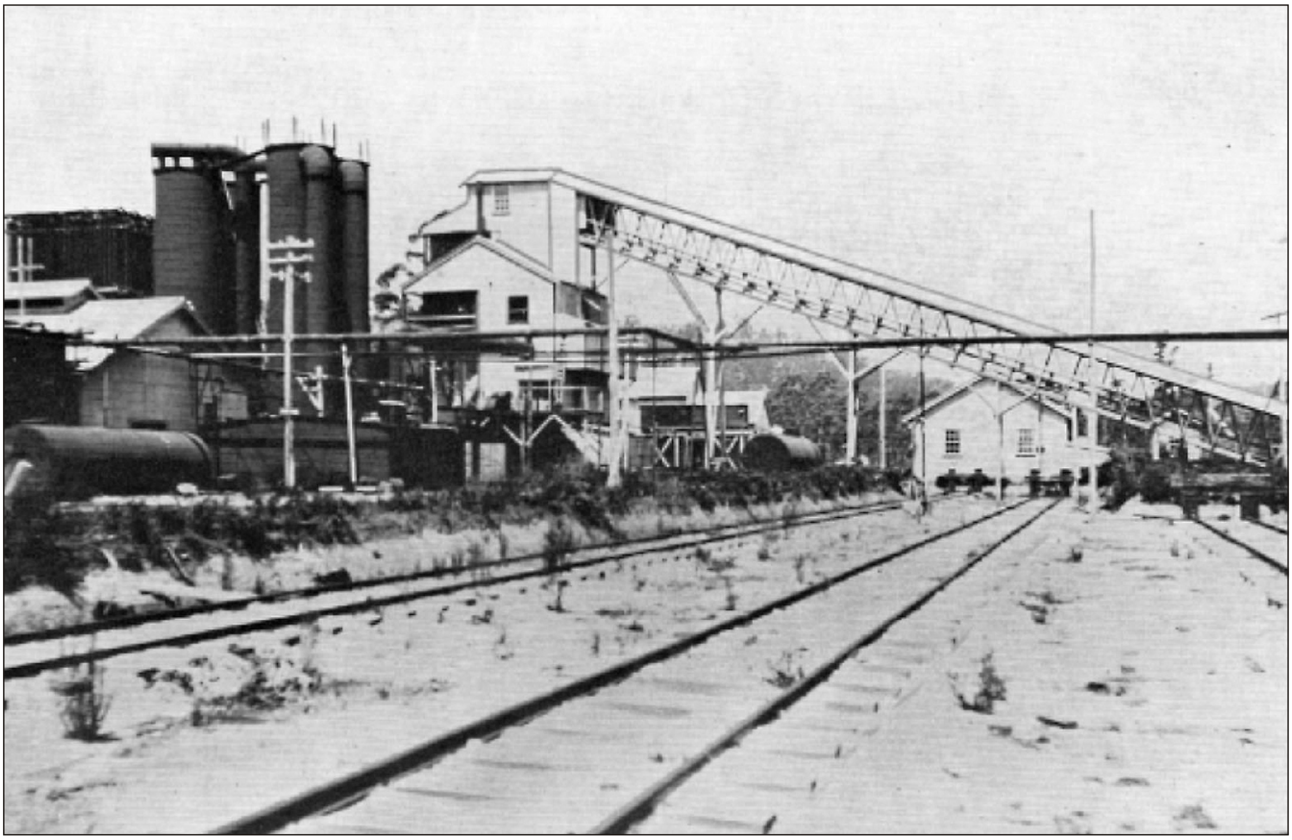


Plate 6

Australian Shale Oil Company works near Latrobe, 1928

Plate 7

Vacuum Oil Company vehicle, late 1930's
(Queen Victoria Museum and Art Gallery QVM:1991:P:127)

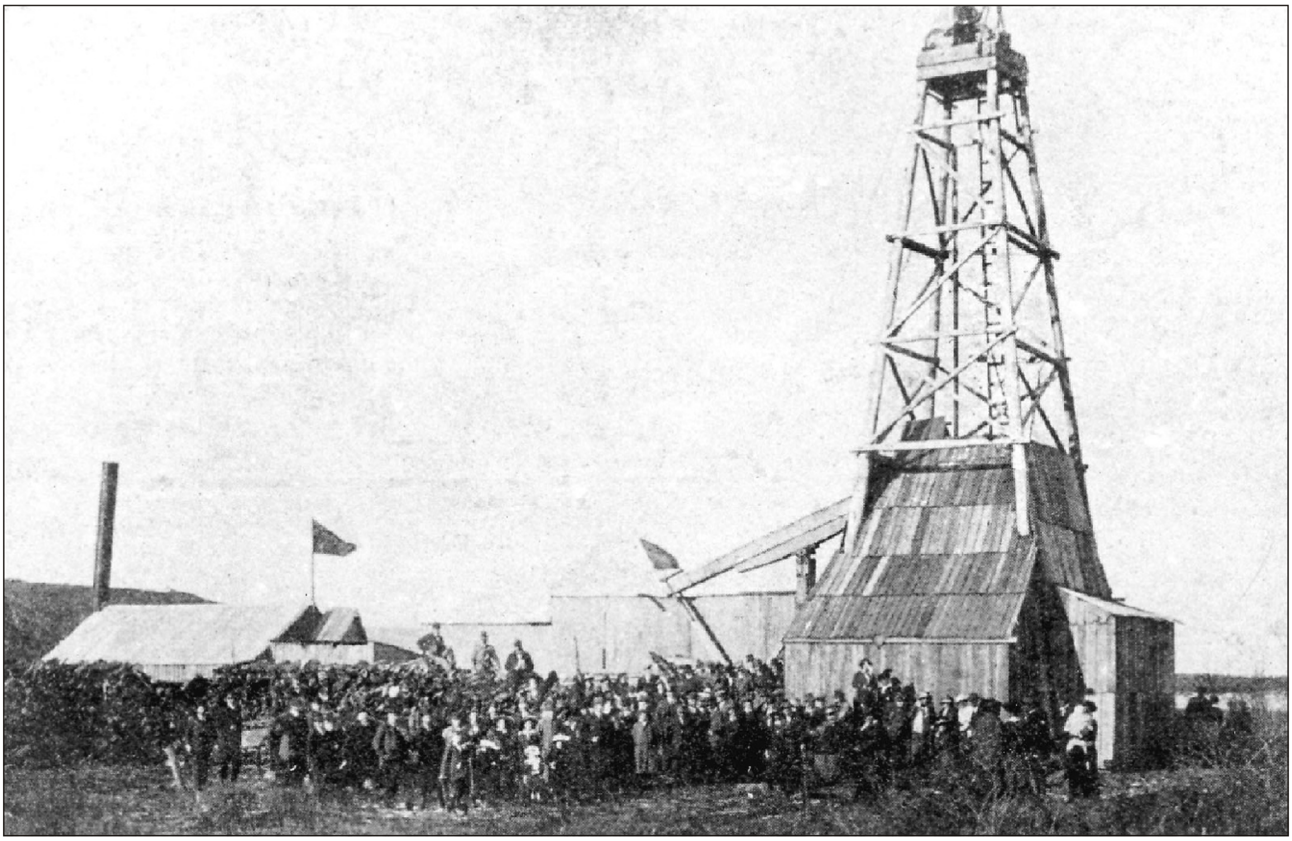
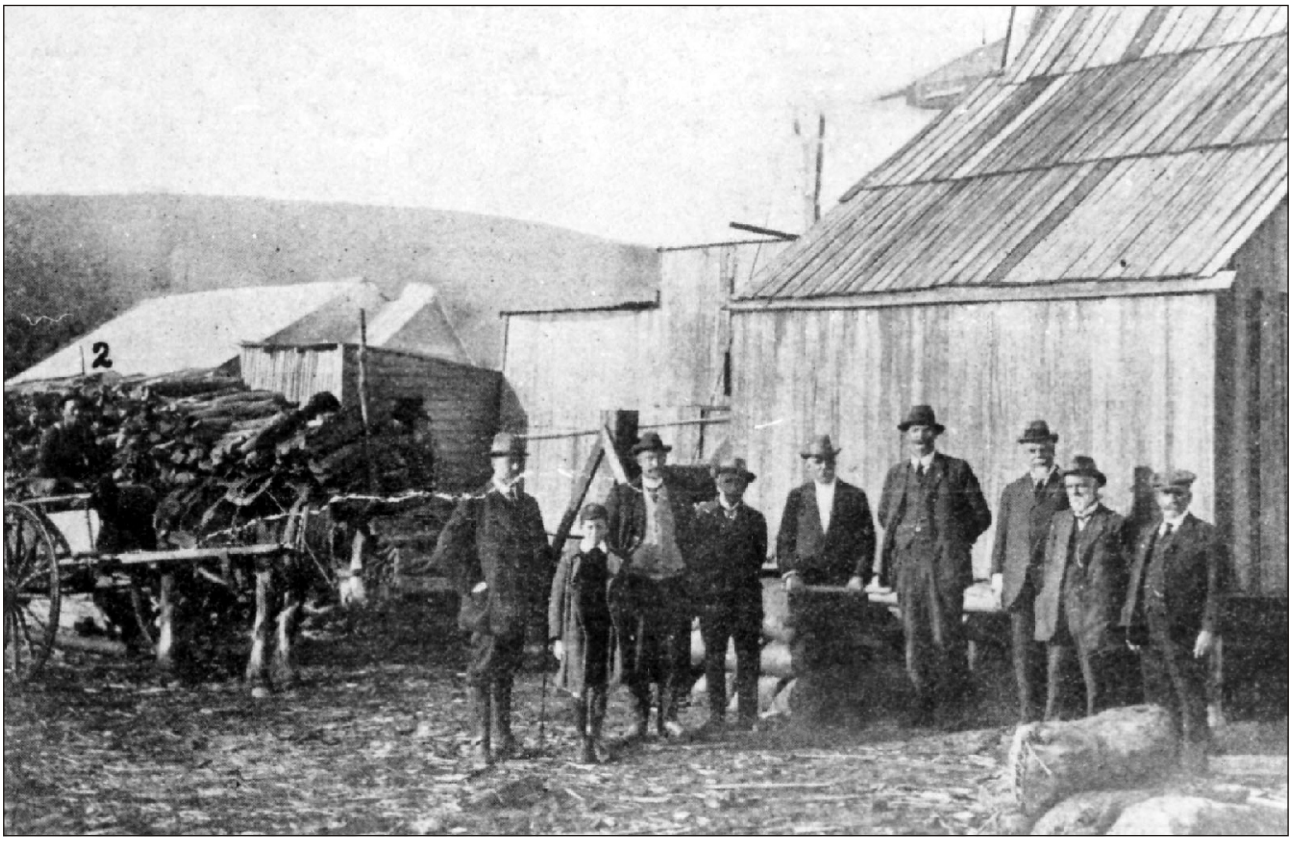


Plate 8

Drilling at Andrews Bore, Bruny Island, 1915
(Tasmanian Mail, 29 June 1916)
(Top) Visitors from Hobart visiting the site works
(Bottom) The company's staff G. R. Andrew (Superintendent), A. McDonald (Driller), C. Koslowski (Assistant Driller)



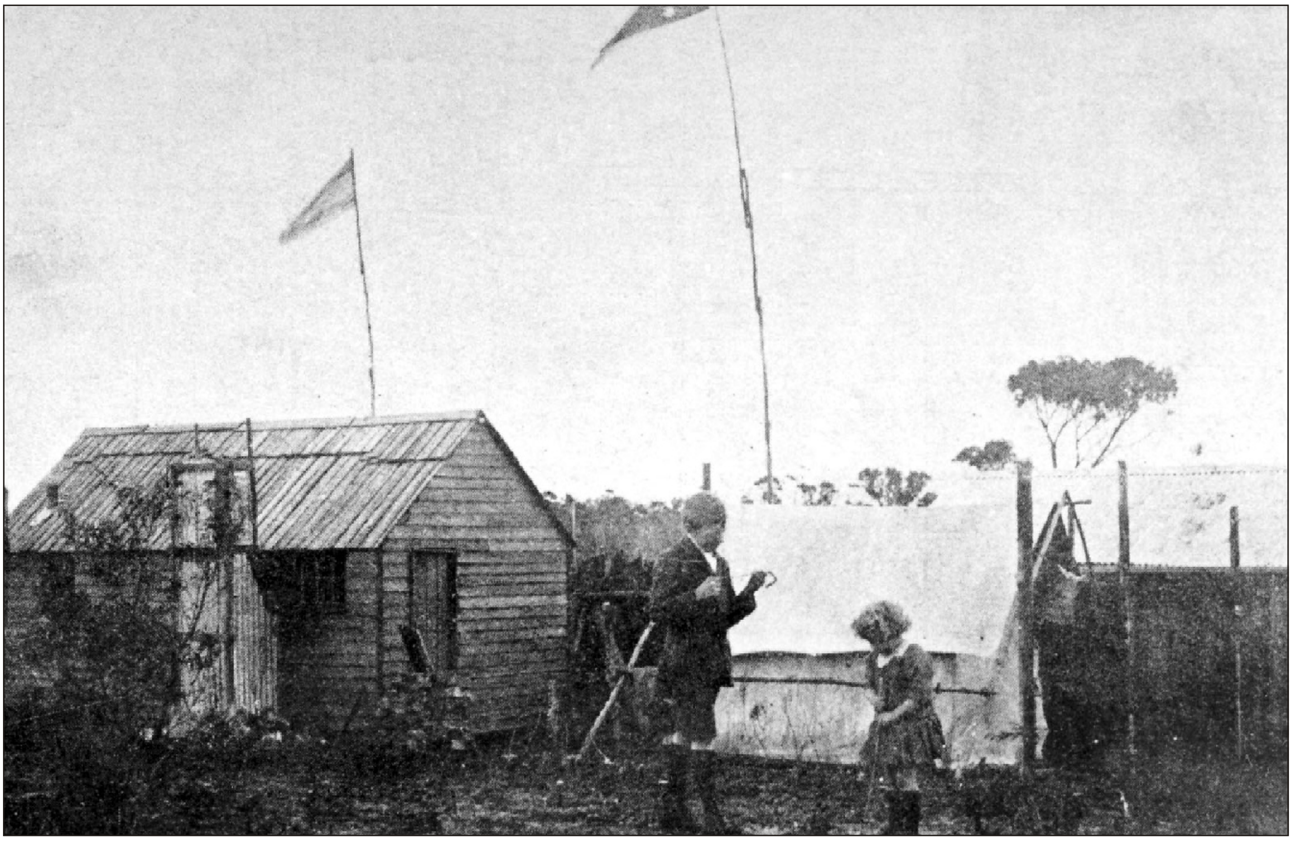


Plate 9

Drilling at Andrews Bore, Bruny Island, 1915
(Tasmanian Mail, 29 June 1916)

(Top) Some of the Directors visiting the site works
(Bottom) The camp at Bruny Island

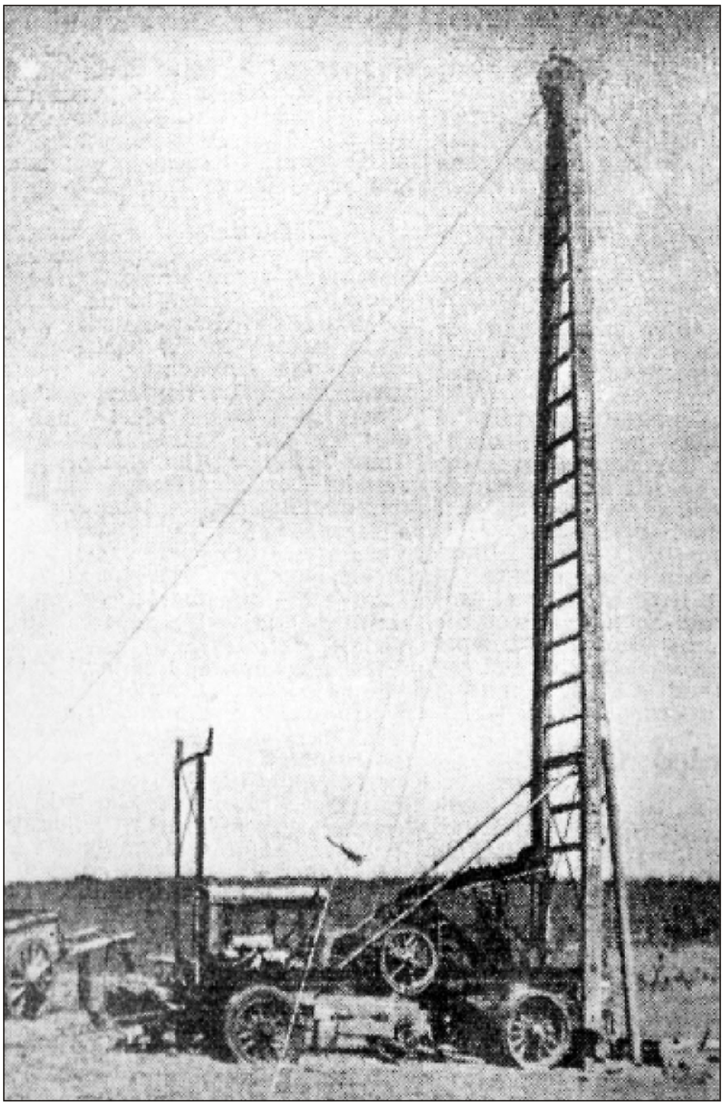


Plate 10

Tasmanian Oil Bore No. 1, drilled at Danbury Park near Launceston in 1939 by Producers Oilwell Supplies Ltd

(The Mercury)

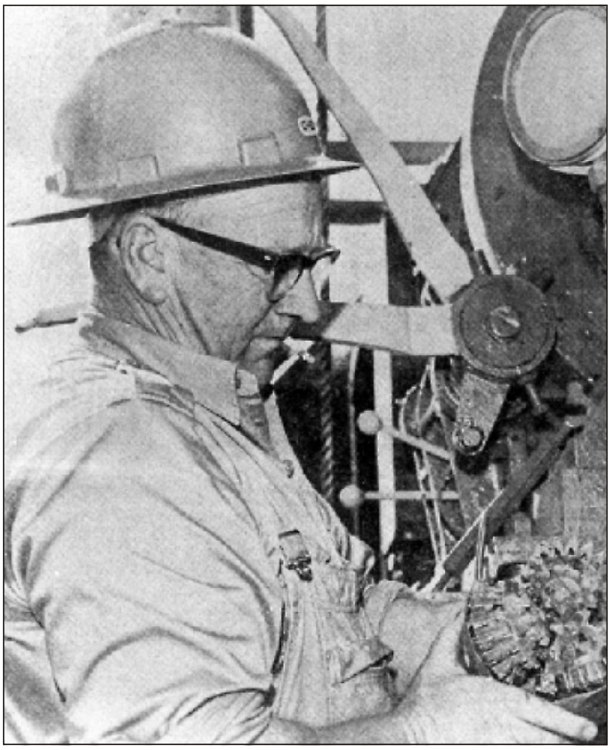


Plate 11

Drilling by Mr Sulzberger at Port Sorell, 1966. Mr Lee and a drilling bit (The Advocate)

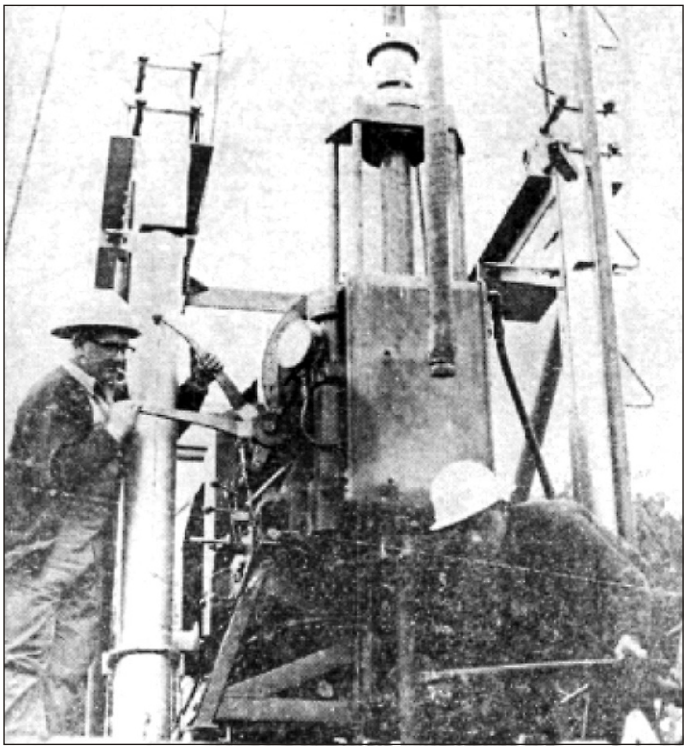


Plate 12

Drilling by Mr Sulzberger at Port Sorell, 1966. Mr Lee and the drilling rig (The Examiner)

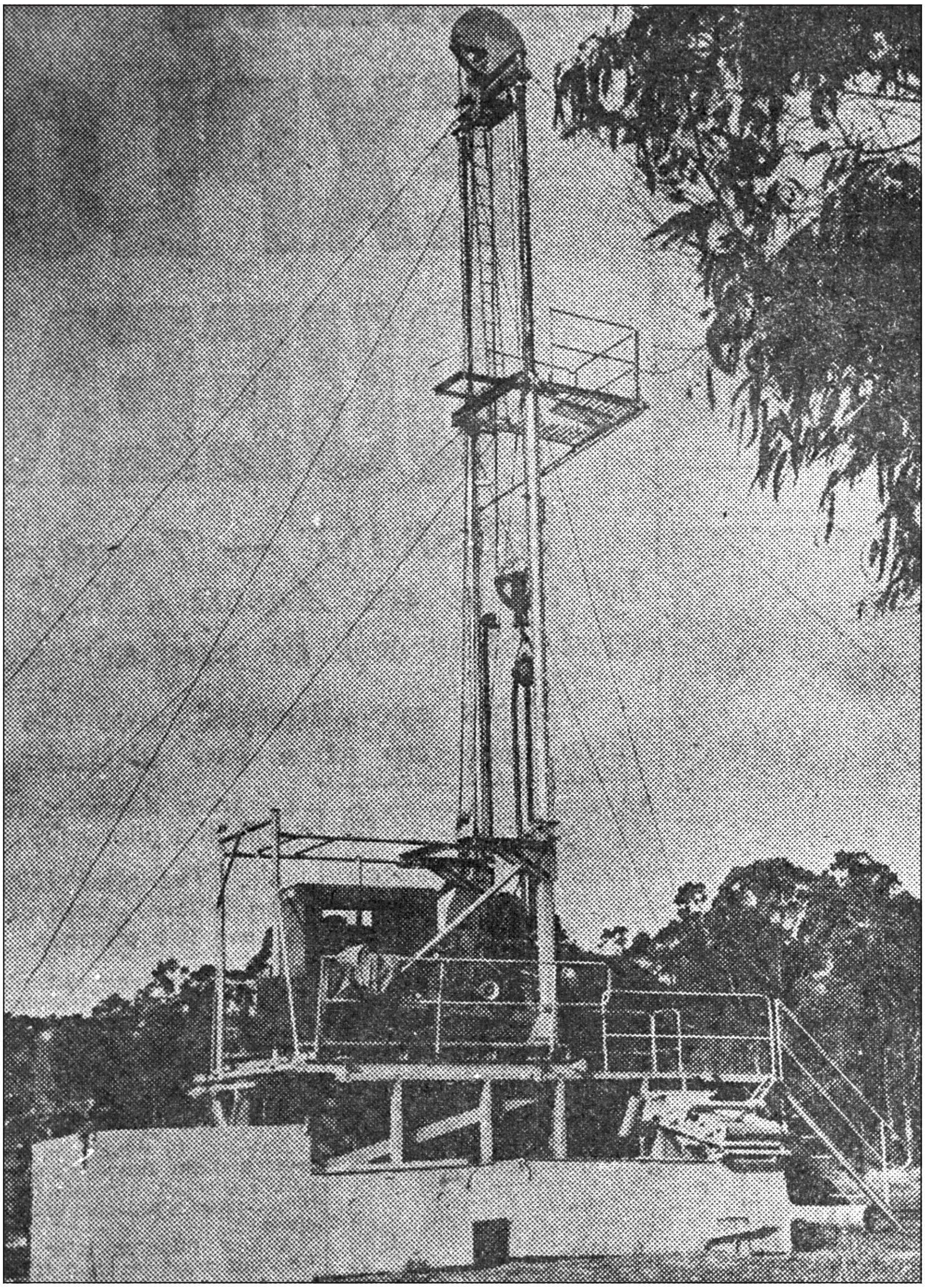


Figure 13

The drilling rig, imported by C. G. Sulzberger in 1963, on location at Parkers Ford, near Port Sorell

(The Advocate)

Plate 14 (below)

Drill rig used to deepen hole Shittim 1 on Bruny Island in 1996

APPENDIX 1

Reported oil and gas 'seeps' in Tasmania

Location	Reported by	Date reported	Material reported	Reported observations	Conclusions	Status
Hummock Island (Prime Seal Island)	Charles Gould	1871	bitumen	stray lump of bitumen (Twelvetrees, 1917).	bitumen stranding	C
Sandy Cape	T. B. Moore	1876	bitumen	small pieces of bitumen, very soft (Twelvetrees, 1915).	bitumen stranding	C
Macquarie Harbour	T. B. Moore	1876	bitumen	small pieces of bitumen, not numerous, near Farm Cove (Twelvetrees, 1915).	bitumen stranding	C
Mainwaring River	T. B. Moore	1876	bitumen	stranded bitumen (Twelvetrees, 1915).	bitumen stranding	C
Farm Cove	T. B. Moore	1895	bitumen	stranded bitumen (Twelvetrees, 1915).	bitumen stranding	C
Port Davey	P. Hutchings	1895	bitumen	stranded bitumen, piece given to Geological Survey (Twelvetrees, 1915).	bitumen stranding	C
Derwent Valley	?	1910	bitumen	bituminous exudations reported on banks of River Derwent, 2 miles from Glenora railway station (Annual Report Director of Mines, 1910, p.36).	probably associated with Tertiary lignite (Annual Report Director of Mines, 1910, p. 36).	U
Chudleigh	M. Petterd	1910	asphaltum	on east bank of Mersey River, black, actile, burns with dense smoke and strong odour, occurs in aluminous shale.	possibly weathered coal from Mersey Coal Measures — high sulphur content would account for smell on burning, fissile nature when weathered; or could be lignite or compressed vegetable matter from Quaternary alluvium. Geological map shows Gog Range Greywacke and alluvium 4 miles from Chudleigh.	U
New River Beach	Smith, Adams, Glover	1912	bitumen	large pieces of asphaltum, one weighing more than a hundredweight (Twelvetrees, 1915).	bitumen stranding	C
Cape Sorell–Point Hibbs	L. Hills	1914	bitumen	stranded bitumen along whole coastline (Hills, 1914).	bitumen stranding	C
Rocky Boat Harbour	Adams	1914	bitumen	stranded bitumen (Twelvetrees, 1915).	bitumen stranding	C
South Cape Bay	Bolton Brothers	1914	bitumen	stranded bitumen (Twelvetrees, 1915).	bitumen stranding	C
Bruny Island	Bruni Island Petroleum Co.	1915	oil	two seepages of liquid bitumen; been active for 50 years (Bruni Island Petroleum Co. prospectus).	seeps not visible to Guy Andrew in 1915 as "cold weather had caused points of bitumen exit to close" (Bruni Island Petroleum Co. prospectus). Wade (1915) could find no evidence of these two seeps.	U
Cape Barren Is.	?	1915	bitumen	stranded bitumen (Twelvetrees, 1915).	bitumen stranding	C
Wynyard	?	1915	bitumen	stranded bitumen on beach (Twelvetrees, 1915).	bitumen stranding	C
Deep Creek (Port Davey)	?	1915	bitumen	stranded bitumen, "found in considerable quantity, about a quarter of a ton having been brought to Hobart for inspection" (Twelvetrees, 1915).	bitumen stranding	C
Cox Bight	?	1915	bitumen	stranded bitumen in a bay east of Cox Bight (Twelvetrees, 1915).	bitumen stranding	C
New River		1915	asphaltum	3 miles up New River and on coastline (Twelvetrees, 1915).	bitumen stranding due to tidal influences	C

Location	Reported by	Date reported	Material reported	Reported observations	Conclusions	Status
West Tamar	W. Twelvetrees	1917	oil	vague reports reaching Department of Mines suggesting the existence of oil scums or oozings.	not examined officially, no samples of exuding material submitted.	U
Newstead	W. Twelvetrees	1917	oil	as above	as above	U
Evandale	W. Twelvetrees	1917	oil	as above	as above	U
Longford	W. Twelvetrees	1917	oil	as above	as above	U
Penguin	E. Eastall	1920	gas	bubbles in a river (E. Eastall to L. Hills, December 1920).	Hills replied “the bubbles were neither unique nor unusual” (L. Hills to E. Eastall, 14 December 1920).	F
Port Sorell	J. H. Moate	1920	oil	saw oil on water at gap at Port Sorell (Adelaide Oil Exploration Co Interim Report to Shareholders).	various possible origins.	U
East Devonport	J. H. Moate	1920	oil	seepage seen on Marshall’s and Saddler’s properties; viewed at 7.30 pm a seep appeared “luminous” (*ibid*).	not inspected	U
Scottsdale	E. Nasson	1920	oil	‘skim’ noticed on pile of loam when wet (E. Nasson to Govt Geologist, 20.9.20).	various possible origins, but not a petroleum seep.	F
Lawrenny	C. Brock	1920	oil	material in borehole sent to Mines Department.	material found to be organic matter in clay; distillate of this gives a tarry matter (Asst Govt Geologist to C. Brock, 6.12.1920).	F
Spring Bay	Fiedler	1920	oil	oil claimed to exist (W. Wallace to Government Geologist).	not investigated	U
Somerset	A. Richardson	1921	oil	rock in back yard which when put in fire makes ‘a fair report’ (G. Richardson to Mines Department, 8 July 1921).	considered to be sandstone (L. Hills to G. Richardson, 12 July 1921).	F
Rosevale	various	pre 1921	oil	statements have been made that oil and oil shale occur at Rosevale (Hills, 1921*b*).	investigations have found lignite but no oil shale or oil (Hills, 1921*b*).	F
Barn Bluff	A. G. Black	1921	oil, gas	oil and gas seepages plainly manifest, large quantities of oil have been produced & may confidently be sought in anticlines (*London Times Supplement* 29.1.1921).	loose blocks of cannel coal present in moraines near Barn Bluff, one piece 16 feet square in area (Reid, 1919).	F
Nook	A. M. Reid	1923	oil, gas	scum of oil on water in shaft 10’ deep dug next to a fault with coal on one side and sandstone on the other (Reid, 1923*a*).	considered to be oil escaping on a fault plane (Reid, 1923*a*).	U
Nook	A. M. Reid	1923	oil, gas	another occurrence downstream (Reid, 1923*a*).	considered by Reid to be genuine (Reid, 1923*a*).	U
Mersey Valley	A. M. Reid	1923	oil, gas	seeping from Tertiary strata, noticed where tree stumps have been removed by fire on Rockcliffe’s land. By probing beneath the crust of peaty clay, oil was found in two places and natural gas was “everywhere” (Reid, 1923*b*).	considered by Reid to be genuine (Reid, 1923*b*).	U
Thirlstane	A. M. Reid	1923	oil, gas	escape of oil and gas reported (Reid, 1923*a*).	not verified by Reid (Reid, 1923*a*).	U
Sassafras	A. M. Reid	1923	oil	seeps near hill, on Syke’s land, oil detected during heavy rain (Reid, 1923*b*).	films of iron oxide issuing at many points (Reid, 1923*b*).	F
Sassafras	P. Roche	1923	oil	seep noticed during periods of heavy rainfall, near top of hill in Tertiary strata (Reid, 1923*a*).	considered by Reid to be genuine (Reid, 1923*a*).	U
Sassafras	A. M. Reid	1923	gas	bore 8 of the Adelaide Oil Exploration Co (Iles bore) was discontinued at 1100’ due to an inrush of sand; bore intersected bed of sand containing natural gas under enormous compression; strong odour of gas accompanied outbreak (Reid, 1923*a*).	considered by Reid to be an occurrence of gas.	U

Location	Reported by	Date reported	Material reported	Reported observations	Conclusions	Status
King Island	A. B. Pritchard	1927	bitumen	stranded bitumen (Pritchard, 1927).	stranding of large piece of bitumen on granite rocks near Pass River.	C
Bruny Island	A. M. Reid	1929	oil	at Johnson's Well, when bedrock struck oil globules rise to surface (Reid, 1929).	considered by Reid to be genuine (Reid, 1929).	U
Bruny Island	A. M. Reid	1929	oil	an oily scum on backwaters of Myles Creek (Reid, 1929).	considered by Reid to be genuine (Reid, 1929).	U
Bruny Island	A. M. Reid	1929	oil	reports of oil in wells near Andrew's bore (Reid, 1929).	probably contamination (Reid, 1929).	U
Bruny Island	A. M. Reid	1929	oil	in a small creek flowing into Great Bay (Reid, 1929).	occurrence below high tide mark, might be derived from floating material brought in by tide (Reid, 1929).	U
Bruny Island	A. M. Reid	1929	oil	showing of oil in an inlet north of Cape Frederick Henry (Reid, 1929).	samples tested; waste substance discharged from vessels (Reid, 1929).	F
Bruny Island	A. M. Reid	1929	bitumen	at north end of Myles Beach (Reid, 1929).	from shipwreck circa 1860 of cargo of tar: sample resembled creosote (Reid, 1929).	F
Bruny Island	A. M. Reid	1929	resin	found in paddocks by ploughing (Reid, 1929).	resin from the local grass trees (Reid, 1929).	F
Henty River	J. Robertson	1929	gas	sticks poked into alluvium in the river bed produced bubbles which could be ignited.	marsh gas (Nye, 1929*a*).	F
King Island		1929	asphaltum	lump of asphaltum found in 1927 near Pass River re-examined.	lodged into place (on granite rocks) by sea action (Blake, 1929).	C
Hobart	Broughton	1930	oil	sample left at Mines Department.	material is organic, derived from animal dung, probably that of bats (Nye to Broughton, 13 October 1930).	F
Castle Forbes Bay	J. H. Moate	1930	oil	enclosed newspaper cuttings reporting oil discovery at Castle Forbes Bay (J. H. Moate to A. M. Reid, 24 January 1930).	a black organic substance resulting from alteration of vegetable matter (A. M. Reid to J. H. Moate, 29 January 1930).	F
Mengha		1930	oil	an oily substance was noted in post holes 18" deep dug near house (Nye, 1930).	mixture of clay and water seen in holes (Nye, 1930).	F
Stoodley	A. Wright	1930	oil	reported a spring which after rain was impregnated with an oily substance (A. Wright to Govt Geologist, 29.8.1930).	bottle of water examined and found to contain precipitates of iron oxide (P. B. Nye to A. Wright, 8 September 1930).	F
Dunalley	H. G. Gray	1930	oil	sample of material said to contain free oil brought in for testing (A. M. Reid to L. H. Bath, 27 January 1930).	sample of brown sand did not contain any trace of natural oil (A. M. Reid to Gray, 8 February 1930). Deemed by Nye (1930) to be colouration due to iron oxides and organic matter.	F
Cradoc	W. J. Armstrong	1931	oil gas	brown sand at top of shaft (Nye, 1931). bubbling through water in base of shaft 3–4' deep (Nye, 1931).	tested for liquid petroleum and for a yield of crude oil after distillation — nil result; considered by Nye to be marsh gas (Nye, 1931).	F
Leprena	G. H. Smith	1931	oil	seepage of dark brown colour, smells like carbide (G. H. Smith to P. B. Nye, 19 January 1931).	sample analysed and found to be seawater with clay and decomposed seaweed (P. B. Nye to G. H. Smith, 9 February 1931).	F
Flinders Island		1931	oil	oil bearing material allied to coorongite occurs in bed of a small artificially drained lagoon (Nye, 1931).	not related to petroleum (Nye, 1931; Carey, 1946).	F

Location	Reported by	Date reported	Material reported	Reported observations	Conclusions	Status
Golden Valley	B. Whittle	1932	gas	gas reported at several localities (B. Whittle to Chairman of Shale Oil Committee); after poking a stick and stirring up bottom of ponds, bubbles appear (Nye, 1930).	considered to be methane or marsh gas (P. B. Nye to L. H. Bath, 22 March 1933). Sample collected by Nye did not contain any petrol (file note L. H. Bath, 7 December 1932).	F
Unknown	R. White	1932	oil	visited a place 40 years ago, sure there was oil present, bubbling out of ground with area bare of vegetation (R. White to P. B. Nye, 24.10.1932).	re-visited: area now ploughed and under cultivation (R. White to P. B. Nye, 24.10.1931); probably a spring with mineral salts deposited on ground (P. B. Nye to R. White, 23 November 1932).	U
D'Entrecasteaux Channel	Loyd Owens	1933	oil	drops of oil rising to surface close to shore (L. Owens to Government Mineralogist, 7 November 1933).	advised to collect a sample and forward to Department of Mines for testing (P. B. Nye to L. Owens, 7 November 1933).	U
Legerwood	W. Bartlett	1936	oil	petrol coming into a (water) well (W. Bartlett to Major Davis, 5 February 1936).	well polluted, probably from nearby storage of petroleum oils (W. Williams to Minister for Mines, 21 April 1936).	F
Ross	C. Davis	1939	oil	scum in puddles (Blake, 1939).	multi-coloured scum in puddles was iron oxide (Blake, 1939).	F
Ross	C. Davis	1939	gas	bubbles seen when alluvium in bottom of ditches poked with a shovel (Blake, 1939).	bubbles deemed to be marsh gas (Blake, 1939).	F
Unknown	Robert Taylor	1939	oil	found an oil field and traced it for a long way (R. Taylor to Minister for Mines, 19.7.1939).	offered a geological inspection of the area (Secretary for Mines to R. Taylor, 27 July 1939).	U
Colebrook	Percy Clark	1941	oil	a show of oily fluid which comes out of the ground during wet periods (P. W. Clarke to W. H. Williams, 5.6.1941).	requested to forward a sample for testing (Director of Mines to P. W. Clarke, 11 June 1941).	U
Strahan	W. Holmes	1942	asphaltum	quantity of pitch washed up onto Ocean Beach. During a storm water offshore was coloured black and after storm passed pieces of pitch found on beach. Two hundred pounds collected (K. A. Rae to Minister for Mines, 5.12.1947).	found to be similar to the asphaltum deposited elsewhere on the Tasmanian coastline (K. A. Rae to Minister for Mines, 5.12.1947).	C
Burnie	Miss E. Joyce	1942	oil	submitted sample of 'flowing oil'.	sample submitted was a bottle of water containing fungus. The cork had been in contact with an essential oil (Director of Mines to E. Joyce, 19 February 1942).	F
Bridport	A. Thorpe	1944	oil	oil in puddles in road gravel quarries; lease taken out by divining from these spots (D. E. Thomas to Director of Mines, 21.2.1944).	puddles found to be full of tadpoles and mosquito lavae; quarries in granite. Water discoloured by mud and vegetation (D. Thomas to Director of Mines, 21.2.1944). Samples taken contained no mineral oil (Director of Mines to A. Thorpe, 17 March 1944).	F
Flinders Island	F. Henwood	1945	oil	thought Flinders Island would be prospective for oil due to presence of limestones, which were favourable indicators of same (Carey, 1945).	no concrete evidence of any oil (Carey, 1945).	F
Port Davey	H. Keid	1945	asphaltum	piece of bitumen on foreshore, 4 ounces	coastal bitumen	C
Tarraleah	H. Harris	1946	gas	Knows of a wet boggy gully and when walk bubbles will come up which can be lit with a match (H. Harris to Secretary for Lands, 2.6.1946).	considered to be marsh gas from rotting vegetation (Director of Mines to G. Harris, 11 July 1946).	F

Location	Reported by	Date reported	Material reported	Reported observations	Conclusions	Status
South Flinders Island	S. W. Carey	1946	peat	highly inflammable deposit in a drained swamp, on distillation yields 80% oil and tar (Carey, 1946).	a semi-peat composed of algal bodies similar to coorongite (Carey, 1946; Cane, 1966).	F
Redpa	Burt	1948	oil	sounds heard in wells dug in 1928 were analogous to thumping and booming sounds heard in Rumanian oil wells as described in a magazine (T. Hughes to Director of Mines, 31 March 1948).	no concrete evidence of oil and nothing to suggest rocks are oil bearing (T. Hughes to Director of Mines, 12 May 1948).	F
Strahan	H. Fletcher	1953	oil	brown stain on sand; iridescence on wet sand not enough to be collected (J. Elliston to Director of Mines, 10.1.1952).	scum caused by decay of small organisms (Hughes, 1953).	F
Strahan	H. Fletcher	1953	oil	an area of 'black' water seen off Ocean Beach (Hughes, 1953).	water swirling around either decayed vegetation or maybe the effect of fine-grained ilmenite (Hughes, 1953).	F
Henty River	H. Fletcher	1953	oil	seep reported (Hughes, 1953).	investigation revealed no sign of oil seepages or what may even be mistaken for oil seepages (Hughes, 1953).	F
Hobart	W. Pott	1954	gas	at a place within 50 miles of Hobart there is gas below ground 'two spades' deep (W. Pott to Mr Reece, 5 July 1954).	various possible causes.	U
King Island	Adams	1955	bitumen	had found bitumen on beach near Pass River in 1925. Applied for a lease (Corby to Director of Mines, 22 February 1955).	beach stranding of bitumen (Pritchard, 1927; Blake, 1929, Dickinson, 1943).	C
Longford	Eva Marchant	1956	oil	reported that on land once owned by husband a well was sunk and water of an 'oily nature' found reflecting all the colours of the rainbow (E. Marchant to Minister for Mines, 16 February 1956).	iridescence due to decomposing vegetable matter or oxides of iron (J. G. Symons to E. Marchant, 21 February 1956).	F
King Island	Mrs A. I. Smith	1956	bitumen	bitumen found below high tide mark; inaccessible at high tide or during rough weather (Mrs A. Smith to J. G. Symons, 23 April 1956).	bitumen stranding	C
unknown	E. A. Haigh	1957	gas	reporting an observation of gas bubbles in water seen in 1920 (E. Haigh to J. G. Symons, 24 May1957).	feature probably has now ceased to operate (J. G. Symons to E. Haigh, 6 June 1957).	U
Cambridge	F. W. Evans	1957	oil	traces reported, located by divining four to five years previously (A. H. Blissett to Director of Mines, 9 December 1957).	inspection revealed seepage of peaty water but no trace of mineral oil (Blissett, 1957).	F
Kingston	Mrs Wilkinson	1958	oil	scum on dam (phone message from Mrs Wilkinson to Department of Mines, 22 December 1958).	probably iron oxide	U
Hamilton	W. C. Inglis	1958	oil	films on water (A. B. Gulline to Director of Mines, 1 October 1958).	iron oxide (A. B. Gulline to Director of Mines, 1.10.1958.	F
Burnie	Mrs E. Davey	1960	oil	was told by a friend 50 years ago that his boots became covered in oil while eating his lunch next to a river (E. Davey to Mr E. Reece, 21 March 1961).	various possible origins	U
Central Highlands	K. Slater	1960	oil	spring water coming out of hill has an oily film on surface and nearby pools also covered; coats vegetation next to pools (Slater to Mines Department, 3 May 1960).	geologist called but was unable to locate. Mr Slater requested to provide more details (J. G. Symons to K. Slater, 8 July 1960).	U
Detention River	C. R. Pyke	1960	oil	on surface of Detention River during a flood (Hughes, 1960).	inspection revealed no trace of oil (Hughes, 1960).	F
Mt Cameron	F. W. Ford	1960	bitumen	report of bitumen find on coast between Mt Cameron and Green Point; he had used in 1920–25 to mend a boat (F. Ford to Mines Department, 4 April 1960).	bitumen stranding	C

Location	Reported by	Date reported	Material reported	Reported observations	Conclusions	Status
Marrawah	A. J. Wigg	1960	bitumen	found small pieces of bitumen on a beach near Marrawah (A. J. Wigg to Director of Mines, 10 June, 1960).	bitumen strandings, washed up by the sea (J. G. Symons to A. J. Wigg, 14 June 1960).	C
Unknown	L. E. Costello	1961	oil		two samples tested by Department of Mines, tests negative for oil (J. G. Symons to L. E. Costello, 24 October 1961).	F
Burnie	L. F. Egan	1962	oil	foundations for HEC substation at South Burnie uncovered a layer of carbonaceous material and sand (L. Egan to Director of Mines, 22 June 1962).	described by G. Everard as sand coated with black organic material (G. Everard to Director of Mines). Test revealed no oil (Certificate of Analysis, 20 June 1963).	F
Burnie	Adams	1962	oil	seepage behind paper mill (J. G. Symons to L. F. Egan, 17 July 1962).	no investigation recorded	U
Launceston	Mr Carroll	1962	oil	In 1923 a sample of oil in water was collected from water flowing from bank into Distillery Creek (R. W. Morris to Director of Mines, 16 October 1962).	no oil found on visiting site, place on bank sampled in 1923 has eroded away (R. W. Morris to Director of Mines, 16 October 1962).	F
Bridgenorth	Mr W. Rattray	1962	oil	after rain, water with an oily surface ‘seeps out from a hill’ (W. Rattray to Premier E. Reece, 12 April 1962).	S. M. Rowe found films of oil oxide and a greenish black gelatinous plant material that could be mistaken for oil (S. M. Rowe to Director of Mines, 15 May 1962).	F
Marrawah (?)	C. Hine	1962	oil		sample of mud analysed (locality not stated); contained no oil (W. St C. Manson to C. Hine, 2 October, 1962).	F
Table Cape	Jackson	1963	gas	report of seeing bubbles offshore from Table Cape 25 years previously (K. Burns to Director of Mines, 3 April 1963).	enquiries revealed no other person had seen bubbles, including two cray fishermen who had been setting pots in area for 15 years (K. Burns to Director of Mines, 3 April 1963).	F
Tamar Valley	E. G. Hall	1964	oil	oil deposits discovered by divining (M. J. Longman to Director of Mines, 23 February 1965).	no surface indications of oil, no samples of oil available, just a belief in divining abilities (M. J. Longman to Director of Mines, 23 February 1965).	F
Ulverstone	C. Flowers	1965	bitumen	bitumen seen in a stretched pebble conglomerate (J. G. Symons to C. Flowers, 25 November 1965).	sample of bitumen sent in to Mines Department is same as that used in road construction; is not likely that the bitumen is naturally occurring (J. G. Symons to C. Flowers, 25 November 1965).	F
Fossil Bluff	Mrs S. Veenstra	1965	oil	knows of places where oil is flowing out of the ground (Mrs S. Veemstra to Director of Mines, 7 April 1965).	seepages from side of hill along the shoreline, pools of stagnant water covered by iron oxide films (W. L. Matthews to Director of Mines, 13 September 1965).	F
Launceston	W. Thurlow	1965	oil	oil seep in gutter outside toilets in Elizabeth Street, Launceston, has existed for 50 years, more noticeable after rain (W. Thurlow to Minister for Mines, 25 September 1965).	sample examined and found to contain no petroleum oil (L. F. Egan to Director of Mines, 8 November 1965).	F

Location	Reported by	Date reported	Material reported	Reported observations	Conclusions	Status
Lebrina	L. L. Hill	1965	oil	film on water in puddles (L. L. Hill to Director of Mines, 6 October 1965).	stagnant stretches of water in swamp and isolated puddles carry a surface film of iron compounds (D. J. Jennings to Chief Geologist, 9 November 1965).	F
South Arm	F. Sproule	1965	oil	oil in well dug by the Army on Cape Direction 24 years ago (Lucarelli, 1965).	no inspection made	U
Forth River	H. E. Flight	1966	gas	extrusion of gas bubbles in water below high tide mark on a mud flat (H. Flight to Director of Mines, 8 April 1966).	probably methane type gas emanating from Tertiary sediments below the muds (B. Noldart to Chief Geologist, 22 April 1966).	U
King Island	W. Liveridge	1966	oil	advised that he had divined an oilfield west-south-west of King Island whilst on a plane "which (he) can do" (Liveridge to Secretary, Department of Mines, 8 November 1966).	reply that area held by Haematite Explorations Pty Ltd (Director of Mines to W. Liveridge, 15 November 1966).	U
Sassafras	Egan	1966	oil	samples submitted for analysis.	clay containing a green organic stain (H. Wellington to Director of Mines, 28 September 1966).	F
Cradoc	D. Leaman	1967	oil	seepages of bituminous material or oil reported (Leaman, 1967).	probably ferruginous films (Leaman, 1967).	F
Table Cape	Miss A. Jackson	1967	oil, gas	reported her grandfather found an oil and gas seepage in 1916; a dark brown substance bubbling to surface. Can only be seen at low tide when sea is calm (W. L. Matthews to Director of Mines, 11 July 1967).	inspection revealed no trace of oil (W. L. Matthews to Director of Mines, 11 July 1967).	F
Penguin	J. M. Bates	1968	oil	oil seepage seen in drainage ditch dug into boggy ground; most noticeable after rain (T. Bates to Mines Department, 4 June 1968).	various possible origins	U
Prion Bay	Harry Ackerley	1974	bitumen	pale blue material, greasy like plasticine, came out of the sea and rolled up the beach in balls, burnt readily, seen in 1950's (H. Akerley to J. G. Symons, 9 February 1974).	bitumen stranding	C
Kimberley	W. L. Matthews	1978	gas	gas reported associated with a thermal spring (Matthews, 1978).	analysis determined the gas to be of biogenic (bacterial) origin (Baillie, 1992).	F
Maydena	BHP	1980	oil	traces of petroleum hydrocarbons in water in drill hole (25 mg/l) (BHP, 1982*b*).	not considered significant by explorer. Hole intersected Woody Island Siltstone. Various possible origins.	T
Bruny Island	Janice Higgins	1987	oil	remembered oily smell in garden at Killora as a child; carrots needed cleaning to reduce oily diesel-like smell; oil scum on creek near house in summer (Morrison, 1987).	no oily smell or residue noticed on inspection (Morrison, 1987). Kerosene was often sprayed on carrots to reduce weeds at the seedling stage in home gardens.	F
Bruny Island	Conga Oil P/L	1987	oil	scum in cattle hoof prints and scum in toilet (Morrison, 1987).	toilet used dam water and was permanently discoloured; no cattle on land — a normal ¼ acre block (Morrison, 1987).	F
Bruny Island	A. Bain	1987	oil	possible oil seep (Morrison, 1987).	water with a metallic blue scum seeping from eucalypt bark and offcuts from sawmill (Morrison, 1987).	F
Bruny Island	Conga Oil P/L	1987	oil	scum from surface of dam on probable site of Johnson's Well (Morrison, 1987).	traces of biogenic and petroleum hydrocarbons detected (Volkman, 1987*a*).	T

Location	Reported by	Date reported	Material reported	Reported observations	Conclusions	Status
Bruny Island	Conga Oil P/L	1987	oil	mud from dam as above (Morrison, 1987).	traces of biogenic and petroleum hydrocarbons detected (Volkman, 1987*a*).	T
Bruny Island	Conga Oil P/L	1987	oil	scum from dam floor as above (Morrison, 1987).	traces of biogenic and petroleum hydrocarbons detected (Volkman, 1987*a*).	T
Bruny Island	Conga Oil P/L	1987	oil	scum from Hazell's dam (Morrison, 1987).	traces of biogenic and petroleum hydrocarbons detected (Volkman, 1987*a*).	T
Bruny Island	Conga Oil P/L	1987	oil	scum on waterhole 100 m north of Johnson's Well (Morrison, 1987).	traces of biogenic and petroleum hydrocarbons detected (Volkman, 1987*a*).	T
Bruny Island	Conga Oil P/L	1987	oil	scum on waterhole 200 m west of Andrew's bore (Morrison, 1987).	traces of biogenic and petroleum hydrocarbons present (Volkman, 1987*a*).	T
Bruny Island	Conga Oil P/L	1987	oil	soil sample, Johnson's Well (Morrison, 1987).	traces of biogenic and petroleum hydrocarbons present (Volkman, 1987*a*).	T
Bruny Island	Conga Oil P/L	1987	oil	scum and sediment from Miles Creek at mouth of creek (Morrison, 1987).	traces of biogenic and petroleum hydrocarbons present (Volkman, 1987*a*).	T
Cradoc	Conga Oil P/L	1987	oil	scum on creek water from farm (Morrison, 1987).	traces of biogenic and petroleum hydrocarbons (Volkman, 1987*a*).	T
Bruny Island	S. Forsyth	1988	bitumen	sample found of bitumen-impregnated sandstone at Little Taylors Bay on ledge approx. 1 m above high tide mark.	bitumen may have been thrown into position by a very high tide, or placed there by visitors; not actively seeping bitumen (Forsyth, pers. comm.).	X
Dysart	M. Bendall	1988	bitumen	pieces of black material found in sandstone cave in Green Valley Road (Brighton South sample).	determined to be bat guano on inspection by CSIRO.	F
Bridgewater	M. Bendall	1988	bitumen	tar allegedly found years ago when water pipe installed, sample collected in 1988. Two samples, one of tarry material and one of underlying rock.	no evidence to show that hydrocarbons in tar and rock were related; tarry material has been subject to high temperature burning (Volkman and Holdsworth, 1989*a*). Could possibly be pieces of tar from installation of water pipe, when pipes were coated with pitch or bitumen.	U
Barnes Bay	D. E. Leaman	1988	bitumen	bitumen found above high tide mark at Barnes Bay.	Sample Bit #1, Volkman and Holdsworth (1989*a*), reported as being from the midlands. Origin not determined, but possibly heating of immature sediment by dolerite.	X
Marion Bay	P. Baillie	1990	gas	gas bubbling out of sand in intertidal area (Baillie, 1990).	CSIRO analysis concludes gas is of biogenic origin (Baillie, 1990).	F
Tunnack	M. Bendall	1990	bitumen	medium-coarse grained sandstone with bituminous matrix (Volkman and O'Leary, 1990*b*).	possibly derived from man-made petroleum products; or could be products of dolerite heating of organic-rich but immature sediment.	X
South Bruny Island	M. Bendall (same as Forsyth, 1988)	1990	bitumen	black brittle tar on weathered sandstone (Volkman and O'Leary, 1990*b*).	possibly derived from man-made petroleum products; or could be products of dolerite heating of organic-rich but immature sediment.	X

Location	Reported by	Date reported	Material reported	Reported observations	Conclusions	Status
Smithton	P. Baillie	1992	gas	gas was reported seeping into standing water in a paddock; been active for 50 years.	analysis determined the gas to be carbon dioxide of geothermal origin (Baillie, 1992).	F
Douglas River	M. Bendall	1993	gas	gas escaping from drill hole (Revill and Volkman, 1993).	gas determined to be of biogenic origin (Summons, 1993).	F
Bruny Island	Conga Oil P/L	1994	gas	bubbles appeared when stick poked into dam (Johnson's Well) and stirred around in mud on bottom of hole.	sample of gas analysed and determined to be of biogenic origin (Revill and Volkman, 1994).	F
Bruny Island	M. Bendall	1994	gas	gas bubbles in water in pit near old brick kilns.	sample of gas analysed and determined to be of biogenic origin (Revill and Volkman, 1994).	F
Bruny Island	M. Bendall	1994	tar	tar on rock chip samples from drill hole Shittim 1 (transcript ABC Radio interview, January 1995).	analysed by MRT laboratory; found to possibly be manganese oxide.	F
Bruny Island	M. Bendall	1994	tar	tar in rock samples from Shittim 1; samples brought to MRT for analysis.	XRD analysis showed to be smectite clays and other minerals (Bottrill, 1995).	F
Pelham	M. Bendall	1994	bitumen	apparently found on EL 17/65 by EZ Company.	no record found	U
Bruny Island	M. Bendall	1995	oil	oil suspected in core from Shittim 1; rock had peculiar smell.	smell due to water; minute traces of hydrocarbons from two different source types found; probably due to contamination (Revill, 1995).	U
Lonnavale	R. Bottrill	1995	bitumen	bitumen and a liquid found with zeolites in fractures in dolerite in road quarry.	found to be generated from *Tasmanites*.	V
Zeehan	M. Bendall	1996	bitumen	suspected bitumen found in an ore body at the Comstock prospect, near Zeehan. Black crumbly material with a sulphurous smell.	XRD analysis showed material to be galena with some protographite.	F
Bruny Island	Great Southland Minerals P/L	1996	gas	Presence of C_1–C_8 and helium reported from deep drill hole on Bruny Island.		V

There has been a total of 139 reported oil and gas 'seeps'. These can be summarised as:

C — Reports of coastal bitumens: 24

V — Petroleum hydrocarbons confirmed by analysis: 2

T — Petroleum hydrocarbons – detected in trace amounts by modern analysis: 10

F — Investigated reports shown phenomena other than petroleum hydrocarbons: 62

U — Unverified/uninvestigated reports: 38

X — Possibly bitumens derived by dolerite heating immature organic sediments: 3

APPENDIX 2

Bores drilled in search of petroleum in Tasmania to 1994

Bore	Drilled By	Location	AMG co-ords	Latitude	Longitude	Year Drilled	Total Depth (m)
Andrews	G. Andrew (Bruni Island Oil Company)	Bruny Island	EN309128	43°14.2’S	147°22.8’E	1915	131
	Summary log: 0–34 m sand, clay; 34–131 m limestone.						
	C. A. Brock	Hamilton	DN795925	42° 31’S	146°45’E	1920	158
	Summary log: Tertiary sediments overlying sandstone.						
Driscoll	Mersey Valley Oil Co. (No. 1)	Sassafras	DQ555321	41°15.7’S	146°28.1’E	1922	91
(Reid 21)	*Summary log:* 0–9 m clay; 9–91 m Permian mudstone and sandstone.						
Ingram	Mersey Valley Oil Co. (No. 3)	Sassafras	DQ555310	41°16.3’S	146°28.1’E	1922	242
(Reid 22)	*Summary log:* 0–4 m clay; 4–146 m Permian sandstone and and mudstone; 146–225 m conglomerate; 225–242 m basement quartzite, schist and conglomerate.						
Bourkes	Mersey Valley Oil Co. (No. 2)	Sassafras	DQ547301	41°16.7’S	146°27.5’E	1922	115
	Summary log: 0–3 m clay; 3–28 m mudstone and sandstone with basalt pebbles; 28–44 m conglomerate; 44–64 m quartzite; 64–80 m dolerite; 80–115 m quartz/conglomerate.						
Racecourse	Mersey Valley Oil Co. (No. 4)	Latrobe	DQ532353	41°13.9’S	146°26.7’E	1922	305
(Reid 24)	*Summary log:* 0–1 m clay; 1–294 m Permian sandstone and mudstone; 294–305 m conglomerate and quartzite.						
Atkinsons	Mersey Valley Oil Co. (No. 5)	Latrobe	DQ532335	41°14.9’S	146°26.5’E	1922	59
(Reid 25)	*Summary log:* 0–5 m clay; 5–47 m mudstone and sandstone; 47–59 m quartzite and schist.						
Staggs	Mersey Valley Oil Co. (No. 6)	Latrobe	DQ535353	41°13.9’S	146°26.7’E	1922	305
(Reid 26)	*Summary log:* 0–3 m clay, weathered Permian sandstone; 4–402 m sandstone, mudstone, conglomerate and shale (302–305 m dolerite).						
Camerons	Adelaide Oil Exploration Co. (No. 5)	Latrobe	DQ497335	41°14.9’S	146°24.0’E	1922	192
(Reid 16)	*Summary log:* 0–5 m gravel and clay; 5–151 m Permian mudstone; 151–186 m Permian conglomerate; 186–192 m Precambrian(?) schist						
Smiths	Adelaide Oil Exploration Co. (No. 6)	Spreyton	DQ454359	41°13.6’S	146°20.9’E	1922	141
(Reid 17)	*Summary log:* 0–12 m sand and clay; 12–131 m Permian mudstone and sandstone; 131–141 m quartzite.						
Allisons	Adelaide Oil Exploration Co. (No. 7)	Tarleton	DQ465341	41°14.6’S	146°21.7’E	1922	101
(Reid 18)	*Summary log:* 0–5 m clay, 5–90 m Permian mudstone; 90–101 m quartzite.						
Kites	Adelaide Oil Exploration Co. (No. 1)	On ML 4777M	DQ543234	41°20.4’S	146°27.2’E	1922	172
(Reid 12)	*Summary log:* 0–148 m Permian mudstone and sandstone; 148–172 m quartzite.						
Hoggs Bridge	Adelaide Oil Exploration Co. (No. 2)	near Hoggs Bridge	DQ547237	41°20.2’S	146°27.5’E	1922	90
(Reid 13)	*Summary log:* 0–82 m Permian mudstone; 82–90 m quartzite.						
(Reid 14)	Adelaide Oil Exploration Co. (No. 3)	Native Plain	DQ551235	41°20.3’S	146°27.8’E	1922	158
	Summary log: 0–155 m Permian mudstone; 155–158 m quartzite.						
(Reid 15)	Adelaide Oil Exploration Co. (No. 4)	Native Plain	DQ554230	41°20.6’S	146°28.0’E	1922	253
	Summary log: 0–5 m clay; 5–218 m Permian mudstone and sandstone; 218–253 m basement of slaty mudstone and quartzite.						
(Reid 27)	Adelaide Oil Exploration Co. (No. 10)	Merseylea Bridge	DQ566211	41°21.6’S	146°28.9’E	1922	288
	Summary log: 0–6 m gravel and clay; 6–279 m Permian mudstone and sandstone; 279–288 m conglomerate.						
Windy Ridge	?	Moriarty	DQ574369	41°13.1’S	146°29.5’E	1923	?
	No log available.						
Haines	Mersey Valley Oil Co. (No. 7)	East Devonport	DQ501389	41°12.0’S	146°24.3’E	1923	87
(Reid 33)	*Summary log:* 0–6 m clay; 6–87 m Permian sandstone and mudstone.						
Hermitage	Mersey Valley Oil Co. (No. 8)	Moriarty	DQ384359	41°13.5’S	146°15.9’E	1923	204
(Reid 28)	*Summary log:* 0–12 m basalt; 12–132 m mudstone, clay and sand; 132–204 m dolerite.						
Parsons	Mersey Valley Oil Co. (No. 9)	Sassafras	DQ605359	41°13.6’S	146°31.7’E	1923	351
(Reid 31)	*Summary log:* 0–18 m clay, gravel and conglomerate; 18–116 m basalt; 116–351 m mudstone, soft sandstone and lignite.						

Bore	Drilled By	Location	AMG co-ords	Latitude	Longitude	Year Drilled	Total Depth (m)
Iles	Adelaide Oil Exploration Co. (No. 8)	Harford	DQ613363	41º13.4'S	146º32.3'E	1923	336
(Reid 29)	*Summary log:* 0–8 m clay and ironstone; 8–118 m basalt; 118–124 m tuffaceous material; 124–127 m basalt; 127–336 m clay and sand with lignite; 336 m quartz sand. **Gas reported**						
Burgess	Adelaide Oil Exploration Co. (No. 9)	Harford	DQ608343	41º14.5'S	146º31.9'E	1923	355
(Reid 30)	*Summary log:* 0–18 m clay, sand, soft sandstone; 18–168 m basalt; 168–339 m clay, gravel, lignite; 339–355 m dolerite.						
Watlings (Reid 32)	Adelaide Oil Exploration Co. (No. 11)	Quoiba	DQ457383	41º12.2'S	146º21.1'E	1923	?
Northdown Beacon	?	Northdown Beach	DQ561431	41º9.7'S	146º28.6'E	1924	?
	No log available, bottomed in dolerite.						
Northdown Foreshore	?	Northdown Beach	DQ580448	41º8.8'S	146º30.0'E	1928	206
	Summary log: 0–7 m pebbles; 7–206 m Permian sandstone, mudstone and quartzite; 206 m Precambrian(?) quartzite.						
Johnsons Well	A. G. Black (Tasmanian Oil Exploration Co.)	Bruny Island	EN317170	43º11.9'S	147º23.4'E	1930	52
	Oil stained water reportedly struck at 27 m.						
Danbury Park	W. R. Richmond (Producers Oilwell Suppliers P/L)	Launceston	EQ050176	41º23'S	147º3'E	1939	?
	Spot chosen by patent oil finder, shallow hole drilled.						
Parkers Ford	C. G. Sulzberger	Port Sorell	DQ610408	41º11.0'S	146º32.1'E	1967	305
	Summary log: 3–38 m sand; 38–151 m basalt; 151–180 m sand; 180–305 m dolerite.						
Elphington 1	C. G. Sulzberger	Squeaking Point	DQ624394	41º11.7'S	146º33.1'E	1967	381
	Summary log: 0–332 m sand and clay; 332–381 m dolerite.						
Browns 1	C. G. Sulzberger	Squeaking Point	DQ619399	41º11.5'S	146º32.7'E	1967	335
	Summary log: 0–256 m sand and clay; 256–335 m dolerite.						
Hardys 1	C. G. Sulzberger	Harford	DQ618364	41º13.4'S	146º32.7'E	1967	381
	Summary log: 0–5 m sand and clay; 35–95 m basalt; 95–366 m sand and clay; 366–381m dolerite.						
DP1	C. G. Sulzberger	Bracknell	DP999885	41º39.3'S	146º59.9'E	1968	687
(Badcocks)	*Summary log:* 0–670 m Tertiary sediments, clay, sand, wood fragments, gravel, bottomed in dolerite.						
DP2	C. G. Sulzberger	Hagley	DQ980024	41º31.8'S	146º58.6'E	1970	831
(Fairview)	*Summary log:* 0–792 m Tertiary sediments as above, bottomed in dolerite.						
Rosevale 1	C. G. Sulzberger	Rosevale	DQ926162	41º24.3'S	146º54.7'E	1974	50
	Summary log: clay, dolerite at base.						
Rosevale 2	C. G. Sulzberger	Rosevale	DQ927157	41º24.6'S	146º54.8'E	1974	50
	Summary log: clay, dolerite at base.						
Other holes which have encountered gas							
Conara railway yard	Mines Department	Conara	EP353697	41°49.9'S	147°25.5'E	1990	30
	Summary log: 0.6 m clay; 6–16 m sandy clay; 16–24 m sand; 24–30 m clay.						
Chilvers' property	Mines Department	Cleveland	EP336714	41°48.5'S	147°24.3'E	1963	48
	Summary log: 0–20 m clay and sand; 20–30 m clay and quartz gravel; 30–32 m clay and decomposed wood fragments; 32–38 m gravel; 38–48 m sand and clay, bottomed in dolerite.						

Thirty-eight holes have been drilled for oil/gas, plus two others in others in which gas was reported.
Some details in this table were derived from Burns (1963, 1964) and Reid (1924).

APPENDIX 3

Offshore oil wells, Tasmanian waters

Well	Spud Date	Status	Well Category	Latitude	Longitude	Rig	Oil/gas Recoveries
Wells drilled in Bass Basin							
Flinders 1	29.11.1992	P & A	Exploration	40°22'51.810"S	145°40'18.690"E	Ocean Epoch	
King 1	30.10.1992	P & A	Exploration	39°35'24.331"S	145°31'01.780"E	Ocean Epoch	
Seal 1	11.02.1986	P & A	Exploration	39°21'48.979"S	144°52'52.700"E	Atwood Margie	
Chat 1	15.01.1986	P & A	Exploration	40°10'53.430"S	146°41'54.955"E	Atwood Margie	
Pelican 5	28.12.1985	P & A	Appraisal	40°20'43.472"S	145°51'49.296"E	Diamond M Epoch	gas
Koorkah 1	27.11.1985	P & A	Exploration	39°37'57.000"S	145°09'05.000"E	Diamond M Epoch	
Yolla 1	08.06.1985	Suspended	Exploration	39°50'18.890"S	145°48'20.550"E	Robert F Bauer	gas/oil
Tilana 1	05.09.1985	P & A	Exploration	39°53'36.730"S	145°58'41.970"E	Diamond M Epoch	gas
Tas Devil 1	27.08.1984	P & A	Exploration	40°44'16.206"S	146°09'44.958"E	Diamond M Epoch	
Squid 1	16.07.1984	P & A	Exploration	40°11'53.547"S	146°18'27.456"E	Diamond M Epoch	
Pipipa 1	04.05.1982	P & A	Exploration	40°23'14.000"S	145°41'45.000"E	Southern Cross	
Pelican 4	17.01.1979	P & A	Appraisal	40°21'40.020"S	145°52'15.360"E	Ocean Endeavour	gas
Nangkero 1	24.04.1974	P & A	Exploration	40°04'24.161"S	145°58'41.952"E	Glomar Conception	
Aroo 1	04.03.1974	P & A	Exploration	39°47'30.325"S	145°26'47.976"E	Glomar Conception	minor gas
Toolka 1A	14.01.1974	P & A	Exploration	39°24'35.678"S	145°23'45.108"E	Glomar Conception	
Yurongi 1	03.07.1973	P & A	Exploration	39°55'29.936"S	146°15'58.866"E	Glomar Conception	
Konkon 1	13.05.1973	P & A	Exploration	39°12'19.584"S	145°03'39.721"E	Glomar Conception	
Narimba 1	31.08.1973	P & A	Exploration	40°16'18.080"S	145°43'53.581"E	Glomar Conception	
Dondu 1	30.05.1973	P & A	Exploration	39°59'12.520"S	146°13'02.600"E	Glomar Conception	
Durroon 1	22.10.1972	P & A	Exploration	40°32'02.940"S	147°12'48.490"E	Glomar Conception	
Tarook 1	03.10.1972	P & A	Exploration	40°02'36.950"S	145°40'28.560"E	Glomar Conception	
Poonboon 1	29.08.1972	P & A	Exploration	40°08'15.190"S	145°55'01.290"E	Glomar Conception	minor gas
Pelican 3	01.05.1972	P & A	Exploration	40°15'44.990"S	145°51'50.000"E	Glomar Conception	
Pelican 2	28.07.1970	P & A	Exploration	40°18'28.426"S	145°49'12.270"E	Ocean Digger	gas
Cormorant 1	11.06.1970	P & A	Exploration	39°34'22.800"S	145°31'35.700"E	Ocean Digger	gas/oil
Pelican 1	19.03.1970	P & A	Exploration	40°20'20.800"S	145°50'37.100"E	Ocean Digger	gas
Bass 3	11.02.1967	P & A	Exploration	39°59'51.000"S	145°16'57.000"E	Glomar 3	gas
Bass 2	14.04.1966	P & A	Exploration	39°53'09.000"S'	146°18'15.000"E	Glomar 3	
Bass 1	21.07.1965	P & A	Exploration	39°46'18.000"S	145°44'03.000"E	Glomar 3	
Wells drilled in Otway/Sorell Basins							
Cape Sorell 1	05.07.1982	P & A	Exploration	42°08'09.646"S	145°01'45.840"E	Diamond M Epoch	
Whelk 1	06.03.1970	P & A	Exploration	39°53'57.080"S	143°33'20.900"E	Ocean Digger	
Clam 1	09.07.1969	P & A	Exploration	40°51'52.419"S	144°12'55.153"E		
Prawn A1	29.12.1969	P & A	Exploration	39°21'23.420"S	143°06'41.890"E	Ocean Digger	
Wells drilled in Gippsland Basin							
Sailfish 1	12.10.1971	P & A	Exploration	39°27'24"S	148°37'54.4"E	Glomar Conception	
Bluebone 1	16.09.1969	P & A	Exploration	39°24'24.296"S	147°50'52.740"E	Glomar 3	
Mullet 1	09.01.1969	P & A	Exploration	139°13'02"S	147°51'22"E	Glomar 3	

APPENDIX 4

Tenements held to search for oil in Tasmania

Location	Held By	Date	Licence/lease	Type of Tenement
North Bruny Island	Bruni Island Petroleum Company	1915	Licences to Search	6 Licences to Search, 320 acres each
Recherche Bay	Asphaltum Glance & Oil Syndicate	1915	LTS	Licence to Search, 640 acres
New River	Asphaltum Glance & Oil Syndicate	1915	LTS	4 Licences to Search, 320 acres each
Bruny Island	R. J. P. Davey	1918	LTS 6	Licence to Search, 3200 acres
Bruny Island	R. J. P. Davey	1918	LTS 6	Licence to Search, 3200 acres
North Bruny Island	W. H. T. Brown	1918		Licence to Search, 1400 acres
Elderslie	Stella Chapman	1919	LTS 8	Licence to Search, 3000 acres
Elderslie	S. Chapman	1919	LTS 8	Licence to Search, 3000 acres
Elderslie	V. A. Chipman	1920	LTS 12	Licence to Search, 3200 acres
Elderslie		1920	LTS 13	Licence to Search, 3200 acres
Elderslie	J. Fritzoni	1920	LTS 90	Licence to Search, 100 acres
Elderslie	J. Fritzoni	1920	LTS 91	Licence to Search, 45 acres
Elderslie	H. Thomas	1920	LTS 93	Licence to Search, 2560 acres
Elderslie	E. M. Mathias	1920	LTS 94	Licence to Search, 1400 acres
Elderslie		1920	LTS 112	Licence to Search, 500 acres
Port Davey	Donellan & others	1920	LTS 40	Licence to Search, 200 acres
Port Davey	W. T. A. Cleveland	1920	LTS 41	Licence to Search, 3200 acres
South Bruny Island	V. A. Chipman	1920	LTS 12	Licence to Search, 3200 acres
Bruny Island	C. C. Brown	1920		Licence to Search, 500 acres
Barn Bluff	C. C. Manton & A. G. Black	1920		Licence to Search, 3200 acres
Barn Bluff	A. G. D. Bernaceli	1920		Licence to Search, 3200 acres
Barn Bluff	P. Evans	1920		Licence to Search, 3200 acres
Cradle Mountain	The Granville Prospecting & Mining Company NL	1920		Licence to Search, 3200 acres
Mt Olympus	L. G. Thompson	1920		Licence to Search, 3200 acres
Narcissus River	L. M. Stackhouse	1920		Licence to Search, 3200 acres
Port Davey	M. J. Donellan, C. Smith & J. Jones	1920	LTS 40	Licence to Search, 3200 acres
South Bruny Island	S. Perry	1920	LTS 13	Licence to Search, 3200 acres
Barn Bluff	W. A. Mudie	1920		Licence to Search, 3200 acres
Barn Bluff	A. L. Nichols	1920		Licence to Search, 3200 acres
Mt Achilles	C. C. Reilly	1920		Licence to Search, 3200 acres
Barn Bluff	E. Hawson	1920		Licence to Search, 3200 acres
Port Davey	W. T. A. Cleveland	1920	LTS 41	Licence to Search, 3200 acres
Coal Hill to Mt Byron, Lake St Clair	T. McDonald	1920		Licence to Search, 3200 acres
Davey River	W. T. A. Cleveland	1920		Licence to Search, 3200 acres
Dulverton	E. Morse	1921	LTS 76	Licence to Search, 380 acres
Railton	F. D. Kite	1921	LTS 77	Licence to Search, 239 acres
Mersey	S. Stewart	1921	LTS 79	Licence to Search, 1382 acres
Preolenna	Margetts & Margetts	1921	LTS 80	Licence to Search, 200 acres
Between Lagoon River and Interview River	F. W. Heritage	1921		Licence to Search, 3200 acres
Mt Pelion	A. Baker	1921		Licence to Search, 3200 acres
Mt Pelion	T. B. Harrington	1921		Licence to Search, 3200 acres
Mt Pelion	R. Duncan	1921		Licence to Search, 3200 acres
Mt Pelion	E. J. Stott	1921		Licence to Search, 3200 acres
Mt Pelion	C. H. Augas	1921		Licence to Search, 3200 acres
Mt Pelion	L. W. Mudie	1921		Licence to Search, 200 acres
Mt Pelion	J. West	1921		Licence to Search, 3200 acres
Mt Pelion	J. T. Moate	1921		Licence to Search, 3200 acres
Mt Pelion	T. B. Harrington	1921		Licence to Search, 3200 acres
Mt Pelion	J. N. Duncan	1921		Licence to Search, 3200 acres
Mt Pelion	A. W. Duncan	1921		Licence to Search, 3200 acres

Location	Held By	Date	Licence/lease	Type of Tenement
Mt Pelion	A. L. Kirkham	1921		Licence to Search, 3200 acres
Mt Pelion	R. P. Kirkham	1921		Licence to Search, 3200 acres
Mt Pelion	R. H. Nicholson	1921		Licence to Search, 3200 acres
Barn Bluff	A. J. Forster	1921		Licence to Search, 3200 acres
Douglas River	H. G. R. McWilliams	1921		Licence to Search, 2000 acres
Mt Pelion	Jean Irene MacKenzie	1921		Licence to Search, 3200 acres
Mt Pelion	F. W. James	1921		Licence to Search, 3200 acres
Mt Pelion	K. B. C. Kirkham	1921		Licence to Search, 3200 acres
Mt Pelion	E. L. Potter	1921		Licence to Search, 3200 acres
Mt Pelion	S. V. V. Moate	1921		Licence to Search, 3200 acres
Mt Pelion	L. M. Beckwith	1921		Licence to Search, 3200 acres
Barn Bluff	Lena Adele Mofflin	1921		Licence to Search, 3200 acres
Barn Bluff	R. A. Mofflin	1921		Licence to Search, 3200 acres
Barn Bluff	R. J. McCutcheon	1921		Licence to Search, 3200 acres
Barn Bluff	G. B. McCutcheon	1921		Licence to Search, 3200 acres
Mt Pelion	G. Adams	1921		Licence to Search, 3200 acres
Mt Pelion	S. C. Hocking	1921		Licence to Search, 3200 acres
Mt Pelion	R. Sharples	1921		Licence to Search, 3200 acres
Preolenna	Margetts & Margetts	1921	LTS 80	Licence to Search, 200 acres
Mt Pelion	F. W. R. Reid	1921		Licence to Search, 3200 acres
Dulverton	E. Morse	1921	LTS 76	Licence to Search, 380 acres
Railton	F. D. Kite	1921	LTS 77	Licence to Search, 239 acres
Mersey	J. Stewart	1921	LTS 79	Licence to Search, 1382 acres
South Bruny Island	V. A. Chipman	1921		Licence to Search, 3200 acres
South Bruny Island	S. Perry	1921		Licence to Search, 3200 acres
South Bruny Island	C. C. Brown	1921		Licence to Search, 500 acres
Barn Bluff	G. Simson Hope	1921		Licence to Search, 3200 acres
Barn Bluff	A. W. Craig	1921		Licence to Search, 3200 acres
Barn Bluff	H. B. Denniston	1921		Licence to Search, 3200 acres
Adventure Bay	J. L. Frizoni	1921	LTS 90	Licence to Search, 100 acres
South Bruny Island	J. L. Frizoni	1921	LTS 91	Licence to Search, 45 acres
North Bruny Island	H. Thomas	1921	LTS 93	Licence to Search, 2560 acres
North Bruny Island	E. M. Mathias	1921	LTS 94	Licence to Search, 1400 acres
North Bruny Island	W. C. Bart	1922	LTS 101	Licence to Search, 1000 acres
Latrobe	Victas Oil Shale	1922	LTS 95	Licence to Search, 20 acres
Latrobe	G. D. Mendell	1922	LTS 100	Licence to Search, 310 acres
Latrobe	Mersey Valley Oil Co. Ltd	1922	LTS 113	Licence to Search, 159 acres
Railton	R. Richards	1922	LTS 115	Licence to Search, 1000 acres
Inglis River	J. A. Wanchope	1922	LTS 97	Licence to Search, 720 acres
Inglis River	J. A. Wauchope	1922	LTS 97	Licence to Search, 720 acres
Inglis River	J. A. Wauchope	1922		Licence to Search, 150 acres
Inglis River	J. A. Wauchope	1922		Licence to Search, 40 acres
Mersey, Latrobe	G. D. Mendall	1922	LTS 100	Licence to Search, 310 acres
Port Davey	W. C. Bart	1922	LTS 101	Licence to Search, 1000 acres
South Bruny	W. T. Rofe	1922	LTS 112	Licence to Search, 500 acres
Kermode Franklin Rivulet	Mersey Valley Oil Co. Ltd	1922		Licence to Search, 1000 acres
Latrobe	Victas Oil Shale	1922	LTS 95	Licence to Search, 20 acres
Latrobe	Mersey Valley Oil Co. Ltd	1922	LTS 113	Licence to Search, 159 acres
Railton	R. Richards	1922	LTS 115	Licence to Search, 1000 acres
Strahan	H. E. Evenden	1923	LTS 138	Licence to Search, 3200 acres
Harford	W. B. Cocker	1923	LTS 117	Licence to Search, 61 acres
Port Sorell	R. C. Grubb	1923	LTS 120	Licence to Search, 640 acres
Harford	W. B. Cocker	1923		Licence to Search, 61ac, 2r, 4p
Burgess	J. A. Wanchope	1923		Licence to Search, 660 acres
Mersey	D. M. C. Griffin	1923		Licence to Search, 2510 acres

Location	Held By	Date	Licence/lease	Type of Tenement
Port Sorell	R. C. Grubb	1923		Licence to Search, 640 acres
Harford	W. B. Cocker	1923	LTS 117	Licence to Search, 61 acres
Port Sorell	R. C. Grubb	1923	LTS 120	Licence to Search, 640 acres
Port Sorell	G. N. Levy & A. Brown	1923		Licence to Search, 500 acres
Port Sorell	J. D. Johnstone	1923		Licence to Search, 640 acres
Port Sorell	E. Baker	1923		Licence to Search, 3200 acres
Franklin Rivulet	L. J. Douglas	1923		Licence to Search, 1028 acres
Burgess	F. M. McDonald	1923		Licence to Search, 30 acres
Burgess	E. J. McDonald	1923		Licence to Search, 300 acres
Port Sorell	J. H. Addison	1923		Licence to Search, 400 acres
Burgess	H. D. Green	1923		Licence to Search, 84 acres
Port Sorell	R. W. MacKenzie	1923		Licence to Search, 2450 acres
Port Sorell	T. S. F. MacKenzie	1923		Licence to Search, 1000 acres
Barn Bluff	G. R. Plante	1923		Licence to Search, 3200 acres
Barn Bluff	L. Mudie	1923		Licence to Search, 3200 acres
Barn Bluff	E. E. Black	1923		Licence to Search, 3200 acres
Barn Bluff	R. Stoneham	1923		Licence to Search, 100 acres
Strahan	H. E. Evenden	1923	LTS 138	Licence to Search, 3200 acres
Strahan	Mersey Valley Oil Co. Ltd	1923		Licence to Search, 3200 acres
New River	F. T. Boddy	1924	LTS 146	Licence to Search, 3200 acres
Henty River	J. A. Wauchope	1924		Licence to Search, 3200 acres
Barn Bluff	B. H. Edwards	1924		Licence to Search, 3200 acres
Barn Bluff	B. D. Reynolds	1924		Licence to Search, 3200 acres
New River	F. T. Boddy	1924	LTS 146	Licence to Search, 3200 acres
New River	E. Hawson	1924		Licence to Search, 3200 acres
New River	F. W. Heritage	1924		Licence to Search, 3200 acres
Quamby Brook	Osmaston Shale Prospecting Syndicate	1925	LTS 165	Licence to Search, 640 acres
Flowerdale	D. Berechree	1925	LTS 158	Licence to Search, 83 acres
New River	E. F. Heritage	1925		Licence to Search, 3200 acres
New River	H. E. Evenden	1925		Licence to Search, 3200 acres
Flowerdale	D. Berechree	1925	LTS 158	Licence to Search, 83ac,3r, 27p
Quamby Brook	Omaston Shale Prospecting Syndicate	1925	LTS 165	Licence to Search, 640 acres
Barn Bluff	G. S. Hope	1926		Licence to Search, 3 sq. miles, 1920 ac.
King Island	O. Bonney	1928	LTS 170	Licence to Search, 100 acres
King Island	O. Bonney	1928		Licence to Search, 100 acres
North Bruny Island	G. F. Boddy	1928		Licence to Search, 800 acres
North Bruny Island	H. M. Boddy	1928		Licence to Search, 800 acres
North Bruny Island	A. G. Black	1928		Licence to Search, 800 acres
North Bruny Island	M. Hayton	1928		Licence to Search, 300 acres
South Bruny Island	A. H. Jackson	1929		Licence to Search, 180 acres
North Bruny Island	A. J. Miller	1929		Licence to Search, 299 acres
King Island	A. J. Adams	1929	10103/M	Mining Lease, 588 acres
North Bruny Island	J. McD. Hay	1930		Licence to Search, 800 acres
King Island	L. Gatenby	1930		Licence to Search, 100 acres
Lady Barron	A. A. Summerhayes	1936	LTS 189	Licence to Search, 2100 acres
Lady Barron	Austral Oil Drilling Co.	1936	LTS 190	Licence to Search, 2600 acres
Lady Barron	C. S. Demaine	1936	LTS 191	Licence to Search, 2200 acres
Lady Barron	A. W. Inray	1936	LTS 192	Licence to Search, 3000 acres
Flinders Island	A. A. Summerhayes	1936	LTS 189	Licence to Search, 2100 acres
Flinders Island	Austral Oil Drilling Syndicate NL	1936	LTS 190	Licence to Search, 2600 acres
Flinders Island	C. S. Demaine	1936	LTS 191	Licence to Search, 2200 acres
Flinders Island	A. W. Inray	1936	LTS 192	Licence to Search, 3000 acres
Launceston (Danbury Park)	W. R. Richmond	1939		Permit to Enter over 3520 acres applied for; Warden granted prospecting rights to W. Richmond over ¼ acre

Location	Held By	Date	Licence/lease	Type of Tenement
Launceston (Danbury Park)	H. E. Evenden	1940	LTS 197	Licence to Search, 3200 acres
Port Davey	H. E. Evenden	1940	LTS 197	Licence to Search, 3200 acres
Flinders Island	Austral Oil Drilling Syndicate	1945		Prospecting Leases over 30,000 acres
King Island	Mrs A. S. Adams-Smith	1955	LTS	Licence to Search, 588 acres
King Island	S. Adams	1957	LTS	Licence to Search, 3200 acres
King Island	A. H. Adams	1957	LTS	Licence to Search, 3200 acres
King Island	R. S. J. & F. J. Adams	1957	LTS	Licence to Search, 2711 acres
King Island	Alice J. Smith	1957	LTS	Licence to Search, 2420 acres
King Island	J. R. G. Adams	1957	LTS	Licence to Search, 3196 acres
	C. Sulzberger	1959	EL 10/59	Exploration Licence
	Broken Hill Co. Pty Ltd	1960	EL 1/60	Exploration Licence 28,975 sq. miles
King Island	J. A. Adams	1961	LTS 209	Licence to Search, 80 acres
King Island	W. M. Westley	1961	LTS 210	Licence to Search, 1840 acres
King Island	S. P. J. Adams	1961	LTS 211	Licence to Search, 2680 acres
Preolenna	W. M. Adams	1961	LTS 212	Licence to Search, 2560 acres
Southeast Tasmania	A. G. Gill	1965	EL 17/65	Exploration Licence
West & southwest coasts	Esso Australia Inc.	1965	EL 18/65	Exploration Licence
	Nudec Petroleum Exploration Co. P/L	1965	EL 19/65	Exploration Licence
	Nudec Petroleum Exploration Co. P/L	1965	EL 18/65	Exploration Licence
Southeast Tasmania	EZ Co. of Australia Ltd	1965	EL 17/65	Exploration Licence, 8000 km^2
North & southwest coasts	Esso Australia Inc.	1965	EL 18/65	Exploration Licence
	Nudec Petroleum Exploration Co. P/L	1966	EL 6/66	Exploration Licence
	Nudec Petroleum Exploration Co. P/L	1967	EL 15/67	Exploration Licence, 349 km^2
West Coast	Amoco Aust. Petroleum Co. & Tasman Oil Co. Inc.	1975	EL 5/75	Exploration Licence, 517 km^2
	Nudec Petroleum Exploration Co. P/L	1978	EL 10/78	Exploration Licence
East Coast	Meekatharra Minerals	1978	EL 25/78	Exploration Licence, 510 km^2
East Coast	Meekatharra Minerals	1980	EL 33/80	Exploration Licence
Midlands	Victor Petroleum and Resources Ltd	1980	EL 31/80	Exploration Licence, 9500 km^2
East Coast	Meekatharra Minerals	1981	EL 20/81	Exploration Licence, 510 km^2
Southern Tasmania	Conga Oil Pty Ltd	1984	EL 29/84	Exploration Licence, 4395 km^2
Southern Tasmania	M. Bendall	1986	EL 6/86	Exploration Licence, 50 km^2
Southern Tasmania	Conga Oil Pty Ltd	1986	EL 7/86	Exploration Licence, 296 km^2
Southern Tasmania	Conga Oil Pty Ltd	1986	EL 52/86	Exploration Licence, 481 km^2
Southern Tasmania	Conga Oil Pty Ltd	1986	EL 53/86	Exploration Licence, 493 km^2
Southern Tasmania	Conga Oil Pty Ltd	1987	EL 8/87	Exploration Licence, 317 km^2
Southern Tasmania	Conga Oil Pty Ltd	1987	EL 9/87	Exploration Licence, 359 km^2
Southern Tasmania	Conga Oil Pty Ltd	1987	EL 10/87	Exploration Licence, 491 km^2
Southern Tasmania	Conga Oil Pty Ltd	1987	EL 11/87	Exploration Licence, 430 km^2
Southern Tasmania	Conga Oil Pty Ltd	1987	EL 12/87	Exploration Licence, 498 km^2
Southern Tasmania	Conga Oil Pty Ltd	1987	EL 13/87	Exploration Licence, 469 km^2
Southern Tasmania	Conga Oil Pty Ltd	1987	EL 14/87	Exploration Licence, 120 km^2
	Parish	1987	EL 45/87	Exploration Licence, 136 km^2
Southern Tasmania	Conga Oil Pty Ltd	1987	EL 46/87	Exploration Licence, 390 km2
Southern and Central Tasmania	Conga Oil Pty Ltd	1988	EL 1/88	Exploration Licence, 24 000 km^2
East Coast	Conga Oil Pty Ltd	1990	EL 17/90	Exploration Licence, 231 km^2
Southern Tasmania	Great Southland Minerals Pty Ltd	1996	EL 19/95	Exploration Licence, 3121 km^2
Northern Tasmania	Great Southland Minerals Pty Ltd	1996	EL 21/95	Exploration Licence, 5353 km^2

A total of 203 tenements have been issued to search for oil/gas (excludes Permits to Enter held over private property in the Mersey Valley during the 1920–30's; such Permits were held for oil shale and/or liquid oil; the table also excludes permits held for oil shale.

APPENDIX 5

Geochemistry results, various possible source rocks

BMR No.	Location	Formation	Age	Depth (m)	Rock type	TOC	EOM (mg/g)	T_{MAX} (°C)	S1	S2	S3	PI	HI	OI
1988	Bass Highway	Parmeener Supergroup	Perm./Triassic	outcrop		0.11		437	0.02	0.04	0.07	0.33	36	64
1989	Bass Highway	Wynyard Tillite	Permian	outcrop	tillite	0.1		401	0.01	0.02	0.17	0.33	20	170
1990	Golden Valley borehole	Quamby Mudstone	Permian	135.9	mudstone	0.67		442	0.16	0.49	0.05	0.25	73	7
1991	Golden Valley borehole	Quamby Mudstone	Permian	170.4	mudstone	0.95		447	0.29	1.74	0.07	0.14	183	7
1992/2250/ 2251/5971	Andersons Creek borehole	Mudstone	Permian	124.4	mudstone	0.33		445	0.02	0.10	0.08	0.17	30	24
1993	Andersons Creek borehole	Mudstone	Permian	129.5	mudstone	0.29		425	0.02	0.11	0.09	0.15	38	31
1994	Hellyer Gorge	Tasmanites oil shale	L Carboniferous	outcrop	oil shale	0.36		363	0	0.05	0.33	0	14	92
1995	Mersey Great Bend	Tasmanites oil shale	L Carboniferous	outcrop	oil shale	31.3	52	444	12.50	304	5.60	0.04	971	18
1996	Hellyer Gorge	Tasmanites oil shale	L Carboniferous	outcrop	oil shale	5.43		449	1.30	38.90	2.50	0.03	716	46
1997	Relapse Creek area	Quamby Mudstone	Permian	outcrop	mudstone	1.61		449	0.65	4.37	0.31	0.13	271	19
1998/5350	Musselroe Bay Borehole 1A	Marine mudstone	Permian	17.1	mudstone	0.44		459	0.03	0.02	0.17	0.60	5	39
1999	Musselroe Bay Borehole 1A	Freshwater Sequence	Permian	12.8	mudstone	1.9		277	0.03	0.02	0.07	0.60	1	4
2000	Golden Valley borehole	Lower Pameener Supergroup	Permian	16.6	siltstone	4.25		435	0.47	3.64	0.13	0.11	86	3
2001/6147	Mt Nicholas Borehole 9	Lower Pameener Supergroup	Permian	64.3	mudstone	34.2		434	3.50	109	6.10	0.03	319	18
2002	Relapse Creek area	Preolenna Coal Measures	Permian	outcrop	coal	32.9		442	7.30	101	5.20	0.07	307	16
2003	Relapse Creek area	Preolenna Coal Measures	Permian	outcrop	coal	26.2		444	10.10	102	5.20	0.09	389	20
2004	Relapse Creek area	Preolenna Coal Measures	Permian	outcrop	coal	32.1		445	6.60	68.90	4.90	0.09	215	15
5722			Ordovician		algal laminate			280	0	0	0			
5723	Ida Bay	Gordon Limestone	Ordovician	outcrop	limestone			286	0	0	0			
5724		Birdseye Limestone	Ordovician		limestone			248	0	0	0			
5725	Settlement Road	Lords Siltstone	Ordovician		siltstone			280	0	0	0			
5726		Westfield Formation?	Ordovician					321	0	0	0			
5727		Golden Valley Mudstone	Lower Permian		mudstone	0.93	110	448	0.52	1.11	0	0.32	119	0
5728		Golden Valley Mudstone	Lower Permian		mudstone	0.72		450	0.32	0.71	0	0.31	99	0

BMR No.	Location	Formation	Age	Depth (m)	Rock type	TOC	EOM (mg/g)	T_{MAX} (°C)	S1	S2	S3	PI	HI	OI
5729	Ida Bay	Benders Quarry shale	Ordovician	outcrop	shale			454	0.04	0.04	0	0.5		
5730		Florentine Valley Mudstone	L Ordovician		mudstone			423	0	0	0			
5731		Westfield Formation	Ordovician	outcrop				280	0	0	0			
5732		Woody Island Siltstone	Permian		siltstone	1.26	176	453	1.75	1.22	0	0.59	97	0
5733	Stan Murray Road		Ordovician					321	0	0	0			
5734	Queenstown Q1	Gordon Limestone	Ordovician	outcrop	limestone	0.08		233	0	0	1.23		0	1538
5735	Queenstown Q2	Gordon Limestone	Ordovician	outcrop	limestone	0.2		346	0	0.02	0.74	0	10	370
5800	Douglas River	Tasmanites oil shale	L Carboniferous	321.05	oil shale	16.99		449	8.01	152	0	0.05	895	0
	Douglas River	Tasmanites oil shale	L Carboniferous		oil shale	17	290	446	6.28	147.5	0.15	0.04	563	1
5801/13536	Ross Borehole 2	Tasmanites oil shale	L Carboniferous	409	oil shale	1.19	0.6	447	0.15	0.09	0	0.63	8	
5802/13978	Tunbridge Borehole 2	Tasmanites oil shale	L Carboniferous	676.4	oil shale	2.8	34	458	0.56	0.92	0	0.38	33	0
7043	Forest DDH 1	Crimson Creek correlate	Cambrian	667	mudstone			436	0					
7044	Forest DDH 1	Crimson Creek correlate	Cambrian	668	mudstone			275	0					
7045	Forest DDH 1	Crimson Creek correlate	Cambrian	675	mudstone			302	0					
7047	Forest DDH 1	Black River Dolomite	Precambrian	826	mudstone			311	0					
7048	Forest DDH 1	Black River Dolomite	Precambrian	828	mudstone			408	0					
7049	Forest DDH 1	Black River Dolomite	Precambrian	1026	dolomite			247	0					
7050	Forest DDH 1	Black River Dolomite	Precambrian	1043	dolomite			395	0.52	0.14				
8469	Granton DDH 1	Berriedale Limestone	Permian	80	limestone	0.29		436	0	0	0	0	0	0
8470	Grange DDH 1	Berriedale Limestone	Permian	130	limestone	0.19		415	0.01	0	0	1	0	0
8471	Zeehan, Oceania BH 13	Bell Shale	Ordovician	66.14	siltstone	0.01		219	0	0	0	0	0	0
8472	Zeehan, Oceania BH 13	Bell Shale	Ordovician	70.1	phyllitic pelite	0.17		329	0	0	0	0	0	0
8473	Zeehan, Oceania BH 13	Bell Shale	Ordovician	73.15	siltstone	0.18		383	0	0	0	0	0	0
8474	Forest DDH 1	Kununnah Supergroup		76	mudstone	0.57		359	0	0	0	0	0	0
8475	Forest DDH 1	Black River Dolomite	Precambrian	1015	dolomite	0.05		219	0	0	0	0	0	0
8476	Fingal Tier DDH 60	Upper Parmeener Supergroup	Triassic	466	mudstone	2.65		441	0.05	3.69	0	0.01	139	0
8477	Grieves Siding ZB1007	Gordon Limestone	Ordovician	277	dolomite	0.18		400	0	0	0	0	0	0

BMR No.	Location	Formation	Age	Depth (m)	Rock type	TOC	EOM (mg/g)	T_{MAX} (°C)	S1	S2	S3	PI	HI	OI
8478	Lune River BH 2	Gordon Limestone	Ordovician	56.5	limestone	0.17		224	0	0	0	0	0	0
8479	Zeehan	Tertiary lignite	Tertiary	outcrop	carb. mudstone	1.24		299	0.12	0	0	1.00	0	0
8480	Ross BH 1	Woody Island Siltstone	Permian	388	mudstone	0.80		435	0.14	0.38	0	0.27	48	0
8481	Bicheno BH 10	Woody Island Siltstone	Permian	327	mudstone	0.84		449	0.40	0.71	0.01	0.36	85	1
*1	Oonah	Tasmanites oil shale	L Carboniferous	concentrate	oil shale		23	446	30.8	590.8	2.3	0.05	937	3
*2	Oonah	Tasmanites oil shale	L Carboniferous	outcrop	oil shale		66	443	3.6	65.2	0.3	0.05	937	4
*3	Oonah	Siltstone	L Carboniferous	outcrop	siltstone			437	0.04	0.89	0.73	0.04	88	82
*4	Oonah	Siltstone	L Carboniferous	outcrop	siltstone		32	440	0.07	1.3	0.34	0.05	166	43
*5	Oonah	Tasmanites oil shale	L Carboniferous	outcrop	oil shale			440	1.4	54.4	2.2	0.03	675	27
*6	Oonah	Tasmanites oil shale	L Carboniferous	concentrate	oil shale			444	22.8	535	32	0.04	872	5
*7	Oonah	Siltstone	L Carboniferous	outcrop	silstone		35	436	0.1	1.8	0.6	0.05	163	51
*8	Mersey Great Bend	Tasmanites oil shale	L Carboniferous	outcrop	oil shale	2.58		436	0.03	19.3	0.3		748	11

* The Oonah samples are taken from Revill *et al*. (1994). These samples were:

1. Tasmanites oil shale fossil concentrate;
2: Tasmanites oil shale upper seam total;
3. Siltstone above upper seam;
4. Siltstone between seam;
5. Tasmanites oil shale lower seam total;
6. Tasmanites oil shale lower seam fossil concentrate;
7. Siltstone below lower seam.
8. Sample from Baillie (1987).