PROGNOSIS FOR A STRATIGRAPHIC DRILL HOLE AT BRUNY ISLAND

BENDALL, M.R.

NOVEMBER 1994

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CONDOR OIL INVESTMENTS PTY LTD

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CONDOR OIL INVESTMENTS PTY. LTD.

A.C.N. 055 403 515

84 Wells Parade
Blackmans Bay, Tasmania 7052

Telephone: 002 29 6576
Facsimile: 002 29 2153

15th November, 1994.

Mr. M.W.D. Ayre,
Director of Mines,
P.O. Box 56,
ROSNY PARK Tas. 7018

Dear Sir,

Please find attached copies of statements for the financial status of Condor Oil Investments Pty Ltd, a summary of previous work, a prognosis for a stratigraphic hole and notes on well pad specifications.

We have also attached copies of previous documentation related to earlier drilling proposals, equipment and expenditure.

The prognosis comments on drilling conditions. We draw attention to the type of hole envisaged and previous Tasmanian experience and request normal conditions of security, safety and specification for a deep diamond hole. Condor Oil notes that deep holes in Western Tasmania have encountered hydrocarbons but these have never caused problems and no special conditions are applied. Many of these holes are also much deeper.

We have the agreement of the property owner (R. Hazell) to drill at "Murrayfield" and now await your early approval to drill this stratigraphic hole.

We note that a bond with value greater than drilling cost has been mooted. We believe this to be inappropriate, especially given the losses forced on the company from previous proposals and restrictions. We believe the drilling should be encouraged under fair conditions. No reply has ever been received to correspondence concerning previous drilling proposals and associated losses.

The timing of this effort is of some concern. The company lost 4 months operation this year due to M.R.T. tendering process for surrounding areas. No financier would support the company until the issue of competition or re-acquisition could be settled. The commercial risks were too great.

Every effort is being made to drill this hold to the tenement schedule but it may not be possible, depending on your approval processes and rig availability.

Yours faithfully,

M.R. BENDALL
MANAGING DIRECTOR

850004

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DRILLING PROPOSAL

CONDOR OIL INVESTMENTS

NORTH BRUNY ISLAND

A PROGNOSIS FOR A WELL

INTRODUCTION

The well defined and described in this prognosis is the first well to be drilled by Condor *Oil Investments in Tasmania.*

The site chosen stands above Variety Bay on the eastern coast of North Bruny Island and overlooks Storm Bay. *See Figure 1.*

Location: 533 900 mE
5215 000 mN
~25 mASL

BACKGROUND INFORMATION

Petroleum products have been reported on North Bruny Island for several decades and active exploration was undertaken more than sixty years ago.
Several wells have already been attempted in the Great Bay and Big Lagoon region. All have been limited by the funds and equipment available. The details of this drilling and the companies involved were described by Bendall (1991).

The most important of these wells was Johnstone's Well drilled in 1929. The site is shown in Figure 1. Although it reached a depth of less than 50 m and no reliable records of formations or hydrocarbons encountered have survived some oil was recovered. It was a light oil and was stored in drums at the site. It was not analysed and none has been preserved. Its source is unknown. The well did not penetrate deeply into the Permian succession due to jamming.
The deepest drilling in the area, at the north end of the isthmus, was to 135 m and this does not appear to have encountered the thick dolerite sheet which could have been expected at this approximate depth.
Any hydrocarbons found in the area, or these holes, must have drained from, or through, the Deep Bay and, more probably, the Minnie Point Formation which includes porous sandstones.
A number of other seepages have been reported in this same general area and all occur in rocks at about the stratigraphic level of the Minnie Point Formation. All these units are Permian in age. Many of these seepages, and tar coatings, have been found around Variety Bay.

The knowledge of this old drilling programme and the company behind it was forgotten for nearly sixty years. As were the seepage reports.

Exploration was renewed by Conga Oil in 1984. The new exploration incorporated an initial literature search and relocation of reported seepage sites. The site of Johnstone's Well was found and samples taken of muds, soil and local fluids. These confirmed the trace presence of hydrocarbons and the chemistry was consistent with a source within the Ordovician Gordon Group limestones of southern Tasmania. Unfortunately the trace amounts recovered do not permit any definite conclusions or complete appraisal of the oil - as might a small jar of the actual oil.
The exploration was expanded to include regional gravity and magnetic surveys (Figures 2, 3) which were interpreted to suggest that possible source rocks may exist to the west and southwest but were most unlikely beneath North Bruny Island itself (Figures 5, 7). This was essentially confirmed by the trial seismic traverse along the ridge from Trumpeter Bay to Church Hill (Figure 4). The geophysical analyses were primary and regional but did provide an understanding of the setting of the region, possible locations of critical structures and older basins, and a context for migration paths (Figure 6). Some work was begun to crystallize the detailed local setting of North Bruny Island but this work was never funded nor completed. Samples of the initial analyses are reproduced in Figures 8 and 9 and this incompleted evaluation provides the information used for location of the present well proposal. Complete details of the status of exploration studies (geophysical and geochemical) actually completed may be found in Leaman (1990, 1991 and Carne, 1992).
There remains scope for much more work but further work would be enriched by some new control information; including depth to basement and seismic velocities.

The seepages recorded in the area can be understood in terms of the structures described regionally. A reservoir to the west, sealed by the base Permian unconformity, may leak up dip to the large dolerite feeder near Ford Bay or the faults marginal to Storm Bay which were reactivated throughout the Tertiary. Given the thermal history of the region it is possible that actual generation did not commence until the Cretaceous and may still be occurring (see Carne, 1992).

Earlier drilling programs may have intersected some near surface migration paths. As would the newer fault fracture systems. All leakage appears to occur slowly and there is no evidence of any high pressures. The association of seepages with seismic activity also suggests a tight, low volume system above the unconformity or seals.

Consequently any new well drilled in the North Bruny region must have a conceptual or stratigraphic basis with the direct aim of further sampling any migration paths and confirmation of sequence.
Such a well would provide proof that oil is indeed migrating through a viable fracture net and that either generation is continuing or that there may be a large reservoir nearby. A reasonable sample would also resolve many of the source and generation issues since it would allow exhaustive chemical analysis.
These are the primary objectives of this well.

HISTORY OF PROPOSALS

Conga Oil proposed re-drilling of the Johnstone's Well site in 1987 in order to prove the veracity of the old records, obtain a small sample and complete chemical appraisals. The recovery of even a small sample from a fracture or bedding seepage would also have been of considerable financial benefit to both the project and the company since it would have established that parts of Tasmania do have petroleum potential - a possibility that had been long dismissed in both large company and government circles and whose attitudes made financing of the exploration difficult indeed. The company itself had sufficient confidence in the project to employ a drilling engineer, review used equipment in North America, and to purchase a rig with a capacity in excess of 2500 m. This equipment was never imported into Australia for reasons beyond the scope of this prognosis and became the source of considerable financial loss to the shareholders.

Drilling of the site was again proposed in 1991 (Bendall, 1991).

Final stage evaluation of the geophysical and structural information available, however, did indicate that the Johnstone's Well site may not provide an optimal stratigraphic section. The nearness of a dolerite feeder and the risk of thickened dolerite coupled with a higher stratigraphic level meant that any hole at the old site may be several hundred metres deeper than one across the hill. This issue became important to the company felt the loss of its own drilling equipment and funding became more restricted in the 1990-1993 period .

WELL PROGNOSIS

Any drilling programme is dependent on the exploration undertaken and in this case only limited regional analysis has been completed.
Site selection has been judged, therefore, on the basis of minimum depth to basement (in order to establish the stratigraphy of the region), the loci of seepages (in order to maximise opportunities to sample the migration path) and good drilling conditions.

No formation older than the Deep Bay Formation outcrops on North Bruny Island and the site selected lies near the top of this formation.

The prognosis for the well is

Surface to 20 m	Minnie Point Formation	sandstone/siltstone
20 - 50 m	Deep Bay Formation	foss. mudstone
50 - 400 m	dolerite	
400 - 450 m	Deep Bay Formation	foss. mudstone
450 - 550 m	Bundella Formation	foss. mudstone
550 - 700 m	Woody Island Siltstone	mudstone
700 -1000 m	Truro Tillite	tillite
unconformity		
1000 -	Precambrian schists	

Some key unknowns are included in this prediction.
a) Thickness of dolerite. 350 m is an average estimate.
b) Only one dolerite sheet is presumed. Two are possible but a basal sheet may be relatively thin.
c) Thickness of tillite. This may vary from nil to 700 m.
d) Thickness of the Deep Bay and Bundella Formations. The estimates are representative of local formations but a variation of up to 50% is possible.

Items c) and d) depend upon the location of this site with respect to the basin deposition axes. All formations older than the Minnie Point Formation may occupy active rift stages and their thickness thus depends on the location of this site with respect to the block rotation of the rift. Insufficient work has been completed in southern Tasmania to establish this with certainty but if older structures have been rejuvenated then it is possible that this eastern location is comparable with Glenorchy where the tillite was absent.

Hydrocarbons seepages could be encountered at any level and very careful monitoring of fluorescence within the core recovered will be essential. The site itself has been selected with regard not only to the position of exposed faults disturbed along the Storm Bay coast during the Tertiary but also the likely Jurassic disposition of faults - several of which are either no longer exposed or disguised by intrusions. A comparison of Figure 8 and the regional geological map of the area (Kingborough) will indicate some of these differences. The surface geological map is not, in itself, a reliable guide to fracture foci or faults. The coalescence of structures east of Church Hill and south of Variety Bay may well account for the number of small seepage sightings in this part of the island.

The well will also be used for seismic velocity tests in order to permit review and reprocessing of seismic data.

WELL REQUIREMENTS

Type of well:
Two types of petroleum-related wells may be defined (e.g. Carne, 1991):
1. Exploration well (wildcat) is one drilled to discover whether previously untested trap conditions contains oil or gas, and
2. Stratigraphic well drilled solely to obtain subsurface information on sediments, structure, organic maturity and provide control for geophysical purposes.

The proposed well falls within the second category.

No specific target or source is proposed; indeed, all regional work suggests that the primary target for wildcat drilling lies several kilometres to the west.

The well will be a small diameter diamond hole which will be continuously cored.

A diamond hole to a depth of 1000 m needs few special requirements beyond those normally specified for control of drilling fluids, access and landholder compensation.

Comments on equipment experience:
The history of all previous drilling of this type within Tasmania supports this view. No Mines Department diamond drilling has ever required any special equipment, including the 1000 m hole at nearby Woodbridge. No problems have ever been encountered with high pressure hydrocarbons including the Douglas River hole drilled by the department, and which is still flowing gas. Other drilling in regions with oil shale, whether for the shale or for groundwater, have ever posed pressure problems. The much deeper mineral exploration holes in western Tasmania have, likewise, not presented any experience of problem conditions even though gas risks may increase with depth in any basement type.
The Variety Bay area is not noted for large seepages, or very gassy ones, and there is no ground for any expectation of incidents. The load of a full drill stem in a limited diamond hole is clearly safe given all past experience. Were special regulations to be imposed on this hole, as has been suggested to the company, then this company would respectfully insist that they should also be applied to every water bore in Tasmania and all mineral holes in western Tasmania as well. It would also ask why government drilling did not operate to comparable standards.
Quite different requirements might well apply to a hole aimed directly at a fully investigated petroleum reservoir structure drilled using standard exploration open hole mud-control methods. This is not such a hole.

Detection of hydrocarbons:
It is expected that fluoresence methods will be required to detect any hydrocarbons in the hole/core since no large flows are anticipated in any formation given the seepage styles and seismicity relationships.

HOLE NAME

The name designated for this well is SHITTIM-1.

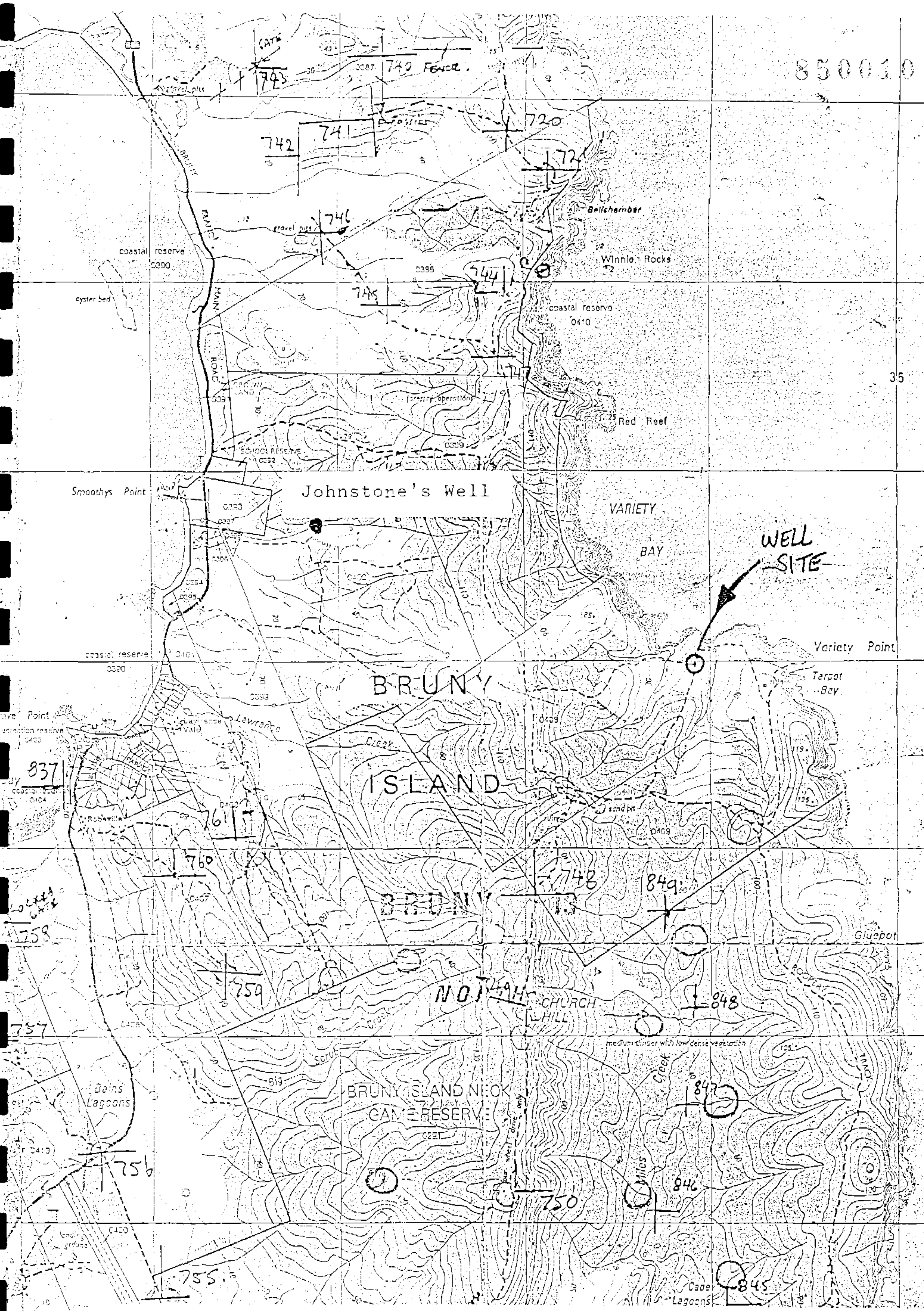
This name has a number of important connotations - for both the company and the area.

The name has historical significance as the place where both a new start and a turning point was achieved. This is clearly what is hoped for on North Bruny and for the company. It might also mean a new start for the way in which this state is viewed by petroleum explorers. It is also the name of an attractive tree whose relatives are common in this country and which produces a useful light oil.

Prognosis submitted on behalf of Condor Oil Investments

by L Keaman
Keaman Geophysical
[illegible]

850010



CONDOR OIL INVESTMENTS - LOCATION OF WELL NORTH BRUNY ISLAND

FIGURE 1

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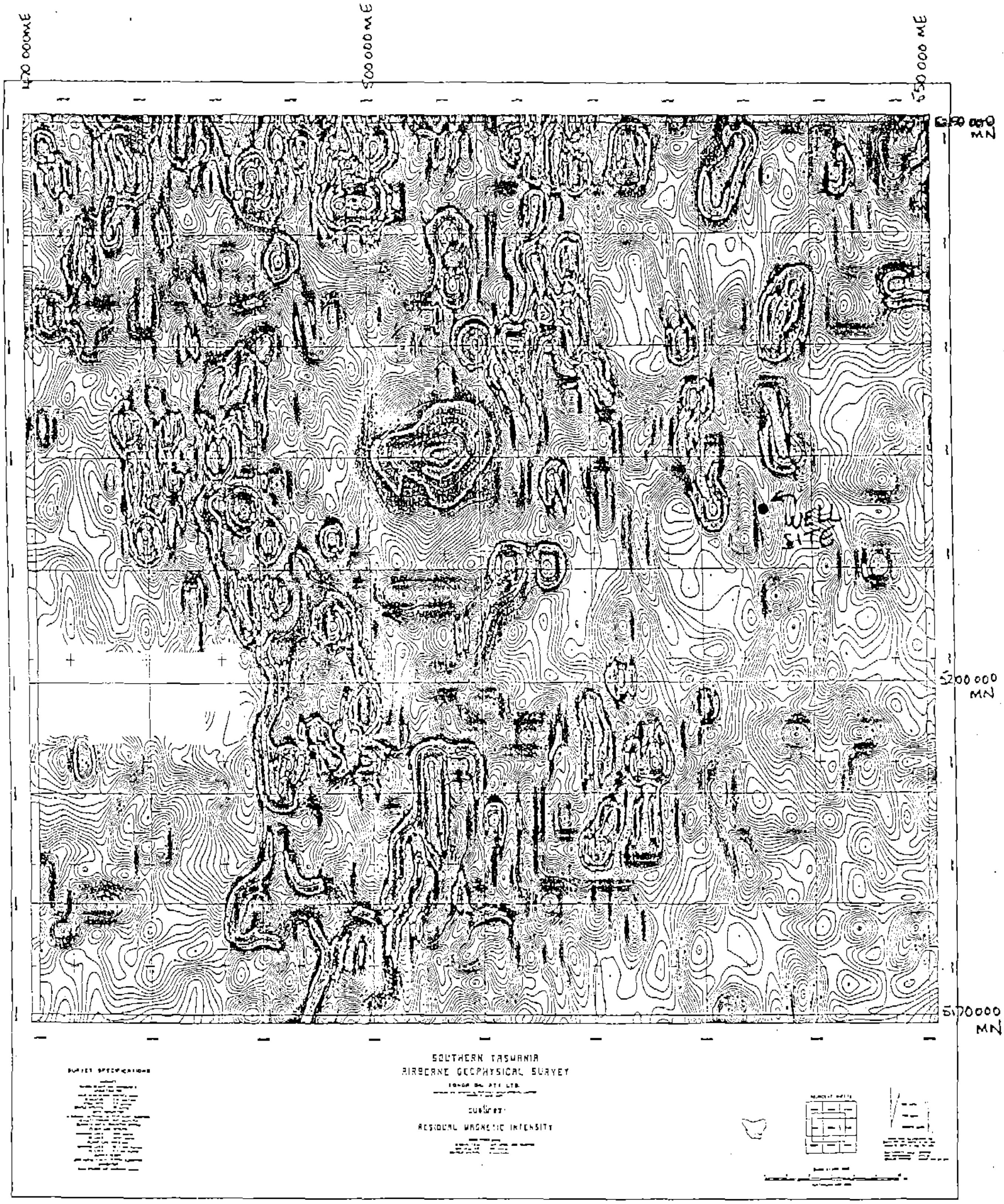
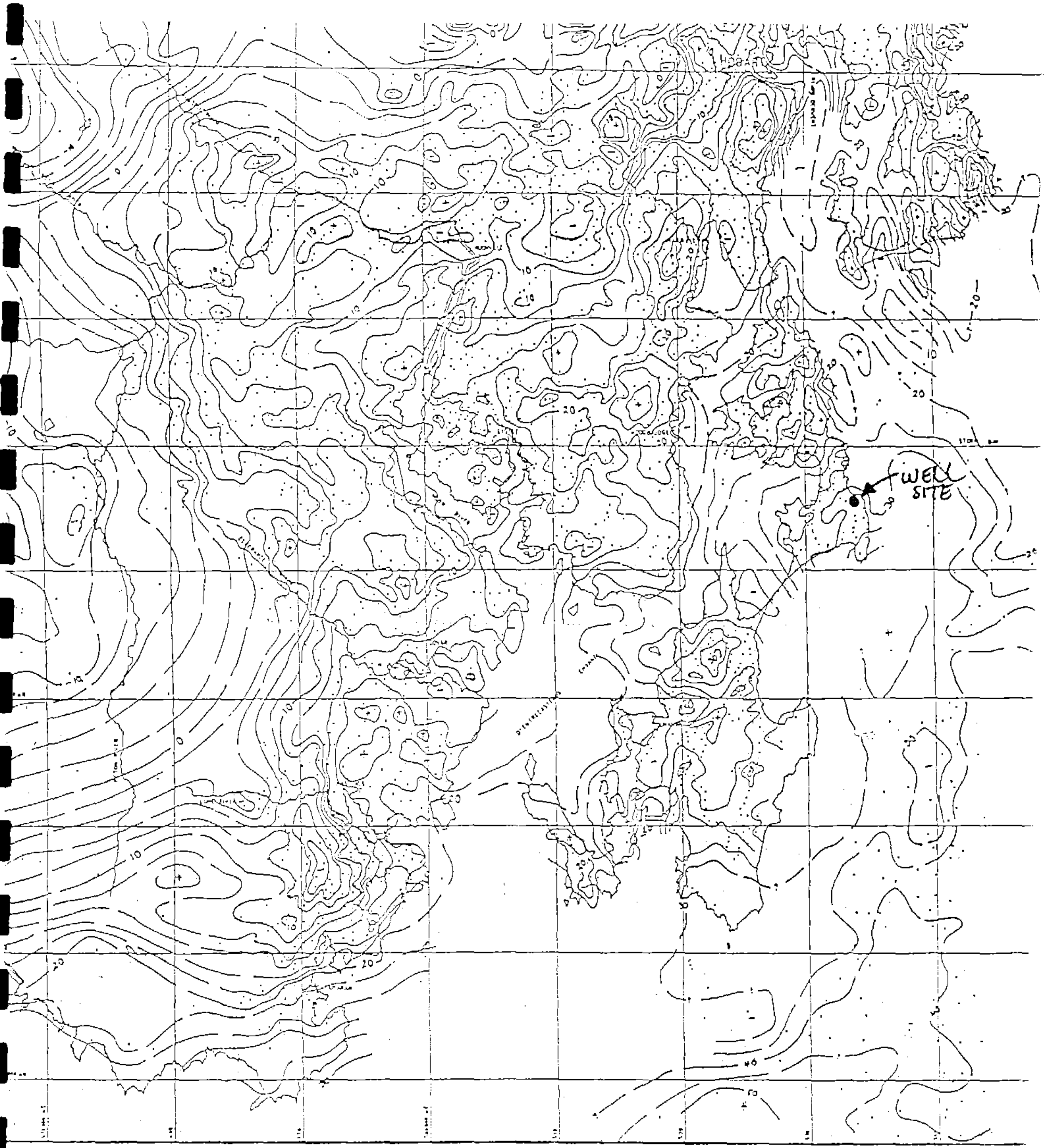


CONDOR OIL INVESTMENTS
FIGURE 2

NORTH BRUNY WELL

COMPILATION MAP: AEROMAGNETIC SURVEY AT 1000 M ASL

(Use transparent geographic overlay to locate positions)



NGA OIL PTY LTD

PROJECT: D'ENTRECASTEAUX GRAVITY SURVEY

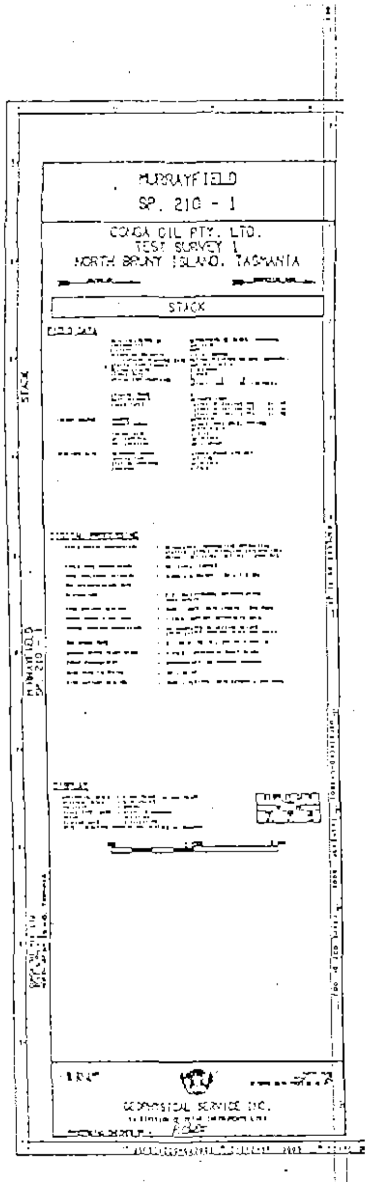
BOUGUER ANOMALY (2.67 t/m³)

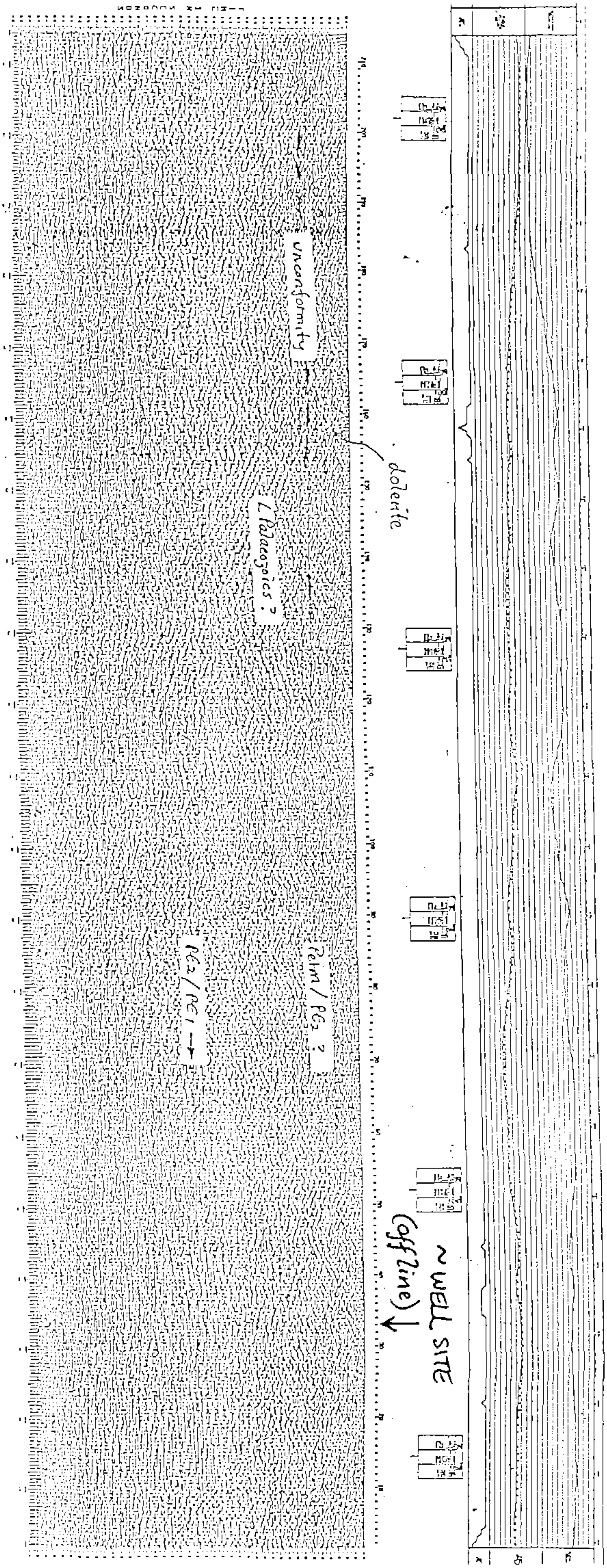
CONTOUR INTERVAL: 2 mgal (5 mgal offshore)

850012

GRAVITY FIELD IN SOUTH EAST TASMANIA

CONDOR OIL INVESTMENTS
FIGURE 3





MURRAYFIELD TRAVERSE
NORTH BRUNY ISLAND

CONDOR OIL INVESTMENTS
NORTH BRUNY WELL

FIGURE 4

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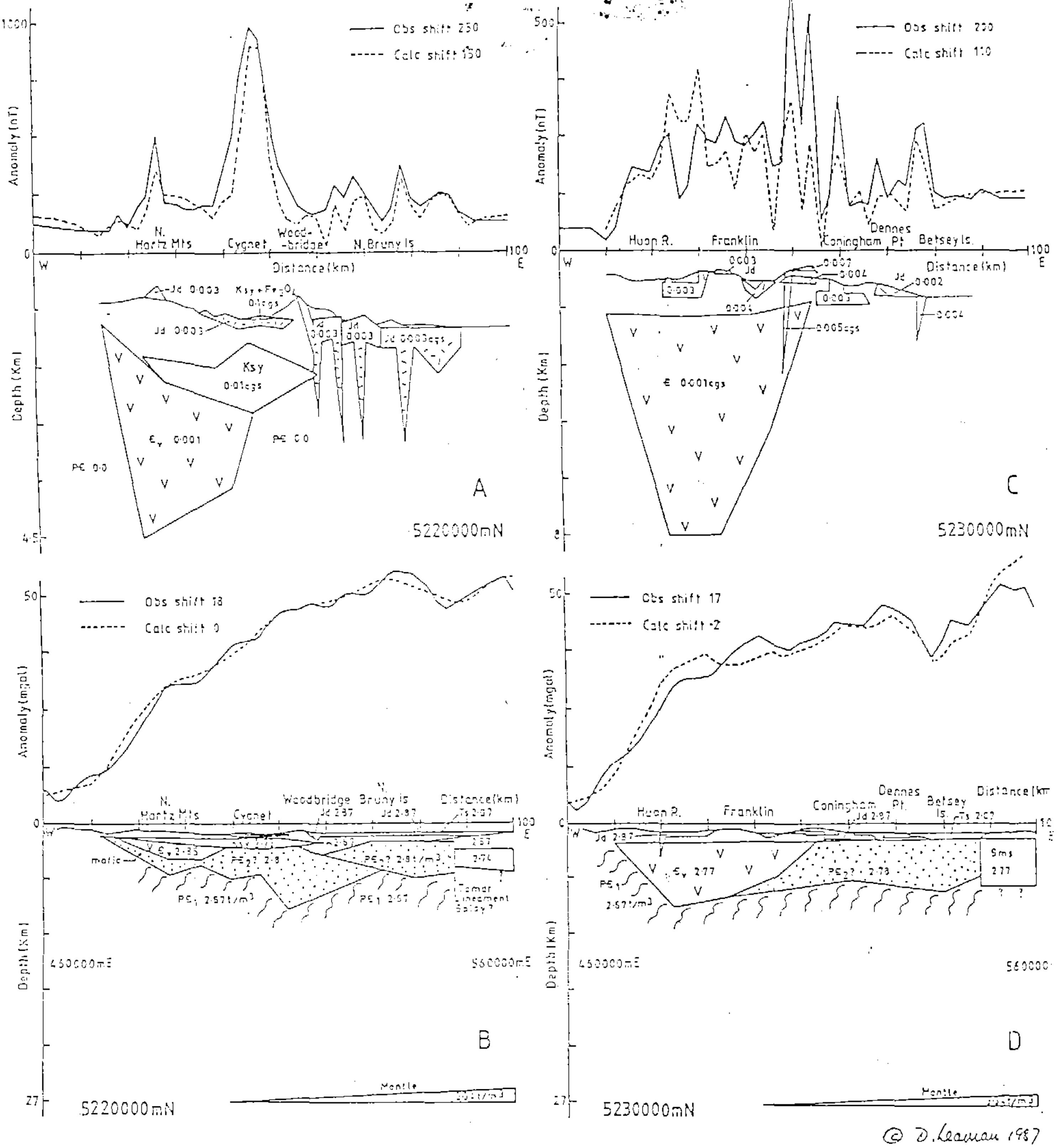

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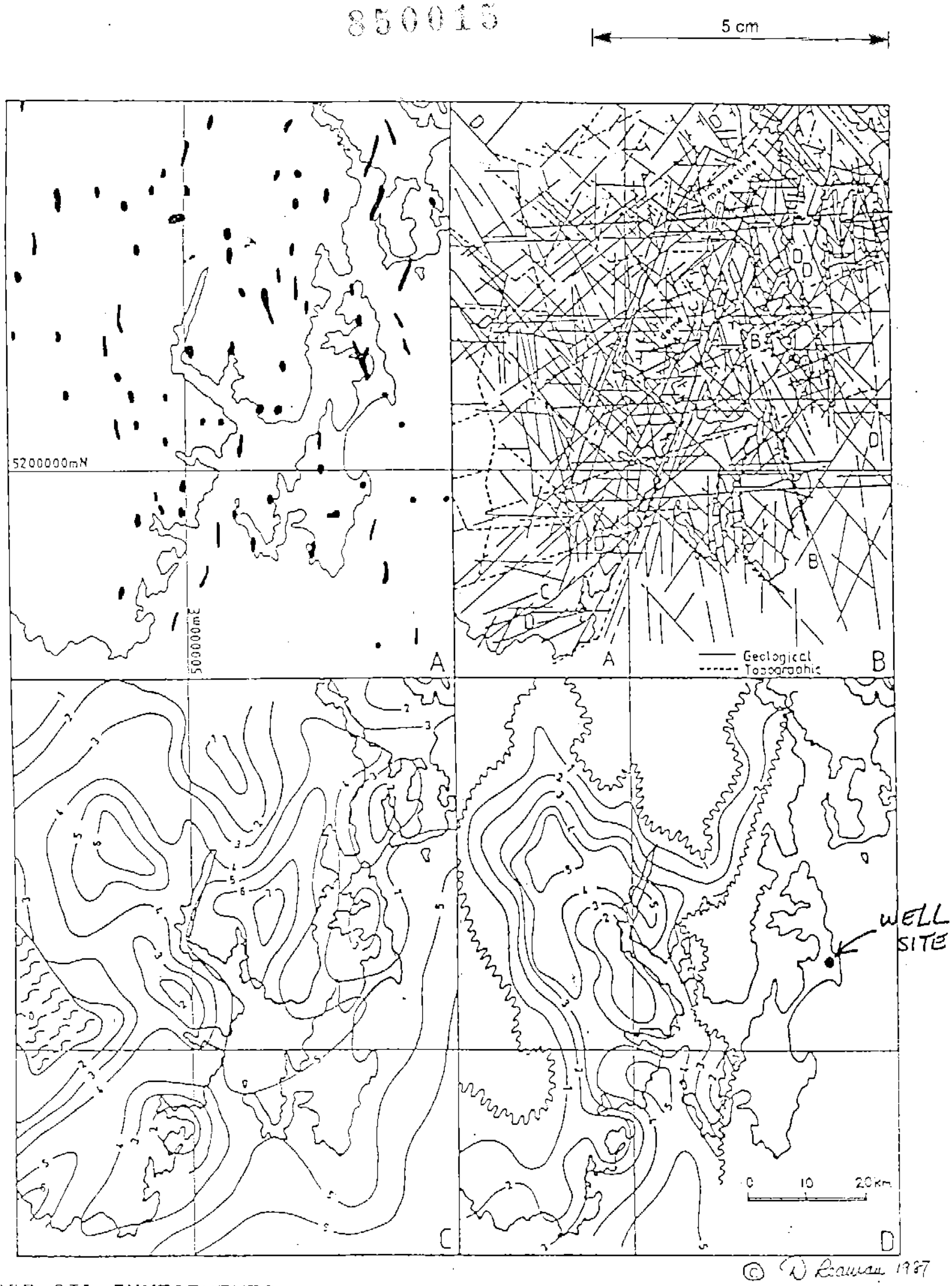
CONDOR OIL INVESTMENTS
INTERPRETED SECTIONS ACROSS BRUNY ISLAND

EXAMPLES OF INTERPRETATION MODELS AND CHARACTER OF MAGNETIC AND GRAVITY FIELDS IN SOUTH EAST TASMANIA

FIGURE 5

850015



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CONDOR OIL INVESTMENTS

SUMMARY OF STRUCTURAL INFORMATION DEDUCED FROM GRAVITY AND MAGNETIC DATA IN SOUTH EAST TASMANIA. See also Figures 5B, 5D, 5E.

A: Location and orientation of Jurassic dolerite feeders. The pattern is non random and is related to older flexures.

B: Trend summary diagram, all data. Labelled structures exemplify major axes rejuvenated.

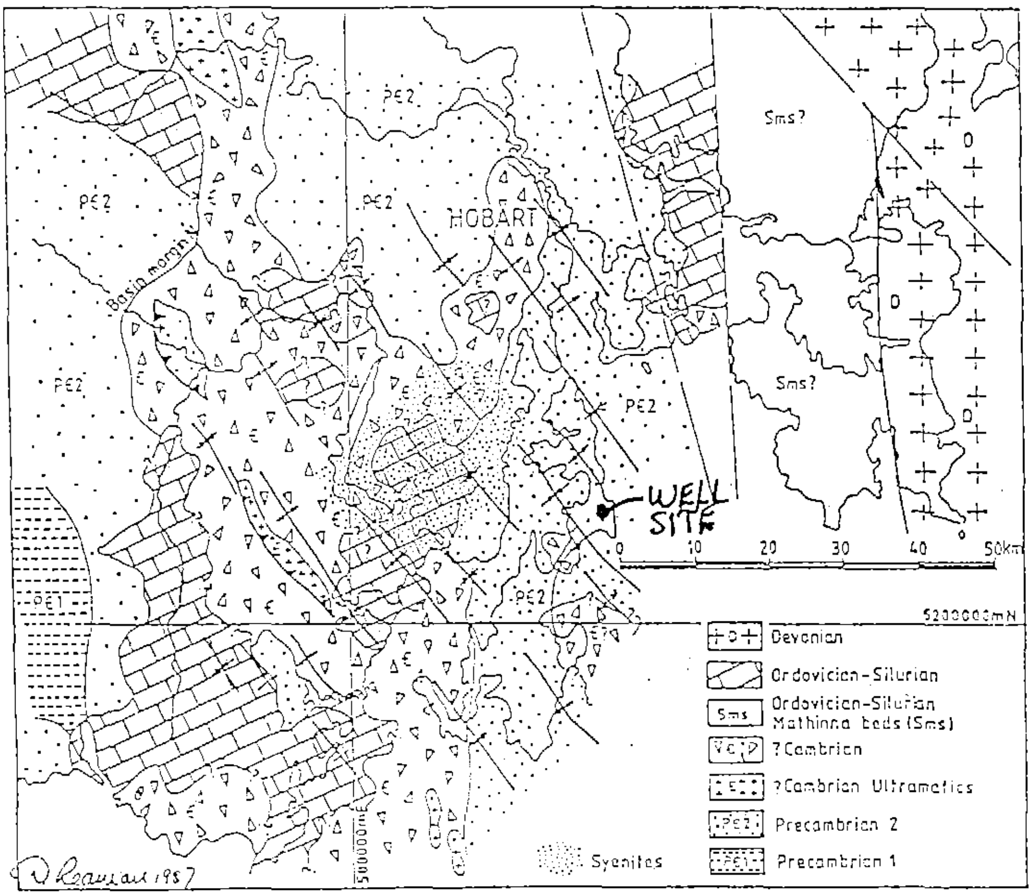
C: Contours in km below sea level of depth to crystalline basement.

D: Contours in km below sea level of base of Cambrian (?) units - incl. volcanics. Gap between C and D represents a variable thickness of Late Precambrian dolomitic sequences.

FIGURE 6

850016

5 cm



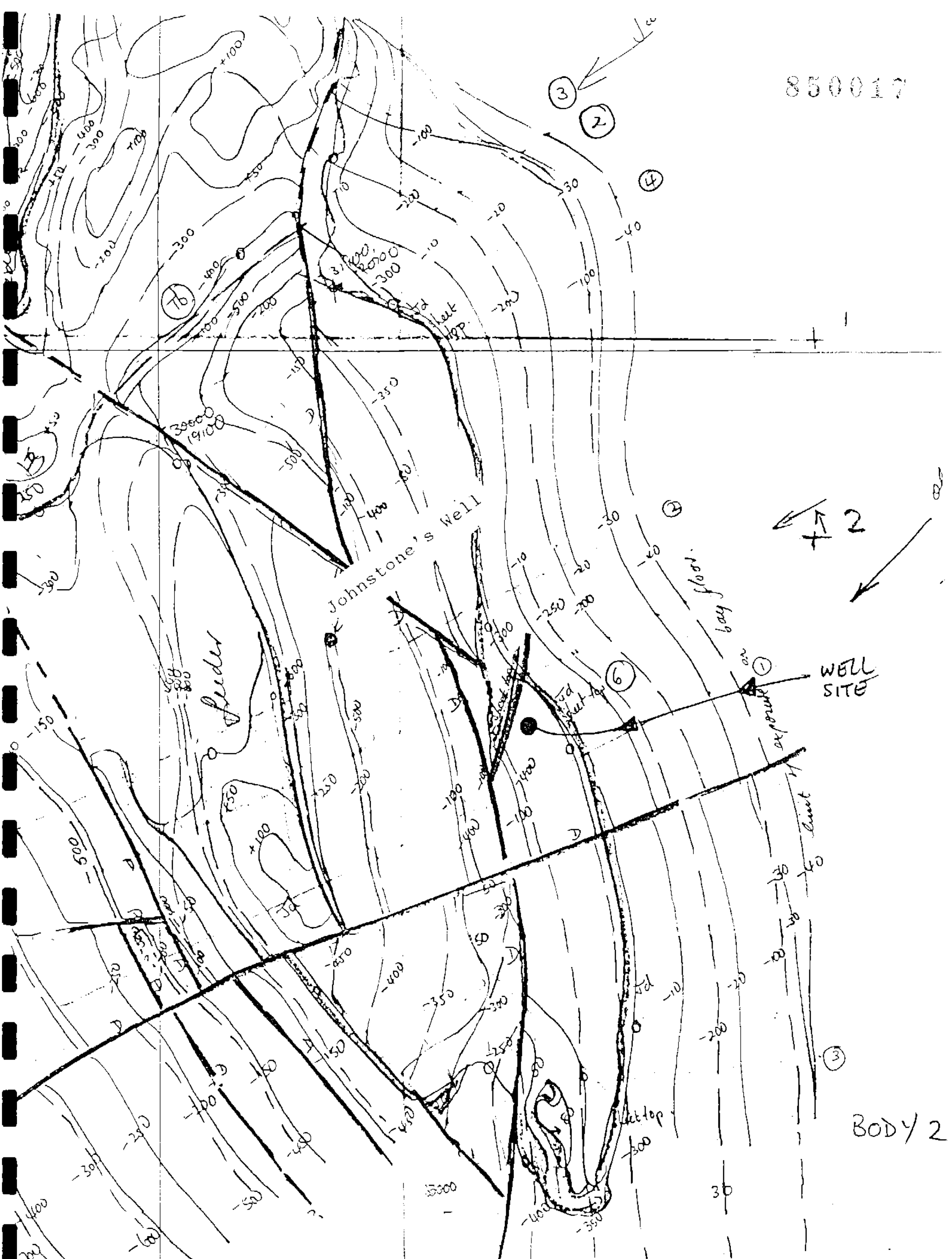
NATURE OF GEOLOGY INFERRED BENEATH PERMIAN UNCONFORMITY IN SOUTHERN TASMANIA
(based on initial geophysical interpretations. Provisional)
Note that distribution of Ordovician-Silurian rocks is not yet well defined and will be the subject of second order refined analysis. The indicated fold systems are likewise sketchy at this stage.
Compare this plan with sections and basin structure contours in

CONDOR OIL INVESTMENTS

NORTH BRUNY WELL

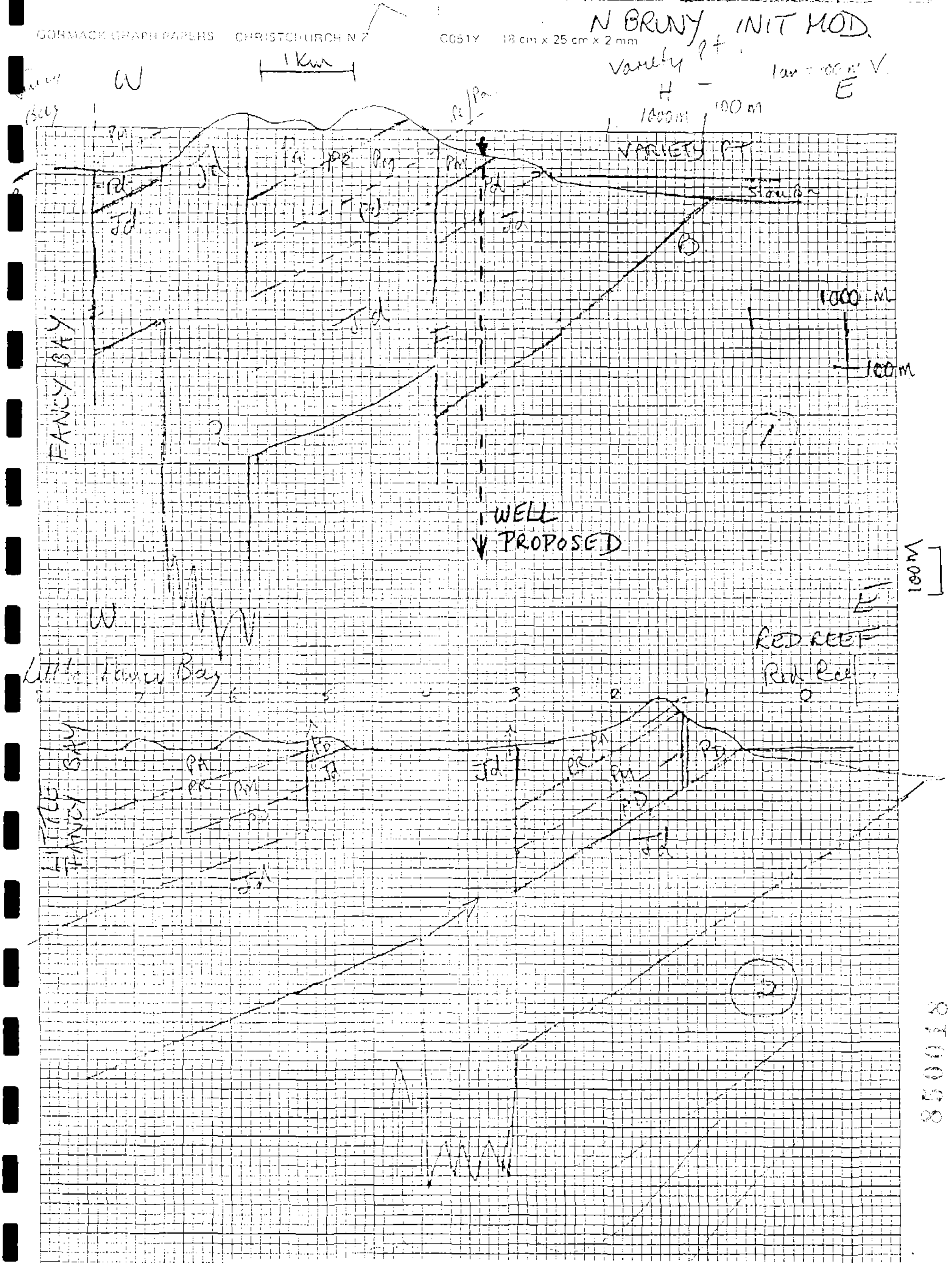
FIGURE 7

850017



CONDOR OIL INVESTMENTS NORTH BRUNY WELL
SKETCH MAP: PART OF INCOMPLETE 3D INTERPRETATION OF NORTH BRUNY REGION SHOWING LOCATION AND CONTINUITY OF DEEPER FAULTS
Analysis by Leaman Geophysics 1988

FIGURE 8



CONDOR OIL INVESTMENTS — NORTH BRUNY WELL

SKETCH SECTIONS: VARIETY BAY AND GREAT BAY REGION

Upper section through well site.

Draft section by Leaman Geophysics 1988

FIGURE 9

850018

800019

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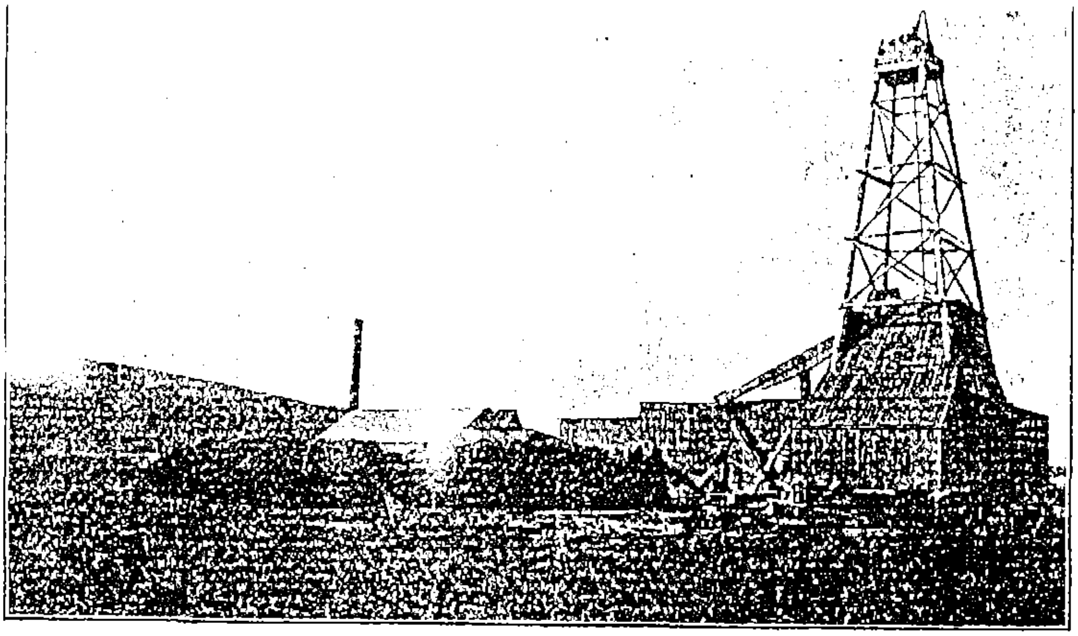
PREVIOUS DRILLING RIGS

850080



FIRST DRILLING OIL PLANT IN TASMANIA. BRUNY ISLAND PETROLEUM CO., N.L.

CERTIFICATE

No. 780

FOR Shares,

BRUNY ISLAND PETROLEUM COMPANY

No Liability

TASMANIA.

ISSUED TO

DATED

OFFICE OF COMPANY.
STOCK EXCHANGE, COLLINS STREET,
HOBART.

TRANSFER.

I, ... *of*
(hereinafter called the said Transferror) for valuable consideration do hereby transfer to................................
.... *of* .... *(hereinafter called the said Transferee) the* .... *shares numbered*.............. *to* .... *standing in my name in the books of the* BRUNY ISLAND PETROLEUM COMPANY, NO LIABILITY, *to hold unto the said Transferee, his executors administrators, and assigns, subject to the several conditions on which I held the same at the time of the execution hereof. And I, the said Transferee, do hereby agree to take the said shares subject to the same conditions.*

As witness our hands the .... *day of* *191*

Signed by the said Transferror in the presence of

Signed by the said Transferee in the presence of

SHARES 15 — *Registered under The Mining Companies Act, 1884* — SHARES 15

850021

Bruny Island Petroleum Company

NO LIABILITY (TASMANIA)

REGISTERED OFFICE OF COMPANY
STOCK EXCHANGE, COLLINS ST., HOBART

Under Sixteen Shares

No. of Issue 780

CAPITAL - - - £30,000, in 60,000 Shares of Ten Shillings each

This is to Certify *that* ____________ *of* N. Bruny

is the registered holder of Fifteen *Shares in the* Bruny Island Petroleum Company, No Liability, *numbered* 4[illegible],199 *to* 4[illegible],213 *inclusive, which are issued* **FULLY PAID UP TO TEN SHILLINGS (10/-)** *per share, subject to the rules and regulations of the Company*

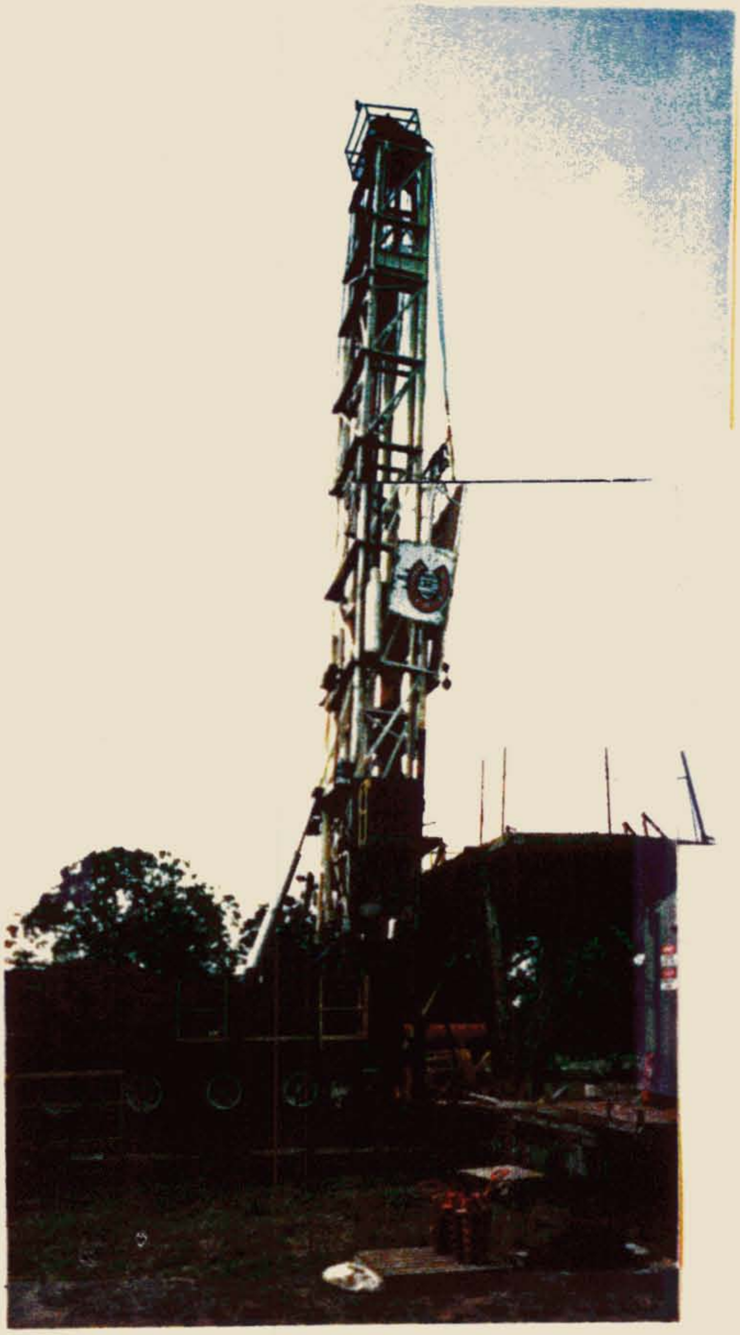
Given under the Common Seal of the Company this 18th *day of* August 1916.

W. M. Williams
Th. Lyons
Directors.

M. Smith
Manager.

THE ... PRINTING OFFICE, HOBART

850022



Houston TEXAS

1987

Pictures taken by condors current Petroleum Engineer TED McNally.

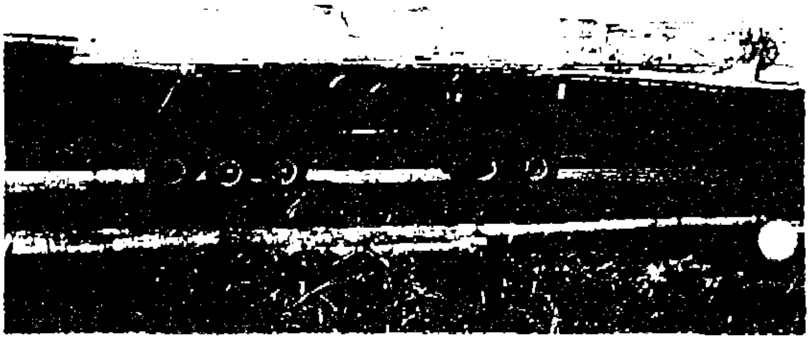
7610

SKYTOP BREWSTER

850023

The Skytop Brewster Company • 4801 Woodway, Suite 400E • Houston, TX 77056
Phone: (713) 960-1666 • Telex: 77-4343 • TWX: 910-881-1165 • Cable: SKYTOPHOU

RR-600 Ranger Rig Series



The Skytop Brewster Model RR-600 is specifically designed for well servicing operations.

Drawworks. The Model H1-4610B-38 (double drum) drawworks has a nominal 575 horsepower rating. Drum shaft bearings are double row, self-aligning type roller bearings, and drum clutch is full air type. Drawworks brake cooling system offers either spray or circulated water cooling. Brake blocks are oversize 1⅛" thick and API drilled for interchange convenience.

Portable Mast. The Model 103-255XF portable mast has a clear working height of 103 feet from ground to the underside of the crown, and the static API hookload capacity of 255,000 pounds on six lines, or 275,000 pounds with the optional crown on eight lines. Construction is of high strength alloy tubular legs, channel steel girts, and tubular diagonal bracing. All main crown sheaves are mounted on tapered roller bearings with grease seals. The portable mast is complete with crown safety platform and handrails, ladder to crown, traveling block carrying cradle and all required guylines.

Carrier. The Model 518 is a five axle back-in type carrier with a wide flange beam frame rigidly braced to support rig and portable mast, complete with two front and one rear tow loops. The two front axles have a 44,000 pound rating, and the three rear axles have a 66,500 pound rating.

Drawworks	**Model H1-4610B-38**
Application	Well Servicing
Drive	Power Shift Transmission With Torque Converter
Nominal Horsepower Rating	575
Recommended Wire Line Size	1" or 1⅛"
Main Drum Diameter x Width (In.)	18 x 38
Brake Rim Diameter x Width (In.)	46 x 10
Brakes (Contact Area — Sq. In.)	2640
Brakes (Type Cooling)	Spray*
Hoisting Speeds Main Drum	8
Drum Clutch	P0324
Sandline Drum Clutch	P0224
Brake Rim Diameter x Width (In.)	38" x 6"
Brakes (Contact Area — Sq. In.)	1750
Capacity 9/16" Line	15,000'
Drum Drive Chain	1½" Double
Auxiliary Brake	Model 22" SR
Portable Mast	**Model 103-255XF****
Type Base	Fixed

*Circulating Optional.
**110-275XF Optional.

Hook Load Capacity (No. of Lines)	(6)—255,000 lbs. Standard (8)—275,000 lbs. Optional
Crown Block Fast Sheave	(1) 34"
Cross Sheaves	6 Lines-(2) 30"/8 Lines-(3) 30"
Deadline Sheave	(1) 24"
Sandline Sheave	20"
Type Racking	Doubles
Racking Board Height	55'-70' Adjustable
Capacity	(Range 2) 2⅞" EUE 18,480' 3½" D.P. 12,400' 4½" D.P. 10,080'
Rod Hangers Optional	
Carrier	**Model 518**
Engine	Detroit Diesel 12V71N65†
Transmission	Allison Model CLT-5861
Air Compressor	24 CFM
Hydraulic System	2,000 PSI, 50 GPM
Batteries	(2) 8D
Fuel Tanks	(2) 125 Gallon
Tool Boxes	(2) Splash Proof
Operator's Controls	Air Operated
Leveling Jacks	Hydraulic
Front Tires	18:00 x 22.5 Singles
Rear Tires	10:00 x 20 Duals
Front Axle Capacity	44,000 lbs.
Rear Axle Capacity	66,500 lbs.

†Other engines available.

Operational Rig Inventory: North Bruny Is. No. 1

	Site Survey Site and Cellar Construction	U.S. $5,000
	Rig Mobilization	7,000
	Fuel and Lub.	42,000
	Rig Operating and Lab	168,000
**	Air Percussion and Down Hole Package	286,000
	Casing and Accessories (w/out 7")	82,000
*	Mud Materials & Service	24,000
*	Haliburton Cement & Press Testing	38,000
	BOP - Chokes (Incl. Above)	
	Drilling bits, hole reamers	26,750
	Misc. Tool rental (Stbs Jars)	18,000
	Drill Stem Tests (2)	32,000
	Core & Service (2)	15,000
	Wellsite Geologist (30 days)	12,000
	Wellsite Logging (30 days)	12,000
*	Schlumberger Geophysical	100,000
	Sidewall Cores & Velocity Survey (Incl Above)	
	Intangibles Misc.	43,200
	Catering	8,200
	Water	
	Transport	3,600
	Office	5,500
	Total	U. S. $926,250

850025

Aquisition of Rig

Skytop Brewster TR-800

As provided in Fax dated 3-23-87

Estimate includes purchase price and shipment of inventory detailed in Fax but excludes customs and handling at Port of Hobart.

Best estimate before sealed bids and R. C. Chapman proposal to bid is:

U.S. $395,000

Total Estimated Expenditures

	North Bruny Is. No 1
Aquisition of Rig	$ 395,000
Operations Inventory	$ 928,250
Insurance (Not Incl.)	$ <10,000>
Total	U.S. $1,323,250
	A. $1,865,780

Est. Rate of Exchange U.S. $1.00 = A. $1.41

* Means item subject to bid.

** Means item subject to bid or contract bid.

850026

CONDOR OIL INVESTMENTS PTY. LTD.

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PROPOSALS AND ASSOCIATED LOSSES

850027

CONGA OIL PTY. LTD.

Oil Exploration and Drilling Company

Registered Office:

84 Wells Parade,
BLACKMANS BAY, Tasmania 7152
Telephone: (002) 29 6576

8 March 1987

The Director,
Department of Mines & Energy,
P.O. Box 151,
EASTWOOD S.A. 5063

Dear Sir,

We understand there was a phone call made to you on Friday 6th March by the Director of the Tasmanian Mines Department overturning Mr Billingham's request for Mr Dick Hancock to go to the U.S.A. and asking to recover a letter sent by Mr R. Billingham.

We also understand some doubts were cast upon Conga Oil Pty. Ltd. I would like the opportunity to supply any financial or background information you may need in order to reverse your decision as relayed to Mr Dick Hancock and acted upon by the cancellation of his booked tickets.

I would appreciate the opportunity to regain my excellent working relationship with your department. I should point out that your petroleum division, mainly through Messrs Gravestock-Hancock, has provided myself with helpful personal service of a standard rarely seen or expected from a Government department. I believe that their conduct has been beyond reproach and I regret that certain problems have arisen between the Tasmanian Chief Inspector of Mines Mr Billingham, his Director and Conga Oil Pty. Ltd. I hope to have this sorted out forthwith.

Yours faithfully,

(M. Bendall)
MANAGING DIRECTOR
EXPLORATION MANAGER,
CONGA OIL PTY. LTD.

850028

CONGA OIL PTY. LTD.

Oil Exploration and Drilling Company

Registered Office:

34 Wells Parade,
BLACKMANS BAY, Tasmania 7152
Telephone: (002) 29 5576

8 March 1987

Director of Mines,
P.O. Box 56,
ROSNY PARK, Tas. 7018

Attention Mr Geoff Thomas (Chief Draughtsman)

Re Definition of Recent Applications

Dear Sir,

As regards our conversation on the 6th March 1987 I understand your frustration at wanting to co-operate with Conga Oil Pty. Ltd., but being given work of apparently higher priority therefore being unable to finish work on our recent licence applications. I must apologise if I seemed upset that the work had not been done as I was assured by the Director that every effort would be made to quicken the processes on these applications. However, it appears the licence applications have a low priority within the department and I must accept the unacceptable in that regard. I would like to thank you for your total co-operation in the past and can only hope that the priorities set, that you are forced to accept, may be changed in the very near future.

Yours faithfully,

(M. Bendall)
MANAGING DIRECTOR
CONGA OIL PTY. LTD.

CONGA OIL PTY. LTD.

Oil Exploration and Drilling Company

Registered Office:

84 Wells Parade,
BLACKMANS BAY, Tasmania 7152
Telephone: (002) 29 5576

8 March 1987

Director of Mines,
P.O. Box 56,
ROSNY PARK, Tas. 7018

Attention: Mr P. Baillie (Chief Petroleum Geologist)

Re D'Entrecasteaux Programme

Dear Sir,

I would like to acknowledge your support for our exploration programme in the D'Entrecasteaux region. Following discussions with Dr David Leaman on February 24th which clarified issues related to technical matters, play options and funding you have been prepared to recommend our application. David advised me after that meeting that you indicated that you could see no reasonable impediment to approval. You confirmed that to me.

Although other colleagues have similarly reviewed the application there is evidence accumulating of delay and selective withholding of correspondence in respect of Conga Oil Pty. Ltd. applications. I understand that you only viewed our first year's report as inadequate because some geochemical reports had not been circulated to you. This omission nearly cost us EL 29/84 but was not your fault. It is appreciated that the play concepts being floated are new to Tasmania and your preparedness to accept the soundness of them is noted. The Ordovician limestone play proposed in the materials originally seen by you would have seemed irrelevant in the absence of the other hydrocarbon geochemistry results not circulated to you.

Yours faithfully,

(M. Bendall)
MANAGING DIRECTOR
CONGA OIL PTY. LTD.

850030

CONGA OIL PTY. LTD.

Oil Exploration and Drilling Company

Registered Office:

84 Wells Parade,
BLACKMANS BAY, Tasmania 7152
Telephone: (002) 29 6576

8th March 1987

The Director,
Department of Mines and Energy,
P.O. Box 151,
EASTWOOD S.A. 5063

Attention Mr Richard Hancock

Dear Sir,

I deeply regret any embarrassment or compromising of your status within the department caused by the phone call to your Director on Friday 6th March. I hope you accept my sincere apology for this unusual sequence of events with Mr Billingham's judgements as relayed to yourself being overturned by our Director of Mines. I hope to have this situation sorted out forthwith.

Yours faithfully,

(M. Bendall)
MANAGING DIRECTOR
EXPLORATION MANAGER
CONGA OIL PTY. LTD.

850031

CONGA OIL PTY. LTD.

Oil Exploration and Drilling Company

Registered Office:

84 Wells Parade,
BLACKMANS BAY, Tasmania 7152
Telephone: (002) 29 6576

8th March 1987

Director of Mines,
P.O. Box 56,
ROSNY PARK, Tas. 7018

Attention: Mr R. Billingham (Chief Inspector of Mines)

Re Drilling Equipment; Conga Oil

Dear Sir,

I am very sorry that my proposal to acquire a drilling rig in the U.S. per the good offices and advice of both yourself and R. Hancock (S.A. Department of Mines and Energy), may have caused severe embarrassment when the proposal was summarily rejected by the Director at our Friday afternoon meeting (6th March). This was an incredible sequence of events in which your inter-governmental relationships have been disturbed given the decisions and correspondence after Thursday's meeting. Conga Oil Pty. Ltd. has been attempting to acquire a sound rig within Australian standards and we are disappointed that the Director should see fit to overrule your technical advice and capacity to assist, all at no cost to the State of Tasmania.

Yours faithfully,

(M. Bendall)
MANAGING DIRECTOR
CONGA OIL PTY. LTD.

850032

CONGA OIL PTY. LTD.

Oil Exploration and Drilling Company

Registered Office:

84 Wells Parade,
BLACKMANS BAY, Tasmania 7152
Telephone: (002) 29 6576

8 March 1987

The Director,
Department of Mines,
P.O. Box 56,
ROSNY PARK Tas. 7018

Dear Sir,

In view of recent problems I have encountered in my dealings with your department and the conflict revealed last week a number of issues must be clarified or at least clearly stated. I am most unhappy with the way my companies (and myself) have been treated. There is no sound basis for any of the complaints or objections offered. I regret that I have tried to support, until recently, all my applications and should have employed other technical and legal staff. However hare-brained or silly you have regarded me or my proposals they were well intended and I have been prepared to risk capital in backing them. I have shown Mr Hargreaves that I have met your reasonable conditions and expenditure requirements and still been treated as a no-one. You are not employed to sit in judgment in this way. Many of the following points have been clarified in letters to Messrs Hargreaves, Baillie, Dwyer, Hopkins and Billingham. Mr MacDonald before his retirement recognised that I may not have been treated fairly and noted correspondence accordingly (noted 26/7/84, my letter 17/7/84).

1. I have always met (or exceeded) expenditure requirements on all my licences. This is true of El 29/84. I cannot understand where the impression that this was not so arose. After your conversation with the S.A. Department of Mines and Energy the impression was certainly abroad that I was financially suspect and they have reacted in consequence.

   If there was any concern that funding for my enlarged works programme was doubtful then that topic should have been discussed with me first and not third parties.

2. There has been a history of obstruction and delay with most of my licence applications. Some clarifications demanded have been legitimate and have all been answered more promptly than any processing of them. You should realise that small companies may contribute to exploration and provided they can fill commitments should be allowed to try. Conga is no longer a small company but this has not changed the attitude to our applications.

3. You seem unable or unwilling to accept the advice of your professional staff. Recent examples include Mr Billingham on the suitability of rigs and people fit to recommend equipment and Mr Baillie on the works programme. Mr Baillie, who previously recommended against renewal of EL 29/84 on the basis of sighting of only part of the relevant file, now recognises that while the oil play is unusual for Tasmania, it is valid. All previous efforts, largely discredited, worked toward establishing that play.

4. None of my works programmes extensions or proposals included any costs to your department. My proposal to send a drilling engineer overseas, undertake seismic research etc. would have been fully paid. Similarly my provision of on-shore drilling regulations (from South Australia) three years ago was at my cost. These regulations, needed in the near future, have still not been taken up.

I repeat that I do not believe I have been fairly treated. In addition it seems that most of your staff believe this to be fair comment.

My backers and I intend to proceed with our programme ahead of winter and the recent unnecessary delays may now mean that Conga would not be obliged to present all data to the Department. My consultants believe this would be unfortunate and a loss. Such loss would clearly be your responsibility since no effort has been made in practice to process my applications even though correspondence exists to show that recommendations on some licences were made some time ago. I can only deduce that a personality conflict has been allowed to interfere with fairness and good judgment.

The state could only benefit from Conga's enlarged programme. It is perhaps the most significant oil programme in recent times because it tackles virgin problems and the potential may be substantial. At least Conga will find out. We would like your co-operation and assistance but will proceed, if necessary, without it.

Yours faithfully,

(Mr M. Bendall)
MANAGING DIRECTOR
CONGA OIL PTY LTD

SMITS LESLIE BARWICK

Solicitors

LEVEL 5
12-14 O'CONNELL STREET
SYDNEY NSW 2000
DX 1205 SYDNEY
TELEPHONE
INT: 612 NAT: (02) 223 2222
FACSIMILE
INT: 612 NAT: (02) 223 6351

Our ref: JHL:MLB:000459

31 August 1992

The Directors
Conga Oil Pty Limited
ACN: 009 495 845
84 Wells Parade
BLACKMANS BAY TASMANIA

CERTIFIED MAIL

Dear Sir,

RE: **NOTICE OF DEMAND FOR FIVE HUNDRED AND FIFTY NINE THOUSAND, NINE HUNDRED AND SEVENTY TWO DOLLARS AND FORTY FIVE CENTS (AUD$559,972.45)**

We advise that we act for Natwest Australia Bank Limited.

We enclose herewith by way of service upon you Demand dated 28 August, 1992.

Yours faithfully,
SMITS LESLIE BARWICK

3362D

ASSOCIATED FIRM
SMITS LESLIE BARWICK
LEVEL 12
[illegible] QUEEN STREET
BRISBANE QLD 4000
DX 217 BRISBANE
TELEPHONE
(07) 832 3288
FACSIMILE
(07) 832 7192

850035

6 April 1987

Director of Mines,
P.O. Box 56,
ROSNY PARK, Tas. 7018

Attention Dr Bob Richardson

Dear Sir,

I am disturbed that I have not received a reply to my letter dated 8th March 1987.

Considering the urgency of this matter, I would appreciate some sort of a reply at your earliest convenience.

I simply cannot afford the luxury of unexplained bureaucratic delays.

Yours faithfully,

(M.R. Bendall)
EXPLORATION MANAGER
CONGA OIL PTY. LTD.

850036

CONGA OIL PTY. LTD.

Oil Exploration and Drilling Company

Registered Office:

84 Wells Parade,
BLACKMANS BAY, Tasmania 7152
Telephone: (002) 29 6576

6 April 1987

The Director of Mines,
P.O. Box 56,
ROSNY PARK, Tas. 7018

Dear Sir,

In reply to your letter dated 13 March 1987 and delivered on the 16th March 1987 I would make the following points.

1. I have sought Mr Young's assistance throughout the recent events. In addition I have also sought mainland legal advice.

2. My drilling engineer, Mr Ted McNally, was physically in Adelaide where a qualified petroleum engineer, Mr Dick Hancock, also was. Unfortunately my verbal communications in regard to this matter do not seem to have passed any further than Mr Hargreaves.

3. I would point out that the so-called "errors and omissions" were perceived and not real, as Mr Bailley's recent reversal of opinion would suggest. I have recently explained to the Minister how one "omission" was in reality a departmental inference not relevant to an application in any event.

4. The Department is hardly prompt. Nine months to renew licences, more than a year to grant them (5 years in one case) - an issue argued before the Minister.

5. Our meeting as suggested by yourself was not productive and I would suggest that all parties hear one another. I felt my time was wasted.

In addition to this I was relayed your comments that you would try to discredit myself to the Minister and that I was only a ratbag. Say what you want, the truth will surface in due course.

Yours faithfully,

(M.R. Bendall)
EXPLORATION MANAGER
CONGA OIL PTY LTD

850037

CONGA OIL PTY. LTD.

Oil Exploration and Drilling Company

Registered Office:

34 Wells Parade,
BLACKMANS BAY, Tasmania 7052
Telephone: (002) 29 6575

6 April 1987

Director of Mines,
P.O. Box 56,
<u>ROSNY PARK</u>, Tas. 7018

<u>Attention Mr Rod Hargreaves</u>

Dear Sir,

I am disturbed that I have not received a reply to my letter dated 8th March 1987.

Considering the urgency of this matter, I would appreciate some sort of a reply at your earliest convenience.

I simply cannot afford the luxury of unexplained bureaucratic delays.

Yours faithfully,

(M.R. Bendall)
EXPLORATION MANAGER
CONGA OIL PTY. LTD.

CONGA OIL PTY. LTD.

Oil Exploration and Drilling Company

Registered Office:

84 Wells Parade,
BLACKMANS BAY, Tasmania 7152
Telephone: (002) 29 6576

6 April 1987

Director of Mines,
P.O. Box 56,
ROSNY PARK, Tas. 7018

Attention Mr R. Billingham

Dear Sir,

I am disturbed that I have not received a reply to my letter dated 8th March 1987.

Considering the urgency of this matter, I would appreciate some sort of a reply at your earliest convenience.

I simply cannot afford the luxury of unexplained bureaucratic delays.

Yours faithfully,

(M.R. Bendall)
EXPLORATION MANAGER
CONGA OIL PTY. LTD.

850039

CONGA OIL PTY. LTD.

Oil Exploration and Drilling Company

Registered Office:

84 Wells Parade,
BLACKMANS BAY, Tasmania 7153
Telephone: (002) 29 6576

6 April 1987

Director of Mines,
P.O. Box 56,
ROSNY PARK, Tas. 7018

Attention Mr Steve McManus

Dear Sir,

I am disturbed that I have not received a reply to my letter dated 8th March 1987.

Considering the urgency of this matter, I would appreciate some sort of a reply at your earliest convenience.

I simply cannot afford the luxury of unexplained bureaucratic delays.

Yours faithfully,

(M.R. Bendall)
EXPLORATION MANAGER
CONGA OIL PTY. LTD.

850040

CONGA OIL PTY. LTD.

Oil Exploration and Drilling Company

Registered Office:

84 Wells Parade,
BLACKMANS BAY, Tasmania 7152
Telephone: (002) 29 6576

6 April 1987

Director of Mines,
P.O. Box 56,
ROSNY PARK, Tas. 7018

Attention Mr P. Baillie

Dear Sir,

I am disturbed that I have not received a reply to my letter dated 8th March 1987.

Considering the urgency of this matter, I would appreciate some sort of a reply at your earliest convenience.

I simply cannot afford the luxury of unexplained bureaucratic delays.

Yours faithfully,

(M.R. Bendall)
EXPLORATION MANAGER
CONGA OIL PTY. LTD.

850041

CONGA OIL PTY. LTD.

Oil Exploration and Drilling Company

Registered Office:

8: Wells Parade,
BLACKMANS BAY, Tasmania 7152
Telephone: (002) 29 6576

6 April 1987

Director of Mines,
P.O. Box 56,
ROSNY PARK, Tas. 7018

Attention Mr M. Dwyer

Dear Sir,

I am disturbed that I have not received a reply to my letter dated 8th March 1987.

Considering the urgency of this matter, I would appreciate some sort of a reply at your earliest convenience.

I simply cannot afford the luxury of unexplained bureaucratic delays.

Yours faithfully,

(M.R. Bendall)
EXPLORATION MANAGER
CONGA OIL PTY. LTD.

850042

4 - CONDOR OIL INVESTMENTS PTY LTD

- ACCOUNTS JUNE 1993

850043

AUSTRALIAN TAXATION OFFICE

1993 COMPANY INCOME TAX RETURN

1 July 1992 to 30 June 1993 or* / / to / /

(specify period if part year or approved substitute period)

Tax File Number

Is a refund due? NO

1 Name of company and A.C.N./A.R.B.N.: CONDOR OIL INVESTMENTS PTY. LTD.

ACN: 055 403 515

2 Postal address for service of notices — *If the address is unchanged, please show it exactly as shown on the last return lodged.*
c/- G.R. GARROTT & CO.
LEVEL 7, 39 MURRAY STREET, HOBART Postcode 7000

3 Place of central management in Australia: HOBART Postcode 7000 (f)

4 Postal address on previous return — If the address has changed, please show it exactly as shown on the last return lodged.
Postcode (f)

5 Final return — If this is the final return for the company write 'FINAL' here: (f)

DECLARATION

I declare that the particulars shown in this return and the relevant records used to ascertain the taxable income, as shown, derived by the company from all sources in and out of Australia during the year of income are true and correct. (Non-resident companies declare 'and out of')

Name of public officer - please print: MALCOLM ROY BENDALL

Public officer's signature — Date / /

TAX AGENT'S CERTIFICATE

Where the agent is a partnership or a company, this certificate must be signed in the name of the partnership or company, as the case requires, by a person who is registered as a nominee of that partnership or company. That person's name must also be appended.

WE, G.R. GARROTT & CO. having charged a fee directly or indirectly for preparing or assisting in the preparation of this return, hereby certify that this return has been prepared in accordance with the information supplied by the taxpayer.

Agent's signature — Date / /

Client's reference number

Contact: TINA BALL

Public officer's/agent's telephone number: 34 6533

Agent's reference number: 14 668 002 (f)

6 Description of main business activity: TRUSTEE COMPANY

Estimated gross business income derived from this activity: 0

Industry code

7 Status of company — Place X in applicable boxes

Resident C1	X	Private D1	X	Co-operative D3	
Non-resident C2		Public D2		Non-profit D4	
				Registered organisation D5	
Multiple business E1		Ceased business E2		Commenced business E3	

(f)

Calculation Statement

Foreign tax credits C	$
Other rebates and credits D	$
Franking deficit tax offset E	$
Total (transfer to Label F)	$ 0
PPS credit	$
Other refundable credits	$
Total (transfer to Label K)	$ 0

Taxable income A	$ 0
Gross tax B	$ 0
Less: total of Labels C to E F	$ 0
Subtotal	$ 0
Add: S102AAM additional tax G	$ 0
Tax assessed H	$ 0
Less: total of Labels I and J K	$ 0
Subtotal	$ 0
Less: previous payment(s)	$ 0
Amount of payment/refund	$ 0

(f)

NAT 656

IN CONFIDENCE (when completed)

AUSTRALIAN TAXATION OFFICE

Remittance Advice - 08

ATO Code (Office Use Only)

Name of Company

Tax File Number

A.C.N./A.R.B.N.

Amount of Payment for 1993 $

* Cross out whichever is not applicable

ATTACH PAYMENT TO THIS REMITTANCE ADVICE

IN CONFIDENCE (when completed)

850044

ALL COMPANIES TO COMPLETE — **Information Statement** — Refer to *The 1993 Form C Instructions* for information about completing this return.

Calculation of Taxable Income

Income

Income/loss from partnership/trust	A	
Gross rents and royalties	B	
Gross interest	C	
Gross dividends	D	
Other gross income	E	
Total income (Labels A to E)	F	0

Expenses

External labour costs	G	
Superannuation	H	
Cost of sales	I	
Bad debts	J	
Lease expenses	K	
Rent expenses	L	
Interest expenses – within Australia	M	
Interest expenses – overseas	N	
Royalty expenses – within Australia	O	
Royalty expenses – overseas	P	
Depreciation expenses	Q	
Motor vehicle expenses	R	
Repairs and maintenance	S	
All other expenses	T	
Total expenses (Labels G to T)	U	
Operating profit/loss and extraordinary items (Label F less Label U)	V	0

Reconciliation to taxable income/loss

Add – Net capital gains	A	
Other addback items	B	
Less – Depreciation deducted	C	
Special building write-off	D	
Other subtraction items	E	
Prior year losses recouped	F	
Losses transferred in	G	
Taxable income/loss	H	0

Financial Information

Sales	A	
Opening stock	B	
Closing stock	C	
Trade debtors	D	
All current assets	E	8
Total assets	F	8
Trade creditors	G	
All current liabilities	H	
Total liabilities	I	
Shareholders' funds	J	8

Other Information

Total salary and wage expenses	A	
Research and development	B	
Gross PPS income	C	
Dividends paid – franked	D	
Dividends paid – unfranked	E	
Payments to associated persons	F	
Losses transferred out	G	
Depreciable assets purchased	H	
Depreciable assets sold	I	
Net foreign income	J	
Attributed foreign income	K	
Foreign exchange profit/loss	L	
Capital losses applied	M	
Land degradation expenses	N	
Taxable OBU income/loss	O	
Franking account balance	P	

Licensed clubs only

Percentage of non-member income	Q	%

Life assurance companies and registered organisations only

Item	Label	Amount
Superannuation business income - complying	R	
- non-complying	S	
- net capital gains	T	
- gross taxable contributions	U	

Overseas transactions or interests - If YES to any question 1 to 3 below, complete and attach *Schedule 25A.*

1 OVERSEAS TRANSACTIONS
Did the company engage in overseas transactions, of any kind, with related overseas entities, including a permanent establishment, during the year of income? See page 2 of *Schedule 25A* for the meaning of terms. — Yes V1 [ ] No V2 [x]

2 INTEREST IN A FOREIGN COMPANY OR TRUST
Was the company an attributable taxpayer of a controlled foreign company or trust, or a transferor trust? — Yes W1 [ ] No W2 [x]

3 FOREIGN INVESTMENT FUND AND FOREIGN LIFE ASSURANCE POLICY
Did the company have an interest in a foreign company or trust apart from Label W, or a foreign life assurance policy? — Yes X1 [ ] No X2 [x]

Parent company tax file number

If the company is a subsidiary company:
Show the name of the parent company

Show the tax file number of the parent company __ __ __ | __ __ __ | __ __ __

IMPORTANT:
Please ensure that the return form has been completed correctly and has been signed. Unsigned and/or incomplete returns may not be considered lodged and may be returned for completion.

AUSTRALIAN TAXATION OFFICE

Trust Estate

1993 INCOME TAX RETURN

1 July 1992 to 30 June 1993

850045

(a) Is a refund due? NO

(b) Have you attached any 'other attachments'?

CLIENT'S COPY

Tax File Number

Notes to assist in the preparation of this return are provided in *The 1993 Form T Instructions*. Instructions may be obtained from any Tax Office. Post or deliver this return to a Tax Office by 31 October 1993. The addresses of Tax Offices are shown in the instructions.

me of trust estate se block letters)	CONDOR OIL INVESTMENTS UNIT TRUST NO. 1
Postal address for service of notices se block letters) he address is unchanged, please show it actly as shown on the last return lodged.	~~G. R. GARROTT & CO.~~ G.R. GARROTT & CO. ~~LEVEL 7, 39 MURRAY ST.~~ LEVEL 7, 39 MURRAY STREET, HOBART ~~HOBART~~ Postcode 7000
stal address on previous return he postal address has changed, insert the postal dress exactly as shown on the last return lodged.	Postcode
ll name of the trustee whom notices should be sent.	Place X in one box Mr ☐ Mrs ☐ Miss ☐ Ms ☐
If the trustee is an individual show details here	Surname or family name: Given names:
If the trustee is a company show details here	Name: CONDOR OIL INVESTMENTS PTY. LTD.
revious return details if no previous return lodged see *The 1993 Form T Instructions.*	Office where return was lodged: FIRST RETURN
iability of trustee	Is the trustee assessable on all or part of the net income of this trust estate? Yes ☐ No X
rust estate of a deceased person	Is this the trust estate of a deceased person? Yes ☐ No X — If yes, show the date of death.

Final return
If this is the final return for the trust estate write 'FINAL' in the box and attach a statement in accordance with he notes in *The 1993 Form T Instructions.*

mportant

Before making the declaration please check to ensure all income has been disclosed and the return is true and correct in every detail. If you are in oubt about any aspect of the return, place all the facts before the Tax Office. The income tax law provides severe penalties for false or nisleading statements in returns.

Declaration

I declare that:

a) the particulars shown in this return and in the accompanying documents are true and correct in every detail and disclose a full and complete statement of the total income derived from all sources in and out of Australia during the year of income;

b) the trust has the necessary receipts and other records to support any claims made for car and travel expenses in this return.

Signature ______ Date ______

This declaration and all attached documents must be signed by a trustee or public officer.

Tax agent's certificate

Where the agent is a partnership or a company, this certificate must be signed in the name of the partnership or company, as the case requires, by a person who is registered as a nominee of that partnership or company, and that person's name must also be appended.

Tax agent's phone number	Client reference number	Contact
34 6533		TINA BALL

I, G.R. GARROTT & CO. G. R. GARROTT & CO.

aving charged a fee directly or indirectly for preparing or assisting in the preparation of this return, hereby certify that this return has been repared in accordance with the information supplied by the taxpayer.

Agent's signature	Date	Agent's reference number
		14 668 002

Tax Office use only

Indics X

850046

1 Description of main business activity: OIL EXPLORATION

Estimated gross business income derived from this activity: 0

Industry code **A** 1600

2 Status (Place X in applicable box)

Multiple business **B1** [ ] Ceased business **B2** [ ] Commenced business **B3** [x]

3 Total business income / Expenses

	Primary production		Non-primary production		Total
Total business income	**A** . /		**B** . /		0 . /
Expenses					
External labour costs	.		.	**C**	.
Superannuation	.		.	**D**	.
Cost of sales	. /		. /	**E**	. /
Bad debts	.		.	**F**	.
Lease expenses	.		.	**G**	.
Rent expenses	.		.	**H**	.
Total interest expenses	.		.	**I**	.
Total royalty expenses	.		.	**J**	.
Depreciation expenses	.		.	**K**	.
Motor vehicle expenses	.		.	**L**	.
Repairs and maintenance	.		.	**M**	.
All other expenses	.		.	**N**	.
Total expenses (Labels C to N)	.		.	**O**	.
Reconciliation adjustment	. /		. /	**P**	. /
Net income/loss from business	**Q** . /		**R** . /	**S**	0 . /

4 Prescribed payments system (PPS) credit **T** $ c

Other income

5 Partnerships and trusts

Net primary production income distribution **A** . /

Net non-primary production income distribution **B** . /

Share of prescribed payments system (PPS) credit **C** $ c

Share of imputation credit from franked dividends **D**

Share of TFN amounts deducted on interest and/or dividends **E**

6 Rent, premiums, etc.

Gross amount . Interest deductions **F** . Other rental deductions **G** . **H** . /

7 Interest (incl. Commonwealth Government Loan interest)

TFN amounts deducted on interest **I** $ c **J** .

8 Dividends

Unfranked amount **K** .

Franked amount **L** .

Imputation credit **M** .

TFN amounts deducted on dividends **N** $ c

9 Other Australian income (give details)

Name of each item of income Expected net income .

O . /

10 Total of Item 3 (Label S) to Item 9 0 . /

Deductions

11 Deductions relating to Australian investment income — P: .

12 Other deductions (give details - show only Australian source deductions)

Nature of each item of deduction	Amount
	.
	.

Q: .

13 Total of Items 11 and 12 — .

14 Net Australian income/loss (other than capital gains) - Subtract Item 13 from Item 10 — $: 0 .

15 Net capital gain — *Excepted net capital gain* . — R: .

16 Attributed foreign income

Was the trust estate an attributable taxpayer of a controlled foreign company or trust, or a transferor trust? S: 2

Did the trust estate have an interest in a foreign company or trust apart from Label S, or a foreign life assurance policy? T: 2

If Yes to either question, complete and attach *Schedule 25A* — U: .

17 General net foreign source income (excluding foreign source losses) — Foreign tax credit $ c — V: .

18 *Total net income/loss from all sources* (excluding foreign source losses) - Total of Items 14 to 17 — 0 .

19 Overseas transactions

Did the trust estate engage in overseas transactions with related overseas entities? W: 2

If Yes, complete and attach *Schedule 25A*

Business/professional declaration items

The following information must be filled in for all trust estates carrying on a business.

20 Business name of trust estate's main business: CONDOR OIL INVESTMENTS PTY. LTD.

21 Business address of trust estate's main business: LEVEL 7, 39 MURRAY STREET, HOBART — A: 7000 (Postcode)

22	Sales	B	.
23	Opening stock	C	.
24	Closing stock	D	.
25	Trade debtors	E	.
26	All current assets	F	.
27	Total assets	G	90218 .
28	*Trade creditors*	H	12631 .
29	All current liabilities	I	12838 .
30	Total liabilities	J	40098 .
31	Proprietors' funds	K	50120 .
32	*Total salary and wage expenses*	L	.
33	Payments to associated persons	M	.
34	Depreciable assets purchased	N	.
35	Depreciable assets sold	O	.
36	Gross PPS income	P	.
37	Overseas interest expenses	Q	.
38	Overseas royalty expenses	R	.
39	Land degradation expenses	S	.

Medicare levy reduction or exemption - For further information, see *The 1993 Form T Instructions.*

40 Full levy exemption — Number of days A:

Half levy exemption — Number of days B:

Levy reduction — 1992-1993 taxable income of spouse (if nil show '0') C: .

Number of dependent children and students D:

 850048

ot [redacted] Each beneficiary's *tax file number is needed to make sure we correctly identify their tax records*. It is not an offence not c[redacted]te a tax file number. The information is needed for taxation purposes and is required by the Income Tax Assessment Act. o[redacted] information may be given to certain government bodies as described in tax law. For more details see the *1993 Tax Pack* the free brochure entitled *Safeguarding Your Privacy* obtainable from any Tax Office.

S[redacted]ement of distribution of net Australian income as shown at Item 14 (excludes capital gains), any prescribed payments s[redacted]em credit, *any imputation credits for franked dividends* and any TFN credit. (Please enter all appropriate details - see instructions for more information.)

(1) Name in full of each beneficiary and file number [redacted] or postal address	(2) Birth date	(3) Legal dis.?	(4) 1993 return	(5) Share of income: Primary production income $	(5) Share of income: Non-primary production income $	(6) PPS credit $	c	(7) Imputation credit $	c	(8) TFN credit $	c
Q DISTRIBUTION				A	B	C					
[redacted]				A	B	C					
[redacted]				A	B	C					
				A	B	C					
[redacted]				A	B	C					
[redacted]				A	B	C					
				A	B	C					
[redacted] Sub-totals of Columns (5), (6), (7) and (8) →											
nc[redacted] to which no beneficiary is presently entitled and in which no beneficiary has an indefeasible vested interest Column 5), and Trustee's share of credit for tax deducted C[redacted]n 6, Column 7 and Column 8). →											
[redacted] Totals of Columns (5), (6), (7) and (8) →				A	B	C					

[redacted]

UE[redacted]TIONS AT ITEMS 42 TO 48 MUST BE ANSWERED FOR ALL TRUST ESTATES - *If you answer YES to any of the* uestions at Items 42 to 48, please write 'YES' in the 'other attachments' box on page 1 of this return.

2 [redacted]stribution of trust estate income at the discretion of the trustee — YES [ ] NO [X]
[redacted]as the income of the trust estate distributed to, or applied for the benefit of, any beneficiary at the discretion of the trustee? *If YES, attach a signed and dated copy of the trustee's resolution.*

3 [redacted] any of the amounts shown at Items 15, 16 and 17 relate to income to which no beneficiary is, or is [redacted]emed to be, presently entitled? *If YES, state the amount of each of the following to which no beneficiary is,* [redacted] *is deemed to be, presently entitled (insert 'Nil' if applicable):* — YES [ ] NO [X]

Net capital gain $ [redacted] General net foreign source income $

[redacted]ttributed foreign income $ Foreign tax credit $

4 [redacted] any of the amounts shown at *Items 15, 16 and 17 relate to income distributed to beneficiaries under* [redacted] legal disability? *If YES, attach a statement detailing the distribution of income and/or credit to each beneficiary under a legal disability.* — YES [ ] NO [X]

5 [redacted]as the trust estate derived any excepted income or is any beneficiary considered an 'excepted [redacted]erson'? If excepted income was derived, it must be shown in the appropriate boxes at Items 9 and 15. Also attach a statement detailing the distribution of excepted income to each beneficiary. *If applicable, attach with supporting reasons a statement listing each beneficiary who is considered to be an 'excepted person'.* — YES [ ] NO [X]

6 [redacted]eneficiary under 18 years who is presently entitled to income from another trust estate — YES [ ] NO [X]
Was a beneficiary in this trust estate less than 18 years of age at 30 June 1993 and also presently entitled to a share of the net income of another trust estate? *If YES, or the answer is not known, please furnish the information* [redacted]equested in *The 1993 Form T Instructions.*

47 [redacted]on-resident beneficiary presently entitled to income — YES [ ] NO [X]
Was any beneficiary who was not a resident of Australia at any time during the year of income, presently entitled to [redacted] share of the net income of the trust estate? *If YES, attach the information requested in The 1993 Form T* [redacted]*nstructions.*

48 Non-resident trust estate (see *The 1993 Form T Instructions* for the definition of a non-resident trust estate) — YES [ ] NO [X]
[redacted] the trust estate a non-resident trust estate? If YES, state the amount of income derived outside Australia to [redacted]*hich no beneficiary is presently entitled.*

CONDOR OIL INVESTMENTS PTY. LTD.

AS TRUSTEE OF

THE CONFOR OIL INVESTMENTS UNIT TRUST NO. 1

30TH JUNE, 1993

ACCOUNTANTS' STATEMENT

The accompanying accounts have been prepared by us from records, information and instructions furnished to us by the abovenamed client. They are not general purpose accounts and have not been prepared in accordance with Statements of Accounting Concepts and Accounting Standards. As our instructions did not include an audit we have not audited the accounts and we as accountants responsible for the preparation of the accounts do not express any opinion as to whether they present a true and fair view of the position and of the operating results, and neither we nor any of our employees accept any responsibility for the accuracy of the material from which the accounts have been prepared. Further, the accounts have been prepared at the request of and for the purpose of the abovementioned client only and neither we nor any of our employees accept any responsibility on any ground whatsoever to any other party.

....

G.R. GARROTT & CO.

This 21st day of February 1994 .

CONDOR OIL INVESTMENTS PTY. LTD.

AS TRUSTEE OF

THE CONDOR OIL INVESTMENTS UNIT TRUST NO. 1

STATEMENT OF ASSETS & LIABILITIES

AS AT 30TH JUNE, 1993

NON-CURRENT ASSETS		
Exploration Expenditure		90,218
LESS: LIABILITIES		
Trade Creditors	12,631	
ANZ Bank	207	
Loan: D. & M. Bendall	27,260	
		40,098
NET ASSETS		50,120
		======
TRUST FUNDS		
A Class Units of $1 each	121	
Premium on Issue of Units	49,999	
		50,120
		======

Condor Oil Investments Pty Ltd as Trustee for
The Condor Oil Investments Unit Trust No 1

Oil Lease Development account.

Travelling expenses	20544	70
Filing fees and Penalties ASC	2443	00
Bank charges	825	54
Telephone	3478	60
Vehicle expenses	1126	79
Printing + stationery	3633	26
Postage	128	30
Bank interest	4	11
Legal expenses	10692	68
Advertising	321	30
Mines Department lease payments	34470	00
Testing CSIRO	7000	00
Accountancy - Cargo Oil	5550	00
	90218	28

850052

1993 COMPANY INCOME TAX RETURN

1 July 1992 to 30 June 1993 or

/ / to / /

(specify period if part year or approved substitute period)

AUSTRALIAN TAXATION OFFICE

COPY

Tax File Number: 94 | 089 | 772

Is a refund due? NO

1 Name of company and A.C.N./A.R.B.N.	CONGA OIL PTY. LTD. — 009 495 845
2 Postal address for service of notices. If the address is unchanged, please show it exactly as shown on the last return lodged.	G.R. GARROTT & CO. LEVEL 7, 39 MURRAY STREET, HOBART Postcode 7000
3 Place of central management in Australia	HOBART Postcode 7000
4 Postal address on previous return. If the address has changed, please show it exactly as shown on the last return lodged.	Postcode
5 Final return	If this is the final return for the company write 'FINAL' here:

DECLARATION

I declare that the particulars shown in this return and the relevant records used to ascertain the taxable income, as shown, derived by the company from all sources in and out of Australia during the year of income are true and correct. (Non-resident companies delete 'and out of'.)

Name of public officer - please print: MALCOLM ROY BENDALL

Public officer's signature — Date / /

TAX AGENT'S CERTIFICATE

Where the agent is a partnership or a company, this certificate must be signed in the name of the partnership or company, as the case requires, by a person who is registered as a nominee of that partnership or company. That person's name must also be appended.

WE, G.R. GARROTT & CO. having charged a fee directly or indirectly for preparing or assisting in the preparation of this return, hereby certify that this return has been prepared in accordance with the information supplied by the taxpayer.

Agent's signature — Date / /

Client's reference number

Contact: G.R. GARROTT

Public officer's/agent's telephone number: 34 6533

Agent's reference number: 14 668 002

6 Description of main business activity: MINING

Estimated gross business income derived from this activity: 0

Industry code B: 1600

7 Status of company — Place X in applicable boxes

Resident C1: X	Private D1: X	Co-operative D3:	Multiple business E1:
Non-resident C2:	Public D2:	Non-profit D4:	Ceased business E2:
		Registered organisation D5:	Commenced business E3:

Calculation Statement

		Taxable income A	$ 0
		Gross tax B	$ 0
Foreign tax credits C	$	Less: total of Labels C to E F	$ 0
Other rebates and credits D	$	Subtotal	$ 0
Franking deficit tax offset E	$	Add: S102AAM additional tax G	$ 0
Total (transfer to Label F)	$ 0	Tax assessed H	$ 0
		Less: total of Labels I and J K	$ 0
PPS credit I	$	Subtotal	$ 0
Other refundable credits J	$	Less: previous payment(s) L	$ 0
Total (transfer to Label K)	$ 0	Amount of payment/refund M	$ 0

NAT 555 — IN-CONFIDENCE (when completed)

AUSTRALIAN TAXATION OFFICE

Remittance Advice - 08

ATO Code (Office Use Only)

Name of Company

Tax File Number

* A.C.N./A.R.B.N.

Amount of Payment for 1993: $

* Cross out whichever is not applicable

ATTACH PAYMENT TO THIS REMITTANCE ADVICE

IN-CONFIDENCE (when completed)

ALL COMPANIES TO COMPLETE — **Information Statement** — Refer to *The 1993 Form C Instructions* for information about completing this return.

Calculation of Taxable Income

Income

Income/loss from partnership/trust	A	
Gross rents and royalties	B	
Gross interest	C	
Gross dividends	D	
Other gross income	E	50
Total income (Labels A to E)	F	50

Expenses

External labour costs	G	
Superannuation	H	
Cost of sales	I	
Bad debts	J	
Lease expenses	K	
Rent expenses	L	
Interest expenses - within Australia	M	18198
Interest expenses - overseas	N	
Royalty expenses - within Australia	O	
Royalty expenses - overseas	P	
Depreciation expenses	Q	1038
Motor vehicle expenses	R	184
Repairs and maintenance	S	
All other expenses	T	527162
Total expenses (Labels G to T)	U	546582
Operating profit/loss and extraordinary items (Label F less Label U)	V	(546532) L

Reconciliation to taxable income/loss

Add - Net capital gains	A	
Other addback items	B	
Less - Depreciation deducted	C	
Special building write-off	D	
Other subtraction items	E	
Prior year losses recouped	F	
Losses transferred in	G	
Taxable income/loss	H	(546532) L

Financial Information

Sales	A	
Opening stock	B	
Closing stock	C	
Trade debtors	D	
All current assets	E	
Total assets	F	
Trade creditors	G	
All current liabilities	H	
Total liabilities	I	1732178
Shareholders' funds	J	(1732178)

Other Information

Total salary and wage expenses	A	4330
Research and development	B	
Gross PPS income	C	
Dividends paid - franked	D	
Dividends paid - unfranked	E	
Payments to associated persons	F	4330
Losses transferred out	G	
Depreciable assets purchased	H	
Depreciable assets sold	I	
Net foreign income	J	
Attributed foreign income	K	
Foreign exchange profit/loss	L	
Capital losses applied	M	
Land degradation expenses	N	
Taxable CEU income/loss	O	
Franking account balance	P	0

Licensed clubs only

Percentage of non-member income	Q	%

Life assurance companies and registered organisations only

Superannuation business income - complying	R	
- non-complying	S	
- net capital gains	T	
- gross taxable contributions	U	

Overseas transactions or interests - if YES to any question 1 to 3 below, complete and attach *Schedule 25A*.

1 OVERSEAS TRANSACTIONS
Did the company engage in overseas transactions of any kind, with related overseas entities, including a permanent establishment, during the year of income? See page 2 of *Schedule 25A* for the meaning of terms. Yes V1 [ ] No V2 [x]

2 INTEREST IN A FOREIGN COMPANY OR TRUST
Was the company an attributable taxpayer of a controlled foreign company or trust, or a transferor trust? Yes W1 [ ] No W2 [x]

3 FOREIGN INVESTMENT FUND AND FOREIGN LIFE ASSURANCE POLICY
Did the company have an interest in a foreign company or trust apart from Label W, or a foreign life assurance policy? Yes X1 [ ] No X2 [x]

Parent company tax file number

If the company is a subsidiary company:
Show the name of the parent company

Show the tax file number of the parent company ___ ___ ___ | ___ ___ ___ | ___ ___ ___

IMPORTANT:
Please ensure that the return form has been completed correctly and has been signed. Unsigned and/or incomplete returns may not be considered lodged and may be returned for completion.

CONGA OIL PTY. LTD.

30TH JUNE, 1993

ACCOUNTANTS' STATEMENT

The accompanying accounts have been prepared by us from records, information and instructions furnished to us by the abovenamed client. They are not general purpose accounts and have not been prepared in accordance with Statements of Accounting Concepts and Accounting Standards. As our instructions did not include an audit we have not audited the accounts and we as accountants responsible for the preparation of the accounts do not express any opinion as to whether they present a true and fair view of the position and of the operating results, and neither we nor any of our employees accept any responsibility for the accuracy of the material from which the accounts have been prepared. Further, the accounts have been prepared at the request of and for the purpose of the abovementioned client only and neither we nor any of our employees accept any responsibility on any ground whatsoever to any other party.

....

G.R. GARROTT & CO.

This 24th day of March 1994.

CONGA OIL PTY. LTD.

STATEMENT OF ASSETS & LIABILITIES

AS AT 30TH JUNE, 1993

CURRENT ASSETS		
Cash on Hand	-	
Receivables	-	
		-
NON CURRENT ASSETS		
Property, Plant & Equipment	-	
Exploration & Evaluation Costs	-	
		-
TOTAL ASSETS		-
CURRENT LIABILITIES		
Bank Overdraft	108,411	
Sundry Creditors & Accruals	-	
		108,411
NON CURRENT LIABILITIES		
Loan: Kinka Pty. Ltd.	1,115,220	
Trial Harbour Mining Co. Pty. Ltd.	23,048	
Aust Gold Resources	443,545	
Australia Wide Industries Ltd.	32,507	
M.R. Bendall	9,447	
I. Herzog	-	
		1,623,767
TOTAL LIABILITIES		1,732,178
NET ASSETS		(1,732,178)
SHAREHOLDERS' FUNDS		
Authorised Capital (20,000 shares of $1 each)	20,000	
Issued & Paid Up Capital	400	
Asset Revaluation Reserve	100	
Retained Earnings	(1,732,678)	
		(1,732,178)

CONGA OIL PTY. LTD.

STATEMENT OF PROFIT & LOSS

YEAR ENDED 30TH JUNE, 1993

INCOME		50
EXPENSES		
Bank Fees	56	
Interest	18,198	
Motor Expenses	184	
Petty Cash Expenses	400	
Salaries	4,330	
Exploration Costs Written Off	522,376	
Depreciation - Scrap	1,038	
		546,582
NET LOSS		$(546,532)
		=======

CONGA OIL PTY. LTD.

PROFIT & LOSS APPROPRIATION ACCOUNT

YEAR ENDED 30TH JUNE, 1993

Accumulated Losses 1st July 1992	(1,203,146)
Net Loss for Year	(546,532)
Accumulated Losses 30th June, 1993	(1,749,678)
Extraordinary Item	
Release of Liability	
Loan: I. Herzog	17,000
BALANCE 30TH JUNE, 1993	(1,732,678)
	==========

850058

CONDOR OIL INVESTMENTS PTY. LTD.

A.C.N. 055 403 515

84 Wells Parade
Blackmans Bay, Tasmania 7052

Telephone: 002 29 6576
Facsimile: 002 29 2153

PREVIOUS EXPENDITURE

4 - CONDOR OIL INVESTMENTS PTY LTD

- TOTAL PAST EXPENDITURE 1980-94

850060

G. R. Garrott & Co.

Chartered Accountants

Geoffrey R. Garrott F.C.A.
Telephone. (002) 34 6530
(002) 34 6060
Fax: (002) 31 2805

7th Level T.B.T. Building, 39 Murray Street, Hobart, 7000

GRG:sg

25th March 1994

Henry Brookman Esq.
Brookman Tilley
Barristers & Solicitors
"Galleria"
33 Salamanca Place
HOBART   TAS   7000

Dear Mr. Brookman,

CONDOR OIL INVESTMENTS PTY. LTD.

A. For your information and from records of the oil interests, a total of approximately $3,355,528 has been expended over a period of ten years calculated as follows:-

1.	134,000	Condor Oil Investments Pty Ltd	
2.	2,571,528	Conga Oil Pty Ltd	
3.	650,000	CSIRO	$450,000
		Shell	$200,000
	$3,355,528		

B. Total capitalization of Condor Oil Investments Unit Trust is $1,320,000 calculated as follows:-

132 "A" @ $10,000 each $1,320,000

BASIS FOR 30% INVESTOR

A. 30% = $1,438,083
B. 30% = $ 565,714

BASIS FOR 50% INVESTOR

A. 50% - $3.355M
B. 50% = $1.320M

For an investment from an outside party of $500,000, it is believed that the Federal & State Government will spend a further $1.650m on these oil interests as follows:-

../2

C.S.I.R.O.	$200,000
Mines Dept.	350,000
AGSO	1,100,000
	$1,650,000

The above information should be sufficient to negotiate an appropriate percentage for a $500,000 investor.

Yours faithfully,

CHARTERED ACCOUNTANTS

4.1 EXPLORATION LICENSE EL 1/88

EXPLORATION LICENCE 1/88

BRUNY ISLAND

1. LEASE DATA

Licence No.	1/88
Location	South of Hobart, Bruny Island
Granted	1988
Area	3,700 sq km
Land Status	Crown and private land
Ownership	Condor Oil Investments Pty. Ltd.
Encumbrances	Nil
Mineral	Oil and Gas
Past expenditure	$3,355,528

Licence conditions

To complete and fulfill a works program with an estimated expenditure of $500,000. That program includes two drill holes each with an estimated total depth of about one kilometre drilling thru the surface. Permian rocks of the Tasmanian basin to the under lying rocks which are thought to be the Ordovician Gordon limestone. Geochemistry is continuing in conjunction with the C.S.I.R.O and further seismic surveys are being undertaken in conjunction with the mines department and A.G.S.O. this work is estimated to cost $1.650,00.and be completed by June 1995.

2. EXISTING INFRASTRUCTURE

Most of the Exploration license is serviced by road and power and cleared farmland covers extensive areas within the E/L. The Derwent river runs through the whole licence , Storm bay at the mouth of the Derwent and Hobart on its banks are also covered.

3. CURRENT ACTIVITY OF ADJACENT LICENCES

Condor currently is in the application process for EL 17/90 on which there is a verified gas flow and intends to drill a new production assessment hole before June 1995. Condor has all other prospective ground under EL 4/94 and therefore has its results from investments on the current licences protected from other partys.

4. SUMMARY OF SALIENT GEOLOGY

The licence covers Permian and Triassic sediments which are up to 1.5 KM in thickness and intruded by Jurassic dolerites and Cretaceous syanite porphyrs.

5. PREVIOUS MINING AND EXPLORATION

A comprehensive summary of previous historical prospecting and drilling results is in Bendall 1990 which is appended

6. POTENTIAL TARGET

Commercial reserves of oil and gas on a similar scale to the Cooper Basin of South Australia and the Amadaeous Basin of central Australia.are the expected results of drilling exploration.

7. WORK UNDERTAKEN BY CONDOR.

Appended is the 1991 A.P.E.A paper and the 1992 geological evaluation by stock exchange recognized international geological consultants Questa Australia titled "AN EVALUATION OF THE OIL AND GAS POTENTIAL OF TASMANIA" these summarise the work carried out to date.

8. PROPOSED FUTURE EXPLORATION AND COST

Appended is the agreed works program approved by the Dept of Resourses and Development.

850065

A HISTORY OF PETROLEUM OCCURENCES AND EXPLORATION IN TASMANIA.

M. R. BENDALL

January, 1990.

850066

CONTENTS

ABSTRACT:

Archival research of petroleum sightings in Tasmania has revealed more than 100 occurences of liquids and tars in the last 100 years. Many of these ephemeral occurrences were confirmed by experts of the day. Some were attractive enough to encourage investors and drilling.

Little recovery was achieved and all wells were shallow and sited in ignorance of the geology at depth.

Unfortunately, government or bureaucratic support has never been provided due to incorrect assumptions and presumptions.

A "no oil in Tasmania" psychology has developed, these sightings not withstanding.

This archival search shows that reports of seeps are not random and correlate with structural lineament trends recognised from regional geophysical data - a correlation which adds to the credibility of the historical records.

INTRODUCTION:

It is now 115 years since the first sign of petroleum was recorded on-shore in Tasmania. Since then 107 reported indications of petroleum, 127 exploration licences, and the sinking of 35 drill holes constitute the oil exploration histroy of Tasmania. next page

It is remarkable that the only paper to look seriously at the possibility of on-shore oil in Tasmania ("Twelvetrees, 1917") is 73 years old but remains the most recent Tasmanian Mines Department report on the subject.

The first prospecting syndicate searching for oil on-shore, in 1915, identified the Ordovician limestone as the source of the shows of oil and tar at New River Lagoon and correctly correlated the rocks with the upper Ordovician Trenton 'series' of the Texas Pan-Handle, famous at that time for oil gushes.

At that time many geologists called the Ordovician, Upper Silurian as the new term Ordovician had not really caught-on.

Archival records reveal a fascinating history of false preconceptions, plain ignorance, meddlesome belligerance, lack of scientific integrity and political and financial sabotage. All these elements have conspired to discourage on-shore petroleum exploration in Tasmania.

Although this history is best forgotten for the sake of a brighter future, it must, however, be recorded in order to understand how oil exploration in Tasmania has been retarded. Since the existence of any oil exploration in the State had been largely forgotten an archive search was undertaken. This paper records some of the findings.

850068

COMPANIES AND EXPENDITURE

Many companies have been involved or floated on the basis of recorded sightings. Several instigative drilling programmes at seepage sights - a high risk and blind wildcat procedure were completed.
The companies were:-

Port Davey Mineral and Oil Prospecting Syndicate	1915
The Asphaltum Glance and Oil Syndicate	1915
The Bruni Island Oil Company	1916
The Tasman Oil Company	1921
The Mersey Valley Oil Company	1922
The Adelaide Oil Exploration Company	1922
The Tasmanian Oil Company	1929
The Austral Oil Drilling Syndicate	1936
Producers Oilwell Supplies	1939
Nudec Pty. Ltd.	1965
E.Z. Company Pty. Ltd.	1965
B.H.P. Ltd.	1980
Conga Oil Pty. Ltd.	1984

The most recent drilling was more than 20 years ago by Charlie Sulzberger's Company, Nudec Pty. Ltd. An estimated 10 million dollars, in 1990 terms, was spent. They found a gas show and two oil shows out of thirty five wells. The programme was, however, defeated by ignorance; the source of the shows was not Tertiary, Cretaceous or Permian, as then thought, but Ordovician. Inconsistent with earlier intro.

No company succeeded in penetrating Permian or post-Permian cover; most rigs were either unsuitable for the rock types or too limited in capacity.

OCCURENCES

The occurences related to seeps, licences and drill holes, have been listed in chronological order (Appendix, 1) and demonstrate the extent of oil exploration and interest. Regional groupings and recorded evaluations are discussed below.

1. SOUTH COAST OCCURENCES

The Asphaltum Glance Oil Syndicates oil leases were inspected by W.H. Twelvetrees in 1915 and reported under the title "Reconnaissance of Country between Recherche Bay and New River, Southern Tasmania". The syndicate found oozing tars in New River, tars in the lagoon, Prion Beach, and oil scums off shore as strong indications that the Ordovician limestone was both source and also reservoir for the shows. They compared the occurences with the Trenton Limestone in America (Ordovician) and the Devonian limestone of Canada as prolific producers of oil and gas and correctly correlated the Gordon Limestone of New River to the Trenton Limestone. (Burrett, et al. 1981)

Twelvetrees correlated the limestone to the Silurian (Ordovian in modern usage) states incorrectly that "signs of bitumen or oil have never been detected in this rock".

He goes on to state, "In any case there is no reason for regarding the New River Limestone as having any bearing on the question of the derivation of the pieces of asphaltum picked up off the New River Beach". He made this statement after assigning the oozing tars of New River to deep pockets of Tertiary within the Gordon Limestone, - all insubstantiated conclusion.

He did, however, determine that the specific gravities and physical characteristics of the tars, as listed below, were remarkably similar.

Upstream Gordon Limestone	Asphaltum from Port Davey	1.0349
On Gordon Limestone	Asphaltum from Rocky Boat Harbour	1.0429
On Gordon Limestone	Asphaltum from Surprise River Beach	1.0426
On Gordon Limestone	Asphaltum from North of Point Hibbs (Albina)	1.0459

W.F. Ward, Government Analyst, confirmed that the S.G. of "The Tasmanian Asphaltum ranged from 1.0313 to 1.0459 (the S.G. of salt water is 1.03)".

The most interesting of the tar's physical properties is that they all sink in salt water, a point discussed below. The syndicate also held a lease for oil at Recherche Bay. The D'Entrecasteaux River catchment contains Gordon Limestone, which has tars and has also been reported oozing oil, and the river is the main stream into Recherche Bay.

A kerosene stone reported at Southport, may be related to the Gordon Limestone hydrocarbons, laying beneath the Permian, both there and at Recherche Bay.

Leases taken out in 1915 around the Eastern mouth of the Davey River, at Deep Creek, are very interesting as a half tonne sample of asphaltum, heavier than salt water, was taken to Hobart. The leases were on Precambrian rocks, but Gordon Limestone outcrops upstream in the Davey River.

Another occurrence on the Precambrian rocks was at Louisa Bay, and on Triassic at South Cape Bay.

2. WEST COAST

Tars at the mouth of the Mainwaring River are in Cambrian rocks but Ordovician rocks may occur off shore and are exposed near Point Hibbs. Most tars have been reported on Ocean Beach. In 1923, the Mersey Valley Oil Company and a Mr H.E. Eveden pegged leases covering the area from the Strahan township to Ocean Beach and north towards the Henty River.

In 1942, Mr. W. Holmes, Manager of the Union Steamship Company, reported a stretch of water 4 miles long, suddenly became discoloured. This was just off Ocean Beach approximately due west of Strahan. After a subsequent storm a large amount of tar was collected by the coast guard. In this same position about 8 years later, over a period of two years, a school teacher, Mr. H. Fletcher, described oil seepages on Ocean Beach (irridescent films) and on the banks of a creek inland. He also described a black patch just off shore and tar being burnt in fires after storms. Mr. Fletcher also made sightings in dune lakes north of the Henty River. The Henty River itself has been reported as seeping gas, and tars can be found in the Gordon Limestone south of Zeehan.

The historical evidence seems to indicate the tars originate from strata inland of Ocean Beach, not from off-shore sources far removed. The possibility of an Ordovician source is highly likely since a thick Ordovician to Devonian sequence is exposed north and east of Strahan.

Tars (distinguished from fossil resins) within Macquarie Harbour, reported near Farm Cove caused an extensive search by a Sydney explorer in 1895 but no source was found.

Tars were located recently in the headwaters in the King River in Gordon Limestone which had thermal maturity within the oil window. Sediment samples of the King River delta taken by C.S.I.R.O. revealed hydrocarbons, but the source has not yet been determined.

3. D'ENTRECASTREAUX CHANNEL - SOUTH EAST TASMANIA

Six companies have concentrated their efforts in this district, the Bruni Island Oil Company, the Tasmanian Oil Company, Producers Oilwell Suppliers Pty. Ltd., E.Z. Company, B.H.P., and Conga Oil Pty. Ltd.

(a) DOVER AREA

Oil and gas was reported in shallow sea water by separate observers somewhere near Dover in 1933 and 1957.

(b) CYGNET AREA

Cygnet's first reported seep was in 1876 followed by two sightings in 1939 on opposite sides of the Cygnet dome structure, prompting a public meeting by Producers Oilwell Supplies, in both 1939 and 1953. Nebulous reports of seeps at Crabtree, 20 km North of Cygnet were made around 1960. Two deaths due to H_2S were reported in a shaft at Cygnet, the source of the gas is open to Question.

(c) BRUNY ISLAND AREA

This area consists mainly of Permo-Triassic Parmeener Supergroup sediments with Jurassic dolerite intrusions. The onshore seeps consist of tars, oils and gas mainly escaping along fault lines. On the basis of modern geophysical interpretation the basement is probably mainly Precambrian with some remnant Ordiovician sections, the edge of the main Cambrian trough being some 10 kilometres to the west of the island itself. (Leaman, 1990). The source of the seeps is thought to be from Gordon Limestone within this trough. (Analyses, Dr. J. Volkman, C.S.I.R.O.).

In 1916, with a capital of 50,000 pounds, the Bruni Island Oil Company put down 7 shallow holes on the basis of 2 seeps of exuding tars cited in their prospectus. The deepest of their holes was 450 feet, quite inadequate for any pre-Permian target. After this failed attempt, the Tasmanian Oil Company drilled 3 holes in 1929 on a confirmed show of oil and gas at the bottom of a well. (McIntosh Reid, 1929). Oil was collected in bottles after drilling to a depth of 125 feet.

Numerous leases have been held on Bruny Island, from Adventure Bay to Great Bay, on various seepages up until the present day. Various samples of marine sediment in the D'Entrecastreaux Channel collected by the C.S.I.R.O. and terrestrial samples on Bruny Island collected by Conga Oil Pty. Ltd. and analysed by the C.S.I.R.O. have shown Ordivicien hydrocarbon signatures. (Volkman, 1989).

In 1940 a seep of oil was reported in an army well at Fort Direction, South Arm, and 1 km north, it was reported in 1988 that seeps had been occurring on Spring Beach over the last 40 years. Some 10 kilometres to the east in the lagoon behind Clifton Beach, a Mines Department seismic spread indicated an extensive sequence of reflections below the Permian cover which may possibly indicate a section of Palaeozoic rocks including limestone. (Leaman, 1978).

4. MIDLANDS

Seeps of light oil have been reported at Glenlusk, Colebrook, Cambridge, Tunnack and Jericho. Reports of tars from Brighton and Dysart in recent times indicate the reason for an exploration licence for oil taken out at Elderslie by S. Chapman, in 1919. Tar samples recently collected from Tunnack have been sectioned and show total impregnation of the rock by hydrocarbons. (Dr C. Burrett, D. Leaman, pers. comm.).

At the north end of this lineament are the gas shows reported at "Rose Neath", Ross, (1939) and 1 kilometre to the west is a reported show of oil in a water bore (1984, G. & G. Gleason).

5. NORTH - NORTHWEST

A line of oozings from Newstead through Relbia to Evandale, was reported by W.H. Twelvetrees, 1917. Recent geophysical interpretation implies a lower Palaeozoic section below these seeps. (Dr D. Leaman, R. Hencauto, pers. comm.). A continuation of this trend north of Launceston extends to the site of the 1939 Producers Oilwell Supplies drill rig at Danbury Park. Oil has been reported seeping from Permian rocks west of this hole at Bridgenorth (1962) and at Rosevale (1921) in Tertiary rocks. The most northerly seep was reported by a mine geologist at Beaconsfield; seepage directly into the mine water, presumably from the Flowery Gully Limestone (Gordon Limestone).

The Cressy - Port Sorell structures have been the most drilled for oil in Tasmania, with 20 holes sunk in 1922-23 alone (by the Mersey Valley Oil and Adelaide Oil Exploration Companies). Three more bores were sunk by C. Sulzberger, between 1966 and 1969. The original companies were greatly encouraged by increased rates of seepage following an earthquake in 1922. A major earth quake occurs in Tasmania every 20 years, it is 30 years since a major quake.

6. DERWENT VALLEY OCCURRENCES

The 1910 Annual Report to the Director of Mines, reported a bituminous exudation on the banks of the Derwent River at Kenmore Estate, Macquarie Plains, and 20 kms upstream, Mr. W.C. Inglis reported seeps of oil on his property in 1958. A drill hole for oil was put down 520 feet (158.5 m) at "Lawrenny" (1920) but was abandoned at that depth after the rods "stuck". Mr. G.C. Harris reported gas at Tarraleah in 1946.

An unbroken line of oil leases between Lake St. Clair and Cradle Mountain was taken up in the 1921 "oil rush". There is much confusion over the cause of the 1921 "oil rush", mainly because coal in the district contains thin petroliferous layers. (Mersey Coal Measures and Preolenna Oil Shales correlates). Tars were also exhumed from the glacial Moraines of the field but consultants did not believe the hydrocarbons to be derived from the Preolenna Oil Shales.

Consider two quotes:

(i) Report from the field, 1921.

On the 28th May, Mr. A.C. Black, Field Manager of the Tasman Oil Company, wired from Sheffield, Tasmania, to his Principals in Melbourne , as follows:-

"Now in a position report absolutely, facts can be produced from data collected recent developments that oil exists at Barn Bluff".

Since his consulting geologist had just returned from a visit to this region, the Secretary of the Melbourne Company wired to him asking for his opinion regarding Mr. Black's statement and replied:

"I have no hesitation in confirming Black's statement that oil exists at Barn Bluff, gas and oil seepages being plainly manifest during my recent inspection there. Also the geological features of the field generally indicate that large quantities of oil have unquestionably been produced by natural process of distillation and may be confidently sought for in the Anti-clines".

(ii) Report of Mr. W.A. Dixon, F.I.C. F.C.S., Sydney, 1893.

"On distillation, "pelionite" (from glacial Moraines) produced hydrocarbons of the aromatic series (benzene, naphalene etc.) and not as are contained in the Preolenna kerosene shale those of the aliphatic series (olefines, paraffines etc.)"

The Preolenna Kerosene Shale equivalent unit does outcrop in the Barn Bluff area but its products are waxy and immature. It is not able to account for gas shows in the area and cannot produce the composition of the "fossil tars" present in the glacial Moraine.

7. NORTH WEST TASMANIA

One of the first recorded tars was described from Chudleigh in Pettard's, 1896 "Catalogue of Tasmanian Minerals". He describes it as, "occuring about 4 miles from Chudleigh on the eastern bank of the Mersey River. It was perfectly black, sectile and burned with a dense smoke and strong odour. It occurs in drab coloured aluminous shale of (presumed) Ordovician age."

In 1956, at Mole Creek, seven kilometres to the west, on the Gordon Limestone, a well was reported to have seeps of oil. A further occurrence was at a small outcrop of Gordon Limestone directly under the capping Parmeener Supergroup in Muddy Creek, Golden Valley. This was reported emitting flammable gas in 1932. The Adelaide Oil Exploration Company Field Manager reported shows near Devonport. Drill hole no. 8, of this company at Port Sorell, was reported by a Government geologist, A. McIntosh Reid, 10.9.1923, as having penetrated a bed with natural gas under enormous pressure - causing an outbreak closing the hole. In the same report he sites numerous seeps of oil and gas escaping from both Permian and Tertiary strata in the Latrobe - Sassafras district.

A sample of mature oil was obtained by Conga Oil Pty. Ltd. from basal Permian rock at Poatina, which has neither a Permian Tasmanite nor Ordovician carbonate signature. (Dr. J. Volkman, C.S.I.R.O., pers. comm.)

Other occurrences have been reported from the Mount Read Volcanic Bel-

Oil was reported by McIntosh Reid (1923) on the west bank of Ray Creek at Nook, and at Stoodley in 1930. Two separate sightings of oil and gas (1920 and 1966) escaping from the bedrock of the Forth River about 2 km inland from the mouth have been reported - in 1920 and 1966. In 1966, Mr. C. Flowers of Ulverstone, described a tar exuding from a stretched pebble conglomerate (Precambrian) and provided a sample and photographs to the Department of Mines who did not investigate the occurence. Mr. J. Bates of Penguin, reported oil seeping at his property in 1968 and a Mr. L.F. Egan reported a similar occurrence at Burnie in 1962.

There are ten occurences reported from the far northwest. The first in 1915, was that of tar on the beach at Wynyard. Shows of oil have been reported since at Table Cape (1963), Fossil Bluff (1965), Flowerdale (1925) and Distillery Creek (1962). Three licences to search for oil were issued in the Inglis River. In 1956, Mr. B.A. Farquhar reported oil seeps at West Takone, and in 1921, Mr. N.J. Richardson reported oil seeping at his property at Cam Road, Somerset.

In 1921, a licence to search for oil was issued to F.W. Heritage on Precambrian rocks between the Interview and Lagoon Rivers. As far back as 1876, Mr. T.B. Moore, reported numerous tars on the beaches both north and south of Sandy Cape. Only Precambrian rocks, including some carbonates, occur on the rivers flowing to these beaches. At Green Point, (1962) and Redpa (1948) oil shows occurred in the Precambrian limestones and at Mt. Cameron in 1925, tar was reported seeping from the limestone. Constant reports of seeps at Mengha from 1930 are also near Precambrian limestone (dolomite).

In 1915, W.H. Twelvetrees reported on beach tars at King Island, presuming them to have been washed there. However, the Precambrian Granites on the foreshore presented petroleum seeping from the fractures which yields tars at the surface. This phenomenon was confirmed by the Department of National Development when Mr. S.P.J. Adams took samples to Canberra in 1960 after failing to elicit any interest from the Tasmanian Department of Mines. Two licences were issued to search for oil in 1960, one in his own name and one in his wife's name. Earlier in 1955 a Mrs. A.J. Smith held a licence to search and also offered to show the Mines Department the oozing tars. She stated her son would blast the rock to prove they were oozing and also sited seeps of tar inland along the Pass River. In that same period a licence to search for oil was issued to a Mr. W.K. Westley, in 1960. There are no records of what prompted his application.

8. NORTH EAST TASMANIA

The "oil rush" of 1930 was led by the Austral Oil Drilling Syndicate who cited abundant limestone and glauconite of Cape Barren and Flinders Island as excellent indicators of oil. Large lagoons burned for years when ignited after being drained; the corky substance present yielding 85 gallons per tonne of oil. Similar material was reported near Smithton and is thought to be derived by algal activity.

Mr. A.H. Thorpe has reported oil seeping to the surface in Muddy Creek, Bridport. He took up a licence to search but no evidence has been found to support his claim.

DISCUSSION AND CONCLUSION

Many sightings, or possible sightings, have often been considered due to oxide scums on water. Many of the above references could also be considered suspect or due to neighbourhood publicity. Map 1 shows, however, that there are non random relationships in the observations and not all can be called into question - if any. The distribution of unambiguous onshore sightings suggests that several source materials may be present; Geochemical work by Dr. J. Volkman of C.S.I.R.O., for Conga Oil Pty. Ltd. has already shown that Ordovician limestones source seepages in Tasmania. Geophysical-structural work by Leaman (1990) has confirmed that the necessary structural styles and sequences are present, but concealed, in this region.

Most of the trends evident in Map 1 can be recognised in the preliminary crustal interpretation of Leaman & Richardson (1990). The recognition of a close correlation, suggesting a need for further work, between presumed/actual sightings and basement-induced gravity and magnetic trends adds considerable credibility to the archival records.

The overall spread of records indicates that Late Precambrian dolomites may also be source rocks. It is clear, therefore, Tasmania does contain onshore petroleum sources and reservoirs.

Archival records also show that enterpreneurs, companies, visiting consultants and agents of the Federal Government have been actively discouraged in their efforts to explore. Many legal actions have resulted. Most problems can be assigned to a widely held not just a bureaucratic view that "there is no oil in Tasmania", very similar to that once held in Arabia. This view derives from a number of false assumptions, some of which have been alluded to in the main text, and which are only now being resolved by Conga Oil Pty. Ltd. with assistance from the Mines Department.

The original prospectors of New River (in 1915) deduced the importance of the oil seeps and tars, identified the Gordon Limestone source and correlated it to similar prolific oil-producing limestones in the United States. The discovery of oil and gas in limestones of Ordovician age on mainland Australia, mainly the Amadeus Basin, points to the increased validity of the play concept. Current evidence and historical data suggests that the lack of exploration work for oil and gas does not reflect upon the prospectivity of the Tasmanian Basin or absence of indications of petroleum, but on the false preconception of several generations of Tasmanian geologists.

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I would also like to thank Dr John Volkman for contributions through his precise geochemical work done at the C.S.I.R.O., Hobart.

I would also like to acknowledge myself as founder of Conga Oil Pty Ltd and father of the play concept now born.

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APPENDIX 1.

CHRONOLOGICAL LIST OF OIL SEEPS, LICENCES AND DRILL HOLES

Date	Place	Occurrence	Name
1871	Prime Seal Is.	Tar	Mr. Chas Gould
1876	Sandy Cape	Tar	T.B. Moore
1876	Mainwaring River	Tar	T.B. Moore
1876	Point Hibbs	Tar	T.B. Moore
1876	Farm Cove	Tar	T.B. Moore
1876	Cygnet	Oil	Robert Taylor
1889	Ross	Salt	Mr. Barwick
1893	Barn Bluff	Oil	A. Montgomery
1895	Port Davey	Tar	P. Hutchings
1896	Chudleigh	Tar	M. Pettard
1895	Macquarie Harbour	Tar	Sydney Explorer
1910	Deep Crk, Port Davey	Tar	Twelvetrees
1910	Hamilton (River Bank)	Tar*	Twelvetrees
1914	Hamilton	Oil	Walter Blackwell
1915	Nth. Bruny Island	Tar	Bruni Is. Oil Company
1915	New River	Lease	The Asphaltum Glance & Oil Syndicate
1915	Davey River	Tar	W.H. Twelvetrees
1915	New River	Lease	The Asphaltum Glance & Oil Syndicate
1915	New River	Tar, Oil	The Asphaltum Glance & Oil Syndicate
1915	New River	Lease	" " "
1915	Flinders Island	Tar*	W.H. Twelvetrees
1915	Three Hummock Is.	Tar	W.H. Twelvetrees
1915	Marrawalt	Tar*	W.H. Twelvetrees
1915	Cape Barren Is.	Tar	W.H. Twelvetrees
1915	Wynyard Beach	Tar	W.H. Twelvetrees
1915	King Island	Tar*	W.H. Twelvetrees
1915	Albina (20km Nth Pt. Hibbs)	Tar*	W.H. Twelvetrees
1915	Point Hibbs	Tar*	W.H. Twelvetrees
1915	Louisa Bay	Tar*	W.H. Twelvetrees
1915	New River	Tar*	W.H. Twelvetrees
1915	Rocky Boat Harbour	Tar*	W.H. Twelvetrees
1915	Surprise River Beach	Tar*	W.H. Twelvetrees
1915	South Cape Bay	Tar*	W.H. Twelvetrees
1915	New River	Tar*	W.H. Twelvetrees
1915	Recherche Bay	Oil	The Asphaltum Glance & Oil Syndicate
1916	North Bruny Is.	Drill Holes 1 - 7	Bruni Is. Oil Company
1916	Nth. Bruny Is.	Tar	Bruni Is. Oil Company
1917	Southport	Tar, Oil	Twelvetrees
1917	Arthur River	Tar	Twelvetrees
1917	Newstead	Oil	Twelvetrees
1917	Relbia - Evandale	Oil	Twelvetrees
1917	Longford	Oil	Twelvetrees
1918	Zeehan	Tar	Fredrick Chapman
1918	Nth. Bruny Is.	L.S.	W.H.T. Brown
1918	Nth Bruny Is.	L.S.	R.J.P. Davey
1919	Barn Bluff	Tar	A. McIntosh Reid
1919	Elderslie	L.S.	S. Chapman
1920	Spring Bay	Oil	Mr. Fielder
1920	Hamilton 'Lawrenny'.	Drill 1	C.A. Brock

1920	Sth. Bruny Is.	L.S.	C.C. Brown
1920	Davey River	L.S.	M.J. Donellan, C. Smith & J. Jones.
1920	Forth River	Oil	E. Eastall, G. Richardson & A.Stocks
1920	Barn Bluff	L.S.	C.C. Manton & A.C. Black
1920	Barn Bluff	L.S.	A.C.D. Barneceli
1920	Barn Bluff	L.S.	P. Evans
1920	Cradle Mountain	L.S.	The Granville Prospecting & Mining Co.
1920	Mt. Olympus	L.S.	L.G. Thompson
1920	Narcissus River	L.S.	L.M. Stackhouse
1920	Sth. Bruny Is.	L.S.	S. Perry
1920	Barn Bluff	L.S.	W. Mudie
1920	Barn Bluff	L.S.	A.L. Nichols
1920	Mt. Achilles	L.S.	C.C. Reilly
1920	Barn Bluff	L.S.	E. Hawson
1920	Lake St. Clair	L.S.	T. McDonald
1920	Davey River	L.S.	W.T.A. Cleveland
1921	Sth. Bruny Is.	Oil	V.A. Chipman
1921	Sth. Bruny Is.	L.S.	S Perry
1921	Sth. Bruny Is.	L.S.	C.C. Brown
1921	Sth. Bruny Is.	Oil	J.L. Frizoni
1921	Nth. Bruny Is.	Oil	H. Thomas
1921	Nth. Bruny Is.	Oil	E. Thomas
1921	Sth. Bruny Is.	Oil	J.L. Frizoni
1921	Somerset. Cam Rd.	Oil	M.J. Richardson
1921	Between Lagoon & Interview River	Tar, L.S.	F.W. Heritage
1921	Douglas River	L.S.	H.G.R. McWilliams
1921	Mt. Pelion	L.S.	L.W. Mudie
1921	Mt. Pelion	L.S.	J. West
1921	Mt. Pelion	L.S.	J.T. Moate
1921	Mt. Pelion	L.S.	T.B. Harrington
1921	Mt. Pelion	L.S.	J.N. Duncan
1921	Mt. Pelion	L.S.	A.W. Duncan
1921	Mt. Pelion	L.S.	A.L. Kirkham
1921	Mt. Pelion	L.S.	R.P. Kirkham
1921	Mt. Pelion	L.S.	R.H. Nicholson
1921	Barn Bluff	L.S.	A.J. Forester
1921	Mt. Pelion	L.S.	Jean MacKenzie
1921	Mt. Pelion	L.S.	F.W. James
1921	Mt. Pelion	L.S.	M.B.C. Kirkham
1921	Mt. Pelion	L.S.	E.L. Potter
1921	Mt. Pelion	L.S.	A. Baker
1921	Mt. Pelion	L.S.	Stella Moate
1921	Mt. Pelion	L.S.	T.B. Harrington
1921	Mt. Pelion	L.S.	L.M. Beckwith
1921	Mt. Pelion	L.S.	R. Duncan
1921	Barn Bluff	L.S.	Lena Mofflin
1921	Mt. Pelion	L.S.	E.J. Stott
1921	Barn Bluff	L.S.	R.A. Mofflin
1921	Mt. Pelion	L.S.	C.H. Augas
1921	Barn Bluff	L.S.	G.B. McCutcheon
1921	Barn Bluff	Lease	R.J. McCutcheon
1921	Mt. Pelion	L.S.	C. Adams
1921	Mt. Pelion	L.S.	S.C. Hocking
1921	Mt. Pelion	L.S.	R. Sharples
1921	Mt. Pelion	L.S.	F.W. Reid
1921	Dulverton	L.S.	E. Morse
1921	Railton	L.S.	[illegible]
1921	[illegible]		

1921	Sth. Bruny Is.	L.S.	V.A. Chipman
1921	Sth. Bruny Is.	L.S.	C.C. Brown
1921	Barn Bluff	L.S.	C. Simson Hope
1921	Barn Bluff	L.S.	A.W. Craig
1921	Barn Bluff	L.S.	H.B. Denniston
1921	Adventure Bay	L.S.	J.L. Frizoni
1921	Sth. Bruny Is.	L.S.	J.L. Frizoni
1921	Nth. Bruny Is.	L.S.	H. Thomas
1921	Nth. Bruny Is.	L.S.	E. Mathias
1921	Rosevale	Oil	Loftus Hills
1921	Barn Bluff	Oil & Gas	Mr Black, Field Manager- Consulting geologist confirming seeps.
1922	Inglis River	L.S.	J.A. Wauchope
1922	Inglis River	L.S.	J.A. Wauchope
1922	Inglis River	L.S.	J.A. Wauchope
1922	Mersey	L.S.	G.D. Mendall
1922	Jericho	Oil	R. White
1922	Sth. Bruny Is.	L.S.	W.T. Rope
1922	Davey River	L.S.	W.C. Hart
1922	Davey River	Tar	W.T.A. Cleveland
1922	Kermode	L.S.	The Mersey Valley Oil Co.
1922	Latrobe	Drill No. 1	The Mersey Valley Oil Co.
1922	Railton	Drill No. 1	(Adelaide Oil Exploration Company.)
1922	Barn Bluff	Drill	
1922	Latrobe	Drill No. 2	The Mersey Valley Oil Co.
1922	Latrobe	Drill No. 3	The Mersey Valley Oil Co.
1922	Latrobe	Drill No. 4	The Mersey Valley Oil Co.
1922	Latrobe	Drill No. 5	The Mersey Valley Oil Co.
1922	Latrobe	Drill No. 6	The Mersey Valley Oil Co.
1922	Latrobe	Drill No. 7	The Mersey Valley Oil Co.
1922	Latrobe	Drill No. 8	The Mersey Valley Oil Co.
1922	Latrobe	Drill No. 9	The Mersey Valley Oil Co.
1922	Latrobe	Drill No. 2	Adelaide Oil Exploration Company.
1922	Latrobe	Drill No. 3	Adelaide Oil Exploration Company.
1922	Latrobe	Drill No. 4	Adelaide Oil Exploration Company.
1922	Latrobe	Drill No. 5	Adelaide Oil Exploration Company.
1922	Latrobe	Drill No. 6	Adelaide Oil Exploration Company.
1922	Latrobe	Drill No. 7	Adelaide Oil Exploration Company.
1922	Latrobe	Drill No. 8	Adelaide Oil Exploration Company.
1922	Latrobe	Drill No. 9	Adelaide Oil Exploration Company.
1922	Latrobe	Drill No.10	Adelaide Oil Exploration

1922	Latrobe	Drill No.11	Adelaide Oil Exploration Company.
1922	Latrobe	Drill No.12	Adelaide Oil Exploration Company.
1923	Rockliffes Farm	Oil & Gas	A. McIntosh Reid
1923	Roches Farm	Oil & Gas	A. McIntosh Reid
1923	Harford	L.S.	W.B. Cocker
1923	Burgess	L.S.	J.A. Wauchope
1923	Mersey	L.S.	D.M.C. Griffin
1923	Port Sorell	L.S.	R.C. Grubb
1923	Port Sorell	L.S.	G.N. Levy & A. Brown
1923	Port Sorrell	L.S.	J.D. Johnstone
1923	Port Sorell	L.S.	E. Baker
1923	Franklin Rivulet	L.S.	L.J. Douglas
1923	Burgess	L.S.	F.M. McDonald
1923	Burgess	L.S.	E.J. McDonald
1923	Port Sorell	L.S.	J.H. Addison
1923	Burgess	L.S.	H.D. Green
1923	Port Sorell	L.S.	R.W. MacKenzie
1923	Barn Bluff	L.S.	G.R. Plante
1923	Barn Bluff	L.S.	L. Mudie
1923	Barn Bluff	L.S.	E.E. Black
1923	Barn Bluff	L.S.	R. Stoneham
1923	Little Henty River	Tar	S.A. Clark
1923	Strahan	L.S.	H.E. Evenden
1923	Strahan	L.S.	The Mersey Valley Oil Co.
1924	New River	L.S.	F.T. Boddy
1924	New River	L.S.	E. Hawson
1924	New River	L.S.	F. Heritage
1924	Henty River	L.S.	J.A. Wauchope
1924	Barn Bluff	L.S.	B.H. Edwards
1924	Barn Bluff	L.S.	B.D. Reynolds
1925	New River	L.S.	E.F. Heritage
1925	New River	L.S.	H.E. Everden
1925	Flowerdale	L.S.	D. Berechree
1925	Mt. Cameron	Tar	T.F. Ford
1926	Barn Bluff	L.S. Oil	C.S. Hope
1928	Nth. Bruny Is.	L.S.	H.M. Boddy
1928	King Island	L.S. Tar	O. Bonney
1928	Nth. Bruny Is.	L.S. Oil	C.F. Boddy
1928	Nth. Bruny Is.	L.S.	A.C. Black
1928	Nth. Bruny Is.	L.S.	M. Hayton
1928	Sth. Bruny Is.	L.S.	A.H. Jackson
1929	North Bruny Is.	Drill 1.	Tasmanian Oil Co.
1929	North Bruny Is.	L.S.	A.J. Miller
1929	No rth Bruny Is.	Drill 2	Tasmanian Oil Co.
1929	Great Bay, Nth. Bruny Is.	Oil & Gas	A. McIntosh Reid
1929	North Bruny Is.	Drill 3	Tasmanian Oil Co.
1929	North Bruny Is.	Oil, Tar & Gas	Tasmanian Oil Co.
1929	Sth Bruny Is.	Oil	(Sgd) L.W. Marsden
1929	Henty River	Gas	J.H. Robertson
1930	Nth. Bruny Is.	L.S.	J. McD. Hay
1930	King Island	L.S.	L. Gatenby
1930	Stoodley	Oil	A. Wright
1930	Mengah	Oil	J. Healy
1931	Cradoc	Oil	W.J. Armstrong
1931	Leprena	Oil (Kerosene)	G.H. Smith
1933	Dover	Oil	Lloyd J. Owens
[illegible]	[illegible]		

1936	Flinders Is.	L.S.	A.A. Summerhayes
1936	Flinders Is.	L.S.	Austral Oil Drilling Syndicate
1936	Flinders Is.	L.S.	C.S. Demaine
1936	Flinders Is.	L.S.	A.W. Imray
1939	Cygnet	Oil	R. Taylor
1939	Cradoc	Oil & Gas	Producers Oilwell Supplies Ltd.
1939	Danbury Park	Drill 1	Producers Oilwell Supplies Ltd.
1939	Ross	Gas	C. Davis
1940	South Arm	Oil	E.Z. Company
1940	Port Davey	L.S. tar	H.E. Evendon
1941	Tunnack	Oil	A. Mackie
1942	Ocean Beach, Strahan	Tar	Mr W. Holmes
1944	Bridport	Oil	A.H. Thorpe
1945	Flinders Island	Oil	W. Carry
1946	Tarraleah	Gas	G. Harris
1948	Redpa	Oil	C. Burt Senr.
1952	Cambridge	Oil	P.W. Evans
1953	Cygnet	Oil	R. Dunning
1953	Strahan	Oil, Tar	H. Fletcher
1955	Prion Beach	Tar	H. Akerley
1955	King Island	L.S.	Mrs. A.J. Smith
1956	Arthur River	L.S.	R.K. Cumming
1956	West Takone	L.S.	B.A. Farquhar
1956	King Island	Tar	Mrs. A.J. Smith
1956	Mole Creek	Oil	Eva Marchant
1957	Dover	Oil, Gas	E.A. Haigh
1958	Tinderbox	Oil	Mrs. Wilkinson
1958	Hamilton	Oil	T.B. Gulline
1960	Crabtree	Oil	Unknown
1960	Port Sorell	Gas	C. Sulzberger
1960	King Island	L.S.	Mr. S.P.J. Adams
1960	Marrawah	Tar **	F.W. Ford
1960	King Island	L.S.	F.J. Adams
1960	King Island	L.S.	W.K. Westly
1960	Central Highlands	Oil	K. Slater
1960	Detention River	Oil	C.R. Pyke
1962	Jericho	Oil	R. White
1962	Bridgenorth	Oil	W. Rattray
1962	Marrawah	Oil	C.K. Hine
1962	Burnie	Oil	L.F. Egan
1962	Distillery Creek, Wynyard	Oil	J. Carol
1963	Table Cape	Oil, Gas	Mr. Jackson
1965	S.E. Tasmania	Lease	E.Z. Company
1965	Fossil Bluff	Oil	S. Veenstra
1965	Ulverstone	Tar	Mr. C. Flowers
1966	Forth River	Gas	H.E. Flight
1966	Hagley	Drill 1 + Lease	C. Sulzberger
1966	Hagley	Drill 2 + Lease	C. Sulzberger
1968	Cressy	Drill 3 + Lease	C. Sulzberger
1968	Penguin	Oil	J. Bates
1969	Hagley	Oil	C. Sulzberger
1980	S.E. Tasmania	Oil Lease	B.H.P.
1984	Ross	Oil	G. & G. Gleeson
1986	Glenlusk	Oil	Unknown
1986	North Bruny Is.	Oil, Gas	Conga Oil Pty. Ltd.
1987	Ida Bay	Tar	R. Bender

1987 North Bruny Is.		Oil, Gas	C.S.I.R.O.
1987 Queenstown		Tar	Conga Oil Pty. Ltd.
1987 South Bruny Is., Cole Pt.		Oil	A. Farmer
1988 Spring Beach, South Arm		Oil	Mr. Morris Potter
1989 Cape Pillar		Oil	R. Billingham (Mines Dept.)
1989 South Bruny Is.		Tar	Steve Forsyth (Mines Dept)
1989 Brighton		Tar	C. Wallis
1989 Dysart		Tar	D. Green (Mines Dept.)
1989 Beaconsfield		Oil	Mine Geologist
1989 Colebrook		Tar	C. Wallis

Tars marked * , ** represent occurences where samples exist in museum collections; Queen Victoria and Tasmanian Museum respectively. G.C.M.S. analysis of these tars have conclusively proved they originated from an Ordovician source. (Dr. J. Volkman, C.S.I.R.O., 1990)

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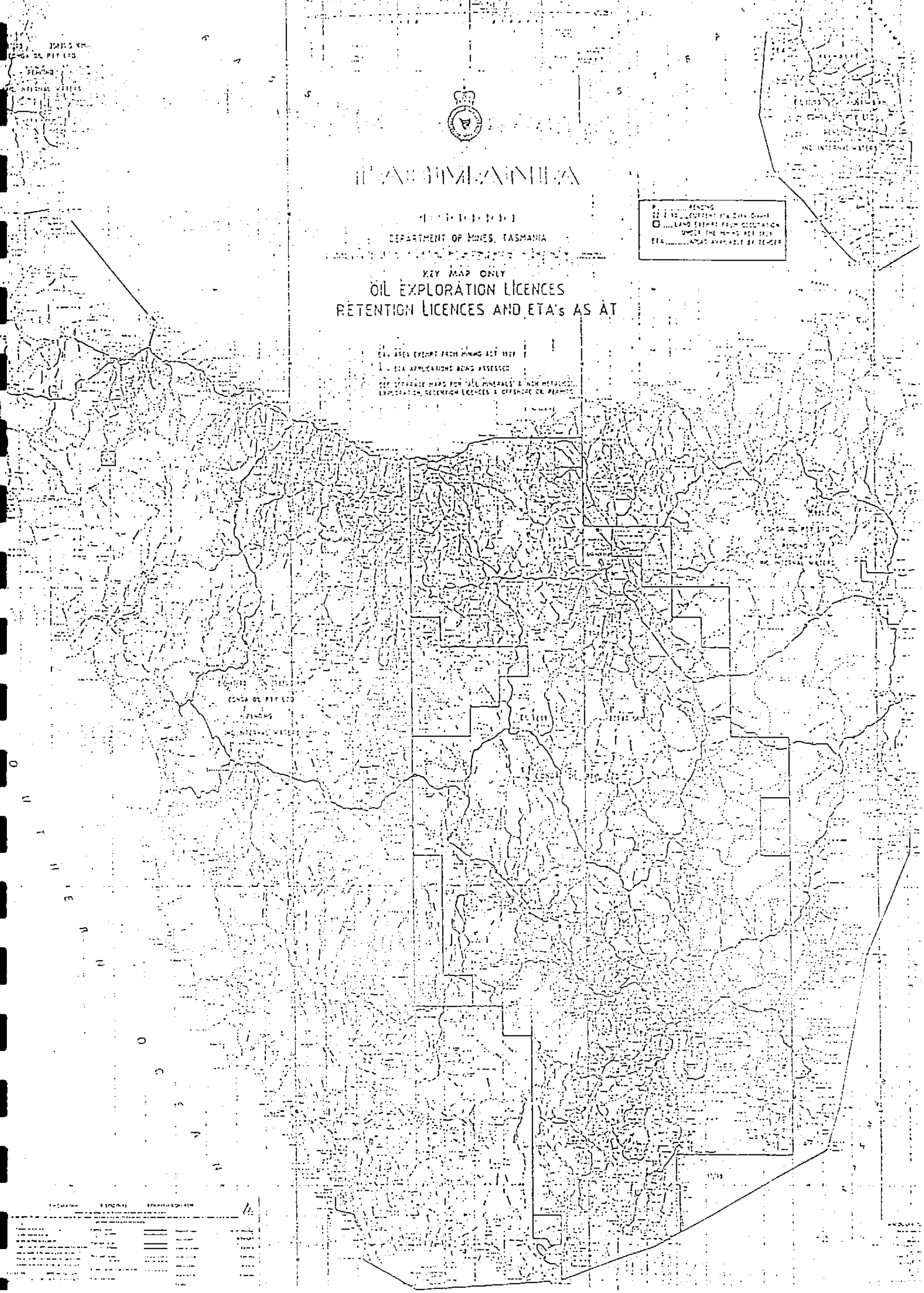
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RECENT DEVELOPMENTS IN EXPLORATION FOR OIL IN TASMANIA

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ABSTRACT

Recent work on oil seeps, organic geochemistry, geophysics, structural geology and palaeontology suggests that there is considerable potential for onshore petroleum in Tasmania.

Archival research has shown that hydrocarbon seeps were commonly reported in the first half of this century and that wildcats produced gas (at Port Sorell in the north) and oil (at Johnson's Well on Bruny Island, in the south). Almost all of the 270 historical hydrocarbon occurrences lie on lineaments revealed independently by gravity and magnetic surveys. The thermal maturity of conodonts from Ordovician and Siluro-Devonian carbonates suggests that much of the pre-Upper Carboniferous beneath the Tabberabberan unconformity is within the oil and gas windows.

Organic geochemistry reveals a very close similarity between hydrocarbons from Ordovician limestones, those from the drill site at Bruny Island and with tar samples from the Tasmanian coast, but little similarity with the Permian Tasmanite Oil Shale, or with the Gippsland crudes and botryococcane-rich South Australian bitumens. The predominance of C_{27} steranes in Tasmanian bitumens suggests a widespread algal source and the abundant diasteranes imply a clay or silt-rich source that extends across much of Tasmania.

Recent geophysical and structural work suggests that a thin skinned interpretation of Tasmania's structure is reasonable. Most sightings of hydrocarbons are associated with either faults or fractures which have post-Jurassic displacements or with intersections of major high angle faults with thrusts. The delineation of reservoirs within the thrust sheets is a priority.

INTRODUCTION

Onshore Tasmania has been considered unprospective for hydrocarbons for over 50 years. This view has resulted from misunderstandings or ignorance about the nature and origin of the many occurrences of hydrocarbons previously recorded. Oil shales of Permian age have long been known in Tasmania and some production (by retorting) has been derived from them.

The numerous records of seepage or tar sightings from the period 1880–1935 were generally ascribed to an oil shale source. The absence of serious exploration in recent times has led to general ignorance of the existence of these records. Modern maps of Australian basins refer to the 'Tasmanian Basin' when considering Tasmania. This is taken to mean the Late Carboniferous–Triassic deposition presumed to overlie economic basement (Fig. 1).

Consequently, if it is assumed that any hydrocarbons present were derived from Permian oil shale then no reliable seals or traps of any magnitude are likely to exist, due to disruption of the post-Carboniferous sequences by faulting and intrusion and an absence of closed structures. An unprospective environment is a valid conclusion based on these assumptions.

Many pre-war observers did not have this view since many seepage sites are far removed from Permian rocks and several occur in Precambrian quartzite (Port Davey) or Precambrian granite (King Island) (Figs 2 & 3). Many are directly associated with or occur near Ordovician carbonates. They could not, therefore, offer a credible explanation for these occurrences.

The lack of exploration activity since 1939 may be contrasted with that of the previous 50 years when many companies were floated. All were based on effusive oil or tar seepages. Some accumulations were large; sufficient to fill the hold of a coastal cargo vessel (from Port Davey). Few drilling proposals were converted into action but several attempts were made to drill at Port Sorell and Bruny Island. The maximum depth of any such hole was about 400 m but gas was recorded in one well at Port Sorell and oil was recovered in small quantities from another at Bruny Island.

This paper presents information assembled during the last 10 years, and especially the last three years. It suggests that the faith of the early explorers was justified and that the perceptions of the last 50 years have been wrong. Hydrocarbon occurrences have been verified, are widespread and are associated with seismic activity. The chemistry of the seep hydrocarbons is not consistent with Permian oil shale derivation but is indicative of lower

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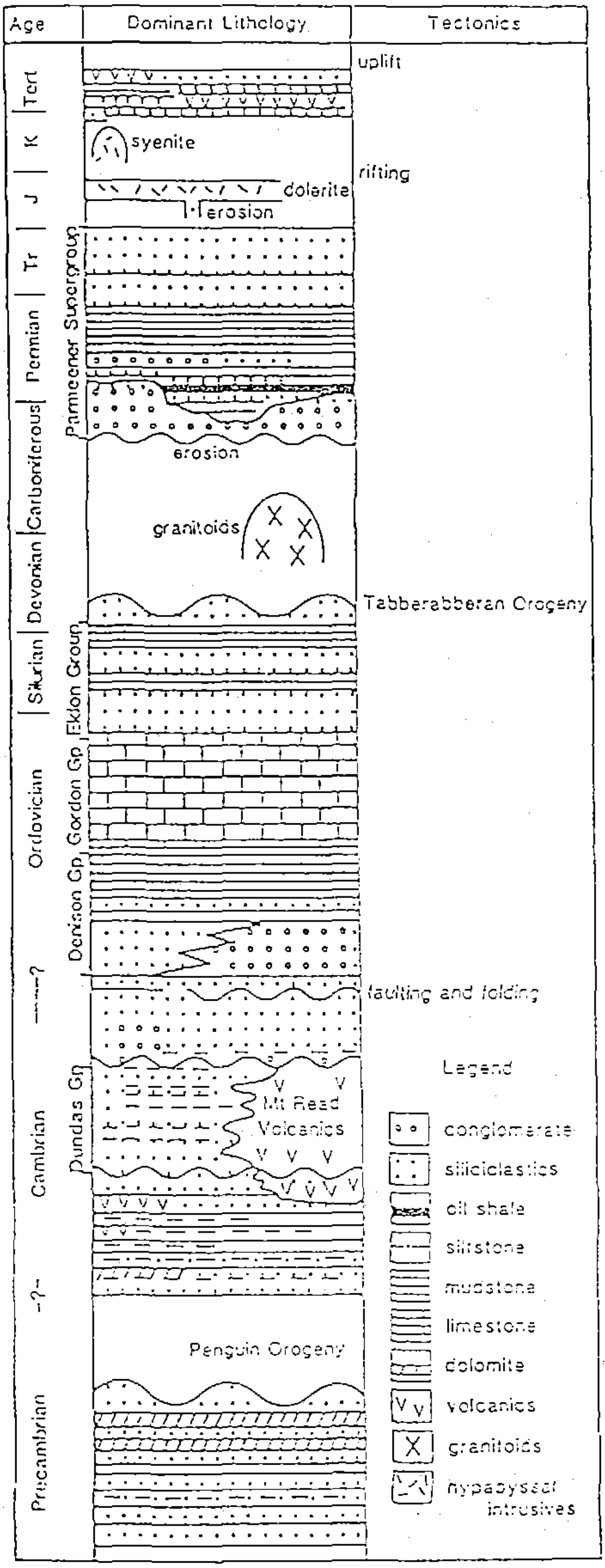

Figure 1. Highly generalised geological column for Tasmania.

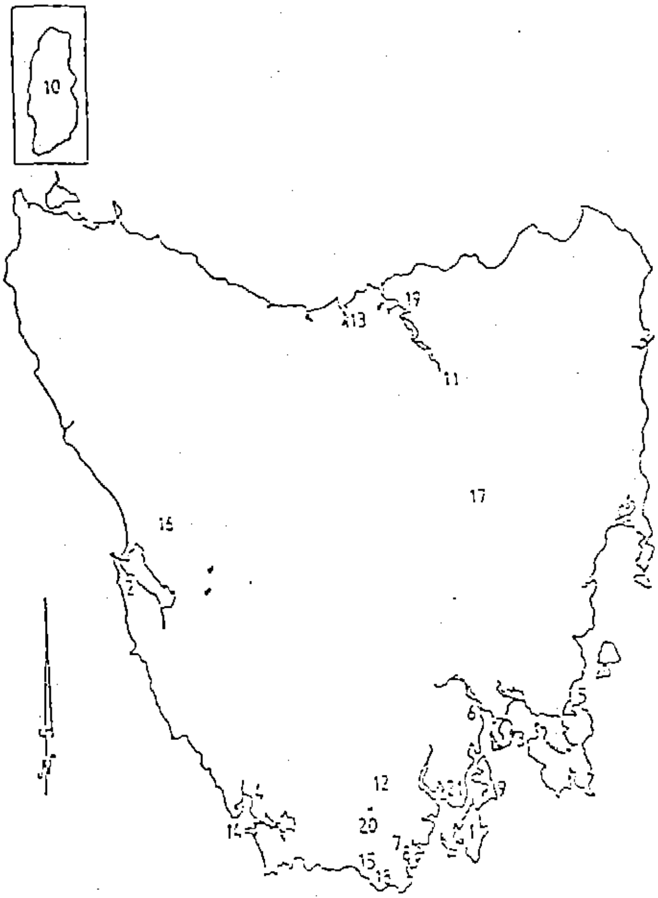

Figure 2. Locality map. 1–Bruny Island, 2–Cape Sorell, 3–Clifton Beach, 4–Deep Creek, 5–Dunalley, 6–Hobart, 7–Hastings, 8–Ida Bay, 9–Johnson's Well, 10–King Island, 11–Launceston, 12–Picton River, 13–Port Sorell, 14–Port Davey, 15–Precipitous Bluff, 16–Queenstown, 17–Ross, 18–Surprise Bay, 19–Tamar River, 20–Vanishing Falls, 21–Woodbridge.

Palaeozoic source rocks. This knowledge, when coupled with a revised structural view of Tasmania, transforms prospectivity assessments.

GEOLOGICAL HISTORY

A full and recent account of the geology of Tasmania may be found in Burrett and Martin (1989). The oldest rocks in Tasmania (Fig. 1) are Proterozoic quartzites, phyllites and dolomites which crop out extensively in the central and northwestern parts of the island. After the Penguin Orogeny at 750 Ma these were unconformably overlain by shallow marine quartz sandstones and dolomites and then by marine turbidites, mudstones and basalts in the late Proterozoic or early Cambrian. A mineral-rich island arc (Mt Read Volcanics)-back arc basin (Dundas Group) complex formed in the middle to late Cambrian and was unconformably overlain by turbidites and volcanoclastics in the latest Cambrian. These mainly marine sediments were successively overlain in the Ordovician by fanglomerates (Owen Conglomerate and correlates), by shallow marine sandstones (Moina Sandstone and correlates), by subtidal siltstones and mudstones (Florentine Valley Mudstone and correlates) and by a thick succession of tropical carbonates (Gordon Group). The Gordon Group carbonates are up to 1.5 km thick in central Tasmania and are dominantly micritic. Dolomitisation is common. In the south there is a transition southwards from shallow marine conditions near Vanishing Falls, to platform margin buildups at Precipitous Bluff, to deep (> 200 m) water carbonate turbidite-graptolitic shale environments at Surprise Bay (Burrett et al., 1981, 1983, 1984). The Gordon Group carbonates were conformably overlain by the dominantly marine siliciclastics of the Late Ordovician–Early Devonian Eldon Group. In the eastern third of the state, Ordovician–Devonian sediments consist of graptolitic basinal turbidites (Mathinna Beds).

The Tabberabberan Orogeny in the Early Devonian created a fold–thrust belt producing approximately north-south trending folds in most areas but with east-west trending folds in the north-west of the state. Numerous and extensive granitoids were intruded between 395 and 320 Ma. Regional metamorphism gave rise to the pattern of conodont CAI (Colour Alteration Index) isograds shown in Figure 3, with heating of the lower Palaeozoics to 300°C in the west and north-west and much lower temperatures (150°C) in central and southern Tasmania (Burrett, in press). In the Late Carboniferous–Permian, a sequence of glaciterrestrial and glacimarine predominantly siliciclastics (lower Parmeener Supergroup) were deposited unconformably on the older rocks and were succeeded conformably by Triassic terrestrial sandstones of the upper Parmeener Supergroup. Coals are present in both divisions of the Parmeener and the famous Tasmanite Oil Shale occurs just above the basal tillite of the supergroup.

Extensive, thick (often 500 m) sills of dolerite fed by narrow feeder dykes were intruded in the Middle Jurassic and presently outcrop over about half of the state. Although the dolerite is voluminous, metamorphism appears to be restricted to the immediate vicinity of the sheets. Minor local syenites were intruded in the Cretaceous but regional heating was sufficient to reset the Palaeozoic palaeomagnetism. North to northwesterly-trending horsts and graben were produced in a general extensional environment in the Late Cretaceous to Early Tertiary and the graben were filled with up to 1 km of mainly terrestrial sediments. Many Tertiary volcanic centres are present onshore.

SEEP DISTRIBUTION AND ORGANIC GEOCHEMISTRY

SEEPS

The distribution pattern and historical background of seeps are summarised by Bendall (1990). The distinctive NW/SE, NE/SW seep trends (Fig. 3) transect all rock types, strongly suggesting that deep crustal lineaments are still active. Seepages have been mainly reported directly after major quakes. The records of oil shows from archival research include reports from 35 drill holes, 127 oil leases and 120 other signs of either tar, oil or gas. The discovery of samples of some of the tars in Launceston's museum, along with archived photographs, confirms the validity of the old records. Geochemical confirmation of hydrocarbons around the 1929 Bruny Island drill hole, current gas seeps at that site and wet gas recently found at Dunalley are all on lineaments and suggest the validity of other unconfirmed sightings on those lineaments. Many companies were formed to exploit the potential that the seeps indicated (Bendall, 1990). Of these companies only two produced shows of hydrocarbons both of which were confirmed by government geologists, as were many of the historical reports of tars and seeps.

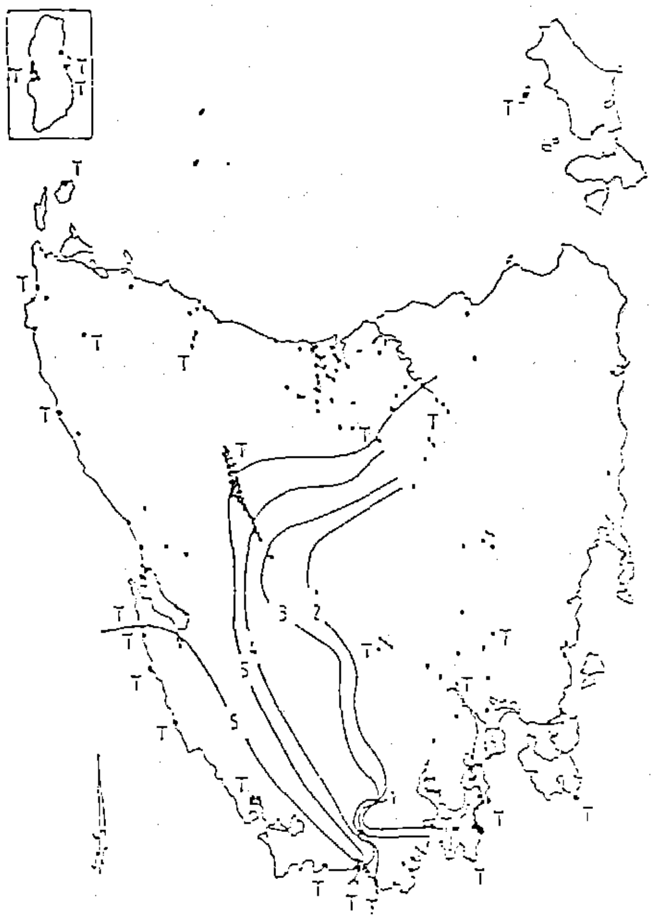

Figure 3. Seep distribution in Tasmania from Bendall (1990). T = tars. Contour lines are isograds based on conodont Colour Alteration Indices (CAI) from Burrett (in press). CAI 5 = 300°C and CAI 1 = 100°C.

ORGANIC GEOCHEMISTRY

Methods

Sediment from the site of the 1929 drilling at Johnson's Well on Bruny Island was extracted using hexane with ultrasonication. Solvents of greater polarity were not used due to the high concentrations of naturally occurring polar lipids. The limestone sample from Ida Bay in southern Tasmania was crushed and then a portion was extracted using chloroform-methanol with ultrasonication. The bitumen from Port Davey in western Tasmania was extracted directly with chloroform, which dissolved the entire sample. Portions of each extract were analysed by Iatroscan thin-layer chromatography-flame ionisation detection (Volkman et al., 1986) to determine the total hydrocarbons.

Saturated and aromatic hydrocarbons were isolated by applying a portion of the extract to a column of silicic acid capped with activated alumina. Aliphatic hydrocarbons were eluted with hexane and a second fraction containing aromatic hydrocarbons was obtained by eluting with toluene:hexane. Resins and asphaltenes were eluted with chloroform and methanol.

Each hydrocarbon fraction was analysed by capillary gas chromatography on a non-polar methyl silicone fused silica capillary column to determine the distribution of straight-chain and isoprenoid alkanes. These fractions were then analysed by gas chromatography-mass spectrometry (GC-MS) in selected ion monitoring mode (SIM) (Volkman et al., 1988). Ion chromatograms for ions m/z 217 and 218 (steranes), m/z 259 (diasteranes), m/z 231 (methyl steranes), m/z 191 (hopanes and other triterpanes), m/z 177 (demethylated hopanes), m/z 205 (methyl hopanes) plus some molecular ions were acquired.

Results

Geochemical analyses of two soil samples from Johnson's Well were undertaken. These revealed small amounts of hydrocarbons (about 400 ng/g) which were dominated by n-alkanes of plant origin, plus the common petroleum constituents pristane and phytane (ratio 2.1). GC-MS fingerprinting conclusively demonstrates the presence of trace amounts of petroleum hydrocarbon biomarkers including steranes and diasteranes (Fig. 4) and hopanes (Fig. 5). Trace amounts of petroleum-derived hydrocarbons were also detected in a few water and sediment samples from elsewhere on the island, but the amounts were generally too low for detailed fingerprinting studies. The low concentrations of petroleum-derived hydrocarbons at Johnson's Well indicated that petroleum seeps are no longer active at this site but provided some evidence for their former presence.

A limited organic geochemical study of the hydrocarbons in Ordovician limestones from Ida Bay in southern Tasmania and Queenstown in the west was undertaken. One sample from Queenstown was of interest as it appeared to contain flecks of asphaltic material. These rocks contained low amounts of hydrocarbons (2.9 mg/g at Ida Bay and 0.8 and 1.2 mg/g at Queenstown), but the distributions were typical of those found in mature petroleum. Although sediments from the Queenstown area have much higher conodont CAIs (Fig. 3), which suggest a higher thermal maturity, the biomarker maturity parameters in samples from the two regions are remarkably similar.

The sterane distributions in the limestones show many similarities to those in the Johnson's Well soil sample. In particular, the ratios of C_{27}:C_{28}:C_{29} steranes, which is a useful source input parameter (Mackenzie, 1984), are almost

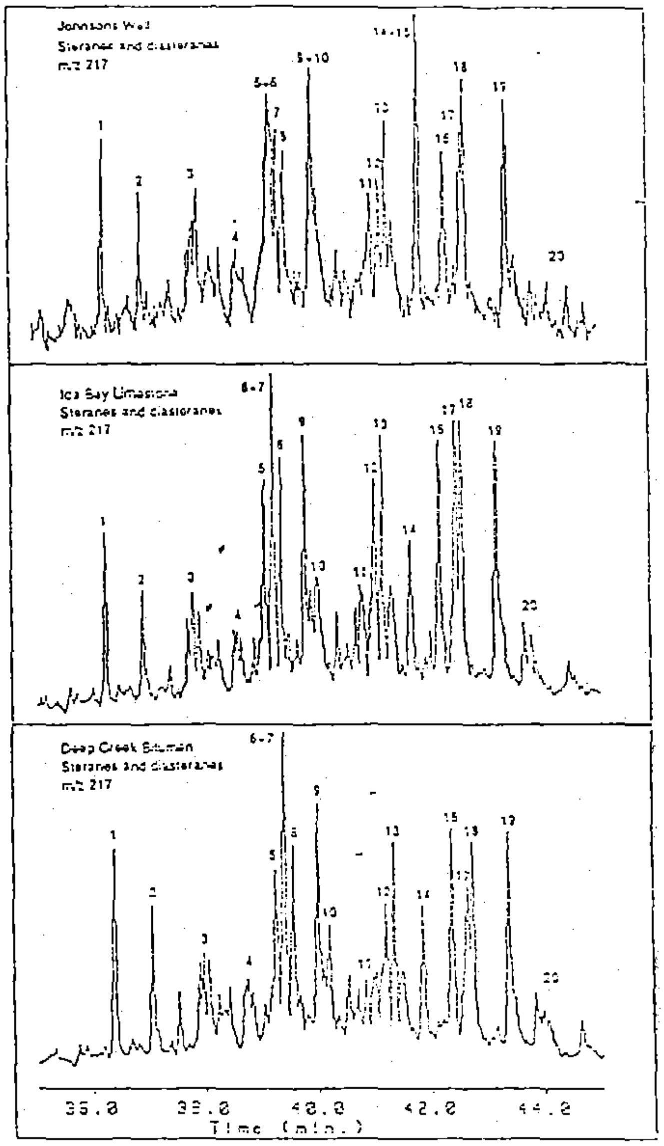

Figure 4. Mass fragmentograms for m/z 217 showing distributions of C_{27}–C_{30} steranes and diasteranes in (a) soil from Johnson's Well on Bruny Island, (b) Ordovician carbonate from Ida Bay and (c) tar from the mouth of Deep Creek near Port Davey on the west coast of Tasmania. Compound identifications are from peaks in m/z 217 mass fragmentograms.

Peak		Steranes and Diasteranes
1	C_{27}	(20S)-13β(H),17α(H)-diasterane
2	C_{27}	(20R)-13β(H),17α(H)-diasterane
3	C_{28}	(20S)-13β(H),17α(H)-diasterane
4	C_{28}	(20R)-13β(H),17α(H)-diasterane
5	C_{27}	(20S)-5α(H),14α(H),17α(H)-cholestane
6	C_{29}	(20S)-13β(H),17α(H)-diasterane
7	C_{27}	(20R)-5α(H),14β(H),17β(H)-cholestane
8	C_{27}	(20S)-5α(H),14β(H),17β(H)-cholestane
9	C_{27}	(20R)-5α(H),14α(H),17α(H)-cholestane
10	C_{29}	(20R)-13β(H),17α(H)-diasterane
11	C_{28}	(20S)-5α(H),14α(H),17α(H)-24-methylcholestane
12	C_{28}	(20R)-5α(H),14β(H),17β(H)-24-methylcholestane
13	C_{28}	(20S)-5α(H),14β(H),17β(H)-24-methylcholestane

14	C_{28}	(20R)-5α(H),14α(H),17α(H)-24-methylcholestane
15		Unknown
16	C_{29}	(20S)-5α(H),14α(H),17α(H)-24-ethylcholestane
17	C_{29}	(20R)-5α(H),14β(H),17β(H)-24-ethylcholestane
18	C_{29}	(20S)-5α(H),14β(H),17β(H)-24-ethylcholestane
19	C_{29}	(20R)-5α(H),14α(H),17α(H)-24-ethylcholestane
20	C_{30}	24-propylcholestanes

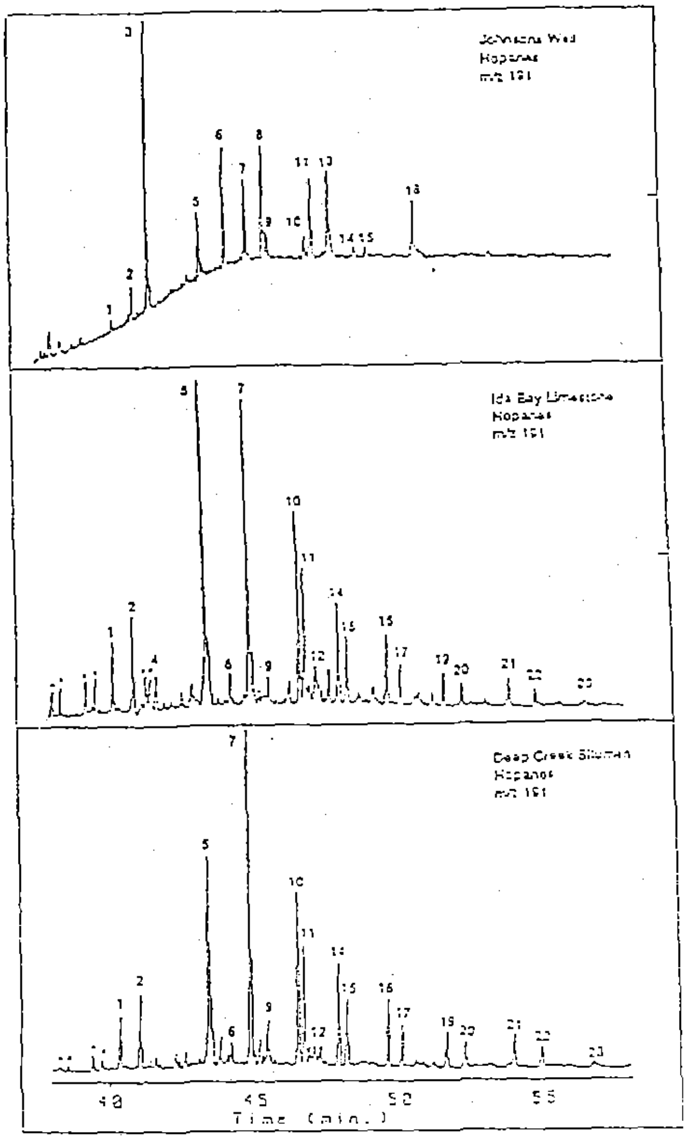

Figure 5. Mass fragmentograms for m/z 191 showing distributions of C_{27}–C_{36} hopanes in (a) soil from Johnson's Well on Bruny Island, (b) Ordovician carbonate from Ida Bay and (c) tar from the mouth of Deep Creek on the west coast of Tasmania. Tricyclic alkanes are denoted by *. The baseline rise in mass fragmentogram (a) is due to a contribution of the m/z 191 ion from column bleed. Identifications of peaks in hopane (m/z 191) and methyl hopane (m/z 205) mass fragmentograms:

Peak		Hopane
1	C_{27}	18α(H)-22,29,30-trisnorneohopane (Ts)
2	C_{27}	17α(H)-22,29,30-trisnorhopane (Tm)
3	C_{27}	17β(H)-22,29,30-trisnorhopane
4	C_{28}	17α(H),21β(H)-29,30-bisnorhopane
5	C_{29}	17α(H),21β(H)-30-norhopane
6	C_{29}	17β(H),21α(H)-30-normoretane
7	C_{30}	17α(H),21β(H)-hopane
8	C_{29}	17β(H),21β(H)-30-norhopane
9	C_{30}	17β(H),21α(H)-moretane
10	C_{31}	(22S)-17α(H),21β(H)-homohopane
11	C_{31}	(22R)-17α(H),21β(H)-homohopane
12	C_{31}	(22R+S)-17β(H),21α(H)-homomoretane
13	C_{30}	17β(H),21β(H)-hopane
14	C_{32}	(22S)-17α(H),21β(H)-bishomohopane
15	C_{32}	(22R)-17α(H),21β(H)-bishomohopane
16	C_{33}	(22S)-17α(H),21β(H)-trishomohopane
17	C_{33}	(22R)-17α(H),21β(H)-trishomohopane
18	C_{31}	(22R)-17β(H),21β(H)-homohopane
19	C_{34}	(22S)-17α(H),21β(H)-tetrakishomohopane
20	C_{34}	(22R)-17α(H),21β(H)-tetrakishomohopane
21	C_{35}	(22S)-17α(H),21β(H)-pentakishomohopane
22	C_{35}	(22R)-17α(H),21β(H)-pentakishomohopane
23	C_{36}	(22S)-17α(H),21β(H)-hexakishomohopane

identical. Similar ratios have been found in carbonate-derived oil from the Middle East, and from Ordovician sediments from mainland Australia (Hoffmann et al., 1987). However, this ratio is very different from those found in oils presently recovered from the Gippsland Basin which show a strong predominance of C_{29} steranes. The presence of similar amounts and proportions of rearranged steranes (diasteranes) is also of interest since these compounds are usually of very low abundance in pure carbonates.

In 1990, 15 samples of bitumens collected early this century from coastal sites were obtained from Tasmanian museums for geochemical analysis. Many of these samples are mentioned in an early report on petroleum exploration in Tasmania (Twelvetrees, 1917). All the samples are black, shiny asphaltic bitumens which show a characteristic conchoidal fracture and an aromatic odour when broken. They contain no inorganic matter and dissolve completely in chloroform.

Aliphatic hydrocarbons represented 13.2–15.0 per cent of the total extract of the bitumens, aromatic hydrocarbons 3.9–6.7 per cent, with the remainder consisting of polar resins and asphaltenes. The distributions of aliphatic hydrocarbons in each bitumen are similar to those of mature crude oils except that volatile hydrocarbons (<n-C_{15}) are absent. The n-alkanes extend at least to n-C_{33} with no odd or even predominance. Higher molecular weight components are not abundant indicating that the bitumens are not derived from a waxy crude like that from the Gippsland Basin. The major n-alkane is either n-C_{16} or n-C_{17}. Pristane and phytane are the most conspicuous branched constituents in all samples. Longer-chain isoprenoids are

comparatively minor components and botryococcane, which occurs in some bitumens found on South Australian beaches (McKirdy et al., 1986), was not detected. The pristane/phytane ratios of most samples fall in the range 1.30–1.35. All of the chromatograms show a small 'unresolved complex mixture' (UCM or 'hump') throughout the chain-length range typical of crude oils. The aliphatic hydrocarbon distributions give the overall impression of a non-waxy, weathered heavy crude oil.

GC–MS fingerprinting shows that the sterane distributions in all of the bitumens are remarkably similar. The Port Davey (Deep Creek) sample is typical (Figs 4 and 5). Although C_{27} steranes (peaks 5, 7, 8 and 9) predominate, they are only slightly more abundant than the C_{29} steranes and C_{28} steranes. This feature is also found in hydrocarbons isolated from the Ordovician limestone samples and the soil from Johnson's Well (Fig. 4). The bitumens also contain significant amounts of diasteranes. Mass fragmentograms for m/z 231 show that small amounts of methyl steranes are present in all the bitumens, but individual compounds were not identified.

The distributions of hopanes were characterised from mass fragmentograms of the major fragment ion m/z 191 (Fig. 4). Comparable data for the hopanes isolated from the Johnson's Well and Ida Bay samples are also shown. The major hopane peak in the bitumens is C_{30}, with C_{29} next most abundant. Moretanes are present in low abundance (peaks 6, 9 and 12), and the ratios of 22S to 22R epimers in the extended hopanes (i.e. $>C_{30}$; e.g. peaks 10 and 11) are typical of a mature oil. These isomers isomerise to an equilibrium mixture before the onset of the oil window. The ratio of the two C_{27} hopanes Ts (peak 1) and Tm (peak 2) is a sensitive indicator of thermal maturity. Ts was less abundant than Tm in all samples implying that all bitumens were generated at closely similar thermal maturities at an equivalent vitrinite reflectance of about 0.6–0.7.

Although the sterane distributions from Johnson's Well, the Ida Bay limestone and various bitumen samples are all very similar, the hopane distributions show significant differences. The hopanes in the limestone contain significantly more C_{29} hopane due to the presence of a series of 29-norhopanes which are not present in detectable amounts in the bitumens. The bitumen hopane distributions are more typical of those found in shales. The carbonates also contain a series of C_{28}-C_{33} 2-methylhopanes, whose mass spectra have a characteristic base peak at m/z 205. These compounds are trace constituents of the bitumens, implying that the bitumens are unlikely to be derived from a carbonate source rock. C_{29} demethylated hopanes were not detected in any of the samples using m/z 177 mass fragmentograms. These compounds are commonly associated with highly biodegraded residues of crude oil (Volkman et al., 1983), which suggests that the bitumens are not simply tar residues from exposed reservoirs.

The hopane distributions in the Johnson's Well sample do not, at first sight, appear to be at all related to either the Ida Bay carbonates or to the bitumen samples. This is due to a predominance of hopanes from microorganisms in the soil. Several of these hopanes have 17β(H),21β(H)-stereochemistry (peaks 8, 13 and 18) which is typical of biologically produced hopanoids. This complication must always be considered when attempting to fingerprint petroleum-derived hydrocarbons in soil or in geologically young sediments (Volkman et al., 1983). However, hopanes of obvious petroleum origin such as Ts, Tm and extended hopanes were present. 2-Methylhopanes were not detected, which rules out Ordovician carbonates as the source.

The remarkable similarity between all the sterane distributions implies that the hydrocarbons in the bitumens are probably derived from the same type of organic matter which contributed to the carbonates. The predominance of C_{27} steranes is not found in oils generated from higher plants or from coaly matter, but is more typical of algal matter. The presence of abundant diasteranes implies a depositional environment in which the sediments contain a high content of silt or clay. The absence of methylhopanes argues against a shallow carbonate depositional environment.

The very low abundance of tricylic alkanes in the bitumens indicates that the Tasmanite Oil Shale, in which these compounds are the predominant biomarkers (Denwer, 1986; Simoneit, 1986), was not the source of these hydrocarbons. Also, the oil shales show a much higher predominance of C_{29} steranes and a very different diasterane/sterane ratio (Denwer, 1986). Moreover, the maturity of the hydrocarbons in the bitumens is significantly greater than that found in Tasmanite Oil Shale.

Organic geochemical studies show a very close similarity between hydrocarbons from Ordovician Gordon limestone, those from Johnson's Well on Bruny Island and with tars collected from the Tasmanian coast. Little similarity is observed between the aforementioned hydrocarbons and lower Permian Tasmanite Oil Shale, the waxy Gippsland crudes or botryococcane-rich South Australian bitumens. The preponderance of C_{27} steranes suggests a widespread algal source and the abundant diasteranes imply a clay or silt-rich source that extends over most of Tasmania.

GEOPHYSICS AND STRUCTURE

Any suggestions that the historic and modern hydrocarbon occurrences might be derived from lower Paleozoic source rocks and that reservoir potential might exist in the rocks beneath the unconformity at the base of the Upper Carboniferous–Triassic Parmeener Supergroup pose problems for conventional models of Tasmanian geology. The pre-Parmeener rocks are concealed across more than half of Tasmania and the proposed source and reservoir rocks are never the dominant materials exposed elsewhere. Much of Tasmania consists of exposed Cambrian and Precambrian in the west and the Ordovician–Devonian turbidites in the northeast — all intruded by Devonian granitoids — and these have been inferred to occur at shallow depth beneath the unconformity. The few drill holes to have penetrated pre-Parmeener basement have proven Precambrian dolomites, Ordovician–Devonian turbidites or Cambrian volcanics. No hole is deeper than about 1000 m and all have been drilled for stratigraphic evaluation of the lower Parmeener. Yet the seepages are widespread and apparently associated with thrusts and lineaments.

Conga Oil began exploration on Bruny Island in southern Tasmania. No pre-Parmeener rocks are exposed for more than 30 km in any direction, although drilling had proven Precambrian rocks at 999 m at nearby Woodbridge and Cambrian volcanics at 600 m beneath the northern suburbs of Hobart. Appreciation of the significance of the 1929 Johnson's Well drilling find depended first on imaging beneath the Jurassic dolerite, stripping off the Parmeener cover and finally assessing of the likely composition and distribution of material beneath the unconformity.

GRAVITY AND MAGNETIC SURVEYS

Gravity and magnetic methods have a long and proven record for structural assessment (e.g. Leaman and Richardson, 1981) in this complex surface environment and have formed the basis for all of our deep appraisal.

Because of their cost effectiveness and their ability to reveal shallow structures and constrain the geometry of dolerite bodies, gravity and magnetic surveys were extended from the area of the Bruny Island hydrocarbon occurrence to central Tasmania in 1987.

The gravity coverage has taken the form of an infilling of the state gravity data base such that the nominal station spacing is now about 2.5 km. All stations were fully corrected, including 22 km radius terrain corrections and were reduced using a crustal reference density of 2.67 t/m^3. The aeromagnetic surveys were flown at elevations of 1000 and 1600 m for the southern and northern areas respectively with line spacings of 2.5 and 5 km. All specifications have been directed at resolution of primary structures and relationships at depths of 1000–5000 m below meter or sensor. The coupling of these two potential field methods is essential to the resolution of any concealed structures with the minimum of ambiguity.

Details of the southern survey and its interpretation have been discussed by Leaman (1990). Interpretation of the northern survey remains incomplete although it is now known that structural styles inferred in the southern survey and which are comparable with those exposed in western Tasmania, persist across the island toward Bass Strait.

The surveys have revealed the presence of deep Cambrian troughs containing thick piles of mafic and intermediate volcanics. These troughs are commonly limited by major structures containing ultramafics. Interfaces within presumed Precambrian basement rock are also implied at depths which range from the sub-Parmeener unconformity to perhaps four kilometres. Other Palaeozoic rocks overlap both Cambrian and Precambrian rocks and may be up to two kilometres thick in southern Tasmania. The presumed Ordovician and Silurian rocks can be traced to outcrops of the Gordon Group in the region west of Hastings or the Picton River. Figure 6 shows the geology as might be seen if the Parmeener and dolerite cover were stripped away.

STRUCTURE

The gravity and magnetic analyses have provided several geological revelations. The 'Tamar Lineament', a fundamental crustal structure extending NNW–SSE across the island from the Tamar River to the south-east as proposed by Williams (1979), is not supported by either data set. Magnetic trends are acute to the supposed structure. The granites of eastern Tasmania are present as giant bodies elongated N–S and their western margin cuts across all types of basement geology (Leaman and Richardson, 1990). The granites of western and central Tasmania are relatively isolated but are sometimes large bodies (Leaman and Richardson, 1989).

Many structural and stratigraphic patterns are repeated. The important and recognisable units include the ultramafics of Early–Middle Cambrian age and thick dolomitic successions of latest Precambrian age. At least three major repetitions can be identified beneath the Parmeener. Similar repetitions have now been implied in western Tasmania where the same rocks are exposed. All parts of the lower Paleozoic succession are involved.

Although relatively small-scale thrusting has been recognised and mapped for many years, large scale movements involving basement or large portions of the Palaeozoic succession have rarely been accepted or proven. Leaman et al. (1973) reported the first such demonstration based on gravity data and this has now been confirmed by mapping and structural review. Other instances have been recognised since acquisition of much new data in western Tasmania as part of the Mt Read Volcanics Project (1986–). Examples of large-scale basement and, occasionally, crustal involvement in thrust stacks have been given by Leaman (1986, 1987, 1988). Such overthrust structures at Cape Sorell have now been established by drilling. Structures are complex; in western Tasmania the westward trending Devonian thrusts have disturbed pre-existing west-facing early Cambrian thrusts. Current interpretations suggest that little of the pre-Devonian geology of Tasmania, as presently exposed, is autochthonous.

SEISMIC SURVEYS

Very little seismic data is available for onshore Tasmania; however, a survey of Bruny Island was undertaken by Conga Oil in 1987. Data records have been generally poor. This was initially ascribed to local terrain and high velocity surface problems. Jurassic dolerite produces irregular high velocity intrusion forms which couple with topographic effects to impose complex static corrections. The dolerite also reflects much energy from its upper surfaces and apparent reflector shadows appear beneath. The base of a dolerite sheet is not generally revealed even though the velocity contrasts are large. Processing problems associated with such difficult data are presently being assessed. Offshore surveys in southern Tasmania by Amoco in 1969 and by the Bureau of Mineral Resources in 1988, exhibit seismic character very similar to land-based surveys.

Both onshore and offshore surveys have recorded events, fragmentally, at times of 1–3 seconds. At Bruny Island, an event could be traced the length of the 7 km traverse at about two seconds. The implied depth of 3–4 km is consistent with the potential field inference of a major density contrast at this level.

Although most records appear bland for times in excess of 300 to 900 ms — the time depth of the base Parmeener unconformity in most cases — it has been possible to obtain excellent records to two-way times of 11 seconds (to mantle levels) at rare localities. One example was reported

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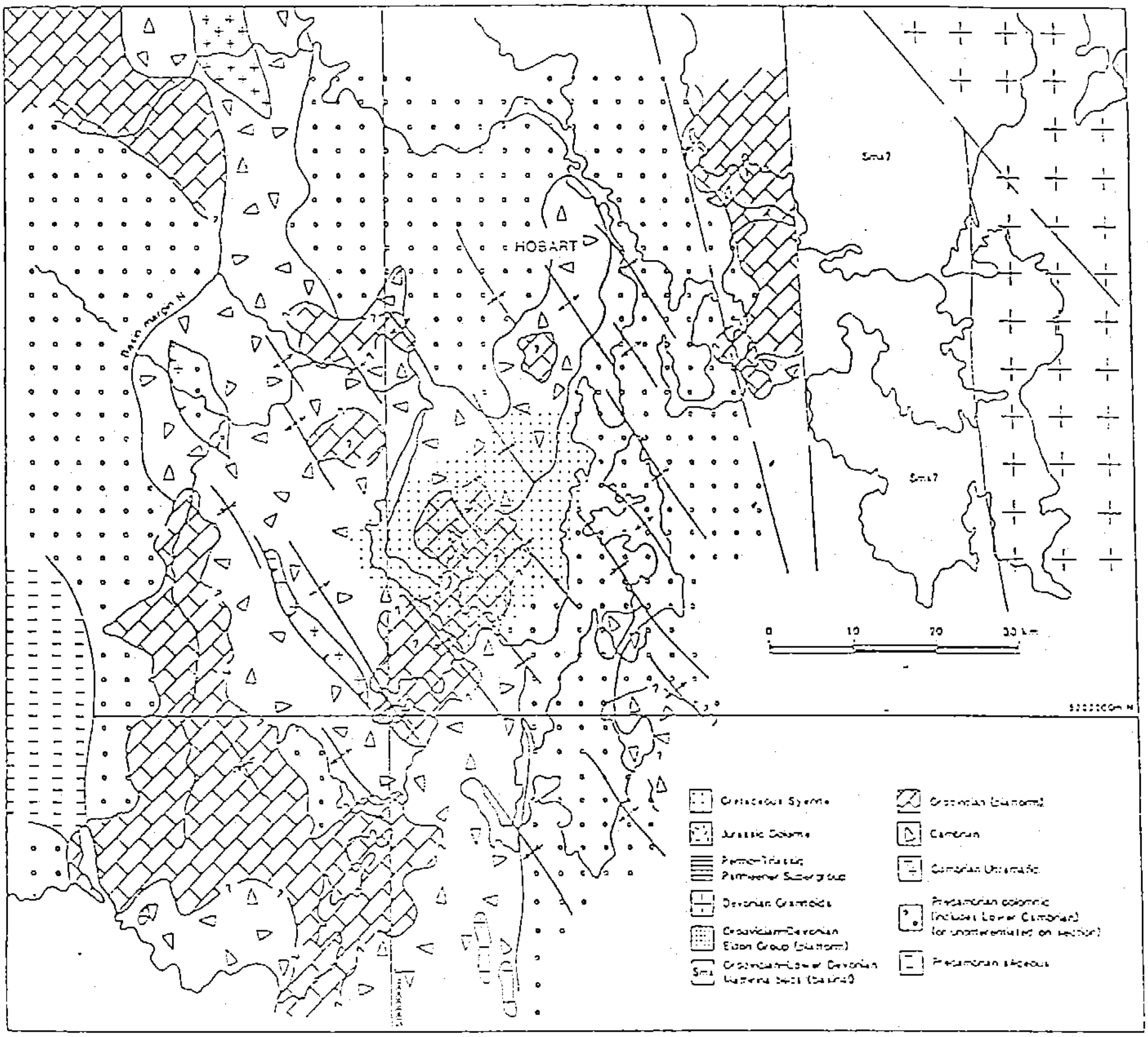

Figure 6. Pre-Parmeener geological map of southeast Tasmania based on magnetic and gravity interpretations supplemented by sparse drillhole data.

near Clifton Beach south of Hobart (Leaman, 1973). Results of this type suggest that seismic methods are viable when the entire Palaeozoic section is present but that the bulk of the geology beneath the unconformity, for most of the areas sampled, is not strongly stratified and is, therefore, either Cambrian or Precambrian.

LINEAMENTS

The gravity and magnetic data sets define some spectacular lineaments (Fig. 7). An initial outline of these and their relationship to major tectonic elements is provided by Leaman & Richardson (1990).

DISCUSSION AND NEW PLAY CONCEPTS

INTEGRATION

Recent work has shown that the hydrocarbon sightings of the past century are likely to be reliable and that the hydrocarbons have been generated from lower Palaeozoic sources rather than from Permian oil shales. The sightings are reasonably systematic and the patterns are both statewide and correlate well with structural lineaments identified in gravity and magnetic data.

Comparison of sighting patterns and seismic activity in the Tasmanian region suggests that hydrocarbons, as oil or

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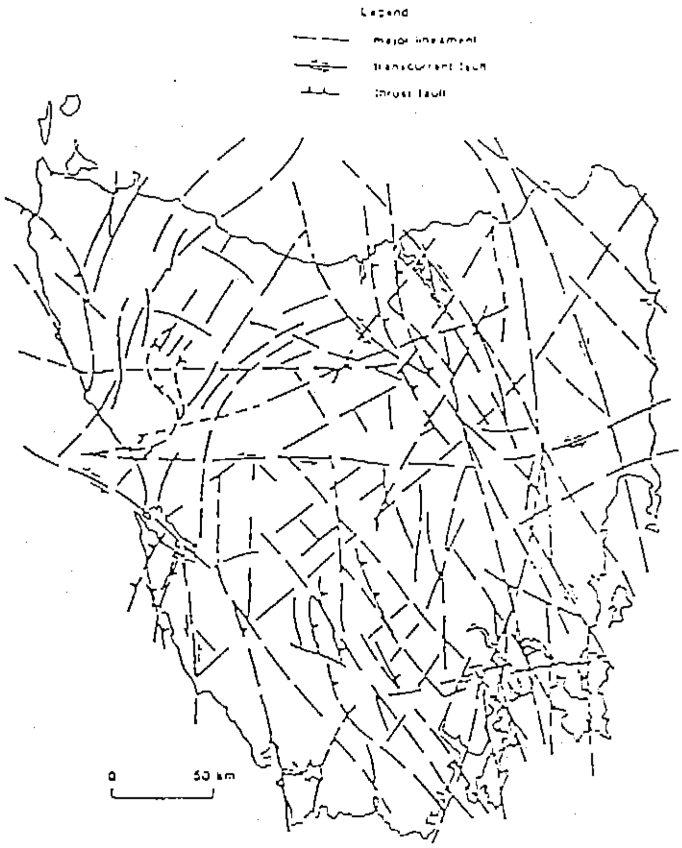

Figure 7. Major crustal lineations based mainly on magnetic and gravity surveys.

tars, are generally observed in the period immediately following intense activity or occasional large earthquakes. A relatively quiescent period since 1957 has decreased release volumes and consequent reports.

Most sightings are associated with either faults or fractures which have post-Jurassic displacements or with intersections of major high angle faults with thrusts.

The evidence suggests that hydrocarbons have been, and perhaps still are being generated and that the reservoir systems are either tight or well sealed. The thrust surfaces or the base Parmeener unconformity may act as sealing surfaces since the materials directly above them are either homogeneous quartzite and dolomitic siltstones or dense mudstones respectively. All possible source rocks have yet to be analysed but hydrocarbons in southern Tasmania have been generated from the Gordon Group. The similarities and differences between seep analyses suggest hydrocarbon generation from at least three other lower Palaeozoic sources.

Reservoir conditions exist within the Ordovician carbonates where they were karstified after folding in the Early Devonian, before being overlain unconformably by Upper Carboniferous tillites. Primary porosities of 15 per cent have been measured in Gordon Group carbonates and larger secondary porosities have been reported. Porosities of about 20 per cent are known in some Early Ordovician siliciclastics.

PLAY CONCEPTS

Many possible play concepts may be envisaged. Simple closed structures involving Ordovician and Silurian source and reservoir rocks may occur at the Parmeener unconformity where medium to long closures (1 to 4 km) are known or beneath the major thrust surfaces. The lower Palaeozoic may occur as a thin residual beneath the unconformity generally but may locally exceed 4 km in thickness where full sequences have been preserved. The pre-Parmeener erosional unconformity cuts Gordon Group limestones at several localities and palaeokarst reservoirs may be expected beneath Parmeener seals. Facies variations within the Gordon Group may also provide stratigraphic trap conditions. Many variations are possible and the most likely target category cannot be defined at the present time, however Figure 8 summarises some relationships and possible plays.

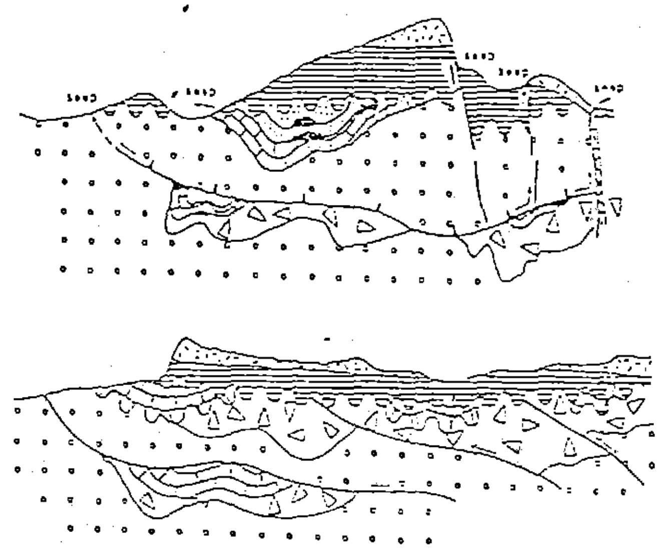

Figure 8. Schematic cross-sections showing possible play concepts in Tasmania. (Stratigraphy is denoted by same symbols as in Figure 6.)

The principal exploration problems at present relate to the location and identification of target successions and possible structures within them. The gravity and magnetic data which have been extensively used to date have been able to define regional structural elements, infer the presence of target successions and suggest fold elements, but are limited in ultimate resolution. Information recovered from these sources is sufficient to set viable stratigraphic targets — essential given the paucity of drilling control available — but not adequate for wildcat hydrocarbon proposals.

Specific prospect definition will not be possible until more seismic data is available and the processing requirements assessed and refined. Seismic surveys can be specific since the potential field data have already defined general target locations. This is considered the most cost-effective approach to the difficult problems presented by exploration in onshore Tasmania.

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CONCLUSIONS

Recent appraisals of archived records, preserved tar samples, and structural reconstructions of Tasmania have shown that:

- Most hydrocarbons recovered over many decades have been derived from lower Palaeozoic rocks and not Permian oil shales.
- The potential source and reservoir sequence is largely concealed on an island-wide basis and the exposed rocks, whether of the Carboniferous-Triassic 'Tasmania Basin' or the so-called Precambrian basement inliers, are irrelevant to prospectivity assessments.
- Tasmania must be seen as a typical fold-thrust province in terms of its hydrocarbon potential. Several major and minor thrusts are stacked. All Palaeozoic units are repeated and the entire overthrust system has been folded and intruded by granites. Precambrian basement inliers previously considered basement are blocks involved in the thrust stack. Devonian thrusting has been from east to west.
- Hydrocarbons have been produced in some quantity but are probably well sealed, as observations of seeps have only been made after intervals of intense seismic activity.

ACKNOWLEDGEMENTS

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AN EVALUATION OF THE OIL AND GAS POTENTIAL OF TASMANIA

PREPARED FOR

MR MALCOLM BENDALL

BY

QUESTA AUSTRALIA PTY LTD

Report 092- 45
Oct 1992

INDEPENDENT GEOLOGIST REPORT

QUESTA AUSTRALIA PTY LTD

23 May 1992,

The Directors,
Condor Oil Pty Ltd,
84 Wells Parade,
BLACKMANS BAY TAS 7052

Dear Sirs,

This report has been prepared at your request for inclusion in a Prospectus to be issued by Condor Oil Pty Ltd.

INTRODUCTION

Condor Oil Pty Ltd hold an Oil and Gas Exploration Licence which covers _____ hectares of onshore, eastern Tasmania. Numerous companies have demonstrated a strong interest in the oil and gas potential of the State's offshore sedimentary basins, but until recently, the hydrocarbon potential of Tasmania's onshore sedimentary basin areas has been largely ignored.

The proposed Condor Oil Pty Ltd "float" is unique in Australia in that the presence of commercial volumes of oil and gas in the onshore sedimentary basins of Tasmania has yet to be demonstrated. Onshore Tasmania has not been previously explored using modern exploration concepts and techniques. There are few well defined structures waiting to be drilled, and no promises of an early oil or gas discovery to be made. Although Condor has identified specific areas in Tasmania which offer considerable hydrocarbon potential and which ought to be and will be eventually drilled, there remains a considerable amount of work to be done before relatively low risk drilling locations might be sighted.

Until Condor Oil became interested, explorationists considered onshore Tasmania to have little hydrocarbon potential, based largely on past writings and understandings. New concepts and interpretations and recent investigations by Condor Oil have, however, shed a new light on the oil and gas prospectivity of Tasmania.

Condor Oil realised that there was considerable potential for commercial accumulations of oil and gas being present in Tasmania and commenced a programme in 1989 to verify (or deny) their original expectations. Information on historically reported oil "seepage" sightings has been collated and "seep" locations mapped to determine trends, sophisticated geochemical analyses have been performed to identify and quantify oil and gas source potential, detailed and extensive gravity and magnetic acquisition and interpretation have been carried out to better determine the structural configuration and magnitude of Tasmania's onshore sedimentary basin(s) and a small amount of seismic has been acquired to determine the feasibility of obtaining good and usable data in Tasmania. All of Condor's findings to date have been very positive and progressive and indicate that Tasmania is prospective for oil and gas. Before a site for a petroleum exploration well can be considered, however, more information is needed on source rock and reservoir quality and distribution and more knowledge is required on the structural configuration of the subsurface sediments. In order to obtain further, required information, several fully cored boreholes will have to be drilled and geochemical, palaeontological and petrophysical analyses conducted on recovered rock samples. Petroleum exploration in Tasmania is still at a preliminary stage. The exploration program planned by Condor for the next two years will achieve many goals. It will greatly improve the geological knowledge and understanding of subsurface Tasmania. This will provide direction as to where Condor should intensify their exploration efforts and will hopefully lead to identifying structures which might contain commercial volumes of oil and gas.

When Questa was first approached by Condor to prepare a geological summary of the hydrocarbon potential of Tasmania, we were a little hesitant. We, as many others considered Tasmania to have very little if any oil and gas potential. A paper presented by M. R. Bendall, a Director of Condor Oil, at the Australian Petroleum Exploration Association (APEA) Conference in 1991 enlightened us. A comprehensive literature review, discussions with other geoscientists including Dr. David Leaman, a prominent geophysical/geological consultant and long time resident of Tasmania, Dr. John Volkman, a chemical oceanographer and organic geochemist with CSIRO in Hobart and Mr Malcolm Bendall, the founder of Condor Oil, and a considerable amount of in-house burial history and maturation modelling, have led Questa to be optimistic about the potential for oil and gas in Tasmania.

As indicated above, the first serious and methodical investigations into the petroleum potential of Tasmania were initiated by Condor Oil in the 1980's, financed entirely by their own resources. Work carried out by Condor Oil in the past three years has led to some very encouraging results, providing a considerable degree of optimism that all of the criteria essential for hydrocarbon generation and accumulation could very well be present in Tasmania, and that commercial accumulations of oil and/or gas might be discovered in the near future with a concentrated and efficient exploration program, a program which is backed by sound scientific concepts and, very importantly, sufficient funding.

The elements necessary for oil and gas accumulations are:

1) The accumulation and preservation of organic rich source material within fine grained sediments (source rocks).

2) Deposition and preservation of porous and permeable reservoir rocks.

3) The presence of efficient, impermeable seals overlying reservoir quality rocks.

4) Trapping mechanisms formed by folding and/or faulting of rock sequences or involving lateral changes in rock composition (porosity and permeability variances).

5) Heating of preserved organic material to temperatures at which hydrocarbons are generated and expelled from source rocks. Generally about 1500 - 2000 metres of sediment overburden is required to generate the required temperatures. Trap mechanisms must be in place before conditions for hydrocarbon generation are achieved to prevent hydrocarbons from escaping to the Earth's surface.

6) Conduits to provide reservoirs access to hydrocarbons migrating from maturing source rocks. Conduits may be established by permeable reservoir rocks being adjacent to maturing source rocks. Faults may often also assist.

7) Preservation of hydrocarbon accumulation(s) from excessive temperatures and, maintaining of trap integrity.

8) Sufficient pressure within hydrocarbon saturated reservoirs to facilitate movement of hydrocarbons from reservoir to surface production facilities. Pressure is usually induced by considerable thicknesses of rock overlying the reservoir horizon. Pressure may, however, be artificially induced.

The absence of any one of the first seven of the above criteria will preclude any chance of a hydrocarbon accumulation being present. Until Condor Oil began its investigations into the petroleum potential of the State, several of the above criteria were considered lacking. Currently, it appears that all of the elements are present, at least over considerable parts of the Condor Oil Permit area.

The difficulty now lies in identifying specific locations in which all of the elements are likely to be present and favourable. Before a drilling program with the specific intent of locating hydrocarbon accumulations can be initiated, considerable regional information must be obtained on source rock distribution, quality and maturation, on reservoir development and on basin structure. In order to obtain this basic information, boreholes without oil or gas objectives will have to be drilled and cores obtained and analysed. Specific target objectives must be defined and good quality seismic obtained to pin-point optimum drilling locations over valid and robust targets which exhibit generous hydrocarbon drainage areas.

PREVIOUS EXPLORATION FOR PETROLEUM IN TASMANIA

The first record of an interpreted, onshore petroleum occurrence in Tasmania was made more than 115 years ago. Some 200 examples of possible onshore petroleum seepages and bitumen occurrences in Tasmania have been reported during the past 100 years. From 1915 to 1940, there was considerable exploration for oil in Tasmania. This exploration was inspired by the numerous reports of oil "seepages" across the State and the occurrences of what now appears to be unrelated bitumens, on the west coast of Tasmania. To date some thirteen companies, including Condor Oil Pty Ltd, have actively explored for petroleum in the island State. A total of 127 exploration licences have been held and some forty shallow boreholes drilled. Almost all of the wells were drilled at the site of petroleum seepages without any real knowledge of subsurface structure and stratigraphy. Most wells were shallow and in spite of considerable early activity, not one company evaluated the Pre-Permian sedimentary sequence, largely because of limitations on drilling rig capacity, but also due to a lack of understanding of what constitutes hydrocarbon prospective rocks in Tasmania. Most wells entered near-surface Jurassic dolerite (volcanic) intrusions and many terminated within them. Until recently, there were no valid methods to predict the distribution and magnitude of dolerite stacks in the subsurface. In spite of all of the above, small volumes of oil and/or gas were reportedly recovered or observed in several of the drill holes.

Around the world, oil strandings, seeps and other surface petroleum occurrences have led to the discovery of significant subsurface oil accumulations. Before success can be met in pursuing the origin of such "seeps", however, the explorer must have a good knowledge of the structural history of the basin from which the seeps are originating, of the stratigraphy and structural geometry in the environs of recognised seeps and of the maturation history of potential source rocks. These are elements which have not been observed in petroleum exploration in Tasmania in the past.

GEOLOGICAL HISTORY

Pre-Cambrian quartzites, phyllites and dolomites which are exposed extensively in the central and northwestern part of Tasmania and which may date back as far as 1100 Ma, constitute the oldest rocks in the State. They are almost entirely of sedimentary origin and range from relatively unmetamorphosed subgreenschist facies sequences through to highly metamorphosed amphibolite facies. The sediments were severely deformed and intruded with granites during the Penguin Orogeny which occurred about 725 -750 million years ago. Terrestrial sediments and shallow marine, predominantly quartzose, sandstones and dolomites, deeper marine mudstones and turbidites and basalts were deposited across the deformed surface during late Pre-Cambrian and Early Cambrian time.

A thick sequence of volcano-clastic sediments was deposited during Middle and Late Cambrian time. The sequence includes the arcuate zone of the mineral rich Mt. Read Volcanics, and the Dundas Group, which comprises conglomerates and finer grained clastics of a predominantly volcanic origin, deposited in a basin setting. Local interruptions of conglomerates suggest intermittent uplift of the basin margins. Tensional tectonics gave rise to horst and graben structural development.

The Ordovician is represented by the Denison and Gordon Groups. The Denison Group comprises a succession of predominantly silici-clastic sediments which were deposited in a spectrum of depositional environments ranging from braided stream and meandering stream through to deltaic and shallow and deep marine and indicate a Late Cambrian to Early Ordovician marine regression, followed by a later Early Ordovician marine transgression. Late Cambrian submarine fans and other slope deposits are progressively overlain by shallow marine and later terrestrial deposits (regression), which are in turn progressively overlain from the southeast by a sequence of shallow marine silts and muds. Highland areas appear to have developed in the western and northwestern part of the State as is evidenced by conglomeratic alluvial fan complexes.

As stream gradients on the uplifted areas decreased, limiting clastic transport, carbonate deposition began to replace clastic deposition. Up to 2000 metres of Gordon Group carbonates overlie the Denison Group clastics in central Tasmania. Shallow marine to platform margin build-ups to deep water (>200m) carbonate and turbidite - graptolitic shale environments are present with rapid lateral and vertical facies changes noted.

The change from clastic deposition to carbonate deposition was gradual and considerable inter-fingering of the two rock types occurs. Dolomitization of inter and supratidal rocks is widespread and believed to have occurred shortly after deposition, although in some cases, rocks have been de-dolomitized. Limestone is richly fossiliferous in many places, the biota indicating deposition in warm, clear, shallow water. Evidence of evaporite producing conditions is seen in several places. Coral gardens appear to have been widespread and possible back reefs have been identified. Algal "lawns" are also reported to be widespread across the State.

Towards the end of the Ordovician, clastic material advanced rapidly across the carbonate platform, and the Gordon Group carbonates were conformably overlain by predominantly shallow marine silici-clastics of the Late Ordovician - Early Devonian Eldon Group. The Eldon Group comprises three major cycles of sandstone and siltstone, which, with a minor limestone contribution, reaches a thickness over 2000 metres. The greater coarseness of grains and the higher sand to shale ratios of the Eldon Group in western Tasmania, imply a source area in the west of the State. In the eastern part of the basin, basinal graptolitic, turbidite deposits were deposited (Mathinna Beds).

Lower Devonian and older rocks were extensively deformed during the Tabberabberan Orogeny. Approximately northwest to north-northwest trending folds developed across most of the State, but east-west trending folds developed in the northwest. Several laterally and vertically extensive, north-south trending thrusts developed and numerous and relatively large granitoids were discordantly intruded between about 348 and 395 Ma in northeastern Tasmania and 332 and 367 Ma in western Tasmania. Conodont colour alteration indices (CAI) indicate that Lower Palaeozoic sediments were heated to about 300°C adjacent to intrusions in the western part of the State. In central and southern Tasmania, Lower Palaeozoic sediments were heated up to an estimated 100°C, even where distant from the granitoid masses. This major heating event is relevant to the development of petroleum in Tasmania.

During the Late Carboniferous and Permian, glacial deposits (Lower Parmeener Supergroup) were deposited unconformably across the deformed, uplifted and eroded, older rocks. Lateral variations in lithofacies are considerable, particularly in the vicinity of topographic highs generated during the Tabberabberan Orogeny. As a result, rock unit nomenclature varies widely from place to place. Environments of deposition range from glacio-terrestrial (including glacio-lacustrine) to glacio-marine. The basal part of the Supergroup includes the Tasmanites oil shales, glacio-restricted marine deposits which have an extremely high organic content. Permian rock sequences typically are 600-1000 metres thick.

Triassic rocks are represented by up to 750-800 metres of fresh water, lacustrine and fluvial deposits of the Upper Parmeener Supergroup. In places, Triassic sediments rest directly on Devonian granites. The lower part of the upper Parmeener

Supergroup commonly consists of granular conglomerate and coarse sandstone. The upper parts of the sequence are commonly represented by up to 400 metres of feldspathic and coal-rich sandstone. Dark grey shale horizons and subordinate coal measures occur throughout the sequence. Almost everywhere in Tasmania, rocks of the Parmeener Supergroup are regionally sub-horizontal, although contrary to many published reports, they are in many areas, highly deformed.

Extensive sills of dolerite fed by narrow feeder dykes were intruded during the Middle Jurassic. The intrusions, which presently extend over half of the land mass of Tasmania, were probably related to tensional stresses between continental blocks at the commencement of breakup of the Gondwanaland supercontinent. Within the dolerite swarm there are generally two or more stacked sills, each averaging about 200 to 350 metres in thickness. Large scale thrusting affected much of the State.

While thick (up to 8000 metres) accumulations of alluvial fan, fluviatile and volcanic sediments were deposited in the newly formed Bass, Otway and Sorell marginal basins which now occupy offshore Tasmania, only a relatively thin succession of non-marine and volcanic sediments were deposited in local depressions across onshore Tasmania. During the Late Cretaceous to Early Tertiary, a series of large scale, north to northwesterly trending horsts and grabens were formed as an extensional regime was set up and Antartica fully separated from Australia. Up to a kilometre of mainly terrestrial sediments was deposited in the grabens. Syenite intrusions up to 300 metres in thickness and of Cretaceous age are not uncommon. At the end of the Eocene and in the earliest Oligocene, northwesterly directed compression rejuvenated many of the earlier formed structures, but this period of compression appears to have been centred more on the Gippsland and Otway basins to the north. Tertiary basalt flows are common throughout Tasmania with sheets up to 300 metres in thickness.

KNOWN PETROLEUM OCCURRENCES

In 1871, surface tar was reported from Prime Seal Island on the west coast of Flinders Island. Since that time, some 200 reports of possible, onshore, liquid petroleum and natural gas "seepages" and "flows" and bitumen occurrences in Tasmania have been documented, most of these before 1970 but some as recent as the late 1980's. Many of these were confirmed by government geologists of the time.

Samples and photographs of some of the tars collected from Tasmanian coastal beaches have been preserved in museums and libraries, further validating early reports, but geochemical analyses of beach collected bitumens strongly suggest that they are related to Tasmania's offshore basins. Unfortunately, although numerous, there are mainly only written, unconfirmed reports of seepages and shows in the interior of the State with very few preserved samples.

Considerable enthusiasm is, however, justified by the abundance of records over the past century. One of the more dramatic excerpts is from a report by a consulting geologist to the Tasman Oil Company in 1921, concerning a property in the Derwent Valley:

"I have no hesitation in confirming Black's (Field Manager for the Tasman Oil Company) statement that oil exists at Barn Bluff, gas and oil seepages being plainly manifest during my recent inspection there. Also the geological features of the field generally indicate that large quantities of oil have unquestionably been produced by natural processes of distillation and may be confidently sought for in the Anti-Clines."

Although the word "field" is not applicable and the general tone of the full statement was intended to promote the Tasman Oil Company, reports such as the above provide encouragement that commercial volumes of oil may have accumulated in the subsurface in Tasmania. One would trust that the report was not entirely promotional in concept.

The only paper to look seriously at the possibility of oil in on-shore Tasmania was prepared 75 years ago by government geologist W. H. Twelvetrees. Numerous hydrocarbon occurrences were reported by Twelvetrees in 1915 and in 1917.

Seepages in Tasmania appear to be related to seismic activity as most of the sightings of seepages have been made directly after major earth tremors. Most sightings are within five years of the occurrence of either considerable, long term seismic activity or events greater than a magnitude of 4 on the Richter Scale. There have not been a large number of reports of petroleum shows since 1969 but then Tasmania has not experienced a major earth tremor since 1958. The Figure shows the distribution of reported seeps in Tasmania (from Bendall 1990). Northeast - southwest trends in seep distribution are evident from the Figure and these trends correspond very closely to established gravity and magnetic trends, which have been interpreted as representing deep seated (crustal) thrust faults and lineaments (Leaman and Richardson 1990). Seepage appears, therefore, to be related to movements along established fault lineaments during times of seismic activity.

Records are incomplete, but it appears that not more than about thirty-five boreholes have been drilled in Tasmania with petroleum objectives. Wells have been very shallow, the deepest being no more than about 500 metres. All wells drilled to date have been initiated solely on the basis of effusive oil or tar seepages, without any real knowledge of subsurface structure or stratigraphy. Nevertheless, oil was reported to have been recovered from a depth of 27 metres at Johnson's Well on Bruny Island in the south of Tasmania, and a small quantity of gas was reported to have been produced from a well at Port Sorell in the north. Reports describe storage of some of the light oil from Johnson's Well in drums. Minor oil and gas flows were reported from at least two other petroleum boreholes and from at least one water bore. Minor oil was recovered from a _Tasmanites_ oil shale interval from the Ross No. 2 stratigraphic borehole, drilled to 480 metres in 1985 by the Department of Mines and a small and brief gas flow was reported by Dr. D. Leaman, from a stratigraphic borehole, while drilling through the Quamby Mudstone at Douglas River. Oil and gas have almost definitely been generated and it looks like low volume seepage has been occurring off and on over a large part of Tasmania.

"Seepages" in the Bruny Island region may represent migration updip along the pre Permo-Carboniferous unconformity surface to Jurassic induced faults disturbed during the Tertiary, from the concealed lower Palaeozoic basin some 10 to 20 kilometres to the west (Leaman, 1990).

There has not been a major earthquake episode in Tasmania since about 1958 and consequently reports of "seepages" in recent years have been minimal. Most of the early sightings were not confirmed by knowledgeable 'experts' and certainly not by geochemical analysis, and one would anticipate that bacterial action would have destroyed any evidence of many early occurrences. There have, however, been a large number of sightings over many years which provides in itself considerable credibility to their presence. In addition, the sightings, when located on a map of Tasmania, follow well defined lineament trends established by recent gravity and magnetics interpretations. These lineaments have been interpreted as deep seated thrust faults and there is therefore good reason to consider the "seepages" may have originated from subsurface hydrocarbon accumulations.

GEOCHEMISTRY

Potential Source Rocks

Until the late 1980's, explorers and geoscientists had very little knowledge regarding the actual source(s) of the tars, bitumens and natural gas occurrences across the State. The original explorers of New River (circa 1915 - 1925) conjectured, and perhaps correctly, that the Gordon Limestone was the primary source of the abundant oil seeps and tars. Similarities were drawn between the Gordon Limestone and time equivalent, prolific oil producing limestones in the U.S.A. It has been presumed by more recent investigators, however, that oil generated and revealed as "seeps" was derived from the Permian oil shales. Although organically very rich and often oil saturated themselves, these rocks were not, however, considered to have ever been sufficiently buried to achieve temperatures necessary for the generation of significant hydrocarbons.

Today, as a result of considerable work initiated primarily by Condor Oil and analyses carried out by CSIRO, the BMR and AMDEL, there is considerable evidence that carbonates, shales and evaporates of the Gordon Limestone Group and shales and coals of the lower Parmeener Supergroup all have the potential to have generated significant volumes both oil and gas. Other known potential source rocks include Pre-Cambrian shales and dolomites.

The Gordon Limestone was formed under shallow water, marine conditions. Dark graptolitic shales and evaporite sequences within the Group should provide excellent, oil prone, source potential.

The frequent occurrences of pyrite in conjunction with carbonaceous shales implies an anaerobic and toxic environment, which is vital for the preservation of algal and other oil prone organic material.

Most "seepage" sites are adjacent to or overlie areas known to contain Ordovician and older rocks, or are related to drainage catchments containing such rocks. Organic geochemistry reveals a very close similarity between hydrocarbons extracted from Ordovician Limestones from Ida Bay and those obtained from the surface sediments at the drilling site of the Johnson's Well on Bruny Island. Geochemical analyses of two soil samples from Johnson's Well revealed only traces of hydrocarbons. The low concentrations of petroleum derived hydrocarbons indicate that petroleum seeps are no longer active at Johnson's Well, but provide some evidence for their former presence. These analyses indicate that neither the oil from Bruny Island, nor the coastal bitumens were generated from the Tasmanites oil shales.

Hydrocarbons isolated from Ordovician limestones from Lune River and Queenstown show distributions of biomarkers characteristic of mature crude oils. Although the Gordon Limestone has been identified as the most likely source for the hydrocarbons in southern Tasmania, it is not known whether it remains a source across the entire State. The very limited number of samples analysed precludes authorative conclusions and judgements to be made. Considerably more investigations must be initiated.

The Parmeener Supergroup also includes intervals of organically rich, oil and gas prone source rocks. Very little work has been completed on the organic petrology of the Parmeener Supergroup, but that which indicates the unit is highly variable both in a lateral and a vertical sense, with total organic carbon values (TOC's) ranging from just a trace, to more than 30 percent in oil shales and coals. Organic quality too, is highly variable with some samples particularly rich in exinite (oil prone) and other samples consisting of predominantly inertinite (neither oil nor gas prone). Sampling within the Parmeener Supergroup has been very limited to date (seventeen samples from Douglas River, Ross River and Tunbridge borehole No. 2, analysed by BMR) and samples on hand may not be representative of the unit as a whole. Nevertheless, results are very encouraging.

It appears the Tasmanites oil shales provide the best potential source interval in Tasmania. The oil shale had been mined at Latrobe from 1910 to 1932, with artificial distillation resulting in the recovery of 939,221 litres (248,114 gallons) of oil. Total organic carbon (TOC) values within the Tasmanites range up to 30 percent and higher and even on world standards, provides an exceptionally rich, Type 1, oil prone source rock. The Tasmanites in north and northwest Tasmania consists of a single called algae known as Tasmanites punctatus, which has a H/C ratio of about 1.5 and an O/C ratio of about 0.12. It may thus be considered as representing the optimum type of oil source rock.

The Tasmanites oil shales appear to be sporadically developed across Tasmania, being patchy in areal extent and thin where present. Considerable work will have to be undertaken to determine their geographical distribution. The potential source rock is particularly prominent in the north of the State near the base of the Quamby Formation. Nevertheless, it has been identified in numerous outcroppings and drillholes, and may be of a greater geographic distribution than currently recognised.

Banks (1963) described oil shale and cannel coal from the top of the Mersey Coal Measures. These potential source rocks are similar to the Tasmanites oil shales in their thin and patchy distribution and in their organic richness.

A rock sample of lower Permian mudstone from Poatina, and stratigraphically related to the Quamby Mudstone, was analysed by CSIRO. The sample was grey in colour and had a noticeable petroleum-like odour when broken open. The sample was found to contain considerable amounts of hydrocarbon having the characteristic distribution found in mature crude oil. Biomarkers were distinctly different from those found in Ordovician carbonates and it is believed (Volkman 1989) the Quamby Mudstone hydrocarbons were indigenous to the rocks from which they were extracted. Thin, oil shale intervals are commonly present within the Quamby Mudstone sequence. A borehole drilled beside the Douglas River Bridge as part of the Tasmanian Department of Mines coal assessment program flowed gas during penetration of the formation (Leaman - pers comm). Geochemical analysis indicated the formation to be geochemically mature, albeit only marginally mature, at the Douglas River location.

Dark grey shale and subordinate coal horizons occur throughout the Parmeener Supergroup sequence and these too could offer considerable source potential.

Unusual tars obtained from Bridgewater and other locations appear to be derived from higher plants, indicating a Permian source.

ORGANIC MATURATION

There have been numerous misconceptions concerning the maturity of organic material contained in potential source rocks in Tasmania. Many investigators believed (and many still believe), the early Palaeozoic sequence constituted effective basement, having neither reservoir nor source potential. Clarke, Farmer and Gulline, in their paper published in "Economic Geology of Australia and Papua New Guinea, Volume 3-Petroleum" published by the Australian Institute of Mining and Metallurgy in 1976, refer only to sediments of the Upper Carboniferous to Triassic Parmeener Supergroup and these sediments alone constitute what is referred to as the Tasmania Basin, even today.

Due to insufficient depths of burial, Parmeener Supergroup sediments were considered to be nowhere sufficiently mature for the generation of commercial volumes of oil and/or gas. The high organic content of the Tasmanites oil shales was well known, but explorationists considered the unit was everywhere insufficiently mature for the generation and release of significant quantities of hydrocarbons.

In more recent years, as initial geochemical data was obtained, researchers became aware of the excellent source potential of Ordovician and older sequences across Tasmania, but another misconception led many to believe that hydrocarbons generated from within the early Palaeozoic sequence would have escaped when strata were deformed and uplifted, and anticlinal closures breached during the Devonian Tabberabberan Orogeny. These researchers believed that hydrocarbon generation from the Early Palaeozoic and Pre-Cambrian sequence would have been initiated in response to high heat flows introduced into the basin during the orogeny. With no effective seals, migrating and entrapped hydrocarbons would have found their way to the Earth's surface where they would have been destroyed by bacterial and weathering action. The particularly high basin temperatures were interpreted from conodont colour alteration index (CAI) values from Early to Middle Palaeozoic marine carbonate rocks of western and west central Tasmania. Low vitrinite reflectance values from unconformably overlying Parmeener Supergroup sediments suggested that the major heat input into the pre-Carboniferous sequence occurred prior to Parmeener Supergroup deposition.

Isograds of CAI values in western and northwestern Tasmania form an arcuate belt following the outcrop of the early Palaeozoic rocks around Pre-Cambrian metamorphic basement rocks. Regional metamorphism in western and northwestern Tasmania is interpreted to have been in excess of 300°C immediately adjacent to igneous intrusions. Low CAI values, however, in the southwest and central Tasmania, suggest that if Gordon Group source rocks are present at depth, and there is strong suggestion that they are, they are currently within the oil and gas windows. Maturation modelling suggests that it is unlikely that hydrocarbons would have been expelled from these more basinward sediments (at least from the upper part of the Gordon Group) until after a considerable and protective Parmeener Supergroup cover (seal) was in place. Over large parts of the State, therefore, the Gordon Group offers considerable hydrocarbon potential.

Until very recent time, no mature source rocks of Permian - Carboniferous age were thought to exist in Tasmania. Recent investigations by CSIRO, the Bureau of Mineral Resources (now the Australian Geological Survey Organisation) in Canberra, The Tasmanian Department of Mines, Amdel Core Laboratories and others have demonstrated that organic sediments within the Tasmania Basin are in the oil window, with vitrinite reflectance values ranging from 0.7% (lower oil window) at the edge of the basin to 1.35% (upper oil window) towards the centre of the basin. The 1.35% value was estimated on the basis of spore colouration interpretations. The Methyl Phenanthrene Index (MPI) measured from the aromatic fractions of hydrocarbons extracted from Permian rocks in the basin, indicates a similar range of maturity for the basin. One might ask how this can be, given relatively shallow depths of burial experienced by the Upper Palaeozoic sediments. Tasmania currently has a relatively high heat flow which is up to twice the world average of 60 mW/M^2. Present geothermal gradients onshore Tasmania are 30 - 40°C/km and up to 60° and 70°C/km (Summons 1981) and there is strong evidence that geothermal gradients were higher in the past. Recent zircon and apatite fission track data (Hills - Bidal verbal communication to M. Bendall in 1991) appears to confirm a Cretaceous heating event which is predicted from Maturation Modelling. A Jurassic heating event is also quite probable.

Gravity and magnetics and surface outcrop data indicate greater thicknesses of sedimentary sequence than previously thought in graben and other basin depressions, and a post Parmeener Supergroup cover in the order of 2.0 to 2.5 kilometres is interpreted for the central basin area.

All of the geochemical evidence to date indicates that within Tasmania there is a wide range of maturation levels, from early mature to extremely over mature (post wet gas preservation), for Ordovician and older sediments. Parmeener Supergroup sediments appear to range from immature to marginally mature on the edges of the Tasmania Basin, to fully mature for peak generation of oil and gas at the centre of the basin. This makes much of onshore Tasmania prospective for hydrocarbons.

RESERVOIRS

Very little definitive data is available on the reservoir potential of the sedimentary rock sequence in Tasmania, but several potential reservoirs are present within the Gordon 'Limestone' Group and the Parmeener Supergroup.

Until the 1980's, it was believed that Pre-Permian sedimentary rocks were present only in western Tasmania. It has now been demonstrated that a Lower Palaeozoic and Upper Pre-Cambrian sequence extends as far east as Ross, Oatlands and Sorell. There is thus, a thick (up to several thousand metres) and geographically extensive, sedimentary sequence in which well developed reservoirs should be present.

Coral 'gardens' appear to have been common across much of Tasmania during the Upper Ordovician, but to date no authentic bioherms have been identified. C. F. Burrett (Summons T. G. 1981) postulates that the coralline facies at the top of the Benjamin Limestone in the Florentine Valley was a backreef, with a yet to be discovered forereef to the east. Forereef development would be anticipated and would have migrated westward (landward) from the southwest with the westward transgressing sea.

Thick sections of Ordovician reef and shelf limestones appear to have been re-crystallized (at Lune River at least) and have high porosity, where the limestone was exposed during the Tabberabberan Orogeny, and karst and weathering porosity was developed.

Secondary dolomites are known from several places in the Gordon Group. At Lune River, secondary dolomites were formed through the action of hypersaline brines which developed in supratidal depressions. The dolomite at Lune River is porous and vuggy. The Eldon Group comprises alternating sequences of sandstone and siltstone with minor limestone. The Group has a high sandstone to shale ratio and should therefore offer considerable reservoir potential. No data relevant to its porosity or permeability, however, is available.

Until very recently, it was believed that reservoir conditions within the Permian/Triassic sequence were virtually nonexistent. Several potential reservoir intervals are, however, present. These include the Liffey and Risdon Sandstones.

The Permian Liffey Sandstone is a very important and recognised potential reservoir objective. The unit is the first semi-regional, coarse, clastic unit (? reservoir) above the *Tasmanites* oil shales. Effective porosities of one small sample, as measured by Amdel Laboratories in 1981, range from 10.66 to 11.00 percent.

Sandstones which constitute the Melbina Formation, the Triassic Ross Sandstone and the Permian Risdon Sandstone should also be considered as potential reservoirs although artesian flows through these units are uncommon. Porosity - permeability data is apparently totally lacking for these units. A strong hydrocarbon smell is present in outcropping Risdon Sandstone at Risdon, a suburb of Hobart after which the unit was named. Basal Permian conglomerates and tillites provide further potential.

Mudstones generally provide source rock or seal potential, but the Quamby Mudstone seemingly offers in addition to these, reservoir potential. The formation includes the organically very rich *Tasmanites* oil shales and, independent of the oil shales, could prove itself to be an effective source rock in places. Where seen in outcrop, the formation is highly fractured. The fracturing may very well have been induced by pressure unloading, resulting from uplift and erosion accompanying Jurassic and Tertiary deformation, or alternatively the formation may have been highly water saturated prior to uplift and the fracturing could therefore be related to shrinkage from de-watering. In the subsurface, the Quamby Mudstone does not appear to be commonly fractured, although fractures were observed in at least one shallow borehole (BHP Styx River) and gas appears to have flowed from the formation in the Douglas River borehole.

The mudstone has porosities as high as 30 percent as might be presumed from a fine grained rock, but matrix permeability would be expected to be very low. If there is sufficient fracture development within the unit in the subsurface, the matrix, if hydrocarbon saturated, would be expected to contribute significant volumes of hydrocarbon into the fracture network. Where encountered to date, however, in stratigraphic and water boreholes, the formation has not provided significant flows of water, suggesting the formation is generally poorly permeable.

SEALS

Intraformational seals are abundant within both the Lower Palaeozoic (Gordon Group) and Upper Palaeozoic (Parmeener Supergroup) sequences. There has been, however, considerable concern that anticlines formed during the Tabberabberan Orogeny would have been breached during an extensive period of erosion which accompanied and followed the orogeny. The concern is that hydrocarbons generated during this time would have escaped to the Earth's surface, there being no effective vertical seals to hold any significant accumulations. The concern appears to be largely unwarranted.

The thought process which generates the concern implies either that the vertical succession of pre-Permian rocks constitute one continuous, extensive and thick reservoir, or that all potential reservoirs have been breached. Both of these possibilities are very unlikely. The breaching of Devonian generated anticlines has been documented in outcrop, but the degree of breaching is expected to vary according to the relative position of structures in the basin and the degree of structural relief imposed upon the anticlines as a result of the orogeny.

Up to 420 metres of shale, siltstone and mudstone (Bell Shale) has been recognised at the top of the Eldon Group (Baillie 1989). Its original actual thickness is unknown but may have exceeded 1500 metres. This would provide a competent and conformable seal, where not entirely eroded away, for underlying reservoirs. It is quite possible and perhaps even probable, that the Bell Shale has been preserved on some of the lower relief anticlines in the centre of the basin. The formation is certainly present in synclines and on the flanks of anticlines over at least parts of Tasmania. Anticlines truncated beneath the Pre-Permian unconformity surface may form effective trapping mechanisms with the Bell Shale providing a lateral seal and Permo-Carboniferous tillites, and fine grained clastics providing the vertical (top) seal. Maturation modelling suggests that over much of Tasmania, the main phase of oil and gas generation from potential source rocks of the Gordon Group would not likely have been reached until after Permian deposition had commenced.

Late Permian and post Permian siltstones, shales and marls and Jurassic dolerites present imposing semi-regional top seals for the Parmeener Supergroup reservoirs.

STRUCTURE

Pre-Permian rocks are concealed across more than half of Tasmania and the described source rocks and reservoir rocks of the Gordon Limestone Group are rarely exposed where the Parmeener cover is absent. Pre Cambrian rocks are exposed in the west and Ordovician to Devonian turbidites are exposed in the northeast. Borehole data is limited to the east of the State and very few wells have fully penetrated the Parmeener Supergroup cover. Over much of the State, the geology of the pre Permo-Carboniferous sequence is unknown. Gravity and magnetics interpretations by Dr. D. E. Leaman indicates Ordovician to Devonian sediments to be present under a relatively thick Parmeener and Tertiary cover in central Tasmania.

Only a paucity of seismic data is available and the limited onshore record sections acquired have been of generally poor resolution. A high velocity surface layer coupled with stacked, near surface Jurassic dolerite sheets have made it very difficult to obtain good seismic data. Acquisition and processing problems associated with such difficult conditions are now being assessed and it is hopeful that all major difficulties can be overcome. The inability to acquire good quality seismic data beyond the base Parmeener unconformity would be of considerable concern.

Fair seismic data has already, however, been obtained in some locations with clear, albeit discontinuous, reflections being observed over many seconds of record. At one locality, records to two-way times of 11 seconds (mantle levels) were obtained. Most records, however, appear blind for times in excess of 300 - 900 ms, or below the base Parmeener Group Unconformity.

Gravity and magnetics, where properly integrated, have a proven record for subsurface structural assessment and are together ideal for targeting areas for more detailed (and considerably more expensive) seismic reconnaissance.

Preliminary and in places detailed gravity and magnetics analyses and interpretations have been made by Dr. Leaman for the eastern part of the State. Although much of Dr. Leaman's work remains provisional, the gravity and magnetics data in association with surface geology, has delineated several areas of particular merit, all of which include Silurian and/or Ordovician rock sequences. It is evident that pre-Devonian rocks are highly folded. Dr. Leaman's work has established large scale, basement involved thrust sheets. In some locations, rock sequences appear to be repeated more than once as a consequence of the thrusting. Overthrust structures have subsequently been established by drilling. Structures are complex and considerable work is required to sort the main features out. In western Tasmania, westward trending Devonian thrusts are interpreted to have overprinted pre-existing east facing thrusts.

Evidence is strong that Cambrian and Ordovician sequences have been preserved beneath the Upper Carboniferous unconformity in numerous locations and in places, Gordon Group carbonates are interpreted to be thick, particularly in synclinal positions. Interpretations indicate that in southern Tasmania, Ordovician - Devonian rocks overlap older Palaeozoic and Precambrian rocks and may be traced to outcrops of the Gordon Group in the Picton River area.

Descriptions in the literature suggest that Parmeener Supergroup (Permian - Triassic) sediments are essentially flat lying and undeformed. Generally speaking, and in comparing the Supergroup with the highly deformed and underlying Early Palaeozoic succession, this may be considered true. Nevertheless, Permo-Triassic sediments have been considerably deformed and effective trap mechanisms involving these sediments are expected.

Supratenuous folding (drape) of Permian sediments across an undulating pre-Permian unconformity surface would generate passive structuring through differential compaction of sediments. On a much larger scale, Jurassic compression resulted in extensive, large scale thrusting which involved Parmo-Triassic sediments.

Structures formed during Devonian, Jurassic and other times were reactivated during periods of Tertiary movements.

The emplacement of massive igneous intrusions at various times throughout Tasmania's geological history further deformed the sedimentary sequence.

Tasmania appears to be a typical fold-thrust province. The interpretation by Leaman indicates that several minor and large scale thrusts are stacked and the entire overthrust system has been folded and intruded, and in places reactivated.

MATURATION MODELLING

In order to obtain at least some understanding of the maturation histories of potential source rock horizons in Tasmania, maturation modelling was conducted by Questa, using techniques similar to those introduced by Russian Geologist N. V. Lopatin in 1971. Models were constructed for two potential source rock intervals, the Gordon Group (Ordovician) and the *Tasmanites* oil shales (Permo-Carboniferous). Maturation modelling requires a knowledge of both the depositional (and erosional) and the geothermal history of a basin. Our current knowledge of these two entities in Tasmania is poor, but nevertheless, some meaningful findings have resulted from the modelling which has been performed.

The depositional history of onshore Tasmania remains clouded due to the considerable erosion which has taken place along basin edges, and the concealing nature of Tertiary and upper Permian sediments in the centre of the basin. Seismic coverage is almost nonexistent. There have been several periods of deformation which have affected the basin, but it remains uncertain as to how much sediment may have been removed through erosion during tectonic activity and through Permian glaciation. Questa is not aware of any complete or even nearly complete measured stratigraphic sequences in the basin. Gravity and magnetics along with measured outcrop intervals and a minimal amount of bore-hole information provide considerable insight regarding current stratigraphic thicknesses. It still remains difficult, however, to gauge the amount of sediment which may have been removed during the Tabberabberan Orogeny, the Cretaceous uplift and during the latter part of the Tertiary. Up to three (3) kilometres is suggested by Hills et al (APEA).

There is considerable indication to suggest that geothermal gradients in Tasmania have remained high since at least Devonian time and that there have been several major heating events, the most recent being during the Cretaceous. The degree and extent of these heating episodes remain largely unknown.

In most basins, a good impression of basin heatflow can be obtained through comparing results of maturation modelling with results obtained through quantitative geochemical analyses. One must first, however, have some knowledge of the depositional history of the basin.

Very little geochemical work has been carried out to determine the maturation of source rocks in Tasmania, certainly not enough to answer the required questions. The analyses which have been completed do, however, demonstrate that there is a considerable volume of potential source rock in Tasmania within the oil window and they also provide some standards on which to evaluate the results of maturation modelling.

Maturation modelling indicates that over much of Tasmania, source rocks within the Ordovician Gordon Group would not have reached the conditions required for significant generation and release of hydrocarbons until after deposition of a protective Permo-Carboniferous cover. Anticlines breached during the Tabberabberan Orogeny would most probably not have contained any significant volumes of oil or gas at the time of breaching. Modelling also supports the results obtained from direct geochemical analysis in indicating that the _Tasmanites_ oil shales should be sufficiently mature for the generation and release of large volumes of oil over much of central Tasmania. The abundance of Type I algae _Tasmanites punctatus_ in the _Tasmanites_ oil shales suggests that oil would have been generated from this unit at relatively low temperatures. Conditions suitable for the main phase of oil generation and expulsion from Permian source rocks are interpreted to have been achieved during Cretaceous time.

Gordon Group source rocks, where overlain by a full sequence of Eldon Group and younger sediments, are probably matured beyond the wet gas preservation deadline and are therefore probably prospective only for dry gas (methane). In such situations, however, oil and wet gas generated from the Gordon Limestone while the intra-group source rocks were at shallower depths of burial, may have been preserved through upwards migration along fracture and fault planes and unconformity surfaces, into stratigraphically younger and less deeply buried rocks. Towards and on the edges of the main basin, the full post Gordon Group sedimentary sequence is not present and Gordon Group source rocks would consequently be less mature, and in places remain prospective for oil and wet gas.

PLAY CONCEPTS

As there are numerous and varied potential reservoir objectives and source rocks ranging in age from Pre-Cambrian to Triassic, as the geothermal history of source rocks, in particular those within the Gordon Group, varies considerably, both regionally and locally, across the State and as structuring of the stratigraphic sequence has been complex, there being at least three significant periods of structural deformation which affected the basin, many possible play concepts can be envisaged.

Both structural and stratigraphic hydrocarbon trapping mechanisms are foreseen. Conventional and simple closed anticlinal structures up to four kilometres long and involving Ordovician to Devonian carbonates and clastics, are believed to occur at the base of the Parmeener Supergroup unconformity. Similar or larger closures should be present beneath major thrust surfaces and these should include sequences of up to four kilometres in thickness. Where Gordon Group carbonates were folded, uplifted and exposed to the atmosphere during and immediately after the Tabberabberan Orogeny, palaeo-karst reservoirs may be expected beneath Parmeener Supergroup seals. Subconformity karsts and sandstones could provide significant hydrocarbon trapping potential.

Hydrocarbon trapping potential of Parmeener Supergroup sediments is seen where reservoir/seal pairs drape across Devonian induced horst blocks and other topographic highs.

Conventional anticlinal development is also seen in Parmeener Supergroup sediments, the result of Jurassic and Tertiary earth movements.

Specific prospect definition will not, however, be possible until more knowledge about the subsurface stratigraphy of Tasmania is acquired and until better, more definitive, structural control is obtained. With perhaps the exception of the "seeps" themselves, there is insufficient geological information at this time to initiate or even to consider a wildcat drilling program. The origin of the hydrocarbons seen as "seepages" at fault exposures is unknown. Hydrocarbons may be migrating some considerable distances, both laterally and vertically along fault planes towards the earth's surface where they are revealed as "seeps". It is essential that boreholes be drilled specifically for the purpose of obtaining much needed information on source rock and reservoir quality, on the stratigraphic succession in general and on the structural configuration of the subsurface sequence. The positions of the proposed stratigraphic boreholes will be determined largely on the basis of reported hydrocarbon seeps and gravity and magnetics results. Stratigraphic drilling should considerably reduce the risk of future, more expensive, conventional, Wildcat drilling.

Areas known to exhibit particular hydrocarbon potential are Johnson's Well on Bruny Island, Douglas River, and Ross in east central Tasmania. Sorell, Hamilton and Southport are also of considerable interest.

Mackintosh Reid, the then Director of Mines, in 1929 confirmed oil and gas seeping into Johnston's Well on Bruny Island. The Tasmania Oil Company was formed to evaluate the origin of the "seepage" and a borehole was drilled. Upon drilling through a mudstone into a sandstone at 30 metres, the well is reported to have flowed oil and gas, the oil being collected into drums until all available were filled. Very little was known about the accumulation, but the well was abandoned and no further interest shown in the well until 1987, when samples of the mud around the well were analysed and traces of oil with an apparent Ordovician signature identified.

Condor Oil plans to drill a stratigraphic well east of the original "Murray" borehole. It is intended that the hole will be drilled in late 1992 to a depth of at least 700 metres and will penetrate the entire Parmeener Supergroup interval and may possibly, depending upon shows, maturation indications etc, be continued to intersect considerable Lower Palaeozoic section. As several stacked thrust sheets are interpreted to be present in the Bruny Island area, a very thick sequence of Upper Pre-Cambrian and Lower Palaeozoic rock is probable. There are no intentions to evaluate the full sequence. It is hoped that information will be obtained on source rock (in particular the Quamby Mudstone - Tasmanites oil shales) quality and maturity and on reservoir distribution and quality.

Condor intends to follow up the stratigraphic drilling with a conventional petroleum exploration well. Condor have already acquired 260 kilometres of marine seismic data near Bruny Island and in Storm Bay. Although most of the data proved to be of very poor quality, a strong seismic event could be traced the length of one seismic traverse at a depth of about 2 seconds TWT - an implied depth of 3-4 kilometres. It is probable that additional seismic will be acquired offshore and possibly onshore Bruny Island, and the well drilled in late 1994 or early 1995.

Condor also plans to drill a stratigraphic borehole to further evaluate a flow of gas reported by D. E. Leaman, from a borehole which was being drilled through the Quamby Mudstone in a coal assessment well at the Douglas River bridge. Two seams of Tasmanites oil shale were identified (C. Calver et al, 1984) and free oil was observed in core. Analysis of the oil indicated it to be marginally mature. Should the results of a stratigraphic well prove encouraging, a conventional oil exploration well will be drilled to assess production potential.

Condor also intends to drill (tentatively 1993-1994) a stratigraphic evaluation well, 20 kilometres to the west of the Ross No. 2 borehole, to evaluate source (in particular the Tasmanites oil shales) maturity and quality and reservoir potential at that location. The Ross No. 2 well was drilled in 1985 by the Department of Mines to a depth of 480 metres. Core recovered from the hole revealed small amounts of live oil upon cutting and a Tasmanites horizon was identified at 410 metres.

It would be premature to consider the actual drilling of petroleum exploration (wildcat) wells before 1994-1995.

There is considerable evidence to suggest that the most prospective part of Tasmania for oil and gas will be the east central part (Central Plateau) of the State. The evidence comprises gravity and magnetics data and extrapolations of surface geology. There is, however, absolutely no subsurface information for this part of the State. No boreholes have been drilled, even to shallow horizons. Condor intend to drill as a priority, several stratigraphic wells in central Tasmania, to evaluate the hydrocarbon potential of this promising area. The first of these wells is scheduled for early 1993. An abundance of "seeps" provides optimism for commercial accumulations of oil (and gas) in the subsurface, and it is hoped that the stratigraphic and other geological information to be obtained from stratigraphic drilling, coupled with gravity and magnetics interpretations and seismic data, will provide considerable insight as to where these accumulations might be positioned. Results of the stratigraphic drilling in this part of Tasmania may prove to be discouraging but Questa is confident results will be positive and will lead to the drilling of a petroleum exploration well.

Borehole information is essential, not only to provide stratigraphic, geochemical and structural information, but also to provide control points for seismic velocity information. Processing of acquired seismic has been hampered in part by a lack of subsurface velocity knowledge.

NEAR- SURFACE DOLERITES AND OTHER IGNEOUS INTRUSIONS

Near surface dolerite intrusions and feeder dykes have perhaps more than anything else discouraged oil and gas exploration in Tasmania. Several thousand cubic kilometres of magma formed what might be perceived as a nearly continuous body through the Permian and Triassic sediments over almost all of the State. Up to three dolerite sills have been recognised within the Parmeener Supergroup sequence, the lowest of these being located near the pre-Permian unconformity.

The Jurassic dolerites reflect considerable seismic energy in the upper surface, leaving predominantly low frequency energy to define structurally deeper horizons. Reflector shadows appear beneath the dolerites. The high velocity inherent to the dolerites along with topographic effects, impose considerable static difficulties. Seismic processing problems are being assessed. It is simply a matter of not being able to see (seismically) through the dolerite bodies which may each be as thick as 200 - 350 metres. The problem can theoretically be overcome through sophisticated seismic processing and acquisition techniques.

Expert gravity/magnetics interpretation can resolve where the dolerites are of least significance and this will assist the location of both future seismic lines and well locations.

Stocks of porphyritic syenite and a radial dyke system of various porphyries occur at Port Cygnet and are thought to be of Cretaceous age. Tertiary basalt flows are common throughout Tasmania with sheets up to 300 metres in thickness.

The abundance of igneous intrusions and volcanic sediments throughout the stratigraphic sequence across much of Tasmania is on first impression discouraging, but the major portion of the sedimentary section appears to have been relatively unaffected by the volcanics, contact metamorphism being of minimal extent. It may be viewed that the high heat flows associated with the intrusions were necessary to bring Permian source rocks to a state of organic maturity and the intrusions themselves would have generated structures capable of trapping migrating hydrocarbons.

CONCLUSIONS

Tasmania is prospective for oil and gas; there is no longer any reason to say otherwise. Although it remains uncertain as to whether or not significant hydrocarbon accumulations will ultimately be found, evidence suggests that there is a very good chance that commercial accumulations of oil and gas are present in the subsurface. A carefully planned and methodical exploration program should reveal optimum drilling locations and hopefully identify accumulations of significance.

Onshore Tasmania appears to have all of the criteria of a potential hydrocarbon province. Organically rich, oil prone source rocks have been identified and analysed geochemically. The Tasmanites oil shales are of particularly good source rock quality and there is very good evidence that potential source units lie within the oil window across much of Tasmania. Considerable work remains to be carried out on reservoir distribution and quality, but several potential, porous reservoirs have already been identified. Permeability relationships must still be verified. The integrity of seals has been challenged many times in the past, but there appear to be an abundance of seals. Structures have not been adequately defined, there being very limited seismic control in Tasmania, but the Tasmania Basin (in particular the Early Palaeozoic basin which underlies it) appears to be a typical thrust-fold province which should offer a broad spectrum of structural and stratigraphic trapping possibilities. Maturation modelling indicates that structures were formed prior to the primary periods of peak oil and gas generation.

Numerous past reportings of oil and gas seepages provide considerable encouragement and small volumes of oil and gas have been recovered from shallow boreholes. What appears to be the most prospective region of Tasmania, the central (Derwent Valley) part of the State, has not been penetrated by a well bore, not even in the near surface.

Even small accumulations of oil and/or gas would prove to be commercially attractive in Tasmania, as distances to potential markets and ports are nowhere large and land access is very good.

Before a well can be drilled with the primary objective of finding a commercial hydrocarbon accumulation, boreholes must be drilled to obtain stratigraphic, structural and geochemical information. Without such information, petroleum exploration wells could prove to be of very high risk and petroleum exploration wells are considerably more expensive than stratigraphic boreholes.

The biggest risk in exploring for oil and gas in onshore Tasmania appear to lie in the ability to acquire meaningful seismic data which will define the structural configuration of the subsurface.

GLOSSARY OF GEOLOGICAL TERMS

Aeromagnetic Survey:	Magnetic observations made from a specially equipped aircraft. Provides information on subsurface configuration.
Anticline:	A fold in layered rocks in which the strata slopes down and away from the axis.
Back Reef:	Depositional environment between a reef and the shoreline.
Basement:	Non prospective rocks underlying a sedimentary basin.
Basin:	A segment of the earth's crust which has downwarped and in which sediments have accumulated.
Bioherm:	A mound-like mass built exclusively or mainly by sedimentary organisms such as corals, etc. Often contain important hydrocarbon accumulations.
Carbonates:	Sedimentary rocks composed mainly of calcium carbonate (e.g. limestone and dolomite).
Cambrian:	The oldest geological period of the Palaeozoic Era corresponding to approximately 500 - 570 million years ago.
Closure:	An upwardly confined, three dimensional configuration of strata; generally implies capable of hosting an accumulation of oil and/or gas.
Conglomerate:	Rounded, water-worn fragments of rock or pebbles cemented together by another mineral substance which may be of siliceous or argillaceous (clay rock) nature.
Conodont:	Microscopic phosphatic tooth-like structures from probable vertebrate which ranged from Cambrian to Jurassic time.
Core:	A cylindrical sample of rock obtained when drilling a bore hole, through the use of a hollow drilling bit.

Cretaceous: Geological period corresponding to approximately 65 - 135 million years ago.

Devonian: Geological period corresponding to approximately 345 - 395 million years ago.

Dolerite: An igneous rock also known as diabase.

Dolomitization: The process whereby limestone becomes dolomite by the substitution of magnesium carbonate for a portion of the original calcium carbonate, thereby becoming porous.

Evaporites: Sediments deposited from an aqueous solution through evaporation (e.g. sodium chloride and gypsum).

Exinite: Organic constituents comprising plant spores and cuticular matter considered to be capable of forming oil.

Exploration Well: A well drilled to discover whether a previously untested trap contains oil or gas - often called a wildcat well.

Facies: The aspect of belonging to a geological unit of sedimentation including mineral composition, type of bedding, fossil content, etc.

Fault: A break in a body or layers of rock across which there has been some vertical or lateral displacement.

Fluvial: Pertaining to a river.

Fold: The bending of strata, usually as the result of compression.

Formation: The basic unit for the naming of rock units in stratigraphy.

Graben: An elongate downthrown block between parallel faults; antonym is horst.

Graptolite: Extinct colonial organism.

Gravity Survey: Airborne or ground survey over a grid, using instruments which measure variations in the magnitude of the earth's gravitational field.

Horst: An elongate upthrown block between parallel faults.

Hydrocarbon: Any organic compound comprising carbon and hydrogen. Examples are coal, natural gas and oil.

Igneous: Pertaining to rock units which are formed by solidification from a molten or partially molten state.

Igneous Rocks: Rocks which have been consolidated from hot liquid magmas. These include granite and pegmatite as examples.

Inertinite: Plant material of various origins which has undergone extensive oxidation prior to deposition and which will not yield significant hydrocarbons.

Intertidal: Bounded by the high and low water extremes of the tides.

Intrusion: A body of igneous rocks that invades older rock.

Joint: A large planar feature in a rock in which there is no relative displacement of the two sides.

Jurassic: Geological period corresponding to approximately 135 - 195 million years ago.

Karst: Limestone dissolved by rain or rivers giving rise to surface erosional features as well as caves and even underground river channels into which the surface drainage sinks by rifts and swallow-holes which have been similarly dissolved out.

Kerogen: Usually defined as that organic material in sedimentary rocks which is insoluble in ordinary organic solvents.

Lacustrine: Pertaining to a lake.

Lithology: Systematic description of rocks in terms of mineral composition and texture.

Marine Transgression: Progressive submergence of the land by rising sea level.

Mature Source Rocks:	Rock containing organic material and considered able to release liquid or gaseous hydrocarbons which have been generated from within.
Metamorphic:	Pertaining to rocks which have formed in the solid state in response to pronounced changes in pressure, temperature and chemical environments.
Migration:	The movement of hydrocarbons within sedimentary rocks.
Oil Seep:	A natural flow of oil to the earth's surface.
Ordovician:	The second geological period in the Palaeozoic Era, corresponding to approximately 435 - 500 million years ago.
Orogeny:	Profound deformation of rock bodies along restricted zones and within a limited time interval; essentially mountain building.
Outcrop:	That part of a rock unit occurring at the surface of the earth.
Overthrust:	In a position overlying a thrust fault plane.
Palaeozoic:	A geological era comprising the Cambrian, Ordovician, Silurian, Devonian, Carboniferous and Permian periods and corresponding to approximately 225 - 570 million years ago.
Permeability:	The degree to which fluids (such as gas and oil) can move through a reservoir rock - measured in darcies or millidarcies.
Permian:	Geological period corresponding to approximately 225 - 280 million years ago.
Phyllite:	A rock containing appreciable clay and which is intermediate in metamorphic grade between slate and schist.
Porosity:	A measure of the free pore space of voids in a reservoir rock compared with the total rock volume.

Prospect:	A geological feature in which there is thought to be the potential for oil or gas accumulation.
Quartzite:	A granulose metamorphic rock consisting essentially of quartz.
Regressive:	Applies to sediments deposited during the relative lowering of sea level.
Reservoir:	A permeable sedimentary rock containing adequate pore space to provide storage room for fluids such as oil, gas and water.
Rock Eval Pyrolysis:	A standardised geochemical technique of pyrolysis used to indicate source rock potential.
Seal:	An impervious layer of rock over a reservoir which prevents escape of fluids from the reservoir.
Sedimentary Rocks:	Rocks formed by the accumulation on land or in water of mineral or skeletal particles.
Seismic:	A method of geophysical prospecting involving the generation and recording of reflected sound waves to determine the structure and depth of sedimentary layers.
Shows:	The detectable presence of hydrocarbons observed during the drilling of a well - not necessarily indicative of a commercial accumulation.
Sill:	An intrusive body of igneous rock of approximately uniform thickness and relatively thin with respect to lateral extent which has been emplaced parallel to the bedding of host rocks.
Static (Seismic):	Interferences with acoustic and seismic waves.
Stratigraphic Well:	A borehole drilled solely to obtain subsurface information on sediments, structure, organic maturity, etc. Usually a small diameter borehole.
Syncline:	A structure in which strata are folded into a concave upwards, trough like form.

Source Rock:	An organic rich sedimentary rock which is capable of generating hydrocarbons under optimum maturation conditions of temperature and time.
Stratigraphic Traps:	Type of trap where hydrocarbons are enclosed as a result of a change in rock from porous/permeable to non permeable.
Stratigraphy:	That part of geology dealing with the subdivision, composition, age and correlation of sedimentary rocks.
Tectonic:	Pertaining to structural movements of the earth's crust.
Tertiary:	Geological period corresponding to approximately 3 - 65 million years ago.
Thrust Fault:	A fracture characterized by a low angle of inclination which results in the emplacement of older strata above younger strata.
Total Organic Carbon (TOC):	A measure of the relative organic richness of a potential source rock.
Trap:	A body of reservoir rock, vertically and laterally sealed, the geometry of which allows it to retain hydrocarbons should they migrate into it.
Triassic:	Geological period corresponding to approximately 195 - 225 million years ago.
Turbidite:	Sediments deposited in deep water by the process of gravity sliding off the continental shelf.
Unconformity:	A surface of erosion or non deposition, usually the former, that separates younger rocks from older rocks.
Vitrinite Reflectance:	A technique of measuring degree of organic maturity.
Volcanogenic:	Produced by volcanic activity or derived from previously deposited volcanic products.

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QUALIFICATIONS

Questa Australia Pty Ltd (Questa) was formed in Adelaide, South Australia in 1988 and has operated since that time as independent consultants to the oil and gas industry.

Questa is a well known and respected petroleum consultancy group which specialises in oil and gas field evaluations (reserves, deliverability, development, economics). Much of Questa's work has been carried out for State Government Energy Groups and for lending institutions.

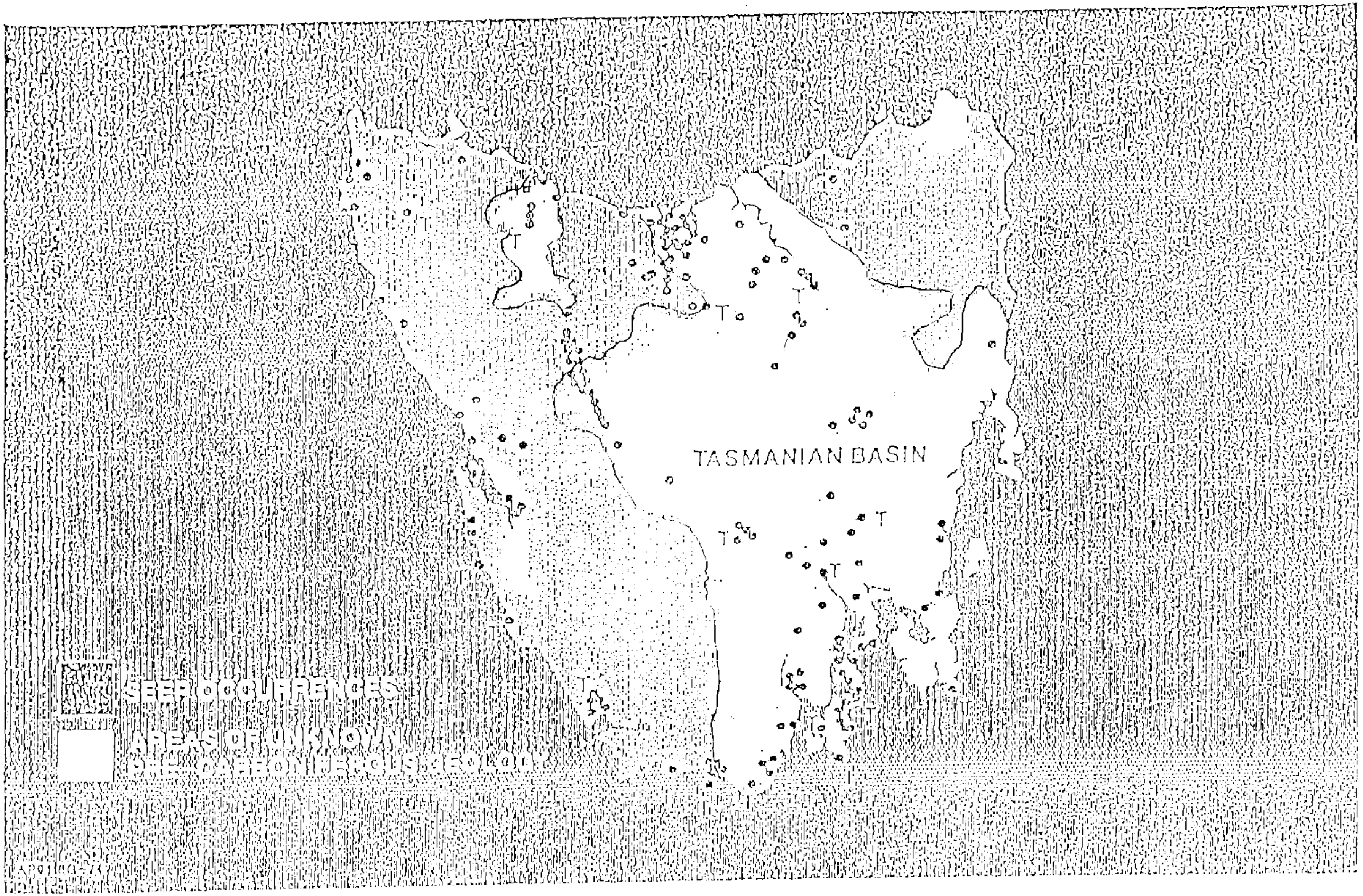
The geological report included in this Prospectus was prepared by G. E. Carne; a Director of Questa. Mr. Carne graduated from Queen's University in Kingston, Ontario, Canada in 1971 with a Bachelor of Science degree, receiving First Class Honours. He worked as a petroleum geologist for major and junior companies in Canada, Indonesia and Australia before becoming a consultant in 1984. He has had considerable experience in sedimentary basin analysis, in particular in frontier areas of Canada and Indonesia.

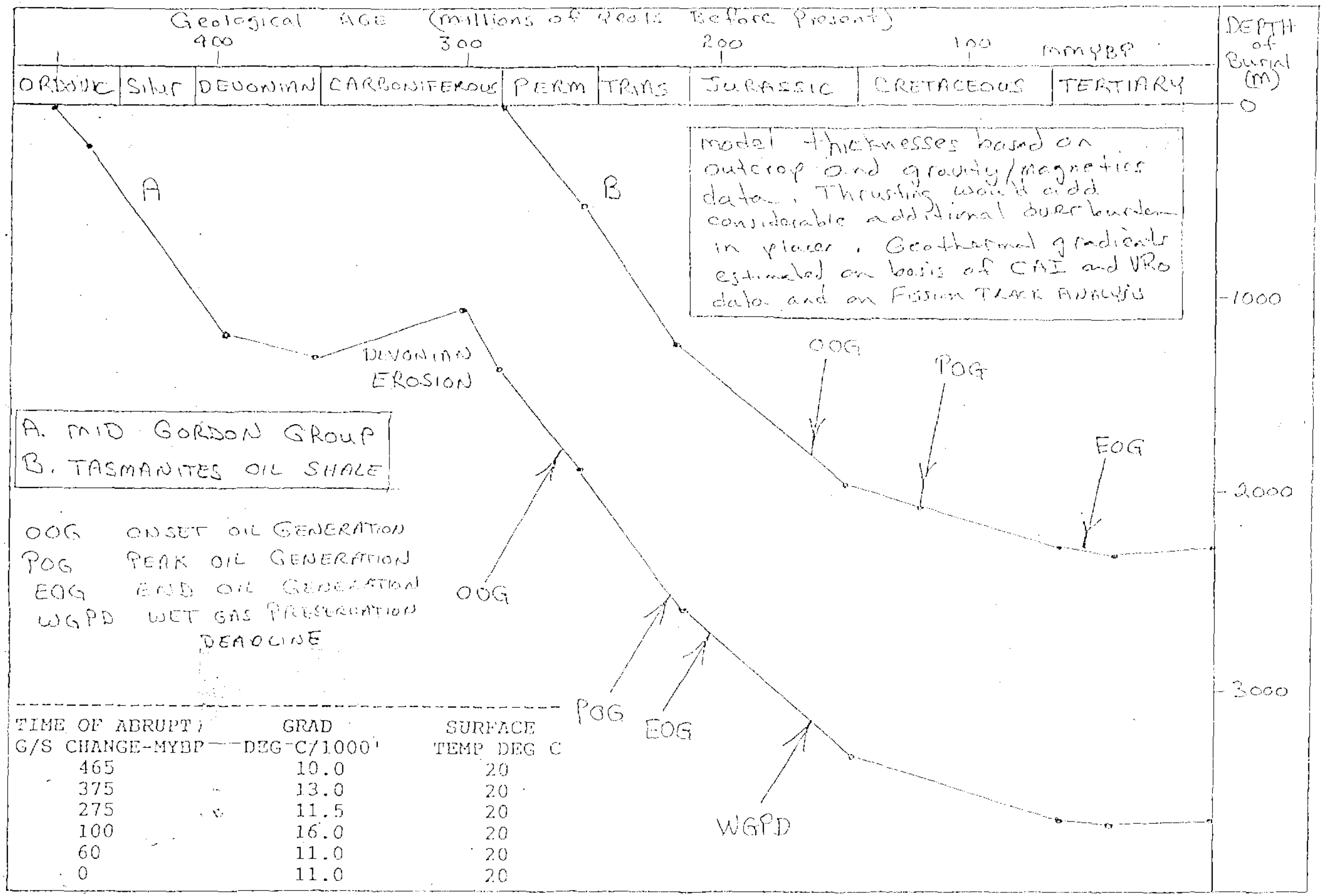
DISCLAIMER

Questa has relied on published documents which for the most part, originated from Condor Oil, and on discussions with senior professionals involved in the "oil search" in Tasmania, to formulate the ideas and conclusions contained in the above geological report. Questa has no first hand experience with the geology of the State of Tasmania. We have relied on geochemical, petrophysical and geophysical analysis carried out by others, to form the basis of our report. Questa have no reason to doubt the expertise, the motives or the credibility of those concerned and accept the data used in the report as being factual.

Gerry Carne, the primary author of the Geological Report, has made three trips to Tasmania during the course of preparing this Prospectus, holding discussions with key government and industry professionals and officers and carrying out a brief but enlightening geological reconnaissance of certain parts of the State.

Drafts of this geological report were critically reviewed by Mr. Peter Baillie, Petroleum Geologist with the Tasmanian Department of Mines, by Dr. J. K. Volkman, a Chemical Oceanographer and Geochemist with CSIRO, by Dr. D. E. Leaman, a consultant Geophysicist based in Tasmania and by Mr. M. R. Bendall, a Geologist and a Director of Condor Oil. Errors in factual content contained in draft versions of this report and pointed out by the above professionals, have been corrected.


TASMANIAN BASIN
SEEP OCCURRENCES
AREAS OF UNKNOWN
PRE-CARBONIFEROUS GEOLOGY



TIME OF ABRUPT G/S CHANGE-MYBP	GRAD DEG C/1000'	SURFACE TEMP DEG C
465	10.0	20
375	13.0	20
275	11.5	20
100	16.0	20
60	11.0	20
0	11.0	20

Burial HISTORY and Maturation model of Idealized TASMANIAN SEDIMENTARY [redacted]

4.2 EXPLORATION LICENSE EL 17/90

850130

EXPLORATION LICENCE 17/90

BICHENO

1. LEASE DATA

Licence No.	17/90
Location	Bicheno,east coast Tas
Granted	pending
Area	300 SKM
Land Status	Crown and private Land
Ownership	Condor Oil Investments Pty. Ltd.
Encumbrances	Nil
Mineral	Oil and Gas

Licence conditions

To complete and fulfill a works program with an estimated expenditure of $50,000. drilling a production assesment well.to a depth of 320 Metres.

2. EXISTING INFRASTRUCTURE

Most of the Exploration licence is serviced by road and power and cleared farmland covers extensiveareas within the licence.The eastern edge of the licence ends in the Tasman sea.

3. CURRENT ACTIVITY OF ADJACENT LEASES

Condor has an agreed works program on EL 1/88 which is currently underway and the rights to all other prospective areas in Tasmania under EL 4/94.

4. SUMMARY OF SALIENT GEOLOGY

The licence area contains a thin cover of Permian and Triassic rocks which onlap upon Devonian granites to the East along a line which currently roughly coincides to the current coast line.

5. PREVIOUS MINING AND EXPLORATION

No previous oil exploration has occured within the area however extensive regional coal exploration produced one stratigraphic hole at Douglas river(320 metres deep) which produced a methane gas flow . Biomarker work by the C.S.I.R.O has also identified three different types of mature hydrocarbons (oil) in that same hole implying three different types of source rocks generating them.One of the biomarkers matches the lower Permian Tasmanites.oil shale the other matches the Quamby mudstone of which the former is a member. The third group of hydrocarbon biomarker type found in the same hole can most closely be equated to the Ordovician Gordon limestone however previous preconceptions would have that rock over.100 KM to the West so until further drilling is completed the Douglas river hole has posed more questions than it has answered.

6. POTENTIAL TARGET

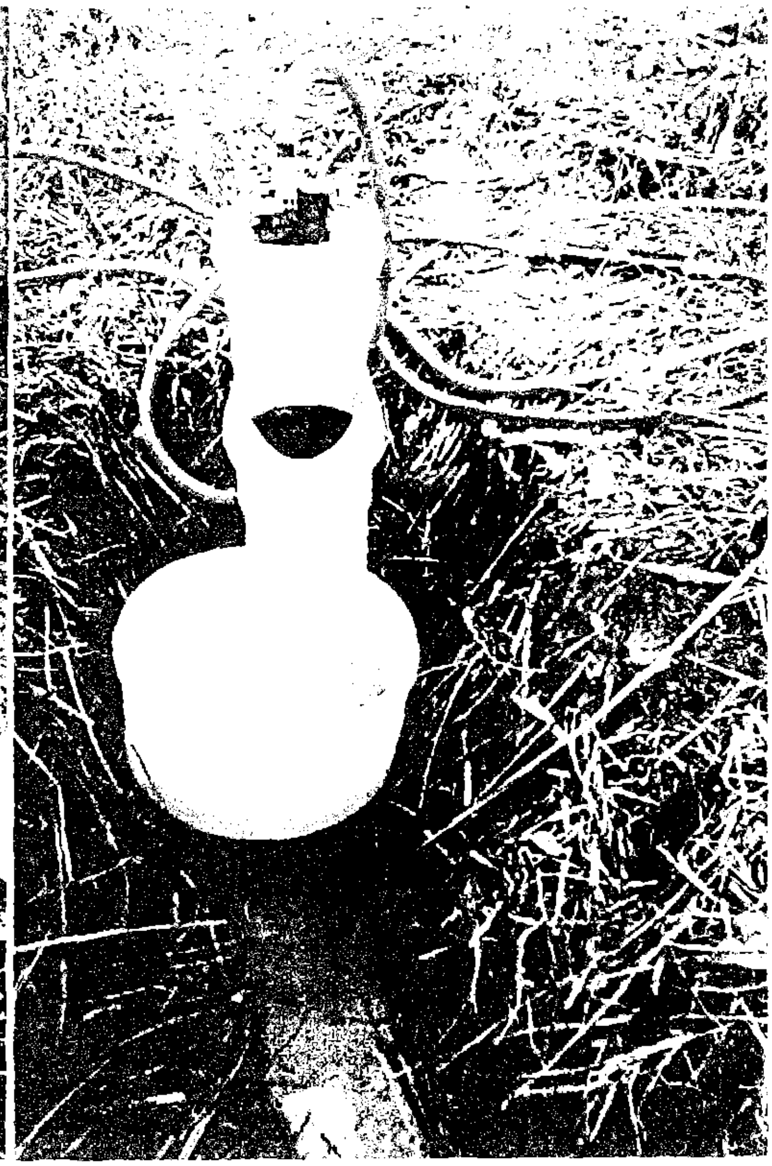
The area is relatively shallow in geological terms however if as indicated from current research the gas is eminating from formations at the bottom of the hole then the gas may be at over 450 P.S.I .There is a big possibility if verified that a commercial operation could be established on that flow if the reserves where large enough.

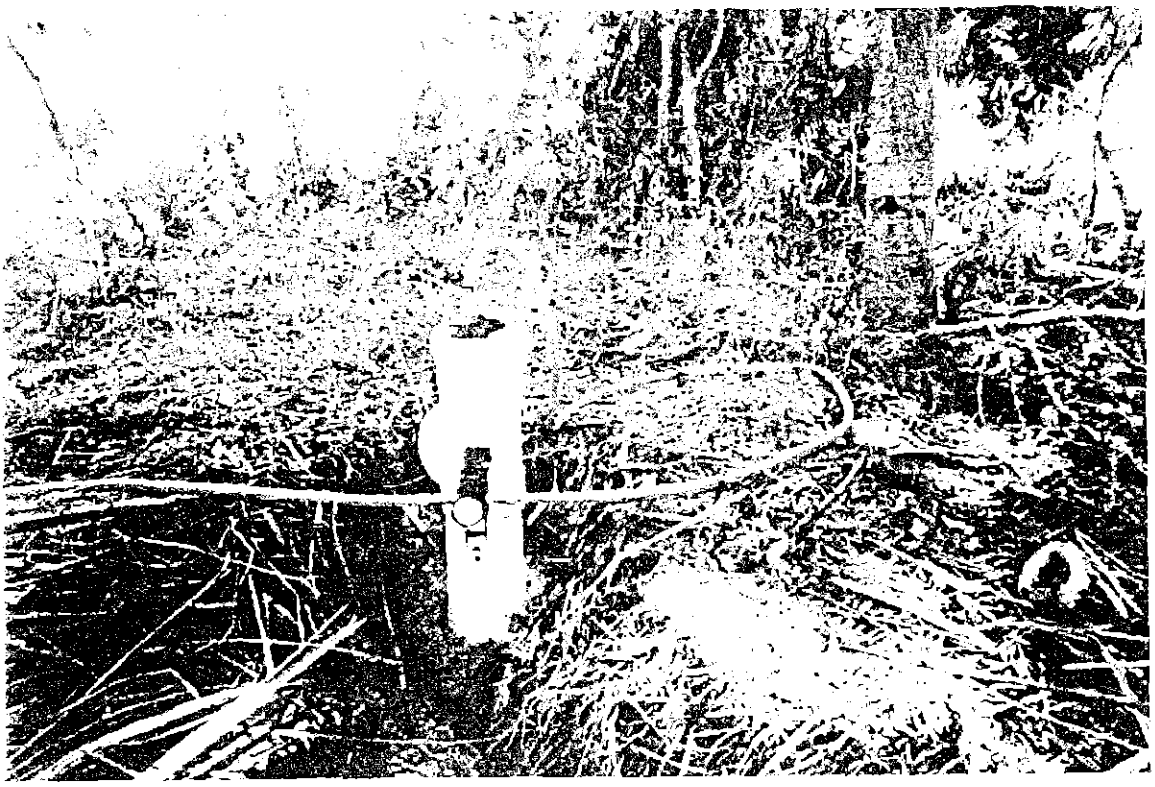
7. WORK UNDERTAKEN BY CONDOR

Initial relocation of the Douglas river hole, establishment of a collar and subsequent sampling in conjunction with the mines department C.S.I.R.O and the B.M.R has been completed.

8. PROPOSED FUTURE EXPLORATION AND COST

Drilling of the Douglas river production assessment hole with appropriate blowout prevention gear and petroleum engineer will cost approximatly $50,000.





4.3 EXPLORATION LICENSE ELA 4/94

EXPLORATION LICENCE 4/94

TASMANIA BASIN

1. LEASE DATA

Licence No.	4/94
Location	Central Tasmania
Granted	pending
Area	37000 sq km
Land Status	Crown and private Land
Ownership	Condor Oil Investments Pty. Ltd.
Encumbrances	Nil
Mineral	Oil and Gas
Past expenditure	$3,355,528

Licence conditions

To be negotiated.

2. EXISTING INFRASTRUCTURE

Most of the exploration licence is serviced by road and power and cleared farmland covers extensive areas within the licence application area.

3. CURRENT ACTIVITY OF ADJACENT LEASES

Condor has an agreed works program on EL 1/88 and EL 17/90 is currently awaiting approval.

4. SUMMARY OF SALIENT GEOLOGY

The licence application area covers Permian and Triassic sediments which are up to 1.5 km in thickness and intruded by Jurassic dolerites and Cretaceous Syanite porphyrs.

5. PREVIOUS MINING AND EXPLORATION

A comprehensive summary of previous historical occurances and drilling results are documented in Bendall 1990 which is appended.

6. POTENTIAL TARGET

Commercial reserves of oil and gas on a similar scale to the Cooper Basin of South Australia and the Amadaeous Basin of central Australia are the expected rewards of exploratory drilling.

7. WORK UNDERTAKEN BY CONDOR.

Appended is the 1991 A.P.E.A.paper and the 1992 geological evaluation by the Australian stock exchange recognised international geological consultants Questa Australia Pty Ltd titled " An evaluation of the oil and gas potential of Tasmania " these summarise the work carried out to date on the project.

8. PROPOSED FUTURE EXPLORATION AND COST

After appraisal of the results obtained from work on EL 1/88 and EL 17/90 an appropriate works program and budget can be framed.