COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Petroleum Search Subsidy Acts

PUBLICATION No. 77

SUMMARY OF DATA AND RESULTS

GIPPSLAND BASIN, VICTORIA

Southwest Bairnsdale No. 1 Well

Duck Bay No. 1 Well

OF

WOODSIDE (LAKES ENTRANCE) OIL COMPANY N.L.

AND

ARCO LIMITED

Issued under the Authority of the Hon. David Fairbairn
Minister for National Development
1966

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

MINISTER: THE HON. DAVID FAIRBAIRN, D.F.C., M.P.

SECRETARY: R. W. BOSWELL

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

DIRECTOR: J. M. RAYNER

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Canberra A.C.T.

FOREWORD

Under the Petroleum Search Subsidy Act 1959-1961, agreements relating to subsidized operations provide that the information obtained may be published by the Commonwealth Government six months after the completion of field work.

The growth of the exploration effort has greatly increased the number of subsidized projects and this increase has led to delays in publishing the results of operations.

The detailed results of subsidized operations may be examined at the office of the Bureau of Mineral Resources in Canberra (after the agreed period) and copies of the reports may be purchased.

In order to make the main results of operations available early, short summaries are being prepared for publication. These will be grouped by area and date of completion as far as practicable. Drilling projects and geophysical projects will be grouped separately. In due course, full reports will be published concerning those operations which have produced the more important new data.

This Publication contains summaries of data and results of two drilling operations undertaken in the Gippsland Basin, Victoria : Southwest Bairnsdale No. 1, and Duck Bay No. 1. The information has been abstracted by the Petroleum Exploration Branch of the Bureau of Mineral Resources from well completion reports furnished by Arco Limited.

J. M. RAYNER
Director

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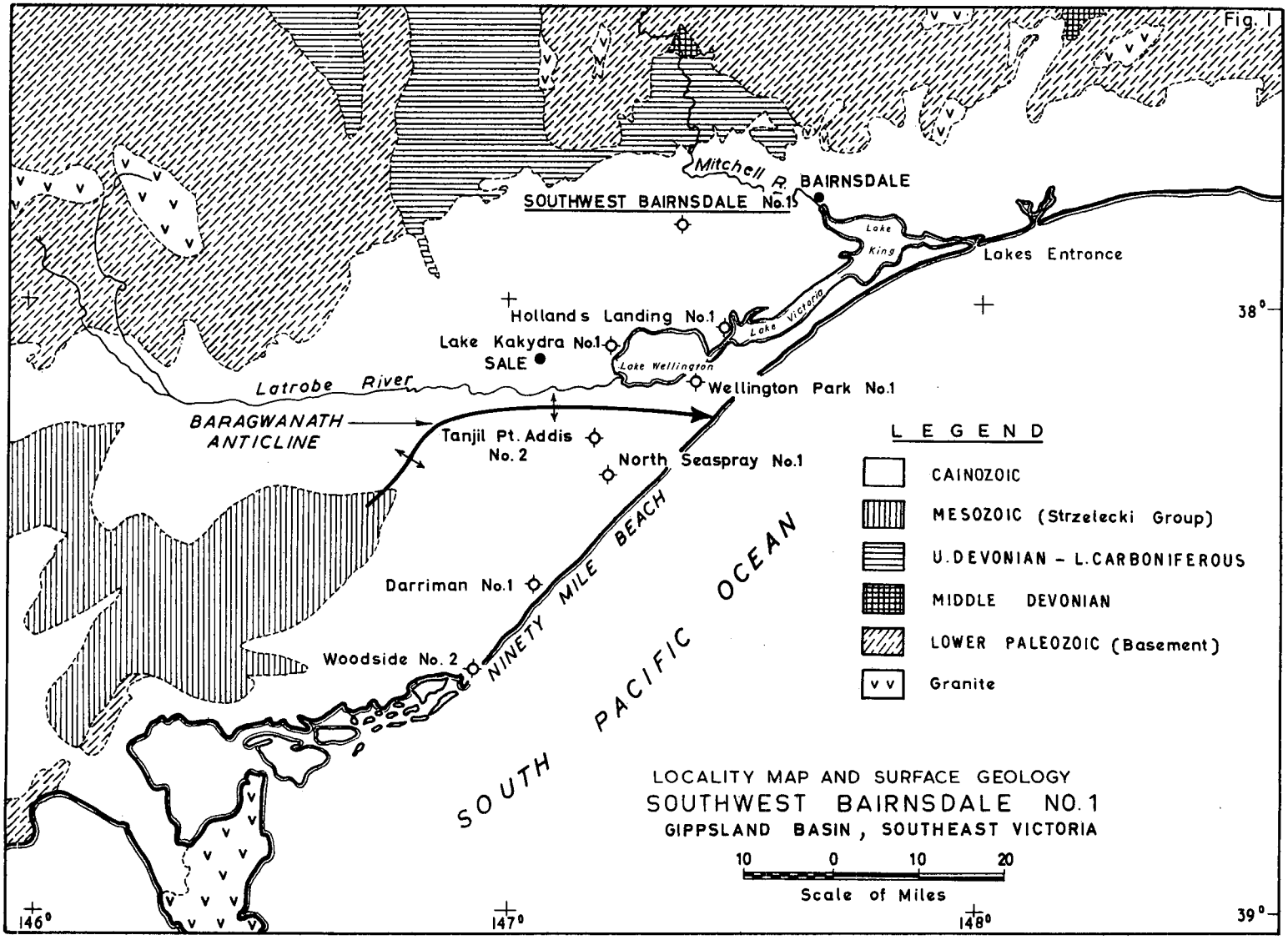
of

WOODSIDE (LAKES ENTRANCE) OIL COMPANY NO LIABILITY

and

ARCO LIMITED

SUMMARY OF DATA AND RESULTS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10 0 10 20
Scale of Miles
146°
147°
148°
39°

SOUTHWEST BAIRNSDALE NO. 1

SUMMARY OF DATA AND RESULTS *

SUMMARY

Southwest Bairnsdale No. 1 Well was located about 15 miles west-south-west of Bairnsdale, in the Gippsland Basin of Victoria. The well was drilled by Reading and Bates (Australia) Pty Ltd for Woodside (Lakes Entrance) Oil Company No Liability and Arco Limited, to total depth of 3926 feet. Drilling commenced on 8th January, 1963 and was completed on 14th February, 1963. A full programme of coring and logging was undertaken.

The objectives of the drilling operation were to obtain stratigraphic data, and to test the hydrocarbon potential of the pre-Tertiary sediments by a well favourably situated to intersect pinch-out zones in the expected Upper Devonian-Lower Carboniferous sequence occurring below a thin Tertiary cover.

The well achieved its objectives; Tertiary sediments were penetrated from surface to 1408 feet, Lower Carboniferous-Upper Devonian non-marine sediments to 3806 feet, and pre-Upper Devonian biotite granite to total depth at 3926 feet.

Middle Devonian marine sediments, which are exposed in the highlands 25 miles north of the well, were not encountered. Basal Tertiary gravels, although having good porosity and permeability, contained only fresh water. The Lower Carboniferous-Upper Devonian sandstones are well cemented and have very little porosity or permeability. No shows of hydrocarbons were found in the well.

One formation test was made over the interval 2522 to 2559 feet after a small quantity of gas was recorded by the gas detector. The test recovered only 120 feet of drilling mud and the flowing pressures recorded were very low. The well was later plugged and abandoned as a dry hole.

The off-structure drilling operation at Southwest Bairnsdale No. 1 was subsidized under the Petroleum Search Subsidy Act 1959-1961, from surface to total depth.

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* Abstracted from : Final Well Report, Southwest Bairnsdale No. 1 Well, by F.T. Ingram, Arco Limited, and N. Meyers, Consulting Geologist, June, 1963.

WELL HISTORY

General Data

Well name and number:	Southwest Bairnsdale No. 1
Location:	Latitude 37°52'06"S. Longitude 147°21'58"E.
Name and address of Tenement Holder:	Victorian Oil N.L., 792 Elizabeth Street, Melbourne, Victoria
Details of Petroleum Tenement:	Petroleum Prospecting Licence No. 185, Victoria
Total Depth:	3926 feet
Date drilling commenced:	8th January, 1963
Date drilling completed:	14th February, 1963
Date well abandoned:	14th February, 1963
Date rig released:	14th February, 1963
Elevation (ground):	225 feet
Elevation (K.B.):	236 feet (datum for depths)
Status:	Dry hole, plugged and abandoned
Cost:	£67,436

Drilling Data

Drilling Plant:

Make:	National
Type:	50

Hole sizes and depths:	16"	to	30 feet
	12 1/4"	to	489 feet
	8 3/4"	to	3926 feet

Casing details:

Size (in.):	13 3/8	9 5/8
Weight (lb./ft):	48	36
Grade:	J.55	J.55
Range:	2	2
Setting depth (ft):	30	477

Logging and Testing

Ditch Cuttings:	
Interval:	Ten feet from surface to total depth; reduced to five feet when coring.
Coring:	Six cores were cut using a Hughes Type "J" core barrel and hard formation core heads. A total of 49 feet was cored and 41.5 feet (85%) recovered.
Sidewall Cores:	No sidewall cores were taken.
Electric and other logging (Schlumberger):	
Electrical Log:	475-3860 feet (2 runs)
Microlog-Microcaliper Log:	475-3860 feet (2 runs)
Sonic Log:	475-3856 feet (1 run)
Continuous Dipmeter Survey:	2000-3856 feet (1 run)
Velocity Survey:	Eight horizons were tested at intervals from 475 to 3856 feet.
Drilling rate, Oil, and Gas Log:	Continuous drilling rate and hydrocarbon plots were recorded during drilling.
Formation Testing:	One formation test over the interval 2522-2559 feet was carried out during the drilling operation. Recovered 120 feet of drilling mud.
Deviation Survey:	The hole deviation was determined at regular intervals with a Totco instrument. Maximum hole deviation was 4 3/4°.
Temperature Survey:	No temperature logs were run. BHT's measured by Schlumberger were 120° at 3342 feet, and 122° at 3860 feet.

GEOLOGY

General

North of the Gippsland Basin, sedimentary rocks of Devonian and Carboniferous age have been mapped and described, but before drilling Southwest Bairnsdale No. 1 Well these rocks had not been investigated in the subsurface of the Basin.

The Tabberabbera Beds of Middle Devonian age crop out along the Mitchell River valley where they consist of marine, interbedded limestone, sandstone, and shale.

Farther east in the vicinity of Buchan, sediments of the same age consist mostly of limestones, with a well developed biostromal facies.

Unconformably overlying the Middle Devonian in the Mitchell River area is a non-marine sequence of shales, sandstones, and volcanics of Lower Carboniferous-Upper Devonian age. The Mitchell River approximately follows the north-south axis of a southward plunging syncline developed in these sediments. When seen in outcrop, the sandstones are often porous and fairly "clean".

Because of the very thick Mesozoic section present in the southern part of the Gippsland Basin no wells had encountered Palaeozoic sediments which are believed to underlie most of this area. In the northern part of the Basin, west of the Lakes Entrance area, several wells had been drilled but only one had penetrated the Tertiary before the drilling of Southwest Bairnsdale No. 1. This well, Frome-Lakes Gippsland No. 5, drilled about five miles south-west of Bairnsdale, found Tertiary sediments in contact with phyllite of Ordovician age, at a depth of 1485 feet.

Stratigraphy

The stratigraphic sequence encountered in Southwest Bairnsdale No. 1 is summarized in the Table below:

Age	Formation	Depth Intervals (feet)	Thickness (feet)
Upper Pliocene	Lake Wellington Formation, and/or Haunted Hill Gravels	11- 200	189 +
Upper Miocene	Tambo River Formation	200- 275	75
Miocene	Gippsland Limestone	275-1035	760
Oligocene	Lakes Entrance Formation	1035-1230	195
Eocene	Colquhoun Gravels	1230-1408	178
	——————Unconformity——————		
Lower Carboniferous-Upper Devonian	Avon River Group (Iguana Creek Beds)	1408-3806	2398
	——————Unconformity——————		
Pre-Upper Devonian	Basement	3806-3926	120 +

Detailed:

Lake Wellington Formation, and/or Haunted Hill Gravels (Upper Pliocene): Surface to 200 feet

Yellow to white, fine to coarse-grained sand, mostly quartz with a few chert and rock fragments; and white, yellow, and red clay, partly limonitic.

Tambo River Formation (Upper Miocene): 200 to 275 feet (75 feet)

White, fine to medium-grained sand with abundant pelecypods, gastropods, echinoids, and foraminifera. This sand probably represents a near shore deposit formed during a regression of the sea which started at the end of the Miocene and continued until Middle Pliocene.

Gippsland Limestone (Miocene): 275 to 1035 feet (760 feet)

Medium grey, slightly silty, fossiliferous, glauconitic marl, with interbeds of tan to grey, fine-grained, fossiliferous, glauconitic limestone between 580 and 760 feet. The Gippsland Limestone thickens southwards; it was 1655 feet thick in Hollands Landing No. 1 Well.

Lakes Entrance Formation (Oligocene): 1035 to 1230 feet (195 feet)

Grey to brown, calcareous, glauconitic, pyritic, fossiliferous siltstone, with minor limestone and marl, to 1135 feet; followed by white, soft clay, white, medium to coarse-grained pebbly sand, siltstone, marl, and limestone. 786 feet of the Lakes Entrance Formation were encountered in Hollands Landing No. 1.

Colquhoun Gravels (Eocene): 1230 to 1408 feet (178 feet)

Sand and gravel, mostly "clean" and unconsolidated; white to medium grey, hard sandstone; and brown to white, lignitic clay. Most of the clay occurs in the top 40 feet. The pebbles in the gravel are commonly greater than one inch in diameter and consist of quartz and metamorphic rocks. Foraminifera are present in the upper 60 feet.

Avon River Group (Iguana Creek Beds) (Lower Carboniferous to Upper Devonian): 1408 to 3806 feet (2398 feet)

This is a series of "red beds" of non-marine origin consisting of shale, siltstone, sandstone, and conglomerate, containing no organic remains, and becoming increasingly arenaceous and rudaceous downwards. The shale is brown to red, soft to brittle, silty and micaceous, and is mottled in shades of grey and green. The siltstone is brown-red to green, slightly calcareous, argillaceous, micaceous, and siliceous. The sandstone is hard, light grey, green, and red, fine to coarse-grained, consisting of angular grains of quartz and volcanic rock fragments. It is calcareous in the upper part and becomes siliceous in the lower part. The conglomerate is hard, siliceous, and argillaceous, and consists of quartz with fragments of chert, volcanics, and other rocks.

Basement (Pre-Upper Devonian): 3806 to 3926 feet (120 feet +)

Weathered, light grey, medium to coarse-grained, biotite granite containing quartz, biotite, and potash and soda feldspars.

Structure

A continuous dipmeter survey was made from 2000 to 3856 feet. The average dip in the Avon River Group was 14^{o} at 168^{o}, and confirms the well position as slightly west of the southward projection of the axis of the Mitchell River syncline. The absence of volcanics in the lower part of the Avon River Group may indicate that the basement granite was a topographic "high" during Devonian vulcanicity.

Porosity and Permeability of Sediments Penetrated

The first occurrence of porosity was noted in sands in the lower part of the Tambo River Formation, and in marls at the top of the Gippsland Limestone. A water bore at the well site produced water from this zone at an approximate rate of 100 barrels per day.

The Microlog showed that the Gippsland Limestone is impervious, except for occasional thin porous beds.

Very good porosity was found in about 75 percent of the Colquhoun Gravels. These gravels are "clean" for the most part, and should have high permeability.

The sandstones of the Avon River Group are very tight because of the calcareous and siliceous cement. The siltstones, and the sandstones to a lesser extent, are argillaceous and also very tight. A formation test of the interval 2522 to 2559 feet produced no formation fluid.

Fig. 2

W

E

Before

Nindoo No. 1

Coongulmerang No. 3

Southwest Bairnsdale No. 1

TERTIARY

MESOZOIC

U. DEVONIAN - L. CARBONIFEROUS

Volcanics

M. DEVONIAN

ORDOVICIAN (Basement)

After

Nindoo No. 1

Haunted Hill Gravels and/or Lake Wellington Fm.

Coongulmerang No. 3

Southwest Bairnsdale No. 1
T.D. 3926'

Gippsland Limestone

Tambo River Fm.

Lakes Entrance Fm.

Colquhoun Gravels

U. DEVONIAN - L. CARBONIFEROUS

Avon River Group

Volcanics

ORDOVICIAN

ORDOVICIAN

Biotite Granite

Sea Level

- 1000'
- 2000'
- 3000'
- 4000'
- 5000'
- 6000'
- 7000'
- 8000'

ARCO LTD. / WOODSIDE (LAKES ENTRANCE) OIL CO. N.L.

SOUTHWEST BAIRNSDALE NO. 1

GEOLOGIC CROSS - SECTION BEFORE AND AFTER DRILLING

Horizontal Scale

1 0 1 2

Miles

Prepared by F. Ingram

Drafting by GEODRAFTING SERVICES

Date 24 · 5 · 63

ADDITIONAL DATA FILED IN THE BUREAU OF MINERAL RESOURCES

The following additional data relating to Southwest Bairnsdale No. 1 Well have been filed in the Bureau of Mineral Resources, Canberra, and are available for reference:

(i) Well Completion Report, by F.T. Ingram and N. Myers — 21 pp.

Appendix 1:	List and interpretation of electrical and other logs.	2 pp.
	Velocity survey report, by V. Bychok	2 pp.
Appendix 2:	Formation testing report	1 p.
Appendix 3:	Palaeontological report, by D.J. Taylor	5 pp.
Appendix 4:	Petrological reports, by J.A. Talent, and G. Bell	4 pp.
Appendix 5:	Core descriptions	2 pp.

(ii) Daily drilling reports for period 6th January, 1963 to 16th February, 1963

(iii) Well logs including the following:

(a) Electrical Log

Run 1, 475 - 3342 feet (scale 2", 5": 100 ft)
Run 2, 3200 - 3860 feet (scale 2", 5": 100 ft)

(b) Microlog

Run 1, 475 - 3342 feet (scale 2", 5": 100 ft)
Run 2, 3200 - 3860 feet (scale 2", 5": 100 ft)

(c) Sonic Log

Run 1, 475 - 3856 feet (scale 2", 5": 100 ft)

(d) Continuous Dipmeter

Run 1, 2000 - 3856 feet (scale 1.2" : 100 ft)

DUCK BAY NO. 1

of

WOODSIDE (LAKES ENTRANCE) OIL COMPANY NO LIABILITY

and

ARCO LIMITED

SUMMARY OF DATA AND RESULTS

7210/66.—2

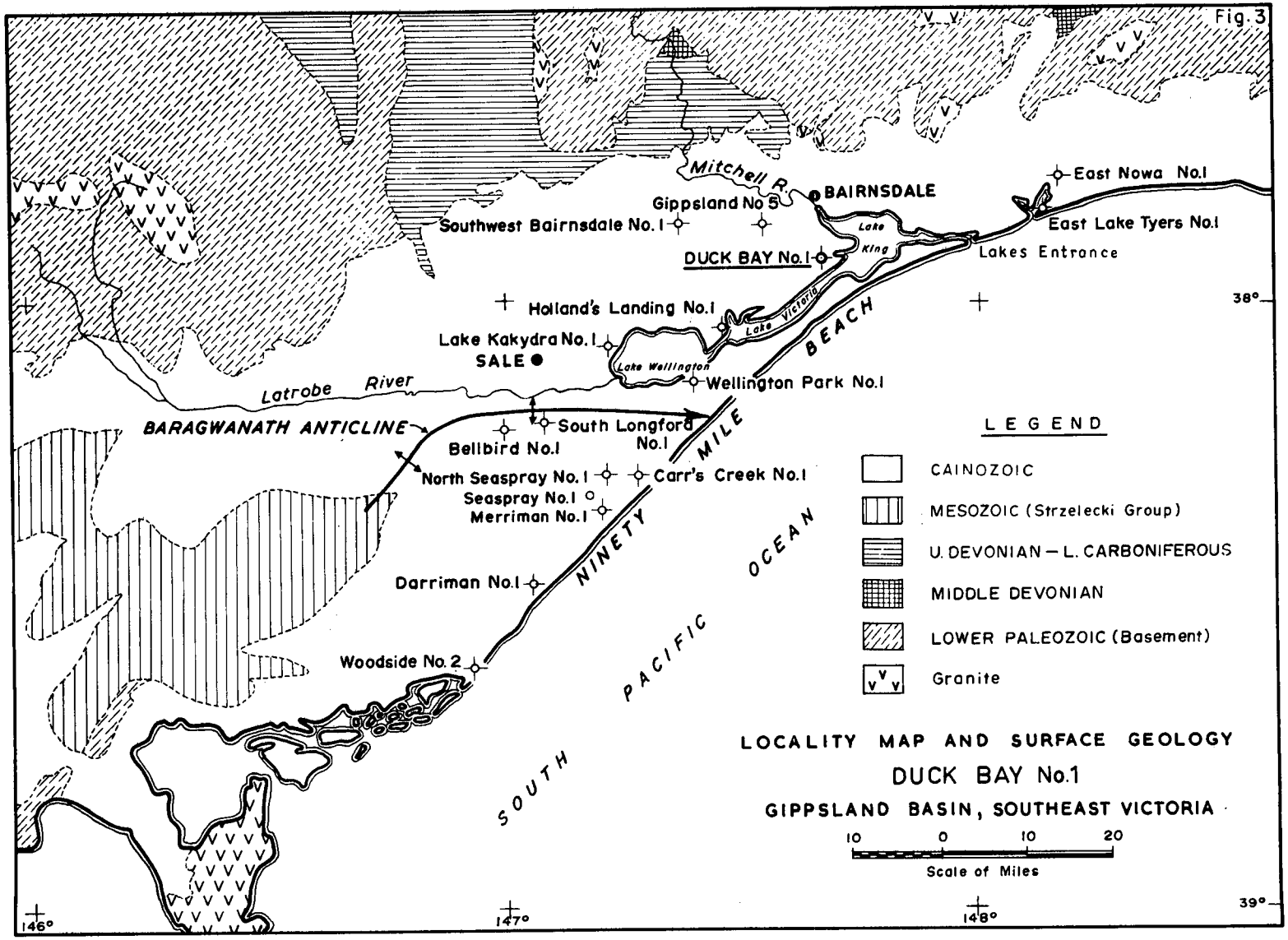
Fig. 3
Mitchell R.
BAIRNSDALE
East Nowa No.1
Gippsland No 5
Southwest Bairnsdale No. 1
East Lake Tyers No.1
Lake King
DUCK BAY No.1
Lakes Entrance
38°
Holland's Landing No.1
Lake Victoria
Lake Kakydra No.1
SALE
Lake Wellington
BEACH
Latrobe River
Wellington Park No.1
BARAGWANATH ANTICLINE
South Longford No.1
Bellbird No.1
MILE
North Seaspray No.1
Carr's Creek No.1
Seaspray No.1
Merriman No.1
NINETY
OCEAN
Darriman No.1
PACIFIC
Woodside No. 2
SOUTH
LEGEND
CAINOZOIC
MESOZOIC (Strzelecki Group)
U. DEVONIAN — L. CARBONIFEROUS
MIDDLE DEVONIAN
LOWER PALEOZOIC (Basement)
Granite
LOCALITY MAP AND SURFACE GEOLOGY
DUCK BAY No.1
GIPPSLAND BASIN, SOUTHEAST VICTORIA
10 0 10 20
Scale of Miles
39°
146°
147°
148°

DUCK BAY NO. 1

SUMMARY OF DATA AND RESULTS *

SUMMARY

Duck Bay No. 1 Well was located four miles south-west of Paynesville, and about 17 miles east-south-east of Southwest Bairnsdale No. 1 Well, in the Gippsland Basin of Victoria. The well was drilled by Reading and Bates (Australia) Pty Ltd for Woodside (Lakes Entrance) Oil Company No Liability and Arco Limited, to total depth of 4238 feet. Drilling commenced on 15th February, 1964 and was completed on 26th February, 1964. A full programme of coring and logging was undertaken.

The objectives of the drilling operation at Duck Bay No. 1 were to explore the Strzelecki Group in an area where the Group was thought to be thinning, and to obtain data from the pre-Strzelecki sediments.

The well spudded in the Upper Pliocene, and drilled through a thin but complete Tertiary sequence to 2684 feet, Lower Cretaceous Strzelecki Group to 3175 feet, Lower Permian volcanics and non-marine sandstone to 4124 feet, and bottomed in Ordovician metamorphics at 4238 feet.

No significant shows of hydrocarbons were detected and the well was plugged and abandoned as a dry hole on 28th February, 1964.

The stratigraphic drilling operation at Duck Bay No. 1 was subsidized under the Petroleum Search Subsidy Act 1959-1961, from surface to total depth.

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* Abstracted from: Final Well Report, Duck Bay No. 1 Well, by F.T. Ingram, Arco Limited, April, 1964.

WELL HISTORY

General Data

Well name and number:	Duck Bay No. 1
Location:	Latitude 37°56'45"S. Longitude 147°39'36"E.
Name and address of Tenement Holders:	Woodside (Lakes Entrance) Oil Company No Liability, and Arco Limited, 792 Elizabeth Street, Melbourne, Victoria
Details of Petroleum Tenement:	Petroleum Exploration Permit No. 44, Victoria
Total Depth:	4224 feet (Driller) 4238 feet (Schlumberger)
Date drilling commenced:	15th February, 1964
Date drilling completed:	26th February, 1964
Date well abandoned:	28th February, 1964
Date rig released:	28th February, 1964
Elevation (ground):	68 feet
Elevation (K.B.):	79 feet (datum for depths)
Status:	Dry hole, plugged and abandoned
Cost:	£34,680

Drilling Data

Drilling Plant:			
Make:	National		
Type:	50		
Hole sizes and depths:	22"	to	23 feet
	17 1/2"	to	420 feet
	8 3/4"	to	4238 feet
Casing details:			
Size (in.):	18 5/8		13 3/8
Weight (lb./ft):	78		48
Grade:			J.55
Range:	2		2
Setting depth (ft):	23		410

Logging and Testing

Ditch Cuttings:	
Interval:	Ten feet from surface to total depth, reduced to five feet when coring.
Coring:	Nine cores were cut using a Hughes Type "J" core barrel and hard and soft formation core heads. A total of 136 feet was cored and 81.5 feet (60%) recovered.
Sidewall Cores:	Twelve samples were recovered from thirteen shots fired.
Electric and other logging (Schlumberger):	
Electrical Log:	410 - 4237 feet (1 run)
Microlog-Caliper:	410 - 4231 feet (1 run)
Sonic-Gamma Ray Log:	410 - 4221 feet (1 run)
Continuous Dipmeter Survey:	1000 - 4220 feet (1 run)
Velocity Survey:	Ten horizons were tested at intervals from 410 to 4229 feet.
Drilling rate, Oil and Gas Log:	Continuous drilling rate and hydrocarbon plots were recorded during drilling.
Formation Testing:	No formation tests were made.
Deviation Survey:	The hole deviation was determined at regular intervals with a Totco instrument. The deviation between 140 and 3880 feet varied from 1/4° to 1 1/4°. At 4152 feet, the last survey, the deviation was 2 1/2°.
Temperature Survey:	No temperature surveys were made.

GEOLOGY

General

The surface in the Duck Bay area is covered by late Pliocene to Recent sediments, which mask the underlying geology. Palaeozoic rocks were studied on the northern side of the Basin where they form extensive outcrops in the highlands.

The Gippsland Basin was covered by a gravity survey in 1949 by the Robert H. Ray Company, and this work was later complemented by additional gravity and aeromagnetic surveys by the Bureau of Mineral Resources, Geology and Geophysics.

In 1962, a reflection seismic survey in the Lake Victoria and Lake King area was made by Austral Geo Prospectors Pty Ltd for Arco Limited and Woodside (Lakes Entrance) Oil Company N.L. During this survey good reflections in the Tertiary section were obtained, but only poor to fair reflections were obtained from the pre-Tertiary strata. Two refraction surveys were also made by the same contractor west of the Duck Bay area.

Before drilling Duck Bay No. 1, the only indication of Upper Palaeozoic sediments in the Gippsland Basin was an isolated outcrop of conglomerate (or glacial tillite) on the south side of the Carrajung Uplift. The Duck Bay No. 1 Well revealed the presence of 624 feet of Upper Palaeozoic (Lower Permian?) sediments overlain by 325 feet of volcanics of possible Permian age.

At the time of drilling Duck Bay No. 1, no sediments of Triassic age had been identified in the Gippsland Basin.

The Strzelecki Group of late Jurassic to early Cretaceous age, was deposited in a great trough, oriented east-west. The sequence consists of non-marine clastics with an estimated thickness of 10,000 to 20,000 feet in the Carrajung Uplift. A total of 8211 feet of this sequence was penetrated in the Wellington Park No. 1 Well, with no indication of reaching the base. The unit thins rapidly towards the northern margin of the trough so that only 491 feet is present in Duck Bay No. 1.

The continuous dipmeter log run in the Duck Bay No. 1 Well indicates a slight angular unconformity between the Lower Cretaceous and Upper Palaeozoic strata.

In Eocene time downwarping resulted in widespread deposition of the Latrobe Valley Coal Measures over structurally complex rocks ranging in age from Ordovician to Lower Cretaceous. In the Duck Bay area, the Lower Cretaceous and Upper Palaeozoic rocks have been tilted to the south-east, and Tertiary strata, with a regional dip to the south of about 200 feet per mile, overlie Lower Cretaceous beds dipping to the south-east at about 16°.

Further downwarping in Oligocene time produced a widespread transgression of the sea over the Gippsland Basin. Marine conditions existed until about Middle Pliocene; during this time interval the Lakes Entrance Formation, Gippsland Limestone, Tambo River Formation, and Jemmy's Point Formation were deposited.

From Upper Pliocene to Recent time non-marine conditions prevailed in the area now forming the landward portion of the Basin. During this time a widespread cover of sand, clay, and gravel, known as the Haunted Hill Gravels and/or the Lake Wellington Formation, was deposited over the marine sediments.

Stratigraphy

The stratigraphic sequence encountered in Duck Bay No. 1 is summarized in the following Table:

Age	Formation	Depth Intervals (feet)	Thickness (feet)
Upper Pliocene	Lake Wellington Formation, and/or Haunted Hill Gravels	11 - 300	289 +
Lower Pliocene	Jemmy's Point Formation	300 - 400	100
Upper Miocene	Tambo River Formation	400 - 420	20
Miocene	Gippsland Limestone	420 - 1900	1480
Oligocene	Lakes Entrance Formation	1900 - 2285	385
Lower Oligocene-Upper Eocene	Latrobe Valley Coal Measures	2285 - 2684	399
	————Unconformity————		
Lower Cretaceous	Strzelecki Group	2684 - 3175	491
	————Unconformity————		
Lower Permian (?)	Unnamed	3175 - 3500	325
Lower Permian (?)	Unnamed	3500 - 4124	624
	————Unconformity————		
Ordovician	Undifferentiated	4124 - 4238	114 +

Detailed:

Lake Wellington Formation and/or Haunted Hill Gravels (Upper Pliocene): Surface to 300 feet

Fine to coarse-grained, light grey to yellow sand; gravel; grey to yellow clay; and lignite.

Jemmy's Point Formation (Lower Pliocene): 300 to 400 feet (100 feet)

Fine to medium-grained sand, subrounded grains, above medium grey, silty, fossiliferous, glauconitic marl. Fragments of bryozoa, gastropods, pelecypods, and foraminifera are abundant in the sands.

Tambo River Formation (Upper Miocene): 400 to 420 feet (20 feet)

Medium grey, silty, fossiliferous marl. This unit, like the Jemmy's Point Formation, thickens westward; it ranges from 100 to 160 feet thick in the Lake Wellington - Seaspray area.

Gippsland Limestone (Miocene): 420 to 1900 feet (1480 feet)

Grey-brown, silty, glauconitic, fossiliferous marl down to 510 feet; white to brown, finely crystalline to fine-grained, fossiliferous, friable to hard limestone to 1015 feet; interbedded limestone and marl to 1350 feet; and grey, fossiliferous, glauconitic, calcareous claystone with minor marl to 1900 feet. The main limestone is slightly glauconitic, porous in the upper part, and argillaceous and tight in the lower.

Lakes Entrance Formation (Oligocene): 1900 to 2285 feet (385 feet)

An upper unit of claystone similar to that of the Gippsland Limestone; a middle unit of brown-green, glauconitic, pyritic, fossiliferous shale; and a lower unit of fine to coarse-grained, glauconitic, pyritic sand becoming lignitic towards the base.

Latrobe Valley Coal Measures (Lower Oligocene to Upper Eocene): 2285 to 2684 feet (399 feet)

The basal sand of the Lakes Entrance Formation grades downwards into an interbedded series of fine to coarse-grained sand; clean to lignitic gravel; poor quality brown coal; and clay. The thin dolomitic beds present in the Lake Wellington-Seaspray area are absent in Duck Bay No. 1, and brown coal is represented in the well by only one significant seam.

No fossils, other than spores, were found in the Coal Measures. The base of the formation rests unconformably upon the Mesozoic.

Strzelecki Group (Lower Cretaceous): 2684 to 3175 feet (491 feet)

Dark green-grey to brown, compact, silty, carbonaceous shale and mudstone, with light grey to brown, argillaceous, carbonaceous, micaceous siltstone. A marine or brackish water environment is possible for part of the sequence. The Strzelecki Group thickens rapidly to the west. The relation between the thin sequence at Duck Bay No. 1 and the sequence greater than 8000 feet thick at Wellington Park No. 1 is not known.

Unnamed Formation (Lower Permian?): 3175 to 3500 feet (325 feet)

Predominantly dark green to black, chloritized, fine-grained to aphanitic, crumbly, fractured basalt with subordinate tuff, breccia, and ash. Traces of dark red-brown shale and sandy siltstone with inclusions of volcanic material were noted between 3330 and 3380 feet. There is a marked angular unconformity between the volcanics and the Strzelecki Group.

Unnamed Formation (Lower Permian?): 3500 to 4124 feet (624 feet)

Predominantly white to light grey, fine-grained, friable sandstone with argillaceous, sericitic matrix and carbonaceous flakes and laminae. Minor dark brown to grey shale and slightly dolomitic, light grey siltstone beds are present.

The age of these sediments has been determined by the identification of spores in Core No. 6 (3699 to 3709 feet). No marine fossils have been found in these sediments, and because of the presence of carbonaceous material, it is probable that the sequence is non-marine in origin.

An Upper Palaeozoic section has not been seen elsewhere in the Gippsland Basin, and its exact correlation with sediments in other basins has not been established.

Undifferentiated (Ordovician): 4124 to 4238 feet (114 feet +)

Dark grey, dense, silty, pyritic slate; hard, siliceous siltstone; and very hard, siliceous, fine-grained, sandstone. These are similar to the Ordovician sediments cropping out north-west of the Basin.

Structure

Duck Bay No. 1 Well was not located on any known structure; its objectives were entirely stratigraphic.

The dipmeter survey indicated angular unconformities between the Tertiary and Mesozoic, and between the Mesozoic and Palaeozoic. Regional dips throughout are to the south.

Porosity and Permeability of Sediments Penetrated

Porous sands are present from about 120 feet down to 350 feet. The friable limestones in the upper part of the Gippsland Limestone in the interval 420 to 730 feet are very porous. Between 730 and 1500 feet there are several thin porous zones, the best of which occur from 1350 to 1500 feet. From 1500 to 2240 feet the section is tight. The basal glauconitic sands of the Lakes Entrance Formation have fair to good porosity.

The sands of the Latrobe Valley Coal Measures have fair to good porosity (calculated porosities from Microlog and Sonic Log range from 28% to 39%). These sands have been flushed with fresh water, but the salinities of 700 to 1050 ppm. NaCl equivalent, in Duck Bay No. 1 are greater than in the Lake Wellington-Seaspray area where they are only 300 to 400 ppm.

The mudstones of the Strzelecki Group are tight throughout. The volcanic sequence from 3175 to 3500 feet has no intergranular porosity, but there may be some fracture porosity.

Relevance to Occurrence of Petroleum

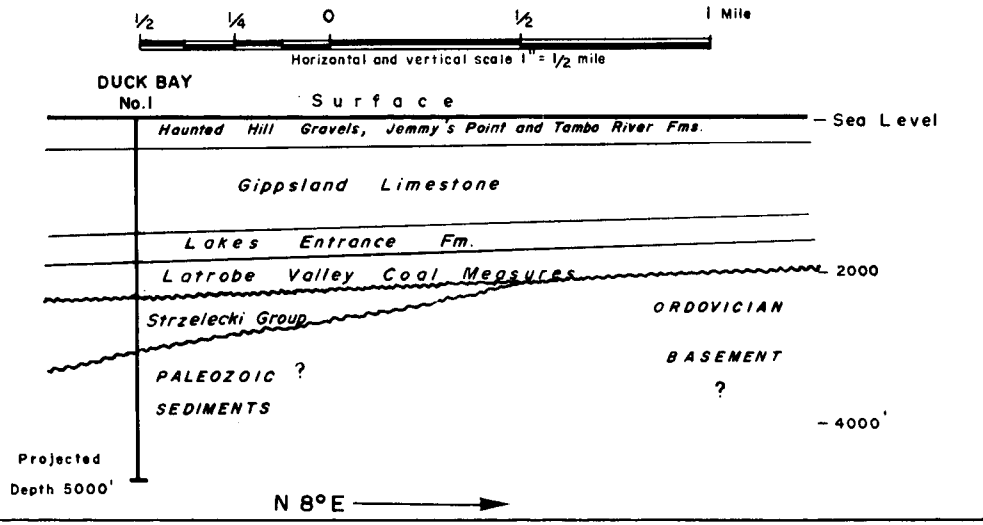
During drilling operations, several small gas shows were recorded in the Gippsland Limestone and in the top of the Latrobe Valley Coal Measures. The electrical and other logs indicated that these shows originated from porous zones with 100% water saturation. The gas shows in the Gippsland Limestone probably originated in marine beds, but the gas in the Coal Measures is more likely to be of a carbonaceous origin.

Fig. 4

ARCO LTD. / WOODSIDE (LAKES ENTRANCE) OIL CO. N. L.

GEOLOGIC CROSS-SECTION BEFORE AND AFTER DRILLING

DUCK BAY No. 1



The oil in the Lakes Entrance area occurs in the glauconitic sand at the base of the Lakes Entrance Formation. This section in Duck Bay No. 1, although porous, appears to have 100% water saturation.

No gas shows were recorded in the Lower Cretaceous or Upper Palaeozoic. The Strzelecki Group was completely lacking in reservoir beds, and the Upper Palaeozoic section contained only very thin porous beds having at the best about 20% porosity. Both of these units are lacking in marine fossils, and appear to have been deposited in fresh or possibly brackish water.

REFERENCES

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS, (Ed.), 1965: Wellington Park No. 1 Well, in Summary of Data and Results, Gippsland Basin, Victoria. Bur. Min. Resour. Aust. Petrol. Search Subs. Acts Publ. 71.

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ESSO EXPLORATION AUSTRALIA, INC.. 1966: Esso Gippsland Shelf No. 1 Well, Victoria. Bur. Min. Resour. Aust. Petrol. Search Subs. Acts Publ. 76.

INGRAM, F.T., 1962: Well completion report, Wellington Park No. 1. Unpublished report for Arco Limited and Woodside (Lakes Entrance) Oil Company N.L.

INGRAM, F.T., 1963: Well completion report, North Seaspray No. 1. Unpublished report for Arco Limited and Woodside (Lakes Entrance) Oil Company N.L.

INGRAM, F.T., 1964: Well completion report, Duck Bay No. 1. Unpublished report for Arco Limited and Woodside (Lakes Entrance) Oil Company N.L.

REFERENCES (Cont'd)

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RINGWOOD, A.E., 1955: The geology of the Mitchell River area. Unpublished report for Frome - Lakes Pty Ltd.

ROD, EMILE, 1962: Investigation of selected localities in the Palaeozoic framework of the Gippsland Basin. Unpublished report for Arco Limited.

TALENT, J.A., 1955: Upper Devonian - Carboniferous rocks west of Freestone Creek, Gippsland, Victoria. Unpublished report for Frome - Lakes Pty Ltd.

ADDITIONAL DATA FILED IN THE BUREAU OF MINERAL RESOURCES

The following additional data relating to Duck Bay No. 1 Well have been filed in the Bureau of Mineral Resources, Canberra, and are available for reference:

(i)	Well Completion Report, by F.T. Ingram		24 pp.
	Appendix 1:	List and interpretation of electrical and other logs, by F.T. Ingram.	2 pp.
		Velocity survey report, by V. Bychok	2 pp.
	Appendix 2:	Report on Tertiary stratigraphy, by J.B. Hocking.	4 pp.
		Palynological examinations, by J. Douglas, E.A. Hodgson, and P.R. Evans	4 pp.
	Appendix 3:	Core descriptions	4 pp.
	Appendix 4:	Petrological reports, by Sylvia Whitehead, J.B. Hocking, and K.G. Bowen	10 pp.

(ii) Daily drilling reports for period 13th February, 1964 to 28th February, 1964

(iii) Well logs including the following:

(a) Electrical

Run 1, 410 - 4237 feet (scale 2", 5" : 100 ft)

(b) Microlog-Caliper

Run 1, 410 - 4231 feet (scale 2", 5" : 100 ft)

(c) Sonic-Gamma Ray Log

Run 1, 410 - 4221 feet (scale 2", 5" : 100 ft)

(d) Continuous Dipmeter

Run 1, 1000 - 4220 feet (scale 1.2" : 100 ft)

COMPOSITE WELL LOG

COMPANY: ARCO LTD. / WOODSIDE (LAKES ENTRANCE) OIL CO. N.L.

WELL NO: SOUTHWEST BAIRNSDALE NO. 1

PETROLEUM TENEMENT: P.P.L. No.185 | STATE: VICTORIA | 4 - MILE SHEET: BAIRNSDALE | BASIN: GIPPSLAND | WELL STATUS: ABANDONED

LOCATION: Lat 37° 52′ 06″ South, Long 147° 21′ 58″ East

ELEVATION: Reference Pt. K.B. 236′ ASL.
Ground 225′ ASL.

Date Spudded. January 8, 1963
Date Drilling Stopped. February 14, 1963
Date Rig Released. February 14, 1963

Total Depth: Driller 3926′

Hole Size.	In.	From	To
	16	Surface	30′
	12¼	30′	489′
	8¾	489′	3926′

Casing.	In.	Wt.	Gr.	Depth	Cement	Cmt'd to
	13⅜	48 lb	J-55	30′	20 sx.	Surface
	9⅝	36 lb	J-55	477′	210 sx.	Surface

Cement Plugs:	From	To	Sacks
	0′	10′	5
	410′	510′	50
	1160′	1260′	50

Well Head Fittings: Welded steel plate
Drilled By: Reading and Bates (Aust.) Pty. Ltd.
Logged By: Schlumberger
Mud Logging By: Arco Ltd.
Cemented By: Halliburton
Drilling Method: Rotary
Lithology By: F. Ingram, N. Meyers and D. Rutledge
Drafting by: Geodrafting Services

ELECTRIC LOG DATA / MICROLOG CALIPER DATA

Run No.	1	2	1	2
Date	January 31, 1963	February 12, 1963	January 31, 1963	February 12, 1963
First Reading	3342′	3860′	3342′	3860′
Last Reading	475′	3200′	475′	3200′
Interval Measured	2867′	660′	2867′	660′
Casing Schlumberger	475′	475′	475′	475′
Casing Driller	477′	477′	477′	477′
Depth Reached	3343′	3861′	3343′	3861′
Bottom Driller	3338′	3855′	3338′	3855′
Mud Nature	Bentonite	Bentonite	Bentonite	Bentonite
Density / Viscosity	10·5 / 41	10·8 48	10·5′ / 41	10·8 / 48
Mud Resistivity	2·11 @ 90° F	1·60 @ 74° F	2·11 @ 90° F	1·60 @ 74° F
Mud Resist BHT	1·65 @ 120° F	1·00 @ 122° F	1·65 @ 120° F	1·00 @ 122° F
pH / Fluid Loss	9 / 9·4 cc / 30 min.	9 / 8 cc / 30 min.	9 / 9·4 cc / 30 min.	9 / 8 cc / 30 min.
Origin of Sample	Circulation	Circulation	Circulation	Circulation
Rmf	2·05 @ 82° F	1·65 @ 74° F	2·05 @ 82° F	1·65 @ 74° F
Rmc	2·30 @ 82° F	1·80 @ 74° F	2·30 @ 82° F	1·80 @ 74° F
Bit Size	8¾″ to Bottom	8¾″ to Bottom	8¾″ to Bottom	8¾″ to Bottom
Casing Size	9⅝″	9⅝″	9⅝″	9⅝″
Opr. Rig Time	4 hours	2 hours	2 hours	1½ hours
Truck No.	2520	2520	2520	2520
Recorded by	G. Guigues	G Guigues	G. Guigues	G. Guigues
Witness	F. Ingram	F. Ingram	F. Ingram	F. Ingram

OTHER WELL LOGS

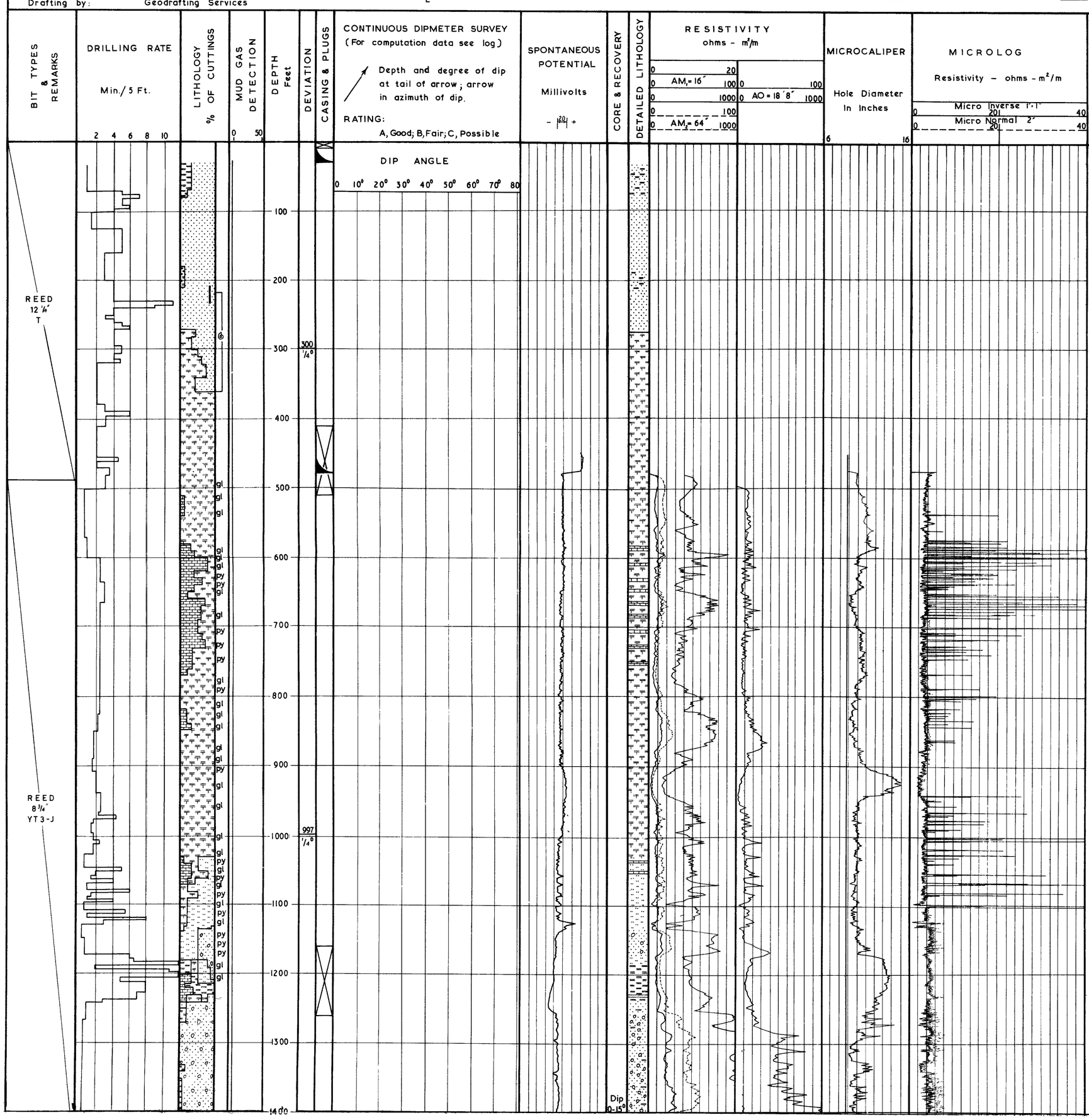
Sonic Log 475′ - 3856′
Dipmeter 2000′ - 3853′

WELL SYMBOLS

- Core interval number and recovery (in black)
- Plugged interval
- Casing shoe
- Formation test interval and no.
- Macro - Fossil

LITHOLOGIC REFERENCE

- Sandstone
- Claystone
- Marl
- Limestone
- Siltstone
- Shale
- Gravel
- Conglomerate
- Coal
- Biotite Granite
- gl Glauconitic
- py Pyritic



LITHOLOGIC DESCRIPTION

30′-225′ Sand, yel.-wh., f.-cse. gd., mostly qtz. w/occ. chert and rock frag., and Clay, wh. yel. and red, partly limonitic, impervious and non-water bearing lignitic in interval 210′-240′.

225′-275′ Sand, wh. f.-med. gd, w/vy. abund. fossils of pelecypods, gastropods, forams and echinoids, water bearing.

275′-585′ Marl, med. gry., soft to gummy, sly. silty, vy. fossiliferous.

585′-1035′ Marl, as above and sly. glauconitic; and Limestone, tan, gry. and brn., friable to sly, hard, f. gd., vy. fossiliferous, sly. to mod. glauconitic.

1035′-1135′ Siltstone, lt. gry. brn., tan and gry., calc., vy. glauconitic and pyritic, sly. hd., foss.; Limestone, tan, brn. and cream, glauc., sly. hd, foss., and Marl, gry., soft and sticky.

1135′-1252′ Clay, wh., soft and sticky; and Sand, wh., med.-cse. gd. w/occ. pebble, mostly qtz., trace of ligneous Silt.

1252′-1408′ Sand and Gravel, mostly clean, unconsol., w/ minor Sandstone, wh. to med. gry., hd., and Clay, brn. to wh., partly ligneous, soft, traces of brn. coal and pyrite.

STRATIGRAPHIC COLUMN

TERTIARY
GIPPSLAND LIMESTONE
LAKES ENTRANCE FM. 1035′
LAKE WELLINGTON AND/OR HAUNTED HILL GRAVELS 200′
TAMBO RIVER FORMATION 275′
COLQUHOUN GRAVELS 1230′

PLATE 1
SHEET 2

COMPOSITE WELL LOG

SOUTHWEST BAIRNSDALE No. 1

1400'-3926'

Sheet 2 of 2

BIT TYPES & REMARKS

DRILLING RATE — Min/5 Ft — 2 4 6 8 10 — Scale Change 20 60 80 100

LITHOLOGY % OF CUTTINGS

MUD GAS DETECTION — 0 50

DEPTH Feet

DEVIATION

CASING & PLUGS

CONTINUOUS DIPMETER SURVEY (For computation data see log)

Depth and degree of dip at tail of arrow, arrow in azimuth of dip

RATING: A, Good, B, Fair, C, Possible

SPONTANEOUS POTENTIAL — Millivolts — -20 +

CORE & RECOVERY

DETAILED LITHOLOGY

RESISTIVITY — ohms - m^2/m

0 20
0 AM, = 16" 100 | 0 100
0 1000 | 0 AO = 18 8" 1000
10 100
0 AM, = 64" 1000

MICROCALIPER — Hole Diameter In Inches — 6 16

MICROLOG — Resistivity - ohms - m^2/m

Micro Inverse 1"
0 20 40
Micro Normal 2"
0 20 40

DRILL STEM TEST

STRATIGRAPHIC COLUMN

1408'

HTC 8¾" HF	
REED 8¾" YTL-J	
HTC 8¾" OWV-J	
HTC 8¾" HF	
HTC 8¾" OWV-J	
HTC 8¾" OWV-J	
SEC 8¾" S6-J	
REED 8¾" YT3-J	
HTC 8¾" HF	
REED 8¾" YT3-J	
REED 8¾" YT3-J	
REED 8¾" YS-J	
GRANGE 8¾" DS	
GRANGE 8¾" DS	
REED 8¾" YTL	
HTC 8¾" HF	
REED 8¾" YTL	
REED 8¾" YS-J	
YS-J	
GRANGE DS	
REED 8 / 2H5	
MHV-3GLOBE	
GRANGE 8¾" DS	
HTC 8¾" OW	
HTC 8¾" OW-J	
GRANGE 8¾" DS	
SEC H-7	
SEC H-7	
GRANGE DS	
REED YTL	
GRANGE 8¾" DS	
DS 8¾"	
GRANGE 8¾" DS	
HTC 8¾" HF	
W 7 R	
GRANGE 8¾" MD	
SEC M4N	
W7R	
W7R 8¾"	
HTC W7R	
GRANGE MD	
H7L SEC	
W7R 8¾"	
W7R	
W7	
DIAMOND	
HTC W7	
H7L	
H7W SEC 8¾"	
HTC W7	
TD GRANGE	
H7W SEC	
TD GRANGE	
TD GRANGE	
SEC H7L	
HTC HF	
W7	
TD	
SEC H7L	
W7R HTC 8¾"	

1400 — 1433 3/4° — Rec. 10 — 1443 — 1 — 1454 — Den. 2.41

1500

1600

1700

1800 — 1865 3¼° — Dip 5-10° Rec. 9 — 1810 — 2 — 1820 — Den. 2.63

1900 — 1925 3°

2000 — 1-B

2044 3¼° — 2-B, 3-B, 4-B, 5-C

2100

2160 3½° — 6-B

2200 — 7-B, 8-B

2286 2¾° — Dip 5-6° Rec. 10 — 2330 — 3 — 2340 — Den. 2.58

2300 — 9-B, 10-B

2320 2¾° — 11-B, 12-B, 13-B

2400 — 14-B

2435 3° — 15-B

2460 3¼° — 16-A, 17-B

2500 — 18-B, 19-B

2559 3° — 20-B

2600 — 21-B

2647 3° — 22-B

2701 3° — 23-B

2700 — 24-B, 25-B

2800 — 26-B

Dip Low Rec. 4-5 — 2840 — 4 — 2848

2840 3¼° — 27-A, 28-B

2900

2937 3¾° — 29-B

2987 3½° — 30-B

3000

3052 4° — 31-B

3100 — 32-B, 33-B

3138 4° — 34-A

35-B

3200 — 36-C

3211 3¾°

Dip 5-10° Rec. 4 — 3332 — 5 — 3338

3300 — 37-A

3358 4½° — 38-B

3400 — 39-B

3431 4°

3500 — 40-B

3522 4° — 41-B

3600

3612 3¾° — 42-B

3700 — 43-B

3731 4° — 44-A

3800

3826 3° — Rec. 4 — 6 — 3826 — 3830

3873 3°

3900

3905 4°

T.D. 3926

Run No.2

① D.S.T. No.1 2522'-2559', T.O. 1 hr., no shut in, IHP 1270 psi, FHP 1300 psi, IFP 30 psi, FFP 90 psi, rec. 120' drilling mud

1408-2830' Shale, dk. red to brn. red, soft to sly. hd. and brittle, sly. silty and mic., often mottled lt. grn., lt. gry. and wh, common lt. grn. orange and wh. calc. inclusions and concretions. occ. inclusions of tan to gry. algal limestone; interbedded w/ Siltstone, brn. red, grn. and gry. grn., sly. calc., mostly argill., mic., partly siliceous, friable to hd.; and Sandstone, grn. gry. to dk. brn. red, v.f.- f.gd., sly. to mod. hd., mostly argill., sly. calc. and siliceous, very tight, traces of calcite from fractures, poorly bedded, sly. to mod. cross-bedded, non-fossilif.

2830'-3338' Sandstone, lt gry., lt. grn. gry. and lt. red, f.-med. gd., often .cse. gd. and conglomeratic, ang. grains of qtz. and lt. grn., gry. and blk. frag. of volcanic rocks, also inclusions of red shale, siliceous and vy. sly. calc., hd. and abrasive, clean to sly. argill., vy. tight; Shale, dk. red - brn. red, w/ lt. grn. and lt. gry. mottling, wh. and orange calc. inclusions common; and Siltstone, gry. grn. to red, argill., part siliceous, hd.

3338'-3806' Sandstone, lt. gry., lt.-med. red and lt. grn., f.- cse. gd., clean to mod. argill., siliceous, ang to sub-ang., mostly qtz. w/oran. feldspar and gry. to grn. rock frag., mic., tight and abrasive, no shows; Conglomerate, hd., siliceous, sandy and argill., mostly qtz. w/ chert, volcanic and other rock frag., feldspar and red shale inclusions, hd., tight, vy. abrasive; Shale, red w/ lt. grn. and wh. calc. inclusions, sly. hd. to soft, sly. silty; and minor Siltstone, red to red brn., argill., sly. hd., partly mic. Traces of calcite from fractures.

Biotite Granite - Basement 3806'

Biotite Granite, lt. gry., med. cryst., hd., approx. composition 45% dull gry. feldspar, 45% clear qtz., 5% dk. grn. gry. biotite and 5% dk. grn. mafic minerals, oblique fractures w/ alteration products of chlorite common along fracture planes, feldspar weathered orange in top 20'.

STRATIGRAPHIC COLUMN

DEVONIAN — LOWER — AVON RIVER GROUP

UPPER

3806'

PRE-UPPER DEVONIAN

COMPOSITE WELL LOG

COMPANY: ARCO LTD./ WOODSIDE (LAKES ENTRANCE) OIL CO. N. L.

WELL NUMBER: DUCK BAY No. 1

PETROLEUM TENEMENT: P.L.P. 44 STATE: VICTORIA 4-MILE SHEET: BAIRNSDALE BASIN: GIPPSLAND WELL STATUS: ABANDONED

LOCATION: Latitude 37° 56' 45" S
Longitude 147° 39' 36" E

ELEVATION: K.B. 79'
G.L. 68'

Date Spudded: Feb. 15, 1964
Date Drilling Stopped: Feb. 26, 1964
Date Rig off: Feb. 28, 1964

Total Depth: Driller 4224'
E Log 4238'

Hole Size	In	From	To
	22	K.B.	23'
	17½	23'	420'
	8¾	420'	4238'

Casing	In.	Wt.	Gr.	Depth	Cmt.	Cmt'd to
	18⅝	78 lb.		23'	25 sx	Surface
	13⅜	48 lb.	J-55	410'	380 sx	Surface

Cement Plugs	From	To	Sacks
	Surface	12'	10 sx
	360'	460'	40 sx
	2190'	2290'	40 sx
	2623'	2723'	40 sx

Well Head Fittings: ¼" steel plate welded on to 13⅜" casing and 2" pipe welded to casing and extending 3' above ground.
Drilled by: Reading and Bates (Australia) Pty. Ltd.
Logged by: Schlumberger
Mud Logging by: Core Lab. Portable Gas Detector
Cemented by: Halliburton
Drilling Method: Rotary
Lithology by: F. Ingram and G. Fleit

	ELECTRIC LOG DATA	MICROLOG-CALIPER DATA
RUN NUMBER	1	1
Date	25-2-64	26-2-64
First Reading	4237'	4231'
Last Reading	410'	410'
Interval Measured	3827'	3821'
Casing Schlumberger	410'	410'
Casing Driller	410'	410'
Depth Reached	4238'	4232'
Bottom Driller	4224'	4224'
Mud Nature	Bentonite	Bentonite
Density / Viscosity	10·4 / 55	10·4 / 55
Mud Resistivity	2·86 @ 70° F	2·86 @ 70° F
Mud Resistivity BHT	@ 140° F	@ 140° F
pH / Fluid Loss cc./30min.	8 / 8·8	8 / 8·8
Origin of Sample	Flow Line	Flow Line
Rmf	2·28 @ 76° F	2·28 @ 76° F
Rmc	3·03 @ 76° F	3·03 @ 76° F
Bit Size	8¾"	8¾"
Casing Size	13⅜"	13⅜"
Opr. Rig Time	6 hrs.	2 hrs.
Truck No.	L - 2520	L - 2520
Recorded by	J.A.W. White	J.A.W. White
Witness	F. Ingram	F. Ingram

OTHER LOGS

Gamma Ray - Sonic	410 - 4221'
Continuous Dipmeter	1000 - 4220
Gamma Ray Curve Plotted on Composite Log	2000 - 4200'

WELL SYMBOLS

- Core, interval, number and recovery (in black)
- Sidewall core
- Plugged interval
- Casing shoe
- Macro fossil

LITHOLOGIC REFERENCE

- Sand or Sandstone
- Silt or Siltstone
- Clay or Claystone
- Claystone, calcareous
- Shale
- Marl
- Limestone
- Coal
- Volcanics
- Slate
- py: Pyritic
- gl: Glauconitic

Drafting by Geodrafting Services.
April, 1964

BIT TYPE and REMARKS: Reed 17¼" T; Security 8¾" S3J

DRILLING RATE Min./5 Ft. (1 2 3 4 5)

LITHOLOGY % of cuttings

WELL SYMBOLS

MUD GAS DETECTION — TOTAL GAS UNITS (0 25 50 75)

DEPTH feet (100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000)

DEVIATION (¼° ¼° 1° 1° 1° ¾° 1°)

CASING and PLUGS: 18⅝" @ 23'; 13⅜" @ 410'; 4-ND, 5-ND, 6-ND, 7-B, 8-ND, 9-ND, 10-ND, 11-ND, 12-ND, 13-ND, 14-ND, 15-ND, 16-ND, 17-ND, 18-ND, 19-ND, 20-ND, 21-B, 22-B, 23-B, 24-B, 25-ND, 26-ND, 27-ND

CONTINUOUS DIPMETER SURVEY (For computation data see log)
Depth and degree of dip at tail of arrow; arrow in azimuth of dip.
RATING A - Good, B - Fair, C - Possible. ND - No appreciable dip
DIP ANGLE (0 10° 20° 30° 40° 50° 60° 70°)
1-C

SPONTANEOUS POTENTIAL — Millivolts (10)

CORES and RECOVERY

INTERPRETATIVE LITHOLOGY

RESISTIVITY Ohms - m²/m — Short Normal 16" (0 10 50 500); Long Normal 64" (0 50 500)

RESISTIVITY Ohms - m²/m — Lateral 18' 8" (0 50 500)

CALIPER — Hole Diameter in Inches (6 8 10 12 14 16)

MICROLOG Ohms - m²/m — Micro Inverse 1"x1" (0 10 20); Micro Normal 2" (0 10 20)

LITHOLOGIC DESCRIPTION

40 - 300' Sand, medium to very coarse grained and pebbly: Clay, yellow to gray: and Lignite.

300 - 350' Sand, fine - medium grained with some coarse grains and pebbles, very shelly; and Clay, gray, sandy.

350 - 510' Marl, medium gray, silty, soft, very fossiliferous.

510 - 1015' Limestone, white, yellow and light brown, finely crystalline to fine grained, very fossiliferous and often coquinoidal in upper half, friable to slightly hard, porous in upper half, argillaceous and tight in lower half, slightly glauconitic.

1015 - 1350' Limestone, cream to white, fine grained, very fossiliferous; and Marl, gray to gray green, friable, slightly glauconitic, upper and lower boundaries gradational.

1350 - 2190' Claystone, light to medium gray, soft and sticky in cuttings, slightly fossiliferous and slightly glauconitic, calcareous; and minor Marl, medium gray to gray green, friable.

STRATIGRAPHIC COLUMN

- UPPER PLIOCENE to PLEISTOCENE — HAUNTED HILL GRAVELS and/or LAKE WELLINGTON FORMATION — 300'
- LOWER PLIOCENE — JEMMY'S POINT FORMATION — 400'
- UPPER MIOCENE — TAMBO RIVER FM. — 420'
- MIOCENE — LIMESTONE — GIPPSLAND — 1900'

PLATE 2
SHEET 2

COMPOSITE WELL LOG

D U C K B A Y No. 1

2000 - 4238'

Sheet 2 of 2

BIT TYPE and REMARKS

DRILLING RATE Min./5 Ft. (1 2 3 4 5)

LITHOLOGY % of cuttings

WELL SYMBOLS

MUD GAS DETECTION — TOTAL GAS UNITS (0 50 100)

DEPTH feet

DEVIATION

CASING and PLUGS

CONTINUOUS DIPMETER SURVEY (For computation data see log)
Depth and degree of dip at tail of arrow; arrow in azimuth of dip
RATING
A-good, B-fair, C-possible
ND-No appreciable dip
DIP ANGLE (0 10° 20° 30° 40° 50° 60° 70°)

SPONTANEOUS POTENTIAL — Millivolts (10)

CORES and Recovery

INTERPRETATIVE LITHOLOGY

RESISTIVITY Ohms - m^2/m
Short Normal 16" (0 10)
Long Normal 64" (0 50 500)

RESISTIVITY Ohms - m^2/m
Lateral 18' 8" (0 50 500)

GAMMA RAY
Background 20cps
+Test source 210 cps
Time constant 2 sec.
Recording speed 30ft/min
API (0 120)

CALIPER
Hole Diameter in Inches (6 8 10 12 14 16)

MICROLOG Ohms - m^2/m
Micro Inverse 1"x 1" (0 10 20)
Micro Normal 2" (0 20)

LITHOLOGIC DESCRIPTION

STRATIGRAPHIC COLUMN

HTC SF. 8¾"
HTC SF 8¾"
Sec. 8¾" S3J
HTC SF 8¾"
HTC 8¾" OSCIG
HTC SF. 8¾"
Sec. 8¾" S3J RR
HTC SF 8¾"
HTC 8¾" OSCIG
HTC HF 8¾" Coring Time 70 min. 92 min.
HTC 8¾" OSCIG
HTC SF 8¾"
HTC 8¾" OSCIGJ
HTC 8¾" OSCIGJ
HTC HF 8¾"
HTC 8¾" OSCJ
HTC HF 8¾" Coring Time 130 min. 120 min.

CHANGE OF SCALE (5 10 15 20 25)
CHANGE OF SCALE (20 40 60 80 100)

Shale Gas

1° 1¼° 1° 1° 1° 1¼° 2° 2½°

Cores 1&2 No rec.
Core 3 2831' 2851' Rec 20' Dip 0-5°
Core 4 3182' 3202' Rec 20
Core 5 3393' 3403' Rec 1-75'
Core 6 3699' 3709' Rec. 9 5 Dip 15-20°
Core 7 3880' 3896' Rec. 16' Dip 0-10°
Core 8 4152' 4162' Rec. 10'
Core 9 4214' 4224' Rec. 4'

28-B 29-B 31-ND 32-ND 33-C 34-C 35-B 36-B 37-A 38-A 39-A 40-B 41-B 42-A 43-B 44-B 45-B 46-B 47-B 48-B 49-A 50-A 51-B 52-B 53-B 54-B 55-B 56-B 57-C 58-A 59-B 60-A 61-B 62-C 63-B 64-C 65-C 66-B 67-C

2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200 3300 3400 3500 3600 3700 3800 3900 4000 4100 4200 4300

2190 - 2240' Shale, brown green and gray green, firm, moderately to very glauconitic and pyritic, fossiliferous, floating coarse sand grains common.

2240 - 2285' Sand, dark green gray to medium brown, fine to coarse grained, glauconitic and pyritic, good to fair porosity, slightly argillaceous, slightly micaceous, gradational downward into ligneous sand.

2285 - 2685' Sand, fine to very coarse and Gravel, mostly sub-angular, clean to very ligneous and argillaceous, fair to very good porosity; and Brown Coal, brittle to soft, partly silty and shaly. Presence of Clay assumed from logs.

2685 - 3100' Shale - Mudstone, dark gray, gray green and brown, compact, often silty, carbonaceous; and
Siltstone, light gray to light brown, argillaceous, carbonaceous, micaceous.

3100 - 3175' Clay, light gray to light brown, with traces of green chlorite grains; and
Shale, as above. This interval is possibly highly weathered volcanics although it appears on the electric logs similar to the overlying section.

3175 - 3500' Volcanics, dark green to black, aphanitic to finely crystalline, highly altered, chloritic Basalt; light brown to pink, very fine grained Tuff; and minor Breccia. Traces of Shale, dark red-brown and Siltstone, dark red brown, sandy with inclusions of volcanic fragments.

3500 - 4124' Sandstone, white to light gray, very fine to coarse-grained, white argillaceous matrix, friable to slightly hard, tight, carbonaceous flakes and laminations common, slightly micaceous; and minor
Shale, dark brown and medium gray; and
Siltstone, light gray, partly slightly dolomitic. Very poor samples in this interval due to severe caving of formations above.

4124 - 4238' Slate, dark gray, metallic luster, dense, hard, well developed cleavage, partly silty, slightly pyritic;
Siltstone, medium to dark gray, siliceous hard, slightly argillaceous; and
Sandstone, medium to dark gray, fine grained, siliceous, approaching quartzite. Numerous milky, white to light gray quartz veins ⅛" to ¼" wide parallel to and cutting bedding, also black chert filling some fractures.
Dip 30° - 40°

STRATIGRAPHIC COLUMN	
OLIGOCENE	LAKES ENTRANCE FORMATION (2285')
UPPER EOCENE-LOWER OLIGOCENE	LATROBE VALLEY COAL MEASURES (2684')
LOWER CRETACEOUS	STRZELECKI GROUP (3175')
PERMIAN?	VOLCANICS UN-NAMED (3500')
UPPER PALEOZOIC (LOWER PERMIAN?)	UN-NAMED (4124')
ORDOVICIAN	ORDOVICIAN UNDIFFERENTIATED