W545

DEPT. NAT. RES & ENV
PE904908

Natural Resources and Environment

AGRICULTURE • RESOURCES • CONSERVATION • LAND MANAGEMENT

FLATHEAD-1 (G.B.)
WELL SUMMARY

(OFFSHORE)

1 Folio No	2 Referred to	3 Date	4 Clearing Officer's Initials	1 Folio No.	2 Referred to	3 Date	4 Clearing Officer's Initials

FILE COVER INSTRUCTIONS FOR ACTION OFFICERS

(1) FOLIO NUMBERS: Each subject paper attached to a file is to be given a consecutive number by the attaching officer. Papers must not be removed from or attached to a file without approval.

(2) REFERRAL TO OTHER OFFICERS: When an Officer completes action on the file and further action is required by some other Officer, please initial Column (4) and on the next vacant line, enter the relevant folio number in Column (1), indicate to whom the file is to be forwarded in Column (2) and record the date in Column (3).

(3) BRING UP MARKINGS: When action on a file is required at a later date, the officer will initial Column (4) and, on the next vacant line, enter the relevant folio number in Column (1), then write "B/U" followed by the action officer's name in Column (2) and the date the file is required in Column (3).

(4) PUTAWAY MARKINGS: When ALL action on a file is completed the officer concerned will initial Column (4) and, on the next vacant line, write "P/A" in column (2).

REGISTRY MUST BE NOTIFIED OF ANY FILE MOVEMENTS BETWEEN OFFICERS

LOCATION

EARLIER FILES	LATER FILES	RECORDS DISPOSITION

ATHEAD - I

T.D [redacted] S

38 01 21

GLOMAR III
W.P. 173

PE900009

IES	Run 1	2	825 — 1344		
"	" 2	"	1344 — 2030		
"	" 3	"	2030 — 3495	[illegible]	
"	" 1	5"	825 - 1344	Bay H	
"	" 2	"	1344 - 2030		
"	" 3	"	2030 - 3495.		
BHCS/GR.	" 1	2"	825 — 1330		
BHCS	" 2	"	1330 — 3490.		
BHCS/GR.	1	5"	825 — 1330		
BHCS.	" 2	"	1330 — 3490.		
FDC.	" 1	2".	1326 — 2031.		
"	" 2	"	2031 — 3497.		
"	" 1	5"	1326 — 2031		
"	" 2	"	2031 — 3497.		
GRN	" 1	2"	1326 — 2326.		
"	" 1	5"	1326 — 2326.		
ont. Dipmeter. other T/S. 3arms.	" 1		1326 - 3495		
TEMPERATURE LOG.	R1+2. T/4				
FIT	" 1.	Test No 1, 2, 3 & 4. 5, 6, 7, 8, 9, 10, 11.			

ore Lab report for Core, Mud & Cuttings Analysis, includes Complete Coregraph + 2 copies & Grapholog + 1 co

CORE ANALYSIS RESULTS CORES 2-7. B.M.R.

aleontology by David Taylor.

alynology " L.E Stover. Plus revision

ime Depth Curve (Needs masking)

ide Well Core Descriptions Runs 1+2 From 1007 - 3442' Plus 1 copy from 1374 - 3442'

Well Completion Log. Plus 1 copy * AMDEL REPORT GS 235/81

eological Cross Section A - A

Structure Map. Top of Latrobe Complex

Isochron Map of Greensand - Strzelecki Interval.

tructure Map on Top of Lakes Entrance "Greensand"

eological Cross Section B - B'.

Structure Map Inner Strzelecki Mapping Point

ore Descriptions 1 — 7 Plus 1 copy 3 — 7

tructure Contours Latrobe Delta Topographic Surface.

Weekly Reports 28/4/69 — 26/5/69. [illegible] GH-82A 141282 Vol 1)

[illegible]

Cores 1 — 7 and cuttings 860 - 3472 IN STORE

EX
Secr
Depu
Exe
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Exe
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Exe
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Mana
Mana
Mana
Mana

PR
SC
Mana
Mana
Chie
Dire
Dire
Dire
Dire

FLATHEAD 1

TABLE OF CONTENTS

WELL SUMMARY, 29 pages.

FLATHEAD-1.

Purpose of Well

Flathead 1 was drilled to evaluate the hydrocarbon potential of an east-west trending fault line closure on the upthrown side of a regional wrench fault. The primary objectives were the sandstones of the Latrobe Complex and underlying sandstones of the Strzelecki Group.

Statistical Summary

Lease:	Vic-P/1, Shot Point 8524, Line EH-120A.
Latitude:	38° 01' 21"
Longitude:	148° 32' 04"
Elevation:	Sea Level Datum, Rotary Table 31'
Water Depth:	174'
Total Depth:	3496'
Spud Date:	April 25, 1969.
Completion Date:	May 26, 1969.
Well Status:	Plugged and abandoned as a non-commercial oil discovery.

Generalised Lithology

[illegible]e Gippsland Formation consisted of soft grey, fossiliferous marl interbedded with occasional thin skeletal limestones from the sea floor down to a depth of 1468'. The underlying Lakes Entrance formation was represented by 74' of glauconitic siltstone. The interval 1542-1564' contained porous and permeable quartzose sandstones of the Latrobe Complex. These sandstones were well rounded, coarse grained and conglomeratic. The underlying Strzelecki Group consisted predominantly of lithic-feldspathic sandstone. with an abundant clay matrix, interbedded with occasional thin coal beds. These sandstones in general exhibited poor permeability, in comparison to sandstones of the Latrobe Complex.

FLATHEAD - 1.

Geologic Summary

Flathead 1 was located 12 miles north of the Tuna Field and 32 miles southeast of the town of Lakes Entrance. It was drilled to a total depth of 3496' on a structure consisting of a faulted east-west trending anticline (Plates I, 2, and 3). The fault which strikes east-west is tentatively interpreted to be a right lateral wrench fault, with intermittent movement and structure occurring from Lower Cretaceous to Upper Miocene

The Lakes Entrance "greensand" which apparently uniformly drapes the structure is composed of mostly tight glauconitic siltstone with thin permeable sands (based on sidewall core examination). Structural closure, as mapped on the top of the Lakes Entrance "greensand", is indicated to be approximately 500' ± . The area of closure extends over 12 square miles (Plate I). The present structural configuration appears to be Miocene or younger in age.

The porous and permeable Latrobe sandstone complex was originally anticipated to be about 350' thick, however, only 22' of the Latrobe section were present in the well. Due to thinness, the Latrobe cannot be defined on the seismic section and the reflection mapped is the Lakes Entrance "greensand". Most of the Latrobe core was too unconsolidated for analysis, however, a few samples yield porosities from 34% to 41% and permeabilities of 300 Md to 1200 Md. These sediments do appear to thicken away from the structure. Underlying sandstones of the Strzelecki Group appear for the most part to be clay-choked and poor reservoir rocks. However, the upper 200 ft. of Strzelecki, does have fair to good porosity and permeability. From core analysis over most of this interval porosity ranges from 25% - 35% and permeability from less than 10 Md to greater than 500 Md. Considering only those sands with a permeability of 100 millidarcies or greater to be potentially oil productive, 35' net sand occur in the 85' gross of Strzelecki down to the lowest recorded oil at 1649' K.B. This is in addition to the 22' of net sand in the Latrobe. The time of oil accumulation is postulated to be post Oligocene.

FLATHEAD - 1.

Hydrocarbon Potential

Oil shows were encountered in the cuttings and cores from the top of Lakes Entrance formation at 1468' down through the Latrobe Complex sandstones and into sandstones of the Lower Cretaceous Strzelecki group, to a depth of 1649'. Permeable and porous sandstone of the Latrobe Complex with excellent oil fluorescence and cut was encountered at 1542'. Conventional cores were then continuously taken from 1545' down into the water leg to a depth of 1716' (Plate VII - I.E.S.). Core analyses indicated the sandstones to have oil saturations ranging from 5 to 22% in conjunction with good permeability and porosity values down to a depth of 1649'. Approximately 40' of shale was cored between the lowest oil and highest water and a precise contact is indeterminate.

Eleven wireline tests were later performed in an attempt to evaluate the hydrocarbon bearing section. Of the eleven wireline tests attempted, only FIT tests at 1648' and 1545' recovered a scum of oil, with the remaining tests recovering mud filtrate (Plate VII - I.E.S.). Because of the unsatisfactory results obtained by use of wireline testing methods 9 5/8" casing was later set to a depth of 1953' and conventional production tests were performed.

Production test No. 1 was completed through perforations 1607-1652' with no formation fluid being recovered by swabbing, even after treating the well with mud acid. This test was in sandstones of the Strzelecki Group. Upon completion of the test the interval was cemented.

Production test No. 2 was completed through perforations 1542-1564' in sandstones of the Latrobe Complex. The well did not flow after perforating and approximately 16 barrels of either formation water or filtrate and some hydrogen sulphide gas was swabbed from the well without any trace of oil being present. The formation was then treated with 20 barrels of mud acid which was swabbed back with still no trace of oil. At this point the well was plugged and abandoned.

Since no formation oil was recovered on either Production Test 1 or 2, oil saturated cores were sent to Core Laboratories and flushed with hot water and pentane in an attempt to gain information concerning the A.P.I. gravity of the crude. Oil was recovered having a corrected gravity of 14.6° API and a viscosity of 50 centipoise, which was described as "dark, heavy and smelling of tar". This oil sample may not be representative formation oil. Several weeks passed between the time of core recovery and the time of analysis, and it seems likely that some of the lighter ends had escaped.

545

INTERP.

~~BASIC~~

PE900004

COMPLETION REPORT

FLATHEAD I

B.L. Culp
April 19, 1970.

INDEX

FLATHEAD - 1.

INTERPRETATIVE

LIST OF ILLUSTRATIONS

Purpose of Well

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Stratigraphy

Summary

Flathead 1 was drilled to a total depth of 3496' penetrating the following sediments (Plate VII).

Age	Group or Formation	Interval
Miocene-Oligocene	Gippsland Formation	Sea Floor - 1468'
Oligocene	Lakes Entrance Fm.	1468-1542
Unconformity		
Eocene-U. Paleocene	Latrobe	1542-1564
Unconformity		
Lower Cretaceous	Strzelecki Group	1564-3496 T.D.

Note: Interval depths are from the electrical log. Subtract 31' K.B. to obtain subsea values.

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PE900017

This is an enclosure indicator page.
The enclosure PE900017 is enclosed within the container PE904908 at this location in this document.

The enclosure PE900017 has the following characteristics:
ITEM_BARCODE = PE900017
CONTAINER_BARCODE = PE904908
NAME = Structure Map
BASIN = GIPPSLAND
PERMIT = VIC/P1
TYPE = SEISMIC
SUBTYPE = HRZN_CONTR_MAP
DESCRIPTION = Flathead 1 Structure Map on Top of Lakes Entrance ""Greensand"". Plate 1.
REMARKS =
DATE_CREATED = 31/08/69
DATE_RECEIVED =
W_NO = W545
WELL_NAME = Flathead-1
CONTRACTOR =
CLIENT_OP_CO = Esso Australia

(Inserted by DNRE - Vic Govt Mines Dept)

PE900019

This is an enclosure indicator page.
The enclosure PE900019 is enclosed within the container PE904908 at this location in this document.

The enclosure PE900019 has the following characteristics:

ITEM_BARCODE = PE900019
CONTAINER_BARCODE = PE904908
NAME = Structure Map
BASIN = GIPPSLAND
PERMIT = VIC/P1
TYPE = SEISMIC
SUBTYPE = HRZN_CONTR_MAP
DESCRIPTION = Flathead 1 Structure Map Inner Strzelecki Mapping Point (Well tops on actual Strzelecki tops). Plate 2.
REMARKS =
DATE_CREATED = 31/08/69
DATE_RECEIVED =
W_NO = W545
WELL_NAME = Flathead-1
CONTRACTOR =
CLIENT_OP_CO = Esso Australia

(Inserted by DNRE - Vic Govt Mines Dept)

PE900016

This is an enclosure indicator page.
The enclosure PE900016 is enclosed within the container PE904908 at this location in this document.

The enclosure PE900016 has the following characteristics:

ITEM_BARCODE = PE900016
CONTAINER_BARCODE = PE904908
NAME = Isochron Map
BASIN = GIPPSLAND
PERMIT = VIC/P1
TYPE = SEISMIC
SUBTYPE = ISOCHRON_MAP
DESCRIPTION = Flathead 1 Flathead area Isochron map of Greensand- Strzelecki interval. Plate 4.
REMARKS =
DATE_CREATED = 31/08/69
DATE_RECEIVED =
W_NO = W545
WELL_NAME = Flathead-1
CONTRACTOR =
CLIENT_OP_CO = Esso Australia

(Inserted by DNRE - Vic Govt Mines Dept)

PE900018

This is an enclosure indicator page.
The enclosure PE900018 is enclosed within the container PE904908 at this location in this document.

The enclosure PE900018 has the following characteristics:

ITEM_BARCODE = PE900018
CONTAINER_BARCODE = PE904908
NAME = Structure Map
BASIN = GIPPSLAND
PERMIT = VIC/P1
TYPE = SEISMIC
SUBTYPE = HRZN_CONTR_MAP
DESCRIPTION = Flathead 1 Structure Map Top of Latrobe Complex. Plate 3.
REMARKS =
DATE_CREATED = 31/08/69
DATE_RECEIVED =
W_NO = W545
WELL_NAME = Flathead-1
CONTRACTOR =
CLIENT_OP_CO = Esso Australia

(Inserted by DNRE - Vic Govt Mines Dept)

PE904909

This is an enclosure indicator page.
The enclosure PE904909 is enclosed within the container PE904908 at this location in this document.

The enclosure PE904909 has the following characteristics:

ITEM_BARCODE = PE904909
CONTAINER_BARCODE = PE904908
NAME = Geological Cross Section A-A'
BASIN = GIPPSLAND
PERMIT = VIC/P1
TYPE = WELL
SUBTYPE = CROSS_SECTION
DESCRIPTION = Flathead 1 Geological Cross Section A-A'. Plate 5.
REMARKS =
DATE_CREATED = 31/08/69
DATE_RECEIVED =
W_NO = W545
WELL_NAME = Flathead-1
CONTRACTOR =
CLIENT_OP_CO = Esso Australia

(Inserted by DNRE - Vic Govt Mines Dept)

PE904910

This is an enclosure indicator page.
The enclosure PE904910 is enclosed within the container PE904908 at this location in this document.

The enclosure PE904910 has the following characteristics:

ITEM_BARCODE = PE904910
CONTAINER_BARCODE = PE904908
NAME = Geological Cross Section B-B'
BASIN = GIPPSLAND
PERMIT = VIC/P1
TYPE = WELL
SUBTYPE = CROSS_SECTION
DESCRIPTION = Flathead 1 Geological Cross Section B-B'. Plate 6.
REMARKS =
DATE_CREATED = 31/08/69
DATE_RECEIVED =
W_NO = W545
WELL_NAME = Flathead-1
CONTRACTOR =
CLIENT_OP_CO = Esso Australia

(Inserted by DNRE - Vic Govt Mines Dept)

PE904911

This is an enclosure indicator page.
The enclosure PE904911 is enclosed within the container PE904908 at this location in this document.

The enclosure PE904911 has the following characteristics:

ITEM_BARCODE = PE904911
CONTAINER_BARCODE = PE904908
NAME = Time-Depth Curve
BASIN = GIPPSLAND
PERMIT = VIC/P1
TYPE = WELL
SUBTYPE = VELOCITY_CHART
DESCRIPTION = Flathead 1 Time Depth Curve. Plate 7.
REMARKS =
DATE_CREATED = 9/03/70
DATE_RECEIVED =
W_NO = W545
WELL_NAME = Flathead-1
CONTRACTOR =
CLIENT_OP_CO = Esso Australia

(Inserted by DNRE - Vic Govt Mines Dept)

2. LITHOLOGY

Lithology:

865 to 1040 feet:	Marl: light green, fossiliferous, massive, soft, slightly glauconitic, interbedded with coquina and trace sand.
1040 to 1130 feet:	Marl as above, interbedded with coquina and limestone, hard, micritic, skeletal.
1130 to 1340 feet:	Limestone interbedded with marl, coquina and trace sand.
1340 to 1525 feet:	Mudstone: light grey to light green, very soft to moderately firm, non-calcareous, grades to shale. Shale: light green to light grey, soft, non-fissile, silty. Siltstone: medium to dark brown, hard, glauconitic, non-calcareous.
1525 to 1545 feet:	Sandstone: unconsolidated, very fine to coarse-grained, rounded to sub-angular grains, pale yellow fluorescence and weak cut.

Core No.1 1545 to 1549 feet; cut 4 ft, recovered 2 ft:

Barrel jammed.
Recovered 2 feet of unconsolidated sand, very fine to coarse-grained, good fluorescence, cut and odour.

Core No.2 1549 to 1555 feet; cut 6 ft, recovered 6 ft:

Sandstone: few thin shale streaks, good fluorescence, odour and cut.

Core No.3 1555 to 1576 feet; cut 21 ft, rec. 16 ft:

1 foot	unconsolidated, conglomeratic sandstone, pebbly, spotty fluorescence.
13 feet	massive sandstone: fine to coarse grained, light brown, bright yellow fluorescence, good cut and odour.
2 feet	cross-bedded sandstone, shows as above.

Core No.4 1576 to 1607 feet; cut 31 ft, rec. 31 ft:

Top 6 inches	Shale.
7½ feet	Shale.
3 inches	Sandstone no show.
1^3/4 feet	Shale.
1 foot	Sandstone; no show.
2 feet	Shale.
1 foot	Siltstone.
2½ feet	Sandstone; no show.
Bottom 14½ feet	Shale interbedded with sandstone with shows.

LITHOLOGY CONT.

Core No.5 1607 to 1660 feet; cut 53 ft, rec. 47 ft:

3 feet	Interbedded sandstone and shale with fluorescence, cut and odour.
2 feet	Sandstone and some shale; good fluorescence.
3 feet	Sandstone: massive, good show.
3 inches	Shale.
1 ft 9 ins	Sandstone: massive, good show.
9 feet	Interbedded sandstone and shale; good show.
4 feet	Sandstone with shale laminae; good show.
6 inches	Siltstone: light grey, no shows.
2 ft 6 ins	Interbedded sandstone and siltstone; good show in sandstone.
10 feet	Sandstone: massive, fine to medium-grained, fluorescence, odour, cut and bleeding gas.
11 feet	Shale: with some coal.

Core No.6 1660 to 1716 feet; cut 56 ft, rec. 56 ft:

4 feet	Shale: medium grey, silty, slightly carbonaceous, rare plant debris, blocky.
1 foot	Sandstone quartz to quartz wacke, light grey, very fine to fine grained, sub-angular, well sorted, abundant lithics and clay, poor visible porosity, slightly friable, no shows.
26 feet	Shale as above.
15½ feet	Sandstone as above, no shows.
1½ feet	Sandstone: dolomitic, no shows.
1½ feet	Sandstone: non dolomitic, slightly friable, no shows.
1½ feet	Sandstone: dolomitic.
4½ feet	Sandstone: non dolomitic, friable, no shows.
1½ feet	Sandstone: dolomitic.

1716 to 1840 feet:	Sandstone: mixed as above, some with calcareous cement.
1840 to 1980 feet:	Claystone: white, soft, fissile, light grey, waxy blocky shale, trace sand.
1980 to 2000 feet:	Sandstone as above, noted trace pink and green chert, fine to medium grained.
2000 to 2070 feet:	Clay and shale with occasional coal streaks.
2070 to 2092 feet:	Cuttings lost.

Lithology: *Cont*

2092 to 2142 feet: Drilled while cleaning up hole.

2142 to 2810 feet: Mainly shale, grey, blocky, minor quartzwacke, very fine to medium-grained, abundant lithics and unweathered feldspar, interstitial clay and dolomitic cement, poor porosity and permeability, rare thin coal bed.

2810 to 3472 feet: Interbedded siltstone and shale with some quartzwacke.

Core No.7, 3472 to 3494 feet, cut 22 feet, rec. 22 feet -

3472 to 3493 ft 6 ins: Sandstone, arkosic, slightly dolomitic, very fine to fine-grained with some medium-grained, abundant lithics and feldspar, poor porosity, no shows.

3493' 6" to 3494': Shale, grey to light grey, carbonaceous, hard.

No significant gas readings.

Test Results:

F.I.T.✓No.1, 1648 feet - 2000 ccs filtrate, scum of oil.

✓ No.2, 1644 feet - 1500 ccs filtrate.

✓No.3, 1555 feet - 3500 ccs mud - packer failure.

No.4, 1498 feet - 1000 ccs filtrate

No.5, 1645 feet - 2000 ccs filtrate, scum of oil.

No.6, 1484 feet - 1700 ccs filtrate.

No. 7, 1567 feet - mis-run.

No. 8, 1567 feet - mis-run.

No. 9, 1567 feet - 1700 ccs filtrate.

No.10, 1625 feet - mis-run.

No.11, 1625 feet - 2000 ccs filtrate.

Production test - 1607 to 1652 feet - nil returns (see above).

2.1 CORE DESCRIPTION

part of pe900010 1/7

RECEIVED
18 JUN 1969
MINES DEPT

ESSO STANDARD OIL (AUSTRALIA) LTD.

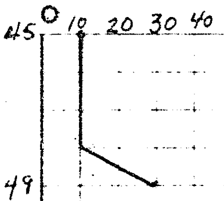
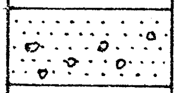
CORE DESCRIPTION

Core No. 1

WELL: FLATHEAD-1

Interval Cored 1545-1549 ft., Cut 4 ft., Recovered 2 ft., (50 %) Fm. LATROBE

Bit Type C-14 , Bit Size in., Desc. by J. BLACK Date 3/5/69

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 10 20 30 40 45 49 				SAND - Clear & FROSTY WHITE QTZ f/CRSE W few WELL RND Pebb. TO 3cm. UNCONSOL. SUBANG TO SUB RND GOOD POR & PERM. GOOD BRIGHT Yello FL W/ GOOD CUT WEAK PETR. ODOR

REMARKS:

2/7

RECEIVED
18 JUN 1969
MINES DEPT.

ESSO STANDARD OIL (AUSTRALIA) LTD.

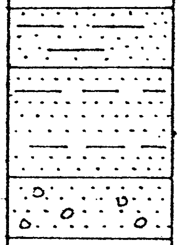
CORE DESCRIPTION

Core No. 2

WELL: FLATHEAD #1

Interval Cored 1549-1555 ft., Cut 6 ft., Recovered 6 ft., (100 %) Fm. LATROBE

Bit Type C-22, Bit Size in., Desc. by J. BLACK Date 4/5/69

Depth & Coring Rate (min./ft.)	Graphic (1" 5')	Shows	Interval (ft.)	Descriptive Lithology
0 50 55			1549-50½	SAND - BRN WH. f/m g subang QTZ UNCON-SOL. W/ few ½" bRN-gry consold. shale streaks. SD. gns GOOD FL., GOOD CUT, FAIR ODOR, STAINED.
			1550½-53½	SAND - AS ABOVE but SPOTTY FL. GOOD CUT, FAIR ODOR.
			1553½-55.	SAND - Cl. & FROSTY WH. F/V. CRSE QTZ w/ few QTZ Pebbles To 3 CM. GOOD FL GOOD CUT & ODOR.

REMARKS:

RECEIVED
14 MAY 1969
MINES DEPT.

ESSO STANDARD OIL (AUSTRALIA) LTD.

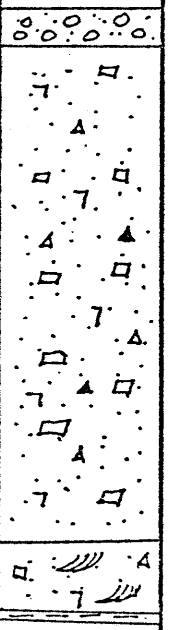
CORE DESCRIPTION

Core No. 3

WELL: Flathead-1

Interval Cored 1555-1575 ft., Cut 20 ft., Recovered 16 ft., (%) Fm. Latrobe

Bit Type C-22, Bit Size 8 5/16" in., Desc. by R.V. Hicks Date 4 May 1969

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0			1555-56	Conglomerate, granule to pebble size rounded qtz & chert fragments, spotty flour due to flushing
			1556-1569	Sandstone (Quartzwacky) lt. tan to lt grey w/ green cast, ±60% qtz grs. abundent lithics wthd felds, chert & biotite, detrital asphaltic grains, rd to c size, sd grs vf to f occ m sub rd, mod w srtd. wh cly plugging abundant. poor vis por & perm. friable, good even yel-yel green flour, good to ex flush & rib cut, g odor. Massive.
			1569 - 1570 3/4	Sandstone aa, thin lam w/ large scale X bedding
			1570 3/4 - 1571	Shale - m lt gy, mica, waxy, micro X-lam with lt gy siltstone mica, w/ sho aa.

REMARKS:

ESSO STANDARD OIL (AUSTRALIA) LTD.

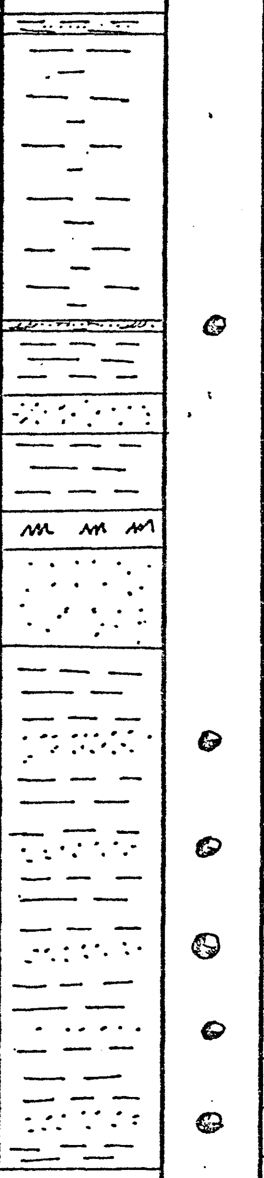
CORE DESCRIPTION

Core No. 4

WELL: FLATHEAD-1

Interval Cored 1576-1607 ft., Cut 31 ft., Recovered 31 ft., (100 %) Fm. LATROBE

Bit Type C-22, Bit Size 8 5/16" in., Desc. by R.V. Hicks Date 4 MAY 1969

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0				
			1576-1576½	interlaminated shale c̄ sandstone shale m grey waxy, v fine mica, firm laminated
			1576½-84	Shale aa
			1584-1584.25	Ss w/ shale lamin, ss. vf, lt gy, abdt lithics cly choked, p vis ϕ c̄ K, g flour yel, cut, c̄ odor
			1584.25-1586	Shale aa.
			1586-1587	Sandstone vf-f lt gy aa N.S.
			1587-1589	Shale aa
			1589-1590	Siltstone m lt gy N.S.
			1590-1592.5	Sandstone vf gr, abdt. lithics c̄ clay, biotite common, sub ang, w srtd, p ϕ c̄ K, NS.
			1592.5-1607	Shale aa w/ interlaminated ss and thin beds of sandstone 4"-6" thick Sandstone- vf-f, subang to subrd, w srtd, abdt lithics and cly, weathered felds, blk c̄ green chert common, sands w/ g even yel flour, g cut c̄ odor

REMARKS:

ESSO STANDARD OIL (AUSTRALIA) LTD.

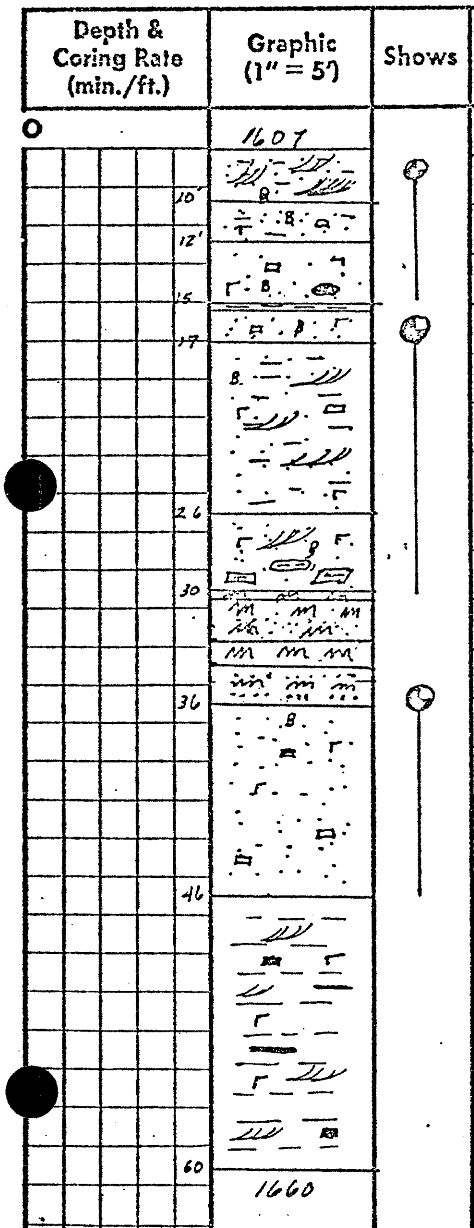
CORE DESCRIPTION

Core No. 5

WELL: FLATHEAD - 1

Interval Cored 1607-1660 ft., Cut 53 ft., Recovered 53 ft., (100 %) Fm. LATROBE

Bit Type C-11, Bit Size 8 5/16 in., Desc. by R.V. Hicks Date 5 MAY 1969



Interval (ft.)	Descriptive Lithology
1607-1610	interlam ss & sh, ss - qtzwack, vf, w srtd, sub ang lt gy, lith & clay common, fr Φ&K, fr yel flour, fr cut, g odor Shale - dk gry, carb mica
1610-12	Ss. w/ occ thn sh lam, litho aa
1612-1615	Ss, lt gry, qtzwack, vf-f, wthd felds, biotite, clay common, poor vis Φ&K, Good flour & cut.
1615-1615.25	Shale, m gy, mica, lam to fis.
1615.25-1617	Sandstone aa
1617-1626	interlam ss & sh, ss -(qtzwack.) slt-vf, lt gy, w srtd, some cly, g. sho, Sh, m gy mica, X-bdd.
1626-1630	Ss, w/ occ sh lam, & sh clast to 1/4"-1" ss, vf-f, lt tan-lt gy, abdt lithics & clay, g. show
1630-1630.5	Sltstn, v lt gy NS.
1630.5-1632.5	Interbdd sltstn & ss aa N.S.
1632.5-1633.5	Sltstn aa
1633.5-1636	Interbdd sltstn & ss aa
1636-1646	Ss. lt gy, f-m, subang-subrd, w srtd, (qtzwacky) abundant lith & clay, p vis Φ&K, g yel flour, g. cut, g odor, bleeding O&G
1646-1660	Sh, m gy to dk gy, v finely lam & X-bdd, carb, mica common, occ thin coal stk.

REMARKS:

6/7

ESSO STANDARD OIL (AUSTRALIA) LTD.

CORE DESCRIPTION

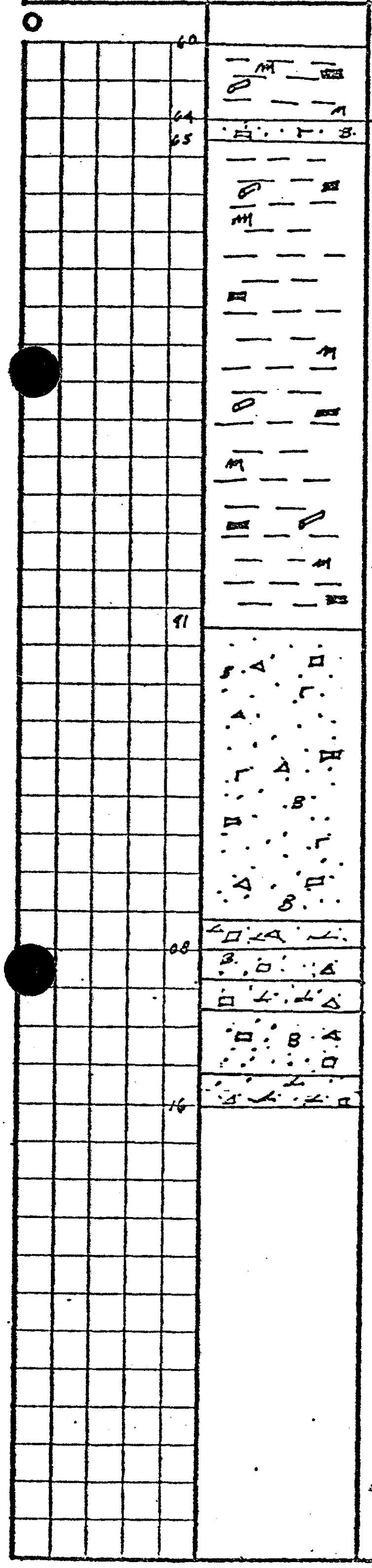
Core No. 6

WELL: FLATHEAD-1

Interval Cored 1660-1716 ft., Cut 56 ft., Recovered 56 ft., (100 %) Fm. LATROBE

Bit Type C-11, Bit Size 8 5/16" in., Desc. by R.V. HICKS Date 5 MAY 1969

Depth & Coring Rate (min./ft.) | Graphic (1" = 5') | Shows



Interval (ft.)	Descriptive Lithology
1660-1664	Shale m grey slty, sl carb, rare plant debris, blky
1664-1665	Sandstone (Quartzwacky) lt grey, vf-f gr subang w srtd, abdt lithics & clay N.S.
1665-1691	Shale aa
1691-1706.5	Sandstone, (qtzwacky) vf-f occ m, subang, well srtd, Lithics biotite, clay abdt, poor vis φ & k, N.S. sl fri
1706.5-1708	Sandstone dolic, lt gy, vf-f, sub ang w srtd, Lithics common, hd, tt, NS
1708-1709.5	Sandstone Non dolic, aa
1709.5-1711	Sandstone dolic aa
1711-1714.5	Sandstone non dolic aa
1714.5-1716	Sandstone dolic aa

REMARKS:

7/7

ESSO STANDARD OIL (AUSTRALIA) LTD.

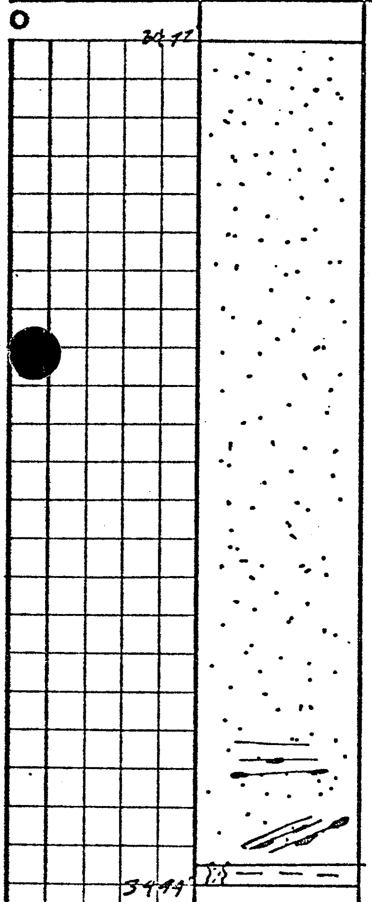
CORE DESCRIPTION

Core No. 7

WELL: FLATHEAD - 1

Interval Cored 3472-3494 ft., Cut 22 ft., Recovered 22 ft., (100 %) Fm. STREZ

Bit Type C-20, Bit Size 8 5/16 in., Desc. by R.V. Hicks Date 11 May 1969

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
			3472 - 3493.5	Sandstone (arkosic) very slightly dolomitic, Greenish grey, very fine to fine occasionally medium, angular to sub angular, abundant white green and red feldspar (orthoclase and possible some plagoclase) biotite common, interstitial clay, coarse to granule size detrital coal grains concentrated in thin bands along depositional bedding planes in lower portion of core. dips vary from 20° to horizontial probably indicating beach environment.
			3493.5 - 3494	Shale, medium light grey in contact with dark brown grey carbonaceous shale. with very small horizontal burrows at contact. Large (to 1") sand filled burrows vertical from overlying sand. Probably indicating beach and shore face environment.

REMARKS:

2·2 SIDE WALL CORES

1.

SIDEWALL CORE DESCRIPTIONS

WELL FLATHEAD #1 | SERV.CO. Schlum. | DATE 30/4/69 | LOG RUN NO. 1 | GEOLOGIST J.BLAC

REF.# | FIE Gippsland | STATE VICTORIA V[illegible]ORIA | ATT. 34 REC. 31 | PAGE [illegible] OF 3 PA

NO.	DEPTH	REC	LITHOLOGY	COLOR	DISS CLAY	CONS	CALC	ODOR	FIDO	FLUORESENCE			CUT		CUT FLUOR.		SHOW	PROB. PROD.
										DIST	INT	COL	QUAN	COL	INT	COL		
1	1337	1¾"	Shale - lt. GRY., V.SOFT	lt.gr.			V.											
			clayey, V. CALC.															
2	1320	½	Shale - lt. GRN., V. Soft, V.CALC.	lt. GRN			V.											
			foss, MASS clayey, Plastic															
3	1306	1¾"	Shale - lt. grn'sh gr., CALC.	lt. grn. gry.			V.											
			V. foss. SOFT - M. FIRM.															
4	1297	1½"	Shale - lt. grn., CALC., foss, SOFT.	lt. GRN			V											
5	1280	0	NO RECOV. SEE SPL 34															
6	1270	1¾	Shale - lt. grn, CALC, foss, Soft	lt. grn			V											
7	1254	1¾"	Shale - Med GRY, CALC., V.foss,	M. GRY			V											
			SOFT, w/ FRAGS lt. gry LS.															
8	1249	1¾	SHALE - lt. grn. gry., V. SDY	lt. grn. gry			V											
			w/ f-Vf. g., V. GLAUC., V. FOSS															
9	1245	1½"	SHALE - buff wh w/ 30% spl	buff wh.			V.											
			MADE up of glauc., CALC.															
			fairly firm, Tr. f.g. sd. V. foss															
10	1232	1¼"	SHALE - lt. gry, MARLY	lt. gry			V											
			sugary texture TR glauc.															
			fairly firm. V. CALC.															
11	1224	2"	Shale - lt. grn gry MARLY	Lt grn gry.			V											
			TR. glauc. w/ gr. ls. frags															
12	1212	1¾	Shale - lt. grn gr., fairly	lt grn gry			V											
			firm, foss. w/ Nodule															
			of DK grn sh, glauc?															

Page 1 of 5

SIDEWALL CORE DESCRIPTIONS

WELL FLATHEAD #1 | SERV.CO. Schlum | DATE 30/4/69 | LOG RUN NO. 1 | GEOLOGIST J BLA
REF.# | FIELD GIPPSland | STATE Victoria | ATT. 34 REC. 31 | PAGE 2 OF 3 PAGE

NO.	DEPTH	REC	LITHOLOGY	COLOR	DISS CLAY	CONS	CALC	ODOR	FIDO	FLUORESENCE			CUT		CUT FLUOR.		SHOW	PROB. PROD.
										DIST	INT	COL	QUAN	COL	INT	COL		
13	1205	2"	SHALE - olive gry, V. FOSS calc. FAIRly FIRM	Olive GRY			V.											
14	1194	1"	SHALE - lt. GRY, SDY, Sli FOSS, FAIRly FIRM	LT.GRY			V.											
15	1182	2"	SHALE - M. GRY, F. FIRM, FOSS	M. GRY			V.											
16	1167	1¾"	SHALE - M. GRY., F. FIRM, V. FOSS, GLAUC.	M GRY			V											
17	1150	1¾"	SHALE - LT GRN GRY, FOSS F. FIRM, V. CALC., GLAUC.	LT GRN GRY			V											
18	1139	2"	SHALE - LT GRN GRY, FOSS F. FIRM, CALC, TR. Glauc.	LT GRN GRY			V											
19	1134	1¾"	SHALE - M. GRY. FOSS, FIRM	M. GRY			V.											
20	1111	1¾"	SHALE - GRN GRY, V. FOSS, F. FIRM	GRN GRY			V.											
21	1092	1"	SHALE - Buff GRY, FOSS, SDY	Buff GRY			V											
22	1086	1¾	SHALE - OLIVE GRY. FOSS. F. FIRM	OlIVE GRY			V.											
23	1072	1½"	SHALE - M. GRY, SDY-Silty, F. FIRM, FOSS	M. GRY			V.											
24	1058	1¾"	SHALE - OLIVE GRY, F. FIRM V. FOSS, CALC, MARly	Olive GRY			V											
25	1053	2"	SHALE - olive GRY, F. FIRM V. FOSS, CALC. MARLY	OlIVE GRY			V											
26	1042	1¾	SHALE - OlIVE GRY, F. FIRM FOSS CALC. MARly	OlIVE GRY			V											

2/5

SIDEWALL CORE DESCRIPTIONS

WELL FLATHEAD #1
SERV. CO. Schlum
DATE 29/4/69
LOG RUN NO. 1
GEOLOGIST J. BLAC
REF. #
FIELD GIPPSLAND
STATE VICTORIA
ATT. 34 REC: 31
PAGE 3 OF 3
PAGE

NO.	DEPTH	REC	LITHOLOGY	COLOR	DISS CLAY	CONS	CALC	ODOR	FIDO	FLUORESENCE			CUT		CUT FLUOR.		SHOW	PROB. PROD.
										DIST	INT	COL	QUAN	COL	INT	COL		
27	1036	1¾	SHALE - LT. GRN GRY, FOSS	Lt. GRN GRY			V.											
			F. FIRM, CALC.															
28	1031	2"	SHALE - Lt. GRN. GRY. FOSS	H. GRN GRY			V											
			F. FIRM, CALC. MARLY															
29	1007		NO RECOVERY SEE #35															
30	1001		NO RECOVERY															
32	1320	1½	REPEAT OF SPL #2															
			SHALE - LT GRN, V. SOFT, Plastic	LT GRN			V											
			CLAYEY, CALC., TR MICA															
33	1306	2"	REPEAT OF SPL #3															
34	1280	2"	SHALE - LT GRN, SOFT, Clayey	LT GRN			V.											
			V. FOSS, CALC, TR glauc.															
35	1007	1"	SHALE - GRN GR., SOFT,	GRN GRY.			V											
			FOSS, CALC															

3/5

FLATHEAD - 1 Side Wall Cores

Run 2

1374	Rec. 2" Mudstone to Marl. Very light green grey. Glauconitic, with abundant skeletal debris.
1400	No Recovery
1417	Rec. 2" Mudstone as above.
1436	No Recovery
1455	Rec. 2" Mudstone as above
1464	No Recovery
1476	Rec. 2" Siltstone brown very argillaceous (almost silty shale) very fine mica, poor visible porosity and permeability, very faint yellow florescence very poor cut.
1484	Rec. 2" Siltstone as above, with good cut
1499	Rec. 2" Siltstone brown very glauconitic, very argillaceous, very faint spotty florescence, very poor cut, poor visible porosity and permeability
1495	Rec. 1 3/4" Siltstone brown very glauconitic, argillaceous, dull spotty yellow florescence slow cut, poor visible porosity and permeability.
1498	Rec. 2" Siltstone, brown, glauconitic argillaceous, soft, friable, show as above.
1508	Rec. 2" Siltstone as above.
1516	Rec. 2" Siltstone as above.
1525	Rec 1 3/4" Siltstone as above with slight visible porosity and permeability, very faint yellow florescence, slow cut.
1533	Rec. 2" Siltstone as above.
1538	Rec. 2" Siltstone as above.
1543	Rec. 2" Siltstone to very fine grained sandstone, light tan grey, slightly argillaceous, friable, fair visible porosity and permeability.
1948	Rec. 3/4" Sandstone very light grey, (salt and pepper sandstone) very fine grained, sub angular, well sorted, friable, good porosity and permeability. No show.
1965	Rec. 1¼" Shale, light grey, silty, waxy, soft.
2042	Rec. 1½" Shale as above.
2253	Rec. 1 1/8" Shale, medium grey, blocky soft.
2324	Rec. 1 1/8" Shale, medium light grey, slightly silty, waxy, with scattered carbonaceous debris.
2430	Rec. 1½" Shale, as above.
2775	Rec. 3/4" Shale, medium dark grey carbonaceous blocky.

FLATHEAD-1 S.W.C.

2890	Rec. ½" Shale, as above.
3015	Rec. 3/4" Shale, black, very carbonaceous
3315	Rec. 3/4" Shale, medium dark grey, silty, micaceous, blocky.
3442	Rec. 3/4" Shale as above.

2.3 CORE ANALYSIS RESULTS

1/3

Petroleum Tec[illegible]ogy Laboratory, Bureau of Mineral Resources, Ge[illegible]y and Geophysics, Canberra

CORE ANALYSIS RESULTS

NOTE: (i) Unless otherwise stated, porosities and permeabilities were determined on two plugs (V&H) cut vertically and horizontally to the axis of the core. Ruska porosimeter and permeameter were used with air and dry nitrogen as the saturating and flowing media respectively. (ii) Oil and water saturations were determined using Soxhlet type apparatus. (iii) Acetone test precipitates are recorded as Neg., Trace, Fair, Strong or Very Strong.

WELL NAME AND NO. FLATHEAD No. 1

DATE ANALYSIS COMPLETED OCTOBER 15, 1975

Core No.	Sample Depth		Lithology	Average Effective Porosity two plugs (% Bulk Vol.	Absolute Permeability (Millidarcy)		Average Density (gm/cc.)		Fluid Saturation (% pore space)		Core Water Salinity (p.p.m. NaCl)	Acetone Test	Fluorescence of freshly broken core	Sample "cut" in tetrachlorethylene
	From	To			V	H	Dry Bulk	Apparent Grain	Water	Oil				
2	1553'0"	1554'0"	Sst;f.gr.to c.gr.slty	32.9	N.D.	N.D.	1.92	2.94	57	17.1	N.D.	Strong	Dull irregular yellow	good
3	1555'0"	1556'0"	Sst;m.gr. arg.	36.4	N.D.	N.D.	1.71	2.69	33	26.0	N.D.	V.strong	Good even yellow	good
4	1588'6"	1589'7"	Sst;v.f.gr.	24.0	30	56	2.11	2.77	27	Tr	N.D.	Trace	Nil	Nil
4	1602'0"	1603'0"	Slst;aren.	28.1	16	31	1.84	2.56	43	15.2	N.D.	Strong	Good even yellow	good
5	1610'1"	1611'0"	Sst;m.gr. arg.grwke.	31.8	N.D.	240	1.83	2.69	29	8.5	N.D.	Strong	Fair irregular yellow	good
5	1616'11"	1617'7"	Slst;arg.	25.6	<0.1	N.D.	1.99	2.67	69	4.6	N.D.	Trace	Dull irregular yellow	fair
5	1624'4"	1625'0"	Sst;m.gr. arg.grwke.	26.9	4.2	N.D.	1.90	2.60	52	20.6	N.D.	Fair	Dull even yellow	good
5	1630'4"	1631'4"	Sst;f.gr. arg.	25.0	4.8	5.1	2.02	2.67	43	13.0	N.D.	Trace	Dull yellow	fair

Remarks: - Core No. 1 - insufficient sample

General File No. ~~62/299~~ 74/1076

Well File No.

Page 1 of 3

Petroleum Technology Laboratory, Bureau of Mineral Resources, Geology and Geophysics, Canberra

CORE ANALYSIS RESULTS

NOTE: (i) Unless otherwise stated, porosities and permeabilities were determined on two plugs (V&H) cut vertically and horizontally to the axis of the core. Ruska porosimeter and permeameter were used with air and dry nitrogen as the saturating and flowing media respectively. (ii) Oil and water saturations were determined using Soxhlet type apparatus. (iii) Acetone test precipitates are recorded as Neg., Trace, Fair, Strong or Very Strong.

WELL NAME AND NO. FLATHEAD No. 1

DATE ANALYSIS COMPLETED OCTOBER 15, 1975

503

Core No.	Sample Depth		Lithology	Average Effective Porosity two plugs (% Bulk Vol.	Absolute Permeability (Millidarcy)		Average Density (gm/cc.)		Fluid Saturation (% pore space)		Core Water Salinity (p.p.m. NaCl)	Acetone Test	Fluorescence of freshly broken core	Sample "cut" in tetrachlorethylene
	From	To			V	H	Dry Bulk	Apparent Grain	Water	Oil				
5	1652'1"	1652'11"	Slst	27.3	0.51	6.8*	1.88	2.65	65	1.0	N.D.	Trace	Good even yellow	fair
6	1663'0"	1664'0"	Sst;m.gr. grwke	29.3	9.9	6.9	1.90	2.69	49	Nil	N.D.	Nil	Dull irregular yellow	Nil
6	1691'1"	1692'0"	Sst;f.gr. grwke	26.3	<0.1	82	1.97	2.66	43	Nil	N.D.	Nil	Nil	Nil
6	1697'0"	1697'11"	Sst;m.gr. grwke	26.5	6.5	3.7	1.96	2.67	66	Nil	N.D.	Nil	Nil	Nil
6	1703'7"	1704'2"	as above	6.0	<0.1	<0.1	2.52	2.69	25	Nil	N.D.	Nil	Trace dull yellow	Nil
6	1709'0"	1709'9"	Sst;f.gr. to m.gr. carb	28.5	105	56	1.91	2.67	47	Nil	N.D.	Nil	Nil	Nil
6	1712'1"	1713'0"	Sst;f.gr. grwke	25.9	1.7	5.2	1.97	2.66	59	Nil	N.D.	Nil	Nil	Nil
7	3475'0"	3476'0"	Sst;f.gr. grwke	9.5	<0.1	<0.1	2.42	2.69	26	Nil	N.D.	Nil	Nil	Nil

Remarks: - * - Fractured

General File No. ~~62/399~~ 74/1076
Well File No. ______________

3/3

Petroleum Technology Laboratory, Bureau of Mineral Resources, Geology and Geophysics, Canberra

CORE ANALYSIS RESULTS

NOTE: (i) Unless otherwise stated, porosities and permeabilities were determined on two plugs (V&H) cut vertically and horizontally to the axis of the core. Ruska porosimeter and permeameter were used with air and dry nitrogen as the saturating and flowing media respectively. (ii) Oil and water saturations were determined using Soxhlet type apparatus. (iii) Acetone test precipitates are recorded as Neg., Trace, Fair, Strong or Very Strong.

WELL NAME AND NO. FLATHEAD No. 1

DATE ANALYSIS COMPLETED OCTOBER 15, 1975

Core No.	Sample Depth		Lithology	Average Effective Porosity two plugs (% Bulk Vol.	Absolute Permeability (Millidarcy)		Average Density (gm/cc.)		Fluid Saturation (% pore space)		Core Water Salinity (p.p.m. NaCl)	Acetone Test	Fluorescence of freshly broken core	Sample "cut" in tetrachlorethylene
	From	To			V	H	Dry Bulk	Apparent Grain	Water	Oil				
7	3479'2"	3479'7"	Sst;f.gr. grwke	8.6	<0.1	<0.1	2.39	2.61	27	Nil	N.D.	Nil	Nil	Nil

Remarks: -

General File No. ~~62/300~~ 74/1076

Well File No.

3/3

3. PETROGRAPHY AND CLAY MINERALOGY

OIL and GAS DIVISION - 5 AUG 1980

The Australian
Mineral Development
Laboratories

Flemington Street, Frewville,
South Australia 5063
Phone Adelaide 79 1662
Telex AA 82520

Please address all
correspondence to
P.O. Box 114 Eastwood
SA 5063
In reply quote:

amdel

Page 1 of 7

29 July 1980

GS 3/205/0

Phillips Australian Oil Company,
GPO Box 2066,
PERTH, WA 6001.

Attention: N.C. Tallis

FLATHEAD - 1.

REPORT GS 235/81

YOUR REFERENCE:	Letter of 14 July 1980
MATERIAL:	3 sandstones
IDENTIFICATION:	1545-48; 1555-61; 1569
DATE RECEIVED:	15 July 1980
WORK REQUIRED:	Petrography and clay mineralogy

Investigation and Report by: Drs Brian Steveson and Roger Brown

Manager, Geological Services Division: Dr Keith J. Henley

Keith Henley

for Norton Jackson
Managing Director

jd/5:1

Pilot Plant: Osman Place
Thebarton S.A.
Telephone 43 8053
Branch Laboratory: Perth

2/7
AMDEL

EXAMINATION OF THREE LITHIC TERRIGAROUS SEDIMENTS

1. INTRODUCTION

Three small friable sandstone fragments were received from Phillips Australian Oil Company with a request for petrography, X-ray diffraction analsysis and SEM/EDAX studies.

Results of petrography and clay mineralogy have been given to the client by telephone; if SEM/EDAX work is needed more of each sample will be required. The samples submitted were as small as can be used for clay mineralogy investigations by X-ray diffraction.

2. PETROGRAPHY

Sample: 1545-1548; TSC30002

Rock Name:
Lithic sandstone

Thin Section:
Approximately 25% of the volume of this rock consists of detrital grains of quartz and feldspar; much of the remainder of the thin section consists of clays or secondary minerals. The diversity of the clay is strong evidence that the material is derived from original rock fragments and does not represent an argillaceous matrix deposited with the sand-grade grains. The rock is, consequently, an immature sandstone which contains a large proportion of labile rock fragments; during compaction and lithification many of the softer of these fragments have been compressed between the more rigid quartz and feldspar grains and any original porosity in the sand has been choked by this clay material filling pore throats. X-ray diffraction analysis suggest that the rock contains a significant amount of natrojarosite (a hydrated sodium iron sulphate mineral), barite and gypsum. It is likely that the barite has been derived from drill mud and the introduction of this into the rock may well have caused some reduction in porosity but it is thought that this is likely only to have been a minor effect compared with the choking of the original pores caused by the abundance of clay in the original sandstone.

The quartz grains have a wide size range up to about 0.4 mm. The average size is approximately 0.15 mm. Most of the grains are distinctly angular in shape although there is, exceptionally, a range towards subround grains. Feldspar is fresh and both microcline and plagioclase could be identified in the rock. The feldspar comprises probably less than 2% of the overall volume of the sample, however.

Between these quartz and feldspar grains is a heterogeneous mosaic of clay. In plane polarized light there are slight differences in colour and texture which serve to show the outline of original detrital rock fragments. These are similar in size to the grains of quartz and most are equant and more or less angular in shape. Most of the clay grains contain extremely fine-grained material but in some there is evidence of intermixing of clays and quartz on a fine scale. Some probably also contain gypsum but this could not be identified optically. Some of the clay grains have, under crossed nicols, a texture which pseudomorphs a well developed cleavage and these grains are interpreted as being derived from the virtually complete

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alteration of original mica flakes. It is likely that, in the original sand, rock fragments and mica flakes comprise considerably more than 50% of the material.

The sandstone contains some equant irregular patches of translucent dark yellow material which is interpreted as being natrojarosite. The most likely interpretation of this material is that it was derived from the oxidation of pyrite and that the sodium in the natrojarosite was derived in some way from seawater (there being no other obvious source of sodium in the sandstone system).

The sample is, therefore, an extremely lithic sandstone and it is thought likely that the low porosity and permeability of the rock derived from the effect of squeezing clays into original pore throats during compaction. There has clearly been some introduction of barite into the sandstone but it is thought that this contributed only to a small extent to reduction of the sands' original porosity. The presence of a considerable suite of clay minerals indicates the heterogeneity of the lithic material and the presence of natrojarosite is thought to be a result of oxidation and alteration of pyrite associated with marine conditions.

Sample: 1555-1561; TSC30003

Rock Name:
Lithic sandstone

Thin Section:
This rock is similar in most respects to that described immediately above but it contains a little identifiable carbonate which appears to be of authigenic origin but the patches of dark material derived from the alteration of pyrite are absent. Fragments of quartz and feldspar comprise about 30 to 35% of the rock and the remainder consists of heterogeneous clays essentially of lithic origin.

The quartz and feldspar fragments (and a few quartzite fragments also) range in size up to about 0.4 mm but the material is fairly ill-sorted about an average size of approximately 0.15 mm. Feldspar is more abundant than in the rock described above and most fields of view contain one or two feldspar crystals. Most of these appear to be very slightly altered turbid potassium feldspar with somewhat less plagioclase. The grains of quartz and feldspar are generally distinctly angular in shape. Quartzite fragments are commonly finely granular rocks probably of metamorphic origin. In one place in the section there is a micrographically intergrown aggregate of quartz and ?potassium feldspar such as characterises high-level igneous intrusive rocks.

These detrital components occur in matrix of heterogeneous clays and fine-grained quartz. This material is essentially of lithic origin and consists of rock fragments similar in size to the quartz and feldspar grains which have been slightly deformed during compaction of the rock. Most of the grains are brownish, partly altered clays and some contain finely intergrown quartz and feldspar. The heterogeneity of this material is the key to realising that it is of detrital origin and is not either authigenic or derived from an original argillaceous mud deposited with the quartz and feldspar.

The rock contains a little authigenic carbonate which occurs as dark reddish patches (?of siderite) up to about 0.2 mm in size. Some of these patches have a radiating appearance with finer material near the

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centre and coarser material round the outside; the material has probably partly replaced adjacent fine-grained clay materials during a relatively late period of diagenesis of the rock.

This is an immature fine-grained sandstone containing abundant fine-grained clay fragments probably of sedimentary or metasedimentary rocks mainly. During compaction the more plastic rock fragments have been compressed between rigid quartz and feldspar grains and by this process original pore throats have been choked with clay material. Subsequently there has been a little authigenesis of carbonate but this has probably contributed only a little to the reduction in the original porosity.

Sample: 1569; TSC30004

Rock Name:
Sandy siltstone

Thin Section:
The bulk of the thin section consists of a turbid aggregate of fine-grained clay material which is distinctly heterogeneous over the area of the thin section. By analogy with the two samples described above, it is thought likely that much of the material was deposited as small silt-grade rock fragments which have subsequently been compressed, distorted and possibly slightly recrystallized. As a result of these processes, clay has been forced into pore throats particularly during compaction between the more rigid quartz and feldspar grains. This has been the principal process by which porosity in the original silt has been significantly decreased. The rock contains small amounts of authigenic kaolinite and a little authigenic carbonate; the growth of these two minerals probably contributed only a small amount to porosity reduction.

Quartz and feldspar grains are of approximately coarse silt-grade and comprise of the order of 30% of the volume of the rock. As is characteristic of grains of this size, the quartz and feldspar fragments are angular in shape. The grains are well separated from each other and there is no way in which they form any kind of framework. Feldspar is commonly a little difficult to identify but rather turbid grains and some showing a little twinning are clearly both feldspar and it is possible that there is rather more of this mineral present than is apparent from optical examination alone.

The quartz and feldspar occur in a aggregate of brown argillaceous material which shows colour and texture variations over a scale of about 0.1 to 0.2 mm. This is thought to reflect the origin of the clay as detrital material. Most of the material has a low birefringence and is possibly somewhat stained by ferruginous material. In some places clay shows a bulk extinction and hence there is some orientation of the flakes but in other grains there are more equigranular textures and in some of these there is fine-grained quartz intergrown with the clay. Most of the fragments are of metasedimentary or sedimentary fine-grained rock. One or two fragments, however, have textures which could well be derived from the alteration of original volcanic rock fragments.

The thin section contains a brownish authigenic carbonate which is present as small patches, some of which show a radial texture. Elsewhere there are rather coarse-grained aggregates of ?kaolinite and it is thought that these represent a trace amount of authigenic kaolinite which probably developed in the rock relatively early in its diagenetic history (before the porosity was markedly reduced).

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AMDEL

As in the case of the rocks described above, the low porosity of this sample appears to be function of the amount of clay originally deposited in the sediment; this material has been deformed and possibly somewhat dispersed during compaction of the rock and this has resulted in a significant reduction of pore space as a result of choking of pore throats with clays.

3. X-RAY DIFFRACTION ANALYSIS

3.1 Procedure

Portion of each sample was powdered finely and used to prepare an X-ray diffractometer trace which was interpreted by standard procedures, to give the mineralogy of the bulk material.

Weighed subsamples were taken and dispersed in water with the aid of deflocculants and an electric blender, and allowed to sediment to produce a -4 μm e.s.d. size fraction by the pipette method. The resulting dispersions were examined by plummet balance to determine their solids contents, and were then used to produce oriented clay preparations on ceramic plates. Two plates were prepared per sample, both being saturated with Mg^{++} ions, and one in addition being treated with glycerol. When air-dry, these were examined in the X-ray diffractometer.

3.2 Results

The results are given in Table 1, which lists the following:

(a) The mineralogy of the total sample, as derived from examination of the bulk material, with supporting evidence as available. The minerals found are listed in approximate order of decreasing abundance, using the semiquantitative abbreviations given. Coverage of clays may be incomplete, and for full clay mineralogy Section (c) should be consulted. This Section (a) is for information on non-clay minerals and to give a general idea of the makeup and proportions.

(b) The proportion of the sample found to separate into the -4 μm size fraction, as determined by the plummet balance. The figure obtained applies only to the pre-treatment and dispersion conditions used.

(c) The mineralogy of the -4 μm fraction, given as Section (a).

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TABLE 1: MINERALOGY BY X-RAY DIFFRACTION ANALYSIS

Sample	(1) 1545-48		(2) 1555-1561		(3) 1569	
Mineralogy of bulk:	Q	D	Q	CD	Q	D
	B	A	F	CD	F	A-SD
	NJ	Tr-A	K	A	B	A
	F	Tr-A	C	A	C	A
	Gy	Tr-A	M	A	K	A
	M	Tr-A			M	A
	Cal?	Tr				
-4 µm fract. % of total:	9		23		11	
Mineralogy:	M	D	Mo	D	Mo	D
	K	SD	K	A	K	SD
	Mo	A-SD	M	A	M	A
	B	A	Q	A	C	A
	NJ	A	C	Tr-A	Q	Tr-A
	Q	Tr				

Mineral Key:

B	Barite	K	Kaolinite
C	Chlorite	M	Mica/illite
Cal	Calcite	Mo	Montmorillonite (smectite)
F	Feldspar	NJ	Natrojarosite
Gy	Gypsum	Q	Quartz

Semiquantitative Abbreviations:

D = Dominant. Used for the component apparently most abundant, regardless of its probable percentage level.

CD = Co-dominant. Used for two (or more) predominating components, both or all of which are judged to be present in roughly equal amounts.

SD = Sub-dominant. The next most abundant component(s) providing its percentage level is judged above about 20.

A = Accessory. Components judged to be present between the levels of roughly 5 and 20%.

Tr [illegible] Trace. Components judged to be below about 5%

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Barite is estimated in sample 1 as 10 to 20% and in sample 3, 5 to 10%. These are very approximate estimates; accurate measurement of the proportion of barite should be obtained from a barium analysis.

4. PALYNOLOGY

OIL and GAS DIVISION

PALYNOLOGY OF SAMPLES FROM CORES 6 AND 7, FLATHEAD-1 (ESSO, GIPPSLAND BASIN)

W545

0 1 JUL 1985

JUNE 1985

PALYNOLOGY OF SAMPLES FROM CORES 6 AND 7, FLATHEAD-1 (ESSO, GIPPSLAND BASIN)

As part of a review of the Gippsland Basin cores 6 (Latrobe Fm.) and 7 (Strzelecki Fm) of Flathead-1 were sampled for palynology and maturity studies. Of the 10 samples available, 8 were selected for preparation. All gave an acid-insoluble residue of plant remains and palynomorphs. Results were as follows:

> 1662 - 1696 ft. (6 core samples) : rich and varied assemblages of pollen and spores, well-preserved. The presence of COPTOSPORA PARADOXA, CLAVATIPOLLENITES HUGHESII, CUPULIFEROIDOPOLLENITES cf. PARVULUS, DICTYOTOSPORITES COMPLEX, CRYBELOSPORITES STRIATUS, LYCOPODIUMSPORITES INTRAVERRUCATUS and L. CIRCOLUMENUS, together with the absence of PROTEACIDITES spp. and NOTHOFAGIDITES spp suggests a base Late Cretaceous (Uppermost Albian (= Vraconian) to ? Turonian) age. Some Triassic reworking was noted.

No dinoflagellates or other marine indicators were present. Acritarchs were found at 1696 ft. and these may indicate brackish conditions. The assemblages as a whole, including the types and sizes of the plantremains suggest a non-marine, fluvial/lacustrine environment of deposition. Sporomorph-colours, both under transmitted white light and using U.V. incident light indicate that the organic matter is immature for hydrocarbon generation. One sample, at 1676 ft. is very organic rich (6 millilitre of O.M per 10 grams of sediment) and is of source rock quality. Type of organic matter : humic.

> 3487 - 3493 ft. (2 core samples) : assemblages, although rich in specimens, were of very poor diversity and lacked markers.

Bisaccates and MICROCACHRYIDITES ANTARCTICUS were most common. Of the spores present BACULATISPORTES COMAUMENSIS, CICATRICOSISPORITES AUSTRALIENSIS, LEPTOLEPIDITES VERRUCATUS, NEORAISTRICKIA TRUNCATA and a single DICTYOTOSPORITES SPECIOSUS were noted. All are longer ranging types, and although the assemblages are definitely not older than Lower Cretaceous it is impossible to be more precise.

No dinoflagellates or other marine indicators were present and in fact the general aspect of assemblages and plant remains is typically that of a freshwater swamp environment.

Sporomorph-colours indicate that the organic matter is early mature for hydrocarbon generation. Both samples are organic rich but especially at 3493 ft. (7 millilitres O.M. per 10 grams of sediment). Type of O.M. : humic.

SHELL COMPANY OF AUSTRALIA LIMITED

Exploration and Production

Oil and Gas

Melbourne, 22 May 1985

PALYNOLOGY REPORT

ON

FLATHEAD -1

BY

LEWIS E. STOVER

Palynology Report 1970/24

June 1970.

6/12

FLATHEAD-1

INTRODUCTION

As part of a regional study of microplankton from the Nothofagidites asperus Zone in the Gippsland Basin, dinoflagellate bearing samples from Flathead -1 at 1495 and 1516 feet were studied. Evans & Mulholland, 1969 (Palynology Report 1969/8) provisionally assigned an Oligocene age to both samples.

SUMMARY

Sample	Drill Depth	Age	Dinoflagellate Zone
swc	1495 feet	Oligocene or younger	Unnamed
swc	1516 feet	M/L Eocene	D. extensa

COMMENTS

Spores, pollen and dinoflagellates are sparse in the sample from 1495 feet. Except for Epicephalopyxis indentata and Operculodinium centrocarpum - both long ranging forms - no definitive Late Eocene dinoflagellates were observed. Specimens of Nothofagidites dominate the spore-pollen fraction.

A considerably more diverse palynomorph assemblage was recovered from the sample at 1516 feet. The spores and pollen suggest that the sample is from the older part of the N. asperus Zone and this contention is supported by the dinoflagellates. The sample contains Peridinium eocenicum and Leptodinium reticulodotum, both of which begin in Taylors late Middle Eocene N zonule in the Browns Creek section. The sample also contains Diphyes colligerum which has also been identified in Tuna -3 at 4500 feet and in Bream -3 at 6447 feet.

L. E. STOVER.
JUNE 1970.
PALYNOLOGY REPORT
1970/24

PALYNOLOGY OF SAMPLES FROM CORES 6 AND 7, FLATHEAD-1 (ESSO, GIPPSLAND BASIN)

As part of a review of the Gippsland Basin cores 6 (Latrobe Fm.) and 7 (Strzelecki Fm) of Flathead-1 were sampled for palynology and maturity studies. Of the 10 samples available, 8 were selected for preparation. All gave an acid-insoluble residue of plant remains and palynomorphs. Results were as follows:

> 1662 - 1696 ft. (6 core samples) : rich and varied assemblages of pollen and spores, well-preserved. The presence of COPTOSPORA PARADOXA, CLAVATIPOLLENITES HUGHESII, CUPULIFEROIDOPOLLENITES cf. PARVULUS, DICTYOTOSPORITES COMPLEX, CRYBELOSPORITES STRIATUS, LYCOPODIUMSPORITES INTRAVERRUCATUS and L. CIRCOLUMENUS, together with the absence of PROTEACIDITES spp. and NOTHOFAGIDITES spp suggests a base Late Cretaceous (Uppermost Albian (= Vraconian) to ? Turonian) age. Some Triassic reworking was noted.

No dinoflagellates or other marine indicators were present. Acritarchs were found at 1696 ft. and these may indicate brackish conditions. The assemblages as a whole, including the types and sizes of the plantremains suggest a non-marine, fluvial/lacustrine environment of deposition. Sporomorph-colours, both under transmitted white light and using U.V. incident light indicate that the organic matter is immature for hydrocarbon generation. One sample, at 1676 ft. is very organic rich (6 millilitre of O.M per 10 grams of sediment) and is of source rock quality. Type of organic matter : humic.

> 3487 - 3493 ft. (2 core samples) : assemblages, although rich in specimens, were of very poor diversity and lacked markers.

Bisaccates and *MICROCACHRYIDITES ANTARCTICUS* were most common. Of the spores present *BACULATISPORTES COMAUMENSIS*, *CICATRICOSISPORITES AUSTRALIENSIS*, *LEPTOLEPIDITES VERRUCATUS*, *NEORAISTRICKIA TRUNCATA* and a single *DICTYOTOSPORITES SPECIOSUS* were noted. All are longer ranging types, and although the assemblages are definitely not older than Lower Cretaceous it is impossible to be more precise.

No dinoflagellates or other marine indicators were present and in fact the general aspect of assemblages and plant remains is typically that of a freshwater swamp environment.

Sporomorph-colours indicate that the organic matter is early mature for hydrocarbon generation. Both samples are organic rich but especially at 3493 ft. (7 millilitres O.M. per 10 grams of sediment). Type of O.M. : humic.

SHELL COMPANY OF AUSTRALIA LIMITED
Exploration and Production
Oil and Gas

Melbourne, 22 May 1985

9/12

BASIN GIPPSLAND DATE

WELL NAME FLATHEAD -1 ELEVATION KB +31 feet.

AGE	PALYNOLOGIC ZONES	HIGHEST DATA Preferred Depth	Rtg.	Alternate Depth	Rtg.	2 way time	LOWEST DATA Preferred Depth	Rtg.	Alternate Depth	Rtg.	2 way time
LIG- IO.	P. tuberculatus										
	U. N. asperus										
EOCENE	M. N. asperus										
	L. N. asperus	1516	1	1495	2		1516	1			
	P. asperopolus	1549	1				1550	1			
	U. M. diversus										
	M. M. diversus										
	L. M. diversus										
PALEOCENE	U. L. balmei										
	L. L. balmei										
	T. longus										
E CRE...EOUS	T. lilliei										
	N. senectus										
	C. trip./T.pach										
	C. distocarin.										
	T. pannosus										
EARLY CRETACEOUS	C. striatus	1580	2				3494	2			
PRE-CRETACEOUS	T.D.	3496									

COMMENTS: Deflandrea heterophlycta Zone 1495 (2) — 1516 (1)

RATINGS:
0; SWC or CORE, EXCELLENT CONFIDENCE, assemblage with zone species of spores, pollen and microplankton.
1; SWC or CORE, GOOD CONFIDENCE, assemblage with zone species of spores and pollen or microplankton.
2; SWC or CORE, POOR CONFIDENCE, assemblage with non-diagnostic spores, pollen and/or microplankton.
3; CUTTINGS, FAIR CONFIDENCE, assemblage with zone species of either spore and pollen or microplankton, or both.
4; CUTTINGS, NO CONFIDENCE, assemblage with non-diagnostic spores, pollen and/or microplankton.

NOTE: If a sample cannot be assigned to one particular zone, then no entry should be made. Also, if an entry is given a 3 or 4 confidence rating, an alternate depth with a better confidence rating should be entered, if possible.

DATA RECORDED BY: LES. DATE Dec. 1971

DATA REVISED BY: A.D.P. DATE Jan. 1975

ORM No R 315 12/72

10/12

13/28

W. J. PALEY

FLATHEAD-1

Latrobe Group

Cores 3,4 and 6 (1570', 1583', 1693'): Middle to Late Albian

All the above samples showed the same basic spore and pollen assemblage. Gymnospermous trisaccate and bisaccate pollen grains dominate the assemblage, e.g. *Podocarpidites ohikaensis, P.*cf.*ellipticus, Podosporites microsaccatus* (Core 4), and *Alisporites grandis* (Core 3). Common spores include the abundant *Cicatricosisporites australiensis, Cyathidites australis, Lycopodiumsporites austroclavatidites, L.nodosus* and *Aequitriradites spinulosus.* Spores found in core samples 3 and 4 but not in 6 include *Osmundacidites wellmanii,Foveotriletes* cf.*parviretus, Ceratosporites equalis* and *Foraminisporis dailyi.* The latter species is not found later than Albian. In finer detail, each assemblage differs slightly. Only in core sample 3 are *Schizosporis reticulatus, Rouseisporites reticulatus, Pilosisporites* cf.*notensis* and *Foraminisporis asymmetricus* (Barremian-Albian) noted. In core sample 4, *Velosporites triquetrus* and *Leptolepidites major* are found. In core sample 6, the assemblage differs with the appearance of *Klukisporites scaberis, Pilosisporites parvispinosus* (Barremian-Albian), *Rouseisporites radiatus, Araucariacites australis* and *Dictyotosporites* cf.*speciosus.* The latter species is used by Dettmann and Playford 1969 as a zone fossil. They give a stratigraphic range of Valanginian to Aptian. Morgan and others, however, extend this to the Early Albian. The occurrence of *D.*cf.*speciosus* with *Coptospora paradoxa* in core sample 6 would, on the Dettmann and Playford zonation scheme, give a precise age as Latest Aptian, i.e. earliest *Coptospora paradoxa* zone. The work of Burger, Morgan and others, however, suggests a Middle Albian to earliest Late Albian age. *Coptospora paradoxa* also occurs in core sample 3. This, together with the occurrence of *Crybelosporites striatus* in core samples 3, 4 and 6, places these assemblages in the *Coptospora paradoxa* zone.

Core 7: 3490' Early Albian

The spore and pollen assemblage resembles the Late Albian assemblages of core samples 3, 4 and 6 in containing common trisaccates and bisaccates. Spores, which are found in numbers, include *Cicatricosisporites australiensis,* the zone fossils *Crybelosporites striatus* and *Foraminisporis wonthaggiensis* (Valanginian to Albian). Other species noted include *Cyathidites australis, Foraminisporis dailyi, Pilosporites parvispinosus, Aequitriradites spinulosus, Osmundacidites wellmanii,Lycopodiumsporites austroclavatidites, Cicatricosisporites hughesi, Rouseisporites reticulatus, R. simplex* and *Araucariacidites australis.* The presence of *Dictyotosporites filosus,* together with the absence of *Coptospora paradoxa,* indicates a Middle to Late Aptian age, according to the zonation of Dettmann and Playford 1969, or an Early Albian age after the zonation scheme by Burger, which is used in this report.

DISCUSSION

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W.J. PALEY

The greater part of the Gippsland Basin lies off the coast of South East Victoria. Published information (Stover and Evans 1973) indicates that the basin is fault bounded to the north and south forming a graben structure. The basin has been folded by N.W. to S.E. compressional forces, producing a series of anticlinal folds, trending approximately N.E. to S.W. usually subparalleling the Victorian coastline.

Fig.1 shows the relative offshore positions of each well in this study. Fig.2, a cross section, attempts to correlate the ages of the Labtrobe Group and Strzelecki Group in each well across the basin. The base of the Oligocene is used as the standard time horizon and, with the exception of Barracouta-1, this is the base of the Gurnard Formation (Oligocene). Only the age diagnostic species have been inserted on the cross section. Few time lines can be drawn with certainty, since only a few spot samples were provided for the study. Time lines in fig.2 are, therefore, tentative. Even so, the overall impression of basinal sedimentation is illustrated. Deposition seems to be greatest and apparently continuous in the Barracouta-1 area, with both condensed sequences and non-deposition occurring along the margins of the north and south platforms.

The unconformity shown on the Flathead-1 graphic log may represent a transgressive event. On palynological evidence, the hiatus is of brief duration and if present must be restricted to Early to Middle Albian times. Morgan 1980 and Burger 1980 record an Early to Middle Albian transgression in Australia, which had an effect on microfloral assemblages. Unfortunately, there is only a slight change in microfloral composition across the unconformity, and no marine indicators were found. In the assemblage above the unconformity, there was no palynological evidence for a Late Cretaceous or Early Tertiary age, thus reducing the possibility of the Albian microfloras being reworked assemblages.

In the graphic log of Perch-1 the samples are thought to be mislabelled. Their probable position has, therefore, been corrected in fig.2.

The interpretation of palaeoenvironments based upon spore and pollen content was not attempted in this report. Spores and pollen tend not to be as facies controlled as dinocysts and acritarchs, and may be found in several depositional environments. Dinocysts and acritarchs, with a few exceptions, tend to be confined to marine or brackish water conditions. Thus their presence in a microfloral assemblage indicates a marine influence in the depositional environment.

There are a number of Australian zonation schemes available for use in age dating studies in the Cretaceous and Tertiary. All the schemes used in this report use first and last appearance datums of particular spore and pollen species. The zonation scheme of Stover and Evans 1973 is used in this report for dating of the Campanian to Eocene whilst the Dettmann and Playford 1969 zonation scheme is used for the Cenomanian to Campanian. Burger 1973 and 1980 (in press) and Morgan and co-workers 1980 (in press) have revised the Lower Cretaceous part of the Dettmann and Playford scheme. The Burger and Morgan zonation schemes, used in this report, are approximately half a stage younger for Albian and Aptian stages. Morgan places the

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W.J. PALEY 15/28

Coptospora paradoxa zone and the *Crybelosporites striatus* zone in the Late and Early Albian respectively. Burger shows a similar division but places the *C. paradoxa* zone in the Middle Albian. In contrast to these zonation schemes Dettmann and Playford 1969 place the *C.striatus* zone in the Late Aptian and the *C. paradoxa* zone in the Uppermost Aptian to early Late Albian.

BASIN GIPPSLAND DATE

WELL NAME FLATHEAD -1 ELEVATION + 31 feet

AGE	PALYNOLOGIC ZONES	HIGHEST DATA					LOWEST DATA				
		Preferred Depth	Rtg	Alternate Depth	Rtg	2 way time	Preferred Depth	Rtg.	Alternate Depth	Rtg.	2 way time
MIOC.	T. bellus										
	P. tuberculatus										
EOCENE	U. N. asperus										
	L. N. asperus	1516	1	1495	2	[illegible]	1516	1			[illegible]
	P. asperopolus	1549	1			[illegible]	1550	1			[illegible]
	U. M. diversus										
	L. M. diversus										
PALEO-CENE	L. balmei										
	T. longus										
LATE CRETACEOUS	T. lilliei										
	N. senectus										
	C. trip./T.pach.										
	C. distocarin.										
	T. pannosus										
EARLY CRETACEOUS	C. paradoxa										
	C. striatus										
	U. C. hughesii										
	L. C. hughesii										
	C. stylosus										
Pre-Cretaceous											

Superseded

COMMENTS: SWC at 1495 feet is probably L. N. asperus; poor assemblage

(0.916)

T.D. 3496

RATINGS:
- 0; SWC or CORE, EXCELLENT CONFIDENCE, assemblage with zone species of spores, pollen and microplankton.
- 1; SWC or CORE, GOOD CONFIDENCE, assemblage with zone species of spores and pollen or microplankton.
- 2; SWC or CORE, POOR CONFIDENCE, assemblage with non-diagnostic spores, pollen and/or microplankton.
- 3; CUTTINGS, FAIR CONFIDENCE, assemblage with zone species of either spores and pollen or microplankton, or both.
- 4; CUTTINGS, NO CONFIDENCE, assemblage with non-diagnostic spores, pollen and/or microplankton.

NOTE: If a sample cannot be assigned to one particular zone, then no entry should be made. Also, if an entry is given a 3 or 4 confidence rating, an alternate depth with a better confidence rating should be entered, if possible.

DATA RECORDED BY: L.E.S. DATE DEC. 1971

DATA REVISED BY: DATE

FORM No. P200 4/71

Form 3 193 3/71

BASIN GIPPSLAND BASIN BY David TAYLOR

WELL NAME FLATHEAD-1 DATE 19 April 1973 ELEV. +31

Foram Zonules

		Highest Data	Quality	2 Way Time	Lowest Data	Quality	2 Way Time
MIOCENE	A						
	Alternate						
	B						
	Alternate						
	C						
	Alternate						
	D_1						
	Alternate						
	D_2						
	Alternate						
	E						
	Alternate						
	F	1150	0				
	Alternate						
	G				1338	0	
	Alternate						
	H_1	1374	0				
	Alternate						
	H_2				1400	3	
	Alternate						
OLIGOCENE	I_1	1417	0		1455	0	
	Alternate						
	I_2						
	Alternate						
	J_1	1538	2		1538	2	
	Alternate						
	J_2						
	Alternate						
EOC.	K						
	Alternate						
	Pre K						

Determination of J is in disagreement with observed spore-pollen and dinoflagellates from SWC at 1516' which give Middle Eocene, Lower N. asperus Zone age

COMMENTS: Disturbed sequence in F & G.

Note: If highest or lowest data is a 3 or 4, then an alternate 0, 1, 2 highest or lowest data will be filled in if control is available.

If a sample cannot be interpreted to be one zonule, as apart from the other, no entry should be made.

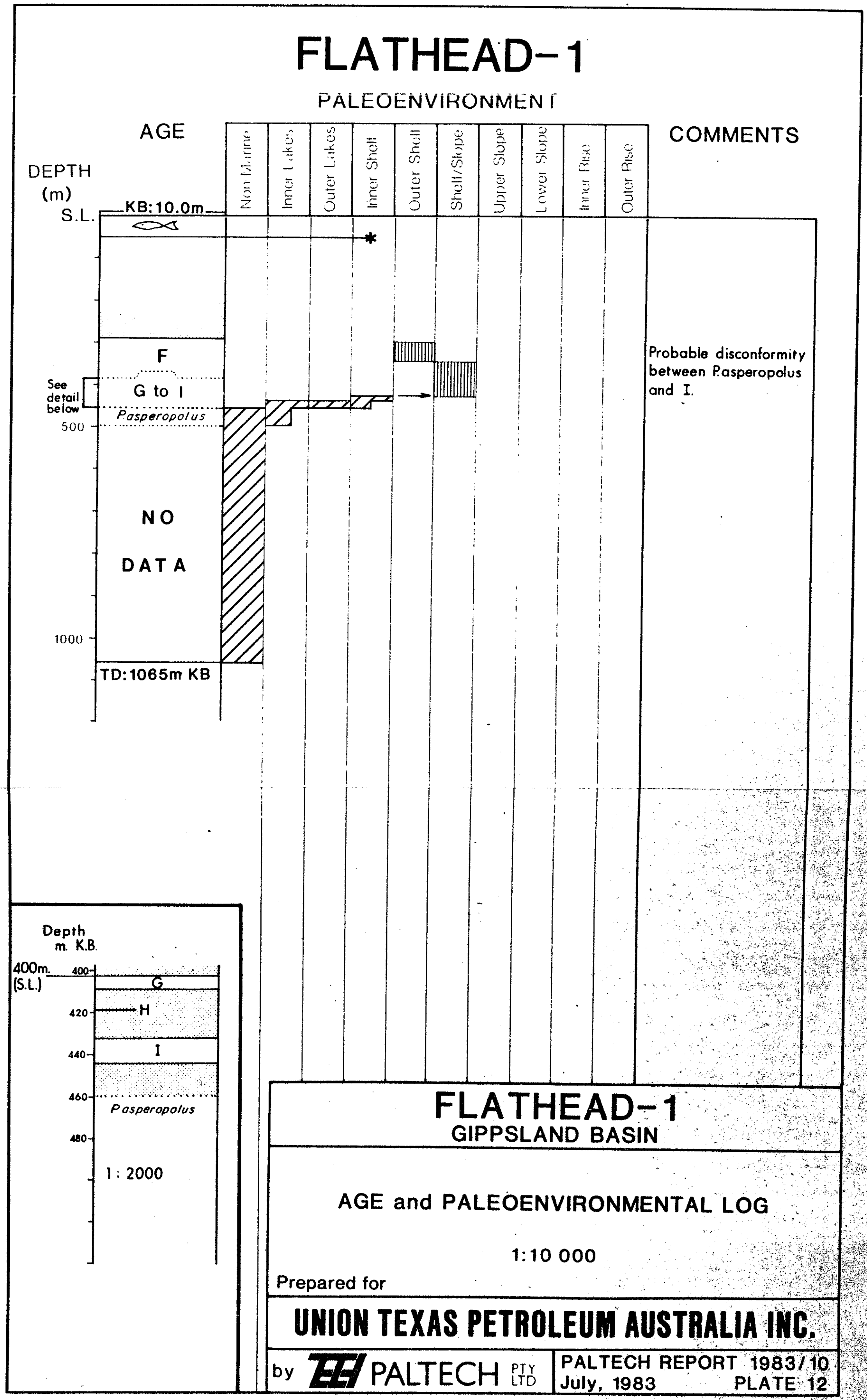
0 SWC or Core - Complete assemblage (very high confidence).
1 SWC or Core - Almost complete assemblage (high confidence).
2 SWC or Core - Close to zonule change but able to interpret (low confidence).
3 Cuttings - Complete assemblage (low confidence).
4 Cuttings - Incomplete assemblage, next to uninterpretable or SWC with depth suspicion (very low confidence).

Date Revised ____________

By ____________

5/12

FLATHEAD-1



FLATHEAD-1
GIPPSLAND BASIN

AGE and PALEOENVIRONMENTAL LOG

1:10 000

Prepared for

UNION TEXAS PETROLEUM AUSTRALIA INC.

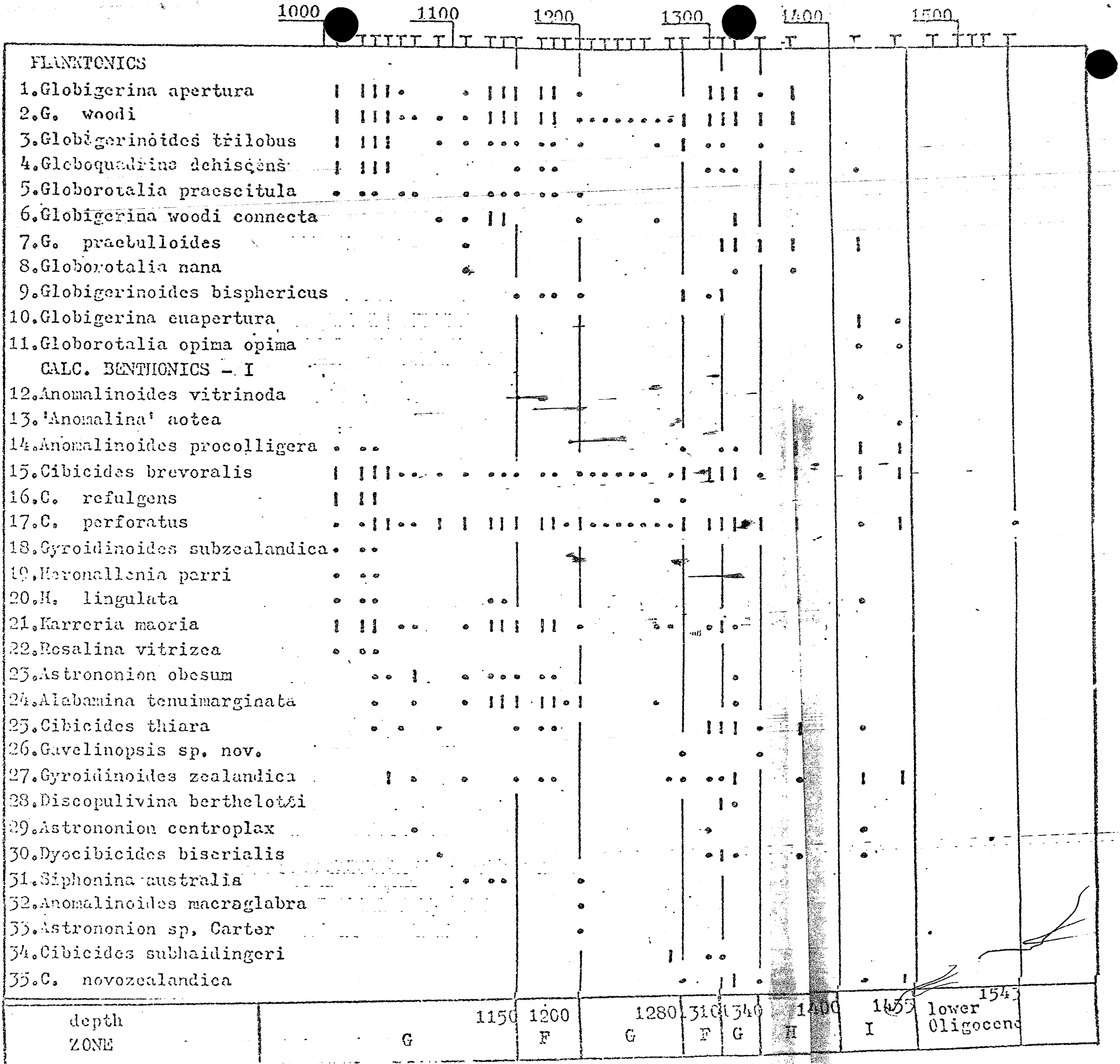
by PALTECH PTY LTD

PALTECH REPORT 1983/10
July, 1983
PLATE 12

FLATHEAD-1

SPECIES LIST.

PAGE 1 OF 3



Page 1 of 3

SPECIES LIST.
Page 2 of 3

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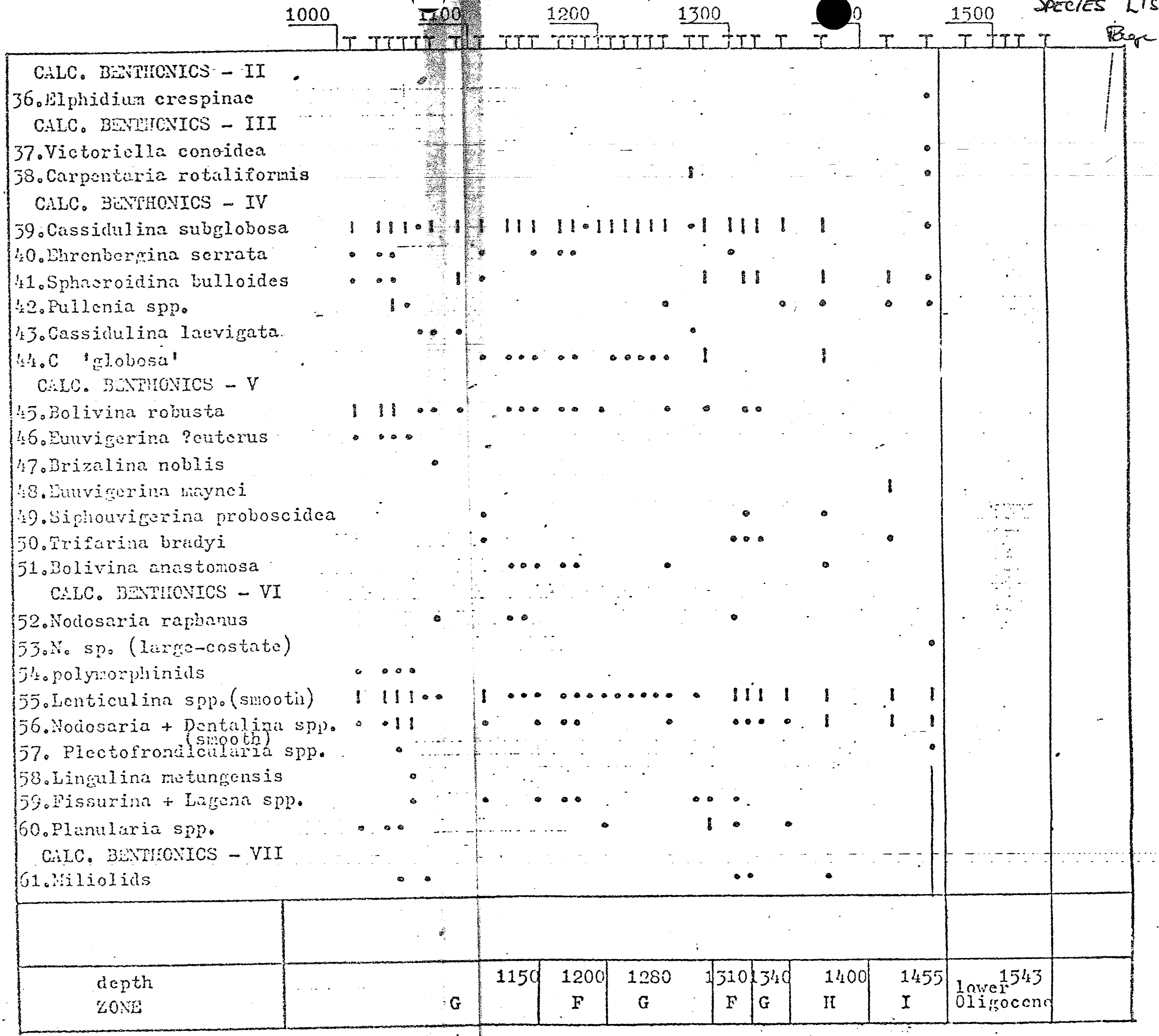
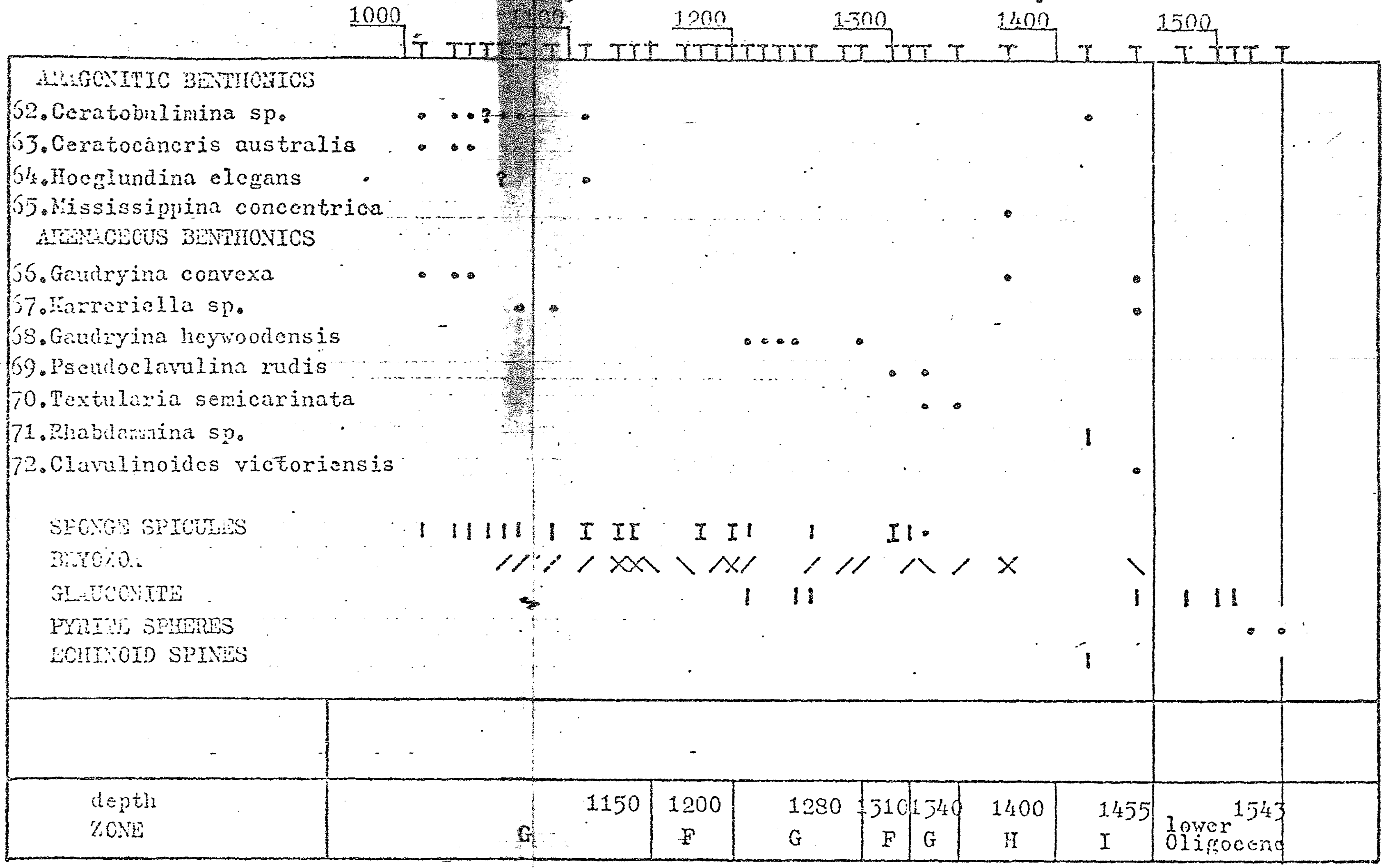


FLATHEAD-1

SPECIES LIST. Pg [illegible] of 3.

Sheet)
of ~~4 Sheets~~



T= side wall cores.
All depths are those shown on side wall core jars.
Datum + 31'
At - 1007, 1031, 1036, 1042, 1053, 1058,
1072, 1086, 1092, 1111, 1134, 1139,
1150, 1167, 1182, 1194, 1205, 1212,
1224, 1232, 1245, 1249, 1254, 1270,
1280, 1297, 1306, 1320, 1337, 1374,
1417, 1455, 1476, 1484, 1498, 1508,
1525, 1538 & 1543.

• = 1-20

I = over 20

I = well preserved sponge specules

\ = well preserved bryozoa

/ = worn bryozoa.

3/3

5. WELL LOG ANALYSIS

HUGH CROCKER CONSULTANTS

Page 1 of 13

WELL LOG ANALYSIS

Sunfish No. 1
Emperor No. 1
Flathead No. 1

Hugh Crocker
April 1979

28/8/79

Logs Available

Sunfish No.1

Induction/SFL/S.P.	2786 - 7559'
Induction/SFL/S.P.	7250 - 8156'
BHC Sonic/Gamma Ray	620 - 2777'
BHC Sonic	2786 - 7513'
BHC Sonic	7300 - 8167'
Density/Neutron/Gamma Ray	5300 - 7564'
Density/Neutron/Gamma Ray	7156 - 8176'
H.R. Dipmeter	5300 - 7521'
Formation Tester - Runs 1 through 21	
Baroid ppm log	680 - 8175'

Flathead No.1

Induction/Electrical	825 - 3495'
BHC Sonic/Gamma Ray	825 - 3490'
Comp Density/Gamma Ray	1326 - 3497'
Gamma Ray/Neutron	1326 - 2326'
Formation Tester - Runs 1 through 11	
Corelab Coregraph	865 - 3494'
Core description	1 through 7
BMR Core analysis	1 through 7
Sidewall core description	1 through 35.

3/13

General

Only Sunfish No.1 has a fairly complete modern logging suite and therefore we shall deal with this well first and rather thoroughly. Then, based upon data from Sunfish No.1,we shall treat the remaining two wells. Of course, the interpretation is less exact when logging programmes are limited. We shall use Sunfish No.1 to determine the petrophysical characteristics of these sands and to estimate the reliability of the assumptions made, calibrate the logs in water sands, and to apply as many crosschecks as we may.

In all wells we have chosen zones where porosity may be developed based upon any of the following:

- low gamma ray reading
- S.P. development from the shale base line.
- Porosity seen on the Sonic, Density or Neutron logs.
- Separation between the shallow and deep resistivity tools.

All log values are read and listed in a Table for each well. Charts referred to in the text are those of the 1977 Schlumberger Chartbook.

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FLATHEAD

Formation Water

The S.P. shows a positive displacement from the shale baseline opposite the clean sand (Gamma Ray log) 1542 - 1564 but there is also a positive displacement opposite the Gamma Ray peak immediately above 1536 - 1542 hence this positive peak is probably due to some abnormal effect such as electrokinetic/osmostic potential rather than the normal electrochemical potential. If we ignore the positive displacement opposite this sand then the S.P. is almost featureless.

All tests have been unsatisfactory and water recovered from FIT tests have had around 8000 ppm NaCl salinity. This approximates the salinity of the mud filtrate and would account for the lack of SP development. Of couse, it is also likely that the FIT recovered only filtrate. Hence, we have no conclusive data on formation water salinity. Since we need Rw to calculate water saturation in the pore space we shall arbitrarily assume that there is little resistivity contrast between mud filtrate and formation water.

Clay Content

The available Neutron log is an early GNT model for which local calibration in terms of porosity are needed. Unfortunately we have no clean water filled sands that are needed for this purpose. Nevertheless in Figure 1 we have made the calibration plot of Neutron counts per second versus Density derived porosity on a linear log grid since.

$$N = A \log \phi + B$$

from which

$$\phi_n = 10^{\left(\frac{1332 - N}{500}\right)}$$

We have listed N counts per second and ϕ_n in columns 7 and 10 of table 3 respectively.

Then using Density and Neutron we have found clay content as seen by these tools and as previously described for the Sunfish well. This Vclnd is listed in column 14.

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We have also made the estimation of clay content from the Gamma Ray log also as previously described. These Vclgr values are listed in column 15 of table 3.

Again, because we doubt the accuracy of the Vclnd values, we prefer to use the Vclgr values for subsequent computing.

Porosity

For completeness sake we have listed Sonic readings (column 11) and using the Wiley time average formula calculated the Sonic porosity of column 12. It is clear that the range of values 43 - 71 is ridiculous but at these depths is not surprising since these rocks are quite unconsolidated and the Wiley equation is inapplicable. We could attempt to correct $\emptyset_s$ but the correction would be greater than the final value and therefore very unsatisfactory.

As already discussed this early Neutron requires local calibration in clean waterfilled sands. Since we cannot make such calibration we prefer not to rely too heavily upon the Neutron log porosity.

7/13

Hence we are left with the Density log. The cuttings, sidewall samples and core descriptions clearly point to a very complex lithology. This is evident on the Density log by very rapid changes of Density. If we are to proceed we must make some simplifying assumptions. It seems that 1465 - 1530 is reasonably homogenous and characterised by silt, argillaceous sands with glauconite very abundant throughout. For this interval a suitable grain density would be 2.65 g/cc. Below 1540 there is little glauconite but the lithology is quartzwacke sandstones and often conglomeratic. For these sands a suitable grain density of 2.68 seems applicable. We shall use these values to compute Density porosities $\emptyset_d$.

Next we have computed a clay correction to the density porosity as previously described and listed this $\emptyset_{dc}$ in column 16. We have used a clay density of 2.25 g/cc.

Since the evidence strongly points to oil rather than gas being present and since also we have no reliable Neutron log to distinguish between oil and gas we think it would be unwise to correct the Density for hydrocarbons. Even if we used a hydrocarbon Density of 0.7 it would affect the $\emptyset_{dc}$ value very little.

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Saturation

For such shallow unconsolidated sands the Humble formula for the formation resistivity factor is unsuitable. We have no clean water filled sands from which we could find the constants a and m

$$F = {}^{a}/_{\emptyset^m}$$

Hence we must rely upon experience of similar sands elsewhere. We think a = 1 and m = 0.5 is probably appropriate.

Using the Indonesian equation and the following;

$Rw = 0.5$
$Rcl = 2.5$
$Rt = Ril$
$\emptyset = \emptyset dc$
$a = 1$
$m = 1.5$
$Vcl = Vclgr$

We compute Sw of column 18 table 3.

It is clear that water saturations are high throughout, and clean oil production is unlikely even in the clean sand. To increase the oil saturation in the clean sand we would require:

Vcl decreased - It is already zero

Rcl decreased - This only is effective if Vcl present

ρm decreased - It is already very low and experience warns against artificially reducing it below 1.5

ϕdc increased - we have already increased g to 2.68 and this is probably an upper limit

Rt increased - the induction log in this range is usually reliable and must be close to Rt.

Rw decreased - as already explained under S.P. discussion, its likely that Rw Rnf not less than Rnf hence we cannot easily decrease Rw 0.352 m.

Hence we must accept that means we have some extraordinary condition of which we are unaware that the oil saturation is only some 30% in the clean sand

Permeability

The FIT tests are all inconclusive and only recovered small amounts of water in the production tests.

1) 1607 - 1652 produced nothing

2) 1542 - 1564 produced 16 bbls of water of 8500 ppm NaCl and a little H_2S gas without evidence of oil.

Hence the permeability of these rocks is questioned. No satisfactory general relationship between log response and permeability exists although some locally developed ones have proved valuable. Qualitatively we may assess the permeability by assuming the clay minerals to be dispersed and then

$$q = \frac{Vcl}{\phi + Vcl}$$

if q exceeds 40% then commercial permeability has ceased to exist.

Of course, this cannot apply in thinly lanimar sands but for these rocks it is probably as good a guide as can be found. Hence we have computed q of column 17 table 3. We note that only the clean sand 1543 - 1563 has any hope of being permeable.

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Conclusion

1. 1465 - 1530. Argillaceous sands, silt with abundant glauconite. Impermable but with average 45% oil saturation.

2. 1543 - 1563. Clean sand, often conglomeratic essentially without glauconite. Average porosity 22.8%, oil saturation 29%.

3. Below 1563. Silt and shales non permeable.

COMPANY: BEACH PETROLEUM WELL: FLATHEAD No.1 DATE: APRIL 79

TABLE 3

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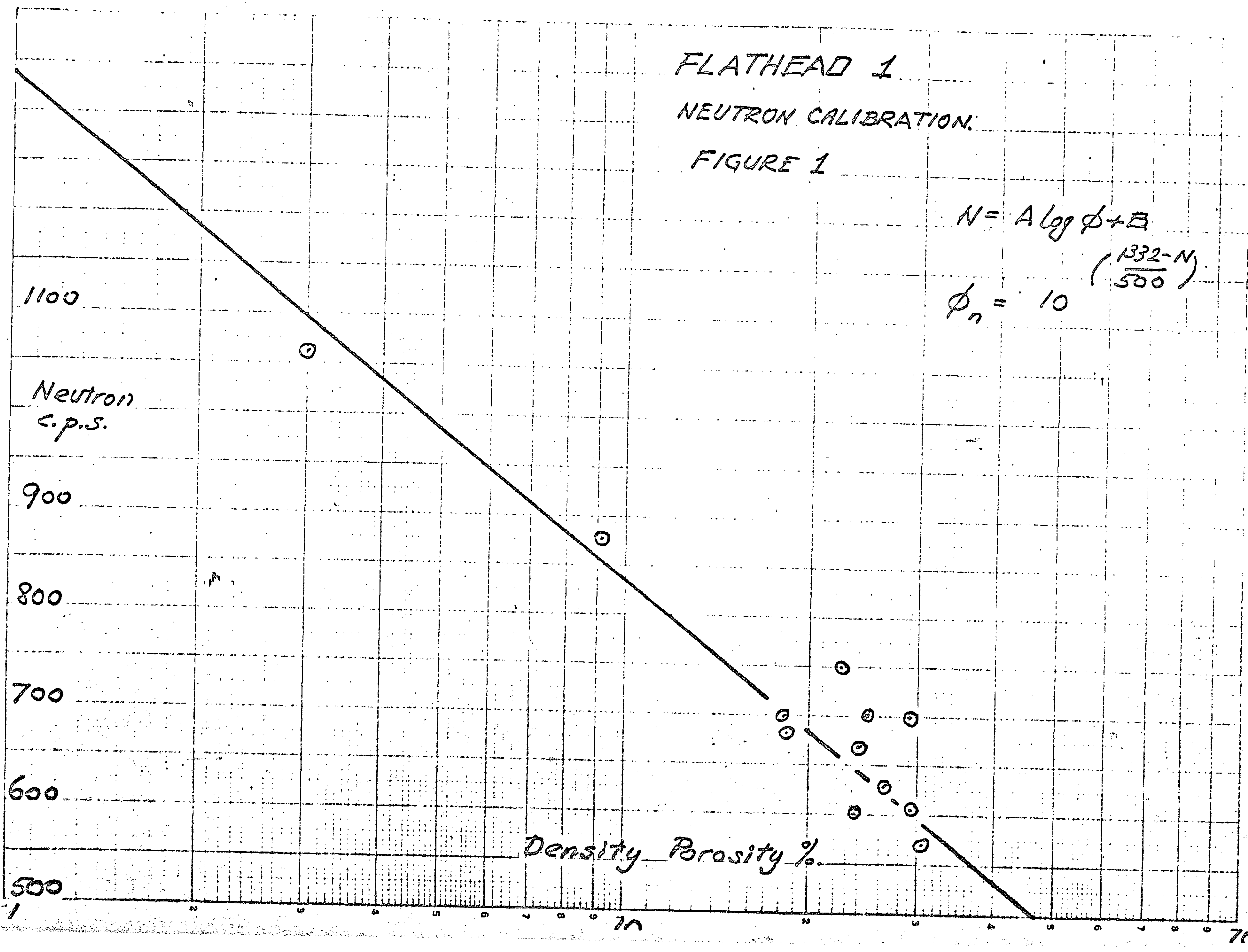
Nº	DEPTH IES	Ril	Rsn	Rmll	SP	NL c.p.s.	GR	ρ_b	ϕ_n	t	ϕ_s	ϕ_{nd}	Vclnd	Vclgr	ϕ_{dc}	$\frac{V_{cl}}{\phi + V_{cl}}$	Sw			REMARKS. fluid/productivity
1	1477	12	9		+2	610	59	2.20	27.8	–	–	22.7	25	40	18.7	57	41			oil/tight
2	1485	9	7.5		+4	580	50	2.32	31.9	145	67	4	88	30	13.6	69	61			oil/tight
3	1494	6	6		+2	565	56	2.16	342	150	71	21	47	37	21.9	63	56			oil/tight
4	1500	6.7	6		+6	585	70	2.22	31.2	147	68	16.8	51	52	15.0	78	53			oil/tight
5	1515	6	5.5		+6	560	52	2.24	35.0	144	66	10.4	79	32	18.1	64	64			oil/tight.
6	1537	6	6		+16	620	120	2.13	26.5	145	67			100						Shale
7	1544	11.5	8		+16	910	17	2.35	7.0	120	48	25.9	45	0	19.6	0	70			oil-water
8	1549	11	8.3		+20	920	15	2.37	6.7	113	43	23.8	37	0	18.5	0	75			oil-water
9	1553	6	6		+19	700	18	2.17	18.4	140	63	36	38	0	304	0	70			oil-water.
10	1560	7.8	7		+20	920	24	2.36	6.7	126	53	25	41	3	18.3	14	86			water
11	1569	5.2	5.4		+4	655	59	2.18	22.6	130	55	30.5	11	40	20.0	67	60			oil/tight
12	1577	3.1	3.9		+5	600	62	2.22	29.1	133	58	18.9	39	43	16.9	72	81			water/tight
13	1588	3	3.8		+5	585	76	2.28	31.2	145	67	0?	100	58	9.8	86	85			water/tight
14	1607	3	3.5		+5	610	61	2.20	27.8	125	52	22.7	25	42	18.4	69	81			water/tight.
15																				
16																				
17																				
18																				
19																				
20															$\rho_g = 2.65$ $= 2.68$		Rcl 2.5 Rw 0.5			
21															$\rho_{sh} = 2.25$		a = 1			
22																	m = 1.5			
23																				
24																				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21



FLATHEAD 1

NEUTRON CALIBRATION.

FIGURE 1

$N = A \log \phi + B$

$\phi_n = 10^{\left(\frac{1332-N}{500}\right)}$

6. F.I.T. Test Data

BASIC DATA

Test Data - FLATHEAD #1

PRODUCTION TEST I through perfs 1607'-1652'
Rec No formation fluid after mud acid treatment and swabbing.

PRODUCTION TEST II through perfs 1542'-1564'
Rec. 16 bbls water and hydrogen sulphide gas NaCl of Rec water 8500ppm Mud filrate cl 8500ppm
No trace of Oil.

FIT-1 1648' Rec 2000cc filtrate, Scum of oil Rrf 0.79 at 66°F. Cl 8200ppm. Mud Cl 8500ppm. FP 0psi FSIP 500psi HP 1030psi

FIT-2 1694' Rec. 1500cc filtrate, Rrf. 1.03 at 64° Cl 5[illegible]00ppm FP 0psi FSIP [illegible] HP 1110 psi

FIT-3 1555' Rec 3500cc Mud lost packer seat.

FIT-4 1498' Rec. 1000cc mud filtrate Rrf 0.96 at 78° Cl 5500ppm FP 0psi FSIP 0psi HP 1000psi

FIT-5 1545' Rec 2000cc filtrate, scum of oil, Rrf 0.70 at 72° Cl 8500ppm FP 0psi FSIP 700psi HP 930psi

FIT-6 1484' Rec. 1500cc filtrate FP 0psi FSIP 0psi HP 1000psi

FIT-7 1567' Tool malfunction

FIT-8 1567' Tool malfunction

FIT-9 1567' Rec 1700cc filtrate Rrf 0.66 at 74° Cl 8500ppm FP 0psi FSIP 0psi HP 980psi

FIT-10 1625' Tool malfunction

FIT-11 1625' Rec. 1200cc filtrate FP 0psi FSIP 780psi HP 1000psi

Also
1. All wire line logs
2. Corelab Mud Log
3. Corelab Coregraphs
4. Sample descriptions
5. Core & S.W. Core descriptions

NOT composite log

PE904912

This is an enclosure indicator page.
The enclosure PE904912 is enclosed within the container PE904908 at this location in this document.

The enclosure PE904912 has the following characteristics:

ITEM_BARCODE = PE904912
CONTAINER_BARCODE = PE904908
NAME = Flathead 1 F.I.T. Data
BASIN = GIPPSLAND
PERMIT = VIC/P1
TYPE = WELL
SUBTYPE = FIT
DESCRIPTION = Flathead 1 Formation Interval Test (F.I.T.) Data.
REMARKS =
DATE_CREATED =
DATE_RECEIVED =
W_NO = W545
WELL_NAME = Flathead-1
CONTRACTOR = Schlumberger
CLIENT_OP_CO = Esso Australia

(Inserted by DNRE - Vic Govt Mines Dept)

7, ENCLOSURES

PE603210

This is an enclosure indicator page.
The enclosure PE603210 is enclosed within the container PE904908 at this location in this document.

The enclosure PE603210 has the following characteristics:

ITEM_BARCODE = PE603210
CONTAINER_BARCODE = PE904908
NAME = Flathead 1 Grapholog
BASIN = GIPPSLAND
PERMIT = VIC/P1
TYPE = WELL
SUBTYPE = MUD_LOG
DESCRIPTION = Flathead 1 Grapholog (Mudlog)
REMARKS =
DATE_CREATED =
DATE_RECEIVED = 21/05/69
W_NO = W545
WELL_NAME = Flathead-1
CONTRACTOR = Core Laboratories, INC.
CLIENT_OP_CO = Esso Australia

(Inserted by DNRE - Vic Govt Mines Dept)

PE601363

This is an enclosure indicator page.
The enclosure PE601363 is enclosed within the container PE904908 at this location in this document.

The enclosure PE601363 has the following characteristics:

ITEM_BARCODE = PE601363
CONTAINER_BARCODE = PE904908
NAME = Well Completion Log
BASIN = GIPPSLAND
PERMIT = VIC/P1
TYPE = WELL
SUBTYPE = COMPOSITE_LOG
DESCRIPTION = Flathead 1 Well Completion Log
REMARKS =
DATE_CREATED = 11/05/69
DATE_RECEIVED =
W_NO = W545
WELL_NAME = Flathead-1
CONTRACTOR =
CLIENT_OP_CO = Esso Australia

(Inserted by DNRE - Vic Govt Mines Dept)

PE900011

This is an enclosure indicator page.
The enclosure PE900011 is enclosed within the container PE904908 at this location in this document.

The enclosure PE900011 has the following characteristics:

ITEM_BARCODE = PE900011
CONTAINER_BARCODE = PE904908
NAME = Completion Coregraph
BASIN = GIPPSLAND
PERMIT = VIC/P1
TYPE = WELL
SUBTYPE = DIAGRAM
DESCRIPTION = Flathead 1 Completion Coregraph
REMARKS = Cores 3-7. Cores 1 and 2 too unconsolidated for analysis.
DATE_CREATED = 11/05/69
DATE_RECEIVED =
W_NO = W545
WELL_NAME = Flathead-1
CONTRACTOR = Core Laboratories, INC.
CLIENT_OP_CO = Esso Australia

(Inserted by DNRE - Vic Govt Mines Dept)