BHP

Australia Division
BHP Petroleum

MINERVA-2/2A, VIC/P31
WELL COMPLETION REPORT
INTERPRETIVE

MINERVA-2/2A, VIC/P31

INTERPRETATIVE

WELL COMPLETION REPORT

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70551.WCR

DATE: 27th July, 1994

BHP PETROLEUM PTY. LTD.
A.C.N. 006 918 832

TABLE OF CONTENTS

FIGURES

APPENDICES

ENCLOSURES

1 WELL INDEX SHEET

COMPANY:	BHP Petroleum Pty Ltd		
SPUDDED:	2030 hrs 18th September 1993	WELL: Minerva-2	TYPE:Appraisal
COMPLETED:	1915 hrs 21st September 1993	BASIN: Otway	TENEMENT: VIC/P31
TD: 560 mRT		ELEV. W.D.:60 m	Lat: 38⁰ 43' 04.165" South
		R.T.:25 m	Long. 142⁰ 57' 19.476" East
STATUS: P & A			1st FLANGE: 30" @ 120m

CASING/TUBING SIZE	30"
LANDED AT (m)	120

TEST RESULTS, FLUID ANALYSIS, LOST CIRCULATION, (INTERVAL, CAUSES) PLUGS , REMARKS

Fish cemented in hole 551 - 290m
Plug No 1 was set 184 - 134m

Minerva-2 was abandoned after the drillstring became stuck prior to setting 20" casing.

WELL INDEX SHEET

COMPANY: BHP Petroleum Pty Ltd
SPUDDED: 1915 hrs 21st September 1993
COMPLETED: 0830 hrs 17th October 1993
TD: 2170 mRT

STATUS: Suspended

WELL: Minerva-2A
BASIN: Otway
ELEV. W.D.:60 m
R.T.:25 m

TYPE:Appraisal
TENEMENT: VIC/P31
Lat: 38° 43' 04.535" South
Long. 142° 57' 20.800" East
1st FLANGE: 30" @ 118m

FORMATION/ MARKER	TOPS (m) DRILL	SUB SEA	SEISMIC TWT	LITHOLOGICAL SUMMARY/ REMARKS
				No returns 85 - 570m
Heytesbury/Nirranda Groups	85	60		
Wangerrip Group				
Pember Mudstone	553(?) (from casing shoe)	528(?)	533	Silty claystone with minor interbedded sandstone and pebbly conglomerate
Pebble Point	631	606	600	Medium to coarse sandstone with minor clay and dolomite
Sherbrook Group	757	732	694	Claystone with trace sandstone and minor dolomite increasing towards the base
Upper Shipwreck Group	1583	1557	1260	Sandstone interbedded with silty claystone
Lower Shipwreck Group	2103	2078	1550	Interbedded sandstone, siltstone and claystone

LOGS:

SUITE 1
DLL-MSFL-AS-GR-AMS-SP
CST
CSI (VSP)

SUITE 2
DLL-MSFL-GR-AMS-SP
SDT-LDL-CNL-GR-AMS-FMS
CSI (VSP)
RFT-HP
CST

SWC: SHOT 30 REC 29
STORED: KESTREL Management,
Mt Waverley, VIC

DITCH SAMPLES: 565-2170m
CORES: Core-1 1728.5-1733.5m
100% Recovery
Core-2 1838.8-1855.6m
97.5% Recovery
Core-3 1855.5-1882.5m
100% Recovery
Core-4 1915-1942.75m
99% Recovery
Core-5 1943-1969m
100% Recovery

CASING/TUBING SIZE	30"	20"	13.375"
LANDED AT (m)	118	553	1526

TEST RESULTS, FLUID ANALYSIS, LOST CIRCULATION, (INTERVAL, CAUSES) PLUGS , REMARKS

Plug No 1 was set 1784 - 1975m
Plug No 2 was set 1686 - 1775m
Plug No 3 was set 1490 - 1575m
Bridge Plug at 1484m with 9m of cement on top
Plug No 4 was set 122-171m

RFT: one RFT run with 34 pretests; one segregated sample collected at 1849.7mTVDSS

2 WELL SUMMARY

Minerva-2A was drilled as an appraisal well designed to test the hydrocarbon potential of the southern block of the Minerva structure. Minerva-1 was drilled in March 1993, into the northern horst block and encountered a 128m gas column in high quality reservoirs of the Shipwreck Group. The Minerva-2 well was spudded on the 12th September, 1993 in 60 m of water, by the semi-submersible 'Byford Dolphin'. The well was abandoned at 560m, after 7 x 8" drill collars became stuck at the base of the well and fishing operations were unsuccessful. Minerva-2A was spudded on the 21st September, 1993 and drilled to a total depth of 2170mRT. The Minerva Field is located in the northern area of permit VIC/P31 in the eastern offshore Otway Basin (Figure 1) approximately 7km from the nearest landfall and 26.5km east of the Pecten-1A well.

The primary target was the sandstones of the Late Cretaceous Upper Shipwreck Group within the southern fault block of the Minerva structure. The structure is sealed by the overlying claystones of the Upper Shipwreck Group. Secondary targets exist higher in the Upper Shipwreck Group where gas was encountered in two small sands in Minerva-1 and in the Sherbrook Group where a total of 0.2m of net gas sand was encountered over a 25m column.

In Minerva-2A, although gas shows were recorded in the Sherbrook Group over the interval 1400 - 1405mRT, the sands are interpreted to be tight.

A total of 10m of net gas sand is interpreted in the upper sands of the Upper Shipwreck Group over a 20m gross interval with an average porosity of 16% and an average water saturation of 31%. In the lower sands a total of 97.9m of net gas sand is interpreted over a 111m gross interval with an average porosity of 19% and an average water saturation of 15%.

The well was cased and suspended as a future gas producer on the 17th October 1993.

3 HYDROCARBONS

There were no visual hydrocarbon shows recorded in the Tertiary section. Recording of ditch gas commenced within the Cretaceous section at 908mRT, where background readings, consisting dominantly of C1, were recorded up to 0.02%. Background gas increased gradually throughout the Sherbrook to between 0.1 and 0.2% with minor amounts of C2 and C3.

At 1402mRT a gas peak of 1% TG (total gas) was recorded corresponding to thin sands within the Sherbrook Group. No fluorescence was recorded in these sands and log interpretation (Appendix 3) indicates that they are tight.

A further gas bearing interval was intersected between 1719 - 1740mRT in the Upper Shipwreck Group, where gas readings peaked at 4% TG. Again no fluorescence was recorded throughout these sands. Log interpretation indicates a total of 10m of net gas sand over a 20m gross interval (50% N/G), with an average porosity of 16% and an average water saturation of 31%.

On penetrating the lower sands in the Upper Shipwreck Group at 1831mRT the gas increased to between 0.1 - 3% TG. Log interpretation indicates a total of 97.9m of net gas sand over a 111m gross interval (88% N/G), with an average porosity of 19% and an average water saturation of 15%.

Interpretation of the RFT pretest measurements (Appendix 4) indicate that the two gas bearing sands intersected by the Minerva-2A well, have a common gas gradient of 0.164 psi/m. The gas/water contact of the main Shipwreck sand is interpreted to be at 1915.1 mTVDSS, which compares well with that determined from Minerva-1 (1914.7 mTVDSS).

One segregated sample was taken from the main gas bearing interval in Minerva-2A at 1849.7 mTVDSS. Both the one gallon upper and the 2-3/4 gallon lower chambers were kept sealed for analysis.

Below 1950mRT the gas decreased to between 0.2 - 0.3% TG and the section is interpreted to be entirely water saturated.

4 STRATIGRAPHY

The stratigraphic sequence penetrated at Minerva-2A was very similar to the anticipated section (Figure 3). Minerva-2A reached a total depth of 2170mRT, terminating in the Late Cretaceous Lower Shipwreck Group. Delineation of age units is based primarily on log correlation with nearby wells, together with palynology (Appendix 1) to further define the formations.

The stratigraphic section is shown in Figure 3 and Enclosure 1. Age, lithology, and drilling data are marked on the composite well log accompanying this report. No ditch cuttings were obtained above 570m.

Lower Shipwreck Group (2170 - 2103mRT)

The Shipwreck group was deposited as a vast delta system and changes regionally from non-marine/fluvial facies onshore in the north to nearshore and offshore/deltaic in the southern permit areas.

In the Minerva-2A well 67m of Lower Shipwreck Group sediments were intersected. The sequence consists of interbedded argillaceous sandstone and claystone. The sands are generally clear to very light grey, very fine to fine grained, friable with abundant loose grains, subangular to subrounded and moderately sorted.

Upper Shipwreck Group (2103 - 1583mRT)

The base of the Upper Shipwreck Group is marked by a Turonian unconformity.

A 520m section of Upper Shipwreck sediments were intersected in the Minerva-2A well, which consist of argillaceous siltstones grading to silty claystones towards the top, and interbedded sandstones increasing in abundance towards the base. Five cores were cut over the intervals 1728.5 - 1733.5mRT (100% recovery); 1838.8 - 1855.6mRT (97.5% recovery); 1855.5 - 1882.5mRT (100% recovery); 1915 - 1942.75mRT (99% recovery) and 1943 - 1969.0mRT (100% recovery). The cores consisted of interbedded sandstone and claystone, with minor coal. The sands are clear to light grey, medium to coarse grained, subrounded to rounded, well sorted with common light grey argillaceous matrix. The sands generally have good reservoir characteristics. An interpretation of the cores is given in Appendix 5.

Sherbrook Group (1583 - 757mRT)

The base of the Sherbrook Group is marked by a regional, angular to occasionally parallel unconformity which formed in response to the breakup and onset of sea floor spreading, at around 85 Ma.

In Minerva-2A a 826m section of medium to dark grey claystones were intersected with minor interbedded sandstone. The sand content increases towards the top of the Sherbrook

Group, consisting of light grey, medium to coarse grained, moderately sorted quartz grains. The claystones of the Sherbrook Group act as the seal for the underlying Shipwreck Group.

Wangerrip Group (757 - 553mRT(?) from casing shoe)

Pebble Point Formation (757 - 631mRT)
Pember Mudstone (631 - 553mRT(?) from casing shoe)
Dilwyn Formation (?)

The base of the Wangerrip Group is marked by a regional unconformity which may represent a starvation of sediment in combination with a relative fall in sea level. The Wangerrip Group sediments prograde over this unconformity, and are deposited as a regressive deltaic sequence.

In Minerva-2A Wangerrip Group sediments were intersected with only the basal 204m sampled from cuttings. The base of the section consists of 126m of medium to coarse grained sandstone of the Pebble Point Formation. This passes up into the silty claystones of the Pember Mudstone. The Dilwyn Formation was not sampled, however it is known to consists of sands and silts elsewhere in the permit.

Heytesbury/Nirranda Groups (? - 82mRT)

The Nirranda Group was not sampled in this well, however is interpreted to consist of shoreface sands overlain by marls and limestones of the Narrawaturk Marl.

The Heytesbury Group was not sampled during the drilling of this well, however is interpreted to consist of a prograding bioclastic sequence.

5 STRUCTURE

The Minerva structure is an anticline that has been broken up into two rotated fault blocks by northwest to southeast trending normal faults. Minerva-2A was an appraisal well designed to prove up reserves in the southern fault block. Minerva-1 had previously discovered a gas accumulation in the northern block. Both of the fault blocks have three way dip closure in combination with fault closure to the southwest.

The Minerva structure began development at the end of the Early Cretaceous and continued to develop during the Late Cretaceous. It experienced very little growth during the Early Tertiary until the Oligocene or more recent times where significant structural growth has occurred. Two distinct phases of normal faulting are evident. The Early Cretaceous - Late Cretaceous faults terminating within the Sherbrook Group claystones and the Late Cretaceous - Tertiary faults extending to the water bottom and soling out within the claystones of the Upper Shipwreck Group.

6 GEOPHYSICAL DISCUSSION

6.1 Seismic Coverage

The Minerva structure is defined by a 1 by 1 to 1.5 kilometre grid of 2D seismic data which was acquired in 1980, 1981, and 1991. The data acquired in 1980 and 1981 were reprocessed in 1991 together with the 1991 acquired data. The data is of good quality and is correctly located in order to give optimum imaging of the faults in the area. A closer seismic line spacing is required to more accurately map horizons and correlate faults over the Minerva structure.

6.2 Post-Drill Mapping

Minerva-2A encountered a gas column some 39 metres deeper than prognosed. The pre-drill map at the Top Main Gas Zone level carried the seismic response (a peak) at the top of the reservoir in the northern block (Minerva-1) across to the southern block (Minerva-2A). Post-drill results indicate that the top of the reservoir corresponds to a trough in the southern block and it is this variation across the fault that caused the error in prognosis. A revised map at the Top Main Gas Zone was created after the drilling of Minerva-2A. It is included as Enclosure 2.

6.3 Time-Depth Conversion

The Minerva-1 time-depth curve was used for the time to depth conversion of horizons in Minerva-2A. The depths at Minerva-2A varied by less than 5% with differences at the primary objectives of 1% or less (Refer figure 1, predicted v's actual).

7 GEOLOGICAL DISCUSSION

7.1 Previous Work

Three wells had been drilled in the permit prior to Minerva-2A, viz. Mussel-1 (ESSO, 1969), Eric The Red-1 (BHPP, 1993), and Minerva-1 (BHPP,1993).

Mussel-1 was drilled to a TD of 2450mRT where the drill string twisted off. Fishing operations were unsuccessful with electric logs being run to 2286mRT. The well was plugged and abandoned on the 18th September,1969. The primary target was the Late Cretaceous Shipwreck Group on a structural high within a tilted fault block. Seismic remapping by BHPP has suggested the well was drilled off structure.

Eric The Red-1 was drilled to a TD of 1875mRT in the Otway Group sediments. The primary objective of the well was the Late Cretaceous Shipwreck Group, with the Otway and Sherbrook Groups as secondary objectives. The well was plugged and abandoned, without encountering hydrocarbon shows, on 6 March 1993.

Minerva-1 was drilled to a total depth of 2425mRT in the Otway Group sediments. The primary objective of the well was the Late Cretaceous Lower Shipwreck Group within a tilted fault block. The well encountered gas bearing sands within both the Sherbrook Group and the Upper Shipwreck Group. A total of 0.2m of net gas sand is interpreted in the Sherbrook Group and 2.9m and 118.5m of net gas pay from two sands in the Upper Shipwreck Group. The well was production tested and flowed at approximately 29MMSCFD.

7.2 Regional Geology

The Otway Basin, situated on the southeastern margin of Australia, is one of a series of basins formed in association with the breakup of Gondwana and Australia's separation from Antarctica.

Rifting within Gondwana was initiated at Late Jurassic to very Early Cretaceous time. Early Cretaceous sediments have only been penetrated in Pecten-1A in the permit area, however are known directly onshore from the permit area and to the west. Rifting produced northwest-southeast oriented normal faulting which controlled the major structural style of the area. Sediments deposited within the Early Cretaceous rift and post-rift sequences thicken southwestwards across faults towards the basin centre.

From Valanginian to Barremian times, it is interpreted that the Pretty Hill Formation was deposited in the permit as alluvial fan sands, silts and clays in tilted half-graben settings. An ensuing sag phase due to thermal cooling and contraction of the crust led to a regional unconformity above the Pretty Hill Formation. The Eumeralla Formation was deposited from the Aptian to the latest Albian during the sag, comprising of both fluvial and lacustrine sands, silts and clays, with common coals deposited in a lake margin coal-swamp environment.

Reactivation of rift activity is interpreted at the earliest Cenomanian, which created a regional unconformity above the Eumeralla Formation. The rifting enhanced the structural style of the previous rifting episode, generating a series of northwest-southeast trending terraces, such as the Mussel Terrace, stepping down into the basin.

Rifting continued from the Cenomanian to the Santonian. During this time sediments of the Upper and Lower Shipwreck Groups were deposited, with the two separated by an unconformity dated approximately at 90 Ma. The sediments were deposited as a vast delta system changing regionally from non-marine/fluvial facies onshore in the north to nearshore and offshore/deltaic in the south.

The end of the second rifting episode, and the inception of sea-floor spreading, is suggested to occur in the permit area at 85Ma, which resulted in a compressive episode which gently folded the Shipwreck Group sediments. This resulted in a regional to occasionally parallel unconformity.

The Sherbrook Group sediments onlap and downlap the breakup unconformity. The sediments consist predominantly of distal clays and silts which grade vertically to more proximal delta sand/silt facies. During the deposition of the Sherbrook Group the basin underwent continued northeast-southwest extension along pre-existing normal faults, coincident with periods of northwest-southeast compression. The compression overprinted the previous minor regional folding.

Overlying the regional unconformity above the Sherbrook Group are Maastrichtian to Middle Eocene Wangerrip Group sediments. After a rapid marine transgression, which is often represented by a basal sand of the Pebble Point Formation, the Wangerrip Group prograded basinward, being deposited as a regressive sequence in deltaic settings represented by sands and silts of the Pember Mudstone and Dilwyn Formation.

The Nirranda Group, comprising of the Mepunga Formation shoreface sands overlain by marls and limestones of the Narrawaturk Marl, unconformably overlies the Wangerrip Group. The Nirranda Group represents a large marine transgression at Late Eocene time.

Northwest-southeast compressional tectonism was reactivated at earliest Oligocene time, with partial inversion of some faults, folding of strata and formation of a regional unconformity.

Open marine conditions since the Oligocene have produced the prograding, bioclastic carbonate sequence of the Heytesbury Group. Minor extension and some compressional tectonism have continued until present day, particularly in the northeast of the permit area, resulting in the partial erosion of the Heytesbury and Nirranda Group sediments.

7.3 Contribution to Geological Concepts and Conclusions

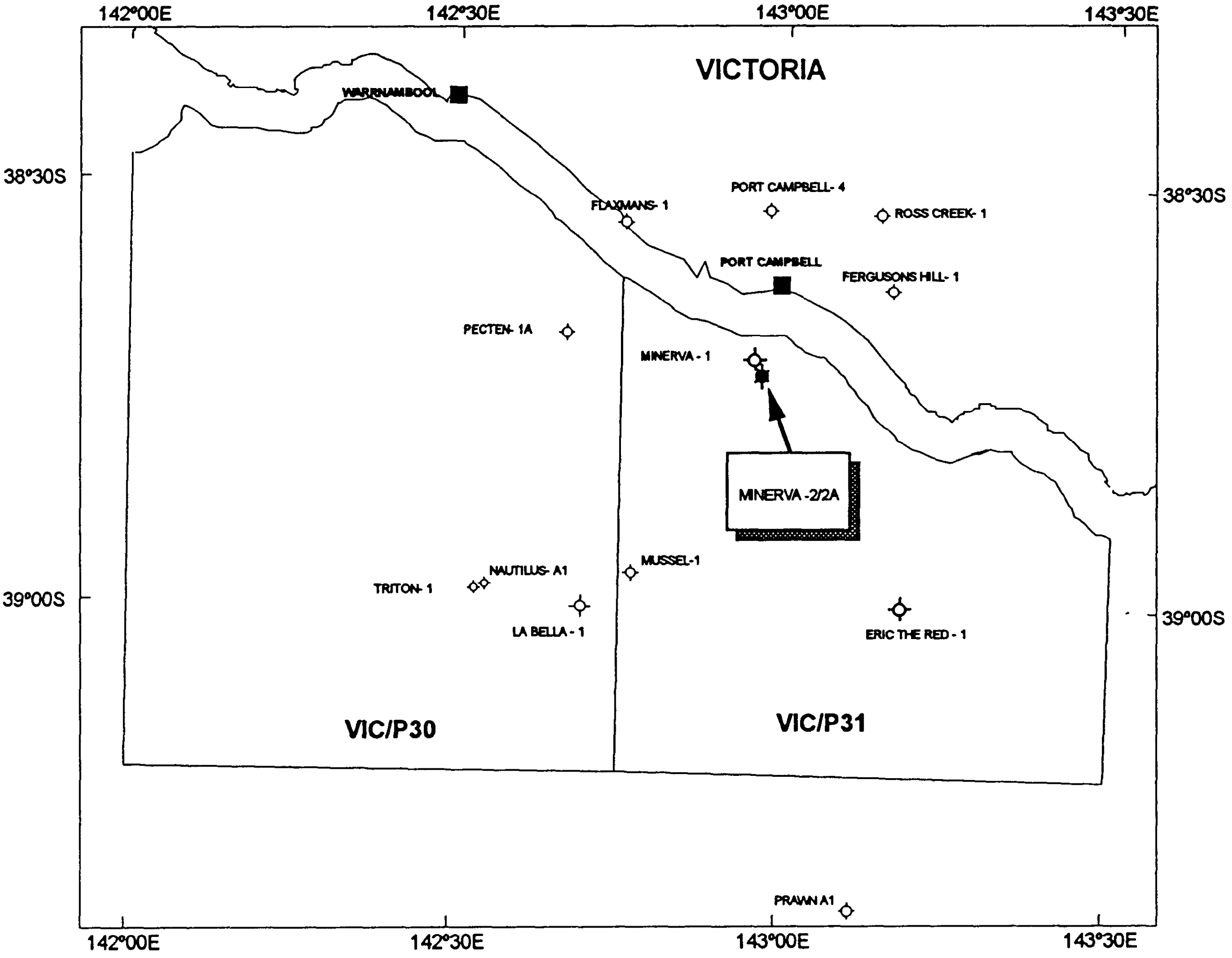
Minerva-2A was drilled as an appraisal well in order to test the lateral extent of the gas accumulation discovered by the Minerva-1 well. Minerva-1 tested the central horst block of the Minerva structure. The Minerva-2A well was located in a fault block immediately to the south of the Minerva-1 horst.

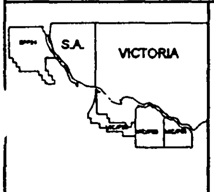
Minor gas shows only were encountered in the secondary objective, Sherbrook Group. The Minerva-1 well encountered a small (0.2m) amount of net gas sand in this group, however the sand is considered to be entirely tight at the Minerva-2A location.

In the Upper Shipwreck Group two gas bearing intervals were intersected. The upper sand is interpreted to have a total of 10m of net gas sand over the interval 1720 - 1740mRT (50% net/gross) with an average porosity of 16% and an average water saturation of 31%. In the lower sand a total of 97.9m of net gas sand is interpreted over the interval 1829 - 1940mRT (88% net/gross) with an average porosity of 19% and an average water saturation of 15%.

The RFT interpretation indicates that the two Upper Shipwreck Group sands have a common gas gradient of 0.164psi/m. The gas/water contact of the main Shipwreck sand is interpreted to be at 1915.1m TVDSS, which compares well with that determined from Minerva-1 (1914.7mTVDSS).

Five core chips over the interval 1732.8 - 1963.7 m were solvent extracted in an attempt to identify any residual hydrocarbons within the gas column (Appendix 2). Four of the samples amounted to less than 500 ppm, too low to represent residual hydrocarbon saturations. The fifth sample (1860.3 m), from a coal, yielded over 7000 ppm. Saturate-fraction GC data suggests that it was generated from higher land-plant, derived organic matter within source sediments deposited under strongly oxic conditions, consistent with its origin in a coal. Biomarker data also indicates the origin from an immature coal, suggesting that the recovered hydrocarbon is indigenous to the 1860.3m coal. None of the five extracts are considered to represent thermally mature, migrated hydrocarbons.





MINERVA-2/2A
LOCATION MAP

BHP Petroleum

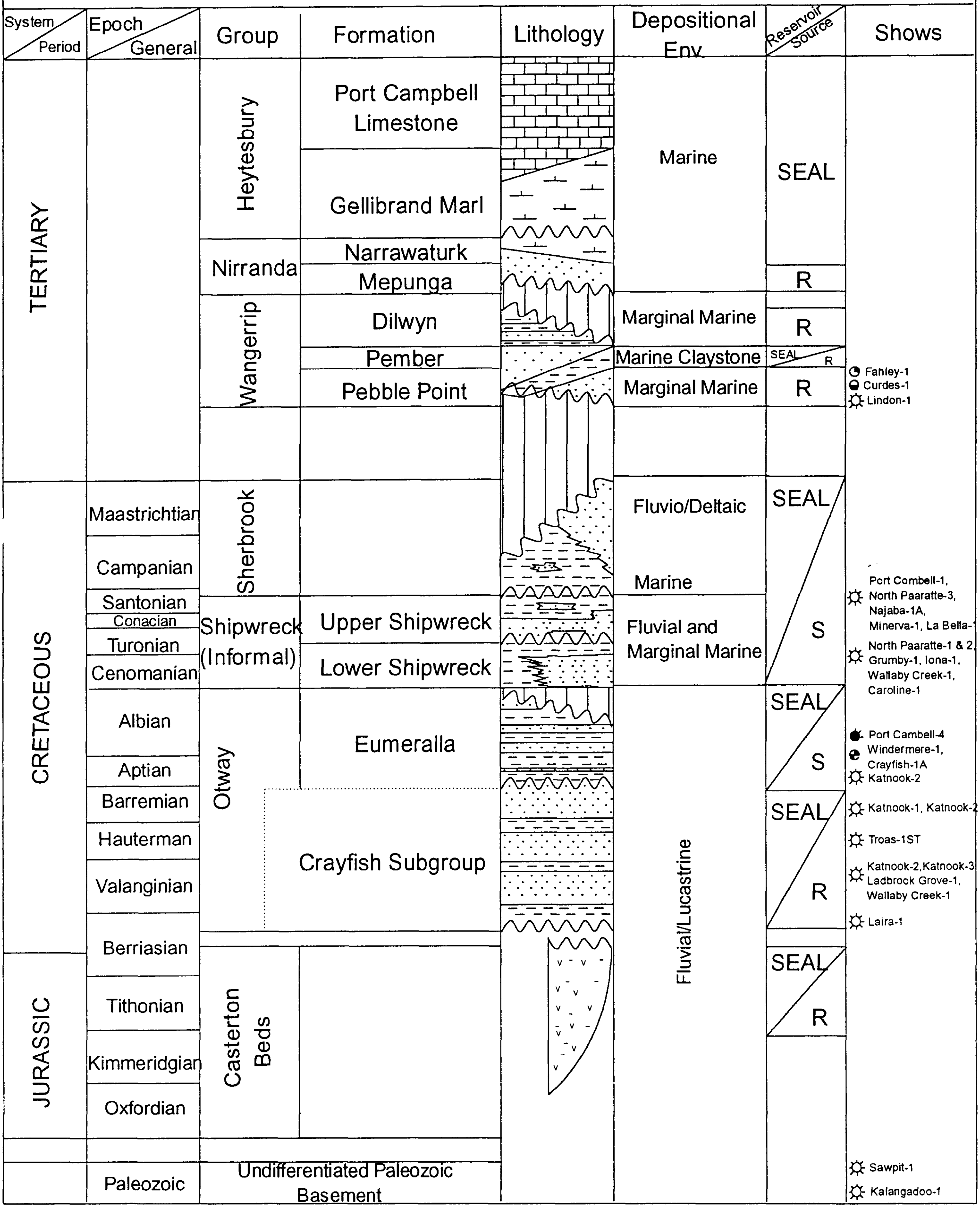
OTWAY BASIN

MINERVA-2/2A
LOCATION MAP

DRAWN BY:	E.SMITH	DWG NO.	03ES

BHP

OTWAY BASIN
STRATIGRAPHIC COLUMN



Drawn By: Angelo Mustica

Date: 30-5-1994

File: STRATOTW.PRE

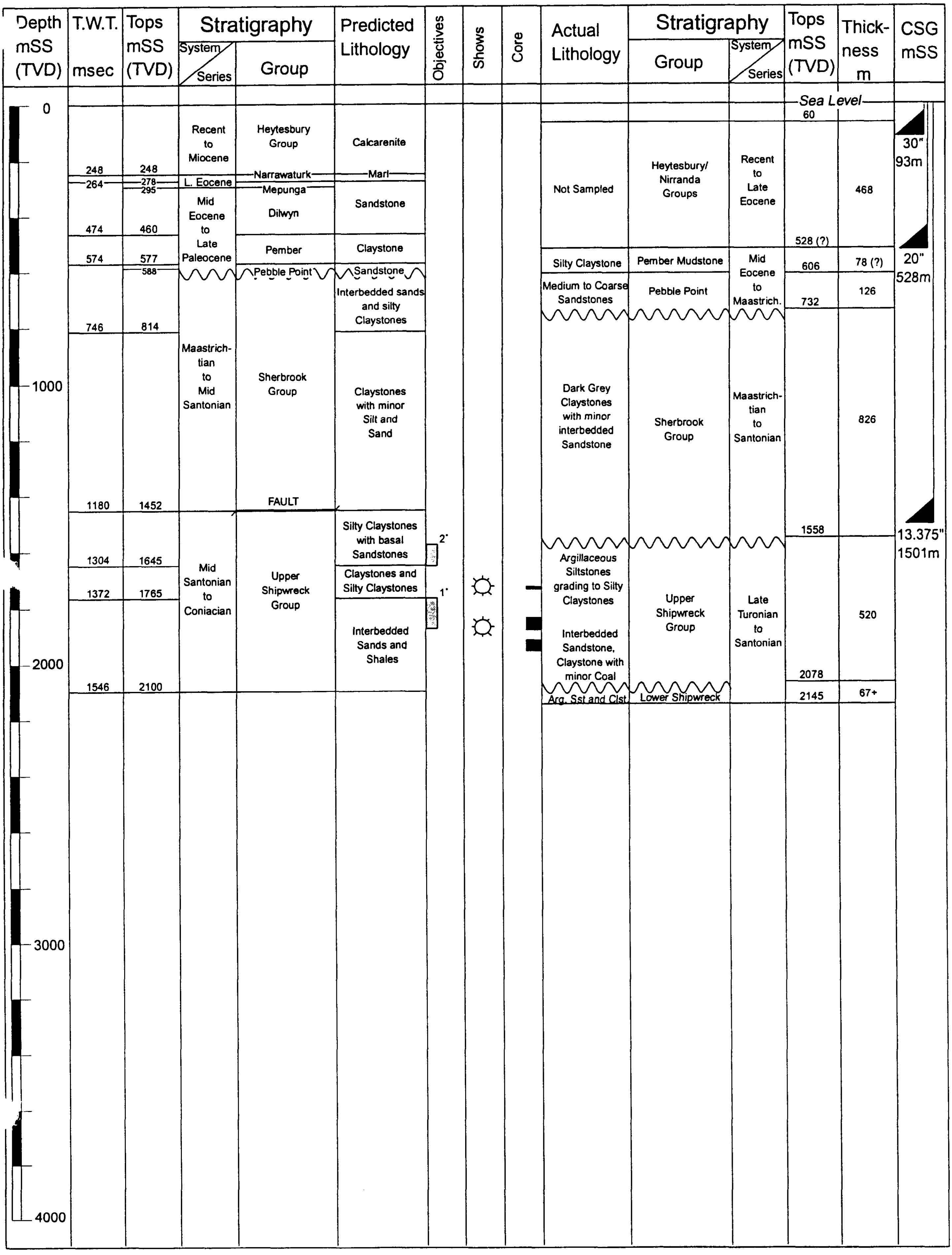
BHP

MINERVA-2A
PREDICTED v ACTUAL

PERMIT: VIC/P31

LINE: OE80A-1056 LAT: 38°43' 04.535" S ELEV: RT: 25m SPUD: 21-9-1993 STATUS: SUSPENDED

SP: 4067 LONG: 142°57' 20.800" E WATER DEPTH: 60m RIG RELEASE: 17-10-1993 RIG: Byford Dolphin



T.W.T. msec	Tops mSS (TVD)	Stratigraphy System / Series	Stratigraphy Group	Predicted Lithology	Objectives
		Recent to Miocene	Heytesbury Group	Calcarenite	
248	248	L. Eocene	Narrawaturk	Marl	
264	278		Mepunga	Sandstone	
	295	Mid Eocene to Late Paleocene	Dilwyn		
474	460		Pember	Claystone	
574	577		Pebble Point	Sandstone	
	588	Maastrichtian to Mid Santonian	Sherbrook Group	Interbedded sands and silty Claystones	
746	814			Claystones with minor Silt and Sand	
1180	1452	Mid Santonian to Coniacian	FAULT Upper Shipwreck Group	Silty Claystones with basal Sandstones	2°
1304	1645			Claystones and Silty Claystones	1°
1372	1765			Interbedded Sands and Shales	
1546	2100				

Actual Lithology	Stratigraphy Group	Stratigraphy System / Series	Tops mSS (TVD)	Thickness m	CSG mSS
			Sea Level 60		
Not Sampled	Heytesbury/ Nirranda Groups	Recent to Late Eocene		468	30" 93m
Silty Claystone	Pember Mudstone	Mid Eocene to Maastrich.	528 (?)	78 (?)	20" 528m
Medium to Coarse Sandstones	Pebble Point		606	126	
Dark Grey Claystones with minor interbedded Sandstone	Sherbrook Group	Maastrichtian to Santonian	732	826	
Argillaceous Siltstones grading to Silty Claystones Interbedded Sandstone, Claystone with minor Coal	Upper Shipwreck Group	Late Turonian to Santonian	1558	520	13.375" 1501m
Arg. Sst and Clst	Lower Shipwreck		2078	67+	
			2145		

Drawn By: Angelo Mustica

File: MINERVA2.PRE

APPENDICES

1

MORGAN PALAEO ASSOCIATES
PALYNOLOGICAL/PETROLEUM GEOLOGICAL CONSULTANTS

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PALYNOLOGY OF BHPP MINERVA-2A, OFFSHORE OTWAY BASIN, VICTORIA, AUSTRALIA

BY

ROGER MORGAN

for BHP PETROLEUM

February 1994

REF:OTW.RPMINER2

PALYNOLOGY OF BHPP MINERVA-2A

OFFSHORE OTWAY BASIN, VICTORIA, AUSTRALIA

BY

ROGER MORGAN

CONTENTS **PAGE**

I SUMMARY

570-600m(cutts) : *diversus* Zone : Early Eocene : brackish to non-marine : immature

600-620m(cutts) : apparently *balmei* Zone : ? Paleocene : marginally marine : immature

620-740m(cutts) : *balmei* Zone : Paleocene : marginally marine : immature

740-60m(cutts) : upper *longus* Zone (*druggii* dino Zone) : Maastrichtian : nearshore marine : immature

760-840m(all cutts) : *longus* Zone (*druggii* dino Zone markers are probably caved) : Maastrichtian marginally marine : immature

860-940m(cutts) : *lillei* Zone (900-940m *korojonense* dino Zone) : Maastrichtian-Campanian : marginally marine : immature

960-1140m(all cutts) : upper *senectus* Zone (960-1020m upper *australis* dino Zone, 1040-1140 lower *australis* dino Zone) : Campanian : very nearshore to marginal marine : immature

1140-1300m(all cutts) : middle *senectus* Zone (1140-1180m upper *aceras* dino Zone 1230-1300m middle to lower *aceras* Zone) : Campanian : nearshore to very nearshore marine : immature

1340-60m(cutts) : lower *senectus* Zone (middle to lower *aceras* dino Zone) : Campanian : nearshore marine : immature

1380(cutts)-1565.5m(swc), upper *apoxyexinus* Zone (1380-1460m upper *cretaceum* dino Zone, 1480-1565.5m lower *cretaceum* Zone) : Santonian : nearshore marine : immature

1589.5m(swc)-1701.0m(swc) : middle *apoxyexinus* Zone (1589.5m lower *cretaceum* dino zone, 1620.0-1643.5m upper *porifera* dino Zone) : Santonian : nearshore to very nearshore : immature

1717.75m(swc)-1820.5m(swc) : lower *apoxyexinus* Zone : Santonian : nearshore marine : immature

1828.0m(swc)-1917.35(Core) : upper *mawsonii* Zone : Coniacian : marginal marine, brackish and non-marine : marginally mature for oil

1926.25m(Core)-2049.0m(swc) : lower *mawsonii* Zone : Turonian : nearshore marine below 1970m, very nearshore, brackish and non-marine above 1970m : marginally mature

2066.0m(swc)-2131.0m(swc) : *distocarinatus* Zone : Cenomanian : nearshore to non-marine : marginally mature.

Depth	Sample	S/P Zone	Dino %	Dino diversity	Algal %	Likely Environment
1728.50	Core	lower apoxyexinus	10	7	0	nearshore marine
1733.60	Core	lower apoxyexinus	8	10	0	nearshore marine
1755.0	swc	lower apoxyexinus	26	11	0	nearshore marine
1774.0	swc	lower apoxyexinus	15	12	0	nearshore marine
1801.5	swc	lower apoxyexinus	36	17	0	nearshore approaching intermediate marine
1820.5	swc	lower apoxyexinus	24	16	0	nearshore marine
1828.0	swc	upper mawsonii	15	16	1	nearshore marine
1839.75	Core	upper mawsonii	1	1	5	slightly brackish anoxic lake
1841.00	Core	upper mawsonii	1	1	11	slightly brackish oxic lake
1843.20	Core	upper mawsonii	<1	1	20	slightly brackish oxic lake
1857.30	Core	upper mawsonii	1	2	10	slightly brackish anoxic lake
1860.30	Core	upper mawsonii	3	2	10	brackish lake (tidal influence)
1866.50	Core	upper mawsonii	5	5	2	marginal marine lagoon or estuary
1876.50	Core	upper mawsonii	2	4	2	marginal marine lagoon or estuary
1879.00	Core	upper mawsonii	7	9	1	nearshore (?tidal lagoon or estuary)
1881.00	Core	upper mawsonii	5	4	2	very nearshore anoxic (?stagnant brackish lagoon or estuarine backwater)
1900.0	swc	upper mawsonii	absent	0	0	non-marine (?levee bank or freshwater swamp)
1917.35	Core	upper mawsonii	3	5	1	brackish swamp (wood shards)
1926.25	Core	lower mawsonii	absent	0	1	non-marine (?levee bank or freshwater swamp)
1933.10	Core	lower mawsonii	3	3	0	brackish swamp (wood shards, spores)
1935.50	Core	lower mawsonii	8	8	5	nearshore marine lagoon or estuary (significant freshwater algal influence)
1939.35	Core	lower mawsonii	6	6	8	nearshore marine lagoon or estuary (significant freshwater influence)
1941.65	Core	lower mawsonii	3	11	4	nearshore marine lagoon or estuary (significant freshwater influence)
1943.00	Core	lower mawsonii	absent	0	5	non-marine (freshwater lake)
1948.00	Core	lower mawsonii	absent	0	4	non-marine (freshwater lake or swamp)
1953.00	Core	lower mawsonii	6	3	3	brackish lagoon or estuary
1955.60	Core	lower mawsonii	3	10	1	very nearshore (near normal salinity estuary)
1961.25	Core	lower mawsonii	5	10	6	very nearshore (?backbarrier tidal lagoon-note significant freshwater and saline influences)
1968.25	Core	lower mawsonii	3	7	8	very nearshore (?backbarrier tidal lagoon-note significant freshwater and saline influences)
1996.5	swc	lower mawsonii	13	13	0	nearshore marine
2012.5	swc	lower mawsonii	28	9	1	nearshore marine
2049.0	swc	lower mawsonii	9	12	0	nearshore marine
2066.0	swc	distocarinatus	16	13	0	nearshore marine
2077.0	swc	distocarinatus	11	7	0	nearshore marine
2105.0	swc	distocarinatus	9	8	0	nearshore marine
2119.0	swc	distocarinatus	absent	0	4	freshwater lake or swamp
2131.0	swc	distocarinatus	1	5	0	very nearshore (?brackish tidal lagoon)

Table 1 **Detailed suggested environments, reservoir section of Minerva-2A**

REF:OTW.MINERV2

II INTRODUCTION

After well completion, sixty eight samples (23 core chips, 20 swcs, 25 cuttings) were submitted for detailed study. These results are summarised herein.

Palynomorph occurrence data are shown as Appendix I and form the basis for the assignment of the samples to fourteen spore-pollen and dinoflagellate units of Early Eocene to Cenomanian age.

Specimen counts were made on all assemblages and expressed in the raw data as percentages. In the running text, percentages from cuttings are always bracketed (5%) to show that they may be inaccurate due to caving.

The Cretaceous spore-pollen zonation is essentially that of Dettmann and Playford (1969), but has been significantly modified and improved by various authors since, and most recently discussed in Helby et al (1987), as shown on Figure 1. The Late Cretaceous zonation has been modified by Morgan (1992) in project work for BHPP (Figure 2). Tertiary zones are essentially those of Partridge (1976).

Maturity data was generated in the form of Spore Colour Index, and is plotted on Figure 3 Maturity Profile of Minerva-2A. The oil and gas windows on Figure 3 follow the general consensus of geochemical literature. The oil window corresponds to spore colours of light-mid brown (Staplin Spore Colour Index of 2.7) to dark brown (3.6). These correspond to vitrinite reflectance values of 0.6% to 1.3%. Geochemists argue variations on kerogen type, basin type and basin history. The maturity interpretation is thus open to reinterpretation using the basic colour observations as raw data. However, the range of interpretation philosophies is not great, and probably would not move the oil window by more than 200 metres.

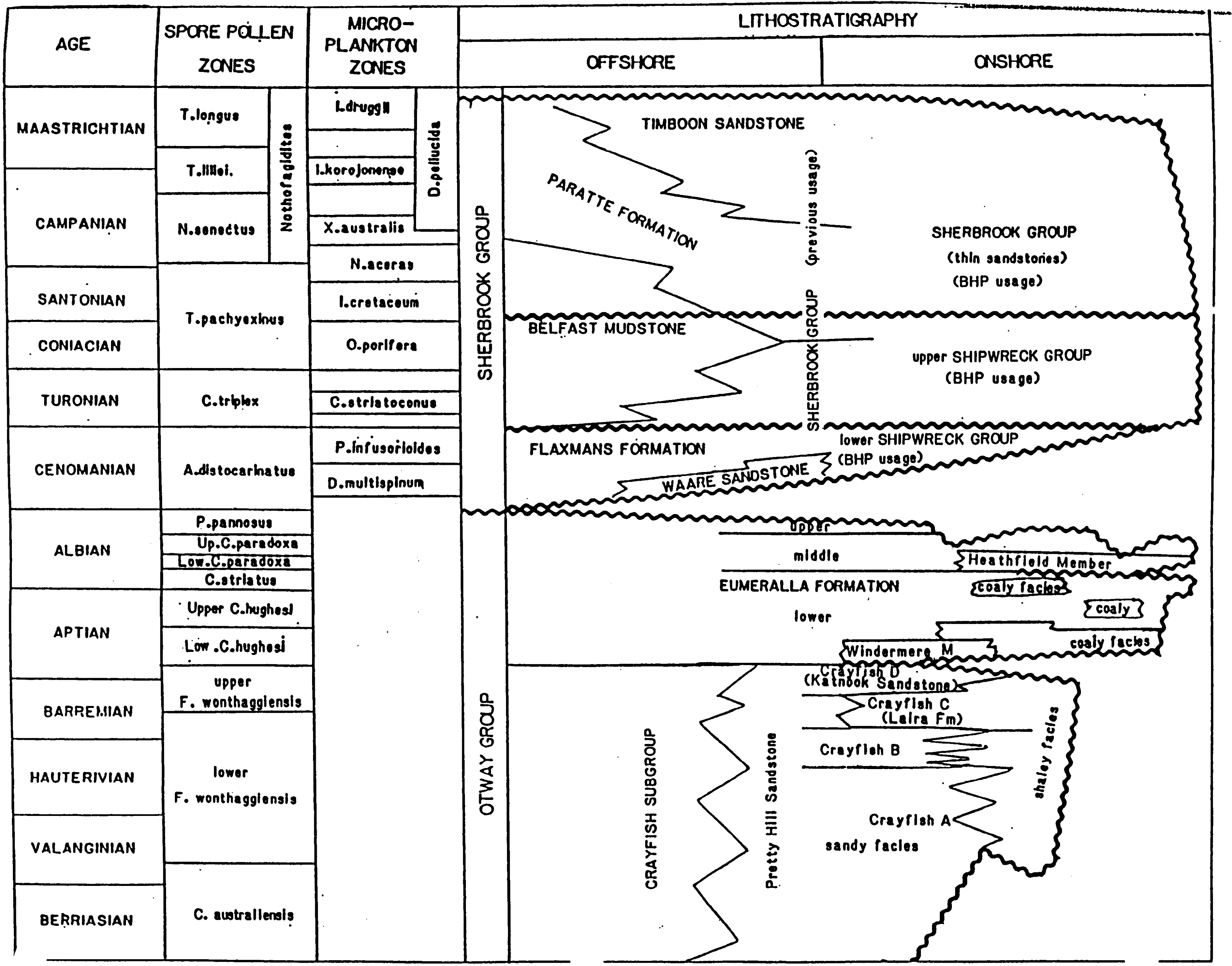

FIGURE 1. CRETACEOUS REGIONAL FRAMEWORK, OTWAY BASIN

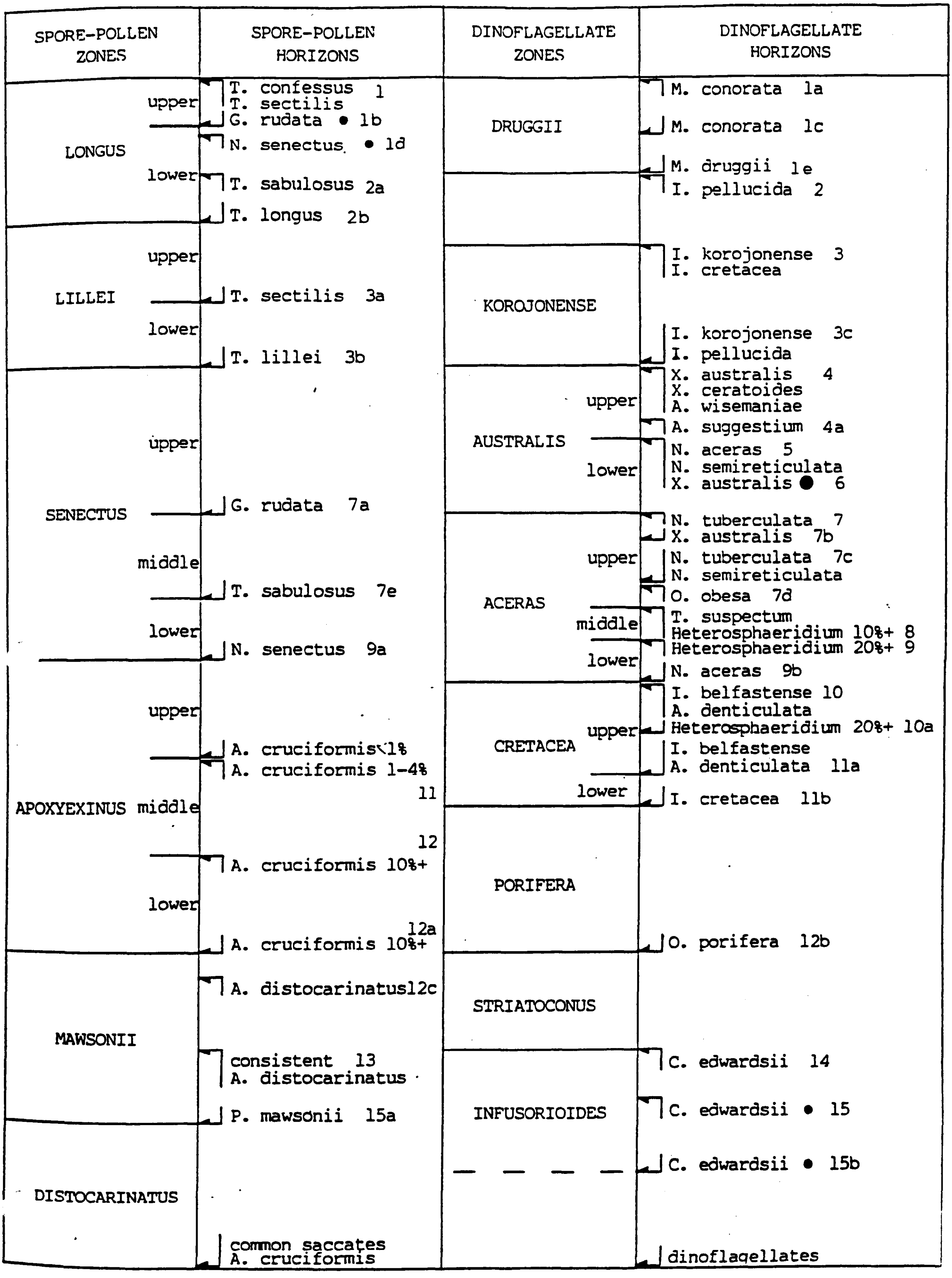

FIGURE 2 ZONATION USED HEREIN SHOWING THE NUMBERED HORIZONS AGAINST THE EXISTING FORMAL ZONATION.

● =frequent (4-10%) ● =common (11-30%)

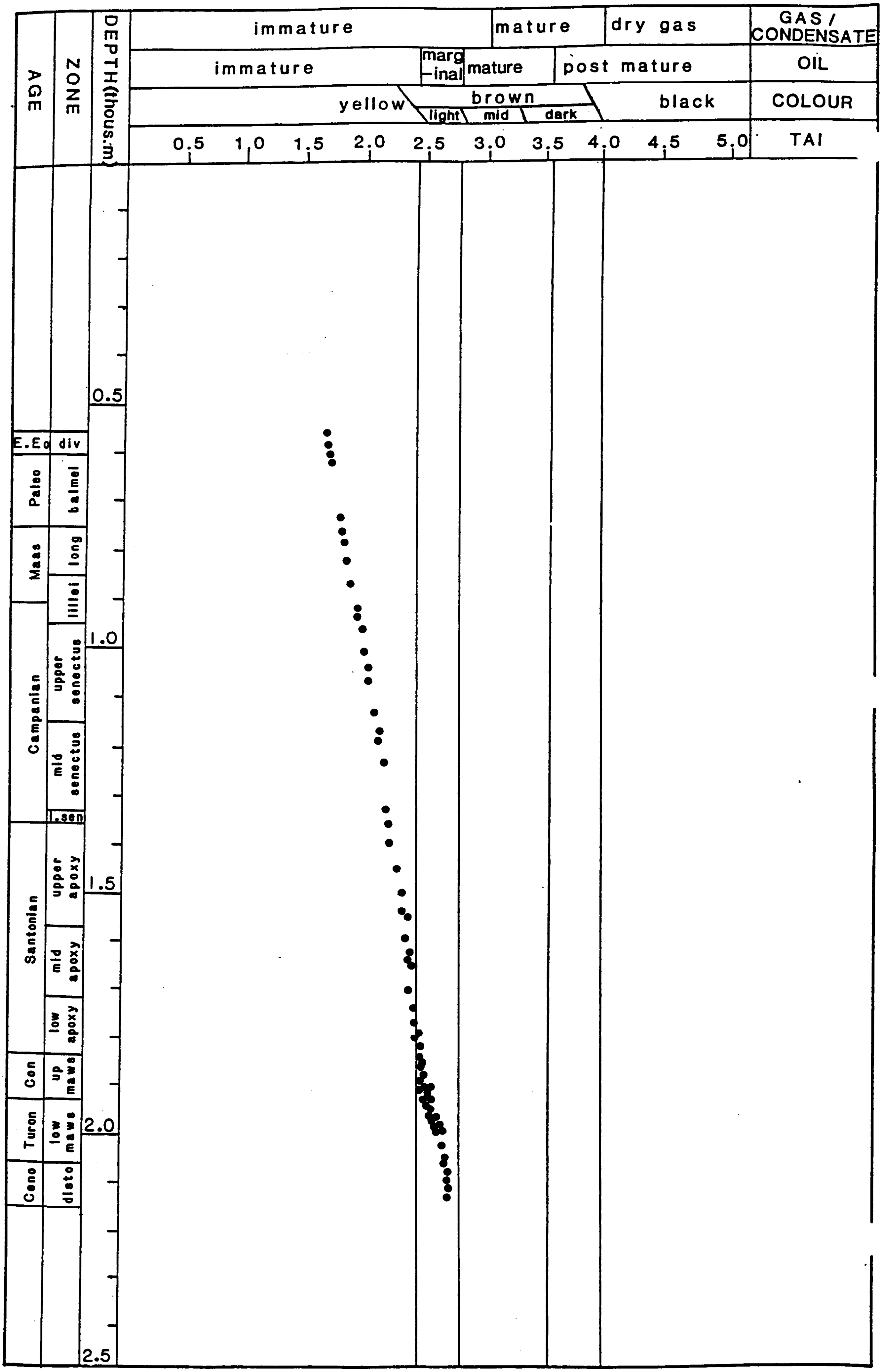

FIGURE 3 MATURITY PROFILE : MINERVA-2A

III PALYNOSTRATIGRAPHY

A 570-80m(cutts), 580-600m(cutts) : *diversus* Zone

Assignment to the middle *Malvacipollis diversus* Zone of Early Eocene age is suggested at the top by the absence of younger markers and at the base by oldest *Proteacidites kopiensis* (580m) *P. clarus* (600m) and *Triporopollenites ambiguus* (580m). The presence of *Cyathidites gigantis* at 580m may suggest the lower *diversus* Zone or older, but its range is not well documented in the Otway Basin. In these cuttings, the middle *diversus* markers may be caved, so a general *diversus* assignment only is made. Common species are *Proteacidites* and *Dilwynites granulatus* with frequent *Lygistepollenites florinii*, *Haloragacidites harrisii*, *Falcisporites* and *Cyathidites*.

Amongst the very rare dinoflagellates, *Deflandrea medcalfii* is consistent with the Early Eocene age.

Marginally marine (580m) to non-marine (600m) environments are indicated by the dominant and diverse spore-pollen, abundant cuticle, and rare dinoflagellates (1% and absent downhole). Common freshwater algae (26% and 39% downhole) indicate lake environments, although brackish at 580m.

Colourless spore colours indicate immaturity for hydrocarbons.

B 600-620m(cutts) : apparently *balmei* Zone

This assemblage appears to belong to the *Lygistepollenites balmei* Zone on youngest *L. balmei* without older markers. However, only one good specimen was seen and the other key marker *Gambierina rudata* was not seen. It is therefore possible that this sample might belong to the *diversus* Zone with minor reworking of *L. balmei*. Taxa normally restricted to the *diversus* and younger zones include *C. orthoteichus*, *Intratriporopollenites notabilis*, *Proteacidites clarus*, *P. ornatus* and *Spinozonocolpites prominatus*, but these could all be caved slightly in these cuttings. *Proteacidites* spp are common, with *Dilwynites* and *Falcisporites* very frequent and *H. harrisii*, *Cyathidites* and *Gleicheniidites* frequent.

Amongst the very rare dinoflagellates, youngest *Deflandrea speciosus* supports the *balmei* assignment and rare *Apectodinium* spp and *Wetzeliella articulata* suggest the very youngest part of it, but could be caved.

Brackish lake environments are favoured by the high freshwater algal content (12%) with low content (4%) and diversity of dinoflagellates. Spores and pollen are dominant and diverse. Considering the high *Botryococcus* contents above, part of their presence in this sample may be caved.

Colourless spore colours indicate immaturity for hydrocarbons.

C 620-40m, 720-40m(cutts) : *balmei* Zone

The presence of consistent *L. balmei* and *G. rudata* without older markers, indicates the *L. balmei* Zone. *Falcisporites* and *Proteacidites* are common with *Dilwynites*, *Cyathidites* and *Microcachryidites* frequent.

The dinoflagellate *Deflandrea speciosa* confirms the Paleocene assignment. A single *Homotriblium tasmaniense* is caved from upper *diversus* to *asperopolus* zones unsampled at the top of the section.

Marginally marine environments are indicated by the low dinoflagellate content (1% and 6%) and their low diversity. *Botryococcus* content is significant (7% and 4%) but could be partly caved.

Colourless spore colours indicate immaturity for hydrocarbons.

D 740-60m(cutts) : upper *longus* Zone

Assignment to the upper *Tricolpites longus* Zone of late Maastrichtian age is indicated at the top by youngest *T. longus* supported by youngest *Grapnelispora evansii*, *Tricolpites confessus*, *Tricolporites lillei* and *Triporopollenites sectilis*. At the base, oldest *Stereisporites punctatus* and low *Nothofagidites* content is diagnostic. *Proteacidites* and *Falcisporites* are common with *Cyathidites* and *Dilwynites* very frequent.

Amongst the scarce dinoflagellates (6%), *Manumiella coronata* and *M. druggii* indicate the *druggii* dinoflagellate Zone, correlative with the upper *longus* Spore-Pollen Zone. *M. coronata* and *Spiniferites* are the most frequent dinoflagellates. *Deflandrea speciosa*, *D. striata* and *D. pachyceros* are all rare and considered caved.

Nearshore marine environments are indicated by the low dinoflagellate content (6%) and their low diversity. *Botryococcus* is frequent (9%) suggesting significant freshwater influence, but could be caved.

Yellow spore colours indicate immaturity for hydrocarbons.

E 760-80m, 820-40m(cutts) : *longus* Zone

Assignment to the lower *T. longus* Zone of Maastrichtian age is indicated at the top by the absence of younger markers and a downhole influx of *Nothofagidites* and at the base by oldest *T. longus* (although this could be caved slightly). Common taxa are *Proteacidites* and *Falcisporites* with *Phyllocladidites mawsonii* very frequent. *Nothofagidites* (3%) out number *G. rudata* (1 and 2%). Minor Permian reworking was seen. The presence of *M. coronata* suggests the *druggii* dino Zone but these are considered caved.

Environments are probably marginally marine although the dinoflagellate content (11% and 8% downhole) suggests nearshore environments. This content is discounted here as it is probably caved. The correlable section in Minerva-1 contains 6% and 0% dinoflagellates.

Yellow spore colours indicate immaturity for hydrocarbons.

F 860-880m, 900-920m, 920-940m(cutts) : *lillei* Zone

Assignment to the *Tricolporites lillei* Zone of Campanian age is indicated at the top by the absence of younger markers and at the base by oldest *T. lillei* (920m) and *T. sectilis* (940m) without older dinoflagellate markers. *Proteacidites* are common and *Cyathidites*, *Falcisporites* and *Podosporites microsaccatus* are frequent. *Tricolporites apoxyexinus* and *T. confessus* are rare elements. Rare Cretaceous and Permian reworking were seen, and the Cretaceous taxa notably include *Dingodinium cerviculum* at 920m (suggesting that marine Aptian is present in this part of the basin).

Dinoflagellates are rare and some are clearly caved. Present and probably in place is *Isabelidinium korojonense* at 920m and 940m indicating the *korojonense* Dinoflagellate Zone, correlative with the *lillei* Spore-Pollen Zone.

Environments are marginally marine with rare dinoflagellates (3%, 2%, <1%) of low diversity, some of which are clearly caved (*M. coronata*). *Botryococcus* is common (4%, 13%, 3%) suggesting a brackish lake.

Yellow spore colours indicate immaturity for hydrocarbons.

G 960-80m, 1000-1020m, 1040-60m, 1080-1100m, 1120-40m(all cutts) : upper *senectus* Zone

Assignment to the upper *Nothofagidites senectus* Zone of Campanian age is indicated at the top by the absence of younger markers confirmed by the dinoflagellates and at the base by oldest *G. rudata* (although this could be caved slightly). Common are *Falcisporites* and *Proteacidites* with frequent forms *Cyathidites*, *Gleicheniidites*, *Dilwynites* and *Microcachryidites*. *Tricolpites sabulosus* has a distinctive acme at 1100m (5%) and 1140m (3%). *T. confessus* was not seen below 1060m. Rare Permian and Triassic reworking was seen.

Amongst the dinoflagellates, youngest *Xenascus australense* (980m) and *Xenikoon australis* (1020m) without older markers indicate the upper *australis* Dinoflagellate Zone, correlative with the upper *senectus* Spore-Pollen Zone. Beneath this, youngest *Nelsoniella semireticulata* at 1060m (also present at 1100m), the presence of frequent to common *Xenikoon australis*, and the absence of older markers indicate the lower *X. australis* Zone, correlative with the upper *senectus* Spore-Pollen Zone. *X. australis* is the only common form, all other being rare. *Nelsoniella aceras* is a rare component of all assemblages.

Environments are very nearshore to marginal marine, as shown by the low dinoflagellate content (2%, 2%, 16%, 10%, 7% downhole). Spores and pollen are dominant and diverse.

Yellow spore colours indicate immaturity for hydrocarbons.

H 1140-60m, 1160-80m, 1220-40m, 1280-1300m(all cutts) : mid *senectus* Zone

Assignment to the mid *N. senectus* Zone of Campanian age is indicated at the top by the absence of younger markers and at the base by oldest *T. sabulosus* (although this could be caved slightly). Common taxa are *Dilwynites*, *Falcisporites* and *Proteacidites* with *Cyathidites* and *Microcachryidites* frequent. *Nothofagidites* are rare (1-2%) and *T. sabulosus* is very rare but consistent.

Amongst the dinoflagellates, *Nelsoniella tuberculata* at 1160m and 1180m indicates the upper *Nelsoniella aceras* Dinoflagellate Zone, while the rare presence of *N. aceras* to the base suggests the middle to lower *aceras* Dinoflagellate Zone. *X. australis* occurs to the interval base but is considered caved below 1180m. *Heterosphaeridium heteracanthum*, *Spiniferites* and caved *X. australis* are the most frequent of the rare dinoflagellates.

Nearshore to very nearshore marine environments are indicated by the low dinoflagellate content (12%, 5%, 8%, 9% downhole) with low to moderate diversity. Spores and pollen are abundant and diverse.

Yellow spore colours indicate immaturity for hydrocarbons.

I 1340-60m(cutts) : lower *senectus* Zone

Assignment to the lower *N. senectus* Zone of Campanian age is indicated at the top by the absence of younger markers and at the base by oldest *N. senectus* (which could be caved slightly in these cuttings) and the absence of older markers. *Dilwynites* and *Falcisporites* are common with *Proteacidites* and *Cyathidites* frequent. Minor Permian and early Cretaceous reworking was seen.

Amongst the dinoflagellates, *N. aceras* and *Odontochitina obesa* suggest the middle to lower aceras Zone, but these elements could be caved in these cuttings. *H. heteracanthum* is frequent (4%) with all other dinoflagellates rare, including *Odontochitina porifera*, *Gillinia hymenophora* and *Areosphaeridium suggestium*.

Environments appear to be nearshore with low dinoflagellate content (10%) but moderate diversity. Spores and pollen are abundant and diverse.

Yellow spore colours indicate immaturity for hydrocarbons.

J 1380-1400m, 1440-60m, 1480-1500m, 1535-38m(all cutts), 1565.5m(swc) : upper *apoxyexinus* Zone

Assignment to the upper *Tricolporites apoxyexinus* Zone of Santonian age is indicated at the top by the absence of younger markers and confirmed by the dinoflagellates, and at the base by very rare *Amospopollis cruciformis* and frequent *Proteacidites* without older markers. Within the interval, *Dilwynites* and *Falcisporites* are common, with *Microcachryidites*, *Podosporites* and *Proteacidites* frequent. Rare Permian reworking was seen.

Amongst the dinoflagellates, the presence of *Isabelidinium belfastense* (1400m and 1460m) and youngest *Chatangiella victoriensis* (1400m) indicate the upper *Isabelidinium cretaceum* Dinoflagellate Zone, but could be caved at the base. Beneath this, oldest *I. cretaceum* down to 1565.5m(swc) without younger markers, indicates the lower *I. cretaceum* Dinoflagellate Zone. *Heterosphaeridium* and *Odontochitina* spp are the most common taxa. *Trithyrodinium glabra* occurs at 1400m, 1460m and 1500m but could be caved at the base range.

Nearshore marine environments are indicated by the low dinoflagellate content (12%, 30%, 30%, 22%, 13% downhole) and moderate dinoflagellate diversity. Spores and pollen are dominant and diverse in generally inertinite dominated assemblages.

Yellow spore colours indicate immaturity for hydrocarbons.

K 1589.5m, 1620.0m, 1643.5m, 1664.0m, 1701.0m(all swcs) : middle *apoxyexinus* Zone

Assignment to the middle *T. apoxyexinus* Zone of Santonian age is indicated at the top by the downhole influx of *A. cruciformis* (from <1% above to 2-9% in the interval) and at the base by the absence of older markers. Within the interval, *Falcisporites* are common with *Cyathidites*, *Microcachryidites* and *Dilwynites* frequent. *A. cruciformis* is mostly around 5%. Minor Permian reworking is seen.

Amongst the dinoflagellates, oldest *I. cretaceum* at 1589.5m indicates the lower *cretaceum* Dinoflagellate Zone. At 1620.0m and 1643.5m, consistent *Isabelidinium rectangulare* occurs, indicating the upper *Odontochitina porifera* Dinoflagellate Zone. Beneath that, dinoflagellates do not clearly indicate workable dinoflagellate zones. *Conosphaeridium striatoconus* and *Isabelidinium balmei* occur at 1701.0m(swc). *H. heteracanthum* is very frequent with *Spiniferites* frequent. Other taxa are rare. *C. deflandrei* is consistent from 1565.5m and below. Oldest *O. porifera* is at 1643.5m.

Nearshore to very nearshore marine environments are indicated by low dinoflagellate content (16%, 20%, 14%, 9%, 23% downhole) and their low to intermediate diversity. Spores and pollen are dominant and diverse in inertinite dominated assemblages.

Yellow spore colours indicate immaturity for hydrocarbons.

L 1717.75m(swc), 1728.5m(Core), 1733.60m(Core), 1755.0m(swc), 1774.0m(swc), 1801.5m(swc), 1820.5m(swc) : lower *apoxyexinus* Zone

Assignment to the lower *T. apoxyexinus* Zone of Santonian age is indicated at top and base by the common presence of *A. cruciformis* (10% plus). Within the interval, *Falcisporites* are consistently common to very common, with *Cyathidites* frequent to common. *Dilwynites* are rare at the top (1, 2% at 1717.5m and 1755.0m) but frequent to common (8-31%) beneath. *A. cruciformis* is also frequent to common, mostly around 10%. Minor Permian reworking is seen.

Amongst the dinoflagellates, zone diagnostic taxa were not seen. Potentially useful are *I. balmei* (consistent down to 1755.0m) *Apteodinium granulatum* (top at 1733.60m), *Aptea* sp (top at 1801.5m) and *Chlamydophorella nyei/ambigua* (top at 1820.5m). *H. heteracanthum* and *Spiniferites* are the most frequent forms. A single *Cribroperidinium edwardsii* occurs at 1820.5 but is considered reworked.

Nearshore marine environments are indicated by the low dinoflagellate content (30%, 10%, 8%, 26%, 15%, 36%, 24% downhole) and their moderate to high diversity. Spores and pollen are abundant and diverse in inertinite dominated microfloras.

Yellow to light brown spore colours indicate immaturity for hydrocarbons.

M 1828.0m(swc), 1839.75m(Core), 1841.00m(Core), 1843.00m(Core), 1857.30m(Core), 1860.30m(Core), 1866.50m(Core), 1876.50m(Core), 1879.00m(Core), 1881.00m(Core), 1900.0m(swc), 1917.35m(Core) : upper *mawsonii* Zone

Assignment to the upper *Phyllocladidites mawsonii* Zone of Coniacian age is indicated at the top by youngest *Appendicisporites distocarinatus* coincident with the downhole decrease of *A. cruciformis* (from 10% plus above, to near 5% within the unit), and at the base by the downhole decrease of *A. cruciformis* (from 5% within the unit to 1% or less beneath). Within the zone, *Dilwynites* and *Falcisporites* are common with *Cyathidites* and *Microcachryidites* very frequent, and *A. cruciformis* frequent (around 5%). *A. distocarinatus* and *P. mawsonii* are consistent but rare. Rare Permian and very rare Triassic reworking were seen. Dinoflagellates are scarce to very scarce and are not zone diagnostic. *Heterosphaeridium* and *Botryococcus* are the most frequent microplankton.

Environments are variable within the range of marginal marine, brackish, and non-marine, as shown by microplankton content of low to absent (15%, 1%, 1%, <1%, 1%, 3%, 5%, 2%, 7%, 5%, absent, 3%) and low to very low diversity. The single exception is the topmost sample (15% dinoflagellates of moderate diversity) which is considered nearshore marine. More detailed environments are suggested in table 1 which also tabulates the dinoflagellate diversity and the freshwater algal content. Dinoflagellate diversity is higher towards the base (1866.50-1881.0m) suggesting more marine influence, while freshwater algae are more common towards the top (1839.75-1860.30m) suggesting lakes and brackish lakes. Cuticle fragments are abundant throughout. Some anoxic environments are suggested by common amorphous organic matter (AOM). The detailed environments are suggestions only, based on the palynological data and should be evaluated in concert with the sedimentological data (core).

Light brown spore colours indicate marginal maturity for oil, but immaturity for gas/condensate.

N 1926.25m(Core), 1933.10m(Core), 1935.50m(Core), 1939.35m(Core), 1941.65m(Core), 1943.00m(Core), 1948.00m(Core), 1953.00m(Core), 1955.60m(Core), 1961.25m(Core), 1968.25m(Core), 1996.5m(swc), 2012.5m(swc), 2049.0m(swc) : lower *mawsonii* Zone

Assignment to the lower *P. mawsonii* Zone of Turonian age is indicated at the top by the downhole decrease of *A. cruciformis* (5% to <1%), and at the base on oldest *P. mawsonii.* Within the interval, *Cyathidites*, *Dilwynites* and *Falcisporites* are common to very common, with *Podosporites* and *Microcachryidites* frequent. *A. distocarinatus* and *P. mawsonii* are consistent but rare. Rare Permian and very rare Triassic reworking are seen.

Dinoflagellates are very rare to absent above 1970m and frequent to common beneath but largely lack zone diagnostic taxa. In the basal sample (2049.0m) rare *Cribroperidinium edwardsii* occurs, indicating the *Palaeohystrichophora infusorioides* Dinoflagellate Zone. *Heterosphaeridium* and *Botryococcus* are the most frequent microplankton.

Environments are variable but fall into two fairly distinct groups. The upper part of the section (above 1970m) is very nearshore, brackish and non-marine, as shown by low dinoflagellate contents (absent, 3%, 8%, 6%, 3%, absent, absent, 6%, 3%, 5%, 3%), low dinoflagellate diversity, and significant freshwater algae (*Botryococcus*) and high cuticle content. Some anoxic environments are indicated by significant to abundant amorphous organic matter (AOM). More detailed environments are suggested in table 1 but these are only suggestions, made in ignorance of the sedimentological data. The lower part of the section (below 1970m) is nearshore marine as shown by higher dinoflagellate content (13%, 28%, 9% downhole) and diversity. Spores and pollen are common and diverse throughout.

Light brown spore colours indicate marginal maturity for oil but immaturity for gas/condensate.

O 2066.0m(swc), 2077.0m(swc), 2105.0m(swc), 2119.0m(swc), 2131.0m(swc) : *distocarinatus* Zone

Assignment to the *A. distocarinatus* Zone of Cenomanian age is indicated at the top and base by *A. distocarinatus* without younger and older markers. Within the interval, *Falcisporites* are very common with *Dilwynites*, *Cyathidites* and *Microcachryidites* common to frequent. *Clavifera triplex* occurs down to 2066m but not beneath. *Phyllocladidites ennuchus* occurs rarely to the interval base.

Amongst the rare dinoflagellates, *C. edwardsii* occurs down to 2105m indicating the *infusorioides* Dinoflagellate Zone. *Heterosphaeridium* and *Spiniferites* are the most frequent taxa.

Environments range from nearshore marine to non-marine with low dinoflagellate content (16%, 11%, 9%, absent, 1% downhole) and low diversity. High freshwater algal content at 2119.0m (4%) suggests a freshwater lake or swamp. Detailed environments are suggested in table 1. Spores and pollen are common and diverse in all samples.

Light brown spore colors indicate marginal maturity for oil, and immaturity for gas/condensate.

IV CONCLUSIONS

At the top, the sampled section is Tertiary (Paleocene to Early Eocene) in very nearshore marine and marginally marine environments. Conformably beneath, almost all of the late Cretaceous is seen from Cenomanian to Maastrichtian although the late Campanian *lillei* Zone is condensed. At the base, the reservoir section is mostly very nearshore to non-marine (Cenomanian *distocarinatus* to Coniacian *mawsonii* Zone). Above this, claystone dominated facies in mostly nearshore to marginal marine environments (Santonian *apoxyexinus* to Maastrichtian *longus* zones).

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MINERVA #2A

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CLIENT: BHPP
WELL: MINERVA #2A
FIELD/AREA: OFFSHORE OTWAY BASIN, VICTORIA
ANALYSTS: Roger Morgan / Nigel Hooker DATE: Feb. '94
NOTES: all depths are in metres
all figures are percentages based on 100 specimen count
"X" represents RARE presence outside the count
in uncounted samples: "A" = abundant "C" = common
"F" = few "R" = rare

RANGE CHART OF OCCURRENCES BY % & HIGHEST APPEARANCE:grouped

		1 MICROPLANKTON %	2 REWORKING: PERMIAN	3 REWORKING: CRETACEOUS	4 REWORKING: TRIASSIC	5 BOTRYOCOCCUS	6 PARALECANIELLA INDENTATA	7 NUMMUS	8 NUMMUS MONOCULATUS	9 DEFLANDREA MEDCALFII	10 SPINIDINIUM SP	11 SPINIFERITES FURCATUS/RAMOSUS	12 APECTODINIUM HOMOMORPHA (SH. SP)	13 AREOLIGERA SENONENSIS	14 DEFLANDREA OBLIQUIPES (L.H.)	15 DEFLANDREA SPECIOSUS	16 HYSTRICHOSPHAERIDIUM TUBIFERUM	17 MICRHYSTRIDIUM SP	18 WETZELIELLA ARTICULATA	19 HOMOTRIBLIUM TASMANIENSE	20 GLAPHYROCYSTA RETIINTEXTA	21 HAFNIASPHAERA SEPTATA	22 HAFNIASPHAERA SP	23 TRITHYRODINIUM EVITTII	24 ALISOCYSTA CIRCUMTABULATA	25 CORDOSPHAERIDIUM INODES	26 DEFLANDREA PACHYCEROS (SH. H)	27 DEFLANDREA STRIATA	28 MANUMIELLA CORONATA	29 MANUMIELLA DRUGGII	30 ALISOCYSTA MARGARITA	31 EXOCHOSPHAERIDIUM PHRAGMITES	32 HETEROSPHAERIDIUM CONJUNCTUM	33 KIOKANSIUM POLYPES	34 VERYHACHIUM	35 CRIBROPERIDINIUM SP	36 ISABELIDINIUM PELLUCIDUM	37 CANNINGINOPSIS BRETONICA	38 EISENACKIA CRASSI ULATA
0570-80	CUTTS	1	.	.	.	26	.	.	.	X	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0580-00	CUTTS	.	.	.	.	38	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0600-20	CUTTS	5	.	.	.	12	1	.	.	.	.	1	X	1	X	X	1	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0620-40	CUTTS	1	.	.	.	7	.	.	.	.	.	1	.	.	.	X	.	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0720-40	CUTTS	6	.	.	.	2	2	.	.	.	X	2	.	4	.	.	.	.	.	.	?	X	X	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0740-60	CUTTS	6	.	.	.	9	2	.	.	.	.	3	.	1	.	X	.	.	.	.	.	.	.	.	X	X	X	X	2	X	.	.	.	.	.	.	.	.	.
0760-80	CUTTS	11	.	.	.	7	1	.	.	.	1	1	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	X	X	1	.	.	.	.	.	.	.
0820-40	CUTTS	8	X	.	.	1	.	.	.	.	X	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	1	1	1	.	.	.	.
0860-80	CUTTS	3	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	2	1	.	.
0900-20	CUTTS	2	X	X	.	13	.	X	.	.	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	X	X
0920-40	CUTTS	>1	.	.	.	3	.	2	.	.	X	.	.	X	.	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.	.	.	.	X	X	.	.
0960-80	CUTTS	2	.	.	.	9	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.
1000-20	CUTTS	2	.	.	.	2	.	X	.	.	.	.	.	X	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.
1040-60	CUTTS	16	.	.	.	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1080-00	CUTTS	10	1	.	1	1	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	1	.	.	.
1120-40	CUTTS	7	.	.	.	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.
1140-60	CUTTS	12	.	.	.	3	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1160-80	CUTTS	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1220-40	CUTTS	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.
1280-00	CUTTS	9	.	.	.	.	.	.	.	.	X	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1340-60	CUTTS	10	X	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	X	.	.	.	.
1380-00	CUTTS	12	X	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	1	.	.	.	.
1440-60	CUTTS	30	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.
1480-00	CUTTS	30	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
1535-38	CUTTS	22	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
1565.5	SWC	13	X	.	.	.	.	.	X	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.
1589.5	SWC	16	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.
1620.0	SWC	20	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	
1643.5	SWC	14	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	
1664.0	SWC	9	1	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
1701.0	SWC	23	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1717.75	SWC	30	X	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	1	.	.	.	.
1728.50	CORE1	10	.	.	.	.	.	1	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.
1733.60	CORE1	8	X	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	1	.	.	.	.	.
1755.0	SWC	26	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.
1774.0	SWC	15	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.
1801.5	SWC	36	.	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.
1820.5	SWC	24	.	.	.	.	.	.	2	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
1828.0	SWC	15	.	.	.	.	.	.	1	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
1839.75	CORE2	1	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
1841.0	CORE2	1	.	.	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1843.20	CORE2	.	.	.	.	20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.
1857.3	CORE3	1	X	.	.	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
1860.3	CORE3	3	1	.	1	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.
1866.05	CORE3	5	1	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
1876.5	CORE3	2	.	.	.	2	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
1879.0	CORE3	7	.	.	.	1	.	X	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.
1881.0	CORE3	5	.	.	.	2	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.
1900.0	SWC	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1917.35	CORE4	3	1	.	.	1	.	.	.	.	.	X	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
1926.25	CORE4	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1933.1	CORE4	3	X	.	X	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
1935.50	CORE4	8	.	.	.	4	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.
1939.35	CORE4	6	.	.	.	8	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.
1941.65	CORE4	3	.	.	.	4	.	1	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	X	.	.	.	.	.
1943.0	CORE5	.	X	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1948.0	CORE5	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
1953.0	CORE5	6	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	.	.	.	.
1955.60	CORE5	3	.	.	.	1	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	X	.	.	.	.	.
1961.25	CORE5	5	1	.	.	6	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	1	.	.	.	.	.
1968.25	CORE5	3	.	.	.	8	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.
1996.5	SWC	13	.	.	X	.	.	.	1	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	X	.	.	.	.	.
2012.5	SWC	28	.	.	.	1	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	3	.	1	.	.	.
2049.0	SWC	9	.	.	.	X	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.
2066.0	SWC	16	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	X	.	.	.
2077.0	SWC	11	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.
2105.0	SWC	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2119.0	SWC	.	.	.	1	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2131.0	SWC	1	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.

		39 ISABELIDINIUM KOROJONENSE	40 APTEA SP	41 CHATANGIELLA TRIPARTITA	42 HETEROSPHAERIDIUM HETEROCANTHUM	43 OLIGOSPHAERIDIUM PULCHERRIMUM	44 TRICHODINIUM INTERMEDIUM	45 XENASCUS AUSTRALIENSE	46 XENIKOON AUSTRALIS	47 NELSONIELLA ACERAS	48 NELSONIELLA SEMIRECTICULATA	49 NELSONIELLA SP	50 ODONTOCHITINA PORIFERA	51 ODONTOCHITINA STUBBY	52 TRICHODINIUM	53 NELSONIELLA TUBERCULATA	54 PALAEOHYSTRICHOSPHORA INFUSORIOIDES	55 EUCLADINIUM MADURENSE	56 MADURADINIUM PENTAGONUM	57 ODONTOCHITINA OPERCULATA	58 HETEROSPHAERIDIUM CF LATEROBRACHIUS	59 GILLINIA HYMENOPHORA	60 ISABELIDINIUM CRETACEUM	61 PTEROSPERMELLA AUREOLATA	62 TRITHYRODINIUM MARSHALLII	63 AREOSPHAERIDIUM SUGGESTIUM	64 NELSONIELLA CF ACERAS (PSILATE)	65 ODONTOCHITINA CRIBROPODA	66 ODONTOCHITINA OBESA	67 PTEROSPERMELLA AUSTRALIENSIS	68 XIPHOPHORIDIUM ALATUM	69 CHLAOISPHAERIDIUM ASYMMETRICUM	70 CHATANGIELLA VICTORIENSIS	71 ISABELIDINIUM BELFASTENSE ROTUNDATA	72 TRITHYRODINIUM (THICK RETIC)	73 TRITHYRODINIUM GLABRA (THICK SMOOTH)	74 BOURKIDINIUM GRANULATUM	75 HYSTRICHODINIUM PULCHRUM	76 ISABELIDINIUM BELFASTENSE
0570-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0580-00	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0600-20	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0620-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0720-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0740-60	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0760-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0820-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0860-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0900-20	CUTTS	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0920-40	CUTTS	X	X	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0960-80	CUTTS	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1000-20	CUTTS	.	X	.	X	.	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1040-60	CUTTS	.	.	.	.	.	.	.	17	X	X	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1080-00	CUTTS	.	.	.	.	.	.	.	7	1	X	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1120-40	CUTTS	.	.	.	1	.	.	.	3	X	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1140-60	CUTTS	.	.	.	1	.	.	.	5	1	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1160-80	CUTTS	.	.	.	2	.	.	.	1	.	.	.	1	.	.	X	.	X	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1220-40	CUTTS	.	.	.	2	.	.	.	3	.	.	.	.	.	.	.	2	.	1	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1280-00	CUTTS	.	.	.	1	1	.	.	2	X	.	.	.	.	.	.	.	.	.	.	X	1	X	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1340-60	CUTTS	.	.	.	4	.	.	.	.	2	.	.	X	.	X	.	1	.	.	1	.	X	X	.	X	X	X	X	X	X	?	.	.	.	.	.	.	.	.
380-00	CUTTS	.	.	.	6	.	.	.	.	1	.	.	X	.	.	.	1	.	X	1	.	.	.	.	.	.	.	.	.	.	.	X	X	1	X	X	.	.	.
1440-60	CUTTS	.	.	X	7	.	.	.	.	.	.	.	.	4	.	.	.	.	.	12	.	.	.	.	1	?	.	1	.	.	.	.	X	X	X	2	X	X	1
1480-00	CUTTS	.	.	.	12	.	.	.	.	.	.	.	.	X	.	.	.	.	.	4	.	.	1	.	2	.	.	1	.	.	.	.	X	.	2	X	.	.	.
1535-38	CUTTS	.	.	.	5	.	.	.	.	.	.	.	2	X	.	.	.	X	.	1	.	1	4	.	2	.	.	2	X	.	.	.	.	.	.	.	.	.	.
1565.5	SWC	.	.	.	4	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1589.5	SWC	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	X	.	.	.	.	.	.	.	.	.	.	X	.	.	.
1620.0	SWC	.	.	.	11	X	.	.	.	.	.	.	.	.	.	.	1	.	.	X	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1643.5	SWC	.	X	.	3	.	.	.	.	.	.	.	X	.	.	.	.	.	.	X	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.
1664.0	SWC	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1701.0	SWC	.	.	.	7	.	.	.	.	.	.	.	.	.	1	.	2	.	.	2	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1717.75	SWC	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.	1	.	.	4	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1728.50	CORE1	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1733.60	CORE1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1755.0	SWC	.	.	.	11	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
1774.0	SWC	.	.	.	3	.	.	.	.	.	.	.	.	.	1	.	2	.	.	1	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1801.5	SWC	.	1	.	12	.	.	X	.	.	.	.	.	.	X	.	7	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.
1820.5	SWC	.	2	.	5	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	1	.
1828.0	SWC	.	1	.	4	X	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1839.75	CORE2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1841.0	CORE2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1843.20	CORE2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1857.3	CORE3	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1860.3	CORE3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1866.05	CORE3	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1876.5	CORE3	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1879.0	CORE3	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1881.0	CORE3	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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1917.35	CORE4	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1926.25	CORE4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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1935.50	CORE4	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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1943.0	CORE5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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1953.0	CORE5	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1955.60	CORE5	.	.	.	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1961.25	CORE5	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1968.25	CORE5	.	.	.	2	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1996.5	SWC	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.
2012.5	SWC	.	.	.	10	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2049.0	SWC	.	.	.	2	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2066.0	SWC	.	.	.	3	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2077.0	SWC	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2105.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.
2119.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2131.0	SWC	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

		ODONTOCHITINA NO HORNS 77	OLIGOSPHAERIDIUM COMPLEX 78	CASSICULOSPHAERIDIA RETICMAGNA 79	DINOGYMNIUM ACUMINATUM 80	ODONTOCHITINA COSTATA 81	SUBTILISPHAERA ROTUNDATA 82	CIRCULODINIUM DEFLANDREI 83	ISABELIDINIUM CF BELFASTENSE 84	ISABELIDINIUM COOKSONIAE 85	AMPHIDIADEMA DENTICULATA 86	ISABELIDINIUM RECTANGULARE CONTRACTUM 87	TRITHYRODINIUM SUSPECTUM 88	ISABELIDINIUM RECTANGULARE DIVERSUM 89	ISABELIDINIUM RECTANGULARIS 90	ISABELIDINIUM BALMEI 91	TANYOSPHAERIDIUM SALPINX 92	CONOSPHAERIDIUM STRIATOCONUS 93	XENASCUS CERATOIDES 94	CIRCULODINIUM SOLIDA 95	APTEODINIUM GRANULATUM 96	CYMOSOSPHAERIDIUM MAGNIFICA 97	DAPSILIDINIUM SP 98	FLORENTINIA DEANEI 99	ALTERBIA ACUMINATUM 100	CHLAMYDOPHORELLA NYEI/AMBIGUA 101	CRIBROPERIDINIUM EDWARDSII 102	PALAEOPERIDINIUM CRETACEUM 103	CONOSPHAERIDIUM TUBULOSUM 104	ISABELIDINIUM GLABRUM 105	CYCLONEPHELIUM COMPACTUM 106	CHATANGIELLA MICROCANTHA 107	ISABELIDINIUM SP 108	CANNINGIA SPINY . 109	CLEISTOSPHAERIDIUM 110	ARAUCARIACITES AUSTRALIS 111	CLAVIFERA TRIPLEX 112	CYATHIDITES GIGANTIS 113	CYATHIDITES SPP 114
0570-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	X	7
0580-00	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	X	.	4
0600-20	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	6
0620-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	1	.
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0740-60	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	.	9
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0820-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
0860-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
0900-20	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	.
0920-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
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1000-20	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
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1080-00	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	1	.	.
1120-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
1140-60	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
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1220-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	.	.	.
1280-00	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	X	.	.
1340-60	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.
1380-00	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.
1440-60	CUTTS	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	
1480-00	CUTTS	X	X	X	1	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	
1535-38	CUTTS	.	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	2	.	.
1565.5	SWC	.	.	.	.	.	.	1	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	1	.	.
1589.5	SWC	.	.	.	.	X	.	1	.	4	?	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	.
1620.0	SWC	.	X	.	.	.	.	1	.	3	.	X	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
1643.5	SWC	.	1	.	.	.	.	1	.	.	.	X	.	2	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	1	.	.
1664.0	SWC	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9	2	.	.
1701.0	SWC	.	.	.	.	.	.	1	.	.	.	.	X	.	.	2	.	X	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.
1717.75	SWC	.	4	.	.	.	.	3	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
1728.50	CORE1	.	.	.	.	.	.	2	.	.	.	.	.	.	.	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.
1733.60	CORE1	.	1	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	X	.	.
1755.0	SWC	.	.	.	.	.	1	3	.	.	.	.	.	.	.	2	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2	.	.
1774.0	SWC	.	X	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	2	.	.
1801.5	SWC	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	1	X	1	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
1820.5	SWC	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	X	2	1	.	.	.	.	.	.	.	.	5	.	.	.
1828.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	X	X	.	X	.	.	.	.	.	.	.	3	.	.	.
1839.75	CORE2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.
1841.0	CORE2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
1843.20	CORE2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
1857.3	CORE3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.
1860.3	CORE3	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	X	.	.
1866.05	CORE3	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	1	.	.	.	.	.	.	.	5	.	.	.
1876.5	CORE3	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	4	1	.	.
1879.0	CORE3	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	2	X	.	.
1881.0	CORE3	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	4	.	.	.
1900.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.
1917.35	CORE4	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.
1926.25	CORE4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
1933.1	CORE4	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.
1935.50	CORE4	.	X	.	.	.	.	2	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.
1939.35	CORE4	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2	.	.
1941.65	CORE4	.	X	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	X	.	.	.	.	2	X	.	.
1943.0	CORE5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	1	.	.
1948.0	CORE5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
1953.0	CORE5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	1	.	.
1955.60	CORE5	.	X	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	.	.	4	1	.	.
1961.25	CORE5	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	.	1	1	.	.
1968.25	CORE5	.	1	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
1996.5	SWC	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	1	.	2	.	.	X	.	.	.	.	3	.	.	.
2012.5	SWC	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	3	.	.	.
2049.0	SWC	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	X	1	.	.	1	.	.	.	.	2	1	.	.
2066.0	SWC	.	3	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	2	1	.	.	X	.	.	.	.	4	X	.	.
2077.0	SWC	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	3	.	.	
2105.0	SWC	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	
2119.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2131.0	SWC	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	?	.	.	.	.	.	.	.	.	3	.	.	.

		DILWYNITES GRANULATUS	ERICIPITES SCABRATUS	FALCISPORITES SIMILIS	FOVEOTRILETES CRATER	GEPHRAPOLLENITES WAHOOENSIS	HALORAGACIDITES HARRISII	LAEVIGATOSPORITES OVATUS	LAEVIGATOSPORITES USMENSIS	LYGISTIPOLLENITES FLORINII	MALVACIPOLLIS DIVERSUS	MALVACIPOLLIS SUBTILIS	MICROCACHRYIDITES ANTARCTICUS	MYRTACEIDITES PARVUS/MESONESUS	NOTHOFAGUS BRACHYSPINULOSUS	NOTHOFAGUS EMARCIDUS/HETERUS	NOTHOFAGUS FLEMINGII	PERIPOROPOLLENITES POLYORATUS	PERIPOROPOLLENITES VESICUS	PHYLLOCLADIDITES MAWSONII	PODOSPORITES MICROSACCATUS	PROTEACIDITES	PROTEACIDITES GRANDIS	PROTEACIDITES INCURVATUS	PROTEACIDITES KOPIENSIS	STEREISPORITES ANTIQUISPORITES	STEREISPORITES PUNCTATUS	TRICOLPORITES	TRILETES TUBERCULIFORMIS	TRIPOROPOLLENITES AMBIGUUS	VERRUCOSISPORITES KOPUKUENSIS	CUPANIEIDITES ORTHOTEICHUS	GLEICHENIIDITES CIRCINIDITES	PROTEACIDITES CLARUS	PROTEACIDITES LEIGHTONII	PROTEACIDITES SCABORATUS	RETITRILETES AUSTROCLAVATIDITES	AUSTRALOPOLLIS OBSCURUS	CAMEROZONOSPORITES BULLATUS
		115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
0570-80	CUTTS	15	1	7	?	X	5	1	X	7	1	4	2	1	X	1	X	1	1	3	2	6	2	X	X	X	1	1	X	X	X	.	.	.	.	.	.	.	.
0580-00	CUTTS	10	1	6	.	.	6	1	.	5	1	1	1	.	X	.	.	1	1	.	2	13	.	1	.	.	.	.	.	.	X	X	4	X	1	X	1	.	.
0600-20	CUTTS	11	.	8	.	.	5	1	.	2	.	1	2	.	1	.	X	.	.	2	.	21	.	.	.	4	.	1	1	.	1	1	5	1	.	.	.	1	1
0620-40	CUTTS	17	2	7	.	.	3	2	.	5	X	1	1	.	2	.	.	2	.	1	.	9	1	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.
0720-40	CUTTS	10	.	20	.	.	.	.	.	X	.	.	7	.	1	.	.	.	.	5	5	15	X	.	.	2	3	.	.	.	.	.	3	.	.	.	2	3	.
0740-60	CUTTS	9	.	14	.	.	.	.	.	.	2	1	3	.	.	.	.	.	.	4	3	16	.	.	.	3	1	.	.	.	.	.	4	.	.	X	.	1	X
0760-80	CUTTS	5	.	14	.	.	.	1	.	2	.	.	4	.	.	.	.	1	.	11	1	15	.	.	.	2	.	.	1	.	.	.	.	.	.	.	1	.	.
0820-40	CUTTS	2	.	11	.	X	.	3	.	1	.	.	5	.	.	.	.	.	.	7	4	9	.	.	.	5	.	.	.	.	.	.	.	.	.	.	2	.	.
0860-80	CUTTS	7	2	11	.	X	3	1	.	3	.	.	7	.	.	.	.	.	.	4	6	18	.	.	.	2	.	.	.	.	.	.	.	.	.	.	1	.	.
0900-20	CUTTS	3	1	7	.	X	.	1	.	1	.	.	.	.	.	.	.	X	.	3	5	21	.	.	.	3	.	.	.	.	.	.	.	.	.	.	4	1	.
0920-40	CUTTS	9	1	16	.	.	1	.	.	.	.	.	4	.	.	.	.	.	.	5	4	13	.	.	.	1	X	.	.	.	.	.	.	.	.	.	1	.	.
0960-80	CUTTS	4	.	13	.	1	1	.	.	.	.	.	4	.	.	.	.	.	.	4	.	10	.	.	.	3	.	.	.	.	.	.	.	.	.	.	2	.	.
1000-20	CUTTS	3	1	15	.	.	.	.	.	X	.	.	6	.	.	18	.	1	.	4	5	13	.	.	.	1	.	X	.	.	.	.	.	.	.	.	2	.	.
1040-60	CUTTS	1	.	16	.	.	.	2	.	.	.	.	3	.	.	.	.	.	.	3	2	7	.	.	.	1	.	1	.	.	.	.	.	.	.	.	2	X	.
1080-00	CUTTS	6	.	13	.	.	.	1	.	.	.	.	7	.	.	.	.	.	.	2	4	11	.	.	.	1	.	.	.	.	.	.	.	.	.	.	5	.	.
1120-40	CUTTS	10	.	20	.	.	.	1	.	.	.	.	12	.	.	.	.	.	.	3	3	9	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2	1	.
1140-60	CUTTS	11	.	17	.	.	.	1	.	.	.	.	14	.	.	.	.	.	.	4	X	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.
1160-80	CUTTS	22	.	11	.	.	.	2	.	.	.	.	4	.	.	.	.	.	.	3	8	15	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	2	.
1220-40	CUTTS	5	.	15	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	4	2	5	.	.	.	2	.	.	.	.	.	.	.	.	.	.	1	3	.
1280-00	CUTTS	14	.	21	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	3	1	9	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	1	.
1340-60	CUTTS	11	.	18	.	.	.	1	.	.	.	.	7	.	.	.	.	.	.	.	8	8	.	.	.	3	.	.	.	.	.	.	.	.	.	.	1	X	.
1380-00	CUTTS	16	.	26	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	2	2	6	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	1	.
1440-60	CUTTS	19	.	11	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	1	4	3	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	1	.
1480-00	CUTTS	13	.	15	.	.	.	.	.	.	.	.	10	.	.	.	.	.	.	1	4	1	.	.	.	3	.	.	.	.	.	.	.	.	.	.	1	.	.
1535-38	CUTTS	11	.	15	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	2	6	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.
1565.5	SWC	17	.	21	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	3	8	X	.	.	.	4	.	.	.	.	.	.	.	.	.	.	2	.	.
1589.5	SWC	16	.	30	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	1	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.
1620.0	SWC	9	.	24	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	1	2	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	.	.
43.5	SWC	6	.	18	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.
64.0	SWC	7	.	22	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	1	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
1701.0	SWC	8	.	23	.	.	.	.	.	.	.	.	9	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
1717.75	SWC	1	.	25	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	.	.
1728.50	CORE1	2	.	16	.	.	.	1	.	.	.	.	8	.	.	.	.	.	.	2	5	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	1	1	.
1733.60	CORE1	9	.	18	.	.	.	1	.	.	.	.	9	.	.	.	.	.	.	5	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	2	.
1755.0	SWC	8	.	15	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	1	4	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	.	.
1774.0	SWC	12	.	26	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	X	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.
1801.5	SWC	16	.	16	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
1820.5	SWC	31	.	12	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.
1828.0	SWC	17	.	21	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	3	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	1	.	.
1839.75	CORE2	9	.	9	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	1	32	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	1	.	.
1841.0	CORE2	21	.	20	.	.	.	.	.	.	.	.	10	.	.	.	.	.	.	1	6	1	.	.	.	2	.	.	.	.	.	.	.	.	.	.	1	.	.
1843.20	CORE2	10	.	17	.	.	.	X	.	.	.	.	14	.	.	.	.	.	.	2	6	.	.	.	.	6	.	.	.	.	.	.	.	.	.	.	1	.	.
1857.3	CORE3	14	.	13	.	.	.	2	.	.	.	.	7	.	.	.	.	.	.	2	10	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	1	.	.
1860.3	CORE3	22	.	12	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	3	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
1866.05	CORE3	7	.	22	.	.	.	1	.	.	.	.	13	.	.	.	.	.	.	.	6	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	1	.	.
1876.5	CORE3	11	.	27	.	.	.	2	.	.	.	.	6	.	.	.	.	.	.	1	4	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	1	.	.
1879.0	CORE3	14	.	21	.	.	.	.	.	.	.	.	11	.	.	.	.	.	.	.	5	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2	.	.
1881.0	CORE3	27	.	13	.	.	.	1	.	.	.	.	7	.	.	.	.	.	.	.	2	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2	.	.
1900.0	SWC	5	.	24	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	1	6	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	2	.	.
1917.35	CORE4	16	.	25	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	1	4	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.
1926.25	CORE4	15	.	10	.	.	.	4	.	.	.	.	3	.	.	.	.	.	.	6	10	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	X	.
1933.1	CORE4	27	.	14	.	.	.	1	.	.	.	.	8	.	.	.	.	.	.	.	4	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.
1935.50	CORE4	7	.	18	.	.	.	1	.	.	.	.	9	.	.	.	.	.	.	3	6	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	1	1	.
1939.35	CORE4	20	.	10	.	.	.	3	.	.	.	.	9	.	.	.	.	.	.	1	3	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	.	.
1941.65	CORE4	8	.	14	.	.	.	5	.	.	.	.	8	.	.	.	.	.	.	5	15	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2	X	.
1943.0	CORE5	4	.	21	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	5	3	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2	.	.
1948.0	CORE5	3	.	20	.	.	.	1	.	.	.	.	11	.	.	.	.	.	.	6	6	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	2	.	.
1953.0	CORE5	9	.	21	.	.	.	1	.	.	.	.	8	.	.	.	.	.	.	3	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.
1955.60	CORE5	20	.	20	.	.	.	.	.	.	.	.	15	.	.	.	.	.	.	4	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.
1961.25	CORE5	16	.	22	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	2	4	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.
1968.25	CORE5	17	.	16	.	.	.	1	.	.	.	.	10	.	.	.	.	.	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.
1996.5	SWC	20	.	15	.	.	.	X	.	.	.	.	8	.	.	.	.	.	.	.	5	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	1	.	.
2012.5	SWC	18	.	13	.	.	.	X	.	.	.	.	4	.	.	.	.	.	.	X	4	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X	.	.
2049.0	SWC	15	.	15	.	.	.	.	.	.	.	.	12	.	.	.	.	.	.	X	6	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	1	.	.
2066.0	SWC	19	.	17	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
2077.0	SWC	20	.	14	.	.	.	X	.	.	.	.	13	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	.	.
2105.0	SWC	X	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	?	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.
2119.0	SWC	.	.	30	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	3	.	.
2131.0	SWC	12	.	20	.	.	.	.	.	.	.	.	16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.

		INTRATRIPOROPOLLENITES NOTABILIS 153	LYGISTIPOLLENITES BALMEI 154	NOTHOFAGUS ENDURUS 155	PROTEACIDITES ANNULARIS 156	PROTEACIDITES ORNATUS 157	SPINIZONOCOLPITES PROMINATUS 158	TRICOLPITES 159	AMOSOPOLLIS CRUCIFORMIS 160	CAMEROZONOSPORITES OHAIENSIS 161	CERATOSPORITES EQUALIS 162	CICATRICOSISPORITES FOVEOAUSTRALIENSIS 163	CYATHIDITES MINOR 164	CYATHIDITES SPLENDENS 165	FALCISPORITES GRANDIS 166	FOVEOGLEICHENIIDITES 167	GAMBIERINA RUDATA 168	GLEICHENIIDITES 169	TRICOLPITES PHILLIPSII 170	TRIPOROLETES RETICULATUS 171	AEQUITRIRADITES SPINULOSUS 172	NOTHOFAGUS SENECTUS 173	CONTIGNISPORITES COOKSONIAE 174	GAMBIERINA EDWARDSII 175	GRAPNELISPORA EVANSII 176	HERKOSPORITES ELLIOTTII 177	PROTEACIDITES HAPUKUI 178	TRICOLPITES CONFESSUS 179	TRICOLPITES LONGUS 180	TRICOLPORITES LILLIEI 181	TRIPOROPOLLENITES SECTILIS 182	COROLLINA TOROSUS 183	CYATHIDITES AUSTRALIS 184	PROTEACIDITES PALISADUS 185	CINGUTRILETES CLAVUS 186	CYCADOPITES FOLLICULARIS 187	GAMBIERINA RUDATA (TWISTED) 188	ORNAMENTIFERA SENTOSA 189	OSMUNDACIDITES WELLMANII 190
0570-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0580-00	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0600-20	CUTTS	1	1	1	1	1	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0620-40	CUTTS	.	1	4	1	.	.	.	X	X	2	1	7	1	6	1	X	5	3	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0720-40	CUTTS	.	1	1	.	.	.	.	1	.	.	.	.	.	.	.	1	.	1	.	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0740-60	CUTTS	.	1	1	.	.	.	.	.	X	2	.	.	.	.	.	4	.	.	.	.	1	1	X	X	X	1	1	1	X	X	.	.	.	.	.	.	.	.
0760-80	CUTTS	.	1	3	.	.	.	1	3	1	1	.	4	.	2	.	1	1	.	.	.	.	.	.	.	.	X	.	X	.	.	1	1	X	.	.	.	.	.
0820-40	CUTTS	.	.	3	.	.	.	.	.	.	3	.	4	.	2	.	2	5	.	.	X	.	.	.	.	2	1	.	1	2	1	1	3	1	1	1	1	1	3
0860-80	CUTTS	.	1	4	.	.	.	.	.	1	1	.	6	.	.	.	1	3	.	.	.	1	.	X	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
0900-20	CUTTS	.	X	2	.	.	.	.	.	1	1	.	5	.	5	.	3	2	.	.	.	1	.	.	.	.	.	X	.	X	.	1	5	2	.	1	.	.	1
0920-40	CUTTS	.	.	7	.	.	.	.	.	.	3	.	3	.	3	.	2	10	.	.	.	3	.	X	.	.	.	.	X	.	1	.	5	.	.	.	.	.	1
0960-80	CUTTS	.	2	8	.	.	.	.	.	2	1	.	7	.	4	.	2	2	.	.	.	3	.	.	.	.	.	.	.	1	.	.	3	.	.	.	.	.	2
1000-20	CUTTS	.	.	.	.	.	.	.	.	1	1	.	6	.	.	.	.	4	.	.	.	3	.	.	.	.	.	1	.	.	.	.	5	.	.	.	.	.	X
1040-60	CUTTS	.	.	.	.	.	.	1	.	2	2	.	8	.	2	.	.	7	.	.	.	1	.	.	.	.	.	1	.	.	.	1	3	.	1	1	.	.	1
1080-00	CUTTS	.	.	.	.	.	.	.	.	.	2	.	7	.	2	.	.	2	.	.	.	5	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	1
1120-40	CUTTS	.	.	.	.	.	.	.	1	1	.	.	5	.	2	.	X	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	1	.	.	2
1140-60	CUTTS	.	.	1	.	.	.	.	X	2	.	.	10	.	1	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	1	2	1	1	2	.	.	2
1160-80	CUTTS	.	.	1	.	.	.	2	.	.	1	.	5	.	1	.	.	2	.	.	.	1	.	.	.	.	.	.	.	.	.	1	1	.	2	1	.	.	1
1220-40	CUTTS	.	.	1	.	.	.	.	.	X	.	.	10	.	4	.	.	3	.	.	.	3	1	.	.	.	.	.	.	.	.	4	2	.	2	2	.	.	5
1280-00	CUTTS	.	.	1	.	.	.	1	.	X	1	.	8	.	4	.	X	3	.	.	.	1	.	.	.	.	.	.	.	.	.	1	1	.	1	1	.	1	4
1340-60	CUTTS	.	.	.	.	.	.	2	.	.	2	.	6	.	6	.	.	2	.	.	.	X	X	.	.	.	.	.	.	.	.	1	2	.	X	.	.	X	4
1380-00	CUTTS	.	.	.	.	.	.	.	.	X	.	.	8	.	2	.	.	1	.	X	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	2	.	.	2
1440-60	CUTTS	.	.	.	.	.	.	X	X	1	2	.	7	.	1	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	1	1	.		
1480-00	CUTTS	.	.	.	.	.	.	.	X	.	2	.	3	.	3	.	.	3	.	2	.	.	.	.	.	.	.	.	.	.	.	1	2	.	1	1	.		
1535-38	CUTTS	.	.	.	.	.	.	.	1	2	1	.	9	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	.	2	.	.	2
1565.5	SWC	.	.	.	.	.	.	.	X	.	1	.	7	.	1	.	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	X	.	.	2
1589.5	SWC	.	.	.	.	.	.	.	5	.	1	.	2	.	4	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
1620.0	SWC	.	.	.	.	.	.	.	5	.	2	.	8	.	6	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	1	.	.	1
1643.5	SWC	.	.	.	.	.	.	.	9	.	2	.	18	.	3	.	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	.	1
1664.0	SWC	.	.	.	.	.	.	.	2	.	5	.	9	.	5	.	.	7	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	1	.	X	1
1701.0	SWC	.	.	.	.	.	.	.	5	.	1	.	10	.	3	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	.	.	.	.	1
1717.75	SWC	.	.	.	.	.	.	.	10	.	1	.	7	.	4	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	6	.	.	1	.	.	2
1728.50	CORE1	.	.	.	.	.	.	1	9	.	1	.	10	.	3	.	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4	.	1	1	.	.	3
1733.60	CORE1	.	.	.	.	.	.	1	10	.	2	.	13	.	2	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	5	.	1	1	.	.	1
1755.0	SWC	.	.	.	.	.	.	.	12	.	.	.	6	.	3	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	.	2	.	.	1
1774.0	SWC	.	.	.	.	.	.	.	6	.	2	.	3	.	5	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	1	.	.	5
1801.5	SWC	.	.	.	.	.	.	.	2	.	.	.	5	.	3	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	1	1	.	.	2
1820.5	SWC	.	.	.	.	.	.	.	11	.	1	.	1	.	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	1
1828.0	SWC	.	.	.	.	.	.	.	8	.	1	.	5	.	4	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	1	.	.	.	5
1839.75	CORE2	.	.	.	.	.	.	.	.	.	1	.	14	.	1	.	.	5	.	.	X	.	.	.	.	.	.	.	.	.	.	3	4	.	1	1	.	.	1
1841.0	CORE2	.	.	.	.	.	.	.	3	.	.	.	7	.	3	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	1	.	.	1
1843.20	CORE2	.	.	.	.	.	.	.	3	.	1	.	7	.	1	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	.	.	.	.	1
1857.3	CORE3	.	.	.	.	.	.	.	5	.	2	.	9	.	1	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	1	2	.	.	2
1860.3	CORE3	.	.	.	.	.	.	.	3	.	3	.	3	.	3	.	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	1	1	.	.	1
1866.05	CORE3	.	.	.	.	.	.	.	4	.	1	.	7	.	3	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	5	.	1	2	.	.	4
1876.5	CORE3	.	.	.	.	.	.	1	4	.	.	.	10	.	3	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	6	.	1	1	.	.	4
1879.0	CORE3	.	.	.	.	.	.	1	3	.	.	.	13	.	5	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	1	.	.	4
1881.0	CORE3	.	.	.	.	.	.	.	4	.	X	.	10	.	2	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	1	4	.	.	1
1900.0	SWC	.	.	.	.	.	.	.	X	.	2	X	14	.	4	.	.	4	.	X	.	.	.	.	.	.	.	.	.	.	.	5	5	.	1	2	.	.	1
1917.35	CORE4	.	.	.	.	.	.	.	6	.	1	.	5	.	4	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	1	2	.	.	4
1926.25	CORE4	.	.	.	.	.	.	.	.	.	1	.	18	.	4	.	.	10	.	.	.	.	.	.	.	.	.	.	.	.	.	1	6	.	1	1	.	.	1
1933.1	CORE4	.	.	.	.	.	.	.	1	.	1	.	8	.	2	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	1	1	.	.	6
1935.50	CORE4	.	.	.	.	.	.	.	.	.	3	.	7	.	4	.	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	1	.	.	.	2
1939.35	CORE4	.	.	.	.	.	.	.	3	.	1	.	5	.	2	.	.	7	.	.	.	.	X	.	.	.	.	.	.	.	.	2	4	.	1	.	.	.	3
1941.65	CORE4	.	.	.	.	.	.	1	.	.	.	.	10	.	1	.	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	1	1	.	.	1
1943.0	CORE5	.	.	.	.	.	.	.	.	.	3	.	19	.	3	.	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.	2	6	.	1	2	.	.	5
1948.0	CORE5	.	.	.	.	.	.	.	.	.	.	.	17	.	3	.	.	9	.	X	.	.	.	.	.	.	.	.	.	.	.	2	3	.	1	1	.	.	2
1953.0	CORE5	.	.	.	.	.	.	.	.	.	.	.	5	.	6	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	1	1	.	.	2
1955.60	CORE5	.	.	.	.	.	.	.	.	.	.	.	13	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	3	.	1	1	.	.	1
1961.25	CORE5	.	.	.	.	.	.	.	.	.	1	.	11	.	2	.	.	6	.	.	.	.	X	.	.	.	.	.	.	.	.	1	4	.	1	1	.	.	2
1968.25	CORE5	.	.	.	.	.	.	.	.	.	2	.	10	.	1	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	1	1	.	.	2
1996.5	SWC	.	.	.	.	.	.	.	.	.	.	X	12	.	3	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	2	4	.	.	.	.	.	1
2012.5	SWC	.	.	.	.	.	.	.	.	.	1	.	14	.	1	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	1	.	.	.
2049.0	SWC	.	.	.	.	.	.	.	.	.	2	.	7	.	2	.	.	5	.	1	.	.	.	.	.	.	.	.	.	.	.	3	1	.	1	2	.	.	1
2066.0	SWC	.	.	.	.	.	.	.	1	.	X	.	12	.	1	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4	.	.	1	.	.	4
2077.0	SWC	.	.	.	.	.	.	.	2	.	1	.	14	.	4	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	X	1	.		2
2105.0	SWC	.	.	.	.	.	.	.	X	.	X	.	X	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.	.	.	X	X	.	.	.	.		.
2119.0	SWC	.	.	.	.	.	.	.	.	.	1	.	18	.	3	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.	.	8
2131.0	SWC	.	.	.	.	.	.	.	.	.	2	.	23	.	3	.	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.	3	6	.	.	1	.	.	3

		PEROTRILETES JUBATUS/MORGANII 191	TRICOLPITES GILLII 192	VITREISPORITES PALLIDUS 193	ISCHYOSPORITES PUNCTATUS 194	TRICOLPORITES APOXYEXINUS 195	CICATRICOSISPORITES AUSTRALIENSIS 196	CICATRICOSISPORITES LUDBROOKIAE 197	TRICOLPITES SABULOSUS 198	KLUKISPORITES SCABERIS 199	PHYLLOCLADIDITES VERRUCOSUS 200	CALLIALASPORITES TURBATUS 201	CRYBELOSPORITES STRIATUS 202	LEPTOLEPIDITES MAJOR 203	PROTEACIDITES LARGE 204	TETRACOLPORITES RETICULATA 205	MUROSPORA FLORIDA 206	AEQUITRIRADITES VERRUCOSUS 207	ORNAMENTIFERA MINIMA 208	CAMEROZONOSPORITES HORRENDUS 209	LYCOPODIACIDITES ASPERATUS 210	COPTOSPORA PILEOSA 211	LEPTOLEPIDITES VERRUCATUS 212	PHIMOPOLLENITES PANNOSUS 213	PILOSISPORITES NOTENSIS 214	RETITRILETES NODOSUS 215	CALLIALASPORITES DAMPIERI 216	TRIPOROLETES SIMPLEX 217	DENSOISPORITES VELATUS 218	PERINOPOLLENITES ELATOIDES 219	PEROTRILETES MAJUS 220	CYCLOSPORITES HUGHESI 221	BALMEISPORITES HOLODICTYUS 222	RETITRILETES CIRCOLUMENUS 223	FORAMINISPORIS DAILYI 224	CYATHEACIDITES TECTIFERA 225	RETITRILETES EMINULUS 226	APPENDICISPORITES DISTOCARINATUS 227	DILWYNITES TUBERCULATUS 228
0570-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0580-00	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0600-20	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0620-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0720-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0740-60	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0760-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0820-40	CUTTS	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0860-80	CUTTS	.	4	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0900-20	CUTTS	.	1	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0920-40	CUTTS	X	.	.	.	1	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0960-80	CUTTS	.	.	.	1	.	1	.	2	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1000-20	CUTTS	.	2	.	.	.	1	X	1	.	.	1	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1040-60	CUTTS	.	.	1	.	.	.	X	1	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1080-00	CUTTS	.	.	3	1	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1120-40	CUTTS	.	.	1	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1140-60	CUTTS	.	.	.	.	.	.	.	2	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1160-80	CUTTS	.	.	1	.	.	1	.	2	.	.	.	.	.	.	.	.	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1220-40	CUTTS	.	.	2	.	.	.	.	1	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1280-00	CUTTS	.	X	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1340-60	CUTTS	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	X	1	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1380-00	CUTTS	.	.	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
1440-60	CUTTS	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1480-00	CUTTS	1	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1535-38	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1565.5	SWC	.	.	X	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.
1589.5	SWC	.	1	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	X	1	X	.	.	.	.	.	.	.	.
1620.0	SWC	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	X	.	.	.	.	.	.	.
1643.5	SWC	.	.	.	.	X	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1664.0	SWC	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	1	X	.	.	.	.	.
1701.0	SWC	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
1717.75	SWC	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.
1728.50	CORE1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
1733.60	CORE1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.
1755.0	SWC	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
1774.0	SWC	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.
1801.5	SWC	.	.	.	X	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1820.5	SWC	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
1828.0	SWC	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	X	.
1839.75	CORE2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	X	1
1841.0	CORE2	.	.	3	1	.	X	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1843.20	CORE2	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	X	.
1857.3	CORE3	.	.	1	.	.	X	.	.	.	.	2	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.
1860.3	CORE3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1866.05	CORE3	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1876.5	CORE3	X	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1879.0	CORE3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	1	.
1881.0	CORE3	.	.	1	.	.	X	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
1900.0	SWC	.	.	2	.	.	X	.	.	.	.	.	.	X	.	.	.	.	.	.	1	.	1	.	.	.	1	.	.	1	.	.	X	.	.	.	.	X	.
1917.35	CORE4	1	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.
1926.25	CORE4	1	.	1	1	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.
1933.1	CORE4	X	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1935.50	CORE4	.	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	X	.	.	.	.
1939.35	CORE4	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.
1941.65	CORE4	.	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1943.0	CORE5	.	.	.	1	.	1	.	.	.	.	.	.	X	.	.	X	X	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.
1948.0	CORE5	.	.	.	1	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	X	.
1953.0	CORE5	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	X	.
1955.60	CORE5	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1961.25	CORE5	.	.	.	1	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	X	.	X	.	.	X	.
1968.25	CORE5	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1996.5	SWC	1	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	X	.	.	.	1	X	.
2012.5	SWC	.	.	X	X	.	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	1	.
2049.0	SWC	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	1	.
2066.0	SWC	.	.	.	1	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.
2077.0	SWC	1	.	.	X	.	1	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	X	.
2105.0	SWC	.	.	.	X	.	X	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.
2119.0	SWC	1	.	.	.	.	.	.	.	.	.	5	.	2	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
2131.0	SWC	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.

		TRICOLPITES VARIVERRUCATUS 229	LAEVIGATOSPORITES SPP 230	FORAMINISPORIS WONTHAGGIENSIS 231	SESTROSPORITES PSEUDOALVEOLATUS 232	APPENDICISPORITES TRICORNITATUS 233	CAMEROZONOSPORITES SOLIDA 234	RETITRILETES FACETUS 235	PHYLLOCLADIDITES EUNUCHUS 236	COPTOSPORA PARADOXA 237	KUYLISPORITES ZIPPERI 238	SENECTOTETRADITES FISTULOSUS 239	DICTYOPHYLLIDITES 240	HOEGISPORIS 241	TRIPOROLETES RADIATUS 242	PHYLLOCLADIDITES CF MAWSONII 243	DICTYOTOSPORITES SPECIOSUS 244	FORAMINISPORIS ASYMMETRICUS 245	STERIESPORITES REGIUM 246		
0570-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0570-80	CUTTS
0580-00	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0580-00	CUTTS
0600-20	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0600-20	CUTTS
0620-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0620-40	CUTTS
0720-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0720-40	CUTTS
0740-60	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0740-60	CUTTS
0760-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0760-80	CUTTS
0820-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0820-40	CUTTS
0860-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0860-80	CUTTS
0900-20	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0900-20	CUTTS
0920-40	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0920-40	CUTTS
0960-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0960-80	CUTTS
1000-20	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1000-20	CUTTS
1040-60	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1040-60	CUTTS
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1140-60	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1140-60	CUTTS
1160-80	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1160-80	CUTTS
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1480-00	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1480-00	CUTTS
1535-38	CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1535-38	CUTTS
1565.5	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1565.5	SWC
1589.5	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1589.5	SWC
1620.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1620.0	SWC
1643.5	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1643.5	SWC
1664.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1664.0	SWC
1701.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1701.0	SWC
1717.75	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1717.75	SWC
1728.50	CORE1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1728.50	CORE1
1733.60	CORE1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1733.60	CORE1
1755.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1755.0	SWC
1774.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1774.0	SWC
1801.5	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1801.5	SWC
1820.5	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1820.5	SWC
1828.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1828.0	SWC
1839.75	CORE2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1839.75	CORE2
1841.0	CORE2	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1841.0	CORE2
1843.20	CORE2	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1843.20	CORE2
1857.3	CORE3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1857.3	CORE3
1860.3	CORE3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1860.3	CORE3
1866.05	CORE3	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1866.05	CORE3
1876.5	CORE3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1876.5	CORE3
1879.0	CORE3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1879.0	CORE3
1881.0	CORE3	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1881.0	CORE3
1900.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1900.0	SWC
1917.35	CORE4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1917.35	CORE4
1926.25	CORE4	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	1926.25	CORE4
1933.1	CORE4	.	.	.	.	.	1	X	.	.	.	.	.	.	.	.	.	.	.	1933.1	CORE4
1935.50	CORE4	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1935.50	CORE4
1939.35	CORE4	.	.	1	.	.	.	.	.	?	.	.	.	.	.	.	.	.	.	1939.35	CORE4
1941.65	CORE4	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1941.65	CORE4
1943.0	CORE5	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	1943.0	CORE5
1948.0	CORE5	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	1948.0	CORE5
1953.0	CORE5	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1953.0	CORE5
1955.60	CORE5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1955.60	CORE5
1961.25	CORE5	.	.	.	.	.	X	.	.	.	.	1	.	.	.	.	.	.	.	1961.25	CORE5
1968.25	CORE5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1968.25	CORE5
1996.5	SWC	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1996.5	SWC
2012.5	SWC	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	2012.5	SWC
2049.0	SWC	.	.	.	.	1	.	.	X	.	.	.	2	1	1	.	.	.	.	2049.0	SWC
2066.0	SWC	.	.	.	.	.	.	.	X	.	.	.	.	.	.	X	.	.	.	2066.0	SWC
2077.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2077.0	SWC
2105.0	SWC	.	.	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	2105.0	SWC
2119.0	SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2119.0	SWC
2131.0	SWC	.	.	.	.	.	.	.	X	.	X	.	.	.	.	.	X	1	X	2131.0	SWC

Index numbers are the columns in which species appear.

INDEX NUMBER	SPECIES
172	AEQUITRIRADITES SPINULOSUS
207	AEQUITRIRADITES VERRUCOSUS
24	ALISOCYSTA CIRCUMTABULATA
30	ALISOCYSTA MARGARITA
100	ALTERBIA ACUMINATUM
160	AMOSOPOLLIS CRUCIFORMIS
86	AMPHIDIADEMA DENTICULATA
12	APECTODINIUM HOMOMORPHA (SH. SP)
227	APPENDICISPORITES DISTOCARINATUS
233	APPENDICISPORITES TRICORNITATUS
40	APTEA SP
96	APTEODINIUM GRANULATUM
111	ARAUCARIACITES AUSTRALIS
13	AREOLIGERA SENONENSIS
63	AREOSPHAERIDIUM SUGGESTIUM
151	AUSTRALOPOLLIS OBSCURUS
222	BALMEISPORITES HOLODICTYUS
5	BOTRYOCOCCUS
74	BOURKIDINIUM GRANULATUM
69	CALLAOISPHAERIDIUM ASYMMETRICUM
216	CALLIALASPORITES DAMPIERI
201	CALLIALASPORITES TURBATUS
152	CAMEROZONOSPORITES BULLATUS
209	CAMEROZONOSPORITES HORRENDUS
161	CAMEROZONOSPORITES OHAIENSIS
234	CAMEROZONOSPORITES SOLIDA
109	CANNINGIA SPINY
37	CANNINGINOPSIS BRETONICA
79	CASSICULOSPHAERIDIA RETICMAGNA
162	CERATOSPORITES EQUALIS
107	CHATANGIELLA MICROCANTHA
41	CHATANGIELLA TRIPARTITA
70	CHATANGIELLA VICTORIENSIS
101	CHLAMYDOPHORELLA NYEI/AMBIGUA
196	CICATRICOSISPORITES AUSTRALIENSIS
163	CICATRICOSISPORITES FOVEOAUSTRALIENSIS
197	CICATRICOSISPORITES LUDBROOKIAE
186	CINGUTRILETES CLAVUS
83	CIRCULODINIUM DEFLANDREI
95	CIRCULODINIUM SOLIDA
112	CLAVIFERA TRIPLEX
110	CLEISTOSPHAERIDIUM
93	CONOSPHAERIDIUM STRIATOCONUS
104	CONOSPHAERIDIUM TUBULOSUM
174	CONTIGNISPORITES COOKSONIAE
237	COPTOSPORA PARADOXA
211	COPTOSPORA PILEOSA
25	CORDOSPHAERIDIUM INODES
183	COROLLINA TOROSUS
102	CRIBROPERIDINIUM EDWARDSII
35	CRIBROPERIDINIUM SP
202	CRYBELOSPORITES STRIATUS
145	CUPANIEIDITES ORTHOTEICHUS
225	CYATHEACIDITES TECTIFERA
184	CYATHIDITES AUSTRALIS
113	CYATHIDITES GIGANTIS
164	CYATHIDITES MINOR
165	CYATHIDITES SPLENDENS
114	CYATHIDITES SPP
187	CYCADOPITES FOLLICULARIS
106	CYCLONEPHELIUM COMPACTUM
221	CYCLOSPORITES HUGHESI
97	CYMOSOSPHAERIDIUM MAGNIFICA
98	DAPSILIDINIUM SP
9	DEFLANDREA MEDCALFII
14	DEFLANDREA OBLIQUIPES (L.H.)
26	DEFLANDREA PACHYCEROS (SH. H)
15	DEFLANDREA SPECIOSUS
27	DEFLANDREA STRIATA
218	DENSOISPORITES VELATUS
240	DICTYOPHYLLIDITES
244	DICTYOTOSPORITES SPECIOSUS
115	DILWYNITES GRANULATUS
228	DILWYNITES TUBERCULATUS
80	DINOGYMNIUM ACUMINATUM
38	EISENACKIA CRASSITABULATA
116	ERICIPITES SCABRATUS
55	EUCLADINIUM MADURENSE
31	EXOCHOSPHAERIDIUM PHRAGMITES

31	EXOCHOSPHAERIDIUM PHRAGMITES
166	FALCISPORITES GRANDIS
117	FALCISPORITES SIMILIS
99	FLORENTINIA DEANEI
245	FORAMINISPORIS ASYMMETRICUS
224	FORAMINISPORIS DAILYI
231	FORAMINISPORIS WONTHAGGIENSIS
167	FOVEOGLEICHENIDITES
118	FOVEOTRILETES CRATER
175	GAMBIERINA EDWARDSII
168	GAMBIERINA RUDATA
188	GAMBIERINA RUDATA (TWISTED)
119	GEPHRAPOLLENITES WAHOOENSIS
59	GILLINIA HYMENOPHORA
20	GLAPHYROCYSTA RETIINTEXTA
169	GLEICHENIIDITES
146	GLEICHENIIDITES CIRCINIDITES
176	GRAPNELISPORA EVANSII
21	HAFNIASPHAERA SEPTATA
22	HAFNIASPHAERA SP
120	HALORAGACIDITES HARRISII
177	HERKOSPORITES ELLIOTTII
58	HETEROSPHAERIDIUM CF LATEROBRACHIUS
32	HETEROSPHAERIDIUM CONJUNCTUM
42	HETEROSPHAERIDIUM HETEROCANTHUM
241	HOEGISPORIS
19	HOMOTRIBLIUM TASMANIENSE
75	HYSTRICHODINIUM PULCHRUM
16	HYSTRICHOSPHAERIDIUM TUBIFERUM
153	INTRATRIPOROPOLLENITES NOTABILIS
91	ISABELIDINIUM BALMEI
76	ISABELIDINIUM BELFASTENSE
71	ISABELIDINIUM BELFASTENSE ROTUNDATA
84	ISABELIDINIUM CF BELFASTENSE
85	ISABELIDINIUM COOKSONIAE
60	ISABELIDINIUM CRETACEUM
105	ISABELIDINIUM GLABRUM
39	ISABELIDINIUM KOROJONENSE
36	ISABELIDINIUM PELLUCIDA
87	ISABELIDINIUM RECTANGULARE CONTRACTUM
89	ISABELIDINIUM RECTANGULARE DIVERSUM
90	ISABELIDINIUM RECTANGULARIS
108	ISABELIDINIUM SP
194	ISCHYOSPORITES PUNCTATUS
33	KIOKANSIUM POLYPES
199	KLUKISPORITES SCABERIS
238	KUYLISPORITES ZIPPERI
121	LAEVIGATOSPORITES OVATUS
230	LAEVIGATOSPORITES SPP
122	LAEVIGATOSPORITES USMENSIS
203	LEPTOLEPIDITES MAJOR
212	LEPTOLEPIDITES VERRUCATUS
210	LYCOPODIACIDITES ASPERATUS
154	LYGISTIPOLLENITES BALMEI
123	LYGISTIPOLLENITES FLORINII
56	MADURADINIUM PENTAGONUM
124	MALVACIPOLLIS DIVERSUS
125	MALVACIPOLLIS SUBTILIS
28	MANUMIELLA CORONATA
29	MANUMIELLA DRUGGII
17	MICRHYSTRIDIUM SP
126	MICROCACHRYIDITES ANTARCTICUS
1	MICROPLANKTON % ....
206	MUROSPORA FLORIDA
127	MYRTACEIDITES PARVUS/MESONESUS
47	NELSONIELLA ACERAS
64	NELSONIELLA CF ACERAS (PSILATE)
48	NELSONIELLA SEMIRECTICULATA
49	NELSONIELLA SP
53	NELSONIELLA TUBERCULATA
128	NOTHOFAGUS BRACHYSPINULOSUS
129	NOTHOFAGUS EMARCIDUS/HETERUS
155	NOTHOFAGUS ENDURUS
130	NOTHOFAGUS FLEMINGII
173	NOTHOFAGUS SENECTUS
7	NUMMUS
8	NUMMUS MONOCULATUS
81	ODONTOCHITINA COSTATA
65	ODONTOCHITINA CRIBROPODA
77	ODONTOCHITINA NO HORNS
66	ODONTOCHITINA OBESA
57	ODONTOCHITINA OPERCULATA
50	ODONTOCHITINA PORIFERA
51	ODONTOCHITINA STUBBY

51	ODONTOCHITINA STUBBY
78	OLIGOSPHAERIDIUM COMPLEX
43	OLIGOSPHAERIDIUM PULCHERRIMUM
208	ORNAMENTIFERA MINIMA
189	ORNAMENTIFERA SENTOSA
190	OSMUNDACIDITES WELLMANII
54	PALAEOHYSTRICHOSPHORA INFUSORIOIDES
103	PALAEOPERIDINIUM CRETACEUM
6	PARALECANIELLA INDENTATA
219	PERINOPOLLENITES ELATOIDES
131	PERIPOROPOLLENITES POLYORATUS
132	PERIPOROPOLLENITES VESICUS
191	PEROTRILETES JUBATUS/MORGANII
220	PEROTRILETES MAJUS
213	PHIMOPOLLENITES PANNOSUS
243	PHYLLOCLADIDITES CF MAWSONII
236	PHYLLOCLADIDITES EUNUCHUS
133	PHYLLOCLADIDITES MAWSONII
200	PHYLLOCLADIDITES VERRUCOSUS
214	PILOSISPORITES NOTENSIS
134	PODOSPORITES MICROSACCATUS
135	PROTEACIDITES
156	PROTEACIDITES ANNULARIS
147	PROTEACIDITES CLARUS
136	PROTEACIDITES GRANDIS
178	PROTEACIDITES HAPUKUI
137	PROTEACIDITES INCURVATUS
138	PROTEACIDITES KOPIENSIS
204	PROTEACIDITES LARGE
148	PROTEACIDITES LEIGHTONII
157	PROTEACIDITES ORNATUS
185	PROTEACIDITES PALISADUS
149	PROTEACIDITES SCABORATUS
61	PTEROSPERMELLA AUREOLATA
67	PTEROSPERMELLA AUSTRALIENSIS
150	RETITRILETES AUSTROCLAVATIDITES
223	RETITRILETES CIRCOLUMENUS
226	RETITRILETES EMINULUS
235	RETITRILETES FACETUS
215	RETITRILETES NODOSUS
3	REWORKING: CRETACEOUS
2	REWORKING: PERMIAN
4	REWORKING: TRIASSIC
239	SENECTOTETRADITES FISTULOSUS
232	SESTROSPORITES PSEUDOALVEOLATUS
10	SPINIDINIUM SP
11	SPINIFERITES FURCATUS/RAMOSUS
158	SPINIZONOCOLPITES PROMINATUS
139	STEREISPORITES ANTIQUISPORITES
140	STEREISPORITES PUNCTATUS
246	STERIESPORITES REGIUM
82	SUBTILISPHAERA ROTUNDATA
92	TANYOSPHAERIDIUM SALPINX
205	TETRACOLPORITES RETICULATA
52	TRICHODINIUM
44	TRICHODINIUM INTERMEDIUM
159	TRICOLPITES
179	TRICOLPITES CONFESSUS
192	TRICOLPITES GILLII
180	TRICOLPITES LONGUS
170	TRICOLPITES PHILLIPSII
198	TRICOLPITES SABULOSUS
229	TRICOLPITES VARIVERRUCATUS
141	TRICOLPORITES
195	TRICOLPORITES APOXYEXINUS
181	TRICOLPORITES LILLIEI
142	TRILETES TUBERCULIFORMIS
242	TRIPOROLETES RADIATUS
171	TRIPOROLETES RETICULATUS
217	TRIPOROLETES SIMPLEX
143	TRIPOROPOLLENITES AMBIGUUS
182	TRIPOROPOLLENITES SECTILIS
72	TRITHYRODINIUM (THICK RETIC)
23	TRITHYRODINIUM EVITTII
73	TRITHYRODINIUM GLABRA (THICK SMOOTH)
62	TRITHYRODINIUM MARSHALLII
88	TRITHYRODINIUM SUSPECTUM
144	VERRUCOSISPORITES KOPUKUENSIS
34	VERYHACHIUM
193	VITREISPORITES PALLIDUS
18	WETZELIELLA ARTICULATA
45	XENASCUS AUSTRALIENSE
94	XENASCUS CERATOIDES
46	XENIKOON AUSTRALIS
68	XIPHOPHORIDIUM ALATUM

2

BHP Petroleum

GEOCHEMICAL EVALUATION OF MINERVA-2/2A

OTWAY BASIN

OFFSHORE VICTORIA AUSTRALIA

PREPARED BY: J. Preston
Senior Geochemist

0792.rep

DATE: June, 1994

BHP PETROLEUM PTY. LTD.
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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Following completion of the Minerva-2/2A well, an analytical programme was undertaken to evaluate the geochemical character of fluids recovered from the drilled sequence.

Five core fragments were solvent-extracted for contained hydrocarbons. One extract was then analysed by whole-extract GC, separated and analysed by the saturate fraction GC, SIR GC-MS (branched/cyclics) and SIR GC-MS (aromatics) techniques.

This report provides a compilation of the petroleum geochemistry data obtained from the Minerva-2/2A well, together with an interpretation of these data.

2 FLUIDS CHARACTERISATION

2.1 Whole-Extract GC Analysis

Five core-chip samples were solvent-extracted for their contained hydrocarbons. The resulting extract yields are listed in Table 1, and shown in Figure 1. Four of the yields were less than 500ppm; the fifth sample, a coal, yielded over 7000ppm.

Two of the extracts, from 1860.3m (7159ppm) and 1963.7m (472ppm), were analysed by the whole-extract GC method. The whole-extract GC traces are shown in Figure 2. No n-alkane abundances were reported for the 1963.7m extract, which was considered not to represent true hydrocarbons, and which was not therefore recommended for further analysis.

2.2 Saturate Fraction GC Analysis

The 1860.3m extract, after separation into its constituent fractions by liquid chromatography, was found to consist of 26% saturates, 38% aromatics and 36% NSOs, typical of a coal.

The saturate fraction of the 1860.3m extract was analysed by the saturate fraction GC method. The resulting saturate GC trace is shown in Figure 3; the n-alkane distribution data are reported in Table 2, normalised in Figure 4. The n-alkane compositional data for the extract are listed in Table 3 and partly summarised in Figure 5. Note that the value of Pr/Ph (4.59) and the ratio of Pr/nC_{17} to Ph/nC_{18} (4.71) in the 1860.3m extract are typical of hydrocarbons generated from terrestrial (non-marine) sediments deposited in an oxic environment and containing higher land plant-derived organic matter.

2.3 SIR GC-MS (Branched/Cyclics) Analysis

The branched and cyclic compounds were isolated from the saturate fraction of the 1860.3m extract and analysed by the SIR GC-MS (B/C) technique. Selected m/z 191 (triterpane) and m/z 217 (sterane) biomarker distributions are given in Figure 6; full suites of mass fragmentograms are provided in Volume 1 of the Minerva-2/2A well completion report (Basic Data).

Detailed compound abundances and calculated parameters are listed in Tables 4-1 and 4-2; normalised compound abundances and values for calculated parameters for the m/z 191 ions (terpanes) are summarised in Figure 7 and for the m/z 217 ions (steranes) in Figure 8.

2.3.1 Terpane Parameters

The relative abundance of C_{27} triterpanes, 18α(H)-hopane (Ts) and 17α(H)-hopane (Tm), is theoretically useful for the maturity assessment of medium to high maturity oils. With increasing maturity, more of the maturable C_{27} triterpane (Tm) is converted to the stable C_{27} triterpane (Ts). The relative amounts of Ts and Tm in the condensate and water-extract show a predominance of maturable (Tm) over stable (Ts) (Ts/Ts+Tm = 7%), suggesting that they are thermally immature. Note that the Ts/Ts+Tm parameter is lithofacies-dependent, and should be used with some caution as an absolute indicator of thermal maturity (it is best used as a maturity indicator of oils from a common source of consistent organic facies).

Moretanes are diastereomers of the hopanes, and, being less stable than the latter, are destroyed more rapidly with increasing maturity. The moretane/hopane ratio decreases from about 0.80 in immature bitumens to values of 0.15-0.05 in mature source rocks and oils. The relative abundances of the C_{29} and C_{30} moretanes and hopanes in the 1860.3m extract reveal a predominance of hopanes (moretane/hopane = 0.35), implying that they are immature. (Note that, like Ts/Ts+Tm, the moretane/hopane parameter is to some extent lithofacies-dependent, its value, for example, being higher in Tertiary source rocks.)

The C_{31}22S-hopane/C_{31}22R-hopane ratio can be used to assess thermal maturity. As maturity increases, the proportion of the 22S isomer increases at the expense of the biologically produced 22R isomer, until equilibrium is reached, at which point the 22S isomer accounts for about 60% of the mixture. This is achieved soon after the onset of oil generation (at about 0.60% VR, before significant oil generation has occurred), limiting the use of this parameter at higher levels of maturity. In the 1860.3m extract, the 22S isomer accounts for 0.59% of the mixture, implying that isomeric equilibrium has been reached, and that the source rock was thermally matured at least to the point of initial oil-generation. Note that the 22S isomer of the C_{32} hopanes forms 53% of the isomeric mixture, contradicting the C_{31} hopane data, and indicating thermal immaturity to marginal maturity (concurring with the Ts/Ts+Tm and moretane/hopane parameters).

C_{28}28, 30-bisnorhopane is reported in the 1860.3m extract. This compound is considered to be derived from original (post-diagenetic) free bitumen (S_o) in thermally immature sediments, and its presence in the 1860.3m extract supports the view that the extract is indigenous to the coal, and does not represent a thermally mature, migrated fluid.

2.3.2 Sterane Parameters

The relative proportion of the geological 20S and biological 20R isomers of the C_{28} and $C_{29}\alpha\alpha\alpha$ (normal) steranes, expressed as the 20S/20S+20R ratios, is perhaps the most reliable biomarker maturity parameter (it is not greatly influenced by lithofacies variations). Equilibrium, when the 20S isomer forms about 52-55% of the mixture, is reached at, or around, 0.80% vitrinite reflectance. In the Minerva-2/2A 1860.3m extract, the 20S isomer forms 23% of the C_{29} mixture, suggesting generation at less than 0.60% vitrinite reflectance.

The relative proportions of C_{29} normal ($\alpha\alpha\alpha$) and iso-($\beta\beta\alpha$) steranes can be effective in assessing the thermal maturity of source rocks and oils. The normal ($\alpha\alpha\alpha$) steranes, produced biologically, become less dominant relative to the iso-steranes ($\beta\beta\alpha$) with increasing maturity, until equilibrium is reached at a value of $\beta\beta\alpha/(\beta\beta\alpha+\alpha\alpha\alpha)$ of about 67-71% (VR=0.90%). In the Minerva-2/2A 1860.3m extract, the normal steranes dominate the iso-steranes ($\beta\beta\alpha/\alpha\alpha\alpha+\beta\beta\alpha$ = 36%), suggesting that the source rock was immature at the time the extract was generated.

Diasterane/sterane ratios are affected by both thermal maturity and inorganic (lithological) characteristics of the source rock. Conversion of steranes to diasteranes is catalysed by clay minerals, so that diasterane/sterane ratios are typically low (less than 0.30) in carbonate source rocks and derived oils. A high-Eh (oxidising) depositional environment and increasing thermal maturity can each result in a high diasterane/sterane ratio. C_{29} diasteranes dominate the C_{29} normal/iso-sterane mixture in the Minerva-2/2A 1860.3m extract, implying that these hydrocarbons were expelled from non-carbonate source rocks. It is difficult to estimate the absolute level of thermal maturity at which the extract was generated (the proportion of diasteranes being partly dependent on lithofacies), but it seems likely, based on other biomarker parameters, that the source sediment was immature.

Figure 9 shows a triangular plot of C_{27}, C_{28} and C_{29} normal steranes. Note that S isomers of the normal steranes were not reported for the extract; Figure 9 is constructed accordingly (R isomers only), and appears to show a predominance of C_{28}R normal steranes rather than C_{29}R or C_{27}R.

Figure 10 shows a crossplot of Pr/Ph ratio versus $C_{29}R/C_{27}R$ for the 1860.3m extract, suggesting a relatively oxic, non-marine environment for deposition of the source sediments, based on the dominance of the C_{29}R steranes (and diasteranes) relative to C_{27}. By contrast, the triterpane/sterane ratio, as expressed by Ratio C, is low in the 1860.3m extract (0.65), suggesting generation from source sediments deposited in a relatively oxic, aquatic environment.

2.4 SIR GC-MS (Aromatics) Analysis

The aromatics fraction from the 1860.3m extract was analysed by the SIR GC-MS technique. Full suites of mass fragmentograms were provided in Volume 1 of the WCR (Basic Data). Detailed compound abundances, and parameters calculated from them, are listed in Table 5.

The primary application of these data is for maturity assessment. Perhaps the most widely used parameter is the Methylphenanthrene Index (MPI-1), due to its better calibration against the vitrinite reflectance scale, equivalent values of which can be calculated (Radke et al, 1982). Figure 11 shows a plot of MPI-derived vitrinite reflectance versus depth for the 1860.3m extract, which gave a value of R_c(a) of 0.64%, appropriate to the entrance to the oil-generative window.

The relative abundances of certain aromatic compounds can be applied to source input assessment, particularly the degraded diterpanes, such as 1,2,5-TMN, 1,7-DMP, 1-MP and retene, which are thought to be derived from resin precursors in conifers (such as Araucariaceae, Cupressaceae and Podocarpaceae in the Jurassic to Lower Cretaceous of Australia). Source sediments which pre-date the appearance of such conifers in the Late Triassic will display different distributions of degraded aromatic compounds, so that the data provide a useful correlation tool. Figure 12 shows crossplots of ratios involving these compounds which can be used for the purposes of comparison with data from nearby wells.

2.5 Gas Analysis

One gas sample, recovered by RFT from 1875.0m in Minerva-2/2A, was analysed by Petrolab, Adelaide for its chemical composition.

2.5.1 Chemical Composition

The chemical composition of the RFT gas is summarised in Table 6 and normalised in Figure 13. The gas contains 94% methane, 2.2% ethane and 1.6% carbon-dioxide, revealing a composition very similar to the RFT gas recovered from 1931.0m in Minerva-1.

3 CONCLUSIONS

Five core-chips from the 1732.8-1963.7m interval in Minerva-2/2A were solvent-extracted in an attempt to identify any residual hydrocarbons within the gas column. Four of the extracts amounted to less than 500ppm, too low to represent genuine hydrocarbon saturations, even residual; the fifth sample, a coal from 1860.3m, yielded over 7000ppm.

The extract from 1963.7m (472ppm) was analysed by whole-extract GC, but did not reveal the presence of true hydrocarbons.

The extract from the 1860.3m coal was subjected to whole-extract GC, liquid chromatography, saturates-GC, SIR GC-MS (branched/cyclics) and SIR GC-MS (aromatics) analysis. Saturate-fraction GC data from the extract suggest that it was generated from higher land-plant-derived organic matter within source sediments deposited under strongly oxic conditions, consistent with its origin in a coal. Biomarker data, from SIR GC-MS analysis of the saturates and aromatics fractions, support this. Isomeric equilibria were not exceeded in the case of those biomarker indicators appropriate to lower levels of thermal maturity, indicating thermal immaturity. A value of $R_c(a) = 0.64\%$ was calculated from MPI-1. These GC-MS data, in particular the presence of C_{28} bisnorhopanes in the extract, point to it being indigenous to the 1860.3m coal.

None of the five extracts, therefore, is considered to represent thermally mature, migrated hydrocarbons.

REFERENCES

PETERS, K.E., and MOLDOWAN, J.M., 1993, "**The Biomarker Guide**" (Prentice Hall, 363pp).

RADKE, M., WELTE, D.H., and WILLSCH, H., 1982, "**Geochemical Study on a Well in the Western Canada Basin: Relation of the Aromatic Distribution Pattern to Maturity of Organic Matter**" Geoch. Cosomochim. Acta, 46, 1-10.

TABLE 1

SUMMARY OF EXTRACTION AND LIQUID CHROMATOGRAPHY - SEDIMENTS

WELL NAME = MINERVA-2A
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB =

DEPTH 1	DEPTH 2	WEIGHT OF ROCK EXTD (grams)	TOTAL EXTRACT (ppm)	LOSS ON COLUMN (ppm)	% REC.	SATURATES (ppm)	AROMATICS (ppm)	POLARS (ppm)	SATURATES (rel %)	AROMATICS (rel %)	POLARS (rel %)	EOM(mg)/ TOC(g)	SAT(mg)/ TOC(g)	SAT/ AROM	HC/ non-HC
1732.80	1732.80	60.90	208.6	-	-	-	-	-	-	-	-	-	-	-	-
1860.30	1860.30	33.90	7158.9	1432.2	80.0	1502.7	2179.6	2044.4	26.2	38.1	35.7	-	-	.69	1.80
1928.20	1928.20	44.60	354.5	-	-	-	-	-	-	-	-	-	-	-	-
1956.20	1956.20	53.60	278.2	-	-	-	-	-	-	-	-	-	-	-	-
1963.70	1963.70	25.40	471.7	-	-	-	-	-	-	-	-	-	-	-	-

EOM = Extractable organic matter
AROM = Aromatic compounds
POLARS = Polar (Asphaltenes + resins)
HC = Hydrocarbon
TOC = Total organic carbon
REC. = Recovered
SAT = Saturated compounds
\- = no data

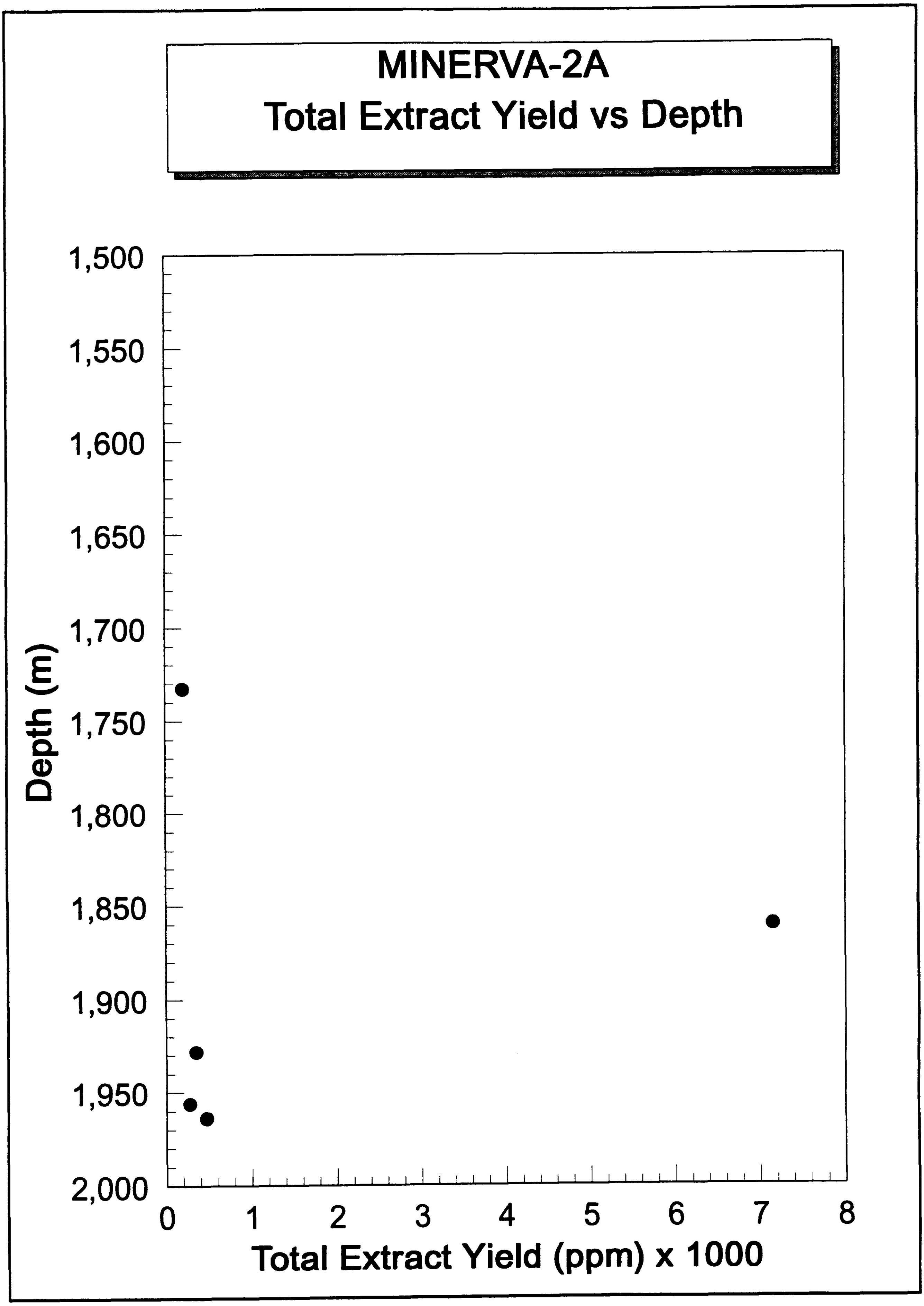
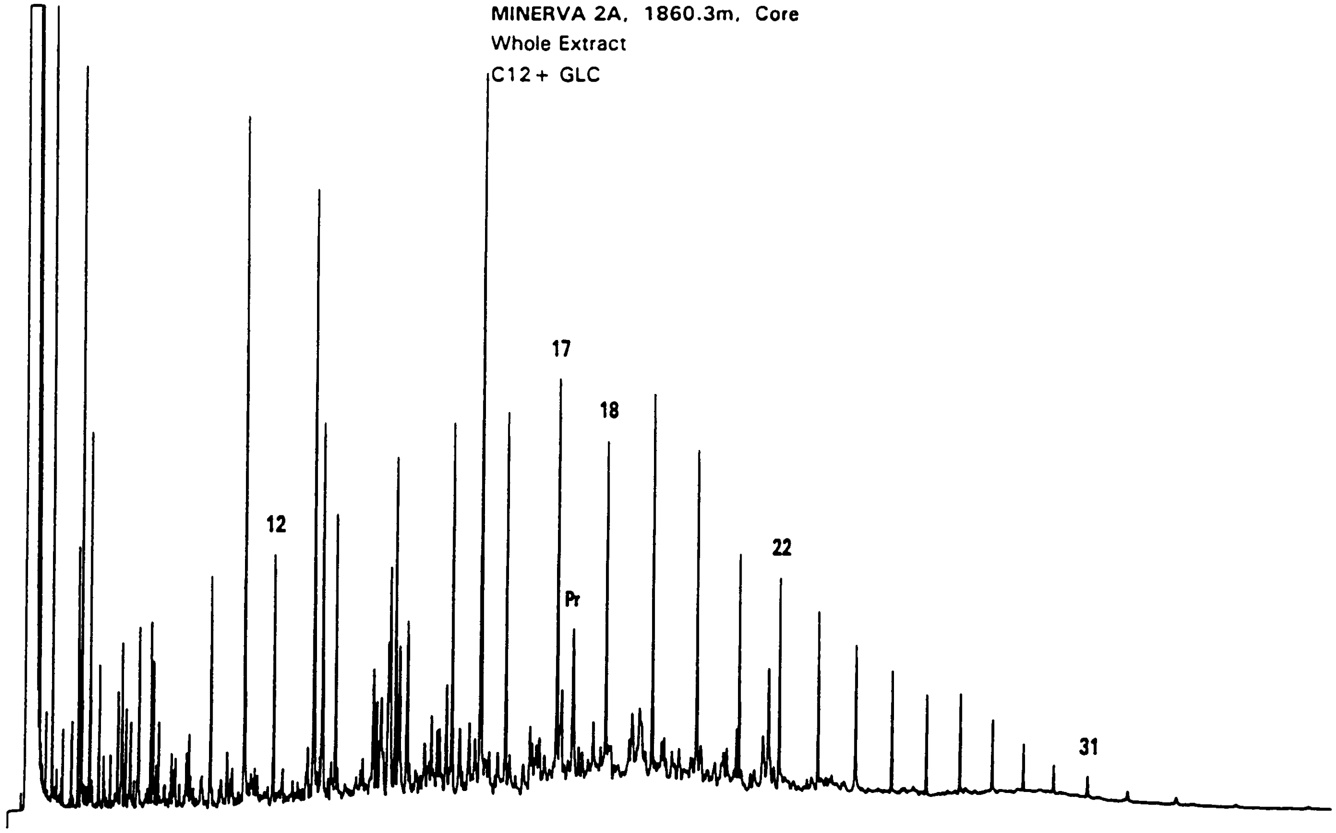

MINERVA-2A
Total Extract Yield vs Depth
Depth (m)
1,500
1,550
1,600
1,650
1,700
1,750
1,800
1,850
1,900
1,950
2,000
0
1
2
3
4
5
6
7
8
Total Extract Yield (ppm) x 1000

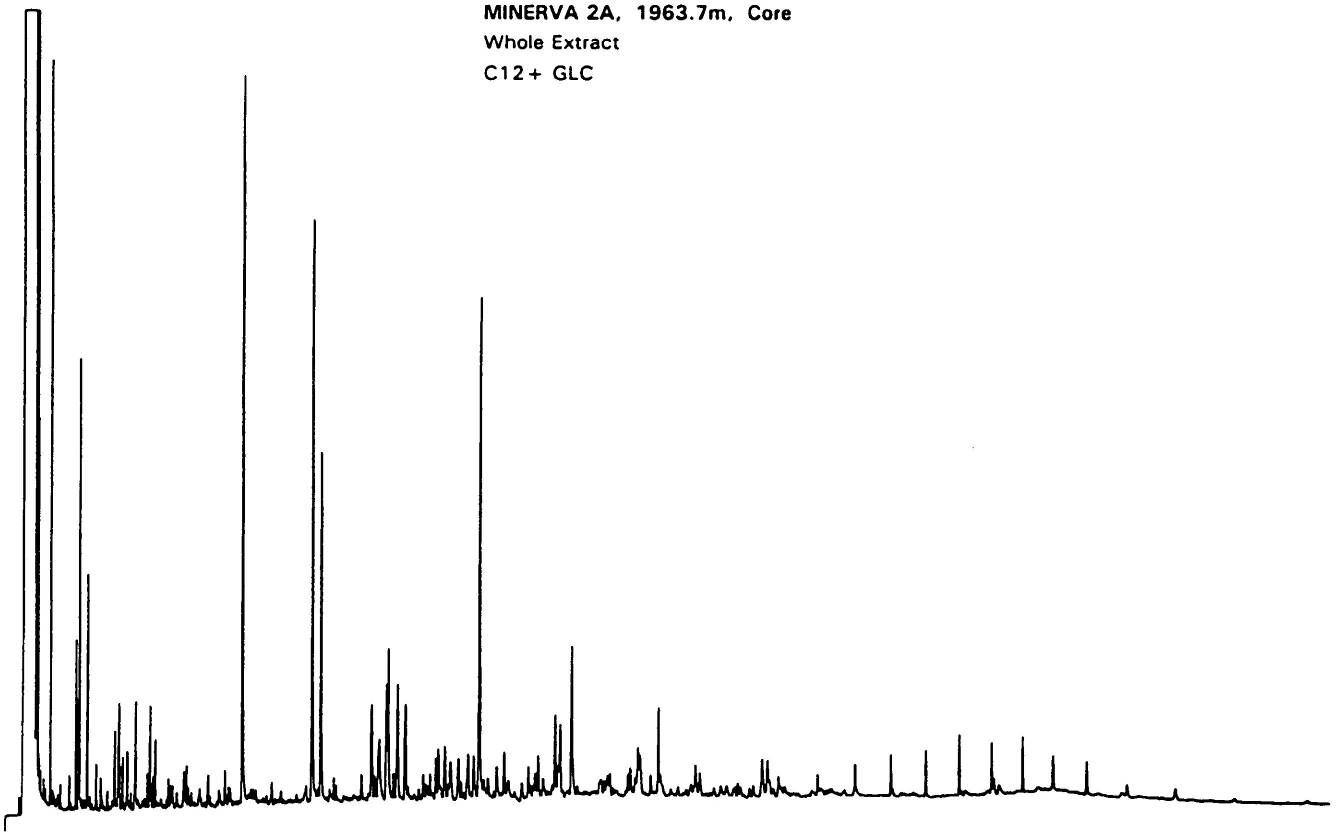
FIGURE 1

FIGURE 2



MINERVA 2A, 1860.3m, Core
Whole Extract
C12+ GLC

GEOTECHNICAL SERVICES PTY LTD



MINERVA 2A, 1963.7m, Core
Whole Extract
C12+ GLC

GEOTECHNICAL SERVICES PTY LTD

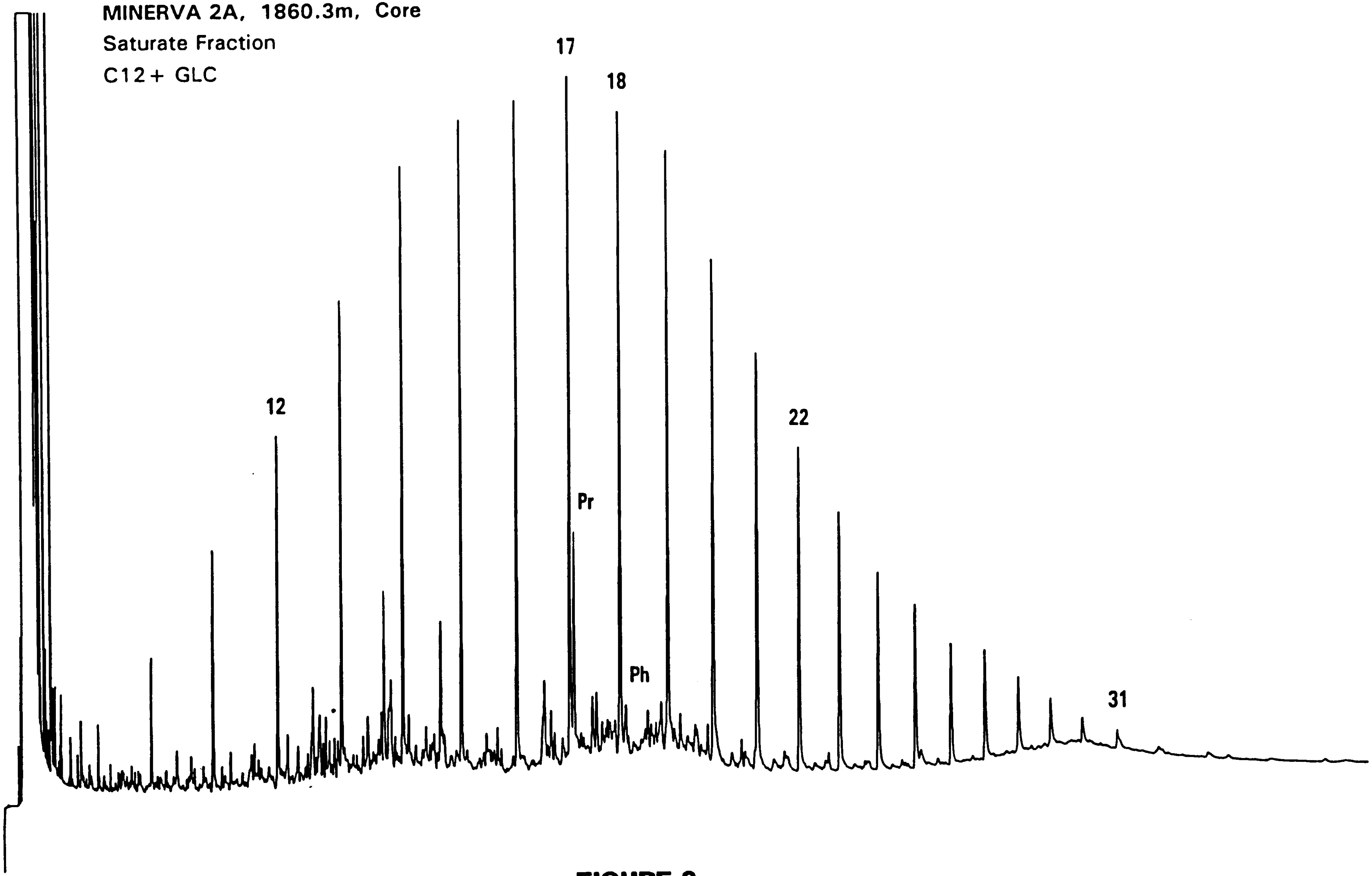


FIGURE 3

GEOTECHNICAL SERVICES PTY LTD

MINERVA-2A: Extract 1860.3m
GC(Sats) Normalised Relative Abundance

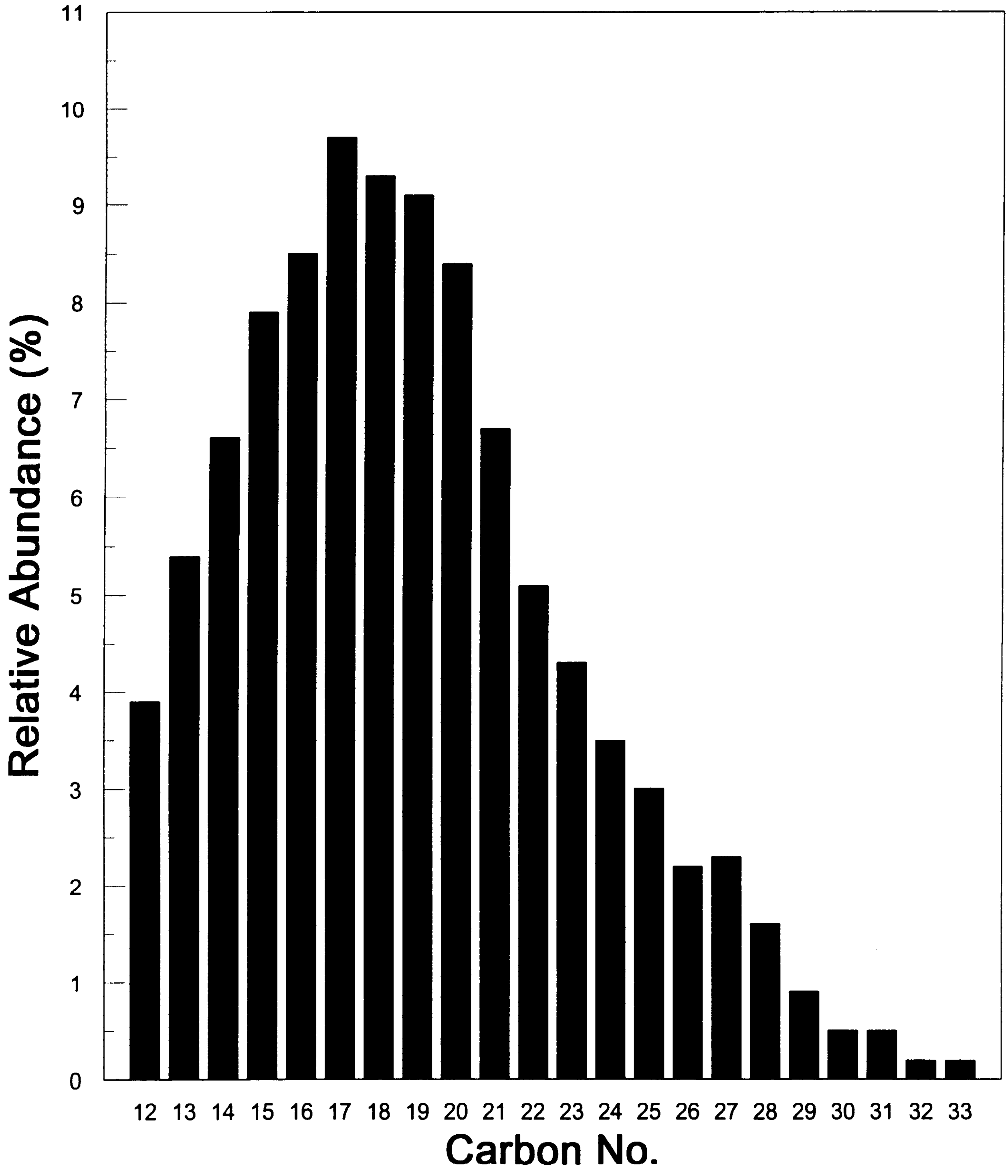
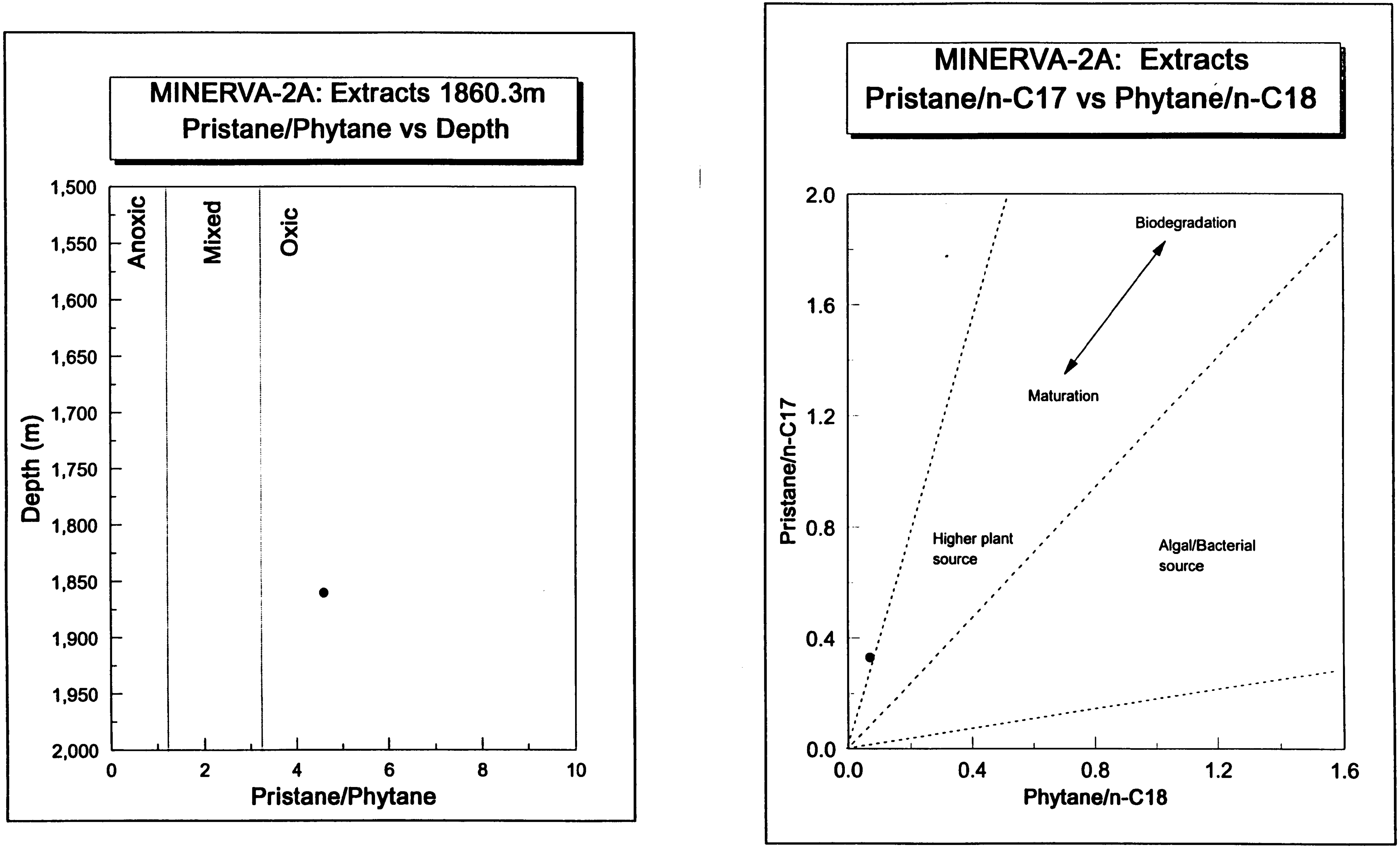


Figure 4



MINERVA-2A: Extracts 1860.3m
Pristane/Phytane vs Depth

MINERVA-2A: Extracts
Pristane/n-C17 vs Phytane/n-C18

FIGURE 5

FIGURE 6

m/z 191 and m/z 217 BIOMARKER TRACES: 1860.3m Extract

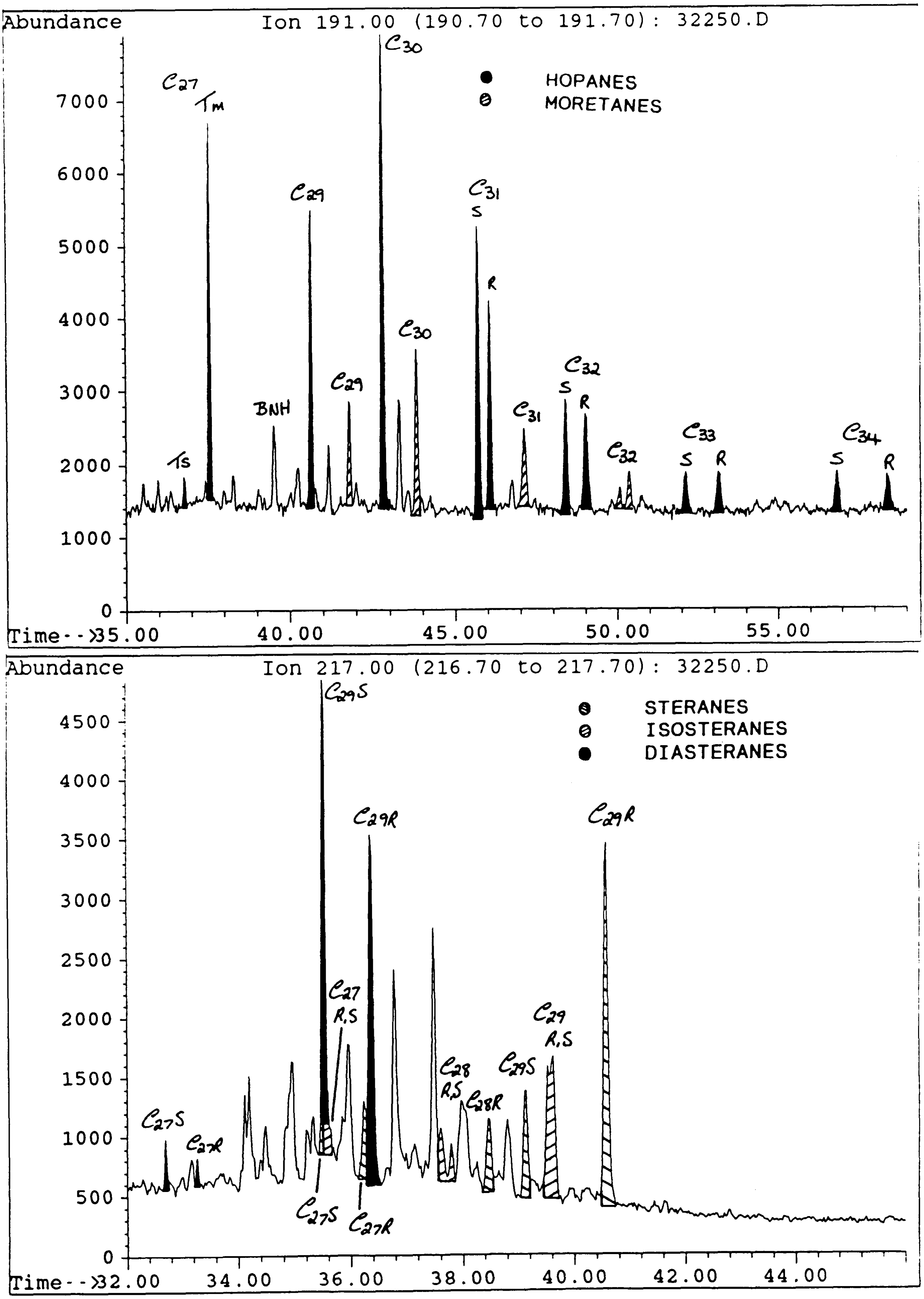


TABLE 3

SUMMARY OF GAS CHROMATOGRAPHY DATA - SEDIMENTS
ALKANE COMPOSITIONAL DATA

WELL NAME = MINERVA-2A
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB =

DEPTH 1	DEPTH 2	ANALYSIS TYPE	PRISTANE/PHYTANE	PRISTANE/n-C17	PHYTANE/n-C18	TMTD/PRISTANE	CPI(I)	CPI(II)	(C21+C22)/(C28+C29)
1732.80	1732.80	SF	-	-	-	-	-	-	-
1860.30	1860.30	SF	4.59	0.33	0.07	0.63	1.12	1.10	4.62
1928.20	1928.20		-	-	-	-	-	-	-
1956.20	1956.20	SF	-	-	-	-	-	-	-
1963.70	1963.70	WE	-	-	-	-	0.93	0.91	0.40

CPI = Carbon preference index TMTD = Trimethyltridecane - = no data
SF = Saturate fraction WE = Whole extract

TABLE 2

SUMMARY OF GAS CHROMATOGRAPHY DATA - SEDIMENTS
ALKANE DISTRIBUTIONS

WELL NAME = MINERVA-2A
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB =

DEPTH 1	DEPTH 2	nC12	nC13	nC14	TMTD	nC15	nC16	iC18	nC17	iC19	nC18	iC20	nC19	nC20	nC21	nC22	nC23	nC24	nC25	nC26	nC27	nC28	nC29	nC30	nC31	nC32	nC33
1732.80	1732.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1860.30	1860.30	3.6	5.0	6.1	1.8	7.3	7.8	2.3	8.9	2.9	8.6	.6	8.4	7.7	6.2	4.7	4.0	3.2	2.8	2.0	2.1	1.5	.8	.5	.5	.2	.2
1928.20	1928.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1956.20	1956.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1963.70	1963.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	2.2	5.7	4.7	8.6	7.1	8.3	10.7	10.4	9.4	8.0	7.2	3.7	3.9

i = iso
- = no data
n = normal
TMTD = Trimethyltridecane

N.B. Values are relative %

TABLE 4-1

SATURATE FRACTION SIR GC/MS DATA - SEDIMENTS
DETAILED COMPOUND ANALYSIS

WELL = MINERVA-2A
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB =

DEPTH 1 = 1860.30   DEPTH 2 = 1860.30

COMPOUND	ION	RELATIVE AMOUNT	COMPOUND	ION	RELATIVE AMOUNT
C23 Tricyclic	191	-	C24 Tricyclic	191	-
C25 Tricyclic	191	-	C26 Tricyclic	191	-
C28 Tricyclic	191	-	C29 Tricyclic	191	-
C24 Tetracyclic	191	-			
C27 Hopane (Ts)	191	434.3	C27 Hopane (Tm)	191	5185.0
C27 Hopane (17B)	191	-			
C28 Hopane (25,30)	191	-	C28 Hopane (28,30)	191	1177.0
C29 Hopane	191	4105.0	C29 Moretane	191	1430.0
C29 Demeth. Hopane	191	552.0	C29 Hopane (BB)	191	-
C30 Hopane	191	6522.0	C30 Moretane	191	2270.0
C30 Hopane (BB)	191	-			
C31S Hopane	191	4043.0	C31R Hopane	191	2877.0
C31S+R Hopane (BB)	191	-	C31S+R Moretane	191	1123.0
C32S Hopane	191	1603.0	C32R Hopane	191	1390.0
C32S+R Hopane (BB)	191	-	C32S+R Moretane	191	973.0
C33S Hopane	191	-	C33R Hopane	191	-
Gammacerane	191	-	Oleanane (18a)	191	-
Unknown 1	191	-	Unknown 2	191	-
Unknown 3	191	-	Unknown 4	191	953.0
C27 Demeth. Hopane	177	-	C28 Demeth. Hopane	177	-
C29 Hopane	177	-	C29 Demeth. Hopane	177	-
C29 Moretane	177	-	C29 Hopane (BB)	177	-
Unknown 3	177	-			
C30 2-Methylhopane	205	-	C31 2-Methylhopane	205	-
C31S Hopane	205	-	C31R Hopane	205	-
C31S+R Moretane	205	-	C31S+R Hopane (BB)	205	-
C21 Sterane	217	-	C22 Sterane	217	-
C27S Normal Sterane	217	-	C27R Normal Sterane	217	661.0
C27S Isosterane	217	-	C27R Isosterane	217	-
C27S Diasterane	217	-	C27R Diasterane	217	-
C28S Normal Sterane	217	-	C28R Normal Sterane	217	632.0
C28S Isosterane	217	-	C28R Isosterane	217	-
C28S Diasterane	217	-	C28R Diasterane	217	-
C29S Normal Sterane	217	912.0	C29R Normal Sterane	217	3073.0
C29S Isosterane	217	1207.8	C29R Isosterane	217	1069.0
C29S Diasterane	217	3986.0	C29R Diasterane	217	2964.0
C27S+R Isosterane	218	188.0	C28S+R Isosterane	218	670.0
C29S+R Isosterane	218	2903.0			
C27S Diasterane	259	192.0	C27R Diasterane	259	189.0
C28S Diasterane	259	978.0	C28R Diasterane	259	945.0
C29S Diasterane	259	2532.0	C29R Diasterane	259	1727.0
16a Phyllocladane	123	-	16B Phyllocladane	123	34084.0
Beyerene	123	16280.0	Labdane	123	-
Fichtelite	123	-	Rimuane	123	-
Nortetracyclane	123	8296.8	Pimerane	123	-
Isopimerane	123	-	Kaurane	123	14263.0
Norisopimerane	123	23988.0	Unknown 1	123	-
Drimane	123	34912.0	Homodrimane	123	46676.0
Rearranged Drimane 1	123	43647.0	Rearranged Drimane 2	123	24108.0
Eudesmane	123	-			
C15 Alkylcyclohexane	83	-	C17 Alkylcyclohexane	83	-
C21 Alkylcyclohexane	83	-	C22 Alkylcyclohexane	83	-
C25 Alkylcyclohexane	83	-	C29 Alkylcyclohexane	83	-

- = no data   IUPAC names corresponding to common names used here are shown at the end of the tables

TABLE 4-2

SATURATE FRACTION SIR GC/MS DATA - SEDIMENTS

CALCULATED DATA

WELL = MINERVA-2A
COUNTRY = Australia
BASIN = Otway

DEPTH 1(m) = 1860.30
DEPTH 2(m) = 1860.30

DEPTH UNIT = Metres
DATE OF JOB =

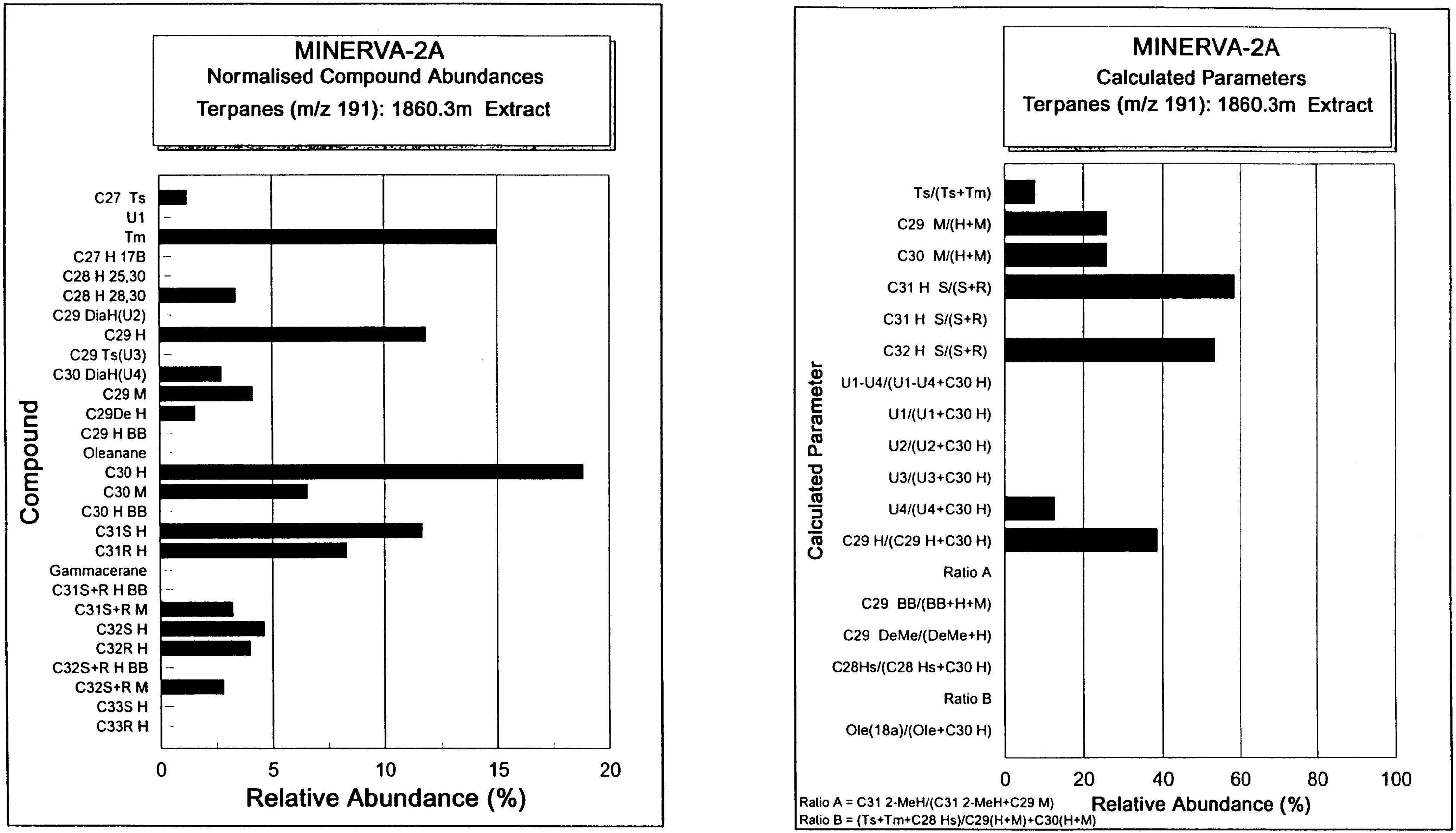
------ TERPANE PARAMETERS ------

PARAMETER	ION(s)	VALUE
% Ts / (Ts + Tm)	191	7.73
% C29 M / (C29 H + C29 M)	191	25.84
% C30 M / (C30 H + C30 M)	191	25.82
% C31S H / (C31S H + C31R H)	191	58.42
% C31S H / (C31S H + C31R H)	205	-
% C32S H / (C32S H + C32R H)	191	53.56
% U1-U4 / (U1-U4 + C30 H)	191	-
% U1 / (U1 + C30 H)	191	-
% U2 / (U2 + C30 H)	191	-
% U3 / (U3 + C30 H)	191	-
% U4 / (U4 + C30 H)	191	12.75
% C29 H / (C29 H + C30 H)	191	38.63
% C31 2-MeH / (C31 2-MeH + C30 H)	191, 205	-
% C29 BB / (C29 BB + C 29H + C29 M)	191	-
% C29 DeMe / (C29 DeMe + C29H)	177	-
% C28 H's / (C28 H's + C30 H)	191	-
% (Ts + Tm + C28 H's) / C29(H + M) + C30(H + M)	191	-
% Oleanane (18a) / (Oleanane + C30H)	191	-
% Drimane / Homodrimane	123	74.80
% Rea. Drimanes / (Drimane + Homodrimane)	123	83.05
% C22 Alkycyclohex. / C30 H	83, 191	-
% C29 Alkycyclohex. / C30 H	83, 191	-
% C23-C29 Tricyclics / C30 H	191	-
% (C30 H + C30 M) / (C29(NS's + IS's + DS's)	191, 217	66.55

------ STERANE PARAMETERS ------

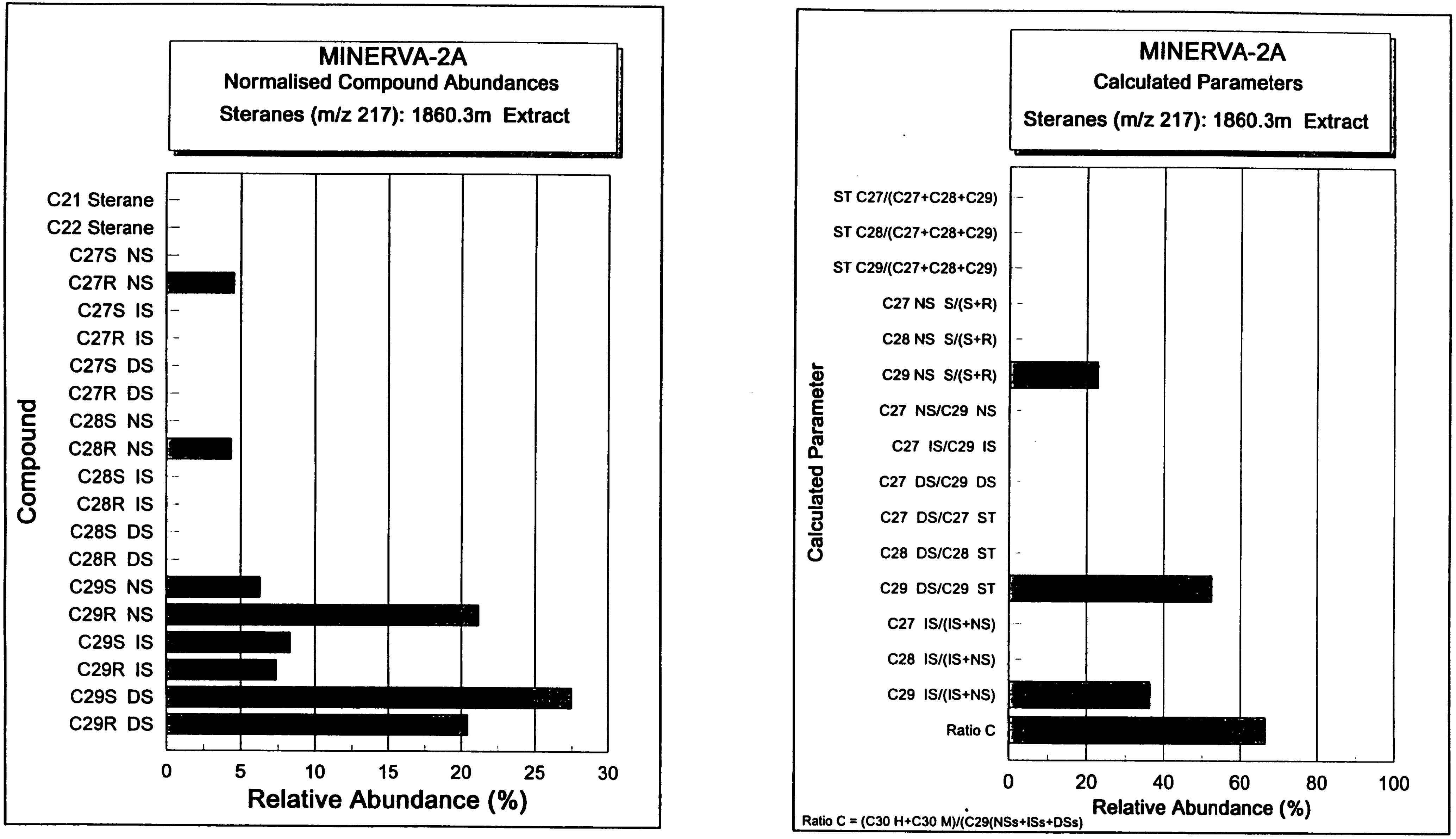
PARAMETER	ION(s)	VALUE
% C27 ST's / (C27 + C28 + C29) ST's	217	-
% C28 ST's / (C27 + C28 + C29) ST's	217	-
% C29 ST's / (C27 + C28 + C29) ST's	217	-
% C27S NS / (C27S NS + C27R NS)	217	-
% C28S NS / (C28S NS + C28R NS)	217	-
% C29S NS / (C29S NS + C29R NS)	217	22.89
% C27 NS's / C29 NS's	217	-
% C27 IS's / C29 IS's	217	-
% C27 DS's / C29 DS's	217	-
% C27 DS's / C27 ST's	217	-
% C28 DS's / C28 ST's	217	-
% C29 DS's / C29 ST's	217	52.60
% C27 IS's / (C27 IS's + C27 NS's)	217	-
% C28 IS's / (C28 IS's + C28 NS's)	217	-
% C29 IS's / (C29 IS's + C29 NS's)	217	36.36

NOTES : H = Hopane M = Moretane Me = Methyl NS = Normal Sterane
IS = Iso Sterane DS = Dia Sterane ST = NS + IS + DS U = Unknown
- = no data available



Ratio A = C31 2-MeH/(C31 2-MeH+C29 M)
Ratio B = (Ts+Tm+C28 Hs)/C29(H+M)+C30(H+M)

FIGURE 7



MINERVA-2A
Normalised Compound Abundances
Steranes (m/z 217): 1860.3m Extract

MINERVA-2A
Calculated Parameters
Steranes (m/z 217): 1860.3m Extract

Ratio C = (C30 H+C30 M)/(C29(NSs+ISs+DSs)

FIGURE 8

MINERVA-2A: 1860.3m

Facies Interpretation based on Sterane Abundances (R Isomers Only)

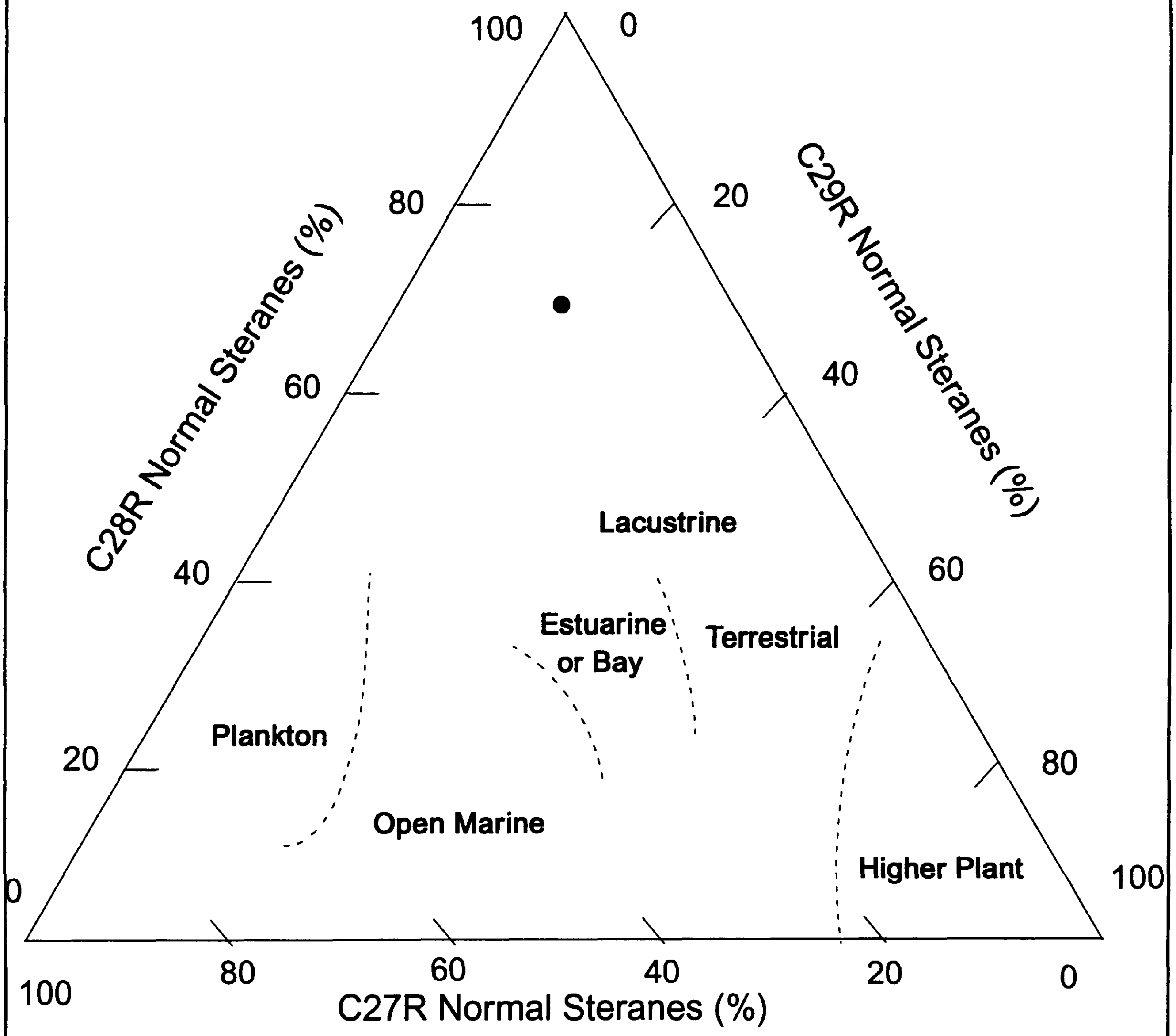
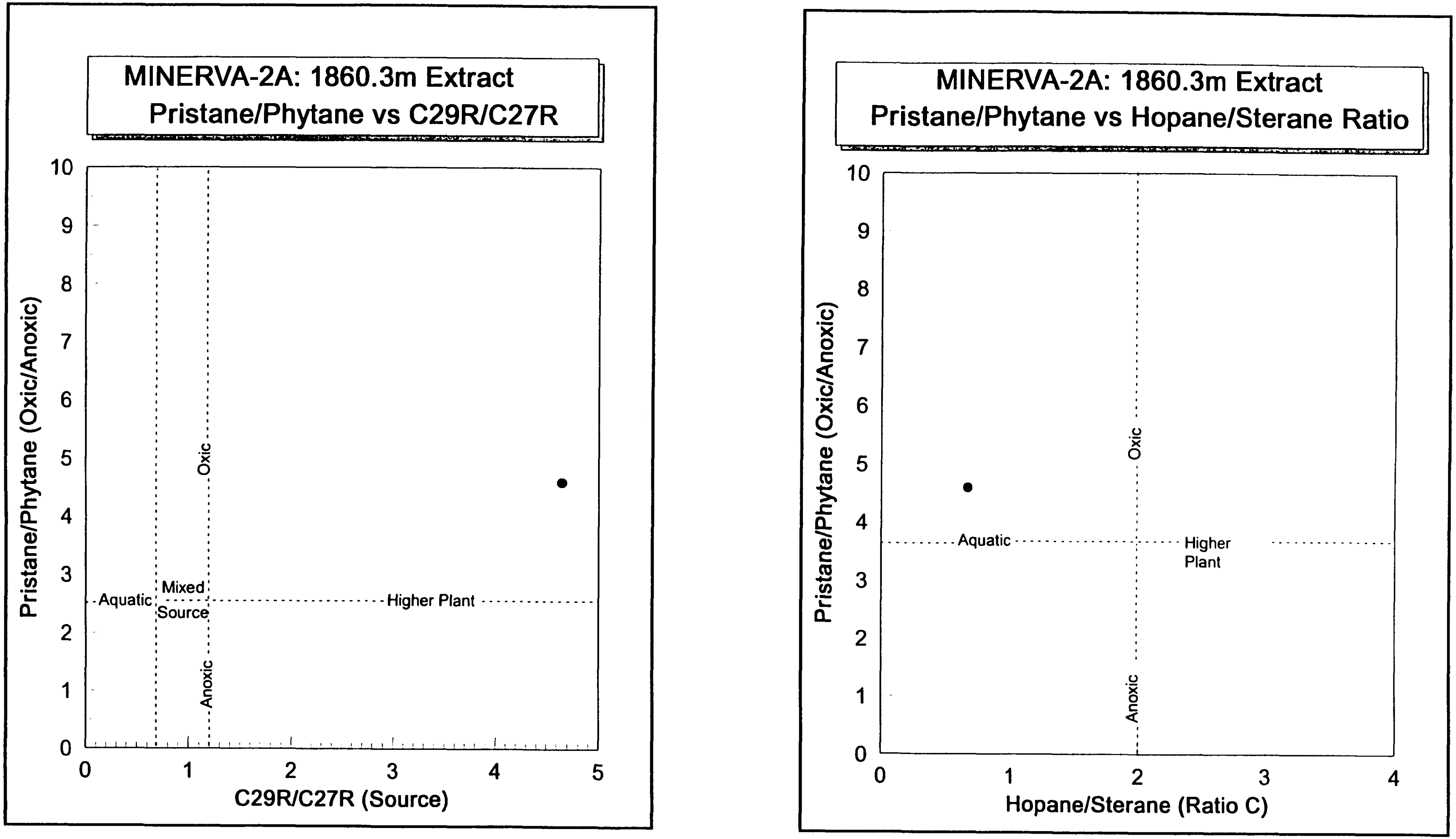


FIGURE 9


MINERVA-2A: 1860.3m Extract
Pristane/Phytane vs C29R/C27R

MINERVA-2A: 1860.3m Extract
Pristane/Phytane vs Hopane/Sterane Ratio

FIGURE 10

TABLE 5

DI & TRI NUCLEAR AROMATIC GC/MS DATA - SEDIMENTS

WELL = MINERVA-2A
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB =

DEPTH 1 = 1860.30 DEPTH 2 = 1860.30

A. DETAILED COMPOUND ANALYSIS

COMPOUND	ION	RELATIVE AMOUNT
1,5-Dimethylnaphthalene	156	340221.0
1,6-Dimethylnaphthalene	156	1283462.0
1,8-Dimethylnaphthalene	156	10320.0
2,6-Dimethylnaphthalene	156	706275.0
2,7-Dimethylnaphthalene	156	0.0
1,4+2,3-Dimethylnaphthalene	156	607019.0
1,2,5-Trimethylnaphthalene	170	4262756.0
1,2,7-Trimethylnaphthalene	170	0.0
1,3,6-Trimethylnaphthalene	170	246200.0
1,3,7-Trimethylnaphthalene	170	123100.0
2,3,6-Trimethylnaphthalene	170	179073.0
1,3,5+1,4,6-Trimethylnaphthalene	170	356743.0
Phenanthrene	178	2342308.0
1-Methylphenanthrene	192	462488.0
2-Methylphenanthrene	192	423802.0
3-Methylphenanthrene	192	279023.0
9-Methylphenanthrene	192	647601.0
1,7-Dimethylphenanthrene	206	434304.0
Compound X (1,3 + 3,9 + 2,10 + 3,10-DMP)	206	168173.0
Retene	219	556555.0
Cadalene	198	-
Eudalene	184	-

B. CALCULATED DATA

PARAMETER	ION	VALUE
DNR-1 = (2,6-DMN + 2,7-DMN) / 1,5-DMN	156	2.08
DNR-2 = 2,7-DMN / 1,8-DMN	156	0.00
DNR-5 = 1,6-DMN / 1,8-DMN	156	124.37
DNR-6 = ((2,6-DMN + 2,7-DMN) / 1,4+2,3-DMN)*0.91	156	1.06
TNR-1 = (2,3,6-TMN / 1,3,5+1,4,6-TMN)*0.82	170	0.41
TNR-5 = (1,2,5-TMN / 1,3,6-TMN)*0.75	170	12.99
TNR-6 = 1,2,7-TMN / 1,3,7-TMN	170	0.00
MPR-1 = (2-MP + 3-MP) / 1-MP	192	1.52
MPI-1 = (1.5 x (2-MP + 3-MP)) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.39
MPI-2 = (3 x 2-MP) / (0.667*Ph + 1-MP + 9-MP)	178,192	0.48
Rc(a) = (0.6 x MPI-1) + 0.4	na	0.63
Rc(b) = (-0.6 x MPI-1) + 2.3	na	2.07
1,7-Dimethylphenantrene / Compound X	206	2.58
Retene / 9-Methylphenantrene	192,219	0.86
1-Methylphenanthrene / 9-Methylphenanthrene	192	0.71

Notes : DMN = Dimethylnaphthalene TMN = Trimethylnaphthalene - = no data
MP = Methylphenanthrene Ph = Phenanthrene na = not applicable

MINERVA-2A: 1860.3m
MPI-1-derived Rc(a) vs Depth

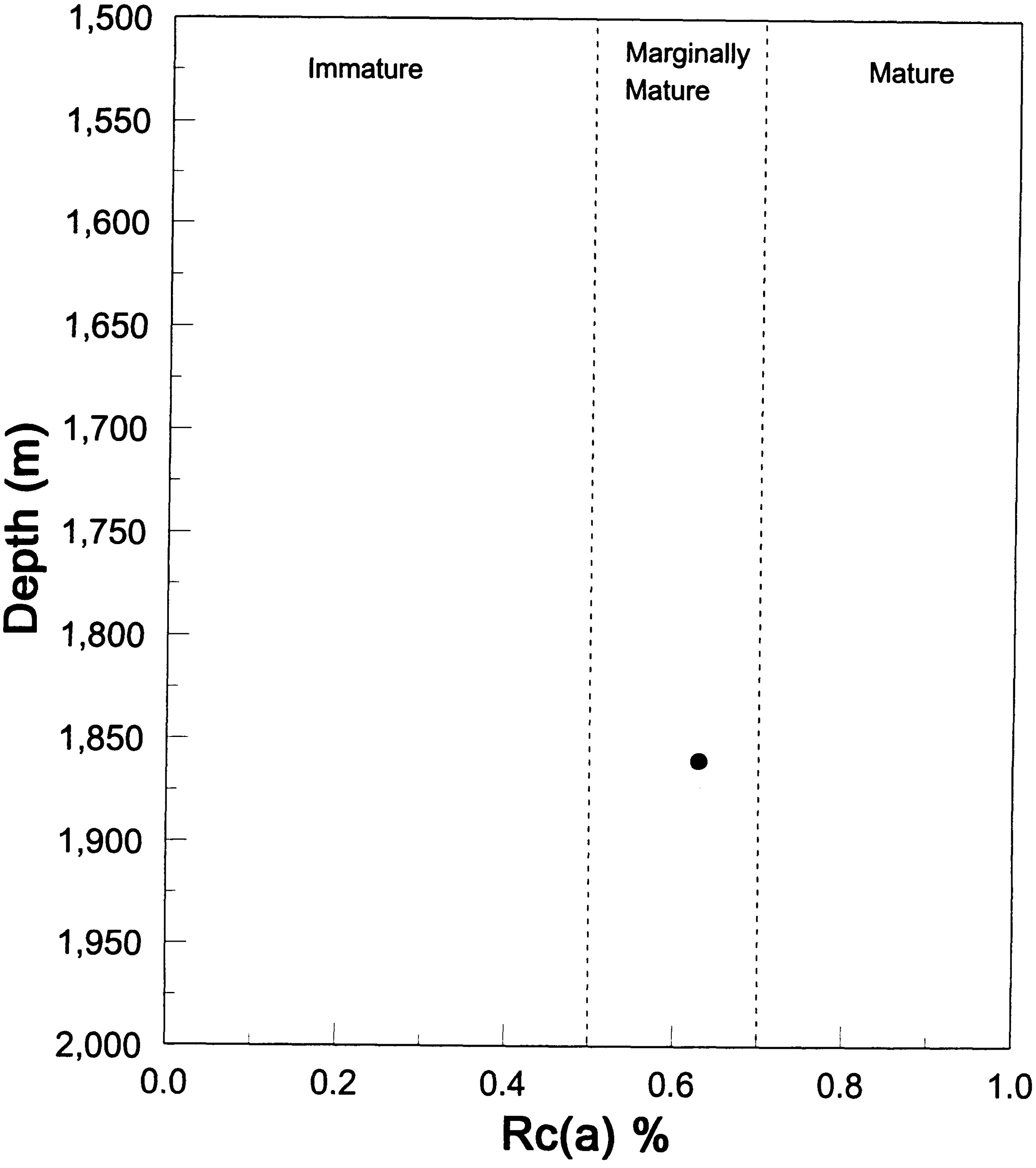
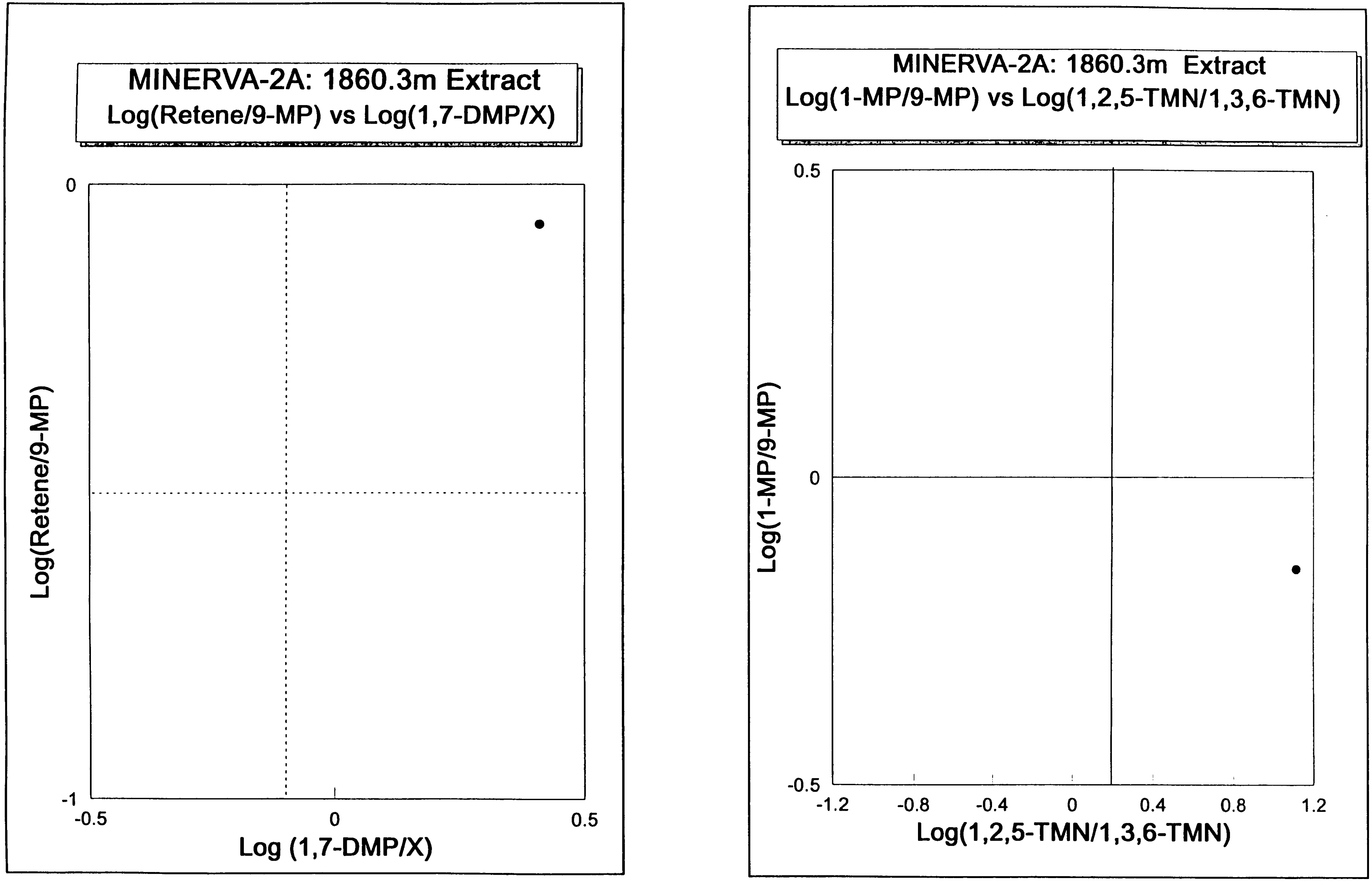


FIGURE 11



MINERVA-2A: 1860.3m Extract
Log(Retene/9-MP) vs Log(1,7-DMP/X)

MINERVA-2A: 1860.3m Extract
Log(1-MP/9-MP) vs Log(1,2,5-TMN/1,3,6-TMN)

FIGURE 12

MINERVA-2A: 1875m
Gas Analysis Data
Normalised Relative Abundances

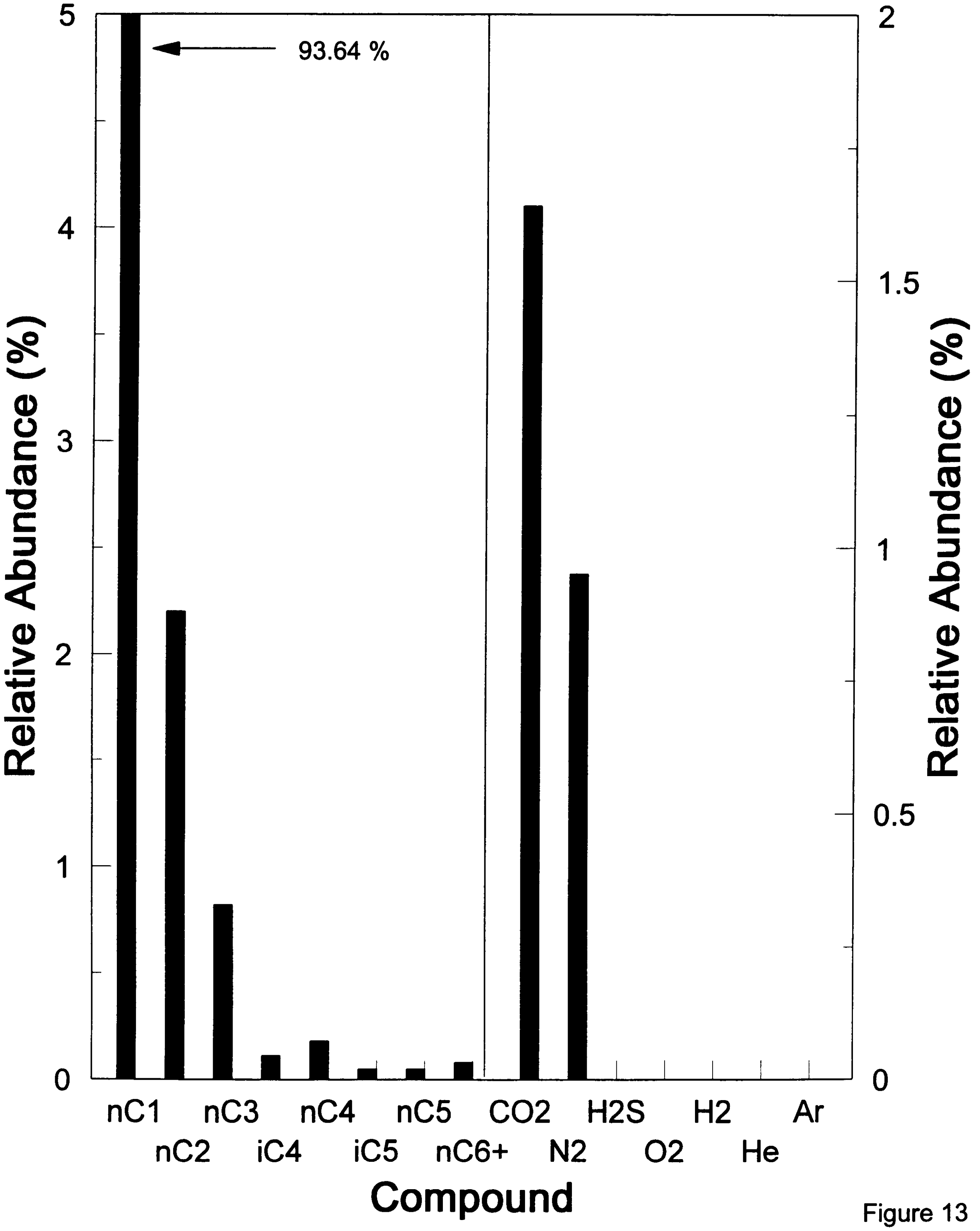


Figure 13

3

BHP

MINERVA-2A

PETROPHYSICAL INTERPRETATION

REPORT

PREPARED BY:

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APPROVED BY:

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Reservoir Evaluation Manager

File No: Min-2a/PP/S01/R

DATE: 5th July, 1994

BHP PETROLEUM PTY. LTD.
A.C.N. 006 918 832

SUMMARY

Minerva-2 was interpreted using the all the available log data and calibrated with core data. The logs were corrected for environmental effects using the relevant algorithms and interpreted using a shaly sand interpretation model. The well encountered 111 m of gross hydrocarbon column with a gas/water contact at 1940 m, which was in good agreement with the Repeat Formation tester derived contact. The main reservoir exhibited 97.9 m of net sand with an average porosity of 19% and an average water saturation of 15%.

All depths in this report are in metres along hole below the Rotary Table of the drilling rig Byford Dolphin, which was 25.0 m above mean sea level.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ENCLOSURES

1 BASIC DATA

1.1 Wireline Logs

Wireline logs were run by Schlumberger on a Maxis 500 logging unit. Table 1 shows the available log data, with temperature information and time data.

Table 1: Wireline Logs & Temperatures

Time Circ Stopped / Circ Time Time log on bottom	TOOL STRING	Maximum Temperature	INTERVAL
1-Oct-93 @ 01:00/2.75	**Suite 1**		
2-Oct-93 @ 11:30	DLL-MSFL-SDT-GR-SP-GPIT-CAL-AMS	58°C	553.0 - 1517.5 m
11-Oct-93 @ 20:00 / 1.00	**Suite 2**		
12-Oct-93 @ 03:45	DLL-MSFL-AS-GR-SP-CAL	76°C	1526.0 - 2170.0 m
12-Oct-93 @ 12:00	LDL-CNL-FMS-GR	82°C	1526.0 - 2170.0 m
13-Oct-93 @ 00:00/2.0	wiper trip		
13-Oct-93 @ 15:00	RFT-HP	73°C	
13-Oct-93 @ 21:00	CSI (VSP)	84°C	
14-Oct-93 @ 07:10	CST-GR [30 shot]		

1.2 Conventional Cores

Five conventional cores were cut in Minerva-2A. The first was cut in a thin sand above the main reservoir from 1728.5 - 1733.5 m (recovered 5.0 m, 100%). The second and the third cores were cut consecutively at the top of the main reservoir. Core 2 1838.8 - 1855.6 m (recovered 15.1 m, 97.5%), Core 3 1855.6 - 1882.5 (26.9 m ,100%) . Cores 4 and 5 were also cut consecutively starting at 1915 m. Core 4 1915.0 - 1945.75 m (27.75 m, 99%) and Core 5 1943.0 - 1969.0 m (26 m, 100%).

A full program of routine core analyses was carried out and included core gamma, helium injection porosity and air permeability (at ambient and overburden conditions), summation of fluids porosity, water saturation determination, as well as the calculation of grain densities. The ambient conditions data was plotted against the overburden conditions data (2100 psi) to derive transforms for the conversion of all the ambient data given below.

Porosity $\phi_{ovb}(\%) = 0.988 * \phi_{amb}(\%) - 0.63$

Permeability $K_{ovb} = 0.84 * K_{amb}^{1.002}$

The core data have been fully integrated into the log interpretation and were used to calibrate the petrophysical model. Core depths have been adjusted to match the wireline log data (see **Enclosure 1**). The depth shifts for the various sections of core are given in Table 2.

Table 2: Core Depth Shifts

Core Number	Drillers Depth (mRT) top of core section	Adjusted Depth (mRT)	Shift (+ core to be shifted down)
1	1728.5	1732.75	4.25 m
2 & 3	1388.8	1841.55	2.75 m
	1855.2	1858.2	3.0 m
	1876.4	1879.0	2.6
4 & 5	1915.0	1917.0	2.0
	1936.0	1937.65	1.65
	1961.5	1962.75	1.25

1.3 Sidewall Cores

30 sidewall cores were shot in the 12-1/4" open hole with 29 cores recovered; one bullet was empty.

1.4 RFT Data

Data from the RFT program was used primarily to indicate effective permeability, identify the type of hydrocarbons present, determine the maximum extent of the hydrocarbon column and to calculate the density of hydrocarbons recovered from RFT samples. For a complete discussion of RFT results refer to the Minerva-2A RFT Report.

1.5 Drill Stem/Production Tests

No production tests were carried out at Minerva-2A prior to the suspension of the well.

2 INTERPRETATION PROCEDURE

2.1 Data Preparation

Wireline log data was read from tapes and loaded into "Well Data System" (WDS), a log storage, manipulation, interpretation and presentation software package developed by Western Atlas International Inc. The Suite-2 wireline data was prepared for interpretation by depth matching and by applying environmental corrections as per the Schlumberger chart book, (Schlumberger, 1991).

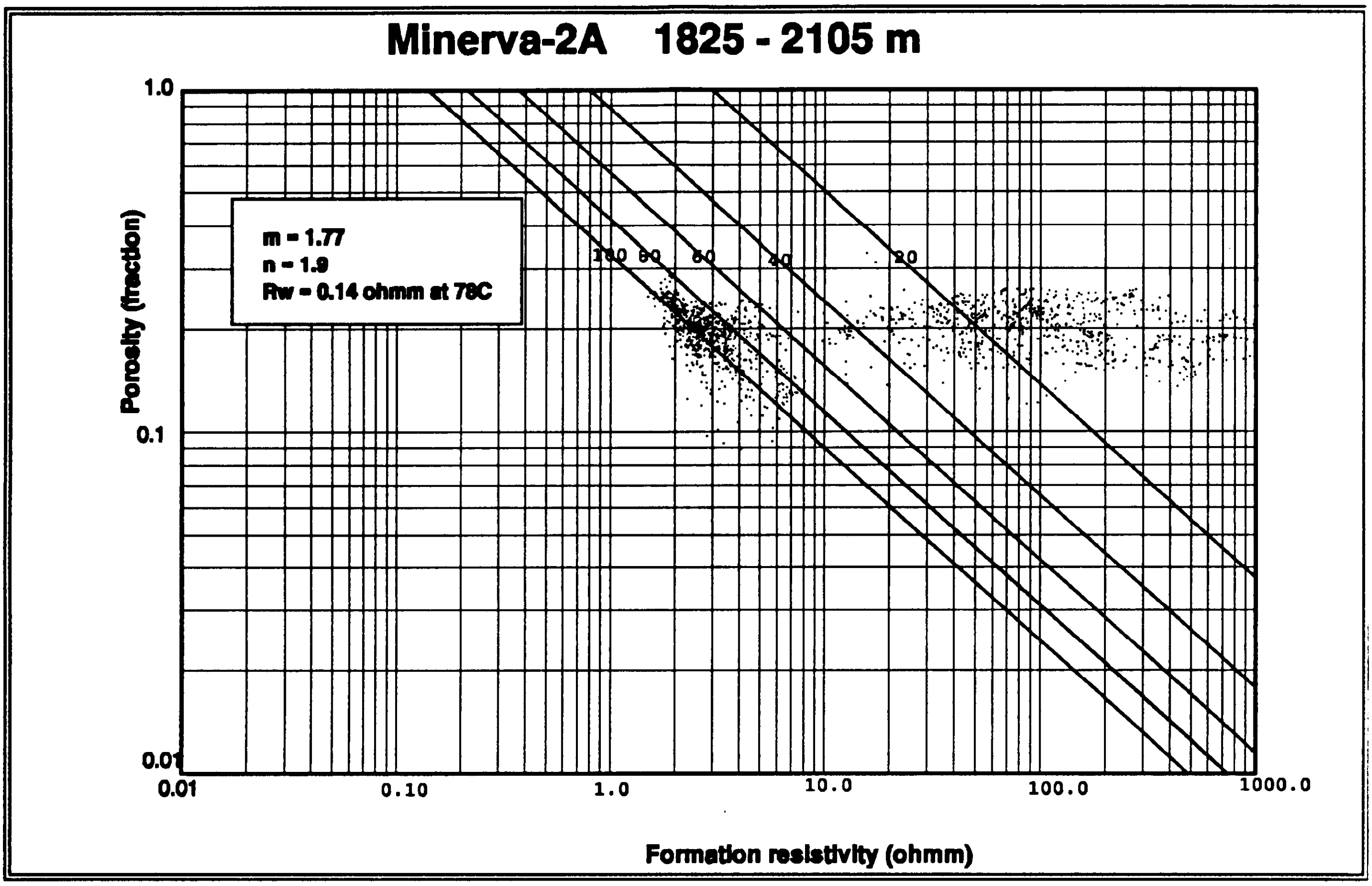
2.2 Interpretation Model

The data were interpreted using a shaly sand interpretation model which incorporated the Juhasz Water Saturation Model. Shale fraction was derived from the gamma ray and porosity was derived from the density and neutron logs, corrected for the effects of gas.

2.3 Water Salinity

The SP log is well developed in Minerva-2A . In the porous water sands below around 2025 m the maximum deflection recorded by the static SP was 50 mV using a sloping baseline. This suggests a value for R_w of 0.31Ω-m at 25°C, or about 19,000 ppm NaCl equivalent and agrees with the Pickett plot derived value shown in Figure 1.

Figure 1 Pickett Plot



2.4 Formation Electrical Properties

The electrical properties were taken from measurements undertaken on the Minerva-1 core. The cementation exponent "m" was measured to be 1.77, "a" was taken to be 1.0 and the saturation exponent "n" was measured to be 1.90.

3 INTERPRETATION RESULTS

Table 3 contains a summary of the interpretation results using a porosity cut-off of 5% and a shale fraction cut-off of 50%. The depths and thicknesses are given along hole. The gas water contact was placed at 1940 m, which was in good agreement with the free water level calculated from the RFT pressure gradient.

Table 3: Interpretation Results

Zone	Depth (mRT)	Gross (m)	Net (m)	N/G (%)	Por. (%)	Sw (%)
Shipwreck (upper zone)	1720 - 1740	20	10.0	50	16	31
Shipwreck (lower zone)	1829 - 2105	276.0	253.9	92	17	n/a
Shipwreck (gas zone)	1829 - 1940	111.0	97.9	88	19	15

4 INTERPRETATION PARAMETERS

Tables 4, 5 & 6 contain the input parameters for the interpretation model.

Table 4: Interpretation parameters 1720 - 1740 m

Log	Matrix	Shale	Water	Filtrate	Gas
Gamma Ray	40	140			
Sonic	55.5	82		189	
Density	2.65	2.56		1.01	.1
Neutron	-.03	.22			.8 (excav)
Resistivity		20	.14	0.097	
Temperature	78		78	14	

Table 5: Interpretation Parameters 1825 - 1942 m

Log	Matrix	Shale	Water	Filtrate	Gas
Gamma Ray	35	155			
Sonic	55.5	82		189	
Density	2.65	2.62		1.01	.1
Neutron	-.03	.18			.82 (excav)
Resistivity		20	.14	0.097	
Temperature	78		78	14	

Table 6: Interpretation parameters 1942 - 2105

Log	Matrix	Shale	Water	Filtrate	Gas
Gamma Ray	35	185			
Sonic	55.5	82		189	
Density	2.65	2.56		1.01	1
Neutron	-.03	.22			1 (excav)
Resistivity		20	.14	0.097	
Temperature	78		78	14	

5 DISCUSSION OF RESULTS

These results are preliminary and the data from Minerva-1 will be combined with Minerva-2A in a petrophysical field study (in progress) to determine whether field-wide parameters may be derived as well as incorporate the "special" core analysis (capillary pressure and drainage studies) which is being undertaken at the time of writing.

PE900400

This is an enclosure indicator page.
The enclosure PE900400 is enclosure within the
container PE900102 at this location in this document.

The enclosure PE900400 has the following characteristics:

ITEM_BARCODE = PE900400
CONT AINER_BARCODE = PE900102
NAME = Minerva 2A Enclosure 2 Top Main Gas Zone Depth Structure Map

BASIN = OTWAY
PERMIT =
TYPE = SEISMIC
SUBTYPE = HRZN_CONTR_MAP
DESCRIPTION = Minerva 2A Enclosure 2 Top Main Gas Zone Depth Structure Map

DATE_CREATED =
DATE_RECEIVED =
W_NO = W1086
WELL_NAME = Minerva-2_2A
CONTRATOR = BHP
CLIENT_OP_CO = BHP

4

BHP Petroleum

MEMORANDUM

TO: DISTRIBUTION

FROM: RESERVOIR EVALUATION MANAGER

DATE: 10th February, 1994

OUR REF: rah:ly:1567:ec

FILE: Min-2A/RE/F04/c

MINERVA-2A RFT REPORT

Please find attached the Minerva-2A RFT report.

Summary/Conclusions

The results of the Minerva-2A open hole RFT survey indicated that the well intersected two gas bearing sands in the Upper Shipwreck Group, with a common gas gradient of 0.164 psi/m. A water bearing sand was intersected below the gas in the main reservoir sand and had a water gradient of 1.39 psi/m. Based on the pretest data, a free water level of 1915.1 mTVDSS was interpreted.

One sample was recovered from the main reservoir sand at 1849.7 mTVDSS. Analysis of the sample indicated dry gas with 93.64% methane.

ROBERT A.M. HOGARTH

Distribution List:

Area Exploration Manager (Otway/Duntroon Basin) - P.Nicholls
Bridge Oil Company, Sydney - N.Seage

Minerva-2A

RFT REPORT

25 January 1994

Prepared by

Sean Hanrahan

Approved by

Robert Hogarth
Reservoir Evaluation Manager

January 1994.

Our Ref: rah:ly:1567:ec
File No: Min-2A/WL/G02/R

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ENCLOSURES

1. OPERATIONS SUMMARY

One RFT run was carried out in Minerva-2A on 12 October 1993 and the RFT operations from rig up to rig down of the RFT-B tool was approximately 15 hours.

A total of 34 pretests were performed but only 21 gave reliable formation pressures. Of the remaining pretests, 8 were tight, 1 resulted in seal failure and 4 were considered supercharged. One segregated sample comprising of a one gallon upper chamber and a 2-3/4 gallon lower chamber was taken at 1849.7 mTVDSS.

2. CONCLUSION

Based upon the data and interpretations contained in this report, the following conclusions can be made:

1. Two gas bearing sands were intersected in the Upper Shipwreck Group and they have a common gas gradient of 0.164 psi/m.
2. A water bearing sand was intersected below the gas in the main reservoir sand of the Upper Shipwreck Group. The aquifer had a pressure gradient of 1.39 psi/m, and is close to the expected hydrostatic pressure.
3. Fluid gradients measured in the Upper Shipwreck Group indicated a free water level at 1915.1 mTVDSS. No other fluid gradients were observed.
4. One segregated sample was recovered from the Main Upper Shipwreck sand at 1849.7 mTVDSS. The table below details the composition of the upper chamber .

Component		Mole %
Carbon Dioxide	CO_2	1.64
Nitrogen	N_2	0.95
Methane	C_1	93.64
Ethane	C_2	2.20
Propane	C_3	0.82
n-Butane	$n\text{-}C_4$	0.18
i-Butane	$i\text{-}C_4$	0.11
Pentane+	C_5^+	0.46

3. GEOLOGY

Minerva-2A was drilled in the offshore Eastern Otway Basin of Vic/P31, approximately 1.7 km south of Minerva-1. It was an appraisal well to confirm the extension of the Shipwreck Group gas-bearing reservoir within the southern fault block of the Minerva structure.

The primary target, the Main Upper Shipwreck sand, was intersected at 1829 mRT and contained about 111m gross gas column as interpreted from the electric logs.

The secondary target, Upper Shipwreck 1 sand was intersected at 1722 mRT and was gas bearing.

Table 1 contains the well data sheet which summarises the well information.

4. RFT PROGRAM

4.1. Objectives

The main objectives of the Minerva-2A RFT program were as follows:

a. Determine the fluid gradients and contacts within the reservoir sections of the Minerva-2A well.

b. Recover representative hydrocarbon samples in order to determine PVT properties from the main reservoir sand.

4.2 RFT Tool Configuration

The formation sampling tool used on Minerva-2A was the Schlumberger RFT-B tool, incorporating a long nose probe with a standard packer and a HP quartz crystal gauge. The tool was run with an AMS and Gamma Ray sonde and three 1" stand-offs. A 1 gallon upper and a 2-3/4 gallon lower sample chamber were used, both with water cushions. Four x 20/1000" chokes were used in both the 1 and 2-3/4 gallon chambers.

4.3 Open-Hole Log Reference

All Minerva-2A RFT depths were correlated to the 12-1/4" open hole AS-MSFL-DLL-GR-AMS-SP log run on 12/10/93 (see Enclosure 1).

The hole diameter ranged between 12-1/4" and 13-1/2" between 1722 and 1829 mRT. The hole was in good condition over the remaining intervals programmed for the RFT survey.

Our Ref: rah:jy:1567xc / 25 Jan 94

4.4 Tool Performance

RFT-B

Stabilisation times were relatively short for the HP pressure gauge. There were no operational problems with the tool.

5. RFT PRETEST INTERPRETATION

5.1 Pressures

All pretest and sample pressures are given in Table 2 and are shown plotted in Figure 2. Of the 34 pretests attempted; 21 pretests recorded good formation pressures, 8 were tight, 1 unsuccessful due to seal failure and 4 pretests were considered supercharged.

All pretest pressures were obtained when both the HP and strain gauge pressures and temperatures had stabilised.

Figure 3 shows a plot of the initial and final hydrostatic pressure gradients measured with the HP gauge. The hydrostatic gradients indicate a mud specific gravity (S.G.) of 1.16. This is in good agreement with the mud S.G. measured on the rig (1.16 S.G.).

5.2 Temperature

Table 2 lists all the temperatures measured in Minerva-2A during the RFT survey. The maximum temperature recorded during the RFT survey was 73.4°C at 1959.2 mTVDSS. This temperature was recorded 15 hours after circulation was stopped. An accurate reservoir temperature on Minerva-2A could not be determined during the logging run and a reservoir temperature of 95°C was assumed based on the RFT survey and the DST flowback results from Minerva-1.

5.3 Reservoir Fluid Gradients

Figures 2 to 4 show the interpreted results of the Minerva-2A RFT survey. Two gas bearing sands were intersected by the well; the Upper Shipwreck 1 sand between 1696.5 and 1703 mTVDSS and the Main Upper Shipwreck sand between 1804 and 1960 mTVDSS.

The reservoir fluid gradients, which were determined from the HP gauge pretest data by linear regression, are given below:

Pretests	Fluid (psi/m)	Fluid Gradient(β) Level	Confidence Interval
3,4,11-23 gas (excl.12,20,22)	0.164	95%	$0.163<\beta<0.167$
24,27-34 water	1.39	95%	$1.37<\beta<1.41$

There was considerable scatter in the pretest data in the Upper Shipwreck 1 sand and it could possibly be due to localised supercharging effects in the sand. Three of the pretest data (namely #3, #4 and 11) were incorporated with the pretest data from the Main Upper Shipwreck sand to determine the best fit fluid gradient intersected by the two sands. A best fit gas gradient of 0.164 psi/m was determined based on the assumption that these two sands were in hydraulic communication.

The best fit water gradient of 1.39 psi/m was interpreted below 1915.1 mTVDSS in the Main Upper Shipwreck sand. It should be noted that there was no significant scatter observed in the pretest data of the water bearing sand.

5.4 Fluid Contacts

A free water level at 1915.1 mTVDSS in the Main Upper Shipwreck sand is interpreted using the gas and water gradients derived from the pretest data (see Figure 2). This depth is in close agreement to the interpreted FWL of 1914.7 mTVDSS from Minerva-1 RFT survey (see Figure 4).

5.5 Permeabilities

Spherical mobility estimates from the pretests are given in Table 2. The assumptions made to correct the calculated spherical mobility to horizontal permeability are:

1. Mud filtrate viscosity = 0.43 cP
   (Temp = 82^{0}C, Pressure = 2742 psia,
   Equivalent NaCl salinity = 74,250 ppm)

2. $K_h/K_v = 1$

The correction used was:

$K_h = [K_D \times (K_h/K_D)]/K_{rw}$

Where, K_D = Drawdown permeability
= (Mobility) x (Filtrate Viscosity)

K_h/K_D = 1
= ratio of horizontal to drawdown permeability. This is a function of K_h/K_v and flow geometry; which is spherical, (Table A1, Ref [2]).

K_{rw} = relative permeability to filtrate.

Reference [2] suggests the use of $K_{rw} = 0.3$ for formations with a hydrocarbon saturation and a permeability greater than one Darcy, and $K_{rw} = 0.15$ for permeability less than 1 Darcy. A K_{rw} of 1.0 is used for water saturated sands.

From the results shown in Table 2, the main reservoir sand has permeabilities between 9 and 1096 mD. The Upper Shipwreck 1 sand has permeabilities between 19 and 390 mD.

5.6 Comparison to other wells

Minerva-1 was a gas discovery in the Upper Shipwreck formation. The well intersected a 98m gross gas column in the main reservoir sand with a free water level interpreted at 1914.7 mTVDSS.

The gas and water gradients intersected by Minerva-2A in the main reservoir sand of the Upper Shipwreck Group are within 2% of the corresponding gradients determined in Minerva-1. The pressure data in the aquifer obtained from Minerva-1 and 2A lie on the same line (see Figure 4) which indicates that the wells are now or were at one stage in hydraulic communication. The pressures in Minerva-1 and 2A and nearby wells Pecten-1A and Eric The Red-1 are all close to, or at normal hydrostatic pressure (see Figure 6).

However, the pressures recorded in La Bella-1 indicate that it is in a separate pressure regime (Ref. 1). The well intersected a 68m gross gas column in the Upper Shipwreck Group. The RFT data from the well indicated an overpressured Upper and Lower Shipwreck Group of 180 psi and about 600psi respectively with respect to the normally pressured water bearing sand of the Upper Shipwreck Group in the Minerva wells.

Our Ref: rab:ly:1567:ec / 25 Jan 94

6. RFT SAMPLES

One segregated sample of the formation fluid was recovered from 1849.7 mTVDSS (1875 mRT). Both the one gallon upper and the 2-3/4 gallon lower chambers were kept sealed and sent to Petrolab for PVT analysis. Appendix A contains a copy of the Petrolab report, giving detailed analysis of the contents of the upper gallon chamber.

The lower 2-3/4 gallon chamber was flushed at high pressure from the single phase to atmospheric pressure and 30 cc of condensable liquid hydrocarbon was collected using the dry ice cold trap method. This liquid was forwarded to the BHPP laboratory for compositional analysis using the Simulated Distillation method. Appendix B details the results.

7. REFERENCES

[1] Minerva-1 RFT Report, BHP Petroleum.
June 1993.

[2] BHP Petroleum RFT Manual.
December 1988.

Well Data Sheet

Table 1.

Well:		Minerva-2A
Permit:		VIC/P31
Location:	Lat:	38 º 43 ' 4.54 " South
	Long:	142 º 57 ' 20.80 " East
Rig:		Semi-Submersible Byford Dolphin
Seismic Reference Line:		OE80A-1056 SP 4067
KB Elevation:		25.3 m above MSL
Water Depth		60.0 m
Well TD (12.25" Hole) :		2170.0 mKB
Spud Date:		21st September 1993
Date Reached TD:		11th October 1993
Well Status:		Suspended
Casing Points:		30" @ 118 mKB 20" @ 553 mKB 13 3/8" @ 1526 mKB
Reservoir Tops:	Upper Shipwreck 1	1721.5 mKB
	Main Upper Shipwreck	1829.0 mKB
Datum Depth (FWL):		1915.1 mTVDSS
Pressure at Datum:		2747.1 psia
Reservoir Temperature:		95.0 deg C (ex-MINERVA-1)
Trittium Used:		No
Fluids In Well:	Gas:	Yes
	Oil:	No
	Water:	Yes
Contacts:	GOC:	N/A
	OWC:	N/A
	FWL:	1915.1 mTVDSS

MINERVA-2A OPEN HOLE RFT RESULTS

Test No.	Depth		Time	Initial Hydrostatic Pressure		Formation Pressure		Temperature	Final Hydrostatic Pressure		Mobility	Permeability*	Comments
				Strain Gauge	HP Gauge	Strain Gauge	HP Gauge		Strain Gauge	HP Gauge			
	mAHKB	mTVDSS	hh:mm	psig	psia	psig	psia	DegC	psig	psia	mD/cp	mD	
1	1722.5	1697.2	06:10	2870.6	2890.86	2692.10	2711.99	65.1	2870.0	2890.49	18.1	52	Possibly supercharged
2	1723.5	1698.2	06:25	2871.2	2891.71	2696.00	2717.00	65.2	2871.3	2891.82	3.3	9	Tight
3	1724.5	1699.2	06:42	2872.6	2893.01	2691.30	2711.32	64.7	2872.1	2893.05	136.0	390	Good Test
4	1725.5	1700.2	06:58	2873.8	2894.64	2691.50	2712.15	64.9	2874.5	2895.36	6.8	19	Low Permeability
5	1726.5	1701.2	07:12	2876.1	2896.55	2695.50	2716.44	64.9	2876.1	2897.18	0.5	1	Tight
6	1727.3	1702.0	07:28	2877.3	2897.78	2698.10	2718.83	65.1	2877.4	2898.09	5.9	17	Tight?
7	1722.5	1697.2	07:45	2868.4	2889.56	-	-	65.3	2868.2	2890.02			Tight
8	1723.0	1697.7	07:55	2870.3	2891.15	2691.50	2712.38	65.1	2870.4	2891.40	9.3	27	Possibly supercharged
9	1723.5	1698.2	08:05	2871.2	2892.25	-	-	65.2	-	-			Lost Seal
10	1723.7	1698.4	08:12	2871.1	2892.34	2696.40	2717.50	65.3	2871.1	2893.08	0.9	3	Tight
11	1724.5	1699.2	08:27	2872.3	2892.81	2690.60	2711.52	65.4	2872.0	2893.37	9.8	28	Low Permeability
12	1729.2	1703.9	08:38	2880.1	2901.18	-	-	65.5	2880.7	2902.41			Tight
13	1833.0	1807.7	09:01	3052.5	3073.29	2710.30	2729.56	69.7	3052.2	3072.87	420.0	602	Good Test
14	1840.0	1814.7	09:16	3063.3	3084.26	2711.60	2730.76	69.2	3063.4	3084.13	224.3	643	Good Test
15	1853.0	1827.7	09:31	3085.7	3106.33	2713.40	2732.82	68.8	3085.4	3105.95	50.4	144	Good Test
16	1875.0	1849.7	09:50	3121.6	3142.62	2717.00	2736.12	69.1	3121.5	3142.19	764.6	1096	Good Test
17	1890.0	1864.7	10:08	3146.5	3167.25	2720.20	2738.98	69.5	3146.2	3166.70	362.0	519	Good Test
18	1907.0	1881.7	10:21	3174.7	3195.84	2722.50	2741.60	70.8	3174.8	3195.35	43.9	126	Good Test
19	1925.0	1899.7	10:45	3205.8	3226.42	2726.10	2744.82	72.5	3204.6	3224.93	12.4	36	Good Test
20	1930.0	1904.7	10:59	3213.1	3233.34	-	-	71.9	3212.2	3233.22			Tight (shale test)
21	1933.5	1908.2	11:08	3218.4	3238.85	2727.70	2745.93	71.2	3218.3	3238.34	22.7	65	Good Test
22	1937.5	1912.2	11:25	3225.0	3244.80	2732.00	2751.77	71.2	3224.7	3244.80	2.5	7	Possibly supercharged
23	1939.0	1913.7	11:56	3227.6	3247.26	2728.70	2746.75	71.5	3227.1	3247.28	N/A	N/A	Good Test
24	1940.5	1915.2	12:21	3229.6	3250.31	2729.00	2747.35	71.9	3229.2	3249.84	972.2	418	Good Test
25	1942.5	1917.2	12:33	3232.6	3253.25	-	-	-	-	-			Tight
26	1942.8	1917.5	12:42	3233.2	3253.61	2733.70	2753.12	72.2	3233.6	3254.10	11.2	5	Possibly supercharged
27	1944.0	1918.7	12:56	3235.3	3256.27	2734.00	2752.47	72.3	3235.8	3256.47	135.0	58	Good Test
28	1947.0	1921.7	13:10	3240.9	3261.20	2738.20	2756.32	72.1	3240.3	3260.36	120.5	52	Good Test
29	1949.0	1923.7	13:27	3244.0	3263.59	2740.80	2758.60	72.0	3243.5	3263.20	268.1	115	Good Test
30	1954.0	1928.7	13:50	3251.9	3271.32	2748.10	2766.14	72.5	3251.3	3271.65	446.7	192	Good Test
31	1961.5	1936.2	14:04	3263.9	3284.47	2758.20	2775.90	72.5	3264.0	3283.76	191.2	82	Good Test
32	1971.0	1945.7	14:28	3279.3	3299.63	2770.80	2789.95	72.9	3279.2	3299.36	19.8	9	Good Test
33	1975.0	1949.7	14:35	3286.6	3307.18	2776.90	2795.26	73.1	3286.5	3306.16	86.7	37	Good Test
34	1984.5	1959.2	14:53	3302.3	3322.40	2790.30	2808.22	73.4	3302.3	3322.09	79.7	34	Good Test
S1	1875.0	1849.7	15:25	3121.2	3141.15	2717.70	2736.28	71.6	3120.9	3141.14			Segregated sample

Filtrate:

Temp	179.6 Deg F
% NaCl	74250 ppm
Pressure	2742 psia
Viscosity	0.43 Cp

*N.B. Permeabilities rounded.
K(h)/k(v)=1
Filtrate Viscosity = 0.43 cP
k(rw)=1.0 in water zone
k(rw)=.15 or .3 in h/c zone if perm. < or > 1D respectively.

Table 2.

RFT Sample Data Sheet

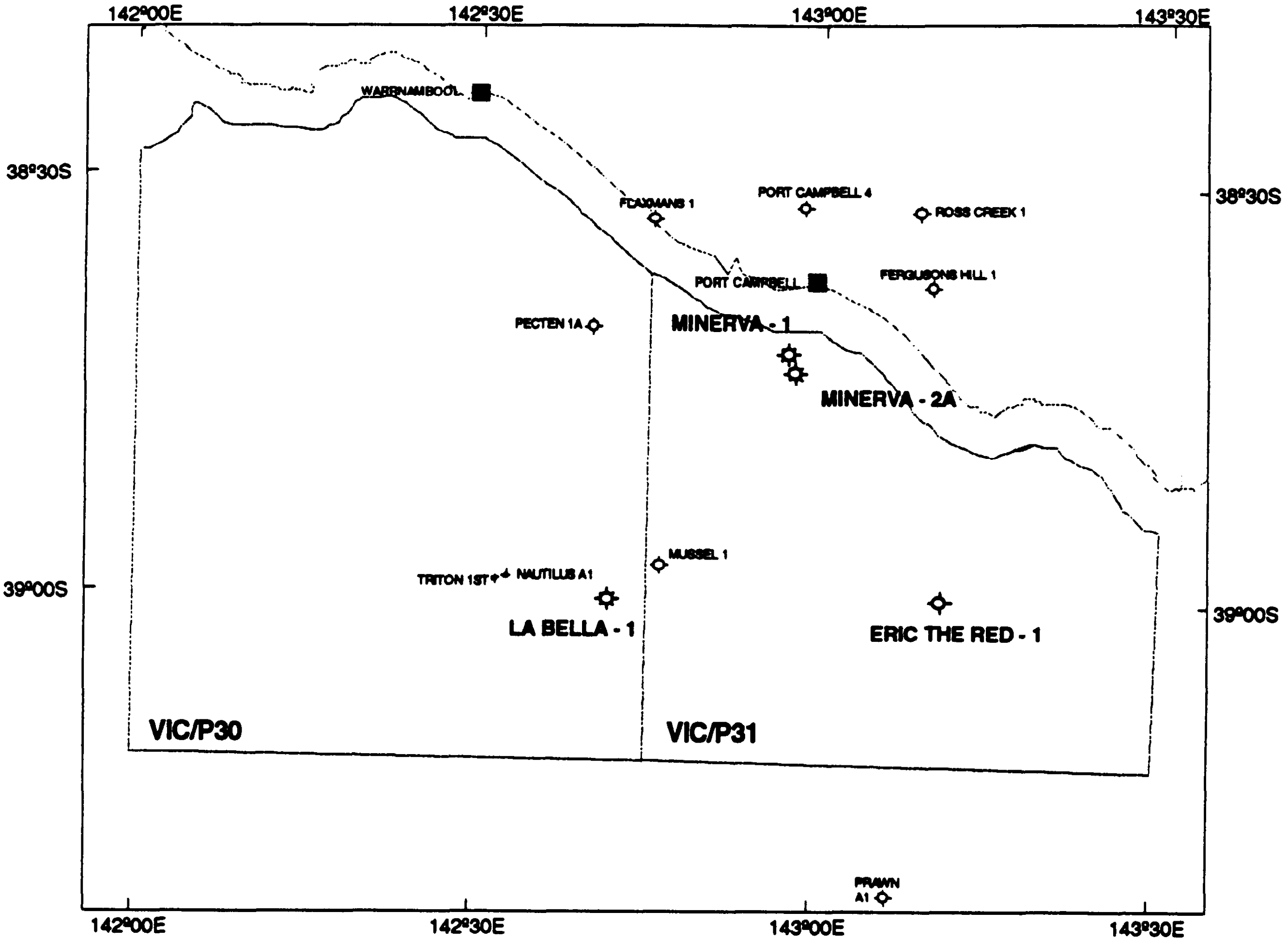
Table 3.

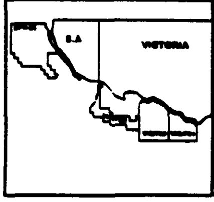
Well: Minerva-2A Date: 13 October 1993.

KB: 25.3 m
Sample No 1 **Depth:** 1875 mAHKB
Formation Pressure 2736.3 psia

	Lower	**Upper**	
Chamber No:	RFS-AD-1289	RFS-AD-1227	
Chamber Size:	2.75	1	gal
Flowing Pressure:	approx 2500	approx 2700	psig
Time To Fill:	10	5	minutes
Opening Pressure:			psig
Gas Volume:	Preserved for	Preserved for	ft^3
Total Liquids:	PVT Analysis	PVT Analysis	cc
Oil/Condensate Volume:			cc
Filtrate/Water Volume:			cc
Gas Oil Ratio:			scf/stb
Condensate Gas Ratio:			stb/MMscf

Figure 1.





VICP30/31
WELL LOCATIONS

BHP Petroleum

OTWAY BASIN

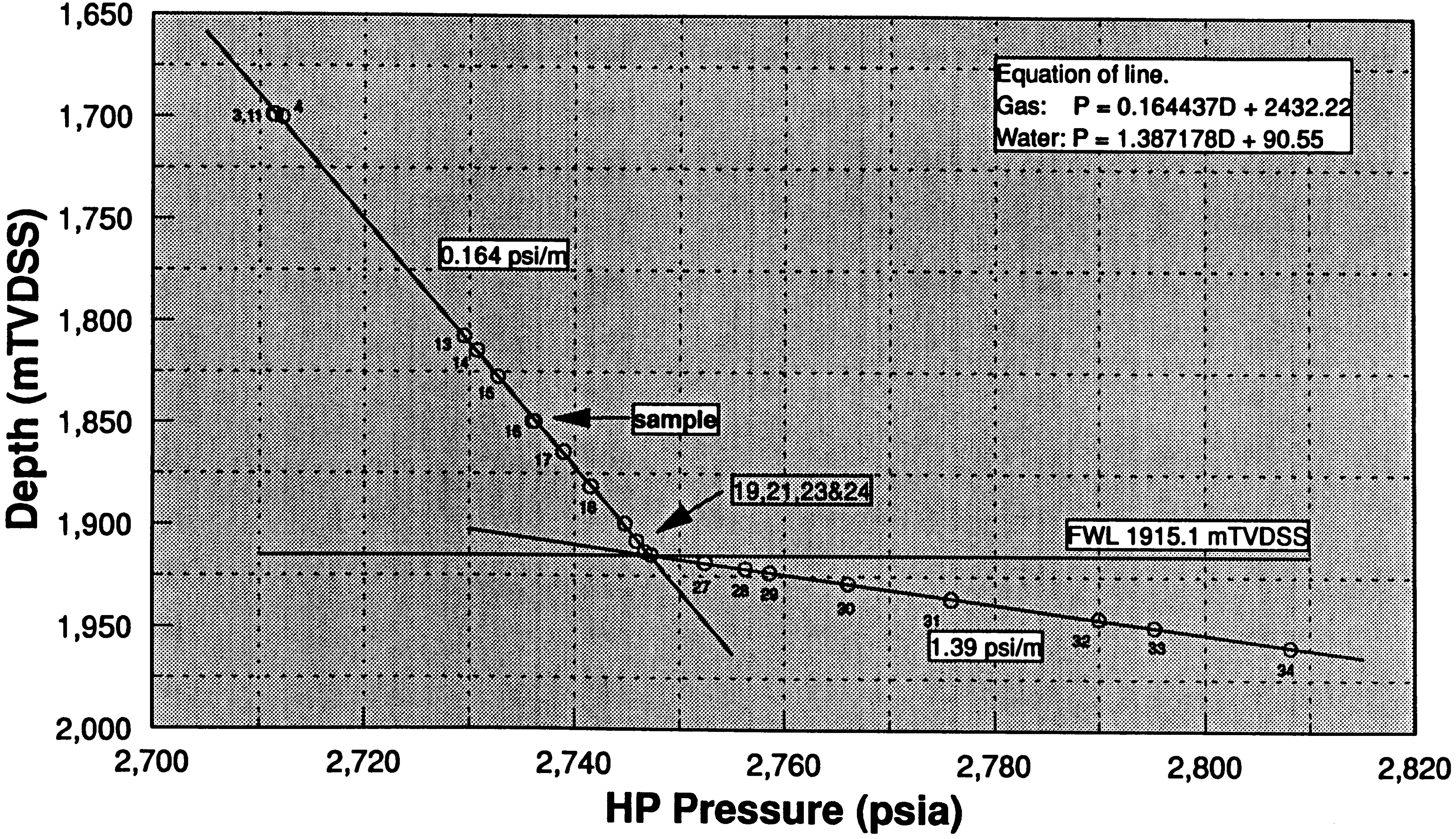
VICP30/P31
LOCATION MAP

AUTHOR:	DATE: 05/04/93
DRAWN BY TDELPHIN	DWG 000004 MK_R.W_V

Figure 2.

Minerva-2A

Formation Pressure vs Depth

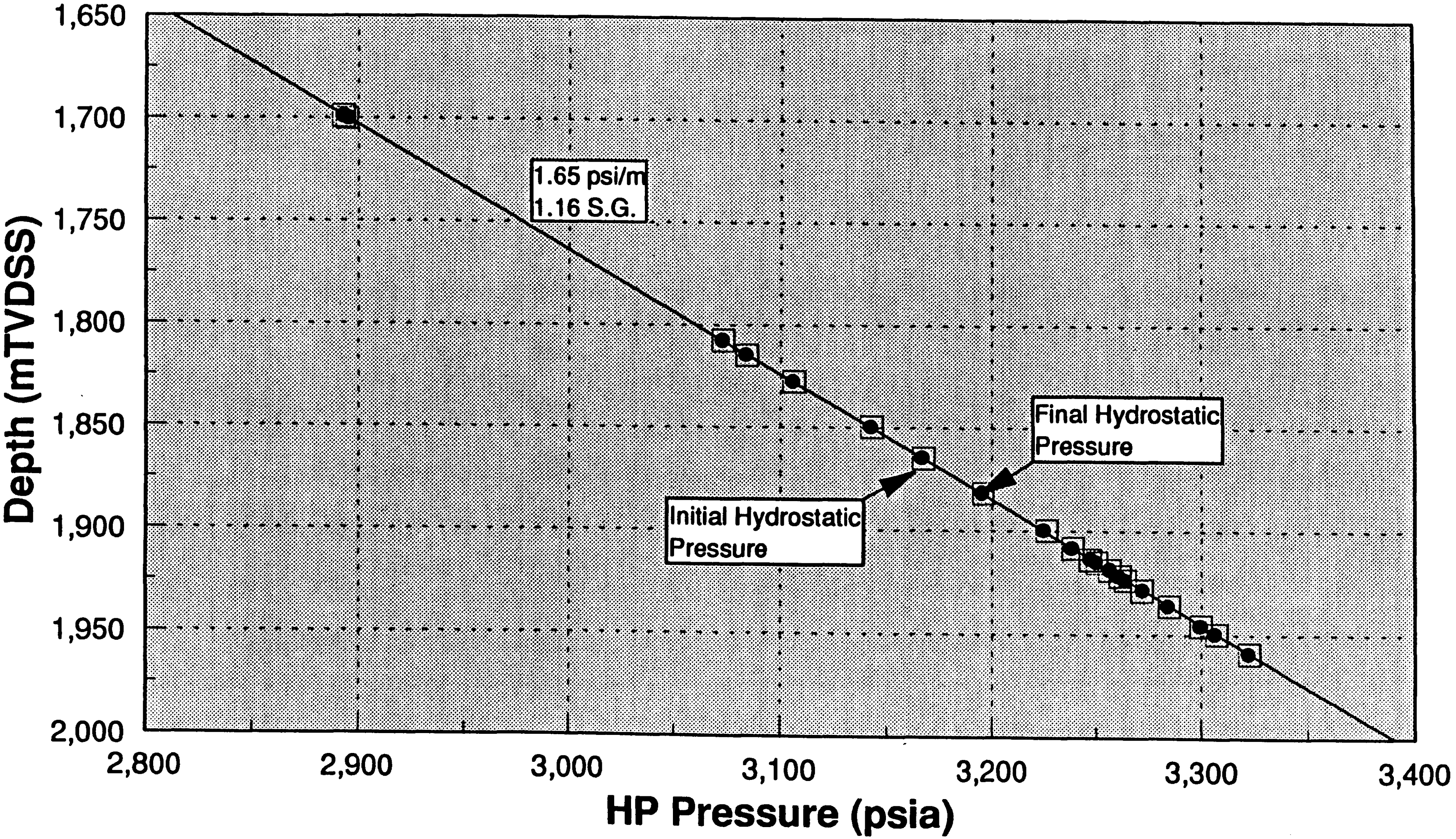


filename:min2A.p.d

Figure 3.

Minerva-2A

Hydrostatic Pressure vs Depth



filename:min2A.pre

Figure 4.

Minerva-2A and Minerva-1
Formation Pressure vs Depth

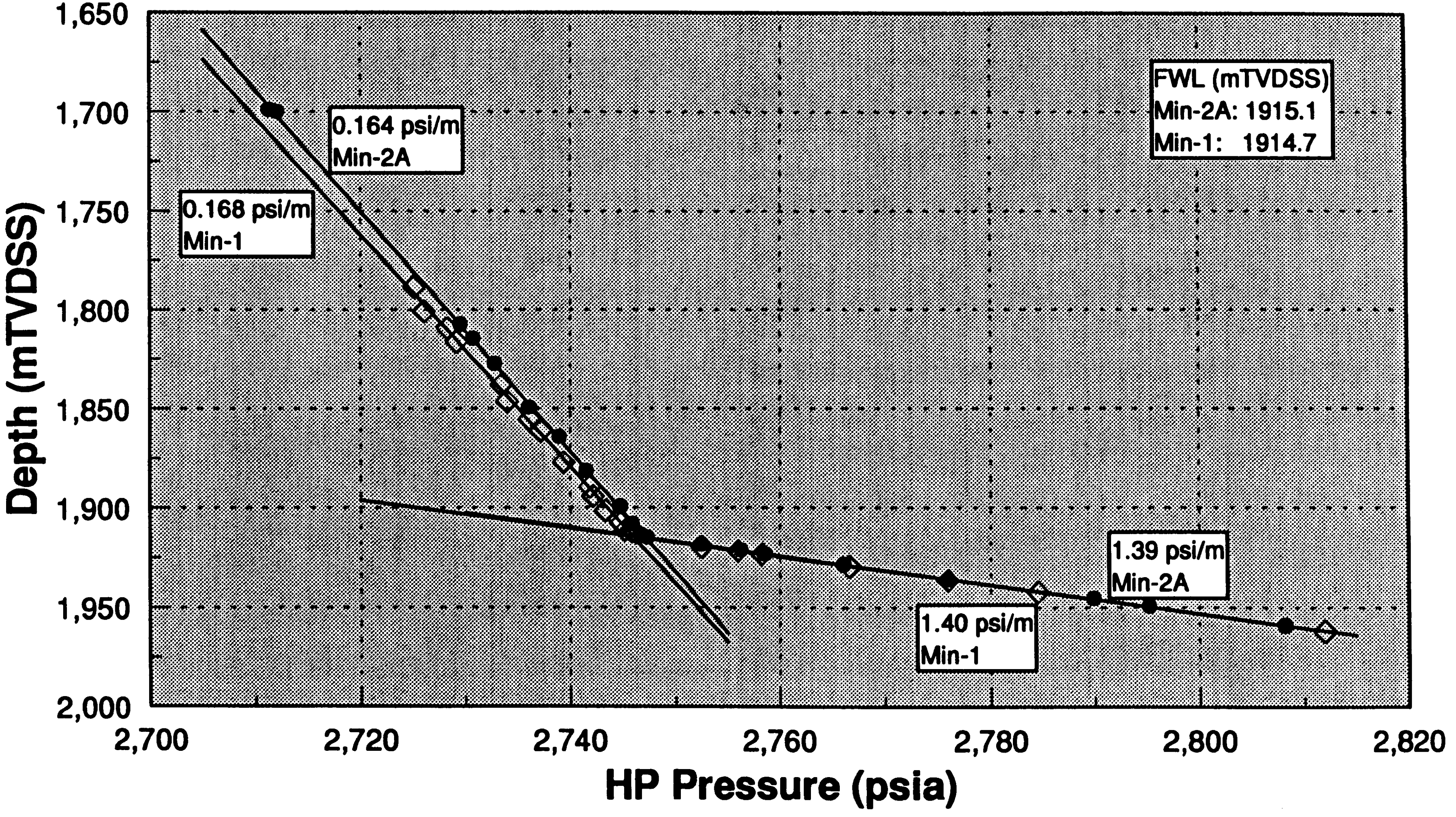


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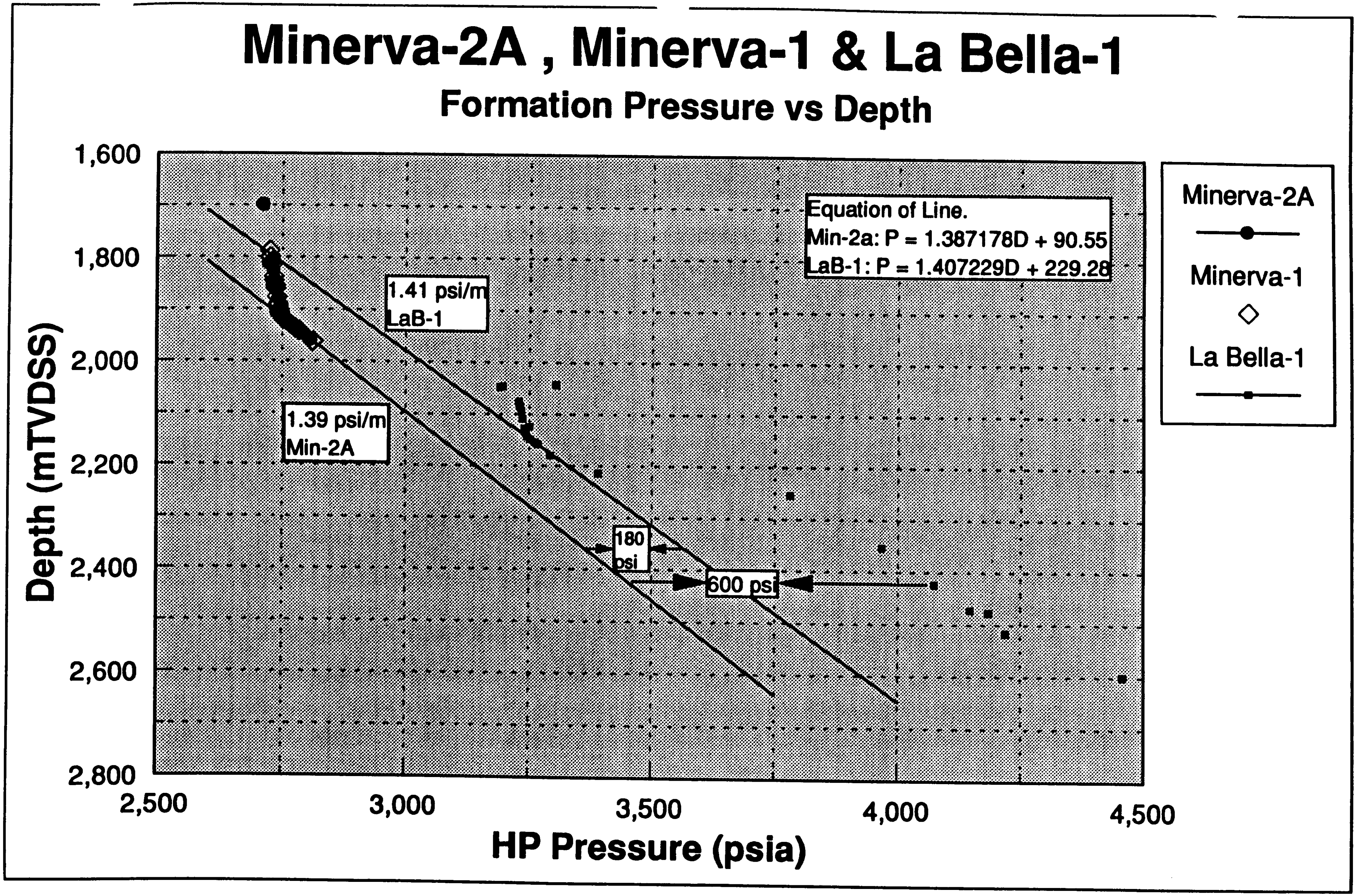
Figure 5.

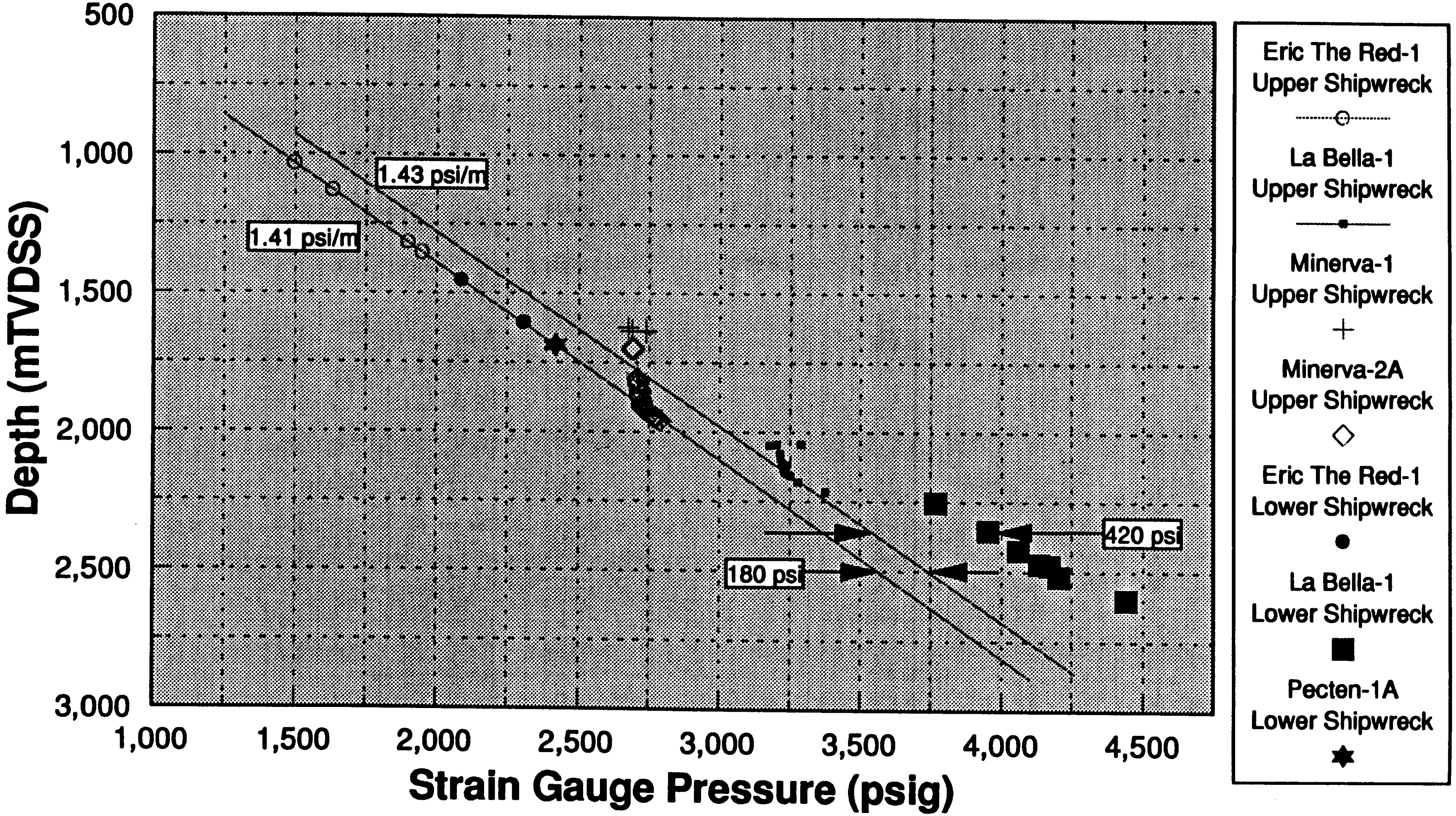


filename:min2A.pre

Figure 6.

VIC/P30 and VIC/P31 Formation Pressure Data

Formation Pressure vs Depth



APPENDIX A:

PETROLAB PVT ANALYSIS REPORT

TRANSFER DETAILS

RFS # AD # 1227 Upper Chamber

Depth Datum	:	KB
Elevation above MSL(m)	:	25.3
Sample Type	:	Segregated Open Hole RFT
Depth	:	1875 m DF
Reservoir Pressure	:	2736.3 psia
Reservoir Temperature	:	95 ° C.
Capacity	:	1 Gallon
Received	:	October 23, 1993
Opening Pressure	:	2150 Psig @ 15 ° C.

Injected 100 cc's of mercury in chamber to stir up sample. Chamber compressed to 5000 psig with approximately 1850 cc's of water behind piston. Transferred 1975 cc's of gas into Petrolab cylinders # L-058, L-125 and L-329 @ 5000 psig. Recovered 3 cc's of water.

RFS # AD # 1289 Lower Chamber

Depth Datum	:	KB
Elevation above MSL(m)	:	25.3
Sample Type	:	Segregated Open Hole RFT
Depth	:	1875 m DF
Reservoir Pressure	:	2736.3 psia
Reservoir Temperature	:	95 ° C.
Capacity	:	2 3/4 Gallon
Received	:	October 23, 1993
Opening Pressure	:	2175 psig @ 15 ° C.

Chamber compressed to 5000 psig with approximately 5500 cc's of water behind piston. Flashed gas content to atmospheric pressure using the DRY ICE COLD TRAP method to collect any condensed hydrocarbon liquids.The gas was bled off showly for a period of two days and the temperature of the cold trap was kept around – 100 deg. F using dry ice. Recovered 30 cc's of liquid in two separate bottles and forwarded them to BHP Petroleum on the November 11, 1993 and 80 cc's of water.Chamber(1 Gallon) dismantled and cleaned of all mercury.Both chambers (1 and 2 3/4 gal) shipped back to Schlumberger Sale on November 11, 1993.

PETROLAB

Company : BHP Petroleum Pty. Ltd.
Well : Minerva # 2A

Page : 2 of 2
File : B 9303F

COMPOSITIONAL ANALYSIS OF Reservoir Fluid

RFS # AD # 1227 Upper

Component		Mol %	GPM
Hydrogen Sulphide	H2S	0.00	
Carbon Dioxide	CO2	1.64	–
Nitrogen	N2	0.95	
Methane	C1	93.64	
Ethane	C2	2.20	0.589
Propane	C3	0.82	0.226
Iso–Butane	iC4	0.11	0.036
N–Butane	nC4	0.18	0.057
Iso–Pentane	iC5	0.05	0.018
N–Pentane	nC5	0.05	0.018
Hexanes	C6	0.08	0.031
Heptanes	C7	0.14	0.059
Octanes	C8	0.07	0.032
Nonanes	C9	0.04	0.020
Decanes	C10	0.02	0.011
Undecanes	C11	0.01	0.006
Dodecanes Plus	C12+	0.00	0.000
TOTAL		100.00	1.103

(P)ressure : 2622 psig (T)emperature: 203 °F

Pressure Base : 14.696
Zsc : 0.998

Mol Weight : 17.64
Gas Gravity : 0.610
Pc : 670.4
Tc : 356.7

Mol Weight C6+ : 101.8
Density C6+ : 0.6914

Mol Weight C7+ : 106.9
Density C7+ : 0.6979

Mol Weight C8+ : 117.7
Density C8+ : 0.7107

Mol Weight C11+ : 147.0
Density C11+ : 0.7400

Mol Weight C12+ : --
Density C12+ : --

Heating Value (BTU/ft3)
Gross : 1044
Nett : 942

Wobbe Index : 1337

Zpt * : 0.915

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47 Woodforde Road, Magill,
South Australia, 5072
P^ Box 410,
I, South Australia, 5072

PETROLAB

Fax: 364 1500
Telex: AA88214
Tel: (08) 364 1500
(08) 333 0787

Reservoir Fluid and Core Services, Laboratory Consulting and Analysis

A. C. N. # 008 130 667

Adelaide, January 6, 1994
P. O. Box 410
MAGILL 5072
South Australia

BHP Petroleum Pty. Ltd.
GPO Box 1911-R
MELBOURNE 3001
Victoria

Subject: Reservoir Fluid Study
Well: Minerva # 2A
File: B - 93038

Attention: Mr. Lee Yong

Dear Sirs,

Please find enclosed the dew point pressure determination performed on the gas sample stored in Petrolab Cylinder # L-058 from the Minerva # 2A RFT.

This sample has a dew point at 1885 psig and 203 °F.

We thank BHP Petroleum Pty. Ltd. for the opportunity to be of service. Please do not hesitate in contacting us should you require any further information or if we can assist you in any other way.

Yours Sincerely,

Marcel Volant
Laboratory Manager

APPENDIX B:

BHPP LABORATORY ANALYSIS REPORT

Sample No : 1
Sample Name: Minerva-2A 2.3/4 gas RFT

BHP 12 - Simulated Distillation

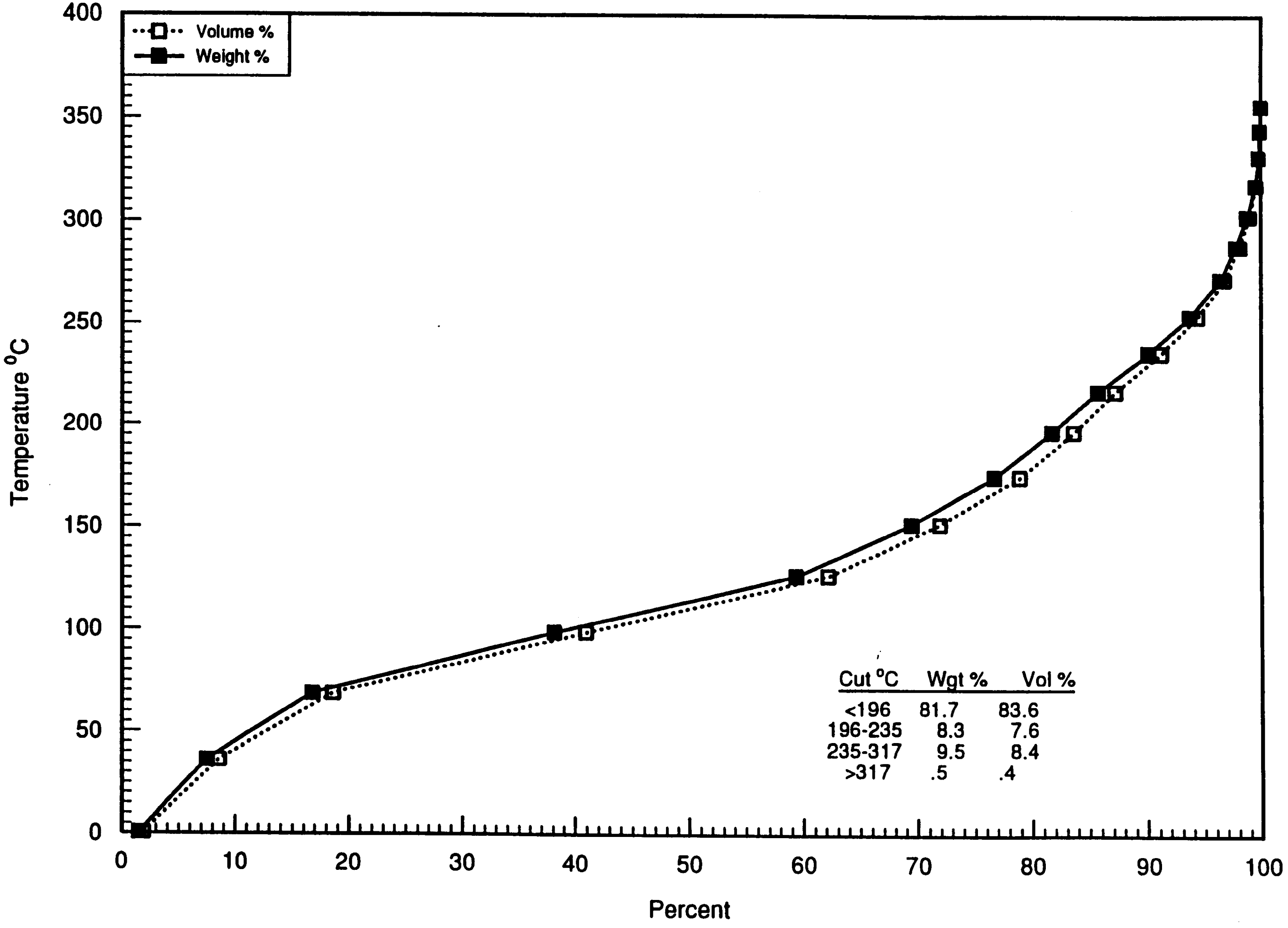
Component	BP deg C	Cum Wgt%	Cum Vol%
C4	0.5	1.5	1.9
C5	36.1	7.5	8.6
C6	68.7	16.8	18.6
C7	98.4	38.1	40.9
C8	126.0	59.3	62.1
C9	151.0	69.4	71.9
C10	174.0	76.7	78.9
C11	196.0	81.7	83.6
C12	216.0	85.7	87.2
C13	235.0	90.1	91.2
C14	253.0	93.7	94.4
C15	271.0	96.4	96.8
C16	287.0	97.8	98.1
C17	302.0	98.8	99.0
C18	317.0	99.5	99.6
C19	331.0	99.8	99.8
C20	344.0	99.9	99.9
C21	356.0	100.0	100.0

Summary

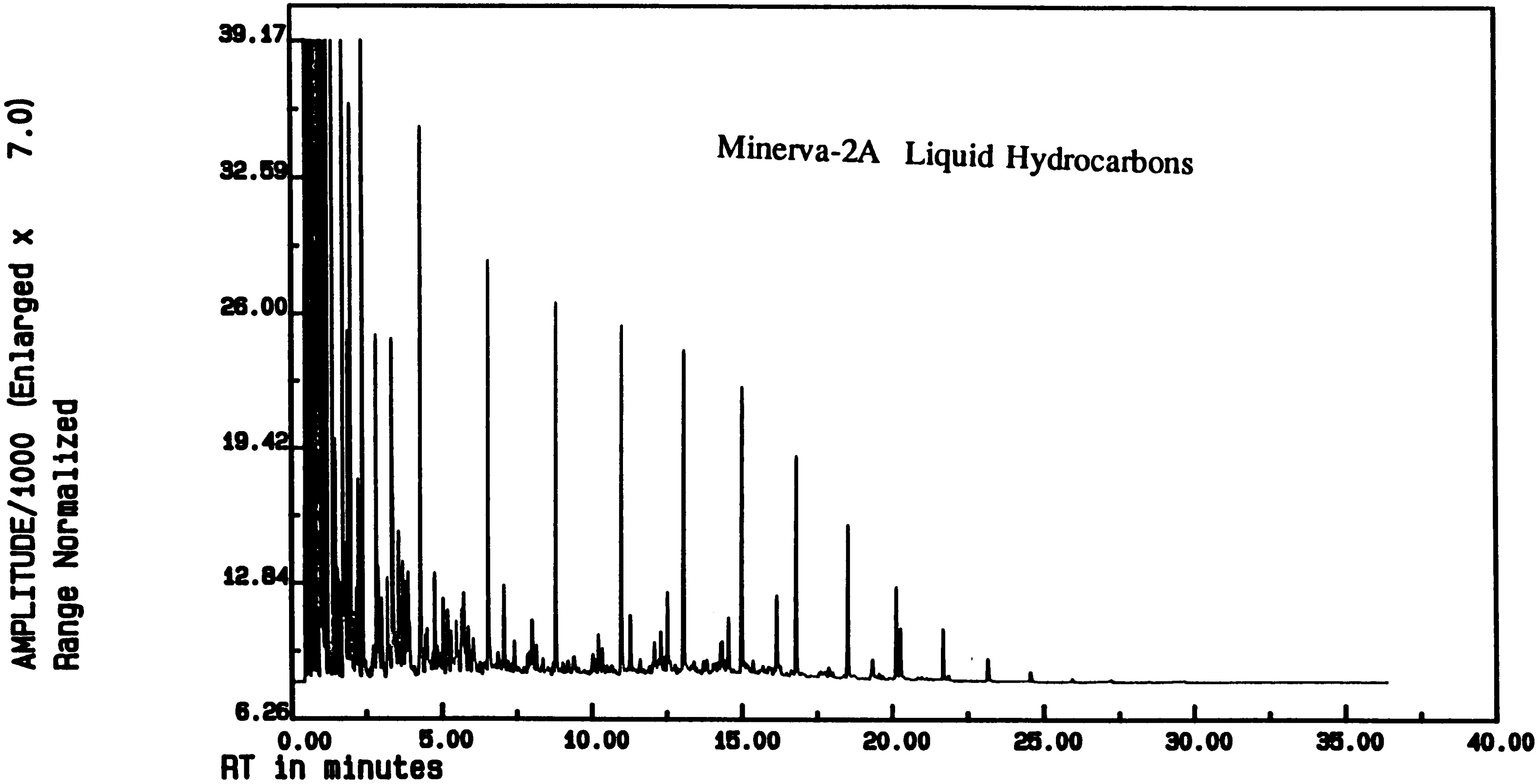
Cut degC	Wgt %	Vol %
<196	81.7	83.6
196-235	8.3	7.6
235-317	9.5	8.4
>317	0.5	0.4

SIMULATED BOILING POINT DISTRIBUTION

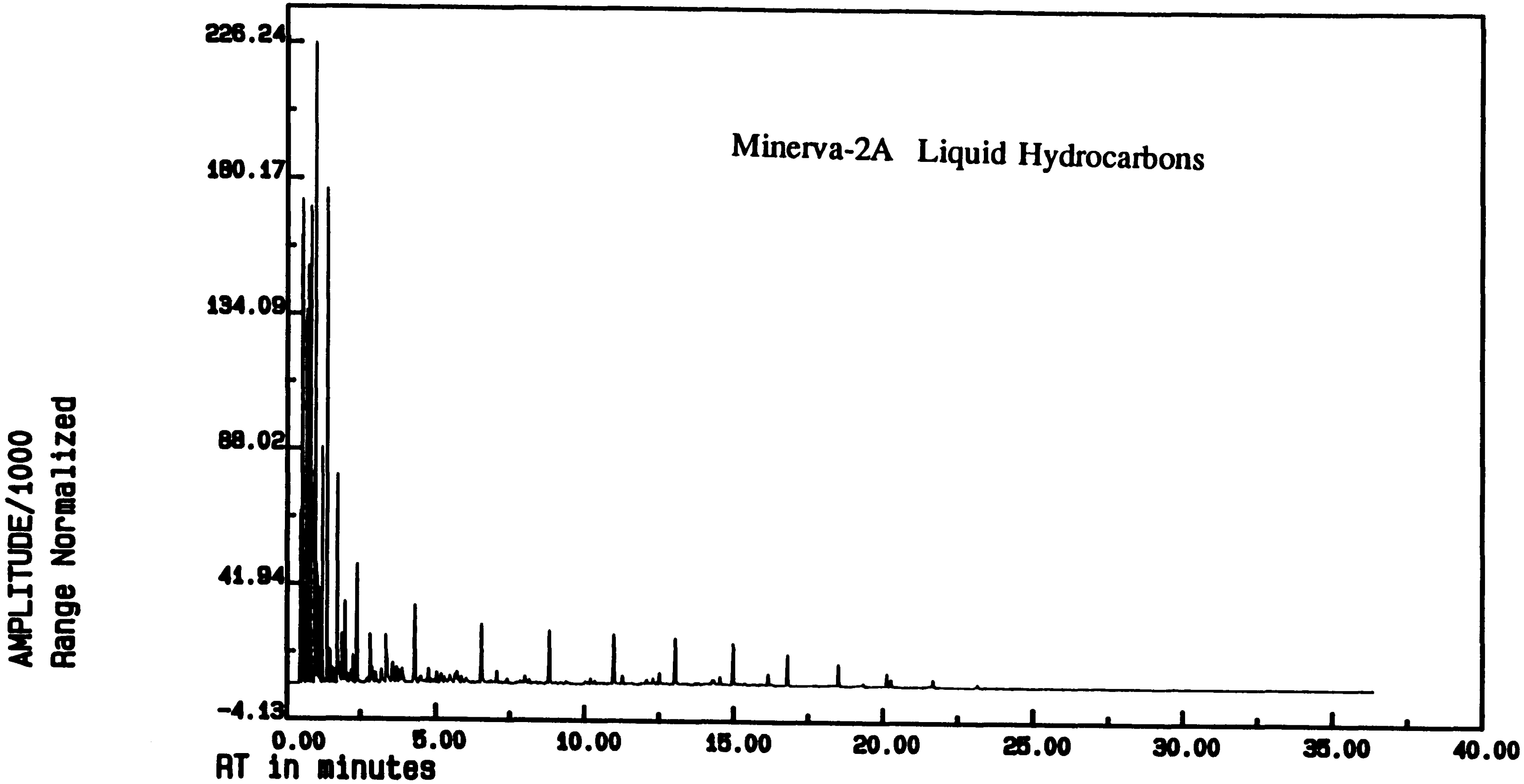
Report/Sample No. 93-226-1 Minerva-2A 2.3/4 gas RFT



Cut °C	Wgt %	Vol %
<196	81.7	83.6
196-235	8.3	7.6
235-317	9.5	8.4
>317	.5	.4



SAMPLE: MINERVA 2A INJECTED AT 15: 41: 21 ON NOV 19, 1993
Meth: SIMMIM Raw: RMN2A Proc: PMN2A



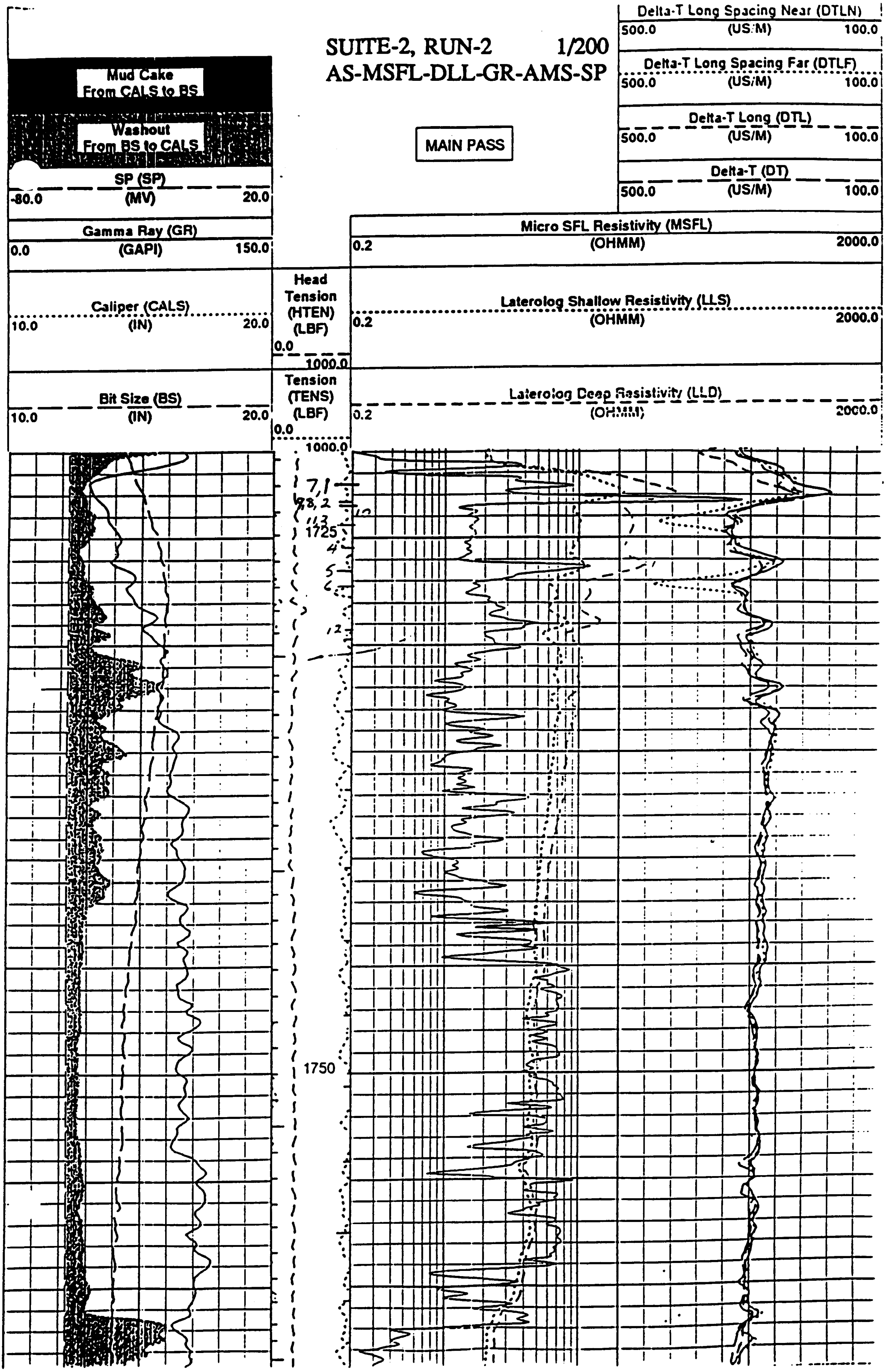
SAMPLE: MINERVA 2A INJECTED AT 15: 41: 21 ON NOV 19, 1993
Meth: SIMMIM Raw: RMN2A Proc: PMN2A

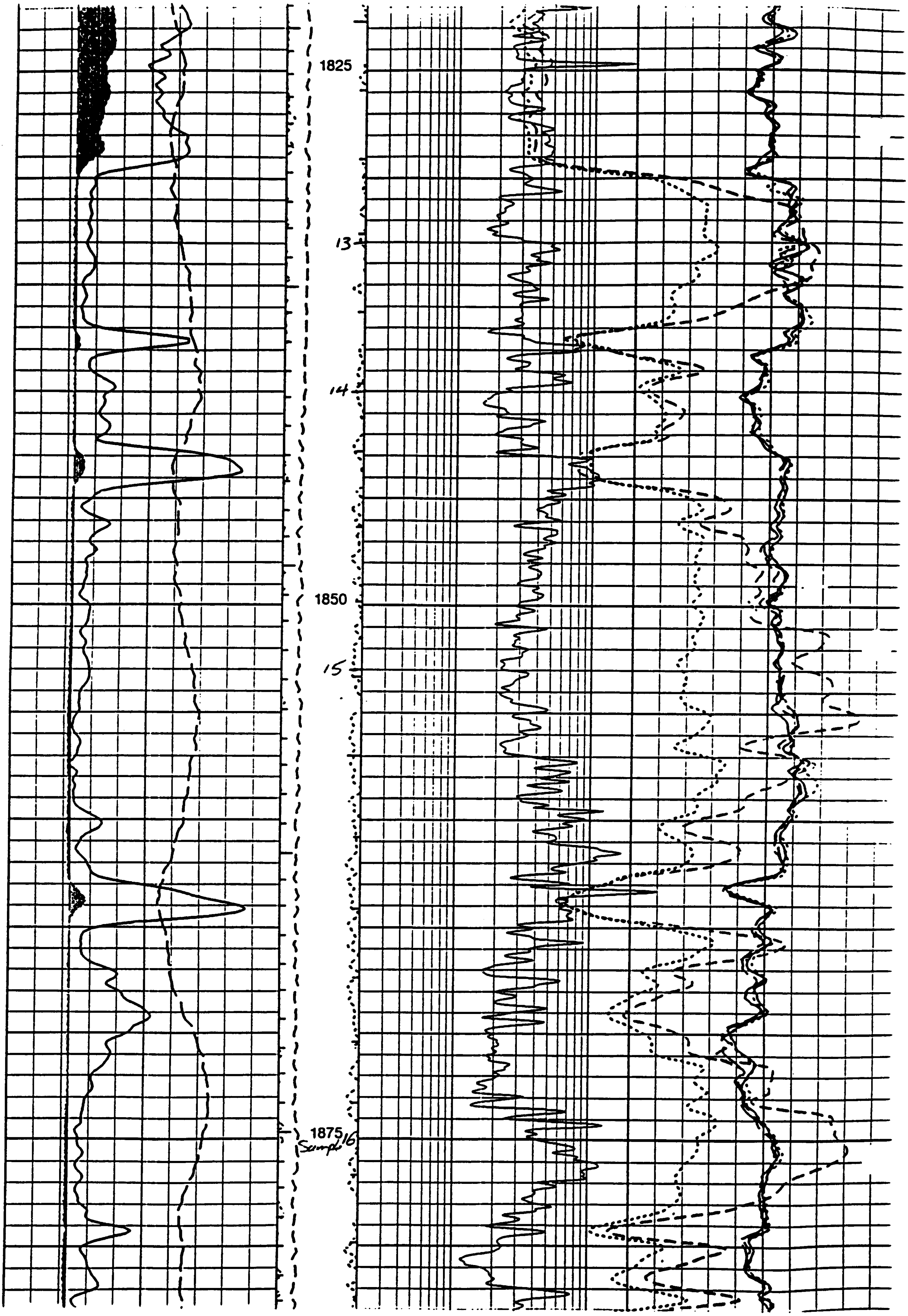
ENCLOSURE 1:

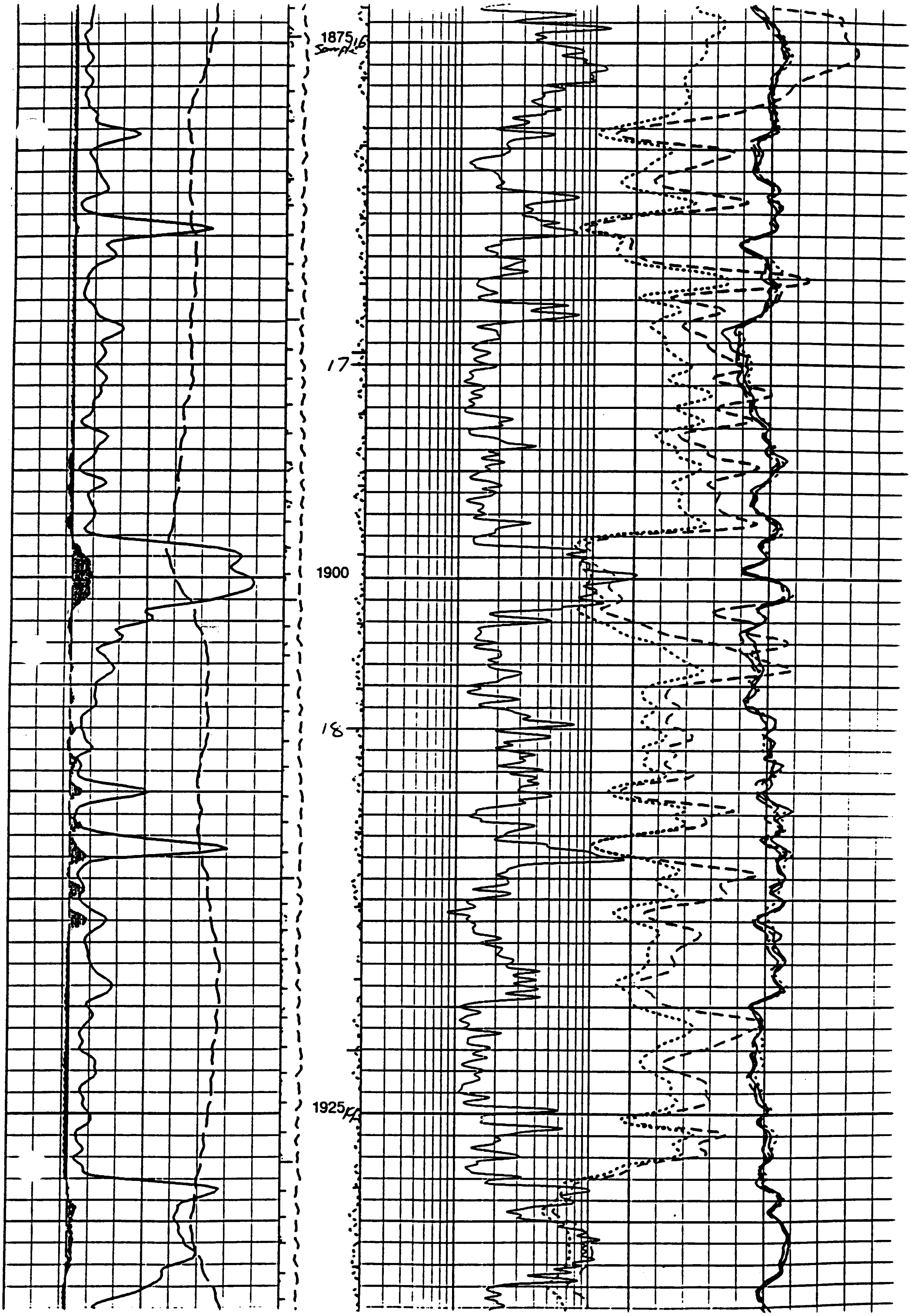
MINERVA-2A DLL-MSFL-SDT-GR-AMS LOG

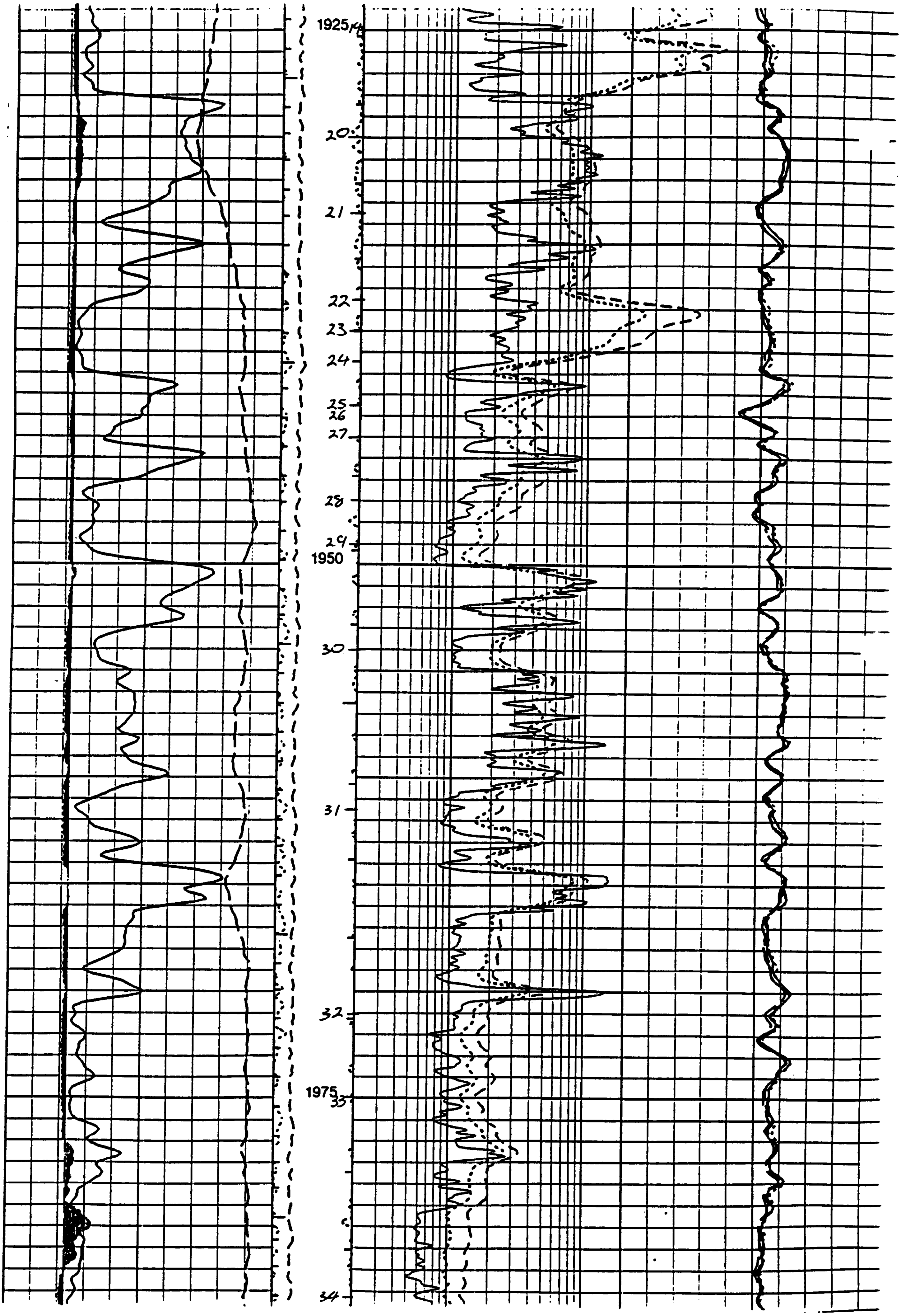
SUITE-2, RUN-2 1/200
AS-MSFL-DLL-GR-AMS-SP

MAIN PASS




1825
13
14
1850
15
1875
16
Sample


1875
16
Sample
17
1900
18
1925


1925
20
21
22
23
24
25
26
27
28
29
1950
30
31
32
1975
33
34

PE600430

This is an enclosure indicator page.
The enclosure PE600430 is enclosed within the container PE900102 at this location in this document.

The enclosure PE600430 has the following characteristics:

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CONTAINER_BARCODE = PE900102
NAME = Minerva 2A AS-MSFL-DLL-GR-AMS-SP (2170-1526m), 1:200
BASIN = OTWAY
PERMIT = VIC/P31
TYPE = WELL
SUBTYPE = WELL-LOG
DESCRIPTION = Minerva 2A AS-MSFL-DLL-GR-AMS-SP (2170-1526m), 1:200, Suite 2, Run2, Vol 2 Appendix 4
REMARKS =
DATE-CREATED = 12/10/93
DATE-RECEIVED = 3/11/93
W_NO = W1086
WELL-NAME = MINERVA 2 & 2A
CONTRACTOR = Schlumberger
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)

PE600431

This is an enclosure indicator page.
The enclosure PE600431 is enclosed within the
container PE900102 at this location in this
document.

The enclosure PE600431 has the following characteristics:

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CONTAINER_BARCODE = PE900102
NAME = Minerva 2A AS-MSFL-DLL-GR-AMS-SP (2170-1526m), 1:500
BASIN = OTWAY
PERMIT = VIC/P31
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = Minerva 2A AS-MSFL-DLL-GR-AMS-SP (2170-1526m), 1:500, Suite 2, Run2, Vol 2 Appendix 4
REMARKS =
DATE_CREATED = 12/10/93
DATE_RECEIVED = *
W_NO = W1086
WELL_NAME = MINERVA 2 & 2A
CONTRACTOR = Schlumberger
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)

5

BHP
Petroleum

BHP PETROLEUM PTY. LTD.
A.C.N. 006 918 832

REPORT ON A STUDY OF MINERVA-1 and MINERVA-2 CONVENTIONAL CORE, VIC/P31, OTWAY BASIN

PREPARED BY: P.A. ARDITTO
SEDIMENTOLOGIST, TECHNICAL
CONSULTING GROUP

0146

DATE: JANUARY, 1994

TABLE OF CONTENTS

1 INTRODUCTION

This report is based on the detailed examination and description/interpretation of some 123 metres of conventional core cut in Minerva-1 and Minerva-2A in the BHP Petroleum operated permit VIC/P31 within the offshore eastern Otway Basin. The study was undertaken by Messrs P.A. Arditto and S. Horan initially on Minerva-2A core at the AMDEL laboratories in Adelaide (10-12 November, 1993) and later on Minerva-1 core at the Kestral warehouse in Melbourne (24 November, 1993). Minerva-1 had 20.67m of core recovered and Minerva-2A had 101.97m of core recovered for study.

Lithological description and environmental interpretation of each cored interval are followed by core description sheets at 1:25 scale, core gamma ray log data and a selection of wireline log data over and adjacent to the cored interval. A key to the symbols used on the core description sheets is given at the end of the report. Where available, depositional environment inferences from palynological data by Roger Morgan were used to augment environmental interpretation made from core observations.

The results and conclusions of this study form an integral part of the evaluation and characterisation of the reservoir section in the Minerva Gas Field as well as contributing to the regional geology of the basal portion of the Upper Shipwreck Group in the eastern Otway Basin.

2 SUMMARY

The main reservoir interval cored in Minerva-1 and Minerva-2A comprises an overall upward shoaling estuarine to fluvial succession of medium to very coarse grained sandstone channel fill lithofacies with minor preserved finer grained estuary bay and fluvial overbank lithofacies. The depositional model for the reservoir interval is that of a high energy fluvial system dumping significant quantities of coarse quartz detritus as it encroached into a nearshore marine setting along an embayed coastline.

The reservoir quality of these multistorey high energy channel sandstone successions is excellent as they are commonly coarse grained and very well sorted. The depositional setting inferred for the reservoir interval predicts that individual sandstone channel units will be highly interconnected across the field. The minor thin overbank shales present within the high energy fluvial succession comprising the upper portion of the reservoir interval would not be individually extensive as these would be incised and breached by successive channel cuts.

3 MINERVA-1

3.1 Core 1

3.1.1 Description and Interpretation

Lithological Description

The interval 1821.00m to 1823.35m is sandstone, predominantly very coarse grained and poorly sorted, comprised of six upward fining units separated by scour surfaces with pebble lags. Internally it is homogeneous with minor trough cross bedding and sporadic shale rip up clast horizons. Abundant disseminated pyrite cement is present over the interval 1821.50m to 1822.75m. Unfortunately about one third of this part of the core is preserved as rubble which does not make more detailed observations possible.

The interval 1823.35m to 1824.04m is sandstone, medium grained and homogeneous with minor shale rip up clast horizons and pebble lags on scour surfaces. This entire interval is core rubble.

Environmental Interpretation

The relatively short length of core together with almost 50% of it preserved as rubble makes it difficult to be categoric on inferring depositional environments. The available evidence points to the cored section being cut in a succession of stacked lower point bar or braid bar channel units deposited during flood to early falling stage of a low sinuosity fluvial system. Core gamma ray and wireline log data are consistent with this interpretation.

3.2 Cores 2 and 3

3.2.1 Description and Interpretation

Lithological Description

Core 2 was cut over the interval 1828.00m to 1841.27m and core 3 over the interval 1842.50m to 1846.87m. The interval 1828.00m to 1829.50m is sandstone, very coarse grained to granule at the base (scour surface) fining upwards to medium to coarse grained at the top. The sandstone is well sorted and predominantly homogeneous with minor trough cross bedding in the upper half. The interval 1829.50m to 1833.15m is sandstone, predominantly very coarse grained, pebbly and very poorly sorted, comprising seven units separated by scour surfaces. Internally the units are homogeneous with minor planar inclined laminations (? trough cross bedding). The basal portion of each unit contains a concentration of pebbles and sporadic shale rip up clasts.

The interval 1833.15m to 1836.90m is sandstone, predominantly medium to coarse up to very coarse grained and moderately well sorted, comprising eleven upward fining units separated by scour surfaces. Internally these units are trough cross bedded with minor current ripple and carbonaceous to shaly flaser laminations at the top. Rare pillow and flame features and dewatering features are evident over the interval 1835.15m to 1835.30m. The lowermost metre of sandstone is very well sorted.

The interval 1836.90m to 1837.06m is shale, highly carbonaceous, with sporadic resin blebs and pyrite cement near the top contact (scour surface). The interval 1837.06m to 1837.23m is coal, black, brittle and sub bituminous with pyrite cement. The interval 1837.23m to 1838.85m is shale, dark grey to black and highly carbonaceous with rootlets, plant stems and abundant resin blebs in the upper third and dark grey and homogeneous with minor plant stems and sporadic resin blebs in the lower two thirds.

The interval 1838.85m to 1839.70m is siltstone to very fine grained sandstone comprising two upward fining units. Internally the siltstone is homogenised through rootlet bioturbation and dewatering. The interval 1839.70m to 1840.35m is predominantly shale, dark grey with a thin coal and resin blebs in the upper half and becoming silty with microfoundering features in the lower half. The base is wavy and gradational into the unit below.

The interval 1840.35m to 1841.27m (base of core 2) is sandstone, predominantly fine to medium grained, comprising two upward fining units separated by a scour surface. The units are planar bedded to current ripple laminated in the lower half and flaser bedded to rooted with dewatering features in the upper half.

Core 3 commences at 1842.50m and the entire interval to 1846.87m (base) is sandstone, predominantly medium to coarse grained up to very coarse grained and well sorted, comprised of multiple upward fining cycles separated by scour surfaces and pebble lags. Internally the units are trough cross bedded and some unusually high angle trough cross bed laminae may indicate slump rotation during initial compaction.

The sandstone throughout this core has a sucrosic texture and the sand grains sparkle through abundant overgrowth development. Several subhorizontal to near vertical fractures healed by silica cement are developed over the interval 1844.21m to 1844.40m and 1845.60m to 1846.30m.

Environmental Interpretation

The interval 1828.00m to 1833.40m is interpreted as a stacked high energy channel succession deposited during late flood to early falling stage cycle in a low sinuosity fluvial system. The interval 1833.40m to 1836.90m is interpreted as a succession of lower point bar channel units deposited during the falling stage cycle in a low sinuosity fluvial system. The interval 1836.90m to 1838.85m represents deposition of overbank/abandoned channel fill during the low stage cycle of a low sinuosity fluvial system. The interval 1838.85m to 1840.35m is interpreted to represent deposition of distal crevasse splays and abandoned channel fill during a low stage cycle. The interval 1840.35m to 1841.27m (base of core 2) is interpreted to represent stacked middle point bar channel units deposited during a falling stage cycle.

The entire interval of core 3 (1842.50m to 1846.87m) is interpreted to be a succession of stacked channel units deposited during late flood to early falling stage cycle in a low sinuosity fluvial system.

4 MINERVA-2A

4.1 Core 1

4.1.1 Description and Interpretation

Lithological Description

The entire cored interval, 1728.50m to 1733.60m is sandstone, very fine grained and silty towards the base, grading upwards to very fine to fine grained muddy sandstone at the top. It is very poorly sorted through intensive bioturbation with sparse sand-filled dwelling burrows developed near the top of the interval. Faint subhorizontal disturbed laminations are developed throughout although primary sedimentary features are largely destroyed through biological churning of the original sediment. Sporadic sideritic nodular mudstone intervals are developed within some burrow features.

Environmental Interpretation

The relatively short length of core together with the *homogeneity of* lithology and structures make it difficult to be categoric [illegible] depositional environment. The relatively [illegible] bioturbated nature of the interval, comb[illegible] generated features, indicate a possible offsh[illegible] Wireline log data indicates that core was taken fro[illegible] grossly upward coarsening (progradational) cycle some 70[illegible]

4 MINERVA-2A

4.1 Core 1

4.1.1 Description and Interpretation

Lithological Description

The entire cored interval, 1728.50m to 1733.60m is sandstone, very fine grained and silty towards the base, grading upwards to very fine to fine grained muddy sandstone at the top. It is very poorly sorted through intensive bioturbation with sparse sand-filled dwelling burrows developed near the top of the interval. Faint subhorizontal disturbed laminations are developed throughout although primary sedimentary features are largely destroyed through biological churning of the original sediment. Sporadic sideritic nodular mudstone intervals are developed within some burrow features.

Environmental Interpretation

The relatively short length of core together with the homogeneity of lithology and structures make it difficult to be categoric in the discussion of depositional environment. The relatively fine grained and intensely bioturbated nature of the interval, combined with an absence of wave generated features, indicate a possible offshore open marine setting. Wireline log data indicates that core was taken from near the base of a grossly upward coarsening (progradational) cycle some 70 m thick. The inferred environmental setting is that of a distal toe of a prograding shoreface (or ?deltaic) unit just below wavebase.

Samples for palynology taken at 1733.50m and 1733.60m had a high ratio and diversity of dinoflagellates and were inferred to be nearshore marine.

4.2 Cores 2 and 3

4.2.1 Description and Interpretation

Lithological Description

The interval 1838.80m to 1839.67m is sandstone, medium up to coarse grained and granule, comprised of fining upward cycles 0.1m to 0.3m in thickness separated by scour surfaces and pebble lags. The sandstone is well sorted and trough cross bedded with minor flasers towards the top of each unit. The interval 1839.67m to 1840.77m is shale, medium grey, mottled with sparse carbonaceous rootlets. It is generally homogeneous with minor starved ripple and microfoundering features in the lower half. Sparse scattered resin blebs occur in the upper half of the interval. The interval 1840.77m to 1840.79m is coal, black and sub bituminous. The interval 1840.79 to 1841.15m comprises shale, silty, with starved ripples and microfoundering features. Rare resin blebs occur at the top of the unit.

The interval 1841.15m to 1841.82m is sandstone, very coarse grained to granule, moderately sorted and trough cross bedded to planar laminated with rip up clasts and flasers near the top which is transitional into the overlying unit. The base of the unit rests on a scour surface. The interval 1841.82m to 1842.80m is sandstone, coarse to very coarse grained and well sorted with minor granule trains along sporadic lamina. Internally it is trough cross bedded with minor high angle carbonaceous flaser drapes. The base of the unit rests of a prominent scour surface.

The interval 1842.80m to the base of core 2 (1855.05m) is sandstone, predominantly coarse to very coarse grained and well sorted. This interval is comprised of stacked upward fining units, typically 0.2m to 0.5m in thickness, separated by scour surfaces. Internally the sandstone units are trough cross bedded and typically have basal pebble lags and minor carbonaceous flaser laminated tops.

Core 3 commences at 1855.60m and the interval 1855.75m comprises grey argillaceous siltstone core rubble. The interval 1855.75m to 1860.23m is sandstone, fine to medium up to very coarse grained and comprised of upward fining units 0.15m to 0.70m in thickness separated by scour surfaces and pebble or shale rip up clast lags. Internally these units are trough cross bedded with several containing flaser laminations or lenticular bedded sandstone near the top. Several units over the interval 1858.90m to 1857.55m contain sparse up to abundant ophiomorpha burrows along with an overall upward fining throughout.

The interval 1860.23m to 1861.75m is shale, highly carbonaceous with sparse rootlets and minor thin coals, black and sub bituminous. Small resin blebs occur within the shale adjacent to the coaly horizons. Internally the shale is homogeneous throughout.

The interval 1861.75m to 1865.30m is predominantly sandstone, medium up to coarse grained, comprised of upward fining units 0.4m to 0.7m in thickness capped by carbonaceous flaser laminations or, more rarely, flasered thin shale intervals. Internally these units are trough cross bedded and separated by scour surfaces with sporadic basal shale rip up clast lags.

The interval 1865.30m to 1866.00m is sandstone, coarse grained at the base and fining up to fine to medium grained at the top. The lower one third contains shale rip up clasts and pebbles overlain by a trough cross bedded zone grading upward to flaser to lenticular bedded sandstone with burrows at the very top. The interval 1866.00m to 1866.75m is sandstone, predominantly fine to medium grained and muddy, comprised of three upward fining units. Internally it is heavily burrowed to bioturbated with recognisable ophiomorpha burrows. The lower half is flaser to lenticular bedded.

The interval 1866.75m to 1869.55m is sandstone, predominantly fine to medium grained, trough cross bedded in the lower half and flaser to current ripple laminated in the upper half. The interval 1869.55m to 1871.70m is sandstone, medium up to coarse grained, comprised of three upward fining units separated by scour surfaces. Internally the bulk of each unit is trough cross bedded with the uppermost part flaser laminated. The interval 1871.70m to 1873.90m is sandstone, predominantly coarse to very coarse grained up to granule and pebbly, comprised of four upward fining units, around 0.55m in thickness, separated by prominent scour surfaces and pebble lags. Internally these units have well developed trough cross bedding. The interval 1873.90m to 1876.35m is sandstone, predominantly medium to coarse grained, comprised of six upward fining units separated by scour surfaces and pebble lags. Internally these units are trough cross bedded and some have thin flaser laminated tops.

The interval 1876.35m to 1876.58m is shale, black and carbonaceous with silty starved ripples. The interval 1876.58m to 1880.63m is predominantly sandstone comprised of a series of stacked units, separated by scour surfaces, ranging in thickness from 0.40m to 0.90m. This interval displays an overall upward fining stacked succession from coarse to very coarse grained at the base to fine to medium grained at the top. Internally the basal 0.80m is trough cross bedded (basal 0.30m pyrite cemented) and well sorted and grades upwards into muddy poorly sorted burrowed to bioturbated finer grained sandstone for the remainder of the interval. Recognisable ophiomorpha burrows occur throughout.

The interval 1880.63m to 1881.05m is shale, black and highly carbonaceous with fine silty starved current ripple flasers. It is pyritic throughout with a layer of resin blebs at the very top. The remainder of the core (1881.05m to 1882.50m) is sandstone, predominantly medium to coarse grained and moderately well sorted, comprised of five upward fining units separated by scour surfaces. Internally the units are homogeneous to current ripple and flaser laminated with local development of ophiomorpha burrow horizons.

Environmental Interpretation

The interval 1838.80m to 1839.67m is interpreted to be a series of stacked basal channel fill units deposited during the late flood to early falling stage cycle within a low sinuosity fluvial system. The interval 1839.67m to 1841.80m is interpreted to represent a relatively complete accretionary point bar cycle deposited during low stage within a high sinuosity fluvial system. The cycle grades up from a lower through middle to upper point bar/abandoned channel fill succession. The interval 1841.80m to 1855.05m (base core 2) is interpreted to be a succession of stacked basal channel fill units deposited during late flood to early falling stage in a low sinuosity fluvial system. Palynological studies on shale samples from 1839.75m, 1841.00m and 1843.20m interpreted the environment to be that of a slightly brackish oxic to anoxic lake setting.

The interval 1855.75m (in situ top of core 3) to 1860.23m is interpreted to be a series of stacked basal channel fill units. Much of the succession is interpreted to be deposited in a low sinuosity fluvial dominated system although the 1857.55m to 1858.90m contains good ophiomorpha burrows which indicate shallow water marine conditions. This latter interval is interpreted to be deposited as a series of channel units building out into a shallow water estuary at the mouth of a fluvial complex and represents a small transgressive pulse into a predominantly fluvial system. A palynological study of a shale sample from 1857.30m gave a slightly brackish anoxic lake setting.

The interval 1860.23m to 1862.45m is interpreted to represent a relatively complete accetionary point bar cycle deposited during low stage within a high sinuosity fluvial system. This cycle grades relatively abruptly from lower point bar channel fill to upper point bar/abandoned channel fill with very little middle point bar preserved. A palynological study of a shale sample from 1860.30m was interpreted to be a brackish lake (tidal influence) setting. The interval 1862.45m to 1864.60m is interpreted as a series of stacked basal channel fill units deposited during late flood to early falling stage in a low sinuosity fluvial system.

The interval 1864.69m to 1866.00m contains two upward fining, trough cross bedded, sandstone channel fill units with flasered and burrowed tops. These are interpreted as a stream mouth bar or proximal estuary channel succession deposited in a nearshore marine setting at the mouth of a low sinuosity fluvial system. The interval 1866.00m to 1866.75m a distal tidal (estuary) stacked channel succession as indicated by the intensity of burrowing and bioturbation throughout. This interval represents the maximum extent of a minor marine transgression into a predominantly fluvial dominated system. A palynological study on a shale sample from 1866.50m was interpreted to be marginal marine lagoon or estuary.

The interval 1866.75m to 1871.70m is interpreted as a succession of stacked tidal/estuarine channel units within the mouth of a fluvial system entering a bay. Although no burrows are evident the entire interval is highly flasered indicative of episodic (?tidal) flow. The interval also demonstrates an overall upward fining pattern suggestive of a rise in base level (onset of a transgression).

The interval 1871.70m to 1876.35m is interpreted as a succession of stacked basal channel fill units deposited during a late flood stage cycle in a low sinuosity fluvial system. This interval gradually coarsens up through the successive stacking of coarser grained channel units to 1872.80m followed be a gradual fining upwards through the successive stacking of finer grained channel units. This vertical grainsize distribution is interpreted as initial prograding of the fluvial system over the underlying more marine units followed be a retreat of the fluvial system during a transgressive phase into the overlying more marine units.

The interval 1876.35m to 1882.50m is interpreted to be a succession of stacked tidal estuarine channel units deposited beyond the mouth of the feeding fluvial system. These channels typically have unidirectional current flow structures in the lower half with burrowed to bioturbated zones in the upper half. This estuary setting interpretation is further re-enforced by the presence of common ophiomorpha burrows within the channel sandstones.

Minor overbank/abandoned channel fill units occur over the interval 1876.35m to 1876.55m and 1880.63m to 1881.05m. These are interpreted to have been deposited during the low stage cycle of a high sinuosity tidal/estuary system and are preserved erosional remnants.

Palynological studies on shale samples taken over the above interval gave the following interpretations; 1876.50m (marginal marine lagoon or estuary), 1879.00m (nearshore ?tidal lagoon or estuary) and 1881.00m (very nearshore anoxic ?stagnant brackish lagoon or estuarine backwater).

4.3 Cores 4 and 5

Lithological Description

The interval 1915.00m (top of core 4) to 1916.57m is sandstone, coarse grained up to very coarse grained and pebbly, comprised of several units separated by scour surfaces. Upward fining character is evident the upper units. Internally these units are trough cross bedded to flaser laminated with minor shale rip up clast horizons.

The interval 1916.57m to 1917.13m is sandstone, predominantly very coarse grained, muddy and poorly sorted, comprised of three units separated by scour surfaces. Internally the sandstone contains discontinuous flaser laminations and minor burrows. The interval 1917.13m to 1918.30m is sandstone, predominantly fine to medium grained, muddy and very poorly sorted. The upper 0.15m is pebbly and grades up to very coarse grained. Internally the interval is homogeneous and heavily burrowed with ophiomorpha burrows.

The interval 1918.30m to 1920.33m is sandstone, fine to medium grained up to medium to coarse grained, comprised of five units of variable thickness separated by scour surfaces. Internally these units are trough cross bedded with flaser laminated tops. The interval 1920.33m to 1921.75m is sandstone, predominantly fine to medium grained (ranging from very fine to coarse grained) muddy and very poorly sorted. Internally the sandstone contains minor trough cross bedding, flaser laminations and burrows (including ophiomorpha) and can be divided into several units separated by scour surfaces.

The interval 1921.75m to 1926.20m is sandstone, predominantly medium to coarse grained and well sorted, comprised of nine upward fining units of variable thickness separated by scour surfaces. Internally these units are trough cross bedded with minor carbonaceous flaser laminations towards the top. Shale rip up clast horizons form basal lags in a few of these units.

The interval 1926.20m to 1926.75m is siltstone grading upwards to shale. The lower half is lenticular bedded with minor rootlets and the upper half is carbonaceous with common rootlets and minor resin blebs. The entire interval contains sparse nodular pyrite cement. The interval 1926.75m to 1928.90m is siltstone to very fine grained sandstone grading upwards into very fine grained sandstone. Internally the lower half of the interval contains abundant sandy microfoundering structures with minor current ripple to flaser laminations, rare wave oscillation ripple laminations, and minor pyrite cement. The upper half has better developed and common current ripple to flaser laminations and is burrowed to bioturbated. The topmost part contains carbonaceous rootlets.

The interval 1928.90m to 1930.35m is sandstone, comprised of three upward fining units fine to medium grained at the base grading upwards to very fine grained at the top and separated by scour surfaces. Internally they are current ripple to flaser laminated with minor microfoundering features and rare mud cracks. Rare burrows occur towards the base of the units. The interval 1930.35m to 1932.30m is sandstone, predominantly fine to medium up to coarse grained, comprised of eight units of variable thickness separated by scour surfaces. Overall the interval has an upward fining character developed through the stacking of successively finer grained units. Internally individual units are trough cross bedded or current ripple laminated to flaser or lenticular bedded with burrows developed in the upper four units.

The interval 1932.30m to 1933.20m is sandstone, very fine grained and silty, lenticular bedded in the lower half and current ripple to flaser laminated in the upper half. The interval 1933.20m to 1933.97m is sandstone, fine to medium up to coarse grained and muddy, comprised of four upward fining units of varying thickness separated by scour surfaces. Internally these units are lenticular bedded and burrowed. The interval 1933.97m to 1934.50m is sandstone, coarse to very coarse grained and well sorted. Internally it is trough cross bedded with minor shale rip up clasts and flaser to lenticular bedded at the very top. The interval 1934.50m to 1935.55m is sandstone, fine up to fine to medium grained, muddy and poorly sorted. Internally it is flaser laminated to burrowed and bioturbated with a 15cm long sand-filled burrow projecting down from the top of the interval. Minor pyrite occurs throughout the interval.

The interval 1935.55m to 1937.25m is sandstone, predominantly medium to coarse grained, well sorted and trough cross bedded. The very top of the interval is burrowed. The basal 0.25m of this interval fines from very coarse grained, with a pebble lag above a scour surface upwards to medium to coarse grained. The interval 1937.25m to 1939.35m is sandstone, medium to coarse up to very coarse grained, comprised of five upward fining units separated by scour surfaces and basal pebble lags. Internally these units are homogeneous to trough cross bedded with rare flaser laminations and rip up clasts.

The interval 1939.35m to 1941.35m is sandstone, fine to medium towards the base fining upwards to very fine grained silty sandstone at the top through a succession of stacked progressively finer grained upward fining units. Internally the interval is flaser bedded and burrowed in the lower half and burrowed to bioturbated with carbonaceous flasers and pyrite cemented towards the top. Overall the interval is muddy and very poorly sorted. The interval 1941.35m to 1942.70m (base of core 4) is sandstone, predominantly medium grained up to very coarse grained, comprised of seven upward fining units of variable thickness separated by scour surfaces. Internally these units and homogeneous to trough cross bedded with minor burrows and flaser laminations.

The interval 1943.00m (top of core 5) to 1943.20m is shale, dark grey with abundant silty microfoundering features. The interval 1943.20m to 1945.07m is sandstone, fine grained up to very coarse grained, comprised of a succession nine upward fining units of variable thickness separated by scour surfaces and pebble lags. Internally the units are homogeneous to trough cross bedded within the basal coarser grained part and are flaser to lenticular bedded in the finer grained upper part. The interval displays an overall upward fining character through the vertical stacking of successively finer sandstone units.

The interval 1945.07m to 1947.95m is sandstone, medium up to coarse grained and well sorted, comprised of six upward fining units separated by scour surfaces. The entire interval displays an overall upward fining through the stacking of successively finer units. Internally these units are trough cross bedded with flaser and lenticular bedding and dewatering features in the uppermost unit. The interval 1947.95m to 1949.25m is sandstone, medium to coarse grained at the base and grading upwards to very fine grained at the top. Internally the basal portion is trough cross bedded with the bulk of the interval current ripple to flaser laminated. The uppermost portion is lenticular bedded with microfoundering features. Sporadic pyrite cement is dispersed throughout the interval.

The interval 1949.25m to 1951.05m is sandstone, fine up to coarse grained, comprised of four upward fining units separated by scour surfaces. Internally these units are current ripple to flaser laminated or lenticular bedded with sporadic microfoundering features in the finer grained units. The interval 1951.05m to 1952.95m is sandstone, predominantly medium grained up to coarse grained and moderately well sorted, comprised of four upward fining units separated by scour surfaces. Internally these units are trough cross bedded in the lower half and current ripple to flaser laminated in the upper half. Shale rip up clasts occur as a basal lag in the lowest unit and the top of the uppermost unit is burrowed.

The interval 1952.95m to 1956.95m is sandstone, predominantly fine grained grading up to very coarse grained, comprised of a succession of upward fining units. The entire interval displays an upward fining character through the stacking of successively finer grained units. Internally the interval is muddy and very poorly sorted through intense bioturbation. Rare load (pillow) features, dewatering features and current ripple to flaser laminations occur towards the base. The basal 7 cm of the interval contains quartz pebble and shale rip up clast lag material. The interval 1956.95m to 1959.35m is a repeat of the above interval with coarse to very coarse grained sandstone at the base grading upwards,the stacking of successively finer units, to fine grained sandstone at the top. The basal half of the interval contains recognisable burrows and current ripple laminations while the upper half is bioturbated with thin lenticular bedded horizons and load cast (pillow) horizons.

The interval 1959.35m to 1960.60m is sandstone, predominantly coarse to very coarse grained and well sorted, comprised of four upward fining units separated by scour surfaces. Internally these units are trough cross bedded with thin flaser to lenticular bedded tops. The interval 1960.60m to 1960.78m is sandstone, coarse grained and heavily burrowed. The interval

1960.78m to 1962.24m is sandstone, predominantly medium grained, comprised of four upward fining units separated by scour surfaces. Internally the basal unit is homogeneous to trough cross bedded with successive overlying units having flaser to lenticular bedding with burrows to finally becoming bioturbated towards the top.

The interval 1962.24m to 1964.32m is sandstone, predominantly fine grained, comprised of eight fining upward units separated by scour surfaces. Internally the interval is homogeneous to current ripple laminated to lenticular bedded with rare burrows and bioturbation. The interval 1964.32m to 1967.03m is sandstone, medium grained, comprised of at least seven units separated by scour surfaces or load and flame surfaces. Internally the interval is current ripple to flaser laminated with rare trough cross bedding. The basal unit contains inclined flaser draped accretionary surfaces. The uppermost 0.4m of the interval contains long dwelling burrows. The interval 1967.03m to 1969.00m (base of core 5) is sandstone, comprised of stacked upward fining units, (separated by scour surfaces), varying in grainsize from very coarse grained and pebbly to very fine to fine grained. Internally these units are trough cross bedded to current ripple and flaser laminated with sparse ophiomorpha burrows. Minor dewatering, load and flame features are locally developed.

Environmental Interpretation

The interval 1915.00m to 1917.13m is interpreted as a succession of stream mouth bar channel units deposited in a inner bay setting proximal to a fluvial system (only rare burrows are recognised). The interval 1917.13m to 1918.30m is interpreted to represent more distal tidal/estuary channel deposition as evidenced by the presence of abundant ophiomorpha burrows. This interval represents a small marine transgressive cycle into a predominantly fluvially dominated system. A palynological study on a shale sample taken at 1917.35m gave a brackish swamp setting for the environment. The interval 1918.30m to 1920.33m is interpreted as a succession of stream mouth bar channel units deposited in an inner bay setting proximal to a fluvial setting (rare burrows preserved). The interval 1920.33m to 1921.75m is interpreted to represent more distal tidal/estuary channel deposition as evidenced by the presence of ophiomorpha and other non identifiable dwelling burrows.

The interval 1921.75m to 1926.20m is interpreted to represent a succession of stacked channel units deposited in a high energy low sinuosity fluvial system during the late flood stage cycle. The interval 1926.20m to 1926.75m is interpreted as deposition of overbank or abandoned channel fill during the low stage of a high sinuosity fluvial system. A palynological study of a shale sample taken at 1926.25m gave a non-marine (?levee bank or freshwater swamp) setting for the environment. The interval 1926.75m to 1930.35m is interpreted as a succession of proximal to distal crevasse splay units deposited during the falling stage cycle of a high sinuosity fluvial system.

The interval 1930.35m to 1932.30m is interpreted as a succession of stream mouth bar channels building into a proximal estuary setting. The interval 1932.30m to 1933.20m is interpreted to represent more distal deposition of the overlying channel units. A palynological study on a shale sample taken at 1933.10m gave a brackish swamp setting for the environment. The interval 1933.20m to 1934.50m is interpreted to be a succession of stacked stream mouth bar or tidal/estuary channel units building into a proximal bay setting. The interval 1934.50m to 1935.55m is interpreted as a succession of distal tidal/estuary channel units related to the overlying interval. A palynological study on a shale sample taken at 1935.50m gave a nearshore marine lagoon or estuary setting for the environment.

The interval 1935.55m to 1939.35m is interpreted as a succession of stacked channel units deposited in a high energy low sinuosity fluvial system during the late flood stage cycle. The interval 1939.35m to 1942.70m (base of core 4) is interpreted to represent a succession of stacked tidal/estuarine channel units deposited during an overall waning fluvial (early falling cycle grading upwards to late falling or low stage cycle). A palynological study made on shale samples taken at 1939.35m and 1941.65m gave a nearshore marine lagoon or estuary setting for the environment.

The interval 1943.00m (top of core 5) to 1945.07m is interpreted to be a succession of stacked channel units grading upwards from high energy basal channel fill to abandoned channel fill deposited during a flood to falling and low stage cycle within a low sinuosity fluvial system. A palynological study made on a shale sample taken at 1943.00 gave a non-marine (freshwater lake) setting for the environment. The interval 1945.07m to 1947.95m is interpreted to be a repeat of the above cycle. The interval 1947.95m to 1952.95m is interpreted to represent the deposition of three waning fluvial to estuary channel successions building into an inner bay setting. A palynological study made on a shale sample taken at 1948.00m gave a non-marine (freshwater lake or swamp) setting for the environment.

The interval 1952.95m to 1956.95m is interpreted to represent a succession of proximal to distal estuary channel units, which display an overall upward waning in energy, deposited in an inner to middle bay setting. A palynological study of shale samples over this interval made the following interpretation; 1953.00m (brackish lagoon or estuary) and 1955.60m (very nearshore - near normal salinity estuary). The interval 1956.95m to 1959.35m is a repeat of the above depositional setting. The interval 1959.35m to 1960.60m is interpreted to be a succession of stacked basal channel units deposited during the late flood stage of a low sinuosity fluvial system.

The interval 1960.60m to 1962.25m is interpreted to be a succession of stacked proximal estuary basal channel units deposited in an inner bay setting (good ophiomorpha and other dwelling burrows occur throughout). A palynological study made on a shale sample taken from 1961.25m inferred a very nearshore (?backbarrier tidal lagoon) setting for the environment. The interval 1962.25m to 1964.32m is interpreted as a succession of stacked middle to upper point bar tidal channel units deposited around the bay fringe near the mouth of a fluvial system. The interval 1964.32m to 1966.75m is interpreted as a succession of stacked middle point bar estuary channel units deposited at the mouth of a fluvial system. The interval 1966.75m to 1969.00m (base of core 5) is interpreted to be a succession of stacked proximal estuary basal channel units deposited at the mouth of a fluvial system. A palynological study made on a shale sample taken from 1968.25m inferred a very nearshore (?backbarrier tidal lagoon) setting for the environment and a study from a swc sample taken from 1996.50m inferred a nearshore marine setting for the environment.

5 REFERENCES

MORGAN, R., 1994: Minerva-2A interim palynology report.
- MORGAN PALAEO ASSOCIATES, January, 1994, report for BHP Petroleum (Unpubl.).

6 FIGURES

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
DATE:
CORE NO.: 2
Page: 3a
AUTHOR: P.Arditto / S.Horan
INTERVAL:
RIG: Byford Dolphin
CUT:
K.B.: 25mRT
W.D.:
CORE BARREL & MUD TYPE:

DEPTH (m)	LITHOLOGY	SHOWS T U	SHOWS F	SHOWS G	GRAIN SIZE SILT	GRAIN SIZE V.FINE	GRAIN SIZE FINE	GRAIN SIZE MEDIUM	GRAIN SIZE COARSE	GRAIN SIZE V.COARSE	SEDIMENTARY STRUCTURE	LITHOLOGICAL DESCRIPTION
1838												
												TOP CORE 2
1839												SANDSTONE

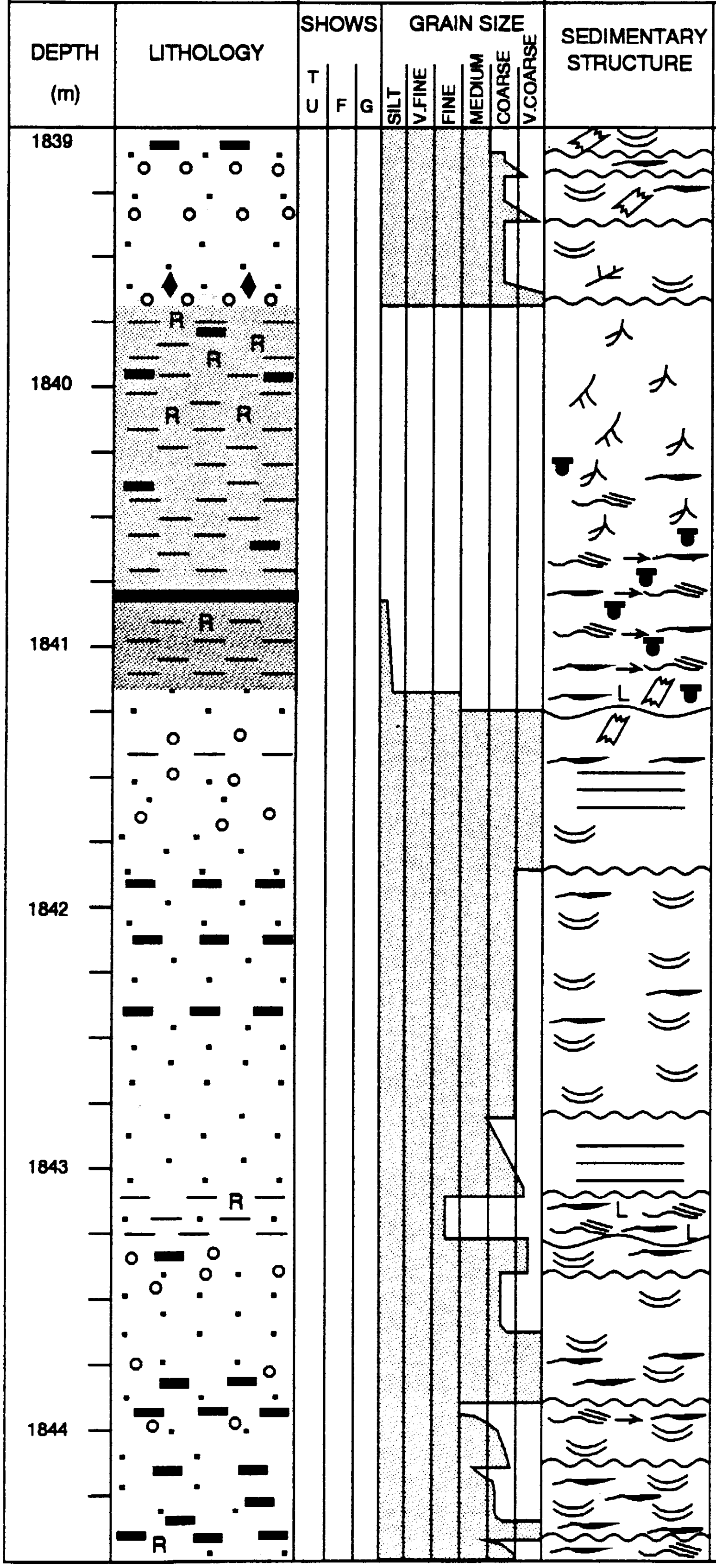
November 1993

Base drawing No.F988
F989

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31	DATE:	CORE NO.: 2	Page: 3
AUTHOR: P.Arditto / S.Horan	INTERVAL:		
RIG: Byford Dolphin	CUT:		
K.B.: 25mRT W.D.:	CORE BARREL & MUD TYPE:		



LITHOLOGICAL DESCRIPTION

SANDSTONE, medium to very coarse grained,trace granule, tough cross bedded with pyritized plant stems, shale rip ups.

SHALE, medium grey, mottled with sparse carbonaceous rootlets, homogeneous with minor starved ripples and microfoundering feature near base.

COAL, black, sub bituminous.

SHALE, dark grey-black with starved ripples and microfoundering features.

SANDSTONE, very coarse to granule moderately sorted, trough cross bedded to planar laminated with rip up clasts and flasers near top.

SANDSTONE, coarse to very coarse grained, well sorted with minor granule trains along sporadic cross bed laminate. Trough cross bedded with minor high angle carbonaceous flaser drapes.

SANDSTONE, medium to very coarse grained, well sorted, planar laminated.

SANDSTONE, fine grained, flaser and lenticular bedded.

SANDSTONE, very coarse trace granule, trough cross bedded.
SANDSTONE, coarse granule, trace pebbles, trough cross bedded with carbonaceous flasers.

SANDSTONE, fine grained, trough cross bedded, flaser to ripple laminated, minor carbonaceous ripples.

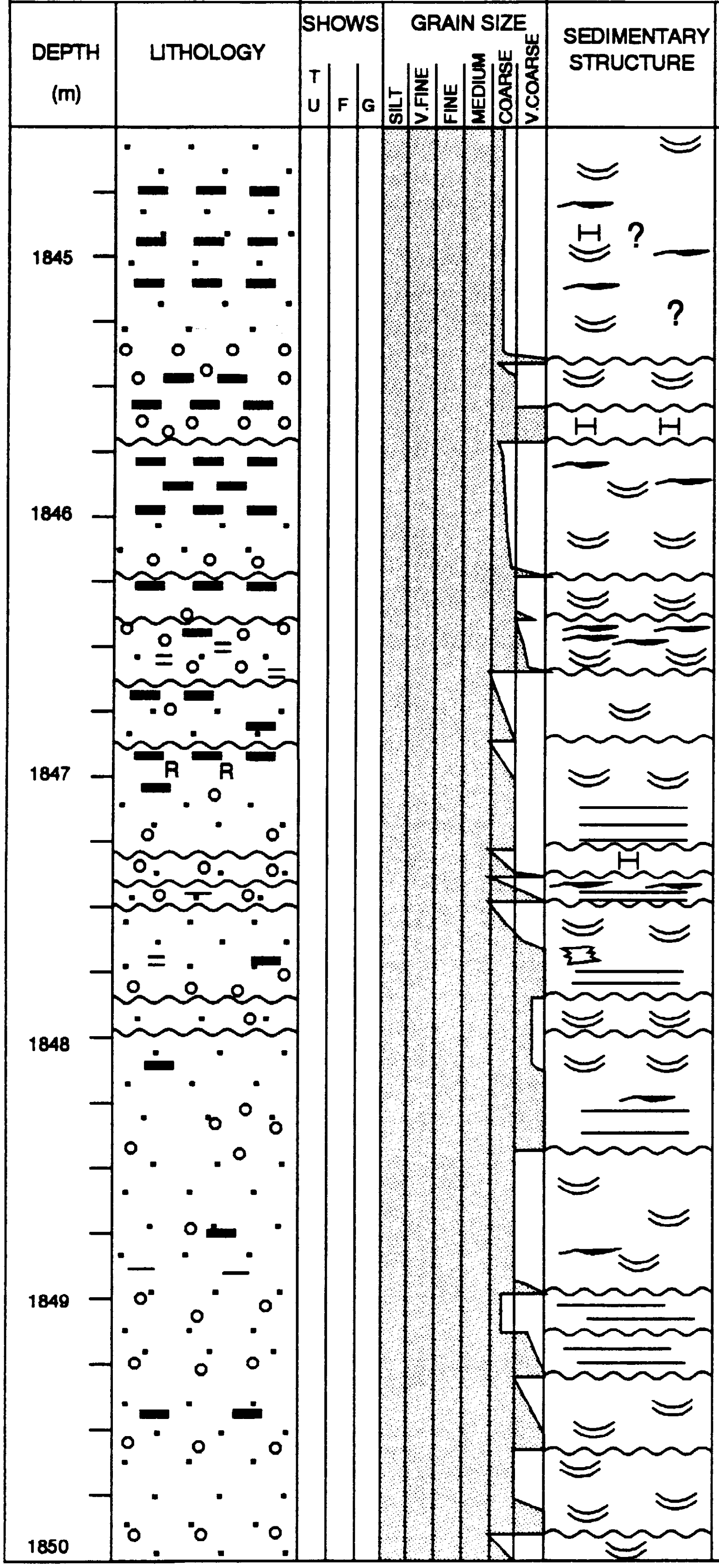
Base drawing No.F988
F990

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31	DATE:	CORE NO.: 2	Page: 4
AUTHOR: P.Arditto / S.Horan	INTERVAL:		
RIG: Byford Dolphin	CUT:		
K.B.: 25mRT W.D.:	CORE BARREL & MUD TYPE:		



LITHOLOGICAL DESCRIPTION

SANDSTONE: very coarse grained, trough cross bedded to homogenous.

Quartzose pebbles up to 1cm diameter

SANDSTONE: coarse granule, scattered pebbles, trough cross bedded with shale / carbonaceous flasers.

SANDSTONE: medium to very coarse, trace granule, trough to planar bedded resin blebs, flaser bedded and homogeneous in part.

SANDSTONE: medium to granule, planar to trough cross bedded, trace rip up clasts and carbonaceous flasers.

SANDSTONE: coarse to granule, scattered pebbles, planar to trough cross bedded, trace shale flasers.

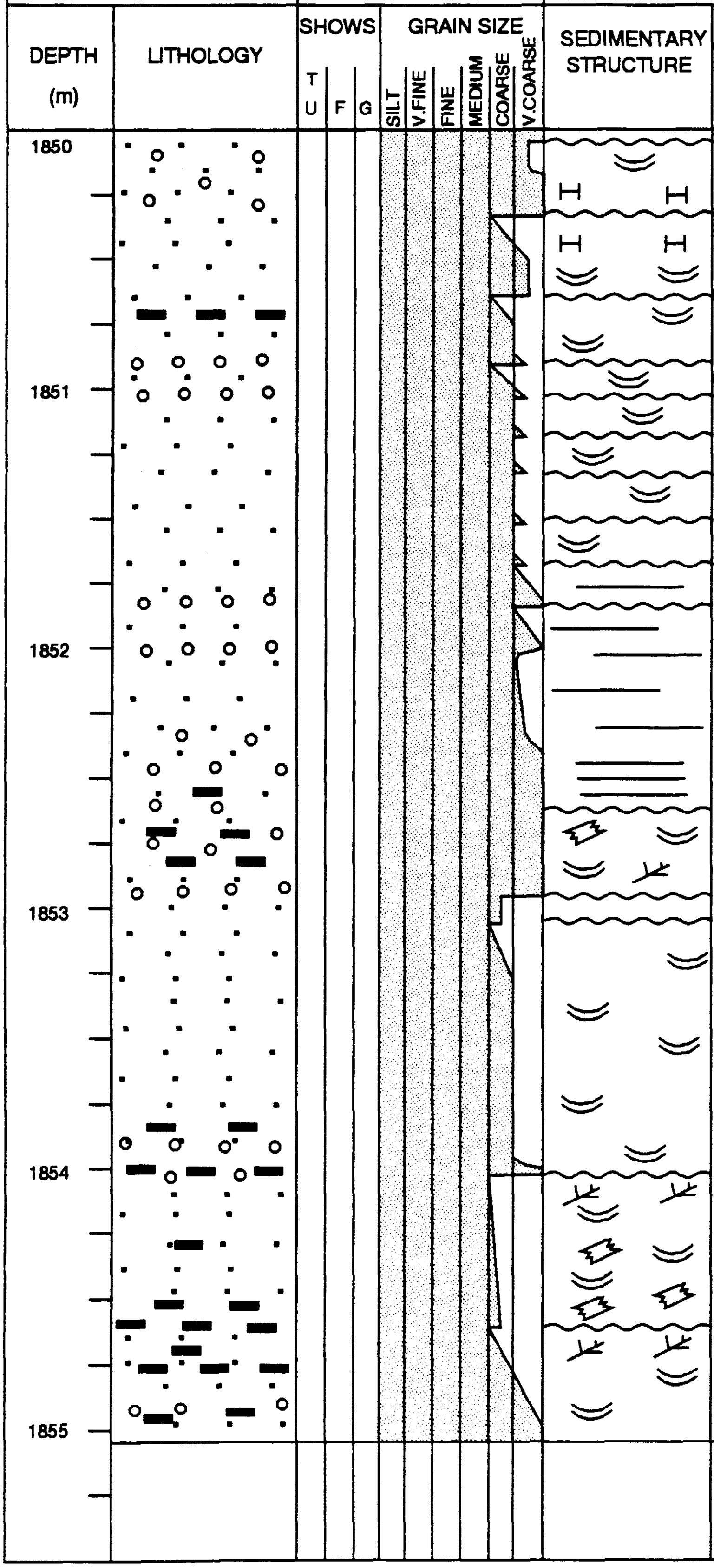
Base drawing No.F988
F991

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
DATE:
CORE NO.: 2
Page: 5
AUTHOR: P.Arditto / S.Horan
INTERVAL:
RIG: Byford Dolphin
CUT:
K.B.: 25mRT
W.D.:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

SANDSTONE: mediun granule, trough cross bedded homogenous in part.

SANDSTONE: coarse to very coarse, trace granule and scattered pebbles, trough cross bedded, trace planar bedded.

SANDSTONE: coarse granule, trace scattered pebbles, planar bedded.

SANDSTONE: very coarse granule, trace pebbles, trough cross bedded with trace plant stems.

SANDSTONE: medium to very coarse trace granule - pebble, trough cross bedded.

SANDSTONE: medium granule, trough cross bedded with plant stems and carbonaceous rip ups.

BOTTOM CORE 2

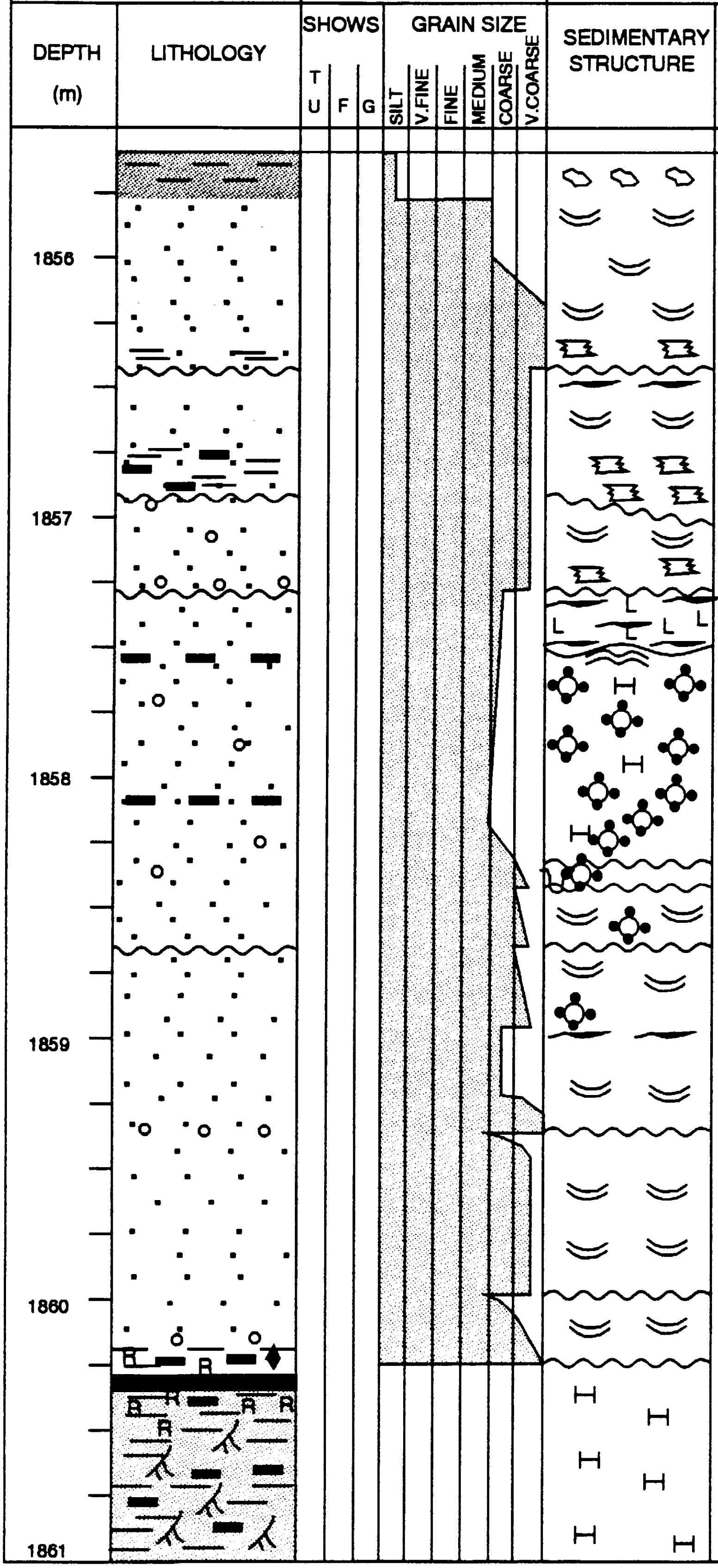
Base drawing No.F988
F992

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
DATE:
CORE NO.: 3
Page: 6
AUTHOR: P.Arditto / S.Horan
INTERVAL:
RIG: Byford Dolphin
CUT:
K.B.: 25mRT
W.D.:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

TOP CORE 3

Grey arg siltstone core rubble.

SANDSTONE: medium granule, trough cross bedded with shale rip ups at the base.

SANDSTONE: very coarse grained, well sorted, common shale and carbonaceous rip up clasts, trough cross bedded, trace flasers,

SANDSTONE: coarse grained, lenticular bedded wavy carbonaceous drape

SANDSTONE: coarse, poor to moderately sorted, scattered granule, slightly muddy, homogenised by abundant Ophiomorpha burrows.

Carbonaceous drape.

SANDSTONE: coarse to granule, trough cross bedded with flaser laminations in part, common Ophiomorpha.

SANDSTONE: coarse to granule, trough cross bedded.

SHALE: black highly carbonaceous - coaly with resin blebs, minor pyrite.

COAL: black, subbituminous, with resin blebs.

SHALE: black, highly carbonaceous, minor rootlets.

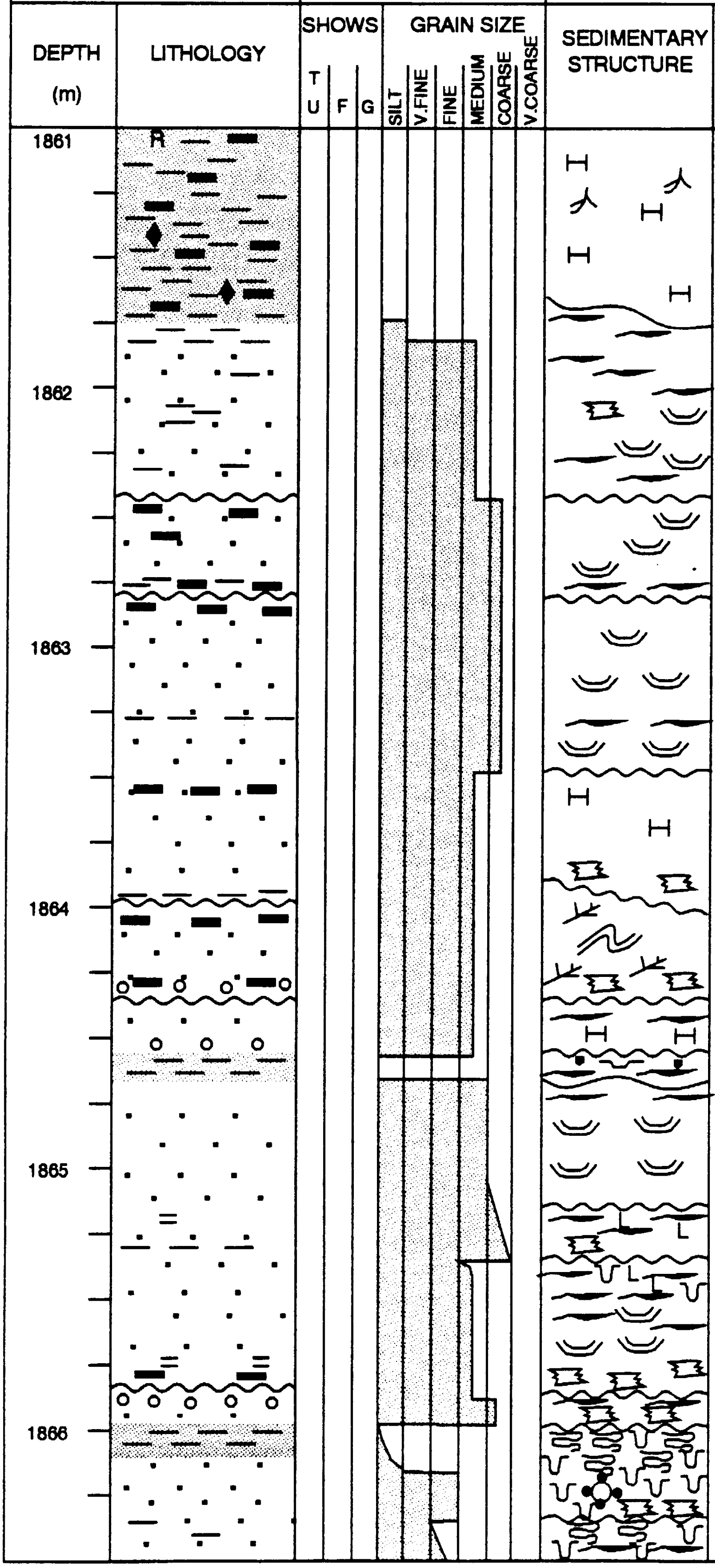
Base drawing No.F988
F993

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
AUTHOR: P.Arditto / S.Horan
RIG: Byford Dolphin
K.B.: 25mRT
W.D.:
DATE:
CORE NO.: 3
Page: 7
INTERVAL:
CUT:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

COAL: black, bituminous

SHALE: black - dark grey, highly carbonaceous

1861.13 - 1861.33 slicken sided shale core rubble.

SANDSTONE: mediun to coarse trough cross bedded with flaser beds and shale rip up clasts.

SANDSTONE: medium grained, homogenous with minor shale / carbonaceous rip ups, plant stems and dewatering structures.

SHALE: dark grey, common flasers, microfoundering structures and load casts.

SANDSTONE: fine to medium grained, trough cross bedded with flasers, lenticular beds, burrows and carbonaceous / shale rip ups.

SANDSTONE: heavily burrowed to bioturbated, trace Ophiomorpha burrows.

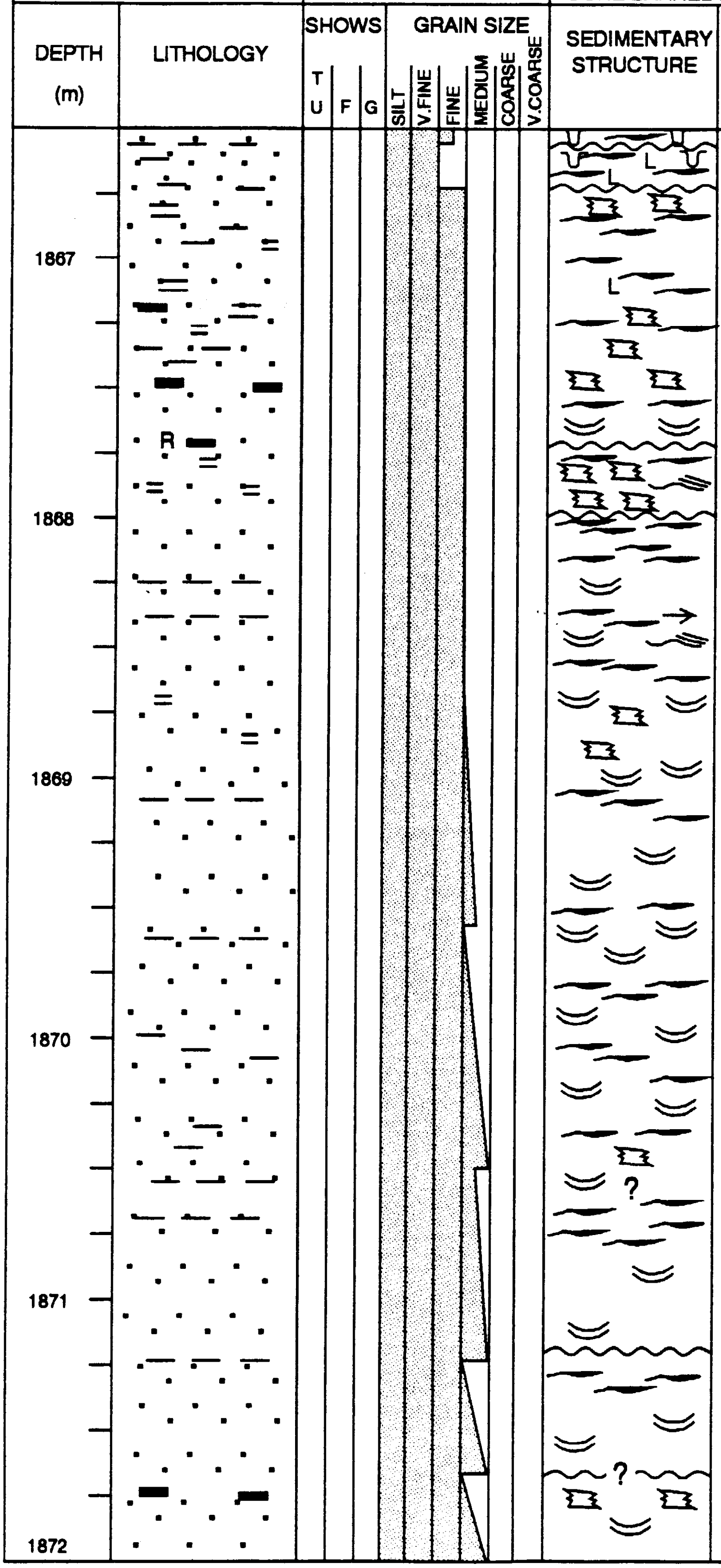
Base drawing No.F988
F994

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
DATE:
CORE NO.: 3
Page: 8
AUTHOR: P.Arditto / S.Horan
INTERVAL:
RIG: Byford Dolphin
CUT:
K.B.: 25mRT
W.D.:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

SANDSTONE: fine to medium, well sorted, trough cross bedded, with common high angle flaser drapes, rare carbonaceous / shale rip ups, flaser grading to current ripple laminations in places.

1867 - 1867.5m SANDSTONE: coarse rubble.

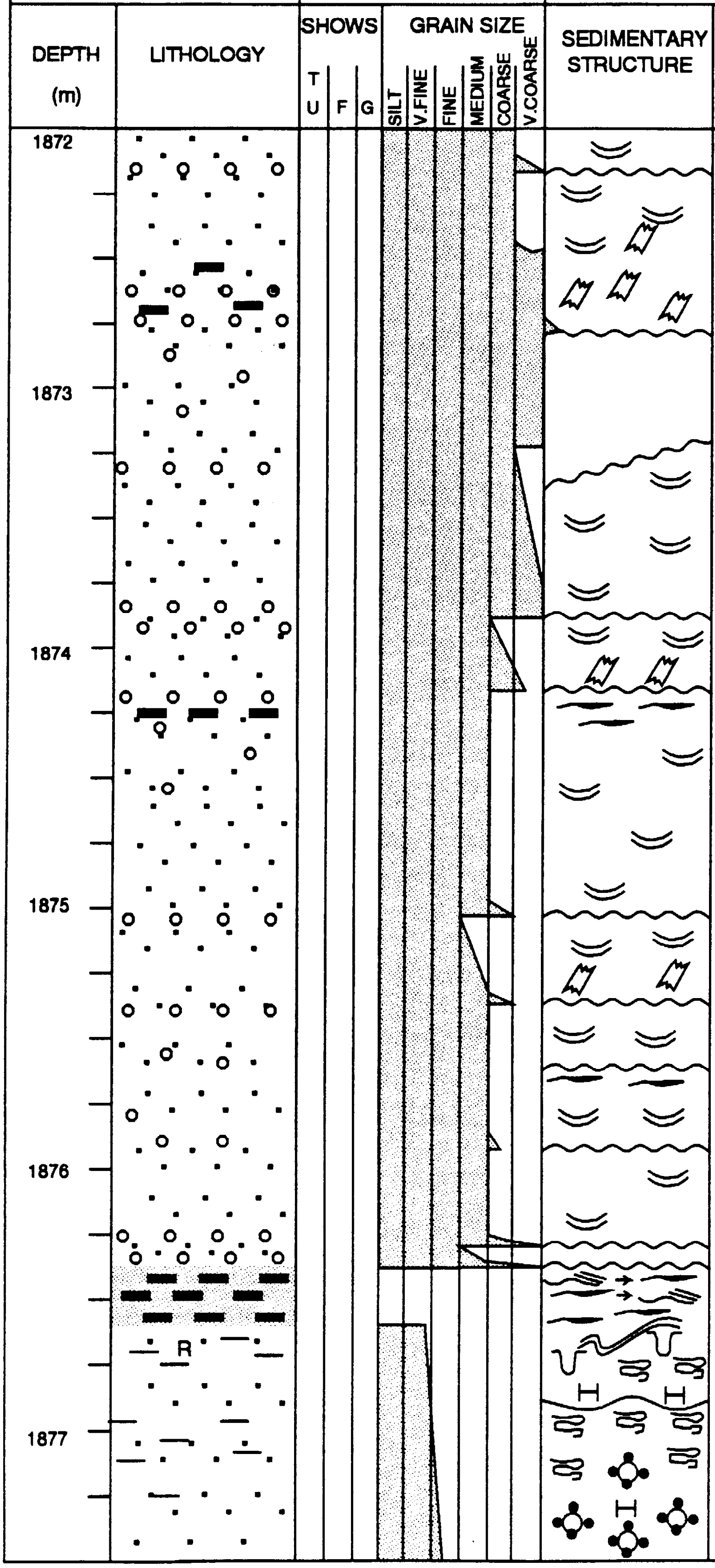
SABDSTONE: fine to coarse, trough cross bedded in inclined flaser laminations.

SANDSTONE: medium granule, scattered pebbles, trough cross bedded with shale / carbonaceous rip ups.

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31		DATE:	CORE NO.: 3	Page: 9
AUTHOR: P.Arditto / S.Horan		INTERVAL:		
RIG: Byford Dolphin		CUT:		
K.B.: 25mRT	W.D.:	CORE BARREL & MUD TYPE:		



LITHOLOGICAL DESCRIPTION

SANDSTONE: very coarse to granule with common pebble, well sorted. Core rubble.

SANDSTONE: medium to coarse grained, well sorted, trough cross bedded in units separated by scour surfaces.

SHALE: black, carbonaceous with starved ripples.

SANDSTONE: fine to medium grained, bioturbated with dewatering features.

SANDSTONE: fine to medium grained, with ophiomorpha barrows, bioturbated near top.

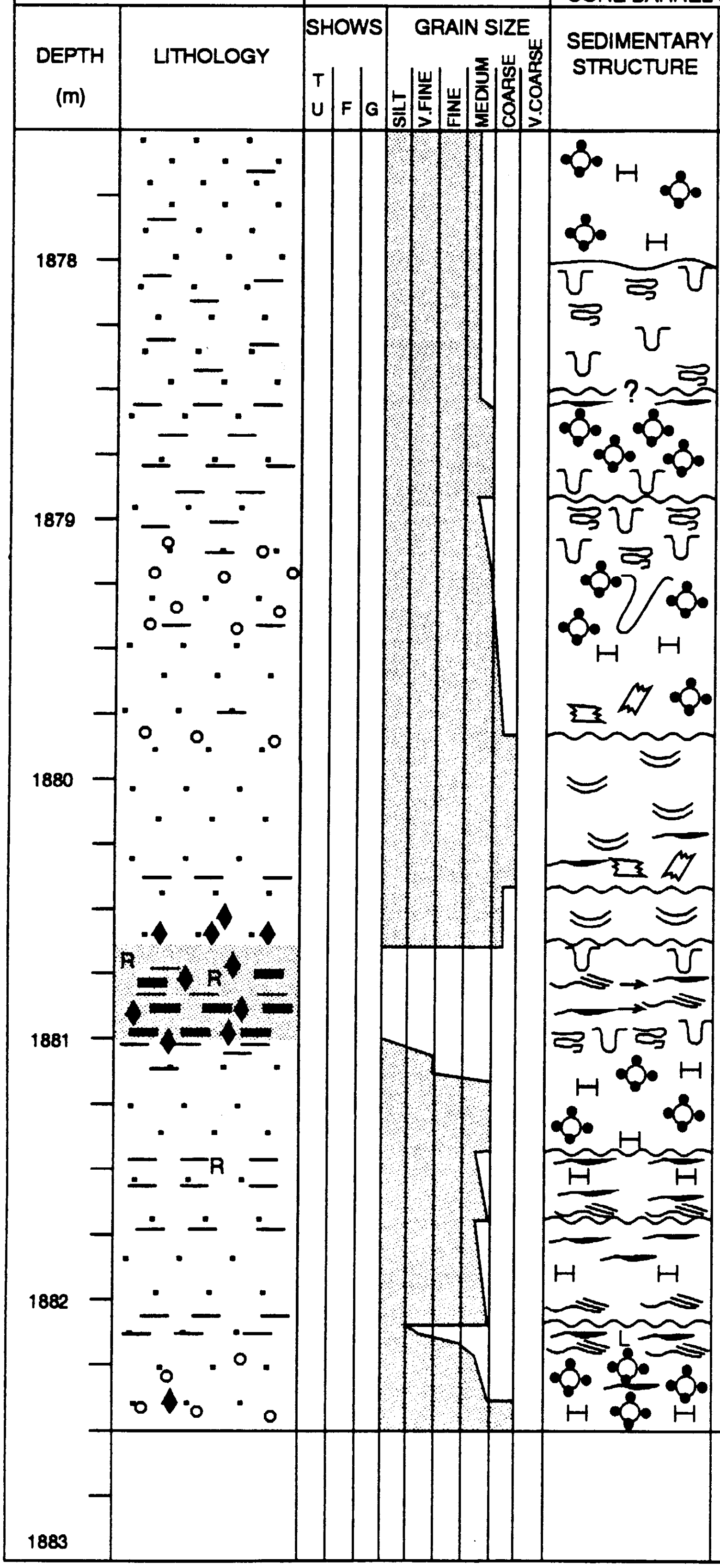
Base drawing No.F988
F996

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31	DATE:	CORE NO.: 3	Page: 10
AUTHOR: P.Arditto / S.Horan	INTERVAL:		
RIG: Byford Dolphin	CUT:		
K.B.: 25mRT W.D.:	CORE BARREL & MUD TYPE:		



LITHOLOGICAL DESCRIPTION

SANDSTONE: medium grained, well sorted, homogenous to burrowed with ophiomorpha.

SANDSTONE: medium grained, muddy burrowed to bioturbated.

SANDSTONE: medium to coarse grained, muddy with common ophiomorpha burrows.

SANDSTONE: medium to coarse grained, well sorted and trough cross bedded.

SHALE: black, highly carbonaceous with fine silty starved ripple flasers, pyritic.

SANDSTONE: medium to coarse grained, moderately sorted, current rippled to flaser, laminated with local ophiomorpha.

BOTTOM CORE 3

Base drawing No.F988
F997

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31

AUTHOR: P.Arditto / S.Horan

RIG: Byford Dolphin

K.B.: 25mRT

W.D.:

DATE:

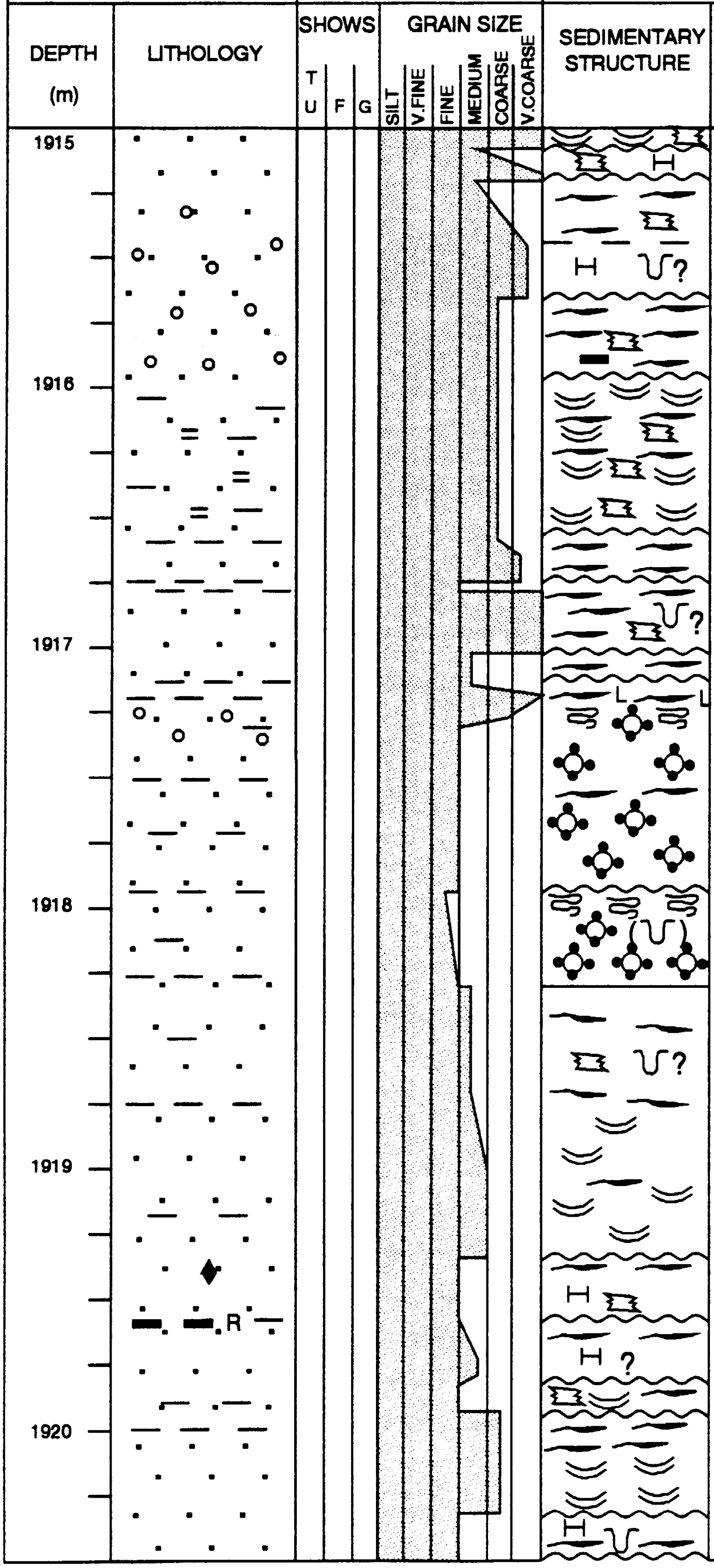
CORE NO.: 4

Page: 11

INTERVAL:

CUT:

CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

TOP CORE 4

SANDSTONE: medium grained, well sorted, trough cross bedded and shale rip up clasts and flasers.

SANDSTONE: coarse grained, trace pebbles, well sorted, trough cross bedded to flaser laminated, shale rip up clasts and carbonaceous material.

SANDSTONE: very coarse grained, poor sorted, argillaceous, discontinuous flasers and burrowed.

SANDSTONE: fine to medium with granule to pebble at top, poor to moderately sorted, homogenous bedding with abundant ophiomorpha and trace flaser bedding.

Escape burrow.

Saw cut surface.

SANDSTONE: medium to coarse, trough cross bedded to flaser draped.

SANDSTONE: fine to coarse grained, trough cross bedded to flaser laminated, homogenous in part with shale rip ups.

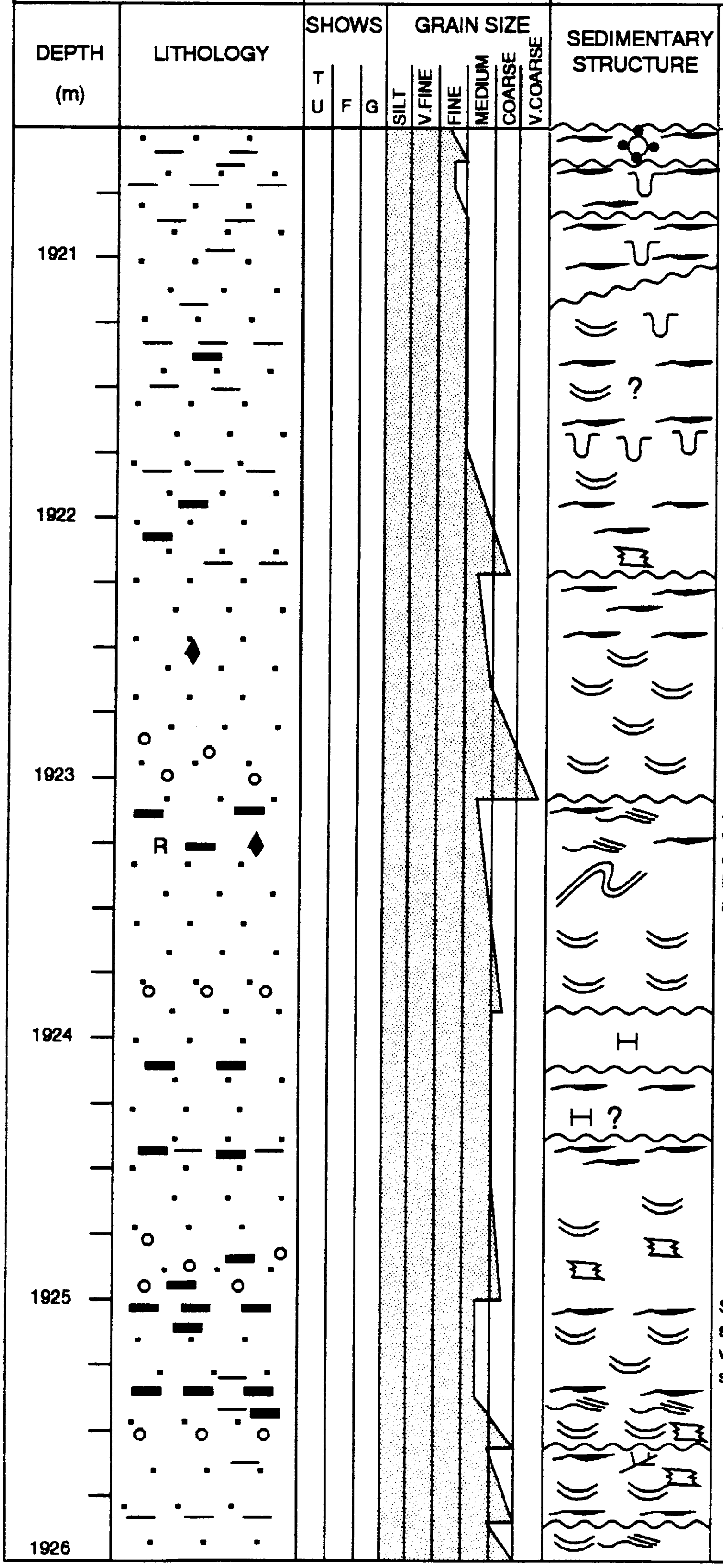
Base drawing No.F988
F998

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31	DATE:	CORE NO.: 4	Page: 12
AUTHOR: P.Arditto / S.Horan	INTERVAL:		
RIG: Byford Dolphin	CUT:		
K.B.: 25mRT W.D.:	CORE BARREL & MUD TYPE:		



LITHOLOGICAL DESCRIPTION

SANDSTONE: very fine to fine, flaser laminated with ophiomorpha burrows.

SANDSTONE: very fine to coarse, with parallel to inclined flaser lamination, trace trough cross beds, burrows, and shale rip up clasts.

SANDSTONE: coarse to very coarse, trace pebbles, trough cross bedded to flaser dropped.

SANDSTONE: medium to coarse grained, well sorted, trough cross bedded with carbonaceous flasers, current ripple lamination, load features (dewatering) and homogenous bedding.

SANDSTONE: medium to very coarse, scattered pebbles, trough cross bedded with carbonaceous/shale flasers, plant stems and shale rip up clasts.

Base drawing No.F988
F999

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31

AUTHOR: P.Arditto / S.Horan

RIG: Byford Dolphin

K.B.: 25mRT

W.D.:

DATE:

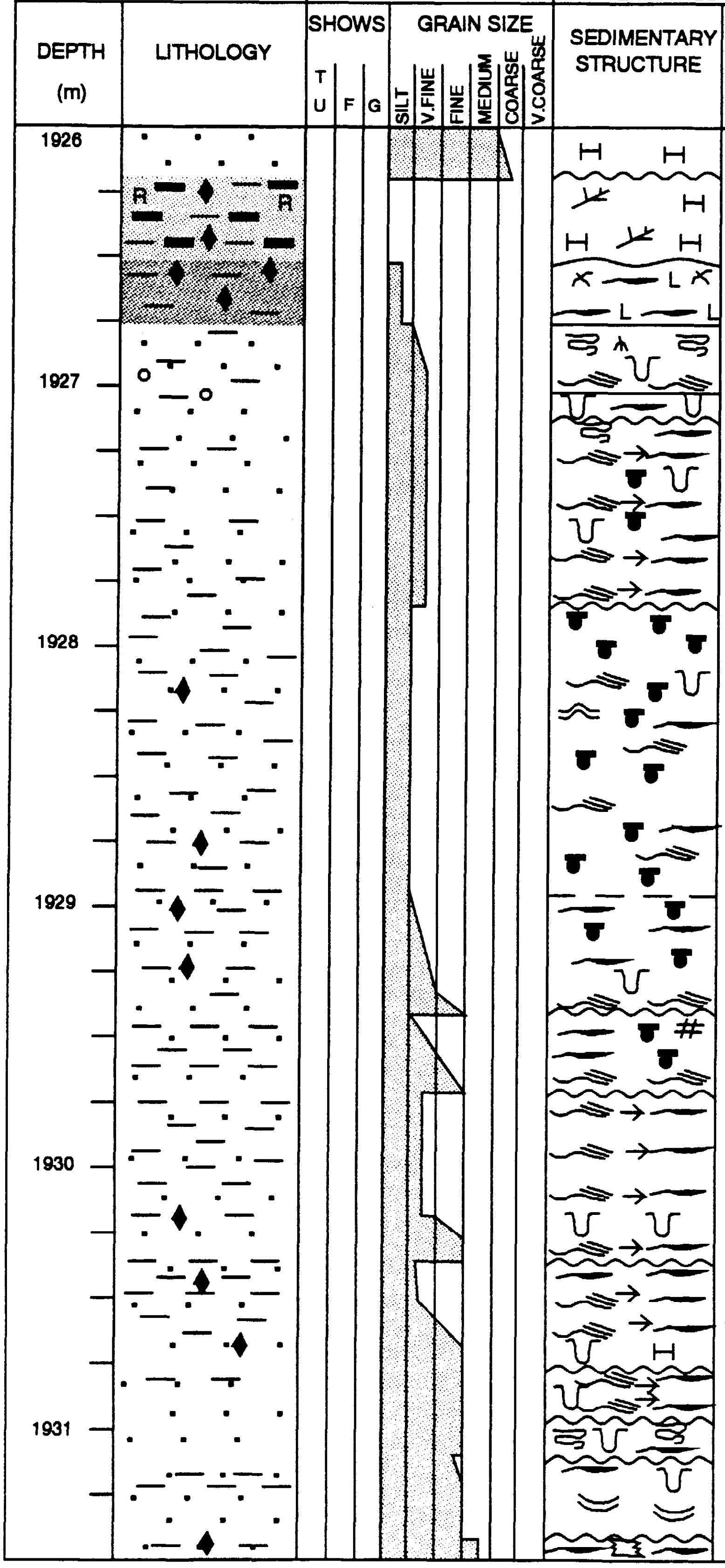
CORE NO.: 4

Page: 13

INTERVAL:

CUT:

CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

SHALE: dark grey to black, homogenous with abundant coaly plant stems, sparse resin blebs, sparse nodular pyrite cement.

SANDSTONE: silty to very fine grained, current ripple laminated to flaser bedded, burrowed to bioturbated, scattered pebbles and trace rootlet.

SILTY SANDSTONE: silty to very fine grained, argillaceous, abundant sandy microfoundering structures, rare current ripple to flaser laminations, trace burrows.

SANDSTONE: very fine to medium grained, current ripple laminated to flaser bedded, mud crack and microfoundering features at top.

SANDSTONE: very fine to medium grained, flaser to current ripple laminated, trace trough cross beds, burrowed to bioturbated in part.

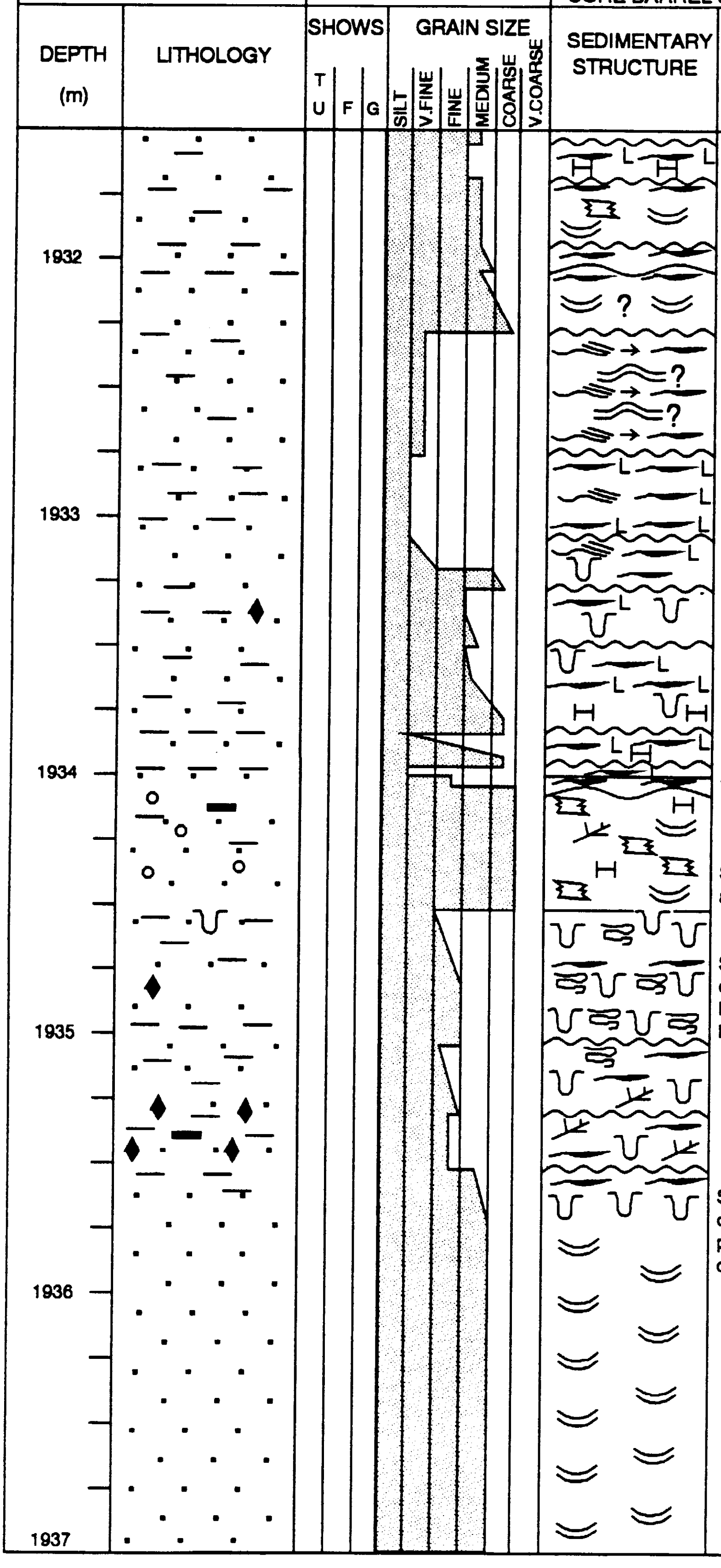
November 1993

Base drawing No.F988
F1000

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
AUTHOR: P.Arditto / S.Horan
RIG: Byford Dolphin
K.B.: 25mRT
W.D.:
DATE:
CORE NO.: 4
Page: 14
INTERVAL:
CUT:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

SANDSTONE: fine to coarse grained, flaser to lenticular bedded, trough to homogenous bedding in part.

SANDSTONE: silty to very fine grained, lenticular bedded, current rippled to flaser laminated, possible wave ripple laminated ?, burrowed ?.

SANDSTONE: fine to coarse, trace silty, lenticular bedded, burrowed.

Saw cut.

Saw cut boundary, burrow incures 15cm and is filled by coarse sand.

SANDSTONE: very fine to fine, carbonaceous/shale flasers, burrowed to bioturbated, plant stems, rootlets in burrows.

SANDSTONE: medium to coarse, trough cross bedded, trace homogenous beds, pyritised plant stems, burrows and carbonaceous flasers.

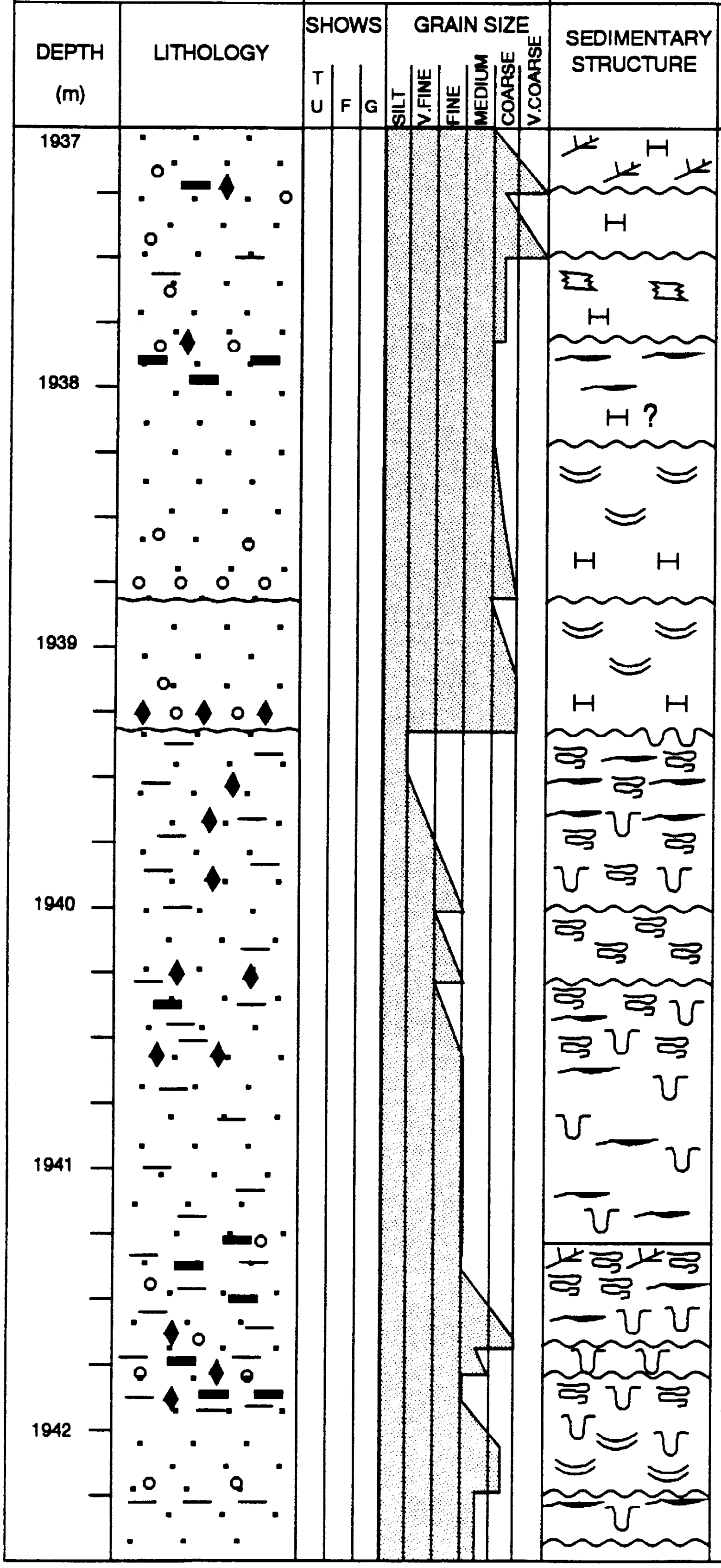
Base drawing No.F988
F1001

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
AUTHOR: P.Arditto / S.Horan
RIG: Byford Dolphin
K.B.: 25mRT
W.D.:
DATE:
CORE NO.: 4
Page: 15
INTERVAL:
CUT:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

SANDSTONE: medium to very coarse grained, scattered granule, well sorted, trough to homogenous bedded, trace carbonaceous flasers and shale rip ups.

SANDSTONE: medium to very coarse fining to silt, trace scattered pebbles, poor to moderately sorted, shale/ carbonaceous flasers, burrowed to bioturbated, trace resin blebs.

Transitional contact.

Saw cut boundary.

SANDSTONE: fine to medium, trough to flaser bedded, trace current ripple lamination, burrowed to bioturbated.

Base drawing No.F988
F1002

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
DATE:
CORE NO.: 4
Page: 16
AUTHOR: P.Arditto / S.Horan
INTERVAL:
RIG: Byford Dolphin
CUT:
K.B.: 25mRT
W.D.:
CORE BARREL & MUD TYPE:

DEPTH (m)	LITHOLOGY	SHOWS T U	SHOWS F	SHOWS G	GRAIN SIZE SILT	GRAIN SIZE V.FINE	GRAIN SIZE FINE	GRAIN SIZE MEDIUM	GRAIN SIZE COARSE	GRAIN SIZE V.COARSE	SEDIMENTARY STRUCTURE	LITHOLOGICAL DESCRIPTION
												
												BOTTOM CORE 4
1943												

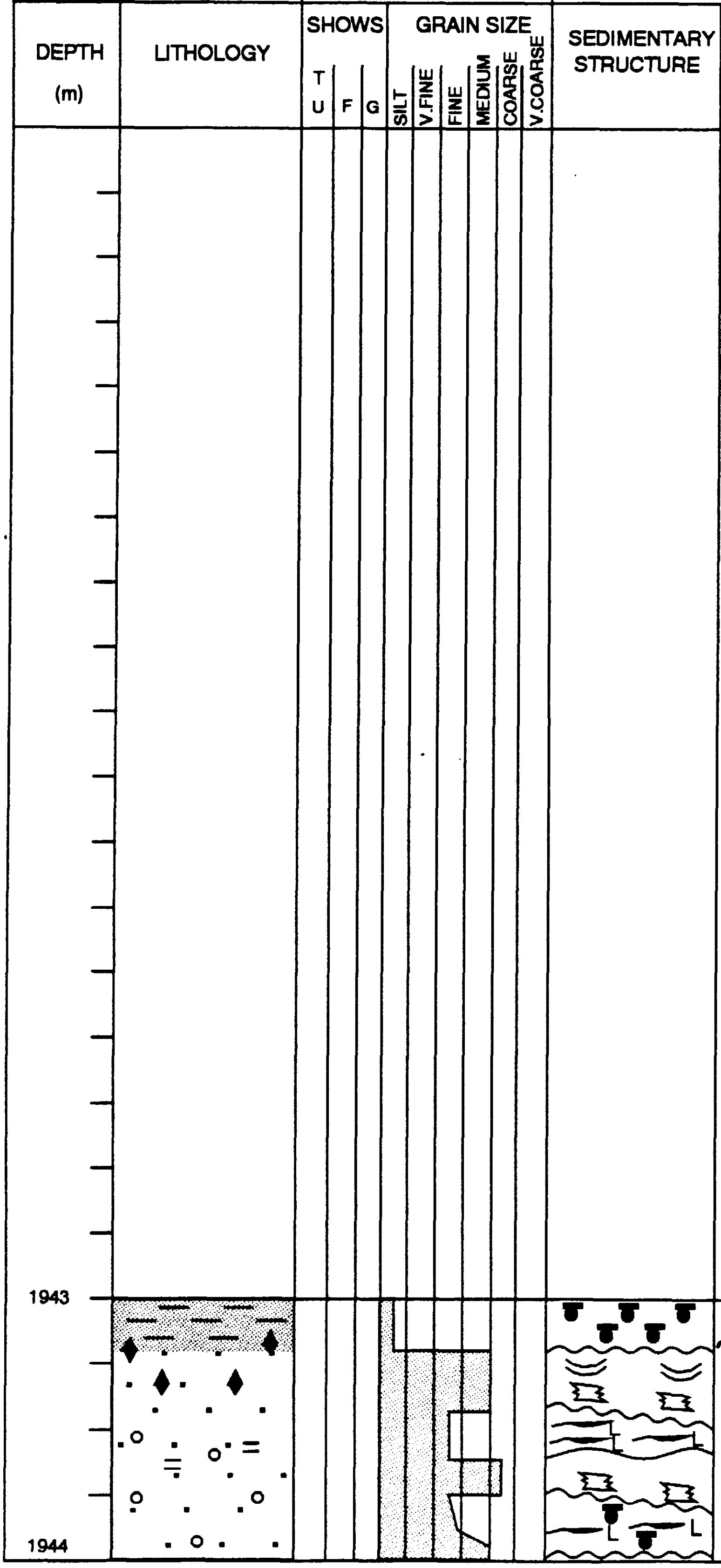
November 1993

Base drawing No.F988
F1003

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
AUTHOR: P.Arditto / S.Horan
RIG: Byford Dolphin
K.B.: 25mRT
W.D.:
DATE:
CORE NO.: 5
Page: 16
INTERVAL:
CUT:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

TOP OF CORE 5

? SHALE: silty, with abundant microfoundering features.

SANDSTONE: very coarse to fine grained, flaser to current ripple laminated, commonly lenticular bedded, trace micro foundering structures.

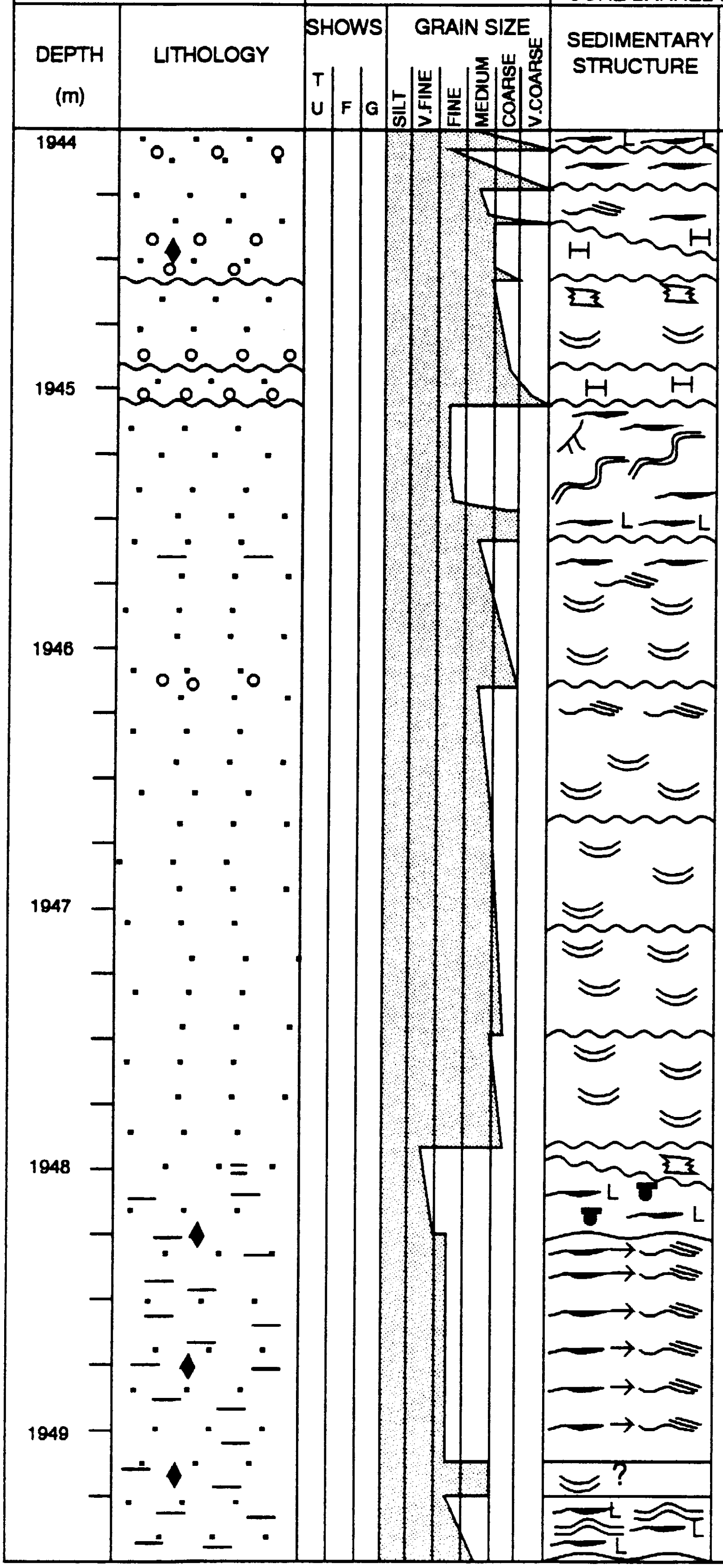
November 1993

Base drawing No.F988
F1004

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
AUTHOR: P.Arditto / S.Horan
RIG: Byford Dolphin
K.B.: 25mRT
W.D.:
DATE:
CORE NO.: 5
Page: 17
INTERVAL:
CUT:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

SANDSTONE: very coarse to medium grained, common pebbles, trough cross bedded to homogeneous trace rip ups.

SANSTONE: very coarse to coarse, fining to fine grained, lenticular to flaser bedded, dewatering structures rootlet.

SANDSTONE: medium to coarse, well sorted, trough cross bedded, trace current ripple laminated trace pebbles.

SANDSTONE: fine grained, flaser bedded to current ripple laminated.

SANDSTONE: fine to medium grained lenticular bedded and wave oscillation ripple.

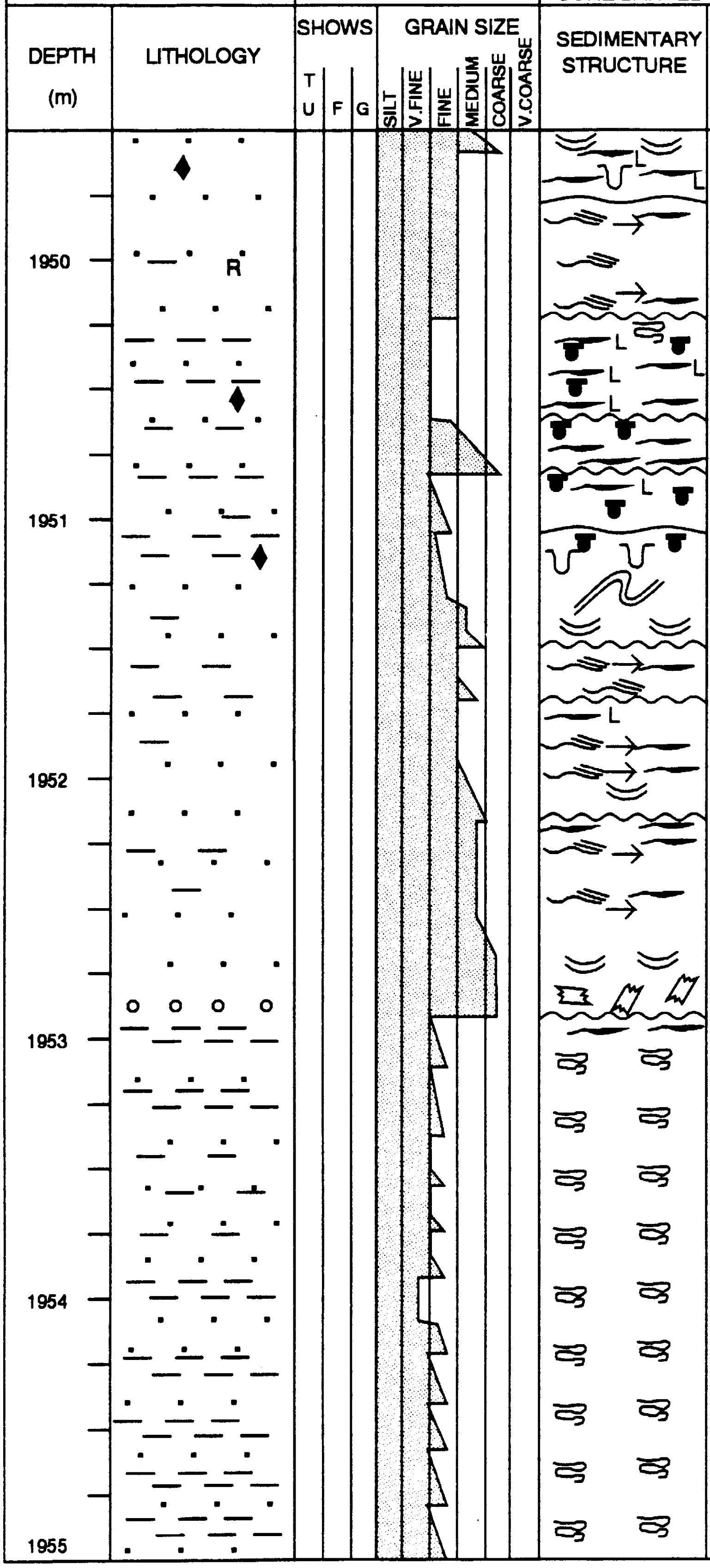
Base drawing No.F988
F1005

November 1993

BHP
Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
AUTHOR: P.Arditto / S.Horan
RIG: Byford Dolphin
K.B.: 25mRT
W.D.:
DATE:
CORE NO.: 5
Page: 18
INTERVAL:
CUT:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

SANDSTONE: coarse to fine grained flaser bedded to current ripple laminated, with micro foundering features.

SANDSTONE: medium to very fine grained, trough cross bedded and current ripple laminated to flaser bedded.

SANDSTONE: medium to coarse grained, fining to fine to medium, well sorted, shale rip up clasts, trough cross beds, current ripple laminated to flaser bedding.

SANDSTONE: very fine to fine grained in units 0.2m thick, muddy and bioturbated in upper half, lower half homogeneous.

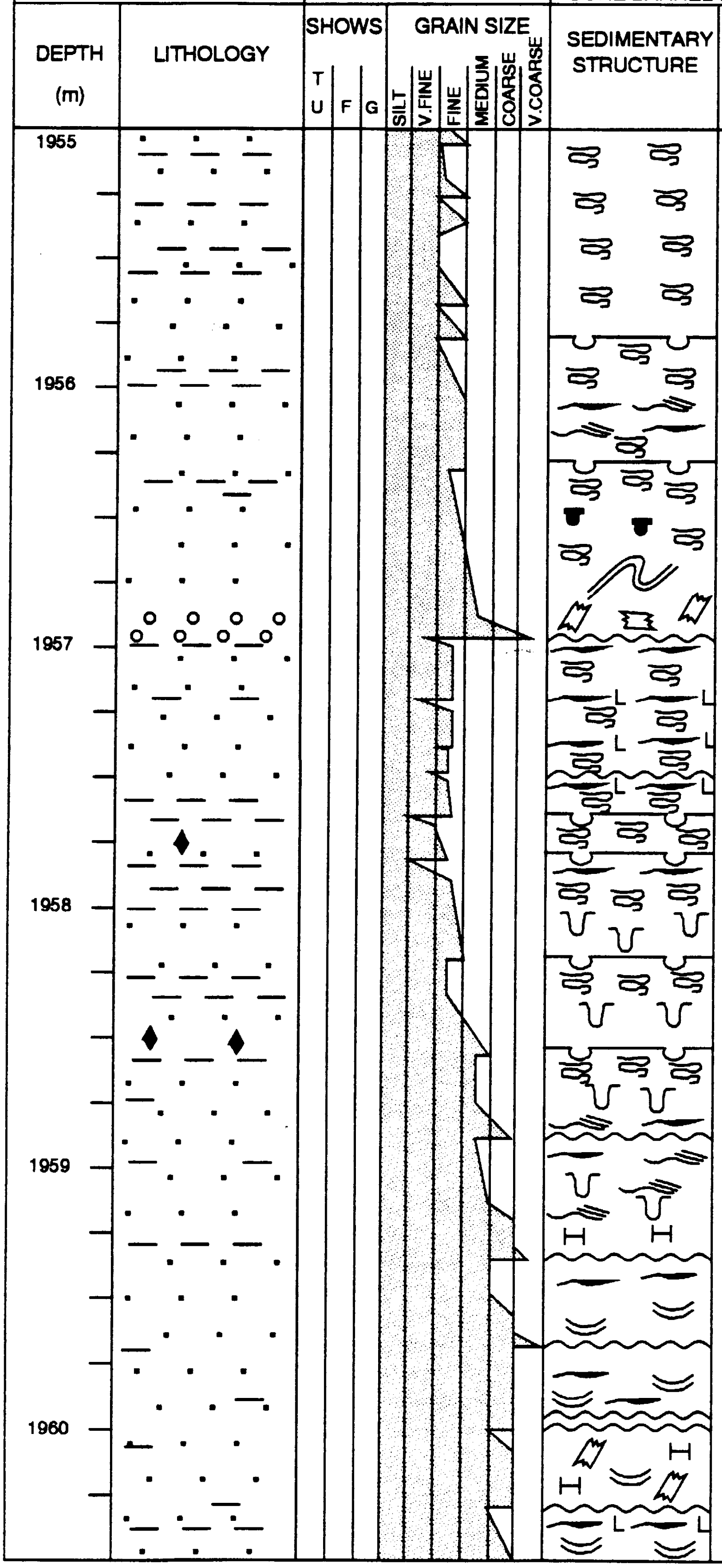
Base drawing No.F988
F1006

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
AUTHOR: P.Arditto / S.Horan
RIG: Byford Dolphin
K.B.: 25mRT
W.D.:
DATE:
CORE NO.: 5
Page: 19
INTERVAL:
CUT:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

SANDSTONE: very fine to fine grained, bioturbated, minor load casts, flasers and current ripple lamination.

SANDSTONE: very coarse fining to fine grained, pebbles at base, rip up clasts, dewatering features, microfoundering features and bioturbated.

SANDSTONE: very fine to fine grained, burrowed and bioturbated, load casts at base, flaser-lenticular bedding at top.

SANDSTONE: very coarse to medium grained, trough cross bedded, flaser beds and minor burrows, trace current ripple lamination.

November 1993

Base drawing No.F988
F1007

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31

AUTHOR: P.Arditto / S.Horan

RIG: Byford Dolphin

K.B.: 25mRT

W.D.:

DATE:

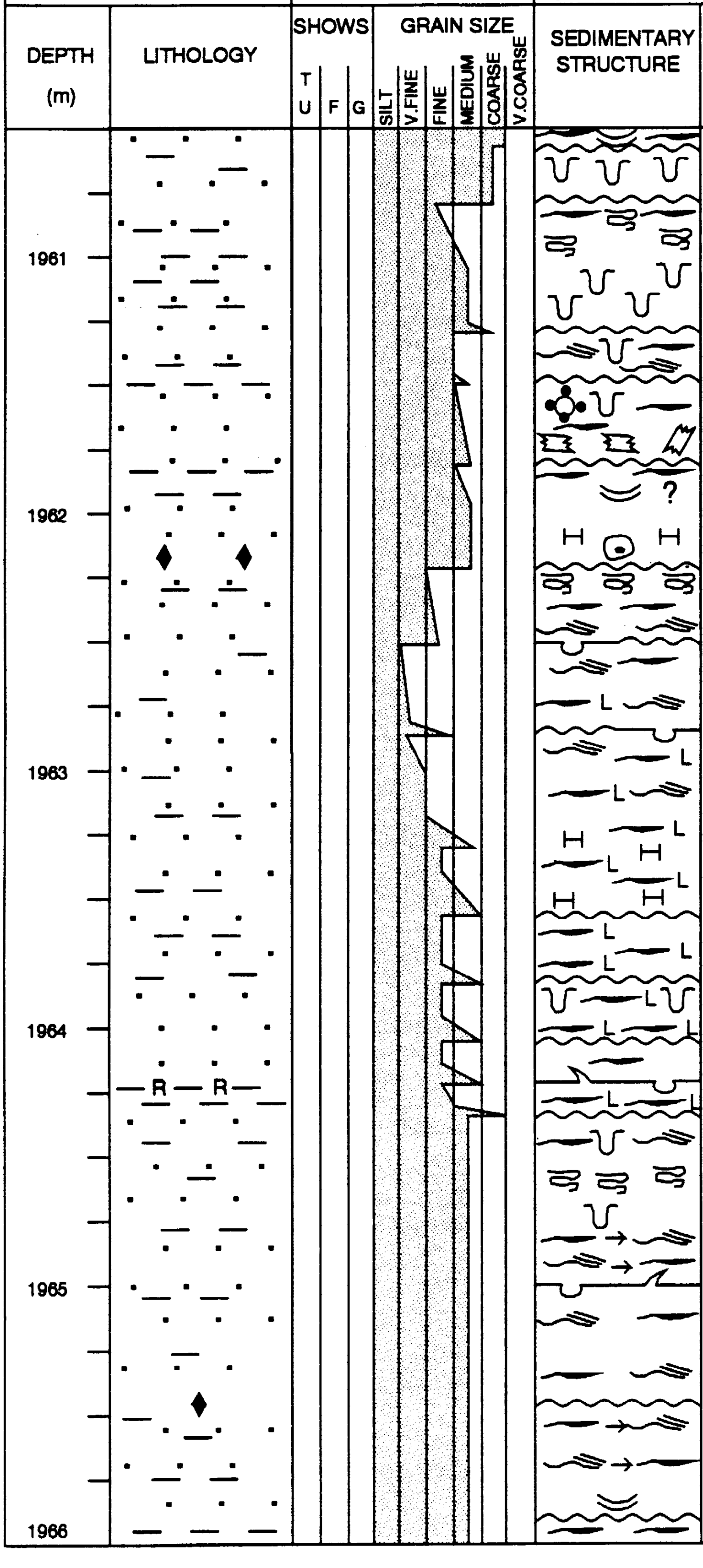
CORE NO.: 5

Page: 20

INTERVAL:

CUT:

CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

SANDSTONE: predominantly medium to fine grained trough crossbedded to current ripple laminated and flaser to lenticular bedded with burrowing to bioturbation. Units separated by scour surfaces.

Concretionary pyrite.

SANDSTONE: very fine to fine grained lenticular bedded with siltstone/shale abundant starved ripples.

SANDSTONE: fine up to medium grained, thin lenticular bedded units separated by scour surfaces. Minor burrows.

Resin blebs.

SANDSTONE: medium grained, current ripple laminated to flaser laminated units separated by scour surfaces or load and flame surfaces. Uppermost 0.4m contains long dwelling burrows.

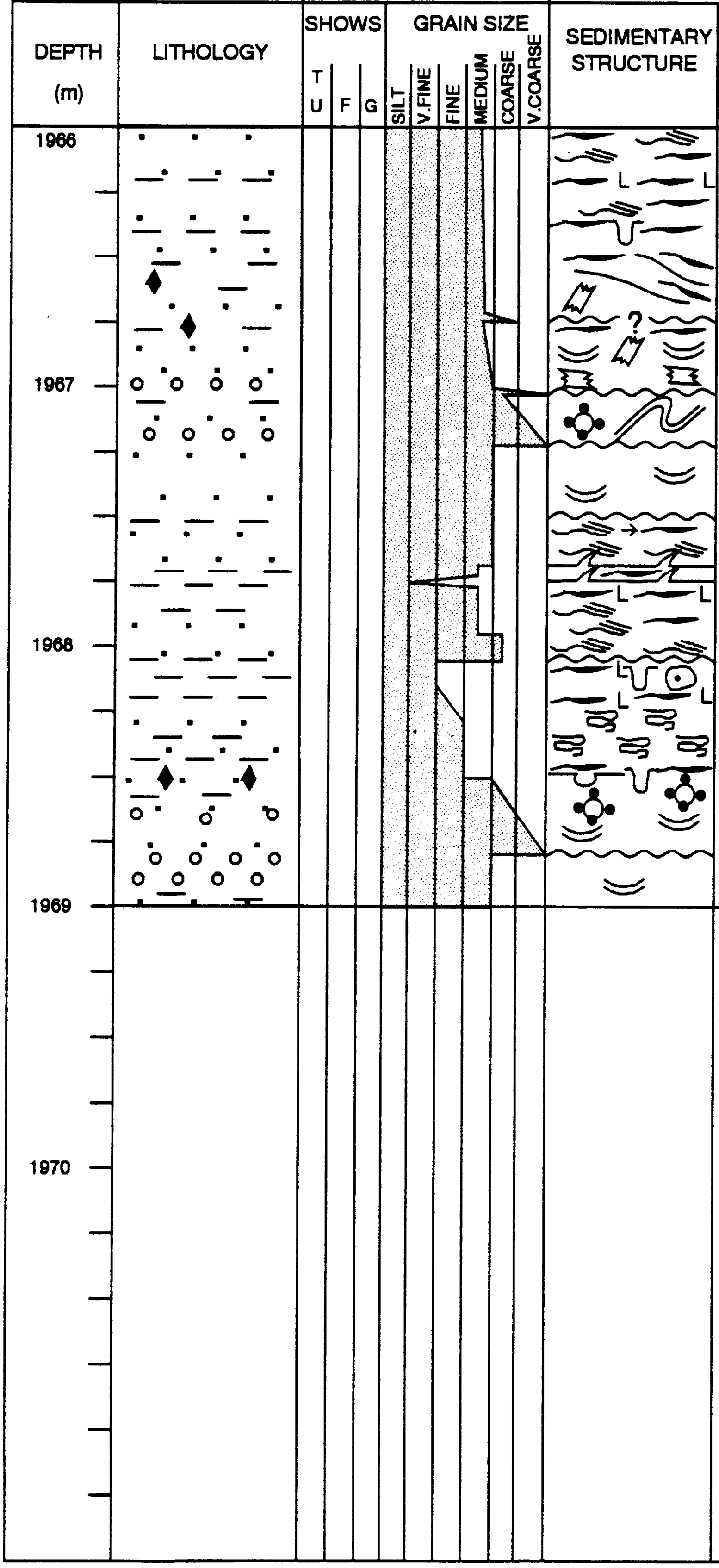
Base drawing No.F988
F1008

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31
DATE:
CORE NO.: 5
Page: 21
AUTHOR: P.Arditto / S.Horan
INTERVAL:
RIG: Byford Dolphin
CUT:
K.B.: 25mRT
W.D.:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

SANDSTONE: medium grained current ripple laminated to flaser laminated.

SANDSTONE: medium grained with a accretionary flaser draped inclined surfaces. Shale rip up clasts at base.

SANDSTONE: coarse to medium grained, trough cross bedded with minor shale rip up clasts.

SANDSTONE: very coarse to coarse grained with burrow.

SANDSTONE: medium to coarse grained trough cross bedded.

SANDSTONE: medium to coarse grained current ripple laminated, flasered in upper half, load cast/flame base.

SANDSTONE: medium to coarse grained, current ripple laminated to flaser laminated, lenticular bedded at top.

SANDSTONE: fine to medium grained, bioturbated to fine grained lenticular and burrowed, shaley, pyrite nodules at base. Siderite nodules at top.

SANDSTONE: fining to medium coarse, trough cross bedding, burrowed, pebbles 0.5cm diameter.

SANDSTONE: coarse grained moderately sorted, trough cross bedded, minor carbonaceous laminations.

BOTTOM CORE 5

November 1993

Base drawing No.F988
F1009

BHP Petroleum

CORE DESCRIPTION
MINERVA- 2A

PERMIT: VIC / P31

AUTHOR: P.Arditto / S.Horan

RIG: Byford Dolphin

K.B.: 25mRT

W.D.:

DATE:

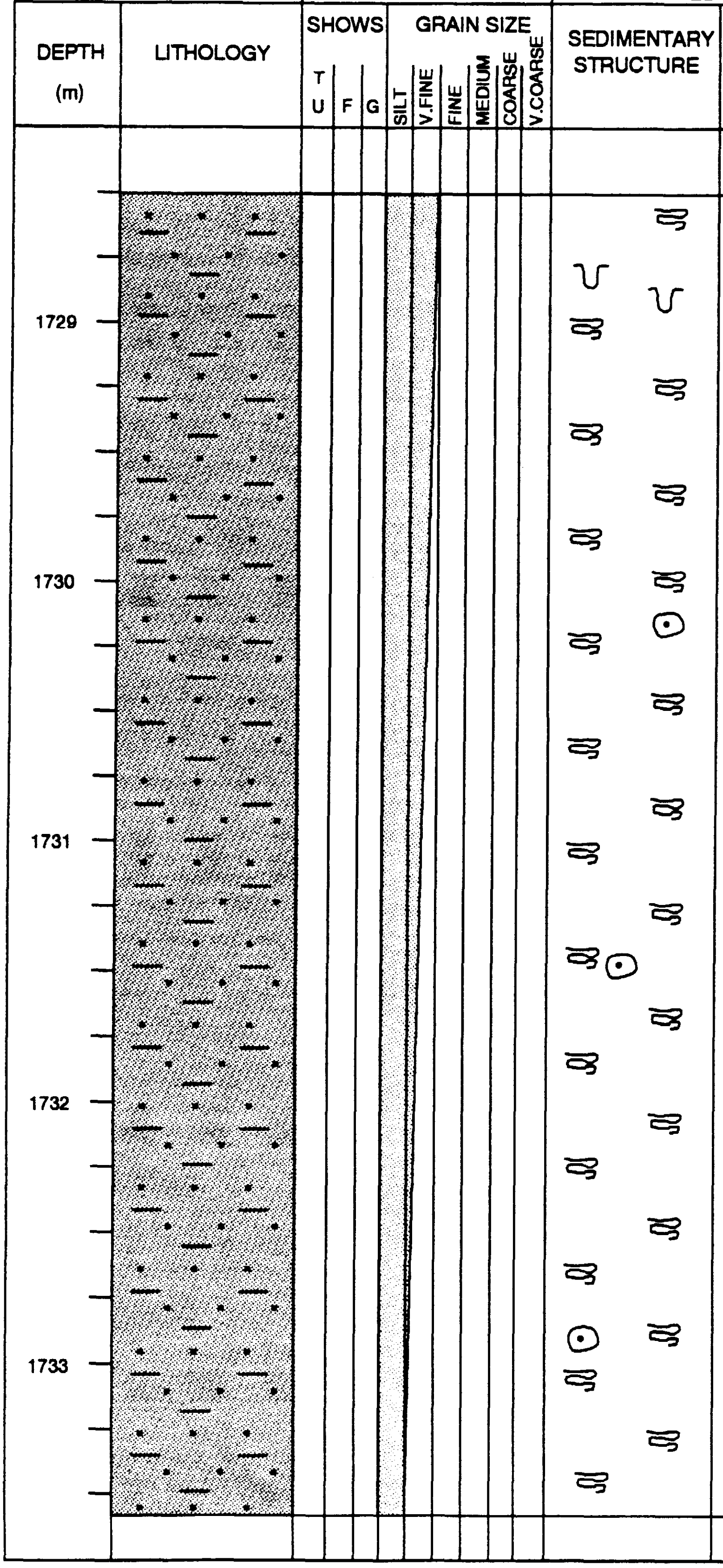
CORE NO.: 1

Page:

INTERVAL:

CUT:

CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

TOP OF CORE 1

Sandstone, very fine grained, silty, grading upwards to very fine to fine grained, muddy and very poorly sorted through extensive bioturbation.
Faint subhorizontal disturbated laminations throughout although primary sedimentary structured largely destroyed through bioturbation.
Sparse sand filled dwelling burrows near top of interval.
Sporadic sideritic nodular mudstone intervals evident replacing burrow features.

BOTTOM OF CORE 1

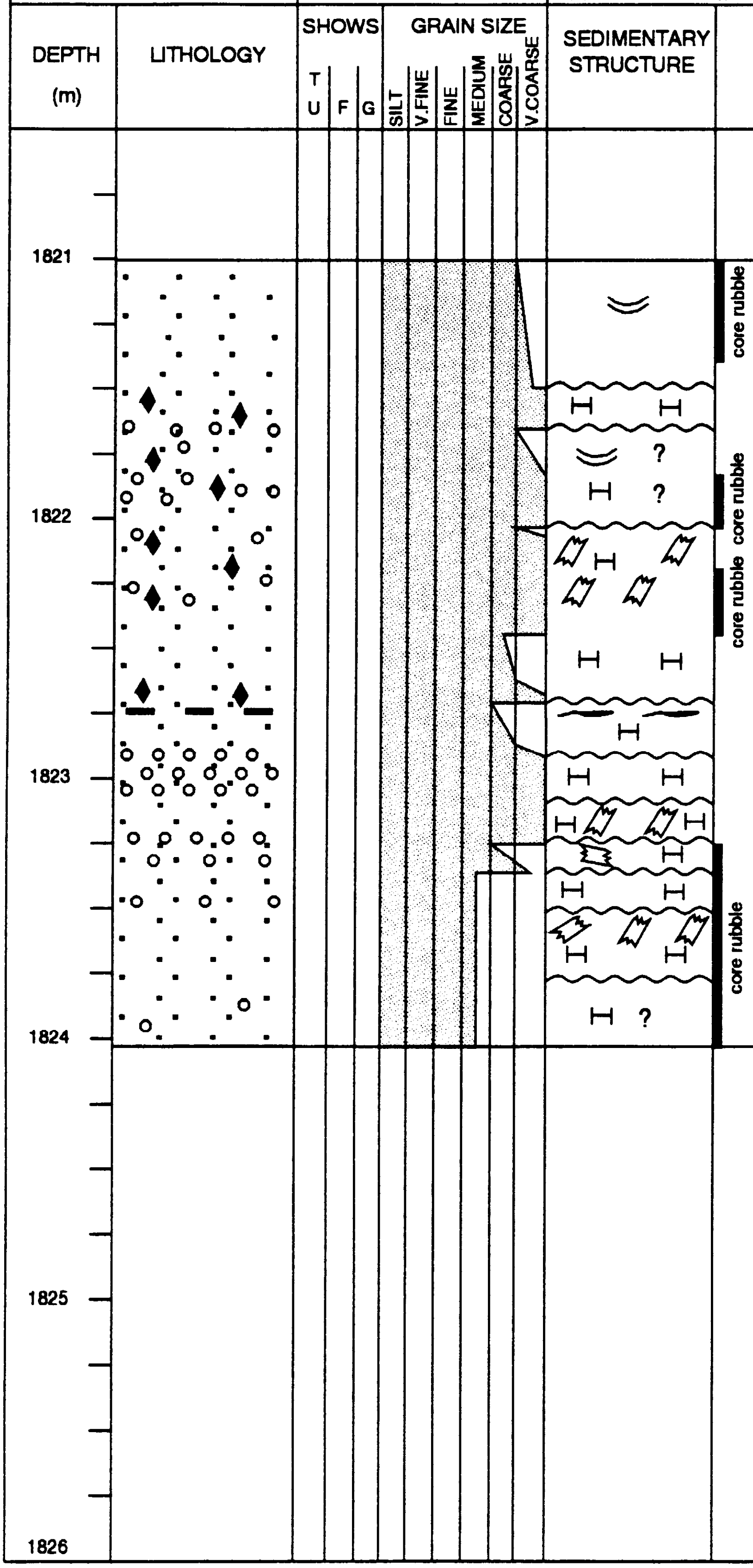
November 1993

Base drawing No.F988
F1033

BHP Petroleum

CORE DESCRIPTION
MINERVA-1

PERMIT: VIC / P31
AUTHOR: P.Arditto / S.Horan
RIG:
K.B.:
W.D.:
DATE:
CORE NO.: 1
Page: 1/5
INTERVAL:
CUT:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

TOP OF CORE 1

SANDSTONE, coarse up to granule, poorly sorted with common pebbles. Internally it is predominantly homogeneous with minor trough cross bedding and shale rip up clasts. Abundant disseminated pyrite cement as shown.

Lag pebbles up to 2 cm diameter

SANDSTONE, very coarse to granule, poorly sorted with abundant pebbles up to 2 cm diameter. Homogeneous.

SANDSTONE, predominantly medium grained (minor coarse grained), homogeneous with minor shale rip up clasts and pebbles on scour surfaces.

BOTTOM OF CORE 1

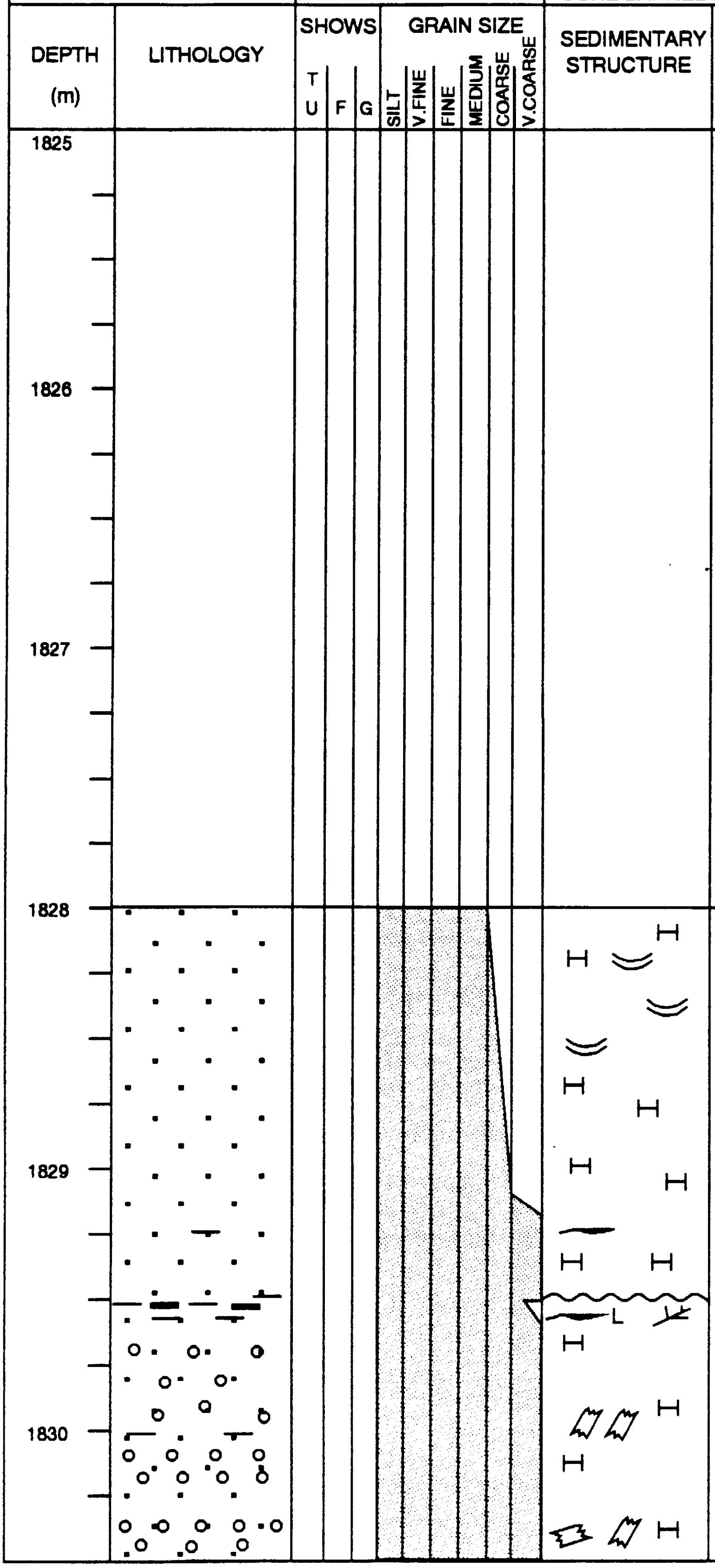
November 1993

Base drawing No.F988
F1034

BHP Petroleum

CORE DESCRIPTION
MINERVA-1

PERMIT: VIC / P31
DATE:
CORE NO.: 2
Page: 2/5
AUTHOR: P.Arditto / S.Horan
INTERVAL:
RIG:
CUT:
K.B.:
W.D.:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

TOP OF CORE 2

SANDSTONE, medium up to granule grained, well sorted, predominantly homogeneous with minor trough cross bedding in upper half.

SANDSTONE, pebbly, very coarse grained to pebbly, very poorly sorted, homogeneous with rare shale rip up clasts.
Lenticular bedded in upper 6 cm.

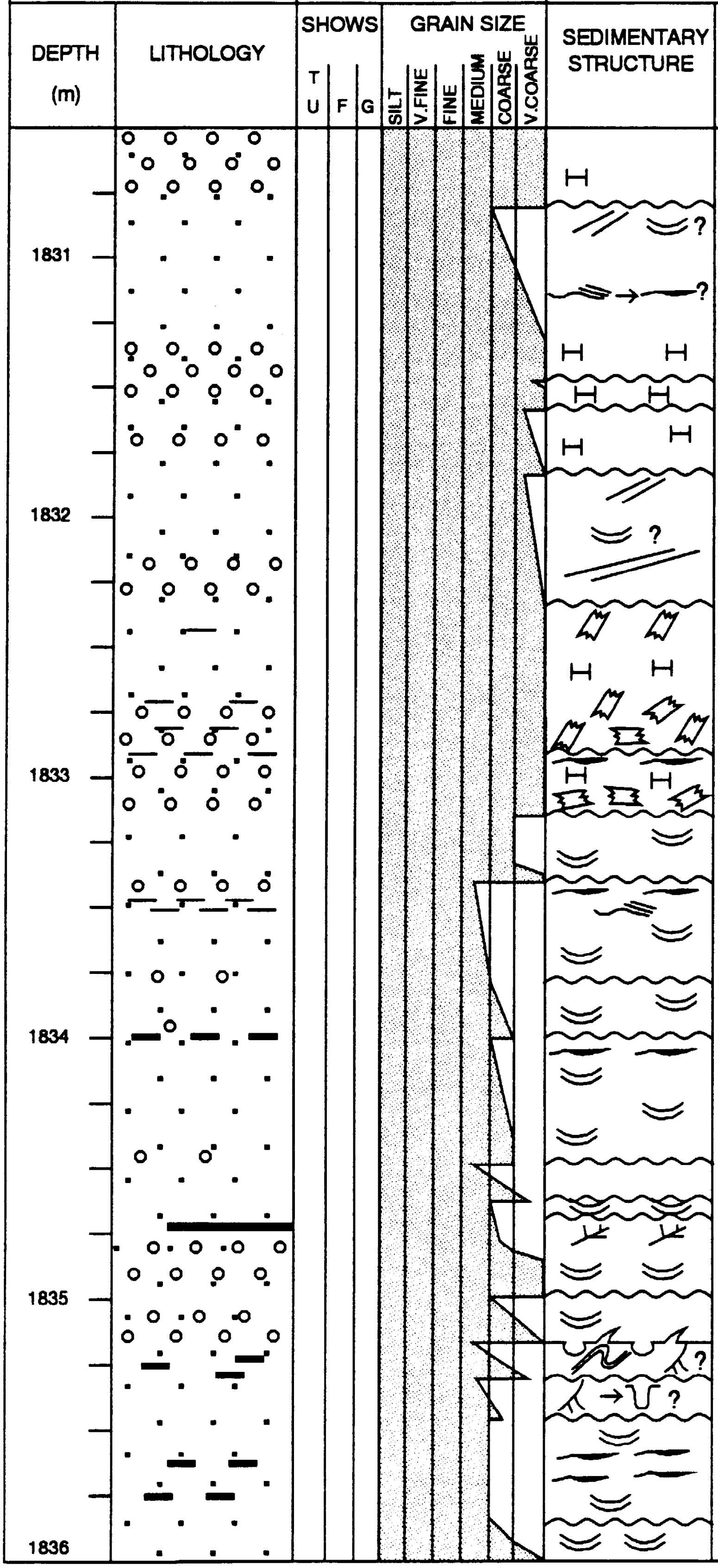
November 1993

Base drawing No.F988
F1035

BHP Petroleum

CORE DESCRIPTION
MINERVA-1

PERMIT: VIC / P31
AUTHOR: P.Ardittо / S.Horan
RIG:
K.B.:
W.D.:
DATE:
CORE NO.: 2
Page: 3/5
INTERVAL:
CUT:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

SANDSTONE, medium up to granule with common pebbles in basal portions.
Planar inclined to trough cross bedded near top.
Possible trace current ripples.

SANDSTONE, very coarse to granule, poorly sorted with planar inclined bedding to ? trough cross bedding.

SANDSTONE, very coarse to granule with common pebbles, poorly sorted with shale rip up clasts up to 3 cm diameter.

As above.

SANDSTONE, medium up to very coarse grained, moderately sorted with minor current ripple to flaser laminations at the top of each unit.

SANDSTONE, coarse grained to granule, common pebble, poor to moderately sorted, trough cross bedded, base of lower unit contains pillow and flame features.

Plant root to burrow.

SANDSTONE, medium to coarse grained, well sorted, trough cross bedded with minor carbonaceous flaser laminations.

Base drawing No.F988
F1036

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA-1

PERMIT: VIC / P31

AUTHOR: P.Arditto / S.Horan

RIG:

K.B.:

W.D.:

DATE:

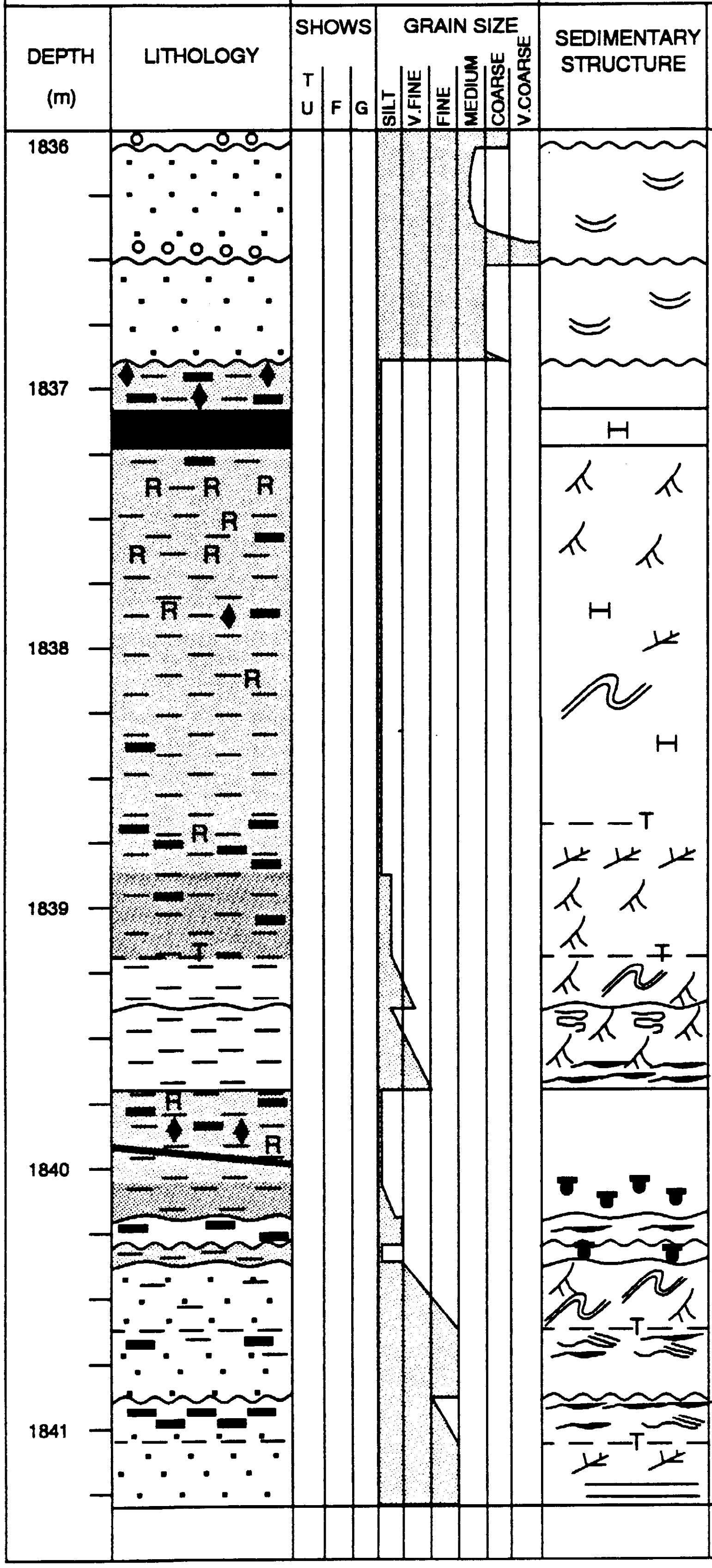
CORE NO.: 2

Page: 4/5

INTERVAL:

CUT:

CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

SANDSTONE, medium to coarse, very well sorted, trough cross bedded.

COAL, black, brittle, sub bituminous pyrite cemented in upper part of coal.

SHALE, dark grey, highly carbonaceous with abundant rootlets and stems abundant resin blebs.

SHALE, dark grey, homogenous with minor carbonaceous plant stems, sporadic pyrite nodule cemented, sporadic resin blebs, minor dewatering feature.

Highly carbonaceous shale.

SILTSTONE

Wavy

Saw cut

SHALE, dark grey, subfissile in lower half, upper half carbonaceous with coaly streaks and resin blebs, with minor pyrite nodules base gradational with underlying unit.

Wavy

Flaser (carbonaceous) to current ripple laminated.

BOTTOM CORE 2

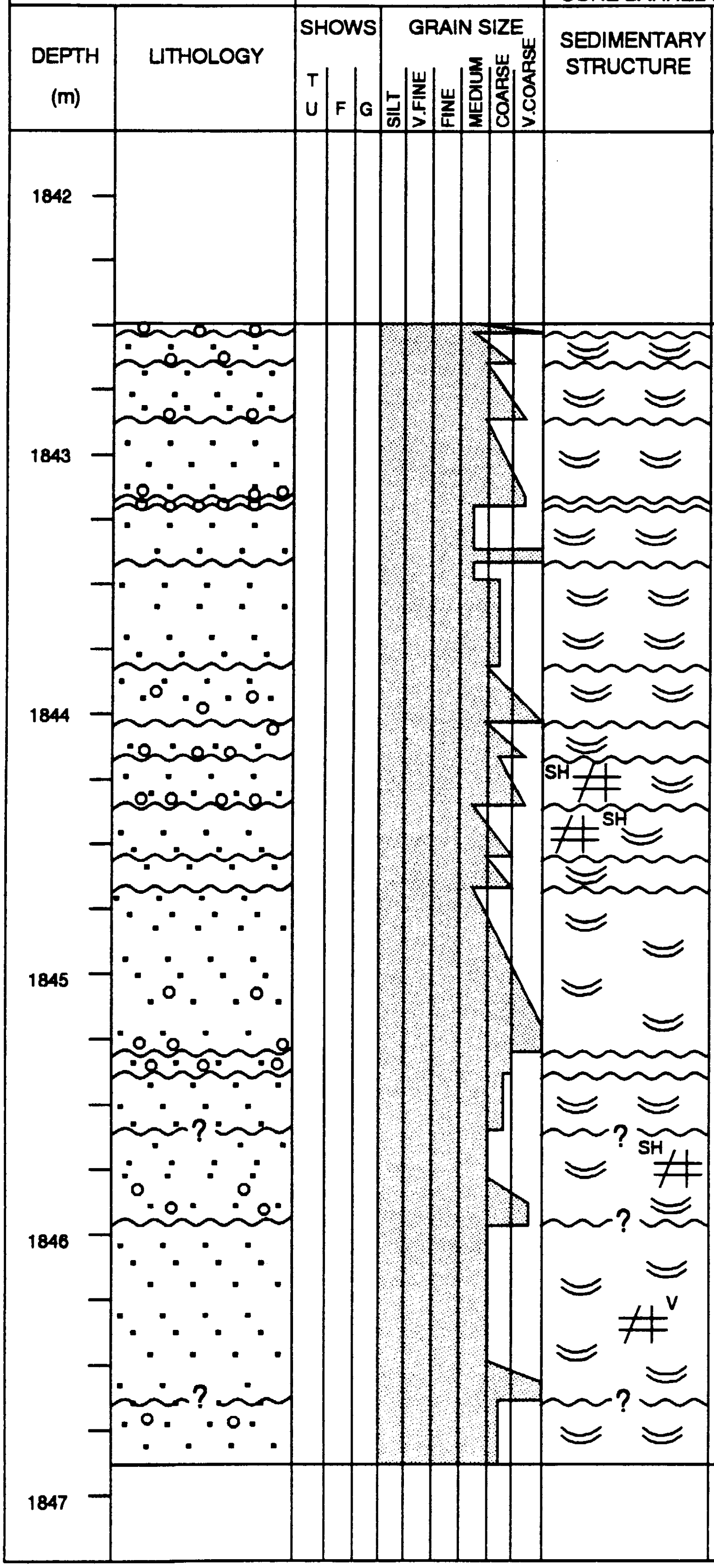
Base drawing No.F988
F1037

November 1993

BHP Petroleum

CORE DESCRIPTION
MINERVA-1

PERMIT: VIC / P31
AUTHOR: P.Arditto / S.Horan
RIG:
K.B.:
W.D.:
DATE:
CORE NO.: 2
Page: 5/5
INTERVAL:
CUT:
CORE BARREL & MUD TYPE:



LITHOLOGICAL DESCRIPTION

TOP OF CORE 3

SANDSTONE, medium to coarse, up to very coarse to granule, moderately well sorted, trough cross bedded, separated by scours into fining upwards units. Scours have pebble lags on top of surface.
SANDSTONE, has sucrosic texture due to abundant development of quartz overgrowths and several healed silica cemented fractures subhorizontal to near vertical. Some unusually high angle trough cross beds may indicate slump rotation. Overall sandstone appears extensively silica cemented.

Heal fractures 1844.21-1844.40

1846.20 - 1846.40 Siliceous mineral filled fractures.

SANDSTONE, coarse grained.

BOTTOM CORE 3

November 1993

Base drawing No.F988
F1038

ENCLOSURES

PE602777

This is an enclosure indicator page.
The enclosure PE602777 is enclosed within the container PE900102 at this location in this document.

The enclosure PE602777 has the following characteristics:
ITEM-BARCODE = PE602777
CONTAINER_BARCODE = PE900102
NAME = Minerva 2A Well Summary Log
BASIN = Otway
PERMIT = VIC/P31
TYPE = WELL
SUBTYPE = COMPOSITE_LOG
DESCRIPTION = Minerva 2A Well Summary Log
REMARKS = new barcode PE900512 replaced with PE602777
DATE-CREATED = *
DATE-RECEIVED = *
W_NO = W1086
WELL-NAME = MINERVA 2
CONTRACTOR =
CLIENT_OP_CO =

(Inserted by DNRE - Vic Govt Mines Dept)

PE900400

This is an enclosure indicator page.
The enclosure PE900400 is enclosure within the
container PE900102 at this location in this document.

The enclosure PE900400 has the following characteristics:
ITEM_BARCODE = PE900400
CONT AINER_BARCODE = PE900102
NAME = Minerva 2A Enclosure 2 Top Main Gas Zone Depth Structure Map

BASIN = OTWAY
PERMIT =
TYPE = SEISMIC
SUBTYPE = HRZN_CONTR_MAP
DESCRIPTION = Minerva 2A Enclosure 2 Top Main Gas Zone Depth Structure Map

DATE_CREATED =
DATE_RECEIVED =
W_NO = W1086
WELL_NAME = Minerva-2_2A
CONTRATOR = BHP
CLIENT_OP_CO = BHP