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Australia Division
BHP Petroleum

ERIC THE RED-1, VIC/P31
WELL COMPLETION REPORT
INTERPRETIVE

BHP

OTWAY BASIN, VIC/P31

ERIC THE RED-1

WELL COMPLETION REPORT INTERPRETATIVE VOLUME

PREPARED BY: D.H. Wong
Petroleum Geologist

70284_1.WCR

DATE: May 1994

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

ACKNOWLEDGMENT

This report was compiled and written with the help of the following:

1 Chris Luxton, Petroleum Geophysicist.
2 Simon Horan, Petroleum Geologist.
3 Mark Lemaire, Database Administrator.
4 Elise Smith, Technical Assistant.

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ENCLOSURE

1 WELL INDEX SHEET

COMPANY: BHP Petroleum Pty Ltd
WELL: Eric The Red - 1
TYPE: W/cat
SPUDDED: 0700 hrs 17th Feb 1993
BASIN: Otway
COMPLETED: 0330 hrs 6th Mar 1993
TENEMENT: VIC/P31
TD: 1875 mRT
ELEV. W. D.: 100 mRT
R.T.
K. B.: 25 m
LOCATION: Lat. 39deg 00min 45.44sec South Long. 143deg 10min 51.45sec East
STATUS: P & A
1st FLANGE: 30" @ 137 m

FORMATION/ LITHOLOGIC SUMMARY/ MARKER	TOPS(m) DRILL	SUB SEA	SEISMIC TWT	REMARKS
No returns	100-364			
Tertiary	100	75		Fossiliferous calcarenite with interbedded marl.
Nirranda Group	370	345		Sandstones with minor siltstones.
Wangerrip Group	413	388		Sandstones with minor claystone and siltstones.
Sherbrook Group	537	512	545	Interbedded siltstones, sandstones and claystones with calcite cement, pyrite nodules and trace glauconite.
Shipwreck Group				
Upper	1043	1018	1000	Interbedded sandstones, siltstones and claystones with minor coal at base.
Lower	1436	1411	1080	Interbedded sandstones and claystones with minor coal. Conglomerate near the base.
Otway Group				
Eumeralla Formation	1747	1722	1310	Interbedded sandstones and claystones with minor siltstones.

LOGS:

SUITE 1	SUITE 2
DLL-MSFL-SDT-GR-SP-CAL-AMS	DLL-MSFL-SDT-GR-CAL-SP-AMS
VSP	FMS-LDL-CNL-GR-AMS
CST-GR (30)	VSP
	RFT
	CST-GR (60)

SWC: SHOT 90 REC 74
DITCH SAMPLES: 370 - 1875 m
STORED: Kestrel Management, Mt. Waverley, Vic.
CORES: No cores cut.

CASING/TUBING SIZE	30"	13.375"	9.625"
LANDED AT (m)	137	355	1007
CEMENT (sacks)	456	500	254

TEST RESULTS, FLUID ANALYSIS, LOST CIRCULATION (INTERVAL, CAUSES) PLUG TOPS, REMARKS
Plug No. 1 was set from 1100-900 m; 270 sacks cement
g No. 2 was set from 174-124 m; 120 sacks cement

2 WELL SUMMARY

Eric the Red-1 (ETR-1) was spudded on the 17th February 1993 and is located approximately 35 km east of the Mussel-1 well, in the permit VIC/P31 which lies in the eastern offshore Otway Basin, off the southern coast of Victoria (Figure 1). The actual geographic location of ETR-1 is :

39 deg 00 min 45.44 sec South.
143 deg 10 min 51.45 sec East.

The well was designed primarily to test the hydrocarbon potential of the quartzose sandstones of the late Cretaceous Shipwreck Group within a faulted anticline.

ETR-1 was drilled to TD of 1875mRT (1850 mSS) within the top of the Eumeralla Formation (Otway Group) without encountering any significant hydrocarbon fluorescence and cuttings gas in the primary prospective sequence. The well was plugged and abandoned as a dry well.

3 HYDROCARBONS

3.1 Hydrocarbon Occurrences

Eric the Red-1 intersected no hydrocarbons. No direct or cut hydrocarbon fluorescence were observed in the cuttings or in SWC's. Gas readings was insignificant, but went up to C3 when associated with coal beds. An RFT program was conducted in the open hole to 1785mRT and the report is presented in Appendix 6. In summary, the RFT results indicated that all the sands intersected in the prospective Shipwreck Group are water bearing and are in hydraulic communication vide a common aquifer. A fluid gradient of 1.41 psi/m was measured in these sands. Permeabilities measured with the RFT tool ranges from 1000 to 5000 md.

Pressure gradient plot for ETR-1 and Pecten-1A indicated that the Shipwreck Group intersected in these two wells have at one stage been in hydraulic communication. La Bella-1 on the other hand, has an overpressured Shipwreck Group with respect to ETR-1, indicating that these formations are not in communication between La Bella-1 and ETR-1.

4 STRUCTURE

The Eric the Red structure is an anticline that has been broken by extensional faulting to form a series of fault blocks with dip closure in the strike (east-west) direction. The structure has significant overall closure in the dip direction but the fault block in which the Eric the Red-1 well was drilled relied upon fault seal against the Sherbrook Group to the north and south.

Roll-over in the strike direction was caused by several east-west compressional events from the end of the early Cretaceous through to the Tertiary.

The Eric the Red-1 well penetrated a much sandier than prognosed Sherbrook Group, the results of the well demonstrated that the faults were not sealing.

5 STRATIGRAPHY

5.1 Predicted Vs Actual

The lithology and stratigraphy encountered in Eric the Red - 1 (ETR-1) are illustrated in Figure 2 (predicted vs actual) and are summarised below with depths in metres subsea (RT=25 m amsl).

FORMATION/ MARKER	TOPS(mSS) PREDICTED	ACTUAL	DIFF (m)
Returns to seabed	75 - 364		
Tertiary			
Nirranda Group	264	no returns	
Wangerrip Group	377	388	+11
Sherbrook Group	550	512	-38
Shipwreck Group			
Upper	1160	1018	-142
Lower	1305	1411	+106
Otway Group			
Eumeralla Formation	1720	1722	+2

The sedimentary section drilled at ETR-1 fits fairly well into the regional geological scheme even though the Sherbrook Group penetrated at ETR-1 is more sandy than originally predicted. Description from cuttings, sidewall cores, wireline log character, palynology and well correlations provide the basis for the stratigraphic breakdown. The composite log in Enclosure 1 provides a more detailed representation of the actual lithology and stratigraphy encountered in ETR-1.

5.2 Stratigraphic Summary

Surface 100 - 364 mRT

Returns to seabed.

Tertiary 365 - 537 mRT

As there were no returns from above 365mRT, lithology from the Heytesbury Group was not described. The first returns at 370mRT was from the sandstone of the Mepunga Formation of the Nirranda Group. The sandstone is friable and unconsolidated with medium to coarse, subrounded to rounded poorly sorted quartz grains which are dominantly iron stained. The sandstone has an argillaceous matrix and has good to very good visual porosity. The minor interbedded claystone is dark grey, brownish grey to olive black and is soft, blocky when firm, dispersive and non calcareous. Palynological analysis on the SWC's from 373.5mRT and 388mRT gave a late Eocene mid *N. asperus* zone.

Underlying the Nirranda Group from 413-537mRT is the late Paleocene to mid Eocene Wangerrip Group comprising the Dilwyn Formation (413-464mRT), Pember Mudstone (464-477.5mRT) and the Pebble Point Formation (477.5-537mRT). The Dilwyn Formation consists of mainly medium to coarse grained, subrounded, moderately well sorted, greyish brown to light grey quartz sandstone with minor silty claystone. The sandstone has trace to commonly iron stained grains, contains iron oxide pellets and has good to very good visual porosity. A palynological analysis of the SWC from 429mRT yielded a mid Eocene lower *N. asperus* zone which places this part of the stratigraphic section to be within the Dilwyn Formation. Underlying the Dilwyn Formation is the early Eocene Pember Mudstone. The dusky brown to light brownish grey silty claystone of the Pember Mudstone is non calcareous and overlies 59.5 m of medium to coarse grained, subangular to rounded moderately sorted quartz sandstone belonging to the Pebble Point Formation. An early Eocene upper *M. diversus* zone was determined from a SWC sampled from 469mRT. The sediments of the Tertiary section sampled and analysed were mainly nearshore marine facies. Palynological analysis has not revealed any Paleocene within the Tertiary section but could be present in the interval from 467-537mRT (top of Sherbrook Group) which was unsampled for biostratigraphy.

Sherbrook Group (Late Cretaceous) 537 - 1043 mRT

The top of the mid Santonian to Maastrichtian Sherbrook Group is picked at 537mRT based on palynological data, log character and lithological description. The first encounter of the latest Maastrichtian *T. longus* zone is at 553mRT (SWC). The top of the Sherbrook Group is marked by a characteristic limonite-rich 'laterite' like conglomeritic claystone and argillaceous conglomerate which consists of very coarse to granule, subrounded to rounded quartz and lithic pebbles, iron stained in part, with presence of trace fine to medium grained glauconite pellets. The argillaceous conglomerate is also friable, unconsolidated with very poor visual porosity.

A sandstone interbedded with claystone section was encountered from 550-622mRT. This represents the palynological *T. longus* zone. The sediments were deposited in a very nearshore marine to marginal marine environments. The sandstone is unconsolidated, friable, light grey to translucent, subangular to subrounded, fine to very coarse grained and is poorly sorted. It also contains common metamorphic(?) lithics and chert. The claystone is dark to greenish grey, soft, dispersive and contains common glauconite.

The section from 622 - 690mRT is more clayey (silty claystone) which was deposited in a non marine environment, possibly a freshwater lake setting due to the absence of *dinoflagellates*. Palynological analysis on SWC's at 612.5mRT and 642mRT respectively yielded a questionable *T. lillei* zone. The section graded into a mainly sandstone (80-100%) interbedded with claystone (0-20%) lithology from 690-1043mRT which is picked as the top of the Upper Shipwreck Group. The sandstone ranges from 30 to 60 m thick and contains thin possibly calcareous cemented beds or calcite rich layers which gave the high resistivity, high RHOB and low sonic (fast velocity) peaks on the wireline logs. The sandstone is unconsolidated, friable, light greenish grey to light grey, medium to coarse grained, subrounded to rounded with dispersive light greenish grey to light grey argillaceous matrix and rare light brown lithics and rare glauconite pellets. It has good to very good visual porosity but no hydrocarbon fluorescence was observed. The claystone is dark greenish grey to brownish grey, soft, occasionally firm to hard, slightly dispersive, non calcareous with rare carbonaceous flecks.The sediments in this section were deposited in a nearshore marine environment. Palynological analysis of SWC's from this interval points to an upper *N. serectus* (early Campanian) zone in the upper part and a mid *T. apoxyexinus* (Santonian) zone at the lower section.

Shipwreck Group (Late Cretaceous) 1043 - 1747 mRT

Upper Shipwreck Group 1043 - 1436 mRT

The top of the Upper Shipwreck is picked at 1043mRT on top of a light grey unconsolidated, friable medium grained subrounded quartz sandstone. The sandstone has moderate to good visual porosity and contains trace to common light greenish argillaceous matrix and thin calcite cemented beds. The Upper Shipwreck Group can be split into three lithological units: the top unit consisting of sandstone/claystone interbeds, the middle unit of claystone/siltstone, coaly interbeds and the lower unit of sandstone/minor claystone interbeds.

The top sandstone /claystone interbeds unit (1043-1185mRT) appears to have been deposited in a nearshore with non marine (freshwater) influenced environment. Palynological analysis indicated a lower *T. apoxyexinus* zone at 1080mRT and an upper *P. mawsonii* zone at 1097-1180mRT. The fining upwards sandstone at 1148-1158mRT appears to have been deposited in a freshwater lacustrine environment. The sandstone is light grey to very light grey, clear to translucent, friable, loose, fine to coarse grained quartz, subangular to subrounded, poorly sorted and have good visual porosity. No hydrocarbon fluorescence was observed. The claystone is non calcareous, medium to light grey to medium dark grey, soft, dispersive with trace glauconite in the upper part but has trace to common carbonaceous flecks and coaly fragments towards the lower part of the unit. On the wireline logs, thin questionable calcareous streaks are also present within some of the sandstone beds but are not as common as in the Sherbrook Group. These calcareous streaks are likely to be calcite cemented thin laminae which could be due to diagenesis rather than deposition, especially if the sediments were deposited in a non marine environment.

The middle unit (1185-1330mRT) consists of mainly claystone interlaminated with minor fine sandstone/siltstone and coal beds. The claystone is generally the same as that in the top unit. Palynology indicates a *P. mawsonii* zone and the environment of deposition was nearshore to non marine.

The lower unit (1330-1436mRT) consists mainly sandstone with minor claystone. The sandstone is clear to light grey, friable, loose, medium to coarse grained,subangular to subrounded, poorly to moderately sorted quartz with common grey to off-white dispersive argillaceous matrix and has good visual porosity. Trace grey lithics, rare mica and common coal fragments are also present. No hydrocarbon fluorescence was observed. Sediments within this unit has also been deposited in a nearshore, marginal marine environment in the *P. mawsonii* zone.

From 1436-1459mRT, the well penetrated a claystone interval. A SWC sample at 1452mRT gave a possible *distocarinatus* zone. This claystone represents the top part of the Lower Shipwreck Group.

Lower Shipwreck Group 1436 - 1747 mRT

The Lower Shipwreck encountered in ETR-1 is a sandstone with minor claystone sequence. The sandstone is very light grey to light grey, clear to translucent grains, friable, loose, medium to coarse grained, subangular to subrounded, poorly sorted quartz with trace light grey argillaceous matrix. It also contains rare moderately strong pyrite cement, common multicoloured questionable metamorphic and cherty lithics and has poor to fair visual porosity. The quartz sandstone graded to argillaceous sandstone with depth with abundant off-white to light grey argillaceous matrix, in part grading to arenaceous claystone. No hydrocarbon fluorescence was also observed in both the quartz sandstone and argillaceous sandstone. The lower part from 1575mRT to the basal part of the sequence appears to have been deposited in a marginal marine to brackish water environment. Palynological analysis of SWC's within this sequence gave a Cenomanian *A. distocarinatus* zone while those below this sequence gave indeterminate ages. Lithologically the sequence below is primarily an argillaceous quartzose or lithic sandstone which is believed to be from the Albian Eumeralla Formation (Otway Group).

Otway Group (early Cretaceous) 1747 - 1875 mRT(TD)

The questionable Albian Eumeralla Formation of the Otway Group penetrated in ETR-1 is mainly argillaceous and lithic sandstone which is light grey, friable, fine to medium grained subangular to subrounded, moderately to well sorted black, light green and white lithic and feldspathic grains while most of the quartz grains are clear to translucent. It contains abundant very light grey argillaceous matrix grading to arenaceous claystone. It has poor visual porosity with no shows observed. The sediments appeared to have been deposited in a brackish environment but the presence of *botryococcus* in the four SWC samples suggests a strong lacustrine influence. The wide sampling intervals, however, can not conclusively point to an exclusion of marine influence during its depositional history.

No definitive palynological dating could be determined for this sequence but lithological correlation of similar lithologies from Prawn-A1 and La Bella-1 suggests that this sequence contains the Otway Group age sediments, possibly that of the Eumeralla Formation.

6 GEOPHYSICAL DISCUSSION

6.1 Seismic Coverage

The Eric the Red structure is defined by a 1 by 1 km grid of good quality seismic data that was acquired in 1991. Several 1981 and 1982 seismic lines that were reprocessed in 1991 provided additional coverage of the area. The 1991 seismic data is not optimally positioned to define many of the faults in the structure and the steep dips create a problem with events appearing from out of the plane of the section. Despite this problem, the relatively close spacing of the lines and good quality of the data relieves much of the interpretational uncertainty evoked by the structural complexity of the area.

6.2 Post-Drill Mapping

Eric the Red - 1 encountered a much sandier section than prognosed above the mapped Top Upper Shipwreck Group. This is suspected to be a key factor for the absence of hydrocarbons at the Eric the Red - 1 location. Subsequent to the drilling of Eric the Red - 1, the interval above the mapped Top Upper Shipwreck Group has been divided into three sand and shale packages.

6.3 Velocities

A smoothed seismic velocity model was created to be used for the pre-drill depth conversion. The velocity model was then intersected with seismic times for the five interpreted horizons. This enabled the calculation of smoothed average and interval velocities. The interval velocities were than used to convert time to depth. The prognosed versus actual depth of each horizon time pick varied by less than 6%, indicating that the calculated velocities were reasonably accurate.

The following table compares the prognosed depth for four of the mapped horizons with the actual depth taken from the VSP for the same two-way time.

HORIZON	TWT (msec)	PROGNOSED DEPTH (mSS)	VSP DEPTH (mSS)	DIFF (m)	DIFF (%)
Base Tertiary	545	550	532	18	3.4
		(2681 m/sec--Vint--2576 m/sec)			
Top Upper Shipwreck	1000	1160	1118	42	3.8
		(3625 m/sec--Vint--3050 m/sec)			
Top Lower Shipwreck	1080	1305	1240	65	5.2
		(3609 m/sec--Vint--3348 m/sec)			
Top Otway	1310	1720	1625	95	5.8

7 GEOLOGICAL DISCUSSION

7.1 Previous Work

Eric The Red-1 is the second well to be drilled in the Permit VIC/P31 area. The only other well drilled in the permit was Mussel-1 (Esso, 1969).

Mussel-1 was drilled to a TD of 2450mRT (RT was 30.2m above sea level) where part of the drill string twisted off. Fishing operations were unsuccessful so electric logs were run to 2286mRT (top of fish was at approximately 2300mRT) and the well was plugged and abandoned on 18th September, 1969. The primary target was the lower late Cretaceous Waarre Sandstone (Shipwreck Group) on a structural high within a tilted fault block. The secondary targets were the minor structural closures mapped within the Eocene Mepunga and Dilwyn Formations. The well reached total depth in Cenomanian Shipwreck Group sediments after encountering water bearing sandstones in the Mepunga and Dilwyn Formations and weak gas shows in the Waarre Sandstone.

Mussel-1 was sited using widely spaced, poor quality, low fold seismic of 1967-68 vintage. Seismic remapping by BHPP using modern and reprocessed vintage data has suggested that the well was drilled off structure. BHPP as part of its permit obligations has reprocessed a large portion of the vintage (pre-1990's) seismic data using today's modern processing techniques (such as land DMO correct migration) has improved processed data quality comparable to their own 1991's OH91 survey which was used in the interpretation of Eric The Red.

7.2 Summary of Regional Geology

VIC/P31 is located in the eastern Otway Basin. The Eric The Red structure lies on the southern margin of the Mussel Terrace. The Otway Basin consists of a series of superimposed sedimentary sequences, each deposited during different phases of the separation of the Antarctic continental landmass from the Australian southern margin. The eastern margin of the basin is defined by the outcropping King Island - Mornington Peninsula basement high while the continental shelf margin marks the economic southern limit of the basin. The Otway Basin is subdivided into a number of embayments and troughs separated by uplifted areas. The structural development of the Otway Basin has been discussed by Griffiths (1987) and Yu (1988), while Laing et al (1989) gave an overview of the basin hydrocarbon prospectivity.

BHPP has subdivided the Otway Basin geologic history within the VIC/P31 permit area into three major tectonostratigraphic stages (Pickavance et al, 1993 and BHPP, 1992), namely:

(i) Early Cretaceous rifting and deposition of the syn-rift Pretty Hill Formation extended from the Valanginian to the Barremian. Rifting was aborted during the Aptian, and the subsequent sag phase led to the deposition of the Eumeralla Formation until latest Albian.

(ii) Rifting was reactivated in the earliest Cenomanian. The recently identified syn-rift Shipwreck Group was deposited in half-graben settings from Cenomanian until mid Santonian. Continental break-up and initiation of seafloor spreading was proposed at mid Santonian (85Ma). The Sherbrook Group was deposited in a sag phase following the break-up from mid Santonian to latest Maastrichtian. In the Eric the Red structure, the Sherbrook Group has been demonstrated to be much sandier than originally predicted.

(iii) During a moderately quiescent Tertiary drift stage, Wangerrip Group sediments, Nirranda Group sediments and Heytesbury Group sediments were deposited on the increasingly marine-influenced margin.

The geologic evolution of the offshore eastern Otway Basin as defined in the permit area VIC/P31 could therefore be best understood by examining the above three periods of geologic history. The structure and stratigraphy of the eastern Otway Basin are summarised in Figures 3 and 4.

7.3 Contributions to Geological Concepts & Conclusions

ETR-1 penetrated good quality sandstone reservoirs within the primary target, the Shipwreck Group. No hydrocarbon fluorescence or significant cuttings gas were recorded during drilling and log (RFT) interpretation indicates that the section is water saturated.

The overlying Sherbrook Group was predicted to provide adequate fault seal for the trapping mechanism and hydrocarbon retention. The section was much sandier than originally predicted, resulting in inadequate fault seal, and the failure of the structure to retain hydrocarbons.

The potential source was predicted from the Eumeralla Coal Measures which was not penetrated in ETR-1. The claystones and minor coal intersected in the well within the Sherbrook and Shipwreck Groups contain mainly gas-prone Type II/III to Type III organic matter. Thermal maturity data and vitrinite reflectance measurements show that the Sherbrook and Shipwreck Groups are thermally immature while the Otway Group is marginally mature at TD.

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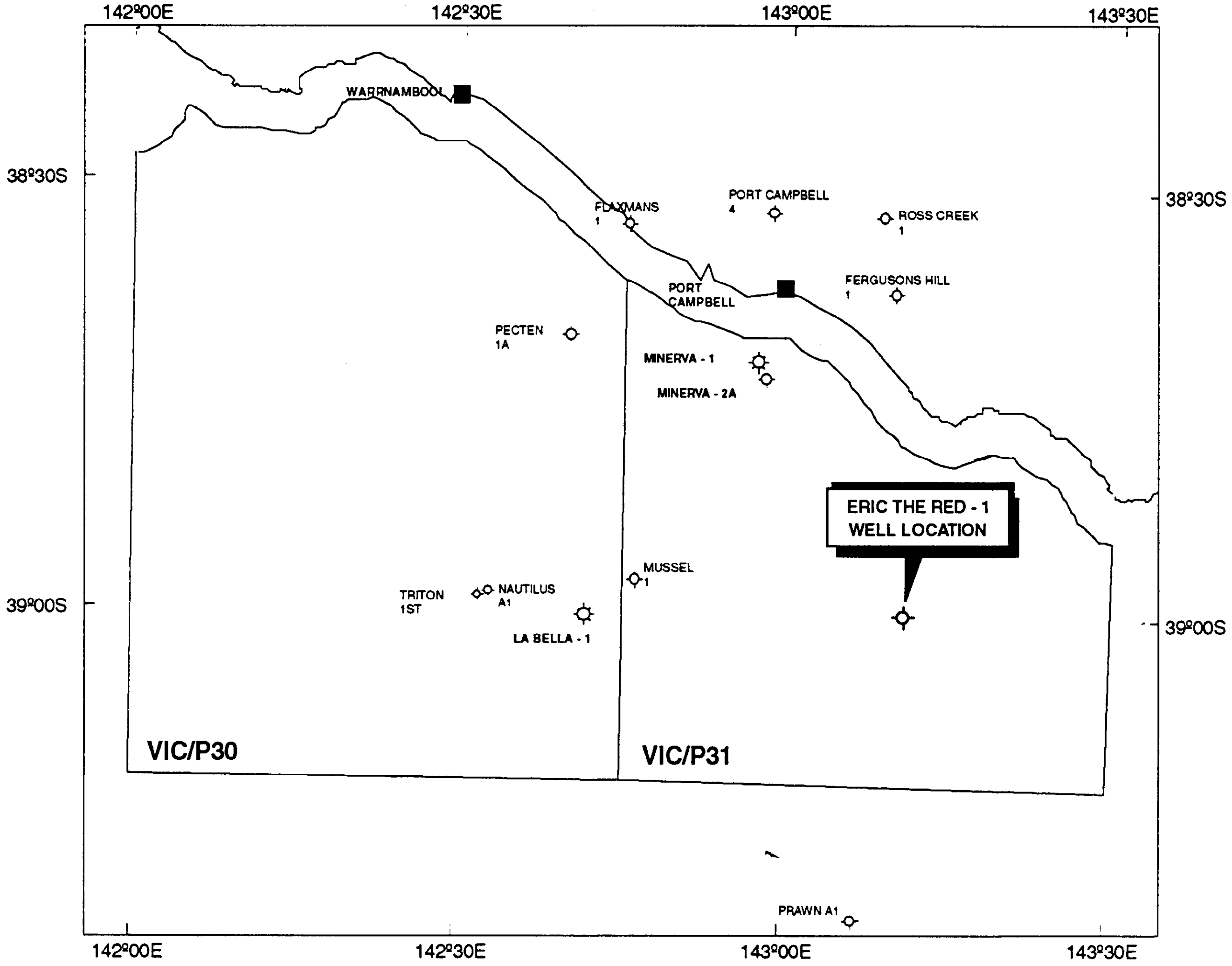
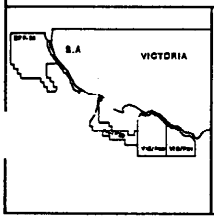
FIGURES





ERIC THE RED-1 WELL LOCATION

BHP Petroleum

OTWAY BASIN

Eric the Red-1

Eric the Red-1

PERMIT: VIC/P31

PREDICTED v ACTUAL

LINE : OH91-186
SP : 1188

LAT 39°00'45.44"S
LONG :143°10' 51.45"E

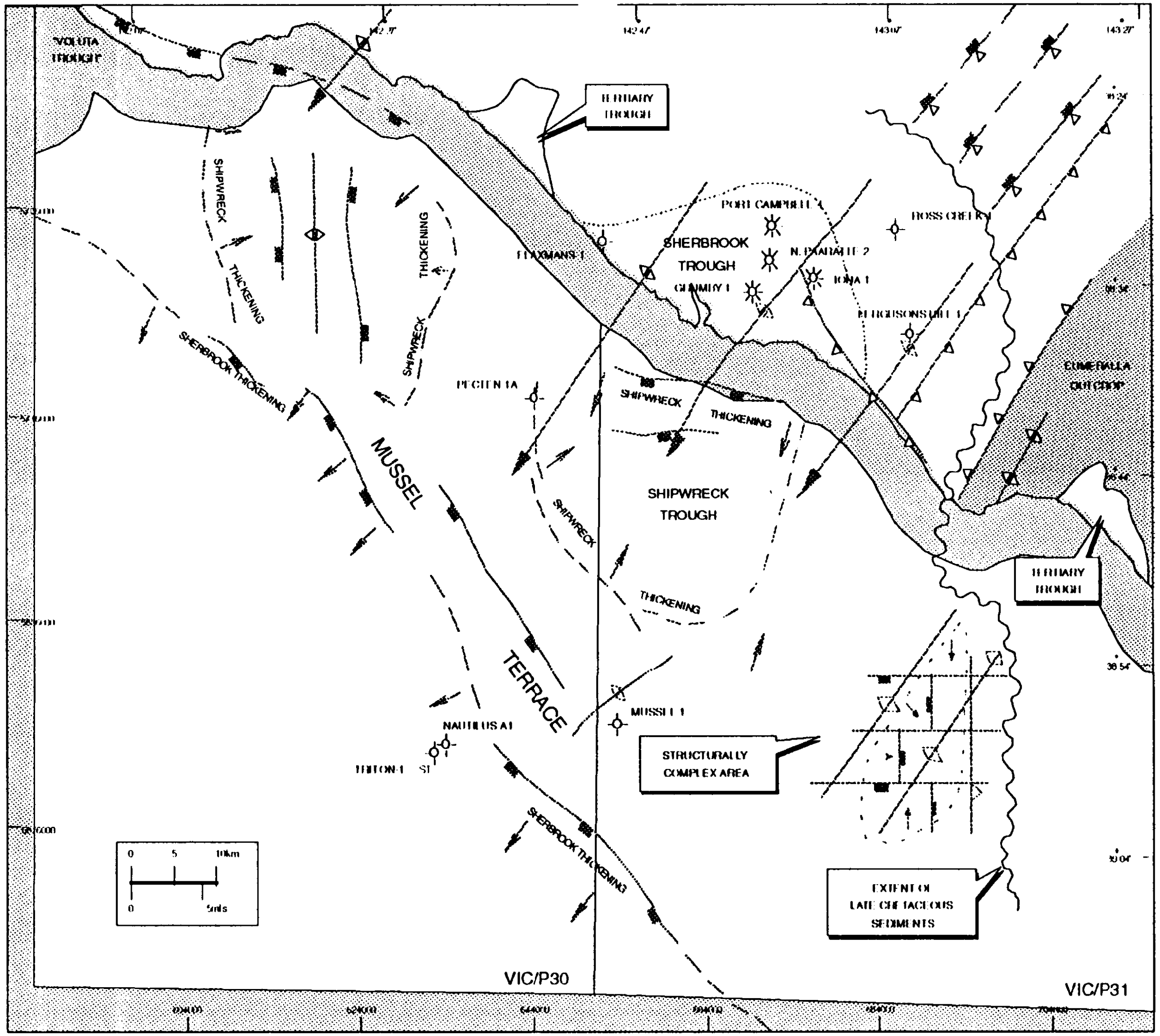
ELEV : Rt :25mamsl
WATER DEPTH : 75 mbmsl

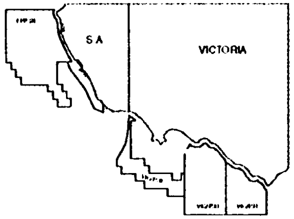
SPUD :17/2/93
RIG RELEASE : 06/3/93

STATUS : Plugged & Abandoned
RIG : Byford Dolphin

Depth mss (TVD)	T.W.T. msec	Tops mss (TVD)	STRATIGRAPHY Series	STRATIGRAPHY Stages	STRATIGRAPHY GP	PREDICTED LITHOLOGY	OBJECTIVES
0		75				Sea water	
		264	Tertiary	Oligocene - Recent	Heyesbury	Limestones with minor marl	
	282	377	Tertiary	L.Eocene	Nirranda	Marl and minor sandstone	
500	372	550	Tertiary	Paleo-Mid Eocene	Wangerrip	Sandstone and claystone	
1000	545	1160	Late cretaceous	Mid Santonian - Maastrichtian	Sherbrook	Interbedded claystones, siltstones and sandstones	
	1000	1305	Late cretaceous	Coniacian-Mid Santonian	Upper Shipwreck	Sandstones, siltstones and claystones	▨
1500	1080	1720	Late cretaceous	Cenomanian - Turonian	Lower Shipwreck	Sandstones and claystones and minor coal	▨
	1310	1850 TD	E.Cret.	Albian	Otway	Sandstones and claystones	
2000							

ACTUAL LITHOLOGY	STRATIGRAPHY GP	STRATIGRAPHY Series	STRATIGRAPHY Stages	Tops mss (TVD)	Thick-ness m	CSG mss
Sea water				75		
☒		Tertiary		339 ☒		30" 111m 13 3/8" 330m
Sandstones	Nirranda	Tertiary	Late Eocene	388		
Sandstones	Wangerrip	Tertiary	Mid Eocene	512	124	
Mainly sandstones with minor interbedded claystones	Sherbrook	Late Cretaceous	Mid Santonian - Maastrichtian	1018	506	9 5/8" 982m
Interbedded sandstones and claystones	Upper Shipwreck	Late Cretaceous	Coniacian-Mid Santonian	1411	393	
Mainly sandstones with minor claystones	Lower Shipwreck	Late Cretaceous	Cenomanian - Turonian	1722	311	
Mainly sandstones	Otway	E.Cret.	Albian	1850 TD		





VIC P30/P31

STRUCTURAL ELEMENTS MAP

OTWAY BASIN

VIC/P30 & VIC/P31

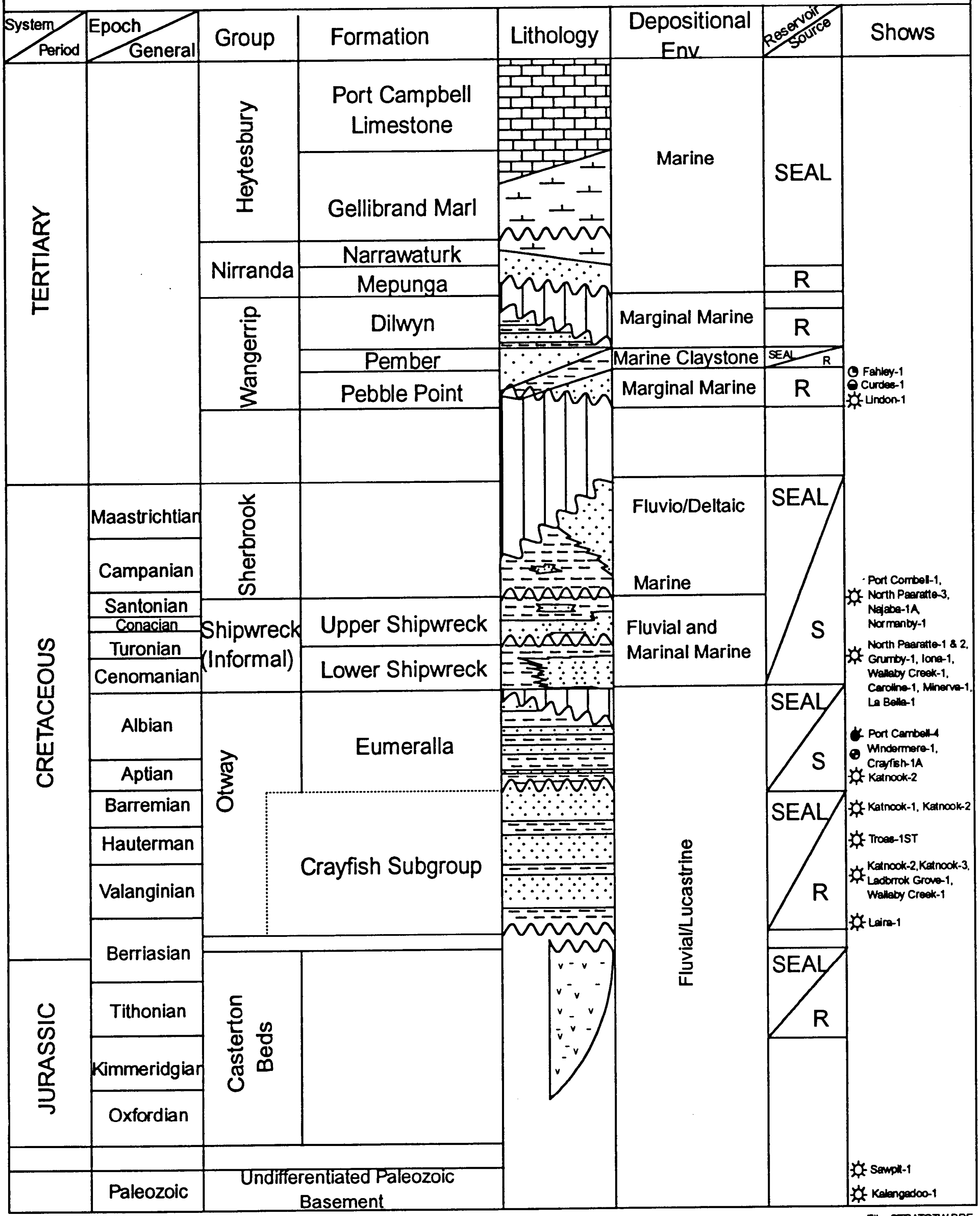
FIGURE 3.0

SH 15/07/92

TD

BHP

OTWAY BASIN
STRATIGRAPHIC COLUMN



Drawn By: Angelo Mustica

Date: 30-5-1994

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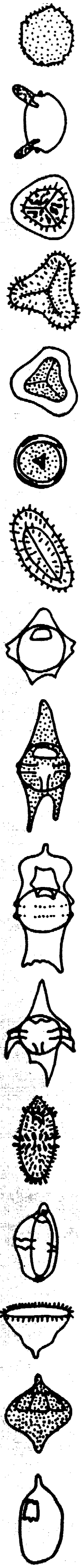
APPENDICES

MORGAN PALAEO ASSOCIATES
PALYNOLOGICAL/PETROLEUM GEOLOGICAL CONSULTANTS
POSTAL ADDRESS: Box 161, Maitland, South Australia 5573
DELIVERIES: 1 Shannon Tce, Maitland, South Australia 5573
Phone (088) 32 2795 Fax (088) 32 2798



FINAL PALYNOLOGY OF BHPP ERIC THE RED #1

OFFSHORE OTWAY BASIN, VICTORIA, AUSTRALIA

BY

ROGER MORGAN AND NIGEL HOOKER

for BHP PETROLEUM

JUNE 1993

REF:W.OTW.RPERICR1

FINAL PALYNOLOGY OF ERIC THE RED #1

OFFSHORE OTWAY BASIN, VICTORIA, AUSTRALIA

BY

ROGER MORGAN AND NIGEL HOOKER

CONTENTS

I SUMMARY

373.5m(swc), 388.0m(swc) : apparently middle *asperus* Zone : Late Eocene : very nearshore marine : immature

429.0(swc) : lower *asperus* zone (*australicum* dinoflagellate zone) : Middle Eocene : nearshore marine : immature

467.0m(swc) : upper *diversus* Zone : Early Eocene : nearshore marine : immature

553.0m(swc), 562.0m(swc), 569.0m(swc), 599.0m(swc) : *longus* Zone (553.5m *druggii* dinoflagellate zone, 599.0m *korojonense* dinoflagellate zone) : Maastrichtian : nearshore to very nearshore marine : immature

612.5m(swc), 642.0m(swc) : extremely lean *senectus* Zone or younger : Campanian-Maastrichtian : possibly non-marine (no dinoflagellates seen)

664.5m(swc), 689.5m(swc), 720.5m(swc), 746.0m(swc) upper *senectus* Zone (664.5m swc upper *australis* dinoflagellate zone, 689.5m-720.5m lower *australis* dinoflagellate zone) : Campanian : nearshore and very nearshore marine : immature

812.5m(swc) : middle *senectus* Zone (*aceras* dinoflagellate zone) Campanian : nearshore marine : immature

876.0m(swc), 893.5m(swc), 970.0m(swc) upper *apoxyexinus* Zone (876.0m upper *cretacea* dinoflagellate zone, 893.0m-970.0m lower *cretacea* dinoflagellate zone): Santonian : nearshore marine : marginally mature

1010.0m(swc), 1025(cutts) : middle *apoxyexinus* Zone (*porifera* dinoflagellate zone) : Santonian : nearshore marine : marginally mature

1080m(cutts) : lower *apoxyexinus* Zone : Santonian : nearshore marine : marginally mature

1097.0m(swc), 1151.0m(swc), 1177.0m(swc), 1180(cutts) : apparently all upper *mawsonii* Zone : ?Coniacian : non-marine and nearshore : marginally mature

1219.5m(swc), 1250.5m(swc), 1275.0m(swc), 1306m(cutts), 1316.0m(swc), 1328.5m(swc), 1334.0m(swc), 1336.0(swc),1364.5m(swc), 1437.0m(swc) : *mawsonii* Zone (1437.0m *infusorioides* dinoflagellate zone) : Coniacian-Turonian : mixed non-marine and nearshore marine : marginally mature

1452m(cutts), 1515m(cutts) : *distocarinatus* or *mawsonii* Zones (P. *mawsonii* may be caved in these cuttings) (*infusorioides* dinoflagellate zone) : Turonian-Cenomanian : marginally marine : marginally mature

1575.0m(swc), 1602.0m(swc), 1630.0m(swc), 1667.0m(swc), 1678.0m(swc), 1703.0m(swc), 1719.0m(swc) : *distocarinatus* zone (*infusorioides* dinoflagellate zone at 1719m unless the single *C. edwardsii* is mud contamination) : mixed non-marine and brackish : early mature for oil, early marginally mature for gas/condensate

1749.5m(swc), 1754.5m(swc), 1790.0m(swc), 1813.5m(swc) : extremely lean and indeterminate : early mature for oil, early marginally mature for gas/condensate.

II INTRODUCTION

During drilling six cuttings samples were studied on an urgent basis and were reported in 2 faxed reports. After well completion, a further forty two swcs were submitted for detailed study. All results were summarised herein.

Palynomorph occurrence data are shown as Appendix I and form the basis for the assignment of the samples to twelve spore-pollen units of Cenomanian to Eocene age. 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 Cretaceus zonation has been modified by Morgan (1992) in project work for BHPP. Eocene 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 Eric the Red #1. 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.

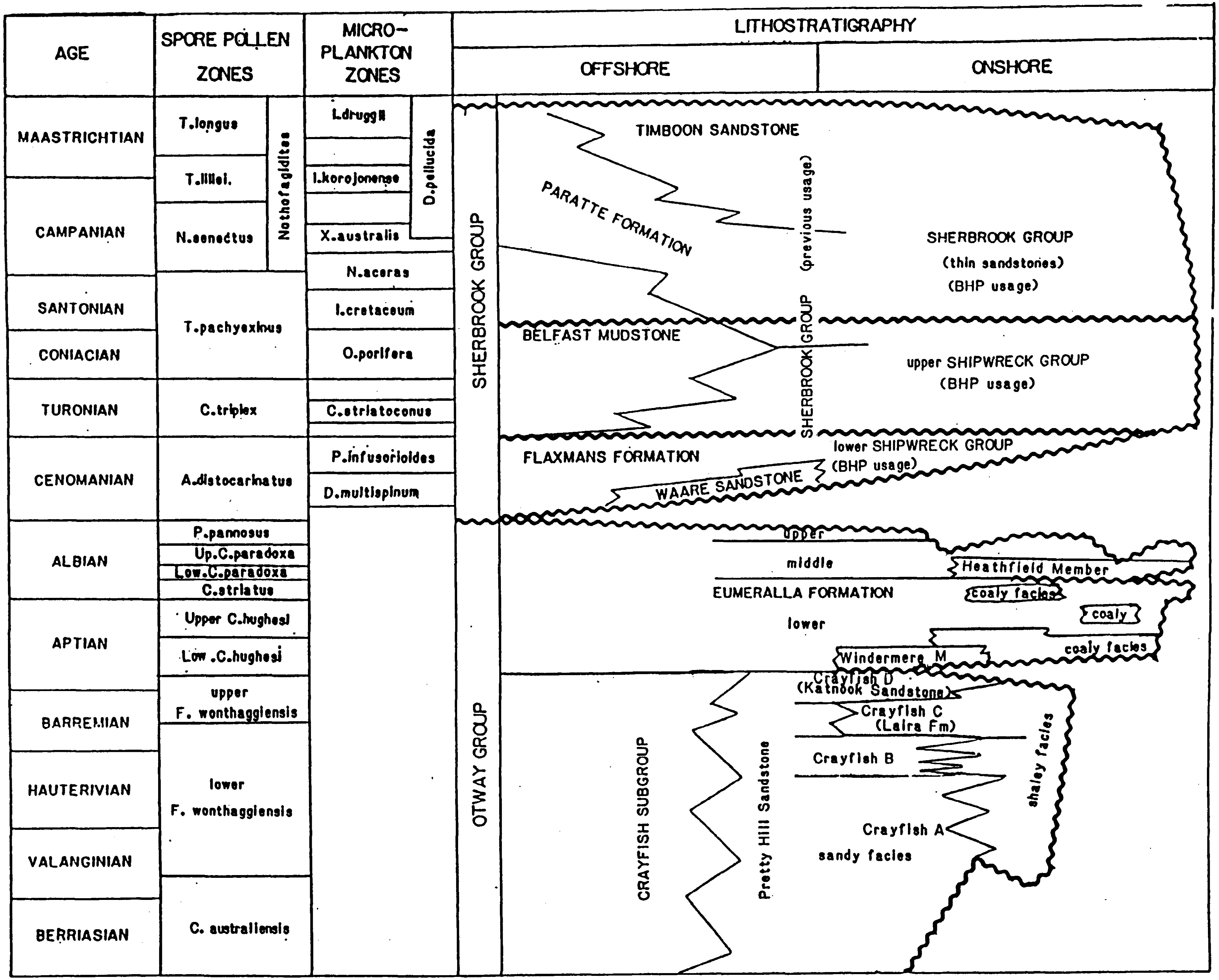


FIGURE 1. CRETACEOUS REGIONAL FRAMEWORK, OTWAY BASIN

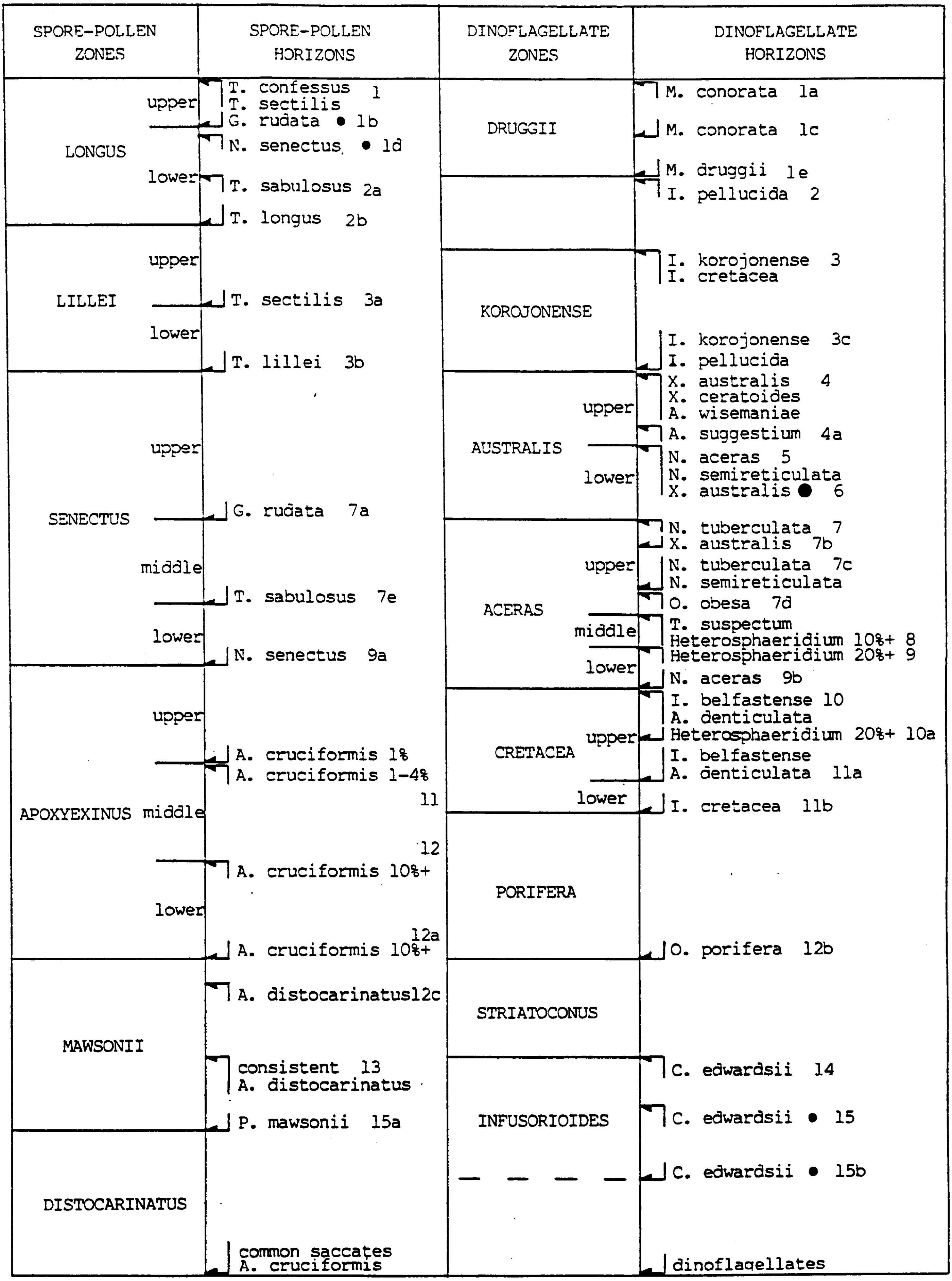


FIGURE 2 ZONATION USED HEREIN SHOWING THE NUMBERED HORIZONS AGAINST THE EXISTING FORMAL ZONATION.

● =frequent (4-10%) ⬤=common (11-30%)

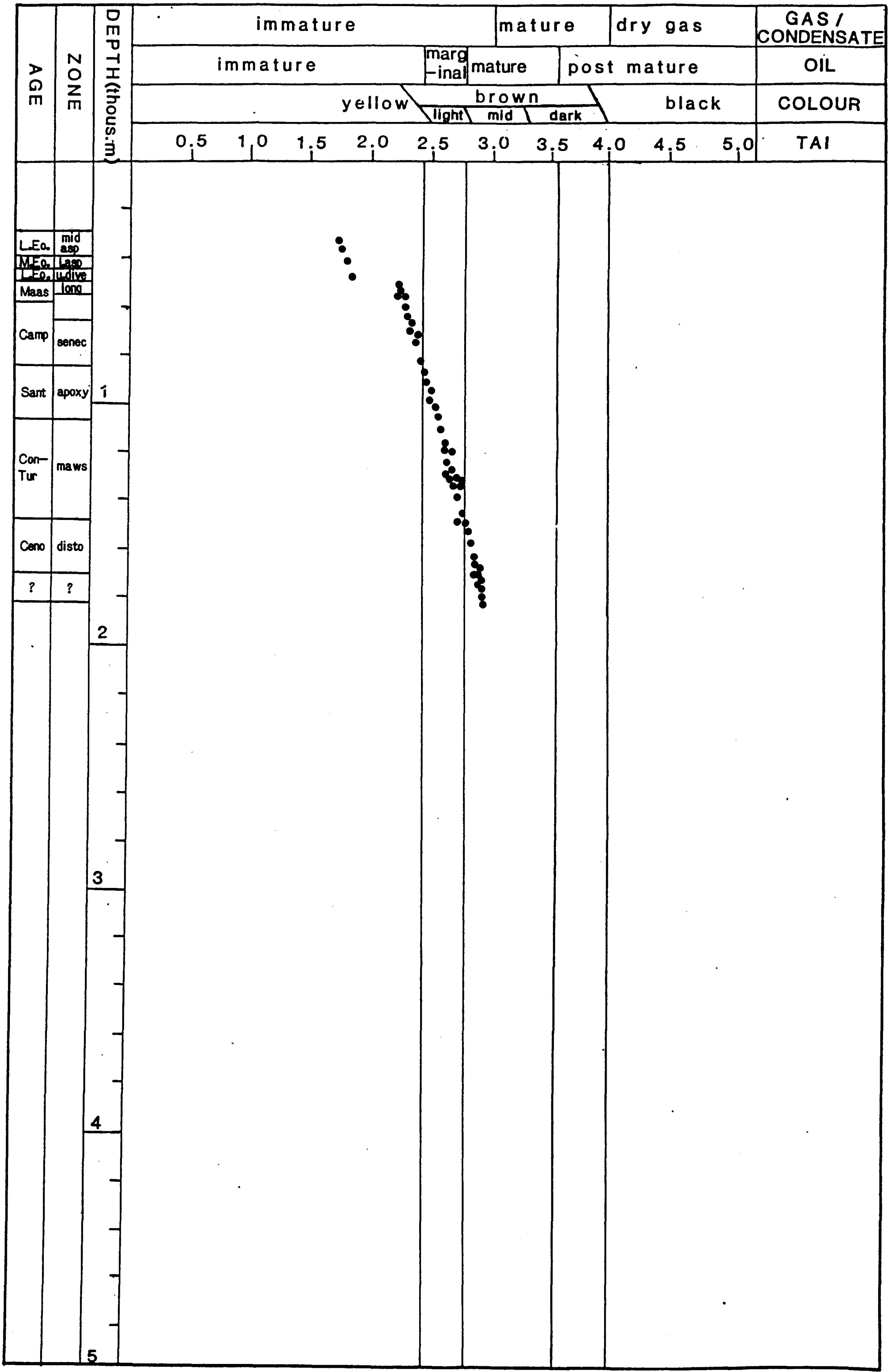


FIGURE 3 MATURITY PROFILE - ERIC THE RED # 1

III PALYNOSTRATIGRAPHY

A 373.5m(swc), 388.0m(swc) : apparently middle *asperus* Zone

Assemblages are lean and bland, but probable *Triorites magnificus* in both samples suggest the middle *Nothofagidites asperus* Zone of Late Eocene age. Other spores and pollen consistent with this zone include *Beaupreadites verrucosus, Kuylisporites waterbolkii, Nothofagidites falcatus, Polycolpites esobalteus, Proteacidites kopiensis, P. pachypolus* and *Santalumidites cainozoicus*. Dominant taxa include *Proteacidites* spp and *Haloragacidites harrisii* while *Nothofagidites* spp, *Cyathidites* spp and *Falcisporites* spp are common.

Amongst the rare dinocysts, frequent *Phthanoperidinium comatum* (373.5m) and rare *Vozzhennikovia extensa* (388.0m) suggest the *Corrudinium incompositum* dinocyst zone, correlative with the middle *asperus* spore-pollen zone. Dinocysts are rare and of low diversity.

Nearshore to marginal marine environments are suggested by the scarce dinocysts (3-5%) and their low diversity, and the dominant and diverse spore-pollen.

Colourless palynomorphs indicate immaturity for hydrocarbons.

B 429.0m(swc) : lower *asperus* Zone

Assignment to the lower *N. asperus* Zone of Middle Eocene age is indicated at the top by youngest *Intratriporopollenites notabilis* and at the base by oldest *Nothofagidites deminutus* and the dinoflagellate data. Of the spore pollen, *Dilwynites* and *H. harrisii* are common with *Proteacidites, Cyathidites* and *Ericipites* frequent. Rare elements include *Polycolpites esobalteus, Proteacidites asperopolus, P. leightonii, P. pachypolus* and *P. tuberculiformis*. Rare Permian reworking was noted.

The dinoflagellates include *Deflandrea phosphoritica* and *Areosphaeridium australicum*, indicating the *A. australicum* dinoflagellate zone, correlative with most of the lower *asperus* spore pollen zone. *A. australicum* is common with *Spiniferites* rare and other elemenents very rare.

Nearshore marine environments are indicated by the subordinate dinoflagellates (20%) and their low diversity, the dominant and diverse spores and pollen, and the common cuticle.

Colourless palynomorphs indicate immaturity for hydrocarbon generation.

C 467.0m(swc) : upper *diversus* Zone

Assignment to the upper *Malvacipollis diversus* Zone of early Eocene age is indicated by oldest *P. pachypolus* without younger markers. Age significant datums consistent with the assignment include youngest *Intratriporopollenites notabilis, Proteacidites tuberculiformis* and *P. ornatus* and oldest *Anacolosidites acutullus, Periporopollenites demarcatus* and *P. tuberculiformis*. Common taxa are *Dilwynites granulatus* and *Proteacidites* spp with *Malvacipollis subtilis* and *Falcisporites* frequent. Dinocysts are extremely rare and not age diagnostic.

Marginally marine environments are indicated by the rare dinocysts (3%), and their low diversity. Spores and pollen are abundant and diverse. Freshwater algae (*Botryococcus* at 3%) are significant, suggesting some lacustrine influence.

Colourless spores indicate immaturity for hydrocarbon generation.

D 553.0m(swc), 562.0m(swc), 569m(swc), 599.0m(swc) : *longus* Zone

Assignment to the *Tricolpites longus* Zone of Maastrichtian age is indicated at the top by youngest *Amosopollis cruciformis, Tricolpites confessus, T. longus, T. waipawaensis, Tricolporites lillei* and *Triporopollenites sectilis* and at the base by oldest *Tetracolporites verrucosus* and *Tricolpites longus*. Dinocyst data also confirm the zonal assignment as discussed below. Within the zone, oldest *Tripunctisporis punctatus* occurs at 553.5m and *Nothofagidites* out number *Gambierina rudata* at 569.0m and below, providing intra zone correlation. Within the interval, *Proteacidites* and *Falcisporites* are common, with *Nothofagidites, G. rudata, Gleicheniidites, Ceratosporites* and *Phyllocladidites* frequent.

Amongst the dinocysts, *Manumiella coronata* at 553.5m indicates the *Manumiella druggii* Zone of latest Maastrichtian age.and *Isabelidinium korojonense* and *I.*

pellucidum at 599m indicate the *I. korojonense* Zone of earliest Maastrichtian and Campanian age.

Very nearshore to marginally marine environments are indicated by the low dinocyst content (3%, 8%, 3%, 7%) and their low diversity. Spores and pollen are abundant and diverse and freshwater algae occur especially at 553.5m (6% *Botryococcus* and 4% *Paralecaniella*).

Yellow spore colours indicate immaturity for hydrocarbons.

E 612.5m(swc), 642.0m(swc) : extremely lean *senectus* Zone or younger

These two swcs are extremely lean and cannot be confidently assigned to any one zone. The presence of *Nothofagidites endurus*, *N. senectus*, *Gambierina rudata* and *Tricolpites sabulosus* however, indicate an upper *senectus* or younger zone. Saccate pollen (*Falcisporites* and *Microcachryidites*) are frequent to common, with *Proteacidites* also frequent. From the stratigraphic position, the *lillei* zone seems likely.

Non-marine environments are suggested by the total absence of dinoflagellates. The 642m samples is so lean that this is not necessarily conclusive. At 612.5m, common algal acritarchs (*Nummus* sp, *Paralecaniella, Botryococcus*) suggest freshwater lake environments.

Yellow spore colours indicate immaturity for hydrocarbons.

F 664.5m(swc), 689.5m(swc), 720.5m(swc), 746.0m(swc) : upper *senectus* Zone

Assignment to the upper *Nothofagidites senectus* Zone of early Campanian age is indicated at the top by the absence of younger indicators and confirmed by the dinoflagellate data and at the base by oldest *G. rudata.* Within the interval, saccate pollen are dominant (*Falcisporites, Microcachryidites* and *Podosporites*) with *Phyllocladidites mawsonii, Proteacidites* and *Nothofagidites* frequent. Minor Triassic and Permian reworking was seen.

Amongst the dinoflagellates, *Xenikoon australis* without older markers indicates the upper *australis* dinoflagellate zone of early Campanian age at 664.5m. Youngest *Nelsoniella semireticulata* at 689.5m indicates the lower *australis* dinoflagellate zone over the interval 689.5-720.5m and youngest *Areosphaeridium suggestium* at 720.5m is consistent. *X. australis* occurs in all except 746.0m. Of the very rare dinoflagellates, the most consistent are *Heterosphaeridium heteracanthum, X. australis* and *N. semireticulata* with none being frequent. A single *Nelsoniella tuberculata* at 720.5m is considered reworked.

Environments are nearshore marine and very nearshore marine with dinoflagellate contents of <1%, 4%, 10% and 2% respectively. Algal acritarchs are very rare (1% or less) indicating only very minor lacustrine influence. The very strong terrestrial influence is shown by the common cuticle and the very dominant and diverse spore-pollen.

Yellow to light brown spore colours indicate immaturity for hydrocarbons but approaching early marginal maturity.

G 812.5m(swc) : middle *senectus* Zone

Assignment to the middle *N. senectus* Zone of early Campanian age is indicated by oldest *T. sabulosus*, here coincident with oldest *N. senectus*. Saccate pollen continue to dominate (*Falcisporites, Microcachryidites* and *Podosporites*) but *Proteacidites* is also common. Rare elements include *Amosopollis cruciformis, Ornamentifera sentosa* and *Tricolpites confessus*. Rare Permian reworking was noted.

Dinoflagellates include *Nelsoniella aceras* without *X. australis*, indicating the *aceras* dinoflagellate zone, but the dinoflagellate subzone is unclear in the absence of closer spaced cuttings samples. *H. heteracanthum* is the most common dinoflagellate (6%) and other significant taxa include *Odontochitina porifera, Maduradinium pentagonum* and *Heterosphaeridium* cf *laterobrachius*. The upper *aceras* dinoflagellate zone seems most likely.

Nearshore marine environments are indicated by the dinoflagellate content (9%) and their moderate diversity. Major terrestrial influence is shown by the abundant cuticle and common and diverse spore pollen.

Yellow to light brown spore colours indicate immaturity approaching early marginal maturity for oil.

H 876.0m(swc), 893.5m(swc), 970.0m(swc) : upper *apoxyexinus* Zone

Assignment to the upper *Tricolporites apoxyexinus* Zone of Santonian age is indicated at the top by the absence of younger indicators and confirmed by the dinoflagellate data, and at the base by the absence of older indicators, also confirmed by dinoflagellate data. Within the interval, saccate pollen (mostly *Falcisporites similis*) are common to abundant while spores are also prominent (*Cyathidites* common, *Osmundacidites* frequent). *Amosopollis cruciformis is* very rare (<1%) while *Proteacidites* spp are also very rare (1% and less in contrast to 5-15% above). Minor Permian reworking was seen in all samples.

Amongst the dinoflagellates, the presence of *Isabelidinium belfastense*, *Amphidiadema denticulata, Chatangiella victoriensis* and *Heterosphaeridium* 20%+ at 876.0m(swc), indicates assignment to the upper *cretacea* dinoflagellate zone, correlative with the upper part of the upper *apoxyexinus* spore-pollen zone. The two deeper samples contain *Isabelidinium cretacea* without younger indicators and are assigned to the lower *cretacea* dinoflagellate zone, correlative with the lower part of the upper *apoxyexinus* spore-pollen zone. At 876.0m, *Heterosphaeridium* dominates (28%) while the two deeper samples contain frequent *Heterosphaeridium* and rare *I. cretacea.*

Environments are nearshore marine becoming more marine towards the top as shown by the low but increasing dinoflagellate content in time (40%, 13% and 10% downhole), and their low, increasing to moderate, diversity. Spores and pollen are abundant and diverse.

Light brown spore colours indicate early marginal maturity for oil generation.

I 1010.0m(swc), 1025m(cutts) : middle *apoxyexinus* Zone

Assignment to the middle *Tricolporites apoxyexinus* Zone of Santonian age is indicated at the top by the downhole influx of *A. cruciformis* (3-5% within this interval, <1% above) and at the base by the absence of older markers. Within the interval, saccate pollen dominate (*Falcisporites* 25-30%, *Microcachryidites* 8-12%, *Podosporites* 1-7%) with frequent spores (*Cyathidites* 9-17%, *Osmundacidites* 4-1%). *Proteacidites* (1-3%) are rare with *A. cruciformis* significant (3-5%). Minor Permian reworking was seen.

Amongst the dinoflagellates, *Isabelidinium rectangularis* occurs and its presence without *I. cretacea* indicates the upper *Odontochitina porifera* Zone. Youngest *Circulodinium deflandrei* occurs at 1010m and is consistent with the mid *apoxyexinus* spore-pollen zone. *Heterosphaeridium* spp are the most consistent dinoflagellate element.

Environments are nearshore marine with significant freshwater lacustrine influence. Dinoflagellates comprise 9% and 7% respectively and are of moderate to low diversity. *Botryococcus* comprises 5% and 3% indicating significant input from freshwater lakes. Spores and pollen are dominant and diverse.

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

J 1080m(cutts) : lower *apoxyexinus* Zone

Assignment to the lower *T. apoxyexinus* Zone of Santonian age is indicated at the top and base by the numerical acme of *A. cruciformis* (15%) contrasting with 3-5% immediately above and below. *Cyathidites*, *Falcisporites* and *A. cruciformis* are all common. Minor early Cretaceous reworking was seen.

Dinoflagellates include *Isabelidinium rectangularis* but it may be caved at this point. *Heterosphaeridium* spp are common, and *C. deflandrei* is consistent.

Nearshore marine environments are indicated by the low dinoflagellate content (20%) and low diversity.

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

K 1097.0m(swc), 1151.0m(swc), 1177.0m(swc), 1180m(cutts) : upper *mawsonii* Zone

These samples are assigned on the absence of younger markers seen above (the *A. cruciformis* acme at 1080m) and older markers seen below (youngest *A. distocarinatus* at 1219.5m). Within the interval, saccate pollen dominate (*Falcisporites* 5-48%, *Microcachryidites* 2-24%, *Podosporites* 1-30%), with spores relatively minor and lacking in diversity. Minor Permian and Early Cretaceous reworking was seen. Dinoflagellates are rare and not age diagnostic. Youngest *Aptea* sp occurs at 1180m and is usually intra *apoxyexinus*.

Non-marine and very nearshore marine environments are indicated by the generally very low dinoflagellate content (60%, <1%, 1% and 1%, the last in cuttings) and very low dinoflagellate diversity (mostly one or two species). At 1097.0m the high dinoflagellate content (60%) is anomolous representing just two species and is caused by freak environmental conditons. At 1180m(cutts), the dinoflagellates appear to all be caved. At 1151.0m(swc), abundant *Botryococcus* (52%) suggests a major freshwater lake.

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

L **1219.5m(swc), 1250.5m(swc), 1275.0m(swc), 1306m(cutts), 1316.0m(swc), 1328.5m(swc), 1334.0m(swc), 1336.0m(swc), 1364.5m(swc), 1437.0m(swc) : *mawsonii* Zone**

These samples are all assigned to the *Phyllocladidites mawsonii* Zone of Turonian-Coniacian age on youngest consistent *Appendicisporites distocarinatus* at the top and oldest *P. mawsonii* at the base. Oldest consistent *Clavifera triplex* occurs at 1334.0m. Within the interval, saccate pollen continue to dominate (*Falcisporites* 13%-30%, *Microcachryidites* 73%-26%, *Podosporites* 2%-15% and *Phyllocladidites* 1%-21%) with spores generally subordinate. *Dilwynites granulatus* is frequent to common (mostly 10-29%). Very rare Triassic and Permian reworking was seen. Youngest *Camerozonosporites robusta* (1275.0m), *Liliacidites kaitangataensis* and *Senectotetradites varireticulosus* (both at 1334.0m) are consistent with the *mawsonii* zonal assignment.

Of the very rare dinoflagellates, only youngest *Cribroperidinium edwardsii* at 1437.0m is age significant and indicates the *Palaeohystrichophora infusorioides* Zone. Very few dinoflagellates occur in some samples with *Heterosphaeridium* and *Odontochitina operculata* most consistent.

Environments are mixed non-marine and very nearshore marine with dinoflagellate contents dowhole of absent, absent, absent, 1% but in cuttings 2%, 10%, absent, absent, absent and 1%. Those lacking dinoflagellates are non-marine and several have significant algal content (1219.5m 16%, 1306m 4%, 1334m 5%, 1364.5m 3%) suggesting lacustrine influence. Those containing dinoflagellates are very nearshore marine. Abundant cuticle fragments and abundant and diverse spores and pollen are present throughout.

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

M 1452m(cutts), 1515m(cutts) : *distocarinatus* or *mawsonii* Zones

These cuttings samples cannot be confidently assigned to either of these zones. Oldest *P. mawsonii* and *C. triplex* at 1515m suggests assignment to the *mawsonii* Zone, but it could be caved at this point into the *distocarinatus* Zone. Common taxa are *Falcisporites* (23% and 11%), *Microcachryidites* (17% and 10%), *Podosporites* 7% and 20% and *Dilwynites* (17% and 23%). *A. distocarinatus* is consistent throughout while rare spores include *Coptospora pileosa*, *Trilobosporites trioreticulosus* and *Lileacidites kaitangataensis*.

Dinoflagellates are extremely rare but include *C. edwardsii*, indicating the *P. infusorioides* dinoflagellate zone, although these elements could be caved into non-marine section.

Environments appear to be marginally marine with <1% and 1% very low diversity dinoflagellates, but these could be caved. *Botryococcus* is present in both (2% and 7%), suggesting significant lacustrine influence. Vast cuticle and abundant and diverse spore pollen attest to the strong terrestrial influence.

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

N 1575.0m(swc), 1602.0m(swc), 1630.0m(swc), 1667.0m(swc), 1678.0m(swc), 1703.0m(swc), 1719.0m(swc) : *distocarinatus* Zone

Assignment to the *Appendicisporites distocarinatus* Zone of Cenomanian age is indicated at the top and base by *A. distocarinatus* without younger or older markers. Within the interval, several samples are extremely lean to barren (1602.0m, 1667.0m 1703.0m) and cannot be confidently assigned on their assemblages. Amongst the others, saccate pollen generally dominate

(*Falcisporites* and *Microcachryidites*) but two (1678.0m and 1703.0m) are spore dominated and probably represent swamp or swamp margin environments. Minor Permian reworking was noted in several samples.

Dinoflagellates are mostly absent but at 1719m, a single specimen of *C. edwardsii* suggests the *infusorioides* dinoflagellate zone.

Environments are mixed non-marine to brackish with dinoflagellate contents of 1%, barren, absent, barren, absent, barren and <1% dowhhole. High algal content at 1630.0m (10% without dinoflagellates) suggests a freshwater lake while high algal contents at 1575.0m (3%) and 1719.0m (9%) with dinoflagellates suggests brackish lakes with strong freshwater influence. Vast cuticle and tracheid together with dominant and diverse spore pollen indicate very strong terrestrial influence.

Light to mid brown spore colours indicate early maturity for oil and early marginal maturity for gas/condensate.

O 1749.5m(swc), 1754.5m(swc), 1790.0m(swc), 1813.5m(swc) : indeterminate

These samples are extremely lean and the taxa seen may all comprise mud contamination of these sandy swcs. Neither *A. distocarinatus* nor *Coptospora paradoxa* were seen and so these cannot be assigned to any zones. Saccate pollen are common (mostly *Falcisporites* and *Microcachryidites*), but spores also represent a significant proportion (mostly *Cyathidites* and *Osmundacidites*).

Environments appear to be brackish with dinoflagellates totally absent and spiny acritarchs (*Micrhystridium* and *Veryhachium*) rare. *Botryococcus* is present in most samples, suggesting significant lacustrine influence. However, too few specimens were seen to exclude the possibility of stronger marine influence, or that most of the taxa seen might represent mud contamination of these sandy swcs.

Light to mid brown spore colours indicate early maturity for oil and early marginal maturity for gas/condensate.

IV CONCLUSIONS

At the top, a thick probably incomplete Eocene was sampled in very nearshore marine facies. The Paleocene appears to be missing on an unconformity, but could be present but unsampled in the 86m sample gap.

Beneath this, an apparently complete Late Cretaceous section (Cenomanian to Maastrichtian) occurs in mostly nearshore to occasionally non-marine facies.

The section appears to be early mature for oil only at its base.

V REFERENCES

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MORGAN PALAEO ASSOCIATES
PALYNOLOGICAL/PETROLEUM GEOLOGICAL CONSULTANTS

POSTAL ADDRESS: Box 161, Maitland, South Australia 5573
DELIVERIES: 1 Shannon Tce, Maitland, South Australia 5573
Phone (088) 32 2795 Fax (088) 32 2798

PALYNOLOGY OF TWO FOLLOWUP SWCS FROM BHPP ERIC THE RED-1

OTWAY BASIN, AUSTRALIA

BY

ROGER MORGAN

for **BHPP** May 1994

I SUMMARY

1455.0m(swc) - 1520.0m(swc) : *distocarinatus* Zone (*infusorioides* Dino Zone at 1520m) : Cenomanian : marginally marine (<1% dinos and 4% dinos respectively).

II INTRODUCTION

These two swc samples were submitted by Simon Horan to clarify ambiguous cuttings based data. Appendix I comprises full quantitative data for the well including the present and all previous work. Zonation and maturity frameworks are as described in Morgan and Hooker 1993.

III PALYNOSTRATIGRAPHY

Assignment to the *Appendicisporites distocarinatus* Zone of Cenomanian age is indicated by the presence of *A. distocarinatus* without younger or older markers. Common are *Cyathidites minor, Dilwynites granulatus, Falcisporites similis, Gleicheniidites circinidites* and *Microcachyidites antarcticus*. Frequent are *Laevigatosporites ovatus* and *Podosporties microsaccatus*. Rare but significant are *A. distocarinatus, Phyllocladidites eunuchus, Trilobosporites trioreticulatus* and *Triporoletes reticulatus*.

Dinoflagellates are very rare and include *Cribroperidinium edwardsii* at 1520m, indicating the *Palaeohystrichophora infusorioides* Dinoflagellate Zone. *Heterosphaeridium* and *Botryococcus* continue to be the most consistent microplankton.

Environments are marginally marine, as shown by very rare dinoflagellates (<1% and 4% downhole) and their very low diversity. Significant lacustrine influence is indicated by freshwater algae (2% and 3% *Botryococcus* downhole). Spores and pollen are abundant and diverse.

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

IV REFERENCES

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PALYNOLOGICAL DATA SHEET

BASIN: OTWAY DINOFLAGELLATE ZONES ELEVATION: KB: ________ GL: ________

WELL NAME: ERIC THE RED-1 TOTAL DEPTH: ________

ACE		PALYNOLOGICAL ZONES	HIGHEST DATA				LOWEST DATA			
			Preferred Depth	Rtg	Alternate Depth	Rtg	Preferred Depth	Rtg	Alternate Depth	Rtg
LATE CRETACEOUS	Maas	M. druggii ♀	554	0			554	0		
	Camp	I. korojonense ♀	599	0			599	2		
		upper X. australis ♀/✡	665	0			665	1		
		lower X. australis ♀/✡	690	0			721	0		
	Sant	N. aceras ♀	813	1			813	0		
		I. cretaceum ♀	876	0			970	0		
	Con	O. porifera ♀	1010	0			1025	4		
	Turo	C. striatoconus								
	Ceno	P. infusorioides ♀/✡	1437	1			1520	1	1719	?

Environments :

- o lacustrine (algal acritarchs).
- 🍃 non-marine (no or very few 5% algal acritarchs).
- ✡ brackish (spiny acritarch, no or very few dinoflagellates 1%).
- ✡/♀ marginal marine (1-5% very low diversity dinoflagellates).
- ♀ nearshore marine (6-30% low to medium diversity dinoflagellates).
- ♀/♀♀ intermediate marine (31-60% medium diversity dinoflagellates).
- ♀♀ offshore marine (61%-80% medium to high diversity dinoflagellates).
- ⊖ far offshore marine/oceanic (81%-100% high diversity dinoflagellates and/or planktonic forams).

Confidence Ratings :

0 : good to excellent with numerous zone fossils in core/swc.
1 : fair with rare zone fossils in core/swc.
2 : poor with non-diagnostic assemblage in core/swc. Often occurs next to a distinctive 0 to 1 rating, lacking the zone fossil seen adjacent.
3 : good with extinction event (top range) in cuttings.
4 : poor to fair with inception event (base range) in cuttings and therefore may be picked too low if caved or too high if swamped by cavings.
5 : poor with non-diagnostic assemblage in cuttings. Usually seen adjacent to a higher rating and picked on the absence of key zone fossil.
? : no confidence. Picked as a best guess in very poor data.

Data recorded by : Roger Morgan and Nigel Hooker June 93

Data revised by : Roger Morgan May 94

BASIN: OTWAY SPORE-POLLEN ZONES ELEVATION: KB: ______ GL: ______

WELL NAME: ERIC THE RED-1 TOTAL DEPTH: ______

AGE		PALYNOLOGICAL ZONES	HIGHEST DATA				LOWEST DATA			
			Preferred Depth	Rtg	Alternate Depth	Rtg	Preferred Depth	Rtg	Alternate Depth	Rtg
NEOGENE	Plei	T. pleistocenicus								
	Plio	M. lipsus								
	Mio	C. bifurcatus								
		T. bellus								
		P. tuberculatus								
	Olig	upper N. asperus								
PALEOGENE	L.Eo	mid N. asperus ♀/✡	374	0			388	0		
	Mid Eo	lower N. asperus								
		P. asperopolus								
	Earl Eo	upper M. diversus ♀	467	2			467	0		
		mid M. diversus								
		lower M. diversus								
	Pale	upper L. balmei								
		lower L. balmei								
LATE CRETACEOUS	Maas	upper T. longus ✡-♀	553	0						
		lower T. longus					599	0		
		T. lillei								
	Camp	N. senectus ✡/♀	665	2			813	0		
	Sant	up T. apoxyexinus ♀	876	2			970	2		
		mid T. apoxyexinus ♀	1010	1			1025	5		
	Con	low T. apoxyexinus ♀	1080	3			1080	4		
	Tur	P. mawsonii Ø/♀	1097	?	1220	1	1437	0		
	Ceno	A. distocarinatus Ø/✡	1455	2			1719	0		
EARLY CRETACEOUS	Alb	P. pannosus								
		upper C. paradoxa								
		lower C. paradoxa								
		C. striatus								
	Apt	upper C. hughesi								
		lower C. hughesi								
	l.Ne	F. wonthaggiensis								
	e.Ne	up C. australiensis								

Environments :

o lacustrine (algal acritarchs).

Ø non-marine (no or very few 5% algal acritarchs).

✡ brackish (spiny acritarch, no or very few dinoflagellates 1%).

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? : no confidence. Picked as a best guess in very poor data.

Data recorded by : Roger Morgan and Nigel Hooker June 93

Data revised by : Roger Morgan May 94

26th May, 1994

NOTE TO: FILE

FROM: SIMON HORAN

OUR REF: sth.012:tt

COPIES:

PALYNOLOGICAL SAMPLES PROCESSING AND SAMPLE EXAMINATION METHODOLOGY

Following discussion with Roger Morgan, the sample processing techniques and sample examination methodology used in palynological studies of the Fergusons Hill-1, Ross Creek-1, Mussel-1, Pecten-1A, Triten-1ST, La Bella-1, Eric the Red-1, Minerva-1, Minerva-2A and Loch Ard-1 is listed below.

Sample processing usually involves the following steps. Extra techniques are only used if required:

a) digest about 10gm of crushed rock in 50% HF overnight
b) wash out several times over 10 micron polyester sieve. Acidify with conc HCI if fluorosilicate gel forms
c) heavy liquid separation used concentrate $ZnBr_2$ with SG of 2.0
d) wash out float fraction over 10 micron polyester sieve. Acidify if $Zn(OH)_2$ precipitate forms
e) mount a sieved kerogen slide
f) oxidise in Schutze Solution (conc 30% HNO_3 with crystalline $KClO_3$)
g) wash out over 10 micron polyester sieve
h) add 5% KOH to dissolve humic acids
i) wash out over 10 micron polyester sieve
j) examine under microscope for satisfactory oxidation. Repeat steps (f) to (g) if required
k) heavy liquid separation using $ZnBr_2$ solution (SG of 20.)
l) wash out float fraction using polyester sieve. Acidify if $Zn(OH)_2$ precipitate forms
m) dehydrate onto coverslip
n) mount microscope slides using Eukitt medium

Sample examination usually involved the following steps:

a) scan two traverses at a x10 to log the bulk of the assemblage and get some idea of age
b) scan at x40 and count the first 100 specimens to get percentage contents for each species. From this, saline "Microplankton Content" (%) can be developed to provide an index of marine influence. Where the sample is too lean to provide 100 specimens, frequency is estimated from the specimens

seen with A = abundant, C = common, F = frequent, R = rare

c) return to x10 to scan at least two large coverslips to log rare species, and finalise age conclusions. Log more slides if required

d) develop "Salines Microplankton Diversity" by counting up total species identified of dinoflagellates plus spiny acritarchs, as a second index of marine influence. This count includes species seen both inside and outside the court

e) develop "Freshwater Microplankton Content" by totally all freshwater algal elements (*Botryococcus, Schizosporis, Paralecaniella, Leiosphaeridia, Nummus*)

f) examine sieved kerogen slide for specimens of *Cyathidites* to establish spore colour for Spore colour Maturity Index

ERIC THE RED #1

MORGAN PALAEO ASSOCIATES: Palynological Consultants
Box 161, Maitland, South Australia, 5573.
phone (088) 32 2795 .. fax (088) 32 2798

CLIENT: BHP Petroleum Exploration
WELL: Eric the Red
FIELD/AREA: Otway Basin

ANALYST: Roger Morgan
DATE : March '93
NOTES: all sample depths are in metres
RW = reworked * = caved CF = comparable to
? = questionable identification X = present outside count
figures are percentages based on 100 specimen count

RANGE CHART OF OCCURRENCES BY LOWEST APPEARANCE (by groups)

	MICRHYSTRIDIUM 1	VERYHACHIUM 2	CRIBROPERIDINIUM EDWARDSII 3	OLIGOSPHAERIDIUM COMPLEX 4	APTEA SP 5	CLEISTOSPHAERIDIUM SPP 6	CIRCULODINIUM DEFLANDREI 7	HETEROSPHAERIDIUM CONJUNCTUM 8	HETEROSPHAERIDIUM HETEROCANTHUM 9	ODONTOCHITINA OPERCULATA 10	PALAEOPERIDINIUM CRETACEUM 11	TRITHYRODINIUM *FINE GRANULES* 12	KIOKANSIUM POLYPES 13	CANNINGIA SPINOSA 14	CHLAMYDOPHORELLA NYEI 15	CRIBROPERIDINIUM sp 16	EXOCHOSPHAERIDIUM PHRAGMITES 17	FLORENTINIA DEANEI 18	OLIGOSPHAERIDIUM PULCHERRIMUM 19	PTEROSPERMELLA AUREOLATA 20	PTEROSPERMELLA AUSTRALIENSIS 21	SPINIFERITES FURCATUS/RAMOSUS 22	FLORENTINIA SP 23	CALLAIOSPHAERIDIUM ASYMMETRICUM 24	CIRCULODINIUM HIRTELLUM 25	CYCLONEPHELIUM COMPACTUM 26	ISABELIDINIUM COOKSONIAE 27	SUBTILISPHAERA TRENDALLII 28	ASCODINIUM PARVUM 29	ISABELIDINIUM BELFASTENSE 30	APTEA POLYMORPHA 31	ISABELIDINIUM RECTANGULARIS 32	HETEROSPHAERIDIUM SOLIDA 33	TRITHYRODINIUM MARSHALLII 34	ISABELIDINIUM BALMEI 35	ISABELIDINIUM BELFASTENSE ROTUNDATA 36	ISABELIDINIUM SP 37	ISABELIDINIUM CRETACEA 38	CANNINGIA FOVEOLATA 39	HYSTRICHODINIUM PULCHRUM 40	ISABELIDINIUM LATUM 41	MADURADINIUM PENTAGONUM 42	ODONTOCHITINA COSTATA 43	ODONTOCHITINA CRIBROPODA 44	TRITHYRODINIUM PUNCTATE 45	TRITHYRODINIUM SUSPECTUM 46	TRITHYRODINIUM THICK PSILATE 47	TRITHYRODINIUM THICK RETICULATUS 48	AMPHIDIADEMA DENTICULATA 49	CHATANGIELLA VICTORIENSIS 50	ODONTOCHITINA PORIFERA 51	PTEROSPERMELLA SP 52	HETEROSPHAERIDIUM LATEROBRACHIUS 53	NELSONIELLA ACERAS 54	ODONTOCHITINA STUBBY 55	SPINIDINIUM SP 56	AREOSPHAERIDIUM SP 57	AREOSPHAERIDIUM SUGGESTIUM 58	CANNINGIA RETICULATA CF 59	NELSONIELLA SEMIRETICULATA 60	NELSONIELLA TUBERCULATA 61	TRICHODINIUM 62	XENIKOON AUSTRALIS 63	EXOCHOSPHAERIDIUM SP 64	OLIGOSPHAERIDIUM SP 65
0373.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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0562.0 SWC	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0569.0 SWC	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.
0599.0 SWC	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0612.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0642.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0664.5 SWC	X	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.
0689.5 SWC	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	X	1	X
0720.5 SWC	.	.	.	1	.	.	.	X	1	.	.	.	.	.	.	1	X	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	X	X	X	5	.	.
0746.0 SWC	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	?	.	.	.	.	.	.	.	.
0812.5 SWC	.	1	.	X	.	.	.	.	5	.	.	.	.	.	.	.	X	.	.	.	.	2	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	X	.	1	X	X	X	.	.	.	.	.	.	.	.	.
0876.0 SWC	.	1	.	.	.	.	.	9	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	X	.	.	.	.	3	3	.	.	.	.	X	2	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.
0893.5 SWC	.	X	.	.	.	.	.	.	2	X	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	F	.	.	.	.	4	X	X	X	X	X	X	2	2	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0970.0 SWC	.	.	.	.	.	.	.	.	9	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1010.0 SWC	.	1	.	X	.	.	X	.	6	.	.	.	.	.	.	X	.	.	X	.	.	1	.	.	.	.	.	.	.	.	.	?	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1025 CUTTS	.	.	.	.	.	.	2	.	4	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	CF	.	X	1	.	1	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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1097.0 SWC	.	X	.	.	.	.	.	1	59	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1151.0 SWC	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1177.0 SWC	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1180 CUTTS	.	.	.	.	X	.	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	CF	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1219.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1250.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1275.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1306 CUTTS	.	.	.	.	.	.	1	.	X	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	?	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1316.0 SWC	.	.	.	1	.	.	X	.	X	X	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1328.5 SWC	.	.	.	1	.	.	1	.	X	X	.	.	2	1	.	X	1	.	1	1	.	X	.	X	X	1	?	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1334.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1336.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1364.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1437.0 SWC	.	.	X	X	.	.	.	.	X	.	.	.	.	X	X	X	X	X	X	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1452 CUTTS	.	.	1	.	.	.	.	.	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1455.0 SWC	.	.	.	X	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1515 CUTTS	.	.	X	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1520.0 SWC	1	.	X	.	.	.	X	1	X	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1575.0 SWC	.	.	.	.	?	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1602.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1630.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1667.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1678.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1703 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1719.0 SWC	X	.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1749.5 SWC	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1754.5 SWC	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1790.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1813.5 SWC	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	CANNINGINOPSIS BRETONENSIS 66	ISABELIDINIUM KOROJONENSE 67	ISABELIDINIUM PELLUCIDUM 68	AREOLIGERA SENONENSIS 69	AREOLIGERA CORONATA 70	CERATIOPSIS SPECIOSUS 71	CORDOSPHAERIDIUM SP 72	MANUMIELLA CORONATA 73	CORDOSPHAERIDIUM INODES 74	DYPHES COLLIFERUM 75	OPERCULODINIUM CENTROCARPUM 76	APECTODINIUM HOMOMORPHA (SH. SP) 77	AREOSPHAERIDIUM ARCUATUM 78	AREOSPHAERIDIUM AUSTRALICUM 79	DEFLANDREA PHOSPHORITICA 80	HYSTRICHOSPHAERIDIUM TUBIFERUM 81	MILLIOUDIDINIUM TENUITABULATUS 82	VOZZHENNIKOVIA EXTENSA 83	CEREBROCYSTA SP 84	DEFLANDREA TRUNCATA 85	OPERCULODINIUM 86	PHTHANOPERIDINIUM COMATUM 87	SYSTEMATOPHORA PLACACANTHA 88
0373.5 SWC	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	X	?	1	1	X
0388.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.
0429.0 SWC	.	.	.	.	.	.	.	.	1	.	X	1	X	14	1	.	.	.	.	.	.	.	.
0467.0 SWC	.	.	.	X	.	.	.	.	X	1	1	.	.	.	.	.	.	.	.	.	.	.	.
0553.5 SWC	.	.	.	1	X	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0562.0 SWC	2	.	?	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0569.0 SWC	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0599.0 SWC	X	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0612.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0642.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0664.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0689.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0720.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0746.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0812.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0876.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0893.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0970.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1010.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1025 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1080 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1097.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1151.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1177.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1180 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1219.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1250.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1275.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1306 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1316.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1328.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1334.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1336.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1364.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1437.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1452 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1455.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1515 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1520.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1575.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1602.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1630.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1667.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1678.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1703 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1719.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1749.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1754.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1790.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1813.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	ARAUCARIACITES AUSTRALIS 89	CALLIALASPORITES TURBATUS 90	CERATOSPORITES EQUALIS 91	COROLLINA TOROSUS 92	CYATHIDITES AUSTRALIS 93	CYATHIDITES MINOR 94	FALCISPORITES GRANDIS 95	FALCISPORITES SIMILIS 96	FORAMINISPORIS DAILYI 97	GLEICHENIIDITES 98	MICROCACHRYIDITES ANTARCTICUS 99	OSMUNDACIDITES WELLMANII 100	RETITRILETES AUSTROCLAVATIDITES 101	CALLIALASPORITES DAMPIERI 102	CONTIGNISPORITES COOKSONIAE 103	LEPTOLEPIDITES MAJOR 104	PODOSPORITES MICROSACCATUS 105	STERIESPORITES ANTIQUASPORITES 106	ARAUCARIACITES FISSUS 107	CICATRICOSISPORITES LUDBROOKIAE 108	COUPERISPORITES TABULATUS 109
0373.5 SWC	.	.	.	.	5	1	2	9	.	.	2	.	.	.	.	.	.	.	.	.	.
0388.0 SWC	.	.	1	.	6	1	.	2	.	1	.	.	2	.	.	.	1	1	.	.	.
0429.0 SWC	.	.	2	.	.	.	.	2	.	1	1	.	.	.	.	.	3	1	.	.	.
0467.0 SWC	.	.	1	.	.	.	.	6	.	.	.	.	X	.	.	.	3	X	.	.	.
0553.5 SWC	1	.	3	.	1	5	4	10	.	1	5	.	3	.	.	.	5	1	.	.	.
0562.0 SWC	.	.	7	.	15	.	1	14	.	7	2	5	2	.	.	.	.	.	.	.	.
0569.0 SWC	1	.	1	.	1	9	5	6	.	2	5	3	4	.	.	.	5	3	.	.	.
0599.0 SWC	.	.	5	.	8	.	.	13	.	7	5	3	2	.	.	.	.	1	.	.	.
0612.5 SWC	2	.	.	.	5	3	8	8	.	1	4	4	1	.	.	.	1	3	.	.	.
0642.0 SWC	.	.	.	.	X	.	.	X	.	.	X	X	.	.	.	.	.	.	.	.	.
0664.5 SWC	2	.	3	.	2	3	7	21	1	2	7	5	2	.	.	.	8	1	.	.	.
0689.5 SWC	.	.	5	2	6	.	.	35	.	.	4	8	2	.	.	.	.	.	.	.	.
0720.5 SWC	2	.	3	.	3	3	4	14	.	3	14	2	X	.	.	.	6	X	.	.	.
0746.0 SWC	.	.	4	3	7	.	.	37	.	2	4	16	5	X	.	.	.	.	.	.	.
0812.5 SWC	X	.	1	.	3	6	11	15	.	4	9	3	1	.	.	.	6	1	.	.	.
0876.0 SWC	.	.	1	1	15	.	1	15	.	6	4	11	1	.	.	.	.	.	.	.	.
0893.5 SWC	1	.	.	2	5	5	6	25	.	1	10	4	1	1	.	.	5	.	.	.	.
0970.0 SWC	.	.	5	4	23	.	.	35	.	3	.	10	7	.	.	.	.	.	.	.	.
1010.0 SWC	.	.	3	3	5	4	9	20	X	3	12	4	2	1	.	.	1	.	.	.	.
1025 CUTTS	.	.	.	5	5	12	1	16	.	6	8	1	3	1	.	.	7	1	.	.	.
1080 CUTTS	5	.	1	.	20	3	7	14	.	1	4	.	1	2	.	.	.	.	.	.	.
1097.0 SWC	.	.	1	1	11	.	1	12	.	.	5	4	X	X	.	.	.	.	.	.	.
1151.0 SWC	X	.	1	X	1	2	.	5	.	1	2	X	1	.	.	.	30	.	.	.	.
1177.0 SWC	.	.	.	.	9	.	.	48	.	.	26	11	1	.	.	.	.	.	.	.	.
1180 CUTTS	4	1	.	.	1	9	.	11	.	6	24	X	X	X	.	.	25	.	.	.	.
1219.5 SWC	2	.	X	X	3	7	6	17	.	1	10	.	1	.	.	.	14	.	.	X	.
1250.5 SWC	2	.	.	.	58	.	.	15	.	.	9	9	.	.	.	.	.	.	.	.	.
1275.0 SWC	3	.	1	1	1	3	5	9	.	9	3	1	1	.	.	.	1	1	.	.	.
1306 CUTTS	2	.	.	2	2	7	7	14	.	6	6	1	1	.	.	.	15	.	.	.	.
1316.0 SWC	1	.	.	2	27	.	.	28	.	4	7	10	1	.	.	.	.	.	.	.	.
1328.5 SWC	X	3	X	1	2	12	5	13	.	2	7	1	X	.	X	.	3	.	.	X	.
1334.0 SWC	2	.	.	X	6	10	7	20	.	7	5	1	X	1	.	1	10	X	.	X	.
1336.0 SWC	.	.	4	.	20	.	.	30	.	4	4	5	3	.	X	.	.	.	.	.	.
1364.5 SWC	1	3	1	.	5	12	8	16	X	6	11	2	X	.	.	X	8	1	.	.	.
1437.0 SWC	X	X	X	.	X	X	X	X	.	X	X	X	.	.	.	.	X	.	.	.	.
1452 CUTTS	.	X	.	1	5	11	5	18	.	7	17	1	X	.	.	.	7	X	.	X	.
1455.0 SWC	1	.	2	2	1	18	3	9	.	8	10	1	2	.	.	.	9	3	.	.	.
1515 CUTTS	.	.	2	3	2	12	2	9	.	7	10	2	1	X	.	.	20	1	.	.	.
1520.0 SWC	3	.	2	1	1	10	1	11	.	10	13	2	1	.	.	.	7	1	.	.	.
1575.0 SWC	4	1	3	5	7	11	12	21	.	1	10	7	4	1	.	.	.	2	.	.	.
1602.0 SWC	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.
1630.0 SWC	1	1	2	.	10	12	8	20	.	1	5	2	5	.	1	.	3	1	.	X	.
1667.0 SWC	.	.	X	.	.	X	.	X	.	.	X	.	.	.	.	.	.	.	.	.	.
1678.0 SWC	.	.	.	.	X	X	.	X	.	.	X	X	X	.	.	.	.	X	.	.	.
1703 CUTTS	X	X	X	X	X	X	X	X	.	X	X	X	X	.	.	.	.	.	.	X	.
1719.0 SWC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	.	X	X	.	.	.
1749.5 SWC	.	X	X	X	X	X	X	X	.	.	X	X	X	.	X	.	.	.	.	.	.
1754.5 SWC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	.	.	X	.	X	X	X
1790.0 SWC	.	.	X	X	X	X	X	X	.	X	X	X	X	X	X	X	X	X	.	.	.
1813.5 SWC	X	X	X	X	X	X	X	X	X	X	X	X	X	.	.	.	.	.	.	.	.

	CRYBELOSPORITES STRIATUS 110	CYCADOPITES FOLLICULARIS 111	DICTYOPHYLLIDITES 112	DICTYOTOSPORITES COMPLEX 113	DILWYNITES GRANULATUS 114	LEPTOLEPIDITES VERRUCATUS 115	RETITRILETES NODOSUS 116	AEQUITRIRADITES SPINULOSUS 117	AEQUITRIRADITES TILCHAENSIS 118	CICATRICOSISPORITES AUSTRALIENSIS 119	CYCLOSPORITES HUGHESI 120	DICTYOTOSPORITES SPECIOSUS 121	FORAMINISPORIS ASYMMETRICUS 122	FOVEOTRILETES PARVIRETUS 123	ISCHYOSPORITES PUNCTATUS 124	NEVESISPORITES VALLATUS 125	PERINOPOLLENITES ELATOIDES 126	POLYCINGULATISPORITES CRENULATUS 127	RETITRILETES CIRCOLUMENUS 128	TRIPOROLETES RADIATUS 129	APPENDICISPORITES DISTOCARINATUS 130
0373.5 SWC	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0388.0 SWC	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.
0429.0 SWC	.	.	.	.	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0467.0 SWC	.	.	.	.	28	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
0553.5 SWC	.	.	.	.	3	.	.	.	.	X	.	.	X	.	.	.	.	.	.	.	.
0562.0 SWC	.	.	2	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0569.0 SWC	.	.	.	.	4	.	.	.	.	.	.	.	X	.	.	.	.	.	X	.	.
0599.0 SWC	.	.	4	.	.	X	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
0612.5 SWC	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0642.0 SWC	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0664.5 SWC	.	1	.	.	5	.	.	.	.	X	.	.	1	.	1	.	.	X	.	X	.
0689.5 SWC	.	.	2	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
0720.5 SWC	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0746.0 SWC	.	.	2	.	.	1	.	.	.	2	.	.	?	.	.	.	.	.	.	X	.
0812.5 SWC	.	.	1	.	5	X	.	.	.	X	.	1	.	.	.	.	.	.	.	.	.
0876.0 SWC	.	.	2	.	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	.
0893.5 SWC	.	1	.	.	7	1	.	.	.	X	.	.	X	.	.	.	.	.	X	.	.
0970.0 SWC	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1010.0 SWC	.	.	.	.	10	1	1	.	.	X	.	.	.	.	.	.	.	.	.	.	.
1025 CUTTS	.	1	.	.	9	.	.	.	X	X	.	.	.	.	.	.	.	.	.	.	.
1080 CUTTS	.	1	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
1097.0 SWC	.	.	.	.	X	X	.	X	.	1	X	.	.	.	.	.	.	.	.	.	.
1151.0 SWC	.	X	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1177.0 SWC	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
1180 CUTTS	.	.	1	.	7	.	1	.	.	X	.	.	.	.	.	.	.	.	.	.	.
1219.5 SWC	.	.	.	.	19	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	X
1250.5 SWC	.	.	3	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.
1275.0 SWC	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X
1306 CUTTS	.	X	.	.	24	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X
1316.0 SWC	.	.	.	.	11	1	.	.	.	4	.	.	.	.	.	X	.	.	.	.	X
1328.5 SWC	.	.	.	.	29	.	.	.	.	X	.	.	X	.	.	.	.	.	.	.	X
1334.0 SWC	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	X	X
1336.0 SWC	.	.	7	.	10	1	.	.	.	4	.	.	.	.	.	1	.	.	.	X	X
1364.5 SWC	.	.	.	.	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	1
1437.0 SWC	.	X	.	.	X	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X
1452 CUTTS	.	3	.	X	16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X
1455.0 SWC	.	1	.	.	18	.	.	.	.	X	.	.	.	.	.	.	1	.	.	.	2
1515 CUTTS	.	1	.	X	23	1	.	.	.	X	.	X	.	.	.	.	.	.	.	X	X
1520.0 SWC	.	2	.	.	11	.	.	.	.	2	.	X	.	.	.	.	1	.	.	1	X
1575.0 SWC	.	.	1	.	.	X	.	.	.	.	.	X	.	.	.	.	.	1	.	.	.
1602.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1630.0 SWC	X	X	2	.	5	1	X	.	1	2	.	1	2	.	.	.	.	.	X	.	X
1667.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1678.0 SWC	.	X	.	.	.	.	.	.	.	X	.	.	X	.	X	.	.	.	.	X	.
1703 CUTTS	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X
1719.0 SWC	X	X	.	.	X	X	X	.	.	X	.	X	.	.	.	.	.	.	X	X	X
1749.5 SWC	?	X	.	.	.	X	.	X	X	X	?	X	X	X	X	X	X	X	X	X	.
1754.5 SWC	X	X	X	X	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1790.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1813.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	131 FORAMINISPORIS WONTHAGGIENSIS	132 KLUKISPORITES SCABERIS	133 PHYLLOCLADIDITES EUNUCHUS	134 PHYLLOCLADIDITES MAWSONII	135 PILOSISPORITES NOTENSIS	136 POLYCINGULATISPORITES MOONIENSIS	137 BALMEISPORITES HOLODICTYUS	138 BIRETRISPORITES	139 CICATRICOSISPORITES FOVEOAUSTRALIENSIS	140 CONCAVISSIMISPORITES PENOLAENSIS	141 FOVEOGLEICHENIIDITES	142 TRILOBOSPORITES TRIORETICULOSUS	143 BALMEISPORITES TRIDICTYUS	144 CRYBELOSPORITES MAGNIFICA	145 CRYBELOSPORITES MEGASTRIATUS	146 DENSOISPORITES VELATUS	147 JANUASPORITES SPINULOSUS	148 PEROTRILETES JUBATUS/MORGANII	149 TRIPOROLETES RETICULATUS	150 TRIPOROLETES SIMPLEX	151 CICATRICOSISPORITES HUGHESI	152 CINGUTRILETES CLAVUS	153 CONTIGNISPORITES GLEBULENTUS	154 COPTOSPORA PILEOSA	155 COPTOSPORA WRINKLY	156 CORONATISPORA PERFORATA	157 RETITRILETES FACETUS	158 CAMEROZONOSPORITES ROBUSTA	159 CLAVIFERA TRIPLEX	160 LAEVIGATOSPORITES OVATUS	161 VITREISPORITES PALLIDUS	162 AMOSOPOLLIS CRUCIFORMIS	163 PROTEACIDITES	164 LYCOPIACIDITES ASPERATUS	165 TRIPOROLETES BIRETICULATUS	166 APPENDICISPORITES TRICORNITATUS	167 CICATRICOSPORITES WRINKLY AUSTRALIENSIS	168 LILIACIDITES KAITANGATAENSIS	169 AUSTRALOPOLLIS OBSCURIS	170 CICATRICOSISPORITES RADIATUS	171 INTERULOBITES INTRAVERRUCATUS	172 KUYLISPORITES ZIPPERI	173 LYGISTIPOLLENITES FLORINII	174 CALAMOSPORA SP	175 CIBOTIUMSPORA JURIENSIS	176 PEROTRILETES SP	177 TRILOBOSPORITES TRIBOTRYS	178 SENECTOTETRADITES VARIRETICULATUS	179 CYATHEACIDITES TECTIFERA	180 ORNAMENTIFERA SENTOSA	181 TRICOLPITES SP	182 PHIMOPOLLENITES PANNOSUS	183 CAMEROZONOSPORITES OHAIENSIS	184 TRICOLPITES GILLII	185 BACULATISPORITES	186 ISCHYOSPORITES SP	187 COPTOSPORA PARADOXA	188 PROTEACIDITES: large	189 AEQUITRIRADITES VERRUCOSUS	190 CADARGASPORITES BACULATUS
0373.5 SWC	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	16	.	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0388.0 SWC	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	25	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0429.0 SWC	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	6	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0467.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	2	.	.	18	.	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0553.5 SWC	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	X	1	.	.	.	.	.	.	.	.	.	2	3	.	X	8	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	2	1	.	.	.	X	.	.
0562.0 SWC	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
0569.0 SWC	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.	.	X	2	.	X	14	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	X	.	.	2	X	.	.	.	1	.	.
0599.0 SWC	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	17	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0612.5 SWC	.	1	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	X	.
0642.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0664.5 SWC	X	.	.	6	.	.	1	.	.	.	.	.	.	.	.	.	.	X	X	.	.	.	.	X	.	.	.	.	X	2	.	.	5	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X	.	.	X	X	.	.	.	.	.	.
0689.5 SWC	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	X	2	X	.	.	.	.	.	.	.	.	.	.	.	.	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
0720.5 SWC	.	X	.	5	.	.	X	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	1	.	.	2	4	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	X	.	.	1	X	.	.	.	1	.	.
0746.0 SWC	.	.	X	.	X	.	X	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.
0812.5 SWC	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	1	1	.	X	14	.	.	.	.	.	3	X	.	.	.	.	.	.	.	.	.	X	.	.	X	.	.	.	.	.	.	.
0876.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0893.5 SWC	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	X	1	.	.	.	.	X	.	.	.	.	1	.	.	X	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	X	2	.	.	.	.	.	.
0970.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1010.0 SWC	.	.	.	1	X	.	X	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	X	.	.	5	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	X	X
1025 CUTTS	.	.	.	3	.	.	.	.	.	1	.	.	.	.	.	X	.	1	.	.	.	X	.	.	.	.	.	.	1	.	.	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	X	X	.	.
1080 CUTTS	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.	15	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1097.0 SWC	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
1151.0 SWC	.	.	.	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1177.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.
1180 CUTTS	.	.	X	4	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	X	1	1	2	X	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	.	.	.	.	.	.
1219.5 SWC	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	.	.	.	.	.	.	.	.
1250.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1275.0 SWC	.	.	.	39	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	12	6	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.
1306 CUTTS	.	.	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1316.0 SWC	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	1	.	X	1	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1328.5 SWC	.	.	4	1	.	.	X	.	.	.	.	.	.	.	.	.	.	X	X	.	.	.	.	X	.	.	.	2	X	2	.	.	.	X	.	.	.	.	.	1	.	1	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
1334.0 SWC	.	.	16	3	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	X	1	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.
1336.0 SWC	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	1	?	1	.	.	.	.	.	.	.	.	.	.	.	.	.
1364.5 SWC	.	.	X	2	.	.	X	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.	.	.	X	.	.	.	3	.	X	.	1	X	1	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1437.0 SWC	X	.	X	?	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	?	.	.	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1452 CUTTS	.	.	*	.	.	.	X	.	.	.	.	.	.	.	.	X	.	1	.	.	.	.	.	X	.	.	.	X	.	.	.	.	*	.	.	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1455.0 SWC	.	1	2	?	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2	.	.	.	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1515 CUTTS	.	.	1	1	.	.	X	.	.	.	.	X	.	.	.	.	.	.	X	X	.	.	.	.	.	.	.	.	X	.	.	X	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1520.0 SWC	.	.	2	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	X	.	.	1	.	X	.	.	.	X	X	7	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1575.0 SWC	X	X	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1602.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1630.0 SWC	X	1	X	?	.	.	1	.	.	.	.	.	.	.	.	.	.	1	X	.	X	X	1	X	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1667.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1678.0 SWC	X	.	.	.	.	.	.	X	X	.	.	.	X	X	X	X	X	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1703 CUTTS	.	X	.	.	.	.	X	X	X	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1719.0 SWC	X	X	X	?	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1749.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1754.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1790.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1813.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	PEROTRILETES MAJUS 191	ERICIPITES SCABRATUS 192	GAMBIERINA RUDATA 193	LILIACIDITES PERORETICULATUS 194	MUROSPORA FLORIDA 195	POLYPOROPOLLENITES POLYORATUS 196	TRICOLPITES SABULOSUS 197	TRICOLPITES VARIVERRUCATUS 198	NOTHOFAGIDITES SENECTUS 199	TRICOLPITES CONFESSUS 200	NOTHOFAGIDITES ENDURUS 201	PROTEACIDITES PALISADUS 202	PEROTRILETES LINEARIS 203	PHYLLOCLADIDITES VERRUCATUS 204	NEORAISTRICKIA 205	TETRACOLPORITES VERRUCOSUS 206	TRICOLPITES LONGUS 207	TRICOLPORITES APOXYEXINUS 208	TRICOLPORITES LILLIEI 209	TRIPOROPOLLENITES SECTILIS 210	GEPHRAPOLLENITES WAHOOENSIS 211	LYGISTIPOLLENITES BALMEI 212	PERIPOROPOLLENITES POLYORATUS 213	STERIESPORITES REGIUM 214	TETRACOLPORITES RETICULATUS 215	TRICOLPITES DETTMANNIAE 216	TRICOLPITES WAIPAWAENSIS 217	CAMEROZONOSPORITES SP 218	HERKOSPORITES ELLIOTTII 219	NOTHOFAGIDITES BRACHYSPINULOSUS 220	PILOSISPORITES GRANDIS 221	PROTEACIDITES GRANDIS 222	PROTEACIDITES RETICULOCONCAVUS 225	TRIPOROPOLLENITES AMBIGUUS 226	TRIPUNCTISPORIS PUNCTATUS 227	ANACOLOSIDITES ACUTULLUS 228	CYATHIDITES SPP 229	DILWYNITES TUBERCULATUS 230	HALORAGACIDITES HARRISII 231	INTRATRIPOROPOLLENITES NOTABILIS 232	MALVACIPOLLIS SUBTILIS 233	NOTHOFAGIDITES EMARCIDUS 234	NOTHOFAGIDITES FLEMINGII 235	PERIPOROPOLLENITES DEMARCATUS 236	PROTEACIDITES ASPEROPOLUS 237	PROTEACIDITES OBESOLABRUS 238	PROTEACIDITES PACHYPOLUS 239	PROTEACIDITES SCABORATUS 240	PROTEACIDITES TUBERCULIFORMIS 241	TRICOLPORITES ESTOUTUS 242	VERRUCOSISPORITES KOPUKUENSIS 243	MYRTACEIDITES PARVUS 244	NOTHOFAGIDITES DEMINUTUS 245	POLYCOLPITES ESOBALTEUS 246	PROTEACIDITES ANNULARIS 247	PROTEACIDITES LEIGHTONII 248	BEAUPREADITES VERRUCOSUS 249	CAMEROZONOSPORITES LATROBENSIS 250	MALVACIPOLLIS LARGE 251	TRIORITES MAGNIFICUS 252	DIPORITES SP. 253	KUYLISPORITES WATERBOLKII 254	NOTHOFAGIDITES FALCATA 255	PROTEACIDITES HAPUKUI 256	PROTEACIDITES KOPIENSIS 257	SANTALUMIDITES CAINOZOICUS 258
0373.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	2	.	X	.	.	X	.	.	.	9	.	1	9	7	5	.	.	X	.	.	X	2	X	X	1	1	.	1	.	1	1	X	2	X	X	X	1
0388.0 SWC	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	28	.	3	2	.	X	.	.	X	.	.	X	3	.	.	.	X	.	1	1	3	?	.	.	.	.	.	.
0429.0 SWC	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	1	.	X	.	.	.	.	8	4	11	1	3	1	X	.	1	.	1	.	X	.	1	2	1	X	1	X	.	.	.	.	.	.	.	.	.	.
0467.0 SWC	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	X	.	1	.	.	X	1	4	1	7	X	8	1	X	X	?	X	X	1	X	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0553.5 SWC	.	.	1	.	.	1	.	.	.	X	8	.	.	2	.	X	1	.	X	X	X	1	.	.	.	.	X	.	1	X	?	X	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0562.0 SWC	.	.	7	.	X	.	?	.	6	.	.	.	.	.	.	X	5	.	X	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0569.0 SWC	.	X	2	.	.	.	X	.	3	X	8	X	.	.	.	.	.	X	1	X	1	1	1	X	X	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0599.0 SWC	.	.	5	.	X	.	.	.	13	X	.	.	.	.	1	X	X	1	2	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0612.5 SWC	.	.	X	.	.	.	1	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0642.0 SWC	.	.	X	.	.	.	.	.	X	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0664.5 SWC	.	.	.	.	.	.	7	.	1	.	3	.	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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0720.5 SWC	.	X	X	.	.	X	7	.	1	2	1	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0746.0 SWC	.	.	1	.	.	.	?	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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0876.0 SWC	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0893.5 SWC	.	1	?	1	X	X	?	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0970.0 SWC	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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1025 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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1275.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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1316.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1328.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1334.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1336.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1364.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1437.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1452 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1455.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1515 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1520.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1575.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1602.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1630.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1667.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1678.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1703 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1719.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1749.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1754.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1790.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1813.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	BOTRYOCOCCUS	SCHIZOSPORIS RETICULATUS	LEIOSPHAERIDIA	SCHIZOSPORIS PSILATA	MICROFASTA EVANSII	NUMMUS SP	NUMMUS MONOCULATUS	PARALECANIELLA	FUNGAL SETAE	REWORKING - PERMIAN	REWORKING - TRIASSIC	REWORKING - JURASSIC	
	259	260	261	262	263	264	265	266	267	268	269	270	
0373.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	0373.5 SWC
0388.0 SWC	4	.	.	.	.	.	.	.	.	.	.	.	0388.0 SWC
0429.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	0429.0 SWC
0467.0 SWC	3	.	.	.	.	.	.	1	.	.	.	.	0467.0 SWC
0553.5 SWC	6	.	.	.	.	.	.	4	.	4	.	.	0553.5 SWC
0562.0 SWC	.	.	.	.	.	.	.	.	.	X	.	X	0562.0 SWC
0569.0 SWC	.	.	.	.	.	.	6	.	.	X	.	.	0569.0 SWC
0599.0 SWC	.	.	.	.	.	.	.	.	.	X	.	X	0599.0 SWC
0612.5 SWC	X	.	.	.	.	.	42	4	.	.	.	.	0612.5 SWC
0642.0 SWC	.	.	.	.	.	.	.	.	.	.	X	.	0642.0 SWC
0664.5 SWC	1	.	.	.	.	.	.	.	.	1	X	.	0664.5 SWC
0689.5 SWC	.	.	.	.	.	.	.	.	.	X	X	.	0689.5 SWC
0720.5 SWC	1	X	.	.	.	.	.	.	.	X	.	.	0720.5 SWC
0746.0 SWC	.	.	.	.	.	.	.	.	.	.	X	.	0746.0 SWC
0812.5 SWC	1	.	.	.	.	.	.	.	.	1	.	.	0812.5 SWC
0876.0 SWC	.	.	.	.	.	.	.	.	.	X	.	.	0876.0 SWC
0893.5 SWC	1	.	.	.	.	.	X	.	.	1	.	.	0893.5 SWC
0970.0 SWC	.	.	.	.	.	.	.	.	.	X	.	.	0970.0 SWC
1010.0 SWC	3	.	.	.	.	.	.	.	.	X	.	.	1010.0 SWC
1025 CUTTS	5	.	.	.	.	.	.	.	.	.	.	.	1025 CUTTS
1080 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	1080 CUTTS
1097.0 SWC	.	.	.	.	.	.	.	.	.	X	.	.	1097.0 SWC
1151.0 SWC	52	.	.	.	.	.	.	.	.	.	.	.	1151.0 SWC
1177.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	1177.0 SWC
1180 CUTTS	1	.	.	.	.	.	.	.	F	.	.	.	1180 CUTTS
1219.5 SWC	16	.	.	.	.	.	.	.	.	.	.	.	1219.5 SWC
1250.5 SWC	.	.	.	.	.	.	.	.	.	.	1	.	1250.5 SWC
1275.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	1275.0 SWC
1306 CUTTS	4	.	.	.	.	.	3	1	.	.	.	.	1306 CUTTS
1316.0 SWC	.	.	.	.	.	.	.	.	.	.	X	.	1316.0 SWC
1328.5 SWC	.	.	.	.	.	.	1	.	.	1	.	.	1328.5 SWC
1334.0 SWC	7	.	.	.	.	.	.	.	.	.	.	.	1334.0 SWC
1336.0 SWC	.	.	.	.	.	.	.	.	.	X	X	.	1336.0 SWC
1364.5 SWC	3	.	.	.	.	.	.	.	.	.	.	.	1364.5 SWC
1437.0 SWC	X	.	.	.	.	X	.	.	.	X	.	.	1437.0 SWC
1452 CUTTS	7	.	.	.	RW	.	.	.	.	.	.	.	1452 CUTTS
1455.0 SWC	2	.	.	.	.	.	.	.	.	.	.	.	1455.0 SWC
1515 CUTTS	2	.	.	.	.	.	.	.	.	.	.	.	1515 CUTTS
1520.0 SWC	3	.	.	.	.	.	.	.	.	.	.	.	1520.0 SWC
1575.0 SWC	3	.	.	1	.	.	.	.	.	1	.	.	1575.0 SWC
1602.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	1602.0 SWC
1630.0 SWC	10	.	.	.	.	.	.	.	.	.	.	.	1630.0 SWC
1667.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	1667.0 SWC
1678.0 SWC	.	X	X	.	.	.	.	.	.	.	.	.	1678.0 SWC
1703 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	1703 CUTTS
1719.0 SWC	X	.	.	.	.	.	.	.	.	X	.	.	1719.0 SWC
1749.5 SWC	X	.	.	.	.	.	.	.	.	X	X	.	1749.5 SWC
1754.5 SWC	X	X	.	.	.	.	.	.	.	X	X	.	1754.5 SWC
1790.0 SWC	.	.	.	.	.	.	.	.	.	.	.	.	1790.0 SWC
1813.5 SWC	.	.	.	.	.	.	.	.	.	.	.	.	1813.5 SWC

SPECIES LOCATION INDEX

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49	AMPHIDIADEMA DENTICULATA
228	ANACOLOSIDITES ACUTULLUS
77	APECTODINIUM HOMOMORPHA (SH. SP)
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166	APPENDICISPORITES TRICORNITATUS
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170	CICATRICOSISPORITES RADIATUS
167	CICATRICOSPORITES WRINKLY AUSTRALIENSIS
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145	CRYBELOSPORITES MEGASTRIATUS
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94	CYATHIDITES MINOR
229	CYATHIDITES SPP
111	CYCADOPITES FOLLICULARIS
26	CYCLONEPHELIUM COMPACTUM
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253	DIPORITES SP.
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36	ISABELIDINIUM BELFASTENSE ROTUNDATA
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38	ISABELIDINIUM CRETACEA
67	ISABELIDINIUM KOROJONENSE
41	ISABELIDINIUM LATUM
68	ISABELIDINIUM PELLUCIDUM
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212	LYGISTIPOLLENITES BALMEI
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42	MADURADINIUM PENTAGONUM
251	MALVACIPOLLIS LARGE
233	MALVACIPOLLIS SUBTILIS
73	MANUMIELLA CORONATA
1	MICRHYSTRIDIUM
99	MICROCACHRYIDITES ANTARCTICUS
263	MICROFASTA EVANSII
82	MILLIOUDIDINIUM TENUITABULATUS
195	MUROSPORA FLORIDA
244	MYRTACEIDITES PARVUS
54	NELSONIELLA ACERAS
60	NELSONIELLA SEMIRETICULATA
61	NELSONIELLA TUBERCULATA
205	NEORAISTRICKIA
125	NEVESISPORITES VALLATUS
220	NOTHOFAGIDITES BRACHYSPINULOSUS
245	NOTHOFAGIDITES DEMINUTUS
234	NOTHOFAGIDITES EMARCIDUS
201	NOTHOFAGIDITES ENDURUS
255	NOTHOFAGIDITES FALCATA
235	NOTHOFAGIDITES FLEMINGII
199	NOTHOFAGIDITES SENECTUS
265	NUMMUS MONOCULATUS
264	NUMMUS SP
43	ODONTOCHITINA COSTATA
44	ODONTOCHITINA CRIBROPODA
10	ODONTOCHITINA OPERCULATA
51	ODONTOCHITINA PORIFERA
55	ODONTOCHITINA STUBBY
4	OLIGOSPHAERIDIUM COMPLEX
19	OLIGOSPHAERIDIUM PULCHERRIMUM
65	OLIGOSPHAERIDIUM SP
86	OPERCULODINIUM
76	OPERCULODINIUM CENTROCARPUM
180	ORNAMENTIFERA SENTOSA
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266	PARALECANIELLA
126	PERINOPOLLENITES ELATOIDES
236	PERIPOROPOLLENITES DEMARCATUS
213	PERIPOROPOLLENITES POLYORATUS
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203	PEROTRILETES LINEARIS
191	PEROTRILETES MAJUS
176	PEROTRILETES SP
182	PHIMOPOLLENITES PANNOSUS
182	PHIMOPOLLENITES PANNOSUS
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204	PHYLLOCLADIDITES VERRUCATUS
221	PILOSISPORITES GRANDIS
135	PILOSISPORITES NOTENSIS
105	PODOSPORITES MICROSACCATUS
127	POLYCINGULATISPORITES CRENULATUS
136	POLYCINGULATISPORITES MOONIENSIS
246	POLYCOLPITES ESOBALTEUS
196	POLYPOROPOLLENITES POLYORATUS
163	PROTEACIDITES
247	PROTEACIDITES ANNULARIS
237	PROTEACIDITES ASPEROPOLUS
222	PROTEACIDITES GRANDIS
256	PROTEACIDITES HAPUKUI
257	PROTEACIDITES KOPIENSIS
248	PROTEACIDITES LEIGHTONII
238	PROTEACIDITES OBESOLABRUS
223	PROTEACIDITES ORNATUS
224	PROTEACIDITES OTWAYENSIS
239	PROTEACIDITES PACHYPOLUS
202	PROTEACIDITES PALISADUS
225	PROTEACIDITES RETICULOCONCAVUS
240	PROTEACIDITES SCABORATUS
241	PROTEACIDITES TUBERCULIFORMIS
188	PROTEACIDITES: large
20	PTEROSPERMELLA AUREOLATA
21	PTEROSPERMELLA AUSTRALIENSIS
52	PTEROSPERMELLA SP
101	RETITRILETES AUSTROCLAVATIDITES
128	RETITRILETES CIRCOLUMENUS
157	RETITRILETES FACETUS
116	RETITRILETES NODOSUS
270	REWORKING - JURASSIC
268	REWORKING - PERMIAN
269	REWORKING - TRIASSIC
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262	SCHIZOSPORIS PSILATA
260	SCHIZOSPORIS RETICULA
178	SENECTOTETRADITES VAR. [illegible]CULATU
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22	SPINIFERITES FURCATUS/RAMOSUS
106	STERIESPORITES ANTIQUASPORITES
214	STERIESPORITES REGIUM
28	SUBTILISPHAERA TRENDALLII
88	SYSTEMATOPHORA PLACACANTHA
215	TETRACOLPORITES RETICULATUS
206	TETRACOLPORITES VERRUCOSUS
62	TRICHODINIUM
200	TRICOLPITES CONFESSUS
216	TRICOLPITES DETTMANNIAE
184	TRICOLPITES GILLII
207	TRICOLPITES LONGUS
197	TRICOLPITES SABULOSUS
181	TRICOLPITES SP
198	TRICOLPITES VARIVERRUCATUS
217	TRICOLPITES WAIPAWAENSIS
208	TRICOLPORITES APOXYEXINUS
242	TRICOLPORITES ESTOUTUS
209	TRICOLPORITES LILLIEI
177	TRILOBOSPORITES TRIBOTRYS
142	TRILOBOSPORITES TRIORETICULOSUS
252	TRIORITES MAGNIFICUS
165	TRIPOROLETES BIRETICULATUS
129	TRIPOROLETES RADIATUS
149	TRIPOROLETES RETICULATUS
150	TRIPOROLETES SIMPLEX
226	TRIPOROPOLLENITES AMBIGUUS
210	TRIPOROPOLLENITES SECTILIS
227	TRIPUNCTISPORIS PUNCTATUS
12	TRITHYRODINIUM FINE GRANULES
34	TRITHYRODINIUM MARSHALLII
45	TRITHYRODINIUM PUNCTATE
46	TRITHYRODINIUM SUSPECTUM
47	TRITHYRODINIUM THICK PSILATE
48	TRITHYRODINIUM THICK RETICULATU
243	VERRUCOSISPORITES KOPUKUENSIS
2	VERYHACHIUM
161	VITREISPORITES PALLIDUS
83	VOZZHENNIKOVIA EXTENSA
63	XENIKOON AUSTRALIS

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MICROPALAEONTOLOGICAL ANALYSIS
ERIC THE RED-1, PERMIT VIC-P-31
OTWAY BASIN

FOR

BHP PETROLEUM PTY LTD

J.P. REXILIUS

SEPTEMBER, 1993

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UNIT 2, 10 STATION STREET
P.O. BOX 26
COTTESLOE 6011
WESTERN AUSTRALIA
PHONE 3852571 FAX 3843257

CONTENTS

I. SUMMARY

Eric The Red-1 was drilled in offshore petroleum permit Vic-P-31, Otway Basin to a depth of 1875mKB. A total of 3 sidewall core samples from the Tertiary section have been examined for foraminifera and calcareous nannoplankton. All 3 samples are clean sandstones which are barren of foraminifera and nannoplankton.

APPENDIX NO. 1 : SUMMARY OF MICROPALAEONTOLOGICAL DATA, ERIC THE RED-1

DEPTH (mKB)	FORAM YIELD	FORAM PRESERV.	FORAM DIVERSITY	NANNO YIELD	NANNO PRESERV.	NANNO DIVERSITY
SWC30, 373.5	barren	-	-	barren	-	-
SWC28, 388	barren	-	-	barren	-	-
SWC24, 467	barrren	-	-	barren	-	-

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PETROLOGY REPORT

ERIC THE RED #1

OTWAY BASIN

Report prepared for BHP Petroleum Pty Ltd

by

Dr S E PHILLIPS

ACS LABORATORIES PTY LTD
31 Flemington St
Frewville SA 5063

September 1993

CONTENTS

1. SUMMARY

BHP Petroleum Pty Ltd submitted 8 sidewall cores from Eric The Red #1 in the Otway Basin, for petrological description. Samples were selected from the Sherbrook, Shipwreck and Otway Groups. The aims of the study were to identify the mineralogy and compare the Shipwreck Group sandstones with those previously studied from La Bella #1. Petrophysical analysis of the well indicated that there were some significant differences in water salinity. It was hoped that the mineralogy might explain these variations.

The lithology and mineralogy of each sample is summarised in Table 1. Typically the sidewall cores were fragmented and grains fractured making descriptions difficult. Data presented in Table 1 are based on visual estimates, not point counts. The mineralogy does not explain problems with the salinity data.

In terms of sediment provenance there appears to have been a constant source of volcanic, metamorphic and sedimentary lithics throughout the depositional history of these samples. The relative proportions of these components have changed with time and there is evidence of a significant change in source with the increased input of polycrystalline quartz in the Upper Shipwreck of Swc 70 (depth 1297m). This change is probably related to the unconformity noted at this depth. It is possible that many of the volcanic lithics and heavy minerals throughout the sequence have been reworked from the Otway Group.

Depositional environments appear to range from marine (Sherbrook Group) to marginal marine and possibly terrestrial (Shipwreck and Otway Groups). These suggestions are based on the percentage of glaucony, sedimentological characteristics and presence of plant matter.

There are no patterns in the diagenetic alteration of these samples. Each sample has a slightly different combination of authigenic minerals. Only in Swc 70 (depth 1297m) has there been significant alteration with the precipitation of carbonate cement. Elsewhere alteration has been relatively minor. Glauconite, chlorite, pyrite, carbonate, kaolin and quartz have precipitated in the sandstones. Silicification is restricted to trace amounts in the Otway Group sample (Swc 32, depth 1790m). In addition there is evidence of mechanical compaction and grain dissolution in most samples.

TABLE 1. SUMMARY OF LITHOLOGY, TEXTURE AND MINERALOGY ERIC THE RED #1

GROUP	Sherbrook	Upper Shipwreck			
Swc	10	85	81	70	61
Depth (m)	778.5	1102	1146	1297	1340
Lithology	sublitharenite	quartzarenite	sublith arenite	sublitharenite	quartzarenite
Grain size	fine	fine	v fine	coarse	coarse
Sorting	mod	mod	mod	mod	poor
Structures	laminae	stringers	?beds ?bioturb	-	-
Framework grains					
Quartz	60	72	70	52	77
Feldspar	2	tr	3	2	tr
Lithics	7	tr	5	15	tr
Mica	1	tr	tr	-	tr
Accessory	tr	tr	2	-	tr
Matrix					
Clay	7	-	7	-	-
Opaque material	-	-	-	-	2
Drilling mud	-	-	-	-	-
Authigenic minerals					
Glauconite/glaucony	3	tr	tr	-	-
Chlorite	6	-	3	-	-
Pyrite	2	4	1	-	-
Carbonate	-	8	-	30	-
Kaolin	-	tr	tr	tr	tr
Quartz	-	-	-	-	tr
Illite	-	-	-	-	tr
Porosity					
Intergranular	?10	?15	3	-	?20
Dissolution	tr	tr	5	-	-

GROUP	Lower Shipwreck		Otway
Swc	54	47	32
Depth (m)	1464.5	1598.5	1790
Lithology	sublitharenite	sublitharenite	litharenite
Grain size	medium	m-coarse	m-coarse
Sorting	mod	poor	mod
Structures	-	-	bedding
Framework grains			
Quartz	68	78	15
Feldspar	2	1	2
Lithics	9	15	58
Mica	3	tr	1
Accessory	tr	-	-
Matrix			
Clay	-	-	-
Opaque material	-	-	-
Drilling mud	?	?	-
Authigenic minerals			
Glauconite/glaucony	tr	tr	tr
Chlorite	-	-	5
Pyrite	-	-	-
Carbonate	2	-	-
Kaolin	5	2	tr
Quartz	tr	tr	tr
Porosity			
Intergranular	?10	-	12
Dissolution	-	3	6

Although the diagenetic events are different in each sample the overall paragenetic sequence is probably similar. These events are summarised in the diagram below:

Event	Early	Middle	Late
		Diagenetic Stage	
glauconite	---		
pyrite	----		
chlorite	-----		-----
carbonate	----		----
dissolution		-----	
kaolin		-----	
compaction	----------	----------	
recrystallisation			-----
quartz			----

In terms of lithology the Shipwreck Group in Eric The Red #1 does not show the sharp change from quartzarenites to litharenites that was apparent in La Bella #1 at the boundary between the Upper and Lower units. Quartzarenites probably represent smaller intervals in Eric The Red #1.

LOWER SHIPWRECK GROUP

Grain size in the Lower Shipwreck is medium to coarse in both La Bella and Eric The Red which may indicate that these samples were deposited by a similar high energy hydraulic regime. Sorting is only slightly better at La Bella #1 and there are suggestions of bedding which indicate fluctuations in current activity.

In La Bella #1 there is a higher percentage of labile feldspars and lithics in the Lower Shipwreck. This suggests that for La Bella #1 either sediment transport was over shorter distances than for Eric The Red #1 or that there was a change in sediment source. It is unlikely that these differences can be attributed to greater compressional tectonism at Eric The Red #1 because this should have resulted in an increase, rather than a decrease, in erosion and hence the proportion of labile grains. Sediment provenance appears to be very similar in both wells. Lithics were comprised of metamorphic, volcanic and sedimentary rock fragments. Plagioclase in La Bella #1 and granitic lithics in Eric The Red #1 were probably derived from a granitic basement.

Precipitation of authigenic minerals has been greater in La Bella #1. There are higher percentages of carbonate, kaolin and quartz. This is reflected in a reduction of porosity compared to Eric The Red #1. These differences may be due to the greater tectonic activity recognised for Eric The Red #1.

UPPER SHIPWRECK GROUP

A slightly coarser grain size within Eric The Red #1 samples may reflect either stronger current activity for this location or closer proximity to the source area. The latter hypothesis is supported by the higher percentage of feldspars and lithics. Overall sorting and mineralogical

Bella #1 samples. Volcanic lithics would be more susceptible to weathering than the chert, schist and quartzite that were recognised. The Upper Shipwreck at La Bella #1 was interpreted as a prograding delta whereas at Eric The Red #1 this unit appears to be marginal marine with a stronger terrestrial influence.

There are similar proportions of pyrite and carbonate cements in both wells. However there have not been any siderite nodules recognised from the petrology of Eric The Red #1. This is probably a difference in the depositional environment rather than diagenetic alteration. The amount of kaolin is higher in La Bella #1 and there is no quartz or barite in Eric The Red #1. As for the Lower Shipwreck Group these differences could be a function of tectonic stability in this region. Chlorite detected in Eric The Red #1 is restricted to one sample and is probably related to the marine depositional environment.

2. INTRODUCTION

BHP Petroleum Pty Ltd submitted 8 sidewall cores from Eric The Red #1 in the Otway Basin, for petrological description. Samples were selected from the Sherbrook, Shipwreck and Otway Groups. The aims of the study were to identify the mineralogy and compare the Shipwreck Group sandstones with those previously studied from La Bella #1. Petrophysical analysis of the well indicated that there were some significant differences in water salinity. It was hoped that the mineralogy might explain these variations.

The following samples were examined:

Swc	Depth (m)	Group	Thin section
10	778.5	Sherbrook	Brief
85	1102	Upper Shipwreck	Detailed
81	1146	Upper Shipwreck	Brief
70	1297.0	Upper Shipwreck	Brief
61	1340.0	Upper Shipwreck	Detailed
54	1464.5	Lower Shipwreck	Brief
47	1598.5	Lower Shipwreck	Detailed
32	1790	Otway	Brief

3. METHODS

Sidewall cores were impregnated with araldite prior to thin section preparation. Blue dye was used in the araldite to facilitate description of porosity and permeability. Thin sections were systematically scanned to determine lithology, composition, porosity and textural relationships. All percentages given in thin section descriptions are based on visual estimates, not point counts. Rock classifications are based on the work of Folk (1974) for clastics and Dunham (1962) for carbonates.

4. PETROLOGY

4.1 Eric The Red #1, Swc 10, depth 778.5m

Thin section description

The sample has been moderately disrupted and fractured during sidewall coring. It is a fine grained, moderately sorted, mineralogically and texturally submature sublitharenite. Grains are typically subrounded to subangular with low sphericity. Texturally the sample is grain supported with tangential and point contacts dominant. There are vague concentrations of clay that could indicate the presence of laminae or contamination by drilling mud. Porosity is very difficult to describe because of disruption during coring and the presence of clays. Where clays are absent there are good intergranular pores. Elsewhere the pore filling clays and grain rimming chlorite have limited porosity and permeability. Rare feldspars have been corroded to produce honeycomb porosity.

Framework grains of quartz, K-feldspar, lithics (metamorphic, granitic and volcanic), mica and zircon are apparent. The pore filling clay is anhedral and pale yellowish brown, it includes minor opaques. Authigenic minerals and cements of glaucony (glauconite and chlorite) and pyrite are evident. Distinctive chlorite rims on volcanic lithics precipitated before clays filled the pores. This suggests that the pore filling clay is either a contaminant or filtered into the sediment after deposition.

Visual Estimate of Composition		%
Framework grains	Quartz	60
	Feldspar	2
	Lithics	7
	Mica	1
	Accessory minerals	tr
Matrix	Clay	7
Authigenic minerals and cements	Glauconite	3
	Chlorite	6
	Pyrite	2
Porosity	Intergranular	?10
	Dissolution	tr

4.2 Eric The Red #1, Swc 85, depth 1102m

Thin section description

Rock classification: Quartzarenite

Texture:
Sidewall coring has caused minor grain fracturing and there is a rim of drilling mud on the edge of the section. The sample is a moderately sorted, fine grained, mineralogically mature and texturally submature quartzarenite. Grains range in diameter from approximately 0.05mm (coarse silt) to 0.60mm (coarse sand) and are typically subangular with low to moderate sphericity. Texturally the quartzarenite is grain supported with dominantly point contacts. Rare discontinuous stringers of anhedral dusty carbonate have probably replaced clay stringers. The presence of bent and splayed micas indicates that there has been minor mechanical compaction of the sample.

Porosity:
Primary intergranular pores appear to have been well preserved throughout the sample. These pores have probably been enhanced by slight disruption during sampling. Corrosion of feldspars along crystallographic axes has resulted in isolated honeycomb porosity.

Visual Estimate of Composition		%
Framework grains	Quartz	72
	Feldspar	tr
	Lithics	tr
	Mica	tr
	Accessory minerals	tr
Matrix		nd
Authigenic minerals and cements	Glaucony	tr
	Pyrite	4
	Carbonate	8
	Kaolin	tr
Porosity	Intergranular	?15
	Dissolution	tr

Framework grains:
Quartz is both monocrystalline and polycrystalline. The latter have undulose extinction and straight crystal boundaries. Monocrystalline quartz has straight to slightly undulose extinction with vacuoles scattered throughout the grain. Rarely the vacuoles are aligned to form Boehm lamellae and there are mineral inclusions of apatite, zircon and rutile needles. Feldspars are typically potassic in composition but there are examples with albite twinning indicating the presence of plagioclase. One feldspar has a micrographic texture due to an intergrowth with quartz. Potassic feldspars display various stages of alteration due to sericitisation and corrosion. Lithics include fragments of chert, micaceous schist and felsic volcanics. Flakes of mica are commonly highly altered, splayed and partially replaced along cleavage planes by pyrite. Very fine sand size epidote and angular zircon represents the accessory minerals.

Authigenic minerals and cements:

pyrite. Anhedral single crystals and clusters of dusty carbonate spar are scattered throughout the sample (Fig. 1). Typically crystals are approximately 30 microns in diameter, rounded or spherical in shape and have a reddish colour that could indicate the presence of siderite. Where darker cores are apparent in the carbonate this indicates neomorphic replacement. In the discontinuous stringer the carbonate is dark red and micritic in habit with minor recrystallisation to anhedral spar. Rare patches of anhedral kaolin booklets were precipitated prior to the carbonate. Kaolin has also replaced micas. Pyrite framboids and anhedral single crystals are scattered along grain margins. Commonly the framboids are up to 40 microns in diameter. Rarely the pyrite forms a patch of massive cement between framework grains and concentrates in the discontinuous carbonate stringer.

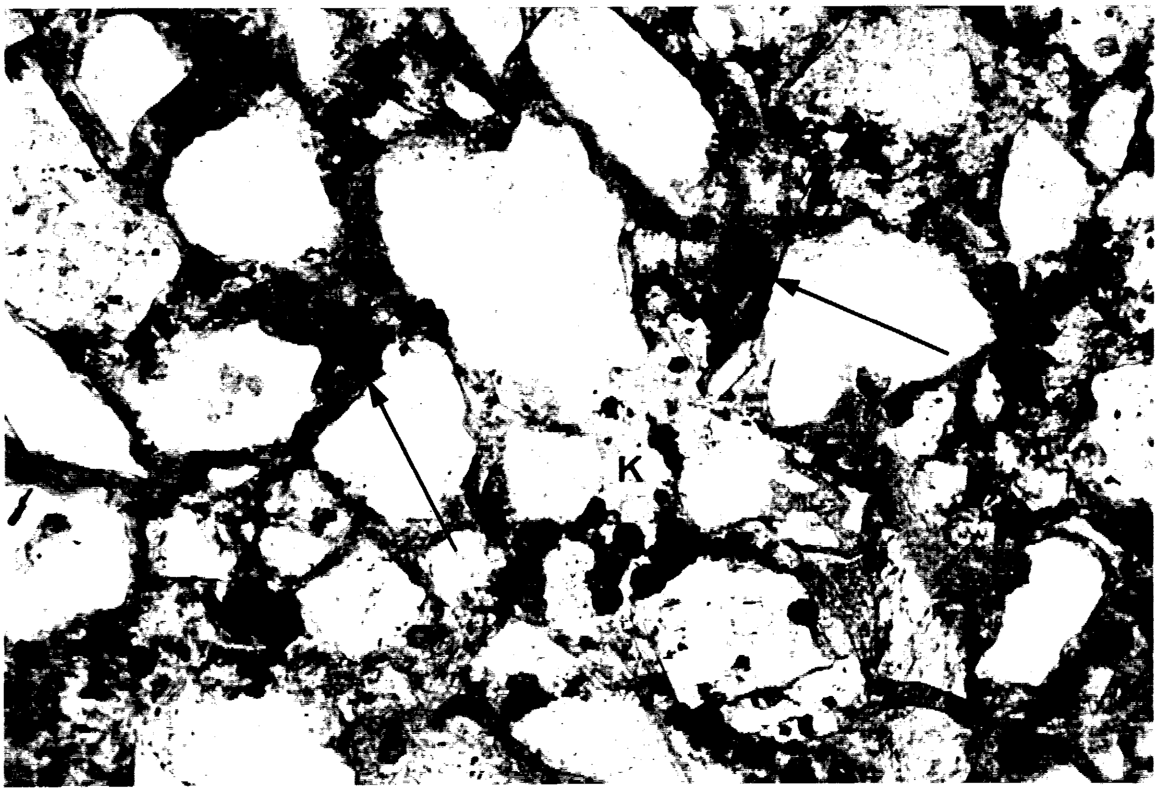

Figure 1.
Single crystals of anhedral carbonate spar (arrows) are scattered throughout the sample. Note the intergranular porosity (blue) which has been enhanced by sampling. A patch of kaolin (K) has been partially replaced by pyrite (opaque). Eric The Red #1, Swc 85, depth 1102m. Plane light. Field of view 0.88mm.

4.3 Eric The Red #1, Swc 81, depth 1146m

Thin section description

The sidewall core has been fragmented during sampling. It is a moderately sorted, very fine grained, texturally and mineralogically submature sublitharenite. There are vague suggestions of cleaner sandy laminae that could be attributed to disrupted bedding or bioturbation. Grains are typically subrounded to subangular with low sphericity. Texturally the sample is grain supported with dominantly tangential grain contacts. In the zones of cleaner sand, porosity is a mixture of primary intergranular pores and secondary dissolution pores. Where detrital clay matrix is apparent pores are restricted and typically secondary in nature. There are examples of oversize pores. Permeability is unlikely to be good due to the irregular distribution of matrix.

Framework grains consist of quartz, sericitised K-feldspars, metamorphic and volcanic lithics, mica and accessory minerals. The accessory minerals are dominated by zircon with minor tourmaline, epidote and opaques. Matrix is anhedral brown clay that fills pores and is associated with pyrite. Authigenic minerals include glaucony grains (glauconite), grain rimming chlorite, vermiform kaolin and pyrite framboids.

Visual Estimate of Composition		%
Framework grains	Quartz	70
	Feldspars	3
	Lithics	5
	Mica	tr
	Accessory minerals	2
Matrix	Clay	7
Authigenic minerals and cements	Glauconite	tr
	Chlorite	3
	Pyrite	1
	Kaolin	tr
Porosity	Intergranular	3
	Dissolution	5

4.4 Eric The Red #1, Swc 70, depth 1297.0m

Thin section description

The sample is a moderately sorted, coarse grained, mineralogically submature carbonate cemented sublitharenite. Grains have been fractured and the sample disrupted during sidewall coring. There are patches where textural integrity has been retained. Grains range in diameter from approximately 0.10mm (very fine sand) to 0.85mm (coarse sand) and are typically subangular with low sphericity. Grain shape has been slightly modified due to embayment by the carbonate cement. The texture is grain supported with dominantly point and tangential grain contacts. In places the grains appear to float in carbonate cement. There are no sedimentary structures apparent. Any porosity evident is attributed to disruption during sampling.

The framework grains consist of quartz (polycrystalline represents 30%), K-feldspars (micrographic intergrowths), and metamorphic, volcanic, granitic, chert and chalcedonic lithics. Twinned poikilotopic carbonate spar has cemented, embayed and replaced framework grains. Kaolin booklets have replaced grains.

Visual Estimate of Composition		%
Framework grains	Quartz	52
	Feldspars	2
	Lithics	15
Matrix		nd
Authigenic minerals and cements	Carbonate	30
	Kaolin	tr
Porosity		nd

4.5 Eric The Red #1, Swc 61, depth 1340.0m

Thin section description

Rock classification: Quartzarenite

Texture:
The sample has been disaggregated during sidewall coring and most grains are fractured. This has resulted in a very angular fine fraction. It would appear to be a poorly sorted, coarse grained, mineralogically mature quartzarenite. Those grains which are intact range in diameter from approximately 0.07mm (very fine sand) to 4.3mm (pebbles) and are commonly subrounded with low to moderate sphericity. Pebble size grains are rare. Texturally the sample was probably grain supported with point and tangential grain contacts but it has now been totally disrupted.

Porosity:
Lack of authigenic cements and matrix tend to suggest that reservoir quality was good. Porosity was probably dominated by primary intergranular pores with open pore throats.

Visual Estimate of Composition		%
Framework grains	Quartz	77
	Feldspars	tr
	Lithics	tr
	Mica	tr
	Accessory minerals	tr
Opaque material		2
Authigenic minerals and cements	Kaolin	tr
	Quartz	tr
	Illite	tr
Porosity	Intergranular	?20

Framework grains:
Quartz is typically monocrystalline with straight to slightly undulose extinction, scattered vacuoles and rare mineral inclusions of zircon, apatite, biotite, rutile needles and tourmaline. Grains of polycrystalline quartz are less abundant and have either sutured or straight crystal boundaries and undulose extinction. One polycrystalline quartz grain has a mineral inclusion of biotite and another contains rutile needles. K-feldspars are corroded along preferred crystallographic axes and lack twinning. Lithics of dusty radiating chalcedony and micaceous schist are evident. Highly altered and bent mica flakes have been partially replaced by kaolin and minute opaques. Other fresh flakes of muscovite are straight and up to 0.75mm in length. Yellowish brown tourmaline has been fragmented during sidewall coring. These grains were up to medium sand in size.

Authigenic minerals and cements:
The only authigenic minerals are those replacing grains, namely kaolin, sericite and opaques. These minerals are present in trace amounts. Rare dust rims on quartz grains indicate the presence of syntaxial overgrowths. The anhedral and discontinuous nature of these overgrowths suggests that they were inherited. One corner of the sample has been cemented by fragments of angular opaque material that is probably organic

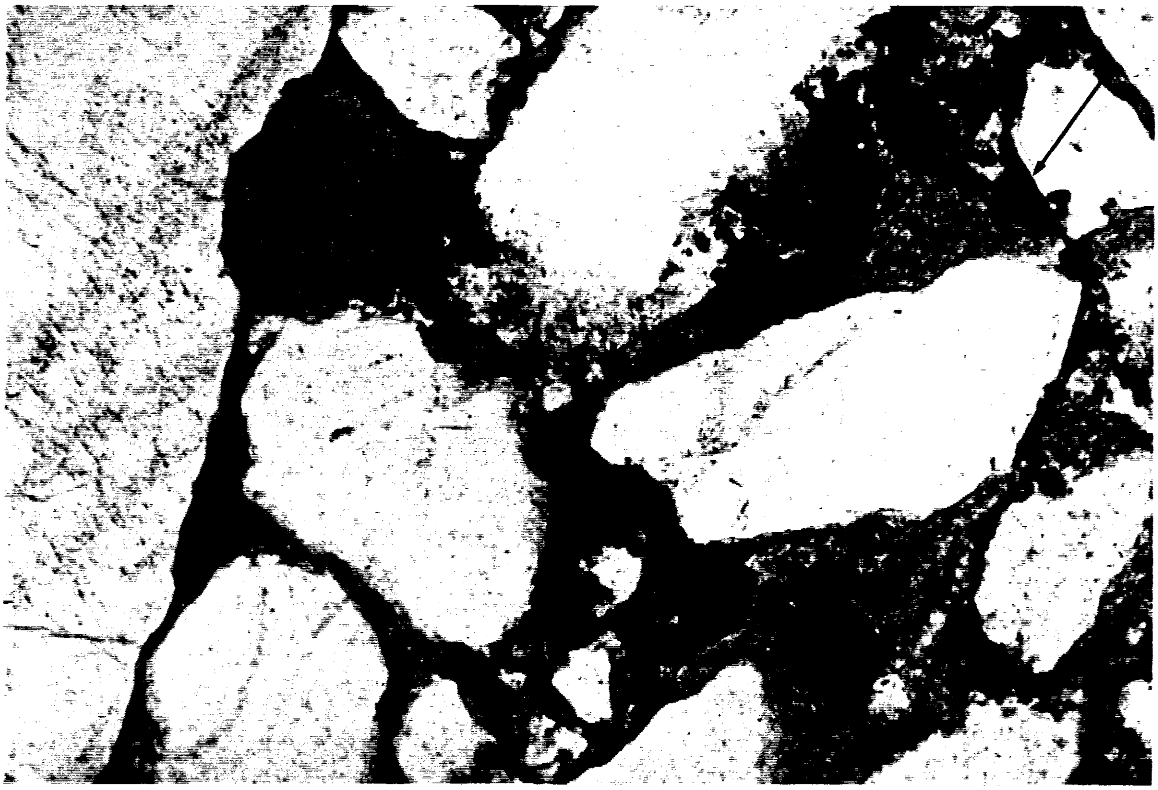

Figure 2.

Fragments of opaque material rim and partially fill pores in this poorly sorted quartzarenite. An inherited quartz overgrowth (arrow) is apparent. Eric The Red #1, Swc 61, depth 1340.0m. Plane light. Field of view 0.88mm.

4.6 Eric The Red #1, Swc 54, depth 1464.5m

Thin section description

The sample has been fractured and in part disaggregated due to sidewall coring. It is a moderately sorted, medium grained, mineralogically and texturally submature sublitharenite. Typically grains are fractured and this has formed a very angular fine fraction. However, grains appear to range in diameter from approximately 0.08mm (very fine sand) to 1.1mm (very coarse sand) and are subangular to subrounded with low to moderate sphericity. Texturally the sample is grain supported with tangential and rare concavo-convex grain contacts. The latter have resulted from the deformation of ductile lithics and micas during compaction. In part this deformation could be attributed to sampling. The extent of porosity preservation is difficult to ascertain because of the disrupted nature of the sample and possible contamination by drilling mud. If the lithics have been deformed by compaction then this is the major cause of porosity reduction.

Framework grains are comprised of quartz (monocrystalline and polycrystalline), corroded K-feldspars, metamorphic, volcanic and chert lithics, muscovite, tourmaline and zircon. Dusty carbonate microspar and micrite form a patchy cement. In addition there are rare grains of glaucony (glauconite), inherited quartz overgrowths, micas and feldspars altered to kaolin and pore filling kaolin.

Visual Estimate of Composition		%
Framework grains	Quartz	68
	Feldspars	2
	Lithics	9
	Mica	3
	Accessory minerals	tr
Matrix		nd
Authigenic minerals and cements	Glaucony	tr
	Carbonate	2
	Kaolin	5
	Quartz	tr
Porosity	Intergranular	?10

4.7 Eric The Red #1, Swc 47, depth 1598.5m

Thin section description

Rock classification: Sublitharenite

Texture:
The sample is a poorly sorted, medium to coarse grained, mineralogically and texturally submature sublitharenite (Fig. 3). Grains have been fractured during sidewall coring and the sample is rimmed and infiltrated by drilling mud. The latter is associated with very angular silt size sand. Grains range in diameter from approximately 0.1mm (very fine sand) to 2.1mm (granules) and are typically subangular to subrounded with low to moderate sphericity. Texturally the sample is grain supported with tangential and concavo-convex grain contacts. Ductile deformation of lithics has resulted in the concavo-convex contacts and indicates that there has been moderate mechanical compaction.

Porosity:
Secondary dissolution pores are preserved in rare patches. These appear to be due to partial dissolution of lithics. There are examples of feldspars corroded along preferred crystallographic axes to produce honeycomb pores.

Visual Estimate of Composition		%
Framework grains	Quartz	78
	Feldspar	1
	Lithics	15
	Mica	tr
Matrix		nd
Authigenic minerals and cements	Glaucony	tr
	Kaolin	2
	Quartz	tr
Porosity	Dissolution	3

Framework grains:
Quartz is both monocrystalline and polycrystalline. The latter tend to be coarse grained with either straight or sutured crystal boundaries and undulose extinction. Scarce mineral inclusions of apatite and rutile needles are evident in the polycrystalline quartz. Monocrystalline quartz is more abundant, it has straight to slightly undulose extinction, scattered vacuoles and rare mineral inclusions of zircon, apatite, rutile needles and tourmaline. K-feldspars display various stages of alteration and rarely tartan twinning indicates the presence of microcline. Lithics are commonly very fine grained and highly altered making positive identification difficult. Examples of bedded siltstone, micaceous schist, chert, granite and possible volcanics are apparent. The ?volcanics have a very fine siliceous groundmass and felsic or micaceous laths float in the groundmass. Flakes of muscovite are relatively fresh, splayed and bent.

Authigenic minerals and cements:
Traces of glaucony with a wormy texture typical of glauconite has partially replaced some framework grains. Pore filling kaolin occurs as subhedral booklets that are up to 50 microns in diameter. Syntaxial

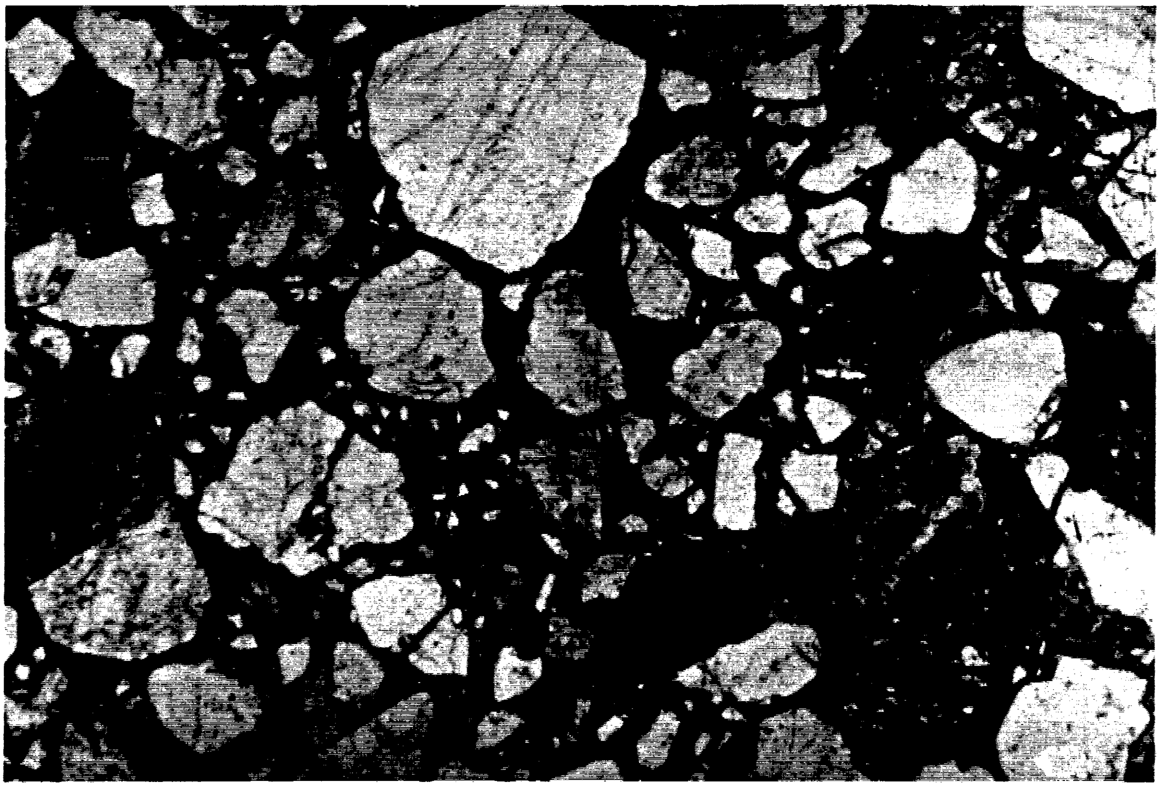

Figure 3.
General view of poorly sorted sublitharenite. Deformation of ductile lithics gives the appearance of matrix. Secondary dissolution pores (blue) are apparent. Eric The Red #1, Swc 47, depth 1598.5m. Plane light. Field of view 2.72mm.

4.8 Eric The Red #1, Swc 32, depth 1790m

Thin section description

The sample is a moderately sorted, medium to coarse grained, mineralogically and texturally immature litharenite. Grains are aligned due to the influence of bedding. There has been minor damage as a result of sidewall coring with fracturing of quartz grains and slight disruption of the texture. Typically grains are subangular with low to moderate sphericity. Texturally the litharenite is grain supported with dominantly tangential grain contacts. Rare deformation of lithics and micas has resulted in concavo-convex contacts. Porosity is a combination of primary intergranular pores and secondary dissolution pores. The latter have resulted from grain dissolution and partial corrosion of feldspars.

Framework grains are dominated by lithics (volcanic, metamorphic and sedimentary), quartz, feldspars (potassic and sodic varieties) and biotite. Felsic volcanic lithics are most abundant. Thin fibrous chloritic rims are apparent on grains and there are pores filled with chlorite. Rarely the chlorite appears to have been oxidised. Glaucony grains have been highly deformed and grains have been replaced by kaolin. Rare quartz prisms have precipitated after the chlorite.

Visual Estimate of Composition		%
Framework grains	Quartz	15
	Feldspar	2
	Lithics	58
	Mica	1
Matrix		nd
Authigenic minerals and cements	Glauconite	tr
	Chlorite	5
	Kaolin	tr
	Quartz	tr
Porosity	Intergranular	12
	Dissolution	6

5. DISCUSSION

a) Lithology and mineralogy

SHERBROOK GROUP

The Sherbrook Group sample consists of a fine grained, moderately sorted sublitharenite (Swc 10, depth 778.5m). Framework grains consist of quartz, feldspars, lithics, mica and accessory zircon. Detrital clay matrix represents approximately 7% of the sublitharenite. There is a relatively high percentage of glaucony (9%) in the sublitharenite when compared to other samples from Eric The Red #1. Minor pyrite cement is the only other authigenic mineral.

UPPER SHIPWRECK

There is considerable lithological variation in the 4 samples from the Upper Shipwreck Group. There is a fine grained quartzarenite (Swc 85, depth 1102m), a very fine grained sublitharenite (Swc 81, depth 1146m), a coarse grained carbonate cemented sublitharenite (Swc 70, depth 1297m) and a coarse grained quartzarenite (Swc 61, depth 1340m). All samples contain varying proportions of quartz, feldspar and lithics, and only the very fine sublitharenite and the quartzarenites contain micas and accessory minerals. In the very fine sublitharenite there is a relatively high concentration (2%) of accessory zircon, with lesser amounts of tourmaline, epidote and opaques. This sample also contains approximately 7% detrital clay matrix. Authigenic minerals in the quartzarenite are restricted to trace amounts of kaolin and illite that are associated with the alteration of feldspars. The very fine grained sublitharenite and fine grained quartzarenite contain glaucony (glauconite and chlorite), pyrite and kaolin. Carbonate has cemented the fine grained quartzarenite (8%) and the coarse grained sublitharenite is cemented by carbonate spar (30%) and a trace amount of kaolin.

LOWER SHIPWRECK

Lithologically the two samples from the Lower Shipwreck are very similar. They are comprised of medium to coarse grained sublitharenites. Both samples (Swc 54, depth 1464.5m and Swc 47, depth 1598.5m) have framework grains of quartz, feldspar, lithics and mica. Trace amounts of tourmaline and zircon were also noted in Swc 54. Authigenic minerals are restricted to trace amounts of glaucony and minor kaolin in both samples. Swc 54 (depth 1464.5m) also contains minor carbonate (2%) micrite and microspar.

OTWAY GROUP

The high percentage of lithics (58%) in Swc 32 (depth 1790m) differentiates this litharenite from any of the other samples in this suite from Eric The Red #1. It is a medium to coarse grained, moderately sorted litharenite. Framework grains are comprised of quartz, feldspars, lithics and mica. There are distinctive chlorite rims on detrital grains and trace amounts of authigenic quartz and kaolin.

b) Reservoir quality

Typically reservoir quality is difficult to estimate in these sidewall cores due to disruption during sampling. Grain fracturing has resulted in a fine angular fraction in Swcs' 61, 54 and 47 which fills pores and

SHERBROOK GROUP
Reservoir quality has been controlled by the percentage of detrital clay matrix and chloritic rims on grains in the Sherbrook Group. Primary intergranular pores (?10%) are dominant where there is no matrix and the chlorite has minimised the influence of mechanical compaction. Trace amounts of dissolution porosity have not significantly enhanced reservoir quality. Permeability is probably poor in this sample due to the presence of laminae which would limit vertical interconnection.

UPPER SHIPWRECK GROUP
Visual estimates of porosity in this group range from zero in Swc 70 (depth 1297m) to approximately 20% in Swc 61 (depth 1340m). Porosity has been controlled by the percentage of authigenic carbonate cement, detrital matrix and grain size. To a lesser extent the deformation of ductile lithics has probably also contributed to a reduction in porosity. In the very fine grained sublitharenite of Swc 81 (depth 1146m) detrital clay matrix and very fine grain size have limited porosity. There are minor intergranular pores (3%) and secondary dissolution pores (5%) in this sublitharenite. In the coarse grained sublitharenite of Swc 70 (depth 1297m) porosity has been occluded by carbonate cement. Carbonate cement and fine grain size have limited intergranular porosity to ?15% in the fine quartzarenite. Excellent reservoir quality (?20% porosity) is probably preserved in the coarse grained quartzarenite of Swc 61 (depth 1340m) which lacks matrix and significant authigenic cements.

LOWER SHIPWRECK GROUP
Reservoir quality was very difficult to estimate in these sublitharenites because of grain fracturing. Primary intergranular pores (?10%) appear to be better preserved in Swc 54 (depth 1464.5m) due to better sorting and possibly the lower percentage of ductile lithics. Although micropores were not evident in thin section there could be some associated with the kaolin in Swc 54 (depth 1464.5m). Deformation of ductile lithics and poor sorting probably controlled reservoir quality in Swc 47 (depth 1598.5m). Porosity was later enhanced by the dissolution of feldspars and lithics but this is unlikely to improve permeability because of the lack of interconnection between pores.

OTWAY GROUP
Although there is a very high percentage (58%) of ductile lithics in this sample (Swc 32, depth 1790m) there appears to have been minimal mechanical compaction. Therefore primary intergranular pores have not been reduced by deformation of lithics. This fact combined with the relatively coarse grain size and moderate sorting have resulted in the preservation of approximately 12% intergranular pores. In addition there has been corrosion to produce secondary dissolution pores (6%). Permeability in this sample is probably limited due to the presence of grain rimming chlorite that may block pore throats.

c) Sediment provenance and depositional environments

In terms of sediment provenance there appears to have been a constant source of volcanic, metamorphic and sedimentary lithics throughout the depositional history of these samples. The relative proportions of these components have changed with time and there is evidence of a significant related to the unconformity noted at this depth. It is possible that many of the volcanic lithics and heavy minerals throughout the sequence have been reworked from the Otway Group.

Depositional environments appear to range from marine (Sherbrook Group) to marginal marine and possibly terrestrial (Shipwreck and Otway Groups). These suggestions are based on the percentage of glaucony, sedimentological characteristics and presence of plant matter.

SHERBROOK GROUP

Sediments in the Sherbrook Group were dominantly derived from metamorphic, volcanic and granitic terranes. Quartz is the common volcanic/plutonic variety and polycrystalline quartz probably had a granitic source. The latter is consistent with the dominance of K feldspars.

The fine grain size and clay matrix of this sample indicates a low energy depositional environment. Grains were probably transported in suspension and via saltation. Detection of glauconite indicates that this was a shallow marine environment with low rates of sedimentation.

UPPER SHIPWRECK

Each sample within this group has a slightly different sediment provenance and depositional environment. Sediments have been derived from metamorphic, volcanic, granitic and sedimentary terranes. Depositional environments probably range from marginal marine to terrestrial.

The fine grained quartzarenite (Swc 85, depth 1102m) contains traces of glauconite that indicate this was a shallow marine depositional environment. A low energy regime is suggested by the fine grain size and stringers of clay that were replaced by carbonate. Mineralogical maturity reflects long distances of sediment transport or reworking. The dominant sediment source was a volcanic/plutonic terrane with minor input from sedimentary and metamorphic sources.

The very fine grained sublitharenite (Swc 81, depth 1146m) contains metamorphic and volcanic lithics, K-feldspars and monocrystalline quartz which are consistent with the provenances indicated by the heavy mineral suite. Tourmaline indicates an igneous source and epidote a metamorphic terrane. Traces of glauconite in this sample suggest that it was a marginal marine environment. Evidence of bedding and the very fine grain size are consistent with fluctuations in the hydraulic regime of a low energy environment.

High energy was required for deposition of the coarse grained sublitharenite (Swc 70, depth 1297m). The abundance of polycrystalline quartz and lithics suggests material was being rapidly shed from a nearby source. Typically polycrystalline quartz breaks down during transport therefore it is commonly a very minor component of sandstones. The lithics indicate that the terrane included metamorphic, volcanic, granitic and sedimentary (chert and chalcedony) rocks. However it was probably dominated by a granitic basement.

Rapid deposition in a high energy environment (possibly a channel) would account for the poorly sorted, mineralogically mature, coarse grained plant material and lack of glaucony support the hypothesis of at least close proximity to a terrestrial environment. Rare lithics were derived from metamorphic and sedimentary terranes which suggests the volcanic and granitic provenances evident in other samples were not as prominent at this time. However, medium sand size tourmaline and minor polycrystalline quartz with straight crystal boundaries would have been derived from an igneous source.

LOWER SHIPWRECK

Moderate to poor sorting, and medium to coarse grain size for these mineralogically submature sublitharenites could have resulted from rapid deposition in a moderate to high energy environment. Traces of glauconite indicate that it was a marginal to shallow marine setting. Sediment provenance shows an increase in the proportion of sedimentary lithics and inherited quartz overgrowths in this interval. These features are consistent with reworking of older sediments. Other lithics of metamorphic, volcanic and granitic provenance could have all been reworked from the underlying Otway Group.

OTWAY GROUP

The high percentage of volcanic lithics in this litharenite (Swc 32, depth 1790m) were probably derived directly from a volcanic terrane after only short distances of sediment transport. Traces of glauconite indicate that this was a marginal to shallow marine depositional environment. Fluctuations in the energy regime to produce bedding could have resulted from current or tidal activity.

d) Diagenetic alteration

There are no patterns in the diagenetic alteration of these samples. Each sample has a slightly different combination of authigenic minerals. Only in Swc 70 (depth 1297m) has there been significant alteration with the precipitation of carbonate cement. Elsewhere alteration has been relatively minor. Glauconite, chlorite, pyrite, carbonate, kaolin and quartz have precipitated in the sandstones. Silicification is restricted to trace amounts in the Otway Group sample (Swc 32, depth 1790m). In addition there is evidence of mechanical compaction and grain dissolution in most samples.

SHERBROOK GROUP

Evidence from this group indicates that all diagenetic alteration was relatively early. Glauconite forms at the sediment-water interface when pH is near 8, Eh is at the oxidation-reduction boundary and there is sufficient Fe^{3+} and Fe^{2+} available. Glauconite has replaced detrital grains and it is possible that the chlorite rims are an alteration product of the glauconite. This would explain how detrital clay appears to have entered the sediment after the chlorite. The sequence probably involved the formation of glauconite at the sediment-water interface, followed by infiltration of detrital muds during periods of very low energy and then the diagenetic alteration of grain rimming glauconite to chlorite after burial. Pyrite may have formed during early diagenesis when Fe^{2+} became available from the glauconite and organic matter, and sulphide was produced by the bacterial reduction of dissolved sulphate in pore waters.

UPPER SHIPWRECK GROUP

Red stained micrite and dark cores in the carbonate spar of Swc 85 (depth 1102m) probably indicate the presence of siderite. Siderite would have precipitated when pore waters were alkaline, slightly more reducing than for the pyrite and sulphide activity was low. Thus it is likely that the carbonate precipitated after the pyrite and glauconite. After burial the ?siderite was recrystallised via neomorphism to spar. Concentration of the ?siderite in the quartzarenite is not completely understood but it is possible that it is related to the better reservoir quality of this sediment. Carbonate has replaced the traces of kaolin in Swc 85 (1102m) which had formed due to the alteration of micas. Kaolin typically precipitates when conditions are acidic and there is low K+ activity. This suggests that there could have been flushing by meteoric waters soon after burial that would also have caused the partial dissolution of labile grains. Therefore the diagenetic sequence would appear to be: glauconite, pyrite, dissolution, kaolin, siderite, compaction and recrystallisation.

Diagenetic alteration of the very fine grained sublitharenite (Swc 81, depth 1146m) would have followed a similar path to that described for the fine grained quartzarenite. There are trace amounts of glauconite, pyrite, kaolin and minor chlorite and evidence of grain dissolution. Grain replacing kaolin is also apparent in the coarse grained sublitharenite (Swc 70, depth 1297m) and quartzarenite (Swc 61, depth 1340m). This suggests that there was a phase when pore waters were acidic throughout the Upper Shipwreck Group. At this same time feldspars in the quartzarenite were altered to illite and kaolin and elsewhere labile grains were dissolved. In the paragenetic sequence these acidic conditions probably developed prior to the precipitation of carbonates which require alkaline conditions. The extensive spar cement in Swc 70 (depth 1297m) is probably related to later burial diagenesis.

LOWER SHIPWRECK GROUP

Trace amounts of glauconite would have formed at the sediment water interface in these two sublitharenites under similar conditions to those described for the Sherbrook Group. Clearly there was low sulphide activity since there is no pyrite and this would have favoured the precipitation of micrite if pore waters were alkaline. This micrite was later recrystallised to microspar after burial. Possible flushing by meteoric waters that resulted in the precipitation of kaolin elsewhere, also influenced the Lower Shipwreck Group. Kaolin has replaced micas and feldspars and precipitated from solution in pores. It is possible that the slightly higher concentration of kaolin in these samples indicates that ground water circulation was restricted rather than open. Si and Al derived from feldspar dissolution was not removed from the reservoir and thus precipitated as kaolin. Deformation of lithics during compaction has resulted in a reduction of porosity. The paragenetic sequence was probably: glauconite, carbonate, dissolution, kaolin, compaction and recrystallisation.

OTWAY GROUP

Fibrous chlorite rims on grains in the litharenite are distinctive. In sublitharenites from the Sherbrook and Upper Shipwreck Groups chlorite rims are not fibrous and radial in habit. Alteration of ferromagnesian minerals in volcanic lithics from the Otway Group could have provided the source of Fe and Mg for the precipitation of fibrous chlorite. Chlorite mechanical compaction. However, there are rare quartz prisms attached to the chlorite rims. These clearly postdate the chlorite and would have formed when pore waters were acidic and saturated in silica. Trace amounts of glauconite and kaolin in the litharenite were probably formed by mechanisms similar to those described above. Flushing by meteoric waters could have caused oxidation of the chlorite rims. The paragenetic sequence in this sample from the Otway Group could have been: glauconite, chlorite, dissolution, kaolin and quartz.

Although the diagenetic events are different in each sample the overall paragenetic sequence is probably similar. These events are summarised in the diagram below:

Event	Early	Middle	Late
		Diagenetic Stage	
glauconite	---		
pyrite	----		
chlorite	-----		-----
carbonate	----		----
dissolution		-----	
kaolin		-----	
compaction		--------------------	
recrystallisation			-----
quartz			----

e) Shipwreck Group from La Bella compared with Eric The Red

Results from both wells are summarised in the table below. Figures given in the table include both the range of values for a particular item and the average in brackets. It should be noted that where sample size (N) is small, these values may not be representative of the whole unit.

In terms of lithology the Shipwreck Group in Eric The Red #1 does not show the sharp change from quartzarenites to litharenites that was apparent in La Bella #1 at the boundary between the Upper and Lower units. Quartzarenites probably represent smaller intervals in Eric The Red #1.

LOWER SHIPWRECK GROUP
Grain size in the Lower Shipwreck is medium to coarse in both La Bella #1 and Eric The Red #1 which may indicate that these samples were deposited by a similar high energy hydraulic regime. Sorting is only slightly better at La Bella #1 and there are suggestions of bedding which indicate fluctuations in current activity.

In La Bella #1 there is a higher percentage of labile feldspars and lithics in the Lower Shipwreck. This suggests that for La Bella #1 either sediment transport was over shorter distances than for Eric The Red #1 or that there was a change in sediment source. It is unlikely that these differences can be attributed to greater compressional tectonism at Eric The Red #1 because this should have resulted in an increase, rather than a decrease, in erosion and hence the proportion of

	ERIC THE RED #1		LA BELLA #1	
SHIPWRECK GROUP	Upper N = 4	Lower N = 2	Upper N = 9	Lower N = 3
Lithology	sublith/-quartzarenites	sublitharenites	quartzarenites	litharenites
Grain size	v fine-coarse (medium)	medium-coarse (medium)	v fine-v coarse (fine)	medium-coarse (medium)
Sorting	poor-mod	poor-mod	poor-well	poor-mod well
Structures	?bedding	-	laminae	?bedding
Framework grains				
Quartz	52-77 (68)	68-78 (73)	48-80 (68)	45-48 (46)
Feldspar	tr-3 (1.3)	1-2 (1.5)	tr-1 (tr)	6-8 (6.6)
Lithics	tr-15 (5)	9-15 (12)	tr-1 (tr)	18-30 (24)
Mica	0-tr (tr)	tr-3 (1.5)	0-2 (tr)	tr-1 (tr)
Accessory	0-2 (tr)	0-tr (tr)	tr-1 (tr)	tr
Matrix				
Clay	0-7 (1.8)	-	tr-5 (1.4)	0-tr (0)
Opaque material	0-2 (0)	-	0-4 (tr)	0-1 (0)
Authigenic minerals				
Glauconite/glaucony	0-tr (0)	tr (tr)	0-3 (tr)	tr-4 (1.3)
Chlorite	0-3 (1)	-	-	-
Pyrite	0-1 (1.3)	-	tr-2 (tr)	0-1 (tr)
Carbonate	0-30 (9.5)	0-2 (1)	0-40 (10)	6-10 (7.6)
Kaolin	tr	2-5 (2.3)	tr-7 (1.4)	3-10 (6)
Quartz	-	-	0-4 (2)	tr-2 (1.3)
Illite/barite	tr	-	tr	-
Porosity				
Intergranular	0-20 (9.5)	0-10 (5)	0-20 (10.8)	2-5 (4)
Dissolution	0-5 (1.3)	0-3 (1.5)	0-5 (2.2)	tr-1 (0.6)

The Red #1 were probably derived from a granitic basement.

Precipitation of authigenic minerals has been greater in La Bella #1. There are higher percentages of carbonate, kaolin and quartz. This is reflected in a reduction of porosity compared to Eric The Red #1. These differences may be due to the greater tectonic activity recognised for Eric The Red #1.

UPPER SHIPWRECK GROUP

A slightly coarser grain size within Eric The Red #1 samples may reflect either stronger current activity for this location or closer proximity to the source area. The latter hypothesis is supported by the higher percentage of feldspars and lithics. Overall sorting and mineralogical maturity are better in La Bella #1 and this could be achieved by longer distances of transport or constant reworking of the sediment. Either hypothesis could explain the relative lack of volcanic lithics in the La Bella #1 samples. Volcanic lithics would be more susceptible to weathering than the chert, schist and quartzite that were recognised. The Upper Shipwreck at La Bella #1 was interpreted as a prograding delta whereas at Eric The Red #1 this unit appears to be marginal marine with a stronger terrestrial influence.

the petrology of Eric The Red #1. This is probably due to a difference in the depositional environment rather than diagenetic alteration. The amount of kaolin is higher in La Bella #1 and there is no quartz or barite in Eric The Red #1. As for the Lower Shipwreck Group these differences could be a function of tectonic stability in this region. Chlorite detected in Eric The Red #1 is restricted to one sample and is probably related to the marine depositional environment.

6. CONCLUSIONS

1. Framework grains in the Sherbrook, Shipwreck and Otway Groups of Eric The Red #1 are comprised of varying proportions of quartz, feldspars, lithics, mica and accessory minerals. Authigenic minerals in the Sherbrook Group consist of glaucony and pyrite. In the Upper Shipwreck there is authigenic glaucony, pyrite, carbonate, kaolin and illite. The Lower Shipwreck contains glaucony, carbonate and kaolin, whilst the Otway Group sample contains glaucony (glauconite and chlorite), kaolin and quartz.

2. The mineralogy is unlikely to explain problems with interpretation of salinity data.

3. Sediment provenance has been dominated by metamorphic, volcanic and granitic terranes with minor sedimentary input in Eric The Red #1. The relatively coarser grain size and greater abundance of labile grains in the Upper Shipwreck of Eric The Red #1 suggests it could be closer to the sediment source than the equivalent interval in La Bella #1. The Lower Shipwreck in Eric The Red #1 contains less labile grains than La Bella #1 and this could be attributed to longer distances of transport or reworking.

4. The Shipwreck Group in Eric The Red #1 does not show a sharp change in lithology between the Upper and Lower units.

5. There is a higher percentage of authigenic cements (carbonate, kaolin, quartz) in La Bella #1 that could be attributed to the greater tectonic stability of this region.

7. GLOSSARY OF TERMS

Boehm lamellae	Parallel trails of vacuoles in quartz that are thought to form during deformation (metamorphism) of grains.
Framboid	A cluster of pyrite crystals with a spheroidal outline.
Glaucony	A term used to describe green minerals without any genetic connotations. If the green minerals can be identified, a specific mineral name is given.
Granophyric Texture	A variety of micrographic intergrowth of quartz and alkali feldspar that is either crudely radiate or is less regular than micrographic texture.
Honeycomb Porosity	Secondary porosity produced by the corrosion (etching) of detrital grains.
Hydrocarbon envelope	Solid bitumen surrounding a mineral containing radioactive elements. Radiation causes polymerisation of hydrocarbon chains within oil that rims grains.
Micrographic Intergrowth	A regular intergrowth of two minerals.
nd	Abbreviation meaning not detected.
Neomorphism	All transformations between a mineral and the same mineral, or another of the same general composition.
Poikilotopic	A sedimentary textural term denoting a single crystal of carbonate enclosing more than one framework grain.
Vacuole	Gas or liquid filled inclusion.

4

BHP
Petroleum

BHP PETROLEUM PTY. LTD.

A.C.N. 006 918 832

GEOCHEMICAL EVALUATION OF ERIC THE RED-1

OTWAY BASIN

OFFSHORE VICTORIA AUSTRALIA

PREPARED BY: J. PRESTON
SENIOR GEOCHEMIST

0508.rep

DATE: April, 1994

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1 INTRODUCTION

Following completion of the Eric the Red-1 well, a programme was undertaken to evaluate the source rock character and thermal maturity of the drilled sequence.

The evaluation of source rock character firstly involved analysis of seven sidewall cores for total organic carbon (TOC) content by Geotech, Perth. All the samples analysed, including two coals, yielded a TOC greater than 1.0%, and were accordingly pyrolysed by the Rock-Eval method.

In an attempt to evaluate the thermal maturity of the Eric the Red-1 section, vitrinite reflectance measurements were made on nine SWCs from the well.

Two SWCs were solvent-extracted in an attempt to establish the presence of residual hydrocarbons. One of the resulting extracts was analysed by the whole-extract GC method.

This report provides a compilation of the petroleum geochemistry data obtained from the Eric the Red-1 well, together with an interpretation of these data.

2 SOURCE ROCK CHARACTERISATION

2.1 Screening Analyses

2.1.1 Total Organic Carbon (TOC)

As indicated in Table 1, the seven samples analysed for total organic content (TOC) originated in the Late Cretaceous Sherbrook and Shipwreck Groups. Although 0.5% TOC is commonly used as the minimum requirement for a petroleum source rock, it is uncommon for sediments from the southern margin of Australia with less than 1.0% TOC to be significant petroleum sources. On the basis of seven samples, it is clear that the Late Cretaceous section in Eric the Red-1 contains potential petroleum source rocks, their TOC values ranging from 1.46-3.51% (Table 2, Figure 1 and Enclosure 1). Note that two samples from 1151m and 1275m consisted of coal (TOC=36.3-60.0%).

2.1.2 Rock-Eval Pyrolysis

All seven samples (in which the TOC was found to exceed 1.0%) were pyrolysed using the Rock-Eval method. Two of these samples, from 812.5-1010.0m, gave HI values of 64-73 and S1+S2 yields of 1-2 mg/g (Figures 2 and 3), indicating poor generative potential for gas. Three samples from 1316-1630m gave HI values of 111-140 and S1+S2 yields of 3-4 mg/g, indicating fair potential for gas, and perhaps some condensate. The data from the two coal samples (HI=130-224) suggest that there is greater potential for liquids generation in the coals.

It is clear from the S1+S2 yields of the Eric the Red-1 samples that expulsion, if any, would be possible only at relatively high levels of thermal maturity. At such levels of thermal maturity, considerable secondary cracking of liquids to gas would occur, such that these source rocks would perhaps be more "gas prone" than indicated by the source character data.

The Rock-Eval pyrolysis data listed in Table 2 are summarised in the form of crossplots in Figures 4 and 5. Figure 4 reflects the overall quality of the kerogen in the samples analysed, in terms of their oil-prone or gas-prone character: most samples plot in the gas/condensate-prone Type II/III and Type III areas of the diagram (HI < 150). (Note that the 1316m sample is omitted from this diagram due to its artifically high OI value.) The more liquids-prone character of one of the coal samples is reflected in its more obvious Type II affinity. Figure 5 reflects the generative capacity of the samples, in terms of their source quality and thermal maturity; none of the samples approach the threshold of significant hydrocarbon generation and expulsion, due to their poor quality and thermal immaturity.

Maceral petrography associated with the vitrinite reflectance determinations shows that the organic matter in most of the samples is dominated by inertinite, followed by vitrinite (Figure 6). However, liptinitic/exinitic (Type II) macerals are identified in all samples except the 1151m coal (described as 100% vitrinite), confirming the presence of some liquids-prone components. In the Shipwreck Group, the Type II macerals appear to be supplemented by small amounts of oil-prone alginitic (Type I) macerals.

2.2 Thermal Maturity

Rock-Eval parameters which are often used for maturity assessment are Tmax and Production Index (PI). A Tmax value of 435°C, and a PI value of 0.10, are regarded as marking the entrance to the oil-generative window.

As Table 2 and Figure 7 show, values of Tmax range from 408-436°C. Values of PI (Figure 8) are generally less than 0.10. There is therefore an agreement between the maturity estimates based on the PI and Tmax data in the Eric the Red-1 well, namely that the 812.5-1630m section is thermally immature.

Vitrinite reflectance measurements on nine samples from the 812.5-1630.0m interval do not exceed 0.51% (see Table 3/ 3A and Figures 9 and 10). The value for one sample in the Otway Group (at 1831.5m) is 0.68%. The Late Cretaceous interval in Eric the Red-1 can therefore be considered to be thermally immature, and the Otway Group at T.D. marginally mature.

Because kerogens will generate products with markedly different compositions as thermal maturity progresses, it follows that certain analyses and the interpretation of their results will be fundamentally affected by maturity, in particular Rock-Eval pyrolysis data. The observation that the drilled interval has not attained thermal maturity means that this need not be a consideration in the interpretation of geochemical data from the Eric the Red-1 well. The poor source quality of parts of the drilled sequence cannot therefore be attributed to advanced thermal maturity.

3 FLUIDS CHARACTERISATION

3.1 Whole-Extract GC Analysis

Two SWC samples, from 1097m and 1340m, were solvent-extracted in an attempt to establish the presence of residual hydrocarbons. The resulting extract yields are listed in Table 4, and summarised in Figure 11. The 1097m extract was analysed by the whole-extract GC method, the GC trace being shown in Figure 12.

As Figure 11 shows, the extract yields ranged from 223-690 ppm. These results, combined with the character of the 1097m whole-extract GC trace, suggest that the extracts are unlikely to represent residual saturations of mature migrated hydrocarbons, but instead appear to represent small amounts of indigenous, or very locally migrated, immature hydrocarbons. No n-alkane distribution data are reported.

4 CONCLUSIONS

Seven SWC samples, from the Late Cretaceous Sherbrook and Shipwreck Groups, were analysed for their TOC content. All these samples, including two coals, yielded values greater than 1.0%, and were accordingly analysed by Rock-Eval pyrolysis. The resulting data revealed a predominance of mainly gas-prone Type II/III to Type III organic matter with HI values less than 150, with the exception of one coal sample (1275m) characterised by a more liquids-prone organic facies. Liptinitic/exinitic (Type II) macerals were identified in most samples (supplemented by a sparse alginitic component in the Shipwreck Group), suggesting minor liquids potential. However, it is clear from the S1+S2 yields that expulsion from these source rocks would be possible only at relatively advanced levels of thermal maturity; at such levels, secondary cracking of liquids to gas would occur, such that these source rocks would become more gas-prone than indicated by the source character data.

Thermal maturity data, namely Tmax, PI and vitrinite reflectance measurements, suggest that the Sherbrook Group and Shipwreck Group are thermally immature, but that the Otway Group is marginally mature at TD. The generative potential of the source rocks discussed above has therefore not been realised at the Eric the Red-1 location. A further inference is that the quality of these source rocks can in no way be linked to advanced maturity, their relative leanness being more a function of the type and preservation state of their contained organic matter.

Two SWC samples were solvent-extracted in an attempt to identify any residual hydrocarbons (namely, any hydrocarbons which represent the remains of an earlier liquids saturation). The resulting extract yields were low (less than 700ppm). One extract (1097m) was analysed by the whole-extract GC method, and the nature of the GC trace, taken together with the low extract yield, did not suggest that the extracts represented residual hydrocarbons.

TABLE 1

GEOLOGIC & GENERAL DATA - SEDIMENTS

WELL NAME = ERIC THE RED-1
COUNTRY = Australia
BASIN = Otway

DEPTH 1	DEPTH 2	GEOLOGIC PERIOD/EPOCH	GEOLOGIC AGE	FORMATION	PRIMARY LITHOLOGY	PERCENT PRIMARY	SECONDARY LITHOLOGY	PERCENT SECONDARY	SAMPLE TYPE	SAMPL QUALI
812.50	812.50	L.CRET	-	SHERGP	-	-	-	-	SWC	-
1010.00	1010.00	L.CRET	-	SHERGP	-	-	-	-	SWC	-
1097.00	1097.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
1151.00	1151.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
1275.00	1275.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
1316.00	1316.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
1340.00	1340.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
1455.00	1455.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
1575.00	1575.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
1630.00	1630.00	L.CRET	-	SHIPGP	-	-	-	-	SWC	-
1831.50	1831.50	E.CRET	-	OTWAGP	-	-	-	-	SWC	-

N.B. Code definitions at end of table
- = No data

CODE DEFINITIONS FOR TABLE 1

ERIOD CODES

etaceous
taceous

GEOLOGICAL AGE CODES

FORMATION CODES

OTWAGP = Otway Group
SHERGP = Sherbrook Group
SHIPGP = Shipwreck Group

PRIMARY/SECONDARY LITHOLOGY CODES

SAMPLE TYPE CODES

SWC = Sidewall Core

SAMPLE QUALITY CODES

CONTRACTOR CODES

GTS = Geotechnical Servics

TABLE 2

TOC AND ROCK-EVAL PYROLYSIS DATA - SEDIMENTS

WELL NAME = ERIC THE RED-1
COUNTRY = Australia
BASIN = Otway

DEPTH 1	DEPTH 2	TOC	TMAX	SO	S1	S2	S3	S1+S2	S2/S3	PI	PC	HI	OI
812.50	812.50	2.16	432	-	.19	1.57	.72	1.76	2.18	.11	.15	73	3
1010.00	1010.00	1.46	435	-	.03	.94	.71	.97	1.32	.03	.08	64	4
1151.00	1151.00	36.30	408	-	4.92	47.12	7.48	52.04	6.30	.09	4.32	130	2
1275.00	1275.00	60.00	422	-	5.25	134.44	6.46	139.69	20.81	.04	11.59	224	1
1316.00	1316.00	2.40	426	-	.17	3.27	12.21	3.44	.27	.05	.29	136	50
1455.00	1455.00	3.51	431	-	.14	3.88	8.04	4.02	.48	.03	.33	111	22
1630.00	1630.00	2.10	436	-	.29	2.94	.39	3.23	7.54	.09	.27	140	1

TOC = Total organic carbon
S2 = HC generating potential
HI = Hydrogen index

TMAX = Max. temperature S2
S3 = Organic carbon dioxide
OI = Oxygen index

SO = Volatile gaseous HC's
PI = Production index
\- = no data

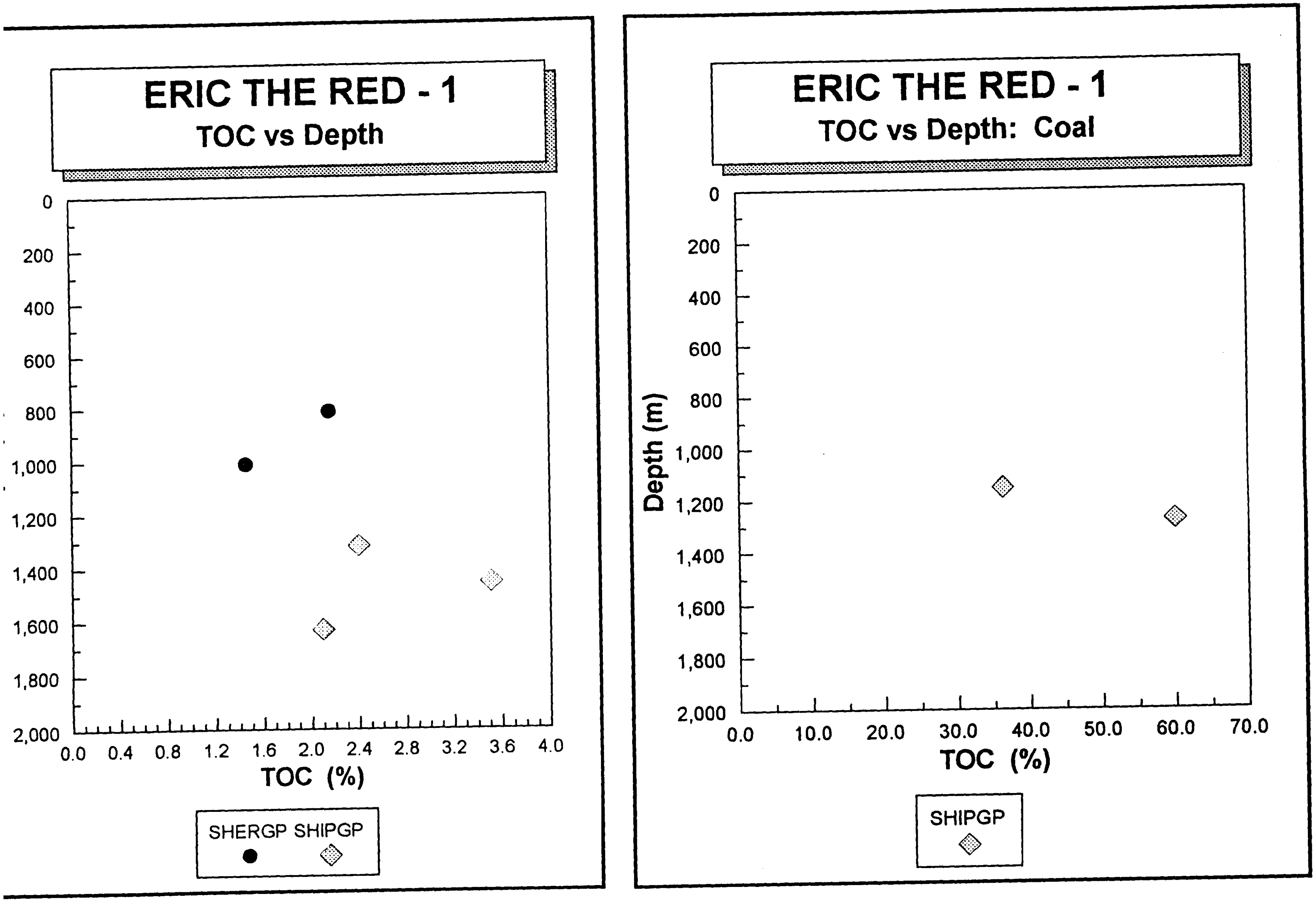
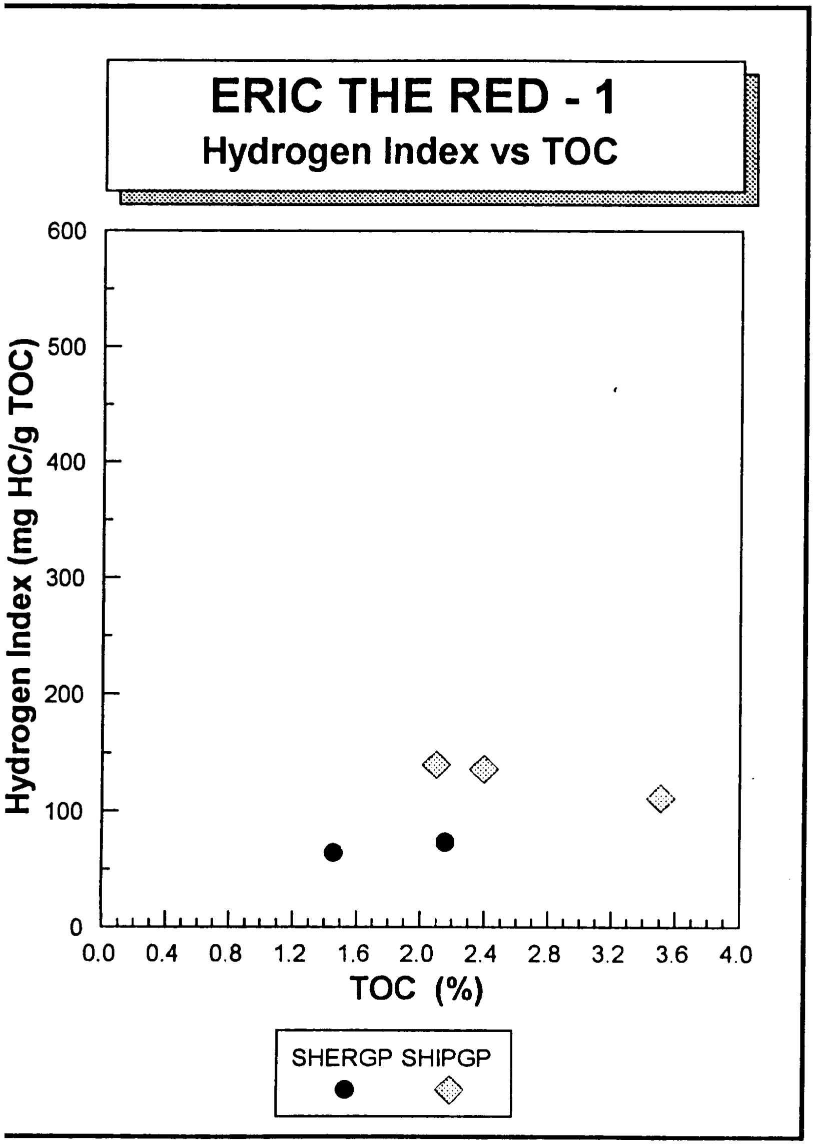

ERIC THE RED - 1
TOC vs Depth
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
0.0 0.4 0.8 1.2 1.6 2.0 2.4 2.8 3.2 3.6 4.0
TOC (%)
SHERGP ●
SHIPGP ◈
ERIC THE RED - 1
TOC vs Depth: Coal
Depth (m)
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0
TOC (%)
SHIPGP ◈

Figure 1


ERIC THE RED - 1
Hydrogen Index vs TOC
Hydrogen Index (mg HC/g TOC)
600
500
400
300
200
100
0
0.0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
3.2
3.6
4.0
TOC (%)
SHERGP
SHIPGP

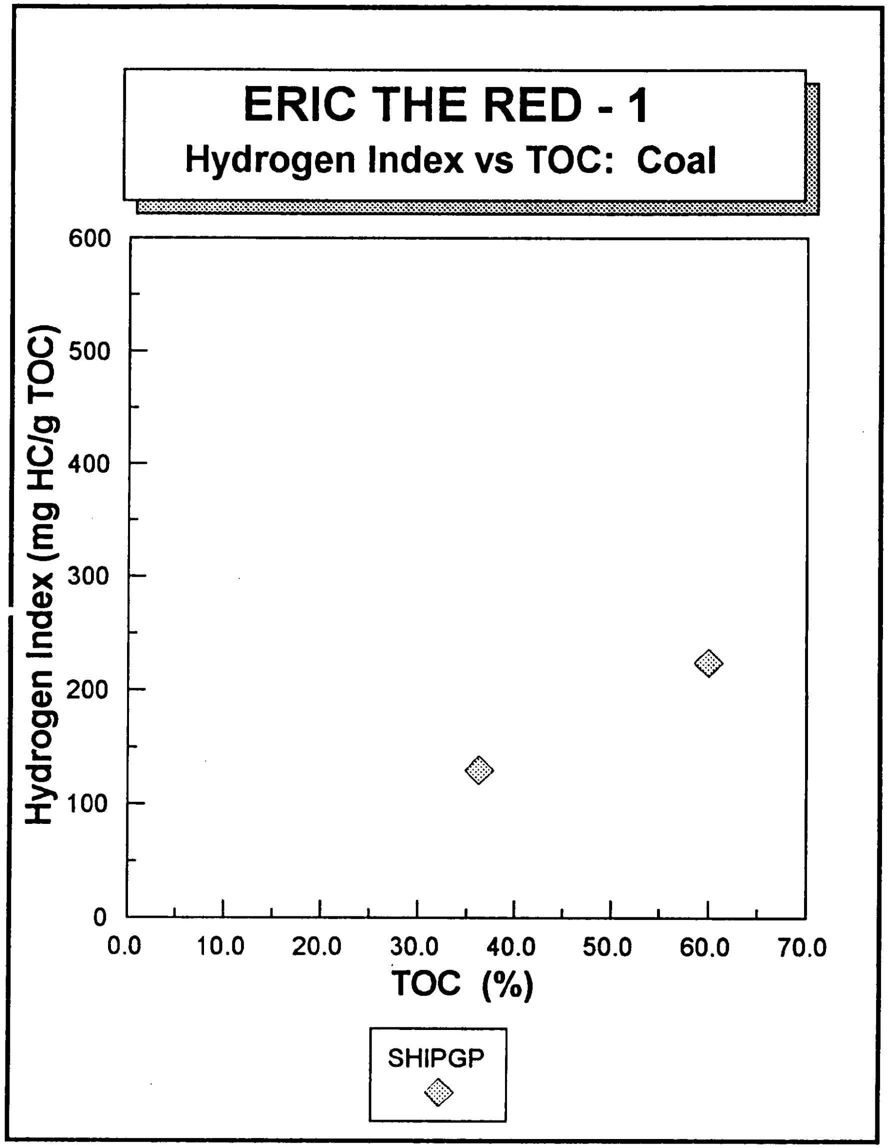

ERIC THE RED - 1
Hydrogen Index vs TOC: Coal
Hydrogen Index (mg HC/g TOC)
600
500
400
300
200
100
0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
TOC (%)
SHIPGP

Figure 2

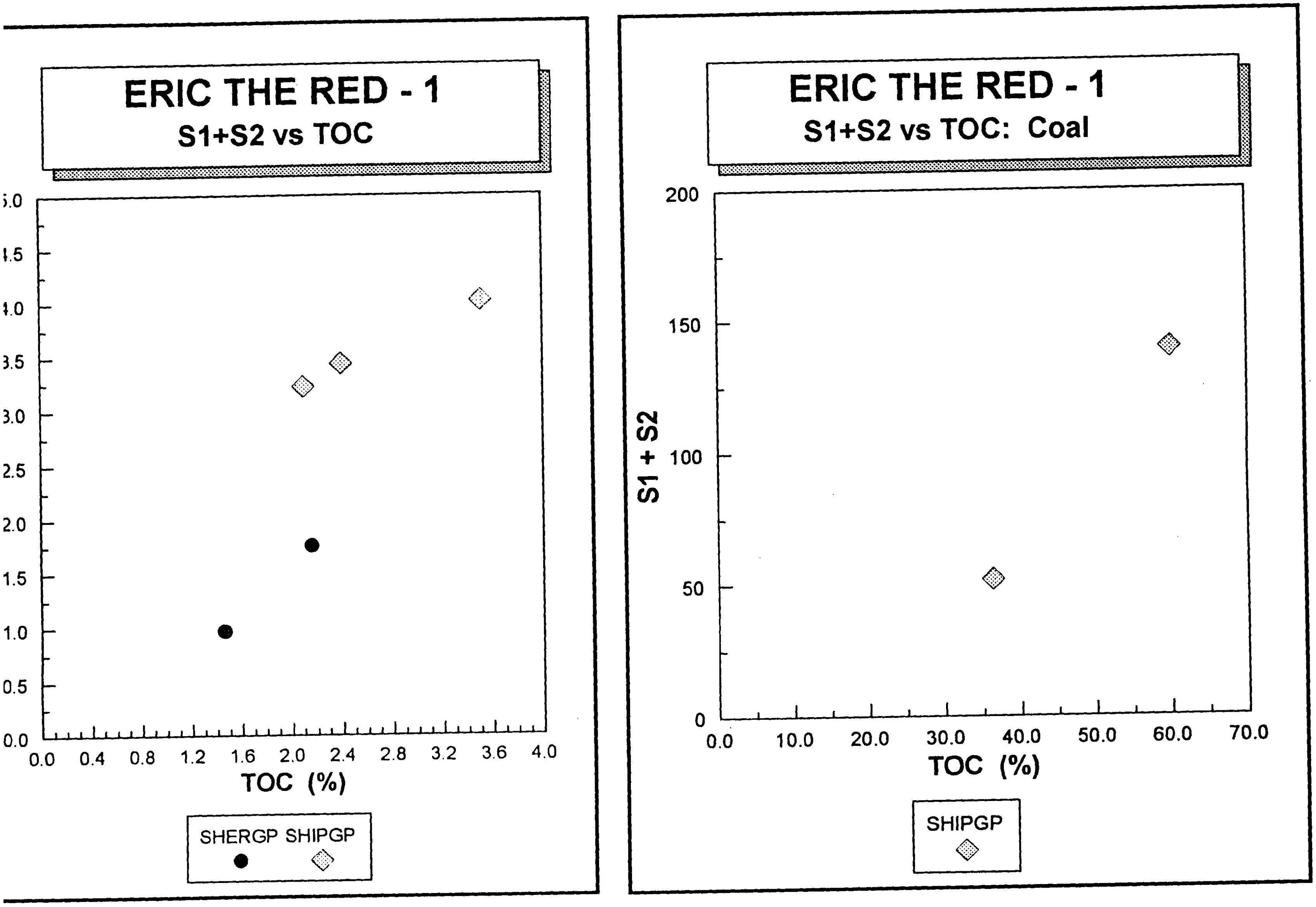

ERIC THE RED - 1
S1+S2 vs TOC
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0 0.4 0.8 1.2 1.6 2.0 2.4 2.8 3.2 3.6 4.0
TOC (%)
SHERGP SHIPGP
ERIC THE RED - 1
S1+S2 vs TOC: Coal
S1 + S2
200
150
100
50
0
0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0
TOC (%)
SHIPGP

Figure 3

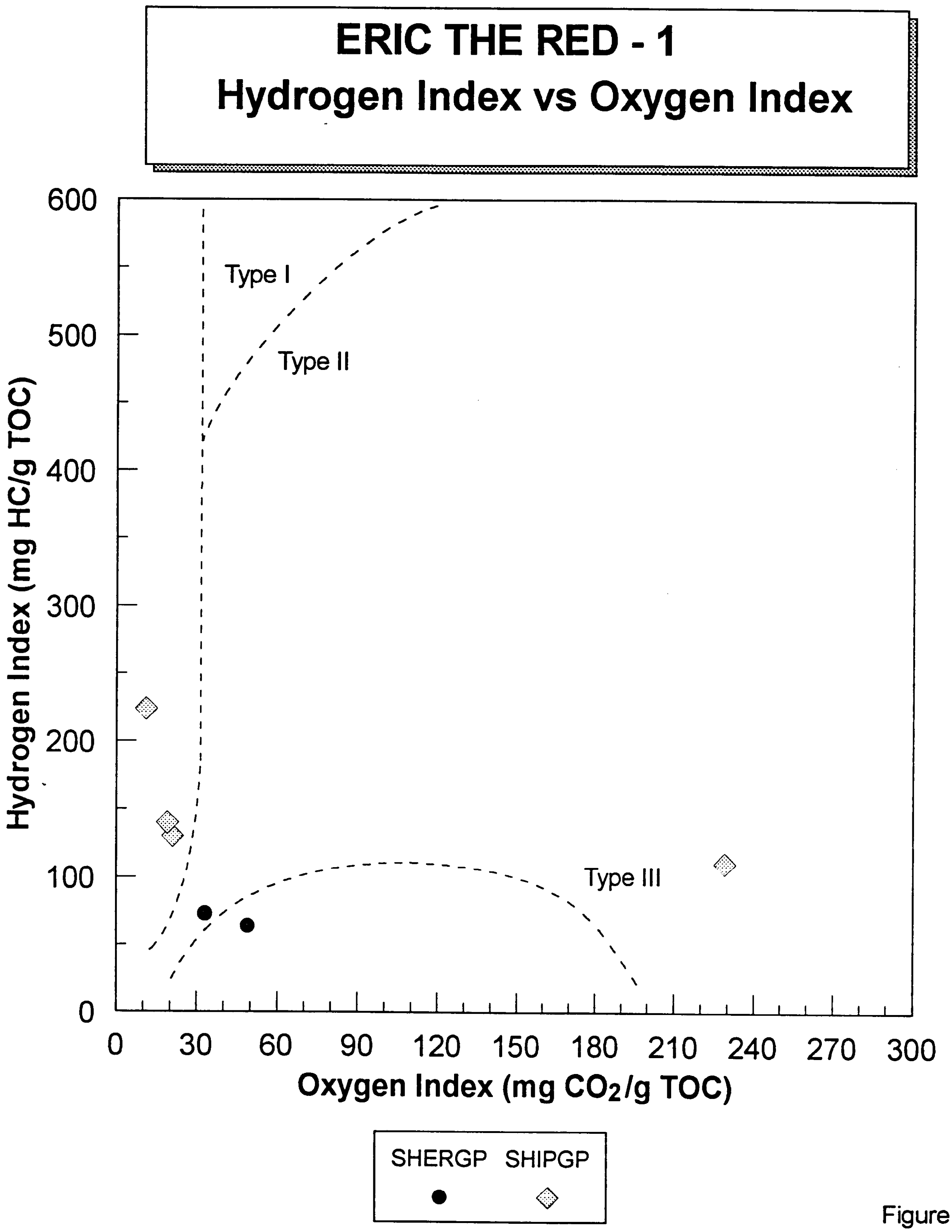

ERIC THE RED - 1
Hydrogen Index vs Oxygen Index
600
500
400
300
200
100
0
Hydrogen Index (mg HC/g TOC)
0
30
60
90
120
150
180
210
240
270
300
Oxygen Index (mg CO2/g TOC)
Type I
Type II
Type III
SHERGP ●
SHIPGP ◇

Figure 4

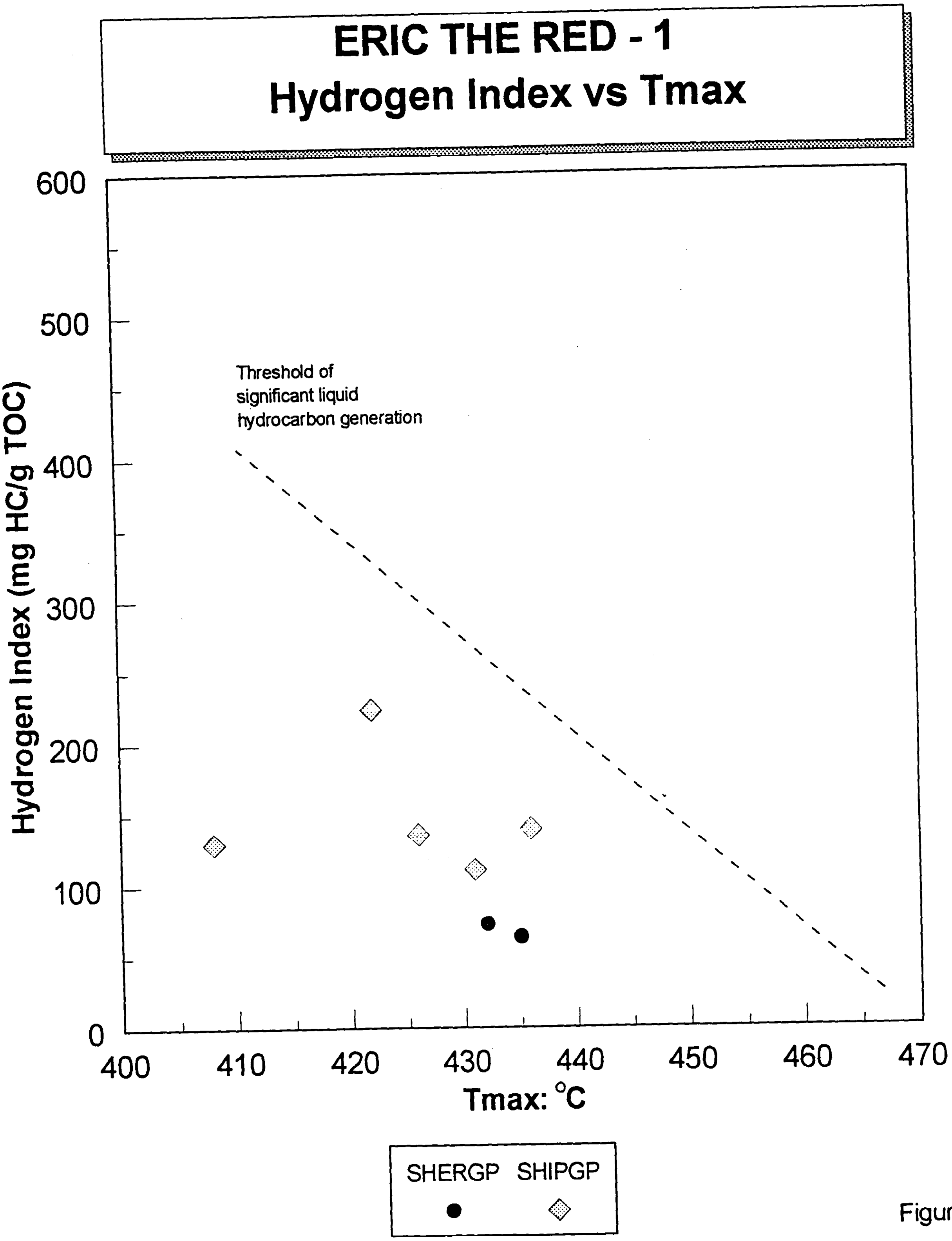

ERIC THE RED - 1
Hydrogen Index vs Tmax
Hydrogen Index (mg HC/g TOC)
600
500
400
300
200
100
0
400
410
420
430
440
450
460
470
Tmax: °C
Threshold of significant liquid hydrocarbon generation
SHERGP ●
SHIPGP ◇

Figure 5

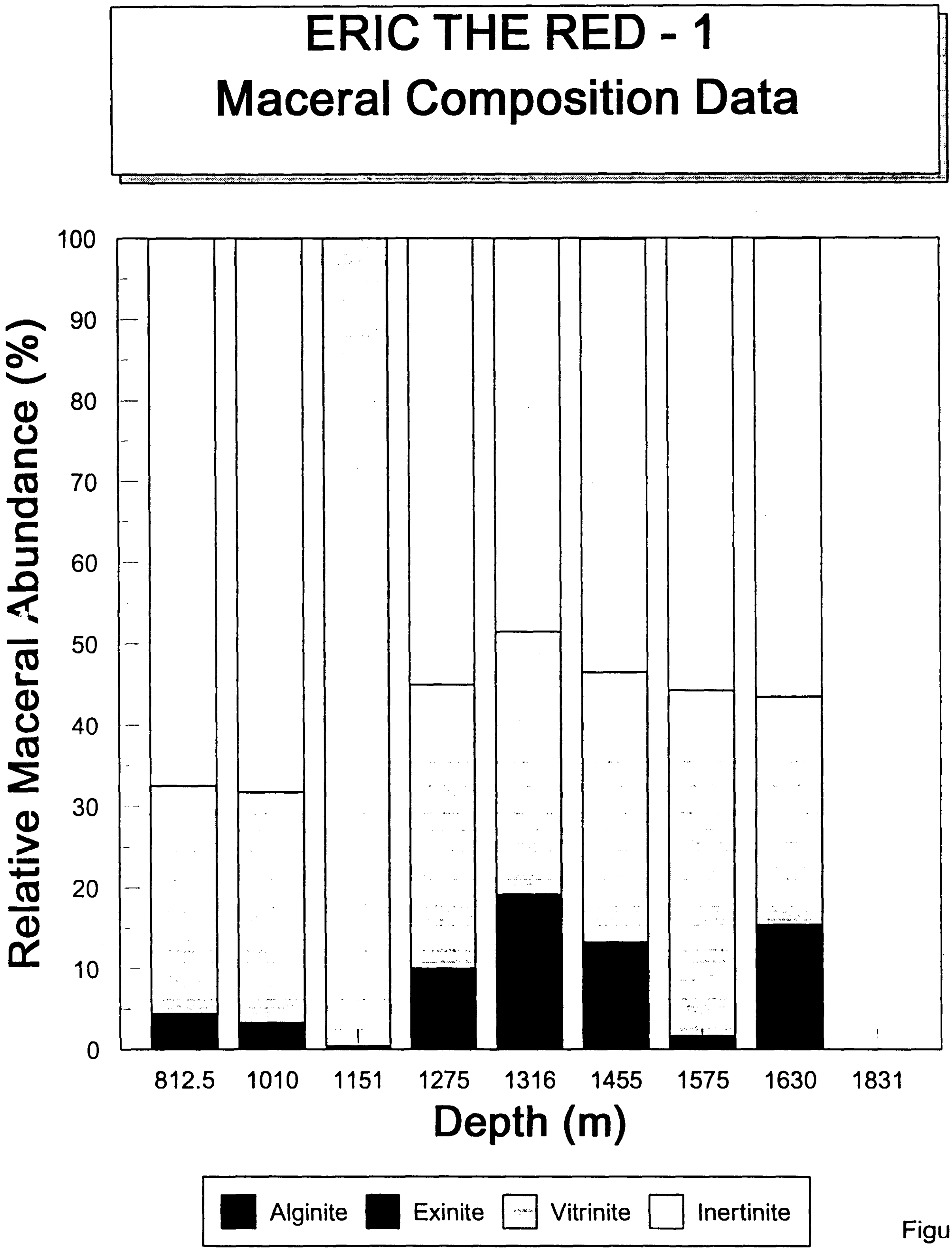

ERIC THE RED - 1
Maceral Composition Data
Relative Maceral Abundance (%)
100
90
80
70
60
50
40
30
20
10
0
812.5
1010
1151
1275
1316
1455
1575
1630
1831
Depth (m)
Alginite
Exinite
Vitrinite
Inertinite

Figure 6

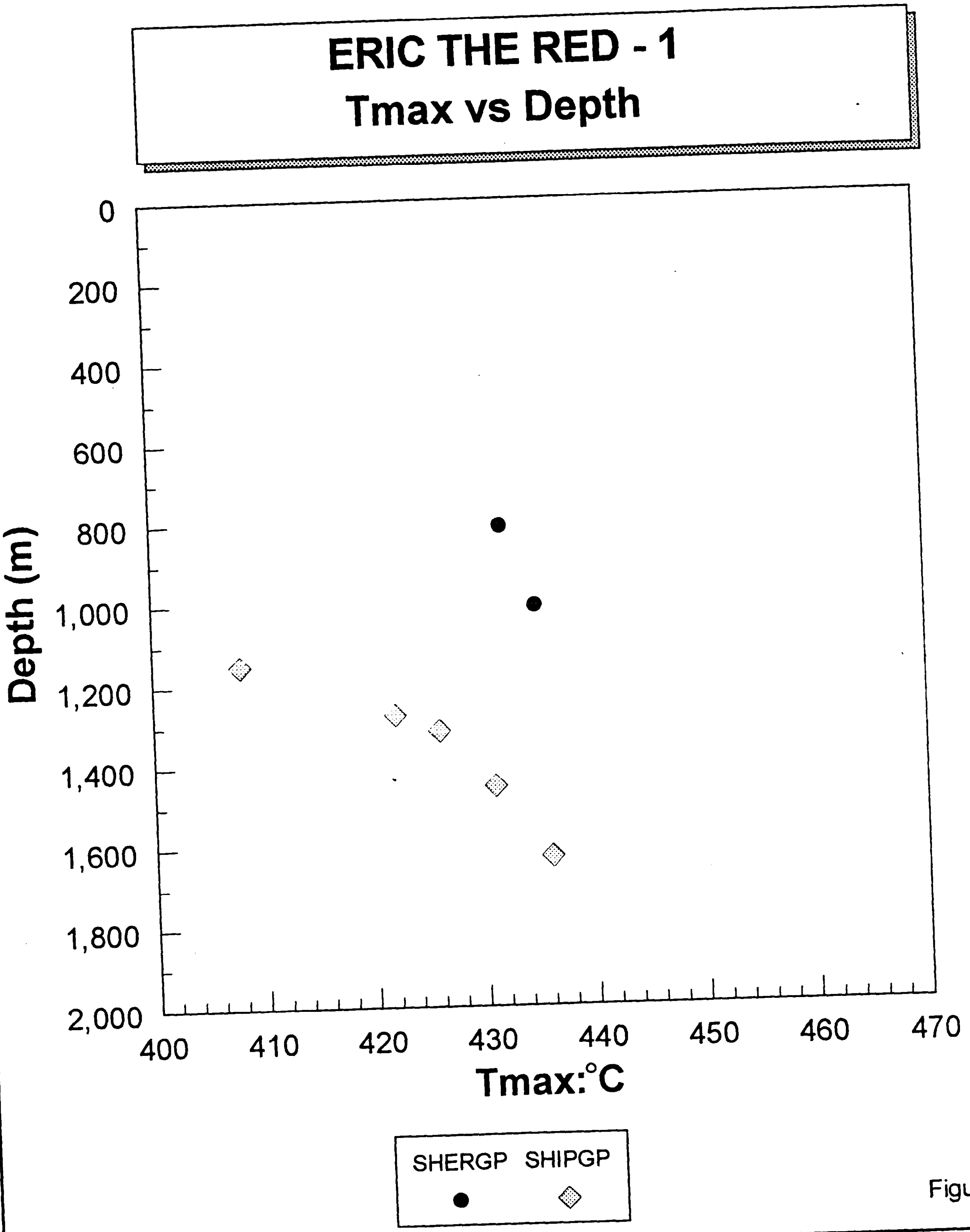

ERIC THE RED - 1
Tmax vs Depth
Depth (m)
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
400
410
420
430
440
450
460
470
Tmax:°C
SHERGP ●
SHIPGP ◈

Figure 7

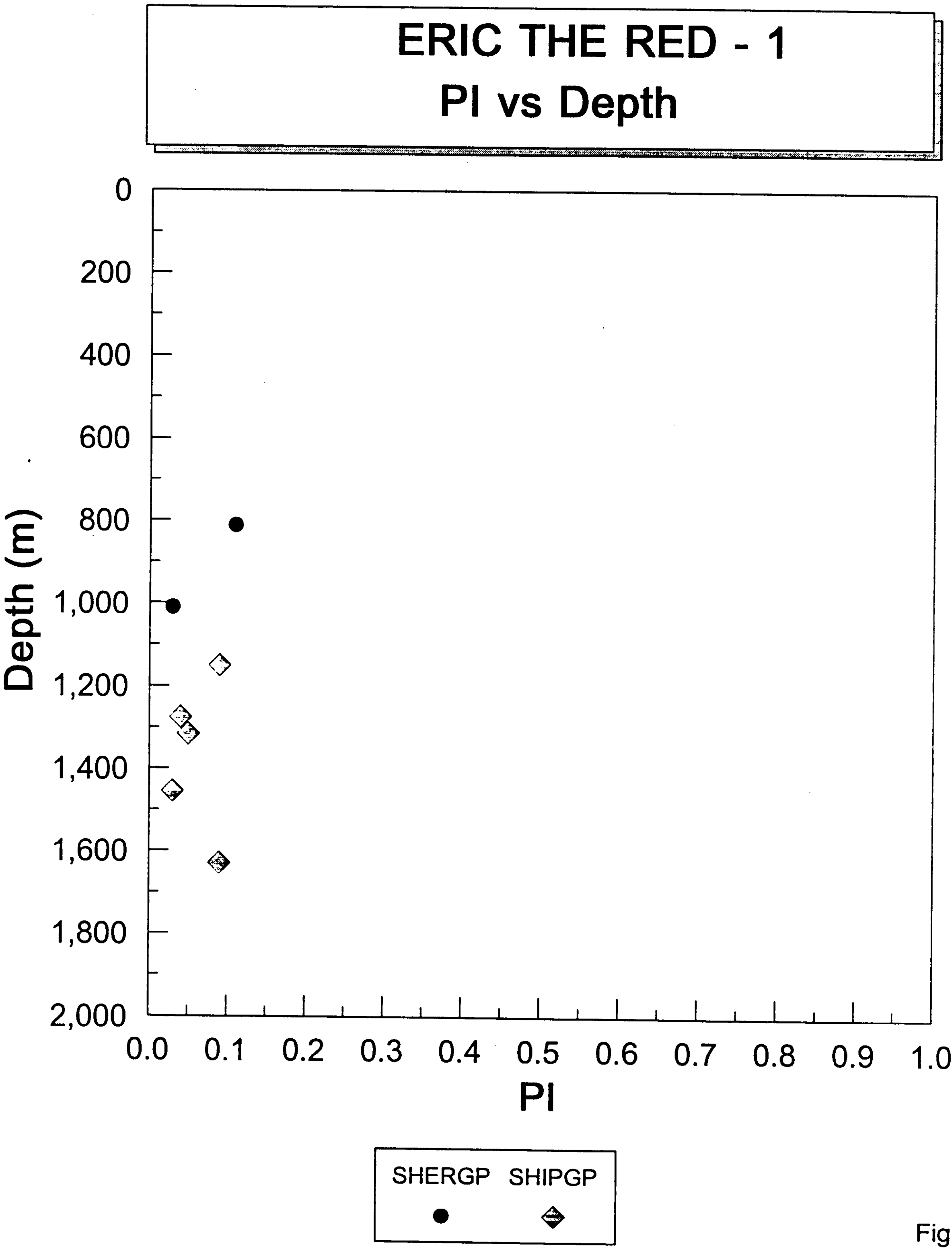

ERIC THE RED - 1
PI vs Depth
Depth (m)
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
PI
SHERGP
SHIPGP

Figure 8

TABLE 3

VITRINITE REFLECTANCE AND COAL MACERAL DATA - SEDIMENTS
ALL MACERAL POPULATIONS

WELL NAME = ERIC THE RED-1
COUNTRY = Australia
BASIN = Otway

		POPULATION	MEAN	MINIMUM	MAXIMUM	NUMBER	STANDARD		MACERAL
DEPTH 1	DEPTH 2	TYPE	% REFL.	% REFL.	% REFL.	READINGS	DEVIATION	% ALGINITE	% EXINITI
812.50	812.50	V	.43	.36	.51	27	.04	0.00	4.50
1010.00	1010.00	V	.45	.36	.53	26	.05	0.00	3.40
1151.00	1151.00	V	.40	.37	.43	26	.02	0.00	.50
1275.00	1275.00	V	.39	.35	.42	26	.02	0.00	10.10
1316.00	1316.00	V	.46	.34	.62	32	.07	4.80	14.50
		R	.70	.65	.74	3	.05		
1455.00	1455.00	V	.49	.42	.63	26	.05	1.30	12.00
1575.00	1575.00	V	.47	.37	.61	27	.07	0.00	1.70
		R	.65	.63	.66	3	.02		
1630.00	1630.00	V	.51	.41	.65	25	.07	0.00	15.50
1831.50	1831.50	V	.68	.68	.68	1	0.00	-	-

N.B. Code definitions at end of table
- = no data

CODE DEFINITIONS FOR TABLE 3

POPULATION TYPE CODES

R = REWORKED
V = VITRINITE

CONTRACTOR CODES

GTS = Geotechnical Servics

JOB 1940A, ERIC THE RED-1, OTWAY BASIN

Sample No(s)	Depth(m)/ Sample type	$\bar{R}_v$ max (%)	Range (%)	N	Description Including Liptinite Fluorescence Characteristics
v7788	812.5 SWC-8	0.43	0.36-0.51	27	Sparse cutinite, sporinite and liptodetrinite, yellow to orange, rare resinite, yellow to orange, rare suberinite, orange to dull orange. (Siltstone>>coal. Coal rare, V>I. Vitrite>inertite. Dom abundant, I>V>L. Inertinite and vitrinite abundant, liptinite sparse. Oil drops rare, yellow. Mineral fluorescence pervasive, weak orange to weak dull orange. Iron oxides sparse. Pyrite abundant.)
v7789	1010.0 SWC-1	0.45	0.36-0.53	26	Sparse resinite, yellow to orange, rare cutinite and sporinite, yellow to orange, rare suberinite, orange to dull orange. (Siltstone>>coal. Coal rare, V>I. Vitrite>inertite. Dom abundant, I>V>L. Inertinite and vitrinite abundant, liptinite sparse. Oil drops rare, yellow. Mineral fluorescence pervasive, weak orange to weak dull orange. Iron oxides sparse. Pyrite abundant.)
v7790	1151.0 SWC-80	0.40	0.37-0.43	26	Sparse resinite, yellow to orange, rare cutinite and sporinite, yellow to orange. (Coal. Coal dominant, V>>L. Vitrite>>clarite. Texto-ulminite is the main vitrinite maceral. Mineral-free maceral group composition of the coal: vitrinite - 99.5%, inertinite - absent, liptinite - 0.5%. Pyrite abundant.)
v7791	1275.0 SWC-72	0.39	0.35-0.42	26	Abundant sporinite, yellow to orange, sparse resinite and liptodetrinite, yellow to orange, sparse cutinite, orange, rare suberinite, orange to dull orange. (Coal. Coal dominant, I>V>L. Clarodurite>duroclarite>inertite>vitrinertite>vitrite. Desmocollinite>telocollinite. Mineral-free maceral group composition of the coal: vitrinite - 35.0%, inertinite - 55.0%, liptinite - 10.0%. Pyrite common.)
v7792	1316 SWC-67	0.48 *Reworked	0.34-0.62 0.65-0.74	32 3	Sparse cutinite, lamalginite, liptodetrinite and resinite, yellow to orange, rare sporinite, yellow to orange. (Calcareous siltstone>carbonate. Dom abundant, I>V>L. Inertinite abundant, vitrinite and liptinite common. Reworked vitrinite sparse, R_v max = 0.65% to 0.74%. Oil drops rare, green. Mineral fluorescence pervasive, moderate green to yellowish green. Iron oxides sparse. Pyrite abundant.)
v7793	1455 SWC-55	0.49	0.42-0.63	26	Sparse cutinite, sporinite, liptodetrinite and lamalginite, yellow to orange, rare resinite, yellow to orange. (Clayey siltstone>carbonate>shaly coal>coal. Coal rare, V>>L>I. Vitrite. Shaly coal rare, V>>L>I. Vitrite>clarite. Dom abundant, I>V>L. Inertinite and vitrinite abundant, liptinite common. Bitumen rare, greenish yellow. Mineral fluorescence pervasive, weak moderate green to weak orange. Iron oxides sparse. Glauconite sparse. Pyrite common.)

TABLE 3A

JOB 1940A, ERIC THE RED-1, OTWAY BASIN

Sample No(s)	Depth(m)/ Sample type	$\bar{R}_v$ max (%)	Range (%)	N	Description Including Liptinite Fluorescence Characteristics
v7794	1575 SWC-49 *Reworked	0.49	0.37-0.61 0.63-0.66	27 3	Sparse cutinite, yellow to orange, rare sporinite and resinite, yellow to orange. (Sandstone>>shaly coal>coal. Coal abundant, vitrite>duroclarite>vitrinertite>inertite. Mineral-free maceral group composition of the coal: vitrinite - 48%, inertinite - 47%, liptinite - 5%. Dom abundant, I>V>>L. Inertinite abundant, vitrinite common, liptinite rare. Reworked vitrinite sparse $R_v$max = 0.63% to 0.66%. Mineral fluorescence pervasive, moderate green to moderate yellow. Iron oxides sparse. Pyrite sparse.)
v7795	1630 SWC-45	0.51	0.41-0.65	25	Sparse cutinite and sporinite, yellow to orange, sparse, resinite, lamalginite and liptodetrinite, yellow to dull orange. (Calcareous siltstone>carbonate. Dom abundant, I>V>L. Inertinite abundant, vitrinite and liptinite common. Mineral fluorescence patchy, moderate green. Iron oxides sparse. Pyrite common.)
v7796	1831.5 SWC-31	0.68	-	1	Rare lamalginite, yellow. (Sandstone>>carbonate. Dom rare, I>V=L. All maceral groups rare. Mineral fluorescence rare, very weak green. Iron oxides sparse. Pyrite rare.)

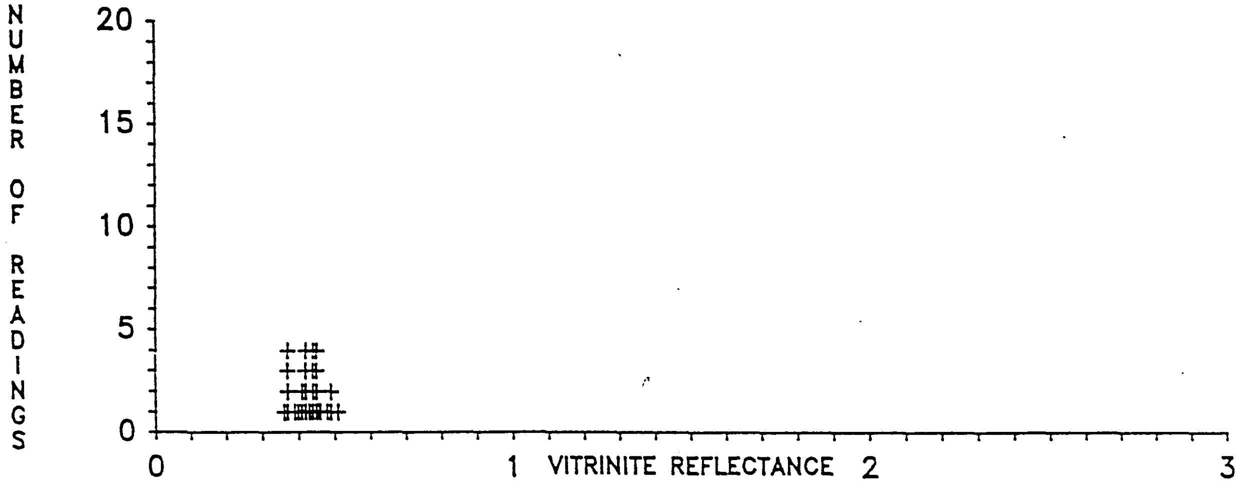
FIGURE 9

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: ERIC THE RED-1 CLIENT: BHP PETROLEUM SAMPLE TYPE: SWC
SAMPLE ID: 812.5 METRES DATE: MAY 1993

(Total No. of Readings=27) 0.36 0.37 0.37 0.37 0.37 0.39 0.40 0.41 0.41 0.42 0.42 0.42 0.42 0.43 0.44 0.44 0.44 0.44 0.45 0.45 0.45 0.45 0.46 0.48 0.49 0.49 0.51

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	27	0.43	0.36	0.51	0.04	INDIGENOUS(+)	28.10	67.40	4.50	0.00



SAMPLE ID: 1010.0 METRES SAMPLE TYPE: SWC

(Total No. of Readings=26) 0.36 0.37 0.37 0.40 0.40 0.40 0.41 0.42 0.43 0.43 0.44 0.45 0.45 0.45 0.46 0.47 0.47 0.47 0.48 0.48 0.49 0.49 0.50 0.50 0.52 0.53

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	26	0.45	0.36	0.53	0.05	INDIGENOUS(+)	28.40	68.20	3.40	0.00

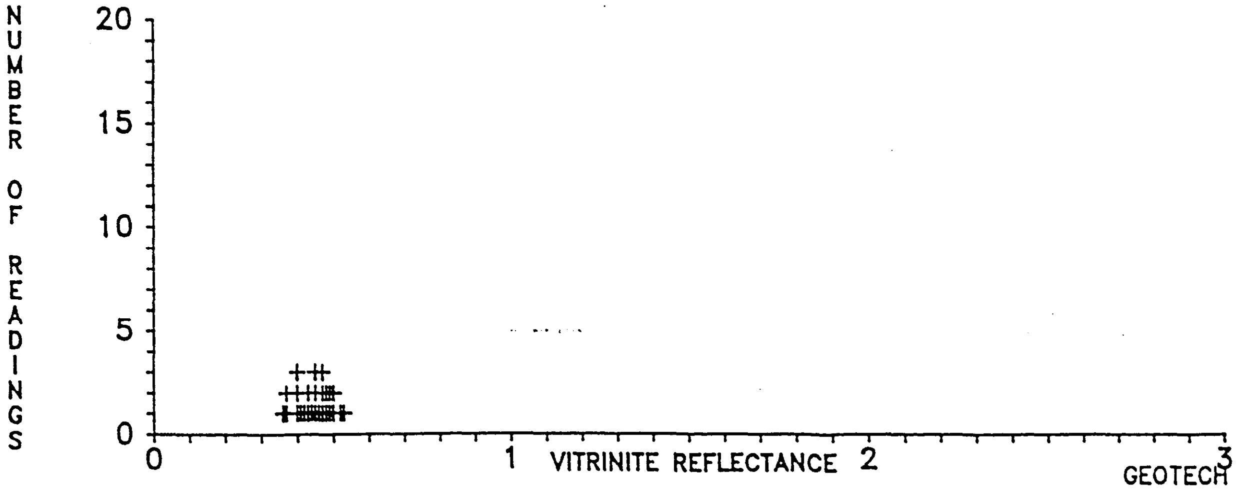


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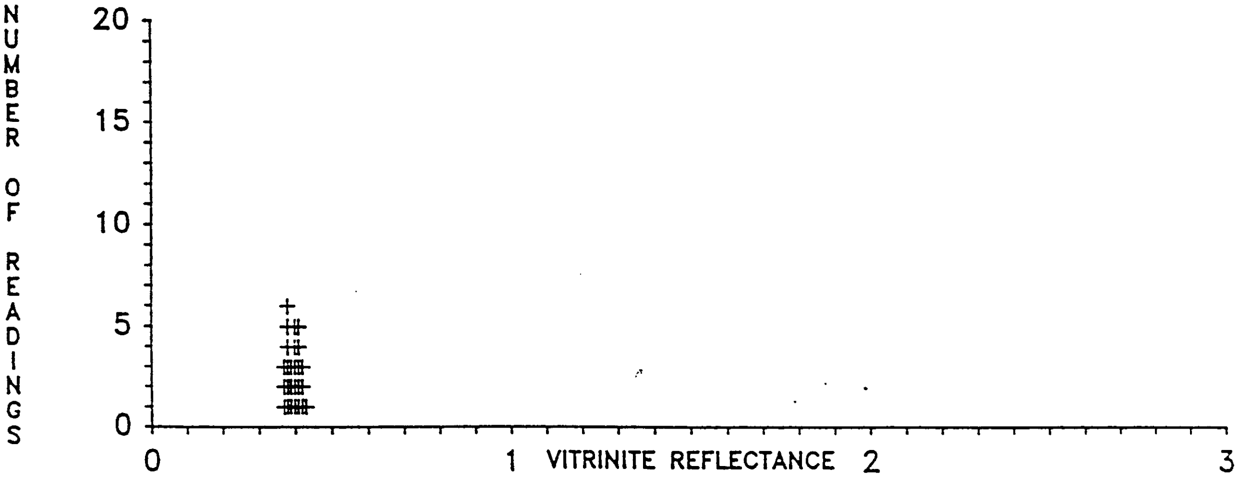
FIGURE 9 (cont'd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: ERIC THE RED-1 CLIENT: BHP PETROLEUM SAMPLE TYPE: SWC
SAMPLE ID: 1151.0 METRES DATE: MAY 1993

(Total No. of Readings=26) 0.37 0.37 0.37 0.38 0.38 0.38 0.38 0.38 0.38 0.39 0.39 0.39 0.40 0.40 0.40 0.40 0.40 0.41 0.41 0.41 0.41 0.41 0.42 0.42 0.42 0.43

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	26	0.40	0.37	0.43	0.02	INDIGENOUS(+)	99.50	0.00	0.50	0.00



SAMPLE ID: 1275.0 METRES SAMPLE TYPE: SWC

(Total No. of Readings=26) 0.35 0.35 0.36 0.37 0.37 0.37 0.37 0.38 0.38 0.38 0.39 0.39 0.39 0.40 0.40 0.40 0.40 0.40 0.40 0.40 0.40 0.40 0.40 0.41 0.41 0.42

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	26	0.39	0.35	0.42	0.02	INDIGENOUS(+)	35.00	55.00	10.00	0.00

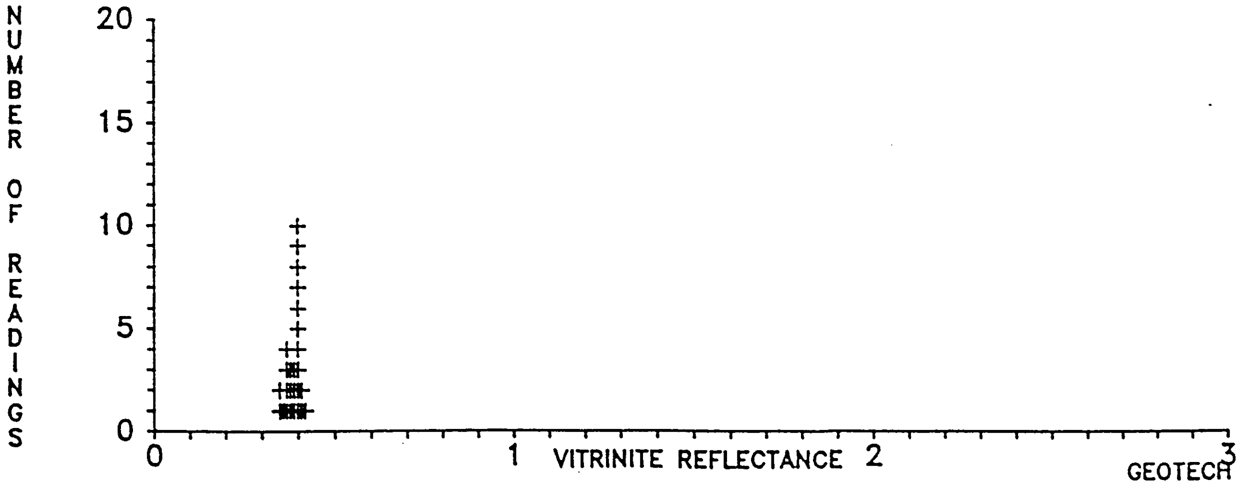


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FIGURE 9 (cont'd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

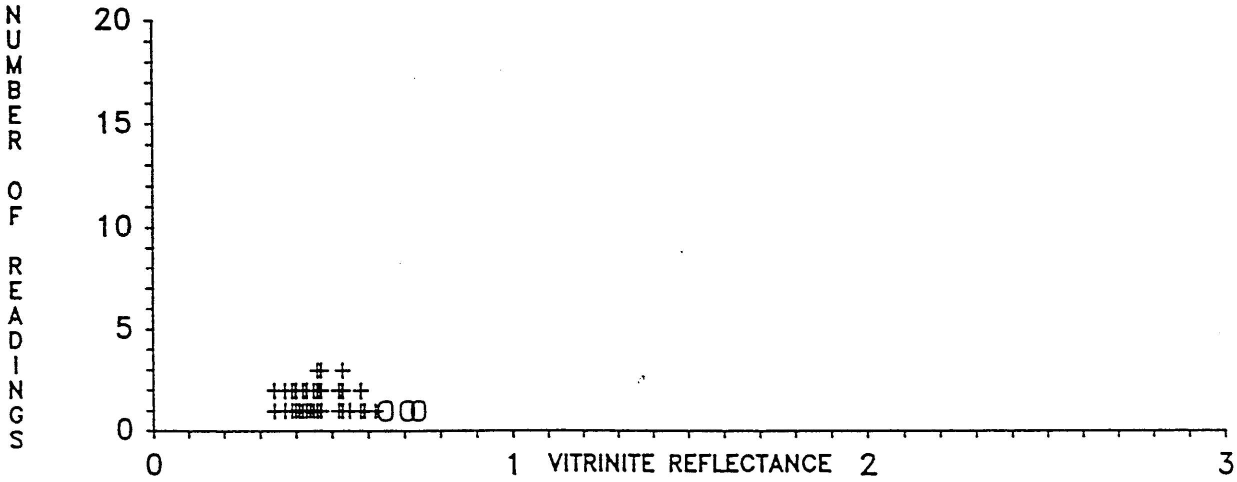
WELL: ERIC THE RED-1
SAMPLE ID: 1316.0 METRES

CLIENT: BHP PETROLEUM
DATE: MAY 1993

SAMPLE TYPE: SWC

(Total No. of Readings=35) 0.34 0.34 0.37 0.37 0.39 0.39 0.40 0.40 0.41 0.42 0.42 0.43 0.43 0.44 0.45 0.45 0.46 0.46 0.46 0.47 0.47 0.47 0.52 0.52 0.53 0.53 0.53 0.55 0.58 0.58 0.59 0.62 0.65 0.71 0.74

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	91.4	32	0.46	0.34	0.62	0.07	INDIGENOUS(+)	32.30	48.40	19.30	0.00
2	8.6	3	0.70	0.65	0.74	0.05	REWORKED(O)				



SAMPLE ID: 1455.0 METRES

SAMPLE TYPE: SWC

(Total No. of Readings=26) 0.42 0.43 0.44 0.45 0.45 0.45 0.45 0.46 0.46 0.47 0.47 0.47 0.48 0.49 0.49 0.50 0.51 0.51 0.52 0.52 0.54 0.54 0.54 0.55 0.57 0.63

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	26	0.49	0.42	0.63	0.05	INDIGENOUS(+)	32.90	52.60	13.20	0.00

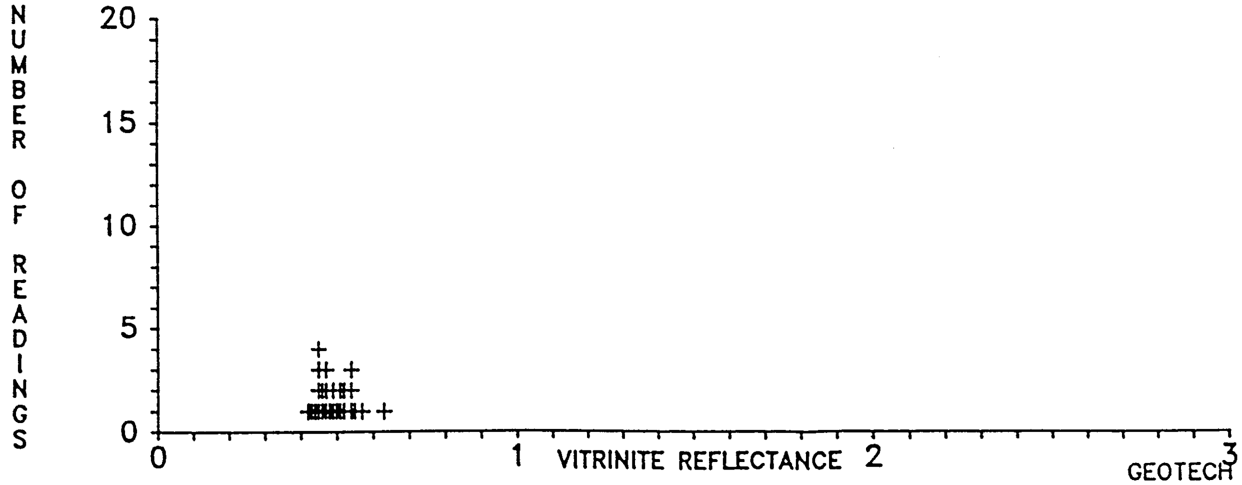


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FIGURE 9 (cont'd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

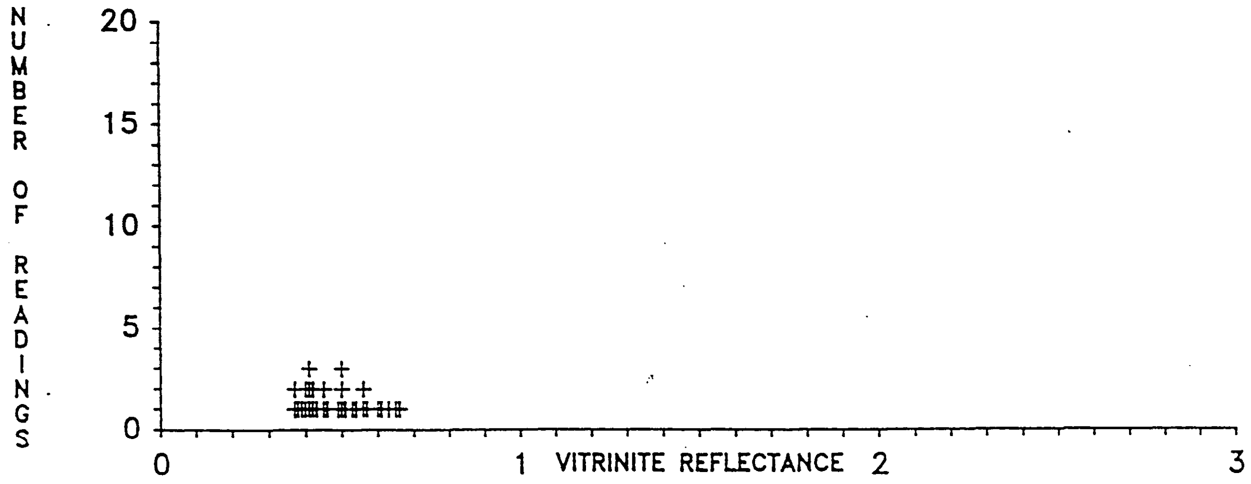
WELL: ERIC THE RED-1
SAMPLE ID: 1575.0 METRES

CLIENT: BHP PETROLEUM
DATE: MAY 1993

SAMPLE TYPE: SWC

(Total No. of Readings=30) 0.37 0.37 0.38 0.39 0.40 0.40 0.41 0.41 0.41 0.42 0.42 0.43 0.45 0.45 0.46 0.49 0.50 0.50 0.50 0.51 0.53 0.54 0.56 0.56 0.57 0.60 0.61 0.63 0.65 0.66

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	POPULATION %	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.00	30	0.49	0.37	0.66	0.09	INDIGENOUS(+)	42.70	55.60	1.70	0.00



SAMPLE ID: 1630.0 METRES

SAMPLE TYPE: SWC

(Total No. of Readings=25) 0.41 0.44 0.44 0.44 0.45 0.45 0.46 0.46 0.46 0.47 0.47 0.47 0.50 0.50 0.51 0.52 0.56 0.56 0.58 0.59 0.59 0.60 0.60 0.62 0.65

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	POPULATION %	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	25	0.51	0.41	0.65	0.07	INDIGENOUS(+)	28.20	56.30	15.50	0.00

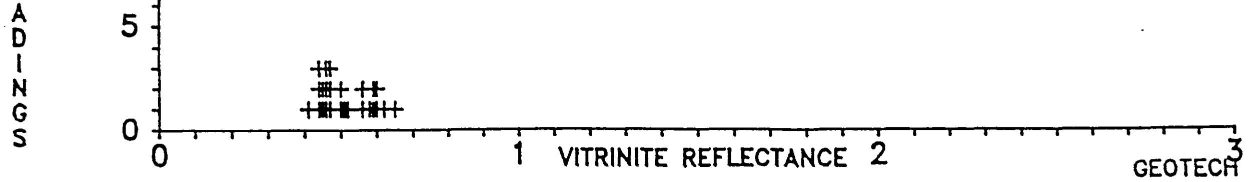


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FIGURE 9 (cont'd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

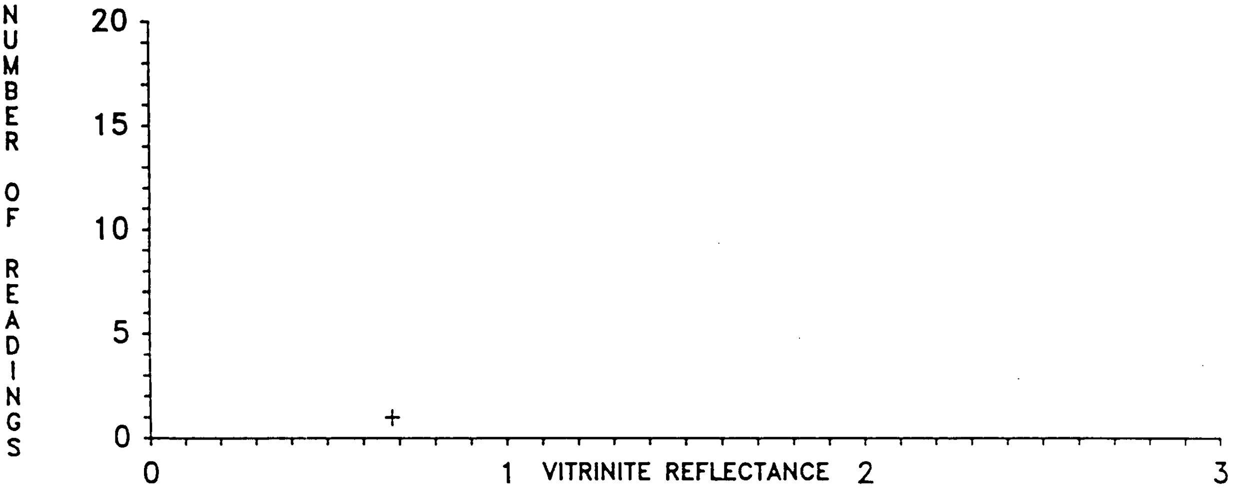
WELL: ERIC THE RED 1
SAMPLE ID: 1813.5 METRES

CLIENT: BHP PETROLEUM
DATE: MAY 1993

SAMPLE TYPE: SWC

(Total No. of Readings=1) 0.68

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	3	0.68	0.68	0.68	0.00	INDIGENOUS(+)	33.30	33.30	33.40	0.00



ERIC THE RED - 1
Vitrinite Reflectance vs Depth

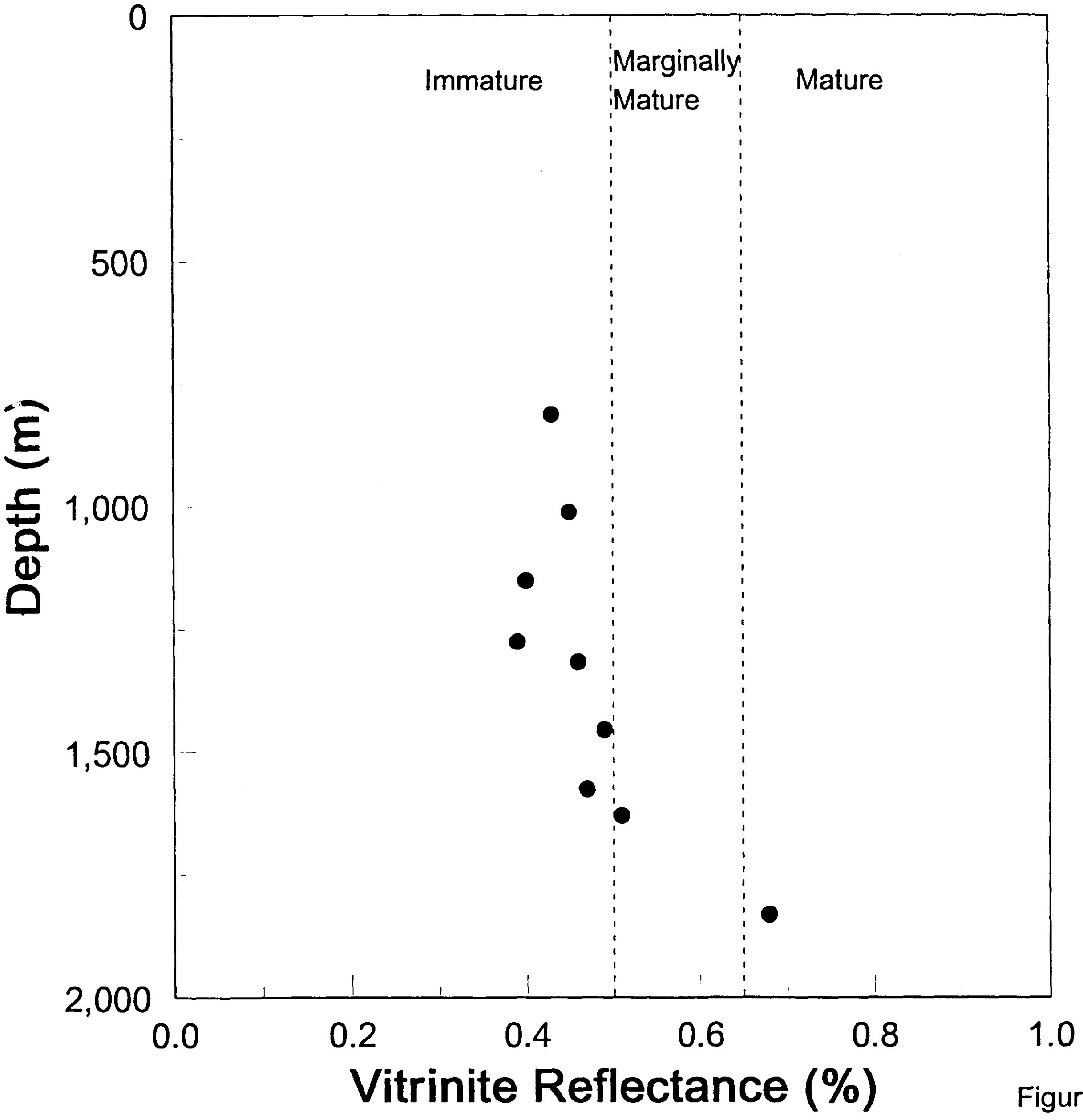


Figure 10

TABLE 4

SUMMARY OF EXTRACTION AND LIQUID CHROMATOGRAPHY - SEDIMENTS

ERIC THE RED-1
Australia
Otway

DEPTH UNIT = Metres
DATE OF JOB = Dec 93

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
1097.00	11.00	689.7	-	-	-	-	-	-	-	-	-	-	-	-
1340.00	17.10	222.9	-	-	-	-	-	-	-	-	-	-	-	-

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

ERIC THE RED - 1
Total Extract Yield vs Depth

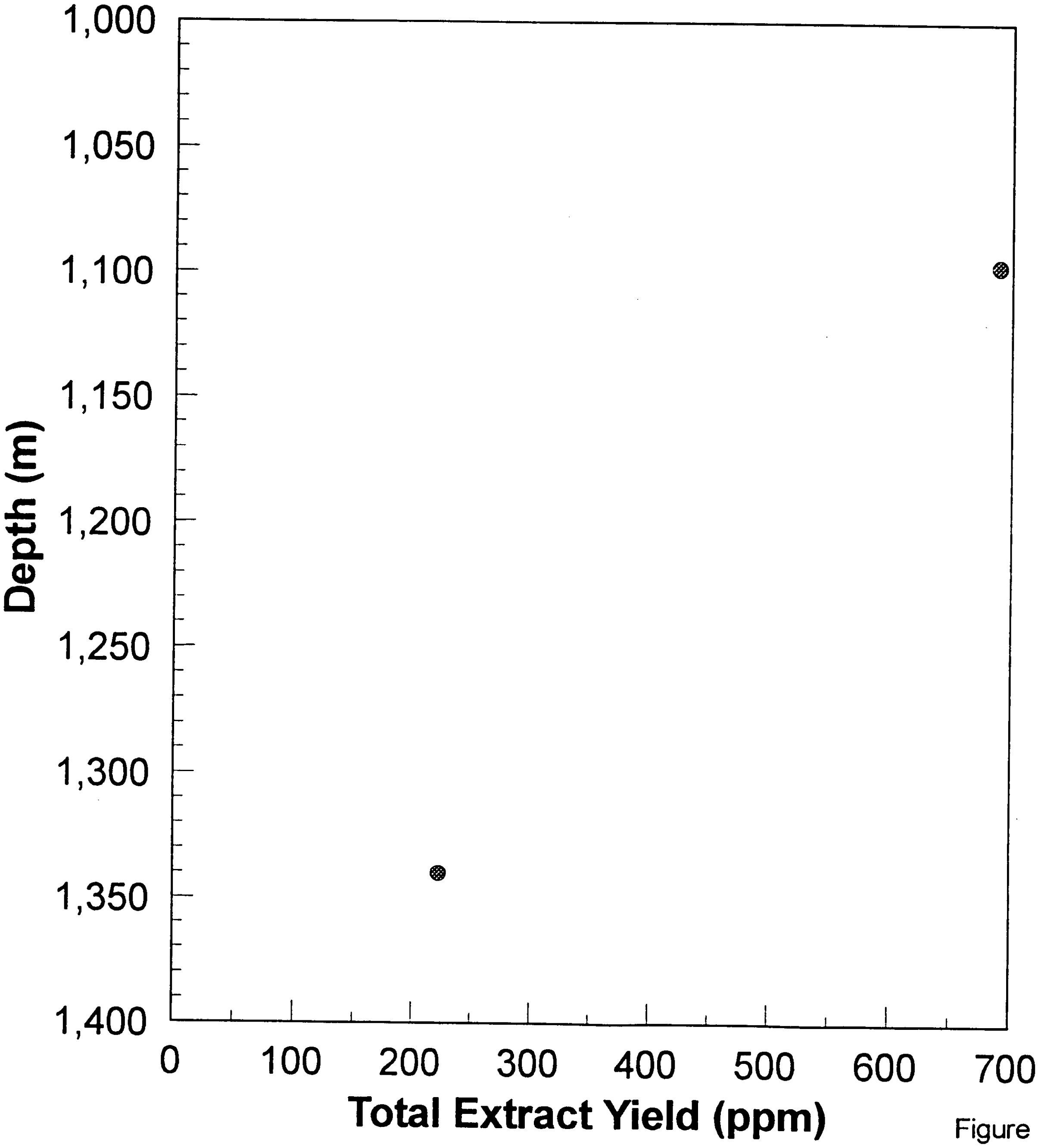


Figure 11

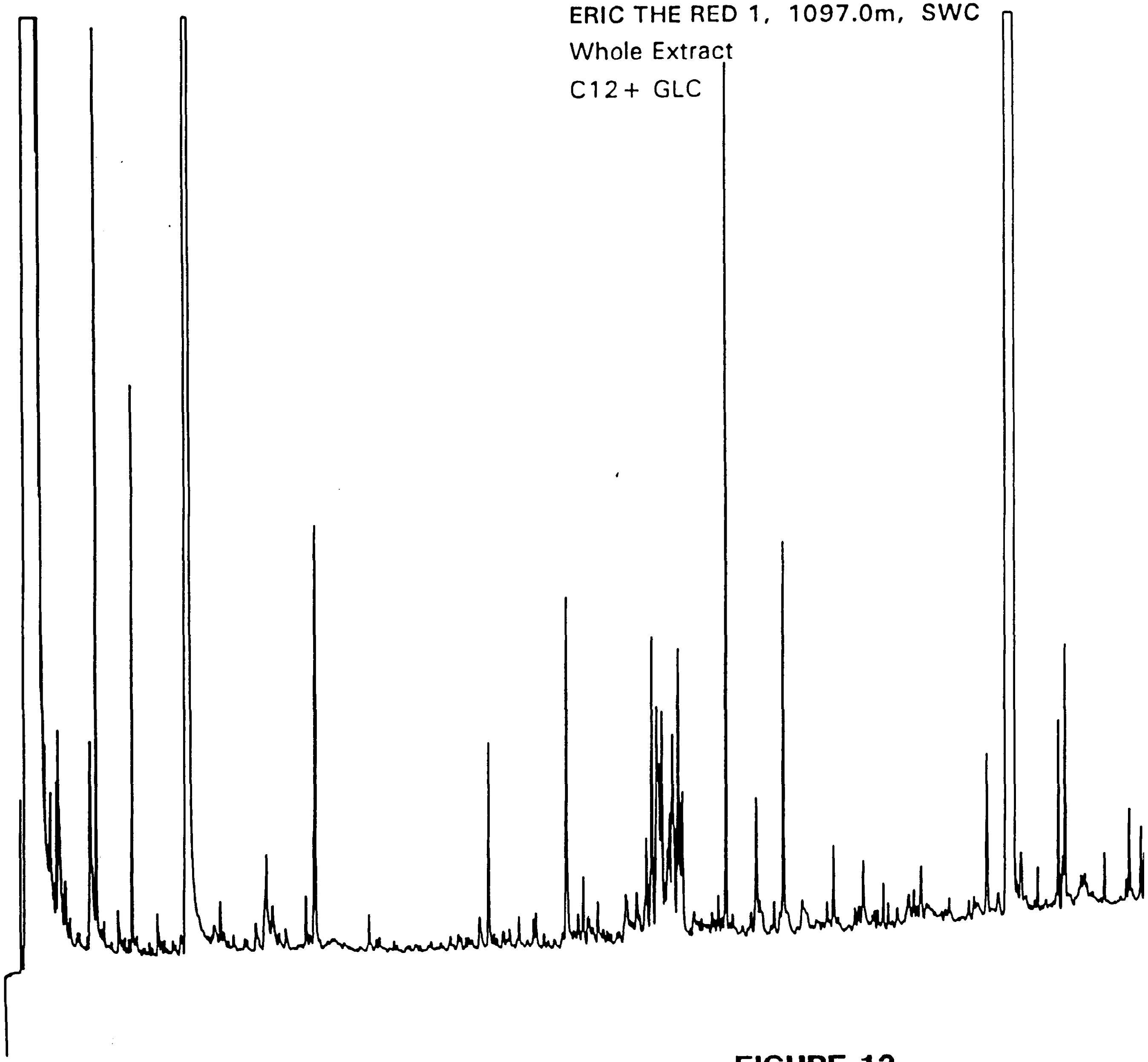


FIGURE 12

PE600052

This is an enclosure indicator page.
The enclosure PE600052 is enclosed within the container PE900173 at this location in this document.

The enclosure PE600052 has the following characteristics:

ITEM_BARCODE = PE600052
CONTAINER_BARCODE = PE900173
NAME = ERIC THE RED 1 GEOCHEMISTRY LOG / PYROLYSIS SCREENING DATA
BASIN = Otway
PERMIT = VIC/P31
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = ERIC THE RED 1 GEOCHEMISTRY LOG / PYROLYSIS SCREENING DATA
REMARKS =
DATE_CREATED = 31/05/94
DATE_RECEIVED = *
W_NO = W1077
WELL_NAME = ERIC THE RED 1
CONTRACTOR = BHP
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)

5

ERIC THE RED

PETROPHYSICAL INTERPRETATION REPORT

JUNE 1994

PREPARED BY:

Matt Yacopetti
Petrophysicist

APPROVED BY:

Robert A. Hogarth
Reservoir Evaluation Manager

rah:my:1709:ec
File No: Etr-1/PP/S01/R

DATE: 17th June, 1994

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

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1. INTRODUCTION

Eric The Red-1 was an exploration well drilled by BHP Petroleum in the Otway Basin (VIC/P31), during February 1993. The main objective was to test clastic reservoirs associated with a fault dependent structure mapped within the lower Late Cretaceous interval, known informally as the "Shipwreck Group".

Eric The Red-1 encountered good quality reservoir sands at the target horizons but no shows were recorded. After logging, the well was tested with the RFT and then plugged and abandoned.

The abbreviations used for depth measurements in this report are:

rt	rotary table height (25.0m) above sea level.
m	metres measured by driller below rt
m rt	metres measured by logger below rt

2. HOLE CONDITIONS

2.1 Caliper

The objective section was drilled with a 8-1/2" bit. The hole was in good condition when logged with evidence of mudcake of up to 0.5" across the sands, and wash-outs generally limited to 2.0" or less in the shalier sections.

2.2 Borehole Fluids

Listed in Table 1 below, is a summary of the mud parameters used in the open hole section beneath the 9-5/8" casing shoe.

Table 1 : Suite-2 Borehole Fluids

Mud type	**KCl / PHPA**
Mud Weight	**1.10 g/cm^3**
KCl Content	**7.4 %**
NaCl$_{eq}$	**67,750 ppm**
Barite Content	**10.15 lbs/bbl**
R$_{mf}$	**0.104 Ω.m @ 19.0°C**
R$_{mc}$	**0.132 Ω.m @ 19.0°C**
R$_{m}$	**0.114 Ω.m @ 20.0°C**

2.3 Temperature

The extrapolated bottom hole temperature at 1840 m, is estimated to be 77.5°C (171.5°F), ± 1.4°C, as calculated from (logarithmic) regression analysis (r^2 = 0.97). The calculated present day gradient is approximately 3.13°C/100 m, using a surface temperature of 20°C.

Listed in Table 2 below, are the maximum temperatures recorded during Suite-2 logging:

Table 2 : Maximum Recorded BHT's

BHT (°C)	DEPTH (m rt)	TOOL STRING	TIME SINCE LAST CIRC. in Hrs. [t]	CIRC. TIME in Hrs. [Δt]
62	1840	DLL-MSFL	5.25	1.25
67	1840	LDL-CNL	9.25	-
73	1790	RFT-HP	21.25	-

3. AVAILABLE DATA

3.1 Wireline Logs

Two suites of wireline logs were acquired at Eric the Red-1. The Suite-1 logs have not been processed any further as no hydrocarbon bearing reservoir was encountered. The Suite-2 logs were recorded over the objective sections and have been analysed in detail for this report.

Suite-1 data listed in **Table-1** below, were obtained in three runs performed in the 12-1/4" open hole between 355.0 m rt and 1017.0 m.

Table 3 : Suite-1 Wireline Logs

DATE & TIME	TOOL STRING	INTERVAL (m rt)
21/02/93 @ 15:30 hrs	DLL-MSFL-SDT-GR-SP-CAL-AMS	355.0 - 1012.5
21/02/93 @ 21:00 hrs	CSI (VSP) [36 levels]	175.0 - 1005.0
22/02/93 @ 04:50 hrs	CST-GR [30 shot]	374.0 - 1010.0

In general data quality from all tools was good, although the resistivity devices were somewhat affected by over-gauge hole conditions. The caliper recorded wash-outs of up to 6.75" between 437.0 and 538.0 m. A 'noisy' sonic response between 585.0 and 790.0 m correlates with MSFL spikes over the same interval. In addition, the static SP shows a strong positive deflection across all sandy intervals.

Suite-2 logs were recorded in the 8-1/2" open hole and consisted of six logging runs listed in Table 4. The 9-5/8" casing shoe was set at 1007.0 m and total depth (TD), was reached at 1875.0 m.

Gauge conditions were generally excellent over the open hole interval with wash-outs limited to 2.0" below 1050.0 m and with mudcake of 0.25" to 0.5" developed over the majority of the objective section. The good hole conditions meant that good repeatability was established for the first two logging runs. A good match between the separate runs was achieved, after a depth adjustment of +0.7 m was made to the neutron-density log.

High quality data was obtained from the resistivity-sonic and neutron-density runs, although the sonic device did exhibit some separation between the four acoustic responses across cemented zones. The resistivity device similarly recorded the location of these tight bands, as elevated resistivity spikes.

Owing to sticky hole conditions near TD, the neutron-density run began at 1825.0 m, and the bottom was reached only on the repeat section. The PEF is barite affected and was not used in this interpretation.

Table 4: Suite-2 Wireline Logs

DATE & TIME	TOOL STRING	INTERVAL (m rt)
26/02/93 @ 15:30 hrs	DLL-MSFL-AS-GR-SP-CAL-AMS	1007.0 - 1871.0
26/02/93 @ 19:30 hrs	FMS-LDT-CNL-GR-CAL-AMS	1007.0 - 1870.0
27/02/93 @ 01:50 hrs	CSI (VSP) - Abandoned	N/A
27/02/93 @ 04:50 hrs	RFT-HP-GR	1058.6 - 1785.1
27/02/93 @ 11:50 hrs	CSI (VSP) [42 levels]	900.0 - 1820.0
27/02/93 @ 19:40 hrs	CST-GR	1029.0 - 1813.6

3.2 MWD Data

Teleco Sonat MWD collars were used to record resistivity, gamma ray and deviation data in the 12-1/4" and 8-1/2" open hole sections between 372.0 m and 1875.0 m. Overall, data quality is good except for a number of small intervals where data was missed, generally due to erratic torque. (eg. 1075.0 m - 1475.0 m).

The MWD resistivity devices exhibit a consistent profile throughout the well with the Phase Difference, response generally reading lower than the Attenuation response. A comparison of the MWD and wireline logs show that there is good correspondence between the magnitude of the resistivities, except across cemented zones where the MWD resistivities are typically much less than that of the wireline device. A small depth correction of +1.5 to +2.0 m is necessary to depth match the MWD log with the wireline logs.

3.3 Conventional Cores

No conventional cores were cut.

3.4 Sidewall Cores

Twenty-one cores were recovered from 30 bullets taken with the Suite-1 logs in the 12-1/4" hole section; 3 bullets were lost and 6 were misfired. In addition, a further fifty-three sidewall cores were recovered from 60 bullets taken with the Suite-2 logs; here 4 bullets were lost and 3 were empty. A set of 8 sidewall cores covering the interval between 778.5 m to 1790.0 m were submitted to ACS Laboratories for petrographic analysis (Phillips, 1993).

3.5 Wireline Repeat Formation Tests

One RFT run was carried out during the Suite-2 logging program to record 6 pre-test pressures in the Shipwreck and Otway Group sandstones. The calculated fluid gradients indicated that the intervals tested were all water bearing. For further details on the RFT program, results are available in the RFT Interpretation Report (BHPP, 1993).

3.6 Production Tests

No production testing was conducted.

4. INTERPRETATION PROCEDURE

4.1 Data Preparation

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

4.2 Interpretation Model

The log interpretation was carried out using the "*Optima*" program, a probabilistic log interpretation package which forms part of WDS. Where possible, all modelling errors in this interpretation were limited to ≤ 2%.

For this interpretation, the section between 1020.0 m and 1810.0 m has been divided into four separate zones. Individual parameters used in each of these zones are given in the appendices. Water saturations were calculated using the Indonesia equation and sonic porosities were estimated from the Raymer-Hunt equation. A summary listing of the interpretation results is presented in **Table 6**. A 1:200 scale graphic presentation of the log analysis is included as **Enclosure-1**, and a composite log of the Suite-2 wireline data, as **Enclosure-2**.

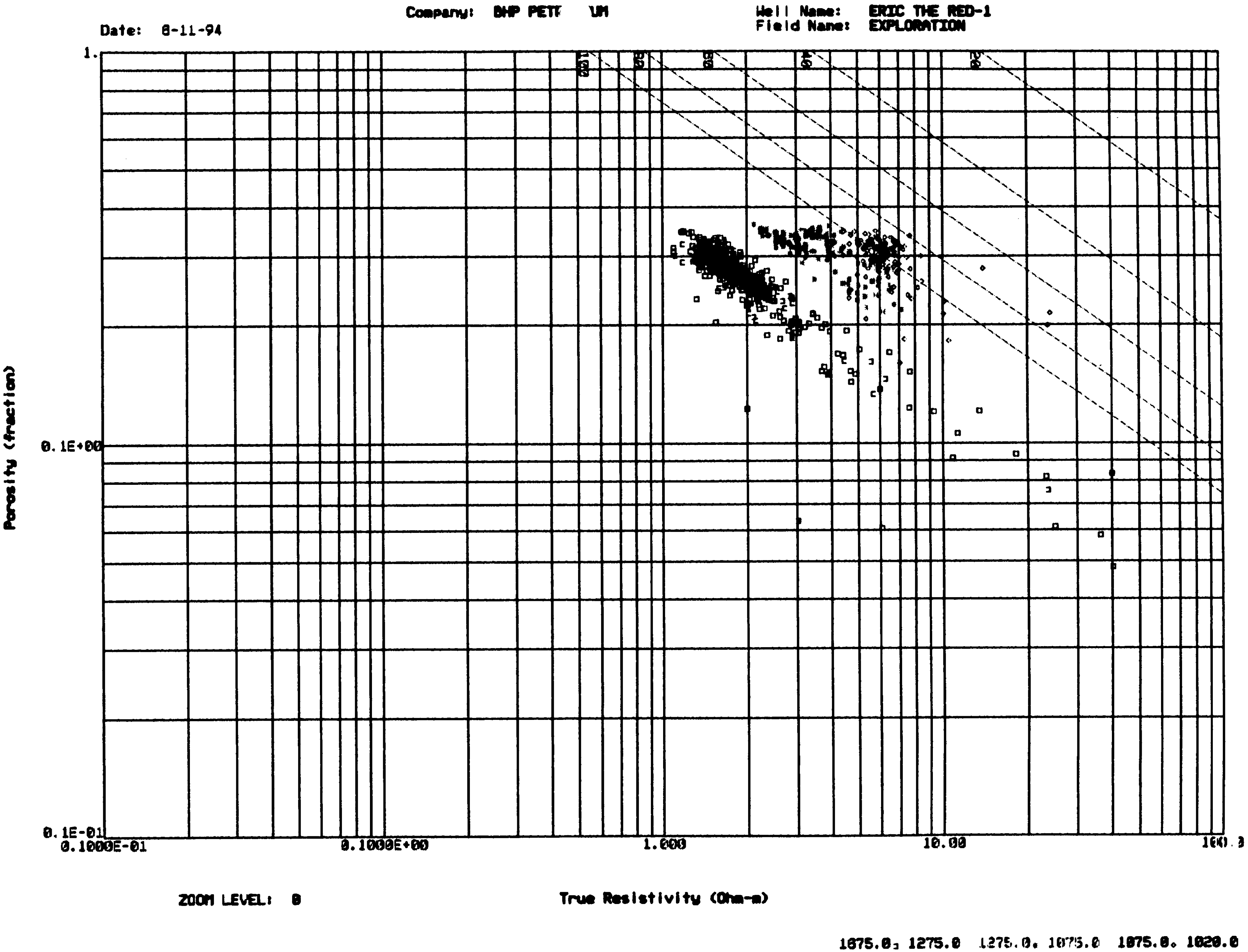
4.3 Resistivity

The wireline resistivity response opposite the cleaner porous sandstones gives a consistent profile with the MSFL ≤ LLs ≤ LLd. Across 'tight' intervals and shale beds the LLs response generally matches the LLd in magnitude and the MSFL is commonly greater than both. Separation between the resistivity responses in the clean sands suggests that some filtrate invasion has occurred and that the beds are permeable.

Borehole corrections for the wireline resistivity devices were minimal and environmental corrected responses were used in the calculation of R_t and R_{xo} from LLd, LLs and MSFL.

4.4 Formation Water Salinity

The SP response across porous sandier intervals exhibits a strong positive deflection. Between 1007.0 m and 1275.0 m the SP deflection ranges up to +55 mV and between 1275m and 1675m it approaches is +25 to +30 mV. Below 1675m the sands are somewhat argillaceous and the SP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0.1000E+00
1.000
10.00
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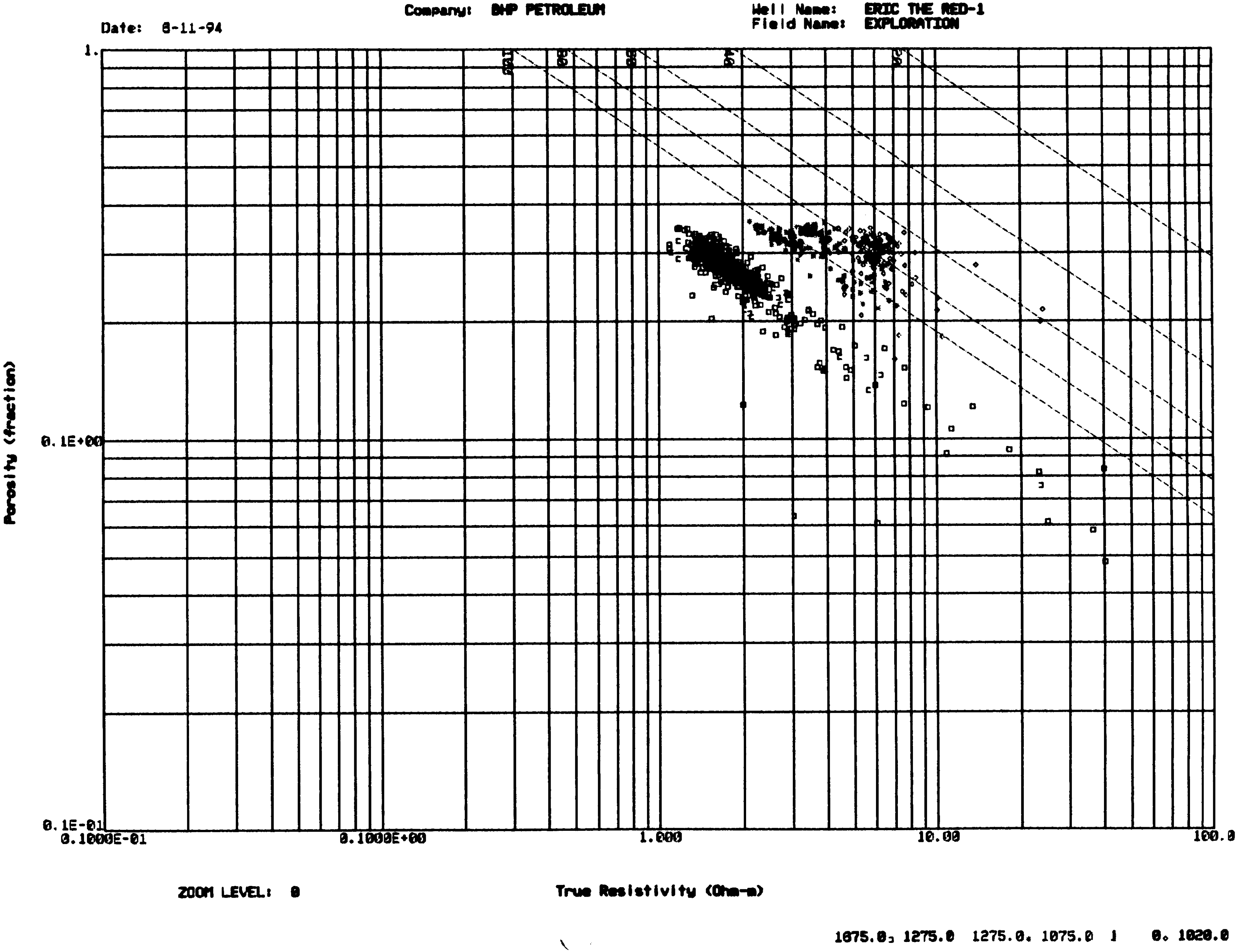
ZOOM LEVEL: 0
True Resistivity (Ohm-m)
1875.0, 1275.0 1275.0, 1075.0 1075.0, 1020.0

Figure 1

Figure 2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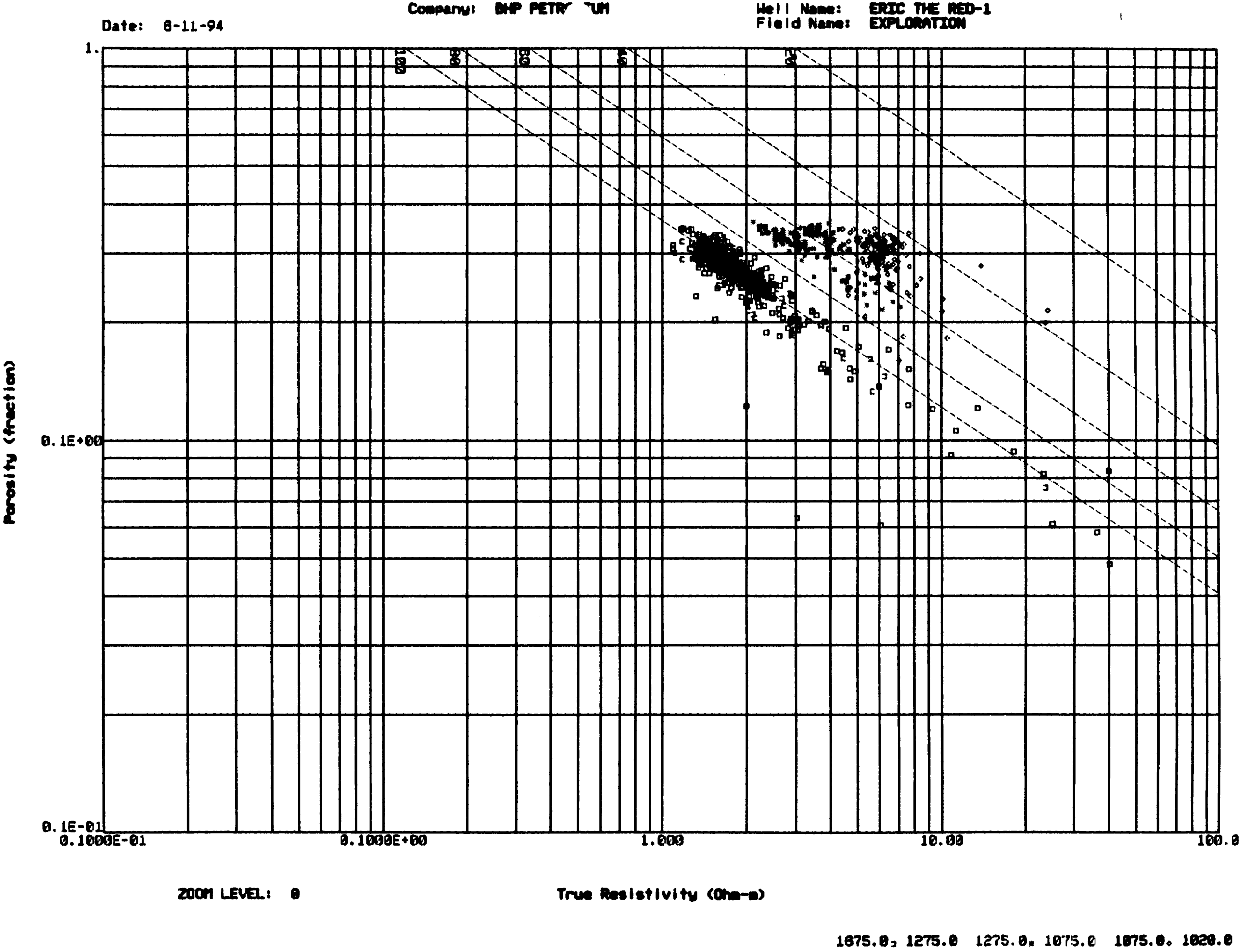
0.1E-01
Porosity (fraction)
0.1000E-01
0.1000E+00
1.000
10.00
100.0
True Resistivity (Ohm-m)
ZOOM LEVEL: 0
1075.0₃ 1275.0 1275.0* 1075.0 1 0○ 1020.0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Field Name: EXPLORATION
100
80
60
40
20
1.
0.1E+00
0.1E-01
Porosity (fraction)
0.1000E-01
0.1000E+00
1.000
10.00
100.0
ZOOM LEVEL: 0
True Resistivity (Ohm-m)
1675.0, 1275.0 1275.0* 1075.0 1075.0◦ 1020.0

Figure 3

Company: BHP PETROLEUM

Date: 8-11-94

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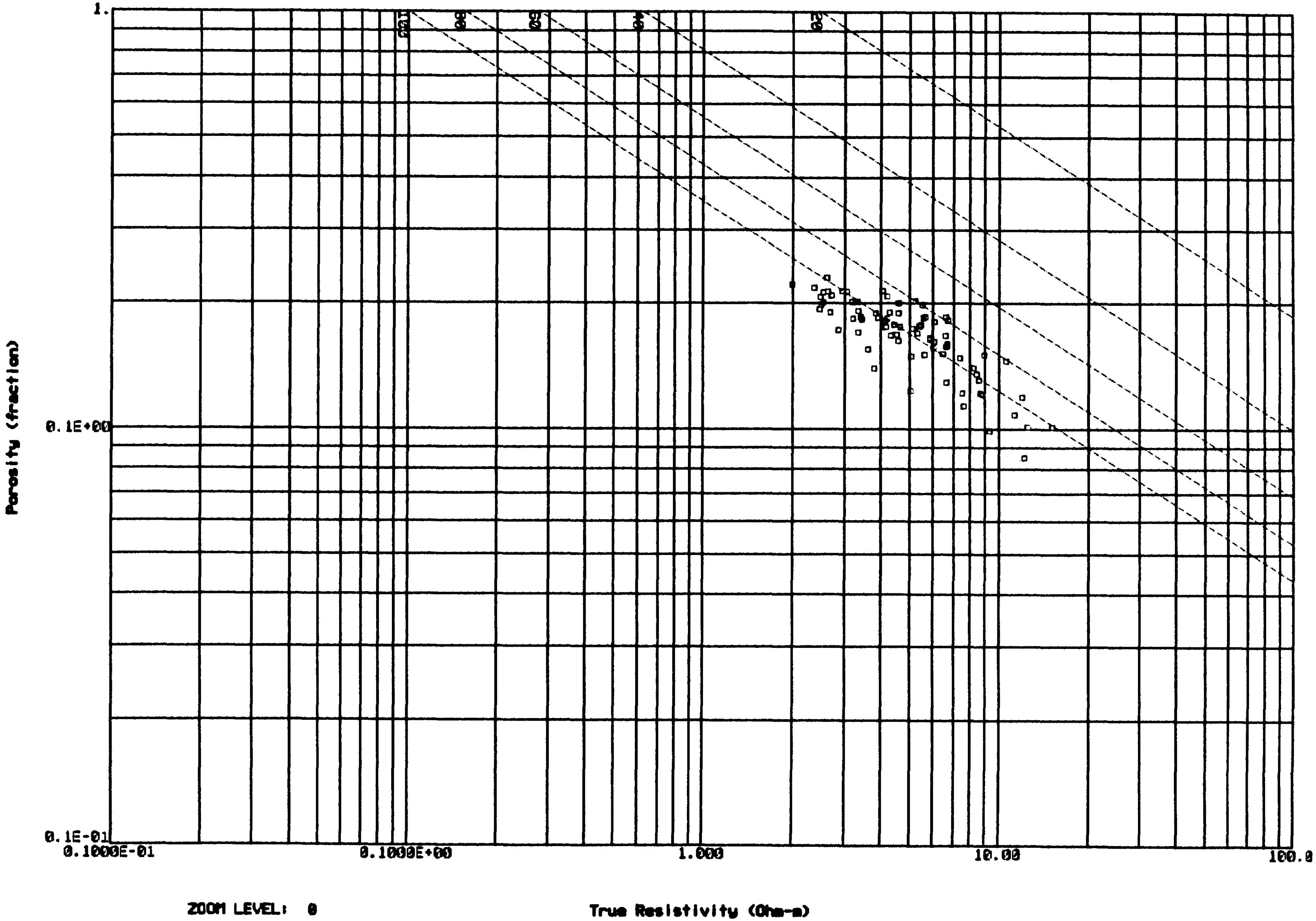
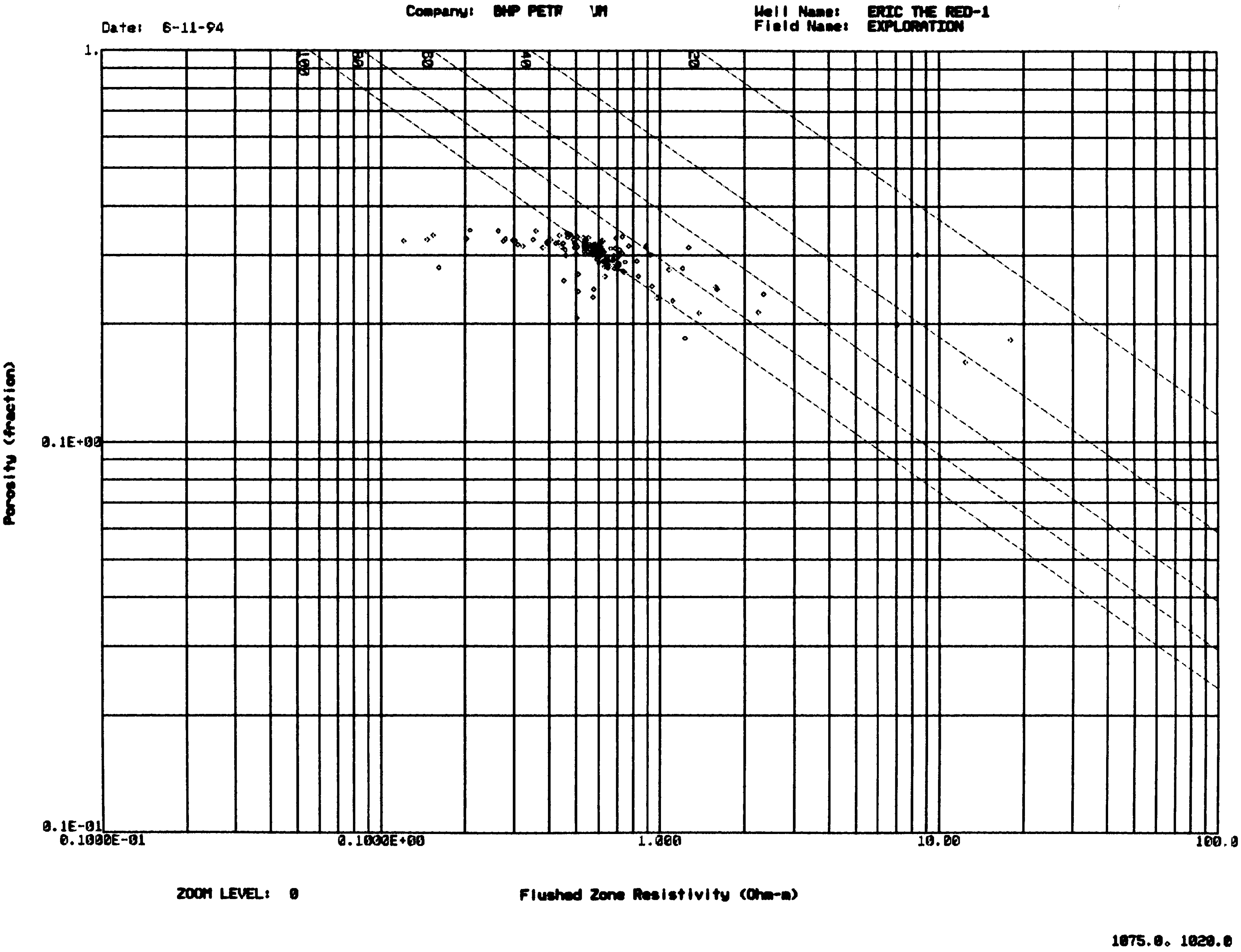
Field Name: EXPLORATION



ZOOM LEVEL: 0

1. .0 1875.0

Figure 4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60
40
20
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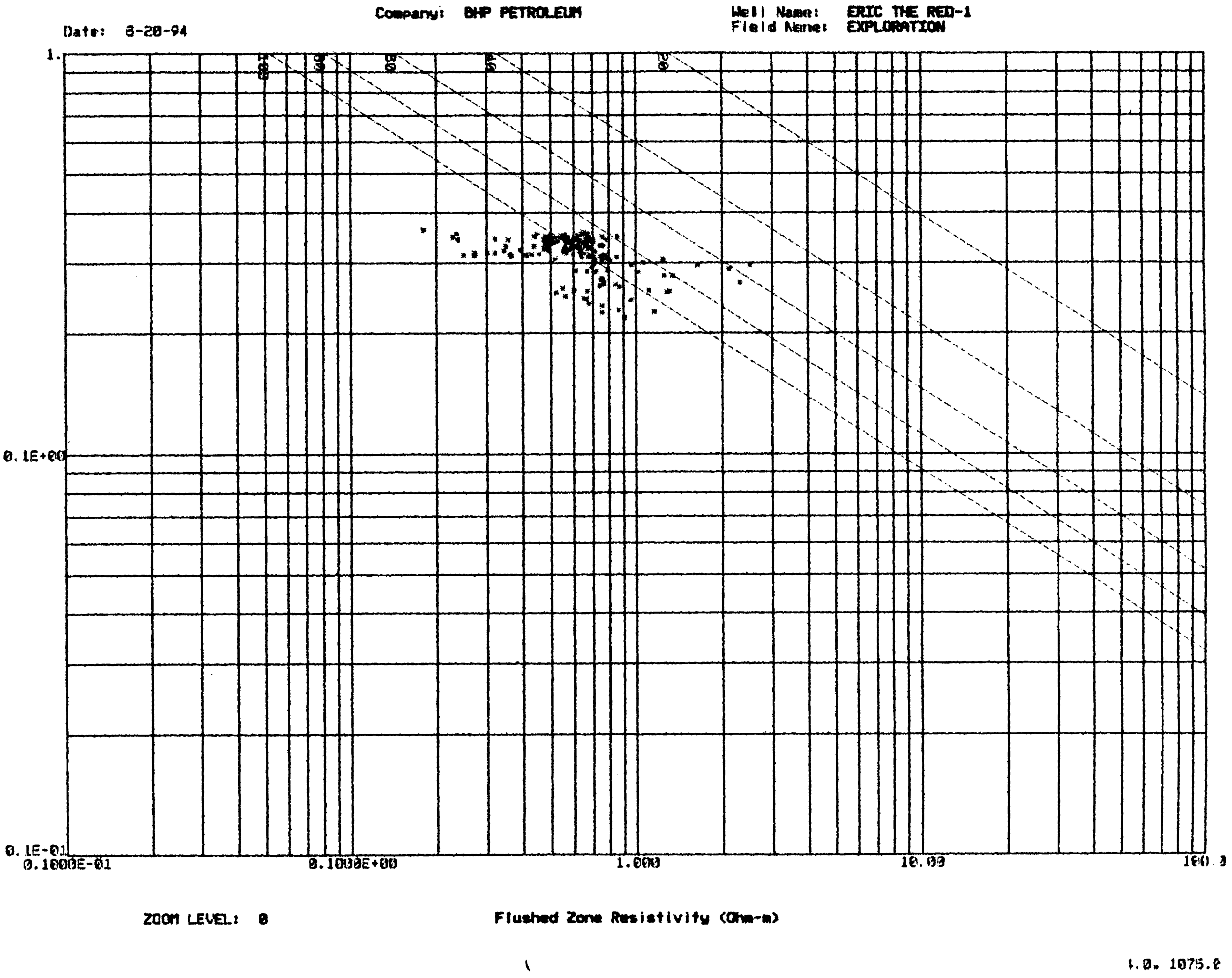
0.1E-01
Porosity (fraction)
0.1000E-01
0.1000E+00
1.000
10.00
100.0
ZOOM LEVEL: 0
Flushed Zone Resistivity (Ohm-m)
1075.0, 1020.0

Figure 5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80
40
20
1.
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0.1E-01
Porosity (fraction)
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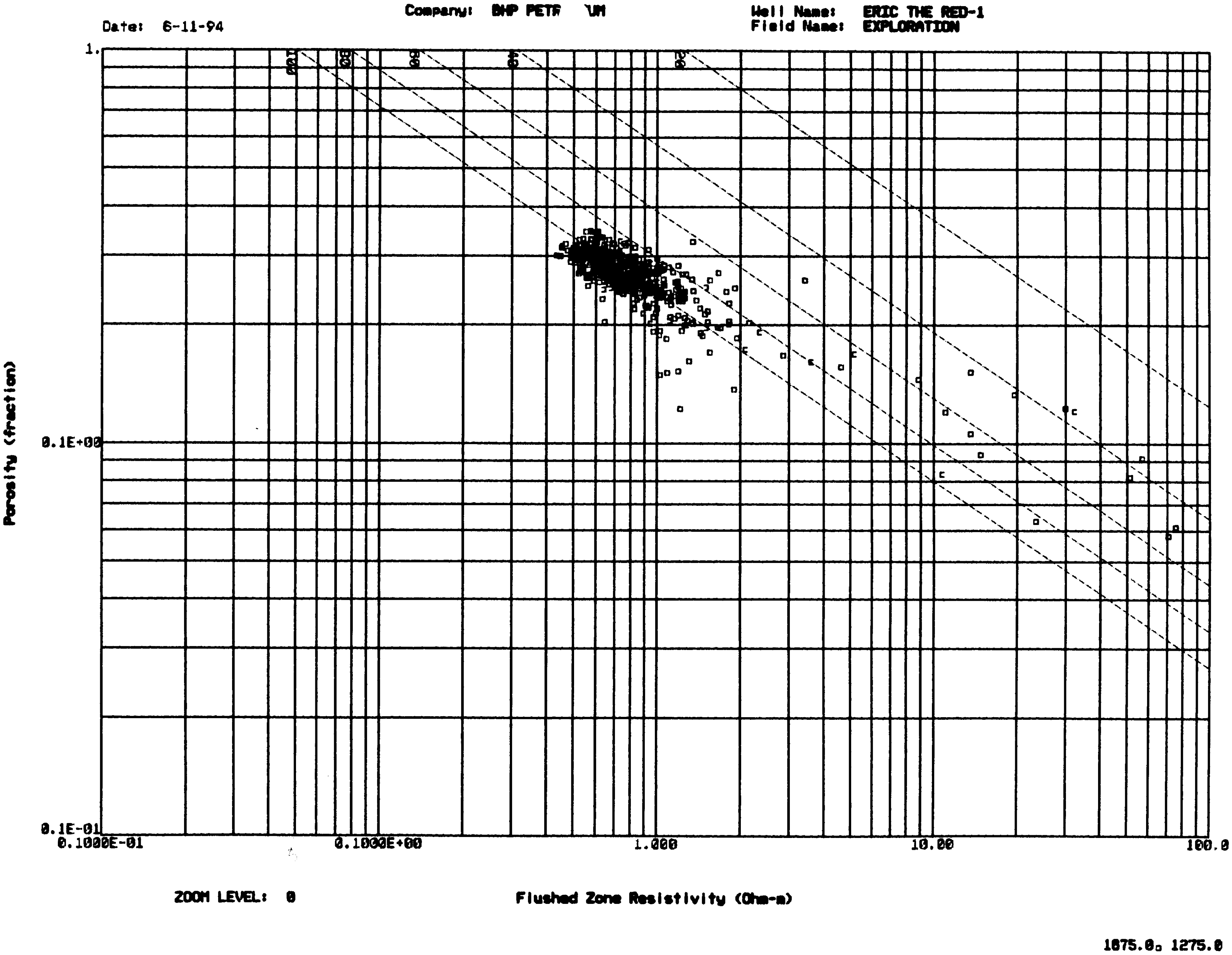
0.1000E+00
1.000
10.00
100.0
ZOOM LEVEL: 0
Flushed Zone Resistivity (Ohm-m)
1.0. 1075.0

Figure 6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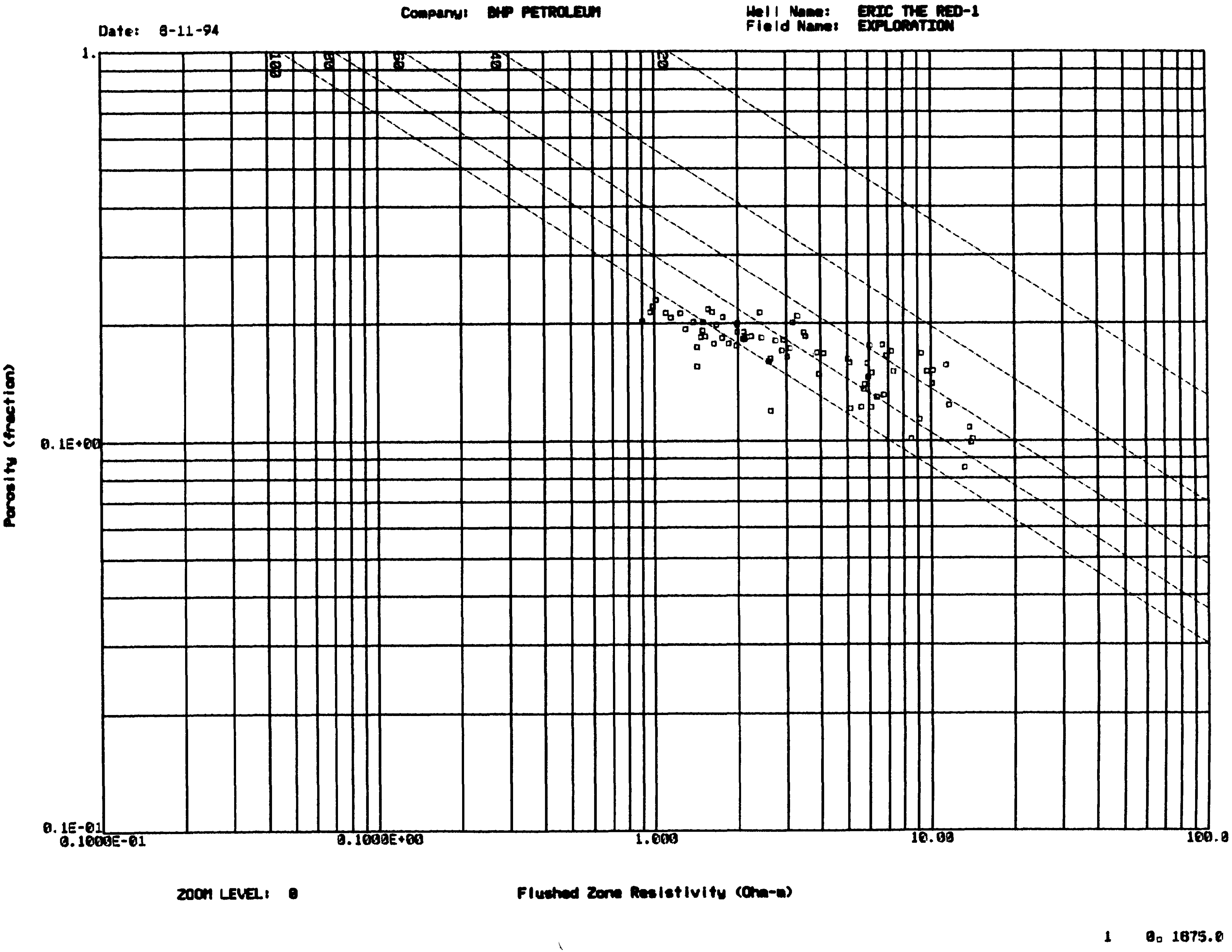
0.1E+00
0.1E-01
Porosity (fraction)
0.1000E-01
0.1000E+00
1.000
10.00
100.0
Flushed Zone Resistivity (Ohm-m)
ZOOM LEVEL: 0
1075.0, 1275.0

Figure 7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Well Name: ERIC THE RED-1
Field Name: EXPLORATION
Date: 6-11-94
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80
60
40
20
1.
0.1E+00
0.1E-01
Porosity (fraction)
0.1000E-01
0.1000E+00
1.000
10.00
100.0
ZOOM LEVEL: 0
Flushed Zone Resistivity (Ohm-m)
1 0 1675.0

Figure 8

response is considered unreliable. However, the diminishing magnitude of the SP deflection with increasing depth, down to 1675m, suggests that the salinity contrast between the mud filtrate and the formation water decreases (ie. the formation water becomes appreciably more saline below 1275.0 m).

Water saturated sandstones were recorded over the entire objective section at Eric The Red-1. Water salinities have been estimated for the four gross intervals and Pickett plots of R_t and R_{xo} vs. Wireline Porosity produced for each (see **Figures 1 - 4**). Formation water resistivities used for each of these intervals are summarised in **Table 5**.

Table 5 : Estimated Formation Water Salinities

INTERVAL (m)	ESTIMATED BHT (°C)	R_w (Ω.m)	R_{mf} (Ω.m)	SALINITY (ppm $NaCl_{eq}$)
1020.0-1075.0	53.3 @ 1075 m	0.550	0.055	6,000
1075.0-1274.0	59.1 @ 1250 m	0.300	0.052	10,500
1274.0-1675.0	65.3 @ 1450 m	0.120	0.050	27,000
1675.0-1810.0	76.3 @ 1800 m	0.100	0.045	29,000

4.5 Formation Electrical Properties

In the absence of any measured core data relating to formation electrical properties, the following values were used:

1020.0 m to 1075.0 m : a = 1.0, m = 2.0 and n = 2.0
1075.0 m to 1675.0 m : a = 1.0, m = 2.2 and n = 2.0
1675.0 m to 1810.0 m : a = 1.0. m = 2.2 and n = 2.0

Plots of R_{xo} vs Porosity indicate that the cementation exponents used here are consistent with the R_{mf} values obtained for the nominated formation temperatures from each interval (see **Figures 5 - 8**).

5. INTERPRETATION RESULTS

The results of the log interpretation are discussed here in terms of their currently interpreted stratigraphic succession.

5.1 Lower Sherbrook Group; 1020.0 - 1043.0 m (Middle, Late Cretaceous)

This interval consists largely of claystone interbedded with thin sandstones. Porosity within the sands appears to be limited by carbonate (dolomitic?) cement, particularly below 970.0 m where the Lower Sherbrook Group is characterised by a number of thin (1 - 2 m) sands which display low porosity sonic spikes.

The one sidewall core from the Sherbrook Group included for petrographic analysis was sampled from a sandstone above the 13-3/8" casing shoe, at 778.5 m. This sample, described as a sub-mature *sub-litharenite*, is composed predominantly of quartz, lithics and glauconite, and shows evidence of lamination. Formation water salinities were not calculated for this interval as reliable porosity data was not available. The sands are interpreted as either 'tight' or water bearing and the estimated net-to-gross for this interval is only 1% (see **Table 6**).

5.2 Upper Shipwreck Group; 1043.0 - 1468.0 m (Lower, Late Cretaceous)

Based on lithologic character, the Upper Shipwreck Group can be broken out into four sub-intervals The first of these, between 1048.0 and 1157.0 m, is comprised of a series of coarsening upward sands interbedded with massive claystones. The upper portion of these sandstones are clean and exhibit high effective porosities, although cemented bands up to a metre in thickness are also evident. These sandstones are interpreted as entirely water bearing which is consistent with the lack of shows while drilling, and RFT pre-test results. The formation water salinities interpreted for this zone are relatively fresh at around 6,000 to 10,000 ppm $NaCl_{eq}$. The low water salinity is thought to reflect a significant meteoric water component sourced from nearby onshore exposures of the Wangerrip Group rocks which directly overlie the Sherbrook Group.

Two sidewall cores from this zone (1102.0 m & 1146.0 m), were submitted for petrographic analysis. They are characterised as moderately sorted, fine to very fine grained *quartz arenites* and *sub-litharenites* composed predominantly of quartz with minor lithic and feldspar grains, pyrite and sparry carbonate cement.

The next sub-interval, between 1157.0 and 1275.0 m, is comprised mainly of mudstone interbedded with thin argillaceous sands and minor coal. The argillaceous sands are typically only 1 - 2 m thick and appear to be cemented in part with calcareous (dolomitic?) cement. In addition, a number of thin coals are identified from logs, the most noticeable examples occurring at 1252.0 and

1275.0 m (see **Enclosure 1**). Sands from this interval are also interpreted as water bearing with an estimated formation water salinity of approximately 10,500 ppm $NaCl_{eq}$.

The third sub-interval, between 1274.0 m and 1330.0 m, is characterised by series of impure sandstones interbedded with thick, massive claystones and minor coal. The sandstones range from 2 - 5 m in thickness but are somewhat argillaceous. A sidewall core sampled at 1297.0 m is described as a moderately sorted, coarse grained, cemented sub-litharenite, composed predominantly of quartz, lithics and sparry Fe-carbonate. A coal interpreted at 1325.0 m is also evident, indicating that the depositional environment for this sequence had a strong terrestrial influence. Sands from this interval are interpreted as entirely water bearing despite saturation spikes that are related to coals, rugose hole or 'tight' sands. Formation water salinities are estimated at 27,000 ppm $NaCl_{eq}$.

The fourth sub-interval occurs between 1330.0 and 1468.0 m and represents the basal section of the Upper Shipwreck Group. This interval is comprised of thick blocky sands interbedded with carbonaceous claystones and minor coal. The sandstones, down to 1413.5 m, are very clean and exhibit high effective porosities. This section represents the highest quality potential reservoir interval encountered in the well. A sidewall core sampled from 1340.0 m is described as a poorly sorted, coarse grained, mineralogically mature *quartz arenite*, composed almost entirely of quartz. These sands are interpreted as water bearing with interpreted formation water salinities of 27,000 ppm $NaCl_{eq}$. Between 1414.0 m and 1468.0 m porosity and net-to-gross diminish, reflecting a more argillaceous character for this lower interval. Petrographic descriptions of a sidewall core taken at 1464.0 m indicate that these basal sands contain appreciable quantities of feldspar, lithics, mica, patchy carbonate cement and pore filling clays.

5.3 Lower Shipwreck Group; 1468.0 - 1748.0 m (Lower, Late Cretaceous)

The contact marking the position of the unconformity between the Upper and Lower Shipwreck Group is not easily recognised, although dipmeter data indicates a subtle change in dip magnitude and azimuth at this depth. The upper part of the Lower Shipwreck Group, down to 1508.0 m, is composed almost entirely of relatively clean, blocky sandstones similar in mineralogy and character to those described above. Cemented sands generally 1 - 2 m thick are interpreted, and are seen on sonic and density-neutron logs as low porosity spikes. This interval is interpreted as water bearing which was confirmed from the fluid gradient derived from RFT pre-tests. Formation water salinities estimated at 27,000 ppm $NaCl_{eq}$ are consistent with those recorded in the Upper Shipwreck Group.

Between 1508.0 m and 1748.0 m, the basal part of the Lower Shipwreck Group, consists of poorly sorted, fine to coarse grained impure sandstones interbedded with massive claystones. The upper most portion of this section is distinctly argillaceous and is composed almost entirely of claystone grading to argillaceous sandstone below 1521.0 m. The sandstones tend to be relatively thin bedded, fine to medium grained and moderately well sorted *sub-litharenites*. Cemented bands 1 - 2 m thick are common, but tend to occur in only the cleanest sands.

5.4 Otway Group; 1748.0 - 1810.0 m (Upper, Early Cretaceous?)

This interval consists of thick, relatively clean, massive sandstones interbedded with claystone. The high proportion of lithics identified in these sands serve to differentiate them from those of the Shipwreck group immediately above. The sands are moderately well sorted, medium to coarse grained, texturally and mineralogically immature *litharenites*, and contain an abundance of felsic volcanic lithics, quartz and feldspars. Authigenic minerals noted include minor chlorite, kaolin and quartz. Many of the sands are described as argillaceous and include samples that appear to be grading to arenaceous claystone. The lithic content of these sands causes an upward shift in the baseline gamma ray response. In this interval the gamma ray is approximately 85 API units, which is significantly higher than that for the sands of the Shipwreck Group, which are typically < 60 API units. The Otway Group sands are interpreted as entirely water bearing with salinities in the order of 29,000 ppm $NaCl_{eq}$ - essentially the same as those of the overlying Shipwreck Group.

Table 6: Reservoir Summary

CUT OFFS

Porosity	> 0.120
Vshale	< 0.330
Sw	< 1.000

FORMATION / ZONE	DEPTH (m)	GROSS (m)	NET (m)	N/G (%)	POR. (%)	Sw (%)	E.P.C. (m)	E.H.C. (m)
Sherbrook Group	1020.0 - 1043.0	23.0	1.4	6.0	20.0	100.0	0.28	0.00
Upper Shipwreck Group	1043.0 - 1468.0	425.0	216.2	51.0	26.0	95.0	55.50	2.85
Lower Shipwreck Group	1468.0 - 1748.0	280.0	168.3	60.0	19.0	97.0	32.45	0.83
Otway group	1748.0 - 1810.0	62.0	12.1	20.0	16.0	82.0	1.96	0.35

6. REFERENCES

Eric the Red-1 RFT Report, 1993	RFT Interpretation Report, BHP Petroleum, File Report: Etr-1/WL/G/02, Unpublished.
Schlumberger, 1991	Log Interpretation Charts, Schlumberger Educational Services, U.S.A.
Phillips, S.E., 1993.	Petrology Report, Eric the Red-1, Otway Basin.Prepared for BHP Petroleum by ACS Laboratories Pty Ltd, September 1993, File Report: Otw/1/Eric the Red-1/007, Unpublished.

APPENDIX 1

LOG INTERPRETATION PARAMETERS

WELL: ERIC THE RED-1

COMPANY: BHP PETROLEUM

ZONE	1	2	3	4
Depth (m RT)	1015.0 - 1043.0	1043.0 - 1468.0	1468.0 - 1748.0	1748.0 - 1810.0
Formation	SHERBROOK GROUP	UPPER SHIPWRECK GROUP	LOWER SHIPWRECK GROUP	OTWAY GROUP
ZONE PARAMETERS				
a	1.0	1.0	1.0	1.0
m	2.0	2.0 - 2.2	2.1 - 2.2	2.2
n	2.0	2.0	2.0	2.0
Rt Shale	3.7	3.5 - 6.9	2.0 - 8.0	2.0
Rxo Shale	1.9	0.7 - 5.7	1.0 - 6.8	1.0
Rw	0.550	0.550 - 0.120	0.120 - 0.110	0.110
Rmf	0.055	0.055 - 0.050	0.050 - 0.045	0.045
Dt Shale (us/ft)	125.0	56.0 - 170.0	56.0 - 110.0	80.0
Compaction Factor	1.0	1.0	1.0	1.0
RHOB Shale (g/cc)	2.45	1.15 - 3.10	2.70 - 2.95	2.75
CNL Shale (p.u. frac.)	0.35	0.0 - 0.60	0.20 - 0.50	0.40
GR Shale (API)	150.0	105.0 - 225.0	115.0 - 175.0	150.0
MINERAL VOLUMES				
Shale	0 - 100 %	0 - 100%	0 - 100%	0 - 100%
Quartz	0 - 99 %	0 - 99 %	0 - 99 %	0 - 99 %
K-Feldspar	0 - 15 %	0 - 15 %	0 - 10 %	0 - 10 %
Dolomite	0 - 10 %	0 - 50 %	0 - 10 %	0 - 5 %
Coaly Matter	0 - 10 %	0 - 50 %	0 - 10%	0 - 10%
FLUID PROPERTIES				
H/C Density (g/cc)	0.70	0.70	0.70	0.70
Mud Density (g/cc)	1.10	1.10	1.10	1.10

PE600078

This is an enclosure indicator page.
The enclosure PE600078 is enclosed within the container PE900173 at this location in this document.

The enclosure PE600078 has the following characteristics:

ITEM_BARCODE = PE600078
CONTAINER_BARCODE = PE900173
NAME = ERIC THE RED 1 WIRELINE LOG INTERPRETATION; 1:200, ENCLOSURE 1
BASIN = Otway
PERMIT = VIC/P31
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = ERIC THE RED 1 WIRELINE LOG INTERPRETATION; 1:200, ENCLOSURE 1
REMARKS =
DATE_CREATED = *
DATE_RECEIVED = *
W_NO = W1077
WELL_NAME = ERIC THE RED 1
CONTRACTOR = BHP
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)

PE600079

This is an enclosure indicator page.
The enclosure PE600079 is enclosed within the container PE900173 at this location in this document.

The enclosure PE600079 has the following characteristics:

ITEM_BARCODE = PE600079
CONTAINER_BARCODE = PE900173
NAME = ERIC THE RED 1 COMPOSITE WIRELINE LOG; 1:200, ENCLOSURE 2
BASIN = Otway
PERMIT = VIC/P31
TYPE = WELL
SUBTYPE = COMPOSITE_LOG
DESCRIPTION = ERIC THE RED 1 COMPOSITE WIRELINE LOG; 1:200, ENCLOSURE 2
REMARKS =
DATE_CREATED = *
DATE_RECEIVED = *
W_NO = W1077
WELL_NAME = ERIC THE RED 1
CONTRACTOR = BHP
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)

9

Eric The Red-1

RFT REPORT

27 February 1993

Prepared by

Chris Taylor

Chris Taylor
Reservoir Engineer

Approved by

M. Shircore

26/4/93

Mark Shircore
New Developments Manager

ETR1_REP.DOC

APRIL 1993

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1. CONCLUSIONS

1. A fluid gradient of 1.41 psi/m was measured in the sands present in the Lower Shipwreck Group.
2. All of the sands intersected in the Lower Shipwreck Group were at one stage, or are now, in hydraulic communication via a common aquifer.
3. Permeabilities measured with the RFT tool in Eric The Red-1 lie between 1000 and 5000 mD.
4. The pressure measured during the Pecten-1A DST lies on the same aquifer gradient as the pressures measured in Eric The Red-1.
5. The pressures measured in La Bella-1, in the same formation as those tested in Eric The Red-1, are overpressured by at least 550 psi and have a different gradient.

2. GEOLOGY[1]

Eric The Red-1 was drilled in the southeastern part of Vic/P31 in the eastern Otway basin approximately 35 km east of Mussel-1, (Figure 1). The well was designed to test the fault dependant closure mapped at the top of the Upper Shipwreck Group.

The Eric The Red-1 structure is a northeast-southwest trending elongate anticline. Both older east-west and younger north-south oriented faults cross cut and bound the structure.

The primary reservoir is the Lower Shipwreck Group and is sealed by overlaying claystones and siltstones of the Sherbrook Group and the Upper Shipwreck Group. The well intersected no hydrocarbons. Preliminary investigations indicated that leakage of any hydrocarbons into thief zones may have occurred across the numerous faults present throughout the structure.

The well data sheet, which provides a summary of the key well information, is given as Table 1.

3. RFT PROGRAM

3.1 Objective

1/. To determine the aquifer fluid gradient and pressure regimes of the various sands intersected by Eric The Red-1.

3.2 RFT Tool Configuration

The Schlumberger RFT-B tool with a Gamma Ray sensor, and AMS sonde were used. A standard area packer and standard long nose probe was used. Stand offs were placed on the Gamma Ray sensor.

3.3 Open Hole Reference Log

All depths are referenced to the 8 ½" open hole DLL/MSFL/SDT/GR logs run on 26th February 1993, (Enclosure 1).

4. RFT PRE-TEST INTERPRETATION

4.1 Pressure Summary

All pretest and sample pressures are given in Table 2. The pretest data is plotted in Figure 2.

4.2 Temperature

Figure 3 shows the temperatures measured in the Eric The Red-1 ST well versus depth, and Figure 4 shows the temperature versus time from the start of the RFT survey.

The maximum temperature recorded during the RFT survey was 71 °C at 1781.0 mRT.

4.3 Quality Control

Initial and final strain gauge hydrostatic mud pressures recorded before and after each pretest were in close agreement (see Table 2 and Figure 5). Figure 6 shows a plot of the hydrostatic pressure gradient measured with the strain gauge. The hydrostatic gradient indicates a mud specific gravity (SG) of 1.10 (1.56 psi/m). This is exactly the same as the reported mud gravity measured on the rig (1.10 S.G).

4.4 Reservoir Fluid Gradients

The reservoir fluid gradients which were determined from the strain gauge pretest data are shown in Figure 2. As can be seen from this figure, the pretest points lie on a 1.41 psi/m water gradient.

Extrapolating this gradient to sea level gives an overpressuring of 40 psi, indicating within the accuracy of the evaluation, that the aquifer is normally pressured.

No hydrocarbon-water contacts were interpreted in Eric The Red-1.

4.6 Permeabilities[2]

Horizontal permeability estimates calculated from the open hole pretests are given in Table 2.

The assumptions made to correct the calculated spherical mobility to horizontal permeability were:

1. Mud filtrate viscosity = 0.50 cP
   (Temp = 60^0C, Pressure = 2,400 psia,
   Equivalent NaCl salinity = 41,000 ppm)

2. $K_h/K_v = 1$

The correction used was:

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

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

K_h/K_D = 1.00
= ratio of horizontal to drawdown permeability. This is a function of K_h/K_v and flow geometry; which is spherical, (Table A1, Ref [1]).

K_{rw} = relative permeability to filtrate.
= 1.0

The permeability estimates made from the RFT pretests are listed in Table 2, they range from 1000 to 5300 mD.

4.7 Comparison to other wells

The RFT program in Eric The Red-1 (ETR-1) was designed to provide data on the regional aquifer. Prior to the ETR-1 RFT survey there were only two other pressure data points in the two permits VIC/P30 and VIC/P31, (La Bella-1, and Pecten-1A).

Pecten-1A was drilled in 1967 by Shell in what is now VIC/P30. The well drill stem tested a small gas sand in the Lower Shipwreck Group. The well completion report states the SIBHP measured during the DST to be 2420 psig at 1688 mSS.

La Bella-1 was drilled in 1993 by BHPP in the southeastern part of Vic/P30. The well was designed to test the fault dependant closure mapped at the Upper Shipwreck Group. The well intersected a 68 m gross gas column in the Upper Shipwreck Group. RFT data indicated an overpressured zone in the Lower Shipwreck Group with an abnormally high fluid gradient of 1.66 psi/m.

As can be seen in Figure 7, the single pressure point obtained in Pecten-1A lies along the observed pressure gradient of ETR-1. This would indicate that ETR-1 and Pecten-1A are, or have at one stage, been in hydraulic communication.

La Bella-1, on the other hand, has an overpressured Upper and Lower Shipwreck Group, (w.r.t ETR-1) which indicates that this formation is not in communication with La Bella-1 and ETR-1.

5. REFERENCES

[1] Eric The Red-1 Drilling Program.

[2] BHP Petroleum RFT Manual.
December 1988.

ERIC THE RED - 1: RFT DATA SHEET

Test	Depth		Time	Initial Hydrostatic Pressure	Formation Pressure	Temperature Deg C		Final Hydrostatic Pressure	Mobility	Permeability*	Comments
No.	mRT	mTVDSS	hh:mm	psig	psig	AMS	Strain	psig	mD/cp	mD	
1	1058.5	1033.5	05:20	1679.2	1496.8	50.2	51.8	1677.8	3164	1600	Good Test
2	1154.0	1129.0	05:35	1828.0	-----	-----	-----	-----			Lost Seal
3	1343.5	1318.5	06:05	2129.5	1897.8	57.7	59.3	2123.5	340	170	Good Test
4	1378.5	1353.5	06:17	2178.0	1947.2	58.3	60.1	2178.2	60	30	Good Test
5	1478.5	1453.5	06:30	2334.0	2088.8	60.4	61.8	2339.7	8	10 **	Good Test
6	1631.5	1606.5	06:55	2573.4	2306.6	65.1	66.8	2573.7	7	10 **	Good Test
7	1781.0	1756.0	07:25	2806.5	-----	70.0	71.4	-----	-----		Tight
8											
9	1154.5	1129.5	05:40	1828.3	1631.1	52.4	54.4	1828.2	1095	550	Good Test
10	1781.5	1756.5	07:30	2807.0	-----	-----	-----	-----	-----		Tight
11	1785.0	1760.0	07:35	2812.7	-----	-----	-----	-----	-----		Tight

* Permeabilities rounded to nearest 10 mD for <1000 mD, and nearest 100 mD for >1000 mD.

** Qualitative log inspection indicates permeabilities far greater than those indicated here.

Witness: James Boorman

Date: 27th Janurary 1993

Well KB: 25.0 **m above MSL**

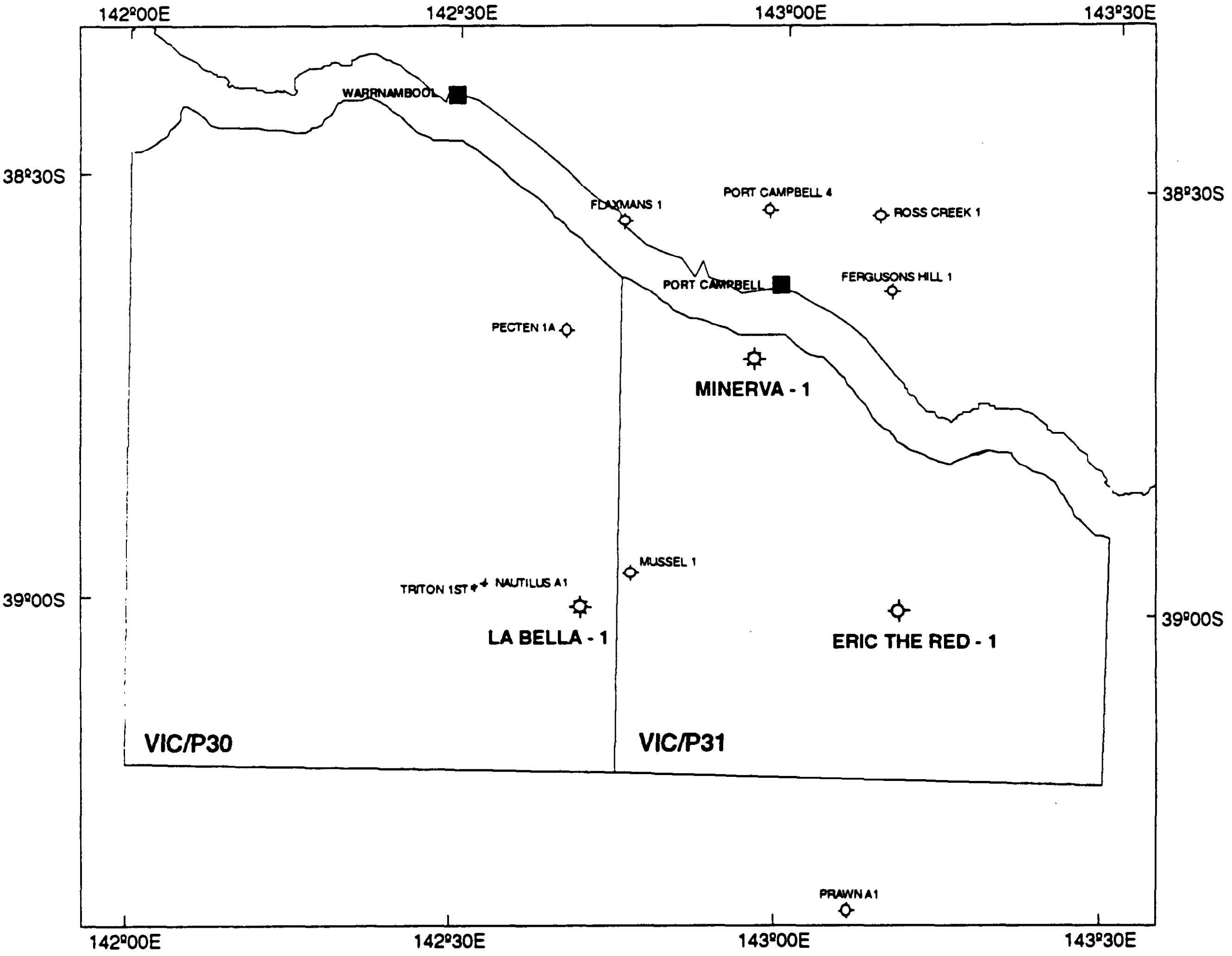
Riig: Byford Dolphin

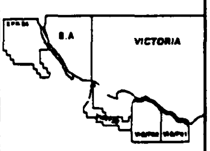
Filtrate Viscosity = 0.5 cP

k(rw) = 1.0

k(v)/k(h)=1.0

Table 2.





VICP30/31
WELL LOCATIONS
LABELLA-1, ERIC THE RED-1 & MINERVA - 1

BHP Petroleum

OTWAY BASIN

VICP30/P31
LOCATION MAP

AUTHOR:	DATE: 05/04/93
DRAWN BY TDELPHIN	DWG NO: 006_TD

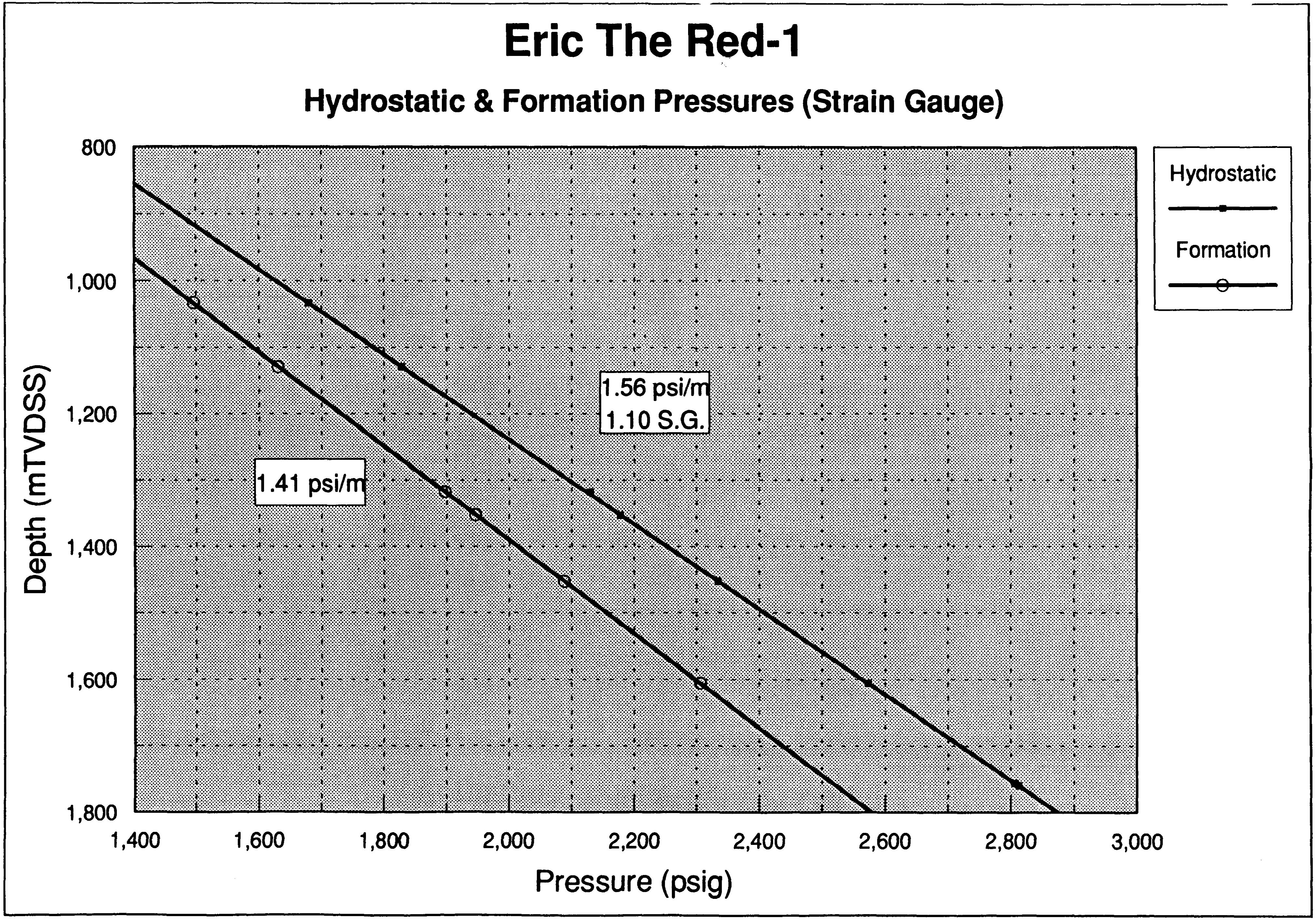

Eric The Red-1
Hydrostatic & Formation Pressures (Strain Gauge)
Depth (mTVDSS)
800
1,000
1,200
1,400
1,600
1,800
1,400
1,600
1,800
2,000
2,200
2,400
2,600
2,800
3,000
Pressure (psig)
Hydrostatic
Formation
1.56 psi/m
1.10 S.G.
1.41 psi/m

Figure 2.

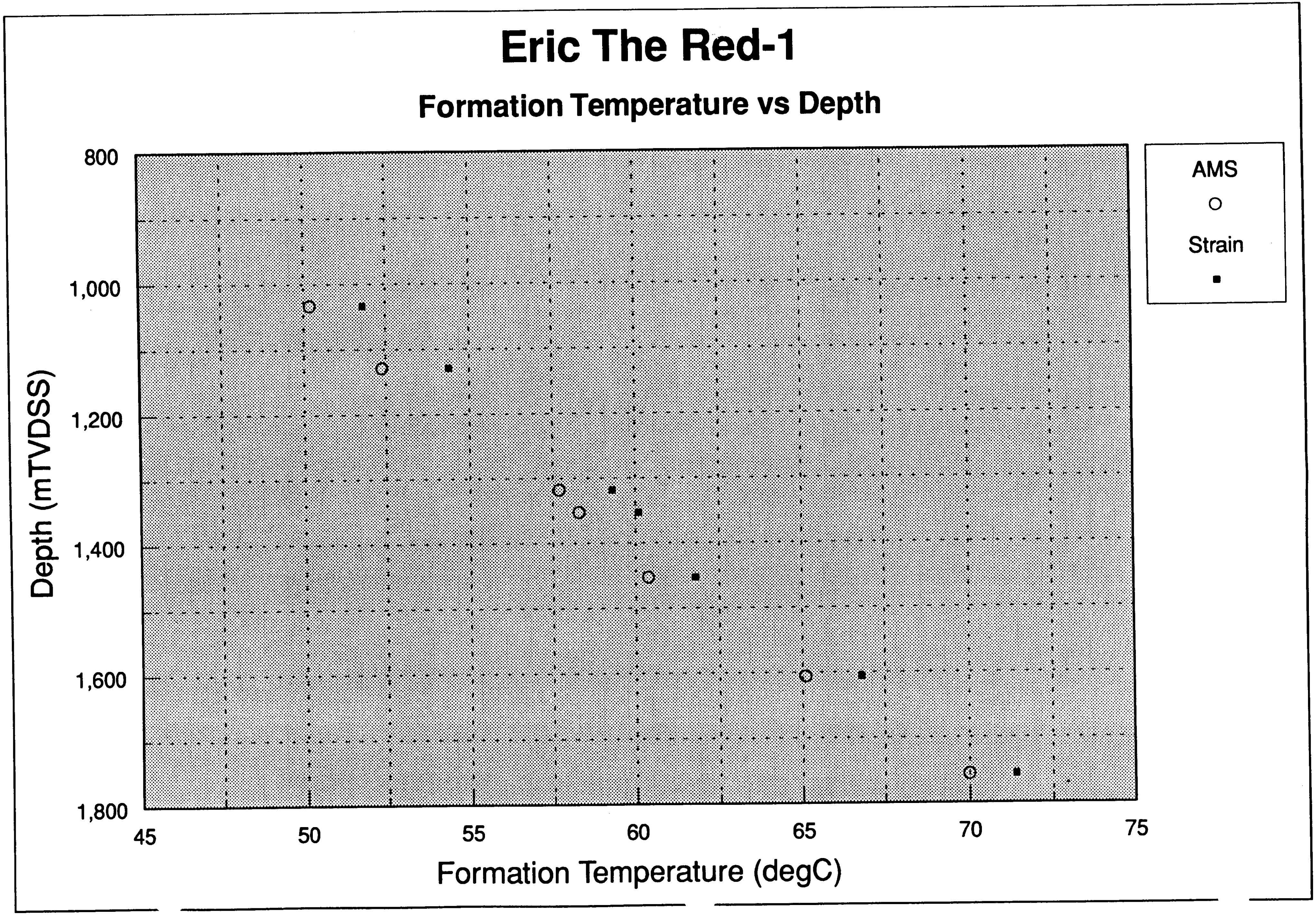

Eric The Red-1
Formation Temperature vs Depth
Depth (mTVDSS)
800
1,000
1,200
1,400
1,600
1,800
45
50
55
60
65
70
75
Formation Temperature (degC)
AMS
○
Strain
■

Figure 3.

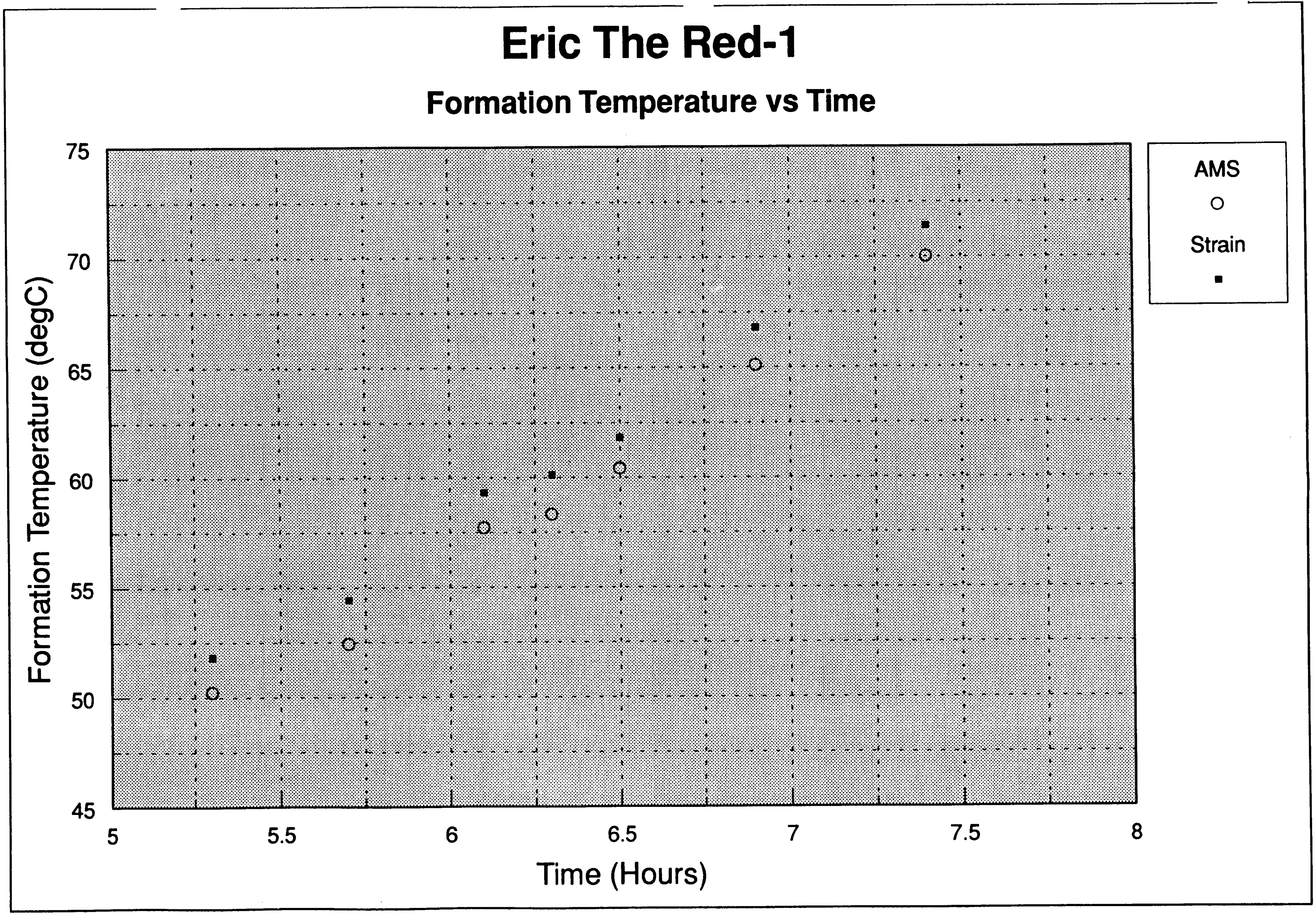

Eric The Red-1
Formation Temperature vs Time
Formation Temperature (degC)
75
70
65
60
55
50
45
5
5.5
6
6.5
7
7.5
8
Time (Hours)
AMS
○
Strain
■

Figure 4.

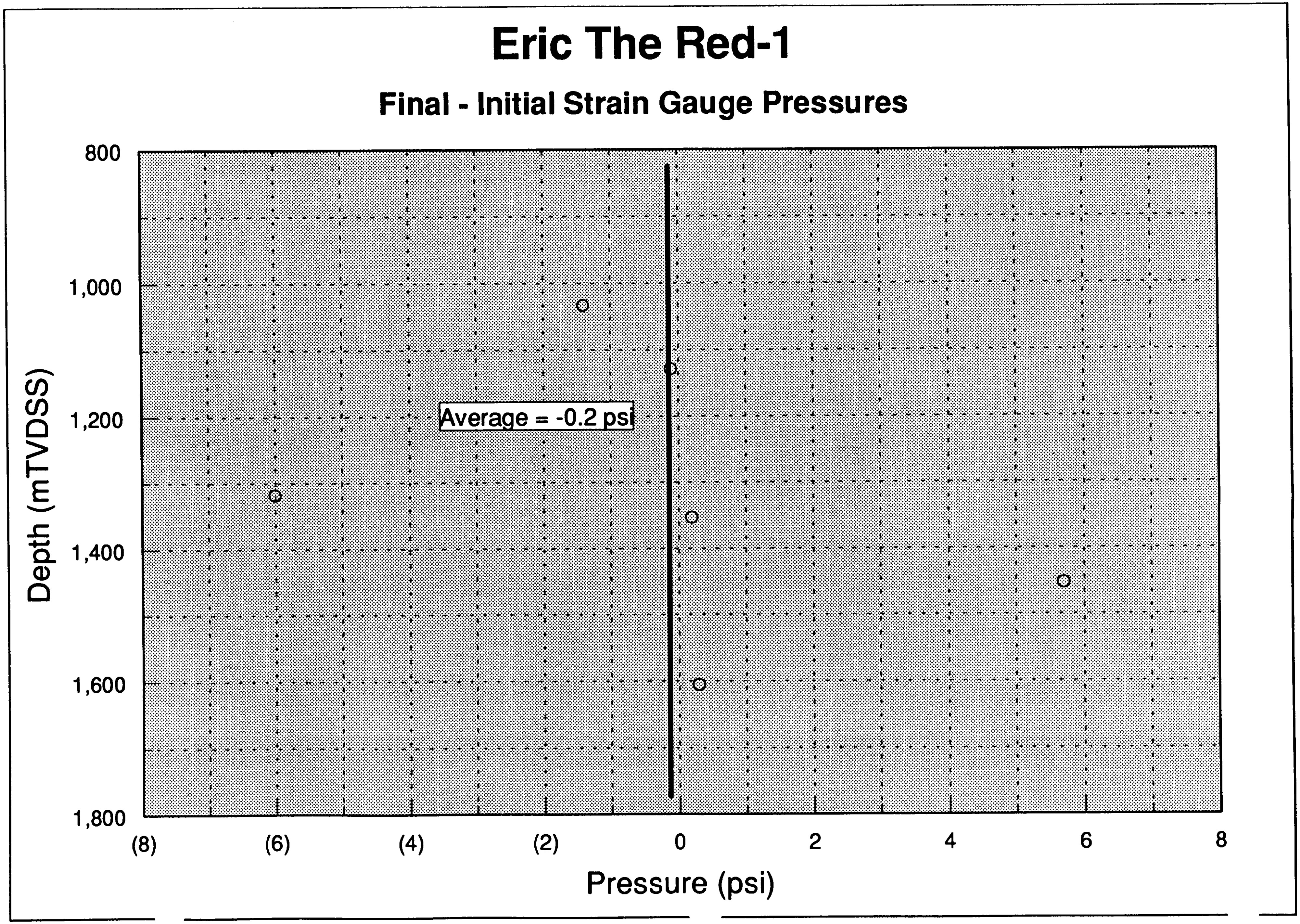

Eric The Red-1
Final - Initial Strain Gauge Pressures
Average = -0.2 psi
Depth (mTVDSS)
800
1,000
1,200
1,400
1,600
1,800
(8)
(6)
(4)
(2)
0
2
4
6
8
Pressure (psi)

Figure 5.

Eric The Red-1

Hydrostatic Pressure (Strain Gauge)

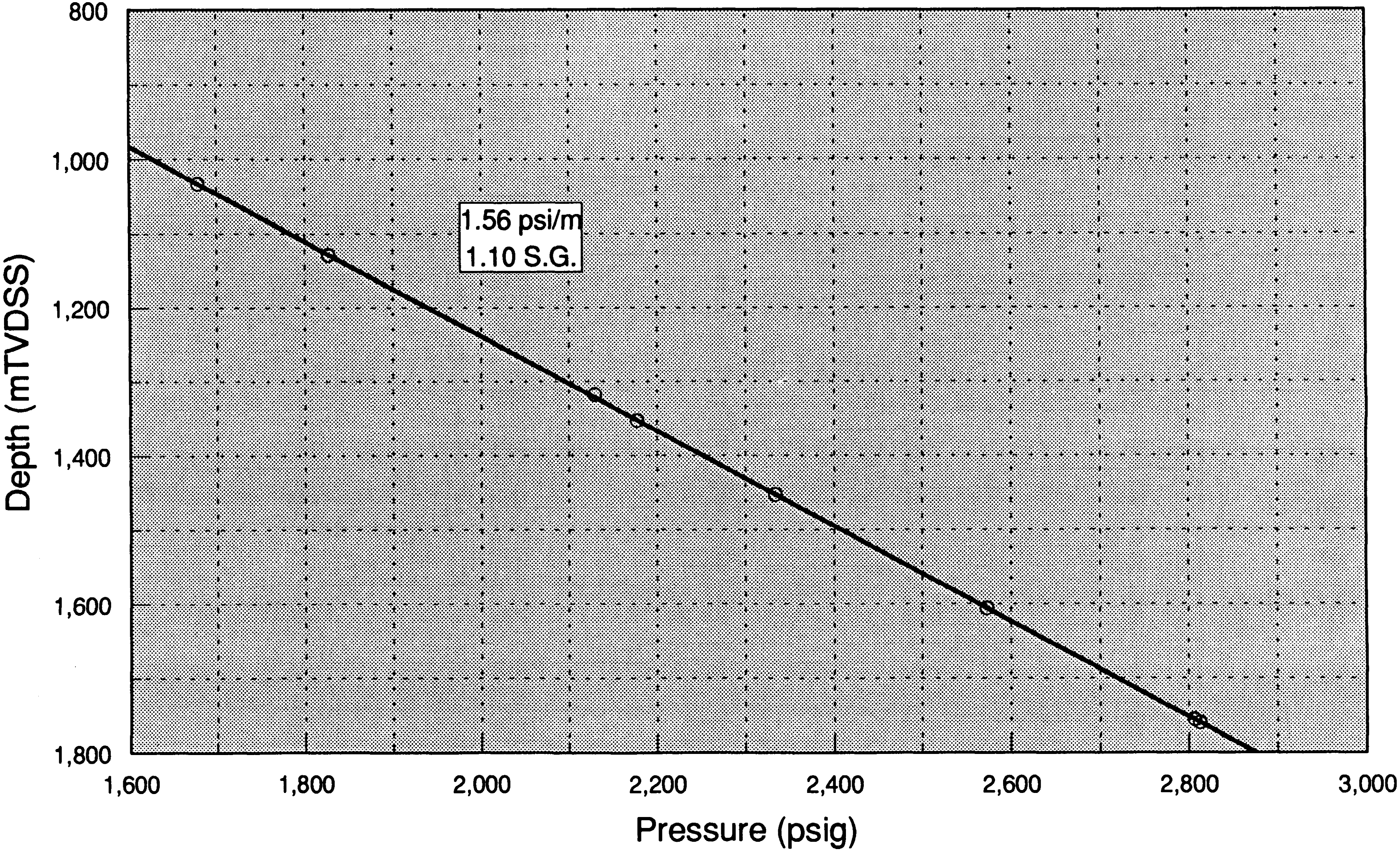


Figure 6.

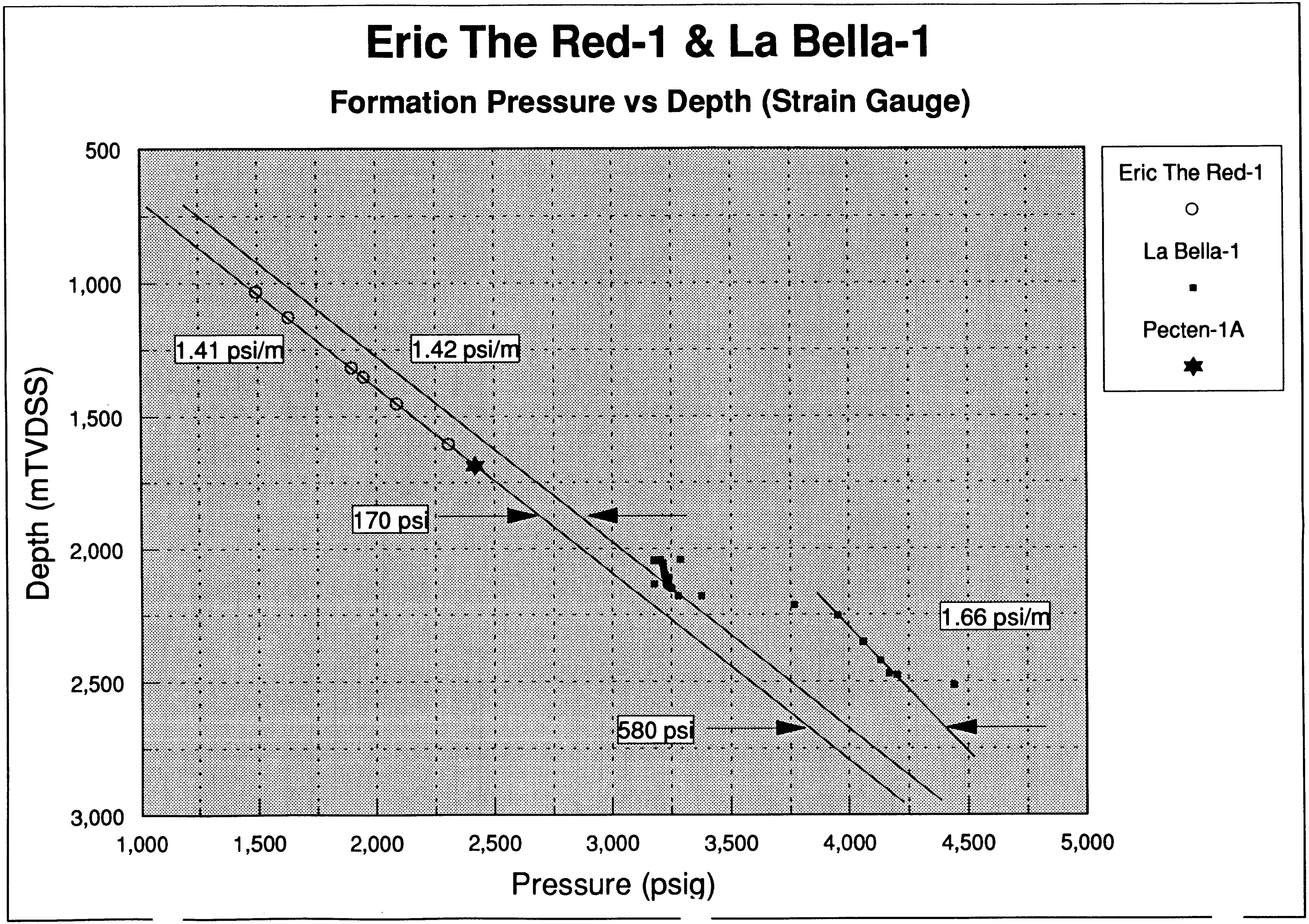

Eric The Red-1 & La Bella-1
Formation Pressure vs Depth (Strain Gauge)
Depth (mTVDSS)
500
1,000
1,500
2,000
2,500
3,000
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
Pressure (psig)
1.41 psi/m
1.42 psi/m
170 psi
580 psi
1.66 psi/m
Eric The Red-1
○
La Bella-1
■
Pecten-1A
★

Figure 7.

ENCLOSURE 1:

Eric The Red-1 DLL-MSFL-SDT-GR-AMS LOG

PE600068

This is an enclosure indicator page.
The enclosure PE600068 is enclosed within the container PE900173 at this location in this document.

The enclosure PE600068 has the following characteristics:

ITEM_BARCODE = PE600068
CONTAINER_BARCODE = PE900173
NAME = ERIC THE RED 1 DLL-MSFL-AS-GR-AMS-SP (1871-1007M), SUITE-2; RUN-2; 1/200
BASIN = Otway
PERMIT = VIC/P31
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = ERIC THE RED 1 DLL-MSFL-AS-GR-AMS-SP (1871-1007M), SUITE-2; RUN-2; 1/200
REMARKS =
DATE_CREATED = *
DATE_RECEIVED = 16/03/93
W_NO = W1077
WELL_NAME = ERIC THE RED 1
CONTRACTOR = SCHLUMBERGER
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)

PE600069

This is an enclosure indicator page.
The enclosure PE600069 is enclosed within the container PE900173 at this location in this document.

The enclosure PE600069 has the following characteristics:

ITEM_BARCODE = PE600069
CONTAINER_BARCODE = PE900173
NAME = ERIC THE RED 1 DLL-MSFL-AS-GR-AMS-SP (1871-1007M), SUITE-2; RUN-2; 1/500
BASIN = Otway
PERMIT = VIC/P31
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = ERIC THE RED 1 DLL-MSFL-AS-GR-AMS-SP (1871-1007M), SUITE-2; RUN-2; 1/500
REMARKS =
DATE_CREATED = *
DATE_RECEIVED = 16/03/93
W_NO = W1077
WELL_NAME = ERIC THE RED 1
CONTRACTOR = SCHLUMBERGER
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)

PE600054

This is an enclosure indicator page.
The enclosure PE600054 is enclosed within the container PE900173 at this location in this document.

The enclosure PE600054 has the following characteristics:

ITEM_BARCODE = PE600054
CONTAINER_BARCODE = PE900173
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BASIN = Otway
PERMIT = VIC/P31
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = ERIC THE RED 1 WELL SUMMARY LOG
REMARKS =
DATE_CREATED = *
DATE_RECEIVED = *
W_NO = W1077
WELL_NAME = ERIC THE RED 1
CONTRACTOR = BHP
CLIENT_OP_CO = BHP

(Inserted by DNRE - Vic Govt Mines Dept)