W775

WCR
HAMMERHEAD-1
(W775)

SHELL - AUSTRALIA E. & P. OIL AND GAS

I.D. 0390A/0073A

SDA 412

WELL COMPLETION REPORT
HAMMERHEAD-1
GIPPSLAND BASIN,
OFFSHORE VICTORIA (VIC/P19)

OFFSHORE VENTURES TEAM/
PETROLEUM ENGINEERING

JULY 1982

Keywords: exploration well, Rosedale Fault, Latrobe, intra-Latrobe, Strzelecki, coastal, barrier, coastal plain, alluvial, braided streams, carbonaceous mudstone, coal, glauconite, Eocene, Paleocene, Upper Cretaceous, coastlines, co-ventures

SHELL DEVELOPMENT (AUSTRALIA) PTY LTD

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* included in basic data package

1. SUMMARY

Hammerhead-1, the first well to be drilled in Permit VIC/P19, was designed to test a potentially large fault closure (about 25 sq. km) against the complex Rosedale fault system, some 9.5km WSW of Dart-1. The objective was Upper Cretaceous/Paleocene coastal sand, topsealed by a marine shale of Paleocene age and laterally sealed by tight continental sediments of the upthrown Strzelecki Group. Critical factors for the prospect included the absence of direct evidence of effective seals within the area and uncertainties concerning source rock quality within the drainage area of the trap (the southern sector of Permit VIC/P19).

The well was spudded on the 17th May 1982 by the semi-submersible rig Diamond M 'Epoch', and plugged and abandoned as a dry hole on the 24th June, at a total depth of 2130m bdf (loggers depth 2126m). Repeat formation tests recovered saline water (21,900 ppm NaCl) from the objective section, which comprised clean coastal sand of good reservoir quality. Although all formations were encountered close to prognosis, the postulated top seal section included only about 6m of holomarine facies of good sealing quality; the remainder consisted of about 50m of interbedded sand and shale developed in a coastal plain/lagoonal environment. The thin top seal is regarded as the prime cause of failure of the trap.

The data from this well has refined the palaeogeography (essential to assessment of the hydrocarbon prospects) of the central and southeastern part of the permit area.

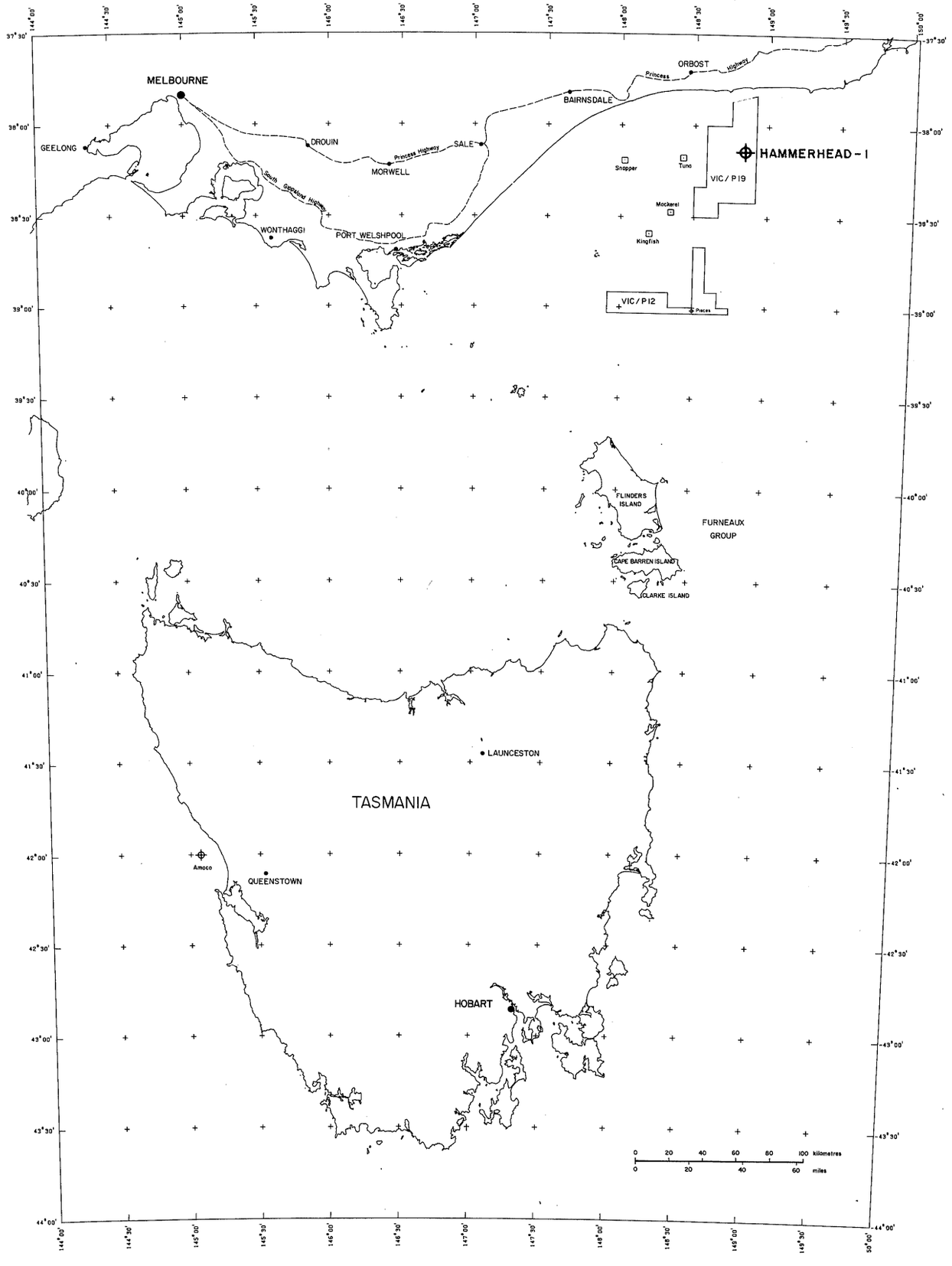
2. INTRODUCTION

Hammerhead-1 was the first well to be drilled by Shell in permit area VIC/P19, in partnership with News (20%), TNT (20%), Crusader (15%) and Mincorp (5%). The well is located 9.5km WSW of Dart-1 at SP 5124 on seismic line GS81A-81 in a water depth of 121m (Fig 1).

The well tested a potential intra-Latrobe trap on the southern, basinward side of the Rosedale Fault System. The objective reservoir was Upper Cretaceous/Paleocene coastal sand sealed above by a (postulated) marine shale of Paleocene age, and laterally by tight continental sediments of the Strzelecki Group.

Seismic interpretation based on a 1981 grid of average density 1.5 x 3 km, with dip lines migrated, showed a large mid-Paleocene closure (up to 25 sq. km), fault-bounded to the north. This closure formed in late Eocene times and increased in size during the Late Tertiary due to southward regional tilt. The structure has a large effective drainage area (covering the entire southeastern part of the permit), which has been mature for oil generation since Miocene time. Late Cretaceous-early Paleocene (Latrobe) lower coastal plain source rocks with oil and gas potential were predicted to be present (as in Hapuku-1), as well as the possibility of Cretaceous (Strzelecki) mature gas source rocks.

The Hammerhead prospect was initially identified by the SD(A) Southern Australia Team in 1975 as the "A" lead (SDM 154), subsequently becoming the "K" prospect in the application study (SDA 289). Prior to 1981, seismic control over the prospect consisted primarily of a 3 x 3 km grid of 12 and 24 fold data shot for Esso in 1969. This was augmented by a further three lines acquired in 1971. Although the quality of these lines was fair, sections available on open file were unmigrated and lacked definition at depth. To clarify the complex structural picture, a grid consisting of 11 dip lines and 2 strike lines was acquired by GSI for SDA in late 1981, with an average spacing of 1.5 km between N-S orientated lines and 3 km between E-W sections.



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HAMMERHEAD - 1

LOCATION MAP

Author: EPE/1	Date: August 1982	Fig. 1
Report No.: SDA 412	Drawing No.: 14368	

The particular well location and total depth were chosen so as to minimise the risk of leaving commercial quantities of oil up-dip, and to maximise the amount of geological information obtained for prospect evaluation of the poorly known central and southeastern portions of VIC/P19.

3. WELL HISTORY

HAMMERHEAD — 1

3.1 Summary of Well Data

Well Classification	Expendable exploration well	
Final location coordinates	38° 10' 34.23"S	
	148° 49' 59.30"E	
Contractor/Rig	Diamond M Drilling Co./Epoch	
Derrick Floor Elevation	22m above MSL	
Water Depth	121m below MSL	
BOP stack	10,000 psi, 16-3/4"	
Start of Operations	1700 hrs, 15.5.82	
Spudded	0230 hrs, 17.5.82	
Abandoned	0930 hrs, 23.6.82	
Rig Released	0455 hrs, 2.7.82	
Objective	Evaluation of Upper Cretaceous/ Paleocene sequence of the Latrobe Group	
T.D.	2130m (loggers depth 2126m)	
Formation at T.D.	Probably Strzelecki Group (Upper Cretaceous)	
Results	Dry hole	
Costs	A$12,219,606	
Casing Record	30" at 194m	
	20" at 554m	
	9-5/8" at 1184m	
Logs	ISF/BHC/GR/SP	2125 - 530m
	FDC/CNL/GR/CAL	2124 - 530m
	MSFL/DLL/GR	1183 - 2113m
	CST	Interval 1195-600m
		Interval 2123-1199m
	RFT	Interval 2111-1296.5m
	HDT	2115 to 1183m
	Velocity Survey	Interval 2110-560m

3.2 Site Survey

Prior to Diamond-M Epoch's arrival, a site survey and sea bed sample programme was performed over three chosen sites in the permit area (See Fig. 2), the Hammerhead-1 site being conducted from 10-12 April, 1982 (Site Survey 3).

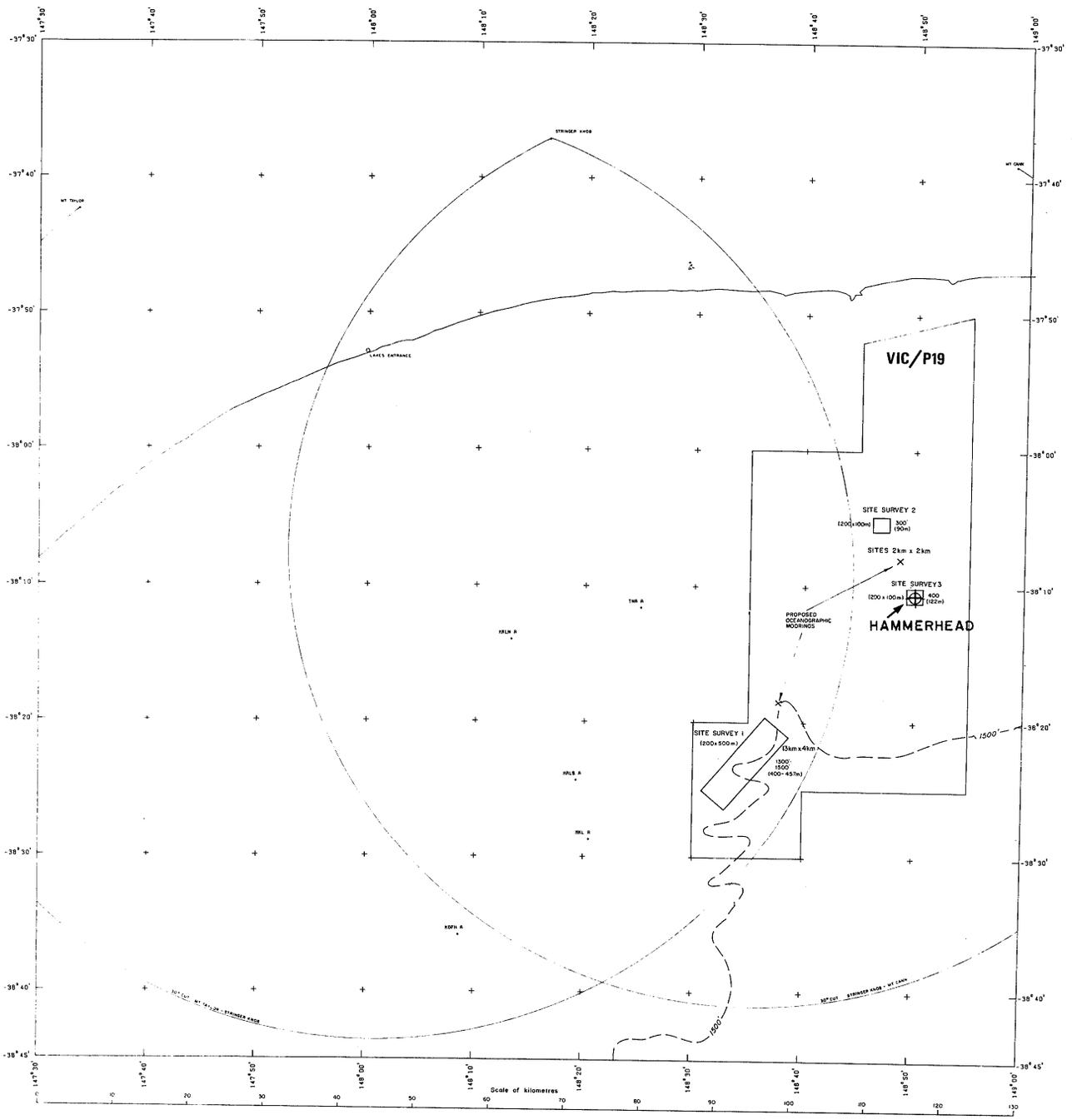
Prior to drilling an offshore well, it is preferred for safety and insurance purposes to have some knowledge of any near surface gas pockets, sea bed irregularities and a sample of the sea bed for anchor holding. In addition, information of sea current speed and direction is essential, especially in deep water areas.

For this purpose, E G & G were contracted to provide a 9kJoule Sparker System and 1200 ft 24 group (50 ft/group) streamer, recording seismic data on a 24 channel Electromechanique digital system. Seismic survey data was sampled at 1/2 millisecond, and 106.984km of 24 fold coverage recorded across profiles spaced 100 metres apart in the north-south direction, 200 metres apart in the east-west direction, 1 second of data was recorded and later processed by Digicon (Singapore).

As an aid to interpretation, a High Resolution Boomer was also employed to provide near surface data. E G & G (Singapore) were contracted to interpret the seismic sections and their report (number R4252) indicated that near surface gas pockets were unlikely.

Five sea bed cores were taken, one on the Hammerhead-1 location and one on each corner of the 2km x 2km site. On average, a metre of fine sand with silt and clay was recovered from every drop core catcher.

Prior to its use, the 'Sunrad EA' echosounder was calibrated to an accuracy of 0.5% with a bar check to 70 metres, and the resultant analog display proved that the water depth over the site was generally 120 metres. Velocity of sound averaged 1506 m/sec.



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GIPPSLAND BASIN

VIC/P19

SITE SURVEY LOCATIONS

Author: EPE/1	Date: August 1982	Fig. 2
Report No.: SDA 412	Drawing No.: 14369	

The side scan sonar deployed over the Hammerhead-1 site, to locate and display any sea bed features showed a flat and featureless bottom, with only sand ripples evident.

As an ongoing oceanographic programme to observe sea current conditions, a mooring was positioned 5km north-west of the Hammerhead-1 location, recording 3 levels of sea current speed and direction plus wave height data. Upon completion of the well, the mooring was removed. During the time of drilling activity, a peak wave height of 28 ft was recorded.

The survey vessel used was M/V Halcyon, working out of Portland, Victoria. During the survey, the vessel travelled to Eden where its propeller was removed and repaired. On completion of the total site survey programme, the vessel deployed the oceanographic moorings prior to Epoch's arrival.

Associated Osiris Surveys were contracted to provide a Syledis shore-based navigation chain, with 3 stations along the Victorian coastline. A Hewlett-Packard HP9845 computer was usefully employed to perform the site survey, on completion of which the equipment was placed on stand-by, and later used for the Epoch rig positioning. Further details of the equipment may be obtained from the positioning section of this report.

3.3 Navigation and Positioning

As described previously, prior to the rigs arrival a site survey was performed, the positioning of which was by three shore based radio location Syledis beacons occupying first order points at Mt Taylor, Stringer Knob and Mt Cann.

On completion of the site survey, the navigation equipment was stored in Melbourne and re-mobilised for the rig's arrival.

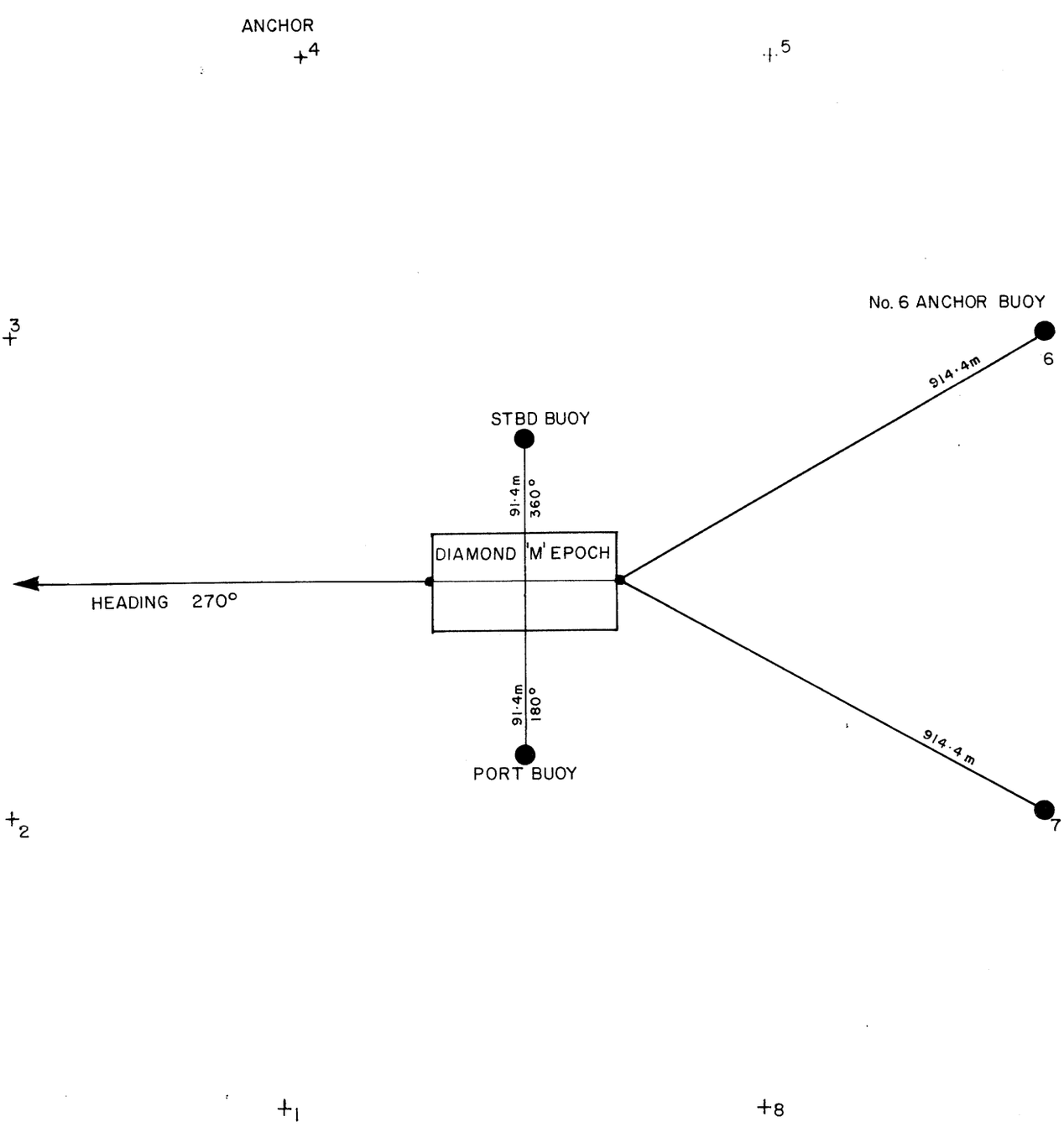
Prior to the rig's arrival, the Syledis chain was calibrated at Seaspray Beach, Victoria across a short baseline of 3.605km. The three stations were then established, with the mobile set being installed on the vessel M/V Coral-J. The vessel departed Port Welshpool for the location on 11th May, arriving during the morning of 12th May.

Four marker buoys had been made for positioning either side of the location and to mark anchors 6 and 7 (Fig. 3). However, these were not deployed since the rigs departure from the previous location was delayed due to inclement weather. As a result of the same storm, M/V Coral-J sheltered during the evening of 12th May in Lakes Entrance, departing at mid-day on 14th May when it was considered that the rig would commence picking up anchors at any time.

An RMS error of some 2-3 metres was computed by the HP 9845 interfaced with the Syledis mobile, and the four marker buoys were deployed during the evening of 14th May. During the following morning, a re-check of the buoys confirmed a shift of the port location buoy of some 70 metres, while no other marker buoy was found. It was surmised at the time that fishing vessels had removed the buoy, but later proved that a poorly designed shackle had sheared. The port buoy was repositioned while starboard location and anchor 6 marker buoys were replaced.

The Syledis mobile and HP9845 computer were transferred to the rig on the evening of 15th May . The rig was towed to location by M/V Maersk Handler during the early hours of 16th May, anchor 6 being deployed at 03.15 hours. The computer video displayed desired location with respect to actual rig location, and was usefully employed by the barge master to assist anchor deployment decision making.

During anchor running, RMS errors were computed at 0-3 metres, peaking to 7 metres occasionally. As the rig rotated during anchor tensioning, values of RMS error of positioning varied to 10 metres.



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GIPPSLAND BASIN

PROPOSED ANCHOR PATTERN FOR HAMMERHEAD-1 DIAMOND 'M' EPOCH (REVISED)

Author: EXN/1	Date: April 1982	Fig. 3
Report No.: SDA 412	Drawing No.: 13685	

Anchors were storm tensioned soaked and relaxed while the rig settled on location (see Fig. 4). At 20.30 hours on 16th May anchors were set and derrick position computed as 7 metres west, 3 metres south of desired location i.e. 38°10'34.23"S; 148°49'59.3"E (660566E, 5773035N).

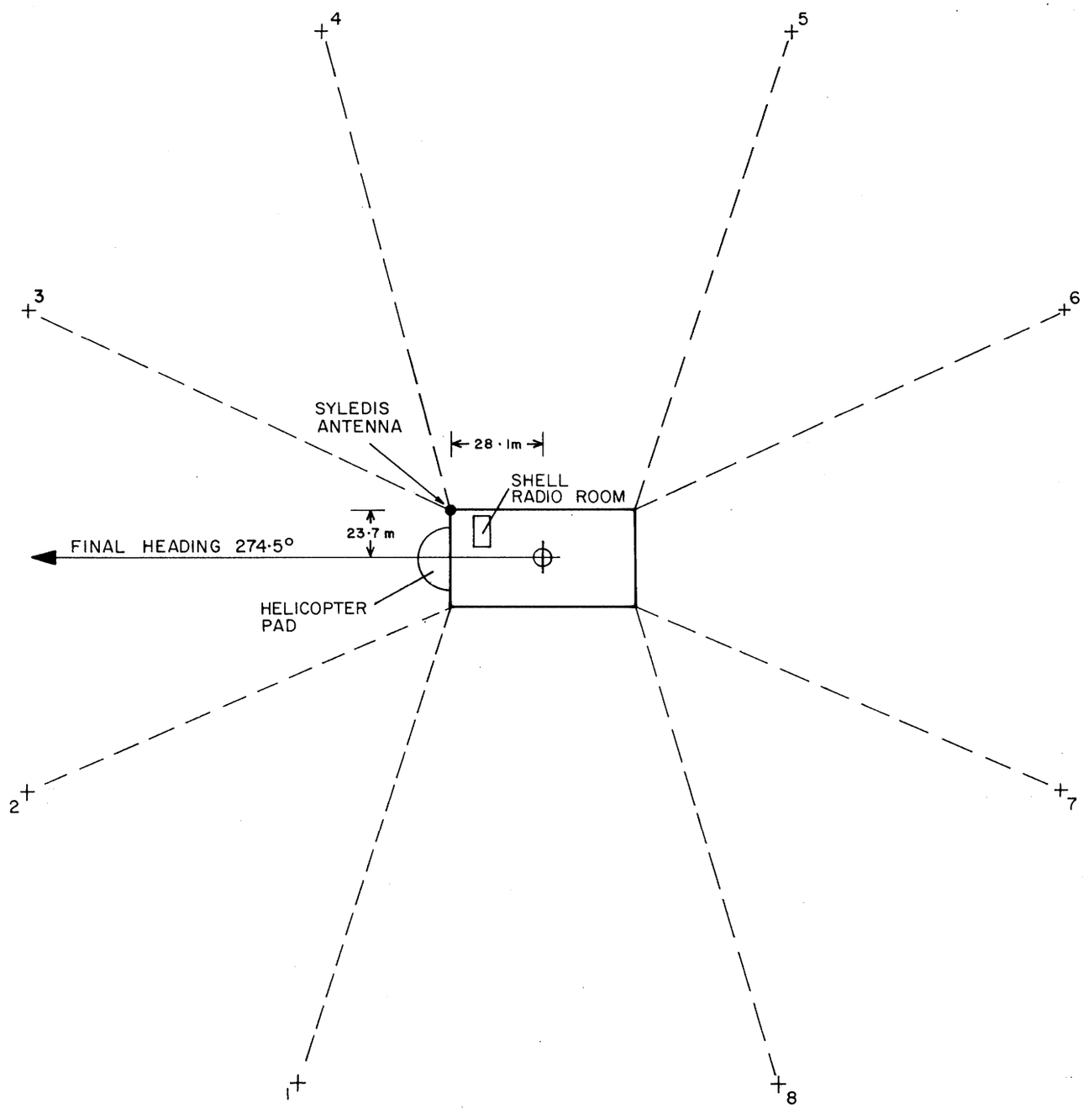
Shortly after spudding-in, work on the drilling floor caused a large fluctuation in rig supply frequency, which caused a fault with the computer. In addition, reflections of swinging cranes caused instability in signal reception. Thereafter, signal ranges were averaged and position computed with a T.I. 59 calculator.

During the morning of 17th May, a further suite of readings confirmed the location (as above) $\pm$4 metres radially.

At 10.00 hrs that morning, the Syledis mobile and computer were re-installed on M/V Coral-J and a series of transits past the rig confirmed the rig heading as 274.5 degrees true, with a bearing to the flag pole (from the drilling floor) of 1.5 degrees from rig heading.

M/V Coral-J was then instructed to head for Port Welshpool and was eventually demobilised on 18th May 1982.

For further information on the rig location, the reader should refer to report SDA 400.



38° 10' 34·23" S, 148° 49' 59·30" E

660566E, 5773035N

AMG. ZONE 55, CM 147°

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GIPPSLAND BASIN

HEADING AND ANCHOR PATTERN OF DIAMOND 'M' EPOCH AT HAMMERHEAD - 1

Author: EXG/2	Date: May 1982	Fig: 4
Report No.: SDA 412	Drawing No.: 13816	

3.4 Drilling History

The Diamond M "Epoch" (with support boats M/V Maersk Helper and M/V Maersk Handler) was accepted from Union Texas at 1700 hrs, 15.5.82, about 100km from the proposed location Hammerhead-A. With the "Helper" towing and the "Handler" in attendance, the rig arrived on location at 0330 hrs, 16.5.82, whereupon anchoring commenced and was completed at 1325 hrs. Six anchors had been laid by 0900 hrs, but because anchors 2 and 4 had dragged they were left to soak in for a further four hours. Ballasting of the rig was completed by 1830 hrs and final tensioning by 1900 hrs. All anchors were tested to 132 mt. Coordinates of the location were fixed at: Lat. 38^{o} 10' 34.23"S; Long. 148^{o} 49' 59.30"E.

Anti-rotation legs were attached to the TGB and it was landed at 121m below mean sea level. A penetration test was performed with the 26" bit/36" hole opener and gave 0.25m penetration with 2.3mt WOB. The well was spudded at 0230 hrs, 17.5.82, but the guideline wires became tangled and delayed drilling by 2.5 hours. The 36" hole was drilled to 202m in seven hours using seawater and viscous pills. Four joints of 30" casing were run, but some damaged and missing "O" rings resulted in leaks in the joints. After replacing and adding the rings, the casing was re-run with the Permanent Guide Base and cemented at 194m.

After the wellhead was washed, the riser with 30" pin connector was run, latched and tested with 23mt overpull. The diverter was installed and function tested, and a 14-3/4" bit was run to drill out the cement from 188-194m. A 12-1/4" pilot hole was drilled to 565m in eleven hours with seawater and viscous pills.

Rough weather (80 knot gusts and 10m waves at times) required disconnecting the pin connector and hanging off the riser. No further operations were possible for 91.5 hours. An unsuccessful attempt to run piggy-back anchors was made when the weather had subsided.

Logging in the 12-1/4" pilot hole was cancelled as no indication of gas had shown during drilling and the well had been observed static after disconnecting. A 12-1/4" bit/26" hole opener was run and the pilot hole was opened in 38.5 hours using seawater and viscous pills. The hole was displaced with 64 cum of viscous mud prior to chaining out of the hole and running 20" casing. Two cones were missing from the 26" hole opener. During this section of the hole 9mt piggy-back anchors were run 150m out from anchors 1, 2 and 3.

Twelve joints of 20" casing were run. No drag or fill was experienced. The casing was cemented with the shoe at 554m. An attempt to release the FMC 20" running tool was unsuccessful. One cum of seawater was pumped to overdisplace the stinger content and the casing pressured to 3450 kPa (500 psi) to try and assist in freeing the tool. This pressure was maintained for 15 minutes, after which time the circulating head broke off 10m above the rig floor. A Schlumberger casing-collar locator was subsequently run to ascertain that the stinger had not been cemented in place. The stinger was found free. Two primacord string shots were set off at 144m, while 45mt overpull was maintained on the drill string, without success. This procedure was repeated with 57mt overpull and the running tool came free.

The 16-3/4" BOP stack was function tested and run with two joints of riser. The choke line broke loose at the ball joint when tested to 27600 kPa (4000 psi) necessitating the stack to be pulled and the choke line to be repaired. After re-running, the stack passed all pressure tests. The cement was drilled out with a 12-1/4" bit and the pocket cleaned out to 565m. Junk from the 26" hole opener was observed.

Ninety five hours were spent drilling, milling, and fishing with a magnet to try and recover the junk and to make hole. After reaching 591m, a cement plug was set and the well was sidetracked from below the 20" shoe using a plug from 591-530m. The cement plug was dressed off with a 14-3/4" bit to 555m. Fifteen hours after the cement was in place a mud-motor with 2^{o} bent sub and

12-1/4" bit was used to commence the deviated hole which was drilled to 592m. Maximum deviation was 4^{o} at 585m. The mud-motor was laid down and 12-1/4" hole was drilled to 1200m. This section was drilled with a bentonite-CMC mud of 1.09-1.14SG.

A wiper trip was made to the 20" shoe without experiencing drag and the hole was conditioned prior to logging. In the first logging run (ISF/BHC sonic/GR/SP) the tool could not be lowered past 1041m and consequently the hole was logged from that depth. At 877m the tool became stuck and 3.6mt overpull was required to free it. Two rubber stand-off fins and the thermometers were lost. During the subsequent wiper trip, bridges were washed through at 939, 1041 and 1049m and 16cum of viscous mud was spotted on bottom. The second run (FDC/CNL/GR/CAL) and third run (SWS) were successful. All of the 30 sidewall samples shot were recovered and found to contain good samples.

A check trip was made and the wear bushing retrieved before rigging up to run 87 joints of 9-5/8" casing in 7.5 hours. The shoe was cemented at 1184m using a Halliburton subsea release system, however the top plug did not bump after overdisplacing by 0.8cum. The running tool was retrieved and the wellhead washed out before the seal assembly was set and tested to 5000psi. Before drilling out the cement a gyro multi-shot survey was run. It was decided to pressure test the casing first to 1000 psi in case there was no cement at the shoe and so not to exceed the formation breakdown gradient.

An 8-1/2" bit was run in the hole, cement was tagged at 1068m and dressed off to 1146m. Another pressure test to 2000 psi was conducted. Cement was drilled out to the shoe and the pocket cleaned out to 1200m. An extra 4m was drilled before the bit was pulled after balling up. Six additional drill collars were added to the bottom hole assembly and drilling continued to 1221m. A formation intake test was limited to 1.88SG equivalent mud weight and no leak-off was observed.

The 8-1/2" hole was drilled without event to 1722m, using a bentonite-CMC-lignosulphonate mud of 1.15-1.20 SG, when high torquing and detection of hydrogen by Geoservices indicated bit wear. A slug was pumped after circulating bottoms up and the bit was pulled out of the hole after 44.5 rotating hours. All three cones were lost and the bit was 1.25" out of gauge. In addition, the stabilizer was 1.5" out of gauge at its lower end. A soft formation bit was run with two stabilizers and the hole was reamed from 1697 to 1722m. After six hours on bottom with intermittent torquing, the bit was pulled at 1765m and was found to have a cone missing. A reverse circulating basket was run in hole when at 1754m the hole was undergauge and only 1m was reamed before pumping a slug and pulling out. A junk sub was added and six bit runs were made before TD was reached at 2130m. An abrasive formation, in addition to the junk in the hole, contributed to bit wear.

Before rigging up Schlumberger the hole contents were circulated and a check trip was made to 1725m. The hole was conditioned and the following TD logging was undertaken:-

Run No.	1	ISF/BHC Sonic/GR	2125-1183m
	2	FDC/CNL/GR/CAL	2124-1183m
	3	DLL/MSFL/GR	2113-1183m
	4	HDT	2115-1183m
	5	Velocity Survey	21 levels from 2100-560m

Total elapsed time for the above logging was 21.5 hours. A check trip was made prior to three RFT runs (17.5 hours) and two CST runs (5.5 hours). During the three RFT runs, 26 pretests from 2038-1296m were taken as well as two samples (1560m and 2038m). In CST run 1, 51 shots were attempted, 19 misfired, 1 was lost and 31 recovered. In CST run 2, 30 shots were attempted, 2 lost, and 28 recovered.

The plugging back programme was instigated after the above logging was completed. A 227m x 3-1/2" tubing cement stinger was run on drillpipe to 2080m and 6.4cum of viscous mud was spotted from bottom. Plug no. 1 was set from 1980-1780m and a second pill of

6.4cum of viscous mud spotted from 1680m. Plug No. 2 was set from 1580-1380m, 9cum of viscous mud spotted from 1326m and plug no. 3 set from 1214-996m. After laying down the tubing, drill pipe and bit were run back into the hole and cement plug no. 3 was tagged at 996m with 11.4mt WOB. The surface plug was set from 288-188m after spotting 5.6cum of viscous mud at 389m. Wellhead, casing and riser were subsequently displaced with seawater prior to pulling the stack on the marine riser.

The 16-3/4" running tool with ICI casing cutting explosives on drill pipe stringer were run in the hole with the explosives positioned to cut all casings below the wellhead. All casing stumps, wellhead, 30" wellhead housing and both guide bases were retrieved, and Hammerhead-1 was abandoned at 0930 hrs, 24.6.82. Due to adverse weather conditions, further three days were spent picking up anchors before tow commenced to a temporary anchorage en route to the Amoco location. The M/V Maersk Helper was towing. After anchoring, an emergency bridle was hooked up, repairs were made to anchor chains and bolsters, and supply boats were off/back loaded. With the M/V Maersk Helper towing, the rig left the safe anchorage and proceeded to the Amoco location at an average speed of about 5 knots, arriving at 0455 hrs on 2.7.82.

3.5 List of Contractors, Service Companies and Main Equipment

The Diamond M Epoch was brought into Australian waters under a two-year contract by Phillips. Shell Development (Australia) Pty Ltd had been assigned the contracts between Phillips Australian Oil Company and its contractors and service companies for the duration of the Hammerhead well:-

Drilling Contract	- Diamond M Marine Company
Supply Vessels	- Australian Offshore Services
Helicopter Services	- Okanagan Helicopter Australia Pty Ltd
Electric Logging etc.	- Schlumberger Seaco Inc.
Mud Logging	- Geoservices Overseas Inc.
Subsea Support Services	- Solus Ocean Systems
Surface Production Testing	- Flopetrol Schlumberger International Ltd
Cementing Services	- Halliburton Australia Pty Ltd (Services)
	- B.J. Service International Inc (Equipment)
Mud Service and Materials	- Baroid Australia Pty Ltd

Main Equipment

Drilling Vessel	
Design:	Diamond "M"
Built:	1977
Class:	ABS MG A7 Dr. unit
Derrick:	160 ft, 1,000,000 lbs
Drawworks:	Oilwell E-3000
Mud Pumps:	Oilwell 1700 PT Triplex
BOP's:	CIW 16-3/4 x 10,000 psi WP H4 wellhead connector
Accumulator:	Koomey 660 gals x 3000 psi

Well Head Equipment:	FMC-OCT
Cementing Unit:	Dowell
Solids Control Equipment:	Dual Hutcheson Hayes "Rhumba" 102 shakers Desander Demco 6 x 8" cones Desilter Demco 16 x 4" cones Mudcleaner Baroid 10 x 4" cones Degasser Wellco 5200

3.6 Drilling Data

3.6.1 Bit Record

See Table 1: Bit Record

3.6.2 Casing Summary

See Table 2: Casing Summary

3.6.3 Cement Record

See Table 3: Cement Record

3.6.4 Mud Record

See Table 4: Mud Record

The 36" and 26" holes were drilled with seawater and viscous pills with minimum control of properties. Before running the 20" casing the 26" hole was displaced with viscous mud (prehydrated Bentonite). For the 12-1/4" and 8-1/2" holes a Bentonite-CMC-lignosulphonate system was used. During the 8-1/2" section a continuing problem of aerating mud was attributed to contaminated drillwater causing a bicarbonate

PE904894

This is an enclosure indicator page.
The enclosure PE904894 is enclosed within the container PE902661 at this location in this document.

The enclosure PE904894 has the following characteristics:

ITEM_BARCODE	= PE904894
CONTAINER_BARCODE	= PE902661
NAME	= Bit Record Summary
BASIN	= GIPPSLAND
PERMIT	= VIC/P19
TYPE	= WELL
SUBTYPE	= DIAGRAM
DESCRIPTION	= Hammerhead 1 Bit Record Summary. Table 1 of WCR.
REMARKS	=
DATE_CREATED	= 31/07/82
DATE_RECEIVED	= 19/10/82
W_NO	= W775
WELL_NAME	= Hammerhead-1
CONTRACTOR	=
CLIENT_OP_CO	= Shell Australia

(Inserted by DNRE - Vic Govt Mines Dept)

TABLE 2. CASING SUMMARY WELL - HAMMERHEAD-1

DATE RUN	SIZE	GRADE	WT (lbs/ft)	COUPLING	SHOE DEPTH (m. bdf)	REMARKS
17.5.82	30"	B	310 (1" WT)	ATD (30" WHH: ATD-RB)	194	O-rings in coupling 4 joints
25.5.82	20"	X-56	133	Vetco LS (16-3/4" WHH: ATD)	554	O-rings in coupling 12 joints
7.6.82	9-5/8"	N-80	47	BTC	1184	87 joints

PE904895

This is an enclosure indicator page.
The enclosure PE904895 is enclosed within the container PE902661 at this location in this document.

The enclosure PE904895 has the following characteristics:

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BASIN	= GIPPSLAND
PERMIT	= VIC/P19
TYPE	= WELL
SUBTYPE	= DIAGRAM
DESCRIPTION	= Hammerhead 1 Cement Record. Table 3 of WCR.
REMARKS	=
DATE_CREATED	= 31/07/82
DATE_RECEIVED	= 19/10/82
W_NO	= W775
WELL_NAME	= Hammerhead-1
CONTRACTOR	=
CLIENT_OP_CO	= Shell Australia

(Inserted by DNRE - Vic Govt Mines Dept)

TABLE 4. MUD RECORD - WELL HAMMERHEAD-1

DEPTH METRE	TEMP deg C	W.T. sg	VIS sec	PV cp	YP	GELS 10 sec	GELS 10 mn	FILTRATE API cc	FILT cake	FILTRATE ANALYSIS Ca ppm	FILTRATE ANALYSIS Cl ppm	SAND %	RETORT ANALYSIS Water %	RETORT ANALYSIS Sols %	pH	pF	ME	MBT
565	20	1.03	37	4	9	3	7		2/32		17000	0.50	96	4	8.0	0.05		
576	21	1.03	34	4	11	4	5		4/32	600	13500	Trc	97	3	8.0	0.0	0.2	12.5
532	22	1.04	33	4	6	3	5		3/32	520	13000	Trc	97	3	8.5	0.08	0.22	12.5
593	24	1.04	32	4	5	3	4		3/32	480	13000	Trc	97	3	9.0	0.11	0.23	12.5
603	16	1.04	37	6	21	6	8		6/32	680	13500	Trc	96	4	12.0	0.38	0.54	12.5
778	18	1.09	31	3	4	3	4		4/32	540	14000	Trc	94	6	9.0	0.06	0.17	14
865	18	1.10	33	5	4	2	5	22.8	3/32	280	13000	Trc	94	6	8.5	0.05	0.14	17.5
975	20	1.10	40	10	8	3	14	9.4	1/32	40	1300	Trc	93	7	10.0	0.34	0.67	20
1050	27	1.12	38	9	7	4	16	12.0	1/32	120	15000	Trc	91	9	9.0	0.08	0.31	19
1200	29	1.15	45	11	12	7	22	11.2	2/32	60	15000	0.20	90	10	10.0	0.48	0.95	22.5
1221	30	1.14	60	16	9	3	28	14.0	2/32	20	15000	Trc	91	9	11.0	0.8	1.2	25
1360	31	1.15	41	10	10	2	12	11.0	2/32	20	13000	Trc	92	8	10.0	0.82	1.3	22
1428	33	1.17	43	19	9	2	23	8.0	2/32	Trc	12000	Trc	90	10	10.0	0.5	0.8	22
1505	35	1.20	55	18	29	2	27	6.0	2/32	8	12000	Trc	88	12	11.5	0.85	1.85	20
1546	33	1.20	50	17	12	2	25	6.0	2/32	0	12000	Trc	90	10	11.0	0.8	1.6	20
1638	33	1.20	42	14	8	2	12	7.0	2/32	0	14000	Trc	912	9	11.5	0.65	1.45	20
1750	38	1.20	42	15	15	2	27	6.0	2/32	0	14000	Trc	91	9	10.0	0.1	0.9	20
1760	40	1.20	50	14	20	3	30	6.0	2/32	300	14000	0.50	91	9	11.0	0.35	1.15	20
1778	40	1.21	48	14	16	2	20	7.0	2/32	300	14000	1.25	91	9	10.0	0.5	0.9	18
1835	40	1.18	48	15	15	2	23	8.0	2/32	0	14000	Trc	92	8	10.0	0.15	0.45	17
1881	40	1.18	49	16	16	2	26	6.0	2/32	Trc	14000	Trc	92	8	11.0	1.2	1.4	17
1921	34	1.20	49	16	9	2	20	6.0	2/32	Trc	14000	Trc	92	8	11.0	1.0	1.5	17
1946	34	1.2	50	14	9	2	17	6.0	2/32	Trc	14000	Trc	92	8	10.5	0.9	1.7	17
1997	32	1.20	45	14	13	2	16	7.0	2/32	Trc	14000	Trc	92	8	11.0	1.1	1.5	17
2050	32	1.17	40	12	12	2	12	7.0	2/32	Trc	15000	Trc	92	8	11.0	1.0	1.4	17
2094	40	1.17	44	12	13	2	20	7.0	2/32	Trc	14000	Trec	92	8	10.0	0.2	0.5	17
2131	40	1.17	40	11	12	2	17	8.0	2/32	60	14000	Trc	92	8	11.0	1.4	1.8	17

overbalance, low calcium content and high progressive gel strengths. Attempts were made to treat the mud with lime, but this was not entirely successful.

3.6.5 Leak-Off Test

A hesitation-type leak-off test was performed after drilling out the 9-5/8" casing shoe at 1184m. The lithology at this point was a marlstone of the Lakes Entrance Formation. Using mud of density 1.15SG and pumping in 20 litre increments with the cement pumps, no leak-off was observed at an equivalent mud density of 1.88SG, and the test was limited to this value. A total of 318 litres were pumped and 139 litres were returned.

3.6.6 Lost Circulation

None.

3.6.7 Perforations

None.

3.6.8 Fishing

Two cones were missing when the 26" hole opener was pulled at 565m. After running and cementing the 20" casing the shoe and cement were drilled out to 568m but the junk prevented further progress. Fishing consisted of running in with a flat mill, reverse circulating basket, magnet and rock bits (in all 14 trips were made over 95 hours) to recover the junk.

Whilst drilling the 8-1/2" hole between 1405 and 1763m four cones were lost off two bits. A reverse circulating basket was run in at 1763m but no junk was recovered. A junk sub was subsequently added to the bottom hole assembly and small quantities of iron and roller bearings were recovered with only minimal impairment to drilling.

3.6.9 Sidetracking

A cement plug was set above the junk in the 26" hole between 591 and 530m. This cement was dressed off with a 14-3/4" bit to 555m prior to sidetracking with a mud-motor with 2^{o} bent sub and 12-1/4" bit. The hole was drilled to 592m with surveys at 570m ($2-1/2^{o}$), 579m ($3-1/4^{o}$) and 585m (4^{o}).

3.6.10 Deviation

See Table 5: Deviation Record.

See Fig. 5: Well Path (Plan view)

3.6.11 Abandonment

See Fig. 6: Well Status Diagram

TABLE 5. DEVIATION RECORD - WELL HAMMERHEAD-1

DEPTH A.H. (m)	INCLINATION (deg)	AZIMUTH (deg)	TYPE INSTRUMENT	REMARKS
197	1.4	-	Eastco	
565	0.5	-	Eastco	Sidetrack K.O.P. @ 555m
570	2.5	-	"	
579	3.25	-	"	
585	4.0	-	"	
667	2.50	-	"	
25 00	0	0	E.W. 3" Gyro	Run inside 9-5/" csg
50 00	15'	S40W	"	
75 00	0	0	"	
100 00	0	0	"	
125 00	30'	S07W	"	
150 00	20'	S66E	"	
175 20	0	0	"	
200 00	15'	S52E	"	
225 10	0	0	"	
250 00	0	0	"	
275 1	15'	N64E	"	
300 00	15'	S60E	"	
325 00	10'	S07E	"	
350 00	0	0	"	
375 00	10'	S30W	"	
400 00	0	0	"	
425 00	0	0	"	
450 00	0	0	"	
475 00	10'	S43E	"	
500 10	0	0	"	
525 00	15'	S53E	"	
550 00	1°00'	S75E	"	
575 00	4°00'	S80E	"	
600 20	3°15'	S83E	"	
625 00	3°30'	S83E	"	
650 00	2°30'	S78E	"	
675 10	2°10'	N89E	"	
700 10	1°30'	S81E	"	
725 10	1°10'	N87E	"	
750 00	1°10'	N83E	"	
775 00	45'	N82E	"	
800 00	45'	N78E	"	
825 00	45'	N82E	"	
850 10	30'	N79E	"	
875 10	30'	N88E	"	
900 00	45'	S23E	"	
925 00	30'	S62E	"	
950 00	30'	S43E	"	

Table 5 contd.

DEPTH A.H. (m)	INCLINATION (deg)	AZIMUTH (deg)	TYPE INSTRUMENT	REMARKS
1000 00	30'	N81E	EW 3" Gyro	
1025 00	10'	N53E	"	
1050 00	30'	N76E	"	
1066 00	30'	N64E	"	Closure at 1066m: 11.89m directions S80°32"E
1405	1-1/2	-	Eastco	
1523	1-3/4	-	Eastco	
1684	1/2	-	Eastco	
1871	1°			

PE904896

This is an enclosure indicator page.
The enclosure PE904896 is enclosed within the container PE902661 at this location in this document.

The enclosure PE904896 has the following characteristics:

ITEM_BARCODE	= PE904896
CONTAINER_BARCODE	= PE902661
NAME	= Plan View of Well Path
BASIN	= GIPPSLAND
PERMIT	= VIC/P19
TYPE	= WELL
SUBTYPE	= DIAGRAM
DESCRIPTION	= Hammerhead 1 Plan View of Well Path. Figure 5 of WCR.
REMARKS	=
DATE_CREATED	= 31/08/82
DATE_RECEIVED	= 19/10/82
W_NO	= W775
WELL_NAME	= Hammerhead-1
CONTRACTOR	=
CLIENT_OP_CO	= Shell Australia

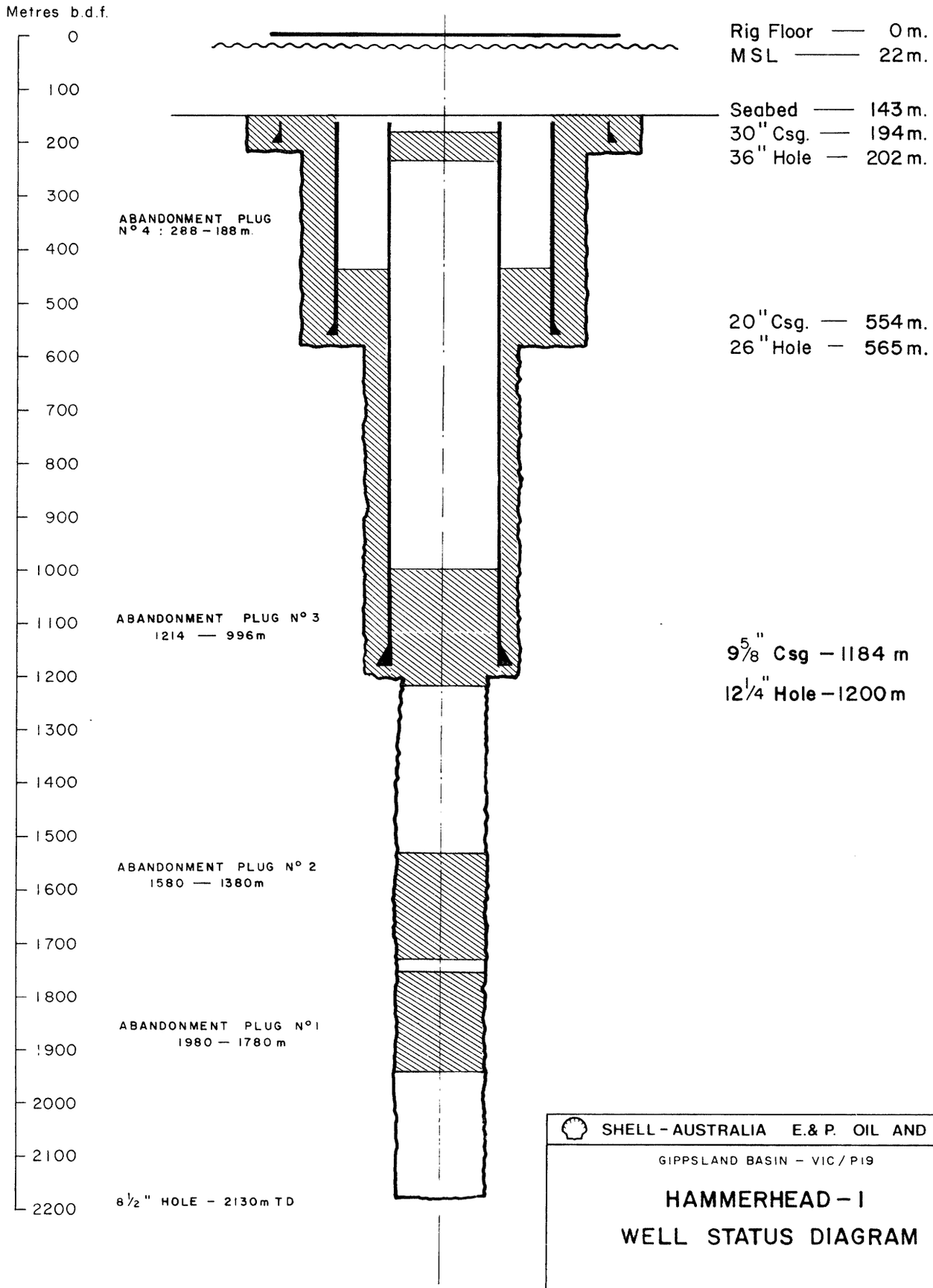
(Inserted by DNRE - Vic Govt Mines Dept)

WELL : HAMMERHEAD - 1

FINAL CO-ORDS : 38°10'34·23" S.
148°49'59·30" E.

RIG : DIAMOND M EPOCH

RIG RELEASED BY UNION TEXAS : 1700hrs, 15·5·82
SPUDDED HAMMERHEAD - 1 : 0230hrs, 17·5·82
ABANDONED WELL : 0930hrs, 24·6·82
RIG HANDED OVER TO AMOCO : 0455 hrs, 2·7·82



SHELL - AUSTRALIA E.& P. OIL AND GAS.

GIPPSLAND BASIN - VIC/P19

HAMMERHEAD - 1
WELL STATUS DIAGRAM

Author EPE / 1	Date: June 1982	Fig: 6
Report No. : G.A. 412	Drawing No.: 14318	

3.7 Formation Evaluation

3.7.1 Mudlogging Services

The mudlogging unit on the rig was provided by Geoservices Ltd from surface to total depth. Two mudlogging engineers and two 'Total Data Control' (computer) engineers were on board, with one of each working at all times. Services included collection, washing, drying and packing of cuttings samples, routine examination of cuttings and checking for hydrocarbon indications; continuous monitoring of drilling parameters (ROP, WOB, torque, pump rate), mud tank levels, and mud weight; continuous monitoring and chromatographic analysis of gas. These values were recorded at one metre or five minute intervals (which ever was the more frequent) by an on-line computer which also produced real-time prints and plots (against driller's depth) of this data. Logged depths were calculated automatically by the computer. An offline computer, printer and plotter was also provided for producing more specialised plots such as 'd' exponent and bit cost plots.

The depths recorded by the mudlogging unit (shown on the mudlog, Encl 3) are 'driller's depths'; it should be noted that these are 5m deeper than 'logger's depths' (Schlumberger) below the 9-5/8" casing shoe.

3.7.2 Cuttings

Cuttings samples were collected every 10m from 194m (the 30" casing shoe) to 1184m (the 9-5/8" casing shoe), and every 3m thereafter to total depth. The samples were bagged and distributed as follows:

(a) Four sets of washed and dried samples (in 100 gm packets) were prepared; one set each was sent to the Bureau of Mineral Resources and the Victorian Dept of Minerals and Energy, and two sets were sent to Corelab, Perth to be stored on behalf of Shell Development.

(b) An additional set of washed and dried samples was packed into miniature plastic samplex trays and sent to Shell Development in Perth for office use.

(c) Two sets of unwashed cuttings packed in half-kilogram bags was sent to Corelab, Perth (for Shell).

Descriptions are given in Appendix 6.1.

3.7.3 Sidewall Samples

A total of 89 sidewall samples was recovered from the well. 30 were taken from the interval 600 to 1195m in the 12-1/4" hole, and 59 from the interval 1199 to 2123m in the 8-1/2" hole. The latter were taken from three guns in two runs (30 SWS-gun + 21 SWS-gun and a 30 SWS-gun), in which there were 19 misfires and 3 non-recoveries. Descriptions are given in Appendix 6.2.

3.7.4 Wireline Logs

The following wireline logs were run.

	INTERVAL (m bdf)	TYPE
12-1/4" hole:	554-1039	ISF/SONIC/SP/GR
	530-1197	FDC/CNL/CAL/GR
8-1/2" hole:	1183-2125	ISF/SONIC/SP/GR
	1183-2124	FDC/CNL/CAL/GR
	1183-2113	MSFL/DLL/GR
	1183-2125	HDT

The ISF/SONIC/SP/GR stood up at 1039m, although an additional wiper trip allowed the FDC/CNL/CAL/GR log to reach the bottom of the 12-1/4" hole. No such problems were encountered in the 8-1/2" hole.

A full set of logs is given as Enclosure 8, which includes the Dipmeter Interpretation (Arrow plot).

3.7.5 Repeat Formation Tests

19 pressure levels were recorded between 1183 and 2113, and two samples were taken at 1560 and 2038m. (See Appendix 6.5 and 6.6).

3.7.6 Velocity Survey

The velocity survey, performed by Seismograph Services Ltd, comprised 21 levels. The results are shown in Appendix 6.7.

3.8 Well Cost, Time Allocation

See Fig. 8: Drilling Time Graph

See Table 7: Time Allocation

See Table 8: Well Costs

See Table 9: Chemical Consumption

PE904897

This is an enclosure indicator page.
The enclosure PE904897 is enclosed within the container PE902661 at this location in this document.

The enclosure PE904897 has the following characteristics:

ITEM_BARCODE	= PE904897
CONTAINER_BARCODE	= PE902661
NAME	= Drilling Time Graph
BASIN	= GIPPSLAND
PERMIT	= VIC/P19
TYPE	= WELL
SUBTYPE	= DIAGRAM
DESCRIPTION	= Hammerhead 1 Drilling Time Graph. Figure 8 of WCR.
REMARKS	=
DATE_CREATED	= 30/06/82
DATE_RECEIVED	= 19/10/82
W_NO	= W775
WELL_NAME	= Hammerhead-1
CONTRACTOR	=
CLIENT_OP_CO	= Shell Australia

(Inserted by DNRE - Vic Govt Mines Dept)

TABLE 7: TIME ALLOCATION WELL HAMMERHEAD-1

		Hours	%
I.	PREPARATION	-	-
II.	MOBILISATION, MOVING etc.		
	Moving	117	10
	Rigging Up/Down/Anchoring	81.5	7
	Dismantling	16.5	1
III.	MAKING HOLE		
	Drilling	246.5	22
	Adding Pipe	8	1
	Surveys	8.5	1
	Check Trip	10	1
	Round trip - Bit Change	54.5	5
	- Deviation Operation	6	1
	Circulation	16.5	1
	Reaming/Washing	1.5	-
	Fishing	118	10
	Rig Service	1.5	-
	Repairs	2.5	-
	Wait Time	101.5	9
	Miscellaneous (Run Riser)	10	1
IV.	SECURING HOLE		
	Drilling Cement	7.5	1
	Adding Pipe	5.5	-
	Check Trip	9	1
	Round Trip - Cement Drilling	9.5	1
	- Before Casing	2	-
	Circulation	2.5	-
	Reaming/Washing	18	2
	Repairs	7	1
	Casing/Liner - Run & Cement	54.0	5
	Flanging Up (BOP)	16.5	1
	Miscellaneous	12.5	1
V.	FORMATION EVALUATION		
	Check Trip	7.5	1
	Round Trip - Logging	16	1
	Circulation	12	1
	Rig Service	1.5	-
	Logging - Open Hole	57.5	5
VI.	COMPLETION/SUSPENSION		
VII.	PLUG-BACK ABANDONMENT		
	Wait Time/WOW	48	4
	Abandonment	47.5	4
	Miscellaneous	6	1
	TOTAL:	1140.00 47-1/2 days	100

TABLE 8: WELL COST - WELL HAMMERHEAD-1

(Accounting Well No: ME 301)

COST TYPE	COST TO 22.9.82 $	ADJUSTMENTS TO COME $
0 - Preparation	1,824,489	2,444,800 (Mobilisation)
1 - Drilling Installation	4,780,237	
2 - Mud	132,987	
3 - Bits	108,534	
4 - Casing & Cement	233,173	321,000 (Casing)
5 - Evaluation	401,108	
6 - Production Testing	202,455	
7 - Abandonment	21,576	
8 - Transportation	1,749,243	
TOTAL PAYMENTS ME301:	9,453,802	
TOTAL ESTIMATED COST ME301	12,219,606	

Note:

Cost Type 101 - Rig Contractor Day Rates Estimated Cost: $4,088,401

Cost Type 501 - Open Hole Logging Estimated Cost: $ 335,483

TABLE 9: CHEMICAL CONSUMPTION/COST - HAMMERHEAD-1

Interval: Surface - 194 metre

Casing Size 30" at 194m

Product	Quantity	Cost
Gel	180 sacks	
Lime	3 sacks	
Soda Ash	2 sacks	
Caustic	4 sacks	
	Total	$2908
	Cost/Metre	$15/metre

Interval: 194-554m

Casing Size 20"

Product	Quantity	Cost
Gel	78	
Caustic	2	
Soda Ash	1	
Barites	40	
		$1660
	Cost/Metre	$4.6/metre

Interval 554m-1184m

Casing size 9-5/8"

Product	Quantity	Cost
Gel	805 sacks	
Caustic	26	
Q. Broxin	86	
Soda Ash	25	
CMC LV	18	
CMC HV	8	
Barite	538	
Sod. Bicarb	8	
Surfl. W300	1	
	Total	$19310
	Cost/Metre	$30.65/metre

Interval 1184m-2130m

Product	Quantity		Cost
Gel	323		
Barite	436 + 10 ton		
Caustic	33		
Lime	50		
Soda Ash	5		
CMC HV	22		
CMC LV	88		
XC-P	5		
Bar foam	4		
Q. Broxin	86		
Sod. Bicarb	20		
W300	3 drum		
		Total	$31889
		Cost/Metre	$33.70/metre
Total Mud Chemicals			$55,767

Cementing Additives

		$Cost
HAL 22A	10 sacks	3475
CFR-2	47 sacks	10575
Cement G	188 ton	
Cement A	47 ton	

4. GEOLOGY

4.1 Regional Setting

The Gippsland Basin and the underlying Strzelecki Basin are the most easterly of the sedimentary basins that border the southern Australian continental margin (SDA 289).

The Strzelecki Basin formed as part of the initial subsidence prior to break-up along Australia's southern and eastern margins in the Jurassic/Early Cretaceous, whereas the Gippsland Basin formed as a 'failed' rift arm (aulacogen) associated with the initial opening of the Tasman Sea in the Late Cretaceous. Before the opening of the Tasman Sea about 80 m.y. B.P., the Gippsland Basin was landlocked. After break-up the sea gradually transgressed the basin from the southeast, but probably nowhere crossed the north and south bounding fault systems (the Rosedale and Foster, respectively, Fig. 9) until late Paleocene time.

Hammerhead-1 tested a potential Intra-Latrobe trap on the southern, downthrown side of the Rosedale fault zone in the eastern part of VIC/P19. The postulated top seal was a marine shale of Paleocene age, the lateral seal tight Strzelecki rocks on the upthrown side of the main Rosedale fault.

The well was located on line GS81A-81 at S.P. 5124 approximately 1.6km south of the main Rosedale fault and 9.5km WSW of Dart-1 in order to:-

i) test the trap sufficiently close to the culmination that no significant oil accumulation could be left updip

ii) allow integration of the well results into the regional seismic framework

iii) penetrate the entire Latrobe sequence where the lower units are fully developed, and to establish the nature of the contact with the Strzelecki.

PE904898

This is an enclosure indicator page.
The enclosure PE904898 is enclosed within the container PE902661 at this location in this document.

The enclosure PE904898 has the following characteristics:

ITEM_BARCODE	= PE904898
CONTAINER_BARCODE	= PE902661
NAME	= Tectonic Elements
BASIN	= GIPPSLAND
PERMIT	= VIC/P19
TYPE	= GENERAL
SUBTYPE	= GEOL_MAP
DESCRIPTION	= Hammerhead 1 Tectonic Elements. Figure 9 of WCR.
REMARKS	=
DATE_CREATED	= 30/09/82
DATE_RECEIVED	= 19/10/82
W_NO	= W775
WELL_NAME	= Hammerhead-1
CONTRACTOR	=
CLIENT_OP_CO	= Shell Australia

(Inserted by DNRE - Vic Govt Mines Dept)

4.2 Stratigraphic Table

AGE	FORMATION	DEPTH BDF, m	DEPTH ss, m
	Sea Level	22	0
	Sea Floor	143	121
Late-Middle Miocene	Gippsland Limestone Formation	143-1058	143
Middle Miocene-Oligocene	Lakes Entrance Formation	1058-1291	1036
Eocene-Late Cretaceous	Latrobe Group	1291-1948	1269
	Paleocene Shale	1491-1497	1469
Late Cretaceous	?Strzelecki Group	1948-T.D.	1926
	T.D.	2126	2104

4.3 Well Stratigraphy

The stratigraphic sequence in Hammerhead-1 is summarized in table (4.2) and on Enclosures 1 and 2. The section penetrated agreed fairly closely with that predicted prior to drilling (Fig. 10). The main difference, however, was that the Paleocene shale, the top seal for the prospect, was much thinner than expected and included only about 6m of holomarine facies of good sealing quality; also, because of its thinness it does not terminate against upthrown Strzelecki rocks (Encl. 7). It is doubtful whether Hammerhead-1 penetrated the Strzelecki Group. The entire well section below the Lakes Entrance Formation is very sandy and contains few well preserved sporomorphs for accurate dating. There is also no distinct lithological break to mark the boundary.

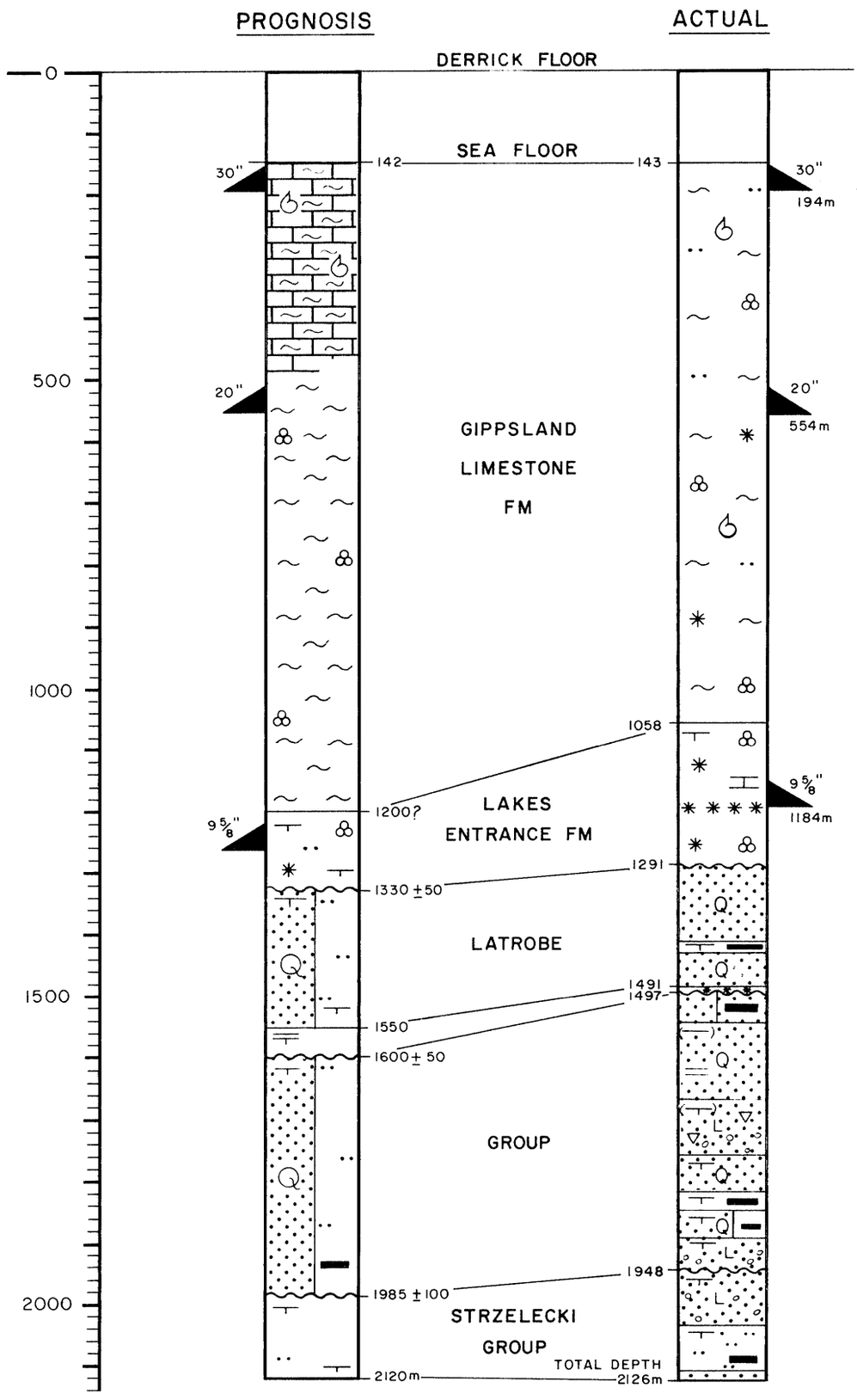
The lithological sequence in Hammerhead-1 is as follows (all depths are bdf):-

4.3.1 Gippsland Limestone: 143-1058m (915m)

143-203m. No cuttings were collected in this interval so the lithology has been inferred from seabottom drop cores, drill speed and the gamma ray log. The interval is thought to consist mainly of bioclastic, foraminiferal, poorly sorted, unconsolidated calcisiltite and minor argillaceous, calcareous, arkosic sand, fine to very coarse-grained, poorly sorted and unconsolidated.

203-440m. Greenish-grey calcisiltite, with angular fossil fragments and glauconite flakes and rare fine to medium-grained subangular to rounded quartz and feldspar sand grains. The rock is weakly consoldiated.

440-1058m. Grey, slightly silty and glauconitic calcilutite/bioclastic marlstone. Particles consist of very fine, angular, broken fossil fragments and unbroken, well preserved forams. Glauconite occurs as fine, angular, green flakes and occasionally as dark green nodular aggregates of medium to coarse size. Traces of lithic and carbonaceous material and pyrite are present and thin beds (?) of hard aphanitic, buff, calcareous dolomite occur in places.



SHELL - AUSTRALIA E.& P. OIL AND GAS.

GIPPSLAND BASIN

HAMMERHEAD - 1

STRATIGRAPHY: PROGNOSIS V. ACTUAL

Author	EXH/4	Date	July 1982
Report No	SDA 412	Drawing No.	14305

Fig. 10

The Gippsland Limestone is thought to have been deposited in an outer shelf environment (water depth about 150m), possibly as canyon fill sediments. This assumption is based on the presence of recycled glauconitic moulds of shallow water benthonic forams (R 4363).

4.3.2 Lakes Entrance Formation: 1058-1291m (233m).

This formation consists mainly of calcareous mudstone, with some calcareous siltstone and dolomitic calcareous siltstone near the base. The mudstone (1058-1273m) and calcareous siltstone (1273-1285m) are dark grey with scattered forams, granular pyrite and medium-to coarse-grained dark green nodular glauconite. Generally the glauconite content is in the order of 1% but increases to greater than 10% between 1195 and 1205m. The calcareous dolomitic siltstone (1285-1291m) is dark grey to greenish grey and contains fine dolomite crystals and glauconite nodules.

The upper part of the mudstone unit is interpreted to have been deposited as fill in a shelf edge canyon in water about 200m deep, whereas the lower part and the calcareous siltstone were deposited on the prograding edge of the continental shelf. The dolomitic siltstone is a marginal marine, probably lagoonal or estuarine deposit (R4363).

4.3.3 Latrobe Group: 1291-?1948m (657m)

The Latrobe Group consists predominantly of quartzose sands and sandstones with some carbonaceous mudstones and lithic sandstones. Many of the sands contain detrital mica and some heavy minerals (probably zircon), which are apparently responsible for the higher than normal gamma ray readings in these fairly clean sands. The top 200m of the Latrobe contains three transgressive/regressive cycles. The base of each cycle, corresponding to a marine transgression, is marked by a relatively thin glauconitic, pyritic sand which is overlain by clean coarsening upwards sand. The lowermost cycle includes coastal plain deposits.

1291-1339m. Light grey, fine-grained, quartz sand, with well-sorted, subangular to subrounded quartz grains (see Fig. 11). Locally pyritic and micaceous with minor feldspar and lithic fragments. The unit coarsens upwards, becoming bimodal in the top ten metres (Fig. 12).

1339-1353m. Glauconitic, pyritic, sandstone, fine to very fine (probably fining upwards), well sorted, subangular to subrounded quartz and minor feldspar grains. The pyrite and glauconite, which make up over 50% of the rock (see Fig. 13), are authigenic, the pyrite replacing glauconite and clastic grains.

1353-1382m. Quartz sand, similar to that from 1291-1339m.

1382-1386m. Dark, slightly greenish grey glauconitic, pyritic sandstone. The sandstone contains bimodal, medium to very coarse subrounded quartz and minor feldspar grains. It is friable and very glauconitic and pyritic.

1386-1401m. Quartz sand, similar to that from 1291-1339m.

1401-1417m. Light grey, fine to very coarse-grained moderately sorted quartz sand with minor lithic fragments, mica, glauconite feldspar and pyrite in places. The sand becomes very glauconitic in the top three metres.

1417-1432m. Carbonaceous mudstone, dark brown to black with thin interbeds of sand and black coal.

1432-1443m. Calcareous quartz sandstone, light brownish-grey, fine-to coarse-grained with calcite cement and minor feldspar and mica.

1443-1491m. Light grey, fine to medium-grained, slightly micaceous, arkosic sand. Pyritic, glauconitic and weakly consolidated in the lower 15m. Feldspar constitutes up to 50% of the rock in places.

PE904964

This is an enclosure indicator page.
The enclosure PE904964 is enclosed within the container PE902661 at this location in this document.

The enclosure PE904964 has the following characteristics:

ITEM_BARCODE	= PE904964
CONTAINER_BARCODE	= PE902661
NAME	= Photomicrograph
BASIN	= GIPPSLAND
ON_OFF	= OFFSHORE
PERMIT	= VIC/P19
TYPE	= WELL
SUBTYPE	= PHOTOMICROGRAPH
DESCRIPTION	= Hammerhead 1 Photomicrograph of Thin Sections. Figure 11 Latrobe Group 1325 m; Figrue 12 Latrobe Group 1354 m.
REMARKS	=
DATE_CREATED	= 31/07/82
DATE_RECEIVED	= 19/10/82
W_NO	= W775
WELL_NAME	= Hammerhead 1
CONTRACTOR	=
CLIENT_OP_CO	= Shell Development (Australia) PTY LTD.

(Inserted by DNRE - Vic Govt Mines Dept)

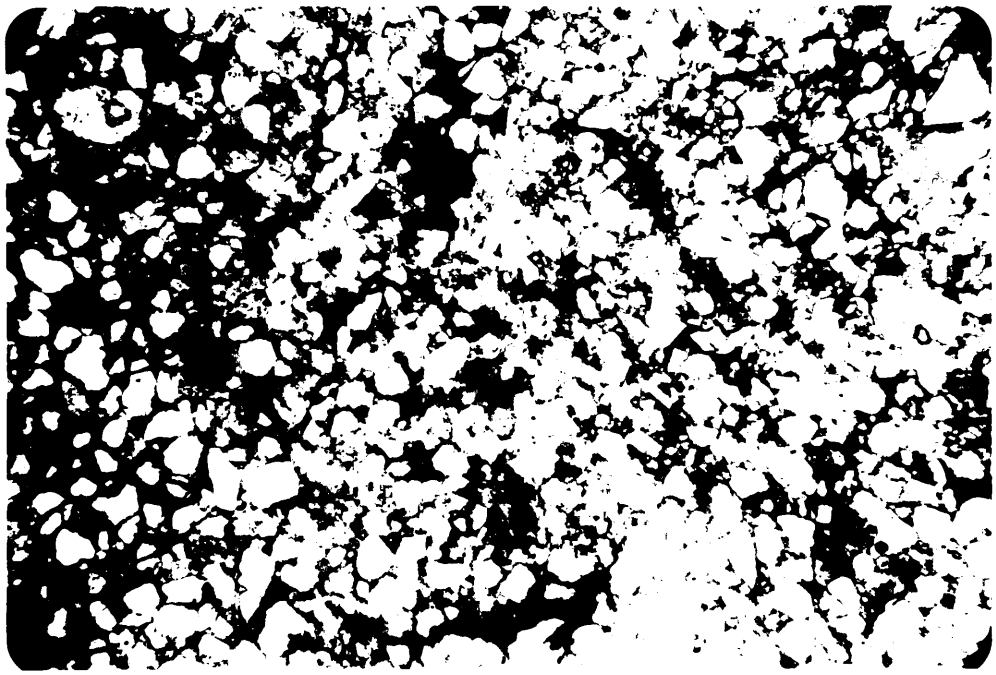


Figure 11. Latrobe Group 1325m. Typical clean, quartz sand (stone) with minor pyrite and feldspar. Blue is porosity. Field of view ca 4.4mm. Plane polarized light.

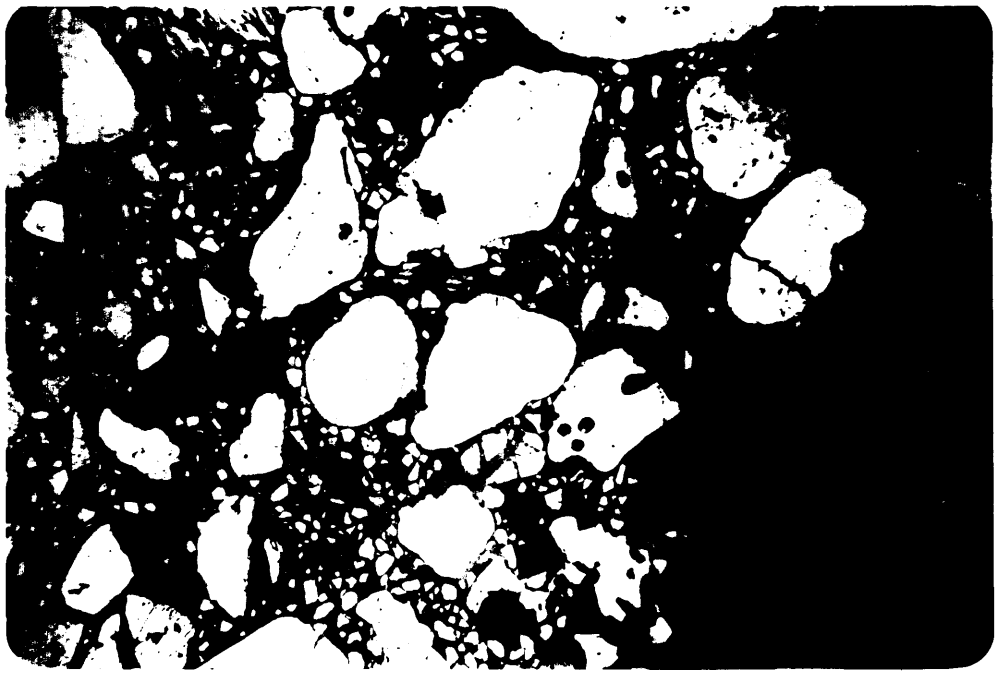


Figure 12. Latrobe Group 1354m. Bimodal quartz sandstone with large rounded to subrounded quartz grains and subangular to subrounded smaller grains in an argillaceous matrix. Porosity shown in blue. Field of view ca 9mm. Plane polarized light.

PE904965

This is an enclosure indicator page.
The enclosure PE904965 is enclosed within the container PE902661 at this location in this document.

The enclosure PE904965 has the following characteristics:

ITEM_BARCODE	= PE904965
CONTAINER_BARCODE	= PE902661
NAME	= Photomicrograph
BASIN	= GIPPSLAND
ON_OFF	= OFFSHORE
PERMIT	= VIC/P19
TYPE	= WELL
SUBTYPE	= PHOTOMICROGRAPH
DESCRIPTION	= Hammerhead 1 Photomicrograph of Thin Sections. Figure 13 Latrobe Group 1495 m; Figrue 14 Strzelecki Group 2111 m.
REMARKS	=
DATE_CREATED	= 31/07/82
DATE_RECEIVED	= 19/10/82
W_NO	= W775
WELL_NAME	= Hammerhead 1
CONTRACTOR	=
CLIENT_OP_CO	= Shell Development (Australia) PTY LTD.

(Inserted by DNRE - Vic Govt Mines Dept)

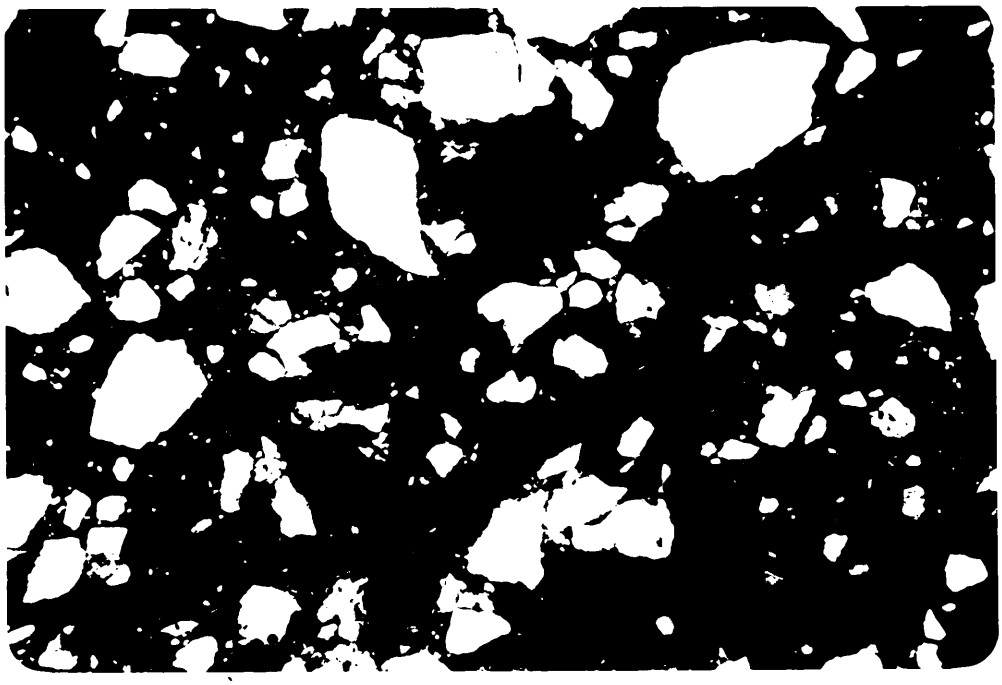


Figure 13. Latrobe Group 1495m. Glauconitic, pyritic sandstone. The glauconite and pyrite are authigenic, replacing the matrix and in some cases quartz grains. Porosity shown in blue. Field of view ca 9mm. Plane polarized light.

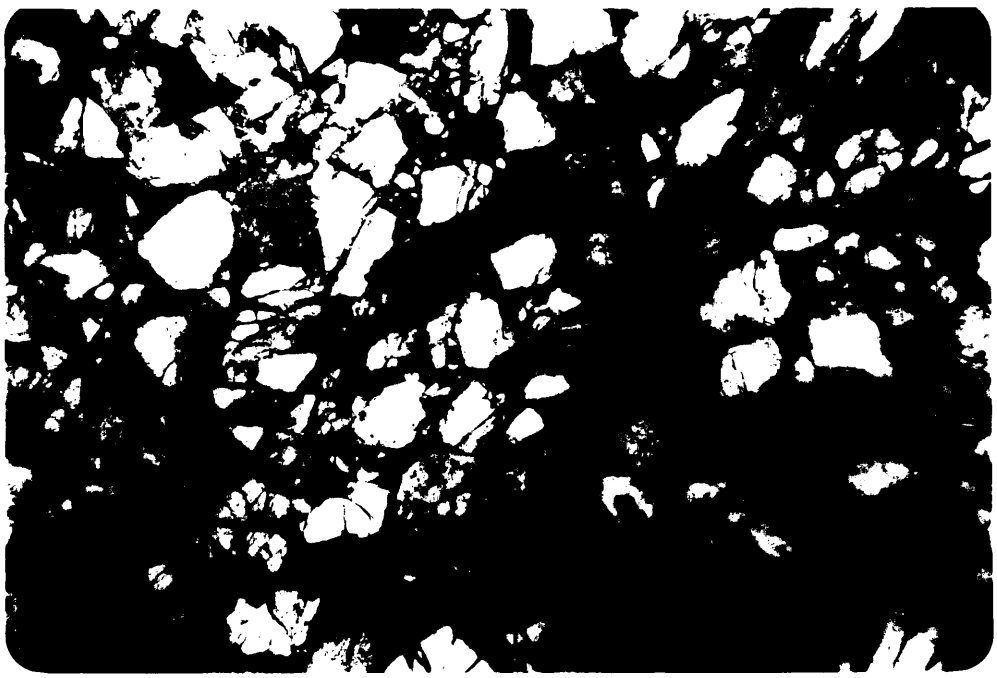


Figure 14. Strzelecki Group 2111m. Lithic sandstone. Lithic, quartz and feldspar grains in an argillaceous/calcareous matrix. Porosity shown in blue. Field of view ca 4.4mm. Plane polarized light.

1491-1495m. Glauconitic mudstone, greenish, grey, slightly calcareous and pyritic with abundant finely diseminated and nodular glauconitic.

1495-1497m. Glauconitic, pyritic sandstone, dark green, fine-grained, well sorted, angular to subrounded quartz and minor feldspar dominated by authigenic glauconite and pyrite.

1497-1597m. Interbedded, fine to medium-grained, well sorted quartz sandstones interbedded with dark grey to dark brown mudstones, which are carbonaceous in the upper part of the interval.

1547-1675m. Very light grey quartz sandstone very fine to coarse-grained, bimodal with minor dark lithic grains and a calcareous and slightly argillaceous matrix.

1675-1764m. Lithic quartz sandstone with coarse to pebbly, angular to subangular quartz, chert and felsic igneous lithoclasts weakly cemented by calcite.

1764-1824m. Light grey, slightly argillaceous, medium to coarse-grained, well sorted quartz sandstone, with three thin (1-2m) dark brown to black carbonaceous mudstone/coal interbeds.

1824-1847m. Dark grey to black, slightly silty, soft, carbonaceous mudstone with thin coal and sandy interbeds.

1847-1900m. Quartz sandstone, slighty and argillaceous with medium to coarse, well sorted, subangular to subrounded quartz grains and about 5% felsic igneous clasts interbedded with rare thin carbonaceous mudstones.

1900-1948m. Lithic conglomeratic sandstone grey to multi-coloured with coarse to granular, poorly to moderately sorted quartz grains and felsic igneous clasts becoming increasingly lithic and conglomeratic towards the base.

The sands and sandstones in the Latrobe Group above 1500m are considered to have been deposited as part of a coastal/barrier system; the glauconitic sandstones representing periods of transgression, with the overlying sands being deposited during the building out of the coastal/barrier sediments. Glauconite forms today on the continental shelf in water depths of 50-500m and has its best development in areas with low sediment accumulation rates (R4401).

Below 1500m the sediments are largely coastal plain/back barrier deposits. The sandstones in this section are generally not as well sorted as those above and are interbedded with shales and coals, typical of lower coastal plain, fluviatile and swamp deposits. The lithic and conglomeratic lithic sands below 1675 and 1900m were probably deposited in an aluvial environment by braided streams.

4.3.4 ?Strzelecki Group:1948-2126m (178m)

Possible Strzelecki Group is interpreted below 1948m. Lithologically there is no marked break and the palynological results are inconclusive as the section is very sandy and contains few sporomorphs. Dipmeter and seismic data suggest possible faults at 2050m and 2080m.

1948-2048m. Lithic sandstone and conglomerate, medium to pebble sized quartz grains and polymict felsic igneous clasts, with a slightly calcareous clay matrix.

2048-2126m. Dark brown carbonaceous siltstone and silty mudstone with a lithic, partly calcite cemented sandstone from 2110 to 2126m (Fig. 14).

The depositional environment is similar to that of the lower Latrobe sediments.

4.4 Structure

The Hammerhead closure had a long history of development. The Rosedale faults, including the arcuate boundary faults of the prospect, grew in the Late Cretaceous/early Paleocene. At the end of this time there was still very little closure, because there was limited regional tilt towards the south. Closure started to develop during the growth of the Dart-Sole nose in the late Eocene, which warped the Hammerhead trap gently about a northeast-southwest axis. In the late Tertiary the regional southward tilt and consequently the trap volume increased; however, this has changed little since the carbonate shelf prograded across the area in the Miocene. (Enclosure 6).

Interpretation of dipmeter data over the interval 1180m to total depth showed mostly southerly dips in the Latrobe Group. From about 1770m to 1940m, however, the dips gradually increase and their direction swings round to the northeast. Below 1950m the dips again have a predominantly southern trend. On the basis of this and seismic evidence the boundary between the Latrobe and Strzelecki Groups has been placed tentatively at 1948m. The dipmeter indicates either a fault or an unconformable contact. Faults may also be present at 2050m and 2080m.

A dipmeter log was produced with the structural dip removed so more information could be gained about the sedimentary dip trends. In the section from 1291m to 1500m there is a predominant northerly component to the dips, which supports the lithological interpretation that the sands are part of a coastal barrier system, with the well penetrating mainly the landward side of the barrier. The dipmeter interpretation is given in Enclosure 8.

4.5 Hydrocarbon Indications and Reservoir Potential

No significant hydrocarbon shows were encountered in Hammerhead-1. Minor ditch gas was recorded from 1510 to 1720m over an interval containing coals and carbonaceous shales. Some weak fluorescence and cut were also present from between 1445 and 1600m. However, a repeat formation test carried out in this interval recovered only saline water.

Reservoir quality of the Latrobe sandstones is excellent, especially in the upper part of the sequence. Generally the sands are medium to coarse-grained and well sorted. As no cores were cut, no direct measurements of porosity and permeability are available, but log evaluation indicates average porosity values of 21%-30% for the sands above 1500m, while those below have average values ranging from 17-21%. The lithic sandstones of the Strzelecki Group are less porous with values averaging 14%.

4.6 Conclusions and Contributions to Geology

1. Hammerhead-1 encountered no significant hydrocarbons. The Paleocene top seal for the prospect was much thinner than anticipated and included only 6m of holomarine facies of good sealing quality. The lack of seal is regarded as the main cause of failure of the trap.

2. It is not certain whether the well penetrated Strzelecki sediments. Although the Strzelecki is predicted from the seismic data to be present below 1948m, and the dipmeter shows a break at this depth, the palynological results indicate that the rocks near the base of well are Campanian in age. This is much younger than would be expected for Strzelecki Group sediments in this basin-margin position.

3. Seismic and dipmeter data suggest the lower part of the well penetrated two faults, one at 2050m and another at 2080m.

4. Data from the well has refined the palaeogeography of the central and southeastern part of the permit area.

5. REFERENCES

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R4401. De glauconiarum origine. Odin G.S., & Matter, A., Sedimentology 1981.

R4363. Foraminiferal sequence in Hammerhead-1. Paltech, 1982.

R4454 Hammerhead No. 1 well; Palynological examination and kerogen typing of sidewall cores. Harris, W.K., 1982.

APPENDIX 6.1

CUTTINGS DESCRIPTIONS

(see basic data package)

OIL and GAS DIVISION

SHELL DEVELOPMENT (AUSTRALIA) LIMITED

Page 1

18 AUG 1982

CUTTING DESCRIPTION

HAMMERHEAD-1

Described By: J.G. Stainforth

NO	LITHOLOGICAL DESCRIPTION 2-7 NAME	QUAL	QUAL	a²	BUN 10 G/S 11	PART 8,9 SRT 13	RND	ARCH 12 POR	PERM	16 COL	17,18 ACC/ FOOS	23 CONS	CMT	REMARKS
1	ST	LS	F			SF		PI	KI	((GN)) GE	GC	C3	CC	Liths 1,2
2	MS	LS	F			FF		PI	KI		((LG))	C3	CC	Grade into LS CL ST
3	S	QZ	FD		FM	S4	R3/5			(YE) WH		C1		
4	MS	LS	SJ		LS W	FP	LC	PI	KI	LT GE	(GC)	C3 BQ	CC	Loc → LS CL SJ
	MR	SJ												

1–8 Cuttings %
9 –15 OIL INDICS
16 % C_1 Methane
17 % C_2 Ethane
18 % C_3 Propane
19 Shale Density
20 'd' exponent
21 °C temp. IN
22 °C temp. OUT

Well. HAMMERHEAD -1

Depth. 220 - 590

Date. 20/5/82 1/6/82

Depth at 00.00 m.

Sheet

Depth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 (IN)	16	17	18	19	20	21	22
203 - 240	100								Z	0	Z	0	0	0		-						
240 - 440	100	-	5													-						
440 - 565	50	50														<.1						
570 - 590				100												-						

HAMMERHEAD-1.

Page 1 of 12

[redacted]LL [redacted]LOR[redacted]T ([redacted]RAL[redacted] LI[redacted]D [redacted] 2 [redacted]12

CUTTING DESCRIPTION

Described By: J.G. Stainforth

NO	LITHOLOGICAL DESCRIPTION: NAME (2-7)	QUAL	QUAL	%	DCN 10 G/S 11	PART 8,9 SRT 13	PART 8,9 RND	ARCH 12 POR	PERM	16 COL	17,18 ACC/FOSS	23 CONS	CMT	REMARKS
1	AL	(SJ)	(GC)		W/X	FP		PI	KI	GE	GC	C3	CC	→ LS W CL

1–8 Cuttings %
9 –15 OIL INDICS
16 % C_1 Methane
17 % C_2 Ethane
18 % C_3 Propane
19 Shale Density
20 'd' exponent
21 °C temp. IN
22 °C temp. OUT

Well.
HAMMERHEAD -1

Depth.
590 - 660 M

Date.
3/6/82

Depth at 00.00 0750 hr 660 m.

Sheet

Depth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 (IN)	16	17	18	19	20	21	22
a. 590 - 660	100								Z	0	Z	0	2	0								

NOTES :

(i) Cut fluorescence in interval (a) most probably from pipe dope. (22 trips from C. 570 - 590M)!

(ii) Lith. 1 contains well preserved planktonic forams (Orbulina spp. etc), and is on the classificational borderline with LS CL.

2/12

SHELL DEVELOPMENT (AUSTRALIA) LIMITED

CUTTING DESCRIPTION

Described By: J.G.Stainforth

NO	LITHOLOGICAL DESCRIPTION 2-7 NAME	QUAL	QUAL		DUN 10 G/S 11	PART 8,9 SAT 13	RND	APCH 12 FOR	PERM	16 COL	17,18 ACC/ FOSS	23 CONS	CMT	REMARKS
1	AL	(GC)			W/X	FF	SF	P1	K1	GE	GC PY	C3	GC	
2	DM	LS	(CL)		A	-	-	1A	K1	BF		C5		

1–8 Cuttings %
9 –15 OIL INDICS
16 % C_1 Methane
17 % C_2 Ethane
18 % C_3 Propane
19 Shale Density
20 'd' exponent
21 °C temp. IN
22 °C temp. OUT

Well. Hammerhead-1

Depth. 660 – 900m

Date. 4/6/82

Depth at 0740 00.00 914 m.

Sheet.

Depth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 (IN)	16	17	18	19	20	21	22
660 - 785	100								Z	0	Z	0	0	0		<.1						
785 - 788	?20	?80																				
788 - 900	100																					

NOTES

(a) Lith 1 is composed of approx 50:50 carbonate:clay; carbonate as micrite, st-size fossil hash, and fine (re-)crystallised cc.

(b) Glauconite is ~1% rock vol, as flakes and occasionally clots of flakes.

(c) Most abundant foram is Orbulina spp.

3/12

CUTTING DESCRIPTION

Described By: J.G.Stainforth

NO	LITHOLOGICAL DESCRIPTION 2-7 NAME	QUAL	QUAL	%	DUN 10 G/S 11	PART 8,9 SRT 13	RND	ARCH 12 POR	PERM	16 COL	17,18 ACC/ FOSS	23 CONS	CMT	REMARKS
1	AL	(GC)			W/X	FF	SF	P1	K1	GE	GCPY	C3	CC	→ LS CL W
2	MS	LS				(FF)		P1	K1	DKGE	occ. GCPY	C3 BQ	(CC)	((ST))

1–8 Cuttings %
9 –15 OIL INDICS
16 % C_1 Methane
17 % C_2 Ethane
18 % C_3 Propane
19 Shale Density
20 'd' exponent
21 °C temp. IN
22 °C temp. OUT

Well. HAMMERHEAD-1

Depth. 900 – 1200m

Date. 5/6/82

Depth at 00.00 0700 1080 m.

Sheet.

Depth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	(IN) 15	16	17	18	19	20	21	22
900 – 1062	100								Z	0	Z	0	0	0		<.1						
1062 – 1080		100							Z	0	Z	0	0	0		<.1						
1080 – 1200		100							Z	0	Z	0	0	0		<.1						

NOTES

(a) Lith 1 becomes LTGE below 1000m, and contains traces of LG.

(b) Lith 2 is more argillaceous, less calcareous than Lith 1, and lacks the fine granular/crystalline texture of Lith 1, which could be described as a bioclastic marl.

Calcimetry: Lith 1 at 910m: 55% $CaCO_3$; Lith 2 at 1130m: 35% $CaCO_3$

(c) Between 1180 and 1190m there is a marked (downwards) increase in glauconite content (as rounded nodules of coarse grainsize).

4/12

CUTTING DESCRIPTION

Described By: J.G.Stainforth

No	LITHOLOGICAL DESCRIPTION 2-7 NAME	QUAL	QUAL	%	DUN 10 GAS 11	PART 8,9 SRT 13	PART 8,9 RND	ARCH 12 POR	PERM	16 COL	17,18 ACC/ FOOS	23 CONS	CMT	REMARKS
1	MS	LS	GC			FF	FP	P1	K1	DKGE	GCPY	BQ C3		((SJ))
2	SA	QZ	C1		MR	S79	R34	P7	K7	WHGE	PY	C1		sph=04/05
3	SS	QZ	(LC)		F	S7	R3	P3	K34	LTGE	PYGC	C5	DM	
4	SH	LS								GE		FK C3		diff to dist from cavings
5	CO							P1	K1	BK		BQ C5		

1–8 Cuttings %
9 –15 OIL INDICS
16 % C_1 Methane
17 % C_2 Ethane
18 % C_3 Propane
19 Shale Density
20 'd' exponent
21 °C temp. IN
22 °C temp. OUT

Well. HAMMERHEAD-1

Depth. 1200 – 1405

Date. 10/6/82

Depth at 0600 00.00 1405 m.

Sheet.

Depth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 (IN)	16	17	18	19	20	21	22
1200 – 1296	100								Z	O	Z	O	1	O		<.1						
1296 – 1342		100																				
1342 – 1346		80		?20																		
1346 – 1368		100																				
1368 – 1370				?50	?50																	
1370 – 1386			100																			
1386 – 1388				?100																		
1388 – 1396		100																				
1396 – 1405		?50		?50																		

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SHELL DEVELOPMENT (AUSTRALIA) LIMITED

CUTTING DESCRIPTION

Described By: J.G.Stainfort

No	LITHOLOGICAL DESCRIPTION 2-7 NAME	QUAL	QUAL	%	DUN 10 G/S 11	PART 8,9 SRT 13	PART 8,9 RND	ARCH 12 POR	PERM	16 COL	17,18 ACC/ FOSS	23 CONS	CMT	REMARKS
1	SA	QZ			MC	S79	R34	P7	K7	LTGE	PY	C1		pyritic qz
2	SS	QZ	(LC)		F	S7	R3	P13	K13	LTGE	PYGC	C5	DM	intergran py
3	SH	(LS)	(SJ)							GE		FKC3		
4	SH	(CO)								GE BW	CO	FKC3		
5	CO									BK		BKC5		
6	MS	GC	(LS)					P1	K1	GNGE	GCPY	C13		GC finely dissem & ND

1–8 Cuttings %
9 –15 OIL INDICS
16 % C_1 Methane
17 % C_2 Ethane
18 % C_3 Propane
19 Shale Density
20 'd' exponent
21 °C temp. IN
22 °C temp. OUT

Well. HAMMERHEAD-1

Depth. 1405 – 1500m

Date. 10/6/82

Depth at 2300 00.00 1500 m.

Sheet.

Depth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 (IN)	16	17	18	19	20	21	22
1400 – 1410	40		60						Z	0	Z	0	0	0		<·1						
1410 – 1420	70		30																			
1420 – 1425	10		90																			
1425 – 1428	90		10																			
1428 – 1431			10	20	70																	
1431 – 1436			70		30																	
1436 – 1440	80		20																			
1440 – 1446	20		80																			
1446 – 1470	80	TR	20						Z	0	Z	1	2	0	1,2							
1470 – 1494	10	50		40											2	·12	·06	·05				
1494 – 1500		10				90																

6/12

SHELL DEVELOPMENT (AUSTRALIA) LIMITED

CUTTING DESCRIPTION

Described By: J.G.Stainforth

No	LITHOLOGICAL DESCRIPTION 2-7 NAME	QUAL	QUAL	%	DUN 10 G/S 11	PART 8,9 SRT 13	RND	ARCH 12 FOS	PERM	16 COL	17,18 ACC/ FOSS	23 CONS	CMT	REMARKS
1	MS	(LS)	((SJ))					P1	K1	LTGE	((GC))	C1		→ SH, FK
2	SA	QZ		90	CR	S79	R2	P7	K7	LTGE	((LC))	C1		((LC))=1% V?
2	CL	((LS))		10						LTYE	((GC))	C1		slight clay matrix
3	SS	QZ			VF	S5	R3	P13	K13	LTGE	PYGC	C5	DM	
4	CO									BK		BKC5		→ SH CO, bw

1–8 Cuttings %
9 –15 OIL INDICS
16 % C_1 Methane
17 % C_2 Ethane
18 % C_3 Propane
19 Shale Density
20 'd' exponent
21 °C temp. IN
22 °C temp. OUT

Well. HAMMERHEAD-1

Depth. 1500 – 1682m

Date. 11/6/82
12/6/82
revised 13/6/82

Depth at 0900 12/6
00.00 1700 m.

Sheet.

Depth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 (IN)	16	17	18	19	20	21	22
1500 – 1505	65	10	25						Z	O	Z	O	1	O		<.1						
1505 – 1510	20	80	TR																			
1510 – 1516	50			50																		
1516 – 1522	80	15	TR	5												.12	.06	.04				
1522 – 1550	50	50														.10	.05	.02				
1550 – 1595	5	95							C	1	D	1	2	O	(2)							
1595 – 1596				?100					Z	O	Z	O	1	O								
1596 – 1625		100														.25	.03	.01				
1625 – 1631	90			10												.15	.05	.02				
1631 – 1679	5	90	5																			
1679 – 1682	100			TR																		

21/4

SHELL DEVELOPMENT (AUSTRALIA) LIMITED

CUTTING DESCRIPTION

Described By: J.G.Stainforth

LITHOLOGICAL DESCRIPTION														
	2-7				SUN 10	PART 8,9		ARCH 12	PERM	16	17,18	23		
NO	NAME	QUAL	QUAL	%	C/S 11	SRT 13	RND	POR	PERM	COL	ACC/ FOSS	CONS	CMT	REMARKS
1	SA	QZ	CT		CR	S5	R23	P5	K5	LTYE	CTLC	C13		LTYE CL mat
2	MS	(LS)	(SJ)					P1	K1	LTGE	(PYGC)	C3		SH
3	SA	QZ	LC		C PB	S5	R2	P5	K5	"	CT ~~EXIN~~	C13		30% LC
4	SA	QZ	CL		MC	S7	R34	P5	K5	"		C13		LTYE CL mat
5	MS	CO						P1	K1	(GE)	BW LG	C3		non-LS

1–8 Cuttings %
9 –15 OIL INDICS
16 % C_1 Methane
17 % C_2 Ethane
18 % C_3 Propane
19 Shale Density
20 'd' exponent
21 °C temp. IN
22 °C temp. OUT

Well. HAMMERHEAD-1

Depth. 1682 - 1832

Date. 14/6/82

Depth at 00.00 0900 1832 m.

Sheet.

Depth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 (IN)	16	17	18	19	20	21	22
1682 - 1715	100								Z	0	Z	0	0/1	0		<.1						
1715 - 1719		100																				
1719 - 1769			100																			
1769 - 1780				50	50																	
1780 - 1789				100																		
1789 - 1793					100																	
1793 - 1829				100																		
1829 - 1832					100																	

SHELL DEVELOPMENT (AUSTRALIA) LIMITED

CUTTING DESCRIPTION

Described By: J.G.Stainforth

NO	LITHOLOGICAL DESCRIPTION 2-7 NAME	COL	SUBL	BUN 10	PART 8,9 SRT 13	RND	ARGIL 12 POR	PERM	16 CCL	17,18 ACC/ FOSS	23 CONS	CMT	REMARKS
1	MS	CO	((SJ))				P1	K1	(GE)BW	LG	C3		((LS))-non-LS
2	CO	BK					P1	K1	BK		C5		
3	SA	(LC)	(CL)	(M)C	S7	R34	P35	K35	LTYE	LCPY	C13		5% LC ~~10% CL matrix~~

1–8 Cuttings %
9 –15 OIL INDICS
16 % C_1 Methane
17 % C_2 Ethane
18 % C_3 Propane
19 Shale Density
20 'd' exponent
21 °C temp. IN
22 °C temp. OUT

Well. HAMMERHEAD-1

Depth. 1832 - 1921

Date. 15/6/82

Depth at 0700 00.00 1921 m.

Sheet.

Depth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 (IN)	16	17	18	19	20	21	22
a. 1832 - 1838	95		5						Z	0	Z	0	0	0		<.1						
b. 1838 - 1840	?40		?60																			
c. 1840 - 1851	80	5	15																			
d. 1851 - 1921			100																			

NOTES

(i) Units b and c: Proportions difficult to estimate in unwashed samples.

(ii) Unit d: Slight downwards decrease and increase in, respectively, grain-size and lithic content.

9/12

[redacted] SHELL DEVELOPMENT (AUSTRALIA) LIMITED [redacted] Sheet 2 [redacted]

CUTTING DESCRIPTION

Described By: J.G.Stainforth

LITHOLOGICAL DESCRIPTION

No	2-7 NAME	QUAL	QUAL	%	DUN 10 G/S 11	PART 8,9 SRT 13	RND	ARCH 12 FOR	PERM	16 COL	17,18 ACC/FOSS	23 CONS	CMT	REMARKS
1	SA/CG	LC			CGR	S4	R34	P4?	K4?	VMGE		C13		YEBW CL mat.
2	CG	LC			CPB	S4	R4	P3?	K3?	VMGE		C3		polymict LC
3	MS	CO						P1	K1	BK		C3		
4	CO	BK						P1	K1	BW		C5		

1–8 Cuttings %
9 –15 OIL INDICS
16 % C_1 Methane
17 % C_2 Ethane
18 % C_3 Propane
19 Shale Density
20 'd' exponent
21 °C temp. IN
22 °C temp. OUT

Well. HAMMERHEAD-1

Depth. 1921 - 1980

Date. 16/6/82

Depth at 0830
00.00 1980 m.

Sheet.

Depth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 (IN)	16	17	18	19	20	21	22
1921 - 1950	100								Z	0	Z	0	0	0		<.1						
1950 - 1958		100																				
1958 - 1980	100																					
c.1953,1956			?50	?50																		

NOTES

(i) 1950 - 1958: very slow drilling: 1.5-2 m hr^{-1}, but no dominance of any one component in polymict cuttings to suggest a single lithology.

(ii) Lithics in entire interval 1921 - 1950: miscellaneous intrusives, extrusives, cherts, quartzites, fine well-cemented sandstones. (Probably 10, up to 20, different lithotypes).

(iii) Coal in cuttings at lagged depths 1953,56 is difficult to place; possibly cavings.

[redacted] ELL DEVELOPMENT (AUSTRALIA) LIMITED [redacted] ell [redacted] 12

CUTTING DESCRIPTION

Described By: J.G.Stainforth

LITHOLOGICAL DESCRIPTION

	2-7 NAME	2-7 COLR	2-7 SUBCL	%	8,9 SORT 11	8,9 SIZE 13	8,9 RND	ARCH 12 ROCK	PERM	16 COL	17,18 ACC/FOSS	23 CONS	CYC	REMARKS
1	SA/CG	LC			MPB	S4	R34	?	?	VM		C13		polymict:mainly acid igneous lithoclasts. ?LTYE CL mat.
2	SA	LC			C	S4	R34	?	?	VM		C13		
3	MS	(COSU)						P1	K1	DK (BW) GE		BQC3		non-LS
4	CO	BK						P1	K1	BK		BQC5		

1–8 Cuttings %
9 –15 OIL INDICS
16 % C_1 Methane
17 % C_2 Ethane
18 % C_3 Propane
19 Shale Density
20 'd' exponent
21 °C temp. IN
22 °C temp. OUT

Well: HAMMERHEAD-1

Depth: 1980 – 2073

Date: 17/6/82

Depth at 0730 00.00: 2080 m.

Sheet:

Depth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 (IN)	16	17	18	19	20	21	22
a. 1980 – 2015	100								Z	O	Z	O	O	O		<1						
b. 2015 – 2052		100																				
c 2052 – 2073			95	5																		

NOTES

(i) Liths 1 and 2 contain around 20 different lithotypes, mainly acid igneous (intrusive and extrusive) rocks, cherts, quartzites, fine indurated sandstones (about 5 to 10%), ?epidote. Matrix may be a light yellow clay, but this is scarcely in evidence. Rock is grey to multicolored on account of its polymict nature.

(ii) Sequence b is probably divided into several units demarcated by drill-speed/grainsize discontinuities. Faster drilling streaks probably contain more fine sand than the norm.

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SHELL DEVELOPMENT (AUSTRALIA) LIMITED

CUTTING DESCRIPTION

Described By: J.G.Stainforth

	LITHOLOGICAL DESCRIPTION													REMARKS
	2-7				DUN 10	PART 8,9		ARCH 12		16	17,18	23		
	NAME	QUAL	QUAL	%	G/S 11	SRT 13	RND	POR	PERM	COL	ACC/FOSS	CONS	CMX	
1	MS	SJ	(CO)					P1	K1	DK (BW) GE		BQc3		non-LS
2	SA/CG	LC			C	(PB) S4	R34	?P3	?K3	VM		C13		polymict ign. ?lt ye cl mat

1–8 Cuttings %
9 –15 OIL INDICS
16 % C_1 Methane
17 % C_2 Ethane
18 % C_3 Propane
19 Shale Density
20 'd' exponent
21 °C temp. IN
22 °C temp. OUT

Well. Hammerhead-1

Depth. 2073 - 2131

Date. 18/6/82

Depth at 00.00 2000 hr 2131 m.

Sheet.

Depth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 (IN)	16	17	18	19	20	21	22
2073 - 2115	100	TR							Z	0	Z	0	0	0		<.1						
2115 - 2131	TR	100							Z	0	Z	0	1	0		↓						

12/12

APPENDIX 6.2

SIDEWALL SAMPLE DESCRIPTIONS

(see basic data package)

M = Moderate
P = Poor
F = Fractured
FF = Highly Fractured
C = Mud Contaminated
CC = Highly Contaminated

HAMMERHEAD-1

SIDEWALL SAMPLE DESCRIPTION

Well: Hammerhead-1 Gun No: 1 Date: 7/6/82 Page 1 of 2
Fired: 30 Rec: 30 Paid For: 30 Lost: 0 Misfired 0 Empty: 0
FM: Ref Log: GR/FDC/CNL Run No: 1 Described By: Stainforth

OIL and GAS DIVISION
18 AUG 1982

Page 1 of 10

No	DEPTH (m)	QUAL REC (mm)	LITHOLOGICAL DESCRIPTION 2-7 NAME	QUAL	QUAL	%	DUN 10 G/S 11	PART 8,9 SRT 13	RND	ARCH 12 POR	PERM	16 COL	17,18 ACC/FOSS	23 CONS	CMT	OIL INDICS						19 - 26 REMARKS (Structures, Stain Etc)
1	1195	32G	MS	LS	GC			(FF)		P1	K1	DK BW GE	PYGC	C4	CC	Z	O	Z	O	O	O	>10% GC ND (M/C)
2	1187	40G			GC			FF						C3								~ 5% GC ND
3	1180	35G																				
4	1170	35G																				decreasing GC
5	1160	30G																				
6	1150	30G	MS	LS						P1	K1	DK BWGE	occ PYGC	C3	CC							
7	1140	33G																				
8	1130	45G																				
9	1115	30G																				
10	1110	30G																				
11	1092	40G																				
12	1077	55G																				
13	1060	35G																				
14	1055	20M	AL	SF	(GC)		W/X	FF	SF	P1	K1	BWGE	PYGC	C3	CC							Bioclastic marlst.
15	1040	20M			GC																	~ 5% GC ND

Well: [illegible]mmerhead-1 Gun No: 1 Date: 7/6/82 Page 2 of 2

Fired: 30 Rec: 30 Paid For: 30 Lost: 0 Misfired 0 Empty: 0

FM: Ref Log: GR/FDC/CNL Run No: 1 Described By: Stainforth

SIDEWALL [illegible]

2/10

P = Poor
F = Fractured
FF = Highly Fractured
C = Mud Contaminated
CC = Highly Contaminated

No	DEPTH (m)	QUAL REC (mm)	LITHOLOGICAL DESCRIPTION 2-7 NAME	QUAL	QUAL	%	DUN 10 G/S 11	PART 8,9 SRT 13	RND	ARCH 12 POR	PERM	16 COL	17,18 ACC/FOSS	23 CONS	CMT	OIL INDICS						19 - 26 REMARKS (Structures, Stain Etc)
6	1010	25G	AL	SF	(GC)		W/X	FF	SF	P1	K1	BWGE	PYGC	C3	CC	Z	O	Z	O	O	O	occ. GC as flakes
7	980	30G																				
18	965	35G																				→ MS CL
19	928	35G																				
20	897	35G																				
21	849	35G																				
22	830	35G																				
23	805	42G																				
24	782	35G																				
25	750	30G																				
26	720	25G																				
27	690	35G																				
28	663	40G																				
29	623	45G																				
30	600	30G																				

[redacted] = Good
[redacted]dera
[redacted] = Poor
F = Fractured
HF = Highly Fractured
MC = Mud Contaminated
HMC = Highly Contaminated

Well: [redacted]mmerneaa -1 Cum No: 2,3,4 Date: 19.6.82 Page 1 of 5
Field: 62 Rec: Field For: Lost: Misfired Empty:
FM: Latrobe Ref Log: FDC-CNL-GR Run No: Suite 2 Described By: J.G. Stainforth

3/10

	DEPTH (m)	QUAL REC (mm)	LITHOLOGICAL DESCRIPTION 2-7 NAME	QUAL	QUAL	x?	DUN 10 G/S 11	PART 8,9 SRT 13	RND	ARCH 12 POR	PERM	16 COL	17,18 ACC/ FOSS	23 CCSS	CMT	OIL INDICS						19 - 26 REMARKS (Structures, Stain Etc)
1	2123	5PCC	CL													Z	0	Z	0	0	0	Considerable mudcake
2	2116	25M	SS	(LC)			M	S45	R3	P3	K3	LTGE		C3	CC							
3	2111	25M																				
4	2104	10PC	MS	SJ	(Cø)					P1	K1	DK(BW) GE		BQ C3								NON-LS
5	2085	20M																				V.F. Cø Detritus
6	2068	20C	SS	CL			VF	S4	R4	P3	K3	LTGE		C3								
7	2049	30G	MS/ST	Cø						P1	K1	DKBW		C35								
8	2037	20M	SS	LC			M	S4	R34	P3	K3	LTGE (VM)		C3								
9	1966	25M	MS	Cø	SJ					P1	K1	DKBW	?((MC))	C3								
0	1952	18M	SS	CL	(Cø)		F	S5	R4	P13	K13	GE		C3								
1	1948	38G	MS	Cø						P1	K1	DKBW BK		C3								
2	1946	40G	MS	Cø						P1	K1											
3	1901	0	Misfired																			
4	1862.5	25G	ST	Cø	LM					P13	K13	GE,BK		C3								LM GE/BK (Cø)
5	1846	35G	MS	Cø	(SJ)					P1	K1	DKGE, BK		C3								

G = Good
M = Moderate
P = Poor
F = Fractured
FF = Highly Fractured
C = Mud Contaminated
CC = Highly Contaminated

Well: Hammerhead -1 Gun No: 2,3,4 Page 2 of 5
Fired: Rec: Paid For: Lost: Date: 19.6.82 Misfired Empty:
FM: Ref Log: Run No: Described By: J.G. Stainforth

SIDEWALL SAMPLE DESCRIPTION

4/10

o	DEPTH (m)	QUAL REC (mm)	LITHOLOGICAL DESCRIPTION 2-7 NAME	QUAL	QUAL	%	DUN 10 G/S 11	PART 8,9 SRT 13	RND	ARCH 12 POR	PERM	16 COL	17,18 ACC/ FOSS	23 CONS	CMT	OIL INDICS	19 - 26 REMARKS (Structures, Stain Etc)
5-30	1841.5	-1640		.15	Samples Misfired												
31	1623	25G	MS							P1	K1	LTBW	?(Cø)	C3		Z 0 Z 0 0 0	
32	1598	15M	SS	QZ			(F-) CR	?SB S3	R34	P3	K1	LTGE -WH	((LC))	C3			WH CLLS Matrix ? Bimodal
33	1567	20G	MS	(LS)	((SJ))					P1	K1	(BW) GE		C3			
34	1557.5	15M	SS	QZ			(F-) CR	S3	R34	P3	K3	LTGE -WH	?DM SD(BW)	C3		C 1 D 0 0 0	As No.32.Min Fluor in SD
35	1546	35G	MS	SJ	Cø					P1	K1	GE - DKGE		C3		Z 0 Z 0 0 0	
36	1538	25G	MS SS	SA CL			F	S5?7	R34	P3	K3	LTGE		C3			
37	1526	25G	MS	(LS)						P1	K1	(BW) GE		C3			
38	1516.5	45G	Cø MS	Cø						P1	K1	DKBW -BK		C3			
39	1515	40G	MS	Cø						P1	K1	DKGE		C3			
40	1509	25G	MS	Cø						P1	K1	DKBW -BK		C3			
41	1499	20G	ST SS,V	(Cø)			(V)	S7		P13	K13	DKGE		C3			
42	1495.5	38G	(SS)	GC	PY		F	S7	R34	P13	K13	DKBW GN	PY,GC	C5			Sample consists almost entirely of PY and GC. Very dense.
43	1493	0	Lost														
44	1487	40G	SS	PY	(GC)		F	S5	R3	P3	K3	LTBW GE	PY,(GC) ?MC	C35			

SHELL DEVELOPMENT (AUSTRALIA) LIMITED

SIDEWALL SAMPLE DESCRIPTION

Well: Hammerhead -1 Gun No: 2,3,4 Date: 19.6.82 Page 3 of 5

Fired: Rec: Paid For: Lost: Misfired Empty:

FM: Ref Log: Run No: Described By: J.G. Stainforth

5/10

- Good
- Moderate
P = Poor
F = Fractured
HF = Highly Fractured
C = Mud Contaminated
CC = Highly Contaminated

	DEPTH (m)	QUAL	LITHOLOGICAL DESCRIPTION 2-7				DUN 10	PART 8,9		ARCH 12		16	17,18	23		OIL INDICS						19 - 26 REMARKS (Structures,Stain Etc)
No		REC (mm)	NAME	QUAL	QUAL	%	G/S 11	SRT 13	RND	POR	PERM	COL	ACC/ FOSS	CONS	CMT							
45	1482	37G	SA	QZ			F	S7	R34	P57	K57	LTGE	GC	C13		Z	0	Z	0	0	0	
46	1441	22M(C)	SS	QZ	(LS)		M	S5	R34	P57	K57	(BW) GE	MC	C(1)3	CC							
47	1433	15PC	SS	QZ	LS		FC	S5	R34	P3	K3	LTBW		C5	CC							BW Colour from mud contamination
48	1429	40G	MS	CØ						P1	K1	DKBW BK		C35								CØ, BK
49-51	1422, 1419, 1415			Misfired																		
52	1410	35G	SA	QZ			F	S7	R4	P7	K7	LTGE	(GC) (LC)	C13								
53	1402	30FC	SA/SS	QZ	GC		FR	S45	R45	P7	K7	LT(BW) GE	GC	C13								BW colour from mud contamination
54	Empty																					
55	1395	30G	SA	QZ			F	S9	R34	P57	K57	LT(BW) GE	(CL)	C13								(CL) LM, DK GE
56	1388	25P(C)	SA	QZ			MR	SB S4	R25	P7	K7	LTGE	((PY))	C1	((CC))							Bimodal M Grains : R2 CR Grains : R5
57	1384	30G	SS	GC	PY		MR	SB S4	R25	P3	K3	DK(GN) GE	PY GC	C3	CC							
58	1381	40G	SA	QZ			F	S9	R34	P7	K7	LTGE		C1(3)								
59	1354	35PC	SA	QZ			RPB	S5	R5	P7	K7	LTGE		C1								
60	1342	30M	SS	PY	GC		VF	S7	R34	P3	K3	DKBW	PY GC	C3	(CC)							
61	1340	25M(C)	SS	(PC	GC)		VF	S7	R34	P5	K5	DKBW	PY GC	C3								

Good
Moderate
= Poor
= Fractured
= Highly Fractured
= Mud Contaminated
C = Highly Contaminated

SIDEWALL SAMPLE DESCRIPTION

Well: [illegible]mmerhead -1 Gun No: 2,3,4 Date: 19.6.82 Page 4 of 5
Fired: Rec: Paid For: Lost: Misfired Empty:
FM: Ref Log: Run No: Described By: J.G. Stainforth

	DEPTH (m)	QUAL REC (mm)	LITHOLOGICAL DESCRIPTION 2-7 NAME	QUAL	QUAL		DUN 10 G/S 11	PART 8,9 SRT 13	RND	ARCH 12 POR	PERM	16 CCL	17,18 ACC/FOSS	23 CONS	CMT	OIL INDICS	19 - 26 REMARKS (Structures, Stain Etc)
62	1325	30G	SA	QZ			F	S7	R34	P7	K7	LTGE	(LC,CØ)	C1			
63	1316.5	35G	SA	QZ			F	S7	R34	P7	K7	LTGE	(LC,CØ)	C1			
64	1308	35G	SA	QZ													
65	1303.5	25M	SA	QZ													
66	1293	15M	SA/SS	QZ			FR,PB	SB S3	R25	P5	K5	WH LTGE	LS (LC)	C13	CC		F = R2 R,PB = R45
67	1291	45G	MS	LS	GC		FP			P1	K1	DK(BW) GE	SJ PY GC	C3	CC		FP replaced by GC
68	1285.5	Lost															
69	1288	45G	ST/SS	CL	GC		V	S7	R3	P1	K1	DK(BW) GE	GC PY	C3			SS CL V
70	1286.5	50G	ST/SS	CL			V	S7					(GC)				
71	1285	45G	ST/SS	CL			V	S7									
72	1282.5	45G	ST/SS	CL			V	S7									

6/10

[redacted] = Good
[redacted] Moderate
P = Poor
F = Fractured
FF = Highly Fractured
C = Mud Contaminated
CC = Highly Contaminated

SIDEWALL SAMPLE DESCRIPTION

Well: Hammerhead -1 Gun No: 2,3,4 Date: 19.6.82 Page 5 of 5
Fired: Rec: Paid For: Lost: Misfired Empty:
FM: Ref Log: Run No: Described By: J.G. Stainfor

7/10

No	DEPTH (m)	QUAL REC (mm)	LITHOLOGICAL DESCRIPTION 2-7 NAME	QUAL	QUAL	%	DUN 10 G/S 11	PART 8,9 SRT 13	RND	ARCH 12 POR	PERM	16 COL	17, 18 ACC/FOSS	23 CONS	CMT	OIL INDICS						19 - 26 REMARKS (Structures, Stain Etc)
81	1199		MS	LS	GC		(FF)			P1	K1	DK BW GE	PYGC	C4	CC	Z	0	Z	0	0	0	
80	1203		MS	LS						P1	K1	↓	OCC PYGC	C3	CC							
79	1207		↓							↓						↓						
78	1225																					
77	1240																					
76	1256																					
75	1265																					
74	1270																					
73	1278		↓							↓						↓						

STANDARD ABBREVIATIONS FOR LITHOLOGICAL DESCRIPTION 8/10 IIIC3-5

(July 1975)

MAIN LITHOTYPE AND QUALIFIERS (GD01 61-66,71-76 AND GD02 27-32)

MAIN LITHOTYPE:GD01 61-62,71-72 AND GD02 27-28
TWO QUALIFIERS:GD01 63-66,73-76 AND GD02 29-32

CAUTION: UNLESS SPECIFIED OTHERWISE,SAME CODE FOR:
-NOUN(LIMESTONE/CLAY)=MAIN LITHO TYPE
-ADJECTIVE (CALCAREOUS/ARGILLACEOUS)=QUALIFIER

EXAMPLE:SSLSST = CALCAREOUS,SILTY SANDSTONE
LSPT= PELLETAL LST
C EV=CARBONATE/EVAPORITIC
DMCT=DOLOMITE/CHERTY
DLAH=DOL.-LIMESTONE/ANHYDRITIC
SHBT=SHALE/BITUMINOUS
BTSR= BITUMINOUS STREAKS
CTBA=BANDED CHERT
LSCTBA=LIMESTONE/CHERT BANDS

AN -ANDESITE
AH -ANHYDRITE
AHCW-ANHYD.CONCRETIONS-COMPRESSED(CHICKEN-WIRE)
DA -ANHYDRITE-DOLOMITE MIXED
AR -ARAGONITE
CL -ARGILLACEOUS/CLAY
AL -ARGILLACEOUS LIMESTONE
AS -ARGILLACEOUS SAND/SANDSTONE
AK -ARKOSE
AE -ASBESTOS
AP -ASPHALT

BA -BANDS
BS -BASALT(MAIN LITHOTYPE ONLY)
SF -BIOCLASTIC/DETRITAL/SHELL FRAGMENTS
BI -BIOTITE (LITHO QUALIFIER ONLY)
CB -BIOTURBATED/CHURNED
BY -BIRDSEYE STRUCTURE/KEYSTONE VUGS
BI -BISCHOFITE (MAIN LITHOTYPE ONLY)
BT -BITUMINOUS
BK -BLACK
BQ -BLOCKY
BL -BLUE
BO -BORINGS
SFBO-BORED SURFACE (IN REMARKS ONLY)
BN -BOUDINAGE
RH -BOXWORK STRUCTURE/RAUHWACKE
BR -BRECCIA
BW -BROWN
LG -BROWN COAL/LIGNITE
BF -BUFF
BU -BURROWS

LS -CALCAREOUS/LIMESTONE
CA -CALCITE
CS -CALICHE
CO -CARBONACEOUS/COAL
CE -CARBONATES-EVAPORITES MIXED
OC -CARBONATES-ORGANIC ROCKS MIXED
C -CARBONATES UNSPECIFIED
CN -CARNALLITE
CV -CAVERNOUS
CY -CHALCEDONY
CK -CHALK
CT -CHERT
CI -CHLORITE
CB -CHURNED/BIOTURBATED
CL -CLAY/ ARGILLACEOUS
MS -CLAYSTONE/MUDSTONE
CO -COAL/CARBONACEOUS
CO -COATED -USE ONLY WITH FOSSILS EG.FLCO
CC -CONCRETIONS
CG -CONGLOMERATE
CU -COPPER
FE -COPROLITES/FAECAL PELLETS
CY -CRYPTO
XA -CRYSTAL

DK -DARK
SF -DETRITAL/BIOCLASTIC/SHELL FRAGMENTS
DB -DIABASE
DI -DIORITE
DO -DOLERITE (MAIN LITHOTYPE ONLY)
DM -DOLOMITE
DA -DOLOMITE-ANHYDRITE MIXED
DL -DOLOMITE-LIMESTONE/DOLOMITIC LIM[illegible]
DO -DOMES (LITHO QUALIFIER ONLY)
DY -DYKE

EV -EVAPORITE/EVAPORITIC
CE -EVAPORITES-CARBONATES MIXED
EX -EXTRUSIVE ROCK

FE -FAECAL PELLETS
FD -FELDSPAR
FZ -FERRICRETE
FG -FERRUGINOUS/IRONSTONE/LIMONITE
FT -FETID
FI -FISSILE
FY -FLAGGY BEDDED
FK -FLAKY
FF -FORAMINIFERAL
F -FOSSILIFEROUS
FC -FRACTURED

GA -GABBRO
GC -GLAUCONITE
GS -GNEISS
GD -GOLD
GN -GRANITE (MAIN LITHOTYPE ONLY)
PSAG-GRAPESTONE
GV -GRAVEL
GN -GREEN
GE -GREY
GK -GREYWACKE
GU -"GRUMELEUX"
GY -GYPSUM

NA -HALITE/ROCK SALT
HM -HEAVY MINERALS
HE -HEMATITE
HO -HORNBLENDE
HT -HORSE-TAILING

IG -IGNEOUS ROCK
IL -ILLITE
IC -INTERCALATIONS
IT -INTRACLAST
IN -INTRUSIVE ROCK
FG -IRONSTONE/LIMONITE/FERRUGINOUS

J -JOINTS IN GENERAL
JH -JOINTS-HORIZONTAL
JV -JOINTS-VERTICAL

KA -KAINITE
KL -KAOLINITE
BY -KEYSTONE VUGS/BIRDSEYE STRUCTURE
KI -KIESERITE

LM -LAMINATIONS
LA -LATERITE
LE -LEACHED
LN -LENSES/LENTICULAR
LT -LIGHT
LG -LIGNITE/BROWN COAL
LS -LIMESTONE/CALCAREOUS
AL -LIMESTONE,ARGILLACEOUS
DL -LIMESTONE-DOLOMITE MIXED/DOL.LIMEST.
SC -LIMESTONE,SANDY (MAIN LITHO.ONLY)
LM -UNCONSOL.LIME(CALC.OOZE)(MAIN LITH.ON
FG -LIMONITE/IRONSTONE/FERRUGINOUS
LC -LITHIC/LITHOCLAST/ROCKFRAGMENT
LCAG-LITHOCLASTS,AGGREGATED

KM -MAGNESIUM,POTASSIUM SALTS IN GENERAL
MN -MANGANESE
MR -MARL
OL -MASS FLOW
MM -METAMORPHIC
MC -MICA/MICACEOUS
MG -MINERAL GRAINS
M -MIXED ROCK (UNSPECIFIED)
MD -MODERATE/MEDIUM COLOUR
MO -MONTMORILLONITE
VM -MOTTLED/VARIEGATED
MS -MUDSTONE/CLAYSTONE
MV -MUSCOVITE

NK -NICKEL
ND -NODULES/NODULAR
NO -NOT OBSERVED;INFO.INCOMPLETE/ABSENT

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OL -OLISTOLITH/SLIDE/ROCKFALL
OL -OLISTOSTROME / MASS FLOW
OI -OLIVE
OV -OLIVINE
OK -ONKOIDAL
OD -OOID/OOLITIC/OOIDAL
OZ -OOZE
OA -OPAL
OP -OPHIOLITE/OPHIOLITE SUITE
OT -OPHITIC
ON -ORANGE
O -ORGANIC ROCKS UNSPECIFIED
OC -ORGANIC ROCK+CARBONATES(MIXED)
OS -ORGANIC ROCK+SILICICLASTICS(MIXED)
OM -ORGANIC ROCK+UNSPECIFIED SEDS.(MIXED)
OR -ORTHOCLASE

PR -PAPERY
PA -PARTLY+LOCALLY
PE -PEAT
PT -PELLETAL/PELLETOID/PELLETS(1/16-2 MM)
PM -MICROPELLETOID(<1/16 MM)
PR -PERIDOTITE (MAIN LITHOTYPE ONLY)
PK -PINK
PD -PISOLITIC+PISOID
PP -PHOSPHATE/PHOSPHATIC
PG -PLAGIOCLASE
P -PLUTONIC
PH -POLYHALITE
PC -PORPHYRITIC
KM -POTASSIUM+MAGNESIUM SALTS IN GENERAL
DV -PULL-APART STRUCTURES
PU -PURPLE
PY -PYRITE/PYRITIC
VC -PYROCLASTIC ROCK IN GENERAL
PX -PYROXENE

QZ -QUARTZ
QT -QUARTZITE

RA -RADIOLARITE
RH -RAUHWACKE/BOXWORK STRUCTURE
RE -RED
RB -RED BEDS
RP -REPLACEMENT
RS -RESIDUAL
RW -REWORKED
RL -RHYOLITE
LC -ROCK FRAGMENT/LITHOCLAST/LITHIC
OH -ROCKFALL/SLIDE/OLISTOLITH
RT -ROOT BED/ROOT TUBES
PS -ROUNDED PARTICLES
PSAG-ROUNDED+AGGREGATED PTLS.(GRAPESTONE)

SL -SALT IN GENERAL
SA -SAND/SANDY
SS -SANDSTONE
AS -SAND/SANDSTONE+ARGILLACEOUS
SC -SANDY LIMESTONE (MAIN LITHOTYPE ONLY)
SC -SCOUR+FILL STRUCTURES
SN -SERPENTINE
SH -SHALE
SF -SHELL FRAGMENTS/BIOCLASTIC/DETRITAL
SD -SIDERITE/SIDERITIC
SI -SILICEOUS
S -SILICICLASTIC ROCK UNSPECIFIED
OS -SILICICLASTICS-ORGANIC ROCKS MIXED
SZ -SILCRETE
ST -SILT/SILTSTONE
SY -SLABBY
SK -SLICKENSIDES
OH -SLIDE/ROCKFALL/OLISTOLITH
SX -SOLUTION
SR -STREAKS
SQ -STROMOTACTIS
SE -STYLOLITES
SU -SULPHUR
SV -SYLVINITE

TY -TACHYDRITE
TA -TAR
TI -TILLITE
TF -TUFF

UM -ULTRAMAFIC ROCK IN GENERAL
UR -URANIUM

VM -VARIEGATED/MOTTLED
VV -VARVES
VN -VEIN
VA -VOLCANIC AGGLOMERATE
V -VOLCANIC ROCK UNSPECIFIED/VOLCANIC
VG -VUGS

WT -WEATHERED
WD -WEDGE-SHAPED LAYERS
WH -WHITE

YE -YELLOW

ZE -ZEOLITES,ZEOLITIC

BEDDING: B1 -NO APPARENT BEDDING/MASSIVE
B3 -SLIGHTLY (POORLY) BEDDED
B5 -FAIRLY WELL BEDDED/BEDDED
B7 -WELL BEDDED
B9 -VERY WELL BEDDED
NOTE: MASSIVE-SLIGHTLY BEDDED=B2

BB -MILIMETRE BEDDED (<1 CM.)
BC -CENTIMETRE BEDDED (1-10 CM.)
BD -DECIMETRE BEDDED (10-100 CM.)
BM -METRE BEDDED (>100 CM.)
BJ -THIN BEDDED
BH -VARIABLY BEDDED
BV -CONVOLUTE BEDDING
BX -CROSS-BEDDED
BG -GRADED BEDDING
BS -SLUMPED+CONTORTED BEDDING

SED.STRUCTURES: XF -FLUTE CASTS
XG -GROOVE CASTS (>2 MM.WIDE)
XL -LOAD CASTS
XP -PROD CASTS/BOUNCE CASTS
XS -STRIATION CASTS (<2 MM.WIDE)
XC -GEOPETAL FABRIC/FLOORED CAVITIES
XM -MUDCRACKS
XI -PEBBLE IMBRICATION
XN -PSEUDO-NODULED/PHACOIDS
XO -PULL-OVER/FLAME STRUCTURE
XR -RAIN+GAS+AIR OR SPRING PITS
XX -SALT MOULDS OR HOPPERS
XT -TEPEE STRUCTURE

LINEATIONS: YF -FOSSIL(SHELL)LINEATION
YP -PARTING LINEATION
YR -PEBBLE LINEATION
YL -PLANT FRAGMENT(LIGNITE)LINEATION
YQ -SAND GRAIN LINEATION
YS -STREAMING LINEATION

ROUNDING: R1 -VERY ANGULAR <0.1
R2 -ANGULAR 0.2
R3 -SUBANGULAR 0.3
R4 -SUBROUNDED 0.4
R5 -ROUNDED 0.6
R6 -WELL ROUNDED >0.85

SPHERICITY: O1 -VERY ELONGATED <0.5
O2 -ELONGATED 0.5-0.6
O3 -SLIGHTLY ELONGATED 0.6-0.7
O4 -ALMOST SPHERICAL 0.7-0.8
O5 -SPHERICAL 0.8-0.9
O6 -VERY SPHERICAL >0.9

SORTING: S1 -VERY POORLY SORTED/UNSORTED
S3 -POORLY SORTED
S5 -MODERATELY WELL SORTED
S7 -WELL SORTED
S9 -VERY WELL SORTED
NOTE: POORLY-FAIRLY WELL SORTED = S4

PERMEABILITY: K1 -IMPERMEABLE/TIGHT
K3 -SLIGHTLY (POORLY) PERMEABLE
K5 -MODERATELY PERMEABLE/PERMEABLE
K7 -HIGHLY PERMEABLE
NOTE: SLIGHTLY PERMEABLE-PERMEABLE = K4

POROSITY: P1 -NON-POROUS/DENSE
P3 -SLIGHTLY (POORLY) POROUS
P5 -FAIRLY POROUS/POROUS
P7 -HIGHLY POROUS

CONSOLIDATION: C1 -UNCONSOLIDATED/LOOSE
(CEMENTATION) C3 -SLIGHTLY CONSOLIDATED/FRIABLE
C5 -CONSOLIDATED/CEMENTED/HARD
C7 -STRONGLY CEMENTED/HIGHLY CONSOL.
(E.G. QUARTZITIC SANDSTONE)

10/10.

FOSSILS (CAN BE RECORDED AS LITHO QUALIFIERS
------- USING THE FOLLOWING CODES OR IN GD
REMARKS USING CODE OR FULL NAME)

AC -ACRITARCHES(MICROPLANKTON)
AG -ALGAE
AM -AMMONITES

BE -BELEMNITE
BP -BRACHIOPODA
BZ -BRYOZOA

CP -CALCISPHERES
CH -CHARA
CZ -CHITINOZOA
CD -CONODONTS
CR -CORALS
CS -CRINOIDS

DT -DIATOMAE
DF -DINOFLAGELLATES (MICROPLANKTON)

EM -ECHINODERMA

FE -FAECAL PELLETS/COPROLITES
FH -FISH REMAINS
FF -FORAMINIFERA/FORAMINIFERAL
FL -FORAMINIFERA LARGE
FS -FORAMS SMALL
FB -FORAMS BENTHONIC
FP -FORAMS PLANKTONIC
F -FOSSILS IN GENERAL/FOSSILIFEROUS

GR -GASTROPODS
GP -GRAPTOLITES

LB -LAMELLIBRANCHS/PELECYPODS

MP -MICROPLANKTON IN GENERAL
MI -MILIOLIDAE
ML -MOLLUSCA

NC -NANNOCONUS
NP -NANNOPLANKTON

OG -OLIGOSTEGINA
OC -OSTRACODA

PL -PLANT REMAINS
PN -POLLEN/SPORES/SPOROMORPHS

RA -RADIOLARIA
RT -ROOT BEDS/ROOT TUBES
RD -RUDIST

SF -SHELL FRAGMENTS/SKELETAL/BIOCLASTIC
SW -SILICIFIED WOOD
SP -SPICULES
SG -SPONGES
SM -STROMATOPOROID / STROMATOLITE / ALGAL MAT
TR -TRACK,TRAIL,TRACE FOSSIL
TL -TRILOBITES

VE -VERTEBRATES
VT -VERTEBRATE TRACKS

TEXTURE (GD01 67-68,77-78 AND GD02 33-34)

DUNHAM CLASSIFICATION

B -LIME-BOUNDSTONE
G -LIME-GRAINSTONE
P -LIME-PACKSTONE
W -LIME-WACKESTONE
M -LIME-MUDSTONE

A -APHANITIC
X -FINE CRYSTALLINE
S -COARSE CRYSTALLINE/SUCROSIC/SACCHAROIDAL

WENTWORTH CLASSIFICATION

BO -BOULDERS
CB -COBBLES
PB -PEBBLES
GR -GRANULE
R -VERY COARSE (ARENITE)
C -COARSE (ARENITE)
MC -MEDIUM TO COARSE (ARENITE)
M -MEDIUM (ARENITE)
MF -MEDIUM TO FINE (ARENITE)
F -FINE (ARENITE)
V -VERY FINE (ARENITE)
ST -SILT(20-63 MU)
PI -PELITE(<20 MU)

STANDARD ABBREVIATIONS FOR DESCRIPTION OF LITHOLOGICAL REALM

IF NO DETAILED INFORMATION IS AVAILABLE,ONLY THE SEDIMENTARY
REALM OR PROVINCE CAN BE DESCRIBED (GD01 61-64) :
-FILL IN R = REALM (REGIONAL INFORMATION) IN GD01 CC 63
LEAVE GD01 CC 64 BLANK

GD01 CC 61-62 : MAIN LITHOLOGIC PROVINCES:

S -SILICICLASTIC
C -CARBONATE
E -EVAPORITE
M -MIXED (ALL THREE : S,C,E, ARE PRESENT)

V -VOLCANIC

EXAMPLE

SV -MAINLY SILICICLASTICS/ SOME VOLCANICS
VE -VOLCANICS/ SOME EVAPORITES
MV -MIXED PROVINCE/ SOME VOLCANICS

APPENDIX 6.3

PALAEONTOLOGY

See Report R4363, a copy of which is included in the basic data package.

APPENDIX 6.4

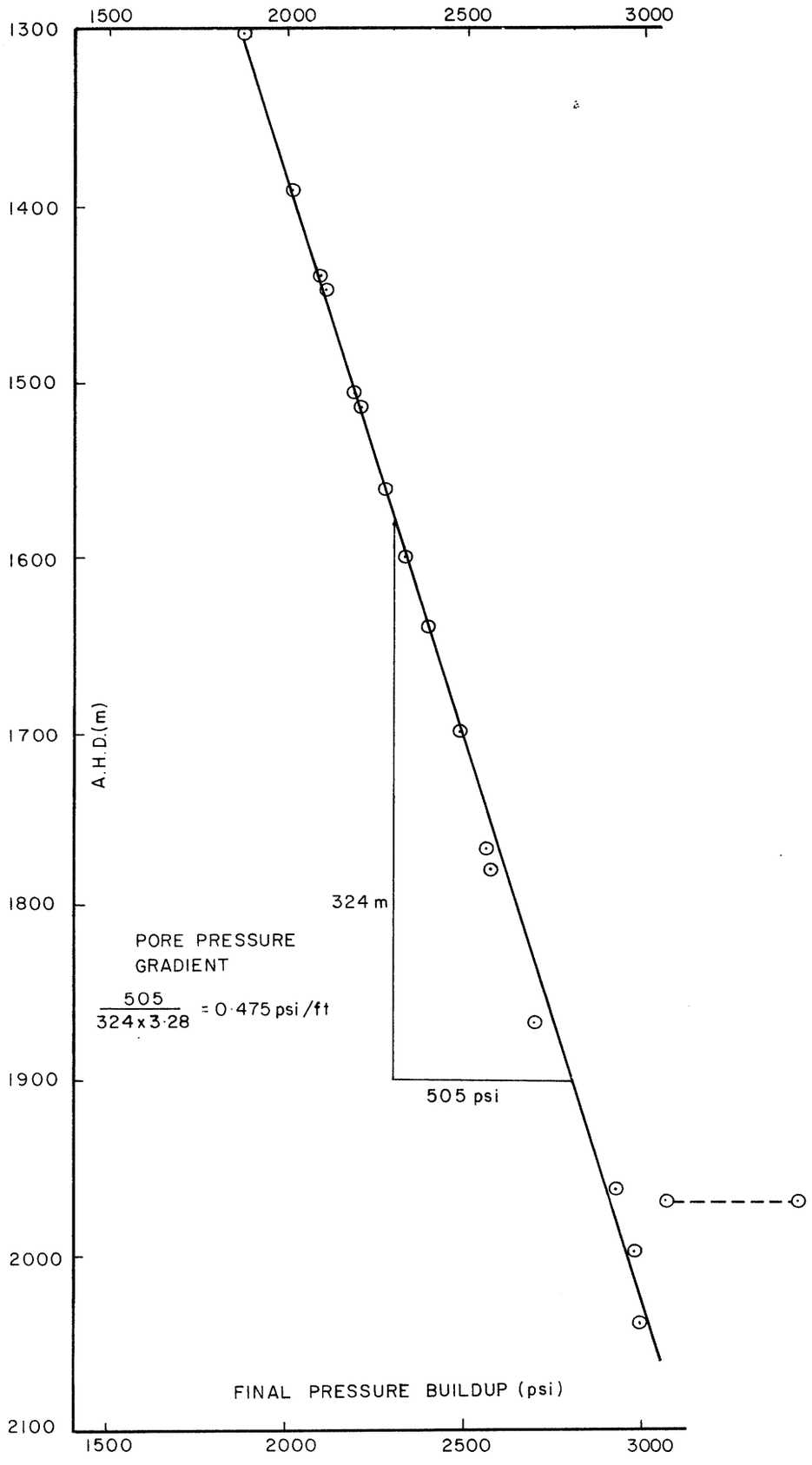
PALYNOLOGY

The palynology results are given in detail in report R4454. The results are generally inconclusive as the majority of samples are barren, and where reasonable organic yields were obtained they were oxidized or poorly diversified. The following sidewall samples gave some indications of age.

SWS at 1429m - L. balmei (Paleocene)
SWS at 1509m - L. balmei (Paleocene)
SWS at 1623m)
SWS at 1846)
SWS at 2049) - T. lilliei or younger (Campanian)
SWS at 2104)
SWS at 2123)

APPENDIX 6.5

REPEAT FORMATION TEST DATA



SHELL - AUSTRALIA E.& P. OIL AND GAS.

GIPPSLAND BASIN

HAMMERHEAD-1

RFT TEST RESULTS

Author EPE	Date JUNE 1982	Fig: 7
Report No SDA 412	Drawing No 14829	

TABLE 6: RFT PRESSURES - WELL HAMMERHEAD-1

DEPTH (mbdf)	BUILD-UP PRESSURE (psig)	REMARKS
1296.5	1895	-
1388	2022	-
1440	2098	-
1445	2108	-
1503	2198	-
1512	2211	-
1560	2276	Sample
1598	2330	-
1639	2390	-
1700	2475	-
1766.5	2569	-
1776	2582	-
1865	2708	-
1960	2921	-
1963	2925	Tight
1970	3074	Tight
1995	2982	Tight
2038	3005	Sample

APPENDIX 6.6

FLUID ANALYSIS

FLOPETROL
Schlumberger

CLIENT : SHELL DEVELOPMENT AUSTRALIA

WELL : 1

WATER ANALYSIS

	SAMPLING 1	SAMPLING 2	SAMPLING 3	SAMPLING 4
Bottle Serial Nos.	9214/98	9024/4	80291/369	80291/316
Date of Transfer	9/7/82	9/7/82	10/7/82	10/7/82
Sample Depth (Metres)	2038	2038	1560	1560
Sampling Bottom Hole Pressure (psig)	2986	2986	2286	2286
Sampling Bottom Hole (Temperature °F)	152.8	152.8	152.8	152.8
ON ANALYSIS OF THE FILTERED SAMPLES, THE FOLOOWING RESULTS WERE OBTAINED :-				
Specific Gravity 25°C/25°C	1.020	1.019	1.019	1.019
Ph	8.2	8.2	8.7	9.0
CATIONS (mg/l)				
Sodium (Na)	13,790	13,880	15,060	14,440
Calcium (Ca)	167	167	50	50
Magnesium (Mg)	24.3	25.2	6.54	4.86
Barium (Ba)	Not Detected	Not Detected	Not Detected	Not Detected
Iron (Fe)	5.68	9.32	0.34	0.23
ANIONS (mg/l)				
Chloride (CL)	15,400	15,350	15,300	14,900
Sulphate (So4)	7,000	7,490	9,430	8,550
Carbonate (Co3)	Not Detecte	Not Detected	360	240
Bicarbonate (HCo3)	1830	1555	1037	1464
Hydroxy (OH)	Not Detected	Not Detected	Not Detected	Not Detected
Total Sulphide (S^{--})	9	8	24	21
Nitrite	Not Detected	Not Detected	Not Detected	Not Detected

APPENDIX 6.7

VELOCITY SURVEY DATA

(see basic data package)

APPENDIX 6.8

TEMPERATURE DATA AND CORRECTED TEMPERATURES

TABLE 10: HAMMHEREAD-1 BOTTOM-HOLE TEMPERATURES

Suite	Log	Z	Z'	t	Tmax
1	ISF/BHC/SP/GR	1039	896	5-1/2	-
1	FDC/CNL/CAL/GR	1197	1054	2-1/2	43.3
2	ISF/BHC/SP/GR	2125	1982	5	70.0
2	FDC/CNL/CAL/GR	2124	1981	9	76.6
2	MSFL/DLL/GR	2113	1970	14	80.0
2	HDT	2125	1982	18-1/2	80.0
2	RFT	2113	1970	29	80.0

Z = max depth bdf, metres

Z' = max depth below seafloor, metres

t = time since last circulation, hrs.

Tmax = maximum recorded temperature

KB = +22m) 143m

WD = -121m)

TABLE 11: HAMMERHEAD-1: TEMPERATURE CORRECTIONS

SUITE	LOG	DEPTH BDF, m	DEPTH BSF, m	Tmax (^{o}C)	t_c est hr	t hr	R= (tc+t)/t	ln R	Tcorr (^{o}C) (est)
1	FDC/CNL/CAL/GR	1197	1054	43.3	3	2-1/2	2.20	0.788	52
2	ISF/BHC/SP/GR	2125	1982	70.0	5	5	2.00	0.693	)
2	FDC/CNL/CAL/GR	2124	1981	76.6	5	9	1.555	0.442	) 87
2	HDT	2125	1982	80.0	5	18-1/2	1.270	0.239	)

N = Nomogram

C = CTRM

APPENDIX 6.9

MUDLOGGING DATA

(see basic data package)

PE902662

This is an enclosure indicator page.
The enclosure PE902662 is enclosed within the container PE902661 at this location in this document.

The enclosure PE902662 has the following characteristics:

ITEM_BARCODE	= PE902662
CONTAINER_BARCODE	= PE902661
NAME	= Well Summary Sheet
BASIN	= GIPPSLAND
PERMIT	=
TYPE	= WELL
SUBTYPE	= MONTAGE
DESCRIPTION	= Well Summary Sheet
REMARKS	=
DATE_CREATED	= 24/06/1982
DATE_RECEIVED	= 19/10/1982
W_NO	= W775
WELL_NAME	= Hammerhead-1
CONTRACTOR	= SHELL
CLIENT_OP_CO	= SHELL

(Inserted by DNRE - Vic Govt Mines Dept)

PE902663

This is an enclosure indicator page.
The enclosure PE902663 is enclosed within the container PE902661 at this location in this document.

The enclosure PE902663 has the following characteristics:

ITEM_BARCODE	= PE902663
CONTAINER_BARCODE	= PE902661
NAME	= Well Data Sheet Hammerhead 1
BASIN	= GIPPSLAND
PERMIT	=
TYPE	= WELL
SUBTYPE	= MONTAGE_LOG
DESCRIPTION	= Well Data Sheet Hammerhead 1
REMARKS	=
DATE_CREATED	= 30/09/1982
DATE_RECEIVED	= 19/10/1982
W_NO	= W775
WELL_NAME	= Hammerhead-1
CONTRACTOR	= SHELL
CLIENT_OP_CO	= SHELL

(Inserted by DNRE - Vic Govt Mines Dept)

PE601341

This is an enclosure indicator page.
The enclosure PE601341 is enclosed within the container PE902661 at this location in this document.

The enclosure PE601341 has the following characteristics:

ITEM_BARCODE	= PE601341
CONTAINER_BARCODE	= PE902661
NAME	= Composite Well Log
BASIN	= GIPPSLAND
PERMIT	=
TYPE	= WELL
SUBTYPE	= COMPOSITE_LOG
DESCRIPTION	= Composite Well Log
REMARKS	=
DATE_CREATED	= 02/07/1982
DATE_RECEIVED	= 19/10/1982
W_NO	= W775
WELL_NAME	= Hammerhead-1
CONTRACTOR	= Schlumberger
CLIENT_OP_CO	= SHELL

(Inserted by DNRE - Vic Govt Mines Dept)

PE902664

This is an enclosure indicator page.
The enclosure PE902664 is enclosed within the container PE902661 at this location in this document.

The enclosure PE902664 has the following characteristics:

ITEM_BARCODE	= PE902664
CONTAINER_BARCODE	= PE902661
NAME	= Striplot Output
BASIN	= GIPPSLAND
PERMIT	=
TYPE	= WELL
SUBTYPE	= MONTAGE_LOG
DESCRIPTION	= Stripplot Output
REMARKS	=
DATE_CREATED	= 30/09/1982
DATE_RECEIVED	= 19/10/1982
W_NO	= W775
WELL_NAME	= Hammerhead-1
CONTRACTOR	= SHELL
CLIENT_OP_CO	= SHELL

(Inserted by DNRE - Vic Govt Mines Dept)

PE902665

This is an enclosure indicator page.
The enclosure PE902665 is enclosed within the container PE902661 at this location in this document.

The enclosure PE902665 has the following characteristics:

ITEM_BARCODE	= PE902665
CONTAINER_BARCODE	= PE902661
NAME	= Time Contour Map Top Latrobe Level Post Drill
BASIN	= GIPPSLAND
PERMIT	=
TYPE	= SEISMIC
SUBTYPE	= HRZN_CONTR_MAP
DESCRIPTION	= Time Contour Map Top Latrobe Level Post Drill
REMARKS	=
DATE_CREATED	= 19/10/1982
DATE_RECEIVED	= 19/10/1982
W_NO	= W775
WELL_NAME	= Hammerhead-1
CONTRACTOR	= SHELL
CLIENT_OP_CO	= SHELL

(Inserted by DNRE - Vic Govt Mines Dept)

PE601343

This is an enclosure indicator page.
The enclosure PE601343 is enclosed within the container PE902661 at this location in this document.

The enclosure PE601343 has the following characteristics:

ITEM_BARCODE	= PE601343
CONTAINER_BARCODE	= PE902661
NAME	= Well log correlation Flounder1, Stonefish 1, Hammerhead,1 Dart 1, Sole 1
BASIN	= GIPPSLAND
PERMIT	=
TYPE	= WELL
SUBTYPE	= CROSS_SECTION
DESCRIPTION	= Well log correlation Flounder1, Stonefish 1, Hammerhead,1 Dart 1, Sole 1
REMARKS	=
DATE_CREATED	= 31/08/1982
DATE_RECEIVED	= 19/10/1982
W_NO	= W775
WELL_NAME	= Hammerhead-1
CONTRACTOR	= SHELL
CLIENT_OP_CO	= SHELL

(Inserted by DNRE - Vic Govt Mines Dept)

PE601344

This is an enclosure indicator page.
The enclosure PE601344 is enclosed within the container PE902661 at this location in this document.

The enclosure PE601344 has the following characteristics:

ITEM_BARCODE	= PE601344
CONTAINER_BARCODE	= PE902661
NAME	= Masterlog geological evaluation
BASIN	= GIPPSLAND
PERMIT	=
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Masterlog geological evaluation
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	= 18/08/1982
W_NO	= W775
WELL_NAME	= Hammerhead-1
CONTRACTOR	= Geoservices overseas s.a.
CLIENT_OP_CO	= SHELL

(Inserted by DNRE - Vic Govt Mines Dept)