WEST SEAHORSE -2
WELL COMPLETION REPORT

PERMIT Vic/P11
1982

Hudbay Oil (Australia) Ltd.

OIL and GAS DIVISION

0 1 JUN 1983

WEST SEAHORSE No.2

WELL COMPLETION REPORT

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CHIEF GEOLOGIST.

Hudbay Oil (Australia) Ltd.

CONTENTS

FIGURES

APPENDICES

ENCLOSURES

ENCLOSURE NO.		Drawing No.
1	Composite Log	Z-GL-132
2	Tectonic Elements	A3-GL-87
3	Air Gun Well Velocity Survey and Calibrated Log Data	
4	Velocity Log	
5	Wellsite Lithology Log	Z-GL-97
6	Mud Log	A4-GL-492

1 WELL HISTORY

1.1 General Data

1.1.1 Name and Address of Operator

Hudbay Oil (Australia) Ltd.,
256 Adelaide Terrace,
PERTH W.A. 6000

1.1.2 Participants

Beach Petroleum N.L.,
32nd Floor,
360 Collins Street,
MELBOURNE VIC. 3000

Hudbay Oil (Australia) Ltd.,
256 Adelaide Terrace,
PERTH W.A. 6000

Gas & Fuel Exploration N.L.,
171 Flinders Street,
MELBOURNE VIC. 3000

1.1.3 Petroleum Title

Vic/P-11, Victoria

1.1.4 District

Melbourne, 1:1,000,000 Block No. 1916

1.1.5 Location - Ref. Figure No.1

Latitude 38° 12' 21.84"S
Longitude 147° 36' 38.53"E

AMG Co-ordinates :
E 553466
N 5771132

Zone 55
Final position is 62 metres N.W. of the intended location.

1.1.6 Water Depth - 38.50 m below Mean Spring Low Water

Total Depth - 2050 m below Rotary Table, reached on February 11, 1982
Rotary Table - 9.45 m above Mean Spring Low Water
Rig on Location - January 22, 1982
Spud Date - January 23, 1982
Rig Release Date - February 17, 1982
Drilling Unit - Petromar "North Sea" (Drillship)

1.1.7 Status

Plugged and Abandoned.

1

WELL HISTORY

(Pages 1 - 4)

1.2 Drilling Summary

The drillship "Petromar North Sea" sailed from the Sperm Whale No 1 location and arrived at the West Seahorse No 2 location at 1230 hours on January 22nd, 1982. The anchors were run and soaked, the rig was positioned over the location, and the mooring chains were tensioned.

The temporary guide base was run and landed on the sea floor. A 36" bottom hole assembly was prepared and the well was spudded at 0300 hours on January 23, 1982. The 36" hole was drilled to 56m, the 36" hole opener was pulled and laid down, and a 26" bottom hole assembly was run. A 26" hole was drilled to 206m and a 20" casing string complete with 20-3/4" wellhead, 30" conductor pile, and permanent guide base was run to 191m. The string was cemented in place with a lead slurry of 2 percent prehydrated gel and a tail slurry of neat cement plus 2 percent $CaCl_2$. The 20-3/4" BOP stack was run on 22" riser and then the casing and stack were pressure tested. The casing would not hold 500 psig surface pressure.

A 17½" bottom hole assembly was made up and the 20" shoe was drilled out. The well was closed in and was pressured up to 550 psi while pumping at 2-4 BPM. The pressure bled to zero as soon as the pumps were shut down. Utilizing electric wireline HRT surveys, a leak in a connector was found at 79m. Open ended drillpipe was run to 85m and the leak was cement squeezed with Class "B" cement plus 2.5 percent $CaCl_2$. After WOC for 6 hours, the casing was tested to 150 psi and bled back to 100 psi in 10 minutes. The excess cement was drilled out, the casing was pressure tested to 100 psi, and mud system was displaced to a gel-polymer system. The 17½" hole was then drilled to 1317m and a series of electric logs were run. A string of 13-3/8" casing was run and cemented in place at 1299m with a 2.5 percent prehydrated gel lead slurry and a neat cement tail slurry. During the displacement, the cement set up leaving 184m of cement in the casing. A 12¼" bottom hole assembly was made up to drill out the cement to 1285m. At this point the 20-3/4" stack was pulled and replaced by a 13-5/8" stack.

There was some difficulty in latching the 13-5/8" collet connector due to the 20" AX ring being left in the wellhead when the 20-3/4" stack was pulled. Divers removed the ring enabling latching of the 13-5/8" connector. After surface installations were completed, the casing and stack were pressure tested.

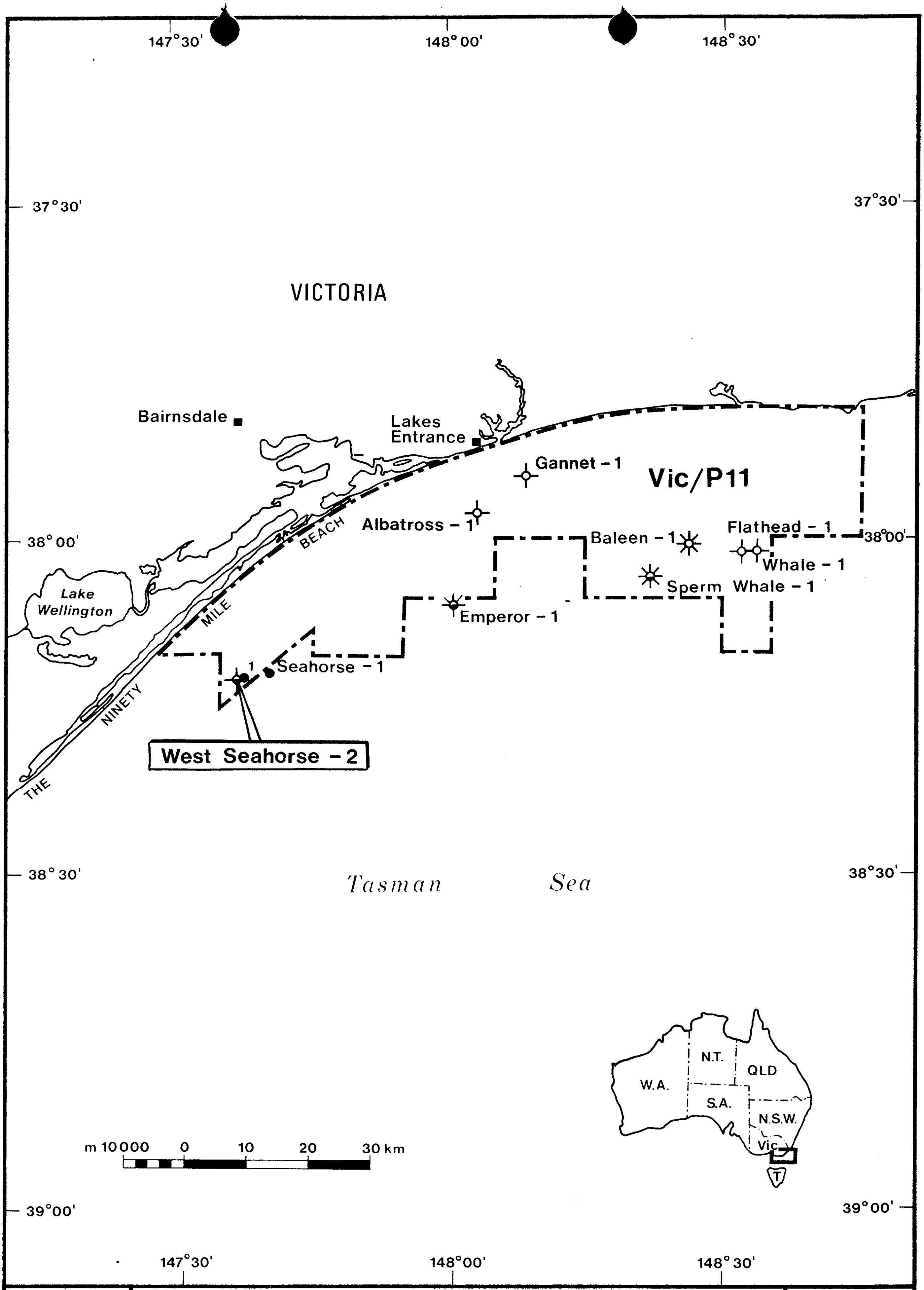
A 12¼" bottom hole assembly was run in, the remaining cement was drilled out, and 3m of new hole were drilled. A formation leak-off test was performed to a 1.69 SG equivalent and the hole was deepened to 1424m. At this point a core was cut to 1438m with 40 percent recovery. A second core was cut to 1449m with 85 percent recovery. The rathole was drilled out and the 12½" hole was extended to 2050m. Electric logs were run, RFT tests were completed and after subsequent evaluation, the decision was made to abandon the well. Two cement plugs were placed in the open hole, a wireline BP was set at 1280m and pressure tested to 2000 psi, and two additional cement plugs were placed in the 13-3/8" casing. The 13-3/8" and 20" casings were mechanically cut and recovered along with the permanent guide base. The temporary guide base was retrieved, the anchors were lifted, and the rig released at 1430 hours on February 17th, 1982. After release from West Seahorse No 2, the rig was moved back to Sperm Whale No 1 to finish the recovery of the subsea equipment on that location.

1.3 Geological Summary (Enclosure 1)

West Seahorse-2 was drilled as a step-out well to appraise the West Seahorse structure. The well was located 1 km to the west of the West Seahorse-1 oil discovery, at shot point 111.1 on seismic line GB81-1A. Closure was mapped at two horizons, designated "Top Latrobe" and "Intra Latrobe". No samples were recovered above the 20" casing shoe, set at 206 metres.

The well intersected 1130 metres of Lower Miocene to Recent carbonates that were skeletal and recrystallized in part. Marls and claystones, locally glauconitic, occur at the base of the carbonate sequence below 1338m, these are dated as Latest Oligocene in age. Directly overlying the Latrobe Group sediments, from 1351.5-1405m, a transgressive unit containing sandstones and glauconitic claystones is evident. The top of the Latrobe Group sediments, at 1405m R.T., is represented by a high Gamma Ray unit and marks the end of non-marine deposition. Interbedded sandstones, siltstones, shales and coals of Upper Eocene to Palaeocene age were intersected from 1405m to T.D. at 2050 metres.

The first oil sand in West Seahorse-1 was not intersected, but the equivalent unit had thinned towards West Seahorse-2 due to lateral lithology variations. The second oil sand was intersected in West Seahorse-2 but it was found to be water wet suggesting that the sand is below OWC in West Seahorse-2. Only 100 ml of oil was recovered within the first objective zone at West Seahorse-2. All other permeable sands either recovered water on test or are interpreted to be water wet from wireline logs.



Scale:

Drawn by: H.O.A.L.

Hudbay Oil (Australia) Ltd.

LOCATION MAP

WEST SEAHORSE - 2

Date: April 1982

Drawing No: A4-GP-485

Figure 1

OIL and GAS DIVISION

0 1 JUN 1983

2

DRILLING

(Pages 5 - 14)

2.0 DRILLING

2.1 Drilling Operations

2.1.1 Drilling Data Summary

Drilling Contractor:	Petromarine Drilling Aust. Pty Ltd Office Suite 1-5, 1st Floor, Stratham House 49 Melville Parade SOUTH PERTH W A 6151
Drawworks:	National 1625 powered by two 752 GE Traction motors
Blow Out Preventor Equipment:	Two stack system 20-3/4" x 2000 psi - Hydril MSP Cameron double gate Type 'U' 13-5/8" x 5000 psi - Hydril Type 'GL' - Cameron Triple gate - Type 'U'
Elevation:	RT to MSL - 9.45m Water Depth - 38.50m Datum - rotary table (47.95m asl)
Pumps:	Two National 12-P-160 Triplex driven by two GE 752 motors.

2.1.2 General Well Data

Location:	Latitude	38° 12' 21.84" S
	Longitude	147° 36' 38.53" E

Dates:

0600 hours	January 22nd 1982 - Rig released from Sperm Whale-1
1230 hours	January 22nd 1982 - Arrived at location
0300 hours	January 23rd 1982 - Spudded
2100 hours	February 11th 1982 - TD reached
1430 hours	February 17th 1982 - Rig released

Days to total depth - 19 days 18 hours

Hole and Casing Details:

Hole Size	Depth	Shoe Depth	Casing
36"	56m	54m	30" Grade B, 310 lb/ft
26"	206m	191m	20" X52, 94 lb/ft Cameron 'CC' Connectors
17½"	1317m	1299m	13-3/8" K55, 61 lb/ft BTC
12¼"	2050m	-	-

2.2 Daily Operation Record

2.2.1 Daily Drilling Operation Summary

See attached Figure 2.

2.2.2 Bottom Hole Assembly Record

36" Hole:	26" bit, 36" HO, Bit sub, 6 x 8" DC's, Cross Over
26" Hole:	26" bit, Bit sub, 12 x 8" DC, Cross Over
17½" Hole:	Interval 206 - 802m 17½" bit, Bit sub, 12 x 8" DC's, Cross Over, 1 x 5" HWDP, jars, 11 x 5" HWDP
	Interval 802 - 1027m 17½" bit, Bit sub, 2 x 8" DC's, Stabilizer, 1 x 8" DC, Stabilizer, 9 x 8" DC, Cross Over, 1 x 5" HWDP, Jars, 11 x 5" HWDP
	Interval 1027 - 1317m 17½" bit, Bit sub, 2 x 8" DC's, Stabilizer, 1 x 8" DC, Stabilizer, 2 x 8" DC's, Bumper sub, 7 x 8" DC's, Cross Over, 1 x 5" HWDP, Jars, 11 x 5" HWDP
12¼" Hole:	Interval 1317 - 1424m 12¼" bit, Junk sub, Bit sub, 1 x 8" DC, Bumper sub, 6 x 8" DC's, Cross Over, 1 x 5" HWDP, Jars, 11 x 5" HWDP
	Interval 1424 - 1449m Core head, Core bbl, Cross Over, Cross Over, 3 x 8" DC's, Bumper sub, 3 x 8" DC's, Cross Over, 1 x 5" HWDP, Jars, 11 x 5" HWDP
	Interval 1449 - 1608m 12¼" bit, Bit sub, 6 x 8" DC's, Bumper sub, 6 x 8" DC's, Cross Over, 1 x 5" HWDP, Jars, 11 x 5" HWDP
	Interval 1608 - 2050m 12¼" bit, Bit sub, 2 x 8" DC's, Stabilizer, 1 x 8" DC, Stabilizer, 3 x 8" DC's, Bumper sub, 6 x 8" DC's, Cross Over, 1 x 5" HWDP, Jars, 11 x 5" HWDP

Hudbay Oil (Australia) Ltd.
Subsidiary of Hudson's Bay Oil and Gas Company Limited

DAILY DRILLING OPERATIONS SUMMARY

WELL WEST SEAHORSE NO 2

DATE	DEPTH	OPERATION
23/1/82	56m	Ran and set anchors. Ran TGB. Made up 36" BHA and drilled 36" hole to 56m. Spotted 25 bbls Hi-Vis mud and POOH to lay down 36" HO. RIH with 26" BHA.
24/1/82	206m	Drilled 26" hole to 206m. Circulated hole to Hi-Vis mud. POOH to TGB and rested hole. RIH to check for fill. Displaced hole to Hi-Vis mud and POOH. Ran 11 joints of 20" casing and landed same with HWDP at 190m. Circulated casing and cemented same with 1135 sacks prehydrated gel lead and 300 sacks plus 2 percent $CaCl_2$ tail slurries. Backed out running tool flushed wellhead and retrieved landing string.
25/1/82	206m	Ran 20-3/4" stack. RIH with test plug and tested stack. Casing would not pressure test. RIH with 17½" BHA and drilled cement from 148 - 188m. Ran HRT tool and then pumped 50 bbl SW.
26/1/82	396m	Ran 2nd HRT survey and found leak at 79m. RIH with OEDP to 85m and pumped 172 sacks Class "B" cement plus 2.5 percent $CaCl_2$. POOH to 45m and squeezed 109 sacks. WOC and pressure tested casing. Made up 17½" BHA and drilled cement from 68 - 86m. Tested casing to 100 psi. Drilled out the shoe. Displaced hole to gel polymer mud. Drilled 17½" hole to 396m.
27/1/82	802m	Drilled 17½" hole to 500m. Surveyed, drilled 17½" hole to 754m. Repaired flowline. Drilled to 802m. Surveyed, POOH.
28/1/82	906m	Finished POOH. Made up bit No 4. Surveyed, POOH. Layed down 21 joints DP. Changed out 5 joints HWDP. RIH with bit No 5. Drilled ahead to 998m.
29/1/82	998m	Drilled 17½" hole 906 - 984m. Pulled out laying down 21 joints of drillpipe. Changed bits. Drilled 984 - 998m.
30/1/82	1120m	Drilled 17½" hole to 1023m. Circulated while attempting to repair compensator. Drilled to 1027m. POOH to change bit and pick up bumper sub. RIH. POOH and close in well due to seamens dispute. RIH and drilled to 1120m.
31/1/82	1300m	Drilled to 1220m. POOH to 988m and replaced Kelly cock. Reamed from 1021m to 1220m. Drilled ahead to 1300m.
1/2/82	1317m	Drilled 17½" hole to 1317m. POOH to 20" shoe to retrieve survey. RIH and reamed from 1134m to 1317m. Circulated and conditioned the hole. POOH to log. Ran logs.
2/2/82	1317m	Finished logging. Made up 13-5/8" WH and cement head. RIH to circulate and condition. POOH to run casing. Began running 13-3/8" casing.
3/2/82	1317m	Finished running 13-3/8" casing and landed shoe at 1299m. Circulated casing. Cemented casing with 2135 sacks Class "B" cement plus 2.5 percent prehydrated gel lead and 300 sacks neat tail slurries. Cement set up during displacement. POOH with running tool. RIH and drilled cement from 1104m to 1132m.
4/2/82	1317m	Drilled cement to 1285m. POOH and shut down for seamens strike.
5/2/82	1317m	Shut down for seamens strike.
6/2/82	1317m	Shut down for seamens strike. Pulled 20-3/4" stack. Jumped divers to check 13-5/8" WH. Ran 13-5/8" stack - unable to latch. Pulled stack up off the wellhead.
7/2/82	1400	Jumped divers to cut 20-3/4" AX ring from the wellhead. Latched 13-5/8" stack. RIH with test plug to test stack. POOH with test plug and ran WB. RIH with test plug to test stack. POOH with test plug and ran WB. RIH with 12¼" BHA to 1285m. Drilled out cement and shoe from 1285m - 1299m. Displaced well to drilling mud. Drilled to 1320m and pulled back into 13-3/8" shoe. Performed formation leak-off test to a 1.69 S.G. equivalent. Tested lower Kelly cock. Drilled to 1329m. Reamed 1320m - 1329m. Drilled 12¼" hole from 1329m - 1400m.
8/2/82	1438m	Drilled to 1424m circulating sample every 5m, POOH. Picked up core barrel and RIH. Cut core 1424m - 1438m and POOH.
9/2/82	1510m	Finished POOH with core barrel. RIH to cut core No 2 from 1438m - 1449m. POOH and laid down core barrel. RIH with 12¼" assembly and reamed out the rat hole. Drilled ahead to 1510m.

Figure 2

Hudbay Oil (Australia) Ltd.
Subsidiary of Hudson's Bay Oil and Gas Company Limited

DAILY DRILLING OPERATIONS SUMMARY

WELL WEST SEAHORSE NO 2 (Continued)

DATE	DEPTH	OPERATION
10/2/82	1731m	Drilled 12¼" hole to 1608m. POOH. RIH with new bit and stabilizer. Reamed 1580m - 1608m. Drilled ahead to 1731m.
11/2/82	1942m	Drilled 12¼" hole to 1806m. Surveyed, POOH to 13-3/8" shoe to recover survey. RIH and drilled to 1942m.
12/2/82	2050m	Drilled 12¼" hole to 2020m. Surveyed, POOH to 13-3/8" shoe to recover survey. RIH to circulate and condition. POOH to log.
13/2/82	2050m	Finished POOH. Ran logs and RFT's.
14/2/82	2050m	Finished RFT's. RIH for conditioning trip. Ran additional RFT's.
15/2/82	2050m	Finished RFT's and ran CST's. RIH with OEDP to 1650m. Spotted cement plug No 1 1650m - 1500m. POOH to 1500m and reversed DP volume. Spotted cement plug No 2 1500m - 1360m. POOH to 1360m and reversed out DP volume. POOH. Ran wireline, set BP at 1280m. Pressure tested same to 2000 psi.
16/2/82		RIH with OEDP to 1279m. Spotted cement plug No 3 1280m - 1239m. Pulled 2 stands and reversed out DP volume. POOH to 145m. Displaced hole to sea water. Set plug No 4 145m - 85m. Pulled 2 stands and reversed DP volume. POOH. Retrieved WB. Pulled 13-5/8" stack. RIH with mechanical cutter. Bumper sub twisted off. RIH with O/shot and latched on to the fish. POOH with the fish. Replaced bumper sub and RIH to cut 13-3/8" casing at 55m. POOH with casing cutter.
17/2/82		RIH with 11¼" cutter. Cut 20" casing at 55m. POOH with cutter. RIH with 13-3/8" spear. Pulled 13-3/8" 20" and PGB. Ran 'J' tool and recovered TGB. Pulled anchors 6, 3, and 4.
18/2/82		Pulled anchors 2, 7, 8, 1 and 5. Underway to Sperm Whale at 1430 hours, February 17th, 1982.

Figure 2
Page 2 of 2

2.2.3 Bit Record

See attached Figure 3.

2.2.4 Time Breakdown Survey

See attached Figure 4.

2.2.5 Well History Chart

See attached Figure 5.

2.3 Casing Record

2.3.1 Casing Details

See Casing and Tubing Tallys, Figures 6 and 7.

2.3.2 Cementation Details

See Casing Running Reports, Figures 8 and 9.

2.4 Mud System

2.4.1 Mud Report Summary

26" Hole Interval

The well was spudded on the 23rd January in 38.5m of water. The 26" hole was drilled with seawater with the assistance of high viscosity, flocculated gel slugs every connection to clean the hole. The hole was displaced with 350 bbl of high viscosity (flocculated) mud twice, then 20" casing was run uneventfully.

A leak was detected in the casing which was found via a Schlumberger temperature logging tool. Cement was squeezed between 85 - 74m and later the casing pressure tested. On drilling out the cement the formation at the shoe was tested to an equivalent mud weight of 1.45 SG.

Hudbay Oil (Australia) Ltd.

BIT RECORD
West Seahorse - 2

Scale N.T.S.
Drawn by A. Clark
Date March 1982
Drawing Nº A4-DR-580

WELL NAME: WEST SEAHORSE NO 2 LOCATION: GIPPSLAND BASIN RT-SB/GL 48 m.
RIG: PETROMAR NORTH SEA CONTRACTOR: PETROMARINE DRILLING AUST PTY LTD HOAL DRLG SPVSR. H SHIRE/B MCELHINNEY
SPUD DATE: 23 JANUARY 1982 COND. CSG: 191 m SURF. CSG: 1299 m INTER. CSG: m SEC. INTER. CSG: m
DATE AT TD: 11 FEBRUARY 1982 PUMP NO 1: NATIONAL 12-P-160 PUMP NO 2: NATIONAL 12-P-160 PUMP POWER: 1600 HP
MUD TYPE: GEL/POLYMER TOOL JTS: Size - 4½" Type - IF O.D. 6-3/8"
DRILL COLLARS: No. - O.D. - I.D. - Length -

BIT NO.	SIZE	MAKE	TYPE	JETS	SERIAL NO.	DEPTH IN (M)	DEPTH OUT (M)	HRS	M/HR	WT (TONNES)	RPM	PUMP PR. (kPA)	PUMP VOL. (L/MIN)	T	B	G	FORMATION/ REMARKS
1RR	36"	SEC	HO	3x24	7850	48	56	2	4	2.3 4.5	60			2	1	I	
	26"	HTC	OSC3AJ	3x18	RB267												
2RR	26"	HTC	OSC3AJ	3x18	LJ320	56	206	9.5	15.7	4.5	70			2	1	I	
3	17½"	HTC	OSC3AJ	3x15	KX477	206	802	28.5	20.9	11.4 13.6	100	13700	2740	3	5	I	CLAYSTONE/ LIMESTONE
4	17½"	HTC	OSC3AJ	1x16 2x15	KX478	802	984	30.5	6.0	11.4 13.6	100	17100	2350	2	6	I	CLAYSTONE/ LIMESTONE
5	17½"	STC	DGJ	3x18	XA4775	984	1027	8	5.4	11.4 13.6	100	10300	2740	2	3	I	CLAYSTONE/ LIMESTONE
6	17½"	STC	DGJ	3x18	XA4844	1027	1317	30	9.7	13.6 15.9	100	10300	2740	2	6	I	CLAYSTONE/ MARL
RR5	17½"	STC	DGJ	3x18	XA4775	CONDITIONING TRIP											
7	12¼"	HTC	OSC3AJ	3x20	EV982	1104	1285	12	15	4.5 5.5	60	5100	1960	2	3	I	DRILLING CMT IN 13-3/8" CASING
8	12¼"	HTC	OSC3AJ	3x14	LS031	1285	1424	9	11.9	11.4 13.6	100	10300	1960	3	4	I	DRILLING CMT 1285-1299m
9	8-15/32	CHRIS	C-20		81E0672	1424	1449	10	2.5	6.8	70	5100	980	90 pct salvage			
10	12¼"	HTC	J1	3x14	AE704	1449	1608	13	12.2	13.6 15.9	100	10300	1960	6	2	1/8	
11	12¼"	HTC	J22	3x14	858NL	1608	2050	43.5	10.2	15.9	65	10600	1960	3	3	I	SANDSTONE/ CLAYSTONE
RR7	12¼"	HTC	OSC3AJ	3x20	EV982	CONDITIONING TRIP								2	3	I	

Figure 3

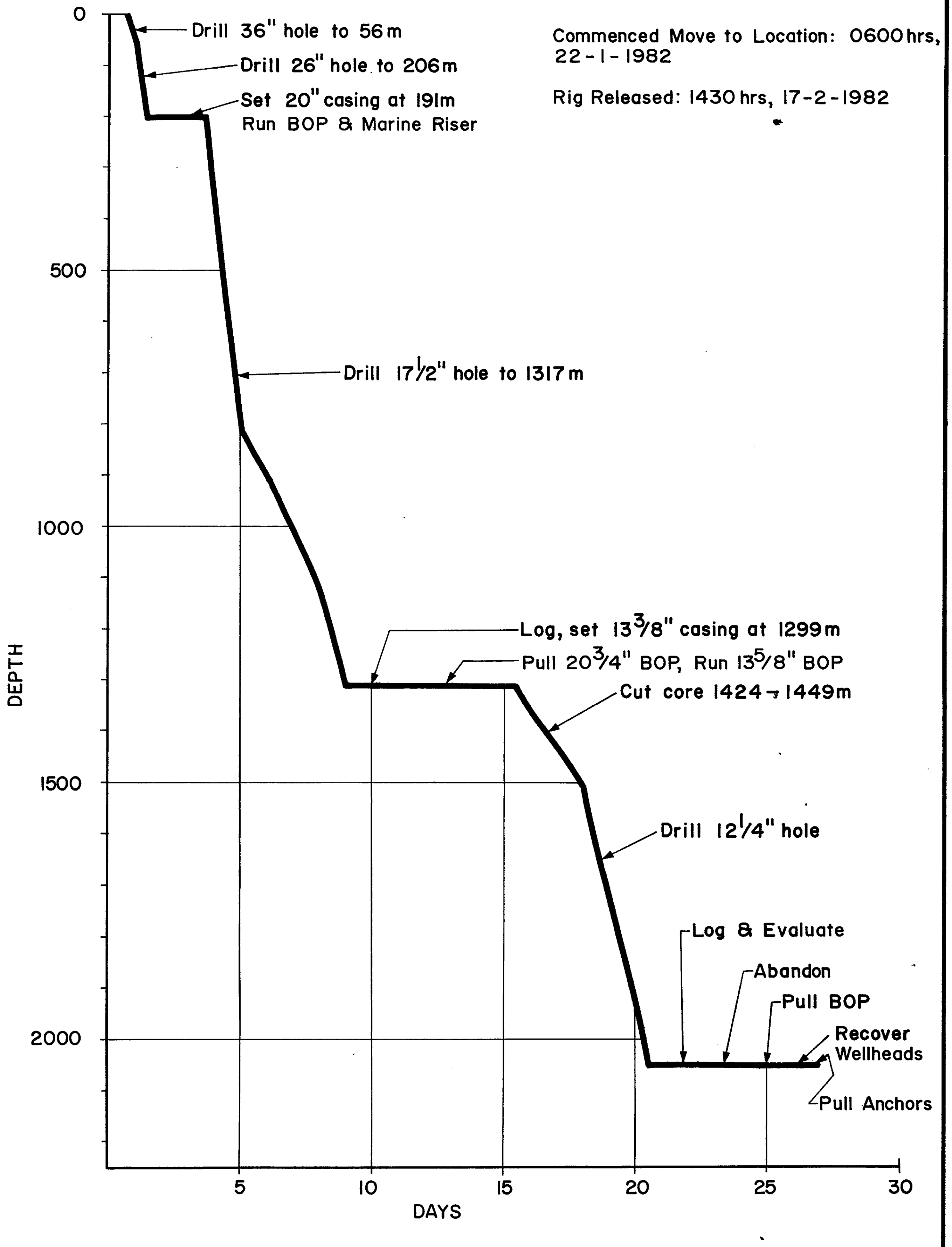
Author: A.L.
Drawn: H.O.A.L.
Date: March 1982

WELL TIME BREAKDOWN ANALYSIS
West Seahorse – 2

Hudbay Oil (Australia) Ltd.

TIME ANALYSIS (Hours)	Moving/ Anchoring	36"/26" Hole	SECTION OF HOLE 17½" Hole	12¼" Hole	8½" Hole	6" Hole	Comp/Test	Total	%
DRILLING:									
Moving to/from Location	6½							6½	1.04
Anchor Handling	12½			23				35½	5.66
Drilling		9½	97	62				168½	26.85
Round Trips		3	23	13½				39½	6.28
Reaming, Cond. Hole, Cond. Trips		3	22	10½				35½	5.66
Running, Pulling and Cementing Casing		8½	27½	2				38	6.05
Running, Pulling Subsea Equipment		10½	14½					25	3.9
Testing Wellhead and BOP's		2	4	½				6½	1.04
Plugging Back, Abandonment, Completion				42½				42½	6.77
Curing Lost Circulation								–	
Fishing and Washouts				1				1	0.16
Well Control								–	
Surveys		½	2	2½				5	0.80
Downtime: Weather								–	
Mechanical Surface			5	½				5½	0.88
Mechanical Subsea									
Others									
EVALUATION:									
Circulating Samples				3				3	0.48
Hole Cond, Trips for Coring, Logging, Testing			7½	31½				39	6.22
Coring				16½				16½	2.63
Electric Logging			10	33				43	6.8
Wireline Flow Testing				20½				20½	3.27
Drill Stem and Production Testing									
Downtime: Logging									
Flow Testing									
Others									
OTHERS Seamens' strike			96½					96½	15.38
Total Time	19	37	309	262½				627½	100.00
% Downtime			1.6	0.2				26d 3½hrs	

Scale: N.T.S.
Drawing Nº A4-DR-577
Figure 4



Commenced Move to Location: 0600hrs, 22-1-1982

Rig Released: 1430hrs, 17-2-1982

Author: K.Putnam	Hudbay Oil (Australia) Ltd.	Date: April 1982
Drawn by: A.Clark	WEST SEAHORSE - 2 WELL HISTORY CHART	Drawing Nº A4-DR-509

Figure 5

HUDBAY OIL (AUSTRALIA) LIMITED

Casing and Tubing Tally

(METRIC)

Page 1 of 1

Well Name and No. WEST SEAHORSE NO. 2 Date 18 JANUARY 1982 Casing Size 20" x 94 lb/ft

Weight 94 lb/ft Grade X52 Connection Cameron cc Joints Run

Joint No.	Length of (m) joint	Total in (m) Hole	Joint No.	Length of (m) Joint	Total in (m) Hole	Joint No.	Length of Joint	Total in Hole
	.							
	.		Carried Forward			Carried Forward		
01	12·27	Shoe Jt	41	.		81	.	
02	12·52		42	.		82	.	
03	12·49		43	.		83	.	
04	12·51		44	.		84	.	
05	12·52		45	.		85	.	
06	12·53		46	.		86	.	
07	12·51		47	.		87	.	
08	12·51		48	.		88	.	
09	12·15		49	.		89	.	
10	12·01		50	.		90	.	
Sub tot	124·02		Sub tot	.		Sub tot	.	
11	12·50		51	.		91	.	
12	12·51		52	.		92	.	
13	12·01		53	.		93	.	
14	12·02		54	.		94	.	
15	.		55	.		95	.	
16	10·15	Pile Jt	56	.		96	.	
17	.		57	.		97	.	
18	.		58	.		98	.	
19	.		59	.		99	.	
20	.		60	.		100	.	
Sub tot	59·19		Sub tot	.		Sub tot	.	
21	.		61	.				
22	.		62	.				
23	.		63	.				
24	.		64	.				
25	.		65	.				
26	.		66	.				
27	.		67	.				
28	.		68	.				
29	.		69	.				
30	.		70	.				
Sub tot	.		Sub tot	.				
31	.		71	.				
32	.		72	.				
33	.		73	.				
34	.		74	.				
35	.		75	.				
36	.		76	.				
37	.		77	.				
38	.		78	.				
39	.		79	.				
40	.		80	.				
Sub tot	.		Sub tot	.				

TALLY SUMMARY

Group No. Ending	Length (Forward)
10	124·02
20	59·19
30	.
40	.
50	.
60	.
70	.
80	.
90	.
100	.
TOTAL	183 21

Tally By

Checked By

REMARKS Pile Jt. 7.07m from top of 20" WH to bottom of ribs for 30"

Operator's Representative

Figure 6

HUDBAY OIL (AUSTRALIA) LIMITED

Casing and Tubing Tally

(METRIC)

Page 1 of 2

Well Name and No. WEST SEAHORSE NO 2
Date 2 FEBRUARY 1982
Casing Size 13-3/8"
Weight 61 lb/ft
Grade K-55
Connection BTC
Joints Run 104 + 1 pup +1 WH

Joint No.	Length of (m) joint	Total in (m) Hole	Joint No.	Length of (m) Joint	Total in (m) Hole	Joint No.	Length of Joint	Total in Hole
Shoe	·60							
01	12·12		Carried Forward			Carried Forward		
Collar	0·43		41	11·95		81	12·07	
02	11·74		42	11·90		82	11·84	
03	12·01		43	11·98		83	11·72	
04	12·00		44	11·95		84	11·93	
05	12·10		45	12· 07		85	12·03	
06	12·00		46	12· 02		86	11·89	
07	11·94		47	11·87		87	11·92	
08	12·03		48	11·99		88	11·86	
09	12·09		49	11·89		89	12·04	
10	12·10		50	12·09		90	11·89	
Sub tot	121·16		Sub tot	119·71		Sub tot	119·19	
11	11·94		51	11·96		91	12·04	
12	12·10		52	11·69		92	11·75	
13	11·99		53	11·81		93	11·92	
14	12·60		54	11·86		94	11·97	
15	3·88		55	12·09		95	11·89	
16	11·92		56	11·97		96	11·97	
17	12·50		57	11·95		97	11·84	
18	11·87		58	12·07		98	11·96	
19	12·50		59	11·98		99	11·93	
20	12·10		60	12·05		100	11·92	
Sub tot	113·40		Sub tot	119·43		Sub tot	119·19	
21	11·85		61	11·89				
22	12·10		62	11·99				
23	11·89		63	11·94				
24	12·30		64	11·98				
25	11·99		65	11·53				
26	11·94		66	12·07				
27	12·50		67	12·07				
28	11·85		68	12·08				
29	12·10		69	12·01				
30	11·98		70	11·90				
Sub tot	120·50		Sub tot	119·46				
31	12·00		71	11·93				
32	11·84		72	11·90				
33	11·97		73	12·04				
34	11·95		74	12·04				
35	12·01		75	12·06				
36	12·03		76	12·06				
37	12·01		77	11·93				
38	11·94		78	11·77				
39	12·08		79	11·97				
40	11·74		80	12·06				
Sub tot	119·57		Sub tot	119·76				

TALLY SUMMARY

Group No. Ending	Length (Forward)
10	121·16
20	113·40
30	120·50
40	119·57
50	119·71
60	119·43
70	119·46
80	119·76
90	119·19
100	119·19
TOTAL	1191 37

Tally By

Checked By

REMARKS

Operator's Representative B MCELHINNEY

Figure 7

HUDBAY OIL (AUSTRALIA) LIMITED

Casing and Tubing Tally

(METRIC)

Page 2 of 2

Well Name and No. WEST SEAHORSE NO. 2 Date 2 FEBRUARY 1982 Casing Size 13-3/8"

Weight 61 lb/ft Grade K-55 Connection BTC Joints Run 104 + 1 pup + 1 WH

Joint No.	Length of (m) joint	Total in (m) Hole	Joint No.	Length of (m) Joint	Total in (m) Hole	Joint No.	Length of Joint	Total in Hole
	.							
	.		Carried Forward			Carried Forward		
101	11.88		41	.		81	.	
102	11.99		42	.		82	.	
03	12.01		43	.		83	.	
04	11.94		44	.		84	.	
05	11.97		45	.		85	.	
06	WH JT =	4.20m	46	.		86	.	
07	.		47	.		87	.	
08	.		48	.		88	.	
09	.		49	.		89	.	
10	.		50	.		90	.	
Sub tot	63.99		Sub tot	.		Sub tot	.	
11	.		51	.		91	.	
12	.		52	.		92	.	
13	.		53	.		93	.	
14	.		54	.		94	.	
15	.		55	.		95	.	
16	.		56	.		96	.	
17	.		57	.		97	.	
18	.		58	.		98	.	
19	.		59	.		99	.	
20	.		60	.		100	.	
Sub tot	.		Sub tot	.		Sub tot	.	
21	.		61	.				
22	.		62	.				
23	.		63	.				
24	.		64	.				
25	.		65	.				
26	.		66	.				
27	.		67	.				
28	.		68	.				
29	.		69	.				
30	.		70	.				
Sub tot	.		Sub tot	.				
31	.		71	.				
32	.		72	.				
33	.		73	.				
34	.		74	.				
35	.		75	.				
36	.		76	.				
37	.		77	.				
38	.		78	.				
39	.		79	.				
40	.		80	.				
Sub tot	.		Sub tot	.				

TALLY SUMMARY

Group No. Ending	Length (Forward)
10	63·99
20	1191·37
30	.
40	.
50	.
60	.
70	.
80	.
90	.
100	.
TOTAL	1255.36

Tally By

Checked By

REMARKS Total length of 104 jts + 1 pup + 1 WH = 1255.36

WH lands out 43.83m BRT

Shoe at 1255.36m + 43.83m BRT = 1299.19m BRT

Bottom of Pup Jt 169.79m Above shoe = 1129.40m BRT

Top of Pup Jt = 1125.52m BRT

Operator's Representative B MCELHINNEY

Figure 7

HUDBAY OIL (AUSTRALIA) LIMITED

Casing, Running Report

Well Name and No. WEST SEAHORSE NO. 2 Date 22 JANUARY 1982 Casing Size 20"

HOLE	Size	36"	26"			
	Depth (m)	56	206m			
CASING	Size	30"	20"			
	Depth (m)	54.32	190.86			

MUD: Type Spud Mud s.g. 1.04 Vis. 60+ YP WL

Power Tong Torque Maximum C.I.W. 'CC' Con. ft/lbs. Minimum ft/lbs.

Fill up Points Cont.

Calc. Displ. (m^3) 156.5 Pump Strokes By Howco

50 psi 500 psi

CASING INFORMATION	m	m
TD		206.00m
OFF BOTTOM	15.14	
Shoe (make and type) Baker Float Landed at		190.86
Length Shoe Plus Joint No.1	12.27	178.59
11 Joints. Grade X52 wt. 94 lb/ft ID. 19.124ins.	124.25	54.34
Landing Collar (make and type)		
Hanger or Suspension joint (make and type) C.I.W. 30" x 20" W/H	10.13	44.21
Top Hanger or Suspension joint		
Landing String 5 Jt HWT + Pup Jt	- 48.21	- 4
metres above R.T. at Zero Tide	.5	
Less tide of		
metres up from R.T.		3.5

DETAILED CASING AND CEMENTING REPORT

Ran a total of 11 jts 94 ppf casing, top of 30"x20" housing @ 178.6m and shoe at 190.8m - circulated out total volume of drill pipe and casing and prior to cement job - pressure tested cement line to 2000 psi - OK. Mixed and pumped 1135 sx class 'B' cement, mixed with 227 bbl fresh water with 2% pre.hyd gel. Average slurry wt. 13.7 ppg. Tailed with 300 sx class 'B' neat cement mixed with 37 bbls seawater with 2% $CaCl_2$ average slurry wt. 15.6 ppg. Displaced with 156.5 bbl seawater - OK, float holding good. Back out R/tool and flush well head with seawater.

Note: No problem shifting cement.

Operators Representative H. SHIRE

Figure 8

HUDBAY OIL (AUSTRALIA) LIMITED

Casing, Running Report

Well Name and No. WEST SEASHORSE NO. 2 Date 2 FEBRUARY 1982 Casing Size 13-3/8"

HOLE	Size	36"	26"	17½"		
	Depth (m)	56m	206	1317m		
CASING	Size	30"	20"	13-3/8"		
	Depth (m)	54.32	190.86	1299.19		

MUD: Type SW/Gel/Dextrid s.g. 1.17 Vis. 43 YP 16 WL 14.5

Power Tong Torque Maximum 10,000 ft/lbs. Minimum 8,000 ft/lbs.

Fill up Points Every 10 Jts

Calc. Displ. (m3) HWDP 1-2 bbl Csg. 620 bbls Pump Strokes 5271 stks @ 95%

psi psi

CASING INFORMATION	Lgth m	mBRT
TD		1317m
OFF BOTTOM	17.81	
Shoe (make and type) W.L. Float Shoe Landed at		1299.19
Length Shoe	0.60	
		1298.59
1 Joints. Grade K55 wt. 61 lb/ft ID. 12.515 ins.	12.12	
		1286.47
Landing Collar (make and type) W.L. Baffle Collar	0.43	
		1286.94
Ran 103 Jts of 13-3/8" x K55 x 61#/ft Csg.	1234.13	
		51.91
1 x Pup Jt of 13-3/8" x K55 x 61#/ft Csg.	3.88	48.03
Hanger or Suspension joint (make and type) CIW 13-5/8" WH for 20"x13-5/8"WH	4.20	43.83
Top Hanger or Suspension joint		
Landing String Running Tool	.44	43.39
5ft Pup	1.52	41.87
5 sgl's 5" HWDP	45.90	
metres above R.T. at Zero Tide		
Less tide of		
metres up from R.T.		4.03

DETAILED CASING AND CEMENTING REPORT

a) Ran a total of 104 jts of csg. + 1 x 3.88m pup jt. Thread locked 1st two connections made.

b) Ran centralizers on 1st, 3rd and 5th connections.

c) Broke circulation prior to running into OH. Picked up air elevators at 20" shoe.

d) Landed without compensator. Unlatched elevators. No heave.

e) Jts No. 19,20,21 and 22 laid down due to damaged box on No. 19 Not making up, Appears slightly egged. Damage to pins minimal.

CEMENTED CSG AS FOLLOWS:

a) Circulated volume of casing and DP prior to cementing.

b) Tested cement liners to 5000 psi.

c) Pumped 20 bbls S/W ahead.

d) Mixed and pumped 556 bbls of 2.5% Pre-Hyd Gel + 0.75% CFR-2 + 0.1% HRL, mix water with 2135 sks cement class 'B' @ 12.8 ppg (1.53 SG) slurry.

Tailed in with 37 bbls of DW with 300 sks Class 'B' cement neat @ 15.8 ppg (1.89 SG).

Displaced with 2 bbls to launch dart @ 3100 psi and pumped 4447 stks (323 bbl @ 95%) prior to cement setting up, leaving 184m of cement above collar. Lost returns after 3800 stks. Contaminated with cement to surface.

Pressure tested casing to 2500 psi.

Operators Representative B. MCELHINNEY

Figure 9

17½" Hole Interval

The 20" casing and rat hole were displaced with a seawater/gel/polymer mud. Drilling proceeded, reaming every connection, dumping the sand trap periodically and diluting with seawater and Q-mix.

The shakers had 60 and 80 mesh screens, the desander and desilter were run continuously as was a seawater stream to contain mud weights to less than 1.10 S.G.

Cellogen was used to compliment the gel mud and overcome a gel shortage beyond 900m.

XC-Polymer and HEC proved a better viscosifying combination.

Sticky hole conditions and evidence of geopressured shale caused the mud weight to be raised to 1.12 initially (by 1300m) then 1.17 (at 1315m) SG, and further Q-mix additions with Dextrid to improve the rheology and water loss control.

This improved hole conditions sufficiently so that the intermediate logs could be run unimpeded.

The last 15m of hole (1302 - 1317m) were reamed and washed prior to running 13-3/8" casing.

Returns were lost while cementing the casing.

12¼" Hole Interval

The rig was subject to 3 days industrial dispute during which time the stack was tested and new mud mixed.

The leak-off test indicated a formation integrity of 1.69+ SG.

A fresh gel polymer mud was displaced (due to cement contamination) with a mud weight of 1.11 SG and water loss of less than 5. Dextrid and Cellogen were the main polymers used in conjunction with the Q-mix.

Again there was some evidence of sloughing shale beneath the shoe with a mud weight of 1.11 SG however, no further trouble was encountered.

Two cores were cut between 1424m - 1438m and 1438m - 1449m. Some coal below these coring points slightly thinned the mud.

The hole was drilled to TD at 2050m (reached on February 11, 1982) with minor mud losses at 15 - 30 bbls/hr between 1490m - 1520m (120 bbls total) and minor deviation corrections.

A comprehensive suite of electric logs, velocity survey, RFT's (two - with a wiper trip between them) and two runs for sidewall cores were completed successfully before finally plugging and abandoning on February 15th, 1982.

Conclusion

The 26" interval was drilled as programmed and within budgeted mud costs. The 17½" hole interval encountered evidence of geopressures resulting in higher mud weights than expected and hence interval cost.

The 12¼" interval was drilled virtually trouble free and as programmed, despite an unusual mud loss of 120 bbls. Interval contamination of the mud in the 13-3/8" casing with cement and subsequent displacement of the hole with new mud did not unduly add to mud costs.

The well was completed with minor trouble with shale geopressures, a minor mud loss and temporary material shortages. The final logging/completion programme was concluded without incident or hold up and the final mud bill was brought in 4 percent below estimate.

2.4.2 Mud Engineering

Mud Engineering services and drilling fluid materials were supplied by Baroid Australia Pty Ltd. Mud Engineers on site were Dan Quinn, Evan Hill and Jim Kelleher.

2.4.3 Mud Record

See attached Figure 10.

2.4.4 Materials Consumption and Costs

Materials	Unit	Cost per Unit	Quantity		Cost	
			Estimate	Actual	Estimate	Actual
36/26" Hole - Interval SF - 206m						
Gel	100 lbs	15.50	236	300	3658.00	4650.00
Soda Ash	40 kg	14.50	6	12	87.00	174.00
Caustic	25 kg	17.75	-	12	-	213.00
Caustic	50 kg	35.50	5	-	177.50	-
Cellogen	25 kg	121.50	-	1	-	121.50
Lime	25 kg	35.50	21	-	141.75	-
				TOTAL COST FOR 36"/26" HOLE	$4064.25	$5158.50

17½" Hole - Interval 206 - 1315m

Materials	Unit	Cost per Unit	Quantity Estimate	Quantity Actual	Cost Estimate	Cost Actual
Gel	100 lb	15.50	780	197	12090.00	3053.50
Soda Ash	40 kg	14.50	25	12	362.50	174.00
Caustic	50 kg	35.50	46	-	1633.00	-
Caustic	25 kg	17.75	-	62	-	1100.50
Dextrid	50 lb	51.60	150	150	7740.00	7740.00
Q-Broxin	25 kg	24.15	55	52	1328.25	1255.80
Barite	100 lb	8.70	100	622	800.00	5411.40
Bara Defoam	5 gal	98.00	-	23	-	2254.00
Cellogen	25 kg	121.50	-	15	-	1822.50
XC Polymer	50 lb	335.00	-	1	-	335.00
HEC	40 lb	149.00	-	3	-	447.10
				TOTAL COST FOR 17½" HOLE	$24248.00	$23593.70

HUDBAY OIL (AUSTRALIA) LIMITED

Mud Properties

WELL WEST SEAHORSE NO 2

MUD COMPANY: BAROID

1. Specific gravity
2. Viscosity (sec)
3. A.P.I. Water Loss (ml)
4. Cake Condition
5. A.P.I. Cake (millimetre)
6. Sand (%)
7. Chloride (ppm x 1000)
8. pH
9. Solids (%)
10. Plastic Viscosity (cp @ 50°C)
11. Yield Point (lb/100ft.^{2})
12. Gels (lb/100ft.^{2} 10 sec/10 min)
13. Total Hardness (epm)
14. Pf
15. Mf
16. Oil %
17. "N" Factor
18. Bentonite Kg/m^3

Date	Depth 0600 hrs (metres)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Jan 23	-	1.04	100+																
24	206	1.04	100+																
25	188		Sea Water																
26	244	1.07	42	NC	-	2	0.25	15	-	3	6	14	5/7	50	0.05	-	-	-	34
27	754	1.08	44	30	-	3	0.25	16.5	-	4	6	12	4/6	70	0.05	-	-	-	34
28	906	1.09	39	NC	-	3	TR	22	-	5	3	9	3/4	90	0.01	-	-	-	23
29	998	1.10	37	NC	-	3	TR	22	-	4	2	8	1/4	97	0.02	-	-	-	15
30	1120	1.09	39	NC	-	3	0.25	22.5	-	4	6	18	3/6	85	TR	-	-	-	30
31	1300	1.12	43	11.2	-	2	0.1	21	-	7	9	16	4/8	56	TR	-	-	-	36
Feb 1	1315	1.17	46	13.8	-	3	TR	22	8.9	8	8	23	9/16	50	0.2	-	-	-	43
2	1315	1.17	43	14.5	-	2	TR	21.5	8.7	9	10	16	6/10	50	0.1	-	-	-	43
3	1315		Sea Water																
4	1315		Sea Water																
5			Mixing Mud																
6			Mixing Mud																
7	1400	1.11	46	5.4	-	2	0.5	15	9	5	10	16	5/8	20	0.2	-	-	-	28
8	1438	1.10	48	3	-	1	0.5	13.5	9.7	5	14	16	3/9	8	0.3	-	-	-	28
9	1510	1.10	45	2.6	-	1	0.5	13	9.6	4.5	12	14	2/11	10	0.2	-	-	-	23
10	1731	1.10	49	3.4	-	1	0.5	12	9.7	5	15	17	3/9	4	0.2	-	-	-	23
11	1942	1.09	46	4.7	-	1	0.25	9.5	10.5	5	15	13	2/6	2	1.3	-	-	-	20
12	2050	1.11	45	4.3	-	1	0.25	10	10.5	5	14	15	2/6	4	1.7	-	-	-	20
13	2050	1.11	45	4.3	-	1	0.25	10	10.5	5	14	15	2/6	4	1.7	-	-	-	20
14	2050	1.11	53	4.8	-	1	0.25	10	10.5	5	19	21	4/9	4	1.4	-	-	-	20

Figure 10

Materials	Unit	Cost per Unit	Quantity		Cost	
			Estimate	Actual	Estimate	Actual

12¼" Hole - Interval 1315 - 2050m

Gel	100 lb	15.50	71	75	1100.50	1162.50
Dextrid	50 lb	51.60	258	275	13312.80	14190.00
Caustic	50 kg	35.50	48	19	1704.00	674.50
Caustic	70 kg	49.70	-	18		894.60
Soda Ash	40 kg	14.50	48	11		159.50
Q-Broxin	25 kg	24.15	-	20		483.00
Cellgoen	25 kg	121.50	103	40	12514.50	4860.00
HEC	25 kg	149.00		5		745.00
XC Polymer	50 lb	335.00		13		4355.00
Barite	100 lb	8.70	1700	80	14790.00	696.00
TOTAL COST FOR 12¼" HOLE					$43421.80	$28220.10

Consumption for 36"/26", 17½" and 12¼" Hole

Gel	100 lb	15.50	1114	572	17267.00	8866.00
Soda Ash	40 kg	14.50	79	35	1145.50	507.50
Caustic	25 kg	17.75	-	74	-	1313.50
Caustic	50 kg	35.50	94	19	3337.00	674.50
Caustic	70 kg	49.70	-	18	-	894.60
Cellogen	25 kg	121.50	103	56	12514.50	6804.00
Lime	25 kg	6.75	21	-	141.75	-
Dextrid	50 lb	51.60	408	425	21052.80	21930.00
Q-Broxin	25 kg	24.15	55	72	1328.55	1738.80
Baradefoam	5 gal	98.00	-	23	-	2254.00
XC Polymer	50 lb	335.00	-	14	-	4690.00
HEC	50 lb	149.00	-	8	-	1192.00
Barite	100 lb	8.70	1800	702	15660.00	6107.40
Coat 888	50 lb	23.20	-	20	-	464.00
Coat 45	20 kg	65.00	-	7	-	455.00
Coat 45	25 kg	81.25	-	39	-	3168.75
TOTAL COST FOR ALL INTERVALS					$72447.10	$61060.05

2.4.5 Mud Equipment Description

1. Reserve mud storage tanks 4 x 500 bbls.
2. Active mud storage 400 bbls complete with 150 bbl settling tank and 85 bbl pill tank.
3. Brandt Dual Tandem Shaker.
4. Demco Desander, 6 cone x 6 inch rated at 1050 gpm with Mission 6 inch x 8 inch cetrifugal pump and 75 HP electric motor.
5. Demco Desilter, 12 cone x 4 inch rated at 1080 gpm with Ingersoll-Rand centrifugal pump and 75 HP electric motor.
6. Pioneer Mud Cleaner, 16 cone x 4 inch rated at 800 gpm with 75 psi head.
7. Degasser - Drilco.
8. Pit Volume Totalizer.
9. Mud Mixer, Lightning mixers 2 ea x 25 HP in active tanks, 4 ea x 25 HP in reserve tanks.
10. Pioneer Sidewinder Mud Mixing Hopper.
11. Mud Mixing Pumps, Ingersoll-Rand MIR 150 with 75 HP electric motors, two on active tank, two on reserve tanks.
12. Mud/Gas separator with vent to Crown block.
13. Swaco super adjustable choke 10,000 psi with control panel.
14. Trip tank - 25 bbls with high-low level switch activated motor for transfer pump to annulus.

2.5 Flow Testing

None performed.

2.6 General Data

2.6.1 Positioning Report

See attached Figure 11 and Appendix A1.

Proposed Location: 038° 12' 23.45" S **Latitude:**
147° 36' 39.84" E **Longitude:**

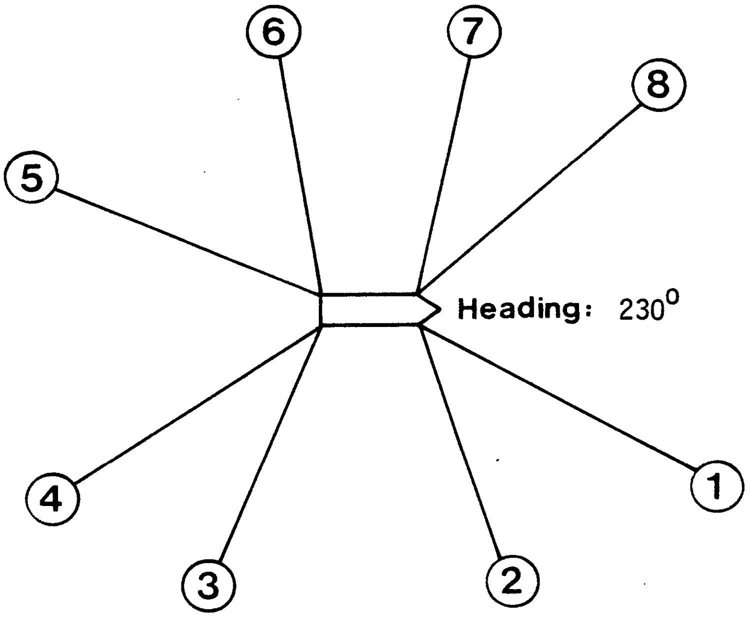
Actual Location: 038° 12' 21.84" S **Latitude:**
147° 36' 38.53" E **Longitude:**

Distance and Bearing from Proposed to Actual: 62m @ 326°

Survey Method: Trisponder System

Checked By: JMR-4 Satellite

Anchor Pattern:



Remarks

Author:	Hudbay Oil (Australia) Ltd. **POSITIONING** WEST SEAHORSE NO 2	Date:
Drawn by:		Drawing Nº Figure 11

2.6.2 Downhole Surveys

Depth	Drift
146m	1^o
206m	$\frac{1}{2}^o$
500m	1^o
802m	2^o
984m	$3/4^o$
1317m	3^o
1608m	2^o
1806m	$1\frac{1}{2}^o$
2050m	$3\text{-}3/4^o$

2.6.3 Plug Back and Squeeze Cementation Record

After the 20" casing had been run and the 20-3/4" stack installed, it was found that there was a leak in the casing. Utilizing an HRT tool, the leak was found in a 'CC' connector at 79m. OEDP was run to 85m, 172 sacks of Class "B" cement plus 2.5% $CaCl_2$ was pumped and balanced, and the OEDP was pulled up to 45m. The hydril was then closed and approximately 109 sacks of cement were squeezed into the leak. After WOC for 6 hours, the casing was pressure tested to 150 psi and held at 100 psi for 10 minutes. The excess cement from the squeeze was drilled out, and the formation below the shoe was pressure tested to 100 psi (i.e. a 12.1 ppg equivalent). Normal drilling operations then resumed.

2.6.4 Fishing Operation

During the abandonment, the bumper sub twisted off while attempts were being made to mechanically cut the 13-3/8" casing. The cutting assembly and marine swivel were successfully caught with an overshot, the bumper sub was replaced, and the cutter was rerun.

2.6.5 Side Tracked Hole

None performed.

2.7 Abandonment Report

West Seahorse No 2 was abandoned on February 17th, 1982. Two cement plugs were placed in the open hole (1650 - 1500m and and 1500 - 1360m). A wireline set BP was set in the 13-3/8" casing at 1280m and a cement plug was placed on top of the BP. The top plug in the 13-3/8" was placed over the interval 145 - 85m. The 13-3/8" and 20" casings were mechanically cut at 55m; the casing stubs, the wellheads, and the PGB were all retrieved; and the TGB was recovered with the J running tool.

Plug No 1: 1650 - 1500m, 350 sacks class "B" cement mixed to 15.8 ppg.

Plug No 2: 1500 - 1360m, 327 sacks class "B" cement mixed to 15.8 ppg.

Plug No 3: Wireline set BP at 1280m, pressure tested to 2000 psi, covered with 50 sacks class "B" cement over the interval 1280 - 1239m.

Plug No 4: 145 - 85m, 146 sacks class "B" cement mixed to 15.8 ppg .

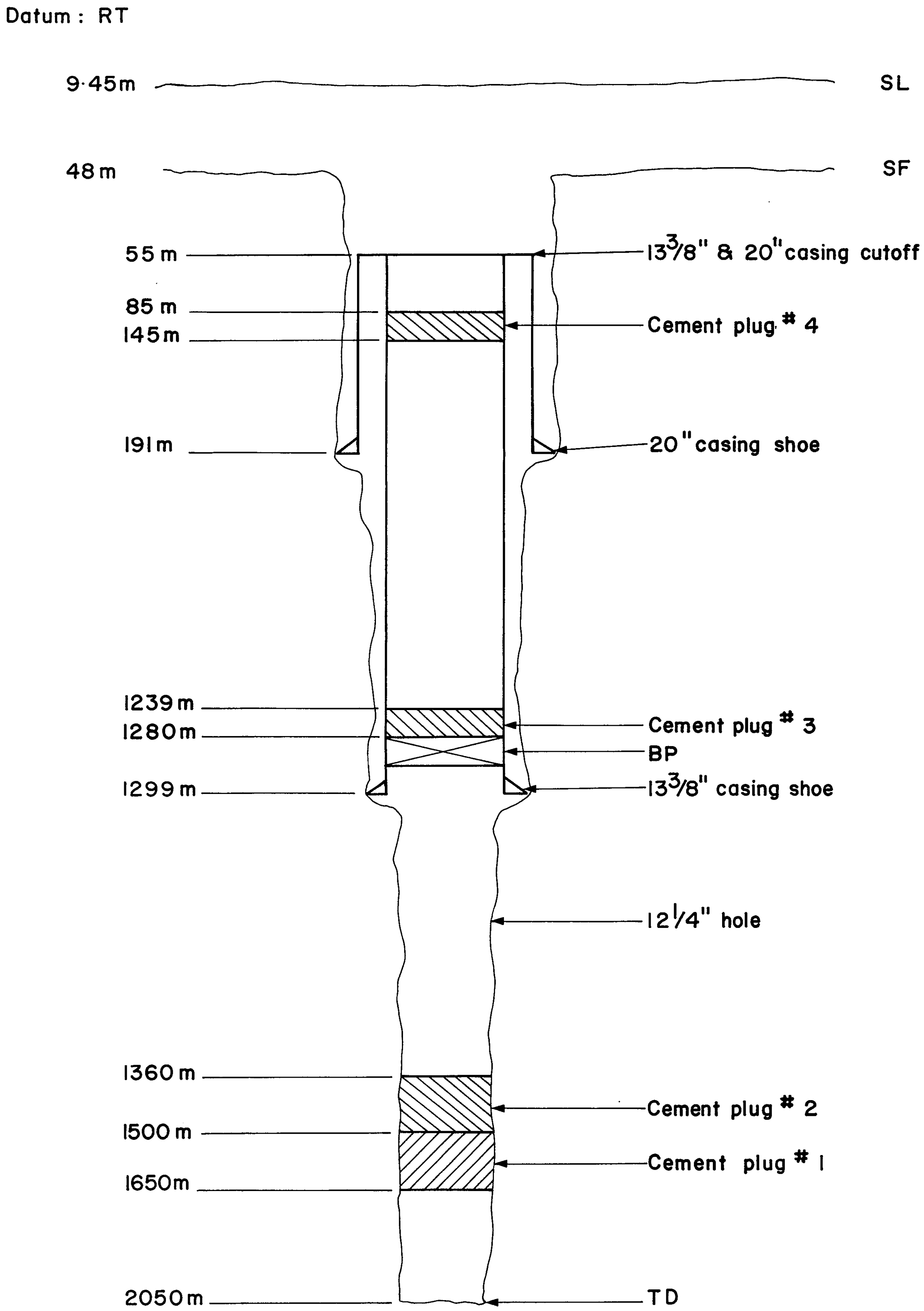
See attached schematic for downhole plug placement, Figure 12.

2.8 Recommendations for Future Drilling Programmes

There were no hole problems encountered in this well that could be related to the type of formations drilled or the mud systems used.

Problems that did occur such as the leaking 'CC' connector etc. were all mechanical and could not be attributed to the procedures in the drilling programme.

From 1300m to TD, there was a tendency for the drift angle to build; however, it was not to the extent that caused any problems to develop. Earlier usage of stabilizers would probably control deviation to more acceptable levels.



Author: K. Putnam	Hudbay Oil (Australia) Ltd.	Scale: N.T.S.
Drawn: A.Clark	WEST SEAHORSE – 2	
Date: May 1982	**AS ABANDONED**	Drawing Nº A4-DR-508

Figure 12

APPENDIX A1 POSITIONING REPORT

WEST SEAHORSE-2

RIG POSITIONING REPORT

March, 1982

Submitted By: K.H. Sit,
SENIOR GEOPHYSICIST.

INTRODUCTION

The West Seahorse-2 positioning survey was conducted between the 11th and 25th January, 1982.

The survey consisted of:-

1. Setting up the Trisponder Survey net.
2. Checking the survey system.
3. Positioning and setting the anchor buoys.
4. Determining the final rig position.

Decca Survey (Australia) Ltd. supplied both personnel and survey equipment.

The equipment used to conduct the survey consisted of:-

1. Two Trisponder Receivers.
2. One JMR-4 Satellite Receiver.
3. Four onshore Trisponder base stations.

The Trisponder was the primary navigation system used to position the rig with the Satellite navigation system as an independent check and a 100% backup.

A licensed surveyor, contracted from Navigation Australia was on board during the positioning of the "Petromar North Sea" to verify all readings during the operation.

A HOAL Geophysicist was also on board to supervise the survey.

Independent reports will be submitted by Decca Survey and Navigation Australia.

PROPOSED LOCATION

The proposed location for West Seahorse-2 was shotpoint 111.1, Line GB81-1A.

The co-ordinates for the position were:-

Latitude	038^{o}	12'	23.45" S
Longitude	147^{o}	36'	39.84" E

UTM Co-ordinates from Central Meridian 147^{o}

0553501	metres east
5771080	metres north

The following base stations were used for the survey:-

	Easting	Northing
Mt. Taylor	549316.2	5826499.9
Longford Tower	513544.2	5769507.0
Jemmys	584670.0	5806793.0
Nowa Nowa	596071.5	5827552.2

The distances to the proposed West Seahorse-2 well from the Base stations were:-

Mt. Taylor	55602	metres
Longford Tower	40004	metres
Jemmys	47418	metres
Nowa Nowa	70747	metres

ANCHOR PATTERN AND BUOYS

Using the given bow heading of 230°, anchor line bearings, and anchor cable and chain length of 557 metres, positions of the anchor buoys were determined geometrically.

The following table lists the positions:

Anchor Buoy No.	Bearing	Easting	Northing
1	260	552915	5770950
2	290	552935	5771253
3	350	553450	5771690
4	20	553730	5771677
5	80	554090	5771240
6	110	554070	5770921
7	170	553555	5770535
8	200	553265	5770558
Bow Heading	230°		

Each anchor buoy consisted of a 51 mm pipe approximately 5.5 metres long with a Norwegian buoy at the centre. A 0.6 metre section of chain was attached to the bottom and a colour pennant was attached to the top. They were anchored by two 1 metre steel rails weighing approximately 112 kg (180 kg for the Moonpool buoy). Three concrete cylinders were also attached to the base of each buoy to keep the pipe vertical. 60 metres of rope were used at each anchor to allow a maximum swing of approximately 26 metres.

SURVEY NET VERIFICATION AND SURVEY CHECKS

To make sure that the survey net used to position the rig matched that used for the seismic recording, large buoys marking the locations of the Seahorse-1 and West Seahorse-1 wells were used to verify the Trisponder survey net.

By positioning the Yardie Creek alongside Seahorse-1 and West Seahorse-1, the Trisponder system located the buoys lying 48 metres and 49 metres south-east of their respective well head positions.

The anchor buoys were positioned on Wednesday 20th January, 1982 between the hours 0900 and 1030. The Co-ordinates of the buoys were checked soon after the last buoy was down between 1045 and 1200 hours the same day. All buoys were within 20 metres of their proposed locations.

On Friday, 22nd, the buoys were checked again between the hours 0830 and 0930. All buoys were found to be within 20 metres of their proposed locations except buoy No.6 which was approximately 60 metres off.

The 'Petromar North Sea' departed the 'Sperm Whale' location at 0555 hours, Friday 22nd January, 1982. It arrived on 'West Seahorse-2' location at 1210 and the first anchor, No.5 was dropped at 1225, last anchor down at 1900. Trisponder signals were extremely good throughout.

At 0030 hours, 23 January, tensioning up was completed.

FINAL POSITION

The final position of the West Seahorse-2 well is:-

Latitude	038°	12'	21.84" S
Longitude	147°	36'	38.53" E

UTM Co-ordinates from the 147° Central Meridian:-

Northing	5771132	metres
Easting	0553466	metres

The Moonpool is 62 metres at a bearing of 326° from the proposed location.

Final distances to the 'West Seahorse-2' well from base stations are:-

Mt. Taylor	55526 metres
Longford	39995 metres
Jemmys	47372 metres
Mt. Nowa Nowa	70690 metres

The JMR-4 Satellite Doppler observations were taken on board the rig to provide independent checking on the West Seahorse-2 location. The Satellite location after 19 passes is:

Latitude	038°	12'	21.35" S
Longitude	147°	36'	38.57" E

UTM Co-ordinates:

Northing	5771145	metres
Easting	0553469	metres

DAILY LOG

Sunday 17th January, 1982

2300 hrs.	H. Sit departed Perth.

Monday 18th January, 1982

0500 hrs.	Arrived Melbourne airport.
0710 hrs.	Arrived Bairnsdale airport.
1100 hrs.	Arrived on rig 'Petromar North Sea'.

Tuesday 19th January, 1982

Final proposed West Seahorse-2 location confirmed from Perth office at 1900 hrs. (is 1600 hrs. Perth time). Instruct Yardie Creek to be on location.

Wednesday 20th January, 1982

Hugh Bradley of Navigation Australia aboard the rig. Positioned all anchor buoys and checked buoy locations.

Thursday 21st January, 1982

1945 hrs.	Petromar North Sea started pulling up anchors.

Friday 22nd January, 1982

0555 hrs.	Petromar North Sea left Sperm Whale-1 location for West Seahorse-2. Buoys location rechecked.
1130 hrs.	Rig on site (West Seahorse-2).
1225 hrs.	First anchor (No.5) dropped.
1900 hrs.	Last anchor dropped (No.2).
2235 hrs.	Commenced tensioning up anchors.

Saturday 23rd January, 1982

0030 hrs.	Phoned A. Ferworn, Perth; rig location accepted.
0300 hrs.	Well spudded in.

0600 hrs.	Final fixing taken, JMR-4A observations commenced.
0930 hrs.	Left 'Petromar North Sea'.
0940 hrs.	Arrived at Bairnsdale.
1020 hrs.	Left Bairnsdale for Melbourne.
1400 hrs.	Arrived in Melbourne.
2000 hrs.	Departed Melbourne airport.
2045 hrs.	Arrived Perth airport (Perth time).

OIL and GAS DIVISION

01 JUN 1983

3

GEOLOGY

(Pages 15 - 31)

3 GEOLOGY

3.1 Summary of Previous Investigations

Gippsland Basin exploration commenced in 1924 with the reported discovery of oil and gas in a water bore drilled onshore near Lakes Entrance. To date, over 125 wells have been drilled in the onshore part of the basin but only minor hydrocarbon accumulations have been encountered.

Initial exploration in the offshore Gippsland Basin was conducted by the Bureau of Mineral Resources when they undertook a regional gravity and aeromagnetic survey between 1951 and 1956. The first permits, covering a large part of the offshore Gippsland Basin, were taken up by BHP Co. Ltd. (later Hematite Petroleum Pty. Ltd.) in 1960. Esso joined the original permittee in 1964 and the first offshore well, Barracouta No.1, was drilled in 1965. Over eighty offshore wells have now been drilled in the basin resulting in the discovery of recoverable reserves approximately 3 billion barrels (0.466×10^{12} m^3) of oil and 8 trillion cubic feet (220.4×10^{12} m^3) of gas.

A summary of early contributions to the understanding of the geology and hydrocarbon potential of the Gippsland Basin was presented by W.F. Threlfall and others in 1974. Esso-BHP have published several papers on basinal stratigraphy and geological evolution during their exploration and development of the basin, and papers dealing with the geology of individual fields have been published as the fields were developed.

Exploration Permit Vic/P-11 consists of 51 blocks which previously formed parts of the Exploration Permits Vic/P-1 and Vic/P-8, held by Esso-BHP and a consortium headed by BOC Australia respectively. The area now covered by Vic/P-11 was gazetted in December 1976 and applications for the permit were invited. The permit was granted to Gas and Fuel Corporation of Victoria on August 8, 1978, and Beach Petroleum subsequently became joint Permittee and Operator.

Hudbay Oil (Australia) Ltd. farmed into the Permit in December, 1980, and in February 1981 shot the GB81 Seismic Survey, consisting of 359 line kilometres of 36-fold seismic survey. Detailed mapping, incorporating data from the GB81 survey, Beach Petroleum's GB79 Seismic Survey and trade data from Esso's G80A Seismic Survey, defined several prospects. West Seahorse-1 was the first of these to be drilled, and was the first well to be drilled by HOAL outside Western Australian waters. After a break of 3-1/2 months, in which time three other prospects were tested, HOAL returned to appraise the West Seahorse structure with the drilling of West Seahorse No.2.

3.2 Geological Setting

3.2.1 Regional Setting

The West Seahorse structure lies towards the northern margin of the Gippsland Basin, which is situated in south-eastern Australia and is bounded to the north and south by the Victorian Highlands and Bassian Rise respectively (Enclosure 2). The western limit of the basin is taken as the Mornington Peninsula and to the east the basin opens to the Tasman Sea. The Gippsland Basin covers approximately 50,000 km^2 and is filled with up to 10,000 metres of Lower Cretaceous to Recent sediments.

3.2.2 Tectonic Elements (Enclosure 2)

The offshore Gippsland Basin is separated by fault complexes into three major divisions: The North Platform, or Lakes Entrance Platform; the graben-like Central Deep or Strzelecki Basin; and the South Platform (Hocking & Taylor, 1964; James and Evans, 1971; Hocking, 1972).

The stable platforms to the north and south are areas where the Tertiary sequence unconformably overlies Palaeozoic basement. In these areas the structures within the Tertiary section consist simply of small-scale drapes over palaeotopographic ridges and small fault scarps.

The Southern Platform is separated from the Central Deep Basin by a major fault complex, the South Bounding Fault. This is an offshore extension of the Foster Fault System and consists of a system of down-to-basin normal faults arranged en echelon. The northern boundary of the Central Deep is less well defined.

Major fault trends within the central part of the basin are offshore extensions of the southwest-northeast trending Yarram Fault and the antithetic, east-west trending Rosedale Fault System. The latter is known to be a reverse fault superimposed upon an older normal fault within the Lower Cretaceous, and to have a throw of up to 160 metres in the

West Seahorse area. Reverse movement along the fault system is believed to have occurred as a result of the same stresses that led to the development of the major anticlines in the central basin during the late Eocene to early Oligocene. Numerous northwest-southeast, basin-forming normal faults have been recognized within the Central Deep.

The major hydrocarbon-bearing anticline structures in the central basin are elongate, with a dominant southwest-northeast axial trend. They were formed by right-lateral, convergent shearing brought about by the movement of continental plates, as will be discussed in Section 3.2.3. The main hydrocarbon traps in the Vic/P-11 Permit were formed as a result of the same shearing stress, resulting in arching associated with reverse movement superimposed upon older normal faults.

3.2.3 Geological Evolution and Regional Stratigraphy (Figure 13)

During the Lower to Middle Palaeozoic a series of major orogenies occurred within the Tasman Geosyncline. This resulted in a dominantly north-south structural grain within the tightly folded and faulted Palaeozoic metamorphics. These geosynclinal sediments were subsequently intruded by Lower Devonian granitic rocks. A major rift formed across southern Australia during the Jurassic due to the operation of the Antarctic and Australian cratons. The rift valley formed over the entire length of the present southern coast of Australia. Into this major depositional axis a typical sequence of rift valley sediments was rapidly deposited, as clastics were stripped from the adjacent Palaeozoic highlands. The initial deposits of the Upper Jurassic to Lower Neocomian consists of conglomeratic wedges and alluvial fan detritus, commonly of a quartzose sandstone nature. Jurassic intrusives and Lower Cretaceous extrusives, both associated with rifting, provided a major provenance for the 3,500 metres of Lower Cretaceous Strzelecki Group sediments.

During Lower Cretaceous times, the Gippsland Basin formed a half graben with the major subsidence along the southern

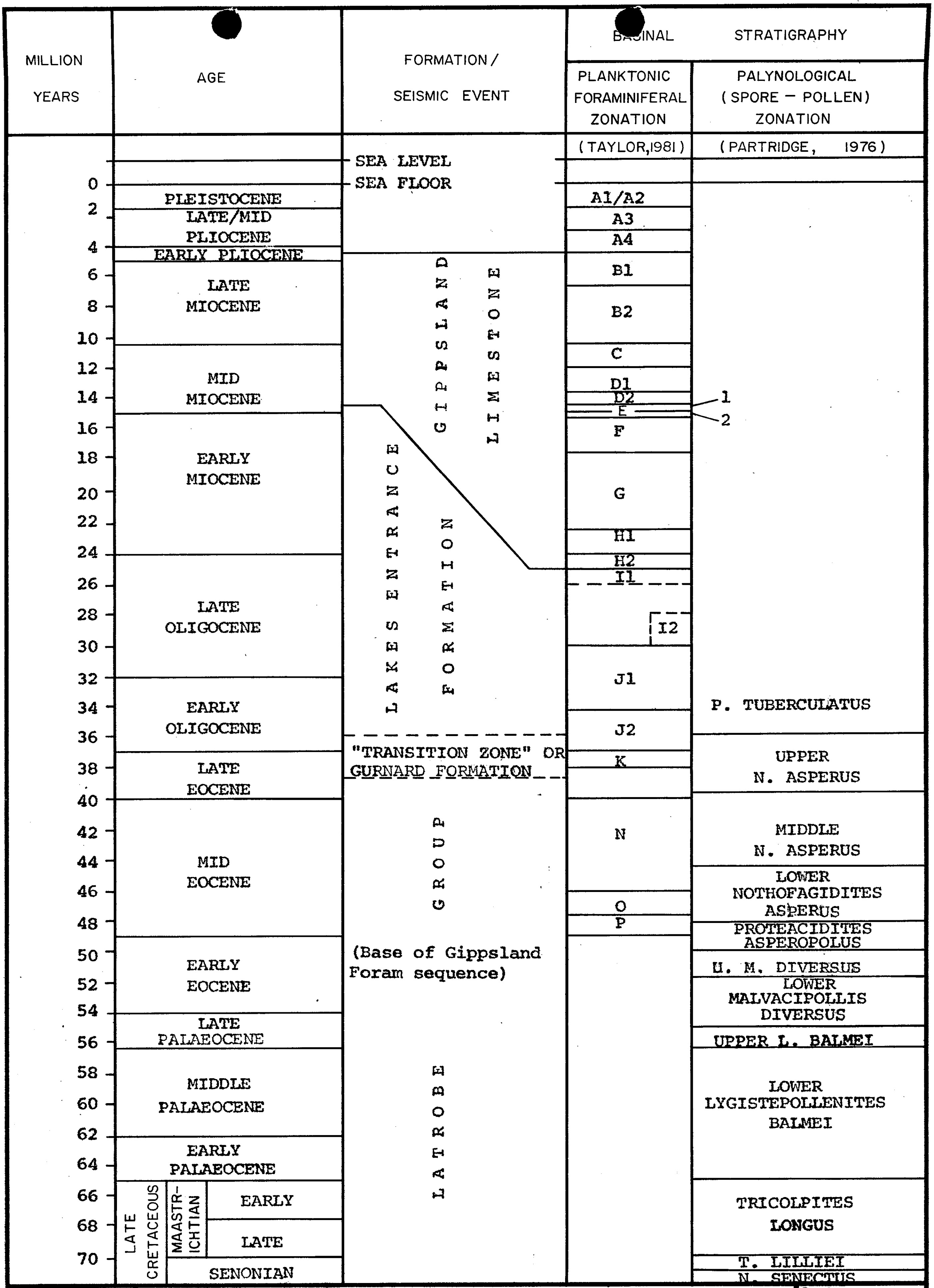
Foster Fault system. The Strzelecki Group sediments are texturally mature but mineralogically immature, being felspathic and chloritic. They consist of a monotonous, cyclic sequence of interbedded sands, silts and muds deposited on a subsiding fluvial plain. A large east-west rift developed, separating sediments of the Tasman Geosyncline. The eastern end of this rift is believed to have terminated in a triple junction formed by the Australian, Antarctic and Lord Howe Rise Plates. The western arm of the triple junction was coincident with the ancestral Otway and Gippsland Basins and, as this arm of the triple junction failed during the Turonian, the Lord Howe Rise plate moved eastwards away from the Australian-Antarctic plate. This resulted in the rifting of the eastern portion of the Antarctic and Australian plates along a line parallel to, and off the west coast of Tasmania. Therefore the Tasmanian craton remained attached to the Australian plate but was separated from it by an east-west, aborted, rift valley basin.

The Lower Cretaceous Strzelecki Group sediments are unconformably overlain by up to 5,000 metres of fluviatile and lacustrine Latrobe Group sediments. Upper Cretaceous sedimentation tended to be superimposed on the underlying Strzelecki Group with the deposition of shales, minor coals and poorly sorted sandstones in a fluviatile environment. In the early Senonian, approximately 85 million years B.P., the Lord Howe Rise Plate moved away, resulting on the deposition of a complex system of fluvial and deltaic plain sediments sourced from the northwest and north. Growth and movement on the basin-forming normal faults resulted in continued subsidence of the basin during the Palaeocene and Eocene.

The northern part of the basin was uplifted as fault movement elsewhere in the basin lessened during the Eocene. A period of submarine and subaerial channel-cutting occurred during the Middle to Upper Eocene in the Tuna-Founder area. The channel-cutting marked the onset of a marine trasngression from the southeast during the uppermost Eocene to Lower Oligocene, a period of instability and basin tilting. The en echelon disposition of the fold trends and fault systems is most likely the result of Upper Eocene east-west, right lateral, convergent shear deformation. The crestal areas of the folds were subsequently eroded during an associated period of relative sea level drop, while the deeper parts of the basin continued to receive sediments. The compressional regime reactivated the severe channeling and the Marlin Channel was formed as subaerial and submarine drainage systems were laterally restricted.

The transgression continued into the Lower Oligocene with the deposition of the shallow water glauconitic sands and silts of the Gurnard Formation. Around the margins of the basin, sand buildups occurred as the transgression reached its maximum extent. During the uppermost Eocene to Lower Oligocene, a marked changed in sediment type occurred: the fluvial and deltaic coarse grained clastics were replaced by fine grained, calcareous shales and marls. The change in sediment type may be due, in part, to a change in provenance related to the widespread deposition onshore of volcanics during the Upper Eocene wrenching episode.

Sea level fluctuations during the Miocene produced a complex system of interfingering and overlapping channels, which cut into the soft limestones and marls of the Lakes Entrance Formation and Gippsland Limestone. A linear, submarine slump zone of over 125 kilometres in length has been observed along the major south-bounding fault system. A wedge of sediment moved towards the centre of the basin as a result of reactivation of this fault system during the Miocene, and a major cratonic uplift, the Kosciusko Uplift, was initiated in the Miocene and culminated during the Upper Pliocene and Lower Pleistocene. The Victorian Highlands were uplifted and provided a renewed clastic provenance, while faults and associated structures around the northern margins of the basin were rejuvenated. Extensive erosion is currently occurring in the Strzelecki Hills and a relatively thin veneer of Quarternary sediments is being deposited across the southeastern Gippsland coastal plain.



Author: B. Butcher	Hudbay Oil (Australia) Ltd. OFFSHORE GIPPSLAND BASIN **REGIONAL STATIGRAPHIC COLUMN**	Scale:
Drawn: A. Clark		Drawing Nº A4-GL-490
Date: April 1982		

Figure 13

3.3 Stratigraphy

A sedimentary section ranging in age from Recent to Palaeocene was penetrated in West Seahorse No.2 (Figure 14).

Age determinations are based upon palaeontological and palynological studies of sidewall cores (Appendices B2 and B3). The boundaries of individual units were established by using the age determinations in conjunction with lithological data from the microscopic examination of drill cuttings and sidewall cores, and wireline log interpretations. Time-rock subdivisions were placed midway between sidewall cores point, unless more accurate subdivisions were made possible by log response or cuttings lithology.

Owing to the standard practice of not installing a marine riser until after the setting of the 20 inch casing, no samples were recovered from the seabed to 206 metres. Due to problems with sampling in the 17-1/2 inch hole sidewall cores were not taken above the 13-3/8 inch casing shoe. Therefore no age determinations were possible above 1300 metres.

The stratigraphy encountered in the well is described below. All depths quoted are below the Rotary Table, which is 9.45 metres above Mean Spring Low Water.

Palaeocene to Eocene (2050 T.D. - 1405 metres)

The first appearance of non-marine sediments at 1405 metres marks the top of the Latrobe Group in the West Seahorse No.2 well. The section consists of interbedded sandstones, coals and claystones with an increase in the number of coal seams above 1650 metres. Also, there is a decrease in the sand to shale ratio above 1500 metres. The evidence of the N.asperus, M.diversus and L.balmei spore-pollen assemblages confirms the presence of non-marine Latrobe Group sediments over this interval.

Upper Eocene to Lower Oligocene (1405 - 1351.5 metres)

The interval 1405 - 1351.5 metres consists dominantly of claystones which are micritic and locally glauconitic. The top and base of this unit was interpreted with the aid of electric logs. The claystones were deposited in an estuarine and lagoonal environments with water depths fluctuating and generally less than 10 metres.

Latest Oligocene (1351.5 - 1338.5 metres)

This layer unconformably overlies the Lower Oligocene claystones and forms the base of the carbonate sequence. This unit was deposited in a mid shelf environment (40-100 metres water depth) and consists of marl which is locally glauconitic.

Lower Miocene to Recent (1338.5 - 206 metres)

A marine carbonate sequence typifies the upper section of the West Seahorse No.2 well. Skeletal calcarenites predominate throughout the interval with localized increases of finer-grained calcisiltites and calcilutites. Below 620 metres carbonate grains replace skeletal fragments as the major constituent. The carbonates are recrystallized in varying proportions between 985 and 740 metres. Below 985 metres calcilutites grade to marl at 1110 metres and the marl continues to the base of the sequence at 1338.5 metres. Palaeontological studies of the sidewall cores indicate a mid-shelf environment below 1325 metres with water depths of 40-100 metres.

STRATIGRAPHY	PLANKTONIC FORAM ZONE	PALYNOLOGICAL (SPORE-POLLEN)	DRILL DEPTH (m)	SUBSEA DEPTH (m)	EVENT	PALAEO DEPOSITIONAL ENVIRONMENT
	(Taylor 1981)	(Partridge 1976)				
			9.45	0	SEA LEVEL	
			48.0	38.5	SEA FLOOR	
RECENT TO MID MIOCENE						MARINE SHELF AND CANYON
LOWER MIOCENE	H-1					MID SHELF
			1341.5	1332	TRANSITIONAL	
LATEST OLIGOCENE	H-2					MID SHELF 40-100 metres
			1351.5	1342	UNCONFORMITY	
LOWER OLIGOCENE	J ?					LAGOONAL AND ESTUARINE 10 metres
			1377.5	1368	TRANSITIONAL	
UPPER EOCENE	K					DELTAIC, LAGOONAL, ESTURAINE
? ?	?	? ?	1405	1395.5	UNCONFORMITY	? ?
UPPER TO MIDDLE EOCENE		N. asperus				NON MARINE
			1457	1447.5		
		BARREN				
			1610	1600.5		
LOWER EOCENE		M. diversus				
			1784	1774.5		
PALAEOCENE		L. balmei				
			2050	2040.5	TOTAL DEPTH	

Scale
N.T.S.

Drawn by
T.Cole

Hudbay Oil (Australia) Ltd.
West Seahorse – 2
STRATIGRAPHIC TABLE

Date
May, 1982

Drawing Nº
A4-GL-733

Figure 14

3.4 Structure

West Seahorse No.2 was drilled 1 km to the southwest of West Seahorse No.1, both wells being on the southern side of a major east-west, high angle reverse fault which is upthrown to the south. Reverse movement, associated with wrenching along a pre-existing, normal, down-to-the-basin fault trend, caused arching into the fault and thereby formed the northern boundary of the structure.

The normal fault trend formed during Upper Jurassic to Lower Cretaceous times, with further growth continuing during the Upper Cretaceous and Lower Tertiary. The wrench faulting, believed to have been associated with the reverse movement, took place during the Upper Eocene to Lower Oligocene. The West Seahorse structure is a 5 km by 2 km, east-northeast trending, asymmetric anticline. Closure has been mapped at three horizons, designated "Top Latrobe", "Intra Latrobe" and "Top Strzelecki", though palynological data indicates that the latter may be a misnomer (Figure 14).

A high resolution dipmeter was run from 2406 metres to the base of the 13-3/8 inch casing, at 1299 metres. Interpretations of the dipmeter data was enhanced by the use of a Cluster-Pooled Arrow Plot, Cyberdip and Geodip run over selected intervals. Dips are generally low over the entire interval of interest so a structural dip component was not removed prior to processing the Geodip log. Interpretations are therefore based on the Cyberdip with the Geodip used between 1375-1575 metres. The data can be subdivided into several intervals, according to the magnitude and direction of recorded dips, as follows:-

Above 1345 m	:	19-39^{o}; random orientation.
1345 - 1365 m	:	5-17^{o}; south-south-easterly
1365 - 1392 m	:	0-20^{o}, dominantly less than 10^{o}; Direction variable but mainly north to east.

1392 - 1409 m : 2-41°; generally west to north, reliability of readings is low.

1409 - 1416 m : 1-14°, dominantly 2-6°; varying from north-west to north-east.

1416 - 1505 m : 0-20°, generally less than 10°; varying from north-west, through west, to south with depth.

1505 - 1526 m : 1-25°, dominantly 5-15°; generally south westerly.

1526 - 1545 m : 1-14°; south-west to south-east, low frequency of readings.

1545 - 1566.5 m : 1-40°, increasing with depth; generally westerly.

1566.5 - 1573 m : 3-34°; south-easterly.

1573 - 1585 m : 1-30°, dominantly 2-10°; north-westerly.

1585 - 1600 m : 1-11°; south-west.

1600 - 2050 m : 1-40°; generally less than 20°; random orientation with southerly trend predominant.

3.5 Predicted and Actual Depth to Seismic Markers

The depths to the main seismic events recognized in West Seahorse No.2 are listed in the following table. Further details are given in Enclosures 3 and 4, and Figure 15.

Horizon Identification - West Seahorse No.2

Location : Line GB81-1A Shot Point 111.1

Horizon	Predicted Depth *	Actual Depth	Recorded 2-way Time (sec)
Water Bottom	39 m	38.5 m	0.051
Top Marl	1020 m	1100 m	0.904
Top Latrobe	1403 m	1395 m	1.141
Top First Coal	1403 m	1407 m	1.148
Total Depth	2050 m	2050 m	1.562

* Note: Depths quoted in this table are subsea,
i.e. R.T. Depth - 9.45 m.

PE905514

This is an enclosure indicator page.
The enclosure PE905514 is enclosed within the container PE902671 at this location in this document.

The enclosure PE905514 has the following characteristics:
ITEM_BARCODE = PE905514
CONTAINER_BARCODE = PE902671
NAME = Predicted and Actual Section
BASIN = GIPPSLAND
PERMIT = VIC/P11
TYPE = WELL
SUBTYPE = STRAT_COLUMN
DESCRIPTION = Predicted and Actual Section (from WCR) for West Seahorse-2
REMARKS =
DATE_CREATED = 30/06/82
DATE_RECEIVED = 1/06/83
W_NO = W765
WELL_NAME = WEST SEAHORSE-2
CONTRACTOR =
CLIENT_OP_CO = HUDBAY OIL (AUSTRALIA) LTD

(Inserted by DNRE - Vic Govt Mines Dept)

3.6 Porosity and Permeability

Porosities within the sandstone units intersected in the West Seahorse NO.2 well have been estimated from wireline log interpretations (Appendix B4) and microscopic examinations of cuttings and cores. Additional data was obtained from core analysis studies (Appendix B5) conducted on cores 1 and 2.

Due to the finely interbedded nature of the uppermost section of the Latrobe Group sediments (above 1450 metres) log derived porosities are extremely variable and exaggerated. The average porosity derived from the interpretation is approximately 26%. True porosity measurements from sandstone samples, recovered from cores 1 and 2, were also highly variable but averaged only 15-16%. Pressure data from RFT tests confirmed the poor permeability qualities of this interval with one exception between 1427 - 1429.4 m.

Below 1450m, within the thicker sandstone units, the log derived porosities decreased from 25-30% to 20-25% at 2050 m. The decrease in porosity is due largely to an increase in matrix content and compaction. Visual porosity estimates documented in cuttings and sidewall core descriptions below 1450m varied from fair to excellent throughout the section. Pressure data from RFT tests in porous zones below 1450m showed excellent reservoir characteristics.

3.7 Hydrocarbon Indications

3.7.1 Summary

Wireline log interpretations from West Seahorse No.2 indicated no movable hydrocarbons within the objective zones. This was confirmed during the RFT programme with only 100 millilitres of oil recovered. Samples of oil from the RFT test and also some material from core No.1 were despatched for Geochemical analyses (Appendix B6).

3.7.2 During Drilling

A continuous record of gas levels in the drilling mud was maintained by Exploration Logging Inc., using a total gas analyser and gas chromatograph. Monitoring commenced at 206 metres in the 17-1/2 inch hole and continued to the total depth of 2050 metres.

Table 1 on the following page summarizes the gas readings observed during drilling.

Fluorescence from Drill Cuttings

Minor pin points of blue-white sample fluorescence were reported between 1410-1414 metres. No fluorescence was described between 1414-1424 metres as the section consisted dominantly of coal. Two cores were cut between 1424-1449 metres and cuttings collected over this interval were devoid of any fluorescence. The interval 1450-1500 metres showed traces of hydrocarbon fluorescence. This was reported as dull to bright, blue-white to yellow-orange with minor slow streaming to moderate blooming blue-white solvent fluorescence.

A trace to 50% very dull to bright, white to lemon-yellow sample fluorescence, which exhibited instant blooming and streaming solvent fluorescence, was noted between 1630-1640 metres. This show was coincident with an interval of coal. Minor traces of orange mineral fluorescence were noted below 1490 metres.

TABLE 1

RANGE OF GAS READINGS

Depth (m)	Total Gas	Pet. Vap.	C_1	C_2	C_3	iC_4	nC_4	C_5
206-910	0	0	0	0	0	0	0	0
910-1315	0-1	0-tr	12-340	0-7	0	0	0	0
1315-1410	1-12	0-1/2	160-2190	0-35	0-28	0-12	0-5	0-15
1410-1424	120-225	1/2-15	2193-30000	35-790	28-380	12-220	15-214	15-168
1424-1438	1/2-16	tr-1	50-3300	tr-35	tr-14	tr-6	tr-6	0
1438-1449	6-7	tr	765-1200	20-35	5-7	tr	tr	0
1449-1530	2-60	tr-5	305-10000	30-840	7-190	0-32	0-12	0-5
1530-1605	1-18	tr-5	50-3600	7-580	7-190	tr-12	tr-12	0
1605-1735	tr-10	0-2	10-1600	0-150	0-160	0-15	0-23	0
1735-1935	tr-1	0-tr	tr-85	0-7	0-6	0	0	0
1935-2050	tr-1	0-tr	15-80	0-6	0-3	0	0	0

Notes:
1) "Petroleum Vapours: includes C_2 and higher hydrocarbons.
2) Total Gas and Petroleum Vapours are given in units, where 1 unit = 200 ppm.
3) C_1 - C_5 are given in ppm.
4) The high gas readings are generally associated with coal seams rather than hydrocarbon zones.

Oil Staining/Free Oil

Traces of oil staining were noted at 1424 metres and 1427.3-1427.5 metres in core No.1, and also in the 1475 m cuttings sample. No evidence of free oil was recorded at the wellsite.

3.7.3 Sidewall Cores and Conventional Cores

Dull yellow-cream to bright blue-white fluorescence was observed on sidewall cores between 1414-1427 metres. This ranged from 20-100% of the surfaces studied. Instant blooming and streaming solvent fluorescence was also observed. Patches of dull yellow to bright orange with instant blooming solvent fluorescence were observed on sidewall cores at 1431 and 1433 metres. Refer to Appendix B7 for further details.

In both Core No.1 and No.2 dull to bright yellow-gold fluorescence was observed in varying amounts from minor pin points to 90% of the surface described. Only traces were recorded in Core No.2. Some solvent fluorescence was noted in Core No.1. Refer again to Appendix B7 for core descriptions.

3.7.4 Further Indications

The RFT programme is summarized in Section 4.3.

3.8 Contributions to Geological Knowledge

1. Palaeontological studies of sidewall cores noted the presence of Upper Eocene to Lower Oligocene sediments (zone K/J) in the West Seahorse No.2 well. This suggests that the apparent absence of these sediments at West Seahorse No.1 is due to erosion rather than faulting. (Refer Section 3.8 of the West Seahorse-1 Well Completion Report).

2. An age dating of non-marine N.asperous zone, from a sidewall core taken at 1407 metres, proves non-marine Latrobe Group above the first coal seam. It suggests, as with Seahorse-1, that the Top Latrobe is the high gamma ray peak above the first coal (a difference of only a few metres).

3. An RFT test at 1427m recovered 100 ml of oil. Geochemical evaluation of the oil sample showed it to be more biodegraded than the West Seahorse No.1 crude, but it was derived from a similar source.

4. The West Seahorse No.2 well failed to confirm the extension to the west of West Seahorse-1, of suitable reservoir rocks within the Top Latrobe section. It is believed the first oil sand intersected at West Seahorse No.1 (1411-1418m) has thinned in the direction of West Seahorse No.2. Core No.1 was cut in this zone and consisted of finely interbedded sandstones and siltstones with minor coals and shales. The average porosity obtained from the thin sands within the core was 15.5%.

5. The 1500m, oil bearing sand encountered at West Seahorse No.1 was intersected at West Seahorse No.2 but no oil was present. The top of the sand in West Seahorse-2 is below the oil-water contact in West Seahorse-1.

6. All other porous sands intersected in West Seahorse No.2 well were water wet. The well bottomed in Latrobe Group sediments of Palaeocene age with sandstones exhibiting reasonable porosities to T.D. at 2050m.

7. Formation factor measurements were performed on core samples from the West Seahorse No.2 well. Favourable results were obtained using the Waxman-Smits method (concentrated saturant brine). This method was used in place of the salinity reversal methods because of the lower costs and quick turnaround time.

4 WELL DATA

(Pages 32 - 39)

4 WELL DATA

4.1 Formation Sampling

A standard "Alpha" unit from Exploration Logging Australia Inc. was used for the 1981-82 Gippsland Basin drilling programme. Exlog personnel provided continuous monitoring of ditch gas and mud pit levels, and recorded the following parameters every 5 metres; ditch gas, gas chromatography, calcimetry, blendor gas analyses and mud weight in and out. Corrected drilling exponent calculations were also performed every 5 metres in shaly intervals, but are not considered reliable due to a faulty motion compensator on the drilling vessel. A Drill Monitor System panel provided continuous readings of engineering/drilling parameters, which were noted every 5 metres.

Washed and dried cuttings samples were collected in 5 metre (minimum) intervals from below the base of the 20" casing shoe, at 191 m, to total depth at 2050 m. Hudbay and Exlog geologists maintained separate lithological logs (see Enclosures 5 & 6 and Appendix B8).

5 metre representative washed and dried samples were taken for lithological and palaeontological identification. In addition, 15 metre composite palynological and geochemical samples were taken below the 20" casing shoe and the 13-3/8" shoe respectively.

4.2 Coring Programme

4.2.1 Conventional Cores

Two conventional cores were cut in West Seahorse No.2.

Core 1

Interval Cored : 12 metres (1424 - 1436 m)
Core Recovered : 4.83 metres (1424 - 1428.83 m)
Recovery : 40%

Lithological Description (see also Appendix B7)

1424.0 - 1424.04 metres

Sandstone, silty in part, light grey to off white, occasionally yellow grey, very fine to medium, dominantly very fine, moderately well sorted, subangular to subrounded, trace mica, trace coal, good intergranular porosity, soft.

1424.04 - 1424.9 metres

Sandstone, as above, with fine multiple interbeds of Siltstone, dark brown to grey black, occasional very fine sand grains, 30-40% mica, trace carbonaceous material, moderately hard.

1424.9 - 1425.0 metres

Coal, black, brittle, vitreous lustre, conchoidal fracture.

1425.0 - 1426.5 metres

Siltstone, dark brown to grey black, occasional quartz grains and granules, micromicaceous, carbonaceous, moderately hard.

Interbedded with multiple fine laminae of Sandstone, clear to off white to light grey, occasional dark brown grains, very fine grained, well sorted, sucrosic, carbonaceous and micromicaceous in part, moderately hard, fair intergranular porosity, fair permeability.

Becoming dominantly Siltstone with occasional coal streaks.

1426.5 - 1426.7 metres

Coal, black, brittle, vitreous lustre, conchoidal fracture.

1426.7 - 1427.0 metres

Siltstone, very dark grey to black, micromicaceous, carbonaceous, moderately hard, grading to Shale.

With minor interbeds of Sandstone, clear to off white to light grey, occasional dark brown grains, very fine grained, well sorted, sacrosic, carbonaceous and micromicaceous in part, moderately hard, fair intergranular porosity, fair permeability.

1427.0 - 1427.03 metres

Shale, black,micromicaceous in part, hard.

1427.03 - 1427.14 metres

Coal, black, brittle.

1427.14 - 1427.30 metres

Siltstone, very dark grey to black, micromicaceous, carbonaceous, moderately hard.

1427.30 - 1427.72 metres

Sandstone, clear to blue grey, very fine, moderately well sorted, subangular, trace clay minerals, 50-70% silicification, very hard, poor intergranular porosity.

1427.72 - 1428.71 metres

Siltstone, slightly calcareous,with multiple fine interbeds of very fine grained Sandstone, 50-70% silicification.

1428.71 - 1428.83 metres

Coal, black, brittle.

1428.82 - 1436 metres

No recovery.

Core 2

Interval cored	:	11 metres (1438 - 1449 m)
Core recovered	:	9.8 metres (1438 - 1447.8 m)
Recovery	:	89.4%

Lithological Description (see also Appendix B7)

1438 - 1439.75 metres

Coal, black, brittle, conchoidal fracture.

1439.75 - 1439.77 metres

Siltstone, dark brown to black, micromicaceous, carbonaceous, hard.

1439.77 - 1440.45 metres

Coal, black, brittle, conchoidal fracture.

1440.45 - 1441.25 metres

Sandstone, light grey to dark grey brown, very fine, well sorted, subangular, trace clay matrix, 5-10% mica, trace carbonaceous material, minor coal, moderately hard, fair intergranular porosity, sucrosic texture.

With interbeds of Siltstone, dark brown, micromicaceous, moderately hard, trace coal.

1441.25 - 1442.2 metres

Sandstone, clear to light grey brown, very fine to very coarse, dominantly coarse, trace calcite cement, trace mica, trace garnet, 50-70% silicification, trace carbonaceous material, bioturbated, very hard, nil to poor intergranular porosity, fining downwards.

No apparent structures.

1442.2 - 1442.7 metres

Siltstone, dark grey to grey, 5-20% very fine quartz grains, 20-30% silicification, micromicaceous, carbonaceous, very hard.

With minor interbeds of coarse grained Sandstone, 50-70% silicification, very hard.

1442.7 - 1443.47 metres

Sandstone, argillaceous, silty, clear to dark grey, very fine to granule, poorly sorted, subangular to subrounded, trace to 10% clay matrix, 5-20% silt, trace glauconite, moderately hard, poor intergranular porosity.

With thin Coal laminae.

And occasional minor interbeds of Sandstone,very fine to medium grained.

1443.47 - 1445.0 metres

Sandstone, clear to light grey, occasionally dark brown, very fine to medium, occasionally very coarse, moderately well sorted, angular to subangular, trace clay minerals, trace silt, trace coal, sucrosic, moderately hard, fair to good intergranular porosity.

With Siltstone, as minor interbeds.

1445.0 - 1447.0 metres

Sandstone, clear to dark grey, fine to coarse, dominantly medium, occasionally granule, moderately well sorted, angular to subrounded, trace carbonaceous material, unconsolidated.

With minor coal laminae.

1447.0 - 1447.75 metres

Sandstone, clear to white to dark brown, fine to medium, moderately well sorted, subangular to subrounded, trace clay matrix, moderately hard, to unconsolidated.

With interbeds 50% Siltstone, dark brown, micromicaceous, carbonaceous.

1447.75 - 1449.0 metres

No recovery.

Note: Initial interpretation of the Corelab core data (Appendix B5), wireline log interpretations and lithology descriptions enabled repositioning of both cores. It is proposed that the top of Core No.1 be relocated from 1424 to 1429 metres and that the top of core No.2 be relocated from 1438 to 1439.55 metres.

4.2.2 Sidewall Cores

Summary

Run 1 (14/02/82)

Interval shot	:	1325 - 1443 metres
Shots attempted	:	30
Cores recovered	:	28
Bullets empty	:	2
Bullets misfired	:	nil
Bullets lost	:	nil

Run 2 (14/02/82)

Interval shot	:	1449 - 2029 metres
Shots attempted	:	30
Cores recovered	:	30
Bullets empty	:	nil
Bullets misfired	:	nil
Bullets lost	:	nil

Refer to Appendix B7 for sidewall core descriptions.

9 sidewall cores over the interval 1325-1395 metres were sent to Paltech Pty. Ltd. for palaeontological examination (Appendix B2).

35 sidewall cores over the interval 1403-2022 metres were sent to W. Harris at Western Mining Corporation, S.A. for palynological examination (Appendix B3).

4.3 Wireline Logs and Wireline Sampling

Schlumberger Seaco ran the following wireline logs and Repeat Formation Tests in West Seahorse No.2:

Suite	Date	Log	Interval	Remarks
1	01/02/82	LDL-GR (1:200 & 1:500)	191 - 1306 m	
	01/02/82	Playback LDL-GR (1:200)	191 - 1306 m	Gamma ray scale changed to improve resolution.
	01/02/82	DIT-BHC-GR (1:200 & 1:500)	191 - 1304.5 m	Gamma ray run to seabed.
2	12/02/82	DLL-MSFL-GR (1:200 & 1:500)	1299 - 2046 m	
	12/02/82	LDL-CNL-GR (1:200 & 1:500)	1299 - 2046 m	
	12/02/82	LDL-CNL-PCL-EPL-GR (1:200	1299 - 2040 m	
	12/02/82	BHC-GR (1:200 & 1:500)	1299 - 2046 m	
	14/02/82	HDT (1:200)	1299 - 2046 m	
	14/02/82	RFT (1:200)	1413 - 2013 m	5k gauge used. Half all pressures
	14/02/82	CST (1:200)	1325 - 2029 m	Two runs made.

Additional Services

Date	Log	Interval
13/02/82	Cyberlook (1:200)	1400 - 1600 m
15/02/82	Cyberlook with Sxo from EPT (1:200)	1413 - 2013 m
14/02/82	Cyberdip (1:200 & 1:100)	1299 - 2046 m
14/02/82	Cluster Analysis (1:500)	1299 - 2049 m
14/02/82	Geodip (1:200 & 1:40)	1375 - 1575 m
25/02/82	High resolution Thermometer (1:200)	1 - 175 m

Log interpretations and further details of the logging programme are provided in Appendix B4.

A velocity survey was run and a synthetic was made by Seismic Services Limited (Enclosures 3 & 4).

Repeat Formation Tests (RFT)

The following table summarizes the RFT programme for West Seahorse No.2:

Date	Interval (m)	Pressure Tests	Sampling Attempts	Total
14/02/82	1413 - 2013	24	5	29

The RFT programme indicated the following:-

a) There is no oil water contact within the objective zone.
b) All permeable formations sampled below the objective zone recovered fresh water.
c) Only 100 millilitres of oil was recovered with water samples at 1427 m.

Data summary of sample points:

Test No.	Depth(m)	Buildup Time (min)		Press (psi)	Recovery
		6 gall.	1 gall.		
5	1427	20	3	2034	water, oil scum
16	2012	24	6	2864	water
21A	1495	21	4	2130	water
22	1598	14	2.5	2275	water
23	1519.5	16	3	2165	water

5 REFERENCES

Hocking, J.B., 1972: Geological Evolution and Hydrocarbon Habitat, Gippsland Basin, J. Aust. Petrol. Expl. Assoc., 12 (1), pp 132-137.

Hocking, J.B., and Taylor, D., 1964: The Initial Marine Transgression in the Gippsland Basin, Victoria, Paps. Aust. Petrol. Expl. Assoc., 1964.

James, E.A., and Evans, P.R., 1971: The Stratigraphy of the Offshore Gippsland Basin. J. Aust. Petrol. Expl. Assoc., 11 pp. 71-74.

Threlfall, W.F., Brown, B.R., and Griffith, B.R., 1976: Petroleum Geology of the offshore Gippsland Basin, *in* Economic Geology of Australia and Papua New Guinea. 3 Petroleum Australia Inst. Min. Metall.

APPENDIX B2 PALAEONTOLOGY REPORT

FORAMINIFERAL SEQUENCE
IN
WEST SEAHORSE # 2.

For:- HUDBAY OIL (AUSTRALIA) LTD.
March 16th, 1982.

Paltech Report 1982/08

PALTECH PTY LTD
MARINE MICROPALEONTOLOGISTS
SYDNEY NEW SOUTH WALES
MIDLAND WESTERN AUSTRALIA

THE FORAMINIFERAL SEQUENCE
IN
WEST SEAHORSE # 2.

Eight sidewall cores from WEST SEAHORSE # 2 were examined for foraminiferal content. A ninth sidewall core jar, labelled 1389.5-"MT" contained no material. The following sequence was interpreted -

SWC Depth (m)	Approx E-log Unit Boundary	Age	Zone*	Paleoenvironment¶
1325.0 to 1343.1		Early MIOCENE	H-1 to ?H-2	Mid Shelf (40-100m)
	1351.5			
1351.5 to 1363.5 to ?1368.5		Early OLIGOCENE	J	Fluctuating-Estuarine (<10m)
	1377.5			
1379.0		late EOCENE	K	as above
	?	?	?	?
1395.0		?	No forams found	Deltaic/lagoonal

— — — — base of sequence examined — — — —

*Planktonic foraminiferal zones after Taylor (in prep.).
¶Paleobathymetric range in parentheses.

A list of sidewall cores studied is shown on Tables 1 & 2 (herein) which details the record summarised above. A micro-paleontological data sheet is included, showing interpreted reliability of the planktonic foraminiferal zonal determinations.

No foraminifera were found in the lowest sample at 1395. Percentage planktonic foraminifera in the next four samples fluctuated from 20% total fauna at 1379.0 and 1363.5, to complete absence of planktonics at 1368.5 and 1351.5. These fluctuations no doubt reflected changes in sea level and access by oceanic currents in an estuarine environment. On Table 2, these fluctuations are shown relatively with designations of *estuarine* (= dominant arenaceous benthonic fauna, barren of planktonics) and *estuarine entrance* (= planktonic associated with more diverse benthonic fauna).

The late Eocene and early Oligocene (Zones K and J) estuarine sequence is much better demonstrated in West Seahorse # 2 than in West Seahorse # 1, but this may be purely an artifact of the sidewall coring programs when the two wells are compared. However, during the late Eocene/early Oligocene period, marine influence was more apparent in the Esso Seahorse # 1 sequence, where the paleoenvironmental data indicates shallow, inner continental shelf deposition, compared with the more shoreward, estuarine sedimentation in West Seahorse # 2. A similar length Oligocene hiatus is evident in all three wells in the Seahorse region.

More detailed comparisons of these wells will be made in a report on correlation of wells in the western portion of the VIC/P11 permit.

MICROPALEONTOLOGICAL DATA SHEET

BASIN: GIPPSLAND ELEVATION: KB: 9.6 GL: 48.0

WELL NAME: WEST SEAHORSE # 2 TOTAL DEPTH:

AGE		FORAM. ZONULES	HIGHEST DATA					LOWEST DATA				
			Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time	Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time
PLEISTOCENE		A_1										
		A_2										
PLIOCENE		A_3										
		A_4										
		B_1										
MIOCENE	LATE	B_2										
		C										
	MIDDLE	D_1										
		D_2										
		E_1										
		E_2										
	EARLY	F										
		G										
		H_1	1325.0	1				1333.9	1			
OLIGOCENE	LATE	H_2	1343.1	2				1343.1	2			
		I_1										
		I_2										
	EARLY	J_1	1351.5	2								
		J_2						1363.5	2			
EOCENE		K	1379.0	1				1379.0	1			
		Pre-K										

COMMENTS: Disconformity between top J and base H was apparent on lithology in SWC at 1351.5 as well as E-log characters, although no planktonic foraminifera were found in SWC 1351.5.

CONFIDENCE RATING:

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

NOTE: If an entry is given a 3 or 4 confidence rating, an alternative depth with a better confidence rating should be entered, if possible. If a sample cannot be assigned to one particular zone, then no entry should be made, unless a range of zones is given where the highest possible limit will appear in one zone and the lowest possible limit in another.

DATA RECORDED BY: *Paltech* Pty. Ltd. DATE: March 11th, 1982.

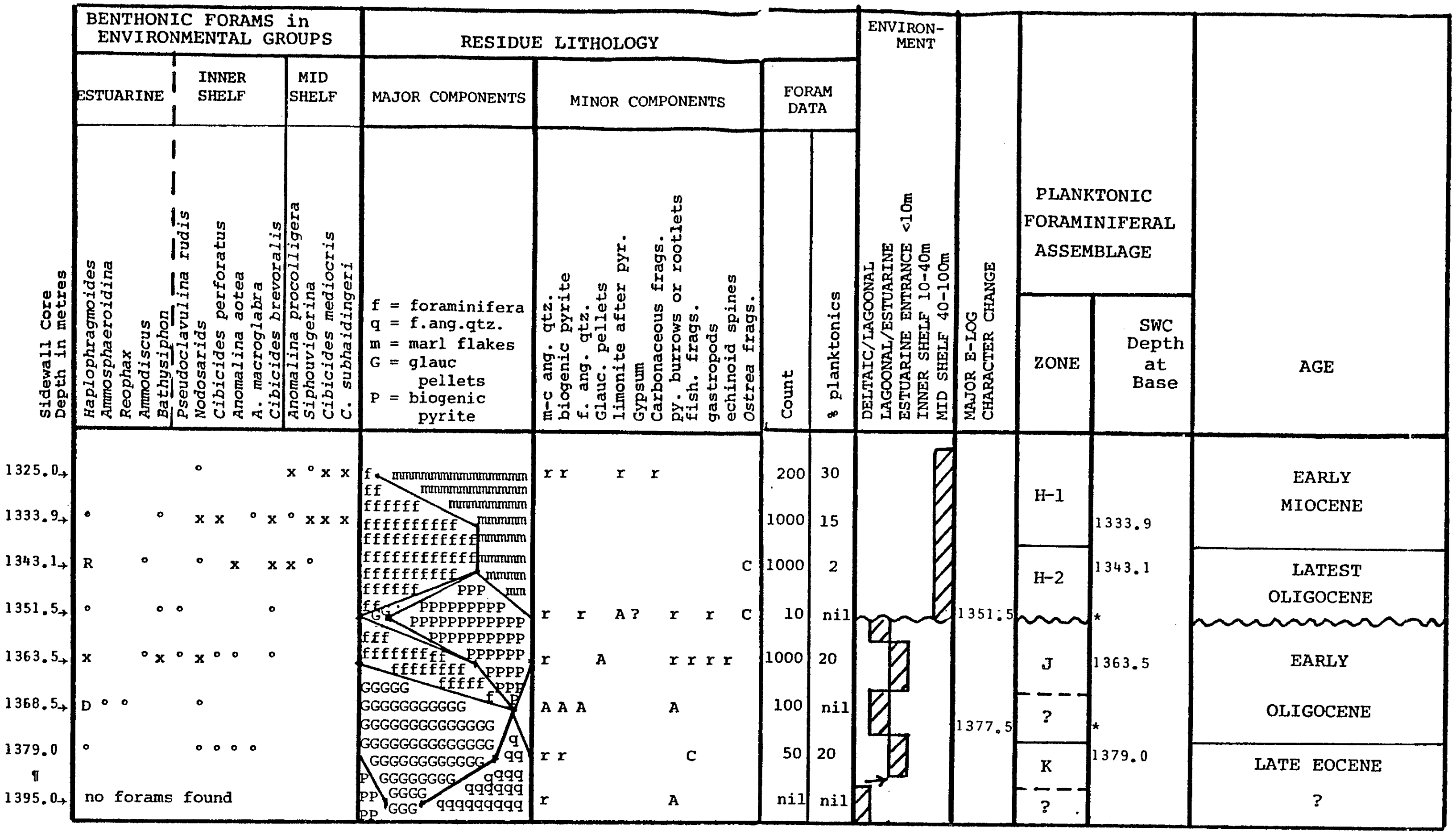
DATA REVISED BY: DATE:

SIDEWALL CORE Depth in metres	PLANKTONIC FORAMINIFERA													PLANKTONIC FORAMINIFERAL ASSEMBLAGE		
	G'ina linaperta	*G'ina angiporoides*	*G'alia gemma*	*G'alia munda*	*G'ina brevis*	*G'ina praebulloides*	*G'quad tripartita*	*G'ina woodi woodi*	*G'ina woodi connecta*	*G'alia continuosa*	*G'alia bella*	*G'alia zealandica*	*G'alia nana*	ZONE	SWC Depth at Base	AGE
1325.0→								x	x		°	°	°	H-1		EARLY MIOCENE
1333.9→						°		°	°	°					1333.9	
1343.1→						x		x						H-2	1343.1	LATEST OLIGOCENE
1351.5→	No planktonics seen														*	
1363.5→		x	°	°	?	x	°							J	1363.5	EARLY OLIGOCENE
1368.5→	No planktonics seen													?		
1379.0→	°	x	°											K	* 1379.0	LATE EOCENE
¶ 1395.0→	No foraminifera found													?		?

KEY: ° <20 specimens
x >20 specimens
? identification doubtful

¶ nil return at 1389.5
* see Table 2.

TABLE 1: PLANKTONIC FORAMINIFERAL DISTRIBUTION - WEST SEAHORSE # 2
PALTECH REPORT 1982/08



Sidewall Core Depth in metres	BENTHONIC FORAMS in ENVIRONMENTAL GROUPS: ESTUARINE: *Haplophragmoides*	*Ammosphaeroidina*	*Reophax*	*Ammodiscus*	*Bathysiphon*	INNER SHELF: *Pseudoclavulina rudis*	*Nodosarids*	*Cibicides perforatus*	*Anomalina aotea*	*A. macroglabra*	*Cibicides brevoralis*	MID SHELF: *Anomalina procolligera*	*Siphouvigerina*	*Cibicides mediocris*	*C. subhaidingeri*	RESIDUE LITHOLOGY: MAJOR COMPONENTS (f = foraminifera q = f.ang.qtz. m = marl flakes G = glauc pellets P = biogenic pyrite)	MINOR COMPONENTS: m-c ang. qtz.	biogenic pyrite	f. ang. qtz.	Glauc. pellets	limonite after pyr.	Gypsum	Carbonaceous frags.	py. burrows or rootlets	fish. frags.	gastropods	echinoid spines	*Ostrea* frags.	FORAM DATA: Count	% planktonics	ENVIRONMENT: DELTAIC/LAGOONAL, LAGOONAL/ESTUARINE, ESTUARINE ENTRANCE <10m, INNER SHELF 10-40m, MID SHELF 40-100m	MAJOR E-LOG CHARACTER CHANGE	PLANKTONIC FORAMINIFERAL ASSEMBLAGE: ZONE	SWC Depth at Base	AGE
1325.0→							°					x	°	x	x	f mmmmmmmmmmmmmmmmm ff mmmmmmmmmmmmmm ffffff mmmmmmmmmm	r	r			r		r						200	30			H-1		EARLY MIOCENE
1333.9→	•				°		x	x		°	x	°	x	x	x	ffffffffff mmmmmm ffffffffffff mmmmm													1000	15				1333.9	
1343.1→	R			°			°		x		x	x	°			ffffffffffff mmmmm ffffffffff mmmmm ffffff PPP mm												C	1000	2			H-2	1343.1	LATEST OLIGOCENE
1351.5→	°				°	°					°					ff G PPPPPPPPP PPPPPPPPPPPP fff PPPPPPPPPP	r		r		A?			r		r		C	10	nil		1351.5		*	
1363.5→	x			°	x	°	x	°	°		°					ffffffff ff PPPPPP ffffffff PPPP GGGGG fffff PPP	r			A				r	r	r	r		1000	20			J	1363.5	EARLY OLIGOCENE
1368.5→	D	°	°				°									GGGGGGGGGG f P GGGGGGGGGGGGG	A	A	A					A					100	nil		1377.5	?	*	
1379.0	°						°	°	°	°						GGGGGGGGGGGGG q GGGGGGGGGGGG qq	r	r							C				50	20			K	1379.0	LATE EOCENE
¶																P GGGGGGGG qqqq																			
1395.0→	no forams found															PP GGGG qqqqqq PP GGG qqqqqqqqq	r							A					nil	nil			?		?

KEY: ° <20 specimens
x >20 specimens
D >60% of total count
R reworked

¶ no return for SWC at 1389.5
* see E-log picks

r rare
C common <20 grains
A abundant - 1%-5% total grains
? origin doubtful

TABLE 2: SIGNIFICANT BENTHONIC FORAMINIFERAL DISTRIBUTION, RESIDUE LITHOLOGY & PALEOENVIRONMENTAL ASSESSMENT - WEST SEAHORSE # 2

PALTECH REPORT 1982/08

APPENDIX B3 PALYNOLOGY REPORT

WEST SEAHORSE NO. 2 WELL
GIPPSLAND BASIN

PALYNOLOGICAL EXAMINATION OF SIDEWALL CORES

by
W.K. HARRIS

PALYNOLOGICAL REPORT

Client : Hudbay Oil (Australia) Ltd.

Study : West Seahorse No. 2 Well

Aim : Determination of age and distribution of kerogen types.

INTRODUCTION

Thirty five sidewall cores from West Seahorse No. 2 Well drilled in the Basin at Lat. 38°12'21.78"S, Long. 147°36'38.44"E in Vic. P-11 were processed by normal palynological procedures.

The basis for the biostratigraphy and consequent age determinations are based on Stover & Partridge (1973) and Partridge (1976).

OBSERVATIONS AND INTERPRETATION

A. Biostratigraphy

Table I summarises the biostratigraphy and age determinations for the samples studied.

Preservation of the productive samples ranged from very poor to fair, and below 1772m most samples were barren. The lithologies in these samples were generally white to pale grey argillaceous sandstones. Throughout the well, assemblages were poorly diversified with very low yields. Many samples produced only one slide for examination.

Species identified in productive samples are listed in the Appendix.

1. ?L. balmei Zone: 1796-1968m
Assemblages from this interval were very poorly preserved and lacked sufficient diversity to be more confident of the zonal assignment. Species which suggest a correlation with the L. balmei zone include L. balmei and H. harrisii. However the low diversity, poor preservation and poor yields places some caution on this assignment. The assemblages are non-marine.

2. Malvacipollis diversus Zone: 1610-1772m
The recognition of this zone is based on the first appearance of Cupanieidites orthoteichus with Banksieaeidites arcuatus and Verrucosisporites kopukuensis and the absence of elements of the L. balmei zone such as L. balmei. Again the diversity of these assemblages is very low and no finer subdivision of this zone is possible on the evidence available. The assemblages are of non-marine aspect.

3. Nothofagidites asperus Zone: 1407-1457m
An increase in diversity and numerical representations of the Nothofagidites group is characteristic of this zone. In particular N. vansteenisi occurs consistently from 1457m upwards. Associated species include V. kopukuensis, T. adelaidensis and M. ornamentalis.

TABLE I

WEST SEAHORSE NO. 2

SUMMARY OF PALYNOLOGICAL DATA

Depth	SWC	Preservation	Diversity	Spore Pollen Zone	Confidence Levels	Environment
1403	51	barren	-	-	-	-
1407	50	fair	very low	?N. asperus	-	Non marine
1410	49	fair	very low	?N. asperus	-	Non marine
1411	48	barren	-	-	-	-
1412	47	fair	very low	N. asperus	-	Non marine
1413	46	barren	-	-	-	-
1427.5	40	fair	very low	?N. asperus	-	Non marine
1431	38	fair	very low	?N. asperus	-	Non marine
1433	36	fair	very low	?N. asperus	-	Non marine
1434.9	34	fair	very low	?N. asperus	-	Non marine
1436	33	fair	very low	?N. asperus	-	Non marine
1438	32	fair	very low	N. asperus	5	Non marine
1449	30	fair	very low	N. asperus	4	Non marine
1457	29	fair	very low	N. asperus	4	Non marine
1512	27	barren	-	-	-	-
1610	24	fair	very low	M. diversus	4	Non marine
1640	23	fair	very low	M. diversus	5	Non marine
1645	22	fair	very low	M. diversus	4	Non marine
1687	21	barren	-	-	-	-
1772	20	fair	very low	M. diversus	4	Non marine
1786	18	barren	-	-	-	-
1796	17	v. poor	very low	?L. balmei	3	Non marine
1803	16	barren	-	-	-	-
1811	15	barren	-	-	-	-
1826	14	barren	-	-	-	-
1841	13	barren	-	-	-	-
1844	12	v. poor	very low	?L. balmei	-	Non marine
1850	11	barren	-	-	-	-
1861	10	v. poor	very low	?L. balmei	-	Non marine
1949	7	barren	-	-	-	-
1936	8	barren	-	-	-	-
1968	6	v. poor	very low	?. L. balmei	-	Non marine
1985	4	barren	-	-	-	-
2007	3	barren	-	-	-	-
2022	2	barren	-	-	-	-

TABLE II

MATURATION LEVELS, Bujak et al. 1977

CATEGORIES	ORGANIC COMPONENTS		OIL	GAS CONDENSATE	THERMALLY DERIVED METHANE
			TAI	TAI	TAI
HYLOGEN	NON-OPAQUE FIBROUS PLANT MATERIAL OF WOODY ORIGIN }	TRACHEIDS VESSELS	>2→3 (2.5-2.9)	>2→≥3 (2.3-3.2)	2→4
PHYROGEN	NON-OPAQUE NON-WOODY ORIGIN }	SPORES POLLEN ALGAE ACRITARCHS CUTICLES	>2→3 (2.2→3)	2→<3+	$>2^{-}\rightarrow 4$
AMORPHOGEN	STRUCTURELESS ORGANIC MATTER }	FINELY DISSEMINATED or COAGULATED FLUFFY MASSES	2→<3+	2→3+	3+→5
MELANOGEN	OPAQUE ORGANIC DEBRIS		-	2+→<3	2.5-4

Notes: (1) Hylogen, Phyrogen, Melanogen 4→5: Traces of Dry Gas and Co$_2$

(2) Hylogen, Phyrogen, Melanogen 1→2: Biogenic methane (Marsh gas).

TAI (Thermal Alteration Index):

1+, 2-, 2 - YELLOWS
2, 2+, 3, 4 - BROWNS
4-, 5 - BLACK

TABLE III
WEST SEAHORSE NO. 2
SUMMARY OF KEROGEN DATA

DEPTH	SWC	TOM	PHYRO	AMORPO	HYLO	MELANO	TAI
1403	51	very low	5	5	-	90	ND
1407	50	very low	10	10	-	80	1+
1410	49	very low	30	10	-	60	-
1411	48	very low	10	10	Tr	80	-
1412	47	very low	30	10	-	60	1+
1413	46	very low	5	15	Tr	80	ND
1427.5	40	very low	30	5	5	60	1+
1431	38	very low	5	15	Tr	80	1+
1433	36	low	5	15	Tr	80	-
1434.9	34	low	10	-	Tr	90	-
1436	33	low	10	20	10	60	-
1438	32	low	20	10	Tr	70	2-
1449	30	low	30	10	Tr	60	2-
1457	29	moderate	60	10	10	20	2-
1512	27	barren	-	-	-	-	-
1610	24	very low	45	5	5	45	2-
1640	23	very low	80	5	-	15	2-
1645	22	moderate	50	15	-	35	2-
1687	21	barren	-	-	-	-	-
1772	20	moderate	70	-	-	30	2-
1786	18	barren	-	-	-	-	-
1796	17	low	80	5	-	15	2-
1803	16	barren	-	-	-	-	-
1811	15	barren	-	-	-	-	-
1826	14	barren	-	-	-	-	-
1841	13	barren	-	-	-	-	-
1844	12	low	20	10	-	70	2-
1850	11	barren	-	-	-	-	-
1861	10	very low	15	-	-	85	2-
1949	7	barren	-	-	-	-	-
1936	8	barren	-	-	-	-	-
1968	6	very low	20	15	-	65	ND
1985	4	barren	-	-	-	-	-
2007	3	barren	-	-	-	-	-
2022	2	barren	-	-	-	-	-

In many of the samples species numbers and diversity is extremely low and samples are tentatively allocated to this zone. However no elements of the younger Proteacidites tuberculatus zone have been recorded, and these assemblages are no older than N. asperus Zone. No finer subdivision is possible because of those same reasons. The assemblages have been entirely derived from a terrestrial source.

B. Kerogen types and spore colouration

During routine palynological processing of sidewall cores an unoxidised kerogen sample was taken and the nature of the kerogens and spore colouration are documented in Table III. Spore colour is expressed as the "Thermal Alteration Index" (TAI) of Staplin (1969) according to the scale in Table II.

Total organic matter (TOM) is expressed semi-quantitatively in the scale-abundant, moderate, low, very low, barren. Samples classed as having abundant or moderate amounts of TOM would be expected to have TOC's (total organic content) greater than 1%.

In this report four classes of organic matter are recognised - amorphogen, phyrogen, hylogen and melanogen and these terms are more or less synonymous with amorphous, herbaceous, woody, and coaly. For reasons as outlined by Bujak et al. (1977) the former terms are preferred because they do not have a botanical connotation. The thermal alteration index scale follows that of Staplin (1969) and as outlined by Bujak et al. (1977). At a TAI of 2+ all four types of organic material contributed to hydrocarbon generation whereas at a TAI of 2, only amorphogen forms liquid hydrocarbons. The upper boundary defining the oil window is at a TAI of approximately 3 but varies according to the organic type. Above TAI 3+ all organic types only have a potential for thermally derived methane.

Total organic matter in samples from West Seahorse No. 2 Well is generally very low with TAI's less than two. Consequently the samples are considered immature for the generation of hydrocarbons and together with their very low organic matter content are believed to be poor potential source rocks.

REFERENCES

Partridge, A.D., 1976: The Geological Expression of Eustacy in the Early Tertiary of the Gippsland Basin. J. Aust. Petrol. Expl. Assoc., 16: 73-79

Staplin, F.L., 1969: Sedimentary Organic Matter, Organic Metamorphism and Oil and Gas Occurrence. Bull. Can. Pet. Geol., 17: 47-66.

Stover, L.E. & Partridge, A.D., 1973: Tertiary and Late Cretaceous Spores and Pollen from the Gippsland Basin, southeastern Australia. Proc. R. Soc. Vict., 85: 237-286.

W.K. Harris
Consulting Geologist

1 March 1983

APPENDIX

WEST SEAHORSE NO. 2 WELL

Depth	Species Listing
1407m	Haloragacidites harrisii Laevigatosporites cf. major Nothofagidites brachyspinulosus N. emarcidus/heterus N. vansteenisii Podocarpidites sp. Phyllocladidites mawsonii Proteacidites sp. Verrucosisporites kopukuensis
1410m	Haloragacidites harrisii Malvacipollis diversus Nothofagidites emarcidus/heterus N. vansteenisii Podocarpidites sp. Phyllocladidites mawsonii Proteacidites sp. Tricolporites adelaidensis
1412m	Cyathidites sp. Haloragacidites harrisii Lygistepollenites florinii Nothofagidites emarcidus/heterus N. flemingii N. vansteenisii Periporopollenites demarcatus Phyllocladidites mawsonii Podocarpidites sp. Proteacidites sp. P. recavus Tricolporites sp.
1427.5m	Cyathidites sp. Gleicheniidites circinidites Malvacipollis diversus Phyllocladidites mawsonii
1431m	Haloragacidites harrisi Nothofagidites emarcidus/heterus N. flemingii Phyllocladidites mawsonii Proteacidites sp. Tricolporites sp.
1433m	Cyathidites sp. Haloragacidites harrisi Malvacipollis diversus Nothofagidites emarcidus/heterus Podocarpidites sp. Phyllocladidites mawsonii

1434.9m	Cupanieidites orthoteichus Gleicheniidites circinidites Haloragacidites harrisii Lygistepollenites florinii Nothofagidites brachyspinulosus N. emarcidus/heterus Phyllocladidites mawsonii Tricolporites adelaidensis
1436m	Beaupreaidites elegansiformis Cyathidites sp. Haloragacidites harrisii Nothofagidites brachyspinulosus Phyllocladidtes mawsonii Tricolporites adelaidensis Verrucosisporites kopukuensis
1438m	Haloragacidites harrisii Malvacipollis diversus Matonisporites ornamentalis Nothofagidites asperus N. emarcidus/heterus Phyllocladidites mawsonii Polypodiidites sp. Proteacidites sp. Tricolporites adelaidensis Verrucosisporites kopukuensis
1449m	Dictyophyllidites sp. Haloragacidites harrisii Laevigatosporites cf. major Malvacipollis diversus Nothofagidites emarcidus/heterus N. flemingii N. vansteenisii Periporopollenites vesicus Podocarpidites sp. Proteacidites sp.
1457	Dilwynites granulatus Haloragacidites harrisii Ilexpollenites anguloclavatus Laevigatosporites cf. major Nothofagidites emarcidus/heterus Nothofagidites vansteenisii Podocarpidites sp. Proteacidites sp. Sapotaceoidaepollenites rotundus Tricolporites adelaidensis T. sphaerica
1610m	Cupanieidites orthoteichus Cyathidites sp. Haloragacidites harrisii Malvacipollis diversus Nothofagidites emarcidus/heterus

	Podocarpidites sp. Proteacidites kopiensis P. latrobensis Tricolporites scabratus Verrucosisporites sp.
1640m	Anacolosidites luteoides Cyathidites sp. Dictyophyllidites sp. Haloragacidites harrisii Liliacidites sp. Lygistepollenites florinii Malvacipollis diversus Myrtaceidites parvus/mesonesus Podocarpidites sp. Proteacidites sp. P. annularis P. kopiensis P. leightonii Stereisporites antiquisporites
1645m	Banksieacidites arcuatus Clavifera triplex Cupanieidites orthoteichus Cyathidites sp. Dilwynites granulatus Haloragacidites harrisii Intratriporopollenites notabilis Ischyosporites gremius Lygistepollenites florinii Malvacipollis diversus Nothofagidites flemingii Podosporites sp. Periporopollenites cf. demarcatus Podocarpidites sp. Polycolpites esobalteus Proteacidites sp. P. annularis Simplicepollis meridianus Stereisporites (Tripunctisporis) punctatus
1772m	Cyathidites australis Podocarpidites sp. Phyllocladites mawsonii Polycolpites cf. esobalteus Proteacidites sp. P. cf. incurvatus Rugulatisporites mallatus Verrucosisporites kopukuensis
1796m	Clavifera triplex Laevigatosporites major Podocarpidites sp. Proteacidites sp.
1844m	Lygistepollenites balmei Podocarpidites sp.

	Phyllocladidites mawsonii Proteacidites sp. (aff. parvus)
1861m	Cyathidites splendens Haloragacidites harrisii Lygistepollenites balmei Phyllocladidites mawsonii Proteacidites sp. indet.
1968m	Nothofagidites aff. emarcidus/heterus Phyllocladidites mawsonii Podocarpidites sp. Proteacidites cf. parvus

APPENDIX B4

WIRELINE LOG
INTERPRETATION

(REFER TO ACCOMPANYING REPORT) PE905515

APPENDIX B5 CORE ANALYSES

SPECIAL CORE ANALYSIS STUDY
FOR
HUDBAY OIL (AUSTRALIA) LIMITED
WELL: WEST SEAHORSE 2

24A LIM TECK BOO ROAD, SINGAPORE 1953. TELEX: RS21423 TEL: 282 1222

CORE LABORATORIES
Special Core Analysis

Hudbay Oil (Australia) Limited
245 Adelaide Terrace
Perth
West Australia

ATTENTION: MR. E M L TUCKER

Subject: Special Core Analysis
Well : West Seahorse 2
File : 304-82006

1st October 1982

Gentlemen,

In a letter dated 11 February, 1982, Mr. E M L Tucker of Hudbay Oil (Australia) Ltd requested Core Laboratories to perform formation factor measurements by a salinity reversal method on core samples from the subject well.

After the high cost and slow turnaround time using a salinity reversal method had been explained (our tlx. no. 9444 dated 16 March 1982), Mr. Tucker agreed to our suggestion of using a concentrated saturant brine for the formation factor measurements together with cation exchange capacity measurements. Some samples were to be tested using the salinity reversal technique upon conclusion of the above measurements (information sent via our Perth office in a telex dated 22 March 1982).

Thirty-six one-and-one-half-inch diameter plug-size samples preserved in plastic wrap, aluminium foil and seal peel were despatched from our Perth office for use in this study. All samples were cleaned in cool solvents to remove residual pore fluids and oven-dried at 60°C. Measurements of helium injection porosity and permeability to air were made and the results are presented on pages 1 through 3 together with brief lithological sample descriptions.

Formation Resistivity Factor (pages 4 through 6)

The clean, dry samples were evacuated and pressure saturated using a simulated formation brine of 200,000 ppm concentration. The constituents of this brine comprised 80% sodium chloride, 10% calcium chloride and 10% potassium chloride since a detailed brine analysis was not available. A highly concentrated saturant was used to minimise the risk of sample failure due to excessive clay swelling.

Electrical resistivities of the brine saturated samples and the saturant brine were measured on consecutive days until readings became stable indicating ionic equilibrium within the samples. Values of formation factor were then calculated and results are presented in tabular form on pages 4 and 5, and graphically on page 6. The composite plot yields an average cementation exponent, "m", of 1.75 with an intercept, "a", of 1.00.

Cont'd....

Cation Exchange Capacity (pages 4 and 5)

The trimmed ends of the plug samples were retained for these measurements which were performed utilising the ammonium-acetate wet-chemistry technique.

Results are presented in tabular form on pages 4 and 5 together with other data necessary for use in Waxman, Smits and Thomas equations to calculate values of F* and m*.

Example calculations of F* are given on page 7 for the four samples later used for the salinity reversal technique.

Formation Factor Using Salinity Reversal (pages 8 through 13)

Upon conclusion of room condition formation factor measurements, four samples (nos. 4, 23, 28, 31) were loaded in a hydrostatic core holder and their electrical resistivities measured at an effective overburden pressure of 200 psi. Porosity reduction was calculated by monitoring brine displacement. Formation factor values were calculated with the original 200,000 ppm saturant in place, and then after flowing 2,000 ppm 30,000 ppm, 200,000 ppm, 30,000 ppm and 2,000 ppm, brines through the samples and allowing readings to equilibriate with each brine present. The constituents of each brine comprised 80% sodium chloride, 10% calcium chloride and 10% potassium chloride. Results are presented in tabular form on page 8 and F* values have been calculated using a method suggested by Hoyer and Spann utilising Co versus Cw plots (pages 9 through 12).

A comparison of F* values calculated using Waxman-Smits and Hoyer-Spann methods is given on page 13. It should be noted that F* values calculated using Waxman-Smits methods are calculated from data generated for the four samples at overburden conditions (with the original saturant 200,000 ppm brine in place) to afford direct comparison to data generated by the salinity reversal technique. The salinity reversal procedure was performed at overburden conditions to minimise the risk of clay swelling causing sample failure in the presence of fresh brine.

Also compared on page 14 are the BQv values derived via Waxman, Smits and Thomas equations utilising cation exchange capacity and grain density measurements, and the BQv values derived from the Co vs Cw plots of the Hoyer-Spann method where the intercept of the best-fit line on the X-axis is equivalent to BQv.

Cont'd....

Due to the high cost, slow turnaround time and favourable comparison with data generated by Waxman-Smits method, the salinity reversal measurements were limited to the four samples only, which were chosen principally to cover the lithology range in terms of clay material present.

From the F* values one can back-calculate the Ro values to be expected at reservoir conditions following the equations given on page 14.

It has been a pleasure to conduct this study for Hudbay, and we look forward to being of service in the future.

Yours faithfully,
CORE LABORATORIES INTERNATIONAL LTD

TONY KENNAIRD
Manager - Core Analysis Services

Encl

TK/aa

TABLE OF CONTENTS

IDENTIFICATION AND DESCRIPTION OF SAMPLES

Company : Hudbay Oil(Australia) Ltd
Well : West Seahorse 2
Formation:
Field:
Country : Australia

Sample I.D.	Depth, Metres	Permeability to Air millidarcys	Porosity, per cent	Lithological Description
1	1424.04	48	20.4	SST:lt gry, vf-f gr, wl cmt, sbrndd-sbang, mod-p srt, abd carb/arg lams.
2	1424.42	0.64	13.2	SST:gry, vf gr, wl cmt, sbrndd-sbang, mod srt, abd carb/arg lams.
3	1424.57	10	21.4	SST:lt gry/lt brn, vf-f gr, wl cmt, sbrndd-sbang, mod srt, abd carb/arg lams and strks.
4	1425.07	3.5	13.1	SST:gry, vf gr, wl cmt, sbrndd-sbang, mod srt, abd carb/arg lams.
5	1425.35	12	17.3	A A
6	1425.77	9.5	19.8	A A
7	1426.01	1.8	14.8	A A
8	1427.30	1.5	5.7	A A
9	1427.82	0.88	5.5	A A
10	1428.15	3.7	18.2	A A
11	1440.68	1.4	16.4	A A
12	1440.90	5.0	19.8	A A

Cont'd....

Sample I.D.	Depth, Metres	Permeability to Air, millidarcys	Porosity, per cent	Lithological Description
13	1441.16	0.18	6.5	SST:gry/brn, vf gr, wl cmt, sbrndd-sbang, mod-p srt abd carb/arg lams, occ crs gr qtz incl, sl Fe.
14	1441.40	0.05	2.8	A A
15	1441.67	0.04	3.3	A A
16	1441.98	0.05	2.6	A A
17	1442.25	0.03	2.9	A A
18	1442.49	0.04	5.0	A A
19	1442.71	0.04	6.4	A A
20	1442.98	2.6	13.8	SST:gry/brn, f-crs gr, wl cmtd, sbang, p srt, abd arg, carb, lams.
21	1443.29	3.5	15.8	SST:gry/brn, f-vf gr, wl cmt, sbang, mod srt, abd carb/arg lams.
22	1443.63	79	21.8	SST:gry/brn, f gr, wl cmt, sbrndd-sbang, mod-wl srt, arg/carb lams.
23	1443.91	206	25.9	SST:gry, f-m gr, wl cmt, sbrndd-sbang, wl srt, occ arg/carb strks.
24	1444.17	3.9	16.8	SST:gry/brn, f gr, wl cmt, sbang, p srt, abd arg/carb lams.
25	1444.47	2.8	16.0	A A
26	1444.73	3.7	15.0	A A
27	1444.98	76	21.3	SST:gry/brn, f-m gr, wl cmt, sbang, mod srt, occ arg/carb lams.
28	1445.25	106	23.4	A A

Cont'd....

Sample I.D.	Depth, Metres	Permeability to Air, millidarcys	Porosity, per cent	Lithological Description
29	1445.64	729	25.8	SST:brn, m-crs gr, mod cmt, sbang, wl srt.
30	1445.90	761	25.1	A A
31	1446.19	495	22.4	SST:gry, m-crs gr, mod cmt, sbang, wl srt, sl carb.
32	1446.44	168	21.6	SST:brn, m gr, mod-wl cmt, sbrndd-sbang, wl srt, carb/arg lams.
33	1446.77	242	24.8	A A
34	1447.35	85	23.1	SST:brn, f-m gr, wl cmt, sbrndd-sbang, wl srt, carb/arg lams.
35	1447.62	13	19.3	SST:gry/brn, f gr, wl cmt, sbrndd-sbang, abd carb/arg lams.
36	1447.92	3.2	16.0	A A

ELECTRICAL RESISTIVITY AND CATION EXCHANGE CAPACITY DATA

Company : Hudbay Oil (Australia) Ltd
Formation:
Country : Australia

Well : West Seahorse 2
Field:

Resistivity of Saturant Brine, Ohm-metres: 0.047 at 72°F*

Sample Number	Porosity Per Cent	Grain Density gm/cc	Cation Exchange Capacity Meq/100gms	Core Resistivity Ro	Formation Factor	Cementation** Exponent m
1	20.4	2.58	2.07	0.667	14.2	1.67
2	13.2	2.57	2.75	1.462	31.1	1.70
3	21.4	2.62	1.53	0.667	14.2	1.72
4	13.1	2.45	3.40	1.622	34.5	1.74
5	17.3	2.52	2.98	1.213	25.8	1.85
6	19.8	2.57	1.59	0.860	18.3	1.79
7	14.8	2.50	2.45	1.523	32.4	1.82
8	5.7	2.62	1.10	8.211	174.7	1.80
9	5.5	2.63	1.86	7.135	151.8	1.73
10	18.2	2.51	2.28	0.893	19.0	1.73
11	16.4	2.63	1.54	1.039	22.1	1.71
12	19.8	2.64	1.31	0.710	15.1	1.68
13	6.5	2.68	1.18	6.213	132.2	1.79
14	2.8	2.69	2.19	24.224	515.4	1.75
15	3.3	2.68	2.01	18.386	391.2	1.75
16	2.6	2.70	1.10	30.014	638.6	1.77
17	2.9	2.69	1.89	25.056	533.1	1.77
18	5.0	2.67	1.31	10.279	218.7	1.80
19	6.4	2.65	1.07	6.091	129.6	1.77
20	13.8	2.60	1.87	1.443	30.7	1.73
21	15.8	2.55	2.53	1.147	24.4	1.73

* Temperature at which Ro measurements made
** Assuming intercept "a" is unity.

ELECTRICAL RESISTIVITY AND CATION EXCHANGE CAPACITY DATA

Company : Hudbay Oil (Australia) Ltd
Formation:
Country : Australia

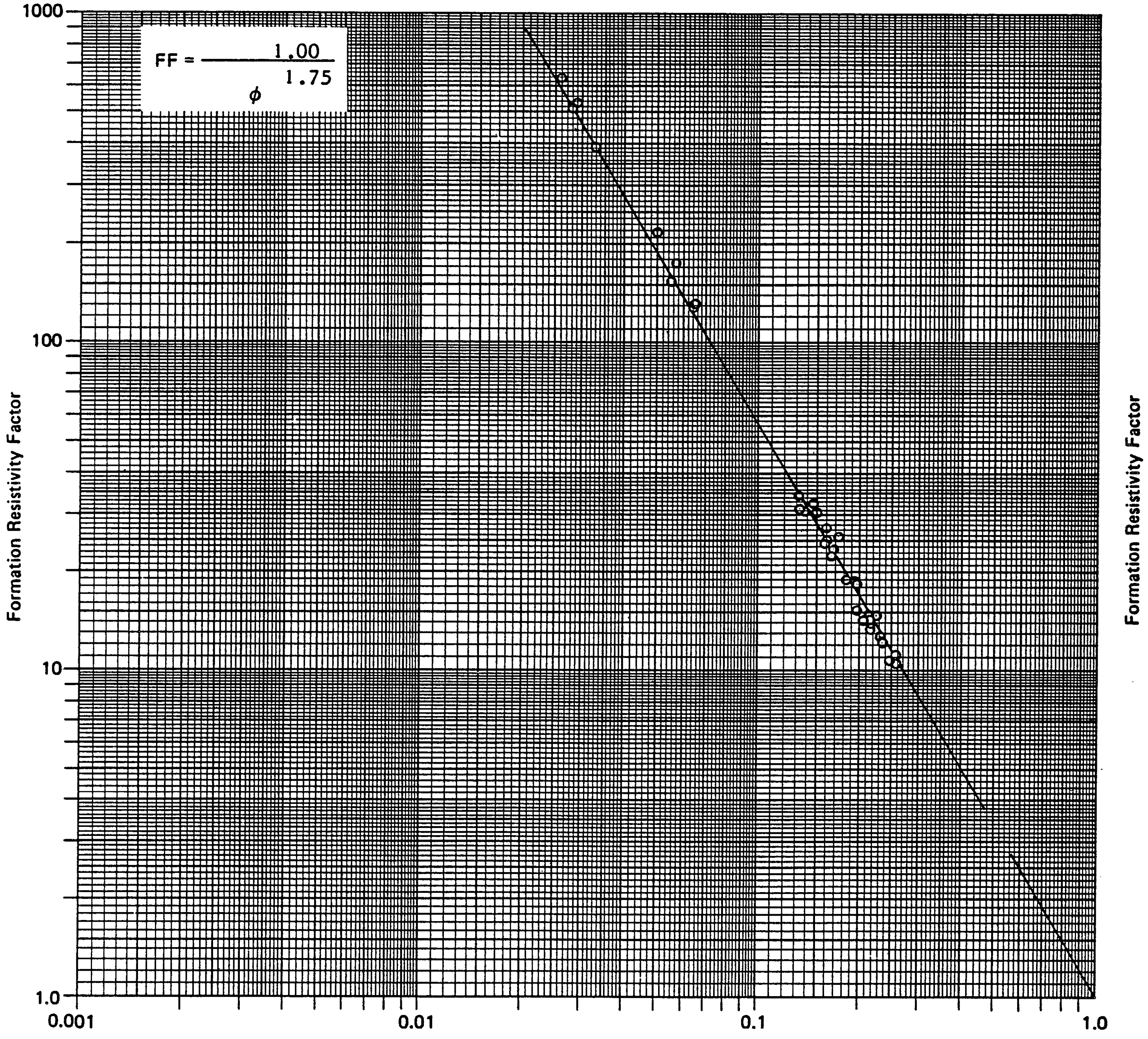
Well : West Seahorse 2
Field:

Resistivity of Saturant Brine, Ohm-metres: 0.047 at 72°F*

Sample Number	Porosity Per Cent	Grain Density gm/cc	Cation Exchange Capacity Meq/100gms	Core Resistivity Ro	Formation Factor	Cementation** Exponent m
22	21.8	2.62	1.09	0.658	14.0	1.73
23	25.9	2.64	0.76	0.494	10.5	1.74
24	16.8	2.62	1.32	1.109	23.6	1.77
25	16.0	2.61	1.00	1.170	24.9	1.75
26	15.0	2.60	1.96	1.424	30.3	1.80
27	21.3	2.65	1.22	0.696	14.8	1.74
28	23.4	2.65	1.53	0.573	12.2	1.72
29	25.8	2.64	0.85	0.520	11.1	1.77
30	25.1	2.66	1.64	0.508	10.8	1.72
31	22.4	2.65	1.57	0.691	14.7	1.80
32	21.6	2.64	1.16	0.630	13.4	1.69
33	24.8	2.64	1.05	0.503	10.7	1.70
34	23.1	2.64	1.69	0.602	12.8	1.74
35	19.3	2.61	1.75	0.888	18.9	1.79
36	16.0	2.59	1.93	1.278	27.2	1.80

* Temperature at which Ro measurements made
** Assuming intercept "a" is unity

Company HUDBAY OIL (AUSTRALIA) LTD
Well WEST SEAHORSE 2
Field
Formation
Country AUSTRALIA



Porosity, Fraction

CALCULATION OF F* USING EQUATIONS DEVELOPED BY WAXMAN-SMITS AND THOMAS

1) $F^* = F (1 + R_w B Q_v)$

2) $Q_v = \frac{CEC (1 - \phi) GD}{100 \times \phi}$

Sample No.	Ø(1)	GD(2)	CEC(3)	B(4)	Ro(5)	Rw(6)	F(7)	F*
4	12.7	2.45	3.40	3.33	2.468	0.047	52.5	57.2
23	25.6	2.64	0.76	3.33	0.620	0.047	13.2	13.3
28	23.0	2.65	1.53	3.33	0.757	0.047	16.1	16.4
31	21.8	2.65	1.57	3.33	0.785	0.047	16.7	17.1

(1) Porosity. Measured at overburden confining conditions.

(2) Grain Density.

(3) Cation Exchange Capacity.

(4) B which is derived from charts developed by Waxman-Smits. The value above is taken at the temperature at which room condition measurements were made - 72°F.

(5) Resistivity of 100% saturated core - at 72°F.

(6) Resistivity of saturant brine - at 72°F.

(7) Formation factor. Measured at overburden confining conditions.

CALCULATION OF F* BY HOYER AND SPANN METHOD

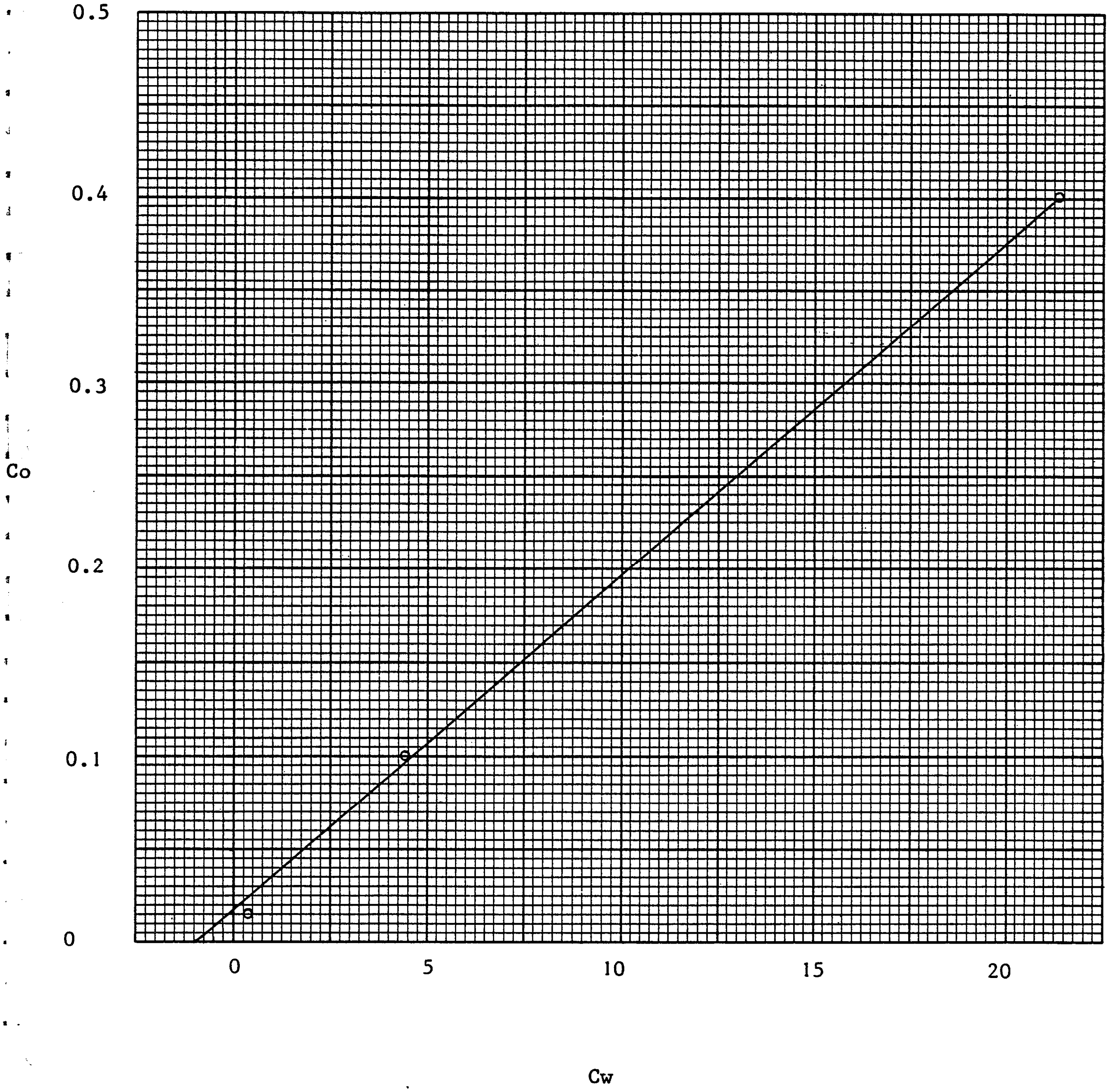
Plot Co vs. Cw at various salinities
Draw best-fit line (please see attached graphs)
Slope of best-fit line= $\frac{1}{F^*}$
(Incidentally intercept on X-axis is equivalent to the term BQv from Waxman-Smits).

ppm Salinity	Ro	Rw	Co	Cw	F	F*
SAMPLE NO. 4						
2,000	67.166	2.846	0.0149	0.351	23.6	55.6
30,000	9.988	0.227	0.100	4.41	44.0	
200,000	2.491	0.047	0.401	21.3	53.0	
30,000	9.806	0.227	0.102	4.41	43.2	
2,000	65.458	2.846	0.0153	0.351	23.0	
SAMPLE NO. 23						
2,000	29.883	2.846	0.0335	0.351	10.5	13.6
30,000	2.656	0.227	0.376	4.41	11.7	
200,000	0.631	0.047	1.585	21.3	13.4	
30,000	2.679	0.227	0.361	4.41	11.8	
2,000	29.598	2.846	0.0338	0.351	10.4	
SAMPLE NO. 28						
2,000	30.168	2.846	0.331	0.351	10.6	16.4
30,000	3.201	0.227	0.312	4.41	14.1	
200,000	0.755	0.047	1.325	21.3	16.1	
30,000	3.210	0.227	0.312	4.41	14.1	
2,000	30.452	2.846	0.0328	0.351	10.7	
SAMPLE NO. 31						
2,000	38.706	2.846	0.0258	0.351	13.6	16.8
30,000	3.609	0.227	0.277	4.41	15.9	
200,000	0.780	0.047	1.282	21.3	16.6	
30,000	3.605	0.227	0.277	4.41	15.9	
2,000	38.602	2.846	0.0259	0.351	13.6	

All electrical measurements reported at 72°F.

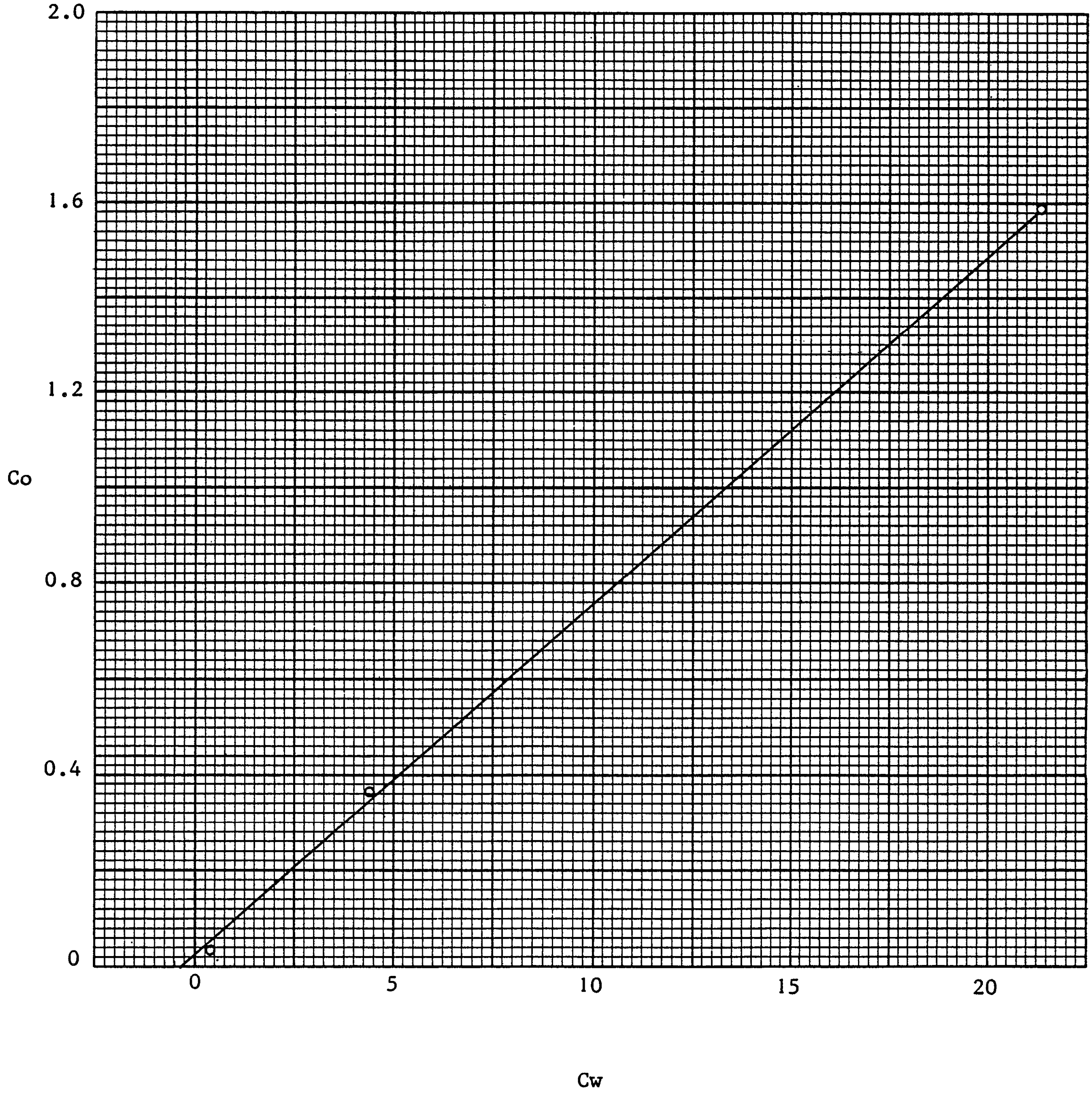
Company HUDBAY OIL (AUSTRALIA) LTD
Well WEST SEAHORSE 2
Field
Formation
Country AUSTRALIA

SAMPLE NUMBER : 4



Company HUDBAY OIL (AUSTRALIA) LTD
Formation
Well WEST SEAHORSE 2
Country AUSTRALIA
Field

SAMPLE NUMBER: 23



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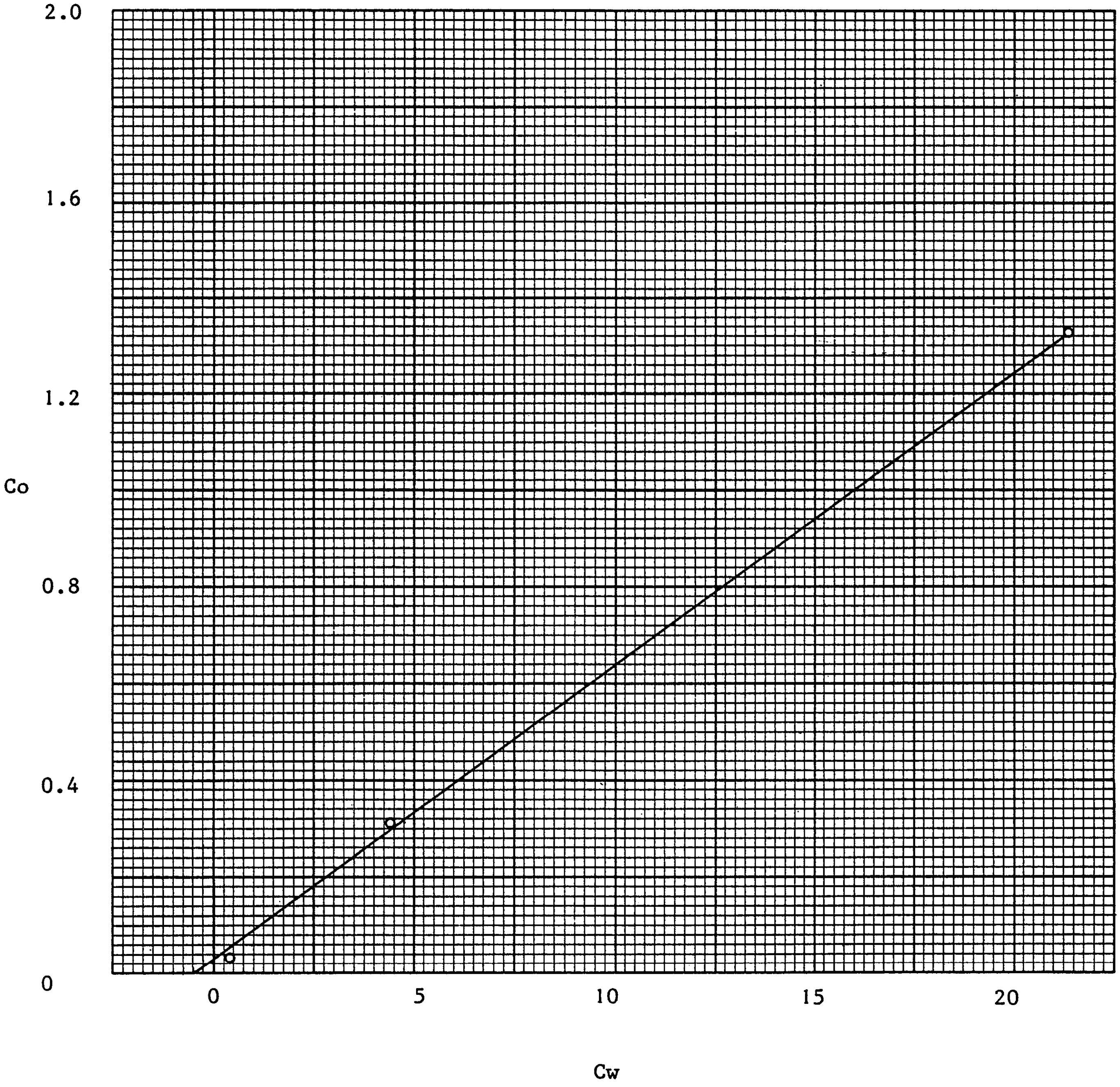
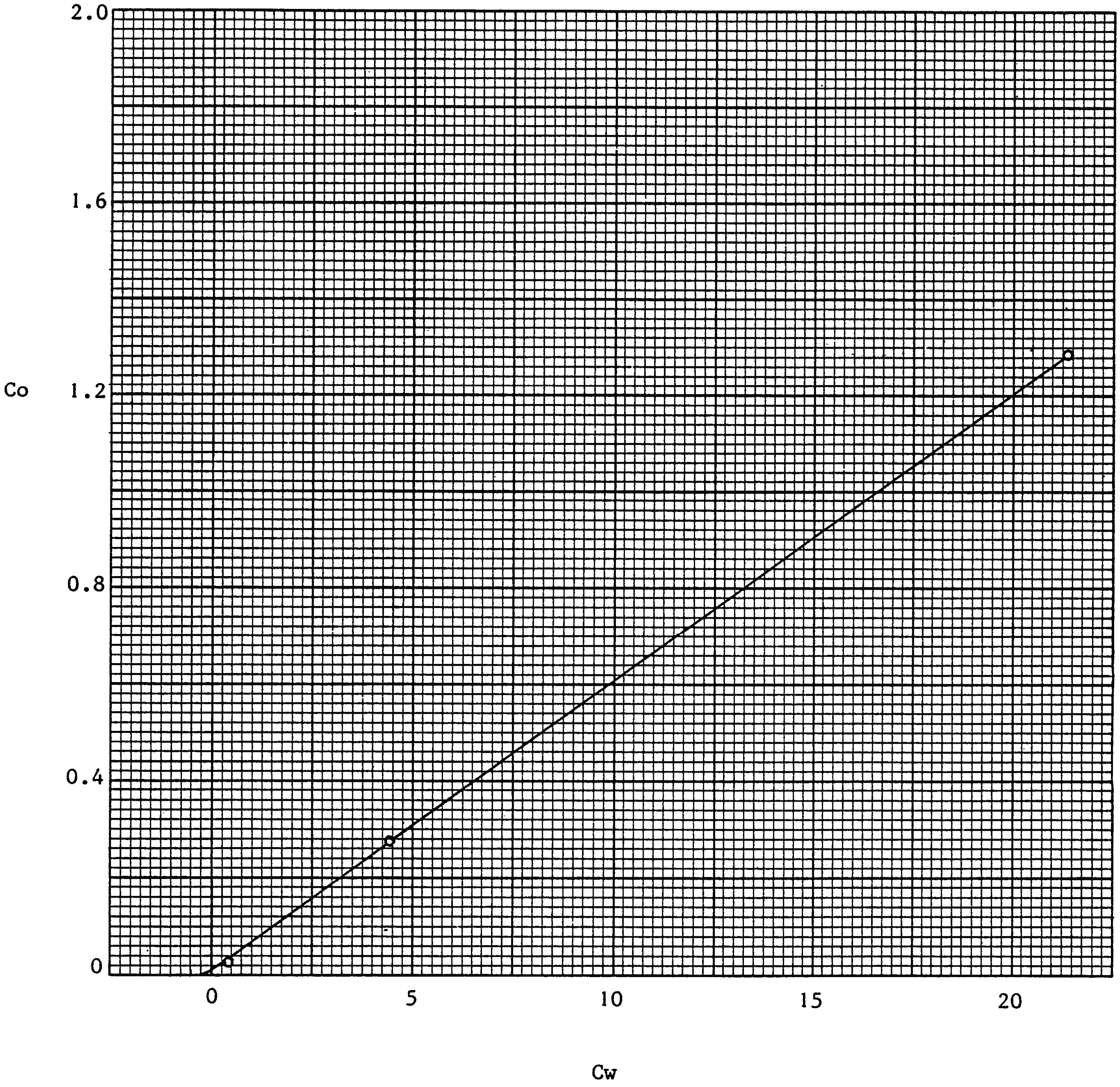
Well WEST SEAHORSE 2
Field
Formation
Country AUSTRALIA

SAMPLE NUMBER : 28



Company HUDBAY OIL (AUSTRALIA) LTD
Formation
Well WEST SEAHORSE 2
Country AUSTRALIA
Field

SAMPLE NUMBER: 31



COMPARISON OF F* VALUES DERIVED BY WAXMAN-SMITS AND HOYER-SPANN METHODS

Sample Number	F*		BQv	
	W-S	H-S	W-S	H-S
4	57.2	55.6	1.908	1.00
23	13.3	13.6	0.193	0.26
28	16.4	16.4	0.453	0.45
31	17.1	16.8	0.496	0.20

W-S Waxman-Smits
H-S Hoyer and Spann

CALCULATION OF Ro AT RESERVOIR CONDITIONS FROM F*

1) $$F = \frac{F^*}{(1 + Rw\ B\ Qv)}$$

Where;

Rw - Value at reservoir temperature.

B - read from charts at reservoir salinity and temperature.

Then:-

2) $$\underset{\text{(Reservoir conditions)}}{Ro} = \underset{\text{(Reservoir conditions)}}{F \times Rw}$$

HUDBAY OIL (AUST) LTD

WEST SEAHORSE NO. 2

PETROLEUM RESERVOIR ENGINEERING · RESEARCH · FIELD SERVICES

CORE LAB

CORE LABORATORIES AUSTRALIA (Q.LD.) LTD.

4/126 RADIUM STREET, WELSHPOOL PERTH,
WESTERN AUSTRALIA 6106
TELEPHONE: 451 3088 TELEX: CORLAB AA94706
CABLES: CORELAB PERTH

APPENDIX B6 GEOCHEMICAL REPORTS

GEOCHEMICAL EVALUATION OF ONE CORE AND ONE RFT TEST FROM WEST SEAHORSE #2

G.W. WOODHOUSE

Petroleum Geochemistry Group
School of Applied Chemistry
W.A. Institute of Technology
Kent Street
BENTLEY WA 6102

April, 1982

CONTENTS

TABULATED DATA

GRAVITY AND SULPHUR DATA

OILNAME	API GRAVITY (deg)	% SULPHUR (w/w)
WEST SEAHORSE NO.2	38.0	0.69

COMPOSITIONAL DATA

OILNAME	%SAT	%AROM	%NSO	PRIST/PHYT	PRIST/NC17	PHYT/NC18	PAP	AROM/SAT	CPI(1)	CPI(2)	21+22/28+29
WEST SEAHORSE NO.2	76.1	17.7	6.2	5.86	4.59	.24	nd	0.23	1.19	1.15	3.2

N-ALKANE DISTRIBUTIONS

OILNAME	CN12	CN13	CN14	CN15	CN16	CN17	CN18	CN19	CN20	CN21	CN22	CN23	CN24	CN25	CN26	CN27	CN28	CN29	CN30	CN31
WEST SEAHORSE NO.2	0.0	0.0	0.0	0.0	0.0	1.7	5.6	10.2	11.6	12.0	11.3	10.3	8.3	7.6	5.2	5.1	3.7	3.5	1.8	2.2

WELLNAME = WEST SEAHORSE NO.2 DATE OF JOB = MARCH 1982

ORGANIC CONTENT OF SEDIMENTS

DEPTH(m)	%SOM	%TOC	SOM(mg)/TOC(g)	SAT(mg)/TOC(g)	%SaOM
1424.0	.616	nd	nd	nd	.381

WELLNAME = WEST SEAHORSE NO.2 DATE OF JOB = MARCH 1982

COMPOSITIONAL DATA

DEPTH(m)	%SAT	%AROM	%NSO	PRIST/PHYT	PRIST/NC17	PHYT/NC18	PAP	AROM/SAT	CPI(1)	CPI(2)	21+22/28+29
1424.0	61.7	29.0	9.3	4.95	4.45	.27	nd	0.47	1.19	1.15	3.64

WELLNAME = WEST SEAHORSE NO.2 DATE OF JOB = MARCH 1982

N-ALKANE DISTRIBUTIONS

DEPTH(m)	CN12	CN13	CN14	CN15	CN16	CN17	CN18	CN19	CN20	CN21	CN22	CN23	CN24	CN25	CN26	CN27	CN28	CN29	CN30	CN31
1424.0	0.0	0.0	0.0	0.0	0.6	1.6	5.3	9.5	12.2	12.0	11.6	10.2	8.2	7.6	5.6	5.1	3.1	3.3	1.7	2.1

SULPHUR CONTENT

DEPTH(m)	%SULPHUR
1424.0	5.3

KEY

%SOM = Percentage of soluble organic matter in the sediment sample (W/W)

%SAT = Percentage by weight of saturated compounds in the extract

%AROM = Percentage by weight of aromatic compounds in the extract

%NSO = Percentage by weight of asphaltenes plus resins in the extract

PRIST = Pristane

PHYT = Phytane

NC17 = n-heptadecane (i.e. n-alkane with 17 carbon atoms)

NC18 = n-octadecane (i.e. n-alkane with 18 carbon atoms)

PAP = Percentage of aromatic protons in the aromatic fraction

CPI = Carbon Preference Index

n-Alkane Composition: CN12 etc. = n-alkane with 12 carbon atoms etc. (Values are weight percent of the n-alkane fraction)

TOC = Total organic carbon (soluble + insoluble)

C_T = Total insoluble organic carbon

C_R = Residual organic carbon

HC = Hydrocarbon

nd = No data

21+22/28+29: Sum of percentages of n-alkanes with carbon numbers 21 and 22 divided by sum of percentages of n-alkanes with carbon numbers 28 and 29

%SaOM = Percentage of saturated organic matter in the sediment sample (W/W)

PI = Production Index

PC = Pyrolysable Carbon

HI = Hydrogen Index

OI = Oxygen Index

THEORY AND METHOD

THEORY AND METHOD

1. PREPARATION OF SEDIMENT SAMPLES FOR EXTRACTION

All samples provided for this study were core material. Each sample was firstly crushed to approximately 1/8" chips using a jaw crusher, air dried for four hours and finally further crushed to 0.1mm using an NV Tema grinder.

2. EXTRACTION OF SEDIMENT SAMPLES

Crushed sediment (maximum of 250g) and 320 mls of purified dichloromethane: methanol (10:1) were placed in a 500 ml conical flask. A double surface condenser was fitted to the flask, and the sample was then extracted under the influence of ultra-sonic vibration (60-70^{o}C) using a Buehler Ultramet II sonic bath for 2 hours. The solvent was then separated from the sediment using a large Buchner filtration system. The extract was recovered by careful evaporation of the solvent on a steam bath and weighed. The weight of extract was used to calculate %SOM(UNC) using the following formula:

$$\%\text{SOM(UNC)} = \frac{\text{Wt. extract}}{\text{Wt. sediment extracted}} \times \frac{100}{1}$$

3. SEPARATION OF EXTRACT INTO CONSTITUENT FRACTIONS

The extracts were separated into saturated, aromatic and NSO (asphaltenes plus resins) fractions by column chromatography on silicic acid. The crude extract was applied to the top of a silicic acid column (sample to adsorbent ratio 1:50) and the saturated compounds were eluted with n-pentane, aromatic compounds with a 50:50 mixture of ether and n-pentane, and finally the NSO fraction was eluted with a 20:1 mixture of methanol and dichloromethane. The neat fractions were recovered by careful removal of the solvent by fractional distillation and weighed.

The sum weight of the three fractions was used to calculate the %SOM using the following formula:

$$\%\text{SOM} = \frac{\text{Wt. AROM.} + \text{Wt. SAT.} + \text{Wt. NSO}}{\text{Wt. SEDIMENT EXTRACTED}} \times \frac{100}{1}$$

This parameter can be used to assess the suitability of the sediments as source rocks according to the classification shown (later in this section) in the table "Classification of Source Rock Richness".

The weight of saturated compounds was used to calculate the percentage of saturated compounds in the sediment according to the following formula:

$$\%\text{SaOM} = \frac{\text{Wt. Saturates}}{\text{Wt. Sediment Extracted}} \times \frac{100}{1}$$

This parameter can be used to assess the suitability of the sediments as oil source rocks according to the classification shown in the table "Classification of Source Rock Richness".

The weight of each fraction was used to calculate the % by weight of each fraction in the extract according to the following formula:

$$\%\ \text{Fraction} = \frac{\text{Wt. Fraction}}{\text{Wt. All Fractions}} \times \frac{100}{1}$$

The composition of the extracts can provide information about their levels of maturity and/or source type (LeTran et al., 1974; Philippi, 1974). Generally, marine extracts have relatively low concentrations of saturated and NSO compounds at low levels of maturity, but these concentrations increase with increased maturation. Terrestrially derived organic matter usually has a low level of saturates and large amount of aromatic and NSO compounds irrespective of the level of maturity.

4. GLC ANALYSIS OF SATURATED COMPOUNDS

Capillary GLC traces were recorded for each saturate fraction. The following information was obtained from these traces:

(a) n-Alkane Distribution - The C_{12}-C_{31} n-alkane distribution was determined from the area under peaks representing each of these n-alkanes. This distribution can yield information about both the level of maturity and the source type (LeTran et al., 1974).

(b) Carbon Preference Index - Two values were determined:

$$\text{CPI(1)} = \frac{(C_{23} + C_{25} + C_{27} + C_{29})\text{Wt\%} + (C_{25} + C_{27} + C_{29} + C_{31})\text{Wt\%}}{2 \times (C_{24} + C_{26} + C_{28} + C_{30})\text{Wt\%}}$$

$$\text{CPI(2)} = \frac{(C_{23} + C_{25} + C_{27})\text{Wt\%} + (C_{25} + C_{27} + C_{29})\text{Wt\%}}{2 \times (C_{24} + C_{26} + C_{28})\text{Wt\%}}$$

The CPI is believed to be a function of both the level of maturity (Cooper and Bray, 1963; Scalan and Smith, 1970) and the source type (Tissot and Welte, 1978). Marine extracts tend to have values close to 1 irrespective of maturity whereas values for terrestrial extracts decrease with maturity from values as high as 20 but don't usually reach a value of 1.

(c) $C_{21}+C_{22}/C_{28}+C_{29}$ - This parameter provides information about the source of the organic matter (Philippi, 1974). Generally, a terrestrial source gives values <1.2 whereas a marine source results in values >1.5.

(d) Pristane/Phytane Ratio - This value was determined from the areas of peaks representing these compounds. The ratio renders information about the depositional environment according to the following scale (Powell and McKirdy, 1975):

<3.0	Marine depositional environment (i.e. reducing environment)
3.0-4.5	Mixed depositional environment (i.e. reducing/oxidising environment)
>4.5	Terrestrial depositional environment (i.e. oxidising environment)

(e) Pristane/$\underline{n}$-C_{17} Ratio - This ratio was determined from the areas of peaks representing these compounds. The value can provide information about both the source type and the level of maturation (Lijmbach, 1975). Very immature crude oil has a pristane/$\underline{n}$-C_{17} ratio >1.0, irrespective of the source type. However, the following classification can be applied to mature crude oil:

<0.5	Marine source
0.5-1.0	Mixed source
>1.0	Terrestrial source

In the case of sediment extracts these values are significantly higher and the following classification is used:

<1.0	Marine source
1.0-1.5	Mixed source
>1.5	Terrestrial source

(f) Phytane/n-C_{18} Ratio - This ratio was determined from the areas of peaks representing these compounds. The value usually only provides information about the level of maturity of petroleum. The value decreases with increased maturation.

(g) Relative Amounts of n-Alkanes and Naphthenes - Since n-alkanes and naphthenes are the two dominant classes of compounds in the saturate fraction, a semi-quantitative estimate of the relative amounts of these compounds was made. This information can be used to assess the degree of maturation and/or the source type of the petroleum (Philippi, 1974; Tissot and Welte, 1978). Very immature petroleum has only small proportions of n-alkanes, but as maturity increases the relative amount of n-alkanes increases. In addition, terrestrial petroleum has a greater proportion of high molecular weight naphthenes than marine petroleum.

5. API GRAVITY

A 1 ml specific gravity (SG) bottle was accurately weighed, then filled with crude oil at 60°F and finally reweighed. The weight difference was divided by the weight of 1 ml of water at 60°F to obtain the specific gravity. The following formula was then used to calculate the API gravity :

$$\text{API Gravity} = \left(\frac{141.5}{\text{SG }(60°\text{F})}\right) - 131.5$$

The reported gravity value is the average of duplicate determinations.

6. SULPHUR DETERMINATION

The % sulphur values were measured using an x-ray fluorescence spectrometer equipped with a liquid sample holder. This parameter is influenced by the nature of the source material from which a crude is derived, the depositional environment of the source rocks, and reservoir alteration processes such as bacterial alteration.

REFERENCES

Alexander, R., Kagi, R.I. and Woodhouse, G.W. "Measurement of thermal maturation of petroleum by proton magnetic resonance spectroscopy". Nature, 276, 1978, 598.

Alexander, R., Kagi, R.I. and Woodhouse, G.W. "A new method for measuring the maturity of petroleum in source rocks". APEA J., 19, 1979, 90-93.

Cooper, J.E. and Bray, E.E. "Apostulated role of fatty acids in petroleum formation". Geochim. Cosmochim. Acta, 27, 1963, 1113-1127.

Gransch, J.A. and Eisma, E. "Characterization of the insoluble organic matter of sediments by pyrolysis". Advances in Organic Geochemistry, 1966, 407-426.

Hunt, J.M. "Geochemistry of petroleum". Am. Assoc. Pet. Geol. Continuing Education Lecture Series.

Lijmbach, G.W.M. "On the origin of petroleum". Proc. 9th World Petroleum Congress, 2, 1975, 357-369.

LeTran, K., Connan, J. and Van der Weide, B. "Diagenesis of organic matter and occurrence of hydrocarbons and hydrogen sulphide in the S.W. Aquitaine Basin". Bull. Centre Rech., Pau-SNPA, 8, 1974, 111.

Philippi, G.T. "The influence of marine and terrestrial source material on the composition of petroleum". Geochim. Cosmochim. Acta, 38, 1974, 947.

Powell, T.G. and McKirdy, D.M. "Geological factors controlling crude oil composition in Australia and Papua New Guinea". Amer. Assoc. Petrol. Geol. 59, 1975, 1176.

Scalan, R.S. and Smith, J.E. "An improved measure of the odd-even predominance in the normal alkanes of sediment extracts and petroleum". Geochim. Cosmochim. Acta, 34, 1970, 611-620.

Stahl, W.J. "Carbon and nitrogen isotopes in hydrocarbon research and exploration". Chem. Geol., 20, 1977, 121-149.

Stahl, W.J. "Source rock-crude oil correlation by isotopic type-curves". Geochim. Cosmochim. Acta, 42, 1978, 1573-1577.

Tissot, B. et al. "Origin and evolution of hydrocarbons in early Toarcian shales, Paris Basin, France". Amer. Assoc. Petrol. Geol., 55, 1971, 2177.

Tissot, B. et al. "Influence of nature and diagenesis of organic matter in the formation of petroleum". Amer. Assoc. Petrol. Geol., 58 1974, 499.

Tissot, B. and Welte, D.H. "Petroleum Formation and Occurrence". Springer-Verlag. Berlin Heidelberg New York, 1978.

Welte, D.H., et al., "Correlation between petroleum and source rock". Proc. 9th World Petroleum Congress, 2, 1975, 179-191.

COMMENTS AND CONCLUSIONS

COMMENTS AND CONCLUSIONS

GENERAL

An RFT test sample from 1427m and a piece of core from 1424m from the West Seahorse #2 exploration well were provided for geochemical analysis. The core sample was crushed and extracted with dichloromethane:methanol (10:1), after which the sulphur content of the extract and the RFT test sample were measured. The API gravity of the RFT test sample was also measured at this stage. A sample of the RFT test and the extract were then separated into saturate, aromatic and NSO fractions by liquid chromatography. The saturate fraction from each sample was analysed by capillary column gas chromatography.

It should be noted that some reference is made to the West Seahorse #1 oil samples in this section of this report. However, the data for these oils is provided in a previous report.

API GRAVITY

On the basis of its API gravity the RFT sample is considered a medium gravity oil. This sample is significantly "heavier" than the samples from West Seahorse #1 which can be accounted for by the fact that it is more biodegraded than any of the samples from West Seahorse #1.

SULPHUR CONTENT

The sulphur content of the RFT sample is moderately high and further is significantly greater than that for the two biodegraded oil samples from West Seahorse #1. This observation is consistent with the fact that the West Seahorse #2 RFT sample is more biodegraded than either of the biodegraded oils from West Seahorse #1.

The % sulphur value for the 1424m core extract is very high. However, this high value is not considered to be due to biodegradation but is more likely some source of sulphur which has been extracted from the core but would not normally be part of migrating or reservoired oil.

HYDROCARBON COMPOSITION

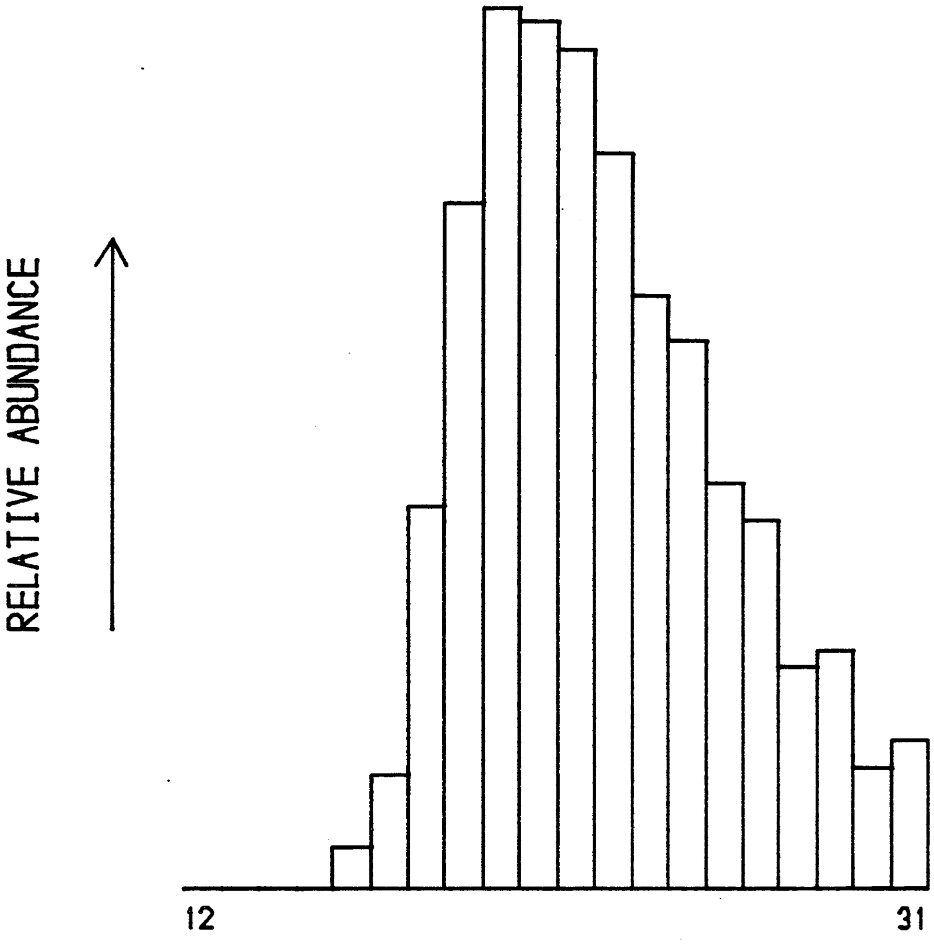
The %SOM value for the 1424m core sample is very high and therefore strongly suggests that this core contains a large proportion of migrating oil. Consequently for discussion of its hydrocarbon composition it can be considered as an oil sample.

The n-alkane distributions for both the core extract and the RFT sample are very similar suggesting in this case that they are from a similar source. It is noticeable that these distributions are devoid of the low molecular weight compounds which we believe is due to partial biodegradation of these samples. Comparison of the West Seahorse #2 distributions to those for the biodegraded West Seahorse #1 samples clearly shows the samples from the #2 well are more biodegraded than those from the #1 well.

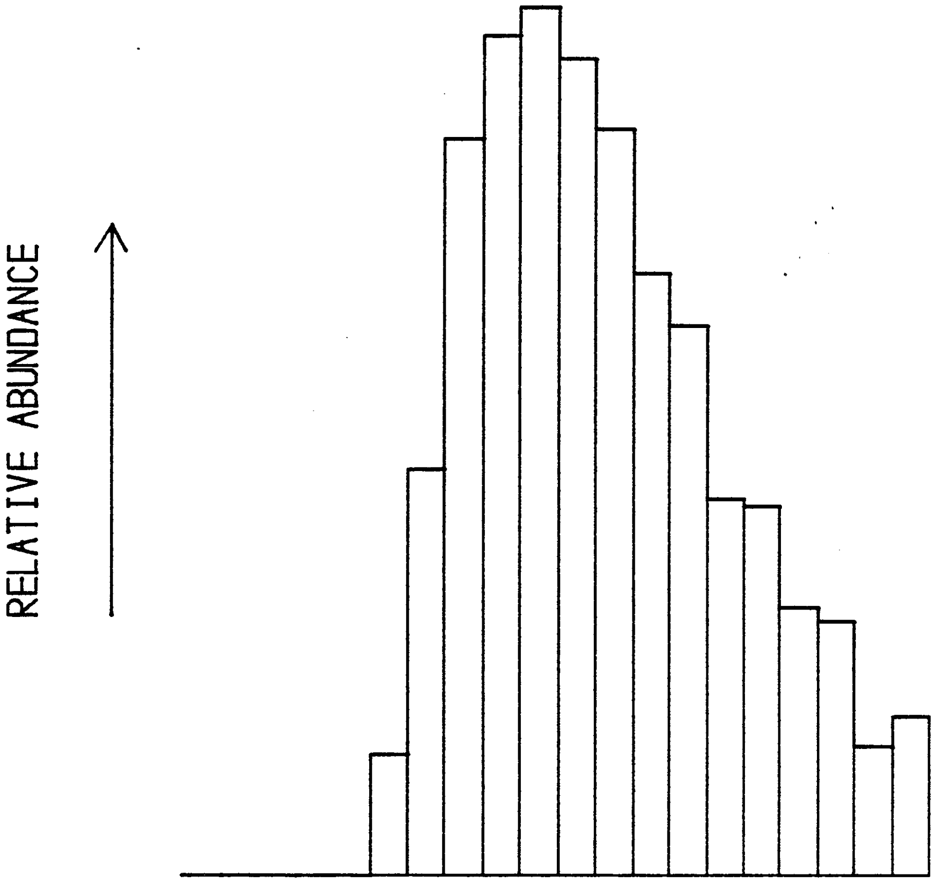
The proportion of saturates in the West Seahorse #2 samples are less than those in the samples from the #1 well which is further evidence that the #2 well samples are the more biodegraded. The fact that the 1424m core sample from the #2 well has a lower %SAT value than the RFT sample is probably due to the method by which the samples were obtained rather than any difference in their degree of biodegradation.

Due to the influence of bacteria on the n-alkane distributions the pristane/ n-C_{17} and $(C_{21} + C_{22})/(C_{28} + C_{29})$ ratios cannot be used in this study. However, like the values for #1 well samples, the pristane/phytane ratios for the #2 well samples suggest that these samples have been derived from source rocks deposited in a relatively oxidizing environment.

n-ALKANE DISTRIBUTIONS

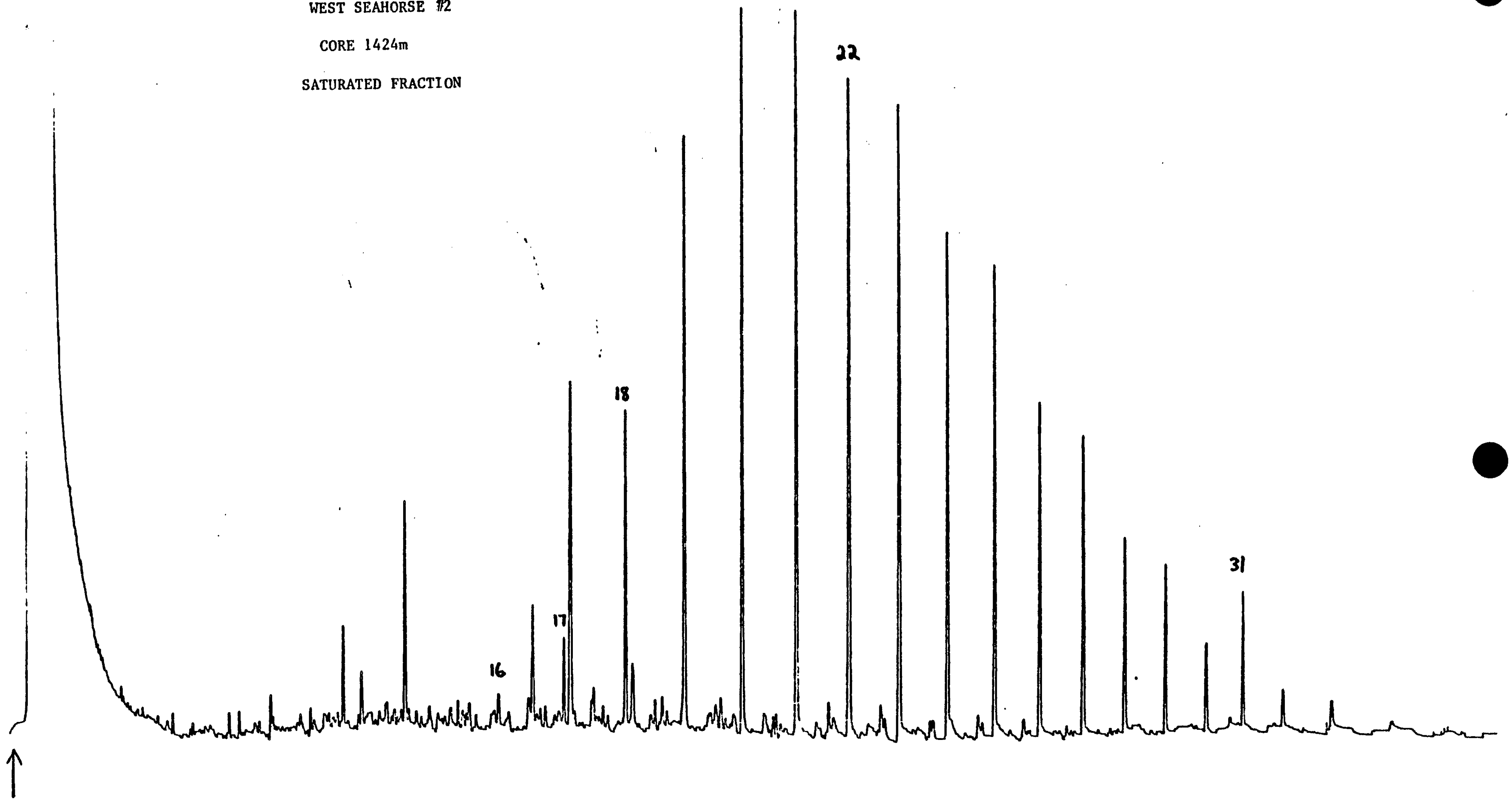


WEST SEAHORSE #2 1424.0M



WEST SEAHORSE #2 OIL

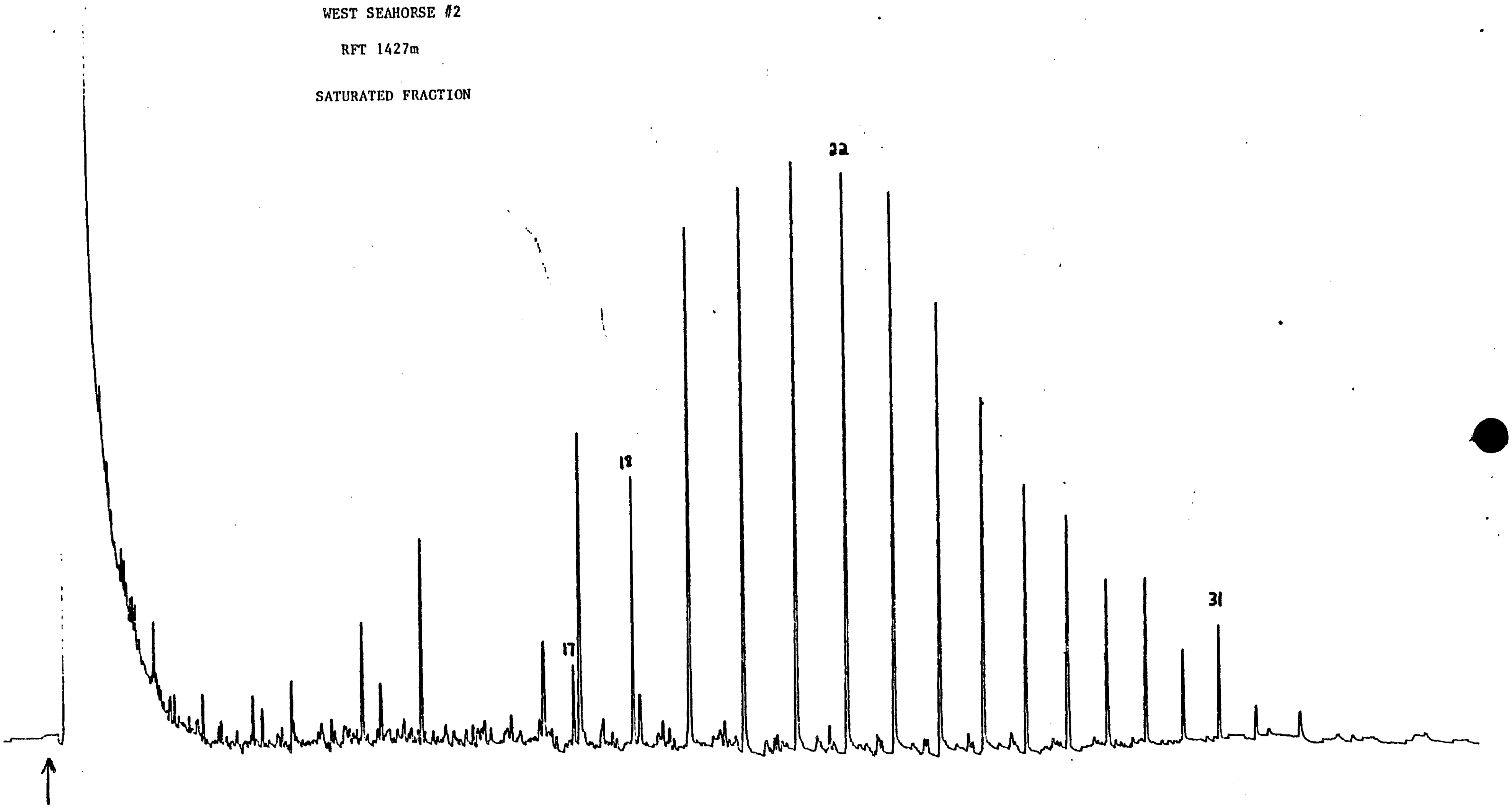
CAPILLARY GLC TRACES


WEST SEAHORSE #2
CORE 1424m
SATURATED FRACTION
16
17
18
22
31

WEST SEAHORSE #2

RFT 1427m

SATURATED FRACTION



ANALABS
52 Murray Road
WELSHPOOL WA 6106

31 March 1982

Attn: Mr Murray Chapman

Dear Sir,

Please perform a water analysis on each of these 12 water samples including measurements of Na, K, Ca, Mg, Cl, HCO_3, CO_3, SO_4, NO_3, sulphide S, Soluble iron Fe, pH, conductivity and specific gravity.

Please ensure thatffor each analysis, a full description of the sample is labelled on the Certificate of Analysis as noted below:

Sample		Description of Sample
1	West Seahorse #2	- RFT 6 gal chamber at 1427 m
2	West Seahorse #2	- RFT 1 gal chamber at 1427 m
3	West Seahorse #2	- RFT 6 gal chamber at 1495 m
4	West Seahorse #2	- RFT 1 gal chamber at 1495 m
5	West Seahorse #2	- RFT 6 gal chamber at 1519.5 m
6	West Seahorse #2	- RFT 1 gal chamber at 1519.5 m
7	West Seahorse #2	- RFT 6 gal chamber at 1598 m
8	West Seahorse #2	- RFT 1 gal chamber at 1598 m
9	West Seahorse #2	- RFT 6 gal chamber at 2012 m
10	West Seahorse #2	- RFT 1 gal chamber at 2012 m
11	Woodada #5	- Recovered March 17 from 2372 - 2378 m after 760 bbls load water recovery
12	Woodada #5	- Sand frac fluid

I cannot emphasize too strongly, the necessity of recording the sample descriptions on the certificate of analysis exactly as noted above.

Please sign and return one copy of this letter to indicate your receipt of these samples and forward the results when they have been completed to the undersigned.

Yours faithfully,
HUDBAY OIL (AUST) LTD

D D Best
DISTRICT PETROLEUM ENGINEER

DDB/

ANALABS

ANALYTICAL CHEMISTS

52 Murray Road
Welshpool
W.A. 6106
Tel: 458 7999

CERTIFICATE OF ANALYSIS

For: Hudbay Oil (Australia)
PO Box 6124
Hay Street East
Perth 6000

Our ref: 108.0.01.2353

Your ref:
Date: 13.04.1982

Description of Samples: Twelve water samples were received on the 31.03.1982 for chemical analysis.

Method of Analysis:

Sample No.

Chemical Data

West Seahorse #2-
RFT 6 gal chamber at 1427m

pH		8.51	
Conductivity(u siemens/cm)		12390	
T.F.R. (calculated)		7930	
		mg/l	m equiv/l
Sodium	Na+	2910	126.6
Potassium	K+	80.4	2.056
Calcium	Ca++	29.2	1.457
Magnesium	Mg++	25.82	2.125
Soluble Iron	Fe	0.6	-
Chloride	Cl-	3216	90.6
Carbonate	CO3--	21	0.7
Bi-Carbonate	HCO3-	2227	36.5
Sulphate	SO4--	498.7	10.39
Nitrate	NO3-	2.16	0.0348
Sulphide	S	108	-
Specific Gravity		1.007	-
Sum of Ions		9010	

Analyst: M.A. CHAPMAN A.P.T.C., A.R.A.C.I., A.A.I.M.M.

Analytical Chemist

THIS DOCUMENT MUST NOT BE REPRODUCED EXCEPT IN FULL

ANALABS

ANALYTICAL CHEMISTS

52 Murray Road
Welshpool
W.A. 6106
Tel: 458 7999

CERTIFICATE OF ANALYSIS

For: Hudbay Oil (Australia)
PO Box 6124
Hay Street East
Perth 6000

Our ref: 108.0.01.23531

Your ref:
Date: 13.04.1982

Description of Samples: Twelve water samples were received on the 31.03.1982 for chemical analysis.

Method of Analysis: Sample No.

Chemical Data		West Seahorse #2- RFT 1 gal chamber at 1427 m	
pH		8.3	
Conductivity(u siemens/cm)		8380	
T.F.R. (calculated)		5363	
		mg/l	m equiv/l
Sodium	Na+	2050	89.17
Potassium	K+	67.5	1.726
Calcium	Ca++	32.9	1.642
Magnesium	Mg++	30.78	2.533
Soluble Iron	Fe	0.9	-
Chloride	Cl-	1931	54.4
Carbonate	CO3--	<0.3	-
Bi-Carbonate	HCO3-	1742	28.55
Sulphate	SO4--	391	8.146
Nitrate	NO3-	2.16	0.0348
Sulphide	S	25.6	-
Specific Gravity		1.005	-
Sum of Ions		6247	

Analyst: M.A. CHAPMAN A.P.T.C., A.R.A.C.I., A.A.I.M.M.

Analytical Chemist

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ANALABS

ANALYTICAL CHEMISTS

52 Murray Road
Welshpool
W.A. 6106
Tel: 458 7999

CERTIFICATE OF ANALYSIS

For: Hudbay Oil (Australia)
PO Box 6124
Hay Street East
Perth 6000

Our ref: 108.0.01.23531

Your ref:
Date: 13.04.1982

Description of Samples: Twelve water samples were received on the 31.03.1982 for chemical analysis.

Method of Analysis:

Sample No.

Chemical Data

West Seahorse #2-
RFT 6 gal chamber at 1495 m

pH		8.52	
Conductivity(u siemens/cm)		10830	
T.F.R. (calculated)		6931	
		mg/l	m equiv/l
Sodium	Na+	2425	105.5
Potassium	K+	66.2	1.693
Calcium	Ca++	9	0.4491
Magnesium	Mg++	14.45	1.189
Soluble Iron	Fe	0.4	-
Chloride	Cl-	2968	83.6
Carbonate	CO3--	10.5	0.35
Bi-Carbonate	HCO3-	738.1	12.1
Sulphate	SO4--	770.8	16.06
Nitrate	NO3-	1.093	0.0176
Sulphide	S	52	-
Specific Gravity		1.005	-
Sum of Ions		7003	

Analyst: M.A. CHAPMAN A.P.T.C., A.R.A.C.I., A.A.I.M.M.

Analytical Chemist

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PO Box 6124
Hay Street East
Perth 6000

Our ref: 108.0.01.23531
Your ref:
Date: 13.04.1982

Description of Samples: Twelve water samples were received on the 31.03.1982 for chemical analysis.

Method of Analysis:		Sample No.	
Chemical Data		West Seahorse #2- RFT 1 gal chamber at 1495 m	
pH		8.28	
Conductivity(u siemens/cm)		7650	
T.F.R. (calculated)		4896	
		mg/l	m equiv/l
Sodium	Na+	1675	72.86
Potassium	K+	57	1.458
Calcium	Ca++	15.45	0.771
Magnesium	Mg++	18.73	1.541
Soluble Iron	Fe	0.5	-
Chloride	Cl-	1974	55.6
Carbonate	CO3--	<0.3	-
Bi-Carbonate	HCO3-	820.5	13.45
Sulphate	SO4--	456.4	9.508
Nitrate	NO3-	<0.05	-
Sulphide	S	25.6	-
Specific Gravity		1.004	-
Sum of Ions		5017	

Analyst: M.A. CHAPMAN A.P.T.C., A.R.A.C.I., A.A.I.M.M.
Analytical Chemist

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CERTIFICATE OF ANALYSIS

For: Hudbay Oil (Australia)
PO Box 6124
Hay Street East
Perth 6000

Our ref: 108.0.01.23531

Your ref:
Date: 13.04.1982

Description of Samples: Twelve water samples were received on the 31.03.1982 for chemical analysis.

Method of Analysis: Sample No.

Chemical Data

West Seahorse #2-
RFT 6 gal chamber at 1519.5 m

pH		7.99	
Conductivity(u siemens/cm)		14440	
T.F.R. (calculated)		9242	
		mg/l	m equiv/l
Sodium	Na+	3385	147.2
Potassium	K+	64.8	1.657
Calcium	Ca++	21.5	1.073
Magnesium	Mg++	13.6	1.119
Soluble Iron	Fe	0.7	-
Chloride	Cl-	4260	120
Carbonate	CO3--	<0.3	-
Bi-Carbonate	HCO3-	549	9
Sulphate	SO4--	1107	23.06
Nitrate	NO3-	1.093	0.0176
Sulphide	S	56.8	-
Specific Gravity		1.007	-
Sum of Ions		9402	

Analyst: M.A. CHAPMAN A.P.T.C., A.R.A.C.I., A.A.I.M.M.
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CERTIFICATE OF ANALYSIS

For: Hudbay Oil (Australia)
PO Box 6124
Hay Street East
Perth 6000

Our ref: 108.0.01.23531

Your ref:
Date: 13.04.1982

Description of Samples: Twelve water samples were received on the 31.03.1982 for chemical analysis.

Method of Analysis:

Sample No.

Chemical Data

West Seahorse # 2-
RFT 1 gal chamber at 1519.5 m

pH		8.37	
Conductivity(u siemens/cm)		10730	
T.F.R. (calculated)		6867	
		mg/l	m equiv/l
Sodium	Na+	2450	106.6
Potassium	K+	50.5	1.292
Calcium	Ca++	23.85	1.19
Magnesium	Mg++	30.75	2.53
Soluble Iron	Fe	0.5	-
Chloride	Cl-	3060	86.2
Carbonate	CO3--	1.5	0.05
Bi-Carbonate	HCO3-	768.6	12.6
Sulphate	SO4--	714.8	14.89
Nitrate	NO3-	<0.05	-
Sulphide	S	39.2	-
Specific Gravity		1.005	-
Sum of Ions		7100	

Analyst: M.A. CHAPMAN A.P.T.C., A.R.A.C.I., A.A.I.M.M.
Analytical Chemist

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CERTIFICATE OF ANALYSIS

For: Hudbay Oil (Australia)
PO Box 6124
Hay Street East
Perth 6000

Our ref: 108.0.01.23531

Your ref:
Date: 13.04.1982

Description of Samples: Twelve water samples were received on the 31.03.1982 for chemical analysis.

Method of Analysis: Sample No.

Chemical Data

West Seahorse #2-
RFT 6 gal chamber at 1598 m

pH		7.59	
Conductivity(u siemens/cm)		3800	
T.F.R. (calculated)		2432	

		mg/l	m equiv/l
Sodium	Na+	715	31.1
Potassium	K+	27	0.6905
Calcium	Ca++	38.65	1.929
Magnesium	Mg++	22.62	1.861
Soluble Iron	Fe	0.7	-
Chloride	Cl-	923	26
Carbonate	CO3--	<0.3	-
Bi-Carbonate	HCO3-	439.2	7.2
Sulphate	SO4--	197.7	4.119
Nitrate	NO3-	<0.05	-
Sulphide	S	4.8	-
Specific Gravity		1.002	-
Sum of Ions		2363	

Analyst: M.A. CHAPMAN A.P.T.C., A.R.A.C.I., A.A.I.M.M.

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CERTIFICATE OF ANALYSIS

For: Hudbay Oil (Australia)
PO Box 6124
Hay Street East
Perth 6000

Our ref: 108.0.01.23531

Your ref:
Date: 13.04.1982

Description of Samples: Twelve water samples were received on the 31.03.1982 for chemical analysis.

Method of Analysis:

Chemical Data		Sample No. West Seahorse # 2- RFT 1 gal chamber at 1598 m	
pH		7.69	
Conductivity(u siemens/cm)		2610	
T.F.R. (calculated)		1670	
		mg/l	m equiv/l
Sodium	Na+	460	20.01
Potassium	K+	46.2	1.182
Calcium	Ca++	47.95	2.393
Magnesium	Mg++	27.65	2.275
Soluble Iron	Fe	0.6	-
Chloride	Cl-	582.2	16.4
Carbonate	CO3--	<0.3	-
Bi-Carbonate	HCO3-	478.9	7.85
Sulphate	SO4--	94.8	1.975
Nitrate	NO3-	<0.05	-
Sulphide	S	1.6	-
Specific Gravity		1.001	-
Sum of Ions		1738	

Analyst: M.A. CHAPMAN A.P.T.C., A.R.A.C.I., A.A.I.M.M.

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PO Box 6124
Hay Street East
Perth 6000

Our ref: 108.0.01.23531

Your ref:
Date: 13.04.1982

Description of Samples: Twelve water samples were received on the 31.03.1982 for chemical analysis.

Method of Analysis: Sample No.

Chemical Data		West Seahorse #2- RFT 6 gal chamber at 2012 m	
pH		8.1	
Conductivity(u siemens/cm)		8530	
T.F.R. (calculated)		5459	
		mg/l	m equiv/l
Sodium	Na+	1850	80.47
Potassium	K+	58.3	1.491
Calcium	Ca++	29.55	1.475
Magnesium	Mg++	22.15	1.823
Soluble Iron	Fe	1	-
Chloride	Cl-	2350	66.2
Carbonate	CO3--	<0.3	-
Bi-Carbonate	HCO3-	628.3	10.3
Sulphate	SO4--	528.1	11
Nitrate	NO3-	<0.05	-
Sulphide	S	33.6	-
Specific Gravity		1.005	-
Sum of Ions		5467	

Analyst: M.A. CHAPMAN A.P.T.C., A.R.A.C.I., A.A.I.M.M.

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Our ref: 108.0.01.23531
Your ref:
Date: 13.04.1982

Description of Samples: Twelve water samples were received on the 31.03.1982 for chemical analysis.

Method of Analysis: Sample No.

Chemical Data		West Seahorse #2- RFT 1 gal chamber at 2012 m	
pH		7.83	
Conductivity(u siemens/cm)		6210	
T.F.R. (calculated)		3974	
		mg/l	m equiv/l
Sodium	Na+	1295	56.33
Potassium	K+	55.5	1.419
Calcium	Ca++	27	1.347
Magnesium	Mg++	20.94	1.723
Soluble Iron	Fe	0.9	-
Chloride	Cl-	1605	45.2
Carbonate	CO3--	<0.3	-
Bi-Carbonate	HCO3-	610	10
Sulphate	SO4--	349.2	7.275
Nitrate	NO3-	<0.05	-
Sulphide	S	8	-
Specific Gravity		1.003	-
Sum of Ions		3962	

Analyst: M.A. CHAPMAN A.P.T.C., A.R.A.C.I., A.A.I.M.M.
Analytical Chemist

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APPENDIX B7 LOG OF CORES

CORE LABORATORIES, INC. CORE LAB *Petroleum Reservoir Engineering*

COMPANY HUDBAY OIL (AUST) LTD. FILE NO WA-CA-196
WELL WEST SEAHORSE NO. 2 DATE 16TH APRIL, 1982 ENGRS GK, AP, GO
FIELD FORMATION ELEV
COUNTY AUSTRALIA STATE VIC DRLG FLD CORES CONV 1-2
LOCATION REMARKS

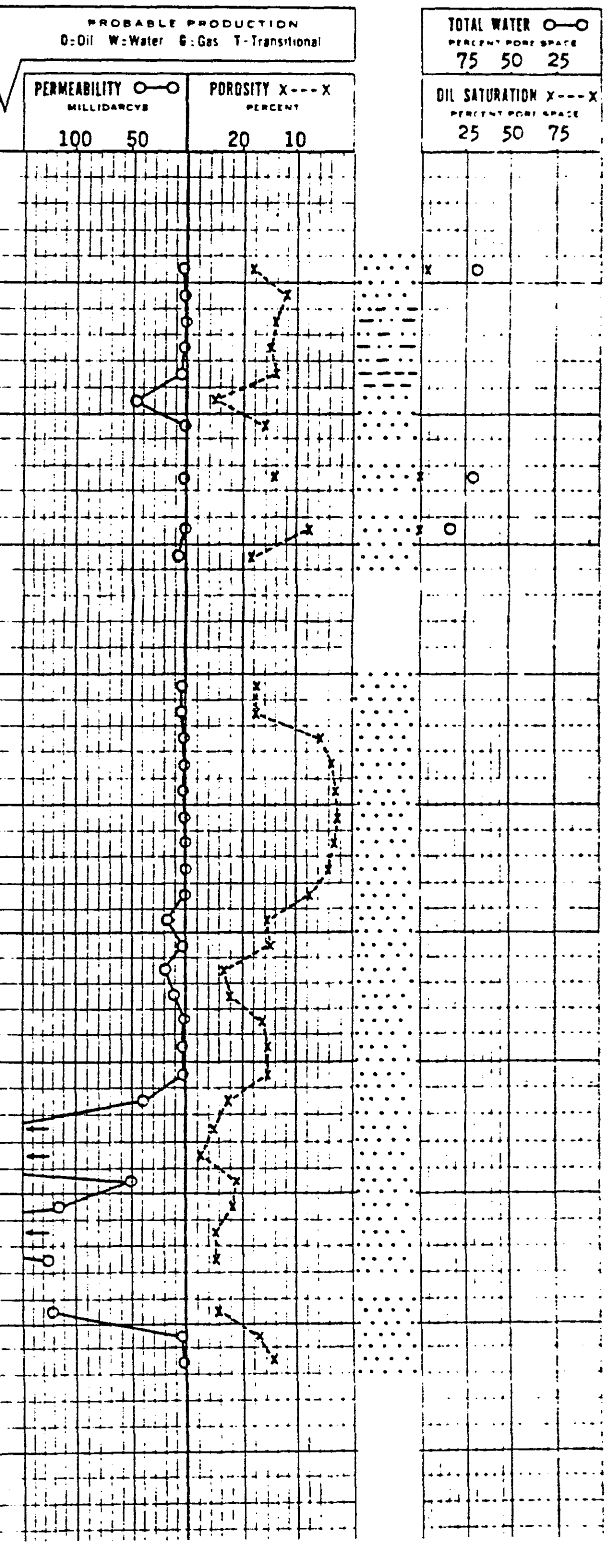
COMPLETION COREGRAPH

SAND ▨ LIMESTONE ▨ CONGLOMERATE ▨ CHERT ▨ ANHYDRITE ▨
SHALE ▨ DOLOMITE ▨ OOLITES ▨

SAMPLE CHARACTERISTICS
F-Fractured L-Laminated FG: MG: CG-Type Grain Size S-Stylolitic V-Vuggy

PROBABLE PRODUCTION
O-Oil W-Water G-Gas T-Transitional

SAMPLE NUMBER	DEPTH METRES	PERMEABILITY, MD * = Horizontal Perm Plug HORIZ KA	GRAIN DENSITY	POROSITY %	RESIDUAL SATURATION % PORE SPACE OIL	TOTAL WATER
1	1424.0	2.3	2.59	18.5	3.0	68.8
2	1424.3	0.4	2.54	12.0		
3	1424.6	0.4	2.59	14.1		
4	1425.0	1.2	2.51	15.0		
5	1425.3	5.3	2.48	14.1		
6	1425.6	47	2.61	24.9		
7	1426.0	0.9	2.53	16.1		
8	1427.2	2.1	2.36	14.2	0.0	70.0
9	1427.8	0.6	2.54	7.8	0.0	83.2
10	1428.1	7.9	2.60	18.2		
11	1440.72	1.7	2.64	17.4		
12	1440.93	2.9	2.63	17.6		
13	1441.2	0.03	2.69	5.5		
14	1441.35	0.02	2.68	3.4		
15	1441.71	0.04	2.68	2.8		
16	1442.02	0.03	2.69	2.4		
17	1442.21	0.01	2.62	3.1		
18	1442.45	0.01	2.65	4.0		
19	1442.75	<0.01	2.64	7.7		
20	1443.02	17	2.56	15.7		
21	1443.37	2.2	2.57	14.9		
22	1443.68	19	2.63	23.2		
23	1443.87	11	2.62	22.1		
24	1444.21	0.04	2.59	16.3		
25	1444.52	1.4	2.61	15.6		
26	1444.68	1.2	2.59	15.4		
27	1445.02	39	2.67	22.4		
28	1445.30	154	2.67	25.0		
29	1445.77	646	2.67	27.4		
30	1445.94	50	2.67	21.0		
31	1446.23	114	2.67	21.7		
32	1446.48	333	2.65	24.5		
33	1446.73	124	2.64	24.3		
34	1447.40	120	2.64	24.0		
35	1447.69	3.4	2.62	17.1		
36	1447.88	1.0	2.52	14.3		



CORE LABORATORIES, INC. CORE LAB *Petroleum Reservoir Engineering*

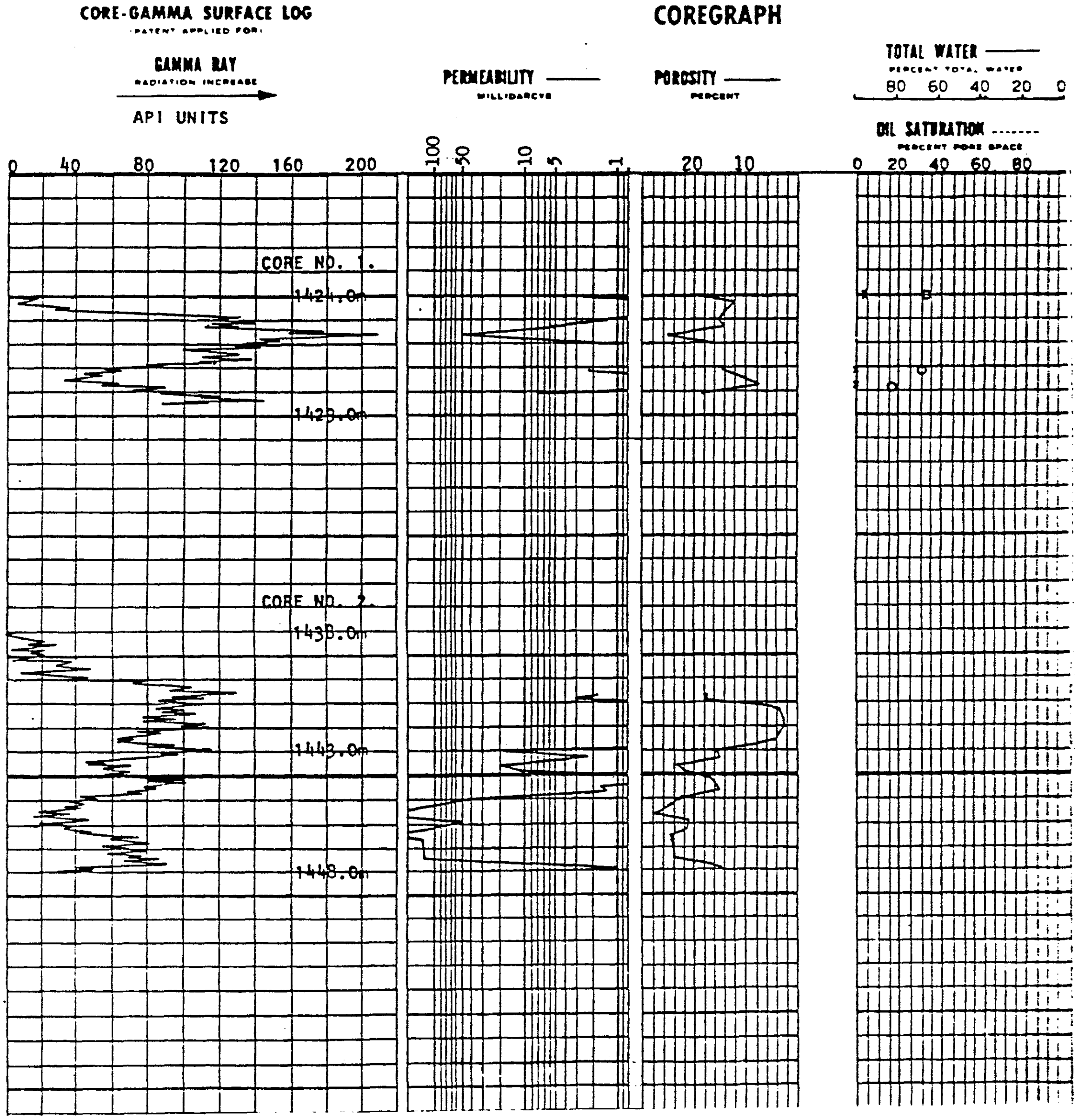
COMPANY HUDBAY OIL (AUST) LTD FIELD FILE WA-CA-196

WELL WEST SEAHORSE NO. 2 DATE 23 FEB. 1982

LOCATION ELEV.

CORE-GAMMA CORRELATION

VERTICAL SCALE 1 CM. = 2 METERS
(1:200)



CL-511-1

CORE LABORATORIES, INC.

Petroleum Reservoir Engineering
DALLAS, TEXAS

Page No. 1 of 3

CORE ANALYSIS RESULTS

Company HUDBAY OIL (AUST) LTD
Formation
File WA-CA-196
Well WEST SEAHORSE NO. 2
Core Type CONV. 1 & 2
Date Report 16 APRIL, 82
Field
Drilling Fluid
Analysts GK, AP, GO
County AUSTRALIA State VIC Elev. Location

Lithological Abbreviations

SAND — SD
SHALE — SH
LIME — LM
DOLOMITE — DOL
CHERT — CH
GYPSUM — GYP
ANHYDRITE — ANHY
CONGLOMERATE — CONG
FOSSILIFEROUS — FOSS
SANDY — SDY
SHALY — SHY
LIMY — LMY
FINE — FN
MEDIUM — MED
COARSE — CSE
CRYSTALLINE — XLN
GRAIN — GRN
GRANULAR — GRNL
BROWN — BRN
GRAY — GY
VUGGY — VGY
FRACTURED — FRAC
LAMINATION — LAM
STYLOLITIC — STY
SLIGHTLY — SL/
VERY — V/
WITH — W/

SAMPLE NUMBER	DEPTH METRES	PERMEABILITY MILLIDARCYS KA	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE		GRAIN DENSITY	SAMPLE DESCRIPTION AND REMARKS
				OIL	TOTAL WATER		
1	1424.0	2.3	18.5	3.0	68.8	2.59	SS: lt gy, vfg, w ind, w std, nor calc cmtd, sub ang, carb banding, micac.
2	1424.3	0.4	12.0			2.54	SS: m gy, vfg, w ind, w std, sl calc cmtd, sub ang, carb slt banding, micac, tr pyr.
3	1424.6	0.4	14.1			2.59	SLTST: m gy, w ind, sl calc cmtd, micac, ss banding, carb slt banding, tr pyr.
4	1425.0	1.2	15.0			2.51	SLTST: dk gy, w ind, sl calc cmtd micac, ss banding, carb slt banding, tr pyr.
5	1425.3	5.3	14.1			2.48	SH: dk gy, w ind,non calc cmtd, ss banding, vfg, fri, w std, non calc, sub ang sub rnd.
6	1425.6	47	24.9			2.61	SS: lt gy, vfg, w ind, p std, non calc cmtd, sub ang sub rnd, carb banding, micac.
7	1426.0	0.9	16.1			2.53	SS: lt gy, vfg, w ind, w std, non calc cmtd, sub ang sub rnd, carb silty banding, micac.
8	1427.2	2.1	14.2	0.0	70.0	2.36	SS: dk gy, vfg, w ind, p std, non calc cmtd, sub ang sub rnd, slt carb micac, banding, micac.
9	1427.8	0.6	7.8	0.0	83.2	2.54	SS: lt gy, vfg, w ind, w std, cal cmtd, sub ang sub rnd, calc slt carb micac banding.
10	1428.1	7.9	18.2			2.60	SS: lt gy, vfg, w ind, p std, cal cmtd, carb lams, carb specks, wh clay, occ fg ss.
11	1440.72	1.7	17.4			2.64	SS: dk gy, vfg, w ind, w std, non calc cmtd, sub ang sub rnd, carb inc, micac, occ mg ss.
12	1440.93	2.9	17.6			2.63	SS: dk gy, slt-vfg, w ind, p std, non calc cmtd, sub ang sub rnd, carb lams, micac, wh cly, occ mg ss.

CL-511-1

CORE LABORATORIES, INC.

Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

Company HUDBAY OIL (AUST) LTD
Formation
File WA-CA-196
Well WEST SEAHORSE NO. 2
Core Type CONV 1 & 2
Date Report 16 APRIL, 82
Field
Drilling Fluid
Analysts GK, AP, GO
County AUSTRALIA
State VIC
Elev.
Location

Lithological Abbreviations

SAND — SD	DOLOMITE — DOL	ANHYDRITE — ANHY	SANDY — SDY	FINE — FN	CRYSTALLINE — XLN	BROWN — BRN	FRACTURED — FRAC	SLIGHTLY — SL/
SHALE — SH	CHERT — CH	CONGLOMERATE — CONG	SHALY — SHY	MEDIUM — MED	GRAIN — GRN	GRAY — GY	LAMINATION — LAM	VERY — V/
LIME — LM	GYPSUM — GYP	FOSSILIFEROUS — FOSS	LIMY — LMY	COARSE — CSE	GRANULAR — GRNL	VUGGY — VGY	STYLOLITIC — STY	WITH — W/

SAMPLE NUMBER	DEPTH METRES	PERMEABILITY MILLIDARCYS KA	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	GRAIN DENSITY	SAMPLE DESCRIPTION AND REMARKS
13	1441.2	0.03	5.5			2.69	SS: gy brn, vf-fg, w ind, p std, calc cmtd, sub ang rnd, dk brn carb slt banding, calcitic mtrx, occ carb inc, sckt mg ss.
14	1441.35	0.02	3.4			2.68	SS: m gy brn, vf-fg, w ind, p std calc cmtd, sub ang rnd, vfg-cg band, calcitic mtrx.
15	1441.71	0.04	2.8			2.68	SS: mgy, slt vfg, w ind, p std, calc cmtd, sub ang sub rnd, dk br slt carb micac banding inc, occ cg ss, tr pyr, calcitic mtrx.
16	1442.02	0.03	2.4			2.69	SS: dk gy, vfg, w ind, p std, calc cmtd, sub ang sub rnd, calcitic mtrx.
17	1442.21	0.01	3.1			2.62	SS: dk gy, vfg, w ind, p std,calc cmtd, sub ang rnd, calcitic mtrx, wh cly, slty carb inc.
18	1442.45	0.01	4.0			2.65	SS: dk gy brn, slt vfg, w ind, p std, sub ang rnd, calcitic mtrx, slty carb inc, micac.
19	1442.75	<0.01	7.7			2.64	SS: dk gy brn, slt vfg, w ind, p std, sub ang rnd, calcitic mtrx, occ f-mg, micac, carb.
20	1443.02	17	15.7			2.56	SS: m gy, vf-fg, w ind, p std, non calc cmtd, sub ang rnd, slty carb banding, cong band, slty cly mtrx.
21	1443.37	2.2	14.9			2.57	SS: m gy, vf-fg, w ind, p std, non calc cmtd, sub ang rnd, slty carb banding, wh cly.
22	1443.68	19	23.2			2.63	SS: lt gy, fg, w ind, m std, non calc cmtd, sub ang rnd, slty cart banding, micac.
23	1443.87	11	22.1			2.62	SS: lt gy, fg, w ind, w std, non calc cmtd, sub ang rnd, slty cart lams, carb inc, slty cly mtrx.
24	1444.21	0.04	16.3			2.59	SS: mgy, f-cg, w ind, p std, non calc cmtd, sub ang rnd, slty cart inc, micac, slty cly mtrx.

CL-511-1

CORE LABORATORIES, INC.

Petroleum Reservoir Engineering
DALLAS, TEXAS

Page No. 3 of 3

CORE ANALYSIS RESULTS

Company HUDBAY OIL (AUST) LTD
Formation
File WA-CA-196
Well WEST SEAHORSE NO. 2
Core Type CONV 1 & 2
Date Report 16 APRIL, 82
Field
Drilling Fluid
Analysts GK, AP, GO
County AUSTRALIA
State VIC
Elev.
Location

Lithological Abbreviations

SAND — SD	DOLOMITE — DOL	ANHYDRITE — ANHY	SANDY — SDY	FINE — FN	CRYSTALLINE — XLN	BROWN — BRN	FRACTURED — FRAC	SLIGHTLY — SL
SHALE — SH	CHERT — CH	CONGLOMERATE — CONG	SHALY — SHY	MEDIUM — MED	GRAIN — GRN	GRAY — GY	LAMINATION — LAM	VERY — V/
LIME — LM	GYPSUM — GYP	FOSSILIFEROUS — FOSS	LIMY — LMY	COARSE — CSE	GRANULAR — GRNL	VUGGY — VGY	STYLOLITIC — STY	WITH — W/

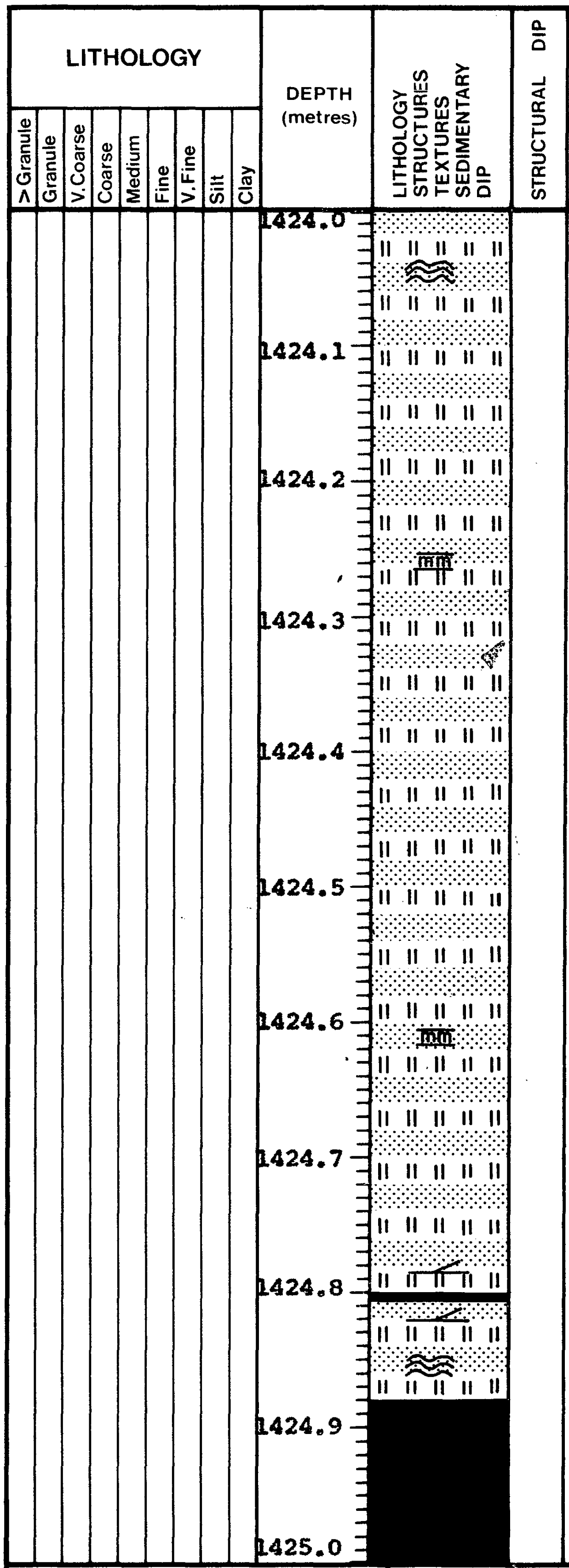
SAMPLE NUMBER	DEPTH METRES	PERMEABILITY MILLIDARCYS KA	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	GRAIN DENSITY	SAMPLE DESCRIPTION AND REMARKS
25	1444.52	1.4	15.6			2.61	SS: mgy, f-mg, w ind, p std, non calc cmtd, sub ang rnd, slty carb inc, micac, slty cly mtrx.
26	1444.68	1.2	15.4			2.59	SS: mgy, vf-fg, w ind, p std, non calc cmtd, sub ang rnd, slty carb inc, slty cly mtrx.
27	1445.02	39	22.4			2.67	SS: mgy, vf-cg, w ind, p std, non calc cmtd, sub ang rnd, slty cly mtrx.
28	1445.30	154	25.0			2.67	SS: mgy, fg, w ind, p std, non calc cmtd, sub ang sub rnd, slty cly mtrx, silty carb lams.
29	1445.77	646	27.4			2.67	SS: mgy, f-cg, w ind, p std, non calc cmtd, ang sub rnd, cly mtrx, carb.
30	1445.94	50	21.0			2.67	SS: A/A.
31	1446.23	114	21.7			2.67	SS: A/A.
32	1446.48	333	24.5			2.65	SS: mgy, f-mg, w ind, p std, non calc cmtd, ang sub rnd, cly mtrx, carb, slty carb banding.
33	1446.73	124	24.3			2.64	SS: mgy, fg, w ind, m std, non calc cmtd, ang sub rnd, cly mtrx, carb, slty carb banding.
34	1447.40	120	24.0			2.64	SS: A/A.
35	1447.69	3.4	17.1			2.62	SS: mgy, vf-fg, w ind, p std, non calc cmtd, ang sub rnd, slty carb lams and inc, slty cly mtrx, mica wh cly.
36	1447.88	1.0	14.3			2.52	SS: mgy, vf-fg, w ind, m std, non calc cmtd, ang sub rnd, slty carb lams and inc, slty cly mtrx, mica wh cly.

Hudbay Oil (Australia) Ltd.

West Seahorse - 2

CORE DESCRIPTION

Core Nº: 1



LITHOLOGICAL DESCRIPTION

SANDSTONE:- Off white to yellow grey, very fine to medium, dominantly medium-grained, interbedded with coal laminae and fine silt layers, trace mica, good intergranular porosity.

SANDSTONE/SILTSTONE:- 50/50 fine interbeds.

SANDSTONE:- Very light grey to light grey, very fine to fine-grained, moderately well sorted, angular to sub-angular, trace carbonaceous material, moderately hard, good intergranular porosity.

SILTSTONE:- Dark brown to black, 30-40% dark brown to black mica, trace carbonaceous material.

SANDSTONE:- Off white to dark brown, very fine to fine, moderately well sorted, fair intergranular porosity, with

SILTSTONE:- Dark brown, micaceous.

SANDSTONE:- Off white, very fine-grained, with thin laminae of dark brown, micaceous siltstone, poor porosity and permeability, trace carbonaceous material.

SANDSTONE:- Light brown to dull off white, very fine, minor coal steak, trace carbonaceous material, micromicaceous, some graded bedding.

COAL:- Black, brittle, vitreous lustre, conchoidal fracture, blocky in part.

HYDROCARBON INDICATIONS

90% bright yellow-gold fluorescence, instant blue-white solvent, dark yellow-brown oil staining, strong petroleum odour.

Geology By: J. Roestenburg	Vertical Scale: 1:5 (20cm = 1m)
Drawn By: C. Clarke	Date: 8·2·82

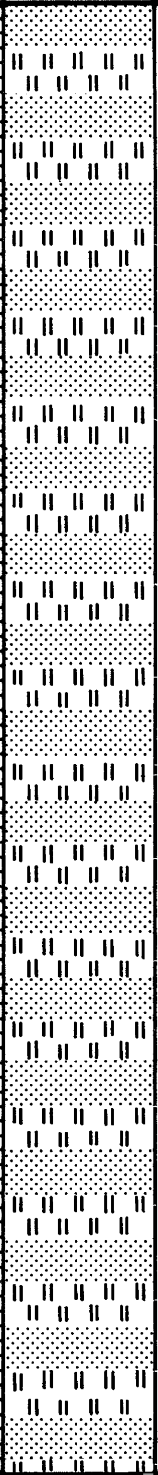
Drawing Nº: A4 - GL - 541

Hudbay Oil (Australia) Ltd.

West Seahorse - 2

CORE DESCRIPTION

Core No:1

LITHOLOGY >Granule, Granule, V.Coarse, Coarse, Medium, Fine, V.Fine, Silt, Clay	DEPTH (metres)	LITHOLOGY STRUCTURES TEXTURES SEDIMENTARY DIP	STRUCTURAL DIP	LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS
	1425.0			SILTSTONE:- Micromicaceous, dark brown to black, sub-fissile, carbonaceous, with minor	
	1425.1			SANDSTONE:- White to dark brownish black, very fine to granule, sub-angular to rounded, 40% clay matrix, trace kaolinite, reminicent of a basal deposit, carbonaceous and micaceous, hard.	
	1425.2				
	1425.3			SILSTONE: Dark brown to black, micromicaceous and carbonaceous, subfissile, moderately hard, micro-interbeds of sandstone.	Good fluorescence in sandstone interbeds.
	1425.4				
	1425.5			SANDSTONE:- White to light grey, very fine-grained, finely interbedded with:- SILTSTONE:- Dark brown to black, micromicaceous, good porosity and permeability. SANDSTONE:- White to light grey very fine-grained, finely interbedded with:- SILTSTONE:- Dark brown to black, micromicaceous, good porosity and permeability.	
	1425.6				
	1425.7				
	1425.8			SILTSTONE:- Dark brown to black, micromicaceous and carbonaceous, interbedded with:- SANDSTONE:- White to light grey, very fine-grained, fair intergranular porosity and permeability.	
	1425.9				
	1426.0				

Geology By: J. Roestenburg

Drawn By: C. Clarke

Vertical Scale: 1:5 (20cm = 1m)

Date: 8·2·82

Drawing No: A4 - GL - 541

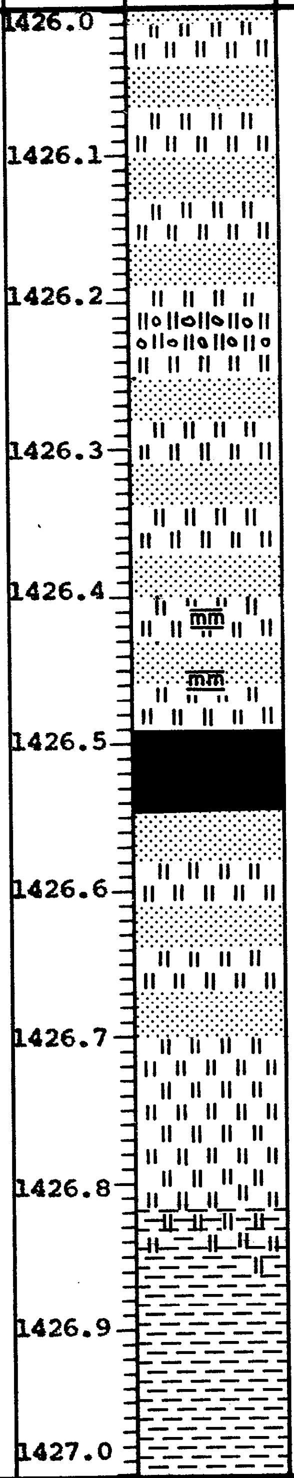
Hudbay Oil (Australia) Ltd.

West Seahorse - 2

CORE DESCRIPTION

Core Nº 1

LITHOLOGY (>Granule, Granule, V.Coarse, Coarse, Medium, Fine, V.Fine, Silt, Clay)	DEPTH (metres)	LITHOLOGY STRUCTURES TEXTURES SEDIMENTARY DIP	STRUCTURAL DIP	LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS



SILTSTONE:- Very dark brown to black, occasional quartz granules, micaceous in part, sub-fissile.

SILTSTONE/SANDSTONE:- Very fine interbeds, trace coal, mica and carbonaceous material.

SILTSTONE:- Dark grey to black, with minor interbeds of very fine-grained sandstone, grades to coal.

SILTSTONE:- Micromicaeous, black, grading to shale, hard, black, subfissile.

SHALE:- Black, very hard, conchoidal fracture.

Geology By: J. Roestenburg

Drawn By: C. Clarke

Vertical Scale: 1:5 (20cm = 1m)

Date: 8·2·82

Drawing Nº: A4 - GL - 541

Hudbay Oil (Australia) Ltd.

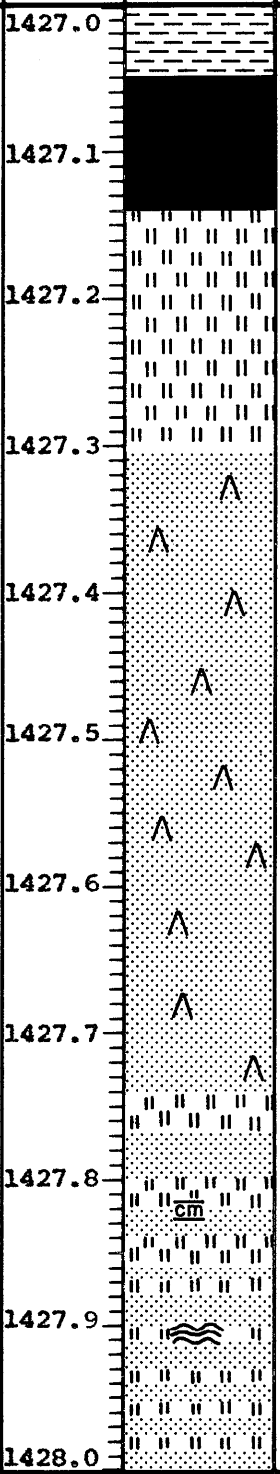
West Seahorse - 2

CORE DESCRIPTION

Core Nº: 1

LITHOLOGY: >Granule | Granule | V.Coarse | Coarse | Medium | Fine | V.Fine | Silt | Clay

LITHOLOGY STRUCTURES TEXTURES SEDIMENTARY DIP | STRUCTURAL DIP



DEPTH (metres)	LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS
1427.0	COAL:- Black, vitreous lustre, conchoidal fracture, brittle.	
1427.1		
1427.2	SILTSTONE:- Grey to dark grey, micromicaceous.	
1427.3	SANDSTONE:- Clear to blue grey, very fine, moderately well sorted, subangular, 50-70% silica cement after recrystallization, trace clay matrix and quartz silt, very hard, poor porosity and permeability, trace carbonaceous matter.	20-30% dull yellow-gold fluorescence, very slow solvent fluorescence, trace oil staining.
1427.4		
1427.5	SANDSTONE:- As above.	20-30% blue-yellow-gold fluorescence, trace oil staining.
1427.6		
1427.7	SANDSTONE:- Blue grey to dark grey, very fine-grained.	Trace pin-point, yellow-gold fluorescence.
1427.8	SILTSTONE/SANDSTONE:- Interbedded dark grey to dark brown, occasionally white, trace carbonaceous material.	
1427.9		
1428.0		

Geology By: J.Roestenburg
Vertical Scale: 1:5 (20cm = 1m)
Drawing Nº: A4 - GL - 541
Drawn By: C.Clarke
Date: 8·2·82

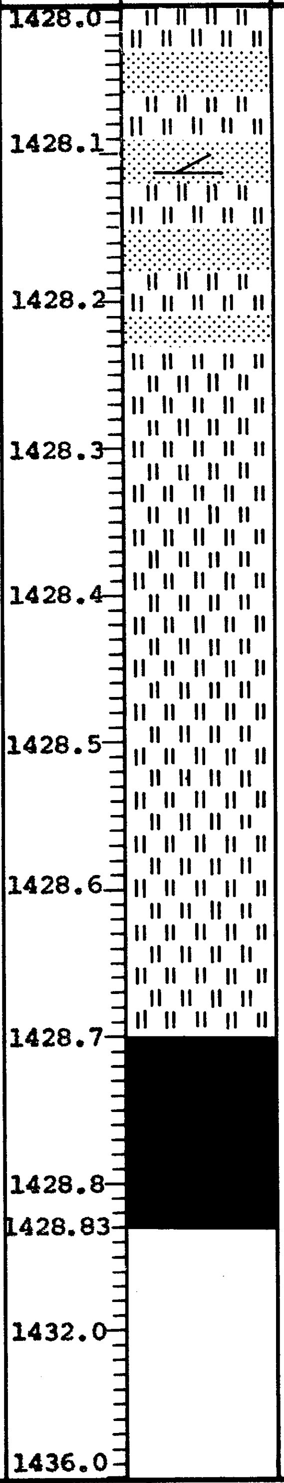
Hudbay Oil (Australia) Ltd.

West Seahorse-2

CORE DESCRIPTION

Core Nº: 1

LITHOLOGY (>Granule, Granule, V.Coarse, Coarse, Medium, Fine, V.Fine, Silt, Clay)	DEPTH (metres)	LITHOLOGY STRUCTURES TEXTURES SEDIMENTARY DIP	STRUCTURAL DIP	LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS



SANDSTONE:- White to dark red brown, very fine, trace - 10% carbonaceous material, sucrosic texture, interbedded with:- SILTSTONE:- Dark brown to grey, micromicaceous and carbonaceous.

SILTSTONE:- Dark grey to dark brown, micromicaceous, trace carbonaceous material.

SILTSTONE:- Dark grey, sub-fissile, micromicaceous.

COAL:- Black, brittle, vitreous lustre, conchoidal fracture.

NO RECOVERY

Geology By: J. Roestenburg

Drawn By: C. Clarke

Vertical Scale: 1:5 (20cm = 1m)

Date: 9·2·82

Drawing Nº: A4 - GL - 541

Hudbay Oil (Australia) Ltd.

West Seahorse –2

CORE DESCRIPTION

Core Nº: 2

LITHOLOGY									DEPTH (metres)	LITHOLOGY STRUCTURES TEXTURES SEDIMENTARY DIP	STRUCTURAL DIP	LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS
>Granule	Granule	V.Coarse	Coarse	Medium	Fine	V.Fine	Silt	Clay					
									1438.0	■		COAL:- Black, brittle, conchoidal fracture.	
									1438.1	■			
									1438.2	■			
									1438.3	■			
									1438.4	■			
									1438.5	■			
									1438.6	■			
									1438.7	■			
									1438.8	■			
									1438.9	■			
									1439.0	■			

Geology By: J. Roestenburg

Drawn By: T. Cole

Vertical Scale: 1:5 (20cm = 1m)

Date: 9-2-82

Drawing Nº: A4 – GL –563

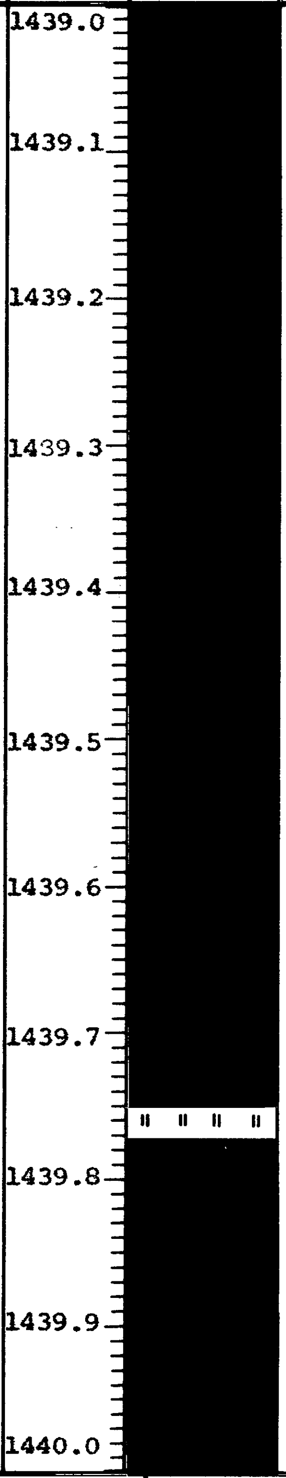
Hudbay Oil (Australia) Ltd.

West Seahorse -2

CORE DESCRIPTION

Core No: 2

LITHOLOGY >Granule, Granule, V.Coarse, Coarse, Medium, Fine, V.Fine, Silt, Clay	DEPTH (metres)	LITHOLOGY STRUCTURES TEXTURES SEDIMENTARY DIP	STRUCTURAL DIP	LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS
	1439.0			COAL:- Black, brittle, conchoidal fracture	
				SILTSTONE:- Dark brown to black, micromicaceous, hard.	Trace dull yellow-gold fluorescence.



Geology By: J. Roestenburg

Drawn By: T. Cole

Vertical Scale: 1:5 (20cm = 1m)

Date: 9-2-82

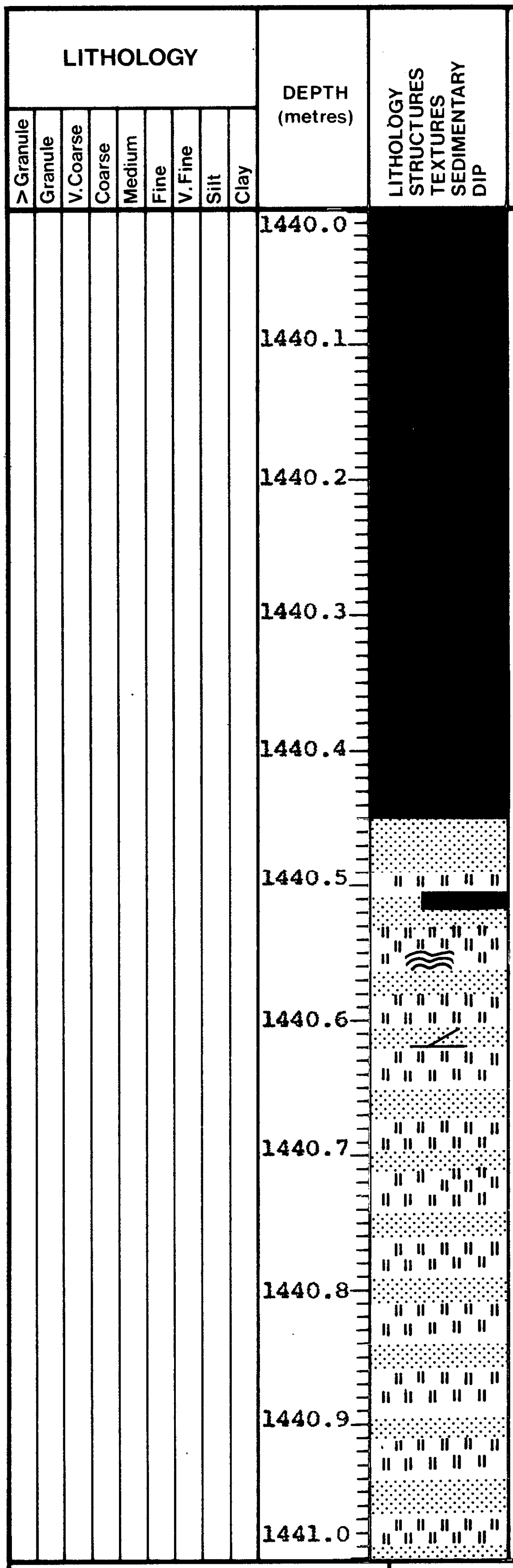
Drawing No: A4 - GL - 563

Hudbay Oil (Australia) Ltd.

West Seahorse -2

CORE DESCRIPTION

Core Nº: 2



LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS
COAL:- Black, vitreous, brittle, conchoidal fracture.	
SANDSTONE:- Light grey to dark greyish brown, very fine-grained, well sorted, sub-angular, 5-10% mica, trace clay matrix, trace carbonaceous material, sucrosic texture, moderately hard, fair inter-granular porosity. with interbeds of:- SILTSTONE:- Dark brown, micro-micaceous, sub-fissile, trace coal, moderately hard.	Minor trace pin-point blue-white fluorescence.

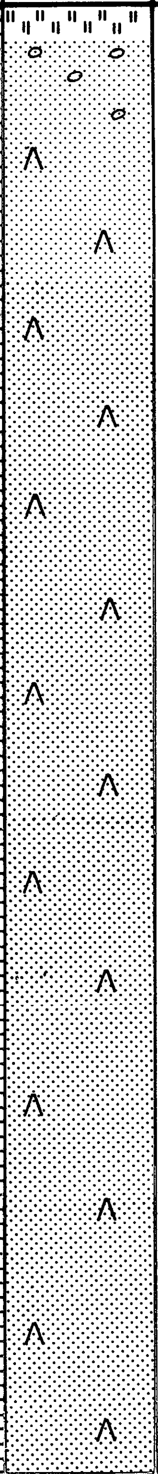
Geology By: J. Roestenburg	Vertical Scale: 1:5 (20cm = 1m)	Drawing Nº: A4 - GL - 563
Drawn By: T. Cole	Date: 9-2-82	

Hudbay Oil (Australia) Ltd.

West Seahorse -2

CORE DESCRIPTION

Core No: 2

LITHOLOGY									DEPTH (metres)	LITHOLOGY STRUCTURES TEXTURES SEDIMENTARY DIP	STRUCTURAL DIP	LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS
>Granule	Granule	V.Coarse	Coarse	Medium	Fine	V.Fine	Silt	Clay					
									1441.0 1441.1 1441.2 1441.3 1441.4 1441.5 1441.6 1441.7 1441.8 1441.9 1442.0			SANDSTONE:- Clear to white to light grey, very fine to granular, poorly sorted, angular to subrounded, trace-5% calcite cement, trace quartz silt, pyrite, mica, unconsolidated to moderately hard, (bioturbated?) SANDSTONE from 1440.75m:- Clear to light brown, very fine to very coarse, dominantly coarse, trace calcite cement, mica, garnet, and carbonaceous material, 50-70% silicification, becoming finer with depth, very hard, nil to poor intergranular porosity, very poor permeability, no apparent structure, possibly bioturbated.	Trace dull yellow-gold fluorescence. Trace dull yellow fluorescence.

Geology By: J.Roestenburg

Drawn By: T. Cole

Vertical Scale: 1:5 (20cm = 1m)

Date: 9-2-82

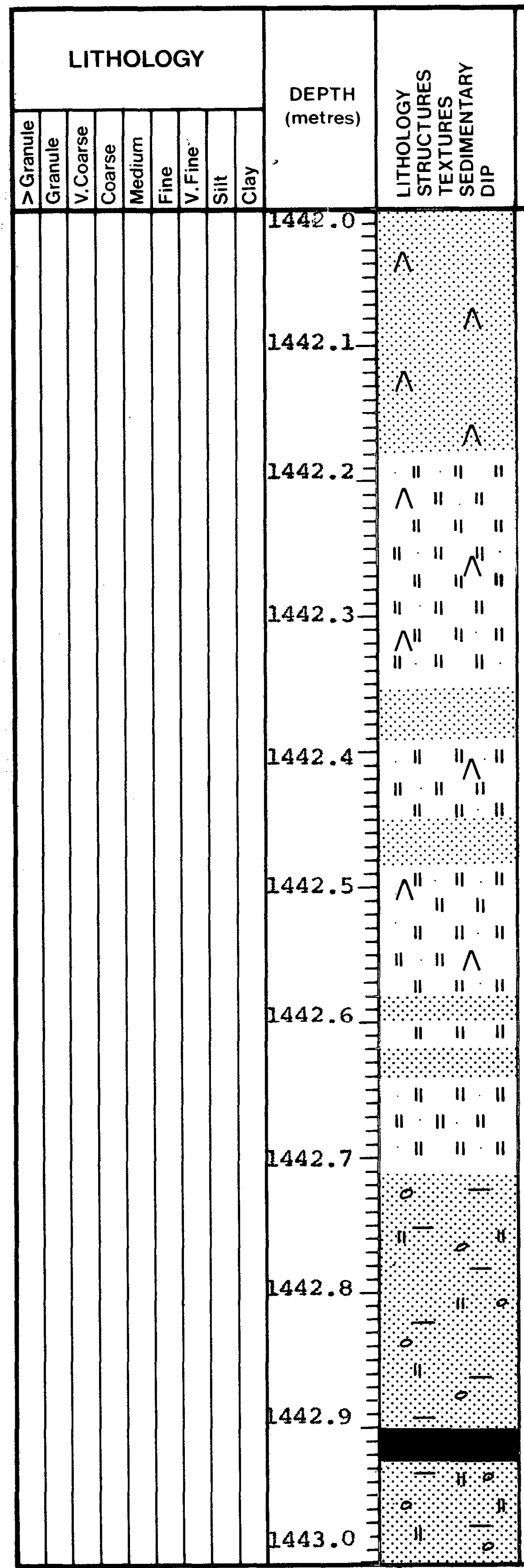
Drawing No: A4 - GL - 563

Hudbay Oil (Australia) Ltd.

West Seahorse -2

CORE DESCRIPTION

Core Nº: 2



DEPTH (metres)	LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS
1442.2	SILTSTONE:- Grey to dark grey, 15-20% very fine quartz grains, 20-30% silicification, micromicaceous, carbonaceous, very hard. With minor interbeds of:- SANDSTONE.	Trace dull yellow fluorescence
1442.7	SANDSTONE:- Argillaceous, clear to dark grey, very fine to granular, poorly sorted, subangular to subrounded, trace-10% clay matrix, 5-20% silt, trace glauconite, moderately hard, poor intergranular porosity, fair permeability.	Trace fluorescence.
	COAL:- Black, brittle.	
1443.0	SANDSTONE:- As at 1442.7 m.	

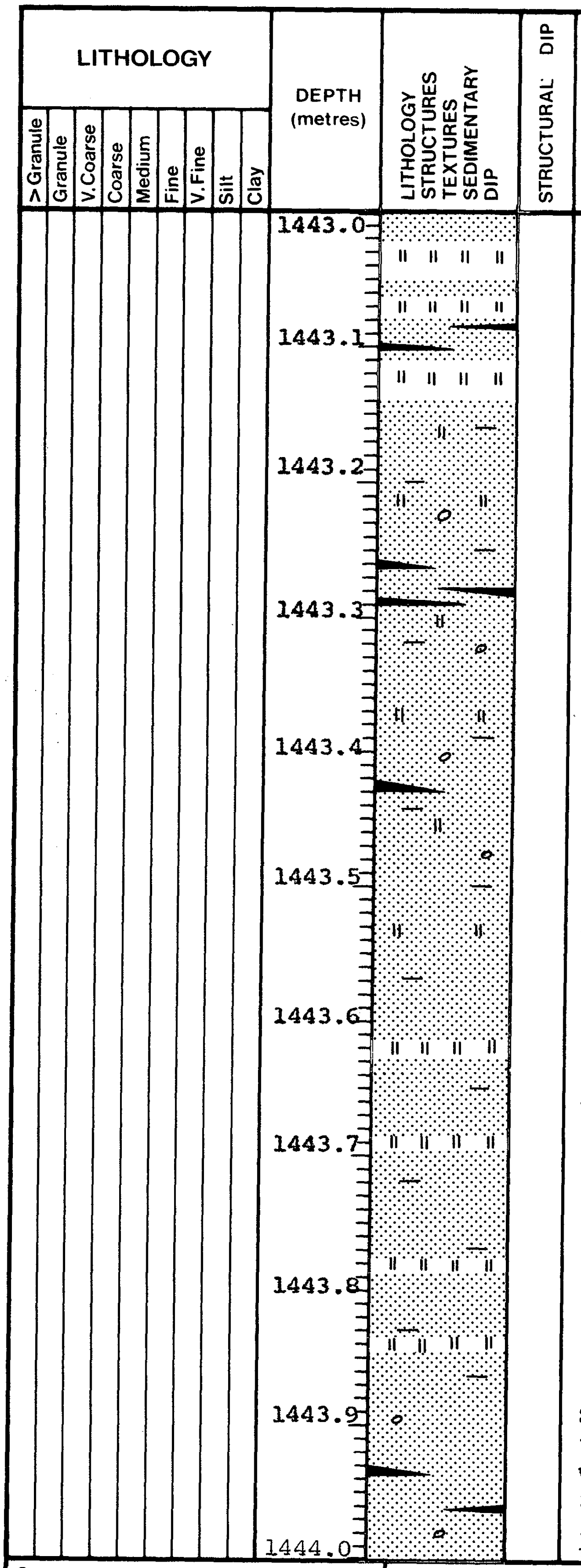
Geology By: J. Roestenburg
Drawn By: T. Cole
Vertical Scale: 1:5 (20cm = 1m)
Date: 9-2-82
Drawing Nº: A4-GL-563

Hudbay Oil (Australia) Ltd.

West Seahorse - 2

CORE DESCRIPTION

Core Nº: 2



LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS
SANDSTONE:- Clear to light grey, very fine to medium, interbedded with:- SILTSTONE:- Dark brown, micromicaceous, with minor coal stringers.	
SANDSTONE:- Argillaceous, clear to dark grey, very fine to granule, poorly sorted, subangular to subrounded, trace-10% clay matrix, 5-20% silt, trace glauconite, moderately hard, poor porosity, fair permeability Thin coal laminae.	
SANDSTONE:- Clear to light grey to dark brown, very fine to medium grained, occasionally, coarse and very coarse, subangular, trace clay minerals, silt, carbonaceous material, moderately hard, sucrosic, fair to good intergranular porosity, with minor siltstone interbeds.	
SANDSTONE:- Clear to grey, fine to medium-grained, moderately well sorted, subangular to subrounded, trace mica, unconsolidated, occasional quartz granule, minor coal laminae.	Trace dull yellow-gold fluorescence

Geology By: J. Roestenburg

Drawn By: T. Cole

Vertical Scale: 1:5 (20cm = 1m)

Date: 9-2-82

Drawing Nº: A4 - GL - 563

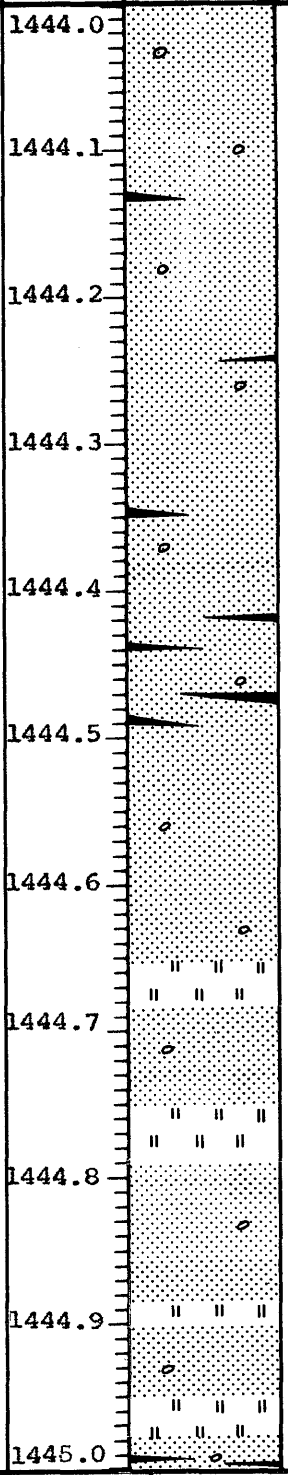
Hudbay Oil (Australia) Ltd.

West Seahorse -2

CORE DESCRIPTION

Core Nº: 2

LITHOLOGY (>Granule, Granule, V.Coarse, Coarse, Medium, Fine, V.Fine, Silt, Clay)	DEPTH (metres)	LITHOLOGY STRUCTURES TEXTURES SEDIMENTARY DIP	STRUCTURAL DIP	LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS



SANDSTONE:- as above, becoming lighter in colour and fining downwards, increasing coal laminae.

SANDSTONE:- Clear to white to light grey, occasionally dark brown, very fine to coarse, occasionally granule,with interbeds of

SILTSTONE:- Dark brown, micromicaceous, carbonaceous, hard.

Minor coal stringer.

Geology By: J. Roestenburg

Drawn By: T.Cole

Vertical Scale: 1:5 (20cm = 1m)

Date: 9-2-82

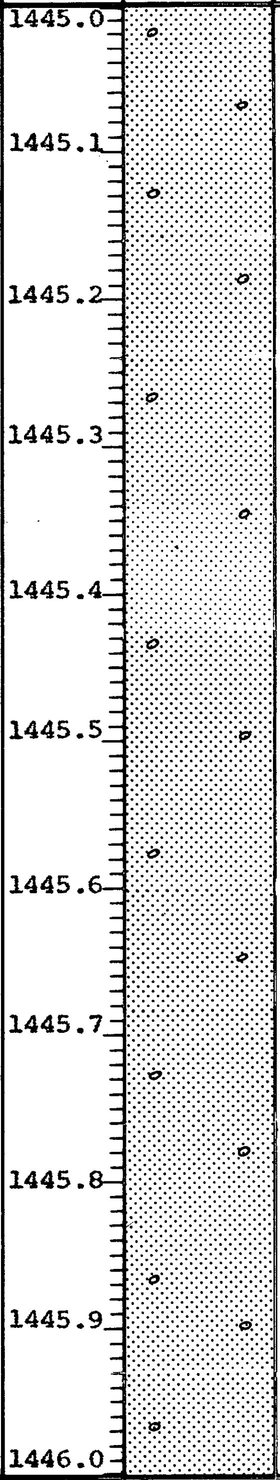
Drawing Nº: A4 - GL - 563

Hudbay Oil (Australia) Ltd.

West Seahorse – 2

CORE DESCRIPTION

Core No: 2

LITHOLOGY									DEPTH (metres)	LITHOLOGY STRUCTURES TEXTURES SEDIMENTARY DIP	STRUCTURAL DIP	LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS
>Granule	Granule	V.Coarse	Coarse	Medium	Fine	V.Fine	Silt	Clay					
												SANDSTONE:- Clear to dark grey, fine to coarse, dominantly medium, occasionally granule, moderately well sorted, angular to subrounded, trace carbonaceous material, unconsolidated.	

Geology By: J.Roestenburg

Drawn By: T. Cole

Vertical Scale: 1:5 (20cm = 1m)

Date: 9-2-82

Drawing No: A4 – GL – 563

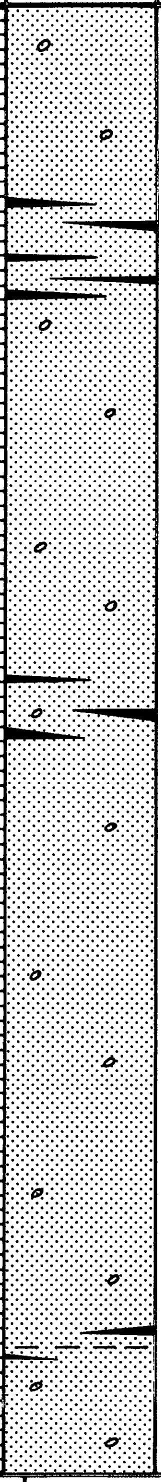
Hudbay Oil (Australia) Ltd.

West Seahorse - 2

CORE DESCRIPTION

Core Nº: 2

LITHOLOGY >Granule / Granule / V.Coarse / Coarse / Medium / Fine / V.Fine / Silt / Clay	DEPTH (metres)	LITHOLOGY STRUCTURES TEXTURES SEDIMENTARY DIP	STRUCTURAL DIP	LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS
	1446.0			SANDSTONE:- As at 1445.0 metres.	
	1446.1				
	1446.2				
	1446.3				
	1446.4				
	1446.5				
	1446.6				
	1446.7				
	1446.8				
	1446.9			Minor coal laminae and very minor shale.	
	1447.0				



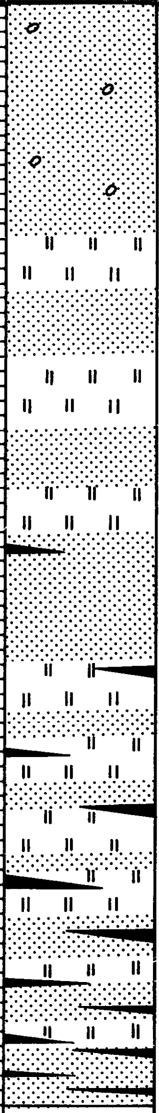
Geology By: J. Roestenburg	Vertical Scale: 1:5 (20cm = 1m)	Drawing Nº: A4 - GL -563
Drawn By: T. Cole	Date: 9-2-82	

Hudbay Oil (Australia) Ltd.

West Seahorse −2

CORE DESCRIPTION

Core No: 2

LITHOLOGY									DEPTH (metres)	LITHOLOGY STRUCTURES TEXTURES SEDIMENTARY DIP	STRUCTURAL DIP	LITHOLOGICAL DESCRIPTION	HYDROCARBON INDICATIONS
>Granule	Granule	V.Coarse	Coarse	Medium	Fine	V.Fine	Silt	Clay					
									1447.0 1447.1 1447.2 1447.3 1447.4 1447.5 1447.6 1447.7			SANDSTONE:- Clear to white to dark brown, fine to medium, moderately well sorted, subangular to subrounded, trace clay matrix, unconsolidated to moderately hard, with interbeds of SILTSTONE:- Dark brown, micromicaceous, and fine interbeds of coal, increasing at base of core.	
									1447.75 1448.0 1449.0			NO RECOVERY	

Geology By: J.Roestenburg	Vertical Scale: 1:5 (20cm = 1m)	Drawing No: A4 − GL − 563
Drawn By: T.Cole	Date: 8-2-82	

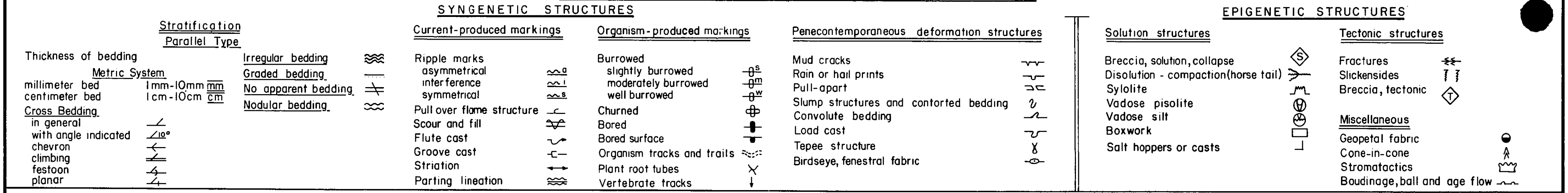
Hudbay Oil (Australia) Ltd.
Subsidiary of Hudson's Bay Oil and Gas Company Limited

SIDEWALL CORE DESCRIPTIONS

WELL: WEST SEAHORSE-2

DEPTH (metres)	RECOVERY (centimetres)	ROCK TYPE	COLOUR	CLAY SIZE %		SILT SIZE %		GRAINS TYPE & %			GRAINS SIZE		CEMENT		DIAGENESIS			ROUNDING	SORTING	HARDNESS	POROSITY TYPE & %	ACCESSORIES			HYDROCARBONS	SEDIMENTARY STRUCTURES	SUPPLEMENTARY DATA
				CLAY MINERALS	MICRITE	QUARTZ	CALCITE	QUARTZ	SKELETAL	CALCITE	RANGE	DOMINANT	TYPE & %	TYPE & %	TYPE	%	TEXTURE					TYPE & %	TYPE & %	TYPE & %			
1325	5.3	MARL	Olv gry	40	60															S					-		
1333.9	3.5	MARL	Med gry	60	40				Tr											S-M					-		
1343.1	4.3	MARL	Med gry	55	45															S-M					-		
1351.5	4.8	MARL	Med dk gry	65	35				Tr											S-M					-		
1363.5	4.0	MARL	Olv gry	65	35															S-M		Py /Tr	Gl/Tr		-		
1368.5	4.7	Glauconitic Silty MARL	Olv gry	30	30	15														M		Gl/25	Py/Tr		-		
1379	2.5	CLAYSTONE	Olv blk	60	15															S-M		Mc/10	G/15		-		
1389.5		NO RECOVERY																									
1395	3.5	CLAYSTONE	Olv blk	70	Tr	5														M		Gl/15	Py/10		-		
1403	3.5	CLAYSTONE	Olv blk	65	Tr	10		5			VF	VF						SR	W	M		Gl/15	Py / 5		-		

STRUCTURES (STRATIFICATION, SEDIMENTARY, DIAGENETIC)



SYNGENETIC STRUCTURES

Stratification
Parallel Type

Thickness of bedding
Metric System
millimeter bed 1mm-10mm mm
centimeter bed 1cm-10cm cm
Cross Bedding
in general
with angle indicated
chevron
climbing
festoon
planar

Irregular bedding
Graded bedding
No apparent bedding
Nodular bedding

Current-produced markings
Ripple marks
asymmetrical
interference
symmetrical
Pull over flame structure
Scour and fill
Flute cast
Groove cast
Striation
Parting lineation

Organism-produced markings
Burrowed
slightly burrowed
moderately burrowed
well burrowed
Churned
Bored
Bored surface
Organism tracks and trails
Plant root tubes
Vertebrate tracks

Penecontemporaneous deformation structures
Mud cracks
Rain or hail prints
Pull-apart
Slump structures and contorted bedding
Convolute bedding
Load cast
Tepee structure
Birdseye, fenestral fabric

EPIGENETIC STRUCTURES

Solution structures
Breccia, solution, collapse
Disolution - compaction(horse tail)
Sylolite
Vadose pisolite
Vadose silt
Boxwork
Salt hoppers or casts

Tectonic structures
Fractures
Slickensides
Breccia, tectonic

Miscellaneous
Geopetal fabric
Cone-in-cone
Stromatactics
Boudinage, ball and age flow

Abbreviations:

GRAIN SIZE
VF Very Fine
F Fine
M Medium
C Course
VC Very Coarse
G Granule & larger

CEMENT
Q Silica
Py Pyrite
C Calcite
D Dolomite
Sd Siderite

DIAGENESIS
D Dolomitization
Q Silicification
X Recrystallization
Ce Chloritization

ROUNDING
R Rounded
SR Subrounded
SA Subangular
A Angular

SORTING
P Poor
M Moderate
W Well
VW Very Well

HARDNESS
U Unconsolidated
VS Very Soft
S Soft
M Moderate
H Hard

POROSITY
g Intergranular
v Vugular
i Intraskeletal

ACCESSORIES
Py Pyrite
Mc Mica
Ch Chert
Cc Lignite/Coal
Hm Heavy minerals
Lf Lithic fragments
Gl Glauconite

DIAGENETIC TEXTURES
CX Crypto<1/256mm
MX Micro 1/256 - 1/16mm

HYDROCARBONS
✱ Signifies presence
Full details described under supplementary data

Hudbay Oil (Australia) Ltd.
Subsidiary of Hudson's Bay Oil and Gas Company Limited

SIDEWALL CORE DESCRIPTIONS

WELL: WEST SEAHORSE - 2

DEPTH (metres)	RECOVERY (centimetres)	ROCK TYPE	COLOUR	CLAY SIZE %		SILT SIZE %		GRAINS TYPE & %			GRAINS SIZE		CEMENT		DIAGENESIS			ROUNDING	SORTING	HARDNESS	POROSITY TYPE & %	ACCESSORIES			HYDROCARBONS	SEDIMENTARY STRUCTURES	SUPPLEMENTARY DATA
				CLAY MINERALS	MICRITE	QUARTZ	CALCITE	QUARTZ	SKELETAL	CALCITE	RANGE	DOMINANT	TYPE & %	TYPE & %	TYPE	%	TEXTURE					TYPE & %	TYPE & %	TYPE & %			
1407	2.3	Arenaceous CLAYSTONE	Olv gry - Olv blk	60				40			VF-G	F						SR	P	S		Gl/Tr			-		
1410	2.4	CLAYSTONE	Olv gry - Olv blk	100		Tr														S					-		
1411	2.5	CLAYSTONE SILTSTONE	Olv blk Lt olv gry	100 -		- 100														S					-	mm	Laminated silt and clay
1412	2.4	CLAYSTONE	Olv gry - Olv blk	90		10		Tr			VF							A		S					-	≋	Small oval lumps of silt in Clst (??Burrows??)
1413	2.5	Carbonaceous CLAYSTONE	Brnsh blk	50																S		Cc/50			-		
1414	2.0	Argillaceous SILTSTONE	Olv gry	35		55		10			VF	VF						SR	W	S		Cc/Tr			*	mm	Thin beds with increase in Cl Cont 100% dul yel crm flu in Sltst Instant blooming sol Fluor no cut
1415	3.0	SANDSTONE	Olv gry	5				95			VF-VC	M-C						SR	P	VS-U	g/20				*		50% brt lemon wh Spl Fluor Instant streaming bl-wh solv Fluor
1416	2.5	Argillaceous SANDSTONE	Lt gry - Olv gry	20				80			VF	VF						SR	W	S	g/5				*		Interbeds with var clay percent 20% bl-wh Fluor Mod blooming solv
1424	2.7	Argillaceous SILTSTONE	Lt olv gry	20		80														S					*	≋ mm	Mnr clay laminae, no Fluor 100% dull crm Fluor in Sltst Instant blooming solv
1427	3.3	SANDSTONE	Lt olv gry	10				90			VF-F	F						SA-SR	W	U	g/10				*		Bright cream-wh Fluor 95% Instant blooming solv

STRUCTURES (STRATIFICATION, SEDIMENTARY, DIAGENETIC)

SYNGENETIC STRUCTURES

Stratification

Parallel Type

Thickness of bedding

Metric System

millimeter bed 1mm-10mm mm
centimeter bed 1cm-10cm cm

Cross Bedding
- in general
- with angle indicated 10°
- chevron
- climbing
- festoon
- planar

Irregular bedding ≋
Graded bedding
No apparent bedding
Nodular bedding

Current-produced markings

Ripple marks
- asymmetrical
- interference
- symmetrical

Pull over flame structure
Scour and fill
Flute cast
Groove cast
Striation
Parting lineation

Organism-produced markings

Burrowed
- slightly burrowed
- moderately burrowed
- well burrowed

Churned
Bored
Bored surface
Organism tracks and trails
Plant root tubes
Vertebrate tracks

Penecontemporaneous deformation structures

Mud cracks
Rain or hail prints
Pull-apart
Slump structures and contorted bedding
Convolute bedding
Load cast
Tepee structure
Birdseye, fenestral fabric

EPIGENETIC STRUCTURES

Solution structures

Breccia, solution, collapse
Disolution - compaction (horse tail)
Sylolite
Vadose pisolite
Vadose silt
Boxwork
Salt hoppers or casts

Tectonic structures

Fractures
Slickensides
Breccia, tectonic

Miscellaneous

Geopetal fabric
Cone-in-cone
Stromatactics
Boudinage, ball and age flow

Abbreviations

GRAIN SIZE	
VF	Very Fine
F	Fine
M	Medium
C	Course
VC	Very Coarse
G	Granule & larger

CEMENT	
Q	Silica
Py	Pyrite
C	Calcite
D	Dolomite
Sd	Siderite

DIAGENESIS	
D	Dolomitization
Q	Silicification
X	Recrystallization
Ce	Chloritization

ROUNDING	
R	Rounded
SR	Subrounded
SA	Subangular
A	Angular

SORTING	
P	Poor
M	Moderate
W	Well
VW	Very Well

HARDNESS	
U	Unconsolidated
VS	Very Soft
S	Soft
M	Moderate
H	Hard

POROSITY	
g	Intergranular
v	Vugular
i	Intraskeletal

ACCESSORIES	
Py	Pyrite
Mc	Mica
Ch	Chert
Cc	Lignite/Coal
Hm	Heavy minerals
Lf	Lithic fragments
Gl	Glauconite

DIAGENETIC TEXTURES	
CX	Crypto <1/256mm
MX	Micro 1/256 - 1/16mm

HYDROCARBONS

✱ Signifies presence
Full details described under supplementary data

Hudbay Oil (Australia) Ltd.
Subsidiary of Hudson's Bay Oil and Gas Company Limited

SIDEWALL CORE DESCRIPTIONS

WELL: WEST SEAHORSE-2

DEPTH (metres)	RECOVERY (centimetres)	ROCK TYPE	COLOUR	CLAY SIZE %		SILT SIZE %		GRAINS TYPE & %			GRAINS SIZE		CEMENT		DIAGENESIS			ROUNDING	SORTING	HARDNESS	POROSITY TYPE & %	ACCESSORIES			HYDROCARBONS	SEDIMENTARY STRUCTURES	SUPPLEMENTARY DATA
				CLAY MINERALS	MICRITE	QUARTZ	CALCITE	QUARTZ	SKELETAL	CALCITE	RANGE	DOMINANT	TYPE & %	TYPE & %	TYPE	%	TEXTURE					TYPE & %	TYPE & %	TYPE & %			
1427.5	2.0	Silty CLAYSTONE	Olv gry	75		25														S	-	Cc/Tr			-	mm	
1430	3.2	SANDSTONE	Brnsh blk	10				90			F-G	VC						SR	P	VS	g/10				*		50-60% dull yel patchy Fluor Instant blooming bl-wh solv no cut
1431	2.0	Argillaceous SANDSTONE	Lt olv gry	25				75			VF	VF						SA-SR	W	S	g/Tr				-	≋	Laminations with increased % clay
1432	2.8	Carbonaceous CLAYSTONE	Olv blk	50		30														S		Cc/20			*	≋ mm	Silt occurs as v. thin laminations Tr brt orange Fluor instant blooming solv
1433	2.2	CLAYSTONE	Olv blk	100																S					-		
1434	3.0	COAL	Black	5																S	-	Cc/95			-		
1434.9	3.0	SANDSTONE	Lt olv gry	15				85			VF-F	F						SA-R	W	S	g/Tr	Cc/Tr			-		
1436	2.3	CLAYSTONE	Olv blk	85		15														S	-				-	≋ mm	Thin stringers of silt
1438	2.5	Silty SANDSTONE	lt gry - lt olv gry	15		35		50			VF	VF						SA-SR	W	S	g/Tr	Mc/Tr			-	≋ mm	
1443	——	NO RECOVERY ——																									

STRUCTURES (STRATIFICATION, SEDIMENTARY, DIAGENETIC)

SYNGENETIC STRUCTURES

Stratification

Parallel Type

Thickness of bedding

Metric System

millimeter bed	1mm-10mm	mm
centimeter bed	1cm-10cm	cm

Cross Bedding
- in general
- with angle indicated 10°
- chevron
- climbing
- festoon
- planar

Irregular Type
- Irregular bedding ≋
- Graded bedding
- No apparent bedding
- Nodular bedding

Current-produced markings
- Ripple marks
  - asymmetrical
  - interference
  - symmetrical
- Pull over flame structure
- Scour and fill
- Flute cast
- Groove cast
- Striation
- Parting lineation

Organism-produced markings
- Burrowed
  - slightly burrowed
  - moderately burrowed
  - well burrowed
- Churned
- Bored
- Bored surface
- Organism tracks and trails
- Plant root tubes
- Vertebrate tracks

Penecontemporaneous deformation structures
- Mud cracks
- Rain or hail prints
- Pull-apart
- Slump structures and contorted bedding
- Convolute bedding
- Load cast
- Tepee structure
- Birdseye, fenestral fabric

EPIGENETIC STRUCTURES

Solution structures
- Breccia, solution, collapse
- Disolution - compaction (horse tail)
- Sylolite
- Vadose pisolite
- Vadose silt
- Boxwork
- Salt hoppers or casts

Tectonic structures
- Fractures
- Slickensides
- Breccia, tectonic

Miscellaneous
- Geopetal fabric
- Cone-in-cone
- Stromatactics
- Boudinage, ball and age flow

Abbreviations:

GRAIN SIZE

VF	Very Fine
F	Fine
M	Medium
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VC	Very Coarse
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CEMENT

Q	Silica
Py	Pyrite
C	Calcite
D	Dolomite
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DIAGENESIS

D	Dolomitization
Q	Silicification
X	Recrystallization
Ce	Chloritization

ROUNDING

R	Rounded
SR	Subrounded
SA	Subangular
A	Angular

SORTING

P	Poor
M	Moderate
W	Well
VW	Very Well

HARDNESS

U	Unconsolidated
VS	Very Soft
S	Soft
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POROSITY

g	Intergranular
v	Vugular
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ACCESSORIES

Py	Pyrite
Mc	Mica
Ch	Chert
Cc	Lignite/Coal
Hm	Heavy minerals
Lf	Lithic fragments
Gl	Glauconite

DIAGENETIC TEXTURES

CX	Crypto <1/256mm
MX	Micro 1/256 - 1/16mm

HYDROCARBONS

✱ Signifies presence
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Hudbay Oil (Australia) Ltd.
Subsidiary of Hudson's Bay Oil and Gas Company Limited

SIDEWALL CORE DESCRIPTIONS

WELL: WEST SEAHORSE - 2

DEPTH (metres)	RECOVERY (centimetres)	ROCK TYPE	COLOUR	CLAY SIZE %		SILT SIZE %		GRAINS TYPE & %			GRAINS SIZE		CEMENT		DIAGENESIS			ROUNDING	SORTING	HARDNESS	POROSITY TYPE & %	ACCESSORIES			HYDROCARBONS	SEDIMENTARY STRUCTURES	SUPPLEMENTARY DATA
				CLAY MINERALS	MICRITE	QUARTZ	CALCITE	QUARTZ	SKELETAL	CALCITE	RANGE	DOMINANT	TYPE & %	TYPE & %	TYPE	%	TEXTURE					TYPE & %	TYPE & %	TYPE & %			
1449	3.0	CLAYSTONE SANDSTONE	Olv gry - Olv blk	100 20		Tr		- 80			VF-F	F						SA	W	VS	g/Tr				-	cm ≋	**Claystone/Sandstone**
1457	1.2	Carbonaceous CLAYSTONE	Brnsh blk	70																H	-	Cc/30			-	≋	Hard but brittle Micro bedding (laminations)
1475	2.5	Silty SANDSTONE	Lt olv gry			20		75			VF	VF						SA -SR	W	VS	g/Tr	Cc / 5	Mc/Tr		-	≋	Carbonaceous material occur as one 1-2mm coal seam
1512	4.0	CLAYSTONE	Lt olv gry	100																VS	-				-	-	
1552.5	1.5	CLAYSTONE	Lt olv gry - olv gry	90		10		Tr			VF							SA -SR	W	VS	-				*	-	V mnr Tr, v fine dull orange pin-point, v slow solv Fluor
1589.5	2.0	CLAYSTONE	Lt grnsh gry	90		10		Tr												VS	-				*		As at 1552.5 no cut
1610	3.0	CLAYSTONE	Olv gry	100																S					-		
1640	4.5	Carbonaceous CLAYSTONE	Brnsh blk	50																VS		Cc/50			-	≋	Irregular lumps of coal throughout
1645	2.2	CLAYSTONE	Brnsh gry - Olv gry	85		5		5			VF							SA	W	VS		Cc/5	Py/Tr		-	≋ mm	mm laminae of silty sand in Clst
1687	1.7	Argillaceous SANDSTONE	Lt blsh gry	20		5		75			VF-C	M	Py/Tr					SA	P	VS -U	g/5				-		Few smokey quartz grains

STRUCTURES (STRATIFICATION, SEDIMENTARY, DIAGENETIC)

SYNGENETIC STRUCTURES

Stratification
Parallel Type

Thickness of bedding

Metric System

millimeter bed	1mm-10mm	mm
centimeter bed	1cm-10cm	cm

Cross Bedding
- in general
- with angle indicated
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Irregular bedding ≋
Graded bedding
No apparent bedding
Nodular bedding

Current-produced markings
- Ripple marks
  - asymmetrical
  - interference
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- Pull over flame structure
- Scour and fill
- Flute cast
- Groove cast
- Striation
- Parting lineation

Organism-produced markings
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  - slightly burrowed
  - moderately burrowed
  - well burrowed
- Churned
- Bored
- Bored surface
- Organism tracks and trails
- Plant root tubes
- Vertebrate tracks

Penecontemporaneous deformation structures
- Mud cracks
- Rain or hail prints
- Pull-apart
- Slump structures and contorted bedding
- Convolute bedding
- Load cast
- Tepee structure
- Birdseye, fenestral fabric

EPIGENETIC STRUCTURES

Solution structures
- Breccia, solution, collapse
- Disolution - compaction (horse tail)
- Sylolite
- Vadose pisolite
- Vadose silt
- Boxwork
- Salt hoppers or casts

Tectonic structures
- Fractures
- Slickensides
- Breccia, tectonic

Miscellaneous
- Geopetal fabric
- Cone-in-cone
- Stromatactics
- Boudinage, ball and age flow

Abbreviations

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Q	Silica
Py	Pyrite
C	Calcite
D	Dolomite
Sd	Siderite

DIAGENESIS	
D	Dolomitization
Q	Silicification
X	Recrystallization
Ce	Chloritization

ROUNDING	
R	Rounded
SR	Subrounded
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SORTING	
P	Poor
M	Moderate
W	Well
VW	Very Well

HARDNESS	
U	Unconsolidated
VS	Very Soft
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POROSITY	
g	Intergranular
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ACCESSORIES	
Py	Pyrite
Mc	Mica
Ch	Chert
Cc	Lignite/Coal
Hm	Heavy minerals
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DIAGENETIC TEXTURES	
CX	Crypto<1/256mm
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Hudbay Oil (Australia) Ltd.
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SIDEWALL CORE DESCRIPTIONS

WELL: WEST SEAHORSE - 2

DEPTH (metres)	RECOVERY (centimetres)	ROCK TYPE	COLOUR	CLAY SIZE %		SILT SIZE %		GRAINS TYPE & %			GRAINS SIZE		CEMENT		DIAGENESIS			ROUNDING	SORTING	HARDNESS	POROSITY TYPE & %	ACCESSORIES			HYDROCARBONS	SEDIMENTARY STRUCTURES	SUPPLEMENTARY DATA
				CLAY MINERALS	MICRITE	QUARTZ	CALCITE	QUARTZ	SKELETAL	CALCITE	RANGE	DOMINANT	TYPE & %	TYPE & %	TYPE	%	TEXTURE					TYPE & %	TYPE & %	TYPE & %			
1722	1.8	Arenaceous CLAYSTONE	Lt gry - olv gry	80				20			VF	VF						SA	W	S		Py/Tr	Cc/Tr		-	≋ cm	Claystone with sand stringers
1760	1.9	SANDSTONE	Lt gry - lt Olv gry	15		5		80			VF-F	VF						SA - SR	W	VS	g/Tr	Cc/Tr			-		Laminations of coal
1786	2.7	Carbonaceous SANDSTONE	Lt gry - Olv blk	10				55			VF-F	VF	Py/5					SA - SR	W	S	g/Tr	Cc/30			-	mm	Laminations of carbonaceous material
1796	1.6	CLAYSTONE	Olv blk	95		5		Tr			VF	VF						SR	W	S	-				-		
1803	3.5	CLAYSTONE	Med gry	100				Tr			VF	VF						SA	W	S	-				-		
1811	1.0	Argillaceous SANDSTONE	Lt gry	25				75			VF-F	F						SA - SR	W	S	-	Cc/Tr	Py/Tr		-		Matrix supported
1826	1.6	Argillaceous SANDSTONE	Med gry	30				70			VF-M	F						SA - SR	W	S		Py/Tr			-		Matrix supported
1841	1.8	Silty CLAYSTONE	Lt gry	70		30														S		Py/Tr			-		Localised accumulations of pyrite
1844	1.7	Arenaceous CLAYSTONE	Olv blk	65				35			VF	VF						SA - SR	W	S		Py/Tr	Cc/Tr		-		
1850	1.5	Argillaceous SANDSTONE	Med dk gry	40				60			VF	VF						SA - SR	W	S		Cc/Tr	Py/Tr		-	≋	Laminae with increase in Cc

STRUCTURES (STRATIFICATION, SEDIMENTARY, DIAGENETIC)

SYNGENETIC STRUCTURES

Stratification
Parallel Type

Thickness of bedding
Metric System
millimeter bed 1mm-10mm mm
centimeter bed 1cm-10cm cm

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- in general
- with angle indicated 10°
- chevron
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Irregular bedding ≋
Graded bedding —
No apparent bedding
Nodular bedding

Current-produced markings
- Ripple marks
  - asymmetrical
  - interference
  - symmetrical
- Pull over flame structure
- Scour and fill
- Flute cast
- Groove cast
- Striation
- Parting lineation

Organism-produced markings
- Burrowed
  - slightly burrowed s
  - moderately burrowed m
  - well burrowed w
- Churned
- Bored
- Bored surface
- Organism tracks and trails
- Plant root tubes
- Vertebrate tracks ↓

Penecontemporaneous deformation structures
- Mud cracks
- Rain or hail prints
- Pull-apart
- Slump structures and contorted bedding
- Convolute bedding
- Load cast
- Tepee structure
- Birdseye, fenestral fabric

EPIGENETIC STRUCTURES

Solution structures
- Breccia, solution, collapse Ⓢ
- Disolution - compaction (horse tail)
- Sylolite
- Vadose pisolite
- Vadose silt
- Boxwork ☐
- Salt hoppers or casts

Tectonic structures
- Fractures
- Slickensides
- Breccia, tectonic Ⓣ

Miscellaneous
- Geopetal fabric
- Cone-in-cone
- Stromatactics
- Boudinagė, ball and age flow

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D	Dolomitization
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ROUNDING

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SORTING

P	Poor
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HARDNESS

U	Unconsolidated
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POROSITY

g	Intergranular
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ACCESSORIES

Py	Pyrite
Mc	Mica
Ch	Chert
Cc	Lignite/Coal
Hm	Heavy minerals
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Gl	Glauconite

DIAGENETIC TEXTURES

CX	Crypto<1/256mm
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HYDROCARBONS

✱ Signifies presence
Full details described under supplementary data

A4-GL-513

Hudbay Oil (Australia) Ltd.
Subsidiary of Hudson's Bay Oil and Gas Company Limited

SIDEWALL CORE DESCRIPTIONS

WELL: WEST SEAHORSE - 2

DEPTH (metres)	RECOVERY (centimetres)	ROCK TYPE	COLOUR	CLAY SIZE %		SILT SIZE %		GRAINS TYPE & %			GRAINS SIZE		CEMENT		DIAGENESIS			ROUNDING	SORTING	HARDNESS	POROSITY TYPE & %	ACCESSORIES			HYDROCARBONS	SEDIMENTARY STRUCTURES	SUPPLEMENTARY DATA
				CLAY MINERALS	MICRITE	QUARTZ	CALCITE	QUARTZ	SKELETAL	CALCITE	RANGE	DOMINANT	TYPE & %	TYPE & %	TYPE	%	TEXTURE					TYPE & %	TYPE & %	TYPE & %			
1861	1.5	Argillaceous SANDSTONE	Med lt gry	20				80			VF-F	VF						SA-SR	W	VS-U	g/Tr	Py/Tr	Cc/Tr		-		
1887	1.5	SANDSTONE	Lt gry	10				90			F-C	M						A-SA	W	VS	g/15	Py/Tr			-		
1936	1.9	SANDSTONE	Lt gry	15				85			VF-M	F-M						SA-SR	M	VS	g/5	Py/Tr			-		
1949	1.0	SANDSTONE	V lt gry - med gry	15				80			F-M	M	Q/5					SA-SR	W	VS	g/Tr	Cc/Tr			-		
1968	1.8	Silty CLAYSTONE	Olv gry	80		20														S		Cc/Tr			-		
1981	1.4	SANDSTONE	Lt gry	10				90			F-C	M						SA-SR	M	VS-U	g/5				-		10% clay is average Clay increase from 0-20% through sample
1985	1.0	Argillaceous SANDSTONE	Lt gry	35		5		60			VF	VF						SA-SR	W	VS	-				-		
2007	1.3	Argillaceous SANDSTONE	Lt gry	40		Tr		60			VF	VF						SA-SR	W	S	-				-		
2022	1.5	Argillaceous SANDSTONE	Lt gry	25		Tr		75			VF-M	F	Q/Tr					SA-SR	M	S	-				-		
2029	2.4	SANDSTONE	Lt gry	10				80			F-C	M						SA-SR	W	S	-	Cc/10	Py/Tr			≋	Stringer of black coal through middle of core

STRUCTURES (STRATIFICATION, SEDIMENTARY, DIAGENETIC)

SYNGENETIC STRUCTURES

Stratification

Parallel Type

Thickness of bedding

Metric System

millimeter bed	1mm-10mm	mm
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Graded bedding —
No apparent bedding
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Ripple marks
- asymmetrical (a)
- interference (i)
- symmetrical (s)

Pull over flame structure
Scour and fill
Flute cast
Groove cast
Striation
Parting lineation

Organism-produced markings

Burrowed
- slightly burrowed (s)
- moderately burrowed (m)
- well burrowed (w)

Churned
Bored
Bored surface
Organism tracks and trails
Plant root tubes
Vertebrate tracks

Penecontemporaneous deformation structures

Mud cracks
Rain or hail prints
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Breccia, solution, collapse (S)
Disolution - compaction(horse tail)
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Vadose silt
Boxwork
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Tectonic structures

Fractures
Slickensides
Breccia, tectonic (T)

Miscellaneous

Geopetal fabric
Cone-in-cone
Stromatactics
Boudinage, ball and age flow

Abbreviations

GRAIN SIZE

VF	Very Fine
F	Fine
M	Medium
C	Course
VC	Very Coarse
G	Granule & larger

CEMENT

Q	Silica
Py	Pyrite
C	Calcite
D	Dolomite
Sd	Siderite

DIAGENESIS

D	Dolomitization
Q	Silicification
X	Recrystallization
Ce	Chloritization

ROUNDING

R	Rounded
SR	Subrounded
SA	Subangular
A	Angular

SORTING

P	Poor
M	Moderate
W	Well
VW	Very Well

HARDNESS

U	Unconsolidated
VS	Very Soft
S	Soft
M	Moderate
H	Hard

POROSITY

g	Intergranular
v	Vugular
i	Intraskeletal

ACCESSORIES

Py	Pyrite
Mc	Mica
Ch	Chert
Cc	Lignite/Coal
Hm	Heavy minerals
Lf	Lithic fragments
Gl	Glauconite

DIAGENETIC TEXTURES

CX	Crypto<1/256mm
MX	Micro 1/256 - 1/16mm

HYDROCARBONS

✱ Signifies presence
Full details described under supplementary data

APPENDIX B8 LOG OF SAMPLES

APPENDIX B8

WEST SEAHORSE No.2 - LOG OF SAMPLES

Description of Cuttings Samples

All depths quoted are below the Rotary Table, which is 9.45 metres above Mean Spring Low Water and 48 metres above the sea floor.

Colours are taken from the Geological Society of America's "Rock Colour Chart". Samples were collected from the base of the 20 inch casing shoe, set at 191 metres.

210 - 350 metres (140 metres)	Calcarenite, rudaceous above 245 m, calcilutitic and calcisiltitic below 325 m, general decrease in grain size and increase in clay/silt fraction with depth, white to olive grey, poor to well sorted, angular to rounded, 0-40% micrite, 0-15% quartz silt, 0-15% calcite cement, trace pyrite, trace glauconite, trace carbonaceous material, unconsolidated to soft, very good to nil porosity. With between 230-245 m, 0-10% Sandstone, clear to dark yellow brown, fine to very coarse, dominantly medium, poorly sorted, subrounded to rounded, unconsolidated.
350 - 400 metres (50 metres)	Calcilutite, calcisiltitic, light olive grey to olive grey, 20-25% skeletal fragments, fine to coarse, 20-25% calcite silt, 5-10% quartz silt, 5-10% quartz grains, very fine, trace-15% calcite cement, trace glauconite, pyrite and carbonaceous material, soft. With below 380 m, 40-50% Calcarenite, olive grey, as between 210-350 m.

400 - 575 metres (175 metres)	Calcarenite, light olive grey, poorly to well sorted, angular to rounded, 0-40% micrite, 0-15% quartz silt, 0-30% quartz grains, very fine to very coarse, dominantly medium, 0-15% calcite cement, trace pyrite, trace glauconite, trace carbonaceous material, unconsolidated to moderately hard, very good to nil porosity. With 10-40% Calcilutite, calcisiltitic, light olive grey, as between 350-400 m.
575 - 800 metres (225 metres)	Calcarenite, yellowish grey to light olive grey, as between 210-350 m, trace to 65% carbonate grains below 600 m, 0-20% recrystallization below 750 m, trace vugular porosity below 750 m. With 10-45% Calcilutite, calcisiltitic, to 735 m, light olive grey to olive grey, as between 350-400 m.
800 - 895 metres (95 metres)	Calcarenite, recrystallised, light olive grey to olive grey, 20-35% carbonate grains, 10% skeletal fragments, 10-15% quartz grains, very fine to very coarse, dominantly medium to coarse, angular to rounded, poorly sorted, nil to trace micrite, trace glauconite, trace pyrite, hard. With 10-30% Calcilutite, olive grey, 10% calcite cement, trace quartz silt, trace skeletal fragments, soft. And below 810 m, 15-35% Claystone, micritic and silty below 825 m, dark grey, 15-20% micrite, 15-25% quartz silt, trace-10% skeletal fragments, 0-5% quartz grains, very fine, soft.

895 - 910 metres (15 metres)	Calcilutite, calcisiltitic, olive grey, as between 350-400m, 30-50% silt size fraction, increasing with depth. With 15-45% Claystone, micritic, silty, dark grey, as between 815-895 m. And 20-25% Limestone, recrystallised, light olive grey.
910 - 960 metres (50 metres)	Calcisiltite, Calcilutite, Calcarenite, olive grey to olive black, 30-40% quartz silt, 25-30% micrite, 10% calcite silt, 10-20% quartz grains, very fine to fine, 5% skeletal fragments, 5% clay minerals, trace carbonate grains, trace pyrite, nil to trace glauconite, soft to moderately hard. With 5-15% Limestone, recrystallised, as between 800-815 metres.
960 - 1045 metres (85 metres)	Calcilutite, Calcisiltitic, olive grey to olive black, 25-40% micrite, 35% quartz silt, 10% calcite silt, 5% clay minerals, 5% quartz grains, fine, 5% skeletal fragments, trace pyrite, soft. With 5-45% Marl, light grey to brown grey, 60-65% micrite, 35-40% clay minerals, soft.
1045 - 1285 metres (240 metres)	Marl, light grey to dark green grey, 40-65% micrite, 35-60% clay minerals, trace pyrite, nil to trace glauconite, soft. With above 1200m, 5-45% Calcilutite, as between 960-1045 m.

1285 - 1315 metres (30 metres)	Calcilutite, very light grey, 15% clay minerals, very soft. With 20-45% Marl, as between 1200-1285 m.
1315 - 1375 metres (60 metres)	Marl, light grey to dark green grey, 50-60% clay minerals, 35-45% micrite, trace-70% glauconite, trace-10% pyrite, trace skeletal fragments, 0-trace mica, soft. With 0-35% Calcilutite, argillaceous, light grey, 80-90% micrite, 10-20% clay minerals, trace pyrite, very soft.
1375 - 1402 metres (27 metres)	Claystone, micritic, glauconitic, olive black, 55-70% clay minerals, 10-20% micrite, 10-25% glauconite, trace-5% pyrite, trace mica, 0-5% calcite cement, 0-trace recrystallisation, 0-trace skeletal fragments, soft to moderately hard. With 0-20% Calcilutite, argillaceous in part, white to light grey, 80-100% micrite, 0-20% clay minerals, 0-trace pyrite, very soft.
1402 - 1410 metres (8 metres)	Sandstone, glauconitic, clear to light grey, medium to very coarse, dominantly coarse, subangular to rounded, trace pyrite and clay minerals, unconsolidated. With 30% Claystone, micritic, glauconitic, olive black, as between 1375-1402 m. And 10% Calcilutite, light grey, soft.
1410 - 1414 metres (4 metres)	Siltstone, dark brown to brown, micromicaceous, trace to 10% clay minerals, trace carbonaceous material moderately hard.

1414 - 1424 metres (10 metres)	Coal, black, brittle, vitreous lustre, conchoidal fracture, blocky, hard in part.
1424 - 1450 metres (26 metres)	Refer to Section 4.2.1 and Appendix B6 for details of the cores taken over this interval.
1450 - 1530 metres (80 metres)	Sandstone, clear to white, very fine to granular, dominantly medium to coarse, poor to well sorted, angular to rounded, 0-10% clay minerals, 0-trace quartz silt, 0-trace silicification, unconsolidated. With 0-60% Coal, black, moderately hard. And 0-65% Siltstone, grey to brown, black, 5% carbonaceous material and mica, soft to moderately hard.
1530 - 1605 metres (75 metres)	Sandstone, celar to white, very fine to granular, dominantly very coarse, grading to dominantly medium with depth, well to poorly sorted, subangular to rounded, 0-10% clay minerals, 0-10% dolomite, 0-trace pyrite, 0-trace glauconite, unconsolidated. With 0-40% Coal, black, soft to moderately hard, percentage decreases with depth. And below 1585 m, 0-5% Siltstone, argillaceous, light green grey, 40% clay minerals, trace glauconite, soft.
1605 - 1735 metres (130 metres)	Sandstone, clear to white to light grey, very fine to granular, dominantly medium to coarse, dominantly fine to medium below 1715 m, poorly sorted, subangular to subrounded, trace to 15% clay minerals, trace to 5% pyrite, 0-trace dolomite and glauconite to 1625 m, unconsolidated, poor to very good porosity.

With 0-20% Claystone, white to light brown grey, very soft.

And between 1625-1645 m, 5-50% Coal, black, soft.

1735 - 1805 metres
(70 metres)

Sandstone, clear to light grey, very fine to granular, dominantly medium to coarse, poor to moderate sorting, subangular to subrounded, 0-25% clay minerals increasing with depth, 0-5% silicification, 0-5% pyrite, trace coal at 1785 m, unconsolidated to very soft, very good to trace porosity.

1805 - 2050 metres (T.D.)
(245 metres)

Sandstone, argillaceous in part, clear to light grey, very fine to granular, dominantly fine to coarse, subangular to subrounded, moderate to poor sorting, trace-25% clay minerals, 0-10% silicification, trace to 5% pyrite, unconsolidated to soft, trace to very good porosity.

With 0-30% Claystone, silty in part, light grey to brown grey, trace-20% quartz silt, trace carbonaceous material, trace quartz grains, very fine, soft.

And between 1805-1835 m, trace-30% Coal, black, soft.

And between 2005-2025m, 0-5% Coal, black, soft.

PE601358

This is an enclosure indicator page.
The enclosure PE601358 is enclosed within the container PE902671 at this location in this document.

The enclosure PE601358 has the following characteristics:

ITEM_BARCODE = PE601358
CONTAINER_BARCODE = PE902671
NAME = Composite Well Log
BASIN = GIPPSLAND
PERMIT =
TYPE = WELL
SUBTYPE = COMPOSITE_LOG
DESCRIPTION = Composite Well Log
REMARKS =
DATE_CREATED = 12/02/1982
DATE_RECEIVED = 01/06/1983
W_NO = W765
WELL_NAME = West Seahorse-2
CONTRACTOR = Hudbay Oil Australia Ltd
CLIENT_OP_CO = Hudbay Oil Australia Ltd

(Inserted by DNRE - Vic Govt Mines Dept)

PE601359

This is an enclosure indicator page.
The enclosure PE601359 is enclosed within the container PE902671 at this location in this document.

The enclosure PE601359 has the following characteristics:

ITEM_BARCODE = PE601359
CONTAINER_BARCODE = PE902671
NAME = Air Gun Well Velocity Survey & calibrated log data
BASIN = GIPPSLAND
PERMIT =
TYPE = WELL
SUBTYPE = VELOCITY_CHART
DESCRIPTION = Air Gun Well Velocity Survey & calibrated log data
REMARKS =
DATE_CREATED = 13/02/1982
DATE_RECEIVED = 01/06/1983
W_NO = W765
WELL_NAME = West Seahorse-2
CONTRACTOR = Hudbay Oil Australia Ltd
CLIENT_OP_CO = Hudbay Oil Australia Ltd

(Inserted by DNRE - Vic Govt Mines Dept)

PE601360

This is an enclosure indicator page.
The enclosure PE601360 is enclosed within the container PE902671 at this location in this document.

The enclosure PE601360 has the following characteristics:

ITEM_BARCODE = PE601360
CONTAINER_BARCODE = PE902671
NAME = Wellsite Lithology Log
BASIN = GIPPSLAND
PERMIT =
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = Wellsite Lithology Log
REMARKS =
DATE_CREATED = 17/02/1982
DATE_RECEIVED = 01/06/1983
W_NO = W765
WELL_NAME = West Seahorse-2
CONTRACTOR = Hudbay Oil Australia Ltd
CLIENT_OP_CO = Hudbay Oil Australia Ltd

(Inserted by DNRE - Vic Govt Mines Dept)

PE601361

This is an enclosure indicator page.
The enclosure PE601361 is enclosed within the container PE902671 at this location in this document.

The enclosure PE601361 has the following characteristics:

ITEM_BARCODE = PE601361
CONTAINER_BARCODE = PE902671
NAME = Exlog Formation Evaluation Log
BASIN = GIPPSLAND
PERMIT =
TYPE = WELL
SUBTYPE = MUD_LOG
DESCRIPTION = Exlog Formation Evaluation Log
REMARKS =
DATE_CREATED = 23/01/1982
DATE_RECEIVED = 01/06/1983
W_NO = W765
WELL_NAME = West Seahorse-2
CONTRACTOR = EXLOG
CLIENT_OP_CO = Hudbay Oil Australia Ltd

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PE603916

This is an enclosure indicator page.
The enclosure PE603916 is enclosed within the container PE902671 at this location in this document.

The enclosure PE603916 has the following characteristics:
ITEM_BARCODE = PE603916
CONTAINER_BARCODE = PE902671
NAME = Velocity Log
BASIN = GIPPSLAND
PERMIT = VIC/P11
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = Velocity Log (from WCR) for West Seahorse-2
REMARKS =
DATE_CREATED = 12/02/82
DATE_RECEIVED = 1/06/83
W_NO = W765
WELL_NAME = WEST SEAHORSE-2
CONTRACTOR = SEISMOGRAPH SERVICE ENGLAND LIMITED
CLIENT_OP_CO = HUDBAY OIL (AUSTRALIA) LTD

(Inserted by DNRE - Vic Govt Mines Dept)

PE902672

This is an enclosure indicator page.
The enclosure PE902672 is enclosed within the container PE902671 at this location in this document.

The enclosure PE902672 has the following characteristics:

ITEM_BARCODE = PE902672
CONTAINER_BARCODE = PE902671
NAME = Tectonic Elements Map
BASIN = GIPPSLAND
PERMIT =
TYPE = GENERAL
SUBTYPE = GEOL_MAP
DESCRIPTION = Tectonic Elements Map
REMARKS =
DATE_CREATED = 01/05/1982
DATE_RECEIVED = 01/06/1983
W_NO = W765
WELL_NAME = West Seahorse-2
CONTRACTOR = Hudbay Oil Australia Ltd
CLIENT_OP_CO = Hudbay Oil Australia Ltd

(Inserted by DNRE - Vic Govt Mines Dept)