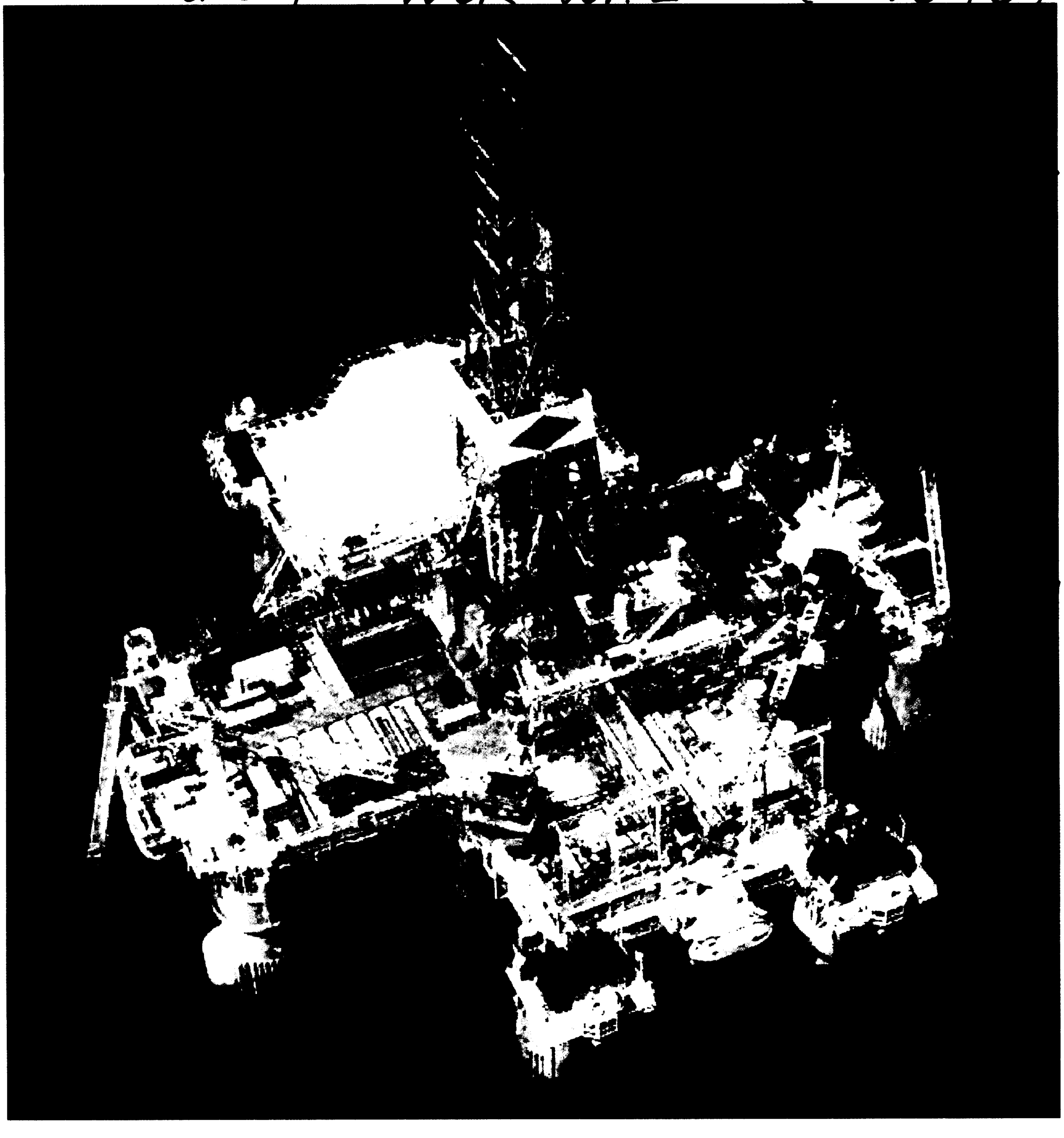
Esso Australia Pty Ltd

913714 001

WELL COMPLETION REPORT
BEARDIE-1
VOLUME 2
INTERPRETIVE DATA
FEBRUARY 2003

PAGE 1 OF 113

Beardie-1 WCR vol. 2 (W1340)



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VOLUME 2
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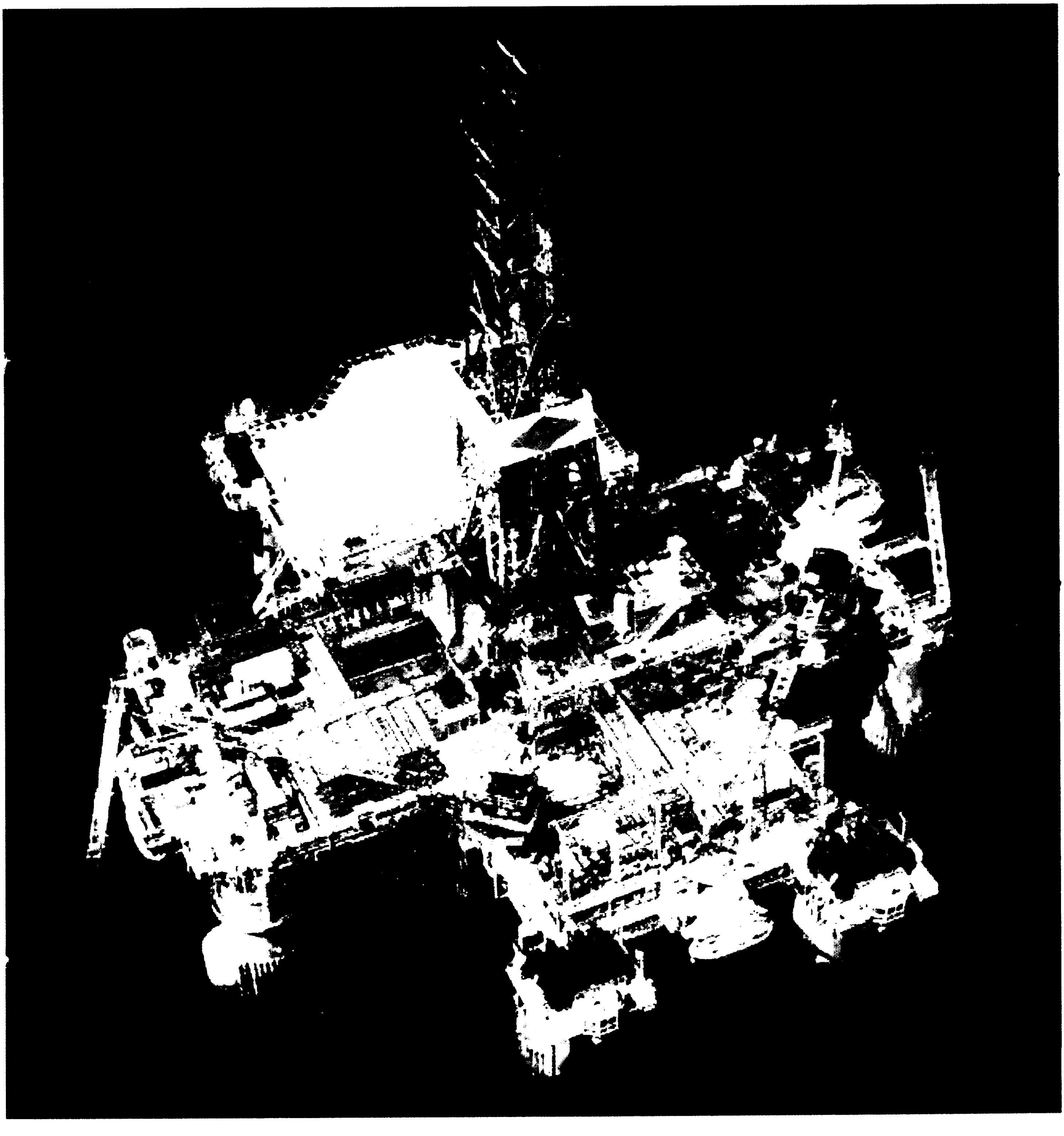

WELL COMPLETION REPORT

BEARDIE -1

VOLUME 2
INTERPRETIVE DATA

GIPPSLAND BASIN
VICTORIA

ESSO AUSTRALIA PTY LTD

Compiled by Andy Zannetos, Sheryl Sazenis
February 2003

WELL COMPLETION RPEORT
BEARDIE- 1

VOLUME 2:

INTEPRETATIVE DATA

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(cont'd)

913714 005

WELL COMPLETION RPEORT
BEARDIE -1

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1. INTRODUCTION

The Beardie-1 well was drilled as a wildcat exploration well, approximately 4 km west of Whiting-1 (Figure 1). The well was located in 51 metres of water, within the VIC/L2 licence area of the Gippsland Basin, and was drilled to a TD of 1880m TVDss.

The well spudded on 26th July 2002, and TD was reached on the 4th August 2002. The well was plugged and abandoned, and the rig was released on the 10th August 2002.

The Beardie-1 well targeted hyrdrocarbons in the fluvial reservoirs within the upper Latrobe Group (*N.asperus - L.balmei* age). A four way dip closure was mapped on the eastern part of the Barracouta anticline. The primary risk for the Beardie-1 well was closure adequacy with a secondary risk of fault seal adequacy was also identified.

2. SUMMARY OF WELL RESULTS

A comparison of prognosed versus actual formation tops penetrated in Beardie 1 is summarised in Table 1, and the relevant stratigraphy is summarised in Figure 2. The prognosed stratigraphy was based on adjacent well data within the Whiting and Barracouta fields.

The well intersected the Top of Coarse Clastics 12m deep to prognosis and the first prognosed reservoir, the N1.6, 20m deep to prediction. The two main targets the N2 and M1 were 21m and 45m, respectively, deep to prediction. The well found a total of 4.6 net metres of oil in thin sands within the N2 seal section. The oil bearing sands were intersected within the intervals (1407.8-1409mRT, 1410.3-1411.5mRT and 1413.5-1417mRT). No clear hydrocarbon contacts were seen on the log data, with all these oil intervals being oil on rock. These hydrocarbons are interpreted to be within the same system with a predicted oil water contact of 1401m TVDss (Fig 3).

No oil was found in the predicted main reservoirs and the well was assessed as uneconomic, then plugged and abandoned.

3. GEOLOGICAL DISCUSSION

OVERVIEW

Exploration in the Gippsland basin has historically focussed on the upper Latrobe, most of the large fields are Top Latrobe closures sealed by overlying Lakes Entrance Formation marine shales. Some large intra-Latrobe fields are also present such as the Tuna T-1 and Halibut/Cobia reservoir that are sealed by coastal plain shales. Within the greater Barracouta, Whiting and Snapper area there are several medium to small size intra-Latrobe hydrocarbon accumulations sealed by coastal plain shales and each of these fields has produced oil from the M.diversus section and above.

The G99A Barracouta3D seismic survey was aquired to progress delineation of the Barracouta gas field. The survey extends across all of Barracouta and includes the Wirrah-3 well. Interpretation of the Barracouta3D survey highlighted an intra-Latrobe closure near the eastern extent of the Barracouta field.

A 3D near trace stack dataset from the G02 Northern Fields3D seismic survey was used in the post-drill evaluation of Beardie-1.

REGIONAL SETTING

The initial formation of the Gippsland Basin was associated with rifting and subsidence that extended along the southern margins of Australia during the Jurassic to Early Cretaceous. During this period, deposition of predominantly volcanoclastic successions occurred in alluvial and fluvial environments, in NE trending en-echelon graben systems (Otway and Strzelecki groups). A phase of structuring and localised uplift of the Strzelecki Group occurred around 100-95Ma.

A renewed phase of Late Cretaceous (approximately 90 Ma) rifting coincided with the onset of Tasman seafloor spreading to the east of Tasmania. This resulted in the rapid development of extensional basins in the Gippsland area, with active extensional faults oriented WNW/ESE (oblique to the earlier extensional event). A thick (overall coarsening-up) succession was deposited in these tectonically active depocentres (Emperor-Golden Beach Groups). Initial rift deposition included marine and lacustrine shales in distal parts of the basin, while deltaic successions and alluvial fans developed along basin margins. The rift fill succession gradually evolved into a fluvial-dominated system. The upper parts of the Golden Beach Group (eg. Kipper sub-volcanic reservoir section) were predominantly braided fluvial to delta plain in character. As the northward migrating Tasman spreading centre passed by the Gippsland Basin around 85-80Ma, the eruption of mafic volcanics and emplacement of related intrusions occurred across the Gippsland Basin. These volcanics form the topseal for several hydrocarbon accumulations (eg. the Kipper volcanics).

The active rift phase in the Gippsland Basin ceased at approximately 80 Ma, as the Tasman Rift proceeded to migrate further northwards towards Queensland. From this time onwards, the Gippsland Basin evolved into essentially a failed arm of the Tasman Rift system. The Latrobe Group was deposited in this sag phase basin setting, with fault controlled subsidence continuing until the Late Paleocene. Most of the Latrobe Group was deposited in a non-marine setting behind a NE-SW tending beach-barrier complex. As sedimentation rates declined, the strandline moved to the northwest, depositing thin Eocene-aged glauconitic green sands over a wide area (Gurnard Formation).

Two major phases of canyon cutting occurred during the Tertiary. The Early Eocene Tuna/Flounder Channel was cut and then filled with predominantly marine sediments of the Flounder Formation. The Marlin Channel was cut during the Middle Eocene and partially filled with distal marine sediment of the Turrum Formation. Erosion associated with the top of Latrobe Group unconformity resulted in the formation of many of the hydrocarbon traps in the basin.

The end of the Latrobe Group is marked by deposition of marl and calcareous siltstone of the Lakes Entrance Formation in response to continued marine transgression in the Oligocene. Prograding limestone and calcareous siltstone wedges of the Gippsland Limestone result in the formation of the present day shelf.

Compressional events in the late Eocene to mid-Miocene caused selective inversion of faults around the basin and the establishment of the major ENE-WSW anticlinal trends in the basin.

3. GEOLOGICAL DISCUSSION (CONT'D)

STRATIGRAPHY

The actual stratigraphic section intersected is very close to predicted and is shown in Figure 2. The well intersected a thick succession of limestones and marls of the Gippsland Limestone, the Lakes Entrance Formation and a thick Latrobe clastic package. The Top Latrobe Coarse Clastics to the Cretaceous/Tertiary Flooding Surface (*N. asperuss* to the upper *L. balmei* age) section is comprised of thick braided fluvial non-marine deposits and marginal marine estuarine and bayhead delta deposits. Stacked sandstone channel facies sequence are interbeded with thin shales and coals, with laterally continous coals beds ranging up to 25m thick. Some dolomitisation has occurred within sandstones in this section.

The primary objective of the Beardie-1 well was to test the oil potential of the Eocene age upper Latrobe sands (*N.asperus to L.balmei* age) The main targets the N2 and M1 reservoirs came in 21m and 45m, respectively, deep to prognosis (1424m MD and 1658m MD). The secondary targets the N1.6, N1.7 and N4 were 20m, 21m and 25m, respectively, deep to prediction.

The Top of Coarse Clastics was 12m deep to prognosis (1195.7m MD). In the original Beardie-1 AtoD the Top of Coarse Clastics was incorrectly labelled as the Top of Latrobe this has been corrected in the Well Completion Report. All depth conversions pre-drill and post-drill were made to the Top of Coarse Clastics.

STRUCTURE

The Beardie area is part of the larger Barracouta-Whiting-Snapper anticlinal trend. The structure was formed by compressional deformation during the Eocene with several subsequent compressional episodes during the miocene. Like the Whiting structure the Beardie NS roll is formed by the reactivation of older normal faults that have undergone reversal during compression.

3. GEOLOGICAL DISCUSSION (CONT'D)

HYDROCARBON DISTRIBUTION

The Beardie 1 well intersected one reservoir system within the pre-drill interpreted N2 seal that at Whiting-2 had been observed to be a good sealing shale. At Beardie-1 several thin high quality sands exist in the basal part of the N2 shale that contain 4.6m of net oil. This system contains oil bearing sands within the intervals (1407.8-1409mRT, 1410.3-1411.5mRT and 1413.5-1417mRT). MDT pressure data gives an estimated oil gradient of 1.04psi/m with a predicted OWC at 1401m TVDss. This predicted contact is 3.5m deeper than the Top of the N2 reservoir where no hydrocarbons were intersected. It is therefore thought that this accumulation is stratigraphically trapped but still in pressure communication with the N2 sands.

4. GEOPHYSICAL DISCUSSION

GEOPHYSICAL DATA

The Beardie-1 prospect was highlighted by the G99A Barracouta survey. The prospect had been observed previously on 2D data but due to the limited coverage and depth conversion risk was not pursued. The seismic data quality on the Barracouta G99A is very good with improved multiple suppression and signal-to-noise ratio compared to previous 2D data.

The initial Barracouta G99A interpretation effort was directed at the N-1 gas at Top Latrobe and involved identifying and interpreting DHI's related to the original and current gas water contacts. Further work pursued the M-1 intra-latrobe oil accumulation beneath the Barracouta N-1 gas which lead to the re-visiting of the Beardie Prospect.

Five wells in the survey area were tied to the seismic data using synthetic seismograms these were Barracouta-1, 3, 4, 5 and Wirrah-3. In addition the Whiting-1 and 2 wells were tied in using G92 2D data.

After the drilling of Beardie-1 a larger seismic dataset became available, the G02 Northern Fields Near Trace Cube, that extended across the previously poorly controlled Whiting field. To better understand the nature, distribution and effect of Miocene channels on the depth conversion and structure a larger number of wells were used together with the Northern Fields 3D Near Trace Stack data. The wells included Seahorse-1 and 2, Harlequin-1, Wirrah-1,2 and 3, Snapper-3, 4 , 5 and 6, Barracouta-1 and 4, Whiting-1 and 2, as well as Beardie-1.

TIME INTERPRETATION

Time interpretations were completed on three Miocene horizons (HVC1, HVC2 and HVC3), the Top of Coarse Clastics, N2 and M1. The three Miocene horizons were observed to have significant velocity breaks or velocity gradient changes and were tied and correlated semi regionally through the area. The second Miocene horizon (HVC2) erodes down into the underlying Miocene sequence in the vicinity of Beardie-1 and the Whiting field (Encl. 4). The Top of Coarse Clastics was also carried semi regionally to give control to the overall depth conversion. The N2 and M1 were carried only around the eastern edge of Barracouta, across Beardie-1 and through the Whiting field. A synthetic produced from the Beardie-1 VSP, sonic and density logs produces a very good tie to the seismic data (Encl. 2). The time position of all key horizons were correctly interpreted pre-drill.

4. GEOPHYSICAL DISCUSSION (CONT'D)

DEPTH CONVERSION

New depth conversions were explored post-drill using the new G02 near trace stack seismic data, seismic velocities, additional wells and semi-regional miocene horizons. The time horizons were ported into Geodepth along with first pass velocity picks from the northern margin 3D that were spaced 500m apart. The depth conversion technique that produced the minimum error to the Top of Coarse Clastics at the wells was one that used seismic velocities to the Top of Coarse Clastics gridded using geostatistical gridding with the second miocene channel (HVC2) as control.

Depth conversion to the N2 was done by using smoothed interval velocities between TCC and the N2 calculated from seismic velocities which were used to isopach down to the N2. Depth conversion to the M1 was achieved by using a constant velocity of 3000m/s to build down from the final N2 depth map.

The final N2 and M1 depth maps display little or no closure at the Beardie-1 location.
It is interpreted that the time closure at Beardie-1 is almost entirely related to time pull up produced by lateral velocity variations within the miocene, mainly attributed to the channel formed by HVC2. On a regional time structure map through this area it is observed that the central axis of HVC2 extends over the Whiting-1 well, this produces a large time distortion on the TCC time map (Encl. 4). A feeder channel also extends over Beardie-1 also producing time pull-up.

The new depth conversion shows that little or no closure exists at the N2 and M1
levels at Beardie-1 (Encl. 3). The hydrocarbons intersected within the N2 seal are interpreted to be stratigraphically trapped across the eastern part of the Barracouta anticline

Tables

FORMATION RESERVOIR TOPS

Formation/ Zone	MtvDSS			mMDRT
	Predicted	Actual	Difference	
Top Lakes Entrance Fm	-1129	-1151	22m high	1176
Top Coarse Clastics	-1159	-1170.7	12m low	1195.7
N1.6	-1243	-1263	20m low	1288
N1.7	-1321	-1342	21m low	1367
N2	-1378	-1398	21m low	1423
N4	-1440	-1465	25m low	1490
M1	-1588	-1633	45m low	1658
Top L. Balmei	-1822	-1791	31m high	1816
TOTAL DEPTH	**-1880**	**-1880**	**0**	**1905**

Table 1.

Figures

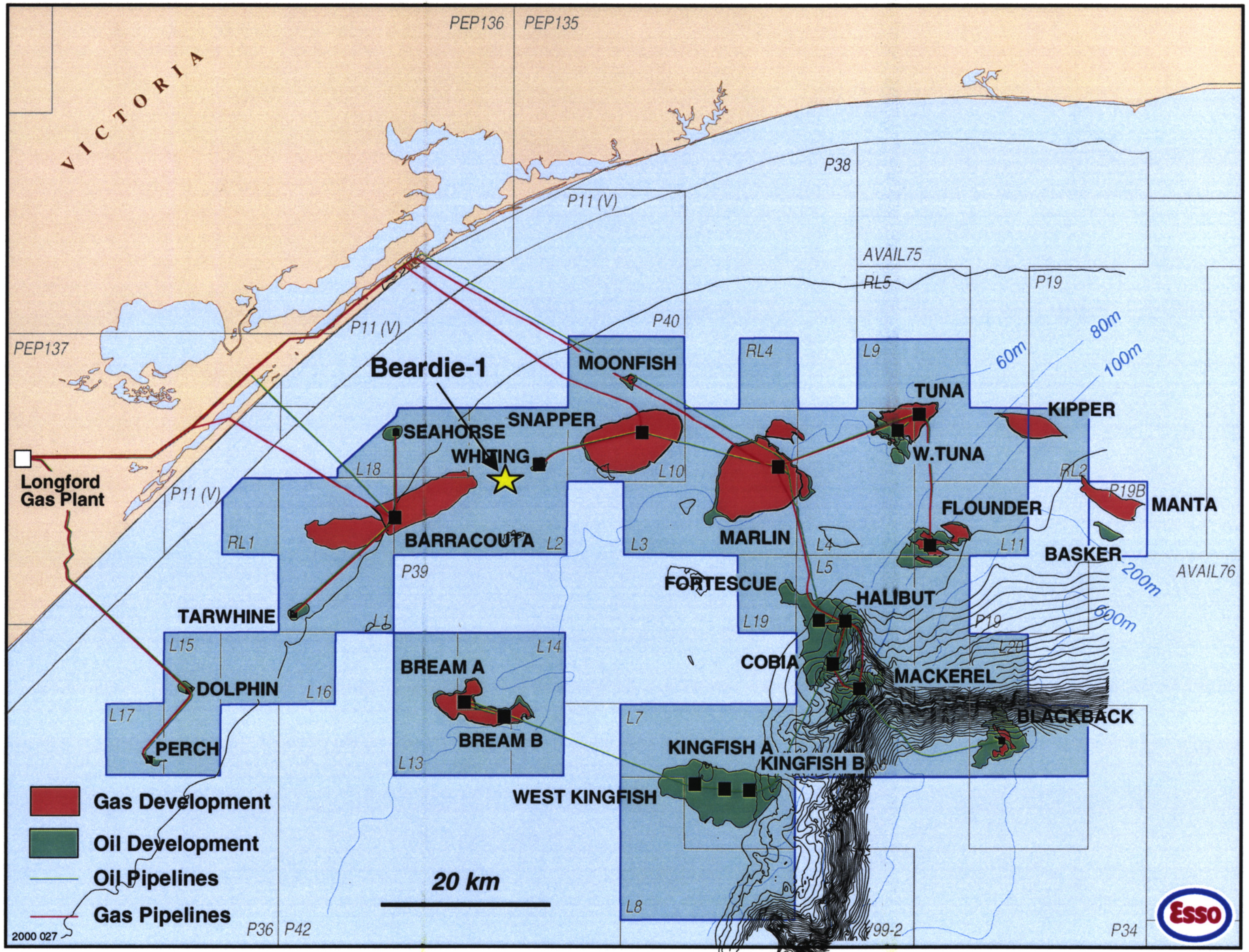
FIGURES

[redacted]

Figure 1. BEARDIE-1 LOCATION MAP

ExxonMobil Exploration

GIPPSLAND 2001



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ExxonMobil Proprietary

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BEARDIE-1 STRATIGRAPHY

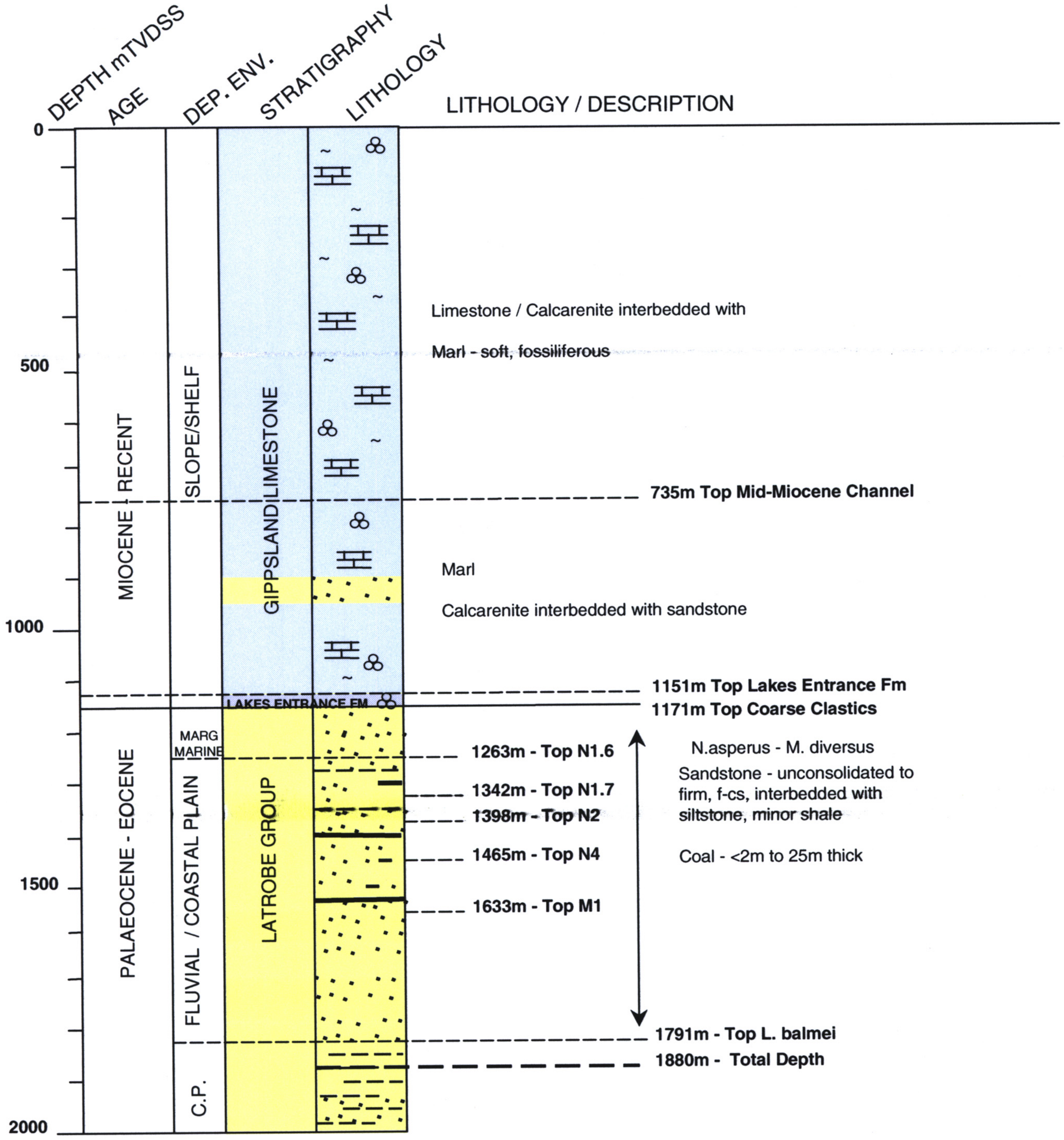

Figure 2.

[redacted]

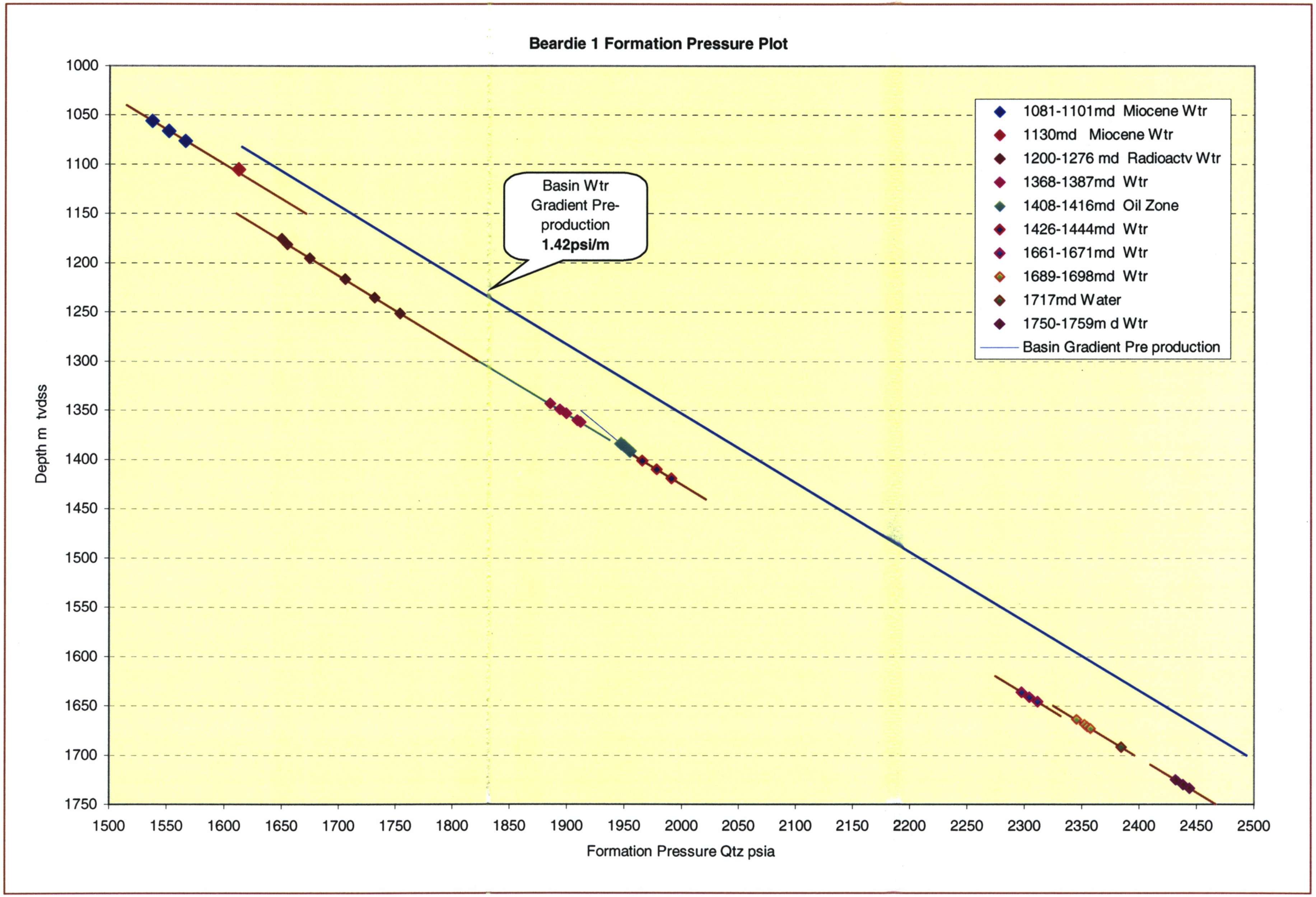

Fig. 3

Enclosures

ENCLOSURES

ENCLOSURE 1

STRUCTURAL CROSS SECTION

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DATE_PROCESSED =
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WELL_NAME = Whiting-2
CONTRACTOR =
AUTHOR =
ORIGINATOR = Esso Australia Ltd
TOP_DEPTH =
BOTTOM_DEPTH =
ROW_CREATED_BY = FH11_SW

(Inserted by DNRE - Vic Govt Mines Dept)

913714 024

ENCLOSURE 2

POST DRILL DEPTH STRUCTURE MAP

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DATE_PROCESSED =
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CONTRACTOR =
AUTHOR = Andy Zannetos
ORIGINATOR = Esso Australia Ltd
TOP_DEPTH =
BOTTOM_DEPTH =
ROW_CREATED_BY = FH11_SW

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE 3

SYNTHETIC SEISMOGRAM

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AUTHOR = Andy Zannetos
ORIGINATOR = Esso Australia Ltd
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BOTTOM_DEPTH =
ROW_CREATED_BY = FH11_SW

(Inserted by DNRE - Vic Govt Mines Dept)

913714 028

ENCLOSURE 4

REGIONAL TIME STRUCTURE MAPS

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ORIGINATOR = Esso Australia Ltd
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(Inserted by DNRE - Vic Govt Mines Dept)

Attachments

ATTACHMENT 1

COMPOSITE WELL LOG

PE651036

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AUTHOR =
ORIGINATOR = Esso Australia Resources Ltd.
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(Inserted by DNRE - Vic Govt Mines Dept)

Appendices

APPENDICIES

APPENDIX 1

MDT ANALYSIS

[redacted]

ExxonMobil

913714 035

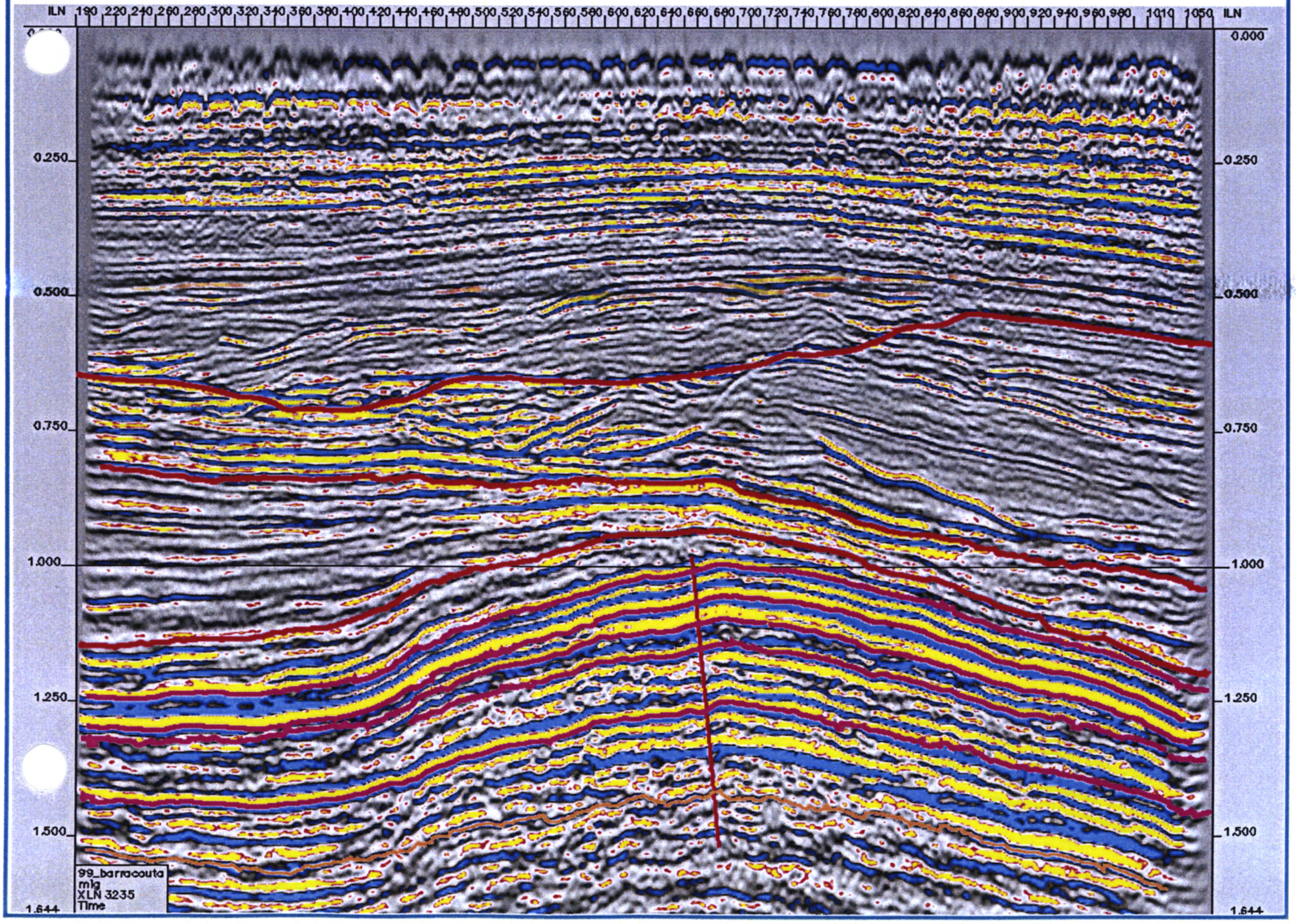
Esso Australia Pty Ltd
Exploration Department

BEARDIE 1

WIRELINE FORMATON TESTING

KUMAR KUTTAN

January 2003



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SUMMARY

Schlumberger's MDT was used in obtaining formation pressures and fluid samples in Beardie 1. A total of 33 pressure tests and 1 fluid sample ware attempted. All the pressure tests were successful but the attempted sample recovery failed due to the probe plugging..

The pressure data suggests that there are at least 3 aquifer pressure systems. The data also indicates that all the sands are drawn down from the original basin gradient, the least drawn down being the Miocene sands. The lower pressures are a reflection of the effects of production in the Basin. The Miocene sands are drawn down about 30 psi whereas the Latrobe sands are drawn down about 100 psi, The calculated water gradients vary from 1.37psi/m to 1.44psi/m and in general appear to be lower than the established basin water gradient of 1.42 psi/m. The differences could be ascribed to slight inaccuracies in the measured pressure data.

All the tested reservoirs are water bearing except for three thin sands in the interval 1407 – 1417m RT. The pressure data indicates the presence of an oil column in these sands. The oil gradient is estimated to be 1.04 psi/m and the data suggested the three reservoirs belong to one pressure system. The OWC for this oil system is estimated to be at 1401m TVDss.

1.0 Operational Summary

Schlumberger's MDT (Modular Dynamic Tester) was used to obtain formation pressures and fluid samples in the Beardie 1 exploration well. The tool was run with the following modules:

Single large area probe with large area packer
Pump-out
Optical Fluid Analyser (OFA)
2 X Multi-chamber module (MRMS)
1-gallon chambers

One run with the MDT run was made. A total of 33 pressure tests were attempted and all were successful. An attempt was made to take a sample at 1689mRT. After pumping for 40 minutes the tool became plugged and a decision was made to abandon further sampling due to absence of hydrocarbons in the sample at 1689mRT and the other target sands. Fine sand is thought to be responsible for the plugging of the sample probe.

2.0 Pressure Data Observation and Interpretation

The MDT data is presented in Tables 2.1. Fig.2.1 is a plot of the pressure data from the top of the Miocene sands at 1080mRT (1055mSS) down to the base of the M-111 sands at 1760mRT (1735mSS). The pressure data indicates that are at least 3 aquifer pressure systems. All the reservoirs are clearly drawn down from the original basin gradient and this is a reflection of the effects of the production in the Basin. The draw down in the Miocene sands is about 30 psi whereas that in the Labtrobe sands is about 100psi. The calculated gradients in the aquifer pressure systems vary from 1.37psi/m to 1.44psi/m and appears to be less than the established basin gradient of 1.42psi/m. The variability and differences could be ascribed to slight inaccuracies in the measured pressures. For the purposes of drawing gradient lines and calculating fluid contact a water gradient of 1.42psi/m has been assumed.

The pressure data indicates that all the tested sands are water bearing except for three thin sands in the interval are 1407mRT - 1417mRT (1382mSS – 1392mSS). The calculated gradient is 1.04psi/m suggesting the fluid reservoired is oil and this supported by oil shows in the sidewall cores. The data also suggest that the three sands are in one pressure system. A OWC for the system is interpreted to be at 1401mSS (1426mRT) (Fig.2.2).

ESSO AUSTRALIA PTY LTD

Well: Beardie - 1
Date 5th August 2002
Tool Type (MDT-GR-LEHQT)
Gauge Type: CQG
Pressure units (psia, psig) psia

Geologist-Engineer Bruce Menzel / Cliff Menhennitt
KB (metres): 25.0
Probe type Large
Temperature units (degF, degC) Deg C

			Strain Gauge				Quartz Gauge					strain	qtz							Gradient Lines	
Sample No	Depth mMD	Depth mTVDSS	Hydrostatic before	PPG	Reservoir psig	PPG	Hydrostatic before	PPG	Reservoir psia	PPG	Tempdeg C	hyd after	hyd after	Comments	Mobility	Calc. Gradiient	Known Gippsland Water Graidient	Intercept	Contacts tvdss	Detph	Pressure
1	1081.00	1056.00	1833.10	10.0	1521.50	8.4555	1848.77	10.0	1537.21	8.54	59.80	1521.50	1537.21	20cc DD	5610.0					1040	1514.7
2	1091.00	1066.00	1850.50	10.0	1536.30	8.4576	1878.52	10.1	1551.70	8.54	61.10	1850.30	1859.92	20cc DD	2181.9	1.439	1.42	37.9		1150	1670.9
3	1101.00	1076.00	1867.40	10.0	1550.00	8.4538	1893.90	10.1	1566.00	8.54	61.00	1867.00	1881.70	20cc DD	115.5						
4	1130.00	1105.00	1916.40	10.0	1596.70	8.4799	1939.17	10.1	1611.86	8.56	61.90	1916.30	1927.50	20cc DD	8.5						
5	1200.00	1175.00	2034.50	9.9	1631.10	8.1465	2055.76	10.1	1649.75	8.24	62.80	2034.40	2049.32	20cc DD	4.2					1150	1610.1
6	1206.00	1181.00	2044.40	9.9	1638.60	8.1424	2060.02	10.0	1654.46	8.22	65.01	2044.70	2059.56	20cc DD	1903.7					1300	1823.1
7	1220.00	1195.00	2068.00	9.9	1659.10	8.1477	2083.66	10.0	1674.16	8.22	66.00	2068.20	2082.85	20cc DD	834.9						
8	1241.00	1216.00	2103.40	9.9	1690.10	8.1566	2118.44	10.0	1705.15	8.23	66.40	2103.60	2118.10	20cc DD	271.3	1.418					
9	1260.00	1235.00	2135.70	9.9	1716.20	8.1551	2149.79	10.0	1731.17	8.23	67.24	2135.40	2149.99	20cc DD	1430.2						
10	1276.00	1251.00	2162.20	9.9	1738.50	8.1554	2177.00	10.0	1753.52	8.23	67.90	2162.20	2176.81	20cc DD	4457.7		1.42	-22.9			
11	1368.00	1343.00	2317.00	9.9	1871.40	8.1775	2331.14	10.0	1885.95	8.24	69.17	2317.20	2331.31	20cc DD Correlate before pretest	1149.8						
12	1374.00	1349.00	2327.10	9.9	1879.70	8.1772	2341.39	10.0	1894.35	8.24	69.60	2327.20	2341.41	20cc DD,	4335.7					1300	1823.74
13	1378.00	1353.00	2334.00	9.9	1885.20	8.1769	2348.13	10.0	1899.93	8.24	70.31	2334.10	2348.13	20cc DD	6095.6	1.382	1.42	-22.26		1380	1937.34
14	1385.00	1360.00	2345.70	9.9	1894.70	8.1758	2359.97	10.0	1909.50	8.24	71.22	2345.70	2359.87	20cc DD	3317.9						
15	1387.00	1362.00	2349.20	9.9	1897.50	8.1759	2363.23	10.0	1912.24	8.24	71.75	2349.30	2363.37	20cc DD	3200.6						
16	1408.50	1383.50	2385.10	9.9	1932.70	8.1981	2399.47	10.0	1947.32	8.26	72.50	2385.60	2399.33	20cc DD	136.8	1.045		501.0081		1350	1912.3367
17	1411.00	1386.00	2389.90	9.9	1935.50	8.1952	2403.79	10.0	1950.03	8.26	72.90	2398.70	2403.82	20cc DD	496.1					1400	1964.6081
18	1416.00	1391.00	2398.20	9.9	1940.70	8.1877	2412.00	10.0	1955.18	8.25	73.58	2398.10	2411.84	20cc DD	343.7						
19	1426.00	1401.00	2415.10	9.9	1951.40	8.1741	2429.07	10.0	1965.92	8.23	74.00	2415.00	2428.38	20cc DD	2583.8					1390	1949.97
20	1435.00	1410.00	2430.30	9.9	1964.00	8.1743	2444.13	10.0	1978.37	8.23	74.51	2430.40	2443.62	20cc DD	4030.3	1.389	1.42	-23.83	**1401.1697**	1440	2020.97
21	1444.00	1419.00	2445.30	9.9	1976.60	8.1746	2459.11	10.0	1990.92	8.23	75.00	2445.40	2459.03	20cc DD	3619.9						
22	1661.00	1636.00	2808.90	9.9	2283.10	8.1898	2823.01	10.0	2297.68	8.24	76.90	2809.50	2823.21	20cc DD GR Correlate before pretest	1837.2					1620	2274.61
23	1666.00	1641.00	2817.50	9.9	2290.10	8.1899	2831.30	10.0	2304.43	8.24	78.60	2817.60	2831.22	20cc DD	3707.5	1.381	1.42	-25.79		1660	2331.41
24	1671.00	1646.00	2826.30	9.9	2297.20	8.1903	2839.98	10.0	2311.49	8.24	79.80	2826.20	2839.54	20cc DD	465.3						
25	1687.00	1662.00	2853.10	9.9		0	2866.70	10.0		0.00	81.11	2853.40	2867.15	Tight							
26	1689.00	1664.00	2856.80	9.9	2331.40	8.1977	2870.57	9.9	2345.44	8.25	82.00	2857.10	2870.35	20cc DD	326.0					1650	2325.12
27	1694.00	1669.00	2865.40	9.9	2338.30	8.2121	2878.75	10.0	2352.19	8.26	82.70	2865.60	2878.81	20cc DD	3856.6					1700	2396.12
28	1696.00	1671.00	2868.80	9.9	2341.10	8.2219	2882.10	10.0	2354.94	8.27	83.50	2868.90	2882.21	20cc DD	4949.7	1.375	1.42	-17.88			
29	1698.00	1673.00	2872.60	9.9	2344.00	8.2223	2885.72	10.0	2357.69	8.27	83.96	2872.60	2885.60	20cc DD	1660.3						
30	1717.00	1692.00	2904.40	9.9	2370.70	8.2226	2917.39	10.0	2384.38	8.27	84.39	2904.60	2917.60	20cc DD	4501.8		1.42				
31	1750.00	1725.00	2969.80	10.0	2418.20	8.2268	2972.70	10.0	2431.84	8.27	84.89	2969.70	2972.60	20cc DD	657.3					1710	2409.85
32	1755.00	1730.00	2968.20	9.9	2424.90	8.2258	2980.99	10.0	2438.34	8.27	85.66	2968.30	2981.21	20cc DD	1403.4					1750	2466.65
33	1759.00	1734.00	2975.00	9.9	2430.50	8.2258	2988.00	10.0	2443.93	8.27	85.90	2975.00	2987.90	20cc DD	4273.1	1.397	1.42	-18.35			
Basin Gradient Pre		1400.00							2067.00							1.422					
production		1700.00							2493.60												

Table 2.1

[redacted]

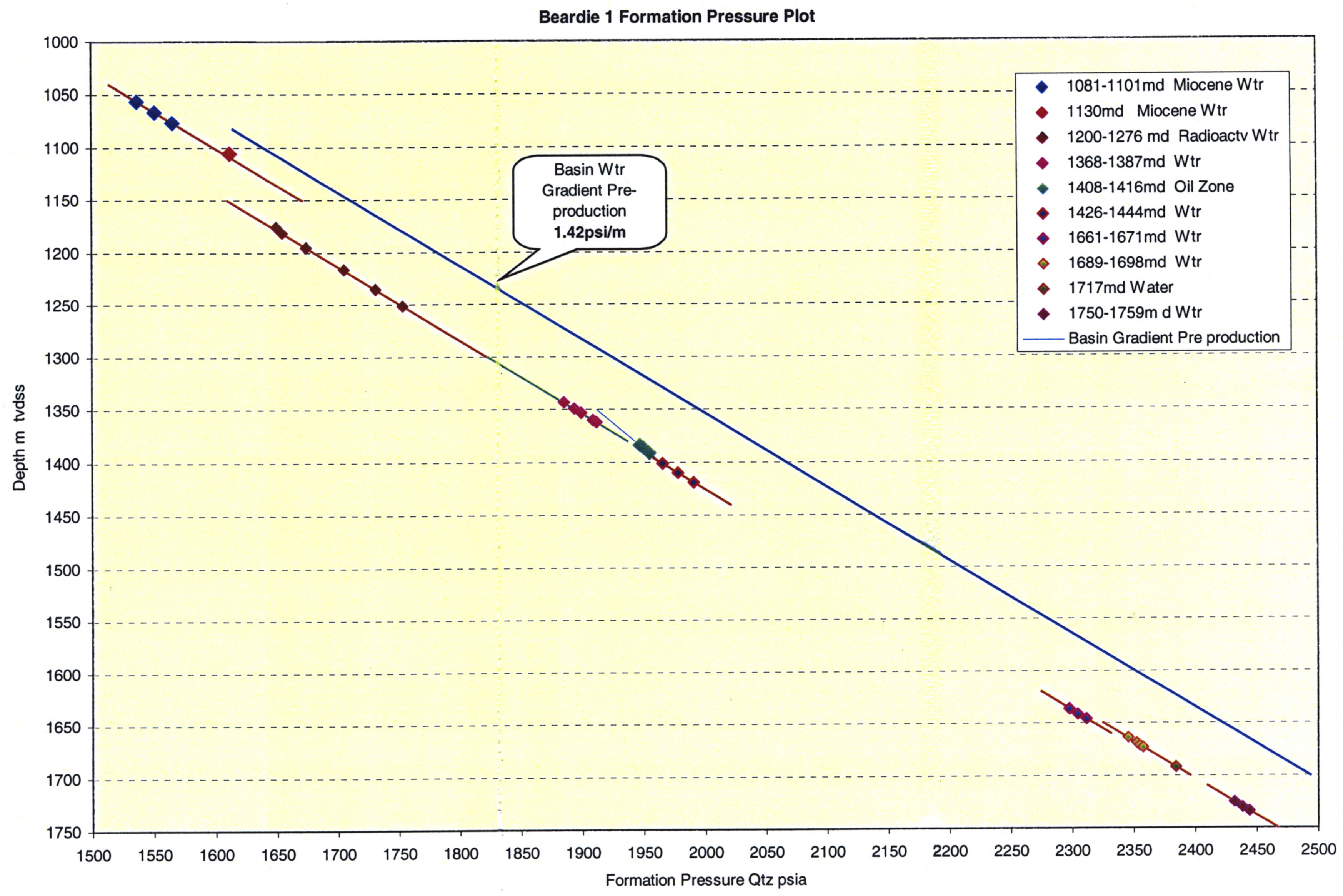

Fig. 2.1

[redacted]

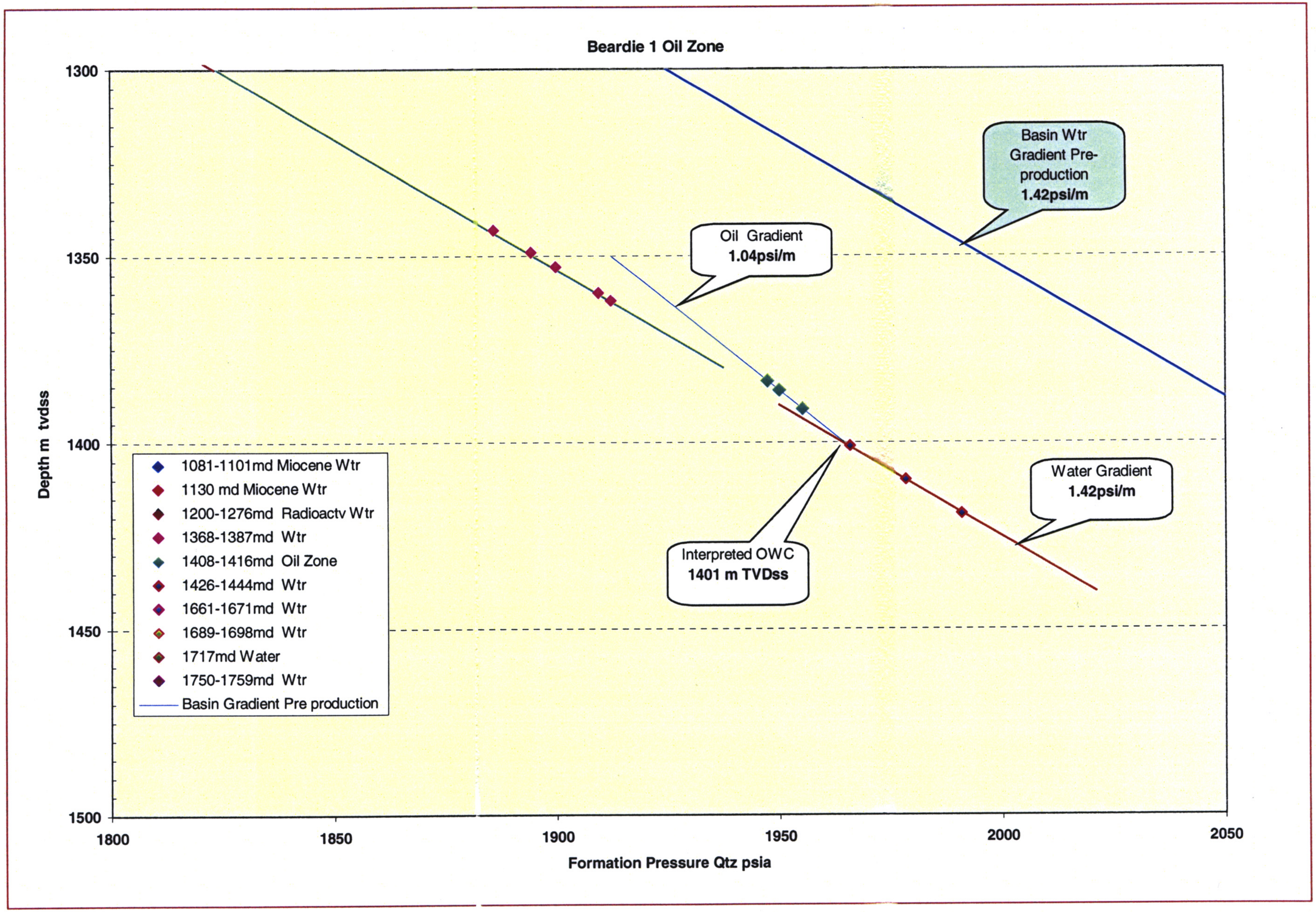

Fig. 2.2

APPENDIX 2

QUANTITATIVE FORMATION EVALUATION

[redacted]

ExxonMobil

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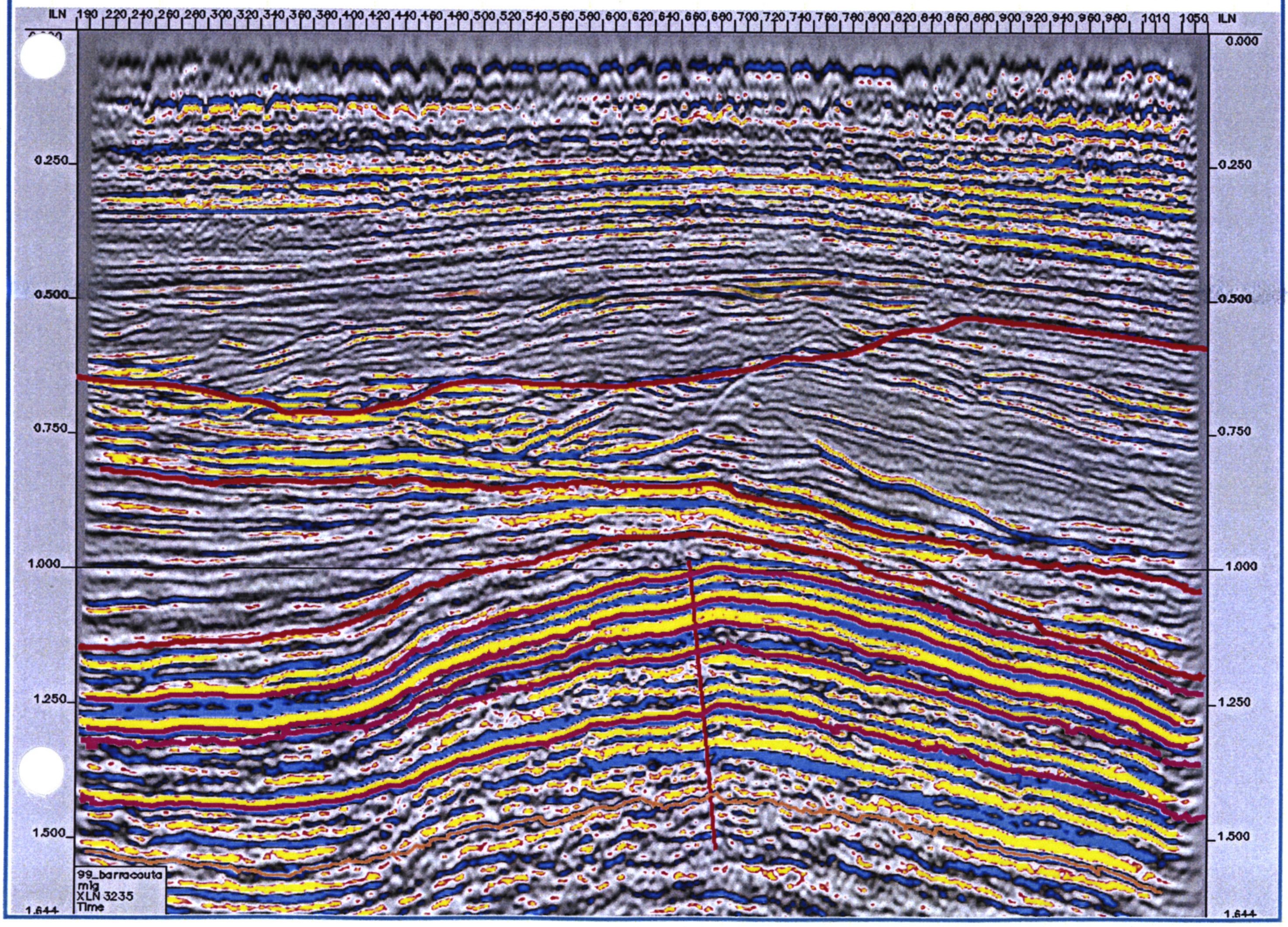
Esso Australia Pty Ltd
Exploration Department

BEARDIE-1

QUANTITATIVE PETROPHYSICAL INTERPRETATION

KUMAR KUTTAN

January 2003



SUMMARY

The Beardie-1 near field wildcat exploration well, located in VIC/L2, was drilled to test the oil potential of the Eocene to Palaeocene aged fluvial reservoirs within a mapped four-way dip closure along the Barracouta anticlinal trend.

With the exception of three thin sands over the interval 1407 - 1417mRT all the target reservoirs were found to be water bearing.

The average effective porosities in the reservoirs range from 14% to 29%, the majority being greater than 20% and are very similar to those in the equivalent reservoirs in Barracouta and Whiting fields.

The three thin sands in the shale above the N2 reservoir interval (1407.8 - 1409mRT, 1410.3 – 1411.5mRT and 1413.5 - 1417mRT) are interpreted to be oil bearing. This interpretation is supported by sidewall core shows and MDT pressure tests. The average effective porosities and water saturations range from 16 - 21% and 37 - 48%. The net oil pay is estimated to be about **4.6m** based on a porosity cut-off of 12%.
Residual hydrocarbons are interpreted in the interval 1687 - 1698mRT and the hydrocarbons are interpreted to be oil, based on the sidewall core and mud log shows.

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Enclosure 1 Beardie-1 Petrophysical Evaluation 1180 - 1900m

[redacted]

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1.0 Introduction

1.1 General

The Beardie-1 near field wildcat exploration well, located in VIC/L2 (Fig. 1.1) was drilled to test the oil potential of the Eocene to Palaeocene aged fluvial reservoirs within a mapped four-way dip closure along the Barracouta anticlinal trend. The well was spudded on the 26th of July 2002, drilled to a total depth of 1905mRT (Driller) 1909.5mRT (Logger) and plugged and abandoned. The primary objective of this quantitative petrophysical interpretation was to evaluate the reservoirs for porosity, water saturation and net pay.

Note: All depths quoted in this report are logged mRT unless otherwise specified

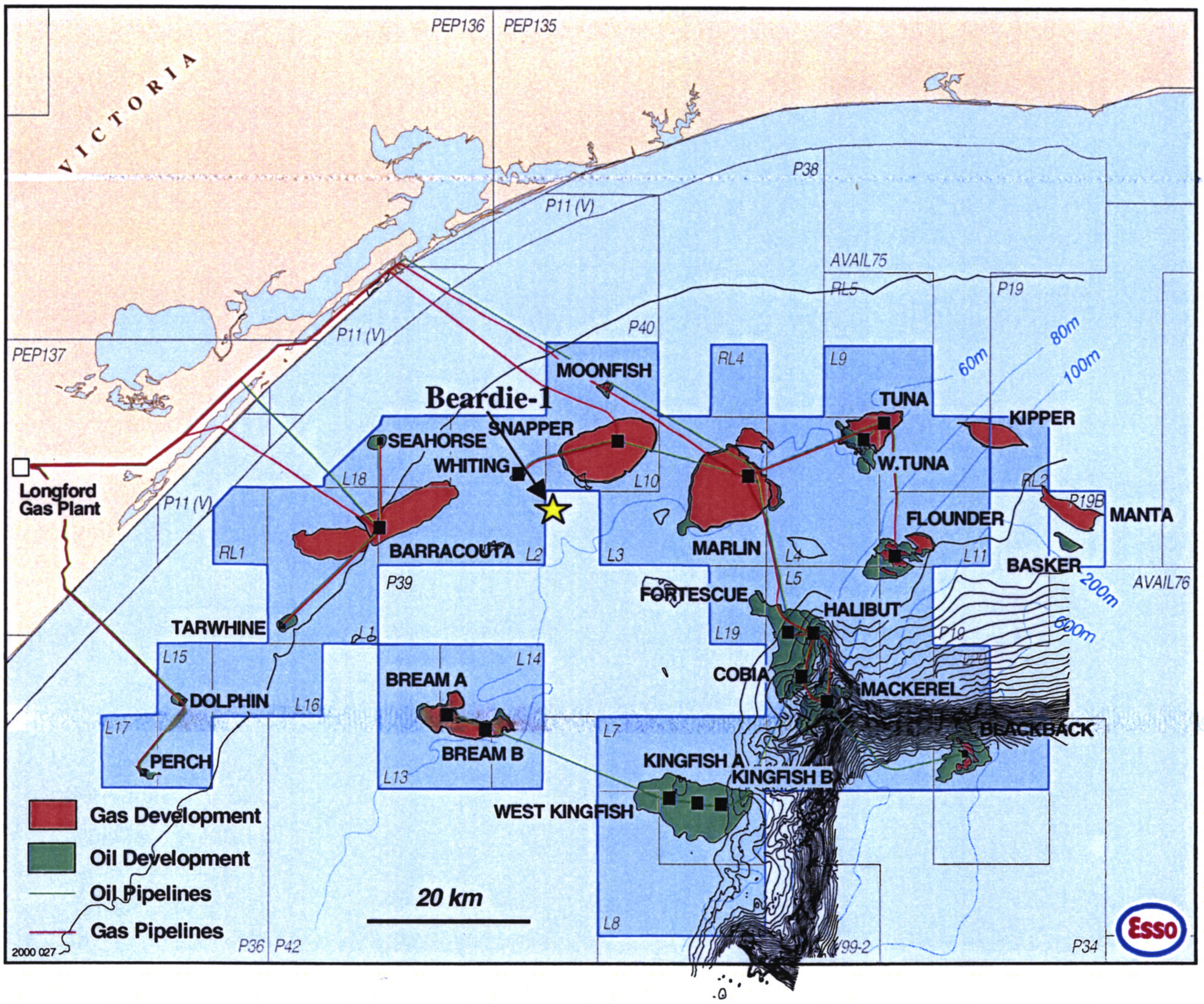


Fig 1.1 Beardie-1 Location Map

2.0 Data

2.1 Wireline Logs

The open hole logs run in the well are listed in Table 2.1.

Survey /Log	Company	Top (m MDRT)	Bottom (m MDRT
Suite 1 Run at 1909.5m MDRT			
MWD Survey	Anadrill	907.95	1905
Gyro Survey	Scientific Drilling	185	845
DUAL AXIS DENSITY-PEX-HALS-LEHQT	Schlumberger	850.5 GR to Sea Floor	1909.5
FMI-DSI-HNGS-GR-LEHQT	Schlumberger	850.5	1909.5
MDT-GR-LEHQT	Schlumberger	1081.0	1759.0
DUAL CSAT-VSP	Schlumberger	138.0	1900.0
CST-GR4	Schlumberger	1070.0	1887.0
DSI (in casing)	Schlumberger	76.2	849.1

Table 2.1 Summary of Wireline Logs

2.2 Logging Suite 1

The PEX density-neutron and GR logs were acquired in high-resolution mode from 1909.5m to 850.5m at 1800ft/hr. In addition to the PEX density, an LDT density (the combination being referred to as Dual-Axis density) was also run with the PEX. The reason for running the additional density was to ensure that good bulk density data was acquired in zones over which the borehole may have been elliptical or washed out in one direction. The only problems encountered with the logging job were:

- failure of the logging engineer to record compressional sonic data from the casing shoe to the sea-floor, which required an additional run with the DSI
- the plugging of the MDT probe while sampling at 1689m
- the 15 sidewall misfires

2.3 Log Quality and Log Responses

The overall data quality of the resistivity, density-neutron logs and the MDT pressure data appear to be good and the calibration data appear to be acceptable. From a log response standpoint, one observation that is worth noting is that all the GRs including the HCGR (HNGS GR that has been corrected for the potassium in the mud) recorded with the various logs appear to be high (60 API) over the sands. Similar sands in the nearby Whiting and Barracouta fields have lower GR levels (<40 API). These sands are generally clean and predominantly (>95%) quartz rich. Another observation is that in Beardie-1 all the sands below 1280m show separation between the bulk density and TNPH and NPHI curves (less with NPHI than with TNPH). The separation suggest that these sands are either shaly or have complex mineralogy which is inconsistent with the density-neutron response in similar reservoirs in the nearby Whiting and Barracouta Fields where the sands are clean and show very little density-neutron separation. Further, in these reservoirs the predominant mineral is quartz with low clay content and very low amounts of feldspars. It is more than likely that the separation is not due to the bulk density data being in error since the calculated density porosities are similar to those in the nearby fields. It is likely that the neutron data is in error. One possible source of the error could be due to one or several of the environmental corrections applied at wellsite. However, it is difficult to determine which correction is in error and the approach that we have taken to adjust the neutron log is discussed in section 2.4 (Data Processing).

Based on the GR and the density-neutron responses, the reservoir interval 1196 - 1280m is clearly different from those below 1280m. The reservoir probably has complex mineralogy as indicated by the high GR over several zones within this interval. Similar responses have not been observed in the nearby Whiting and Barracouta Fields and it is likely this reservoir interval is not present in these fields.

2.4. Data Processing

The standard resolution (6 inch samples) was selected for the final petrophysical evaluation. The NPHI was chosen as the neutron log and the following correction was applied to it so that in most of the sands below 1280m it overlaid the bulk density when the two logs are plotted on a sandstone compatible scale (Bulk Density 1.85 - 2.85g/cc; Neutron 0.45 - -0.15m^3/m^3):

$$NPHIadjus = NPHI - 0.025$$

Given the fact that most of the reservoirs are predominantly quartz, the measured PEFZ values appear to be high and therefore the following adjustment was made:

$$PEFZadjus = PEFZ - 0.25$$

It must be emphasized that higher than expected PEF values have been observed in clean quartz sands in many other Gippsland reservoirs whenever they have been logged with Schlumberger's nuclear density logs.

The HCGR was chosen as the base log for depth matching purposes. The RHOZ and other bulk density measurements (PEFZ, SSOZ, HCAL etc) were first depth matched to the HCGR. The HLLD, HLLS, RXOZ were then depth matched to HCGR-depth matched RHOZ. The adjusted NPHI and associated neutron measurements (TNPH, CFTC, CNTC, TRNA etc) were depth matched to the HCGR-depth-matched RHOZ. The volumetric photoelectric factor U was computed using the following relationship:

$$U = PEFZ * ((RHOZ + 0.1883) / 1.0704)$$

3.0 Quantitative Interpretation

3.1 Methodology

Schlumberger's Geoframe ELAN+ module was used to determine mineral volumes, Total Porosity, (PHIT) and Effective Porosity (PHIE or PIGN). The total porosity, effective porosity and clay volumes from ELAN+ were then used to derive total water saturation (SWT) and effective water saturation (SWE) using the Dual Water saturation model.

Net reservoir and net pay were then calculated using a PHIE cut-off of 0.10 (10%).

The ELAN+ model and input parameters are described in Appendix 1

3.2 Logs Used

The logs used in the ELAN+ model were HCGR, HLLD, RXOZ, RHOZ, NPHI, U and HFK. The HFK was only used in the interval 1196 - 1280m as the HCGR was considered inappropriate for this interval because of the high gamma ray values.

3.3 Formation Salinities and Input Porosities

The formation water salinities were calculated using the RWA method for the water bearing intervals. An *m*=2, *a*=1 and a BHT=90^0 C (estimated from the MDT pressure testing run) were used in the calculations. The following table lists the salinities and input porosities for computing the zone parameters in ELAN+

Depth Int	Zone Name	Sand Salinity(ppm)	Clay Salinity(ppm)	Tot. Por. Sand	Tot. Por. Clay	Mid Zone Depth	Temp^0 C
1196 - 1280	N-1.5	4000	3000	0.30	0.30	1238	61
1280 - 1640	N-1.6-N4	2000	3000	0.27	0.20	1460	71
2640 - 1820	M-1	1200	3000	0.27	0.17	1730	82.5
1820 - 1900	L-1	18000	10000	0.25	0.15	1860	88.2

A salinity of 18000 ppm was used in the hydrocarbon bearing zones in the interval 1407 – 1417m for calculating SWT. This was based on the fact that in Gippsland, the connate waters in hydrocarbon zones underlain by fresh water aquifers tend to be saline (formation water salinities are of order 18000-20000 ppm)

3.1 Results

Except for three thin hydrocarbon bearing sands in the interval 1407 - 1417m all other reservoir quality sands are water bearing. Average effective porosities range from 14% to 29% with the majority being over 20%. The hydrocarbons in the three thin sands in the above interval are interpreted to be oil. This is based on the MDT pressure data and oil shows recorded in the sidewall cores. In these three sands the average effective porosities range from 16% to 21% and the effective water saturation range from 34% to 48%. The only other zone of interest is the sand in the interval 1687 - 1697.8m (M-110 sand). The quantitative interpretation suggests that it has residual hydrocarbons which are interpreted to be oil, based on the mud log and sidewall core shows.

4.0 Net Reservoir and Net Pay

4.1 General

Net reservoir and net pay were determined using an effective porosity cut-off of 12%. Table 4.1 is a summary of the results of the analysis.

The total net oil pay in Beardie-1 is estimated to be **4.6m**. The contribution to this net pay from the three thin oil bearing sands is as follows:

Interval (m)	Net Pay (m)
1407.9 - 1409.0	0.8
1410.3 - 1411.5	1.1
1413.5 – 1416.9	2.7

BEARDIE 1

Petrophysical Analysis Summary 1180 - 1900m

Net Thickness is based on a PHIE Cut-off > **:0.12 volume per volume**
Depth Reference mRT
Mean PHIE, Mean VSH, Mean SWE is of Net Thickness interval
Y= yes N= no

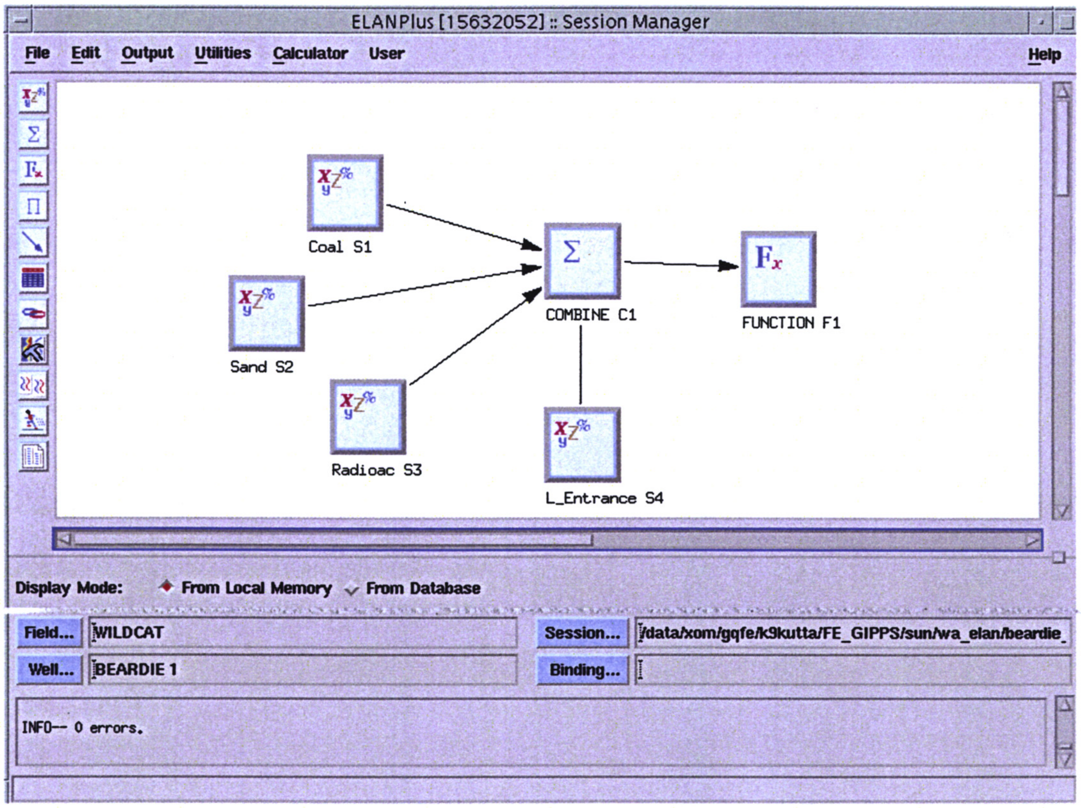
Top Depth	Bottom Depth	Gross Thickness	Net Thickness	Net/Gross Ratio	Mean VSH	Mean PHIE	Mean SWE	Comments	Net Pay
1195.99	1277.01	81.0	73.7	0.910	0.220	0.231	1.000	Water bearing	
1280.82	1308.92	28.1	27.9	0.991	0.160	0.256	1.000	Water bearing	
1311.15	1316.97	5.8	5.5	0.940	0.288	0.216	1.000	Water bearing	
1318.77	1336.45	17.7	17.5	0.989	0.123	0.288	1.000	Water bearing	
1365.23	1378.69	13.5	13.3	0.986	0.122	0.266	1.000	Water bearing	
1383.31	1387.68	4.4	4.2	0.950	0.110	0.270	1.000	Water bearing	
1397.71	1399.34	1.6	1.2	0.752	0.282	0.193	1.000	Water bearing	
1407.87	1409.04	1.2	0.8	0.684	0.340	0.162	0.481	**Oil bearing**	Y
1410.29	1411.51	1.2	1.1	0.922	0.328	0.213	0.345	**Oil bearing**	Y
1413.54	1416.86	3.3	2.7	0.821	0.275	0.203	0.378	**Oil bearing**	Y
1422.33	1485.24	62.9	61.1	0.971	0.105	0.266	1.000	Water bearing	
1488.90	1501.85	13.0	12.8	0.987	0.089	0.251	1.000	Water bearing	
1504.80	1513.51	8.7	8.5	0.972	0.080	0.244	1.000	Water bearing	
1515.77	1524.08	8.3	6.3	0.753	0.297	0.185	1.000	Water bearing	
1530.78	1543.36	12.6	12.2	0.970	0.161	0.249	1.000	Water bearing	
1546.99	1561.31	14.3	14.3	0.997	0.130	0.252	1.000	Water bearing	
1568.12	1574.65	6.5	6.4	0.972	0.108	0.243	1.000	Water bearing	
1576.33	1581.86	5.5	5.3	0.958	0.094	0.235	1.000	Water bearing	
1597.56	1610.41	12.9	12.5	0.972	0.136	0.234	1.000	Water bearing	
1633.30	1637.39	4.1	3.6	0.880	0.236	0.222	1.000	Water bearing	
1642.34	1644.42	2.1	2.0	0.974	0.207	0.202	1.000	Water bearing	
1657.23	1672.44	15.2	14.8	0.971	0.087	0.245	1.000	Water bearing	
1687.15	1689.43	2.3	1.8	0.789	0.241	0.181	0.829	Water bearing, residual oil	
1691.49	1697.84	6.3	6.3	1.000	0.063	0.264	0.814	Water bearing, residual oil	
1712.42	1717.78	5.4	5.2	0.973	0.184	0.203	1.000	Water bearing	
1735.15	1737.34	2.2	1.6	0.708	0.277	0.150	1.000	Water bearing	
1740.87	1760.55	19.7	16.8	0.851	0.162	0.217	1.000	Water bearing	
1762.61	1766.50	3.9	3.7	0.938	0.101	0.242	1.000	Water bearing	
1771.09	1785.95	14.9	14.5	0.976	0.121	0.238	1.000	Water bearing	
1799.85	1812.72	12.9	10.9	0.843	0.213	0.194	1.000	Water bearing	
1822.86	1824.46	1.6	1.0	0.625	0.181	0.205	1.000	Water bearing	
1846.18	1868.73	22.5	19.2	0.852	0.125	0.222	1.000	Water bearing	
1871.65	1877.90	6.3	5.9	0.944	0.110	0.227	1.000	Water bearing	
1880.64	1882.24	1.6	1.1	0.688	0.194	0.200	1.000	Water bearing	
1897.26	1898.55	1.3	0.5	0.388	0.285	0.135	1.000	Water bearing	

Table 4.1 Petrophysical Summary 1180 - 1900m

APPENDIX 1

Beardie - 1

ELAN+ Analysis Model & Parameters



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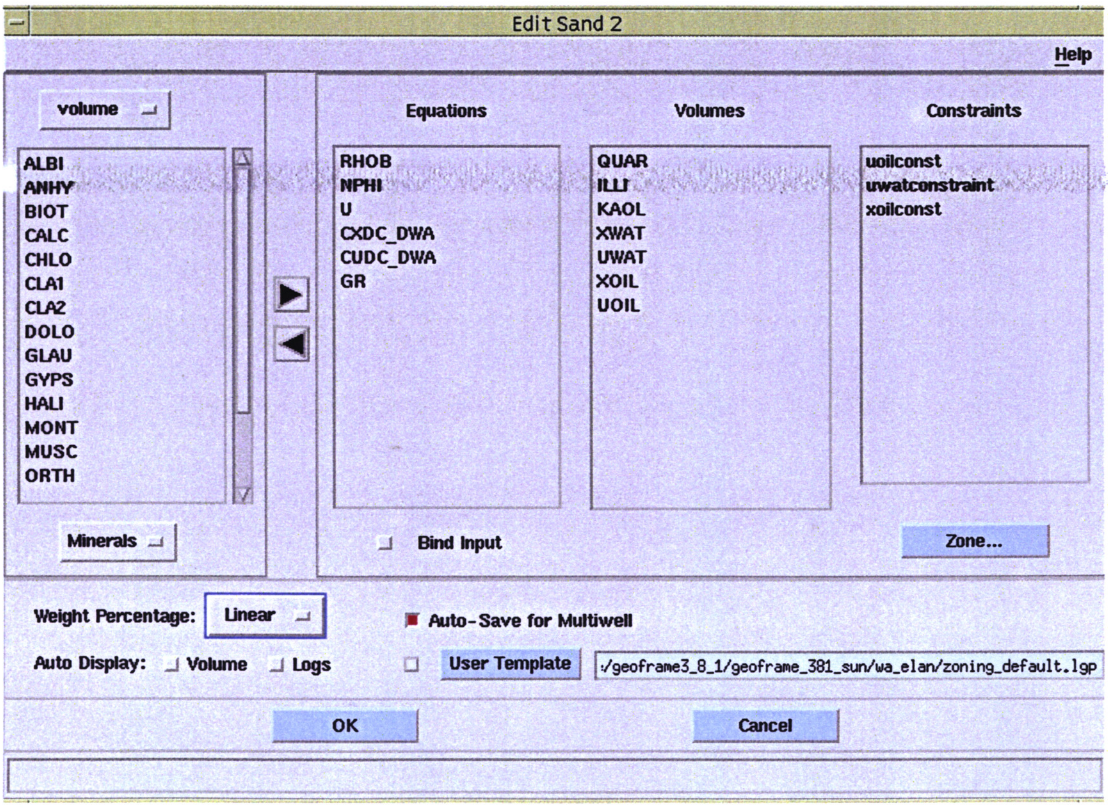
Beardie-1 Elan + Model



Equations:
RHOB
NPHI
U
CXDC_DWA
CUDC_DWA
GR

Volumes:
QUAR
ILLI
KAOL
XWAT
UWAT
XOIL
UOIL

Constraints:
uoilconst
uwatconstraint
xoilconst

☐ Bind Input

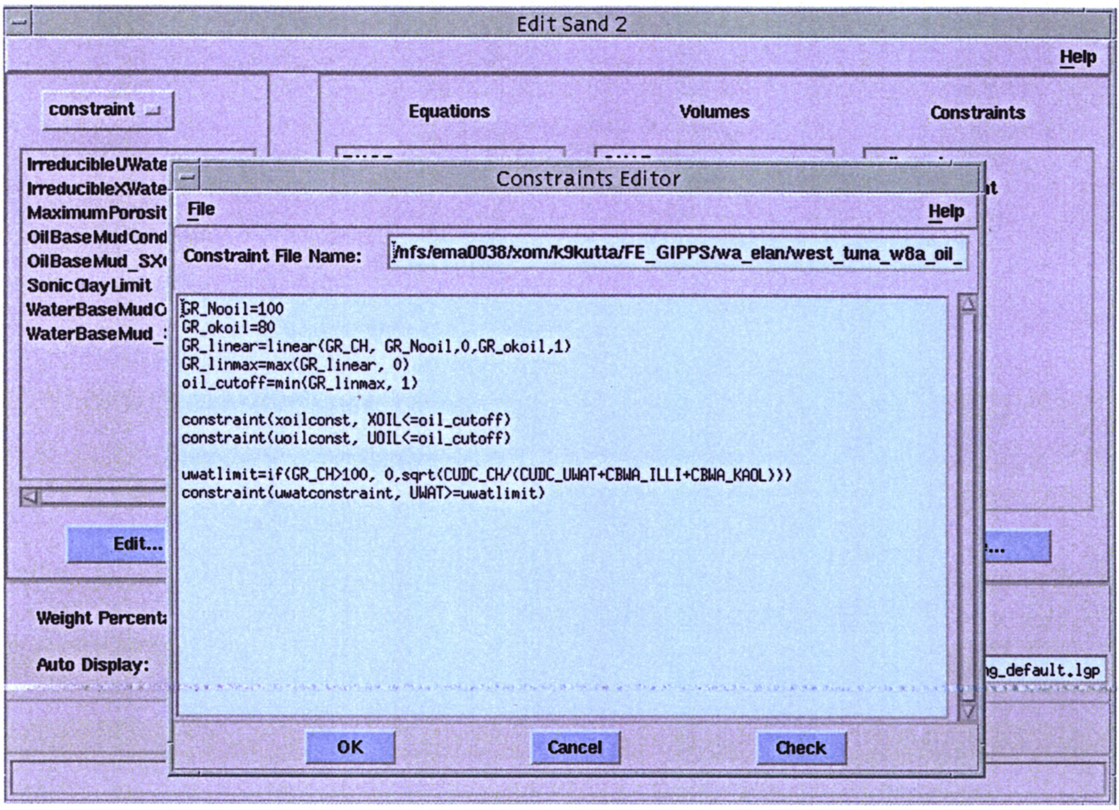
Weight Percentage: Linear

☒ Auto-Save for Multiwell

Auto Display: ☐ Volume ☐ Logs

☐ User Template :/geoframe3_8_1/geoframe_381_sun/wa_elan/zoning_default.lgp

Beardie-1 Sand Solve Process



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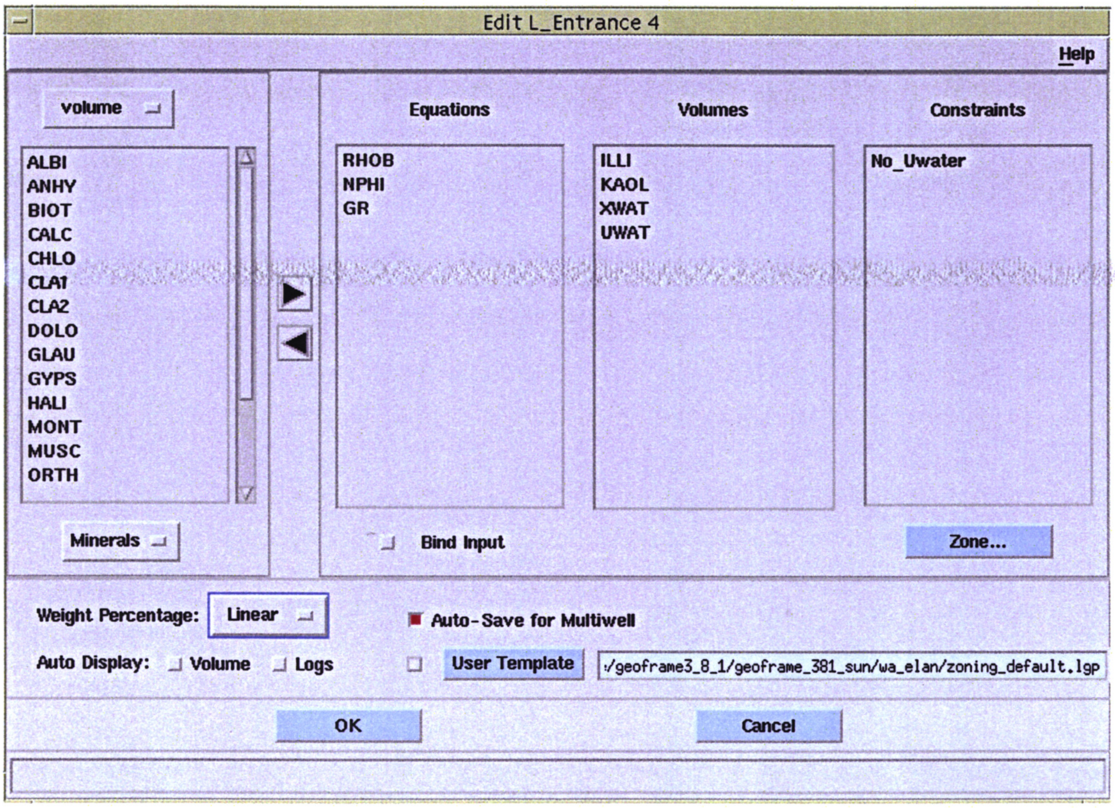
GR_Nooil=100
GR_okoil=80
GR_linear=linear(GR_CH, GR_Nooil,0,GR_okoil,1)
GR_linmax=max(GR_linear, 0)
oil_cutoff=min(GR_linmax, 1)

constraint(xoilconst, XOIL<=oil_cutoff)
constraint(uoilconst, UOIL<=oil_cutoff)

uwatlimit=if(GR_CH>100, 0,sqrt(CUDC_CH/(CUDC_UWAT+CBWA_ILLI+CBWA_KAOL)))
constraint(uwatconstraint, UWAT>=uwatlimit)
```

Beardie-1 Sand Solve Process Constraint



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Volumes: ILLI, KAOL, XWAT, UWAT

Constraints: No_Uwater

☐ Bind Input

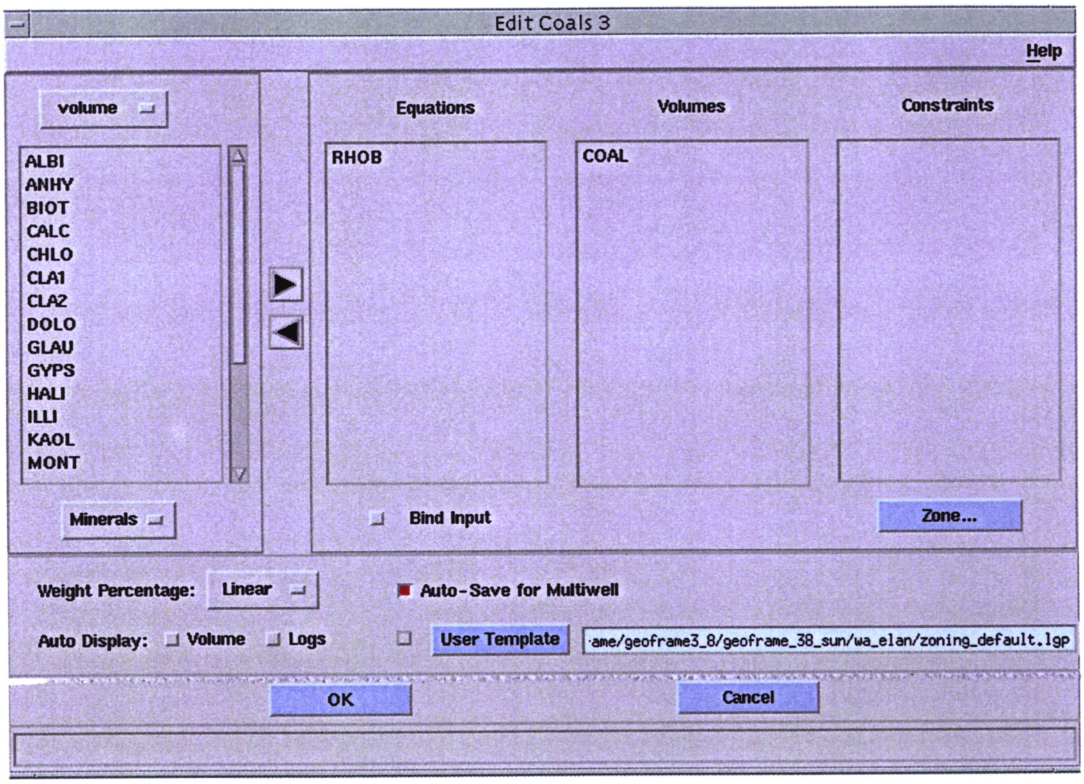
Weight Percentage: Linear

☒ Auto-Save for Multiwell

Auto Display: ☐ Volume ☐ Logs

☐ User Template :/geoframe3_8_1/geoframe_381_sun/wa_elan/zoning_default.lgp

Beardie-1 Lakes Entrance Solve Process



Equations: RHOB

Volumes: COAL

Constraints:

☐ Bind Input

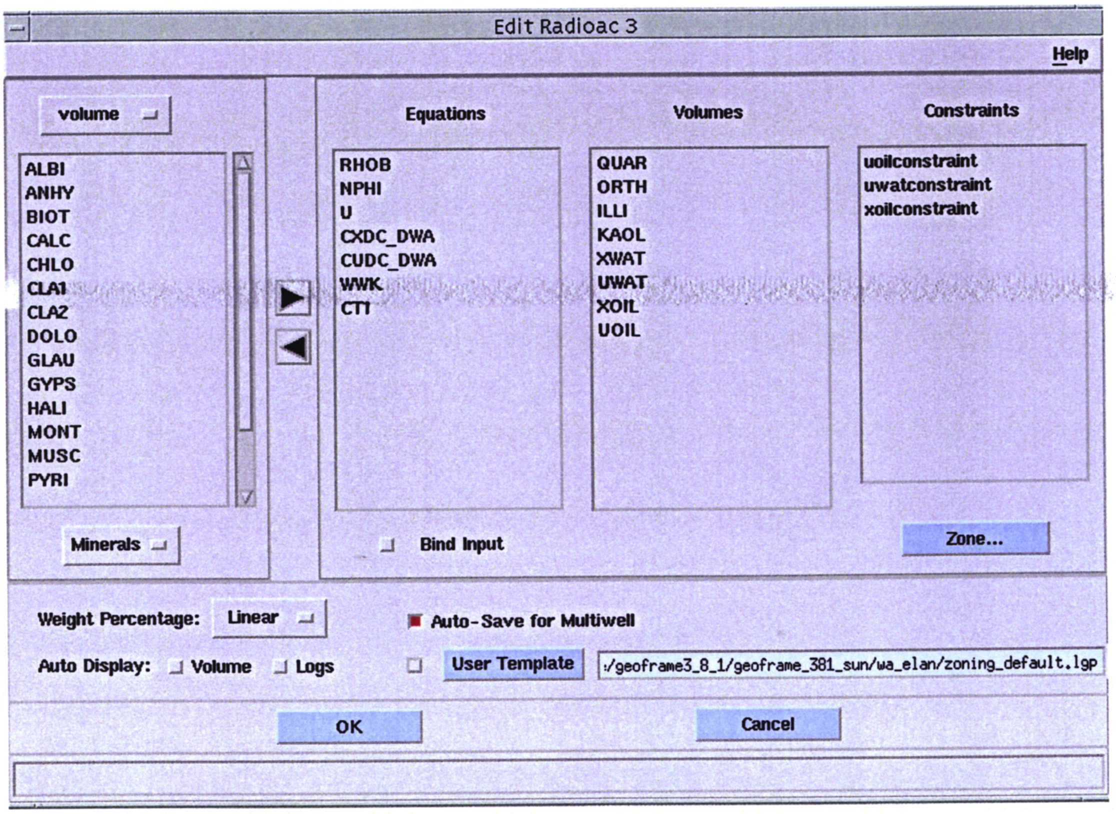
Weight Percentage: Linear

☒ Auto-Save for Multiwell

Auto Display: ☐ Volume ☐ Logs

☐ User Template ame/geoframe3_8/geoframe_38_sun/wa_elan/zoning_default.lgp

Beardie-1 Coal Solve Process



Equations: RHOB, NPHI, U, CXDC_DWA, CUDC_DWA, WWK, CTI

Volumes: QUAR, ORTH, ILLI, KAOL, XWAT, UWAT, XOIL, UOIL

Constraints: uoilconstraint, uwatconstraint, xoilconstraint

☐ Bind Input

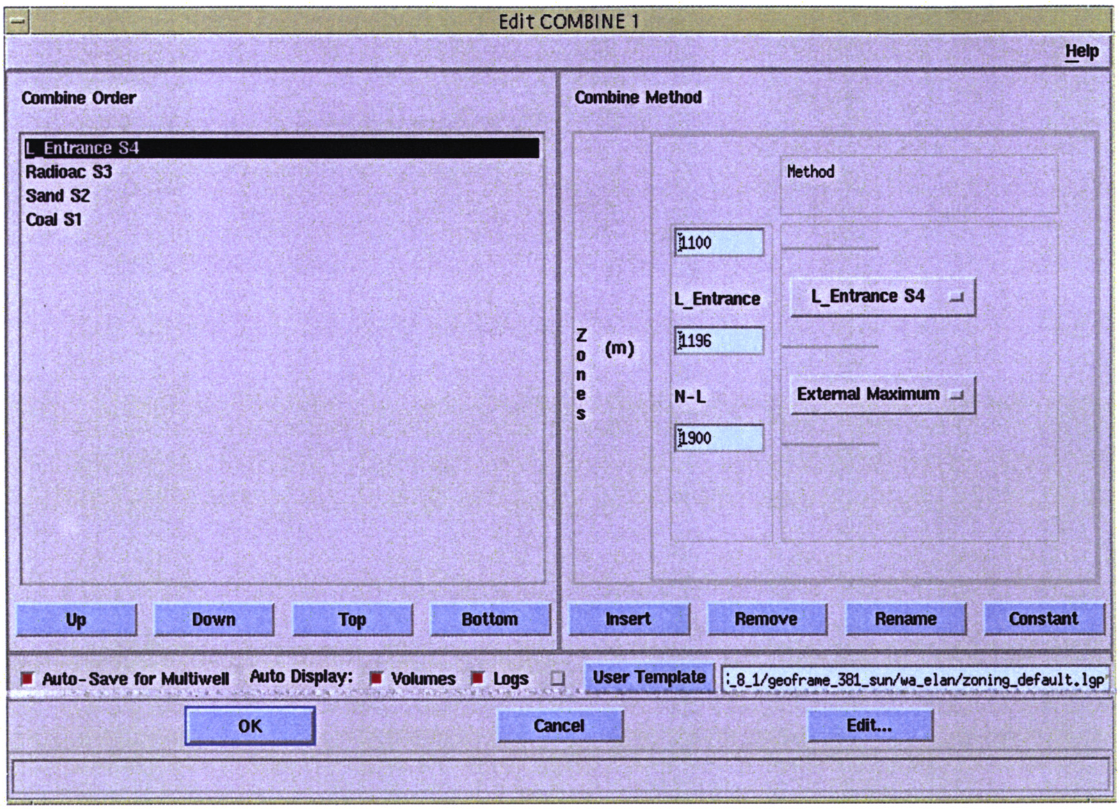
Weight Percentage: Linear

☒ Auto-Save for Multiwell

Auto Display: ☐ Volume ☐ Logs

☐ User Template /geoframe3_8_1/geoframe_381_sun/wa_elan/zoning_default.lgp

Beardie-1 Radioactive Solve Process
(1197 - 1280m)



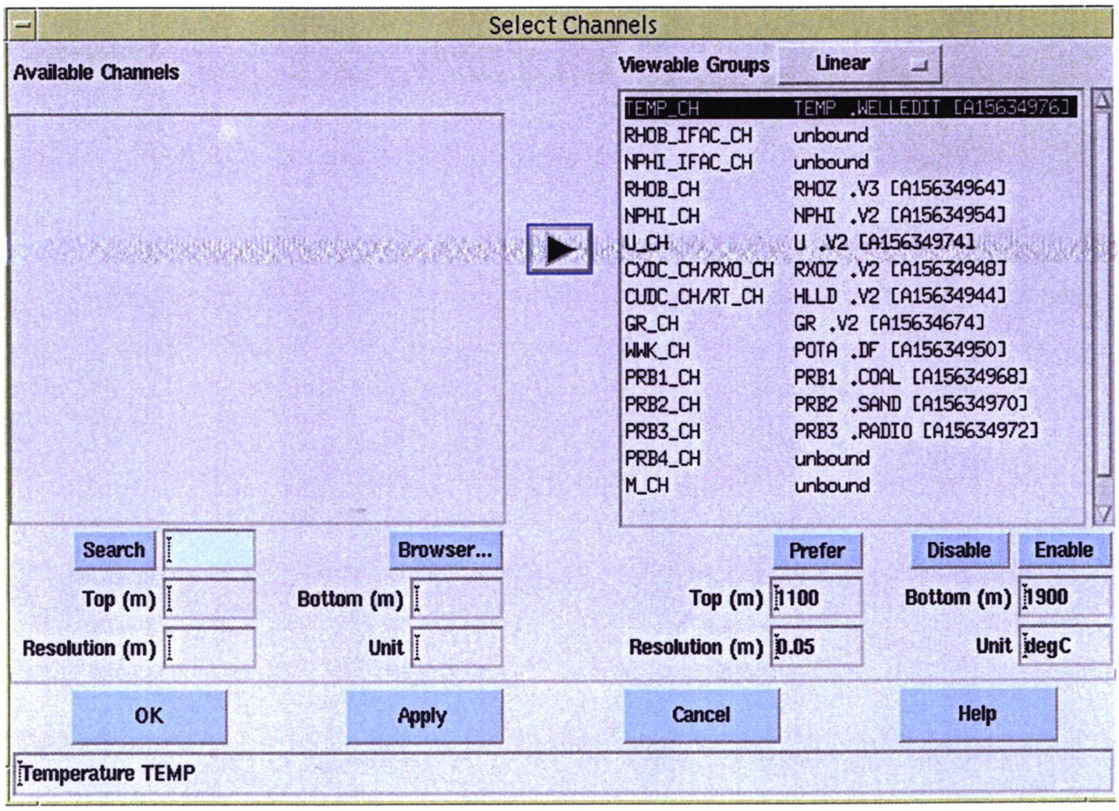
Combine Order:
- L_Entrance S4
- Radioac S3
- Sand S2
- Coal S1

Zones (m):
- 1100
- L_Entrance — L_Entrance S4
- 1196
- N-L — External Maximum
- 1900

☒ Auto-Save for Multiwell Auto Display: ☒ Volumes ☒ Logs ☐

User Template: :_8_1/geoframe_381_sun/wa_elan/zoning_default.lgp

Beardie-1 Combine Process



Viewable Groups: Linear

```
TEMP_CH           TEMP .WELLEDIT [A156349761]
RHOB_IFAC_CH      unbound
NPHI_IFAC_CH      unbound
RHOB_CH           RHOZ .V3 [A156349641]
NPHI_CH           NPHI .V2 [A156349541]
U_CH              U .V2 [A156349741]
CXDC_CH/RXO_CH    RXOZ .V2 [A156349481]
CUDC_CH/RT_CH     HLLD .V2 [A156349441]
GR_CH             GR .V2 [A156346741]
WWK_CH            POTA .DF [A156349501]
PRB1_CH           PRB1 .COAL [A156349681]
PRB2_CH           PRB2 .SAND [A156349701]
PRB3_CH           PRB3 .RADIO [A156349721]
PRB4_CH           unbound
M_CH              unbound
```

Top (m) 1100 Bottom (m) 1900

Resolution (m) 0.05 Unit degC

Temperature TEMP

Beardie-1 Logs Used in Interpretation

PRB1.COAL = FLAG_COAL

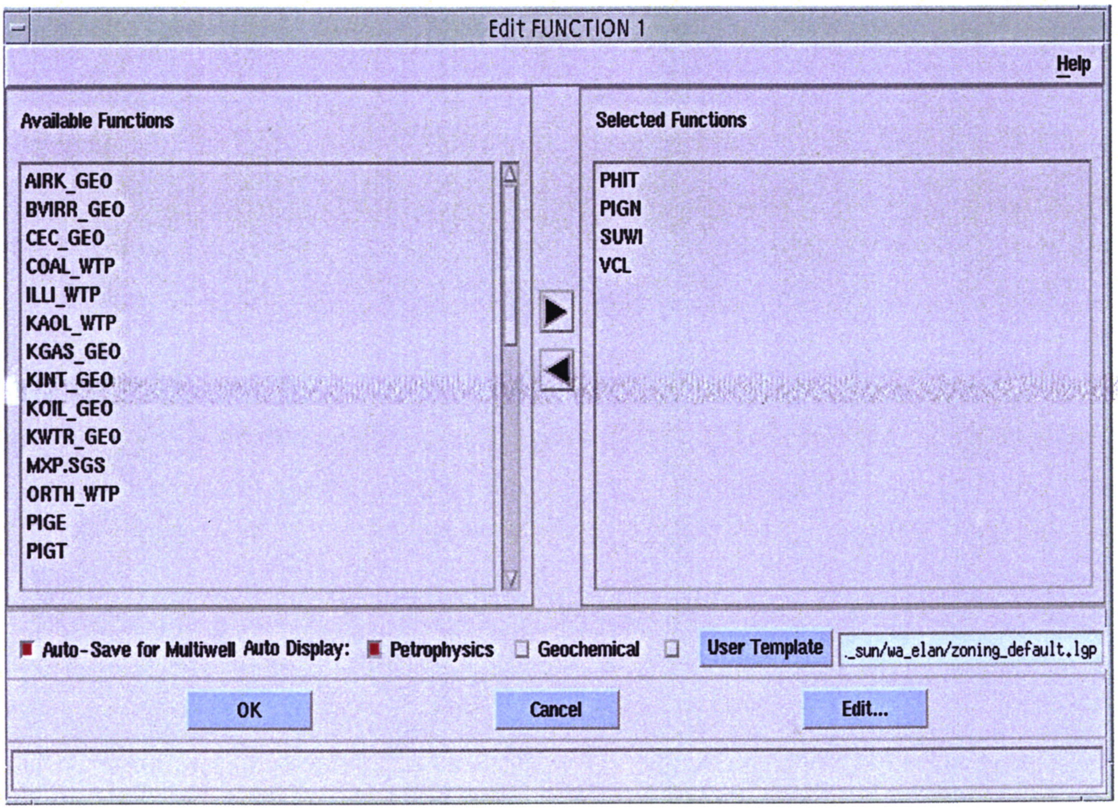
PRB2.SAND = IF ((DEPT >1280) AND (PRB1.COAL= =0) AND (FLAG.RADIOAC = =0), 1,0)

PRB3.RADIOA=IF ((DEPT<1280) AND (PRB1.COAL= =0) AND (FLAG.RADIOAC = =1), 1,0)

Beardie-1 Probability Functions used in the Combine Process

<u>Equation for Constant Tool (CT1)</u>

0.1QUARTZ -ORTH =0



Available Functions

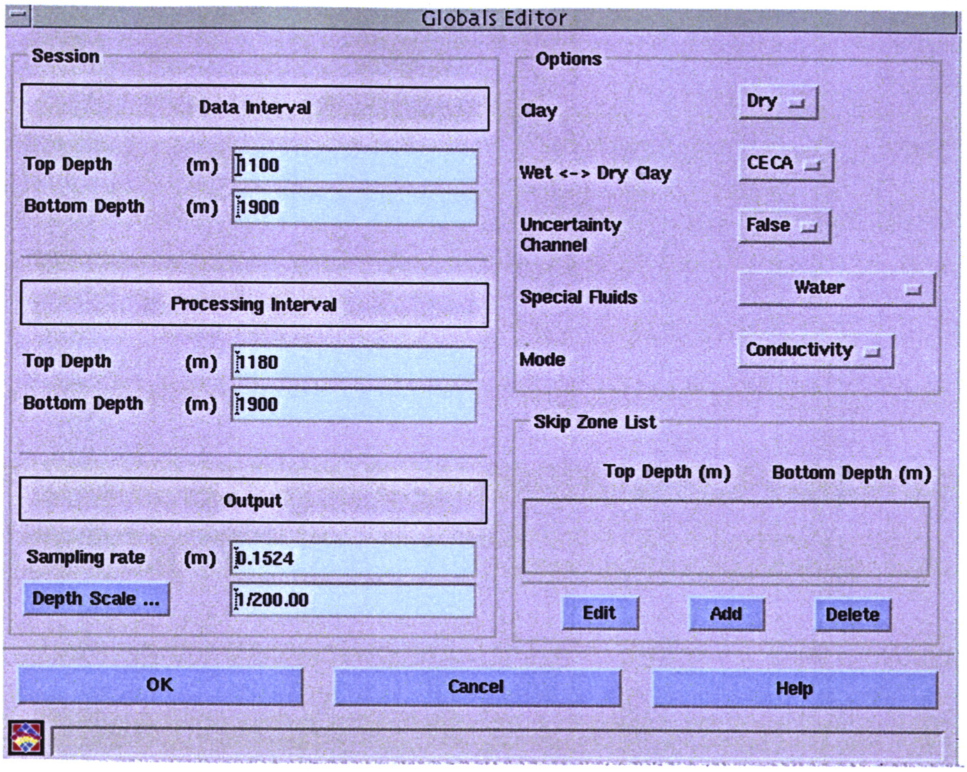
AIRK_GEO
BVIRR_GEO
CEC_GEO
COAL_WTP
ILLI_WTP
KAOL_WTP
KGAS_GEO
KINT_GEO
KOIL_GEO
KWTR_GEO
MXP.SGS
ORTH_WTP
PIGE
PIGT

Selected Functions

PHIT
PIGN
SUWI
VCL

☒ Auto-Save for Multiwell Auto Display: ☒ Petrophysics ☐ Geochemical ☐ User Template _sun/wa_elan/zoning_default.lgp

Beardie-1 Function Process



Data Interval

Top Depth (m) 1100

Bottom Depth (m) 1900

Processing Interval

Top Depth (m) 1180

Bottom Depth (m) 1900

Output

Sampling rate (m) 0.1524

Depth Scale ... 1/200.00

Clay: Dry

Wet <-> Dry Clay: CECA

Uncertainty Channel: False

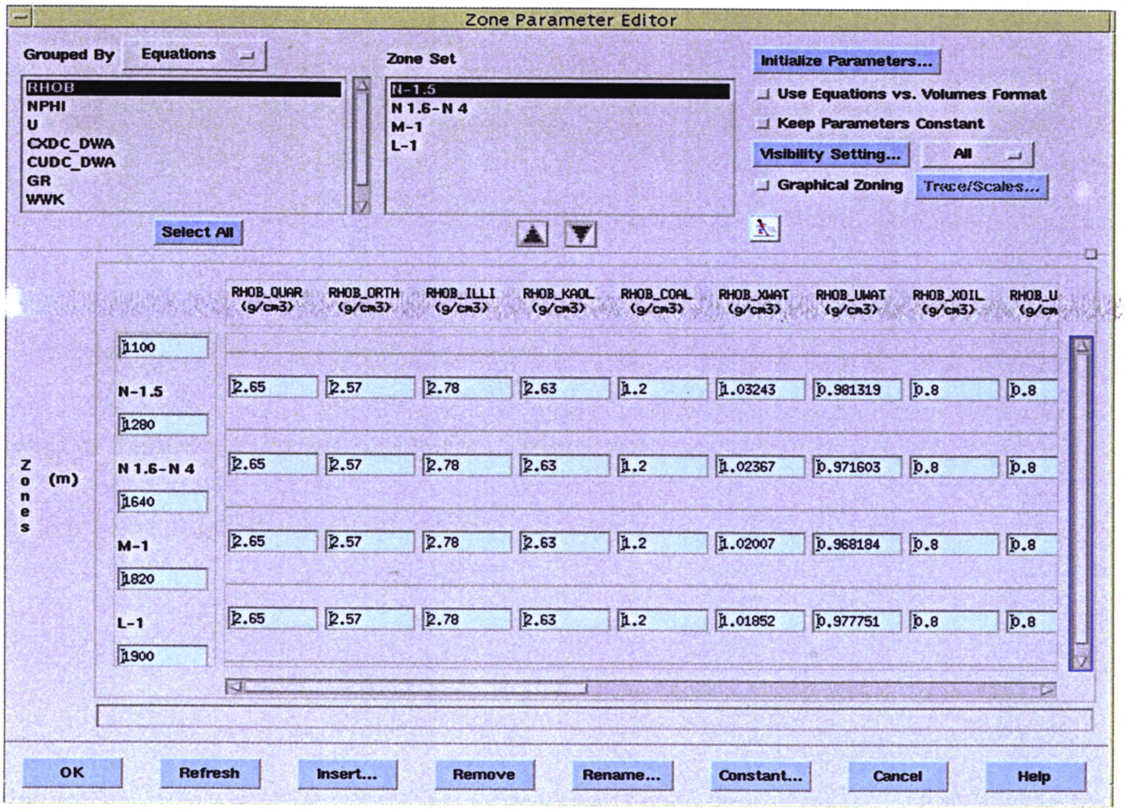
Special Fluids: Water

Mode: Conductivity

Skip Zone List

Top Depth (m)	Bottom Depth (m)

Beardie-1 Globals



Grouped By: Equations

RHOB
NPHI
U
CXDC_DWA
CUDC_DWA
GR
WWK

Zone Set

N-1.5
N 1.6-N 4
M-1
L-1

☐ Use Equations vs. Volumes Format

☐ Keep Parameters Constant

Visibility Setting... All

☐ Graphical Zoning

Zones (m)	RHOB_QUAR (g/cm3)	RHOB_ORTH (g/cm3)	RHOB_ILLI (g/cm3)	RHOB_KAOL (g/cm3)	RHOB_COAL (g/cm3)	RHOB_XWAT (g/cm3)	RHOB_UWAT (g/cm3)	RHOB_XOIL (g/cm3)	RHOB_U (g/cm
1100									
N-1.5	2.65	2.57	2.78	2.63	1.2	1.03243	0.981319	0.8	0.8
1280									
N 1.6-N 4	2.65	2.57	2.78	2.63	1.2	1.02367	0.971603	0.8	0.8
1640									
M-1	2.65	2.57	2.78	2.63	1.2	1.02007	0.968184	0.8	0.8
1820									
L-1	2.65	2.57	2.78	2.63	1.2	1.01852	0.977751	0.8	0.8
1900									

Beardie-1 Zones

Input Parameters

RW(ohm.m):
RWT(degC):
SALIN_UWAT(ppk): 4
RMF(ohm.m): 0.097
MST(degC): 21.5
SALIN_XWAT(ppk):
Zone Temp(degC): 61
Mud Weight(g/cm3): 1.1743
Avg.Porosity(m3/m3): 0.30
TVD(m): 1236
☐ OBM

Output Parameters

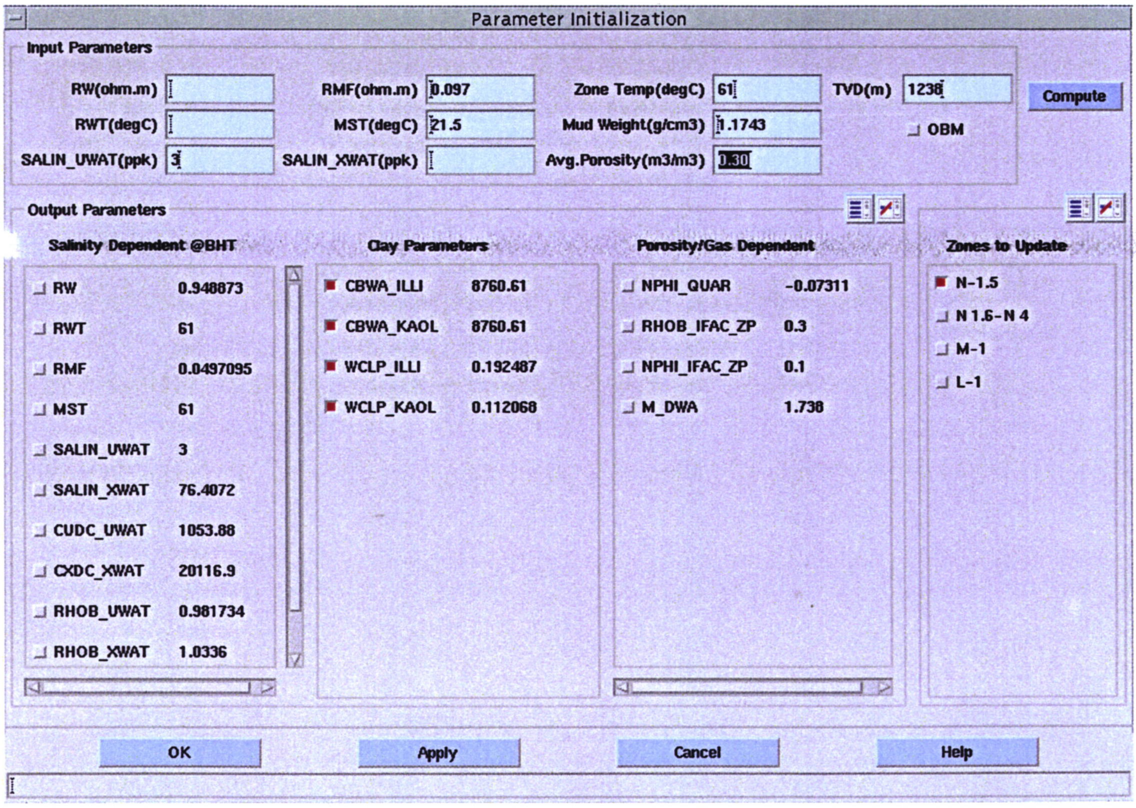
Salinity Dependent @BHT
☒ RW 0.722571
☒ RWT 61
☒ RMF 0.0497095
☒ MST 61
☒ SALIN_UWAT 4
☒ SALIN_XWAT 76.4072
☒ CUDC_UWAT 1383.95
☒ CXDC_XWAT 20116.9
☒ RHOB_UWAT 0.982435
☒ RHOB_XWAT 1.0336

Clay Parameters
☐ CBWA_ILLI 9028.33
☐ CBWA_KAOL 9028.33
☐ WCLP_ILLI 0.187851
☐ WCLP_KAOL 0.109108

Porosity/Gas Dependent
☒ NPHI_QUAR -0.0732334
☒ RHOB_IFAC_ZP 0.3
☒ NPHI_IFAC_ZP 0.1
☐ M_DWA 1.738

Zones to Update
☒ N-1.5
☐ N 1.6-N 4
☐ M-1
☐ L-1

Beardie-1 N-1.5 Free Water Parameters



Input Parameters

RW(ohm.m):
RWT(degC):
SALIN_UWAT(ppk): 3
RMF(ohm.m): 0.097
MST(degC): 21.5
SALIN_XWAT(ppk):
Zone Temp(degC): 61
Mud Weight(g/cm3): 1.1743
Avg.Porosity(m3/m3): 0.30
TVD(m): 1236
☐ OBM

Output Parameters

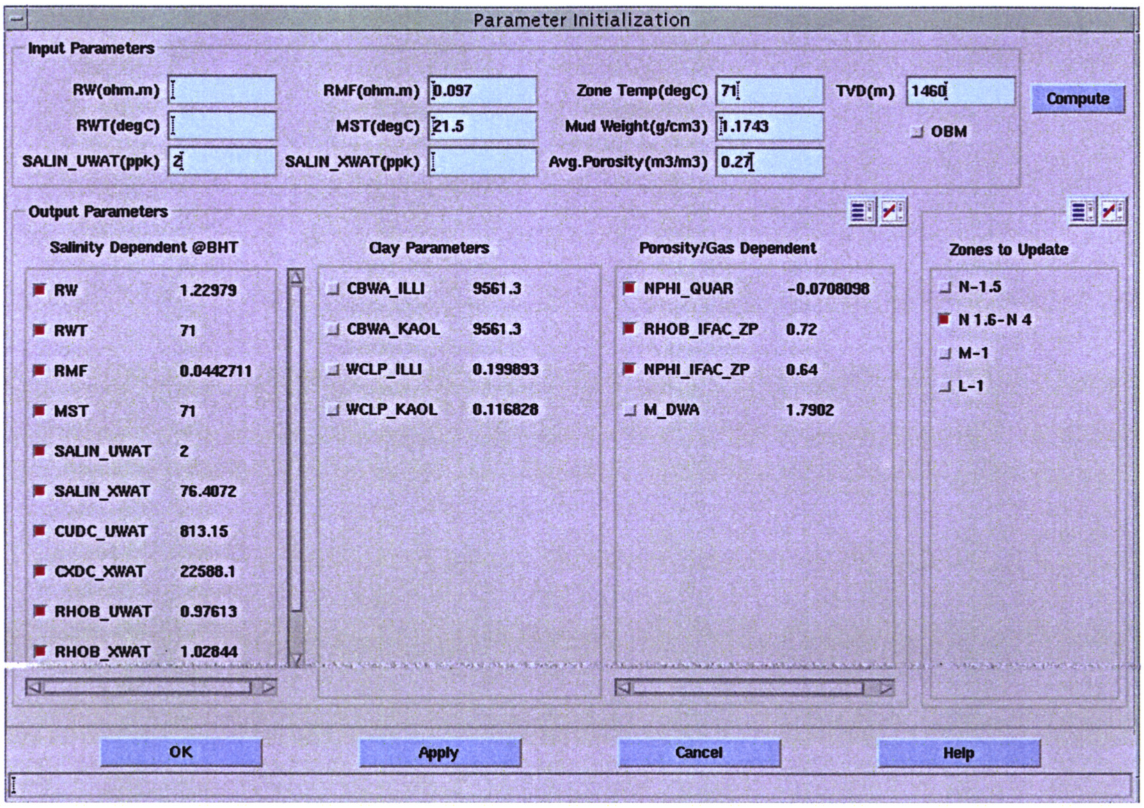
Salinity Dependent @BHT
☐ RW 0.948873
☐ RWT 61
☐ RMF 0.0497095
☐ MST 61
☐ SALIN_UWAT 3
☐ SALIN_XWAT 76.4072
☐ CUDC_UWAT 1053.88
☐ CXDC_XWAT 20116.9
☐ RHOB_UWAT 0.981734
☐ RHOB_XWAT 1.0336

Clay Parameters
☒ CBWA_ILLI 8760.61
☒ CBWA_KAOL 8760.61
☒ WCLP_ILLI 0.192487
☒ WCLP_KAOL 0.112068

Porosity/Gas Dependent
☐ NPHI_QUAR -0.07311
☐ RHOB_IFAC_ZP 0.3
☐ NPHI_IFAC_ZP 0.1
☐ M_DWA 1.738

Zones to Update
☒ N-1.5
☐ N 1.6-N 4
☐ M-1
☐ L-1

Beardie-1 N-1.5 Bound Water Parameters



Input Parameters

RW(ohm.m)
RWT(degC)
SALIN_UWAT(ppk) 2
RMF(ohm.m) 0.097
MST(degC) 21.5
SALIN_XWAT(ppk)
Zone Temp(degC) 71
Mud Weight(g/cm3) 1.1743
Avg.Porosity(m3/m3) 0.27
TVD(m) 1460
☐ OBM

Output Parameters

Salinity Dependent @BHT

☒ RW 1.22979
☒ RWT 71
☒ RMF 0.0442711
☒ MST 71
☒ SALIN_UWAT 2
☒ SALIN_XWAT 76.4072
☒ CUDC_UWAT 813.15
☒ CXDC_XWAT 22588.1
☒ RHOB_UWAT 0.97613
☒ RHOB_XWAT 1.02844

Clay Parameters

☐ CBWA_ILLI 9561.3
☐ CBWA_KAOL 9561.3
☐ WCLP_ILLI 0.199893
☐ WCLP_KAOL 0.116828

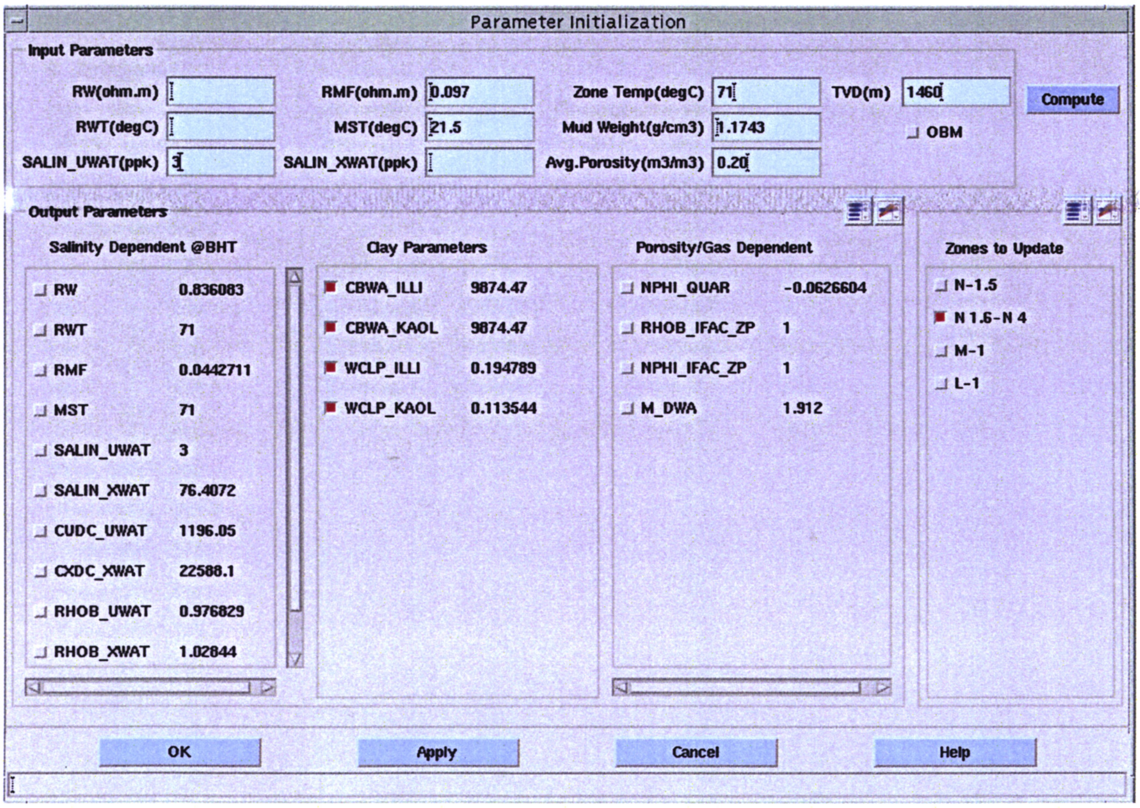
Porosity/Gas Dependent

☒ NPHI_QUAR -0.0708098
☒ RHOB_IFAC_ZP 0.72
☒ NPHI_IFAC_ZP 0.64
☐ M_DWA 1.7902

Zones to Update

☐ N-1.5
☒ N 1.6-N 4
☐ M-1
☐ L-1

Beardie-1 N-1-- N4 Free Water Parameters



Input Parameters

RW(ohm.m)
RWT(degC)
SALIN_UWAT(ppk) 3
RMF(ohm.m) 0.097
MST(degC) 21.5
SALIN_XWAT(ppk)
Zone Temp(degC) 71
Mud Weight(g/cm3) 1.1743
Avg.Porosity(m3/m3) 0.20
TVD(m) 1460
☐ OBM

Output Parameters

Salinity Dependent @BHT

☐ RW 0.836083
☐ RWT 71
☐ RMF 0.0442711
☐ MST 71
☐ SALIN_UWAT 3
☐ SALIN_XWAT 76.4072
☐ CUDC_UWAT 1196.05
☐ CXDC_XWAT 22588.1
☐ RHOB_UWAT 0.976829
☐ RHOB_XWAT 1.02844

Clay Parameters

☒ CBWA_ILLI 9874.47
☒ CBWA_KAOL 9874.47
☒ WCLP_ILLI 0.194789
☒ WCLP_KAOL 0.113544

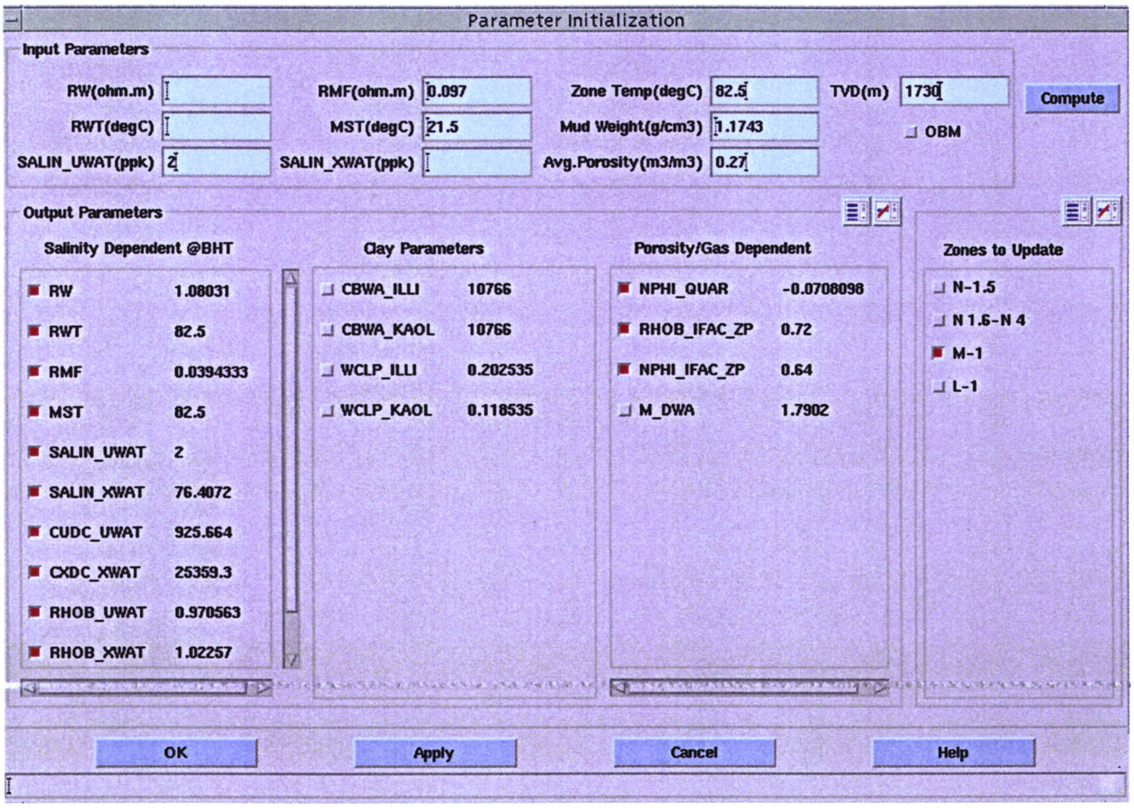
Porosity/Gas Dependent

☐ NPHI_QUAR -0.0626604
☐ RHOB_IFAC_ZP 1
☐ NPHI_IFAC_ZP 1
☐ M_DWA 1.912

Zones to Update

☐ N-1.5
☒ N 1.6-N 4
☐ M-1
☐ L-1

Beardie-1 N-1-- N4 Bound Water Parameters



Input Parameters

RW(ohm.m)
RWT(degC)
SALIN_UWAT(ppk) 2
RMF(ohm.m) 0.097
MST(degC) 21.5
SALIN_XWAT(ppk)
Zone Temp(degC) 82.5
Mud Weight(g/cm3) 1.1743
Avg.Porosity(m3/m3) 0.27
TVD(m) 1730
☐ OBM

Output Parameters

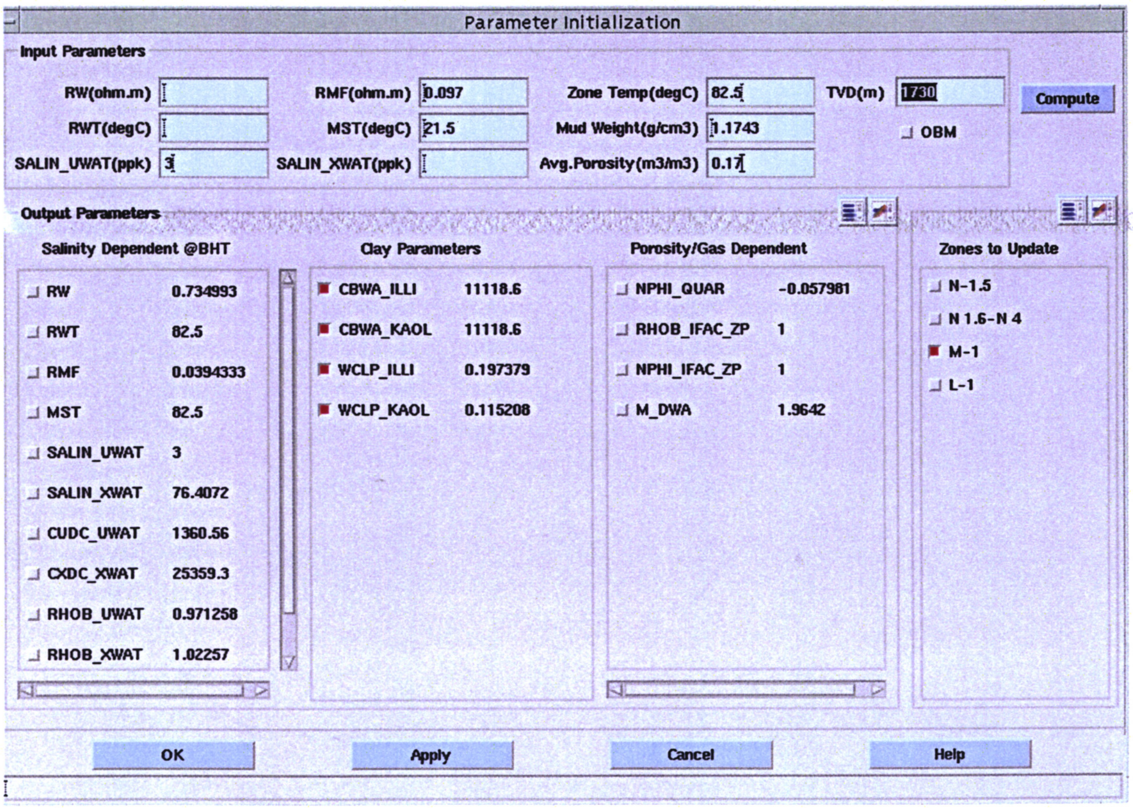
Salinity Dependent @BHT	
☒ RW	1.08031
☒ RWT	82.5
☒ RMF	0.0394333
☒ MST	82.5
☒ SALIN_UWAT	2
☒ SALIN_XWAT	76.4072
☒ CUDC_UWAT	925.664
☒ CXDC_XWAT	25359.3
☒ RHOB_UWAT	0.970563
☒ RHOB_XWAT	1.02257

Clay Parameters	
☐ CBWA_ILLI	10766
☐ CBWA_KAOL	10766
☐ WCLP_ILLI	0.202535
☐ WCLP_KAOL	0.118535

Porosity/Gas Dependent	
☒ NPHI_QUAR	-0.0708098
☒ RHOB_IFAC_ZP	0.72
☒ NPHI_IFAC_ZP	0.64
☐ M_DWA	1.7902

Zones to Update
☐ N-1.5
☐ N 1.6-N 4
☒ M-1
☐ L-1

Beardie-1 M-1 Free Water Parameters



Input Parameters

RW(ohm.m)
RWT(degC)
SALIN_UWAT(ppk) 3
RMF(ohm.m) 0.097
MST(degC) 21.5
SALIN_XWAT(ppk)
Zone Temp(degC) 82.5
Mud Weight(g/cm3) 1.1743
Avg.Porosity(m3/m3) 0.17
TVD(m) 1730
☐ OBM

Output Parameters

Salinity Dependent @BHT	
☐ RW	0.734993
☐ RWT	82.5
☐ RMF	0.0394333
☐ MST	82.5
☐ SALIN_UWAT	3
☐ SALIN_XWAT	76.4072
☐ CUDC_UWAT	1360.56
☐ CXDC_XWAT	25359.3
☐ RHOB_UWAT	0.971258
☐ RHOB_XWAT	1.02257

Clay Parameters	
☒ CBWA_ILLI	11118.6
☒ CBWA_KAOL	11118.6
☒ WCLP_ILLI	0.197379
☒ WCLP_KAOL	0.115208

Porosity/Gas Dependent	
☐ NPHI_QUAR	-0.057981
☐ RHOB_IFAC_ZP	1
☐ NPHI_IFAC_ZP	1
☐ M_DWA	1.9642

Zones to Update
☐ N-1.5
☐ N 1.6-N 4
☒ M-1
☐ L-1

Beardie-1 M-1 Bound Water Parameters

Input Parameters

RW(ohm.m):
RWT(degC):
SALIN_UWAT(ppk): 18
RMF(ohm.m): 0.097
MST(degC): 21.5
SALIN_XWAT(ppk):
Zone Temp(degC): 88.5
Mud Weight(g/cm3): 1.1743
Avg.Porosity(m3/m3): 0.25
TVD(m): 1860
☐ OBM

Output Parameters

Salinity Dependent @BHT

☒ RW 0.131755
☒ RWT 88.5
☒ RMF 0.0373554
☒ MST 88.5
☒ SALIN_UWAT 18
☒ SALIN_XWAT 76.4072
☒ CUDC_UWAT 7589.83
☒ CXDC_XWAT 26769.9
☒ RHOB_UWAT 0.978652
☒ RHOB_XWAT 1.01946

Clay Parameters

☐ CBWA_ILLI 18412.1
☐ CBWA_KAOL 18412.1
☐ WCLP_ILLI 0.136662
☐ WCLP_KAOL 0.0773331

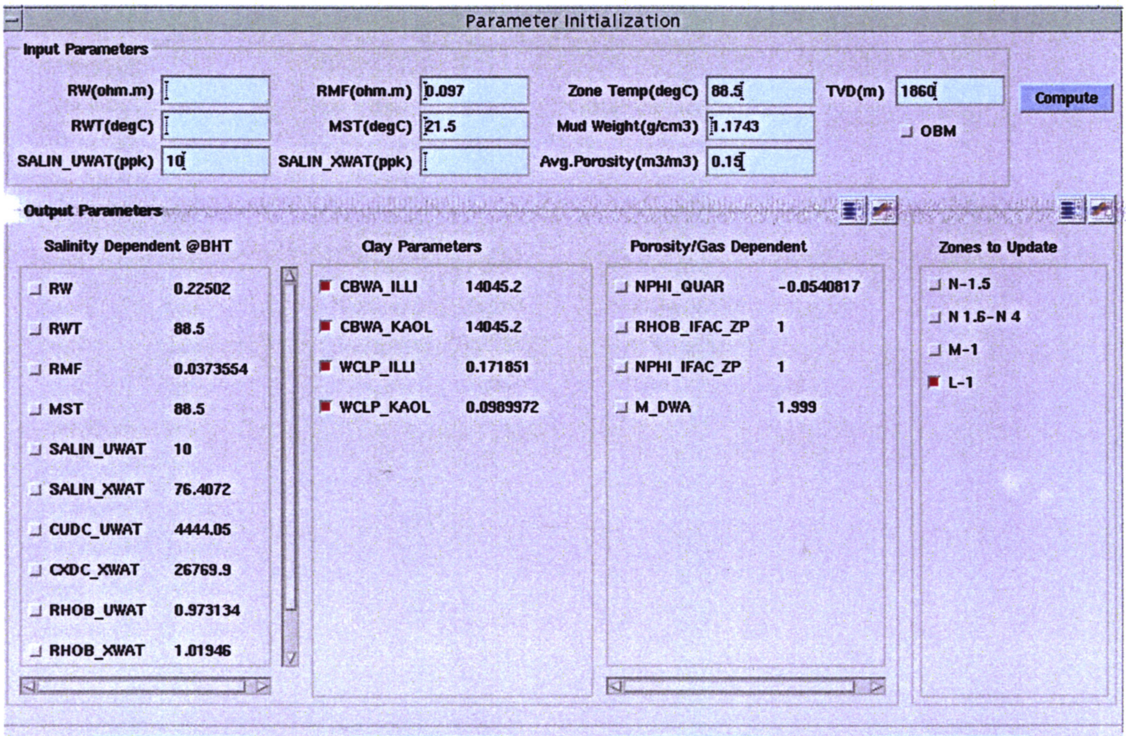
Porosity/Gas Dependent

☒ NPHI_QUAR -0.0695802
☒ RHOB_IFAC_ZP 1
☒ NPHI_IFAC_ZP 1
☐ M_DWA 1.825

Zones to Update

☐ N-1.5
☐ N 1.6-N 4
☐ M-1
☒ L-1

Beardie-1 L-1 Free Water Parameters



Input Parameters

RW(ohm.m):
RWT(degC):
SALIN_UWAT(ppk): 10
RMF(ohm.m): 0.097
MST(degC): 21.5
SALIN_XWAT(ppk):
Zone Temp(degC): 88.5
Mud Weight(g/cm3): 1.1743
Avg.Porosity(m3/m3): 0.15
TVD(m): 1860
☐ OBM

Output Parameters

Salinity Dependent @BHT

☐ RW 0.22502
☐ RWT 88.5
☐ RMF 0.0373554
☐ MST 88.5
☐ SALIN_UWAT 10
☐ SALIN_XWAT 76.4072
☐ CUDC_UWAT 4444.05
☐ CXDC_XWAT 26769.9
☐ RHOB_UWAT 0.973134
☐ RHOB_XWAT 1.01946

Clay Parameters

☒ CBWA_ILLI 14045.2
☒ CBWA_KAOL 14045.2
☒ WCLP_ILLI 0.171851
☒ WCLP_KAOL 0.0989972

Porosity/Gas Dependent

☐ NPHI_QUAR -0.0540817
☐ RHOB_IFAC_ZP 1
☐ NPHI_IFAC_ZP 1
☐ M_DWA 1.999

Zones to Update

☐ N-1.5
☐ N 1.6-N 4
☐ M-1
☒ L-1

Beardie-1 L-1 Bound Water Parameters

PE651037

This is an enclosure indicator page.
The enclosure PE651037 is enclosed within the container PE913714 at this location in this document.

The enclosure PE651037 has the following characteristics:

ITEM_BARCODE = PE651037
CONTAINER_BARCODE = PE913714
NAME = Petrophysical Interpretation Log, 1:500
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = WELL_LOG
DESCRIPTION = Beardie-1 Petrophysical Interpretation Log, Scale 1:500, Victoria, (Enclosure from Appendix 2 of Beardie-1 Well Completion Report, Vol. 2), Exxon Mobile, August 2002.
REMARKS =
DATE_WRITTEN = 04-AUG-2002
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = Exxon Exploration Company
WELL_NAME = Beardie-1
CONTRACTOR =
AUTHOR =
ORIGINATOR = Exxon Exploration Company
TOP_DEPTH = 1180
BOTTOM_DEPTH = 1905
ROW_CREATED_BY = FH11_SW

(Inserted by DNRE - Vic Govt Mines Dept)

APPENDIX 3

PALYNOLOGICAL ANALYSIS

PALYNOLOGY OF

BEARDIE-1

GIPPSLAND BASIN, AUSTRALIA

BY

ROGER MORGAN

Prepared for

ESSO AUSTRALIA PTY LTD

October, 2002

REF: GIPP.BEARDIE-1 REPORT

913714 065

PALYNOLOGY OF
BEARDIE-1
GIPPSLAND BASIN, AUSTRALIA

CONTENTS **PAGE**

1 SUMMARY 3

2 INTRODUCTION 4

3 PALYNOSTRATIGRAPHY 8

4 REFERENCE 12

Table 1 Summary Palynological Data : Beardie-1

Figure 1 Tertiary Zonation Scheme (Partridge 1976 and pers. comm. using time scale of Haq et al)

Figure 2 Maturity Profile : Beardie-1

Appendix 1 Palynological Data Charts

1 SUMMARY

1226.0 m (swc) – 1544.0 m (swc) : *P. asperopolus* – upper *M. diversus* Zones : Early Eocene : non-marine lacustrine to very marginal marine : marginally mature for oil

1657.0 m (swc) – 1793.0 m (swc) : middle *M. diversus* Zone : Early Eocene : non-marine lacustrine to very marginal marine : marginally mature for oil

1795.0 m (swc) – 1845.0 m (swc) : indeterminate (almost barren of palynomorphs)

1870.0 m (swc) – 1877.0 m (swc) : upper *L. balmei* Zone : Paleocene : non-marine lacustrine : early mature for oil

2 INTRODUCTION

Palynological results for Beardie-1 is based on 16 sidewall core samples submitted by Paul Owen and summarised on Table 1.

The zonation scheme used (Figure 1) is essentially that of Partridge (1976 and pers. comm.). All informal names are shown in quotation marks. Names are given in full when first mentioned in the text, but only the genus initial and full species name is given when subsequently mentioned.

Maturity data were generated in the form of Spore Colour Index, and are plotted on Figure 2 Maturity Profile: Beardie-1. The oil and gas windows on Figure 2 follow the general consensus of geochemical literature. The oil window corresponds to spore colours of light-mid brown (Staplin Spore Colour Index of 2.7) to dark brown (3.6), equivalent to vitrinite reflectance values of 0.6% to 1.3%. Geochemists argue variations on kerogen type, basin type and basin history. The maturity interpretation is thus open to reinterpretation using the basic colour observations as raw data. However, the range of interpretation philosophies is not great, and probably would not move the oil window by more than 200 m.

Raw palynological data are included in Appendix 1. The data are based on a 100+ specimen count where possible from which an indication of marine microplankton to terrestrial palynomorph proportions can be derived. The microplankton percentages are listed in Table 1, which also summarize other palynological details. Environmental assessments are derived from the palynomorph counts using content and diversity of saline taxa (dinoflagellates and spiny acritarchs), other microplankton (mostly freshwater algae), and terrestrial spores and pollen. Within non-marine environments, content and diversity of freshwater algae, spores (mostly ferns) and pollen (mostly gymnosperm but including flowering plants) are used for detailed environmental assessment. The criteria for these assessments are defined in Table 1. In running text, frequency of taxa is discussed in the following intervals: Very rare = <1%, Rare = 1-3%, Frequent = 4-10%, Common = 11-29%, Abundant = 30-49%, Super-abundant = 50-100%.

TABLE 1

SUMMARY OF PALYNOLOGICAL DATA – BEARDIE-1

LOG DEPTH (m)	SAMPLE TYPE	MICROFOSSIL YIELD	AGE	PERCENTAGE						DIVERSITY *1		ZONE (SUBZONE)	ENVIRONMENT *2
				FRESHWATER ALGAE	SALINE ACRITARCHS	SALINE DINOCYSTS	SPORE	SACCATE POLLEN	OTHER POLLEN	SALINE MICROPLANKTON	SPORES-		
1226.0	SWC	EX LOW	EARLY EOCENE	23	1	6	54	4	12	LOW	LOW	P. ASPEROPOLUS – UPPER M. DIVERSUS	VERY MARGINAL MARINE
1315.0	SWC	EX LOW	EARLY EOCENE	35	0	0	35	24	6	NIL+LOW		P. ASPEROPOLUS – UPPER M. DIVERSUS	NON-MARINE (LAKE)
1354.0	SWC	EX LOW	EARLY EOCENE	52	0	3	22	12	11	EX LOW	LOW	P. ASPEROPOLUS – UPPER M. DIVERSUS	VERY MARGINAL MARINE
1382.0	SWC	EX LOW	EARLY EOCENE	60	0	<1	13	12	15	EX LOW	LOW	P. ASPEROPOLUS – UPPER M. DIVERSUS	VERY MARGINAL MARINE
1410.0	SWC	EX LOW	EARLY EOCENE	68	0	0	20	7	5	NIL	LOW	P. ASPEROPOLUS – UPPER M. DIVERSUS	NON-MARINE (LAKE)
1422.0	SWC	EX LOW	EARLY EOCENE	62	0	0	14	21	3	NIL	LOW	P. ASPEROPOLUS – UPPER M. DIVERSUS	NON-MARINE (LAKE)
1468.0	SWC	EX LOW	EARLY EOCENE	75	0	0	8	9	8	NIL	LOW	P. ASPEROPOLUS – UPPER M. DIVERSUS	NON-MARINE (LAKE)
1489.0	SWC	EX LOW	EARLY EOCENE	82	0	0	4	10	4	NIL	EX LOW	P. ASPEROPOLUS – UPPER M. DIVERSUS	NON-MARINE (LAKE)
1504.0	SWC	EX LOW	EARLY EOCENE	78	0	0	8	10	5	NIL	LOW	P. ASPEROPOLUS – UPPER M. DIVERSUS	NON-MARINE (LAKE)
1544.0	SWC	EX LOW	EARLY EOCENE	75	0	<1	11	3	5	EX LOW	LOW	P. ASPEROPOLUS – UPPER M. DIVERSUS	VERY MARGINAL MARINE
1657.0	SWC	EX LOW	EARLY EOCENE	21	0	<1	13	15	51	EX LOW	LOW	MIDDLE M. DIVERSUS	VERY MARGINAL MARINE
1793.0	SWC	EX LOW	EARLY EOCENE	19	0	0	48	21	12	NIL	LOW	MIDDLE M. DIVERSUS	NON-MARINE (LAKE)
1795.0	SWC	NEAR BARREN	INDETERMINATE	-	-	-	-	-	-	NIL	LOW	INDETERMINATE	INDETERMINATE
1845.0	SWC	NEAR BARREN	INDETERMINATE	-	-	-	-	-	-	NIL	NIL	INDETERMINATE	INDETERMINATE
1870.0	SWC	MODERATE	PALEOCENE	11	0	0	40	35	14	NIL	MOD	UPPER L. BALMEI	NON-MARINE (LAKE)
1877.0	SWC	MODERATE	PALEOCENE	11	0	0	64	16	8	NIL	MOD	UPPER L. BALMEI	NON-MARINE (LAKE)

*1 DIVERSITY	
VERY HIGH	30+ SPECIES
HIGH	20-29 SPECIES
MODERATE	10-19 SPECIES
LOW	5-9 SPECIES
EX LOW	1-4 SPECIES

*2 ENVIRONMENTS	SALINE MICROPLANKTON CONTENT %)	SALINE MICROPLANKTON DIVERSITY
OFFSHORE MARINE	67 to 100	VERY HIGH
SHELFAL MARINE	34 to 66	HIGH
NEARSHORE MARINE	11 to 33	MODERATE
VERY NEARSHORE MARINE	5 to 10	MODERATE-LOW
MARGINAL MARINE	<1 to 4	LOW-VERY LOW
BRACKISH	LOW SALINE ACRTIARCHS ONLY	EXTREMELY LOW
NON-MARINE (UNDIFF)	NO SALINE MICROPLANKTON, LOW FRESHWATER ALGAE	NIL

THE NON-MARINE ENVIRONMENTS ARE RECOGNISED ON BINT & HELBY (1988) CRITERA, NAMELY	
FLUVIAL:	LEAN, SANDY, POLLEN DOMINANT
FLOODPLAIN:	RICH, POLLEN DOMINANT, SPORES SUBORDINATE AND DIVERSE, NO OR VERY FEW FRESHWATER ALGAE
SWAMP MARGIN:	RICH, POLLEN AND SPORES CO-DOMINANT, SPORES VERY DIVERSE, MINOR FRESHWATER ALGAE <10%
SWAMP:	RICH, SPORES DOMINANT AND LOW DIVERSITY, MINOR FRESHWATER ALGAE <10%
LACUSTRINE:	RICH, FRESHWATER ALGAE 10%,+, POLLEN USUALLY DOMINANT, SPORES SUBORDINATE WITH USUALLY MODERATE TO LOW DIVERSITY

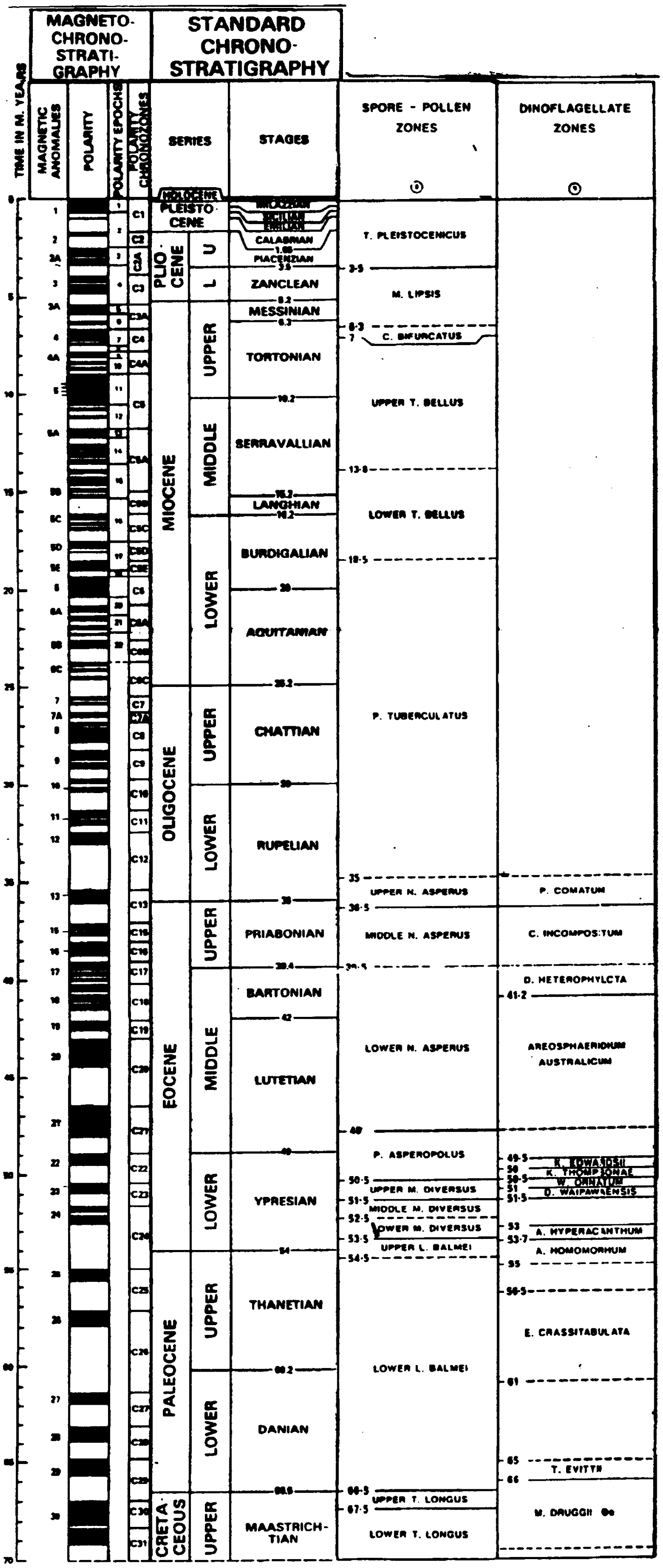
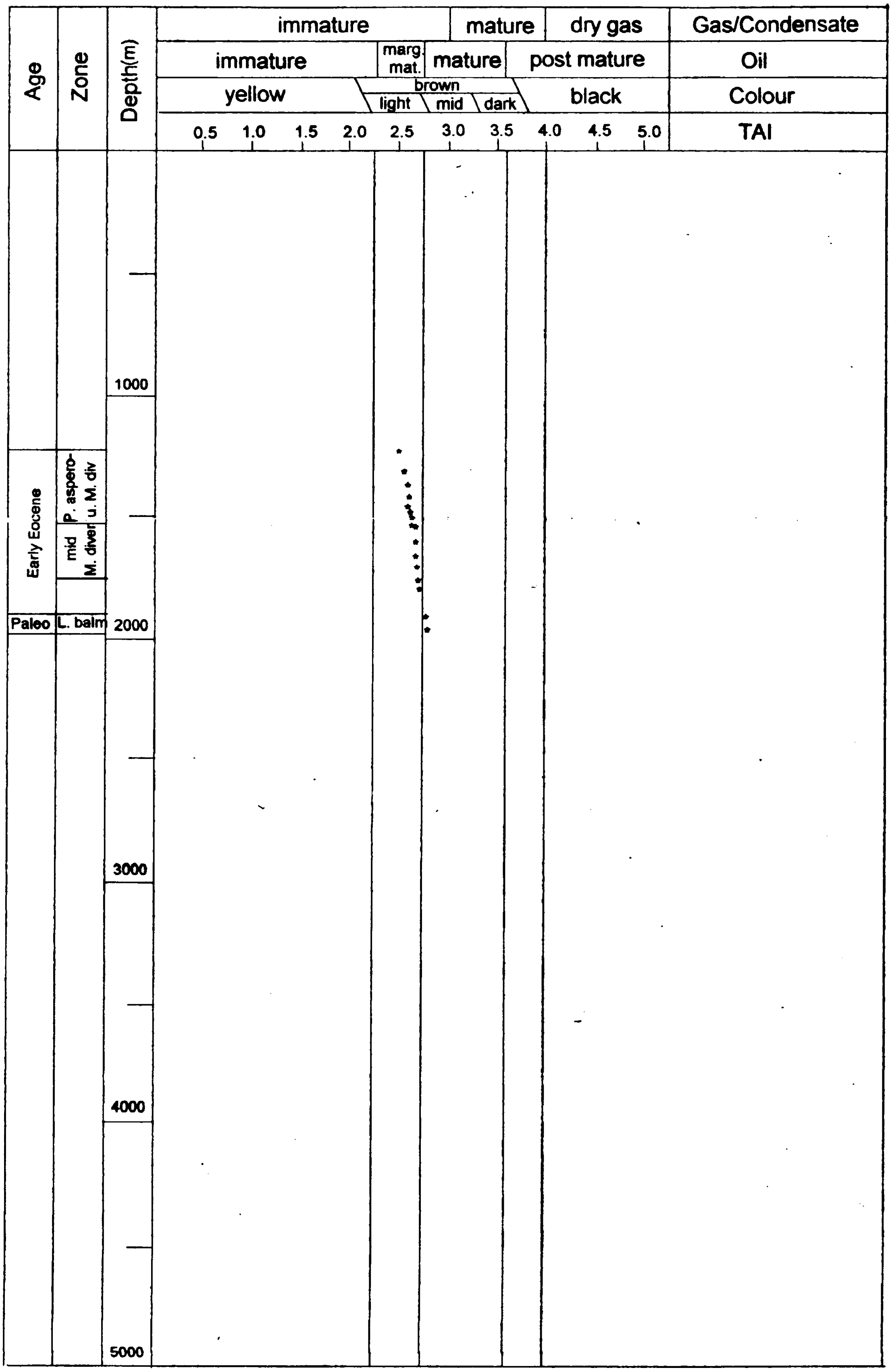


FIGURE 1 TERTIARY ZONATION SCHEME (Partridge 1976 and pers. comm. using time scale of Haq et al)

FIGURE 2 MATURITY PROFILE : BEARDIE-1



3 PALYNOSTRATGRAPHY

3.1 1226.0 m (swc) – 1544.0 m (swc) : *P. asperopolus* – upper *M. diversus* Zones

Organic yields are very good in this interval, but the recovered kerogen is dominated by plant debris (mostly cuticle and inertinite with significant amorphous organic matter (AOM) in some samples) with rare but well preserved palynomorphs. The presence of rare and intermittent *Proteacidites pachypolus* indicates the *P. asperopolus* or upper *M. diversus* Zones, but too few taxa were seen to be more precise. Abundant are *Botryococcus* spp. indicating freshwater environments. Frequent to common are *Cyathidites* spp. and *Falcisporites similis* and intermittently frequent are *Laevigatosporites ovatus, Haloragacidites harrisii* and *Podosporites microsaccatus*. Rare and intermittent taxa include *Beaupreadites verrucosus, Nothofagidites* spp., *Phyllocladidites mawsonii, Proteacidites grandis, Proteacidites kopiensis, P. pachypolus, Proteacidites incurvatus, Proteacidites leightonii, Proteacidites ornatus* and *Proteacidites tuberculiformis*. Since these markers are so rare and intermittent, the base of this interval must be considered approximate.

Dinoflagellates are very rare and intermittent in a few samples and include *Deflandrea flounderensis*, consistent with the spore-pollen assignment, but not sufficient for assignment to the dinoflagellate zones shown in Partridge (1976). The shallowest sample (1226 m) has more dinoflagellates than the others, but cannot be assigned to any zone.

Environments vary, but are all in the range of non-marine mostly lacustrine, to very marginal marine, as described below.

1226.0 m (swc) : Minor dinoflagellates and microforaminifera indicate slight saline influence in very marginal marine environments. Freshwater algae are very common, suggesting flushing of nearby lakes. Amongst the spore-pollen, fern spores are dominant suggesting nearby swamps. Plant debris (cuticle and inertinite) is abundant. A nearshore lagoon with some tidal flow or similar seems likely. Plant debris (cuticle and inertinite) is abundant.

1315.0 m (swc) : The absence of saline markers indicates non-marine environments and very common freshwater algae (*Botryococcus*) indicates lake environments. Saccates and spores are in subequal proportions suggesting some distance from the lake shore. Dominant plant debris (inertinite) and significant amorphous organic matter (AOM) suggest anoxic bottom conditions. A stagnant lake or similar seems likely.

1354.0 m (swc) : Trace dinoflagellates (of a single species) indicate very marginal marine (to possibly brackish) environments. Abundant freshwater algae suggests strong freshwater influence. This could be caused by flushing of nearshore lakes, or by intermittent tidal washover into a nearshore lagoon. Saccates and spores are in subequal proportions. Plant debris (cuticle and inertinite) is dominant. A reduced salinity nearshore lagoon or similar seems likely.

1382.0 m (swc) : A single dinoflagellate specimen indicates very minor marginal marine (or possibly brackish) influence. Abundant freshwater algae suggests strong freshwater influence. Saccates and spores are in subequal proportions, suggesting that fern dominated swamps are not nearby. Plant debris (cuticle and inertinite) is dominant. A nearshore lagoon with minor tidal washover or similar seems likely.

1410.0 m (swc) : The absence of saline markers indicates non-marine environments. Abundant freshwater algae (*Botryococcus*) indicates lake environments. Spores are more frequent than saccate pollen suggesting nearby lake shoreline fern swamps. Plant debris (cuticle and inertinite) is dominant. A large freshwater lake, relatively near to shore, or similar, seems likely.

1422.0 m (swc) : The absence of saline markers indicates non-marine environments. Abundant freshwater algae (*Botryococcus*) indicates lake environments. Spores and saccate pollen are in subequal proportions, suggesting that lake shoreline fern dominated swamps are not nearby. Plant debris (cuticle and inertinite) is dominant. A large freshwater lake or similar, is likely.

1468.0 m (swc) : The absence of saline markers indicates non-marine environments. Abundant freshwater algae indicates lake environments. Spores and saccate pollen are in subequal proportions, suggesting that fern dominated swamps are not nearby. Plant debris (cuticle and inertinite and AOM) is dominant and the common AOM suggests anoxic bottom environments. A large bottom stagnant freshwater lake or similar, seems likely.

1489.0 m (swc) : The absence of saline markers indicates non-marine environments. Abundant freshwater algae indicates lake environments. Spores and saccate pollen are in subequal proportions, suggesting that fern dominated swamps are not nearby. Plant debris (cuticle and inertinite and AOM) is dominant and the common AOM suggests anoxic bottom environments. A large bottom stagnant freshwater lake or similar, seems likely.

1504.0 m (swc) : The absence of saline markers indicates non-marine environments. Abundant freshwater algae indicates lake environments. Spores and saccate pollen are in subequal proportions, suggesting that fern dominated swamps are not nearby. Plant debris (cuticle and inertinite) is dominant. A large freshwater lake or similar, seems likely.

1544.0 m (swc) : Very rare dinoflagellates (of one species) suggests very marginal marine (or possibly brackish) environments. Abundant freshwater algae suggest significant freshwater influence either by flushing of large lakes, or by saline incursion into a freshwater lagoon. Spores outnumber saccate pollen suggesting nearby fern swamps. Plant debris (cuticle and AOM) is dominant suggesting anoxic bottom conditions. A large lagoon, relatively close to the lake shore, with occasional tidal washover, or similar, seems likely.

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

3.2 1657.0 m (swc) – 1793.0 m (swc) : middle *M. diversus* Zone

Organic yield continues to be very high, but with totally dominant plant debris and only very rare spores and pollen. Assignment is on oldest *Proteacidites ornatus* at the base, and the absence of younger markers (especially *P. pachypolus*) at the top. The extreme scarcity of distinctive pollen does reduce confidence, and it is possible that this section might be slightly younger, with the younger markers undetected due to their scarcity. *Botryococcus* is common in both samples. Common at 1657.0 m are *Dilwynites granulatus* and *H. harrisii* with frequent *F. similis* and *Dilwynites pusillum.* At 1793.0 m common are *Araucariacites australis* and *Cyathidites* spp. with frequent *Dictyophyllidites* spp., *Proteacidites* spp. and *Vitreisporites pallidus.* Rare elements include *M. subtilis, Nothofagidites* spp., *P. mawsonii, Proteacidites clarus, P. grandis, P. ornatus* and *Peninsulapollis gillii.*

Environments are very nearshore marine or non-marine, as discussed below.

1657.0 m (swc) : A single dinoflagellate specimen indicates very marginal marine (or brackish) environments. Very common freshwater algae suggests major freshwater influence perhaps by flushing from large lake systems, or by occasional tidal washover into a nearshore lagoon. Spores and saccate pollen occur in subequal proportions suggesting that fern swamps were not nearby. Plant debris (AOM) is dominant, suggesting anoxic bottom conditions. A stagnant bottom nearshore lagoon with occasional tidal washover, or similar, seems likely.

1793.0 m (swc) : The absence of saline markers indicates non-marine environments. Common freshwater algae indicate lake environments. Spores outnumber saccate pollen suggesting that shoreline fern swamps are nearby. Plant debris (cuticle and inertinite) are dominant. Lake environments, relatively close to the lake shore, or similar, are likely.

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

3.3 1795.0 m (swc) – 1845.0 m (swc) : indeterminate

Organic yields are still very high, but plant debris is totally dominant with cuticle, tracheid and inertinite the major components. Too few palynomorphs were seen for valid age or environmental conclusions to be drawn.

3.4 1870.0 m (swc) – 1877.0 m (swc) : *L. balmei* Zone, upper subzone

Organic yields are low in contrast to the overlying section, but palynomorphs are frequent components with plant debris less dominant. Zonal assignment is confident, based on common *Lygistepollenites balmei* in both samples and oldest *Proteacidites grandis* to the interval base. At 1870.0 m, common are *L. balmei, Laevigatosporites ovatus* and *F. similis*, with frequent *Cyathidites, Dictyophyllidites, Nothofagidites* and *Proteacidites.* At 1877.0 m (swc), abundant are *Cyathidites*, with common *L. balmei* and *L. ovatus* and frequent *Dilwynites granulatus* and *F. similis.* Rare elements include *H. harrisii, P. grandis, P. gillii* and *Stereisporites punctatus.*

Environments are non-marine as detailed below.

1870.0 m (swc) : The absence of saline markers indicates non-marine environments. Common freshwater algae indicates lake environments. Spores and saccate pollen are in subequal proportions, suggesting shoreline fern swamps are not nearby. A medium sized lake or similar, seems likely.

1877.0 m (swc) : The absence of saline markers indicates non-marine environments. Common freshwater algae indicates lake environments. Dominant spores suggests nearby shoreline fern swamps. A medium sized lake, but near the lake shore, seems likely.

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

4 REFERENCE

Partridge, A.D. (1976) The geological expression of eustacy in the early Tertiary of the Gippsland Basin APEA J. 16 (1), 73-79

PE913656

This is an enclosure indicator page.
The enclosure PE913656 is enclosed within the container PE913714 at this location in this document.

The enclosure PE913656 has the following characteristics:

ITEM_BARCODE = PE913656
CONTAINER_BARCODE = PE913714
NAME = Beardie-1 Palynology Distribution Chart
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = BIOSTRAT
DESCRIPTION = Beardie-1 Palynology Distribution Chart, % Abundance Histogram, Scale 1:5000, 1226 - 1877m, (Enclosure from Appendix 3 of Beardie-1 Well Completion Report, Vol. 2), By Roger Morgan of Morgan Palaeo Associates for Esso Australia, October 2002.
REMARKS =
DATE_WRITTEN = 21-OCT-2002
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = Esso Australia
WELL_NAME = Beardie-1
CONTRACTOR =
AUTHOR = Roger Morgan
ORIGINATOR = Esso Australia
TOP_DEPTH = 1226
BOTTOM_DEPTH = 1877
ROW_CREATED_BY = FH11_SW

(Inserted by DNRE - Vic Govt Mines Dept)

APPENDIX 4

GEOCHEMISTRY

Report to follow

APPENDIX 5

VELOCITY SURVEY REPORT

913714 079

Schlumberger

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Level 5, 256 St. George's Tce.
Perth WA 6000
Ph: (09) 9420 4800 Fax: (09) 9420 4715

Esso Australia Pty Lt.

WELL SEISMIC PROCESSING REPORT

VSP

Beardie-1

FIELD: Offshore Exploration

COUNTRY: Australia, offshore VIC, Permit VIC/L9

COORDINATES: Latitude: 38" 15' 16.214" S
: Longitude: 147" 48' 24.643" E

DATE OF VSP SURVEY: 5-AUG-2002

REFERENCE NO: DS 0402-003

INTERVAL: 119.9-1900.0 mRT

Prepared by: Y. Solovyov

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1. Introduction

A borehole seismic survey was recorded in one run in vertical well Beardie-1 on 5-th of August 2002. This survey included both rig source VSP and additional checkshot measurements. The data were acquired using a Dual Combinable Seismic Acquisition Tool (CSAT-B) downhole and a cluster of 2 G-Guns suspended from the rig.

This report describes the techniques used, the parameter choices and presents the results of the checkshot and VSP data processing.

2. Data Acquisition

The data were acquired in one logging run in both open and cased hole, using the three component Dual Combinable Seismic Acquisition Tool (CSAT-B), fitted with GAC accelerometer. A cluster of 2 G-guns with 150 cu in capacity each used as the source, was fired at 2000 psi air pressure. The gun cluster was positioned 5.5 m below the SRD sea level. Hydrophone was positioned 2 m above the gun. Recording was made on the Schlumberger Maxis 500 Unit using DLIS format.
The VSP levels were acquired from 1900 mKB to 228 mKB with additional checkshot levels from 198 mKB to 123 mKB. VSP levels were recorded with 15.12 m interval. 5 shots were recorded for each VSP level and 3 shots for each checkshot level.

Table 1. Survey Parameters

Elevation of KB	25 m
Elevation of DF	25 m
Elevation of GL	-51.2 m
Well Deviation	0.58 (vertical)
Energy Source	2x150 cu in. G-guns
Source Offset	61 M
Source Depth	5.5 M below Sea Level
Reference Sensor	Hydrophone
Hydrophone Offset	61 M
Hydrophone Depth	3.5 M below Sea Level
Source & Hyd. Azimuth	104 Deg.
Tool Type	Dual CSAT-B
Tool Combination	CSAT-B+GR
De-coupled Sensors	Yes
Shaker Fitted	Yes
Number of Axis	3
Sensor Type	GAC – Geophone Accelerometer
Frequency Response (GAC)	3-200 Hz
Sampling Rate	1 ms.
Recording Time	6.0 sec.
Acquisition Unit	MAXIS
Recording Format	DLIS

3. Well Seismic Edit

The data for both VSP and the checkshot intervals were prepared using the same methods.

Each shot of the raw GAC integrated data was evaluated and edited to remove bad traces. The hydrophone data were also evaluated for signature changes and timing shifts.

The good shots at each level were stacked, using a median stacking technique, to increase the signal to noise ratio of the data. The transit time of each trace was re-computed after stacking.

The following subsections describe the main aspects of the well seismic edit phase:

- Data Quality
- Transit Time Measurement
- Stacking

3.1 Data Quality

The data quality is good apart from the levels at 1596.9 mKB, 1599.9 mKB, 1642 mKB and 1654.9 mKB. Levels at 1596.9 mKB, 1599.9mKB and 1642 mKB are located below coal layers and recorded signal interfere strongly with coals. Level at 1654.9 mKB was recorded in washed out interval, no good contact with formation, interference from above coal layer is also present. These levels and double level at 1580 mKB were removed from VSP processing.

3.2 Transit Time Measurement

The transit time measured, corresponds to a difference between arrivals recorded by surface and downhole sensors. The reference time (zero time) is the physical recording of the source signal by accelerometers on the gun or sensors positioned near the source. In this case, a hydrophone positioned 3.5 m below the sea level was used as the reference. An inflection point tangent first break picking algorithm was used on both the hydrophone and the geophone data , see Attach. 1.

3.3 Stacking

After reordering and selecting the raw shots, a median stack was performed on the three component data. In this method of stacking, at each sample time, the amplitudes of the input traces are read and sorted in ascending order. The output is the median amplitude value from this ordering. If an even number of traces are input, the first is dropped and a median calculated. Then the last is dropped and another median found. The final output is the average of these two median values. The surface sensor (hydrophone) breaks are used as the zero time for stacking. The break time of each trace is recomputed after stacking. X, Y and Z component median stacks presented in Figure 2,3,4. There is a downgoing shear velocity component observable on X component.

4. VSP Processing Chain

The vertical component of the VSP data was processed using the conventional zero offset processing chain. The following subsections describe the main aspects of the processing chain:

Well Seismic Edit:

- load data
- edit bad records
- pick break time
- Z component median stack

Pre processing:

- ~~transit time correction to datum~~
- spherical divergence correction
- bandpass filter
- trace normalization

VSP Processing:

- wavefield separation
- waveshaping deconvolution
- corridor stack

4.1 Pre Processing

4.1.1 Transit Time Correction to Datum

Seismic Reference Datum (SRD) is at Mean Sea Level.
The source was positioned 5.5 meters below sea surface. The reference hydrophone was located 2 meters above the G-Guns cluster, 3.5 m below sea level. Correction to SRD was calculated using a water layer velocity of 1524 m/s .

4.1.2 Spherical Divergence Correction

To correct the recorded amplitudes for the loss of energy due to spherical divergence, a time varying gain function of the exponential form:

$$Gain(T) = \left(\frac{T}{T_0}\right)^{\alpha}$$

where T is the recorded time, T_0 is the first break time and a = 1 was applied.

4.1.3 Bandpass Filter

The effective bandwidth of the recorded data is evaluated by examining the amplitude spectrum of the stacked vertical component presented in Figure 1. Zero phase Butterworth Bandpass filter was applied to the data limiting the bandwidth to 5-120 Hz.

4.1.4 Trace Normalization

Trace equalization was applied by normalizing the RMS amplitude of the first break to correct for transmission losses of the direct wave. A normalization window of 200 milliseconds used.

4.2 VSP Processing

4.2.1 Wavefield Separation

A velocity filter (coherency) technique was used to separate upgoing and downgoing wavefields.

The downgoing coherent compressional energy is estimated using three levels median velocity filter parallel to the direct arrival curve. The 7, 5 and 3 level velocity filter were tested. 3 level filter produced the best resolution for thin coal bed layers. The filter array is moved down one level after each computation and the process is repeated level by level over the entire dataset.
The downgoing wavefield is displayed in one way time (Figure 5).

The residual wavefield is obtained by subtracting the estimated downgoing coherent energy from the total wavefield. The residual wavefield is dominated by reflected compressional events (Figure 6).

4.2.2 Waveshaping Deconvolution

The waveshaping process shortens the seismic pulse within races and for zero phase centers their amplitude peak on the reflector. This improves the resolution of the seismic data and helps to clarify the correlation of the seismic events. It is also applied to collapse the recorded multiples.

The waveshaping deconvolution operator is a double-sided Wiener-Levinson waveshaping filter. The operator is computed for each level of the downgoing wavefield using a design window length of 2 s starting 20 ms before the picked break times in order to include the wavelet precisely. The designed outputs were chosen to be zero phse with a bandwidth of 5-80 Hz. Once the design is made upon the downgoing wavefield, it is applied to the both downgoing and upgoing wavefields at the same level. The upgoing compressional wavefield is then enhanced using 5 level median coherency velocity filter as shown in Figure9. The same wavefield before enhancement displayed in Fig. 8

The downgoing wavefield is displayed in one way time (Figure 7).

4.2.3 Corridor Stack

A corridor stack was computed on the data after zero phase waveshaping deconvolution by designing a constant 100 ms timing window along the to-way time depth curve and stacking the data onto a single trace. The deepest 7 traces are stacked entirely. The resulting trace under normal circumstances satisfies the assumption of one dimentiality and provides the best seismic representation of borehole. This corridor stack is displayed in Figure 10 along with the enhanced upgoing wavefield in two way time. First track displays enhanced upgoing wavefield, second-corridor stack within 100 ms, third-the same corridor stack phase rotated by –90 degree.

5. Polarity Convention

An increase in acoustic impedance gives a positive reflection coefficient, is written to tape as a negative number and is displayed as a white trough under normal polarity. Polarity conventions are displayed in Figure 14.

6. Shear Velocities from VSP

Despite of near-vertical angle of incidence in rig source VSP, fairly strong converted wave S energy was generated from coal layers. That made possible to attempt S wave extraction in this case using the Parametric Wavefield Decomposition method.

After stacking, the X, Y and Z components need to be rotated into direction of maximum downgoing compressional energy arrival (TRY), which is very similar to vertical Z component in vertical well and maximum horizontal energy arrival (HMX). A polarization analysis using hodograms of the first arrival energy on the 3 components is used to perform these rotations.

Parametric Wavefield Decomposition is used to generate 4 wavefields: Down P, Down S, Up P and Up S. The technique of wavefield decomposition used in this module is a parametric least-squares minimization where the data are modeled locally in a given time window as a superposition of plane-wave events . The data at each depth level are modeled as superposition of down-going and up-going P waves and down-going and up-going S waves. Each wave is modeled by defining its local velocity, its angle of incidence and its waveform.

The technique was developed in Schlumberger by C. Esmersoy. More information can be found in: Inversion of P and SV waves from multicomponent offset VSP's, C. Esmersoy, Geophysics January 1990

Figure 12 shows a snapshot of resulting processing window after executing the parametric wavefield separation.

The inverted slownesses and an incidence angles have been used to produce the vertical shear and comprressional velocity logs shown in Figure 11.

A good match is achieved between P and S slowness derived from VSP and sonic slowness from DSI (Figure 13).

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Amplitude Spectrum

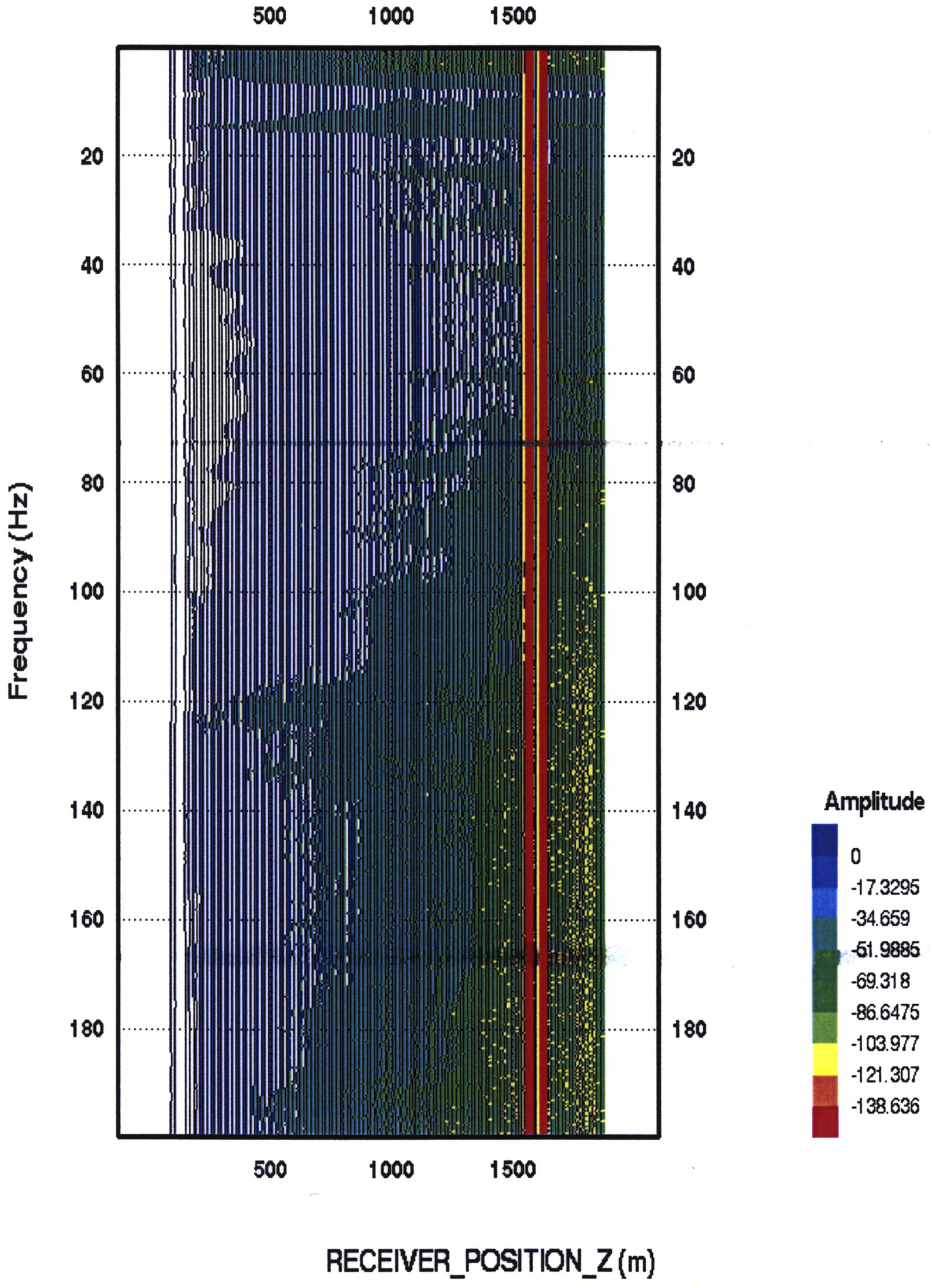

Figure 1. Amplitude Spectrum

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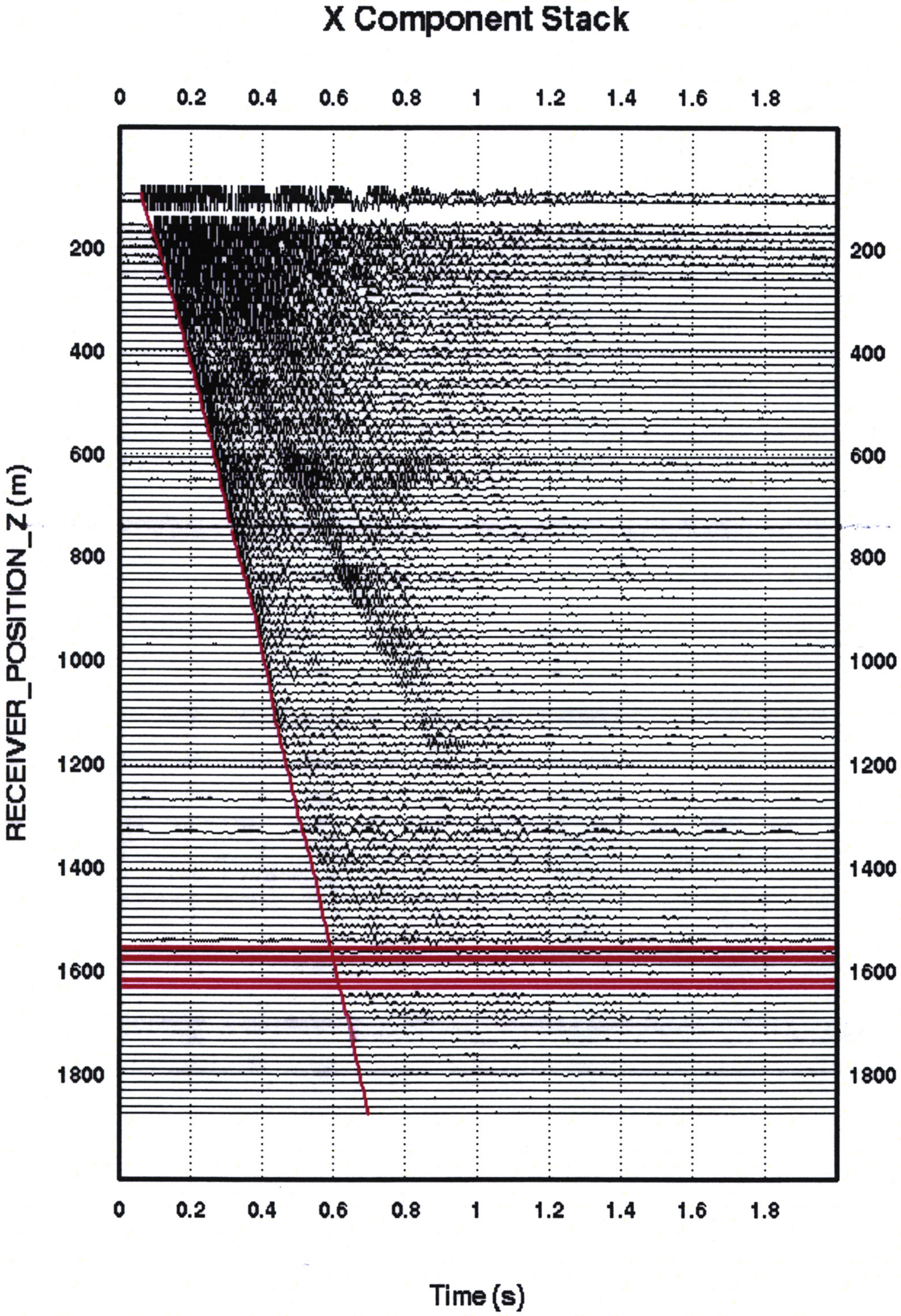

Figure 2. X Component Stack

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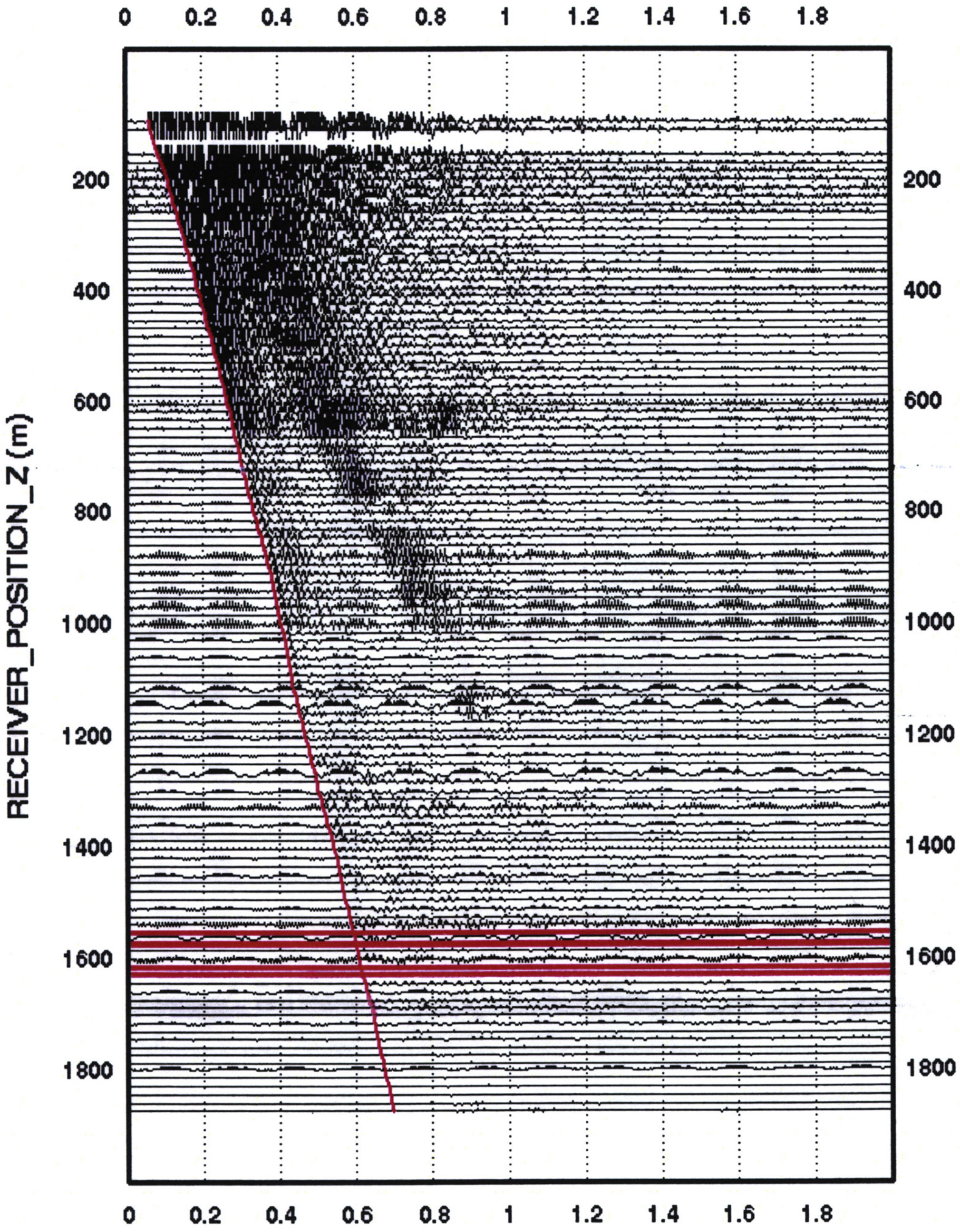

Y Component Stack

Figure 3. Y Component Stack

[redacted]

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Z Component Stack

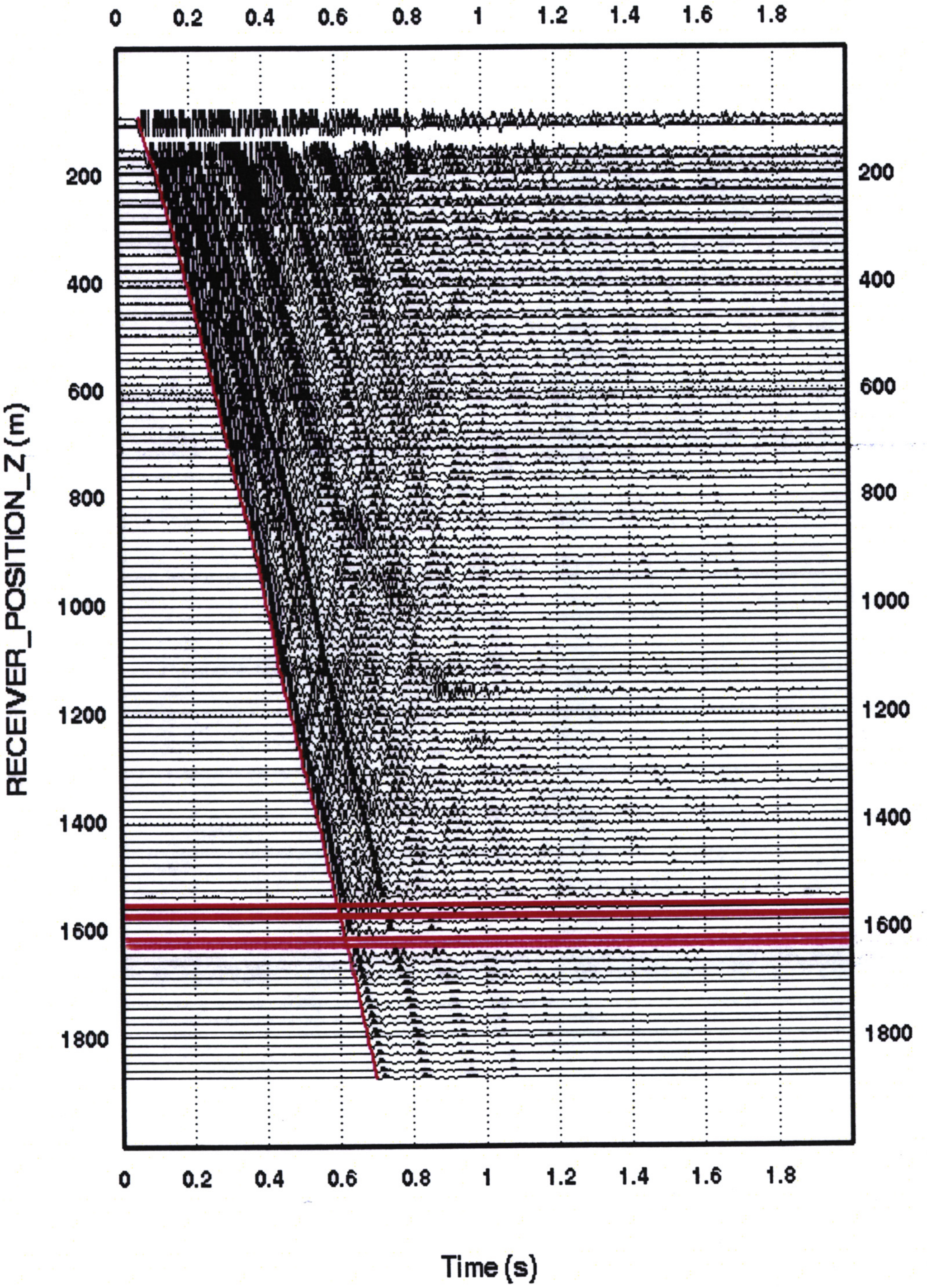

Figure 4. Z Component Stack

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Downgoing Wavefield after VELF

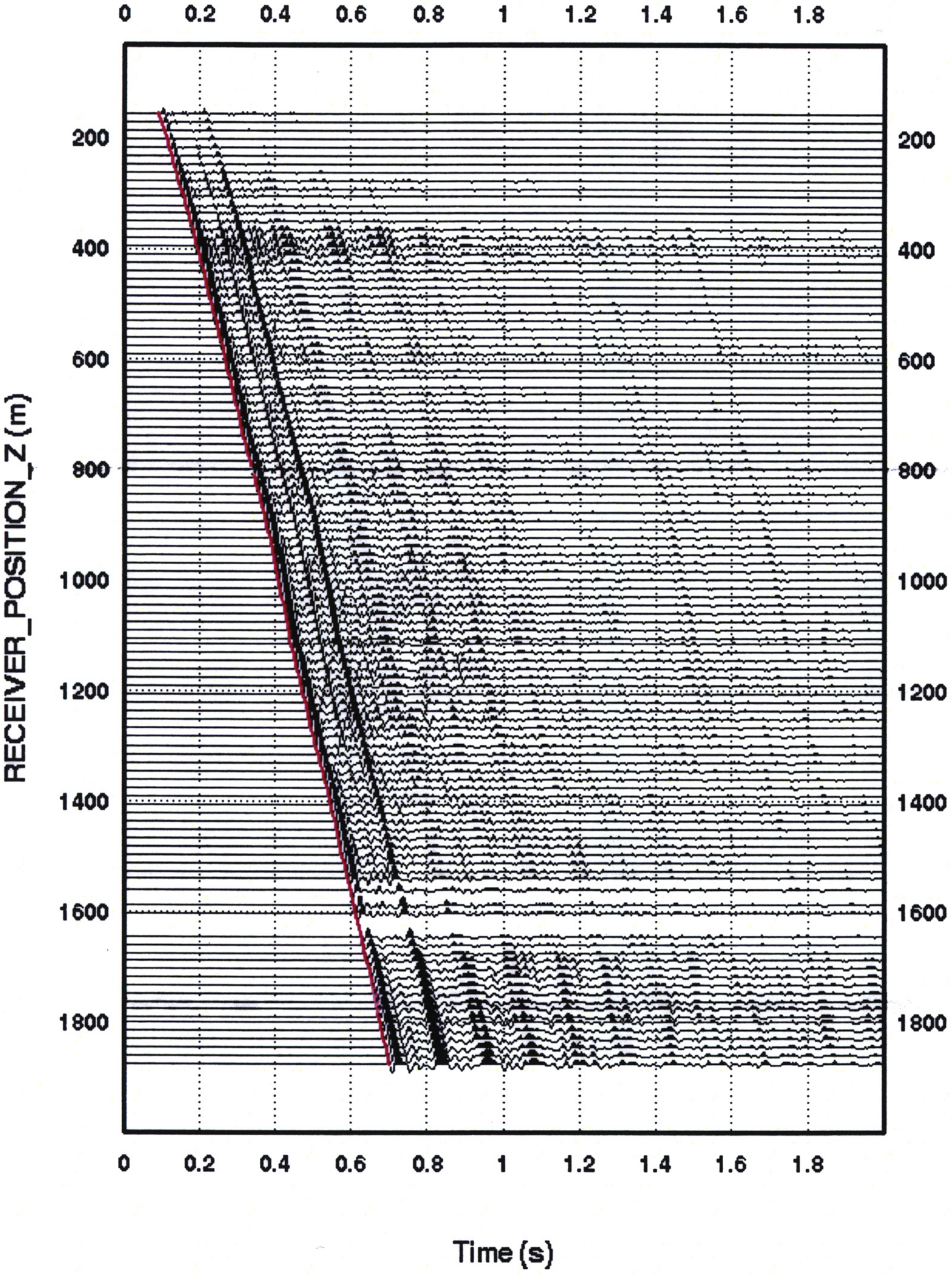

Figure 5. Downgoing Wavefield after VELF

~~PE913714_colour009~~

913714 093

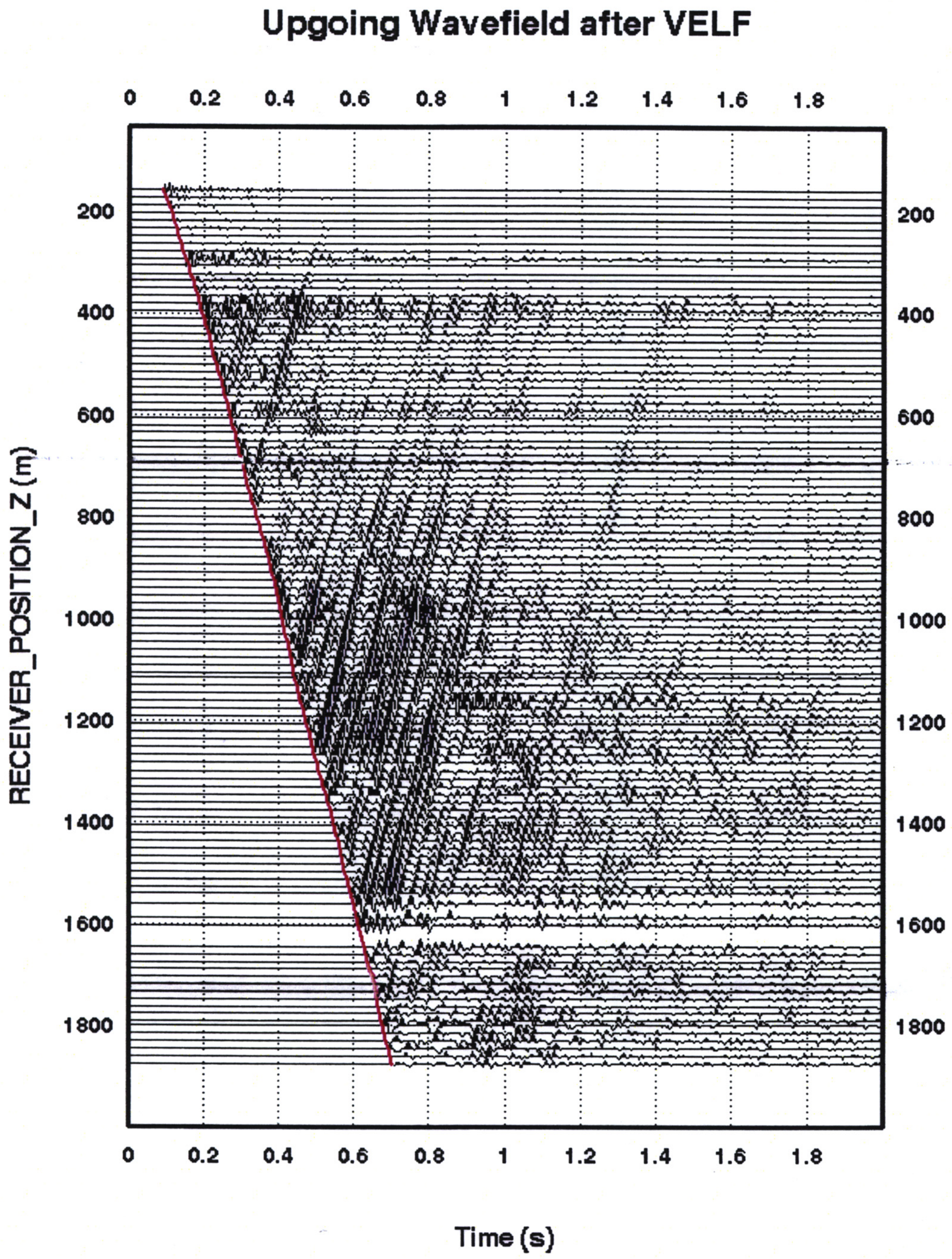

Figure 6. Upgoing Wavefield after VELF

~~PE913714 - colour Ø16~~

913714 094

Schlumberger

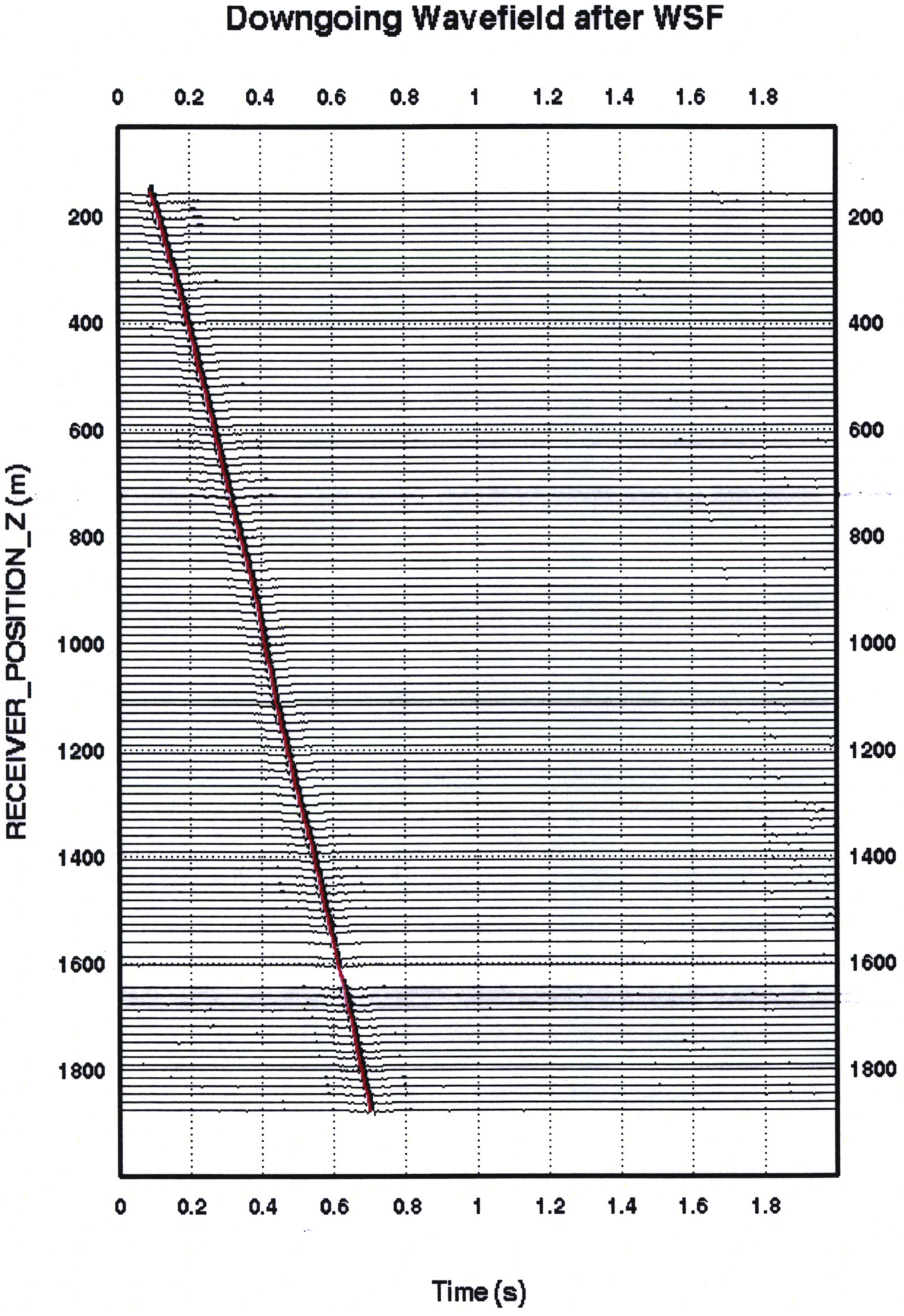

Figure 7. Downgoing Wavefield after WSF

~~PE913714_colour 011~~

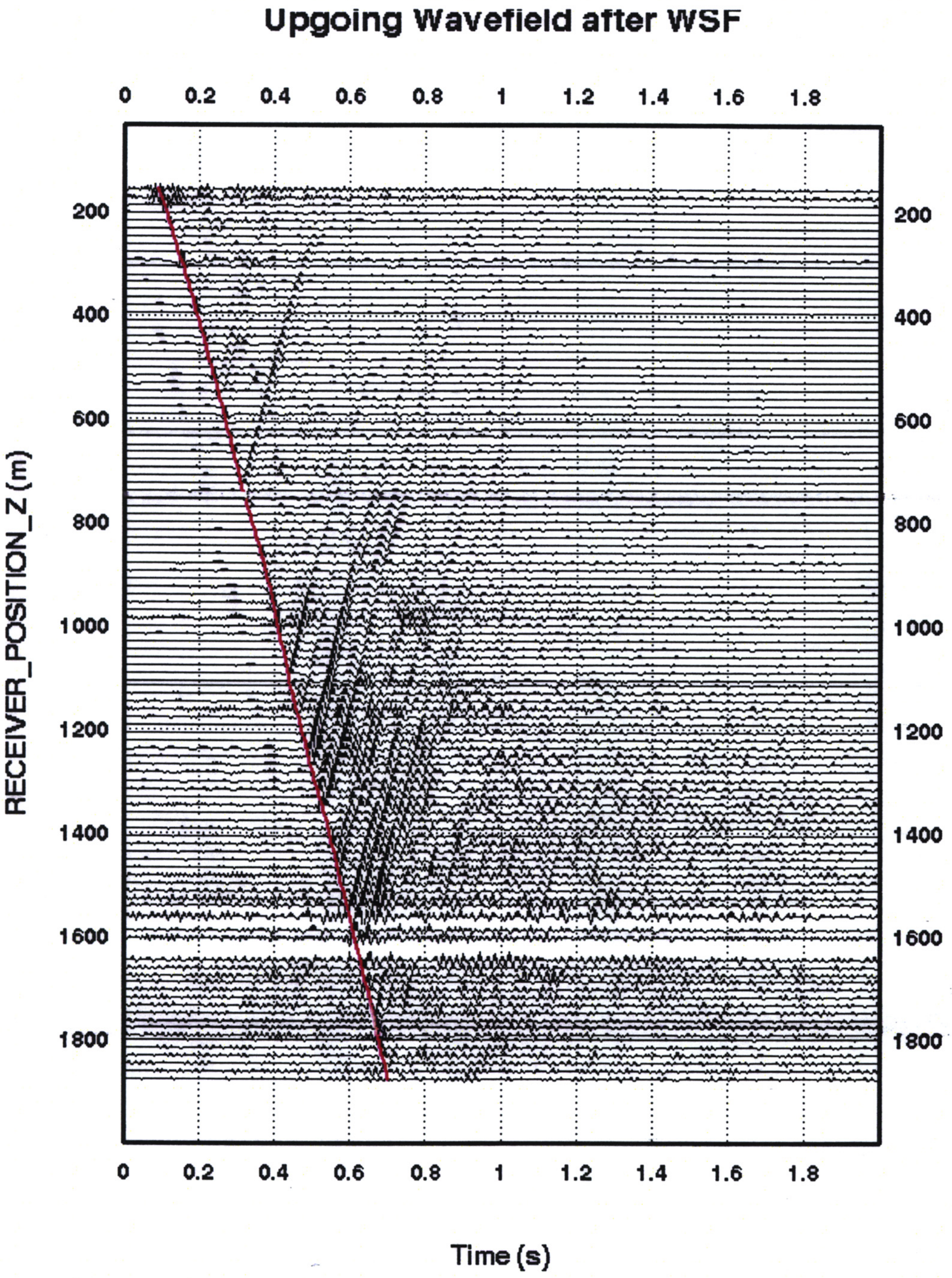

Figure 8. Upgoing Wavefield after WSF

~~PE913714 - colour 012~~

913714 096

Enhanced Upgoing Wavefield after WSF (TWT)

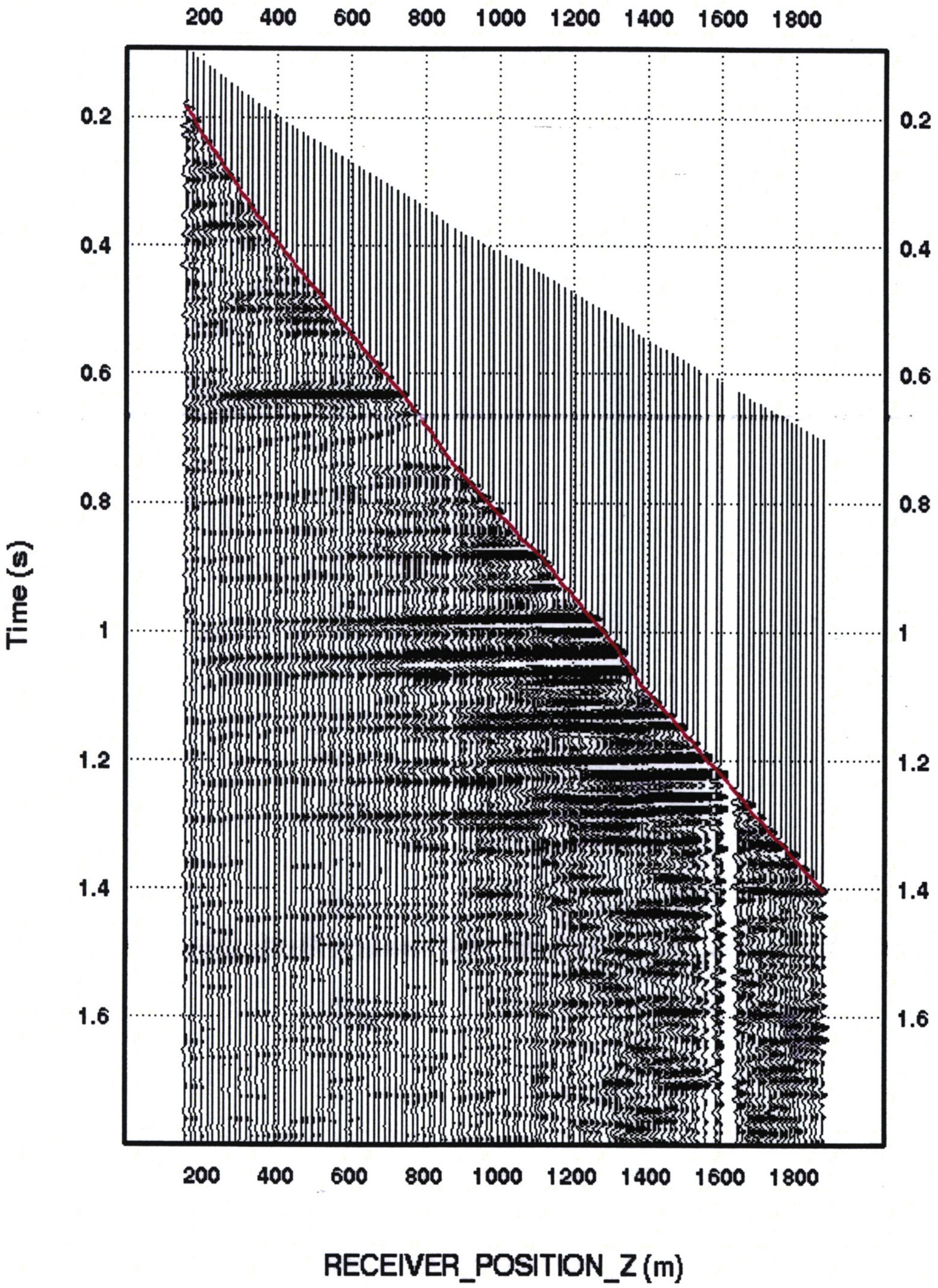

Figure9. Enhanced Upgoing Wavefield after WSF in TWT

[redacted]

913714 097

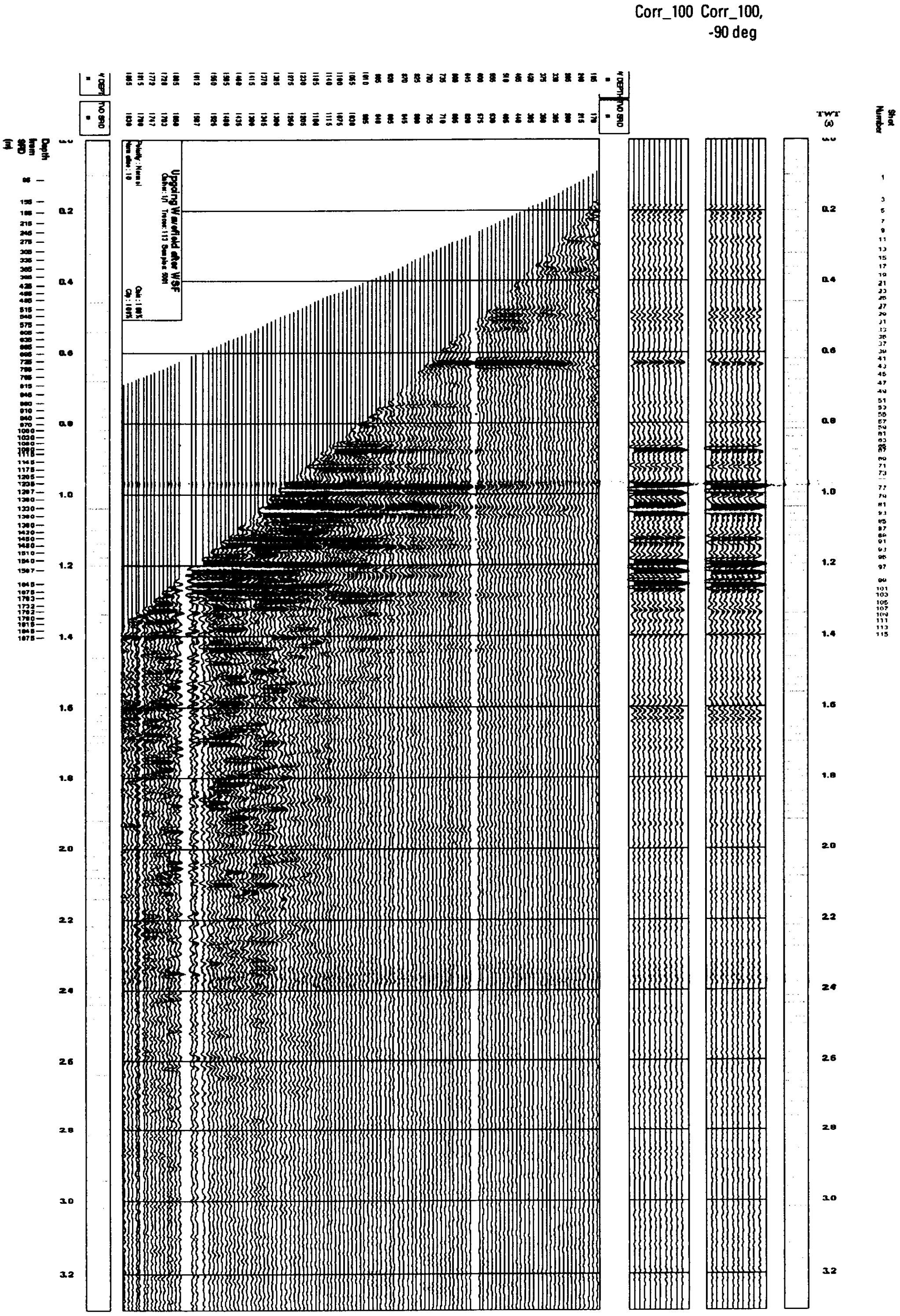

Figure 10. Composite Display

~~PE913714 - colour 014~~

913714 098

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Finally, a velocity crossplot was created, using interval, average and RMS velocities, Figure 11.

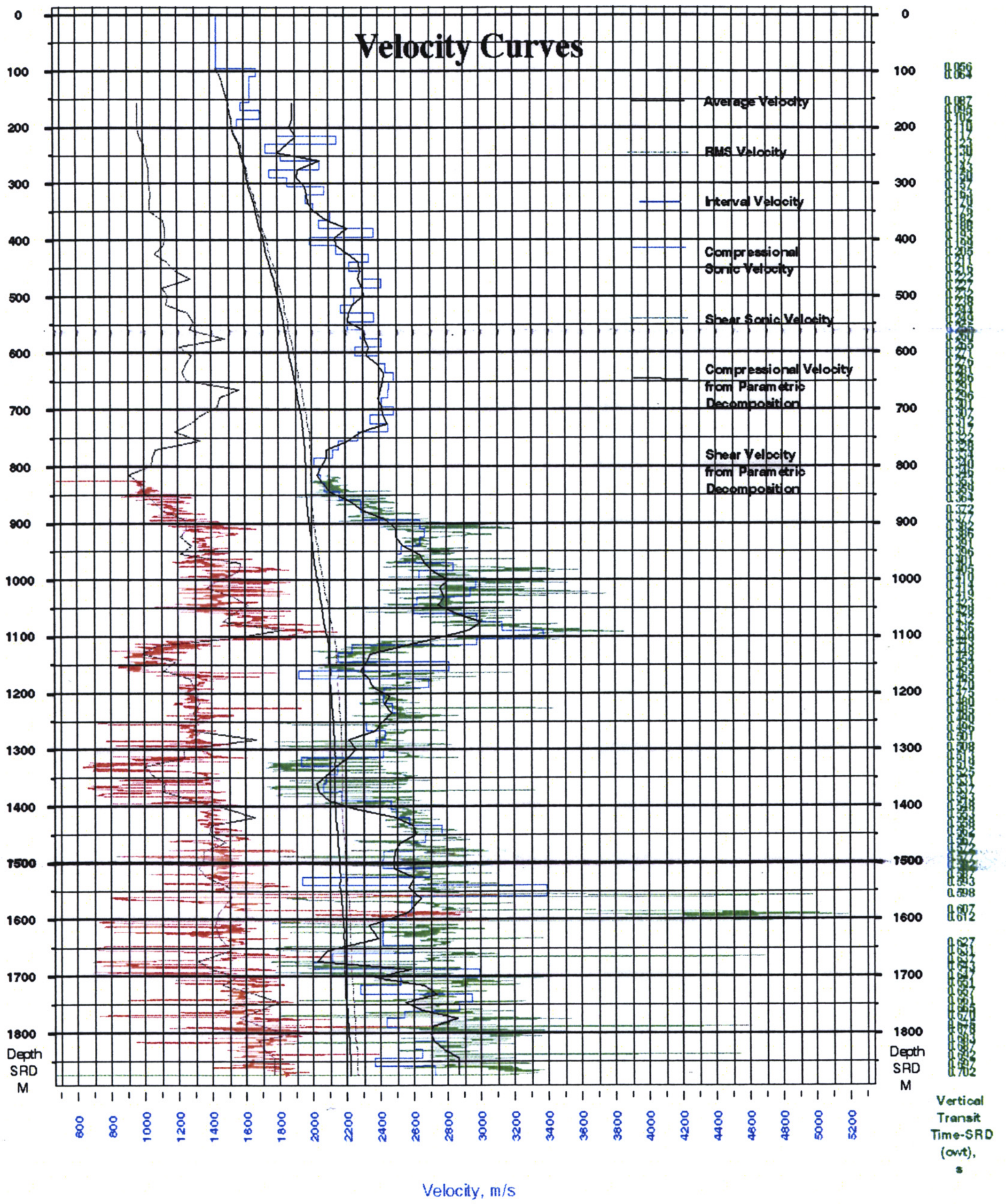

Figure 11. Velocity Crossplot

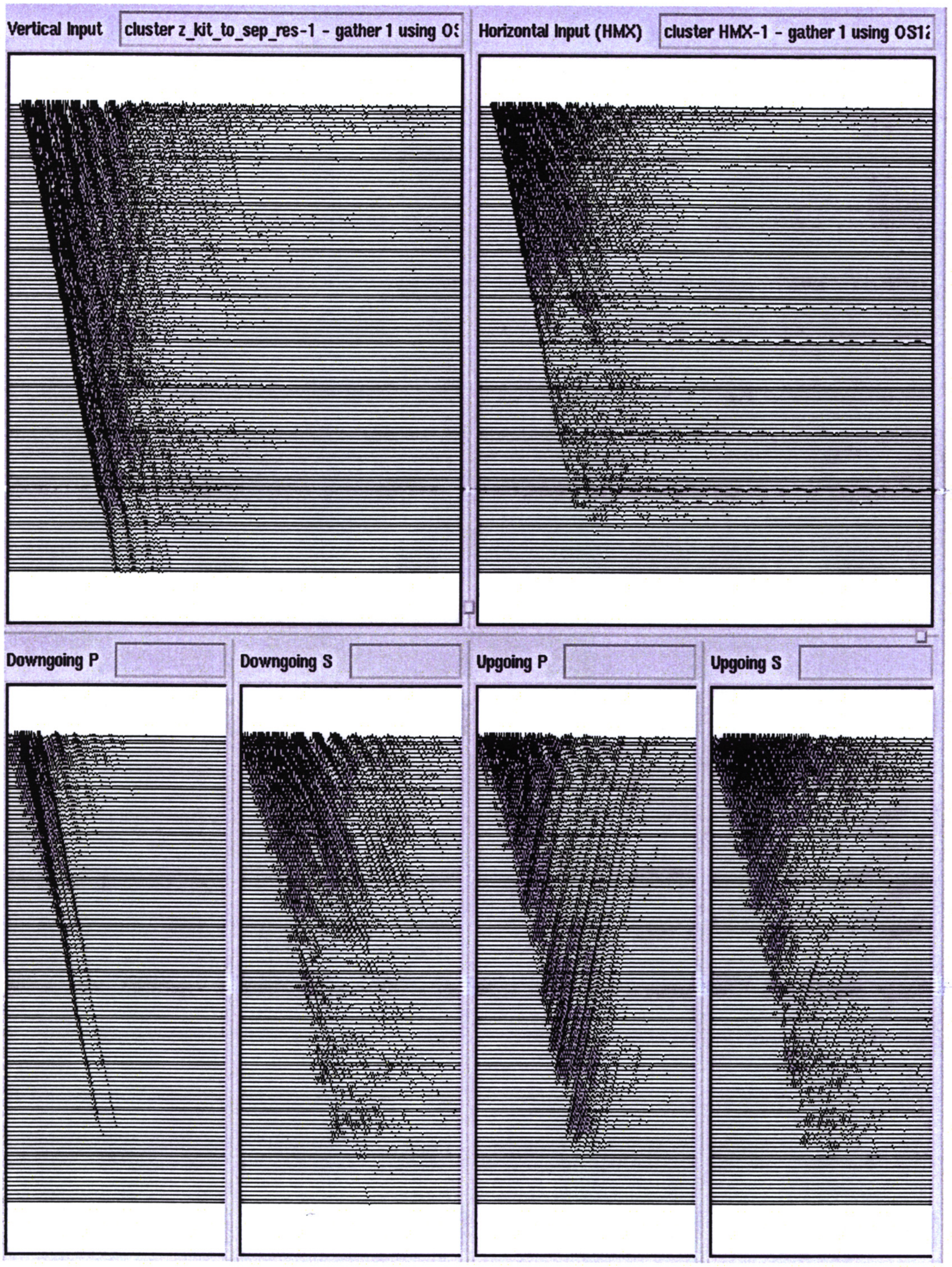

Figure 12. Parametric Wavefield Decomposition

~~Pe913714 _ colour 015~~

913714 100

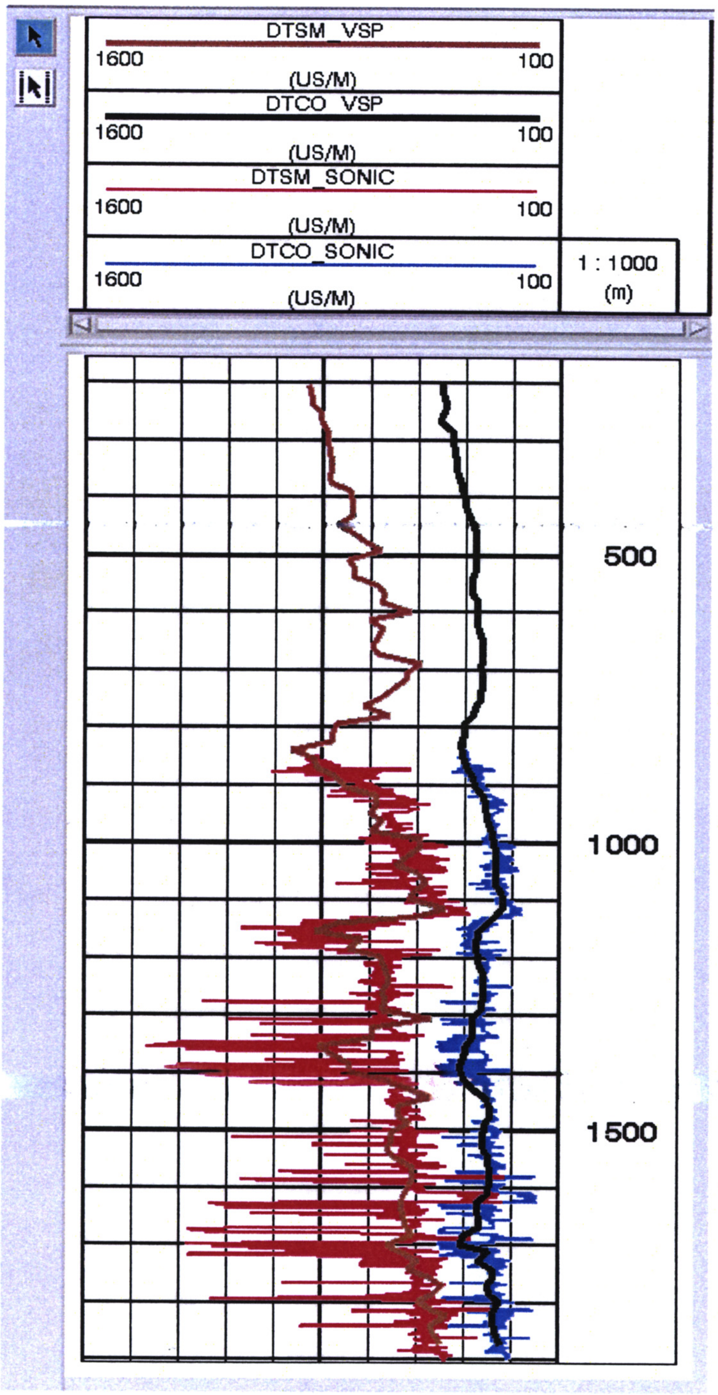

Figure 13. P and S Velocities from VSP vs. Sonic

Summary of Geophysical Listings

One geophysical data listing appended to this report. Following is a brief description of the format.

A1 Check Shot Data

1. Level number: the level number starting from the top level (includes any imposed shots).

2. Vertical depth form SRD: *dsrd*, the depth in metres from seismic reference datum.

3. Measured depth from KB: *dkb*, the depth in metres from kelly bushing.

4. Observed travel time HYD to GEO: *tim*0, the transit time picked form the stacked data by subtracting the surface sensor first break time from the downhole sensor first break time.

5. ~~Vertical travel time SRD to GEO:~~ *shtm*, ~~is *timv* – vertical time, corrected for the vertical~~ distance between source and datum.

6. Delta depth between shots: Δ*depth*, the vertical distance between each level.

7. Delta time between shots: Δ*time*, the difference in vertical travel time (*shtm*),between each level.

8. Interval velocity between shots: the average seismic velocity between each level, Δ*depth*/Δ*time*

9. Average velocity SRD to GEO: the average seismic velocity from datum to the corresponding checkshot level, shtm dsrd .

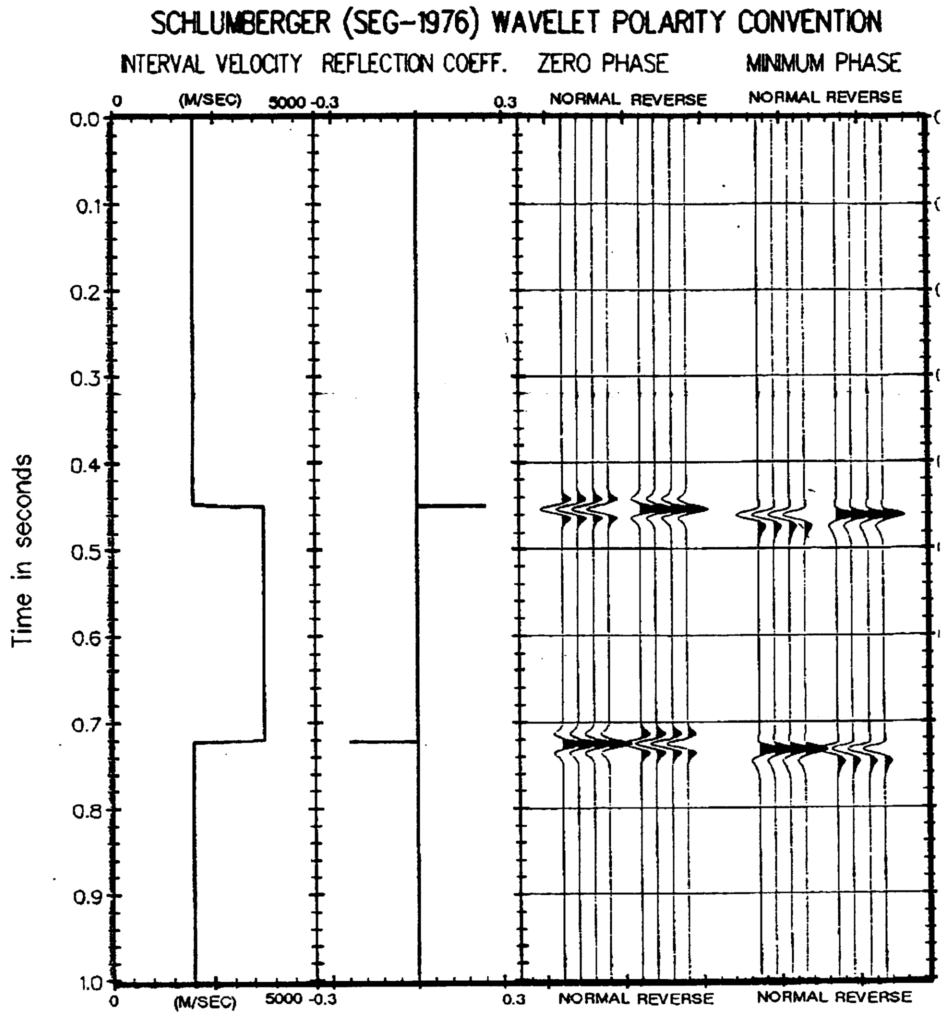

Figure 14. Schlumberger Wavelet Polarity Convention

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A-1 Well Seismic Report

Client and Well Information

Country	**Australia**
State	**Victoria**
Logging Date	**5-Aug-2002**
Company	**Esso Australia Ltd.**
Field	**Offshore Exploration**
Well	**Beardie-1**

Check Shot Data

LEVEL NUMBER	VERTICAL DEPTH FROM SRD m	MEASURED DEPTH FROM KB m	OBSERVED TRAVEL TIME (owt) s	Vertical Transit Time-SRD (owt) s	DELTA DEPTH m	DELTA TIME s	SEISMIC INTERVAL VELOCITY m/s	SEISMIC AVERAGE VELOCITY m/s
1	0.0			0.0000				
							1696	
2	94.9	119.9	0.0620	0.0559				1696
					15.1	0.0076	1992	
3	110.0	135.0	0.0681	0.0635				1732
					44.9	0.0231	1946	
4	154.9	179.9	0.0883	0.0866				1789
					15.1	0.0080	1877	
5	170.0	195.0	0.0958	0.0946				1796
					14.9	0.0074	2020	
6	184.9	209.9	0.1026	0.1020				1812
					15.1	0.0082	1850	
7	200.0	225.0	0.1104	0.1102				1815
					14.9	0.0070	2142	
8	214.9	239.9	0.1169	0.1171				1835
					15.1	0.0059	2580	
9	230.0	255.0	0.1224	0.1230				1870
					14.8	0.0072	2060	
10	244.8	269.8	0.1293	0.1302				1881
					15.1	0.0070	2167	
11	259.9	284.9	0.1360	0.1371				1895
					14.9	0.0061	2457	
12	274.8	299.8	0.1418	0.1432				1919
					15.1	0.0072	2090	
13	289.9	314.9	0.1488	0.1504				1927
					14.9	0.0067	2218	
14	304.8	329.8	0.1554	0.1571				1940
					15.2	0.0061	2493	
15	320.0	345.0	0.1613	0.1632				1960

					14.8	0.0063	2352	
16	334.8	359.8	0.1674	0.1695				1975
					15.2	0.0063	2409	
17	350.0	375.0	0.1736	0.1758				1990
					14.9	0.0059	2530	
18	364.9	389.9	0.1794	0.1817				2008
					15.1	0.0062	2447	
19	380.0	405.0	0.1854	0.1879				2022
					14.9	0.0052	2843	
20	394.9	419.9	0.1905	0.1931				2045
					15.1	0.0063	2380	
21	410.0	435.0	0.1968	0.1995				2055
					14.8	0.0058	2570	
22	424.8	449.8	0.2024	0.2052				2070
					15.2	0.0054	2813	
23	440.0	465.0	0.2078	0.2107				2089
					14.8	0.0055	2667	
24	454.8	479.8	0.2132	0.2162				2104
					15.1	0.0055	2766	
25	469.9	494.9	0.2186	0.2217				2120
					14.9	0.0051	2903	
26	484.8	509.8	0.2237	0.2268				2138
					15.2	0.0057	2681	
27	500.0	525.0	0.2293	0.2325				2151
					14.8	0.0055	2705	
28	514.8	539.8	0.2347	0.2379				2164
					15.2	0.0058	2610	
29	530.0	555.0	0.2405	0.2438				2174
					14.9	0.0052	2848	
30	544.9	569.9	0.2456	0.2490				2188
					15.1	0.0057	2655	
31	560.0	585.0	0.2513	0.2547				2199
					14.9	0.0054	2753	
32	574.9	599.9	0.2566	0.2601				2210
					15.1	0.0052	2901	
33	590.0	615.0	0.2618	0.2653				2224
					14.8	0.0055	2709	
34	604.8	629.8	0.2672	0.2708				2234
					15.1	0.0052	2883	
35	619.9	644.9	0.2724	0.2760				2246
					14.9	0.0051	2926	
36	634.8	659.8	0.2775	0.2811				2258
					15.2	0.0051	2989	
37	650.0	675.0	0.2825	0.2862				2271
					14.9	0.0050	2956	
38	664.9	689.9	0.2875	0.2912				2283
					15.1	0.0051	2947	
39	680.0	705.0	0.2926	0.2963				2295
					14.8	0.0051	2903	
40	694.8	719.8	0.2977	0.3014				2305
					15.2	0.0051	2990	
41	710.0	735.0	0.3027	0.3065				2316
					14.9	0.0053	2819	
42	724.9	749.9	0.3080	0.3118				2325
					15.1	0.0051	2949	
43	740.0	765.0	0.3131	0.3169				2335

					14.9	0.0055	2732	
44	754.9	779.9	0.3185	0.3224				2342
					15.1	0.0058	2587	
45	770.0	795.0	0.3243	0.3282				2346
					14.9	0.0059	2545	
46	784.9	809.9	0.3302	0.3341				2350
					15.1	0.0063	2411	
47	800.0	825.0	0.3364	0.3403				2351
					14.8	0.0061	2442	
48	814.8	839.8	0.3424	0.3464				2352
					15.2	0.0062	2454	
49	830.0	855.0	0.3486	0.3526				2354
					14.8	0.0060	2484	
50	844.8	869.8	0.3546	0.3585				2356
					15.2	0.0059	2592	
51	860.0	885.0	0.3604	0.3644				2360
					19.8	0.0072	2747	
52	879.8	904.8	0.3676	0.3716				2367
					15.2	0.0055	2768	
53	895.0	920.0	0.3731	0.3771				2373
					14.8	0.0047	3177	
54	909.8	934.8	0.3777	0.3818				2383
					15.1	0.0047	3212	
55	924.9	949.9	0.3824	0.3865				2393
					15.0	0.0047	3177	
56	939.9	964.9	0.3871	0.3912				2403
					15.1	0.0050	3047	
57	955.0	980.0	0.3920	0.3961				2411
					14.8	0.0049	3014	
58	969.8	994.8	0.3969	0.4011				2418
					15.2	0.0044	3424	
59	985.0	1010.0	0.4014	0.4055				2429
					14.8	0.0047	3176	
60	999.8	1024.8	0.4060	0.4102				2438
					15.2	0.0042	3590	
61	1015.0	1040.0	0.4102	0.4144				2449
					14.9	0.0042	3546	
62	1029.9	1054.9	0.4144	0.4186				2460
					15.1	0.0048	3161	
63	1045.0	1070.0	0.4192	0.4234				2468
					14.9	0.0048	3133	
64	1059.9	1084.9	0.4239	0.4281				2476
					15.1	0.0042	3596	
65	1075.0	1100.0	0.4281	0.4323				2487
					14.8	0.0039	3781	
66	1089.8	1114.8	0.4320	0.4362				2498
					15.1	0.0037	4086	
67	1104.9	1129.9	0.4357	0.4399				2512
					9.9	0.0028	3595	
68	1114.8	1139.8	0.4384	0.4427				2518
					15.1	0.0056	2684	
69	1129.9	1154.9	0.4440	0.4483				2520
					15.0	0.0058	2578	
70	1144.9	1169.9	0.4499	0.4541				2521
					15.1	0.0045	3393	
71	1160.0	1185.0	0.4543	0.4586				2530

					14.9	0.0065	2294	
72	1174.9	1199.9	0.4608	0.4651				2526
					15.1	0.0047	3240	
73	1190.0	1215.0	0.4654	0.4697				2533
					14.8	0.0051	2917	
74	1204.8	1229.8	0.4705	0.4748				2537
					15.2	0.0052	2904	
75	1220.0	1245.0	0.4757	0.4800				2541
					14.8	0.0050	2976	
76	1234.8	1259.8	0.4807	0.4850				2546
					15.2	0.0051	3007	
77	1250.0	1275.0	0.4857	0.4901				2551
					16.9	0.0061	2782	
78	1266.9	1291.9	0.4918	0.4961				2553
					15.1	0.0052	2926	
79	1282.0	1307.0	0.4970	0.5013				2557
					17.9	0.0063	2852	
80	1299.9	1324.9	0.5032	0.5076				2561
					15.1	0.0052	2911	
81	1315.0	1340.0	0.5084	0.5128				2564
					14.9	0.0065	2310	
82	1329.9	1354.9	0.5149	0.5192				2561
					15.1	0.0059	2569	
83	1345.0	1370.0	0.5207	0.5251				2561
					14.8	0.0059	2495	
84	1359.8	1384.8	0.5266	0.5310				2561
					15.1	0.0061	2470	
85	1374.9	1399.9	0.5328	0.5371				2560
					15.0	0.0058	2607	
86	1389.9	1414.9	0.5385	0.5429				2560
					15.1	0.0051	2960	
87	1405.0	1430.0	0.5436	0.5480				2564
					14.8	0.0049	3000	
88	1419.8	1444.8	0.5485	0.5529				2568
					15.2	0.0049	3098	
89	1435.0	1460.0	0.5534	0.5578				2572
					14.8	0.0044	3340	
90	1449.8	1474.8	0.5579	0.5623				2578
					15.2	0.0047	3217	
91	1465.0	1490.0	0.5626	0.5670				2584
					14.8	0.0047	3129	
92	1479.8	1504.8	0.5673	0.5717				2588
					15.2	0.0052	2908	
93	1495.0	1520.0	0.5725	0.5770				2591
					14.9	0.0051	2898	
94	1509.9	1534.9	0.5777	0.5821				2594
					15.1	0.0046	3249	
95	1525.0	1550.0	0.5823	0.5867				2599
					14.9	0.0064	2315	
96	1539.9	1564.9	0.5887	0.5932				2596
					19.9	0.0048	4104	
97	1559.8	1584.8	0.5936	0.5980				2608
					27.2	0.0087	3111	
98	1587.0	1612.0	0.6023	0.6068				2615
					14.8	0.0048	3073	
99	1601.8	1626.8	0.6071	0.6116				2619

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					43.2	0.0149	2897	
100	1645.0	1670.0	0.6220	0.6265				2626
					14.9	0.0048	3122	
101	1659.9	1684.9	0.6268	0.6313				2629
					15.1	0.0060	2532	
102	1675.0	1700.0	0.6327	0.6372				2629
					12.8	0.0054	2385	
103	1687.8	1712.8	0.6381	0.6426				2626
					15.2	0.0042	3612	
104	1703.0	1728.0	0.6423	0.6468				2633
					13.8	0.0046	3028	
105	1716.8	1741.8	0.6469	0.6514				2636
					15.2	0.0056	2739	
106	1732.0	1757.0	0.6524	0.6569				2637
					14.8	0.0042	3558	
107	1746.8	1771.8	0.6566	0.6611				2642
					15.2	0.0044	3464	
108	1762.0	1787.0	0.6609	0.6655				2648
					12.8	0.0042	3054	
109	1774.8	1799.8	0.6651	0.6697				2650
					15.1	0.0052	2929	
110	1789.9	1814.9	0.6703	0.6748				2652
					9.9	0.0033	3018	
111	1799.8	1824.8	0.6736	0.6781				2654
					15.1	0.0045	3375	
112	1814.9	1839.9	0.6780	0.6826				2659
					14.9	0.0048	3123	
113	1829.8	1854.8	0.6828	0.6873				2662
					15.2	0.0048	3186	
114	1845.0	1870.0	0.6876	0.6921				2666
					14.8	0.0052	2842	
115	1859.8	1884.8	0.6928	0.6973				2667
					15.2	0.0046	3281	
116	1875.0	1900.0	0.6974	0.7020				2671

Listing of Deliverables

1. VSP/Geogram Processing Report in PDF format

2. Graphics in PDS format, 34" plots:

   Plot 1. Composite Display
   Plot 2. Velocity Crossplot

3. SEGY Deliverables

```
Corr_100_minus_90_deg_rot.sgy
Corr_100_minus_90_deg_rot.txt
Corr_100_Zero_Phase.sgy
Corr_100_Zero_Phase.txt
Downgoing_P.sgy
Downgoing_P.txt
Downgoing_S.sgy
Downgoing_S.txt
Horizontal_Component.sgy
Horizontal_Component.txt
Surface_Hydrophone.sgy
Surface_Hydrophone.txt
Upgoing_P.sgy
Upgoing_P.txt
Upgoing_S.sgy
Upgoing_S.txt
VELF_DOWN.sgy
VELF_DOWN.txt
VELF_UP.sgy
VELF_UP.txt
Vertical_Component.sgy
Vertical_Component.txt
WSF_DOWN.sgy
WSF_DOWN.txt
WSF_UP.sgy
WSF_UP.txt
WSF_UP_before_enh.sgy
WSF_UP_before_enh.txt
X_Component_Stack.sgy
X_Component_Stack.txt
X_Geophone.sgy
X_Geophone.txt
Y_Component_Stack.sgy
Y_Component_Stack.txt
Y_Geophone.sgy
Y_Geophone.txt
Z_Component_Stack.sgy
Z_Component_Stack.txt
Z_Geophone.sgy
Z_Geophone.txt
```

4. Listings and Logs

   Beardie_1_Checkshot_Report.xls – Checkshot Report in EXELL format.
   Beardie_1_VSP_vel_SRD.zip – P and S VSP velocities from Parametric Decomposition.

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Attachment 1. Transit Time Picking Algorithms

The time picking can be broken down into several tasks:

First of all focus on the relevant parts of a data trace by selecting time intervals in form of constraints. To this end the user can select velocity, time header and/or initial guess constraints.

Detect a signal or a first break using a detection algorithm.

Tune on a particular phase of the event (e.g. zero-crossing, peak, trough, etc). It should be clear that tuning is only happening if a pick was either detected by an algorithm or retrieved from a header as initial guess.

Despike the picked transit time curve in order to eliminate mispicks either by median filtering or by cross-correlation. The cross-correlation option does not only have filtering features but also allows to pick correlated events within a section after having picked only one event.

Detection algorithm

Energy break: the algorithm determines the maximum of the so-called energy function, which is the integrated signal energy within a sliding time window normalized by the total energy accumulated since the first time of data.

For a trace S(t) an energy function F(•) is calculated with algorithm proposed by (Coppens, 1985)

Geophone break: finds the first break of a downhole sensor. The algorithm compares amplitudes and slopes in consecutive arches. Input parameters are the center frequency of the data to be picked, a linear fit gate time which should be about half a wavelet period, and a detection threshold between 0.0
and 0.5.

Hydrophone break: provides the first break of a downhole sensor. The routine finds the global minimum and maximum amplitude along a trace, takes the smaller one of the corresponding sample indices and outputs the time of the preceding zero-crossing as the first break. The zero-crossing time is determined by linear regression over a selected length (linear fit gate time).

Tuning:

Peak: finds the time of the closest local maximum amplitude in the vicinity of an input break time.

Trough: finds the time of closest local minimum amplitude in the vicinity of an input break time.

Zero-crossing: finds the time of the closest zero-crossing in the vicinity of an input break time. The routine stores the sign of the derivative at the zero-crossing which can be passed on for the tuning of the following trace. Thus artifacts created by cycle skipping can be reduced.

Inflection: finds the time of the closest inflection point in the vicinity of an input break time. The routine stores the sign of the derivative at the inflection point which can be passed on for the tuning of the following trace. Thus artifacts created by cycle skipping can be reduced.

Inflection point tangent: finds the time of the closest inflection point in the vicinity of an input break time. The tuned break time is the zero-crossing time of the corresponding tangent at this inflection point. The routine stores the sign of the derivative at the inflection point which can be passed on for the tuning of the following trace. Thus artifacts created by cycle skipping can be reduced.

Cross-correlation

This option allows to tune transit times by considering the picked phase of a selected reference trace. The cross-correlation gate in time or length units can be specified in the Motif parameter panel of this option. The default

value for the gate is three times the estimated center frequency of the first five traces of the seismic section to be picked. The window is put symmetrically around the transit times of the two traces to be cross-correlated if the option Use Existing Picks for the Gate Center Time is enabled and the
transit times are not absent.

If the option Use Existing Picks for the Gate Center Time is disabled then the cross-correlation is started with the ambient traces around the reference trace. Those two traces, in turn, will be taken to set the time gates for the following ones, and so on. Thus an automatic picking can be provided after having picked only the reference trace.

Retuning can be selected to follow the cross-correlation. In this case the cross-correlation serves as a transit time curve despiker.

The cross correlation process can be stopped automatically if the picking quality degrades. This happens if the time difference between the break of the current and the previous trace exceeds a threshold value derived from a user-specified apparent velocity.

A polynomial amplitude interpolation is proposed in order provide "real" extreme values instead of extreme values at the nearest sample. The algorithm works as follows: the global extreme values are detected with the gate together with the corresponding sample indices. A minimum and maximum amplitude tuning provides an exact time estimate of these amplitudes. Polynomial interpolation determines the amplitudes at these times which generally fall in between samples.

There are a variety of selectable and non-exclusive constraints available in order to stabilize the time picking process . The objective is to extract only the relevant part of the trace for the detection, tuning and/or cross-correlation process using.

Reference:

Coppens, F., 1985, First arrival picking on common offset trace collections for automatic estimation of static corrections, Geophys. Prosp. 33, 1212-1231.

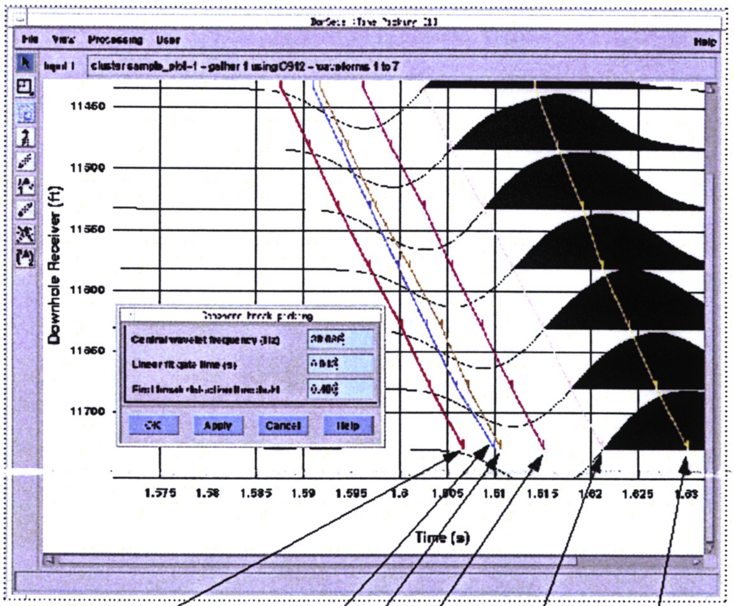
Lee, D. and Morf, M., 1980, A novel innovations based time –domain pitch detection.

[redacted]

Schlumberger

Example:¶

¶



Geophone break &
Inflection point tangeant /.
MAXIS picking.

Geophone break without tuning

Geophone break & Inflection point

Geophone break & Trough tuning
(*shift before tuning* = 0.003s = T/8)

Geophone break &
Peak tuning
(*shift* = 0.015 s =5T/8)

Geophone break & Zero crossing
(*shift* = 0.009 s = 3T/8)

Note: the period of the signal (T) is computed from the central frequency.
the default linear fit gate time =T/2.

§

PE651038

This is an enclosure indicator page.
The enclosure PE651038 is enclosed within the container PE913714 at this location in this document.

The enclosure PE651038 has the following characteristics:
ITEM_BARCODE = PE651038
CONTAINER_BARCODE = PE913714
NAME = Vertical Seismic Profile Composite
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = VELOCITY
DESCRIPTION = Beardie-1 Vertical Seismic Profile Composite Display, Scale 20cm/s, Airgun source, 61m offset, Victoria, (Enclosure from Appendix 5 of Beardie-1 Well Completion Report, Vol. 2), Processed by Schlumberger for Esso Australia Pty. Ltd.
REMARKS =
DATE_WRITTEN =
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = Esso Australia Pty Ltd
WELL_NAME = Beardie-1
CONTRACTOR =
AUTHOR =
ORIGINATOR = Esso Australia Pty Ltd
TOP_DEPTH =
BOTTOM_DEPTH =
ROW_CREATED_BY = FH11_SW

(Inserted by DNRE - Vic Govt Mines Dept)

PE913655

This is an enclosure indicator page.
The enclosure PE913655 is enclosed within the container PE913714 at this location in this document.

The enclosure PE913655 has the following characteristics:

ITEM_BARCODE = PE913655
CONTAINER_BARCODE = PE913714
NAME = Beardie-1 VSP Velocity Cross Plot
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = VELOCITY
DESCRIPTION = Beardie-1 Vertical Seismic Profile Velocity Cross Plot, Depth Scale 1:5000, Airgun source, 61m offset, Victoria, (Enclosure from Appendix 5 of Beardie-1 Well Completion Report, Vol. 2), Esso Australia Pty. Ltd.
REMARKS =
DATE_WRITTEN =
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = Esso Australia Pty Ltd
WELL_NAME = Beardie-1
CONTRACTOR =
AUTHOR =
ORIGINATOR = Esso Australia Pty Ltd
TOP_DEPTH =
BOTTOM_DEPTH =
ROW_CREATED_BY = FH11_SW

(Inserted by DNRE - Vic Govt Mines Dept)