W1146

WELL COMPLETION REPORT

TURRUM 6 & TURRUM 6 ST1

VOLUME 2

WCR VOL 2

TURRUM-6

W1146

Esso Australia Ltd.

WELL COMPLETION REPORT

TURRUM 6 & TURRUM 6 ST1

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VOLUME 2

INTERPRETED DATA

GIPPSLAND BASIN, VICTORIA

ESSO AUSTRALIA LTD

Compiled by : A. Zannetos
P.N. Glenton
November 1996

WELL COMPLETION REPORT

VOLUME 2: INTERPRETATIVE DATA

CONTENTS

TABLES

FIGURES

APPENDICES

ENCLOSURES

ATTACHMENTS

1. SUMMARY OF WELL RESULTS

Turrum-6 spudded on 24 September 1995, and was drilled as a vertical well immediately after Turrum-5. Water depth at the location was 60 m. The primary objective of Turrum-6 was to delineate oil reservoirs discovered by Turrum-5 in the L-360 and L-400 sandstones. These intra-Latrobe Group reservoirs occur within Paleocene (lower *L. balmei* spore-pollen zone) fluvial to marginal marine sediments beneath the top of Latrobe Group Marlin gas field.

The well was sidetracked at 1570 mRT after a tandem mud motor had twisted off. On 11 October 1995 the Turrum-6 Sidetrack-1 reached a total depth of 2740mRT in Late Cretaceous section (Upper *T. Longus* spore-pollen zone). The well was plugged and abandoned and the rig was released on 19 October 1995.

Turrum-6 ST1 intersected the top of the Latrobe Group at 1435.0m subsea, 13m low to prediction (Table 1). The current Marlin field gas-water contact is interpreted from logs to be in sandstone at 1485mSS (8.5m shallower than the interpreted current gas-water contact in Turrum-5). Residual gas is present in the underlying swept zone from 1485 to 1556mSS, and residual oil from 1556 to 1564mSS. The lower part of the residual oil leg is in non-net rock.

The L-110 reservoir in the upper part of the Turrum 'L' reservoir sequence was intersected at 2254mSS and the L-360 at 2575mSS, respectively 20m and 35m deeper than predicted (Table 1).

Within the Turrum 'L' reservoir interval, only the previously unpenetrated L-355 reservoir contained gas (5.5m net pay). No oil zones were intersected. A minor thin gas reservoir is interpreted to be present below the L-550. Reservoir properties are summarised in Appendix 2.

One core was recovered, from the L-355 reservoir. The core recovery is detailed in Volume 1 of the Turrum-6 & Turrum-6 ST1 Well Completion Report and on the Composite Well Log (this volume, Attachment 1). The wireline logging suite at Total Depth included resistivity, gamma ray, density, neutron, sonic, nuclear magnetic resonance imaging, dipmeter/borehole imaging, formation pressure measurements, fluid sampling, vertical incidence VSP, and sidewall core runs.

Table 1 : Predicted vs Actual Formation Tops

Formation/Horizon	Predicted Depth (mss TVD)	Actual Depth (mss TVD)	Actual Depth (m MD KB)
Sea Floor	-55	-60	85.3
Top of Lakes Entrance Formation	-1282	-1289.0	1314.0
Top of Latrobe Group	-1422	-1435.0	1460.0
Top of Latrobe Group'coarse clastics'	-1442	-1439.0	1464.0
Top of L-110 Reservoir	-2234	-2254.0	2279.0
Top of L-200 Reservoir	-2380	-2430.0	2455.0
Naples Yellow Sequence Boundary	-2404	-2444.0	2469.0
Top of L-300 Reservoir (shaled out)	-2445	-2504.0	2529.0
Top of L-350 Reservoir (shaled out)	-2540	-2566.5	2591.5
Top of L-360 Reservoir	-2575	-2610.0	2635.0
Top of L-400 Reservoir	-2615	-2645.0	2670.0
Top of L-500 Reservoir/MFSA seismic marker	-2649	-2671.0	2696.0
Base of L-550 Reservoir	-2760	-2730.0	2755.0
Total Depth	-2815	-2815.0	2840.0

RT Height = 25 m

2. *INTRODUCTION*

Turrum-6/Turrum-6 ST1 is a delineation well in 60m water depth in VIC/L3 in the offshore part of the Gippsland Basin. The well is located 4.1 km to the west of Marlin A platform, 2.8 km northwest of Turrum-5, 3.4 km west northwest of Marlin A-24 (at the level of the L-110 reservoir), and 3.3 km north of Marlin-2.

The five previous wells to have intersected hydrocarbons in the main Turrum block are: the Marlin platform wells A-6 (1969) and A-24 (1973); Turrum-2 (1973); Turrum-3 (1985); and Turrum-5 (1995). Turrum-4 (1992) was a dry hole on the eastern flank, in which all reservoirs were penetrated deeper than predicted.

Four wells (Marlin-1 and Marlin-2 (1966), Turrum-1 (1969) and Marlin-4 (1973)) have tested the Turrum lower *L. balmei* section in nearby fault blocks.

The primary objective of Turrum-6 was to delineate the extent and reservoir quality of the Turrum intra-Latrobe Group oil legs discovered by Turrum-5 in the L-360 and L-400 reservoirs. Turrum-6 was also expected to provide additional control on the extent of other reservoirs within the 'L' interval; in particular the L-110, L-200, L-300, L-350 (the L-500 was expected to be outside closure and wet). In addition, the well was expected to provide additional information about the present position of the gas-water contact and the residual gas saturation in the swept zone for the Marlin gas field

Prior to Turrum-5, it was considered that only thin oil legs would be present within the Turrum 'L' reservoir interval. In the L-100, an oil leg of about 4 metres had been intersected in Turrum-3. In the L-500/550 reservoirs, oil legs in Turrum-3, Marlin A-6, and Marlin A-24 were estimated from well penetrations to be from 5 to 15 m thick. Only gas had been intersected within the L-110 to L-400 interval. By analogy with the Turrum L-100 and L-500/550, and with intra-Latrobe Group accumulations in other Gippsland Basin fields, the potential for downdip oil legs at Turrum was considered to be limited. For assessment purposes oil legs of 10 metres had been used. Turrum-5 challenged this interpretation and indicated the need for the downdip Turrum-6 well, because in Turrum-5 wireline formation fluid samples proved the existence of oil above the expected gas-oil contact in the L-360 and L-400, and pressure data suggested substantial downdip oil potential of about 100 metres in the L-360 and 70 metres in the L-400.

3. *REGIONAL SETTING*

The initial formation of the Gippsland Basin was associated with rifting and subsidence that extended along the southern and eastern margins of Australia during the Jurassic to Early Cretaceous, as Australia separated from the Antarctic. The mainly volcanoclastic Strzelecki Group was deposited in a fluvial environment during this time.

In the Late Cretaceous (about 95 Ma), rifting associated with the separation of the Antarctic diverged along the west coast of Tasmania; and the north-south Tasman rift, which led to the separation of Australia from the Lord Howe Rise, developed along the eastern Australian margin.

The Gippsland Basin became a triple junction arm of the Tasman rift. The Golden Beach Group was deposited in this setting, with initial deep rift lacustrine shales and basin margin alluvial fans gradually evolving into a fluvial-dominated system. Marine transgressions are recorded in the upper Golden Beach Group in the southeast of the basin.

The active rift phase in the Gippsland Basin ceased at about 80 Ma. The Gippsland Basin became a failed rift and deposition of the Golden Beach Group ended.

The Latrobe Group was deposited in this post rift setting during extensional structuring associated with the opening of the Tasman Sea. Fault controlled subsidence continued until the late Paleocene.

Most of the Latrobe Group was deposited in a non-marine setting behind a northeast trending beach-barrier complex. As sedimentation rates declined, the strandline moved to the northwest, and during the Eocene thin glauconitic green-sand units of the Gurnard Formation were deposited over a wide area.

Two major phases of canyon cutting occurred during the Tertiary. The Early Eocene Tuna/Flounder Channel was cut, then filled with mainly marine sediments of the Flounder Formation. The Marlin Channel was cut in response to compressional pulses which occurred during the Middle Eocene, and was 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.

Late Eocene to mid Miocene compression caused selective inversion of faults and established the basin's major east-northeast anticlinal trends.

The Latrobe Group is overlain by marl and calcareous siltstone of the Oligocene Lakes Entrance Formation, which is in turn overlain by the prograding limestone and calcareous siltstone wedges of the Gippsland Limestone that form the present day shelf.

4. STRUCTURE

The Turrum feature is an intra-Latrobe Group fault dependent anticlinal trap situated to the north of the Latrobe Group depositional axis. The structure map on the top of the L-360 reservoir (Enclosure 1) displays the major northeasterly anticlinal axis, formed by the northwest-southeast compression that commenced in the late Eocene.

The Turrum anticline plunges to the southwest and is dissected by a set of west-northwest oriented normal faults which mainly step down-to-the-south. These faults relay and have an average length of 6km. Seismic data indicate that faults become more common with depth and often show growth of the lowside section. Two significant northeast-trending reverse faults have also been identified.

Turrum-6 ST1 tested the western flank of the main Turrum fault block, downdip of Marlin A-24 and Turrum-5.

5. STRATIGRAPHY

A thick section (1229m) of Gippsland Limestone (Mid Miocene to Recent age) was penetrated by Turrum 6 ST1 (Figure 2). No samples were collected above 690mRT as this section was drilled without a riser and cuttings were ejected at the sea floor. Below this depth, the Gippsland Limestone comprised light grey to brown grey fossiliferous calcilutite and calcisiltite.

The Oligocene to Middle Miocene Lakes Entrance Formation is 146m thick and includes light and medium grey to olive grey calcareous claystone and argillaceous calcisiltite with some fossil fragments and carbonaceous material.

The Gurnard Formation at the top of the Latrobe Group is 4m thick at Turrum-6, and consists of glauconitic and pyritic sandstone and siltstone.

Turrum-6 penetrated 1376 metres of the underlying Eocene to Late Cretaceous Latrobe Group 'coarse clastics'.

The uppermost part of the 'coarse clastics' is of Eocene age (*N.asperus* to *M.diversus* spore-pollen zones), and consists mainly of coarse grained marginal marine to lower coastal plain sandstone, with minor siltstone and coal. This forms the Marlin Field 'N' reservoir sequence.

The underlying section is dominated by shale and siltstone with thin sandstone and coal beds, deposited in a mainly lower delta plain environment. Sandstones in this interval are generally less than 5m thick and were deposited in channels, point bars and crevasse splays during the Eocene to Paleocene (lower *M.diversus* to upper *L. balmei* spore-pollen zones).

The objective of Turrum-6 was to test the 500m thick 'L' reservoir section, which is of Paleocene age (lower *L. balmei* spore-pollen zone). Parts of this interval are shaleprone, but thick sandstone packages have been intersected elsewhere in the field. Reservoir quality and extent varies considerably. Coals are more common and thicker than in the overlying section, and help to constrain the stratigraphic framework.

Interpretation of the facies and stratigraphy of the Turrum L reservoirs was an important part of the 1994-95 Exxon Exploration Company Turrum study. The initial stratigraphic framework established during the Esso Australia Collaborative Study (1993-94) was revised substantially when all the Turrum wells were included. The Turrum study incorporated cores, facies, biostratigraphic analysis, and correlation to the seismic surfaces interpreted from the 1993 3D Turrum seismic data set.

The facies interpretation of Marlin and Turrum cores indicate that the main reservoir sandstones were deposited within sandy-braided channel complexes as ***stacked channel and channel-levee deposits*** with associated splay and splay levee deposits; ***point bars encased in floodplain mudstones***; and ***tidal-estuarine deposits***. In general, the channel complexes are interpreted to be oriented parallel to major faults. Trends of meandering stream deposits are considered to be more variable. Reservoir distribution is primarily determined by movement of the rift-margin faults and pivoting of individual tilt-blocks. The Turrum reservoir units are interpreted to thicken on the lowside of major tilted fault blocks, and to be flanked by ponded, brackish-water floodplains.

In the ***stacked channel and channel levee association***, splay levee fine clastics typically grade up into channel levee sandstones and stacked channel sandstones. The vertical stacking pattern reflects the lateral migration of a multi-channel system across floodplain splays and a poorly defined channel levee system. Medium to coarse sands were deposited in a series of downstream-prograding bars within the multichannel system. Laterally equivalent, finer grained sands formed shallow-mounded levees separating floodplain mudstones from riverine sandstones during low water stage.

Point bar deposits typically form upward fining packages up to 10-15 metres thick, separated by a basal scour from the underlying floodplain mudstones and coals. Gravels and coarse sands deposited above the basal scour grade upwards into trough cross bedded sands of the middle point bar, where mud drapes between beds indicate fluctuating water levels. The upper point bar sands are current rippled and interfinger with flood plain deposits. The vertical stacking of these deposits reflects the lateral migration of a single channel and point bar.

Tidal-estuarine sediments were deposited as stacked subtidal bar complexes within an estuarine setting. The narrow, elongate subtidal bar deposits form upward coarsening tidal bar complexes overlain sharply by lagoonal mudstones. This vertical stacking reflects the lateral facies transition from subtidal bar toe to bar core and bar top. Individual bars are typically a few metres thick and may be separated by thin muddy drapes. The bars may toe out into subtidal muds and muddy sands. Tidal bar complexes at Turrum merged to form a sheet-like geometry that filled most of the estuary.

The predominantly non-reservoir or seal-prone facies at Turrum include ***floodplain deposits with small channel fills, splay deposits, and coals;*** and ***bay head delta and***

lagoonal deposits. Sandstones deposited within these environments potentially represent minor reservoir units.

Floodplain deposits are variable and thin bedded, with often abrupt lateral and vertical facies changes. Channels were probably fairly stable and leveed, and are interpreted to have connected with the floodplain via small splays. Coals and individual channel and splay deposits are laterally discontinuous, but overall the floodplain intervals are relatively continuous. The abundance and variable thickness of coal, and the presence of clay zones within the mudstones, indicate significant ponding in the floodplain.

Within the ***bay-head delta and lagoonal association,*** fine grained lagoonal deposits typically coarsen upward through the lower and middle parts of the bayhead delta, into the the coarser clastics deposited in outer and inner stream mouth bars and distributary channels. This succession may be capped by thin, laterally extensive coals and floodplain deposits. Along depositional strike, the bidirectional downlap and clinoforms of the outer stream mouthbar may be truncated by minor channelling. The areal extent of stacked bay-head delta intervals may by 10s of square kilometres.

The L-100 unit is the shallowest significant Turrum reservoir. As predicted by trends from Turrum-5, Marlin A-24 and other wells, the typical L-100 association of stacked fluvial channel and channel levee deposits was absent in Turrum-6 ST1.

The top of the L-110 reservoir was penetrated at 2254 m subsea, 20m deeper than predicted. This reservoir is a stratigraphic trap, previously penetrated in Marlin A-24 where 25 metres of fair to good quality gas-bearing sandstone was intersected; and in Turrum-5, where the L-110 is thinner and of poorer quality. The unit is interpreted from cores in these wells to represent splay levee, channel levee, and stacked fluvial channel deposits. In Turrum-6, 8 metres of shaly wet sandstone was intersected, thinner than in Turrum-5 but of similar facies.

The L-195 to L-260 interval contains only minor, thin wet sandstones in Turrum-6 ST1. In comparison, at Turrum-5 this interval contained several well developed gas sandstones in 3 or 4 fluid systems. In Turrum 6 ST1, a 2 metre sandstone at 2442 m subsea is interpreted to overlie the Naples Yellow Sequence boundary, at the same level as the L-220 sandstone in Turrum-5. This marker was penetrated 40 metres deeper than predicted.

The L-300 reservoir overlying the MFS 'B' sequence boundary was penetrated at 2504 m subsea, 59 metres deeper than predicted. At Turrum-6 ST1 this unit is even thinner and more shaly than at Turrum-5. Prior to the drilling of Turrum-5 and -6 ST1, the L-300 was expected to be an important reservoir, but it is now clear that it is poorly developed in the western part of the field.

The L-350 reservoir which overlies the 'Pink' Sequence Boundary is interpreted to be absent in Turrum-6 ST1, as it was in Turrum-5. This unit is a well-developed 7 metre thick point bar sandstone in Turrum-3, where wireline pressure data suggest it may form a common reservoir system with the underlying L-360 unit, and in Marlin A-24 a sandstone at this level is more than 10 metres thick.

The gas sandstone intersected at 2583.5 m SS is designated the L-355, and is clearly isolated on the basis of contacts and pressure data from the gas and oil-bearing L-360 sandstone intersected updip in Turrum-5. The L-355 reservoir is interpreted to be a fluvial sandstone, pinching out onto the western flank of the Turrum anticline.

The top of the L-360 reservoir was penetrated at 2610 m subsea, 35 metres deep to prediction. The upper part of the unit is non-net in Turrum 6. The L-360 overlies the 'Sub Pink' Sequence boundary, and is correlated as the most extensive reservoir unit above the L-500, and elsewhere in Turrum is interpreted to represent mainly stacked channel and channel-levee deposits. In Turrum-6 ST1, the unit is about 20 metres thick, with less than 5 m net sandstone at an average porosity of about 12%. The top of porosity for the L-360 is at about the estimated oil-water contact for this unit (using Turrum-5 pressure data). However, the wireline log character of this unit is different from that typically observed in other wells in the main Turrum fault block (Turrum-3 and -5 provide good type sections); and in addition, wireline pressure measurements indicate that in Turrum-6 ST1 the L-360 is slightly overpressured relative to the original basin aquifer gradient, whereas in Turrum-4 on the east flank the unit was slightly drawn down because of production from other fields in the Basin. This suggests that a stratigraphic or structural barrier isolates this unit in Turrum-6 from its correlative in wells to the east.

The underlying L-400 reservoir interval is a well-developed and reasonably extensive point bar system in wells to the east, especially in Turrum-3 and -5, and Marlin A-24. However, in Turrum-6 ST1 this interval is of poor quality, with thin, shaly sandstones. As for the L-360, wireline measurements indicate that in Turrum-6 ST1 the interval is slightly overpressured and is therefore isolated from its correlative in wells to the east.

Sandstones in the L-500 to L-550 interval were deposited as tidal bars within an estuarine environment. They are similar in quality to those in Turrum-5, although overall the interval is thinner in Turrum-6. As predicted, these units were outside closure and wet.

About 85m of Late Cretaceous (*T. longus* spore-pollen zone) coastal plain to marginal marine sediment with minor sandstone, common siltstone and shale, and minor coal was drilled below the base of the lower *L. balmei* before the well reached its total depth of 2730mSS. Thin gas sandstones were penetrated in this interval.

6. *HYDROCARBONS AND RESERVOIR*

No significant hydrocarbon shows were encountered within the Gippsland Limestone or Lakes Entrance Formation in Turrum-6 or Turrum-6 ST1. Typically, background gas levels within this section were less than 0.8% (40 units).

The top of the Latrobe Group was penetrated in Turrum-6 ST1 at 1435 m subsea, with gas increasing to about 3.5 units in the 4 m thick Gurnard Formation, and ranging from 5 to 10 units in the underlying Marlin reservoir 'coarse clastics'.

Reservoir properties and net pay in the Latrobe Group 'coarse clastics' are summarised in Appendix 2.

Wireline logs indicate 31.3 m of net gas pay in good quality gas sandstones from 1453 m subsea to the current gas-water contact of 1485 m subsea (with weighted mean porosity 24.0% and water saturation 9%). The current Marlin field gas-water contact is 8.5m shallower than in Turrum-5, and 71m above the original field gas-oil contact. Residual gas is present in the underlying swept zone from 1485 to the original gas-oil contact at 1556mSS, and residual oil from 1556 to 1561mSS. The original oil-water contact, at 1564 m subsea, is in non-net rock. Mud log gas ranged from 5 to 10% gas thoughout the Marlin N-1 reservoir interval, including the residual hydrocarbon zone.

Below the Marlin N-1 reservoir, gas peaks of 5 to 10%, associated with coal, were recorded. Water bearing sands are interpreted from the base of the Marlin N-1 reservoir to the top of the L-355 reservoir at 2583.3 m subsea.

Core 1 was cut in the L-355 reservoir from 2586.0 to 2602.0mRT (15.8m recovered). Log analysis and core description indicates that this reservoir contains 5.5 m net gas pay in very fine to coarse grained sandstone, with average porosity of 15% and average water saturation of 15%. Core analysis indicates air permeabilities ranging from sub-millidarcy to several darcies. Wireline pressure data indicate that a gas-water contact would be at or just below the base of the sandstone, at 2600mSS (Appendix 3). On this basis there is little or no potential for a significant oil leg on this reservoir. The L-355 reservoir in Turrum 6 is interpreted as a new reservoir which has not been intersected by any of the updip wells to the east. On the basis of contact and pressure data, it is isolated from the gas and oil-bearing L-360 sandstone intersected updip in Turrum-5, and it is considered to be a stratigraphic trap which pinches out onto the western flank of the Turrum anticline.

The L-360 reservoir is wet in Turrum-6 ST1. Wireline pressure measurements indicate that the unit is slightly overpressured relative to the original basin aquifer gradient, suggesting that a stratigraphic or structural barrier isolates this unit in Turrum-6 ST1 from its correlative in wells to the east, which are thought to be slightly drwndown (on the basis of the pressures recorded in Turrum-4 on the eastern flank).

Similarly the L-400 equivalent in Turrum-6 ST1 is slightly overpressured.

Minor gas reservoirs were penetrated in thin, low porosity, in the Late Cretaceous interval below 2730m subsea. These were not sampled and are considered to contain very small volumes.

7. *GEOPHYSICAL DISCUSSION*

Turrum-6 was drilled on the western flank of the Turrum field, 2.8km northwest of Turrum-5. The location was identified after integrating the analysis of the Turrum G93C seismic grid with data from the surrounding Marlin and Turrum wells. The actual well depths for the Top of Latrobe and Turrum horizons were within 1.5% of prognosis, except for the Top L300 and Naples Yellow sequence boundary.

Depth conversion was recognised as a major uncertainty after the poor depth prediction results of Turrum-4, which at the lower Turrum levels (L-250 to L-500) was from 50 to 60m deep to prediction. During the Turrum 3D seismic interpretation, depth conversion methods were examined in detail. The preferred depth conversion technique used seismic velocities calculated down to the Top of Latrobe Group, and compaction-based time-velocity relationships intra-Latrobe. The final Top of Latrobe depth map was also verified using attribute analysis that targetted the Marlin gas-oil contact. The Turrum-5 well results verified that a reasonable depth conversion had been made in the near western area. In Turrum-6 the top of Latrobe was intersected at 1439.0mSS, 13m deep to prediction; an error of 0.9%. This is within the expected depth conversion uncertainty of 1% at this level.

The Intra-Latrobe depth conversion from Top of Latrobe to the Blue-Grey Sequence Boundary (intra L-100 marker) was made using a relationship between seismic time and interval velocity, which relates the mid-point seismic time for the interval to the interval velocity seen in the Marlin and Turrum wells. Compaction due to depth of burial beneath Top of Latrobe is the main element in this relationship. Turrum-6 intersected the top of the L-110 at 2254mSS, 20m deep to prognosis: an error of 0.9%. This is within the pre-drill depth conversion uncertainty of 1.5% for Intra-Latrobe horizons.

The top of the L-110 is co-incident with the Blue-Grey Sequence Boundary, a primary depth conversion horizon. The depth error at the Blue-Grey Sequence Boundary has been attributed to the interval velocity being faster than expected.

The horizons from L-200 to L-500 were also depth converted using compaction based relationships, but it was recognised pre-drill that these relationships would be less certain due to variations in the stratigraphy. These horizons were built from seismic boundaries carried during the interpretation. The three key control surfaces were Blue-Grey (intra L-100), Naples Yellow (Base L-250) and MFSA (Top L-500).

The Naples Yellow Sequence Boundary was intersected at 2444mSS, 40m deep to prediction; a depth error of 1.6%. Approximately half this error is related to faster than expected velocities. The rest to the Naples Yellow timepick being followed slightly high relative to the position of the sequence boundary tied from the synthetic. The MFSA Sequence Boundary was intersected at 2671mSS, 22m deep to prediction; a depth error of 0.8%. This error again is related to faster than expected velocities.

The Top L-300 was intersected 59m deep to prediction. The main reason for this is that the MFSB seismic marker that follows the base of the L-300 has been followed too shallow in this area.

Both the Naples Yellow and MFSB sequence boundaries have been followed mainly as trough-peak zero crossings through-out the grid. The Turrum-6 synthetic shows that these boundaries have moved down within the peak in this area, which explains the greater than expected depth prediction errors.

The rest of the resevoir tops including the primary objective the L-360 were within 1.5% of prognosis.

Seven out of nine tops were within 1.5% of prognosis at the Turrum level which is within the expected depth conversion accuracy predicted pre-drill. The MFSB and Naples Yellow sequence boundary errors were outside of this range and can be attributed to the horizons being followed to shallow and a faster than expected velocities.

8. *GEOLOGICAL DISCUSSION*

The Turrum-6 location was designed mainly to assess the downdip potential of oil legs intersected in the L-360 and L-400 reservoirs in Turrum-5. Turrum again proved its complexity, when the correlatives of these units came in deep, water bearing, and in isolated, slightly overpressured fluid systems.

The important results of Turrum-6 ST1 were:

1. The L-355 reservoir was discovered. This unit is considered to be a stratigraphic trap on the western flank of the main block of the Turrum field.

2. Turrum-6 ST1 limits the extent of the L-360 and L-400 reservoirs. Pressure data indicate that a barrier exists at this level between Turrum-6 ST1 and Turrum-5. The well provides valuable information for assesment of hydrocarbon volumes on the western flank of the structure.

3. The known extent of the L-110 reservoir was increased, although the unit is thinner and of poorer quality than at Turrum-5.

4. The good quality sandstones present in the L-195 to L-260 interval in Turrum-5, are absent in Turrum-6 ST1, again demonstrating that Turrum reservoir heterogeneity occurs at a finer scale than well spacing. The data from Turrum-6 are valuable for assessment of this interval.

5. As at Turrum-5, the L-300 reservoir is interpreted to be present but non-net in Turrum-6 ST1, and the L-350 reservoir appears to be absent.

6. The current gas-water contact for the Marlin N-1 gas reservoir was intersected at 1485 m subsea, 8.5 m shallower than at Turrum-5 which was drilled immediately before Turrum-6/6ST1. This information is important for Marlin volumetric assessments.

PE906510

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The enclosure PE906510 is enclosed within the container PE906509 at this location in this document.

The enclosure PE906510 has the following characteristics:

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BASIN =	GIPPSLAND
PERMIT =	VIC/L3
TYPE =	GENERAL
SUBTYPE =	PROSPECT_MAP
DESCRIPTION =	Locality Map for Turrum-6
REMARKS =	
DATE_CREATED =	26/03/96
DATE_RECEIVED =	24/01/97
W_NO =	W1146
WELL_NAME =	TURRUM-6
CONTRACTOR =	
CLIENT_OP_CO =	ESSO AUSTRALIA LIMITED

(Inserted by DNRE - Vic Govt Mines Dept)

LOCALITY MAP

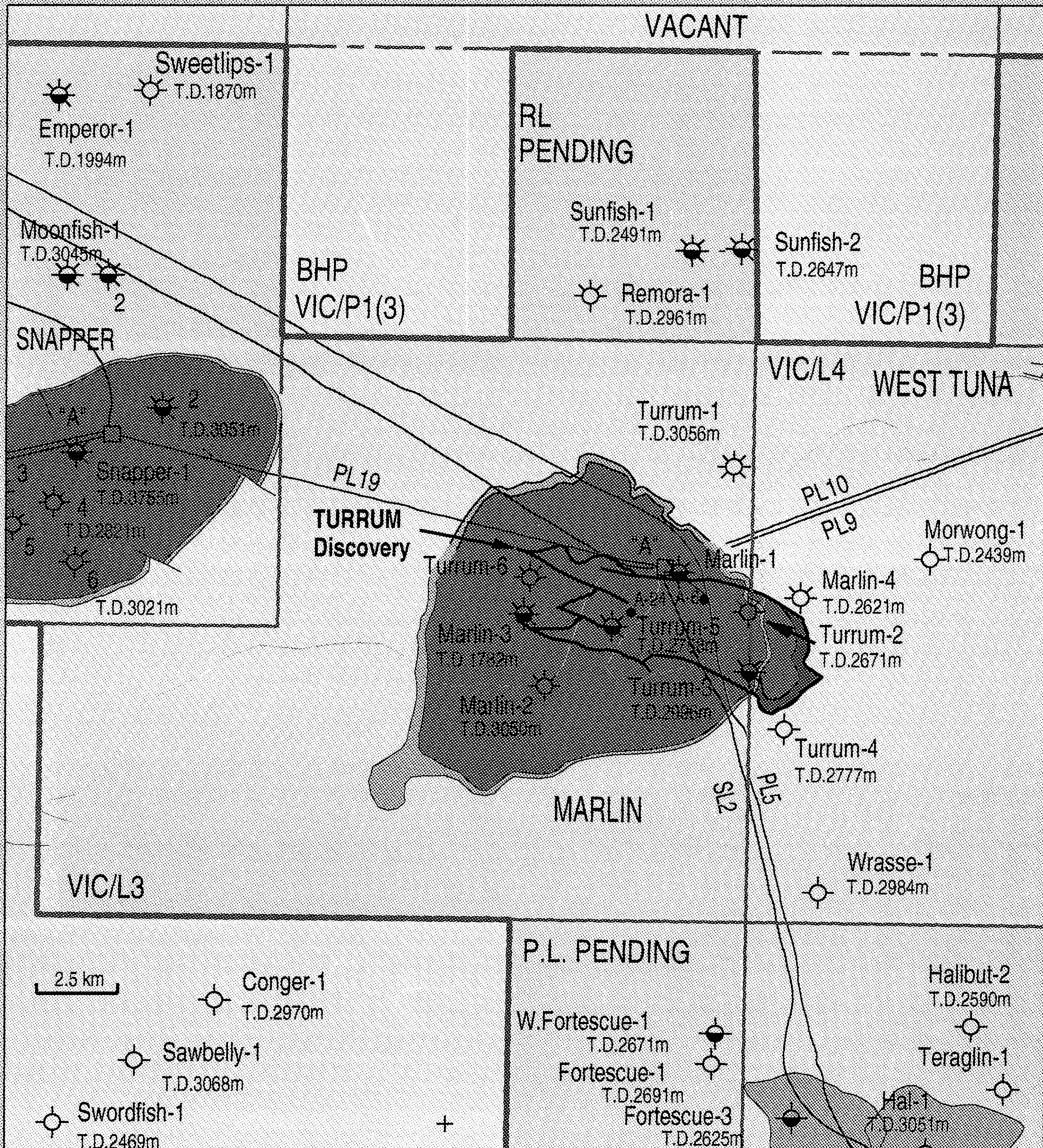


FIGURE 1

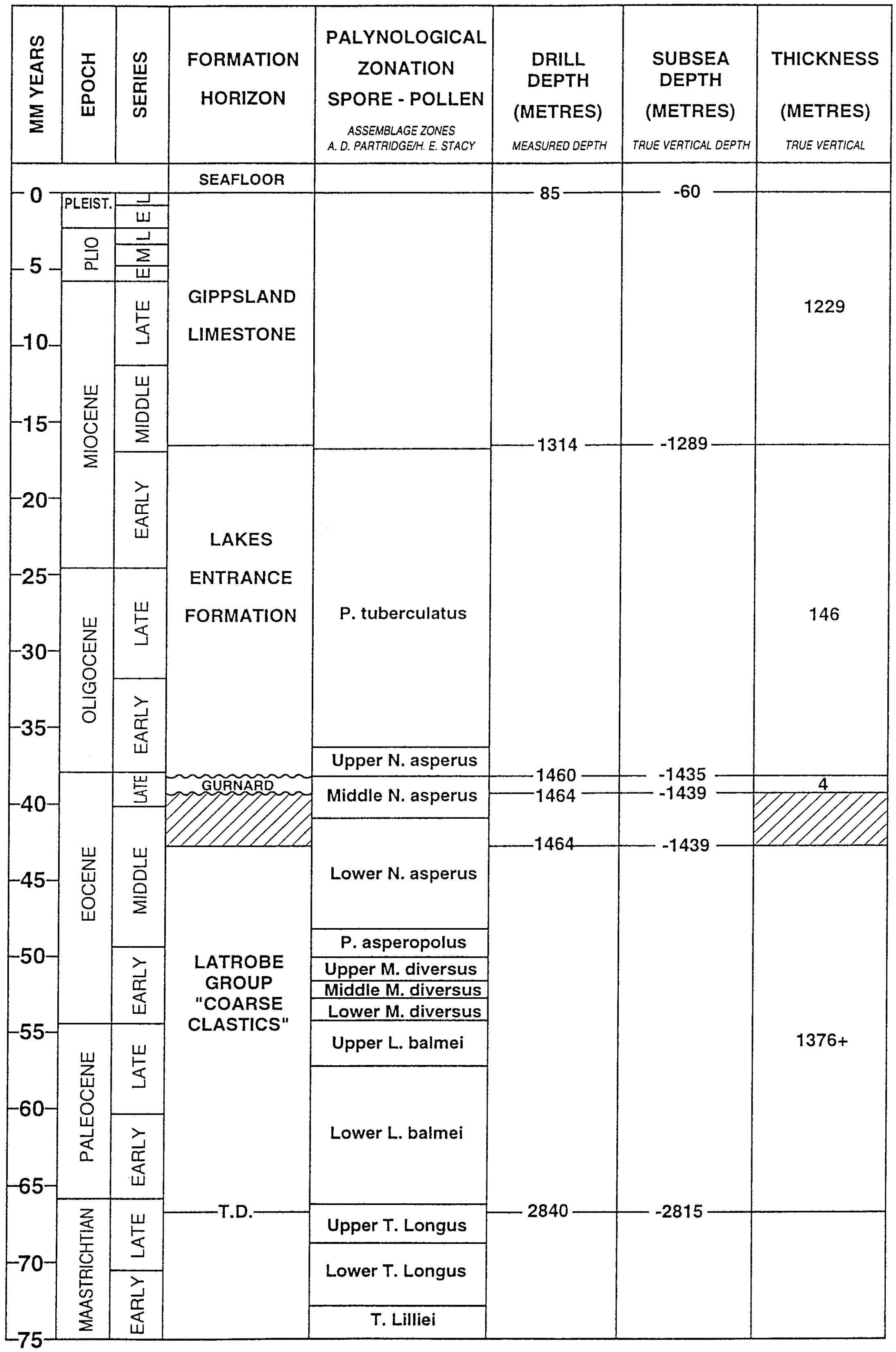
Esso

26/03/96 GPV01419.dwg3

GIPPSLAND BASIN

TURRUM-6 STRATIGRAPHIC SECTION

FIGURE 2



K.B. = 25.0m

NB: Ages are based on correlation to other Marlin/Turrum wells

96210B

APPENDIX 1

APPENDIX 1

TURRUM 6

Palynological Analysis

PE906511

This is an enclosure indicator page.
The enclosure PE906511 is enclosed within the container PE906509 at this location in this document.

The enclosure PE906511 has the following characteristics:

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BASIN = GIPPSLAND
PERMIT = VIC/L3
TYPE = WELL
SUBTYPE = PALY_RPT
DESCRIPTION = Palynostratigraphic Zonation and Paleoenvironments of the Turrum-6 Well, Gippsland Basin, Australia
REMARKS =
DATE_CREATED = 31/05/96
DATE_RECEIVED = 24/01/97
W_NO = W1146
WELL_NAME = TURRUM-6
CONTRACTOR = EXXON EXPLORATION COMPANY
CLIENT_OP_CO = ESSO AUSTRALIA LIMITED

(Inserted by DNRE - Vic Govt Mines Dept)

APPENDIX 2

APPENDIX 2

APPENDIX 2

TURRUM 6

Quantitative Formation Evaluation

Esso Australia Ltd

Exploration Department

TURRUM-6

Formation Evaluation

Log Analysis Report

Petrophysicist: L.J. Finlayson

January 1996

TURRUM-6 LOG ANALYSIS

Turrum-6 wireline logs have been analysed for effective porosity and water saturation over the interval 1455m to 2820m. Analysis was carried out using LASER derived total porosity and a Dual Water saturation model.

Note that all depths quoted below are MDRT unless specified otherwise. Subtract 25m to convert measured-depth to sub sea-depth.

DATA

Logs Acquired

Suite 1

LDT-AS-GR	118m to 658m

Suite 2

DLL-MSFL-AS-GR	2827m to 648.5m (MSFL to 1375m)
FMI-LDT-CNL-NGT	2833m to 1375m (FMI to 2200m, LDT to 648.5m)
MDT	2787.8m to 1479.9m (pretests and samples)
CSAT	2837m to 640m (89 levels)
MRIL-GR	2630m to 2560m, 1590m to 1495m
CST	2819m to 1543m, 60/60 recovered

Note: All logs acquired conventionally on wireline.

Log Quality

- Hole conditions were generally good so that good quality data were recorded across sand intervals. Coals and shales tended to wash out slightly, leading to poorer, though acceptable quality data.
- The Array Sonic curves showed some minor anomalies so an edited DT curve was produced from the four transit time curves available (DT, DTL, DTLN, DTLF).
- The PEF curve was reading too high due to barite in the mud and was not used in the log analysis.

Log Processing

- The NGT curves were environmentally corrected for barite and potassium in the mud by Schlumberger using the ALPHA filtering option.

- Below 2205m the density-neutron was run in high-resolution mode and a high resolution bulk density curve (NRHO) derived from the count-rates using the LOGIC programme ALPHA_LDT in SOLAR. Above 2205m a standard resolution RHOB was used in the analysis as sands in this interval were considered to be either water bearing or thick, massive Marlin gas sands.

- A high resolution NPOR was used below 2205m and a standard resolution TNPH used above this depth.

- A gain of 1.2 was applied to the neutron porosity curve to estimate the environmental corrections.

- An invasion corrected Rt was derived from the dual laterolog curves in fresh water and hydrocarbon zones. In saline water zones the LLD curve is reading too high due to resistive shoulder beds so the LLS curve was used as Rt.

INTERPRETATION

Logs Used

LLD, LLS, MSFL, LDT count-rates, RHOB, NPOR, TNPH, POTA, THOR, DT (Schlumberger).

Analysis Parameters

a	1
m	1.85
n	2
Apparent Shale Porosity (PHISH)	0.15
Shale Resistivity (RSH)	20 ohmm
Bottom Hole Temperature	106 DEGC

Total Porosity

Total porosity was derived from LASER using a 4 mineral model based on quartz, feldspar, illite and kaolinite with gas included as necessary.

Neutron porosity response was modelled in SNUPAR (Schlumberger Nuclear Parameter programme) for each mineral including gas based on Marlin and Turrum composition data.

Both Marlin and Turrum sands are quartz rich with up to 10% feldspar content. When clay is present it is typically illite/smectite with minor amounts of kaolinite. Below 2695m the feldspar content of sands increases to about 20%.

A possible volcanic zone is interpreted from 2294m to 2300m based on log response (low gamma ray, density-neutron separation).

Mineralog

The Mineralog analytical technique is based on the infrared absorption of a finely ground sample dispersed in a potassium bromide matrix.

In this well the samples were from wellsite plugs and the volume percentages of common rock forming minerals are displayed in a table and compared on a depth plot with the LASER outputs. Mineralog accuracy is plus or minus five percent. In general, a good match is seen with the LASER output which validates the mineral model and total porosity calculated.

Coring and Core Analysis

One conventional core was cut from 2611m to 2627m and 15.8m recovered (99%). A +2.5m shift has been added to the core results to match log results.

Routine core porosity and permeability measurements were performed by ACS at overburden conditions on wellsite plugs cut every metre. Final core analysis will be performed by ACS every 20cm . Attached is a plot showing a comparison of core and LASER derived total porosity and grain density. In general, a good match is seen which validates the four mineral model used in LASER.

Shale Volume

The Volume of Wet Clay derived from LASER was used as VSH in effective porosity and water saturation calculations.

Free Formation Water Resistivity

Below the current Marlin GWC free formation water resistivity was derived from RWA calculations in clean water sands. Above the current Marlin contact an Rw equivalent to the deeper saline reservoirs was used instead of the underlying fresh water which is believed to have replaced the original water in this interval.

Listed below are the selected Rw values and equivalent salinity.

Depth (m)	Rw (ohmm)	Salinity (ppm NaCleq)	Comments
1455-1510	0.1	30,000	saline water
1510-1700	0.6-0.5	4,000	fresh water
1700-2820	0.09-0.07	30,000	saline water

The fresh water salinity is consistent with water produced from the Marlin gas reservoirs and the saline water is consistent with regional salinity data below fresh water flushing.

Water Saturations

Total water saturation, SWT, was calculated using LASER total porosity in the Dual Water programme DWGP. Effective porosity, PHIE, and effective water saturation, SWE, were calculated using the LASER VWCL as VSH. Invaded zone saturation, SXO, was calculated from effective porosity and an Rxo derived from the MSFL using an apparent mud filtrate resistivity of 0.06 to 0.04 ohmm.

The SXO calculation should be treated with some caution due to uncertainty in the depth of filtrate invasion and resistivity of the filtrate/formation water in the invaded zone. The uncertainty is greatest where Rmf and Rw are significantly different, as in the case of the freshwater flushed Marlin sands. In these zones, SXO is reading 10 to 30 saturation units too low (when compared to SWE calculations in residual gas zones where both numbers should be similar).

Water saturation was set to 1 and porosity set to 0 in coals and carbonaceous shales.

Nuclear Magnetic Resonance Logging

Numar's MRIL was run in several modes over the interval 1495m to 1590m and 2560m to 2630m. In brief, the tool successfully measured the residual gas saturation in the Marlin sands and located the GWC. Owing to the uncertainty in water salinity in the gas column, a higher confidence is placed upon the MRIL results over the conventional log analysis results.

RESULTS

1. Gas bearing sands are interpreted in the Marlin reservoirs from 1463.8m to 1510m.
2. Residual gas sands are interpreted from 1510m to 1581m.
3. Residual oil sands are interpreted from 1581m to 1586.1m
4. Water bearing sands are interpreted from 1598.3m to 2569m.
5. Turrum gas sands are interpreted from 2608.3m to 2623.5
6. Water sands are interpreted from 2650mm to 2773.6m.
7. Thin gas bearing sands are interpreted below 2783.9m.

Attached are the following presentations of results:

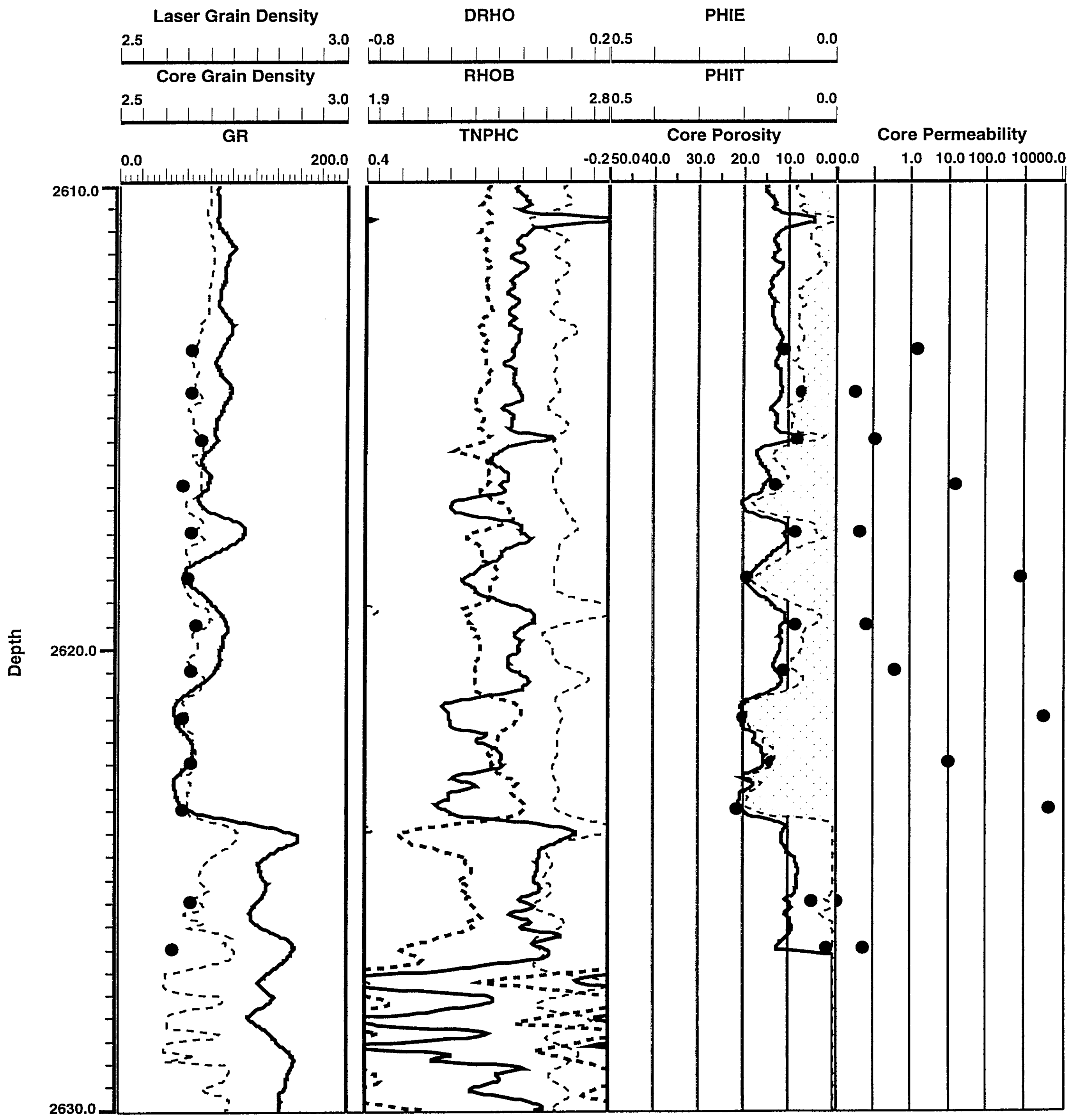
Summary Table
Log Analysis Listing
Core Analysis Plots
Mineralog Tables
Mineralog Plots
Log Analysis Depth Plot
LASER Modelling Results
SNUPAR Modelling Results
MRIL Magnetic Resonance Image Log Results

TURRUM 6 SUMMARY OF RESULTS

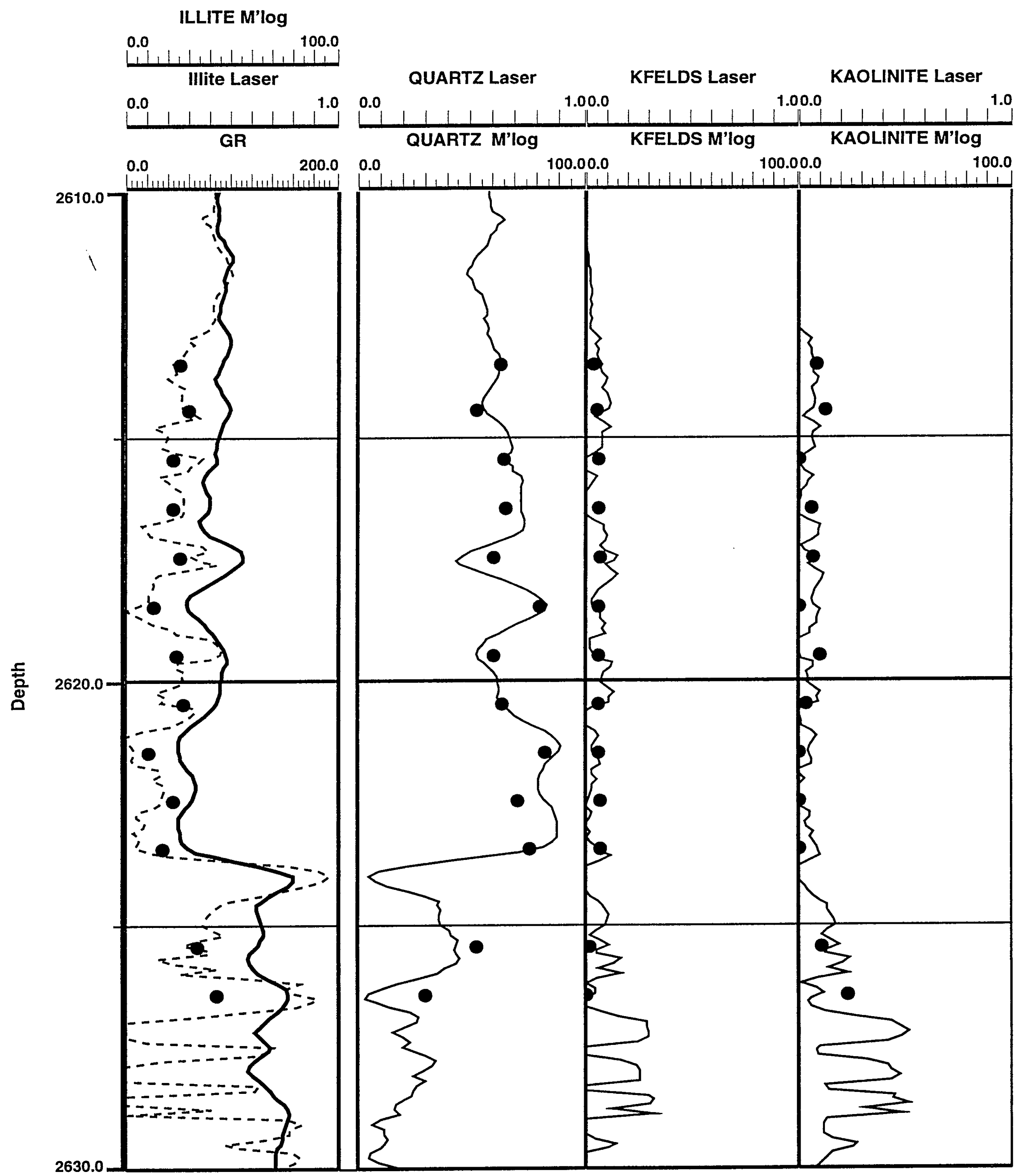
Net Porosity Cut-off: 10%

Depth (mMDRT) (top)	(base)	Gross (m)	Net (m)	N/G (%)	Mean Vwclay	Mean Porosity	(Std.) (Dev.)	Mean Sw	Comments
1463.8	1478.0	14.2	13.8	97.0	0.320	0.140	0.013	0.500	Gas
1478.1	1509.9	31.9	31.3	98.0	0.120	0.240	0.036	0.090	Gas
		Current Marlin Gas - Water Contact at 1510m MDRT							
1510.1	1545.0	34.9	34.9	100.0	0.100	0.240	0.019	0.830	Resid. Gas
1560.0	1581.0	21.0	20.1	96.0	0.120	0.260	0.040	0.780	Resid. Gas
		Original Marlin Gas - Oil Contact at 1581m MDRT (-1556m SS)							
1581.0	1586.1	5.0	4.7	94.0	0.090	0.270	0.032	0.750	Resid. Oil
		Original Marlin Oil - Water Contact at 1589m MDRT (-1564m SS)							
1598.3	1618.2	19.9	19.4	97.0	0.100	0.250	0.035	0.960	Water
1635.2	1649.9	14.8	14.1	95.0	0.080	0.250	0.023	1.000	Water
1658.3	1667.7	9.3	8.8	94.0	0.100	0.250	0.029	1.000	Water
1669.4	1673.4	4.0	3.8	95.0	0.040	0.240	0.023	1.000	Water
1684.3	1693.4	9.1	8.5	94.0	0.140	0.240	0.046	1.000	Water
1697.3	1700.4	3.0	2.9	95.0	0.190	0.230	0.038	1.000	Water
1709.5	1711.1	1.7	0.8	49.0	0.410	0.150	0.028	0.760	Water
1713.4	1714.6	1.2	0.7	61.0	0.420	0.120	0.011	0.650	Water
1718.3	1719.8	1.4	1.1	76.0	0.310	0.190	0.032	0.850	Water
1727.1	1730.6	3.5	3.3	94.0	0.140	0.230	0.042	0.860	Water
1754.9	1768.8	13.9	11.2	81.0	0.120	0.230	0.028	0.940	Water
1806.8	1815.1	8.2	7.5	91.0	0.120	0.220	0.036	1.000	Water
1828.4	1831.1	2.6	2.2	83.0	0.350	0.150	0.015	1.000	Water
1851.4	1853.2	1.7	1.3	76.0	0.250	0.170	0.031	1.000	Water
1879.2	1885.4	6.2	5.8	94.0	0.210	0.200	0.032	1.000	Water
1893.6	1895.1	1.5	1.0	65.0	0.380	0.140	0.018	1.000	Water
1913.3	1918.0	4.7	4.2	89.0	0.190	0.190	0.028	1.000	Water
1948.9	1953.1	4.2	3.8	89.0	0.300	0.160	0.031	1.000	Water
1966.8	1969.2	2.4	1.3	52.0	0.380	0.130	0.011	1.000	Water
2027.0	2028.2	1.3	0.5	40.0	0.310	0.110	0.005	1.000	Water
2051.5	2053.9	2.4	1.8	76.0	0.290	0.140	0.017	1.000	Water
2067.5	2069.8	2.3	1.5	66.0	0.310	0.140	0.015	1.000	Water
2094.9	2097.1	2.3	0.9	41.0	0.380	0.120	0.006	1.000	Water
2152.7	2154.5	1.7	1.1	63.0	0.210	0.170	0.022	1.000	Water
2184.8	2191.5	6.7	5.4	80.0	0.290	0.130	0.012	1.000	Water
2207.6	2210.6	3.0	1.8	62.0	0.320	0.120	0.012	1.000	Water
2218.2	2220.0	1.8	1.2	66.0	0.350	0.110	0.004	1.000	Water
2250.7	2252.2	1.5	1.2	82.0	0.290	0.120	0.010	1.000	Water
2254.9	2258.9	4.0	1.9	48.0	0.200	0.150	0.023	1.000	Water
2279.3	2285.3	6.0	2.7	46.0	0.300	0.110	0.011	1.000	Water
2375.4	2381.3	5.9	5.2	88.0	0.140	0.170	0.036	1.000	Water
2381.5	2386.8	5.3	3.1	59.0	0.260	0.130	0.021	1.000	Water
2413.2	2421.6	8.4	0.3	4.0	0.340	0.100	0.003	1.000	Water
2440.1	2441.6	1.5	1.2	79.0	0.140	0.170	0.018	1.000	Water
2523.8	2525.0	1.2	0.4	36.0	0.250	0.120	0.007	1.000	Water
2563.2	2564.4	1.2	0.9	77.0	0.250	0.130	0.013	0.730	Water
2565.3	2569.0	3.8	3.6	97.0	0.090	0.190	0.024	1.000	Water
2608.3	2623.5	15.2	5.5	37.0	0.180	0.150	0.031	0.150	Gas
2650.0	2652.0	2.0	0.6	31.0	0.260	0.120	0.010	0.580	Water
2652.1	2656.4	4.3	4.2	98.0	0.180	0.120	0.010	0.970	Water
2670.0	2689.0	19.1	6.6	35.0	0.190	0.120	0.011	0.970	Water
2698.3	2709.4	11.1	10.5	95.0	0.100	0.140	0.012	1.000	Water
2712.3	2714.1	1.9	1.4	74.0	0.110	0.120	0.017	1.000	Water
2716.4	2719.3	2.9	2.1	72.0	0.100	0.120	0.009	1.000	Water

2728.5	2731.1	2.6	2.1	82.0	0.080	0.140	0.021	1.000	Water
2732.9	2741.9	9.0	1.5	17.0	0.030	0.110	0.004	1.000	Water
2751.2	2755.0	3.7	1.8	50.0	0.130	0.120	0.011	0.970	Water
2771.2	2773.6	2.4	1.4	60.0	0.140	0.110	0.006	0.850	Water
2783.9	2788.0	4.1	1.5	36.0	0.150	0.130	0.014	0.180	Gas
2800.2	2801.5	1.2	0.0	0.0		Non-net			Gas



CORE ANALYSIS VS LOG ANALYSIS



MINERALOG VS LASER RESULTS

CORE LABORATORIES
MINERALOG ANALYSIS
VOLUME %

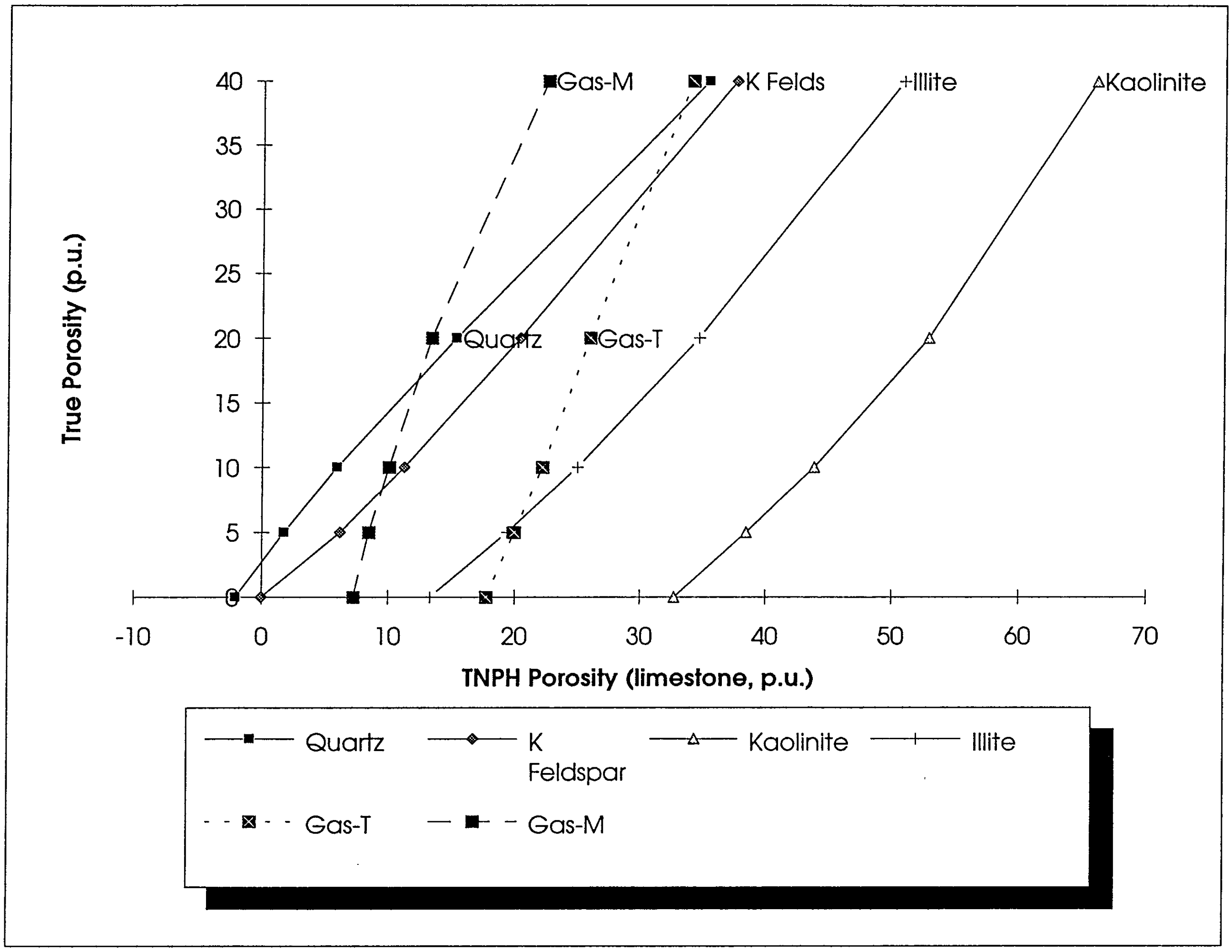
COMPANY: ESSO AUSTRALIA LTD.
WELL NAME: TURRUM #6
WELL LOCATION: AUSTRALIA
SAMPLE TYPE: PLUG OFF-CUTS

FILE NO.: PRP-95051
DATE: 27-Oct-95
ANALYST: D. BEER

SAMPLE NO.	DEPTH (M)	GRAIN DENSITY INDEX	QUARTZ	PLAGIOCLASE	K-FELDSPAR	SIDERITE	DOLOMITE	PYRITE	TOTAL CLAY	KAOLINITE	CHLORITE	ILL+SMEC
1	2611.03	2.65	62	0	3	0	0	0	35	8	0	27
2	2611.95	2.65	52	0	5	0	0	0	43	12	0	31
3	2612.95	2.74	64	0	6	6	0	1	23	1	0	22
4	2613.95	2.64	65	0	6	0	0	0	29	6	0	23
5	2614.95	2.65	59	0	7	0	0	0	34	7	0	27
6	2615.95	2.64	81	0	6	0	0	0	13	0	0	13
7	2616.95	2.65	59	0	6	0	0	0	35	10	0	25
8	2617.95	2.64	63	0	6	0	0	0	31	3	0	28
9	2618.95	2.64	83	0	6	0	0	0	11	0	0	11
10	2619.95	2.64	70	0	7	0	0	0	23	1	0	22
11	2620.95	2.64	76	0	7	0	0	0	17	1	0	16
12	2622.95	2.65	52	0	2	0	0	0	46	11	0	35
13	2623.95	2.65	29	4	0	0	0	0	67	23	0	44

Turrum 5 Thermal Neutron "TNPH" Mineral Response

SNUPAR MODELING RESULTS of TNPH



Molecular Composition Modeled by SNUPAR

Quartz: Si O2
K Feldspar: K Al Si3 O8
Kaolinite: Al4 (Si4 O10) (OH)8
Illite: K0.8 (Al1.6 Fe0.2 Mg0.2) (Si3.4 Al0.6) O10 (OH)2
Marlin Gas: C1.0 H3.383 O0.031 N0.008
Turrum Gas: C1.0 H3.043 O0.169 N0.003

True Porosity	Quartz	K Feldspar	Kaolinite	Illite	Gas-M	Gas-T
0	-2.074	-0.046	32.75	13.34	7.253	17.74
5	1.75	6.18	38.49	19.4	8.474	19.95
10	5.93	11.26	43.88	24.97	10.048	22.16
20	15.32	20.39	52.89	34.65	13.374	25.95
40	35.39	37.62	66.07	50.85	22.545	34.06

SNUPAR MODELLING RESULTS

Petrophysical Response of Common Minerals
LASER Modelling Parameters
Marlin and Turrum Reservoirs

by

Wm Scott Dodge Snr

Mineral Classification	Mineral Name	Chemical Elements	RHOB Litho Density (gm/cm3)	PEF Photoelectric Factor (barns/electron)	U Volumetric Photoelectric Factor (barns/cm3)	TNPH Thermal Neutron Porosity (p.u.)	DT Compressional Transit Time (us/metre)	POTA Potassium (wt %)	THOR Thorium (ppm)
Silica	Quartz	SiO2	2.64	1.81	4.79	-2.1	165.3	0.00	0.5 -> 6.0
Feldspars	Orthoclase	KAlSi3O8	2.54	2.86	7.29	-0.1	175.5	10.50	0.0
Clays	Kaolinite	Al4(Si4O10)(OH)8	2.62	1.70	4.46	32.8	694.6	0.49	7 -> 47
	Illite	K.8(Al1.6Fe.2Mg.2)(Si3.4Al.6)O10(OH)2	2.77	3.03	8.37	13.3		4.91	8 -> 25
Fluids	Water (35 kppm)	H2O(0.965) NaCl(0.035)	1.02	0.61	0.54	100.0	620.0	0.00	0.0
	Gas-Marlin	CH3.383 O0.031 N0.008	0.13	0.61	0.18	7.3	620.0	0.00	0.0
	Gas-Turrum	CH3.043 O0.169 N0.003	0.25	0.61	0.25	17.7	620.0	0.00	0.0

Notes:
Reference: Schlumberger 1990 Element Mineral Rock Catalog
Reservoir sands primary constituent is quartz with secondary potassium feldspar grains.
Muscovite and Biotite are present and commonly decompose to form authigenic clays (i.e. chlorite).
Micro porous clays assosciated with micas are Chlorite, Illite, Illite-Smectite, Glauconite-Smectite mixtures.
Biotite is usually associated with Pyrite from the decomposition of this mica mineral with kaolinite and illite.
Detrital heavy minerals of Zircon and Tourmaline are visible in clean reservoir sands.
Feldspar dissolution develops micro/secondary porosity. Kaolin is formed during dissolution.
Granitic trace minerals causing saturated GR responses: Zircon, Sphene
Radioactive Isotopes: Potassium 40, Thorium 232, Uranium 238

LASER 4 mineral model + gas	
Structural Grains	
	Quartz
	Potassium Feldspar
Structural & Authigenic Clays	
	Kaolinite
	Mixed layer Illite-Smectite
Others	Gas

Version 1: 16/11/92
Version 2: 18/04/94
Version 3: 22/12/94
Version 4: 14/07/95 (EXCEL)

MEMORANDUM

TO: Brodie Thomson
Bob Griffith

DATE: 30 November, 1995

FROM: Andy Mills

CC: Kumar Kuttan (EEC)
Marianne Weaver (EPR)
Dale Fitz (EPMI)
Hans Thomann (ER&E)

SUBJECT: Marlin Residual Gas Saturation using MRIL

Logging of the NUMAR MRIL Magnetic Resonance Image Log on Turrum 6 in the Marlin residual gas reservoirs has been summarised in the attached report. This report focuses on using the MRIL for determination of residual gas saturation.

In brief the tool successfully measured the residual gas saturation in two swept gas reservoirs in the Marlin sands and located the gas-water contact. The present day gas-water contact occurs at 1510 metres as determined from resistivity, neutron and nuclear magnetic resonance petrophysical log measurements. Table 1 shows the residual gas saturation as measured by the MRIL and by three other techniques.

Table 1 Marlin Residual Gas Saturation, S_{gr}

Depth / Method	**MRIL** (%)	LASER (%)	LLD (%)	MSFL (%)
1516 - 1527 metres	**35**	42	22	23
1572 - 1576 metres	**26**	26	24	30

The S_{gr} as determined from the MRIL in the upper residual gas column between 1516 to 1527 metres is 35 percent, whereas in the lower reservoir sand from 1572 to 1576 metres is 26 percent. These S_{gr} values are comparable to that measured on core plugs ranging from 22 percent to 39 percent. Owing to the uncertainty in connate water salinity in the gas column, higher confidence is placed upon the MRIL S_{gr} over the resistivity based methods. This method of selecting an individual measurement of S_{gr} does not follow recommended procedures to average all measurements of S_{gr}.

Residual gas saturation and present day gas-water contact are critical parameters to reservoir engineering estimates of proven gas reserves at Marlin. The resulting gas-water contact definition enabled reservoir engineers to confirm effective flank drainage and subsequently transfer 230 GSCF of gas reserves from probable to proved category. Further technical work in 1996 will integrate the residual gas saturation data.

The attached report will be sent to EPRCo for publication in the Exxon Formation Evaluation Newsletter as a means of technology transfer to Exxon affiliates. If you have any further questions, please feel free to contact Scott Dodge or myself.

Title: Marlin Reservoir Residual Gas Saturation using the MRIL

Authors: Scott Dodge, Lachlan Finlayson, Mike Scott, Peter Glenton

Affiliate: Esso Australia Ltd

Location: Melbourne, Victoria, Australia

PROBLEM

To confirm the reserves in the Marlin gas field, residual gas saturation, S_{gr}, in-situ measurements are needed. Marlin original reserves are 3.35 TCF. The field commenced production in 1969 with cumulative gas production currently at 2.5 TCF. A S_{gr} of 21 to 24 percent was measured from imbibition of water into gas saturated cores (EPRC, 1973) and this value is used today in reserve estimates at Marlin. The Turrum 6 well penetrated the shallower, overlying, Marlin gas sands which provided an opportunity to measure the S_{gr} and present day gas-water contact.

Measurement of S_{gr} using conventional resistivity based saturation models is subject to error due to uncertainty in the resistivity petrophysical parameters; cementation exponent "m", and saturation exponent "n". However even greater uncertainty exists in using resistivity methods due to different connate water resistivity in the underlying water reservoirs as to that in the gas reservoir (Kuttan, 1986). Water salinity decreases from about 30,000 ppm NaCl in the overlying gas reservoir to 6,000 ppm NaCl in the water aquifer caused by meteoric water influx post oil migration. It was decided to log NUMAR's Magnetic Resonance Image Log, MRIL, over the residual gas reservoirs to provide a measurement independent of resistivity to determine S_{gr}.

DISCUSSION

The Turrum 6 - Marlin gas reservoir, residual gas column and underlying water sand are shown in Figure 1. A 71 metre residual gas column is present from the original gas-water contact at 1581 metres, up to the present day gas-water contact at 1510 metres. All depths reported are referenced in metres MDKB. Although identification of the original gas-water contact at 1581 metres is not apparent on the LLD resistivity measurement in track 2, the contact is seen by a reduction in neutron porosity, TNPH, at this depth in track 3. This reduction in neutron porosity above the gas-water contact is caused by the low density, residual gas filled pore volume. A further reduction in neutron porosity occurs above the present day gas-water contact at 1510 metres.

The MRIL porosity, in track 4, shown relative to effective porosity has been used to compute gas saturation from the MRIL. In the water sand below 1600 metres the MRIL porosity is equivalent to effective porosity, however in the residual gas column from 1510 to 1581 metres, the MRIL porosity principally measures the water filled porosity. The next section goes on to develop the basis for using the MRIL to measure residual gas saturation.

Relaxation Time Properties of Marlin Reservoir Fluids

The MRIL C series tool was used to acquire T2 relaxation time data which could be processed to quantify gas filled porosity through the residual gas reservoir; Method A (Prammer, 1995) Differential Spectrum Method (Akkurt, 1995) . If successful, Method A processing would measure S_{gr} independent of other petrophysical log measurements. The theoretical basis for this method of processing T2 CPMG (Carr, 1954 and Meiboom, 1958) pulse trains is outlined in an associated Formation Evaluation Newsletter article, Dodge, Winter 1996, *"Identification of Hydrocarbon Pore Fluids with the MRIL at Turrum"*.

Method A acquisition of the TR long CPMG pulse train at 10 seconds and TR short CPMG pulse train at 2 seconds failed to separate the water filled pore volume from the gas filled pore volume. The reason for this was due to the high porosity and permeability sandstones in the Marlin reservoirs. The Marlin sandstone contains porosity as high as 30 p.u. and permeability greater than 4000 mD. The water filled porosity appears to have a T2 relaxation time equivalent of the bulk relaxation of mud filtrate. Due to the large pores (> 100 microns), surface relaxation is a small component relative to the total T2 relaxation. The longitudinal T1 relaxation time of water shown in Table 1 is similar to that for gas. To separate the gas signal from the water signal successfully, the T1 for gas must be at least three times greater than that for water saturated rocks.

Table 1 Properties of Marlin Reservoir Fluids

Fluid	Density (g/cc)	HI	T1 (ms)	T2 (ms)	Do 10^{-5} (cm^2/s)
Filtrate	1.02	1.00	2100	2100	5.5
Gas	0.13	0.25	2800	18	260

Measurement of Residual Gas Saturation

Although the MRIL Method A processing could not measure the gas filled porosity in the residual gas reservoir, the MRIL porosity, ϕ_{MPHI}, was used in conjunction with LASER total porosity and clay bound water to compute the near wellbore water saturation, *Sxo*. The MRIL porosity response to water and hydrocarbons is determined by the magnitude of magnetisation in the transverse plane at early time in the CPMG pulse echo train. The T2 distribution of relaxation times is extracted from raw CPMG echo trains by breaking the total NMR signal M(t) into 8 components, called bins,

$$M(t) = \sum_{i=1}^{8} a_i e^{-t/T_{2i}} \qquad (1)$$

where a_i is the porosity associated with the i^{th} bin (Prammer, 1994). MRIL porosity, which is uncorrected for the hydrogen index of oil or gas, is defined as the sum of the porosities in all bins,

$$\phi_{MPHI} = \sum_{i=1}^{8} a_i = \phi_w + HI_g \times \phi_g + HI_o \times \phi_o \qquad (2)$$

Marlin gas has a density of 0.13 g/cc and hydrogen index of 0.25 at a reservoir pressure of 2060 psia and temperature of 75 degC. The contribution of gas filled porosity is very low in the Marlin residual gas reservoir, hence, ϕ_{MPHI} responds primarily to water filled porosity, ϕ_w.

Sg has been determined using 4 methods from petrophysical log measurements in Equations 3 through 6. *Assumption: in a residual gas reservoir, gas saturation is not affected by displacement of connate water with mud filtrate.*

MRIL $$S_g = 1 - \frac{\phi_{MPHI} + \phi_{clbw}}{\phi_t} \qquad (3)$$

LASER $$S_g = \frac{\phi_g}{\phi_t} \qquad (4)$$

LLD $$S_g = 1 - S_w \qquad (5)$$

MSFL $$S_g = 1 - S_{xo} \qquad (6)$$

The LASER computed gas saturation results from modelling the neutron gas response with SNUPAR, *Schlumberger Nuclear Parameter Code*, (Ellis, 1987) to determine the gas filled porosity, ϕ_g. The petrophysical properties of the MRIL and LASER computed gas saturations are derived from hydrogen content of the pore space, whereas the LLD and MSFL gas saturations are dependent upon connate water resistivity.

Table 2 shows the results of computing average *Sgr* over a homogeneous reservoir interval using the four techniques:

Table 2 Marlin Residual Gas Saturation, Sgr

DEPTH (metres)	MRIL (%)	LASER (%)	LLD (%)	MSFL (%)
1516 - 1527	35	42	22	23
1572 - 1576	26	26	24	30

In the deeper residual gas reservoir from 1572 to 1576 metres, very good agreement occurs between the four methods with a gas saturation of 26 percent. In the shallower reservoir from 1516 to 1527 metres the MRIL and LASER hydrogen based *Sgr* values are higher than that determined from the LLD and MSFL resistivity based methods. Owing to the uncertainty in connate water salinity in the gas column, higher confidence is placed upon the MRIL *Sgr* of 35 percent. This method of selecting an individual measurement of *Sgr* does not follow recommended procedures to average all measurements of *Sgr*.

Interpretation of T2 Relaxation Distributions

The distribution of T2 relaxation times from the TR long CPMG pulse train of 10 msec is shown in Figure 2. The depth range from 1495 to 1555 metres corresponds to the upper residual gas reservoir including 15 metres of the live gas column above 1510 metres. Below the gas-water contact the reservoir contains 35 percent residual gas and 65 percent water. The MRIL T2 signal from 3 to 20 msec comprises pore volume containing irreducible capillary water and residual gas. Above the gas-water contact, gas saturation is 85 percent, and the MRIL T2 signal is dominated by the relaxation of Marlin gas at about 18 msec. The change in fluid type from water to gas is easily identified by a reduction of T2 amplitude in the live gas column. Interpretation of T2 relaxation in the presence of hydrocarbons complicates the surface relaxation model which suggests relaxation is controlled by the surface-to-volume ratio of the pore system.

The distribution of T2 relaxation times in the lower residual gas reservoir as well as the water sand is shown in Figure 3. The MRIL S_{gr} is 26 percent from 1572 to 1576 metres. Marlin field original gas-water contact at 1581 metres is confirmed by an increase in signal amplitude in the T2 relaxation times below this depth. As discussed previously, this contact is not apparent from water saturation derived from formation resistivity measurements. The transition to lower T2 times at the top of the reservoir above 1563 metres indicates the degradation of reservoir quality into the overlying shale.

The water sand from 1600 to 1618 metres shows a strong "uni-modal" measurement of T2 relaxation time. To achieve complete T1 recovery in this 30 percent porosity water sand, the MRIL was logged with a 10 second TR. Laboratory NMR T1 measurements of multi-Darcy permeability sandstones normally do not exceed 1.5 seconds. Therefore the relaxation mechanism observed by the MRIL may be that associated with the bulk relaxation of the mud filtrate. NMR measurements on core plugs are being undertaken on Marlin sandstones to determine if relaxation is dominated by bulk fluid relaxation due to large pores in this high permeability sandstone.

CONCLUSION

The in-situ residual gas saturation in the Marlin swept residual gas column was successfully measured using Magnetic Resonance Image Logging. The S_{gr} from the MRIL in the upper residual gas column between 1516 to 1527 metres is 35 percent, whereas in the lower reservoir sand from 1572 to 1576 metres is 26 percent. These S_{gr} values are comparable to that measured on core plugs ranging from 22 percent to 39 percent. The present day gas-water contact occurs at 1510 metres as determined from resistivity, neutron and nuclear magnetic resonance petrophysical log measurements. Residual gas saturation and present day gas-water contact are critical parameters to reservoir engineering estimates of proven gas reserves at Marlin.

The MRIL was capable of measuring the change in gas saturation at the Marlin original gas-water contact at 1581 metres when this contact could not be detected with formation resistivity measurements. MRIL porosity measurements are sensitive to the hydrogen index of the pore fluid similar to neutron porosity.

Fluid identification and quantification using the Method A, or Differential Spectrum Method, failed due to the long relaxation times in the Marlin high porosity sandstones. The extremely long TR of 10 seconds in the water sand suggests that T1 and T2 relaxation is dominated by bulk relaxation of the mud filtrate, rather than surface relaxation which is the normal mechanism for relaxation. NMR measurements on core plugs are being undertaken to validate this rare phenomena for water saturated rocks.

NOMENCLATURE

Do	- Diffusivity of the bulk fluid
HI_g	- Hydrogen Index of gas
HI_o	- Hydrogen Index of oil
S_g	- Gas Saturation
S_{gr}	- Residual gas Saturation
S_{xo}	- Flushed zone water saturation
S_w	- Undisturbed zone water saturation
T1	- Longitudinal relaxation time constant
T2	- Transverse relaxation time constant
TR	- Repetition time of CPMG experiments
ϕ_{MRIL}	- MRIL porosity
ϕ_{clbw}	- Clay bound water micro porosity
ϕ_g	- Gas filled porosity
ϕ_o	- Oil filled porosity
ϕ_t	- Total interconnected porosity
ϕ_w	- Water filled porosity

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PERSON TO CONTACT

Scott Dodge
Tele: (61)3 9270 3848
Fax: (61)3 9270 3883
Profs: MELBRNVM(WSDODGE)

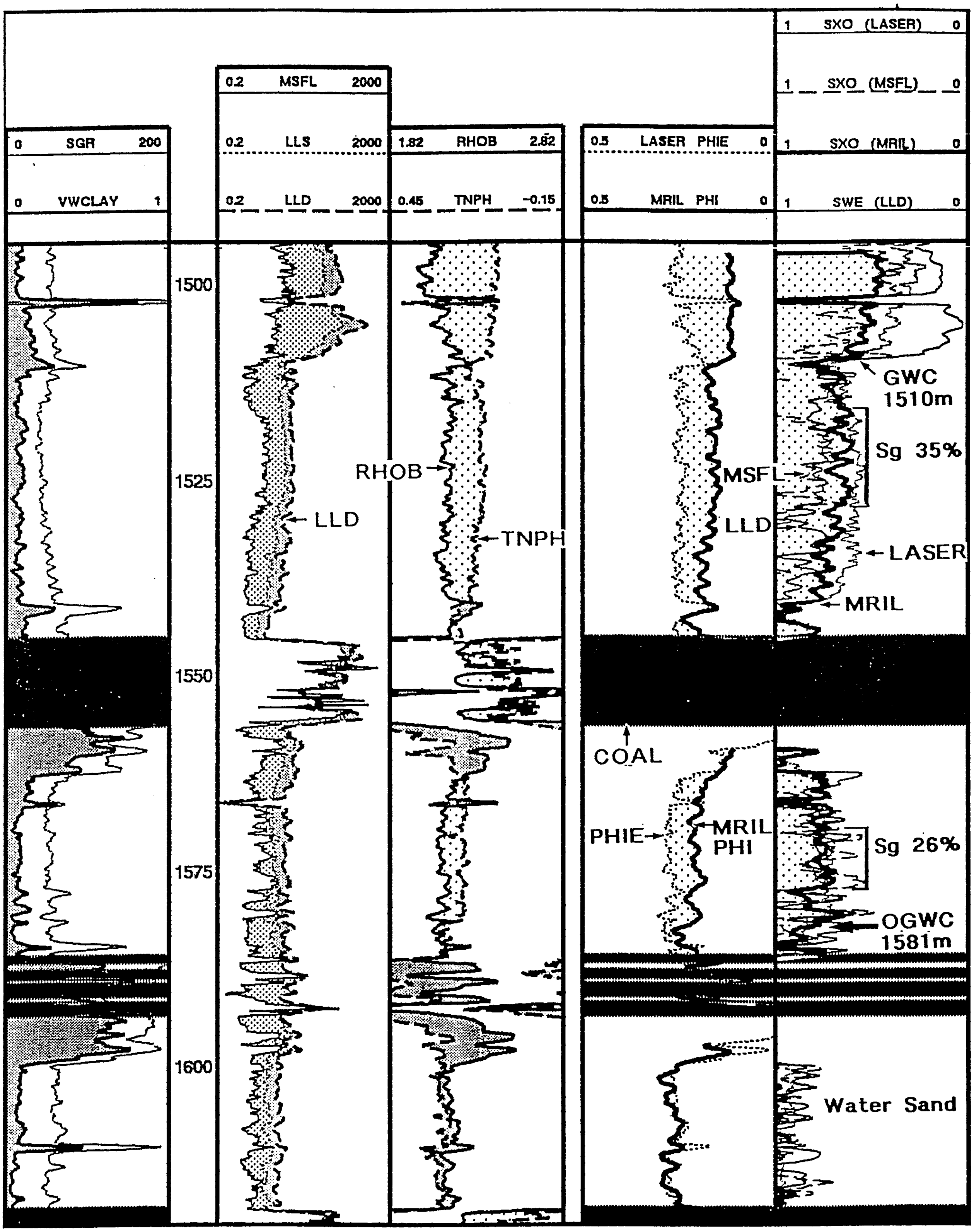

Figure 1 Turrum 6 - Marlin gas reservoir. MRIL residual gas saturation 35 percent from 1511 to 1527 metres and 26 percent from 1572 to 1577 metres. Gas saturation confirmed using other techniques: Resistivity (LLD, MSFL) and LASER neutron porosity model of gas

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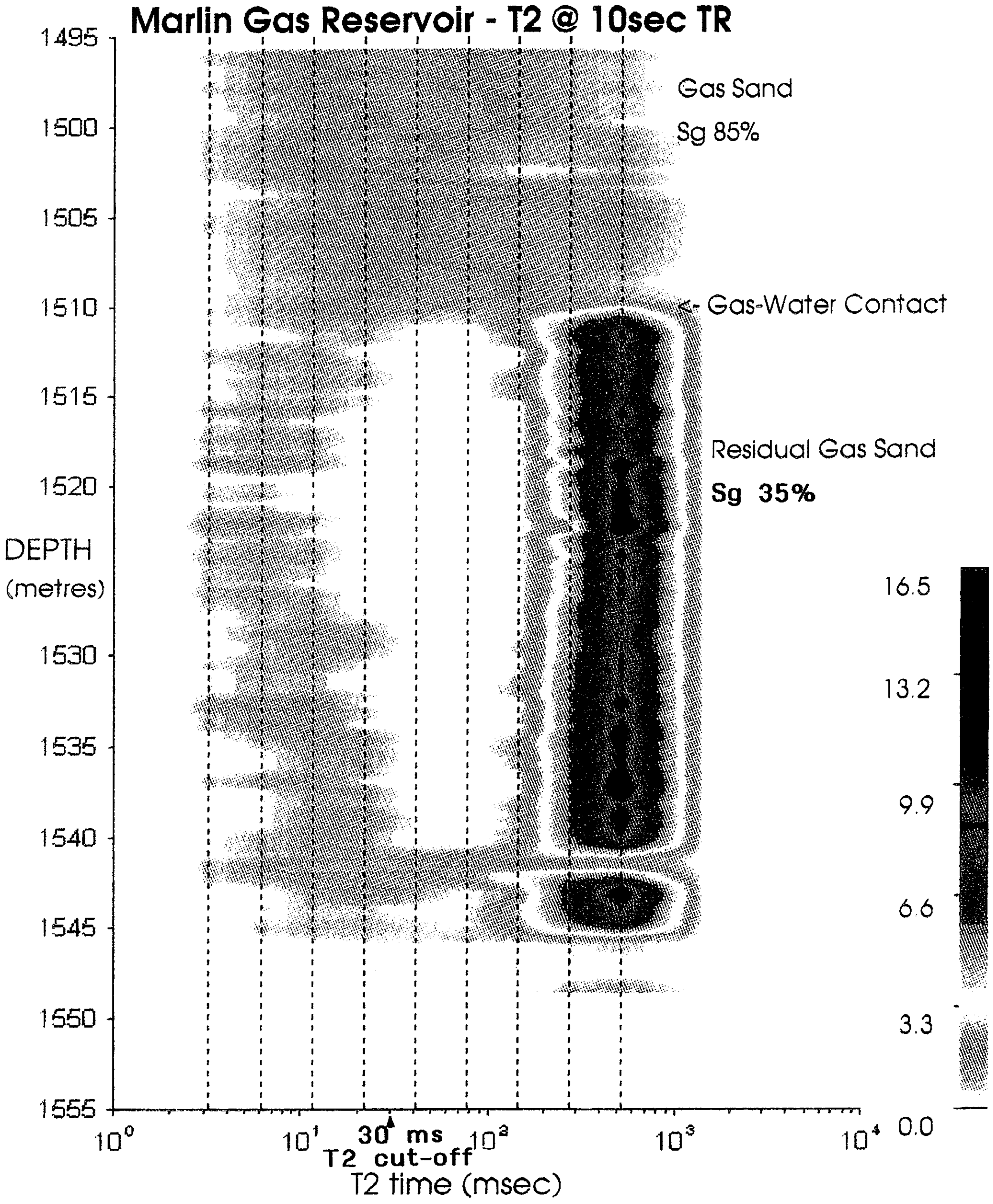

Figure 2 MRIL T2 distribution shows abrupt loss of signal at present day gas-water contact, 1510 metres. T2 diffusion of gas is 18 msec, which places observed signal in BVI window (<30 msec).

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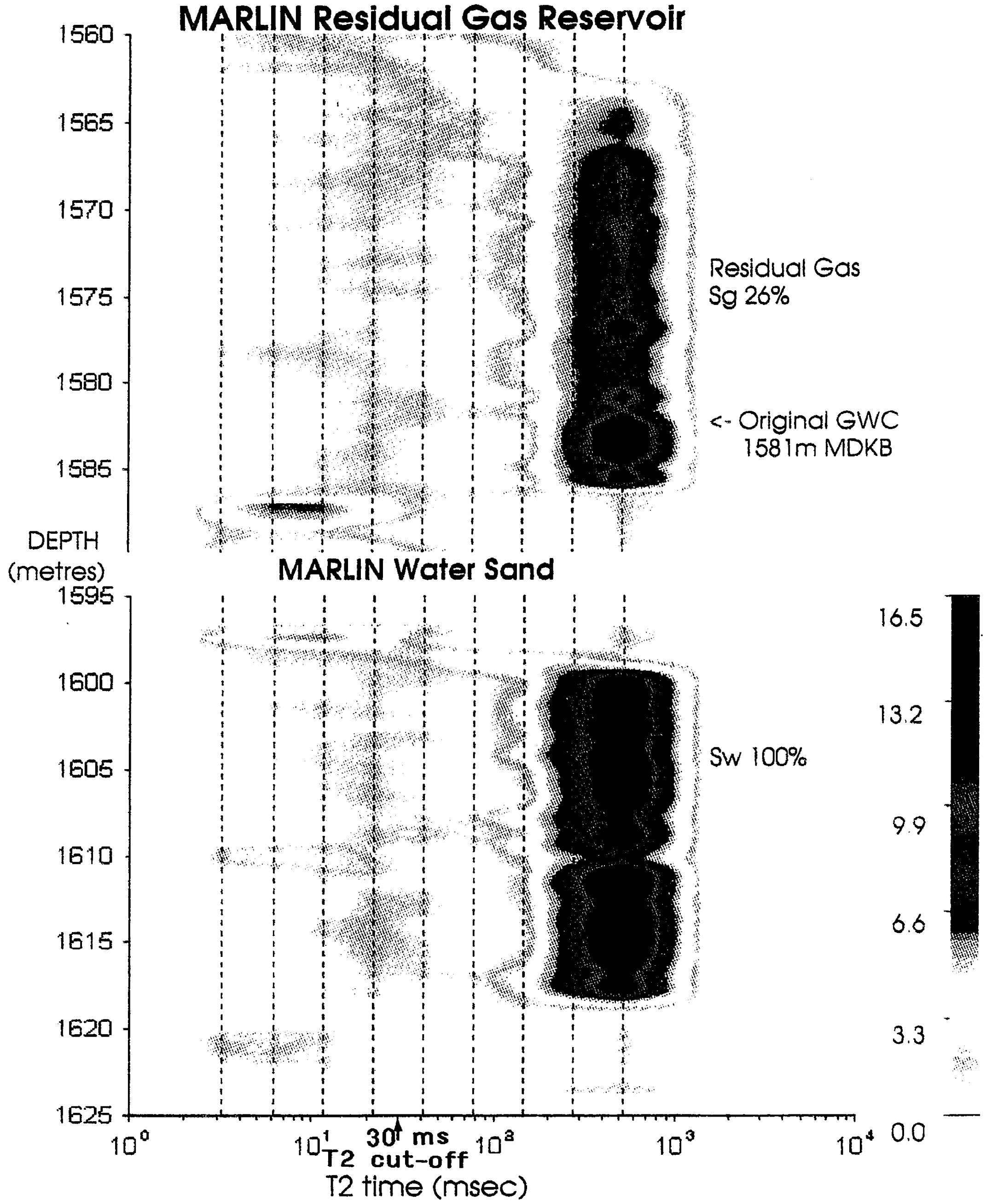
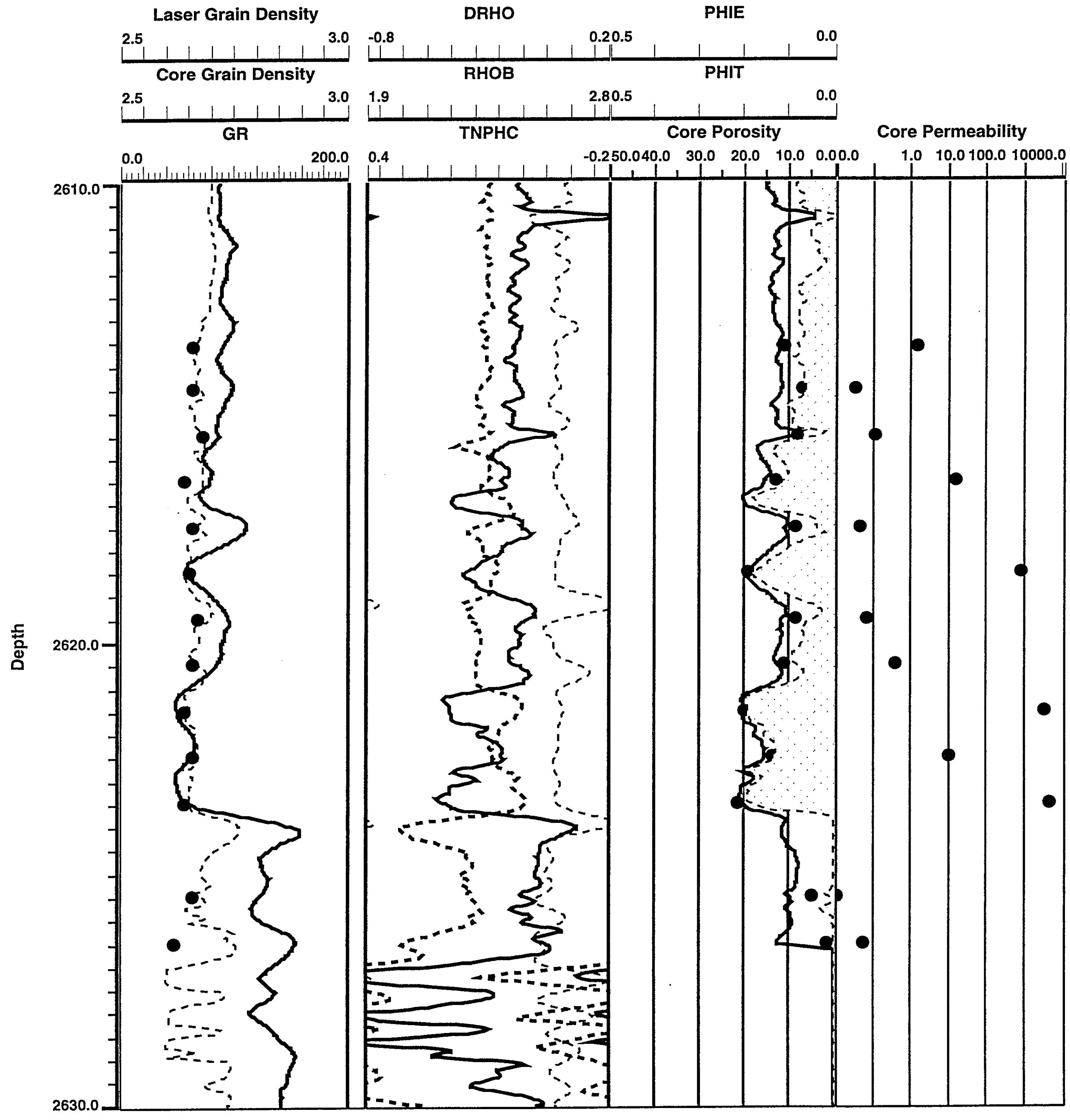
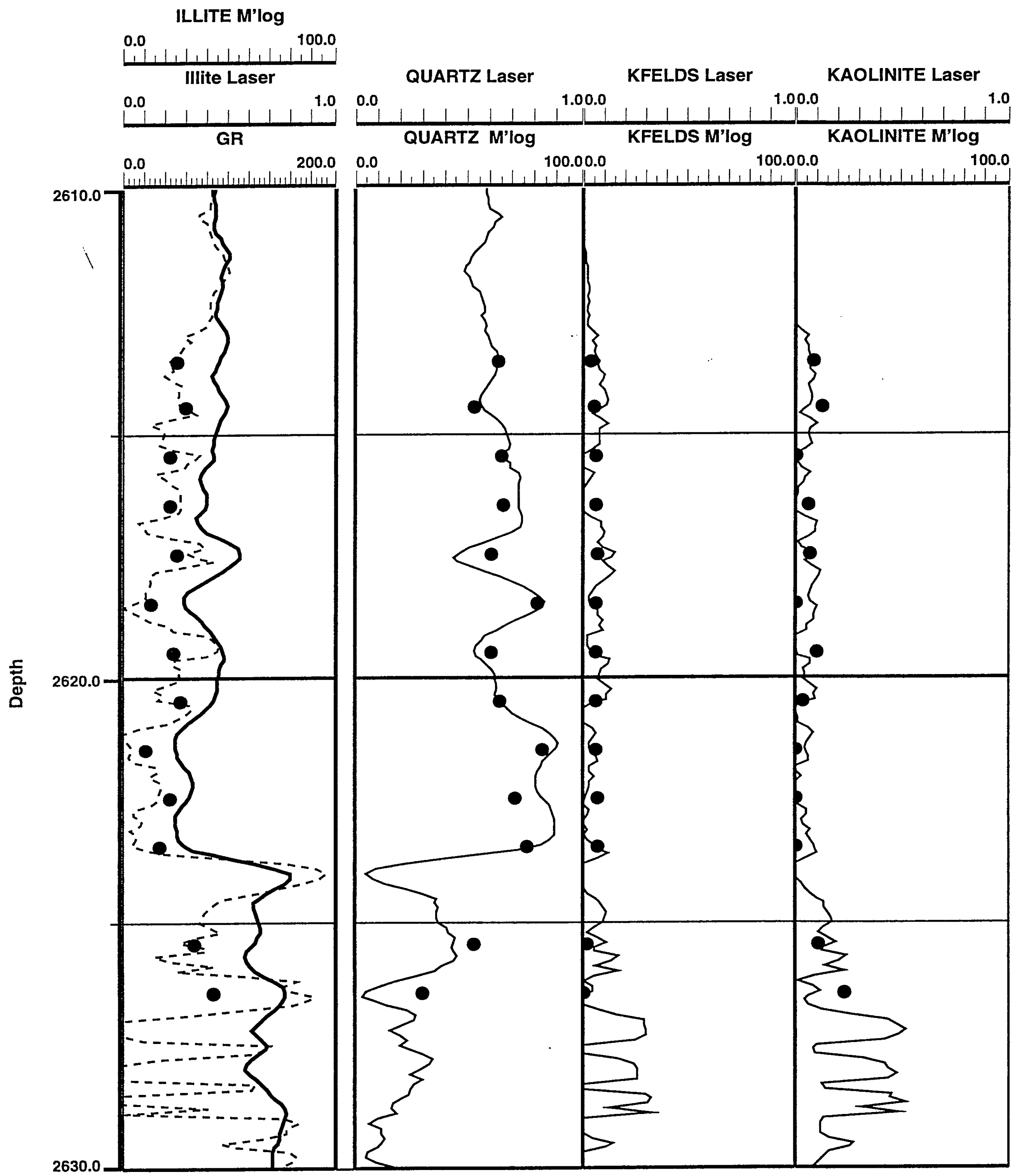


Figure 3 MRIL T2 distribution in residual gas column shows decreased signal amplitude above Marlin original gas-water contact, 1581 metres. Strong uni-modal signal amplitude throughout high porosity sand may be caused by bulk fluid T2 relaxation.

2



CORE ANALYSIS VS LOG ANALYSIS



MINERALOG VS LASER RESULTS

TURRUM 6 LOG ANALYSIS LISTING

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
1455	83	2.2	2.213	0.439	322	0.750	0.000	0.000
1456	86	3.7	2.535	0.307	309	0.750	0.000	0.000
1457	84	3.1	2.509	0.346	312	0.750	0.000	0.000
1458	95	3.2	2.511	0.317	313	0.750	0.000	0.000
1459	103	4.7	2.621	0.336	279	0.750	0.000	0.000
1460	110	3.5	2.462	0.366	341	0.750	0.000	0.000
1461	100	3.3	2.663	0.723	347	0.750	0.000	0.000
1462	99	5.5	2.532	0.502	299	0.750	0.000	0.000
1463	95	1.4	2.735	0.467	317	0.725	0.000	0.000
1464	101	3.1	2.500	0.260	335	0.471	0.062	1.000
1465	96	5.4	2.419	0.246	328	0.324	0.143	0.659
1466	94	6.6	2.422	0.230	326	0.350	0.131	0.603
1467	100	7.7	2.433	0.229	314	0.343	0.127	0.573
1468	114	8.9	2.437	0.197	307	0.365	0.107	0.590
1469	114	8.7	2.388	0.208	315	0.396	0.120	0.524
1470	110	9.2	2.366	0.197	319	0.364	0.135	0.465
1471	114	10.1	2.358	0.206	319	0.325	0.149	0.417
1472	117	10.1	2.369	0.207	319	0.319	0.147	0.424
1473	120	10.4	2.373	0.197	311	0.366	0.133	0.432
1474	119	10.9	2.405	0.215	310	0.393	0.120	0.451
1475	112	11.2	2.383	0.225	306	0.293	0.147	0.409
1476	98	11.8	2.381	0.200	299	0.185	0.158	0.419
1477	95	12.5	2.398	0.188	305	0.164	0.155	0.419
1478	90	14.7	2.409	0.175	311	0.169	0.149	0.387
1479	79	24.0	2.308	0.138	315	0.151	0.180	0.249
1480	77	28.9	2.275	0.122	315	0.183	0.182	0.207
1481	73	27.4	2.249	0.104	316	0.213	0.179	0.206
1482	72	44.9	2.150	0.085	328	0.188	0.212	0.131
1483	64	50.6	2.135	0.068	332	0.194	0.211	0.118
1484	58	76.7	2.033	0.055	336	0.083	0.253	0.102
1485	59	110.9	2.041	0.052	346	0.087	0.253	0.081
1486	59	117.0	1.980	0.053	362	0.085	0.275	0.073
1487	61	254.1	1.938	0.043	368	0.050	0.290	0.050
1488	56	302.7	1.932	0.062	379	0.047	0.300	0.045
1489	62	173.0	2.013	0.084	373	0.121	0.274	0.049
1490	60	233.1	1.989	0.065	369	0.072	0.282	0.047
1491	62	199.2	2.051	0.070	367	0.115	0.262	0.045
1492	61	133.4	2.048	0.092	356	0.109	0.260	0.062
1493	64	123.8	2.051	0.068	348	0.088	0.257	0.072
1494	58	185.5	2.019	0.051	370	0.123	0.267	0.044
1495	56	121.7	2.041	0.056	346	0.106	0.260	0.068
1496	61	131.8	2.057	0.057	334	0.058	0.250	0.080
1497	58	146.5	2.046	0.052	343	0.055	0.260	0.071
1498	57	189.9	1.981	0.052	352	0.062	0.273	0.058
1499	58	204.9	2.032	0.053	347	0.105	0.261	0.048
1500	60	200.4	1.992	0.076	363	0.062	0.279	0.056
1501	57	153.3	2.018	0.061	355	0.072	0.273	0.065

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
1502	140	8.1	2.404	0.185	370	0.527	0.041	0.766
1503	64	224.2	2.107	0.059	336	0.112	0.238	0.047
1504	58	216.8	2.134	0.095	352	0.154	0.227	0.037
1505	49	775.6	2.062	0.072	368	0.115	0.262	0.025
1506	58	314.0	2.136	0.090	337	0.148	0.232	0.026
1507	60	175.5	2.147	0.102	344	0.175	0.224	0.040
1508	66	129.5	2.183	0.089	322	0.163	0.206	0.061
1509	64	74.0	2.178	0.094	328	0.162	0.211	0.099
1510	76	9.8	2.255	0.155	320	0.250	0.184	0.436
1511	64	13.9	2.171	0.167	350	0.126	0.244	0.690
1512	65	8.8	2.096	0.193	345	0.063	0.273	0.831
1513	53	18.1	2.204	0.119	344	0.083	0.227	0.660
1514	56	14.0	2.163	0.145	346	0.079	0.247	0.707
1515	51	14.1	2.242	0.125	344	0.049	0.221	0.784
1516	53	13.0	2.156	0.125	343	0.071	0.247	0.738
1517	45	12.3	2.189	0.114	333	0.092	0.229	0.803
1518	50	11.8	2.170	0.130	339	0.125	0.232	0.788
1519	51	13.6	2.136	0.124	357	0.096	0.253	0.697
1520	53	13.8	2.141	0.129	351	0.094	0.250	0.695
1521	45	12.3	2.134	0.131	344	0.067	0.256	0.737
1522	50	12.3	2.118	0.130	351	0.089	0.257	0.725
1523	51	12.9	2.186	0.113	333	0.107	0.225	0.779
1524	52	12.8	2.172	0.116	339	0.107	0.232	0.763
1525	51	12.4	2.143	0.129	340	0.111	0.244	0.745
1526	48	14.8	2.172	0.115	337	0.073	0.237	0.717
1527	50	12.6	2.138	0.116	335	0.040	0.252	0.752
1528	51	10.3	2.136	0.134	332	0.063	0.252	0.821
1529	54	11.6	2.167	0.121	327	0.093	0.233	0.805
1530	52	8.5	2.159	0.133	341	0.092	0.243	0.918
1531	54	8.8	2.135	0.144	333	0.081	0.243	0.906
1532	55	12.2	2.135	0.141	341	0.081	0.248	0.752
1533	52	12.3	2.151	0.142	332	0.115	0.238	0.761
1534	47	10.9	2.117	0.144	342	0.077	0.254	0.786
1535	58	6.8	2.085	0.153	342	0.060	0.265	0.967
1536	55	8.0	2.136	0.143	337	0.097	0.244	0.935
1537	53	9.8	2.159	0.145	344	0.076	0.246	0.847
1538	64	8.4	2.180	0.156	336	0.095	0.237	0.939
1539	71	7.2	2.123	0.174	346	0.094	0.257	0.952
1540	59	8.4	2.163	0.168	343	0.064	0.249	0.921
1541	96	7.0	2.347	0.225	311	0.262	0.162	1.000
1542	93	4.8	2.288	0.216	331	0.175	0.202	1.000
1543	66	3.9	2.198	0.246	348	0.133	0.247	1.000
1544	66	3.5	2.159	0.224	354	0.098	0.264	1.000
1545	70	3.0	2.143	0.204	348	-	-	Coal
1546	40	355.4	1.264	0.823	477	-	-	Coal
1547	34	392.8	1.197	0.738	463	-	-	Coal
1548	35	347.4	1.249	0.801	446	-	-	Coal
1549	51	250.9	1.334	0.818	425	-	-	Coal
1550	37	196.8	1.216	0.804	468	-	-	Coal
1551	34	169.5	1.206	0.707	466	-	-	Coal

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE, frac
1552	110	11.9	2.324	0.626	365	-	-	Coal
1553	112	23.4	1.538	0.712	450	-	-	Coal
1554	101	19.3	1.670	0.786	475	-	-	Coal
1555	35	472.6	1.229	0.730	467	-	-	Coal
1556	134	57.9	1.848	0.681	457	-	-	Coal
1557	129	7.8	2.212	0.484	366	-	-	Coal
1558	129	13.1	2.487	0.390	284	0.699	0.000	1.000
1559	130	23.1	2.497	0.256	318	-	-	Coal
1560	125	16.2	2.357	0.379	316	-	-	Coal
1561	102	13.7	2.362	0.247	319	0.371	0.140	0.910
1562	123	20.5	2.353	0.246	323	0.451	0.097	0.717
1563	70	16.7	2.268	0.187	351	0.175	0.208	0.667
1564	60	13.6	2.168	0.184	367	0.133	0.254	0.663
1565	58	8.5	2.163	0.196	379	0.125	0.261	0.830
1566	70	0.6	2.428	0.267	382	0.276	0.180	1.000
1567	53	11.1	2.131	0.196	378	0.101	0.272	0.717
1568	55	10.5	2.146	0.205	371	0.073	0.270	0.738
1569	52	9.8	2.125	0.213	373	0.062	0.280	0.748
1570	58	10.4	2.147	0.216	372	0.095	0.265	0.742
1571	59	11.7	2.098	0.195	376	0.085	0.281	0.672
1572	58	9.3	2.116	0.209	369	0.085	0.275	0.772
1573	59	10.3	2.108	0.204	369	0.091	0.276	0.726
1574	55	8.3	2.110	0.191	368	0.080	0.278	0.812
1575	61	9.7	2.090	0.224	366	0.045	0.292	0.735
1576	54	11.3	2.158	0.207	358	0.064	0.263	0.736
1577	54	10.3	2.138	0.209	359	0.080	0.266	0.764
1578	68	10.9	2.136	0.207	363	0.085	0.262	0.755
1579	61	9.1	2.115	0.201	364	0.089	0.272	0.787
1580	60	10.1	2.128	0.196	368	0.122	0.265	0.749
1581	61	5.9	2.064	0.207	367	0.055	0.291	0.937
1582	52	15.5	2.086	0.256	378	0.047	0.288	0.584
1583	58	8.3	2.104	0.274	362	0.050	0.281	0.811
1584	72	9.5	2.110	0.281	357	0.087	0.278	0.754
1585	85	11.6	2.160	0.283	391	0.102	0.258	0.725
1586	119	9.3	2.096	0.349	339	-	-	Coal
1587	156	6.6	2.305	0.584	460	-	-	Coal
1588	144	11.9	2.102	0.677	408	-	-	Coal
1589	144	19.9	2.424	0.460	340	-	-	Coal
1590	142	9.0	2.196	0.486	395	-	-	Coal
1591	107	6.7	2.272	0.395	316	-	-	Coal
1592	111	17.2	1.815	0.429	432	-	-	Coal
1593	124	16.9	2.041	0.710	392	-	-	Coal
1594	151	7.3	2.311	0.484	371	-	-	Coal
1595	149	11.2	2.366	0.352	316	0.640	0.000	1.000
1596	140	20.5	2.530	0.278	275	-	-	Coal
1597	142	8.9	2.334	0.341	387	-	-	Coal
1598	146	20.1	2.513	0.273	297	0.674	0.000	1.000
1599	114	6.6	2.346	0.317	336	0.412	0.130	1.000
1600	66	8.0	2.170	0.288	359	0.094	0.261	0.870
1601	66	7.0	2.110	0.338	355	0.097	0.284	0.859

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE. frac
1602	66	6.1	2.146	0.301	345	0.093	0.265	0.975
1603	60	6.7	2.156	0.303	339	0.096	0.262	0.936
1604	65	6.2	2.175	0.294	339	0.082	0.259	1.000
1605	55	7.8	2.152	0.283	341	0.071	0.268	0.865
1606	65	6.9	2.171	0.286	339	0.072	0.263	0.931
1607	66	8.2	2.221	0.257	325	0.099	0.233	0.937
1608	69	5.2	2.217	0.297	329	0.119	0.235	1.000
1609	66	6.9	2.196	0.269	341	0.089	0.247	0.979
1610	122	6.4	2.266	0.267	348	0.394	0.181	1.000
1611	64	8.1	2.108	0.305	347	0.060	0.287	0.800
1612	57	7.6	2.155	0.310	322	0.058	0.270	0.875
1613	65	5.4	2.164	0.295	335	0.058	0.262	1.000
1614	57	7.0	2.133	0.314	340	0.042	0.281	0.885
1615	57	6.5	2.123	0.311	327	0.034	0.287	0.905
1616	51	5.6	2.145	0.276	347	0.040	0.279	1.000
1617	67	5.8	2.209	0.292	337	0.066	0.252	1.000
1618	58	3.3	2.165	0.286	369	-	-	Coal
1619	38	117.2	1.233	0.604	486	-	-	Coal
1620	40	85.1	1.228	0.721	484	-	-	Coal
1621	35	181.0	1.198	0.708	464	-	-	Coal
1622	75	21.7	1.483	0.817	475	-	-	Coal
1623	34	290.6	1.193	0.731	482	-	-	Coal
1624	47	272.8	1.258	0.782	476	-	-	Coal
1625	143	24.6	2.442	0.374	304	-	-	Coal
1626	119	7.7	2.377	0.296	315	0.445	0.101	1.000
1627	137	19.2	2.417	0.374	389	-	-	Coal
1628	117	14.2	2.134	0.459	432	-	-	Coal
1629	50	318.2	1.233	0.855	459	-	-	Coal
1630	89	5.9	2.076	0.426	255	-	-	Coal
1631	131	17.8	2.119	0.370	382	-	-	Coal
1632	126	6.1	2.210	0.493	373	-	-	Coal
1633	113	19.9	2.511	0.256	272	-	-	Coal
1634	107	10.9	2.480	0.224	281	0.461	0.047	1.000
1635	113	7.2	2.412	0.264	299	0.501	0.049	1.000
1636	67	7.6	2.186	0.276	329	0.083	0.257	0.903
1637	42	6.8	2.175	0.268	321	0.052	0.261	0.942
1638	41	6.5	2.156	0.265	324	0.030	0.272	0.939
1639	44	5.6	2.159	0.276	322	0.035	0.272	1.000
1640	48	5.5	2.160	0.303	322	0.059	0.272	1.000
1641	52	3.4	2.219	0.279	310	0.070	0.243	1.000
1642	59	6.5	2.247	0.248	306	0.083	0.224	1.000
1643	50	7.6	2.178	0.266	318	0.054	0.256	0.901
1644	49	5.9	2.177	0.279	315	0.063	0.257	1.000
1645	49	6.3	2.170	0.287	324	0.068	0.262	0.966
1646	58	4.7	2.194	0.313	319	0.093	0.251	1.000
1647	48	5.6	2.184	0.306	316	0.089	0.258	1.000
1648	53	4.1	2.238	0.257	312	0.120	0.216	1.000
1649	54	5.4	2.145	0.287	343	0.086	0.266	1.000
1650	130	7.2	2.247	0.528	482	-	-	Coal
1651	114	27.8	1.792	0.541	452	-	-	Coal

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE. frac
1652	110	14.6	2.285	0.398	337	-	-	Coal
1653	59	61.5	1.271	0.807	477	-	-	Coal
1654	31	245.8	1.193	0.956	482	-	-	Coal
1655	30	24.8	1.211	0.817	484	-	-	Coal
1656	86	24.3	2.136	0.608	401	-	-	Coal
1657	122	16.9	2.545	0.266	287	-	-	Coal
1658	123	11.5	2.427	0.296	305	0.539	0.028	1.000
1659	97	7.8	2.305	0.302	320	0.289	0.181	1.000
1660	70	6.1	2.182	0.314	337	0.118	0.254	0.980
1661	66	4.2	2.194	0.333	336	0.129	0.250	1.000
1662	65	5.5	2.148	0.305	342	0.071	0.276	0.971
1663	60	5.6	2.158	0.279	334	0.066	0.267	1.000
1664	65	5.3	2.183	0.274	324	0.071	0.256	1.000
1665	76	5.8	2.224	0.304	328	0.126	0.239	1.000
1666	53	6.2	2.195	0.293	323	0.078	0.252	0.998
1667	57	5.8	2.149	0.273	337	-	-	Coal
1668	63	4.7	1.850	0.373	378	-	-	Coal
1669	53	13.7	1.941	0.431	339	-	-	Coal
1670	58	5.5	2.161	0.286	319	0.050	0.265	1.000
1671	52	5.7	2.184	0.255	315	0.037	0.258	1.000
1672	51	5.4	2.248	0.219	309	0.033	0.233	1.000
1673	48	5.9	2.240	0.246	297	-	-	Coal
1674	46	20.8	1.237	0.853	463	-	-	Coal
1675	52	22.3	1.661	0.571	408	-	-	Coal
1676	131	9.8	2.438	0.354	329	-	-	Coal
1677	125	6.7	2.422	0.305	320	0.501	0.053	1.000
1678	141	14.3	2.303	0.430	387	-	-	Coal
1679	66	15.1	1.876	0.819	389	-	-	Coal
1680	132	7.5	2.467	0.356	313	-	-	Coal
1681	147	14.8	2.403	0.391	342	-	-	Coal
1682	90	4.6	2.137	0.491	376	-	-	Coal
1683	128	16.1	2.647	0.349	265	-	-	Coal
1684	97	22.3	2.507	0.218	250	0.468	0.016	1.000
1685	134	6.6	2.350	0.296	312	0.435	0.110	1.000
1686	94	6.0	2.250	0.322	315	0.204	0.213	1.000
1687	84	4.6	2.224	0.310	317	0.127	0.236	1.000
1688	73	6.2	2.202	0.310	319	0.101	0.247	0.989
1689	57	4.0	2.123	0.313	323	0.060	0.280	1.000
1690	60	6.3	2.162	0.306	317	0.073	0.262	0.938
1691	58	5.0	2.132	0.300	324	0.058	0.278	1.000
1692	56	5.5	2.138	0.303	328	0.083	0.269	0.978
1693	74	2.7	2.271	0.327	317	0.309	0.194	1.000
1694	138	12.1	2.408	0.346	322	-	-	Coal
1695	123	9.1	2.146	0.480	348	-	-	Coal
1696	89	3.0	2.321	0.340	314	-	-	Coal
1697	107	6.4	2.197	0.594	345	-	-	Coal
1698	70	1.6	2.208	0.331	317	0.146	0.239	1.000
1699	74	2.2	2.160	0.399	331	0.145	0.263	1.000
1700	53	1.8	2.229	0.335	326	0.186	0.234	1.000
1701	134	8.8	2.241	0.420	382	-	-	Coal

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
1702	131	6.8	2.461	0.386	324 -	-	Coal	
1703	112	3.6	2.310	0.407	340	0.524	0.062	0.890
1704	139	6.0	2.493	0.375	314 -	-	Coal	
1705	131	5.0	2.456	0.360	332 -	-	Coal	
1706	123	4.8	2.383	0.419	329 -	-	Coal	
1707	119	4.9	2.458	0.318	312	0.631	0.000	1.000
1708	126	7.3	2.460	0.327	320	0.658	0.000	1.000
1709	133	7.4	2.454	0.327	315	0.657	0.000	1.000
1710	109	2.8	2.282	0.348	331	0.388	0.181	0.707
1711	151	2.6	2.316	0.284	303	0.485	0.065	1.000
1712	135	5.3	2.470	0.341	306	0.652	0.000	1.000
1713	137	7.4	2.436	0.327	324	0.682	0.000	1.000
1714	109	4.9	2.365	0.300	306	0.428	0.120	0.651
1715	130	7.8	2.427	0.360	331	0.607	0.000	1.000
1716	119	4.6	2.418	0.331	312	0.609	0.000	1.000
1717	123	6.8	2.484	0.349	312	0.683	0.000	1.000
1718	135	7.4	2.439	0.378	313	0.643	0.000	1.000
1719	91	1.9	2.229	0.341	330	0.238	0.219	0.811
1720	128	5.1	2.455	0.320	313	0.592	0.003	1.000
1721	130	7.6	2.448	0.405	320 -	-	Coal	
1722	127	7.5	2.331	0.404	321 -	-	Coal	
1723	110	2.4	2.345	0.273	314	0.413	0.129	1.000
1724	140	9.6	2.479	0.340	318 -	-	Coal	
1725	111	8.5	2.291	0.466	344 -	-	Coal	
1726	142	6.6	2.487	0.343	307	0.711	0.000	1.000
1727	132	4.3	2.456	0.329	293	0.527	0.035	0.984
1728	60	1.5	2.226	0.303	325	0.103	0.240	0.882
1729	57	1.7	2.150	0.308	335	0.076	0.272	0.751
1730	55	1.5	2.175	0.280	334	0.104	0.252	0.839
1731	126	5.0	2.454	0.270	300	0.610	0.000	1.000
1732	136	8.5	2.507	0.329	314	0.763	0.000	1.000
1733	140	7.0	2.462	0.353	357 -	-	Coal	
1734	141	8.7	2.480	0.319	303 -	-	Coal	
1735	145	7.5	2.478	0.386	312	0.790	0.000	1.000
1736	110	6.7	2.560	0.303	259	0.583	0.002	1.000
1737	137	6.4	2.530	0.392	317	0.687	0.000	1.000
1738	129	6.9	2.521	0.303	292 -	-	Coal	
1739	138	6.4	2.431	0.394	333 -	-	Coal	
1740	122	4.4	2.491	0.288	318 -	-	Coal	
1741	141	7.3	2.425	0.419	351 -	-	Coal	
1742	127	9.5	1.883	0.554	444 -	-	Coal	
1743	131	8.6	2.026	0.645	421 -	-	Coal	
1744	55	1.6	2.200	0.268	242 -	-	Coal	
1745	104	9.0	2.355	0.471	257 -	-	Coal	
1746	133	5.4	2.500	0.295	231 -	-	Coal	
1747	104	2.5	2.131	0.309	297 -	-	Coal	
1748	136	2.7	1.483	0.507	440 -	-	Coal	
1749	115	4.9	1.602	0.633	416 -	-	Coal	
1750	147	9.4	2.061	0.506	395 -	-	Coal	
1751	156	5.2	2.179	0.644	435 -	-	Coal	

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
1752	147	6.5	2.552	0.337	258	-	-	Coal
1753	112	7.3	2.264	0.380	307	-	-	Coal
1754	135	5.9	2.540	0.246	262	-	-	Coal
1755	98	2.8	2.422	0.240	296	0.438	0.084	1.000
1756	96	2.4	2.382	0.272	299	0.402	0.129	1.000
1757	64	1.4	2.205	0.292	321	0.118	0.242	0.906
1758	70	1.5	2.209	0.267	317	0.078	0.245	0.871
1759	55	1.2	2.203	0.295	318	0.087	0.251	0.970
1760	58	1.2	2.207	0.277	316	0.086	0.244	0.981
1761	53	1.2	2.177	0.269	310	0.074	0.251	0.975
1762	52	1.1	2.198	0.269	317	0.071	0.247	0.996
1763	56	1.2	2.213	0.265	321	-	-	Coal
1764	98	1.6	2.092	0.484	369	-	-	Coal
1765	59	1.5	2.177	0.284	323	-	-	Coal
1766	68	1.7	2.282	0.288	318	0.175	0.213	0.902
1767	54	1.7	2.168	0.286	324	0.072	0.261	0.782
1768	60	1.5	2.260	0.280	323	0.150	0.220	0.955
1769	134	3.3	2.429	0.413	336	-	-	Coal
1770	73	5.5	1.817	0.781	411	-	-	Coal
1771	109	2.9	2.351	0.304	306	-	-	Coal
1772	121	4.2	2.427	0.292	292	0.547	0.024	1.000
1773	147	5.5	2.489	0.374	340	-	-	Coal
1774	48	9.3	1.336	0.879	448	-	-	Coal
1775	151	7.4	2.559	0.319	292	-	-	Coal
1776	157	7.1	2.244	0.421	408	-	-	Coal
1777	107	5.6	2.483	0.226	294	-	-	Coal
1778	125	5.4	2.213	0.529	287	-	-	Coal
1779	142	4.8	2.365	0.447	317	-	-	Coal
1780	133	6.2	2.581	0.284	265	-	-	Coal
1781	156	4.3	2.314	0.404	433	-	-	Coal
1782	168	6.6	2.368	0.364	350	-	-	Coal
1783	150	4.8	2.342	0.413	340	-	-	Coal
1784	128	5.1	2.470	0.282	295	-	-	Coal
1785	100	3.7	2.402	0.270	321	-	-	Coal
1786	90	9.3	1.766	0.630	354	-	-	Coal
1787	151	8.1	2.400	0.314	316	-	-	Coal
1788	164	6.0	2.542	0.409	289	-	-	Coal
1789	155	6.0	2.541	0.388	289	0.899	0.000	1.000
1790	107	2.1	2.328	0.273	311	0.321	0.156	0.997
1791	110	4.3	2.424	0.305	295	0.525	0.037	0.973
1792	107	4.1	2.406	0.316	286	-	-	Coal
1793	126	7.0	2.254	0.403	294	-	-	Coal
1794	128	6.6	2.544	0.313	216	-	-	Coal
1795	102	7.2	1.623	0.591	243	-	-	Coal
1796	42	9.4	1.455	0.712	415	-	-	Coal
1797	103	20.7	1.658	0.753	359	-	-	Coal
1798	139	6.4	2.497	0.362	302	-	-	Coal
1799	129	6.6	2.113	0.444	352	-	-	Coal
1800	122	5.7	2.549	0.294	270	-	-	Coal
1801	134	6.8	2.438	0.397	325	-	-	Coal

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE. frac
1802	112	3.8	2.475	0.272	250	-	-	Coal
1803	136	6.4	2.471	0.363	270	-	-	Coal
1804	70	5.5	1.869	0.640	353	-	-	Coal
1805	106	2.5	1.746	0.492	404	-	-	Coal
1806	132	6.4	2.548	0.269	270	-	-	Coal
1807	98	2.2	2.409	0.238	280	0.399	0.102	1.000
1808	81	1.3	2.303	0.268	310	0.207	0.183	1.000
1809	64	0.9	2.239	0.314	309	0.124	0.230	1.000
1810	64	1.0	2.279	0.264	303	0.137	0.207	1.000
1811	57	1.0	2.226	0.273	308	0.100	0.230	1.000
1812	53	0.9	2.191	0.277	321	0.070	0.252	1.000
1813	52	1.0	2.181	0.293	309	0.058	0.261	1.000
1814	59	1.0	2.258	0.286	287	0.099	0.221	1.000
1815	55	2.9	2.432	0.151	309	-	-	Coal
1816	132	4.8	2.085	0.686	353	-	-	Coal
1817	155	5.4	2.555	0.367	363	-	-	Coal
1818	148	6.2	2.575	0.359	295	0.884	0.000	1.000
1819	136	5.4	2.491	0.336	334	-	-	Coal
1820	146	3.0	2.447	0.504	317	-	-	Coal
1821	134	3.8	2.520	0.307	290	0.680	0.000	1.000
1822	130	3.7	2.507	0.265	296	0.668	0.000	1.000
1823	134	2.7	2.489	0.311	301	0.681	0.000	1.000
1824	132	4.3	2.713	0.285	264	0.733	0.000	1.000
1825	147	3.3	2.519	0.315	304	0.789	0.000	1.000
1826	121	2.1	2.427	0.337	310	0.554	0.023	1.000
1827	132	3.0	2.458	0.330	317	0.582	0.008	1.000
1828	118	2.3	2.417	0.310	313	0.474	0.073	1.000
1829	106	1.8	2.384	0.295	310	0.378	0.142	1.000
1830	93	1.5	2.346	0.273	318	0.311	0.162	1.000
1831	111	1.9	2.422	0.287	304	0.511	0.045	1.000
1832	127	4.6	2.571	0.338	297	0.746	0.000	1.000
1833	132	4.9	2.609	0.341	280	0.808	0.000	1.000
1834	134	4.7	2.552	0.344	303	0.787	0.000	1.000
1835	143	4.8	2.580	0.356	306	0.789	0.000	1.000
1836	137	4.0	2.548	0.407	315	0.836	0.000	1.000
1837	139	4.9	2.559	0.380	311	0.855	0.000	1.000
1838	154	4.9	2.570	0.411	311	0.916	0.000	1.000
1839	147	4.8	2.506	0.365	334	-	-	Coal
1840	113	4.9	1.910	0.651	353	-	-	Coal
1841	119	3.1	2.422	0.297	308	-	-	Coal
1842	126	3.9	2.474	0.353	314	0.681	0.000	1.000
1843	141	4.2	2.400	0.457	405	-	-	Coal
1844	90	9.7	2.065	0.545	347	-	-	Coal
1845	129	7.9	2.227	0.482	332	-	-	Coal
1846	108	4.4	2.275	0.313	358	-	-	Coal
1847	104	7.1	1.690	0.639	362	-	-	Coal
1848	116	5.6	2.452	0.326	300	-	-	Coal
1849	117	6.6	2.204	0.416	385	-	-	Coal
1850	93	12.0	1.528	0.756	494	-	-	Coal
1851	108	3.7	2.120	0.543	327	-	-	Coal

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE. frac
1852	81	1.4	2.272	0.309	311	0.194	0.204	1.000
1853	92	2.9	2.551	0.275	297	0.476	0.036	1.000
1854	123	3.8	2.501	0.310	313	0.652	0.000	1.000
1855	127	3.1	2.374	0.359	318	0.525	0.047	0.971
1856	109	3.5	2.287	0.313	352 -	-	Coal	
1857	108	2.9	2.366	0.279	323 -	-	Coal	
1858	110	4.3	2.164	0.322	419 -	-	Coal	
1859	87	11.9	1.568	0.630	361 -	-	Coal	
1860	121	3.0	2.401	0.284	302 -	-	Coal	
1861	123	2.8	2.391	0.303	312	0.507	0.050	1.000
1862	118	3.6	2.465	0.278	306	0.534	0.025	1.000
1863	145	5.6	2.488	0.400	354 -	-	Coal	
1864	77	3.0	1.876	0.469	317 -	-	Coal	
1865	98	1.7	2.378	0.296	303 -	-	Coal	
1866	107	2.4	2.433	0.281	307	0.509	0.045	1.000
1867	102	2.0	2.411	0.281	298	0.415	0.108	1.000
1868	128	3.6	2.408	0.415	398 -	-	Coal	
1869	83	6.7	1.380	0.868	413 -	-	Coal	
1870	142	4.8	2.072	0.496	360 -	-	Coal	
1871	133	4.5	2.374	0.339	311 -	-	Coal	
1872	132	5.6	2.538	0.259	278	0.680	0.000	1.000
1873	118	4.1	2.466	0.269	291	0.586	0.004	1.000
1874	134	5.6	2.532	0.265	304	0.692	0.000	1.000
1875	120	4.0	2.437	0.287	289	0.510	0.041	1.000
1876	102	4.5	2.579	0.296	252	0.531	0.009	1.000
1877	112	2.3	2.419	0.252	283	0.461	0.064	1.000
1878	87	24.0	2.722	0.104	207	0.413	0.001	1.000
1879	70	6.5	2.650	0.081	267	0.308	0.001	1.000
1880	90	1.2	2.311	0.284	312	0.272	0.182	1.000
1881	79	1.2	2.331	0.277	311	0.272	0.177	1.000
1882	77	1.1	2.287	0.278	318	0.189	0.205	1.000
1883	68	1.0	2.223	0.287	323	0.099	0.238	1.000
1884	69	0.8	2.191	0.275	317	0.125	0.236	1.000
1885	101	2.0	2.366	0.274	312	0.402	0.140	1.000
1886	92	5.3	1.906	0.427	465 -	-	Coal	
1887	86	11.0	1.553	0.702	401 -	-	Coal	
1888	92	2.8	2.397	0.301	320 -	-	Coal	
1889	116	5.2	2.435	0.289	450 -	-	Coal	
1890	113	7.0	1.598	0.928	361 -	-	Coal	
1891	102	2.5	2.393	0.286	301 -	-	Coal	
1892	130	4.4	2.472	0.308	311	0.580	0.007	1.000
1893	141	4.5	2.467	0.436	327	0.742	0.000	1.000
1894	106	2.2	2.333	0.339	314	0.411	0.151	0.923
1895	96	2.7	2.560	0.250	291	0.527	0.015	1.000
1896	131	4.3	2.502	0.322	323	0.774	0.000	1.000
1897	145	4.2	2.497	0.421	355 -	-	Coal	
1898	113	7.3	2.301	0.418	356 -	-	Coal	
1899	96	2.4	2.247	0.383	308 -	-	Coal	
1900	135	3.6	2.450	0.311	319	0.587	0.006	1.000
1901	145	4.8	2.102	0.524	399 -	-	Coal	

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
1902	130	5.3	2.413	0.407	305	-	-	Coal
1903	118	3.8	2.459	0.277	288	0.508	0.037	1.000
1904	109	1.7	2.367	0.261	305	0.395	0.129	1.000
1905	123	4.3	2.453	0.296	287	-	-	Coal
1906	111	6.6	1.629	0.560	371	-	-	Coal
1907	116	6.3	2.187	0.420	355	-	-	Coal
1908	135	3.6	1.620	0.411	342	-	-	Coal
1909	128	5.8	2.560	0.281	283	-	-	Coal
1910	138	4.8	2.553	0.332	295	0.721	0.000	1.000
1911	127	5.5	2.550	0.275	279	0.606	0.000	1.000
1912	121	4.7	2.551	0.241	281	0.590	0.001	1.000
1913	104	3.1	2.496	0.282	279	0.484	0.044	1.000
1914	85	1.1	2.313	0.274	314	0.247	0.178	1.000
1915	69	0.9	2.285	0.270	316	0.184	0.202	1.000
1916	78	1.1	2.337	0.253	313	0.221	0.173	1.000
1917	64	1.0	2.277	0.305	280	0.141	0.208	1.000
1918	88	4.0	2.491	0.283	283	0.514	0.031	1.000
1919	101	2.4	2.414	0.294	308	-	-	Coal
1920	128	7.4	2.291	0.435	326	-	-	Coal
1921	118	8.5	1.891	0.597	393	-	-	Coal
1922	84	2.1	2.344	0.270	303	-	-	Coal
1923	84	2.8	2.508	0.276	289	0.416	0.074	1.000
1924	130	4.4	2.496	0.311	317	0.649	0.000	1.000
1925	118	7.6	1.886	0.416	405	-	-	Coal
1926	94	2.6	2.381	0.274	306	-	-	Coal
1927	113	4.0	2.447	0.292	308	-	-	Coal
1928	129	5.3	2.434	0.350	361	-	-	Coal
1929	115	3.3	2.377	0.424	307	-	-	Coal
1930	111	2.6	2.432	0.353	313	0.552	0.024	1.000
1931	134	4.4	2.502	0.392	322	0.763	0.000	1.000
1932	111	2.5	2.455	0.322	302	0.485	0.056	1.000
1933	146	4.9	2.522	0.383	322	0.731	0.000	1.000
1934	139	4.8	2.496	0.398	328	0.690	0.000	1.000
1935	116	5.5	2.571	0.289	292	0.708	0.000	1.000
1936	145	4.7	2.507	0.387	330	0.840	0.000	1.000
1937	139	5.5	2.491	0.336	319	0.796	0.000	1.000
1938	121	4.5	2.429	0.299	326	-	-	Coal
1939	108	6.4	1.825	0.459	385	-	-	Coal
1940	94	1.7	2.370	0.277	306	-	-	Coal
1941	122	3.4	2.476	0.270	300	0.602	0.000	1.000
1942	133	4.3	2.486	0.326	312	-	-	Coal
1943	117	3.6	2.405	0.337	313	-	-	Coal
1944	132	4.4	2.455	0.298	293	0.609	0.000	1.000
1945	112	2.7	2.445	0.265	289	0.543	0.020	1.000
1946	120	2.3	2.453	0.250	286	0.544	0.017	1.000
1947	152	1.8	2.400	0.260	297	0.604	0.000	1.000
1948	172	1.4	2.363	0.268	300	0.657	0.000	1.000
1949	120	1.4	2.365	0.259	298	0.404	0.110	1.000
1950	88	1.4	2.361	0.295	301	0.390	0.138	1.000
1951	92	1.3	2.337	0.286	305	0.325	0.156	1.000

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
1952	76	1.3	2.284	0.312	310	0.246	0.188	1.000
1953	64	1.0	2.262	0.250	324 -	-	Coal	
1954	143	6.3	2.322	0.412	333 -	-	Coal	
1955	124	6.8	1.990	0.440	404 -	-	Coal	
1956	74	12.6	1.403	0.751	470 -	-	Coal	
1957	128	7.1	2.420	0.395	324 -	-	Coal	
1958	111	2.5	2.390	0.286	305	0.457	0.082	1.000
1959	126	4.5	2.506	0.313	316	0.605	0.000	1.000
1960	133	5.7	2.487	0.366	315 -	-	Coal	
1961	124	6.8	2.130	0.453	358 -	-	Coal	
1962	120	5.0	2.472	0.292	307 -	-	Coal	
1963	109	5.7	2.355	0.387	308 -	-	Coal	
1964	92	2.2	2.429	0.277	298	0.378	0.116	1.000
1965	116	4.4	2.618	0.338	305	0.630	0.000	1.000
1966	144	5.2	2.524	0.376	314	0.710	0.000	1.000
1967	106	2.6	2.416	0.299	303	0.414	0.113	1.000
1968	88	1.9	2.389	0.282	300	0.393	0.129	1.000
1969	107	2.8	2.438	0.266	300	0.456	0.063	1.000
1970	116	3.2	2.509	0.317	301	0.628	0.000	1.000
1971	138	5.9	2.533	0.324	307	0.791	0.000	1.000
1972	132	6.1	2.475	0.415	351 -	-	Coal	
1973	120	7.2	2.069	0.379	393 -	-	Coal	
1974	104	4.3	2.214	0.422	319 -	-	Coal	
1975	117	2.8	2.429	0.261	301 -	-	Coal	
1976	102	2.2	2.475	0.270	291	0.479	0.047	1.000
1977	121	2.7	2.495	0.288	300	0.621	0.000	1.000
1978	129	3.9	2.479	0.335	303	0.707	0.000	1.000
1979	137	4.8	2.530	0.349	312	0.718	0.000	1.000
1980	118	5.5	2.560	0.383	306	0.717	0.000	1.000
1981	134	5.4	2.533	0.353	310	0.778	0.000	1.000
1982	135	5.5	2.557	0.388	313	0.805	0.000	1.000
1983	146	5.1	2.538	0.392	310	0.779	0.000	1.000
1984	144	5.5	2.648	0.414	300	0.874	0.000	1.000
1985	130	6.3	2.561	0.330	287	0.799	0.000	1.000
1986	136	5.4	2.546	0.369	315	0.802	0.000	1.000
1987	137	5.8	2.532	0.401	318	0.793	0.000	1.000
1988	145	6.2	2.488	0.369	340 -	-	Coal	
1989	102	3.1	2.386	0.355	313 -	-	Coal	
1990	102	4.2	2.587	0.266	286	0.544	0.006	1.000
1991	122	5.0	2.527	0.286	298	0.654	0.000	1.000
1992	129	4.6	2.527	0.306	300	0.632	0.000	1.000
1993	116	2.8	2.453	0.264	294	0.492	0.044	1.000
1994	118	5.2	2.566	0.295	308	0.672	0.000	1.000
1995	134	5.0	2.536	0.370	316	0.729	0.000	1.000
1996	121	4.9	2.566	0.294	273	0.598	0.000	1.000
1997	139	5.1	2.545	0.320	310	0.677	0.000	1.000
1998	139	5.1	2.556	0.382	307	0.788	0.000	1.000
1999	138	5.3	2.538	0.355	324	0.813	0.000	1.000
2000	131	4.9	2.527	0.356	305	0.798	0.000	1.000
2001	138	5.4	2.573	0.351	304	0.854	0.000	1.000

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2002	142	5.3	2.490	0.402	328	0.709	0.000	1.000
2003	128	5.4	2.494	0.369	291	0.561	0.016	1.000
2004	133	5.5	2.498	0.352	328	0.647	0.000	1.000
2005	141	5.7	2.504	0.363	322 -	-	Coal	
2006	88	2.8	2.449	0.313	294 -	-	Coal	
2007	116	3.8	2.505	0.286	299	0.519	0.027	1.000
2008	133	5.7	2.556	0.347	315	0.733	0.000	1.000
2009	137	5.4	2.528	0.371	315	0.722	0.000	1.000
2010	134	5.7	2.480	0.376	333 -	-	Coal	
2011	97	1.8	2.411	0.244	297 -	-	Coal	
2012	110	2.4	2.430	0.270	294	0.515	0.035	1.000
2013	110	3.1	2.533	0.296	300	0.653	0.000	1.000
2014	141	5.5	2.528	0.327	290	0.752	0.000	1.000
2015	136	6.0	2.537	0.345	286	0.740	0.000	1.000
2016	136	6.4	2.553	0.289	314	0.704	0.000	1.000
2017	150	5.7	2.546	0.393	318	0.742	0.000	1.000
2018	148	6.0	2.549	0.367	330 -	-	Coal	
2019	95	8.2	1.548	0.625	438 -	-	Coal	
2020	87	6.9	1.548	0.534	375 -	-	Coal	
2021	97	1.6	2.364	0.268	299 -	-	Coal	
2022	124	3.6	2.469	0.281	282	0.599	0.000	1.000
2023	131	3.8	2.525	0.291	301	0.647	0.000	1.000
2024	85	1.7	2.399	0.259	297	0.394	0.113	1.000
2025	126	3.0	2.468	0.280	301	0.574	0.009	1.000
2026	89	1.7	2.381	0.310	296 -	-	Coal	
2027	79	4.0	2.548	0.120	275 -	-	Coal	
2028	99	3.8	2.467	0.238	289	0.432	0.074	1.000
2029	134	5.2	2.541	0.344	306	0.707	0.000	1.000
2030	134	5.6	2.522	0.349	308	0.700	0.000	1.000
2031	135	5.7	2.530	0.345	305	0.674	0.000	1.000
2032	141	5.8	2.496	0.365	311	0.753	0.000	1.000
2033	140	5.8	2.545	0.320	301	0.724	0.000	1.000
2034	137	5.4	2.531	0.328	304	0.704	0.000	1.000
2035	129	5.9	2.576	0.385	276	0.743	0.000	1.000
2036	135	5.1	2.513	0.327	318	0.726	0.000	1.000
2037	115	7.2	2.137	0.416	404 -	-	Coal	
2038	122	8.1	2.430	0.364	300 -	-	Coal	
2039	127	8.3	2.531	0.259	315 -	-	Coal	
2040	107	7.6	2.009	0.548	315 -	-	Coal	
2041	99	2.5	2.428	0.262	287 -	-	Coal	
2042	131	6.6	2.523	0.345	303	0.742	0.000	1.000
2043	129	6.1	2.513	0.343	318	0.801	0.000	1.000
2044	123	6.1	2.533	0.345	289	0.734	0.000	1.000
2045	141	5.8	2.562	0.322	309	0.816	0.000	1.000
2046	145	6.2	2.553	0.381	318	0.754	0.000	1.000
2047	138	6.6	2.544	0.395	324	0.753	0.000	1.000
2048	137	6.8	2.534	0.380	321 -	-	Coal	
2049	80	13.4	1.534	0.544	432 -	-	Coal	
2050	139	5.0	2.510	0.383	310 -	-	Coal	
2051	134	5.0	2.471	0.332	313	0.636	0.000	1.000

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2052	93	1.2	2.367	0.249	296	0.296	0.139	1.000
2053	80	1.1	2.338	0.217	294	0.237	0.140	1.000
2054	125	2.7	2.527	0.249	285	0.614	0.000	1.000
2055	126	3.6	2.499	0.264	291	0.621	0.000	1.000
2056	125	4.3	2.478	0.290	294	0.566	0.011	1.000
2057	128	5.3	2.518	0.307	299	0.681	0.000	1.000
2058	79	1.8	2.392	0.259	291	0.301	0.135	1.000
2059	127	3.7	2.451	0.296	298	0.607	0.000	1.000
2060	88	1.7	2.350	0.259	306	0.317	0.146	1.000
2061	115	3.1	2.330	0.341	318 -	-	Coal	
2062	83	1.4	2.354	0.258	299 -	-	Coal	
2063	119	3.5	2.431	0.254	317	0.539	0.026	1.000
2064	125	3.8	2.439	0.301	299	0.603	0.000	1.000
2065	97	5.4	2.558	0.182	288	0.517	0.007	1.000
2066	111	3.9	2.452	0.318	303	0.573	0.012	1.000
2067	128	6.0	2.504	0.388	314	0.768	0.000	1.000
2068	84	1.6	2.346	0.249	293	0.257	0.149	1.000
2069	91	2.4	2.431	0.294	287	0.413	0.104	1.000
2070	125	3.3	2.462	0.296	296	0.562	0.015	1.000
2071	114	4.4	2.538	0.363	296	0.588	0.004	1.000
2072	94	2.3	2.408	0.273	290	0.364	0.124	1.000
2073	114	2.5	2.404	0.306	320 -	-	Coal	
2074	119	8.1	2.357	0.507	295 -	-	Coal	
2075	117	1.8	2.360	0.260	292	0.382	0.117	1.000
2076	129	3.9	2.447	0.283	288	0.614	0.000	1.000
2077	129	6.2	2.494	0.350	316	0.701	0.000	1.000
2078	132	6.1	2.515	0.338	302	0.700	0.000	1.000
2079	142	5.1	2.473	0.376	315	0.754	0.000	1.000
2080	99	2.7	2.599	0.300	283	0.558	0.006	1.000
2081	87	9.0	2.671	0.162	252	0.370	0.001	1.000
2082	122	5.0	2.506	0.362	305	0.682	0.000	1.000
2083	122	4.3	2.505	0.391	308	0.672	0.000	1.000
2084	103	2.2	2.403	0.348	297	0.414	0.127	1.000
2085	109	2.6	2.438	0.287	292	0.468	0.070	1.000
2086	125	3.5	2.472	0.366	297	0.658	0.000	1.000
2087	91	2.3	2.450	0.249	279	0.379	0.100	1.000
2088	135	4.3	2.522	0.318	299	0.790	0.000	1.000
2089	133	5.6	2.529	0.318	287	0.738	0.000	1.000
2090	121	3.4	2.468	0.313	302	0.675	0.000	1.000
2091	130	7.5	2.527	0.418	298	0.792	0.000	1.000
2092	134	7.2	2.485	0.379	318	0.722	0.000	1.000
2093	130	8.1	2.526	0.374	296 -	-	Coal	
2094	129	5.9	2.306	0.393	298 -	-	Coal	
2095	123	2.8	2.451	0.286	292	0.480	0.053	1.000
2096	105	2.3	2.404	0.244	294	0.373	0.116	1.000
2097	101	2.6	2.502	0.291	286	0.485	0.043	1.000
2098	127	3.3	2.477	0.266	292	0.519	0.030	1.000
2099	120	4.5	2.516	0.332	299	0.593	0.002	1.000
2100	131	7.1	2.532	0.372	302	0.612	0.000	1.000
2101	133	6.4	2.530	0.355	304	0.654	0.000	1.000

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2102	141	7.0	2.517	0.375	305	0.702	0.000	1.000
2103	85	1.6	2.368	0.241	296	0.297	0.141	1.000
2104	128	5.6	2.530	0.308	284	0.726	0.000	1.000
2105	127	3.8	2.491	0.282	287	0.617	0.000	1.000
2106	81	1.5	2.357	0.223	287	0.254	0.145	1.000
2107	109	5.2	2.614	0.231	234	0.622	0.000	1.000
2108	117	3.8	2.464	0.271	294	0.560	0.013	1.000
2109	140	6.2	2.516	0.331	299	0.677	0.000	1.000
2110	129	6.7	2.629	0.314	288	0.662	0.000	1.000
2111	135	6.6	2.511	0.375	304	0.659	0.000	1.000
2112	133	7.2	2.525	0.380	314	0.607	0.000	1.000
2113	127	7.4	2.513	0.340	301	0.566	0.012	1.000
2114	124	7.6	2.506	0.389	300	0.604	0.000	1.000
2115	128	7.6	2.509	0.369	308	0.657	0.000	1.000
2116	137	6.8	2.537	0.339	309	0.763	0.000	1.000
2117	133	8.0	2.497	0.397	311	0.769	0.000	1.000
2118	129	7.1	2.502	0.367	308	0.759	0.000	1.000
2119	131	7.5	2.488	0.406	307	0.686	0.000	1.000
2120	109	6.8	2.516	0.279	287	0.616	0.000	1.000
2121	123	9.0	2.591	0.326	293	0.736	0.000	1.000
2122	132	7.3	2.552	0.334	299	0.761	0.000	1.000
2123	141	7.1	2.500	0.353	313	0.841	0.000	1.000
2124	135	7.7	2.509	0.379	305	0.713	0.000	1.000
2125	123	6.5	2.491	0.300	292	0.660	0.000	1.000
2126	134	5.2	2.488	0.319	292	0.705	0.000	1.000
2127	123	5.2	2.504	0.283	285	0.606	0.000	1.000
2128	130	6.8	2.505	0.332	283	0.600	0.000	1.000
2129	127	8.0	2.643	0.301	280	0.658	0.000	1.000
2130	133	7.4	2.487	0.438	320	0.724	0.000	1.000
2131	140	7.4	2.539	0.391	303	0.771	0.000	1.000
2132	146	7.6	2.503	0.384	309	0.729	0.000	1.000
2133	138	6.2	2.490	0.328	302 -	-	Coal	
2134	113	4.9	2.321	0.364	299 -	-	Coal	
2135	88	2.0	2.376	0.242	294	0.311	0.135	1.000
2136	117	3.6	2.439	0.303	304	0.589	0.004	1.000
2137	115	3.7	2.461	0.317	295	0.539	0.028	0.995
2138	91	4.2	2.687	0.179	263	0.430	0.001	1.000
2139	148	6.8	2.552	0.364	308	0.872	0.000	1.000
2140	107	3.4	2.483	0.286	301	0.516	0.033	1.000
2141	131	7.4	2.532	0.360	300	0.714	0.000	1.000
2142	128	7.0	2.574	0.348	301	0.690	0.000	1.000
2143	139	7.3	2.526	0.274	290	0.676	0.000	1.000
2144	139	8.0	2.528	0.383	299	0.765	0.000	1.000
2145	119	4.1	2.521	0.271	280	0.575	0.005	1.000
2146	110	2.1	2.408	0.245	283	0.360	0.113	1.000
2147	117	4.5	2.495	0.250	284	0.532	0.020	1.000
2148	93	1.7	2.408	0.288	285	0.390	0.125	1.000
2149	102	4.1	2.488	0.231	277	0.506	0.027	1.000
2150	144	7.5	2.501	0.321	302	0.737	0.000	1.000
2151	124	4.6	2.505	0.337	291	0.588	0.004	1.000

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE. frac
2152	121	5.2	2.540	0.296	292	0.649	0.000	1.000
2153	103	3.0	2.396	0.312	299	0.362	0.143	0.854
2154	95	2.1	2.405	0.260	311 -	-		Coal
2155	138	11.3	2.393	0.388	300 -	-		Coal
2156	126	4.8	2.426	0.320	302	0.610	0.000	1.000
2157	95	2.3	2.415	0.221	286	0.362	0.099	1.000
2158	125	5.3	2.498	0.255	283	0.610	0.000	1.000
2159	73	1.5	2.405	0.252	283	0.291	0.130	1.000
2160	102	3.4	2.515	0.241	281	0.514	0.022	1.000
2161	124	3.3	2.496	0.315	296	0.710	0.000	1.000
2162	128	4.7	2.485	0.366	288	0.736	0.000	1.000
2163	129	3.0	2.441	0.265	288	0.545	0.018	1.000
2164	103	1.9	2.377	0.242	287	0.332	0.121	1.000
2165	115	3.1	2.433	0.266	302 -	-		Coal
2166	108	11.8	2.396	0.466	307 -	-		Coal
2167	86	1.7	2.358	0.230	297	0.289	0.142	1.000
2168	119	3.0	2.450	0.270	292	0.525	0.029	1.000
2169	110	3.8	2.461	0.269	284	0.519	0.029	1.000
2170	118	5.2	2.511	0.296	285	0.608	0.000	1.000
2171	131	8.7	2.477	0.428	325 -	-		Coal
2172	83	2.7	2.398	0.231	282 -	-		Coal
2173	95	2.8	2.432	0.205	288	0.320	0.109	1.000
2174	125	5.9	2.514	0.292	287	0.645	0.000	1.000
2175	107	2.4	2.412	0.268	299	0.399	0.118	1.000
2176	86	3.5	2.582	0.184	232	0.370	0.033	1.000
2177	116	4.3	2.503	0.270	294	0.567	0.010	1.000
2178	100	2.9	2.448	0.243	283	0.361	0.103	1.000
2179	130	6.1	2.513	0.302	281	0.667	0.000	1.000
2180	90	2.3	2.444	0.204	265	0.324	0.097	1.000
2181	101	4.5	2.534	0.238	276	0.471	0.031	1.000
2182	128	6.1	2.538	0.302	293	0.705	0.000	1.000
2183	133	4.5	2.486	0.294	289	0.643	0.000	1.000
2184	128	7.4	2.476	0.344	334 -	-		Coal
2185	82	2.1	2.397	0.240	289 -	-		Coal
2186	72	1.8	2.394	0.217	289	0.256	0.136	1.000
2187	93	2.3	2.423	0.218	285	0.323	0.110	1.000
2188	79	2.0	2.394	0.231	287	0.286	0.131	1.000
2189	77	5.3	2.640	0.219	251	0.458	0.007	1.000
2190	92	2.6	2.440	0.242	286	0.310	0.120	1.000
2191	85	2.6	2.408	0.211	289 -	-		Coal
2192	96	2.2	2.178	0.374	323 -	-		Coal
2193	138	6.4	2.489	0.299	298 -	-		Coal
2194	87	2.3	2.425	0.216	288	0.357	0.104	1.000
2195	122	4.5	2.514	0.277	295	0.715	0.000	1.000
2196	98	3.0	2.479	0.236	271	0.465	0.044	1.000
2197	105	2.7	2.452	0.210	275	0.406	0.068	1.000
2198	97	2.6	2.485	0.256	282	0.520	0.026	1.000
2199	101	2.9	2.474	0.229	280	0.460	0.046	1.000
2200	117	3.0	2.534	0.254	268	0.596	0.001	1.000
2201	102	2.5	2.428	0.240	282	0.404	0.089	1.000

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2202	118	5.0	2.509	0.256	284	0.589	0.002	1.000
2203	129	6.0	2.521	0.323	310	0.655	0.000	1.000
2204	101	3.7	2.438	0.246	272	0.418	0.084	1.000
2205	128	4.9	2.495	0.275	284	0.601	0.000	1.000
2206	130	7.0	2.520	0.309	287	0.664	0.000	1.000
2207	128	7.4	2.535	0.276	295	0.692	0.000	1.000
2208	89	2.1	2.407	0.231	287	0.332	0.118	1.000
2209	101	2.9	2.486	0.242	288	0.491	0.039	1.000
2210	96	2.3	2.399	0.233	280	0.313	0.123	1.000
2211	81	3.5	2.628	0.105	266	0.368	0.001	1.000
2212	115	6.5	2.494	0.302	284	0.598	0.001	1.000
2213	145	8.6	2.506	0.377	286	0.762	0.000	1.000
2214	132	9.7	2.601	0.290	278	0.749	0.000	1.000
2215	129	8.8	2.533	0.326	304 -	-	Coal	
2216	97	3.7	2.365	0.279	292 -	-	Coal	
2217	133	7.1	2.548	0.334	305	0.722	0.000	1.000
2218	123	4.3	2.441	0.296	284	0.556	0.017	1.000
2219	108	2.2	2.391	0.235	283	0.353	0.107	1.000
2220	85	3.7	2.601	0.264	270	0.525	0.007	1.000
2221	113	5.0	2.467	0.256	276	0.518	0.026	1.000
2222	134	7.0	2.546	0.302	303	0.702	0.000	1.000
2223	124	6.9	2.528	0.309	288 -	-	Coal	
2224	133	9.6	2.475	0.405	298 -	-	Coal	
2225	88	2.5	2.357	0.222	286 -	-	Coal	
2226	112	5.7	2.433	0.235	288	0.452	0.059	0.949
2227	131	4.8	2.440	0.253	283	0.512	0.028	1.000
2228	101	3.4	2.404	0.212	272	0.323	0.094	1.000
2229	98	5.4	2.636	0.256	254	0.544	0.000	1.000
2230	139	8.9	2.567	0.360	302	0.822	0.000	1.000
2231	119	8.6	2.330	0.337	322 -	-	Coal	
2232	89	2.7	2.415	0.213	284 -	-	Coal	
2233	91	3.7	2.506	0.193	266	0.376	0.065	1.000
2234	122	6.0	2.511	0.262	284	0.627	0.000	1.000
2235	118	8.6	2.514	0.281	281	0.654	0.000	1.000
2236	124	8.6	2.551	0.292	294	0.723	0.000	1.000
2237	126	9.8	2.472	0.423	307	0.700	0.000	1.000
2238	130	9.2	2.515	0.316	280	0.664	0.000	1.000
2239	110	10.5	2.544	0.261	269	0.592	0.001	1.000
2240	142	9.0	2.550	0.316	295	0.745	0.000	1.000
2241	142	9.2	2.443	0.449	312	0.800	0.000	1.000
2242	132	8.8	2.432	0.431	291	0.683	0.000	1.000
2243	110	6.9	2.478	0.291	275	0.560	0.012	1.000
2244	124	9.5	2.511	0.334	286	0.675	0.000	1.000
2245	138	10.1	2.560	0.340	286	0.740	0.000	1.000
2246	109	10.7	2.301	0.387	406 -	-	Coal	
2247	107	9.0	2.436	0.332	281 -	-	Coal	
2248	112	8.3	2.447	0.247	285	0.488	0.041	0.959
2249	138	12.4	2.555	0.346	323 -	-	Coal	
2250	90	11.2	1.408	0.804	365 -	-	Coal	
2251	77	2.5	2.455	0.210	281 -	-	Coal	

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2252	94	3.3	2.435	0.207	283	0.359	0.094	1.000
2253	137	10.3	2.514	0.351	300 -	-	Coal	
2254	117	6.9	2.476	0.265	276 -	-	Coal	
2255	109	3.8	2.460	0.235	275	0.434	0.065	1.000
2256	85	1.8	2.358	0.190	293	0.173	0.140	1.000
2257	77	1.6	2.357	0.219	280	0.202	0.152	1.000
2258	93	3.8	2.477	0.229	278	0.424	0.065	1.000
2259	104	4.3	2.565	0.214	275	0.562	0.004	1.000
2260	108	6.3	2.772	0.229	267	0.609	0.000	1.000
2261	126	9.6	2.543	0.339	278	0.750	0.000	1.000
2262	127	9.1	2.520	0.271	291	0.671	0.000	1.000
2263	129	10.2	2.524	0.274	265	0.685	0.000	1.000
2264	116	6.3	2.518	0.234	263	0.546	0.009	1.000
2265	105	10.8	2.611	0.246	222	0.614	0.000	1.000
2266	98	5.0	2.477	0.256	278	0.474	0.044	1.000
2267	107	9.6	2.538	0.269	276	0.618	0.000	1.000
2268	120	7.3	2.625	0.284	269	0.675	0.000	1.000
2269	119	9.6	2.535	0.242	273	0.610	0.000	1.000
2270	120	9.8	2.544	0.273	277	0.699	0.000	1.000
2271	94	16.0	1.837	0.527	408 -	-	Coal	
2272	102	2.8	2.378	0.218	294 -	-	Coal	
2273	105	5.2	2.551	0.269	276	0.606	0.000	1.000
2274	98	13.2	2.599	0.224	249	0.530	0.000	1.000
2275	115	7.7	2.549	0.260	283	0.630	0.000	1.000
2276	134	9.3	2.538	0.291	285	0.656	0.000	1.000
2277	129	10.0	2.525	0.326	293	0.640	0.000	1.000
2278	137	11.3	2.474	0.445	319 -	-	Coal	
2279	121	7.0	2.468	0.427	298 -	-	Coal	
2280	94	2.5	2.421	0.218	283	0.352	0.099	1.000
2281	114	4.6	2.509	0.226	277	0.535	0.014	1.000
2282	89	2.4	2.450	0.227	283	0.393	0.094	1.000
2283	82	1.6	2.397	0.221	291	0.313	0.107	1.000
2284	82	2.2	2.375	0.220	279	0.227	0.139	1.000
2285	96	3.3	2.408	0.224	261	0.326	0.107	1.000
2286	82	50.9	2.672	0.111	245	0.389	0.001	1.000
2287	126	6.1	2.483	0.238	285	0.565	0.008	1.000
2288	110	6.1	2.529	0.276	278	0.620	0.000	1.000
2289	115	5.9	2.474	0.267	287	0.584	0.005	1.000
2290	119	3.9	2.420	0.254	300 -	-	Coal	
2291	46	26.1	1.267	0.777	469 -	-	Coal	
2292	107	34.8	1.989	0.521	430 -	-	Coal	
2293	120	6.5	2.486	0.324	286 -	-	Coal	
2294	115	9.7	2.539	0.287	260 -	-	Volcanics	
2295	52	9.2	2.739	0.278	222 -	-	Volcanics	
2296	52	6.3	2.589	0.321	256 -	-	Volcanics	
2297	58	5.4	2.570	0.341	255 -	-	Volcanics	
2298	48	5.5	2.538	0.302	255 -	-	Volcanics	
2299	51	4.3	2.506	0.336	257 -	-	Volcanics	
2300	59	12.7	2.506	0.341	317 -	-	Coal	
2301	92	22.3	1.785	0.426	366 -	-	Coal	

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2302	105	16.0	2.332	0.451	369	-	-	Coal
2303	120	12.6	2.445	0.368	303	-	-	Coal
2304	133	14.3	2.383	0.412	317	-	-	Coal
2305	130	11.7	2.351	0.440	328	-	-	Coal
2306	130	10.0	2.476	0.354	302	-	-	Coal
2307	127	10.4	2.491	0.324	301	0.702	0.000	1.000
2308	130	10.5	2.484	0.344	290	0.693	0.000	1.000
2309	121	11.0	2.518	0.311	287	0.685	0.000	1.000
2310	119	11.8	2.504	0.242	303	0.568	0.005	1.000
2311	107	12.1	2.558	0.254	292	0.622	0.000	1.000
2312	100	11.1	2.539	0.182	268	0.486	0.003	1.000
2313	93	11.0	2.512	0.151	265	0.334	0.031	1.000
2314	106	13.1	2.510	0.270	274	0.554	0.007	1.000
2315	113	13.1	2.496	0.231	271	0.486	0.019	1.000
2316	122	14.2	2.472	0.354	267	0.626	0.000	1.000
2317	112	11.5	2.532	0.201	266	0.486	0.013	1.000
2318	121	10.9	2.470	0.296	280	0.551	0.016	1.000
2319	118	11.8	2.491	0.334	278	0.640	0.000	1.000
2320	102	11.9	2.513	0.271	264	0.557	0.009	1.000
2321	105	12.5	2.569	0.284	267	0.609	0.000	1.000
2322	94	14.2	2.547	0.342	246	0.471	0.039	0.955
2323	85	13.1	2.621	0.372	254	-	-	Coal
2324	100	12.5	2.561	0.186	251	0.505	0.003	1.000
2325	102	7.7	2.526	0.207	247	0.463	0.026	1.000
2326	115	8.4	2.467	0.227	222	0.491	0.031	0.999
2327	122	12.4	2.581	0.290	174	0.698	0.000	1.000
2328	117	11.1	1.828	0.380	200	-	-	Coal
2329	94	38.2	1.637	0.622	267	-	-	Coal
2330	93	31.9	1.816	0.476	326	-	-	Coal
2331	106	13.4	2.507	0.375	327	-	-	Coal
2332	110	8.6	2.435	0.315	316	-	-	Coal
2333	124	15.0	2.555	0.290	282	-	-	Coal
2334	127	10.7	2.338	0.456	300	-	-	Coal
2335	132	9.2	2.532	0.294	279	0.708	0.000	1.000
2336	120	5.3	2.505	0.259	300	0.578	0.005	1.000
2337	105	6.4	2.585	0.268	270	0.588	0.001	1.000
2338	117	7.5	2.487	0.267	288	0.565	0.010	0.965
2339	124	7.5	2.511	0.276	285	0.594	0.001	1.000
2340	118	11.6	2.512	0.269	260	-	-	Coal
2341	126	12.2	2.560	0.223	272	-	-	Coal
2342	115	14.6	2.353	0.409	327	-	-	Coal
2343	118	12.3	2.654	0.291	267	-	-	Coal
2344	122	8.5	2.505	0.367	273	0.668	0.000	1.000
2345	128	11.6	2.590	0.378	289	0.813	0.000	1.000
2346	124	15.6	2.275	0.246	332	-	-	Coal
2347	101	19.6	1.722	0.512	320	-	-	Coal
2348	121	10.5	2.521	0.213	280	-	-	Coal
2349	118	12.0	2.491	0.300	212	0.566	0.009	1.000
2350	97	20.6	1.991	0.482	304	-	-	Coal
2351	107	18.0	1.777	0.476	218	-	-	Coal

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2352	115	12.9	2.650	0.337	276 -	-	Coal	
2353	128	12.4	2.519	0.286	274	0.652	0.000	1.000
2354	132	12.9	2.540	0.300	275	0.698	0.000	1.000
2355	138	11.4	2.554	0.376	296	0.755	0.000	1.000
2356	134	12.9	2.523	0.348	276	0.712	0.000	1.000
2357	122	16.1	2.561	0.296	268	0.693	0.000	1.000
2358	125	17.2	2.570	0.254	265	0.681	0.000	1.000
2359	131	17.8	2.565	0.285	275	0.750	0.000	1.000
2360	131	19.5	2.590	0.307	270	0.822	0.000	1.000
2361	140	18.2	2.585	0.317	264 -	-	Coal	
2362	133	19.4	2.597	0.221	250 -	-	Coal	
2363	117	19.3	2.568	0.196	250	0.601	0.000	1.000
2364	94	11.9	2.534	0.165	259	0.415	0.022	1.000
2365	134	19.6	2.580	0.296	264	0.788	0.000	1.000
2366	103	6.1	2.474	0.221	286	0.417	0.066	0.942
2367	122	9.2	2.587	0.286	277	0.676	0.000	0.923
2368	91	5.0	2.454	0.200	263	0.324	0.081	1.000
2369	123	17.0	2.540	0.246	271	0.629	0.000	1.000
2370	136	16.9	2.572	0.286	272	0.775	0.000	1.000
2371	118	16.7	2.584	0.301	269	0.697	0.000	1.000
2372	128	15.5	2.574	0.312	327 -	-	Coal	
2373	116	10.1	2.518	0.265	272 -	-	Coal	
2374	149	12.2	2.552	0.250	282	0.763	0.000	1.000
2375	125	8.9	2.452	0.244	282	0.488	0.028	1.000
2376	72	1.5	2.348	0.215	297	0.155	0.159	1.000
2377	58	1.4	2.366	0.186	299	0.116	0.157	1.000
2378	53	0.9	2.279	0.234	303	0.059	0.212	1.000
2379	56	1.0	2.248	0.241	304	0.076	0.218	1.000
2380	73	2.0	2.376	0.191	292	0.185	0.134	1.000
2381	85	3.3	2.546	0.195	269	0.415	0.039	1.000
2382	79	2.7	2.410	0.190	268	0.205	0.101	1.000
2383	87	3.4	2.417	0.202	264	0.219	0.098	1.000
2384	85	2.1	2.442	0.187	279	0.319	0.116	1.000
2385	86	2.8	2.385	0.200	291	0.259	0.140	0.906
2386	78	2.4	2.384	0.202	281	0.215	0.125	1.000
2387	118	4.5	2.562	0.234	257	0.600	0.000	1.000
2388	123	12.4	2.538	0.290	283	0.700	0.000	1.000
2389	126	14.0	2.552	0.303	287	0.764	0.000	1.000
2390	132	13.8	2.595	0.309	287	0.799	0.000	1.000
2391	136	14.7	2.607	0.334	287	0.785	0.000	1.000
2392	139	18.9	2.605	0.340	279	0.813	0.000	1.000
2393	119	19.3	2.405	0.281	315 -	-	Coal	
2394	114	15.8	2.552	0.211	261 -	-	Coal	
2395	120	15.6	2.532	0.260	272	0.647	0.000	1.000
2396	108	22.4	2.575	0.207	270	0.616	0.000	1.000
2397	120	12.2	2.465	0.319	290	0.663	0.000	1.000
2398	143	18.7	2.537	0.311	289	0.809	0.000	1.000
2399	121	14.8	2.511	0.271	283	0.625	0.000	1.000
2400	131	21.5	2.310	0.324	334 -	-	Coal	
2401	107	26.4	2.241	0.357	326 -	-	Coal	

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2402	120	19.5	2.533	0.333	268	-	-	Coal
2403	105	9.5	2.781	0.201	271	-	-	Coal
2404	124	9.7	2.560	0.224	265	0.616	0.000	1.000
2405	85	4.8	2.366	0.223	285	0.230	0.084	1.000
2406	118	10.3	2.582	0.256	278	0.640	0.000	1.000
2407	140	13.6	2.632	0.333	285	0.800	0.000	1.000
2408	129	12.4	2.587	0.327	274	0.761	0.000	1.000
2409	137	11.6	2.537	0.289	266	0.729	0.000	1.000
2410	132	8.5	2.522	0.300	291	0.689	0.000	1.000
2411	123	6.3	2.523	0.294	288	0.664	0.000	1.000
2412	100	7.3	2.431	0.293	241	0.503	0.036	0.985
2413	116	4.2	2.458	0.233	233	0.514	0.022	1.000
2414	102	2.2	2.410	0.211	239	0.373	0.087	1.000
2415	91	2.6	2.455	0.223	236	0.422	0.069	1.000
2416	90	2.2	2.438	0.213	238	0.353	0.097	1.000
2417	89	2.3	2.433	0.225	235	0.365	0.097	1.000
2418	96	2.2	2.424	0.222	235	0.361	0.097	1.000
2419	90	2.7	2.446	0.222	236	0.401	0.086	1.000
2420	95	2.8	2.450	0.237	232	0.405	0.089	1.000
2421	83	2.9	2.465	0.283	235	0.459	0.066	1.000
2422	90	4.4	2.506	0.265	239	0.500	0.032	1.000
2423	88	4.3	2.494	0.287	240	-	-	Coal
2424	53	42.9	1.232	0.592	420	-	-	Coal
2425	70	54.0	1.348	0.675	426	-	-	Coal
2426	88	31.7	1.496	0.588	435	-	-	Coal
2427	74	29.7	1.532	0.615	385	-	-	Coal
2428	54	61.3	1.213	0.731	406	-	-	Coal
2429	130	12.1	2.596	0.343	269	-	-	Coal
2430	129	12.1	2.587	0.307	270	0.810	0.000	1.000
2431	117	14.1	2.498	0.314	290	0.689	0.000	1.000
2432	117	14.1	2.500	0.308	281	0.679	0.000	1.000
2433	125	14.6	2.531	0.253	287	0.691	0.000	1.000
2434	116	15.5	2.522	0.270	278	0.627	0.000	1.000
2435	119	8.5	2.541	0.276	279	0.685	0.000	0.987
2436	98	3.9	2.452	0.228	295	0.408	0.085	0.963
2437	80	2.9	2.401	0.193	297	0.279	0.114	1.000
2438	131	14.3	2.527	0.388	302	0.758	0.000	1.000
2439	140	14.7	2.459	0.375	319	0.760	0.000	1.000
2440	130	5.2	2.412	0.477	325	0.694	0.000	1.000
2441	48	1.7	2.290	0.226	316	0.074	0.176	1.000
2442	137	18.1	2.569	0.325	292	0.760	0.000	1.000
2443	143	13.4	2.566	0.390	319	0.805	0.000	1.000
2444	94	21.8	2.095	0.379	423	-	-	Coal
2445	118	15.7	2.501	0.404	274	-	-	Coal
2446	116	11.9	2.547	0.256	266	0.602	0.000	1.000
2447	110	10.9	2.536	0.234	264	0.552	0.005	1.000
2448	117	13.2	2.573	0.250	262	0.655	0.000	1.000
2449	125	15.8	2.505	0.286	300	0.640	0.000	1.000
2450	128	21.4	2.315	0.415	365	-	-	Coal
2451	101	52.0	1.788	0.568	441	-	-	Coal

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2452	119	26.5	2.153	0.510	381 -	-		Coal
2453	114	17.3	2.555	0.357	274 -	-		Coal
2454	128	19.0	2.599	0.318	277	0.732	0.000	1.000
2455	151	16.7	2.498	0.423	305 -	-		Coal
2456	153	16.9	2.562	0.364	302	0.839	0.000	1.000
2457	129	28.7	1.805	0.618	384 -	-		Coal
2458	150	16.2	2.594	0.355	305	0.936	0.000	1.000
2459	130	26.3	2.022	0.650	336 -	-		Coal
2460	143	16.7	2.530	0.385	319 -	-		Coal
2461	145	19.6	2.592	0.360	325 -	-		Coal
2462	87	40.8	1.424	0.712	393 -	-		Coal
2463	91	102.2	1.384	0.619	439 -	-		Coal
2464	150	17.7	2.538	0.466	311 -	-		Coal
2465	135	18.0	2.626	0.283	274	0.779	0.000	1.000
2466	149	12.4	2.525	0.486	273 -	-		Coal
2467	104	8.5	2.522	0.211	278	0.500	0.018	1.000
2468	83	3.5	2.462	0.181	267	0.293	0.084	1.000
2469	72	31.7	2.717	0.119	258 -	-		Coal
2470	141	22.5	2.074	0.505	366 -	-		Coal
2471	122	14.1	2.576	0.283	257 -	-		Coal
2472	112	18.2	2.566	0.215	250	0.596	0.000	1.000
2473	81	22.7	2.514	0.331	247	0.441	0.001	1.000
2474	128	15.5	2.530	0.333	278	0.805	0.000	1.000
2475	140	13.7	2.688	0.350	242 -	-		Coal
2476	104	14.4	2.567	0.261	265 -	-		Coal
2477	92	6.0	2.620	0.221	289 -	-		Coal
2478	108	6.2	2.423	0.237	312 -	-		Coal
2479	144	14.3	2.560	0.327	280 -	-		Coal
2480	115	12.0	2.539	0.236	269	0.603	0.000	1.000
2481	108	10.0	2.557	0.209	270	0.565	0.002	1.000
2482	96	6.7	2.545	0.206	274	0.517	0.012	1.000
2483	117	12.2	2.570	0.247	269	0.658	0.000	1.000
2484	132	17.5	2.560	0.290	270	0.775	0.000	1.000
2485	88	7.4	2.516	0.175	269	0.362	0.052	1.000
2486	116	21.6	2.622	0.241	275	0.659	0.000	1.000
2487	144	22.9	2.230	0.465	356 -	-		Coal
2488	149	21.7	2.164	0.484	369 -	-		Coal
2489	133	25.4	2.509	0.444	398 -	-		Coal
2490	142	21.5	2.189	0.565	405 -	-		Coal
2491	85	70.6	1.406	0.635	478 -	-		Coal
2492	109	28.8	2.370	0.356	474 -	-		Coal
2493	108	53.3	2.005	0.541	444 -	-		Coal
2494	122	15.8	2.625	0.276	280 -	-		Coal
2495	134	13.5	2.526	0.310	267	0.775	0.000	1.000
2496	152	14.2	2.606	0.321	279	0.870	0.000	1.000
2497	144	15.3	2.533	0.260	287	0.695	0.000	1.000
2498	138	12.5	2.584	0.330	279	0.800	0.000	1.000
2499	129	15.3	2.585	0.268	271	0.716	0.000	1.000
2500	126	16.1	2.549	0.232	293	0.653	0.000	1.000
2501	102	8.6	2.509	0.219	283	0.421	0.050	0.928

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2502	102	9.4	2.572	0.216	268	0.520	0.005	1.000
2503	105	11.0	2.539	0.218	271	0.573	0.002	1.000
2504	108	12.4	2.562	0.211	268	0.581	0.000	1.000
2505	129	13.1	2.593	0.271	265	0.720	0.000	1.000
2506	99	14.1	2.591	0.201	248	0.475	0.001	1.000
2507	135	13.7	2.573	0.314	290	0.777	0.000	1.000
2508	134	22.3	2.445	0.314	393 -	-	Coal	
2509	116	64.9	1.859	0.543	446 -	-	Coal	
2510	88	57.5	1.424	0.790	349 -	-	Coal	
2511	136	30.9	2.300	0.437	411 -	-	Coal	
2512	54	126.1	1.325	0.657	432 -	-	Coal	
2513	131	12.0	2.567	0.373	283 -	-	Coal	
2514	133	10.1	2.543	0.257	270	0.698	0.000	1.000
2515	112	8.3	2.533	0.251	272	0.597	0.000	1.000
2516	131	10.2	2.518	0.239	268	0.627	0.000	1.000
2517	117	9.8	2.507	0.254	254	0.553	0.006	1.000
2518	120	11.6	2.554	0.240	268	0.688	0.000	1.000
2519	118	8.7	2.524	0.264	268	0.675	0.000	1.000
2520	120	11.4	2.542	0.231	267	0.599	0.000	1.000
2521	107	7.1	2.540	0.192	269	0.516	0.005	1.000
2522	119	9.2	2.509	0.238	253	0.541	0.006	1.000
2523	139	5.6	2.585	0.286	279	0.714	0.000	1.000
2524	78	2.8	2.512	0.216	291	0.315	0.070	1.000
2525	103	3.6	2.536	0.228	289	0.483	0.024	1.000
2526	116	8.4	2.530	0.229	282	0.587	0.001	1.000
2527	130	11.6	2.551	0.269	280	0.755	0.000	1.000
2528	133	12.3	2.584	0.319	282	0.799	0.000	1.000
2529	140	12.3	2.603	0.258	271	0.706	0.000	1.000
2530	109	9.7	2.512	0.237	280	0.562	0.007	1.000
2531	116	8.0	2.503	0.249	280	0.513	0.021	1.000
2532	137	13.0	2.574	0.318	273	0.746	0.000	1.000
2533	130	13.3	2.536	0.301	284	0.663	0.000	1.000
2534	136	13.8	2.583	0.335	288	0.729	0.000	1.000
2535	137	13.7	2.544	0.307	281	0.700	0.000	1.000
2536	134	13.6	2.563	0.300	271	0.748	0.000	1.000
2537	112	15.8	2.749	0.290	254	0.687	0.000	1.000
2538	127	13.5	2.582	0.269	269	0.741	0.000	1.000
2539	119	14.8	2.946	0.268	264	0.699	0.000	1.000
2540	124	13.3	2.630	0.273	272	0.745	0.000	1.000
2541	134	13.6	2.580	0.293	275	0.760	0.000	1.000
2542	119	14.5	2.552	0.300	266	0.683	0.000	1.000
2543	130	14.7	2.585	0.287	208	0.717	0.000	1.000
2544	132	14.8	2.571	0.266	204	0.714	0.000	1.000
2545	88	20.4	2.228	0.320	354 -	-	Coal	
2546	118	67.9	1.779	0.618	325 -	-	Coal	
2547	136	35.8	2.331	0.399	412 -	-	Coal	
2548	144	31.9	2.342	0.387	423 -	-	Coal	
2549	109	32.0	1.981	0.481	451 -	-	Coal	
2550	74	94.2	2.091	0.589	386 -	-	Coal	
2551	114	26.2	1.943	0.394	421 -	-	Coal	

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2552	160	20.9	2.537	0.310	338	-	-	Coal
2553	112	30.7	2.155	0.632	449	-	-	Coal
2554	79	83.5	1.383	0.637	477	-	-	Coal
2555	101	107.1	1.287	0.818	375	-	-	Coal
2556	134	25.8	2.329	0.409	334	-	-	Coal
2557	134	19.5	2.359	0.394	439	-	-	Coal
2558	122	34.5	1.806	0.566	307	-	-	Coal
2559	159	20.8	2.478	0.366	337	-	-	Coal
2560	148	26.4	2.446	0.388	387	-	-	Coal
2561	147	19.8	2.559	0.342	308	-	-	Coal
2562	115	20.4	2.562	0.532	282	-	-	Coal
2563	112	16.1	2.544	0.251	274	-	-	Coal
2564	79	3.7	2.385	0.183	298	0.233	0.132	0.745
2565	108	8.8	2.475	0.229	311	0.487	0.041	0.866
2566	46	0.9	2.285	0.204	302	0.060	0.204	1.000
2567	37	1.2	2.289	0.211	302	0.044	0.206	1.000
2568	49	1.1	2.284	0.201	301	0.075	0.196	1.000
2569	100	1.4	2.358	0.202	338	-	-	Coal
2570	153	22.0	2.490	0.411	301	-	-	Coal
2571	150	26.0	2.315	0.422	424	-	-	Coal
2572	134	25.7	2.588	0.275	262	-	-	Coal
2573	139	18.5	2.594	0.258	262	0.744	0.000	1.000
2574	124	17.0	2.580	0.229	262	0.639	0.000	1.000
2575	133	18.4	2.529	0.308	315	-	-	Coal
2576	141	20.9	2.539	0.255	304	-	-	Coal
2577	166	18.5	2.538	0.378	340	-	-	Coal
2578	84	29.9	1.353	0.762	377	-	-	Coal
2579	154	28.1	2.576	0.339	275	-	-	Coal
2580	145	27.7	2.550	0.293	288	0.803	0.000	1.000
2581	145	22.9	1.906	0.650	365	-	-	Coal
2582	150	18.3	2.595	0.273	267	-	-	Coal
2583	123	18.5	2.590	0.229	265	0.669	0.000	1.000
2584	125	15.6	2.633	0.308	239	0.788	0.000	1.000
2585	125	18.0	2.565	0.207	263	0.636	0.000	1.000
2586	151	19.1	2.601	0.261	280	0.800	0.000	1.000
2587	143	17.9	2.559	0.268	265	-	-	Coal
2588	99	20.9	2.308	0.394	295	-	-	Coal
2589	149	30.1	2.112	0.567	377	-	-	Coal
2590	163	19.8	2.535	0.363	306	-	-	Coal
2591	151	20.9	2.414	0.430	322	-	-	Coal
2592	54	47.3	1.193	0.690	466	-	-	Coal
2593	57	95.3	1.249	0.614	473	-	-	Coal
2594	102	80.1	1.615	0.698	450	-	-	Coal
2595	140	29.8	2.228	0.568	374	-	-	Coal
2596	122	18.0	2.425	0.338	282	-	-	Coal
2597	123	23.6	2.579	0.283	267	0.697	0.000	1.000
2598	128	26.5	2.507	0.278	306	-	-	Coal
2599	118	36.9	2.338	0.434	310	-	-	Coal
2600	120	30.0	1.838	0.645	383	-	-	Coal
2601	145	23.5	2.462	0.399	312	-	-	Coal

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2602	144	32.3	2.163	0.510	414	-	-	Coal
2603	149	26.3	2.416	0.457	345	-	-	Coal
2604	128	48.9	1.944	0.696	361	-	-	Coal
2605	150	26.8	2.574	0.418	306	-	-	Coal
2606	147	32.8	1.910	0.769	371	-	-	Coal
2607	165	42.1	2.428	0.408	340	-	-	Coal
2608	152	48.7	2.515	0.335	285	-	-	Coal
2609	95	24.0	2.420	0.172	291	0.378	0.105	0.212
2610	87	38.0	2.488	0.141	269	0.413	0.081	0.185
2611	92	50.1	2.528	0.167	287	0.425	0.051	0.481
2612	93	41.6	2.462	0.149	291	0.455	0.050	0.508
2613	100	38.1	2.445	0.161	288	0.348	0.082	0.184
2614	89	35.3	2.472	0.140	285	0.343	0.065	0.232
2615	87	45.4	2.462	0.155	285	0.259	0.086	0.187
2616	74	46.1	2.381	0.143	301	0.248	0.124	0.145
2617	79	54.2	2.214	0.092	295	0.196	0.166	0.113
2618	77	60.4	2.412	0.162	309	0.218	0.110	0.138
2619	82	33.3	2.437	0.163	281	0.288	0.095	0.214
2620	89	49.9	2.490	0.165	282	0.320	0.070	0.171
2621	56	49.3	2.337	0.136	311	0.122	0.154	0.160
2622	65	44.3	2.322	0.123	305	0.144	0.156	0.161
2623	50	83.4	2.281	0.084	330	0.111	0.168	0.106
2624	158	23.9	2.723	0.373	270	0.971	0.000	1.000
2625	129	36.7	2.553	0.217	261	0.577	0.000	1.000
2626	126	26.2	2.500	0.181	291	0.518	0.006	1.000
2627	132	44.7	1.990	0.560	412	-	-	Coal
2628	116	44.4	1.793	0.630	331	-	-	Coal
2629	154	35.6	2.388	0.492	285	-	-	Coal
2630	143	24.3	2.576	0.302	221	-	-	Coal
2631	151	26.5	2.554	0.306	258	0.822	0.000	1.000
2632	113	28.2	2.233	0.288	365	-	-	Coal
2633	135	27.4	2.430	0.402	358	-	-	Coal
2634	139	34.3	2.094	0.496	397	-	-	Coal
2635	141	24.7	2.551	0.269	297	-	-	Coal
2636	137	22.5	2.553	0.290	271	-	-	Coal
2637	131	20.3	2.581	0.242	244	0.715	0.000	1.000
2638	121	18.2	2.624	0.184	236	0.608	0.000	1.000
2639	123	20.3	2.595	0.202	239	0.665	0.000	1.000
2640	131	19.6	2.595	0.196	237	0.658	0.000	1.000
2641	120	18.7	2.593	0.208	234	0.640	0.000	1.000
2642	126	17.5	2.610	0.200	236	0.631	0.000	1.000
2643	111	16.2	2.606	0.178	232	0.573	0.000	1.000
2644	114	15.2	2.579	0.196	240	0.558	0.000	1.000
2645	112	14.3	2.560	0.197	242	0.526	0.004	1.000
2646	109	23.7	2.792	0.251	250	-	-	Coal
2647	102	12.5	2.508	0.242	248	-	-	Coal
2648	97	9.8	2.531	0.212	249	0.447	0.035	0.925
2649	98	10.4	2.500	0.207	247	0.433	0.045	0.854
2650	87	9.0	2.496	0.220	266	0.430	0.055	0.762
2651	75	24.2	2.593	0.266	226	-	-	Coal

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2652	75	5.3	2.412	0.219	266	0.260	0.122	0.680
2653	66	3.4	2.427	0.165	265	0.189	0.115	0.935
2654	61	2.8	2.405	0.191	268	0.194	0.133	0.951
2655	68	2.7	2.411	0.175	263	0.176	0.121	1.000
2656	55	2.6	2.391	0.151	269 -	-		Coal
2657	49	10.1	1.326	0.883	427 -	-		Coal
2658	40	129.5	1.203	0.652	442 -	-		Coal
2659	41	116.3	1.202	0.639	448 -	-		Coal
2660	50	116.0	1.223	0.692	404 -	-		Coal
2661	125	28.2	2.002	0.418	411 -	-		Coal
2662	43	86.5	1.144	0.651	432 -	-		Coal
2663	70	65.3	1.409	0.614	467 -	-		Coal
2664	69	88.8	1.347	0.736	416 -	-		Coal
2665	148	32.8	2.474	0.512	338 -	-		Coal
2666	136	30.9	2.331	0.507	287 -	-		Coal
2667	140	21.8	2.624	0.230	231 -	-		Coal
2668	149	18.7	2.609	0.233	240	0.705	0.000	1.000
2669	143	17.4	2.575	0.253	245	0.725	0.000	1.000
2670	96	6.2	2.468	0.224	272	0.411	0.060	0.959
2671	63	5.1	2.348	0.146	272	0.189	0.092	0.943
2672	88	6.2	2.489	0.157	257	0.305	0.070	0.959
2673	65	4.4	2.380	0.139	260	0.210	0.091	1.000
2674	108	8.9	2.519	0.204	273 -	-		Coal
2675	78	4.0	2.427	0.161	274 -	-		Coal
2676	62	2.6	2.378	0.169	278	0.142	0.145	0.945
2677	67	3.2	2.446	0.178	267	0.259	0.104	1.000
2678	76	3.5	2.454	0.172	260	0.249	0.099	1.000
2679	87	4.8	2.505	0.160	248	0.332	0.060	1.000
2680	69	2.6	2.375	0.162	270	0.119	0.142	0.971
2681	68	3.8	2.446	0.144	260	0.207	0.096	1.000
2682	87	6.9	2.610	0.213	249	0.518	0.003	1.000
2683	71	3.2	2.432	0.172	267	0.210	0.115	0.974
2684	65	3.4	2.423	0.161	264	0.190	0.121	0.922
2685	76	4.4	2.488	0.161	255	0.251	0.085	1.000
2686	67	45.4	2.719	0.083	166	0.249	0.001	1.000
2687	88	7.5	2.519	0.170	258	0.345	0.057	0.928
2688	73	4.2	2.453	0.165	267	0.248	0.101	0.904
2689	89	8.0	2.520	0.162	249	0.347	0.058	0.912
2690	92	11.0	2.558	0.215	227	0.488	0.015	0.999
2691	54	52.7	1.460	0.496	395 -	-		Coal
2692	59	133.4	1.331	0.629	441 -	-		Coal
2693	39	134.9	1.200	0.647	439 -	-		Coal
2694	33	134.7	1.208	0.727	443 -	-		Coal
2695	41	173.4	1.219	0.661	435 -	-		Coal
2696	142	30.7	2.456	0.430	305 -	-		Coal
2697	140	25.0	2.511	0.264	271	0.689	0.000	1.000
2698	111	2.5	2.470	0.397	257	0.630	0.000	1.000
2699	88	3.1	2.482	0.208	264	0.366	0.084	1.000
2700	85	2.2	2.384	0.226	270	0.219	0.146	1.000
2701	77	2.0	2.381	0.143	260	0.081	0.138	1.000

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2702	65	1.6	2.327	0.123	262	0.041	0.160	1.000
2703	79	1.8	2.379	0.143	260	0.079	0.134	1.000
2704	68	1.6	2.344	0.158	266	0.085	0.163	1.000
2705	85	2.2	2.426	0.178	268	0.207	0.115	1.000
2706	61	1.6	2.330	0.152	271	0.048	0.169	1.000
2707	70	1.9	2.377	0.137	262	0.061	0.139	1.000
2708	68	1.7	2.383	0.143	257	0.065	0.138	1.000
2709	65	2.0	2.410	0.141	265 -	-	Coal	
2710	109	7.7	1.840	0.544	320 -	-	Coal	
2711	130	22.8	2.408	0.503	271 -	-	Coal	
2712	135	10.5	2.551	0.231	261	0.634	0.000	1.000
2713	58	2.8	2.389	0.133	260	0.090	0.132	0.985
2714	83	7.1	2.533	0.081	238	0.200	0.043	1.000
2715	91	10.4	2.560	0.131	232	0.361	0.022	1.000
2716	114	13.7	2.621	0.187	234	0.561	0.000	1.000
2717	63	3.2	2.443	0.142	253	0.160	0.107	1.000
2718	67	3.0	2.417	0.126	251	0.098	0.115	1.000
2719	74	3.4	2.405	0.113	245	0.089	0.113	1.000
2720	96	5.9	2.491	0.136	243	0.285	0.055	1.000
2721	107	8.0	2.534	0.133	239	0.390	0.019	1.000
2722	127	11.9	2.574	0.177	233	0.560	0.000	1.000
2723	99	7.0	2.485	0.145	248	0.322	0.053	1.000
2724	100	8.3	2.495	0.177	252	0.357	0.058	0.883
2725	96	10.9	2.248	0.670	326 -	-	Coal	
2726	122	4.4	2.405	0.194	257 -	-	Coal	
2727	128	7.6	2.478	0.234	252	0.499	0.026	1.000
2728	136	7.7	2.494	0.206	246	0.451	0.032	1.000
2729	66	2.5	2.436	0.087	260	0.080	0.111	1.000
2730	65	2.0	2.336	0.146	262	0.036	0.167	1.000
2731	104	7.1	2.496	0.153	254 -	-	Coal	
2732	108	6.3	2.533	0.182	249 -	-	Coal	
2733	108	7.1	2.481	0.147	229	0.244	0.060	1.000
2734	60	3.4	2.474	0.052	238	0.036	0.085	1.000
2735	53	3.6	2.461	0.049	243	0.019	0.092	1.000
2736	61	3.2	2.476	0.052	227	0.037	0.078	1.000
2737	61	3.4	2.461	0.061	229	0.053	0.082	1.000
2738	66	3.6	2.438	0.070	226	0.041	0.097	1.000
2739	62	3.5	2.409	0.070	227	0.033	0.110	1.000
2740	63	4.0	2.459	0.051	226	0.036	0.084	1.000
2741	60	3.4	2.461	0.073	229	0.042	0.092	1.000
2742	104	5.9	2.521	0.146	253 -	-	Coal	
2743	110	5.6	2.424	0.182	228 -	-	Coal	
2744	108	12.0	2.603	0.186	254 -	-	Coal	
2745	105	5.5	2.353	0.186	266 -	-	Coal	
2746	106	3.8	2.538	0.156	312 -	-	Coal	
2747	120	92.6	2.015	0.604	381 -	-	Coal	
2748	143	44.0	2.453	0.306	276 -	-	Coal	
2749	143	34.4	2.502	0.271	279 -	-	Coal	
2750	149	22.2	2.541	0.284	253 -	-	Coal	
2751	118	8.9	2.543	0.277	253	0.681	0.000	1.000

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE. frac
2752	75	4.2	2.441	0.145	259	0.204	0.100	0.994
2753	62	3.2	2.388	0.127	256	0.067	0.135	0.930
2754	71	4.2	2.473	0.130	253	0.199	0.091	1.000
2755	85	5.3	2.547	0.125	250	0.292	0.046	1.000
2756	89	15.9	2.602	0.193	221	0.472	0.008	1.000
2757	118	25.4	2.597	0.155	240	0.506	0.000	1.000
2758	123	33.4	2.584	0.223	247	0.654	0.000	1.000
2759	124	29.2	2.568	0.227	247	0.631	0.000	1.000
2760	125	35.4	2.569	0.218	250	0.633	0.000	1.000
2761	130	37.6	2.575	0.245	247	0.668	0.000	1.000
2762	136	36.8	2.499	0.234	261	0.571	0.004	1.000
2763	132	40.2	2.521	0.238	269 -	-		Coal
2764	116	21.8	2.416	0.283	270 -	-		Coal
2765	130	23.5	2.542	0.257	269	0.699	0.000	1.000
2766	122	18.0	2.478	0.278	294 -	-		Coal
2767	78	21.0	1.336	0.876	348 -	-		Coal
2768	129	21.4	2.511	0.239	257 -	-		Coal
2769	133	18.4	2.580	0.275	248	0.708	0.000	1.000
2770	114	13.2	2.488	0.221	249	0.506	0.010	1.000
2771	101	11.3	2.520	0.185	243	0.414	0.037	0.983
2772	68	5.2	2.437	0.145	259	0.159	0.108	0.829
2773	70	5.0	2.419	0.136	264	0.145	0.111	0.818
2774	148	18.7	2.616	0.313	247	0.821	0.000	1.000
2775	155	22.4	2.569	0.288	261	0.803	0.000	1.000
2776	132	10.3	2.524	0.227	291 -	-		Coal
2777	86	52.3	1.405	0.684	406 -	-		Coal
2778	112	70.9	2.033	0.585	330 -	-		Coal
2779	102	20.1	2.190	0.227	271 -	-		Coal
2780	129	26.7	2.566	0.238	250 -	-		Coal
2781	138	49.9	2.472	0.289	280	0.636	0.000	1.000
2782	122	47.7	2.367	0.333	315 -	-		Coal
2783	131	78.9	2.277	0.396	342 -	-		Coal
2784	91	35.3	2.455	0.157	265 -	-		Coal
2785	88	51.9	2.449	0.181	267	0.309	0.087	0.141
2786	93	46.7	2.476	0.179	268	0.357	0.077	0.142
2787	68	60.1	2.423	0.149	286	0.196	0.121	0.137
2788	78	61.8	2.419	0.101	340 -	-		Coal
2789	146	32.8	2.456	0.308	286 -	-		Coal
2790	127	20.5	2.277	0.514	266 -	-		Coal
2791	115	24.4	2.561	0.244	248	0.553	0.003	1.000
2792	146	22.5	2.498	0.274	278	0.678	0.000	1.000
2793	117	25.8	2.687	0.251	233	0.539	0.000	1.000
2794	136	24.3	2.541	0.219	257 -	-		Coal
2795	86	19.9	2.464	0.268	266 -	-		Coal
2796	141	26.4	2.448	0.308	268 -	-		Coal
2797	112	21.6	2.576	0.165	242 -	-		Coal
2798	137	16.3	2.503	0.204	272 -	-		Coal
2799	114	13.8	2.508	0.201	240 -	-		Coal
2800	108	16.9	2.523	0.163	250	0.426	0.020	1.000
2801	88	10.8	2.383	0.237	277	0.340	0.068	0.650

DEPTH (mRKB)	GR api	RT ohmm	RHOB g/cc	NPHI frac	DT us/m	VWCLAY frac	PHIE frac	SWE frac
2802	92	20.3	2.727	0.169	235	0.455	0.001	1.000
2803	137	19.3	2.579	0.203	239	0.636	0.000	1.000
2804	130	21.0	2.631	0.258	266	-	-	Coal
2805	119	90.2	1.955	0.434	370	-	-	Coal
2806	125	28.0	2.515	0.227	259	-	-	Coal
2807	123	27.6	2.536	0.259	252	0.679	0.000	1.000
2808	119	32.5	2.580	0.238	245	0.628	0.000	1.000
2809	137	31.9	2.508	0.235	284	-	-	Coal
2810	131	35.5	2.395	0.282	308	-	-	Coal
2811	161	20.7	2.471	0.341	272	-	-	Coal
2812	145	20.4	2.517	0.210	310	-	-	Coal
2813	110	19.1	2.339	0.158	254	-	-	Coal
2814	133	25.3	2.506	0.212	276	-	-	Coal
2815	130	27.6	1.711	0.231	260	-	-	Coal
2816	137	22.1	2.419	0.097	249	-	-	Coal
2817	134	49.9	2.473	0.156	257	-	-	Coal
2818	136	55.5	2.510	0.117	265	-	-	Coal
2819	135	55.0	2.105	0.178	294	-	-	Coal
2820	127	24.4	2.599	Nul	260	-	-	Coal

APPENDIX 3

APPENDIX 3

APPENDIX 3

TURRUM 6

MDT Analysis

TURRUM-6 MDT INTERPRETATION

VIC/L3 Bass Strait

Ocean Bounty

12th October 1995

Mike Scott/Tim Hoffman

Reservoir Technology

Production Department

Contents

Attachments:

1.0 Summary and Conclusions

Turrum-6 was spud 17:00hrs 25th September 1995, reached TD at 15:00hrs 12th October 1995 and the rig was released from location at 18:15hrs 19th October 1995. The well is located in VIC production licence L3 at 5767279 m North and 602832 m South (Longitude: 140 10' 29.99"E, Latitude: 38 14' 11.34"N) and lies approximately 4 km west of the Marlin-A platform in 60m of water.

Turrum-6 is a near vertical well with a maximum deviation of 3.6 degrees, drilled to a total depth of 2840 m with a KB height of 25 metres. The well encountered the Marlin gas reservoir with top of latrobe group at 1460 m MDRKB (1435 m TVDSS) and top of coarse clastics at 1464 m MDRKB (1439 m TVDSS), a Turrum gas sand at 2609-2624 m MDRKB (2584-2599 m TVDSS) and an oil sand at 2652-2657 m MDRKB (2627-2632 m TVDSS). All other sands encountered within the Turrum reservoirs appear to be wet.

The MDT obtained 66 pressure survey points (50 apparently valid, 4 tight, 8 potentially supercharged and 4 seal failures) and 3 gas samples (6 gallon, 2-3/4 gallon and 1 gallon - all at 2621.5 m MDRKB) in a single run. The full MDT pressure dataset is demonstrated in Figure 1.

The conclusions of the MDT interpretation are:

1. A gas-water contact for the Marlin reservoir is interpreted at 1486 m TVDSS. The gas bearing sands above this depth are all in communication which is demonstrated by the common gas pressure gradient (Figure 2).

2. The aquifer pressures in the Turrum reservoirs vary. Relative to the original aquifer the current aquifer pressures range from drawn-down by 40 psi to over-pressured by 30 psi (Figures 3 & 4). Because of this complex pressure regime it is difficult to interpret definitive hydrocarbon-water contacts for the Turrum reservoir systems.

3. The gas sand at 2584-2599 m TVDSS (Figure 5) has a gradient of 0.32 psi/m. Due to the unknown aquifer pressure in this area a definitive gas-water contact cannot be determined. Using the original aquifer gradient or water data from an upper water zone, potential gas-water contacts can be interpreted at 2613.2 m TVDSS and 2599.8 m TVDSS respectively. Low known gas, from log analysis, is at 2599 m TVDSS.

4. The pressure data in the sand at 2627-2632 m TVDSS (Figure 6) has a gradient of 0.76 psi/m. This may indicate that the reservoir contains oil. However, no sample was obtained in this sand to confirm this interpretation. Extrapolation of the pressure data to the original aquifer pressure yields a potential oil-water contact at 2661.44 m TVDSS. Due to the complexity of the surrounding aquifer pressures there is low confidence that such a large oil column exists in this thin sand.

5. Preliminary fluid analysis of the gas sample at 2621.5 m MDRKB reveals that the sample is not representative of the reservoir fluid because the measured dewpoint is in excess of 6000 psig. Compositional analysis reveals that the gas sample has 22 MOL% CO_2.

2.0 Marlin @ TOL Interpretation

Figure 2 details the MDT interpretation for the Marlin reservoir at TOL. As can be seen from Figure 2 a gas water contact is interpreted at 1486 m TVDSS. The gas sands above this depth are all in communication, which is demonstrated by the common gas gradient of 0.19 psi/m. The water sands below the gas water contact also appear to be in good communication.

The gas contact for Marlin has risen 70m since discovery - original gas contact is interpreted to be 1556m TVDSS. This rise of water contact represents a hydrostatic head pressure decline of 99 psi. The total pressure drop in the gas sands is calculated to be 224 psi (99 psi hydrostatic and 125 psi aquifer decline).

3.0 Figure 3 - Turrum-6 MDT 2200-2450 m TVDSS Interpretation

Figure 3 shows the upper Turrum water sands which demonstrate varying degrees of communication with the regional aquifer. The upper sand is drawn-down 32 psi and the middle sands have an average drawdown of 17 psi, when compared to the regional aquifer.

The lowest sand in Figure 3 (pretests - #1/25 and 1/26) is 180 psi overpressured when compared to the original aquifer pressure. It is unusual for such a large overpressure to exist at this shallow depth in the Gippsland Basin and a more likely interpretation is that this sand is supercharged.

4.0 Figure 4 - Turrum-6 MDT 2530-2770 m TVDSS Interpretation

Figure 4 summarises the total lower portion of the Turrum-6 MDT pressure survey. As can be seen from this figure the sand at approximately 2540 m TVDSS is overpressured by 15 psi, the sands around 2650 m TVDSS are overpressured by 30 psi, the sands around 2690 m TVDSS are drawdown by 40 psi and the sands at 2730 m TVDSS are drawdown by 20 psi. Overpressure is unusual in the Gippsland basin at these depths and supercharging of these low permeability formations cannot be discounted.

The gas sand at 2584-2599 m TVDSS m and the possible oil sand at 2627-2632 m TVDSS are more fully interpreted in Figures 5 and 6 respectively.

5.0 Figure 5 - Turrum-6 MDT 2580-2620 m TVDSS Interpretation

The reservoir at 2584-2599 m TVDSS is interpreted to be a gas sand from the MDT pressure analysis, MDT sampling and log interpretation. As can be seen from Figure 5, a gradient of 0.32 psi/m is interpreted to best fit the data.

The gas sand could have a gas-water contact at 2613.2 m TVDSS, which is the intersection between the gas gradient and the original aquifer gradient . However, due to the complexity of the aquifer pressures in this area, an alternate interpretation would place a gas-water contact at 2599.8 m TVDSS, which is the intersection between the gas gradient and the water gradient extrapolated from the upper water pressure tests (#1/27 & 28). As stated previously however, pretests #1/27 and #1/28 may be supercharged.

The extrapolated water gradient from the lower water pressure tests (#1/44, 45, 46 & 47) intersects the gas column at a depth shallower that the gas column and therefore this would not provide a valid interpretation.

Due to the complexity of the aquifer in this area the height of the gas column cannot be accurately estimated. The base of the sand, from log analysis, is at 2599 m TVDSS which is interpreted as low known gas.

The gas sample point in Figure 5 (#S1/1) demonstrates MDT tool/gauge temperature hysteresis. The initial pretest for the sample depth, which is the pressure shown on the Figure 5, is approximately 1 psi less than formation pressure. As the tool temperature stabilised towards the end of the sampling (25 minutes), the difference between the final sample pressure and initially measured formation pressure had fallen to 0.3 psi.

Examination of the MDT log reveals that a pressure survey point was taken prior to the sampling but not used for sampling as the formation was tight at that location. The point was not reported on the MDT pressure survey sheets and therefore for future reference the data is tabulated below.

Pretest # (run/survey)	Depth (m MDRKB)	Formation Pressure (psia)	Mobility (md/cp)
1/67	2621.39	3783.63	5.48

Pressure survey point #1/67 also suffered from temperature hysteresis and has not been shown in Figure 5.

6.0 Figure 6 - Turrum-6 MDT 2620-2680 m TVDSS Interpretation

The pressure data in the sand at 2627-2632 m TVDSS (Figure 6) has a gradient of 0.76 psi/m. This may indicate that the reservoir contains oil. However, no sample was obtained in this sand to confirm this interpretation. Extrapolation of the pressure data to the original aquifer pressure yields a potential oil-water contact at 2661.44 m TVDSS. Due to the complexity of the surrounding aquifer pressures there is low confidence that such a large oil column exists in this thin sand.

Water pressure tests immediately below the sand (which may be overpressured or supercharged) would result in an oil-water gradient intersection at a depth shallower than the reservoir which is obviously invalid.

A gradient of 0.76 psi/m has been chosen for the interpretation but there is a small point to point scatter which would effect the interpretation. This interpretation scatter effect is shown in the table below:

Point Start	Point End	Resulting Gradient (psi/m)	Resulting oil-water contact with original aquifer gradient (m TVDSS)	Column height - top sand (2627 m TVDSS) to FWL (metres)
Interpretation value		0.76	2661.4	34.4
40	43	0.76	2661.4	34.4
40	42	1.10	2697.2	70.2
43	42	0.53	2653.5	26.5

Although some scatter in the data has been identified the MDT pressure response for points 40, 42 and 43 appear to be valid.

It must be noted that the hydrocarbon bearing potential of this zone is very much open to interpretation. There was no hydrocarbon fluorescence reported from four sidewall cores taken in this reservoir (some trace mineral fluorescence was reported), the mudlog response is inconclusive due to the interference effects of the gas sand immediately above this reservoir, the porosity (≈10%) and the permeability (<70 md) is low raising issues of pressure survey validation and the log resistivity response could be affected by the very resistive shoulder beds.

7.0 Turrum-6 MDT Sampling

Three samples were taken in the gas sand at 2621.5 m MDRKB (2596.5 m TVDSS) - one 6 gallon and one 2-3/4 gallon chamber were opened on the rig floor and a 1 gallon chamber was preserved and sent for fluid analysis.

The fluid liberated from the 6 gallon and 2-3/4 gallon chambers is detailed in the fluid sample sheets attached to this report.

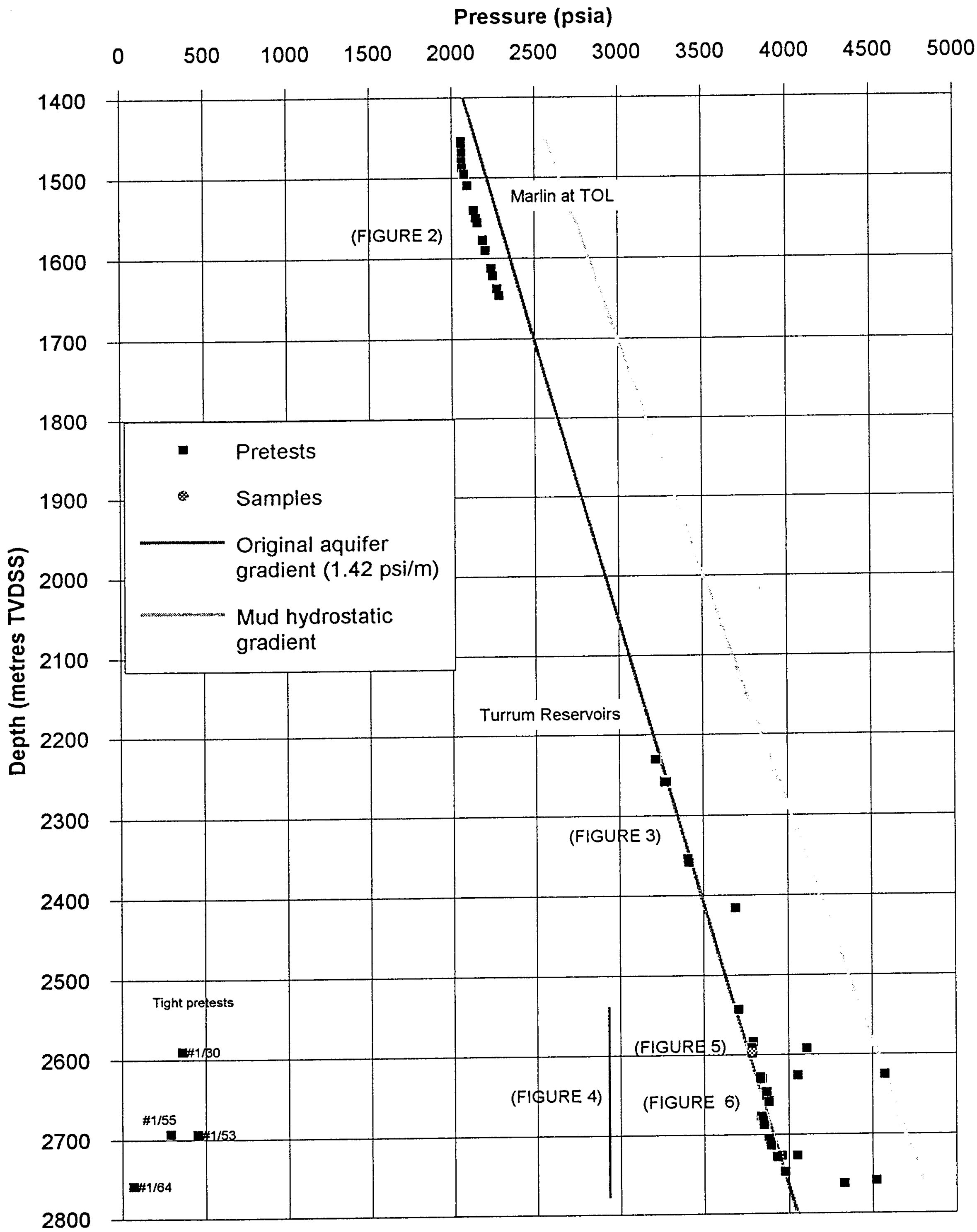
The condensate gas ratio and CO_2 concentration is reported to be 13.8 bbl/mmscf and 18 MOL% from the 6 gallon chamber and 29.9 bbl/mmscf and 16 MOL% from the 2-3/4 gallon chamber.

Preliminary fluid analysis reports the CO_2 from the preserved 1 gallon chamber to be 22.33 MOL%.

Dewpoint analysis of the 1 gallon sample indicates that the dewpoint is in excess of 6000 psig. This indicates that the sample is not representative of the reservoir fluid. One potential explanation is that the checking of the sample pressure at the rig floor probably flashed off enough gas to the MDT xmas tree to render the sample invalid. The removal of lean gas to the xmas tree would increase the liquids content of the remaining gas thus raising the dewpoint of the sample. The checking of the sample pressure at the rig-floor was considered necessary after a large number of empty sample chambers were sent for PVT analysis from the Turrum-5 well. Unfortunately this rig floor validation has potentially corrupted the integrity of the sample rendering it unsuitable for further PVT analysis.

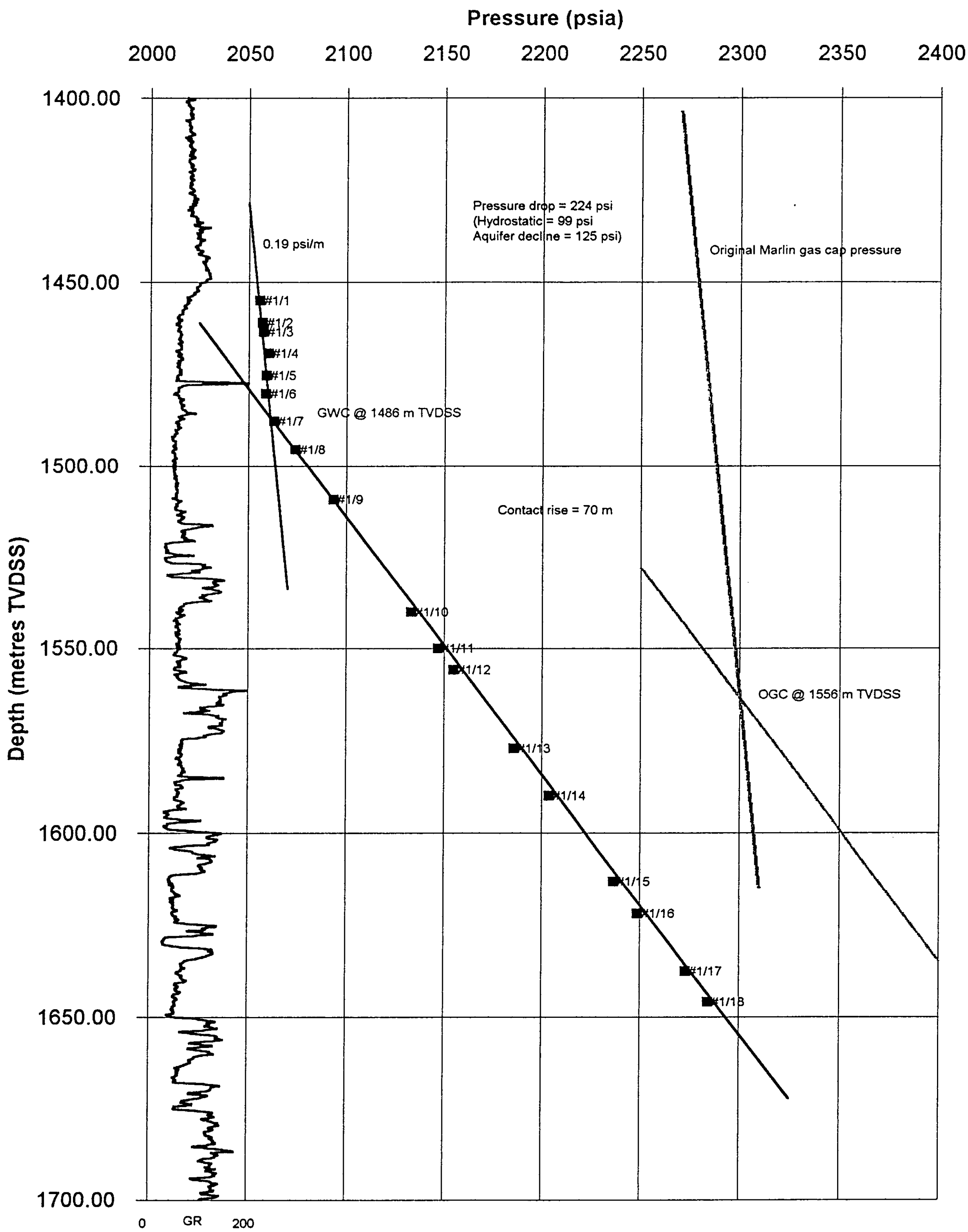
An alternative explanation is that excessive liquids were captured during sampling at the reservoir and that the sample was never representative of the reservoir fluids. Both are equally valid explanations.

FIGURE 1 - Turrum-6 MDT - Full Pressure Dataset



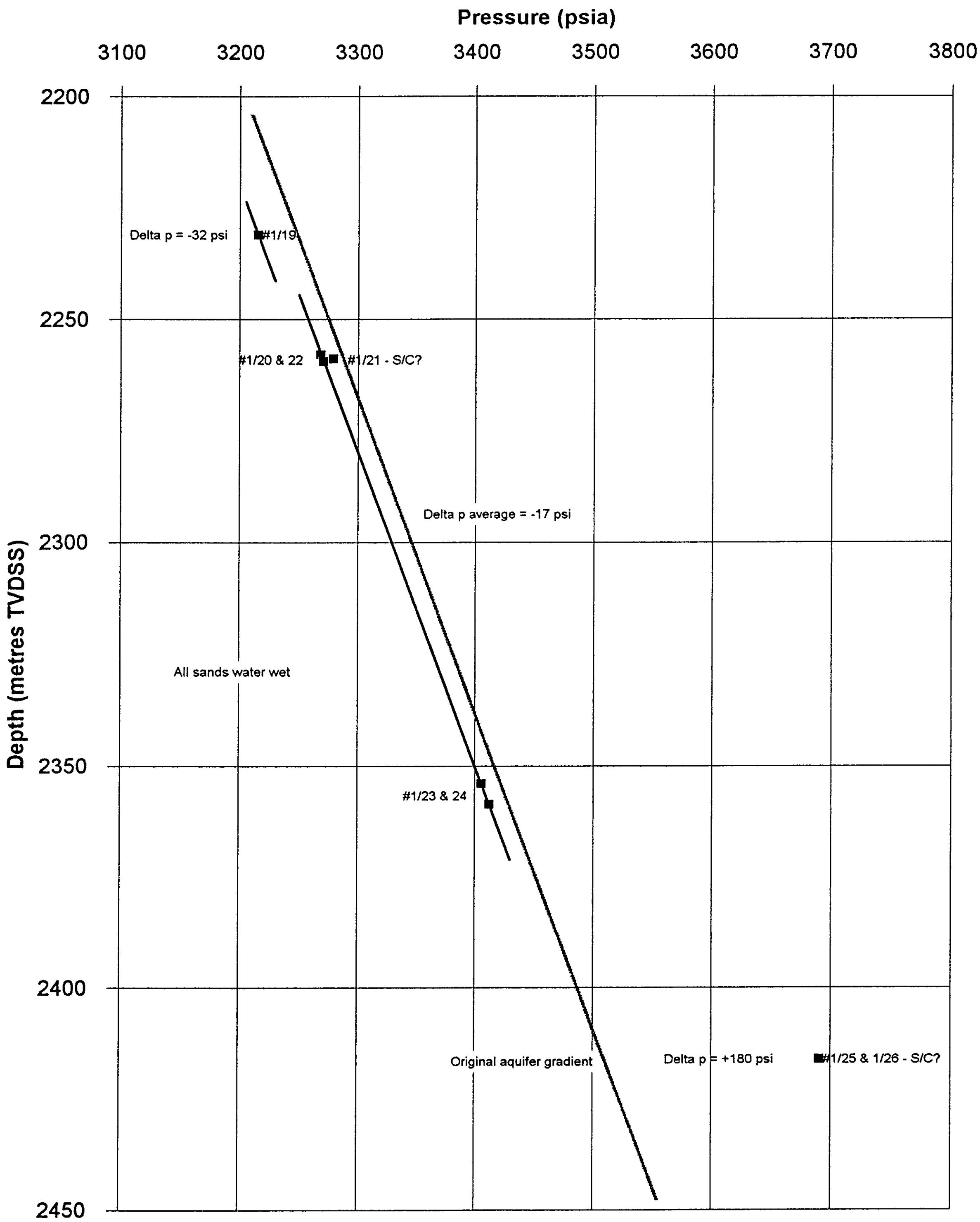
(TKH/MTS/ResTech/T6_MDTF1.XLS/20/12/95)

FIGURE 2 - Turrum-6 MDT - MARLIN @ TOL



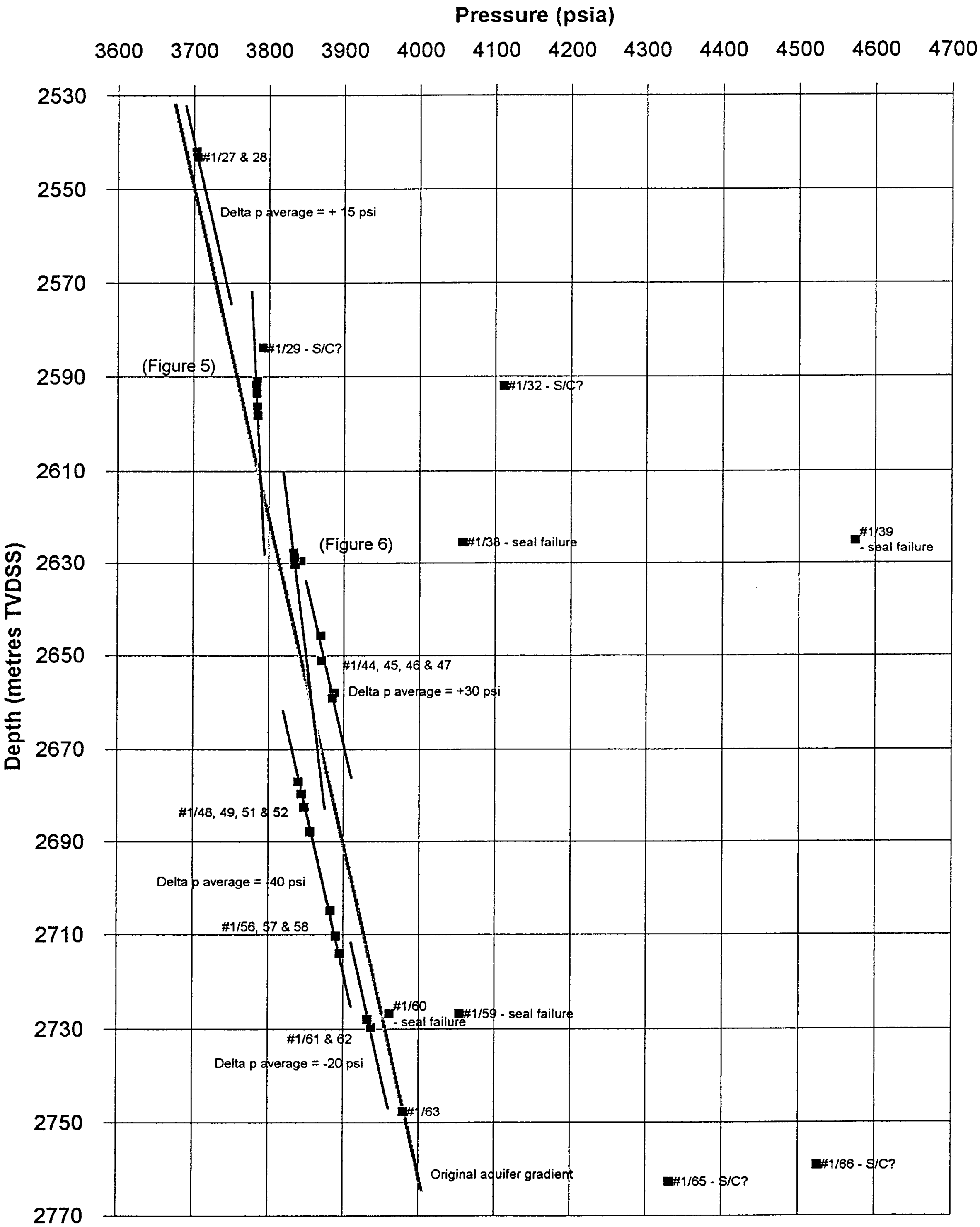
(TKH/MTS/ResTech/T6_TOL.XLS/23/11/95)

FIGURE 3 - Turrum-6 MDT 2200 - 2450 m TVDSS



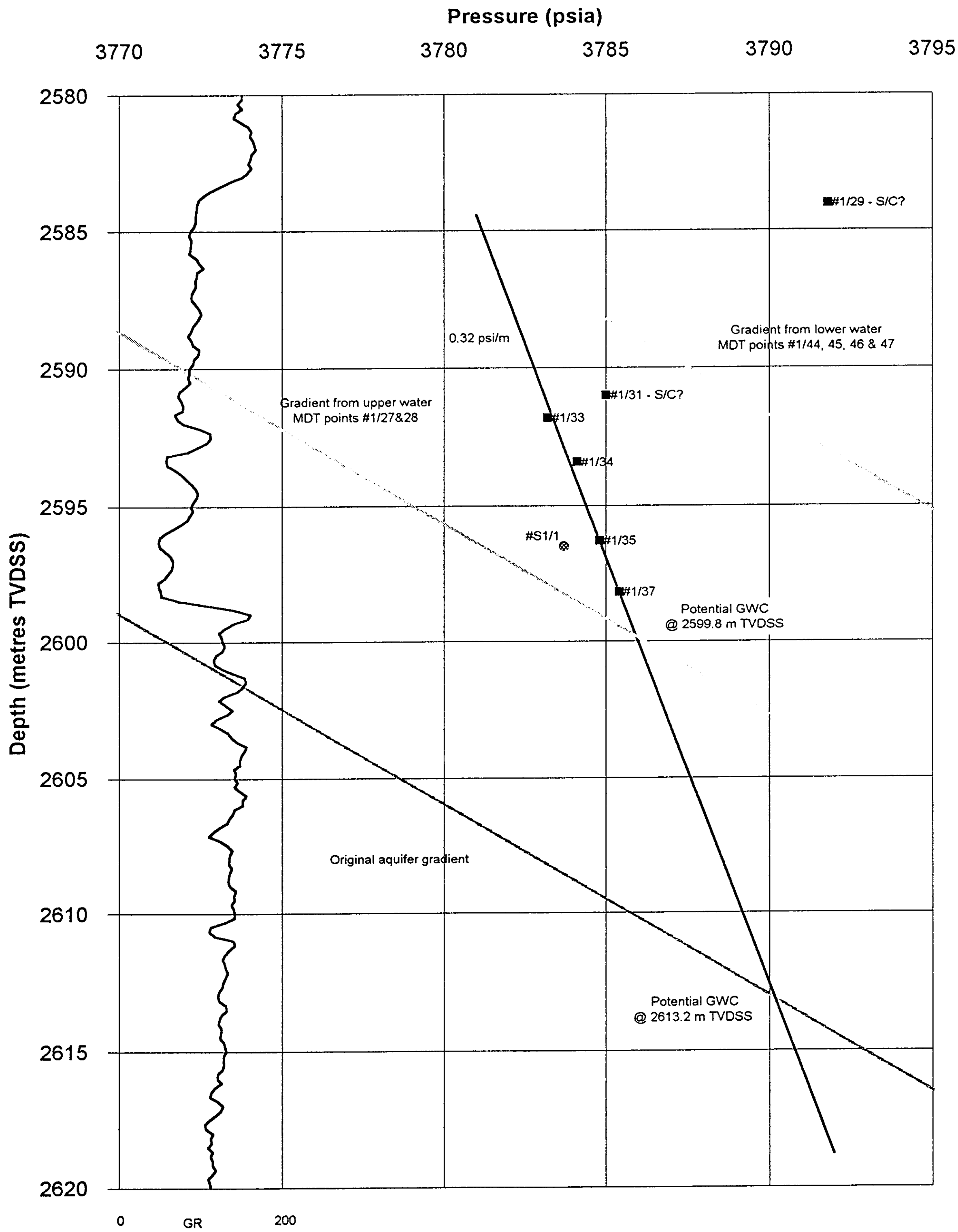
(TKH/MTS/ResTech/T6_MDTF3.XLS/23/11/95)

FIGURE 4 - Turrum-6 MDT 2530 - 2770 m TVDSS



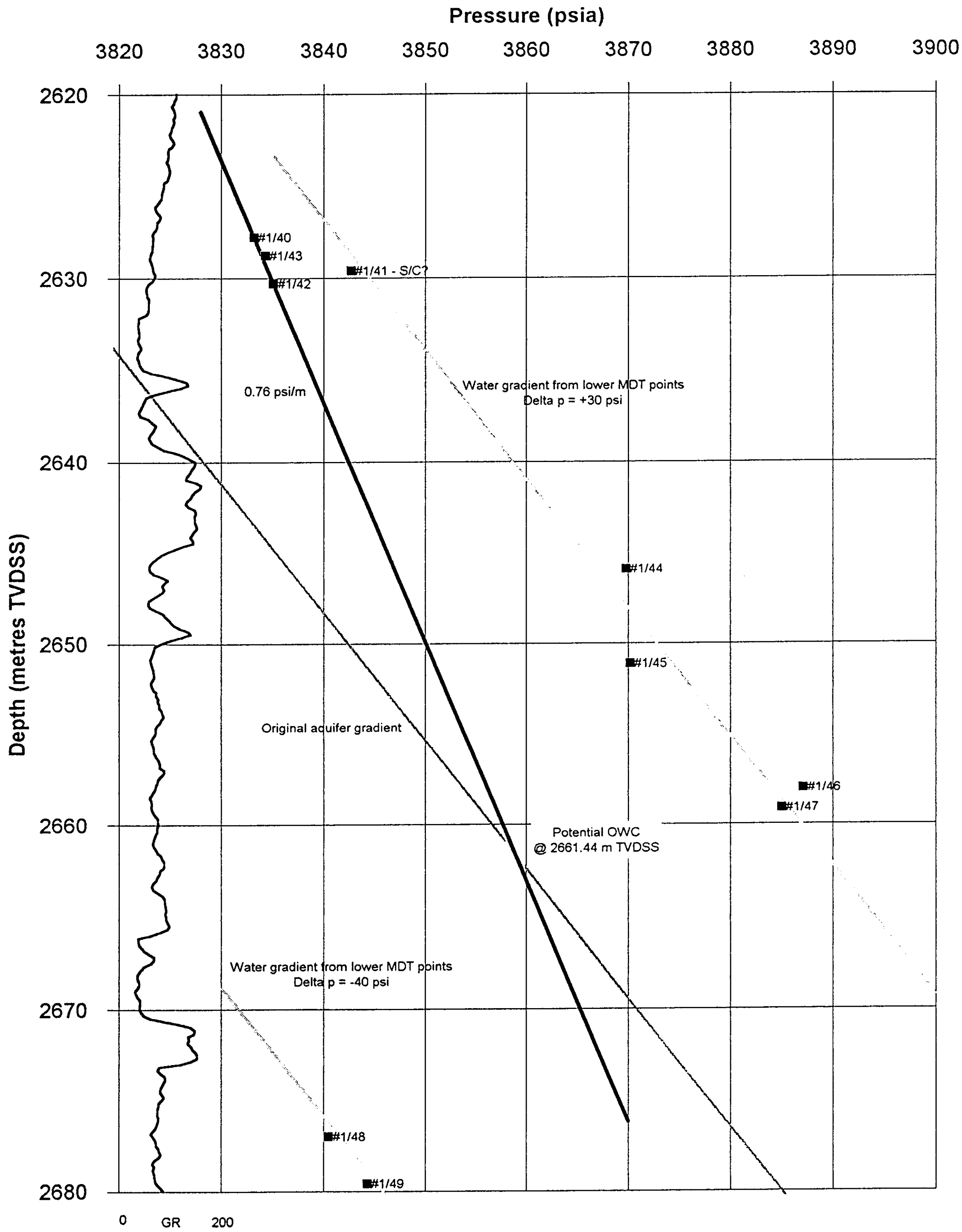
(TKH/MTS/ResTech/T6_MDTF4.XLS/23/11/95)

FIGURE 5 - Turrum-6 MDT 2580 - 2620 m TVDSS



(TKH/MTS/ResTech/T6_MDTF5.XLS/18/01/96)

FIGURE 6 - Turrum-6 MDT 2620 - 2680 m TVDSS



(TKH/MTS/ResTech/T6_MDTF6.XLS/18/01/96)

ESSO AUSTRALIA LTD - PRESSURE DATA FORM

Well	TURRUM-6	Page	1 of 7
Date	12/10/95	Geologist-Engineer	Scott Dodge/Greg Clota
Tool Type (MDT, RFT)	Schlumberger MDT	KB (metres):	25
Gauge Type	CQG (+/- 2 psi + 0.01% rdg, 0.3 psi precision)	Probe type	Long nose
Pressure units (psia, psig)	PSIA	Temperature units (degF, degC)	degC

Run-Seat Number	P=Pretest S=Sample	Depth m MDRKB	Depth m TVDSS	Initial Hydrostatic Pressure	PPg	Time Set (HH:MM)	Minimum Flowing Pressure	Formation Pressure	PPg	Temp	Time Retract (HH:MM)	Final Hydrostatic Pressure	PPg	Delta Time (MM:SS)	Comments Including Test Quality and Fluid Type.
1/1	P	1479.9	1454.9	2569.7	10.19	4:02	1951.0	2055.6	8.15	74.6	4:08	2569.1	10.19	06:00	20cc pretests set md/cp=54.9
1/2	P	1486.0	1461.0	2580.6	10.19	4:11	2054.0	2057.0	8.12	74.9	4:18	2579.4	10.19	07:00	md/cp=1912.2
1/3	P	1488.5	1463.5	2584.5	10.19	4:24	2055.0	2057.4	8.11	74.9	4:29	2583.6	10.19	05:00	md/cp=4453.0
1/4	P	1494.3	1469.3	2594.0	10.19	4:34	2055.0	2060.0	8.09	75.1	4:40	2593.3	10.18	06:00	Partial seal failure md/cp=731.8
1/5	P	1500.1	1475.1	2604.1	10.19	4:45	2040.0	2059.0	8.06	75.6	4:51	2603.1	10.18	06:00	md/cp=701.6
1/6	P	1505.1	1480.1	2612.8	10.19	5:07	2056.0	2058.8	8.03	75.6	5:12	2612.6	10.19	05:00	md/cp=570.1
1/7	P	1512.5	1487.5	2625.6	10.19	5:14	2060.0	2063.0	8.00	75.9	5:20	2625.6	10.19	06:00	md/cp=5288.9
1/8	P	1520.3	1495.3	2639.4	10.19	5:23	2073.0	2073.9	8.01	76.0	5:27	2639.4	10.19	04:00	md/cp=17129.0
1/9	P	1534.3	1509.3	2663.6	10.19	5:30	2092.0	2093.4	8.01	76.0	5:35	2663.5	10.19	05:00	md/cp=14739.8
1/10	P	1565.2	1540.2	2717.3	10.19	5:44	2131.0	2133.1	8.00	76.3	5:48	2717.7	10.19	04:00	md/cp=3358.6

ESSO AUSTRALIA LTD - PRESSURE DATA FORM

Well	TURRUM-6	Page	2 of 7
Date	12/10/95	Geologist-Engineer	Scott Dodge/Greg Clota
Tool Type (MDT, RFT)	Schlumberger MDT	KB (metres):	25
Gauge Type	CQG (+/- 2 psi + 0.01% rdg, 0.3 psi precision)	Probe type	Long nose
Pressure units (psia, psig)	PSIA	Temperature units (degF, degC)	degC

Run-Seat Number	P=Pretest S=Sample	Depth m MDRKB	Depth m TVDSS	Initial Hydrostatic Pressure	PPg	Time Set (HH:MM)	Minimum Flowing Pressure	Formation Pressure	PPg	Temp	Time Retract (HH:MM)	Final Hydrostatic Pressure	PPg	Delta Time (MM:SS)	Comments Including Test Quality and Fluid Type.
1/11	P	1575.0	1550.0	2734.3	10.19	5:52	2143.0	2146.7	8.00	76.6	5:55	2734.2	10.19	03:00	md/cp=1844.3
1/12	P	1580.8	1555.8	2744.3	10.19	5:57	2153.0	2154.8	8.00	76.9	6:04	2744.0	10.19	07:00	md/cp=10658.9
1/13	P	1602.3	1577.3	2781.3	10.19	6:09	2184.0	2185.7	8.01	77.9	6:15	2781.1	10.19	06:00	md/cp=6087.6
1/14	P	1615.1	1590.1	2803.2	10.19	6:17	2201.0	2203.6	8.01	78.0	6:23	2803.2	10.19	06:00	md/cp=2785.0
1/15	P	1638.0	1613.0	2842.3	10.18	6:25	2224.0	2236.4	8.01	78.7	6:32	2842.7	10.18	07:00	md/cp=1035.3
1/16	P	1646.8	1621.8	2857.9	10.18	6:34	2244.0	2248.7	8.01	78.6	6:40	2858.0	10.18	06:00	md/cp=1610.4
1/17	P	1662.5	1637.5	2884.9	10.18	6:42	2270.0	2272.8	8.02	79.2	6:48	2285.0	8.07	06:00	md/cp=3829.8
1/18	P	1670.8	1645.8	2899.4	10.18	6:50	2240.0	2284.2	8.02	79.9	6:56	2899.3	10.18	06:00	md/cp=1643.3
1/19	P	2256.2	2231.2	3905.0	10.16	7:20	3152.8	3215.4	8.36	90.9	7:23	3904.0	10.15	03:00	md/cp=113.5
1/20	P	2283.0	2258.0	3949.5	10.15	7:32	3249.4	3268.7	8.40	93.3	7:36	3949.3	10.15	04:00	md/cp=244.4

ESSO AUSTRALIA LTD - PRESSURE DATA FORM

Well	TURRUM-6	Page	3 of 7
Date	12/10/95	Geologist-Engineer	Scott Dodge/Greg Clota
Tool Type (MDT, RFT)	Schlumberger MDT	KB (metres):	25
Gauge Type	CQG (+/- 2 psi + 0.01% rdg, 0.3 psi precision)	Probe type	Long nose
Pressure units (psia, psig)	PSIA	Temperature units (degF, degC)	degC

Run-Seat Number	P=Pretest S=Sample	Depth m MDRKB	Depth m TVDSS	Initial Hydrostatic Pressure	PPg	Time Set (HH:MM)	Minimum Flowing Pressure	Formation Pressure	PPg	Temp	Time Retract (HH:MM)	Final Hydrostatic Pressure	PPg	Delta Time (MM:SS)	Comments Including Test Quality and Fluid Type.
1/21	P	2284.0	2259.0	3951.3	10.15	7:41	2834.2	3279.0	8.43	94.2	7:45	3950.8	10.15	04:00	Abort - supercharged md/cp=14.2
1/22	P	2284.5	2259.5	3952.0	10.15	7:48	2924.0	3270.7	8.40	95.3	7:55	3951.7	10.15	07:00	10cc pretests set md/cp=17.9
1/23	P	2379.0	2354.0	4112.2	10.14	8:02	3400.0	3405.5	8.40	96.5	8:12	4112.4	10.14	10:00	md/cp=1124.4
1/24	P	2383.7	2358.7	4121.0	10.15	8:15	3386.0	3412.6	8.40	97.6	8:20	4120.8	10.15	05:00	md/cp=197.9
1/25	P	2441.1	2416.1	4218.9	10.14	8:25	3641.0	3690.4	8.87	98.4	8:36	4218.7	10.14	11:00	md/cp=399.4
1/26	P	2441.0	2416.0	4218.9	10.14	8:40	3678.0	3690.4	8.87	99.3	8:44	4219.0	10.14	04:00	Verify test #25 md/cp=443.3
1/27	P	2567.0	2542.0	4433.1	10.13	8:53	3691.0	3703.8	8.47	102.9	9:07	4433.3	10.14	14:00	md/cp=295.0
1/28	P	2568.0	2543.0	4435.7	10.14	9:04	3701.0	3705.2	8.47	103.9	9:13	4435.6	10.14	09:00	md/cp=1145.1
1/29	P	2609.0	2584.0	4505.7	10.13	9:25	364.0	3791.8	8.53	104.6	9:36	4505.3	10.13	11:00	Low perm - S/C? md/cp=0.3
1/30	P	2615.1	2590.1	4515.9	10.13	9:42	334.0	359.0	0.81	107.1	9:46	-	-	04:00	Abort - tight md/cp=n/a

ESSO AUSTRALIA LTD - PRESSURE DATA FORM

Well	TURRUM-6	Page	4 of 7
Date	12/10/95	Geologist-Engineer	Scott Dodge/Greg Clota
Tool Type (MDT, RFT)	Schlumberger MDT	KB (metres):	25
Gauge Type	CQG (+/- 2 psi + 0.01% rdg, 0.3 psi precision)	Probe type	Long nose
Pressure units (psia, psig)	PSIA	Temperature units (degF, degC)	degC

Run-Seat Number	P=Pretest S=Sample	Depth m MDRKB	Depth m TVDSS	Initial Hydrostatic Pressure	PPg	Time Set (HH:MM)	Minimum Flowing Pressure	Formation Pressure	PPg	Temp	Time Retract (HH:MM)	Final Hydrostatic Pressure	PPg	Delta Time (MM:SS)	Comments Including Test Quality and Fluid Type.
1/31	P	2616.0	2591.0	4517.6	10.13	9:50	1460.0	3785.0	8.49	107.4	9:56	4517.3	10.13	06:00	md/cp=1.9
1/32	P	2617.0	2592.0	4519.4	10.13	10:00	835.0	4111.0	9.22	108.8	10:07	4519.1	10.13	07:00	Supercharged md/cp=0.9
1/33	P	2616.8	2591.8	4519.3	10.14	10:10	3711.0	3783.2	8.48	109.1	10:15	4518.8	10.13	05:00	md/cp=73.4
1/34	P	2618.4	2593.4	4521.8	10.13	10:17	3710.0	3784.1	8.48	109.1	10:22	4521.4	10.13	05:00	md/cp=88.5
1/35	P	2621.3	2596.3	4526.6	10.13	10:24	3781.0	3784.8	8.47	109.6	10:32	4526.3	10.13	08:00	md/cp=925.3
1/36	P	2623.4	2598.4	4530.1	10.13	10:33	269.0	-	-	110.3	10:39	4530.4	10.13	06:00	Tight-abort md/cp=n/a
1/37	P	2623.2	2598.2	4529.8	10.13	10:40	3681.0	3785.4	8.47	110.2	10:46	4529.6	10.13	06:00	md/cp=68.6
1/38	P	2650.5	2625.5	4575.5	10.13	10:56	2987.0	4057.0	8.98	111.0	11:02	4574.8	10.13	06:00	Seal failure md/cp=3.3
1/39	P	2650.2	2625.2	4575.1	10.13	11:06	-	4574.0	10.13	111.6	11:10	4574.9	10.13	04:00	Seal failure md/cp=n/a
1/40	P	2652.8	2627.8	4579.3	10.13	11:12	3657.0	3833.2	8.48	111.9	11:20	4579.0	10.13	08:00	20cc pretests set md/cp=36.6

ESSO AUSTRALIA LTD - PRESSURE DATA FORM

Well	TURRUM-6	Page	5 of 7
Date	12/10/95	Geologist-Engineer	Scott Dodge/Greg Clota
Tool Type (MDT, RFT)	Schlumberger MDT	KB (metres):	25
Gauge Type	CQG (+/- 2 psi + 0.01% rdg, 0.3 psi precision)	Probe type	Long nose
Pressure units (psia, psig)	PSIA	Temperature units (degF, degC)	degC

Run-Seat Number	P=Pretest S=Sample	Depth m MDRKB	Depth m TVDSS	Initial Hydrostatic Pressure	PPg	Time Set (HH:MM)	Minimum Flowing Pressure	Formation Pressure	PPg	Temp	Time Retract (HH:MM)	Final Hydrostatic Pressure	PPg	Delta Time (MM:SS)	Comments Including Test Quality and Fluid Type.
1/41	P	2654.6	2629.6	4582.2	10.13	11:25	3047.0	3842.7	8.50	112.0	11:32	4582.0	10.13	07:00	Abort - supercharged md/cp=4.8 10cc pretests set
1/42	P	2655.3	2630.3	4583.4	10.13	11:35	3763.0	3835.3	8.48	112.5	11:39	4583.3	10.13	04:00	md/cp=66.1
1/43	P	2653.8	2628.8	4580.9	10.13	11:44	1678.0	3834.3	8.48	112.6	11:47	4580.6	10.13	03:00	md/cp=3.2
1/44	P	2670.9	2645.9	4609.5	10.13	11:57	3721.0	3869.8	8.50	112.5	12:00	4609.5	10.13	03:00	md/cp=42.8
1/45	P	2676.1	2651.1	4618.8	10.13	12:05	2710.0	3870.2	8.49	113.0	12:10	4618.6	10.13	05:00	md/cp=4.2
1/46	P	2683.0	2658.0	4630.3	10.13	12:15	603.0	3887.1	8.50	113.5	12:27	4629.8	10.13	12:00	md/cp=1.3
1/47	P	2684.1	2659.1	4629.9	10.12	12:30	1627.0	3885.0	8.49	114.6	12:40	4629.6	10.12	10:00	md/cp=2.8
1/48	P	2702.0	2677.0	4660.5	10.12	12:45	2874.0	3840.5	8.34	114.9	12:55	4660.4	10.12	10:00	20cc pretests set md/cp=7.9
1/49	P	2704.6	2679.6	4666.3	10.13	13:00	3741.0	3844.3	8.34	115.4	13:04	4666.3	10.13	04:00	md/cp=77.0
1/50	P	2707.5	2682.5	4671.1	10.12	13:07	3689.0	-	-	-	-	4671.2	10.12	-	Seal failure md/cp=n/a

ESSO AUSTRALIA LTD - PRESSURE DATA FORM

Well	TURRUM-6	Page	6 of 7
Date	12/10/95	Geologist-Engineer	Scott Dodge/Greg Clota
Tool Type (MDT, RFT)	Schlumberger MDT	KB (metres):	25
Gauge Type	CQG (+/- 2 psi + 0.01% rdg, 0.3 psi precision)	Probe type	Long nose
Pressure units (psia, psig)	PSIA	Temperature units (degF, degC)	degC

Run-Seat Number	P=Pretest S=Sample	Depth m MDRKB	Depth m TVDSS	Initial Hydrostatic Pressure	PPg	Time Set (HH:MM)	Minimum Flowing Pressure	Formation Pressure	PPg	Temp	Time Retract (HH:MM)	Final Hydrostatic Pressure	PPg	Delta Time (MM:SS)	Comments Including Test Quality and Fluid Type.
1/51	P	2707.5	2682.5	4671.1	10.12	13:12	3735.0	3848.2	8.34	116.5	13:15	4671.2	10.12	03:00	md/cp=58.9
1/52	P	2712.9	2687.9	4680.2	10.12	13:20	3414.0	3855.8	8.34	116.7	13:24	4680.2	10.12	04:00	md/cp=18.7
1/53	P	2718.7	2693.7	4689.9	10.12	13:26	164.0	452.0	0.98	117.1	13:34	-	-	08:00	Tight md/cp=n/a
1/54	P	2718.5	2693.5	4690.5	10.13	13:35	-	-	-	-	13:40	-	-	05:00	Tight md/cp=n/a
1/55	P	2718.3	2693.3	4689.7	10.12	13:48	140.0	290.0	0.63	118.0	13:56	4689.3	10.12	08:00	Tight md/cp=n/a
1/56	P	2729.9	2704.9	4709.2	10.12	13:59	3838.0	3882.7	8.35	118.2	14:08	4708.9	10.12	09:00	md/cp=188.1
1/57	P	2735.3	2710.3	4718.5	10.12	14:05	3841.0	3890.2	8.35	118.3	14:17	4718.3	10.12	12:00	md/cp=113.8
1/58	P	2739.0	2714.0	4724.8	10.12	14:22	901.0	3895.2	8.35	119.2	14:30	4724.5	10.12	08:00	md/cp=2.8
1/59	P	2751.8	2726.8	4746.4	10.12	14:31	2619.0	4054.0	8.65	119.2	14:40	4746.3	10.12	09:00	Seal failure md/cp=n/a
1/60	P	2751.8	2726.8	4746.2	10.12	14:41	2857.0	3961.0	8.45		14:47	4745.9	10.12	06:00	md/cp=6.88

ESSO AUSTRALIA LTD - PRESSURE DATA FORM

Well	TURRUM-6	Page	7 of 7
Date	12/10/95	Geologist-Engineer	Scott Dodge/Greg Clota
Tool Type (MDT, RFT)	Schlumberger MDT	KB (metres):	25
Gauge Type	CQG (+/- 2 psi + 0.01% rdg, 0.3 psi precision)	Probe type	Long nose
Pressure units (psia, psig)	PSIA	Temperature units (degF, degC)	degC

Run-Seat Number	P=Pretest S=Sample	Depth m MDRKB	Depth m TVDSS	Initial Hydrostatic Pressure	PPg	Time Set (HH:MM)	Minimum Flowing Pressure	Formation Pressure	PPg	Temp	Time Retract (HH:MM)	Final Hydrostatic Pressure	PPg	Delta Time (MM:SS)	Comments Including Test Quality and Fluid Type.
1/61	P	2754.7	2729.7	4751.1	10.12	14:50	147.0	3937.0	8.39	120.0	14:58	4750.8	10.12	08:00	Low perm - S/C? md/cp=1.3
1/62	P	2753.0	2728.0	4748.2	10.12	15:03	3272.0	3931.7	8.38	120.0	15:07	4747.8	10.12	04:00	md/cp=15.3
1/63	P	2772.7	2747.7	4781.8	10.12	15:17	169.0	3979.3	8.42	120.6	15:26	4781.1	10.12	09:00	Low perm - S/C? md/cp=1.5
1/64	P	2784.1	2759.1	4800.7	10.12	15:35	60.0	65.0	0.14	-	-	-	-	-	Abort -tight md/cp=n/a
1/65	P	2787.8	2762.8	4806.8	10.12	15:45	3501.0	4331.3	9.12	121.0	15:47	4806.1	10.12	02:00	md/cp=10.4
1/66	P	2784.2	2759.2	4800.6	10.12	15:53	2755.0	4525.0	9.54	121.0	15:55	-	-	02:00	5cc pretest set md/cp=1.1 Abort - S/C?

ESSO AUSTRALIA LTD

WELL : TURRUM-6

OBSERVER : DODGE | CLOTA   DATE : 12/10/95   RUN No. : 1

	CHAMBER 1 (lit.) 6 GALLON		CHAMBER 2 (lit.) 2¾ GALLON	
SEAT NO.	1		2	
DEPTH	2621.5	m	2621.5	m
A. RECORDING TIMES				
Tool Set	1620	hrs		hrs
Pretest Duration	2	mins		mins
Chamber Open	1622	hrs	16:30	hrs
Chamber Full	—	mins	3	mins
Seal Chamber	16:30	hrs	16:33	hrs
Fill Time	18	mins	4	mins
Finish Build Up	—	hrs	16:34	hrs
Build Up Time	—	mins	1	mins
Tool Retract	—	hrs		hrs
Total Time	—	mins		mins
B. SAMPLE PRESSURE				
Initial Hydrostatic	4525.2	psia	—	psia
Initial Formation Pressure (Pretest)	3783.7	psia	—	psia
Initial Flowing Pressure — THROTTLED	3000	psia	1967	psia
Final Flowing Pressure	3631	psia	2998	psia
Final Form'n Pressure	—	psia	3783.3	psia
Final Hydrostatic	—	psia	—	psia
C. TEMPERATURE				
Temp. @ Sample Depth (AMS)	110	deg C	110	deg C
Rm @ Sample Depth (AMS)	0.06	ohm-m	0.06	ohm-m
D. SAMPLE RECOVERY				
Surface Pressure	1800	psia	1350	psia
Volume Gas	159.1	cu ft	52.7	cu ft
Volume Oil	—	lit	—	lit
Volume Condensate	350 cc	lit	250cc	lit
Volume Water (Total)	MUD 100 cc	lit	MUD 250cc	lit
E. SAMPLE PROPERTIES				
Gas Composition				
C1	45279	ppm	58728	ppm
C2	21694	ppm	31405	ppm
C3	9094	ppm	16683	ppm
C4	1726	ppm	2150	ppm
C5	246	ppm	116	ppm
C6+	—	ppm		ppm
CO_2/H_2S	18% / —	ppm	16% / —	ppm
Oil/Cond. Properties	59.9 deg API @ 15.5	deg C	59.9 deg API @ 15.5	deg C
Colour	CLEAR / STRAW		CLEAR / STRAW	
Fluorescence	BLUE / WHITE		BLUE / WHITE	
~~GOR~~ CGR (bbl/mmscf)	13.8		29.9	
Pour Point	>0		>0	
Water Properties				
Resistivity	ohm-m @	deg C	ohm-m @	deg C
NaCl Equivalent		ppm		ppm
Cl-titrated		ppm		ppm
Tritium		DPM		DPM
pH				
Est. Water Type				
F. MUD FILTRATE PROPERTIES				
Resistivity	0.133 ohm-m @ 14	deg C	0.133 ohm-m @ 14	deg C
NaCl Equivalent	49,995	ppm	49,995	ppm
Cl-titrated	30,300	ppm	30,300	ppm
pH	8.6		8.6	
Tritium (in Mud)	—	DPM	—	DPM
G. GENERAL CALIBRATION				
Mud Weight	10.1	ppg	10.1	ppg
Calc. Hydrostatic	4515	psi	4515	psi
Serial No. (Preserved)	—		—	
Choke Size/Probe Type	VARIABLE		VARIABLE	
REMARKS				

ESSO AUSTRALIA LTD

WELL: TURRUM-6

OBSERVER: DODGE | CLOTA   DATE: 12/10/95   RUN No.: 1

	CHAMBER 1 (lit.) 1 GALLON		CHAMBER 2 (lit.)	
SEAT NO.	3			
DEPTH	2621.5	m		m
A. RECORDING TIMES				
Tool Set		hrs		hrs
Pretest Duration	—	mins		mins
Chamber Open	16:33	hrs		hrs
Chamber Full	4	mins		mins
Seal Chamber	16:45	hrs		hrs
Fill Time	12	mins		mins
Finish Build Up	16:45	hrs		hrs
Build Up Time	0	mins		mins
Tool Retract	16:45	hrs		hrs
Total Time	12	mins		mins
B. SAMPLE PRESSURE				
Initial Hydrostatic	—	psia		psia
Initial Formation Pressure (Pretest)	—	psia		psia
Initial Flowing Pressure	2944	psia		psia
Final Flowing Pressure	3774	psia		psia
Final Form'n Pressure	3784.5	psia		psia
Final Hydrostatic	4525.0	psia		psia
C. TEMPERATURE				
Temp. @ Sample Depth (AMS)	113	deg C		deg C
Rm @ Sample Depth (AMS)	0.06	ohm-m		ohm-m
D. SAMPLE RECOVERY				
Surface Pressure		psia		psia
Volume Gas	/	cu ft		cu ft
Volume Oil		lit		lit
Volume Condensate		lit		lit
Volume Water (Total)		lit		lit
E. SAMPLE PROPERTIES				
Gas Composition				
C1	/	ppm		ppm
C2		ppm		ppm
C3		ppm		ppm
C4		ppm		ppm
C5		ppm		ppm
C6+		ppm		ppm
CO2/H2S	% /	ppm	% /	ppm
Oil/Cond. Properties	deg API @	deg C	deg API @	deg C
Colour	/			
Fluorescence				
GOR				
Pour Point				
Water Properties				
Resistivity	ohm-m @	deg C	ohm-m @	deg C
NaCl Equivalent	/	ppm		ppm
Cl-titrated		ppm		ppm
Tritium		DPM		DPM
pH				
Est. Water Type				
F. MUD FILTRATE PROPERTIES				
Resistivity	0.133 ohm-m @ 14	deg C	ohm-m @	deg C
NaCl Equivalent	49,995	ppm		ppm
Cl-titrated	30,300	ppm		ppm
pH	8.6			
Tritium (in Mud)	—	DPM		DPM
G. GENERAL CALIBRATION				
Mud Weight	10.1	ppg		ppg
Calc. Hydrostatic	4515	psi		psi
Serial No. (Preserved)	MRSC BB90			
Choke Size/Probe Type	VARIABLE			
REMARKS	SAMPLE PRESERVED (1800 psi @ SURFACE)			

APPENDIX 4

APPENDIX 4

TURRUM 6

Core Analysis

ROUTINE CORE ANALYSIS REPORT
of
TURRUM NO. 6
for
ESSO AUSTRALIA LIMITED
by
ACS LABORATORIES PTY LTD

22nd March, 1996

ACS
LABORATORIES
PTY. LTD.

Esso Australia Limited
360 Elizabeth Street
MELBOURNE VIC 3000

Attention: A. Mills

REPORT: 002-233 - WELL NAME: TURRUM NO.6

CLIENT REFERENCE: Contract No. 2710080 RFS No. 5

MATERIAL: Core Plugs

LOCALITY: Gippsland Basin VIC-L-3

WORK REQUIRED: Routine Core Analysis

Please direct technical enquiries regarding this work to the signatory below under whose supervision the work was carried out.

W J (Bill) DERKSEMA
Laboratory Supervisor
on behalf of ACS Laboratories Pty. Ltd.

Address: P.O. Box 396, Chermside, Qld. 4032 Australia
Telephone: 61 7 3350 1222 Facsimile: 61 7 3359 0666
E-mail: acs.bris@b022.aone.net.au

ACS Laboratories Pty. Ltd.
ACN: 008 273 005

CONTENTS

PLOTS

22nd March, 1996

ACS
LABORATORIES
PTY. LTD.

Esso Australia Limited
360 Elizabeth Street
MELBOURNE VIC 3000

Attention: A. Mills

FINAL DATA REPORT - ROUTINE CORE ANALYSIS

REPORT: 002-233 WELL NAME: TURRUM NO. 6

LOGISTICS

70 core plugs were delivered to ACS Laboratories, Brisbane on 17th January, 1996. The plugs (including vertical plugs) arrived stored in vials and consisted of 70 plugs from Core No. 1.

INTRODUCTION

The following report includes tabular data of permeability to air, helium injection porosity and density determinations. Data presented graphically includes a core log plot of the above and a porosity versus permeability to air plot.

Analysis commenced after pilot study on Turrum No. 6.

STUDY AIMS

The analyses were performed with the following aims:

1. To provide overburden air permeability, helium injection porosity and density data.

Samples were prepared and analysed as follows:

1. SAMPLE EXTRACTION

Cleaning was performed in a soxhlet system using a refluxing azeotropic solvent of 3:1 chloroform: methanol. This technique was utilised such that the samples and the condensing solvent were not exposed to heating elements and therefore at room temperature. Cleaning continued until tests for oil (fluorescence under UV light) and salt (silver nitrate precipitation) showed negative.

2. SAMPLE DRYING

After cleaning, all plugs were dried in a controlled humidity environment at 50°C and 50% relative humidity. The plugs were stored in an airtight plastic container and allowed to cool to room temperature before analysis.

3. OVERBURDEN AIR PERMEABILITY

The plugs are placed in a heavy duty Hassler sleeve. The assembly is loaded into a thick walled hydrostatic cell capable of withstanding the simulated reservoir overburden stress. The overburden pressure used, as supplied by Esso, was 4480 psi.

During the measurement a known air pressure is applied to the upstream face of the sample, creating a flow of air through the sample. Permeability for each sample is then calculated using Darcy's Law through knowledge of the upstream pressure and flow rate during the test, the viscosity of air and the plug dimensions.

4. OVERBURDEN HELIUM INJECTION POROSITY

Overburden Helium Injection Porosities are determined indirectly by the following method.

The apparent grain volume of each sample was measured by expansion of helium into the sample loaded in a matrix cup. The grain volume is derived by application of Boyle's law. The bulk volume of the sample is determined by mercury immersion. The sample is then loaded into a hydrostatic cell where the pore volume reduction, from ambient to the applied overburden stress is determined by measuring changes in the helium pressure within the pore space and applying Boyle's law. The reduction in the bulk volume is assumed to be equivalent to a reduction in the pore volume. Grain volume remains constant.

5. APPARENT GRAIN DENSITY

The apparent grain density is determined by dividing the weight of the plug by the grain volume determined from the helium injection porosity measurement.

6. ABSOLUTE GRAIN DENSITY

A plug offcut, uncleaned and oven dried, is used for this measurement. The sample is crushed to approximately grain size or a little coarser and the granular material weighed. The volume of the grains is determined by pyconometry. By this means the actual density of the grains is determined.

On completion of the analysis the plug samples were re-wrapped in gladwrap and tissue, and are presently stored at ACS Laboratories for possible future studies.

We have enjoyed working for Esso look forward to working with you in the near future.

END OF REPORT

ACS LABORATORIES PTY. LTD.

ACN: 008 273 005

Petroleum Reservoir Engineering Data

OVERBURDEN ANALYSIS FINAL REPORT

Overburden Pressure: 4480 psi

Company	ESSO AUSTRALIA LTD.	**Date**	22-Feb-96
Well	TURRUM # 6 ST 1	**File**	002 - 233
Field	TURRUM	**Location**	Vic - L - 3
Core Int.	C#1: 2611.00 - 2626.80m	**ACS Lab.**	Brisbane 002
		Analyst	WJD, BJS

Sample Number	Depth (meters)	Permeability to Air (millidarcys)	Porosity (percent)	Grain Density Calculated (g/cm^3)	Grain Density Absolute (g/cm^3)	Remarks
3	2611.20	0.04	8.4	2.67	2.66	
5	2611.40	1.70	12.0	2.67	2.67	
7	2611.60	0.13	8.6	2.67	2.67	
9	2611.80	0.04	7.1	2.65	2.65	
11V	2611.90	0.03	9.2	2.67	2.67	Vertical
13	2612.00	0.06	6.9	2.66	2.69	
15	2612.20	1.38	6.9	2.62	2.64	
17	2612.40	0.04	8.2	2.67	2.68	
21	2612.80	85	15.8	2.65	2.64	
25	2613.00	0.02	4.4	2.77	2.71	
29	2613.45	121	16.7	2.65	2.66	
31	2613.60	23	14.8	2.66	2.67	
33	2613.80	7.18	12.5	2.65	2.66	
35V	2613.90	<0.01	9.3	2.65	2.65	Vertical
37	2614.00	14	11.8	2.66	2.66	
39	2614.16	0.32	10.3	2.65	2.66	
41	2614.35	1049	20.3	2.66	2.66	
43	2614.60	2572	22.0	2.65	2.65	
45	2614.77	2306	18.2	2.65	2.67	
47V	2614.90	<0.01	7.8	2.66	2.67	Vertical
49	2615.00	0.67	11.4	2.67	2.69	
51	2615.20	0.05	4.5	2.67	2.67	
53	2615.40	0.02	6.6	2.66	2.65	
55	2615.60	3.74	12.3	2.65	2.65	
57	2615.80	51	15.8	2.66	2.68	
59V	2615.90	12	16.7	2.66	2.67	Vertical
61	2616.00	2065	21.1	2.65	2.66	
63	2616.20	816	18.2	2.65	2.65	
65	2616.43	8.03	12.4	2.65	2.64	
67	2616.60	0.14	7.8	2.39	2.44	
69	2616.80	0.26	9.9	2.68	2.67	
71V	2616.90	0.04	9.3	2.67	2.66	Vertical
73	2617.00	0.08	8.0	2.67	2.66	
75	2617.20	0.07	9.1	2.67	2.68	

Sample Number	Depth (meters)	Permeability to Air (millidarcys)	Porosity (percent)	Grain Density Calculated (g/cm^3)	Grain Density Absolute (g/cm^3)	Remarks
77	2617.40	0.05	8.3	2.65	2.65	
79	2617.60	0.06	8.5	2.66	2.66	
81	2617.80	0.33	10.6	2.66	2.65	
83V	2617.90	0.09	10.8	2.66	2.68	Vertical
85	2618.00	0.22	10.4	2.66	2.66	
87	2618.20	0.02	7.4	2.68	2.67	
89	2618.40	0.10	9.3	2.75	2.75	
91	2618.60	4.43	12.4	2.68	2.66	
93	2618.80	5106	21.6	2.65	2.63	
95V	2618.90	2593	21.2	2.65	2.65	Vertical
97	2619.05	2314	20.8	2.65	2.65	
99	2619.20	2199	20.4	2.65	2.64	
101	2619.40	102	13.1	2.66	2.67	
103	2619.60	350	18.8	2.65	2.65	
105	2619.80	14	14.5	2.66	2.67	
107V	2619.90	1.55	13.9	2.66	2.66	Vertical
109	2620.00	0.44	9.2	2.68	2.67	
111	2620.20	53	15.0	2.66	2.67	
113	2620.40	5048	22.6	2.65	2.65	
115	2620.60	342	17.8	2.65	2.65	
117	2620.80	1357	20.2	2.65	2.64	
119V	2620.90	72	20.8	2.65	2.65	Vertical
121	2621.02	6426	21.4	2.65	2.66	
123	2621.20	7915	22.0	2.65	2.63	
125	2621.40	1812	17.5	2.59	2.6	
133	2622.00	<0.01	3.6	2.67	2.67	
135	2622.20	<0.01	5.0	2.66	2.67	
137	2622.40	<0.01	6.1	2.66	2.66	
139	2622.60	<0.01	4.7	2.67	2.67	
141	2622.80	<0.01	4.5	2.67	2.67	
143V	2622.90	<0.01	5.3	2.66	2.66	Vertical
145	2623.00	<0.01	3.7	2.65	2.64	
147	2623.20	<0.01	5.0	2.62	2.62	
149	2623.40	0.03	8.6	2.66	2.64	
151	2623.60	0.10	10.0	2.67	2.67	
153	2623.80	0.02	8.0	2.66	2.67	

ACS LABORATORIES PTY. LTD.

ACN: 008 273 005

Petroleum Reservoir Engineering Data

OVERBURDEN ANALYSIS FINAL REPORT

Overburden Pressure: 4480 psi

Company	ESSO AUSTRALIA LTD.	**Date**	22-Feb-96
Well	TURRUM # 6 ST 1	**File**	002 - 233
Field	TURRUM	**Location**	Vic - L - 3
Core Int.	C#1: 2611.00 - 2626.80m	**ACS Lab.**	Brisbane 002
		Analyst	WJD, BJS

Sample Number	Depth (meters)	Permeability to Air (millidarcys)	Porosity (percent)	Grain Density Calculated (g/cm³)	Grain Density Absolute (g/cm³)	Remarks
3	2611.20	0.04	8.4	2.67	2.66	
5	2611.40	1.70	12.0	2.67	2.67	
7	2611.60	0.13	8.6	2.67	2.67	
9	2611.80	0.04	7.1	2.65	2.65	
13	2612.00	0.06	6.9	2.66	2.69	
15	2612.20	1.38	6.9	2.62	2.64	
17	2612.40	0.04	8.2	2.67	2.68	
21	2612.80	85	15.8	2.65	2.64	
25	2613.00	0.02	4.4	2.77	2.71	
29	2613.45	121	16.7	2.65	2.66	
31	2613.60	23	14.8	2.66	2.67	
33	2613.80	7.18	12.5	2.65	2.66	
37	2614.00	14	11.8	2.66	2.66	
39	2614.16	0.32	10.3	2.65	2.66	
41	2614.35	1049	20.3	2.66	2.66	
43	2614.60	2572	22.0	2.65	2.65	
45	2614.77	2306	18.2	2.65	2.67	
49	2615.00	0.67	11.4	2.67	2.69	
51	2615.20	0.05	4.5	2.67	2.67	
53	2615.40	0.02	6.6	2.66	2.65	
55	2615.60	3.74	12.3	2.65	2.65	
57	2615.80	51	15.8	2.66	2.68	
61	2616.00	2065	21.1	2.65	2.66	
63	2616.20	816	18.2	2.65	2.65	
65	2616.43	8.03	12.4	2.65	2.64	
67	2616.60	0.14	7.8	2.39	2.44	
69	2616.80	0.26	9.9	2.68	2.67	
73	2617.00	0.08	8.0	2.67	2.66	
75	2617.20	0.07	9.1	2.67	2.68	
77	2617.40	0.05	8.3	2.65	2.65	
79	2617.60	0.06	8.5	2.66	2.66	
81	2617.80	0.33	10.6	2.66	2.65	
85	2618.00	0.22	10.4	2.66	2.66	
87	2618.20	0.02	7.4	2.68	2.67	

Sample Number	Depth (meters)	Permeability to Air (millidarcys)	Porosity (percent)	Grain Density Calculated (g/cm^3)	Grain Density Absolute (g/cm^3)	Remarks
89	2618.40	0.10	9.3	2.75	2.75	
91	2618.60	4.43	12.4	2.68	2.66	
93	2618.80	5106	21.6	2.65	2.63	
97	2619.05	2314	20.8	2.65	2.65	
99	2619.20	2199	20.4	2.65	2.64	
101	2619.40	102	13.1	2.66	2.67	
103	2619.60	350	18.8	2.65	2.65	
105	2619.80	14	14.5	2.66	2.67	
109	2620.00	0.44	9.2	2.68	2.67	
111	2620.20	53	15.0	2.66	2.67	
113	2620.40	5048	22.6	2.65	2.65	
115	2620.60	342	17.8	2.65	2.65	
117	2620.80	1357	20.2	2.65	2.64	
121	2621.02	6426	21.4	2.65	2.66	
123	2621.20	7915	22.0	2.65	2.63	
125	2621.40	1812	17.5	2.59	2.6	
133	2622.00	<0.01	3.6	2.67	2.67	
135	2622.20	<0.01	5.0	2.66	2.67	
137	2622.40	<0.01	6.1	2.66	2.66	
139	2622.60	<0.01	4.7	2.67	2.67	
141	2622.80	<0.01	4.5	2.67	2.67	
145	2623.00	<0.01	3.7	2.65	2.64	
147	2623.20	<0.01	5.0	2.62	2.62	
149	2623.40	0.03	8.6	2.66	2.64	
151	2623.60	0.10	10.0	2.67	2.67	
153	2623.80	0.02	8.0	2.66	2.67	

ACS LABORATORIES PTY. LTD.

ACN: 008 273 005

Petroleum Reservoir Engineering Data

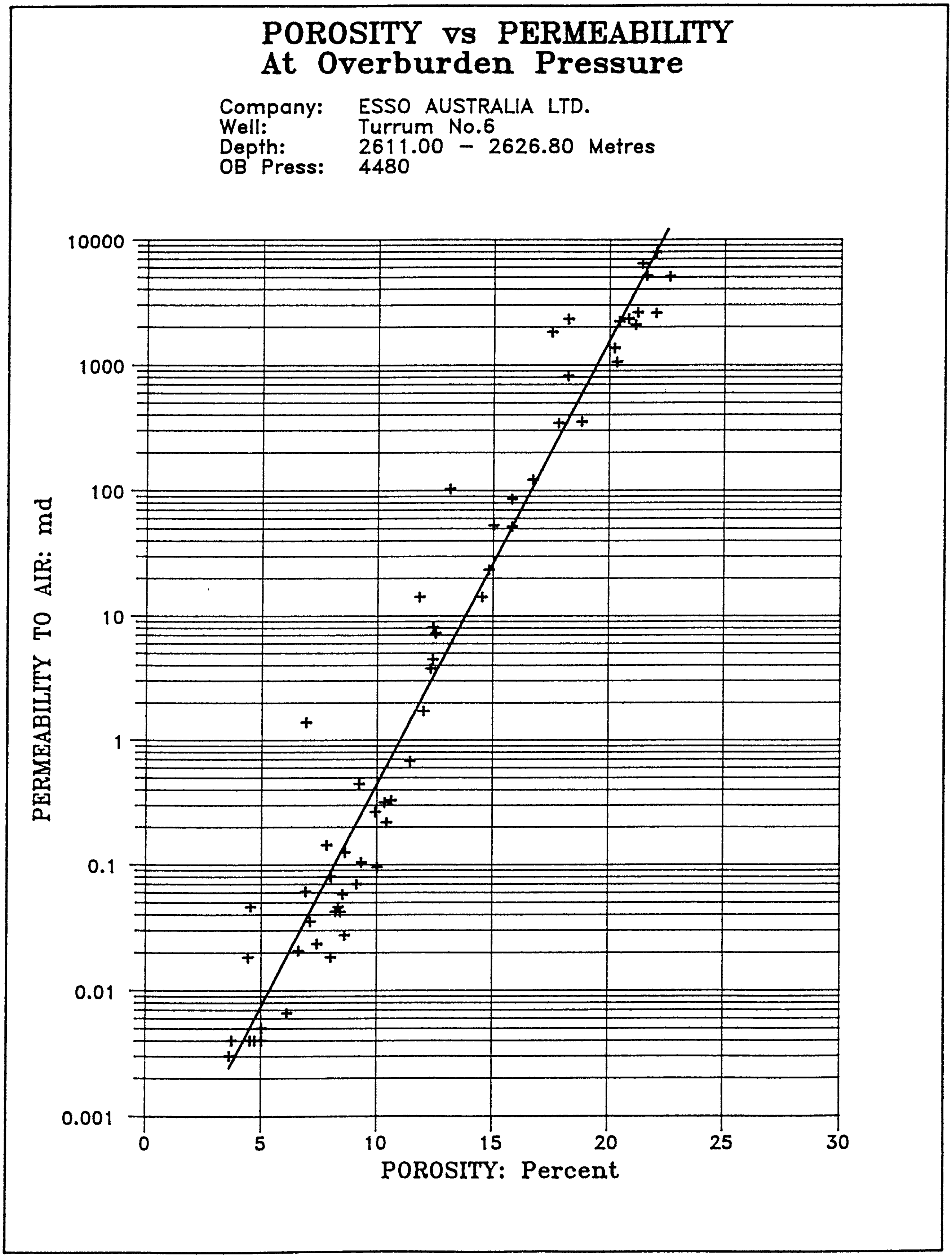
OVERBURDEN ANALYSIS FINAL REPORT

Overburden Pressure: 4480 psi

Company	ESSO AUSTRALIA LTD.	**Date**	22-Feb-96
Well	TURRUM # 6 ST 1	**File**	002 - 233
Field	TURRUM	**Location**	Vic - L - 3
Core Int.	C#1: 2611.00 - 2626.80m	**ACS Lab.**	Brisbane 002
		Analyst	WJD, BJS

Sample Number	Depth (meters)	Permeability to Air (millidarcys)	Porosity (percent)	Grain Density Calculated (g/cm^3)	Grain Density Absolute (g/cm^3)	Remarks
11V	2611.90	0.03	9.2	2.67	2.67	
35V	2613.90	<0.01	9.3	2.65	2.65	
47V	2614.90	<0.01	7.8	2.66	2.67	
59V	2615.90	12	16.7	2.66	2.67	
71V	2616.90	0.04	9.3	2.67	2.66	
83V	2617.90	0.09	10.8	2.66	2.68	
95V	2618.90	2593	21.2	2.65	2.65	
107V	2619.90	1.55	13.9	2.66	2.66	
119V	2620.90	72	20.8	2.65	2.65	
143V	2622.90	<0.01	5.3	2.66	2.66	

POROSITY vs PERMEABILITY AT
OVERBURDEN PRESSURE CROSSPLOT


POROSITY vs PERMEABILITY
At Overburden Pressure
Company: ESSO AUSTRALIA LTD.
Well: Turrum No.6
Depth: 2611.00 – 2626.80 Metres
OB Press: 4480
PERMEABILITY TO AIR: md
10000
1000
100
10
1
0.1
0.01
0.001
0
5
10
15
20
25
30
POROSITY: Percent

CORE PLOT

PE604596

This is an enclosure indicator page.
The enclosure PE604596 is enclosed within the container PE906509 at this location in this document.

The enclosure PE604596 has the following characteristics:

ITEM_BARCODE = PE604596
CONTAINER_BARCODE = PE906509
NAME = Core Analysis Plot
BASIN = GIPPSLAND
PERMIT = VIC/L3
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = Core Analysis Plot for Turrum-6
REMARKS =
DATE_CREATED = 22/03/96
DATE_RECEIVED = 24/01/97
W_NO = W1146
WELL_NAME = TURRUM-6
CONTRACTOR = ACS LABORATORIES AUSTRALIA
CLIENT_OP_CO = ESSO AUSTRALIA LIMITED

(Inserted by DNRE - Vic Govt Mines Dept)

APPENDIX 5

APPENDIX 5

APPENDIX 5

TURRUM 6

Well Seismic Processing Report
Zero Offset VSP and Geogram

(This appendix despatched 18 March,1996)

ENCLOSURES

ENCLOSURES

ENCLOSURE 1

TURRUM 6

Post Drill L360 Depth Structure Map

PE906514

PE906514

This is an enclosure indicator page.
The enclosure PE906514 is enclosed within the container PE906509 at this location in this document.

The enclosure PE906514 has the following characteristics:

ITEM_BARCODE =	PE906514
CONTAINER_BARCODE =	PE906509
NAME =	L360 Depth Map
BASIN =	GIPPSLAND
PERMIT =	VIC/L3
TYPE =	SEISMIC
SUBTYPE =	HRZN_CNTR_MAP
DESCRIPTION =	Post-Drill L360 Depth Structure Map for Turrum-6
REMARKS =	
DATE_CREATED =	11/12/95
DATE_RECEIVED =	24/01/97
W_NO =	W1146
WELL_NAME =	TURRUM-6
CONTRACTOR =	
CLIENT_OP_CO =	ESSO AUSTRALIA LIMITED

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE 2

TURRUM 6

Synthetic Seismogram

PE604597

PE604597

This is an enclosure indicator page.
The enclosure PE604597 is enclosed within the container PE906509 at this location in this document.

The enclosure PE604597 has the following characteristics:

ITEM_BARCODE =	PE604597
CONTAINER_BARCODE =	PE906509
NAME =	Synthetic Seismogram
BASIN =	GIPPSLAND
PERMIT =	VIC/L3
TYPE =	WELL
SUBTYPE =	SYNTH_SEISMOGRAPH
DESCRIPTION =	Synthetic Seismogram, Turrum-6
REMARKS =	
DATE_CREATED =	24/01/97
DATE_RECEIVED =	
W_NO =	W1146
WELL_NAME =	TURRUM-6
CONTRACTOR =	
CLIENT_OP_CO =	ESSO AUSTRALIA LIMITED

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE 3

TURRUM 6

Seismic Inline I203

~~PE604598~~

PE906515

PE906515

This is an enclosure indicator page.
The enclosure PE906515 is enclosed within the container PE906509 at this location in this document.

The enclosure PE906515 has the following characteristics:

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CONTAINER_BARCODE =	PE906509
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BASIN =	GIPPSLAND
PERMIT =	VIC/L3
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SUBTYPE =	SECTION
DESCRIPTION =	Seismic Inline I203 (interpreted) showing Turrum-6
REMARKS =	
DATE_CREATED =	23/01/97
DATE_RECEIVED =	
W_NO =	W1146
WELL_NAME =	TURRUM-6
CONTRACTOR =	
CLIENT_OP_CO =	ESSO AUSTRALIA LIMITED

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE 4

TURRUM 6

Stratigraphic Cross Section

PE906516

PE906516

This is an enclosure indicator page.
The enclosure PE906516 is enclosed within the container PE906509 at this location in this document.

The enclosure PE906516 has the following characteristics:

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CONTAINER_BARCODE =	PE906509
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BASIN =	GIPPSLAND
PERMIT =	VIC/L3
TYPE =	WELL
SUBTYPE =	DIAGRAM
DESCRIPTION =	Stratigraphic Cross-Section for Turrum-6
REMARKS =	
DATE_CREATED =	10/07/96
DATE_RECEIVED =	
W_NO =	W1146
WELL_NAME =	TURRUM-6
CONTRACTOR =	
CLIENT_OP_CO =	ESSO AUSTRALIA LIMITED

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE 5

TURRUM 6

Structural Cross Section

PE906517

This is an enclosure indicator page.
The enclosure PE906517 is enclosed within the container PE906509 at this location in this document.

The enclosure PE906517 has the following characteristics:

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CONTAINER_BARCODE = PE906509
NAME = Structural Cross-Section
BASIN = GIPPSLAND
PERMIT = VIC/L3
TYPE = WELL
SUBTYPE = DIAGRAM
DESCRIPTION = Structural Cross-Section for Turrum-6
REMARKS =
DATE_CREATED = 21/06/96
DATE_RECEIVED =
W_NO = W1146
WELL_NAME = TURRUM-6
CONTRACTOR =
CLIENT_OP_CO = ESSO AUSTRALIA LIMITED

(Inserted by DNRE - Vic Govt Mines Dept)

ATTACHMENTS

ATTACHMENTS

ATTACHMENT 1

TURRUM 6

Composite Well Log

PE604599

PE604599

This is an enclosure indicator page.
The enclosure PE604599 is enclosed within the container PE906509 at this location in this document.

The enclosure PE604599 has the following characteristics:

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     ITEM_BARCODE = PE604599
CONTAINER_BARCODE = PE906509
             NAME = Well Completion Log
            BASIN = GIPPSLAND
           PERMIT = VIC/L3
             TYPE = WELL
          SUBTYPE = COMPLETION_LOG
      DESCRIPTION = Well Completion Log for Turrum-6
          REMARKS =
     DATE_CREATED = 22/12/96
    DATE_RECEIVED =
             W_NO = W1146
        WELL_NAME = TURRUM-6
       CONTRACTOR =
     CLIENT_OP_CO = ESSO AUSTRALIA LIMITED
```

(Inserted by DNRE - Vic Govt Mines Dept)

EXXON EXPLORATION COMPANY

Palynostratigraphic Zonation and Paleoenvironments of the Turrum-6 Well, Gippsland Basin, Australia

Thomas D. Davies

TECHNOLOGY DEPARTMENT
GLOBAL STUDIES - GEOLOGICAL SERVICES DIVISION
BIOSTRATIGRAPHY SECTION
EEC.19A.BIO.96
MAY, 1996

BIOSTRATIGRAPHY REPORT

EXXON UNCLASSIFIED

EXXON EXPLORATION COMPANY
POST OFFICE BOX 4778 • HOUSTON, TEXAS 77210-4778

TECHNOLOGY DEPARTMENT
GLOBAL STUDIES/DATABASE DIVISION

April 30, 1996

Mr. Brodie Thomson
Esso Australia Limited
360 Elizabeth Street
Melbourne, Victoria
Australia 3000

Attn: Peter Glenton

Dear Brodie:

Attached are three copies of the biostratigraphy report "Palynostratigraphic Zonation and Paleoenvironments of the Turrum-6 Well, Gippsland Basin, Australia" (EEC.19A.BIO.96) by Thomas D. Davies. This report summarizes the results of examination of the palynologic assemblages and biofacies in sidewall core samples from the Turrum-6 Well. This work was originally requested by Peter Glenton.

The purposes of this palynologic study focused on 1) stratigraphic control based on the age/stratigraphic position of sidewall core samples relative to Exxon's Gippsland Basin palynological zonation and 2) constraints on depositional environments. The section studied from 2144 to 2819 mKB ranges in age from basalmost lower Eocene to Upper Maastrichtian.

Nine zones were recognized in this well from the lower Eocene to Upper Maastrichtian. The section from 2144 to 2439 mKB is considered marginal marine to marine, based on abundance, type, and diversity of dinoflagellate cysts. From 2466 to 2496.5 m, no marine microfossils were recovered and this section is interpreted to be nonmarine. Samples 2535 and 2540 m contain abundant dinocysts, but low diversity suggesting a marginal marine environment of deposition. The section from 2559 to 2695.5 m is barren or nearly barren of marine form microfossils and is considered to be nonmarine. Marine dinoflagellates reappear in relatively small numbers in samples in the basal part of the well from 2697.5 to 2819 m and suggest some marine influences at these depths.

This report is unclassified, with all proprietary interpretations removed, so it may be distributed outside Exxon without further permission from EEC.

The Biostratigraphy Section appreciates this opportunity to work with you in ensuring the effective application of biostratigraphy to your project. If you have any questions regarding this work or require any further assistance, please contact Pete at 423-5988 or Tom at 423-5992.

Yours truly,

B. A. Vining

by Peter P. McLaughlin, Jr.

TDD
c: B. A. Vining
R. D. Hammond
Doug A. Shwebel

EXXON EXPLORATION COMPANY
BIOSTRATIGRAPHY REPORT
EEC.19A.BIO.96
APRIL, 1996

Palynostratigraphic Zonation and Paleoenvironments of the Turrum-6 Well, Gippsland Basin, Australia

Thomas D. Davies

UNCLASSIFIED

EXECUTIVE SUMMARY

- The palynology of the Turrum-6 Well was studied to provide stratigraphic control based on age and biostratigraphic position of sidewall core samples from 2144 to 2819 mKB and environments of deposition.

- Biostratigraphy enables subdivision of Paleocene reservoir section into seven palynology zones. One additional zone is recognized above the reservoir section, and one below in the Upper Maastrichtian.

- Palynology demonstrates that Biozone Rb occurs within the Bottle Green sequence about 25 m above the Bottle Green SB, that the top of Zone Rc occur just below Bottle Green SB, and that MFS "E" SB falls within Zone Rc. Near Top L-200 falls near the boundary between Rc and Rd, within the base of Zone Rc. Naples Yellow SB sits in the indeterminate interval between Rd and Re. Zone Re is first recognized at 2535 m just below MFS "B" SB. The top of Zone Rf occurs in the base of the Pink sequence about 20 m above Pink SB picked at 2595.5 m. The base of Rf is approximately 25 m above MFS "A" SB at 2696 m. Zone Rg is identified at 2722 m just above the 450 Marker, but it could occur as high as 2697.5 m. Definitive Upper Maastrichtian is at 2768 m. The possible highest depth for the Cretaceous is 2748 m.

- Many of the "shales" associated with the reservoir sandstone, particularly above the MFS "B" SB, contain common to abundant marine dinoflagellate cysts. Four intervals were identified that contain relatively rich and diverse marine assemblages. These intervals correlate with the marine flooding events associated with MFS "B" SB, Near Top L-200, and MFS "E" SB.

TABLE OF CONTENTS

EXXON EXPLORATION COMPANY
TECHNOLOGY DEPARTMENT
GLOBAL STUDIES - GEOLOGICAL SERVICES DIVISION
BIOSTRATIGRAPHY SECTION

30/04/96

Biostratigraphy Report
Spores, Pollen, and Dinoflagellates

EEC.19A.BIO.96

ESSO AUSTRALIA, LTD **Turrum-6 Well**
Gippsland Basin, Australia

INTRODUCTION

At the request of Esso Australia Limited (Peter Glenton), forty-two samples were studied from the Turrum-6 Well, Gippsland Basin. Samples were analyzed for age and paleoenvironment, and the results of these analyses were integrated with Exxon's Turrum Field palynological zonation recently proposed by Davies (1995).

The main purposes of this palynologic study were to provide: 1) stratigraphic control based on the age and biostratigraphic position of sidewall core samples relative to Exxon's Gippsland Basin palynological zonation, and 2) constraints on the depositional environments.

The age and paleoenvironmental interpretations are based on comparisons with materials from Askin (1990); Besems (1993); Churchhill (1973); Cookson and Eisenack (1965 and 1967); Damassa et al. (1994); Davies (1995, 1996a, and 1996b); Davey et al. (1966); Germeraad et al. (1968); Haq et al. (1987); Heilmann-Clausen (1985); Helby et al. (1987); Marshall (1985); Muller (1964); Partridge (1976 and 1988); Powell (1992); Stover and Evans (1969 and 1973); Stover and Partridge (1973 and 1984); Wilson (1984 and 1988); and Wrenn and Hart (1988).

Interpretations of paleoecology were made based on observed changes in the spore-pollen (S/P) assemblages and biofacies analyses from kerogen slides. Relative abundance abbreviations used below are: VA - very abundant; A - abundant; C - common; F - few; R - rare; and VR - very rare. Other abbreviations used are: SP - spores and pollen, D - dinoflagellates, F - foraminifera. Depths given are in meters KB.

DATABASE AND PRODUCTS

Approximately 125 microscope slides were studied from forty-two Turrum-5 sidewall core samples for palynology and paleoenvironments. These sidewall core samples were processed by EEC's Biostratigraphic Lab in Houston.

Microscope slides: The palynology and kerogen microscope slides from the forty-seven sidewall core samples (2144 to 2819 m) from the Turrum-6 well are stored at EEC's biostratigraphy laboratory in Houston.

BIOSTRATIGRAPHY AND PALEOENVIRONMENTAL SUMMARY

Approximately 125 microscope slides were studied from forty-two Turrum-6 sidewall core samples in the interval from 2144 to 2819 m. Marine dinoflagellate cysts are common to abundant in many of the samples from 2144 to 2540 m, particularly at 2144, 2206.4, 2253, 2308.5*, 2360, 2391.5, 2407*, 2439*, 2535*, 2540, and 2768* m. (Those depths annotated with an asterisk are interpreted as intervals of maximum marine incursions based on dinoflagellate cyst diversity and type.) The section from 2559 to about 2690 is interpreted to be mostly nonmarine, as no indigenous marine microfossils were recovered. Marine dinocysts occur again, mainly in small numbers, in the basal part of this well from 2697.5 to 2819 m. Terrestrially derived spores and pollen are common to abundant in most of the samples, but are often poorly preserved.

Nine palynozones are recognized in the lower Eocene to Upper Maastrichtian section of this well and are summarized below. Questioned depths shown in parenthesis, e.g. (?2748), denotes possible shallowest depth of the zone top.

2144-2206.4	Zone Sz; lower Eocene
2253	Probably Zone Ra; upper Paleocene
2276	Zone Rb
2283	Indeterminate
2308.5-2391.5	Zone Rc
2407-2439	Zone Rd1
2466-2496.5	Indeterminate (possible Rd2 at 2366)
2535-2540	Zone Re
2559-2570	Indeterminate
2577-2668.5	Zone Rf
2674.5-2711.5	Indeterminate (possible Rg at 2697.5)
2722	Rg
(?2748) 2768-2819	Zone Ma; Upper Maastrichtian

Intervals of maximum flooding occur in samples 2308.5*, 2407*, 2439*, 2535*, and 2768* m. These intervals correlate with the marine flooding events associated with MFS "B" SB, Near Top L-200, MFS "E" SB, and the Upper Maastrichtian.

DISCUSSION OF RESULTS

Zone Sz was identified in samples at 2144 to 2206.4 m. Appendix A, following the references, gives a sample-by-sample listing of the important species.

Zone Ra is provisionally assigned to samples from 2253 m. Preservation is poor, partially due to common pyrite scarring, and identification of marker species is difficult. There are no samples between 2206.4 and 2253 m, so the top of Zone Ra is undefined.

Although diagnostic species are rare, the microfossil assemblage and biofacies suggest sample 2276 m is in Zone Rb (Appendix A). Sample 2283 m is indeterminate.

The top Zone Rc (early part of late Paleocene), is placed at 2308.5 m. Samples 2374 and 2391.5 m are also placed to the zone.

The section from 2407 to 2439 m is placed in Zone Rd (probably Rd1). This interval contains an assemblage similar to that attributed to Zone Rd in the other Turrum wells. The zonation of the interval from 2466 to 2496.5 m is indeterminate, however the assemblage recovered from sample 2466 m resembles that noted in Turrum-5 at the top of Zone Rd2.

The top of Zone Re was picked at 2535 m. The assemblage associated with this zone continues down through sample 2540 m. Subzone Re1 and Re2 are not differentiated. Samples 2559 and 2570 m are indeterminate.

Markers for Zone Rf occurs in samples from 2577 to 2668.5 m.

The interval from 2674.5 to 2711.5 m is indeterminate. However palynofacies suggest that the sample at 2697.5 m may be in Zone Rg. The top of definitive Zone Rg is picked at 2722 m, based on an assemblage that is consistent with this zone in the other well in the area.

The top of the Upper Maastrichtian, Zone Ma is tentatively placed at 2748 m. Definitive Maastrichtian is picked at 2768 m.

PALYNOSTRATIGRAPHIC CORRELATION

The palynologic assemblages recovered from this well are similar to those reported for the other wells studied from the Turrum field (Davies, 1995, 1996a, and 1996b). Nine biozones were recognized in this well, based on first, last, and peak occurrences, and concurrent ranges which were compared with ranges previously established in the area by Stover and Partridge (1971 and 1973), Stover and Evans (1973), Helby, Morgan, and Partridge (1987), Wilson (1984, 1988), Wrenn and Hart (1988), and others. The picks for the palynozones were done independently of the stratigraphic picks, resulting in good correlation control, which is consistent with EAL's log picks.

Zone Sz occur in samples from 2144 to 2206.4 m, which is above the reservoir section and above BGF4 at 2224.5 m (as picked by EAL). No samples were provided between 2206.4 and 2253 m, so the top of Zone Ra is unknown. The assignment of sample 2253 m to Zone Ra is provisional, as the identification of marker species is difficult due to preservation state. This sample coincides with EAL's pick for the Blue Grey Sequence Boundary and Blue Grey FS1.

The sample from 2276 m is placed in Zone Rb, but the confidence level is moderate to low, as marker species are very rare. The sample occurs about 20 m below the Blue Grey SB and Blue Grey FS1 picked at 2253 m. The top of Zone Rb occurs at or just below the Blue Grey SB in Turrum-4, Turrum-3, Turrum-2, and Marlin-4 (Davies, 1995), and Turrum-5 (Davies, 1996a).

The top of Palynozone Rc is placed at 2308.5 m and it continues down to 2391.5, which is just below MFS "E" SB. The Bottle Green SB picked by EAL at 2331 m is within the upper part of This zone. Zone Rc was recorded in most of the Turrum field wells and Bottle Green SB occurs within the top of this zone in Marlin-2, possible in Turrum-4, and in Turrum-1.

The Near Top L-200 surface usually occurs between the base of zone Rc and the top of Rd (Davies, 1995). The top of Subzone Rd1 in this well was recorded at 2407 m, which is 6 m beneath the Near Top L-200 surface picked at 2401 m. Near Top L-200 falls between the last pick of Rc at 2391.5 m and the first downhole pick of Rd1 at 2401 m. Subzone Rd1 was recognized in most of the Turrum well, except Marlin-2. Subzone Rd2 was not definitively identified in this well. However, the sample at 2366 m may possibly be in Zone Rd2. Naples Yellow SB which was picked at 2469 m is just beneath this sample. Where this zone was identified, Naples Yellow occurred within it (Davies, 1995; 1996a; 1996b).

Top Zone Re occurs first at 2535 m. MFS "B" SB usually occurs within this zone. The physical surface at about 2531 m, picked by EAL as MFS "B" SB, is just above the recognized top of Re. The top of Zone Re may sit somewhere in the unsampled interval between 2496.5 and 2535 m. This zone was recognized with certainly in Marlin-2, Turrum-4, Turrum-3, and Turrum-2 and in Turrum-5 and Marlin A24 (Davies, 1995, 1996a, and 1996b). Subzone Re2 was not differentiated in this well.

The top of the Rf Zone, which is typically located just above the Pink SB, was recognized at 2577 m. Pink SB, picked by EAL at 2595 m, occurs within the top of Zone Rf. This zone is recognized down to 2668.5 m. MFS "A" SB, which usually occurs in the basal part of Zone Rf is placed by EAL down at 2696 m. To maintain this surface within Rf, alternative picks for MFS "A" SB are beneath the coal at about 2601 m, or beneath the coal at about 2605 m.

Zone Rg top, which generally sits close to the 450 Marker, occurs at 2722 m, or possibly as high as 2697.5 m. This zone was identified with certainty in the six of the Turrum field wells, Turrum-5, Turrum-4, Turrum-3, Turrum-2, Marlin-4, and Marlin A24 (Davies, 1995; 1996a; 1996b). The 450 Marker is placed at 2728.5 m. An alternative for the 450 Marker is the transgressive surface at about 2698 m, which will keep the 450 Marker within or at the top of Zone Rg.

The top of Upper Maastrichtian Palynozone Ma typically appears beneath the Oriental Blue SB at the base of the section and is provisionally placed at 2748 m and certainly at 2768 m. The Oriental Blue SB was picked by EAL at 2755 m. An alternative to this depth is the surface at about 2741 m.

PALEOENVIRONMENTS

Results indicate that deposition of the interval studied from the Turrum-6 well took place in a marginal to non-marine environment with periodic and short-lived marine floods. The middle and upper portions of the reservoir sequence above approximately 2540 m appeared to have experienced more numerous and extensive flooding, whereas the basal part of the section contains fewer marine records. Although many of the shales associated with the reservoir sands above 2540 m contain at least some fossils indicative of marine influence, four horizons were identified that contain rich, relatively diverse marine palynomorph assemblages. These occur near the MFS "B" SB, Near Top L-200, and MFS "E" SB surfaces at 2308.5, 2407, 2439, and 2535. Most of these samples contain relatively diverse dinocyst assemblages. Appendix A give the sample-by-sample interpretation of the paleoenvironments.

The Late Maastrichtian climate in this area was apparently humid and mild, with a cooling trend near the Cretaceous/Tertiary boundary (Askin, 1990). The composition of the palynomorphs and palynofacies assemblage in the basal part (uppermost Maastrichtian to lower Paleocene) of the reservoir section implies a cool and wet climate. A decrease in frequency of indicators of humid environments upward in the section, suggest that conditions became slightly drier during deposition of most of the upper part of the reservoir section.

Pyrite, which is common to transitional marine to nonmarine settings, is abundant in most of the samples, suggesting deposition took place near shore, where there was possibility of some marine influence.

RECOMMENDATIONS

Zones Ra and Rb are not well defined in this well. If further definition of the top of these zones is required, we recommend augmenting the SWC's with a few cuttings samples selected from fine-grained lithologies in the upper part of the well from about 2206 to 2308.5 mKB. To gain confidence in the upper limit of Zone Rc, we recommend studying two or three additional samples in the interval from 2315 to 2360 mKB.

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Appendix A

TURRUM-6 WELL, GIPPSLAND BASIN, AUSTRALIA

BIOSTRATIGRAPHY AND PALEOENVIRONMENTAL SUMMARY

T. D. Davies

2144	Paleoenvironment: Marine to marginal marine Kerogen: woody/coaly (C); amorphous (C-A); biodegraded terr. (R); S/P (VA); dinoflagellates (A-C); pyrite (R-F), poor pres. Spiniferites spp. (D) (indicative of open marine) (VR) Hafniasphaera septatus (D) (indicative of open marine) (VR) Senegalinium dilwynense (D) (F) ?Apectodinium spp. (D) (F) Cleistosphaeridium spp. (D) (R-F) Impagidinium spp. (D) (R) Systematophora cf. placacantha (D) (F) Nothofagidites spp. (SP) (F) Nothofagidites endurus (SP) (R) Proteacidites spp. (SP) (F) Proteacidites annulatus (SP) (VR-R) Stereisporites antiquasporites (SP) (F-C) Phyllocladidites spp. (SP) (F) Lygistipollenites balmei (SP) (F) Lygistipollenites florinii (SP) (F) Bisaccates (SP) (A)
2184	Paleoenvironment: Nonmarine Kerogen: woody/coaly (F-C); amorphous (VA); biodegraded terr. (F); S/P (F-C); dinoflagellates (barren); pyrite (A), very poor pres. Nothofagidites spp. (SP) (VR) Proteacidites spp. (SP) (F) Stereisporites antiquasporites (SP) (R) Lygistipollenites balmei (SP) (VR) Lygistipollenites florinii (SP) (VR) Bisaccates (SP) (F)
2206.4	Paleoenvironment: marginal marine Kerogen: woody/coaly (F-C); amorphous (VA); biodegraded terr. (F); S/P (A); dinoflagellates (C); pyrite (VVA), poor pres. Senegalinium dilwynense (D) (C) Nothofagidites spp. (SP) (F) Nothofagidites emarcidus-heterus (SP) (R) Nothofagidites endurus (SP) (R) Nothofagidites bracyspinulosus (SP) (R) Proteacidites spp. (SP) (F)

Proteacidites annulatus (SP) (VR)
Stereisporites antiquasporites (SP) (R)
Stereisporites (Tripunctisporis) (SP) (R)
Phyllocladidites spp. (SP) (F)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Podosporites antarcticus (SP) (R)
Lygistipollenites balmei (SP) (VR)
Lygistipollenites florinii (SP) (VR)
Bisaccates (SP) (C-A)

2253

Paleoenvironment: Marginal marine
Kerogen: woody/coaly (F-C); amorphous (VA); biodegraded terr. (F); S/P (C); dinoflagellates (A); pyrite (VA), poor pres.
Hafniasphaera septatus (D) (VR)
Senegalinium dilwynense (D) (VA, increase)
Gambierina rudata (SP) (VR)
Nothofagidites spp. (SP) (R-F)
Nothofagidites endurus (SP) (R)
Proteacidites spp. (SP) (F)
Proteacidites cf. angulatus (SP) (VR)
Australopollis obscurus (SP) (F, increase)
Stereisporites antiquasporites (SP) (R)
Stereisporites (Tripunctisporis) (SP) (R)
Phyllocladidites spp. (SP) (F)
Phyllocladidites microsaccatus (SP) (R)
Podosporites antarcticus (SP) (F)
Lygistipollenites balmei (SP) (F, increase)
Lygistipollenites florinii (SP) (R)
Bisaccates (SP) (C)

2276

Paleoenvironment: Marginal marine
Kerogen: woody/coaly (F-C); amorphous (A); biodegraded terr. (F); S/P (C); dinoflagellates (R); pyrite (VA), poor pres.
Spiniferites spp. (D) (indicative of open marine) (VR)
?Apectodinium spp. (D) (R)
Cerodinium sp. S (D) (VR)
Paleocystodinium golzowense (D) (VR)
Glaphyrocysta retiintexta (D) (~no lower than upper Paleocene) (VR)
Nothofagidites spp. (SP) (R)
Nothofagidites emarcidus-heterus (SP) (lower part of lower Eoc. to Paleoc.) (R)
Australopollis obscurus (SP) (R, decrease)
Proteacidites spp. (SP) (F)
Proteacidites angulatus (SP) (R)
Stereisporites antiquasporites (SP) (R)
Stereisporites (Tripunctisporis) (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Podosporites antarcticus (SP) (F)

Lygistipollenites balmei (SP) (F-R)
Lygistipollenites florinii (SP) (R)
Bisaccates (SP) (C)

2283 Paleoenvironment: Nonmarine
Kerogen: woody/coaly (F-C); amorphous (VA); biodegraded terr. (F); S/P (C); dinoflagellates (barren); pyrite (VVA), poor pres.
Nothofagidites spp. (SP) (R)
Nothofagidites endurus (SP) (R)
Nothofagidites emarcidus-heterus (SP) (R)
Nothofagidites brachyspinulosus (SP) (VR)
Australopollis obscurus (SP) (C-F)
Proteacidites spp. (SP) (F)
Stereisporites antiquasporites (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Podosporites antarcticus (SP) (F)
Lygistipollenites balmei (SP) (R)
Lygistipollenites florinii (SP) (R)
Bisaccates (SP) (C)

2308.5 Paleoenvironment: Marine
Kerogen: woody/coaly (C); amorphous (A); biodegraded terr. (F); S/P (C); dinoflagellates (C); pyrite (A), very poor pres. of s/p
Cyclopsiella spp. (D) (F)
Spiniferites spp. (D) (VR)
Hafniasphaera septatus (D) (VR)
Spinidinium-type (D) (VR)
Vozzhennikovia spp. (D) (F)
Senegalinium dilwynense (D) (F)
?Apectodinium spp. (D) (C)
Alisocysta circumtabulata (D) (R)
Isabelidinium spp. (D) (R-F)
Isabelidinium bakeri (D) (R)
Isabelidinium cf. cingulatum (D) (VR)
Cerodinium sp. S (D) (R-F)
Paleocystodinium golzowense (D) (F)
Glaphyrocysta spp. (D) (F)
Glaphyrocysta retiintexta (D) (C-A, increase)
Gambierina rudata (SP) (R)
Nothofagidites spp. (SP) (R)
Nothofagidites bracyspinulosus (SP) (VR)
Proteacidites spp. (SP) (F)
Tricolpites gillii (SP) (R)
Stereisporites antiquasporites (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Podosporites antarcticus (SP) (F)
Lygistipollenites balmei (SP) (R-F)
Lygistipollenites florinii (SP) (R)

Bisaccates (SP) (C)

2360 Paleoenvironment: Marginal marine to marine

Kerogen: woody/coaly (C); amorphous (A); biodegraded terr. (F); S/P (C); dinoflagellates (A); pyrite (VA), very poor pres. of S/P

Senegalinium dilwynense (D) (R)

Cerodinium sp. S (D) (F-R)

Paleocystodinium golzowense (D) (C)

Paleocystodinium australinum (D) (C)

Glaphyrocysta spp. (D) (R)

Glaphyrocysta retiintexta (D) (F)

Stereisporites antiquasporites (SP) (VR)

Phyllocladidites microsaccatus (SP) (R)

Lygistipollenites balmei (SP) (VR)

Bisaccates (SP) (F)

2374 Paleoenvironment: Marginal marine

Kerogen: woody/coaly (C); amorphous (A-C); biodegraded terr. (F); S/P (C); dinoflagellates (F); pyrite (A), very poor pres. of S/P

Cyclopsiella spp. (D) (A)

Spiniferites spp. (D) (R-F)

Cerodinium sp. S (D) (VR)

Paleocystodinium golzowense (D) (R)

Paleocystodinium cf. australinum (D) (VR)

cf. Paleocystodinium pyrophorum (D) (VR)

Glaphyrocysta retiintexta (D) (F)

Cleistosphaeridium spp. (D) (VR)

Proteacidites spp. (SP) (F)

Phyllocladidites spp. (SP) (F)

Phyllocladidites microsaccatus (SP) (R)

Lygistipollenites balmei (SP) (R)

Bisaccates (SP) (F)

2391.5 Paleoenvironment: Marginal marine to marine

Kerogen: woody/coaly (C); amorphous (A); biodegraded terr. (F); S/P (C); dinoflagellates (F); pyrite (VA), very poor pres. of S/P; mud contam.

Spiniferites spp. (D) (indicative of open marine) (R)

Senegalinium dilwynense (D) (R-F)

Cerodinium sp. S (D) (C-A)

Paleocystodinium golzowense (D) (C-A)

Paleocystodinium australinum (D) (C-A)

Glaphyrocysta spp. (D) (F)

Glaphyrocysta retiintexta (D) (C)

Cleistosphaeridium spp. (D) (R)

Proteacidites spp. (SP) (F)

Phyllocladidites spp. (SP) (F-R)

Lygistipollenites balmei (SP) (R)

Bisaccates (SP) (F)

2407 Paleoenvironment: Marine to marginal marine

Kerogen: woody/coaly (C-A); amorphous (C-A); biodegraded terr. (C); S/P (C); dinoflagellates (A); pyrite (VA), very poor pres. of S/P; mud contam.
Spiniferites spp. (D) (R)
Spinidinium spp. (D) (C)
Spinidinium densispinatum (D) (F-C)
Vozzhennikovia spp. (D) (A)
Senegalinium dilwynense (D) (R-F)
Isabelidinium cf. bakeri (D) (VR)
Isabelidinium cf. cingulatum (D) (VR)
Cerodinium sp. S (D) (R-F)
Paleocystodinium golzowense (D) (R)
Glaphyrocysta spp. (D) (F)
Glaphyrocysta retiintexta (D) (F-C)
Cordosphaeridium spp. (D) (VR)
Nothofagidites spp. (SP) (R)
Nothofagidites endurus (SP) (VR)
Nothofagidites bracyspinulosus (SP) (VR)
Proteacidites spp. (SP) (F)
Proteacidites cf. angulatus (SP) (VR)
Tricolpites gillii (SP) (R)
Phyllocladidites spp. (SP) (F-R)
Lygistipollenites balmei (SP) (R-F)
Bisaccates (SP) (F)

2439 Paleoenvironment: Marine to marginal marine
Kerogen: woody/coaly (C-A) amorphous (VA); biodegraded terr. (C); S/P (C); dinoflagellates (F); pyrite (A-C); very poor pres. of S/P
Hafniasphaera septatus (D) (VR)
Spinidinium spp. (D) (R)
Vozzhennikovia spp. (D) (R)
Senegalinium dilwynense (D) (R)
?Apectodinium spp. (D) (F)
Paleocystodinium golzowense (D) (R)
Paleocystodinium australinum (D) (VR)
cf. Paleocystodinium pyrophorum (D) (VR)
Glaphyrocysta spp. (D) (F)
Glaphyrocysta retiintexta (D) (F, mud contam.?)
Cordosphaeridium spp. (D) (VR)
Nothofagidites spp. (SP) (VR)
Nothofagidites endurus (SP) (VR)
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (R-F)
Proteacidites cf. angulatus (SP) (VR)
Phyllocladidites spp. (SP) (F-R)
Lygistipollenites balmei (SP) (R-F)
Bisaccates (SP) (F)

2466 Paleoenvironment: Non to marginal marine; (?Zone Rd2)
Kerogen: woody/coaly (VA); amorphous (R); biodegraded terr. (C); S/P (F); dinoflagellates (nearly barren); pyrite (R); very poor pres. of S/P; mud contam.
Spinidinium densispinatum (D) (VR)

Gambierina edwardsii (SP) (R)
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (C-A)
Proteacidites angulatus (SP) (F-C)
Tricolpites spp. (SP) (VR)
Stereisporites antiquasporites (SP) (VR)
Phyllocladidites spp. (SP) (F-R)
Lygistipollenites balmei (SP) (R-F)
Bisaccates (SP) (F)

2496.5 Paleoenvironment: Nonmarine
Kerogen: woody/coaly (C-A); amorphous (R); biodegraded terr. (A); S/P (F); dinoflagellates (barren); pyrite (R); very poor pres. of S/P; mud contam.
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (C)
Tricolpites gillii (SP) (VR)
Stereisporites antiquasporites (SP) (VR)
Phyllocladidites spp. (SP) (F-R)
Lygistipollenites balmei (SP) (R)
Bisaccates (SP) (R)

2535 Paleoenvironment: Marginal marine to marine
Kerogen: woody/coaly (C); amorphous (R-F); biodegraded terr. (C); S/P (F); dinoflagellates (C-A); pyrite (R); very poor pres. of S/P; mud contam.
Spinidinium spp. (D) (F)
Spinidinium densispinatum (D) (F)
Vozzhennikovia spp. (D) (R)
Senegalinium dilwynense (D) (R-F)
Cerodinium spp. (D) (F)
Cerodinium sp. S (D) (C)
Paleocystodinium golzowense (D) (R)
Proteacidites spp. (SP) (C)
Lygistipollenites balmei (SP) (R)
Lygistipollenites florinii (SP) (R)
Bisaccates (SP) (R)

2540 Paleoenvironment: Marginal marine to marine
Kerogen: woody/coaly (C); amorphous (F-C); biodegraded terr. (C); S/P (F); dinoflagellates (A); pyrite (F); very poor pres. of S/P; mud contam.
Spinidinium spp. (D) (F)
Spinidinium densispinatum (D) (F)
Vozzhennikovia spp. (D) (R)
Cerodinium spp. (D) (F)
Cerodinium sp. S (D) (F-C)
Proteacidites spp. (SP) (F)
Lygistipollenites balmei (SP) (R)
Lygistipollenites florinii (SP) (R)
Bisaccates (SP) (R)

2559	Paleoenvironment: Nonmarine Kerogen: woody/coaly (C-F); amorphous (A); biodegraded terr. (C); S/P (F); dinoflagellates (barren); pyrite (F); very poor pres. of S/P; mud contam. ?Spinidinium densispinatum (D) (VR) Australopollis obscurus (SP) (R) Proteacidites spp. (SP) (F) Proteacidites angulatus (SP) (R) Phyllocladidites mawsonii (SP) (R) Bisaccates (SP) (R-F)
2570	Paleoenvironment: Nonmarine Kerogen: woody/coaly (F); amorphous (F); biodegraded terr. (A); S/P (F); dinoflagellates (barren); pyrite (F); very poor pres. of S/P; mud contam. Gambierina rudata (SP) (VR) Nothofagidites spp. (SP) (VR) Australopollis obscurus (SP) (F-C) Proteacidites spp. (SP) (F) ?Tricolpites cf. confessus (SP) (VR) Proteacidites angulatus (SP) (VR) Phyllocladidites microsaccatus (SP) (R) Lygistipollenites balmei (SP) (VR) Bisaccates (SP) (R-F)
2577	Paleoenvironment: Nonmarine Kerogen: woody/coaly (F); amorphous (F-C); biodegraded terr. (A); S/P (A); dinoflagellates (barren); pyrite (R); poor to fair pres. of S/P. Gambierina edwardsii (SP) (R, slight increase) Australopollis obscurus (SP) (F-C) Proteacidites spp. (SP) (F) Proteacidites angulatus (SP) (R, slight increase) Tricolpites spp. (SP) (VR) Tricolpites cf. confessus (SP) (F) Tetracolporites verrucosus (SP) (R-F, increase) Stereisporites antiquasporites (SP) (VR) Stereisporites (Tripunctisporis) (SP) (R) Phyllocladidites mawsonii (SP) (VR) Phyllocladidites microsaccatus (SP) (R-F) Lygistipollenites balmei (SP) (VR) Bisaccates (SP) (C)
2590	Paleoenvironment: Nonmarine Kerogen: woody/coaly (C); amorphous (C-A); biodegraded terr. (C); S/P (C); dinoflagellates (barren); pyrite (A); very poor pres. of S/P Australopollis obscurus (SP) (F-C) Proteacidites spp. (SP) (F) Proteacidites angulatus (SP) (R) Tricolpites spp. (SP) (VR) Tricolpite cf. confessus (SP) (VR) Stereisporites antiquasporites (SP) (VR)

Phyllocladidites microsaccatus (SP) (R-F)
Bisaccates (SP) (C)

2591 Paleoenvironment: Nonmarine
Kerogen: woody/coaly (C-A); amorphous (A); biodegraded terr. (F); S/P (A); dinoflagellates (barren); pyrite (C-F); poor pres. of S/P
Monocolpopollenites spp. (SP) (F)
Gambierina rudata (SP) (R)
Gambierina edwardsii (SP) (VR)
Australopollis obscurus (SP) (C)
Proteacidites spp. (SP) (F)
Proteacidites angulatus (SP) (R-F)
Tricolpites gillii (SP) (R)
Proteacidites [illegible] (SP) (R-F)
Tricolpites spp. (SP) (R)
Tetracolporites verrucosus (SP) (VR)
Stereisporites antiquasporites (SP) (VR)
Phyllocladidites mawsonii (SP) (R-F)
Phyllocladidites microsaccatus (SP) (R-F)
Lygistipollenites balmei (SP) (R-F)
Lygistipollenites florinii (SP) (R)
Bisaccates (SP) (C)

2606.5 Paleoenvironment: Nonmarine
Kerogen: woody/coaly (C); amorphous (A-C); biodegraded terr. (F); S/P (A); dinoflagellates (barren); pyrite (F); poor-fair pres. of S/P; (2607.5m indeter.)
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (F)
Proteacidites angulatus (SP) (C)
Tricolpites gillii (SP) (R)
Tricolpites spp. (SP) (R-F)
Tricolpites cf. confessus (SP) (R-F)
Tetracolporites verrucosus (SP) (C, influx)
Ephedripites spp. (SP) (VR)
Phyllocladidites microsaccatus (SP) (R-F)
Bisaccates (SP) (C)

2629; 2631 Paleoenvironment: Nonmarine
Kerogen: woody/coaly (A); amorphous (F); biodegraded terr. (F); S/P (VA); dinoflagellates (barren); pyrite (R); poor-fair pres. of S/P
Gambierina rudata (SP) (R)
Gambierina edwardsii (SP) (VR)
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (F)
Proteacidites angulatus (SP) (F)
Tricolpites gillii (SP) (R)
Tricolpites cf. confessus (SP) (VR)
Stereisporites antiquasporites (SP) (VR)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (C-A)
Bisaccates (SP) (VA)

2631; 2651.2 Paleoenvironment: Nonmarine
Kerogen: woody/coaly (A); amorphous (F-R); biodegraded terr. (F); S/P (VA); dinoflagellates (barren); pyrite (R); fair pres. of S/P

Gambierina rudata (SP) (R)
?Gambierina edwardsii (SP) (VR)
Australopollis obscurus (SP) (F-C)
Proteacidites spp. (SP) (F)
Proteacidites angulatus (SP) (F)
Tricolpites gillii (SP) (F-C)
Tricolpites cf. confessus (SP) (VR-R)
Stereisporites antiquasporites (SP) (R)
Stereisporites (Tripunctisporis) (SP) (R-F)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (C-A)
Bisaccates (SP) (VA)

2667; 2668.5

Paleoenvironment: Nonmarine
Kerogen: woody/coaly (A); amorphous (F-C); biodegraded terr. (C); S/P (C); dinoflagellates (barren); pyrite (R-F); poor pres. of S/P
Gambierina rudata (SP) (R)
Nothofagidites spp. (SP) (VR)
Nothofagidites endurus (SP) (VR)
Proteacidites spp. (SP) (F)
Proteacidites angulatus (SP) (F)
Tricolpites gillii (SP) (R)
Tricolpites cf. confessus (SP) (VR-R)
Stereisporites antiquasporites (SP) (R)
Stereisporites (Tripunctisporis) (SP) (VR)
Phyllocladidites mawsonii (SP) (F)
Phyllocladidites microsaccatus (SP) (F)
Lygistipollenites balmei (SP) (R)
Bisaccates (SP) (VA)

2674.5

Paleoenvironment: Nonmarine; (Zonation indeterminate)
Kerogen: woody/coaly (VA); amorphous (F); biodegraded terr. (C); S/P (F); dinoflagellates (barren); pyrite (R-F); poor pres. of S/P
Proteacidites spp. (SP) (R)
Tetracolporites verrucosus (SP) (VR)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (R)
Bisaccates (SP) (R)

2690

Paleoenvironment: Nonmarine; (Zonation indeterminate)
Kerogen: woody/coaly (VA); amorphous (F); biodegraded terr. (C); S/P (F); dinoflagellates (nearly barren); pyrite (R-F); poor preserv.
Spinidinium spp. (D) (VR, mud contam.?)
Senegalinium spp. (D) (VR)
Proteacidites spp. (SP) (F)
Proteacidites angulatus (SP) (R-F)
Tricolpites gillii (SP) (R)
Tricolpites spp. (SP) (R)
Phyllocladidites mawsonii (SP) (F-R)
Phyllocladidites microsaccatus (SP) (F)
Lygistipollenites balmei (SP) (R)

Bisaccates (SP) (C)

2696.5; 2697.5

Paleoenvironment: Marginal marine; (?Zone Rg)
Kerogen: woody/coaly (C); amorphous (C-VA); biodegraded terr. (C); S/P (C); dinoflagellates (rare); pyrite (F-C); very poor preserv.
?Trithyrodinium spp. (D) (R)
Paleocystodinium bulliforme (D) (VR)
Gambierina rudata (SP) (R)
Nothofagidites spp. (SP) (VR)
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (F)
Tricolpites gillii (SP) (R)
Tricolpites spp. (SP) (R)
Tricolpites cf. confessus (SP) (VR)
Stereisporites antiquasporites (SP) (VR)
Stereisporites (Tripunctisporis) (SP) (VR)
Phyllocladidites mawsonii (SP) (F-R)
Phyllocladidites microsaccatus (SP) (F)
Bisaccates (SP) (C)

2711.5

Paleoenvironment: Nonmarine; (Zonation indeterminate)
Kerogen: woody/coaly (C-A); amorphous (C-A); biodegraded terr. (C); S/P (C); dinoflagellates (barren); pyrite (C); very poor pres.; mud contam.
Spinidinium spp. (D) (VR, mud contam.?)
Gambierina rudata (SP) (VR)
Gambierina edwardsii (SP) (VR)
Nothofagidites spp. (SP) (VR)
Proteacidites spp. (SP) (F)
Proteacidites angulatus (SP) (VR)
Tricolpites gillii (SP) (F)
Tricolpites spp. (SP) (R)
Stereisporites antiquasporites (SP) (R)
Phyllocladidites mawsonii (SP) (F-R)
Phyllocladidites microsaccatus (SP) (F)
Bisaccates (SP) (C)

2722

Paleoenvironment: Marginal marine
Kerogen: woody/coaly (C-A); amorphous (C-A); biodegraded terr. (C); S/P (C); dinoflagellates (rare); pyrite (C); very poor pres.; mud contam.
?Trithyrodinium spp. (D) (VR)
Hystichosphaeridium sp. T (D) (R-F)
Gambierina rudata (SP) (R)
Australopollis obscurus (SP) (R)
Proteacidites spp. (SP) (F-C)
Proteacidites angulatus (SP) (VR)
Tricolpites gillii (SP) (R-F)
Tricolpites cf. confessus (SP) (VR)
Phyllocladidites mawsonii (SP) (F-R)
Lygistipollenites balmei (SP) (R)
Lygistipollenites florinii (SP) (VR)
Bisaccates (SP) (C)

2748; 2750	Paleoenvironment: Non- to marginal marine Kerogen: woody/coaly (C-A); amorphous (A-F); biodegraded terr. (C-A); S/P (C); dinoflagellates (nearly barren); pyrite (A-VA); very poor pres.; mud contam. Gambierina rudata (SP) (R) Nothofagidites spp. (SP) (VR) Australopollis obscurus (SP) (R) Proteacidites spp. (SP) (F) Proteacidites angulatus (SP) (VR) Tricolpites gillii (SP) (R) Stereisporites antiquasporites (SP) (R) Stereisporites (Tripunctisporis) (SP) (R) Onamentifera sentosa (SP) (VR) Phyllocladidites mawsonii (SP) (R) Phyllocladidites microsaccatus (SP) (F) Bisaccates (SP) (C)
2759	Paleoenvironment: Nonmarine Kerogen: woody/coaly (C); amorphous (A); biodegraded terr. (C-A); S/P (C); dinoflagellates (nearly barren); pyrite (VA); very poor pres.; mud contam. Nothofagidites spp. (SP) (VR) Australopollis obscurus (SP) (R) Proteacidites spp. (SP) (F) Proteacidites angulatus (SP) (VR) Tricolpites gillii (SP) (R) Tricolpites cf. confessus (SP) (R) Stereisporites antiquasporites (SP) (F) Stereisporites (Tripunctisporis) (SP) (R) Onamentifera sentosa (SP) (VR) Phyllocladidites mawsonii (SP) (R) Phyllocladidites microsaccatus (SP) (F) Bisaccates (SP) (C)
2768	Paleoenvironment: Marine to marginal marine Kerogen: woody/coaly (C-A); amorphous (A); biodegraded terr. (C-A); S/P (C); dinoflagellates (freq.); pyrite (A); very poor pres.; mud contam. Spiniferites spp. (D) (indicative of open marine) (R, mud contam.?) Hafniasphaera septatus (D) (VR, mud contam.?) Manumiella spp. (D) (R-F) Manumiella druggii (D) (R-F) Isabelidinium spp. (D) (VR) Cerodinium spp. (D) (VR) Cerodinium sp. S (D) (VR, mud contam?) Paleocystodinium golzowense (D) (VR) Glaphyrocysta retiintexta (D) (R-F, mud contam.?) Cordosphaeridium spp. (D) (VR) Gambierina rudata (SP) (R-F) Australopollis obscurus (SP) (R)

Proteacidites spp. (SP) (C)
Proteacidites reticulconcavus (SP) (VR)
Proteacidites angulatus (SP) (VR)
Tricolpites gillii (SP) (R)
Tricolpites spp. (SP) (R)
Tricolpites cf. confessus (SP) (R)
Stereisporites antiquasporites (SP) (F)
Stereisporites (Tripunctisporis) (SP) (R)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (F)
Podosporites antarcticus (SP) (R)
Bisaccates (SP) (C)

2781 Paleoenvironment: Non- to marginal marine
Kerogen: woody/coaly (C); amorphous (A); biodegraded terr. (A); S/P (C); dinoflagellates (rare); pyrite (A); very poor pres.; mud contam.
?Manumiella spp. (D) (R-F)*
Glaphyrocysta retiintexta (D) (R-F, mud contam.?)
Gambierina rudata (SP) (R)
Gambierina edwardsii (SP) (R)
Nothofagidites spp. (SP) (VR)
Nothofagidites cf. senectus (SP) (VR)
Proteacidites spp. (SP) (C)
Tricolpites gillii (SP) (R)
Tricolpites spp. (SP) (R)
Stereisporites antiquasporites (SP) (F)
Stereisporites (Tripunctisporis) (SP) (VR)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (F)
Podosporites antarcticus (SP) (R)
Bisaccates (SP) (C)

2789 Paleoenvironment: Marginal marine
Kerogen: woody/coaly (C); amorphous (A); biodegraded terr. (A); S/P (C); dinoflagellates (rare-few); pyrite (A); very poor pres.; mud contam.
Manumiella spp. (D) (R-F)
Manumiella coronata (D) (R)
Gambierina rudata (SP) (C)
Proteacidites spp. (SP) (C)
Tricolpites gillii (SP) (F)
Stereisporites antiquasporites (SP) (F)
Stereisporites (Tripunctisporis) (SP) (R)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (F)
Podosporites antarcticus (SP) (R)
Bisaccates (SP) (C)

2811 Paleoenvironment: Marginal marine
Kerogen: woody/coaly (C); amorphous (A); biodegraded terr. (A); S/P (C); dinoflagellates (freq.); pyrite (A); very poor pres.; mud contam.
Manumiella spp. (D) (C)
Manumiella coronata (D) (F-C)
Paleocystodinium golzowense (D) (VR)
Gambierina rudata (SP) (R-F)

Gambierina edwardsii (SP) (R)
Proteacidites spp. (SP) (C)
Tricolpites gillii (SP) (F)
Tricolpites cf. confessus (SP) (VR)
Stereisporites antiquasporites (SP) (R)
Stereisporites (Tripunctisporis) (SP) (R)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (F)
Podosporites antarcticus (SP) (R)
Bisaccates (SP) (C)

2819 Paleoenvironment: Marginal marine to nonmarine
Kerogen: woody/coaly (C); amorphous (A); biodegraded terr. (A); S/P (C); dinoflagellates (very rare.); pyrite (A); very poor pres.; mud contam.
?Manumiella spp. (D) (R)
Gambierina rudata (SP) (R)
Proteacidites spp. (SP) (C)
Tricolpites gillii (SP) (R)
Tricolpites longus (SP) (VR)
Tricolpites spp. (SP) (R)
Stereisporites antiquasporites (SP) (R)
Stereisporites (Tripunctisporis) (SP) (R)
Phyllocladidites mawsonii (SP) (R)
Phyllocladidites microsaccatus (SP) (F)
Bisaccates (SP) (C)