BHP Petroleum

WELL COMPLETION REPORT

TOMMYRUFF-1

VOLUME 2

INTERPRETIVE DATA

BHP Petroleum
BHP Petroleum Pty. Ltd.
Incorporated in Victoria

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1. SUMMARY

1.1 Drilling Summary.

Tommyruff-1 was spudded by the rig Southern Cross at 0415 hours on 19th May 1990. The 26" hole was drilled from 54-182 mKB and the 20" casing run and cemented to a shoe depth of 175.2 mKB.

A 12-1/2" pilot hole was drilled from 182-790 mKB. The purpose of this was to provide good logging conditions for this section of hole. Suite 1 wireline logs consisted of:

DLL-MSFL-GR-SDT-CAL-SP-AMS

The hole was reamed out to 17-1/2" to a depth of 795 mKB and 13-3/8" casing was run in the hole to a depth of 783 mKB.

The 12-1/4" hole was drilled to 1550 mKB. Suite 2 wireline logs consisted of:

DLL-MSFL-LDL-CNL-SDT-GR-SP-CAL-AMS

SAT

CST

RTF

The well was then plugged and abandoned on the 29th May 1990.

1.2 Geological Summary

The Tommyruff structure lies within the south-western portion of the offshore Gippsland Basin, and to the west of the Perch-Dolphin-Tarwhine trend. At the top of Latrobe the post-drill structure is elongate in form and trends in a northeast-southwest direction (see Enclosure 3).

The well Tommyruff-1 was located in a near crestal position at the intersection of lines GSE89A-18 and GSE89A-09, 16.3km to the south-west of the Perch oil field. The primary objective of the well was to test the hydrocarbon potential of the Latrobe Group sediments, in particular the "Coarse Clastics" unit at the top of Latrobe. A secondary target was within a very small mapped closure in the lower N.asperus spore pollen zone.

Although the well intersected the top of Latrobe 24m low to prediction, the internal stratigraphic units encountered were similiar to prediction. The sands intersected by the well were of good reservoir quality, however all have been interpreted to be water saturated. Consequently no net pay has been assigned to this well.

2. PREVIOUS ACTIVITY

Tommyruff-1 is located in the permit area Vic/P25. Permit Vic/P25 lies to the south-west of the main producing part of offshore Gippsland Basin, along the basin edge. Prior to the drilling of Amberjack-1 and Tommyruff-1 only two wells had previously been drilled in Vic/P25, Kyarra-1 in February 1983 and Wyrallah-1 in May 1986. Both wells were drilled by Australian Aquitaine Petroleum Pty. Ltd, to test the prospectivity of the Latrobe Group sediments. The entire thickness of the Latrobe Group was not penetrated by either well, and there were no hydrocarbons were encountered.

3. BASIN EVOLUTION

The formation of Gippsland Basin began during the early Cretaceous and was associated with the breakup of Gondwanaland. The Gippsland Basin lies along the southern continental shelf, between Australia and Tasmania.

A big depression formed as a consequence of the initial breakup of Gondwanaland and intital basin development began with the deposition of the Strzelecki Group strata. Deposition was widespread at the time and continous across the Gippsland, Bass and Otway Basins. Early Cretaceous rifting led to the development of a complex set of horsts, grabens and half grabens in which Strzelecki Group deposition continued. The Strzelecki Group consists of a thick sequence of non-marine, volcano-clastic sediments, and are generally referred to as "economic basement" in the offshore part of the Gippsland Basin.

A second period of rifting occurred during the late Cretaceous when Australia separated from Antarctica. This period of tectonism is represented seismically by an angular unconformity. After a period of uplift and erosion, downfaulting led to the development of a new graben, Gippsland Basin, which was now isolated from the Bass and Otway Basins. The sedimentary provenance changed and sedimentation of the early Latrobe Group sediments began.

Sedimentation of the older Latrobe Group strata was restricted to a narrow zone which formed the Central Deep. The northern limit of the Central Deep is defined by the Northern Bounding Fault system and the southern limit is defined by the Southern Bounding Fault system. These bounding fault systems trend roughly in an east-west direction as shown in figure 3.

Latrobe Group sedimentation continued as did basin extension, and subsidence was mainly controlled through a series of NW-SE trending fault systems.

The fault controlled subsidence continued thoughout the Paleocene to early Eocene, as did sedimentation, when a change in tectonic activity had begun to take place. The tectonic activity and structural style of the basin architecture began to change as sedimentation became increasingly influenced by the transgression the Tasman Sea, encroaching from a south-easterly direction.

From late Eocene to mid Miocene the structural style of the basin became dominated by a period of compressional tectonism, which produced a series of NE-SW trending anticlinal axes. It is unknown as to what initiated this period of compressive tectonism, but the structures that formed during this time include simple anticlines, faulted anticlines and high and low side fault closures. During this phase of basin development regional uplift also occurred which resulted in a major erosional event of the structural highs, as transgression of the Tasman Sea continued. Many of the major top of Latrobe hydrocarbon traps found so far in Gippsland Basin were formed during this time.

The Seaspray Group consists of a thick sequence of marine sediments that were progressively deposited under the influence of the transgressing Tasman Sea. The Lakes Entrance formation forms the basal part of the group and consists of very fine grained marine sediments which generally provides a regional seal for most of the top of Latrobe Group structures.

During the late Eocene when regional uplift occurred throughout most of the basin, submarine channel systems began to develop particluarly along the eastern seaward margin of the basin. This channelling and erosion of the exposed late Eocene highs created the erosional surface seen at the top of Latrobe. Although the channel fill sedimentation is complex, it occurred penecontemporaneous to deposition of the Gippsland Limestone formation.

From mid Miocene to Pleistocene and Recent, some reactivation of the earlier compressive deformation events occurred which initiated the development of some new anticlinal structures and rejuvenated some earlier ones. These events are particularly evident in the western part of the basin in and near permit area Vic/P25.

4. STRUCTURE

The Tommyruff prospect at the top of Latrobe horizon is a very broad, low amplitude, mound-like feature which is elongate in form, the axis of which trends in a NE-SW direction (Enlosure 8). The prospect is located within permit Vic/P25 which lies along the south-western margin of Gippsland Basin. The crest of the Tommyruff structure at the top of Latrobe horizon lies approximately 16km southwest of the Perch oil field, with the Top of Latrobe horizon being considerably shallower than at Perch field.

Although the structure is fault bounded, independent dip closure is mapped at the top of Latrobe horizon.

The Lakes Entrance isopach (Enclosure 2) indicates thinning of the unit over the Tommyruff structure. Seismic onlap of the Lakes Entrance Formation onto the top of Latrobe horizon can be recognised suggesting that the top of Latrobe structure was a topographic high pre- Lakes Entrance deposition.

5. SEQUENCE STRATIGRAPHY

After the Gippsland Basin became isolated from the Bass and Otway basins, sedimentation continued but was more restricted. However sedimentation was not continous at all times during basin development. A schematic presentation of the generalised Gippsland Basin sequence stratigraphy can be seen in figure 3.

Essentially Gippsland Stratigraphy can be divided into three main units pre-rift, rift and marine.

PRE-RIFT

Sedimentation of the Strzelecki Group commenced during the early Cretaceous as a consequence of the breakup of Gondwanaland. The depression was rapidly filled by alluvial fan, fluvial and volcano-clastic type sediments. During the late Cretaceous rifting resulted in the formation of horsts, graben and half grabens which were bounded by steep normal faults.

RIFT

From the late Cretaceous to late Eocene the Latrobe Group sediments were deposited. The Latrobe Group is composed of a set of synchronous depositional systems - fan delta, fluvial deltaic, near shore coastal plain sediments that onlapped the pre-existing surfaces. Some marine incursions are evident elsewhere in the basin during this period of sedimentation, but were not noted in Tommyruff-1.

In the permit Vic/P25 area, the sediments have predominantly been deposited in a near shore, coastal plain environment which includes sandy barrier bar sequences that are intimately associated with estuarine, lagoonal, back-swamp facies. A modern analogue for the permit area would be the present day Gippsland Lakes area.

MARINE

During the Late Oligocene sedimentation became progressively influenced by the marine transgression which resulted in the deposition of an alternating sequence of high and low energy carbonates. Onset of the marine transgressive sequence was marked by a regional drowning event which is characterised by the glauconite rich, Gurnard Formation and was followed by deposition of the Lakes Entrance Formation of the Seaspray Group.

The Lakes Entrance Formation was deposited in a relatively low energy environment and consists of very fine grained claystone, marl and calclutites. The low permeability Lakes Entrance are overlain by high energy carbonates of the Gippsland Limestone which consist typically of calcarenites which at times are rich in siliclastic content.

The Tommyruff-1 well is located along the south-western margin of the basin. The stratigraphic units intersected by well are similar to the sequence stratigraphy described above which fits into the regional picture. Well to well correlations are presented in Enclosure 4. The well control for stratigraphic analysis is limited in this region, so the T.D. of the well was designed to drill into the Strzelecki Group sediments. The well was drilled to 1550 mKB and T.D'd in upper Cretaceous sediments of the P.mawsonni spore pollen zone which is indicative elsewhere in the basin of very early Latrobe Group sedimentation to very late Strzelecki Group sedimentation.

The following is a description of the sequence stratigraphy intersected at Tommyruff-1. The dates for the Latrobe Group Sediments have been obtained from palynological spore-pollen and dinoflaggelate data (refer Appendix 2 and Enclosure 3).

Turonian-Santonian (1550-1300 mKB)

These upper Cretaceous, Turonian-Santonian (P.mawsonni spore pollen zone) sediments consist predominately of a repetetive sequence of thinly bedded sandstone, siltstone and claystone units. Towards the base if the interval some volcanic lithics were noted in the ditch cuttings which were intimately associated with the sediments.

Within this interval the sandstone units vary in thickness from 5 to 10 meters. The sands are porous and the quartz grains were described in the ditch cuttings as being loose and unconsolidated, medium to coarse grained, occasionally granular, and generally angular.

Electrofacies analysis of this interval is limited as the dipmeter log was not run, and definition of the individual units on the gamma ray log is poor. However some upward fining and upward sequences may be recognised in the porosity logs which suggests that the interval may have been deposited within a fluvial setting, possibly within a floodplain facies.

Dinocysts (refer Appendix 2) have been recognised in this interval that are "Kipper Shale" equivalents which have been found previously to be associated with the northern platform of the offshore Gippsland Basin. The dinocycts are of Turonian-Santonian age and belong to the P.mawsonii spore pollen zone (Helby et.al., 1987). These dinocysts have been documented from the Northern platform by Marshal (Marshall, N.G. 1989) who claims that they are the oldest records of algal cysts found within the offshore region of south-eastern Australia. The occurrence of these dinocysts is now being associated with the oldest occurrence of marine conditions within the basin which appear to have been deposited during the latest rifting/earliest seafloor spreading episode associated with the formation of the Tasman Sea. The importance of this discovery is that these dinocysts have only previously been found in wells that were drilled much closer to the shelf edge along the Southern Platform region.

A marked unconformity can be seen on logs at 1300 mKB.

Paleocene (1300-1220 mKB)

A significant time break between the Upper Cretaceous sediments and the overlying Paleocene (upper L.balmei-lower L.balmei) sediments. This interval also consists of a repetitive sequence of sandstone, siltstone and claystone interbeds that are intimately associated with some thin coal horizons.

A significant change of clay type has occurred in this interval from the underlying upper Cretaceous sediments as is evident on the gamma ray log and porosity logs. The sand intervals are thicker in this interval and display a blocky log character on the gamma ray log. Porosity within the sandstone units is relatively uniform.

The sands were described from the ditch cuttings as being loose and unconsolidated, predominately medium grained, occasionally coarse grained. The individual quartz grains were clear, subangular to subround and poorly sorted.

Early Eocene (1220-1090 mKB)

These early Eocene sediments (upper M.diversus/P.asperopolus - mid N.asperus) are also similar in form to the underlying Paleocene sediments, however the coal seams are much thicker and the grain size has increased.

Late Eocene (1090-900 mKB)

This unit is characterised by a very thick sandstone interval (900-990m) which overlies a sequence of thinly interbedded siltstone, mudstone and coals. The unit appears to have been deposited within the upper foreshore facies of a coastal barrier bar system which overlies the back-barrier swamp facies. The sands in this interval have excellent reservoir characteristics as they are very porous and permeable. The invidual grains were described from the ditch cuttings as being loose and uncondolidated, coarse grained to granular of moderate sphericity, and subangular to subround. Some bioturbation is noted at the top of the interval.

Late Eocene-Early Oligocene (900-840 mKB)

Only a very thin veneer of Gurnard Formation (892-900 mKB) was seen in this well. This interval consists of predominately marl which becomes finely interbedded with sandstone and siltstone and towards the base. The upper part of the interval consists of the Lakes Entrance sediments 840-892 mKB) which are typically green, olive-green coloured and represent the transition from the non-marine to marine period of sedimentation. The units are separated by a marked unconformity that can be seen on the logs at 892 mKB.

Oligocene to Recent

During this period, deposition within the basin was dominated by marine influences. This marine transgressive sequence, known as the Seaspray Group consists of low energy carbonate deposits, the marls, mudstone and calclutite of the Lakes Entrance Formation, which was overlain by higher energy carbonates of the Gippsland Limestone Formation. Within the Gippsland Limestone Formation some alteration between high and low energy deposition exists, reflecting eustatic sealevel changes.

Within this area, on the basin margin, silica-rich sandstone units have been intersected in several wells. Although correlation of these sands is difficult with nearby wells, the sandstone interval does appear to occur at about the same horizon. The sandstone was intersected in this well at 380-410m KB in which the quartz grains were described from the ditch cuttings as being loose and unconsolidated, predominately coarse grained, well sorted and subrounded.

6. RESERVOIRS

Reservoirs are mostly found elsewhere within the offshore part of Gippsland basin within in the Latrobe Group strata. In the Vic/P25 permit area, the Latrobe Group was targeted for potential hydrocarbon reservoirs. The sandstone units within the Latrobe Group typically are of high reservoir quality as they have high porosities and vertical and horizontal permeabilities.

The primary target for the Tommyruff-1 well was located at the top of Latrobe horizon where structural closure had been mapped. The pre-drill stratigraphic interpretion expected to intersect upper shore-face sand bodies at or near the top of Latrobe horizon, which would have provided excellent reservoir characteristics. Tommyruff-1 did infact, intersect the upper shore-face facies at the top of Latrobe horizon.

As the prospectivity of the intra Latrobe Group strata is high elsewhere in the offshore Gippsland Basin, secondary targets are possible. At the Tommyruff prospect a small structural closre was mapped at the lower N.asperus horizon, but no hydrocarbons were encountered in this zone during drilling. The possibility also exists for stratigraphic traps as seen elswhere in the basin.

Within the Gippsland Limestone Formation, the prospectivity of the high stand transgressive sandstone units seen elsewhere along the basin margin in this horizon is relatively unexplored. However the sands also display excellent reservoir characteristics and therefore must be considered as secondary targets. The sandstone unit was intersected by Tommyruff-1 at 380-410 mKB.

7. SEAL

For the primary target, the low permeability fine grained marls, of the Lakes Entrance Formation were expected to provide a seal for the top of Latrobe sediments. The Lakes Entrance Formation was intersected by the well at 840-892 mKB, and is 52.0 metres thick.

Intra-formational claystones and mudstones were expected to provide the seal for the secondary targets of the well.

8. SOURCE ROCK

Within the offshore part of the Gippland Basin central deep, the older Latrobe Group sediments are thought to provide the main source material for most of the reservoirs discovered to date. As the Vic/P25 permit area is relatively unexplored for hydrocarbons, it was considered that the same sediments could provide a local and regional source for the area. Long distance migration pathways, that have not been substantiated from the central deep, were also considered as a possibility to provide hydrocarbons for entrapment within the permit area.

As the permit area is located along the basin margin where the Latrobe Group strata is relatively thin, source contribution from the underlying Strzelecki Group sediments was also considered to be a possibility. Very little is known about the source potential of this group as only a few wells have penetrated this horizon. In the central deep the Strzelecki Group sediments are buried at a considerable depth and therefore potential source rocks are considered to be overmature. However along the basin margins the sediments are much shallower with the posssibility that the source rocks are mature. This hypothesis was supported by the maturation and burial history studies that were carried out pre-drill.

9. HYDROCARBON OCCURRENCE AND SHOWS

During drilling no significant hydrocarbon fluorescence shows were recorded in either the shallow post-Latrobe section or in the Latrobe Group strata. However the cause of a log anomaly at the top of Latrobe Group (900-920 mKB) was investigated thoroughly. RFT pretests indicated that the sediments were water saturated and log anomaly may has been interpreted to be due to very high permeabilities.

10. SEISMIC INTERPRETATION

The check-shot time for the top of Latrobe Coarse Clastics in Tommyruff-1 was 0.762 sec. compared with a picked seismic time of 0.768 sec. which indicates a seismic lag of 6 ms (as would be expected from recent "SEG normal" GSI data from this area). This is confirmed by the synthetic seismogram, (Enclosure 8) with 35 H_z dominant frequency, which gives a good match with the seismic data when moved down by 6 ms. As on earlier data, the top of Coarse Clastics event on the GSE89A seismic data (Line 18, Enclosure 7), is very weak, but the original pick is confirmed, and the Time Map (Enclosure 6) can therefore be considered to be valid.

The seismic average velocity at the Tommyruff-1 location was higher than originally prognosed, being 2278 m/s (see Average Velocity Map, Enclosure 7), although this increased velocity would be expected, given the results of Amberjack-1. The top of Coarse Clastics in Tommyruff-1 was therefore encountered some 25m deep to prognosis.

Multiplying the time map by the seismic average velocity map to give the top of Coarse Clastics Depth Map (Enclosure 1) shows that Tommyruff-1 was drilled at the crest of a valid structural closure, with slightly reduced vertical relief compared to the original mapping. The negative results from the well therefore indicate the lack of a migration path for oil into this structure.

As no significant hydrocarbon shows were recorded during drilling this well the prospectivity of the region has been substantially downgraded.

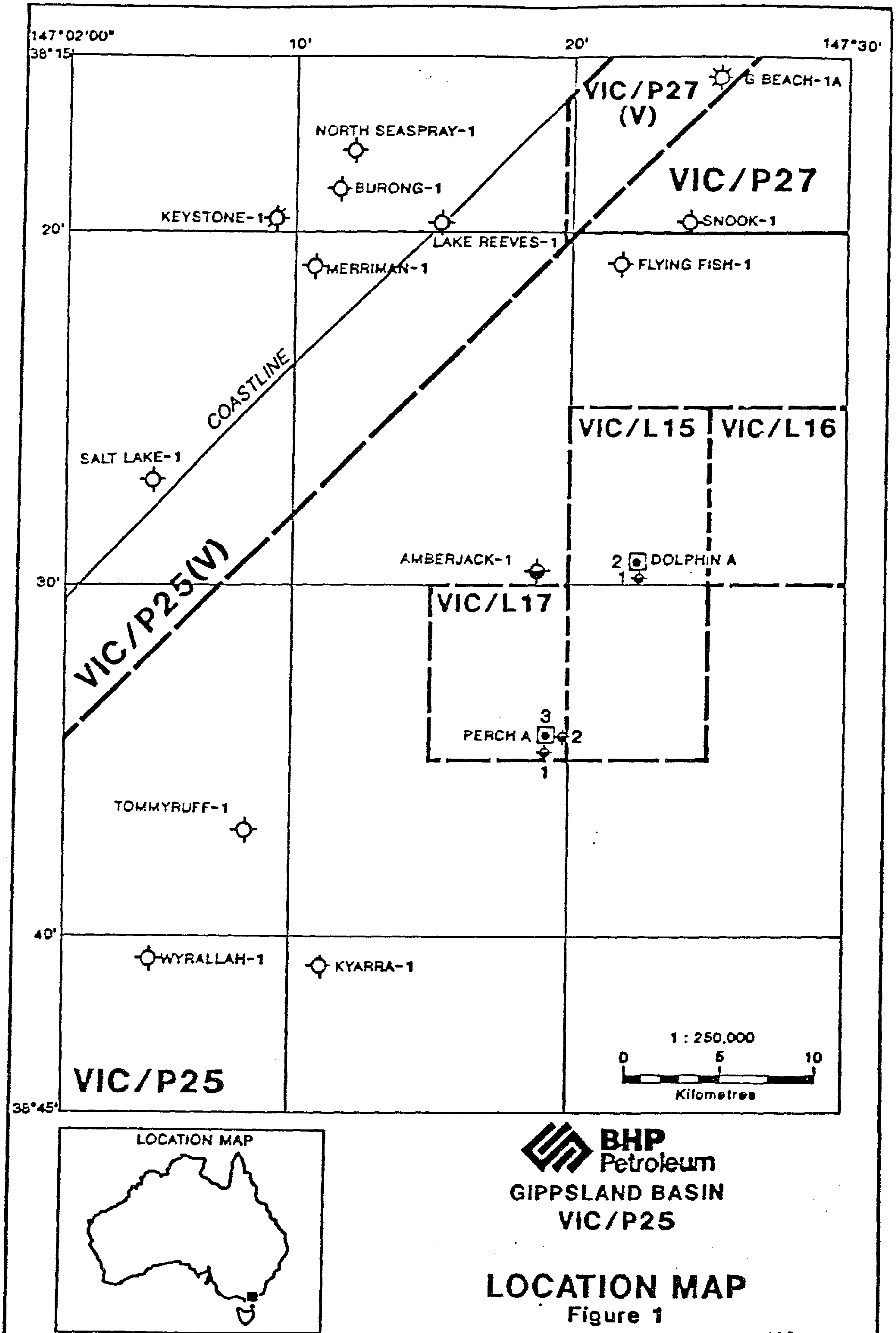
The structural closure mapped at the top of Latrobe horizon has also been confirmed although the shape of the structure is a little different from the pre-drill interpretation.

The geological model proposed for this area was confirmed by the well, ie the Latrobe Group strata were deposited in a coastal environment, within a fore-shore facies that was closely associated with a lagoonal, back-swamp facies.

The Latrobe Group strata consists of a discontinuous sequence of clastic sediments that range in age from Turonian to earliest Santonian (P.mawsonii spore-pollen zone) to the late Oligocene-early Miocene (P.tuberculatus spore pollen zone). Several periods of non-deposition or erosion occurred as indicated by the spore pollen flora recovered from the well.

Figure 1

FIGURE 1



GIPPSLAND BASIN

VIC/P25

LOCATION MAP

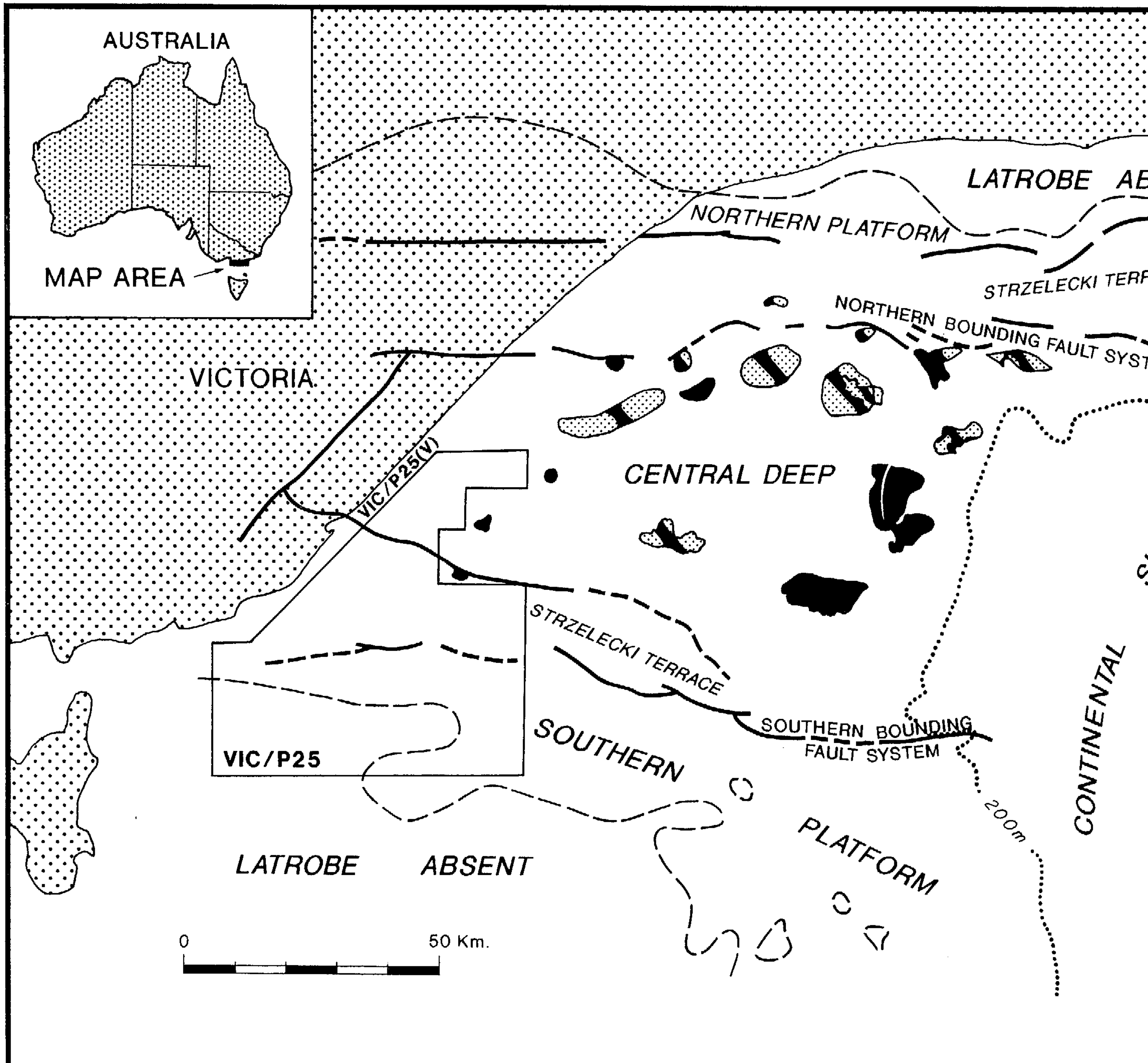
Figure 1

Author : L.Jordan Date : February 1990

OG 23401

Figure 2

FIGURE 2



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VIC/P25

REGIONAL STRUCTURE MAP

Figure 2

Author : A.Cernovskis Drawn By : J.Haydon

Date : January 1991

OG 24277

Figure 3

FIGURE 3

PE906428

This is an enclosure indicator page.
The enclosure PE906428 is enclosed within the container PE906427 at this location in this document.

The enclosure PE906428 has the following characteristics:

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CONTAINER_BARCODE = PE906427
NAME = Stratigraphic Section
BASIN = GIPPSLAND
PERMIT = VIC/P25
TYPE = WELL
SUBTYPE = STRAT_COLUMN
DESCRIPTION = Generalised Gippsland Basin Sequence Stratigraphy
REMARKS =
DATE_CREATED =
DATE_RECEIVED = 22/02/91
W_NO = W1030
WELL_NAME = TOMMYRUFF-1
CONTRACTOR = SIERRA GEOPHYSICS
CLIENT_OP_CO = BHP PETROLEUM

(Inserted by DNRE - Vic Govt Mines Dept)

GIPPSLAND BASIN - GENERAL CHRONOSTRATIGRAPHY

STRATLOG STRATIGRAPHIC CROSS SECTION

LITHOLOGIC SYMBOLS:

NEARSHORE MARINE | OFFSHORE MARINE MUDSTONE | MARINE LIMESTONE | FLUVIAL CHANNEL | NON DEP. OR EROSION

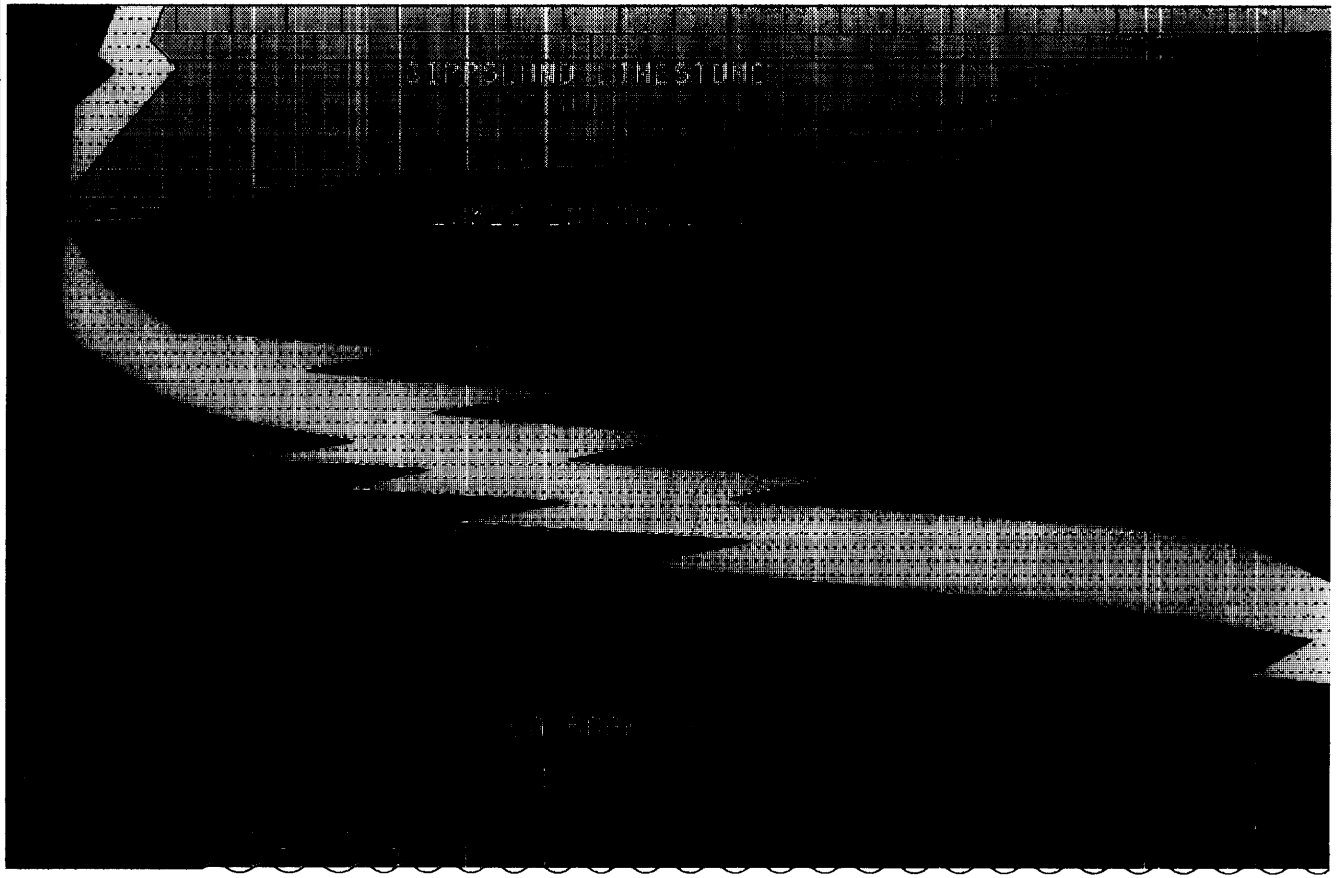
SECTION: GIPPSLAND BASIN

GIPPSLAND BASIN - GENERAL CHRONOSTRATIGRAPHY

TERTIARY	PLIOCENE		M. LIPSUS
	MIOCENE	LATE	C. BIFURCATUS
		MID.	T. BELLUS
		EARLY	P. TUBERCULATUS
	OLIGOC.	LATE	
		EARLY	U. N. ASPERUS
	EOCENE	LATE	L. N. ASPERUS
		MID.	
		EARLY	P. ASPEROPOLIS
			[illegible]
			M. M. DIVERSUS
			L. M. DIVERSUS
	PALAEOC.	LATE	U. L. BALMEI
			L. L. BALMEI
		MID.	
		EARLY	
CRETACEOUS	LATE	MAAST.	T. LONGUS
			T. LILLEI
		CAMPAN.	N. SENECTUS
			T. APOXYEXINUS
		SANTON.	
		CONIAC.	P. MAWSONII
		TURON.	
		CENOMAN.	A. DISTOCARINATUS

ONSHORE

OFFSHORE



ENCLOSURE 1

Enclosure 1

PE906429

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BASIN =	GIPPSLAND
PERMIT =	VIC/P25
TYPE =	SEISMIC
SUBTYPE =	HRZN_CNTR_MAP
DESCRIPTION =	Top of Latrobe Coarse Clastics Time Map (corrected for well velocity surveys) for Tommyruff-1
REMARKS =	
DATE_CREATED =	30/09/90
DATE_RECEIVED =	22/02/91
W_NO =	W1030
WELL_NAME =	TOMMYRUFF-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP PETROLEUM

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE - 2

Enclosure 2

PE906430

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BASIN =	GIPPSLAND
PERMIT =	VIC/P25
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SUBTYPE =	ISOPACH_MAP
DESCRIPTION =	Time Isopach of Lakes Entrance Formation for Tommyruff-1
REMARKS =	
DATE_CREATED =	28/02/90
DATE_RECEIVED =	22/02/91
W_NO =	W1030
WELL_NAME =	TOMMYRUFF-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP PETROLEUM

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE 3

Enclosure 3

PE603813

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REMARKS =
DATE_CREATED = 3/06/90
DATE_RECEIVED = 22/02/91
W_NO = W1030
WELL_NAME = TOMMYRUFF-1
CONTRACTOR =
CLIENT_OP_CO = BHP PETROLEUM

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ENCLOSURE 4

Enclosure 4

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BASIN =	GIPPSLAND
PERMIT =	VIC/P25
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SUBTYPE =	CROSS-SECTION
DESCRIPTION =	Well Correlation for Perch-1A, Tommyruff-1, Wyrallah-1, 2 of 2
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DATE_CREATED =	
DATE_RECEIVED =	22/02/91
W_NO =	W1030
WELL_NAME =	TOMMYRUFF-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP PETROLEUM

(Inserted by DNRE - Vic Govt Mines Dept)

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PERMIT =	VIC/P25
TYPE =	WELL
SUBTYPE =	CROSS-SECTION
DESCRIPTION =	Well Correlation for Perch-1A, Tommyruff-1, Wyrallah-1, 1 of 2
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DATE_CREATED =	
DATE_RECEIVED =	22/02/91
W_NO =	W1030
WELL_NAME =	TOMMYRUFF-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP PETROLEUM

(Inserted by DNRE - Vic Govt Mines Dept)

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           PERMIT = VIC/P25
             TYPE = WELL
          SUBTYPE = CROSS-SECTION
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          REMARKS =
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    DATE_RECEIVED = 22/02/91
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        WELL_NAME = TOMMYRUFF-1
       CONTRACTOR =
     CLIENT_OP_CO = BHP PETROLEUM
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(Inserted by DNRE - Vic Govt Mines Dept)

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ITEM_BARCODE =	PE906434
CONTAINER_BARCODE =	PE906427
NAME =	Well Correlations, 4 of 4
BASIN =	GIPPSLAND
PERMIT =	VIC/P25
TYPE =	WELL
SUBTYPE =	CROSS-SECTION
DESCRIPTION =	Well Correlation for Kyarra-1 and Tommyruff-1, 2 of 2
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	22/02/91
W_NO =	W1030
WELL_NAME =	TOMMYRUFF-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP PETROLEUM

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ENCLOSURE 5

Enclosure 5

PE906435

This is an enclosure indicator page.
The enclosure PE906435 is enclosed within the container PE906427 at this location in this document.

The enclosure PE906435 has the following characteristics:

ITEM_BARCODE =	PE906435
CONTAINER_BARCODE =	PE906427
NAME =	Average Velocity Map
BASIN =	GIPPSLAND
PERMIT =	VIC/P25
TYPE =	SEISMIC
SUBTYPE =	VEL_CONTR
DESCRIPTION =	Average Velocity to Top of Latrobe Coarse Clastics for Tommyruff-1
REMARKS =	
DATE_CREATED =	30/09/90
DATE_RECEIVED =	22/02/91
W_NO =	W1030
WELL_NAME =	TOMMYRUFF-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP PETROLEUM

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ENCLOSURE 6

PE906436

This is an enclosure indicator page.
The enclosure PE906436 is enclosed within the container PE906427 at this location in this document.

The enclosure PE906436 has the following characteristics:

ITEM_BARCODE =	PE906436
CONTAINER_BARCODE =	PE906427
NAME =	Depth Structure Map
BASIN =	GIPPSLAND
PERMIT =	VIC/P25
TYPE =	SEISMIC
SUBTYPE =	HRZN_CNTR_MAP
DESCRIPTION =	Depth Structure to Top of Latrobe Coarse Clastics for Tommyruff-1
REMARKS =	
DATE_CREATED =	31/08/90
DATE_RECEIVED =	22/02/91
W_NO =	W1030
WELL_NAME =	TOMMYRUFF-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP PETROLEUM

(Inserted by DNRE - Vic Govt Mines Dept)

Enclosure 7

ENCLOSURE 7

PE906437

This is an enclosure indicator page.
The enclosure PE906437 is enclosed within the container PE906427 at this location in this document.

The enclosure PE906437 has the following characteristics:

ITEM_BARCODE = PE906437
CONTAINER_BARCODE = PE906427
NAME = Seismic Section GSE89A-18
BASIN = GIPPSLAND
PERMIT = VIC/P25
TYPE = SEISMIC
SUBTYPE = SECTION
DESCRIPTION = Seismic Section GSE89A-18 (Interpreted)
REMARKS =
DATE_CREATED = 7/11/89
DATE_RECEIVED = 22/02/91
W_NO = W1030
WELL_NAME = TOMMYRUFF-1
CONTRACTOR = HALLIBURTON
CLIENT_OP_CO = BHP PETROLEUM

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Enclosure 8

ENCLOSURE 8

PE603814

This is an enclosure indicator page.
The enclosure PE603814 is enclosed within the container PE906427 at this location in this document.

The enclosure PE603814 has the following characteristics:

ITEM_BARCODE	=	PE603814
CONTAINER_BARCODE	=	PE906427
NAME	=	Synthetic Seismogram
BASIN	=	GIPPSLAND
PERMIT	=	VIC/P25
TYPE	=	WELL
SUBTYPE	=	SYNTH_SEISMOGRAPH
DESCRIPTION	=	Geogram Synthetic Seismogram for Tommyruff-1
REMARKS	=	
DATE_CREATED	=	29/05/90
DATE_RECEIVED	=	22/02/91
W_NO	=	W1030
WELL_NAME	=	TOMMYRUFF-1
CONTRACTOR	=	SCHLUMBERGER
CLIENT_OP_CO	=	BHP PETROLEUM

(Inserted by DNRE - Vic Govt Mines Dept)

APPENDIX 1

Appendix 1

PALYNOLOGICAL ANALYSIS, TOMMYRUFF-1

GIPPSLAND BASIN

by

M.K. MACPHAIL

Palaeontological report prepared 20 September 1990
BHP Petroleum Pty. Ltd.

Consultant Palynologist, 20 Abbey St., Gladesville, NSW 2111

INTRODUCTION

SUMMARY OF RESULTS

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INTRODUCTION

Thirty six sidewall core and four cuttings samples, representing the interval 815.0 to 1545.1m in Tommyruff-1 were processed and examined for spore-pollen and dinoflagellates.

Yields and preservation were adequate to good but difficulties in distinguishing between reworking and bioturbation of palynomorphs has meant that marl samples 897.0-1000m cannot be dated with confidence [see Biostratigraphy]. In more general terms, spore-pollen does not allow carbonates above Top of Latrobe to be dated with the same degree of precision as planktonic foraminifera.

Palynological determinations and interpreted lithological units are summarized below. Interpretative and basic data are given in Tables 1 and 2 respectively. Check lists of all species recorded are attached. Electric log data were unavailable.

SUMMARY

AGE	UNIT	ZONE	DEPTH RANGE (M)	ENVIRONMENT
Late Oligocene -Early Miocene	LAKES ENTRANCE FORMATION	P. tuberculatus	815.0-857.0	open marine
- - - - -	- - - - -	unconformity?	- - - - -	- - - - -
latest Eocene-Early Oligocene	"	P. tuberculatus	885.0-894.0	open marine
"	unnamed marl ?	Upper N. asperus	897.0-900.0	open marine?
Late Eocene	LATROBE GROUP coarse clastics	Middle N. asperus	922.4-1092.0	marginal marine
Early Eocene	"	Upper M. diversus - P. asperopolus	1167.1-1220.0	coastal plain
Paleocene	"	Upper L. balmei	1251.5-1281.0	coastal plain
"	"	Lower L. balmei?	1288.0	coastal plain
- - - - -	- - - - -	unconformity	- - - - -	- - - - -
Turonian-early Santonian	[KIPPER SHALE]	P. mawsonii	1312-1513.4	rift valley lake

GEOLOGICAL COMMENTS

1. Tommyruff-1 contains a discontinuous sequence of zones from the Turonian-earliest Santonian P. mawsonii Zone to the Late Oligocene-late Early Miocene P. tuberculatus Zone. There is no evidence that Maastrichtian-Campanian sediments are present. Sediment accumulation rates were low during the Paleocene-Early Eocene and ?Early Oligocene and the entire Tertiary section is characterized by long periods of erosion or non-deposition.

2. Bioturbation and reworking across Top of Latrobe has blurred the boundaries between the Middle and Upper N. asperus Zones and Upper N. asperus and P. tuberculatus Zones.

   Nevertheless it is probable that marls overlying the Latrobe Group coarse clastics consist of two distinct units:

   (a) An upper section between 815.0-857.0m which is likely to be no older than Late Oligocene or younger than late Early Miocene.

   (b) A lower section between 885.0-900m which is likely to be latest Eocene-Early Oligocene.

   This unit [a calcareous shale?] appears to include both P. tuberculatus Zone and Upper N. asperus Zone units, implying continuity of sediment accumulation during this period - unlike at wellsites closer to or within the central deep.

3. The sporadic occurrences of diverse spore-pollen between 1167.1-1288.0m confirm the existence of thin Early Eocene [P. asperopolus Zone?] and Paleocene [L. balmei Zone] units in Tommyruff-1. Unlike Kyarra-1A, Lower M. diversus Zone facies are absent or were not sampled.

4. Conversely, the palynological data are definite that clay-and siltstones between 1312-1513.4m are Turonian-earliest Santonian, P. mawsonii Zone.

   This unit is characterized by an unique association of lacustrine dinocysts [Marshall, 1989] diagnostic of the "Kipper Shale" in the Kipper wells and adjacent wells such as Judith-1, Shark-1 and Admiral-1? drilled along the northern platform.

Along the southern platform this dinocyst flora previously has been recorded only in wells much closer to the shelf edge, in Omeo-2 and Pices-1. Only one other 'inshore' analogue of this assemblage has been recorded to date - within the P. mawsonii Zone interval in Sunfish-1 [Macphail, 1985; Marshall, 1989].

Based on these dinocysts, the unit is certainly a correlative of the Kipper Shale, if not the same formation. The increasing abundance and diversity of the dinocysts upsection indicate that only the basal section of this Kipper Shale equivalent is preserved at Tommyruff-1.

5. In spite of gross mud-contamination of SWCs between 1530.1-1545.1m, it is likely that Tommyruff-1 terminated in the Latrobe Group.

PALAEOENVIRONMENTS

1. Based on the first reliable occurrence of marine dinoflagellates, the Tommyruff-1 wellsite was located in a coastal plain environment but away from any direct marine influence until the Late Eocene, Middle N. asperus Zone.

2. Marginal marine conditions appear to have been replaced by an open marine environment during the latest Eocene-Early Oligocene.

3. During the Turonian-earliest Santonian, the wellsite is likely to have been located within a rift valley, almost certainly within but close to the shoreline of a large freshwater lake.

   This lake appears to have fluctuated in area/depth based on the relative abundance of dinocysts, with times of maximum lacustrine influence occurring at 1312m, 1417.0m, 1451.0-1456.1m and 1490.1m.

BIOSTRATIGRAPHY

Zone and age-determinations have been made using criteria proposed by Stover & Partridge (1973), Helby et al. (1987) and unpublished observations made by M.K. Macphail and A.D. Partridge on Gippsland Basin wells drilled by Esso Australia Ltd.

It is noted that spore-pollen criteria published in Stover & Partridge (1973) for subdividing the Oligocene-Early Miocene P. tuberculatus Zone are no longer considered reliable [see Macphail & Truswell, 1989]. Dinoflagellates may provide an alternative method, but to date the relevant formations in the Gippsland Basin have not closely sampled or all the species systematically recorded

The majority of SWC palynofloras included caved palynomorphs, derived from drilling mud. In most cases, differential uptake of stain allowed caved and in situ specimens to be distinguished. This is critical in the case of P. mawsonii Zone samples which may include both caved and in situ specimens of the nominate/index species Phyllocladidites mawsonii.

This criterion is difficult to apply where no great age difference exists between the contaminant and in situ spore-pollen. For example a number of the SWC shot across Top of Latrobe [897.0-1000m] yielded mixed palynofloras which included two species which simply do not overlap in age: Triorites magnificus, the index species of the Middle N. asperus Zone, and Cyatheacidites annulatus, the index species of the P. tuberculatus Zone.

Since it was unclear whether T. magnificus had been reworked upwards or C. annulatus bioturbated downwards, geological criteria have been used to assist in dating these samples.

Similarly it is unclear whether anomalous species records in the P. tuberculatus Zone interval represent real extensions in the time range of species in the Gippsland Basin or are reworked. The former option is preferred for species such as Proteacidites crassus and P. reticulatus given (i) the nearshore location of the well and (ii) range data from the adjoining Murray Basin [see Macphail & Truswell, 1989].

Samples at 1530.1m, 1542.9m and 1545.1m yielded reworked and caved spore-pollen only and cannot be dated.

Phyllocladidites mawsonii Zone 1312-1513.4m Turonian-earliest Santonian

Palynofloras in this interval are dominated by trilete spore and long-ranging gymnosperm pollen, viz. Araucariacites australis, the Cretaceous var. of Dilwynites granulatus and Podocarpidites. Most also contain reworked Early Cretaceous and Permo-Triassic species and caved Tertiary species derived from drilling mud.

The majority of samples yielded an acritarch [Micrhystridium] and non-marine dinocysts [Luxadinium, Rimosicysta and Wuroia] - an association that is diagnostic of the "Kipper Shale" [see Marshall, 1989]. Although occasional specimens are found [reworked?] above the P. mawsonii Zone, **assemblages** of these dinocysts appear to be restricted to Turonian-earliest Santonian lacustrine facies in the Gippsland Basin.

The base of the zone is provisionally placed at 1513.4m, the lowest sample yielding what appear to be in situ specimens of Phyllocladidites mawsonii and an undescribed Late Cretaceous Tricolpites sp. A more reliable lower boundary is at 1512.6m, based on the lowest record of Micrhystridium.

Rimosicysta first appear at 1490.1m, associated with Micrhystridium [frequent], Amosopollis cruciformis [common], Phimopollenites pannosus and Tricolpites variverrucatus. Reworked Early Cretaceous spp. include Cyclosporites hughesii, Dictyotosporites speciosus and Corollinia spp. Other significant first appearances include:

i. Luxadinium and Laevigatosporites musca at 1451.0m.

ii. Triorites minor at 1446.9m.

iii. Interulobites intraverrucatus at 1418.1.

The association of I. intraverrucatus and Phyllocladidites mawsonii at 1389.9m, 1417.0m and 1418.1m confirm a P. mawsonii Zone date for the associated dinocysts.

The upper boundary is placed at 1312m, a cuttings sample yielding caved L. balmei Zone spore-pollen and the most diverse assemblage of "Kipper Shale" dinocysts recovered in Tommyruff-1: Rimosicysta aspera, R. concava, R. cf eversa, R. kipperii, Tetrachacysta? keenii, Wuroia corrugata and a distinctive but previously unrecorded cyst informally cited as Wuroia luna. Micrhystridium is rare in this sample but frequent in the underlying SWC at 1333.0m

Lower Lygistepollenites balmei Zone 1288.0m Paleocene

One sample is assigned to this zone with a very low degree of confidence, based on Proteacidites retiformis a Late Cretaceous species which ranges into the base of this zone.

However it is noted that Haloragacidites harrisii is unusually frequent for a sample of this age and an Upper L. balmei Zone remains a distinct possibility given high levels of reworking elsewhere in Tommyruff-1. The sample is no older than Lower L. balmei Zone.

Upper Lygistepollenites balmei Zone 1251.5-1281.0m Paleocene

Palynofloras within this interval and at 1288.0m differ from those in the underlying zone in that Proteacidites spp. are abundant and Lygistepollenites balmei and Gleicheniidites are usually frequent to common. Gambierina rudata, a species which ranges no higher than this zone, is present throughout. Rare examples of marine dinoflagellates are assumed to be caved.

The sample picked as the base of the zone [1281.0m] yielded Malvacipollis subtilis and Triporopollenites ambiguus, species which seldom range below this zone. Beaupreadites orbiculatus and Latrobosporites amplus confirm the minimum age is Upper L. balmei Zone.

Banksieaeidites arcuatus, Tricolporites moultonii and Triporopollenites cirrus at 1270.0m and Proteacidites annularis at 1252.6m and 1272.5m provide a confident Upper L. balmei Zone date for these samples.

The upper boundary is placed at 1251.5m, a sample which is no younger than Upper L. balmei Zone based on Australopollis obscurus, abundant Lygistepollenites balmei and frequent Gambierina rudata. The palynoflora includes a variant grain of Triporopollenites ambiguus.

Upper M. diversus - Proteacidites asperopolus Zone 1167.1-1220.0m Early Eocene

Two SWC samples provisionally are assigned to this zone. Both yielded large numbers of the usually very rare pollen Anacolosidites rotundus as well as frequent L. balmei Zone [1220.0m] and occasional Middle N. asperus Zone [1167.1m] species. The intervening SWC at 1218.0m yielded a caved Middle N. asperus zone palynoflora.

Maximum and minimum dates for the interval are Upper M. diversus-P. asperopolus Zone if Santalumidites cainozoicus and [1167.1m] Proteacidites pachypolus, Concolpites apiculatus and Proteacidites tuberculotumulatus are in situ.

Middle Nothofagidites asperus Zone 922.4-1092.0m Late Eocene

Palynofloras in this interval are wholly dominated by Nothofagidites spp. With the exception of cuttings at 1000m, all include the zone index species Triorites magnificus and moderate to abundant numbers of marine dinocysts, chiefly Gippslandica extensa.

The lower boundary, picked at 1092.0m, is defined by the first occurrence of **multiple** specimens of Triorites magnificus and Tricolpites thomasii, a species which typically first appears in this zone. The sample includes T. simatus, a species which ranges no lower than the Lower N. asperus Zone.

A similar palynoflora occurs in cuttings at 1045m. Here the Middle N. asperus Zone date is reinforced by Anacolosidites sectus and Tricolporites retequetrus. Caved species in this sample appear to have come from a T. bellus Zone facies based on Symplocoipollenites austellus and Haloragacidites haloragoides.

The uppermost two samples assigned to the Middle N. asperus Zone [922.4m, 1000m] contain the P. tuberculatus Zone index sp., Cyatheacidites annulatus. These specimens are assumed to be bioturbated based on the lithology of the sediments - sandstones and claystones respectively.

Support for the zonal determination is given by frequent of the usually rare species Schizocolpus marlinensis at 922.4m. Other species that typically range no higher than higher than the Middle N. asperus Zone are Proteacidites crassus, P. rugulatus and Santalumidites cainozoicus. Verrucatosporites attinatus indicates the cuttings sample at 1000m is no older than upper Middle N. asperus Zone.

Upper Nothofagidites asperus Zone 897.0-900.0m latest Eocene -Early Oligocene

Two SWC samples, at 897.0m and 900.0m, are provisionally assigned to this zone with varying degrees of confidence. Proteacidites stipplatus demonstrates the maximum and minimum ages for the interval are upper Middle N. asperus Zone and P.

tuberculatus Zone respectively.

Both more closely resemble palynofloras recovered from the Middle N. asperus Zone coarse clastics than palynofloras in the overlying P. tuberculatus Zone marls in two respects: spore-pollen are more abundant than dinoflagellates and Nothofagidites emarcidus-heterus is the dominant taxon.

The lower sample lacks indicator species of both the P. tuberculatus and Middle N. asperus Zone and is unique in the Tommyruff-1 sequence in that the dinocyst Tritonites sp. cf Holoroginella spinosa is frequent. Unlike the Middle N. asperus Zone dinocyst floras, Gippslandica extensa is very rare and possibly absent if the single "bald" cyst recorded represents a new species. Mud contamination is slight, indicated by a specimen of the T. bellus Zone species Proteacidites symphionemoides.

The upper palynoflora includes Cyatheacidites annulatus, Triorites magnificus, Proteacidites crassus, P. rugulatus and Santalumidites cainozoicus. The date is of low confidence but it is noted this implies sediments at 897.0m have been subjected to bioturbation **and** include reworked material from the underlying Latrobe Group coarse clastics.

Proteacidites tuberculatus Zone 815.0-894.0m Oligocene-Early Miocene

Palynofloras within this interval are dominated by marine dinoflagellates rather than, as in previous samples, spore-pollen. Prominent to abundant types are: Apteodinium australiense, Cyclopsiella vieta, Histrichokolpoma rigaude, Lingulodinium machaerophorum, Operculodinium centrocarpum and Spiniferites. Reworked? Gippslandica extensa occurs at 852.0.

Numbers of spore-pollen recovered vary but, except at 885.0m and 894.0m where Nothofagidites emarcidus-heterus is common, gymnosperms such as Araucariacites australis and Phyllocladidites mawsonii tend to dominate the spore-pollen component. Samples at 815.0m, 835.0m,852.0m and 857.0m have been contaminated by Lygistepollenites balmei.

The lower boundary is defined by the first appearance at 894.0m of Cyatheacidites annulatus in a palynoflora that lacks Triorites magnificus. The dinocyst flora is unusual in it includes a rare in situ specimen of the typically Lower N. asperus Zone species Deflandrea heterophylcta.

The palynoflora at 885.0m includes Granodiporites nebulosus, a species which ranges from within the Upper N. asperus Zone into the lower part of the P. tuberculatus Zone, and Foveotriletes crater and F. lacunosus, species which first appear in the P. tuberculatus Zone.

It is unclear whether records of Proteacidites crassus and P. reticulatus in this sample are due to reworking or represent real extensions in their time-range near the south-west margin of the Gippsland Basin. Both species range into the P. tuberculatus Zone in the adjacent Murray Basin [see Macphail & Truswell, 1989].

Based on G. nebulosus and the relative abundance of Nothofagidites, the interval between 885.0-894.0m is more likely to be Early Oligocene than Late Oligocene-late Early Miocene in age. Conversely, palynofloras at and above 857.0m are more typical of Late Oligocene-Early Miocene assemblages recovered from the Lakes Entrance Formation in central deep wells.

The palynoflora at 857.0m consists mostly of mud-contaminants but is unlikely to be older than Late Oligocene-Early Miocene P. tuberculatus Zone, based on the dinocyst flora. Cyatheacidites annulatus occurs at 852.0m and 835.0m.

The upper boundary of the zone is picked at 815.0m, based on Foveotriletes crater and F. lacunosus and the absence of indicator species of the T. bellus Zone

A number of unusual faunal microfossils are preserved in this [upper] interval: e.g. trochospiral liners of foraminifera [815.0m], fish teeth [835.0] and, as in Amberjack-1 [see Macphail, 1990], fragmented and whole nematocyts [stinging cells] of a unidentified Cnidarian [852.0m].

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TABLE 1: SUMMARY OF INTERPRETATIVE PALYNOLOGICAL DATA

SWC	DEPTH (m)	ZONE S-P	ZONE DINO	CONF. RTG.	COMMENT
59	815.0	P. tub.	-	2	No older than this zone
56	835.0	P. tub.	-	2	
55	852.0	P. tub.	-	1	C. annulatus
54	857.0	P. tub.	-	2	mud contaminants
51	885.0	P. tub.	-	1	G. nebulosus
50	894.0	P. tub.	-	1	C. annulatus
49	897.0	U. N.a.	-	2	C. annulatus + T. magnificus
48	900.0	U. N.a.	-	1	Abund. Nothofagidites
42	922.4	M. N.a.	D. ext.	2	S. marlinensis
ctg	1000	M. N.a.	D. ext.	3	P. tuberculotumulatus
ctg	1045	M. N.a.	D. ext.	3	T. retequetrus
ctg	1051	M. N.a.	D. ext.	3	T. magnificus
41	1092.0	M. N.a.	D. ext.	0	T. magnificus
39	1167.1	P. asp./U. M.d.		-	C. apiculatus
38	1218.0	Indet.	-	-	mud contaminants
37	1220.0	P. asp./U. M.d.		-	S. cainozoicus
36	1251.5	U. L.b.	-	2	L. balmei, G. rudata
35	1252.6	U. L.b.	-	1	P. annularis
34	1270.0	U. L.b.	-	1	B. arcuatus
33	1272.5	U. L.b.	-	1	P. annularis
32	1281.0	U. L.b.	-	2	T. ambiguus
31	1288.0	L. L.b.	-	2	P. retiformis
ctg	1312	P. maw.	Kip. Sh.	3	Kipper Shale dinocysts
30	1333.0	P. maw.	"	1	"
29	1335.0	P. maw.	"	1	"
27	1387.0	P. maw.	"	1	"
26	1389.9	P. maw.	"	0	I. intraverrucatus + P. mawsonii
25	1417.0	P. maw.	"	0	"
28	1418.1	P. maw.	"	0	"
24	1420.0	P. maw.	"	1	P. mawsonii
20	1446.9	P. maw.	"	1	T. minor
19	1451.0	P. maw.	"	1	
16	1456.1	P. maw.	"	1	P. mawsonii
14	1466.0	P. maw.	"	2	
07	1490.1	P. maw.	"	1	Kipper Shale dinocysts
06	1512.6	P. maw.	"	1	P. mawsonii
05	1513.4	P. maw.	-	1	P. mawsonii
03	1530.1	Indet.	-	-	negligible yield
02	1542.9	Indet.	-	-	mud contaminants
01	1545.1	Indet.	-	-	mud contaminants

TABLE 2: SUMMARY OF BASIC PALYNOLOGICAL DATA

SWC	DEPTH (m)	YIELD S-P	YIELD DINO	DIVERSITY S-P	DIVERSITY DINO	PRES.	LITH.*
59	815.0	med.	high	low	med.	good	marl
56	835.0	med.	high	low	high	good	marl
55	852.0	med.	med.	low	low	good	marl
54	857.0	low	low	low	low	good	marl
51	885.0	low	high	high	low	poor	marl
50	894.0	high	high	high	low	mod.	marl
49	897.0	high	med.	high	low	good	marl
48	900.0	low	low	med.	low	good	marl
42	922.4	high	low	high	low	good	sst.
ctg	1000	high	med.	high	med.	good	clst.,sst.
ctg	1045	high	high	med.	low	mod.	clst.,sst.
ctg	1051	med.	med.	med.	low	mod.	clst.,sst.
41	1092.0	high	high	high	med.	good	clst.,coal
39	1167.1	high	low	high	low	good	clst.
38	1218.0	low	caved	low	low	good	clst.
37	1220.0	low	caved	low	low	good	clst.
36	1251.5	high	-	med.	-	good	clst.
35	1252.6	low	caved	med.	-	poor	clst.
34	1270.0	high	-	high	-	good	clst.
33	1272.5	high	caved	high	-	good	clst.
32	1281.0	high	-	high	-	good	clst.
31	1288.0	high	caved	high	-	good	clst.
ctg	1312	high	med.	med.	med.	good	clst.
30	1333.0	med.	low	med.	low	mod.	clst
29	1335.0	low	low	low	low	mod.	clst.
27	1387.0	low	low	low	low	mod.	clst.
26	1389.9	med.	low	med.	low	mod.	clst.
25	1417.0	med.	low	med.	med.	good	clst.
28	1418.1	high	low	high	med.	good	clst.
24	1420.0	med.	low	high	low	good	clst.
20	1446.9	med.	low	high	low	good	clst.
19	1451.0	high	med.	low	low	mod.	clst.
16	1456.1	high	med.	med.	med.	good	clst.
14	1466.0	high	low	med.	low	good	clst.
07	1490.1	med.	med.	med.	med.	mod.	clst.
06	1512.6	low	low	low	low	mod.	clst.
05	1513.4	low	caved	low	low	mod.	clst.
03	1530.1	negl.	-	low	-	mod.	slst.,clst.
02	1542.9	caved	caved	high	med.	good	clst
01	1545.1	caved	caved	high	med.	good	arg. clst.

* Lithological descriptions [main rock type only] taken from sidewall core sample description on transmittal sheets.

TABLE NO.:

Well Name BHP TOMMYRUFF-1 Basin GIPPSLAND Sheet No. 1 of 5

SAMPLE TYPE OR NO. *	S	S	S	S	S	S	S	S	S	T	T	T	S	S	S	S	S	S	S	S	S	S
FOSSIL NAMES / DEPTHS (m)	815.0	835.0	852.0	857.0	885.0	894.0	897.0	900.0	922.4	1000	1045	1051	1092.0	1167.1	1218.0	1220.0	1251.5	1252.6	1270.0	1272.5	1281.0	1288.0
Aglaoreidia qualumis										•												
Anacolosidites rotundus														•		•						
A. sectus											•											
Araucariacites australis	•	•	•	•	•	•	•	•		•			•	•		•		•	•		•	•
Australopollis obscurus																	•				•	
Baculatisporites disconformis					•									•			•			•		•
Banksieaeidites arcuatus											•		•	•		•			•			
B. elongatus		•																				
Basopollis otwayensis														•			•	•		•	•	•
Beaupreadites elegansiformis						•	•						•									
B. orbiculatus																					•	
B. verrucosus							•		•				•	•								
Bluffopollis scabratus			C								•											
Clavifera triplex		C	C						•						•	•	•	•	•	•	•	
Conbaculites apiculatus		C												•								
Concolpites leptos							•															
Cupanieidites orthoteichus								•	•		•	•	•			•						
C. reticularis					•															i		
Cyatheacidites annulatus		•	•		•	•	•		•	•												
Cyathidites australis	•	•		•	•	•							•			•				•		•
C. minor	•	•	•						•	•								•				•
C. palaeospora		•			•			•		•												
C. splendens					•											•	•	•		•		
C. subtilis					•																	
Dicotetradites meridianus												•	•	•		•	•		•	•	•	
Dacrycarpites australiensis							•	•														
Dilwynites granulatus	•		•			•							•	•				•				
Ericipites scabratus	•		•	•		•	•		•		•	•	•						•			
Foveotriletes balteus														•					•			
F. crater					•																	
F. lacunosus		•			•																	
Gambierina spp.															R		•	•	•	•	•	•
Gleicheniidites spp.		•	•	•		•		•		•	•	•		•	•	•	•	•	•	•		•
Granodiporites nebulosus					•																	
Haloragacidites cainozoica								•					•									
H. haloragoides																						
H. harrisii	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Herkosporites elliotii		•			•	•	•	•										•	•	•	•	
Ilexpollenites anguloclavatus	•					•	•	•	•		•	•	•	•		•	•	•				
Ischyosporites gremius	•	•			•	•	•	•		•												
I. irregularis																		•				
I. lachlanensis							•			•												
Kuylisporites waterbolkii							•			•						•						
Laevigatosporites spp.	•	•	•		•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•
Latrobosporites amplus																		•		•	•	•
L. crassus						•		•					•		•							
L. marginis					•	•														•	•	
Liliacidites lanceolatus							•		•	•			•									
L. spp.										•	•		•									
Lygistepollenites balmei	R	R	R	R			R						R		R	R	•	•	•	•	•	•
L. florinii	•	•	•	•	•	•	•	•	•	•	•		•	•	•		•	•	•		•	
Malvacipollis diversus				•																		
M. robustus						•	•	•				•	•							•		
M. subtilis			C		•	•	•	•	•	•	•		•	•	•	•		•	•	•	•	
Matonisporites ornamentalis					•								•									
Microalatidites palaecgenicus	•				•			•		•				•	•						•	•

* C=CORE S=SIDEWALL CORE
T=CUTTINGS J=JUNK BASKET

R - REWORKED SP.
C - CONTAMINANT

TABLE NO.:

Well Name BHP TOMMYRUFF-1 Basin GIPPSLAND Sheet No. 2 of 5

FOSSIL NAMES / DEPTHS (m)	815.0	835.0	852.0	857.0	885.0	894.0	897.0	900.0	922.4	1000	1045	1051	1092.0	1167.1	1218.0	1220.0	1251.5	1252.6	1270.0	1272.5	1281.0	1288.0
SAMPLE TYPE OR NO. *	S	S	S	S	S	S	S	S	S	T	T	T	S	S	S	S	S	S	S	S	S	S
Microcachrydites antarcticus								•	•		•		•		•			•	•			•
Milfordia homeopunctatus													•									
Monogemmites uvatus ms												•										
Myrtaceidites eucalyptoides		•									•											
M. parvus-mesonesus					•		•	•	•	•	•	•	•	•								
M. rhodamnoides						•	•															
Nothofagidites asperus	•	•			•	•	•		•	•	•	•	•	•						C	•	
N. brachyspinulosus	•	•	•	•	•	•	•	•		•	•	•	•		•			•	•			
N. deminutus-vansteenii	•	•			•		•	•	•	•	•		•	•	•	•				C		
N. emarcidus-heterus	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
N. endurus																	•	•	•	•	•	•
N. falcatus	•	•		•	•	•	•	•		•	•	•	•		•		C					
N. flemingii	•	•	C		•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•
N. goniatus	•		C			•	•	•	•		•		•		•							
Paripollis orchesis						•																
Parvisaccites catastus		•			•			•														
Peninsulapollis gillii								•													•	•
Periporopollenites demarcatus				•	•	•	•		•	•				•	•			•	•	?	•	
P. polyoratus							•				•	•				•	•	•	•		•	•
P. vesicus	•				•	•			•				•									
Phyllocladidites mawsonii	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
P. reticulosaccatus			R												R	R	•	•	•	•	•	•
P. verrucosus																						
Podocarpidites exiguus																•		•	•	•	•	•
P. spp.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Podosporites microsaccatus		•	•		•	•	•	•	•	•	•	•		•	•		•	•	•	•	•	•
Polycolporopollenites esobalteus			•				•									•						
Polypodiisporites spp.	•							•		•								•	•			•
Proteacidites adenanthoides												•	•	•			•		•	•	•	•
P. annularis			•		•	•		•	•	•	•	•	•	•		•		•		•		
P. beddoesii																•						
P. callosus								•					•									
P. crassus					•		•		•	•	•	•	•									
P. grandis														•								
P. kopiensis																						
P. latrobensis											•											
P. obscurus							•			•		•				•					•	•
P. pachypolus														•								
P. recavus													•							C		
P. reflexus			•																			
P. reticulatus					•																	
P. reticuloscabratus					•																	
P. retiformis																					•	•
P. rugulatus							•		•		•	•										
P. stipplatus		•			•	•	•	•														
P. symphionemoides								•														
P. tenuiexinus																			•	•		
P. tuberculatus	•				•				•													
P. tuberculotumulatus										•				•								
Pseudowinterapollis cranwellae													•									•
Quintiniapollis psilatispora						•				•										C		
Rhoipites alveolatus									•					•								
Retitriletes spp.			•			•	•										•	•		•	•	
Rugulatisp orites mallatus										•				•				•				
Santaluminidites cainozoicus							•		•			•		•	•							
Sapotaceoipollenites rotundus			•	•				•						•								

* C=CORE S=SIDEWALL CORE
T=CUTTINGS [illegible]

R - REWORKED SP.
C - CONTAMINANT

TABLE NO.:

Well Name BHP TOMMYRUFF-1 Basin GIPPSLAND Sheet No. 3 of 5

FOSSIL NAMES / DEPTHS (m)	815.0	835.0	852.0	857.0	885.0	894.0	897.0	900.0	922.4	1000	1045	1051	1092.0	1167.1	1218.0	1220.0	1251.5	1252.6	1270.0	1272.5	1281.0	1288.0
SAMPLE TYPE OR NO. *	S	S	S	S	S	S	S	S	S	T	T	T	S	S	S	S	S	S	S	S	S	S
Schizocolpus marlinensis									•													
S. rarus							•				•		•									
Simpsonipollis sp.																						
Stephanocolpites oblatus														•								
Stereisporites australis f. crassa		•				•				•												
S. (Tripunctisporis) sp.	R		R													•	•	•		•	•	•
S. regium																				•		
S. spp.	•	•		•	•		•	•										•		•	•	•
Symplocoipollenites austellus											C											
Tetracolporites multistrixus																		•	•		•	
Tricolpites confessus																			•			
T. durus ms																			•			
T. phillipsii																•	•	•	•	•	•	•
T. reticulatus																					•	
T. simatus									•		•		•									
T. thomasii													•	•								
Tricolporites adelaidensis					•		•	•			•		•	•								
T. cf asperamarginis							•															
T. angurium							•				•			•								
T. leuros								•					•									
T. sp. cf T. leuros						•	•			•												
T. moultonii																			•			
T. paenestriatus		•			•	•								•								
T. retequetrus											•											
T. scabratus		•					•			•			•	•								
Undescribed tricolpate/tricolporate spp		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Undescribed trilete spores	•	•	•	•	•	•	•		•	•	•	•		•				•			•	•
Triletes tuberculiformis		•		•		•				•		•						•				
Triorites magnificus							•		•		•	•	•		C							
Triporopollenites ambiguus						•											•				•	
T. cirrus ms																			•			
Verrucatosporites attinatus										•												
Verrucosisporites kopukuensis		•			•						•	•		•		•				•		•
REWORKED MESOZOIC SPP.	•	•	•		•				•						•	•						•
Cleistosphaeridium epacrum															•	•						
Glaphyracysta retiintexta																						
Hystrichokolpoma rigaude	•	•			•		•	•					•									
Schematophora speciousus																						
Deflandrea heterophylcta						•																
D. phosporitica													•									
Gippslandica extensa			C	C			•	•	•		•	•	•	•	C					C		
Achomosphaera alcicornu		•							•	•												
Apteodinium australiense		•																				
Impagidinium spp.	•	•	•	•																		
Lingulodinium machaerophorum	•	•	•	•	•	•	•	•	•	•						C						
Nematosphaeropsis balcombiana/labrynthius	•																					
Operculodinium centrocarpum	•	•	•	•	•	•	•	•		•		•	•		•	•	C					
Pentadinium laticinctum									•	•												
Spiniferites spp.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		C		C		C
Tectadodinium pellitum	•				•	•	•															
Thalassiphora flammea/peligica											•	•										
Polysphaeridium zoharyii		•						•		•												
Protoellipsodinium mammilatus										•												
P. simplex	•	•								•	C				C							
Tritonites sp. cf H. spinata							•	•														

* C=CORE S=SIDEWALL CORE
T=CUTTINGS J=JUNK BASKET

R = REWORKED SP.
C = CONTAMINANT

TABLE NO.:

Well Name BHP TOMMYRUFF-1 Basin GIPPSLAND Sheet No. 4 of 5

SAMPLE TYPE OR NO. *	T	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
FOSSIL NAMES / DEPTHS (m)	1312	1333.0	1335.0	1387.0	1389.9	1417.0	1418.1	1420.0	1446.9	1451.0	1456.1	1466.0	1490.1	1512.6	1513.4	1530.1	1542.9	1545.1
Alisporites grandis			•			•		•				•	•	•				
A. similis											•	•		•				
Amosopollis cruciformis							•				•		•					
Araucariacites australis	•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•
Baculatisporites comaumensis	•				•		•	•	•				•		•	•		
Camarozonosporites australiensis								•										
Cicatricosisporites australiensis	•	•		•	•	•		•	•		•	•	•				•	•
C. ludbrookii							•					•						
Ceratosprotes equalis						•		•			•			•				
Clavifera triplex	•					•					•						•	
C. vultuosus ms									•									
Concavissimisporites penolaenensis										•								
Corollinia spp.		•	•	•	•	•		•	•	•	•	•	•	•	•			
Cyathidites australis	•	•		•	•	•	•	•		•	•	•	•	•	•	•		•
Cyclosporites hughesii									•				•					
Densoisporites vellatus			•							•								
Dictyophyllidites crenatus								•						•				
Dictyotosporites speciosus				•	•	•	•		•		•		•		•			
Dilwynites granulatus [Cret. var.]	•	•	•	•	•		•	•	•	•	•		•		•			
Foraminisporis dailyii									•									
Foveosporites canalis								•			•							
Foveotriletes balteus																		
F. parviretus							•		•									
Gleicheniidites spp.	•	•	•				•	•	•	•	•	•	•		•		•	•
Herkosporites elliotii		•	•		•				•		•		•					•
Interulobites intraverrucatus					•	•	•						•					
Ischyosporites punctatus		•							•									
Klukisporites scaberis		•	•		•			•	•	•		•	•	•				
Kraeuselisporites spp.					•			•										•
Laevigatosporites musca ms							•	•			•		•					
L. spp.	•	•	•			•	•	•	•	•	•	•	•		•			•
Leptolepidites major			•										•					
L. verrucatus		•		•	•	•		•	•	•	•	•		•				•
Lygistepollenites balmei	C								C	C		C	C	C	C	C		C
Lycopodiacites asperatus							•									•		
L. varirugulatus ms.							•		•			•						•
Matonisporites cooksonae											•							
Microcachrydites antarcticus	•	•	•		•	•	•	•	•	•	•	•	•					•
Neoraistrickia truncata		•						•		•		•						
Nothofagidites spp. [caved]	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•
Peninsulapollis gillii																		
Phimopollenites pannosus						•							•					
Phyllocladidites mawsonii [in situ]		•			•	•	•	•			•			•	•			
" [caved]	•	•	•	•		•		•	•	•		•	•	•		•	•	•
Podocarpidites spp.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
Podosporites microsaccatus	•	•			•			•	•	•	•	•	•	•	•	•		
Polycingutriletes pocockii			•					•			•			•				
Polypodiisporites spp.	•										•							
Proteacidites spp. [caved]	•	•	•	•	•		•		•			•		•	•	•		•
Reticulatisporites pudens													•					
Retitriletes australoclavatidites	•	•	•	•	•		•	•	•	•	•	•	•	•				
R. circolumenus						•		•										
R. facetus						•												
R. nodosus								•	•		•	•						
Rogalskaisporites sp.				•						•	•		•					
Stereisporites antiquisporites	•	•	•	•	•	•	•		•		•		•	•				•

* C=CORE S=SIDEWALL CORE
T=CUTTINGS J=JUNK BASKET

R - REWORKED SP.
C - CONTAMINANT

TABLE NO.:

Well Name BHP TOMMYRUFF-1 Basin GIPPSLAND Sheet No. 5 of 5

SAMPLE TYPE OR NO. *	T	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
FOSSIL NAMES / DEPTHS (m)	1312	1333.0	1335.0	1387.0	1389.9	1417.0	1418.1	1420.0	1446.9	1451.0	1456.1	1466.0	1490.1	1512.6	1513.4	1530.1	1542.9	1545.1
Stereisporites spp.		•	•		•	•	•		•	•	•	•	•	•				
Stoveripollis lunaris							•											
Tricolpites variverrucatus ms							•		•		•		•					
T. spp.		•												•	•			
Tricolporites spp.							•	•						•				
Trilobosporites trioreticulatus									•									
Triporoletes reticulatus											•							
T. simplex		•								•								
Triorites minor									•									
Trisaccites spp.	•	•							•		•	•						
Tsugaepollenites spp.				•							•							
Undescribed trilete spores		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
Caved Eocene spp.	•		•	•	•	•		•	•			•		•			•	•
Caved Maastrichtian & Palaeocene spp.	•	•	•	•				•	•	•	•	•	•	•			•	•
Reworked Permo-Triassic spp.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
DINOCYSTS																		
Rimosicysta aspera	•										•		•					
R. concava	•				•	•												
R. kipperii s.l.	•			•	•	•	•	•		•	•		•					
R. sp. cf R. eversa	•										•							
Tetrachacysta? keenii	•																	
Wuroia corrugata	•					•	•			•	•		•					
W. lupa ms	•																	
Trifidicysta ms		•																
Luxadinium	•	•				•				•	•		•					
Micrhystridium spp.	•	•	•	•	•	•	•	•	•	•	•	•	•	•				
Veryhackium							•											
Gippslandica extensa [caved]	•		•	•											•	•	•	•
Operculodinium centrocarpum [caved]			•													•		
Spiniferites spp. [caved]	•			•								•				•		•
Glaphyracysta retiintexta [caved]					•					•		•			•			
Protoellipsodinium simplex [caved]								•										

C=CORE S=SIDEWALL CORE

R - REWORKED SP.

PALYNOLOGY DATA SHEET

BASIN: GIPPSLAND ELEVATION: KB: ______ GL: ______

WELL NAME: TOMMYRUFF-1 TOTAL DEPTH: ______

AGE	PALYNOLOGICAL ZONES	HIGHEST DATA					LOWEST DATA				
		Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time	Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time
NEOGENE	*T. pleistocenicus*										
	M. lipsis										
	C. bifurcatus										
	T. bellus										
PALEOGENE	*P. tuberculatus*	815.0	2	852.0	1		894.0	1			
	Upper *N. asperus*	897.0	2	900.0	1		900.0	1			
	Mid *N. asperus*	922.4	2				1092.0	0			
	Lower *N. asperus*										
	P. asperopolus	1167.1	2								
	Upper *M. diversus*						1220.0	2			
	Mid *M. diversus*										
	Lower *M. diversus*										
	Upper *L. balmei*	1251.1	2	1252.6	1		1281.0	2	1272.5	1	
	Lower *L. balmei*	1288.0	2				1288.0	2			
LATE CRETACEOUS	Upper T. longus										
	Lower T. longus										
	T. lilliei										
	N. senectus										
	T. apoxyexinus										
	P. mawsonii	1312	3	1333.0	1		1513.4	1			
	A. distocarinatus										
EARLY CRET.	*C. paradoxus*										
	C. striatus										
	F. asymmetricus										
	F. wonthaggiensis										
	C. australiensis										
	PRE-CRETACEOUS										

COMMENTS: Gippslandica (Defleanrea) extensa Zone 922.4-1092.4m

"Kipper Shale" dinocyst flora 1312-1490.1m

CONFIDENCE RATING:

- O: SWC or Core, Excellent Confidence, assemblage with zone species of spores, pollen and microplankton.
- 1: SWC or Core, Good Confidence, assemblage with zone species of spores and pollen or microplankton.
- 2: SWC or Core, Poor Confidence, assemblage with non-diagnostic spores, pollen and/or microplankton.
- 3: Cuttings, Fair Confidence, assemblage with zone species of either spores and pollen or microplankton, or both.
- 4: Cuttings, No Confidence, assemblage with non-diagnostic spores, pollen and/or microplankton.

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

DATA RECORDED BY: M.K. Macphail DATE: 20 September 1990

DATA REVISED BY: ______ DATE: ______

APPENDIX 2

Appendix 2

BHP PETROLEUM PTY LTD

LOG INTERPRETATION REPORT

TOMMYRUFF-1
OFFSHORE GIPPSLAND BASIN
VIC/P25

ANALYST:

....
A. Cernovskis
Petroleum Geologist

CONTENTS

1 Summary

2 Introduction

- Wireline Testing
- Sidewall Cores
- Logs Run

3 Hole Conditions

- Caliper
- Borehole Fluids
- Temperature

4 Quantitative Interpretation

- Interpretation Procedure
- Formation Water Salinity
- Shale Parameters
- Hydrocarbon Corrections

5 Discussion of Interpretation Results

6 References

1 SUMMARY

Tommyruff-1 was drilled as an exploration well in permit Vic/P25, offshore Gippsland Basin.

The well spudded on 20th May 1990 and reached a total depth of 1550m KB (driller's depth) on 28th May 1990. After wireline evaluation of the open-hole, the well was plugged and abandoned.

Although the sandstone units intersected by the well were of high reservoir quality no net pay has been interpreted in Tommyruff-1.

Only weak fluorescence shows were reported in a Miocene sand interval from 380-410m KB and very weak indirect fluorescence was noted in sidewall cores 38 and 40 taken from the top of the Latrobe Group "Coarse Clastics" unit.

There were no conventional cores cut in Tommyruff-1.

Tommyruff-1 is located within the zone of meteoric water influx into the offshore Gippsland Basin aquifer system which has altered the formation water salinity profile. It has been demonstrated in nearby wells that the formation water salinity ranges from 500-4000 ppm NaCl equivalent (Kuttan et.al., 1986) which is much fresher than the connate water estimates.

Often there is very little resistivity contrast between water saturated sands and hydrocarbon bearing sands within this zone of fresh water influx often making it difficult to recognise hydrocarbon zones. As there were no significant hydrocarbon indications recorded whilst drilling the potential reservoir section of Tommyruff-1, the very negative spontaneous potential (SP) measurement at the top of the "Coarse Clastics" from 900-920m KB was considered unusual.

RFT pretests were taken throughout the entire sand interval with the SP log anomaly, from 901.5-965m KB, however the pressure versus depth gradient (1.43 psi/m) indicated the sand was water saturated. Permeability estimates from the RFT pretest data demonstrate that the uppermost part of the sand where the SP log anomaly occured has a much higher permeability than the underlying sand (Figure 1).

Sidewall cores were also taken from the interval where the SP log anomaly occurred, but only very weak indirect fluorescence was reported. All of the data obtained for the interval 900-1000m KB therefore supports the log interpretation in that the sand is entirely water saturated.

In this report a detailed quantitative interpretation of the suite 2 logs run at total depth (1550m KB) is presented and the results are listed in Appendix 2. The same rigorous applications have not been undertaken for the Miocene section as bad hole conditions have adversely affected the log quality.

2 INTRODUCTION

Tommyruff-1 was drilled as an exploration well in permit Vic/P25 in the offshore Gippsland Basin. The well is located approximately 17km west south-west of the Perch oil field. The structural form of Tommyruff-1 at the top of Latrobe is that of a large anticlinal feature that trends in a north-south direction.

The primary target of the well was to test the hydrocarbon potential of the Latrobe Group sediments.

The well spudded on 19th May 1990 and reached a total depth of 1550m KB (driller's depth) on 28th May 1990. After wireline evaluation of the open-hole the well was plugged and abandoned.

Note that driller's depths are used in this report unless otherwise specified. The abbreviations used for depth measurements are listed below:

MD = measured depth
KB = meters below the Kelly Bushing
SS = meters below sea level

KB elevation = 21.0 meters above MSL
Seabed depth = 33.0 meters below MSL

WIRELINE TESTING

RFT pretests were taken in Tommyruff-1 during the open-hole logging operations at total depth (1550m KB). There were no samples taken during the RFT operation.

An evaluation of the RFT results is presented in a separate report. (A. Cernovskis).

2 INTRODUCTION

Tommyruff-1 was drilled as an exploration well in permit Vic/P25 in the offshore Gippsland Basin. The well is located approximately 17km west south-west of the Perch oil field. The structural form of Tommyruff-1 at the top of Latrobe is that of a large anticlinal feature that trends in a north-south direction.

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LOGS RUN

			Logger's Depths
SUITE	1	DLL-MSFL-SDT-GR-SP-CAL-AMS	786.0 - 175.5m KB (GR to sea floor)
	2	DLL-MSFL-LDL-CNL-SDT-GR--SP-CAL-AMS (SUPERCOMBO)	1545.5 - 785.5m KB
		RFT-HP-GR	965.0 - 901.5m KB
		VELOCITY SURVEY	1445.0 - 75.0m KB
		CST-GR (60 shots)	1545.1 - 810.0m KB

3 **HOLE CONDITIONS**

CALIPER

Hole conditions through the 12-1/4" (Suite 1) section from 786.0m KB to 175.0m KB are variable with washouts mainly occuring over the sandstone intervals.

The top hole section from 175.5-786.0m KB was initially drilled with a 12-1/4" bit. Once the open-hole had been logged, the hole was then reamed to 17-1/2" before running 13-3/8" casing.

Hole conditions through the 12-1/4" (Suite 2) section from 1545.5-785.5m KB are generally fair with washouts or rugosity mainly occurring in the unconsolidated sandstone units.

BOREHOLE FLUIDS

Suite 1	Type	:	seawater/gel/polymer
	weight	:	9.0lb/gal
	Rm	:	0.445 ohm-m @ 16.0 deg C
	Rmf	:	0.387 ohm-m @ 16.0 deg C
	Rmc	:	0.510 ohm-m @ 16.0 deg C
Suite 2	Type	:	KCl-EZ polymer
	weight	:	9.4lb/gal
	Rm	:	0.197 ohm-m @ 16.0 deg C
	Rmf	:	0.165 ohm-m @ 16.0 deg C
	Rmc	:	0.331 ohm-m @ 16.0 deg C

TEMPERATURE

The following maximum temperatures were recorded during the logging operations:

BHT degC	DEPTH mKB	TOOL	HOURS AFTER CIRCULATION
40.0	786.0	DLT-BHC-GR	4.45
64.5	1545.5	SUPERCOMBO	7.0
64.5	1445.0	SAT	14.0
64.5	1545.0	CST	17.0

It was not possible to extrapolate the bottom hole temperature as the maximum temperature was not recorded with each successive tool run into the hole at total depth. An estimated formation temperature of 48 degC was used for this interpretation based on an average geothermal gradient of 40 degC/KM.

4 QUANTITATIVE INTERPRETATION

INTERPRETATION PROCEDURE

The interval 880-1525m KB was evaluated using the model described in Appendix 1. Log data over this interval was read from the Schlumberger LIS tape and corrected for environmental effects. A plot of the log interpretation results is given in Enclosure 1 and a listing in Appendix 2.

The interval 380-410m KB was not evaluated quantitatively using the model described in Appendix 1. A qualitative analysis of the logs run over this interval indicate that the sands are water saturated.

FORMATION WATER SALINITY

Tommyruff-1 is located on the western margin of Gippsland Basin where it has been demonstrated that meteoric water has permeated into the offshore aquifer system (Kuttan et.al., 1986) affecting the present formation water salinity profile. Typically within the zone of freshwater influx there is very little resistivity contrast seen on the logs between the hydrocarbon zones and the underlying water sands, often making it difficult to recognise hydrocarbon zones.

The following formation water resistivities were used in this interpretation:

2.5 ohm-m @ 25 deg C	=	2,200 ppm NaCl equivalent,	895-1022.5m KB
6.0 ohm-m @ 25 deg C	=	800 ppm NaC1 equivalent,	1022.5-1200 m KB
9.0 ohm-m @ 25 deg C	=	550 ppm NaC1 equivalent,	1200-1300 m KB
0.5 ohm-m @ 25 deg C	=	11,000 ppm NaC1 equivalent,	1300-1515 m KB

The Rw's used for this interpretation were derived from Pickett plots over the water saturated intervals as shown in figures 2A, 2B, 2C, 2D.

The resistivity and SP logs indicate there is an apparent decrease in salinity from the top of the Latrobe Group to 1300m KB. From 1300m KB however the formation water salinity increases significantly.

5 DISCUSSION OF THE INTERPRETATION RESULTS

SUITE 1

No net pay has been interpreted from this suite of logs.

The sand interval intersected from 380-410m KB displayed some very weak fluorescence in the cuttings, suggesting that hydrocarbons may have been present. Unfortunately, due to the unconsolidated nature of the sand over this interval, the hole conditions were poor, allowing only a qualitative interpretation of the logs. The entire section is interpreted to be water saturated.

SUITE 2

Although the reservoir quality of all the sand units intersected was high, no net pay has been interpreted from this suite of logs. All of the sands are interpreted to be water saturated.

The interval 900-995m KB consists of a massive sandstone unit which has very good reservoir characteristics. At the top of this sand a very negative SP log response was recorded which did not appear to be due to problems associated with with the tool eg incorrect depth matching or tool malfunction. An RFT pretest program was conducted to determine if the SP log anomaly was due to a hydrocarbon effect. However the results of the RFT pressures indicate a water gradient exists for the entire interval tested. Further evaluation of the interval suggests that the response may have beeen due to a very high permeability zone from 900-920m KB as implied by the Schlumberger permeability plot generated at the wellsite (figure 1).

The interval 995-1325m KB consists of a repetetive sequence of sandstone, siltstone, claystone and coal interbeds. The sandstone units over this interval have high porosity estimates up to 34% and are interpreted to be entirely water saturated.

From 1325-1550m KB coal is no longer present and the sandstone content has decreased. The interval consists of a repetetive sequence of Claystone, siltstone and relatively thin sandstone interbeds. Porosity estimates for the sandstone units in this interval remain high (up to 30%) and are interpreted as being water saturated.

An analog plot of the interpretation results is presented in Enclosure 1.

6 REFERENCES

Cox, J and Raymer, L. (1976)
'The Effect of Potassium-Salt Muds on Gamma Ray and Spontaneous Potential Measurements' SPWLA 17th Annual Logging Symposium.

Edmundson, H. and Raymer, L. (1979)
'Radioactive Logging Parameters for Common Minerals' SPWLA 20th Annual Logging Symposium.

Juhasz, I. (1981)
'Normalised Qv-The Key to Shaly Sand Evaluation Using the Waxman-Smits Equation in the Absence of Core Data' SPWLA 22nd Annual Logging Symposium.

Kuttan, K. Kulla, JB. and Neumann, RG. (1986)
'Freshwater influx in the Gippsland Basin: Impact on Formation Evaluation, Hydrocarbon Volumes, and Hydrocarbon Migration. APEA Journal.

Raymer, L. Hunt, E. and Gardner, J. (1980)
'An Improved Sonic Transit-to-Porosity Transforms' SPWLA 21st Annual Logging Symposium.

APPENDIX 1

LOG INTERPRETATION METHOD

The quanitiative log interpretation was undertaken using the Atlas Wireline Well Data (WDS) system developed by Western International Inc. Thw ayatem is designed to analyse and manipulate well log data and provides facilities to generate tabular and trace plot displays. The interpretation model used by the WDS system has been developed by BHP Petroleum and is summarised below.

1 True formation resisivity (Rt) is calculated from the Dual Laterolog and MSFL logs by correcting for the effects of invasion.

2 Flushed zone resistivity (Rxo) is calculated by correcting the MSFL log for mudcake thickness.

3 The volume of shale (Vsh) is calculated using five separate shale indicators:

i) gamma ray
ii) neutron
iii) neutron-density crossplot
iv) sonic-density crossplot
v) sonic-neutron crossplot

or

vi) the minimum of two or more of the above indicators.

The optimum Vsh indicator is selected and used in the intepretation.

4 Total porosity is derived from an analysis of the neutron-density crossplot using a shaly sand model. Corrections are made for the presence of hydrocarbons and/or a secondary mineral.

Effective porosity is calculated from the total porosity by correcting for shale as given below.

$\phi e = \phi t - Vsh.\phi tsh$

A sonic porosity is calculated using the Raymer-Hunt-Gardner algorithm (1980) and used where hole conditions are rugose or the neutron and density logs are unavailable.

5. Water saturation (Sw) is calculated using an equation developed by Juhasz (1981). The equation is a derivation of the Waxman-Smits model but uses the concept of 'normalised Qv' which enables all parameters to be obtained directly from the logs. It can be expressed in the form of the Archie Equation as given below:

where $$Swt^n = \frac{\phi t^{-m} .Rwe}{Rt}$$

$$Rwe = \frac{Rw.Rwsh.Swt}{Rwsh.(Swt-Qvn)+Rw.Qvn}$$

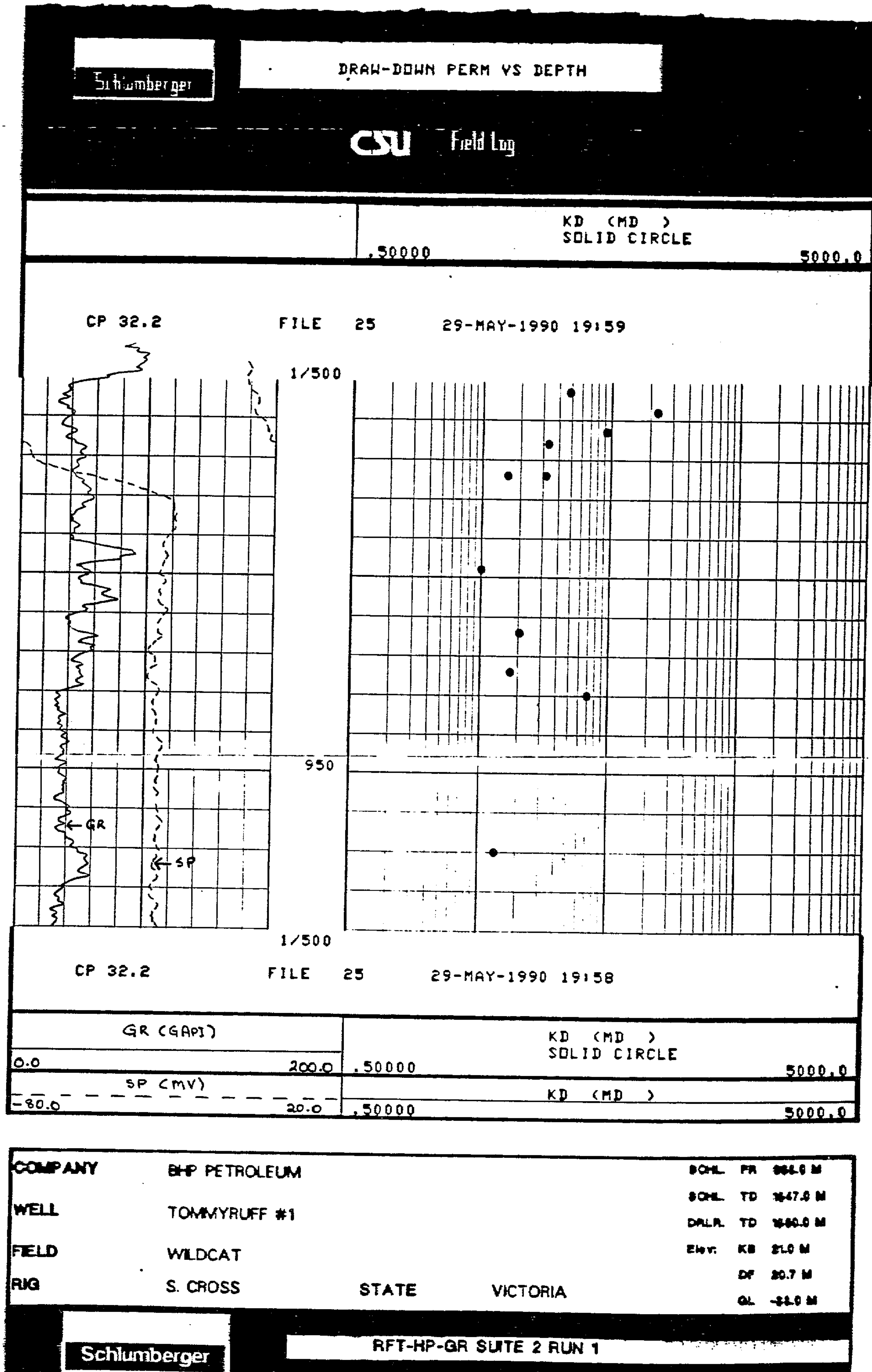
$$Rwsh = Rsh.\phi tsh^m$$

$$Qvn = \frac{Vsh.\phi tsh}{\phi t}$$

and $$Sw = \frac{Swt-Qvn}{1 - Qvn}$$

Flushed zone saturations (SXO) are calculated using RXO and Rmt.

Figure 1


Schlumberger
DRAW-DOWN PERM VS DEPTH
CSU Field Log
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5000.0
CP 32.2
FILE 25
29-MAY-1990 19:59
1/500
950
GR
SP
1/500
CP 32.2
FILE 25
29-MAY-1990 19:58
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SP (MV)
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KD (MD)
SOLID CIRCLE
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5000.0
KD (MD)
.50000
5000.0
COMPANY
BHP PETROLEUM
WELL
TOMMYRUFF #1
FIELD
WILDCAT
RIG
S. CROSS
STATE
VICTORIA
SCHL. FR
SCHL. TD
DRLR. TD
Elev. KB
DF 20.7 M
GL
Schlumberger
RFT-HP-GR SUITE 2 RUN 1

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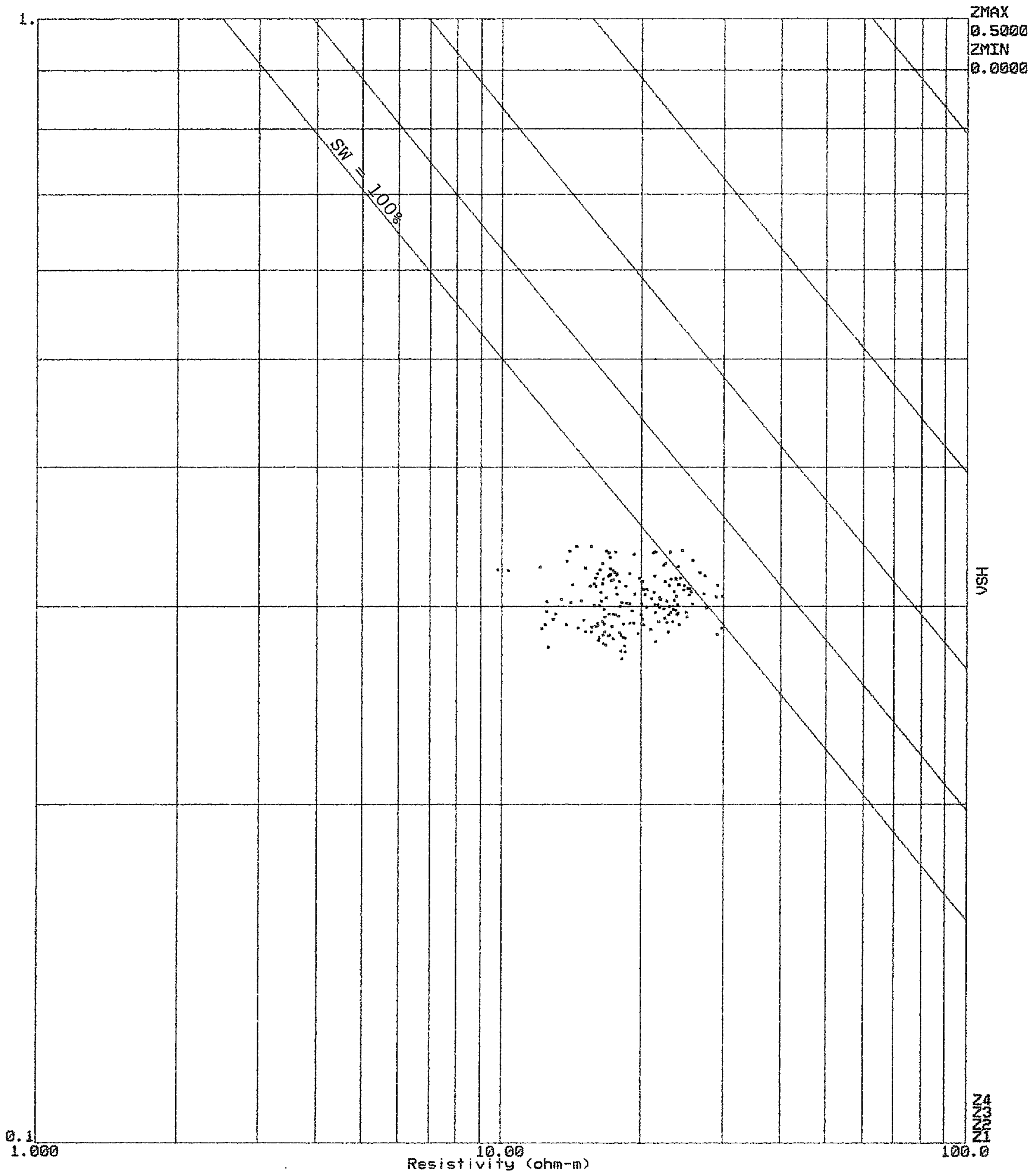
CLIENT_OP_CO =	BHP PETROLEUM

(Inserted by DNRE - Vic Govt Mines Dept)

BHP PETROLEUM TOMMRUFF #1 Figure 2A



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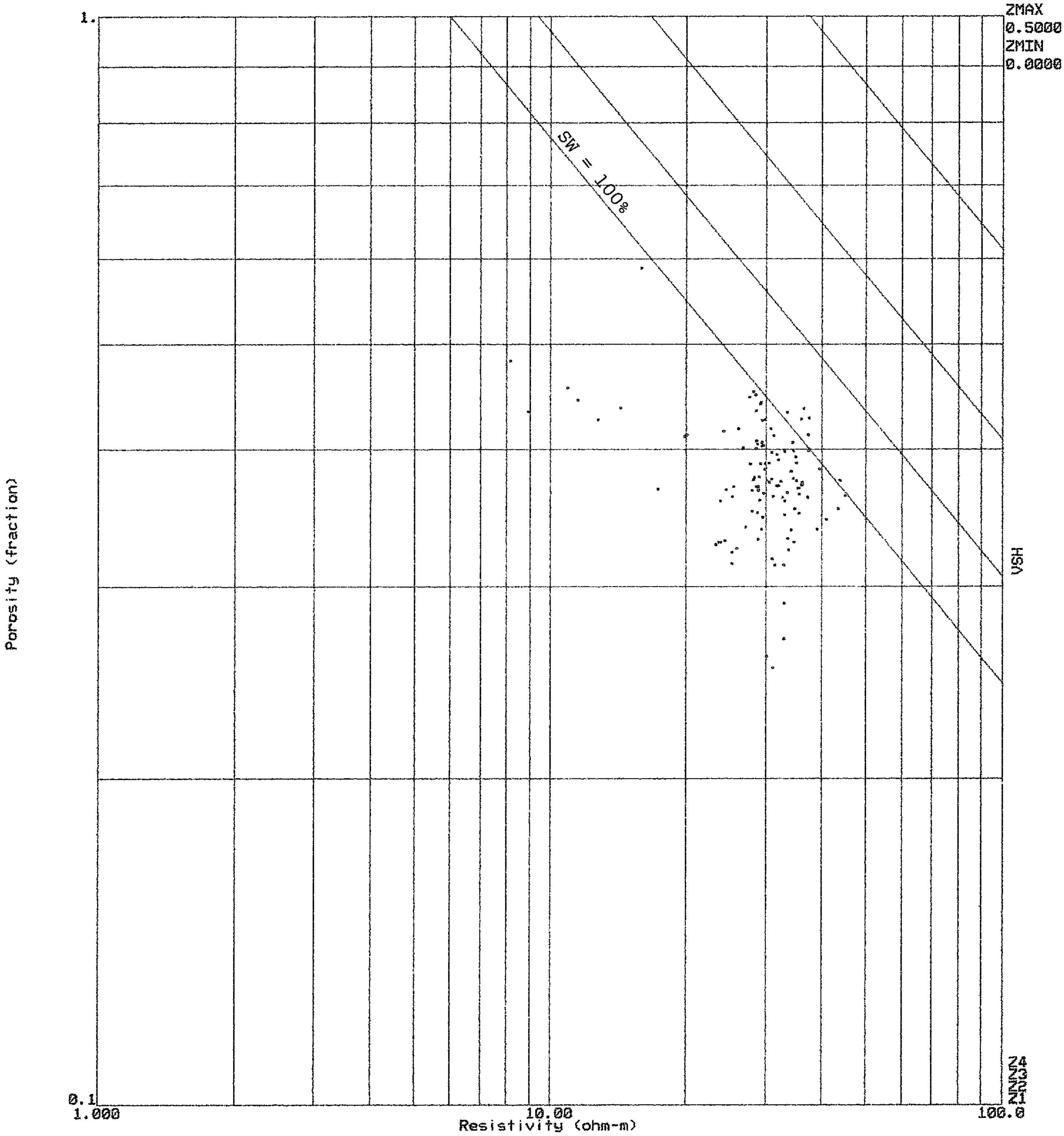
W_NO =	W1030
WELL_NAME =	TOMMYRUFF-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP PETROLEUM

(Inserted by DNRE - Vic Govt Mines Dept)

BHP PETROLEUM TOMMRUFF #1 Figure 2B



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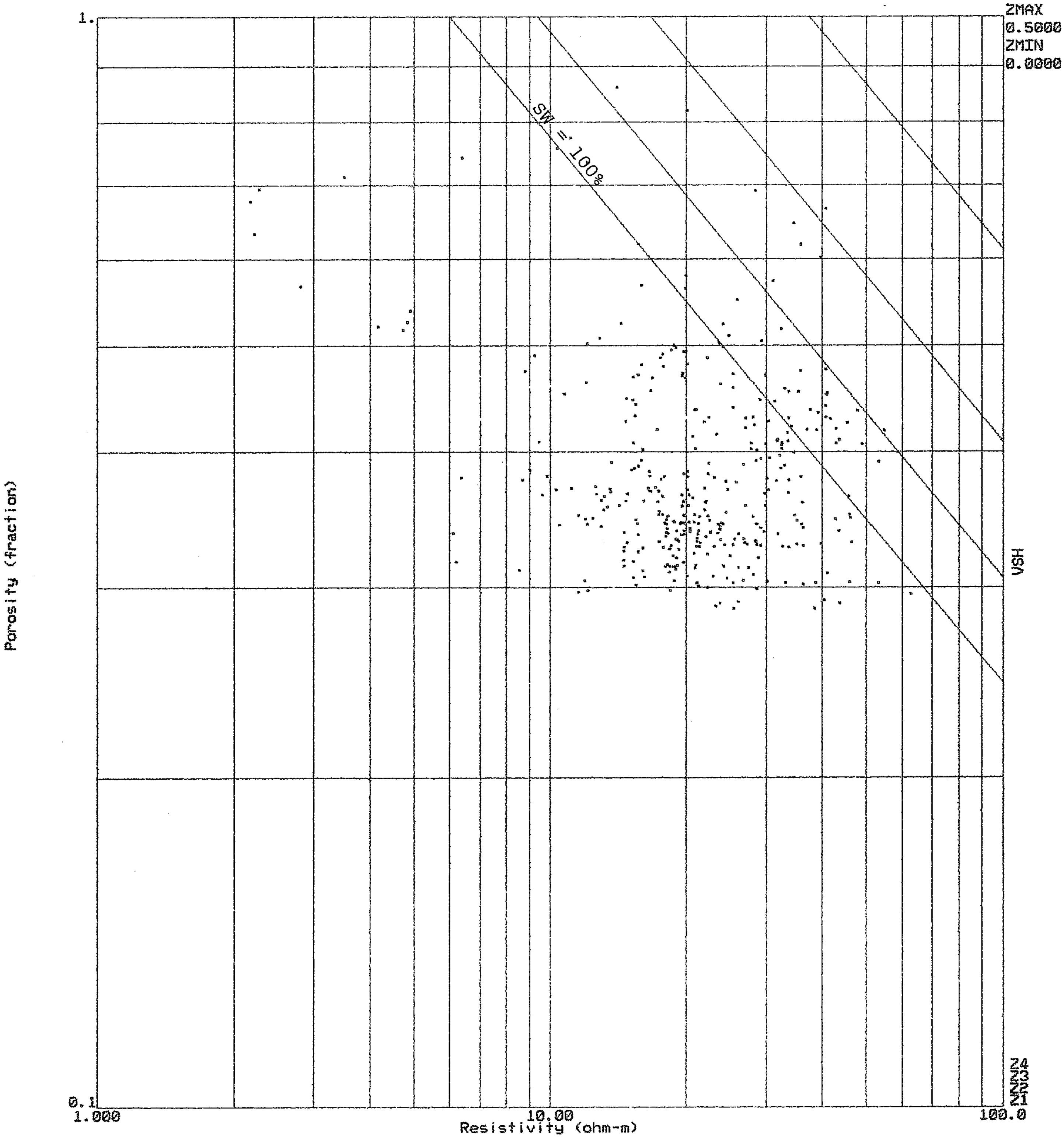
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	22/02/91
W_NO =	W1030
WELL_NAME =	TOMMYRUFF-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP PETROLEUM

(Inserted by DNRE - Vic Govt Mines Dept)

Figure 2C

BHP PETROLEUM TOMMRUFF #1



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SUBTYPE =	DIAGRAM
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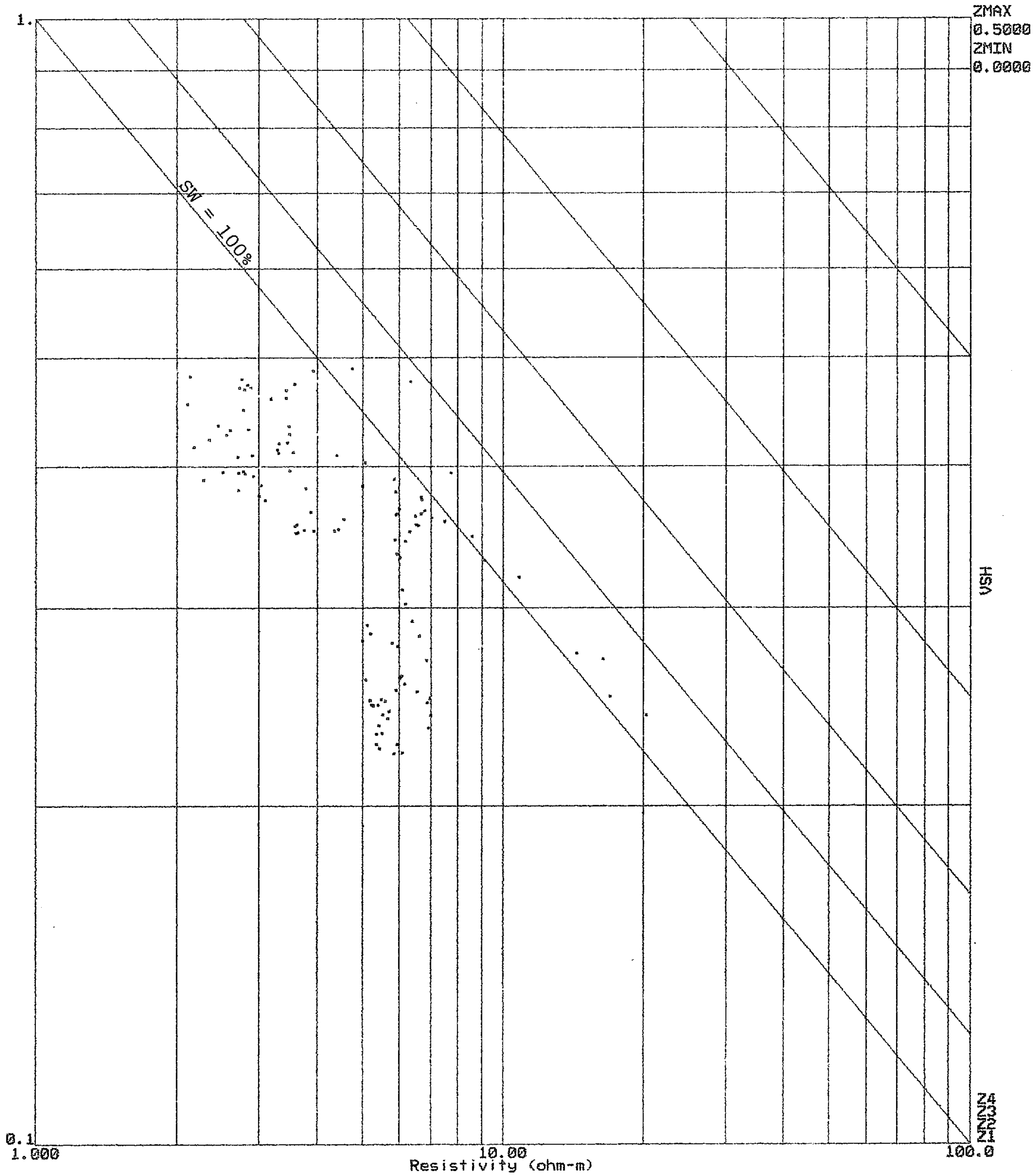
DATE_RECEIVED =	22/02/91
W_NO =	W1030
WELL_NAME =	TOMMYRUFF-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP PETROLEUM

(Inserted by DNRE - Vic Govt Mines Dept)

Figure 2D

BHP PETROLEUM TOMMRUFF #1



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WELL_NAME =	TOMMYRUFF-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP PETROLEUM

(Inserted by DNRE - Vic Govt Mines Dept)

APPENDIX 3

Appendix 3

BHP PETROLEUM PTY. LTD.

TOMMYRUFF-1

RFT REPORT

Written by:

A. Cernovskis
(Petroleum Geologist)

TABLE OF CONTENTS

1. Summary

2. Introduction

3. Interpretation

   3.1 Hydrostatic Pressures

   3.2 Formation Pressures

   3.3 Formation Gradient

4. Tables

5. Figures

1 SUMMARY

Tommyruff-1 was drilled in May 1990 in permit Vic/P25, offshore Gippsland Basin. The well was drilled to 1550m KB.

Wireline logs and RFT program was run at T.D. to evaluate the hydrocarbon potential of the sandstone units intersected below the top of the Latrobe Group.

The RFT program was conducted over the interval 901.5-965m KB. The results show that all the pretest data yields a water gradient of 1.43 psi/m (figure 1).

As there were no indications of hydrocarbons in the zone of interest, no samples were taken from the formation.

The well was plugged and abandoned as a dry hole.

2 INTRODUCTION

Tommyruff-1 was drilled in May 1990 by the drill-rig, the Southern Cross. The well was drilled to a depth of 1550m KB.

Logging suite 2 was conducted at total depth to evaluate the hydrocarbon potential of the sands intersected from 785.5-1550m KB. The first sand interval intersected from 900-995m KB displayed an SP log anomaly at the top, from 900-920m KB which may have been due to hydrocarbons.

The RFT program was conducted to further evaluate this log anomaly, there were no other significant hydrocarbon indications in this section of the well.

17 pretests were conducted of which 3 suffered seal failure and 3 were "tight formation", leaving 11 pretests for interpretation (see Table 1). No samples were taken from the formation.

The results of the pretest data indicate that the formation was water saturated, the pressure versus depth gradient being 1.43 psi/m (figure 1).

Figure 2 generated by Schlumberger Wellsite software indicates that the SP anomaly seen from 900-920m KB was most likely due to a very high permeability zone.

3 INTERPRETATION

3.1 Hydrostatic Pressures

The Hewlett-Packard quartz guage (HP) was used to measure the hydrostatic mud pressure before and after each pretest which were found to be in good agreement. The Figure 1 depicts the initial hydrostatic pressure measured, the hydrostatic pressure gradient is calculated to be 1.40 psi/m.

3.2 Formation Pressures

A total of 17 pretests were attempted over the interval 901.5-965m KB. Three of the pretests proved to be tight and 3 suffered seal failure. Table 1 gives the details of all the pressures measured during the pretests.

3.3 Formation Gradient

A plot of the results presented in figure 1 shows that the line of best fit through all of the points gives a water gradient of 1.43 psi/m.

TABLE 1

TOMMYRUFF-1

Test Numb	Depth (m)	Hydrost. Pressure Before (PSIA)	Hydrost. Pressure After (PSIA)	Formation Pressure (PSIA)	
1	965.0	1575.3			Seal Failure
2	960.0	1567.2	1566.6	1371.4	Pressure
5	952.0	1552.6			Tight
4	949.0	1548.4			Tight
3	948.0	1546.9			Tight
7	940.0	1532.7	1532.7	1342.5	Pressure
8	937.0	1527.4	1527.2	1337.9	Pressure
6	932.0	1520.8	1519.6	1331.7	Pressure
9	924.0	1515.2	1515.3	1322.5	Pressure
10	912.0	1495.8	1495.4	1298.7	Pressure
17	912.0	1494.7	1495.0	1303.1	Pressure
16	911.5	1493.8			Seal Failure
11	908.0	1488.8	1489.6	1298.1	Pressure
12	906.5	1486.6	1486.3	1295.5	Pressure
13	904.0	1482.4	1482.2	1291.8	Pressure
14	902.0	1479.1			Seal Failure
15	901.5	1478.0	1477.9	1288.2	Pressure

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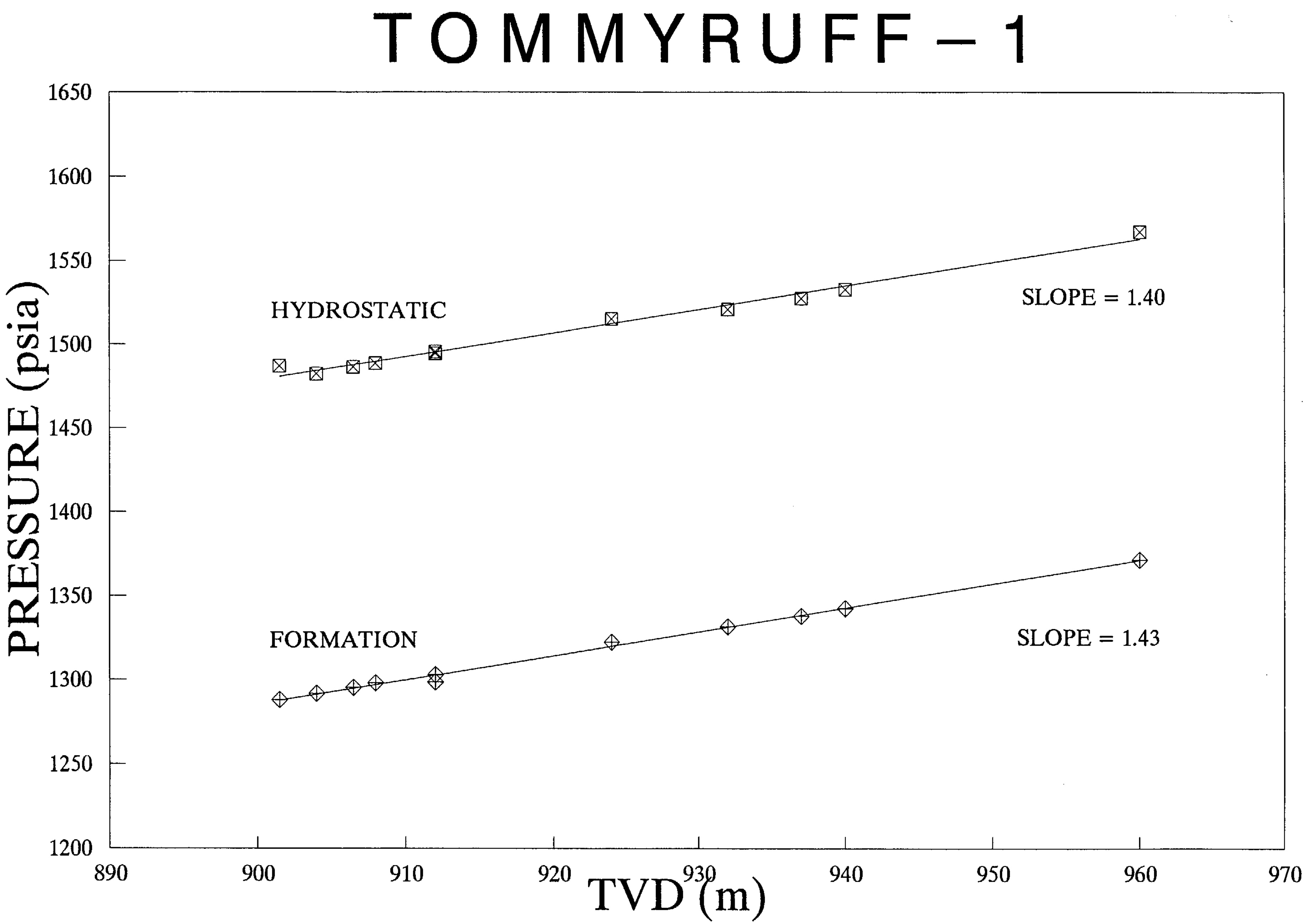
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TVD (m)
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1600
1550
1500
1450
1400
1350
1300
1250
1200
890
900
910
920
930
940
950
960
970
HYDROSTATIC
SLOPE = 1.40
FORMATION
SLOPE = 1.43

Schlumberger

DRAW-DOWN PERM VS DEPTH

CSU Field Log

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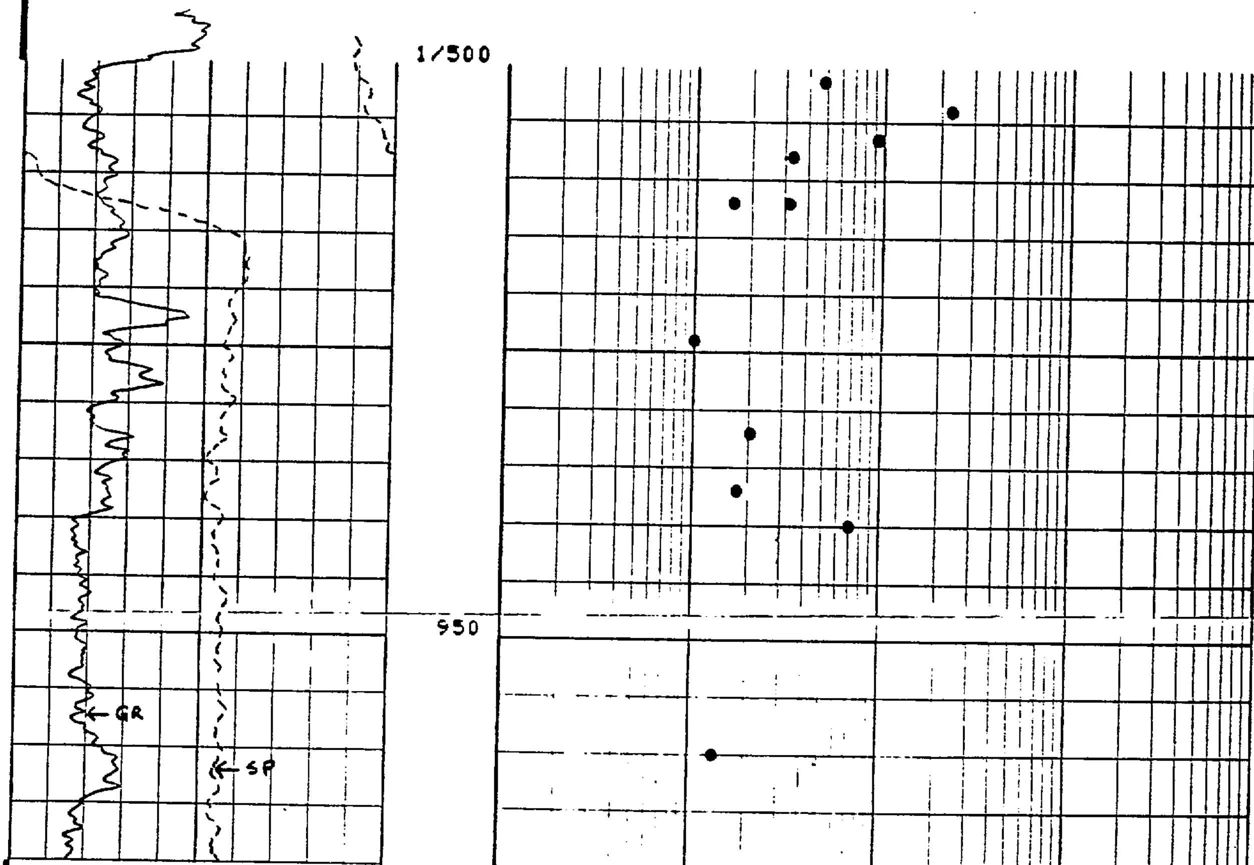
CP 32.2 FILE 25 29-MAY-1990 19:59



1/500

CP 32.2 FILE 25 29-MAY-1990 19:58

GR (GAPI)	KD (MD) SOLID CIRCLE
0.0 — 200.0	.50000 — 5000.0
SP (MV)	KD (MD)
-80.0 — 20.0	.50000 — 5000.0

COMPANY	BHP PETROLEUM	SCHL.	FR	[illegible] M
WELL	TOMMYRUFF #1	SCHL.	TD	1647.0 M
FIELD	WILDCAT	DRLR.	TD	[illegible] M
RIG	S. CROSS STATE VICTORIA	Elev:	KB	21.0 M
			DF	20.7 M
			GL	[illegible] M

Schlumberger

RFT-HP-GR SUITE 2 RUN 1

APPENDIX 4

4. Synthetic Seismogram Processing

GEOGRAM plots were generated using 25,35 and 45 hertz zero phase Ricker wavelet .

The presentations include both normal and reverse polarity on a time scale of 10 and 20 cm/sec.

GEOGRAM processing produces synthetic seismic traces based on reflection coefficients generated from sonic and density measurements in the well-bore. The steps in the processing chain are the following:

Depth to time conversion
Reflection coefficient generation
Attenuation coefficient calculation
Convolution
Output.

4.1 Depth to Time Conversion

Open hole logs are recorded from the bottom to top with a depth index. This data is converted to a two-way time index and flipped to read from the top to bottom in order to match the seismic section.

4.2 Primary Reflection Coefficients

Sonic and density data are averaged over chosen time intervals (normally 2 or 4 millisecs). Reflection coefficients are then computed using:

$$R = \frac{\rho_2.\nu_2 - \rho_1.\nu_1}{\rho_2.\nu_2 + \rho_1.\nu_1}$$

where:

ρ_1 = density of the layer above the reflection interface
ρ_2 = density of the layer below the reflection interface
ν_1 = compressional wave velocity of the layer above the reflection interface
ν_2 = compressional wave velocity of the layer below the reflection interface

This computation is done for each time interval to generate a set of primary reflection coefficients without transmission losses.

4.3 Primaries with Transmission Loss

Transmission loss on two-way attenuation coefficients is computed using:

$$A_n = (1 - R_1^2).(1 - R_2^2).(1 - R_3^2)...(1 - R_n^2)$$

A set of primary reflection coefficients with transmission loss is generated using:

$$Primary_n = R_n.A_{n-1}$$

4.4 Primaries plus Multiples

Multiples are computed from these input reflection coefficients using the transform technique from the top of the well to obtain the impulse response of the earth. The transform outputs primaries plus multiples.

4.5 Multiples Only

By subtracting previously calculated primaries from the above result we obtain multiples only.

4.6 Wavelet

A theoretical wavelet is chosen to use for convolution with the reflection coefficients previously generated. Choices available include:

Klauder wavelet
Ricker zero phase wavelet
Ricker minimum phase wavelet
Butterworth wavelet
User defined wavelet.

Time variant Butterworth filtering can be applied after convolution.

4.7 Polarity Convention

An increase in acoustic impedance gives a positive reflection coefficent, is written to tape as a negative number and is displayed as a white trough under normal polarity. Polarity conventions are displayed in Figure-1.

4.8 Convolution

The standard procedure of convolving the wavelet with reflection coefficients; the output is the synthetic seismogram.

A6 Synthetic Seismogram Table

1. Two way travel time from SRD : This is the index for the data in this listing. The first value is at the top of the sonic. The default sampling rate is 2 millisecs.

2. Vertical depth from SRD : the vertical depth from SRD at each corresponding value of two way time.

3. Interval velocity : the velocity between each sampled depth. Typically, the sampling rate is 2 millisecs two way time, (1 millisec one way time) therefore the interval velocity will be equal to the depth increment divided by 0.001. It is equivalent to column 9 from the the Velocity Report.

4. Interval density : the average density between two successive values of two way time.

5. Reflect. coeff. : the difference in acoustic impedance divided by the sum of the acoustic impedance between any two levels. The acoustic impedance is the product of the interval density and the interval velocity.

6. Two way atten. coeff. : is computed from the series

$$A_n = (1 - R_1^2).(1 - R_2^2).(1 - R_3^2)...(1 - R_n^2)$$

7. Synthetic seismogram primary : the product of the reflection coefficient at each depth and the two way attenuation coefficient up to that depth.

$$Primary_n = R_n.A_{n-1}$$

8. Primary + multiple : a transform technique is used to calculate multiples from the input reflection coefficients.

9. Multiples only : (Primary + multiple) - (Synthetic seismo. primary)

SCHLUMBERGER (SEG-1976) WAVELET POLARITY CONVENTION

Figure 1