BHP Petroleum

WELL COMPLETION REPORT

WCR (VOL. 2)

AMBERJACK-1

AMBERJACK-1

VOLUME 2

W1029

INTERPRETIVE DATA

BHP Petroleum
BHP Petroleum Pty. Ltd.
Incorporated in Victoria

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APPENDICES

1. SUMMARY

1.1 Drilling Summary.

Amberjack-1 was spudded by the rig "Southern Cross" at 0215 hours on 4th May 1990. The 26" hole was drilled from 58-202 mKB and the 20" casing run and cemented to a shoe depth of 196 mKB.

The 17-1/2" hole was drilled to 1010 MKB, 13-3/8" casing run and cemented to a show depth of 1000 mKB, after running open-hole logs. Suite 1 wireline logs consisted of:

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

The 12-1/4" hole was drilled to 1271 mKB, the Schlumberger GCT survey tool was run to survey the hole from 1000 mKB to surface prior to cutting core no. 1:

GCT-GR-AMS.

A 5-1/4" core was cut from 1271-1290 mKB, the cored interval was then reamed and 12-1/4" hole was continued to TD at 1750 mKB. Suite no. 3 wireline logs were run which consisted of:

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

RFT-HP-GR

VSP

CST

The well was then plugged and abandoned and the rig was released at 1700 hours 17th May 1990.

1.2 GEOLOGICAL SUMMARY

The Amberjack structure lies within the western portion of the offshore Gippsland Basin, down-dip from the Perch-Dolphin-Tarwhine trend. At the top of Latrobe the post-drill structure is lobate in form and trends in a northeast-southwest direction (see Enclosure 1).

The well Amberjack-1 was located in a near crestal position 250m south of shot-point 305 of line GSE89A-58, 5km to the west of Dolphin-1. 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.

Although the well intersected the top of Latrobe 32m 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. A core taken at the top Latrobe in the "Coarse Clastics" unit had 11m of oil shows but the RFT pretests indicated a water gradient and log interpretation indicated high water saturations. The oil is interpreted as residual and consequently no net pay has been assigned to this well.

2. PREVIOUS ACTIVITY

Amberjack-1 is located in the exploration permit Vic/P25 which lies to the south-west of the main producing part of offshore Gippsland Basin, along the basin edge. Prior to drilling Amberjack-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 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 initial 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 restriced 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 2.

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 particularly 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 Amberjack prospect is an low amplitude, mound-like feature which is lobate in form, the axis of which trends in a NE-SW direction (Enlosure 1). The prospect is located within permit Vic/P25 which lies along the south-western margin of Gippsland Basin. The crest of the Amberjack structure at the top of Latrobe lies approximately 6km southwest and 40m down dip of the crest of the Dolphin oil field.

Faulting occurs within the intra-Latrobe Group sediments towards the northern part of the feature, however fault expression does not extend through the top of Latrobe horizon as there is no interruption of the seismic marker at the top of Latrobe.

The Lakes Entrance isopach (Enclosure 2) indicates thinning of the unit over the Amberjack structure. Seismic onlap of the Lakes Entrance Formation onto the top of Latrobe horizon can be recognised (eg Line GSE89A-58) 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 generalised Gippsland Basin Sequence Stratigraphy is 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 bound 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 Amberjack-1.

In the Vic/P25 permit area, these 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 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 Amberjack-1 well is located along the south-western margin of the basin. The stratigraphic units intersected by the well are similar to the sequence stratigraphy described above which fits into the regional picture. Well to well correlations are presented in Enclosure 4. As there is reasonable well control in this area for the Latrobe Group strata, the well was not designed to drill to the Strzelecki Group. Instead the T.D. of the well was designed to allow the potential reservoir section to be fully evaluated. As a result the well was drilled to the upper Paleocene.

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

Paleocene-early Eocene (1750-1490m KB)

The Paleocene (upper L.balmei spore pollen zone) to early Eocene (P.asperopolus spore pollen zone) consists of a repetetive sequence of sandstone, siltstone and claystone interbeds, with occasional thin coal interbeds appearing towards the top of the interval.

Within this unit the net to gross ratio is relatively high, the sands are loose and unconsolidated, medium to coarse grained with a silty matrix. Associated with the sandstone units are trace amounts of glauconite and micro-crystalline pyrite. The individual quartz grains as described in the cuttings are clear, subangular to subrounded and of variable sphericity.

Electrofacies analysis of this interval indicates that the interval was deposited in a near shore, coastal plain environment. The gamma ray log character of the sand units tend to be blocky in nature with abrupt upper and lower contacts. Upward coarsening and upward fining sequences can be seen within individual sand units, as are alternating red and blue dip patterns on the dipmeter log. Some of the red and blue dip patterns display the same azimuth which tends to be indicative of foreset beds.

Eocene (1490-1268m KB)

This interval, P.asperopolus to upper N.asperus spore pollen zones, also consists of a repetitive sequence of sandstone, siltstone and claystone interbeds, however the coal content has increased markedly.

The net to gross ratio is not as high as the underlying Paleocene section although the sand intervals display a similar blocky log character. The sands are loose and unconsolidated, fine to medium grained, occasionally coarse grained. The individual quartz grains are clear, subangular to subround and poorly sorted.

The dipmeter log again displays a sequence of alternating red and blue patterns in the sandstone units whereas the shale units display steady dip motifs which are unidirectional. The structural dip of the upper part of this interval is towards the south-west. The log character of the gamma ray tends to be blocky with relatively sharp upper and lower boundaries. The sand-bodies appear to be composed of a sequence of vertically stacked units. These sand bodies are separated from the underlying Paleocene section by a sequence of very fine grained siltstone, claystone and coal interbeds, representative of lagoonal, swamp, floodplain facies. The sand bodies themselves appear to have been deposited in a nearshore, foreshore facies, possibly as foredune ridge or berm in a barrier bar complex. The sand at the top of the interval contains a high incidence of carbonaceous laminae, possibly remnant rootlets, which is often seen in modern analogues, as in the Gippsland Lakes area.

Only a thin veneer of Gurnard Formation (1257-1267 mKB) overlies the Latrobe Group sediments at Amberjack-1, consisting of very fine grained claystone and mudstone. The sequence also contains abundant disseminated glauconite and common to abundant dark-green/black glauconite grains with variable amounts of microcrystalline pyrite. These fine grained sediments are typically green to olive-green in colour and represent the transition from a non-marine to a marine period of sedimentation.

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 400-480m KB in which the quartz grains were described from the ditch cuttings as being loose and unconsolidated, fine to medium grained, occasionally coarse grained, moderate to well sorted, subround to round, and frosting of grains is common. The interval also contained some heavy mineralisation which is very typical of a fore-dune facies within a linear coastline environment.

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 Amberjack-1 well was located at the top of Latrobe horizon where structural closure had been mapped. The pre-drill stratigraphic interpretion was that upper shore-face sand bodies would be intersected at or near the top of Latrobe horizon, which would have provided excellent reservoir characteristics. Amberjack-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 were possible but the trapping mechanism would have been more stratigraphic in nature as there was no structural closure mapped below the top of Latrobe horizon.

Within the Gippsland Limestone Formation, the prospectivity of the high stand transgressive sandstone units seen elsewhere along the basin margin in this unit 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 Amberjack-1 at 400-480 mKB.

7. SEAL

For the primary target, the low permeability fine grained marls, mudstone and calcilutites of the Lakes Entrance Formation were expected to provide a seal for the top of Latrobe sediments. However at the Amberjack prospect some seismic channelling was evident in this unit and consequently the seal integrity was in doubt and a risk was applied to account for this. The Lakes Entrance Formation was intersected by the well at 1215-1256.5 mKB, and is 41.5 m 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 hydrocarbon fluorescence shows were reported from three zones. The first was in a sandstone unit at 400-480 mKB within the Miocene (Gippsland Limestone Formation), the second was in the later Eocene (upper N.asperus spore pollen zone) sediments at the top of Latrobe 1268-1280 mKB, and the third was in the mid Eocene (lower N.asperus spore pollen zone) sediments from 1349-1361 mKB.

Evaluation of the Miocene hydrocarbon shows was hampered because of the hole size. No samples of formation fluid or reservoir pressures were obtained from this section, neither were any sidewall cores or conventional cores. The open-hole and cased-hole logging suites were of limited value because of the washout of the sandstone and the resultant large hole.

One 18 metre conventional core was taken from the upper Latrobe Group from 1271.4-1290 mKB. Visual oil staining, a strong petroliferous odour, and good fluorescence shows were noted in the core from 1271.4-1280 mKB. Routine core analysis was performed on the core which yielded very low oil saturations of less than 6.0% although porosities were high ranging between 25% and 32% (Refer Appendix 3). Core permeabilities were also high and ranged from 100 md to 3000 md (See Figure 4 and Refer Appendix 1).

An RFT pretest and sampling programme was run after T.D. had been reached. The pressure gradient indicated the interval was water saturated and in the samples recovered only thin oil films and scum were noted. The hydrocarbons noted in this interval have been interpreted to be residual and immobile (Refer Appendix 4).

Geochemical analyses of the oil recovered are presented in Appendix 5. The oil is reported to be severely bio-degraded, and the hydrocarbon distributions from gas chromatrography indicate that the samples broadly resemble a mature oil.

Hydrocarbon fluorescence was also noted over the interval 1349-1361 mKB. Again RFT pretests and formation sampling indicated the oil to be residual and immobile.

10. SEISMIC INTERPRETATION

Due to an incorrect projection being used to transfer shot-point location data (in the form supplied by a contractor) from the previous operator, BHP Petroleum had incorrect locations in its database at the time of drilling Amberjack-1. Consequently, the well was drilled 250m south of the location picked on seismic line GSE89A-58, S.P. 305. Fortunately, this error did not place the well in an adverse position relative to the Amberjack structure, as mapped (it may even be in a slightly more crestal location than if it had been located on the line). The well can be projected along strike 200m NNE to S.P. 310 on the same line (Enclosure 5).

The corrected check shot time from the well velocity survey at the top of Latrobe Coarse Clastics is 1.031 sec. two-way, which is 5ms later than the seismic event picked at S.P. 305 but corresponds exactly with the pick at S.P. 310 (if this is taken at the onset of the black peak). Although we picked the top of Coarse Clastics at the centre of the white trough above the black peak for the original mapping, taking the onset of the peak is more consistent with standard "SEG normal" data from the area. This is because the 1989 data has not had source signature deconvolution applied, but a gapped deconvolution instead (which causes some phase differences). The synthetic seismogram run by Schlumberger, (Enclosure 8) with a zero phase Ricker wavelet of 30 Hz dominant frequency, gives a good correlation with the seismic line at S.P. 310 if the synthetic is moved down by about 8 ms., implying a seismic lag of that amount. The trough corresponding with the top of Coarse Clastics on the "SEG normal" display is then, however, the one below the black peak which has been followed on seismic.

The black peak is therefore obviously associated with the top of Latrobe Coarse Clastics (seismic line GSE89A-58, Enclosure 5) but there is some ambiguity as to which part of the cycle one should pick. On balance throughout the Permit, it seems reasonable to pick the onset of the black peak as the top of Coarse Clastics on the GSE89A data. The difference in the Amberjack area, where top reservoir in the well should be picked immediately below the black peak, is probably due to interference effects with the closely-overlying top of Lakes Entrance Formation event, at 1.002 sec. in the well. The discrepancy in the part of the cycle to be picked as top reservoir in the Amberjack area, where channelling effects occur at the top of the Lakes Entrance Formation, can be corrected for by applying a "seismic average velocity" (well depth divided by picked seismic time). These velocities have been contoured for wells in the area, including Amberjack-1, as shown on Enclosure 7. This average velocity map shows a high velocity in the Amberjack-1 area (due to "faster" Gippsland Limestone) relative to Dolphin, which explains why the top of Latrobe Coarse Clastics was encountered some 30m deep to prognosis. Because of the ambiguities of picking the top of Coarse Clastics event in this area, the time map (Enclosure 6) has been corrected to the available well velocity surveys.

The resulting depth map (Enclosure 1) ties the well and gives the best approximation to the structural picture, without using seismic stacking velocities (which are probably only reliable for the 1989 data, of which there is a lot less available than the 1980, 1981 and 1982 data). This shows that Amberjack-1 tested a valid structural closure, somewhat reduced in relief relative to the pre-drill structure map. The presence of only residual oil in this trap may indicate biodegradation, or that the seal has subsequently been breached by either reactivation of the northern "boundary" fault or by channelling into the reservoir sequence (to the south of the Amberjack-1 location) with a permeable channel fill at the base of the Gippsland Limestone. The closure in depth tends to move southwards relative to the original mapping, so that its crest occurs in the Vic/L17 Licence Area, although the up-dip potential from Amberjack-1 in this structure is currently sub-economic.

11. CONCLUSIONS AND RELEVANCE TO HYDROCARBON ENTRAPMENT

Oil shows were present in several horizons in Amberjack-1, however all are interpreted to be residual and immobile. The ability of the sediments to generate and trap hydrocarbons has thus been confirmed although preservation of the generated oil has not.

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

The major salient points drawn from the drilling of Amberjack-1 are summarised in the following:

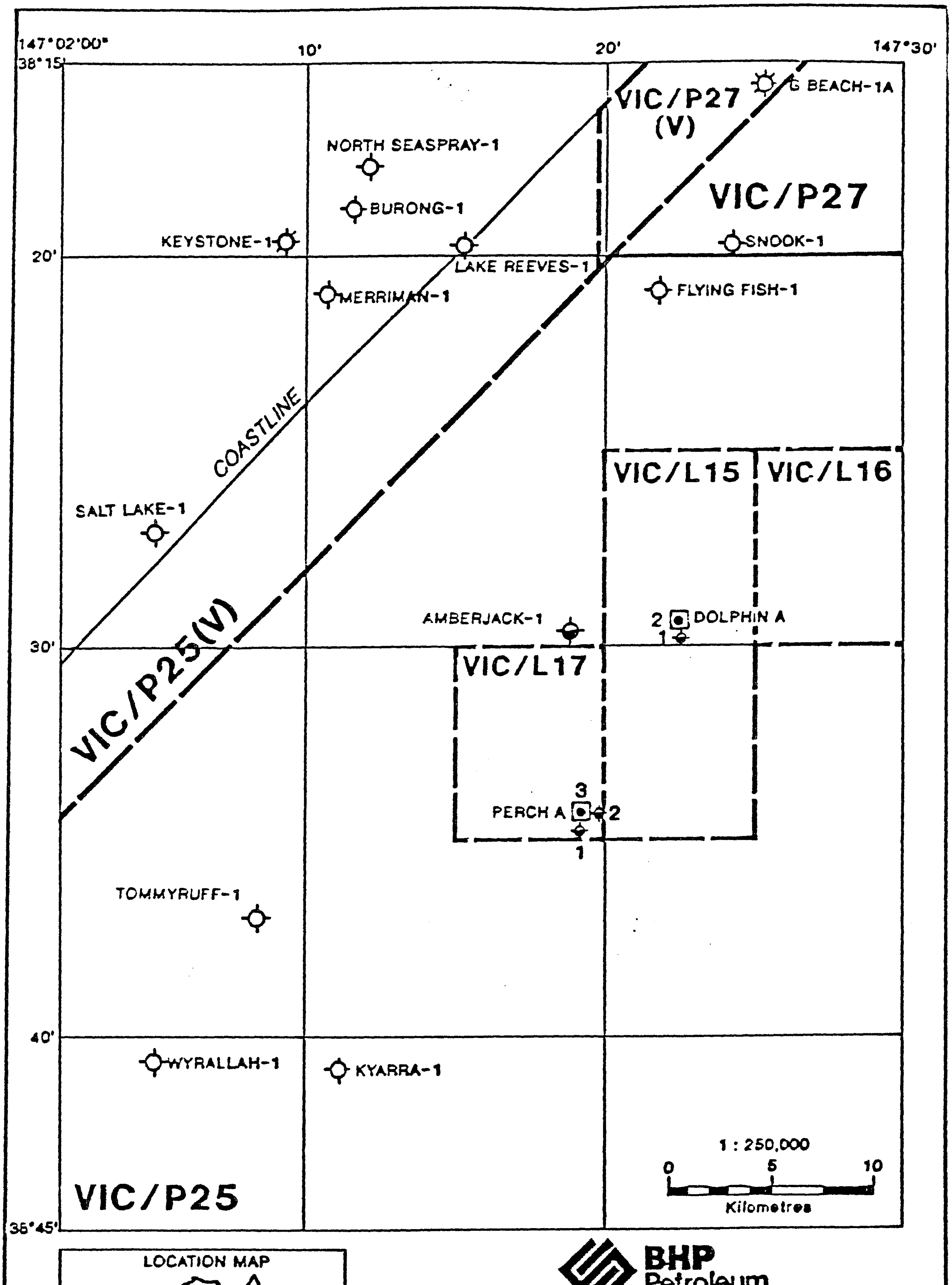
1. Amberjack-1 encountered several zones with oil shows. However, the oil in each of the zones has been interpreted to be residual and immobile.

2. The internal stratigraphic units intersected by the well were similar to prediction in that they were deposited within a nearshore environment, in a fore-shore facies closely associated with a lagoonal, back-swamp facies.

3. The structural interpretation for the top of Latrobe horizon was little changed from the pre-drill interpretation.

FIGURE 1

Figure 1



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GIPPSLAND BASIN
VIC/P25

LOCATION MAP

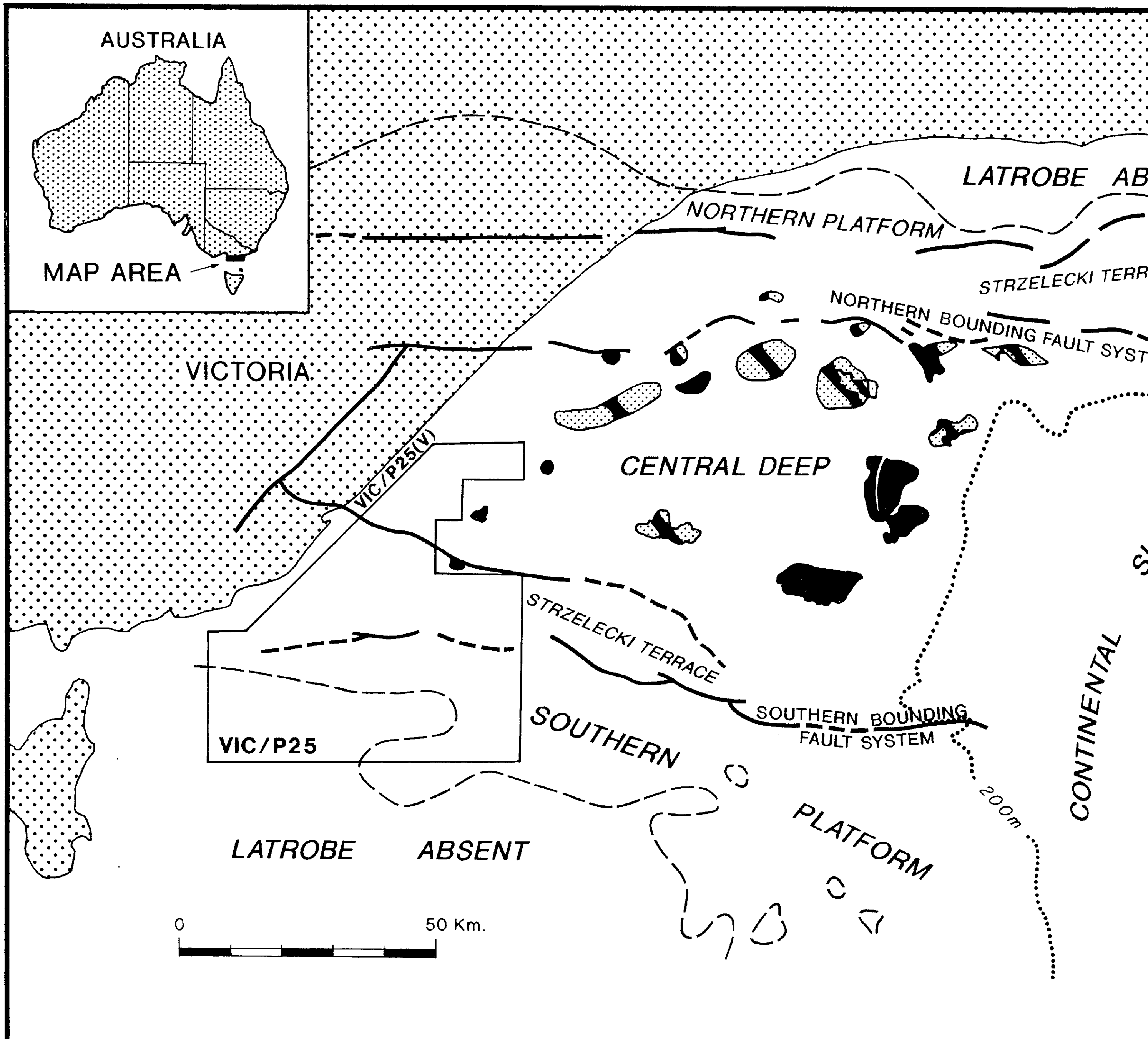
Figure 1

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

FIGURE 4

Figure 4

PE600928

This is an enclosure indicator page.
The enclosure PE600928 is enclosed within the container PE902078 at this location in this document.

The enclosure PE600928 has the following characteristics:

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CONTAINER_BARCODE = PE902078
NAME = Core Composite well log
BASIN = GIPPSLAND
PERMIT =
TYPE = WELL
SUBTYPE = COMPOSITE_LOG
DESCRIPTION = Core Composite well log
REMARKS =
DATE_CREATED = 17/05/1990
DATE_RECEIVED = 22/02/1991
W_NO = W1029
WELL_NAME = Amberjack-1
CONTRACTOR = BHP Petroleum
CLIENT_OP_CO = BHP Petroleum

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE 1

Enclosure 1

PE902079

This is an enclosure indicator page.
The enclosure PE902079 is enclosed within the container PE902078 at this location in this document.

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CONTAINER_BARCODE =	PE902078
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BASIN =	GIPPSLAND
PERMIT =	
TYPE =	SEISMIC
SUBTYPE =	HRZN_CONTR_MAP
DESCRIPTION =	Depth Structure Map for Amberjack-1 : Top of Latrobe Coarse Clastics
REMARKS =	
DATE_CREATED =	01/08/1990
DATE_RECEIVED =	22/02/1991
W_NO =	W1029
WELL_NAME =	Amberjack-1
CONTRACTOR =	BHP Petroleum
CLIENT_OP_CO =	BHP Petroleum

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE 2

Enclosure 2

PE902080

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CONTAINER_BARCODE =	PE902078
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BASIN =	GIPPSLAND
PERMIT =	
TYPE =	WELL
SUBTYPE =	ISOPACH_MAP
DESCRIPTION =	Time Isopach Map of Lakes Entrance Formation; Amberjack-1
REMARKS =	
DATE_CREATED =	01/02/1990
DATE_RECEIVED =	22/02/1991
W_NO =	W1029
WELL_NAME =	Amberjack-1
CONTRACTOR =	BHP Petroleum
CLIENT_OP_CO =	BHP Petroleum

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE 3

PE600927

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CONTAINER_BARCODE = PE902078
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BASIN = GIPPSLAND
PERMIT =
TYPE = WELL
SUBTYPE = COMPOSITE_LOG
DESCRIPTION = Composite Well Log for Amberjack-1
REMARKS =
DATE_CREATED = 17/05/1990
DATE_RECEIVED = 22/02/1991
W_NO = W1029
WELL_NAME = Amberjack-1
CONTRACTOR = BHP Petroleum
CLIENT_OP_CO = BHP Petroleum

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ENCLOSURE 4

Enclosure 4

PE902081

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PERMIT =	
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SUBTYPE =	CROSS_SECTION
DESCRIPTION =	well stratigraphic correlations
REMARKS =	
DATE_CREATED =	01/02/1990
DATE_RECEIVED =	22/02/1991
W_NO =	W1029
WELL_NAME =	Amberjack-1
CONTRACTOR =	BHP Petroleum
CLIENT_OP_CO =	BHP Petroleum

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE 5

PE902082

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DATE_CREATED =	01/02/1990
DATE_RECEIVED =	22/02/1991
W_NO =	W1029
WELL_NAME =	Amberjack-1
CONTRACTOR =	BHP Petroleum
CLIENT_OP_CO =	BHP Petroleum

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE 6

Enclosure 6

PE902083

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PERMIT =
TYPE = SEISMIC
SUBTYPE = HRZN_CONTR_MAP
DESCRIPTION = Top of Latrobe coarse clastics time map (corrected for well velocity surveys)
REMARKS =
DATE_CREATED = 01/09/1990
DATE_RECEIVED = 22/02/1991
W_NO = W1029
WELL_NAME = Amberjack-1
CONTRACTOR = BHP Petroleum
CLIENT_OP_CO = BHP Petroleum

ENCLOSURE 7

Enclosure 7

PE902084

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PERMIT = Vic/P25
TYPE = WELL
SUBTYPE = map
DESCRIPTION = average vel to top of latrobe coarse clastics
REMARKS =
DATE_CREATED = 01/09/1990
DATE_RECEIVED = 22/02/1991
W_NO = W1029
WELL_NAME = Amberjack-1
CONTRACTOR = BHP Petroleum
CLIENT_OP_CO = BHP Petroleum

(Inserted by DNRE - Vic Govt Mines Dept)

Enclosure 8

PE600924

This is an enclosure indicator page.
The enclosure PE600924 is enclosed within the container PE902078 at this location in this document.

The enclosure PE600924 has the following characteristics:

ITEM_BARCODE =	PE600924
CONTAINER_BARCODE =	PE902078
NAME =	Geogram - Synthetic Seismogram
BASIN =	GIPPSLAND
PERMIT =	
TYPE =	WELL
SUBTYPE =	SYNTH_SEISMOGRAPH
DESCRIPTION =	Geogram - Synthetic Seismogram
REMARKS =	
DATE_CREATED =	14/05/1990
DATE_RECEIVED =	22/02/1991
W_NO =	W1029
WELL_NAME =	Amberjack-1
CONTRACTOR =	Schlumberger
CLIENT_OP_CO =	BHP Petroleum

(Inserted by DNRE - Vic Govt Mines Dept)

APPENDIX 1

Appendix 1

AMDEL
CORE
SERVICES

31 May 1990

BHP Petroleum
35 Collins Street
MELBOURNE VIC 3000

Attention: Dr R V Halyburton

REPORT: 005/008

CLIENT REFERENCE:	**RVH, RBM, RP 0083**
WELL:	**AMBERJACK #1**
MATERIAL:	**CORE 1**
LOCALITY:	**VIC-P-25**
WORK REQUIRED:	**CONVENTIONAL CORE ANALYSIS**

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

BILL DERKSEMA
Laboratory Supervisor
on behalf of Amdel Core Services Pty Ltd

Please reply to: PO Box 523 Strathpine Queensland 4500 Tel: 07 3557033
Amdel Core Services Pty Limited
Incorporated in South Australia

31 May 1990

BHP Petroleum
35 Collins Street
MELBOURNE VIC 3000

Attention: Dr R V Halyburton

FINAL DATA REPORT - CONVENTIONAL CORE ANALYSIS

REPORT: 005/008 - AMBERJACK #1

Core No 1, 1271.40-1288.96 (17.56m) was collected from the Heliport at Port Welshpool Airport on 10 May 1990.

The following report includes tabular data of permeability to air, helium injection porosity, summation of fluids porosity, residual fluid saturations and density determinations. Data presented graphically includes a continuous core gamma log, a core log plot and a porosity versus permeability to air plot.

The data contained in this report has been derived by the following methods:

1. CONTINUOUS CORE GAMMA

The core is laid out according to the depths marked on it and a continuous core gamma trace produced by passing the core beneath a gamma radiation detector which is protected from extraneous radiation by a lead tunnel. The speed at which the core is passed beneath the detector is adjusted so as to reproduce the required vertical scale; electronic amplification and digitization are used to produce a gamma trace similar to that of the downhole log.

2. FLUID SATURATIONS

After completion of the core gamma work the core is laid out according to the depth and oriented so as to present the maximum dip of the bedding. Approximately 2 cm of core is dry-trimmed from the whole core pieces at intervals of approximately 30 cms. About 100 gms of this broken material is utilized to determine the residual oil and water saturations. This is done using a thermostatically controlled high temperature retort which is initially heated to 160°C and water produced from the core is recorded versus time. When the initial water production reaches a constant level the temperature is increased to 650°C and residual hydrocarbons and remaining bound water are recovered.

3. SUMMATION OF FLUIDS POROSITY

A small irregular sample is taken from the broken portion of core obtained as in Section 2, above, and this is used for the determination of bulk volume and gas volume. The latter is measured by recording the volume of mercury injected into the sample at 750 psig (5200 kpa). The summation of fluids porosity is then calculated by summing the 3 values: initial water produced, oil produced and gas volume. The porosity is calculated by expressing the sum of these as a percentage of the bulk volume (determined by mercury immersion).

4. PLUG CUTTING & DRYING

Two 1½" diameter plugs are taken at 30 cm intervals adjacent to the core section taken for residual fluids. Liquid nitrogen was used as bit lubricant on first 42 samples due to the soft and friable nature of core. For the remaining 17 samples, tapwater was used as the bit lubricant. One sample is cut parallel, and the second at 90° to the bedding plane, thus giving theoretical maximum and minimum permeability into the well bore. Samples are trimmed square and the offcuts retained. Residual hydrocarbon are extracted from the plugs using toluene in a Soxhlet extractor. The density of the recycled toluene is compared to clean toluene as a control to ensure that no extractable oil remains in the plugs.

After cleaning, the plugs are dried in a controlled humidity environment at temperatures not exceeding 105°C and are then stored in an airtight plastic container and allowed to cool to room temperature.

5. NATURAL DENSITY

The natural density is the bulk density of the rock containing, as near as possible, the in-situ fluids. This density value is determined by mercury immersion, which gives the sample bulk volume, and by weighing the sample in its natural state.

6. PERMEABILITY TO AIR

A plug sample is used for this measurement and is placed in a Hassler cell to which a confining pressure of 200 psig (1380 kpa) is applied; this pressure is used to prevent bypassing of air around the sides of the sample when the measurement is made. A known pressure is then applied to the upstream sample face and the differential pressure (between the upstream and downstream faces) is monitored at the downstream face. Permeability is then calculated using Darcy's Law.

7. HELIUM INJECTION POROSITY

The porosity of a clean dry core plug is determined as follows: it is first placed in a matrix cup where the grain volume is measured by helium injection: a known volume of helium at a known pressure is expanded into the matrix cup which contains the core plug; the resulting pressure is recorded and the unknown volume (that is, the volume of the grains) is determined using Boyle's Law. The bulk volume is determined by mercury immersion. The difference between the grain volume and the bulk volume is the pore volume and from this the porosity is calculated as the volume percentage of pores with respect to the bulk volume.

8. APPARENT GRAIN DENSITY

The apparent grain density is derived from the measurements described in Section 7, above, and is the ratio of the weight of the core plug divided by the grain volume determined as in paragraph 7.

9. POROSITY AND PERMEABILITY AT OVERBURDEN PRESSURE

To determine the porosity and permeability of the core plug at overburden pressure, the sample is first placed in a cylindrical neoprene sheath and this assembly is loaded into a triaxial hydrostatic cell. The pore volume is then determined at "ambient" pressure. The overburden pressure (the value as supplied by the client) is then applied to the sample in the cell and the pore volume reduction caused by this increase in pressure, is measured. By this means the actual overburden pore volume and the bulk volume can be determined and are used to derive a value for the porosity at the applied overburden pressure. The permeability at overburden pressure is then measured in the hydrostatic cell exactly as described in paragraph 7.

10. API GRAVITY

Composite samples from a particular reservoir are collected from the retort during fluid saturation determinations. Specific gravity is measured by the pycnometer method and converted mathematically to degrees API to comply with Industry standards.

11. ROLLING AND SPECIFIED AVERAGES

These averages of both Helium injection porosity and permeability are obtained by using a "rolling" three (3) point method. In the case of porosity a weighted arithmetic average is used:

$$\phi\ av_{(i-1)} = [\phi_i + 2\phi_{(i-1)} + \phi_{(i-2)}]\ /4$$

In the case of permeability a weighted geometric average is used:

$$K\ av_{(i-1)} = 10^{[(\log_{10} K_i + 2\log_{10} K_{(i-1)} + \log_{10} K_{(i-2)})\ /4]}$$

At any sample point, excluding the first and last, a rolling average is obtained by using the value at the specified sample point, the value before it and the value of the sample point after it. In the cases of the first and last sample points, only 2 sample points are used.

Using porosity as an example, the average of the first data point is obtained from the formula:

$$\phi\ av_{(i)} = [2\phi_i + \phi_{(i-1)}]\ /3$$

The average at the final data point is obtained by:

$$\phi\ av_{(f)} = [\phi_{(f-1)} + 2\phi_{(f)}]\ /3$$

The same method is used for permeability averages. At any break in the data the rolling averages are "re-started".

Data Key:

ϕ	=	porosity
K	=	permeability
i	=	initial
av	=	average
f	=	final

Specified averages are normal arithmetic averages which can be taken over any specified section of the core, as well as over the whole core.

On completion of the analysis the core was slabbed into one half, and two quarter slabs using water as the lubricating medium. One quarter was packed and shipped to the Department of Industries Technology and Resources store in Melbourne. The remaining quarter was packed and shipped to the BMR, Canberra. The one half slab was photographed under both white light and ultra-violet light. This half was then packed and shipped to the BHPP core store in Melbourne.

We have enjoyed working with BHPP and look forward to working with you again in the near future.

END OF REPORT

NB

Routine quality control checks identified relatively low porosity results for preliminary data of samples 12, 40, 41, 9A, 11A, 12A, 40A and 41A.

During bulk volume determinations, mercury was found to slightly penetrate the extremities of the sample and thus effectively lowering porosity data.

Appropriate corrections were made to all relevant samples and reported.

Amdel Core Services Pty. Limited

Petroleum Reservoir Engineering Data

PO Box 523 Strathpine Q 4500 Aust.
Tel : (07) 298-5272

CORE ANALYSIS FINAL REPORT

Company : BHP PETROLEUM PTY. LTD.
Well : AMBERJACK #1
Field : WILDCAT (Vic-P-25) Date : 11/05/90
Core Interval : 1271.40 - 1288.96
Core Interval :
File No. : 5-008
Country : AUSTRALIA State : VICTORIA

Sample No.	Depth	Porosity HeInj	Porosity RollPor	Density Nat	Density Grain	Permeability (md) KH	Permeability (md) Roll KH	Summation of Fluids Por	Summation of Fluids Oil	Summation of Fluids Water	Remarks See Below
1	1271.50	32.2	31.8	2.04	2.66	784	821	27.5	5.9	77.1	C# SP
1A	1271.50	31.4	31.3		2.66	672	653				SP
2	1271.70	31.0	31.0	2.05	2.67	902	714	30.0	4.1	75.4	
2A	1271.70	31.0	30.4		2.66	616	510				
3	1272.00	29.8	30.9	2.10	2.66	407	691	28.1	5.2	78.6	
3A	1272.00	28.3	30.0		2.64	266	502				
4	1272.30	32.9	32.3	2.03	2.65	1523	1135	33.2	2.4	80.8	
4A	1272.30	32.3	31.6		2.65	1455	1035				
5	1272.60	33.4	33.2	2.05	2.66	1760	1741	33.2	1.9	85.2	
5A	1272.60	33.4	33.0		2.65	2040	1969				
6	1272.90	33.1	33.3	2.07	2.66	1948	1794	33.7	3.7	85.9	
6A	1272.90	33.0	33.3		2.65	2482	2194				SP
7	1273.20	33.5	33.4	2.07	2.65	1552	1556	33.0	1.3	84.3	
7A	1273.20	33.7	32.8		2.65	1844	1571				
8	1273.50	33.4	32.3	2.04	2.67	1250	1410	33.9	5.4	78.3	SP*
8A	1273.50	30.9	31.1		2.66	721	1169				SP*
9	1273.80	29.0	31.3	2.15	2.65	1629	1417	25.8	2.5	76.8	SP*
9A	1273.80	29.0	30.6		2.65	1948	1435				SP*
10	1274.10	33.7	32.6	2.04	2.66	1216	2852	25.0	.8	82.4	SP*
10A	1274.10	33.4	31.9		2.66	1551	2877				SP*
11	1274.40	34.0	32.9	2.16	2.65	27469	12107	30.0	1.4	90.6	
11A	1274.40	31.8	31.7		2.65	14630	8604				
12	1274.70	29.8	31.5	2.16	2.65	23419	10821	28.6	1.5	90.7	
12A	1274.70	29.7	31.1		2.66	16511	8275				
13	1275.00	32.4	31.5	2.07	2.64	910	1979	33.0	3.1	84.6	SP*
13A	1275.00	33.4	31.4		2.66	1176	1658				SP*
14	1275.30	31.4	31.3	2.10	2.66	792	934	31.5	2.7	88.5	
14A	1275.30	29.1	30.5		2.65	331	511				
15	1275.60	30.0	29.9	2.14	2.67	1335	767	31.8	3.4	84.6	
15A	1275.60	30.5	29.7		2.65	530	442				
16	1275.90	28.3	29.1	2.09	2.65	245	418	30.9	4.7	78.6	
16A	1275.90	28.9	28.9		2.65	411	356				
17	1276.20	29.8	29.4	2.12	2.66	380	324	20.2	3.1	72.3	
17A	1276.20	27.5	28.5		2.65	180	269				
18	1276.50	29.7	29.0	2.10	2.66	310	269	29.3	5.0	81.1	
18A	1276.50	30.1	29.0		2.65	395	293				
19	1276.80	27.0	28.4	2.15	2.66	143	218	30.4	2.1	84.2	
19A	1276.80	28.3	29.4		2.66	261	348				SP*
20	1277.10	30.0	29.3	2.12	2.66	357	293	27.1	1.6	84.6	
20A	1277.10	31.0	30.3		2.67	544	422				SP

BHP PETROLEUM PTY. LTD. :
AMBERJACK #1 : Analysis by
Amdel Core Services Pty. Limited

Sample No.	Depth	Porosity HeInj	Porosity RollPor	Density Nat	Density Grain	Permeability (md) KH	Permeability (md) Roll KH	Summation of Fluids Por	Summation of Fluids Oil	Summation of Fluids Water	Remarks See Below
21	1277.40	30.1	29.3	2.10	2.68	408	319	28.5	2.2	82.1	
21A	1277.40	30.8	30.1		2.68	411	416				SP*
22	1277.70	26.9	28.8	2.17	2.67	175	285	27.2	4.8	82.2	
22A	1277.70	27.7	29.3		2.67	326	413				
23	1278.00	31.4	29.5	2.08	2.68	533	325	31.6	3.9	81.6	
23A	1278.00	31.0	29.6		2.66	668	459				SP*
24	1278.30	28.3	29.8	2.14	2.69	225	357	29.9	5.0	79.2	
24A	1278.30	28.7	30.1		2.67	305	486				
25	1278.60	31.1	30.7	2.09	2.67	603	554	31.9	3.9	83.1	
25A	1278.60	32.0	30.5		2.68	902	649				
26	1278.90	32.5	30.9	2.09	2.67	1150	625	32.2	3.9	83.0	SP
26A	1278.90	29.4	29.1		2.67	716	516				SP*
27	1279.20	27.6	29.9	2.13	2.66	192	489	29.7	2.9	81.0	
27A	1279.20	25.5	28.1		2.64	154	419				
28	1279.50	31.7	31.0	2.08	2.68	1360	920	33.4	4.4	84.9	
28A	1279.50	31.9	30.2		2.67	1823	970				
29	1279.80	32.9	32.1	2.03	2.68	2022	1671	32.0	3.2	81.9	
29A	1279.80	31.3	31.7		2.66	1734	1778				SP
30	1280.10	31.0	31.7	2.10	2.67	1403	1479	30.1	1.4	89.3	
30A	1280.10	32.1	32.1		2.66	1823	1827				
31	1280.40	32.0	31.9	2.07	2.67	1202	1300	29.7	1.4	88.0	OWC
31A	1280.40	32.7	32.2		2.66	1931	1934				
32	1280.70	32.6	32.7	2.10	2.67	1409	1365	31.6	.0	93.7	
32A	1280.70	31.2	32.2		2.66	2058	2009				
33	1281.00	33.5	33.2	2.04	2.67	1454	1435	33.8	.0	89.6	
33A	1281.00	33.5	32.9		2.67	1992	2050				
34	1281.30	33.3	33.1	2.09	2.67	1425	1470	32.8	.0	93.5	
34A	1281.30	33.4	32.9		2.67	2161	2097				
35	1281.60	32.5	32.7	2.09	2.68	1584	1523	32.0	.0	90.3	
35A	1281.60	31.3	32.1		2.68	2078	2082				
36	1281.90	32.6	32.5	2.07	2.68	1505	1429	29.4	.0	90.3	
36A	1281.90	32.5	32.2		2.67	2014	1932				
37	1282.20	32.3	31.2	2.11	2.68	1163	983	32.2	.0	94.3	
37A	1282.20	32.3	31.4		2.67	1652	1147				
38	1282.50	27.4	29.0	2.18	2.68	459	536	26.4	.0	89.3	
38A	1282.50	28.7	28.8		2.67	315	339				
39	1282.80	28.8	27.7	2.15	2.67	338	723	14.6	.0	75.2	
39A	1282.80	25.5	26.4		2.65	81	299				
40	1283.10	25.6	26.1	2.29	2.79	5218	2703	29.8	.0	86.9	
40A	1283.10	25.7	24.8		2.77	3877	1500				
41	1283.40	24.4	25.7	2.30	2.72	5798	6016	16.7	.0	79.9	
41A	1283.40	22.1	24.2		2.70	4168	3900				
42	1283.70	28.3	27.6	2.18	2.67	7469	5827	27.2	.0	95.5	
42A	1283.70	26.8	26.4		2.66	3435	3539				
43	1284.00	29.5	29.4	2.11	2.67	3564	4699	31.2	.0	92.2	
43A	1284.00	30.0	29.1		2.65	3191	3526				
44	1284.30	30.1	29.8	2.10	2.66	5138	4716	31.5	.0	91.4	
44A	1284.30	29.5	29.6		2.65	4420	4074				
45	1284.60	29.5	29.8	2.13	2.66	5257	5172	28.1	.0	93.1	
45A	1284.60	29.2	29.6		2.65	4420	4156				
46	1284.90	30.0	29.8	2.12	2.66	5038	4927	30.5	.0	92.3	
46A	1284.90	30.4	30.3		2.65	3455	3584				

BHP PETROLEUM PTY. LTD. :
AMBERJACK #1 : Analysis by
Amdel Core Services Pty. Limited

Sample No.	Depth	Porosity HeInj	Porosity RollPor	Density Nat	Density Grain	Permeability (md) KH	Permeability (md) Roll KH	Summation of Fluids Por	Summation of Fluids Oil	Summation of Fluids Water	Remarks See Below
47	1285.20	29.4	30.1	2.05	2.66	4416	3987	33.2	.0	84.6	
47A	1285.20	31.0	30.7		2.65	3128	3574				
48	1285.50	31.6	31.1	2.10	2.66	2572	3284	28.0	.0	89.3	
48A	1285.50	30.3	30.6		2.65	4826	4356				
49	1285.80	31.8	31.5	2.08	2.66	3983	3868	33.7	.0	83.4	
49A	1285.80	30.6	31.0		2.66	4943	4459				
50	1286.10	30.6	31.4	2.12	2.67	5484	4809	26.4	.0	93.9	
50A	1286.10	32.2	31.7		2.66	3351	3738				
51	1286.40	32.6	31.5	2.09	2.66	4466	5133	30.9	.0	92.6	
51A	1286.40	31.8	31.7		2.66	3517	3519				
52	1286.70	30.3	31.0	2.08	2.66	6348	5285	32.0	.0	90.5	
52A	1286.70	30.9	31.3		2.66	3699	3744				
53	1287.00	30.8	30.5	2.11	2.66	4334	4845	32.2	.0	92.3	
53A	1287.00	31.7	31.3		2.66	4086	4064				
54	1287.30	30.2	30.1	2.09	2.66	4621	4592	31.5	.0	90.5	
54A	1287.30	30.6	30.2		2.65	4420	4300				
55	1287.60	29.0	29.8	2.10	2.66	4803	4497	31.9	.0	87.0	
55A	1287.60	27.9	29.1		2.66	4282	4109				
56	1287.90	30.8	30.6	2.10	2.66	3836	4316	32.0	.0	92.0	
56A	1287.90	29.9	29.8		2.65	3517	3481				
57	1288.20	32.0	31.2	2.07	2.66	4911	4104	32.8	.0	87.3	
57A	1288.20	31.4	30.6		2.65	2772	2879				
58	1288.50	30.1	30.7	2.13	2.66	3065	3485	26.6	.0	88.0	
58A	1288.50	29.6	30.3		2.65	2541	2570				
59	1288.80	30.7	30.5	2.06	2.66	3196	3152	33.1	.0	82.9	B#
59A	1288.80	30.6	30.2		2.65	2437	2471				

VF = Vertical Fracture; HF = Horizontal Fracture; MP = Mounted Plug; SP= Short Plug
C# = Top of Core; B# = Bottom of Core; OWC = Probable Oil/Water Contact
Tr = Probable Transition Zone; GC = Probable Gas Cap

Amdel Core Services Pty. Limited
Petroleum Reservoir Engineering Data

PO Box 523 Strathpine Q 4500 Aust.
Tel : (07) 298-5272

CORE ANALYSIS FINAL REPORT

Company : BHP PETROLEUM PTY. LTD.
Well : AMBERJACK #1
Field : WILDCAT (Vic-P-25)
Core Interval : 1271.40 - 1288.96
Core Interval :
File No. : 5-008
Country : AUSTRALIA

Date : 11/05/90

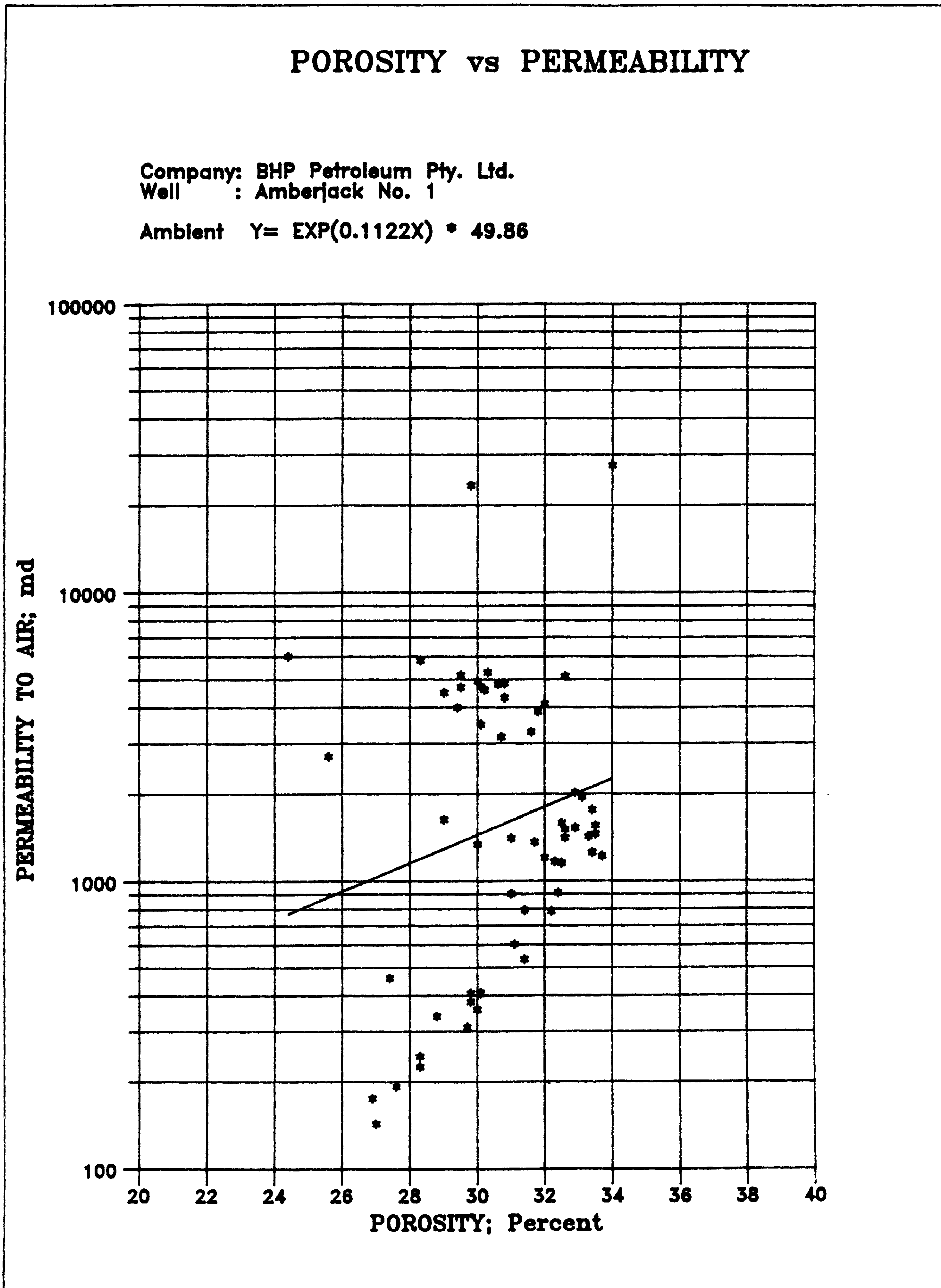
State : VICTORIA

Sample No.	Depth	Porosity HeInj	Porosity RollPor	Density Nat	Density Grain	Permeability (md) KH	Permeability (md) Roll KH	Summation of Fluids Por	Summation of Fluids Oil	Summation of Fluids Water	Remarks See Below
1	1271.50	32.2	31.8	2.04	2.66	784	821	27.5	5.9	77.1	C# SP
2	1271.70	31.0	31.0	2.05	2.67	902	714	30.0	4.1	75.4	
3	1272.00	29.8	30.9	2.10	2.66	407	691	28.1	5.2	78.6	
4	1272.30	32.9	32.3	2.03	2.65	1523	1135	33.2	2.4	80.8	
5	1272.60	33.4	33.2	2.05	2.66	1760	1741	33.2	1.9	85.2	
6	1272.90	33.1	33.3	2.07	2.66	1948	1794	33.7	3.7	85.9	
7	1273.20	33.5	33.4	2.07	2.65	1552	1556	33.0	1.3	84.3	
8	1273.50	33.4	32.3	2.04	2.67	1250	1410	33.9	5.4	78.3	SP*
9	1273.80	29.0	31.3	2.15	2.65	1629	1417	25.8	2.5	76.8	SP*
10	1274.10	33.7	32.6	2.04	2.66	1216	2852	25.0	.8	82.4	SP*
11	1274.40	34.0	32.9	2.16	2.65	27469	12107	30.0	1.4	90.6	
12	1274.70	29.8	31.5	2.16	2.65	23419	10821	28.6	1.5	90.7	
13	1275.00	32.4	31.5	2.07	2.64	910	1979	33.0	3.1	84.6	SP*
14	1275.30	31.4	31.3	2.10	2.66	792	934	31.5	2.7	88.5	
15	1275.60	30.0	29.9	2.14	2.67	1335	767	31.8	3.4	84.6	
16	1275.90	28.3	29.1	2.09	2.65	245	418	30.9	4.7	78.6	
17	1276.20	29.8	29.4	2.12	2.66	380	324	20.2	3.1	72.3	
18	1276.50	29.7	29.0	2.10	2.66	310	269	29.3	5.0	81.1	
19	1276.80	27.0	28.4	2.15	2.66	143	218	30.4	2.1	84.2	
20	1277.10	30.0	29.3	2.12	2.66	357	293	27.1	1.6	84.6	
21	1277.40	30.1	29.3	2.10	2.68	408	319	28.5	2.2	82.1	
22	1277.70	26.9	28.8	2.17	2.67	175	285	27.2	4.8	82.2	
23	1278.00	31.4	29.5	2.08	2.68	533	325	31.6	3.9	81.6	
24	1278.30	28.3	29.8	2.14	2.69	225	357	29.9	5.0	79.2	
25	1278.60	31.1	30.7	2.09	2.67	603	554	31.9	3.9	83.1	
26	1278.90	32.5	30.9	2.09	2.67	1150	625	32.2	3.9	83.0	SP
27	1279.20	27.6	29.9	2.13	2.66	192	489	29.7	2.9	81.0	
28	1279.50	31.7	31.0	2.08	2.68	1360	920	33.4	4.4	84.9	
29	1279.80	32.9	32.1	2.03	2.68	2022	1671	32.0	3.2	81.9	
30	1280.10	31.0	31.7	2.10	2.67	1403	1479	30.1	1.4	89.3	
31	1280.40	32.0	31.9	2.07	2.67	1202	1300	29.7	1.4	88.0	OWC
32	1280.70	32.6	32.7	2.10	2.67	1409	1365	31.6	.0	93.7	
33	1281.00	33.5	33.2	2.04	2.67	1454	1435	33.8	.0	89.6	
34	1281.30	33.3	33.1	2.09	2.67	1425	1470	32.8	.0	93.5	
35	1281.60	32.5	32.7	2.09	2.68	1584	1523	32.0	.0	90.3	
36	1281.90	32.6	32.5	2.07	2.68	1505	1429	29.4	.0	90.3	
37	1282.20	32.3	31.2	2.11	2.68	1163	983	32.2	.0	94.3	
38	1282.50	27.4	29.0	2.18	2.68	459	536	26.4	.0	89.3	
39	1282.80	28.8	27.7	2.15	2.67	338	723	14.6	.0	75.2	

BHP PETROLEUM PTY. LTD. :
AMBERJACK #1 : Analysis by
Amdel Core Services Pty. Limited

Sample No.	Depth	Porosity HeInj	Porosity RollPor	Density Nat	Density Grain	Permeability (md) KH	Permeability (md) Roll KH	Summation of Fluids Por	Summation of Fluids Oil	Summation of Fluids Water	Remarks See Below
40	1283.10	25.6	26.1	2.29	2.79	5218	2703	29.8	.0	86.9	
41	1283.40	24.4	25.7	2.30	2.72	5798	6016	16.7	.0	79.9	
42	1283.70	28.3	27.6	2.18	2.67	7469	5827	27.2	.0	95.5	
43	1284.00	29.5	29.4	2.11	2.67	3564	4699	31.2	.0	92.2	
44	1284.30	30.1	29.8	2.10	2.66	5138	4716	31.5	.0	91.4	
45	1284.60	29.5	29.8	2.13	2.66	5257	5172	28.1	.0	93.1	
46	1284.90	30.0	29.8	2.12	2.66	5038	4927	30.5	.0	92.3	
47	1285.20	29.4	30.1	2.05	2.66	4416	3987	33.2	.0	84.6	
48	1285.50	31.6	31.1	2.10	2.66	2572	3284	28.0	.0	89.3	
49	1285.80	31.8	31.5	2.08	2.66	3983	3868	33.7	.0	83.4	
50	1286.10	30.6	31.4	2.12	2.67	5484	4809	26.4	.0	93.9	
51	1286.40	32.6	31.5	2.09	2.66	4466	5133	30.9	.0	92.6	
52	1286.70	30.3	31.0	2.08	2.66	6348	5285	32.0	.0	90.5	
53	1287.00	30.8	30.5	2.11	2.66	4334	4845	32.2	.0	92.3	
54	1287.30	30.2	30.1	2.09	2.66	4621	4592	31.5	.0	90.5	
55	1287.60	29.0	29.8	2.10	2.66	4803	4497	31.9	.0	87.0	
56	1287.90	30.8	30.6	2.10	2.66	3836	4316	32.0	.0	92.0	
57	1288.20	32.0	31.2	2.07	2.66	4911	4104	32.8	.0	87.3	
58	1288.50	30.1	30.7	2.13	2.66	3065	3485	26.6	.0	88.0	
59	1288.80	30.7	30.5	2.06	2.66	3196	3152	33.1	.0	82.9	B#

VF = Vertical Fracture; HF = Horizontal Fracture; MP = Mounted Plug; SP= Short Plug
C# = Top of Core; B# = Bottom of Core; OWC = Probable Oil/Water Contact
Tr = Probable Transition Zone; GC = Probable Gas Cap



POROSITY vs PERMEABILITY
Company: BHP Petroleum Pty. Ltd.
Well : Amberjack No. 1
Ambient Y= EXP(0.1122X) * 49.86
100000
10000
1000
100
PERMEABILITY TO AIR; md
20
22
24
26
28
30
32
34
36
38
40
POROSITY; Percent

Porosity & Perm Arithmetic Average Specified Interval :5-008

Start Sample :	1	End Sample :	59
Depth :	1271.50	Depth :	1288.80

POROSITY Average : 30.6 over 59 Samples
0 Samples with a ZERO Porosity Value Ignored

Sample Type :R

PERMEABILITY Average : 3058 over 59 Samples
0 Samples with a ZERO Permeablity Value Ignored

Porosity & Perm Arithmetic Average Specified Interval :5-008

Start Sample :	1	End Sample :	29
Depth :	1271.50	Depth :	1279.80

POROSITY Average : 30.9 over 29 Samples
0 Samples with a ZERO Porosity Value Ignored

Sample Type :R

PERMEABILITY Average : 2586 over 29 Samples
0 Samples with a ZERO Permeablity Value Ignored

Porosity & Perm Arithmetic Average Specified Interval :5-008

Start Sample	:	1	End Sample	:	31
Depth	:	1271.50	Depth	:	1280.40

POROSITY Average : 30.9 over 31 Samples
0 Samples with a ZERO Porosity Value Ignored

Sample Type :R

PERMEABILITY Average : 2503 over 31 Samples
0 Samples with a ZERO Permeablity Value Ignored

Porosity & Perm Arithmetic Average Specified Interval :5-008

Start Sample	:	32	End Sample	:	59
Depth	:	1280.70	Depth	:	1288.80

POROSITY Average : 30.3 over 28 Samples
0 Samples with a ZERO Porosity Value Ignored

Sample Type :R

PERMEABILITY Average : 3673 over 28 Samples
0 Samples with a ZERO Permeablity Value Ignored

Amdel Core Services Pty. Limited
Petroleum Reservoir Engineering Data

PO Box 523 Strathpine Q 4500 Aust.
Tel : (07) 298-5272

CORE ANALYSIS FINAL REPORT

Company : BHP PETROLEUM PTY. LTD.
Well : AMBERJACK #1
Field : WILDCAT (Vic-P-25) Date : 11/05/90
Core Interval : 1271.40 - 1288.96
Core Interval :
File No. : 5-008
Country : AUSTRALIA State : VICTORIA

Sample No.	Depth	Porosity HeInj	Porosity RollPor	Density Nat	Density Grain	Permeability (md) KH	Permeability (md) Roll KH	Summation of Fluids Por	Summation of Fluids Oil	Summation of Fluids Water	Remarks See Below
1A	1271.50	31.4	31.3		2.66	672	653				SP
2A	1271.70	31.0	30.4		2.66	616	510				
3A	1272.00	28.3	30.0		2.64	266	502				
4A	1272.30	32.3	31.6		2.65	1455	1035				
5A	1272.60	33.4	33.0		2.65	2040	1969				
6A	1272.90	33.0	33.3		2.65	2482	2194				SP
7A	1273.20	33.7	32.8		2.65	1844	1571				
8A	1273.50	30.9	31.1		2.66	721	1169				SP*
9A	1273.80	29.0	30.6		2.65	1948	1435				SP*
10A	1274.10	33.4	31.9		2.66	1551	2877				SP*
11A	1274.40	31.8	31.7		2.65	14630	8604				
12A	1274.70	29.7	31.1		2.66	16511	8275				
13A	1275.00	33.4	31.4		2.66	1176	1658				SP*
14A	1275.30	29.1	30.5		2.65	331	511				
15A	1275.60	30.5	29.7		2.65	530	442				
16A	1275.90	28.9	28.9		2.65	411	356				
17A	1276.20	27.5	28.5		2.65	180	269				
18A	1276.50	30.1	29.0		2.65	395	293				
19A	1276.80	28.3	29.4		2.66	261	348				SP*
20A	1277.10	31.0	30.3		2.67	544	422				SP
21A	1277.40	30.8	30.1		2.68	411	416				SP*
22A	1277.70	27.7	29.3		2.67	326	413				
23A	1278.00	31.0	29.6		2.66	668	459				SP*
24A	1278.30	28.7	30.1		2.67	305	486				
25A	1278.60	32.0	30.5		2.68	902	649				
26A	1278.90	29.4	29.1		2.67	716	516				SP*
27A	1279.20	25.5	28.1		2.64	154	419				
28A	1279.50	31.9	30.2		2.67	1823	970				
29A	1279.80	31.3	31.7		2.66	1734	1778				SP
30A	1280.10	32.1	32.1		2.66	1823	1827				
31A	1280.40	32.7	32.2		2.66	1931	1934				
32A	1280.70	31.2	32.2		2.66	2058	2009				
33A	1281.00	33.5	32.9		2.67	1992	2050				
34A	1281.30	33.4	32.9		2.67	2161	2097				
35A	1281.60	31.3	32.1		2.68	2078	2082				
36A	1281.90	32.5	32.2		2.67	2014	1932				
37A	1282.20	32.3	31.4		2.67	1652	1147				
38A	1282.50	28.7	28.8		2.67	315	339				
39A	1282.80	25.5	26.4		2.65	81	299				

BHP PETROLEUM PTY. LTD. :
AMBERJACK #1 : Analysis by
Amdel Core Services Pty. Limited

Sample No.	Depth	Porosity HeInj	Porosity RollPor	Density Nat	Density Grain	Permeability (md) KH	Permeability (md) Roll KH	Summation of Fluids Por	Summation of Fluids Oil	Summation of Fluids Water	Remarks See Below
40A	1283.10	25.7	24.8		2.77	3877	1500				
41A	1283.40	22.1	24.2		2.70	4168	3900				
42A	1283.70	26.8	26.4		2.66	3435	3539				
43A	1284.00	30.0	29.1		2.65	3191	3526				
44A	1284.30	29.5	29.6		2.65	4420	4074				
45A	1284.60	29.2	29.6		2.65	4420	4156				
46A	1284.90	30.4	30.3		2.65	3455	3584				
47A	1285.20	31.0	30.7		2.65	3128	3574				
48A	1285.50	30.3	30.6		2.65	4826	4356				
49A	1285.80	30.6	31.0		2.66	4943	4459				
50A	1286.10	32.2	31.7		2.66	3351	3738				
51A	1286.40	31.8	31.7		2.66	3517	3519				
52A	1286.70	30.9	31.3		2.66	3699	3744				
53A	1287.00	31.7	31.3		2.66	4086	4064				
54A	1287.30	30.6	30.2		2.65	4420	4300				
55A	1287.60	27.9	29.1		2.66	4282	4109				
56A	1287.90	29.9	29.8		2.65	3517	3481				
57A	1288.20	31.4	30.6		2.65	2772	2879				
58A	1288.50	29.6	30.3		2.65	2541	2570				
59A	1288.80	30.6	30.2		2.65	2437	2471				

VF = Vertical Fracture; HF = Horizontal Fracture; MP = Mounted Plug; SP= Short Plug
C# = Top of Core; B# = Bottom of Core; OWC = Probable Oil/Water Contact
Tr = Probable Transition Zone; GC = Probable Gas Cap

Porosity & Perm Arithmetic Average Specified Interval :5-008

Start Sample	:	1	End Sample	:	59
Depth	:	1271.50	Depth	:	1288.80

POROSITY Average : 30.3 over 59 Samples
0 Samples with a ZERO Porosity Value Ignored

Sample Type :A

PERMEABILITY Average : 2477 over 59 Samples
0 Samples with a ZERO Permeablity Value Ignored

Porosity & Perm Arithmetic Average Specified Interval :5-008

Start Sample	:	1	End Sample	:	29
Depth	:	1271.50	Depth	:	1279.80

POROSITY Average : 30.5 over 29 Samples
0 Samples with a ZERO Porosity Value Ignored

Sample Type :A

PERMEABILITY Average : 1917 over 29 Samples
0 Samples with a ZERO Permeablity Value Ignored

Porosity & Perm Arithmetic Average Specified Interval :5-008

Start Sample	:	1	End Sample	:	31
Depth	:	1271.50	Depth	:	1280.40

POROSITY Average : 30.6 over 31 Samples

0 Samples with a ZERO Porosity Value Ignored

Sample Type :A

PERMEABILITY Average : 1914 over 31 Samples

0 Samples with a ZERO Permeablity Value Ignored

Porosity & Perm Arithmetic Average Specified Interval :5-008

Start Sample	:	32	End Sample	:	59
Depth	:	1280.70	Depth	:	1288.80

POROSITY Average : 30.0 over 28 Samples

0 Samples with a ZERO Porosity Value Ignored

Sample Type :A

PERMEABILITY Average : 3101 over 28 Samples

0 Samples with a ZERO Permeablity Value Ignored

Amdel Core Services Pty. Limited
Petroleum Reservoir Engineering Data

PO Box 523 Strathpine Q 4500 Aust.
Tel : (07) 298-5272

CORE ANALYSIS FINAL REPORT

Company : BHP PETROLEUM PTY. LTD.
Well : AMBERJACK #1
Field : WILDCAT (Vic-P-25) Date : 11/05/90
Core Interval : 1271.40 - 1288.96
Core Interval :
File No. : 5-008
Country : AUSTRALIA State : VICTORIA

Sample No.	Depth	Porosity HeInj	Porosity RollPor	Density Nat	Density Grain	Permeability (md) KH	Permeability (md) Roll KH	Summation of Fluids Por	Summation of Fluids Oil	Summation of Fluids Water	Remarks See Below
V Samples											
1	2171.90					142					
2	1273.70					806					
3	1275.20					554					
4	1277.30					171					
5	1279.20					90					
6	1281.00					1036					
7	1282.80					34					
8	1284.90					3795					
9	1286.70					2762					
10	1288.50					2202					

VF = Vertical Fracture; HF = Horizontal Fracture; MP = Mounted Plug; SP= Short Plug
C# = Top of Core; B# = Bottom of Core; OWC = Probable Oil/Water Contact
Tr = Probable Transition Zone; GC = Probable Gas Cap

Porosity & Perm Arithmetic Average Specified Interval :5-008				
Start Sample :	1	End Sample :	10	
Depth :	2171.90	Depth :	1288.50	

POROSITY Average : .0 over 0 Samples
10 Samples with a ZERO Porosity Value Ignored

Sample Type :V

PERMEABILITY Average : 1159 over 10 Samples
0 Samples with a ZERO Permeablity Value Ignored

Amdel Core Services Pty. Limited
Petroleum Reservoir Engineering Data

PO Box 523 Strathpine Q 4500 Aust.
Tel : (07) 298-5272

OVERBURDEN ANALYSIS FINAL REPORT

Company : BHP PETROLEUM PTY. LTD.
Well : AMBERJACK #1
Field : WILDCAT (Vic-P-25) Date : 11/05/90
Core Interval : 1271.40 - 1288.96
Core Interval :
File No. : 5-008
Country : AUSTRALIA State : VICTORIA

SAMPLE NUMBER	DEPTH	POROSITY at OVERBURDEN Pressures Ambient	psi 1900	psi 2400	psi 2900	psi 0	psi 0	Porosity Rolling Average 2400	PERMEABILITY at OVERBURDEN Pressures Ambient 200 psi	psi 1900	psi 2400	psi 2900	psi 0	psi 0	PERMEAB Rolling Average 2400
1	1271.50	32.2	29.5	29.1	28.8			28.5	784	579	545	514			440.3
3	1272.00	29.8	27.5	27.3	27.2			28.7	407	306	287	274			486.6
5	1272.60	33.4	31.3	31.1	30.8			28.4	1760	1281	1248	1137			800.1
7	1273.20	33.5	24.1	24.0	23.9			27.3	1552	960	918	884			930.0
10	1274.10	33.7	30.3	30.1	29.9			28.0	1216	822	712	629			1649.4
12	1274.70	29.8	27.7	27.6	27.5			28.7	23419	16107	15911	15213			3105.0
14	1275.30	31.4	29.6	29.4	29.2			27.9	792	539	516	499			896.3
16	1275.90	28.3	25.4	25.1	25.0			26.6	245	163	153	145			221.9
18	1276.50	29.7	27.0	26.8	26.5			26.5	310	222	202	188			204.1
20	1277.10	30.0	27.7	27.5	27.2			26.5	357	321	278	254			205.7
22	1277.70	26.9	24.6	24.4	24.3			25.6	175	120	114	112			149.5
24	1278.30	28.3	26.1	25.9	25.8			26.1	225	154	137	124			179.2
25	1278.60	31.1	28.1	28.0	27.8			26.6	603	517	482	459			259.7
27	1279.20	27.6	24.5	24.4	24.2			26.7	192	151	143	137			332.6
29	1279.80	32.9	30.4	30.3	30.1			28.6	2022	1331	1237	1139			615.7
31	1280.40	32.0	29.7	29.5	29.4			30.0	1202	709	655	652			817.6
33	1281.00	33.5	30.9	30.7	30.5			30.2	1454	920	841	762			818.9
35	1281.60	32.5	30.0	29.9	29.7			30.1	1584	1114	971	881			908.5
37	1282.20	32.3	29.9	29.8	29.7			28.9	1163	919	860	821			660.0
39	1282.80	28.8	26.3	26.1	25.9			26.3	338	277	264	257			739.3
41	1283.40	24.4	23.2	23.1	23.0			25.0	5798	5163	4973	4776			2088.7
43	1284.00	29.5	27.9	27.8	27.7			26.6	3564	3127	2911	2747			3668.5
45	1284.60	29.5	28.4	27.9	27.8			27.7	5257	5183	4298	3780			3685.6
47	1285.20	29.4	27.5	27.4	27.2			28.1	4416	3874	3432	3092			3458.3
49	1285.80	31.8	30.0	29.9	29.8			29.4	3983	3290	2826	2412			3029.6
51	1286.40	32.6	30.5	30.4	30.3			29.9	4466	3397	3074	2869			2920.8
53	1287.00	30.8	29.0	28.8	28.7			28.8	4334	3130	2726	2415			2906.2
55	1287.60	29.0	27.3	27.2	27.1			28.2	4803	3571	3123	2937			2962.0
57	1288.20	32.0	29.8	29.7	29.5			28.7	4911	3285	2895	2588			2887.8
59	1288.80	30.7	28.5	28.4	28.2			28.8	3196	2756	2657	2511			2734.4

APPENDIX 2

Appendix 2

PALYNOLOGICAL ANALYSIS, AMBERJACK-1

GIPPSLAND BASIN

by

M.K. MACPHAIL

Palaeontological report prepared 14 September 1990
BHP Petroleum Pty. Ltd.

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

INTRODUCTION

SUMMARY OF RESULTS

GEOLOGICAL COMMENTS

PALAEOENVIRONMENTS

BIOSTRATIGRAPHY

INTERPRETATIVE DATA

BASIC DATA

SPECIES CHECK LIST

INTRODUCTION

Twenty eight sidewall core and two cuttings samples, representing the interval 1010.0 to 1700m in Amberjack-1 were processed and examined for spore-pollen and dinoflagellates.

With the exception of SWCs between 1495 and 1632m, yields and preservation were medium to high and most samples yielded diagnostic species. It is noted that spore-pollen does not allow the carbonates overlying 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
?Mid-Late Miocene	GIPPSLAND LIMESTONE	T. bellus?	1010.0	open marine
Late Oligocene -Early Miocene	"	P. tuberculatus	1031.0-1210.4	"
"	LAKES ENTRANCE FORMATION	P. tuberculatus	1215.2-1248.1	"
Early Oligocene	unnamed shale	P. tuberculatus	1255.0	open marine
Late Eocene	LATROBE GROUP	Middle N. asperus	1279.9-1333.0	marginal marine
Middle Eocene	"	Lower N. asperus	1351.0-1360.1	"
"	"	Lower N. asperus	1441.0	coastal plain
Early Eocene	"	P. asperopolus	1495.5-1519.0	"
"	"	Lower M. diversus	1633.0	"
Paleocene	"	Upper L. balmei	1697-1700	"

GEOLOGICAL COMMENTS

1. It is unclear whether Amberjack-1 contains a continuous sequence of zones from the Paleocene Upper L. balmei Zone to the late Early Miocene T. bellus Zone or - the preferred option - whether sediment accumulation at the wellsite has been characterized by long periods of erosion or slow or non-deposition during the Early Eocene and ?Early Oligocene.

2. This uncertainty is due (i) to the possibility of bioturbation and reworking across Top of Latrobe, blurring the distinction between the Middle and Upper N. asperus Zone and Upper N. asperus and P. tuberculatus Zone palynofloras, and (ii) the unsuitable nature of many Early Eocene facies for preserving palynomorphs.

3. The occurrence at 1255.0m of a [calcareous?] claystone at the base of the P. tuberculatus Zone strongly suggests that Amberjack-1 has penetrated the equivalent of the latest Eocene-Early Oligocene shale unit overlying non-calcareous siltstones in Perch-2 and adjacent wells such as Bullnose-1.

   The presence or not of a greensand between 1279.9-1325.0m may be helpful in determining if the silty sandstone sampled at 1279.9m is related genetically to the above unit, i.e. Upper N. asperus Zone, or to the underlying Middle N. asperus Zone claystone interval.

4. The sporadic occurrences of diverse spore-pollen between 1441.0-1633.0m confirm the existence of P. asperopolus [plus Upper M. diversus?] and Lower M. diversus Zone units but as yet no Middle M. diversus Zone unit has been substantiated in this sector of the basin. Thicknesses in Amberjack-1 [maximum 192m] are consistent with thinning of Early Eocene sediments as these onlap the margin of the basin [cf Palmer-1].

5. Amberjack-1 almost certainly terminated within (Upper) L. balmei Zone sediments, consistent with palynological data for Palmer-1.

PALAEOENVIRONMENTS

1. With the possible exception of cuttings at 1697m, all Paleocene and Early Eocene samples represent a coastal plain environment.

2.. Marginal marine conditions were established at the wellsite within the Middle Eocene Lower N. asperus Zone given the absence of dinocysts at 1441.0m and their abundance some 80m upsection at 1360.1m. The latter may be a correlative of the A. diktyoplokus marine transgression of Partridge (1976).

   Similar conditions were maintained throughout the Late Eocene, with open marine conditions being present at the wellsite by Late Oligocene, P. tuberculatus Zone times.

BIOSTRATIGRAPHY

Zone and age-determinations have been made using criteria proposed by Stover & Partridge (1973), Helby et al. (1987) and unpublished observations made 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

Upper Lygistepollenites balmei Zone 1697-1700m   Paleocene

Palynofloras in this interval are characterized by frequent Lygistepollenites balmei and multiple specimens of other species which also range no higher than this zone, e.g. Gambierina rudata, Latrobosporites amplus and [1700m] Camarozonosporites bullatus. Cupanieidites orthoteichus is frequent in the SWC at 1698.0m and present in cuttings at 1697m, picked as the top of the zone.

All palynofloras included Oligo-Miocene dinoflagellates and [1697m] the Paleocene species Glaphyracysta retiintexta. It is unclear whether this species is in situ and therefore evidence for a marine influence.

Lower Malvacipollis diversus 1633.0m   Early Eocene

One sample is provisionally assigned to this zone, based on Crassiretitriletes vanraadshoovenii, frequent occurrences of Polypodiaceoisporites varus and frequent-common specimens of Malvacipollis diversus. A few specimens of Lygistepollenites balmei in this palynoflora are assumed to be contaminants. Dinoflagellates are absent.

Sidewall cores between 1542.5-1589.0m yielded sparse palynofloras in which the majority of spore-pollen and all dinoflagellates appear to be caved. Isolated occurrences of Proteacidites pachypolus at 1542.5m, Conbaculites apiculatus at 1566.4m and 1589.0m and frequent Malvacipollis diversus at 1575.0m are consistent with an Early Eocene date, probably no older than Upper M. diversus Zone.

Proteacidites asperopolus 1495.5-1519.0m Early Eocene

The association of Proteacidites asperopolus and frequent P. pachypolus with Myrtaceidites tenuis and Intratriporopollenites notabilis provide a very confident P. asperopolus Zone date for the SWC sample at 1519.0m.

The SWC at 1495.5m is no younger than P. asperopolus Zone, based on a single specimen of M. tenuis in a very sparse and mud-contaminated palynoflora.

Lower Nothofagidites asperus Zone 1351.0-1441.0m

The three palynofloras within this interval are characterized by common-abundant Nothofagidites emarcidus-heterus and Proteacidites spp.

The sample picked as the base of the zone [1441.0m] is confidently dated as Lower N. asperus Zone, based on the simultaneous occurrence of the zone index species Proteacidites asperopolus and Tricolpites simatus. However unusually for this zone, Beaupreadites verrucosus, Malvacipollis spp. and Myrtaceidites parvus-mesonesus also are frequent.

Both the above index species occur at 1360.1m but at this level the assemblage also includes a number of typically Eocene dinoflagellates, e.g. Areosphaeridium capricornum, as well as an undescribed Alisocysta and long-ranging species of Spiniferites and Operculodinium.

The upper boundary is placed provisionally at 1351.0m, a sample which is no older than Lower N. asperus Zone or younger than Middle N. asperus Zone based on specimens of Rugulatisporites trophus and Proteacidites pachypolus respectively. As at 1360.1m, the palynoflora includes low numbers of undiagnostic marine dinoflagellates.

Middle Nothofagidites asperus Zone 1279.9-1333.0m Late Eocene

Palynofloras in this interval are wholly dominated by Nothofagidites spp. All include low to moderate numbers of marine dinocysts, chiefly Gippslandica extensa.

The lower boundary is defined by the first occurrence of Anacolosidites sectus at 1333.0m. Proteacidites pachypolus indicates the sample is no younger than Middle N. asperus Zone. The zone index species, Triorites magnificus, occurs at 1325.0m.

The palynoflora at 1279.9m is similar in terms of species composition and is certainly no older than upper Middle N. asperus Zone based on Aglaoreidia qualumis. However, given the absence of definite zone index species, an Upper N. asperus Zone date remains possible **if** the single specimen of Proteacidites pachypolus is reworked. It is noted that occurrences of P. recavus and the dinoflagellate Gippslandica extensa are more consistent with a Late Eocene rather than an Oligocene date but all species are known to range above the Middle N. asperus Zone outside of the Gippsland Basin.

Proteacidites tuberculatus Zone 1031.0-1255.0m Oligocene-Early Miocene

Palynofloras within this interval are wholly dominated by marine dinoflagellates, in particular Lingulodinium machaerophorum, Operculodinium centrocarpum, Spiniferites and Steptodinium spp. Spore-pollen numbers are variable and Nothofagidites emarcidus-heterus consistently dominates what is recovered.

The lower boundary is defined by the first appearance of Cyatheacidites annulatus at 1255.0m. This palynoflora includes an undescribed Deflandrea sp. [related to D. leptodermata] and a Psilodiporites sp. which is ancestral to modern Alyxia [Apocynaceae: see Macphail & Truswell, 1989]. Acaciapollenites myriosporites first appears at 1226.6m, Foveotriletes lacunosus at 1218.8m, and F. crater associated with Chenopodipollis chenopodiaceoides and Tubulifloridites antipoda at 1138.8m.

A number of unusual faunal microfossils are preserved in the interval: e.g. trochospiral liners of foraminifera, fish teeth and - possibly a first record in Australia - fragmented and whole nematocyts [stinging cells] of a unidentified Cnidarian. *

The upper boundary is placed at 1031.0m, based on the occurrence of Cyatheacidites annulatus and Chenopodipollis chenopodiaceoides in an assemblage lacking index species of the T. bellus Zone. Alyxia and Tricolpites reticulatus are present in this palynoflora and also at 1050.0m

Triporopollenites bellus Zone? 1010.0m late Early Miocene?

The palynoflora at 1010.0m may be T. bellus Zone, based on a badly corroded, **possible** specimen of the nominate species and an undescribed dinocyst [Protoellipsodinium cf simplex] which typically occurs only above the P. tuberculatus Zone. The sample definitely is no older than P. tuberculatus Zone or younger than T. bellus Zone.

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TABLE 1: SUMMARY OF INTERPRETATIVE PALYNOLOGICAL DATA

SWC	DEPTH (m)	ZONE S-P	ZONE DINO	CONF. RTG.	COMMENT
60	1010.0	T. bell.	-	2	No older than P. tub.
59	1031.0	P. tub.	-	1	C. annulatus
58	1050.0	P. tub.	-	1	C. annulatus
57	1095.9	P. tub.	-	1	C. chenopodiac.
56	1111.5	P. tub.	-	1	F. crater
55	1138.8	P. tub.	-	1	T. antipoda
54	1160.0	P. tub.	-	1	F. lacunosus
53	1210.4	P. tub.	-	0	Reworked P. pachypolus
51	1215.2	P. tub.	-	1	D. mammilatus
50	1218.8	P. tub.	-	0	C. annulatus
49	1226.6	P. tub.	-	1	A. myriosporites
48	1236.0	P. tub.	-	2	P. demarcatus
47	1248.1	P. tub.	-	2	I. anguloclavat.
46	1255.0	P. tub.	-	0	C. annulatus
33	1279.9	M. N.a.	G. extensa	2	P. pachypolus
29	1325.0	M. N.a.	G. extensa	0	T. magnificus
28	1333.0	M. N.a.	G. extensa	0	A. sectus
26	1351.0	L. N.a.	-	2	N. falcatus
23	1360.1	L. N.a.	A. dicty.?	0	P. asperopolus
19	1441.0	L. N.a.	-	0	P. asperopolus
12	1495.5	P. asp.	-	2	M. tenuis
11	1519.0	P. asp.	-	0	P. asperopolus
10	1542.5	No older than Upper M. div.			P. asperopolus
09	1566.4	Indet.	-	-	C. apiculatus
08	1575.0	Indet.	-	-	Mud contaminants only
07	1589.0	Indet.	-	-	C. apiculatus
06	1633.0	L. M.d.	-	1	C. vanraadshoov.
ctg	1697	U.L.b.	-	3	C. orthoteichus
03	1698.0	U. L.b.	-	1	L. balmei freq.
ctg	1700	U. L.b.	-	3	C. bullatus

TABLE 2: SUMMARY OF BASIC PALYNOLOGICAL DATA

SWC	DEPTH (m)	YIELD S-P	.	YIELD DINO	DIVERSITY S-P	. DIVERSITY DINO	PRES.	LITH.*
60	1010.0	low		high	med.	med.	poor	marl
59	1031.0	med.	v.	high	med.	med.	mod.	marl
58	1050.0	med.		high	med.	high	good	marl
57	1095.9	low		low	low	med.	mod.	marl
56	1111.5	med.		high	med.	med.	poor	marl
55	1138.8	med.		high	med.	med.	mod.	marl
54	1160.0	low	v.	high	low	high	mod.	marl
53	1210.4	med.		high	med.	high	good	marl
51	1215.2	low		low	low	low	mod.	marl
50	1218.8	med.		high	med.	low	mod.	marl
49	1226.6	low		med.	low	low	mod.	marl
48	1236.0	low		med.	low	low	mod.	marl
47	1248.1	low		low	low	low	mod.	marl
46	1255.0	med.	v.	high	med.	high	mod.	clst.
33	1279.9	med.		low	high	low	good	Slty sst
29	1325.0	high		low	med.	low	poor	clst.
28	1333.0	high		low	med.	low	good	slst.
26	1351.0	med.		low	med.	low	mod.	slst.
23	1360.1	high		low	high	low	mod.	clst.
19	1441.0	high		-	med.	-	mod.	slst.
12	1495.5	low		caved	low	low	mod.	clst.
11	1519.0	low		-	high	-	good	clst.
10	1542.5	low		caved	low	low	mod.	slst.
09	1566.4	low		caved	low	low	mod.	clst.
08	1575.0	low		-	low	-	mod.	clst.
07	1589.0	low		-	low	-	mod.	clst.
06	1633.0	high		-	med.	-	good	clst.
ctg	1697	med.		caved	med.	low	poor	clst.
03	1698.0	low		-	high	-	poor	Slst.
ctg	1700	med.		caved	med.	low	poor	clst.

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

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

SAMPLE TYPE OR NO. *	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
FOSSIL NAMES / DEPTHS (m)	1010.0	1031.0	1050.0	1095.9	1111.5	1138.8	1160.0	1210.4	1215.2	1218.8	1226.6	1236.0	1248.1	1255.0	1279.9	1325.0	1333.0	1351.0	1360.1	1441.0	1495.5	1519.0	1542.5	1566.4	1575.0	1589.0
Acaciapollenites myriosporites											•															
Aglaoreidia qualumis															•											
Anacolosidites sectus																	•									
Araucariacites australis	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•						
Australopollis obscurus																										
Baculatisporites disconformis																		•	•	•			•			
Banksieaeidites arcuatus																•	•		•							
B. elongatus	•		•		•					•									•							
Basopollis otwayensis															•											
Beaupreaidites elegansiformis														•												
B. trigonalis										•	•						•									
B. verrucosus														•		•	•	•	•	•						
Camarozonosporites bullatus																										
C. heskermensis					•										•											
Chenopodipollis chenopodiaceoides		•		•		•																				
Clavifera triplex																										
Conbaculites apiculatus																								•		•
Concolpites leptos																				•						
Corollinia spp. R								•																		
Crassiretitriletes vanraadshooveni																										
Cupaneidites orthoteichus	•						•								•	•	•	•	•	•		•			•	
Cyatheacidites annulatus	•	•	•		•			•		•				•												
Cyathidites australis		•	•	•	•			•				•	•			•				•						
C. minor	•		•												•		•	•				•				
C. palaeospora	•	•	•		•	•		•	•	•					•											
C. splendens	•			•		•	•	•				•			•										•	
C. subtilis									•																	
Dacrycarpites australiensis							•					•			•					•						
Dicotetradites meridianus																		•				•				
Dictyophyllidites arcuatus		•				•	•	•																		
Dilwynites granulatus		•			•	•		•	•	•				•				•						•		
D. tuberculatus		•													•					•						
Diporites delicatus																						•				
Dodonaea triquetra-type																										
Elphedripites notensis																						•				
Ericipites scabratus			•			•	•				•					•	•	•	•	•			•			
Foveotriletes balteus																			•							
F. crater		•	•		•	•																				
F. lacunosus	•		•		•		•	•	•	•																
Gambierina edwardsii																										
G. rudata																										
Gleicheniidites spp.	•	•			•	•		•				•	•	•	•				•	•	•		•	•	•	•
Gothanipollis bassensis																	•		•	•						
Gramminidites media										•																
Gyropollis psilatus																		•								
Haloragacidites cainozoica	•	•	•			•	•								•											
H. harrisii	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•
Herkosporites elliotii			•				•				•			•	•											
Ilexpollenites anguloclavatus							•			•			•	•	•	•	•	•	•				•			
Integricorpus antipoda																										
Intratriporopollenites notabilis																						•				
Ischyosporites gremius	•				•	•		•	•	•	•					•						•				
I. irregularis								•																		
Kuylisporites waterbolkii		•	•		•	•																•				
Laevigatosporites spp.	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•		•	

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

R - REWORKED SP.
C - CONTAMINANT

Well Name BMR AMBERJACK-1 Basin GIPPSLAND Sheet No. 2 of 5

FOSSIL NAMES / DEPTHS (m)	1010.0	1031.0	1050.0	1095.9	1111.5	1138.8	1160.0	1210.4	1215.2	1218.8	1226.6	1236.0	1248.1	1255.0	1279.9	1325.0	1333.0	1351.0	1360.1	1441.0	1495.5	1519.0	1542.5	1566.4	1575.0	1589.0
SAMPLE TYPE OR NO. *	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Latrobosporites amplus																										
L. crassus					•									•					•							
L. marginis						•																				
Liliacidites lanceolatus															•											
L. spp.																			•							
Lygistepollenites balmei						R		R				R							R		R			R		R
L. florinii	•	•	•	•	•	•	•	•	•		•		•	•	•	•	•		•				•	•		•
Malvacipollis diversus							•					•										•		•	•	
M. robustus			•			•						•				•	•	•	•							
M. subtilis			•			•		•	•							•	•	•	•	•	•	•	•		•	•
Matonisporites ornamentalis		•	•		•		•	•					•									•				
Microalatidites palaeogenicus		•			•		•		•	•					•	•	•			•						
Microcachrydites antarcticus	•						•	•							•		•			•						
Monogemmites gemmatus																	•		•							
Monolites alveolatus						•																				
Myrtaceidites eucalyptoides		•	•				•		•						•											
M. parvus-mesonesus	•	•	•			•	•					•		•	•		•		•	•			•			
M. tenuis		R													R						•	•				
M. verrucosus		•													•				•							
Nothofagidites asperus		•	•		•	•	•	•							•	•	•	•		•						
N. brachyspinulosus				•		•		•	•		•		•		•	•	•	•	•	•	•	•				
N. deminutus-vansteenii	•	•	•	•	•	•	•	•			•			•	•	•	•	•	•	•						•
N. emarcidus-heterus	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
N. endurus																										
N. falcatus					•	•	•	•		•	•		•		•	•	•	•	•							
N. flemingii					•	•		•	•	•					•	•	•	•	•	•		•	•	•		
N. goniatus															•	•	•			•		•				
Nupharipollis						•																				
Peninsulapollis gillii																			•							
Periporopollenites demarcatus												•		•	•	•	•	•	•			•				
P. polyoratus																										
P. vesicus														•	•		•		•							
Peromonolites vellosus		•	•							•																
Phyllocladidites mawsonii	•	•	•		•	•		•	•	•		•	•	•	•	•	•	•	•	•	•	•	•		•	•
P. reticulosaccatus																										R
Pilosisporites parvisaccatus R																										
Podocarpidites exiguus								•																		
P. spp.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•		•
Podosporites microsaccatus						•		•				•	•				•									•
Polycolpites langstonii																										
P. reticulatus															•											
Polycolporopollenites esobalteus													•				•		•	•		•				
Polypodiaceoisporites varus																										
Polypodiisporites histeopteroides															•											
P. spp.	•	•		•				•		•				•	•	•										
Proteacidites adenanthoides																•	•	•	•							
P. annularis		•	•		•	•		•	•	•	•		•	•	•		•	•								
P. asperopolus																			•	•		•				
P. callosus	•																		•							
P. crassus						•										•	•	•	•							
P. differentipollis																						•	•			
P. kopiensis							•												•			•				
P. latrobensis																		•	•	•						
P. obscurus																•	•	•	•							
P. pachypolus		R					R	R	R						•	•	•	•	•	•		•	•			
P. rectus																										

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

R = REWORKED SP.
C = CONTAMINANT

Well Name BMR AMBERJACK-1 Basin GIPPSLAND Sheet No. 3 of 5

SAMPLE TYPE OR NO. *	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
FOSSIL NAMES / DEPTHS (m)	1010.0	1031.0	1050.0	1095.9	1111.5	1138.8	1160.0	1210.4	1215.2	1218.8	1226.6	1236.0	1248.1	1255.0	1279.9	1325.0	1333.0	1351.0	1360.1	1441.0	1495.5	1519.0	1542.5	1566.4	1575.0	1589.0
Proteacidites recavus															•	•			•							
P. rectomarginis					•		•																			
P. reticuloscabratus																		•	•					•		
P. rugulatus																										
P. tenuiexinus																				•						
P. truncatus														•												
P. tuberculatus			•		•																					
P. spp.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•			•
Pseudowinterapollis calathus								•																		
P. cranwellae		•													•		•									
Psilodiporites sp. [Alyxia]		•	•											•												
Quintiapollis psilatispora															•											
Retitriletes australoclavatidites									•																	
R. spp.		•						•							•											
Rhoipites sphaerica		•	•		•										•		•	•	•	•		•				
Rugulatisporites cowrensis																						C				
R. mallatus			•										•		•							•				
R. trophus																		•								
Rubipollis oblatus																										
Santaluminidites cainozoicus													•				•	•	•			•				
Sapotaceoidaepollenites rotundus		•				•		•					•	•	•				•							
Simpsonipollis sp.						•																				
Stereisporites australis f. crassa			•		•					•		•														
S. (Tripunctisporis) sp.																		•	•	•		•				
S. spp.		•	•		•	•	•	•	•		•		•	•	•			•	•	•					•	
Tetracolporites multistrixus																						•				
T. verrucosus																										
Tricolpites phillipsii																	•	•								
T. reticulatus		•	•			•								•								•				
T. simatus															•		•	•	•	•						
Tricolporites adelaidensis								•						•	•	•		•	•							
T. angurium									•						•											
T. halis						•																				
T. leuros																•		•								
T. sp. cf T. leuros	•		•	•	•			•						•												
T. paenestriatus						•									•				•		•	•				
T. scabratus	•	•																•	•			•				
Indet. tricolpate/tricolporates	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•
Indet. trilete spores	•		•	•	•		•	•		•	•	•	•	•	•	•		•	•	•		•	•		•	
Triletes tuberculiformis						•							•	•	•	•			•			•				
Triporopollenites ambiguus															•				•							
T. heleosus																			•							
T. spinosus															•											
Tubulifloridites antipoda						•																				
Verrucosisporites cristatus			•			•																				
V. kopukuensis	•		•		•										•			•	•	•		•				
Anacolosidites acutullus																						•				
Cupanieidites reticularis																						•				
Milfordia homeopunctatus												•														
M. hypolaenoides										•																
Nothofagidites longispina										•																
Proteacidites grandis																						•				
P. stipplatus																				•						
Schizocolpus marlinensis																						•				
Triorites magnificus																•										

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

R - REWORKED SP.
C - CONTAMINANT

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

SAMPLE TYPE OR NO. *	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
FOSSIL NAMES / DEPTHS (m)	1010.0	1031.0	1050.0	1095.9	1111.5	1138.8	1160.0	1210.4	1215.2	1218.8	1226.6	1236.0	1248.1	1255.0	1279.9	1325.0	1333.0	1351.0	1360.1	1441.0	1495.5	1519.0	1542.5	1566.4	1575.0	1589.0
DINOFLAGELLATES																										
Alisocysta sp.												•							•							
Areosphaeridium cf capricornum																			•		C					
Cleistosphaeridium epacrum								•					•	•		•		•								
Glaphyracysta sp. [Neogene]	•						•	•		•				•												
Hystrichokolpoma rigaude					•		•	•					•	•												
Schematophora speciosa						•							•													
Deflandrea sp. cf D. leptodermata														•												
Gippslandica extensa s.s.							R								•	•	•									
G. extensa (bald)																•	•									
"G." macmurdoensis																•										
Lejeunacysta																										
Achomosphaera alcicornu				•	•	•	•		•									•								
Impagidinium spp.		•	•	•	•		•	•	•	•	•	•		•							C					
Lingulodinium machaerophorum	•	•	•	•	•			•	•	•	•		•	•										C		
Nematosphaeropsis balcombiana-labrynthius	•	•	•	•		•		•	•	•		•	•	•										C		
Operculodinium centrocarpum	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•			C		C		
Pentadinium laticinctum			•	•	•		•																			
Protoellipsodinium clatatum		•	•	•	•																					
P. mammilatus							•	•	•	•	•			•												
P. simplex		•	•	•	•	•	•																			
Pyxidinopsis pontus	•	•	•	•	•	•	•					•		•												
Rottnestia borussica			•				•																			
Spiniferites spp.	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•			•				C			C
Tectatodinium pellitum			•										•													
Thalassiphora flammea/peligica									•					•												
Polysphaeridium zoharyii	•		•	•			•		•																	
Dapsilodinium pseudocolligerum												•														
Crassosphaera concinna						•																				
Cyclopsiella vieta s.l.		•			•				•																	
Holoroginella spinata																										
Tritonites sp. cf H. spinata														•												
MICROFAUNA																										
fish teeth		•	•		•		•	•																		
netatocysts [Cnidaria]				•	•							•		•												
trochospiral liners [Foraminifera]	•			•									•				•									

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C - CONTAMINANT

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

SAMPLE TYPE OR NO. *	S	T	S	T
FOSSIL NAMES / DEPTHS (m)	1633.0	1697	1698.0	1700
Araucariacites australis	•	•		•
Australopollis obscurus		•	•	•
Clavifera triplex	•			
Crassiretitriletes vanraadshoovenii	•			
Cupaneidites orthoteichus	•	•	•	•
Cyathidites splendens	•	•	•	•
Dicotetradites meridianus				•
Ericipites scabratus		•		
Gambierina edwardsii		•		
G. rudata		•	•	•
Gleicheniidites spp.	•	•	•	•
Haloragacidites harrisii	•	•		•
Integricorpus antipoda		•		
Laevigatosporites spp.	•	•	•	•
Latrobosporites amplus			•	
Lygistepollenites balmei	R	•	•	•
L. florinii		•	•	•
Malvacipollis diversus	•	•		
M. subtilis	•	•		•
Microalatidites palaeogenicus		•		
Microcachrydites antarcticus				•
Nothofagidites asperus		•		
N. endurus		•	•	•
N. flemingii		•	•	•
Periporopollenites polyoratus		•		
Peromonolites densus				•
Phyllocladidites mawsonii		•	•	•
P. reticulosaccatus		•	•	•
Podocarpidites spp.		•	•	
Podosporites microsaccatus		•	•	
Polypodiaceoisporites varus	•			
Proteacidites annularis				•
P. pachypolus				C
P. rectus			•	•
P. spp.	•	•	•	•
Rugulatisporites mallatus	•	•		
Stereisporites antiquisporites			•	
S. (Tripunctisporis) sp.	•		•	
S. spp.		•		
Tetracolporites multistrixus		•	•	•
T. verrucosus		•		
Tricolpites phillipsii			•	•
T. simatus				C
Tricolporites marginatus		•		
undescribed tricolpate/tricolporates	•	•	•	•
undescribed trilete spores	•	•	•	•
Verrucosisporites kopukuensis				
Camarozonosporites bullatus				•
Glaphyracysta retiintextum [in situ?]		•		
Caved Lakes Entrance Fm. dinoflagellates		•	•	•

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C - CONTAMINANT

PALYNOLOGY DATA SHEET

BASIN: GIPPSLAND | ELEVATION: KB: ______ GL: ______

WELL NAME: AMBERJACK-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	1010.0	2				1010.0	2			
	P. tuberculatus	1031.0	1				1255.0	1			
PALEOGENE	Upper *N. asperus*										
	Mid *N. asperus*	1279.9	2	1325.0	0		1333.0	0			
	Lower *N. asperus*	1351.0	2	1360.1	0		1441.0	0			
	P. asperopolus	1495.5	2	1519.0	0		1519.0	0			
	Upper *M. diversus*										
	Mid *M. diversus*										
	Lower *M. diversus*	1633.0	1				1633.0	1			
	Upper *L. balmei*	1697	3	1698.0	1		1700	3	1698.0	1	
	Lower *L. balmei*										
LATE CRETACEOUS	Upper T. longus										
	Lower T. longus										
	T. lilliei										
	N. senectus										
	T. apoxyexinus										
	P. mawsonii										
	A. distocarinatus										
EARLY CRET.	*C. paradoxus*										
	C. striatus										
	F. asymmetricus										
	F. wonthaggiensis										
	C. australiensis										
PRE-CRETACEOUS											

COMMENTS: Gippslandica (Deflandrea) extensa Zone 1279.9-1333.0m

The SWC sample at 1542.5m is no older than Upper M. diversus Zone

CONFIDENCE RATING:

- 0: 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: 18 September 1990

DATA REVISED BY: ______ DATE: ______

APPENDIX 3

Appendix 3

BHP PETROLEUM PTY LTD

LOG INTERPRETATION REPORT

AMBERJACK-1
OFFSHORE GIPPSLAND BASIN
VIC/P25

ANALYST:

A. Cernovskis
Petroleum Geologist

CONTENTS

1 SUMMARY

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

The well spudded on 4th May 1990 and reached a total depth of 1750m KB (driller's depth) on 13th May 1990. After wireline evaluation of the open-hole, the well was plugged and abandoned.

No net pay has been interpreted in Amberjack-1, however during drilling hydrocarbon shows were encountered in the Miocene at 400-470m KB and also within the Latrobe Group sediments at the top "Coarse Clastics" from 1269-1280m KB and in the lower N.asperus/P.asperopolus zone from 1480-1490m KB.

A conventional core was cut in the "Coarse Clastics" unit from 1271.4-1288.96m KB in which visible oil staining was noted down to 1280m KB. Oil saturations determined from core analysis were low and ranged from 0.8% to 5.9%, whereas the porosity and permeability measurements at overburden pressures were high, ranging from 25.6% to 30.0% and 149.5 md to 3105 md respectively.

Log derived oil saturations presented in this report for the zone where the oil was seen in the core are also low and range from 8-15%. However these saturations have been based on an assumed water salinity for the "oil zone" which is more saline than the estimated salinity for the underlying aquifer.

Amberjack-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 salinity ranges from 500-4000 ppm NaCl equivalent (Kuttan et.al., 1986) which is much fresher than the connate water.

The effect that the freshwater influx has on the resisitivity log measurements is that there is very little resistivity contrast between hydrocarbon bearing zones and their underlying water sands, as is demonstrated in this well.

RFT pretests were taken throughout the main zones of interest where hydrocarbon shows were reported during drilling in the Latrobe Group. Samples were taken from 1276m KB, 1480m KB and 1482m KB, to confirm the presence and mobility of the oil shows. However the pressure data when plotted against depth gave a water gradient (1.41 psi/m) and only traces of oil and gas were recovered from the RFT samples.

In this report a detailed quantitative interpretation of the logs run at total depth (1750m KB) is presented. The same rigorous applications have not been undertaken for the Miocene section as bad hole conditions have adversely affected the log quality.

2 INTRODUCTION

Amberjack-1 was drilled as an exploration well in permit Vic/P25 in the offshore Gippsland Basin. The well is located approximately 4km west of the Dolphin oil field. The structural form of Amberjack-1 at the top of Latrobe is a lobate anticlinal feature trending in a SW-NE direction.

The primary target of the well was to test the hydrocarbon potential of the "Coarse Clastics" sediments within the mapped structure at the top of the Latrobe Group.

The well spudded on 4th May 1990 and reached a total depth of 1750m KB (driller's depth) on 13th 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	=	metres below the Kelly Bushing
SS	=	metres below sea level

KB elevation = 21.0 metres above MSL
Seabed depth = 37.0 metres below MSL

WIRELINE TESTING

RFT pretests and samples were taken in Amberjack-1 during the open- hole logging operations at total depth (1750m KB).

A comprehensive evaluation of the RFT results is presented in a separate report (C. Taylor).

CONVENTIONAL CORING

One conventional core was cut in Amberjack-1 from 1271.4-1388.96m KB. The core depth can be adjusted to logger's depth by subtracting 0.2m.

The results of the core analyses are presented in a separate report.

LOGS RUN

			Logger's Depths
SUITE	1	DLL-MSFL-SDT-GR-SP-CAL-AMS (GR to sea floor)	1010 - 200 m KB
	2	GCT-GR-AMS	1271.4- 0.0m KB
	3	DLL-MSFL-LDL-CNL-SDT-GR--SP-CAL-AMS (SUPERCOMBO)	1732.5- 999 m KB
		LDL-CNL-SDT-GR-AMS (Run in casing)	550.0- 300 m KB
		SHDT-GR-AMS	1731 - 999.0m KB
		RFT-HP-GR	1258.0-1570.0m KB
		VELOCITY SURVEY	1727.0- 120 m KB
		CST-GR (60 shots)	1725.0-1010.0m KB

RFT SAMPLE RECOVERY

No.	Depth mKB	Chamber (gal)	Vol Gas cu.m	Vol Oil	Vol Water litre	Remarks
1	1286.0				200ml	filtrate water Run aborted Probe blocked
2	1482.1	2-3/4				No recovery
		1	-	thin film	4.0	filtrate/water
3	1276.0	6	0.025	thin film	21.7	filtrate 120ppm H2S
		1	trace	thin film	3.5	filtrate/water
4	1480.0	6	0.020	trace waxy scum	22.0	filtrate/water
		1	-	-	3.8	filtrate

3 HOLE CONDITIONS

CALIPER

Hole conditions through the 17-1/2" section from 1005.5m KB to 55.0m KB are variable with washouts occuring mostly over the sandstone intervals.

Hole conditions through the 12-1/4" section from 1010-1750m KB are generally good with washouts occurring mainly in the marl unit overlying the top of Latrobe. Throughout the rest of the Latrobe Group the hole is in good condition with evidence of mudcake buildup over most of the sandstone intervals.

BOREHOLE FLUIDS

Suite 1 :	Type	:	seawater/gel
	weight	:	8.6lb/gal
	Rm	:	0.217 ohm m @ 20.0 deg C
	Rmf	:	0.211 ohm m @ 19.0 deg C
	Rmc	:	0.510 ohm m @ 16.0 deg C
Suite 2 :	Type	:	KCl polymer
	weight	:	9.0lb/gal
	Rm	:	0.36 ohm m @ 16.0 deg C
	Rmf	:	0.28 ohm m @ 16.0 deg C
	Rmc	:	0.43 ohm m @ 16.0 deg C
Suite 3 :	Type	:	KCl polymer
	weight	:	9.2lb/gal
	Rm	:	0.210 ohm m @ 15.0 deg C
	Rmf	:	0.188 ohm m @ 15.0 deg C
	Rmc	:	0.296 ohm m @ 15.0 deg

TEMPERATURE

The following maximum temperatures were recorded during the logging operations:

BHT degC	Depth mKB	Tool	Hours After Circulation
41.0	862.0	GCT	4
42.0	1001.5	DLT-BHC-GR	5
58.0	1732.5	SUPERCOMBO	5
58.0	1731.0	SHDT	8.5
58.0	1727.0	SAT	16.5
58.0	1725.0	CST	18.0

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 54 degC was used for this interpretation based on an average geothermal gradient of 34 degC/KM.

4. QUANTITATIVE INTERPRETATION

INTERPRETATION PROCEDURE

The interval 1260-1750m KB was evaluated using the model described in Appendix 1. Log readings over this interval were 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 400-470m KB was not evaluated quantitatively using the model described in Appendix 1 as the hole size over this interval was washed out greater than 21". This precluded the use of the open-hole logging suite for quantitative anlaysis as the hole size was greater than the limits of the depth of investigation of the tools run, consequently the data recorded is heavily influenced by the drilling mud.

FORMATION WATER SALINITY

Amberjack-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.

In conventional log analysis the water saturation in the hydrocarbon zones is usually determined by using the formation water salinity calculated from the underlying water sands. However if this convention were to be followed here the calculated water saturations would be too high for the hydrocarbon zones. A different salinity has therefore been used to calculate the water saturation in hydrocarbon zones from that used for the water saturated sands. RFT sample recoveries, production test data and core analyses from nearby oil and gas wells has confirmed that the formation waters associated with the hydrocarbon zones are in fact more saline than the formation water produced from the underlying water saturated sands within this part of the basin.

The following formation water resistivities (Rw) were used in this interpretation:

* 0.3 ohm m @ 25 deg C = 20,000 ppm Nacl equivalent,1260-1280m KB

1.8 ohm m @ 25 deg C = 3,000 ppm Nacl equivalent,1280-1375m KB

3.5 ohm m @ 25 deg C = 1,500 ppm Nacl equivalent,1375-1475m KB

* 2.0 ohm m @ 25 deg C = 2,500 ppm Nacl equivalent,1475-1495m KB

11.0 ohm m @ 25 deg C = 500 ppm Nacl equivalent,1495-1750m KB

* Fluorescence shows noted during drilling operations.

The geochemical analysis report of the fluid recovered in the RFT samples taken from the zones where hydrocarbon shows were reported during the drilling operations indicate that the formation water samples recovered have each been contaminated to some degree by the mud filtrate. Therefore it was considered pertinent to not use this data when estimating the Rw's for this interpretation. The above Rw's used for the zones where the hydrocarbon shows were recorded are similar to those used in nearby fields where interpreted water saturations have matched physical data.

The Rw's used for this interpretation were derived from Pickett plots over the water saturated intervals as shown in figures 1A, 1B, 1C.

The resistivity and SP logs indicate there is an apparent decrease in the salinity of water saturated sands from the top of the Latrobe Group to total depth which has also been seen in other fields nearby.

5 DISCUSSION OF THE INTERPRETATION RESULTS

SUITE 1

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

The sand interval intersected from 400-470m KB displayed some fluorescence, suggesting the presence of hydrocarbons. Unfortunately, due to the unconsolidated nature of the sand over this interval, the hole washed out to greater than 21". The hole size was then greater than the resolution of the tools run to evaluate the shows. As a result the logs were unable to detect the formation and the data recorded is therefore heavily influenced by the borehole drilling fluids, making it impossible to determine formation water saturations.

SUITE 3

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

A cased hole logging suite was run over the interval 400-470m KB in an attempt to further evaluate the hydrocarbon shows seen during drilling operations. However the logs run were unduly affected by the casing and therefore of limited value.

The interval 1268-1323m KB consists of a massive sandstone unit which has very high porosity and permeability estimates as described by the log interpretation results as listed in Appendix 2 and the core analysis report. Towards the top of this interval the gamma ray log is reading anomalously high values, reaching up to 380 API units. The core gamma also exhibits a similar anomaly over the same interval.

Bioturbation exists in the core over the same interval where the anomalously high gamma ray counts have been recorded. It is possible then that the KCl drilling mud has invaded the formation via conduits created by the bioturbation.

The KCl mud system used to drill this section of the well introduces a source of radioactivity into the mud system. The gamma ray log responds then to the gamma rays emitted from the radioactive potassium in the drilling mud just as it responds to gamma rays emitted from radioactive elements in the sediments. The invasion of the drilling mud via the conduits provided by the bioturbation would then account for the anomalously high gamma ray. This penomena does not occur over the core intervals which have not been bioturbated, ie the gamma ray counts are considered normal in the undisturbed sediments.

Inspection of tables of logging parameters calculated for minerals commonly encountered in sedimentary formations (Edmundson and Raymer, 1979) indicates that only one mineral closely approximates the values recorded by the logs run over the interval with the anomalous gamma ray, Kainite (MgSO4KCl{H20}3), which is an evaporite mineral. However, the chemical formula for Kainite closely resembles the chemistry of the drilling mud. Also it is unlikely that an evaporitic mineral would have been deposited in such an isolated location.

The core cut from 1271.4-1288.96m KB displayed visual oil staining down to 1281.3m KB. Chips taken from the core at the wellsite displayed strong hydrocarbon fluorescence shows down to 1281m KB. The oil saturations listed in the core analysis report are very low which may be a result of the core initially being flushed by the drilling fluids as is indicated by the anomalous gamma ray. Further flushing would have occurred as a result of core handling during preparation of the core for routine analysis, as it is very permeable and porous. However the results of the RFT program indicate that the oil in the formation is residual and immobile. The pretest data when plotted against depth yields a water gradient and only a thin film of oil was recovered from the sample.

The interval 1325-1479m KB consists of an interbedded sequence of sandstone, siltstone, claystone and coal. All the sands are interpreted to be water saturated. Weak visual hydrocarbon shows were recorded from cuttings over the intervals 1349-1361m KB and 1472-1475m KB. Although the sandstone units within these intervals exhibit good porosity they have been interpreted to be water saturated.

The sand at 1479-1489m KB exhibits a slight increase in resistivity of 15 ohm-m from the lower to the upper section of the sand. Again, very weak hydrocarbon shows were recorded from the cuttings over the upper part of the sand however RFT pretests and samples taken from the interval indicate the oil is residual and immobile. The pressure versus depth gradient for the sand yielded a water gradient and only a thin film of oil was recovered from the sample.

Below 1489m KB all of the sandstone units are interpreted to be water saturated. No hydrocarbon shows were recorded in the cuttings during drilling of this interval.

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

6. REFERENCES

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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.

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'An Improved Sonic Transit-to-Porosity Transforms' SPWLA 21st Annual Logging Symposium.

APPENDIX 1

LOG INTERPRETATION METHOD

The quantitative log interpretation was undertaken using the Atlas Wireline Well Data (WDS) system developed by Western International Inc. The system 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 1A, 1B, 1C to follow.

PE905141

This is an enclosure indicator page.
The enclosure PE905141 is enclosed within the container PE902078 at this location in this document.

The enclosure PE905141 has the following characteristics:

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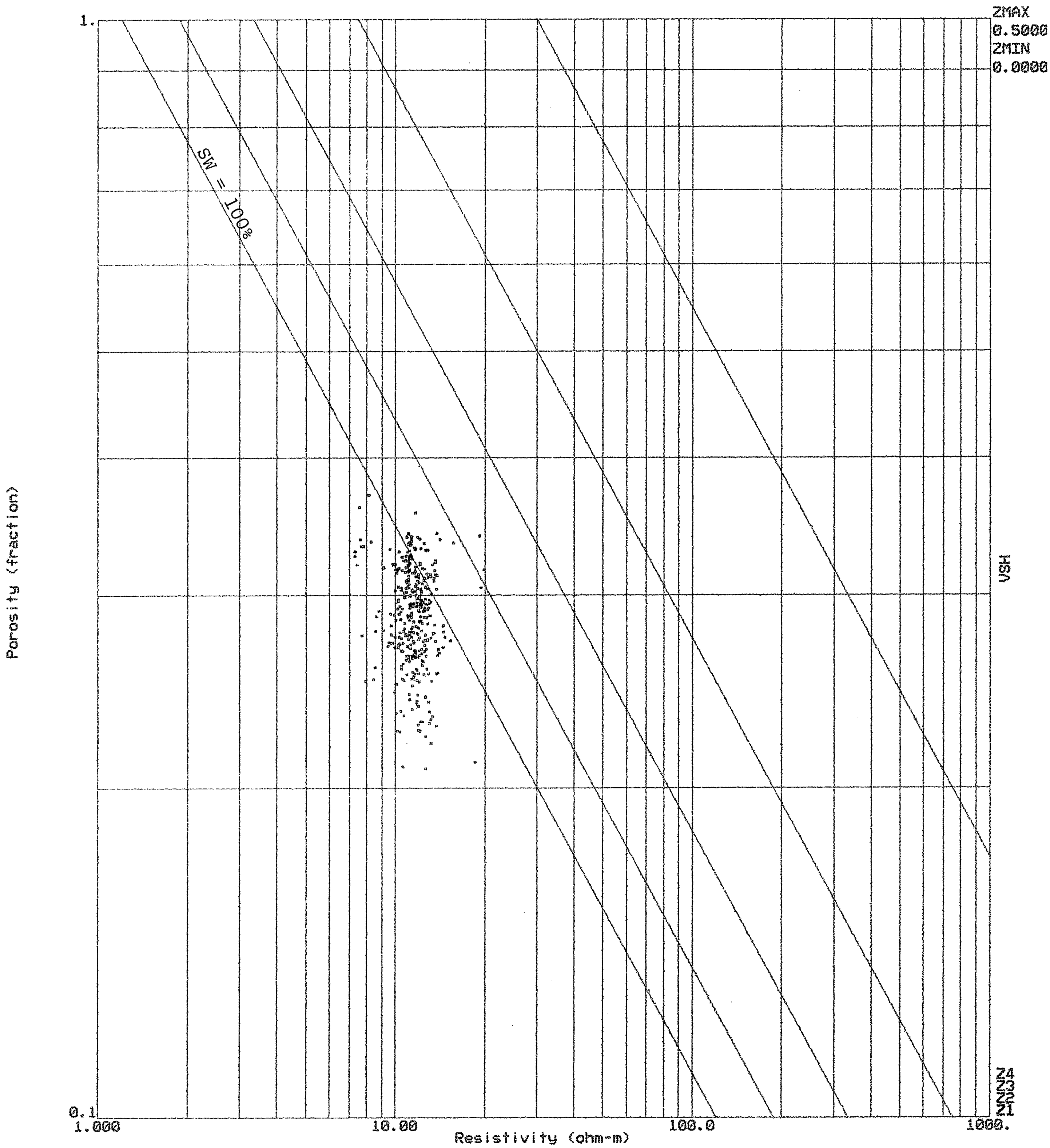
CONTAINER_BARCODE =	PE902078
NAME =	Porosity vs Resistivity Plot
BASIN =	GIPPSLAND
PERMIT =	VIC/P25
TYPE =	WELL
SUBTYPE =	DIAGRAM
DESCRIPTION =	Amberjack-1 Porosity (fraction) verses Resistivity (ohm-m) Plot. Figure 1A from appendix 3 of WCR volume 2.
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	22/02/1991
W_NO =	W1029
WELL_NAME =	Amberjack-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP Petroleum Pty Ltd

(Inserted by DNRE - Vic Govt Mines Dept)

Figure 1A

BHP PETROLEUM AMBERJACK #1



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m = 2
n = 2

1320.0 - 1270.0

PE905142

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The enclosure PE905142 has the following characteristics:

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CONTAINER_BARCODE = PE902078
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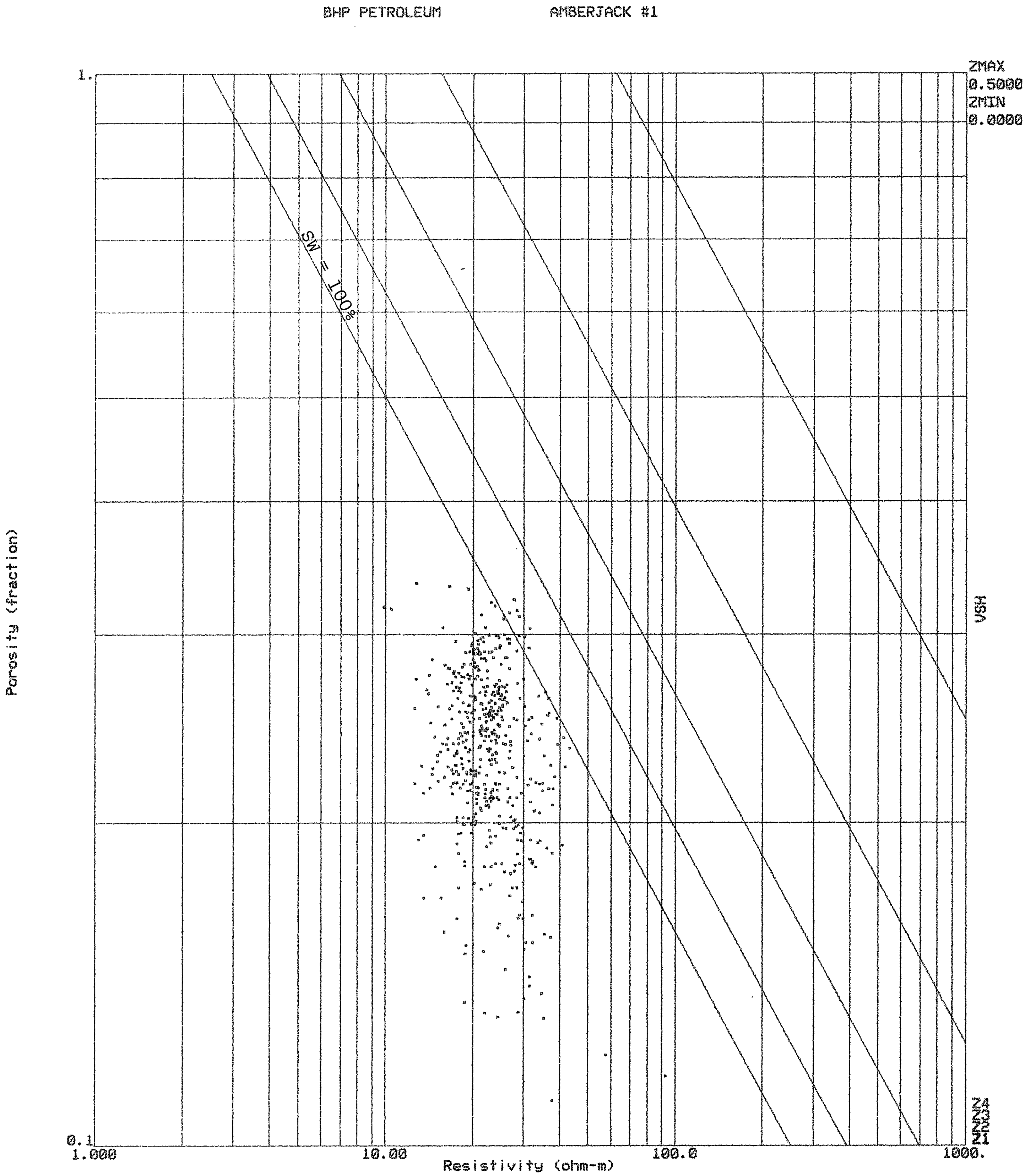
BASIN = GIPPSLAND
PERMIT = VIC/P25
TYPE = WELL
SUBTYPE = DIAGRAM
DESCRIPTION = Amberjack-1 Porosity (fraction) verses Resistivity (ohm-m) Plot. Figure 1B from appendix 3 of WCR volume 2.
REMARKS =
DATE_CREATED =
DATE_RECEIVED = 22/02/1991
W_NO = W1029
WELL_NAME = Amberjack-1
CONTRACTOR =
CLIENT_OP_CO = BHP Petroleum Pty Ltd

(Inserted by DNRE - Vic Govt Mines Dept)

Figure 1B



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m = 2
n = 2

1475.0- 1375.0

PE905143

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The enclosure PE905143 has the following characteristics:

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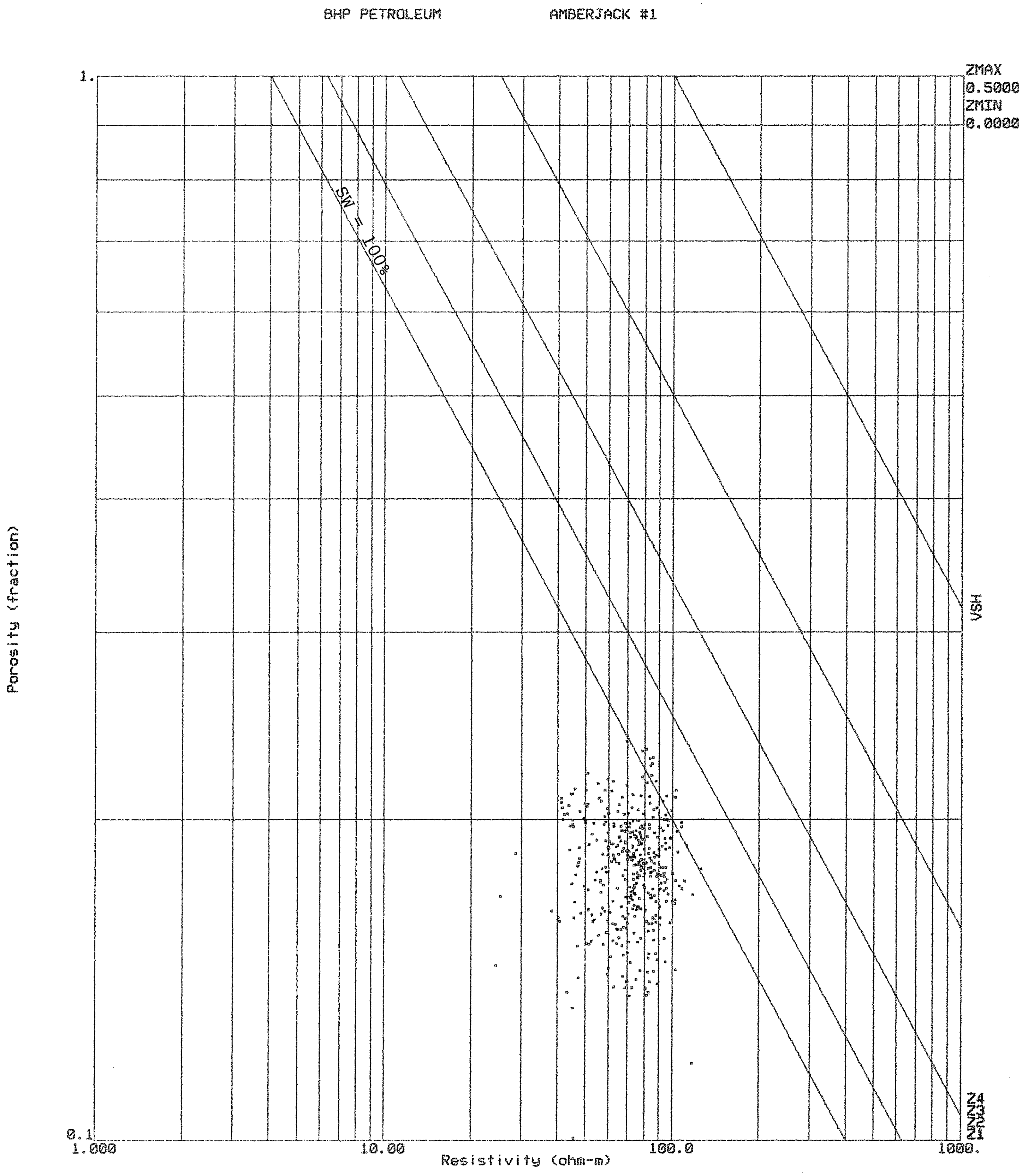
CONTAINER_BARCODE =	PE902078
NAME =	Porosity vs Resistivity Plot
BASIN =	GIPPSLAND
PERMIT =	VIC/P25
TYPE =	WELL
SUBTYPE =	DIAGRAM
DESCRIPTION =	Amberjack-1 Porosity (fraction) verses Resistivity (ohm-m) Plot. Figure 1C from appendix 3 of WCR volume 2.
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	22/02/1991
W_NO =	W1029
WELL_NAME =	Amberjack-1
CONTRACTOR =	
CLIENT_OP_CO =	BHP Petroleum Pty Ltd

(Inserted by DNRE - Vic Govt Mines Dept)

Figure 1C



a = 1
m = 2
n = 2

DEPT. NAT. RES & ENV
PE905143

1700.0- 1590.0

APPENDIX 4

BHP PETROLEUM PTY.LTD.

Repeat Formation Tester (RFT) Report

AMBERJACK - 1
OFFSHORE GIPPSLAND BASIN
VIC/P25

....

C. Taylor
Petroleum Engineer

TABLE OF CONTENTS

1. CONCLUSIONS

Amberjack-1 was drilled as an exploration well in permit VIC/P25, offshore Gippsland Basin by the Semi-Sub drillship 'Southern Cross'.

The well was spudded on 4th May 1990 and was drilled to a depth of 1750 mRKB, (KB elevation = 21.0 m above MSL). Wireline logs and RFT testing was performed on the well before it was plugged and abandoned.

The results and conclusions made from the RFT testing are summarised below;

- There was a water gradient in the formation over the intervals 1270-1295, 1350-1380, and 1475-1500 mRKB.

- There was mobile formation water at depths 1286.0, 1482.1, 1276.0, and 1480.0 mRKB.

- Water samples obtained were probably a mixture of formation water and mud filtrate.

- A small quantity of H_2S gas was recovered at 1276.0 mRKB.

2. INTRODUCTION

Four RFT runs were made resulting in 19 successful pretests, two segregated samples, and two smaller samples being taken. Hydrocarbon indications in the core cut from 1271.4 to 1288.96 mRKB showed oil staining down to 1280.0 mRKB. Logs of the well were used to determine zones overwhich pretests and samples would be taken. These being 1270 - 1295, 1350 - 1380, and 1475 - 1500 mRKB. Pretests were performed over these intervals and indicated a water gradient in all cases (1.410, 1.374, 1.355 psi/m respectively).

The samples recovered from the well were all water with only a very slight scum of oil. No hydrocarbon gas was recovered. However, the sample from run #3 did contain a trace of H_2S gas.

3. INTERPRETATION

3.1 Hydrostatic Pressures

Before and after each pretest, the hydrostatic pressure in the well was measured using the Hewlett-Packard (HP) quartz gauge. Readings taken before and after the pretest were in good agreement, as were the strain gauge readings. The mud column hydrostatic pressure gradient was calculated to be 1.598 psi/m.

3.2 Formation Pressures

All of the pretests used in the calculation of pressure gradients were obtained after temperature stabilising the tool at the test depth. Over the three intervals chosen for testing by log interpretation, a water gradient was observed. These results are summarised below and plotted on graphs 1 - 5.

Depth Interval (mRKB)	Number of Pretests	Pressure Gradient (psi/m)
1270 - 1295	6	1.410
1350 - 1380	5	1.374
1475 - 1500	6	1.355

Of the 30 pretests performed only 19 were used to calculate the pressure gradients. The 11 pretests that were not used consisted of;

- 3 x tight formation
- 3 x bad seal
- 1 x plugged probe
- 4 x tool temperature not stabilised

4. SAMPLE ANALYSIS

4.1 Sample Recovery

Six fluid samples were recovered from Amberjack-1 over the four RFT runs. Segregated samples were taken in 1 & 2 3/4, and 1 & 6 gallon chambers, (two runs with each pair of chambers). Recoveries from the chambers is shown below.

Run	Depth mRKB	Chamber gal	Water Vol. cc	Gas Vol. m^3	Oil
1	1286.0	2 2/3	0	0	None
1	1286.0	1	800	0	None
2	1482.1	2 2/3	0	0	None
2	1482.1	1	4000	0	Film
3	1276.0	6	21700	0.025	Film
3	1276.0	1	3500	0.001	Film
4	1480.0	6	22000	0.020	Film
4	1480.0	1	3800	0	None

The RFT tool was fitted with a 20/1000 " choke

4.2 Water Sample

Below is a table comparing the properties of the recovered water samples and those of the mud filtrate as determined offshore.

			Sample			Mud Filtrate		
Run	Depth mRKB	Chamber gal	pH	Cl- ppm	K- %	pH	Cl- ppm	K- %
1	1286.0	1	8.8	19000	2.7	9.2	22000	3.6
3	1276.0	6	8.0	17000	2.3	9.2	22000	3.6
4	1480.0	6	7.8	8500	1.1	9.2	22000	3.6

From this data it can be concluded that the water recovered by the RFT was not entirely mud filtrate, but was probably a mixture of formation water and filtrate. This indicates mobile formation water was present at the sample depths.

Samples from 1482.1, 1276.0 and 1480.0 mRKB were observed to have a thin film of oil when decantered into a clean sample bucket.

4.3 Gas Sample

A small amount of non-hydrocarbon gas was recovered from the sample chambers from runs 3 and 4. The gas recovered from run 3 contained some H_2S.

R.F.T. Results -- AMBERJACK - 1

Well: Amberjack - 1
Rig: Southern Cross
KB: 21 m.

Date: 13-5-90
Run No: Suite 3, Run 1 RFT
HP Gauge: E

Seat Number	Depth (m.) AH KB	Depth (m.) TVD SS	Initial Hydrostatic HP (psia)	Initial Hydrostatic Strain (psig)	Final Hydrostatic HP (psia)	Final Hydrostatic Strain (psig)	Formation Pressure HP (psia)	Formation Pressure Strain (psig)	Time. (hrs)	Flowing Pressure HP (psia)	COMMENTS
1	1268.0		2055.45	2045.2					2021		Tight
2	1268.5		2055.56	2045.0					2029		Tight
3	1269.0		2056.72	2045.3	2056.85	2045.2	1811.20	1800.3	2058	1339.4	Possible Supercharging
4	1270.5		2058.40	2047.6	2058.80	2047.7	1805.75	1795.8	2119	1786.0	O.K.
5	1276.0		2067.80	2056.6	2067.90	2056.6	1813.87	1803.5	2139	1800.5	O.K.
6	1278.0		2071.35	2059.5	2071.20	2059.6	1816.39	1806.2	2156	1767.6	O.K.
7	1273.5		2063.50	2052.3	2063.60	2052.3	1810.20	1799.8	2215	1778.8	O.K.
8	1280.5		2075.00	2063.7	2075.05	2063.7	1820.14	1809.7	2238	1802.4	O.K.
9	1291.0		2091.10	2082.2	2091.43	2082.5	1834.65	1824.6	2253	1832.8	O.K.
10	1304.2		2112.80	2101.2	2112.70	2101.2	1852.83	1842.9	2315	1851.0	O.K.
11	1353.0		2189.70	2171.9	2190.70	2179.7	1921.81	1911.7	2335	1918.7	O.K.
12	1355.6		2195.30	2184.2	2195.30	2184.3	1925.34	1915.2	2353	1890.6	O.K.
13	1357.3		2198.30	2186.5	2198.30	2186.4	1927.21	1917.0	0012	1870.7	O.K.
14	1376.6		2229.10	2217.3	2229.10	2217.4	1953.54	1943.6	0022	1952.4	O.K.
15	1380.2		2234.70	2223.3	2235.30	2223.7	1959.17	1948.2	0038	1850.2	Slight Plugging
16	1480.0		2394.80	2383.5	2394.80	2382.8	2099.80	2087.1	0102	2099.0	O.K.
17	1482.1		2397.90	2386.1	2398.20	2386.3	2102.37	2091.9	0112	1991.1	O.K.
18	1483.6		2400.00	2388.7	2400.00	2388.3	2104.35	2093.8	0125	2105.6	O.K.
19	1486.2		2404.10	2392.5	2404.20	2392.5	2107.98	2097.6	0138	2098.0	O.K.
20	1487.7		2406.40	2394.8	2406.80	2394.6	2110.11	2099.8	0154	2107.8	O.K.
21	1499.2		2425.10	2413.2	2425.10	2413.2	2126.49	2115.8	0203	2065.6	O.K.
22	1286.0		2083.95	2072.6			1828.55	1818.6	0243	2084.3	Sample Taken, Tool Not Temp Stab.
23	1482.1		2396.40	2389.9	2396.40	2386.4	2102.40	2094.3	0502	2080.9	Sample Taken, Tool Not Temp Stab.
24	1273.5		2060.40	2052.7					0729		No Seal
25	1273.7		2061.30	2051.4					0735		No Seal
26	1276.0		2066.30	2055.2			1851.00	1842.6	0740		Bad Seal
27	1276.0		2066.30	2055.2	2064.70	2054.3	1813.80	1804.2	0746		Sample Taken, Tool Not Temp Stab.
28	1480.0		2390.60	2384.6	2391.40	2380.8	2098.60	2092.8	0954	2033.9	Sample Taken, Tool Not Temp Stab.
29	1535.0		2479.91	2468.4	2480.10	2468.5	2177.09	2166.8	1040	2146.6	O.K.
30	1570.0		2536.00	2524.7	2536.40	2524.1	2226.99	2217.0	1058	2178.5	O.K.

Amberjack - 1, RFT Results.   Formation Sample Data.

Well: Amberjack - 1
Rig: Southern Cross
KB: 21 m.

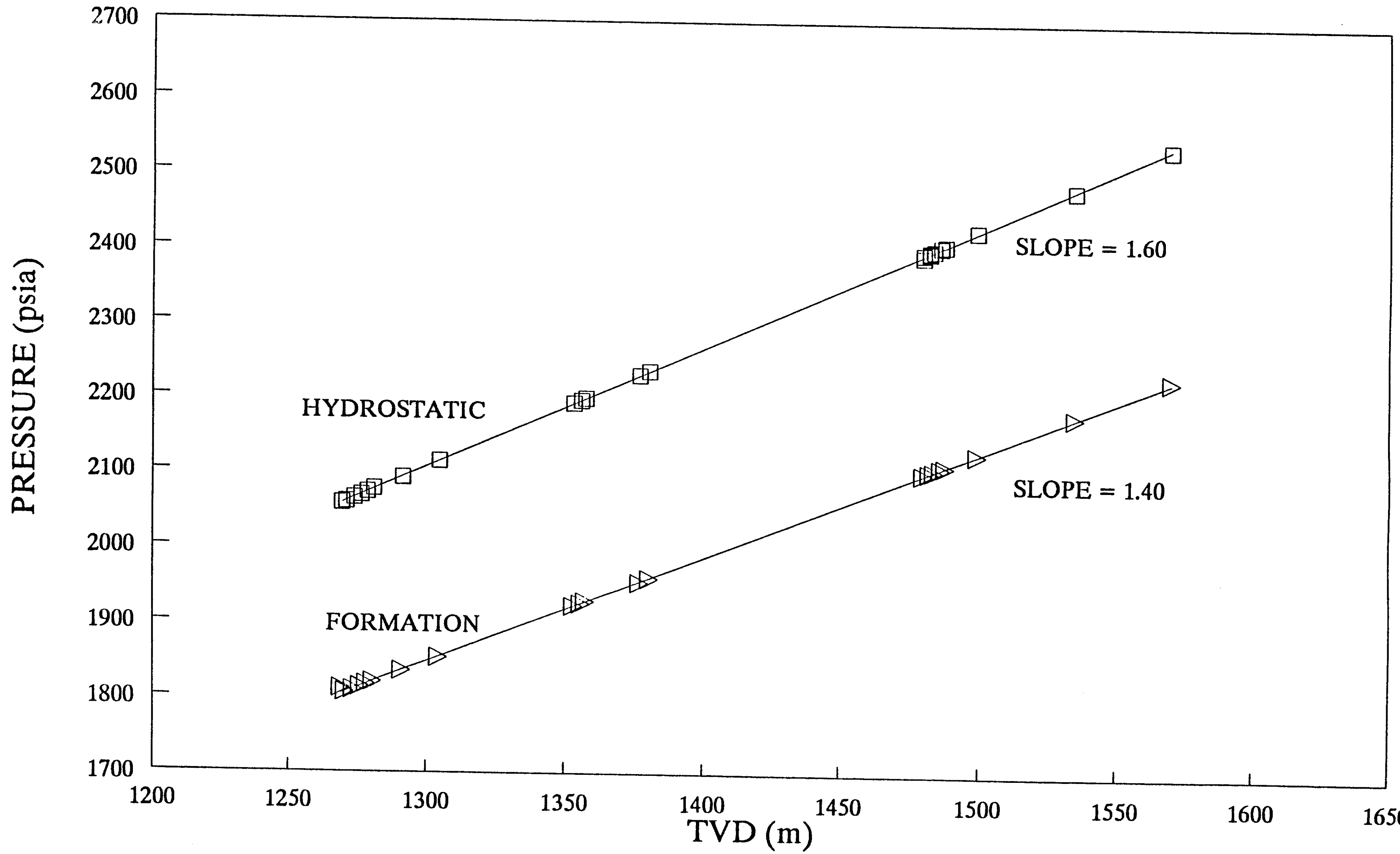
Date: 13-5-90
Run No: Suite 3, Run 1 RFT
HP Gauge: E

Sample Number	Depth (m. AH KB)	Formation Pressure (psia)	Chamber Size (gal)	Flowing Pressure (psia)	Time to Fill (min.)	Status	Surface Opening Pressure (psia)	Water Volume	Gas Volume (Cu.m.)	Gas H_2S Conc. (ppm)	Water Analysis (Preliminary) pH	Water Analysis (Preliminary) Cl- (ppm)	Water Analysis (Preliminary) K+ (%)	Filtrate Analysis (From Mud Pit) pH	Filtrate Analysis (From Mud Pit) Cl- (ppm)	Filtrate Analysis (From Mud Pit) K+ (%)
1 Lower	1286.0	1828.55	2 3/4	42	0.0	Blocked.	14.7	0	0.000					9.2	22000	3.6
1 Upper	1286.0	1828.55	1	40	2.5	O.K.	14.7	800	0.000		8.8	19000	2.7	9.2	22000	3.6
2 Lower	1482.1	2102.40	2 3/4	174	0.6	Blocked	14.7	0	0.000					9.2	22000	3.6
2 Upper	1482.1	2102.40	1	2054	2.4	O.K	14.7	4000	0.000					9.2	22000	3.6
3 Lower	1276.0	1813.80	6	1710	10.0	O.K	24.7	21700	0.025	120	8.0	17000	2.3	9.2	22000	3.6
3 Upper	1276.0	1813.80	1	1762	3.0	O.K	14.7	3500	0.001	120				9.2	22000	3.6
4 Lower	1480.0	2098.60	6	616	20.0	O.K	14.7	22000	0.020		7.8	8500	1.1	9.2	22000	3.6
4 Upper	1480.0	2098.60	1	956	3.8	O.K	14.7	3800	0.000					9.2	22000	3.6

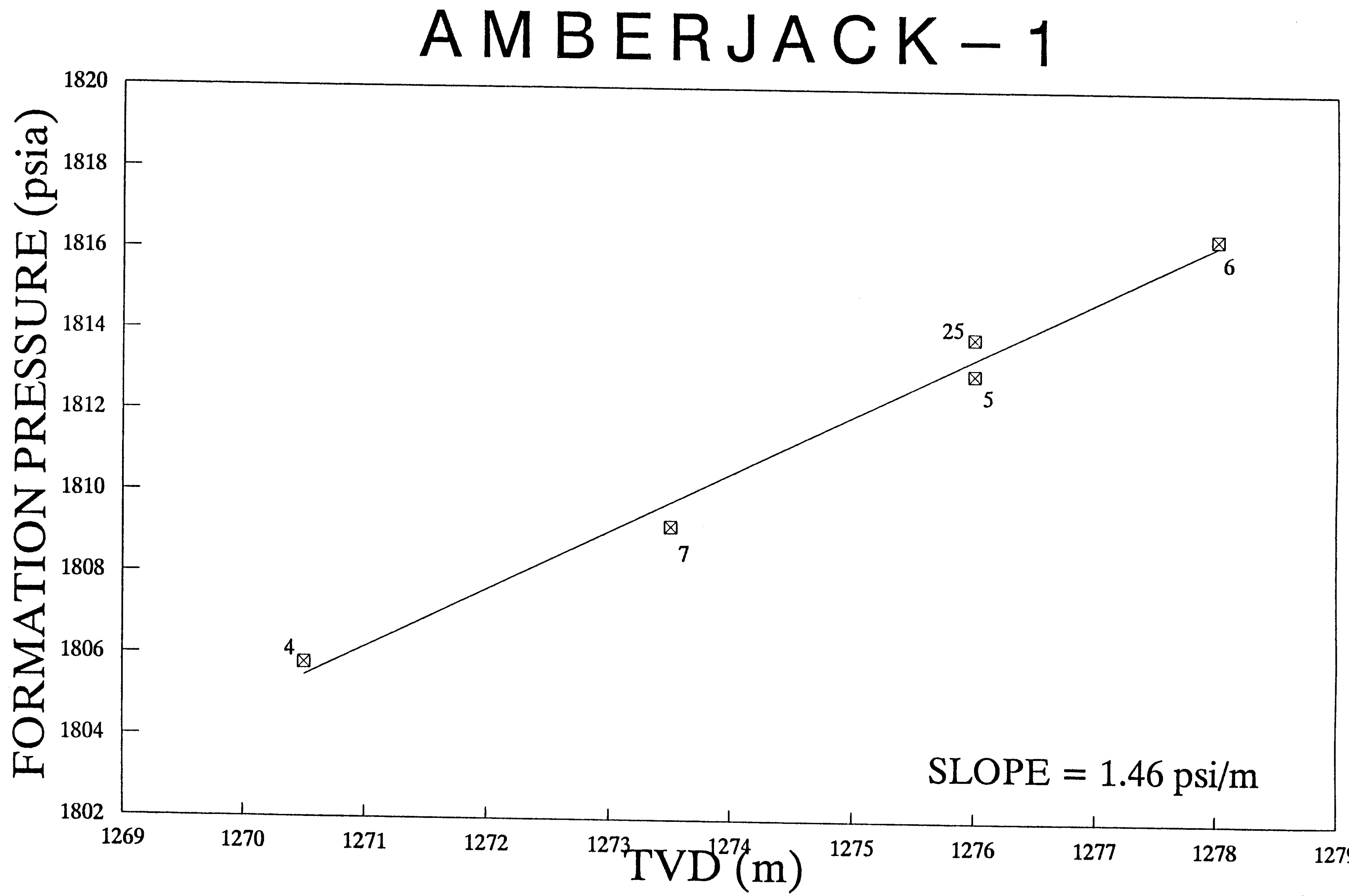
*** All Chambers were fitted with 20 1/1000th. chokes.

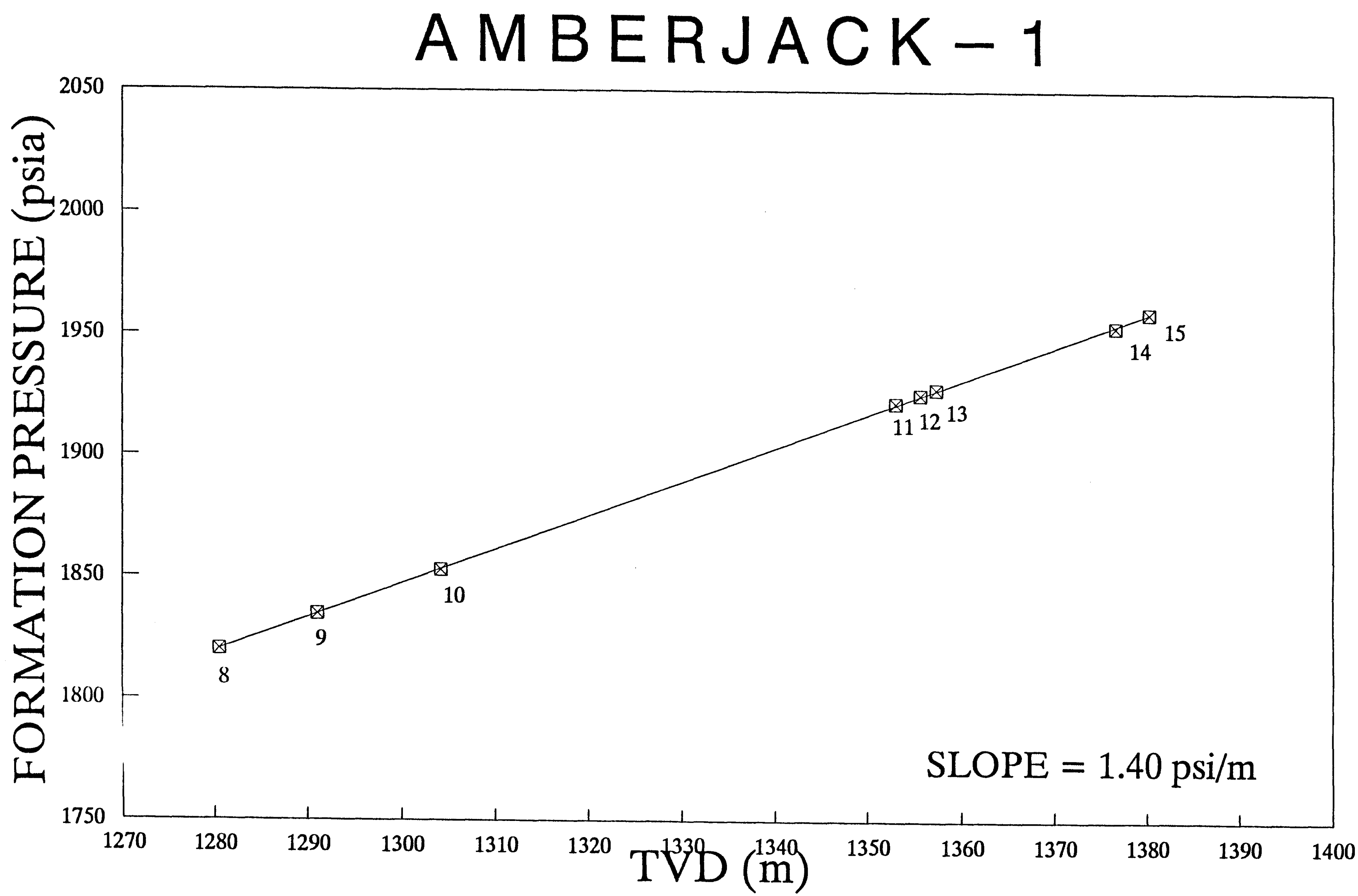
*** Gas analysis Showed NO Hydrocarbon Gas in Any of the Samples Taken.

AMBERJACK-1

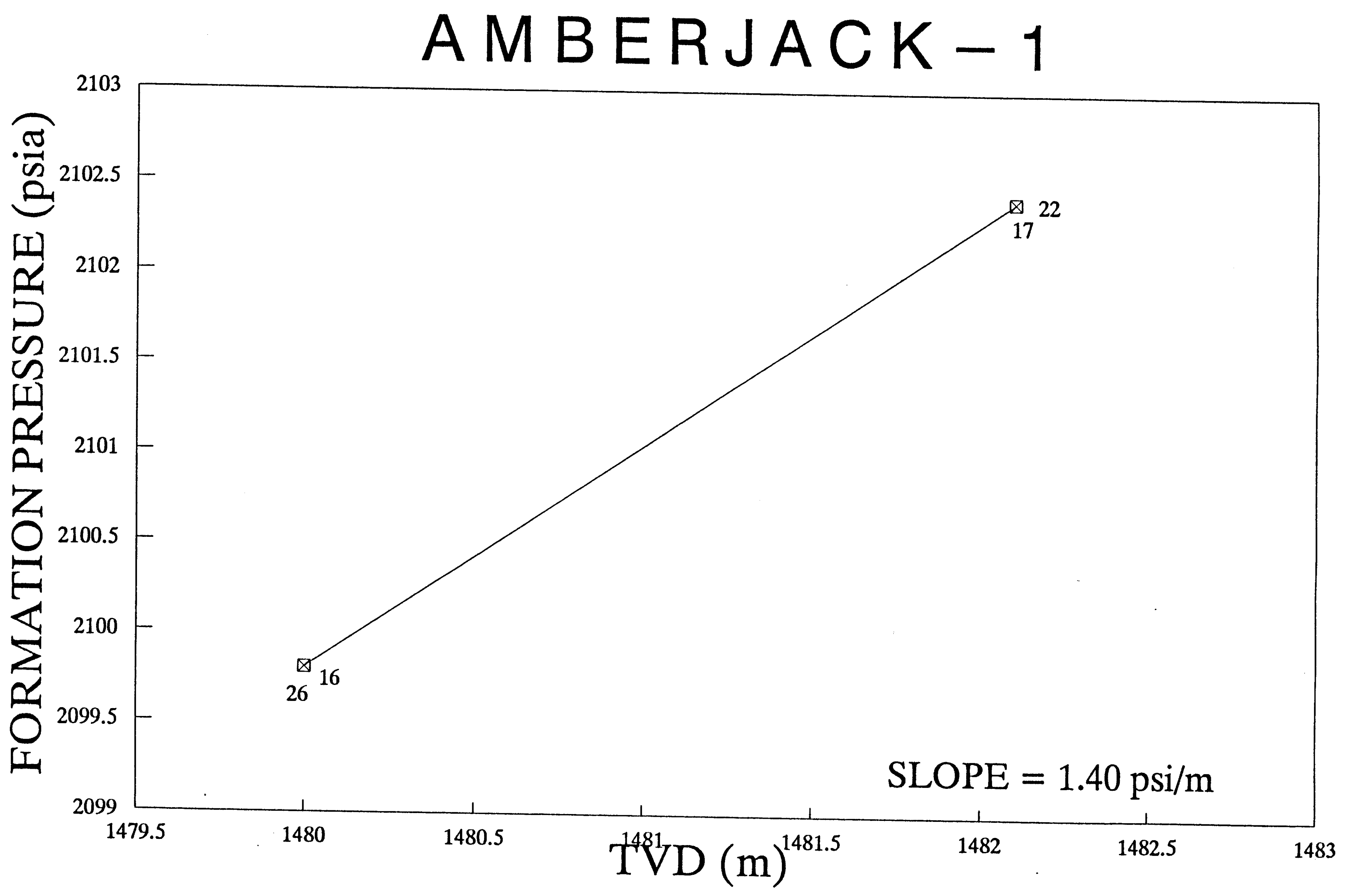


2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
PRESSURE (psia)
1200
1250
1300
1350
1400
1450
1500
1550
1600
1650
TVD (m)
HYDROSTATIC
FORMATION
SLOPE = 1.60
SLOPE = 1.40

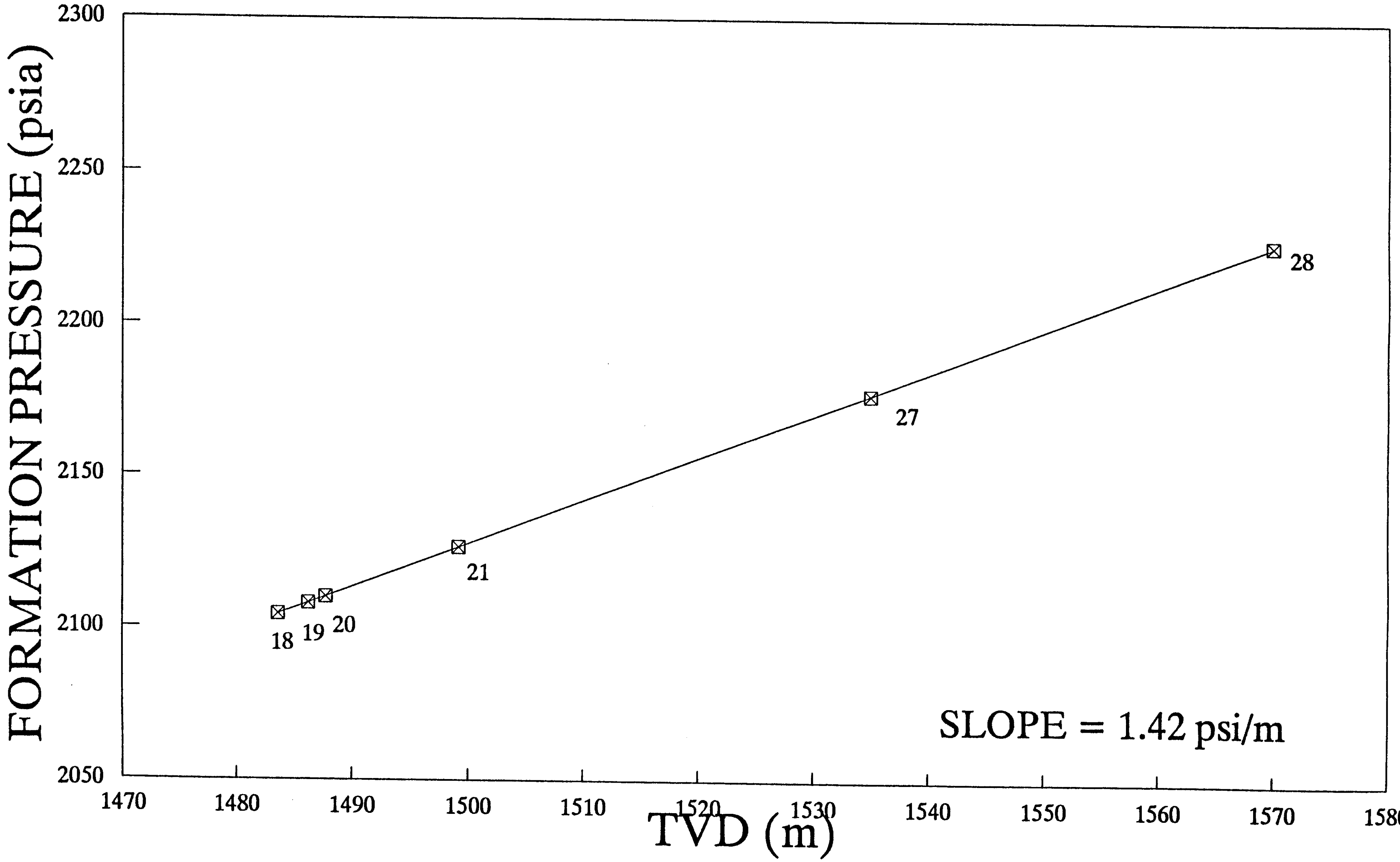

AMBERJACK-1
FORMATION PRESSURE (psia)
1820
1818
1816
1814
1812
1810
1808
1806
1804
1802
1269
1270
1271
1272
1273
1274
1275
1276
1277
1278
1279
TVD (m)
4
7
25
5
6
SLOPE = 1.46 psi/m



AMBERJACK-1
FORMATION PRESSURE (psia)
2050
2000
1950
1900
1850
1800
1750
1270
1280
1290
1300
1310
1320
1330
1340
1350
1360
1370
1380
1390
1400
TVD (m)
8
9
10
11
12
13
14
15
SLOPE = 1.40 psi/m


AMBERJACK-1
FORMATION PRESSURE (psia)
2103
2102.5
2102
2101.5
2101
2100.5
2100
2099.5
2099
1479.5
1480
1480.5
1481
1481.5
1482
1482.5
1483
TVD (m)
22
17
16
26
SLOPE = 1.40 psi/m

AMBERJACK-1



FORMATION PRESSURE (psia)
2300
2250
2200
2150
2100
2050
1470
1480
1490
1500
1510
1520
1530
1540
1550
1560
1570
1580
TVD (m)
18
19
20
21
27
28
SLOPE = 1.42 psi/m

APPENDIX 5

TECHNICAL NOTE

MELBOURNE RESEARCH LABORATORIES

BHP Research & New Technology

MRL/PG/TN/90/013 Circulation Nominated Officer Only

AMBERJACK 1

ANALYSIS OF WATER SAMPLES FOR HYDROCARBONS

by

Robyn J. Klepetko

May 1990

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Amberjack 1 - Analysis of Water Samples for Hydrocarbons

R. J. Klepetko

1. INTRODUCTION

Three water samples from depths 1276m, 1480m and 1482m in the Amberjack well were analysed in these Laboratories for the presence of hydrocarbons. The results of analysis are summarised in this Technical Note.

2. EXPERIMENTAL PROCEDURES

Any organic matter present in the water samples was extracted using dichloromethane, and the extract yield determined. The extracted material was then analysed using the technique of gas chromatography. Full details of the experimental procedures used in sample extraction and analysis are outlined in Appendix 1.

3. RESULTS AND DISCUSSION

From the analyses performed, the following information was obtained for the samples and is included in this report:

* extract yield data (Table 1)
* whole extract gas chromatograms (Figure 1)
* raw peak areas for the n-alkanes, pristane and phytane, calculated from the whole extract gas chromatograms (Appendix 2)
* geochemical parameters calculated from the whole extract raw peak areas (Table 2).

The following observations can be made from the accompanying Tables and Figure:

* the yields of organic matter extracted from the three water samples are quite low, ranging from 94 to 264ppm.

* for each sample, the extract material displays a compound distribution typical of mature oil (Figure 1). The n-alkanes predominate, and pristane and phytane levels are low relative to nC17 and nC18 respectively.

* the extracts all have similar compound distributions, although the 1482m sample appears to contain more low molecular weight compounds. Possibly this material has been lost from the other two samples during sample handling and preparation for analysis.

* the samples display similar values for the calculated geochemical parameters (Table 3), except for the (C21+C22)/(C28+C29) ratio. The different values for this parameter may be due to the weak nature of the GC runs, leading to difficulties in accurately integrating peaks. The moderate pristane/phytane ratios suggest slightly oxidising conditions during deposition of the sediments sourcing the extract material. The low pristane/nC17 and phytane/nC18 ratios and the CPI values of around 1 probably reflect the maturity of the extracts.

* the levels of pristane in the extracts, whilst lower than the levels of nC17, are quite high. This is typical of Gippsland Basin oils.

The geochemical parameters calculated from saturate fraction GC analysis of a number of Gippsland Basin oils are provided in Table 3 for comparison with the Amberjack extracts. The oils and extracts display similar values for most of the calculated geochemical parameters. Ignoring the (C21+C22)/(C28+C29) ratios, the extracts appear most similar to the Luderick 1 oil. This is largely because of the similar pristane/phytane ratios. The Tarwine 1 oil in particular differs from the extracts in that it has a considerably higher value for this parameter.

4. SUMMARY

The three water samples analysed from Amberjack 1 were found to contain low levels of hydrocarbons. Analysis by gas chromatography showed the hydrocarbon distributions in the samples to be broadly similar, resembling mature oil. A comparison of the geochemical parameters calculated from the GC data with those obtained from saturate GC analysis of several Gippsland Basin oils showed the hydrocarbons from the water samples to be most similar to oil from the Luderick 1 well.

5. ACKNOWLEDGEMENTS

Thankyou to Miss Josephine Brennan for acquiring the GC data and to Dr. Evan Evans for reviewing this Technical Note.

TABLE 1 Yields of Organic Matter Extracted from Amberjack 1 Water Samples.

WELL:	AMBERJACK 1		
DEPTH 1 :	1276	1480	1482.1
DEPTH 2 :	1276	1480	1482.1
AV.DEPTH :	1276	1480	1482.1
SAMPLE TYPE :	WATER	WATER	WATER
RUN NUMBER :	3	4	2
DATA BASE NUMBER :	902207	902209	902208
EXTRACT WEIGHTS			
WEIGHT OF LIQUID (g)	500	500	500
WEIGHT OF EXTRACT (g)	0.0472	0.0826	0.132
CALCULATED YIELDS			
% EXTRACT YIELD	0.009	0.017	0.026
ppm EXTRACT	94	165	264

TABLE 2 Geochemical Parameters Calculated from Whole Extract GC Traces.

WELL: AMBERJACK 1

DEPTH 1:	1276	1480	1482
DEPTH 2:	1276	1480	1482
AV DEPTH:	1276	1480	1482
LOCATION :	GIPPS BASIN	GIPPS BASIN	GIPPS BASIN
TYPE:	WATER	WATER	WATER
TEST:	RUN#3	RUN#4	RUN#2
DATA BASE NUMBER:	902207	902209	902208
RAW FILE:	RC0359	RC0357	RC0356
PRISTANE/PHYTANE:	2.47	2.00	2.93
PRISTANE/NC17 :	0.79	0.58	0.92
PHYTANE/NC18 :	0.34	0.27	0.32
(C21+C22)/(C28+C29):	6.06	4.05	2.27
CPI(1) :	1.00	1.05	1.11
CPI(2) :	1.20	1.06	1.07
CPI(3) :	1.01	0.81	1.45
CPI(4) :	1.01	1.06	1.13

NOTE :

CPI(1) = [(nC23+nC25+nC27+nC29)+(nC25+nC27+nC29+nC31)]/ 2(nC24+nC26+nC28+nC30)

CPI(2) = [(nC23+nC25+nC27)+(nC25+nC27+nC29)]/2(nC24+nC26+nC28)

CPI(3) = 2(nC27)/(nC26+nC28)

CPI(4) = [2(nC25+nC27+nC29)]/[nC24+2(nC26+nC28)+nC30]

TABLE 3 Geochemical Parameters Calculated from the Saturate Fraction GC Traces for some Gippsland Oils.

WELL :	BREAM 5	LUDERICK 1	TARWHINE 1
DEPTH 1 :	1940.0	1843.0	1398.0
DEPTH 2 :	1940.0	1843.0	1400.5
AV. DEPTH :	1940.0	1843.0	1399.3
LOCATION :	GIPPS BASIN	GIPPS BASIN	GIPPS BASIN
TYPE :	OIL	OIL	OIL
TEST :	RFT#3	RFT#6/41	PT#2
DATA BASE NUMBER :	860015	860076	860124
PRISTANE/PHYTANE:	3.42	2.88	5.78
PRISTANE/NC17 :	0.65	0.64	0.76
PHYTANE/NC18 :	0.20	0.24	0.16
(C21+C22)/(C28+C29):	6.37	4.94	-
CPI(1) :	1.04	1.02	-
CPI(2) :	1.05	1.00	-
CPI(3) :	1.13	1.15	-
CPI(4) :	-	-	-

FIGURE 1

WHOLE EXTRACT GAS CHROMATOGRAMS FOR AMBERJACK 1 SAMPLES ANALYSED.

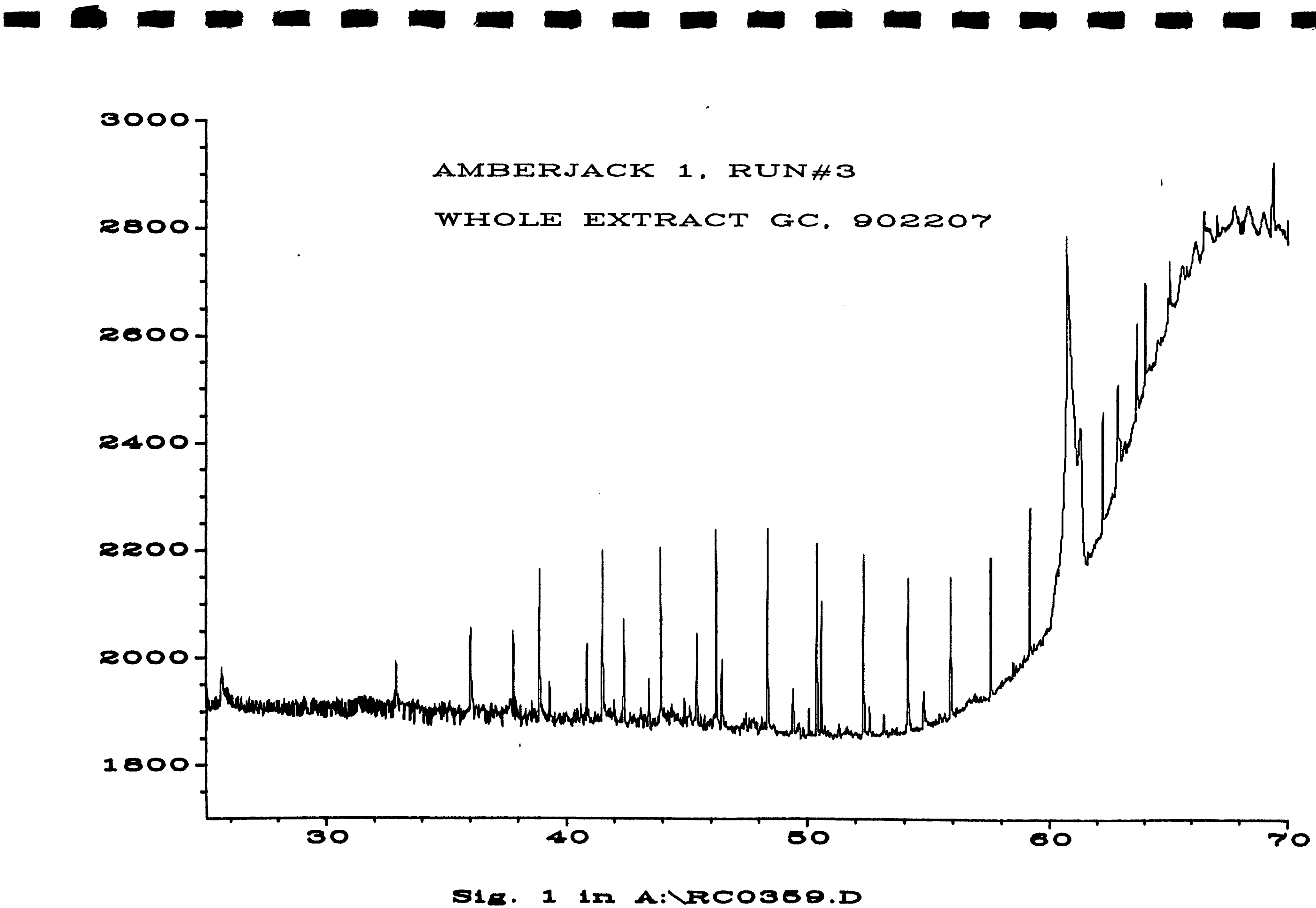


FIGURE 1A Whole extract gas chromatogram for Amberjack 1, Run#3, 1276.0m.

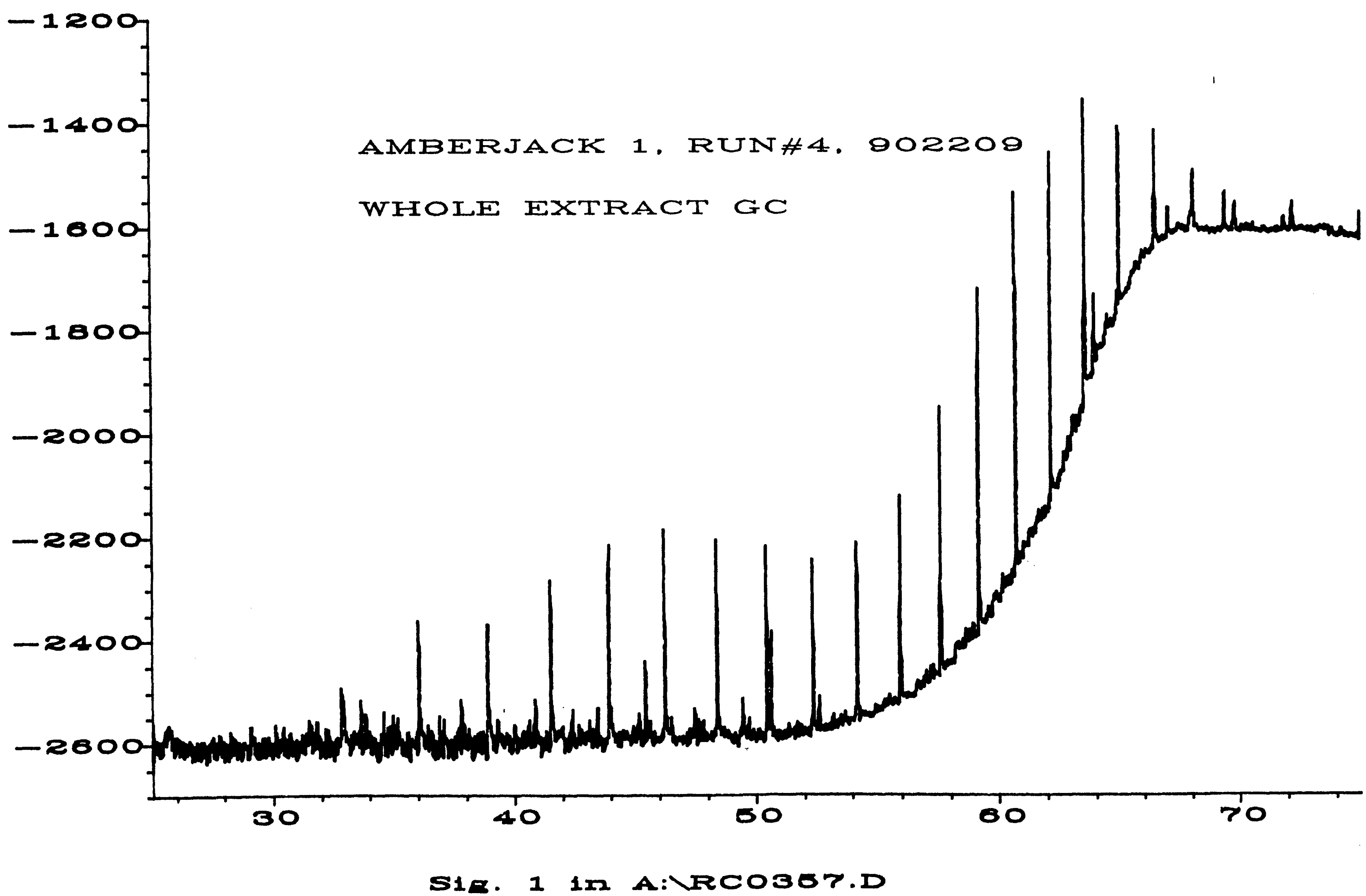


FIGURE 1B Whole extract gas chromatogram for Amberjack 1, Run#4, 1480.0m.

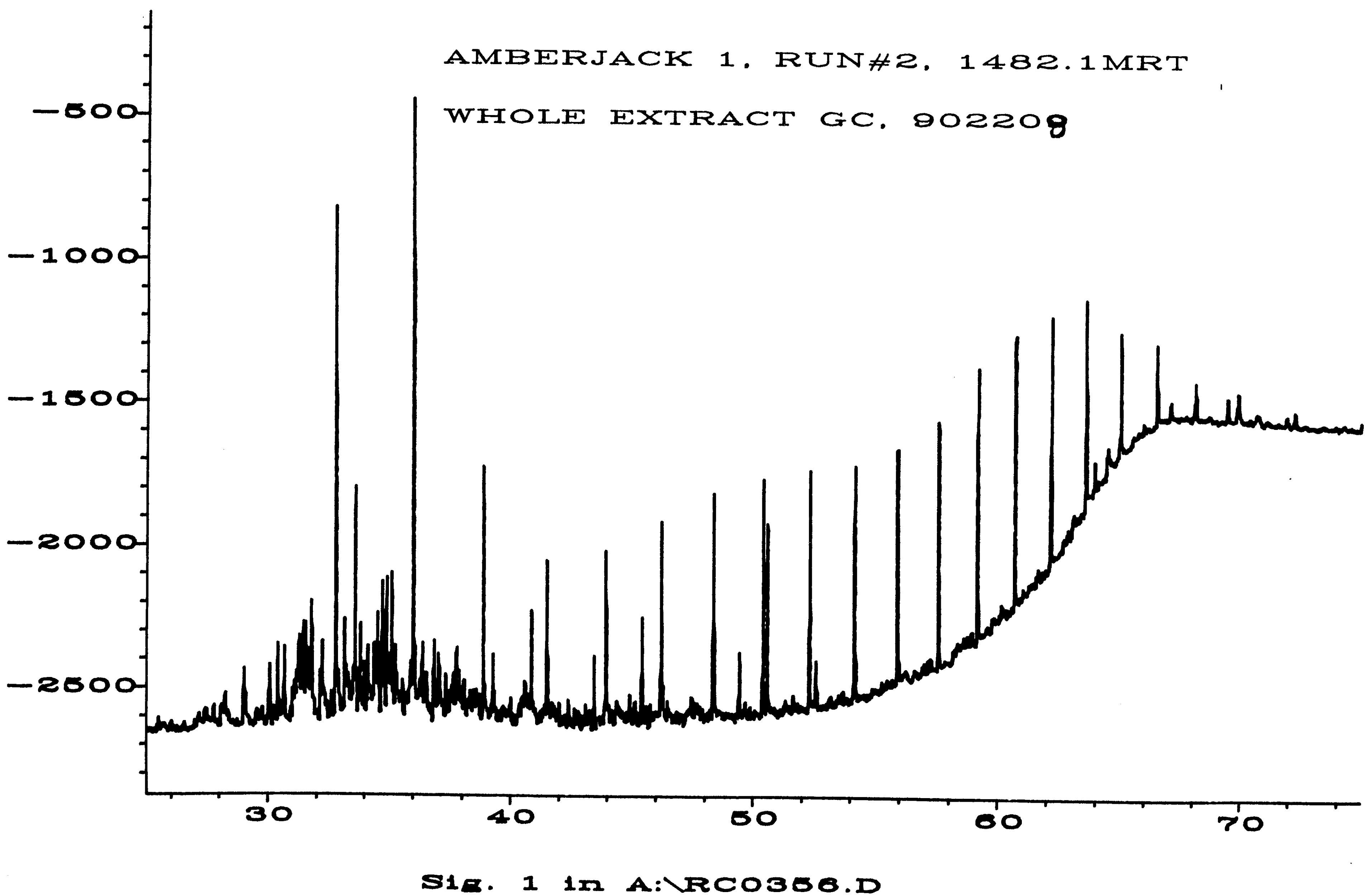


FIGURE 1C Whole extract gas chromatogram for Amberjack 1, Run#2, 1482.1m.

APPENDIX 1

EXPERIMENTAL PROCEDURES

Solvent Extraction

In each case, the water sample (approximately 500ml) was extracted with dichloromethane (3x100ml) in a 2L separating funnel. The extract was collected in a round bottomed flask and the solvent removed using a rotary evaporator, until only a small volume of liquid remained in the flask (2-3ml). The sample was then diluted with dichloromethane (40ml), and anhydrous magnesium sulfate added to remove any traces of water. The mixture was filtered and the filtrate volume reduced using the rotary evaporator before transferring into a weighed vial and taking to dryness.

Sulfur Removal

One sample (Run#3, 1276m) contained sulfur. This was removed by dissolving the sample in dichloromethane (1ml) and filtering through a pasteur pipette packed with copper turnings (the copper was freshly activated by treatment with dilute hydrochloric acid).

Whole Extract Gas Chromatography

Whole extract gas chromatograms were recorded on a HP5890 GC fitted with an SGE Unijector at 280° and a 50m 0.22mm ID SGE BP1 Capilliary Column. A split flow of 20:1 was used for the injection. The GC oven was programmed such that the temperature was held at -10°C for 1 minute, then increased at 3°C from -10 to 50°C, at 6°C from 50 to 300°C and then held at 300°C for 20 minutes. The data was collected and integrated on a HP PC based Chem-Station.

APPENDIX 2 Raw Peak Areas Calculated from the Whole Extract Gas Chromatograms.

WELL: AMBERJACK 1

DEPTH 1:	1276	1480	1482
DEPTH 2:	1276	1480	1482
AV DEPTH:	1276	1480	1482
LOCATION :	GIPPS BASIN	GIPPS BASIN	GIPPS BASIN
TYPE:	WATER	WATER	WATER
TEST:	RUN#3	RUN#4	RUN#2
DATA BASE NUMBER:	902207	902209	902208
RAW FILE:	RC0359	RC0357	RC0356
NC9 :			
NC10 :	484	721	5186
NC11 :	3304	1282	6586
NC12 :	4046	1470	3264
NC13 :	4010	1103	2165
NC14 :	3726	1472	1804
NC15 :	4563	1427	2638
NC16 :	3611	1215	2344
NC17 :	3108	1048	2260
PRISTANE :	2449	611	2068
NC18 :	2894	1118	2238
PHYTANE :	990	306	705
NC19 :	2883	1094	2346
NC20 :	2553	1161	2409
NC21 :	2058	1410	2270
NC22 :	3245	1778	2546
NC23 :	2369	1933	2623
NC24 :	1494	1838	2777
NC25 :	1903	2271	3575
NC26 :	1769	1697	5313
NC27 :	1102	885	4816
NC28 :	421	491	1313
NC29 :	454	296	804
NC30 :	971	310	187
NC31 :	0	234	341
NC32 :	0	0	0
NC33 :	0	0	0

APPENDIX 3

Geochemical Parameters Calculated from the GC Results and the Major Factors Which Influence Them

Saturate GC Parameter	Indicator Type	Typical Range of Values	General Boundaries		Effect of Maturity
Pristane/Phytane	depositional environment/ source	0.3-15	<1 1-3 >2	anoxic, marine sediments/oils oxic, marine sediments/oils oxidising, terrestrial (eg.coals)	-
Pristane/nC17	maturity/ source	0-10	for oils, <0.5 0.5-1.0 >1.0 for sediments, <1 1.0-1.5 >1.5	 marine source mixed source terrestrial source marine source mixed source terrestrial source	decreases
Phytane/nC18	maturity/ source	0-2			decreases
(nC21+nC22)/ (nC28+nC29)	source/ maturity	0.3-10	<1.2 >1.5	terrestrial source marine source	increases
CPI(1) CPI(2) CPI(3) CPI(4)	source/ maturity	0.6-6 (can be up to 30)	<1.0 0.9-1.1 >1.1	very reducing environment?? (eg. some carbonates and evaporites) marine source terrestrial source	value approaches 1.0

Results in mg/L(except where stated and pH)

SAMPLE ID	AMBERJACK-1 #3777	#3778	#3779	METHOD:
pH	7.3	7.2	7.3	WAT 2F
Resistivity (Ohm m @25°C)	0.699	0.328	0.855	WAT 2G
Total Dissolved salts @ 180°C	9440	21310	7490	WAT 7
Specific Gravity	1.004	1.011	1.003	WAT 26
Bicarbonate	274	368	260	WAT 2C
Carbonate	N.P	N.P	N.P	WAT 2C
Chloride	4592	10747	3606	WAT 2B
Sulphate	131	310	101	WAT 2E
Sodium	1052	2602	793	WAT 2A
Calcium	114	199	84.8	WAT 2A
Magnesium	84.8	133	60.9	WAT 2A
Potassium	3044	7087	2494	WAT 2A
Iron	0.2	0.2	0.1	WAT 3B
Strontium	2.6	10.2	1.8	WAT 3B
Barium	1.4	1.1	1.1	WAT 3B

COMMENTS:

N.P = NOT PRESENT AT THIS pH

SAMPLE ID:

#3777= RUN #2 1482.1 M RT
#3778= RUN #3 1276.0 MRT(CONTAINS H2S)
#3779= RFT RUN #4 1480.0

NOTE ACCOMPANYING DATA

BHP
Research and
New Technology

MELBOURNE RESEARCH LABORATORIES
PO Box 264, CLAYTON,
VICTORIA - 3168
FACSIMILE No.: (03) 561 6709
TELEPHONE No.:(03) 560 7066
VOICE LINK: 831 7200

To: **GARRY WOODHOUSE,**
BHP Petroleum,
Collins Towers,
Collins St.

From J.B.BRENNAN,
Extension: 7358

DATE: 11 October, 1990

No. OF PAGES: ....

MESSAGE: Garry,

untreated core plugs

Please find attached the data for the Amberjack 1 samples. The samples contained oil which was found to be severly biodegraded. Three of the sediments were extracted for saturate GC analysis which confirmed this. The thermal desorption yields are unreliable because of the nature of the oil and no calculations could be made from the saturate GC analyses. If you have any queries please contact Evan or myself.

Regards,

[signature]

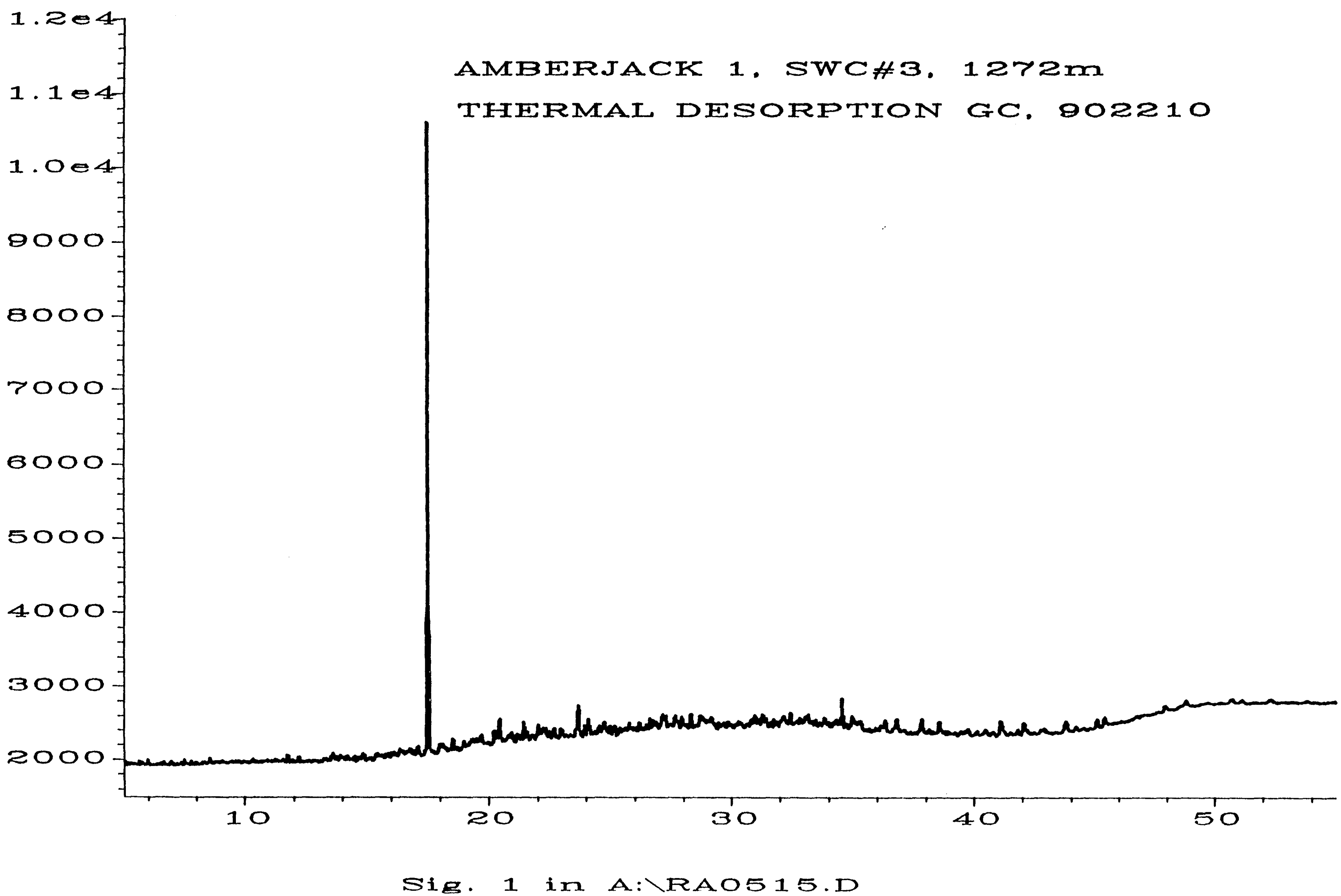
J.B.BRENNAN

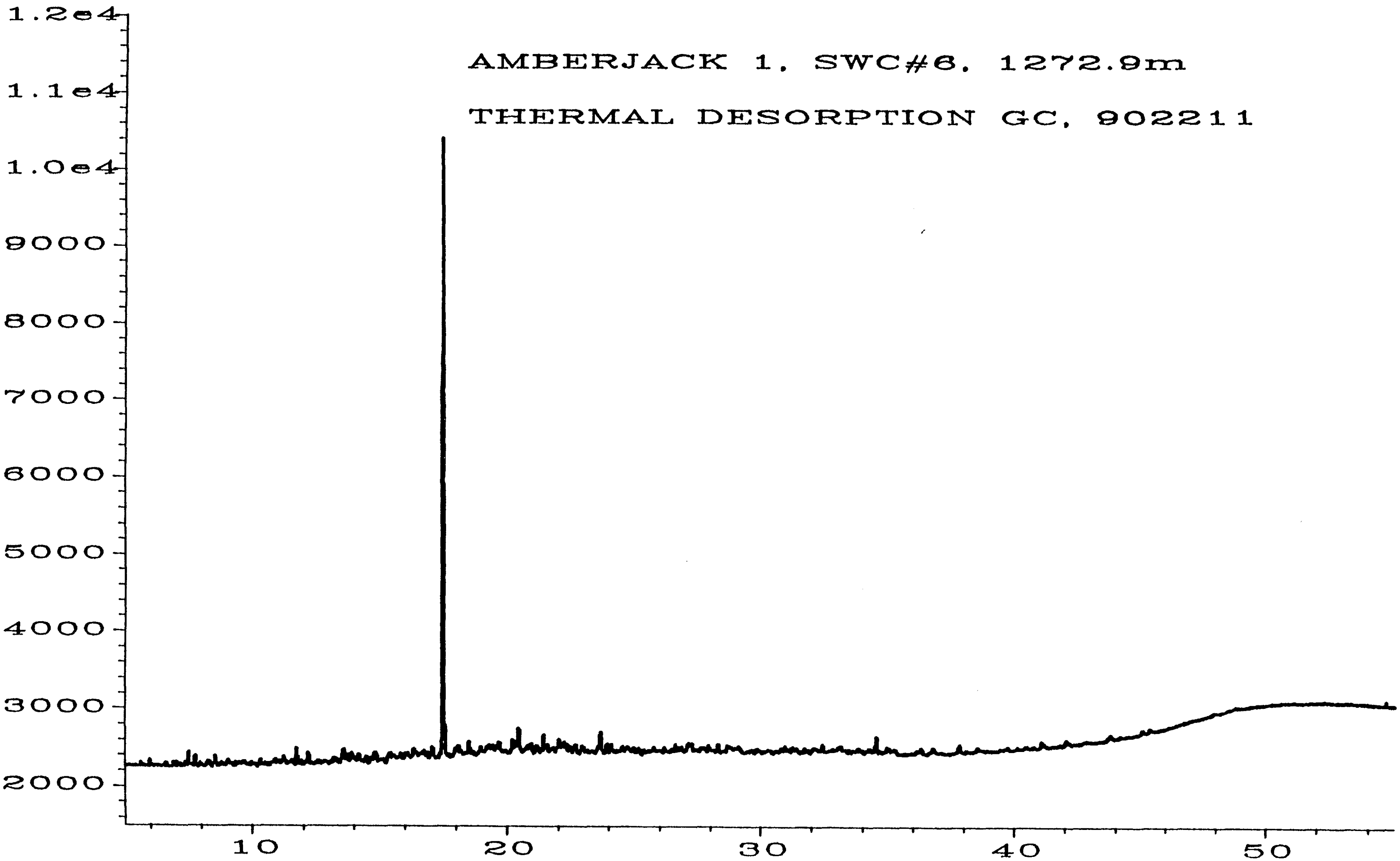
Thermal Desorption Yield Data

WELL: AMBERJACK 1

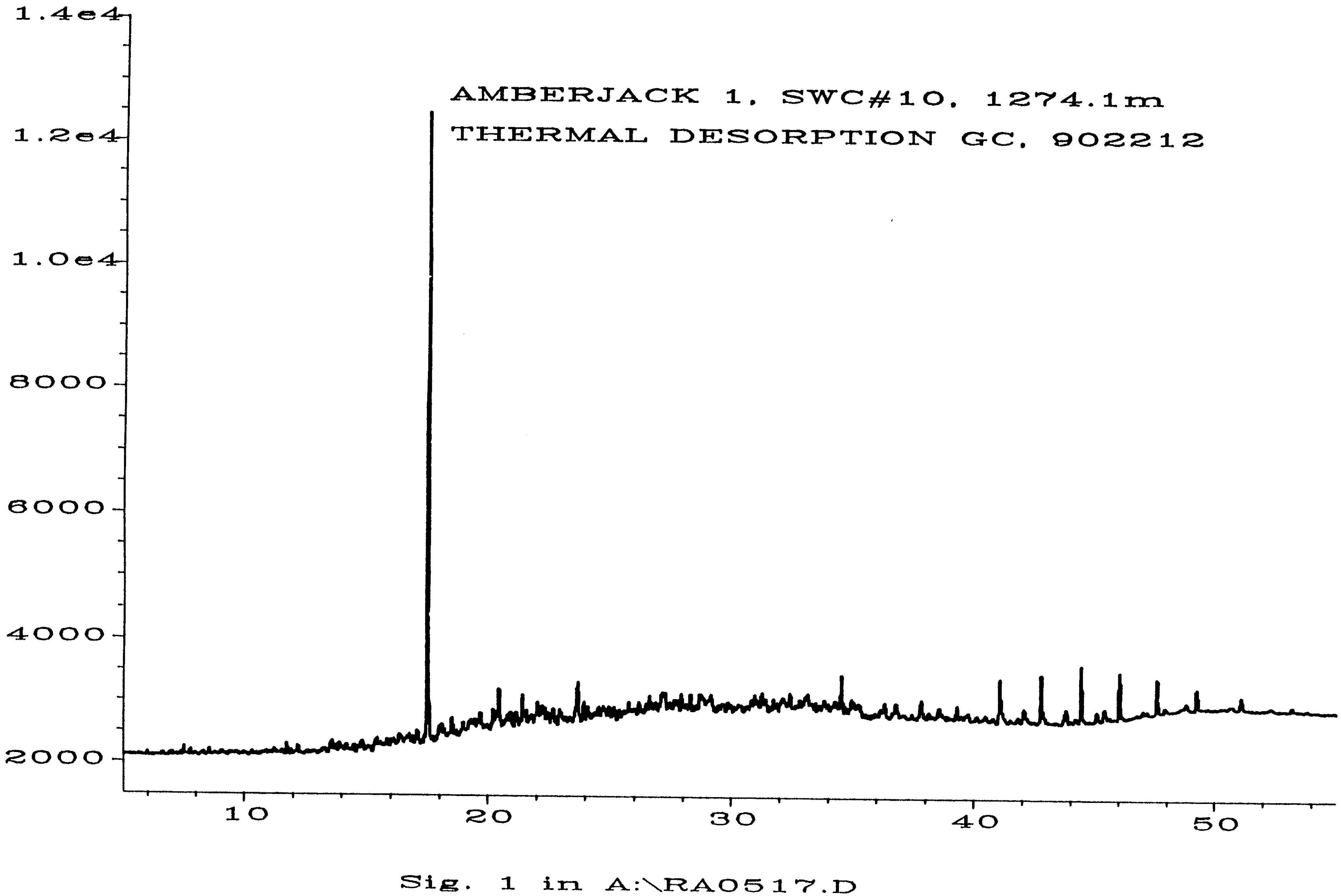
DEPTH 1:	1272	1272.9	1274.1	1275	1275.9	1277.1	1278	1278.9	1278.9	1279.8
DEPTH 2:	1272	1272.9	1274.1	1275	1275.9	1277.1	1278	1278.9	1278.9	1279.8
AV.DEPTH:	1272	1272.9	1274.1	1275	1275.9	1277.1	1278	1278.9	1278.9	1279.8
DATABASE NUMBER:	902210	902211	902212	902213	902214	902215	902216	902217	902217	902218
SAMPLE TYPE:	SWC#3	SWC#6	SWC#10	SWC#13	SWC#16	SWC#20	SWC#23	SWC#26	SWC#26	SWC#29
LABORATORY NUMBER :	G010D1	G010D2	G010D3	G010D4	G010D5	G010D6	G010D7	G011D1	G011D3	G011D2
RUN FILE NAME :	RA0515	RA0516	RA0517	RA0518	RA0519	RA0520	RA0521	RA0522	RA0524	RA0523
MASS OF SAMPLE(g):	0.9862	1.0799	1.0235	1.0989	1.0385	0.9617	1.0727	1.1848	1.0845	1.1432
VOLUME OF STANDARD ADDED(uL):	100	100	100	100	100	100	100	100	100	100
CONCENTRATION OF STANDARD(mg/uL):	0.00102	0.00102	0.00102	0.00102	0.00102	0.00102	0.00102	0.00102	0.00102	0.00102
TOTAL AREA:	320257	130889	526400	68729	101409	569529	485124	1154549	927610	735112
STANDARD AREA:	32476	30463	38159	28298	22655	39947	52879	53646	48131	50643
AREA FOR SAMPLE:	287781	100426	488241	40431	78754	529582	432245	1100903	879479	684469
THERMAL DESORPTION YIELD (mg/g):	0.9	0.3	1.3	0.1	0.3	1.4	0.8	1.8	1.7	1.2
SOLVENT EXTRACTION YIELD (mg/g):	4.5					3.7				3.6

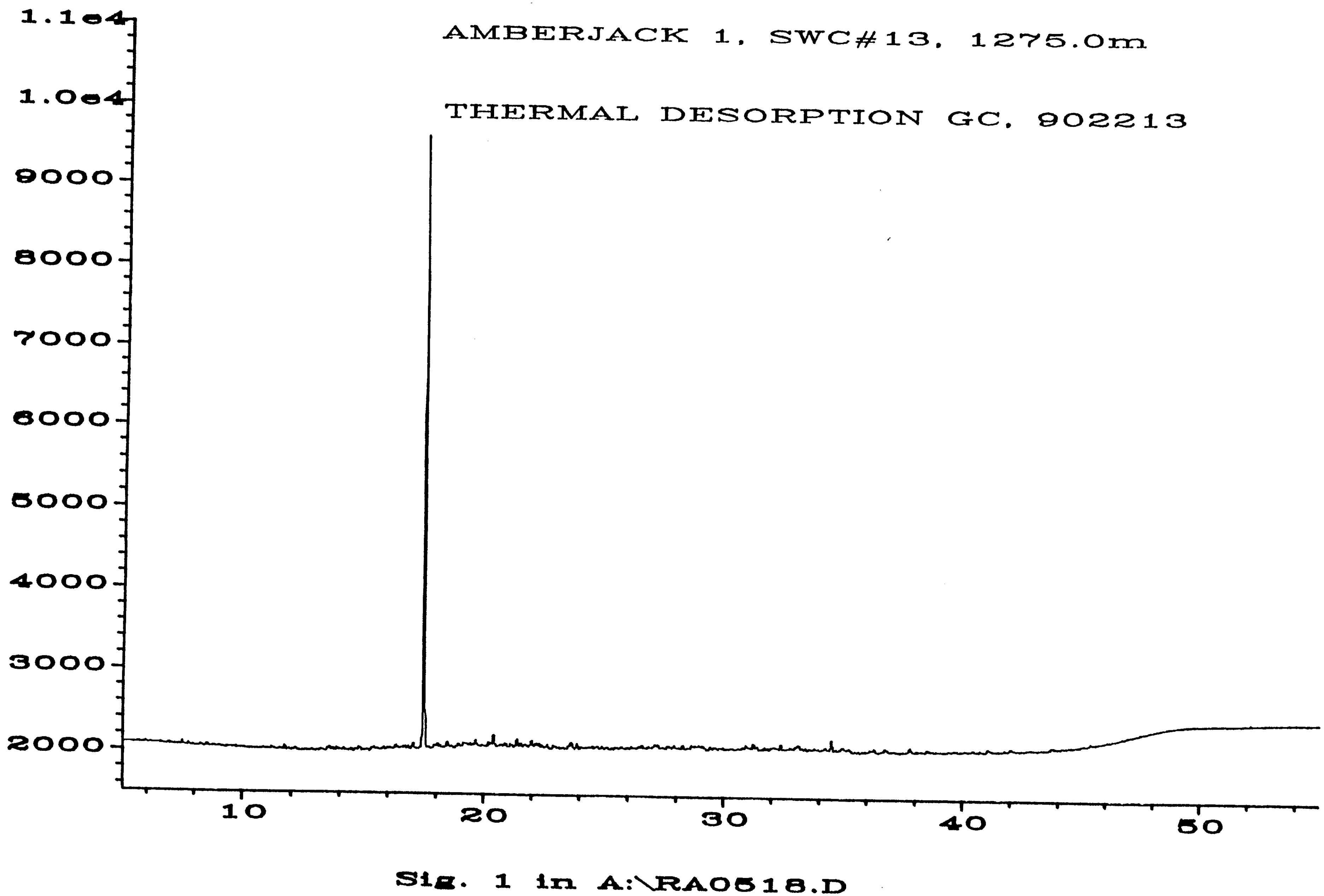
⇒ Coreplugs

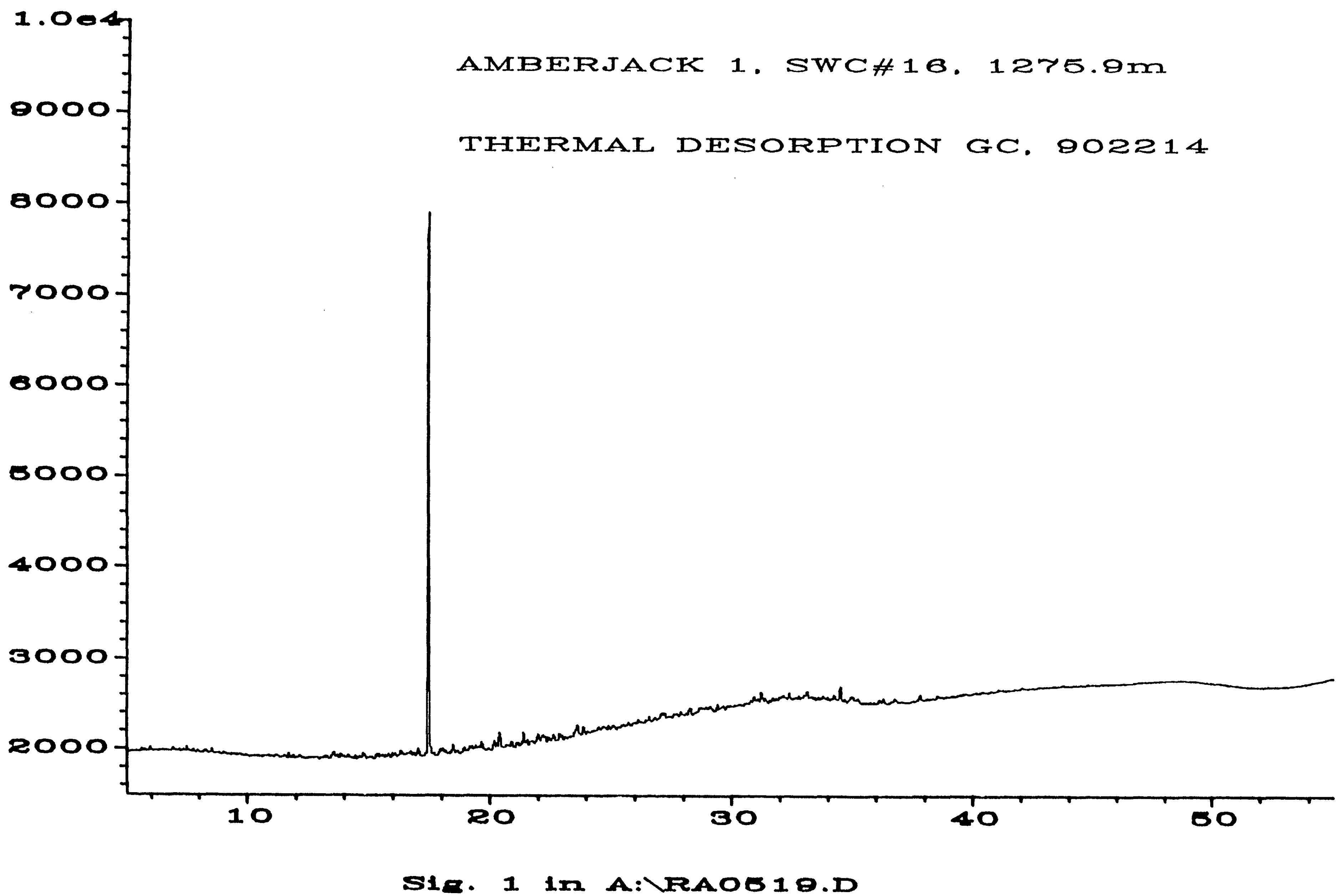

AMBERJACK 1, SWC#3, 1272m
THERMAL DESORPTION GC, 902210
1.2e4
1.1e4
1.0e4
9000
8000
7000
6000
5000
4000
3000
2000
10
20
30
40
50
Sig. 1 in A:\RA0515.D

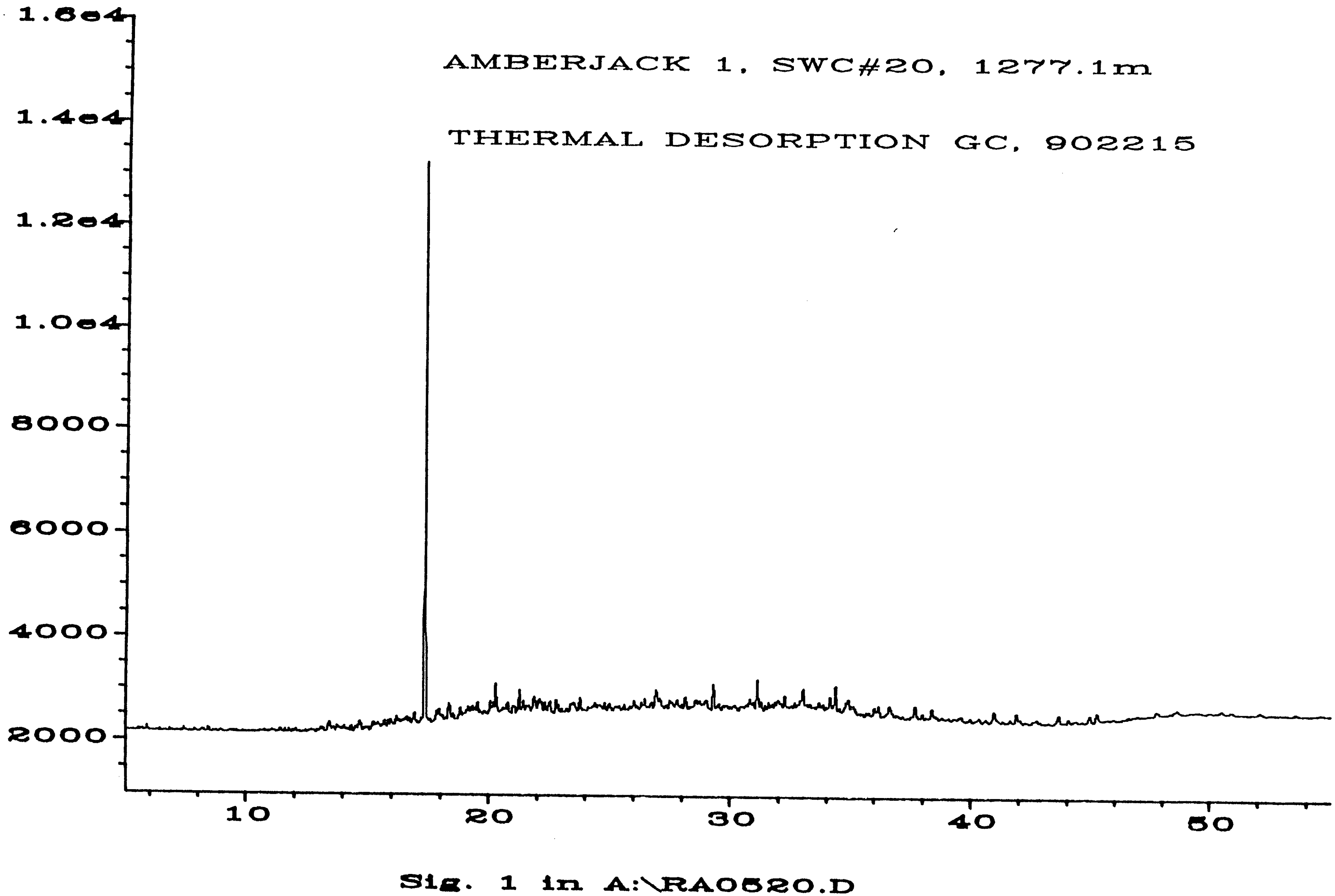


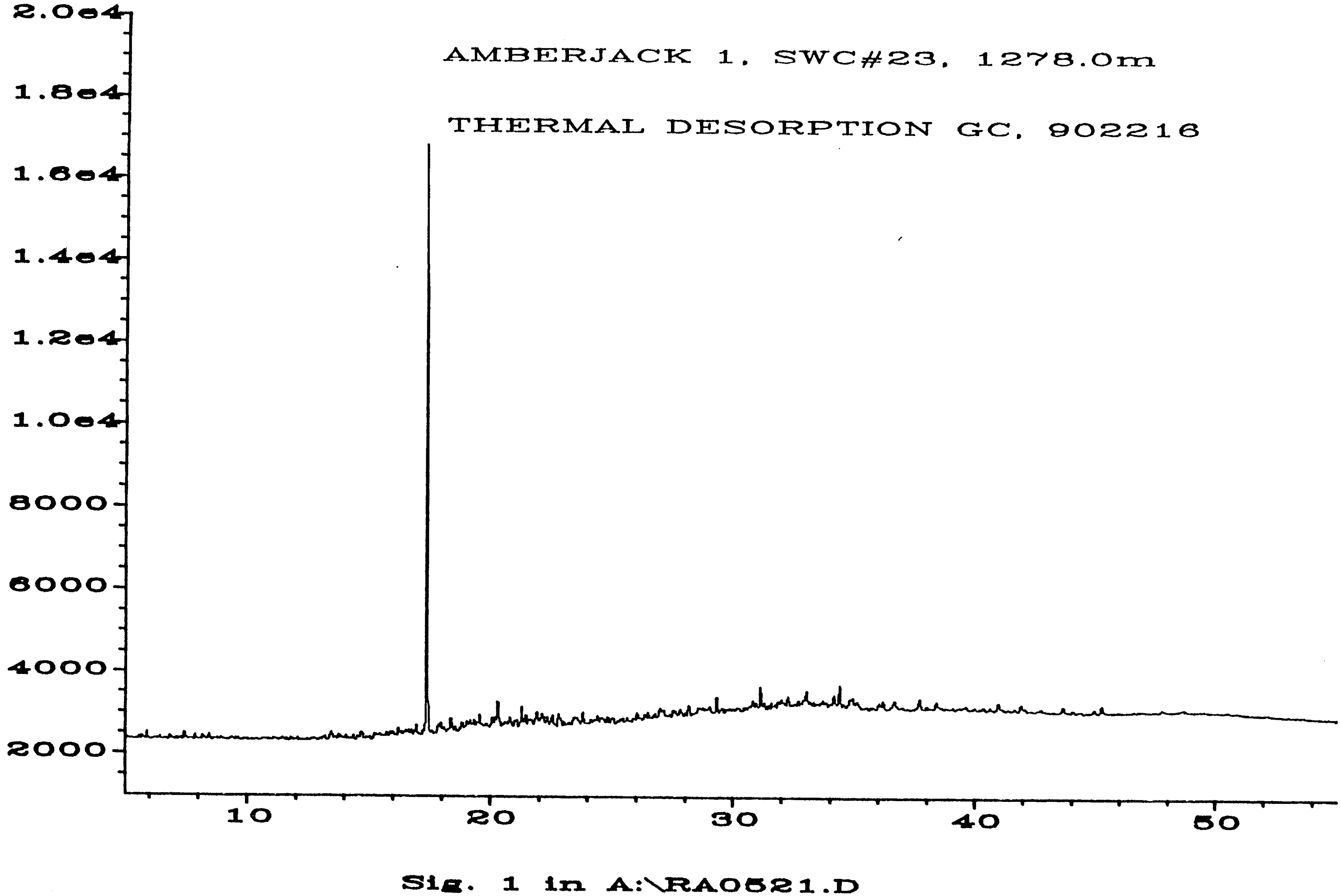
Sig. 1 in A:\RA0516.D


AMBERJACK 1, SWC#10, 1274.1m
THERMAL DESORPTION GC, 902212
1.4e4
1.2e4
1.0e4
8000
6000
4000
2000
10
20
30
40
50
Sig. 1 in A:\RA0517.D

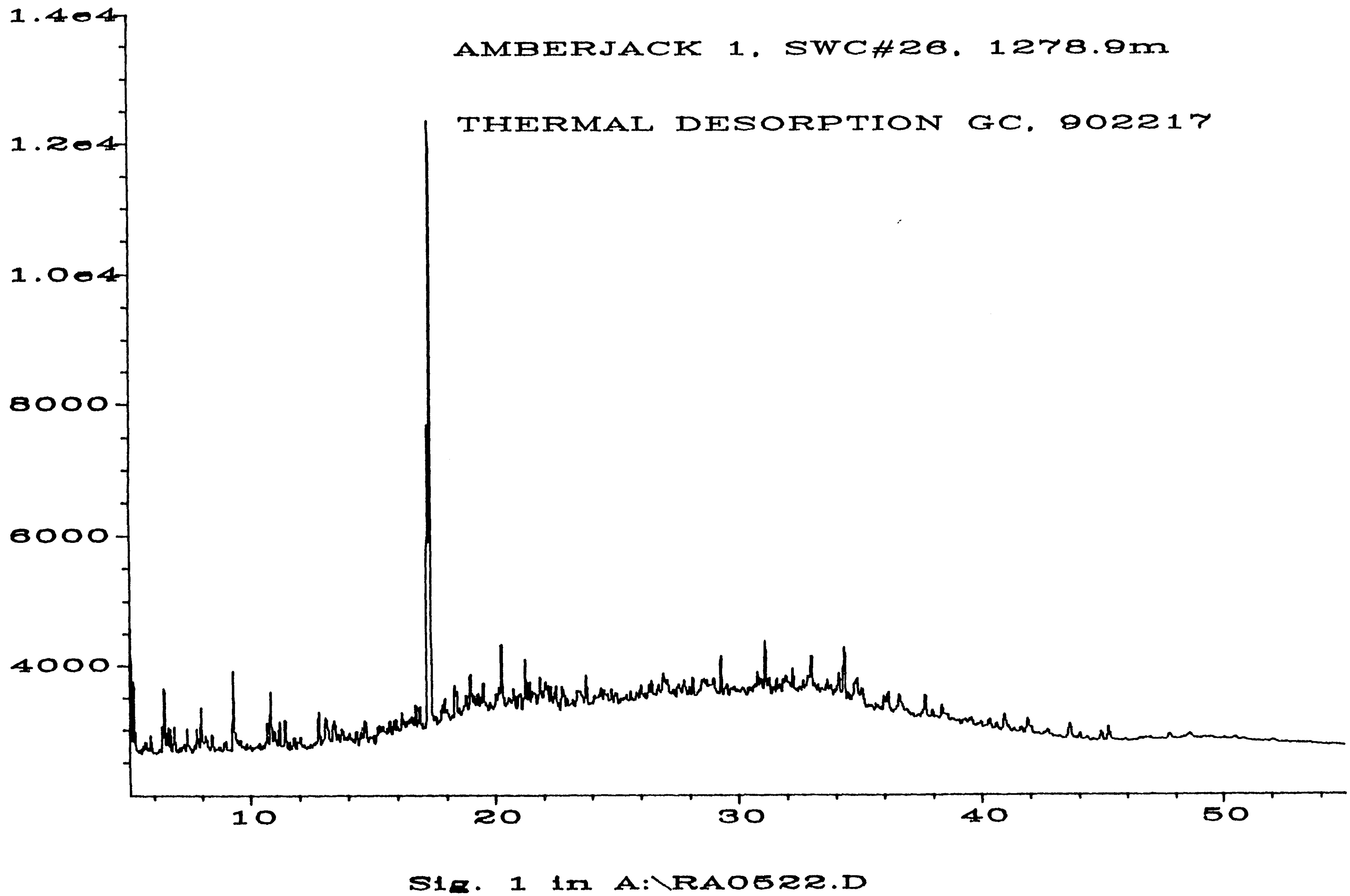

AMBERJACK 1, SWC#13, 1275.0m
THERMAL DESORPTION GC, 902213
1.1e4
1.0e4
9000
8000
7000
6000
5000
4000
3000
2000
10
20
30
40
50
Sig. 1 in A:\RA0518.D

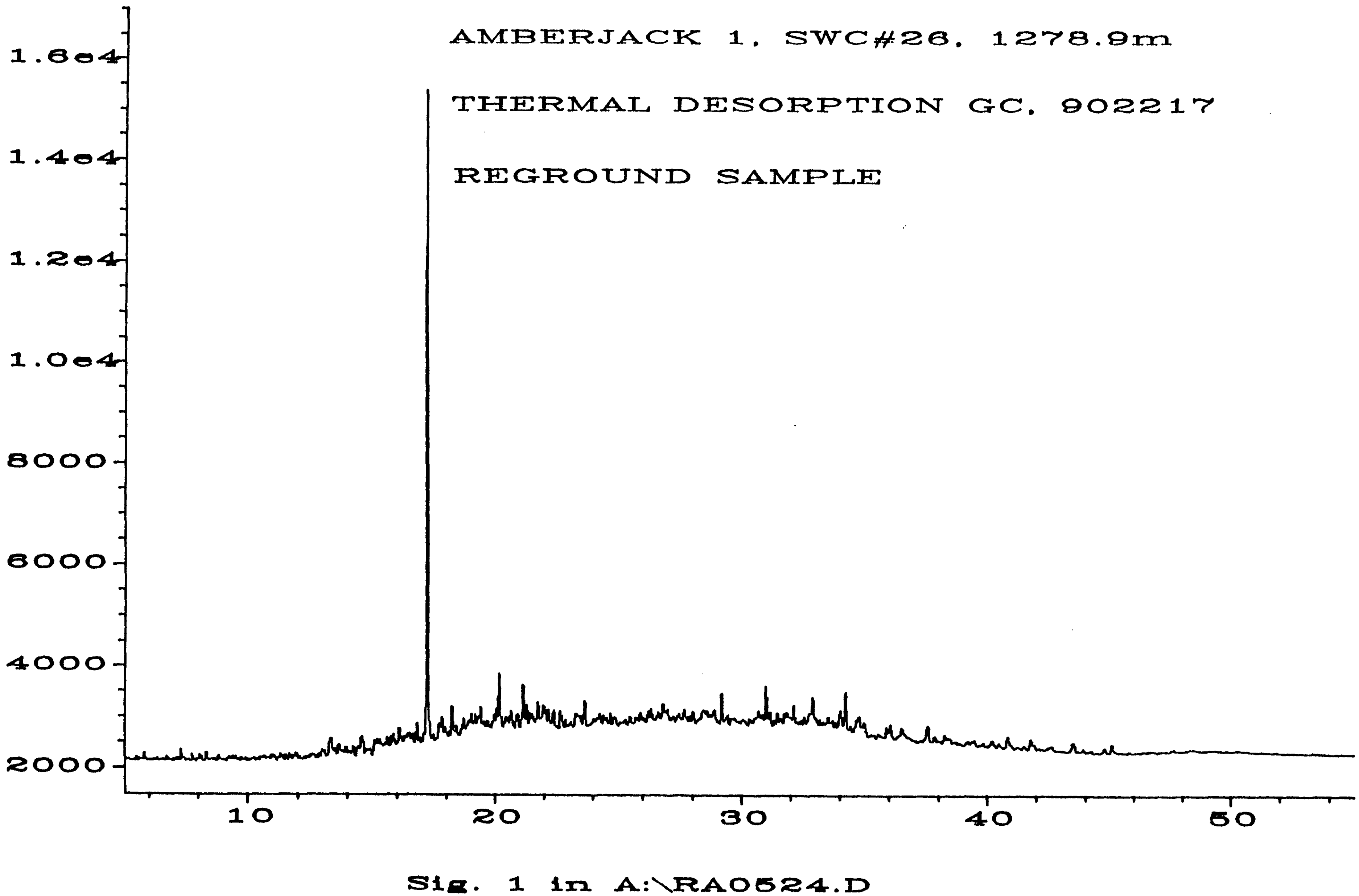

AMBERJACK 1, SWC#16, 1275.9m
THERMAL DESORPTION GC, 902214
1.0e4
9000
8000
7000
6000
5000
4000
3000
2000
10
20
30
40
50
Sig. 1 in A:\RA0519.D

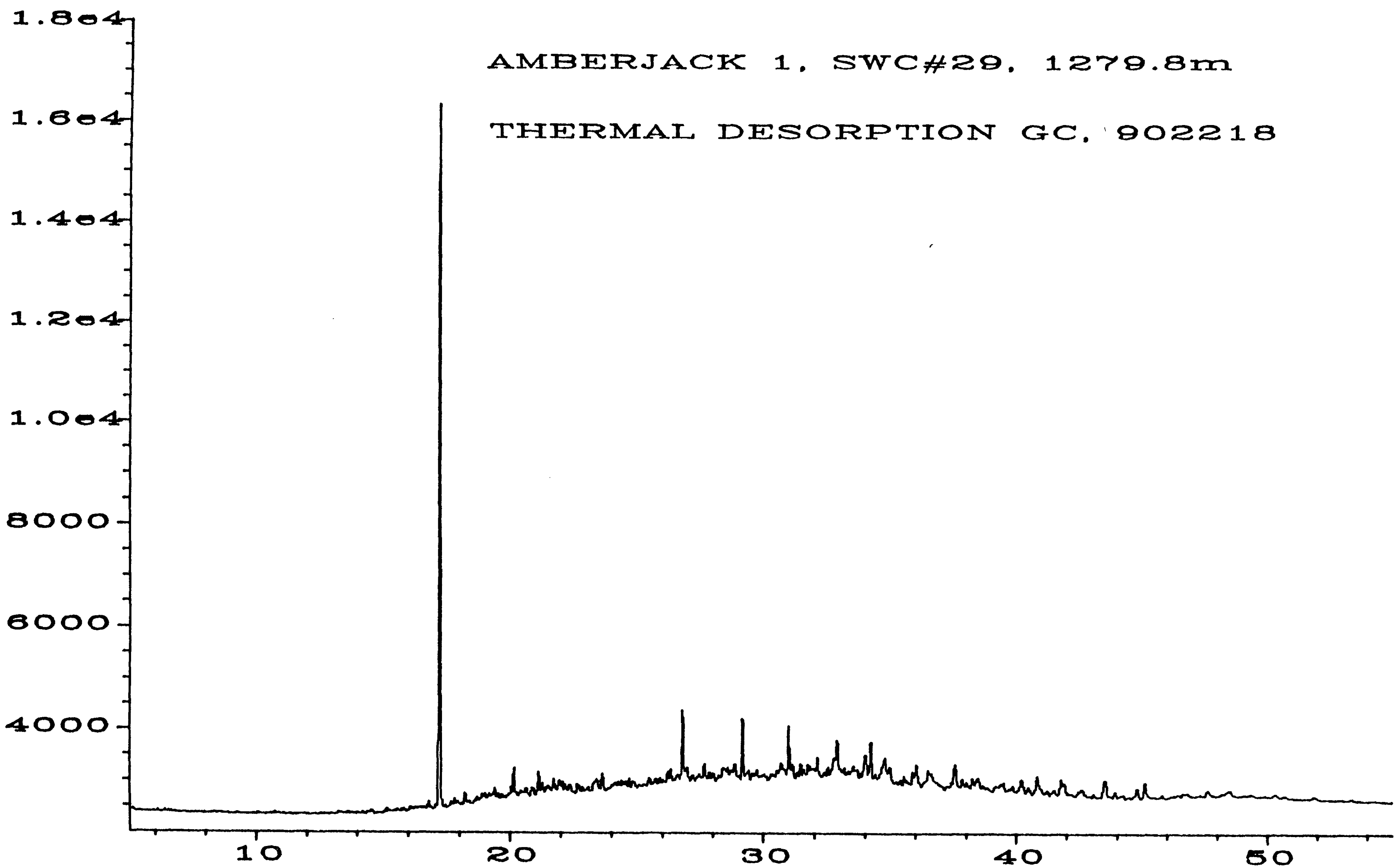

AMBERJACK 1, SWC#20, 1277.1m
THERMAL DESORPTION GC, 902215
1.6e4
1.4e4
1.2e4
1.0e4
8000
6000
4000
2000
10
20
30
40
50
Sig. 1 in A:\RA0520.D



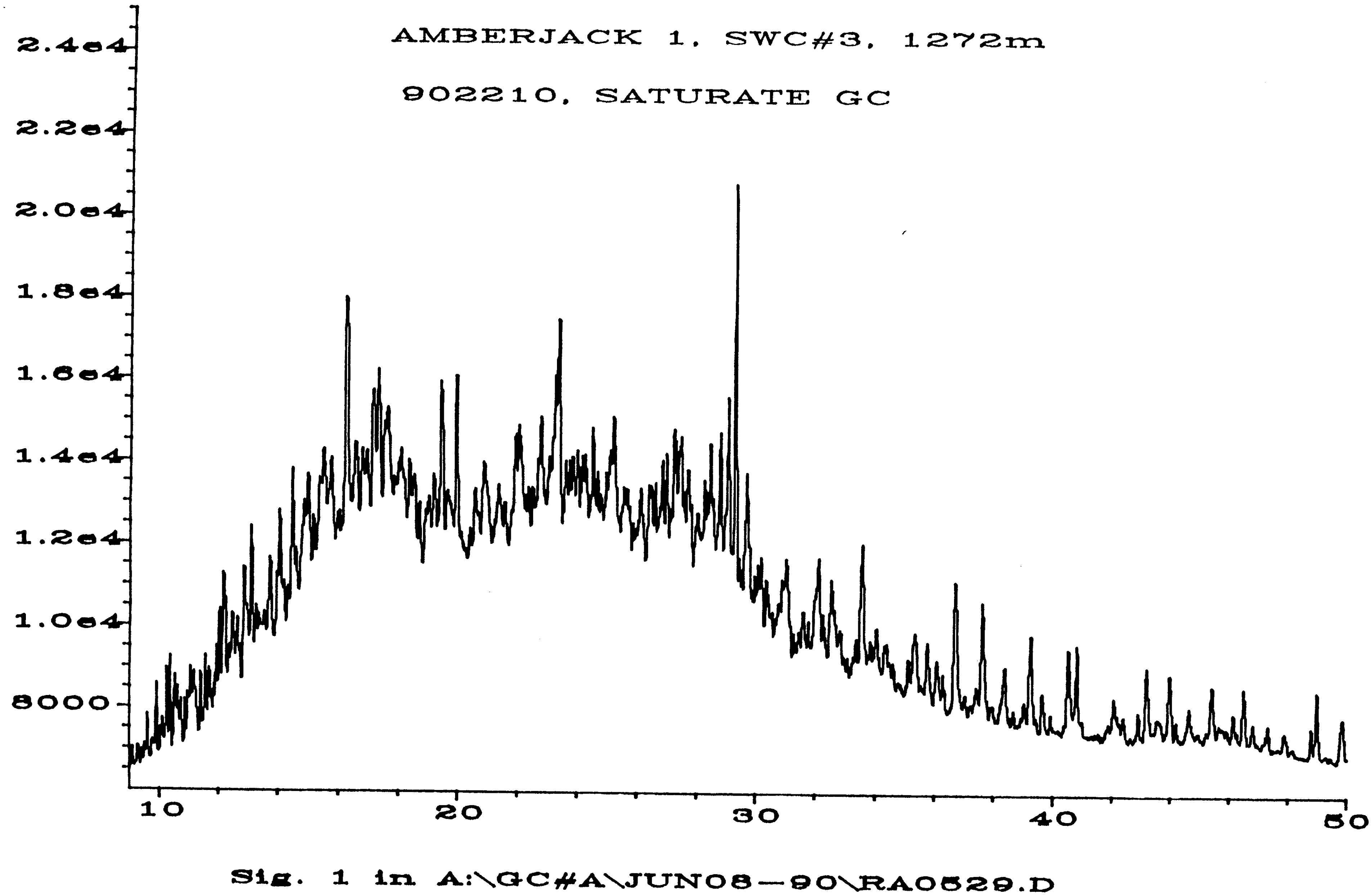
AMBERJACK 1, SWC#23, 1278.0m
THERMAL DESORPTION GC, 902216
2.0e4
1.8e4
1.6e4
1.4e4
1.2e4
1.0e4
8000
6000
4000
2000
10
20
30
40
50
Sig. 1 in A:\RA0521.D

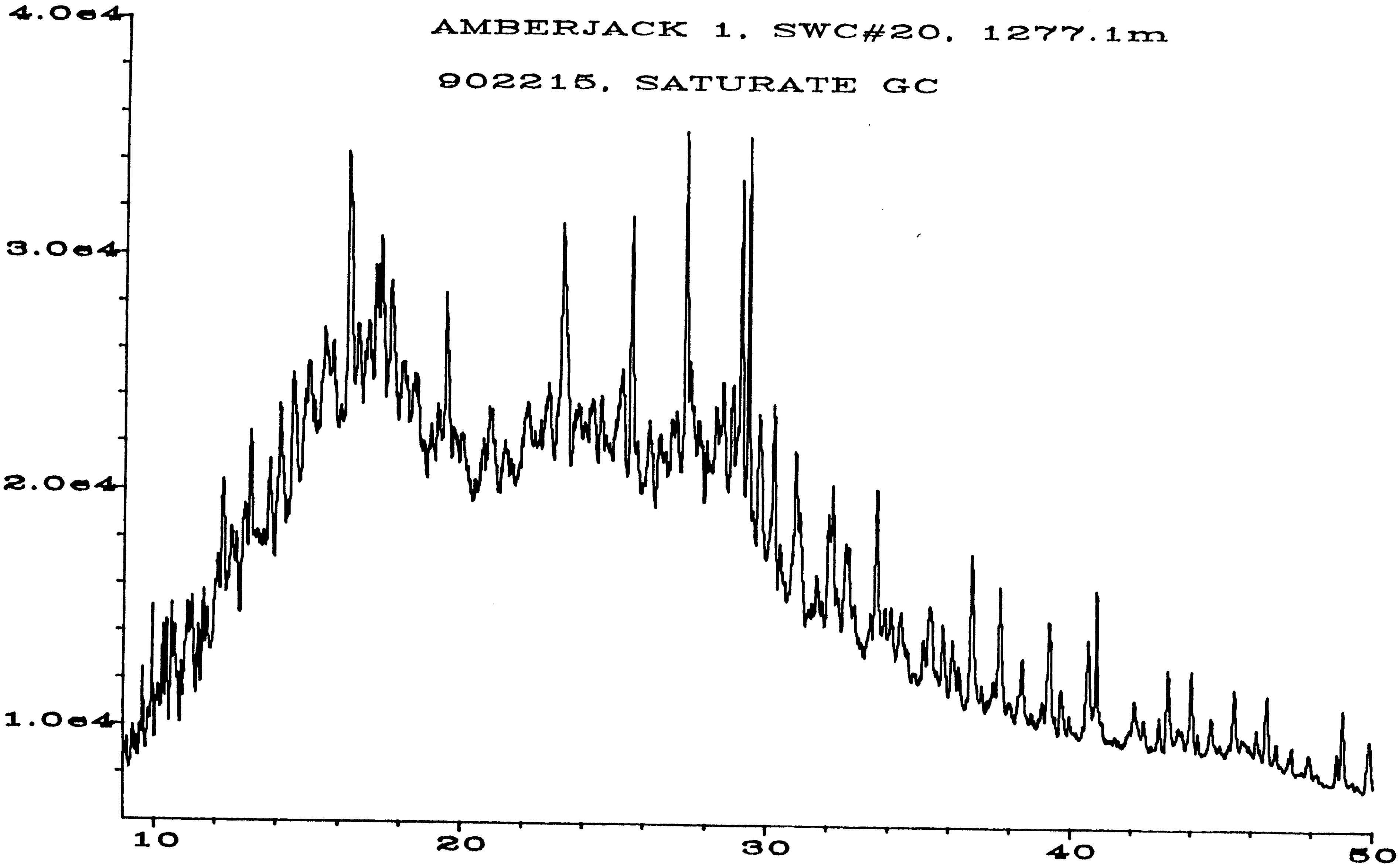

AMBERJACK 1, SWC#26, 1278.9m
THERMAL DESORPTION GC, 902217
1.4e4
1.2e4
1.0e4
8000
6000
4000
10
20
30
40
50
Sig. 1 in A:\RA0522.D


AMBERJACK 1, SWC#26, 1278.9m
THERMAL DESORPTION GC, 902217
REGROUND SAMPLE
1.6e4
1.4e4
1.2e4
1.0e4
8000
6000
4000
2000
10
20
30
40
50
Sig. 1 in A:\RA0524.D

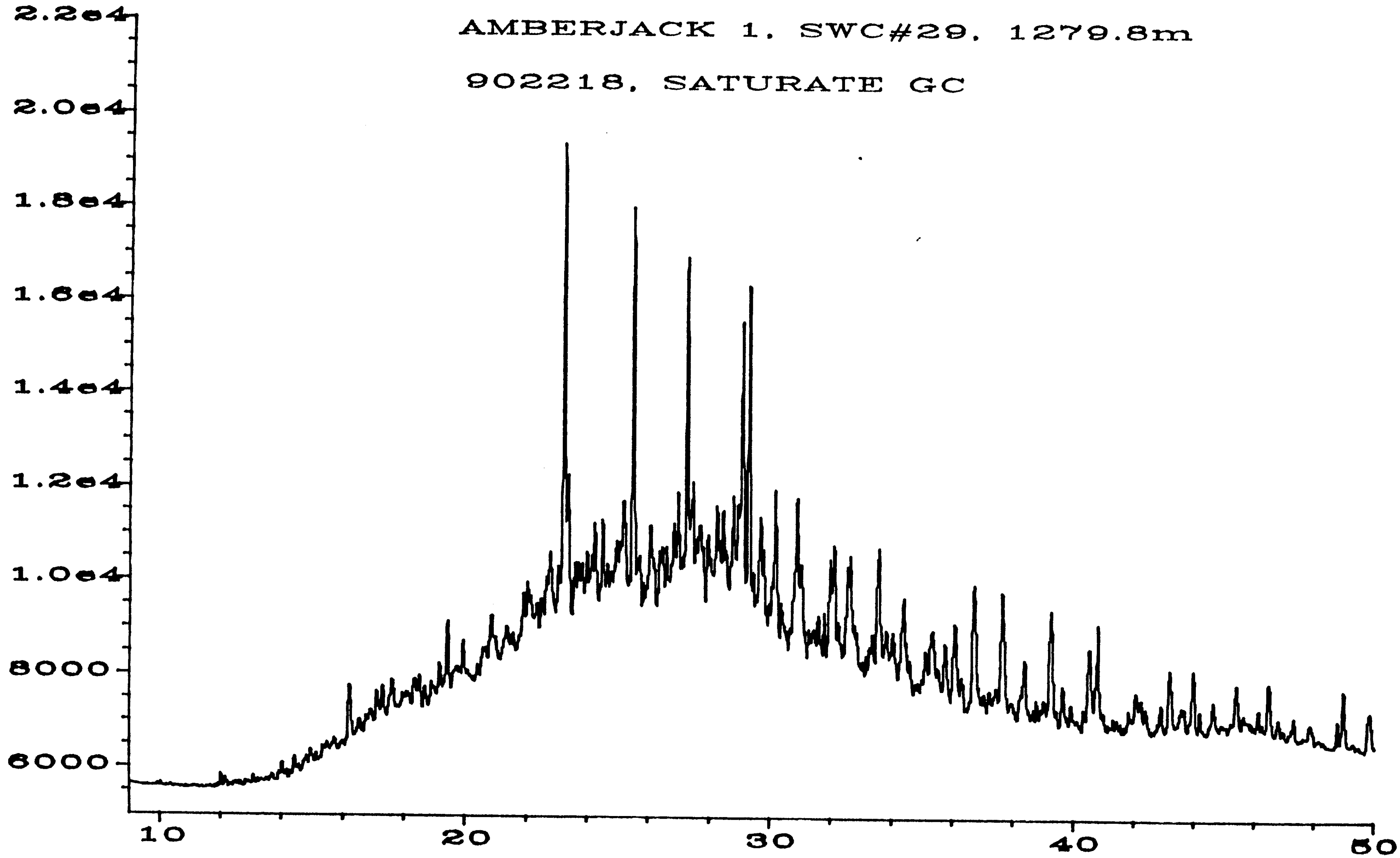


Sig. 1 in A:\RA0523.D


AMBERJACK 1, SWC#3, 1272m
902210, SATURATE GC
2.4e4
2.2e4
2.0e4
1.8e4
1.6e4
1.4e4
1.2e4
1.0e4
8000
10
20
30
40
50
Sig. 1 in A:\GC#A\JUN08-90\RA0529.D



Sig. 1 in A:\GC#A\JUN08-90\RA0528.D



Sig. 1 in A:\GC#A\JUN08-90\RA0530.D

TABLE x Extract and Separation Yields.

WELL :	CASUARINA 1	CASUARINA 1
DEPTH 1 :	1330	1331
DEPTH 2 :	1330	1331
AV. DEPTH :	1330	1331
LOCATION :	TIMOR SEA	TIMOR SEA
TYPE :	SWC#40	SWC#39
AGE :		
DATA BASE NUMBER :	902251	902250
FILE :	G071E1	G072E1
EXTRACT AND SEPARATION WEIGHT		
WEIGHT OF SEDIMENT (g)	15.01	20.02
WEIGHT OF EXTRACT (g)	0.0056	0.017
WEIGHT OF EXTRACT SEPARATED (g)		
WEIGHT OF SATURATES (g)		
WEIGHT OF AROMATICS (g)		
WEIGHT OF POLARS (g)		
CALCULATED YIELDS		
% EXTRACT YIELD	0.037	0.085
ppm EXTRACT	373	849
ppm SATURATES	ERR	ERR
ppm AROMATICS	ERR	ERR
ppm POLARS	ERR	ERR
% RECOVERY	ERR	ERR

Appendix 6

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.

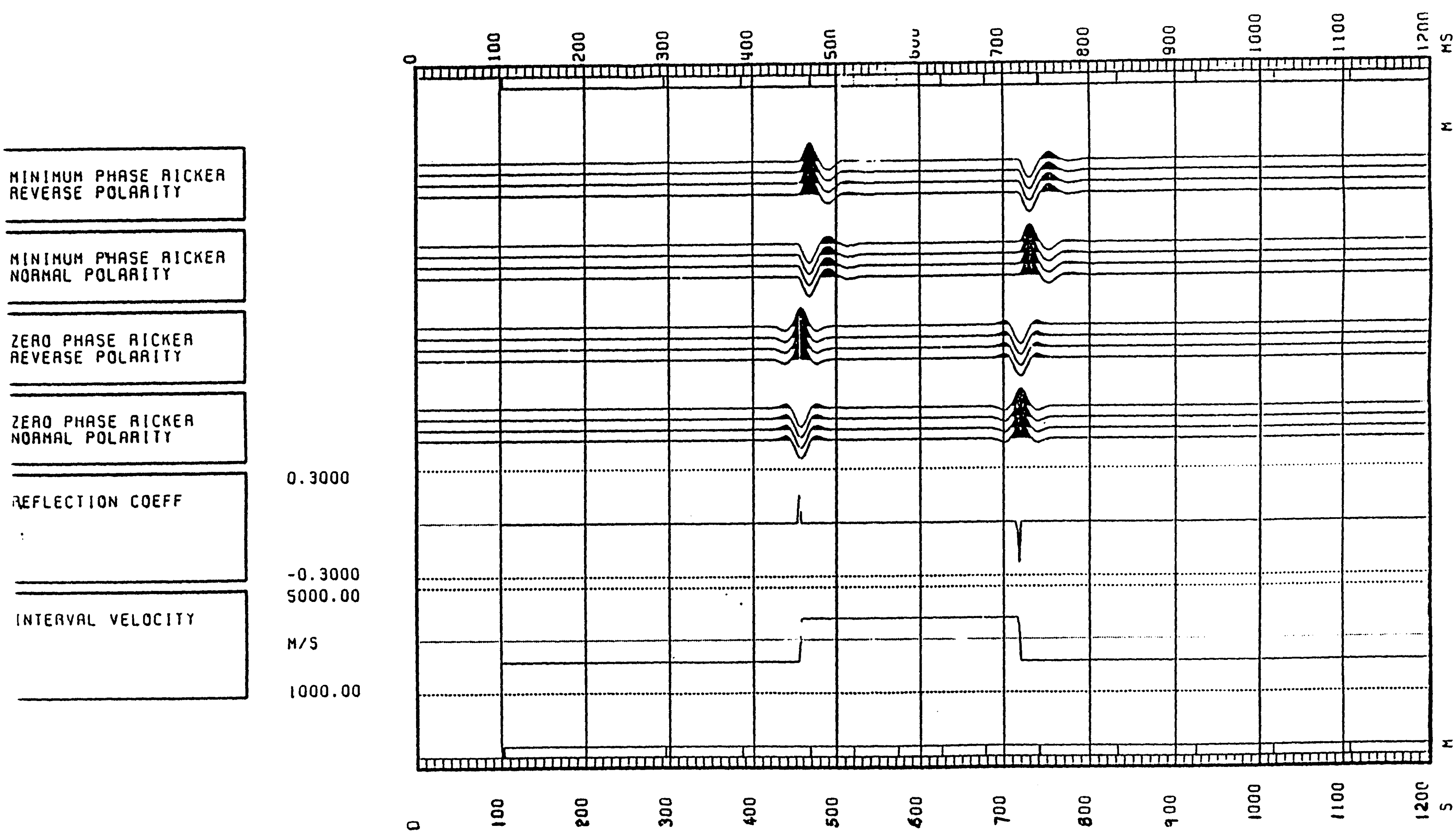
$$Primary_n = R_n.A_{n-1}$$

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



PE600925

This is an enclosure indicator page.
The enclosure PE600925 is enclosed within the container PE902078 at this location in this document.

The enclosure PE600925 has the following characteristics:

ITEM_BARCODE =	PE600925
CONTAINER_BARCODE =	PE902078
NAME =	Drift Corrected Sonic
BASIN =	GIPPSLAND
PERMIT =	
TYPE =	WELL
SUBTYPE =	WELL_LOG
DESCRIPTION =	Drift Corrected Sonic
REMARKS =	
DATE_CREATED =	14/05/1990
DATE_RECEIVED =	22/02/1991
W_NO =	W1029
WELL_NAME =	Amberjack-1
CONTRACTOR =	Schlumberger
CLIENT_OP_CO =	BHP Petroleum

(Inserted by DNRE - Vic Govt Mines Dept)