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# BASS BASIN

Tasmania, Australia
Permit T-16-P

Second Quarter Report
October 21st, 1984 to January 21st, 1985


Submitted by
Weaver Oil & Gas Corporation,
Australia
Houston, Texas USA


OR - 202

Summary

Following the drilling of the Tasmanian Devil #1 exploratory well, August 27th to September 3rd, 1984, the whole of Exploration Permit T-16-P area has been remapped at several stratigraphic levels. This was part of a major seismic mapping effort which covered both of Weaver's Exploration Permits T-15-P and T-16-P area. All the seismic maps so far generated in this effort are enclosed in this report. So are the representative seismic lines which illustrate each of the prospective structures. For purposes of regional consideration and completeness, the two permit areas are treated as a whole in this report.

The results of a regional seismic data acquisition program carried in the Bass Basin by the Bureau of Mineral Resources has been integrated with the well data and the more recent seismic data acquired by the current permit holders. These results have been presented in the form of maps, representative seismic lines, models, etc. at the Bureau of Mineral Resources, Bass Basin Symposium, held in Canberra last November. The models and concepts generated by the Bureau of Mineral Resources studies are very much in line with our own evaluation of the remaining untested hydrocarbon potential of the Bass Basin.

A new exploration concept for the Paleocene/Cretaceous objective section is presented, illustrated and discussed. This concept was generated by the Bureau of Mineral Resources scientists.

The stratigraphic section found in the Durroon #1 well is described. The sandstone porosity and permeability determinations from whole core and plug samples are listed. The reservoir potential of the objective sandstone section is described. The porosity and permeability measurements are taken as a whole and plotted against depth, or broken down by palynologic zone and plotted against depth. Reservoir deterioration does not seem to be controlled to any significant extent by increasing depth of burial. The main controlling factor appears to be the nature and amount of the matrix component and to a lesser extent the amount of the cement component. These are not so much related to depth of burial as they are to the environment at time of deposition where low energy levels did not promote the removal of the fine fraction or where differential settling of the fine fraction takes place and chokes the pore throats of the sandstone. The analysed core intervals indicate that substantial thicknesses of excellent reservoir quality sandstone are present in the Paleocene, and in the Upper Cretaceous section down to the mid-Cretaceous unconformity recognized in the Durroon #1 well at a depth of 5910 feet, or so.

Seismic data indicates that this objective reservoir section expands dramatically away from the structure on which the Durroon #1 well is located. Significant facies changes are expected.

The seismic remapping of the permit area has indicated the presence and outline of several prospects and leads. These are described and illustrated by the enclosed seismic time maps and representative seismic lines. Additional prospect definition seismic data acquisition has been recommended on the best leads and prospects. It is anticipated that data acquisition will take place towards the end of the first quarter of 1985.

All the published data and studies relevent to the source-rock evaluation of the Paleocene and Cretaceous section have been assembled and reviewed. They indicate that the objective section contain shale and fine clastics of source-rock quality and that they are rich enough and mature enough to have generated significant quantities of hydrocarbons.

One page abstract of the key papers presented at the Bureau of Mineral Resources, Bass Basin Symposium, are enclosed.

Results of the drilled and abandoned Tasmanian Devil #1 exploratory well have been discussed in the Well Completion Report and in the previous quarterly report.

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- Bass Basin surveying and deep seismic information
- Cretaceous to Paleocene structural and stratigraphic leads in the Bass Basin
- Development of concepts of hydrocarbon generation from terrestrial sources
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## Introduction

This quarterly report introduces a new exploration concept whereby the Paleocene and Cretaceous sandstone and shale sequence constitutes the objective section of tilted fault blocks located in the southeast corner of the Bass Basin.

The stratigraphic sequence found in the Durroon #1 well is described and tied to mappable seismic horizons. Seismic maps have been constructed and are described.

Conventional cores of the Paleocene/Cretaceous objective section, taken in various wells of the basin, are described as to their lithology and reservoir potential after porosity and permeability determinations.

The prospect and leads are described as to their type, location, mode of occurrence and size.

The source rock potential of the Paleocene and Cretaceous objective section is summarized.

## Play Concept

The whole of Exploration Permit T-16-P area has been remapped at several stratigraphic levels. The seismic map horizons are tied to the Durroon #1 well, as it is the nearest and stratigraphically deepest, in the general area.

Several prospects and leads have been identified and mapped, as well as could be, by using all the presently available data. These prospects and leads consist of tilted fault blocks located below, or related to, a very major unconformity, or unconformities, at the southwest margin of the late Cretaceous Rift Stage fault trend of the Bass Basin.

Results of a regional geophysical survey carried by the Bureau of Mineral Resources has been integrated with well results. These indicate that a "New Paleocene/Cretaceous Play" has been identified in the Bass Basin. The lateral facies changes anticipated to take place in this objective section are shown on Figure 3, "Suggested Hydrocarbon Migration" model. The Durroon #1 well, which displays a very sandy section, would be positioned at the right end of this model, to the southeast, while the prospects and leads would occupy the thicker central area of the model where interbedded sandstone and shale consititute the reservoir and source rock objective section, Figures 1,2,4.

Regional seismic lines tied to the Durroon #1 well indicate that the stratigraphic section expands greatly, to the southwest and to the northwest, away from this well. This is especially well illustrated by representative seismic lines WB-82-32, B-69-A-4 and B-69-A-6, Enclosures 6 & 7, 1 & 2.

The play concept calls for a thick reservoir section and a mature source

rock shale package to be present within the Paleocene/Cretaceous section. It also calls for the presence of early formed structures sealed in a timely manner by surroundings and overlying shales. Available data indicate that these requirements are present in certain areas of Permit T-16-P.

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# NEW PALEOCENE/CRETACEOUS PLAYS IN THE BASS BASIN - A 'BRIGHT SPOT' IN SOUTHEAST AUSTRALIA?

J.C.Branson, M.A. Etheridge, D.A. Falvey, K.L. Lockwood, A.S. Scherl and P.G. Stuart-Smith

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The Cretaceous to Recent Bass, Gippsland and Otway Basins lie predominantly offshore in the Bass Strait region between southeast mainland Australia and Tasmania (see map). The Gippsland Basin is responsible for more than 90% of domestic crude oil production, but the Bass and Otway Basins have yet to yield a commercial hydrocarbon discovery, despite superficial similarities of stratigraphy and evolution.

In the Gippsland Basin, hydrocarbons are largely trapped in anticlinal and fault-related structures at a Late Eocene unconformity. Structures of this age are poorly developed in the Bass Basin. However, a recent review of hydrocarbon potential by BMR scientists, had demonstrated that suitable source rocks and maturation conditions existed in the Late Cretaceous to Paleocene sequence, and that plays could be developed at that level which may justify further examination.

Exploration of this deeper portion of the Bass Basin was previously hampered by relatively poor quality of seismic data generated at and below highly reflective and reverberant Eocene coal measures. In 1982, the Bureau of Mineral Resources, Geology and Geophysics (BMR) conducted a contract seismic survey using a high energy airgun source and a 3200 metre long streamer (96 channel, 48 fold). Over

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3200 kilometres of regional lines covering the whole basin with ties to wells and adjacent basins (Gippsland and Otway) were collected along with gravity and magnetic data. These data have opened up the deeper basin beneath the Eocene coal measures and revealed new and exciting hydrocarbon plays, as well as providing a sounder basis for understanding basin formation mechanisms.

## STRATIGRAPHY

Early Cretaceous deposition filled graben and half-graben with volcanogenic detritus under fluviatile and alluvial conditions. These sediments are at least 6 km thick in the depocentres and thin to a few hundred metres or less over horst blocks and near basin margins. Seismic interval velocities and well data together with the volcanogenic nature of sediment indicate low porosity and low permeability. Slower basin subsidence prevailed in the Late Cretaceous with sediment derived from eroded Palaeozoic and Proterozoic highland regions, as well as elevated portions of horst blocks. These sediments were deposited under fluvial and lacustrine conditions. Minor marine ingressions may have occured as these are known to occur in the Otway Basin to the west. During the Paleocene-Eocene, coal deposition was widespread in what appears to have been a dominantly alluvial basin. In the latest Eocene a barrier

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to the northwest was over stepped by the sea. At the same time the marine influence was increasing in the Otway and Gippsland Basins. Widespread marine marls, limestones and clays were deposited in the Oligocene and Miocene. Marine carbonate shelf conditions prevail to the present day. Volcanism in the latest Tertiary gave rise to intrusives and extrusives in the upper section.

## STRUCTURE

The Early Cretaceous fault geometry recognized from the BMR data demands significant crustal extension, in contrast to the largely vertical movements previously proposed. The faults are planar, with shallow to moderate dips (generally to SSW), and they produce tilts of the basement surface of up to 40 degrees. This "domino-style" rotational faulting resulted from a SSW-NNE upper crustal extension of 50% to 70%. The section shows the tilt blocks and their associated half-graben. The map illustrates the short strike extent of the normal faults, due to disruption along NNE-trending, dextral transverse faults. There is not necessarily a simple strike-slip displacement across these transverse faults ( the heavily drawn fault near the basin centre is a good example), and they may therefore have essentially the same kinematic style and geometry as oceanic transform

faults. In the southeastern extremity of the basin, a near symmetrical Early Cretaceous graben is overprinted by northwest trending, Late Cretaceous tilt blocks . This episode of faulting may be related to Tasman Sea spreading.

The Early Cretaceous fault and tilt blocks play a key role in the development of hydrocarbon plays. Much of the structuring in the more prospective overlying rocks results from differential compaction over and/or rejuvenation of these deep structures. Anticlinal closures over buried tilt block corners have been extensively explored along the basin margin (e.g. Dondu-1,Bass-3). However the major hydrocarbon indications have been found closer to the basin depocentre. The Pelican gas field is located in just such a mid-basin structure. Whereas previous interpretations have correlated the Pelican structures with those along the southwest margin of the basin, this new structural model correlates them across transform-like faults with the major tilt block near Aroo-1 and Bass-1, in the basin centre. The coincidence of an Early Cretaceous tilt block with a thick Late Cretaceous to Paleocene source section is now regarded as being highly prospective, and play concepts have been developed accordingly.

PLAY CONCEPTS

One example of a number of such new, tilt-block related Paleocene/Late Cretaceous plays in the vicinity of Bass-1 is illustrated. The uppermost play (1) is associated with differential compaction over the basement high and occurs in Eocene, Paleocene and Late Cretaceous sediments. In this particlar example, direct hydrocarbon indicators (D.H.I's) are observed on the synthetic sonic log/seismic trace inversion record section. They occur at multiple depths over the structure as both velocity anomalies and 'flat spots'. The origin of such D.H.I's in this basin has not been previously tested. A deeper play (2) is related to sand aprons of Late Cretaceous age associated with the horst block. Such locally elevated areas should give rise to reworked sands during horst block erosion. The global sealevel highstand in the Late Cretaceous could provide a lateral regional seal through deposition of marine ingressive clays, particularly towards the centre of the basin. A play related to possible shale diapirism (3) in the thickest parts of the Late Cretaceous section occurs on the downthrown sides of horst blocks. The Cretaceous paleolatitudes of the region argue against evaporites, whereas overpressuring, related to shale mobilisation is known to occur around Pelican-2.

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## SUBSIDENCE AND MATURATION HISTORY

The subsidence and thermal maturation history ('geohistory') of such a new Bass Basin play have been synthesized using the seismic stratigraphy, well data from Bass-1 and an anomalous paleo-heatflow predicted by a lithospheric extension model developed by Garry Karner (now at Durham University,U.K.)

The computer generated thermal geohistory shown, was prepared for BMR by Ian Deighton (Paltech Pty. Ltd., Sydney) The analysis indicates that the entire Paleocene/ Cretaceous section falls precisely within the oil window (Ro = 0.6 to 1.3%). This is consistent with observed Eocene to Recent maturation levels in adjacent wells. Late Cretaceous and Paleocene source rocks are predicted to have commenced generation in the Miocene, after structural development of the trap. The presence of D.H.I.'s at a depth of 2 kms and above the top of the present oil window implies migration and is consistent with shows of oil observed at similar levels in Cormorant-1.

## STUDIES CONTINUE

This represents just the preliminary results from BMR's Bass

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Basin Study. Work is continuing on other aspects of the new seismic data: a complete structural and stratigraphic synthesis of the Bass Basin; Otway and Gippsland Basin correlations; deepwater Otway and Gippsland Basin studies; and a sedimentological study including work on diagenetic processes being conducted by Monash University (Melbourne).

The majority of this survey data, including the seismic inversion sections, were released to the public between October 1983 and February 1984. The open file data includes processed record sections, digital field tapes and digital stack tapes. The total cost of this survey was $3 million.

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# FIGURES

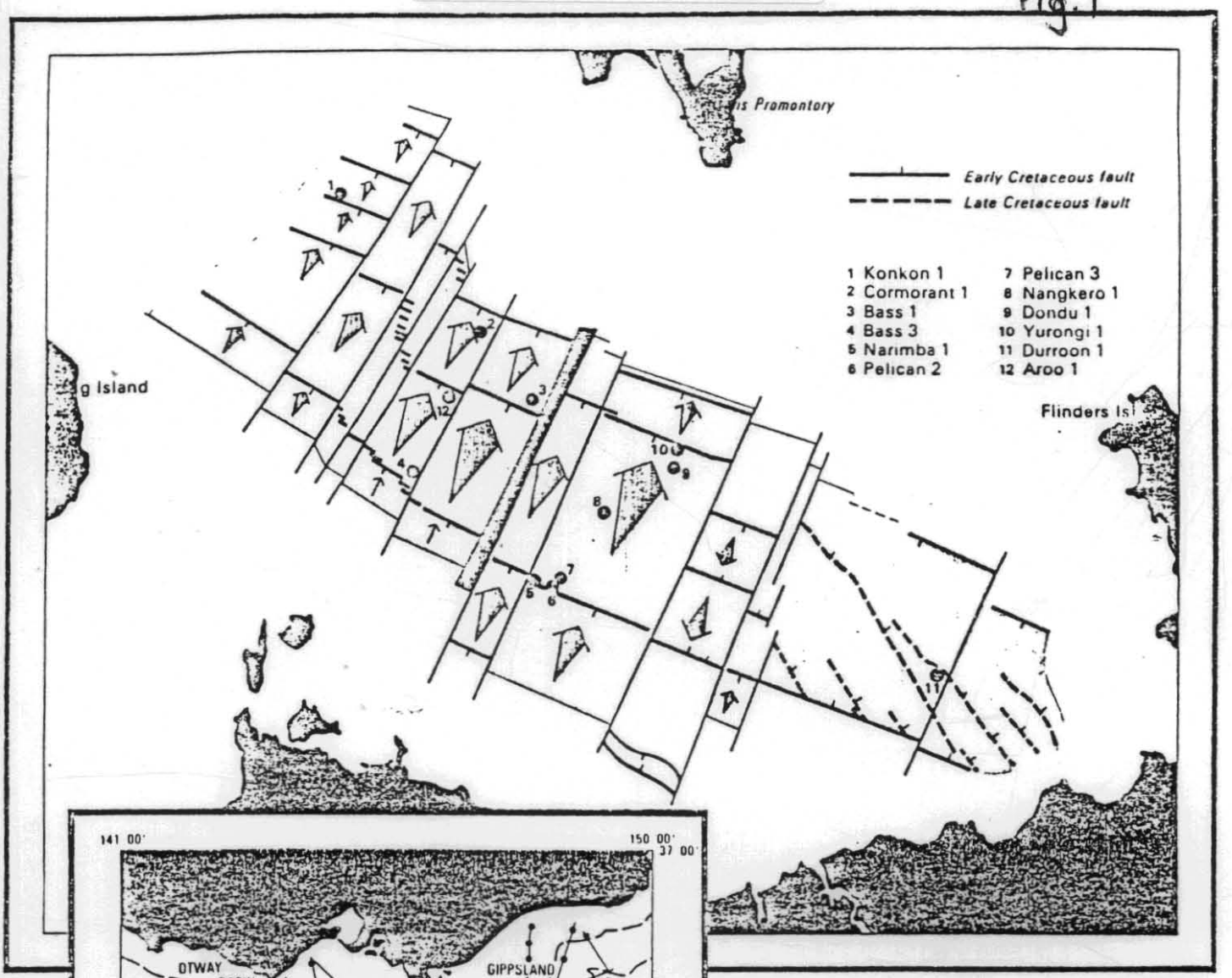
Figure 1. Early Cretaceous structures and sedimentary wedges (green arrows indicate thicknesses of sediment) Regional seismic traverses by BMR 1982.

Figure 2. Play concepts and an equivalent seismic inversion line near Bass-1. Bright spot at 1.55 twt.

Figure 3. Thermal history, subsidence & heatflow curves, near Bass-1 well Bass Basin.

5 cm

Fig. 1


Early Cretaceous fault
Late Cretaceous fault
1 Konkon 1
2 Cormorant 1
3 Bass 1
4 Bass 3
5 Narimba 1
6 Pelican 2
7 Pelican 3
8 Nangkero 1
9 Dondu 1
10 Yurongi 1
11 Durroon 1
12 Aroo 1
Flinders Isl
141 00'
150 00'
37 00'
42 00'
OTWAY BASIN
GIPPSLAND BASIN
King I
Flinders I
200
3000
700
3000
• Exploration well

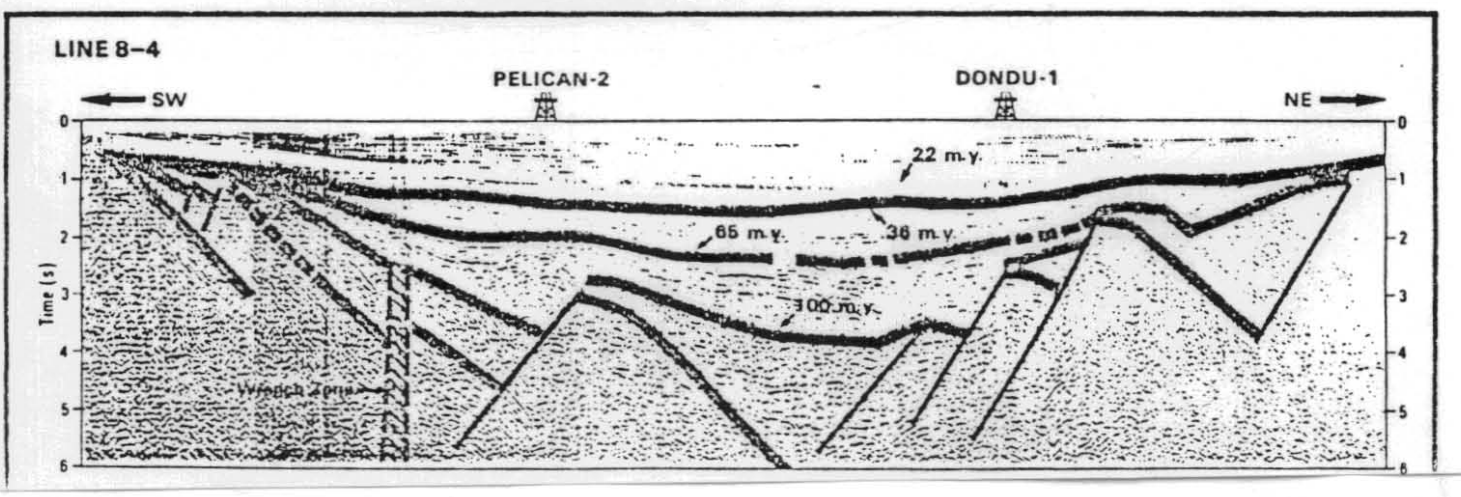
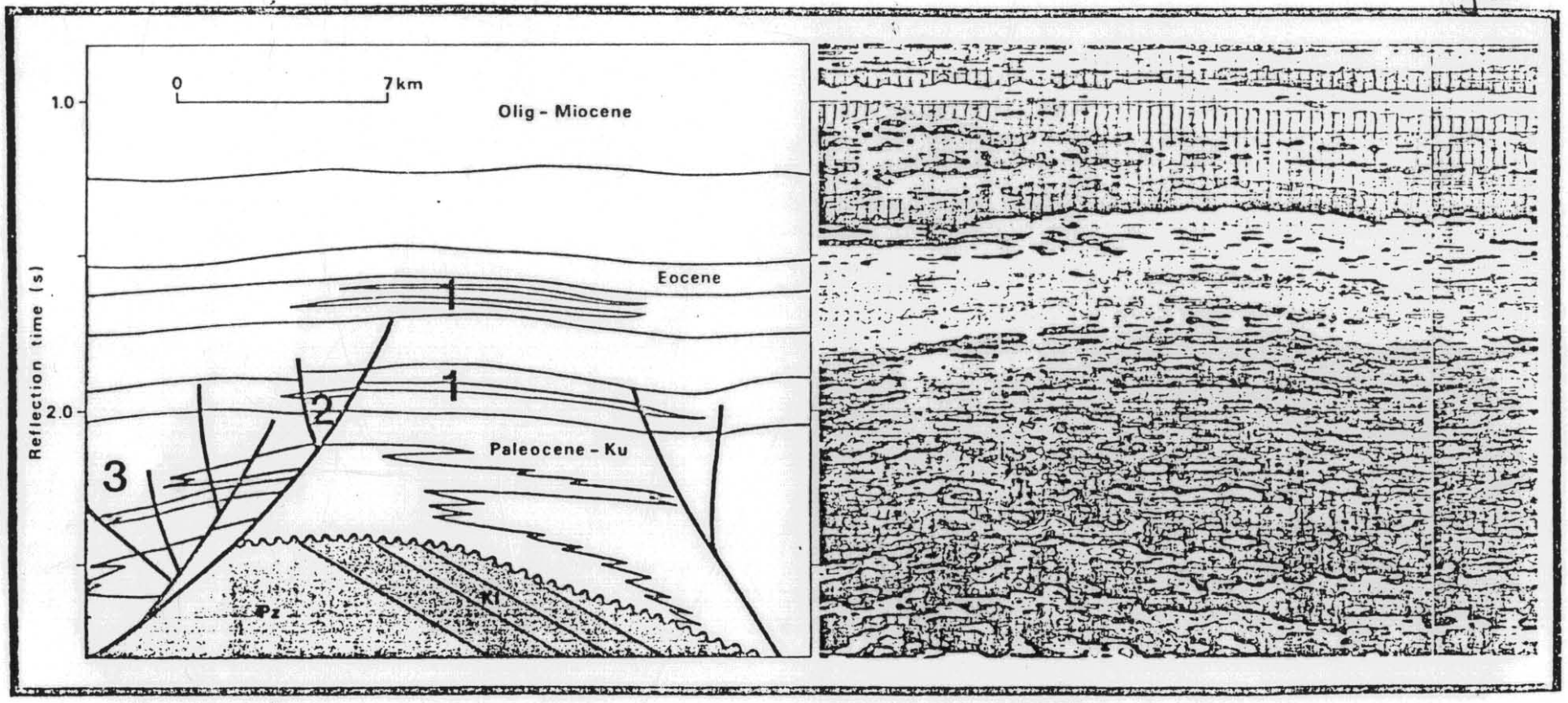

LINE 8–4
SW
PELICAN-2
DONDU-1
NE
Time (s)
22 m.y.
65 m.y.
36 m.y.
300 m.y.
Wrench Zone

Fig.2




5 cm

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Fig. 3

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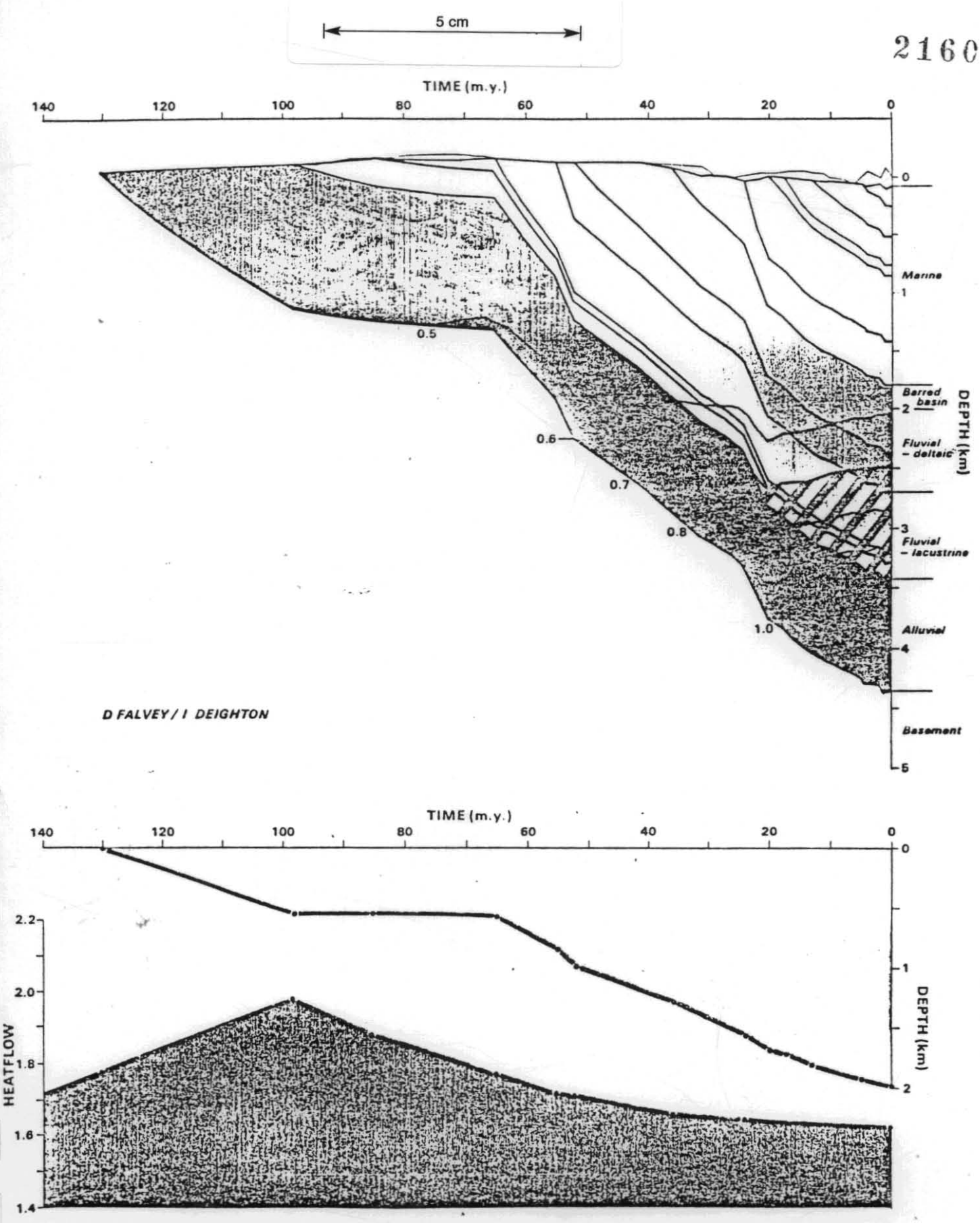
5 cm
TIME (m.y.)
140
120
100
80
60
40
20
0
0.5
0.6
0.7
0.8
1.0
Marine
Barred basin
Fluvial – deltaic
Fluvial – lacustrine
Alluvial
Basement
DEPTH (km)
1
2
3
4
5
D FALVEY / I DEIGHTON
TIME (m.y.)
HEATFLOW
2.2
2.0
1.8
1.6
1.4
DEPTH (km)

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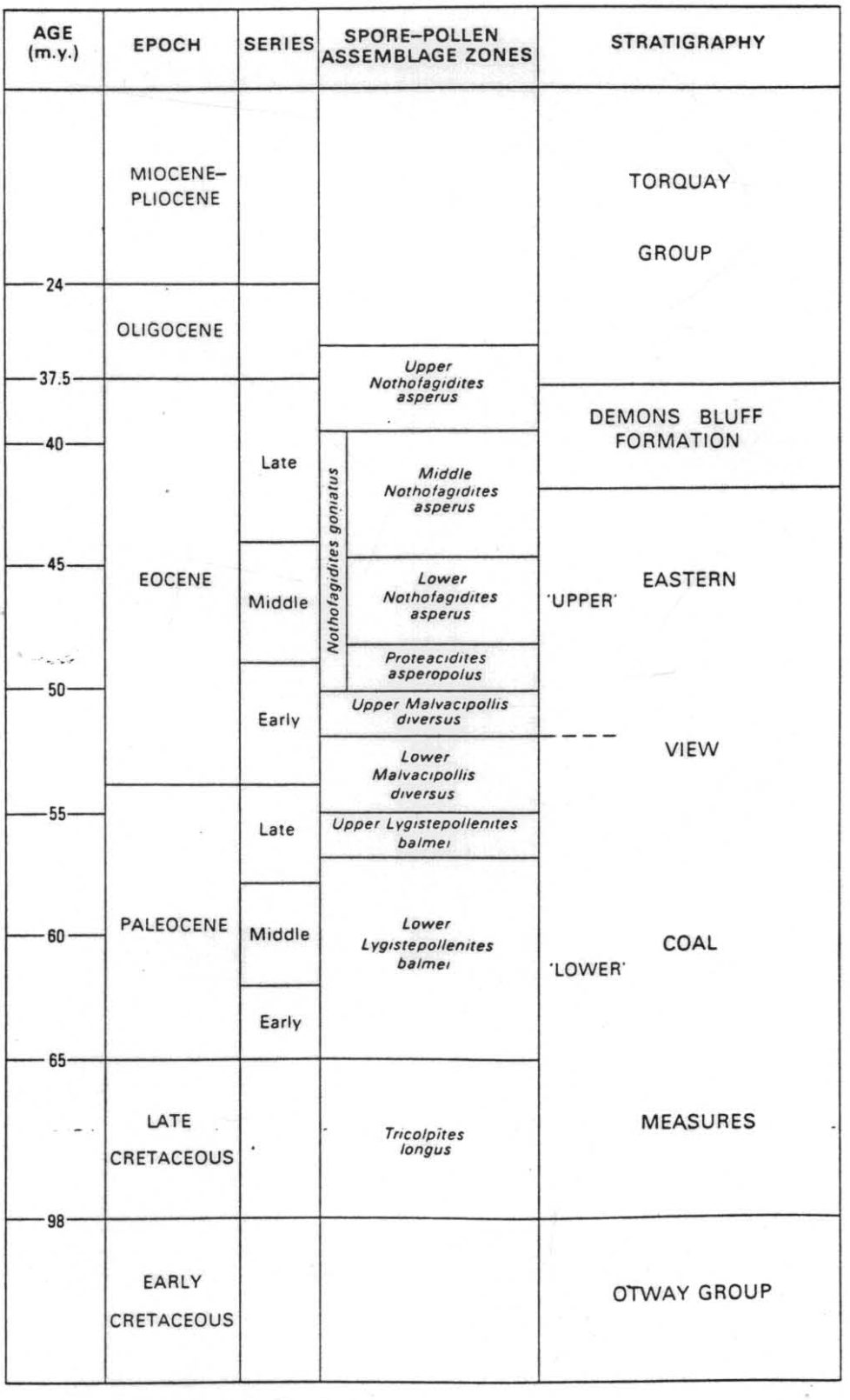


**Stratigraphy of the Bass Basin**

Figure 1

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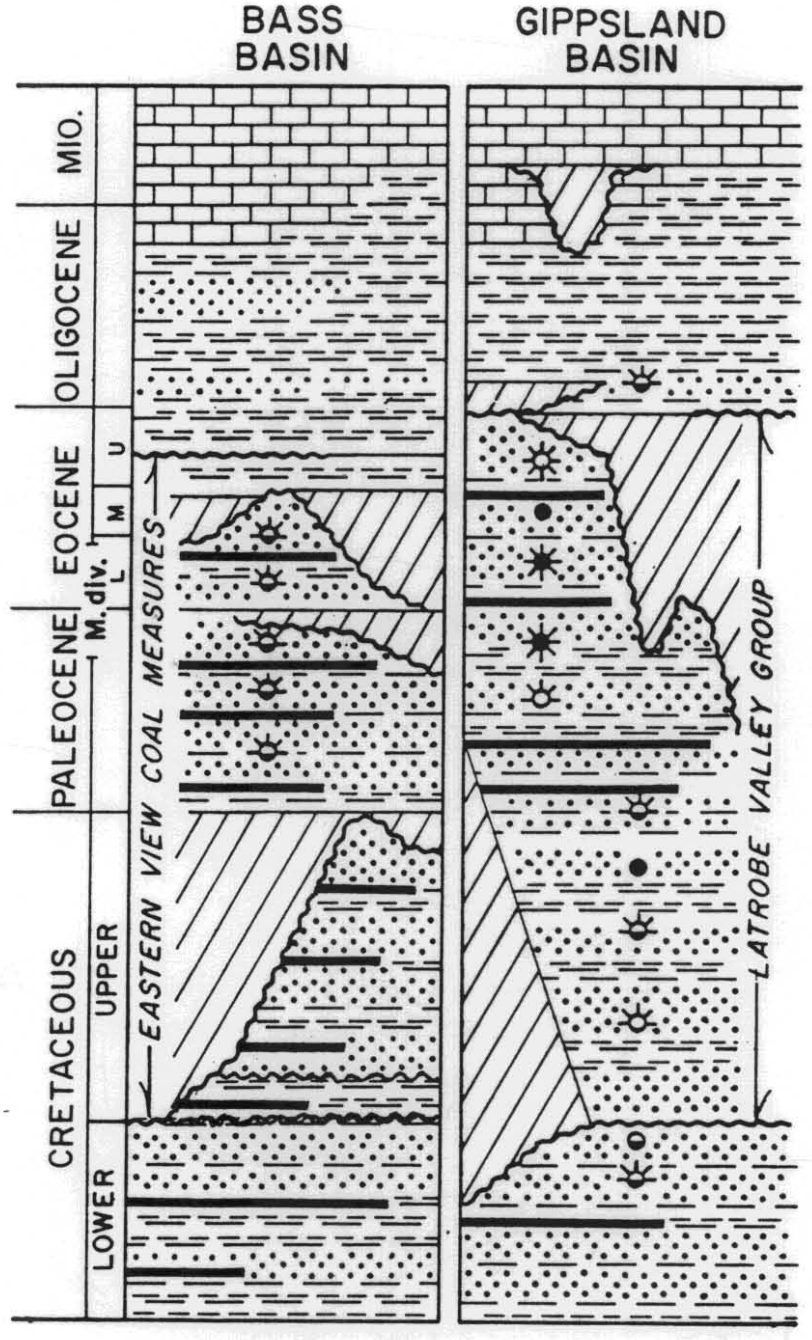


Figure 2

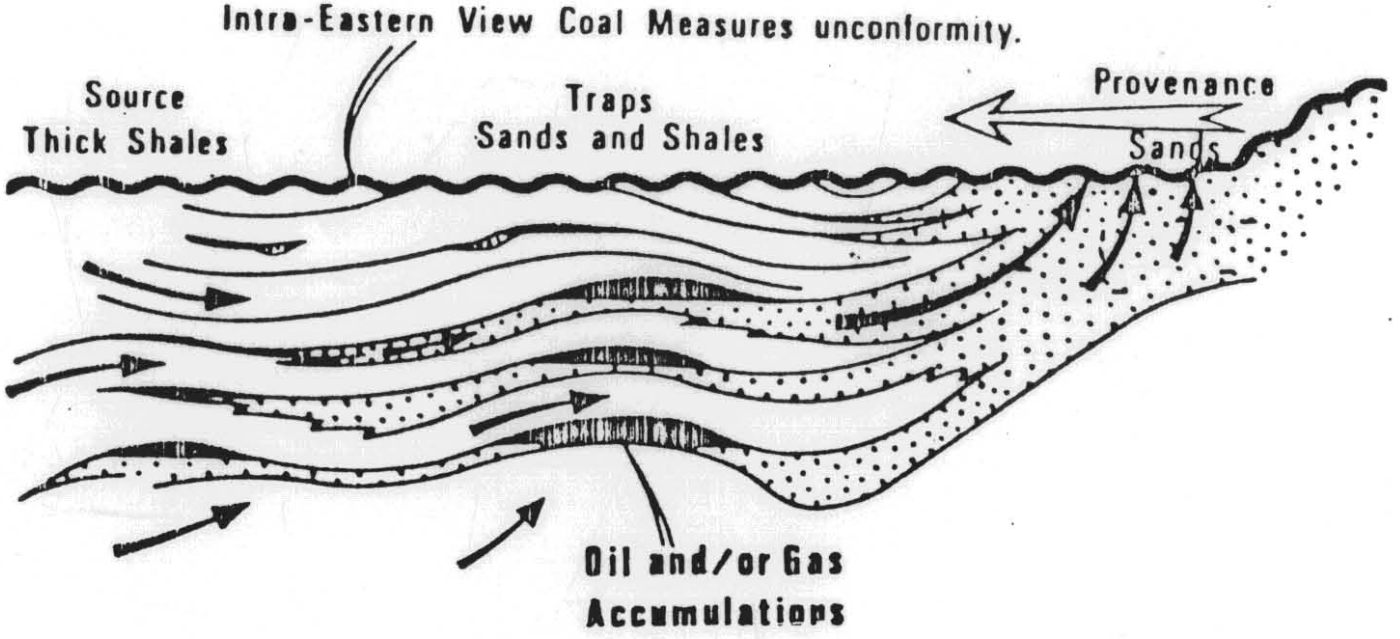


Figure 3

Suggested hydrocarbon migration.

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Durroon #1

The Duroon #1 well was drilled in 1972 by ESSO Australia Pty Ltd on Hematite Petroleum Pty Permit T-6-P of the Bass basin. The well was located in 225 feet of water and reached a total depth of 9922 feet before being plugged and abonadoned as a dry hole. A total of 90 sidewall cores were attempted and 85 were recovered. Five intervals were cored and three of these had recoveries. One FIT test was attempted. The interval was tight and no fluid or gas recovered.

The stratigraphic section found in this well is described in general terms. It is divided in intervals on the basis of lithology, palynologic zonation and seismic reflectors. The various electrical logs, sample studies, sidewall cores and conventional core description have been used. More details can be found in the well completion report.

The key seismic reflectors and map horizons are identified. It should be kept in mind that the Durroon #1 well is located on a very major tilted fault block. The sequence and facies found in this well may not be representative of the condition which prevailed over the wider basin area , Figures 4,16,17,18.

656' - 1225'

This interval, starting at the base of the casing, consist of interbedded marlstone and claystone. Sidewall cores at 807' and 996' are described as marl; very fossiliferous, light green. A sidewall core at 1122' is described as claystone; light green, very fossiliferous. Sample studies are mostly unreliable due to the softness of these sediments and the poor, washed out, returns. This interval is probably Oligocene-Miocene in age. Its interval velocity is 7200 feet per second.

1225' - 1500'

On the basis of three sidewall cores, this interval is described as siltstone; grey-green or brown, sandy, argillaceous, glauconitic. This interval is probably Oligocene-Miocene in age. Its interval velocity is 7100 feet per second.

1550' - 1770'

On the basis of sidewall cores, this interval is described as sandstone; white, very fine to fine, well sorted, rounded, interbedded with minor shale towards the base. Sample studies indicate the presence of sandstone; frosty, fine to medium to very coarse, subrounded to subangular. The interval is assigned to the P. tuberculatus palynologic zone of the Oligocene-Miocene. Its interval velocity is 7100 feet per seconds.

1770' - 1900'

This interval consist of brown shale with very fine grained sandstone stringers or minor beds. Its upper portion, to 1847', is assigned to the P. tuberculatus palynologic zone of the Oligocene-Miocene. From 1847' down it is assigned to the lower N. asperus palynologic zone of the Eocene. A very major hiatus or unconformity is therefore recognized at this depth. The upper and middle N. aspersus palynologic zones of the Eocene are missing and so is the Demons Bluff Formation or Eocene Shale. The top Eastern View Coal Measures defined as the first major occurence of sandstone in the Eocene is at approximately 1900 feet. The nearest reflector on seismic line WB-82-32, through this well, is identified as top Eocene Eastern View Coal Measures (unconformity) Enclosure 7.

1900' - 2196'

This interval consist of sandstone; white, medium grained, unconsolidated. Palynological zonation is not possible due to the coarse nature of the sediment. Nevertheless, this massive sand section represents the undifferentiated P. asperopolus, upper M. diversus, mid M. diversus and lower M. diversus palynologic zones of the Eocene. Its lower boundary is a very major hiatus or unconformity.

The interval velocity of the section 656'-2196' is 7000 to 7300 feet per seconds. A substantial increase to 8300 feet per seconds is noted at 2100' or so.

The nearest reflector on seismic line, WB-82-32, through this well, is identified as Paleocene L. balmei (unconformity) Enclosure 7.

2196' - 3415'

This interval consist mostly of sandstone interbedded with lesser amounts of shale and minor amounts of siltstone.

The sandstone is described in sidewall cores as frosty white, very fine to very coarse grained, poorly to moderatley sorted, rounded, friable. The shale is grey or brown, carbonaceous, sandy, micaceous. Sample studies indicate that the sandstone contains traces of lignite, pyrite and mica.

This interval is assigned to the L. balmei palynologic zone of the Paleocene. Its lower boundary appears to be conformable although a significant increase in interval velocity from 8300 feet per seconds to 9200 feet per seconds is noted. This may represent a significant hiatus.

3415' - 3844'

This interval consist mostly of sandstone interbedded with lesser amounts of shale. The sandstone is light grey to grey, medium to coarse grained, well sorted, subangular to subrounded with traces of lignite, pyrite, mica, light green grains. The shale or mudstone is grey.

This interval is assigned to the T. longus palynologic zone of the Paleocene. Its lower surface marks the boundary with the Upper Cretaceous section. This boundary may represent a hiatus or local unconformity surface.

3844' - 4492'

This interval consist mostly of sandstone with lesser amounts of shale and siltstone. The sandstone is frosty white, very fine to coarse grained, angular to subrounded with abundant mica. The shale or mudstone is light grey to grey, carbonaceous. The siltstone is light grey, slightly sandy.

This interval is assigned to the T. Lilliei and N. Senectus palynologic zones of the Upper Cretaceous.

A very significant unconformity is recognized at the base of this interval as most of the N. senectus section is missing and the entire upper T. pachyexinus and lower T. pachyexenus palynologic zones are totally absent.

A significant reduction in interval velocity from 9200 down to 8000 feet per seconds is also noted at the base of this interval.

For purposes of seismic mapping, the upper boundary of this interval (3844') is called "Upper Cretaceous" horizon.

Also for purposes of seismic mapping, the lower boundary of this interval (4492') is called "intra-Upper Cretaceous Unconformity" horizon.

4492' - 5065'

This interval consist of shale with very rare and minor siltstone. The shale or mudstone is dark grey to black, carbonaceous, fissile. The siltstone is dark grey, carbonaceous.

This interval is assigned to the C. triplex and A. distocarinatus palynological zones of the Upper Cretaceous. Its upper boundary is the intra-Upper Cretaceous Unconformity while its lower boundary, with bright red siltstones, may represent a significant change in depositional environment, a reworked zone, one of aerial or subaerial exposure, (weathered zone) or methasomatism associated with volcanic activity.

Its interval velocity is uniformly 8000 feet per seconds.

The dipmeter interpretation log indicates a significant change at approximately 5000'. Down to about 4750', the dip segments are 0° to 30° with random orientation. From 4750' to 4950', the dip is toward the west at an average angle of 25°. At 5000', or so, the dip is towards the northwest, increasing with depth from less than 20° up to 35°. A minor down-to-the northeast normal fault is recognized at this depth on seismic data. Random dips are measured over the interval 5065' to 5400' or so.

5065' - 5400'

Sample studies describe this interval as siltstone; quartzose in part, white or bright green, bright red, grey-blue, hard, tight, sandy, trace calcite interbedded with shale or mudstone; dark grey, grey black or red brown, soft, carbonaceous.

Detailed petrographic studies of cutting's over the interval 5060' to 5400' describe one hand specimen, from unknown depth within this interval, as a black, very friable, altered vesicular olivine basalt. In thin section it is described as, a highly altered amygdaloidal volcanic rock. The amygdules are filled with fine grained pale green chlorite and clay. The chloritization is believed to be of deuteritic origin. A second hand specimen, also from unknown depth within this interval, is described as a medium grained, grey and black, porphyritic olivine basalt.

A third hand specimen is also described as a medium grained, grey and black, porphyritic olivine basalt. Thin sections of cuttings from the interval 5200' to 5220' are described as: amygdaloidal basalt, blood red altered basalt, altered quartz-mica-clay metamorphic, fine grained brown-rock of uncertain origin, chilled amygdaloidal lava, porphyritic basalt, sandy siltstone, marble, conglomerate.

Logs indicate that this interval consist of interbedded volcanic flows, altered flows, metamorphosed sediments and unaltered sediments. Its interval velocity is 9300 feet per seconds. Very few random dip sediments are shown over the interval 5065' to 5400' on the dip meter interpretation log.

5400' - 5910'

This interval consist mostly of sandstone, siltstone with lesser amounts of shale or mudstone and minor coal. The siltstone is dark borwn grey, carbonaceous, muddy. It mostly is recognized over the interval 5400' to 5500'.

The sandstone is very fine to fine grained with clear white to light grey grains, subangular to subrounded, moderatly sorted, non calcareous, unconsolidated. A white interstitial clay fraction is recognized in some of the sandstone starting around 5560'. It becomes a significant constituent below 5700' where the sandstone is described as having grey, white, clear grains, subangular, subrounded, well rounded, with occasional feldspar grains, quartz pebbles and shale fragments.

The shale or sandstone is grey to dark brown to black, carbonaceous.

A conventional core over the interval 5547' to 5566' is described as follows:
5547' to 5548.5'; sandstone, very fine to fine grained, silty, glauconitic, poorly sorted, firm, with occasional shale clasts.
5548.5' - 5553.5'; shale, grey black, fissile, carbonaceous with stringers of sandstone and siltstone.
5553.5' - 5565.5'; sandstone, grey, medium-fine grained, subangular, moderately sorted, quartzose, carbonaceous, well cemented, grey-white clay matrix.
5565.5' - 5566'; shale, grey brown, fissile, firm, carbonaceous.

A hand specimen taken from the conventional core at 5559' in described as a weakly stratified, rather friable grey-green and white mottled lithic sandstone.

The lithic fraction consist of siltstone and represent 85 to 90 percent of the grain population. There are little cementing material and apart from some deposition iron there are few indications of diagenetic change other than due to compaction and the rock retain an abundance of primary porosity. It is considered that this rock is a near shore marine sediment with source material supplied variously by fossil and igneous, metamorphic and sedimentary rocks.

| Depth (ft) | Lithology | Porosity(%) | Permealibility (md) |
|---|---|---|---|
| 5548' | sand | 16.9 | 0 |
| 5548' | sand | 22.0 | 0.45 |
| 5554' | sand | 26.9 | 52 |
| 5555' | sand | 21.1 | 310 |
| 5556' | sand | 18.0 | 6.2 |
| 5557' | sand | 18.4 | 82 |
| 5558' | sand | 22.6 | 29 |
| 5559' | sand | 17.3 | 4.4 |
| 5560' | sand | 17.0 | 11 |
| 5561' | sand | 19.0 | 3.6 |
| 5562' | sand | 24.0 | 9.1 |
| 5563' | sand | 15.2 | 7.1 |
| 5563' | sand | 14.0 | 3.4 |
| 5564' | sand | 18.0 | 9.8 |
| 5565' | sand | 13.3 | 2.6 |

This interval is assigned to the T. pannosus palynological zone which straddle the Upper Cretaceous-Lower Cretaceous boundary.

Its lower surface, 5910',marks a distinct facies change of the sandstone fraction. The beginning of this change, from relatively clean sandstone of reservoir quality to a sandstone with important clay matrix and various cements, is recognized around 5560' then more so around 5700'. The interval velocity of this section is 10,000 feet per seconds. A significant increase in interval velocity marks its lower boundary which may represent a hiatus or unconformity, at least a very different sedimentary regime.

For purposes of seismic mapping, the lower boundary surface of this interval is labeled the Mid-Cretaceous Unconformity.

The dipmeter interpretation log indicates two separate changes over this interval. Firstly, the dip from 5400' down is highly organized and appears to be almost completely structural, thus indicating a significant difference from most of the section above. From 5400' to 5700 the dip is to the southwest and consistant at 45°. Then a first increase with depth pattern is recognized between 5760'and 5840' where the dip still to the southwest goes from 35° to 45°. The second pattern is between 5840' and 5910' when the dip, still to the southwest goes from 25° to 45°.

5910' - 7300'

This interval consist of sandstone, shale, siltstone and minor coal. The upper 300' is mostly shale while the remainder of the section consist of sandstone and siltstone with lesser amounts of shale. Sample studies indicate that down to 6840', the sandstone is with fine to medium clear-white-grey grains, subangular to subrounded, well sorted with a gummy clay matrix which mostly washes out. It is occasionally consolidated with silica cement. Non calcareous, carbonaceous. Frosty grains are recognized over the interval 6040' - 6080', and so are the occasional large rounded or angular quartzite pebble. Below 6840' the sandstone is consolidated with clay matrix and silica cement. It is also becoming increasingly lithic, silty, poorly sorted, subrounded and non calcareous. Mechanical logs indicate this change in lithology takes place at 6752'.

The shale is light grey to medium light grey, fissile, firm, carbonaceous, coaly. Beginning at 6200' it is mostly black, or dark grey black, firm, fissile, carbonaceous, non calcareous. At 7210' the shale is dark grey or grey-green, gypsiferous, carbonaceous, fissile.

The siltstone is first recognized at 6560' as grey, dark grey, brown, friable to firm, sandy, non calcareous. At 6940' it is carbonaceous in part, slightly micaceous. This interval is assigned to the C. paradoxa palynologic zone of the lower Cretaceous.

Its upper boundary is marked by a significant increase in interval velocity from 10,000 feet per seconds to 12,000 feet per seconds. While its lower boundary is also marked by an increase in velocity to 13,400 feet per seconds.

This interval appears to have limited reservoir capacity due to the sandstone having a clay matrix and silica cement.

The dipmeter interpretation log indicates consistant southwest dip at an average rate of 35° throughout this interval. The Mid-Cretaceous Unconformity at the top of this interval is well shown. In addition, a minor fault pattern is recognized at, or about, 6400'. It is recognized on seismic as a down-to-the east normal fault.

7300' - 8370'

This interval includes a diversity of lithotypes. It consist of sandstone, siltstone, shale, minor coal, possibly gypsum and volcanics or altered volcanics.

The sandstone is light grey to dark grey, subangular to subrounded, micaceous, very firm, consolidated with a clay matrix, traces of red tuff and gypsum. Over the interval 7810' to 8000' the sandstone is described as grey speckled pink, fine to medium grained, subangular to subrounded, with abundant lithic grains.

The interval 8060' to 8110' is described as sandstone, grey-white, very argillaceous, fine to medium grained, abundant lithic grains with appearance of reworked dolerite, very angular.

The siltstone is light red and green, tuffaceous.

The shale is light grey to dark grey to dark brown, carbonaceous, gypsiferous, calcareous in part.

Gypsum is described as an accessory mineral of the shale over several discrete intervals. In the interval 7720' to 7780' it is described as a individual mineral, translucent, soft, base cleavage, dissolves in hot acid.

Several occurrences of volcanics are described. At 7810' it consist of loose pieces of olivine, light green, soapy texture. At 7850' it consist of light to dark green olivine pieces. At 8000' - 8029' it is described as several large pieces of dark grey and black vesicular basalt, again at 8040'. At 8060'-8100' it is described as having the appearance of dolerite. At 8130' it is a dark green and dark grey basalt and red tuff. At 8220' and thereafter it is mostly a black and dark grey basalt with red phenocryst.

This interval is assigned to the C. striatus palynologic zone of the Lower Cretaceous.

The interval velocity of this section is 11,000 feet per seconds from 7300' to 7400', 13,500' feet per seconds from 7400' to 8000', then 13,200 feet per seconds from 8000' to 8370'.

The dipmeter interpretation log indicates consistant southwest dip at an average angle of 35° throughout this interval.

Two small patterns associated with minor normal faults are recognized at or about, 7390' and 7510'. In addition, a very distinct pattern associated with normal faulting and confirmed by seismic is recognized at or about 8200'. The dip is consistant and to the southwest. However at this point it changes from 40° to 30°.

8370' - 8640'

This interval is mostly massive sandstone interbedded with minor shale and coal. Two types of sandstone are recognized.

A conventional core was cut over the interval 8373' to 8425'. This lithotype extends over the interval 8370' to 8422' and 8560' to 8640'. The core is described as follows: 8373' to 85', sandstone, apple green, fine to medium with coarse grains subangular to subrounded, poorly sorted, massive. 8385' to 87' congolmerate with Chert (?) and quartzite pebbles in very fine to very coarse green matrix of sandstone.
8387' to 96' sandstone, light green, very fine to very coarse, subangular to subrounded, non-calcareous.
8396' to 8412' sandstone, grey-white. 8412' to 8422', sandstone, green-grey fine to coarse, silty, subangular, micaceous, cleavage fractures.
8423' to 24.5' coal. 8424.5 to 25' shale, dark grey, silty, sandy, very carbonaceous, wood fragments.

A petrographic description at 8374' refers to a lithic sandstone, cemented with silica-chlorite and by the break-down or distortion of lithic fragments, well sorted, angular to subrounded. At 8376' the rock is described as lithic pebbly sandstone or conglomeratic greywacke with igneous, sedimentary and metamorphic components.

| Depth(ft) | Lithology | Porosity(%) | Permeability |
|---|---|---|---|
| 8380 | Sand | 16.0 | 0 |
| 8387 | Sand | 16.0 | 0 |
| 8394 | Sand | 11.0 | 0 |
| 8401 | Sand | 12.0 | 0 |
| 8408 | Sand | 15.0 | 0 |
| 9415 | Sand | 15.0 | 0 |
| 8422 | Sand | 8.0 | 0 |

Sample studies describe the interval 8370 to 8420' as sandstone: green-white to grey-white, subangular, fine to medium, tuffaceous, interbedded with dark green shale. The same general description applies to the interval 8560'-8640'.

The interval 8420'-8560' consist of interbedded sandstone, light green, fine to coarse, abundant lithic, interbedded with shale, light to dark green, traces of coal, gypsum and volcanics.

A substantial increase in interval velocity is noted at 8370 where the velocity increases from 13,200 to 14,000 feet per seconds. This velocity is maintained down to 9400'.

The dipmeter interpretation log over this interval indicates consistant southwest dip at a rate of 30°.

8640' - 9017'

This interval is mostly shale with interbedded thin sandstone at its base and thicker sandstone and coal at its top.

A sidewall core at 8905' is described as sandstone, green-grey, very argillaceous, very fine to fine grained, subangular to subrounded. A sidewall core at 8674' is described as coal, shaley. Sample studies described this interval from the bottom up, as shale, dark grey brown, fissile, carbonaceous to very carbonaceous, micaceous, gypsiferous, interbedded with minor coal and thin sandstone, green, fine to coarse grained, subangular to subrounded, poorly sorted with trace of coal, shale, gypsum fragments. The upper 125 feet of this interval is characterized by thicker sandstone and coal beds of the same description.

The dip over this interval is towards the southwest at a rate of 30° to 35°. Its interval velocity is 14,100 feet per seconds.

9017' - 9170'

This interval is sandstone.

A sidewall core at 9040' is described as sandstone, slightly argillaceous, lithic, grey-green, very fine to medium grained. Sample studies describe this interval as sandstone, medium dark grey-green, fine to medium grained, clear white quartzitic, lithic, frosty white, subrounded, predominantly unconsolidated with occasional minor calcareous cement, interbedded with minor shale, brownish grey, dark grey, black, gypsiferous, carbonaceous, minor coal.

This interval is assigned to the C. striatus palynological zone of the early Cretaceous.

The dip over this interval is towards the southwest at a rate of 35°. Its interval velocity is 14,100 feet per seconds.

9170' - 9380'

This interval consist of equal amounts of sandstone and shale. A sidewall core at 9214' is described as shale, grey, silty, hard. Sample studies describe this interval as interbedded quartzone sandstone, medium grey-green, consolidated, hard, tight, in part calcareous, some lithic grains, subangular to subrounded with frosty-white grains and trace of gypsum; shale, grey to dark grey, gypsiferous, carbonaceous with minor coal. The average interval velocity of this section is 14,100 feet per seconds. This rather high velocity value is due to the silicous and calcareous cementation of the sandstone.

The dipmeter interpretation log indicates consistant southwest dip at a rate of 35°.

9380' - 9690'

This interval is mostly shale with interbedded sandstone, siltstone and minor coal. Sidewall cores are described as follows:
9385' Coal. 9480' Shale, olive grey-green, silty, carbonaceous. 9490' sandstone, grey-green, argillaceous lithic, micaceous, fine to medium grained, moderatly sorted, subangular to subrounded.
9650' Siltstone, grey-green, very agillaceous.
9675' Sandstone/Conglomerate, grey-green to black, carbonaceous, argillaceous, coal laminae, poor sorting, subangular to subrounded. Sample studies described this interval as interbedded, sandstone, lithic, hard, calcareous, fine to medium to coarse ground; shale, light to dark grey, mostly dark grey, carbonaceous, gypsiferous; siltstone, medium dark grey, agillaceous, tight; coal, black, shaley.

The average interval velocity of this section is 13,800 feet per second. This rather high interval velocity is possibly due to the high matrix content and siliceous-calcareous cementation of the sandstone and siltstone fraction. A sharp decrease in interval velocity is noted at its base.

This interval assigned to the C. striatus palynological zone of the early Cretaceous.

The dip is consistant and to the southwest at a rate of 30°.

9690' - 9922' (Total Depth)

This interval consist mostly of shale interbedded with thin beds of siltstone, sandstone and conglomerate.

A convention core was cut over the interval 9905'-9922'. The section is described as follows: 9905'-9913.5' Sandstone, quartzose with some overgrowth, grey-green, fine grained, silty, argillaceous with calcareous matrix. Common brown and green lithic grains, subangular to subrounded, poor to moderate sorting, minor mica, carbonaceous streaks. Dip of 20° to 30°.
9913.5'-15' Conglomerate, elongated shale and sandstone pebbles and cobbles in grey-green sandstone matrix. Minor gypsum and calcareous pebbles with 1/2" coal band. Dip of 20° to 30°.
9915' - 9922' Sandstone, massive with thin carbonaceous streaks, dip of 20° to 30°.

| Depth(ft) | Lithology | Porosity | Permeability(md) |
|---|---|---|---|
| 9905 | Sand | 10 | 0 |
| 9911 | Sand | 10 | 0 |
| 9918 | Sand | 10 | 0 |

A sidewall core at 9854' is described as siltstone, olive-green, argillaceous, shaley in part. Sample studies describe this interval as interbedded sandstone, fine to medium grained, silty, argillaceous, friable to hard; siltstone, argillaceous, carbonaceous; shale, dark brown or dark grey, gypsiferous, minor coal.

This interval is assigned to the upper C. hughesii palynologic zone of the early Cretaceous. Its average interval velocity is 12,300 feet per seconds. A sharp increase in interval velocity is noted at its upper boundary.

# DURROON No. 1

216040

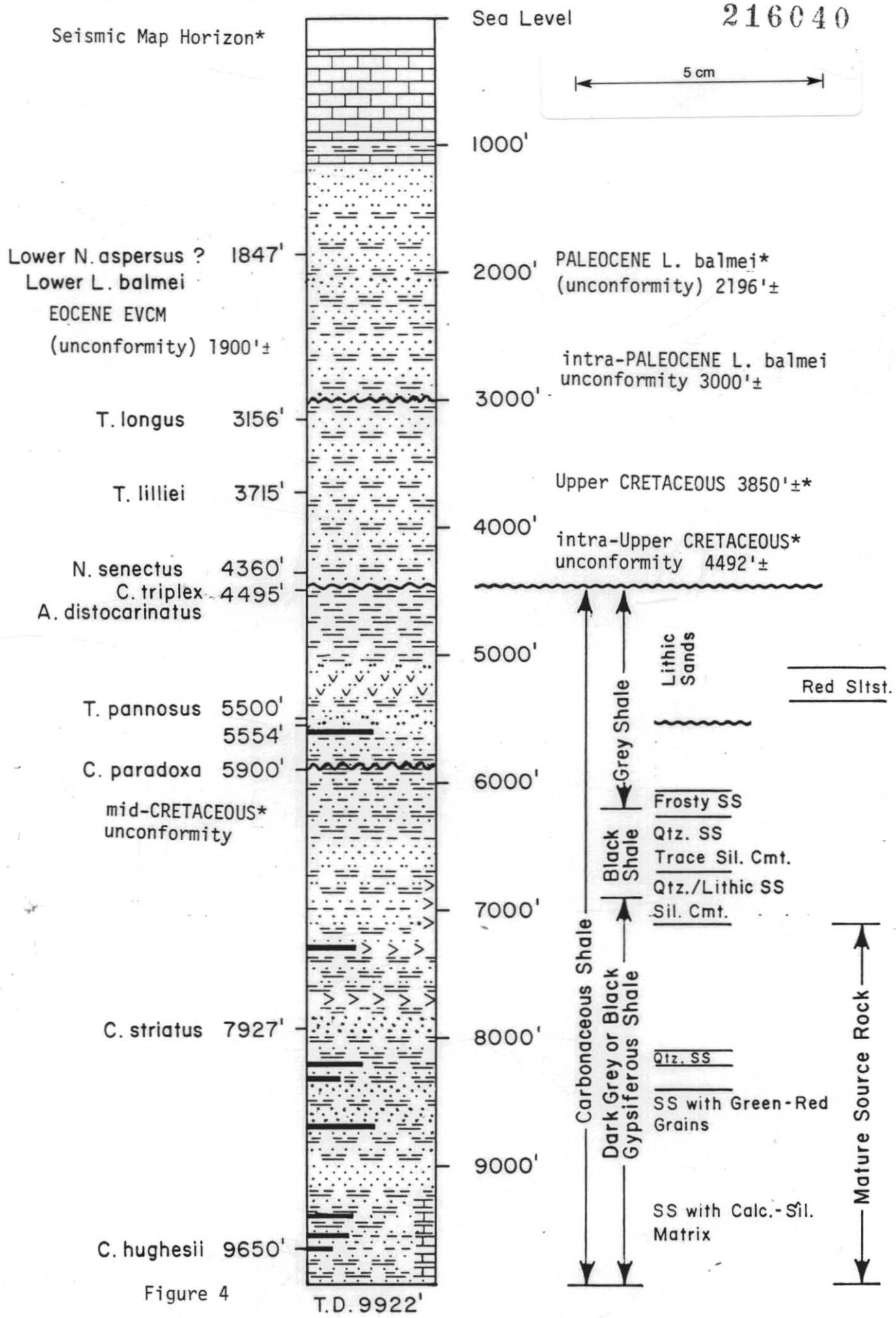


Figure 4

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# BOOBYALLA SUB-BASIN : A CRETACEOUS ONSHORE EXTENSION OF THE SOUTHERN EDGE OF THE BASS BASIN

by W. R. Moore, P. W. Baillie, S. M. Forsyth, J. W. Hudspeth, R. G. Richardson and N. J. Turner
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## ABSTRACT

**Geophysical methods, including gravity, magnetics, refraction and reflection seismic, together with drilling have revealed the presence of a steep, fault-bounded trough of Cretaceous age in the Boobyalla Plains area, northeastern Tasmania. The trough is at least 500 m deep and contains the first proven Cretaceous sedimentary sequence from onshore Tasmania in the Boobyalla Sub-basin. The Boobyalla Sub-basin is the southeastern extremity of the Bass Basin and is bounded by faults having NW–SE, N–S and NE–SW trends.**

**These Late Cretaceous sediments consist of poorly sorted boulder conglomerate, often containing dolerite boulders several metres in diameter, pebble conglomerate and poorly sorted ferruginous sandstone. Clast lithologies are variable but reflect local derivation. Away from the trough margins the infilling sediments become finer grained with conglomerate becoming a less prominent part of the sequence. The coarse-grained sequences are interpreted to have been deposited rapidly in close proximity to a fault scarp.**

**The sediments are biostratigraphic equivalents of and represent a proximal (near-source) facies of the Eastern View Coal Measures, which were encountered in Durroon 1, drilled in the Bass Basin and some 60 km northwest of Boobyalla Plains. A minor volcanic episode probably affected this section of the Bass Basin about 100 Ma B.P. This may be related to tectonic disturbances and could be responsible for an unconformity at the base of the Eastern View Coal Measures indicated by offshore seismic information.**

## INTRODUCTION

The purpose of this paper is to describe a previously unknown onshore extension of Bass Basin, here named the Boobyalla Sub-basin, and to relate the onshore stratigraphy and structure as far offshore as Durroon 1 (Fig. 1). The Boobyalla Sub-basin, lying beneath Boobyalla Plains and the mouth of the Ringarooma River in northeastern Tasmania, contains the only proven Cretaceous sediments known from onshore Tasmania.

The Bass Basin is located between the mainland of Australia and the north coast of Tasmania. It is adjacent to the Otway Basin in the west and is separated from the oil-producing Gippsland Basin on the east by the Bassian Rise. It contains sedimentary infill ranging in age from Early Cretaceous to Late Tertiary and has an area of about 62 000 km$^2$ (Brown, 1976). Summaries of the geology exploration history and previous work are to be found in Robinson (1974), Brown (1976) and Nicholas *et al.* (1981).

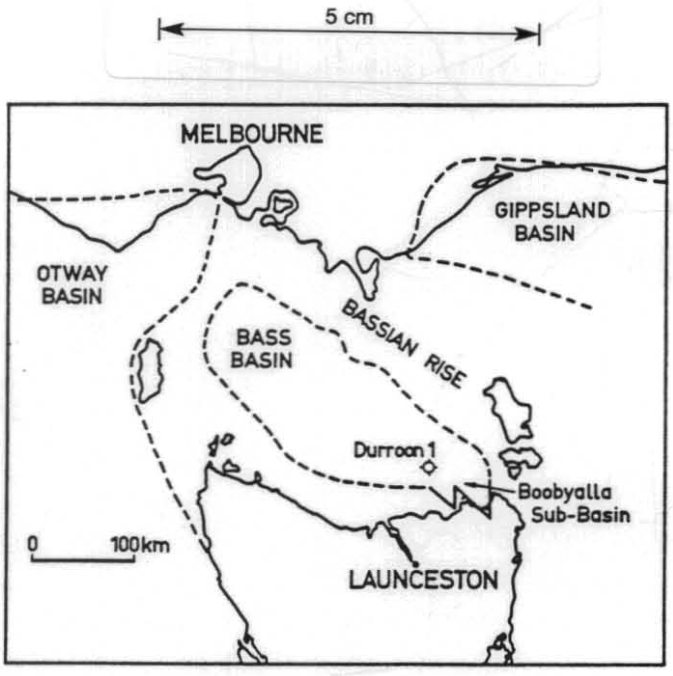


**Figure 1** — Locality map.

In this paper pre-Cretaceous rocks are regarded as forming 'basement'. The rocks consist of folded Ordovician to Early Devonian Mathinna Beds which are intruded by post-tectonic Devonian–?Carboniferous granites unconformably overlain by flat-lying Permian–Triassic Parmeener Supergroup sediments (Williams, 1978; McClenaghan *et al.*, 1982). Substantial bodies of dolerite were emplaced during the Jurassic, marking the onset of the tensional phase that culminated in the breaking-up of Gondwanaland (Griffiths, 1971).

The Bass Basin began to develop in the Cretaceous when differential movement occurred between the Australian plate and a partially detached Tasmanian sub-plate (Griffiths, 1971). The southeastern end of the Bass Basin is the area of oldest tectonic activity (Early Cretaceous), and contains the oldest sediments known in the basin (Robinson, 1974; Brown, 1976).

## BOOBYALLA SUB-BASIN

The Boobyalla Sub-Basin has been detected by means of drill holes and geophysics (refraction and reflection seismic, gravity and magnetics). A seismic refraction survey (Longman, 1969) was the first geophysical survey in the Boobyalla area and attempted to obtain basement profiles to explain unexpected basement depths obtained from a line of drill holes drilled in search of cassiterite-bearing sands. The western end of this seismic investigation failed to find a basement refractor (Longman, 1969). Gravity and magnetic surveys of the entire

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Boobyalla Plains area showed a large gravity low (Fig. 2) with coincident magnetic highs (Leaman, 1973). Leaman's interpretation of the gravity data inferred the presence of a basin approximately 800 m deep with the western margin having a near vertical contact against granitic rocks and the eastern margin being a series of step faults. The rock types of the eastern margin were interpreted as Mathinna Beds (Ordovician–Devonian), which represent a metamorphosed basement, overlain by Permian sedimentary rocks, Jurassic dolerite and Tertiary sediments. Further seismic work was followed by cable tool and rotary drilling on the site of Boobyalla 1 to a depth of 306 m. Moore and Leaman (1974) defined the southern edge of the basin by means of gravity and refraction seismic surveys followed by drilling.

Seismic lines between Durroon 1 and the onshore Boobyalla Sub-basin indicate no faulting of sediments younger than the Eastern View Coal Measures, i.e. Oligocene and younger. Major faulting occurred in the Early Cretaceous with the formation of rapidly subsiding fault-angled depressions in which sediment accumulated (Brown, 1976). Gravity studies indicate that at least 300 m of Cretaceous sediment are present below the drilled sections on Boobyalla Plains (Leaman, 1973).

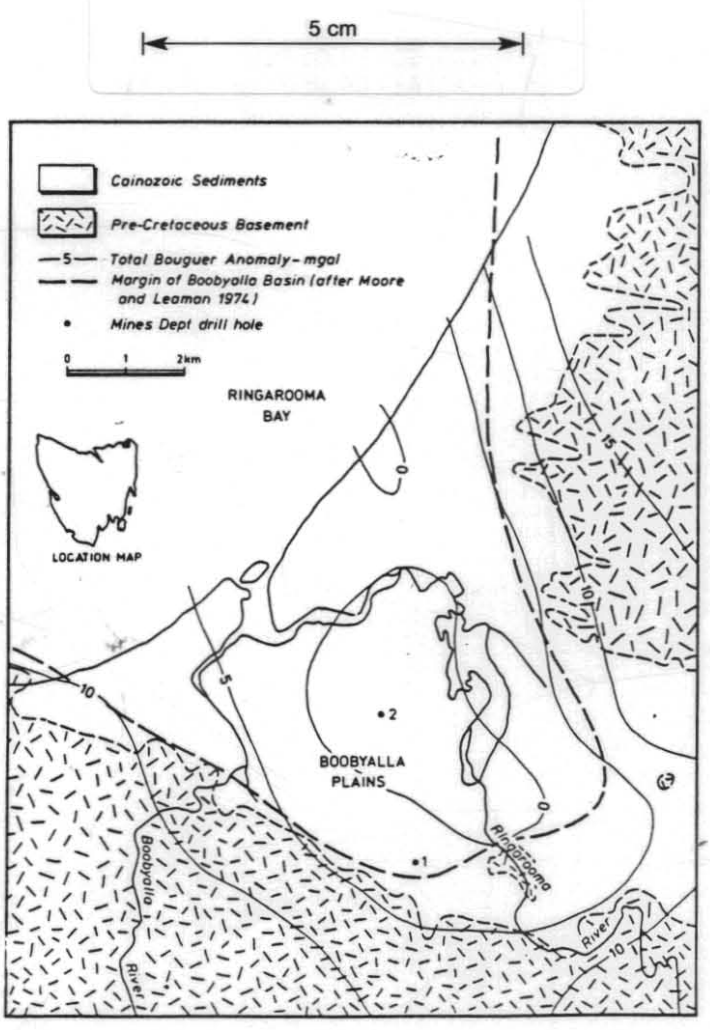


**Figure 2** — Geological map of the Boobyalla Plains area (after Baillie *et al.*, 1979) also showing Total Bouguer Anomaly (after Leaman, 1973).

In late 1979 the Tasmanian Department of Mines recorded single fold reflection seismic along the axis of the basin. Richardson (1981) interpreted the results as showing the presence of channelling and channel-fill in the Cretaceous sequence and he stated that the unchanged average velocity across a number of reflectors in the sequence suggested that thin sand, conglomerate or basalt layers formed the basin infill. However, data quality is poor, and other interpretations are possible.

Two fully-cored diamond drill holes penetrated part of the onshore sequence. Borehole number 1 of Figure 2 (Boobyalla 1) was drilled by the Tasmanian Department of Mines in 1976 and reached a depth of 417 m before being terminated. Borehole number 2 of Figure 2 (Boobyalla 2) was drilled by the Shell Company of Australia (Hall, 1981)to a depth of 265 m and in 1982 was extended by the Department of Mines to 491 m where the hole was abandoned because of drilling problems associated with swelling clays.

## STRATIGRAPHY OF BOOBYALLA SUB-BASIN FROM DRILL HOLES

Boobyalla 1 (Fig. 1) penetrated a sequence of interbedded granule to boulder conglomerate and fine to very coarse grained, often ferruginous, sandstone with occasional beds of brown, micaceous siltstone. Thickness of individual beds varies from a few centimetres in the finer grained sediments to several metres in the conglomerates. The conglomerate/sandstone ratio is greater than 1. Dolerite is by far the most common clast type present and one boulder drilled had a diameter of at least three metres. Other pebbles are also locally derived and include metamorphosed and unmetamorphosed rocks of the Mathinna Beds. Also present are clasts typical of the Parmeener Supergroup. Clast framework varies from continuous to matrix supported.

In contrast to the dolerite-dominated conglomerates, the sandstones have quartz as the dominant component. Thin-section examination shows that the sandstones are moderately well to very poorly sorted and fine to very coarse grained. Grains of quartz (dominantly plutonic but some vein) are most common, with fewer clasts of Mathinna Beds (dominantly metamorphosed), mudstone, lithic sandstone, variably textured dolerite, and rare feldspar. The sandstones are best described as sublitharenites (Folk, 1968).

Boobyalla 2, drilled some 3 km further out into the basin (Fig. 2) penetrated a less-coarse sequence than that penetrated by Boobyalla 1 (Fig. 3). Rocks from surface to 29 m consist of unconsolidated gravel with clasts of dolerite, Mathinna Beds and Parmeener Supergroup rocks as well as soft, brown organic silts. From 29–150 m the hole penetrated a sequence consisting dominantly of more consolidated, massive, grey mudstone or siltstone, sometimes with lignitic material, and minor, thin horizons of doleritic conglomerate.

From 150–250 m, interbedded mudstone and dolerite-conglomerate was penetrated. The mudstone/conglomerate ratio is about 5 to 1. Occasional beds of fine-grained sandstone are present. The thickness of individual conglomerate beds is less than three metres and individual dolerite clasts have a maximum diameter of 40 mm.

Conglomerate comprises the bulk of the sequence from 250–375 m, with brown or red mudstone forming only a minor part of the sequence. Dolerite is the dominant clast type in the conglomerate. Minor clasts of cleaved Mathinna Beds and Parmeener Supergroup rocks are also present. Maximum clast size observed was 1.8 m. Clast framework ranges from continuous to matrix supported. Much of the dolerite has a granophyric texture and many of the boulders display 'onion-skin' weathering.

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The sequence from 375–491 m consists of interbedded doleritic conglomerate and variably coloured mudstone and pebbly mudstone as well as tuffaceous sandstone. The tuffaceous sandstone is very poorly sorted, with clasts ranging in size from 0.05 to greater than 10 mm in a clay (?volcanic) matrix. Clasts consist of quartz, intermediate volcanics, plant fragments, chert and dolerite. Montmorillonite, kaolinite and minor quartz are shown to be present in the rock by XRD.

## BIOSTRATIGRAPHY

Stratigraphic relationships between the two holes drilled at Boobyalla Plains and Durroon 1 are shown as Figure 3.

A core sample in Boobyalla 1 at 65 m (McClenaghan *et al.*, 1982, App. 7) yielded a latest Cretaceous (late Senonian) microflora belonging to either the *Tricolpites longus* or the *Tricolporites lilliei* Zone (Stover & Evans, 1973; Partridge, 1976). In samples from 65 m to 245 m an Early Mesozoic component is present. This is consistent with the recognition of clasts belonging to the Upper Parmeener Supergroup. From depths of 225 m and lower, samples yielded only meagre Late Mesozoic microfloral elements more typical of earlier Cretaceous microfloras but specific zonal assignment is not possible.

Palynological study of Boobyalla 2 indicates that the sequence drilled ranges in age from at least Late Cretaceous to Eocene. An hiatus involving at least the Paleocene and Early Eocene occurs near the top of the sequence at approximately 29 m depth (Fig. 3). There are three problems.

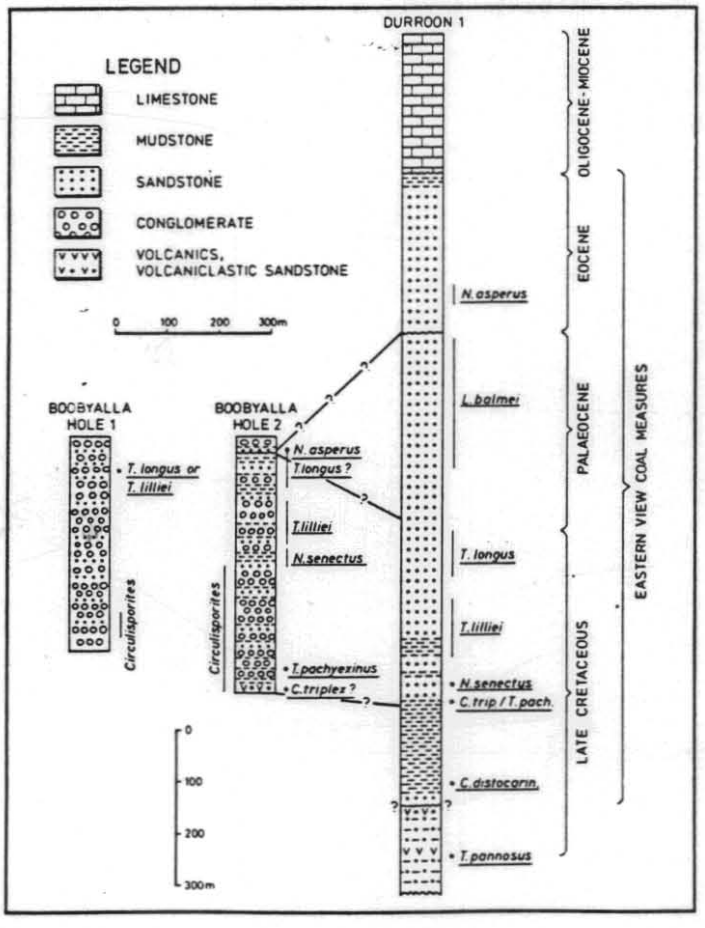


**Figure 3** — Stratigraphic columns showing relationships between Boobyalla 1, Boobyalla 2 and Durroon 1.

Firstly, reworking of palynomorphs is common to such an extent that some Cretaceous microfloras are swamped by vast numbers of early Mesozoic species probably derived from Tasmanian Late Triassic coal measures. Secondly, to aid in representation of biostratigraphic data it is desirable that the zonations, where possible, be based on the zones defined for the adjacent Gippsland Basin (Stover & Evans, 1973; Stover & Partridge, 1973). Certain key species appear either to be absent, or their ranges are different in the Boobyalla Sub-basin when compared with the Gippsland Basin, leading to difficulties in precise zone assignment. To partly overcome this problem the unpublished and interpretive data of spore-pollen ranges for the Bass Basin (Patridge, 1973) have been used, together with a broad direct comparison with Durroon 1. Thirdly, microfloras below 247 m are poor.

The distribution of selected palynomorphs in Boobyalla 2 is shown as Figure 4. At the base of Boobyalla 2 (489 m) angiosperm pollen tend to be simple forms, and indicate that the microflora is not older than Cenomanian, and probably no older than Turonian (Dettmann, 1973). A single specimen of *Clavifera* cf. *triplex* (Bolchovitina), which is only very slightly crenulate, may indicate that the microflora is not older than the *Clavifera triplex* Zone (Dettmann & Playford, 1969). This is supported by the occurrence of *C.triplex*, *Classopollis* sp. and *Cranwellipollis subpalisadus* Couper in similar microfloras from a few kilometres east of Boobyalla 2.

The microflora (489 m) is dominated by finely granulate to baculate to sub-verrucate trilete spores and inaperturate? forms and is comparable with a marked abundance of similar forms in Durroon 1 at 1533 m, which was assigned to the *Appendicisporites distocarinatus* Zone (Dettmann & Playford, 1969) by Esso in 1973. Components of the Durroon microflora at 1387 m immediately below a sample from 1375 m which was assigned to the *C. triplex-Tricolpites pachyexinus* Zone by Esso (1973), include *Classopollis* sp. and *Herkosisporites* cf. *elliottii* Stover.

Several species indicate that the microflora at 255. 4 m is no older than the *Nothofagidites senectus* Zone (Stover & Evans, 1973). It is considered that *Phyllocladidites reticulsaccatus* Harris occurs earlier in Boobyalla 2 than in the Gippsland and offshore Bass Basins.

The interval from 29.2 m to 22.1 m spans a hiatus involving part of the *Tricopites longus*, *Lugistepollenites balmei*, *Malvacipollis diversus* and *Proteacidites asperopolus* Zones of Stover and Evans (1973).

Elsewhere in the Boobyalla area Quaternary microfloras have been obtained from beds directly overlying the Cretaceous succession. At Cape Portland (Fig. 6), in an area marginal to the basin, mid-Tertiary sediments belonging to the *Proteacidites tuberculatus* Zone (Stover & Partridge, 1973) were deposited under both marine and freshwater conditions.

## INTERPRETATION OF DEPOSITIONAL ENVIRONMENT

The contrast between the conglomerates (in Boobyalla 1 and 2 holes) composed dominantly of dolerite and the quartz-rich sublitharenites implies that two different provenances were supplying the two sediment types. Figure 5 is a suggested reconstruction of the Late Cretaceous palaeogeography of the Boobyalla Plains and hinterland area.

The predominance of dolerite in the conglomerates which are often matrix supported, together with the great range of clast sizes observed, suggests that these deposits are laid down near a fault scarp. The main depositional mechanisms were probably debris flow and sheet floods (Collinson, 1978). Episodic deposition of the conglomerate, possibly initiated on occasion by fault activity, interrupted deposition of the



5 cm

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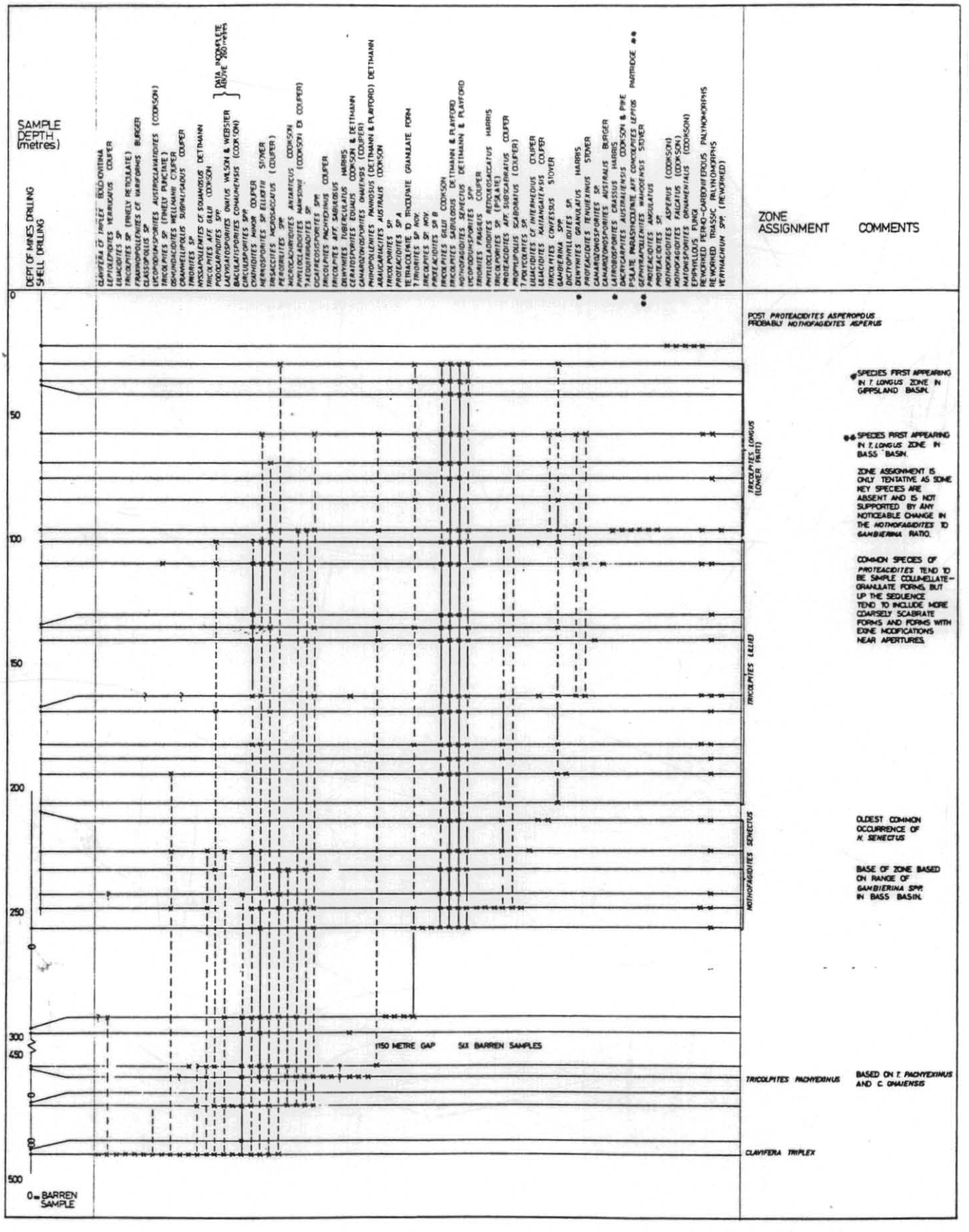


**Figure 4** — Distribution of selected palynomorphs in Boobyalla 2.

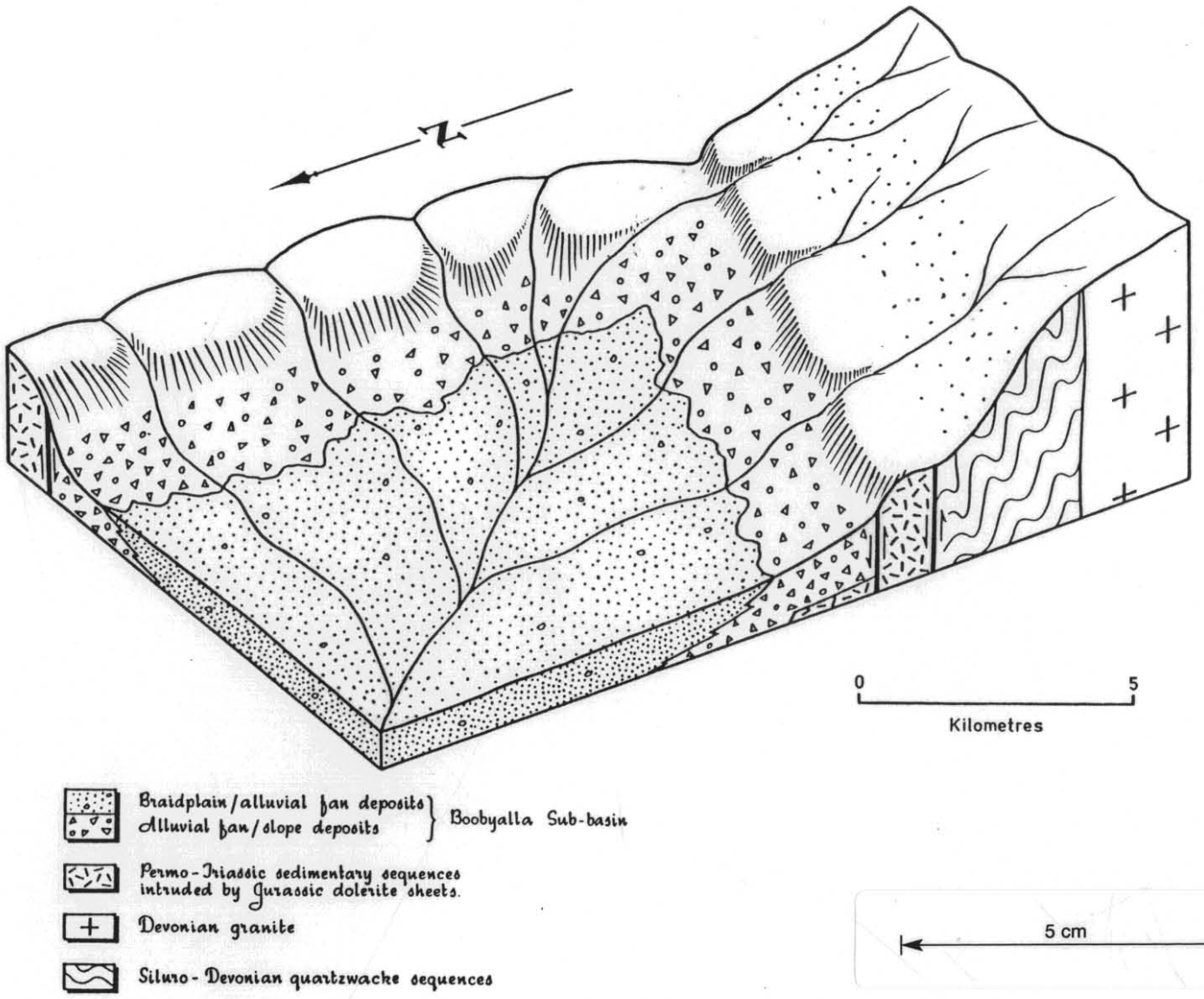


**Figure 5** — Block diagram of the early Late Cretaceous palaeogeography of the Boobyalla Sub-basin.

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'normal' sublitharenites. Many of the poorly sorted sands were probably deposited from debris flows on a series of alluvial fans which formed where drainage channels debouched from the high-relief fault scarp. Further out in the basin the alluvial fan distributaries probably changed into low-sinuousity streams and the sediment was deposited in lower-energy environments, as encountered in the Eastern View Coal Measures drilled at Durroon 1, where 335 m of grey to brown carbonaceous shales are overlain by white coarse-grained sandstones 240 m thick interbedded with thin shale horizons (Brown, 1976).

The section drilled at Boobyalla Plains represents the most proximal facies of the Eastern View Coal Measures and confirms the facies trend noted by both Brown (1976) and Robinson (1974), who noted a coarsening of the Eastern View Coal Measures towards the southeast and suggested that the north coast of Tasmania was the major source of the sediments.

## FAULTING AND VULCANISM

Figure 6 is a map of the southeastern margin of the Bass Basin and differentiates areas of shallow or outcropping basement from areas of significant sediment thickness and was constructed using knowledge of onshore geology (Baillie *et al.*, 1979) and the offshore seismic lines of Esso (1969-1972) and Weaver Oil and Gas (1982). A diagrammatic cross-section is shown as Figure 7. The inferred dominant fault direction is NW–SE, but other major faults are inferred in the NE–SW and N–S directions as determined in general in Tasmania (e.g. Williams, 1969, 1978). Previous structural interpretations in Bass Basin have only recognised NW trending structures, although lineations in other directions (e.g. N, NE) are present on magnetic intensity maps (e.g. Fig. 2 of Brown, 1976).

In the Cape Portland area (Fig. 6), an appinitic intrusive complex and lamprophyre dyke suite are intrusive into Jurassic dolerite and sandstones of the Parmeener Supergroup (Jennings & Sutherland, 1969; McClenaghan *et al.*, 1982). In the same area a small andesite lava occurrence can be shown to be chemically related to the intrusives. Hornblende from both intrusive and extrusive rocks has a K/Ar age of 101–102 Ma (McClenaghan *et al.*, 1982, App. 3).

In Durroon 1 basalt and ?tuffaceous sandstone occur near the boundary between the *A. discocarinatus* and the *Tricolpites pannosus* Zones (Dettmann & Playford, 1969) close to the Early/Late Cretaceous biostratigraphic boundary (Esso, 1973). The absolute age of this boundary is 97.5 Ma (Harland *et al.*, 1982).

Tuffaceous sandstones have been described from the bottom of Boobyalla 2 and are tentatively correlated with the volcanics encountered in Durroon 1 (Fig. 5).

It is suggested that a minor volcanic episode affected the southeastern part of the Bass Basin at about 100 Ma and that this is related to the possible tectonic disturbances which produced the unconformity between Early Cretaceous sediments and the Eastern View Coal Measures as seen in Durroon 1 (Brown, 1976).

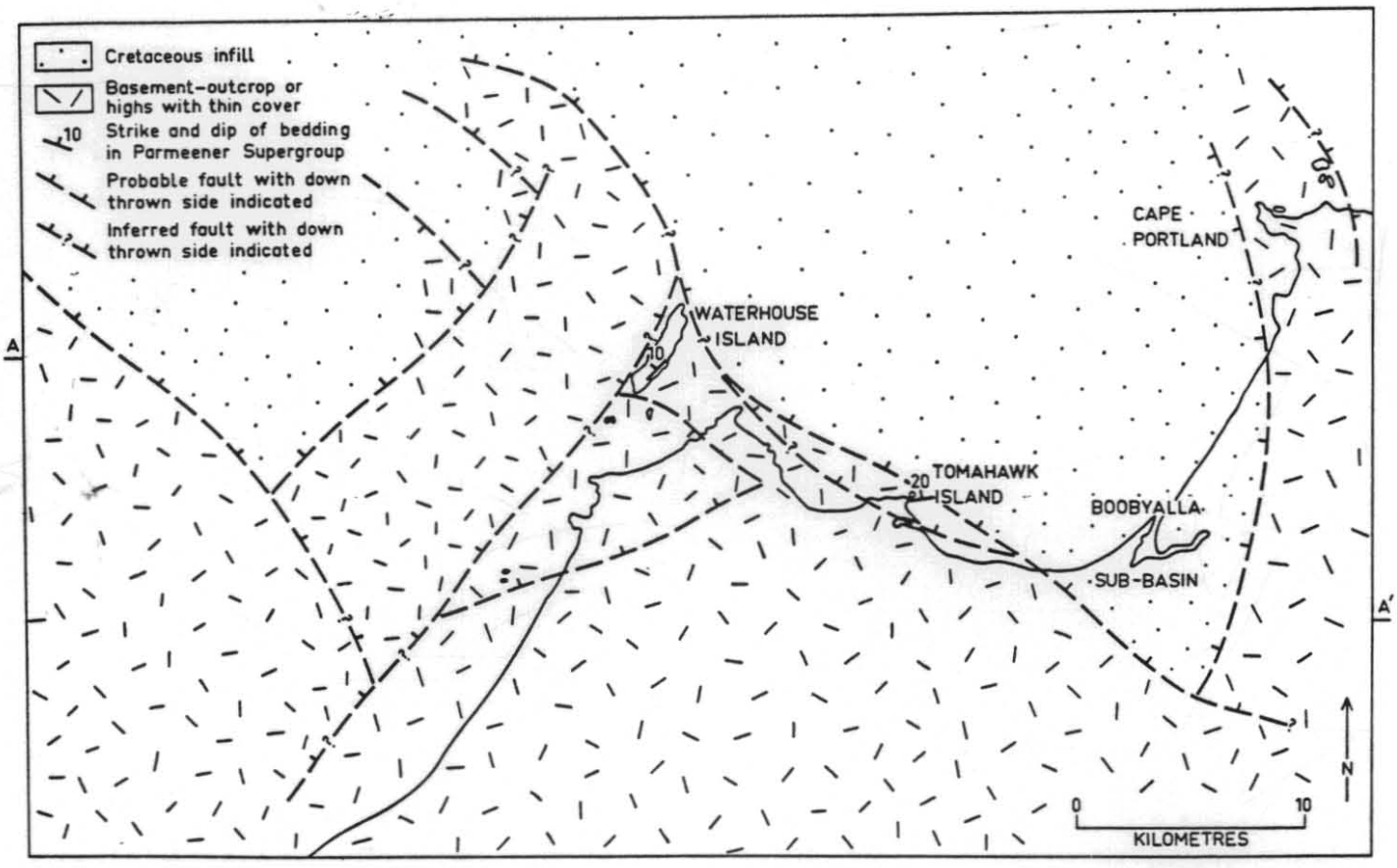


**Figure 6** — Map of the southeastern margin of the Bass Basin showing the distribution of major faults which disrupt basement rocks.



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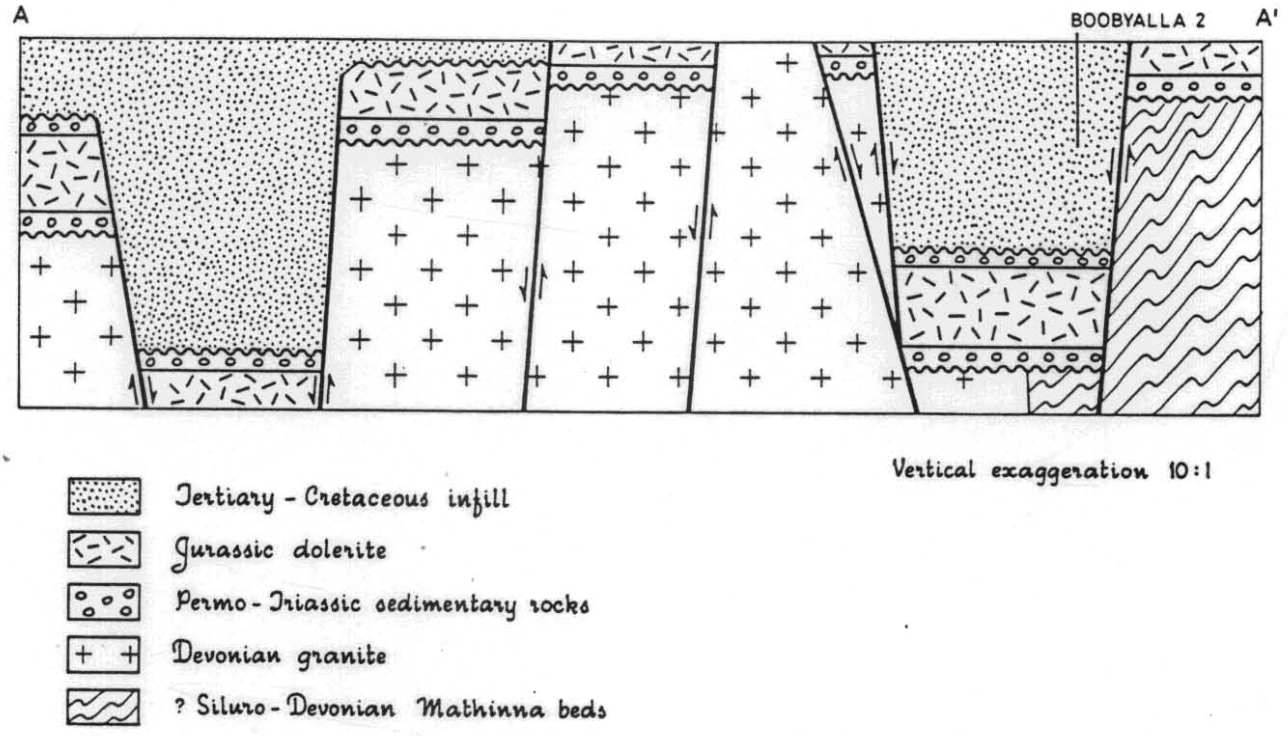


**Figure 7** — Diagrammatic cross-section constructed along line A-A¹ of Figure 5.

## CONCLUSIONS

Northeastern Tasmania was the major sediment source for the Eastern View Coal Measures of the southeastern sector of the Bass Basin. The near-source poorly sorted conglomerates of the Boobyalla Sub-basin represent the most proximal facies of the Eastern View Coal Measures and reflect local derivation. Biostratigraphic subdivisions in Durroon 1 can be recognised in the Boobyalla Sub-basin.

The Boobyalla Sub-basin is the onshore continuation of the Bass Basin.

## ACKNOWLEDGEMENTS

Weaver Oil and Gas Corporation Australia are thanked for access to proprietary data. Drs N. Farmer and E. Williams and Mr I. B. Jennings are thanked for useful discussions and critical reading of the manuscript. This paper is published with permission of the Director of Mines, Tasmania.

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Aeromagnetic Survey

Two northwest trending broad bands of strong positive anomalies are recognized on the Total Magnetic Intensity Map of the general Durroon #1 well area, Figure 5 . Both bands, along with the in-between low area, appear to be related to basement.

In addition, a distinct northeast trend, or series of trends, is also recognized. This northeast trend is associated with discontinuities, termination and offset of the northwest trends. Figure 6 .

The anomaly, on trend and slightly to the northwest of the Durroon #1 well, gives a calculated depth to magnetic basement of 2100 feet from a thin sheet, sill model. At the Durroon #1 well location; the depth to magnetic basement is calculated to be very near 3000 feet below sea level.

The Durroon #1 well results indicate that several basalt flows are present below approximately 5175 feet, drill depth. In addition; several lithic sandstones, containing volcanic grains are described. The well was abandoned at a drill depth of 9922 feet without penetrating basement. Apparent discrepancies between the calculated depth to basement and the well results may be due to the magnetic susceptibility of the volcanics, or the model used. Also unexplained is the depth of the magnetic low located between the two northwest trending high trends.Seismic interpretation tied to the Durroon #1 well shows this trough to be several thousand feet deeper than is indicated by the calculated depths to basement. No well has been drilled in the trough.

In addition to the two major trends or alighments mentioned previously, a third trend with an east-west orientation is shown. This third trend is also recognized on seismic.

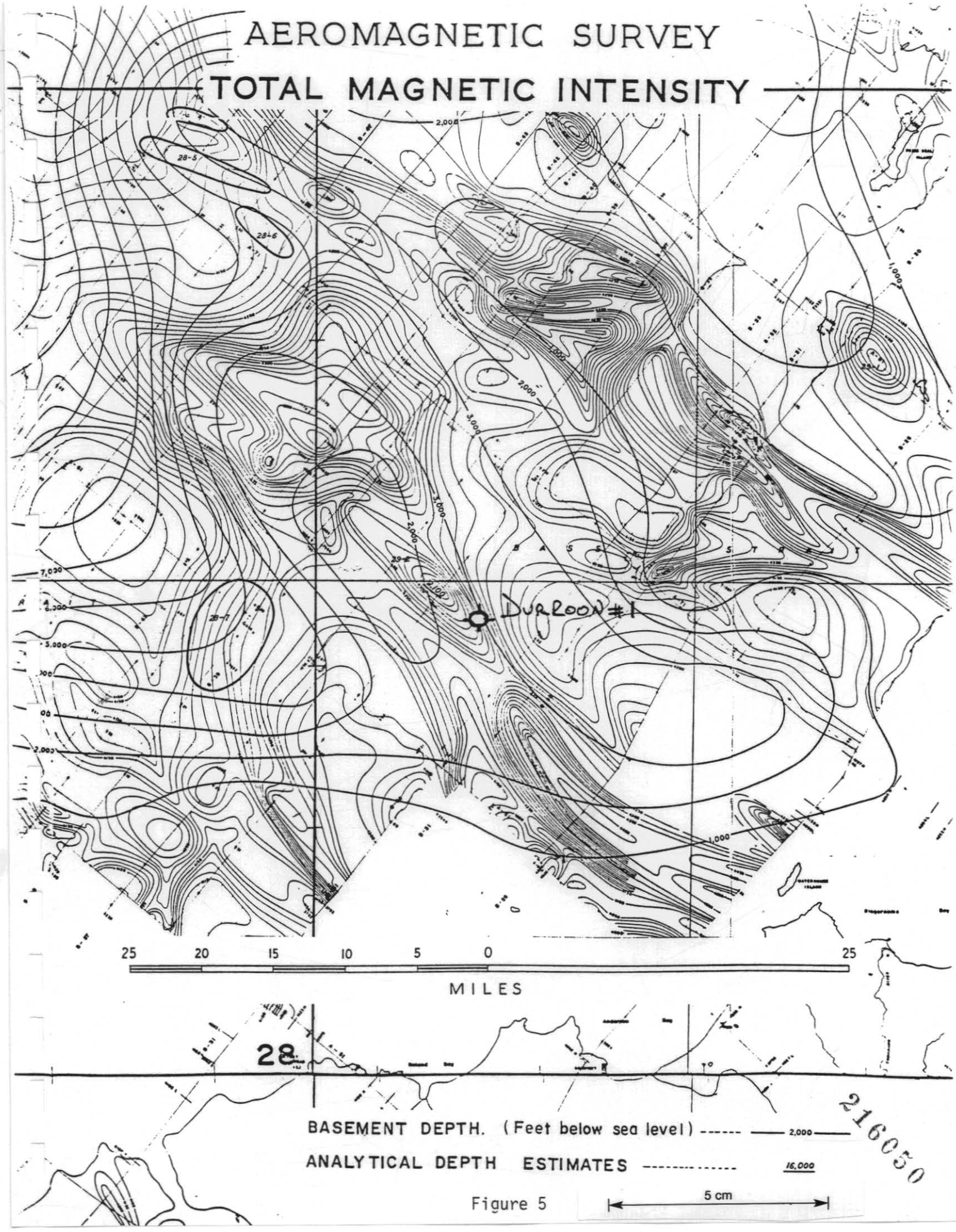


Figure 5

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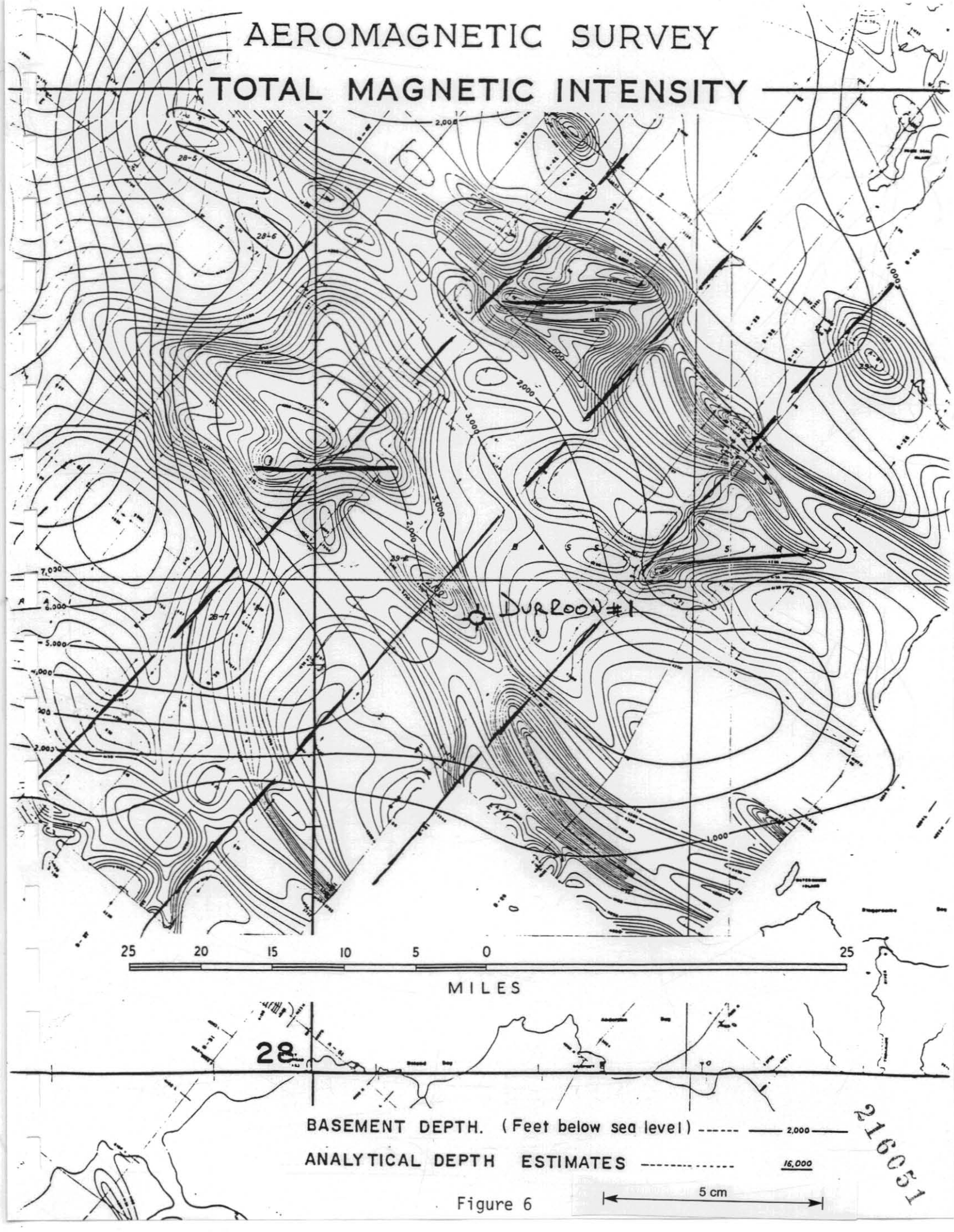
AEROMAGNETIC SURVEY
TOTAL MAGNETIC INTENSITY
DURROW #1
25 20 15 10 5 0 25
MILES
28
BASEMENT DEPTH. (Feet below sea level) ------ 2,000
ANALYTICAL DEPTH ESTIMATES ---------- 16,000
5 cm
2160 51

Figure 6

216052

## Conventional Cores

Conventional cores of the Paleocene and Cretaceous section have been taken in several of the Bass Basin wells. These are listed and described below. Figure 7.

In the Aroo #1 well, two conventional cores were cut in the Lower L. balmei palynologic zone of the basal-most Paleocene section.

Core number one is over the interval 9515' to 9545', while core number two is over the interval 9545' to 9570'.

9515-9527' Sandstone; white, fine to medium, well sorted, sub-angular to rounded, quartz overgrowth, minor coal beds. Bright yellow fluorescent, strong fast cut.

9527'-9529' 4" Coal and shale; brown, carbonaceous, hard, fractured. Fluorescense and cut.

9529'4"-9534' Sandstone; white, carbonaceous, firm, moderately well cemented, medium grained, minor coal stringers, greenish-white fluoresense, good cut.

9534'-9539' 6" Sandstone; white, fine, clean, thinly interbedded with light to dark grey siltstone, tight, carbonaceous, micaceous, cross-bedded, Dull golden or red fluorescense, very slow weak cut or no cut.

9539' 6"-9545' Sandstone; fine to medium grained to very coarse at top, minor siltstone and shale. Sandstone is white, firm, hard, sub to well rounded, micaceous. Yellow-green, yellow and golden, dull golden fluorescense.

9545'-9551' Sandstone; buff to light grey, firm, medium grained, slightly calcareous toward top. Quartz overgrowth, carbonaceous, micaceous, plant debris. Dull gold fluorescense, slow weak cut.

9551'-9555'6" Shale; light grey, silty, hard, thinly bedded, slow weak cut. Thin fine sandstone interbeds with dull gold fluorescense.

9555'6"-9560' Shale; medium grey, very thinly bedded, hard, slightly carbonaceous, slightly micaceous, slow weak cut.

9560'-9570' Mudstone; shaly, grey to brown, massive, hard, slow weak cut.

| Depth(ft) | Effective Porosity(%) | Permeability(md) Vert. | Hor. | Oil Saturation(%) |
|---|---|---|---|---|
| 9516' | 17.6 | 0.80 | 2.0 | 2.4 |
| 9520'4" - 9520'8" | 15.0 | | 3.281 | 3.075 |
| 9521' | 18.6 | 2.3 | 0.76 | 0.84 |
| 9524' | 21.2 | 11.0 | 14.0 | 5.9 |
| 9530' | 20.8 | 113 | 53 | 3.8 |
| 9544' | 17.3 | 0.55 | 0.78 | tr |
| 9546' | 11.7 | 0.26 | 0.11 | nil |
| 9552' | 14.3 | 0.15 | 0.15 | 2.4 |

A formation interval test was conducted at a depth of 9530 feet. The test recovered 1.4 cubic foot of gas, a trace of oil, and 1900 cubic centimeter of water. The final shut-in pressure was 4444 psi. A low permeability is indicated.

The sample studies indicate that the general cored interval consist of interbedded sandstone, siltstone, mudstone and coal. The sandstone is described as cream to brown, soft to firm, medium to fine, carbonaceous in part, micaceous, clay choked in part, well cemented in part, slightly calcareous, with pale blue to bright yellow fluorescense, weak to strong fast cut. The siltstone is grey to light brown, firm, slightly carbonaceous. The mudstone is grey to chocolate brown. soft to hard. The coal is black, hard to friable, waxy.

The gas detector and chromatographer indicate the presence of $C_1$ to $C_{5+}$ over this interval.

| Well Name Total Depth | Paleocene | | Upper Cretaceous | | | | Lower Cretaceous | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | U.L. balmei | L.L. balmei | T. longus | T. lillieï | N. senectus | C. triplex | T. pannosus | C. paradoxus | C. striatus | F. asymetricus (U.C. Hughesii) |
| Aroo #1 12122' | 8900' | 9100' * | | | | | | | | |
| Bass #2 5910' | 4913' * | 5350' * | 5511'± * | | | | | | | |
| Bass #3 7978' | 6490' | 6685' * | 7248' * | | | | | | | |
| Dondu #1 9603' | 7446' * | 8713' | | | | | | | | |
| Durroon #1 9922' | | 2070' | 3156'± | 3715'± | 4360'± | 4495'± | 5500'± * | 5900'± | 7927'± * | 9650'± * |
| Konkon #1 5013' | 4490' | 4648' | 4894' | | | | | | | |
| Nangkero #1 9440' | 8552' | | | | | | | | | |
| Pelican #1 10428' | 10339' * | | | | | | | | | |
| Pelican #3 9537' | 7935' | 8300' * | | | | | | | | |
| Poonboon #1 10715' | 8788' * | 9028' * | 10632' * | | | | | | | |
| Squid #1 | | | | | | | | | | |
| Yurongi #1 8000' | 6488' * | 7302' | | | | | | | | |

Figure 7

Palynological Zonation, Paleocene and Cretaceous section only
* Conventional Core

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In the Bass #2 well, a conventional core was cut within the upper L. balmei palynological zone of the lower Paleocene. The cored interval is 5062' to 5092', fourteen feet were recovered.

5062'-5066.5' Sandstone; quartz, light grey, very fine to silty, sub-angular, fair sorting, slightly calcareous, very argillaceous, coal grains, this laminae of carbonaceous material, tight.

5066.5'-67' Dolomite; mottled, medium dark grey-light brown, micritic, argillaceous, pyritic.

5067'-5072' Sandstone as above.

5072'-5075' Shale; medium grey, carbonaceous, sandy in patches. Slightly petroliferous odor on fresh surface.

5075'-5076' Sandstone; quartz, light grey, very fine, subrounded to sub-angular, fairly well sorted with common carbonaceous grains, non calcareous clay matrix, micaceous, carbonaceous.

According to the gamma ray and spontaneous potential curves, the interval 5062' to 5092' should have recovered a very argillaceous, non reservoir, sandstone down to approximately 5065', or so, then a shale interval from 5065' to 5072' or 5075, then a clean sandstone from 5072'/5075' to 5083', then a dirty sandstone to 5092', the end of the cored interval. It appears that the clean sandstone interval was not recovered possibly because it is friable and has washed out.

| Depth (ft) | Porosity (%) | Permeability (md) |
|---|---|---|
| 5063' | 20.8 | 1.1 |
| 5064' | 19.3 | 1.0 |
| 5065' | 20.1 | 0.6 |
| 5066' | 20.6 | 0.8 |
| 5067' | 18.3 | 0.5 |
| 5069 | 14.4 | 0.1 |

A conventional core was cut within an undifferentiated zone of the Mensozoic. The cored interval is 5508' to 5521', eleven feet were recovered.

5508'-5509' Siltstone; dark reddish brown, very carbonaceous, sandy.

5509'-5510' Sandstone; dark tannish grey, friable, fine grained and very silty, carbonaceous.

5510'-5511' Siltstone; as above

5511' Basal breccia;chips of underlying greenstone in carbonaceous siltstone matrix.

5511'-5519' Greenstone; orthoclase porphyry or altered trachytic rock, brecciated near top and weathered throughout.

A second conventional core was cut within an undifferentiated zone of the Mesozoic. The cored interval is 5900'-5910', nine feet were recovered.

It is described as altered tuffaceous mudstone; medium greyish blue-green, faintly banded, highly fractured, pyritic. A hand speciman is described as bedded tuff. A thin section of the same mentions the presence of glass shards, abundant feldspar, chlorite grains and concludes that this rock was originally a fine-grained vitric-crystal tuff. A second hand specimen is also descirbed as a bedded tuff; hard, tough, grey-green with dark green chlorite bands, grading rapidly into a greyish white quartzitic mudstone. Secondary pyrite is common. A thin section of this specimen describes it as: extremely fine-grained mass of pale green chlorite. This chloritic tuff grades rapidly into a recrystallized mudstone.

7433'-7438' Thinly interbedded shale and sandstone. The shale in medium grey, in part silty to very finely sandy, micaceous, pyritic with fine carbonaceous streaks. The sandstone is grey white to buff, coarse grained to granular, sub-angular to rounded, fairly well sorted with scattered pebbles, grey shale and carbonaceous grains, micaceous, clay matrix.

7438'-7442' Sandstone; grey white to buff, coarse grained to granular with fine pebbles towards the base, clay matrix.

7442'-7450' Shale; medium grey, silty, sandy, conglomeratic, micaceous, with white clay grains, sparsely carbonaceous.

7450'-7450'3" Conglomerate; subangular to subrounded pebbles in poorly sorted light brown, agillaceous, silty, sandy, micaceous, carbonaceous matrix pebbles include quartz, feldspar, dark grey shale, volcanics, tourmaline.

7450'3"-7452'6" Sandstone; as 7442'-7450' with breccia and finely banded shale and coarse grain to granular quartz sandstone.

7452'6"-7453' Sandstone; grey white to buff, coarse grained to granular.

| Depth (ft) | Porosity (%) | Permeability (md) |
|---|---|---|
| 7433 | 28 | 19.3 |
| 7438 | 26 | 19.5 |
| 7439 | 24 | 20 |
| 7441 | 5 | 18.9 |

A conventional core was cut over the interval 7877' to 7892'. Nothing was recovered. On logs this interval appears to be within the so-called basement section.

A conventional core was cut over the interval 7903' to 7914', five feet was recovered.

The core interval appears to consist of a thinly banded and laminated sequence of quartzite, shale and sandstone.

The quartzite, or chert, is light to dark grey to black, very fine grained sparsely pyritic. The shale is dark grey to black, in part silty, carbonaceous, very finely sandy, dense, moderately hard. The sandstone is light to dark grey, argillaceous, fine to very fine grained, in part silica cemented, vuggy

A conventional core was cut over the interval 7974' to 7978', four feet were recovered. The core interval is described or metamorphosed shale with recrystallised segregations of quartz-calcite-biotite and irregular bodies of light to dark grey quartzite. Irregular veins of quartz-calcite and mica, minor pyrite.

In the Bass #3 well, a conventional core was cut within the lower L. balmei palynological zone of the basal Paleocene. The core interval is 6903' to 6933', thirty feet were recovered.

6903'-6905.5' Shale; light grey to light brown, micaceous carbonaceous, slightly dolomitic.

6905.5' - 6906' Shale; brown to black, micaceous, carbonaceous.

6906'-6920' Shale, light grey, micaceous carbonaceous.

6920' - 6922' Sandstone; mottled black, light grey to white, very fine to medium to coarse grained, subrounded to sub-angular, poor sorting, coal grains, micaceous, carbonaceous, clay matrix.

6922'-6923' Sandstone; as above with carbonaceous laminae.

6923'-6924' Sandstone; as 6920'6922'.

6924'-6926' Shale; light brown, micaceous, carbonaceous.

6926'-6930' Sandstone; light grey, fine to coarse grained, subrounded to sub-angular,coal and shale grains, clay matrix, slightly calcareous.

6930' - 6931'Shale; light grey, micaceous, carbonaceous, silty.

6931' - 6932.5' Shale, brown, micaceous, carbonaceous.

6932.5' - 6933' Sandstone; light grey, fine to medium grained, subrounded to sub-angular, fair sorting,micaceous,clay matrix, slightly calcareous.

| Depth (ft) | Porosity (%) | Permeability (md) |
|---|---|---|
| 6921 | 22.2 | 10.28 |
| 6922 | 16.3 | 0.45 |
| 6925 | 16.0 | 28.39 |
| 6926 | 22.3 | 18.24 |
| 6928 | 18.9 | 42.10 |
| 6929 | 25.8 | 0.45 |
| 6930 | 15.5 | 2.30 |
| 6932 | 15.4 | 1.30 |

A formation interval test was conducted at 6740 feet. It recovered 29 cubic feet of gas along with 800 cubic centimeter of condensate, or light oil, and 12,500 cubic centimeters of discolored water which upon analyses appears to be mud filtrate. Sampling pressure during the test was 3025 psi and the final shut-in pressure was 3125 psi.

A conventional core was cut within the T. longus palynological zone of the Upper Cretaceous. The core interval is 7433' to 7453', twenty feet were recovered.

A conventional core was cut over the interval 7674' to 7733' in the Dondu #1 well, This interval is assigned to the upper L. balmei palynological zone of the basal Paleocene.

7674'-7683' Shale; dark brownish grey, silty, micaceous.

7683'-7686' Siltstone; tan-white, hard, micaceous, carbonaceous, sandy towards the base.

7686'-7689' Sandstone; clear and frosty with subangular to subrounded unconsolidated coarse to very coarse quartz grains, moderately well sorted.

7689'-7691' Shale; dark brownish grey, silty, hard, indurated.

7691'-7696' Sandstone; unconsolidated, as 7686'-7689.

7696'-7701' Sandstone; tan, white, fine grained, sub-angular to subrounded quartz grain, very silty, firm, consolidated, carbonaceous bands.

7701'-7703' Sandstone; white, fine to very coarse, predominately medium grained, firm, consolidated, poorly sorted.

7703' - 7706' Sandstone; white, fine to very coarse, predominantly medium grained, firm, consolidated, poorly sorted.

7706'-7713' Sandstone; white, fine to medium grained, very silty, carbonaceous bands.

7713-7717' Sandstone; white, very fine grained with abundant horizontal carbonaceous laminae.

7717'-7721' Siltstone; light grey, very micaceous and sandy, abundant horizontial carbonaceous laminae.

7721'-7725' Sandstone; white , very fine to fine grained, very micaceous, silty, horizontal carbonaceous laminae.

7725'-7730' Siltstone; light grey, very micaceous, abundant horizontal carbonaceous laminae, layers of mica, few thin coals.

7730'-7733' Sandstone; white, very fine to fine to very coarse grained, silty, poorly sorted, carbonaceous laminae.

| Depth(ft) | Permeability (md) | Porosity (%) | Gas (%) |
|---|---|---|---|
| 7689 | 356 | 17 | 6 |
| 7706 | 25 | 21 | 7 |
| 7721 | 11 | 18 | 7 |

A conventional core was cut over the interval 8373' to 8425'. This interval is assigned to the C. striatus palynological zone of the Lower Cretaceous.

8373'-8385' Sandstone; apple green, fine to medium with many coarse grains, subrounded to subangular, poorly sorted, well indurated, abundant lithic grains

8385'-8387' Conglomerate; well rounded pebbles of chert(?) and quartzite in very fine to very coarse grain matrix of sandstone.

8387'-8396' Sandstone; light green, very fine to coarse, sub-angular to subrounded, poorly sorted, very hard, indurated, massive, non calcareous.

8396'-8412' Sandstone; grey-white with few green grains, increasing amounts of very fine to very coarse lithic, poorly sorted, cleavage fracture at 30 degrees. Few thin carbonaceous laminae dipping at 15 degrees are present in the bottom one foot of this interval.

8412'-8422' Sandstone; grey-green, fine to coarse, silty, sub-angular, micaceous, abundant lithic, very hard,

8422'-8423' Shale; dark brown, very carbonaceous, firm, indurated.

8423'-8424.5' Coal; black, brittle, fractured.

8424.5'-8425' Shale; dark grey, very silty, sandy, very carbonaceous, hard, indurated with scattered wood fragments.

A petrographic description at 8374' refers to a lithic sandstone, cemented with silica-chlorite and by the break down or distortion of lithic fragments, well sorted, angular to sub-rounded. At 8376' the rock is described as lithic pebbly sandstone or conglomeratic greywacke with igneous, sedimentary and metamorphic components.

| Depth (ft) | Lithology | Porosity (%) | Permeability(md) |
|---|---|---|---|
| 8380 | Sand | 16.0 | 0 |
| 8387 | Sand | 16.0 | 0 |
| 8394 | Sand | 11.0 | 0 |
| 8401 | Sand | 12.0 | 0 |
| 8408 | Sand | 15.0 | 0 |
| 8415 | Sand | 15.0 | 0 |
| 8422 | Sand | 8.0 | 0 |

In the Durroon #1 well, a conventional core was cut over the interval 5547' to 5566'. This interval is assigned to the T. pannosus palynological zone which straddles the Upper versus Lower Cretaceous boundary.

5547'-5548.5' Sandstone; very fine to fine grained, grey-green, silty, glauconitic, poorly sorted, sub-angular, firm occasional shale clasts

5548.5'-5553.5' Shale; grey black, fissile, carbonaceous, with stringer beds of sandstone; grey, glauconitic. Siltstone grey, firm to friable.

5553.5'-5565.5' Sandstone; grey, medium-fine grained, sub-angular, moderately sorted, quartzose, carbonaceous, well cemented, grey-white clay matrix.

5565.5'-5566' Shale; grey-brown, fissile, firm, micaceous.

Dip throughout this core is 30° approximately. A hand specimen taken from this core at 5599' is described as lithic sandstone; friable, with rare patches of hydrocarbons or coal. The lithic fraction consist of siltstone and represent 85-90% of the grain population.

| Depth (ft) | Lithology | Porosity(%) | Permeability(md) |
|---|---|---|---|
| 5548' | sand | 16.9 | 0 |
| 5548' | sand | 22.0 | 0.45 |
| 5554' | sand | 26.9 | 52 |
| 5555' | sand | 21.1 | 310 |
| 5556' | sand | 18.0 | 6.2 |
| 5557' | sand | 18.4 | 82 |
| 5558' | sand | 22.6 | 29 |
| 5559' | sand | 17.3 | 4.4 |
| 5560' | sand | 17.0 | 11 |
| 5561' | sand | 19.0 | 3.6 |
| 5562' | sand | 24.0 | 9.1 |
| 5563' | sand | 15.2 | 7.1 |
| 5563' | sand | 14.0 | 3.4 |
| 5564' | sand | 18.0 | 9.8 |
| 5565' | sand | 13.3 | 2.6 |

A conventional core was cut over the interval 9905' to 9922'. This interval is assigned to the upper L. hughesii palynological zone of the lower Cretaceous.

9905'-9913.5' Sandstone, grey-green, fine grained, silty, agillaceous with calcareous matrix.Quartzone with some overgrowth, common brown and green lithic grains, mica and carbonaceous streaks, poor to moderate sorting, sub-angular to subrounded, hard, massive bedding with dip at 20 to 30 degrees.

9913.5'-9915' Conglomerate; elongated shale and sandstone pebbles and cobbles in grey-green sandstone matrix, very argillaceous and shaly at base. Minor gypsum and calcareous pebbles, as well as a coal band at the top.

9915'-9922' Sandstone; massive and dipping at 20 to 30 degrees. Thin carbonaceous streaks.

| Depth (ft) | Lithology | Porosity (%) | Permeability(md) |
|---|---|---|---|
| 9905 | Sand | 10 | 0 |
| 9911 | Sand | 10 | 0 |
| 9918 | Sand | 10 | 0 |

A conventional core was cut over the interval 10,386' to 10,398' in the Pelican #1 well. This interval is assigned to the upper L. balmei palynological zone of the Paleocene.

10,386'-10,393.375' Siltstone; light grey-light brown, well indurated, interbedded with dark grey-black, micaceous, hard carbonaceous shale.

10,393,375'-10,398' Shale; dark grey-black, generally massive, carbonaceous, more coaly toward the base.

| Depth | Lithology | Effective Porosity | Permeability |
|---|---|---|---|
| 10387'1"-10387'1" | SLTST | 8.5% | 0.1 md |

The interval 9351' to 9521' was continously cored in the Pelican #3 well. This interval is assigned to the undifferentiated L. balmei palynological zone of the Paleocene.

9351'-9361' Shale; gray, silty, laminated, carbonaceous.

9352'-9353.5' Sandstone; medium to very coarse grained, quartz, feldspar, possibly chert, in shaly carbonaceous matrix with shale and coal laminae.

9353.5'-9361' Sandstone; light grey, clay matrix, sub-angular to subrounded quartz, very fine to fine grains, slight to fair odor with dull gold brown fluroescense, no visible cut. Minor cross bedding, generally massive with some carbonaceous material, minor shaly streak.

9361'-9364' Interbedded sandstone as above and shale as above.

9364'-9366' Shale; with thin silty sandstone laminae.

9366'-9373.5' Thinly interbedded sandstone and shale as above.

9373.5'-9376' Sandstone; light grey, subangular to subrounded quartz grains, fine to very fine, with minor shale partings. Dull gold brown fluorescense, no cut, odor present but not strong.

9376-9378.5' Laminate sandstone and shale.

9378.5'-9397' Shale; dark grey, very carbonaceous.

9397'-9418' Sandstone; light grey to white, fine to medium grained, hard massive, with very minor carbonaceous shale streaks and coaly wood fragments.

Sub-angular to subrounded, well sorted, some overgrowth on quartz. White clay matrix. Dull gold-brown fluorecense , weak, pale cream cut with blue-white residue, evidence of deep drilling mud invasion.

| Depth(ft) | Porosity(%) | Permeability(md) |
|---|---|---|
| 9406' | 22.3 | 10 |
| 9415.5' | 22.9 | 157 |

9418'-9419.5' Shale; dark grey, carbonaceous with thin interbeds of very fine sandstone.

9419.5'-9425.5' Sandstone; as above. Dull gold-brown fluorescense, weak cut and residue.

9425.5'-9428.5' Shale; dark grey, carbonaceous with minor sandstone interbeds.

9428.5'-9430' Sandstone; fine grained, hard with shale streaks.

9430'- 9431.5' Shale; dark grey to black, fissile,hard, carbonaceous and micaceous.

9431.5'-9433' Sandstone; grey-white, fine grained, hard with shaly streaks.

9433'-9438' Shale; dark grey to black, fissile,hard, carbonaceous with sandstone interbeds.

9438'-9440.5' Sandstone; very fine grained, silty, clay matrix, shaly and coaly streaks.

9440.5'-9442' Shale; as above.

9442'-9448' Sandstone; clay matrix, fine to medium, sub-angular to sub-rounded grains, micaceous, carbonaceous, with minor shale and coaly streaks.

9448'-9460' Interbedded sandstone, siltstone and shale. The sandstone is light grey-white, very fine to fine grained, angular to sub-rounded.

9460'9464' Shale; dark grey, fissile, with minor interbedded thin sandstone.

9464'-9467' Thinly interbedded sandstone and shale.

9467'-9477' Sandstone; light grey, very fine to fine, silty,clay matrix, very slightly calcareous, sub-angular, fair to well sorted, carbonaceous. Gold brown fluorescense, slow weak pale yellow cut fluorescense, blue with white fluorescense cut residue, slight odor,

| Depth (ft) | Porosity (%) | Permeability (md) | % Gas Bulk Vol. |
|---|---|---|---|
| 9472 | 18.5 | 1. | 7.4 |

9477'-9479' Interbedded sandstone and shale.

9479'-9486.5' Shale; with some thin sandstone and siltstone laminae.

9486.5'-9504.5' Sandstone; with shale laminae, silty in part, very fine to medium grained, rare quartz overgrowth carbonaceous, clay and fine quartz grains matrix. Gold brown fluorescense, slow weak cut, fair odor.

| Depth (ft) | Porosity (%) | Permeability (md) | %Gas Bulk Vol. |
|---|---|---|---|
| 9492' | 13.2 | 1: | 4.5 |

9504.5'-9509' Thinly interbedded sandstone and shale.

9509'-9518' Shale with sandstone interbedded.

9518'-9521' Shale, dark grey, fissile.

Three conventional cores have been cut in the Paleocene and Upper Cretaceous section penetrated by the Poonboon #1 well.

The 8802' to 8827' core interval is assigned to the upper L. balmei palynological zone of the Paleocene.

8814' - 8815' Sandstone; as above, with abundant coarse grains to pebbles, poorly sorted, carbonaceous stringers.

8815' - 8817' Sandstone; silty to very fine grained.

8817' - 8822' Interbedded siltstone and shale.

Siltstone is grey to grey brown, firm to hard, carbonaceous. Shale is dark gray.

8822' - 8827' Siltstone; grey-green, shaly, firm.

The core interval 9954' to 9982' is assigned to the lower L. balmei palynological zone of the Paleocene.

9954' - 9959' Shale; dark brown grey, carbonaceous, coal streaks.

9959' - 9974' Sandstone; light grey to grey, very fine to medium, silty in part, subangular to subrounded, moderate sorting, firm. Clay matrix, quartz overgrowth, carbonaceous, trace mica, chlorite, lithic grains. Minor spotty dull gold mineral fluorescense.

9974' - 9982' Shale; dark grey, hard, carbonaceous. This section is over-pressured.

The core interval 10,691' to 10,715' is assigned to the T. longus palynological zone of the Upper Cretaceous.

10,691' - 10691.5' Sandstone; tan, white, medium grained, friable, well sorted, subangular to subrounded, clean.

10,691.5' - 10,715' Shale; dark grey, silty, micaceous, carbonaceous.

A hand specimen at 10,691' is described as fine grained agillaceous sandstone. The clay fraction is kaolinite with moderate amounts of chlorite and mica, Quartz represents roughly 10% of the total.

This section is overpressured.

The interval 10,444' to 10,450' is considered to be gas bearing. It was not cored.

| Depth(ft) | Porosity(%) | Permeability(md) | % Gas Bulk Vol |
|---|---|---|---|
| 8803 | 18 | 1230 | 30 |
| 8804 | 29 | 40 | 56 |
| 8805 | 16 | 313 | 25 |
| 8806 | 18 | 142 | 29 |
| 8807.5 | 18 | 150 | 29 |
| 8808.5 | 18 | 105 | 29 |
| 8809.5 | 16 | 367 | 22 |
| 8810 | 14 | 67 | - |
| 8810.5 | 14 | 98 | 22 |
| 8811.5 | 14 | 39 | 26 |
| 8812.5 | 16 | 100 | 36 |
| 8813 | 12 | 50 | 25 |
| 8814 | 15 | 88 | 26 |
| 8814 | 19.7 | 19 | - |
| 8815 | 17 | 122 | 28 |
| 8816 | 15 | 16 | 37 |
| 9960 | 16.9 | 2.1 | 6.9 |
| 9960 | 16.3 | 4.2 | - |
| 9961 | 13.8 | 2.9 | 4.2 |
| 9962 | 16.8 | - | 5.2 |
| 9963 | 14.7 | | 4.3 |
| 9964 | 22.3 | 3.5 | 10.9 |
| 9965 | 16.2 | | 6.06 |
| 9965 | 18.2 | 14.1 | - |
| 9966 | 21.2 | 48 | 9.9 |
| 9967 | 18.9 | 6.8 | 8.2 |
| 9968 | 11.5 | 14.5 | 0.5 |
| 9969 | 17.9 | 20 | 7.0 |
| 9970 | 15.0 | 1.5 | 5.1 |
| 9971 | 17.9 | | 7.9 |
| 9971.5 | 3.7 | 0.99 | - |
| 9972 | 9.8 | | 4.8 |
| 9973 | 16.9 | | 6.6 |
| 10691 | 9 | 276 | 9.8 |

The interval 7045' to 7075' was cored in the Yurongi #1 well. This interval is assigned to the upper L. balmei palynological zone of the Paleocene.

7045'-7075' Sandstone; light grey, fine grained, sub-rounded to angular, poorly sorted, calcareous matrix, abundant muscovite, few fine lithic grains, coal fragments, massive with local faint lamination.

| Depth(ft) | Porosity(%) | Permeability(md) | % Gas Bulk Vol. |
|---|---|---|---|
| 7045 | 19.1 | 1.62 | 8.8 |
| 7054 | 21.2 | 2.5 | - |
| 7056 | 16.6 | 1.51 | 5.4 |
| 7067 | 16.9 | - | 6.6 |

Reservoir Potential

The Paleocene and Cretaceous cored intervals of the Bass Basin wells have been described in the preceding Conventional Core section and the values for the porosity and permeability determined from whole core or plug samples have been listed.

Figure 8. is a plot of porosity versus depth for each core interval. Since the core intervals are relatively thin when plotted at this scale, each core generates a range of porosities which plot as a straight line on the depth scale. It should be noted that individual cores contain porosity ranges up to 17 percent points, thus an appreciable scatter of points is generated for each depth analysed. A best fit line is shown in an attempt to illustrate the deterioration of porosity with increasing depth. The slope of this line is so slight that it leads to the conclusion that porosity preservation is mostly not controlled by depth. Porosities in excess of 20 percent are found at 10,000 feet just as at 5,000 feet.

Figure 9. is a plot of porosity versus depth for the Paleocene upper L. balmei palynologic zone only. The name of the wells in which each core was cut is indicated. A best fit line indicates that porosity decreases with depth, from 5000 feet to 9000 feet, at a rate of one porosity percent point per 1700 feet, or so. This is considered non diagnostic of reservoir deterioration with depth. The range of porosities within one core interval is again up to 17 percent points.

Figure 10. is a plot of porosity versus depth for the Paleocene lower L. balmei palynologic zone. The name of the wells in which each core was cut is indicated. A best fit line indicates that porosity decreases with depth, from 7000 feet to 10,000 feet, at a rate of one porosity percent point per 2000 feet. This is considered non diagnostic of reservoir deterioration with depth. The range of porosities within are core interval is up to almost 13 percent points.

Figure 11. is a plot of porosity for the T. longus palynologic zone of the Upper Cretaceous in the Bass #3 well conventional core. The average porosity of this core interval is 26 percent and the range is 4 porosity percent points. A porosity versus depth decline curve is not generated since this palynological zone has only been cored once in the Bass Basin wells. This core interval indicates excellent reservoir conditions in the Upper Cretaceous section of the Bass #3 well.

Figure 12. is a plot of porosity for the T. pannosus palynologic zone of the Upper and Lower Cretaceous section found in a core interval of the Durroon #1 well. The porosity range is almost 14 percent and the mean porosity is 19 percent.

A porosity versus depth decline curve is not generated since this palynologic zone has only been cored once in the Bass basin wells. This core interval indicates excellent reservoir conditions for the basal Upper Cretaceous and upper-most Lower Cretaceous section found in the Durron #1 well.

Figure 13. is a plot of porosity for the C. striatus palynological zone of the Lower Cretaceous section cored in the Durroon #1 well. The porosity range is 8.5 percent and the mean porosity is approximately 14 percent. This palynological zone has only been cored once in the Bass basin wells. This core interval indicates moderate reservoir conditions for this zone of the Lower Cretaceous.

Figure 14. is a plot of porosity for the L. hughesii palynological zone of the Lower Cretaceous section cored in the Durroon #1 well. A single figure of 10 porosity percent point is indicated.

Figure 15. is a cross-plot on three cycle log paper of porosity determinations measured in percent point versus permeability measured in millidarcies as generated from all the analysed core intervals of the Paleocene and Cretaceous sections available in the Bass basin.

A wide scatter of points is generated. It should be noted that permeabilities of one or less millidarcies are measured in samples with porosities ranging from 6 to 26 percent points. No clear pattern of decreasing permeability associated with decreasing porosity is recognized.

A series of parallel curves have been generated. These curves indicate that for a specific group of porosity determinations, a trend of permeabilities is indicated. It therefore appears that in specific cases, the permeability does decrease with the porosity. Since all the curves generated are parallel it may be concluded that a single reservoir deterioration mechanism is present.

Two rather well defined parallel trends are recognized. As porosity decreases from 28 percent down to 10 percent, the permeability decreases from 1000 millidarcies down to 320 millidarcies. The second trend indicate that as porosity decreases from 29 percent down to 9 percent, the permeability decreases from 400 millidarcies down to one or less millidarcy.

An effective reservoir area is defined by two lines with porosity in excess or 10 percent point and permeability in excess of 10 millidarcies. Half or more of the points fall within this area.

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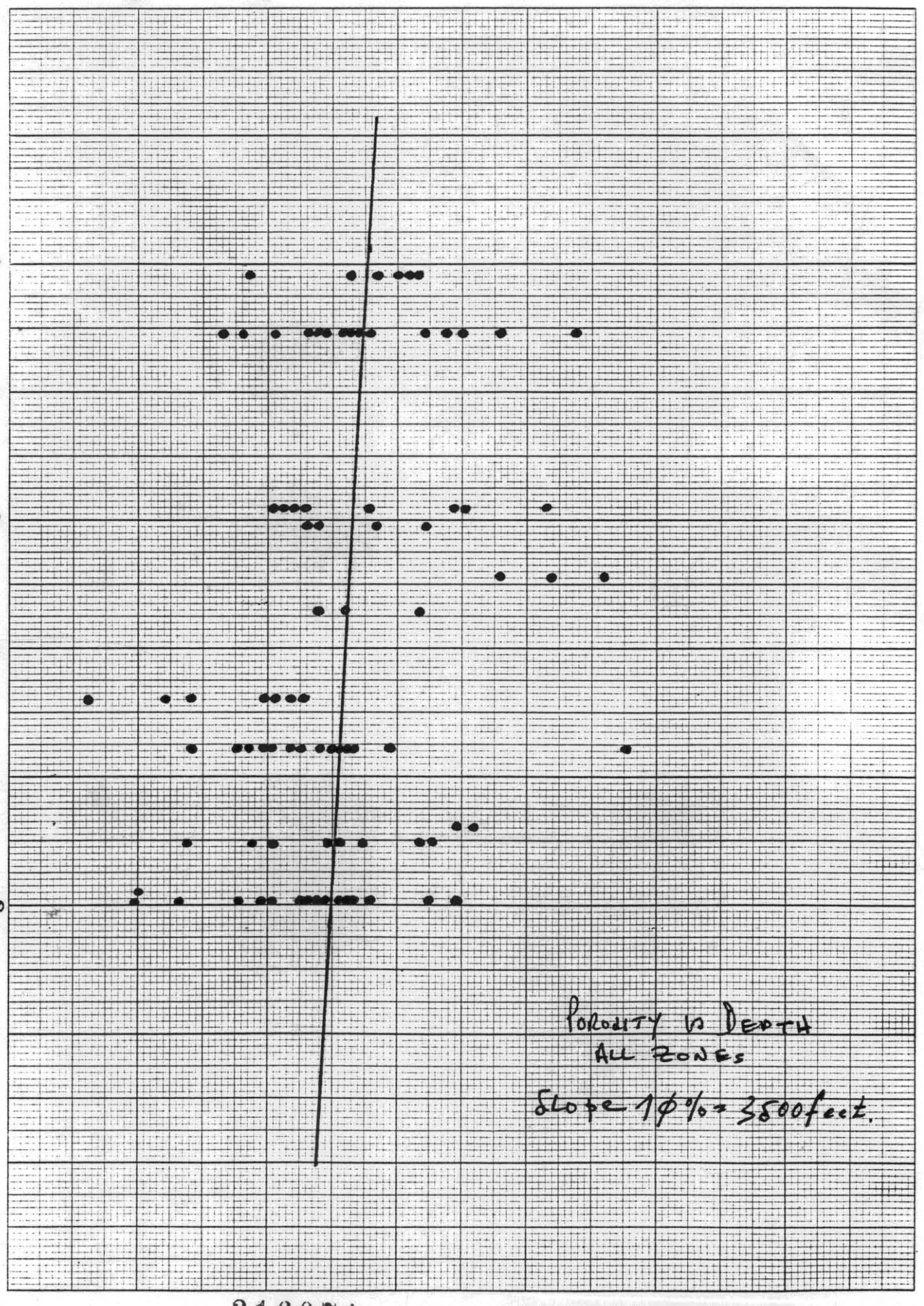
Since plots of porosity versus depth taken collectively, or individually on the basis of palynologic zone, indicate that relatively thin core intervals show very wide ranges of porosity, from poor reservoir conditions to excellent reservoir conditions, and no significant reduction of porosity with depth, it may be concluded that the series of parallel curves generates by the porosity versus permeability cross-plot indicate the presence of individual genetic units, or correlatable groups of genetic units, within which the porosity and permeability vary widely and are related to one another. This relationship may be seen in core descriptions which indicate that permeability is much more sensitive than porosity and is controlled by the amount of clay matrix and calcite or silica cement. Depth is not a significant factor, however age may be a significant factor as the older sediments were deposited in a low energy environment therefore, are less mature and more likely to have a significant matrix component.




46 1242

K&E 20 X 20 TO THE INCH • 7 X 10 INCHES
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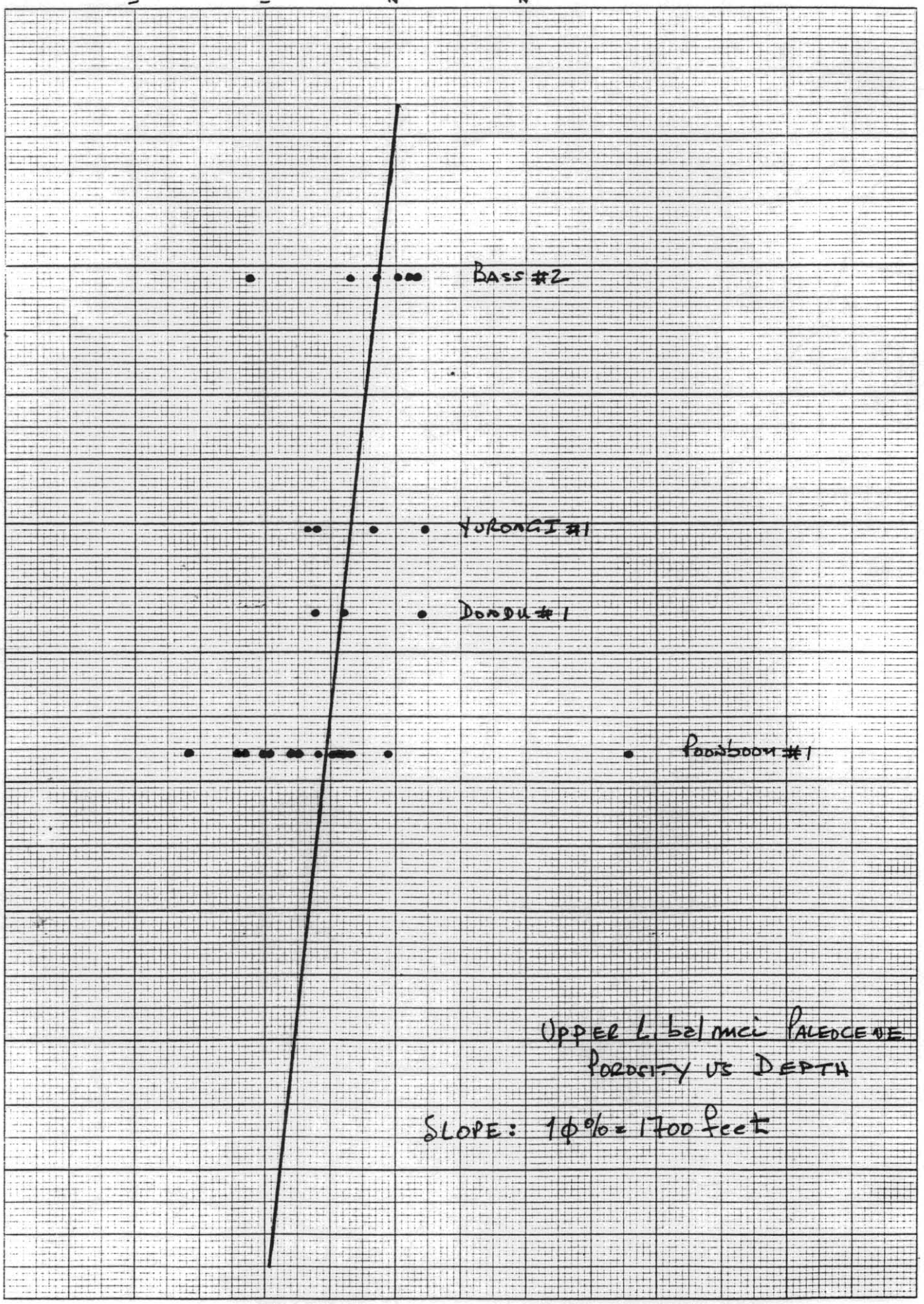
216071

Figure 8

5 cm

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K&E 20 X 20 TO THE INCH • 7 X 10 INCHES
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Figure 9

5 cm

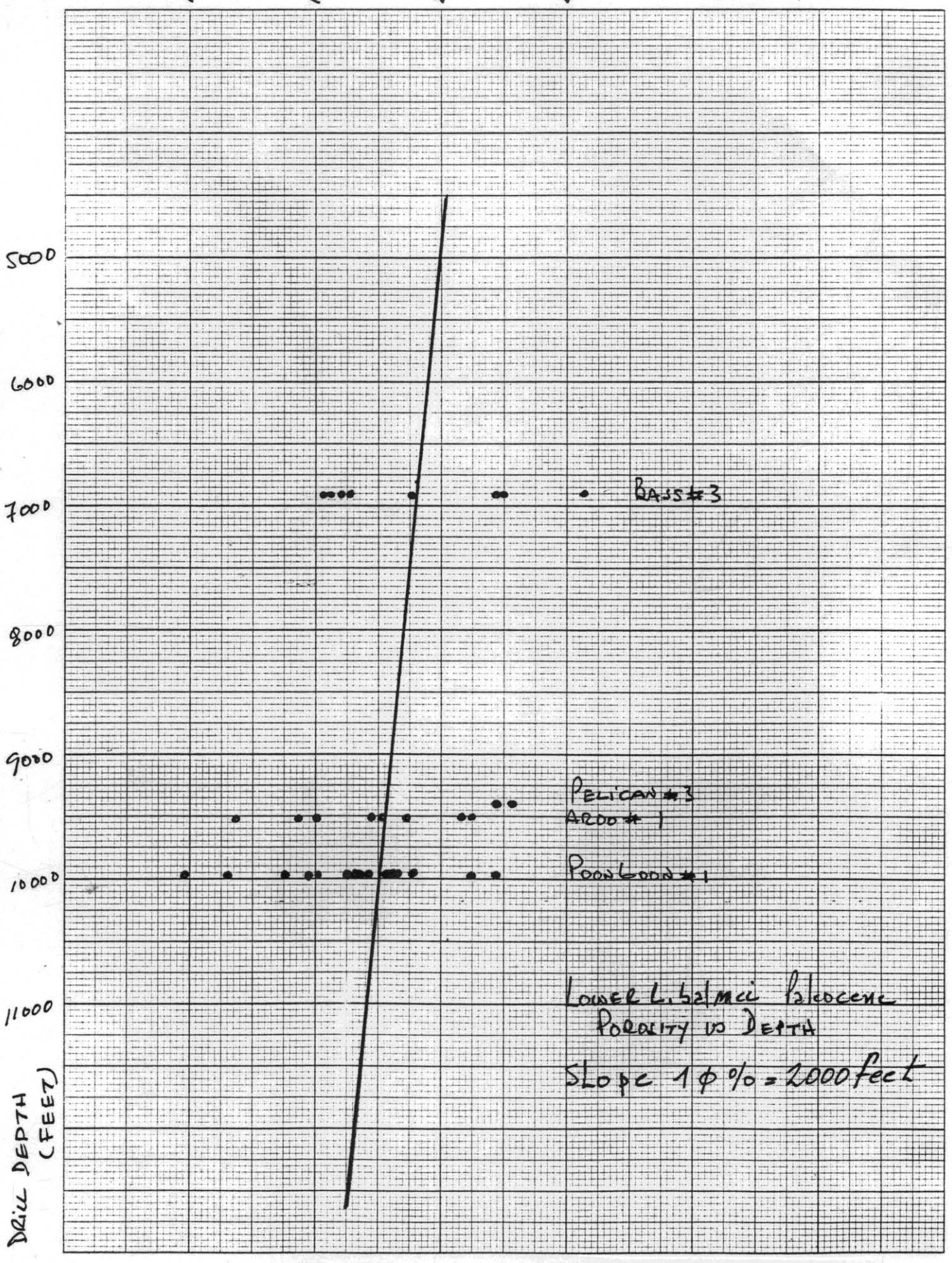


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Figure 10

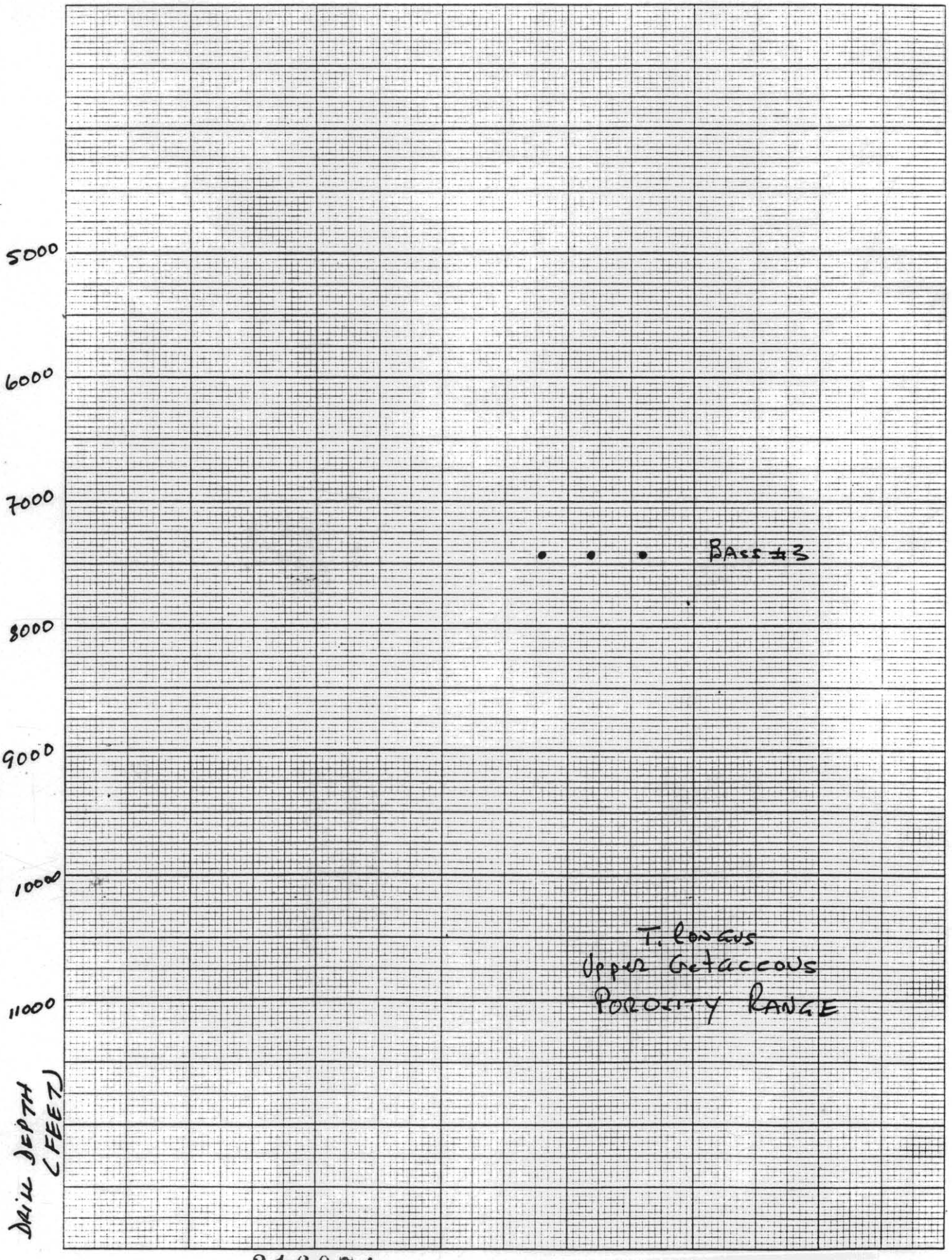


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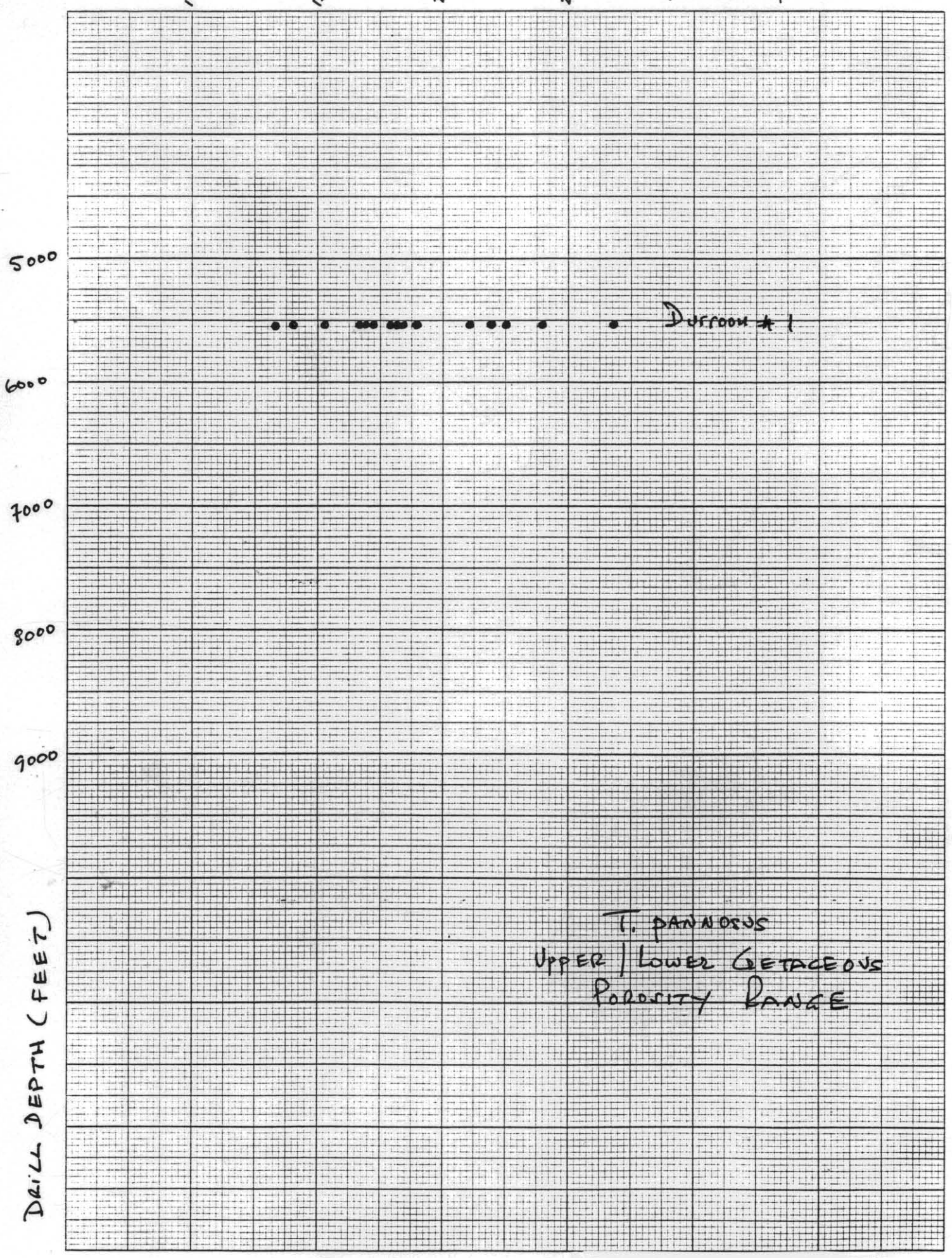
Figure 11

5 cm

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20 X 20 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

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Figure 12

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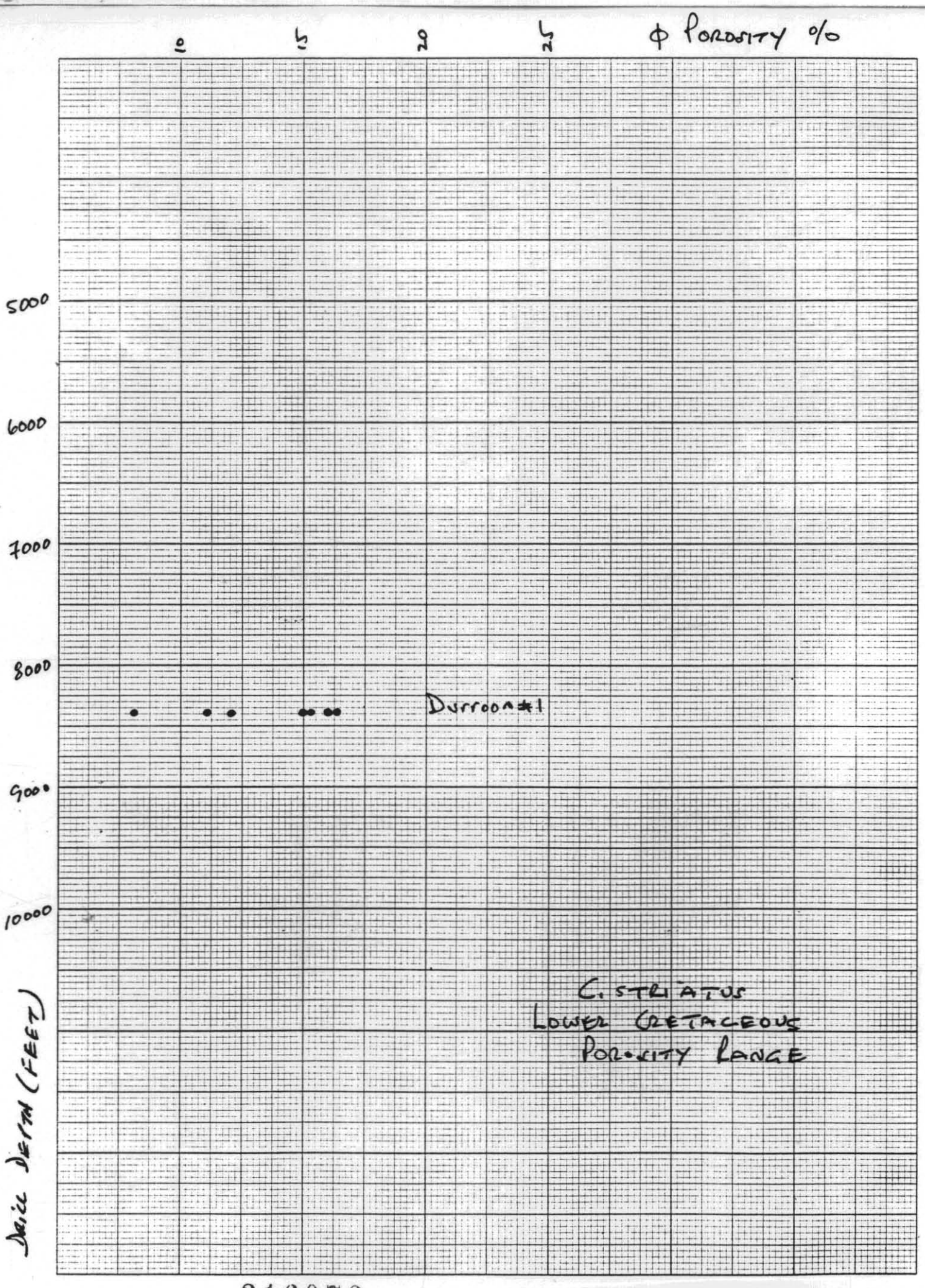


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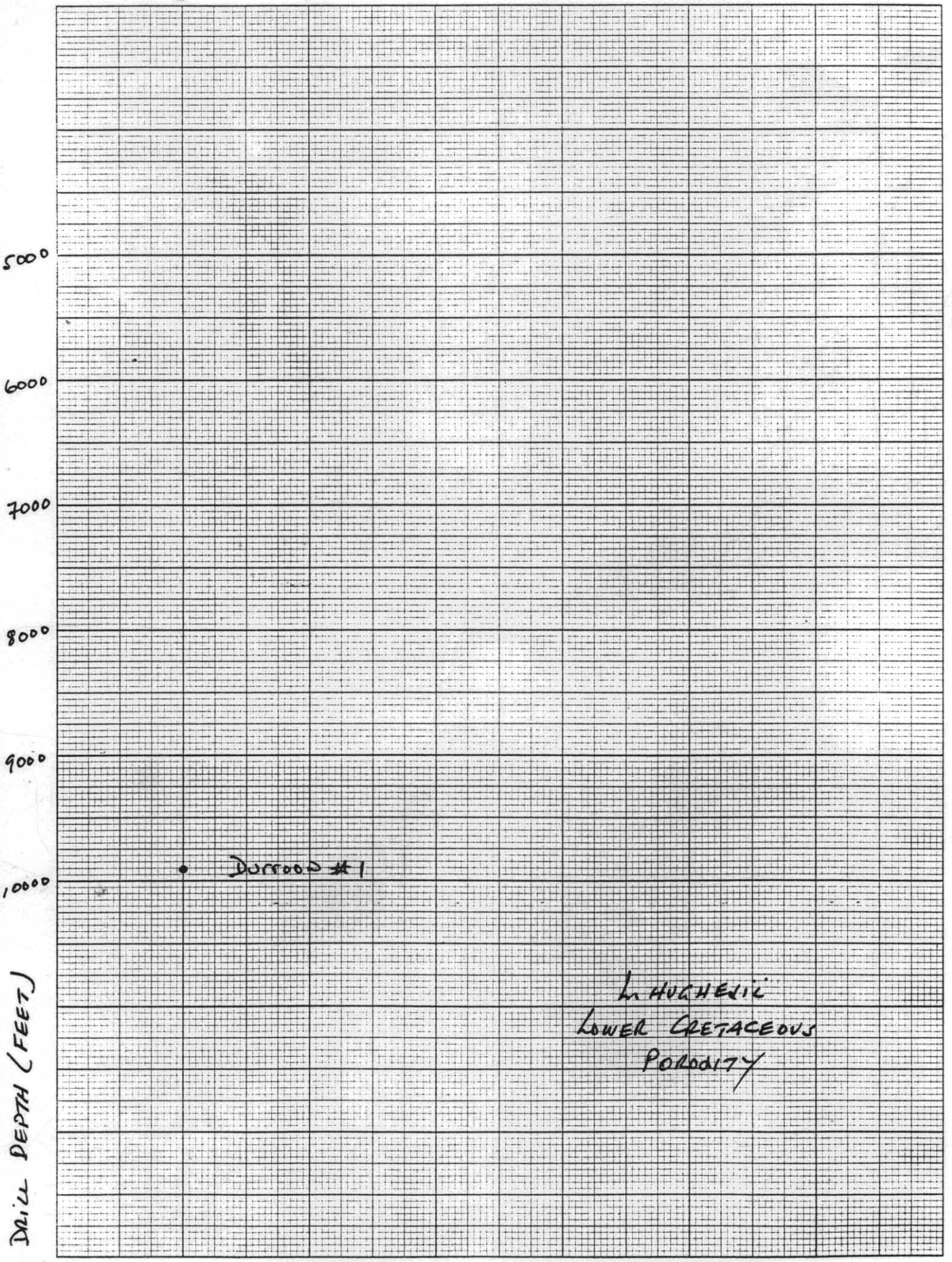
Figure 13



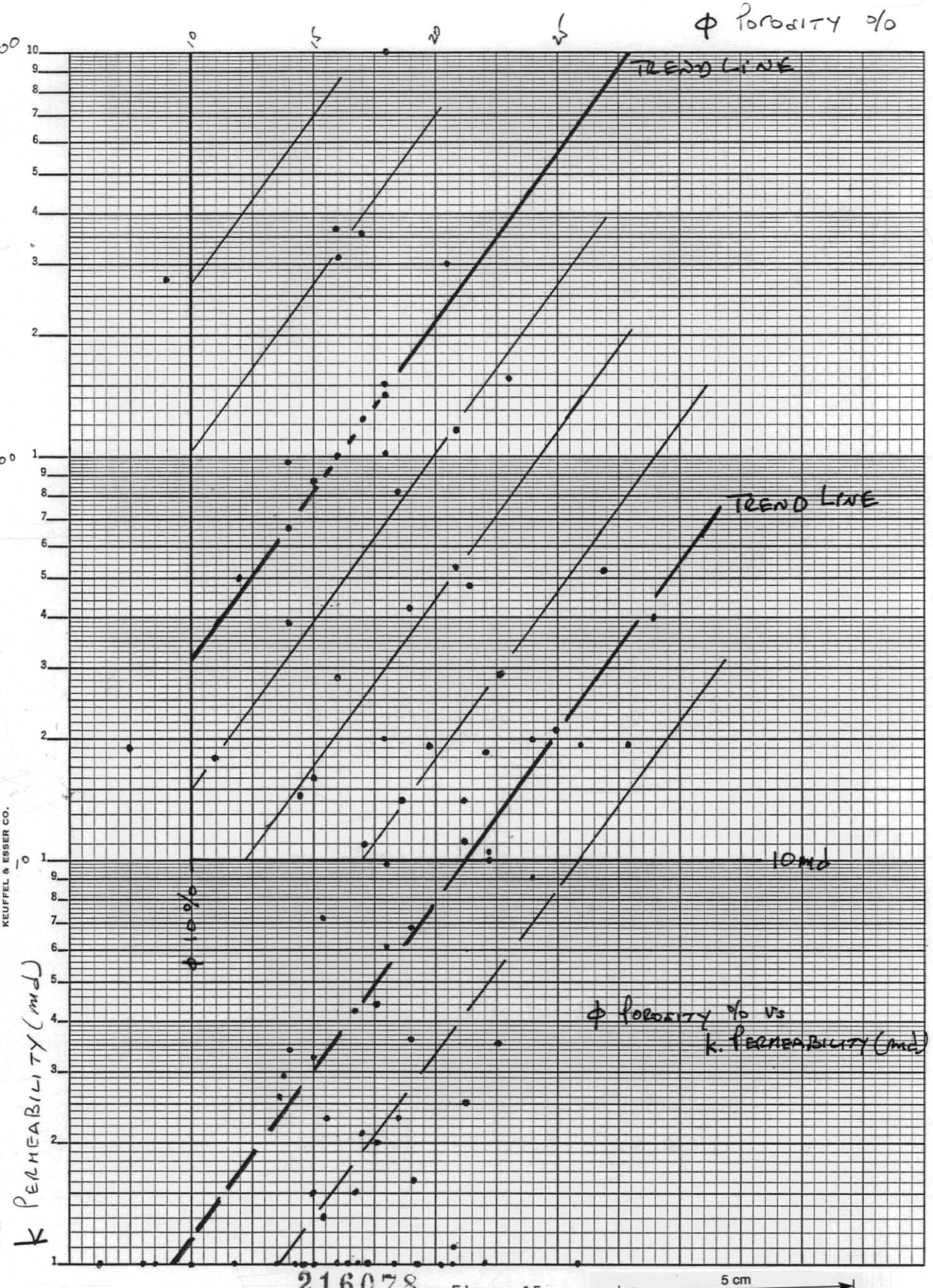

46 1242

K&E 20 X 20 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

216077

Figure 14

5 cm




216078

Figure 15

Seismic Horizons

Weavers seismic line WB-82-32 intersect the Durroon #1 well at shot point 1193 or so. Figure 16.

Key seismic reflectors are identified and color coded. These have been tied to significant lithostratigraphic units, in the Durroon #1 well, through a Time versus Depth Curve, Figure 17 and a Synthetic Seismogram, Figure 18 .

| | |
|---|---|
| 1st Orange | Eocene Eastern View Coal Measures (Unconformity) |
| Green | Paleocene L. balmei (Unconformity)* |
| 1st Blue | intra-Paleocene L. balmei Unconformity |
| 2nd Blue | Upper Cretaceous |
| Purple | intra-Upper Cretaceous / Break-up Unconformity Unconformity * |
| 2nd Orange | mid-Cretaceous Unconformity * |

The asterix (*) indicate that these horizons have been mapped at the local or regional level.

The Durroon #1 well is located near the crest of a major tilted fault block. Several major hiatus and unconformities are recognized. Some of these may be related to periods of growth of this structure and thus be of local relevance only.

Other wells in the basin are located too far and are, in general, too shallow to permit regional correlations. Facies developed in the area of this well may have been controlled, in part, by local structural growth.

The Eocene Eastern View Coal Measures (unconformity) seismic horizon marks the top of the first major occurence of massive sandstone in the Eocene section. It is recognized at a drill depth of 1900 feet in the Durroon #1 well.

The Paleocene L. balmei (unconformity)seismic horizon, and map horizon, is based on Palynologic zonation as well as a marked increase in interval velocity from 7000 feet per seconds to 8300 feet per seconds. Above and below this horizon, the section consist of interbedded sandstone and shale. The intra-Paleocene L. balmei Unconformity seismic horizon is well illustrated on seismic line WB-82-32, Figure 16 at approximately 0.850 seconds. Truncation of beds below this reflector is shown. Above and below this horizon, the section consist of interbedded sandstone and shale.

The Upper Cretaceous seismic horizon, and map horizon, is based on Palynologic zonation. Above and below this horizon, the section consists of interbedded massive sandstone and lesser amounts of shale.

The intra-Upper Cretaceous Unconformity seismic horizon, and map horizon, marks the top of a massive carbonaceous shale section beginning at 4492 feet in the Durroon #1 well. It is recognized regionally. A significant reduction of the interval velocity from 9200 feet per seconds down to 8000 feet per seconds marks this boundary.

The mid-Cretaceous Unconformity seismic horizon, and map horizon, marks the boundary, in this well, between the potential reservoir quality sandstone above and the non reservoir quality sandstone below. The former being porous and permeable, while the later being lithic sandstone with an abundant clay matrix and silica cement. This reflector is recognizable and mappable over a large area however, it may not always represent the unconformable boundary between reservoir and non reservoir sandstones.

# LINE WB82-32

5 cm

DUROON I

216081

LINE B69A-5
SP 2279

T.D. ±2.1 Sec.
9922'

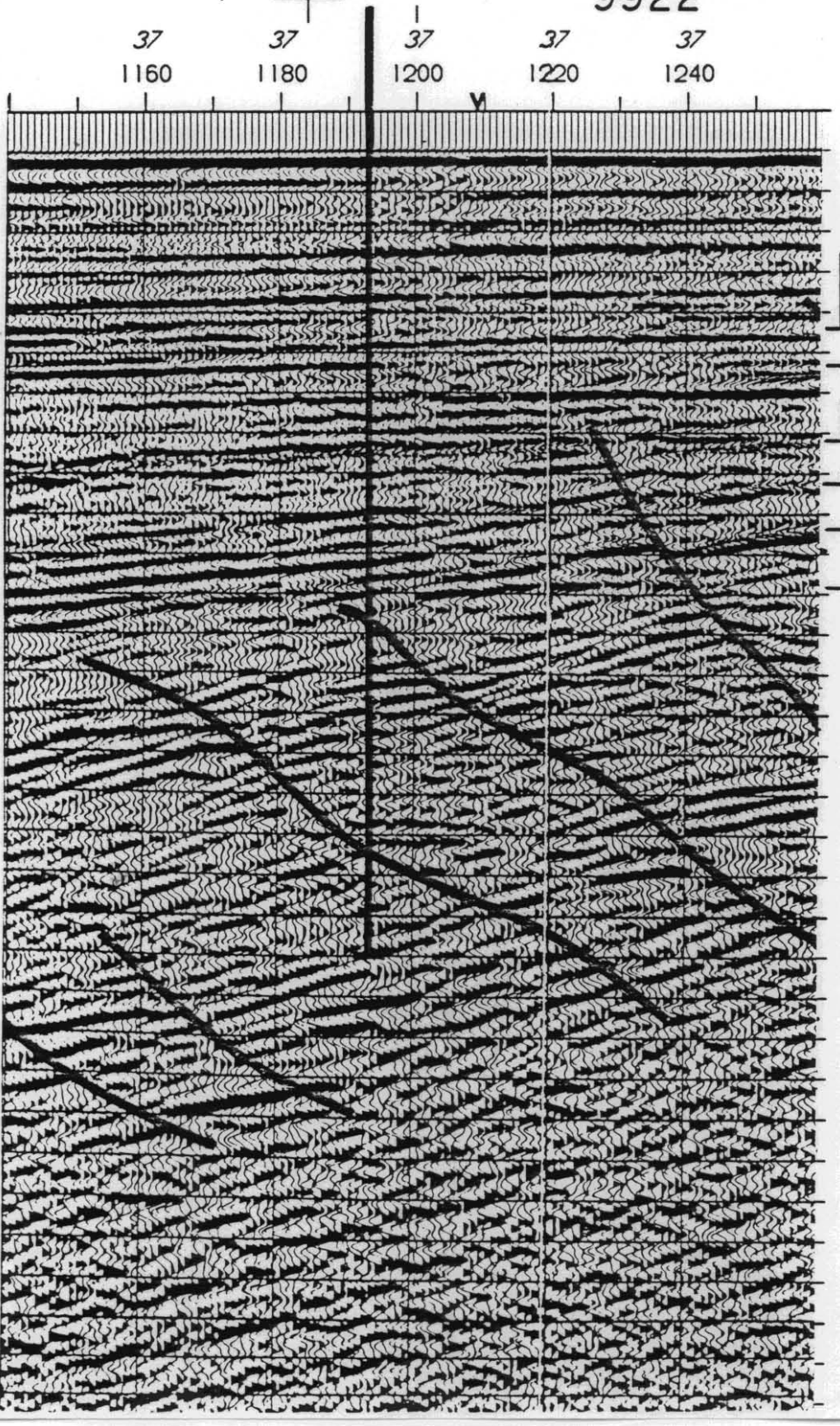



Figure 16

5 cm

216082 *Map Horizon

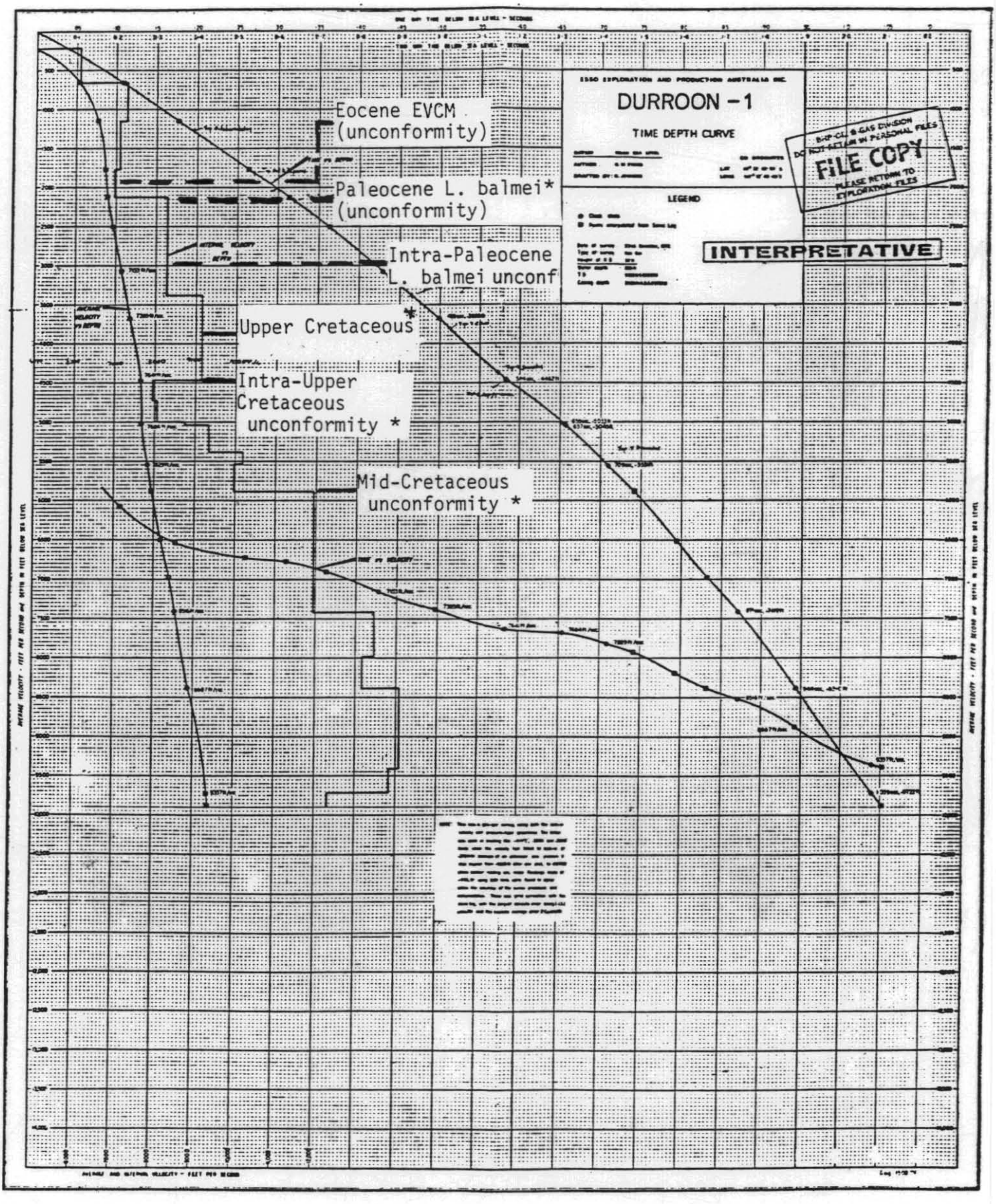



Figure 17

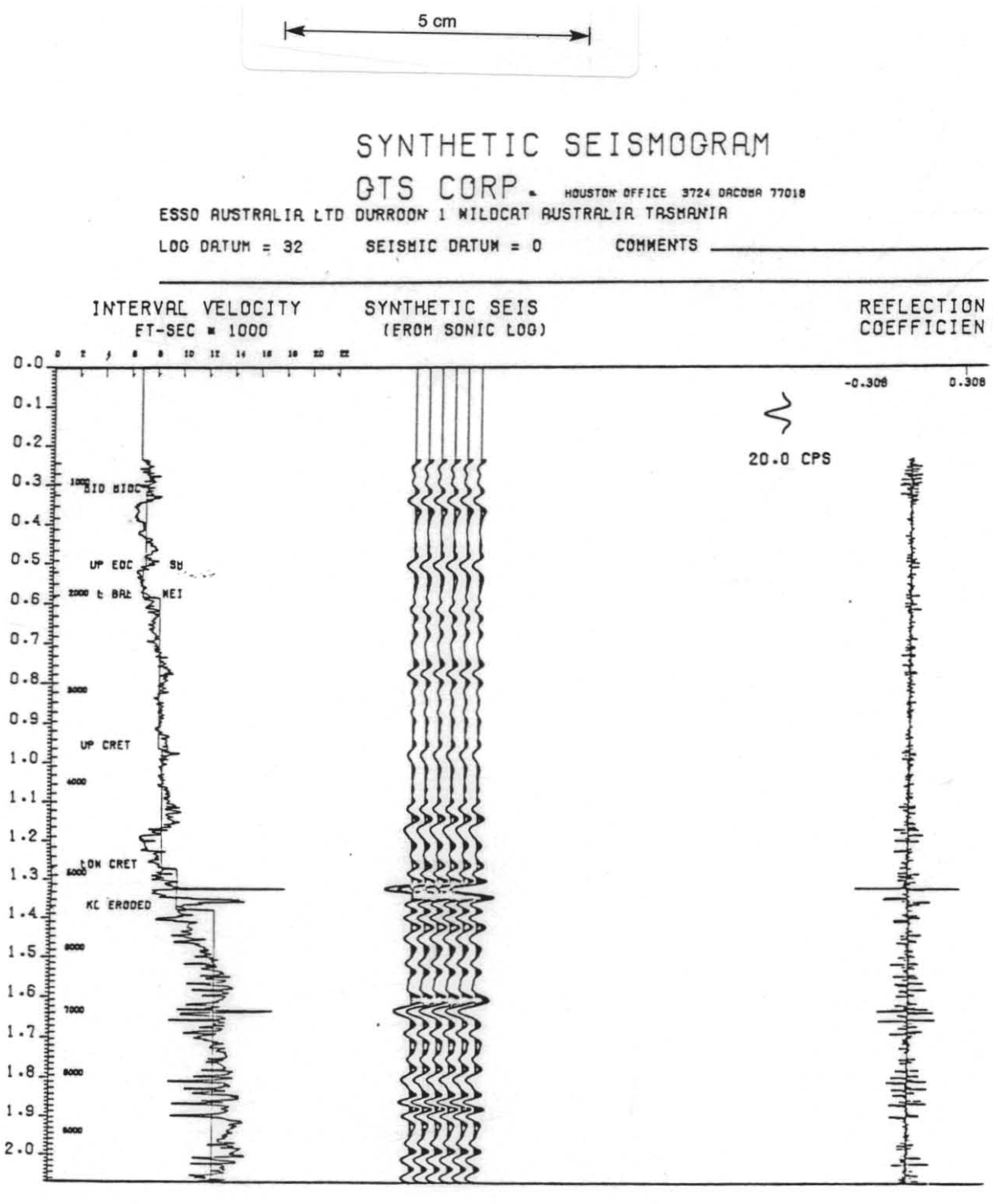

5 cm
SYNTHETIC SEISMOGRAM
GTS CORP. HOUSTON OFFICE 3724 DACOMA 77018
ESSO AUSTRALIA LTD DURROON 1 WILDCAT AUSTRALIA TASMANIA
LOG DATUM = 32
SEISMIC DATUM = 0
COMMENTS
INTERVAL VELOCITY
FT-SEC * 1000
SYNTHETIC SEIS
(FROM SONIC LOG)
REFLECTION
COEFFICIEN
-0.308
0.308
20.0 CPS
UP EOC
UP CRET
LOW CRET
KL ERODED
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0

Figure 18

216084

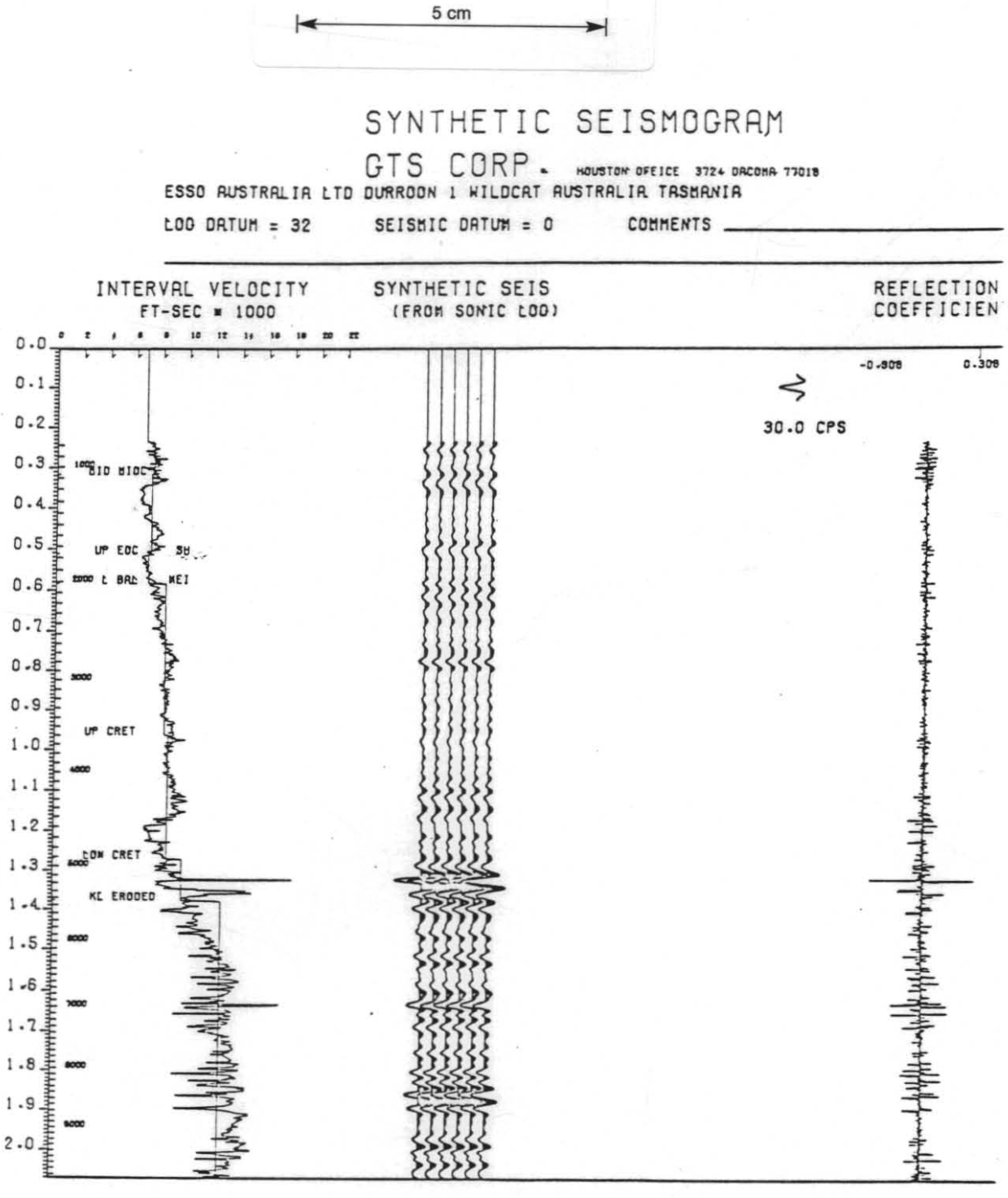



Figure 18

216085

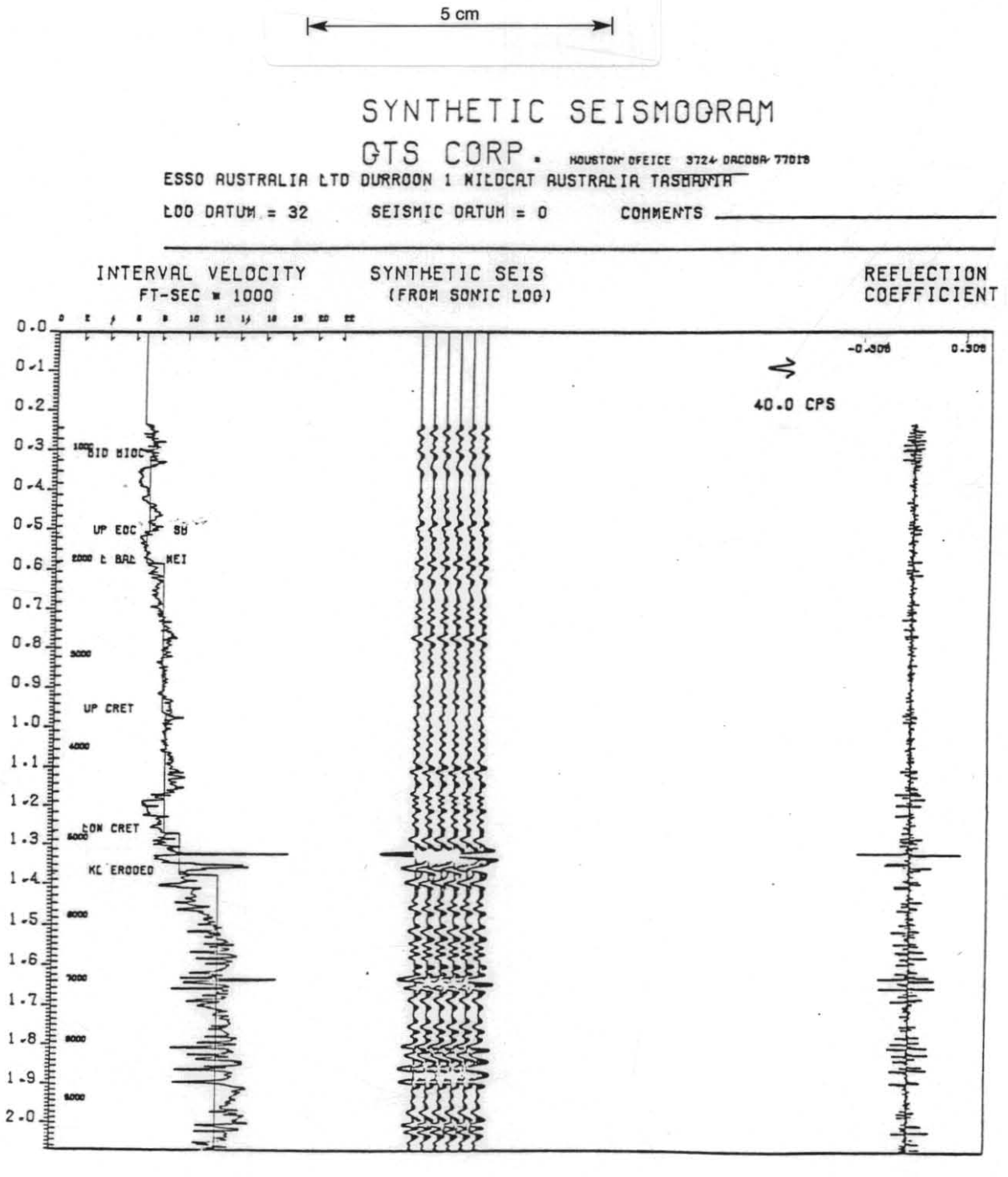



Figure 18

## Prospects and Leads

### Chat Prospect T-15-P

The Chat prospect is best illustrated by Weaver's seismic line WB-82-27, Enclosure 4, and Weaver's seismic line WB-82-28, Enclosure 5. Strong southwest dipping reflectors terminate up-dip, towards the northeast, without rollover, against down- to-the northeast major normal faults. Significant regional covergence, towards the northeast, or, out-of-the basin, is well illustrated.

Seismic time structure maps have been constructed for the general prospect area at the following key horizons levels. The map scale is 1:100,000. The contour interval is shown on each map. The shallowest map level is at the Paleocene L. balmei (unconformity) seismic horizon. Enclosure Map 1. At this level the Chat prospect has an area of closure of some 1600 acres. Its relief is some 50 milliseconds. The intermediate depth map level is at the Upper Cretaceous seismic horizon, Enclosure Map 3. At this level the Chat prospect has an area of closure of some 2500 acres. Its relief is 30 milliseconds.

A down to the southwest fault, with a northwest trend, indicate that the Chat prospect is located on a horst block. The downthrown area to the southwest is characterized both at the level of the Upper Cretaceous and Paleocene L. balmei (unconformity) seismic horizons by several northeast trending normal faults. The throw of these faults is generally towards the southeast. The deepest map level is at the intra-Upper Cretaceous Unconformity seismic horizon, Enclosure Map 4. At this level the Chat prospect has an area of closure of 15,000 acres. Its relief is some 300 milliseconds.

The entire Eastern View Coal Measures section is considered prospective and additional seismic acquistion is planned to better define the potential of the Chat prospect.

"A-4" Prospect T-15-P

The "A-4" prospect is best illustrated in a strike direction by the northwest trending seismic line B-69A-4, Enclosure 1.

Significant convergence towards the northwest as well as critical dip towards the southeast are shown at the intra-Upper Cretaceous Unconformity and the mid-Cretaceous Unconformity reflector levels. A significant fraction of this interval is shown to pinchout across the crest of the structure.

Weaver's seismic line WB-82-33, Enclosure 8, illustrates the near dip direction of the "A-4" prospect. This seismic line also shows significant convergence of the interval between the intra-Upper Cretaceous Unconformity reflector level and the mid-Cretaceous Unconformity reflector level.

A seismic dip rate map has been constructed for the specific prospect area, Enclosure Map 6. It illustrates the attitude of seismic events truncated beneath the intra-Upper Cretaceous Unconformity reflector. A significant area of colsure is indicated.

The lower Eastern View Coal Measures section is considered prospective at the prospect location and additional seismic data acquisition is planned in order to better define its potential.

"A-6" Prospect T-15/16-P

The "A-6" prospect is best illustrated, in a strike direction, by the northwest trending seismic line B-69A-6. Enclosure 2. Of particular interest, among the seismic markers identified on this line, are the Upper Cretaceous reflector, the intra-Upper Cretaceous Unconformity reflector and the mid-Cretaceous unconformity reflector.

Significant convergence towards the northwest as well as critical southeast dip is well illustrated in the lower portion of the interval Upper Cretaceous to intra-Upper Cretaceous Unconformity reflector levels. A significant portion of this section is shown to pinchout across the crest of the structure. Strong convergence towards the northwest as well as accentuated critical dip towards the southeast is shown by the interval intra-Upper Cretaceous Unconformity to mid-Cretaceous unconformity reflector levels.

Seismic line HB-75A-224, Enclosure 14, illustrates the dip direction of the "A-6" prospect. This seismic line also shows significant convergence of the interval Upper Cretaceous to intra-Upper Cretaceous Unconformity reflector level. Convergence of the interval intra-Upper Cretaceous Unconformity reflector level to mid-Cretaceous Unconformity reflector level is also shown.

A seismic time structure map has been constructed for the general prospect area at the intra-Upper Cretaceous Unconformity reflector level. The map scale is 1:000,000. The contour interval is 100 milliseconds, Enclosure Map 4. At this level the "A-6" prospect has an area of closure of 5000 acres and a relief of 50 milliseconds.

The lower Eastern View Coal Measures section is considered prospective at this prospect location and additional seismic acquistion is planned in order to better define its potential. A portion of this prospect is located within the Weaver's T-16-P permit area.

"81-21" Prospect T-16-P

The "81-21" prospect is mostly located within Weaver's Permit T-16-P area. It is on trend, to the northwest, and downdip from the "A-4" prospect which is on Permit T-15-P.

This prospect is best illustrated in a near dip direction, by Weaver's seismic line WB-81-21. Enclosure 3. Significant covergence on the crest of this structure is shown by the interval intra-Upper Cretaceous Unconformity reflector level to mid-Cretaceous Unconformity reflector level.

A seismic dip rate map has been constructed for the specific prospect area. It illustrates the attitude of seismic events truncated beneath the intra-Upper Cretaceous Unconformity reflector. A significant area of closure is indicated. Enclosure Map 8.

The Lower Eastern View Coal Measures section is considered prospective at this location and additional seismic data acquisition is planned in order to better define its potential.

Sea Eagle Prospect T-15-P

The Sea Eagle prospect is best illustrated, in a near dip direction, by Weaver's seismic line WB-82-32, Enclosure 6. The migration version of this line shows some data improvements and a better resolution of the areas surrounding the major faults. Enclosure 7. This seismic line is tied to the Durroon #1 well which was drilled to a depth at 9922 feet and was abandoned within the Lower Cretaceous section.

Seismic time structure maps have been constructed for the general prospect area at various key horizon levels. The map scale is 1:100,000. The contour interval is shown on each map. The shallow map is at the intra-Upper Cretaceous Unconformity horizon level. Enclosure Map 4. Southwest and critical southeast dip are indicated in this upthrown fault blocks. At this level the Sea Eagle prospect has an area of closure of some 7200 acres and a relief of 100 milliseconds. Most of the prospect area of closure is located within the Weaver Permit T-15-P. A small portion of the closure is located outside the permit area.

The deeper map is at the mid-Cretaceous Unconformity horizon level. Enclosure Map 6. Southwest and critical southeast dip are indicated in this upthrown tilted fault block. In addition a smaller closure is shown downthrown from the main down-to-the- east normal fault. At this level the Sea Eagle prospect has an area of closure of some 13,000 acres and a relief of 500 milliseconds. The smaller closure has an area of 4000 acres and a relief of 100 milliseconds. Some of the prospect area is located outside the permit area to the northwest.

A third map has been constructed for the Sea Eagle prospect. The isotime interval intra-Upper Cretaceous Unconformity to mid-Cretaceous Unconformity, Enclosure Map 7, shows a wedge of sediments which pinches out and is totally absent from the crest of the structure. The presence of flat lying reflectors within this isotime interval has been observed on several seismic lines. These are interpreted as possibly representing a hydrocarbon interface.

The lower Eastern View Coal Measures section is considered prospective at the Sea Eagle prospect location and additional seismic acquisition is planned in order to better define its potential.

216091

"227" Lead T-16-P

The "227" lead is recognized on two seismic lines which have been reprocessed by GSI for the Bureau of Mineral Resources. These reprocessed lines are HB-75A-222, a strike line, and HB-75A-227, a dip line. This lead appears to be of the same general description, and is located to the east of the "81-21" prospect on Permit T-16-P.

Additional seismic data acquisition is planned in order to better define the posential of this lead.

Shearwater Lead T-15-P

The Shearwater lead is located in the southeastern most corner of the Bass Basin. It is best illustrated, in a dip direction, by Weaver's line WB-82-36. Enclosure 9. Strong southwest dipping reflectors terminate up-dip, without rollover against a major down-to-the northeast normal fault. Southeast, or counter regional, dip is indicated on several strike lines. Very significant regional convergence towards the northeast, or, out of the basin, is well illustrated.

Seismic time structure maps have been constructed for the general prospect area at the following key horizon levels. The map scale is 1:100,000. The contour interval is shown on each map. The deep map is at the mid-Cretaceous Unconformity horizon level, Enclosure Map 6. Southwest and southeast dip are indicated. The shallow map is at the intra-Upper Cretaceous Unconformity horizon level. Enclosure Map 4. Only southwest dip is recognized.

The Lower Cretaceous section is considered to have limited hydrocarbon potential in this part of the Bass Basin. This is based on the results of the Durroon #1 well which is located on strike and down dip, or basinward, to the northwest. In addition, two wells have been drilled onshore Tasmania, also indicate limited reservoir and source rock potential for this section. Additional acquisition of seismic data is not planned for this lead at this time.

Moray Lead T-15-P

The Moray lead is best illustrated by seismic line HB-75A-211. Enclosure 11. Strong southwest dipping reflectors terminate up-dip, without rollover, against down-to-the northeast normal faults. Significant regional convergence towards the northeast, or out-of-the basin, is well illustrated.

Seismic time structure maps have been constructed for the general lead area at the following key horizon levels. The map scale is 1:100,000. The contour interval is shown on each map. The maps are: Paleocene L. balmei (unconformity), Enclosure map 1, Upper Cretaceous, Enclosure map 3, intra-Upper Cretaceous Unconformity horizon, Enclosure map 4.

Listed below are the level, approximate area of closure, relief and throw of the key fault at each map level.

| Map | Closure | Relief | Throw |
|---|---|---|---|
| Paleocene L. balmei (Unconformity) | 600 Acres | 10 msec | 20 msec |
| Upper Cretaceous | 1600 Acres | 60 msec | 80 msec |
| intra-U. Cretaceous Unconformity | 2300 Acres | 100 msec | 100 msec |

The Moray lead is considered to be not very prospective because of its relatively small size, the lack of rollover into the up-dip faults and its location at the northeast border area of the Bass Basin where facies are expected to mostly consist of coarse clastics. The presence of sealing faults, intraformational sealing shales and shales or fine clastics of source rock quality is doubtful. No additional acquisition of seismic data is planned for this lead at this time.

"222" Lead T-15-P

The "222" lead is best illustrated by seismic line HB-75A-222, Enclosure 12. Strong southwest dipping reflectors terminate in the up-dip direction, without rollover, against a down-to-the southeast normal fault. Significant regional convergence towards the northeast, or out-of-the basin, is well illustrated. The lead has a general northwest-southeast trend.

Seismic time structure maps have been constructed for the general lead area at the following key horizon levels. The map scale is 1:100,000. The contour interval is shown on each map. The maps are: Paleocene L. balmei (unconformity) horizon, Enclosure Map 1, Upper Cretaceous horizon, Enclosure Map 4.

Listed below are the lead approximate area of closure, relief, and throw of the key fault at each map level.

| Map | Closure | Relief | Throw |
|---|---|---|---|
| Paleocene L. balmei (Unconformity) | Small | Small | Small |
| U. Cretaceous | 1600 Acres | 50 msec | 50 msec |

The "222" lead is considered to be not very prospective because of its relatively small size, the lack of rollover into the up-dip fault, and its location at the northeast margin area of the Bass Basin where facies are expected to mostly consist of coarse clastics. The presence of sealing faults, intraformational sealing shales, and shales or fine clastics of source rock quality is doubtful. No additional acquisition of seismic data is planned for this lead at this time.

"A" Lead T-15/16-P

The "A" lead is in part located on Permit T-16-P. The remainder is located on Permit T-15-P. This lead is best illustrated in a near dip direction by seismic line B-71A-65, Enclosure 10. Northeast dipping reflectors terminate in the up-dip direction, with minor rollover, against a down-to-the northeast normal fault. Convergence towards the southwest, or out-of-the-basin is well illustrated.

Seismic time structure maps have been constructed for the general lead area at the following key horizon levels. The map scale is 1:100,000. The contour interval is shown on each map. These maps are: Paleocene L. balmei (unconformity), Enclosure Map 2, and intra-Upper Cretaceous (unconformity), Enclosure Map 5.

The "A" lead is considered to be not very prospective because of its relatively small size and location in the Bass Basin. The presence of sealing faults, intraformational sealing shales, and shales or fine clastics of source rock quality is doubtful. No additional acquisition of seismic data is planned for this lead at this time.

"B" Lead T-15-P

The "B" lead is best illustrated by seismic line HB-75A-223, Enclosure 13. Counter regional dip, towards the southwest, is well shown. Convergence of the section across the top of this horst block is displayed at each of the key seismic horizon levels.

Seismic time structure maps have been constructed for the general lead area at the following key horizon levels. The map scale is 1:100,000. The contour interval is shown on each map. These maps are: Paleocene L. balmei (unconformity), Enclosure Map 2, and Upper Cretaceous, Enclosure Maps 4 and 5.

The "B" lead is considered to be not very prospective because of its relatively small size and density of faulting in this portion of the basin. The presence of sealing faults, intraformational sealing shales and shales or fine clastics of source rock quality is doubtful. No additional acquisition of seismic data is planned for this lead at this time.

216096

Reprocessed Seismic Lines (BMR)

The Bureau of Mineral Resources (BMR) has reprocessed certain seismic lines originally acquired by Hematite Petroleum Party in the course of their HB-75A survey conducted in 1975 in the Bass Basin. Copies of these lines were released to Weaver Oil and Gas Corporation at the BMR Symposium held in Canberra in November 1984. These lines are not enclosed in this report due to the terms under which they were given to Weaver.

The reprocessing was done by GSI in Perth, Western Australia, in 1983. It consist of using a sliding gate AGC program to enhance the deep reflection. Some of the seismic lines were also restacked and migrated.

Seismic line HB-75A-218 is a northeast trending line through the Chat prospect and the Squid structural feature.

Seismic line HB75A-222 is also a northeast trending line. It goes through the "222" lead, followed by a major structural feature on trend with the Chat Prospect and the Durroon #1 well, then the "81-21" prospect and a new lead called "227" which is down-thrown and to the northeast of the "81-21" prospect.

Seismic line HB75A-227 is a northeast trending line which ties together the reprocessed HB75A-218 and HB75A-222 lines. This reprocessed line shows the "227" lead as a southeast dipping tilted fault block. This lead is very similar to the "A-4", "A-6" and "81-21" prospects identified in this area of the Bass Basin.

Seismic line HB75A-230 is a northwest trending line which also ties together the reprocessed HB75A-218 and HB75A-222 lines. It does not display any lead or prospect.

Seismic Maps(Enclosures)

Maps 1 and 2, are the east and west panels of a seismic time structure map at the Paleocene L. balmei (unconformity) horizon. The scale is 1:100,000. The contour interval is 10 milliseconds. These two maps cover the whole of Permits T-15-P and T-16-P area.

The sub-crop area of this horizon is indicated. So is the location of the leads and prospects so far identified. The regional alignments are those of normal faults trending northwest-southeast with some fault segments trending in a more northwesterly or westerly direction. At this level, the deeper part of the basin is towards the northwest or Squid and Pelican general area.

The southeast area, that of the Sea Eagle prospect and Shearwater lead shows limited amounts of faulting. The general area of the A-4 prospect, A-6 prospect, 227 leads and 81-21 prospect also displays limited amount of faulting. This may indicate that these prospects and leads were already in-place by Paleocene L. balmei (unconformity) horizon time and that limited structural activity took place at this horizon time. The Chat prospect area displays more faulting both in the northwest direction and north or northeast direction. It is now recognized that the northwest trending faults are basin forming faults, while the northeast trending faults are transfer faults, and the north trending faults are conjugate faults to both of the previously identified fault trends.

The Squid area, as remapped after the drilling of the Squid #1 exploratory well, displays faulting to the northwest joined by curvilinear segments to almost west trending faults.

The Tasmanian Devil area is one of subcrop at this horizon level.

Map 3, is a seismic time structure map at the Upper Cretaceous horizon. The scale is 1:100,000. The contour interval is 20 milliseconds. At this map horizon level, the Chat prospect is shown to be a major southwestward dipping tilted fault block, in part horst block. Northeast trending transfer faults are recognized in the down-thrown area, or basinward area, to the southwest. This prospect is located at the boundary between the early developed basin, or rift stage of the basin, to the northeast and the later stage of the basin, or sag stage of the basin, to the southwest.

The Moray lead is a tilted fault block located near the subcrop area of this horizon level.

This map covers a small protion of permit T-16-P. The regional trends are relevant to the evaluation of the T-16-P Permit area.

Maps 4 and 5 are the east and west panels of a seismic time structure map at the intra-Upper Cretaceous Unconformity horizon. The scale is 1:100,000. The contour interval is 100 milliseconds. These two maps cover portions of the Permit T-15-P and T-16-P area.

This seismic horizon is a very major unconformity recognized in the Durroon #1 well. Severe truncation of beds occur beneath it. It is recognized and mapped regionally with a relatively high degree of confidence, although it is realized that at Durroon #1 it may be particularly well developed due to the location of this well on a tilted fault block which was obviously active at this horizon time. At the Durroon #1 well location, the unconformity marks the boundary between an objective sequence of interbedded sandstone and shale above and a massive carbonaceous shale sequence below. Seismic lines show that the shale section below the unconformity expands rapidly, off structure, and contains an interbedded sequence

At this map level, the Chat prospect is shown to be located on the upthrown side of a very major northwest trending basin forming fault. On trend with it and to the southeast, are two large closure areas located outside the permits area, further to the southeast is the Durroon #1 well.

The Sea Eagle prospect is located on a sub-parallel and separate fault trend.

The A-6 prospect is well illustrated at this horizon level, while the key fault trends and a minor closure are recognized in the A-4 prospect area.

Map 6 is a seismic dip rate map on events truncated beneath the intra-Upper Cretaceous Unconformity horizon. The scale is 1:100,000 and the contour interval is 100 milliseconds. This map covers portions of Permit T-15-P and T-16-P.

The A-4 and 81-21 prospects are fault bounded, westward dipping, tilted fault blocks. The trapping mechanism is one of termination of beds beneath an unconformity surface at the shallow levels and up-dip termination of beds against a fault plane at the deeper levels. Closure at the unconformity level is mapped at the A-4 prospect location. Regional dip is to the northwest and critical dip is towards the southeast.

Map 7 is a seismic isotime map between the intra-Upper Cretaceous Unconformity horizon and the mid-Cretaceous Unconformity horizon over the Sea Eagle prospect area. This isotime interval pinches-out over the central area of this major southwestward tilted fault block.

The scale is 1:100.000 and the contour interval is 50 milliseconds.

Map 8 is a seismic time structure map at the mid-Cretaceous Unconformity horizon level. The scale is 1:100,000 and the contour interval is 100 milliseconds.

Two sub-parallel, northwest trending, fault systems are shown. A secondary system of almost east-west trending smaller faults is recognized.

The Shearwater lead is shown to be a southwestward tilted fault block located on trend and updip from the Durroon #1 well.

To the northwest is the Sea Eagle prospect area. This is also a major southwestward tilted major fault block spearated by a deep fault escarpment trough from the Durroon #1 well/Shearwater trend.

Map 9 shows the major structural elements and location of the prospect and leads so far identified on permits T-15-P and T-16-P, as well as on Perthshire Petroleum Ltd. Permit T-19-P (a wholly owned subsidiary of Weaver Oil and Gas Corporation, Australia). The scale is 1:250,000. The location and identifiers of the representative seismic lines is also shown.

## Source-Rock Evaluation

### Introduction

The lower Eastern View Coal Measures contain Late Cretaceous, Paleocene and Early Eocene sediments. On the basin margin the sequence is unconformable on the Early Cretaceous, the mid-Cretaceous unconformity, or on Paleozoic basement. Relationship with older units are unknown over large areas of the basin. The Durroon #1 well is the only well to have penetrated a significant thickness of Late Cretaceous sediments. It comprises a sequence of coarse grained sandstone with thin shale intervals unconformably overlying a massive carbonaceous shale. The Early Cretaceous sequence also consists of interbedded sandstone and shale. The Paleocene to Early Eocene section comprises a sequence of interbedded sandstone, siltstone, shale and thin coal seams, which exhibit a broad facies change, being dominantly arenaceous in the south and southeast, and becoming more argillaceous towards the north. Results of the Squid #1 studies have been reported and discussed in the previous quarterly report.

### Types of Organic Matter

Figure 19 contains descriptions of organic types in samples from the Bass Basin that were submitted for microscopic examination. For each well, the stratigraphic unit has been interpreted as gas-prone or oil-prone, depending on whether the dominant organic types are of the humic vitrinite type, or the exinite type. There are too few samples from which to draw definite conclusion about each unit. Figures 20,21,22,23.

### Source-Rock Chemistry

Core samples have been analysed for total organic carbon (TOC) and total extractable organic matter (EOM). The EOM was subdivided by liquid chromatography into three fractions: saturated hydrocarbons (SATS); aromatic hydrocarbons (AROM); and polar organic compounds.

Gas chromatograms were recorded for the saturated fraction only. The results are given in Figure 24. Comparative analysis were also made by pyrolysis, using the Rock-Eval method. Using the generally accepted criteria that a minimum TOC content of 0.5 percent is necessary for a clastic rock to have hydrocarbon source potential, it is readily apparent that since all the samples reach and exceed this value, the lower Eastern View Coal Measures and Early Cretaceous section do have source potential. Disregarding the coal sample, the highest value of 20.10 percent is from a carbonaceous shale of Paleocene age.

216101

*BMR Journal of Australian Geology & Geophysics, 6, 1981, 199-212*

# Petroleum potential of the Bass Basin

*E. Nicholas, K. L. Lockwood, A. R. Martin[1], & K. S. Jackson*

| *Unit* | *Well name* | *Core No.* | *Depth m* | *% of organic types* 1 | 2 | 3 | 4 | 5 | *Comments on exinites* | *Fluorescence* |
|---|---|---|---|---|---|---|---|---|---|---|
| L. EVCM | Bass 3 | 11 | 2265.6 | 58 | 33 | 3 | 3 | 3 | C | Very dull orange |
| L. EVCM | Aroo 1 | 1 | 2903.8 | >99 | >1 | — | — | <1 | C | None |
| L. EVCM | Poonboon 1 | 4 | 3034.0 | 63 | 30 | — | 4 | 3 | C, A, S | Moderate to dull orange |

*Organic types*
1. Vitrinite
2. Semifusinite
3. Fusinite
4. Inertodetrinite
5. Exinite

**Types of organic matter**

*Abbreviations of exinites*
A = Alginite
C = Cutinite
LD = Liptodetrinite
R = Resinite
S = Sporinite

EVCM = Eastern View Coal Measures

Figure 19

DONDO-1

DESCRIPTIONS OF KEROGEN ALTERATION
AND TYPES FROM SIDEWALL CORES
AND CONVENTIONAL CORES.

Descriptions by J.L. Morgan

216102

| Depth | SWC No. | Kerogen Alteration | TYPES OF KEROGEN ** Predominant | Secondary | Other | Remarks |
|---|---|---|---|---|---|---|
| 4840 | 51 | 1+ | W | C | H | Abundant pyrite: also some "2+" microfossils. |
| 5093 | 49 | 2- | W | C | H | Abundant pyrite. |
| 5320 | 48 | 1+ | W | C | H | Abundant pyrite. |
| 5490 | 47 | ? | W | C | H | Contamination? |
| 5600 | 46 | 1+ | W | C | H | |
| 6005 | 42 | 2 | W | C | Al? | |
| 6530 | 37 | 1+ | W | H | C,H | |
| 6608 | 36 | 1+ | W | C | H | |
| 6700 | 35 | 1+ | W | C | H | |
| 7075 | 32 | 2- | W | H | C | |
| 7378 | 29 | 2- | H | W | C | |
| 7510 | 28 | 2- | W | C | H | |
| 7636 | 27 | 2+ | W | C | H | |
| 7674 | Core 1* | 2+ | W | H | C | |
| 7688 | Core 1* | 2+ | W | C | H | |
| 7733 | Core 1* | 2+ | W | C | H | |
| 7980 | 24 | 2+ | W | C | H | |
| 8050 | 23 | 2+ | C | W | H | |
| 8090 | 22 | 2+ | W | C | H | |
| 8125 | 21 | 2+ | W | C | H | |
| 8240 | 19 | 2+ | C | H | W | |
| 8450 | 16 | 2+ | C | W | H | |
| 8680 | 14 | 2+ | C | W | H | |
| 8827 | 13 | 2+ | W | H | C | |
| 9160 | 9 | 2+ | C | W | H | |
| 9239 | 8 | 2+ | C | W | H | |
| 9400 | 5 | 2+ | C | W | H | |
| 9518 | 2 | 2+ | C | W | H | |
| 9590 | 31 | 2+ | W | C | H | |

* Standard Core
** W - Woody
C - Coaly
H - Herbaceous
N - Nonfilamentous Algal
Al - Algal

DONDO-1

DESCRIPTION OF KEROGEN ALTERATION

FROM "PICKED" CUTTINGS

Description by J.L. Morgan

| Depth Feet | Sample Type | Kerogen Alteration | TYPES OF KEROGEN ** Predominant | Secondary | Other | Remarks |
|---|---|---|---|---|---|---|
| 4100 | | 1+ | C | W | H | Also a few "2+" microfossils. |
| 4500 | | 1+ | C | W | H | Also a few "2+" microfossils. |
| 4900 | | 2- | W | H,C | Al | (Mixture of "1+" and "2+" microfossils) |
| 5100 | | 2- | C | W | H | (Mixture of "1+" and "2+" microfossils). |
| 5400 | | 2 | Al | A | F | |
| 5700 | | 2 | Al | A | W,C | |
| 6000 | | 2 | W | Al | A,C | |
| 6500 | | 2 | Al,A | W | C | |
| 6700 | | 2- | Al,A | W | C | |
| 6900 | | 2 | W | C | Al | |
| 7400 | | 2 | W | C | Al | |
| 7600 | | 2+ | Al,W | H | C | |
| 7900 | | 2+ | W | H | C | |
| 8100 | | 2+ | Al,W | C | H | |
| 8400 | | 2+ | W | H,Al | C | |
| 8600 | | 2+ | W | H,Al | C | |
| 8900 | | 2+ | W | H,Al | C | |
| 9200 | | 2+ | Al,W | A | C | |
| 9400 | | 2+ | W,Al? | H | C | |
| 9500 | | 2+ | Al | W,C | H | |
| 9600 | | 2+ | Al | H,C | W | |

H - Herbaceous
W - Woody
C - Coaly
A - Amorphous
Al - Algal
N - Nonfilamentous Algal
F - Finely Disseminated.

Figure 20

DURROON-1

DESCRIPTION OF KEROGEN ALTERATION

FROM "PICKED" CUTTINGS

Description by J.L. Morgan

| Depth Feet | Sample Type | Kerogen Alteration | TYPES OF KEROGEN ** Predominant | Secondary | Other | Remarks |
|---|---|---|---|---|---|---|
| 3300 | | 1+ | C | W | A,H | ("Sapropel II") |
| 4200 | | 1+ | C | W | H | |
| 4700 | | 2- | C | W | A,H | |
| 5100 | | 2- | W | C | H | |
| 5500 | | 2 | C | W,A | H | |
| 6500 | | 2 | C | W | H | |
| 7100 | | 2+ | C | H | W | |
| 7300 | | 2+ | W | H | C | |
| 8300 | | 2+ | W | C | H | |
| 9300 | | 2+ | W | C | H | |
| 9600 | | 2+ | C | W | A,Al | |
| 9900 | | 2+ | H | W,C | A,Al | |

** H - Herbaceous
W - Woody
C - Coaly

A - Amorphous
Al - Algal.

Figure 21

216104

KONKON-1

DESCRIPTIONS OF KEROGEN ALTERATION

FROM "PICKED" CUTTINGS

Description by J.L. Morgan

| Depth Feet | Sample Type | Kerogen Alteration | TYPES OF KEROGEN ** Predominant | Secondary | Other | Remarks |
|---|---|---|---|---|---|---|
| 3500 | | 1+ | W | N | C | |
| 3700 | | 1+ | W | N | C | |
| 4000 | | 2- | Al? | W | C | |
| 4300 | | 2- | W | Al? | C | |
| 4500 | | 1+ | W- | Al,A | C | |
| 4800 | | 2- | W | H | Al,C | |
| 4900 | | 2- | W | Al? | H,C | |
| 5000 | | 2- | Al? | W,H | C | |
| 5043 | | 2- | W | H | Al,C | |

** H - Herbaceous
W - Woody
C - Coaly
A - Amorphous
Al- Algal
N - Nonfilamentous Algal

Figure 22

216105

POONBOON - 1

DESCRIPTION OF KEROGEN ALTERATION

FROM "PICKED" CUTTINGS

Description by J.L. Morgan

| Depth Feet | Sample Type | Kerogen Alteration | TYPES OF KEROGEN ** Predominant | Secondary | Other | Remarks |
|---|---|---|---|---|---|---|
| 6500 | | 2 | NF | W | F | |
| 6600 | | 2+ | NF | W,C | H | |
| 6900 | | 2 | W | - | NF | |
| 7300 | | 2+ | W | NF | H | |
| 7500 | | 2+ | NF | W | H | |
| 7600 | | 2 | W | - | NF | |
| 8100 | | 2+ | Al | W | A,C | |
| 8300 | | 2 | W | - | NF | |
| 8900 | | 2+ | C | NF | A,H | |
| 9200 | | 2+ | W | Al | H,C | |
| 9400 | | 2+ | W | Al | H,C | |
| 9500 | | 2+ | W | - | Al | |
| 9700 | | 2+ | Al | W | C | |
| 9900 | | 2+ | Al | W | C | |
| 10200 | | 2+ | Al | W | H | |
| 10400 | | 2+ | W | Al | C | |
| 10600 | | 2+ | Al | W | H,C | |

** H - Herbaceous
W - Woody
C - Coaly

A - Amorphous
Al - Algal
N - Nonfilamentous Algal
F - Finely Disseminated.

Figure 23

BMR Journal of Australian Geology & Geophysics, 6, 1981, 199-212

# Petroleum potential of the Bass Basin

E. Nicholas, K. L. Lockwood, A. R. Martin[1], & K. S. Jackson

| Unit/zone * | Index No. | Well name | Core No. | Depth (m) | Lithology | TOC % | EOM ppm | SATS ppm | AROM ppm | POLAR ppm | Vitr. R. Ro mean max. † | Source rating. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L. EVCM *L. balmei* | 3 | Aroo 1 | 1 | 2 903.8 | Shale | 6.05 | 5 020 | 608 | 1 450 | 486 | 0.65 | Good |
| L. EVCM *L. balmei* | 11 | Bass 2 | 9 | 1 679.0 | Siltstone | 2.40 | 2 360 | 765 | 484 | 672 | 0.35 | Very good |
| L. EVCM *L. balmei* | 13 | Bass 3 | 10 | 2 104.6 | Shale | 20.10 | 11 500 | 1 100 | 5 460 | 1 410 | 0.63 | Good |
| L. EVCM *L. balmei* | 14 | Bass 3 | 11 | 2 265.6 | Sandstone | 2.40 | 1 530 | 129 | 684 | 353 | 0.56 | Good |
| L. EVCM *T. longus* | 15 | Bass 3 | 13 | 2 408.8 | Siltstone | 0.60 | 152 | 57 | 52 | 54 | — | Fair |
| L. EVCM Lower *M. diversus* | 19 | Narimba 1 | 1 | 2 833.6 | Shale | 7.10 | 12 300 | 6 250 | 3 300 | 1 140 | 0.67 | Very good |
| L. EVCM Lower *M. diversus* | 20. | Narimba 1 | 2 | 2 912.3 | Shale, siltstone | 0.85 | 1 680 | 29 | 353 | 586 | 0.62 | Good |
| L. EVCM Lower *M. diversus* | 21 | Narimba 1 | 3 | 2 972.3 | Shale | 1.85 | 2 600 | 193 | 1 220 | 533 | 0.56 | Very good |
| L. EVCM Lower *M. diversus* | 22 | Poonboon 1 | 2 | 2 472.8 | Coal | 65.80 | 39 930 | 3 270 | 4 820 | 10 290 | 0.60 | Fair |
| L. EVCM *L. balmei* | 23 | Poonboon 1 | 4 | 3 034.0 | Shale | 1.75 | 1 030 | 176 | 324 | 231 | 0.70 | Good |
| L. EVCM *T. longus* | 24 | Poonboon 1 | 5 | 3 258.6 | Siltstone | 1.20 | 809 | 79 | 250 | 202 | 0.66 | Good |
| Otway Group | 27 | Durroon 1 | 3 | 1 695.9 | Sandstone | 1.80 | 988 | 66 | 127 | 595 | 0.38 | Fair |
| Otway Group | 28 | Durroon 1 | 4 | 2 567.0 | Siltstone | 4.50 | 1 200 | 13 | 633 | 319 | (0.54) | Fair |
| Otway Group | 29 | Durroon 1 | 5 | 3 024.2 | Sandstone | 3.75 | 2 500 | 43 | 1 020 | 539 | 0.69 | Good |

† Values in parenthesis are uncertain, too few determinations having been made to give a reliable mean.

**Source rock chemistry**

Figure 24

216106

A plot of total hydrocarbon content, SATS plus AROM against TOC gives a better rating of source-rock potential, Figure 25. The higher hydrocarbon to TOC ratios observed in the three categories - fair, good, very good - is suggestive of a more oil-prone than gas-prone source. Overall, the results indicate that the lower Eastern View Coal Measure contains rocks with good to very good source potential. The Early Cretaceous Otway group has been rated as having fair to good source potential.

Maturation of Organic Matter

Vitrinite reflectance measurements in the range of 0.6 to 0.7 percent indicate close approach to maturation, or maturation levels at which point hydrocarbons may be generated, Figure 26,27.

A later study, Figure 28,29, indicate that mature, above 0.6 percent, source rock are present and capable of hydrocarbon generation.

Microscopic examination of kerogen color in transmitted light are in broad agreement with those indicated by vitrinite reflectance data, showing that the lower Eastern View Coal Measures have reached marginal maturity, and are within the hydrocarbon generation zone at the deepest levels tested.

Geothermal Gradient

Reported geothermal gradients in the Bass Basin tend to be relatively lower in the central parts of the basin than on the flanks. The northeast flank having higher gradient than the southwest.

Initial gradients are determined between the surface and the bottom of each well. The underlying assumption is that the logged temperature is equivalent to the formation temperature after correction for time since drilling mud circulation stopped.

The geothermal gradients in the Bass Basin very between 29°c/km and 37°c/km. The average geothermal gradient in the basin is approximately 35°c/km or 1.92°F/100 feet to 2.9°F/100 feet, Figure 31.

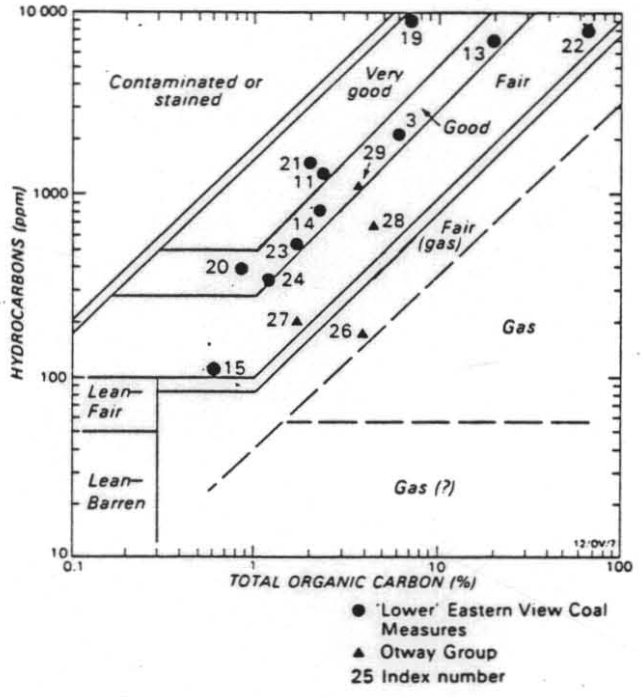
High values of vitrinite reflectance at depths of 3 kilometers are consistent with localized heating. It can be concluded that laterally intensive sources of heat within the basin basement locally affected the deeper basin sediments. Sediments shallower that 2 kilometers remain unaffected.

216108

*BMR Journal of Australian Geology & Geophysics, 6, 1981, 199-212*

# Petroleum potential of the Bass Basin

*E. Nicholas, K. L. Lockwood, A. R. Martin[1], & K. S. Jackson*




**Source-rock richness**

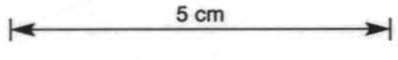



Figure 25

216109

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# Petroleum potential of the Bass Basin

E. Nicholas, K. L. Lockwood, A. R. Martin[1], & K. S. Jackson

| Well | 'Lower' Eastern View Coal Measures (71 samples) | | Otway Gp (9 samples) | |
|---|---|---|---|---|
| | T.A.I. | Source type | T.A.I. | Source type |
| Bass No. 2 | 1 to 1.5 | Gas | | |
| Bass No. 3 | 1.5 to 2 | Oil & gas | | |
| Cormorant No. 1 | 2 to 3 | Gas & some oil | | |
| Durroon No. 1 | 1 to 2 | Gas | 2 to 2.5 | Gas |
| Konkon No. 1 | 1 to 2 | Gas | 1.5 to 2 | Gas |
| Narimba No. 1 | 1 to 1.5 | Gas | | |
| Pelican No. 1 | 1.5 to 2.5 | Gas | | |
| Pelican No. 3 | 2 to 2.5 | Oil & gas | | |
| Poonboon No. 1 | 2 to 2.5 | Oil & gas | | |
| Tarook No. 1 | 2 to 2.5 | Gas | | |
| Dondu No. 1 | 2 to 2.5 | Gas & some oil | | |

Thermal alteration index (based on spore and pollen colouration): 1 to 2, immature
2 to 2.5, transitionally mature
2.5 to 3, mature
3 to 4, increasingly overmature

**Maturation and interpreted hydrocarbon (oil or gas) source type**

Figure 26

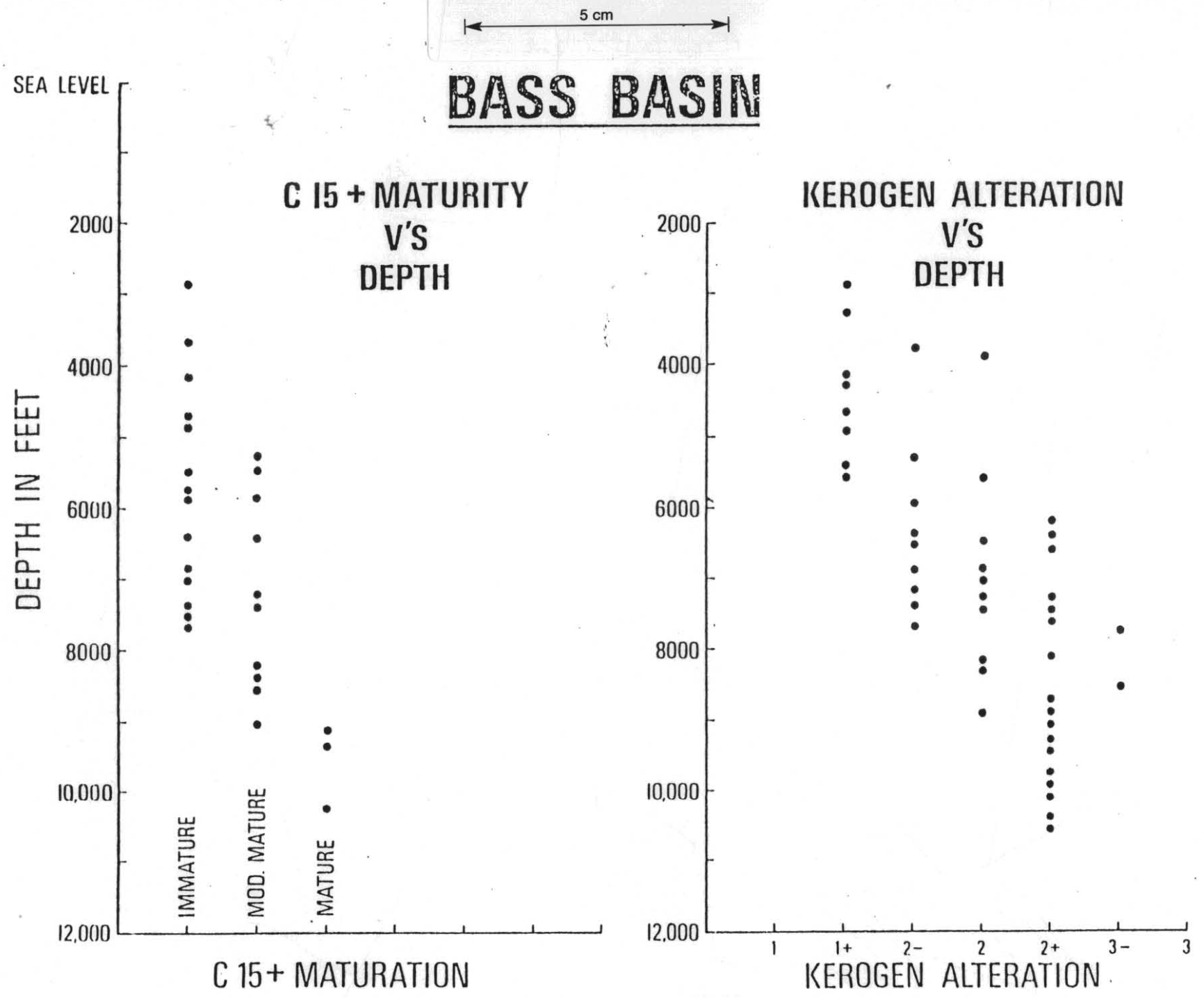


Figure 27

216110

216111

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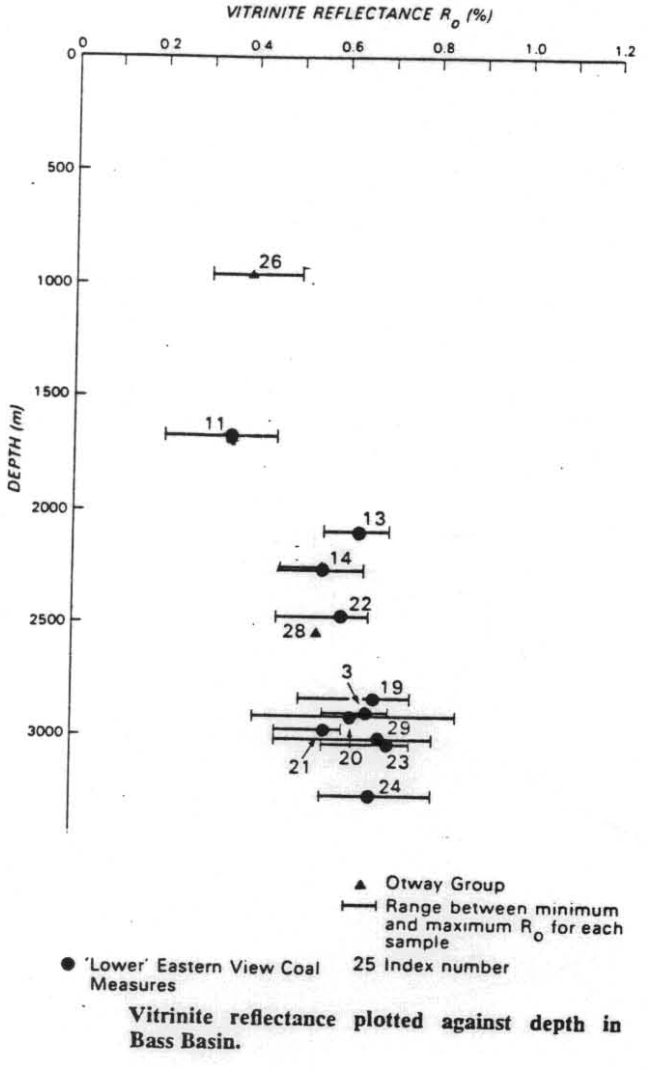
# Petroleum potential of the Bass Basin

*E. Nicholas, K. L. Lockwood, A. R. Martin[1], & K. S. Jackson*




**Vitrinite reflectance plotted against depth in Bass Basin.**

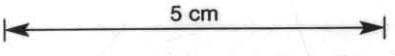



Figure 28

216112

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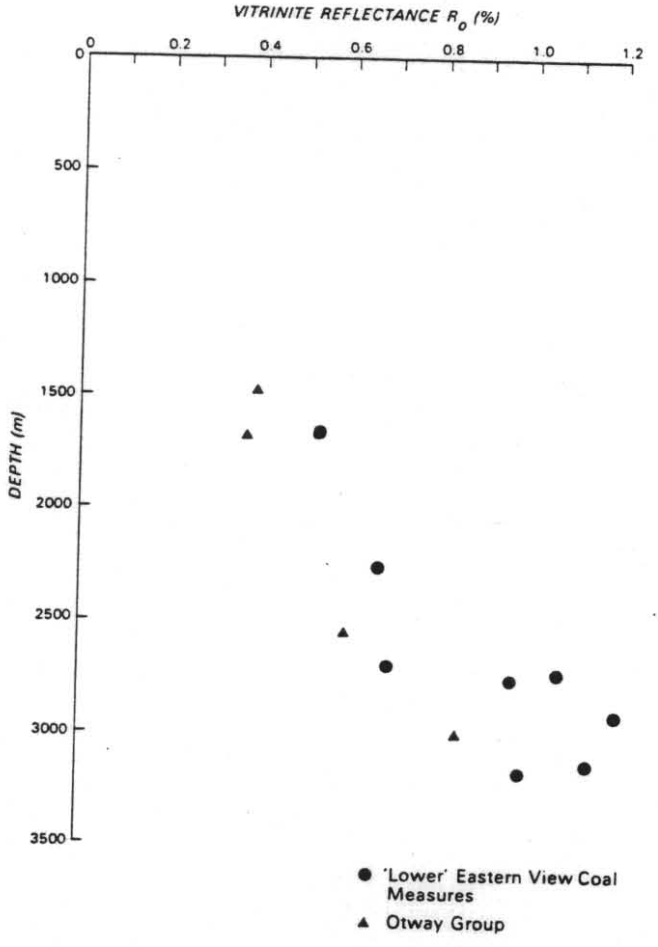
# Petroleum potential of the Bass Basin

*E. Nicholas, K. L. Lockwood, A. R. Martin[1], & K. S. Jackson*



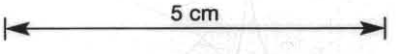




Figure 29

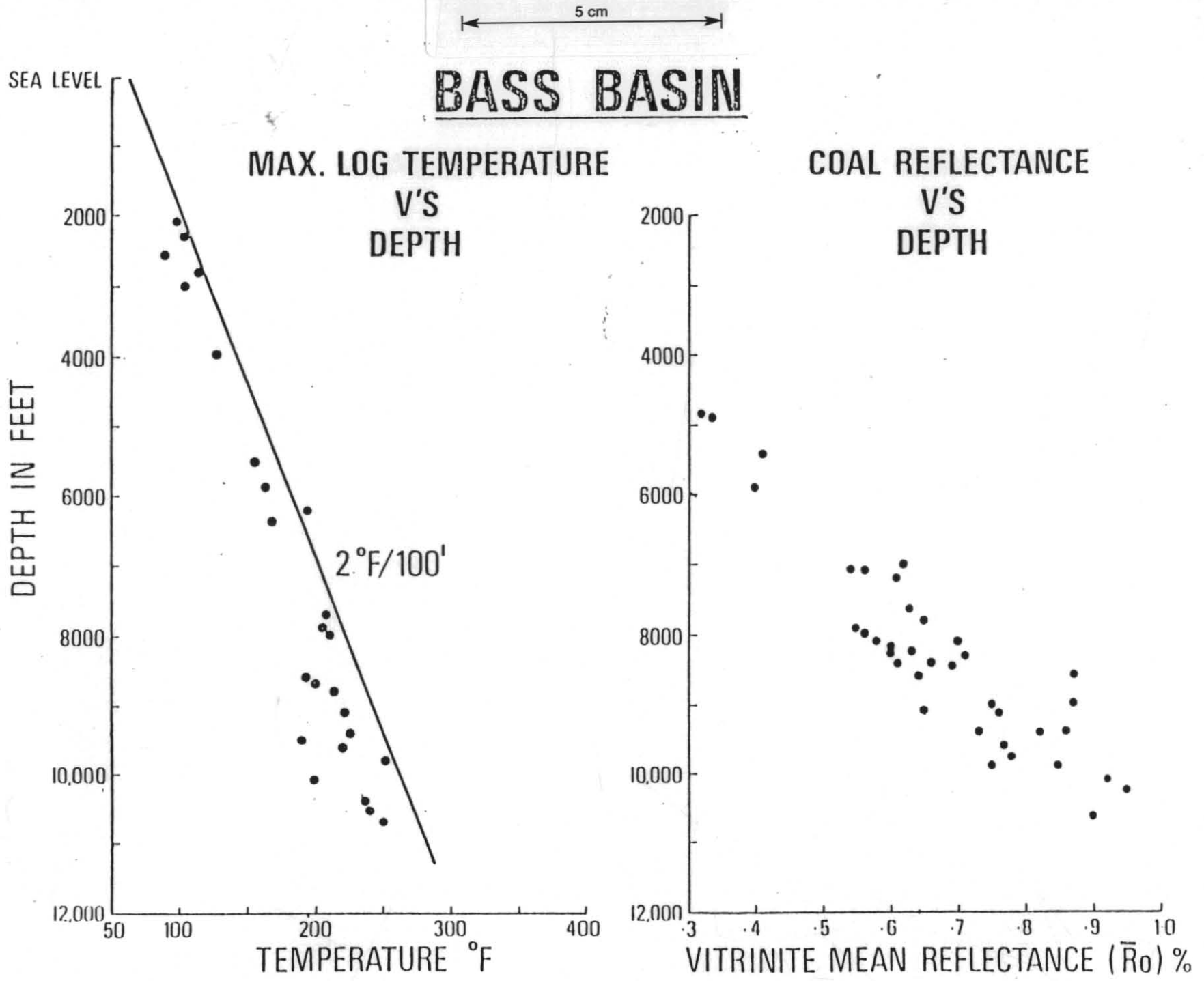



Figure 30

216113

Cases of significant divergence between reflectance gradient and thermal gradient have been reported. Though unexplained at this stage, it should be recognized that such cases of low reflectance gradients and apparent lagging of maturation increase behind temperature increase also are reported in the Gippsland Basin.

Pyrolysis

Core samples have been analysed by pyrolysis, using the Rock-Eval methods. Published results are summarized in Figure 31.

The samples from the lower Eastern View Coal Measure are rated as good to very good in regard to petroleum potential. This is in general agreement with source ratings obtained from other methods.

Gippsland Basin Comparison

Results of several published studies on the subject of source-rock and maturation in the Gippsland Basin are summarized.

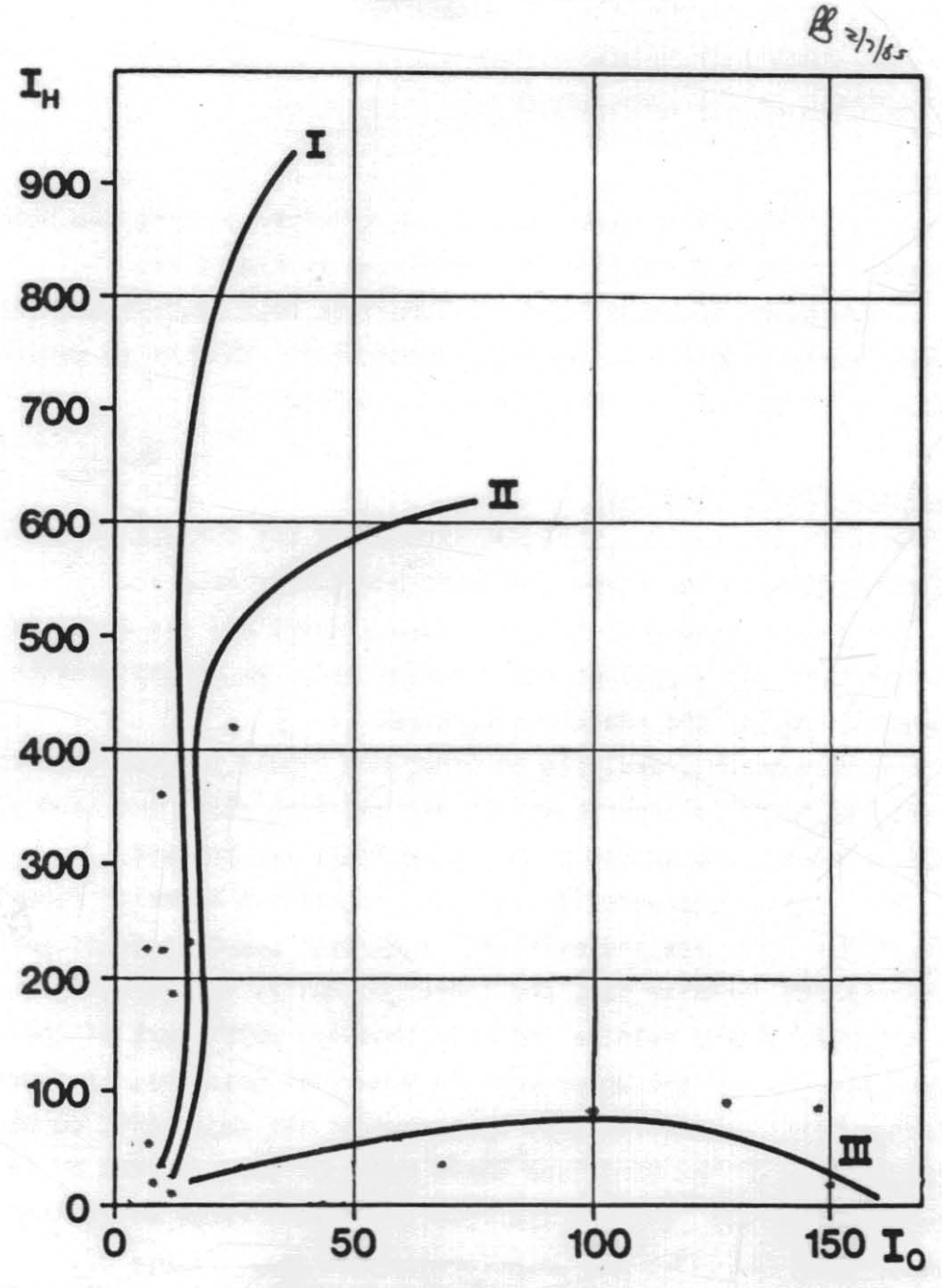
The main source-rock for the extensive oil and gas deposits so far discovered in the Gippsland Basin appear to be at depths greater than those reached by any of the exploratory wells.

Chromatographic analysis of Gippsland crudes suggest that the oils originated in solid organic matter derived from algae and land plants, the latter contributing to the higher than usual wax content.

Microscopic characterization of carbonaceous material reveals high contents of vitrinite and exinite. A typical composition of coal being vitrinite 84%, exinite 12%, and inertite, mostly fusinite, 4%.

Studies of the exinite indicate that the upper part of the Latrobe Group, time equivalent to the upper Eastern View Coal Measures, is above the maturation level. Therefore, it appears that the major oil, condensate and gas accumulations of the Gippsland Basin have not been sourced by in-situ mature source-rock, but are the results of long range migration along fault planes, bedding planes and unconformity surfaces, Figure 32. Figure 33 show that vitrinite reflectance versus depth increases at comparable rates in the Bass Basin as in the Gippsland Basin.

216115




5 cm

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216116

# Petroleum potential of the Bass Basin

*E. Nicholas, K. L. Lockwood, A. R. Martin[1], & K. S. Jackson*

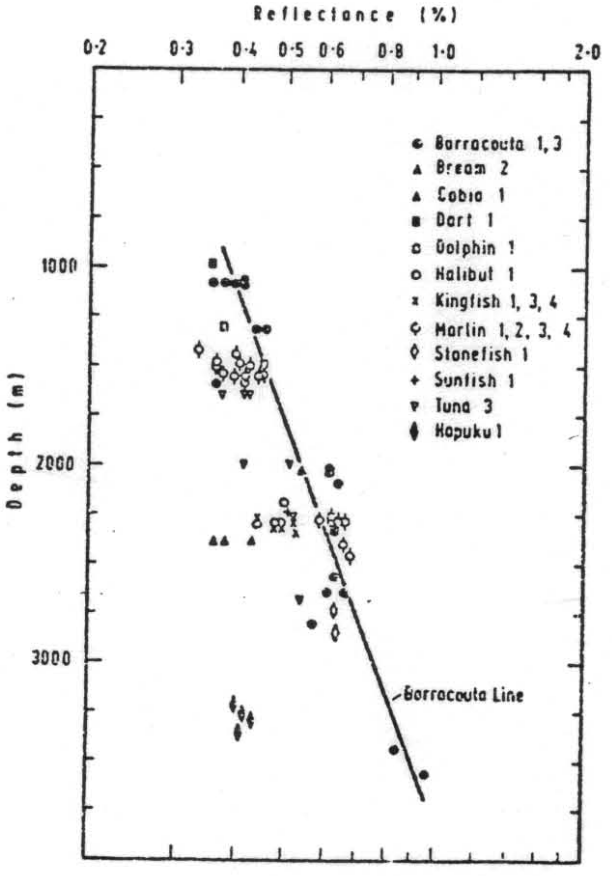
| *Well name* | *Unit* | *Core No.* | *Total organic carbon (TOC) (%)* | *Oil & gas content $S_1$ (mg hydrocarbon/g rock)* | *Petroleum potential $S_1+S_2$ (mg hydrocarbon/g rock)* | *Production index $S_1/(S_1+S_2)$* | *Hydrogen index $S_2/TOC$ (mg hydrocarbon/g TOC)* | *Oxygen index $S_3/TOC$ (mg $CO_2$/g TOC)* | *Hydrogen: oxygen ratio (H/O)* |
|---|---|---|---|---|---|---|---|---|---|
| Aroo No. 1 | L. EVCM | 1 | 6.05 | 0.82 | 22.80 | 0.04 | 365 | 10 | 37 |
| Bass No. 2 | | | | | | | | | |
| | L. EVCM | 9 | 2.40 | 0.21 | 10.90 | 0.02 | 409 | 29 | 14 |
| Bass No. 3 | | | | | | | | | |
| | L. EVCM | 10 | 20.10 | 1.21 | 46.70 | 0.03 | 226 | 10 | 23 |
| | L. EVCM | 11 | 2.40 | 0.13 | 4.74 | 0.03 | 192 | 11 | 18 |
| | L. EVCM | 13 | 0.60 | 0.02 | 0.03 | 0.67 | 2 | 18 | 0.1 |
| Narimba No. 1 | L. EVCM | 1 | 7.10 | 1.81 | 17.70 | 0.10 | 223 | 9 | 24 |
| | L. EVCM | 2 | 0.85 | 0.09 | 0.73 | 0.12 | 76 | 271 | 0.3 |
| | L. EVCM | 3 | 1.85 | 0.19 | 1.72 | 0.11 | 83 | 148 | 0.6 |
| Poonboon No. 1 | L. EVCM | 2 | 65.80* | 19.60 | 160 | 0.12 | 213 | 13 | 16 |
| | L. EVCM | 4 | 1.75 | 0.11 | 1.49 | 0.07 | 79 | 132 | 0.6 |
| | L. EVCM | 5 | 1.20 | 0.13 | 0.88 | 0.15 | 63 | 100 | 0.6 |
| | Otway Gp | 3 | 4.15 | 3.03 | 3.14 | 0.96 | 3 | 150 | 0.02 |
| Durroon No. 1 | Otway Gp | 3 | 1.80 | 0.01 | 0.60 | 0.02 | 33 | 69 | 0.5 |
| | Otway Gp | 4 | 4.50 | 0.17 | 0.98 | 0.17 | 18 | 9 | 2.0 |
| | Otway Gp | 5 | 3.75 | 0.23 | 2.28 | 0.10 | 55 | 9 | 5.9 |

* Coal

**Rock-Eval pyrolysis data for some Bass Basin source rocks**

Figure 31

216117




Reflectance of vitrinite in offshore wells in the Gippsland Basin

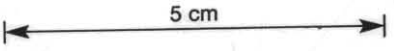
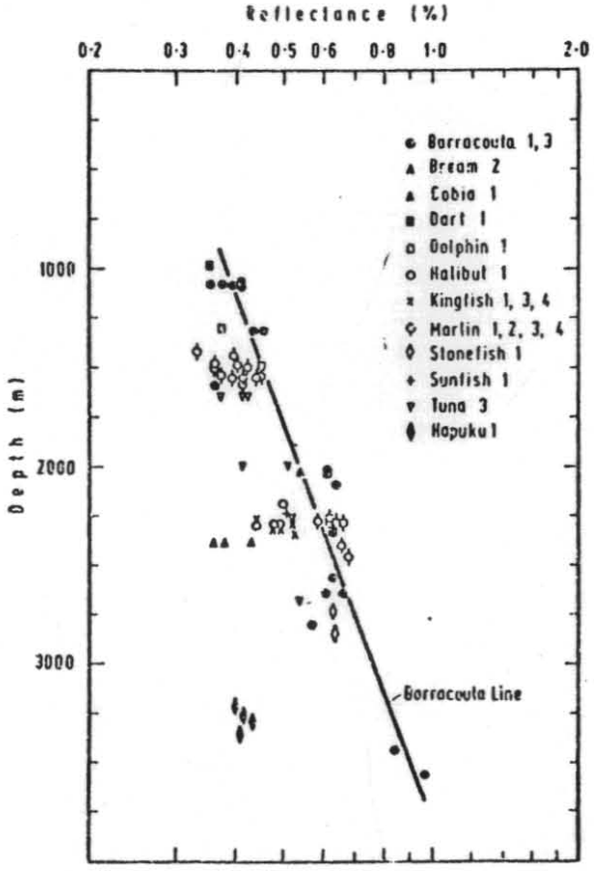


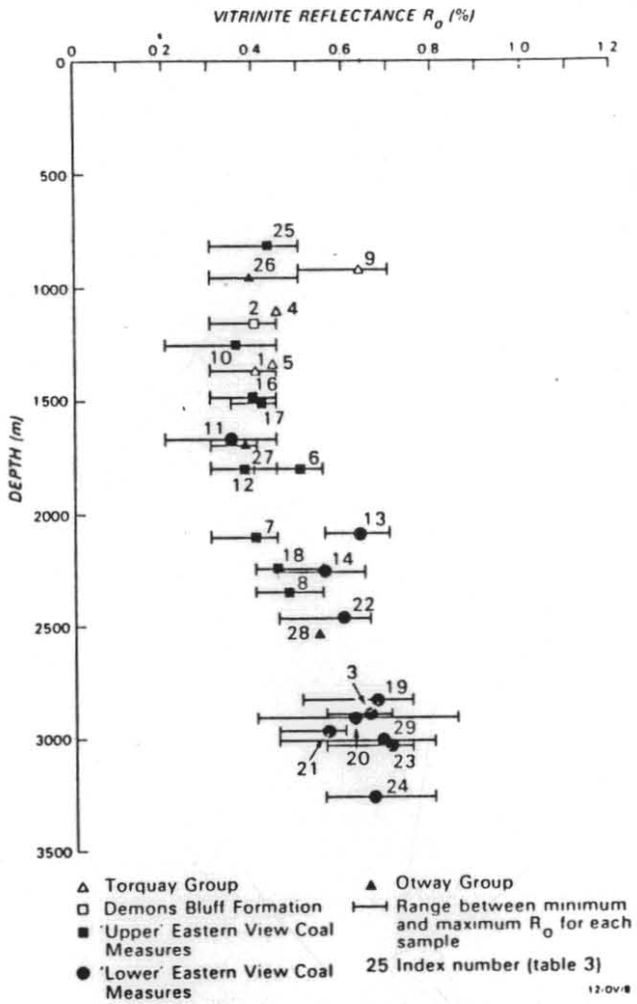

Figure 32

5 cm




Reflectance of vitrinite in offshore wells in the Gippsland Basin

Figure 33




**Vitrinite reflectance plotted against depth in Bass Basin.**

21618

216119

Conclusions

The published source rock studies confirm the hydrocarbon source potential of the Eastern View Coal Measure, especially its lower portion which is rated as having good to very good potential. The presence of vitrinitic kerogen indicates generally gas-prone source rocks, but the exinitic kerogen content in samples from some wells is sufficient to warrant an oil-prone and gas-prone rating.

Thermal maturation indicators show that at the deepest levels tested, the source rocks in the lower Eastern View Coal Measure are within the mature zone for hydrocarbon generation.

216120

## A new look at the Gippsland Basin

P.G. Stuart-Smith, M.A. Etheridge, & J.C. Branson

Major extensional structures have recently been identified in the Bass Strait basins, following a deep seismic survey conducted in 1982 by the Bureau of Mineral Resources and reappraisal of company data. The Gippsland Basin, like the Bass and Otway Basins, was initiated during the Early Cretaceous by north-northeast-south-southwest extension.

Extensional structures in the Gippsland Basin consist of rotational planar normal faults that are up to 5 km in strike length and terminated by a perpendicular set of subvertical transfer faults that trend between 205° and 210°. The normal faults dip between 30° and 60° and show displacements of up to 5 km. Displacements on the transfer faults are mostly sinistral (left-lateral), giving rise to the overall easterly trend of the basin and its bounding structures (e.g., south-bounding Foster Fault System). A major transfer fault zone passing beneath the Kingfish, Halibut, Fortescue, and Tuna oil fields separates predominantly northeast-dipping normal faults to the east. Another major transfer fault possibly terminates the major transfer fault zone terminating significant extension in the southeast Bass Basin.

Identification of the Early Cretaceous extensional structures is limited to the basin margins, owing to the paucity of good quality deep seismic information in the centre of the basin. However, some transfer faults can be matched across the basin and, in places, they are coincident with magnetic trends and sea-bed canyons.

The extensional structures have been a major influence throughout the development of the basin. The normal and transfer faults have partly controlled the distribution and orientation of Late Cretaceous subsidence structures and were important controls on the development of late Eocene and younger hydrocarbon-bearing structures. These structures were, in the main, produced by wrench reactivation of transfer faults and reverse movements on older normal faults during Eocene to Recent northwest-southeast compression.

216121

# Bass Basin stratigraphy

C.J. Pigram, J.B. Colwell, & K.L. Lockwood

The stratigraphy of the Bass Basin is known from the 19 wells* that were drilled between 1965 and 1982. The succession (Table 1.), consisting of thick Early Cretaceous to Eocene non-marine and Eocene to Pliocene marine sediments, rests unconformably on basement of presumed Palaeozoic age. Only two wells (Bass 2 and 3), drilled on basement highs, encountered basement rocks, which are generally assumed to consist of low-grade metasediments, granite, and Late Palaeozoic glacigene sediments similar to those found in northern Tasmania and southern Victoria.

The oldest sediments in the basin are referred to the Early Cretaceous Otway Group and have been intersected in 2 wells. They consist of lithic sandstone, siltstone, minor volcanics, rare conglomerate and thin coal seams. The Otway Group is overlain unconformably by up to 7 km of Late Cretaceous to Eocene non-marine sediments referred to the Eastern View Coal Measures.

The lower, pre-Maastrichtian (Tricolpites longus) part of the sequence has been intersected only in the Durroon well, where it consists of grey to dark brown, non-calcareous shale, siltstone, and fine sandstone.

The Maastrichtian and Tertiary portion of the Eastern View Coal Measures consists of silty shale with thin fine-grained sandstone and rare coal in the lower part. These sediments typically pass up into a coal-rich sequence that is in turn overlain by a sand-rich sequence.

A thin, but extensive restricted marine shale and siltstone sequence of the upper Eocene Demon's Bluff Formation overlies the Eastern View Coal Measures and is in turn conformably overlian by the marine Oligocene-Pliocene Torquay Group. The Torquay Group consists of marl, calcarenite, calcareous shale, and minor volcanics.

Intrusive and extrusive igneous rocks occur throughout the Bass Basin sequence, and probably range in age from Cretaceous to Miocene.

Understanding of the stratigraphy and geological development of the Bass Basin is limited by the small number of wells and their relatively shallow level of penetration. To gain a better understanding of the stratigraphy of the basin, a seismic stratigraphic analysis of some BMR dip lines has been carried out. Four seismic sequences have been identified (Table 1) and each sequence subdivided into seismic facies, which have been given a palaeoenvironmental interpretation.

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* Two further wells - Squid-1, Tasmanian Devil-1 - have been drilled in 1984.

# Bass Basin surveying and deep seismic information

216122

J.C. Branson, G.D. Karner*, K.L. Lockwood & A.S. Scherl

BMR recorded 3209 km of seismic, gravity, and magnetic data between March and May 1982, using a contract vessel, Lady Vilma. Traverses were centred on the Bass Basin and connected with traverses across parts of the Gippsland and Otway Basins. A seismic processing contract was let in June 1982 to Geophysical Service Inc., Sydney. The contractor completed tests, batch processing, and migration of BMR 1982 data and reprocessing of 941 km of data by June 1984. Recording and processing details are given in Table 1.

The major volume of digital processing was made available to lease holders in the survey area in April 1983. and then released to the general public in October 1983. These results provide the highest quality seismic information available in the deepest parts of the Bass Basin and also give good quality seismic correlations between the adjacent basins in Bass Strait. Reprocessing of 1975 regional seismic data by the same techniques used for 1982 data has shown that the 1982 recording techniques improved data quality by use of high channel numbers, high digital sampling rates, longer seismic records, and large capacity tuned airgun arrays.

Analysis of the Bass Basin structure showed that seismic events need to be record ed down to basement. Shallow data recorded in the past to 4 or 5 seconds two-way time do not allow analysis to adequately discriminate between basin-forming structures and the effects of superimposed later tectonic movements. The origin of the Bass Basin and its structural history are important in defining the thermal and sedimentary histories, which in turn are used by the hydrocarbon industry to define subsidence curves.

A thermo-mechanical model of the Bass Basin was developed by Garry Karner in BMR during 1983. The model is based on stretching of the lithosphere by brittle and ductile failure of the crust and mantle, respectively. The results provide an analysis of competing isostatic effect of crustal subsidence, which forms a rift phase, and a following slower thermal decay, which forms a superimposed flexural phase. Structures from deep in the Bass Basin show that large extensions took place in the Early Cretaceous. The magnitude of this extension and the dimensions of the known rift basin have been applied to the model, and the results provide a series of thermal decay curves that are used in geohistory models. There are a number of thermal decay curves developed for various positions within the Bass Basin whose form depends on basement structure and relative proximity of the test sites to a depocentre or basin margin. The example discussed here is located over an elevated region of basement near the basin depocentre and this provides an estimate of thermal maturation during burial history.

The value of detailed deep seismic information is also discussed by scientists studying sedimentary facies and other scientists working on a grid of data to define broad leads in hitherto unexplored Cretaceous and Paleocene sequences.

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* Department of Geology, Durham University, U.K.

216123

# Cretaceous to Paleocene structural and stratigraphic leads in the Bass Basin

P.E. Williamson & A.S. Scherl

Paleocene and Cretaceous hydrocarbon exploration plays have not been extensively tested in the Bass Basin. Only about half the 21 wells have penetrated to the late Paleocene (Lygistepollenites balmei) level and only about a quarter have penetrated the top Cretaceous.

Cretaceous to Paleocene leads for hydrocarbon prospectivity within the Bass Basin have been investigated by regional seismic mapping, using an approximate 15 x 15 km grid of BMR and petroleum industry multichannel seismic data. These leads are defined at Paleocene (L. balmei), Cretaceous rift unconformity and at prerift unconformity levels.

Both structural and stratigraphic leads occur at these levels. Structural leads are predominantly fault-bounded and are the result of normal faulting in longitudinal and traverse directions associated with rifting and extension in the basin at Middle to Late Cretaceous time. Growth on some faults from prerift unconformity to rift unconformity time indicates that the Cretaceous rift phase may have built on an earlier rift phase or at least on existing structural faults. Reactivation of Cretaceous rift faults occurs into the Paleocene, producing structural leads. However, it rarely extends as high in the section as the Eocene top Eastern View Coal Measures, where significant reactivation and reversal of rift faulting has formed structures at top Latrobe in the Gippsland Basin, with associated oil fields. At the equivalent level in the Bass Basin only minor closures occur and many of these were drilled unsuccessfully in the early exploration of the basin. Stratigraphic leads fall into two classes. The predominant type is associated with truncation of Paleocene and Cretaceous strata at the basin edges. These are considered to be lower-order stratigraphic leads. The more attractive stratigraphic leads are associated with clastic accumulations down-thrown to large faults.

The high component of transverse faulting in the Bass Basin has resulted in a large number of fault-bounded structural leads (a number with areas in the order of 100 sq kms), occurring at depths between about 3 and 4 kilometres in Paleocene and Cretaceous stratigraphy. Multiple stacked exploraion targets at these levels are possible, since the strata penetrated are suggestive of suitable reservoir and source-rock facies. Maturation studies also suggest that these levels are more likely to be mature or to have access to mature source rock than are the traditional shallower Eocene Eastern View Coal Measures exploration targets.

Delineation of Paleocene and Cretaceous leads within the Bass Basin thus gives indications of substantial exploration potential in the mature strata of the Basin.

The analysis suggests that the Eastern View Coal Measures have a complex depositional history, involving sediments of alluvial fan, floodplain, lacustrine, and volcanic associations.

# Developments in concepts of hydrocarbon generation from terrestrial sources

216124

T.G. Powell

The majority of Australia's hydrocarbon reserves have been generated from source rocks containing non-marine organic matter. Terrestrial organic matter consists of a mixture of hydrogen-rich and hydrogen-poor components. Hydrogen-rich components include cuticle, spores, suberin, and resin, and are capable of generating oil on maturation, whereas the structural parts of plants (wood, etc) are hydrogen-poor and produce only gas on maturation. The mix of these components depends, in part, on the type of plant that supplied the organic matter, and may be related to the evolutionary stage of the land plants. Mesozoic and Tertiary floras in Australia appear to have produced a greater abundance of hydrogen-rich cuticle, suberin, and resin components compared with their Permian counterparts. A second control is the depositional environment. Deposition of terrestrial organic matter in a mildly oxidising, aquatic environment results in fungal and bacterial degradation of wood and cellulose, and the concentration of hydrogen-rich components. Approximately 20 to 30% of hydrogen-rich components are required for terrestrial organic matter to be a source for oil. Oil generation from terrestrial organic matter occurs at vitrinite reflectance levels above 0.7% Ro, except where resin is a major component, when oil generation can occur at reflectance levels as low as 0.5% Ro. Gas generation is significant at reflectance levels above 0.55% Ro, and entrainment of liquid hydrocarbons in the gaseous phase means that condensate can be included in gas at all stages of maturation.

Most oils from terrestrial sources are paraffinic and may have a high wax content. The wax content is extremely variable and is favoured where depositional conditions result in the concentration of hydrogen-rich components in the source. Resin contributes a variable amount of naphthenic and aromatic oils and condensates. High pristane to phytane ratios (>3.5) and a high proportion of acyclic isoprenoids are typical of most terrestrial source oils, but those extremely waxy oils formed in lacustrine environments may have lower values. The importance of microbial processes in the formation of the source organic matter for non-marine oils is shown by the presence in the oils of a variety of hydrocarbons derived from bacterial precursors. The overall composition and isotopic composition of gases formed from terrestrial organic matter are extremely variable and poorly understood.

# Dynamical models of lithosphere extension, with reference to sedimentary basin formation

216125

G.A. Houseman

Research School of Earth Sciences, Australian National University

The lithosphere extension model proposed by McKenzie (1978) has recently received increasing attention in tha analysis of basin tectonic and subsidence histories. It specifies a uniform horizontal extension, followed by thermal subsidence as the lithosphere returns to its original thermal equilibrium. This model or some variant of it has been applied by different authors to the Aegean Sea, the North Sea, the Bass Basin, and several other examples. The modelling to date is essentially kinematic, in that extension factors have been estimated without reference to the forces driving the tectonic activity. The work described here examines the stress state in the extending lithosphere in order to further develop the extensional model, and, possibly, to obtain useful constraints on the rheology of the lithosphere.

An extensional stress field in the lithosphere can result from localised elevation of the lithosphere by a hot rising thermal sheet or plume in the convecting mantle below. The lithosphere responds to an extensional deviatoric stress by normal faulting in the upper part of the crust and by ductile flow at greater depths. The model assumes that the strongest part of the lithosphere is the upper mantle, and uses the rheological laws for olivine summarised by Goetze (1978). For uplift of 1 km by a convective plume, the depth-averaged deviatoric extensional horizontal stress is around 16 MPa. The resulting strain rates depend strongly on the temperature in the upper part of the mantle.

Numerical models have been used to calculate the evolving temperature and stress fields in the extending lithosphere. The extension will be self limiting if the initial strain rate is sufficiently small, since cooling of the upper mantle associated with the thinning crust causes the ductile rheology to freeze (England, 1983). The subsidence histories for these theoretical extension models show several stages: (i) uplift (and possibly erosion), owing to plume formation; (ii) contemporaneous extension (active normal faulting), resulting in subsidence, owing to the thinned crust; (iii) thermal subsidence, owing to the cooling of the extended lithosphere; and (iv) further subsidence associated with the removal of the mantle plume.

References

England, P.C., 1983-Journal of Geophysical Research, 88, 1145-1152

Goetze, C., 1978-Philosophical Transactions of the Royal Society, London, A, 288, 99-119

McKenzie, D.P., 1978-Earth and Planetary Science Letters, 40, 25-32

216126

# Extensional basin-forming structures in the Bass Basin

M.A. Etheridge, J.C. Branson, & P.G. Stuart-Smith

Major Cretaceous normal faults bounding substantially tilted blocks were recognised early in the interpretation of the 1982 BMR Bass Strait seismic survey. This recognition led to a specific structural study of the early fault configurations, using extensional faulting concepts. The structural study, which also utilised all post-1974 company data, concentrated on the gross fault pattern at Cretaceous level, without detailed horizon picking.

The Early Cretaceous basin-forming normal faults are shallow to moderately dipping, rotational, and approximately planar down to the base of the section (6 sec TWT; 10-12 km). They have displacements of up to 10 km, strike consistently 290 to 300 degrees, mostly dip towards the south-southwest. Rotation on these faults has produced tilts of up to 35 degrees in the basement surface. Mapping shows that the faults are relatively short along strike, being disrupted by a set of steeply-dipping transfer faults that trend 020 to 030 degrees across the full width of the basin. The transfer faults developed at the same time as the normal faults, and are thus restricted to the Early Cretaceous and older sequences. They do not simply displace the normal faults and tilt blocks, but accommodate variations in the positions of and displacements on the extensional structures. They are therefore analogous to oceanic transform faults. The transfer faults in Bass Basin tend to displace the normal faults in a right-lateral sense, giving rise to the basin's overall northwesterly trend.

In the southeast corner of the Bass Basin, an apparently separate set of extensional normal faults and tilt blocks developed during the Late Cretaceous. These faults trend about 320 degrees and dip towards the northeast. Because their age and orientation are different from those of faults underlying most of the basin, and because they are superimposed on an Early Cretaceous graben fill, we conclude that they were not primary basin-forming structures. This conclusion is supported by preliminary thermomechanical modelling, and we further suggest that these structures are related to the early stages of opening of the Tasman Sea.

Preliminary interpretation of BMR and company seismic data from the Gippsland and Otway Basins has identified Early Cretaceous normal and transfer faults with the same trends as those throughout the Bass Basin. It is therefore proposed that all three basins developed by north-northeast to south-southwest extension, and that their gross configuration resulted from offsets on major transfer fault systems.

# Otway margin - a Bass Basin and Gippsland comparison

216127

J.C. Branson & D.A. Falvey

The Otway Basin has provided an ideal area for testing currently proposed models for the formation of passive continental margins. Despite intensive studies in the Atlantic Ocean of regions like the Bay of Biscay, West Africa, and northeast North America, and the North Sea, many processes of continental margin development are poorly understood. The distinction of different types of margin development relies on accurate data from the earliest periods of continental breakup, and most of the Atlantic margin transects have been unsuitable, owing to thick sedimentary sequences, which also include halite. The Otway Basin was surveyed by two long traverse lines during the 1982 Bass Strait Geophysical Survey, and these data augmented by reprocessed 1979 Shell 'Petrel' lines in the same area. Results of these surveys show that detailed sedimentary and structural information is readily available across the whole margin, and some deeper events have been recorded from the upper crust. These high quality data owe their origin to a low sediment supply over long periods of geological time and to high quality recording and processing techniques developed by BMR.

Studies of the deep section in the Bass and Gippsland Basins provide evidence for a regional north-northeast rift and apparent extension at the primary stage of continental separation in the Early Cretaceous. This extension direction is probably also present throughout the Otway Basin. Recognition of the dominant trend for the later, mid-Cretaceous rift in the Otway Basin relied on an analysis of widely spaced lines within the continental margin. Further high-quality geophysical survey data will be required in the future to confirm the tectonic fabric. The present-day trend of the tilted basement blocks and Early Cretaceous sediment across the deep continental margin was imposed during the thermal decay phase of continental margin formation. This follows a possible northwest trend of the earliest breakup phase of the Antarctic and Australian continents. The period from 65 Ma to 44 Ma was a time when the seafloor spreading direction changed to nearly north-south. Also, structures can be seen in BMR traverses across the Torquay Embayment at the northeast end of the Otway Basin, in lines in the Bass Basin, and along the northern margin of the Gippsland Basin. They were formed by a tectonic event that folded and faulted all pre-Pliocene sequences. The structures are consistent with southeast-northwest compression, and this stress field has been measured throughout southeastern Australia. The origin of this regional stress has been attributed to late Miocene to Recent interplate stress transmitted from the Pacific/Australia plate boundary.

Dredged rock samples are required from the deep-water sequences of the rift and postrift fill of the Otway Basin margin. Estimates of age and lithology have been extrapolated over 150 km from shelf exploration wells, and on the slope are expected to be different. The trends of structures within the sea floor and the position of suitable sample sites within continental slope are prime objectives for future scientific investigation in the Australian margin.

216128

# Structural concepts in extensional basin interpretation

M.A. Etheridge, J.C. Branson, & P.G. Stuart-Smith

Lithospheric stretching is generally considered to be one of the most important mechanisms of subsidence and basin formation, especially at passive continental margins. In the upper part of the crust, the stretching is accomplished by normal faulting. Extensions of the magnitude proposed for typical basins (50-100%) require specific and unusual fault geometry, which may play a key role throughout subsequent basin development. We suggest that the structural concepts of large-extension faulting should be routinely applied in seismic interpretation of extensional basins.

The structural history of extensional basins is most conveniently considered in three phases:-

1.) Extensional Phase - The main extensional structures are of two types; a set of rotational, planar, or listric normal faults, and a perpendicular set of subvertical transfer faults. The normal faults are straight to gently curved, have low to moderate dips, and bound tilted basement blocks and syn-rift fill (with poor seismic data the dip of the syn-rift is commonly the best guide to fault orientation and position). The faults commonly dip the same way across the whole basin, but they may change dip across transfer faults. Large displacements (>1 km) are possible, making it unlikely that such faults die out over a short distance. However, they will generally terminate against transfer faults, which are accommodation structures analogous to oceanic transform faults. At rift-fill level, displacement across a transfer fault varies along its length, giving rise to discontinuous traces and unusual geometry (e.g., hinge faults). Seismic sections oblique to normal and transfer faults may give rise to unusual geometry, whose interpretation would be difficult without application of extensional structural concepts.

2.) Subsidence Phase - Subsistence follows extension owing to cooling of the stretched lithosphere. During subsidence, displacement are essentially vertical, smoothly varying, and relatively small, giving rise to the closely spaced steep faults with less than 1 km displacement that are typical of so many basins. These faults will generally be down-to-basin and irrotational. They tend to be uniformly distributed throughout the basin, but reactivation of the extensional structures during subsidence may control their distribution in detail.

3.) Later Reactivation - At any stage in the basin history, a change in tectonic setting may superimpose structures on an extensional basin. Most importantly, the major normal and transfer faults developed during extension provide zones of weakness through much of the crust. Reactivation of these zones of weakness controls the style, orientation, and location of a wide variety of later structures. For example, early normal faults may be reactivated as reverse faults, and subsequent strike-slip movement on transfer faults may produce a range of wrench-style structures in the overlying sequence.

T-15-P

LINE B69A-4 — SE — 12 FOLD STACK TVF TVF 20-60 Hz. 400 ms. 15-55 " 600 " 10-50 " 800 " 10-40 " 1200 " — FAST DIGITAL AGC — LINE B69A-4 Scale Ratio 3·54:1 at 1-Sec. — A-4

B69A-11 81-21 B-8 VG B69A-9 ES-69 82-33 VG ES-49 VG B-7 B69A-7

3723 3729 3735 3741 3747 3753 3759 3765 3771 3777 3783 3789 3795 3801 3807 3813 3819 3825 3831 3837 3843 3849 3855 3861 3867 3873 3879

0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0

Eastern View Coal Measures (Unconformity)

Paleocene L. balmei* (Unconformity)

Upper-Cretaceous*

intra-Upper Cretaceous* Unconformity

mid-Cretaceous* Unconformity

62200 62100 62000 61900 61800 61700

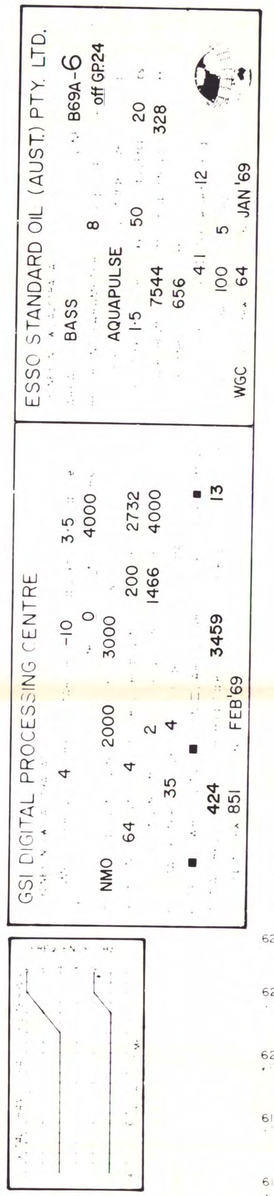
ESSO STANDARD OIL (AUST) PTY. LTD.

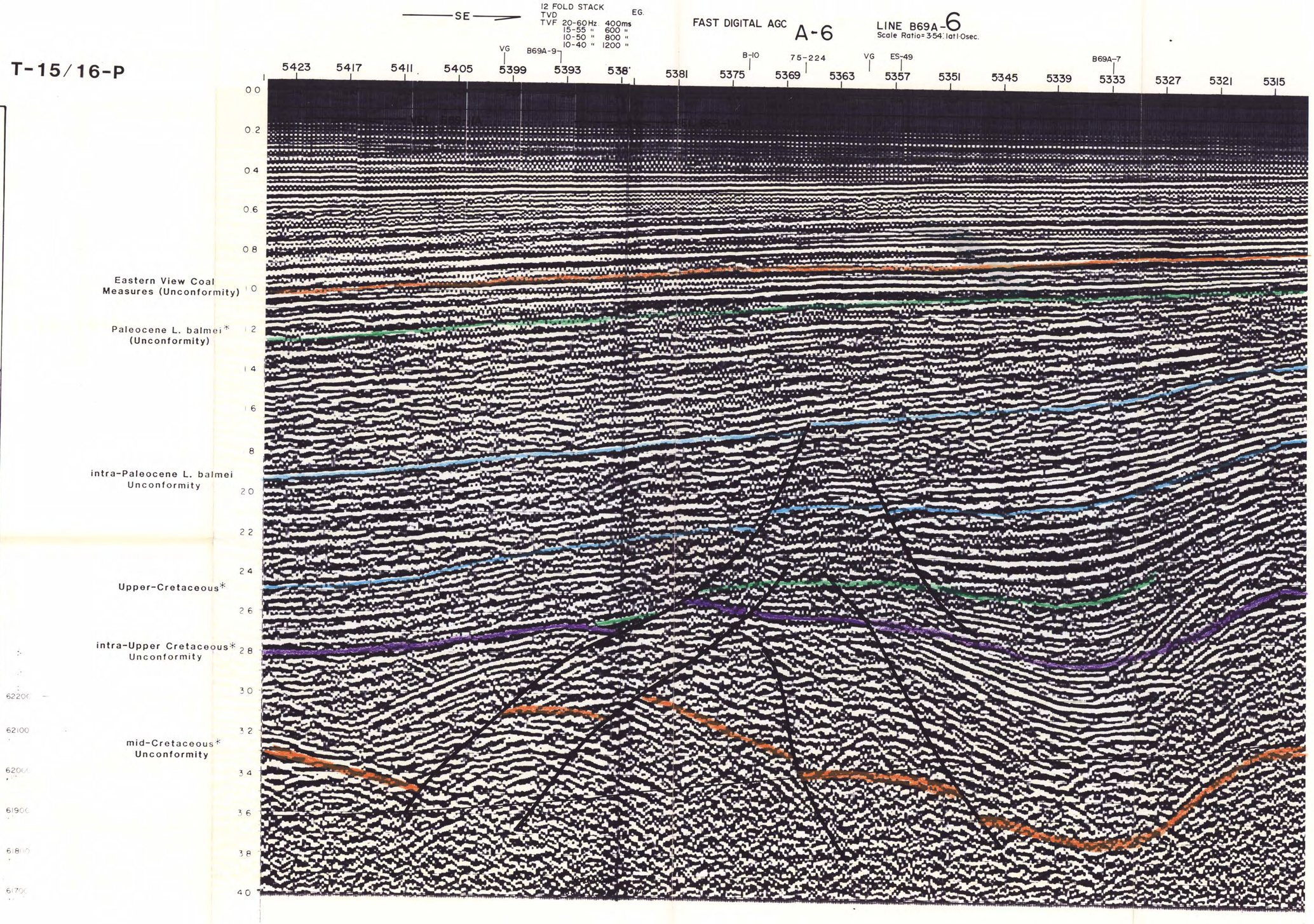
| | |
|---|---|
| | BASS |
| | B69A-4 |
| | off GP24 |
| | 8 |
| | AQUAPULSE |
| | 50 |
| | 20 |
| | 328 |
| | 12 |
| WGC | 64 |
| | 100 |
| | 5 |
| | JAN '69 |

GSI DIGITAL PROCESSING CENTRE

| | | |

T-15/16-P




**Enclosure Line 2**

T/16P Part 6

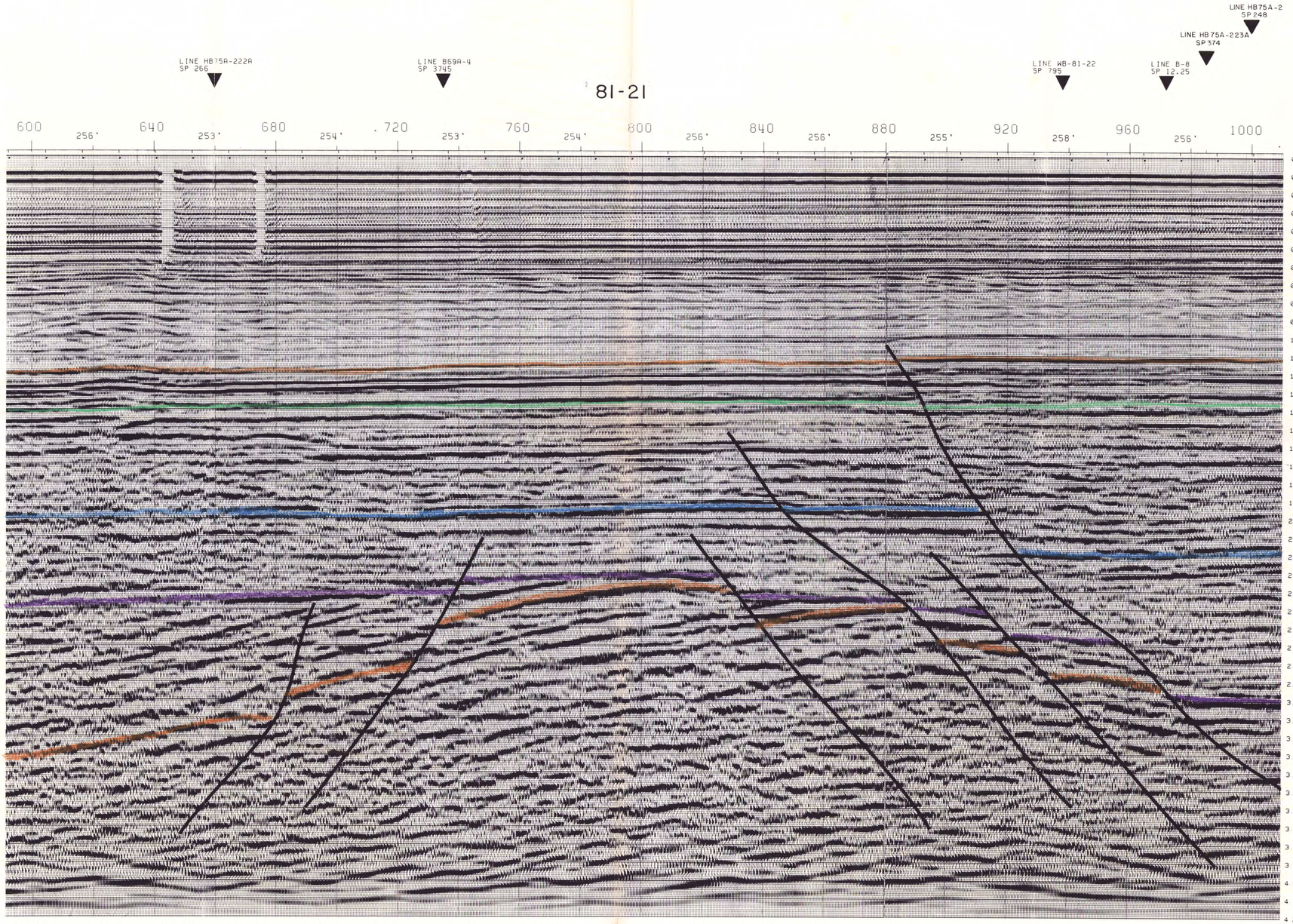
OR-202

5 cm

216130

②

LINE: WB-81-21
S.P.: 100-1686
1X4800%, MIGRATION TVF




T-16-P

EAST

# WEAVER OIL AND GAS

OFFSHORE AUSTRALIA

BASS BASIN, STONEY ROCK

SHOT BY WESTERN GEOPHYSICAL CO. PARTY 86 APRIL 1981
PROCESSED BY WESTERN GEOPHYSICAL HDC GRP 27 JULY 1981
PLAYBACK REEL NO. : 063486

## RECORDING DATA

### SOURCE

| | |
|---|---|
| ENERGY SOURCE | AIR GUNS |
| NUMBER OF GUNS | 10 |
| GUN DEPTH | 6 METERS |
| FIRING INTERVAL | 25 METERS |
| SHOT POINT INTERVAL | 25 METERS |
| DISTANCE OF SOURCE TO ANTENNA | 77.9 MTRS. |

### INSTRUMENTS

| | |
|---|---|
| SYSTEM | DFS V |
| AMPLIFIER | BINARY GAIN |
| FILTER | HG2.5-LOUT |
| SAMPLING INTERVAL | 4 MS. |
| RECORD LENGTH | 6 SEC |

### CABLE

| | |
|---|---|
| TYPE CABLE | STREAMER |
| CABLE LENGTH | 2375METERS |
| CABLE DEPTH | 14.3 MTRS. |
| LEAD IN | 281.7MTRS. |
| GROUP INTERVAL | 25 METERS |
| NUMBER OF GROUPS RECORDED | 96 |

## PROCESSING SEQUENCE AND PARAMETERS

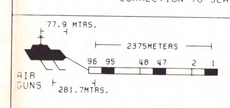
PROCESSING SAMPLING INTERVAL 4 MS

1. EDIT
2. DECONVOLVED BEFORE STACK
   - TYPE - MINIMUM PHASE INVERSE FILTER
   - WINDOW LENGTH 3 EQUAL ZONES
   - LENGTH OPERATOR 200 MS
   - PREDICTION DISTANCE 4 MS
3. NMO STACK 4800 %
4. GAIN
5. MIGRATION
   FINITE DIFFERENCE METHOD
6. TIME VARIANT FILTER

| FILTER TIME | L.C. (HZ.) | H.C. |
|---|---|---|
| .1 SEC | 15 - | 50 |
| 1.0 SEC | 10 - | 40 |
| 1.9 SEC | 8 - | 30 |
| 2.5 SEC | 6 - | 20 |

7. GAIN

96 GROUP CABLE USING ALL GROUPS
SHOTPOINT LOCATION AT ANTENNA
CORRECTION TO SEA LEVEL DATUM 12 MS




LEGEND
▼ INTERSECTIONS
W.D. WATER DEPTH

HORIZONTAL SCALE
80 TRACES EQUALS ONE KILOMETER
1 KILOMETER
VERTICAL SCALE
3.75 INCHES PER SECOND

216131

POLARITY CONVENTION
RECORDING : COMPRESSION PULSE NEGATIVE NUMBER
PROCESSING : COMPRESSION PULSE NEGATIVE NUMBER
DISPLAY : COMPRESSION PULSE TROUGH INCREASING BLACK

5 cm

Enclosure Line 3
T/16P Part 6

OR-202

| SP 169 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 120 | 1490 |
| 550 | 2020 |
| 1160 | 2420 |
| 1800 | 2820 |
| 2400 | 3700 |
| 4000 | 5140 |

| SP 249 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 130 | 1490 |
| 830 | 2100 |
| 1480 | 2420 |
| 2350 | 2900 |
| 3000 | 4020 |
| 4000 | 5140 |

| SP 329 | |
|---|---|
| TIME | VRMS |
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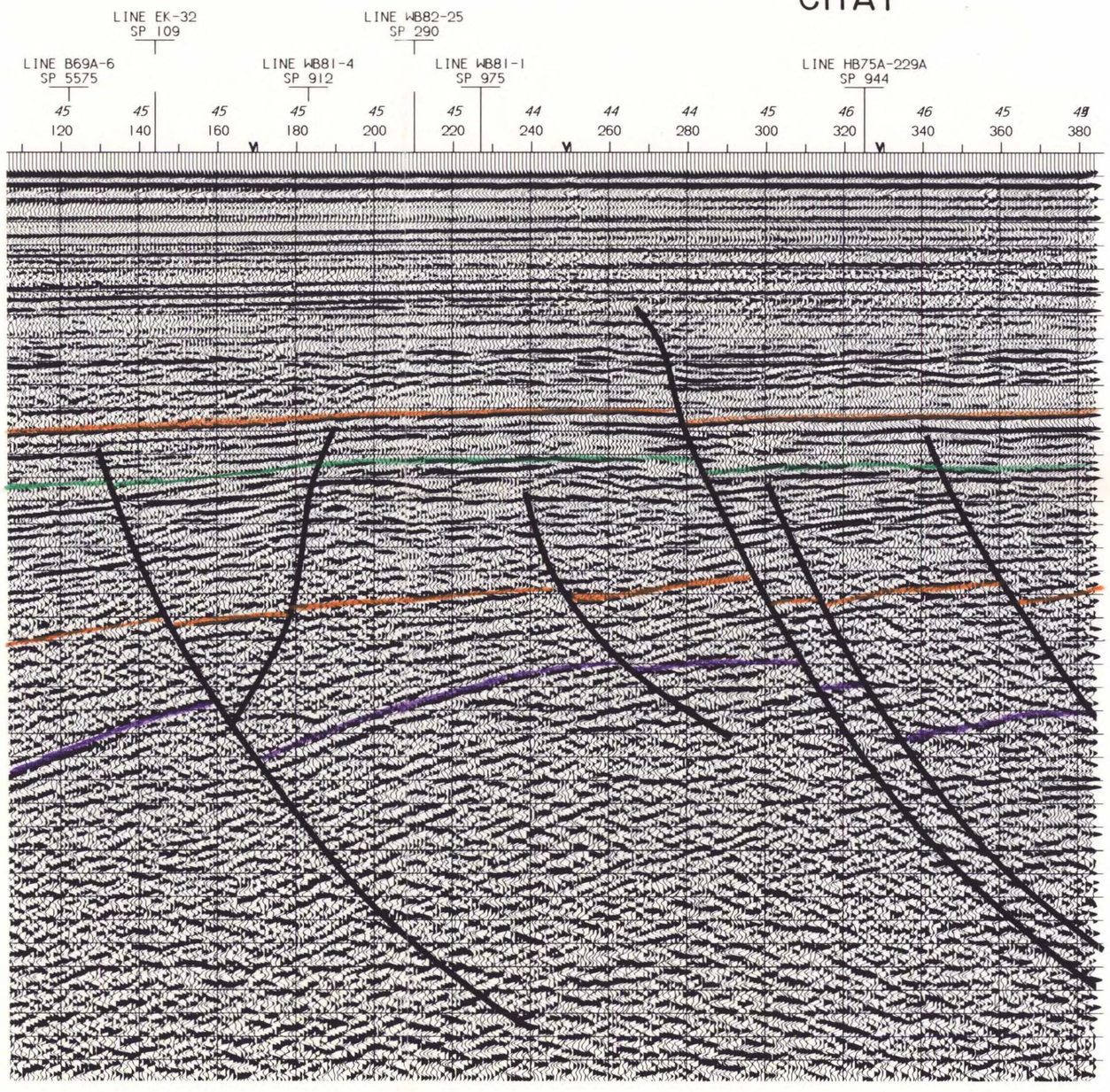
| 130 | 1490 |
| 900 | 2100 |
| 1550 | 2500 |
| 2500 | 3540 |
| 4000 | 5140 |

# CHAT




LINE WB82-27
S.P. 1-388

N.E.
DIRECTION OF SHOOTING

AGC-STACK

**T-15-P**

**WEAVER OIL & GAS**
**BASS BASIN**
**PERMIT T-15-P**

GeoCenter
Houston, Texas

DATE PROCESSED MAY 1982
REEL NUMBER 2767
CONTRACT NUMBER 4805

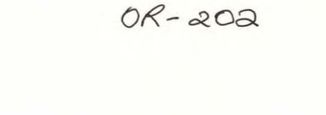
## FIELD RECORDING

RECORDED BY WESTERN GEOPHYSICAL
DATE FEBRUARY 1982 SYSTEM DFSV
FORMAT SEG B GAIN 36 DB

ENERGY SOURCE
TYPE AIR GUNS 760 CU. INS. 4500 PSI.
ARRAY 10 GUNS DEPTH 6 METERS

STREAMER
LENGTH 2375 METERS NO. TRACES 96
DEPTH 40 F.T. GROUP INTERVAL 25 METERS
ARRAY 20 GEOPH/TR OVER 25 METERS

PARAMETERS
RECORDING FOLD 4800% S.P. SPACING 25 METERS
SAMPLE INTERVAL 2 MS RECORD LENGTH 5 SECONDS
RECORDING FILTER OUT - 128HZ @ 70DB/OCTAVE




## DIGITAL PROCESSING

| SEQ | PROCESS | PARAMETERS |
|---|---|---|
| 1 | DEMULTIPLEX | BINARY GAIN RECOVERY OUTPUT 4 MS |
| 2 | GAIN | AMPLITUDE RECOVERY |
| 3 | CDP TRACE GATHER | 4800%/ADJACENT TRACE SUM |
| 4 | PRE-FILTER | SEE BELOW |
| 5 | DECONVOLUTION | SEE BELOW |
| 6 | VELOCITY ANALYSIS | CONSTANT VELOCITY STACK OVER 6 CDPS |
| 7 | NMO, MUTE | NORMAL MOVEOUT MUTE APPLICATION |
| 8 | CDP STACK | 4800% |
| 9 | FILTER | SEE BELOW |
| 10 | EQUALIZATION | DATA DEPENDENT |

ADDITIONAL PARAMETERS

| DECON | * OPERATOR LENGTH | PREDICTIVE GAP | DERIVATION WINDOWS | APPLICATION WINDOWS |
|---|---|---|---|---|
| 5 | 160 | 32 | 0 TO 3500 | RECORD LENGTH |

APPLICATION TIMES

| FILTER | CUT OFF POINT | 6 DB POINT | 6 DB POINT | CUT OFF POINT | APPLICATION TIMES FOR SHOTPOINTS SPECIFIED |
|---|---|---|---|---|---|
| 9 | 12 | 15 | 56 | 66 | 2500 OVERLAP |
| | 4 | 6 | 32 | 40 | 3500-4000 |
| 4 | 4 | 6 | 56 | 66 | RECORD LENGTH |

ALL TIMES IN MILLISECONDS ALL FREQUENCIES IN HERTZ
FILTERS INTERPOLATED LINEARLY BETWEEN APPLICATION TIMES
APPLICATION TIMES INTERPOLATED LINEARLY BETWEEN SHOTPOINTS
*OPERATOR LENGTH GIVEN IS ACTIVE LENGTH ADD GAP FOR TOTAL LENGTH

SAMPLE RATE: 4MS: DATUM CORRECTION: 13 MS

SCALES: HORIZONTAL 24 TR/IN VERTICAL 2.5 IN/SEC

RECORDING POLARITY: NEG. VALUE EQUALS PRESSURE INCREASE

PROCESSING POLARITY: POSITIVE NO. GIVES BLACK PEAK

**Enclosure Line 4**

T/16P Part 6

216132

5 cm

OR-202

④

| 249 | |
|---|---|
| VRMS | |
| 1490 | |
| 1490 | |
| 2100 | |
| 2500 | |
| 2900 | |
| 4020 | |
| 5140 | |

| SP 329 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 100 | 1490 |
| 600 | 2100 |
| 1400 | 2740 |
| 2250 | 3380 |
| 3100 | 4340 |
| 4000 | 5140 |

| SP 409 | |
|---|---|
| TIME | VRMS |
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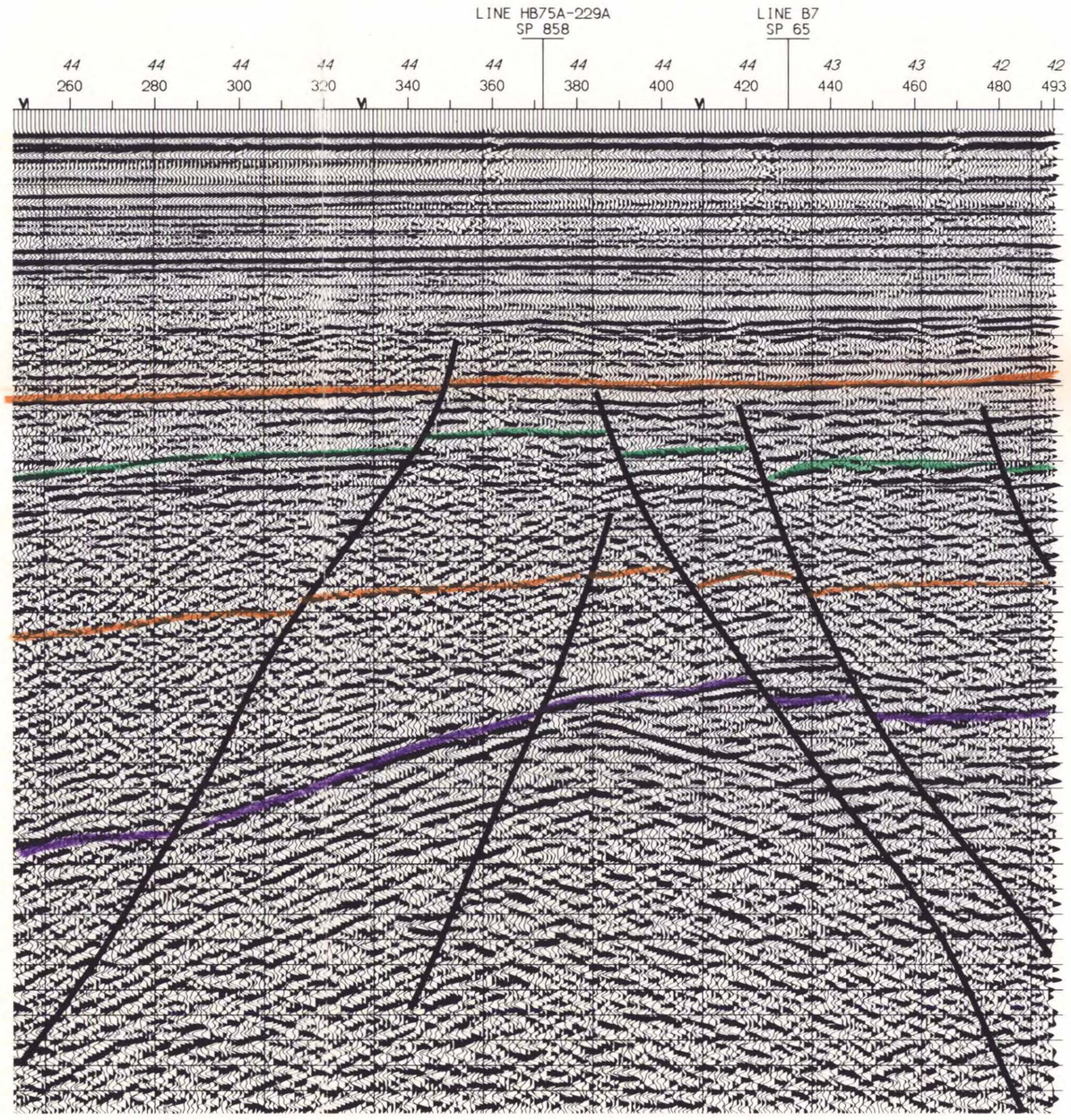
| 800 | 2100 |
| 1600 | 2660 |
| 2500 | 3380 |
| 3200 | 4500 |
| 4000 | 5140 |

# CHAT




Eastern View Coal Measures (Unconformity)

Paleocene L. balmei* (Unconformity)

"Y"

Intra-Upper Cretaceous* Unconformity

LINE WB82-28
S.P. 1-497
N.E.
DIRECTION OF SHOOTING

AGC-STACK

**T-15-P**

**WEAVER OIL & GAS**
**BASS BASIN**
**PERMIT T-15-P**

GeoCenter
Houston Texas

DATE PROCESSED MAY 1982
REEL NUMBER 2704
CONTRACT NUMBER 4805

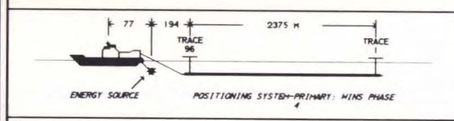
## FIELD RECORDING

RECORDED BY WESTERN GEOPHYSICAL
DATE FEBRUARY 1982 SYSTEM DFSV
FORMAT SEG B GAIN 36 DB

ENERGY SOURCE
TYPE AIR GUNS 760 CU. INS. 4500 PSI.
ARRAY 10 GUNS DEPTH 6 METERS

STREAMER
LENGTH 2375 METERS NO. TRACES 96
DEPTH 40FT GROUP INTERVAL 25 METERS
ARRAY 20 GEOPH/TR OVER 25 METERS

PARAMETERS
RECORDING FOLD 4800% S.P. SPACING 25 METERS
SAMPLE INTERVAL 2 MS RECORD LENGTH 5 SECONDS
RECORDING FILTER OUT - 128HZ @ 70DB/OCTAVE




## DIGITAL PROCESSING

| SEQ | PROCESS | PARAMETERS |
|---|---|---|
| 1 | DEMULTIPLEX | BINARY GAIN RECOVERY OUTPUT 4 MS |
| 2 | GAIN | AMPLITUDE RECOVERY |
| 3 | CDP TRACE GATHER | 4800%/ADJACENT TRACE SUM |
| 4 | PRE-FILTER | SEE BELOW |
| 5 | DECONVOLUTION | SEE BELOW |
| 6 | VELOCITY ANALYSIS | CONSTANT VELOCITY STACK OVER 6 CDPS |
| 7 | NMO, MUTE | NORMAL MOVEOUT MUTE APPLICATION |
| 8 | CDP STACK | 4800% |
| 9 | FILTER | SEE BELOW |
| 10 | EQUALIZATION | DATA DEPENDENT |

ADDITIONAL PARAMETERS

| DECON | * OPERATOR LENGTH | PREDICTIVE GAP | DERIVATION WINDOWS | APPLICATION WINDOWS |
|---|---|---|---|---|
| 5 | 160 | 32 | 0 TO 3500 | RECORD LENGTH |

APPLICATION TIMES

| FILTER | CUT OFF POINT | 6 DB POINT | 6 DB POINT | CUT OFF POINT | APPLICATION TIMES FOR SHOTPOINTS SPECIFIED | | |
|---|---|---|---|---|---|---|---|
| 9 | 12 | 15 | 56 | 66 | 2500 OVERLAP | | |
| | 4 | 6 | 32 | 40 | 0-1000 | | |
| | | | | | 3500-4000 | | |
| 4 | 4 | 6 | 56 | 66 | RECORD LENGTH | | |

ALL TIMES IN MILLISECONDS ALL FREQUENCIES IN HERTZ
FILTERS INTERPOLATED LINEARLY BETWEEN APPLICATION TIMES
APPLICATION TIMES INTERPOLATED LINEARLY BETWEEN SHOTPOINTS
*OPERATOR LENGTH GIVEN IS ACTIVE LENGTH ADD GAP FOR TOTAL LENGTH

SAMPLE RATE: 4MS: DATUM CORRECTION: 13 MS
SCALES: HORIZONTAL 24 TR/IN VERTICAL 2.5 IN/SEC
RECORDING POLARITY: NEG. VALUE EQUALS PRESSURE INCREASE
PROCESSING POLARITY: POSITIVE NO.GIVES BLACK PEAK

**Enclosure Line 5**

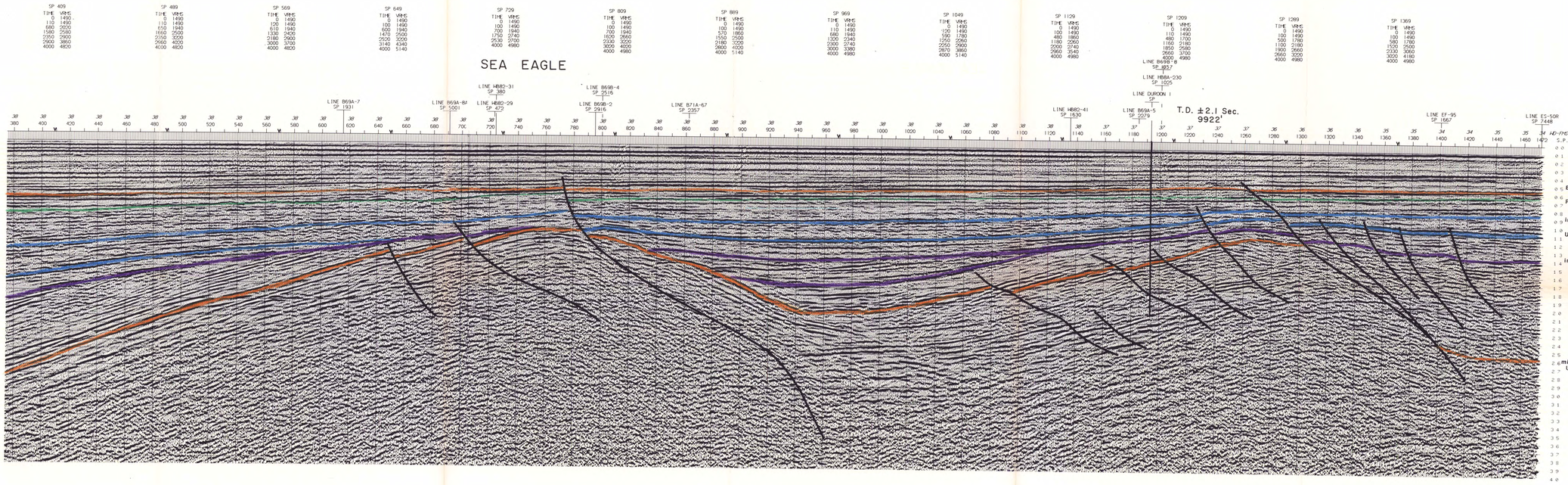
T/16P Part 6

216133

5 cm

OR-202

(5)




LINE WB82-32
S.P. 1-1476
S.E.
DIRECTION OF SHOOTING

AGC-STACK

T-15-P

WEAVER OIL & GAS
BASS BASIN
PERMIT T-16-P

GeoCenter

DATE PROCESSED FEB. 1982
REEL NUMBER 8358
CONTRACT NUMBER 4805

## FIELD RECORDING

RECORDED BY WESTERN GEOPHYSICAL
DATE FEBRUARY 1982 SYSTEM DFDV
FORMAT SEG B GAIN 36 DB

ENERGY SOURCE
TYPE AIR GUNS 760 CU. INS. 4500 PSI
ARRAY 12 GUNS DEPTH 6 METERS

STREAMER
LENGTH 2375 METERS NO. TRACES 96
DEPTH 40 FT GROUP INTERVAL 25 METERS
ARRAY 2D GEOPHYSTR OVER 25 METERS

PARAMETERS
RECORDING FOLD 4800% S.P. SPACING 25 METERS
SAMPLE INTERVAL 2 MS RECORD LENGTH 5 SECONDS
RECORDING FILTER OUT - 12BHZ @ 72DB/OCTAVE




## DIGITAL PROCESSING

| SEQ | PROCESS | PARAMETERS |
|---|---|---|
| 1 | DEMULTIPLEX | DEMUX WITH REFORMAT, OUTPUT 4 MS |
| 2 | GAIN | APPLY TIME RECOVERY |
| 3 | CDP TRACE GATHER | MIDPOINT/OFFSET TRACE SUM |
| 4 | PRE-FILTER | SEE BELOW |
| 5 | DECONVOLUTION | SEE BELOW |
| 6 | VELOCITY ANALYSIS | CONSTANT VELOCITY STACK OVER 9 COPS |
| 7 | RESIDUALS | STATIC, MOVEOUT, AND APPLICATION |
| 8 | CDP STACK | NORMAL |
| 9 | FILTER | SEE BELOW |
| 10 | EQUALIZATION | DATA DEPENDENT |

| DECON | OPERATOR LENGTH (MS) | PREDICTION GAP | DECOLUTION FACTOR (%) | APPLICATION WINDOW RECORD LENGTH |
|---|---|---|---|---|
| 5 | 180 | 30 | 0.1% 3000 | 2.5 3.0 3.5 4.0 |

| FILTER | CUT OFF (HZ) LOW | CUT OFF (HZ) HIGH | SLOPE LOW (DB/OCT) | SLOPE HIGH (DB/OCT) | CUT OFF (HZ) NOTCH | APPLICATION TIMES FOR SHOTPOINTS SPECIFIED |
|---|---|---|---|---|---|---|
| 9 | 10 | 15 | 18 | 36 | 50 (ON) | 3.5 4.0 |
| | 8 | 12 | 18 | 36 | 50 (ON) | |
| 4 | 4 | 8 | 18 | 36 | RECORD LENGTH | |

ALL TIMES ON FOLLOWING ALL PARAMETERS IN MSEC
FILTERS INTERPOLATED LINEARLY BETWEEN APPLICATION TIMES
ROTATION TIMES INTERPOLATED LINEARLY BETWEEN SHOTPOINTS
*OPERATOR LENGTH IS ACTIVE LENGTH, ADD GAP FOR TOTAL LENGTH

SAMPLE RATE: 4MS; DATUM CORRECTION: 13 MS

SCALES: HORIZONTAL 24 TR/IN VERTICAL 2.5 IN/SEC

RECORDING POLARITY: NEG. VALUE EQUALS PRESSURE INCREASE

PROCESSING POLARITY: POSITIVE NO.GIVES BLACK PEAK

Enclosure Line 6
Tile Pan 6

5 cm

OR-202

216134

216235

SP 649 TIME VRMS 0 1490 100 1490 600 1940 1470 2600 2520 3220 3140 4340 4000 5140

SP 729 TIME VRMS 0 1490 100 1490 700 1940 1750 2740 2530 3700 4000 4980

SP 809 TIME VRMS 0 1490 100 1490 700 1940 1620 2660 2330 3550 3020 4020 4000 4980

SP 889 TIME VRMS 0 1490 100 1490 570 1860 1550 2500 2180 3200 2800 4020 4000 5140

SP 969 TIME VRMS 0 1490 110 1490 680 1940 1300 2340 2300 2740 3000 3380 4000 4980

SP 1049 TIME VRMS 0 1490 100 1490 590 1780 1250 2060 2250 2900 2870 3860 4000 5140

SP 1129 TIME VRMS 0 1490 100 1490 480 1860 1180 2260 2000 2740 2960 3540 4000 4980

SP 1209 TIME VRMS 0 1490 110 1490 480 1700 1160 2180 1850 2580 2660 3700 4000 4980

SP 1289 TIME VRMS 0 1490 100 1490 500 1780 1100 2180 1900 2660 2660 3520 4000 4980

SP 1369 TIME VRMS 0 1490 100 1490 580 1780 1550 2500 2330 3060 3050 4180 4000 4980

# SEA EAGLE

LINE B69A-7 SP 1931
LINE B69A-8A SP 5051
LINE WB82-29 SP 472
LINE WB82-31 SP 380
LINE B69B-4 SP 2516
LINE B69B-2 SP 2916
LINE B71A-67 SP 2357
LINE WB82-41 SP 1630
LINE B69B SP 1857
LINE B68A-230 SP 1025
LINE DUROON 1 SP
LINE B69A-5 SP 2279
T.D. ±2.1 Sec. 9922'
LINE EF-95 SP 1667
LINE ES-50R SP 7448

HD-FMS S.P. 600 620 640 660 680 700 720 740 760 780 800 820 840 860 880 900 920 940 960 980 1000 1020 1040 1060 1080 1100 1120 1140 1160 1180 1200 1220 1240 1260 1280 1300 1320 1340 1360 1380 1400 1420 1440 1460 1472 S.P. HD-FMS

Eastern View Coal Measures (Unconformity)

Paleocene L. balmei* (Unconformity)

intra-Upper Cretaceous* Unconformity

mid-Cretaceous* Unconformity

LINE WB82-32
S.P. 600-1472
S.E.
DIRECTION OF SHOOTING

MIGRATION

WEAVER OIL & GAS
BASS BASIN
PERMIT T-16-P

T-15-P

GeoCenter Houston, Texas

DATE PROCESSED MAY 1982
REEL NUMBER 7138
CONTRACT NUMBER 4887

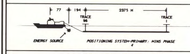
## FIELD RECORDING

RECORDED BY HEWTERN GEOPHYSICAL
DATE FEBRUARY 1982 SYSTEM DFSV
FORMAT SEG B GAIN 36 DB

ENERGY SOURCE
TYPE AIR GUNS 760 CU. INS. 4500 PSI
ARRAY 10 GUNS DEPTH 6 METERS

STREAMER
LENGTH 2375 METERS NO. TRACES 96
DEPTH 40 FT. GROUP INTERVAL 25 METERS
ARRAY 20 GEOPH/TR OVER 25 METERS

PARAMETERS
RECORDING FOLD 4800% S.P. SPACING 25 METERS
SAMPLE INTERVAL 2 MS RECORD LENGTH 5 SECONDS
RECORDING FILTER OUT - 128HZ @ 72DB/OCTAVE




## DIGITAL PROCESSING

| SEQ | PROCESS | PARAMETERS |
|---|---|---|
| 1 | DEMULTIPLEX | BINARY DATA RECORDED OUTPUT 4 MS |
| 2 | GAIN | AMPLITUDE RECOVERY |
| 3 | CDP TRACE GATHER | MERGE/SEQUENCE TRACE SUM |
| 4 | PRE-FILTER | SEE BELOW |
| 5 | DECONVOLUTION | SEE BELOW |
| 6 | VELOCITY ANALYSIS | CONSTANT VELOCITY STACK (NMO & DIPS) |
| 7 | NMO/MUTE | NORMAL MOVEOUT MUTE APPLICATION |
| 8 | CDP STACK | MIXING |
| 9 | FILTER | SEE BELOW |
| 10 | EQUALIZATION | DATA DEPENDENT |
| 11 | MIGRATION | TIME MIGRATION |
| 12 | FILTER | SEE BELOW |
| 13 | EQUALIZATION | DATA DEPENDENT |

| DECON | # OPERATOR LENGTH | PREDICTIVE GAP | DESIGN GATE | APPLICATION GATES |
|---|---|---|---|---|
| 5 | 160 | 32 | 0 TO 2000 | RECORD LENGTH |

| FILTER | CUT OFF FREQ. | % FREQ. POINT | % AMP. POINT | CUT OFF AMP. | APPLICATION GATES FOR SHOTPOINTS SPECIFIED |
|---|---|---|---|---|---|
| 12 | 13 | 15 | 98 | 88 | 0-1000 |
| | 4 | 8 | 92 | 42 | 1000-4000 |
| 4 | 4 | 8 | 98 | 88 | RECORD LENGTH |
| 9 | 4 | 8 | 98 | 88 | RECORD LENGTH |

ALL TIMES IN MILLISECONDS ALL FREQUENCIES IN HERTZ
FILTERS INTERPOLATED LINEARLY BETWEEN APPLICATION TIMES
APPLICATION GATES ARE CENTERED ON THE OUTPUT SAMPLE TIME
*OPERATOR LENGTH EITHER 1/2 ACTIVE LENGTH AND CUT OFF FOR TOTAL LENGTH

SAMPLE RATE: 4MS; DATUM CORRECTION: 13 MS

SCALES: HORIZONTAL 24 TR/IN VERTICAL 2.5 IN/SEC

RECORDING POLARITY: NEG. VALUE EQUALS PRESSURE INCREASE

PROCESSING POLARITY: POSITIVE NO.GIVES BLACK PEAK

**Enclosure Line 7**

5 cm

T/LP Part 6
OR 202

| SP 329 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 120 | 1490 |
| 780 | 2020 |
| 1580 | 2580 |
| 2580 | 3380 |
| 3200 | 4340 |
| 4000 | 5140 |

| SP 409 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 120 | 1490 |
| 480 | 1940 |
| 1120 | 2420 |
| 1920 | 2820 |
| 2680 | 3700 |
| 3330 | 4340 |
| 4000 | 4980 |

| SP 489 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 130 | 1490 |
| 760 | 2020 |
| 1850 | 2740 |
| 2730 | 3540 |
| 4000 | 4980 |

| SP 569 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 120 | 1490 |
| 930 | 2020 |
| 1720 | 2580 |
| 2800 | 3540 |
| 4000 | 5140 |

| SP 649 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 130 | 1490 |
| 950 | 1860 |
| 1820 | 2500 |
| 2430 | 2820 |
| 3200 | 3860 |
| 4000 | 4980 |

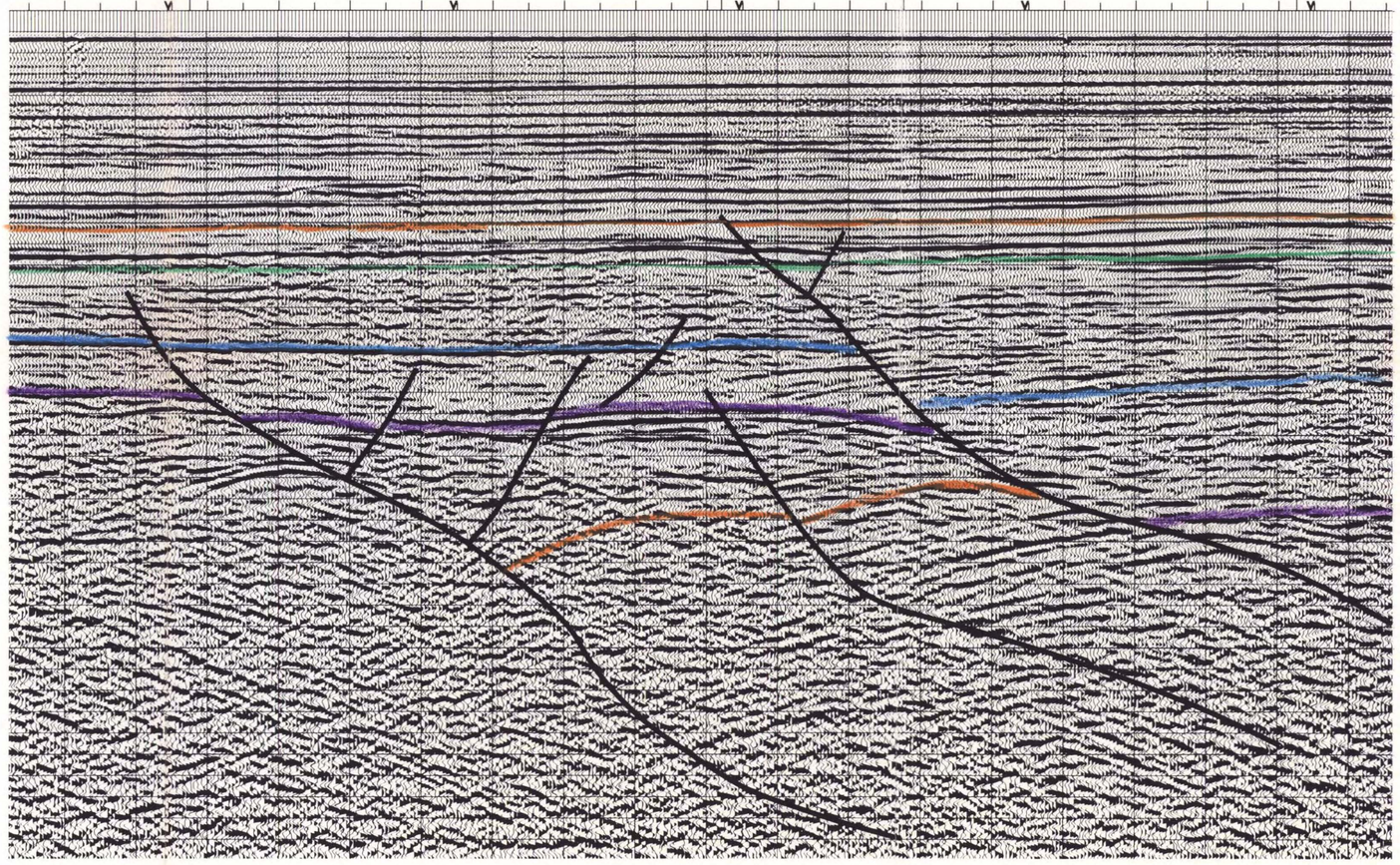
# A-4

LINE WB82-33
S.P. 1-2684
EAST
DIRECTION OF SHOOTING

AGC-STACK

LINE B69A-9 SP 800
LINE WB81-22 SP 1235
LINE B69A-4 SP 3810
LINE WB82-45 SP 380
LINE ES-69B SP 7530
LINE WB82-44 SP 587

42 41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 40 40 WD-FMS
300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600 620 640 660 0 S.P.



Eastern View Coal Measures (Unconformity)

Paleocene L. balmei* (Unconformity)

Upper-Cretaceous*

intra-Upper Cretaceous* Unconformity

mid-Cretaceous* Unconformity

**T-15-P**

**WEAVER OIL & GAS**
**BASS BASIN**
**PERMIT T-15-P**

GeoCenter
Houston, Texas

DATE PROCESSED MAY 1982
REEL NUMBER 1010
CONTRACT NUMBER 4805

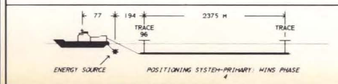
## FIELD RECORDING

RECORDED BY WESTERN GEOPHYSICAL
DATE FEBRUARY 1982 SYSTEM DFSV
FORMAT SEG B GAIN 36 DB

ENERGY SOURCE
TYPE AIR GUNS 760 CU. INS. 4500 PSI.
ARRAY 10 GUNS DEPTH 6 METERS

STREAMER
LENGTH 2375 METERS NO. TRACES 96
DEPTH 40 FT GROUP INTERVAL 25 METERS
ARRAY 20 GEOPH/TR OVER 25 METERS

PARAMETERS
RECORDING FOLD 4800% S.P.SPACING 25 METERS
SAMPLE INTERVAL 2 MS RECORD LENGTH 5 SECONDS
RECORDING FILTER OUT - 128HZ @ 70DB/OCTAVE




## DIGITAL PROCESSING

| SEQ | PROCESS | PARAMETERS |
|---|---|---|
| 1 | DEMULTIPLEX | BINARY GAIN RECOVERY OUTPUT 4 MS |
| 2 | GAIN | AMPLITUDE RECOVERY |
| 3 | CDP TRACE GATHER | 4800%/ADJACENT TRACE SUM |
| 4 | PRE-FILTER | SEE BELOW |
| 5 | DECONVOLUTION | SEE BELOW |
| 6 | VELOCITY ANALYSIS | CONSTANT VELOCITY STACK OVER 6 CDPS |
| 7 | NMO, MUTE | NORMAL MOVEOUT MUTE APPLICATION |
| 8 | CDP STACK | 4800% |
| 9 | FILTER | SEE BELOW |
| 10 | EQUALIZATION | DATA DEPENDENT |

| DECON | * OPERATOR LENGTH | PREDICTIVE GAP | DERIVATION WINDOWS | APPLICATION WINDOWS | |
|---|---|---|---|---|---|
| 5 | 160 | 32 | 0 TO 3500 | RECORD LENGTH | PREDICTIVE DECONVOLUTION |

| FILTER | CUT OFF POINT | 6 DB POINT | 6 DB POINT | CUT OFF POINT | APPLICATION TIMES FOR SHOTPOINTS SPECIFIED | | | |
|---|---|---|---|---|---|---|---|---|
| 9 | 12 | 15 | 56 | 66 | 2500 OVERLAP | | | |
| | 4 | 6 | 32 | 40 | 3500-4000 | | | |
| 4 | 4 | 6 | 56 | 66 | RECORD LENGTH | | | |

ALL TIMES IN MILLISECONDS ALL FREQUENCIES IN HERTZ
FILTERS INTERPOLATED LINEARLY BETWEEN APPLICATION TIMES
APPLICATION TIMES INTERPOLATED LINEARLY BETWEEN SHOTPOINTS
*OPERATOR LENGTH GIVEN IS ACTIVE LENGTH ADD GAP FOR TOTAL LENGTH

SAMPLE RATE: 4MS; DATUM CORRECTION: 13 MS
SCALES: HORIZONTAL 24 TR/IN VERTICAL 2.5 IN/SEC
RECORDING POLARITY: NEG. VALUE EQUALS PRESSURE INCREASE
PROCESSING POLARITY: POSITIVE NO. GIVES BLACK PEAK

**Enclosure Line 8**

THBP Plate 6

5 cm

OR - 202

216136

(6)

216137

| SP 649 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 100 | 1490 |
| 800 | 2020 |
| 1210 | 2260 |
| 1700 | 2660 |
| 2120 | 3060 |
| 2750 | 4020 |
| 4000 | 4820 |

| SP 729 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 100 | 1490 |
| 310 | 1670 |
| 1030 | 2180 |
| 1560 | 2500 |
| 2120 | 3220 |
| 2730 | 4340 |
| 4000 | 4840 |

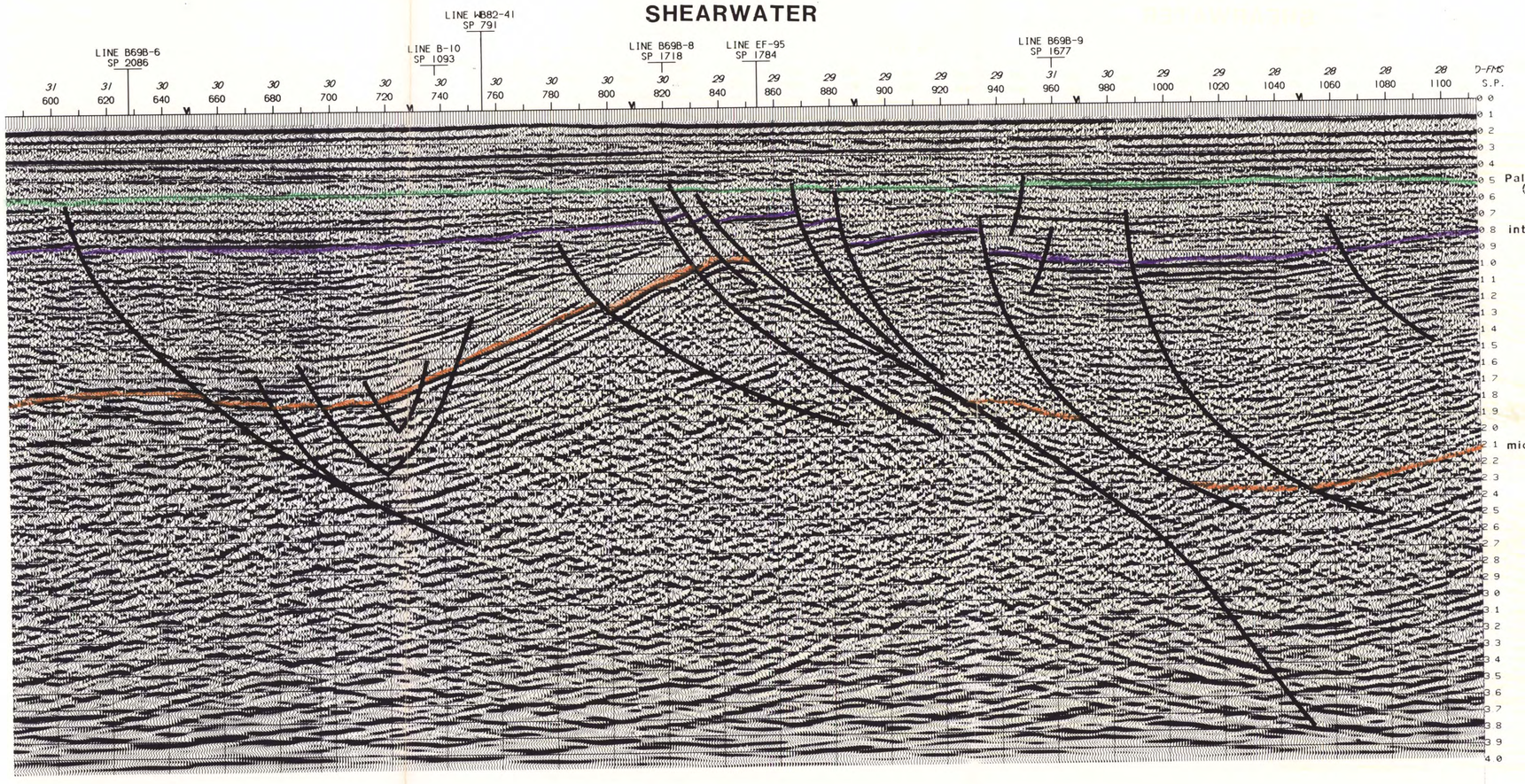
| SP 809 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 80 | 1490 |
| 300 | 1640 |
| 700 | 1860 |
| 1100 | 2180 |
| 1620 | 2740 |
| 2220 | 3540 |
| 4000 | 4980 |

| SP 889 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 90 | 1490 |
| 300 | 1640 |
| 820 | 2100 |
| 1350 | 2420 |
| 1850 | 2740 |
| 2630 | 3700 |
| 4000 | 4820 |

| SP 969 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 80 | 1490 |
| 450 | 1780 |
| 1000 | 2180 |
| 1550 | 2500 |
| 2030 | 2820 |
| 2630 | 3700 |
| 4000 | 4820 |

| SP 1049 | |
|---|---|
| TIME | VRMS |
| 0 | 1490 |
| 80 | 1490 |
| 350 | 1670 |
| 600 | 1860 |
| 1030 | 2180 |
| 1550 | 2660 |
| 1930 | 3060 |
| 2630 | 3860 |
| 4000 | 4820 |

# SHEARWATER




LINE WB82-36
S.P. 1-1535
N.E.
DIRECTION OF SHOOTING

MIGRATION

**T-15-P**

**WEAVER OIL & GAS**
**BASS BASIN**
**PERMIT T-15-P**

GeoCenter
Houston Texas

DATE PROCESSED MAY 1982
REEL NUMBER 2345
CONTRACT NUMBER 4887

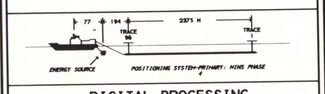
## FIELD RECORDING

RECORDED BY WESTERN GEOPHYSICAL
DATE FEBRUARY 1982 SYSTEM DFSV
FORMAT SEG B GAIN 36 DB

ENERGY SOURCE
TYPE AIR GUNS 760 CU. INS. 4500 PSI.
ARRAY 10 GUNS DEPTH 6 METERS

STREAMER
LENGTH 2375 METERS NO. TRACES 96
DEPTH 40 FT. GROUP INTERVAL 25 METERS
ARRAY 20 GEOPH/TR OVER 25 METERS

PARAMETERS
RECORDING FOLD 4800% S.P. SPACING 25 METERS
SAMPLE INTERVAL 2 MS RECORD LENGTH 5 SECONDS
RECORDING FILTER OUT - 128HZ @ 70DB/OCTAVE




## DIGITAL PROCESSING

| SEQ | PROCESS | PARAMETERS |
|---|---|---|
| 1 | DEMULTIPLEX | BINARY GAIN RECOVERY OUTPUT 4 MS |
| 2 | GAIN | AMPLITUDE RECOVERY |
| 3 | CDP TRACE GATHER | 4800%/ADJACENT TRACE SUM |
| 4 | PRE-FILTER | SEE BELOW |
| 5 | DECONVOLUTION | SEE BELOW |
| 6 | VELOCITY ANALYSIS | CONSTANT VELOCITY STACK OVER 8 CDPS |
| 7 | NMO MUTE | NORMAL MOVEOUT MUTE APPLICATION |
| 8 | CDP STACK | 4800% |
| 9 | FILTER | SEE BELOW |
| 10 | EQUALIZATION | 1000 MS AGC |
| 11 | MIGRATION | WAVE EQUATION |
| 12 | FILTER | SEE BELOW |
| 13 | EQUALIZATION | DATA DEPENDANT |

| DECON | * OPERATOR LENGTH | PREDICTIVE GAP | DERIVATION WINDOWS | APPLICATION WINDOWS |
|---|---|---|---|---|
| 5 | 180 | 30 | 0 TO 3500 | RECORD LENGTH |

| FILTER | CUT OFF POINT | 6 DB POINT | 6 DB POINT | CUT OFF POINT | APPLICATION TIMES FOR SHOTPOINTS SPECIFIED 2500 OVERLAP |
|---|---|---|---|---|---|
| 12 | 10 | 15 | 56 | 68 | 0-1000 |
| | 4 | 6 | 32 | 40 | 3500-4000 |
| 4 | 4 | 6 | 56 | 68 | RECORD LENGTH |
| 9 | 4 | 6 | 56 | 68 | RECORD LENGTH |

ALL TIMES IN MILLISECONDS ALL FREQUENCIES IN HERTZ
FILTERS INTERPOLATED LINEARLY BETWEEN APPLICATION TIMES
APPLICATION TIMES INTERPOLATED LINEARLY BETWEEN SHOTPOINTS
*OPERATOR LENGTH GIVEN IS ACTIVE LENGTH ADD GAP FOR TOTAL LENGTH

SAMPLE RATE: 4MS: DATUM CORRECTION: 13 MS

SCALES: HORIZONTAL 24 TR/IN VERTICAL 2.5 IN/SEC

RECORDING POLARITY: NEG. VALUE EQUALS PRESSURE INCREASE

PROCESSING POLARITY: POSITIVE NO. GIVES BLACK PEAK

**Enclosure Line 9**

T/16 P Pt 6
OR - 202

5 cm

LINE B71A-65 HORIZONTAL SCALE : 1 TRACE = 50 METRES

SCALE RATIO = 2·8 I AT 1·5 SEC.

A

NE

DCN BEFORE STACK
24 FOLD STACK/TVD
TVF 15 - 60Hz. 200ms.
10 - 40Hz. 1500ms.
8 - 32Hz. 3000ms.

ES 66-68R B71A-17 | B71A-64 | B71A-18

292 3298 3304 3310 3316 3322 3328 3334 3340 3346 3352 3358 3364 3370 3376 3382 3388 3394 3400 3406 3412 3417

WATER DEPTHS

VELOCITIES

Eastern View Coal Measures (Unconformity)

Paleocene L. balmei* (Unconformity)

intra-Upper Cretaceous* Unconformity

0·0 0·2 0·4 0·6 0·8 1·0 1·2 1·4 1·6 1·8 2·0 2·2 2·4 2·6 2·8 3·0 3·2 3·4 3·6 3·8 4·0 4·2 4·4

62300 62200 62100 (GAMMAS)

T-15/16-P

GEOPHYSICAL SERVICE INTERNATIONAL
DIGITAL PROCESSING CENTRE
SYDNEY, NSW, AUST.

ESSO AUSTRALIA LIMITED

AREA BASS BASIN LINE B71A-65
RECORDING PARAMETERS: SP 3172 to 3417
Source Air Gun 1300 cu.in., 23 guns, tuned array
Array size 4 pops/SP. Shot off group 48 No. of groups 48
Cable length (centre of gp 1 to centre of gp. 48) 7708 ft.
Offset (array centre to centre of group 48) ±940 ft.
Group interval 164 ft SP interval 656 ft.
30 geophones/group Field polarity first break Negative
Recording system DFS-III Filter 8 to 62 Hz.
Recording length 5·0 sec Sample rate 4 ms
G.S.I. Field crew 909 Date Dec. 1971

VES 1 NMO 4 AR2 — TVD — TVS 3 DCN 2 DPS 5 TVD 6 DCN — DGF — TVF 7 700 Pkg ■

PROCESSING DATA
Groups processed 1-48
TAR B = -17 db α = 3 db/sec.
Vertical stack Odd/Even
Decon before stack DCN 62 pts. 4 ms. No. of gates/trace 1
Design gate (trace A) 2200 to 4650 ms Gate shift -80 ms/trace
Decon after stack TVD 64 pts. 4 ms. No. of gates/trace 2
Design gate (trace I) 300 to 4500 ms Gate shift 0 ms/trace
Digital filter 35 pts. 4 ms to Hz
Displayed digital AGC Playback gain 7 db
Polarity displayed Positive □ / Negative ■
TIAC REQUEST 1000 Hold tape 6255
INPUT CREW PARTY 107-ESO-2 Date March 1972

Sample period 4 ms
Processed 24 fold
Gate 0 to 4500 ms

DIGITAL BAND PASS FILTERING Hz. 60 50 40 30 20 10 0
RECORD TIME 0·0 1·0 2·0 3·0 4·0 5·0 sec

LINE N DIAGRAM 3417 E
W 3372 S 54°

Enclosure Line 10

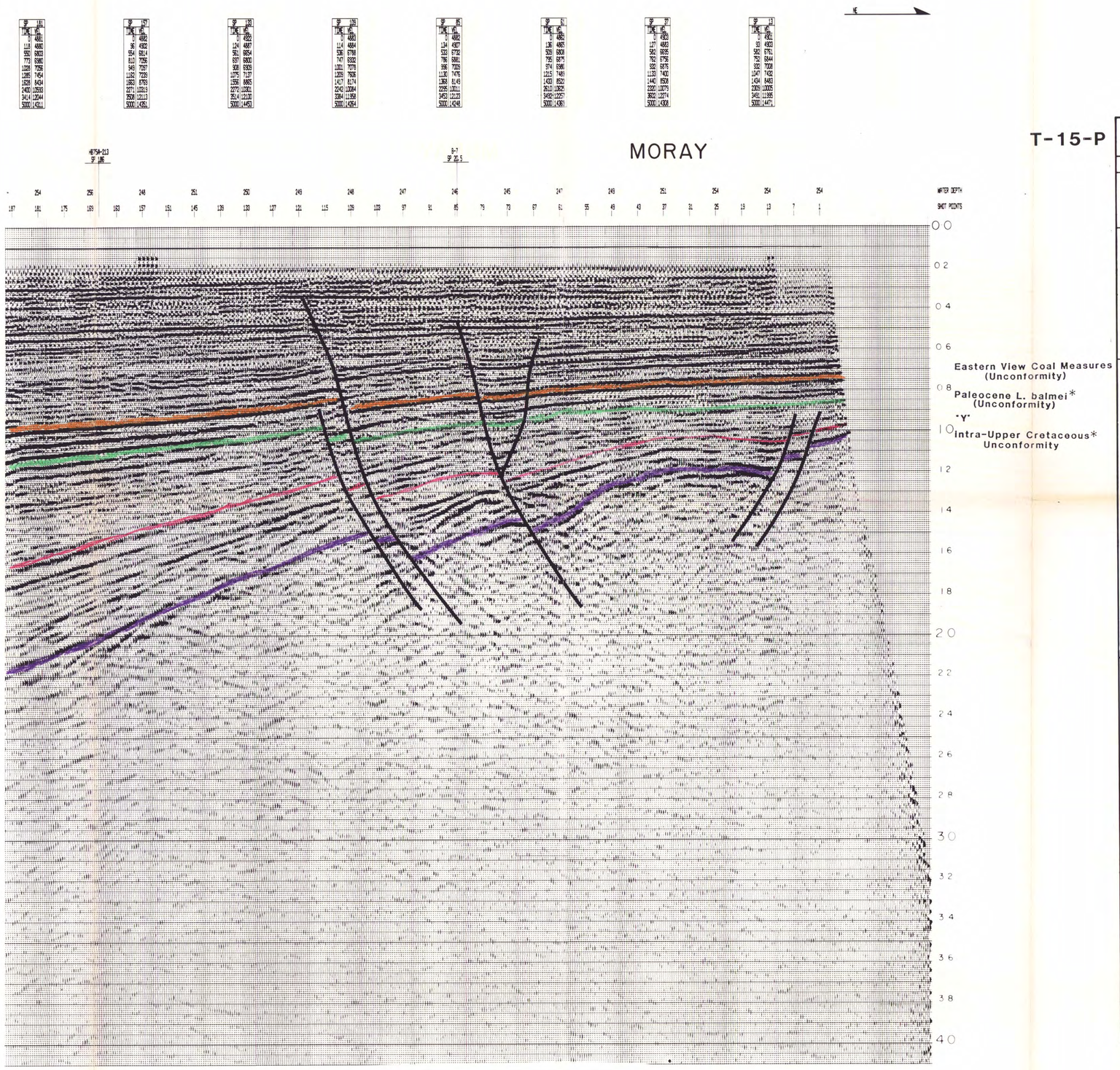
T/L P Part 6

5 cm

OR-202

216138

(10)




T-15-P

# HEMATITE PETROLEUM PTY. LTD.

## HB75A SEISMIC SURVEY

HB75A-211

FIELD DATA: Shot by: GSI Party 931 M.V. McDermott

Recorded: 48 Trace DFS III (2 Systems)
Sample Rate: 4 msecs. Record Length: 5secs.
Filter: HI 62 Hz/72 db/oct, LO 8 Hz/18 db/oct.
Gain: Binary
Energy Source: Airgun, 1200 cub ins
Source Depth: 30-35 ft Streamer Depth: 50-60 ft
Group interval: 219 ft. Shot interval: 73 ft
Streamer: 3200 m, 48 groups, towing group 48
Average Offset to centre of group 48: 969 ft
Date: January '75

LINE 3418 DIAGRAM

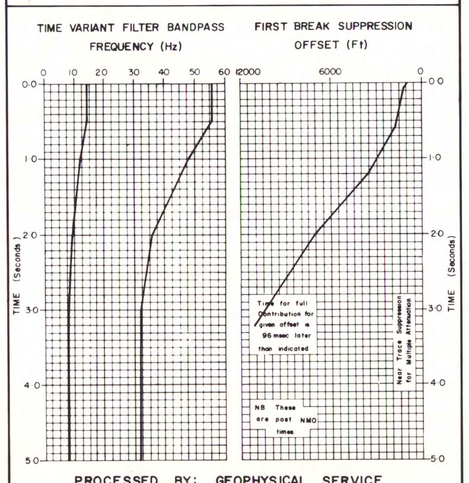
N
W 330 1 E
0032 S Number is block number at end of line.

PROCESSING INFORMATION:

1 True Amplitude Recovery (-12db, 5db/sec. 0-3·5 secs.)
2 Vertical Stack 3:1
3 Deconvolution Before Stack
SP's 1 - 330, 2 Operators/Trace, 64 pts. Gap = 0 msec.

4 24 Fold Common Depthpoint Gather
5 Sealevel Static and Airgun Delay Corrections
6 Preliminary Normal Moveout Corrections
7 Preliminary 24-Fold Stack, 24 Traces.
8 Velocity Analysis:
Continuous 700 Pkg 100m Depth Points
9 Normal Moveout Corrections
10 24 Fold CDP Stack, 48 Traces
11 Deconvolution After Stack, 2 Operators/Trace, 70 pts. Gap = 0 msec.
12 Time Variant Filter
13 Cross Record Mix on T.V.F. Section
Weighted mix over, 3 Traces
Contributions = 10%, 80%, 10%.

14 Display Normal Polarity, 10 traces/cm. (0·53 miles/inch) Horizontal Scale
3·75 ins/sec. Vertical Scale




PROCESSED BY: GEOPHYSICAL SERVICE INTERNATIONAL, SYDNEY.
DATE APRIL 1975

5 cm

216139

Enclosure Line 11

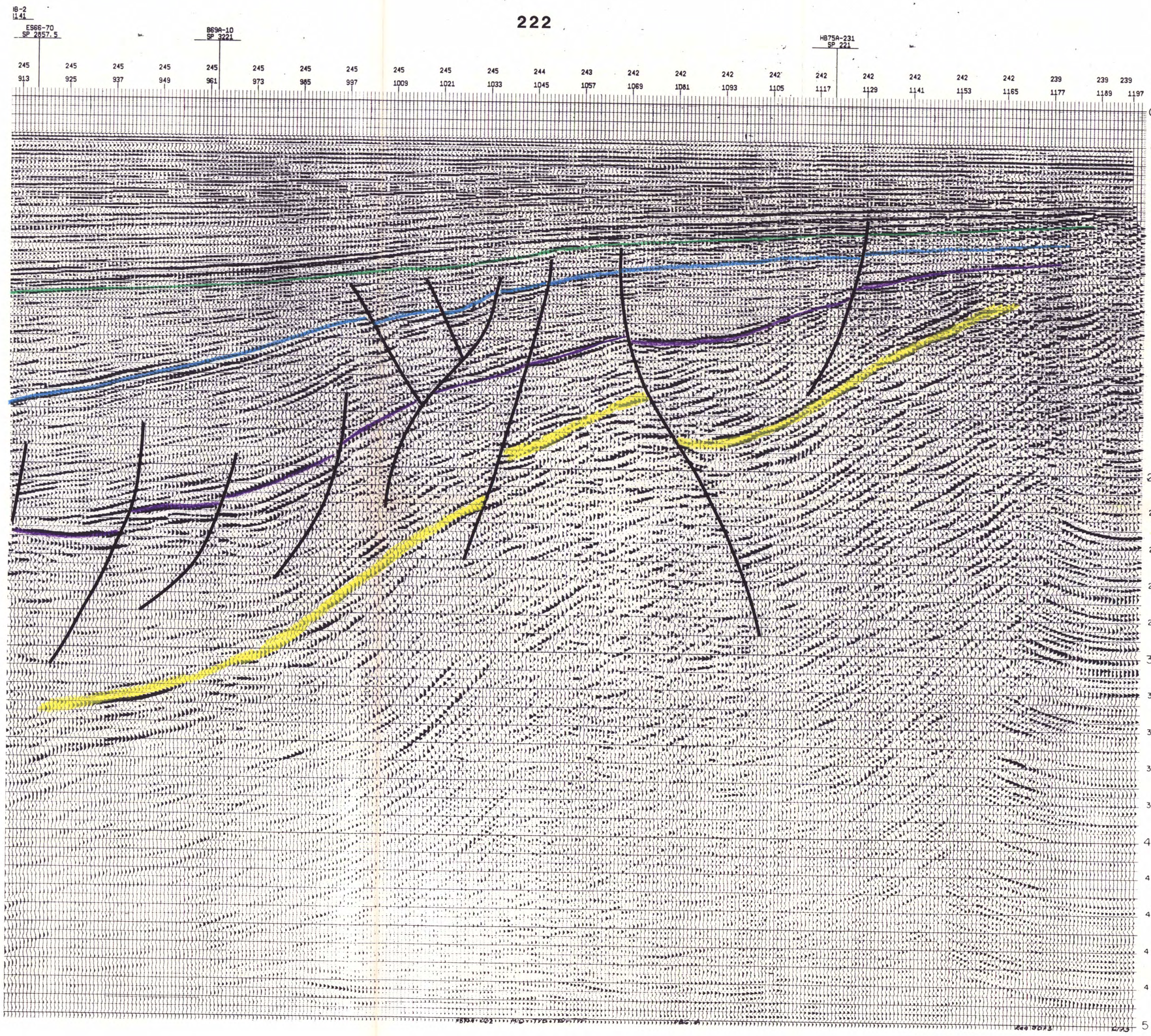
T/16P Part 6

OR-202

(11)

T-15-P

# 222



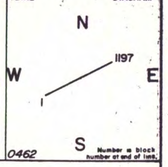

## HEMATITE PETROLEUM PTY. LTD.

**HB75A SEISMIC SURVEY** — **HB75A-222**

FIELD DATA: Shot by GSI Party 931 M.V. McDermott

Recorded: 48 Trace DFS III (2 Systems)
Sample Rate: 4 m secs. Record Length: 5secs.
Filter: HI 62 Hz/72 db/oct, LO 8 Hz/18 db/oct.
Gain: Binary
Energy Source: Airgun, 1200 cub ins
Source Depth: 30-35 ft Streamer Depth: 50-60 ft
Group interval: 219 ft. Shot interval: 73 ft
Streamer: 3200 m, 48 groups, towing group 48
Average Offset to centre of group 48: 872 ft
Date: January '75

LINE DIAGRAM

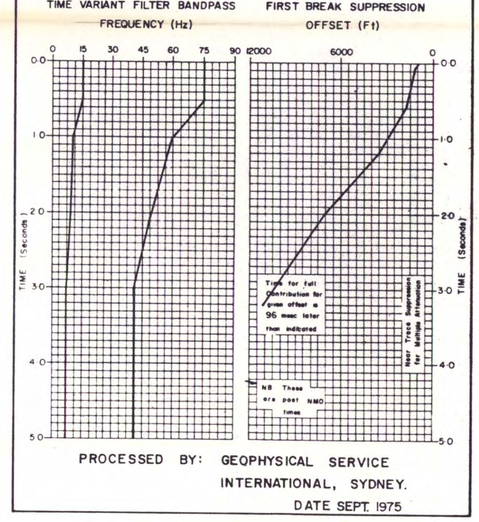



PROCESSING INFORMATION:

1 True Amplitude Recovery (-12 db, 5 db/sec. 0-3·5 secs.)
2 Vertical Stack 3:1
3 Deconvolution Before Stack
SP's 1 - 1197 2 Operators/Trace, 64 pts. Gap = 0 msec.

4 24 Fold Common Depthpoint Gather
5 Sealevel Static and Airgun Delay Corrections
6 Preliminary Normal Moveout Corrections
7 Preliminary 24-Fold Stack, 24 Traces.
8 Velocity Analysis:
Continuous 700 Pkg 100m Depth Points
9 Normal Moveout Corrections
10 24 Fold CDP Stack, 48 Traces
11 2 on 1 Sum of adjacent Traces
12 Migration Stack
13 Time Variant Scaling
14 Deconvolution after Stack 2op./Trace, 64 points. Gap = 0 msec.
15 Time Variant Filter

16 Display Normal Polarity, 5 traces/cm. (0·53 miles/inch) Horizontal Scale 3·75 ins/sec. Vertical Scale -




PROCESSED BY: GEOPHYSICAL SERVICE INTERNATIONAL, SYDNEY.
DATE SEPT. 1975

**Enclosure Line 12**

T/HP Park 6

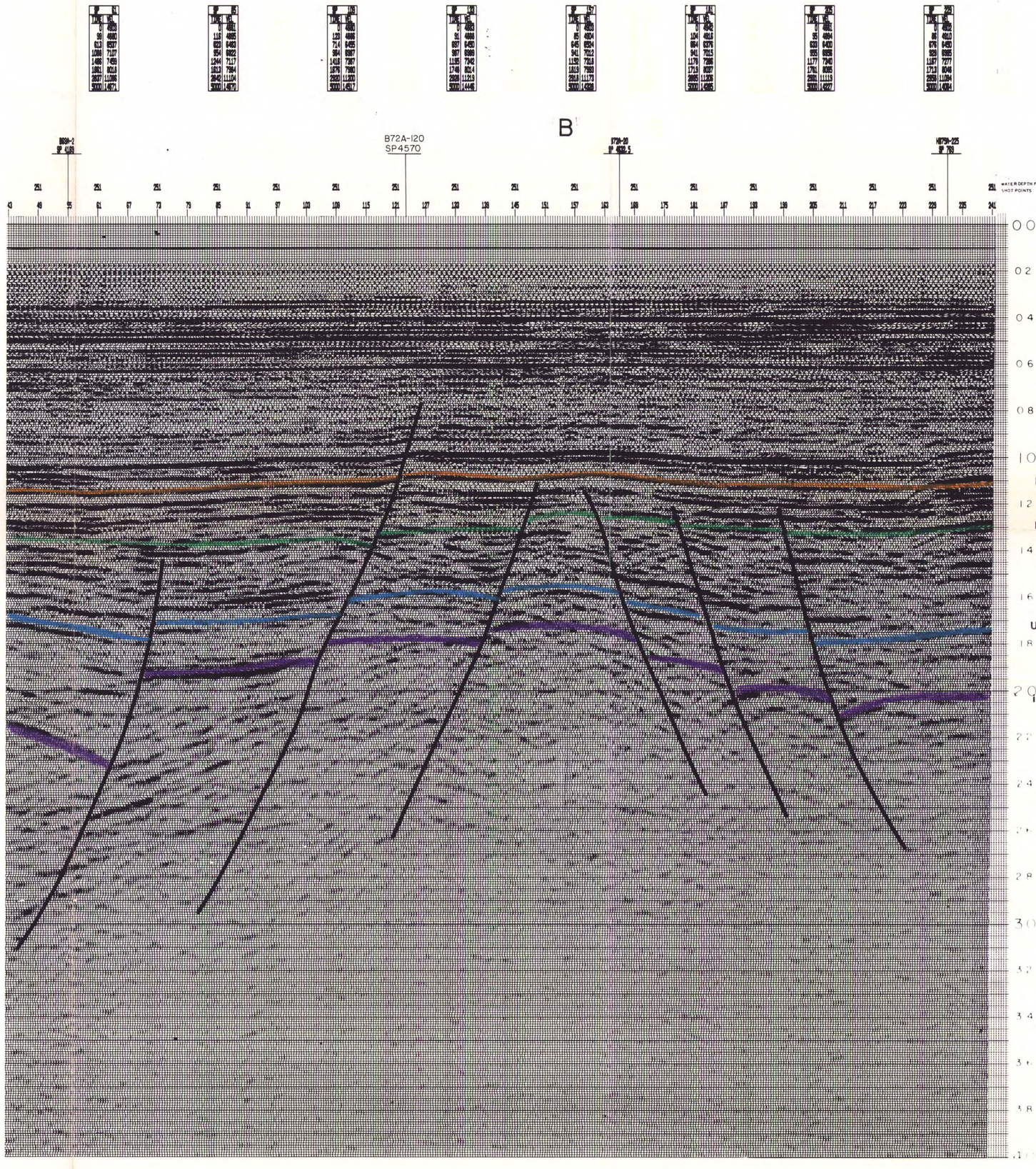
5 cm

OR-202

216140

(12)

T-15-P



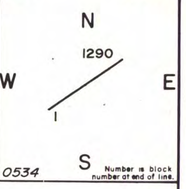

# HEMATITE PETROLEUM PTY. LTD.

| HB75A SEISMIC SURVEY | HB75A-223 |
|---|---|

FIELD DATA: Shot by: GSI Party 931 M.V. McDermott

Recorded: 48 Trace DFS III (2 Systems)
Sample Rate: 4 m secs. Record Length: 5secs.
Filter: HI 62 Hz/ 72 db/oct, LO 8 Hz/ 18 db/oct.
Gain: Binary
Energy Source: Airgun, 1200 cub ins
Source Depth: 30-35 ft Streamer Depth: 50-60ft
Group interval: 219 ft. Shot interval: 73ft
Streamer: 3200 m, 48 groups, towing group 48
Average Offset to centre of group 48: 902 ft
Date: January '75

LINE 0184 DIAGRAM



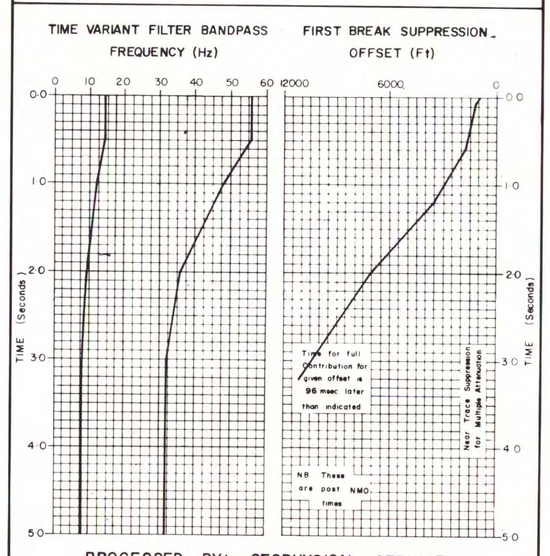

0534 Number is block number at end of line.

PROCESSING INFORMATION:

1 True Amplitude Recovery (-12db, 5db/sec. 0-3·5 secs.)
2 Vertical Stack 3:1
3 Deconvolution Before Stack
SP's 1 - 1290, 2 Operators/Trace, 64 pts. Gap = 0 msec.

4 24 Fold Common Depthpoint Gather
5 Sealevel Static and Airgun Delay Corrections
6 Preliminary Normal Moveout Corrections
7 Preliminary 24-Fold Stack, 24 Traces.
8 Velocity Analysis:
Continuous 700 Pkg 100m Depth Points
9 Normal Moveout Corrections
10 24 Fold CDP Stack, 48 Traces
11 Deconvolution After Stack, 2 Operators/Trace, 70 pts. Gap = 0 msec.
12 Time Variant Filter
13 Cross Record Mix on T.V.F. Section
Weighted Mix over 3 Traces
Contributions = 10%, 80%, 10%.

14 Display Normal Polarity, 10 traces/cm. (0·53 miles/inch) Horizontal Scale
3·75 ins/sec. Vertical Scale




PROCESSED BY: GEOPHYSICAL SERVICE INTERNATIONAL, SYDNEY.
DATE JUNE 1975

**Enclosure Line B-13**

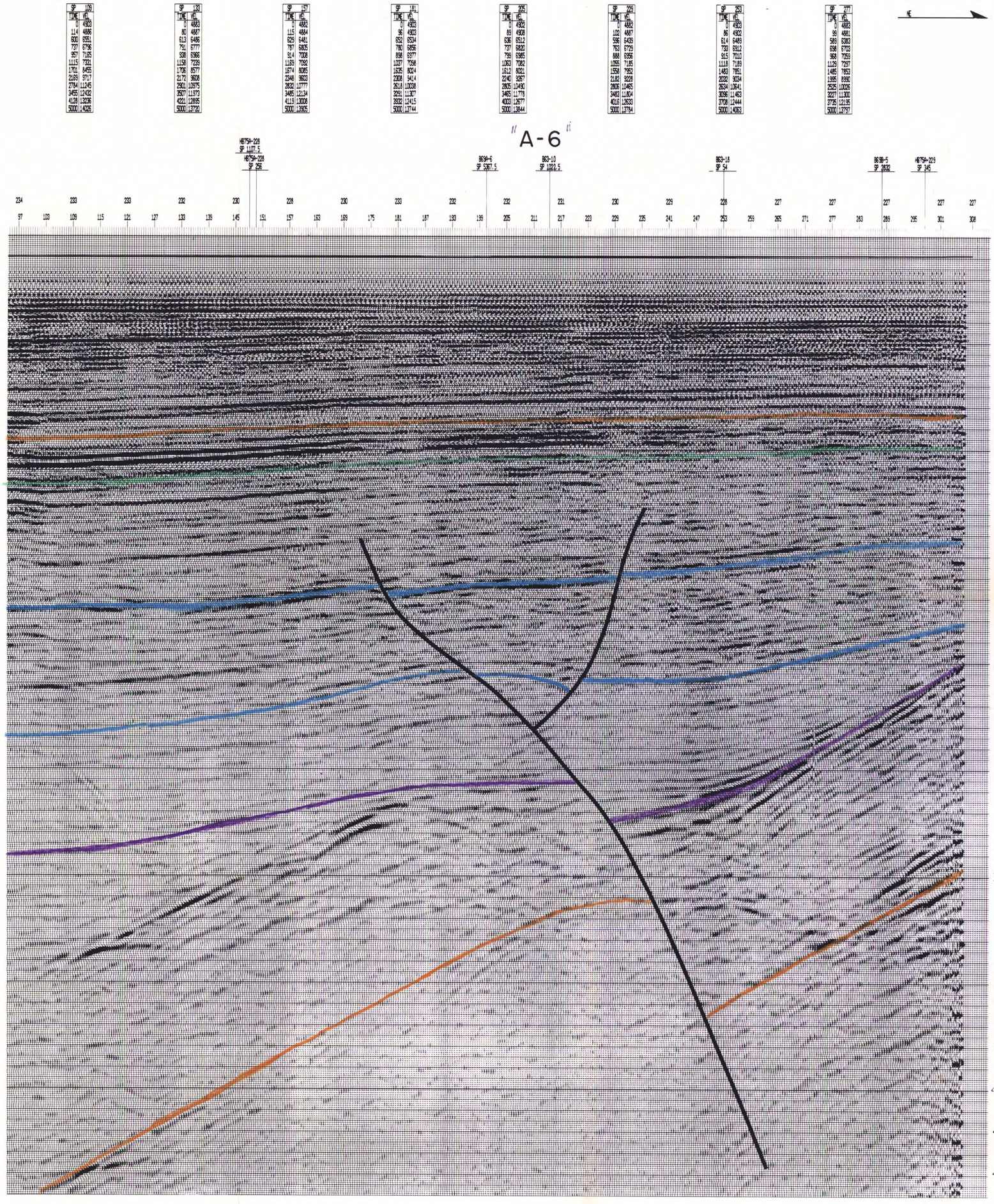
T/16 P Part 6

OR-202

5 cm

216141

(13)




T-15/16-P

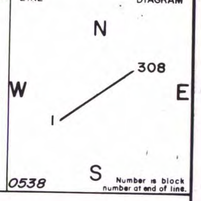
# HEMATITE PETROLEUM PTY. LTD.

| HB75A SEISMIC SURVEY | HB75A-224 |
|---|---|

FIELD DATA: Shot by: GSI Party 931 M.V. McDermott

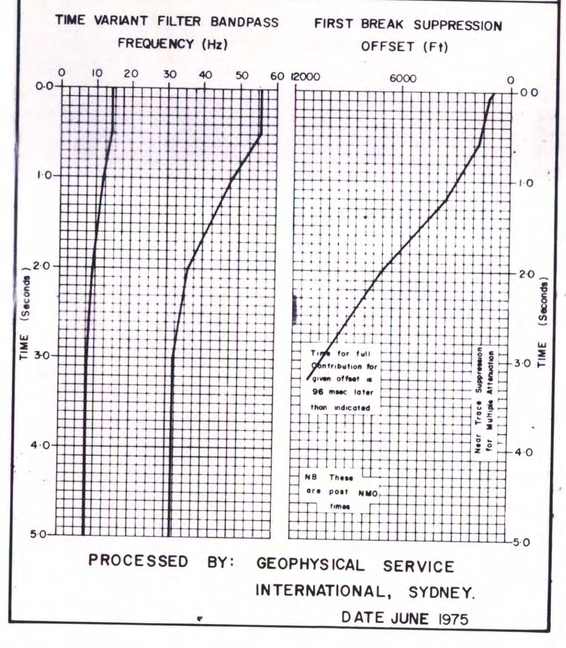
Recorded: 48 Trace DFS III (2 Systems)
Sample Rate: 4 m secs. Record Length: 5secs.
Filter: HI 62 Hz/72 db/oct, LO 8 Hz/ 18 db/oct.
Gain: Binary
Energy Source: Airgun, 1200 cub ins
Source Depth: 30-35 ft Streamer Depth: 50-60ft
Group interval: 219 ft. Shot interval: 73ft
Streamer: 3200 m, 48 groups, towing group 48
Average Offset to centre of group 48: 902 ft
Date: January '75

LINE 0396 DIAGRAM




PROCESSING INFORMATION:

1 True Amplitude Recovery (-12db, 5db/sec. 0-3·5 secs.)
2 Vertical Stack 3:1
3 Deconvolution Before Stack
SP's 1 - 308, 2 Operators/Trace, 64 pts. Gap = 0 msec.
4 24 Fold Common Depthpoint Gather
5 Sealevel Static and Airgun Delay Corrections
6 Preliminary Normal Moveout Corrections
7 Preliminary 24-Fold Stack, 24 Traces.
8 Velocity Analysis:
Continuous 700 Pkg 100m Depth Points
9 Normal Moveout Corrections
10 24 Fold CDP Stack, 48 Traces
11 Deconvolution After Stack, 2 Operators/Trace, 70 pts. Gap = 0 msec.
12 Time Variant Filter
13 Cross Record Mix on T.V.F. Section
Weighted Mix over 3 Traces
Contributions = 10%, 80%, 10%.
14 Display Normal Polarity, 10 traces/cm. (0·53 miles/inch) Horizontal Scale
3·75 ins/sec. Vertical Scale




PROCESSED BY: GEOPHYSICAL SERVICE INTERNATIONAL, SYDNEY.
DATE JUNE 1975

**Enclosure Line 14**

T/LP Part 6

5 cm

OR-202

216142

(14)

TRUNCATION

MORAY

CHAT

T-16-P

222

T-16-P

T-16-P

T-16-P

SEA EAGLE

T-15-P

TASMANIA

Scale 1:100,000

MILES

KILOMETRES

5 cm

WEAVER OIL AND GAS CORPORATION, AUSTRALIA

# BASS BASIN T-15-P, T-16-P

## STRUCTURE MAP

### Paleocene L. balmei (unconformity) Horizon

216443

INTERPRETATION BY:
EXPLORATION ASSOCIATES INTERNATIONAL INC.

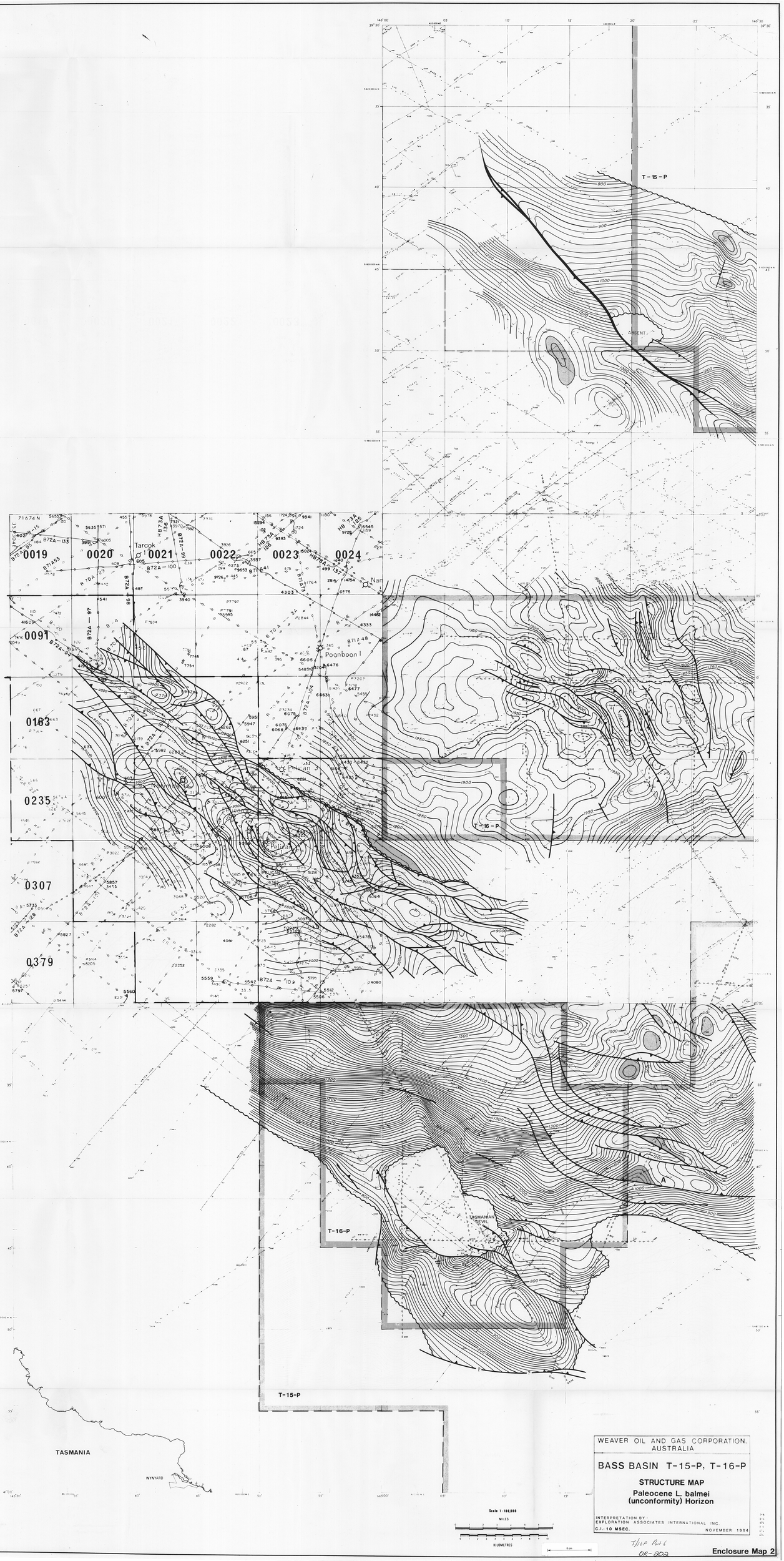
C.I.: 10 MSEC.

NOVEMBER 1984

T/16P Part 6

OR-202

**Enclosure Map 1**




WEAVER OIL AND GAS CORPORATION, AUSTRALIA

# BASS BASIN T-15-P, T-16-P

## STRUCTURE MAP

**Paleocene L. balmei (unconformity) Horizon**

INTERPRETATION BY: EXPLORATION ASSOCIATES INTERNATIONAL INC.

C.I.: 10 MSEC.

NOVEMBER 1984

T/10 Rpt 6
OR-303

Enclosure Map 2

MORAY

CHAT

TRUNCATION

T-15-P

T-16-P

T-16-P

T-16-P

Scale 1 : 100,000

MILES

0 1 2 3 4 5 6 7

0 1 2 3 4 5 6 7 8 9 10

KILOMETRES

5 cm

# WEAVER OIL AND GAS CORPORATION, AUSTRALIA

# BASS BASIN T-15-P, T-16-P

## STRUCTURE MAP

## Upper Cretaceous Horizon

INTERPRETATION BY :
EXPLORATION ASSOCIATES INTERNATIONAL INC.

C.I.: 20 MSEC.

NOVEMBER 1984

216145

T/16P Part 6

OR-202

**Enclosure Map 3**

MORAY

CHAT

T-16-P

T-16-P

T-16-P

T-16-P

T-15-P

T-15-P

A-6

A-4

SEA EAGLE

222

HERMATITE T/S.P

TASM

Scale 1 : 100,000

MILES

KILOMETRES

5 cm

# WEAVER OIL AND GAS CORPORATION, AUSTRALIA

## BASS BASIN T-15-P, T-16-P

### STRUCTURE MAP

### intra-Upper Cretaceous Unconformity Horizon

216146

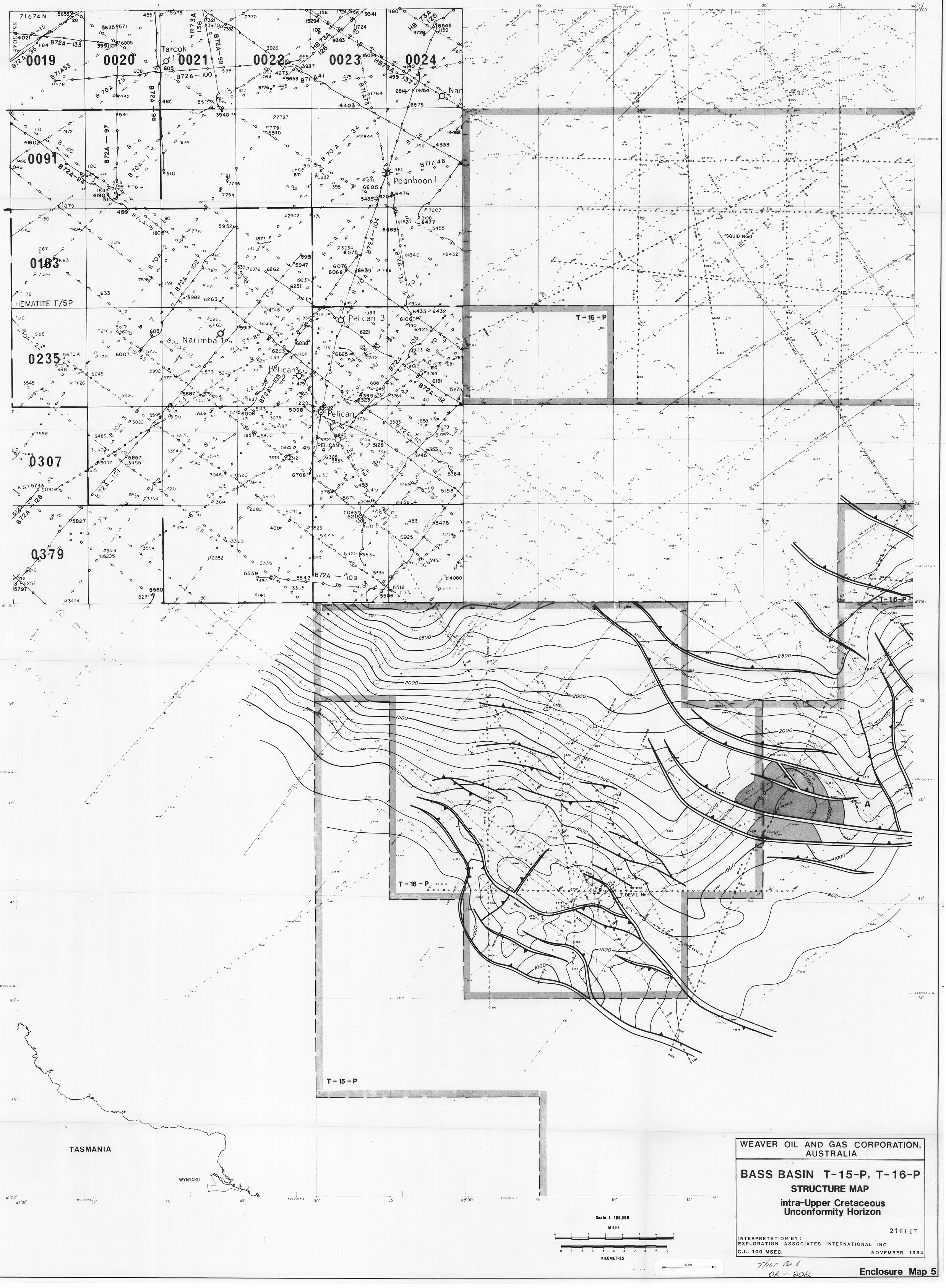
INTERPRETATION BY :
EXPLORATION ASSOCIATES INTERNATIONAL INC.

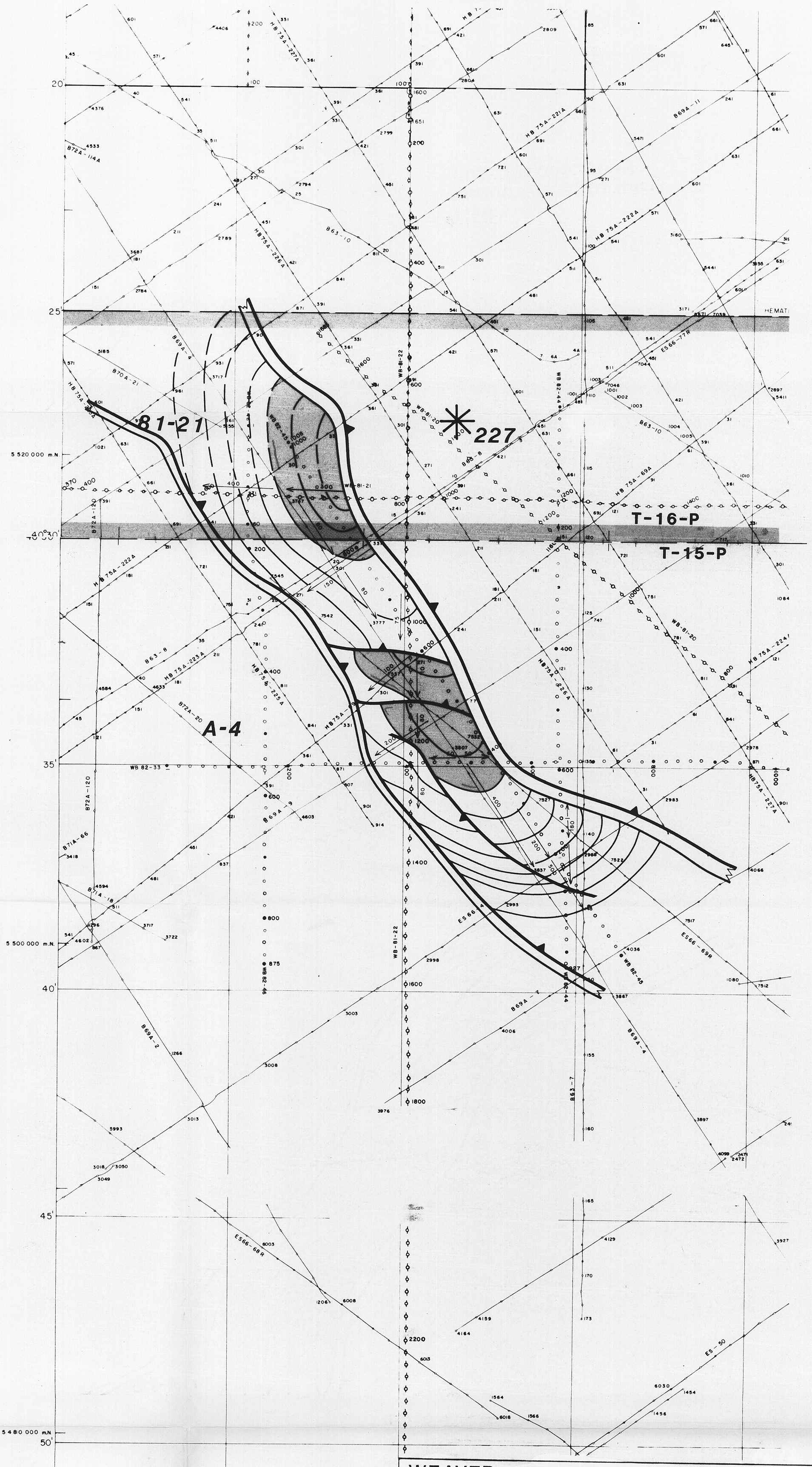
C.I.: 100 MSEC.

NOVEMBER 1984

T/16P Part 6 OR-202

**Enclosure Map 4**


0019
0020
0021
0022
0023
0024
0091
0163
0235
0307
0379
Tarook 1
Narimba 1
Pelican 3
Pelican 2
Pelican 1
PELICAN 4
Poonboon 1
SQUID No.1
T. DEVIL No.1
HEMATITE T/5P
T – 16 – P
T – 15 – P
A
2500
2000
1500
1000
800
TASMANIA
WYNYARD
Scale 1 : 100,000
MILES
KILOMETRES
5 cm
WEAVER OIL AND GAS CORPORATION, AUSTRALIA
BASS BASIN T-15-P, T-16-P
STRUCTURE MAP
intra-Upper Cretaceous Unconformity Horizon
216147
INTERPRETATION BY: EXPLORATION ASSOCIATES INTERNATIONAL INC.
C.I.: 100 MSEC.
NOVEMBER 1984
T/16P Rpt 6
OR – 202.
Enclosure Map 5




Scale 1:100,000

MILES

KILOMETRES

5 cm

WEAVER OIL AND GAS CORPORATION, AUSTRALIA

# BASS BASIN T-15-P, T-16-P

## DIP RATE MAP ON SEISMIC EVENTS TRUNCATED BENEATH intra-UPPER CRETACEOUS UNCONFORMITY

216148

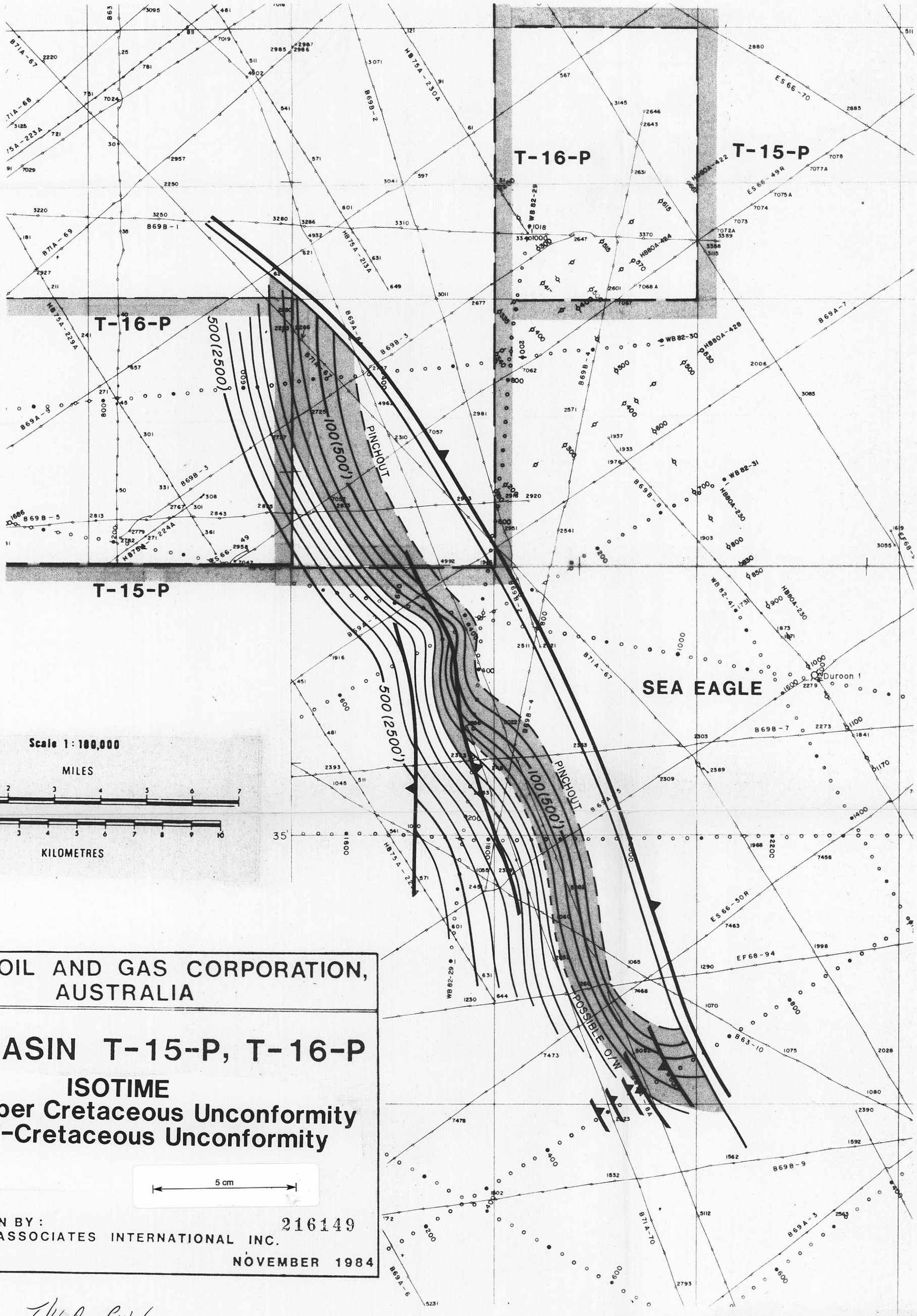
INTERPRETATION BY:
EXPLORATION ASSOCIATES INTERNATIONAL INC.

C.I.: 100 MSEC

NOVEMBER 1984

T/O&P Part 6 OR-202

**Enclosure Map 6**




WEAVER OIL AND GAS CORPORATION, AUSTRALIA

# BASS BASIN T-15-P, T-16-P

## ISOTIME
## intra-Upper Cretaceous Unconformity to mid-Cretaceous Unconformity

5 cm

INTERPRETATION BY:
EXPLORATION ASSOCIATES INTERNATIONAL INC.

216149

C.I.: .050 SEC.

NOVEMBER 1984

T/16 P Part 6

OR-202

**Enclosure Map 7**

T-16-P

T-16-P

SEA EAGLE

SHEARWATER

TASMANIA

Scale 1 : 100,000

MILES

KILOMETRES

WEAVER OIL AND GAS CORPORATION, AUSTRALIA

# BASS BASIN T-15-P, T-16-P

## STRUCTURE MAP

## mid-Cretaceous Unconformity Horizon

5 cm

INTERPRETATION BY :
EXPLORATION ASSOCIATES INTERNATIONAL INC.

C.I.: 100 MSEC.

NOVEMBER 1984

T/16P Part 6 OR-202

Enclosure Map 8

1:250,000

SEAL

MANATEE

PENGUIN

T-19-P

T-15-P

T-16-P

MORAY

CHAT

"222"

"81-21"

"227"

"A-6"

"B"

"A-4"

"A"

SEA EAGLE

SHEARWATER

BASS STRAIT

TASMANIA

KING IS.

FLINDERS IS

HUNTER IS

ROBBINS IS

THREE HUMMOCK IS

WILSON PROMONTORY

VICTORIA

Scale 1:250,000

5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometres

5 cm

— INDEX MAP —

LEGEND

PROSPECT & LEADS

AREA OF CONDENSED SECTION OUTSIDE OF MAIN CRETACEOUS RIFTED DEPOCENTERS

REPRESENTATIVE SEISMIC LINES IN T-15-P & T-16-P

Enclosure Map 9

WEAVER OIL & GAS CORPORATION, AUSTRALIA

BASS BASIN -TASMANIA

T-15-P, T-16-P & T-19-P 216151

MAJOR STRUCTURAL ELEMENTS AND LOCATION OF LEADS & PROSPECTS INCLUDING INDEX TO REPRESENTATIVE SEISMIC LINES IN T-15-P & T-16-P

OR-502 Plate 6

DATE

SCALE 1-250,000

ENCLOSURE NUMBER