223001

# BASS BASIN

Tasmania, Australia
Permit T-19-P

Annual and Fourth Quarter Report
December 27, 1983 to March 27, 1984

Submitted by

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OR-208

223002

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## SUMMARY

Seismic time structure maps have been constructed by Exploration Associates International over what appears to be the most prospective portion of Permit T-19-P. Several leads have been identified and are grouped into the Manatee, Penguin and Seal areas. Because of their location in regard to the major structural elements of the Bass basin, each of these different lead areas offer the possibility of structural and stratigraphic entrapment of hydrocarbons under very diverse conditions.

The Manatee leads consist of tilted fault blocks associated with a major basin forming growth fault. The objective section consists of Eocene, Paleocene and Cretaceous clastics which, the most recent BMR studies, have shown to contain mature marine, deltaic or lacustrine source rocks. The primary objective section is located below a major unconformity which also offers the possibility of entrapment.

The Penguin horst blocks plunge towards the southeast or deeper portion of the basin. These are characterized by significant crestal convergence of the section while their flanks display expanded sections associated with the downthrown graben areas. Their objective sections is the same as at Manatee.

The Seal leads consist of tilted fault blocks located on the northeast side of the central graben area. These are not very well defined due to the low density of quality seismic data in this part of the basin.

A prospect definition seismic program is recommended. The proposed 21 lines amount to 385.25 line kilometers and should adequately define drillable prospects on Permit T-19-P.

## RECOMMENDED SEISMIC PROGRAM

A prospect definition seismic acquisition program is recommended.

The recommended program consist of 21 dip and strike lines and amount to 385.25 line kilometers. The proposed lines are laid in such a way as to provide maximum coverage and are tied to the Perthshire 1981 and 1982 lines as well as to the lines acquired by the previous permit holders.

The emphasis of the program is given to the Manatee leads area which appears to provide the best opportunity for the definition of large prospects in the central graben area. Next are the Penguin and Seal areas. These three areas are to be tied together with two lines across the basin.

The line identifiers and individual lengths are listed.

| Line | Lead | Kilometers |
|---|---|---|
| P-84-1 | Manatee dip | 10.00 |
| P-84-2 | Manatee dip | 10.00 |
| P-84-3 | Manatee dip | 10.30 |
| P-84-4 | Manatee dip | 12.60 |
| P-84-5 | Manatee dip | 14.00 |
| P-84-6 | Manatee/Seal dip | 32.50 |
| P-84-7 | Manatee dip | 16.00 |
| P-84-8 | Manatee strike | 28.90 |
| P-84-9 | Seal dip | 7.95 |
| P-84-10 | Seal dip | 8.60 |
| P-84-11 | Seal dip | 16.20 |
| P-84-12 | Seal dip | 13.40 |
| P-84-13 | Seal strike | 16.85 |
| P-84-14 | Seal strike | 8.90 |
| P-84-15 | W. Penguin/Penguin dip | 15.60 |
| P-84-16 | W. Penguin/Penguin/Seal dip | 35.60 |
| P-84-17 | Penguin dip<br>Manatee strike | 25.90 |
| P-84-18 | Manatee strike | 33.65 |
| P-84-19 | Manatee strike | 30.50 |
| P-84-20 | Manatee dip tangent | 21.30 |
| P-84-21 | Manatee dip tangent | 16.50 |
| | | 385.25 |

MAPS

Three seismic time structure maps and an isochron map has been constructed by Exploration Associates International over the central graben area and flank graben area of Permit T-19-P. The map area has been divided in a west panel area and an east panel area. All the maps are at a scale of 1:50.000. Various contour intervals have been used. The map levels are tied to the Konkon #1 Well by a synthetic seismogram. Figure A1, 2, 3.

The map levels are:

- Top Eatern View Coal Measures
- Lower M. diversus Seismic Horizon
- Top Eastern View Coal Measures to Lower M. diversus Seismic Horizon
- Pre. Lower M. diversus Dip Rate

The lower M. diversus seismic horizon is the deepest reliable reflector of regional extent. Selected dips at various levels below the Lower M. diversus horizon have been used to construct the Pre Lower M. diversus Dip Rate map. These dip segments are only present within the early Tertiary and pre Tertiary depocenters.

The Top Eastern View Coal Measures to Lower M. diversus isochron conforms to the configuration of the Early and Pre Tertiary depocenters. The age of the isochron interval pre-dates Oligocene and later movements of the Mornington - King Island fault.

# SYNTHETIC SEISMOGRAM

GTS CORP. HOUSTON OFFICE 3724 DACOMA 77018

ESSO AUSTRALIA LTD. KONKON 1 WILDCAT AUSTRALIA TASMANIA W

LOG DATUM = 32 SEISMIC DATUM = 0 COMMENTS .

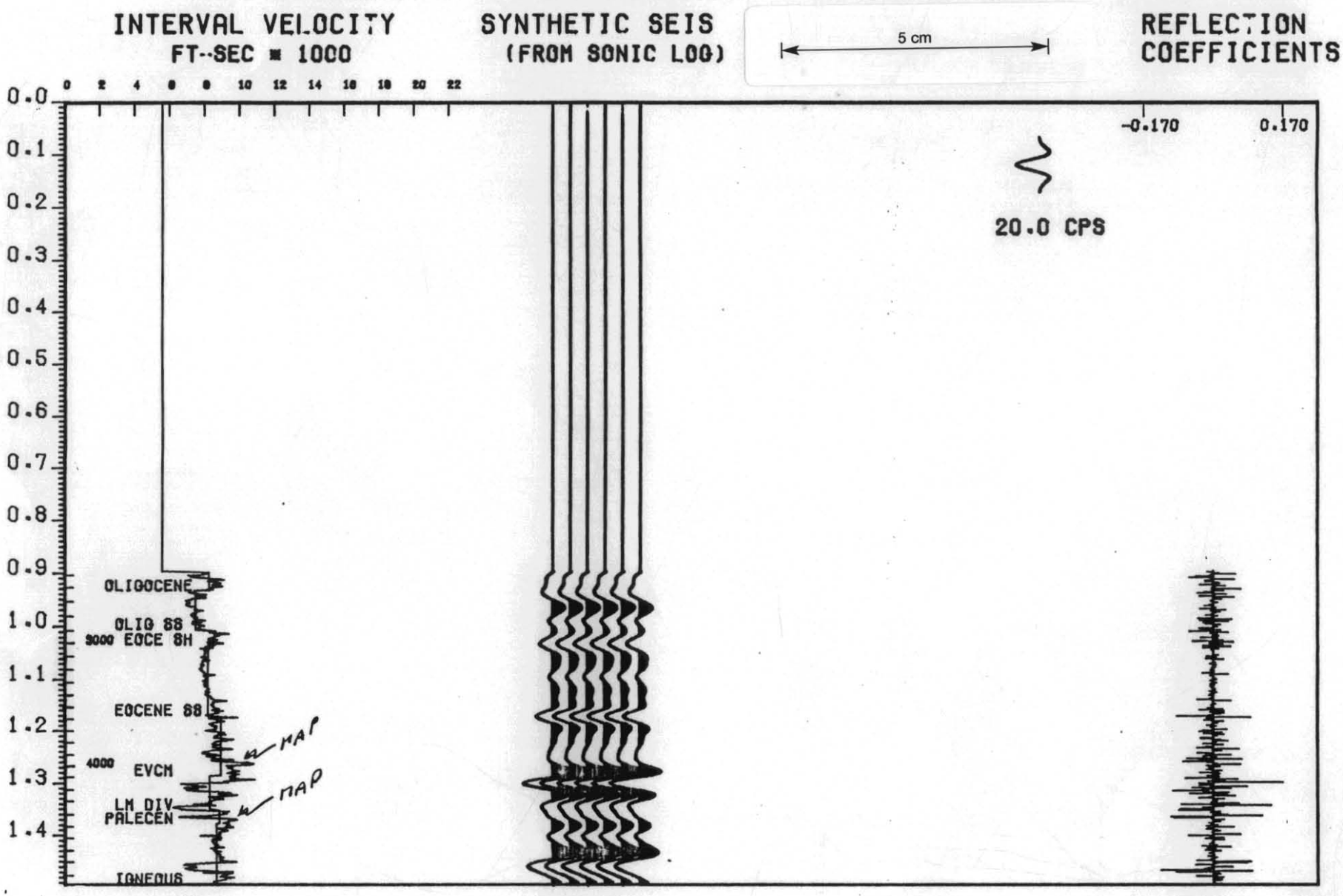


Figure A. 1

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# SYNTHETIC SEISMOGRAM

## GTS CORP. HOUSTON OFFICE 3724 DACOMA 77018

ESSO AUSTRALIA LTD. KONKON 1 WILDCAT AUSTRALIA TASMANIA W

LOG DATUM = 32 SEISMIC DATUM = 0 COMMENTS _____

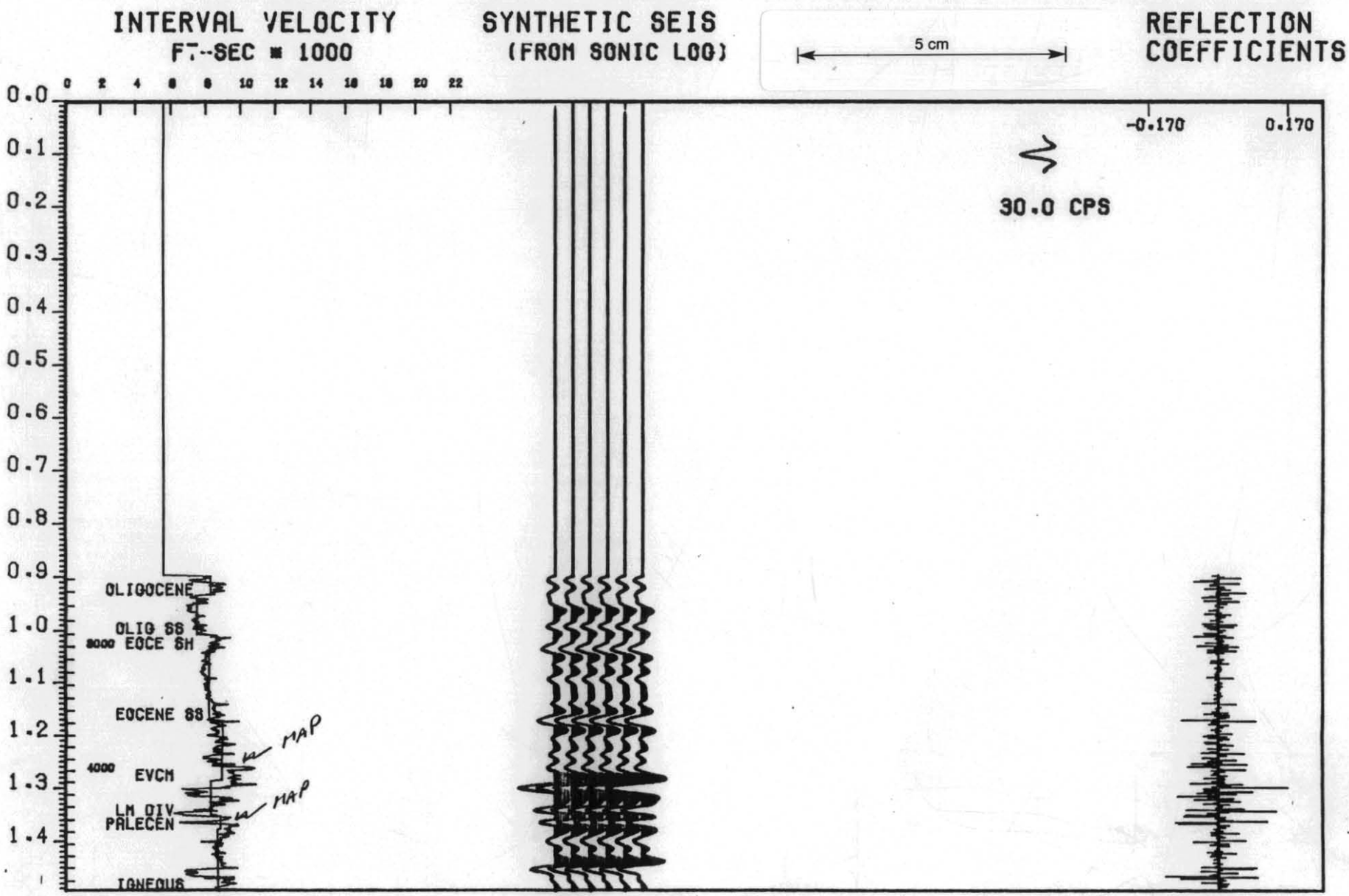


Figure A. 2

223008

# SYNTHETIC SEISMOGRAM

GTS CORP. HOUSTON OFFICE 3724 DACOMA 77018

ESSO AUSTRALIA LTD. KONKON 1 WILDCAT AUSTRALIA TASMANIA N

LOG DATUM = 32 SEISMIC DATUM = 0 COMMENTS _____

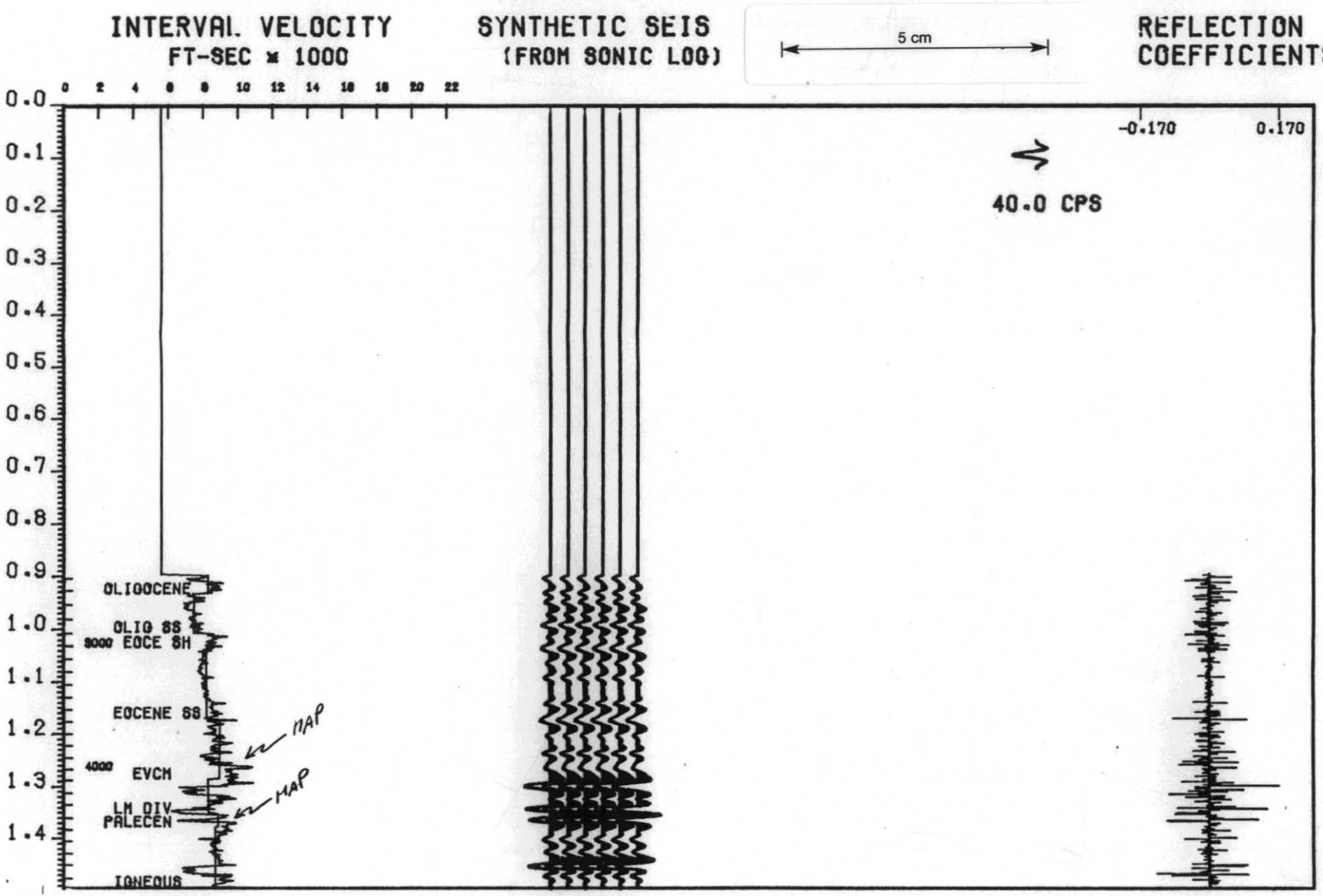


Figure A. 3

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PALEOCENE/CRETACEOUS PLAY

The BMR studies of the Bass Basin J. C. Branson et al, (Enclosure 1.) can be summarized as follows:

- Recent reviews of the hydrocarbon potential have 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.

- Slower basin subsidence prevailed in the Late Cretaceous with sediments devised from eroded Paleozoic and Proterozoic highland areas, as well as Upper and Lower Cretaceous elevated portions of horst blocks. These sediments were deposited under fluvial and lacustrine conditions. Minor marine ingressions may have occured as these are known 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.

- The major hydrocarbon indications have been found closer to the basin depocenter. The Pelican gas/oil field is located on just such an intra-basin structure. Whereas previous interpretation 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 blocks near Aroo #1 and Bass #3, in the basin center. 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.

## BASS BASIN EVOLUTION

The Bass and Gippsland basins are excellent examples of aborted, or failed rifts. Crustal extension during the Cretaceous developed a high relief, rifted terrane of graben and half-graben depocenters filled during the Early Cretaceous with volcanogenic detritus under fluviatile and alluvial conditions. In the Bass Basin the rift system trends NW-SE. In the northwest half of the Bass Basin most rift faults are downthrown to the southwest, forming a series of half-grabens with similar polarity. In the southeast half, rifting was more complex with two rift sequences of different trends.

Worldwide, aborted rifts are ideal environments for occurences of hydrocarbons. The combination of high quality source rocks and optimum thermal history allow for above average productivity on a volumetric basis. Good examples of aborted rifts include the Gippsland basin, the Dampier basin, Vulcan graben and the Viking graben. All of these examples developed through a two-stage evolution. The stages are:

1. Crustal upwarp and extensional rifting
2. Post-rift sag

Large reserves in aborted rifts are generally found in sediments of the first phase. The boundary between the rift and sag phase in the Bass Basin is not clearly understood and is tentatively placed at the base Tertiary.

Exploration to date in the Bass Basin has concentrated on sediments of the second phase (Tertiary sag phase). Results have been disappointing. Continued exploration must be directed towards understanding the Pre-Tertiary rift phase.

223012

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# BASS STRAIT MARINE GEOPHYSICAL SURVEY 1982

1. Shot point location maps as per diagram:

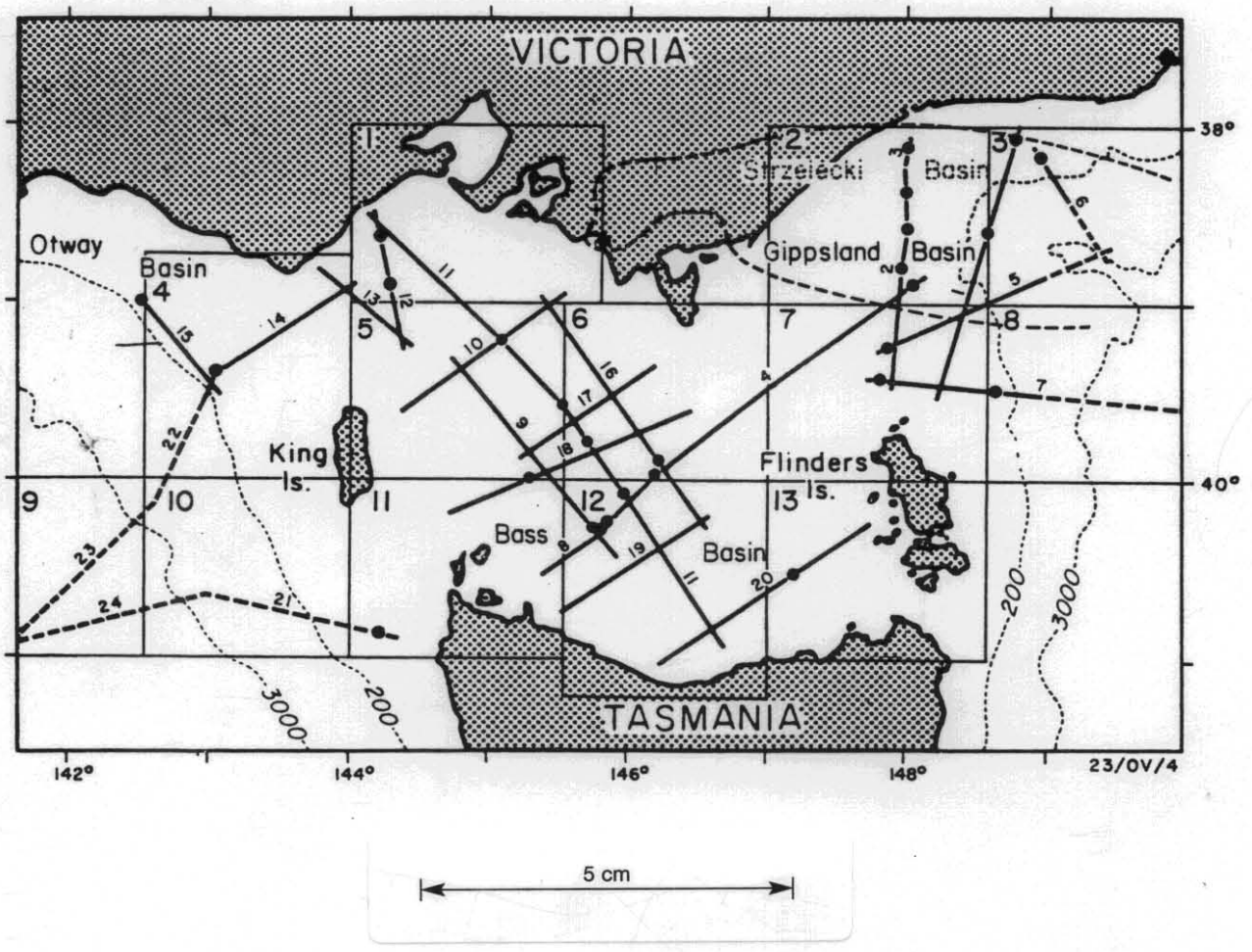



Figure B

Since 1982, the BMR has recorded 3200kms, Figure B, of seismic in the the Bass Basin as part of a study designed to understand the early basin evolution.

Figure C shows the location of six BMR geoseismic traverses, in a northeast-southwest direction, across the Bass Basin. Line drawings based on these traverses are shown in Figure D. Portions of lines 16, 17, and 18 lie in Permit T-19-P. The sections are colored to reflect the two phase evolution characteristic of aborted rifts. Figure C is also a plan view of the major Pre-Tertiary rift faults developed in the Bass Basin. The rift faults are offset by a series of north northeast trending, dextral transverse faults which allowed different directions of tilt blocks to develop and permitted variations in stretch of the brittle lithosphere. The Mornington - King Island fault which trends north northeast through T-19-P may have initially developed as one of these transverse faults.

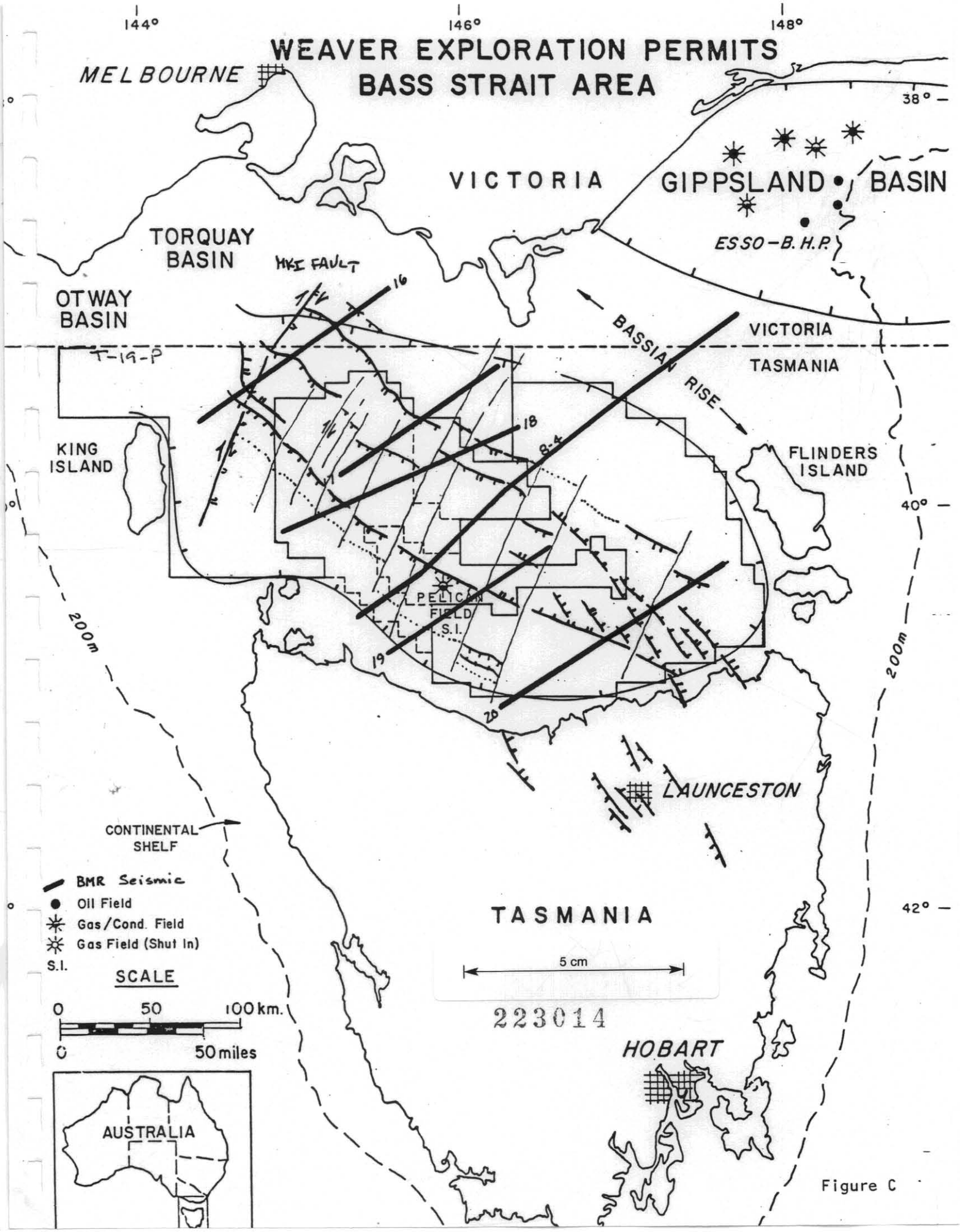

144°
146°
148°
WEAVER EXPLORATION PERMITS
BASS STRAIT AREA
MELBOURNE
38°
VICTORIA
GIPPSLAND BASIN
ESSO-B.H.P.
TORQUAY BASIN
HKI FAULT
OTWAY BASIN
16
BASSIAN RISE
VICTORIA
TASMANIA
T-19-P
18
KING ISLAND
FLINDERS ISLAND
40°
PELICAN FIELD S.I.
19
20
200m
200m
LAUNCESTON
CONTINENTAL SHELF
BMR Seismic
Oil Field
Gas/Cond. Field
Gas Field (Shut In)
S.I.
TASMANIA
42°
5 cm
SCALE
0 50 100 km.
0 50 miles
223014
HOBART
AUSTRALIA

Figure C

223015

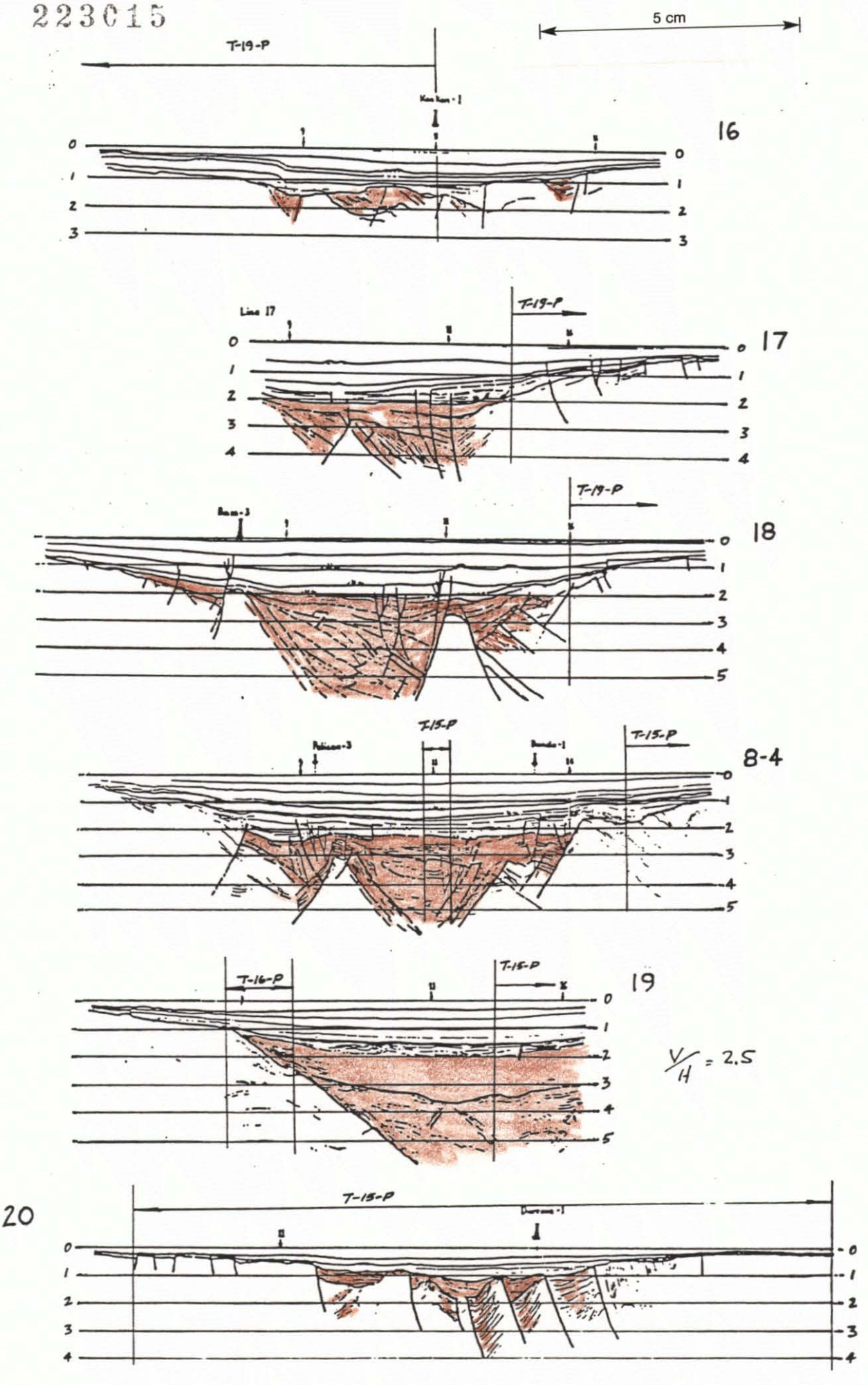



Figure D

STRUCTURAL FRAMEWORK

Permit T-19-P lies at the northwestern end of the Bass Basin. Its tectonic style is unique as compared to the rest of the Bass Basin. This is due to the influence of the Mornington - King Island fault.

Movements on the NNE - SSW trending Mornington - King Island fault commenced in the Oligocene and persist through today as indicated by earthquake pattern studies and available reflection seismic data. This movement is interpreted to be a combination of right lateral wrenching and uplift, and has overprinted early northwest-southeast trends established during initial basin evolution. Both of these trends have to be understood individually in order to remove the effects of the Mornington - King Island fault and resolve the early basin history.

Rifting in T-19-P commenced in the Early Cretaceous.

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 dip, generally to the south-southwest, and produce a tilt of the basement surface of up to 40 degrees. This "domino-style" rotational faulting resulted from a south southwest-north northeast upper crustal extension of 50% to 70%.

This "half-graben" style of rifting allowed for the development of deep Pre-Tertiary depocenters which may contain an adequate source and reservoir rocks section. Such depocenters are recognized in Permit T-19-P and are illustrated on Figure D and Map 1. They lie between prominent horst blocks

established during Early Cretaceous crustal extension. The main depocenter lies approximately 30kms southwest of Konkon #1 and is approximately 20kms wide. Additional subsidiary depocenters lie to the northeast and southwest. The area within this depocenter is considered to be the most prospective area and therefore mapping efforts have concentrated on this portion of Permit T-19-P.

Three geoseismic cross-sections have been constructed across this portion of Permit T-19-P to illustrate the tectonic style, and the relative depths of the three depocenters (Figures 1, 2, and 3.)

Sections BB' and CC' cross the Mornington - King Island fault. The area to the west of the fault, including a portion of the Pre-Tertiary depocenter has been uplifted since the Oligocene. In addition, some degree of wrenching has occurred along the fault. Due to the complexity of these movements, seismic resolution below the Eastern View Coal Measures west of the fault is poor. Calculations indicate between 1400-2500 feet of uplift has occured, west of the fault, since the Oligocene.

GEOSEISMIC CROSS SECTIONS

Regional seismic mapping by Exploration Associates International indicate that a portion of permit T-19-P is occupied by a central graben area bounded to the northeast and to the southwest by half grabens area. To the west is the Mornington - King Island Rise. The remainder of the permit area is mostly occupied by a condensed stratigraphic section.

These major structural elements as well as the prospective lead areas are shown on Map 1. So are the location of the geoseismic cross-sections AA', BB', CC', Figures 1, 2, 3, and the location of the representative seismic lines, Figures 4 to 14. Prospective leads are associated with each of the major structural elements.

The geoseismic cross-sections are based on several seismic lines. The Eastern View Coal Measures and Lower M. diversus reflector horizons are shown. The stratigraphic section below the Lower M. diversus seismic horizons is considered the most prospective.

Geoseismic cross-section AA', Figure 1. trends northeast - southwest. To the left, or southwest, is the Mornington - Kind Island Rise which is bounded to the east by a major basin forming growth fault. The Manatee prospective area occupies the western portion of the central graben. The Mornington-King Island right-lateral, down-to-the east, transverse fault is a late, essentially north-south trending feature which cuts across the countryside regardless of pre-existing structures and relief. To the northeast is the central graben boundary fault. Further northeast, and upthrown, is a half graben and the prospective Seal area. On the basis of reconstruction, the central graben was originally strongly dipping to

the west. Back-up rotation and uplift took place at Lower M. diversus unconformity time, and later, along the central graben southwest-west boundary fault and Mornington - King Island hinge fault.

Geoseismic cross-section BB', Figure 2. also trends northeast - southwest. To the left, or southwest is the Mornington - King Island Rise which is bounded to the east - northeast by a major basin forming fault. The northwest trending propective Penguin and South Penguin horst block leads are identified. The north - south trending prospective Penguin II horst blocks is also identified. It is bounded to the east and separated from the Penguin lead by the Mornington - King Island Fault. To the north-east is the central graben area within which an area of closure is mapped outside of Permit T-19-P area. Further northeast is the central graben boundary fault and the upthrown prospective Seal area. The remainder of the cross-section shows a condensed stratigraphic section and a half graben area where the Konkon #1, Toolka #1A and Cormorant #1 wells are located. These wells recovered modest amounts of gas and oil, however, they are considered marginally relevant to the play since they are not located within the central graben area, where, according to the recent BMR studies, the most prospective section was deposited.

Geoseismic cross-section CC', Figure 3. trends northeast - southwest. To the left, or southwest, is a tilted horst block on which a yet unnamed lead has been mapped. Follows a northeastward tilted graben within which a yet unnamed lead has also been mapped. The Penguin and South Penguin tilted horst block separates this tilted graben from the central graben to the northeast. The Bass #3 well which tested both gas and oil is located on a tilted fault block which is on trend and may be closely related to the Penguin

horst block. The Aroo #1 well is located within the central graben area. Several sand intervals with fluorescense and cut fluorescense associated with wet gas on the mud log have been recognized. To the northeast of the central graben is a half graben area also shown on cross-section BB'. The Seal area is located at the prospective upthrown edge of the major graben boundary fault. The Bass #1 well is located outside of the main graben on what appears to be a tilted fault block. The BMR geochemical and paleo-heat flow study indicates that the entire Bass #1 Paleocene Late Cretaceous section falls precisely within the oil window. The northeast half graben is bounded by a major basin forming fault. Further to the northeast in a severely condensed stratigrapic section.

223021

STRATIGRAPHY

The nearest wells to Permit T-19-P are the Konkon #1, Toolka #1A, Cormorant #1, Aroo #1 and Bass #3. Other wells drilled in the Bass Basin are also relevant, however the distances from the permit area are such that stratigraphic/structural relationships are at best difficult to establish. Map 1.

The main sources of stratigraphic information for the permit are the well completion reports and Mr. Felix Roland Aquing masters dissertation on the Geology of the Eastern View Coal Measures - Bass basin, 1980.

The time-stratigraphic sub-divisions, thicknesses, net sand thicknesses, percent sand and sand-shale ratio are summarized on Figures E, F.

The following were taken from the Aquing dissertations. It should be kept in mind that this study is by definition based on the areas of high density of data, the southeast area, and that consequently the conclusions are a bit stretched in regard the central graben and flank horst blocks areas found on Permit T-19-P. Nevertheless:

- Source - rock analyses and the depositional history of the basin indicate that the northwest part of the basin has the greatest oil-potential. Page 2.

- An abundance of good quality reservoir sands occur throughout the Eastern View Coal Measures, the overlying marine "Upper Eocene Shale" and Oligocene marine shales are capable of forming regional seals. Page 2.

- Abruptly overlying the Eastern View Coal Measures is the dark chocolate brown marine "Upper Eocene Shale" or Demon's Bluff Formation.

| | Upper E. asperus | | | | Middle E. asperus | | | | Lower E. asperus | | | | E. asperoides | | | | Upper E. divarus | | | | Middle E. divarus | | | | Lower E. divarus | | | | Upper L. balmei | | | | Lower L. balmei | | | | T. lemurs | | | | Upper T. pachyexinus - Lower T. pachyexinus | | | | Lower Cretaceous | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Top (Driller's Depth) | Total Thickness | Net Sand Thickness | % Sand | Sand/Shale Ratio | Top (Driller's Depth) | Total Thickness | Net Sand Thickness | % Sand | Sand/Shale Ratio | Top (Driller's Depth) | Total Thickness | Net Sand Thickness | % Sand | Sand/Shale Ratio | Top (Driller's Depth) | Total Thickness | Net Sand Thickness | % Sand | Sand/Shale Ratio | Top (Driller's Depth) | Total Thickness | Net Sand Thickness | % Sand | Sand/Shale Ratio | Top (Driller's Depth) | Total Thickness | Net Sand Thickness | % Sand | Sand/Shale Ratio | Top (Driller's Depth) | Total Thickness | Net Sand Thickness | % Sand | Sand/Shale Ratio | Top (Driller's Depth) | Total Thickness | Net Sand Thickness | % Sand | Sand/Shale Ratio | Top (Driller's Depth) | Total Thickness | Net Sand Thickness | % Sand | Sand/Shale Ratio | Top Upper Balmei Shale | Top Upper Balmei Sandstone | Top Eocene Tiger Shale | Total Eocene Tiger Shale Thickness Penetrated | Total Net Sand | % Sand in section penetrated | Sand/Shale Ratio |
| ABC-1 | 3633' | 358' | 0' | 0.0 | 0.0 | 3987' | 821' | 178' | 21.7 | 0.2 | 6908' | 785' | 458' | 58.3 | 1.7 | 7633' | 1184' | 343' | 28.9 | 0.4 | | | | | | 8733' | 823' | 96' | 11.7 | 0.1 | 8970' | 111' | 0' | 0.0 | 0.0 | [illegible] | 1253' | 368' | 29.5 | 0.5 | | | | | | 6118' | 618' | 6788' | 3603' | 1367' | 37.9 | 0.6 |
| BASS-1 | 4873' | 602' | 0' | 0.0 | 0.0 | 5475' | 847' | 134' | 17.6 | 0.2 | 6162' | 618' | 383' | 62.0 | 1.6 | 6780' | 765' | 373' | 48.9 | 1.0 | 7343' | 734' | 87' | 13.5 | 0.2 | | | | | | | | | | | | | | | | | | | | | 5377' | 119' | 5896' | 1881' | 919' | 50.5 | 1.1 |
| BASS-2 | 3290' | 278' | 198' | 71.2 | 2.5 | 3568' | 411' | 161' | 39.1 | 0.6 | 3979' | 383' | 248' | 65.0 | 2.0 | 4362' | 133' | 91' | 68.4 | 2.8 | | | | | | 4706' | 806' | 138' | 76.7 | 3.4 | 4918' | 438' | 383' | 73.7 | 2.9 | 5330' | 161' | 104' | 64.6 | 2.0 | | | | | | 3618' | 220' | 3838' | 1673' | 1170' | 69.9 | 2.6 |
| BIOL-3 | 4207' | 383' | 0' | 0.0 | 0.0 | 4590' | 943' | 193' | 20.6 | 0.3 | 5535' | 476' | 211' | 84.5 | 7.1 | 6011' | 134' | 110' | 82.1 | 4.6 | 6143' | 253' | 199' | 78.7 | 3.9 | 6398' | 82' | 53' | 64.6 | 1.9 | | | | | | 6480' | 203' | 87' | 42.4 | 0.7 | 6615' | 563' | 221' | 39.3 | 0.6 | 7048' | 582' | 455' | 74.7 | 3.0 | 4734' | 270' | 5304' | 8506' | 1711' | 67.7 | 2.1 |
| CORONARIT-1 | 3002' | 363' | 0' | 0.0 | 0.0 | 3363' | 695' | 23' | 2.0 | 0.0 | 4260' | 906' | 532' | 66.8 | 2.1 | 5066' | 1342' | 618' | 63.9 | 1.8 | 6412' | 738' | 97' | 10.8 | 0.2 | 7120' | 1310' | 63' | 3.3 | 0.0 | 8728' | 1112' | 48' | 4.3 | 0.0 | | | | | | | | | | | 3500' | 268' | 4280' | 5317' | 1338' | 23.8 | 0.4 |
| DUSKY-1 | 4490' | 879' | 118' | 48.3 | 0.7 | 4769' | 903' | 458' | 50.1 | 0.8 | 5678' | 802' | 478' | 58.9 | 2.6 | 6476' | 2061' | 89' | 39.6 | 1.6 | 6708' | 226' | 97' | 43.3 | 2.3 | 6994' | 246' | 133' | 54.9 | 1.4 | 7170' | 776' | 309' | 39.8 | 0.7 | 7946' | 766' | 883' | 36.9 | 0.6 | 8712' | 896' | 256' | 86.3 | 0.4 | | | | | | 4980' | 540' | 5320' | 4283' | 1950' | 44.5 | 1.0 |
| DURROON-1 | Base | Below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EDWARDS-1 | 2885' | 465' | 98' | 20.7 | 0.3 | 3350' | 635' | 162' | 37.2 | 0.6 | 3765' | 165' | 97' | 66.5 | 2.0 | 3910' | 255' | 171' | 67.1 | 2.0 | 4168' | 191 | 28' | 14.7 | 0.2 | 4359' | 91' | 0' | 0.0 | 0.0 | 4450' | 40' | 7' | 17.5 | 0.2 | 4450' | 160' | 0' | 0.0 | 0.0 | 4630' | 246' | 0' | 0.0 | 0.0 | 4894' | 16' | 4' | 25.0 | 0.7 | 3039' | 538' | 3397' | 1313' | 470' | 36.4 | 0.7 |
| HANGERO-1 | 5183' | 393' | 83' | 21.2 | 0.3 | 5515' | 987' | 276' | 28.0 | 0.4 | 6502' | 570' | 329' | 59.3 | 1.8 | 7032' | 662' | 297' | 44.9 | 1.1 | 7734' | 179' | 33' | 23.7 | 0.3 | 7873' | 227' | 76' | 32.6 | 0.4 | 8100' | 452' | 203' | 44.9 | 0.9 | 8552' | 668' | 272' | 30.6 | 0.5 | | | | | | 3748' | -16' | 6158' | 3282' | 1442' | 43.2 | 0.8 |
| KARINA-1 | 4917' | 381' | 17' | 4.5 | 0.0 | 5298' | 892' | 164' | 18.4 | 0.2 | 6190' | 1063' | 714' | 67.2 | 2.2 | 7253' | 359' | 304' | 84.1 | 2.8 | 7612' | 375' | 116' | 30.9 | 2.7 | 8367' | 823' | 374' | 45.4 | 0.9 | 9210' | 1793' | 611' | 34.1 | 0.5 | | | | | | | | | | | 3428' | -57' | 5685' | 5118' | 2643' | 51.6 | 1.1 |
| PELICAN-1 | 5044' | 561' | 66' | 12.2 | 0.1 | 5205' | 892' | 303' | 33.9 | 0.5 | 6097' | 538' | 342' | 63.5 | 2.1 | 6633' | 822' | 341' | 41.5 | 2.6 | 7437' | 653' | 257' | 39.4 | 0.7 | 8110' | 814' | 408' | 50.1 | 1.1 | 8926' | 1416' | 516' | 36.4 | 0.6 | 10340' | 884' | 8' | 9.1 | 0.1 | | | | | | 3364' | 446' | 5760' | 4468' | 2514' | 49.6 | 1.1 |
| PELICAN-2 | 4924' | 582' | 36' | 9.4 | 0.1 | 5306' | 828' | 303' | 32.7 | 0.5 | 6235' | 611' | 383' | 63.0 | 2.0 | 6843' | 830' | 494' | 59.4 | 2.0 | 7677' | 679' | 266' | 37.1 | 1.5 | 8356' | 863' | 323' | 37.4 | 0.6 | 9219' | 847' | 230' | 27.4 | 0.4 | | | | | | | | | | | 3490' | 253' | 5683' | 6181' | 2063' | 49.3 | 1.1 |
| PELICAN-3 | 4917' | 367' | 31' | 8.4 | 0.1 | 5284' | 568' | 351' | 19.0 | 0.4 | 6252' | 463' | 284' | 61.3 | 1.8 | 6715' | 520' | 115' | 22.1 | 0.3 | 7235' | 275' | 168' | 61.4 | 1.1 | 7510' | 188' | 110' | 58.5 | 1.3 | 7698' | 857' | 180' | 15.9 | 3.2 | 7737' | 345' | 130' | 35.6 | 0.6 | 8300' | 1221' | 472' | 38.7 | 0.6 | | | | | | 3464' | 379' | 3863' | 3658' | 1716' | 46.9 | 0.8 |
| POCKBARK-1 | 5173' | 389' | 82' | 21.1 | 0.3 | 5564' | 976' | 310' | 31.8 | 0.5 | 6540' | 672' | 382' | 56.8 | 1.4 | 7213' | 307' | 243' | 80.2 | 3.2 | 7720' | 66' | 45' | 33.0 | 1.7 | 7816' | 252' | 106' | 42.1 | 0.8 | 8138' | 650' | 273' | 42.0 | 0.7 | 8788' | 842' | 115' | 67.5 | 0.9 | 9630' | 1064' | 728' | 45.3 | 0.8 | 10636' | [illegible] | 18' | 22.8 | 0.3 | 3756' | 451' | 6237' | 6308' | 2230' | 49.9 | 1.1 |
| TAROOM-1 | 5078' | 394' | 0' | 0.0 | 0.0 | 5472' | 874' | 173' | 19.7 | 0.2 | 6348' | 647' | 482' | 74.5 | 3.4 | 6993' | 765' | 526' | 68.7 | 2.6 | 7760' | 890' | 206' | 37.1 | 1.4 | 8650' | 405' | 109' | 26.9 | 0.4 | | | | | | | | | | | | | | | | | 3664' | 446' | 6110' | 4965' | 1784' | 60.6 | 1.7 |
| TOOLEA-1 | 3570' | 390' | 66' | 11.8 | 0.1 | 3960' | 836' | 73' | 3.0 | 0.0 | 4796' | 783' | 443' | 36.6 | 1.6 | 5579' | 401' | 162' | 35.4 | 0.8 | 5980' | 389' | 30' | 7.7 | 0.1 | 6369' | 471' | 62' | 13.2 | 0.2 | 6840' | 1124' | 54' | 3.1 | 0.0 | | | | | | | | | | | 3622' | 1150' | 4812' | 3738' | 721' | 19.3 | 0.2 |
| TORONI-1 | 3861' | 883' | 130' | 63.6 | 0.8 | 4144' | 752' | 458' | 60.9 | 1.6 | 4898' | 390' | 249' | 63.5 | 2.6 | 5288' | 339' | 217' | 64.4 | 2.8 | 5647' | 146' | 95' | 65.1 | 2.8 | 5793' | 332' | 221' | 66.6 | 2.4 | 6125' | 363' | 220' | 60.6 | 1.6 | 6488' | 813' | 437' | 53.6 | 1.2 | 7303' | 693' | 296' | 36.7 | 0.6 | | | | | | 4271' | 253' | 4526' | 3478' | 2033' | 58.5 | 1.6 |

| | Upper P. asperus | Middle P. asperus | Lower P. asperus - Upper L. balmei | Lower L. balmei | T. lemurs | T. lilli .. | E. eocenica | Upper T. pachyexinus - Lower T. pachyexinus | C. striata/ C. directocostatus | Lower Cretaceous |
|---|---|---|---|---|---|---|---|---|---|---|
| DURROON-1 | 13007' 150' 150' 100 0.0 | 16507' 620' 594' 93.8 15.2 | [illegible] | 20709' 1084' 953' 87.8 7.2 | 21567' 538' 438' 78.4 3.6 | 22159' 643' 443' 68.7 2.2 | 23507' 135' 120' 88.9 8.0 | [illegible] | 24955' 270' 11' 0.0 0.0 | 3065' |

Note: (i) Volcanic rocks were not included in the calculations.

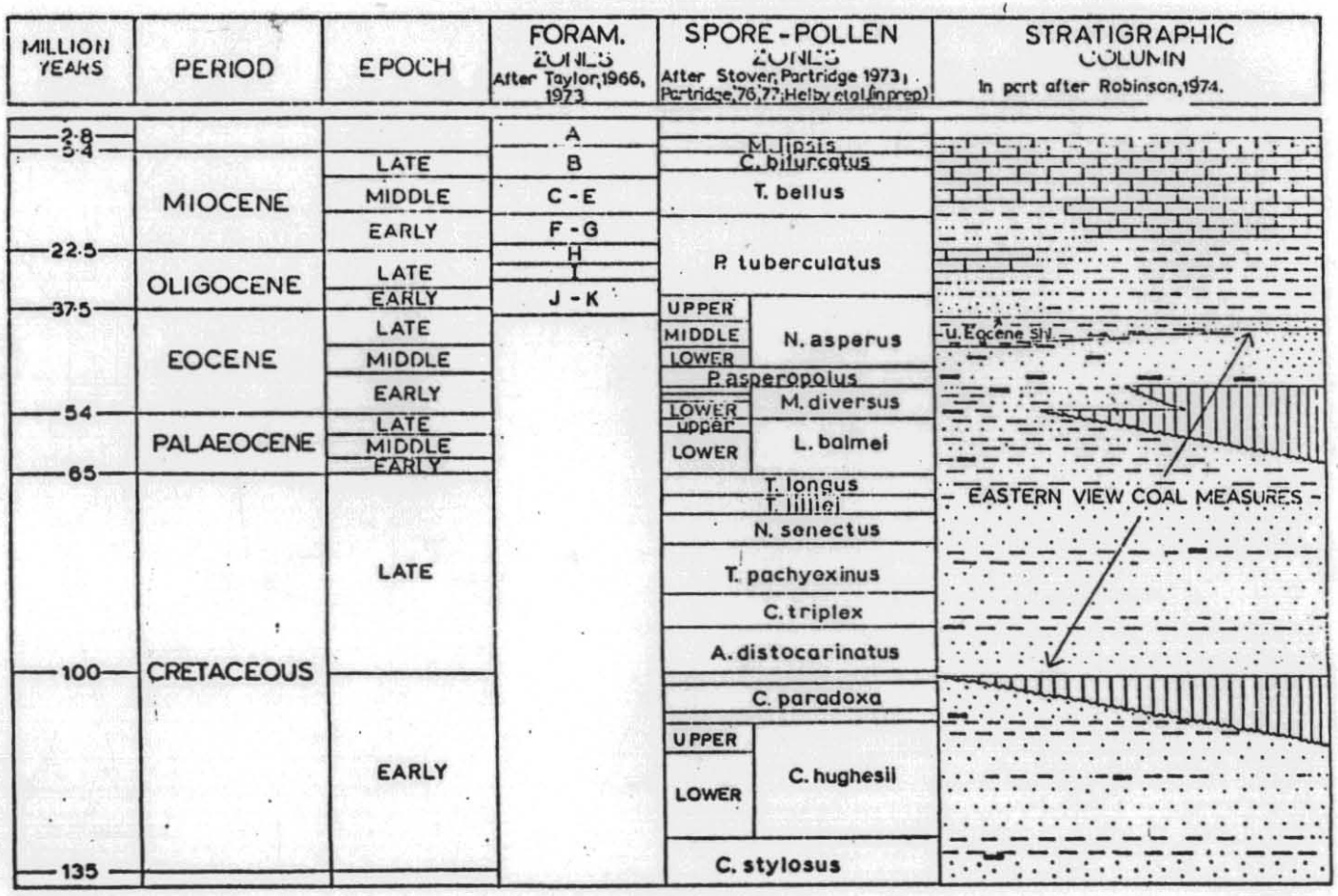
(ii) Sand/Shale ratio = $\frac{\text{Net Sand Thickness}}{\text{Total Thickness} - (\text{Net Sand Thickness} + \text{Coal Thickness})}$

01. 1453' of amygdaloidal basalt were penetrated in Lower L. balmei zone.
02. 248' of intrusive volcanic rock (syenite) were penetrated in Middle E. divarus zone.
03. 43' of olivin basalt were penetrated in Middle E. divarus zone.
04. 363' of intrusive volcanics were penetrated in Lower E. divarus zone.

TIME-STRATIGRAPHIC SUB-DIVISIONS

2230 22

Figure E




**Stratigraphic chart - Bass Basin**

Figure F

223023

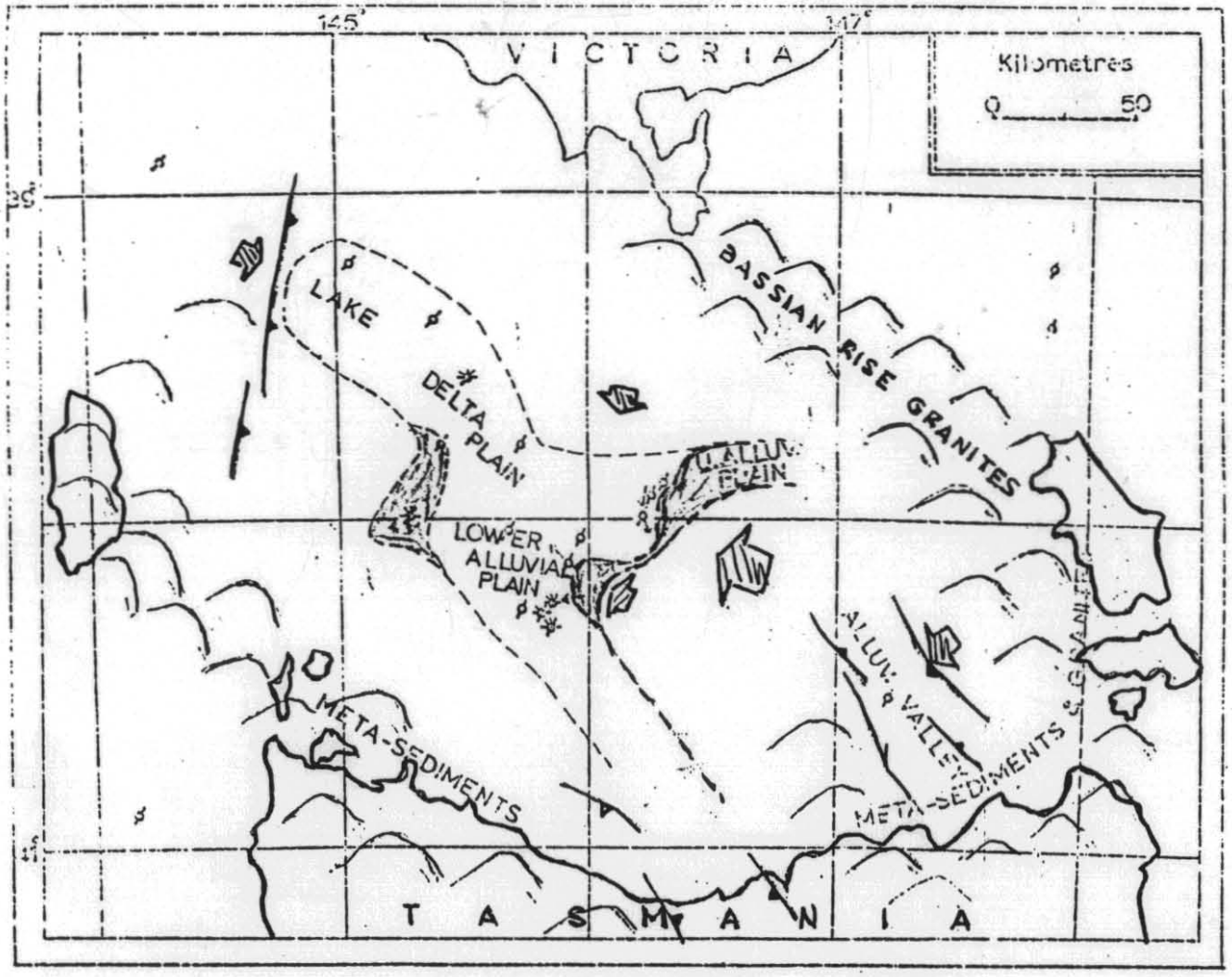
This shale unit is very extensive and reaches a maximum thickness, over 360 meters, in an elongated through situated in the northwestern part of the basin. Figure M. Apparently, the "Upper Eocene Shale" can be traced on seismic sections into the "Torquay Embayment" across the "King Island -- Mornington High". Page 50

- The Bass basin developed in the Early Cretaceous resulting from the postulated initial break-up of the Australian and Antartic continental masses. Major fault movements produced a series of northwest to southwest trending grabens and tilted fault blocks. The environment of deposition for this section is interpreted to be upper alluvial plain including lacustrine. Page 53.

- The distribution of late Cretaceous sediments in the Bass Basin is interpreted to be much more widespread than during Early Cretaceous times as individual trough broadened and merged into a more continuous basin. Page 53.

- During the Paleocene, the basin was structurally quiescent but continued sag along the old major fault systems resulted in over 70 meters of coarse sediments being deposited near the basin margin and possibly over 900 meters of fine sediments in the basin center. Coal deposition throughout the section was limited. The basin appears to have been landlocked with braided streams flowing from the edge of the highlands to the southwest and eastward merging basinward into a broad meandering stream pattern building out into a lacustrine delta plain in the northwest, Figure G, Page 60.

- Increased tectonic activity during the Lower Eocene resulted in renewed movement which gave rise to a slightly smaller basin configuration

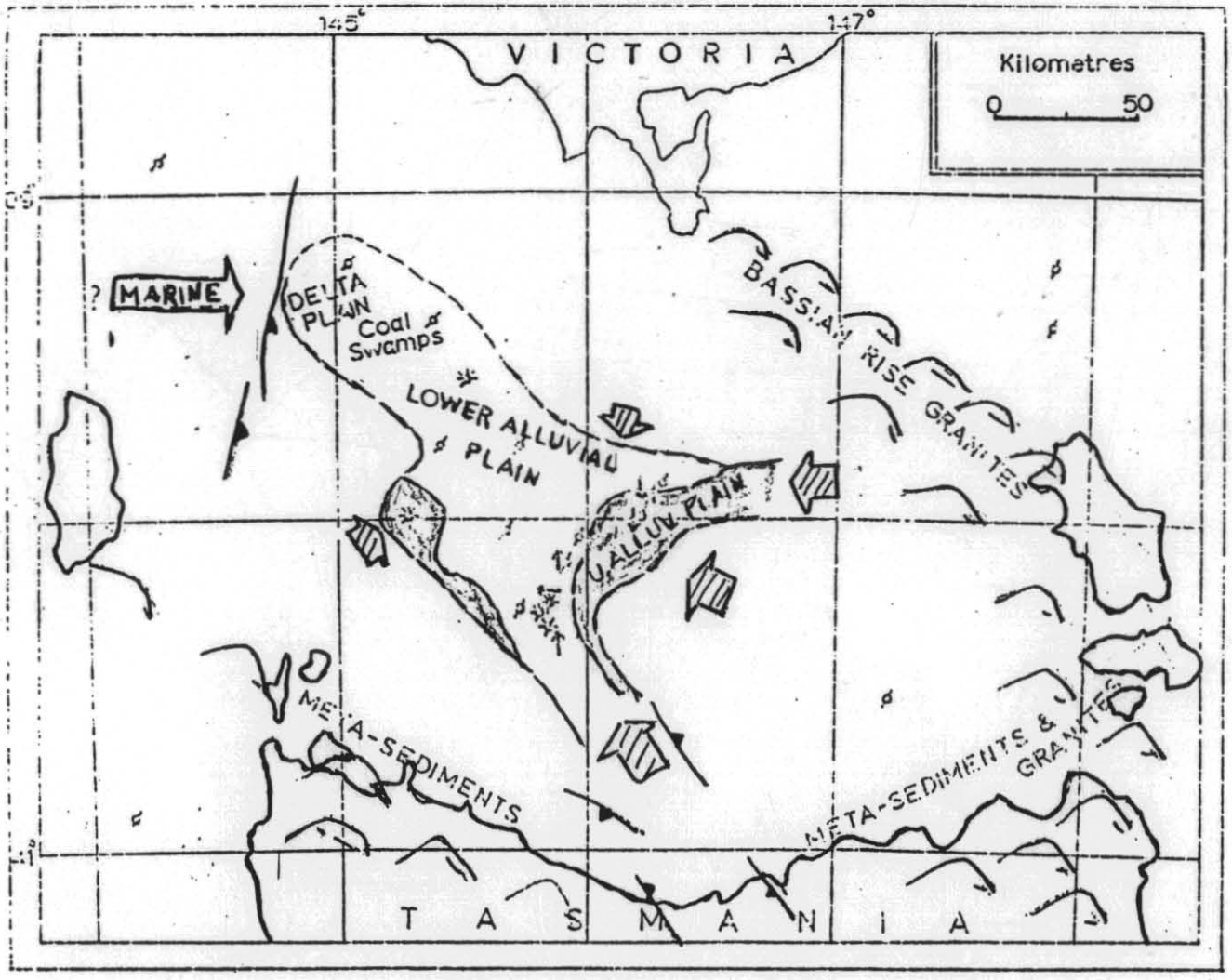



**Palaeogeographic Map - Palaeocene.**

5 cm

223025

Figure G




UPPER ALLUVIAL PLAIN

LOWER ALLUVIAL PLAIN

DELTA PLAIN

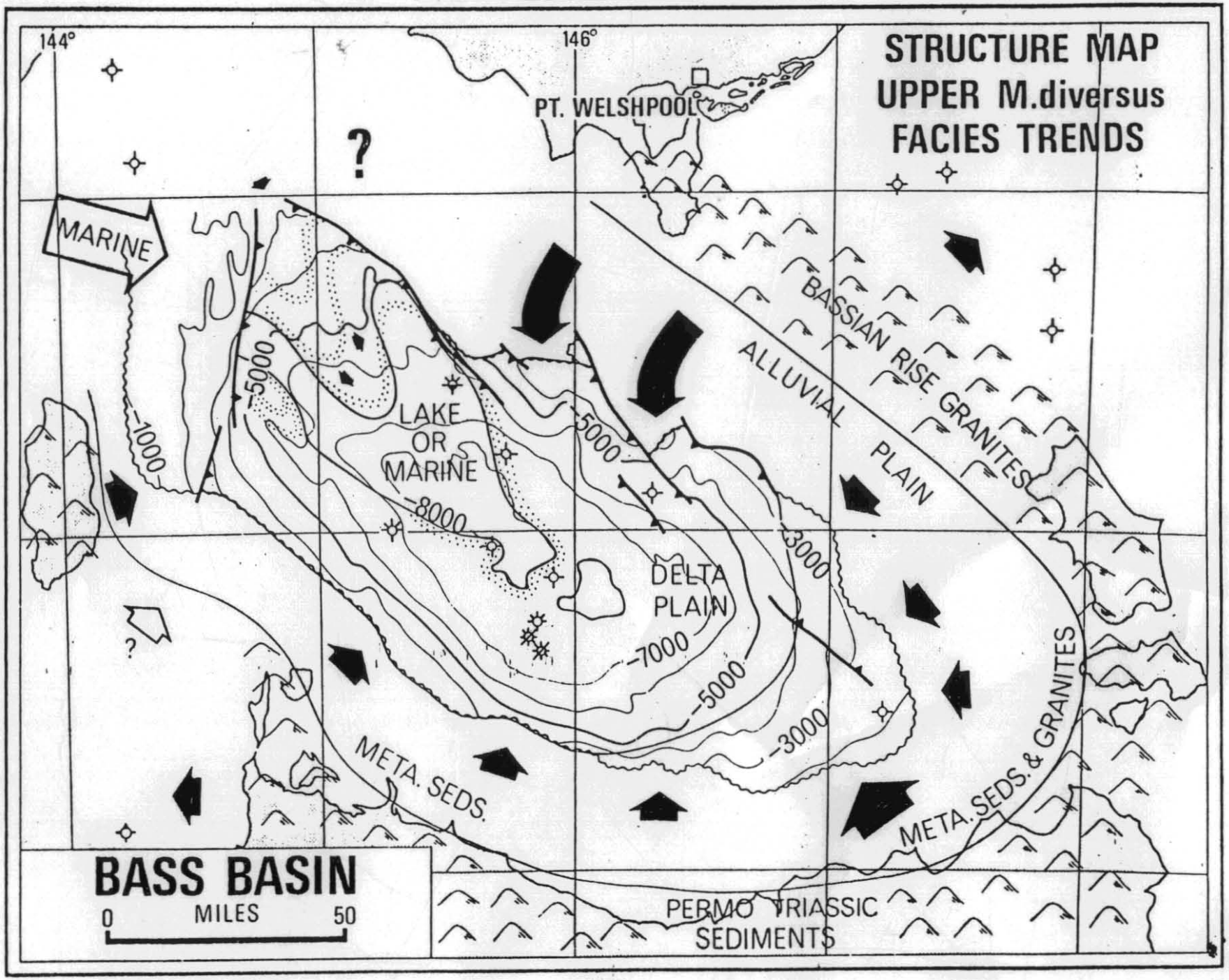
← SEDIMENT TRANSPORT DIRECTION

**Palaeogeographic Map - Early Eocene.**

5 cm

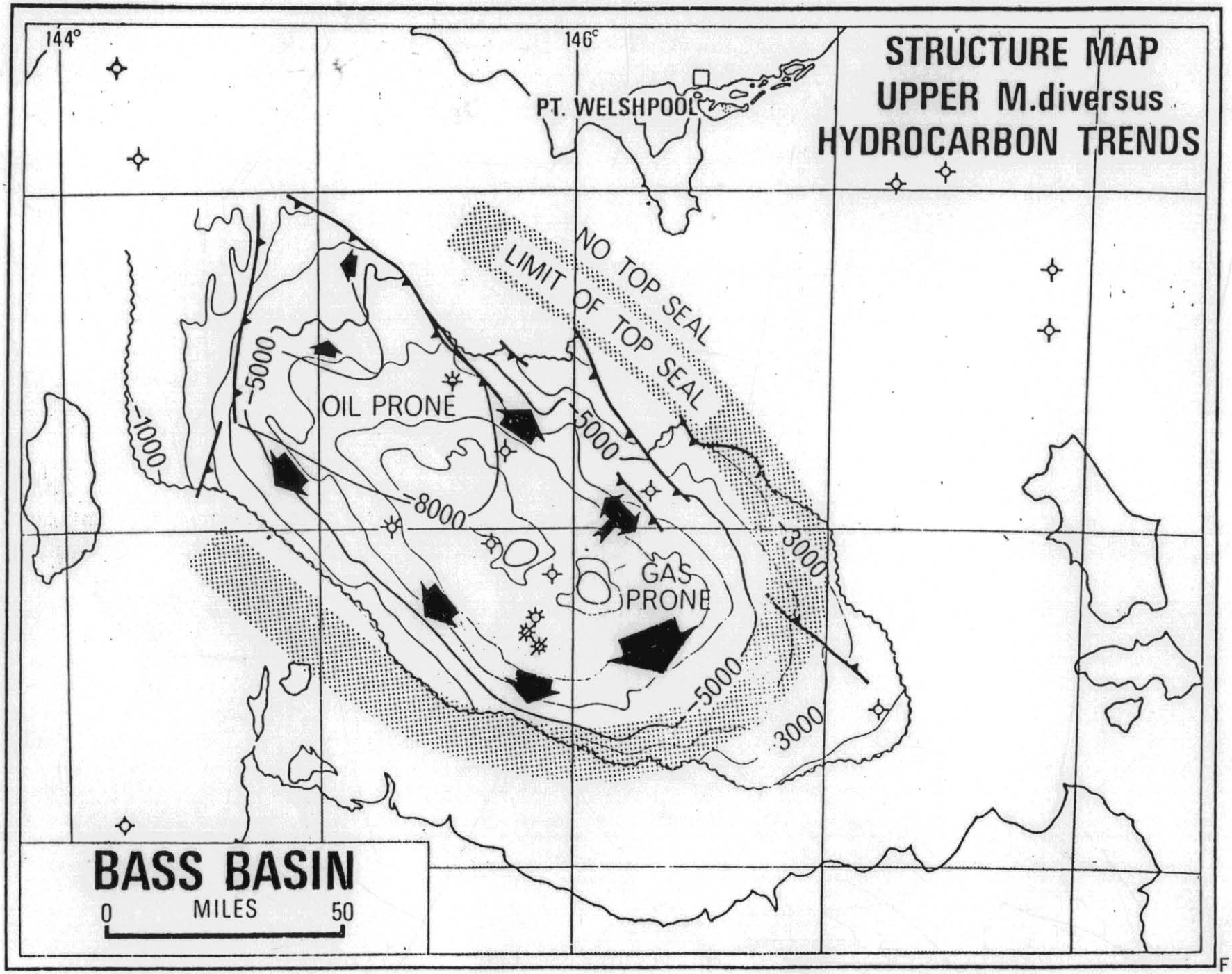
223026

Figure H




223027

Figure 1



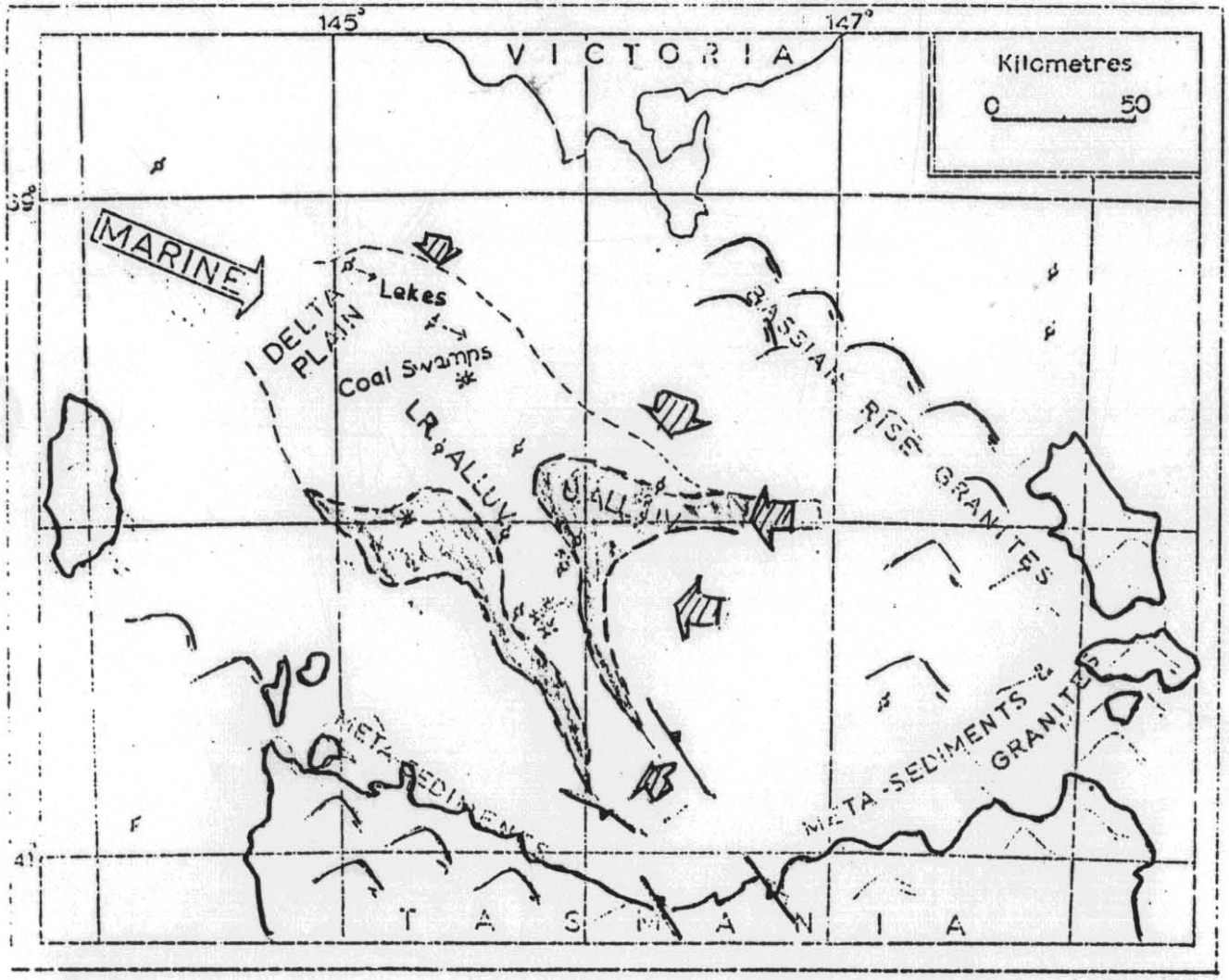

2223028

Figure J

than that which existed during the Paleocene, Page 64. The structural movements were intensified towards the end of the Early Eocene and were accompanied by faulting, folding and local igneous intrusions of the older sediments. Local erosion of the early part of the section produced the unconformity which is seen at the Lower M. diversus zone level. Figure H, I, J.

- During the Middle Eocene, stream activity increased. A pattern of braided streams flowed out from the edge of the rugged basin margin, merging into a cut-and-fill secondary stream channel system which built out over extensively developed coal swamps. This section is characterized as having both the highest sand content and the highest coal percentage within the Eastern View Coal Measures sequence. Provenance areas were located on the Tasmanian mainland in the south, the "Bassian Rise" in the east and for the first time, along the basin margin in the north and northwest. Figure K Page 65.

- The Late Eocene is dominated by the widespread deposition of the "Upper Eocene Shale". This shale unit was depositesd as a result of a marine transfression which started in the northwest and moved very rapid to the southeast. Figure L, M, N.




UPPER ALLUVIAL PLAIN

LOWER ALLUVIAL PLAIN

DELTA PLAIN

MARINE

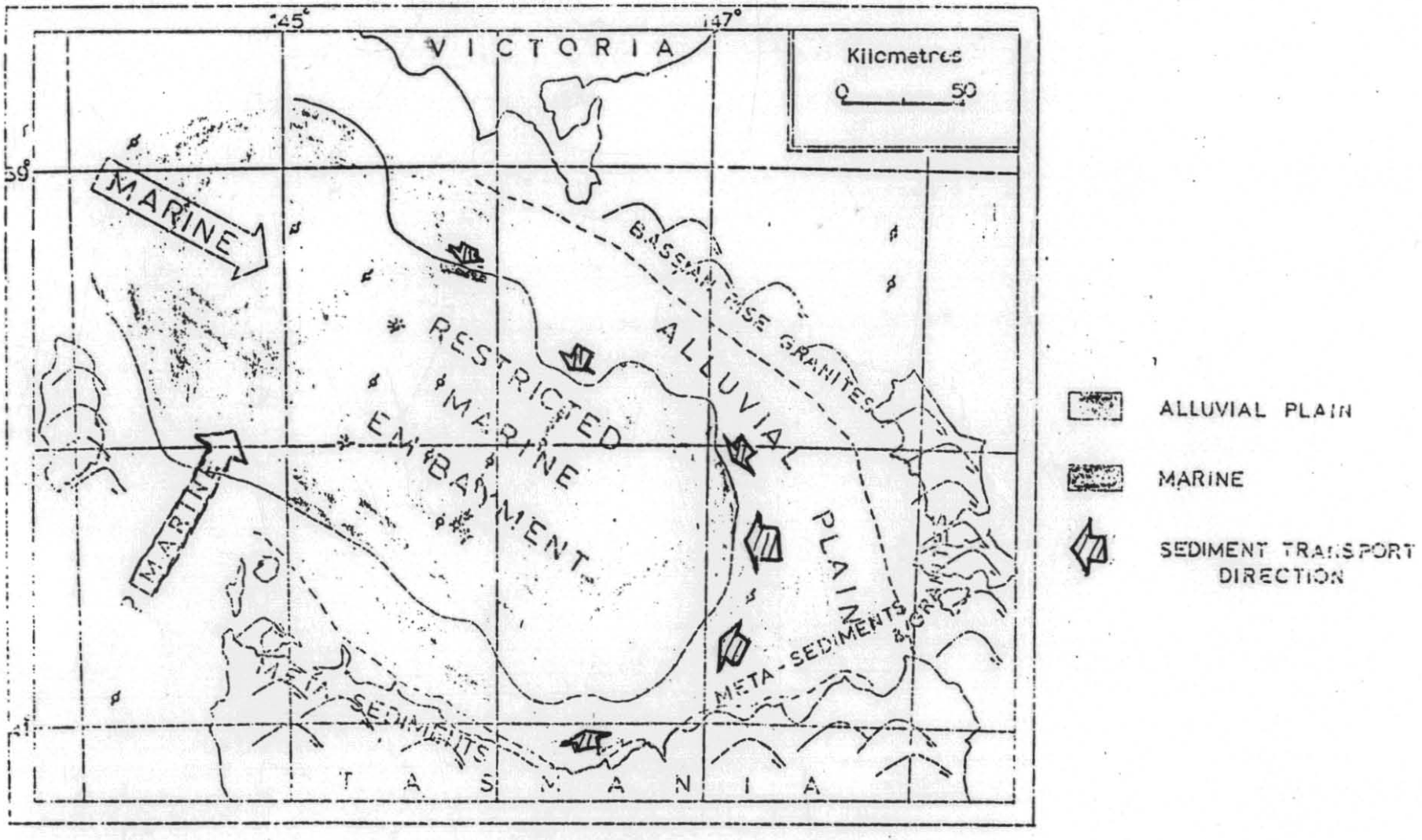
– SEDIMENT TRANSPORT DIRECTION

**Palaeogeographic Map - Middle Eocene.**

5 cm

223030

Figure K

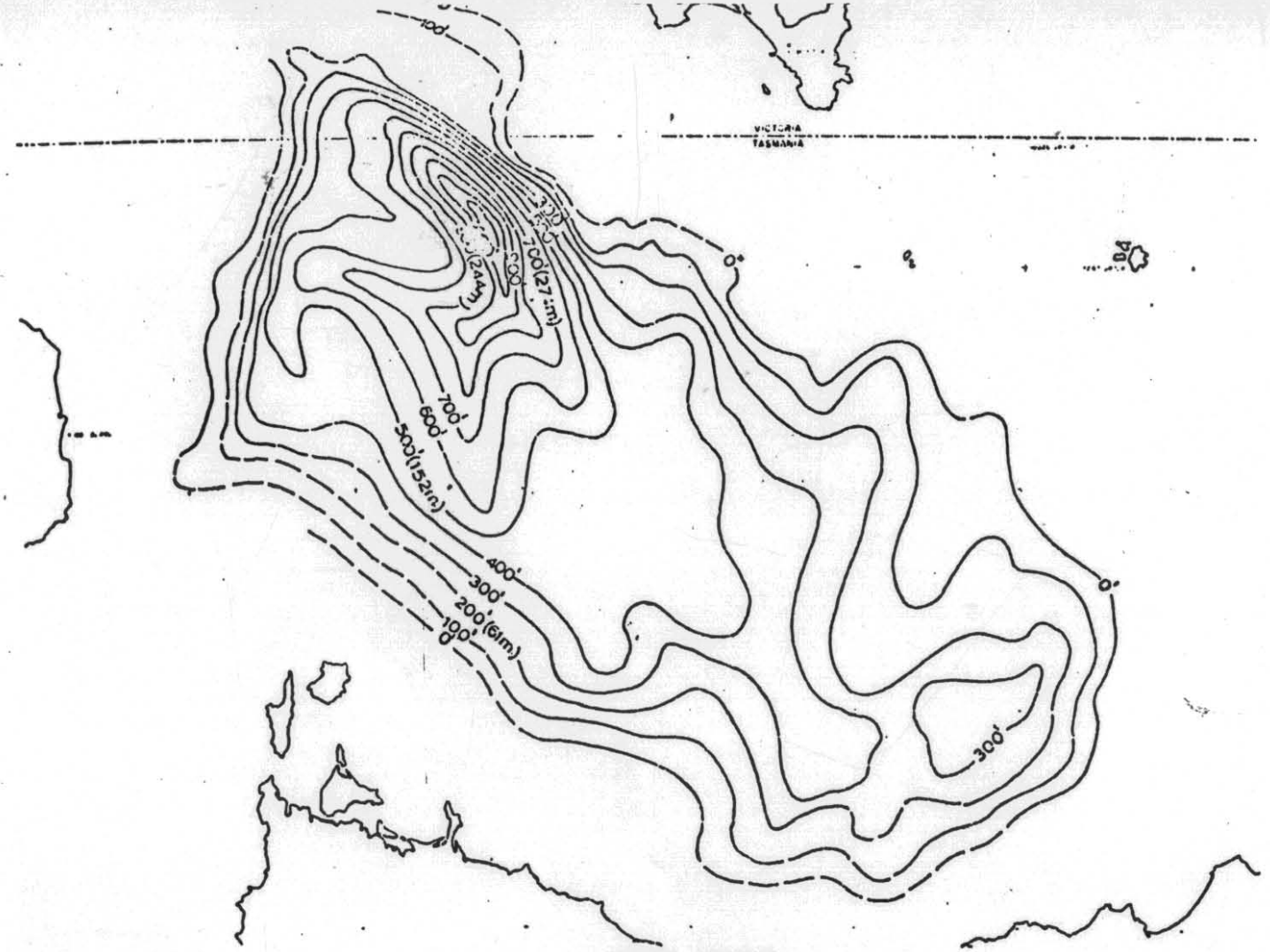



**Palaeogeographic Map - Late Eocene.**

5 cm

Figure L

223031




BASS BASIN
"Upper Eocene Shale" Isopach Map

Contoured in feet

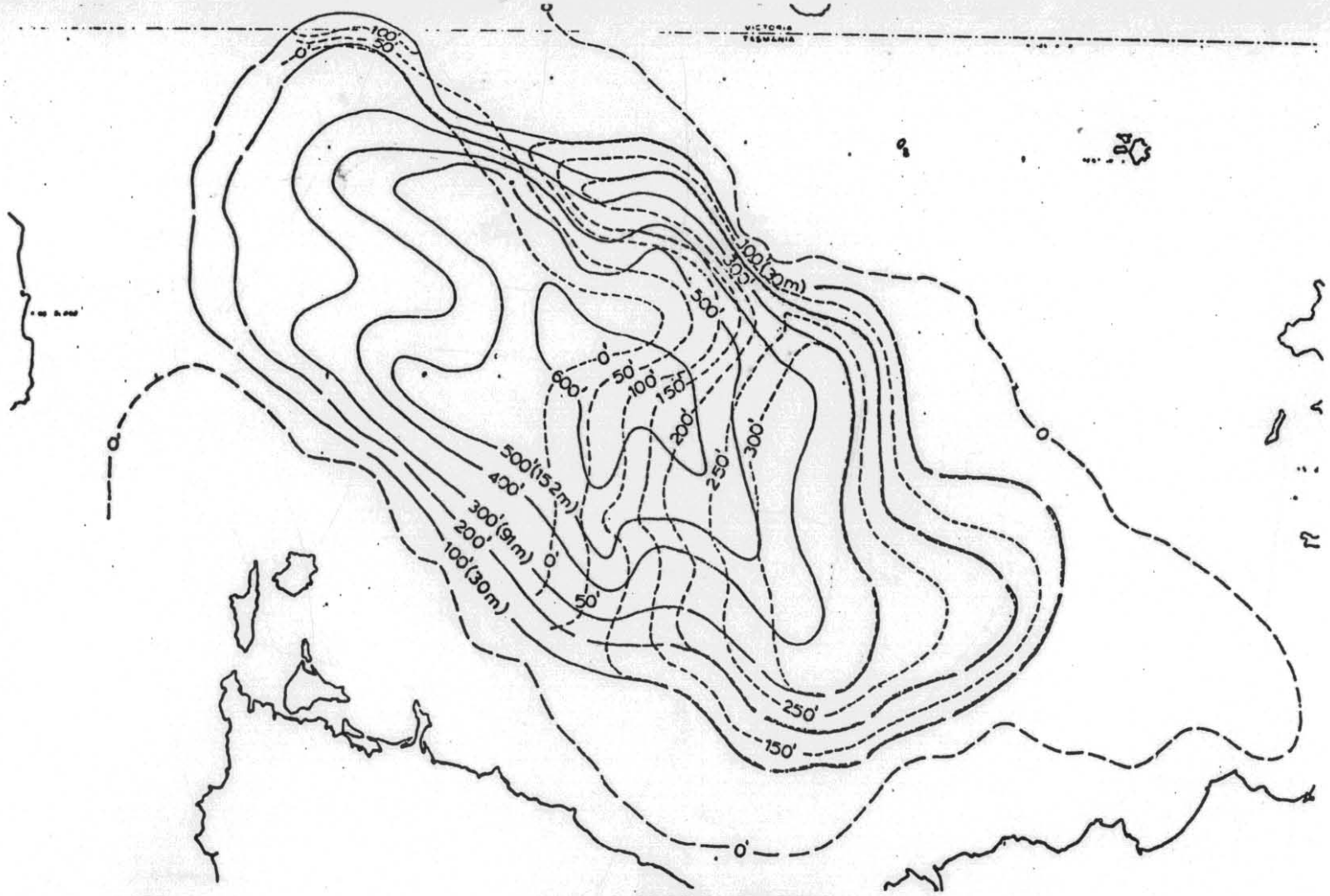
—700'— Isopach

Kilometres
0 25 50 75 100
0 25 Miles 50

5 cm

Figure M

2230032




BASS BASIN

Top Upper N. asperus Zone -
Top "Upper Eocene Shale"

Isopachs and Net Sand Thickness (nearshore/ shallow marine)

~500'~ isopach

-·-150'-·- net sand thickness

Contoured in feet

Kilometres
0 25 50 75 100
0 25 Miles 50

5 cm

Figure N

2233033

## WELL COMPLETION REPORTS

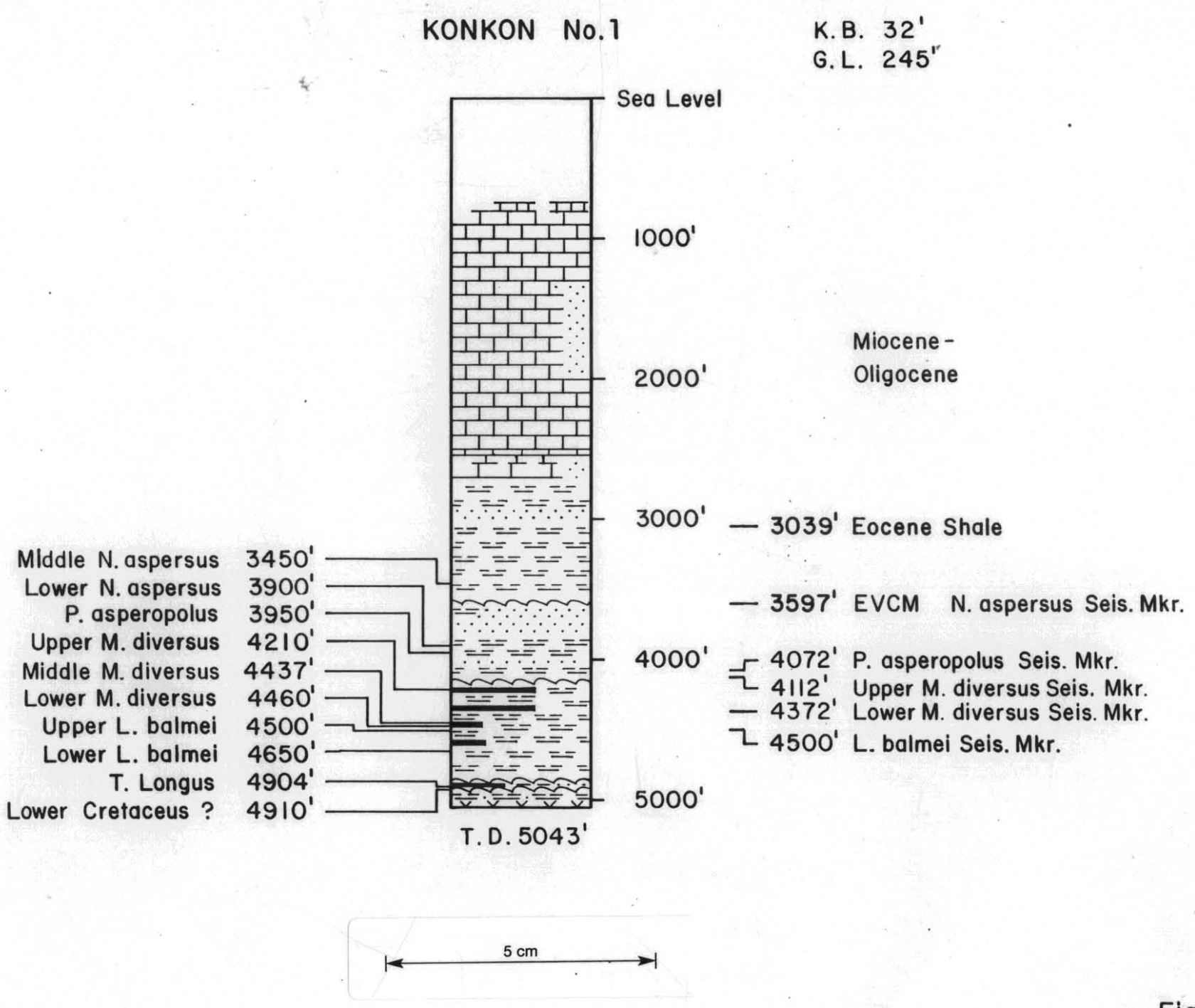
The following is extracted from the well completion reports. Comments are added.

The Konkon #1 well was designed to test an interpreted closed wedge (one contour closure) of M. diversus and older sediments on the flank of a large plunging nose in the northwest portion of the Bass basin. The well encountered the predicted sequence with no shows of oil or gas and was abandoned at 5043 feet in highly altered volcanic rocks. It is interpreted to have bottomed in Lower Cretaceous rocks, although no spore-pollen data were obtained from side wall cores below 4904'. The stratigraphic columns, Figure 0, illustrate the sequence encountered. The section is very condensed due to the structural position of the well.

| | |
|---|---|
| basal Oligocene Sand | 2920' - 3040' |
| Eocene Shale | 3040' - 3980' |
| | |
| Interpreted sand facies of the | |
| Eocene Shale | 3595' - 3860' |
| EVCM | 3860' - 4910' |
| Cretaceous | 4910' - TD. |

The sand facies of the Eocene shale is interpreted to be of local development. The shaly and coaly Eastern View Coal Measures section indicate a starved basin area. Figures G, H, K, L.

The Toolka #1 A well was designed to evaluate a rather ill-defined separate closure on trend and to the northwest of the Cormorant #1 well. The primary objective was the middle Eocene sands which contained oil and gas condensate at Cormorant #1. Structural growth was during the Oligocene - Miocene. Minor oil and gas shows were encountered in the Middle Eocene




223035

Figure O

TOOLKA No. 1-A

K.B. 32'
G.L. 258'

223036

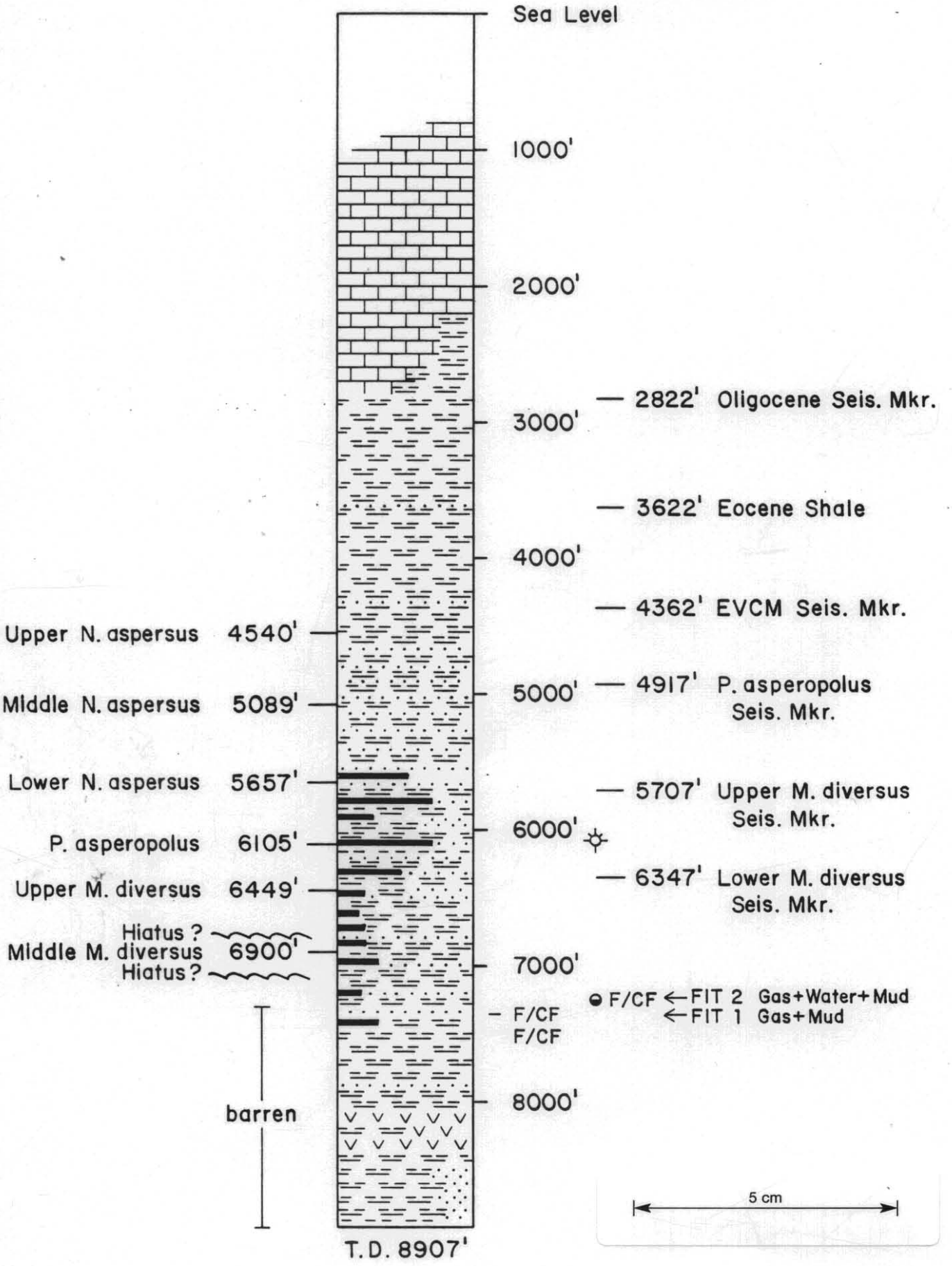



Figure P

while drilling, but F.I.T. test results were negative. Several hundred feet of the Upper Eastern View sand was silted out. The stratigraphic column, Figure P, illustrates the sequence encountered.

| | |
|---|---|
| basal Oligocene Sand | 3560' - 3622' |
| Eocene Shale | 3622' - 4810' |
| EVCM | 4810' - TD |

The well tested a late formed structure, Oligocene-Miocene located in a starved basin characterized by shale and coal sedimentation. Figures G, H, K, L.

The Cormorant #1 well was designed to test the uppermost Eocene sands of the eastern View Coal Measures sectin on an outiclinal closure of Oligocene - Miocene age. The anticlinal closure was encountered as predicted, however the uppermost sands contained salt walt. If the overlying Demon's Bluff shale is assumed to be capable of forming a seal then it would appear that structural growth necessary to trap hydrocarbons in the uppermost sands occured too late. Significant hydrocarbon indications were encountered and are listed.

| | |
|---|---|
| 4918' - 4924' | 6' Oil |
| 5990' - 5996' | 6' Gas |
| 6585' - 6592' | 7' Gas |
| 7458' - 7464' | 6' Gas |
| 7690' - 7698' | 8' Gas |
| 4273' - 4274' | Fluorescense, cut. odor |
| 4620' - 4820' | Fluorescense |
| 4900' - 4934' | Fluorescense, cut |
| 4934' - 4963' | Fluorescense, cut |
| 5513' - 5543' | Fluorescense, cut, odor |
| 6004' - 6010' | Fluorescense, cut, odor, stain |
| 7140' - 7170' | Fluorescense, cut |
| 8620' - 8650' | Pinpoint fluorescense |
| 8680' - 8683' | Spotty fluorescense, cut |
| 8683' - 8707' | Spotty fluorescense, cut |
| 9030' - 9040' | Spotty fluorescense, cut |
| 9070' - 9080' | Spotty fluorescense, cut |
| 9128' - 9180' | Spotty fluorescense, cut |

CORMORANT #1

223.038

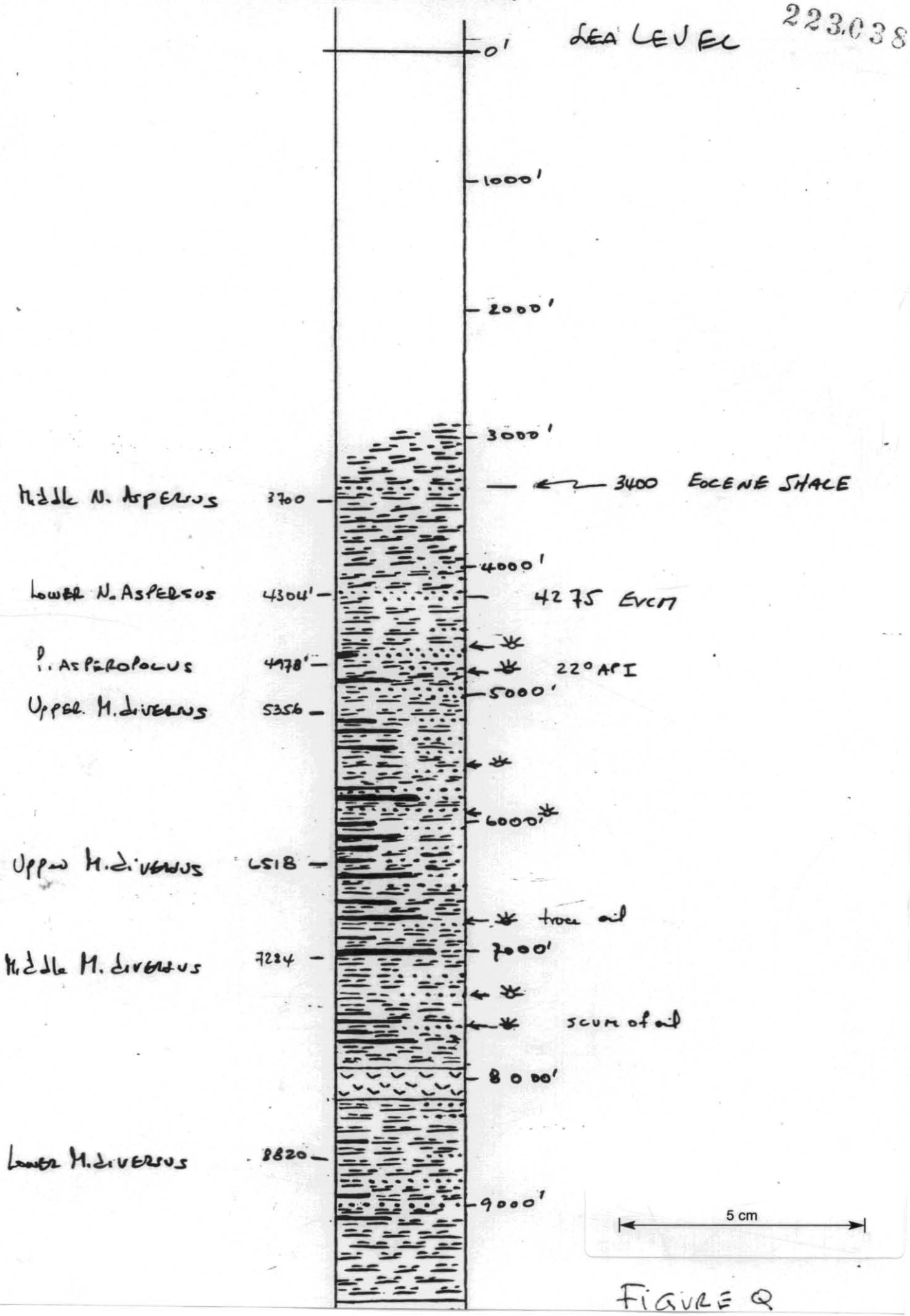



FIGURE Q

Thirteen F.I.T. were taken, the results are as follows:

| | |
|---|---|
| 4647' | 21000 cc filtrate, 1000 cc mud |
| 4703' | Lost Packer Seal |
| 4711' | 20000 cc filtrate, 150 cc mud<br>7.2 cubic feet gas |
| 4922' | 3.2 cubic feet gas, 20000 cc oil<br>dark brown, 22° API |
| 5033' | Lost Packer Seal |
| 5644' | 3500 cc filtrate, 1500 cc mud,<br>0.6 cubic feet gas |
| 6003' | 21.000 cc filtrate, 1000 cc mud,<br>0.8 cubic feet gas |
| 6586' | Misrun |
| 6588' | 4000 cc mud, trace oil |
| 6589' | 0.6 cubic feet gas, 230 cc mud |
| 7456' | 0.7 cubic feet gas, 8000 filtrate.<br>0.1 cubic feet gas |
| 7462' | Misrun |
| 7694' | 1.6 cubic feet gas, 20044 cc<br>filtrate and water, scum of oil |

The stratigraphic column, Figure Q, illustrates the sequence encountered.

| | |
|---|---|
| basal Oligocene Sand | 3475' - 3900' |
| Eocene Shale | 3900' - 4275' |
| EVCM | 4275' - TD. |

The well tested a late formed structure, Oligocene - Miocene, located in a starved basin characterized by thin sands, shale and coal sedimentation. Figures G, H, K, L.

The Aroo #1 well was located over a major northeast-southwest trending basement ridge above which closure had been mapped at three levels interpreted to lie some 2000' to 10,000' below the top of the Eastern View Coal Measures. The deep basins proper lie to the southeast of this ridge and there are a

series of distinct depressions to the northwest. These sub-basins appear to be faulted and reflect structural growth of the ridge throughout the upper Cretaceous. A major northwest-southeast fault to the east of the Aroo structure cuts through the Eocene section. Thickenning of the section, on the downthrown, northeast side of the fault is interpreted to be of the order of 2000 feet of interbedded sediments. The orientation of this fault, and several smaller ones in the Aroo area is parallel to the main basin forming tensional fault system which created this basin.

The stratigraphic column consist of the followig:

| | |
|---|---|
| basal Oligocene Sand | absent |
| Eocene Shale | 5925' - 6723' |
| EVCM | 6723' - TD |
| Interbedded volcanics of Paleocene or pre-Paleocene Age | 10327'- 12112' TD. |

Hydrocarbon indications have been recorded over the following intervals:

Samples:

| | |
|---|---|
| 6950' - 6960' | Fluorescense |
| 8878' | Fluorescense |
| 9447' | Fluorescense |
| 9451' | Fluorescense |
| 9180' | Fluorescense |
| 9514' - 9918' | Fluorescense |
| 10703' - 10886' | Fluorescense |

Sidewall Cores:

| | |
|---|---|
| 6944' | Pinpoint Fluorescense |
| 8878' | Fluorescense, cut |
| 9180' | Fluorescense, cut |
| 9447' | Fluorescense, cut |
| 9451' | Fluorescense, cut |
| 9651' | Fluorescense, cut |

Cores

| | |
|---|---|
| 9515' - 9551' | Fluorescense, cut |

The Aroo #1 well tested a late formed structure related to a northeast-southwest trending volcanic build up associated with a fault. Much of the objective section was not deposited and/or removed by erosion due to local uplift. The well appears to be upthrown to one of the major basin forming faults which borders the central graben area. Figures G, H, K, L.

The Bass #3 well was drilled on the crest of a seismically defined northwest-southeast anticlinal feature.

With the exception of basement, the various formation tops ran consistently low to prediction. This was entirely due to the fact that the velocities of the various rock units were slightly greater than originally predicted. The stratigraphic sequence is as follows:

| | |
|---|---|
| basal Oligocene Sand | 4720' - 4735' |
| Eocene Shale | 4735' - 5305' |
| EVCM (transitional) | 5305' - 5590' |
| Unconformity | 5590' |
| EVCM | 5590' - 7830' |
| Probably unconformity | 7070' |
| Basement | 7830' - 7978' TD |

An F.I.T. was taken at 6740'. It recovered 29 cubic feet of gas, 800cc of condensate and 12500 cc of discolored water. The recovered water was mud filtrate.

Regional structural trends and paleogeographic maps, Figures G to N indicate that the Bass #3 well tested on upthrown tilted fault block on the southwest flank of the central graben area recognized on Permit T-19-P. Well results may be relevant to the evaluation of the Penguin horst block trend.

## LEADS

Several structural anomalies, leads, have been identified and additional seismic data acquisition is recommended to confirm and measure their structural closures.

## MANATEE

The Manatee anomaly was originally recognized on seismic line PB-81-12, Figure 6. where strong reflector at 1.400 to 1.600 seconds dips westward below a major unconformity overlain by east dipping reflectors. The general area has been mapped at the Top Eastern View Coal Measures seismic horizon level, Map 2., the Lower M. diversus seismic horizon seismic level, Map 4. and at a pre-Lower M. diversus seismic horizon level shown on the Dip Rate map, Map 8. An isochron from the top of the Eastern View Coal Measure to the Lower M. diversus seismic horizon has also been constructed Map 6. The most significant map level is the pre unconformity - Dip Rate - map which shows the geometry of the prospective Early Eocene, Paleocene and older section against the western basin border fault. Map 8.

The anomaly area lies along the western margin of the main Early Tertiary and pre-Tertiary Bass Basin depocenter and appears to be associated with a major basin forming, down-to-the-east, growth fault. Westward expansion of the prospective section is recognized. It lies both to the east and to the west of the Mornington - King Island fault and has therefore been influenced by the early rifting tectonics as well as the later movements of this fault. Differential uplift, tilting, deformation and faulting caused the Manatee area to be broken in several fault blocks. At the lower M. diversus seismic time structure map level, Map 4. it is divided in six separate, but related, leads.

The Manatee I lead is a tilted fault block against a down-to-the-east basin forming fault. It is illustrated by seismic line PB-82-25, Figure 5.

Relief: 0.950 to 1.200 seconds
Area : 3700 acres

To the east is the Manatee II lead which also is a tilted fault block against a down-to-the-east fault. It is illustrated by seismic line PB-82-25, Figure 5. and seismic line PB-81-12, Figure 6.

Relief: 1.150 to 1.375 seconds
Area : 6000 acres

To the south is the Manatee III lead. It also is a tilted fault block against a down-to-the-east and northeast fault. It is illustrated by seismic line PB-81-12, Figure 6.

Relief: 1.050 to 1.375 seconds
Area : 3900 acres

To the north is the Manatee IV lead which is a minor rollover closure illustrated by seismic line PB-81-10, Figure 4.

Relief: 1.125 to 1.175 seconds
Area : 2300 acres

A strong reflector at 1.600 seconds shows approximately 60 msec of critical west dip. This event and others below it indicate the presence of a thick Paleocene and older prospective section. These four leads are all located on the upthrown side of the Mornington - King Island fault.

To the east and downthrown of the Mornington - King Island fault are the Manatee V and VI leads. These are illustrated by seismic line PB-82-25, Figure 5 and B-71A-44-S, Figure 12. These leads lie within the Early and pre-Tertiary depocenter and consist of faulted domal features.

V Relief: 1.600 to 1.625 seconds
Area : 2700 acres

VI Relief: 1.575 to 1.600 seconds
Area : 1000 acres

The pre-unconformity section at Manatee has been studied and a Dip Rate Map has been constructed. The major basin forming fault and subsidiary down to the east faults are shown. A large faulted domal feature with significant west and north dip is shown to occupy the Manatee I, II and III leads area mapped at the Lower M. diversus seismic horizon level. Its area of closure is 12000 acres. The Manatee IV lead area is shown to be underlain by an eastward tilted horst block. The two separate closures have an area 1000 acres. The Manatee V and VI leads area is a domal feature with an area of closure of 3900 acres.

The seismic time structure map constructed at the top Eastern View Coal Measures, Map 2. shows mostly regional dip, to the east, over the Manatee area. The basin forming fault is recognized locally and so is the Mornington - King Island Fault. A significant reduction in the rate of dip is shown in the area east of the Mornington - King Island Fault. A minor area of closure is shown over the Manatee V lead.

The isochron top Eastern View Coal Measures to Lower M. diversus seismic horizons shows a thickening of the section to the east of the major basin forming fault, Map 6. This isochron interval is mostly not sensitive to the major period of expansion of the section which took place at pre-unconformity time as shown by the Dip Rate Map, Map 8.

## PENGUIN

The Penguin anomaly trend lies along the southwest margin of the central graben area from which it is separated by the major basin forming fault.

This positive trend is best illustrated at the Lower M. diversus seismic horizon map level, Map 2. At this level a northwest-southeast trending horst block is divided into two separate closures, the Penguin and South Penguin leads. To the northwest, up dip, the Penguin lead terminates, with rollover, against the Mornington - King Island Fault. West of the Mornington King Island Fault is the north-south trending West Penguin lead, and the northwest Penguin lead. Although these four leads share a name, it is obvious that their structural evolution was significantly different.

The Penguin lead is a northwest trending horst block which terminates with rollover to the northwest against the north-south trending Mornington-King Island fault. To the southeast it opens to the deep and expanded section of the central graben area, Figure 7., 13.

Relief: 1.300 to 1.650 seconds
Area : 12500 acres

The South Penguin lead also trends to the northwest. It is down dip and separated from the Penguin lead by its northeast boundary fault, Figure 13. This lead is mostly located on the Permit to the east and south of Permit T-19-P.

Relief: 1.600 to 1.700 seconds
Area : 16900 acres

The west Penguin lead is a north-south trending horst block separated from the Manatee anomaly by the basin forming fault. It is related and

separated from the Penguin lead by the Mornington - King Island fault, Figure 7. and Figure 5. illustrate this lead.

Relief: 0.900 to 1.300 seconds
Area : 11000 acres

The northwest Penguin lead is a horst block located to the west of the basin forming fault. A condensed stratigraphic section is expected.

Relief: 0.800 to 0.900 seconds
Area : 5700 acres

The Penguin anomaly area is recognizable at the level of the Dip Rate map. It is upthrown to the major basin forming fault to the east and northeast. It is also upthrown to the boundary fault of a subsidiary graben to the southwest. To the southeast, the horst block plunges basinward and therefore is connected to the generative area of the Bass basin.

The Penguin anomaly area is also recognizable of the level of the Top Eastern View Coal Measures map. Short segments of the boundary faults have been mapped. The Penguin and South Penguin horst blocks are shown as a broad southeastward plunging high. A small rollover closure is mapped at the intersection of the Penguin horst block with the Mornington - King Island fault. Another small closure is mapped at the intersection of the basin forming fault and the west fault of the West Penguin lead.

The isochron map - Top Eastern View Coal Measures to Lower M. diversus seismic horizon level - shows a very distinct area of thinning over the Penguin, South Penguin and West Penguin trend. It is flanked to the northeast and the southwest by isochron thick areas.

223047

## SEAL

The Seal anomaly lies along the northeast boundary area of the central graben. This horst block is well displayed at the Lower M. diversus seismic horizon map level, Map 2. Two upthrown closures against separate faults have been identified in the basinward area. These leads are illustrated by Figure 7., Figure 11., Figure 10., Figure 9., and Figure 4. Two apparently separate closures constitute the Seal lead.

Relief: 1.400 to 1.450 seconds
Area : 4500 acres

The southwest Seal lead has a very small area of closure at this map level.

The Seal leads are well recognized at the level of the Top Eastern View Coal Measures horizon map. A large closure overlies the two separate Lower M. diversus closures. The southwest Seal lead area also displays a significant domal closure at this map level.

The isochron map - Top Eastern View Coal Measures to Lower M. diversus seismic horizon level - shows a distinct area of thinning over the Seal lead area.

223048

## EASTERN AREA

The area of the permit to the east of the Manatee, Penguin and Seal anomalies has also been mapped at the Lower M. diversus seismic horizon level maps, as well as at the Top Eastern View Coal Measures seismic horizon level, Map and Map 3. An isochron - Top Eastern View Coal Measures to Lower M. diversus seismic horizon - has also been constructed, Map 7. A number of leads have been identified. These leads are not described and seismic acquisiton is not recommended at this stage.

REPRESENTATIVE SEISMIC LINES

Seismic lines of different vintages and scales illustrate the geometry of the leads as well as the resolution and penetration of the seismic signal in various areas of the permit area, Figures 4 to 14. The reflectors are color coded: top Eastern View Coal Measures is purple and the Lower M diversus horizons is red. The other colors serve to highlight organized bands of energy.

Figure 4 is an east-west line acquired by Perthshire in 1981. It illustrates the Manatee IV lead which is located within the central graben area. The major basin forming listric growth fault is shown. Simple rollover is recognized at various levels.

Figure 5 is an east-west line acquired by Perthshire in 1982. It illustrates the Manatee I, II, IV and V leads which are located within the central graben area. The major basin forming fault, the unconformity and the Mornington - King Island Fault are shown. West dip is recognized below the unconformity.

Figure 6 is on east-west line acquired by Perthshire in 1981. It illustrates the Manatee II and III leads which are located within the central graben area. The major basin forming fault, the unconformity and the Mornington - King Island Fault are shown. West dip is recognized below the unconformity.

Figure 12 is a northwest-southeast line located entirely within the central graben area. It illustrates the Manatee V lead. Dip to the northwest is recognized.

Figure 7 is a southwest-northeast line which strikes across the basin. West of the Mornington - King Island Fault is the West Penguin lead followed by the Penguin lead, the central graben area and the Seal anomaly area. Further to the northeast, the section is very condensed.

Figure 13 is a northwest-southeast line which illustrates the rollover of the Penguin lead and the Mornington - King Island Fault.

Figures 8 and 9 are northeast-southwest dip lines which illustrate the Seal leads area.

Figures 10 and 11 are northwest-southeast strike lines which illustrate the Seal leads area.

Figure 14 is a northeast-southwest dip line which illustrates an unnamed lead far removed from the main Teritary and pre-Teritary depocenters.

223051

ENCLOSURE

- 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, P. G. Stuart-Smith.

223052

FIGURES (TO FOLLOW)

1. Geoseismic Section AA'

2. Geoseismic Section BB'

3. Geoseismic Section CC'

4. Seismic Line PB-81-10 M Sp 660-1380
   Manatee/Seal area

5. Seismic Line PB-82-25 Sp 61-617
   West Penguin/Manatee Area

6. Seismic Line PB-81-12M Sp 760-1240
   Manatee Area

7. Seismic Line B-71-A-40 Sp 8132-8266
   Penguin/Central Graben/Seal Area

8. Seismic Line EB-3 Sp 1-44
   Seal Area

9. Seismic Line EB-4 Sp 87-56
   Seal Area

10. Seismic Line B-70-A-24 Sp 9562-9784
    Seal Area

11. Seismic Line HB-75-A-156 Sp 157-409
    Seal Area

12. Seismic Line B-71-A-44-5 Sp 1954-1978
    Central Graben/Manatee Area

13. Seismic Line B-72-A-134 Sp 3655-3623
    Penguin Area

14. Seismic Line HB-75-A-179 Sp 277-139
    Southwest Area

IN TEXT

A.
1.2.3. Synthetic Seismogram Konkon #1 well

B. Bass Strait Geophysical survey 1982
   Bureau of Mineral Resources

C. Location of BMR traverses.

223053

D. Line drawings of BMR Traverses

E. Time - Stratigraphic Sub-divisions

F. Stratigraphic Chart

G. Paleogeographic Map - Paleocene

H. Paleogeographic Map - Early Eocene

I. Structure Map Upper M. diversus, Facies Trends

J. Structure Map Upper M. diversus, Hydrocarbon Trends

K. Paleogeographic Map. Middle Eocene

L. Paleogeographic Map. Late Eocene

M. Upper Eocene Shale Isopach Map

N. Isopach and Net Sand Thickness.
Top Upper N. Aspersus Zone to
Top Upper Eocene Shale
(basal Oligocene Sand)

O. Konkon #1 Stratigraphic Column

P. Toolka #1A Stratigraphic Column

Q. Cormorant #1 Stratigraphic Column

223054

MAPS

1. - Major Structural Elements and Location of Leads. 1:250.000

2. - Seismic Time Structure Map - Top Eastern View Coal Measures. West Panel. 1:50.000

3. - Seismic Time Structure Map - Top Eastern View Coal Measures. East Panel. 1:50.000

4. - Seismic Time Structure Map - Lower M, diversus Seismic Horizon. West Panel. 1:50.000

5. - Seismic Time Structure Map - Lower M. diversus Seismic Horizon. East Panel. 1:50.000

6. - Isochron Map - Top Eastern View Coal Measures to Lower M. diversus Seismic Horizon. West Panel. 1:50.000

7. - Isochron Map - Top Eastern Vie Coal Measures to Lower M. diversus Seismic Horizon. East Panel. 1:50.000

8. - Dip Rate Map - Pre Lower M. diversus Seismic Horizon. 1:50.000

9. - Aquisition Program - Showing Location of Leads and Proposed Seismic Lines. 1:50.000

223055

# 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

223056

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

223057

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

223058

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

223059

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.

223060

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.

223061

## 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

223062

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.

223063

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.

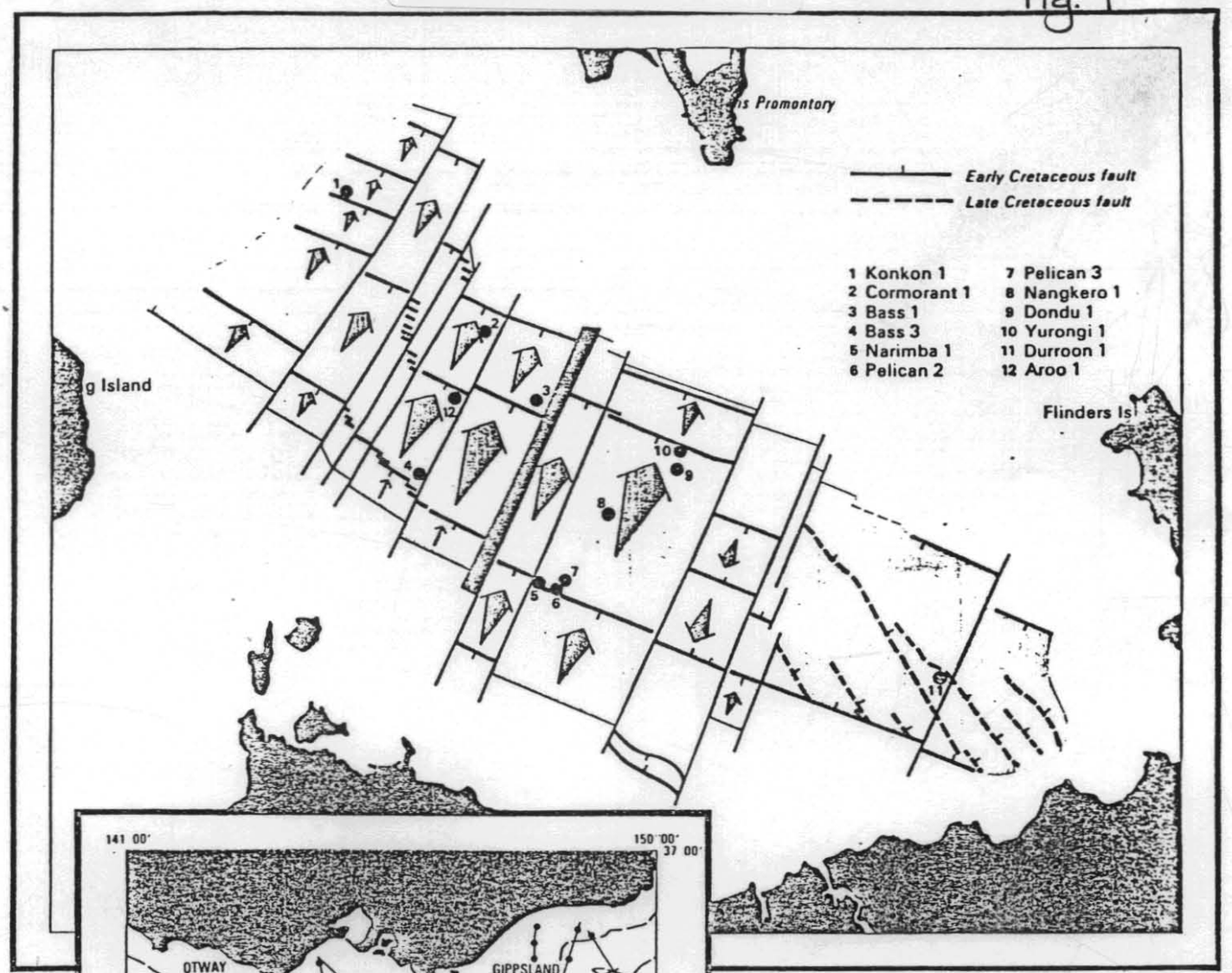
Figure 3. Thermal history, subsidence & heatflow curves, near Bass-1 well Bass Basin.

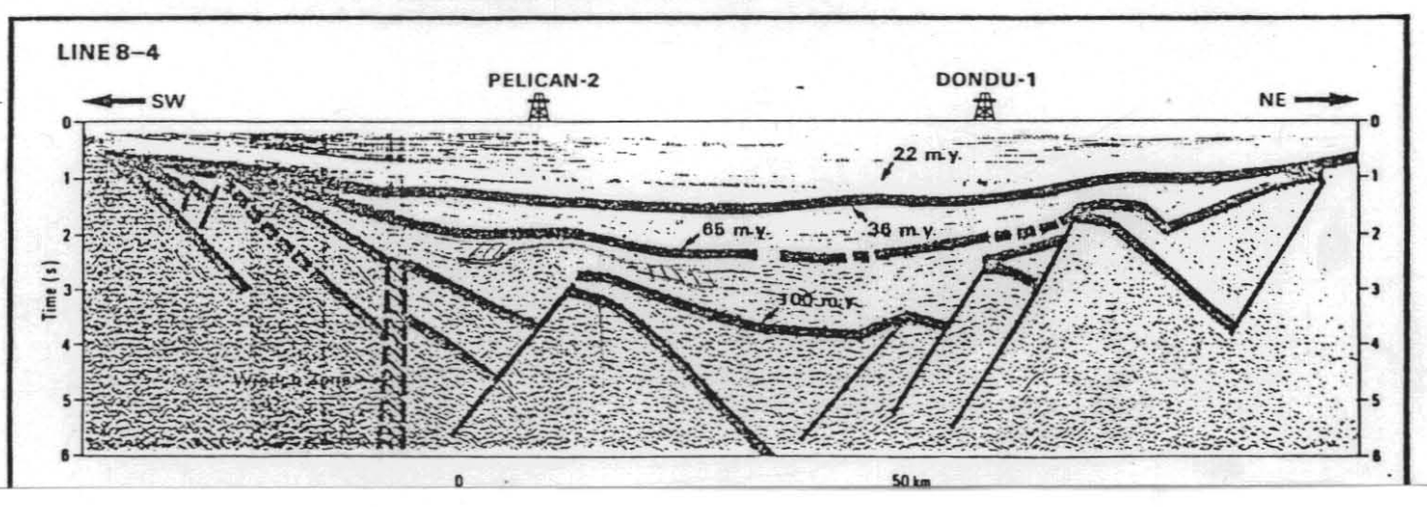
<840223.1019>

Figure 4 Major Cretaceous Structures
Figure 5 Sketch of Regional Model of Cretaceous Lithospheric Stretching
Figure 6 Line Drawings of BMR Traverses

5 cm

223064 Fig. 1



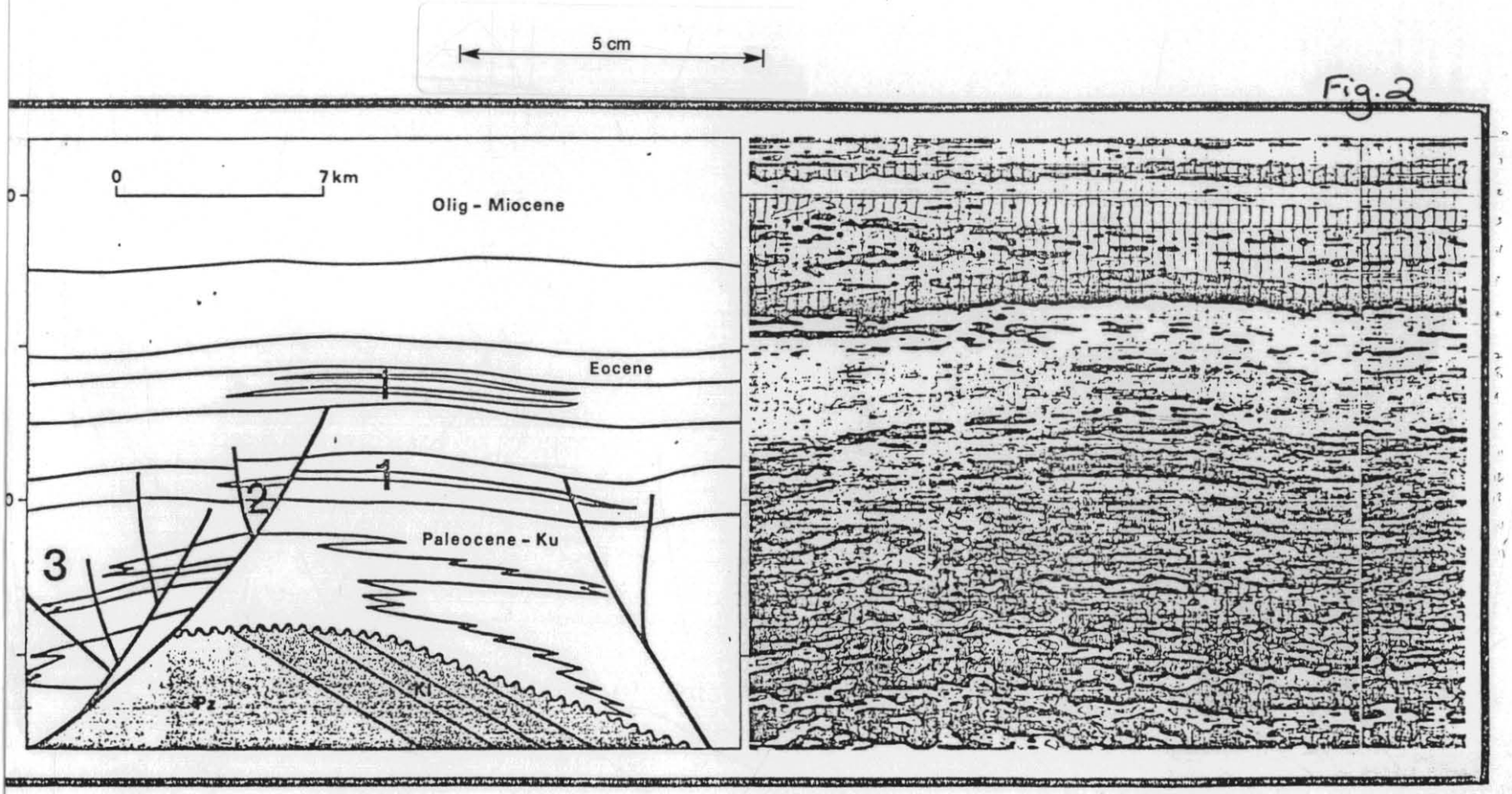
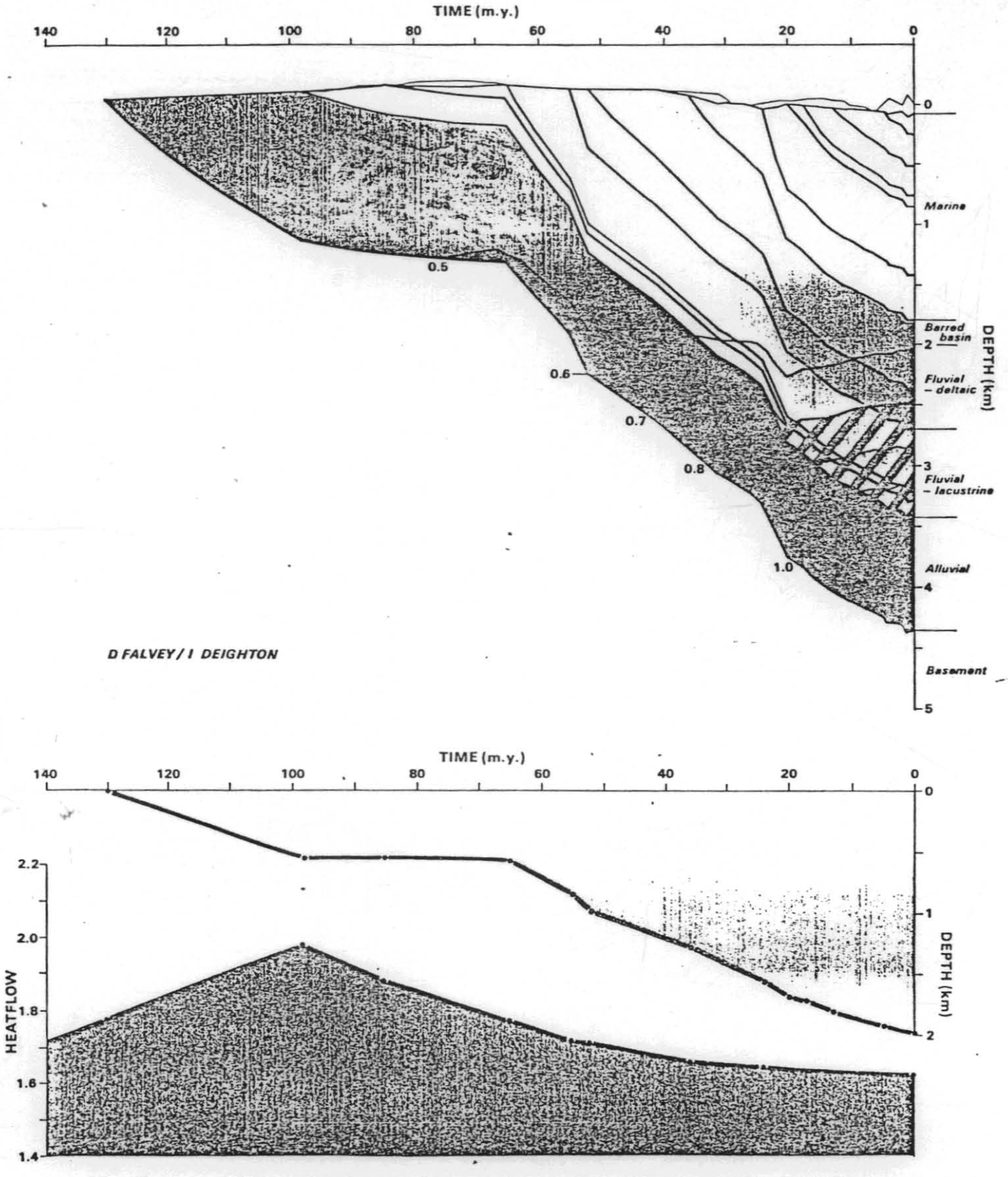



Fig. 2

223065

223066

Fig. 3


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)
0
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)

The earliest deposition within the basin was probably Early Cretaceous, say 125 m.y. as Jurassic dolerites in Tasmania do not seem to be present in the Bass Basin. Faulted tilt blocks formed wedge shaped depressions into which alluvial fans poured material from the basin margins. In the southeast around Durroon this style of faulting continued throughout the Late Cretaceous as well. The major fault patterns were approximately 200° strike. The southeastern fault pattern has a strike 320° which follows the grain of the earlier Palaeozoic. At the basin margins the interplay of 290° 320° faults gives a zig-zag edge to the Cretaceous and this form persists throughout the fluvial phases of Late Cretaceous and Paleocene (early Latrobe equivalent).

Variations in basement tilt block patterns were achieved during the Early Cretaceous by a series of transfer (like transform) faults which allowed different directions of tilt blocks to develop and permitted variations in stretch of the brittle lithosphere of the Bass Basin. We estimate that the basement was extended about 50% across the main basin center.

In a model study by Garry Karner he produced the gravity field and Tertiary sag of the Bass Basin using our tilt block style of movement lasting 20 m.y's and then allowing the lithosphere to recover over the next 20 million years. The results are still being computed for the variations in temperature in the basin center. The lower than expected maturation of the Bass Basin is also explained by Garry's model because he has taken a 2 dimensional heat flow pattern, not the normal one dimensional heat-flow commonly used. This allows heat to escape from a narrow basin along the flanking blocks and suits our Bass Basin case.

The rift filled alluvial centers of the Early Cretaceous are therefore responsible for the driving mechanism for later "sag" (lithospheric flexure) basin which formed from the Late Cretaceous through the Tertiary.

The Mornington-King Island Rise is considered to be a much younger feature than the central Bass Basin. Although the Eocene generally laps-out against the region the northeast fault system appears to cut all marine sediment up to the Plio-Pleistocene and is even to the present day. A network of seismological stations in Melbourne has provided an earthquake pattern which suggests that the north-east fault system is still active.

I am left with two important questions on the Bass Basin region:- Did the Early Cretaceous form the same wedges of alluvial sediment across the Mornington-King Island region as it does in the basin center?

If the dying phases of the fault controlled deposition in the Early Cretaceous formed restricted alluvial systems in the Late Cretaceous and Paleocene, did these fluvial systems occur over the basin flanks?

223068

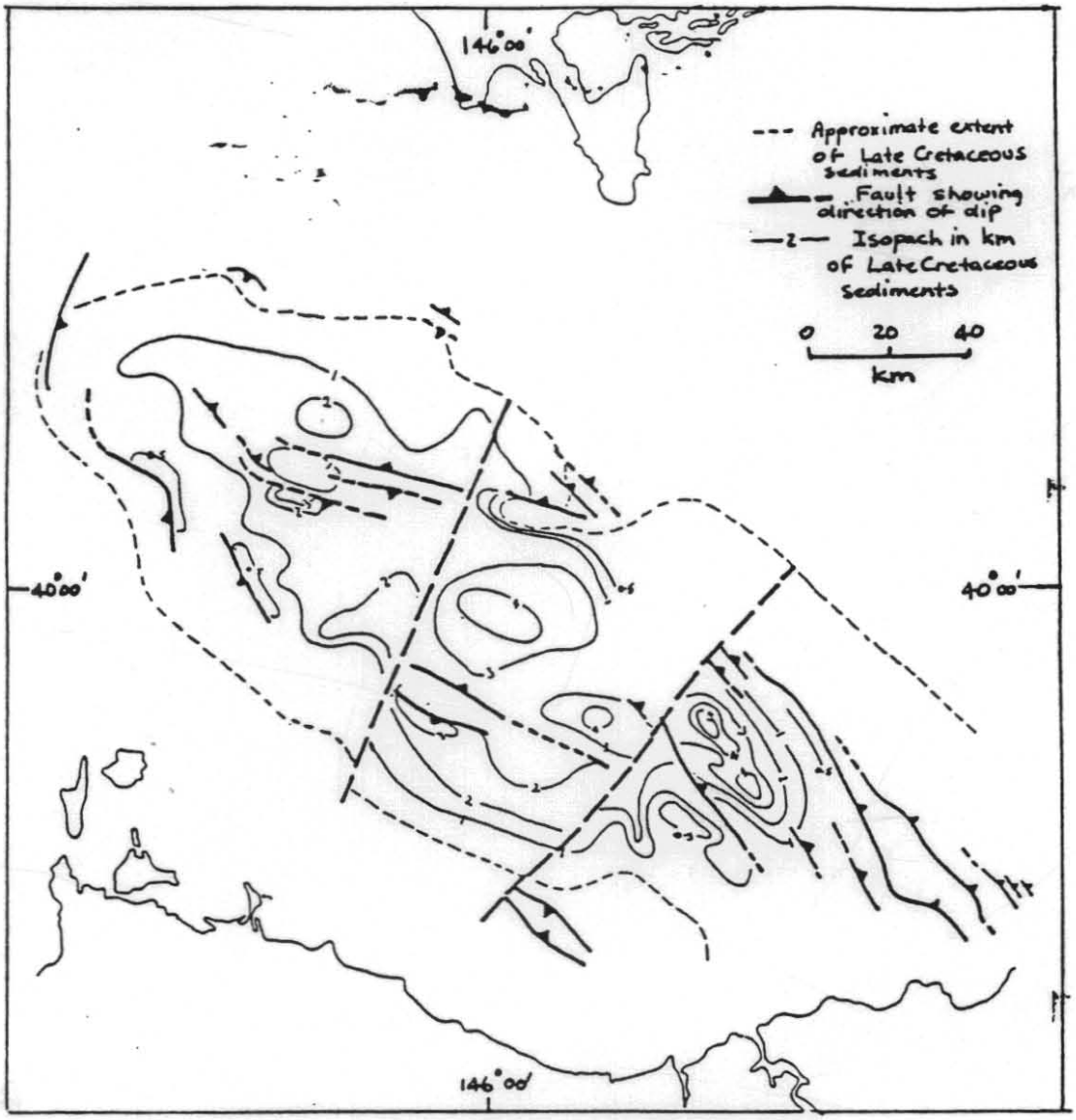



Figure 4 Major Cretaceous structures

5 cm

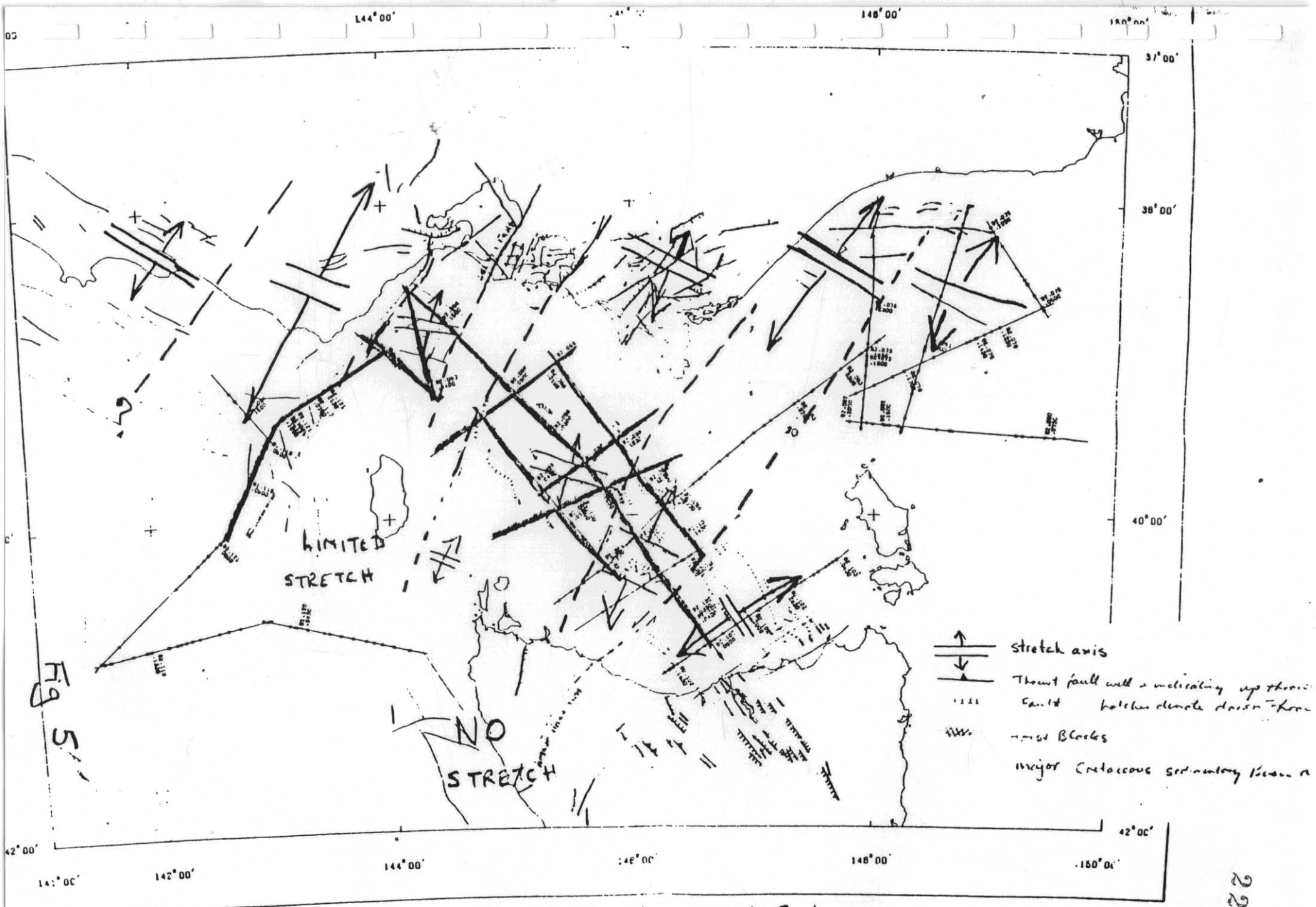



Fig 5

Sketch of regional model of Cretaceous lithospheric stretching.

5 cm

AUSTRALIAN REGIONAL SPHEROID
TRANSVERSE MERCATOR PROJECTION

623422

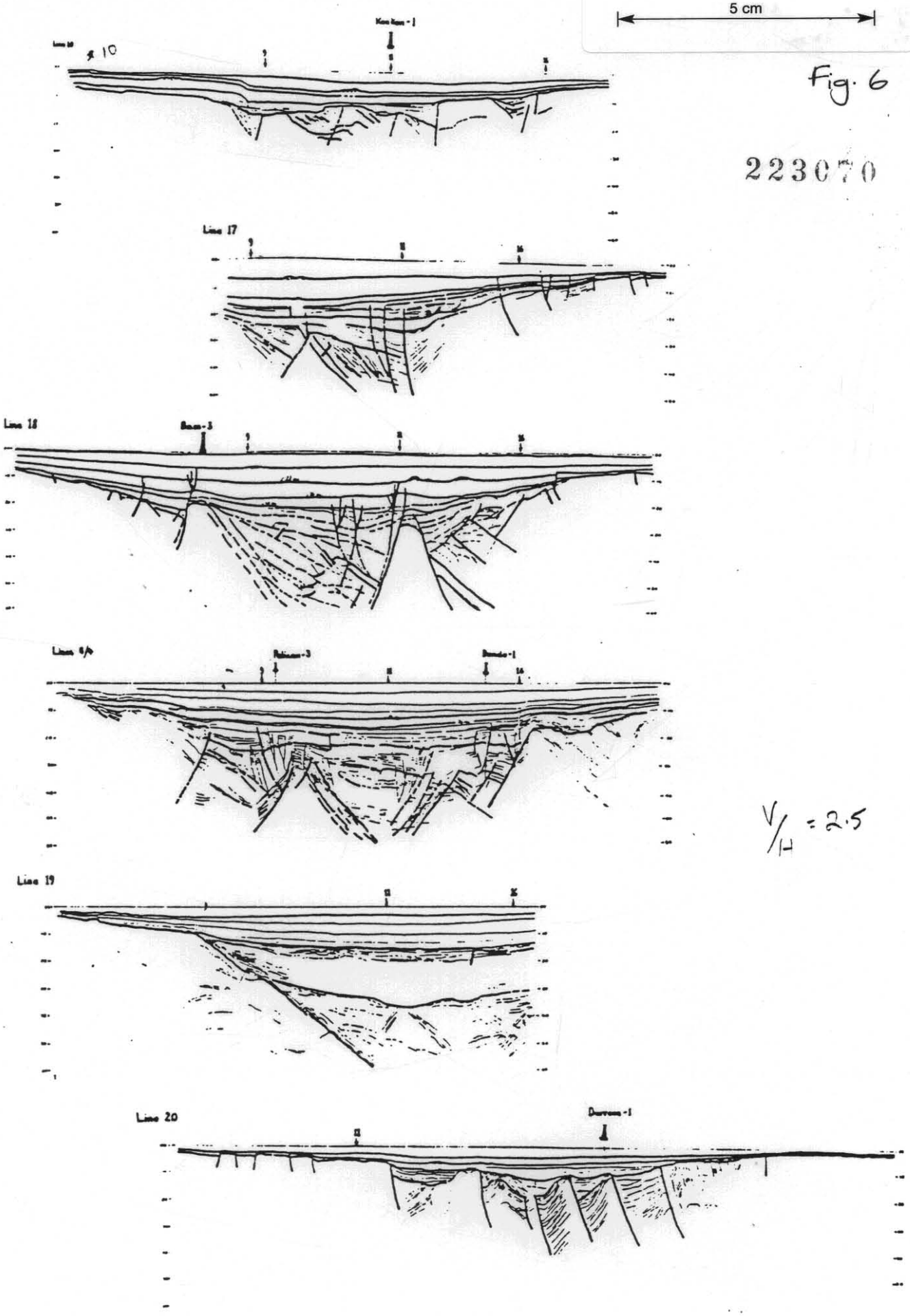
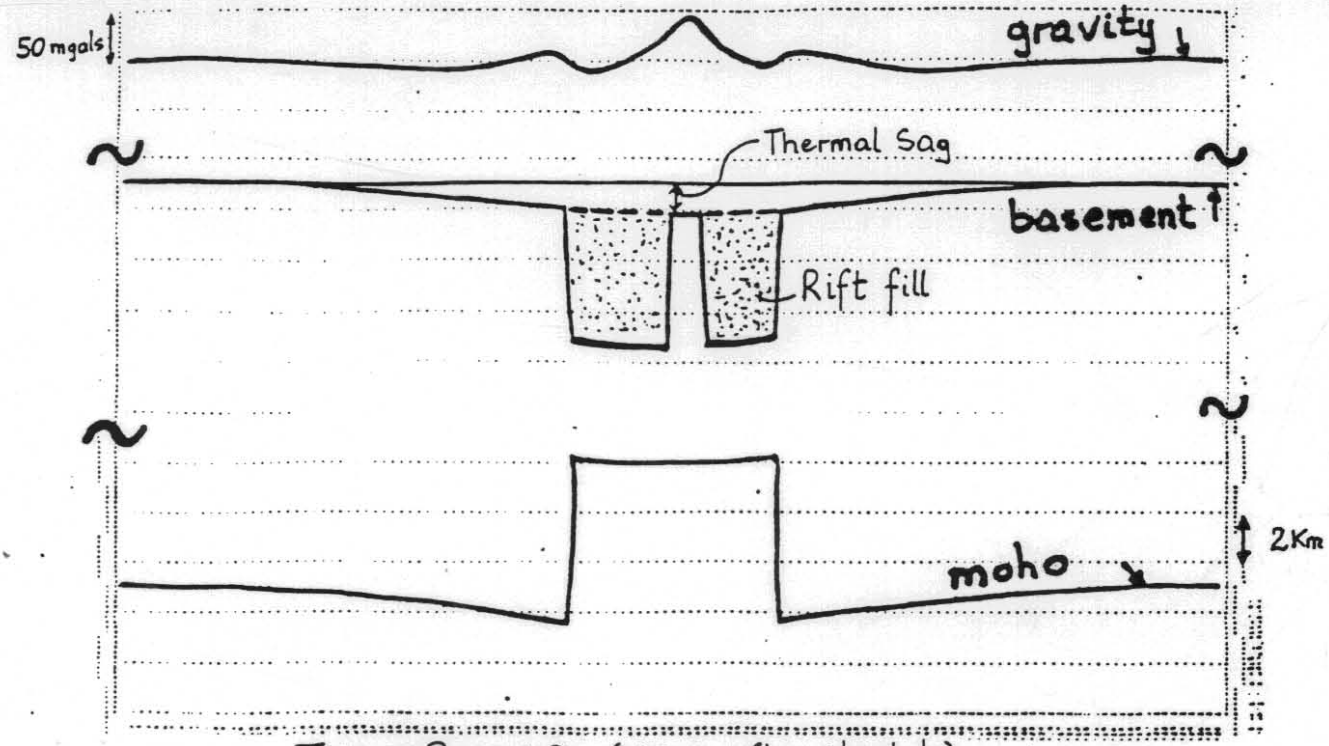



Fig. 6

223070

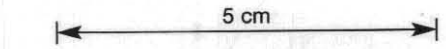
traverses

Fig. 7

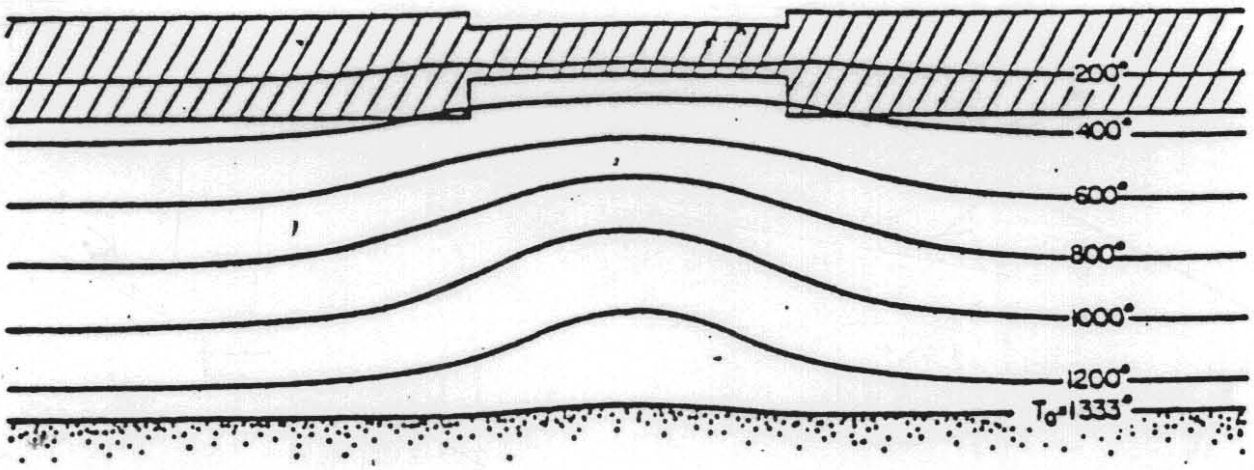



Time = Present Day (125 my. after stretch)

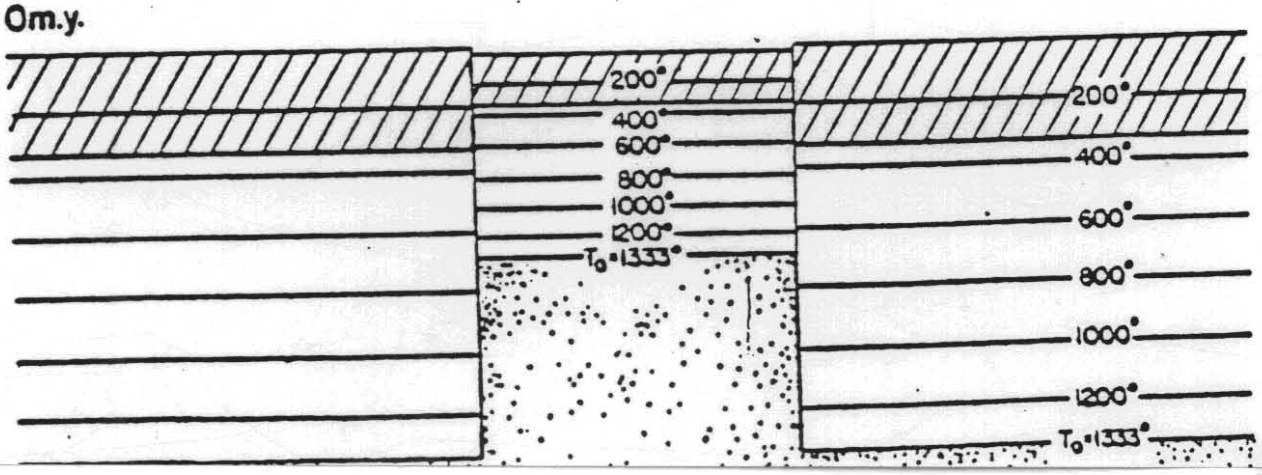
Lithospheric model of isotherm pattern following stretching



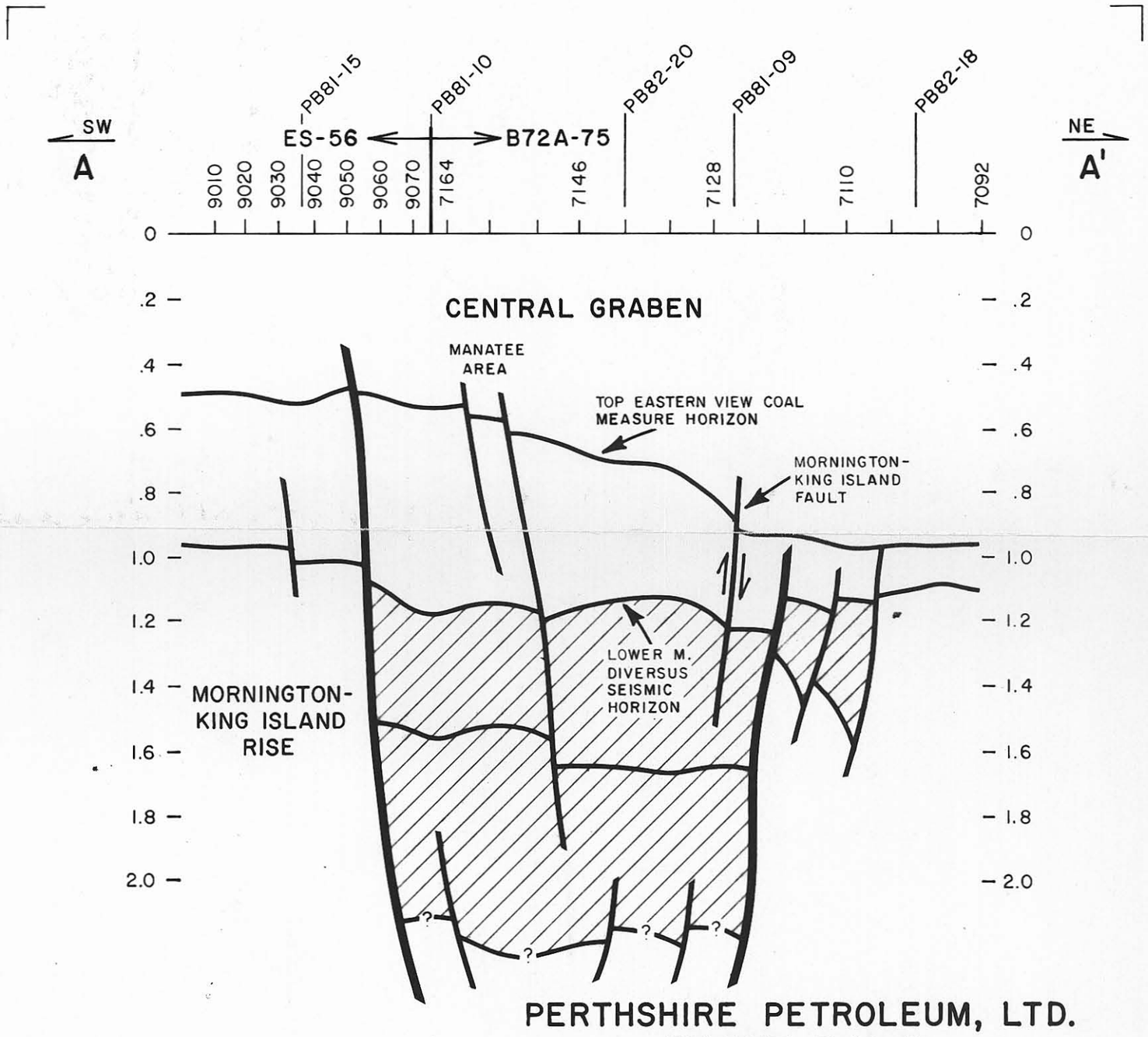

25m.y.




0m.y.




223071




PERTHSHIRE PETROLEUM, LTD.
PERMIT T-19-P

GEOSEISMIC SECTION A-A'

—— EASTERN VIEW COAL MEASURE - EOCENE

PALEOCENE - CRETACEOUS

SECTION BASED ON LINES ES-56 AND B72A-75

0 5 10 15
Km.

Figure 1

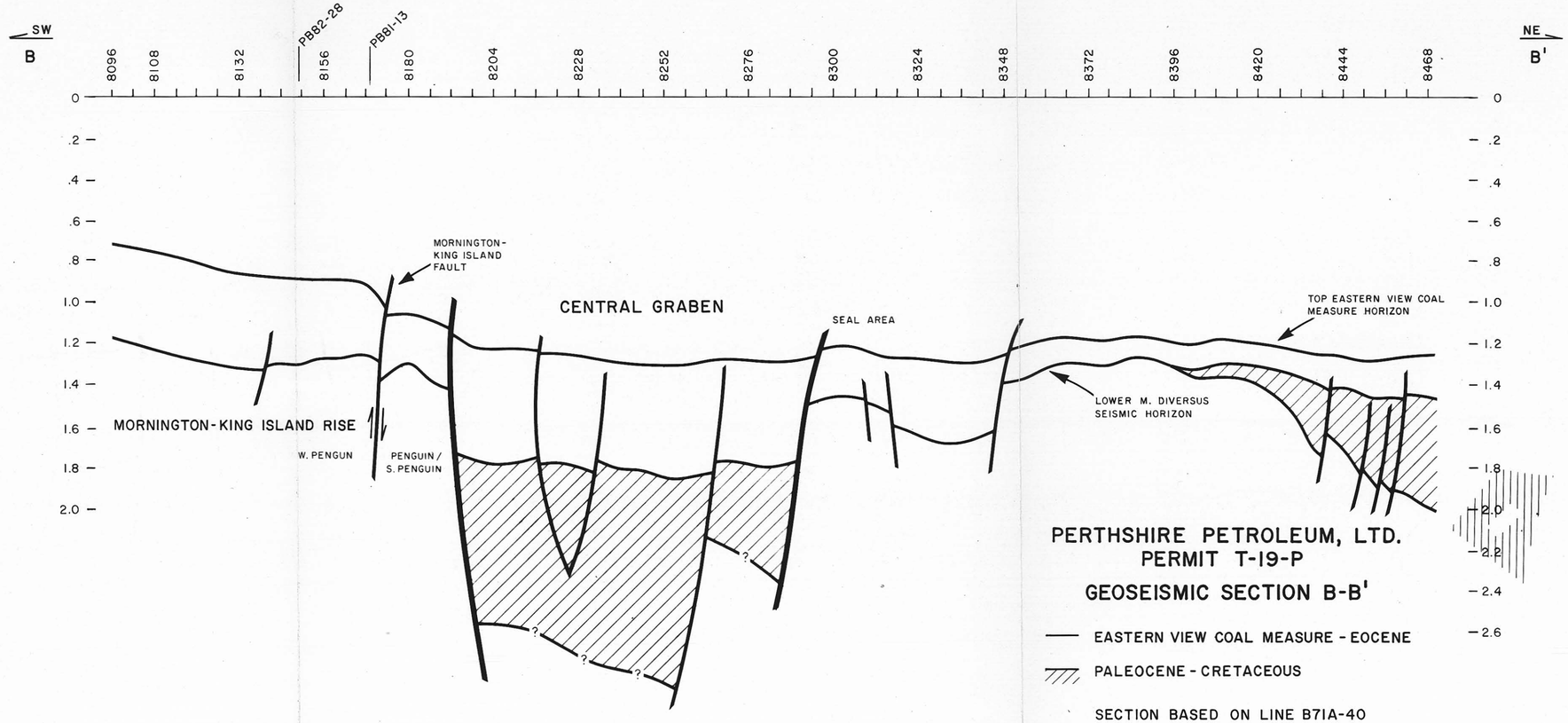
5 cm

OR - 208

T19 P Part 6

223072

(1)




PERTHSHIRE PETROLEUM, LTD.
PERMIT T-19-P

GEOSEISMIC SECTION B-B'

EASTERN VIEW COAL MEASURE - EOCENE

PALEOCENE - CRETACEOUS

SECTION BASED ON LINE B71A-40

0 5 10 15
Km.

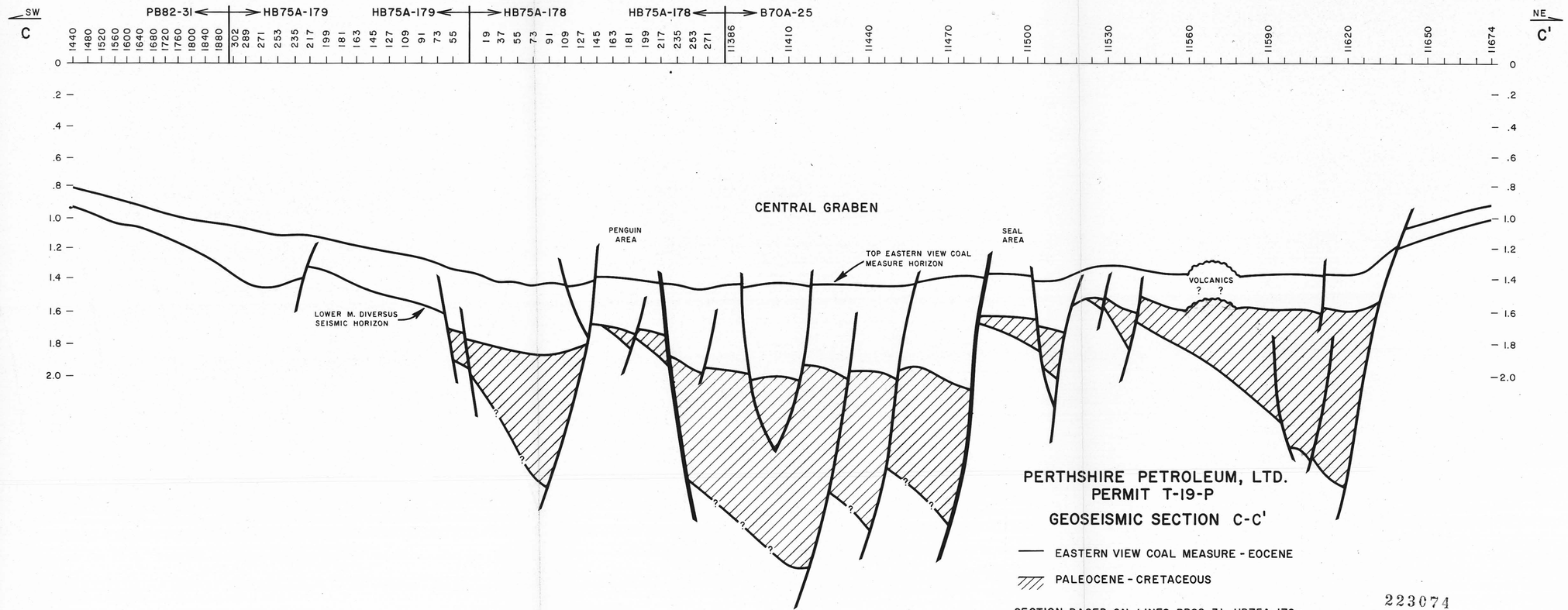
5 cm

Figure 2

T/19P OR-208
Part 6

223073

(2)




223074

Figure 3

OR-208

T/19P Part 6

(3)

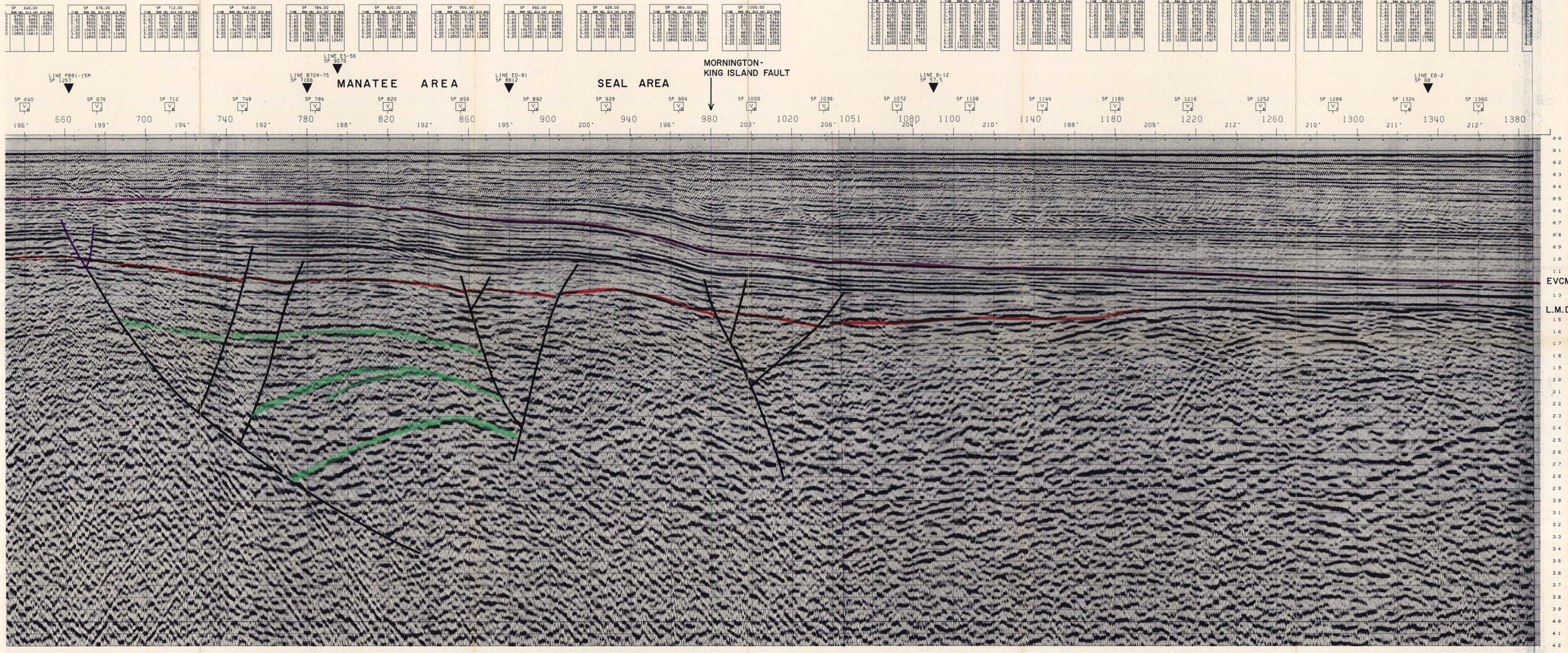
T/19P Part 6

OR-208

**Figure 4**

223075

LINE: PB-81-10M
S.P.: 100 -2469
1X4800%, TVF




EAST

# WEAVER OIL AND GAS

OFFSHORE AUSTRALIA

BASS BASIN, CROCODILE ROCK

SHOT BY WESTERN GEOPHYSICAL CO. PARTY 86 APRIL 1981
PROCESSED BY WESTERN GEOPHYSICAL HOC GRP 27 JULY 1981
PLAYBACK REEL NO. 060119

## 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 | HSZ.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

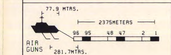
PROCESSING SAMPLING INTERVAL 4 MS

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. 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 |

5. GAIN

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




LEGEND
V VELOCITY ANALYSIS
W.D. INTERSECTIONS WATER DEPTH

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

POLARITY CONVENTION
RECORDING : COMPRESSION PULSE NEGATIVE NUMBER
PROCESSING : COMPRESSION PULSE NEGATIVE NUMBER
DISPLAY : COMPRESSION PULSE TROUGH (DECREASING BLACK)

5 cm

T19P Part 6

OR-208

# Figure 5

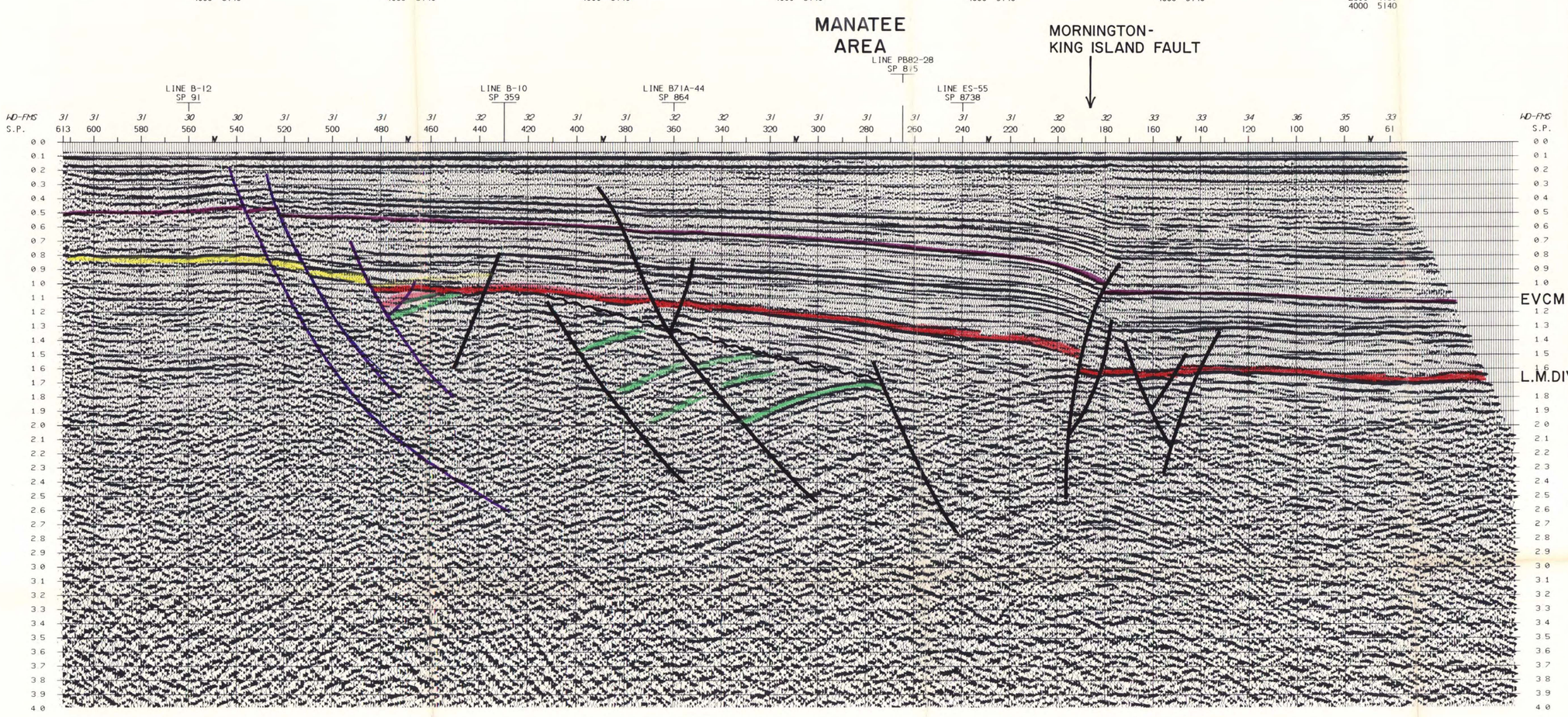
223076

LINE PB82-25
S.P. 61-617

WEST
DIRECTION OF SHOOTING

AGC-STACK

| SP 549 | | SP 469 | | SP 389 | | SP 309 | | SP 229 | | SP 149 | | SP 69 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TIME | VRMS | TIME | VRMS | TIME | VRMS | TIME | VRMS | TIME | VRMS | TIME | VRMS | TIME | VRMS |
| 0 | 1490 | 0 | 1490 | 0 | 1490 | 0 | 1490 | 0 | 1490 | 0 | 1490 | 0 | 1490 |
| 100 | 1490 | 100 | 1490 | 100 | 1490 | 100 | 1490 | 100 | 1490 | 100 | 1490 | 100 | 1490 |
| 550 | 1700 | 500 | 1780 | 450 | 1780 | 500 | 1860 | 600 | 1860 | 800 | 1940 | 800 | 1860 |
| 1400 | 2340 | 900 | 2180 | 1200 | 2500 | 1500 | 2580 | 1400 | 2500 | 1450 | 2340 | 1100 | 2180 |
| 2100 | 2820 | 1600 | 2820 | 1900 | 3380 | 2200 | 3380 | 2100 | 3220 | 2100 | 2820 | 1800 | 2500 |
| 2700 | 3860 | 2500 | 3860 | 2700 | 4340 | 3000 | 4340 | 2900 | 4340 | 2800 | 3860 | 2250 | 3220 |
| 4000 | 5140 | 4000 | 5140 | 4000 | 5140 | 4000 | 5140 | 4000 | 5140 | 4000 | 5140 | 2800 | 4180 |
| | | | | | | | | | | | | 4000 | 5140 |




WEAVER OIL & GAS
BASS BASIN
PERMIT T-19-P

GeoCenter

DATE PROCESSED MAY 1982
REEL NUMBER 4354
CONTRACT NUMBER 4805

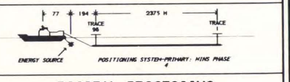
## FIELD RECORDING

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 8 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 | ADDITIONAL PARAMETERS |

| 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

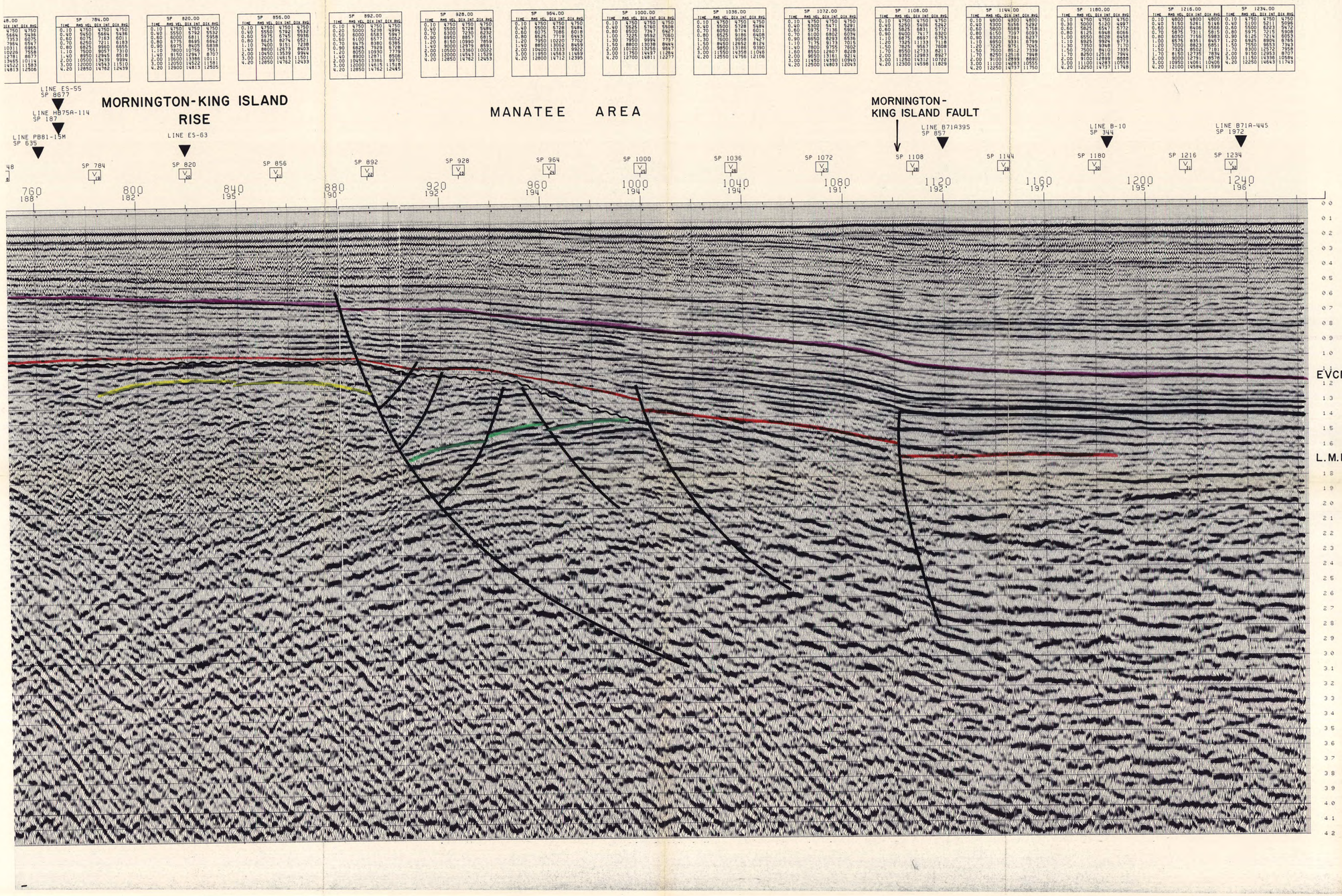
5 cm

T/14P Part 6

OR-208 223677

Figure 6

LINE: PB-81-12M
S.P.: 100-1271
1X4800%, TVF




EAST

# WEAVER OIL AND GAS

OFFSHORE AUSTRALIA

BASS BASIN, CROCODILE ROCK

SHOT BY WESTERN GEOPHYSICAL CO. PARTY 86 APRIL 1981
PROCESSED BY WESTERN GEOPHYSICAL HDC GRP 27 JULY 1981
PLAYBACK REEL NO. :081572

## 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

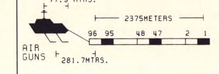
PROCESSING SAMPLING INTERVAL 4 MS

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. 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 |

5. GAIN

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




LEGEND
V VELOCITY ANALYSIS
INTERSECTIONS
W.D. WATER DEPTH

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

POLARITY CONVENTION
RECORDING : COMPRESSION PULSE NEGATIVE NUMBER
PROCESSING : COMPRESSION PULSE NEGATIVE NUMBER
DISPLAY : COMPRESSION PULSE TROUGH (DECREASING BLACK)

5 cm

T/1gp Pat 6

223678

OR- 208
Figure 7

PENGUIN AREA

MORNINGTON-KING ISLAND FAULT

CENTRAL GRABEN

SEAL AREA

NE

SEG 24 FOLD STACK
TVD
TVF 20 - 60 Hz. 400ms.
15 - 55 Hz. 600ms.
10 - 50 Hz. 800ms.
10 - 40 Hz. 1200ms.

LINE B71A-40 HORIZONTAL SCALE 1 TRACE = 50 METRES
SCALE RATIO = 2 IN/AT 1·5 SEC

E566-34 B71A-45 B63-10 B71A-44, B71A-445 B70A-24 E865-2 B63-21

8132 8138 8144 8150 8156 8162 8168 8174 8180 8186 8192 8198 8204 8210 8216 8222 8228 8234 8240 8246 8252 8258 8264 8270 8276 8282 8288 8294 8300 8306 8312 8318 8324 8330 8336 8342 8348 8354 8360 8366

B71A-40-7

WATER DEPTHS
VELOCITIES

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 4·6 4·8 5·0

EVCM

L.M. DIV.

MAGNETOMETER PLOT (GAMMAS)

61900 61800 61700 61600 61500 61400

ESSO AUSTRALIA LIMITED

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

S.P. 8096-8470

AREA: BASS BASIN LINE: B71A-40
RECORDING PARAMETERS SP: 8096 to 8470
Source: Air Gun Array type: 150 cu. in. Depth: 23 ft
4 pops/SP Shot off group: 48 Fold: 24
Cable length (centre of gp 1 to centre of gp 48): 7708 ft Near trace: 682 ft
Group interval: 164 ft Group length: 164 ft Offset: 582 ft
30 geophones/group Field polarity first break: Negative
Recording system: DFS-III Filter: 8 to 62 Hz
Recording length: 9.0 sec Sample rate: 4 ms
G.S.I. Field crew: 909 Date: Dec. 1971

PROCESSING DATA
Processed by: G.S.I. Sample period: 4 ms
TAR: B = 17 db, n = 3 Hz/sec Processed: 24 fold
Vertical stack: Odd/Even Data: 0 to 4500 ms
Decon before stack: DCN 56 ms, 4 ms, 0 ms, No. of gates/trace: 1
Decon after stack: TVD 2200 to 4500 ms, 450 ms, 4 ms, No. of anti-log: 80 ms/trace
Design gate (trace 1): 300 to 4500 ms Gate shift: 0 ms/trace
Displayed: 55 µs/ft Gain: AGC Hz
Polarity displayed: Positive (+) / Negative ■ Phase gain: 7 db
TAPE REQUEST: 481 Hold: 4307
INPUT: FORM PARITY: 407-ESP-2 Date: Feb. 1972

VES 4
NMO —
TVD —
TVS 3
DCN 256
DFS —
TVD —
DCN —
DFF 7
TVF —
700 Pkg ■

DIGITAL BAND PASS FILTERING
Hz: 60 50 40 30 20
0·0 1·0 2·0 3·0 4·0 5·0
SECONDS (TWT)

DIAGRAM
LINE
8470
8096
5 cm

T/19P Part 6

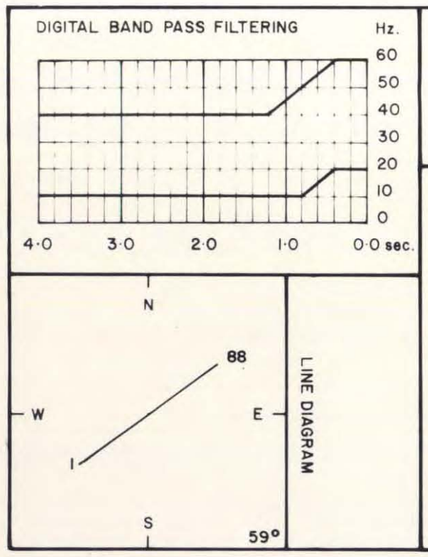
OR-208

Figure 8

223079

SEAL AREA

LINE EB-3 (SHORT CABLE)



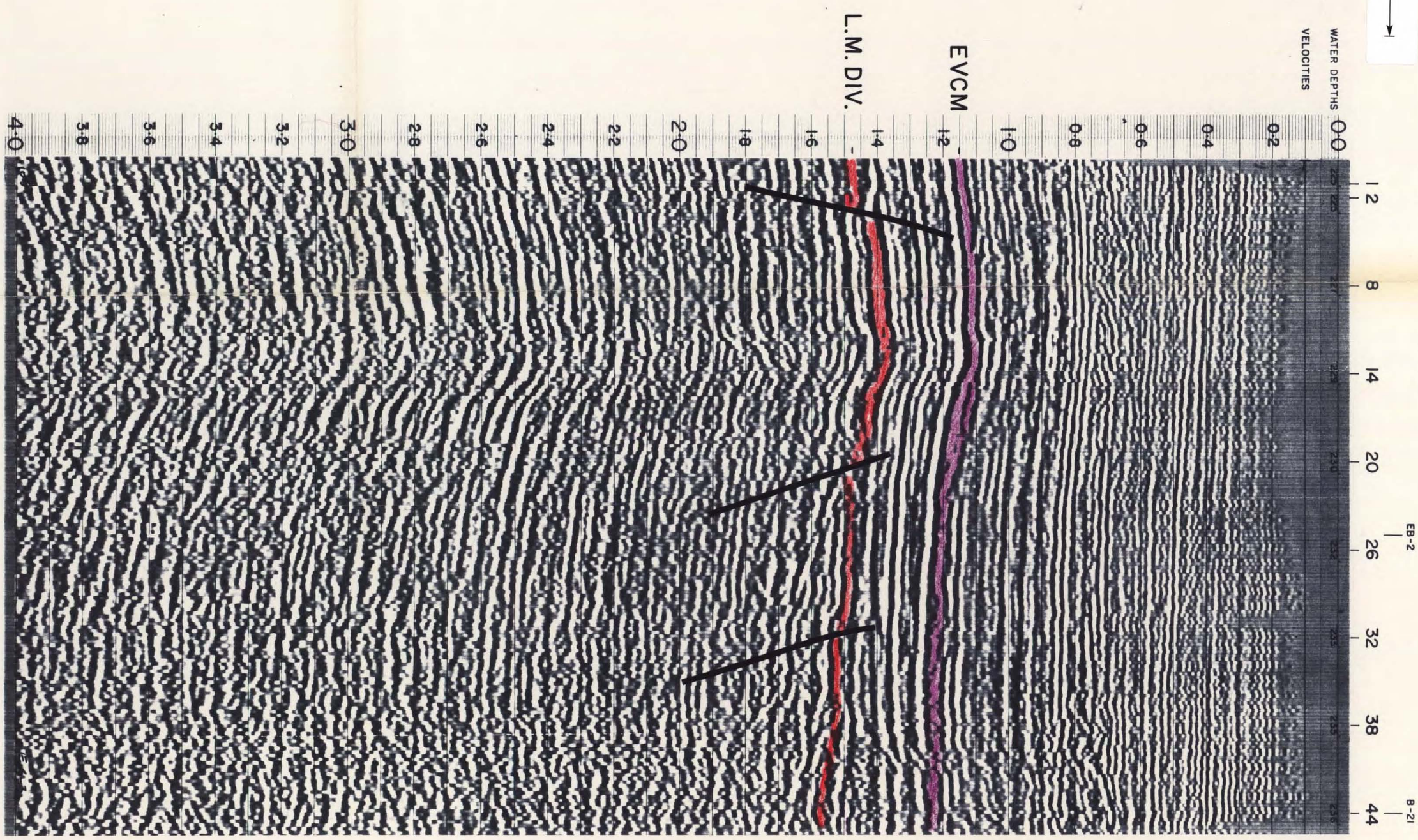

GEOPHYSICAL SERVICE INTERNATIONAL
DIGITAL PROCESSING CENTRE
SYDNEY, NSW, AUST.

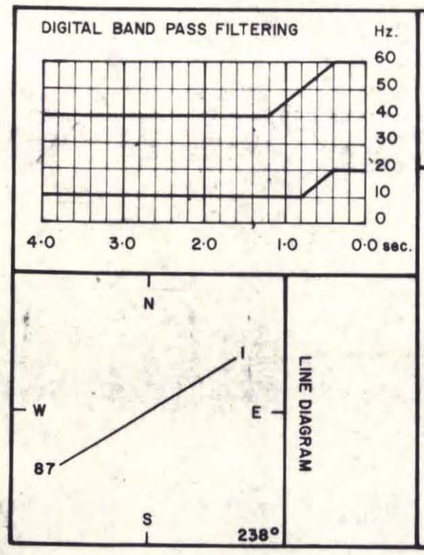
ESSO STANDARD OIL (AUST) LTD.

PROCESSING DATA: Sample period 4 ms.
Groups processed 1-24 Processed 6 fold.
TAR: B - 0 db., α 0 db/sec. Gate ____ to ____ ms.
Vertical stack: NIL
Decon before stack: ____ ____ pts., ____ ms. No. of gates/trace ____
Design gate (trace 1) ____ to ____ ms. Gate shift ____ ms/trace.
Decon after stack: TVD 62 pts., 4 ms. No. of gates/trace 2
Design gate (trace 1) 300 to 3996 ms. Gate shift 0 ms/trace.
Digital filter 35 pts., 4 ms. ____ to ____ Hz.
Display: ____ digital AGC. Playback gain 8 db.
Polarity displayed: Positive □ / Negative ■
TIAC REQ. 3097 Hold tape 6498 Date DEC. 1971
GSI INPUT CREW - PARTY 107-ESO-2

| | |
|---|---|
| A-D | 1 |
| NMO | 3 |
| AR2 | |
| TVD | |
| TVS | 2 |
| DCN | |
| DPS | 4 |
| TVD | 6 |
| DCN | |
| DGF | |
| TVF | 7 |
| MIX | 5 |
| 600 Pkg. □ | |

AREA: BASS BASIN
RECORDING PARAMETERS: LINE: EB-3
Source EXPLOSIVE SP 1 to 88
Charge size 100 lb.
1 Chg./SP. Shot off group 12/13 No. of groups 24
Cable length (centre of gp. 1 to centre of gp. 24) 3936 ft.
Offset (Charge to centre of gp. 12/13) 250 ft.
Group interval 164 ft. SP interval 656 ft.
4 geophones/group. Field polarity first break NEGATIVE
Recording system WESTERN Filter ____ to ____ Hz.
Recording length 4000 ms. Recorded TECHNO-AM
WGC Field crew 87 Date MAY 1965






## GEOPHYSICAL SERVICE INTERNATIONAL

DIGITAL PROCESSING CENTRE
SYDNEY, NSW, AUST.

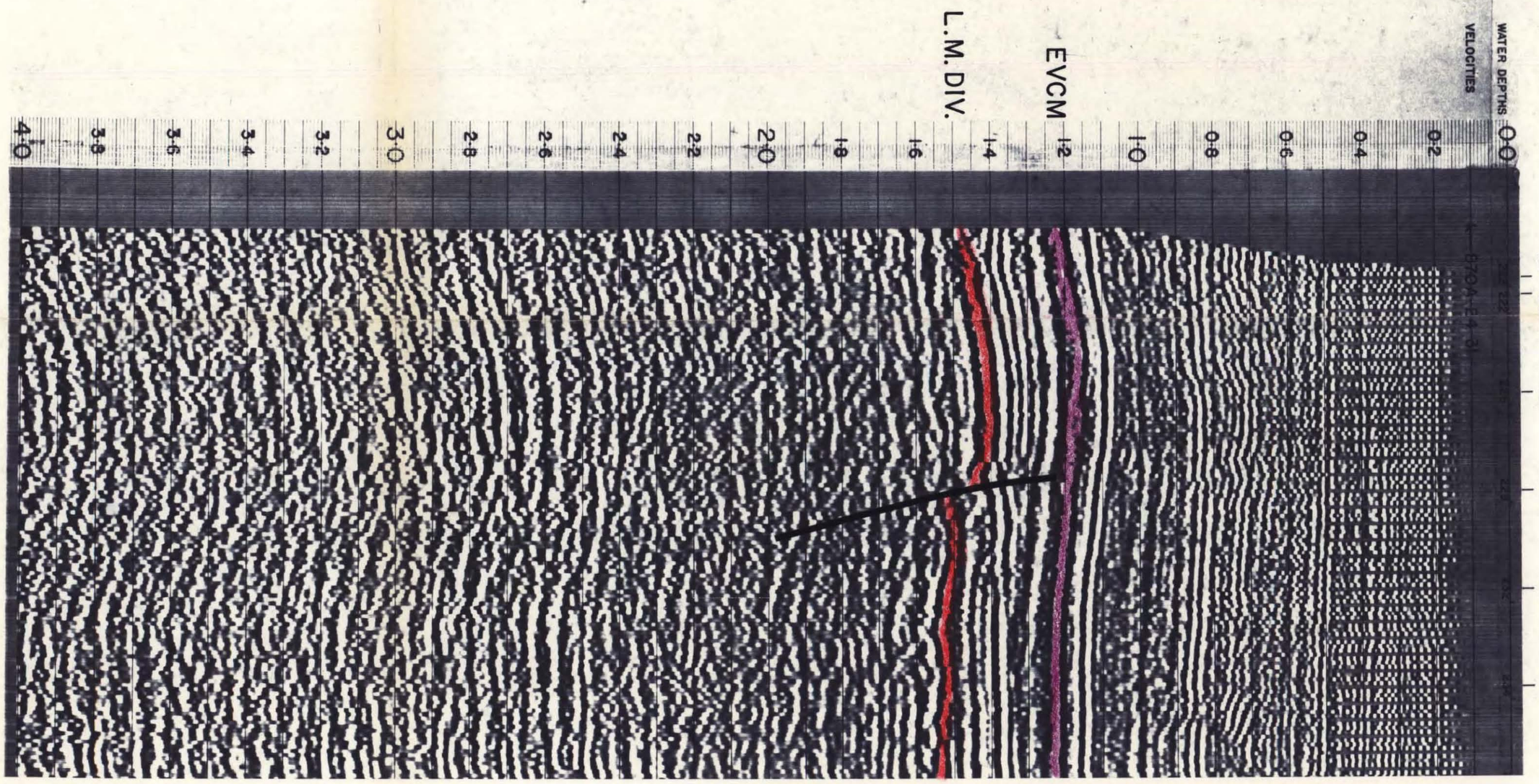
PROCESSING DATA: Sample period 4 ms.
Groups processed 1-24 Processed 6 fold.
TAR: B - 0 db., α 0 db/sec. Gate ____ to ____ ms.
Vertical stack: NIL
Decon before stack: TVD 54 pts., 4 ms. No. of gates/trace 2
Design gate (trace 1) 1060 to 4000 ms. Gate shift -66 ms/trace.
Decon after stack: TVD 62 pts., 4 ms. No. of gates/trace 2
Design gate (trace 1) 300 to 3996 ms. Gate shift 0 ms/trace.
Digital filter 35 pts., 4 ms. ____ to ____ Hz.
Display: ____ digital AGC. Playback gain 8 db.
Polarity displayed: Positive □ / Negative ■
TIAC REQ. 3459 Hold tape 6321 Date NOV. 1971
GSI INPUT CREW - PARTY 107-ESO-2

| | |
|---|---|
| A-D | 1 |
| NMO | 3 |
| AR2 | |
| TVD | 2 |
| TVS | |
| DCN | |
| DPS | 4 |
| TVD | 5 |
| DCN | |
| DGF | |
| TVF | 6 |
| | |
| 600 Pkg. □ | |

## Esso STANDARD OIL (AUST) LTD.

AREA: BASS BASIN
RECORDING PARAMETERS: LINE: EB-4
Source EXPLOSIVE SP 1 to 87
Charge size 100 lb.
1 Chg./SP. Shot off group 12/13 No. of groups 24
Cable length (centre of gp. 1 to centre of gp. 24) 7872 ft.
Offset (Charge to centre of gp. 12/13) 250 ft.
Group interval 328 ft. SP interval 656 ft.
4 geophones/group. Field polarity first break NEGATIVE
Recording system WESTERN Filter ____ to ____ Hz.
Recording length 4000 ms. Recorded TECHNO-AM
WGC Field crew 87 Date MAY 1965

OR-208
Figure 9




223080

SEAL AREA

LINE EB - 4 (LONG CABLE)

9

J/19P Part 6

(10)

223081

OR-208

Figure 10

SEAL AREA

9862 VA 9856 9850 9844 9838 9832 VA 9826 9820 9814 9808 9802 9796 VA 9790 9784

WATER DEPTHS 00
WATER VEL. 4950'/sec.
VELOCITIES

870A-24-31 870A-24-30 870A-24-29

EVCM

L.M.DIV.

00 02 04 06 08 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50

ESSO STANDARD OIL (AUST) LTD.

AREA: BASS BASIN LINE: 870A-24
RECORDING PARAMETERS SP 8871 to 9894
Source AIRGUN guns, tuned array
Array size 860 cu.in., 11 No of groups 48
4 pops/SP. Shot off group 48
Cable length (centre of gp 1 to centre of gp. 48) 7708 ft.
Offset (array centre to centre of group 48) 863/883 ft.
Group interval 164 ft. SP interval 656 ft.
10 geophones/group Field polarity first break Negative
Recording system DFS III Filter 8 to 62 Hz.
Recording length 5 sec Sample rate 4 ms.
GSI Field crew 909 Date DEC'1970

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

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

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

PROCESSING DATA : 1-48
Groups processed
TAR B - 14 db., α 3.5 db/sec.
Vertical stack Odd/Even
Decon before stack: DCN 66 pts., 4 ms. No. of gates 1
Design gate (trace 1) 2200 to 4900 ms Gate shift -78 ms/trace.
Decon after stack TVD 64 pts., 4 ms. No. of gates/trace 2
Design gate (trace 1) 300 to 4500 ms Gate shift 0 ms/trace.
Digital filter 35 pts., 4 ms. to Hz.
Displayed digital AGC. Playback gain 23 db.
Polarity displayed: Positive □ / Negative ■
TIAC REQUEST 674 Hold tape 5401
INPUT CREW PARTY 851 Date MAR 1971

DIGITAL BAND PASS FILTERING Hz.
60 50 40 30 20 10 0
5.0 4.0 3.0 2.0 1.0 0.0 sec.
RECORD TIME

LINE N DIAGRAM
W 9894 8871 E
S 300°

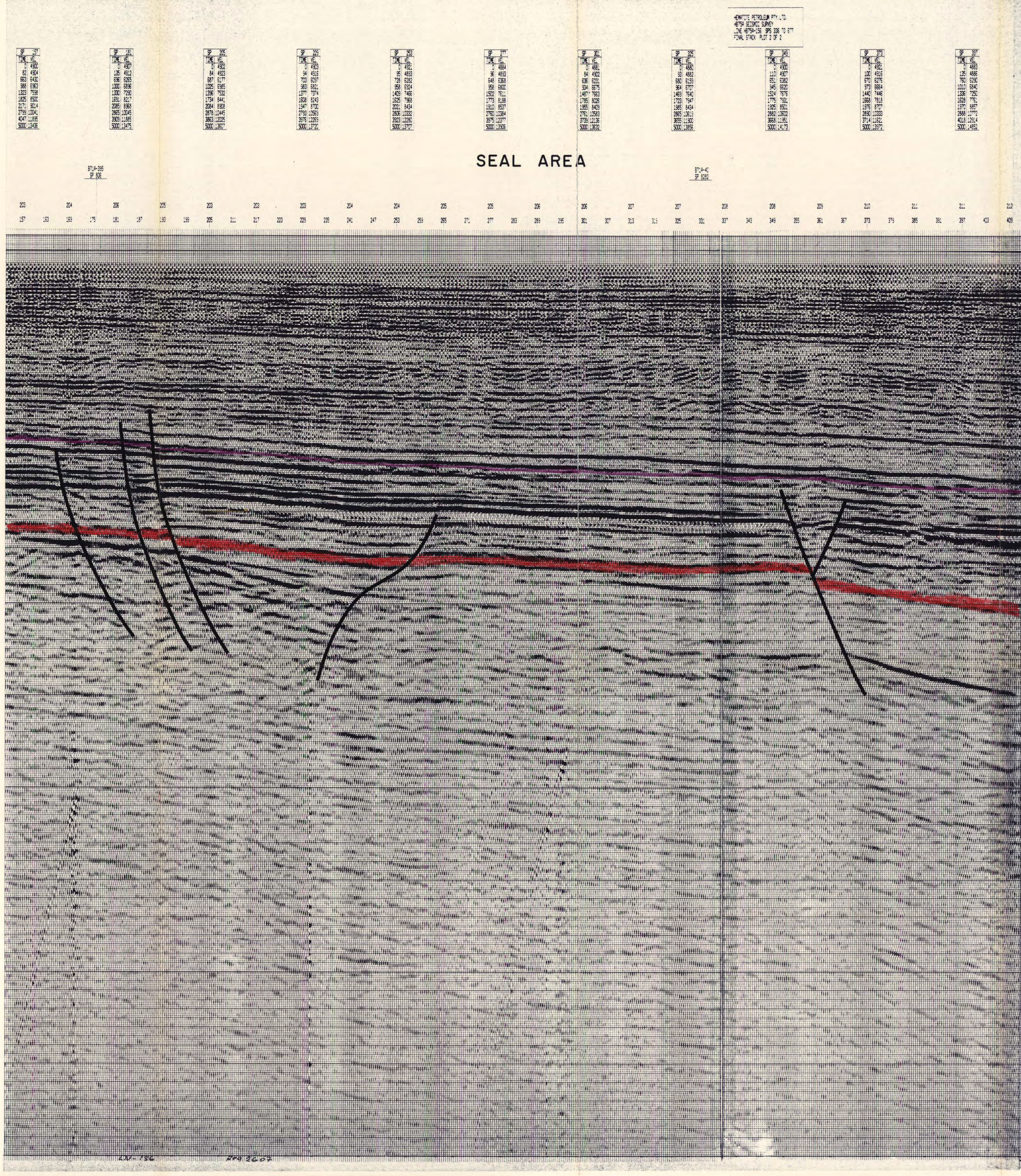
5 cm

T/19P Part 6

OR-208

223082

Figure 11




# HEMATITE PETROLEUM PTY. LTD.

| HB75A SEISMIC SURVEY | HB75A-156 |
|---|---|

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: 855 ft
Date: January '75

2889 LINE DIAGRAM

N
W 1 E
677
S 3038 Number is block number at end of line

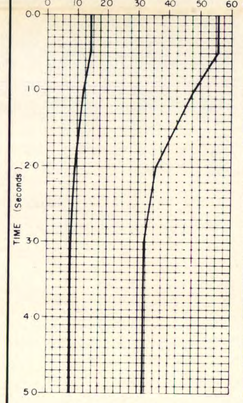
PROCESSING INFORMATION:

1 True Amplitude Recovery (-12db, 5db/sec. 0-3·5 secs.)
2 Vertical Stack 3:1
3 Deconvolution Before Stack
SP's 1 - 677, 2 Operators/Trace, 64 pts. Gap = 0 msec.

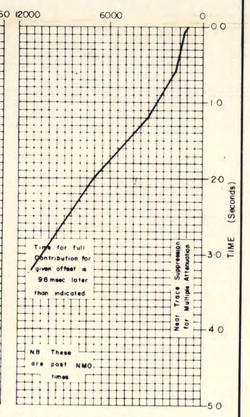
4 24 Fold Common Depthpoint Gather
5 Sealevel Static and Airgun Delay Corrections
6 Preliminary Normal Moveout Corrections
7 Preliminary 24-Fold Stack, 24 Traces.
8 Velocity Analysis:
Continuous 700 Pkg 100m Depth Points
9 Normal Moveout Corrections
10 24 Fold CDP Stack, 48 Traces
11 Deconvolution After 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

TIME VARIANT FILTER BANDPASS FREQUENCY (Hz)




FIRST BREAK SUPPRESSION OFFSET (Ft)




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

5 cm

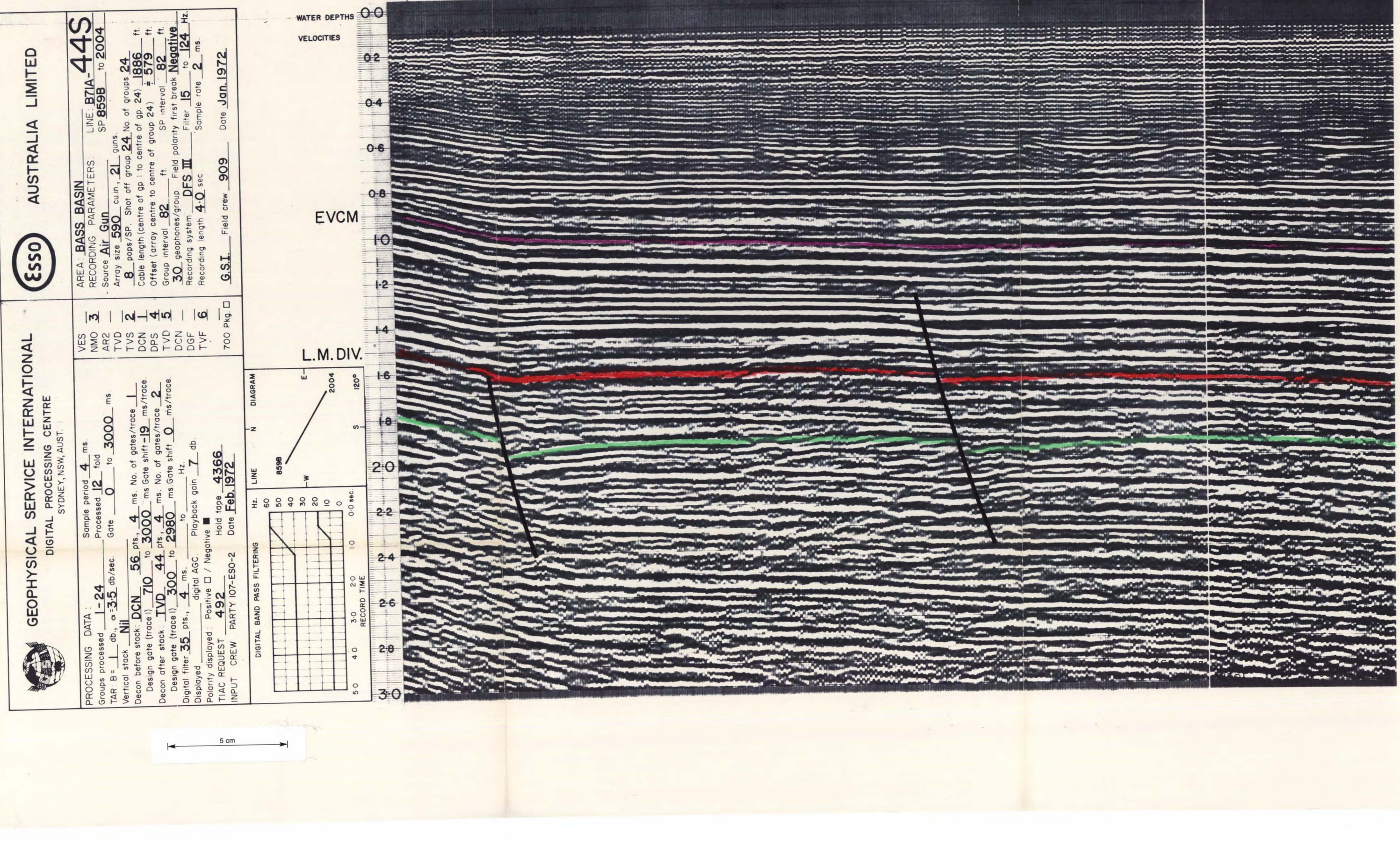
T/19P Part 6

(12)

223083

OR-208

Figure 12



TIAP Part 6

(13)

223684

OR-208

Figure 13

MORNINGTON-KING ISLAND FAULT

PENGUIN AREA

LINE B72A-134

SCALE RATIO = 2·8:1 AT 1·5 SEC.

B71A-40

B63-1

3655 3653 3647 3641 3635 3629 3623

WATER DEPTHS 0·0

VELOCITIES

B72A-134-13 ← 134-13 ← 134-12 ← 134-11 ← 134-10 ← 13

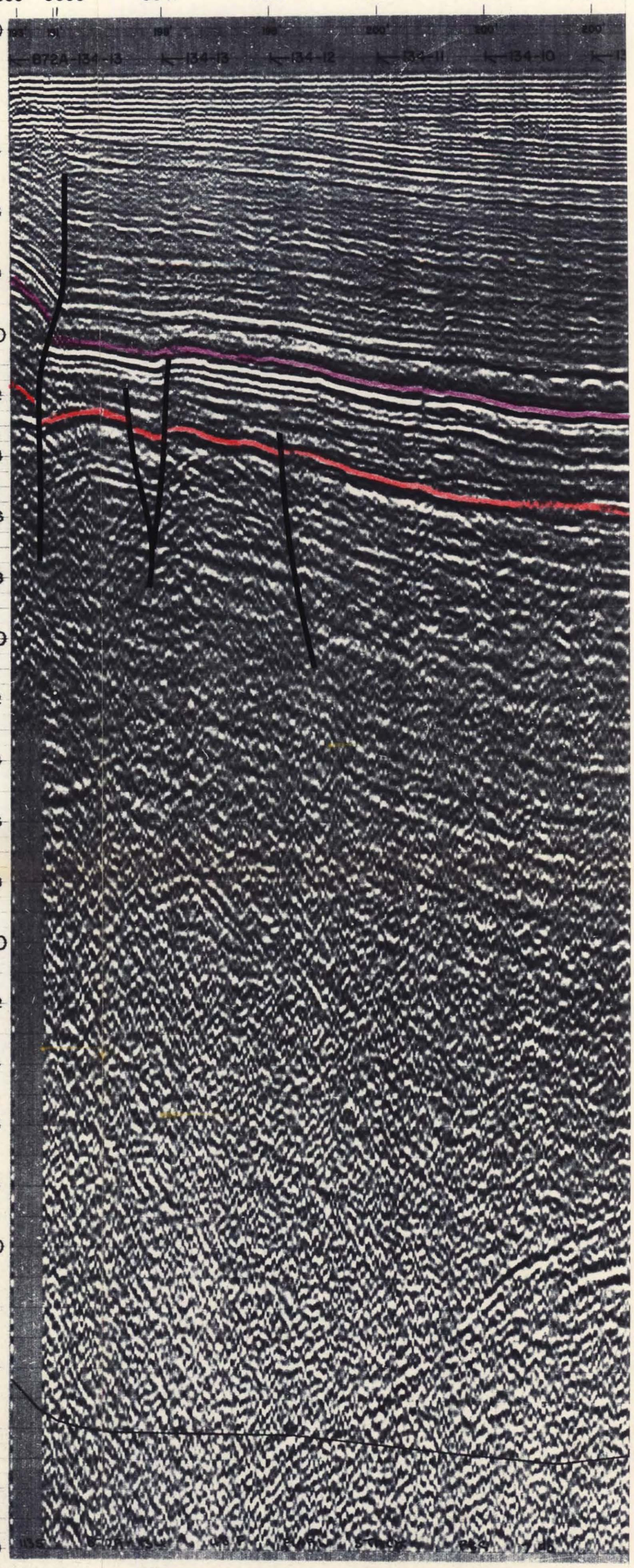
0·2 0·4 0·6 0·8 1·0 1·2 1·4 1·6 1·8 2·0 2·2 2·4 2·6 2·8 3·0 3·2 3·4 3·6 3·8 4·0 4·2 4·4 4·6 4·8 5·0

EVCM

L.M. DIV.

MAGNETOMETER PLOT (GAMMAS)

62000 61900 61800 61700 61600 61500



GEOPHYSICAL SERVICE INTERNATIONAL

DIGITAL PROCESSING CENTRE SYDNEY, NSW, AUST

ESSO AUSTRALIA LIMITED

AREA BASS BASIN LINE B72A-134

RECORDING PARAMETERS SP 3575 to 3655

Source Air Gun

Array size 1200 cu.in., 25 guns, tuned array

8 pops/SP. Shot off group 48 No of groups 48

Cable length (centre of gp 1 to centre of gp. 48) 10246 ft

Offset (array centre to centre of group 48) 832 ft 872 ft

Group interval 218 ft SP interval 872 ft

30 geophones/group. Field polarity first break Negative

Recording system DFS III Filter 8 to 62 Hz

Recording length 5 sec Sample rate 4 ms

G.S.I. Field crew 931 Date Sep. 1972

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

Sample period 4 ms

Processed 48 fold

Gate 0 to 4000 ms

pts, 4 ms No of gates/trace 1

4620 ms Gate shift -98 ms/trace

pts, 4 ms. No. of gates/trace 2

4500 ms Gate shift 0 ms/trace

to Hz

Playback gain 7 db

ative ■

Hold tape TVF 4840

Date Oct. 1972

DIGITAL BAND PASS FILTERING Hz. 60 50 40 30 20 10 0

5·0 4·0 3·0 2·0 1·0 0·0 sec RECORD TIME

LINE N DIAGRAM

3655 W E 3575 S 305°

PROCESSING DATA:

Groups processed 1 - 48

TAR B = -20 db, α = 4 db/sec

Vertical stack Nil

Decon before stack: DCN 44 pts, 4

Design gate (trace 1) 2860 to 4620

Decon after stack TVD 64 pts, 4

Design gate (trace 1) 300 to 4500

Digital filter 35 pts, 4 ms to

Displayed digital AGC Playb

Polarity displayed Positive □ / Negative ■

TIAC REQUEST 3893

INPUT CREW PARTY 107-ESO-3

5 cm

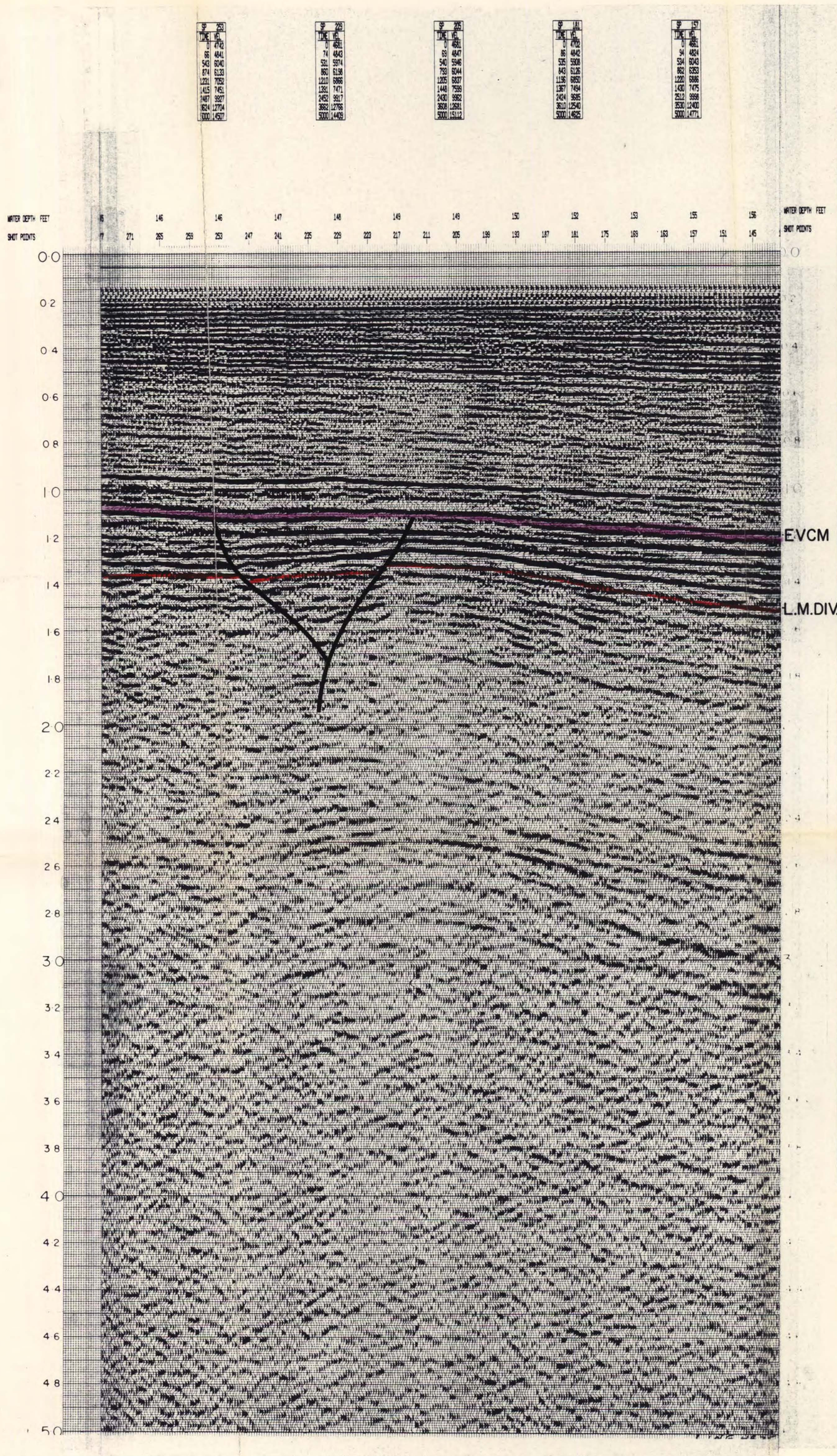
(14)

T/19P Part 6.

OR-208

Figure 14

223085




# HEMATITE PETROLEUM PTY. LTD.

## HB75A SEISMIC SURVEY

HB75A-179

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: 50-60ft
Group interval: 219 ft. Shot interval: 73ft
Streamer: 3200 m, 48 groups, towing group 48
Average Offset to centre of group 48: 895 ft
Date: January '75

LINE 3179 DIAGRAM

N

W 302 1 E

3320 S Number is block number at end of line.

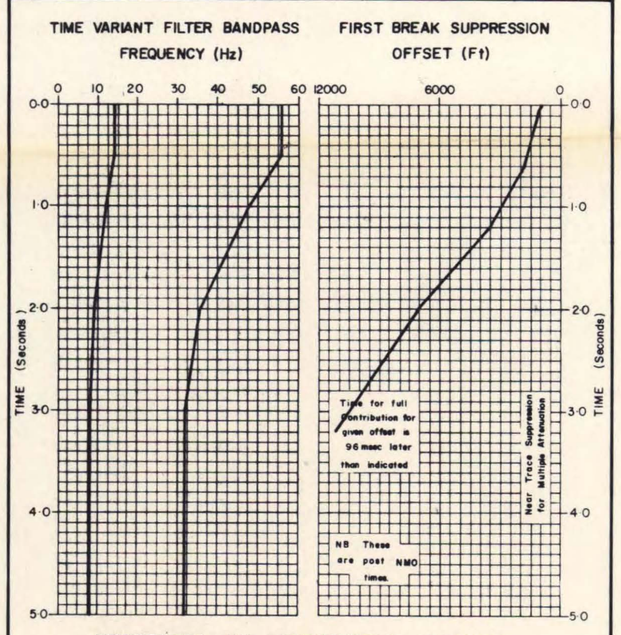
PROCESSING INFORMATION:

1 True Amplitude Recovery (-12db, 5 db/sec. 0-3·5 secs.)
2 Vertical Stack 3:1 (Nears Only)
3 Deconvolution Before Stack

SP's 1 - 302, 2 Operators/Trace, 64 pts. Gap = 0msec.

4 12 Fold Common Depthpoint Gather
5 Sealevel Static and Airgun Delay Corrections
6 Preliminary Normal Moveout Corrections
7 Preliminary 12 - Fold Stack, 24 Traces.
8 Velocity Analysis:
Continuous 700 Pkg Alternate Depth Points
9 Normal Moveout Corrections
10 12 Fold CDP Stack, 24 Traces
11 Deconvolution After Stack, 2 Operators/Trace, 70 pts. Gap = 0msec.
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. (0·53miles/inch) Horizontal Scale
3·75 ins/sec. Vertical Scale




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

5 cm

MORNINGTON-
KING ISLAND FAULT

MORNINGTON-
KING ISLAND RISE

A

A'

B

B'

C

C'

Konkon

Toolka

Cormorant

Aroo

Bass 1

Bass 2

Yurongi

Dondu

Bass 3

Tarook

Nangkero

Poonboon

Squid

Narimba

Pelican

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

SEAL
AREA

Fig. 9

Fig. 10

Fig. 11

Fig. 12

Fig. 13

Fig. 14

I

II

III

IV

V

VI

N.W. PENGUIN

WEST PENGUIN

PENGUIN

S. PENGUIN

CENTRAL
GRABEN

MANATEE

B A S S S T R A I T

2808 2737 PERTHSHIRE T/19P

2880 2809

2952 2881

3024 2953

3095 3096 3025

E Harbinger

W Harbinger C Wickham

3099

3171

3243

Councillor Is

Sea Elephant Rock

3315

3387 3388 3389 3390 3391 3392 3393 3394

3 4 5 6 7 8 9 10

PERTHSHIRE T/19P

2754 2755 B TASMANIA

2826 C' 2827

2899

PERTHSHIRE T/19P TASMANIA

PERTHSHIRE PETROLEUM, LTD.

PERMIT T-19-P

MAJOR STRUCTURAL ELEMENTS
AND LOCATION OF LEADS,
INCLUDING INDEX TO
REPRESENTATIVE SEISMIC LINES
FIGURES 4 THROUGH 14

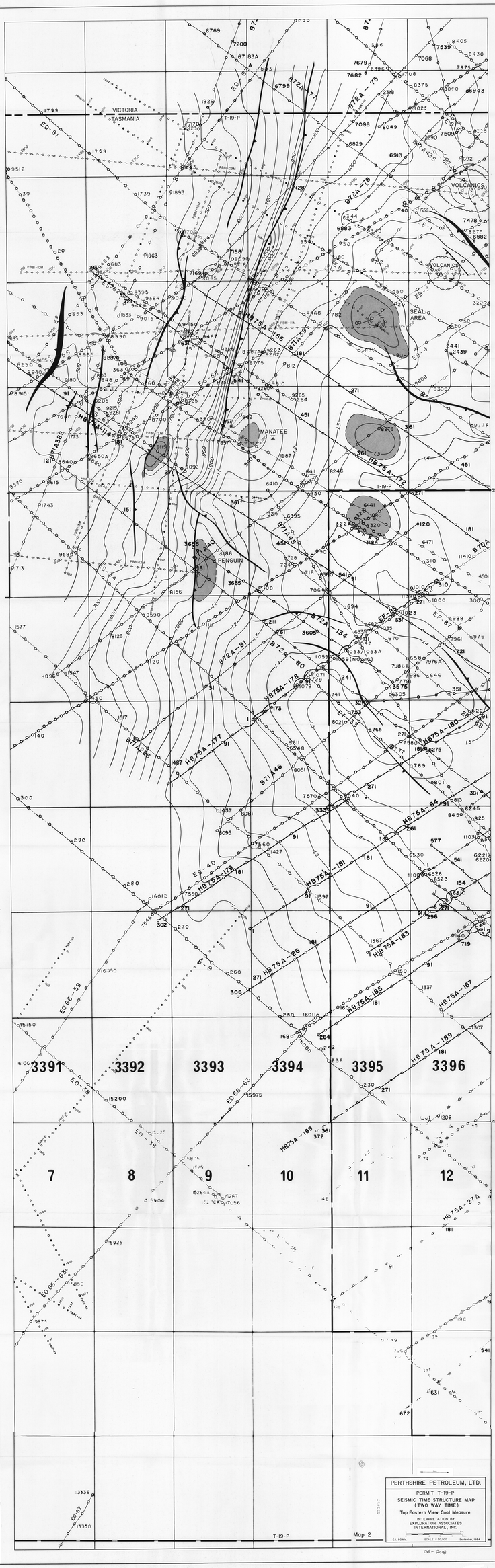
September, 1984

Map 1

5 cm

T/19P
Part 6.
OR-208

223086


VICTORIA
TASMANIA
T-19-P
VOLCANICS
SEAL AREA
MANATEE
PENGUIN
EF-81
EF-83
EF-85
EF-87
EF-89
EF-91
EF-93
EF-95
EO-81
EO-83
EO-85
EO-87
EO-89
EO-91
EO-93
EO-95
EO-97
EO-99
EO-101
EO-103
EO-105
EO-107
EO-109
EO-111
EO-113
EO-115
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EO-121
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EO-135
EO-137
EO-139
EO-141
EO-143
EO-145
EO-147
EO-149
EO-151
EO-153
EO-155
EO-157
EO-159

VICTORIA

TASMANIA

2754

2826

2898

2970

Konkon-1

Toolka 1

T-19-P

PERTHSHIRE PETROLEUM, LTD.

PERMIT T-19-P

SEISMIC TIME STRUCTURE MAP
(TWO WAY TIME)

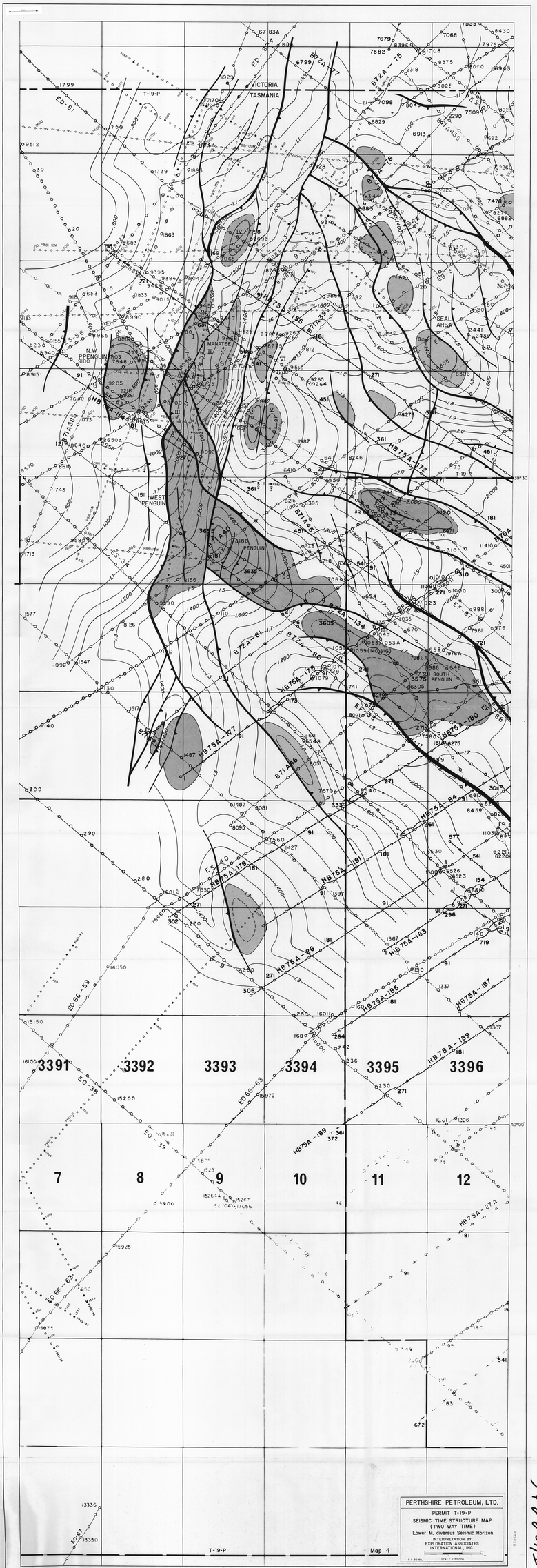
Top Eastern View Coal Measure

INTERPRETATION BY
EXPLORATION ASSOCIATES
INTERNATIONAL, INC.

C.I. 50 Mls. SCALE 1: 50,000 September, 1984

Map 3

T/19P Part 6 OR-208


VICTORIA
TASMANIA
T-19-P
N.W. PPENGUIN
MANATEE
WEST PENGUIN
PENGUIN
SEAL AREA
SOUTH PENGUIN
3391
3392
3393
3394
3395
3396
7
8
9
10
11
12
T-19-P
Map 4
PERTHSHIRE PETROLEUM, LTD.
PERMIT T-19-P
SEISMIC TIME STRUCTURE MAP
(TWO WAY TIME)
Lower M. diversus Seismic Horizon
INTERPRETATION BY
EXPLORATION ASSOCIATES
INTERNATIONAL, INC.
SCALE 1:50,000

T/19 P Part 6.

VICTORIA

TASMANIA

2754

2826

2970

Konkon-1

T-19-P

Toolka 1

VOLCANICS

PERTHSHIRE PETROLEUM, LTD.

PERMIT T-19-P

SEISMIC TIME STRUCTURE MAP
(TWO WAY TIME)

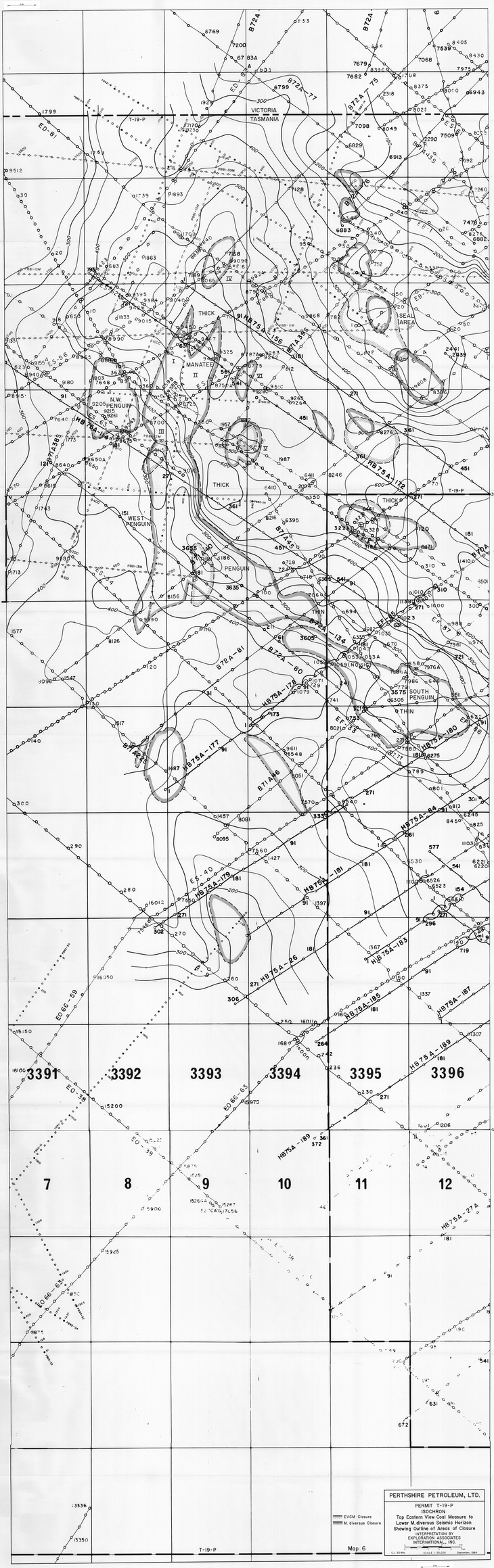
Lower M. diversus Seismic Horizon

INTERPRETATION BY
EXPLORATION ASSOCIATES
INTERNATIONAL, INC.

C.I. 50 Mls. SCALE 1: 50,000 September, 1984

Map 5

T/19P Part 6 OR-208




T/19P Part 6

OR-208

VICTORIA

TASMANIA

2754

2826

2898

2970

Konkon-1

T-19-P

Toolka 1

T-19-P

T-19-P

PERTHSHIRE PETROLEUM, LTD.

PERMIT T-19-P
ISOCHRON
Top Eastern View Coal Measure to
Lower M. diversus Seismic Horizon
Showing Outline of Areas of Closure

INTERPRETATION BY
EXPLORATION ASSOCIATES
INTERNATIONAL, INC.

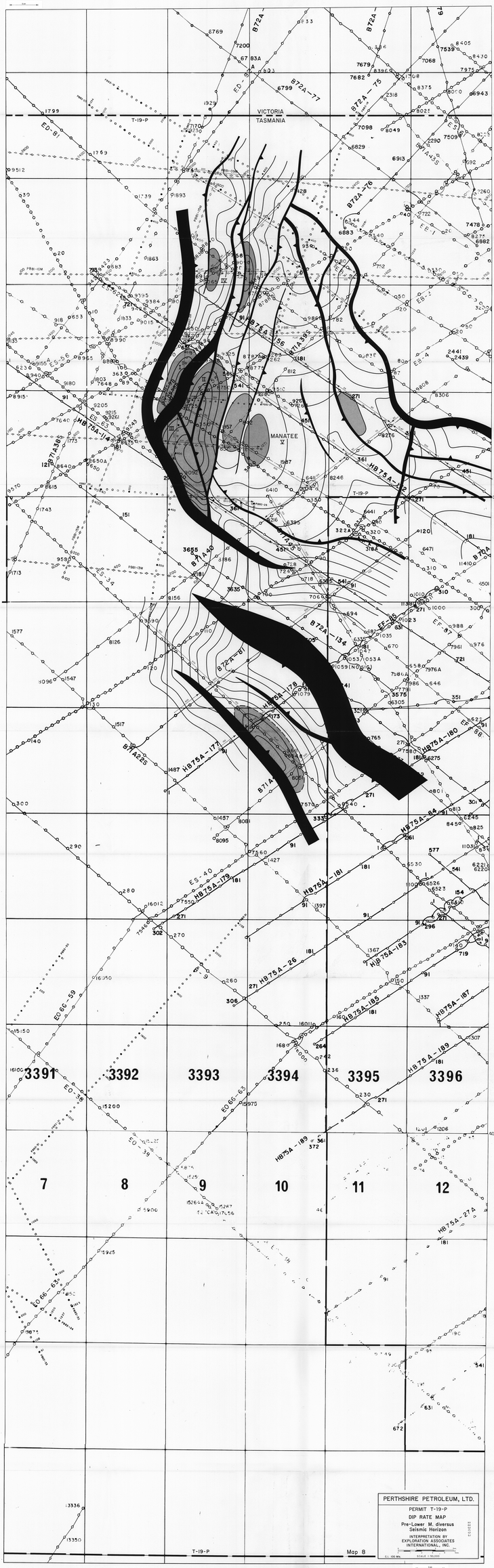
EVCM Closure

M. diversus Closure

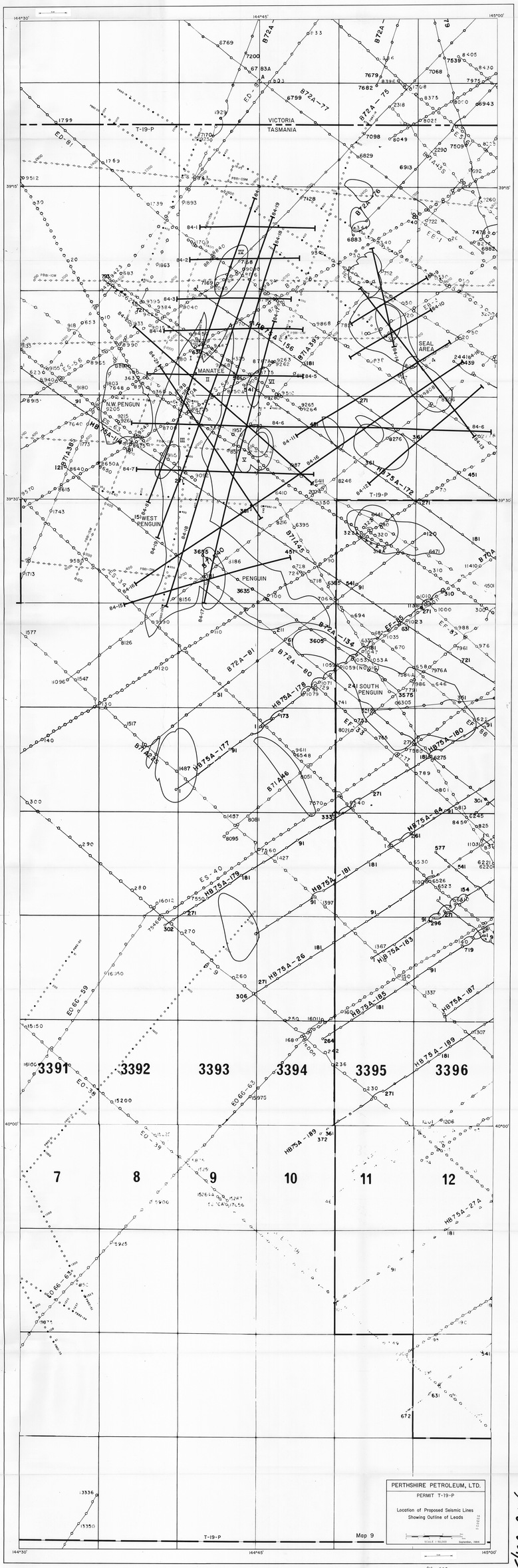
C.I. 50 Mls. SCALE 1:50,000 September, 1984

Map 7

T/19 P Part 6 OR-208


VICTORIA
TASMANIA
MANATEE
T-19-P
3391
3392
3393
3394
3395
3396
7
8
9
10
11
12
PERTHSHIRE PETROLEUM, LTD.
PERMIT T-19-P
DIP RATE MAP
Pre-Lower M. diversus
Seismic Horizon
INTERPRETATION BY
EXPLORATION ASSOCIATES
INTERNATIONAL, INC.
SCALE 1:50,000
T-19-P
Map 8

T19P Part 6


144°30'
144°45'
145°00'
39°15'
39°30'
40°00'
VICTORIA
TASMANIA
T-19-P
SEAL AREA
MANATEE
N.W. PENGUIN
WEST PENGUIN
PENGUIN
SOUTH PENGUIN
3391
3392
3393
3394
3395
3396
7
8
9
10
11
12
PERTHSHIRE PETROLEUM, LTD.
PERMIT T-19-P
Location of Proposed Seismic Lines
Showing Outline of Leads
Map 9
T-19-P
DK-208