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A N N U A L   R E P O R T

PERMIT T-16-P

BASS BASIN, TASMANIA

PERIOD FROM JULY 21, 1983 TO JULY 21, 1984

Submitted By:

WEAVER OIL AND GAS CORPORATION,  
AUSTRALIA  
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OR-200

SUMMARY

The fourth year Annual Report covering the period from July 21, 1983 to July 21, 1984 for Permit T-16-P consists of a collection of selected portions of reports submitted previously.

The results of an aeromagnetic survey, two seismic, gravity and magnetic surveys, depth to magnetic basement calculations, computer models of gravity, magnetic and seismic reflection data are presented. In addition, the published results of geochemical studies of the Bass Basin have been assembled and are summarized.

A drilling prognosis and a drilling program have been prepared in anticipation of the drilling of the Tasmanian Devil #1 Exploratory Well.

Future plans call for the drilling of this well, review of the drilling results, remapping and reevaluation of the permit area.

Previously submitted illustrations such as seismic maps and lines are not enclosed in this report.

OPERATIONS CARRIED OUT

The following is a summary of the activities of the Fourth Quarter and the Fourth Year Work Program performed on Permit T-16P, a Bass Basin Exploration Permit awarded to Weaver Oil and Gas Corporation, Australia on July 21, 1980.

The T-16-P Exploration Permit Area has been the subject of several seismic, gravity, magnetic and aeromagnetic surveys since 1960. Results of these surveys have been reviewed and analyzed. Selected portions of the reports on these surveys are enclosed and constitute the data base which supports this review.

During this fourth year, the whole permit area has been remapped at various seismic reflector levels. Both the old and the new seismic data acquired in 1981 and 1982 by the present permit holder has been reinterpreted and tied to the Pelican #1 Well. Seismic time structure maps and isochron maps have been constructed at various stratigraphic levels.

In addition, results of the gravity and magnetic data, also acquired in 1981 and 1982 by the present permit holder, have been reviewed and integrated with the seismic maps.

The geochemical data available on Bass Basin Wells has been collected and studied. A summary of conclusions derived is enclosed.

A drilling prognosis and drilling program have been prepared in anticipation of the drilling of the Tasmanian Devil #1 Exploratory Well.

No new seismic, gravity, magnetic data were acquired during this fourth year. No well was drilled.

## WEAVER OIL &amp; GAS CORPORATION, AUSTRALIA

T-16-P

Costs Incurred for the 12 months Ended July 21, 1984

	<u>U.S. DOLLARS</u>
Staff (Including Geologist, Geophysicist, Draftsmen and Administrative)	\$106,792.22
Maps, Logs, Seismic and Well Data Purchased (Including Reproduction Costs)	2,606.78
Consultants (Including Geological, Geophysical and Engineering)	17,462.00
Office Expenses	<u>15,422.00</u>
TOTAL COSTS	<u>\$142,283.00</u>

MAIN RESULTS OBTAINED

The whole of Permit T-16-P area has been reviewed during the fourth year. Following is a brief summary and discussion of the main results contributed by each geophysical survey conducted in the area. No exploratory well has ever been drilled within the permit area.

Geophysical interpretation of the results obtained during the 1960-61 Aeromagnetic survey of the Bass Basin area indicates the presence of a major sedimentary basin with several thousand meters of prospective sediments interbedded with volcanics. Structural trends with dominant northeast and northwest directions are indicated and believed to represent faulted, uplifted and offset basement blocks. The location of the proposed Tasmanian Devil #1 Exploratory Well is shown on Figure 2.

The 1981 Stoney Head seismic survey was designed to further evaluate structural anomalies disclosed by earlier seismic surveys as well as to increase stratigraphic and regional control over the whole area. A total of 394.125 kilometers of new seismic data was acquired. A long regional seismic line was taken all the way to the Pelican #1 Well, the nearest well with relevant stratigraphic information. A prominent structural feature was identified, partially mapped and assigned the name Tasmanian Devil lead.

A magnetic and gravity survey was carried along with the Stoney Head seismic survey. Depth to magnetic basement calculations indicate the presence of shallow volcanics as well as

relatively shallow basement in the Tasmanian Devil lead area.

The 1982 Egg Island seismic survey provided further structural control to the Tasmanian Devil lead. This lead was mapped at various stratigraphic levels and upgraded to a fully defined prospect. The remainder of the permit area has also been completely remapped and two other poorly defined deep seated leads have been identified.

A magnetic and gravity survey was carried along with the Egg Island seismic survey. In addition, calculations of depths to the magnetic basement were carried and computer modeling was utilized to integrate magnetic, gravity and seismic information over two intersecting lines on top of the Tasmanian Devil Prospect.

In the prospect area, basement is interpreted primarily as granitic or metasedimentary <sup>rocks,</sup> locally intruded by mafic dikes or plugs. In addition, modeling suggest the presence of thin basalt flows of uncertain locations and extent. Depth to basement is calculated to be in the order of 2,000 to 2,500 feet.

The published results of geochemical studies of the Bass Basin have been used in an evaluation of the petroleum potential of the basin. These studies have confirmed the presence of potential source rocks in the Eastern View Coal Measures.

A drilling prognosis has been prepared for the proposed Tasmanian Devil #1 Exploratory Well. The prospective area has been mapped at various stratigraphic levels and tied to the

Pelican #1 Well synthetic seismogram with a seismic line. The proposed well will test the hydrocarbon potential of the Eastern View Coal Measures section down to a proposed total depth of 3,500 feet. On the basis of the computer modeling of the gravity, magnetic and seismic data, it is anticipated that this well will intersect volcanics or basement before that depth is reached.

A drilling program has been proposed for the prepared Tasmanian Devil #1 Exploratory Well.

CONCLUSIONS

The total T-16-P Permit area has been reviewed and its hydrocarbon potential evaluated. The main sources of basic data consist of seismic, gravity and magnetic surveys. Stratigraphic and geochemical information is somewhat limited and of a speculative nature since it is derived from distant wells. No well has been drilled within the permit area.

Previous seismic mapping indicate the presence of a major tilted fault block, the Tasmanian Devil Prospect, as well as the presence of two or three deep seated structural leads related to the Rift Stage of the basin.

Drilling of an exploratory well on the Tasmanian Devil Prospect will be recommended for next year. In addition, prospect definition seismic acquisition will also be recommended for next year.

FUTURE PLANS

Plans for the fifth permit year call for the drilling of the proposed Tasmanian Devil #1 Exploratory Well to test the structural and stratigraphic hydrocarbon potential of the Oligocene, Eocene and possibly older section of the southwest most area of the Bass Basin. It is expected that this proposed well will also provide valuable information as to the reservoir sand quality, intraformational sealing capacity and maturation of the source - rock shale package of this objective section.

Following the drilling of the proposed Tasmanian Devil #1 Well, the whole permit area will be remapped in order to reflect the new well data acquired.

It is anticipated that additional seismic data acquisition will be recommended in order to better define some indicated leads recognized on older data.

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## LIST OF MAPS (Volume 2)

Total Magnetic Anomaly Map C.I. = 10 gammas

MAP NO. 2

MAP NO. 4

MAP NO. 5

Bouguer Gravity C.I. = 1.0 mgal - density = 2.20

MAP NO. 2

MAP NO. 4

MAP NO. 5

Depth to Magnetic Basement

MAP NO. 2

MAP NO. 4

MAP NO. 5

PERMIT DESCRIPTION

Permit T-16-P consists of thirty-two (32) graticular blocks located in the Bass Basin offshore Tasmania. The permit consists of six parts. Figure 1.

Part 1. Commencing at the northeast corner of the area and being the point of intersection of the parallel of latitude  $40^{\circ}10'$  south and the meridian of longitude  $147^{\circ}00'$  east thence due south to parallel of latitude  $40^{\circ}15'$  south due west to meridian of longitude  $146^{\circ}55'$  east due north to parallel of latitude  $40^{\circ}10'$  south aforesaid thence due east to the point of commencement. (Block #0180)

Part 2. Commencing at the northeast corner of the area and being the point of intersection of the parallel of latitude  $40^{\circ}15'$  south and the meridian of longitude  $146^{\circ}10'$  east thence due south to parallel of latitude  $40^{\circ}20'$  south due west to meridian of longitude  $146^{\circ}00'$  east due north to parallel of latitude  $40^{\circ}15'$  south aforesaid thence due east to the point of commencement. (Blocks #0241 & 0242)

Part 3. Commencing at the northeast corner of the area and being the point of intersection of the parallel of latitude  $40^{\circ}15'$  south and the meridian of longitude  $146^{\circ}45'$  east thence due south to parallel of latitude  $40^{\circ}20'$  south due west to meridian of longitude  $146^{\circ}30'$  east due north to parallel of latitude  $40^{\circ}15'$  south aforesaid thence due east to the point of commencement. (Blocks #0247, 0248 & 0249)

Part 4. Commencing at the northeast corner of the area and being the point of intersection of the parallel of latitude 40°20' south and the meridian of longitude 147°10' east thence due south to parallel of latitude 40°25' south due west to meridian of longitude 147°05' east due north to parallel of latitude 40°20' south aforesaid thence due east to point of commencement. (Block #0326)

Part 5. Commencing at the northeast corner of the area and being the point of intersection of the parallel of latitude 40°25' south and the meridian of longitude 147°00' east thence due south to parallel of latitude 40°30' south due west to meridian of longitude 146°25' east due north to parallel of latitude 40°25' south aforesaid thence due east to the point of commencement. (Blocks #0390, 0391, 0392, 0393, 0394, 0395 & 0396)

Part 6. Commencing at a northeast corner of the area and being the point of intersection of the parallel of latitude 40°30' south and the meridian of longitude 146°15' east thence due south to parallel of latitude 40°35' south due east to meridian of longitude 146°20' east again due south to parallel of latitude 40°45' south due west to meridian of longitude 146°15' east aforesaid again due south to parallel of latitude 40°50' south again due west to meridian of longitude 146°00' east due north to parallel of latitude 40°45' south aforesaid again due west to meridian of longitude 145°55' east again due north to parallel of latitude 40°35' south aforesaid again due west to meridian of longitude 145°50' east again due north to parallel of latitude 40°30' south aforesaid thence again due east to the point of commencement. (Blocks #0455, 0456, 0457, 0458, 0459, 0528, 0529, 0530, 0531, 0532, 0600, 0601, 0602, 0603, 0604, 0673, 0674, 0675)

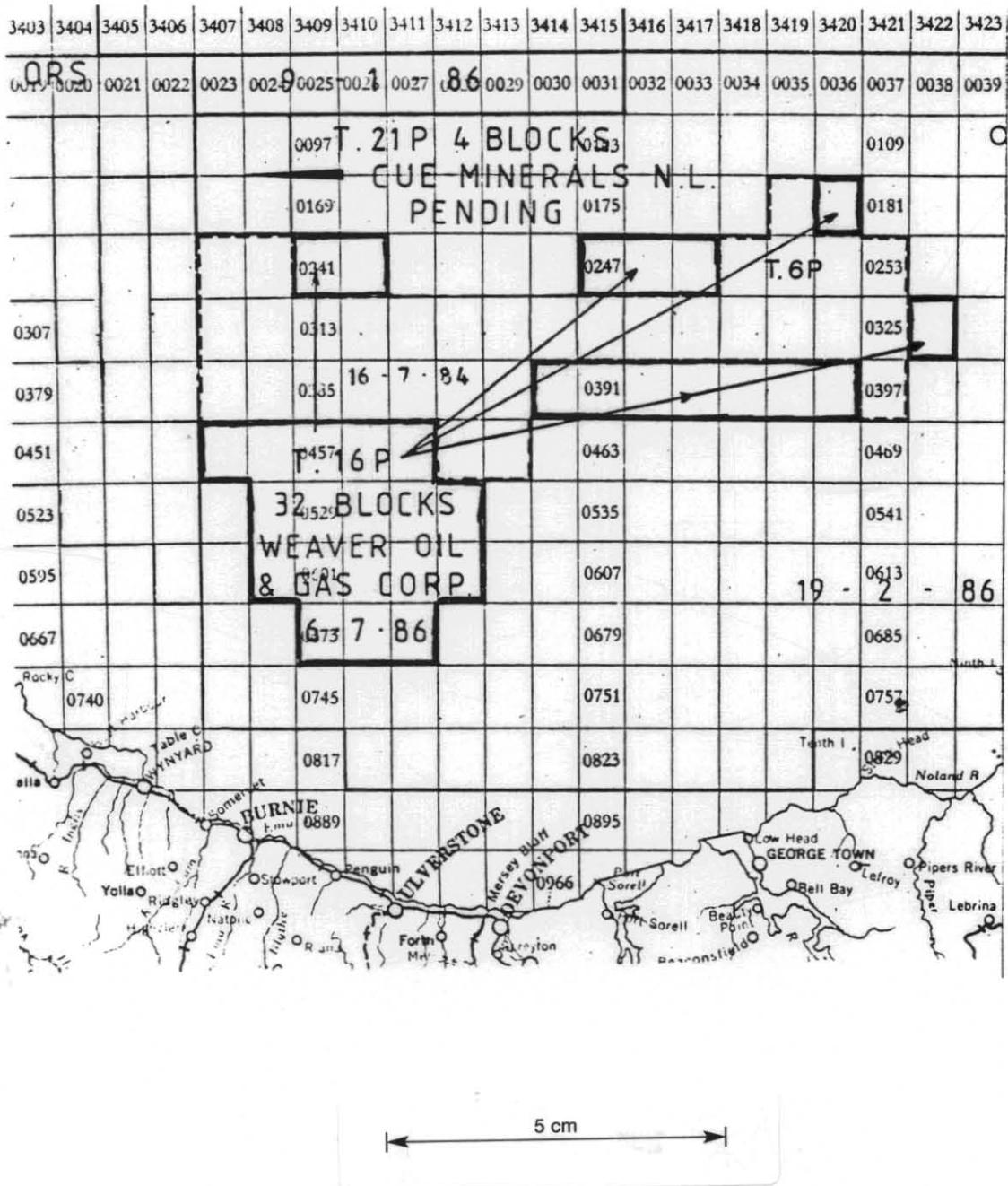


FIGURE 1

214021

S E C T I O N I

AEROMAGNETIC SURVEY

## REGIONAL AEROMAGNETIC SURVEY

SUMMARY

A Regional aeromagnetic survey was carried out for Haematite Exploration Proprietary Limited by Aero Service Limited during 1961. A previous survey was carried out in 1960 and had indicated the presence of deep Tertiary-Mesozoic sedimentary basins. The objective of the later survey was to delineate these basins.

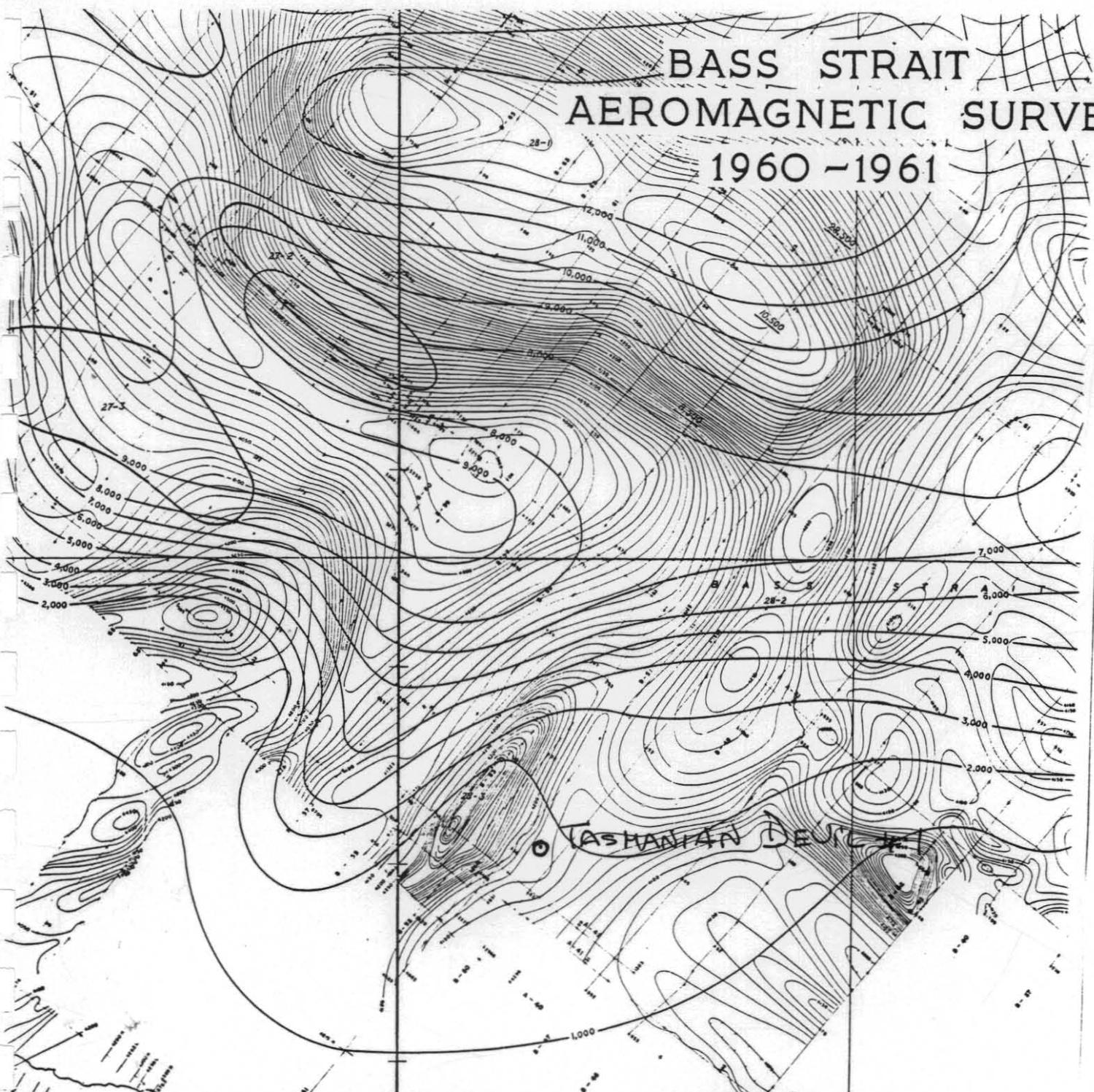
Results of the operation are presented as a contoured map of total magnetic field intensity and of interpreted basement depths. Figure 2. The location of the proposed Tasmanian Devil #1 Well is indicated.

Several anomalies control the apparent basement rise shown along the southern part of the basin. A northeast trending anomaly located to the west of the proposed exploratory well is probably associated with faulting which might persist through to parallel features on strike to the northeast.

At the proposed Tasmanian Devil #1 Well location, the depth to magnetic basement is calculated to be approximately 1900 feet below sea level.

BASS STRAIT  
AEROMAGNETIC SURVEY  
1960-1961

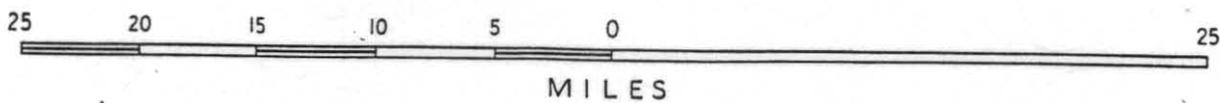
214023



TOTAL MAGNETIC INTENSITY  
GEOPHYSICAL INTERPRETATION

BASEMENT DEPTH. (Feet below sea level) ----- 2,000 -----

ANALYTICAL DEPTH ESTIMATES ----- 15,000 -----

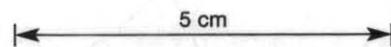


41°15'  
145°45'

146°00'

- 21 -

FIGURE 2



214024

S E C T I O N    I I

G E O P H Y S I C A L   S U R V E Y S

## GEOPHYSICAL SURVEYS

ABSTRACT

The Stoney Head Seismic Survey comprises 394.125 kilometers of new seismic lines on the continental shelf of Tasmania. The survey took place on Weaver Oil and Gas Corporation, Australia Permit T-16-P between April 2nd and April 4th, 1981. Figure 3.

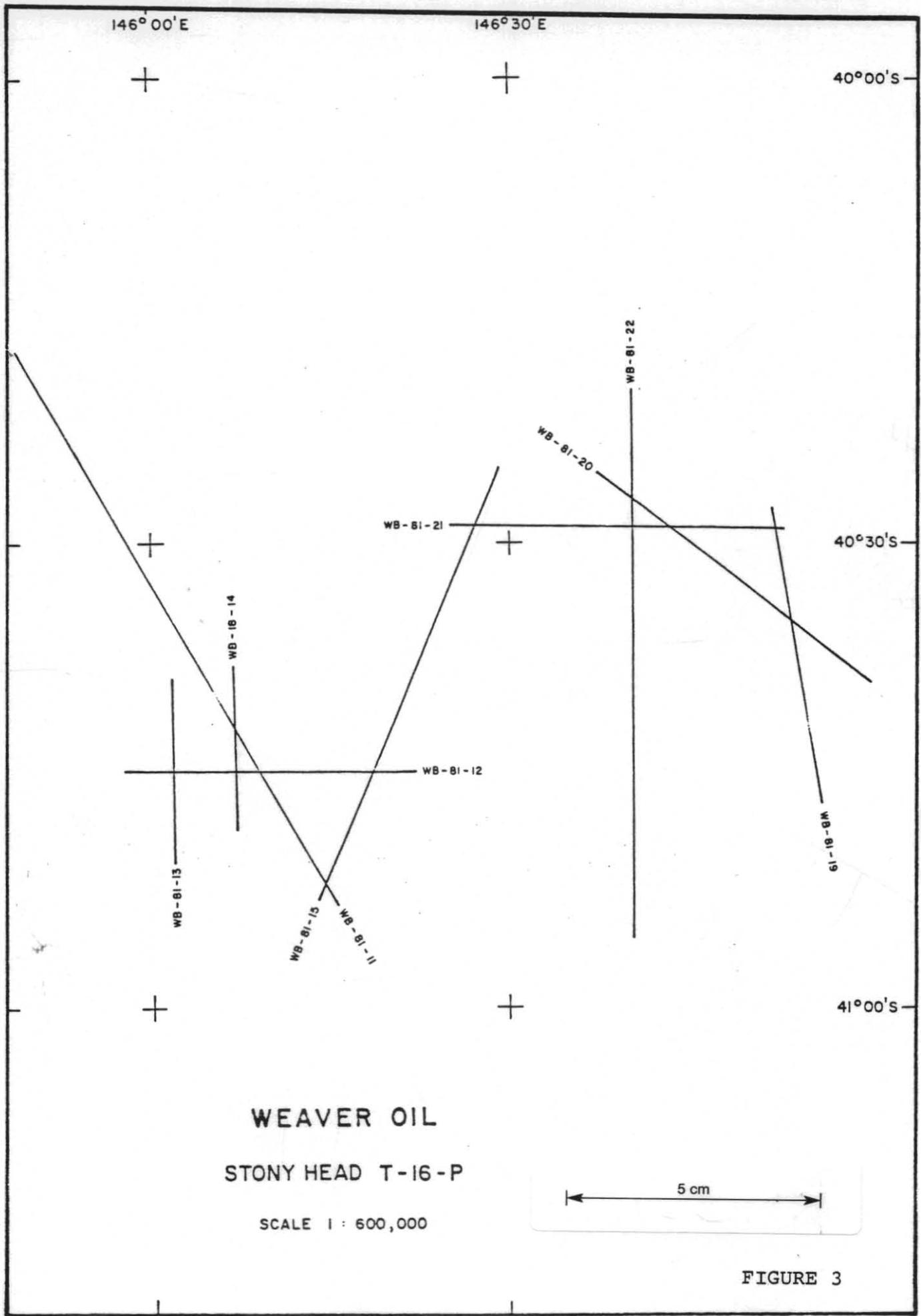
Most of the new lines surveyed were designed to further evaluate structural anomalies disclosed by earlier surveys, with the remainder devoted to gaining stratigraphic and regional control.

INTRODUCTION

The 1981 Stoney Head Seismic Survey was conducted on Exploration Permit T-16-P which was awarded on July 21, 1980 to Weaver Oil and Gas Corporation, Australia.

The M/V Western ODYSSEY, a fully equipped seismic vessel operated by Western Geophysical Company of America, was used to conduct the survey. Some 394.125 kilometers (244.9 miles) of new seismic, gravity and magnetic data were recorded.

The navigation system consisted of Western Geophysical's Western Integrated Navigation System which comprises four main subsystems; a doppler-sonar system to determine the ship's velocity continuously; a satellite system to provide the ship's position at intervals averaging two to four hours, a digital computer and a recording system to record computer data. Calculations, for all subsystems and data integration were handled by onboard general purpose digital computer.



The ship's position was continuously calculated by integrating sonar velocity and updating with satellite fixes.

Seismic recordings were made with a DFS "V" seismic acquisition system manufactured by Texas Instruments consisting of two analog modules, a controller module and four tape transports.

The energy source consisted of twenty high pressure Western airguns. In normal operating circumstances, ten of the airguns were combined to form a 560 cubic inches tuned array. The airguns are operated at a pressure of 5,000 pounds per square inch.

The streamer cable used by the Western ODYSSEY was composed of forty-eight detachable and interchangeable LRS Marine Active Cable sections. Each section is 50 meters in length and contains two 25 meter groups of twenty WM2-036 geophones.

Gravity data was acquired with a LaCoste Romberg meter. Magnetic data was acquired with a Geometrics G801/3 meter.

Interpretations of this data were made at Weaver Oil and Gas Corporation, Australia offices in Houston, Texas.

#### GEOLOGICAL SUMMARY

The Stoney Head Seismic Survey took place in the southern area of the Bass Basin.

The Bass Basin is located offshore between the southern coast of Victoria and the northern coast of Tasmania. It is bounded to the west by King Island and to the east by Flinders Island and the Bassian Rise. Water depth throughout the

basin rarely exceeds 270 feet (82 meters). The area has been actively explored for hydrocarbons since 1963.

The oldest sedimentary rocks encountered while drilling are Early Cretaceous. However, the greatest volume of sediments accumulated during the Tertiary. Lithologies vary from continental sandstone, siltstone, shale and coal in the non marine Cretaceous to Middle Eocene section, while the Upper Eocene to recent section consists of shale, sandstone, marl, mudstone and limestone. Drilling and seismic data indicate that there was a considerable amount of volcanic activity in the basin throughout its history.

The southeastern area of the basin exhibits the earliest structural growth whereas the structural growth in the central and northwestern areas occurred later. Structural style also varies from tilted fault blocks with thousands of feet of vertical displacement in the southeastern area, to low relief small anticlinal folds and minor faults in the northwestern area. Most of the prominent structural trends are oriented in a northwest-southeast direction which is parallel or subparallel to the present basin axis.

The Stoney Head Seismic Survey is tied through line WB-81-11 to the Pelican #1 Well for purposes of stratigraphic and structural control.

The Pelican #1 Well was drilled in 1970 to a measured depth of 10,428 feet (3,178.45 meters) penetrating a section ranging in age from Recent to Upper Paleocene. The deep anticlinal closure was encountered as predicted. The top of the Eocene Shale or Demons Bluff was intersected at 5,365 feet and the top of the sand section at 5,760 feet. The first gas-condensate pay zone was encountered at 8,110 feet. A total of 12 sands are interpreted to contain

hydrocarbons. The sands below 9,822 feet were found to have abnormally high pressures. Reservoir qualities of the sands within the Eocene Eastern View Coal Measures section were found to be satisfactory in regards to porosities and permeabilities. These sands were found to be separated and interbedded with impermeable silstones and shales capable of sealing the trap.

GEOPHYSICAL SUMMARY

Design and location of the Stoney Head Marine Seismic Survey was based on the interpretation of seismic lines as well as magnetic and gravity data previously acquired by the State, the Commonwealth, as well as by the permit holders of the area. These surveys are:

Bass Strait and Encounter Bay Aeromagnetic Survey for Hematite Exploration by Aero Service Limited 1960-1961

Anderson's Inlet Aeromagnetic Survey for Oil Development by Aero Service Limited 1961

Flinders Island-Kingston Seismic Survey for Hematite Exploration by Western Geophysical 1962-1963

Bass Basin Seismic for Esso Australia by Western Geophysical 1965

King Island East Seismic Survey for Esso Australia by Geophysical Service Incorporated 1965

Tasmania Aeromagnetic Survey for the Bureau of Mineral Resources by Aero Limited 1966

Eastern Bass Strait Seismic Survey for Esso Australia by Geophysical Service Incorporated 1966

Bass ED-67 Seismic Survey for Esso Australia by Geophysical Service Incorporated 1967

Bass EF-68 Seismic and Magnetic Survey for Esso Australia by  
Western Geophysical 1968

Bass B69A Seismic and Magnetic Survey for Esso Australia by  
Western Geophysical 1968-1969

Bass B69B Seismic and Magnetic Survey for Esso Australia by  
Western Geophysical 1969

Bass B70A Seismic and Magnetic Survey for Esso Australia by  
Geophysical Service Incorporated 1970-1971

Bass B71A Seismic and Magnetic Survey for Esso Australia by  
Geophysical Service Incorporated 1971-1972

Continental Margins Geophysical - Seismic, Magnetic and Gravity  
Survey for the Bureau of Mineral Resources by GG 1971-1972

Bass B72A Seismic Survey for Esso Australia by Geophysical  
Service Incorporated 1972

Bass HB75A Seismic Survey for Hematite Petroleum by Geophysical  
Service Incorporated 1975

PURPOSE

The Stoney Head marine seismic survey program detailed structural leads developed by preceding surveys, and furnished a fill-in of some wide reconnaissance traverses, thus permitting a more reliable definition of the principal structural and fault trends.

It will be obvious that the interpretation is still incomplete and that some faults could be aligned differently, however, it is doubtful that this incompleteness would significantly affect the evaluation of this area.

A seismic tie between the survey area and the Pelican #1 Well has been established. The correlation is somewhat tenuous due to the great distance involved and the significant variations in signal character, nevertheless it does provide valuable stratigraphic control.

MAP HORIZONS

Semi-continuous reflector horizons are the approximate top of the Eastern View Coal Measures and approximate top of the M. Diversus levels. Their exact stratigraphic position is not always well known due to lack of nearby stratigraphic control as well as the magnitude and relief of the uplifted areas.

FEATURE

A prominent structural feature has been identified, partially mapped and assigned the name Tasmanian Devil.

The Tasmanian Devil anomaly is a deep seated tilted fault block well

illustrated by both the old and the new seismic data. It is considered prospective throughout the entire Eastern View Coal Measures section. The anomaly is inadequately defined by existing seismic.

## DATA ACQUIRED

<u>LINE</u>	<u>SP - SP</u>	<u>PROFILES</u>	<u>KILOMETERS</u>
WB-81-11	100 - 3195	3096	77.400
WB-81-12	100 - 1499	1400	35.000
WB-81-13	100 - 995	896	22.400
WB-81-14	100 - 910	811	20.275
WB-81-15	100 - 2372	2273	56.825
WB-81-19	100 - 150	60	1.500
WB-81-19	160 - 1541	1382	34.550
WB-81-20	100 - 1685	1586	39.650
WB-81-21	100 - 1686	1587	39.675
WB-81-22	100 - 2773	2674	<u>66.850</u>
			394.125

## Raw Magnetics (GAMMAS)

Line WB-81-11 SP 102-1525  
Line WB-81-11 SP 1531-3191  
Line WB-81-12 SP 102-1497  
Line WB-81-13 SP 99-994  
Line WB-81-14 SP 96-910  
Line WB-81-15 SP 95-2369  
Line WB-81-19 SP 95-1542  
Line WB-81-20 SP 100-1683  
Line WB-81-21 SP 95-1684  
Line WB-81-22 SP 98-2772

## BOUGUER GRAVITY PROFILES SHOWING:

Bouguer Gravity (MGALS)

Adj. Free Air Gravity (MGALS)

Filtered Eotvos Gravity (MGALS)

Water Depth (Meters)

Line WB-81-11 SP 1531-3191  
Line WB-81-13 SP 99-994  
Line WB-81-14 SP 96-910  
Line WB-81-15 SP 95-2369  
Line WB-81-19 SP 95-1542  
Line WB-81-20 SP 100-1683  
Line WB-81-21 SP 95-1684  
Line WB-81-22 SP 98-2772

## MIG, TVF

Line WB-81-11 SP 100-3195  
Line WB-81-12 SP 100-1499  
Line WB-81-13 SP 100-995  
Line WB-81-14 SP 100-910  
Line WB-81-15 SP 100-2372  
Line WB-81-19 SP 100-1541  
Line WB-81-20 SP 100-1685  
Line WB-82-21 SP 100-1686  
Line WB-81-22 SP 100-2773

## SEISMIC LINES WITH:

Magnetic Intensity (GAMMAS)

Bouguer Gravity (MGALS) Profiles

Line WB-81-11 SP 102-3191  
Line WB-81-12 SP 102-1497  
Line WB-81-13 SP 99-994  
Line WB-81-14 SP 96-910  
Line WB-81-15 SP 95-2369  
Line WB-81-19 SP 95-1542  
Line WB-81-20 SP 100-1683  
Line WB-81-21 SP 95-1684  
Line WB-81-22 SP 98-2772

## MAGNETICS PROFILE SHOWING:

Total Magnetism Intensity (GAMMAS)

Velocity Analysis VELAN<sup>R</sup>

Line WB-81-11 SP 100-3195  
Line WB-81-12 SP 100-1499  
Line WB-81-13 SP 100-995  
Line WB-81-14 SP 100-910  
Line WB-81-15 SP 100-2372  
Line WB-81-19 SP 100-1541  
Line WB-81-20 SP 100-1685  
Line WB-81-21 SP 100-1686  
Line WB-81-22 SP 100-2773

## Time Variant Filtering

Line WB-81-11 SP 100-3195  
Line WB-81-12 SP 100-1499  
Line WB-81-13 SP 100-995  
Line WB-81-14 SP 100-910  
Line WB-81-15 SP 100-2372  
Line WB-81-19 SP 100-1541  
Line WB-81-20 SP 100-1685  
Line WB-81-21 SP 100-1686  
Line WB-81-22 SP 100-2773

## GRAVITY-MAGNETICS GMI INTERMEDIATE RECORD FORMAT

214038

WORD	FORMAT	DESCRIPTION
1	I*4	Line Number
2	I*4	Julian Date
3	I*4	Greenwich Mean Time (HHMMSS)
4	I*4	Accumulated Time (seconds)
5	R*4	Shotpoint Number
6	A*4	Re-Shot Characters or 'INT '
7	R*4	Accumulated Distance (meters)
8	R*4	Water Depth (meters) or elevation
9	R*4	Latitude (degrees)
10	R*4	Longitude (degrees)
11	R*4	Northing - Y (meters)
12	R*4	Easting - X (meters)
13	A*4	Line Name (1st 4 characters)
14	A*4	Line Name (2nd 4 characters)
15	A*4	Area Name (4 characters)
16	R*4	Magnetics, Field Master
17	R*4	Magnetics, Field Slave
18	R*4	Magnetics, Gradient
19	R*4	Magnetics, Accumulated Gradient Field
20	R*4	
21	R*4	
22	R*4	
23	I*4	
24	R*4	Instrument-Corrected Gravity (Mgals)
25	I*4	Gravity Counter Units
26	R*4	Gravity Corrected for Monitors (Mgals)
27	R*4	Eotvos Correction (Mgals)
28	R*4	Slab Bouguer Gravity (Unfiltered) (Mgals)
29	R*4	Free Air Gravity before Eotvos (Mgals)
30	R*4	System Adj. Bouguer (Mgals)
31	R*4	Final Random Adj. Bouguer (Mgals)
32	R*4	Free Air Gravity (Mgals)
33	R*4	2-D Terrain Correction (Mgals)
34	R*4	Tide Correction (Mgals)
35	I*4	Magnetics, Field Master (gammas)
36	R*4	Magnetics, Diurnal & Regional Removed (gammas)
37	R*4	Magnetics, Regional Correction (gammas)
38	R*4	Magnetics, Diurnal Correction (gammas)
39	R*4	Magnetics, Filtered (gammas)
40	R*4	Magnetics, Systematic Adjusted (gammas)
41	R*4	Magnetics, Random Adjusted (gammas)
42	R*4	Tide (meters)
43	I*4	
44	I*4	
45	R*4	Slab Bouguer Correction (Mgals)
46	R*4	2-D Bouguer Gravity (Filtered)
47	R*4	
48	R*4	
49	R*4	Adjusted Water Depths (Meters)
50	R*4	Filtered Free Air Gravity (Mgals)
51	R*4	3-D Bouguer Correction (Mgals)
52	R*4	3-D Bouguer Gravity (Unfiltered)
53	R*4	Sysfixed Free Air Gravity (Mgals)
54	R*4	3-D Bouguer Gravity (Filtered)
55	R*4	Free Air Gravity, Random Adjusted (Mgals)
56	R*4	Magnetics, Hilbert Transform
57	R*4	Magnetics, Horizontal Derivative (Gammas)
58	R*4	Magnetics, Vertical Derivative (Gammas)
59	R*4	Magnetics, Reduced to Pole (Gammas)
60	I*4	Sequence Number

60-Word Records, 100 Records (24404 Bytes) per Block, Fortran unformatted.

## STONEY HEAD GRAVITY/MAGNETIC SURVEY

THE GRAVITY/MAGNETIC SURVEY

The gravity/magnetic field survey was performed between April 2, 1981 and April 4, 1981, in conjunction with a seismic survey by party 86 on the M. V. Western Odyssey. The gravity meter used was LaCoste and Romberg S-88, which has a constant of 0.09961 milligals per counter division. All data was simultaneously recorded on analog strip charts and magnetic tape.

The in port reading for meter S-88 was made at Portland, Australia and a base value of 980,025.53 milligal was used.

The sea bottom density used on this survey was 2.2 grams per cubic centimeter.

Latitude correction was applied as computed by the gravity formula for the geodetic reference system, 1967 (GFGRS, 1967).

Navigation was by Western Navigation using (phase 4) navigation system. There were 394 kilometers of gravity and magnetics recorded with 10 line segments.

PROCESSING OF GRAVITY/MAGNETIC DATA

Aero Service uses a versatile suite of computer programs in processing, profiling, and contouring of gravity and magnetic data. These programs use the same "GMI Intermediate Tape Format" for interactive utility, and are organized logically to form a truly interrelated gravity/magnetic data base system.

Reformat of Navigation Edit Tape. The navigation reformat program is run

to change the tape format of the navigation edit tape to the gravity/magnetic intermediate (GMI) format.

Gravity/Magnetic Edit. The program is designed to edit gravity/magnetic field data recorded at irregular time intervals on GMI tape. Primary edit capabilities include assigning line numbers, changing GMI word position, step back adjustment for time lags in recording, subsampling or averaging data to one minute time interval, converting of water depth units, and flagging of discontinuities in the data.

Evaluation of Field Data. At this point the digitally recorded data is checked with the strip chart data and any difference resolved. It was noted that there is a line where the gravity meter had malfunctioned. This line is WB 81-11 from SP 102-SP 1524. The line was deleted from the GMI tape and not used in any adjustment.

Navigation Reformat. In this program the final navigation tapes are reformatted to the GMI format.

Navigation Merge. Final navigation data, shot points, and line names are merged with gravity and magnetics. At the same time gravity counter units are reduced to milligals using the gravity meter constant. Latitude corrections are also made at this time and any discontinuities in navigation are flagged.

"Eotvos" Effect Removal. The GMI tape is read using latitude, longitude and time in order to compute raw "Eotvos" correction. The "Eotvos" corrections are filtered by running average of the sample under consideration and one sample on each side. Then a parabolic recursive filter with a frequency of 0.000700 Hz. is applied. At this point the "Eotvos" correction,  $7.503 V \cos$

(Latitude) X SIN (Course) + .004154  $v^2$  is added to each free air gravity sample on the output tape.

Magnetics Reduction. This program computes and subtracts the Earth's main magnetic field (IGRF) from the observed data. Computation variables include the prospect's location and Julian date of the prospect survey. Upon completion, the data is then output onto GMI tape.

Gravity and Magnetics Filter. Data in the form of an evenly spaced time series is smoothed using a recursive parabolic algorithm, this algorithm is used in parallel and cascade in such a way to yield a zero phase, very flat response, low pass filter. The cut-off value used for the free air gravity data was 0.0007 Hz. and the cut-off value used for the magnetic data was .0007 Hz.

Bouguer and Terrain Correction. The water depths on tape were used to compute Bouguer and terrain correction, which were applied to the free air gravity. The terrain correction were two-dimensional and were computed by the Talwani and Ewing method.

Intersection Calculator. Using the latitude and longitude of one minute samples on the GMI tape, the line segments are scanned to determine the location of line intersections.

Systematic Error Adjustment. Intersection mistie information is taken from the output tape of the intersection calculator program and a systematic error adjustment is computed for each line segment, such that the remaining misties are reduced substantially. These adjustments are then added to the selected GMI fields. The average mistie for the free air gravity before adjustment was 1.18 milligals. The average mistie after adjustment was 0.244. The

average mistie before adjustment for the total magnetic field was 9.67 gammas; the average mistie after was 3.28 gammas. There were a total of 42 intersections found.

Gravity/Magnetic Profile. The profile program is a general purpose program that produces a profile plot on a Cal-Comp drum plotter with up to eight fields displayed simultaneously with a variety of scale options. There were two sets of profiles made at this time. Gravity profiles displayed water depths, "Eotvos" correction, free air, and Bouguer gravity.

Map Maker. A GMI tape is input to the map maker program and produces a value posted shot point map on any scale, using almost any type of prescribed projection or spheroid.

Final Adjustment and Contouring of Maps. The remaining misties, called random error, are then resolved by a technician comparing parallel and perpendicular profiles and distributing the misties in such a way that no legitimate anomaly is destroyed nor created; then from the corrected profiles the maps are manually contoured.

#### FINAL PROFILES AND CONTOUR MAPS

Gravity and Magnetic Contour Maps. The maps are plotted on mylar at a scale of 1:100,000. The spheroid used was Australian National with the projection being universal Transverse Mercator. The central meridian is 147°E.

The contour interval for the Bouguer gravity maps is 1 milligal and for the total magnetic intensity map is 10 gammas.

Final Profiles. Final profiles are 10 inches wide plotted on gridded paper

at a horizontal scale of 2540 meters per inch corresponding to contour maps. In addition, another set of profiles were produced on 10 grided paper at a horizontal scale of 400 meters per inch matching the seismic sections. The fields and vertical scales of both sets of profiles are as follows:

A. Gravity

- (a) Free air gravity, adjusted @ 5 milligals per inch
- (b) Bouguer gravity @ 5 milligals per inch
- (c) "Eotvos" correction @ 5 milligals per inch
- (d) Water depths @ 100 meters per inch

B. Magnetics

- (a) Raw Magnetics @ 20 gammas per inch
- (b) Total magnetic intensity @ 20 gammas per inch.

214044

DEPTH TO MAGNETIC BASEMENT  
IN THE  
STONEY HEAD SURVEY AREA OF THE  
BASS BASIN, SOUTHERN AUSTRALIA  
FOR  
WEAVER OIL AND GAS CORPORATION

October, 1981

Aero Service Division  
Western Geophysical  
Company of America  
Houston, Texas

SUMMARY

The interpretation area, the Stoney Head Survey, is located within the Bass Strait of Southern Australia between the Otway Basin to the west and the Gippsland Basin to the east. The Stoney Head Area is located within the boundaries 145°45' to 147°00' east longitude and 40°15' to 41°00' south latitude. It lies over an uplifted basement complex tying Tasmania to Australia, the margin of which may be roughly defined at the depositional boundary of the Eocene (Beddoes, 1973).

Three different types of sources seem to be responsible for the magnetic pattern. Very broad basement anomalies suggest basement depths at approximately 4500 meters in the northwestern portion where one documented well depth reached 3049 meters at Pelican 2 before drilling was stopped due to geopressure (Beddoes, 1973).

In the south central part of the Stoney Head Survey, an area of probable, thin, shallow volcanic cover has been roughly outlined at depths on the order of 1000 meters below sea level. Scarcity of data in that area prevents a prediction of the extent of the cover. A massive igneous body is defined in the southwestern corner of the survey at an average depth of approximately 1500 meters below sea level. The increased magnitude of the associated anomalies allows distinction between this and the probable sheet-like volcanic sources.

In summary, two types of igneous sources are interpreted in the Stoney Head Survey Area. Fairly extensive thin, shallow volcanics probably cover large areas at a depth of approximately 1000 meters and a more massive intrusive igneous source of uncertain extent occurs in the southwestern portion of the area. Others may be present.

## EGG ISLAND SEISMIC SURVEY

SUMMARY

The 1982 Egg Island Seismic Survey was conducted on Exploration Permit T-16-P which was awarded on July 21, 1980 to Weaver Oil and Gas Corporation, Australia.

The M/V Western ODYSSEY, a fully equipped seismic vessel operated by Western Geophysical Company of America, was used to conduct the survey. Some 347.475 kilometers (215.957 miles) of new seismic, gravity and magnetic data were recorded between March 1 to March 4, 1982. Figure 4.

The navigation system consisted of Western Geophysical's Integrated Navigation System which comprises four main subsystems; a doppler-sonar system to determine the ship's velocity continuously; a satellite system to provide the ship's position at intervals averaging two to four hours, a digital computer and recording system to record computer data. Calculations, for all subsystems and data integration were handled by the onboard general purpose digital computer. The ship's position was continuously calculated by integrating the sonar velocity and updating with satellite fixes. The navigation data was shipped to Western Geophysical's Navigation Department in Singapore for processing.

Seismic recordings were made with a DFS "V" seismic acquisition system - manufactured by Texas Instruments consisting of two analog modules, a controller module and four tape transports.

The digital recorded magnetic tapes were shipped to GeoCenter, Inc. in Houston, Texas for processing.

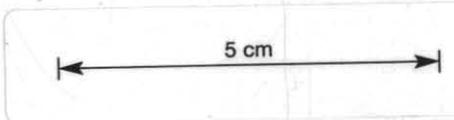
214047

The energy source consisted of twenty high pressure Western airguns. In normal operating circumstances, ten of the airguns were combined to form a 760 cubic inch tuned array. The airguns are operated at a pressure of 4,500 pounds per square inch.

The streamer cable used by the Western ODYSSEY was composed of 48 detachable and interchangeable LRS Marine Active Cable sections. Each section is 50 meters in length and contains two 25 meter groups of twenty WM2-036 geophones.

Gravity data was acquired with a LaCoste Romberg meter while magnetic data was acquired with a Geometrics G801/3 meter.

40°00'S.



WEAVER OIL & GAS CORPORATION  
T-16P BASS BASIN

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40°30'S.

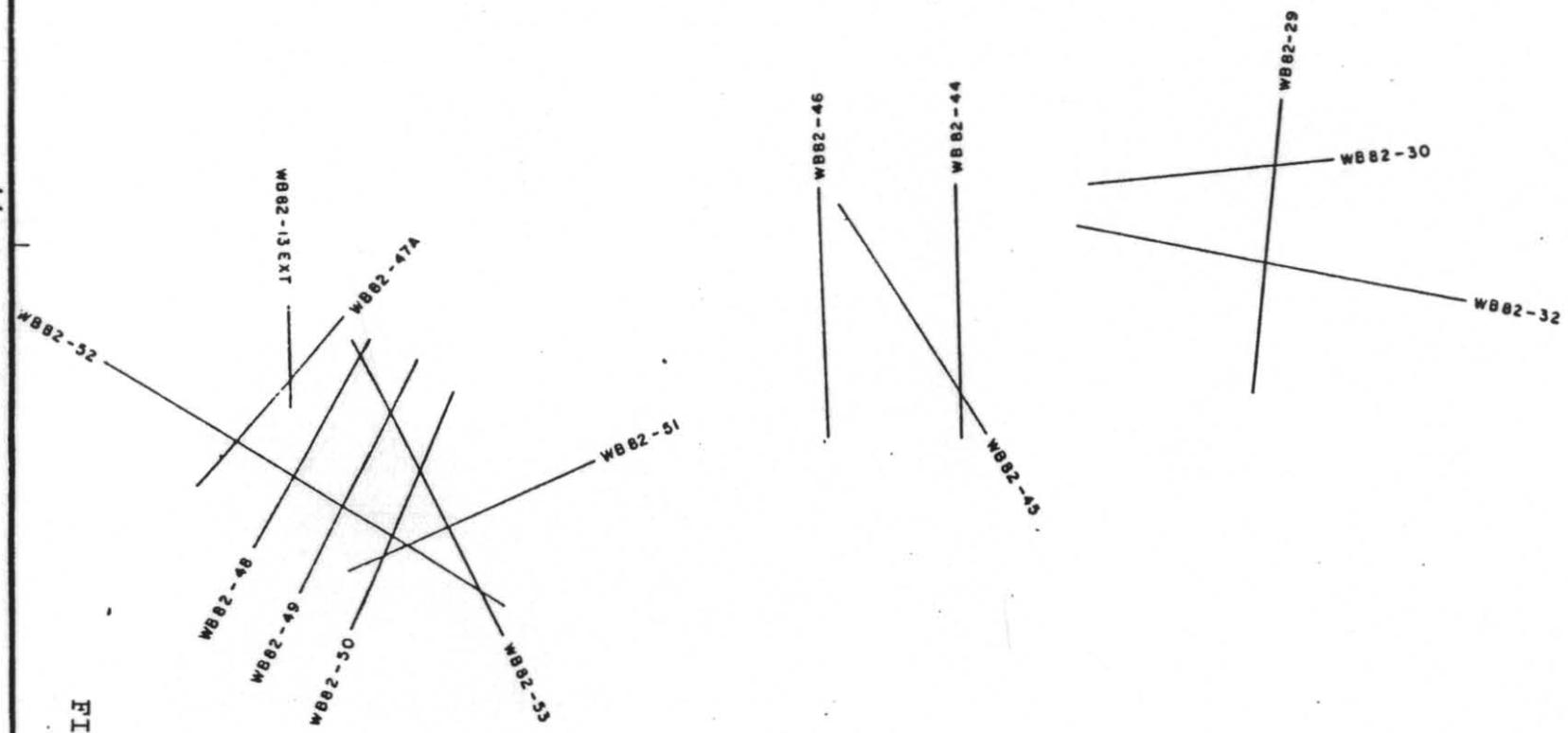


FIGURE 4

146°00'E.

146°30'E.

147°00'

41°00'S.  
147°30'E.

214048

GENERAL

The Egg Island Marine Seismic survey program detailed structural leads developed by preceding surveys, and furnished a fill-in of some wide reconnaissance traverses, thus permitting a more reliable definition of the principal structural and fault trends.

A seismic tie between the survey area and Pelican #1 Well was established during the Stoney Head seismic survey in 1981. The correlation is somewhat tenuous due to the great distance involved and the significant variations in signal character, nevertheless it does provide valuable stratigraphic control.

The top of the Eastern View Coal Measures is a very good, easily correlatable reflective horizon that was carried over the permit area. The M-Diversus reflector is semicontinuous and more difficult to correlate. The high amplitude events of the Eastern View Coal Measures generates a series of multiples that tend to mask and over-ride the M-Diversus reflectors which have a lower reflection coefficient.

STRUCTURAL FEATURES OF INTEREST:

Tasmanian Devil Prospect - A prominent structural feature located along the S.S.W. margin of the Basin was identified from earlier surveys and mapped at different horizon levels. It is a deep seated tilted fault block well illustrated by both the old and the new seismic data. The Eastern View Coal Measures is carried across this anomaly. It is undetermined at this point if the M. Diversus reflector can be carried across this feature, due to the seismic interference created by the EVC. It is quite obvious that the Lower Eocene and Paleocene reflectors thin dramatically on the NE flank of T-Devil, and how

much section is present on the crest of the structure is not determined at this time. Gravity and magnetics modeling is presently being undertaken to try to resolve this question.

The area north and east of T-Devil which includes a portion of Permit T-15-P has been mapped, but has failed to indicate additional prospective features.

DATA ACQUIRED  
EGG ISLAND SURVEY - 1982

<u>LINE</u>	<u>SP - SP</u>	<u>PROFILES</u>	<u>KILOMETERS</u>
WB-82-13EXT	001-363	363	9.075
WB-82-29	001-1018	1018	25.450
WB-82-30	001-944	944	23.600
WB-82-32	001-560	560	14.000
WB-82-32	561-1476	916	22.900
WB-82-44	001-927	927	23.175
WB-82-45	001-871	871	21.775
WB-82-45	872-1008	137	3.425
WB-82-46	001-875	875	21.875
WB-82-47A	001-751	751	18.775
WB-82-48	001-859	859	21.475
WB-82-49	001-929	920	23.225
WB-82-50	001-920	920	23.000
WB-82-51	001-982	982	24.550
WB-82-52	001-1666	1666	41.650
Wb-82-53	001-1181	1181	<u>29.525</u>
			347.475

## EGG ISLAND GRAVITY AND MAGNETIC SURVEY

THE GRAVITY AND MAGNETIC SURVEY

The Gravity and Magnetic field survey was performed between March 1, 1982 and March 4, 1982 by Western Geophysical Company of America, Party 86 on board the M/V Western Odessey. The gravity meter used was LaCoste and Romberg S-88, which has a constant of 0.09961 milligals per counter division. All data was simultaneously recorded on analog strip charts and magnetic tape.

The in port reading for the survey was made at Port Victoria, Australia and a base value of 980,038.85 milligals was used. The sea bottom density used on this survey was 2.2 grams per cubic centimeter.

Latitude correction was applied as computed by the gravity formula for the geodetic reference system, 1967 (GFGRS, 1967).

Navigation coordinates were provided by Western Geophysical Company of America using the ARGO navigation system.

All gravity and magnetic data was directly tied to the previous Bass Basin survey shot in April, 1981.

PROCESSING FLOW

Figure 5 shows the processing flow for gravity and magnetics processing. The following paragraphs discuss the steps involved in the data processing flow.

Edit - This program processes the field tapes data at 20 second intervals and outputs gravity and magnetic samples at every minute by averaging the current sample with the samples occurring 20 seconds earlier and 20 seconds later.

Before averaging, each sample is checked to see if the value falls within a reasonable accepted range for such data. If a value falls outside the acceptable range, it is not used in the average. A delta value check is also made. The values used were:

	<u>DELTA</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>	
Gravity	333	55,000	70,000	Counter units
Magnetics	666	25,000	60,000	Gammas

These numbers were based on empirical information gathered during previous data processing.

Gravity/Magnetics Update - This program is used to make changes to line numbers, water depths, or to manually update sensor information when obvious errors such as one point spikes not trapped by the edit program appear on the quality control profiles.

Navigation Reformat - This program changes the format of navigation tapes to Aero's standard gravity/magnetics tape format to facilitate further processing.

Navigation Resequencing - This program records navigation data to coincide with the gravity and magnetics data.

Navigation Merge - After the reformatting and resequencing operations have been performed, this program merges the navigation data with the gravity and magnetics data, scales gravity counter units to milligals using the gravity meter constant, scales gravity counter units to milligals using the gravity meter constant, and computes latitude corrections. Latitude corrections are computed using the algorithm for the Geodetic Reference System, 1967 (GFRS, 1967). If any discontinuities (large distance jumps) or missing data exist, the affected

samples are flagged. All subsequent processes are performed using the merged gravity magnetics formatted (GMI) tape. It was noticed at this point that there is one line segment of gravity data where the gravity meter had malfunctioned. This line (WB-82-47A) was deleted from further processing.

"Eotvos" Effect Removal - This program reads the GMI tape and computes a raw "Eotvos" correction for each sample using the following formula:

$$E = 7.5 * S * \cos(\text{LAT}) * \sin(\text{HEAD}), \text{ where}$$

E = "Eotvos" Correction

S = Ship's Speed in Knots

LAT = Ship's Latitude

HEAD = Ship's Heading

Speed and heading are computed from the time, latitude and longitude of the tape record. These raw "Eotvos" numbers are smoothed in a three point running average synthetic operation and then filtered using a parabolic recursive filter passing frequencies below 0.0007 Hz. This filter setting has proven to be effective in reducing high frequency noise jitter associated with ship motion and navigation resolution. The final filtered "Eotvos" correction is applied to each free air gravity sample and all values are written onto the output tape.

Magnetic Regional Removal and Horizontal Gradient Calculation - This program reads the GMI tape and computes the earth's normal magnetic field using the International Geomagnetic Reference, 1975 updated to 1981. Each sample's latitude, longitude and time is used to develop a unique value for that sample. This program also calculates the magnetic horizontal gradient from the gradiometer system's master and slave sensors by subtraction and division by the distance between sensors where applicable.

Filtering - Low pass filtering operations are performed on both gravity and magnetics data. The magnetics filtering is used to smooth high frequency instrument noise and the gravity filter is used to smooth the effects of the sea state and wave action. Each preliminary profile is examined and a particular filter length is chosen manually to compensate for observed "noise". A filter length of 0.0003 Hz was used for gravity data and 0.0008 Hz was used for magnetic data. After the filtering process, each line is checked by plotting profiles displaying water depth, "Eotvos", free air gravity without "Eotvos" correction, unfiltered free air gravity with "Eotvos" correction, filtered free air gravity with "Eotvos" and unfiltered magnetics. Any error conditions (such as direct or inverse correlation of "Eotvos" correction and Bouguer gravity, improper filtering or errors in water depths) are spotted and corrected before further processing.

Intersection Picker - Latitude and longitude coordinates from the GMI tape are input to this program and an intersection algorithm calculates sample times at which lines cross one another. Subsequent processing programs use this intersection information to compute statistics for applying systematic corrections.

Intersection Mistie - By using the intersections determined in the Intersection Picker Program and the sensor data tape output by the Filter Program, this program calculates the filtered free air gravity and filtered magnetics misties at intersections. The average free air mistie is 7.67 milligals, and the average magnetics mistie is 14.18 gammas.

Free Air Sysfix - The sensor data output from the Filter Program and the mistie data are used to compute a systematic adjustment bias for each line by the method of least squares. The data is then corrected by adding the applicable

bias to each line. The average filtered adjusted free air gravity mistie for the survey after this process is 2.36 milligals.

Magnetics Sysfix - Next the same procedure as above is used to systematically adjust the magnetics data. The average magnetics mistie for the survey for the adjusted filtered magnetics is 8.36 gammas.

Bouguer and Terrain Correction - The water depths values at each sample are used to compute Bouguer and terrain corrections for application to the adjusted free air gravity. The terrain corrections are two dimensional and are computed by the Talwani, et al method referenced in the Journal of Geophysical Research, Vol. 64, No. 1, January, 1959, page 49. The first and last depth for each line is extended to infinity for purposes of this calculation.

Intersection Mistie - This program is run next to compute mistie in the unadjusted Bouguer gravity after the above correction have been applied. The average mistie for the unadjusted Bouguer gravity is 12.11 milligals.

Bouguer Gravity Sysfix - Using the sensor data output by the Bouguer and terrain correction program and the mistie information listed above, a systematic error correction is computed and applied using least squares to minimize the average errors across the entire survey. After applying this correction for the survey, the average mistie is 2.32 milligals.

Final Gravity/Magnetics Profile - This program creates a Calcomp drum plot tape from the sensor data contained on a GMI tape. This tape is fed to a Calcomp 1052 drum plotter and the final gravity and magnetics profiles are plotted on 10" gridded paper. The horizontal scale of the profiles for the survey is 1 inch = 2,450 meters. Vertical scales of the plotted curves are listed below:

Gravity:

- a) Final Bouguer Gravity @ 5 milligals/inch
- b) Adjusted Free Air Gravity @ 5 milligals/inch
- c) Adjusted Bouguer Gravity @ 5 milligals/inch
- d) "Eotvos" Correction @ 5 milligals/inch
- e) Water Depths @ 20 meters/inch

Magnetics:

- f) Adjusted Raw Magnetics @ 20 gammas/inch
- g) Total Magnetic Intensity @ 20 gammas/inch

In addition to the above presentation, a set of gravity and magnetic profiles were produced on 10" gridded mylar with the horizontal scale of 1" = 575 meters matching the seismic sections scale. Vertical scales of the two plotted curves are as follows:

- h) Final Bouguer Gravity @ 5 milligals/inch
- i) Total Magnetic Intensity @ 20 gammas/inch

Gravity/Magnetics Mapmaker - This program creates a Flatbed plot tape from the sensor data contained on a GMI Tape, this data is fed to a 748 Flatbed plotter and the final mylar maps on which the contours are drafted are made. The maps are at a scale of 1:100,000. The projection used was Universal Transverse Mercator with the spheroid being Australian National.

- a) Six Total Magnetic Anomaly Map @ contour interval =  
10 gammas (MAPS 1-5) and 20 gammas (MAP 6)
- b) Six Bouguer Gravity Map @ contour interval =  
1 milligal.

PROCESSING FLOW CHART

214058

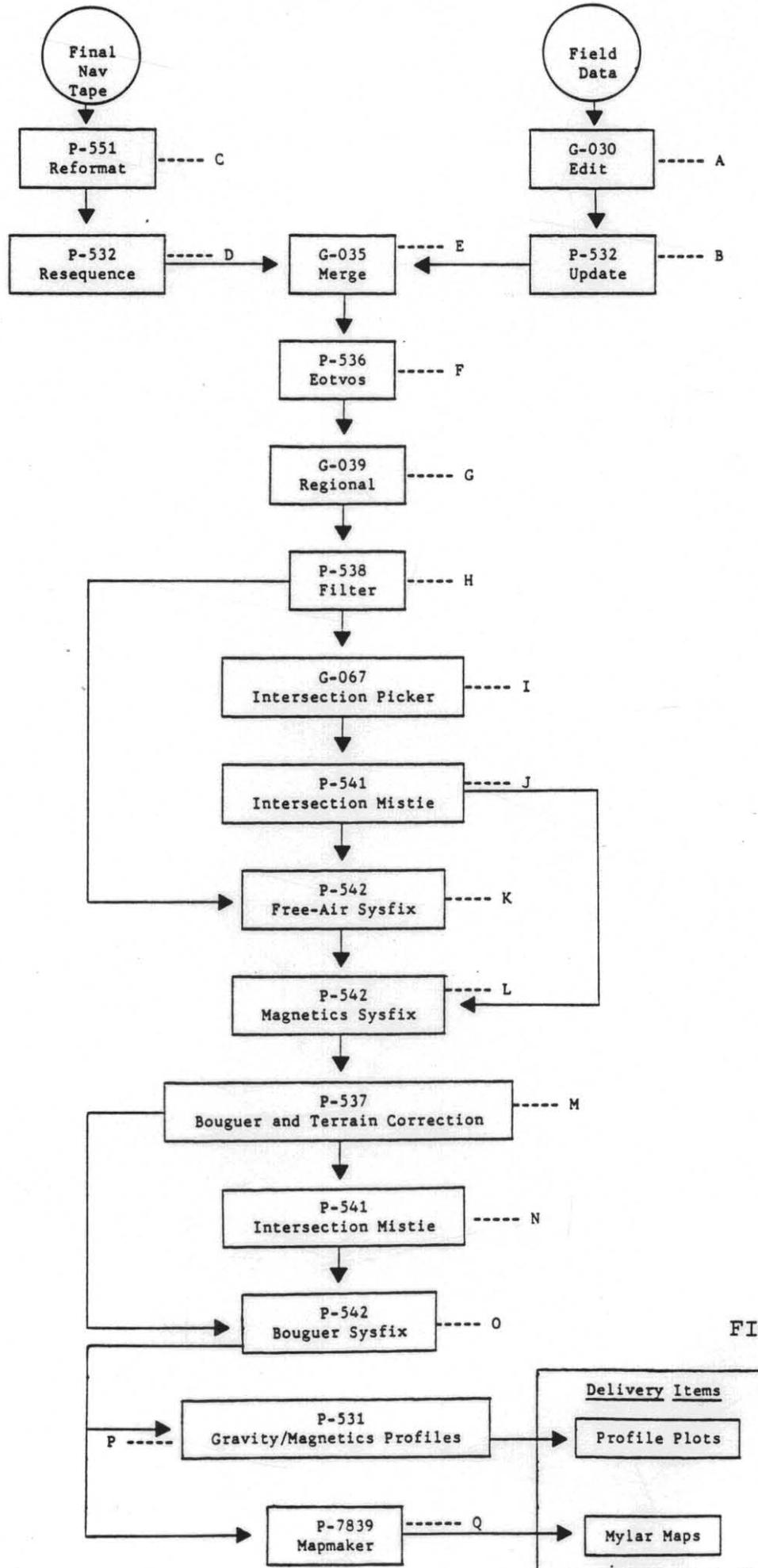


FIGURE 5

214059

S E C T I O N   I I I

MARINE MAGNETIC AND GRAVITY INTERPRETATION

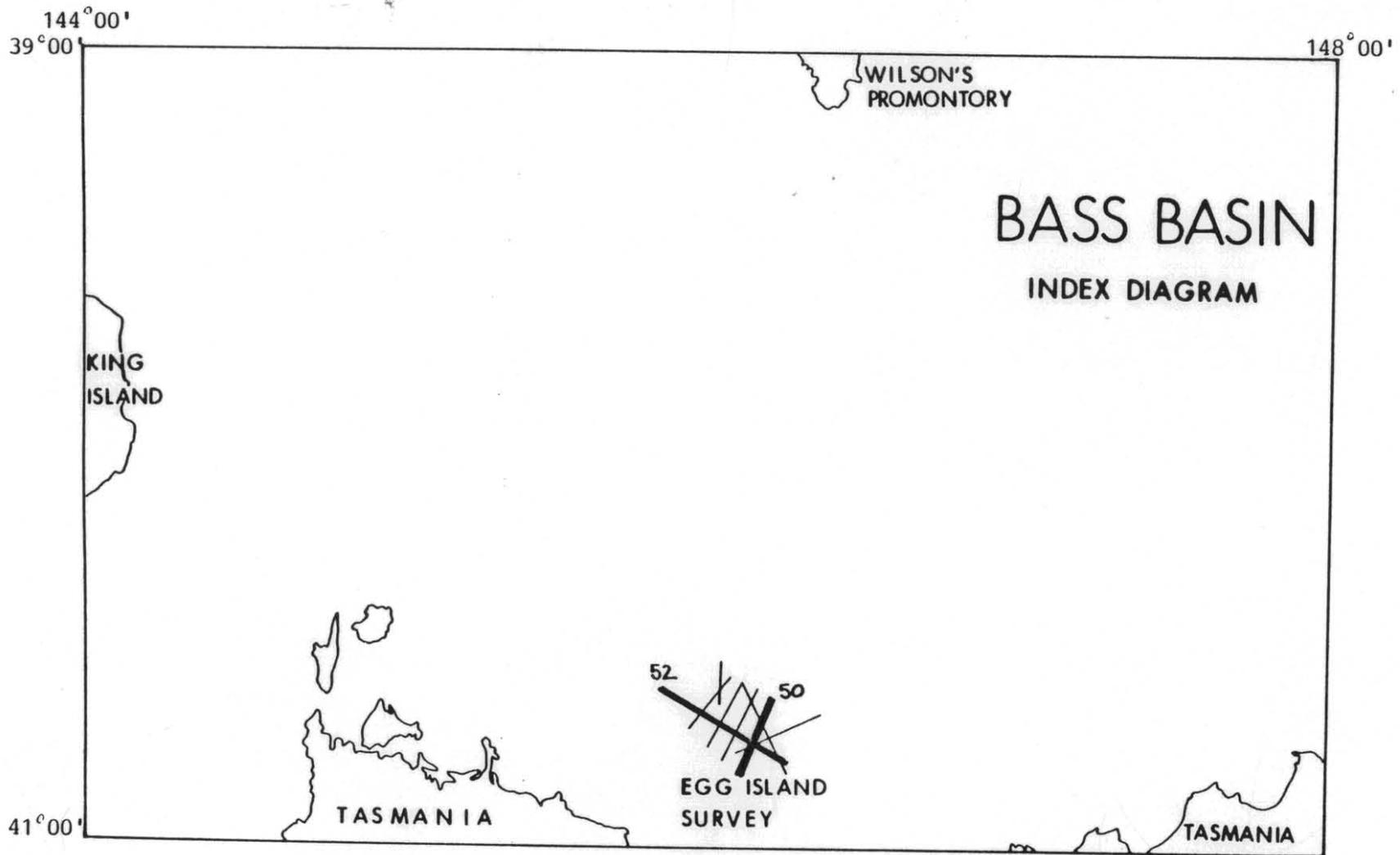
EGG ISLAND SURVEY

INTRODUCTION

Between the dates March 1 and March 4, 1982, marine magnetic and gravity data were collected by Western Geophysical Company of America in conjunction with a marine seismic survey in the Bass Strait of Australia and Tasmania. The present report discusses the results of an interpretation of the potential field data collected over the Egg Island Area. Approximately 347 line kilometers comprise the Egg Island survey, located between 145°45' to 146°30' east longitude and 40°30' to 40°50' south latitude. The survey region is shown on Figure 6.

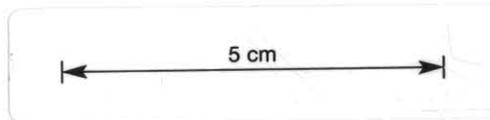
The objectives of the survey were to establish depth to magnetic basement and to obtain other pertinent structural information. Depth calculations were achieved using the Werner deconvolution method (see Friedberg, 1975). Gravity data used in conjunction with the magnetic data, aided in the identification of basement rock type.

Computer modeling was utilized to integrate magnetic, gravity, and seismic information over two intersecting lines. The program used was an interactive, 2 1/2 dimensional, forward modeling program, which allows the interpreter to build a schematic model with variable physical characteristics such as size, shape, orientation, depth, magnetic susceptibility, remnant magnetism, and density. Once the model is constructed, magnetic or gravity anomaly curves can be calculated over the model and then compared with the actual observed anomaly curves, thereby directing the interpreter in the revision of the model parameters. The chief aim of the modeling exercise was to confirm or revise an interpretation of the acoustic basement along lines 50 and 52 which was provided by Weaver Oil. Specific modeling results are contained in Appendix A of this report.



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FIGURE 6



214061

GEOLOGY

Australia is one of the oldest and most stable of continents. Major deep geosynclines and mobilized structural belts involve only the Paleozoic and earlier rocks. The greatest of these and the one pertinent to this survey, is the north-south trending Tasman belt. The Tasman belt is buried beneath Mesozoic sediments, and comprised generally of Paleozoic sediments which are highly deformed (Weeks, 1967).

From late Paleozoic to early Mesozoic time, the continent behaved increasingly like a craton, with tectonic movements within the Australian plate acting, almost entirely vertically (Weeks, 1967). The Mesozoic basins are broad and shallow and faults of normal, transcurrent, gravity and torsion types segment the basins and commonly bound the troughs of greatest subsidence (Weeks, 1967).

During the Cenozoic, even greater stabilization of the continent took place. Only epeirogenic and taphrogenic tectonism is recorded in the orogenic belts of Australia (Weeks, 1967). Orogenic mobile belts of Mesozoic-Tertiary age, such as those which occur along many of the world's continental margins, are not present in Australia (Weeks, 1967).

Bass Basin is one of three Mesozoic-Tertiary basins that adjoin in an east-west alignment along southeastern Australia, just north of Tasmania. The Gippsland and Otway basins extend on the continental shelf, to the east and west respectively, while the Bass Basin is contained entirely within the Bass Strait between the continent and Tasmania.

Bass Basin occupies an area of more than 50,000 square kilometers. That includes a central basin of approximately 23,300 square kilometers with the rest being located over shallow shelf rocks (Weeks, 1967). The basin is flanked to the northeast and southwest by systems of normal faults, and

considered to be a partially developed half graben (Wallis, 1967). The Bass Basin is strongly silled and is completely surrounded by land or shallow basement ridges (Weeks, 1967). Greatest depth to basement along these sills occurs at approximately 800 meters at the northwest end of the basin, and approximately 300 meters along the other outlets (Weeks, 1967).

Esso No. 1 Bass, a 2,570 meter hole drilled near the center of the basin, penetrates Tertiary mudstones, and reaches Upper Cretaceous sandstones and shales. The Upper Cretaceous to Eocene is comprised of a deltaic complex that grades upward into an Upper Eocene sequence of fine, carbonaceous clastics (Wallis, 1967). An Oligocene section, 530 meters in thickness, extends across the entire basin, lapping onto strata of progressively older age. The Oligocene consists of mainly mudstone and volcanics (Wallis, 1967). The Miocene system, with a maximum thickness of 1,000 meters, overlaps the basin's margins. The lower portion consists of a gray-green calcareous mudstone and tuffite, and the upper zone is a poorly consolidated skeletal calcarenite (Wallis, 1967).

The silled condition of the basin influenced the environment of deposition. Porosity is provided in the Oligocene-Miocene limestone and in the sandstone of the Eocene, Paleocene, and Cretaceous (Weeks, 1967). Based on outcrop and seismic studies, porous limestone and sandstone should be well developed around the flanks of the basin (Weeks, 1967). The extent of this development depends on the nature and distribution of the environment of deposition.

The section is continuously transgressive as well. Therefore, 240-300 kilometers of basin flank may provide good places for hydrocarbon accumulation from a source in the central basin, provided the traps formed early enough (Weeks, 1967).

FEATURES

The dominant feature in the total intensity map observed in the Egg Island area is the northeast trending magnetic high that reaches at least 350 gammas against an average overall total field of approximately 61,600 gammas. A gravity high coinciding with this magnetic high may indicate volcanic basement. According to the Haematite report (1965), the data here may be indicative of a structural high comprised primarily of basic material.

Computer modeling of line 52 suggests that the structural high is probably basaltic. Fault N-2, interpreted from the seismic data, borders the interpreted structural high to the south, and intersects line 52 twice. Susceptibilities within the uplift average approximately 3,000 c.g.s. On the downthrown side, they average approximately 2,000 c.g.s., which may be indicative of a change to granitic or metasedimentary rock. The results of the gravity modeling concur with those of magnetic modeling in that the density contrasts are higher within the uplift, approximately 0.2, as opposed to 0.1 on the downthrown side. The basalt flows illustrated on line 52 are suggested by a very strong acoustic reflector occurring above interpreted basement, and some relatively shallow magnetically derived depth values may have originated from the dike or set of dikes within the magnetic high, which causes the major northeast trending anomalies, since their sources are of similar susceptibility and density contrast (see Appendix A). Conclusive evidence to support this interpretation, however, is lacking.

Line 50, which intersects line 52 southeast of the high, is most effectively modeled in the gravity mode. This is due to the poor position of line 50 with respect to the major northeast trending magnetic anomalies.

SUMMARY AND RECOMMENDATIONS

Between the dates March 1 and March 4, 1982, marine magnetic and gravity data were collected by Western Geophysical Company of America, in conjunction with a marine seismic survey in the Bass Basin within the Bass Strait of Australia and Tasmania. This study reports the results of an interpretation of data over the Egg Island Survey Area. Approximately 347 line kilometers of data comprise the Egg Island Survey Area.

The magnetic data was interpreted by using Werner deconvolution profiles and total intensity maps. The gravity data, in conjunction with the magnetic data, aided in determining basement rock type and structure. Forward, 2 1/2 dimensional computer modeling over two lines in the Egg Island Survey was utilized to combine magnetic, gravity, and seismic data in order to aid in determining the nature and depth to basement and to define structures.

Basement is interpreted primarily as granitic or metasedimentary rock which is locally intruded by mafic dikes or plugs. Depth to basement is approximately 1,000 meters in the southern Egg Island Survey Area.

In Egg Island, modeling suggests the presence of thin basalt flows, although their locations and extents are uncertain. Basement magnetic anomalies are generally on the order of 200 gammas.

MODELING RESULTS

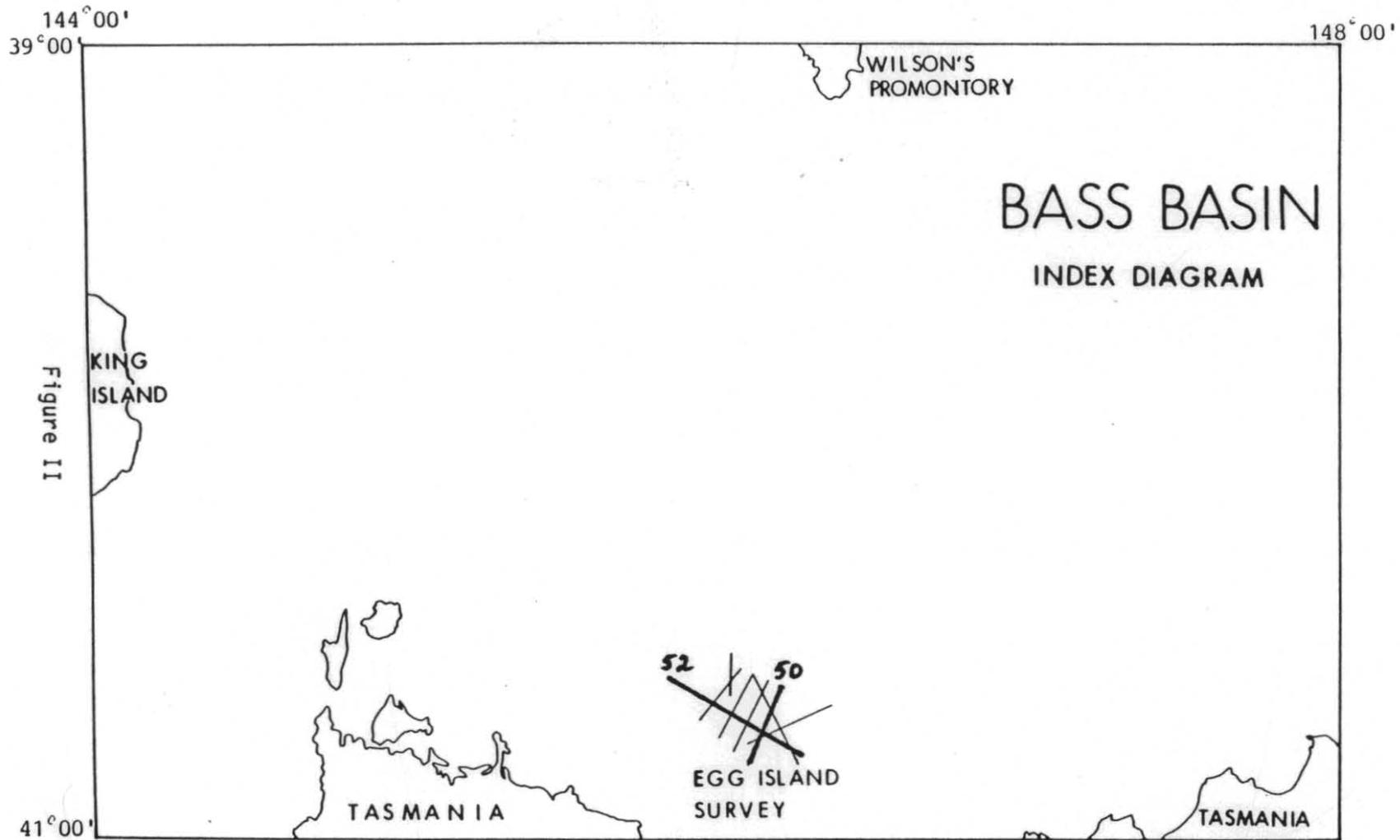
(Appendix A)

For the purpose of confirming to interpretation of seismic data along lines 50 and 52, interactive 2 1/2 dimensional modeling was done along the two intersecting lines (see Figure II). Utilizing a computer based modeling program, the interpreted seismic data comprised the models which were forward modeled and compared to the marine gravity and magnetic data collected over those traverses.

Forward modeling, or direct modeling, involves the construction of a cross-sectional model which is given certain physical characteristics which include X, Y and Z extents, density and magnetic susceptibility. Once the model is constructed, a synthetic anomaly curve can be generated over the model in either the gravity or magnetic mode which can then be compared to the actual observed data thereby indicating the need for, or lack of changes to be made in the interpreted model. This process is an iterative one which could not be accomplished practically without the use of a computer.

The following plates illustrate selected iterations of the forward modeling along lines 50 and 52. Line 52 was modeled first due to its favorably high angle traverse of observed trends in the geophysical data.

Modeling of the gravity and magnetic data over these two lines has shown good support for the interpreted seismic data provided by Weaver Oil Company. Individual descriptions and conclusions are listed on each of the following plate descriptions.

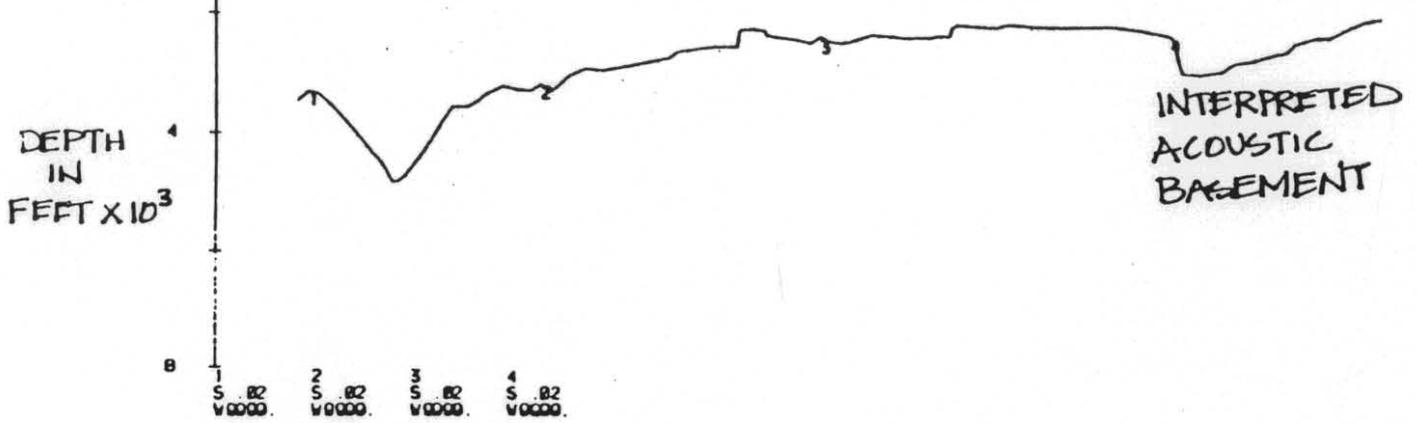
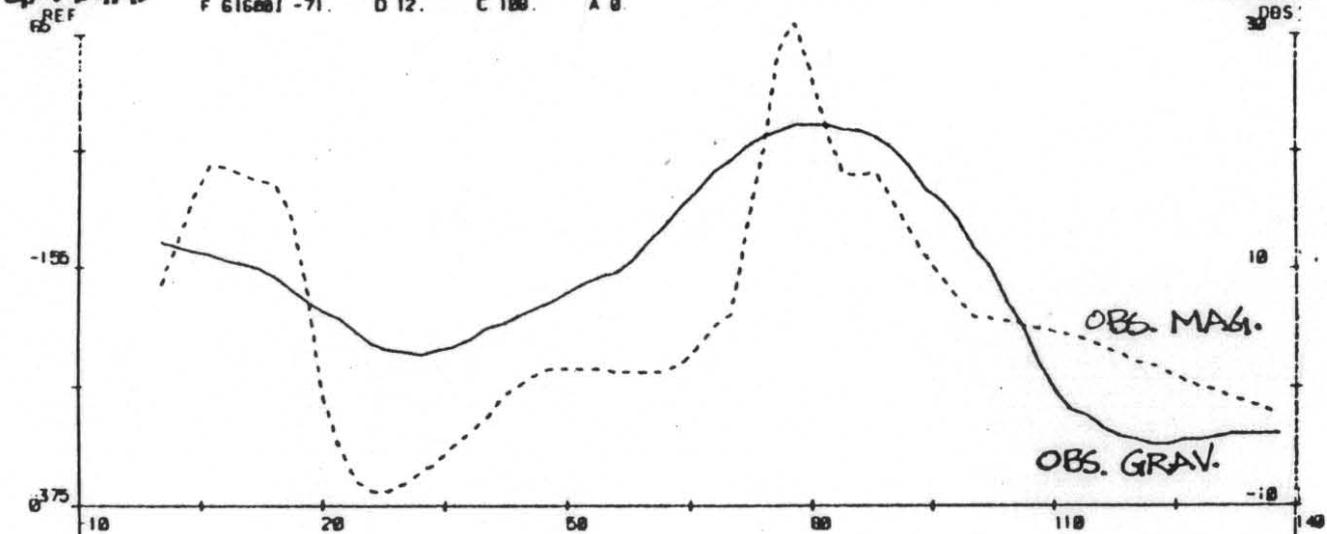


214067

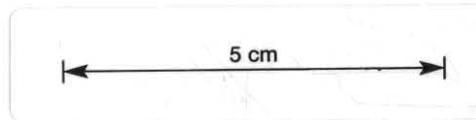
Line 52

Plate I illustrates the digitized interpreted acoustic basement along line 52, along with the gravity and magnetic profiles observed along the traverse.

WEAVER OIL COMPANY / BASS BASIN / LINE 52  
 DISTANCE IN KILOFEET. ANOMALY IN GAMMAS  
 F 616001 -71. D 12. C 100. A 0



1 S .02 W0000.  
 2 S .02 W0000.  
 3 S .02 W0000.  
 4 S .02 W0000.



A-4  
 Plate I

214069

On Plate II the model is given a constant magnetic susceptibility of 2,000 c.g.s. Comparison with the observed data illustrates that given a constant susceptibility, the computed magnetic curve basically reflects only the topography of the interpreted basement surface. Thus, we can conclude from this that changes in the topographic relief of the interpreted basement are insufficient in themselves to produce the magnetic anomalies observed on this line. Deep-seated susceptibility contrasts must be present as well.

OBS.  
GAMMAS

WEAVER OIL COMPANY / BASS BASIN / LINE 52  
DISTANCE IN KILOFEET, ANOMALY IN GAMMAS  
F 61600J -71. D 12. C 100. A B

CALC.  
GAMMAS

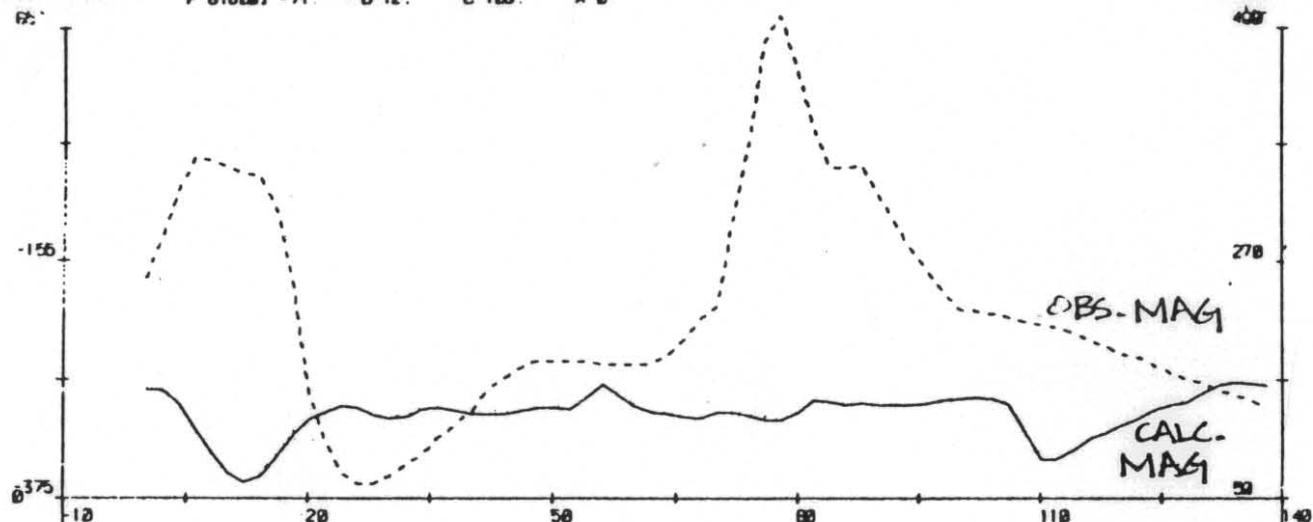
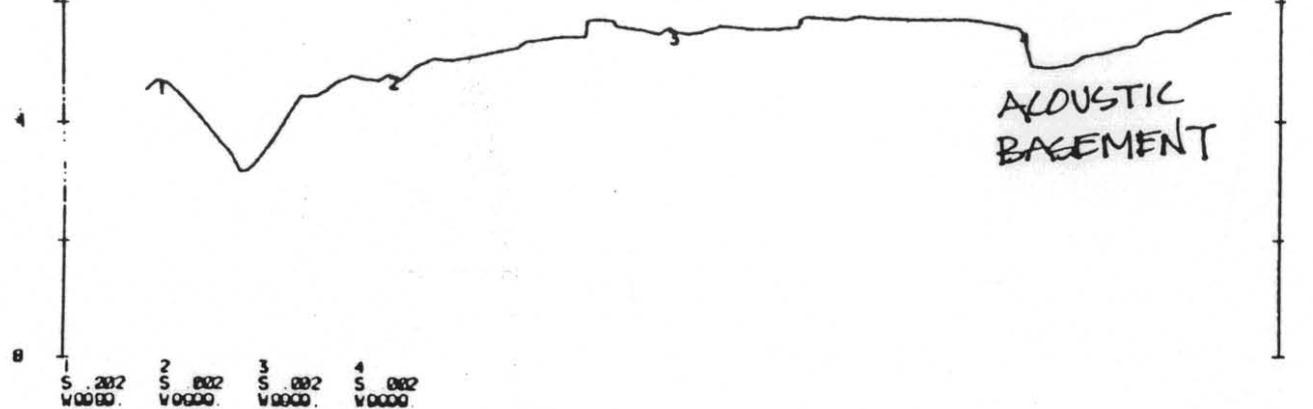


Plate II

A-6

DEPTH  
IN  
FEET  $\times 10^3$



5 cm

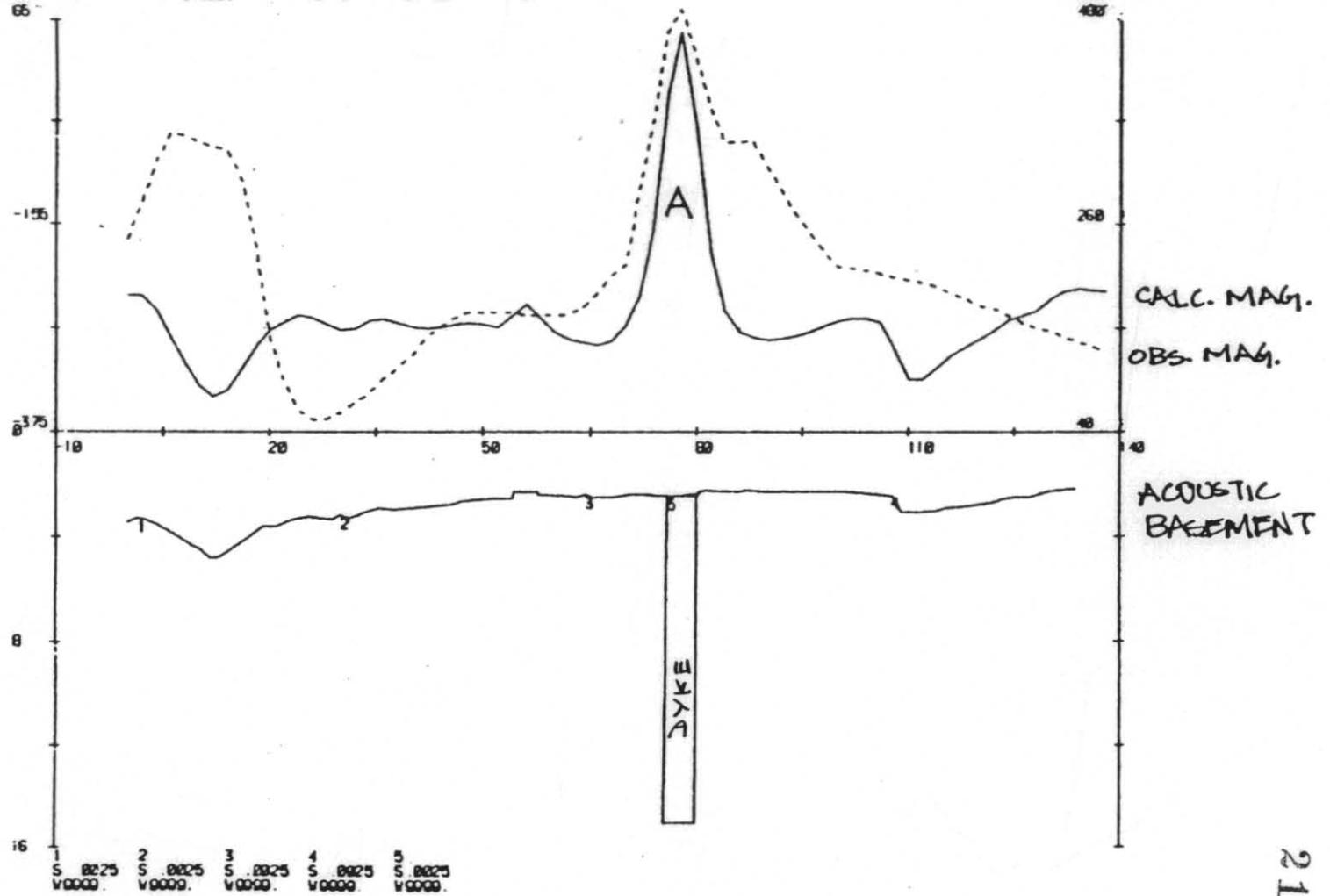
214071

Plate III shows the effect of the emplacement of a highly magnetic (5,000 c.g.s.) plug or closely spaced swarm of dikes. The calculated curve begins to better approximate anomaly A.

OBS. GAMMAS

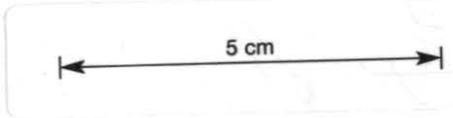
WEAVER OIL COMPANY / BASS BASIN / LINE 52  
DISTANCE IN KILOFEET, ANOMALY IN GAMMAS  
F 616001 -71. D 12. C 100. A 0.

CALC. GAMMAS



A-8  
Plate III

DEPTH  
IN  
FEET x 10<sup>3</sup>



214073

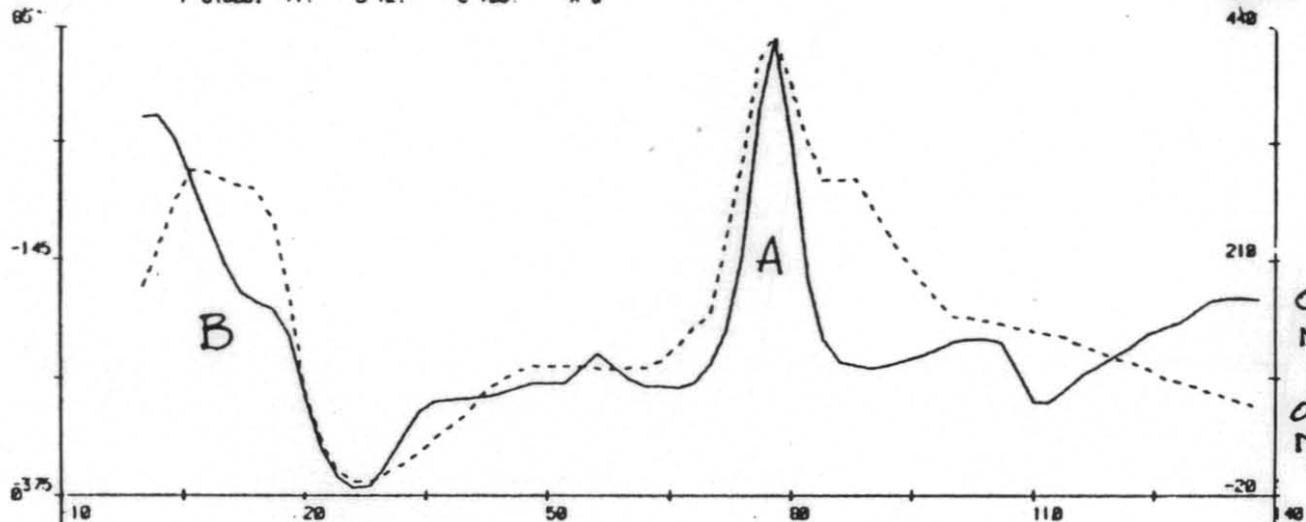
214074

A relatively high susceptibility block (3,500 c.g.s.) is added to the northwestern end of line 52 on Plate IV in an attempt to more closely match anomaly B.

OBS. GAMMAS

WEAVER OIL COMPANY / BASS BASIN / LINE 52  
DISTANCE IN KILOFEET, ANOMALY IN GAMMAS  
F 616881 -71. D 12. C 189. A 0

CALC. GAMMAS

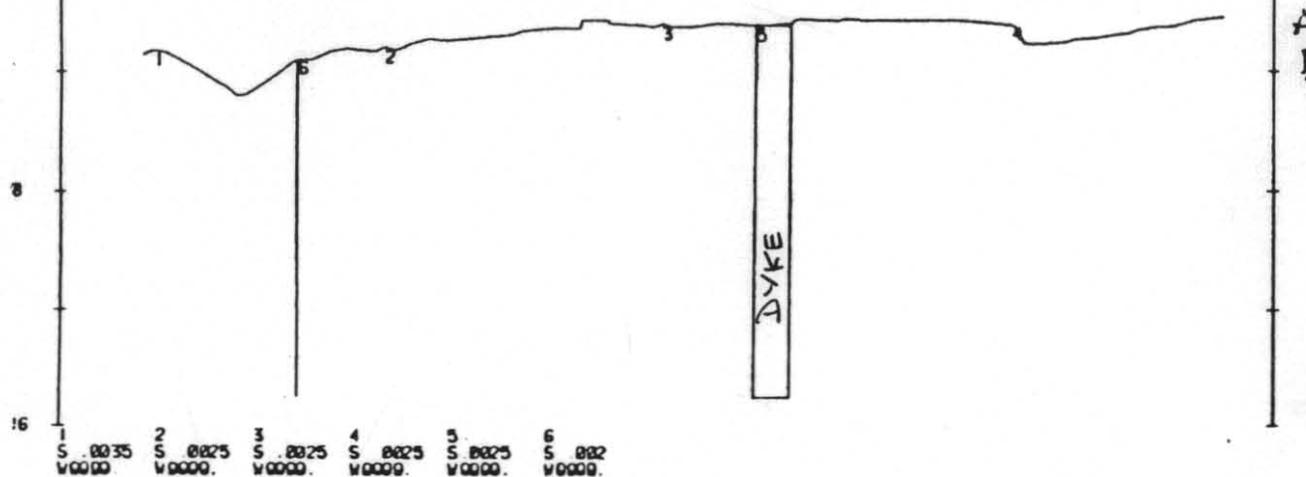


CALC. MAG.

OBS. MAG.

ACOUSTIC BASEMENT

DEPTH IN FEET  $\times 10^3$



1	2	3	4	5	6
S .0035	S .0025	S .0025	S .0025	S .0025	S .002
V0000	V0000	V0000	V0000	V0000	V0000

5 cm

A-10

Plate IV

NW

214075

On Plate V, the effects of several small changes to the model are shown. A moderately low susceptibility block is added to the southeastern portion of the line along with a very thin volcanic layer. Anomaly C could be the result of the edge of the volcanic layer, the existence of which seems justified by the presence of a relatively strong acoustic reflector occurring above interpreted basement on the seismic section.

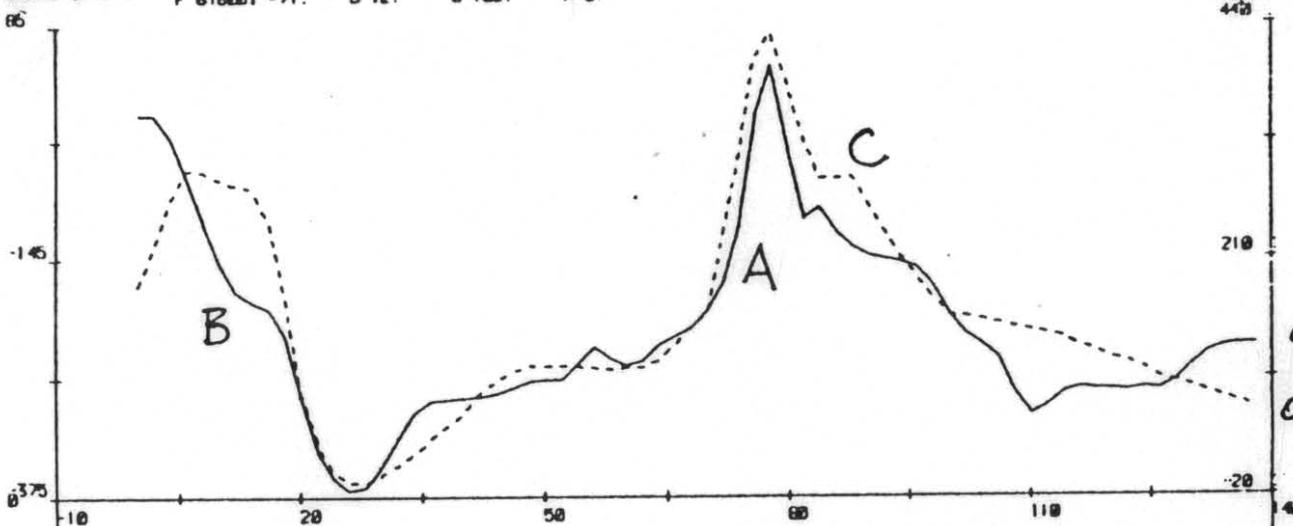
OBS. GAMMAS

WEAVER OIL COMPANY / BASS BASIN / LINE 52  
DISTANCE IN KILOFEET. ANOMALY IN GAMMAS  
F 616001 -71. D 12. C 100. A 0

CALC. GAMMAS

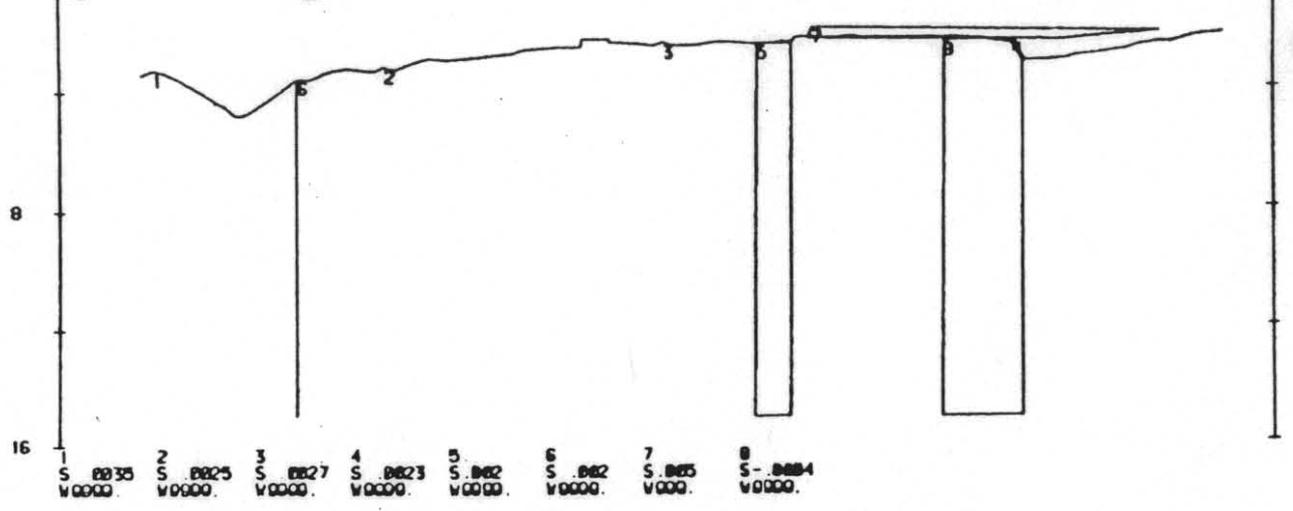
NW

SE



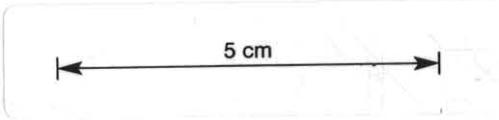
CALC. MAG.  
OBS. MAG.

DEPTH IN FEET X10<sup>3</sup>



ACOUSTIC BASEMENT

1 S 0035 W0000  
 2 S 0025 W0000  
 3 S 0027 W0000  
 4 S 0023 W0000  
 5 S 002 W0000  
 6 S 002 W0000  
 7 S 005 W0000  
 8 S 0004 W0000



A-12

Plate V

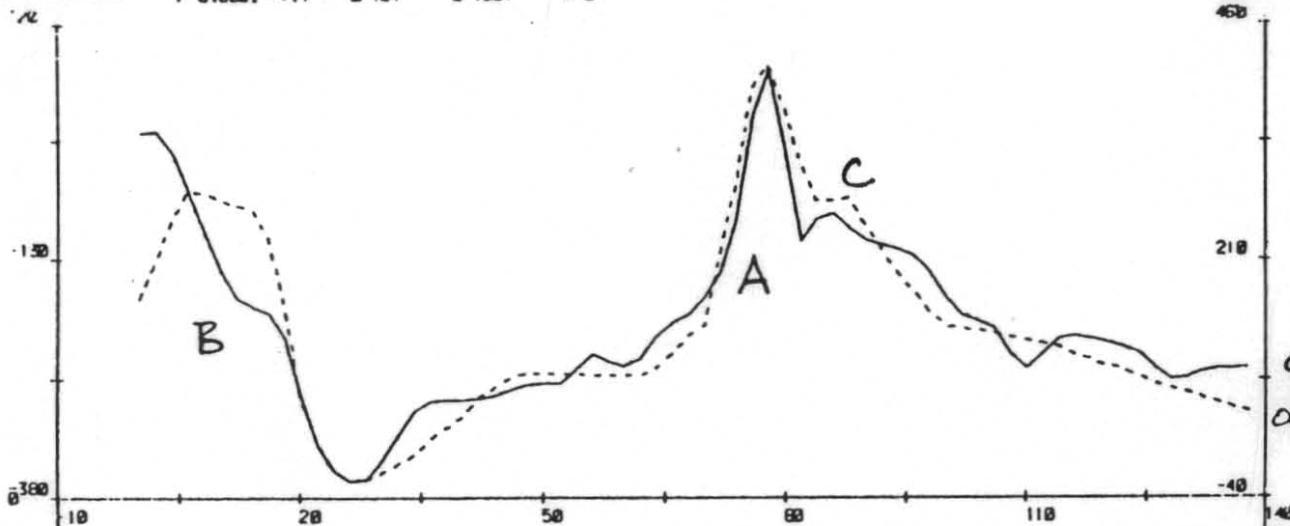
214077

On Plate VI, two minor changes are made within the basement units on the southeastern end of the line. The lower susceptibility block added on Plate V is widened and flanked on the extreme southeast by a slightly lower susceptibility unit. With the addition of the interpreted volcanic unit within the section, these lower susceptibility units are necessary in order to keep the overall level of the computed magnetic profile in proper position.

OBS. GAMMAS

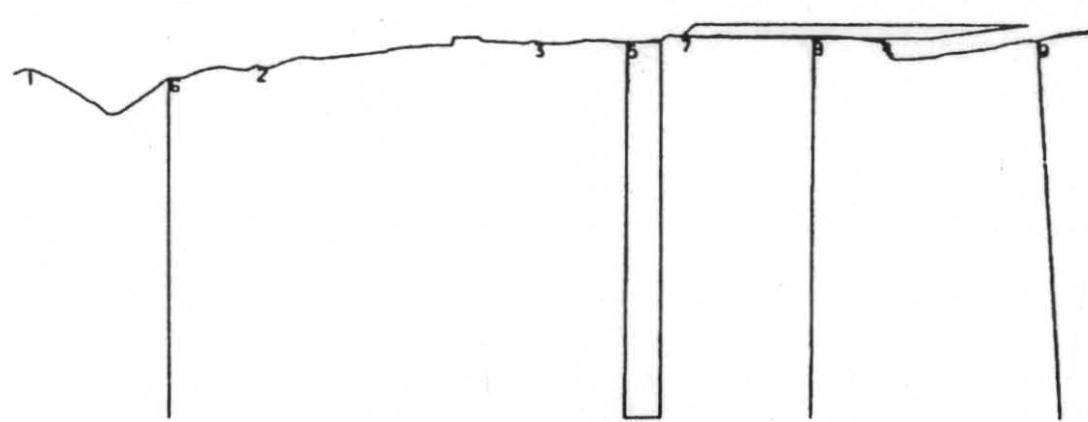
WEAVER OIL COMPANY / BASS BASIN / LINE 52  
DISTANCE IN KILOFEET. ANOMALY IN GAMMAS  
F 616001 -71. D 12. C 100. A 0.

CALC. GAMMAS



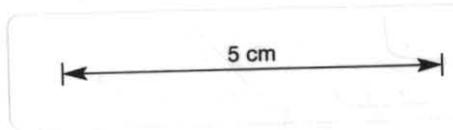
CALC. MAG.  
OBS. MAG.

DEPTH  
IN  
FEET X 10<sup>2</sup>



ACOUSTIC  
BASEMENT

1	2	3	4	5	6	7	8	9
S .0035	S .0025	S .0028	S .0025	S .002	S .002	S .005	S .0004	S .0003
V0000	V0000	V0000	V0000	V0000	V0000	V0000	V0000	V0000



A-14

Plate VI

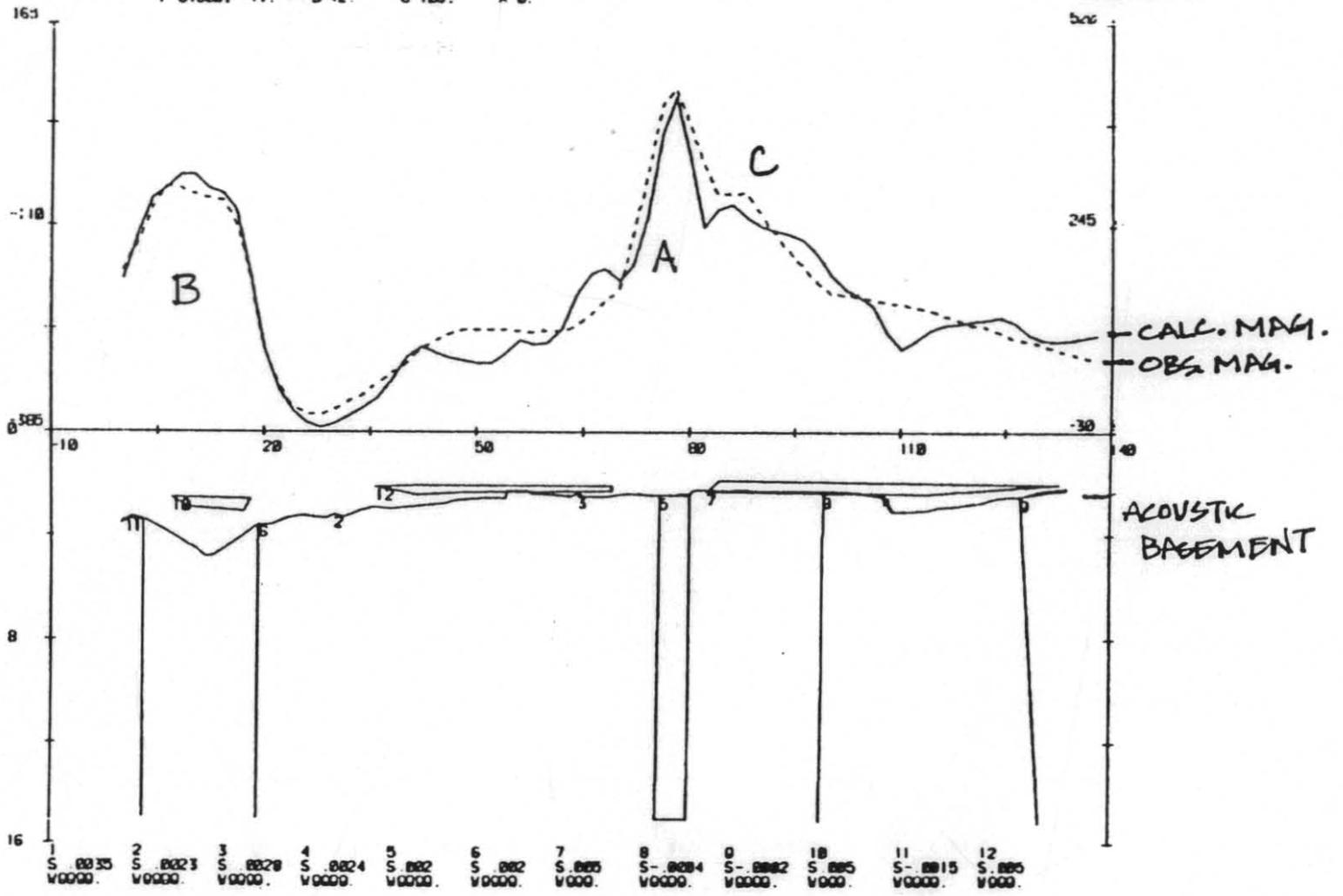
214079

Plate VII incorporates the effects of additional volcanics within the sedimentary section along with other changes in basement susceptibility. Anomaly B is shown to be a composite anomaly resulting from a relatively broad, magnetic unit (plug?) with a magnetic susceptibility of 3,500 c.g.s., surrounded by basement units with susceptibilities of approximately 2,000 c.g.s., along with an overlying thin volcanic unit. The shallow volcanic unit added in the central portion of the profile is needed to maintain the proper level along that portion of the computed curve.

OBS. GAMMAS

WEAVER OIL COMPANY / BASS BASIN / LINE 52  
DISTANCE IN KILOFEET. ANOMALY IN GAMMAS  
F 616281 -71. D 12. C 188. A 8.

CALC. GAMMAS



A-16

Plate VII

DEPTH IN FEET X 10<sup>3</sup>

5 cm

214081

Plate VIII illustrates a better fit in the central portion of the anomaly profile (at D), with the emplacement of a moderately high susceptibility basement unit (#13) along the northwest edges of a small interpreted basement horst.

OBS.

WEAVER OIL COMPANY / BASS BASIN / LINE 52  
DISTANCE IN KILOFEET, ANOMALY IN GAMMAS  
F 6:6001 -71. D 12. C 100. A B.

CALC.

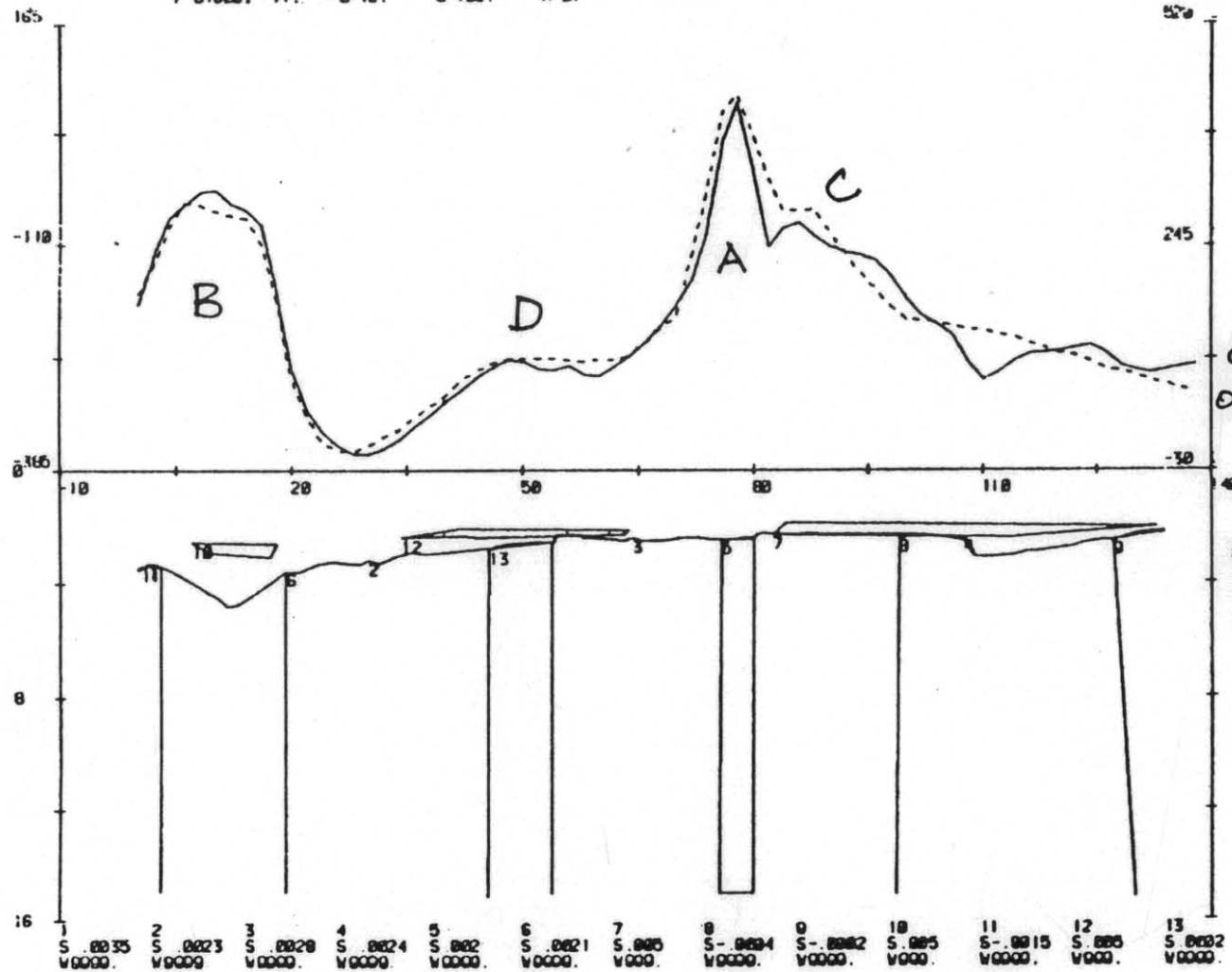


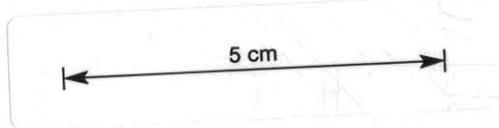
Plate VIII

A-18

DEPTH  
IN  
FEET X 10<sup>3</sup>

CALC. MAG.  
OBS. MAG.

ACOUSTIC  
BASEMENT

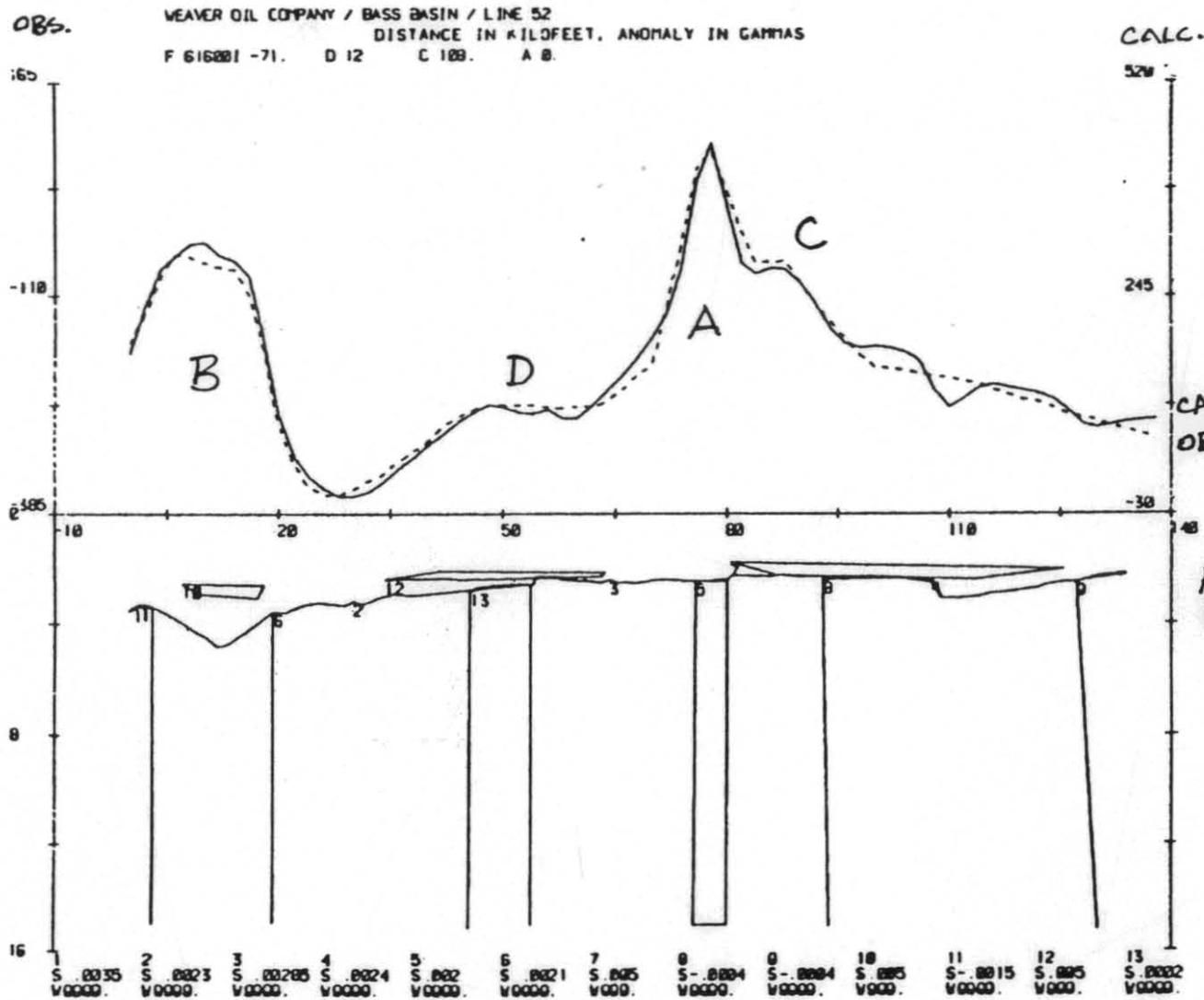


214083

Plate IX demonstrates the effect of moving the western contact of basement unit #8 slightly to the northwest, achieving a better match at anomaly C.

A-20

Plate IX



5 cm

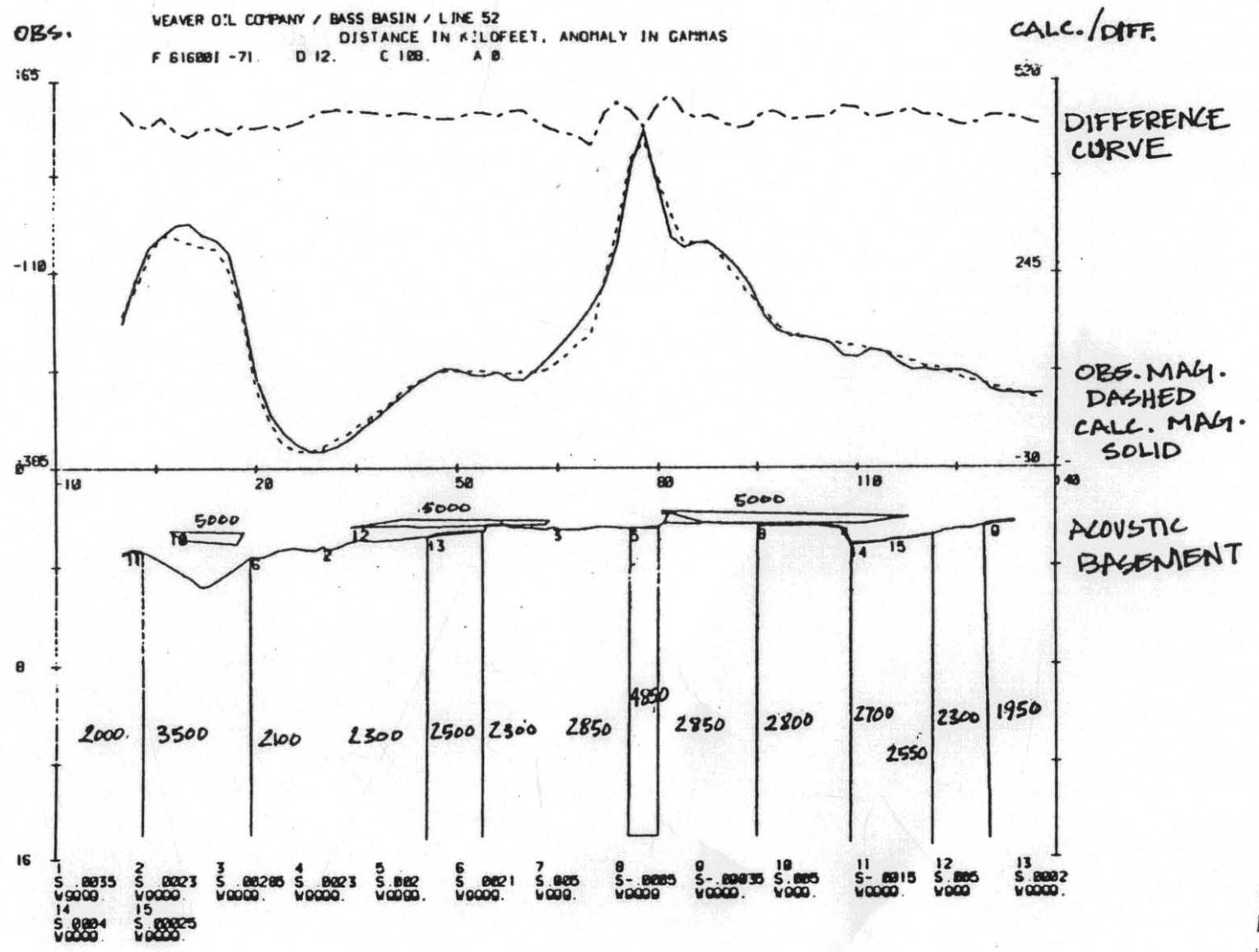
214085

On Plate X, the observed magnetic profile has been satisfactorily matched by the calculated curve and a generated residual curve shows the difference between the two. Additional changes in the model to arrive at this stage include only minor adjustments to basement susceptibility on the southeastern end of the line, along with a slight change in the extent of the overlying volcanics unit.

In the following sequence, gravity data were utilized to further constrain the testing of line 52.

A-22

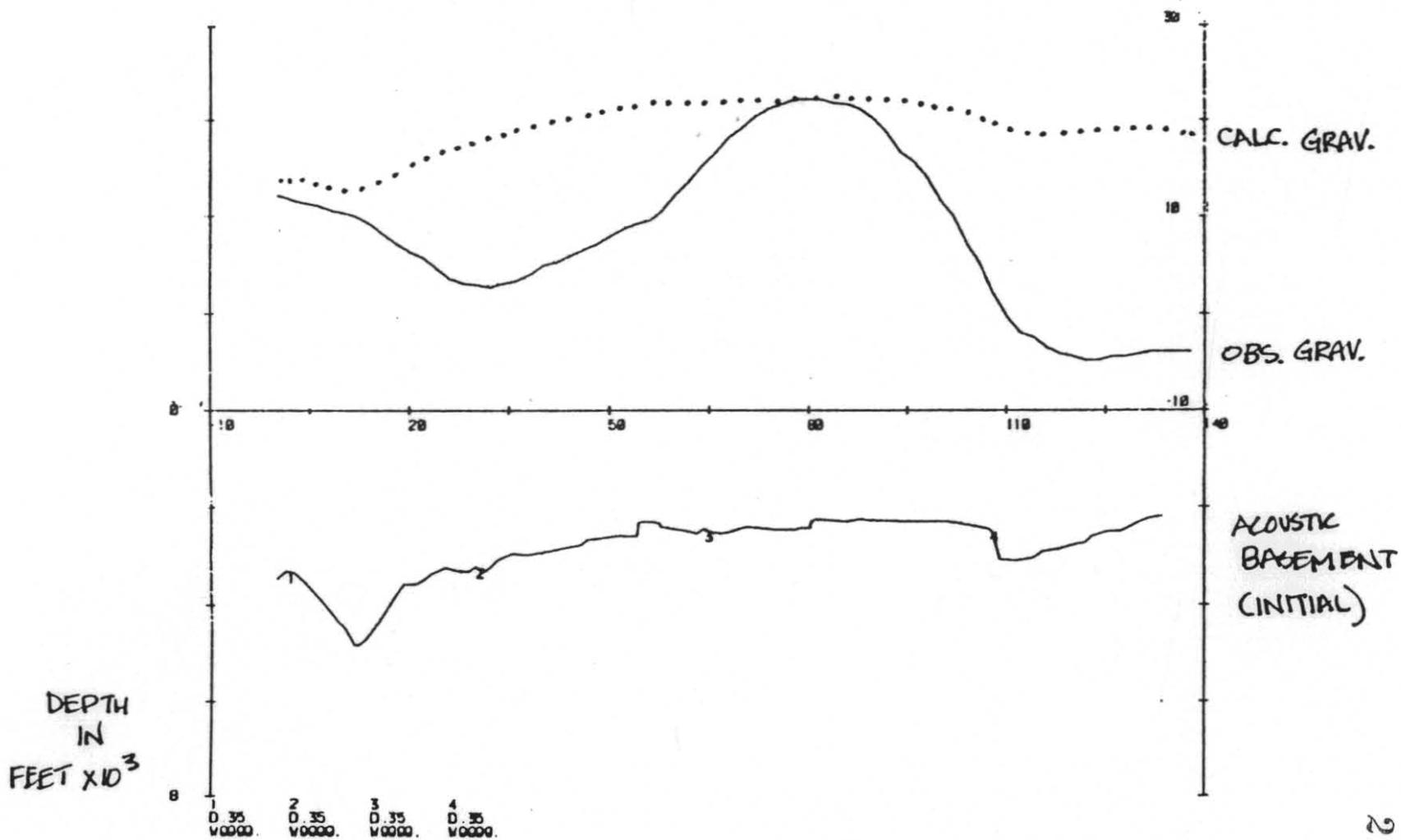
Plate X



214087

Plate XI illustrates the observed and calculated gravity curve over the simple initial model. The differences between the two profiles indicate that considerable density changes are in order within the basement complex; i. e., the topographic effect of the interpreted basement surface alone is insufficient to produce the observed anomaly.

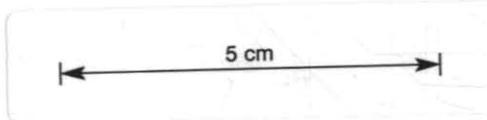
WEAVER OIL COMPANY / BASS BASIN / LINE 52  
DISTANCE IN KILOFEET, ANOMALY IN MILLIGALS



A-24

Plate XI

DEPTH  
IN  
FEET X 10<sup>3</sup>

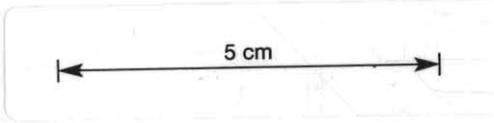
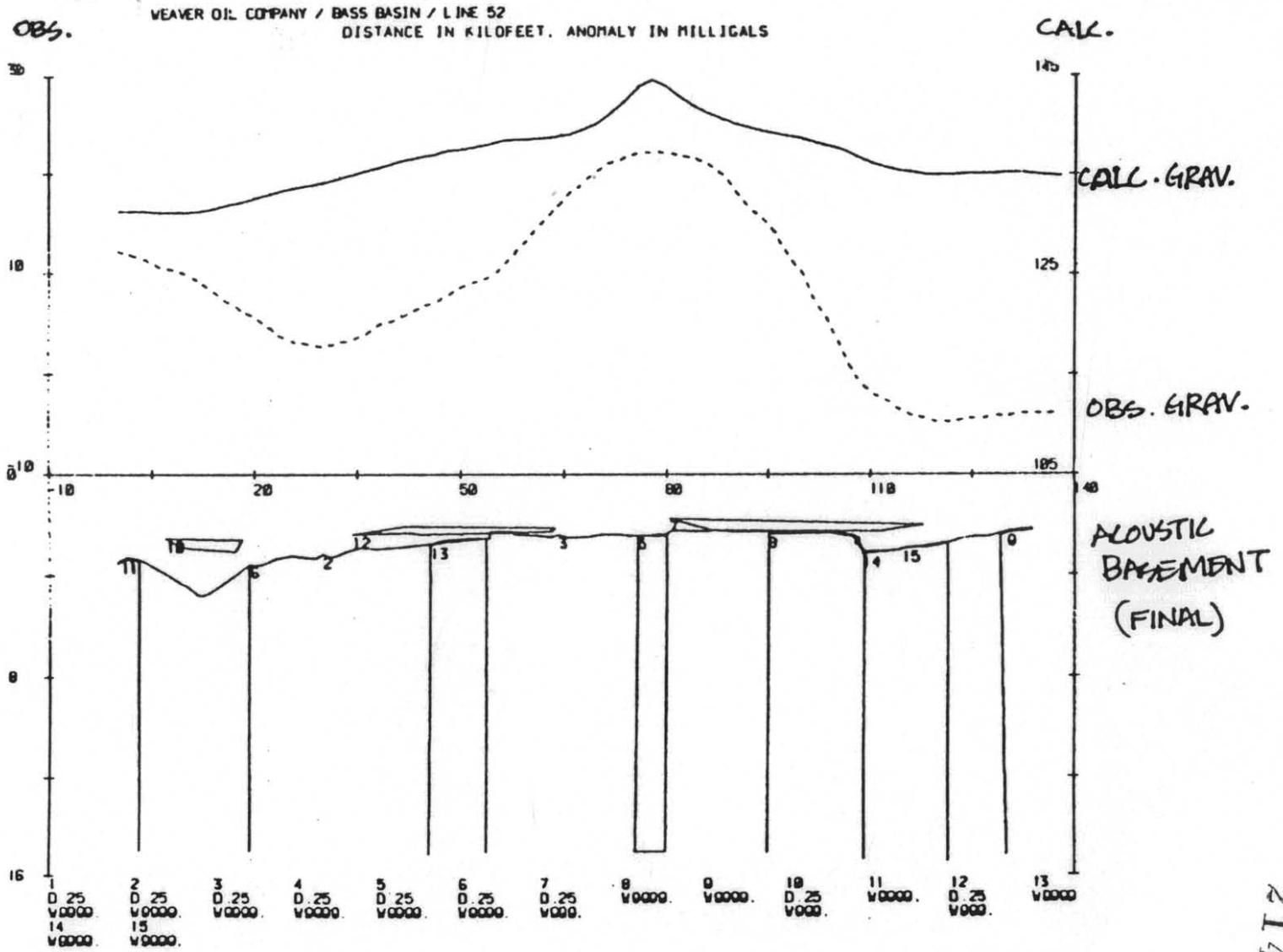


214089

Recorded on Plate XII through Plate XVII are several adjustments in basement densities utilizing the final model derived from the modeling of the magnetic data. No changes were made in the model construction.

A-26

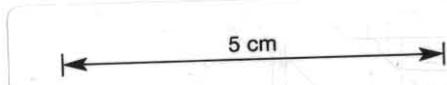
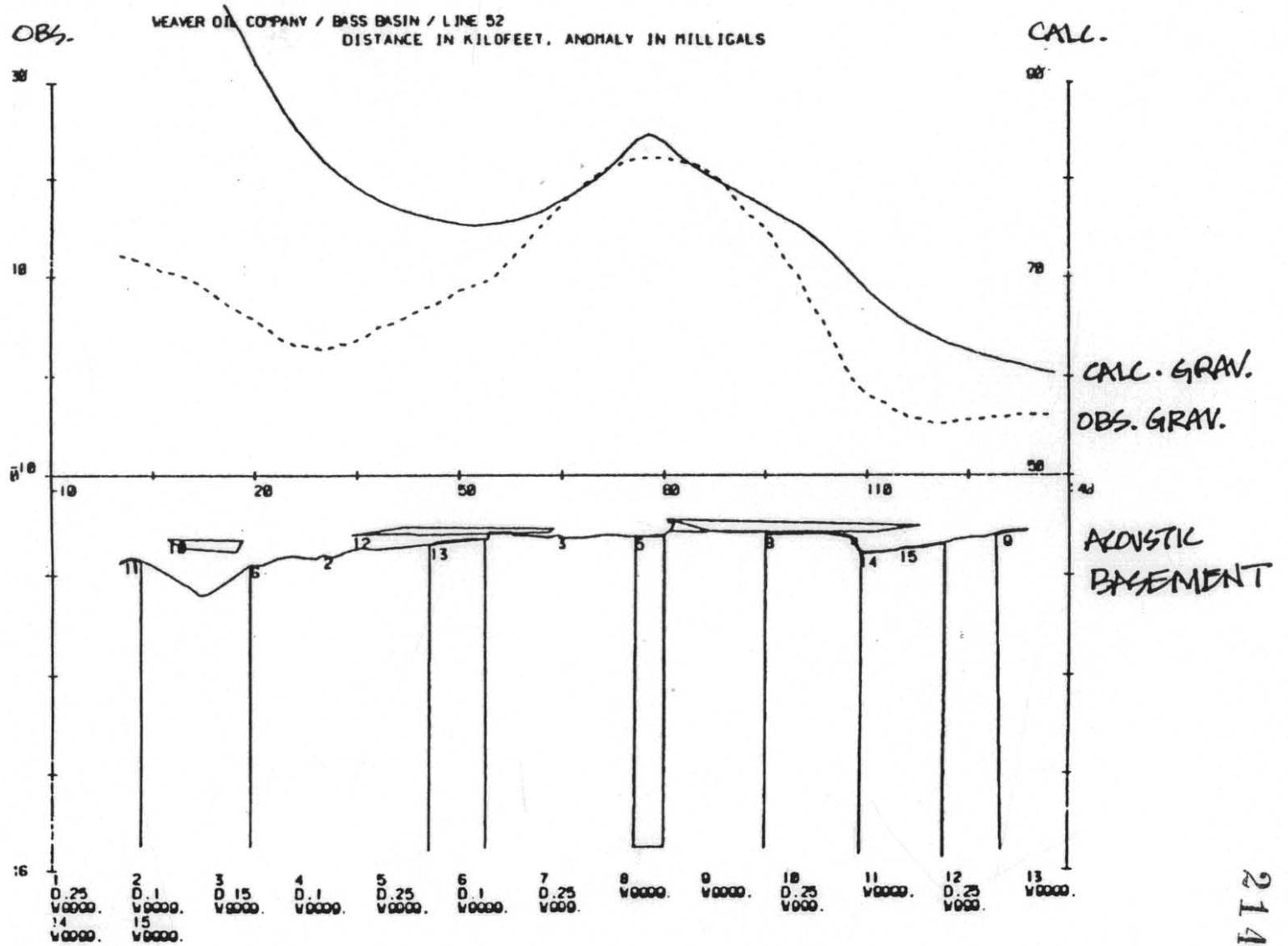
Plate XII



214091

Plate XIII

A-27

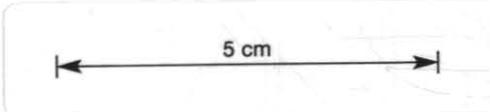
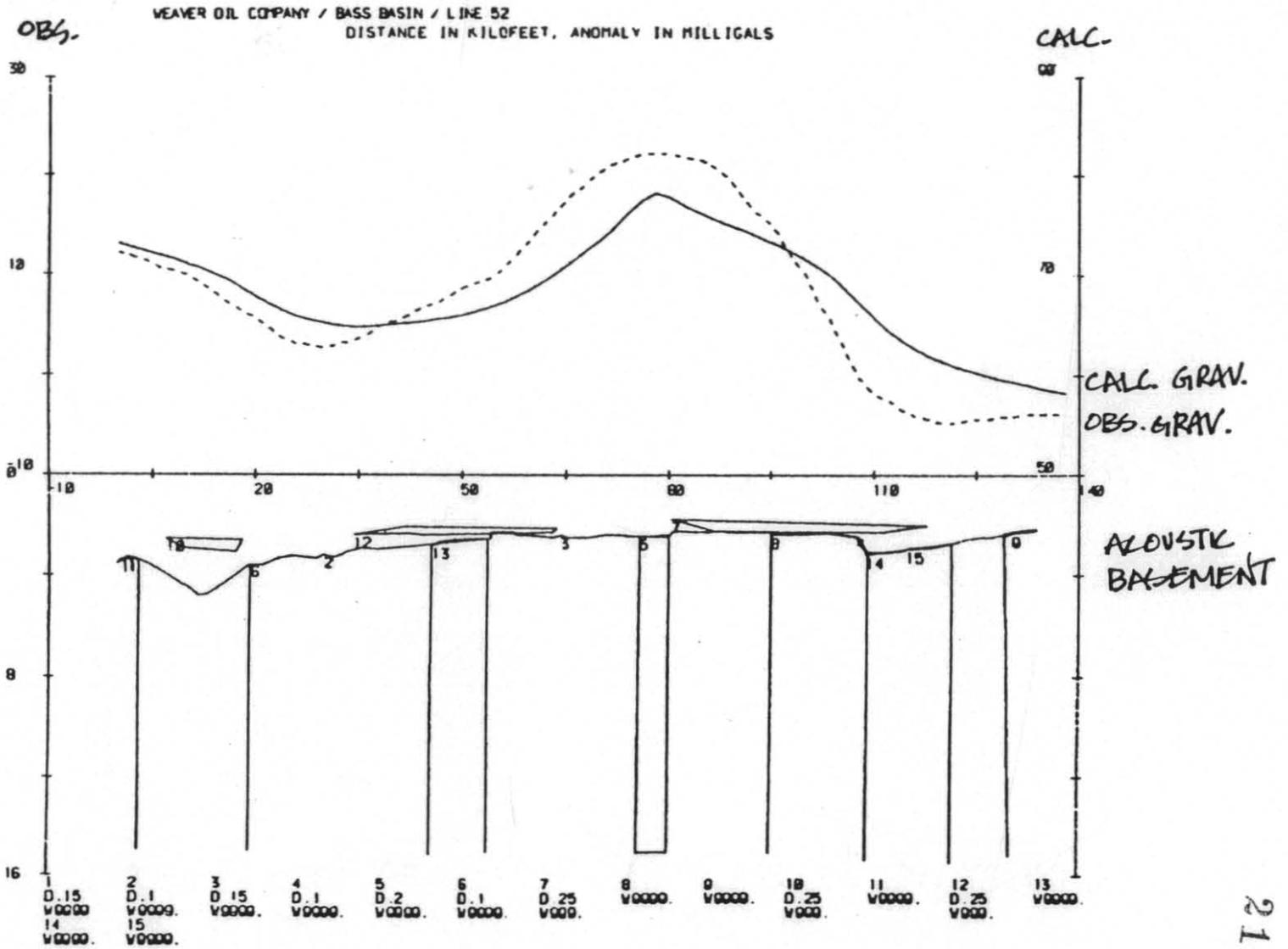


214092

A-28

Plate XIV

DEPTH  
IN  
FEET X10<sup>3</sup>

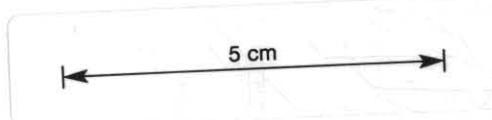
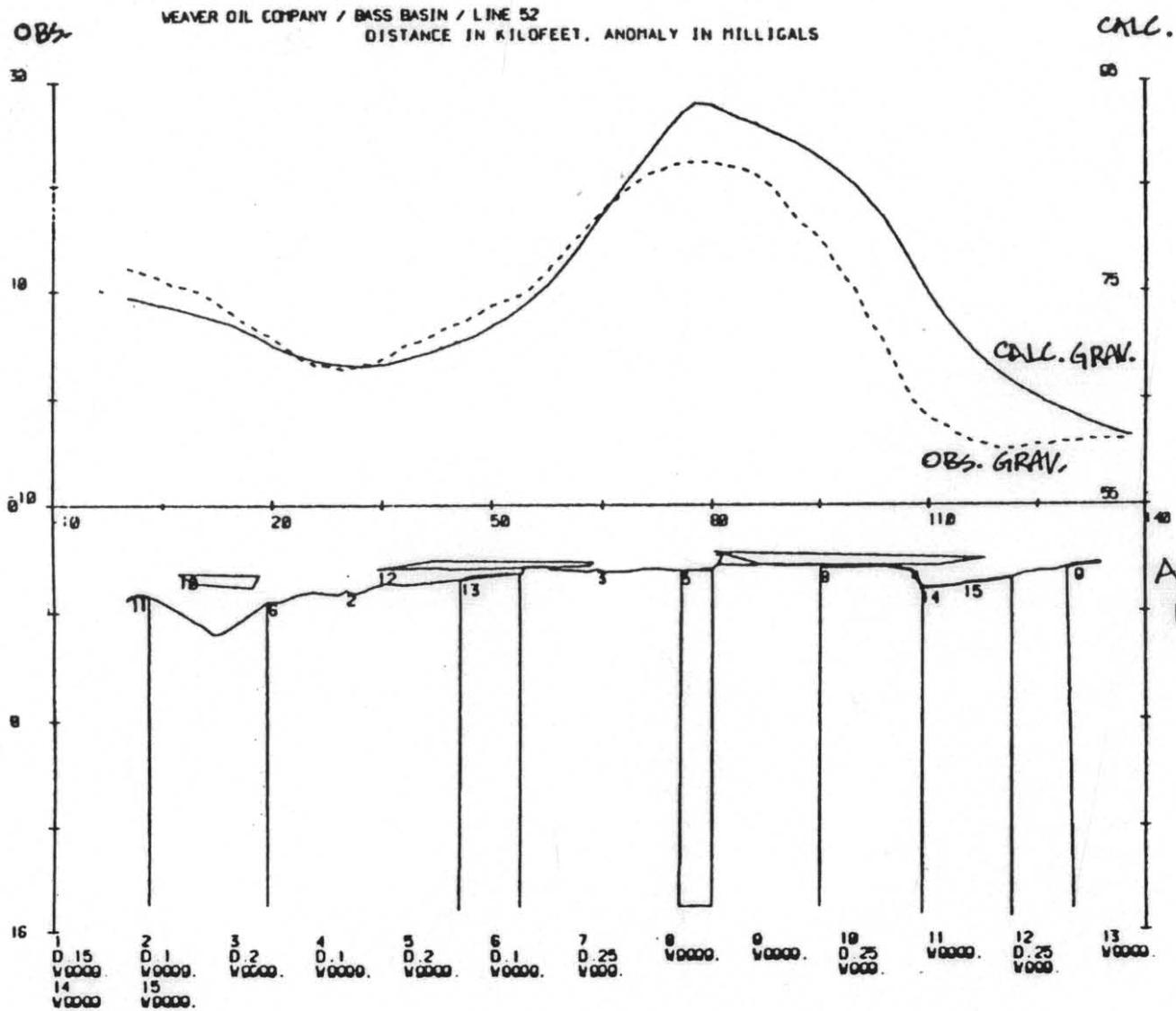


214093

A-29

Plate XV

DEPTH  
IN  
FEET  $\times 10^3$

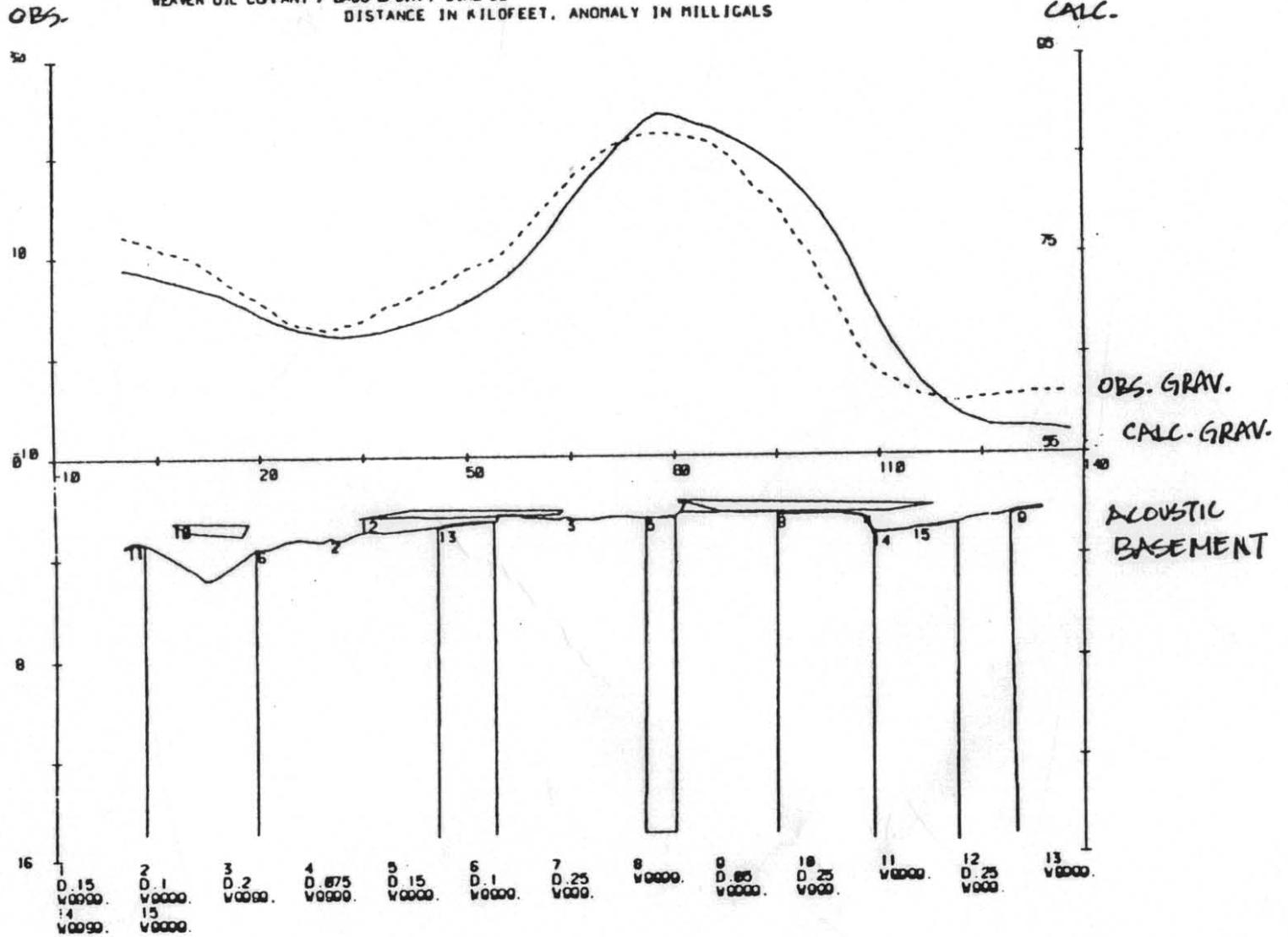


214092

A-30

Plate XVI

WEAVER OIL COMPANY / BASS BASIN / LINE 52  
DISTANCE IN KILOFEET, ANOMALY IN MILLIGALS



214095

WEAVER OIL COMPANY / BASS BASIN / LINE 52  
 DISTANCE IN KILOFEET, ANOMALY IN MILLIGALS

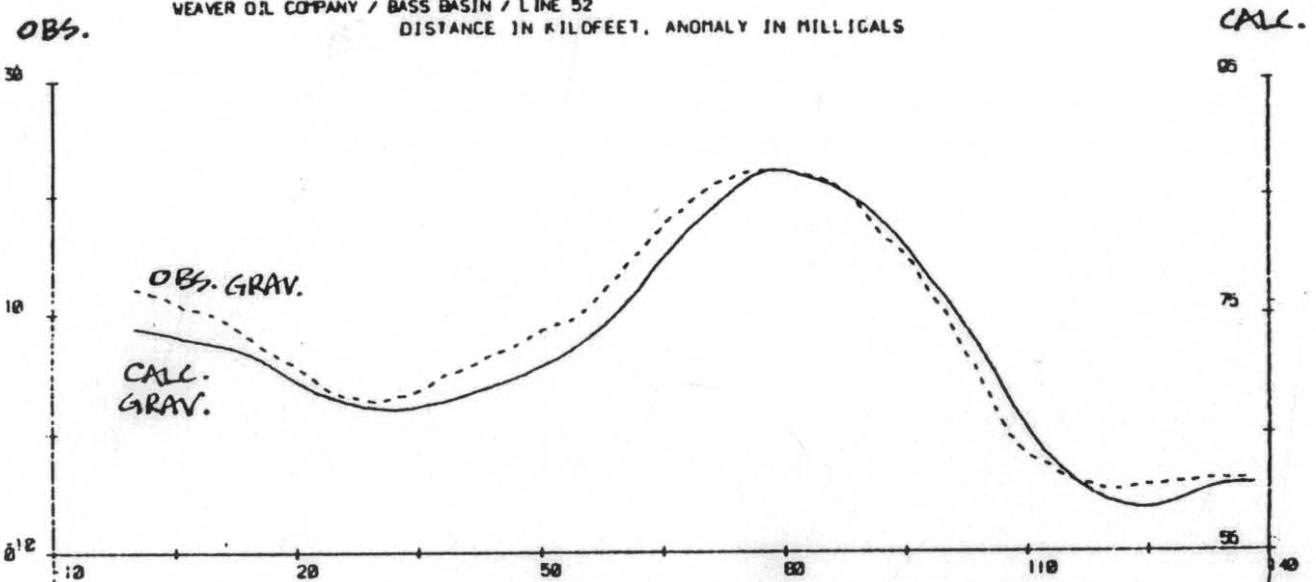
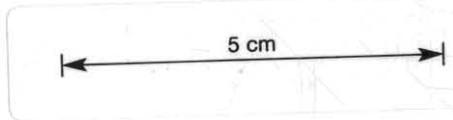
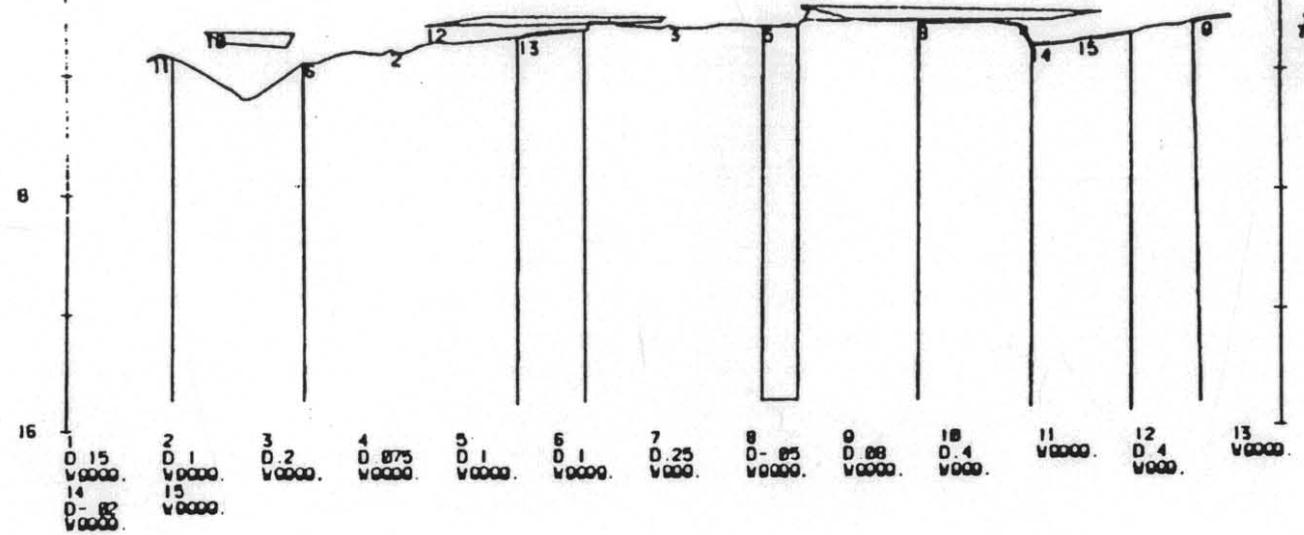


Plate XVII

A-31

DEPTH IN FEET X10<sup>3</sup>

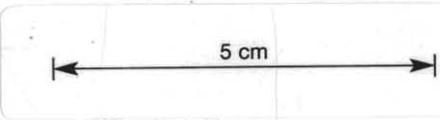


214096

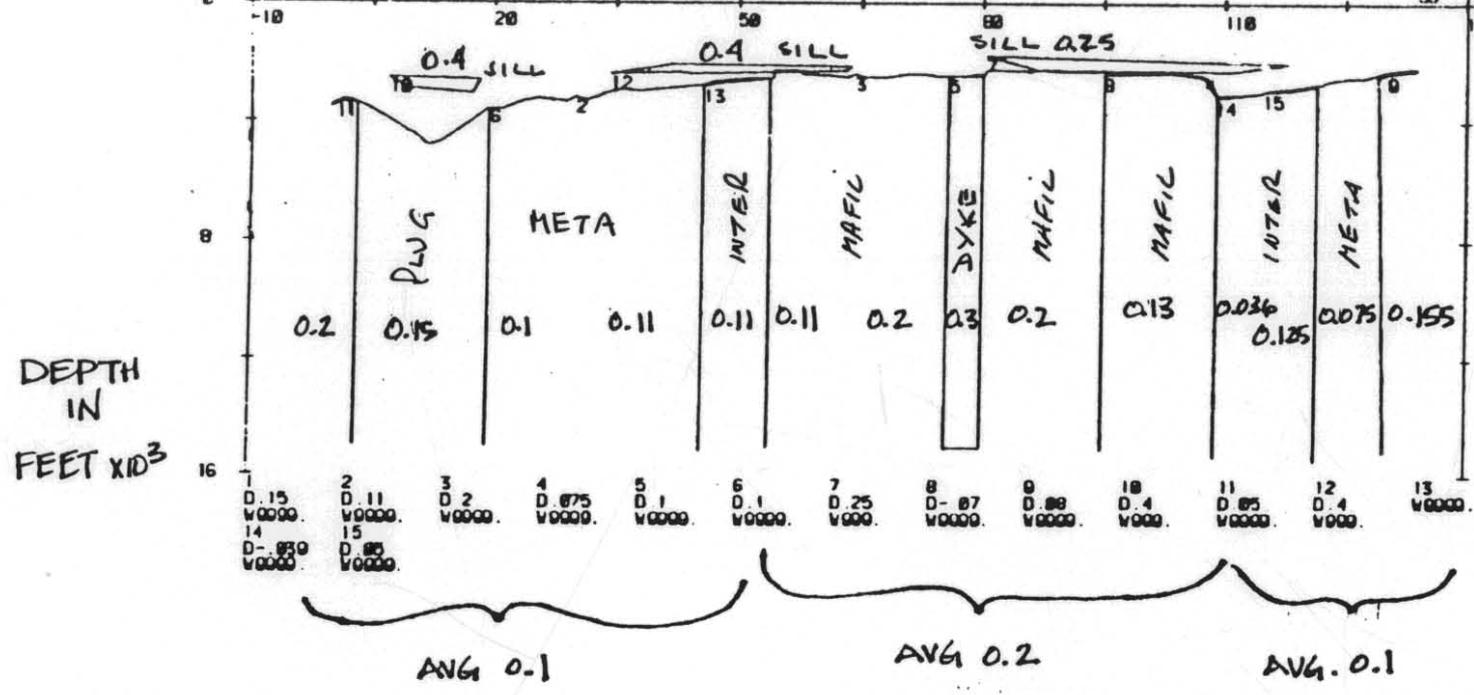
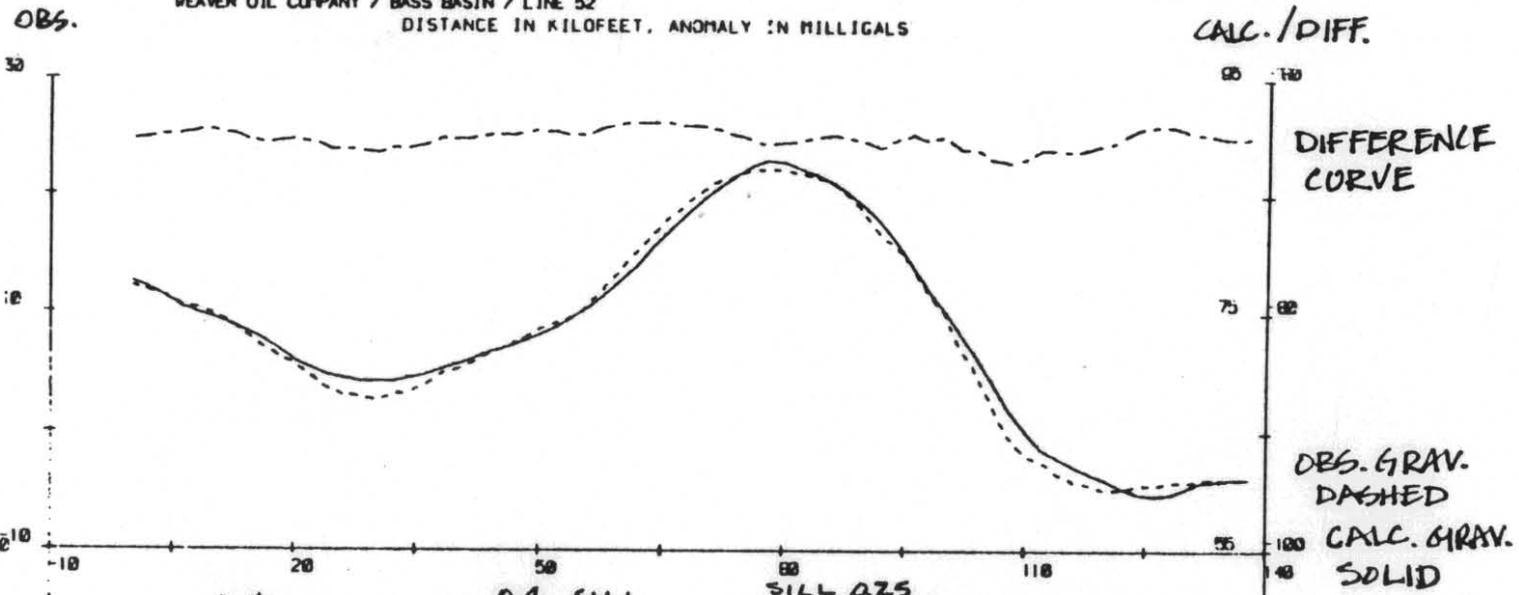
Plate XVIII, using the same model derived from the magnetics, the observed gravity data profile is adequately matched and a difference curve is calculated. Several zones are grouped and are thought to have possible geologic significance.

As on Plate XVIII a, the final magnetic model, the central and horizontal units are thought to be highly magnetic volcanics or dikes. The unit on the northwest end of the model may also be an intrusive plug, though somewhat less magnetic. The northwest portions of the model may represent metasedimentary basement units, probably granitic in composition. The zones on either side of the interpreted uplifted area are considered to be somewhat intermediate in magnetic character. The units in the central area appear to be as a whole, more magnetic and more dense and may represent a mafic complex which probably constitutes much of the uplifted central basement unit.

On a very gross scale, the basement geology along line 52 is interpreted on the basis of modeling seismic, gravity and magnetic data, along with knowledge of surrounding geology, to be a faulted sequence of metasedimentary and intrusive units, from granitic to mafic composition. Results of both gravity and magnetic modeling seem to indicate that the particular configuration of basement here is that of an uplifted mafic complex surrounded by generally less magnetic, less dense lithologic units. The whole basement complex is probably intruded by dikes and plugs of varying composition as would be expected in this particular mobilized terrane. Two large intrusives seem evident on line 52, a broad plug or set of closely spaced dikes on the northwestern end of the line, and a wide dike or set of dikes in the central portion. A thin layer of very magnetic and generally dense volcanics can be interpreted to discontinuously overlie basement. It is undetermined whether or not any of the interpreted dikes are feeders to the volcanics occurring in the section.



WEAVER OIL COMPANY / BASS BASIN / LINE 52  
 DISTANCE IN KILOFEET, ANOMALY IN MILLIGALS



A-34

Plate XVIII

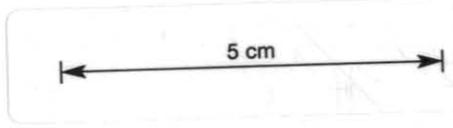
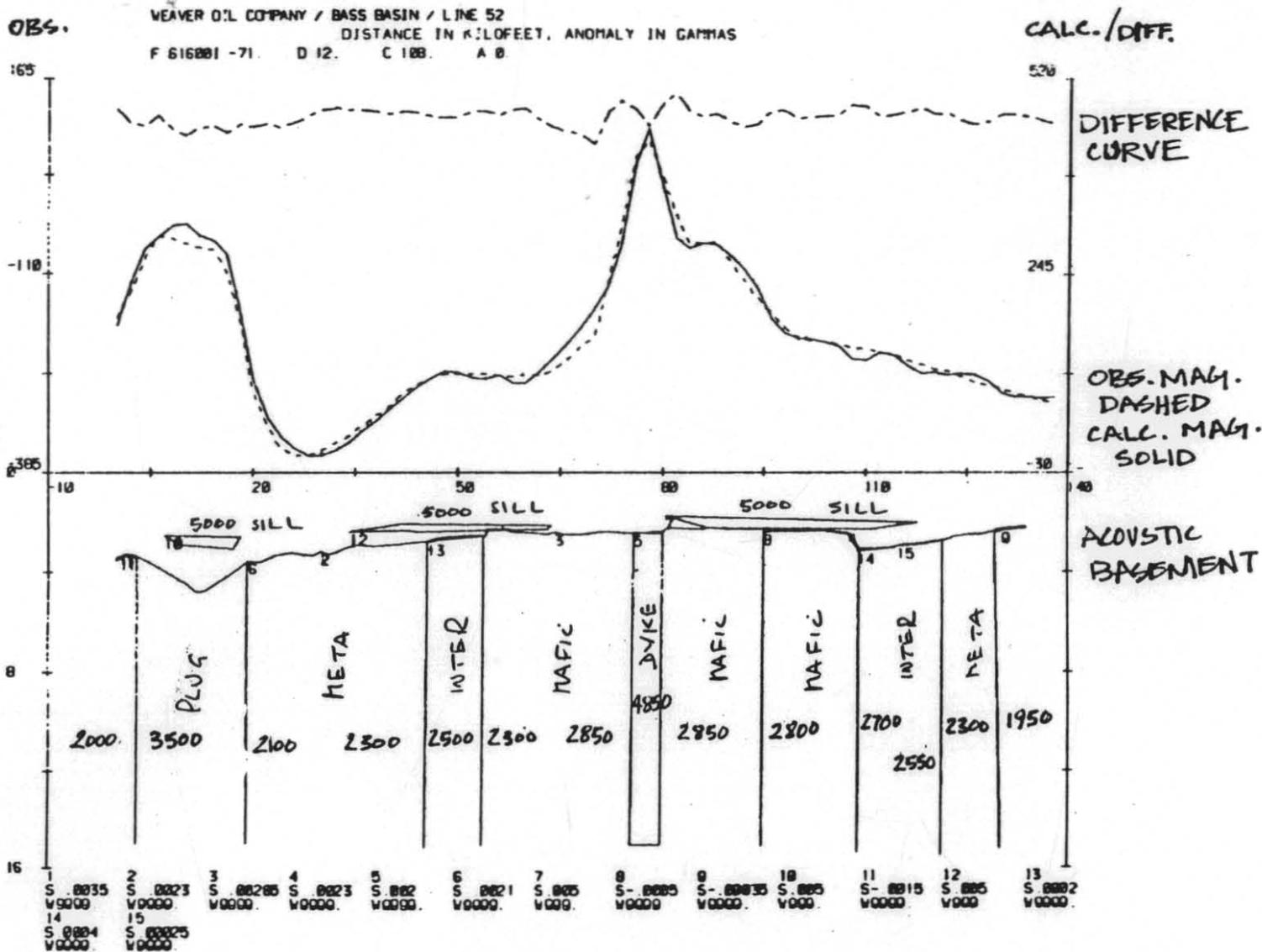
214098

A-35

Plate XVIIIa

NW

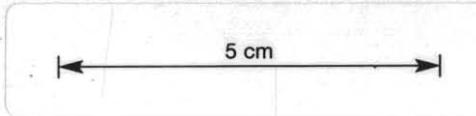
DEPTH IN FEET  $\times 10^3$



214099

Line 50

Plate XIX illustrates the digitized interpreted acoustic basement along line 50, along with the observed gravity data (solid) and a first calculated gravity curve (dotted) over the model, given a constant density contrast of + 0.35. Comparison with the observed gravity profile makes apparent the need for basement density adjustments.



WEAVER OIL COMPANY / BASS BASIN / LINE 50  
 DISTANCE IN KILOFEET. ANOMALY IN MILLIGALS

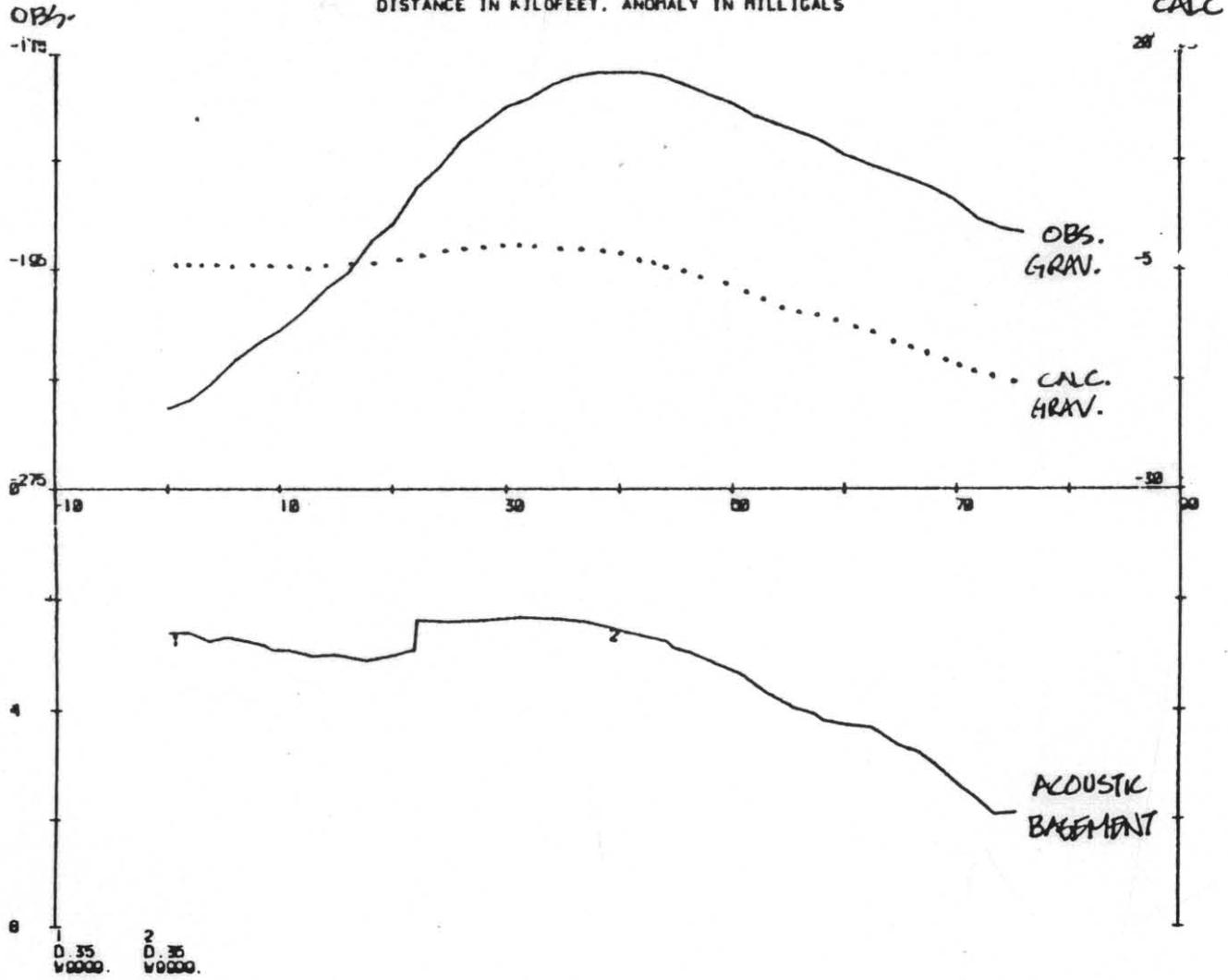
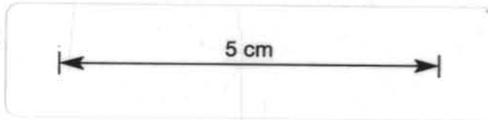


Plate XIX

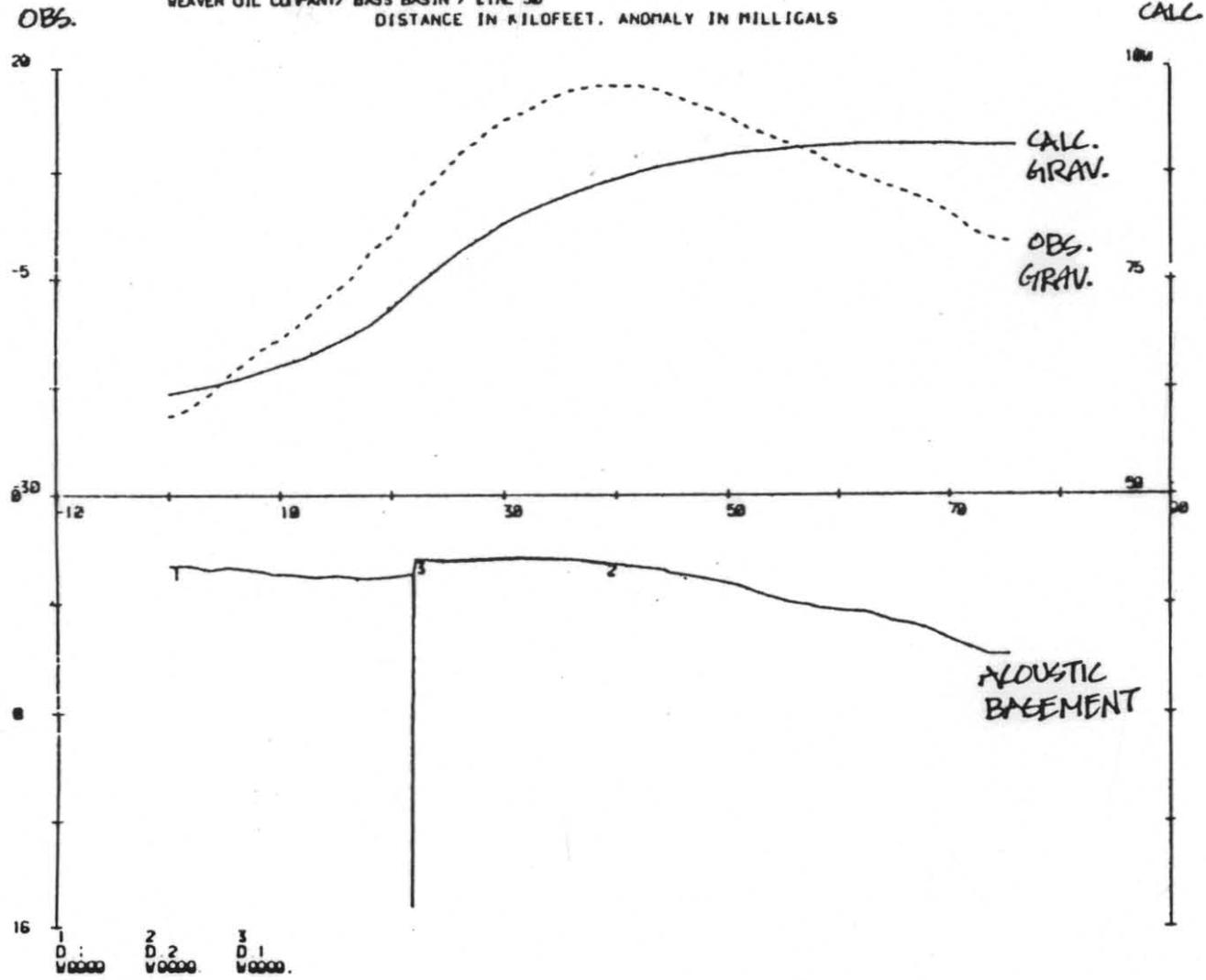
A-37

214101

On Plate XX and Plate XXI, by utilizing information gained from modeling line 52, the model is divided into two units of varying densities for a slightly better fit.



WEAVER OIL COMPANY / BASS BASIN / LINE 50  
 DISTANCE IN KILOFEET, ANOMALY IN MILLIGALS



DEPTH  
 IN  
 FEET  $\times 10^3$

1 D 1  
 W0000  
 2 D 2  
 W0000  
 3 D 1  
 W0000

A-39

Plate XX

214103

WEAVER OIL COMPANY / BASS BASIN / LINE 50  
 DISTANCE IN KILOFEET, ANOMALY IN MILLIGALS

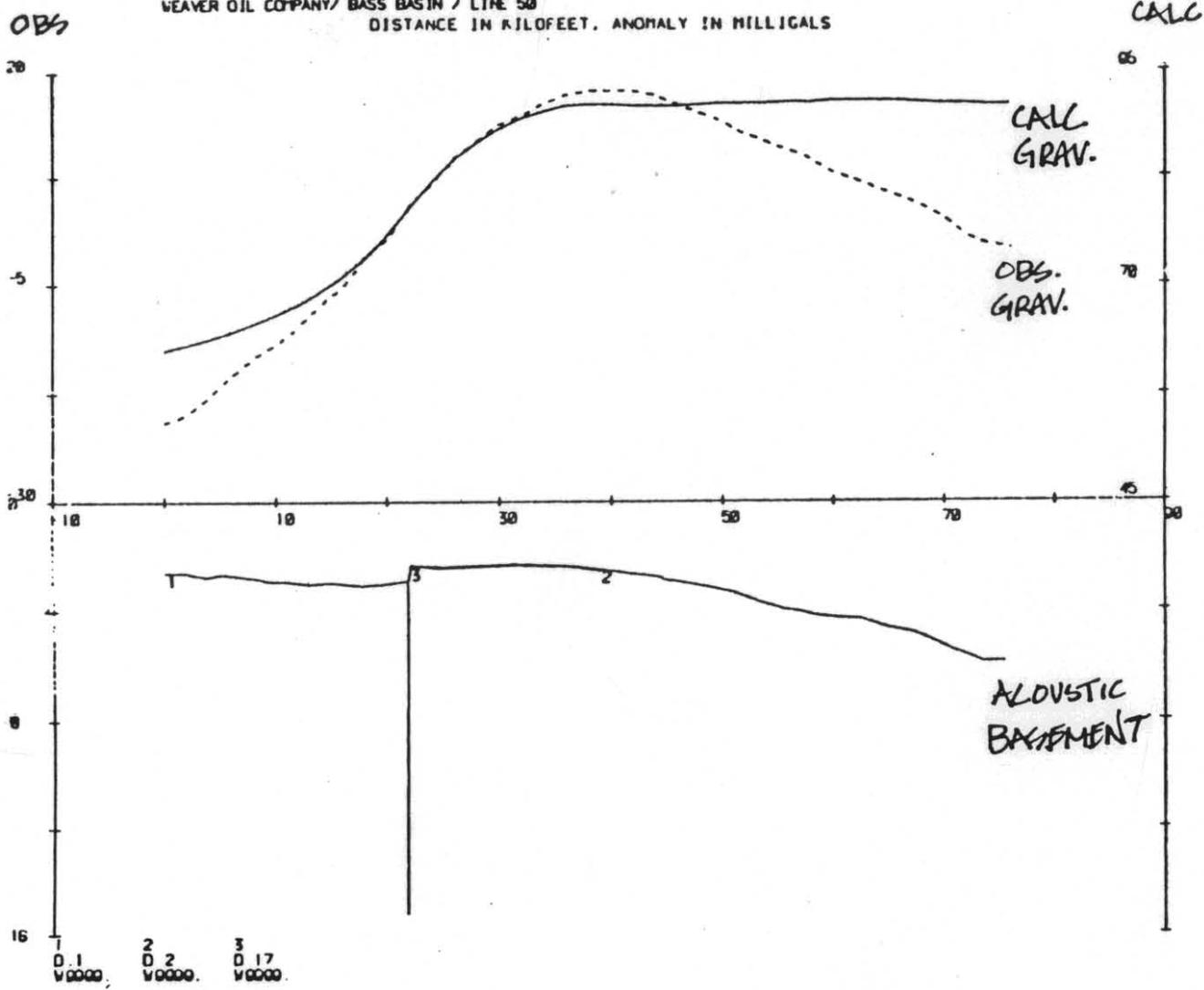
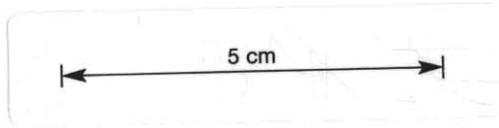


Plate XXI

A-40

DEPTH  
 IN  
 FEET X 10<sup>3</sup>

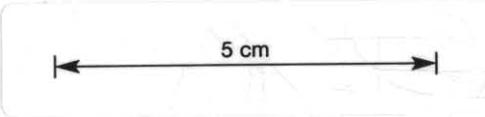
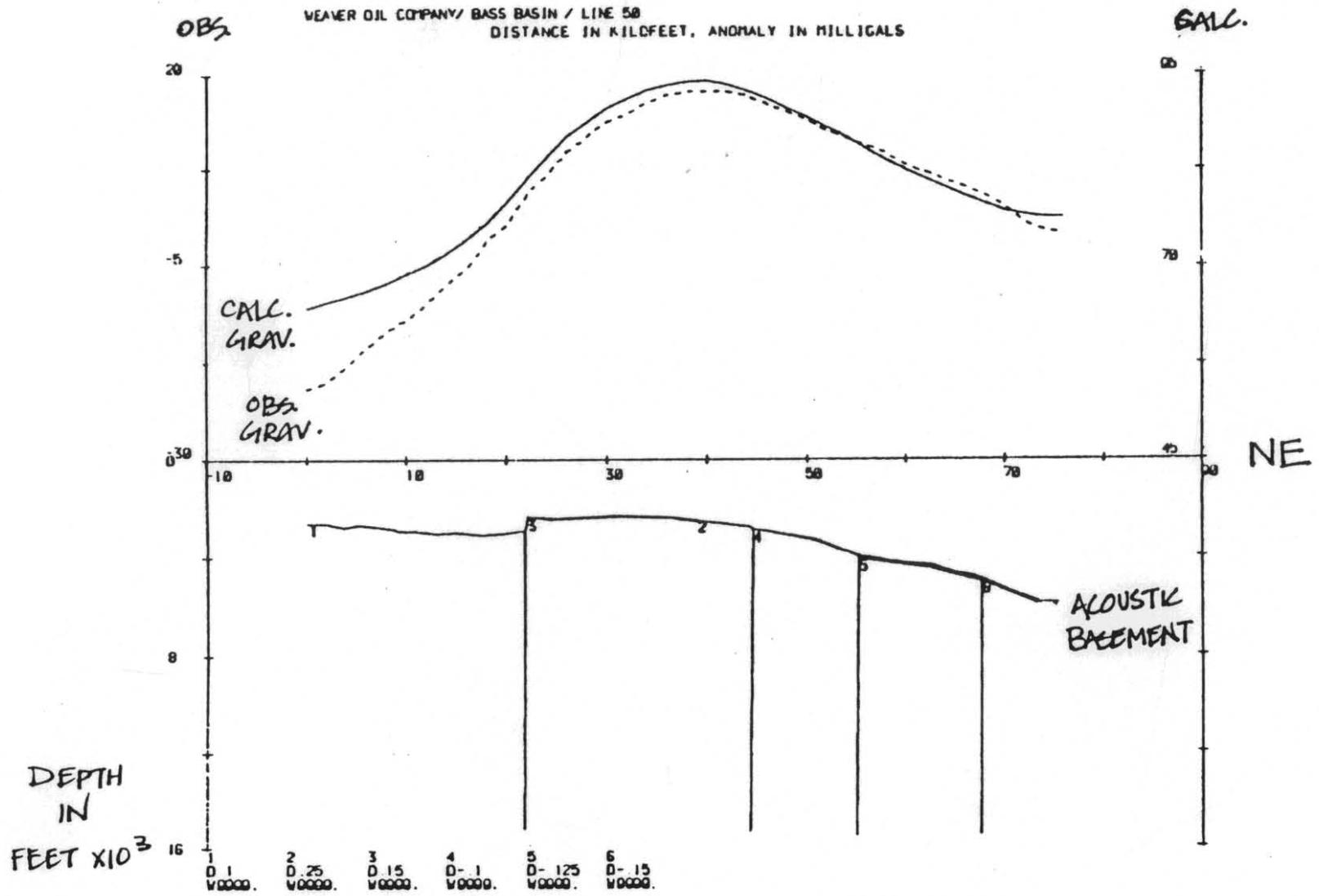


214104

Plates XXII and XXIII illustrate much closer matches between the observed and calculated data from models that can be interpreted in several ways. The essential ingredient to the models is an uplifted, high density unit (0.25 contrast) in the central portion of the line as derived from the previous work on line 52. The aspect which invites speculation is the gradually decreasing density contrasts between basement units and overlying sediment moving from the central portion of the model toward the northeast as basement appears to deepen. Either the basement units are becoming gradually less dense or the overlying sedimentary rocks are becoming more dense with increased depth. Some combination of the above which favors the latter interpretation is preferred.

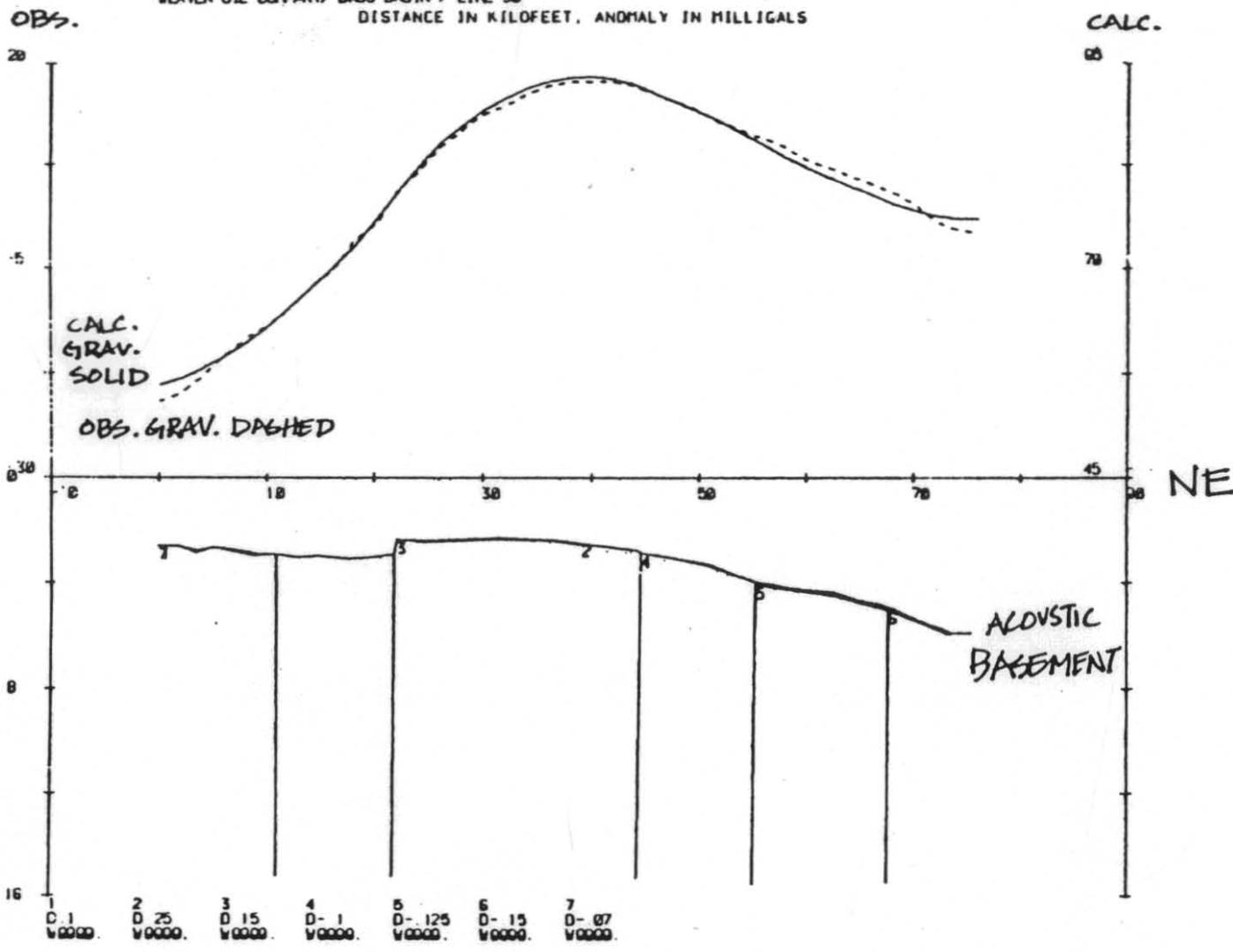
A-42

Plate XXII



214106

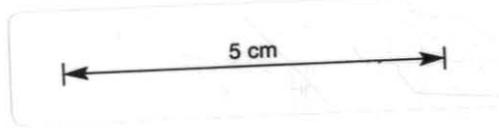
WEAVER OIL COMPANY / BASS BASIN / LINE 50  
 DISTANCE IN KILOFEET, ANOMALY IN MILLIGALS



A-43

Plate XXIII

DEPTH  
 IN  
 FEET  $\times 10^3$



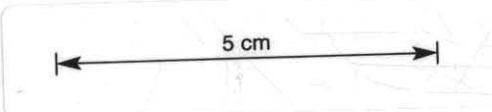
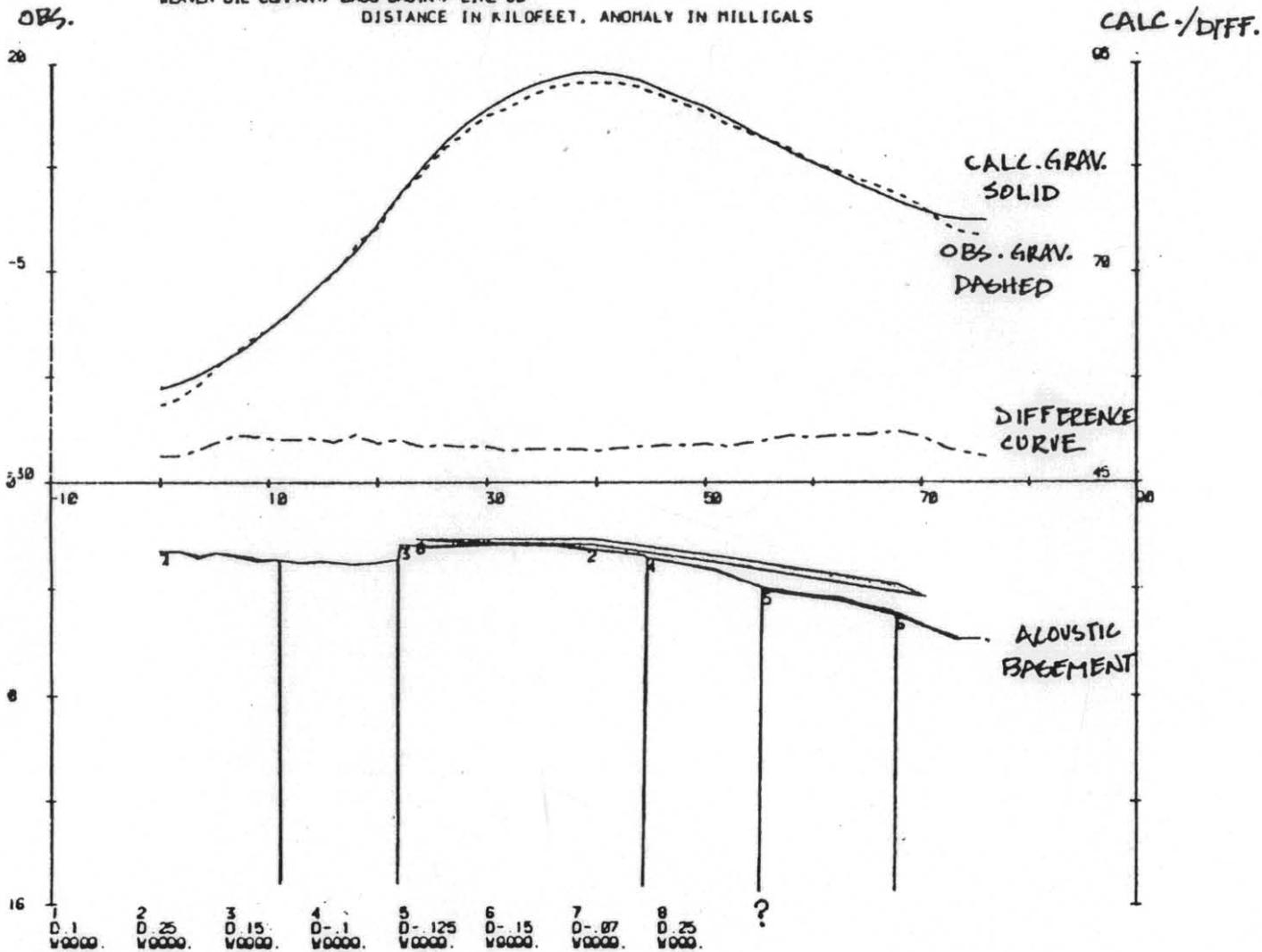
214107

On Plate XXIV the very thin volcanic unit interpreted from intersecting line 52 is added with no great effect on the residual curve illustrating the differences between the observed and calculated gravity profiles.

A-45

Plate XXIV

WEAVER OIL COMPANY/ BASS BASIN / LINE 50  
DISTANCE IN KILOFEET, ANOMALY IN MILLIGALS



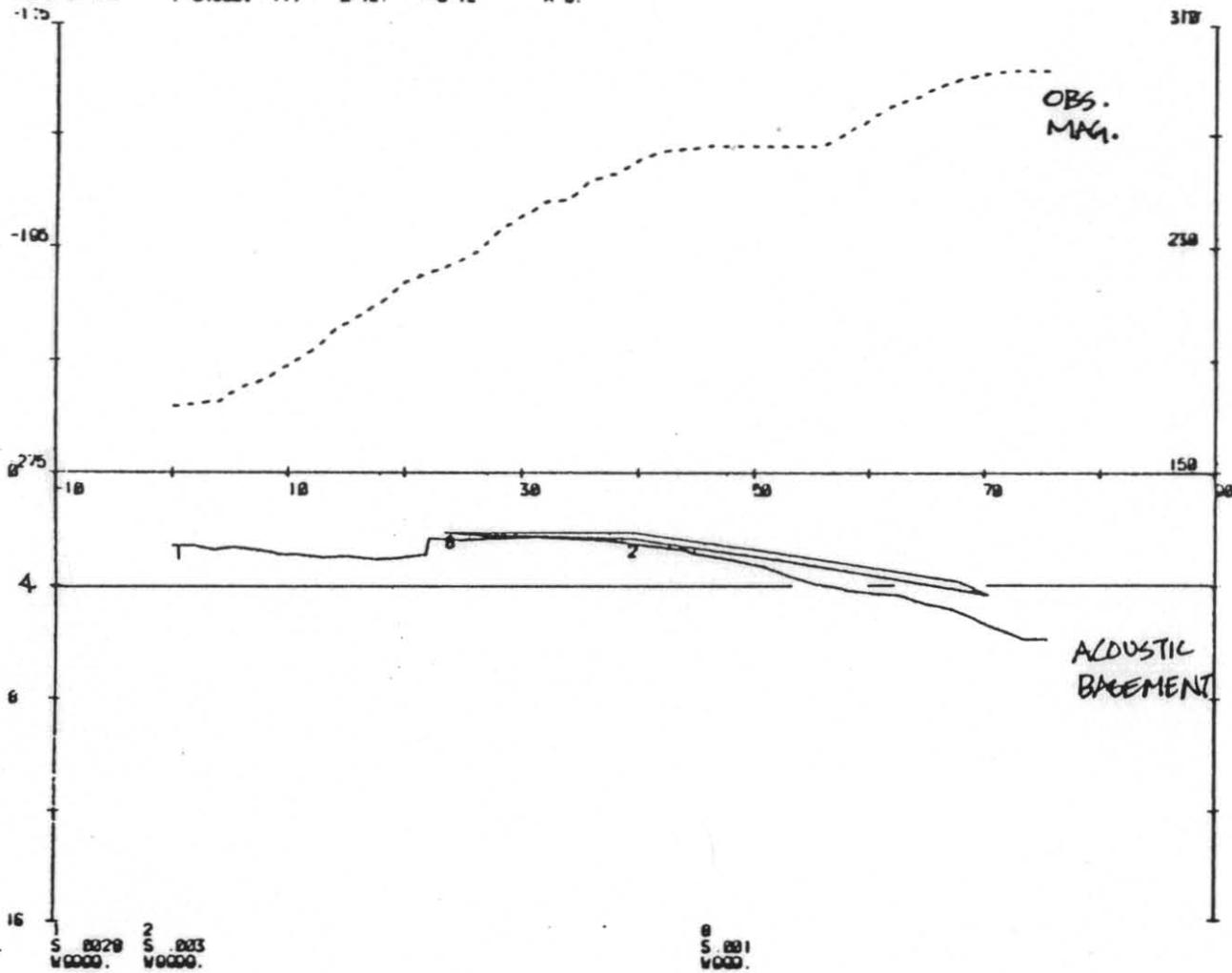
214109

Plate XXV shows the observed magnetic profile over line 50. No modeling of the magnetic data was successfully achieved due to the very poor position of line 50 with respect to the local magnetic trends. Noting the location of line 50 on the total magnetic intensity map (contained in back pocket) it can be seen that line 50 lies parallel to a very strong magnetic gradient resulting from a northeast trending intrusive body (see interpretation map in rear pocket).

Utilizing the present modeling technique, no sure method exists for simulating the effect of a highly magnetic parallel source which is not traversed by the modeling line. In conclusion, however, the results of the gravity modeling are believed to adequately support the interpretation of the acoustic basement along lines 50 and 52.

OBS. GAMMAS

WEAVER OIL COMPANY/ BASS BASIN / LINE 50  
DISTANCE IN KILOFEET. ANOMALY IN GAMMAS  
F 616001 -71. D 12. C 12 A 0.



A-47

Plate XXV

DEPTH IN FEET X10<sup>3</sup>

OBS. GAMMAS

ACOUSTIC BASEMENT

5 cm

214111

S E C T I O N   I V

PETROLEUM GEOCHEMISTRY OF THE BASS BASIN

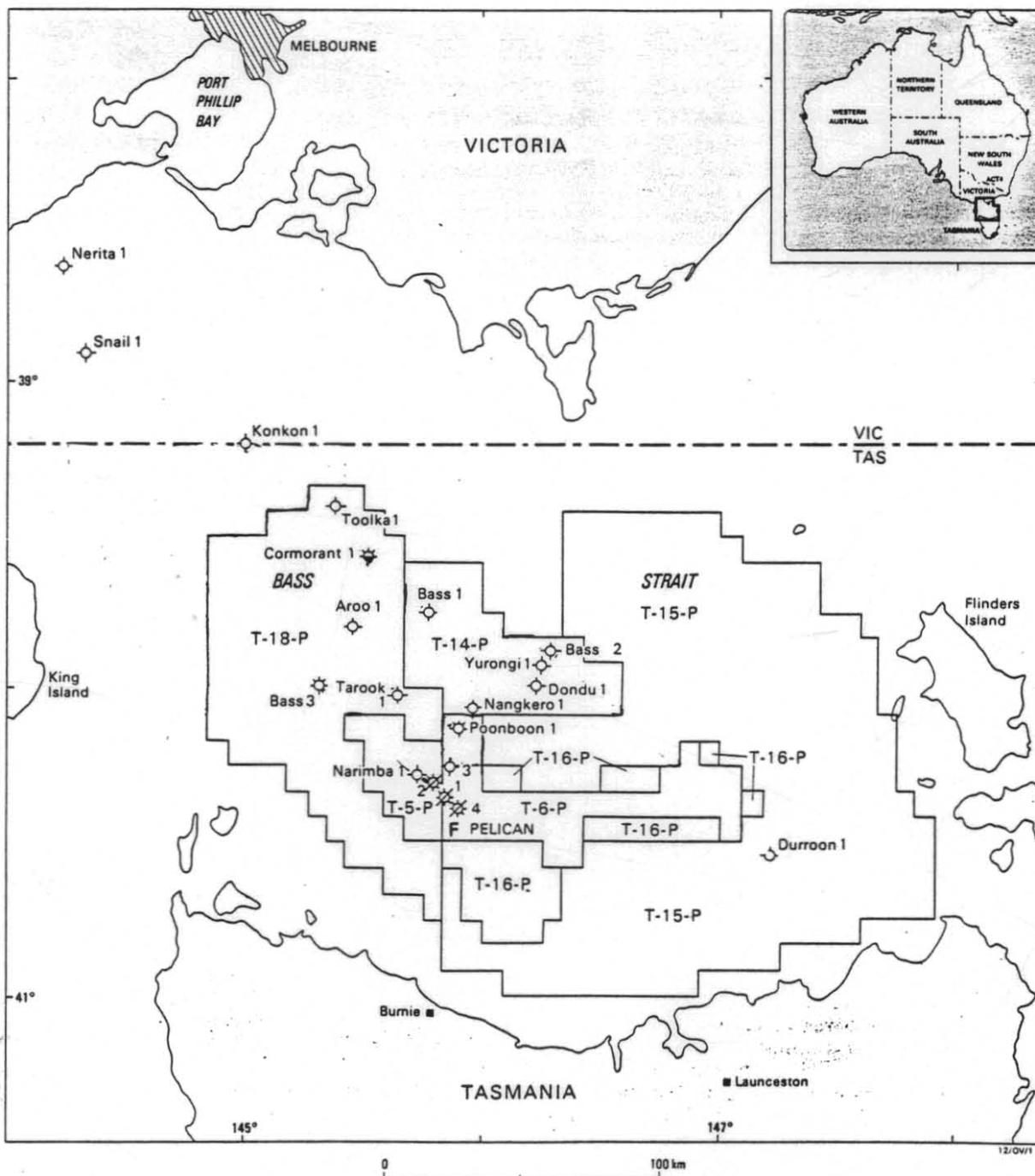
SUMMARY

Geochemical data indicate that a very large volume of oil may have been generated in the Bass Basin and that much of it would be reservoired in sands of the lower part of the Eastern View Coal Measures. A semi-quantitative geochemical estimate puts the volume of recoverable oil in the Basin at several billion barrels. Wider consideration indicates that this estimate is overly optimistic, but it certainly shows that the basin should receive high priority for further exploration.

HISTORICAL

Permits covering the Bass Basin were issued to B.H.P. (Hematite) in 1960. Esso took over exploration in 1965 and drilled 15 wells before withdrawing in 1973. B.H.P. relinquished most of the acreage in 1978 although it has continued to explore the area around the Pelican gas condensate discovery. Weaver and others took up the relinquished acreage around 1980. Figure 7.

5 cm



- |        |  |   |   |
|--------|--|---|---|
| T-5-P  | ] Hematite Petroleum Pty Ltd               | ◇ | Well, dry abandoned                       |
| T-6-P  |  | ☆ | Well, with show of gas, abandoned         |
| T-14-P | Cue Minerals N.L.                          | ⊕ | Well, with show of oil and gas, abandoned |
| T-15-P | ] Weaver Oil and Gas Corporation Australia | ⊗ | Gas well, abandoned                       |
| T-16-P |  |   |   |
| T-18-P | Bass Strait Oil and Gas N.L.               |   |   |

Well locations and petroleum permits

FIGURE 7

STRATIGRAPHY AND STRUCTURE

Details of stratigraphy are given in Brown (1976) and can be summarized as follows:

Tertiary (Eocene-Recent). Largely fine-grained marine carbonates with basal transgressive shale (the Eocene Shale). Deposited in a saucer-shaped depression 2,000m deep and 62,000km<sup>2</sup> in area with little tectonic disturbance.

Late Cretaceous - Eocene. A mixed fluvial lacustrine sequence up to 3,000m thick known as Eastern View Coal Measures (abbreviated here to E.V.C.M.). There is a facies change from lacustrine shales in the northwest to coals with channel sands in the centre of the basin to fluvial sand in the southeast.

Normal faulting with local rotation of fault blocks occurred during deposition of the E.V.C.M. so that the lower parts of the formation are structurally more complex than the upper part.

Early Cretaceous. Thick, indurated volcanogenic sediments of the Otway Group. Generally regarded as basement because of low porosity and permeability. It has been encountered in two wells (Durroon -1, Konkon -1).

Basement. Apart from the two wells mentioned above, two other wells (Bass -2 and Bass -3) bottomed in weakly metamorphosed Palaeozoic rocks.

STRATIGRAPHY OF THE EASTERN VIEW COAL MEASURES

There are no recognizable marker beds in the E.V.C.M. and subdivision is entirely by palynology. Esso's work has established a good zonation. However, detailed correlation between wells is difficult because palynology samples may be barren and/or widely spaced.

Brown (1976) divided the beds into "upper" and "lower" units with an unconformity of "local and possibly regional significance within the M. Diversus zone". However, limited examination of well data indicates no clear evidence of erosion, and it is suspected that the paleo data can be equally well explained by local thinning across faults. The formation will thus be treated as a whole in this report.

A thesis by Aquino (1980) gives an exhaustive analysis of sand/shale ratios and related parameters based on well logs, together with a facies analysis. However, the paleogeographic maps are of limited use because they rely entirely on a few wells, whereas isopach maps based on seismic mapping are needed to give a basin-wide picture.

Subdividing well sections into zones always has an element of uncertainty, and this can be quite large where samples are widely spaced or microfloras are sparse, poorly preserved, or undiagnostic. In most cases in the Bass Basin wells, zones are controlled to within about 100m.

A third set of possible correlations is contained in well completion reports which refer to seismic mapping horizons. They are not considered in this report because there is no information on which well section they are

based on, and it is likely that the horizons were adjusted with each generation of mapping.

During deposition of the E.V.C.M. the basin was surrounded by basement highs, with a lake ponded in the northwest, coal swamps in the centre and alluvial plains around the margins and particularly in the southeast. This pattern seems to persist throughout the sequence.

Several palynological samples contain microplankton, indicating that temporary marginal marine conditions occasionally prevailed, but no clear sequence of transgressions and regressions can be recognized.

SOURCE ROCKS

Source Rocks Richness - Useful data are published by Nicholas, et al (1980) and further data can be found in Esso and Hematite Well Completion Reports made available to Weaver Oil & Gas Corporation, Australia under the Petroleum (Submerged Lands) Act 1967.

Both coals and interbedded shales can be considered for source rocks for oil and gas in the Bass Basin.

Coal is developed best in the central and northwestern part of the basin, with as much as 112m (8.6% of the section) being encountered in Dondu -1. Figure 8.

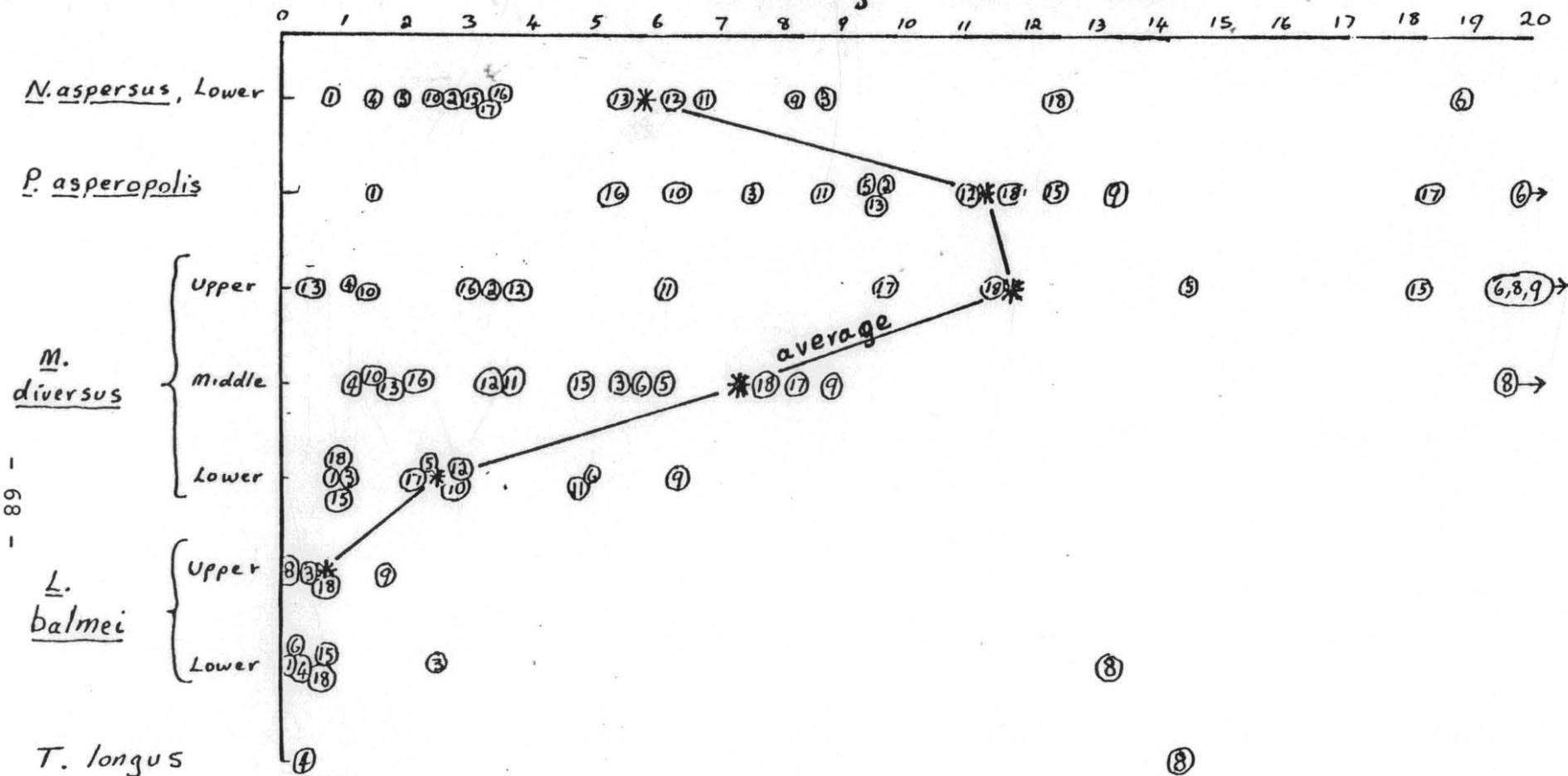
The proportion of coal is highest in the Upper M. Diversus (11.6%) zone and declines downwards at least as far as the Lower L. balmei zone. Aquing records only two values for the T. longus zone (0.3% and 14.3%) and it is uncertain whether the lower part of the formation has abundant coal or not.

Shale forms a substantial part of the formation in the central part of the basin.

Nicholas (1980) gives some analyses for total organic carbon for a suite of core samples. They are grouped below and are samples of shale or siltstone unless noted otherwise.

<u>ZONE</u>	<u>% TOTAL ORGANIC CARBON</u>
N. aspersus	5.35, 3.55, 1.05(sst), 10.1, 2.65(sst), (Av 4.54%)
P. asperopolis	1.9, 0.7
M. diversus, Upper	2.80, 66.9 (coal)
M. diversus, Lower	7.10, 0.85, 1.85, 65.8 (coal)
L. balmei	6.05, 2.4, 20.1, 2.4(sst), 1.75
T. longus	0.6, 1.20

Percentage Coal in zone



- 68 -

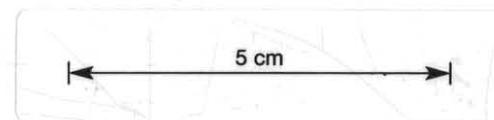
KEY

- |                |               |
|----------------|---------------|
| ① Aroo -1      | ⑩ Narimba -1  |
| ② Bass -1      | ⑪ Pelican -1  |
| ③ Bass -2      | ⑫ Pelican -2  |
| ④ Bass -3      | ⑬ Pelican -3  |
| ⑤ Cormorant -1 | ⑭ Pelican -4  |
| ⑥ Dondou -1    | ⑮ Poonboon -1 |
| ⑦ Durroon -1   | ⑯ Tarook -1   |
| ⑧ Konkon -1    | ⑰ Toolka -1a  |
| ⑨ Nanghero -1  | ⑱ Yurongi -1  |

Data from Aquing (1980)

FIGURE 8

Stratigraphic distribution of coal



214120

Thus shale and siltstone samples have an average of 4.4%, Total Organic Carbon and even the sandstones have appreciable source potential.

With the possible exception of the T. longus zone, the entire E.V.C.M. can be regarded as a rich source as far as total organic material is concerned.

Quality (Oil Potential) of Source Rocks - The oil potential can be evaluated in several ways, none of which are altogether straight forward.

Rock Eval Data - Data published by Nicholas, et al, (1980) are displayed in Figures 5.2-1 to 5.2-5, using the Hydrogen Index/Oxygen Index plot discussed in that text. The data are separated out into palynomorph zones because of the need to consider maturation simultaneously with quality (that is, the best potential source rock is of no value if it is everywhere immature).

Coal is commonly thought of as a source only for gas, although Thomas (1982) has documented the important oil potential of many Cretaceous and Tertiary coals in Australia. The Rock Eval data from the Bass Basin indicates that some, perhaps most, of the coal has a high oil potential.

Visual Examination - Nicholas, et al, also published a summary of the results of visual examination of kerogen by BHP. This involves a semiquantitative visual estimate of both quality and quantity. The results are re-grouped here in Figure 5.2-6.

Esso's Well Completion Report on Narimba -1 contains a detailed geochemical report on visual examination. One set indicates only gas prone material is present in the E.V.C.M. penetrated; the other suggests "Algal" (oil prone) material is present.

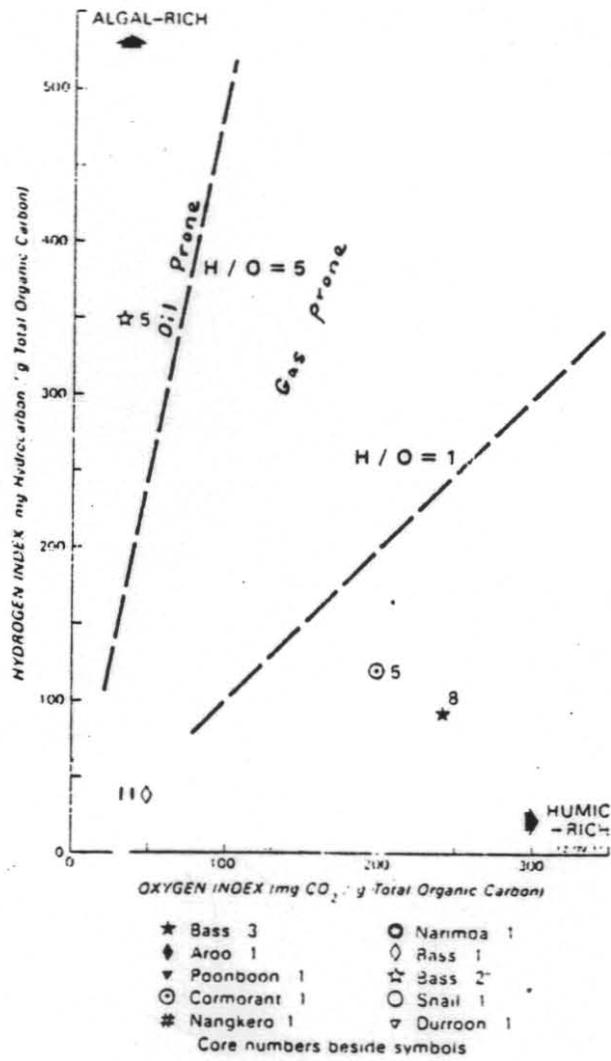


FIGURE 5.2-1  
 Rock Eval data  
 Lower N. asperus zone

5 cm

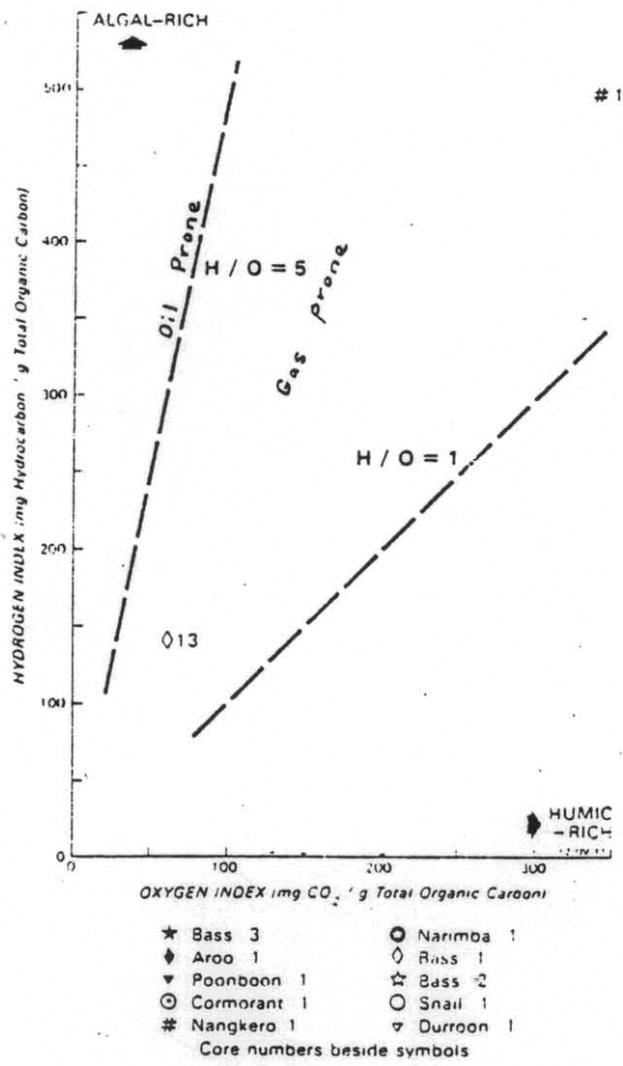
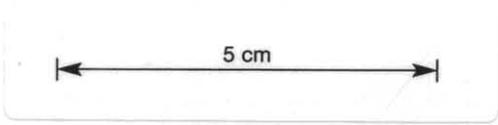


FIGURE 5.2-2  
 Rock Eval data  
P. asperopolis zone



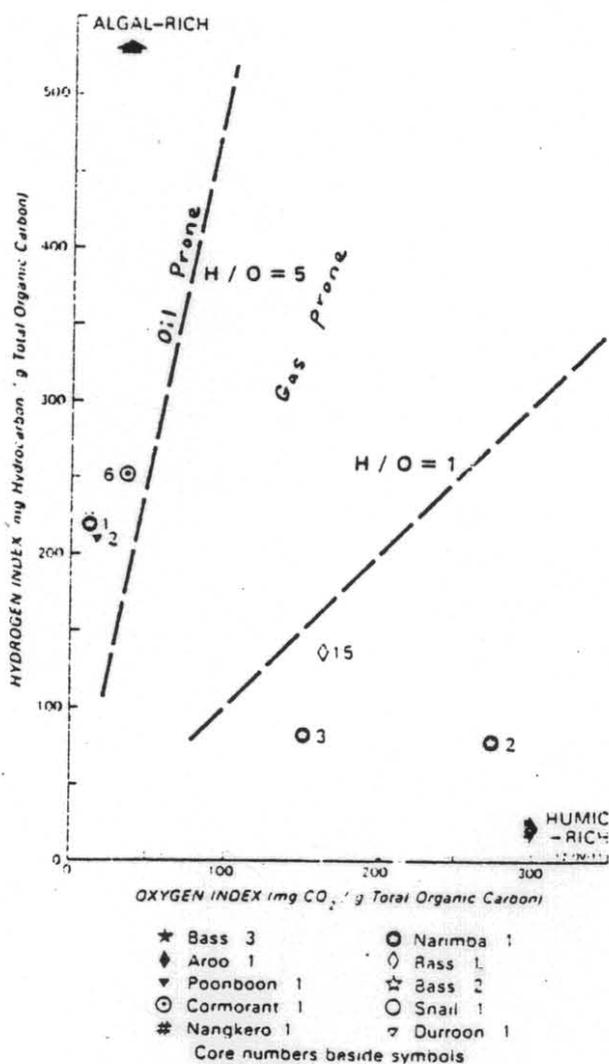


FIGURE 5.2-3  
Rock Eval data  
M. diversus zone

5 cm

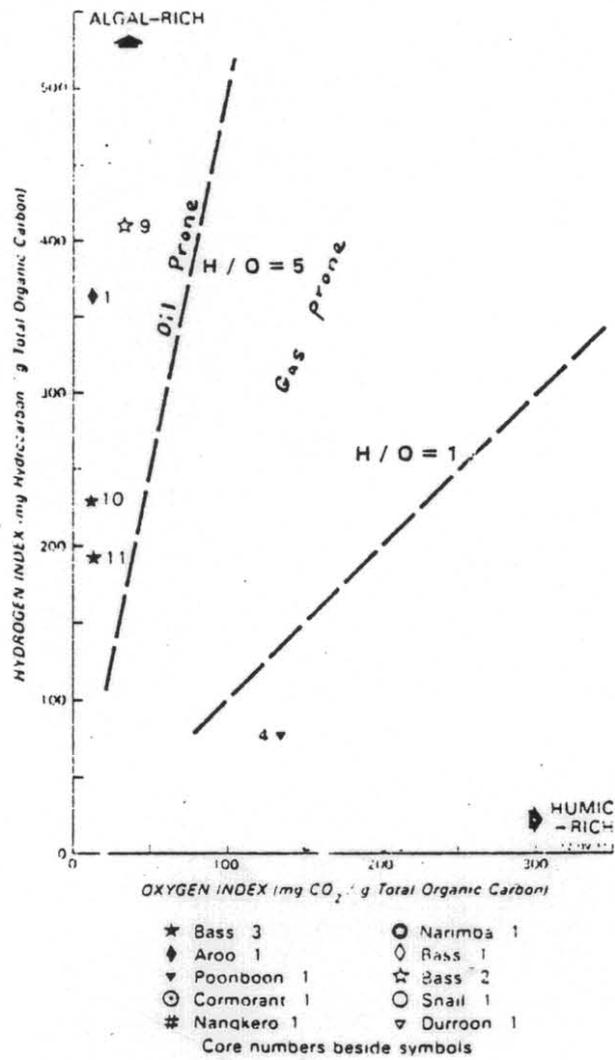
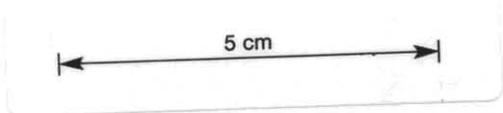


FIGURE 5.2-4  
 Rock Eval data  
L. balmei zone



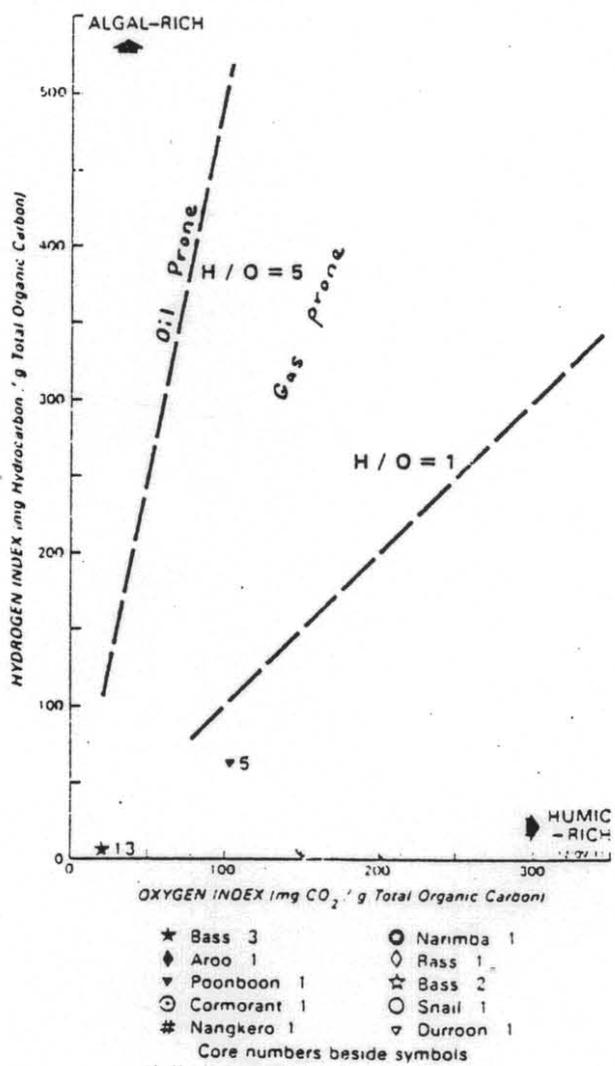


FIGURE 5.2-5  
 Rock Eval data  
T. longus zone

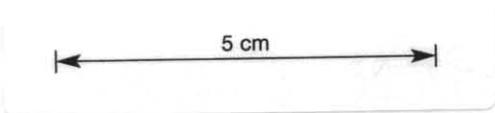
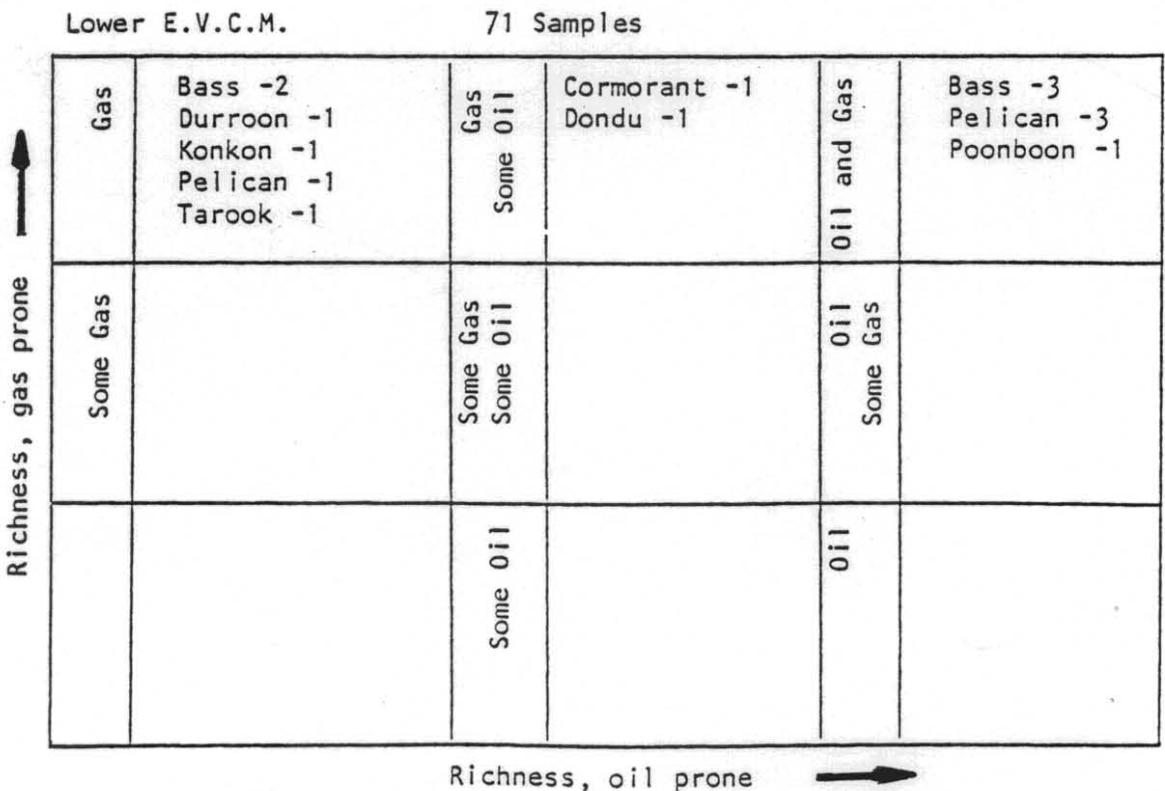
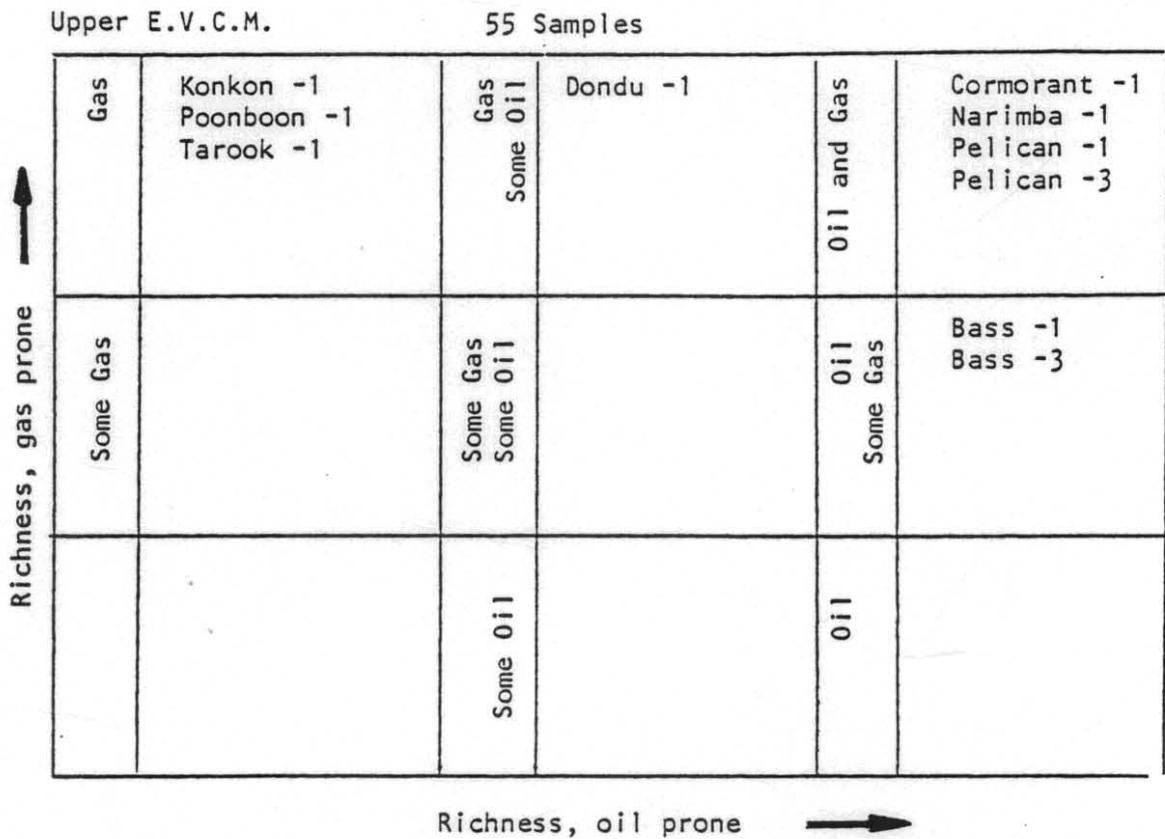


Figure 5.2-6 Kerogen Quality, Visual Examination



Cuttings Gas Analysis - Esso's geochemical study on Narimba -1 canned cuttings included computing the proportion of wet gas (proportion of  $C_2 + C_3 + C_4$  in the total  $C_1 + C_2 + C_3 + C_4$ ). Esso suggests that values higher than 20% or 45% can indicate oil prone source rock.

In Narimga -1 the results for cuttings processed in a blender -

Middle M. diversus zone (2521-2807), 10 samples, average  $64.1 \pm 21\%$

Lower M. diversus zone (2807-3354), 18 samples, average  $59.9 \pm 12.1\%$

The percentage range refers to one standard deviation. The gas from above the cuttings in the cans showed -

Middle M. diversus 10 samples, average  $42.6 \pm 28.7\%$

Lower M. diversus 18 samples, average  $26.0 \pm 10.8\%$

These data are a fair indication that oil prone kerogen is present in the section penetrated.

Gasoline Fraction Analysis - Esso's geochemical study on Narimba canned cuttings included an analysis of the ratio of cyclohexane to methylcyclohexane. Esso believes that a value of less than 0.25 indicates a gas prone section. The results were:

Middle M. diversus 4 samples, average 0.20

Lower M. diversus 6 samples, average 0.76

On this criterion, the Middle M. diversus zone in Narimba is probably gas prone while the Lower M. diversus zone may well be oil prone.

The conclusions from these data are that the basin contains a mixture of both oil prone and gas prone rocks, and although gas prone dominate, there appears to be substantial proportion of oil prone material. However, the data are too few to be sure of the stratigraphic distribution or geographic distribu-

tion of the oil prone material. The Rock Eval data, however, suggests that the L. balmei zone may be a better oil source than other zones.

#### MATURITY

Thermal History - Nicholas, et al, (1980) refer to 60°C as the generally accepted temperature for the onset of hydrocarbon generation, and in a Well Completion Report, BHP refer to 70°C as the temperature they favour for the Bass Basin.

There are two big problems with this approach. Firstly, maximum temperatures recorded during wireline logging substantially under-estimate the true formation temperature and secondly it ignores the fundamental chemical kinetics of generating petroleum.

The first problem can partly be overcome by extrapolation techniques if mud circulation history is known but the available Bass Basin logs poorly document the circulation history. In some cases there is information on "time since circulation" but for many there is simply the temperature for the initial IES logging run. To make a good extrapolation requires information on the period of circulation prior to pulling out for logging and none of the logs record whether wiper trips were made between logging runs. Thus a rough empirical method was developed to try to obtain a rough "true" formation temperature for each suite of logs.

Where "time since circulation" was available for more than two logging runs, temperature increment above the IES reading was plotted against the reciprocal of the "time since circulation". (See Figure 5.3-1). This should allow extrapolation to infinite time with the increment relating to the magnitude of the

temperature. However, there is an irritating amount of scatter in the data and there is no detectable influence of temperature magnitude. (i.e. the well seems to heat up just as much between shallow log runs as between deep ones).

A conservative average extrapolation is drawn in Figure 5.3-1. If logs record only an IES temperature, then 8°C is added. If the IES temperature is given, with the time since circulation, the increment is modified as follows:

6 hrs., add 8°C; 7 hrs., add 7°C; 8 hrs., add 6°C;

9 hrs., add 5°C, 10 hrs., add 4°C; 10-20 hrs., add 3°C

Where there are temperatures from successive logging runs, an increment is chosen that gives the most sensible and conservative result.

To extrapolate and interpolate temperatures with depth in a well, it is generally assumed that the geothermal gradient is constant, i.e. a temperature/depth plot is linear. Commonly however, the gradient increases with depth as thermal conductivity decreases. Since the temperature range of interest is 70-130°C, it is convenient to obtain a linear best fit for that range by using a higher than actual sea bed temperature (20°C instead of about 12°C) and using only the temperature at T.D. (i.e., ignoring shallow logging runs which are generally too cool).

The resulting estimates are tabulated below. (Table 5.3-1). Nicholas and others attempted to make similar estimates and there are numerous variations between them. However, in a generalized study such as this, errors introduced by poor temperature data are probably not significant.

The difficulties of chemical kinetics are best handled by Lopatin's method. Waples (1980) gives a valuable description and recalibration of this method. The technique requires a detailed thermal history of the rock. Following general

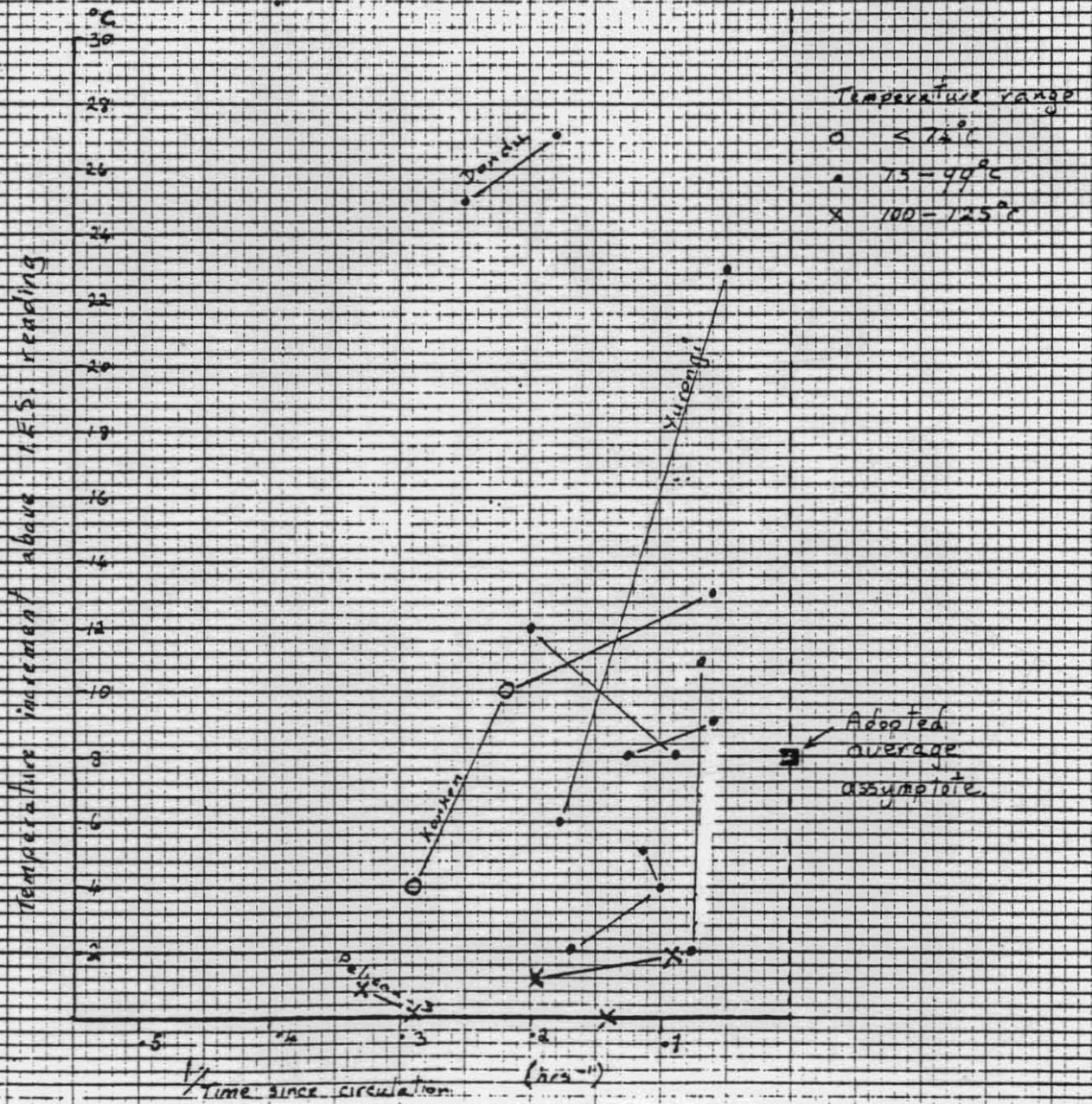
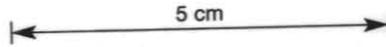


Figure 5.3-1. Bottom hole temperature extrapolation

practice, I have assumed that the past thermal gradient has always been the same as the modern one. To apply numerical ages to the paleo zones, I have interpolated the zonal scheme of the paleo data sheets in Aquino (1980) and their stated correlation with European stages with a recent estimate of their numerical ages and rounded to the nearest million years.

The results may not be entirely correct, (the Upper M. diversus zone particularly, comes out at one million years duration which seems much too short) but they are adequate for this study.

The thermal history of selected wells is plotted and values of Lopatin's Time Temperature Index (TTI) are included.

Two TTI levels are important - the level at which oil generation commences, and the level at which any oil is cracked to gas. Waples suggests values of 15 and about 1000.

The plots indicate that the onset of oil generation level is reached in the following wells:

Aroo	-1	2,900m	Lower L. balmei zone
Cormorant	-1	1,750m	Lower M. diversus zone
Dondu	-1	2,500m	Upper L. balmei zone
Narimba	-1	2,700m	Middle M. diversus zone
Pelican	-1	3,100m	Lower M. diversus zone
Poonboon	-1	2,950m	Lower L. balmei zone

This maturation level is probably reached around T.D. in Pelican -2, but not in Pelican -3. Other wells in the basin were not deep enough to enter the oil generation zone.

Although the Lopatin approach is relatively sophisticated theoretically, the case of the Bass Basin, the simplicity of the subsidence history and simplifications involved in the computation, means the technique degenerates into picking the depth of the 112°C isotherm. However, this temperature is substantially higher than used by previous workers, and its validity will be discussed later.

The oil destruction zone (above a TTI index of about 1000) is reached in the following wells:

Aroo -1	2,400m	Within basalt of Lower L. balmei zone or older
Dondu -1	2,900m	Lower L. balmei zone
Narimba -1	3,200m	Lower M. diversus zone

Spore Colour - Nicholas, et al summarized (Table 2) BHP palynology data. The data is relatively generalized and for E.V.C.M. it can be summarized as:

Upper M. diversus zone & above - mostly immature

Lower M. diversus zone & below - mostly immature and transitionally mature.

The geochemical appendix to Narimba -1 lists details for palynological preparations from sidewall cores and picked cuttings. They are rated as 1 to 2- (immature) down to 2,972m as 2+ (mature) below 3,138m with an indeterminate ("transition") zone between.

In my experience spore colour is a useful cheap guide to maturity but not sufficiently precise at low levels of maturation to determine the onset of oil generation with a useful level of accuracy.

Reflectance of Vitrinite - Bass Basin reflectance data appears in Kantsler, et al (1978) and Nicholas, et al (1980).

The data are tabulated here (Table 5.3-2) together with my corrected

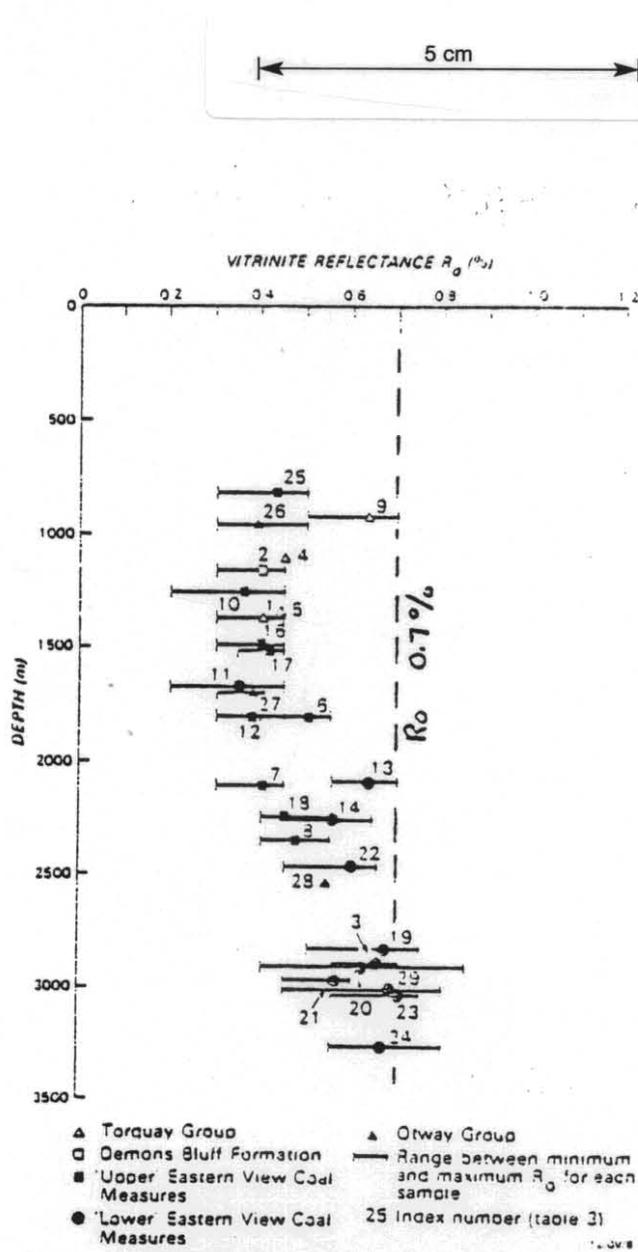


Figure 7a. Vitrinite reflectance plotted against depth in Bass Basin.  
 Data without range bars have too few determinations to give a reliable mean.

FIGURE 5.3-2  
 Vitrinite reflectance plotted against depth;  
 Nicholas et al. data

temperature values. The data are plotted against present corrected temperature and depth (Figures 5.3-2, 5.3-3).

A value of 0.7% is commonly taken as the onset of oil generation. On the available data this is not readily related to my estimates of modern temperature (Figure 5.3-3) but the value of 112°C (suggested from TTI calculations) is not unreasonable.

#### Mudlogs

The occurrence of wet gas (C<sub>2</sub> and higher) while drilling coal and shale can indicate a generative zone.

The following wells drilled E.V.C.M. with mud logs showing little or no wet gas thus indicating that they did not reach the generative zone:

Bass -2  
 Bass -3  
 Durroon -1  
 Konkon -1  
 Nankero -1  
 Yurongi -1

Narimba -1 probably reached the generative zone around 3,080m.

Tarook -1 showed C<sub>2</sub> around 2740m but this seems anomalously shallow.

Mud logs were not available on other Bass Basin wells.

#### Gasoline Fraction in Canned Cuttings

Narimba -1 has a detailed Esso report which suggests that the presence of light gasoline (C<sub>4</sub> - C<sub>7</sub>) indicates a "fair degree of maturity". In Narimba -1 consistently high values are found at 2804m and below.

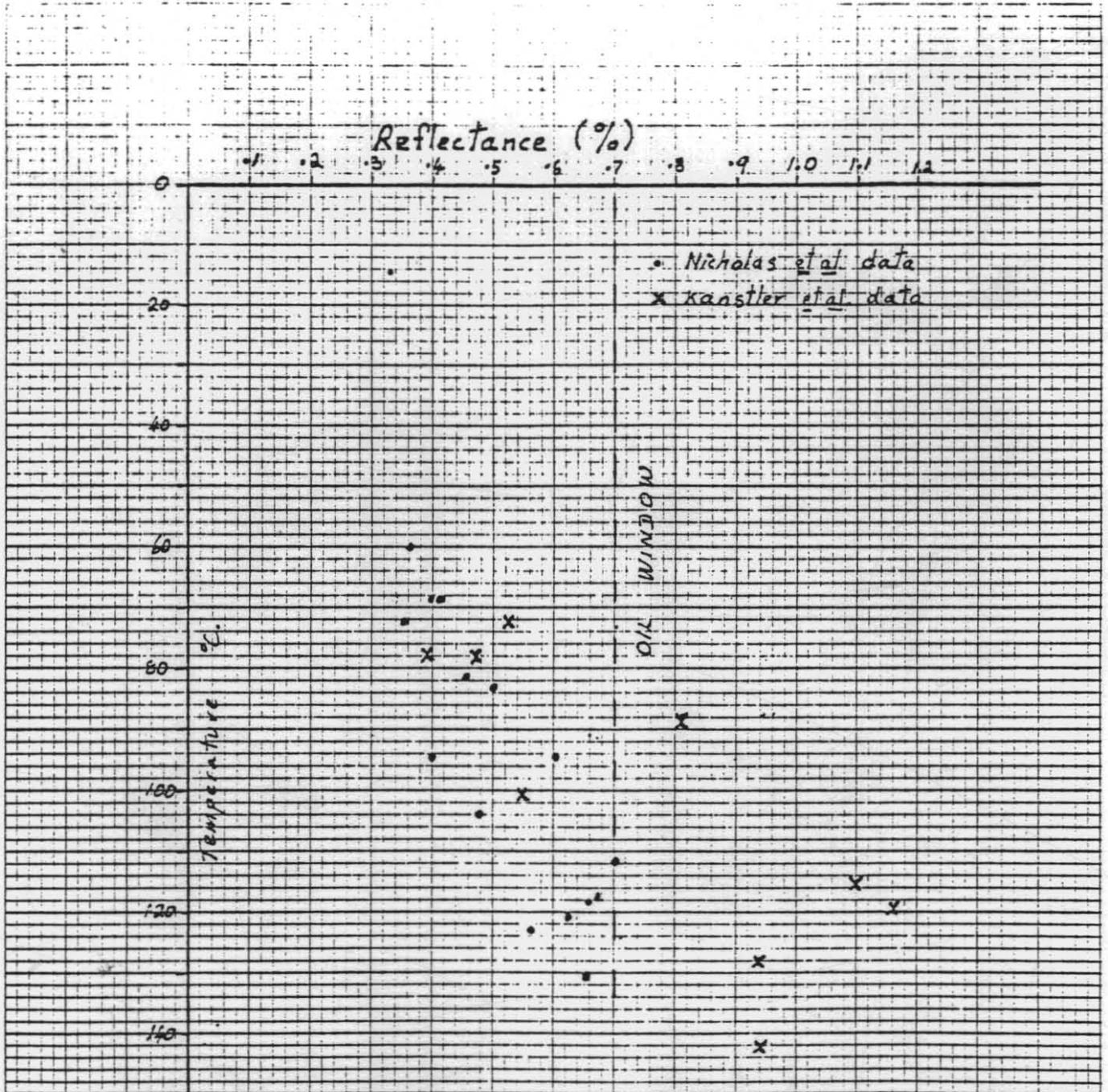


Figure 5.3-3 Reflectance plotted against present corrected temperature

Table 5.3.2 Vitrinite Reflectance

Well	Depth (M)	Kantsler <u>et al.</u>			This Report	
		Present Temp.	Ro	T Gradient	T Gradient	Present Temp.
Aroo -1	3200	121	.94	10 + 3.5	18 + 3.9	142
Bass -1	2250	98	.55	10 + 3.9	17 + 3.7	100
Bass -2	1650	68	.53	10 + 3.5	18 + 3.3	72
Bass -3	2250	91	0.65	10 + 3.6		
Comorant	2950	118	1.16	10 + 3.7	16 + 3.5	119
Dondu	2800	110	0.94	10 + 3.6	15 + 4.0	128
Durroon	3000	80	0.81	10 + 2.3	18 + 2.3	88
Konton	1500	60	0.39	10 + 3.3	17 + 4.1	78
Pelican -1	3150	113		10 + 3.3	17 + 3.1	115
Poonboon	1950	74		10 + 3.3	18 + 3.1	78
Nicholas <u>et al.</u>						
Aroo -1	2903.8		0.65		18 + 3.9	131
Bass -1	1797.7		0.50		17 + 3.7	83
	2112.2		0.40			95
	2351.2		0.47			104
Bass -2	1260.9		0.36		18 + 3.3	60
	1679		0.35			73
Bass -3	1800.5		0.38			
	2104.6		0.63			
	2255.6		0.56			
Cormorant	1509.1		0.40		16 + 3.5	69
	1519.6		0.41			69
Nangkero	2253.6		0.45		18 + 2.83	82
Narimba	2833.6		0.67		16 + 3.6	118
	2912.3		0.62			121
	2972.3		0.56			123
Poonboon	2472.8		0.60		18 + 3.1	95
	3034		0.70			112
	3258.6		0.66			119

HYDROCARBON SHOWS

The actual occurrences of oil and gas shows encountered by drilling also gives some indication of the relative likelihood of future oil or gas discoveries.

The following shows are listed by Nicholas et al.:

*Hydrocarbon occurrences*

The hydrocarbon occurrences have been discussed by Robinson (1974) and Brown (1976), and in company well completion reports. The Pelican gas/condensate accumulation has been the most significant discovery.

Four wells have been drilled on the Pelican structure. In Pelican Nos. 1 and 2, gas and condensate were recovered during formation interval tests (F.I.T.) of thin sandstones at various levels within the Early Eocene section (Fig. 5c). In Pelican No. 1, a maximum recovery of 3.9 m<sup>3</sup> of gas and 600 cm<sup>3</sup> of condensate was made from an F.I.T. at 2661 m, and in Pelican No. 2, an F.I.T. at 2880 m recorded a maximum recovery of 1.05 m<sup>3</sup> of gas and 750 cm<sup>3</sup> of condensate. In Pelican No. 4, an F.I.T. at 2739 m recovered gas and condensate and in Pelican No. 3, minor gas, but no condensate was detected in sandstone of Paleocene age below 2800 m. Abnormal pressures were encountered below this depth in the Pelican area. The gas resources of the Pelican field are presently regarded as subeconomic.

In Bass No. 3 (Fig. 5c), 0.82 m<sup>3</sup> of gas and 300 cm<sup>3</sup> of condensate were recovered during an F.I.T. at a depth of 2055 m. The reservoir was a 15 m thick sandstone in the Paleocene (*L. balmei* Zone) section.

In Cormorant No. 1 (Fig. 5a), an F.I.T. at a depth of 1550.6 m, recovered 22 litres of oil from a thin sandstone in the 'Upper' Eastern View Coal Measures (*N. asperus* Zone), the only oil show recorded in the basin. Hydrocarbon shows also occurred in four thin sands between 1828 m and 2347 m.

In Aroo No. 1 (Fig. 5b), there were indications of hydrocarbons at a number of levels within the Eastern View Coal Measures, the most encouraging being in the *L. balmei* Zone. The Paleocene to Early Eocene section of the Eastern View Coal Measures also gave indications of hydrocarbons in other wells during drilling, in the form of fluorescence and cut in cores and cuttings, and high gas readings on the well-site mud-logging units. The strongest indications were in Dondu No. 1, Pelican No. 3 (Fig. 1), and Poonboon No. 1 (Fig. 5b), from thin, rather tight sands below 2740 m. Abnormal pressures and relatively fresher formation waters occur locally in the basin at these depths.

The recorded shows indicate a preponderance of gas over oil but the number of wells is too small for this to be significant.

IMPLICATIONS FOR EXPLORATION

Quantitative Estimate of Oil in Bass Basin - As a very rough estimate based on geochemical data available, the Bass Basin should contain several billion barrels of recoverable oil.

The Basin was contoured to determine the volume of rock in or below the generative zone for the *M. diversus* and *L. balmei* zones.

Rock Eval data are used because they lend themselves to quantitative manipulation.

One problem when estimating the petroleum potential of a basin is making estimates of the efficiency of migration and trapping. In the case of the Bass Basin there is likely to be considerable variation between the overpressured shaley section in the northwest where drainage into structures may not be efficient and the sandy periphery where trapping is more risky. The simplest approach to this problem is to follow Corelab (1982) who write (p. 96) "The amount of recoverable oil for the average sedimentary basin is generally about three percent (3%) of the amount theoretically generated".

M. diversus zone - There is approximately  $1.22 \times 10^{12} \text{m}^3$  of *M. diversus* zone rocks in or below the oil generation window, that is,  $2.44 \times 10^{15} \text{kg}$ , assuming a density of 2 gm/cc.

If the Rock Eval data for the Upper and the Lower *M. diversus* zones are combined, they show that half of the organic material is oil prone and half is gas prone. The oil prone portion of the organic material will produce 230 mg/g of TOC and according to Table 5 of Nicholas, et al (1980), averages 120 mg

hydrocarbon/g rock. However this is unrealistically high because two of the three oil prone samples are coals whereas only 6% of the zone is coal. Thus the yield is estimated here to average 4.6 g oil/kg rock which corresponds to rock with an average of 4% TOC and half the kerogen yielding 230 mg/g of TOC. The yield must be discounted for the proportion of source to non-source rock in the section. It is usual to discount the sandstone fraction, but in the Bass Basin the sandstones also contain organic material and furthermore there is a small proportion of very rich coal. The yield is here arbitrarily discounted by a factor of 0.7. Thus the potential petroleum yield is  $2.44 \times 10^{15} \times 4.6 \times 0.7 \text{ g} = 6.73 \times 10^{15} \text{ g}$ . However, much of the volume of rock is in the early stage of maturation and will not have yielded its full potential. Assuming one-third has been generated, the volume of oil actually generated is:

$$\begin{aligned}
 &2.62 \times 10^{12} \text{ kg} \\
 &2.91 \times 10^{12} \text{ litres (density 0.9)} \\
 &2.45 \times 10^{10} \text{ bbl (119 litres /bbl)} \\
 &0.7 \times 10^9 \text{ bbl recoverable (3% recoverable)}
 \end{aligned}$$

#### L. balmei zone

There is approximately 3,090 km<sup>3</sup> of L. balmei zone beds within or below the generative window. Rock Eval analyses are very attractive with four out of five samples being oil prone. One of the samples is coaly (20.1% TOC) and has too high a yield to be typical, but the other three have an average petroleum potential of 12 mg hydrocarbon / g rock.

Thus the potential yield is taken here as  $4/5 \times 12 \text{ g oil/kg rock}$ . Only a portion of the zone is fully mature. On the other hand parts are overmature and if the oil has not migrated out, it will have been cracked to gas-condensate. Thus as a rough estimate, only half the oil will have been generated but not cracked. Thus

the yield is taken as 4.8 gm oil/kg of source rock. Again this is discounted by a factor of 0.7 to give an average yield for the formation i.e. to a yield of 3.36 gm oil/kg rock.

Thus:

$$\begin{aligned}
 & 3,090 \times 10^9 \text{ m}^3 \text{ rock} \\
 & = 3,070 \times 2 \times 10^9 \times 10^3 \text{ kg rock} \\
 & = 3,070 \times 2 \times 10^9 \times 10^3 \times 3.36 \text{ g oil generated} \\
 & = 3,070 \times 2 \times 10^9 \times 10^3 \times 4.8 \times 10^{-3} \div 119 \\
 & = 1.73 \times 10^{11} \text{ bbl} \\
 & = 5.2 \times 10^9 \text{ bbl recoverable}
 \end{aligned}$$

#### T. longus zone

There is not much information available on the geochemistry of this zone, and the little information that is available suggests that it is gas prone. Thus no estimate is made here for the amount of oil generated. However, while there is no evidence that the zone has generated oil, it should be remembered that with only four wells intersecting the zone there could be unsampled areas with oil prone kerogen that could add to the attractiveness of the basin.

Thus the geochemical data indicate that the basin has generated substantial volumes of oil, and that 6 billion barrels should be recoverable. Of necessity, such an estimate must have a considerable element of uncertainty - it is based on very sparse sampling and contains subjective estimates of various parameters. Nevertheless, it is a realistic optimistic geochemical estimate based on the data available.

Exploration in the adjoining "look-alike" Gippland Basin was met with immediate success and drilling to date has proved up 3 billion barrels of recoverable oil. Few explorationists would regard the Bass as more attractive than the Gippsland, so the geochemical estimate of 6 billion barrels for the Bass is, in the light of

exploration history, over optimistic. Nevertheless the estimate does mean that the Bass Basin should be given a very high priority for exploration.

No attempt has been made to estimate the volume of gas generated because currently it is of little commercial interest.

#### Previous Exploration

Complete analysis of why most wells in the Bass Basin have been dry would require detailed re-evaluation of seismic mapping, seismic velocities, porosity and permeability etc. This study has involved only the examination of well completion reports of varying degrees of completeness.

However, if it is assumed that most wells were drilled on closed structures, then the dryness of many can best be explained by failure to reach the generative zone and failure for substantial vertical migration. As discussed earlier, it appears that oil generation commences below about 2800 to 3000m depths.

Aroo -1. T.D. 3692m. Drilled on a structure within the E.V.C.M. Wet gas and fluorescence were noted while drilling below 2525m. Wireline log interpretation is unreliable because of hole enlargement. F.I.T.'s recovered water and minor gas from 2784m, 2905m, and 3145m. The well unexpectedly encountered a sequence of volcanics below 3148m, interbedded with thin tight sands giving mud logs shows of gas. I suspect that the sands encountered were too discontinuous and impermeable to allow the migration and accumulation of a significant amount of oil.

Bass -1. T.D. 2352m. First well in the Bass Basin in 1965. Drilled on a Tertiary seismic anomaly interpreted as a carbonate reef but found to be a volcanic tuff.

Bass -2. T.D. 1801m. Drilled on an anticline developed over a basement block. The section is immature and is relatively distant from the generative centre of the basin.

Bass -3. T.D. 2432m. Drilled on an anticline developed over a basement fault block. The well encountered a gas sand 2054 - 2056m and an F.I.T. recovered gas from this interval. The source beds in the vicinity of the well are immature and apparently the conditions did not favour substantial migration from deeper parts of the basin.

Comorant -1. No well completion report is available. An F.I.T. recovered 221 of oil from a thin oil sand at 1550.6m, high in the E.V.C.M. (N. asperus zone) and there were four further hydrocarbon shows in thin sands between 1828m and 2347m. The oil sand evidently results from relatively extensive vertical migration (the N. asperus zone is immature in all parts of the basin).

On my estimates the top of the generative zone is around 2750m but there is virtually solid shale between 2560m and T.D. at 3001m.

Dondu -1. Drilled to 2927m to test a structure at the Lower M. diversus level. Source rocks were expected mature below 7000 feet. The lower part of the well penetrated mature rocks. Received minor mud log gas shows. The lack of significant accumulation is presumably due to poor migration.

Durroon -1. Ineffective seals in the Eastern View Coal Measures

Konkon -1. Drilled to 1537m to test a hypothetical pinch out on a major nose. Validity of pinch out uncertain.

Nankero -1. Drilled to 2877m to test a closure mapped at 2319m. The well completion report indicates that subsequently a velocity gradient was recognized that greatly reduced the critical north-eastern closure. The well did not reach generative depths; evidently there was no effective migration from generative zones downdip.

Narimba -1. Reached 3354m, penetrating the generative window of the E.V.C.M. It tested a structure mapped in the lower part of the E.V.C.M. The well encountered no hydrocarbons and the well completion report attributes this to "the limited migration of fluids in this portion of the basin and the inadequate size of the palaeodrainage area of the prospect".

Pelican -1 to -4. The wells showed the presence of numerous thin gas sands in the Pelican area at depths below 2700m. It seems likely that the gas was generated and reservoired locally. The absence of oil may be because the local source rocks contain humic (gas prone) kerogen, or it may be that the kerogen is barely mature (my thermal history calculation puts the top of the oil window at 3000m in Pelican -1 and below T.D. in Pelican -2 (3068m) and Pelican -3 (2907m) and possibly the gas represents a minor mobile fraction generated in advance of the main generative phase.

Poonboon -1. Tested a closure deep in the E.V.C.M. The well was programmed to 3353m or 3810m if shows warranted. However it was abandoned at 3266m after encountering abnormal pressure at about 2836m. Log analysis indicates a hydrocarbon-bearing zone at 3182 - 3185m and it was probably this zone that caused the well to kick. The hole was too enlarged to test the zone. On my calculations the well entered the generative zone at around 2950m. The reason for the absence of a substantial hydrocarbon accumulation is not clear.

Tarook -1. The well tested an anticline developed in the upper part of the E.V.C.M. There was no closure in the lower part of the well and it did not reach the generative window.

Toolka - 1A. The well was designed to test a shallow structure up-dip from Cormorant. The well bottomed at 2715m and was well above the generative window. The well encountered the shaliest E.V.C.M. section known and the abundance of shale probably prevented the vertical migration seen at Cormorant.

Yurongi -1. The little information available on the Yurongi well indicates it was above the generative window when it bottomed at 2438m.

#### Exploration Plays

There are four main plays in the Bass Basin: Mid-Tertiary channels, shallow E.V.C.M., lower E.V.C.M. and Cretaceous rifts.

#### Mid-Tertiary Channels

Bass -2 encountered a mid-Tertiary sand section where other wells encountered fine-grained carbonates.

#### Shallow Eastern View Coal Measures

The initial exploration of the Bass Basin concentrated on testing sands at the top of the E.V.C.M. The sands are overlain by the marine "Eocene Shale" which forms a regional seal for much of the basin. This objective is stratigraphically the same as the zone which reservoirs 3 billion bbl of recoverable oil in the adjoining Gippsland Basin. However, it is not structurally the same because in the Gippsland the marine shale was preceded by a period of erosion

which carved deep channels in the coal measures and developed topographic highs over which draped the marine shale; whereas the Bass Basin remained an area of internal drainage where the marine shale transgressed conformably over the coal measures.

The geochemistry discussed above indicates that a large volume of oil has been generated in the Bass Basin. The fact that little has yet been found suggests that there has not been substantial vertical or lateral migration from the generative zone to the shallow or basin-margin structures that have been the main exploratory objective in the past.

A further aspect of this play is that most of the obvious structures at Top E.V.C.M. level (Comorant, Toolka, Bass -2, Bass -3, Tarook) have been tested (Brown, 1976).

However, considering the size of the basin, this play deserves further testing and one obvious opportunity is the Tasmanian Devil feature.

#### Deep Eastern View Coal Measures

If there has been no major migration out of the generative zone then structures within the generative zone (roughly 2800 - 3400m) should be the main objectives of future exploration.

Pelican -1 encountered the only substantial hydrocarbon accumulation found so far. The structure is developed some 400m below the top of the E.V.C.M. which is structurally open. The well just reached the top of the generative zone at T.D.

One obstacle to exploration is that structure can vary considerably with depth in the E.V.C.M. and deep structure is difficult to map seismically. The coal seams in the upper part cause attenuation of deeper reflections, and also cause short-path multiples which confuse

the deeper reflections. According to well completion reports, the following wells tested sands where there was structural closure within the generative zone: Arro -1, Dondu -1, Narimba -1, and Poonboon -1. However I feel that because of the difficulty of seismic mapping of deep structures, there may be some doubt that the wells were indeed valid structural tests. If there was structural closure then their failure was probably due to inadequate drainage into the structures.

Another well, Cormorant -1, reached the generative zone but encountered shale section.

This play should, according to the geochemistry, be given the highest priority.

#### Cretaceous Rifts

Seismic sections around the margin of the basin show spectacular wedges of sedimentary rocks that were deposited during active faulting in the Cretaceous. The wedges reach several kilometres in thickness and represent a possible source of hydrocarbons. The Durroon well tested the upturned feather edge of one of these wedges and although the results were not encouraging, the sequence seen in the well is unlikely to be representative of the sedimentary and geochemical facies of the whole wedge. Further testing of this play is desirable but there is insufficient geochemical data to discuss the matter further.

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  - 5.2-3 Rock Eval Data - M. diversus Zone
  - 5.2-4 Rock Eval Data - L. balmei Zone
  - 5.2-5 Rock Eval Data - T. longus Zone
  - 5.2-6 Kerogen Quality
  - 5.3-1 Bottom Hole Temperature Extrapolation
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- 5.3-2 Vitrinite Reflectance

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S E C T I O N   V

DRILLING PROGNOSIS

## INTRODUCTION

The Tasmanian Devil # 1 well, located on Permit T/16P, will test the structural and stratigraphic hydrocarbon potential of the Oligocene, Eocene, and possibly older section, of the southwest most area of the Bass basin. The well will also provide valuable information as to the sand reservoir quality, intra-formational sealing capacity and maturation of the source-rock shale package of this objective sequence. Figure 5, 6, 4.

## SEISMIC INTERPRETATION

The Tasmanian Devil prospect was originally recognized on the old seismic lines B69 A-1 and B71 A-65 as a major tilted fault block bounded to the southwest by a down-to-the-coast normal fault accompanied by a major northwest trending depression.

The nearest well is Pelican # 4 located some 31 miles to the northwest. Further to the northwest is the Pelican # 1 well located some 33 miles away to which the prospect is tied by seismic line WB-81-11. A synthetic seismogram has been constructed for the Pelican # 1 well (Fig. 3). Other wells to the northwest do not add significantly to the basic data base. Figure 2.

The prospect is defined by seven Weaver seismic lines acquired in 1982, in addition to five Weaver seismic lines acquired in 1981. Fourteen lines acquired through the late 60's and early 70's by the previous permit holders have also been used in the interpretation.

# TASMANIAN DEVIL No.1

## ANTICIPATED STRATIGRAPHIC SECTION

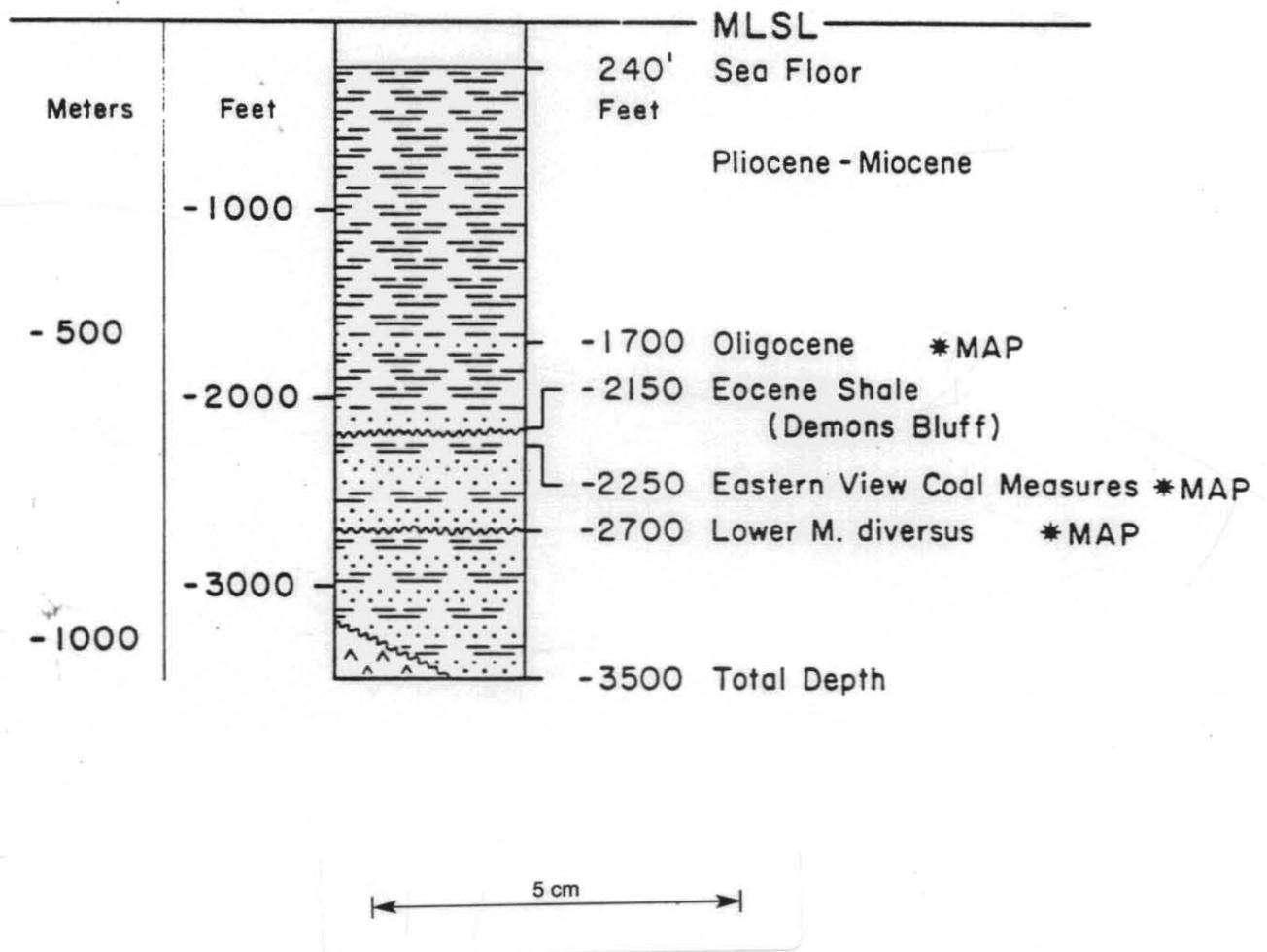
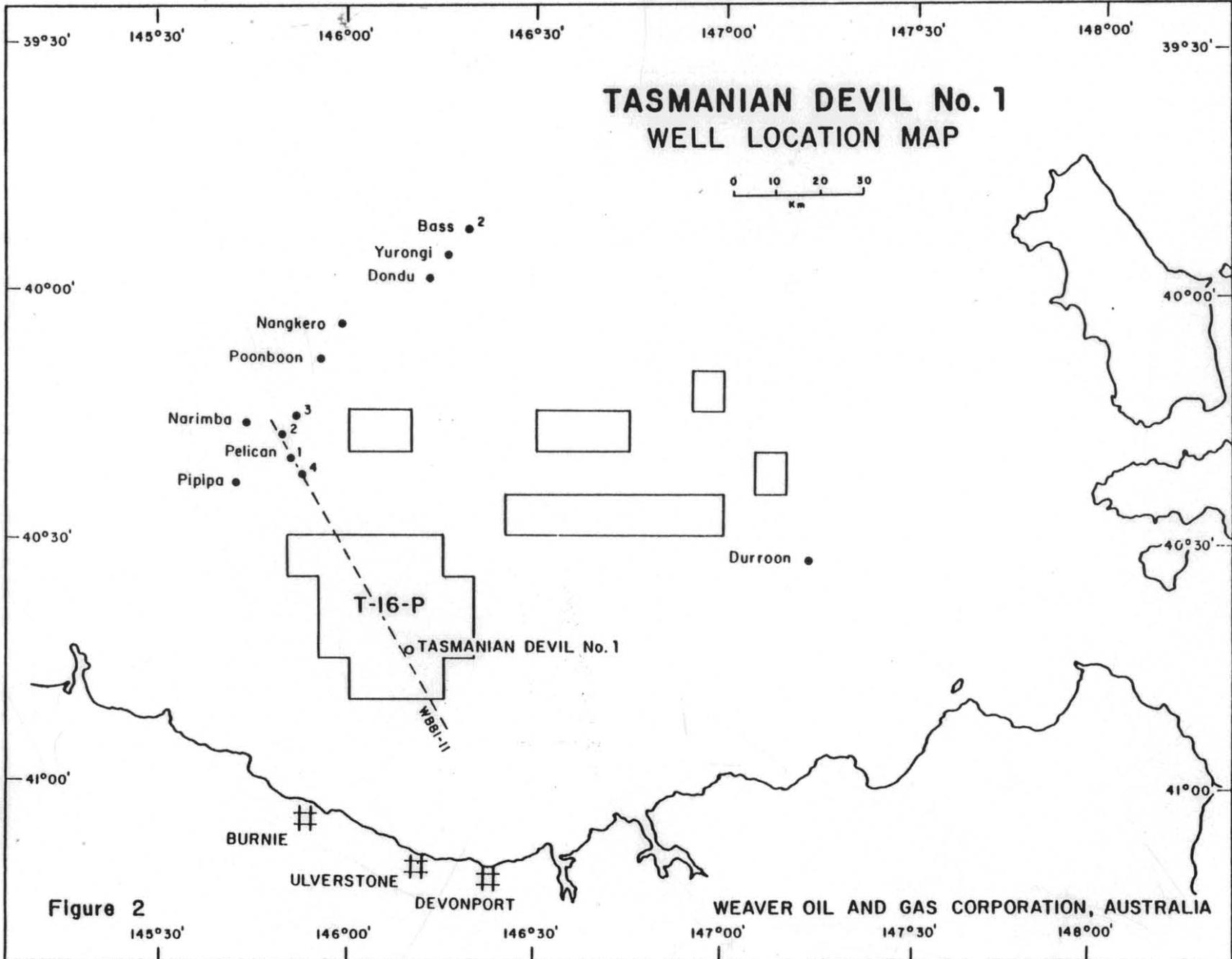
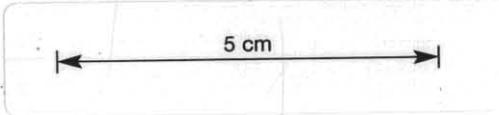


Figure 1



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FIGURE 2

Figure 2

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SYNTHETIC SEISMOGRAM

GTS CORP.

POSITION OFFICE 3724 DACOMB 77018

ESSO EXPL & PROD AUSTRALIA INC PELICAN #1 WILDCAT AUSTRALIA TASMANIA

M

LOG DATUM = 100

SEISMIC DATUM = 0

COMMENTS

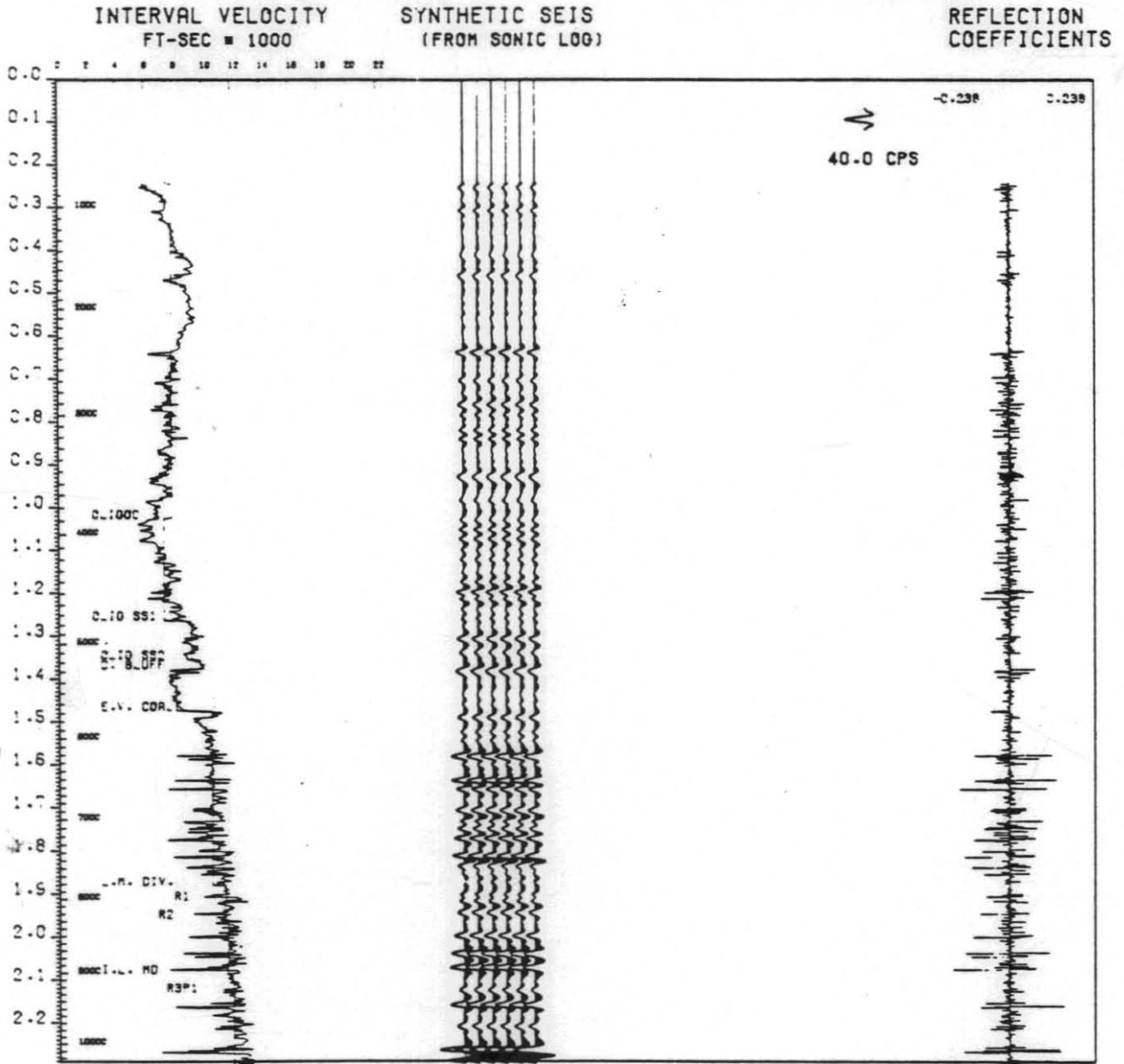


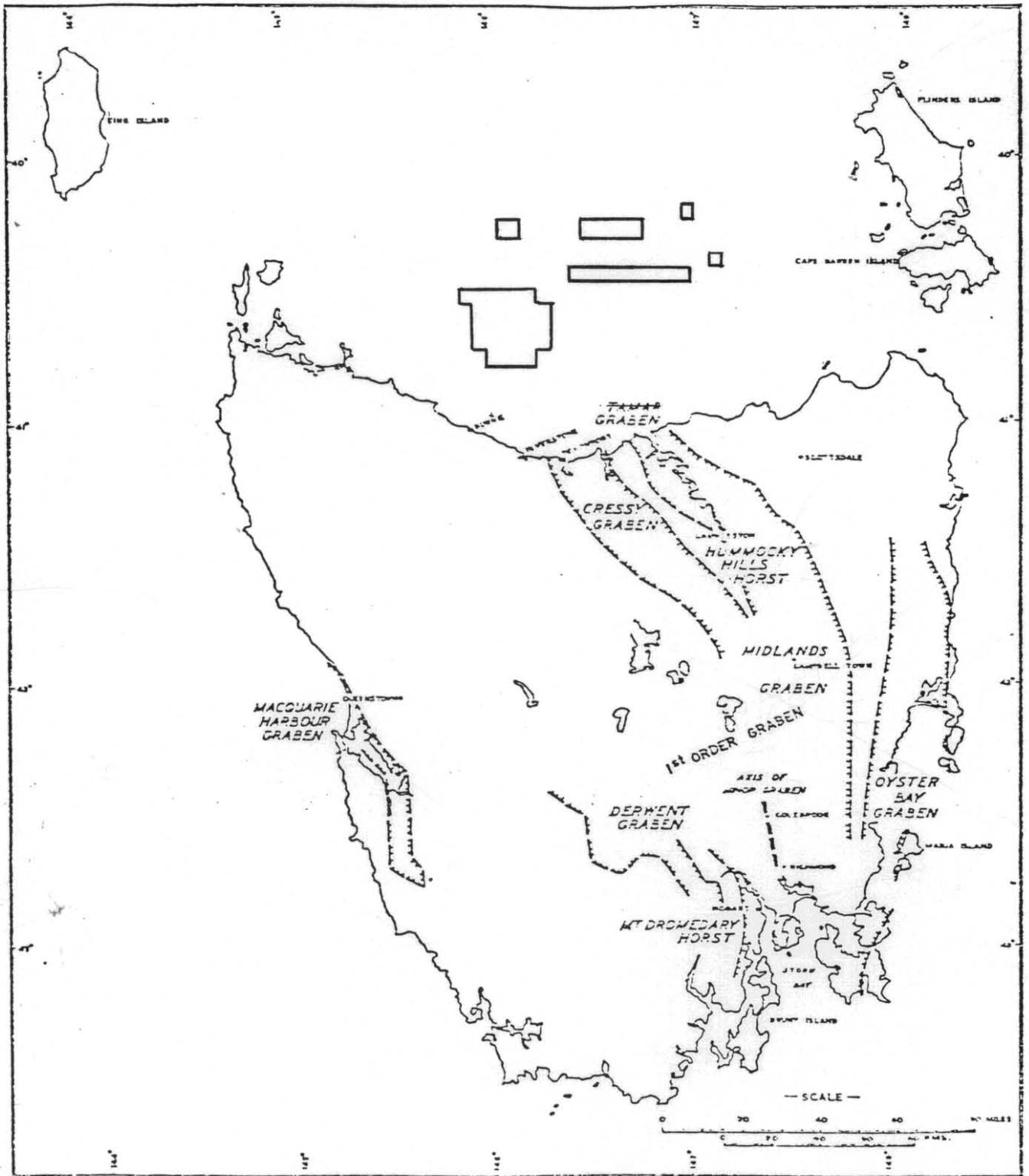
Figure 3

WEAVER OIL AND GAS CORPORATION, AUSTRALIA

5 cm

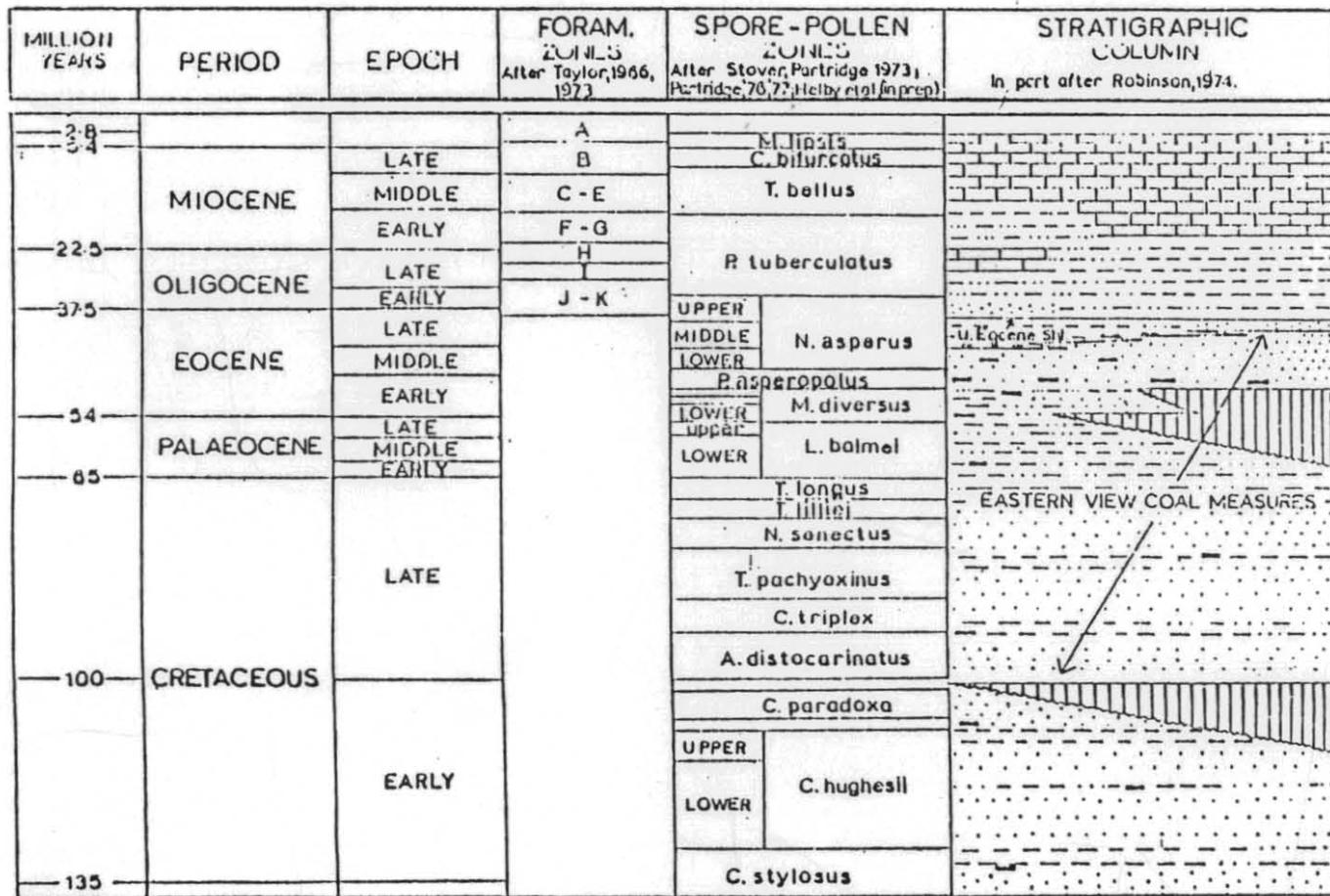
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# GEOLOGY OF TASMANIA



MAJOR TERTIARY STRUCTURES

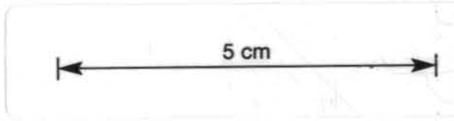
FIGURE 4



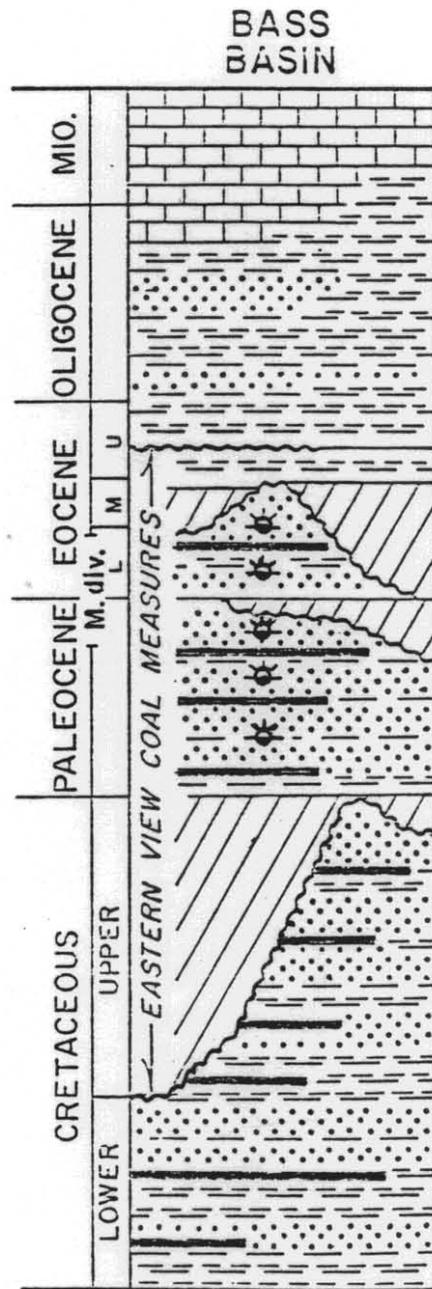
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FIGURE 5

Stratigraphic chart - Bass Basin



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GENERALIZED STRATIGRAPHIC SECTION  
WITH INDICATIONS OF HYDROCARBONS

FIGURE 6

## Weaver's 1981 seismic lines:

WB-81-11 (tie to Pelican # 1 well)  
WB-81-12  
WB-81-13  
WB-81-14  
WB-81-15

## Weaver's 1982 seismic lines

WB-82-13 Ext.  
WB-82-47A  
WB-82-48  
WB-82-49  
WB-82-50  
WB-82-51  
WB-82-52

SEISMIC TIME STRUCTURE MAPS

The final seismic interpretation of the Tasmanian Devil prospect was carried out by Exploration Associates International, Inc. which are consultant to Weaver Oil and Gas Corporation, Australia on the Bass basin project.

Enclosure # 1 is a time structure map constructed at the Oligocene seismic reflector level. The scale is 1:50,000 and the contour interval is .010 seconds. This domal feature has an area of closure of 8500 acres, or approximately 3500 hectares, and a vertical relief of 125 feet, or approximately 38 meters.

Enclosure # 2 is a time structure map constructed at the Top Eastern View Coal Measures seismic reflector level. The scale is 1:50,000 and the contour interval is 0.010 seconds. This tilted fault block has an area of closure of 11,200 acres, or approximately 4530 hectares, and a vertical relief of 200 feet, or approximately 61 meters.

Enclosure # 3 is a time structure map constructed at the Lower Malvacipolis diversus seismic reflector level. The scale is 1:50,000 and the contour interval is .050 seconds. This tilted fault block has an area of closure of 15,500 acres, or approximately 6275 hectares, and a vertical relief of approximately 475 feet or 145 meters.

#### REPRESENTATIVE SEISMIC LINE

The Tasmanian Devil # 1 well will be located on seismic line WB-82-51 at shot point # 700 (Enclosure # 4 and Figure 2). This seismic line was recorded by Weaver Oil and Gas Corporation, Australia and processed in May 1982 as part of its second generation of prospect definition seismic data acquisition. This NE-SW seismic line shows the main bounding fault, the prospective tilted fault block, and the convergence of the Eastern View Coal Measures section on the northeast flank of the tilted fault block. The reflector and map levels are identified.

#### GEOLOGICAL SETTING

In the Bass basin area, the earliest period of sediment accumulation is most likely to date back to the Early Cretaceous period when large thicknesses of coarse clastics, volcanogenic detritus and muds filled major fault bounded troughs and half graben depressions. This first step in the evolution of the basin could be classified as its aborted rift valleys stage characterized by alluvial, fluvial, fluviodeltaic and lacustrine environments of deposition.

Considerably less structural activity took place during the Late Cretaceous period, or second stage of the basin. Slower basin-

wide subsidence prevailed and sediments were derived from the margin areas of the basin as well as from elevated intra-basin areas. These reworked, or second generation sediments, were deposited under alluvial, fluvial and lacustrine conditions. Minor marine incursions may have taken place.

The Bass basin remained a barred basin throughout the Paleocene and Eocene. A time when reworked sand, shale and coal deposition was widespread within what appears to have been a swampy alluvial environment. Regional structural readjustments, in response to an accelerated late Eocene sediment loading, triggered a marine transgression from the northwest. Basal Oligocene coarse clastics were derived from the basin margin areas. These are overlain by widespread mudstones, marl and limestones deposited during the remainder of the Oligocene and Miocene periods. Marine carbonate shelf conditions prevailed thereafter.

Objective reservoir sands interbedded with shales of potential source rock quality have tentatively been identified within the Upper Cretaceous, Paleocene, Eocene and basal Oligocene section.

#### OBJECTIVE SECTION

The objective section of the Tasmanian Devil # 1 well consists of the sand, shale and coal sequence known as the Eastern View Coal Measures of Eocene, Paleocene and Upper Cretaceous age.

The top of this objective section is predicted, on the basis of seismic data, to be at a depth of 2250 feet, or approximately 686 meters, below mean low sea level at the proposed well location.

A similar stratigraphic sequence was tested and found to contain several gas and condensate, or light oil bearing intervals in the Pelican # 1 well to which the Tasmanian Devil prospect is tied seismically through line WB-81-11.

The anticipated stratigraphic section is shown on Figure No. 1.

#### OPENHOLE LOGGING AND FORMATION EVALUATION

The following suite of logs and wireline formation tests program has been specifically designed to evaluate the hydrocarbon potential of the Tasmanian Devil prospect.

The first run of logs will take place before the 13-3/8" surface casing is put in place.

Run # 1 Interval 800' - 2000'  
DIL-LSS-CAL-GR

The second run of logs will take place at total depth.

Run # 2 Interval 2000' - TD (3500')  
DIL-LSS-CAL-GR

Should hydrocarbons be present the second run of logs will be modified to include the following:

LDT-CNT-GR  
DLL-MSFL-CAL

in addition:

Velocity Survey  
HDT  
CST (30 cores) or as required  
RFT (10 pressure tests per chamber)  
as required

#### DRILLING DATA

Mud Logging: Continuous from the 20" conductor casing shoe to total depth.

Cuttings:

Five sets of washed and dried cuttings will be caught every 30 feet from the conductor casing shoe down to a depth of 2000 feet. Sampling intervals may be varied as dictated by rapid drilling rates. Minimum sample size will have a weight of 100 grams. Sampling rate will be reduced to 10 feet over the interval 2000' to total depth.

Conventional Cores:

Below the surface casing shoe, conventional cores will be cut only if significant hydrocarbon indications are encountered.

Sidewall Cores:

Below the surface casing shoe, sidewall cores will be acquired only if significant hydrocarbon indications are encountered.

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1. Anticipate Stratigraphic Section
2. Well Location Map
3. Pelican #1 Synthetic Seismogram
4. Major Tertiary Structures - Tasmania Onshore
5. Stratigraphic Chart - Bass Basin
6. Generalized Stratigraphic Section - Bass Basin  
with indications of hydrocarbons

21416Q

The following enclosures were submitted earlier as part of the well prognosis:

1. Seismic Time Structure Map Oligocene Horizon.
2. Seismic Time Structure Map Eastern View Coal Measures.
3. Seismic Time Structure Map Lower M. diversus Horizon.
4. Seismic Line WB-82-51.

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S E C T I O N   V I

DRILLING PROGRAM

## DRILLING PROGRAM

INTRODUCTION

The Tasmanian Devil #1 Well, located on Permit T/16P, will test the structural and stratigraphic hydrocarbon potential of the Oligocene, Eocene, and possibly older section, of the southwest most area of the Bass Basin.

The objective section of the Tasmanian Devil #1 Well consists of the sand, shale and coal sequence known as the Eastern View Coal Measures of Eocene, Paleocene and Upper Cretaceous age.

The top of this objective section is predicted, on the basis of seismic data, to be at a depth of 2250 feet, or approximately 686 meters, below mean sea level at the proposed well location.

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DEPTH	DRILLING TIME FORECAST	GEOLOGICAL DATA	CASING	BIT AND HYDRAULICS						MUD PROPERTIES				MUD TREATMENT AND REMARKS			
				SIZE	TYPE	W1	RPM	Q	NOZZLE	AV	W1	FUNNEL	W.L.		YP/PV		
0-150	SPUD WITH ONE PUMP (11/19m)	WATER DEPTH - 73m  (MAXIMUM ANGLE 8°)		26"	1-1-1	0-10		0PM	3-20								MIX PREHYDRATED GEL SPUD MUD IN FRESH WATER MIX AS EARLY AS POSSIBLE 100+ FUNNEL VISCOSITY
150-300	20" 8 1/4" WITH 1/4" CONN AND WITH 1 1/2" 8 1/4" TUBG JOINT			26"		10/20	170	1200	8-20	48							SPUD WITH WATER AND BLUE WITH VISCOUS MUD ON CONNECTIONS  RUN LEAK-OFF TEST
300-450				17 1/2"	1-1-1	25/38	170	1200	8-20	105	8.8/81	38	NO CONTROL	18/8			ADD SEAWATER FOR MAKE-UP AND ADD PREHYDRATED GEL TO MAINTAIN YIELD POINT
450-600		(MAXIMUM ANGLE 8°)				30/40	200	1200									FLOCCULATE WITH LIME IF NECESSARY TO MAINTAIN YIELD POINT
600-750	13 5/8" 8 1/4" R BUILT	OLIGOCENE SEISMIC MARKER  POSSIBLE BANDS  Eocene SHALE EASTERN VIEW COAL MEASURES		17 1/2"		30/40	200	1200	8000	105	9.1	38		15/8			ADD WATER AS REQUIRED TO MAINTAIN LOW PV  RUN ONLY GAUGE PROTECTED BITS
750-900	PRIMARY OBJECTIVE SANDS (209m - TD)			12 1/4"	80GH	40	100	780	3000 psi	180	9.1	38	14	20/7			USE PACKED BHA WITH SHOCK SUB
900-1050		(MAXIMUM ANGLE 8°)			80GH OR 8-1-7	70	125	700		135	9.3	38	8	14/8			USE FRESH WATER FOR MAKE-UP DUMP MUD AS REQUIRED TO CONTROL WEIGHT
1050-1200	LDD P/B/A RECOVER ANCHORS	PROBABLY ENCOUNTER NON-BEDIMENTARY ROCKS AT T.D.		12 1/4"		70	100	700		135	9.3	38	8	15/10			MAINTAIN YP WITH CONTINUOUS ADDITIONS OF BENTONITE  ADD DEXTRID FOR WATER LOSS CONTROL AND ASPHALT FOR SHALE STABILITY

TESCO 11-78

2 4 6 10 12 14 16 18 20

DAYS FROM RIG RELEASE ON PREVIOUS WELL

PREPARED BY LINDSEY I. LIPSCOMB

DATE MAY 1, 1984

REV 5/25/84

214165

OFFSHORE DRILLING PROGRAM  
Miscellaneous Data Sheet

214166

Operator: Weaver Oil and Gas Corporation Australia

Well Name: Tasmanian Devil No. 1 Total Depth: 1067 meters

Permit No.: T/16P Water Depth: 73 meters

Graticular Block No.: 0602

Seismic Line: WB 82-51

Location: LAT - 40° 44' 16.034" S LONG - 146° 9' 44.745" E

CASING PROGRAM

<u>Size</u>	<u>Depth</u>	<u>Length</u>	<u>Weight</u>	<u>Grade</u>	<u>Connection</u>	<u>Test Pressure</u>
20"	-	12m	Pile Joint	24"OD x 18"ID	CC	
20"	244m KBE	140m	94	H	JV	500 psi
13 3/8"	610m KBE	518m	54.5	K	Butt	1000 psi

CEMENTING PROGRAM

<u>Casing Size</u>	<u>Cement Class</u>	<u>Excess, %</u>	<u>Yield, M<sup>3</sup>/Sk</u>	<u>Water, CPS</u>	<u>Water Type</u>	<u>Additives %</u>	<u>Top of Cement</u>
20"	G	200	1500	0.033	4.97	Fresh 2% CaCl	SF
13 3/8"							
Lead	G	None	350	0.057	11.3	Fresh None	183m
Tail	G	None	500	0.033	4.97	Fresh 1% CaCl	None

FORMATION EVALUATION

Electric Logging: Run No. 1, 610m to 244m

DIL-LSS-CAL-GR

Run No. 2, TD to 610m

DIL-LSS-CAL-GR

LDT-CNT-GR

DLL-MSFL-CAL

additionally as  
required:

Velocity Survey

HDT

CST (30 cores)

RFT (10 pressure tests per chamber)

Mud Logging: below 20" conductor casing to total depth.

Cuttings: washed and dried samples every 9 meters from 20"  
conductor to 610 meters, and every 3 meters from  
610 meters to total depth.

Conventional Cores: below surface casing, cut only if significant  
hydrocarbon indications are encountered.

Sidewall Cores: below surface casing, acquired only if  
significant hydrocarbon indications are  
encountered.

Production Tests: as required for formation evaluation.

BLOWOUT PREVENTORS:

18 3/4" - 10,000 psi. Test when installed and to 5000 psi after  
running surface casing and weekly thereafter.

LEAK OFF TESTS:

Run a leak-off test after drilling out below the conductor and  
surface casing.

## 2.0 DRILLING PROCEDURES

### 2.1 Positioning the Drilling Vessel

#### 2.1.1 Anchor Pattern

The general mooring pattern will be with the bow facing into the direction of maximum anticipated storm conditions, taking into account the need for the helicopter to land and take off into the prevailing wind and for the work boats to have a comfortable lee side for day-to-day operations. Everything else being equal, the heading should be designed to simplify holding station while running the first moorings.

A detailed mooring pattern should be provided by the barge master or drillship captain showing the preferable pattern for the specific water depth and environmental conditions anticipated.

#### 2.1.2 Surveying and Marking Location

The location will be surveyed using a Decca transponder with three base stations.

At least two days prior to the rig move, set up onshore stations to ensure that all equipment is functional. Install the mobile station on the standby boat.

Establish the location using double triangulation from these shore base stations. Install one location buoy and one buoy at the position to drop the first anchor.

The timing will depend on availability of equipment but complete the survey 24 hours prior to the arrival of the rig at the new location. The survey vessel will standby on the well site to guide the rig as it approaches the location.

### 2.1.3 Mooring Procedures

The Drilling Supervisor will convene all parties for a mooring meeting prior to each move to review the mooring procedures and assign responsibilities for checking availability and condition of equipment.

#### Picking Up Anchors

1. While cutting the 30-inch casing, make preparations for retrieving anchors. Anchor handling crews should be aboard the work boats and the boats in position.
2. As soon as the 30-inch well head has cleared the seafloor, start ballasting up.
3. Whenever bolsters have cleared the water, start retrieving anchors.
4. If the drilling contractor will permit, retain the mud in the tanks while moving. If 8-inch drill collars are being used do not lay them down.
5. While underway, remove the 30-inch housing from the temporary guide base (if applicable) and slip and cut guide wires and tensioner wires.

6. Approach the location 30+ degrees to port or starboard of the prevailing wind (depending on current) and drop either number 6 or 7 at the location indicated by the buoy. This anchor will serve as a brake.
7. After approaching the location, turn the vessel into the prevailing wind.
8. Attach one boat to moorings 2 or 3. Hold the vessel position with this boat while running the other mooring. (Run about 3000 feet of chain).
9. After four anchors are set, take a position fix and start moving the vessel as required by manipulating the mooring lines.
10. While moving the vessel over the location, start ballasting down. Move the temporary guide base into the moonpool and prepare for running.
11. While moving the vessel over the location run the final four moorings.
12. When ballasted down, tension the moorings to 250 kips, take a final fix and run the temporary guide base.
13. Leave the windward anchors off the pawl until surface casing is set.

2.1.4 Testing and Pretension of Moorings

All anchors should be set and tested to 200,000 pounds prior to spudding. All anchors will be tested to 250,000 pounds prior to landing the 18 3/4-inch BOP stack.

## 2.2 Establishing the Well

### 2.2.1 Prior to Arrival on Location

1. Prepare a bentonite, caustic, fresh water spud mud (800 barrels with a 100  $\pm$  second funnel viscosity).
2. Prepare 400 barrels of 11.5 ppg kill mud. (See Sections 8.4 and 8.5, Triton Operations Manual)
3. Inspect all pendant wires for wear and broken strands. Inspect all buoys and pig tails.
4. Slip and cut riser tensioner wires. Finish cutting guide wires.

### 2.2.2 Upon Arrival on Location

1. Measure the length of the 20-inch conductor and pile joint. Dress the running tool and assemble the temporary guide base on the spider deck. Attach the guide lines. Prepare to run.
2. Assemble all tools needed to run the 20-inch casing, pile joint and permanent guide structure.
3. Run the temporary guide base to the ocean floor as soon as ballasted down and a final fix has been taken to ensure the vessel is on location within the accepted tolerance of 300 meters.
4. Note the distance from the rotary table to the sea bed prior to spudding. Record the water depth and air gap measurement on the tour report, noting the date and time of day.

## 2.3 Drilling the 26-inch Hole and Setting 20-inch Casing

### 2.3.1 Drilling the Hole

The 26-inch hole will be drilled with a 26-inch hole pilot bit. Drill to the approximate depth specified on the drilling program but to the precise depth required to run the 20-inch casing and pile joint plus 30 feet of rat hole.

### 2.3.2 Drilling Parameters

2.3.2.1 Weight - a maximum of 5,000 to 10,000 pounds of bit weight should be used to spud the well until the bit and first two drill collars are buried. After drilling 50 feet, the weight can gradually be applied to a maximum of 15,000 to 20,000 pounds. To safeguard against developing hole angle, use the lightest weight reasonable.

2.3.2.2 Rotary Speed - a maximum rotary speed of 50 RPM should be used to spud the well and until the bit and two drill collars are buried, then gradually increase the rotary not to exceed 150 RPM. Note: Release the torque in the string gradually prior to making connections to avoid a possible string back-off.

2.3.2.3 Pump Speed - the first 30 feet of hole should be made with pumps at approximately half speed. Thereafter, the maximum volume from both pumps will be necessary to clean the hole.

### 2.3.3 Hole Cleaning

The hole will be drilled using sea water. Prior to making connections, the hole should be slugged with 10 to 15 bbls. of spud mud (funnel viscosity of the mud should be at least 100 seconds). Should it become difficult to keep the hole open, increase the size of the gel slug prior to making connections.

### 2.3.4 Directional Survey

After reaching total depth, the hole will be displaced with mud and a Totco survey run on wire line prior to pulling out. A maximum of two degrees deviation is allowed.

### 2.3.5 Wiper Trip

A wiper trip should be made to check for bridges and fill. If no fill or drag is experienced, again displace the hole with mud and pull out of hole.

If drag and/or fill-up is experienced, make a second wiper trip and displace the hole with mud again. Repeat until drag and fill are eliminated. In some cases a heavier mud may need to be spotted to keep hole open.

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2.3.6 Running 20-inch Casing, Pile Joint

1. The permanent guide structure should already be on the spider. A string of 20-inch OD, 94 lb/ft casing with Cameron JV Connectors will be run. The top joint of 20-inch casing will have a Cameron CC connector.
2. All connections on the bottom two casing joints will be thread locked to prevent back-off when drilling out.
3. Paint a white strip on the shoe joint approximately 3 feet above the shoe to aid in identifying the location of the shoe on TV while stabbing into the temporary guide base.
4. Fill the casing with water as run. Ascertain that circulation is possible through the float shoe.
5. Have a 20-inch swedge available on the rig floor while running 20-inch casing.
6. Torque the casing properly. Do not weld casing.
7. Run centralizers as follows: One centralizer 10 feet above the float shoe, on each of the bottom three joints. Stab the 20-inch casing into the temporary guide base using ropes or 1/4-inch wire and shackles. Observe the stab with television.
8. Install the 18 3/8-inch housing in the casing string. Run one joint drill pipe as a stinger inside the 20-inch casing. Land the 18 3/8-inch housing and pile joint in the permanent guide base. Pick up the assembly and remove the spider beams.

9. Lower the casing on drill pipe. Land in the temporary guide base. Observe the landing with television.
10. Do not use wiper plugs for cementing.

#### 2.3.7 Cementing 20-inch Casing

1. Break circulation slowly with water. As soon as proper circulation is established start mixing cement.
2. Mix sufficient cement slurry to fill twice the theoretical annular capacity. Observe returns with TV. Pumping five sacks of Mica ahead of the cement will improve the likelihood of recognizing cement returns.
3. Displace cement to within 30 feet of the shoe with Halliburton measuring displacement and release the pressure to check the float.
4. If the float holds, release the running tool, retrieve the running string. If float does not hold, wait on cement until cement will not backflow.

#### 2.3.8 Blow Out Control

Refer to section 8.4 of the Triton Operations Manual for the contingency procedure for kick control in the conductor hole.

## 2.3.9. Checklist for Materials and Equipment 26-Inch Hole

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>LOCATION</u>
1	Temporary Guide Base, Cameron P/N 698514-1 with 6-foot radius and "J" running slots	1	Rig
		1	Base (Standby)
2	Permanent Guide Base, Cameron P/N 676389-2 with ring for attaching to Conductor Housing	1	Rig
		1	Base (Standby)
3	"O" Ring for 20-inch Cameron CC Connector	1	Rig
4	Retainer Lock Ring for 20-inch Cameron CC Connector	1	Rig
5	Tool, Mechanical Release for 20-inch Cameron CC Connector	2	Rig
6	Running Tool for Temporary Guide Base, J-Type	1	Rig
7	Housing, Casing Head, 18 3/4-inch, 10,000 psi w/AX Hub top, w/adaptor, external, to land in Permanent Guide Base and welded to 30 foot piece of 24" OD x 18" ID 4130 steel pile joint w/CC Connector, box down, Cameron P/N 695586-1-1	1	Rig
8	Wear Bushing, 18 3/4-inch Housing with 17 5/8-inch ID, Cameron P/N 690148-1	1	Rig
9	Casing, 20-inch OD Float Shoe Joint, Grade X-52, w/welded float shoe w/JV Connector	2	Rig
10	Casing, 20-inch OD, grade X-52, 94 lb/ft. w/JV Connector	5 extra joints	Rig
11	Casing, 20" OD, grade X-52, 94 lb/ft w/JV Connector pin by CC Connector pin	2	Rig
12	Centralizer, 20-inch Halliburton	4	Rig
13	Stop Ring, 20-inch Halliburton	1	Rig

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## 2.3.9. Checklist for Materials and Equipment 26-Inch Hole

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>LOCATION</u>
14	Housing Running Tool, 18 3/4-inch, w/4 1/2-inch IF box top and bottom, Cameron P/N 689956	2	Rig
15	"O" Ring for 18 3/4-inch Housing Running Tool, Cameron P/N 40314-15-13-85	1	Rig
16	Hole Opener, 26-inch Security Type B-26	2	Rig
17	Hole Opener Cutter, spare sets, Type S	1 set	Rig
18	Bit, 17 1/2-inch, X3A (or equivalent), w/5/8-inch nozzles	2	Rig
19	Bit, 26-inch, X3A (or equivalent), w/5/8-inch nozzles	1	Rig
20	AX Gasket for 18 3/4-inch, 10,000 psi WP Connector	2	Rig

2.4 Drilling the 17 1/2-inch Hole and Running 13 3/8-Inch Casing

2.4.1 Installing the 18 3/4-inch BOP Stack and 21-inch riser.

2.4.1.1 Pressure Testing the BOP Stack on the Test Stump.

1. Prior to testing the stack on the stump, open all rams and check sealing elements for wear or damage. Flush the connector and ram cavities with a high pressure stream of water. Visually inspect the annular sealing element and replace bonnet seals.
2. Function test BOP's. Note gallons to function and closing time.
3. Test BOP's to at least 5000 psi. Complete the BOP test and inspection affidavits and send to shore for filing.

2.4.1.2 Running the Stack and Riser.

The pressure and function check will be completed outside the critical path. Other preparations for running the BOP will proceed simultaneously in order to have the stack ready to run as soon as possible after cementing 20-inch casing.

1. Position the BOP stack on the spider beams. Insert the guide lines in the posts of the BOP stack.
2. Install and lock the lower marine riser package onto the 18 3/4-inch BOP stack.

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3. Install a new AX gasket in the wellhead connector. Clean and grease with proper lubricant.
4. Insert the guide lines in the marine riser guide frame.
5. Place the marine riser handling spider on the rotary table.
6. Pick up a joint of 21-inch marine riser using the marine riser handling sub. Lower the marine riser joint through the marine riser handling spider and make up to top of the ball joint.
7. Pick up the BOP stack, remove the spider beams and lower the marine riser joint until it can be landed on the marine riser handling spider. Continue to run the marine riser spacing out as necessary. Test the choke line as run. (Every third joint to 1000 psi.)
8. Pick up the telescopic joint (locked in the closed position) and attach to the riser assembly.
9. Lower the slip joint through the rotary table and land in the marine riser handling spider. A special landing ring is provided on the slip joint below the packing box for this purpose. Remove the pins that lock the slip joint in the closed position.

10. Stroke out the slip joint inner barrel and pick up the entire assembly. Remove the marine riser handling spider and lower the slip joint through the rotary table until the riser tensioning cables can be installed to the riser tensioning ring on the outer barrel of the slip joint. Adjust the tension on the cables to support approximately 125 percent of the weight of the marine riser.
11. Install the air operating line to the slip joint packing gland; 5 to 10 psi is normally sufficient pressure to maintain an effective seal against the hydrostatic head of the drilling fluid. Install the choke line to the terminal fitting on the slip joint. Install the diverter package.
12. Tension the guide wires for landing the BOP stack.
13. Lower the marine riser and the BOP stack until the wellhead connector of the BOP stack is landed on the wellhead housing. Observe the landing with television.

Note: The Cameron collet connector should be open when the connector is on the rig floor and the control valve maintained in the "open" position until it is landed on the wellhead housing. Lock the BOP stack on the wellhead housing with 1500 psi. A pick-up test of 50,000 pounds above the stack weight should be performed to ensure the connector is latched.

14. Land and lock the diverter housing.
15. Reduce the tension in the guide wires to 5000 lbs.

16. Test the wellhead connector and casing against the blind/shear rams to 500 psi for 15 minutes. It will not be necessary to run a test plug.
17. Prior to drilling out cement, close the diverter bag on drill pipe and test the system to 50 psi.

#### 2.4.2 Drilling the Hole

A 17 1/2-inch hole will be drilled to the setting depth of the 13 3/8-inch casing. A minimum of 40 feet of rat hole should be drilled below the proposed shoe depth.

#### 2.4.3 Leak-Off Test

After drilling out cement and cleaning to bottom, drill 10 feet of new formation. Circulate and condition the mud and perform a leak-off test.

#### 2.4.4 Drilling Parameters

1. Weight - drill the float shoe with a maximum of 10,000 to 15,000 pounds. Restrict the drill-out torque to the make-up torque applied to the casing when running. Gradually increase the weight on the bit but keep the neutral point below the casing until the last stabilizer has cleared the shoe. As a rule, the hevi-wate drill pipe will be run in tension.
2. Rotary Speed - when drilling 17 1/2-inch hole, a maximum of 75 RPM rotary speed should be used until bit and stabilizers have cleared the float shoe and gradually increase to optimum speed (200 ± RPM) according to the formation encountered.

3. Pump Speed - when drilling the 17 1/2-inch hole, annular velocities should be maximized.

#### 2.4.5 Mud Properties

While drilling the 17 1/2-inch hole, a flocculated mud mixed by adding prehydrated gel to sea water will be used. A funnel viscosity 35 to 40 will be used to drill out and sea water additions will be made as needed. No water loss control will be maintained unless there are prospective hydrocarbon intervals in this section of the hole. All solids removal equipment should be in operation whenever circulating to effectively control solids build-up. Maintain 60 to 80 mesh screens on the shale shakers.

Reduce the PV by adding water and maintain the YP by continuous addition of prehydrated bentonite.

Prior to logging, the funnel viscosity should be increased to approximately 50-60 seconds by the addition of prehydrated gel.

#### 2.4.6 Wiper Trips

After drilling the 17 1/2-inch hole, make a wiper trip to the 20-inch casing shoe. Circulate the hole clean then pull out to log. Should the logs fail to go to bottom, raise the viscosity and yield point of the mud and make a second wiper trip. If the logs still fail to go to bottom, make a trip into the hole. Do not circulate. Pull out of hole without rotating the drill string.

#### 2.4.7 Deviation Control

While drilling the 17 1/2-inch hole, Totco surveys will be taken at 500 foot intervals below the 20-inch casing.

#### 2.4.8 Contingency for Kick Control while drilling the Surface Hole

A kick which occurs while drilling the surface hole will be handled as any other kick, but the definite possibility of a kick breaching to the surface around the conductor casing demands added precautions.

#### 2.4.9 Running 13 3/8-inch Casing

1. Prior to the start of running casing:
  - a. Calculate the space-out for the running strings.
  - b. Remove the casing protectors, clean and dry all threads.
  - c. Drift the casing, hanger and pup joint.
  - d. Make up the casing hanger, pup joint and the sub sea cementing plugs into a joint of casing.  
Stand in the derrick.
  - e. Have the cementer on board.
  - f. Mix gel and other additives in fresh water.
  - g. Retrieve the nominal wear bushing.

2. The float shoe, float collar, and all casing collars (on both mill side and field side) on the bottom two joints will be thread locked.
3. As soon as float equipment is picked up, check the floats for circulation.
4. Install centralizers per the drilling program.
5. Fill the casing as run. Calculate the running speed to avoid excessive surge pressures.
6. After installing the hanger, the 13 3/8-inch casing will be run on drill pipe. Drift the HWDP to insure adequate clearance for the ball and dart.

#### 2.4.10 Cementing the 13 3/8-inch casing

1. When the casing is landed and cement lines connected, break circulation slowly. If any hydrocarbon sands were encountered in the surface hole, circulate bottoms up prior to cementing.
2. While circulating, keep the annular velocity the same as used when drilling.
3. Mix cement, pump the dart and shear the wiper plug. Displace with rig pump or cementing pump.
4. Bring the cement 200 feet into the conductor casing. If a caliper log is not available, cement with the theoretical volume required.

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5. Bump the plug with 2000 psi. Do not overdisplace the casing. Check the float. Do not test the casing at this time.
6. Observe returns while cementing. At completion of the cement job, back out the running tool and wash out the wellhead and BOP's thoroughly to remove any cement that might have accumulated in the wellhead, BOP's or riser.
7. If the float holds, back out the running tool and pull the running string.
8. Run the casing pack-off and test to 5000 psi.

## 2.4.11 Checklist for Materials and Equipment 17 1/2-Inch Hole

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>LOCATION</u>
1	Casing, 13 3/8-inch, K-55, 54.5 lb/ft, buttress, R-3 (two joints with loose couplings)	(8 extra)	Rig
2	Float Shoe, 13 3/8-inch buttress	2	Rig
3	Float Collar, 13 3/8-inch buttress box x pin	2	Rig
4	Casing Hanger, flow thru, 18 3/4-inch x 13 3/8-inch, Torque Set with 6-foot buttress pup joint, Cameron P/N 689410	2	Rig
5	Seal Assembly, 18 3/4-inch x 13 3/8-inch, Cameron P/N	2	Rig
6	Casing Hanger Running Tool, 18 3/4-inch x 13 3/8-inch, Cameron P/N 689432-1	2	Rig
7	Wear Bushing for 18 3/4-inch x 13 3/8-inch Housing, Cameron P/N 689701	1	Rig
8	Running and Testing Tool for 18 3/4-inch x 13 3/8-inch Torque Set Seal Assembly, Cameron P/N 689445-5	1	Rig
9	Testing Tool for 18 3/4-inch x 13 3/8-inch x 9 5/8-inch to test BQP, Cameron P/N 689460 c/w spare "O" Ring P/N 40314-14-13-85	1	Rig
10	Centralizer, 13 3/8-inch	10	Rig
11	Stop Collar, 13 3/8-inch	1	Rig

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>LOCATION</u>
12	Sub Sea Cementing Tools, Howco		
	Sub Sea Mandrel, 4-inch NU pin up	2	Rig
	Bottom Plug	2	Rig
	Top Plug	2	Rig
	Ball and Dart Launching		
	Manifold, 4 1/2-inch I.F.	1	Rig
	Ball	2	Rig
	Dart	2	Rig
13	Thread Protectors, 13 3/8-inch Klampon	5	Rig
14	Casing Drift, 12.250-inch O.D.	1	Rig
15	Circulating Sub, 13 3/8-inch buttress pin x 4 1/2-inch I.F. box	1	Rig
16	Thread Lock Compound, equivalent to Bakerlok Product 199-50	3 cans	Rig
17	Thread Lubricant, API Modified (no teflon)	4 pails	Rig
18	Emergency Slip and Seal Assembly w/running tools	1	Base
19	Stabilizer, 17 1/2-inch, four blade, 9 1/2-inch body w/7 5/8-inch API regular box and pin	2	Rig
20	Packer, Halliburton RTTS, for 13 3/8-inch, 54.5 lb/ft casing, adapted to 4 1/2-inch I.F.	1	Howco
21	Bit, 17 1/2-inch, X3A (or equivalent)	2	Rig
22	Marine Casing Cutter, 11 3/4- inch O.D., A-2 Hydraulic C-13 w/2 sets C13-8-19 knives	1	Base

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<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>LOCATION</u>
23	Marine Swivel, A-Z Assembly MSA-10, 12-inch O.D. w/6 5/8- inch API regular box and pin, c/w MSA-10-16 ring to land on 13 5/8-inch Wellhead, Cameron P/N 693880-01	1	Base
24	Cutter Space Out Assembly, A-Z, 6 1/4-inch DX 10-inches long	1	Base
25	Cutter Stabilizer, A-Z, w/ FWS-20 and FWS-5 blades	1	Base
26	Hole Opener, 17 1/2-inch, Security or equivalent, 6 5/8-inch API Reg. box by box	1	Rig
27	Hole Opener Cutters	1 set	Rig
28	Single Joint Elevators, 13 3/8-inch	1	Rig

2.5 Drilling the 12 1/4-Inch Hole and Running 9 5/8-Inch Casing

2.5.1 Testing the 18 3/4-inch BOP's and Casing

1. Test the BOP stack and choke manifold to 5000 psi, and the Hydril to 3500 psi prior to drilling out. The Drilling Supervisor will complete the test affidavit.
2. Test the casing prior to drilling out to 2000 psi.
3. Set the ball joint pressure.
4. Pump through the choke and kill line at 45 and 90 SPM to measure the circulating pressure loss. Record along with mud weight.
5. Perform a hang off drill on the upper pipe rams and post the space out information near the driller.

2.5.2 Drilling Out

1. Run the 12 1/4-inch wear bushing.
2. Check the cement samples prior to drilling out.
3. Restrict the torque when drilling out to the make-up torque applied to the casing while running.
4. When drilling out with stablizers in the drill string keep the neutral point in the open hole.

2.5.3 After drilling out cement and drilling 10 feet of new hole, perform a leakoff test.

#### 2.5.4 Drilling Parameters

Drill the float collar and shoe with a maximum of 10,000 to 15,000 pounds and 75 RPM. Gradually increase the weight on the bit and the rotary speed to comply with the drilling program but maintain the neutral point below the casing until the last stabilizer has cleared the shoe.

#### 2.5.5 Hydraulics

Maintain the annular velocity specified in the drilling program. However, the nozzle sizes specified in the program are approximate and should be adjusted in the field as necessary.

#### 2.5.6 Mud Properties

Follow the mud properties specified in the drilling program. In general, run a flocculated prehydrated gel system until viscosity or water loss control is required, at which time chemical treatment should be initiated. Use the minimum chemical thinner required to control gel strength and reduce the water loss with bentonite and lignite. Prehydrate all bentonite in fresh water.

#### 2.5.7 Well Control

1. Abnormal pressure indicators will be monitored below surface casing.
2. Conduct well control drills routinely.

3. Test the blowout preventors weekly.
4. Function test BOP's on round trips.

#### 2.5.8 Formation Evaluation

The formation evaluation program is detailed in the drilling program.

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S E C T I O N   V I I

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## REFERENCES

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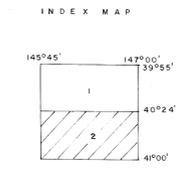
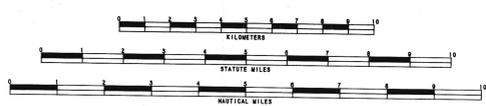
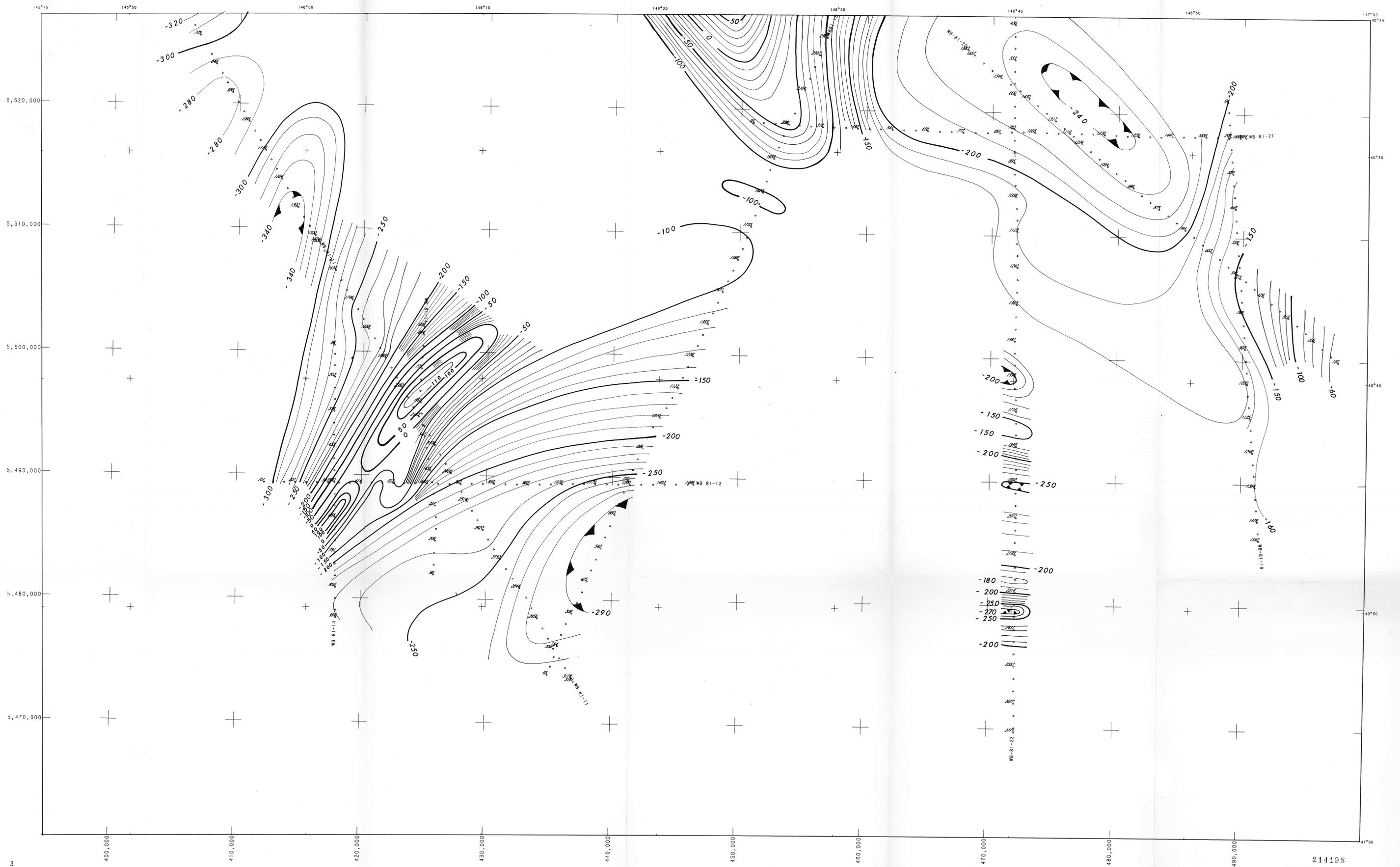
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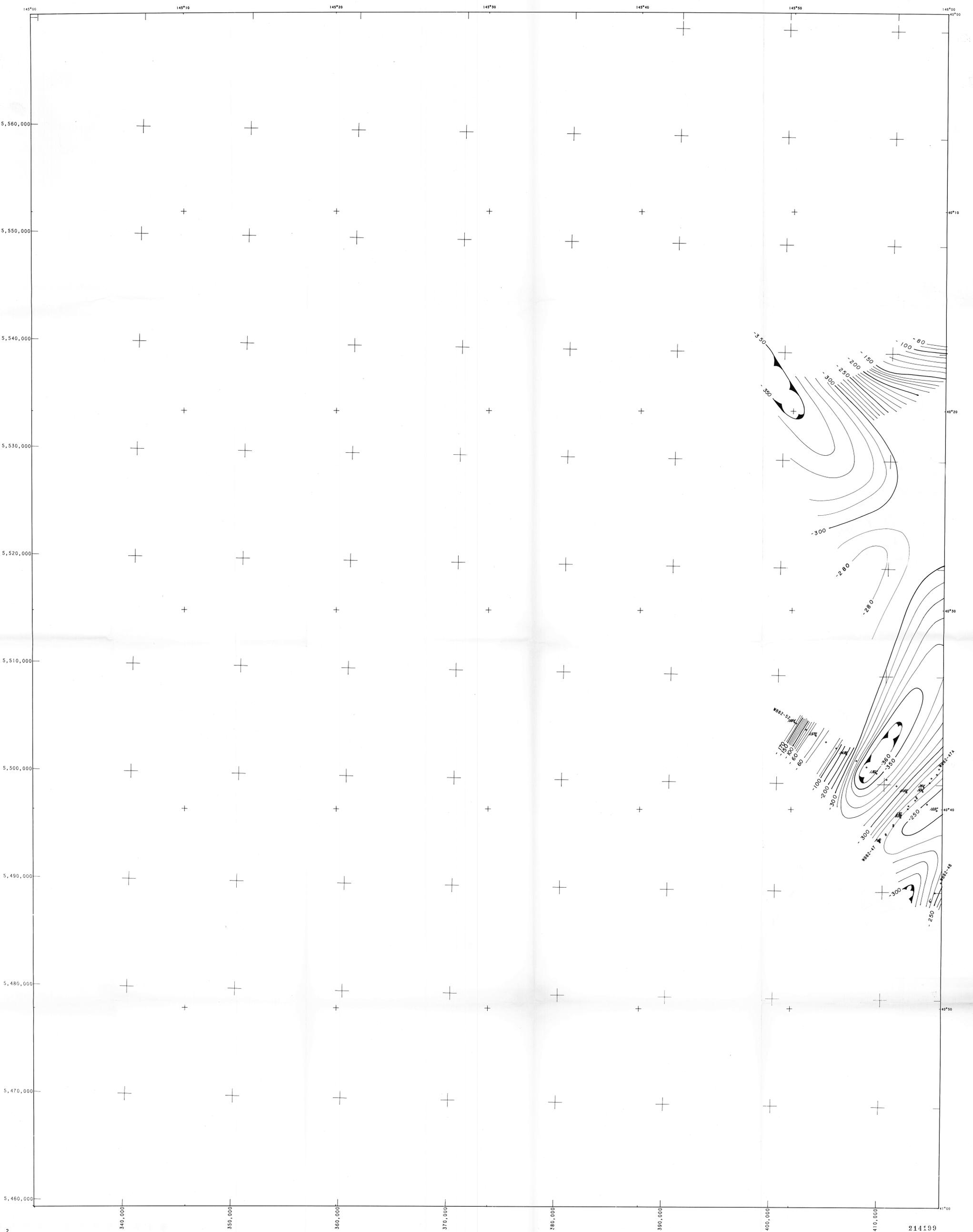
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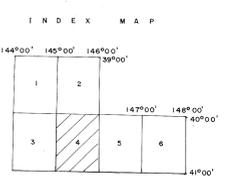
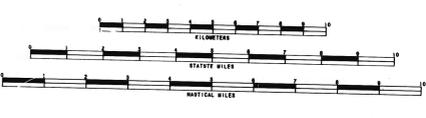
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DATE	BY	WESTERN GEOPHYSICAL COMPANY OF AMERICA	
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		PROJECTION: MERCATOR	STONEY HEAD SURVEY
		SPHEROID: AUSTRALIAN NAT.	T-15-P
		SCALE AT LATITUDE 147° 00'	MAP NO.: 2
		DATE: AUGUST 1981	TOTAL MAGNETIC ANOMALY MAP
			C. I. = 10 GAMMAS

214198  
5 cm

T/Map Part CR-200

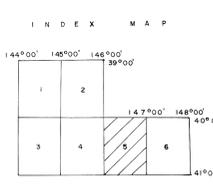
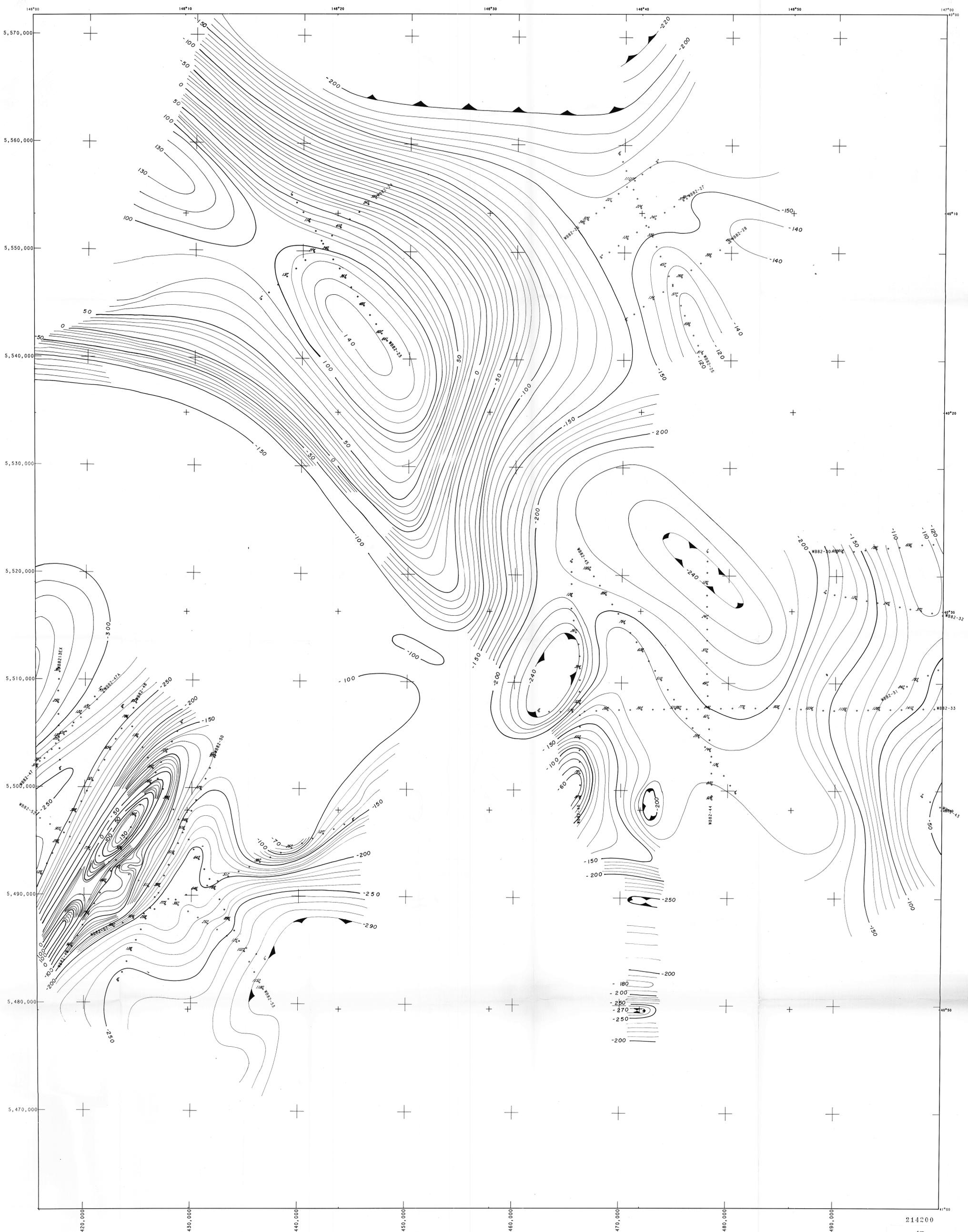


2  
 340,000 350,000 360,000 370,000 380,000 390,000 400,000 410,000  
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 144°00' 145°00' 146°00'

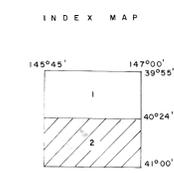
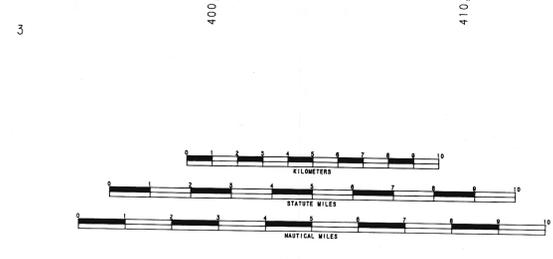
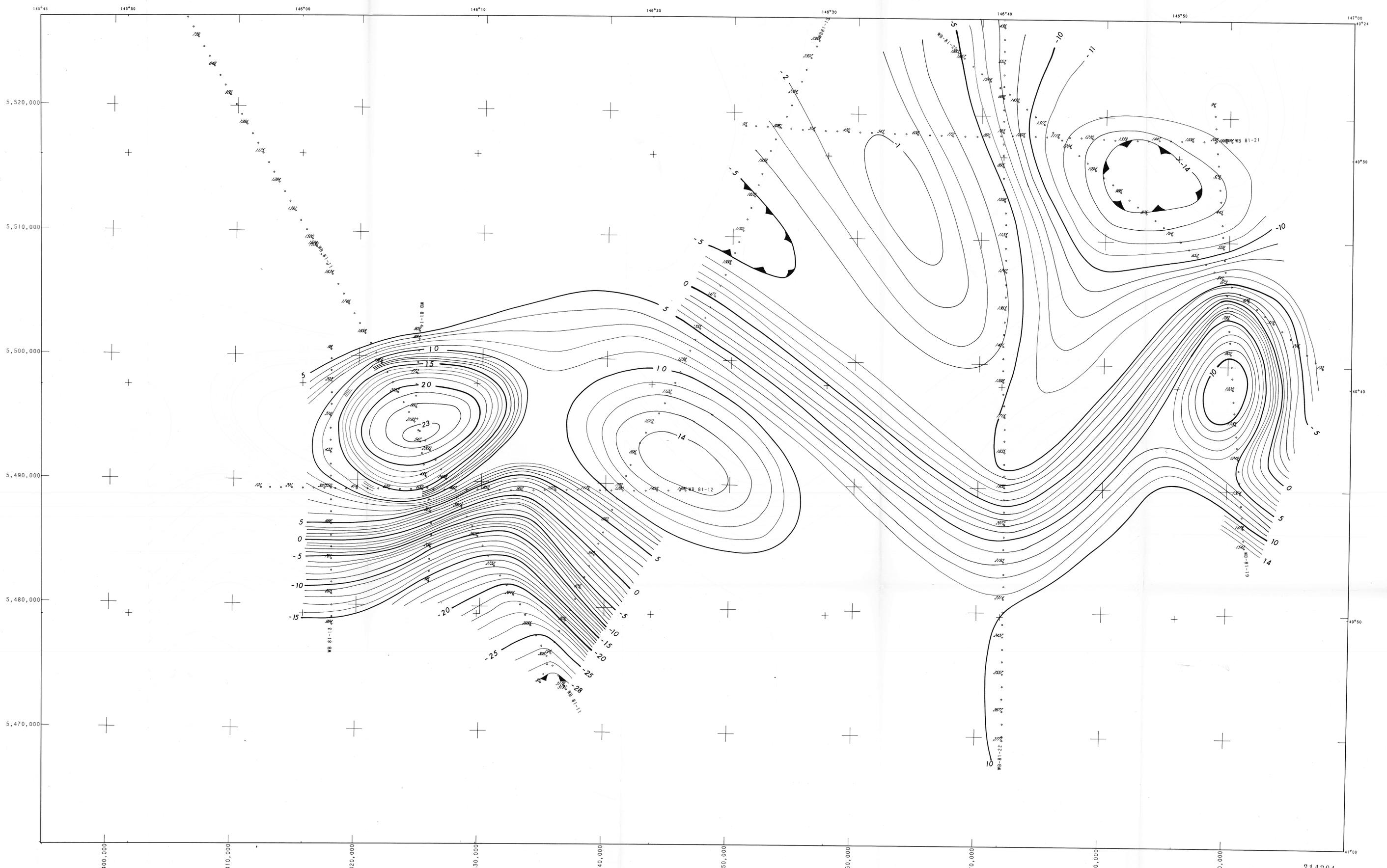


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CLIENT: <b>WEAVER OIL</b>	
PROJECT: <b>BASS BASIN</b>	
SCALE: 1 : 100,000	PROJECTION: U.T.M.
SOURCE: AUSTRALIAN NAT. GEOSURV. 147-00	MAP NO.: 4
DATE: MAY 1982	TOTAL MAGNETIC ANOMALY MAP C.I. = 10 GAMMAS

Sheet Part 5  
 OR-200



AERO SERVICE DIVISION WESTERN GEOPHYSICAL COMPANY OF AMERICA	
CLIENT:	<b>WEAVER OIL BASS BASIN</b>
SCALE: 1 : 100,000	PROJECTION: AUSTRALIAN NAT. SPHEROID: AUSTRALIAN NAT. CENTRAL MERIDIAN: 147° 00'
MAP NO.: 5	TOTAL MAGNETIC ANOMALY MAP C.I. = 10 GAMMA S
DATE: MAY 1982	

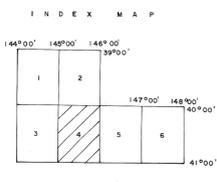
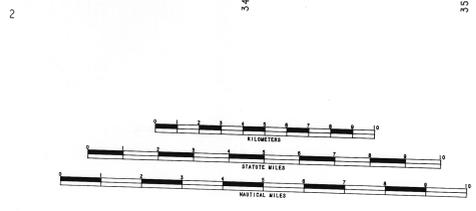
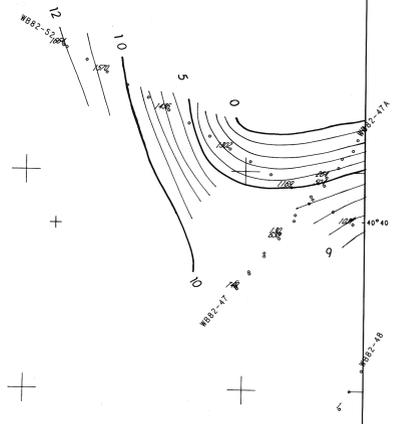
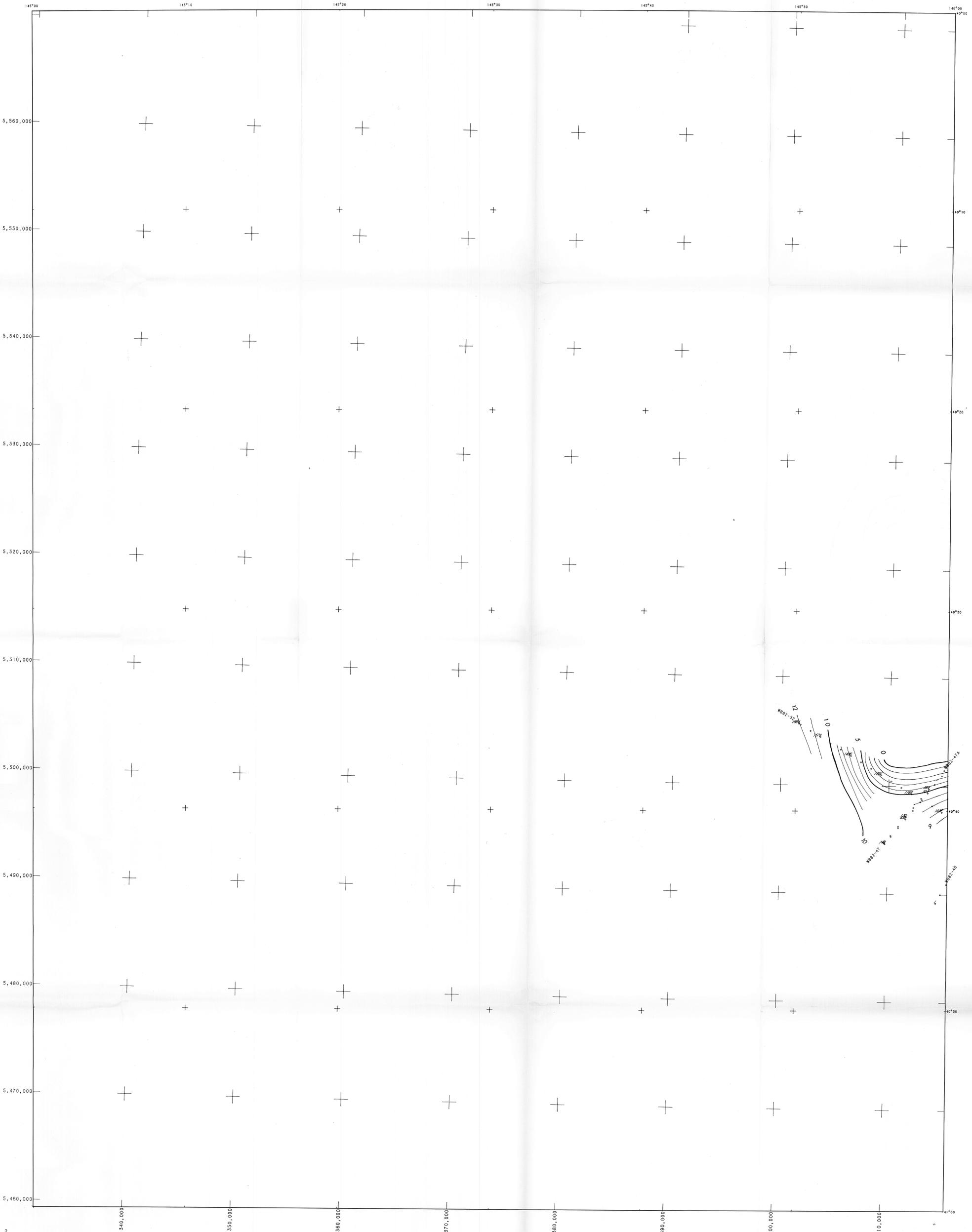


REVISIONS		AERO SERVICE DIVISION	
DATE	BY	WESTERN GEOPHYSICAL COMPANY OF AMERICA	
		CLIENT:	<b>WEAVER OIL</b>
		SCALE: 1 : 100,000	AREA: BASS BASIN
		PROJECTION: MERCATOR	STONEY HEAD SURVEY
		SPHEROID: AUSTRALIAN NAT.	T-16-P
		SCALE AT 147° 00'	MAP NO.: 2
		DATE: AUGUST 1981	BOUGUER GRAVITY
			C.I.=1 MGAL-DENSITY=2.2

214201

5 cm

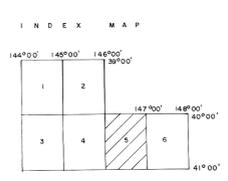
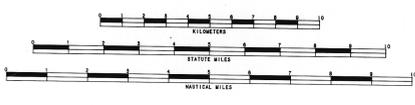
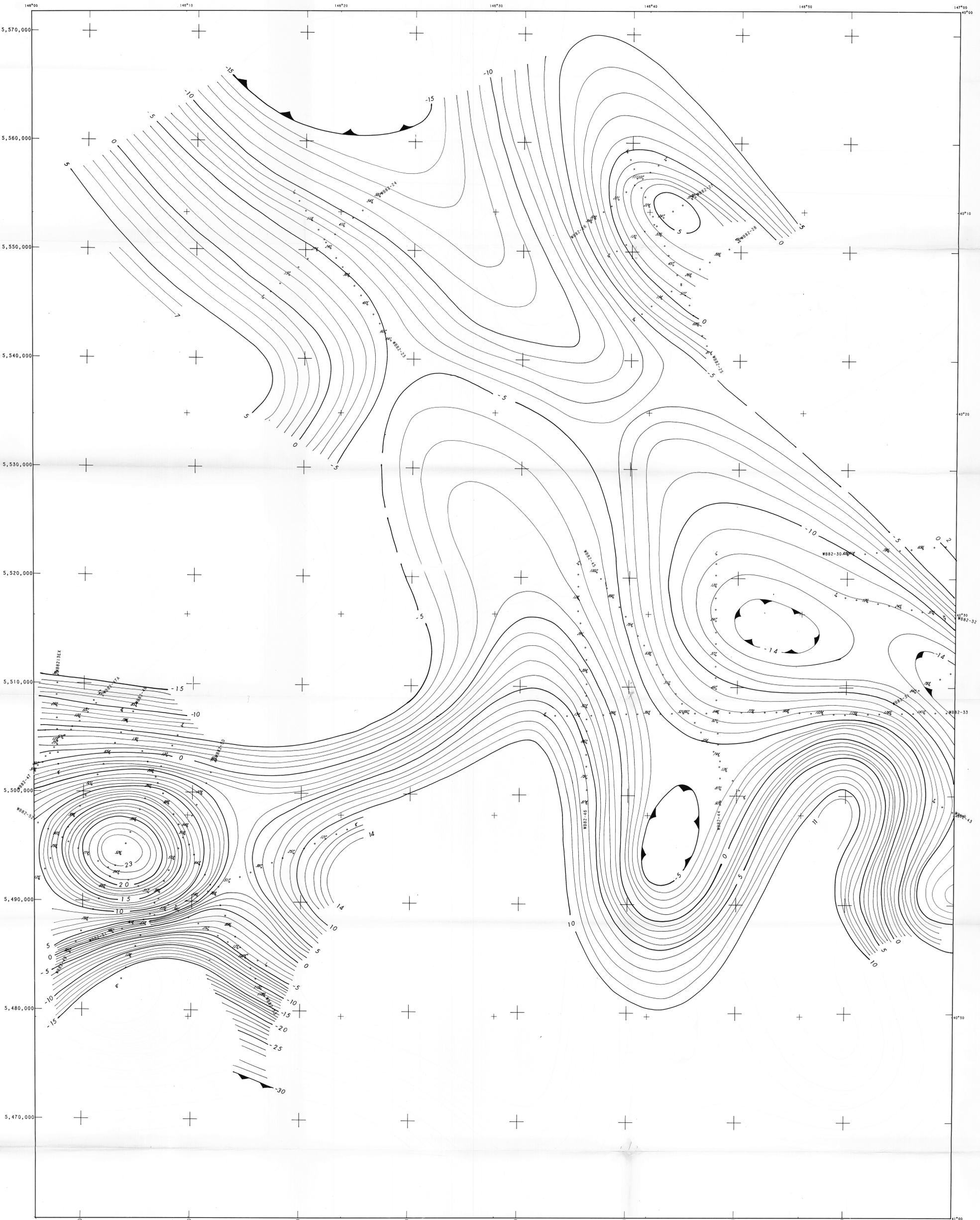
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AERO SERVICE DIVISION		WESTERN GEOPHYSICAL COMPANY OF AMERICA	
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SCALE: 1 : 100,000		AREA: BASS BASIN	
PROJECTION: U.T.M.		CENTRAL MERIDIAN: AUSTRALIAN NAT.	
CENTRAL MERIDIAN: 147° 00'		MAP NO. 4	
DATE: MAY 1982		BOUGUER GRAVITY	
		C.I. = 1.0 MGAL	
		DENSITY = 2.20	

7/60 P-25

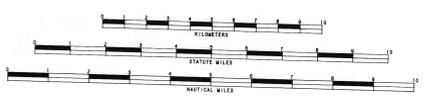
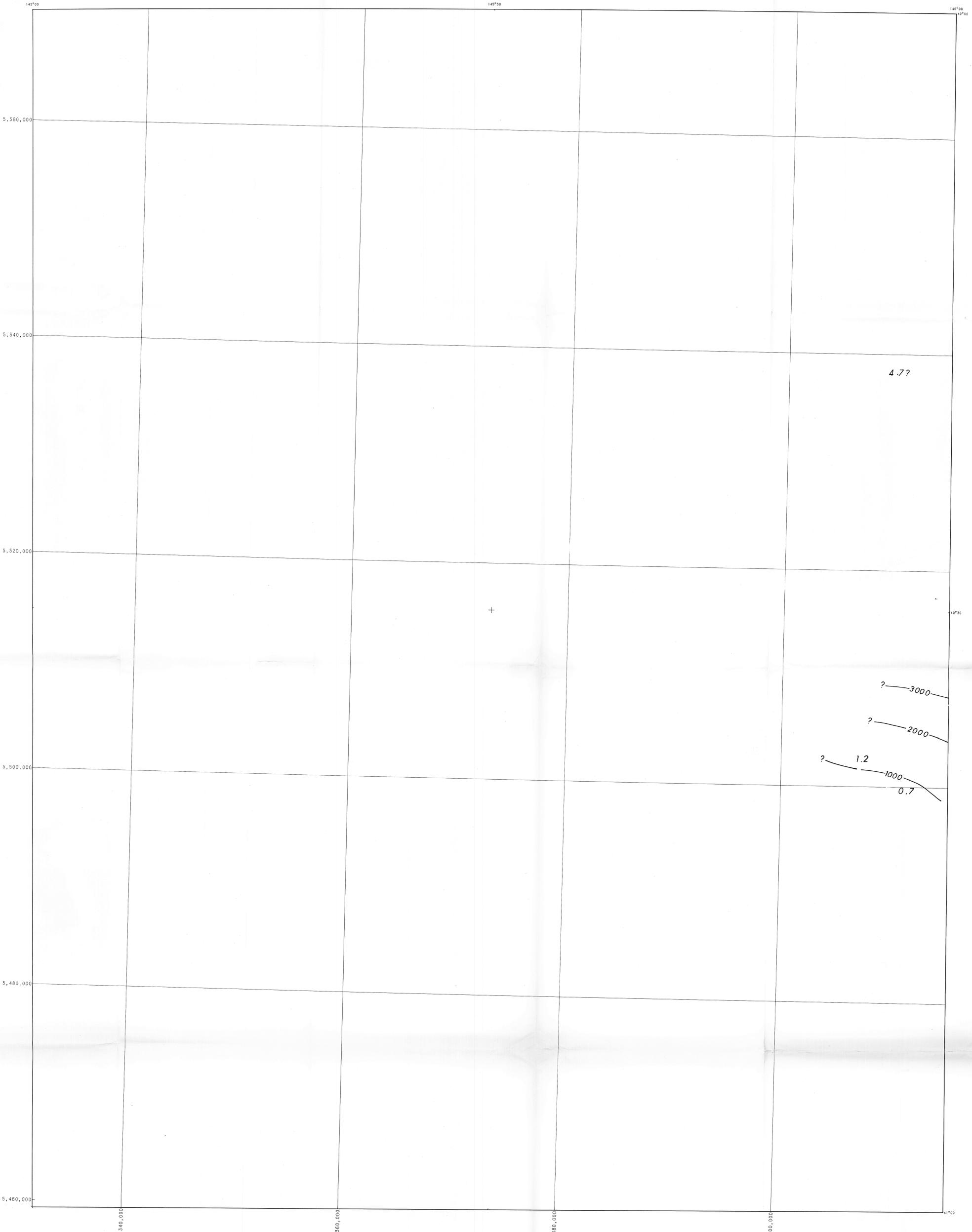
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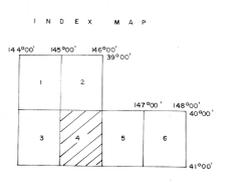
AERO SERVICE DIVISION		WESTERN GEOPHYSICAL COMPANY OF AMERICA	
CLIENT: <b>WEAVER OIL</b>			
PROJECT: <b>BASS BASIN</b>			
SCALE: 1 = 100,000	PROJECTION: S.T.M.	SPHEROID: AUSTRALIAN NAT.	ORIGIN: 147° 00'
DATE: MAY 1982	MAP NO.: 5	BOUGUER GRAVITY C.I. = 10 MGAL DENSITY = 2.20	

T/160 2415





- LEGEND**
- 2.07, 2.0, 2.0 ..... GRADED DEPTH VALUES IN THOUSANDS OF METERS TO INTERPRETED MAGNETIC BASEMENT.
  - [1.2], [2.5] ..... DEPTH VALUES IN PARENTHESES ARE SOURCES OCCURRING ABOVE INTERPRETED BASEMENT VALUES IN BRACKETS OCCUR BELOW INTERPRETED BASEMENT.
  - N-1 ..... POSSIBLE NORMAL FAULT.
  - ~ ..... MAGNETIC OR GRAVITY FAULT. SENSE OF DISPLACEMENT UNCERTAIN.
  - ~ ..... MAGNETIC OR GRAVITY LINEAMENT.
  - ..... DOCUMENTED DRILLING SITE
  - TTT ..... DENOTES POSSIBLE EXTENT OF VOLCANICS
  - ▭ ..... INTRUSIVE BODY



AERO SERVICE DIVISION		WESTERN GEOPHYSICAL COMPANY OF AMERICA	
CLIENT: <b>WEAVER OIL</b>			
AREA: <b>BASS BASIN</b>			
SCALE: 1 : 100,000	PROJECTION: U.T.M.	MAP NO.: <b>4</b>	DEPTH TO MAGNETIC BASEMENT
CORNER: AUSTRALIAN NAT.	GRID: <b>147° 00'</b>	DATE: AUGUST 1982	

214205

*7/16/82*

