

217001

CROCODILE ROCK

BASS STRAIT

TASMANIA

MARINE SEISMIC SURVEY

1981

OR - 203

217002

FINAL REPORT

CROCODILE ROCK

MARINE SEISMIC SURVEY

1981

TASMANIA

PERMIT T-19/P

for

PERTSHIRE PETROLEUM, LTD.  
16TH FLOOR, 109 ST. GEORGE'S TERRACE  
PERTH, (W.A.) AUSTRALIA 6000

by

WESTERN GEOPHYSICAL COMPANY OF AMERICA  
10001 RICHMOND AVENUE  
HOUSTON, TEXAS  
PARTY 86 M/V WESTERN ODYSSEY

Submitted by  
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ABSTRACT

The Crocodile Rock Seismic Survey comprises 270.725 kilometers of new seismic lines on the continental shelf of Tasmania. The survey took place on Perthshire Petroleum, Ltd., Australia Permit T-19/P between April 5th and April 8th, 1981.

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.

The report contains:

- SECTION: I) General Information  
II) Data Acquisition  
III) Navigation  
IV) Data Processing  
IV)<sub>a</sub> Synthetic Seismograms  
IV)<sub>b</sub> Gravity/Magnetic Data Processing  
V) Interpretation  
VI) List of Plates  
VII) Basic Data Submitted  
VIII) Interpretive Data Submitted

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SECTION I

General Information:

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GENERAL INFORMATION

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Introduction

The 1981 Crocodile Rock Seismic Survey was conducted on Exploration Permit T-19/P which was awarded on March 27th, 1981 to Perthshire Petroleum, Ltd., Perth, Western 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 270.725 kilometers (168.23 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 the on-board 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 Western Geophysical Company in Houston, Texas for disposition to the nominated processing center.

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 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 La Coste Romberg meter while magnetic data was acquired with a Geometrics G801/3 meter.

Interpretations of this data were made at Perthshire Petroleum, Ltd. offices in Houston, Texas.

Field tapes and processing tapes are presently at Western Geophysical's processing center in Houston, Texas and will later be stored at Geodata Services, Inc. in Houston, Texas.

DAILY OPERATIONS

Field supervision was provided by Mr. Jack Downing, Vice President - Geophysics, Weaver Oil and Gas Corporation, Australia, and Mr. W. Sleator, Geophysical Consultant, based in Australia. The activities were coordinated through Mr. David C. Lowry, Consulting Petroleum Geologist and Manager of Weaver Oil and Gas Corporation, Australia in Perth. Perthshire Petroleum, Ltd. is a wholly owned subsidiary of Weaver Oil and Gas Corporation.

<u>DATE</u>	<u>EVENT</u>
April 5	1000 hrs - Vessel arrived Crocodile Rock prospect, crew began laying streamer cable. 2000 hrs - Streamer cable deployed and tested, vessel headed to line. 2115 hrs - In production, commenced line PB81-15M.
April 6	In production, completed line PB81-15M. 0118 hrs - Crew began picking up equipment and streamer cable as vessel was under instructions to proceed to previously committed survey. 1330 hrs - Vessel was enroute to next survey location when received telex instructions from party manager directing vessel back to Crocodile Rock Survey. Ensuing survey was to be deployed and vessel was directed to resume production in Crocodile Rock area until further notice. 1845 hrs - Vessel arrived prospect area, crew began laying streamer cable. 2215 hrs - Equipment deployed, vessel headed for line.
April 7	In production, completed lines PB81-9M and PB81-10M. 1525 hrs - Began picking up equipment and streamer cable in order to repair minor leakage problem in cable.

217012

2100 hrs - Streamer cable deployed, tested out ok.

2215 hrs - Commenced production on line PB81-11.

April 8

In production, completed lines PB81-11, PB81-12 and PB81-13.

1240 hrs - Crew began bringing equipment on board in order to head to next program.

1515 hrs - Equipment and streamer cable on board, vessel enroute to next program, survey for Perthshire Petroleum, Ltd. completed.

GEOLOGICAL SUMMARY

The Crocodile Rock Seismic Survey took place in the northwest 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 northwestern-southeastern direction which is parallel or subparallel to the present basin axis.

Stratigraphic control for the project area is provided by seven wells, namely:

Konkon #1  
Toolka #1  
Cormorant #1  
Bass #1  
Aroo #1  
Tarook #1A  
Bass #3

In addition, two wells drilled in the vicinity are considered relevant and are included in this report. These are:

Durroon #1  
Narimba #1

The Konkon #1 well was drilled in 1973 to a measured depth of 5,043 feet (1,537.1 meters) penetrating a section ranging in age from Recent to Lower Cretaceous. The well encountered the predicted sequence with no show of oil or gas and was abandoned in highly altered volcanics.

The Toolka #1 well was drilled in 1974 to a measured depth of 8,907 feet (2,714.85 meters) penetrating a section ranging in age from Recent to Eocene. Minor oil and gas shows were encountered in the Middle Eocene while drilling; however, formation interval test results were negative.

The Cormorant #1 well was drilled in 1970 to a measured depth of 9,846 feet (3,001 meters) penetrating a section ranging in age from Recent to Eocene. Significant indications of oil have been recorded in the Eocene.

The Bass #1 well was drilled in 1965 to a measured depth of 7,717 feet (2,352.14 meters) penetrating a section ranging in age from Recent to Upper Cretaceous. No commercial hydrocarbons were logged.

The Aroo #1 well was drilled in 1974 to a measured depth of 12,112 feet (3,691.74 meters) penetrating a section ranging in age from Recent to Paleocene or pre-Paleocene volcanics. Indications of hydrocarbons were observed at several levels including the top of a sand within the volcanic sequence. Formation tests recovered small amounts of gas.

The Tarook #1A well was drilled in 1972 to a measured depth of 9,100 feet (2,773.68 meters) penetrating a section ranging in age from Recent to Eocene. The well was entirely devoid of hydrocarbon indications.

The Bass #3 well was drilled in 1967 to a measured depth of 7,978 feet (2,431.7 meters) penetrating a section ranging in age from Recent to basement. Hydrocarbon indications were recorded while drilling and a formation interval test recovered gas-condensate and water.

The Durroon #1 was drilled in 1972 to a measured depth of 9,922 feet (3,024.22 meters) penetrating a section ranging in age from Recent to Lower Cretaceous. There were no indications of hydrocarbons nor abnormal formation pressures recorded in the well.

The Narimba #1 well drilled in 1973 to a measured depth of 11,003 feet (3,353.7 meters) penetrating a section ranging in age from Recent to Eocene. There were no hydrocarbons shows reported nor was there abnormally pressured sections penetrated.

GEOPHYSICAL SUMMARY

Design and location of the Crocodile Rock 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 Stait and Encounter Bay aeromagnetic survey  
for Hematite Exploration by Aero Services Limited  
1960-1961

Anderson's Inlet aeromagnetic survey for Oil  
Development by Aero Services 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 Services International 1965

Tasmania aeromagnetic survey for the Bureau of  
Mineral Resources by Aero Services Limited  
1966

Eastern Bass Strait seismic survey for Esso  
Australia by Geophysical Services International  
1966

Bass ED-67 seismic survey for Esso Australia by  
Geophysical Services International 1967

Bass EF-68 seismic 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 Services International  
1970-1971

Bass B71A seismic and magnetic survey for Esso  
Australia by Geophysical Services International  
1971-1972

Continental Margins Geophysical - seismic,  
magnetic and gravity survey - for the Bureau of  
Mineral Resources by GG 1971-1972

217018

Bass B72A seismic survey for Esso Australia  
by Geophysical Services International 1972

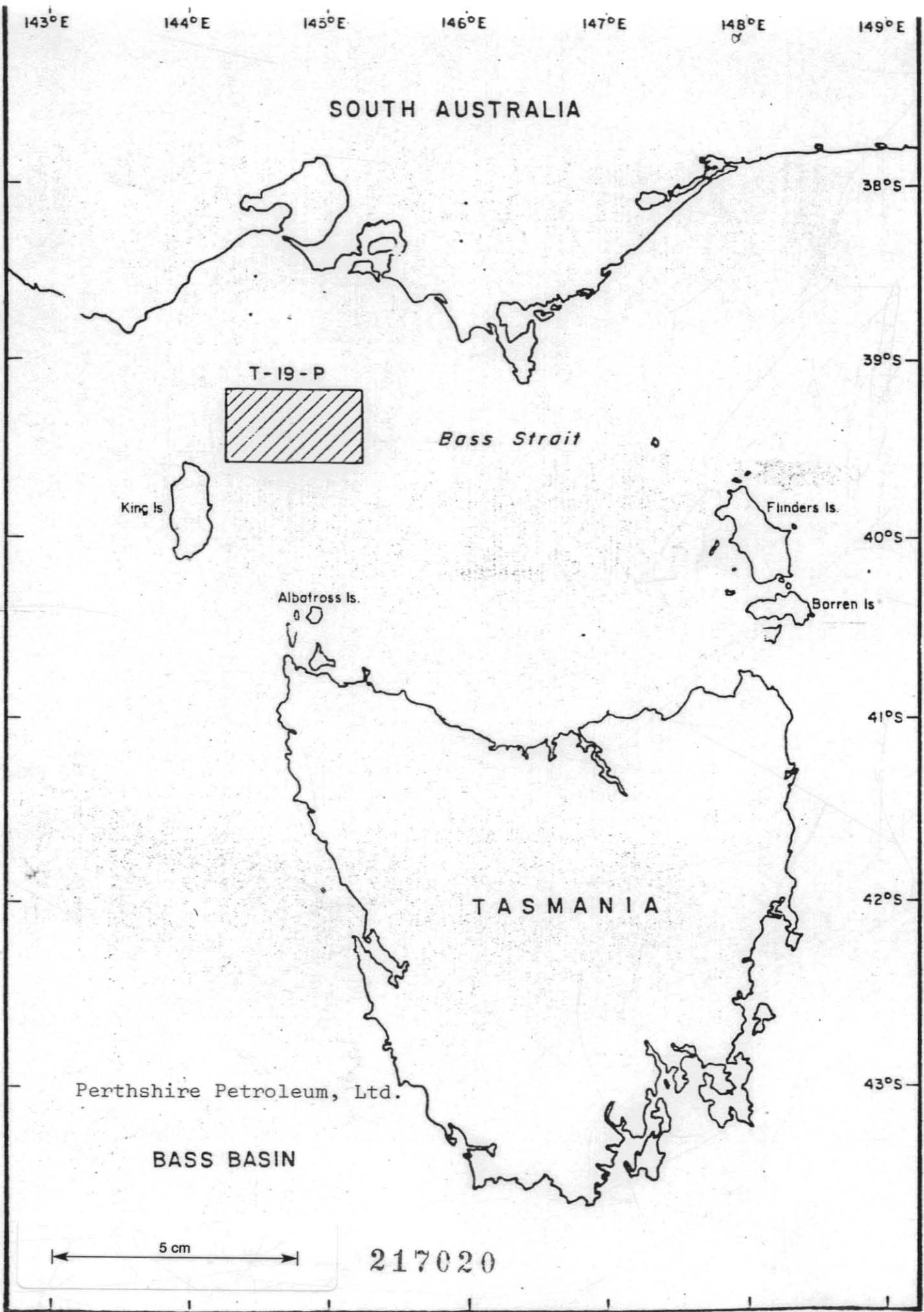
Bass HB75A seismic survey for Hematite Petroleum  
by Geophysical Services International 1975

DESCRIPTION OF SURVEY AREA

The prospect was designed as T-19-P. The survey consisted of 6 lines comprising a total assigned program of 271 kilometers. The survey area is in the Perthshire's Crocodile Rock survey area in the Bass Strait off the coast of Victoria, Australia.

PLATE 1 Location of T-19-P

PLATE 2 Crocodile Rock T-19-P



143°E

144°E

145°E

146°E

147°E

148°E

149°E

SOUTH AUSTRALIA

38°S

39°S

T-19-P

Bass Strait

King Is.

Flinders Is.

40°S

Borren Is.

Albatross Is.

41°S

TASMANIA

42°S

Perthshire Petroleum, Ltd.

43°S

BASS BASIN

5 cm

217020

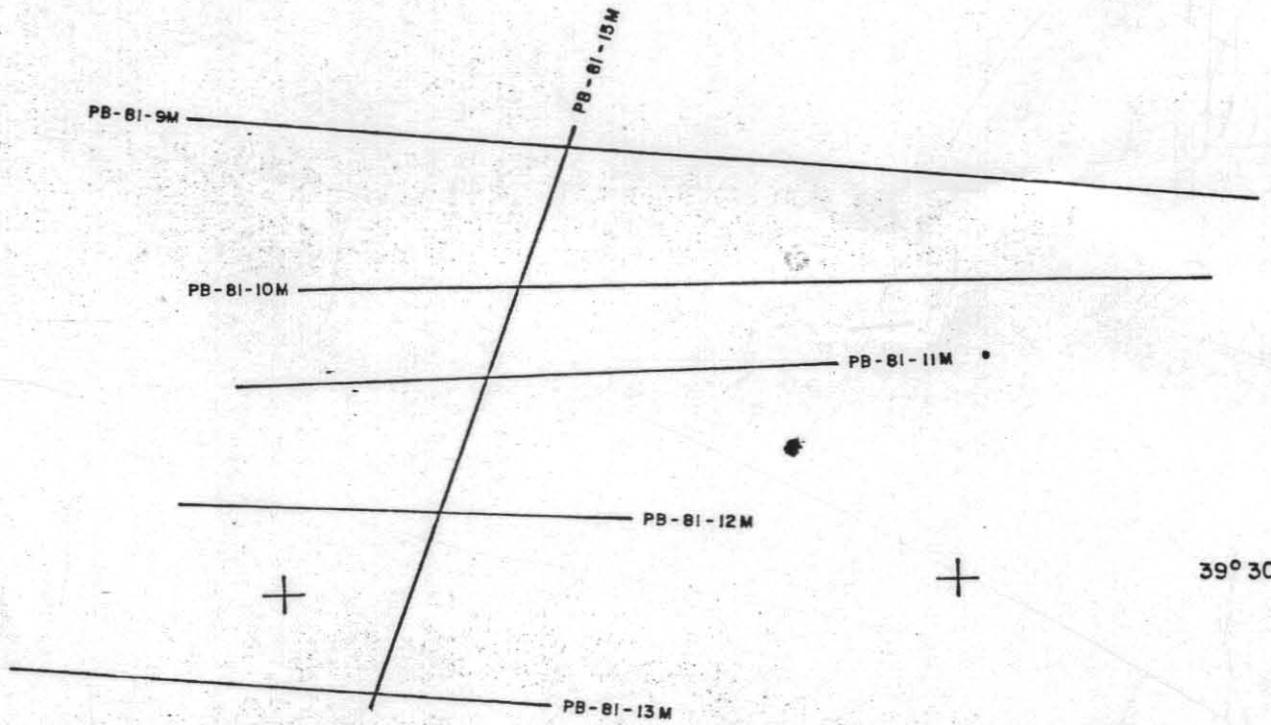


144°30'E

145°00'E

217021

39°00'S



39°30'S

Perthshire Petroleum, Ltd.

CROCODILE ROCK T-19-P

SCALE 1 : 500,000

5 cm

## SECTION II

Data Acquisition:

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Contractors

The survey was conducted on behalf of Perthshire Petroleum, Ltd. of Houston, Texas and Perth, West Australia.

To conduct the survey, Perthshire Petroleum, Ltd. contracted WESTERN GEOPHYSICAL COMPANY OF AMERICA, a Delaware Corporation and a Division of LITTON INDUSTRIES.

Location of Headquarters

The principal office of Perthshire Petroleum, Ltd. is located at 5599 San Felipe Avenue, Suite 1100, Houston, Texas, U.S.A. The office in charge of Australia operations is located in Perth, West Australia and it was to this office that communications pertaining to the operation was directed.

The principal office of WESTERN GEOPHYSICAL COMPANY OF AMERICA is located at 10001 Richmond Avenue, Houston, Texas, U.S.A. The survey detailed in this report was conducted out of WESTERN GEOPHYSICAL's Southeast Asia Division office located at Unit 301, Union Building, 37 Jalan Pemimpin, Singapore 2057, Republic of Singapore.

A temporary field office was established by WESTERN GEOPHYSICAL COMPANY in order to facilitate communications and logistics involving the operation. This office was located at The Entrance in New South Wales for this portion of the survey.

Communications

Daily production updates and vessel status reports were issued to both Perthshire Petroleum, Ltd. office in Perth and WESTERN GEOPHYSICAL's office in Singapore via telex from the field office. Periodic telephone communications were also maintained for detailed discussions of the vessel's movements.

Weather

Moderate winds and seas dominated the weather conditions during the survey operation. Although the Bass Strait is noted for its severe weather, this was fortunately not the case during the vessel's time on the prospect. At no time during the survey was it delayed or interrupted as a result of poor weather.

Key Field Personnel

Perthshire Petroleum, Ltd.

David Lowery : Exploration Manager based at Perth office, responsible for liaison between WESTERN GEOPHYSICAL and Perthshire's principal office.

WESTERN GEOPHYSICAL COMPANY

Paul J. Hughes : Operations Manager, based at field office, responsible for client liaison and vessel logistics.

Tim N. Leighton : Marine Operations Co-ordinator, responsible for vessel's operation at sea including quality control.

Kevin Roberts : Instrument Technician

Brent Wise : Observer

Dicky Chow : Observer

Ian Bramley : Navigator

Jim Green : Navigator

Phil Knight : Airgun Mechanic

Mal Wetherspoon : Airgun Mechanic

Disposition of Data

The digital recorded magnetic tapes were shipped to WESTERN GEOPHYSICAL COMPANY in Houston, Texas for disposition to the nominated processing center. Included with the data shipments were copies of the observer's line summary sheets, streamer cable and airgun configuration prints, co-ordinator's logs, LRS-100 computer printouts, E.P.C. rolls, camera monitor rolls, fathometer rolls and parameter reports.

The navigaton and GDU data was shipped to WESTERN GEOPHYSICAL's Navigation Department in Singapore for processing.

Instrument Test

Semi-monthly and monthly instrument test were conducted on the DFS V system as per the instrument manual's instructions. The results of these test were sent to WESTERN GEOPHYSICAL's processing center in Singapore for processing and initial interpretation, then forwarded to WESTERN GEOPHYSICAL's Houston office for final analysis.

In addition to this, daily test were also conducted to ensure that the instrument's performance was consistent with specifications.

217030

Survey Vessel

Name : M/V Western Odyssey  
Length : 185 feet  
Beam : 40 feet  
Draft : 10 feet  
Tonnage; gross/net : 830/250  
Engines : 2 x Caterpillar D-399 TA  
1090 HP each  
Propulsion : 2 x Kamewa 50 x F/4 Control  
Pitch Propellers  
Generators : 2 x 550 kw - for air  
compressors  
2 x 175 kw - for ship's power  
2 x 30 kw - for instruments  
Radar : 2 x Decca Model 926, 48 mile  
range  
Gyro Compass : Sperry model 227 with auto  
pilot  
Bow Thruster : Kamewa SP 1300 with 350 HP  
Electric Motor  
Stabilization : Flume Type with Anti-Roll  
Blige Keel  
Accommodation : 36 persons  
Endurance : 35 days minimum  
Official Number : 8775  
Call Letters : HO - 3498  
Port of Registry : Panama  
Helideck : 40 feet x 50 feet

Seismic Equipment and Instrumentation

Instruments : DFS V 120 Channel

Main Cable : 2400 Streamer, 96 groups  
 25 m Group spacing - 96  
 ch.mode  
 50 m Group spacing - 48  
 ch.mode

Mini Streamer\* : 6 or 12 groups, 12.5 m group  
 spacing incorporated into  
 main cable offset sections

Compressors : 6 x Price 5000 psi electric  
 drive compressors

Navigation

    Primary : SAT-NAV 16 / ~~WINS PHASE IV~~

    Secondary : LRS Phase IV Integrated  
 Satellite Navigation system

Communications : Comsat 'MARISAT' Satellite  
 Terminal with telex and  
 telephone facilities

Sailor 800 Watt Programmable  
 SSB Ship/Shore Radio

Sailor VHF Radio

UTS 10S Auxillary

SSB Radio, 150 watts

Gravity Meter : La Coste Romberg

Magnetometer : Geometrics G801/3

Ancillary Equipment : LRS Geoscience Data  
 Acquisition System (Data  
 Logger)

EPC Single Trace Plotter

SIE ERC 100 Monitor Camera

LRS-100 Energy Source  
 Synchronizer

217032

LRS Airgun Solenoid Controller

Kalamos M2A Cable Fault Locator

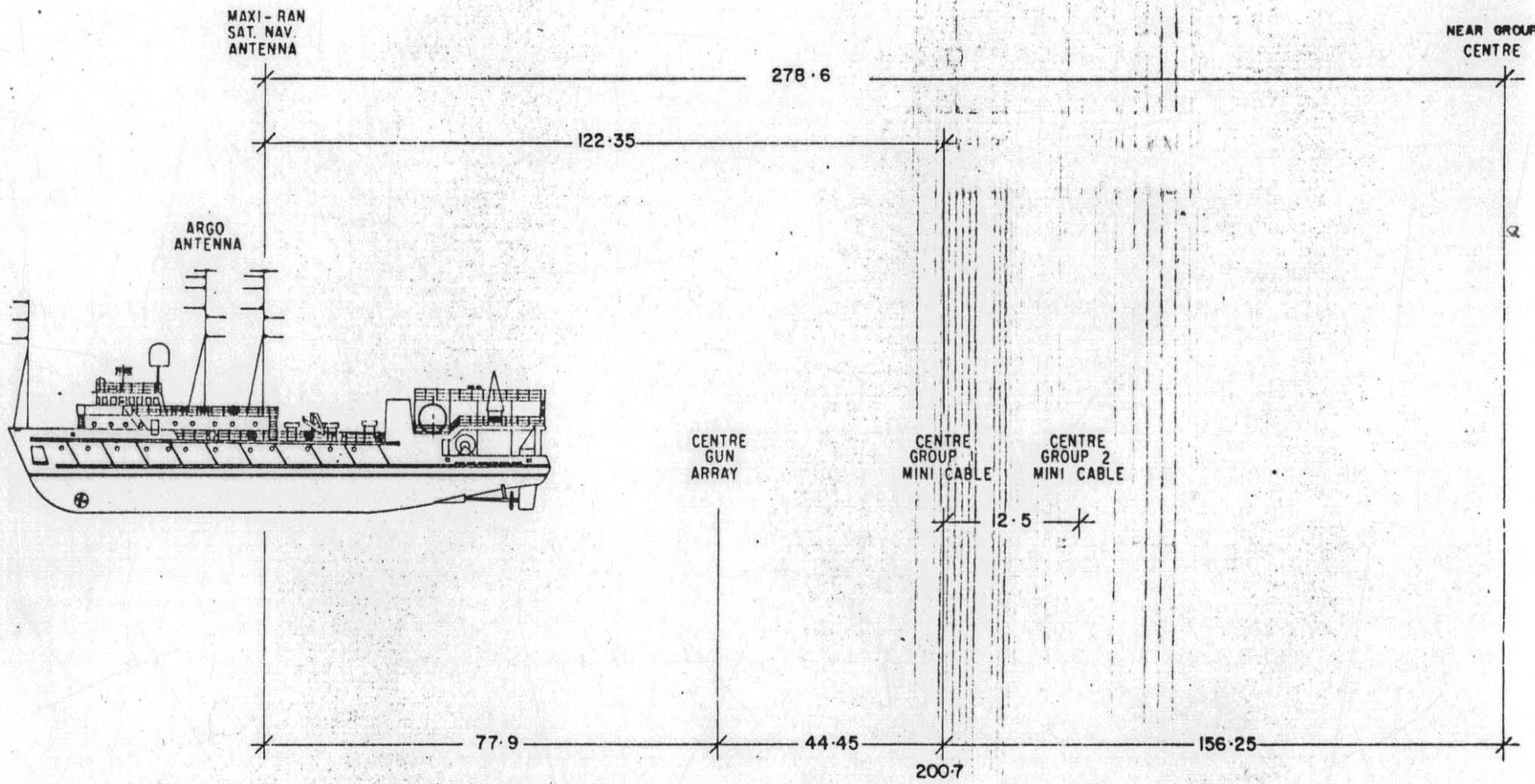
Krupp-Altas Model 6020  
Fathometer - 2000 fathom range

Raytheon model DE 750  
Fathometer - 600 fathom range

Simrad model EX38D  
Fathometer - 1000 fathom range

\* Not in use during this survey.

PLATE 3



**WESTERN ODYSSEY PARTY 86**

(DISTANCES IN METERS)

5 cm

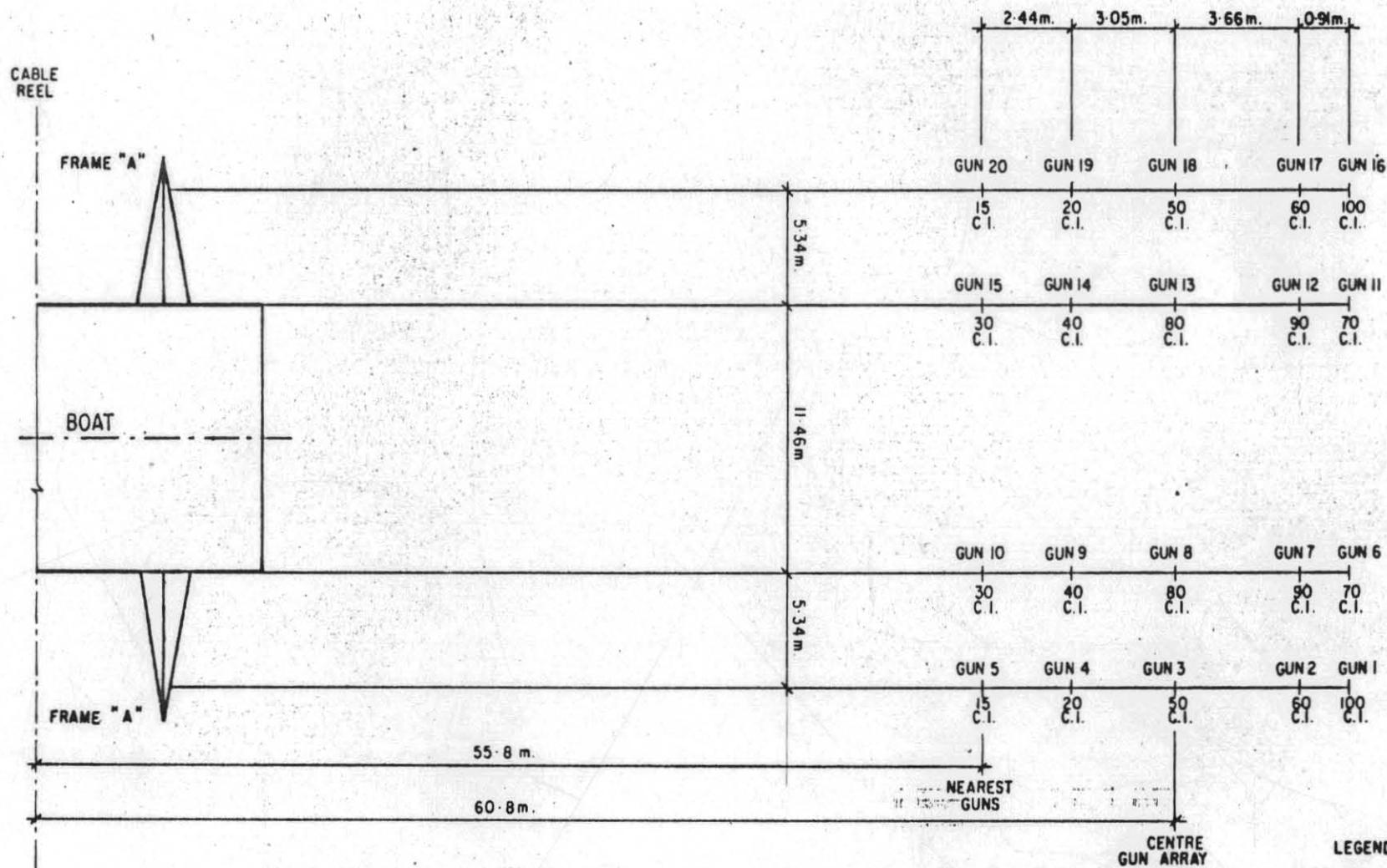
217033



WESTERN GEOGRAPHICAL

5 cm

# WESTERN ODYSSEY PARTY 86 GUN ARRAY CONFIGURATION



LEGEND:  
C.I. - CUBE INCH

217034

### Instrument Description

The WESTERN ODYSSEY is equipped with a DFS V seismic acquisition system consisting of two analog modules, a controller module and four tape transports. The system accepts analog inputs signals from the streamer cable and converts these to digital form for recording on magnetic tape.

Each analog module contains 60 pairs of wires available for data acquisition. These wires come directly from the streamer cable (through a deck cable leading from the cable reel to the instrument room). Each individual channel is passed through a line filter to mitigate the effects of ambient static picked up from the seismic lines. From this filter the signal is applied to a differential pre-amplifier, then an optional lowcut filter, an alias filter and finally through an optional 50 or 60 Hz notch filter.

After the filtration process the signals are time division multiplexed to a floating point amplifier to allow for scanning of all data channels within the specified sample interval. The particular channel which is to be connected to the amplifier in any time slot is determined by an address from the controller module. The floating point amplifier adjust its gain in steps of 4:1 to bring the amplified signal to the optimum level for application to the Analog-to-Digital Converter.

The Controller Module provides a stream of commands to the Analog Module that perform the following functions:

1. Address the channels to be sampled.

2. Command the sending of status and zero offset data.
3. Control whether the gain ranging amplifier automatically selects its gain (AGC) or operates at a gain specified by the operator.
4. Control the source of input to the A/D converter.

In the normal data acquisition mode the floating point amplifier is commanded to be in its automatic gain ranging mode, however the amplifier may be commanded to be in any of eight possible settings (particularly for test and calibration purposes). When in the normal data acquisition mode the A/D converter is commanded to derive its input from the floating point amplifier but for various test and calibration procedures the A/D converter can derive its input from the internal test oscillator in the Analog Module, an external voltage source or ground.

The sequence of address sent out by the Controller to the Analog Module causes each individual analog channel to be sampled in sequence. Before commencement of a new sequence of addresses two time intervals occur that are reserved for specific purposes. During the first time interval, called First Start of Scan (SOS1), a special address is sent which causes the Analog Module to send back status information about the filter settings and gain constants of the Analog Module and to reset stabilize the floating point amplifier. During ensuing second interval, labeled Second Start of Scan (SOS2), the input to the amplifier in the Analog Module is commanded to be short to ground. Thus the information returned to the Controller Module as a result of this

command contains zero offset information. The sequence of addresses is generated continuously whenever the power is on. However when a time break (start of energy source discharge) is received the sequence is interrupted and command for a Data Start and SOS1 are transmitted to commence a new sequence.

The digital data from the Analog Module comes to the Controller Module in bit serial format. After conversion to parallel format, a number which represents the dc offset of the amplifier and A/D converter in the Analog Module is subtracted from each data word (each word represents the instantaneous voltage at the moment of sampling of a channel).

The number to be subtracted is derived from the information obtained during SOS2. Since the dc offset of the amplifier may be somewhat dependent on amplifier gain, the gain is set to a different value during the successive SOS2. A separate value of dc offset is stored in a memory for each of the gain settings of the amplifier. In normal operation, the amplifier sets its own gain and the gain value that it determines is received by the controller in three bits of the data word. These bits are an address in memory from which to obtain the proper number to subtract. It is not appropriate to completely update the memory every time a new sample of the zero offset is obtained because the new value received is exaggerated by the effect of noise and thus would cause values placed in memory to be erratic. Therefore, when a new offset sample is obtained, only a fraction of the difference between the new value and the old value is added to the memory. Thus, the quantity stored in memory is a long-term average of zero offset.

The first filter removes those components of dc offset which are common to all channels but does not help the offset caused by the multiplexes of the individual channels. In order to remove the dc offset of the individual channels, it is necessary to have a memory location for each channel where a number can be stored which is to be subtracted from the data on that channel. The offset information for each channel can only be obtained from the data received from that particular channel. Thus, the number stored in memory for a particular channel is built up by adding (to the number in memory) a fraction of the difference between each new sample and the number stored in memory. Hence, the number to be subtracted is constantly changing. The net effect is the digital equivalent to a capacitor/resistor lowcut filter where the number stored in memory (which is subtracted) is analogous to the voltage across the capacitor in the analog realm. To perform this function in the analog realm would require a capacitor for each channel and switches for selecting the proper capacitors for each channel. Therefore, the digital method is much simpler. The filter time constant is 128 milliseconds.

The standard recording formats of the system are SEG-B and SEG-C. In both formats, each seismic event is recorded in a file consisting of a header block containing record constants and a data block containing seismic data values. The principal difference between the formats is the method of recording data values. Despite this difference, both header block tape formats are similar. The first 24 bytes of the header consist of record constants and processing information. The seismic channel fixed and early gain is recorded next for each channel. After

this strip, the auxiliary channel identifier code is recorded for each auxiliary channel, then any external data may be recorded at the operator's discretion.

In the SEG-B format, data is organized in 2 byte words with each byte consisting of 8 bits of information. The first of the data block comprise the sync group. Bits 0 through 5 of the sync group are recorded as "ones" for a normal time break and as "zeros" if the system is operated from an internal time break. Bit 6 indicates the number of seismic channels as designated in the following chart :

<u>CHANNELS</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
24	0	0	0	0
36	0	1	0	0
48	0	0	0	1
others	1	1	1	1

The next five words after the sync group are the auxiliary channels. The first auxiliary channel is timing word. During the remainder of the scan, seismic channels are recorded. The gain for 4 seismic channels is combined in one data word by 4 data words containing the mantissa of each of the seismic channels. The magnitude representing the channel output is expressed as a binary number with negative values in one's or two's complement code.

In the SEG-C format, data is organised in four 32 bit words, each word containing the data value for one channel. The recorded data value is the actual channel input in millivolts expressed in IBM-compatible floating point notation. In this notation, a data value is represented by a sign bit, a 7 bit

characteristic of exponent and a 24 bit fraction. The characteristic signifies a power of 16 in binary excess 64 code. The fraction is normalized to put the significant digit of the data within the uppermost 4 digits of the fraction.

The data coming from the offset filter (data in the form of a 16 bit two's complement number and a three bit gain for each sample) must be rearranged to be placed on the half inch 9 track (8 bits plus parity) tape. The logic which performs this function is called Format Logic. Only 15 of the 16 bits are actually used. The most significant bit is used to indicate overflow. The output of the Format Logic is a progression of 8 bit words arranged in accordance with either the SEG-B or SEG-C standard formats as chosen by the plug-in Format Logic board in the Controller Module. But after the words are generated, it is further necessary to encode the bits according to either the NRZI or the Phase Encoded modes of writing on the tape. The logic that performs this is called the Write Logic. The Write Logic is on the NZ board for NRZI and on the PE board for Phase Encoded. There must be a timing buffer between the Format Logic and the Write Logic. That is, the data may not be available from the Format Logic at exactly the time when it is desired to feed information to the Write Logic. The average data rate will have to be equal. The required flexibility is provided by a first in/first out memory (FIFO). This device can load a number of words into its input and later read them out of the output in the same order as they were entered. This reading out can occur at different times. The controller Write Logic translates the "ones" and "zeros" of each word into appropriate flux direction

signals to be sent to the Tape Transport for writing on tape. In the case of phase encoded signals, this requires two flux direction bits sent for each signal bit. The data is rearranged into 8-bit-plus parity bit parallel words, and these are encoded into 8-bit-plus parity flux direction words. After this 4 command bits are added to each data, word and the resulting data command words are converted to bit serial form and sent to Tape Transport. Clock and sync signals are also sent to the Tape Transport. The communication from the Tape Transport to the Controller Module is divided into 2 parts :

1. The data read from the tape is communicated to the controller by 10 wire pairs which carry all 9 tracks from the tape and a read clock for NRZI to the controller in parallel.
2. The status information (tape rewind, end of tape, etc.) is carried over a serial interface.

The Tape Transport motion control commands are sent over the serial interface with the write data. The commands are issued by the Controller Module, but the means of executing the commands are in the Tape Transport Module. Before a record is written on tape, a header is written which contains file identification and a number of constants which are introduced from the controller. Also, there are pieces of information such as gain constants and filter settings which are received from the Analog Module. All this information is arranged into a procession of 8-bit-plus parity (the same as the data) and is arranged in a specified sequence by the header logic according to SEG-B or SEG-C format. The header information or the data information is selected at the appropriate time for

feeding the FIFO. The Tape Transport Module is the means by which the digital data from the Controller Module is recorded on magnetic tape. Four transports are used in the system to facilitate dual recording where and when requested by clientele. Each of the 10 inch transports record the data on 1/2 inch tape using IBM-compatible 9-track dual gap heads. The recording can be either 800 bits per inch NRZI or 1600 BPI PE. The transports consists of the capstan drive, mechanical storage systems, supply and take up reel serve systems, record/reproduce head data electronics and tape position sensors.

### Energy Source

The M/V WESTERN ODYSSEY's high pressure energy source system consists of twenty high pressure WESTERN airguns with reservoir capacities ranging from 10 to 100 cubic inches in 10 cu. in. intervals. In normal operating circumstances, 10 of the airguns are combined to form a 560 cu. in. tuned array. The airguns are operated at a pressure of 5,000 psi supplied from 4 of 6 available Price Air Gun Master Compressors.

For various reasons, most airguns have some inherent firing delay and do not fire immediately upon receipt of a "fire" command pulse.—The amount of this delay tends to drift with time and naturally varies from unit to unit. To overcome this problem and to assure all airguns fire within specs required for an optimum energy pulse, the system is controlled by the LRS 100 Energy Source Synchronizer. The LRS 100 is a module microprocessor based system designed specifically to control the firing of a seismic energy source array so that all guns fire concurrently or in a pre-designated staggered time sequence. The system accomplished this by electronically sensing the individual gun delays and automatically establishing a firing sequence to compensate for the variations in delay. The basic sequence of operation is as follows :

1. The Controller Module receives a fire command which signals the start of the firing cycle. The fire command signal may be issued by the seismic system or the LRS 100 Cycle Controller.
2. At some pre-calculated point after receiving the fire command, the controller will issue a fire

pulse to the solenoid power supply for each gun. The solenoid in turn triggers the release of the control pressure air. As this occurs, an imbalance is created between the control pressure reservoir and the high pressure reservoir that allows the high pressure air to force the seat and shuttle upward and expose the exhaust ports, thus releasing the pressure air.

3. Upon firing, a sensor on the guns produces a return signal which is detected by the controller. Ideally, this fire detect signal should occur at a pre-selected time referred to as the Aiming Point.
4. If the fire detect for any guns does not occur at the Aiming Point, the controller will correct the error by adjusting the time at which the next fire pulse is issued to the gun. These adjustments are computed from a filter applied to the previous error values.

Through this method of constant electronic adjustment, the energy source system delivers its optimum seismic signals.

### Streamer Cable

Modern seismic marine streamer cables originated from WW II anti-torpedo technology. The modern cables are 2.5 to 3 inches in diameter and, when filled with a special kerosene based fluid, are neutrally buoyant in the water column. As water density changes, the overall buoyancy of the streamer is adjusted by the addition or removal of thin lead weights taped onto the streamer at various intervals.

The streamer cable used by the WESTERN ODYSSEY is 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 hydrophones. This gives the streamer an overall length of 2400 meters excluding the lead-in and elastic sections.

The 500 foot nylon reinforced neoprene lead-in is heavily weighted in order to depress the front end of the streamer cable to the desired operating depth. It is also outfitted with neoprene florings for noise reduction. In normal operation, two 75 meter elastic sections are attached at the tail of the lead-in for additional noise reduction.

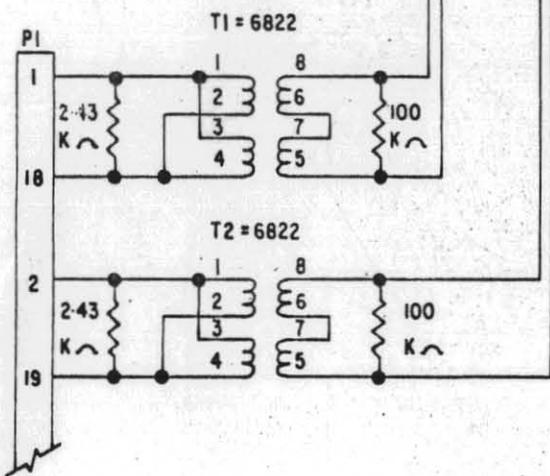
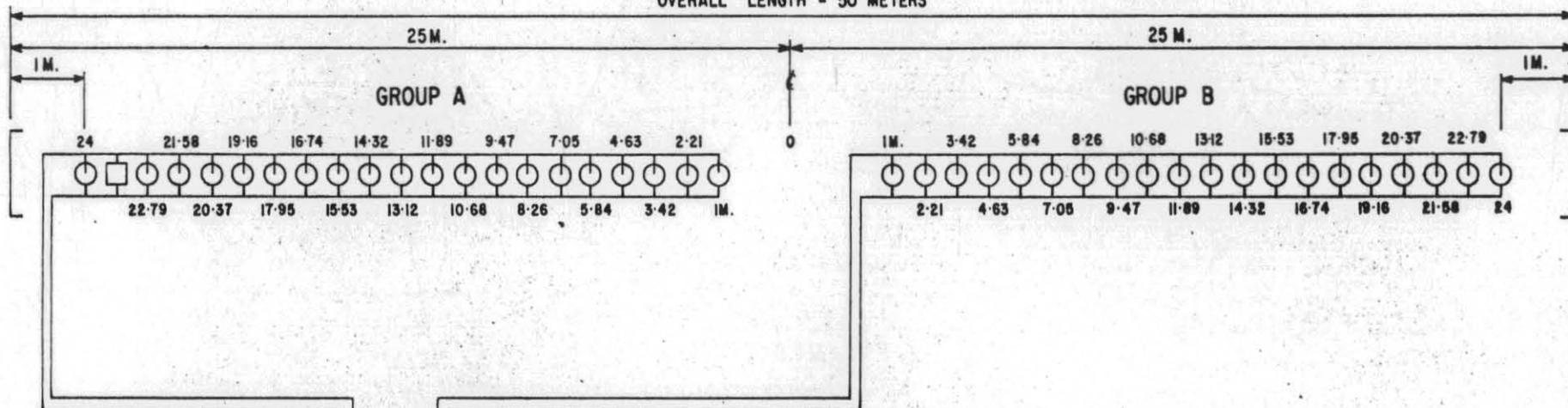
To maintain the streamer cable at the specified depth in the water column, a series of Syntron Depth Controller are employed at equal intervals along the cable. An electronic pulse controls the angle of the wings and thus controls their influence on the cable's depth. The cable depth is monitored from the readouts of pressure sensitive transducers located at regular intervals along the streamer.

A tail buoy is connected at the far end of the cable and is tracked by the vessel's radar, making it possible to observe how closely the cable is trailing the vessel along its line of motion.

In order to give a further indication of the cables physical orientation along the line of motion, 6 of the 48 active sections contain Digicourse heading sensors. Each heading sensor will give the heading in degrees of the streamer at the point of location of the heading sensor. Using the length of the streamer out from the vessel and the heading from the sensors, a simple approximation of the shape of the streamer can be made by connecting the known points with straight lines.

5 cm

OVERALL LENGTH - 50 METERS



HYDROPHONE CONFIGURATION  
WESTERN ODYSSEY 96 CHANNEL

217047

Instrument Settings and Specifications

Model : DFS V

System Number : 408

Tape Format : SEG-B, 9 track

BPI Density : 1600

Number of Channels Available : 124

Number Seismic Channels : 96

Auxiliary Channels : Timebreak - Channel 1  
Waterbreak - Channel 2

Pre-Amp Gain : 36 dB

Total Gain : 120 dB

Lo Cut Filter : Out

Hi Cut Filter : 64 Hz, Slope 70 dB/OCT

Sample Rate : 4 milliseconds

Record Length : 6 seconds

Analog Module Specs

    Frequency Response : 3 to 256 Hz

    Maximum Gain : 132 dB

    Minimum Gain : 24 dB

Input Impedence

    Difference Mode : 20,000 ohm resistive  
    in parallel with  
    0.035 microfarads

    Common Mode : 500 ohms parallel  
    with the series  
    combination of 0.02  
    microfarads and  
    induction of 6 Henries

Max. Input Signal	<u>Gain Constant</u>	<u>Voltage(mV RMS)</u>
Difference Mode:	24	327.68
	26	81.92
	8	20.48

Common Mode:	<u>F. Range (Hz)</u>	<u>Voltage(Peak)</u>
	0 - 60	7
	60 - 700	3.5
	700 - 1K	7
	1K - 3K	10
	3K - 10K	50

Distortion : 0.05% 3 to 256 Hz

Crossfeed Isolation : 80 dB between any 2 channels, feeding 1 channel only

Control Module Specs

Timing Accuracy : -0.005%

Data Word Rate : 64 kHz Max

Cable Parameters

Percent Coverage : 4800%

Pops per km : 40

Number of Groups : 96

Center Energy Source to  
Center Near Group : 200.7 meters

Center Near Group to  
Center Far Group : 2,375 meters

Group Center to Group Center: 25 meters

Number of Phones per Group : 20

Depth Detectors at Head of  
Groups : 2, 16, 32, 48, 64, 80,  
96, Head of Mini

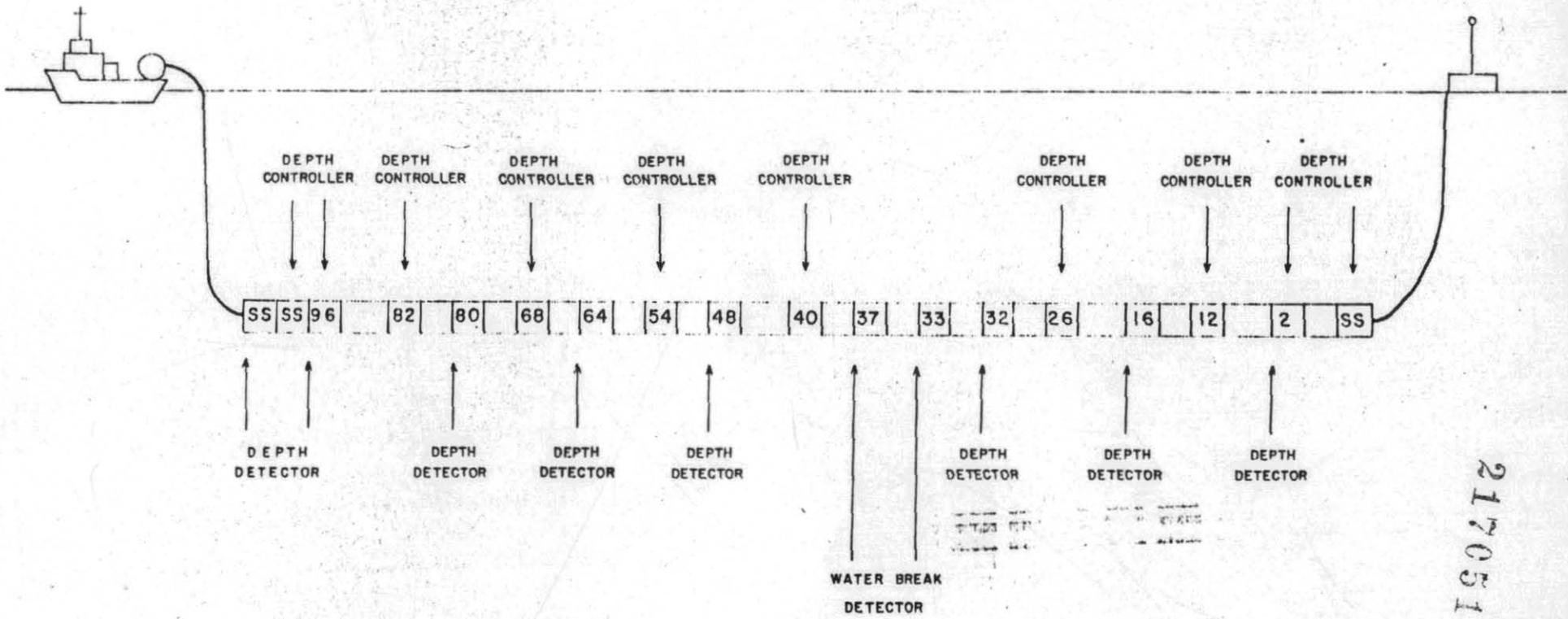
Depth Controllers on Groups : SS 2, 12, 26, 40, 54,  
68, 82, 96, SS

Center Near Group to  
SAT NAV Antenna : 278.6 meters

5 cm

# WESTERN ODYSSEY

## 96 GROUP CABLE CONFIGURATION



217051

217052

C. Airgun Configuration

Array Volume : 555 cu. inches

Number of Guns : 10

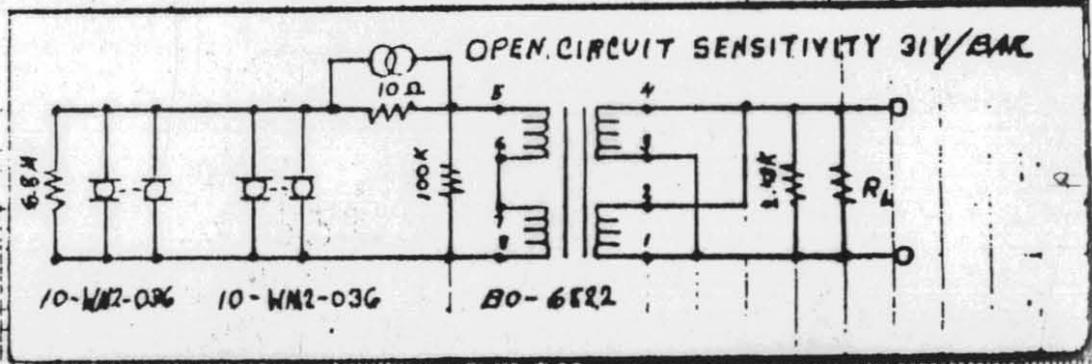
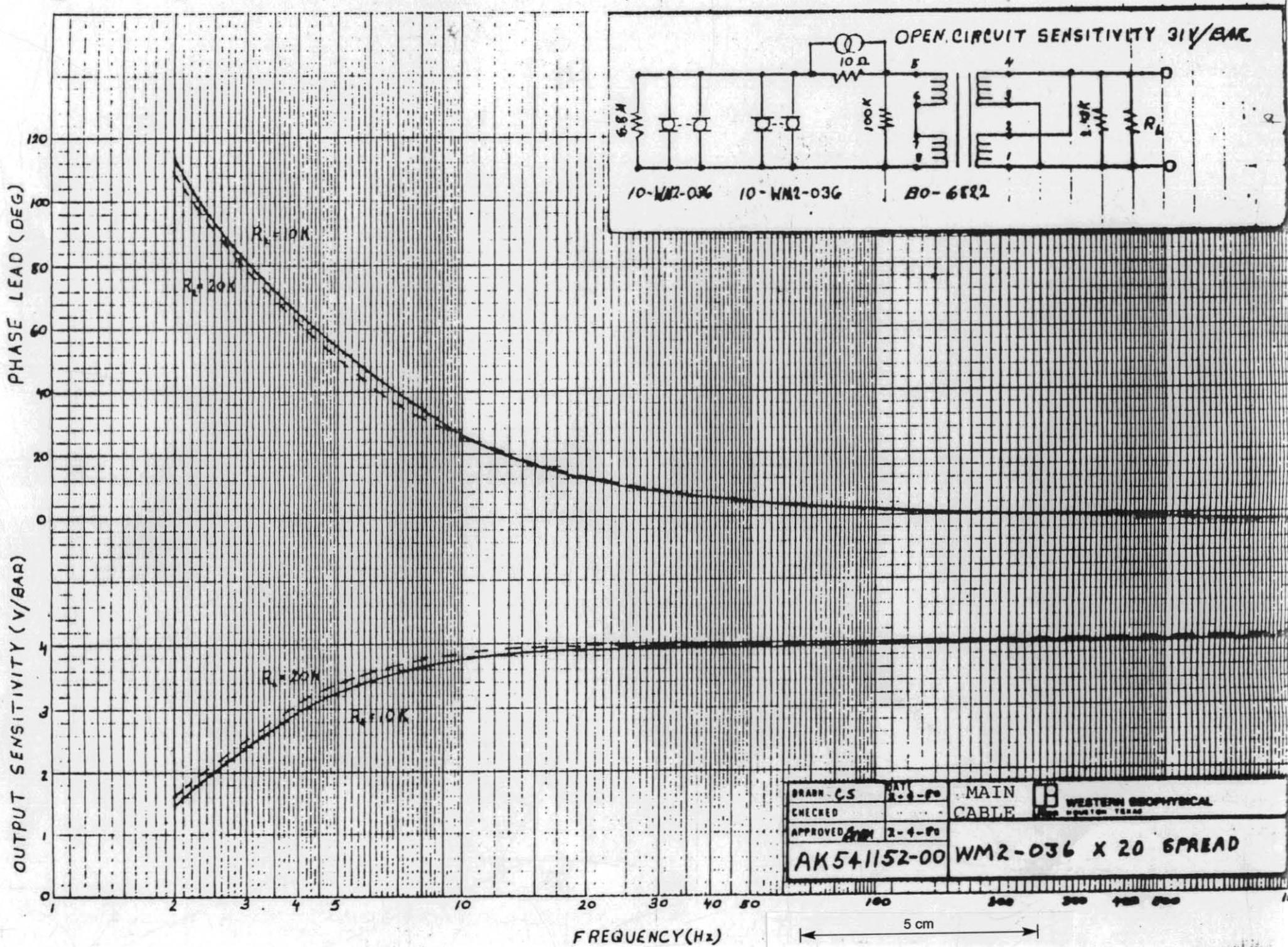
Array Pressure : 4500 psi

Shot Depth : 6 meters

Shot Interval : 25 meters

PLATE 7

217053



DRABN - CS	DATE 2-9-70	MAIN CABLE	WESTERN GEOPHYSICAL
CHECKED			SEISMIC TRENDS
APPROVED	2-4-70		
AK541152-00		WM2-036 X 20 SPREAD	

5 cm



217055

STATISTICAL SUMMARY

<u>DATE</u>	<u>LINE</u>	<u>SP - SP</u>	<u>PROFILES</u>	<u>KMS</u>
April 5	PB81-15M	100 - 1199	1100	27.500
April 6	PB81-15M	1200 - 1695	496	12.400
April 7	PB81-9M	100 - 2849	2750	68.750
	PB81-10M	100 - 2469	2370	59.250
	PB81-11M	100 - 779	680	17.000
April 8	PB81-11	780 - 1645	866	21.650
	PB81-12	100 - 1271	1172	29.300
	PB81-13	100 - 1494	1395	34.875

Total Kilometers: 270.725

LINE SUMMARY

PB81 - 9M  
7th April Start of line, first reel - 091563,  
first shotpoint 100. End of line,  
reel 091614, last shotpoint 2849.

PB81 - 10M  
7th April Start of line, first reel - 091615,  
first shotpoint 100. End of line,  
reel 091659, last shotpoint 2469.

PB81 - 11M  
7th April Start of line, first reel - 091660,  
first shotpoint 100. End of day,  
8th April reel 091673, last shotpoint 779.  
First SP of day, 8th April - 780, on  
reel 091673. End of line, reel  
091689, last shotpoint 1645.

PB81 - 12M  
8th April Start of line, first reel - 091690,  
first shotpoint 100. End of line,  
reel 091712, last shotpoint 1271.

PB81 - 13M  
8th April Start of line, first reel - 091713,  
first shotpoint 100. End of line,  
reel 091739, last shotpoint 1500.

PB81 - 15M  
5th April Start of line, first reel - 091532,  
first shotpoint 100. Last shotpoint  
6th April of day, 5th April - 1199, reel  
091552. End of line, reel 091562,  
last shotpoint 1695.

SECTION III

217057

Navigation:

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Satellite Subsystem	42-43
Computer and Peripheral Equipment	43-44
Survey Operation	44

NAVIGATION SYSTEM - WINS<sup>(R)</sup> PHASE IV

Western Geophysical's WINS<sup>(R)</sup> (Western Integrated Navigation System) is comprised of four main subsystems; a doppler-sonar system to determine ships's velocity continuously, a satellite system to provide ship's position at intervals averaging two to four hours, a digital computer and a recording system to record computed data. Calculations, for all subsystems and data integration, are handled by the on-board general purpose digital computer. The ship's position is continuously calculated by integrating the sonar velocity and updating with acceptable satellite fixes.

DOPPLER SONAR SUBSYSTEMDoppler Sonar

The main unit is a Marquardt 2020A doppler sonar system. This system uses a 4-element transducer, in a single assembly, to transmit and receive pulses of 300 KHZ sonic energy reflected from the sea floor.

The four elements transmit and receive energy at an angle of  $30^{\circ}$  to the vertical in the fore, aft, port and starboard directions. The associated electronics control both the pulse transmission pattern and provide independent phase-locked-loop tracking of each of the four received signals. The output from the tracker circuits are demodulated to determine the frequency shift present in the received signals. The frequency shift of each channel is pulse shaped to provide a digital pulse rate proportional to ship's velocity in that channel. Vertical velocity, heave, is derived in the computer. Pulse rates proportional to velocities in the 2 horizontal ship axes are provided to the computer.

The sonar will normally maintain lock on the sea bottom to depths greater than 600 feet. When "bottom lock" is

lost the sonar will automatically track the sonar return from the water mass. The velocities in this mode are relative to the water mass and therefore in error in the presence of ocean currents. The change in sonar mode may be controlled manually as well as automatically. The sonar mode is indicated to the computer and data logger and also visually displayed.

#### Velocity Resolution and Compensation

The horizontal ship-referenced velocities are resolved into North and East velocities by the computer. The necessary heading reference is provided by a gyro-compass (Sperry MK227) with electronic readout provided by a resolver. A resolver-digital converter provides a digital heading to the computer. The gyro-compass is corrected internally for latitude error. Dynamic gyro-compass errors are corrected in the computer.

Other corrections to the sonar velocities are for sound velocity in water and ship attitude.

Sound velocity in water is measured by a velocimeter (N.U.S. 1020) which provides an output frequency proportional to sonic velocity. This signal is used by the computer for sonar scale factor correction.

Ship attitude data are provided by pendulous resolver inclinometers (G.A.P. S2000) in the pitch and roll axes. The outputs of these devices are converted to digital form and passed to the computer. The computer applies corrections for pitch and roll and pitch-heave and roll-heave interaction.

#### SATELLITE SUBSYSTEM

The satellite receiver, Magnavox 702A-3, automatically acquires and tracks the signal from each satellite as they become available. Each satellite transmits a message on two frequencies, 400 MHz and 150 MHz, which are independently tracked by two phase-lock-loop receivers.

The doppler shift on each frequency is measured. Digital data representing the high channel doppler-shift cycle count, low channel doppler-shift cycle count and satellite message are passed to the computer.

The satellite fix program is a "short doppler" program which employs the accumulated doppler data in 23-second intervals instead of the 2 minute interval used in the earlier programs. Use of the 23-second interval allows accurate fix computation under reception and pass length conditions which would prevent a 2 minute interval program from computing a fix.

Fix accuracy is very much a function of the accuracy of the measurement of the ship's velocity during the pass. In particular one knot error in measurement of the north velocity can induce a position error of up to 1500 ft. in the satellite fix. Accurate knowledge of velocity from the sonar subsystem reduces this error to negligible proportions.

#### COMPUTER AND PERIPHERAL EQUIPMENT

The computer (HP 2100A) is a general purpose digital computer. The computer accepts data from all the sensor units and a manual entry keyboard. A CRT display unit is fed by the computer to provide a display of present latitude, longitude, heading, cross-course velocity and distance, and along-course velocity and distance. Several other parameters are also displayed. Initialization parameters, such as G.M.T., satellite antenna height, shotpoint interval, etc. are entered by the operator via a keyboard.

A digital line printer is used to provide a visual history by printing time and position at 10-minute intervals. The printer is also used to provide a printout of the satellite fix parameters.

The computer program is loaded from magnetic tape. Program may also be loaded with paper-mylar punched tape.

All computed navigation data, are sampled in digital form every twenty seconds. The resulting data scan is accumulated in a core memory and written onto IBM-compatible, 9-track magnetic tape at 10-minute intervals. Satellite data is accumulated for the entire satellite pass and written onto tape at the end of each pass.

The seismic system is interfaced to the computer in order to record the seismic file and reel number on the navigation tape, to allow the positive positioning of each seismic record. This interface also allows the navigation system to control the seismic recording interval on the basis of elapsed distance, instead of the more normal elapsed time method. The required distance is part of the computer initialization data.

To ensure recorded data validity, data recorded on magnetic tape is read back to the computer and compared with the data written to the tape. This data may also be printed for visual verification.

#### SURVEY OPERATION

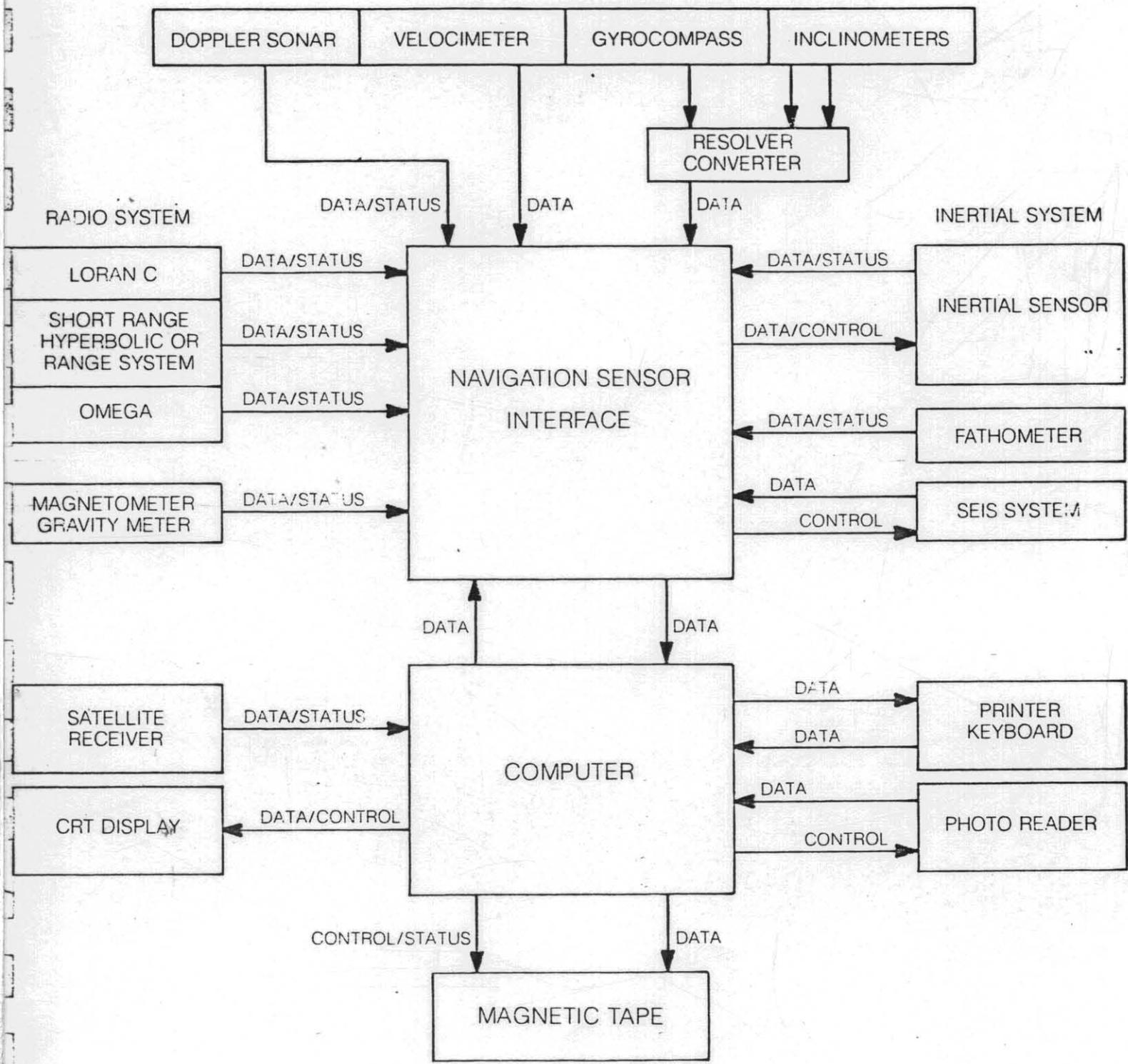
The system is initialized with the Latitude/Longitude end points of the line and shotpoint control parameters; pop and shotpoint interval, initial shotpoint number and direction of count.

The system displays along-course and cross-course distance and velocity relative to the great circle line passing through the specified line end points. These displays are also available in the wheel house. The problems of bringing the vessel on line and keeping it there are thus simplified and do not require voluminous preplot tabulations or track plotter charts.

The system described above provides a reliable means of navigation to the accuracy required for geophysical survey work on the continental shelf independent of any shore base support.

217062

# SONAR SYSTEM



217063

SECTION IV

Data Processing:

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Normal Moveout Application and CDP Stacking	50
Relative Amplitude Presentation	51
Migration After Stack	52
Time Variant Filtering	53
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General

217064

Water depths were recorded in fathoms every 40th shotpoint using an Echograph 600 S, model Atlas by Krupp.

A magnetic survey was taken with a Geometrics SSAA magnetometer. The magnetic reel to sensor was 193 meters. A data logger was used to record the survey.

A S/N S88 gravity meter was used for the gravity survey. A data logger was also used for this survey.

The following are descriptions of the programs and procedures in the order in which they were applied.

## INTRODUCTION

Between April 5 and April 8, 1981, Western Geophysical Company shot ten marine seismic lines Offshore Australia, Bass Basin for Perthshire Petroleum, Ltd. This survey was recorded by Party 86 aboard the "Western Odyssey" and covered 168.23 miles. The digital processing for this survey was performed at the Houston Digital Center from April 16 to June 25, 1981.

The navigation system was by navigation satellite. Antenna positions were located by 16/WINS Phase IV equipment. Mapping was performed by Western Geophysical Company in Singapore at a scale of 1 to 100,000.

The seismic recording was done on a DFS V system. The DFS V recorded 124 channels in SEG-B format at a 4 ms. sampling interval for 6 seconds. The field filter settings were a low cut out and a high cut of 64 hz with a slope of 70 db/octave.

The cable used was a 96 group streamer which was pulled at an average depth of 14 meters. Each group consisted of 20 phones with a 25 meter spacing between group centers. (Hydrophone configuration diagram included.)

The energy source consisted of an array of 10 air guns. The array had a volume of 555 cubic inches with 4500 psi. A shot was made every 25 meters at a depth of 6 meters. (Air gun array diagram included.)

Test pops were taken at the start of each line, and noise file strips were made at the beginning and end of each line. Monitor records were produced every 29th shotpoint.

217066

EDIT

The edit program demultiplexed the 96 recorded channels into a trace sequential format retaining the full-word floating point format. No summing of field pops was done.

A near trace section for each line was displayed to check the results of the editing process and to determine velocity analysis locations.

PREPROCESSOR/DECONVOLUTION

217067

Line WB-81-1 of the Squid Survey was selected as a test line. Three types of predictive deconvolution tests were performed on the above line. After reviewing the tests with the client, it was decided that the 4 ms. predictive distance was the optimum decon to use for these data. Operator lengths were also based on autocorrelation information.

The preprocessor program generates common depth family (CDF) ordered tapes which conform to the SEG "exchange tape" specifications incorporating in reel and trace headers all basic information regarding field parameters such as spread distances and line geometry.

Prior to deconvolution a geometric spreading function was applied to compensate for spherical divergence. Deconvolution was then performed using the Weiner-Levinson least squares minimum phase algorithm. The prediction operator was constructed from an autocorrelation function in a time variant manner only in the sense that the autocorrelation start time and resultant operator for each trace was a function of the distance of the trace from the source. A new operator was calculated for each trace. Autocorrelations were computed before and after deconvolution providing a continuing check on the effectiveness of the decon.

217068

## VELOCITY ANALYSIS PROGRAM

Vertical velocities are automatically determined in the VELAN<sup>®</sup> (velocity analysis) program using cross-correlation techniques on deconvolved CDP gathers from the decon program. Two adjacent CDP families were used for each velocity analysis. Cross-correlations for each CDP family were obtained with the output of both families then summed to a single output, i.e., the VELAN velocity table was the average of two consecutive CDP family analyses.

The calcomp plot that was printed and sent to you is a plot of RMS velocity versus two-way time with a cross-correlation output trace at 40 millisecond intervals. Velocity increments of 250 feet per second were used. Velocity analysis locations were determined by examining near trace gathers.

217069

NORMAL MOVEOUT APPLICATION AND CDP STACKING PROGRAM

Normal moveout calculations were performed independently for each trace, with the velocity function being the same for each member of a CDP family. A straight-ray iso-velocity interpolative method was used between velocity analysis locations. Muting was applied after normal moveout and the application of mute was done for each trace, the members of each CDP family were summed together to produce a stacked output trace. Each sample of time of the stacked output trace was then divided by the number of "live" samples at that time which were summed to produce that stacked sample. Effectively, this retains relative recorded time-varying amplitude of the trace.

Quality control of the applied velocity functions was performed by outputting a stack monitor section. Where deemed necessary, revised velocity functions were used to compute residual normal moveout corrections for the final stack sections.

217070

RAP® PROCESS

A Relative Amplitude Preservation (RAP) section was produced on selected lines picked by the client.

To produce the RAP section the no-gain stack tape was run through an amplitude decay analysis in order to obtain a set of multipliers to compensate for the loss of energy at depth.

An average set of multipliers was used for the area and applied to the stack in the residual amplitude compensation program.

The data was then filtered with a 6-60 band pass for the final RAP display.

217071

## MIGRATION AFTER STACK

The finite-difference method of migration was used for this data. In this program approximations are first made to the Scalar wave equation itself rather than an integral solution, such as used in the diffraction-summation program. This method, is accomplished by propagating waves recorded at the earth's surface backward in time down into the subsurface until scatterers or reflectors are encountered. This backward propagation is accomplished by using discrete (finite-difference) approximations to a differential equation that governs wave motion and results in a migration of the data into a position closely approximating their true position in space.

217072

## TIME VARIANT FILTERING PROGRAM

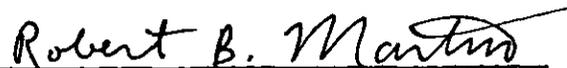
Time variant zero phase digital filter tests were run to determine the optimum filter pass-bands and times of application. Filter pass-bands at 70% response points and times of application are noted in the section headers for each line and these times are linearly variable in order to follow structural trends. The filters were designed with 18 db. slope and 36 db. slope, respectively, on the low and high frequency sides at 3 db. down on the amplitude plot.

217073

CONCLUSION

All final sections were checked for quality and approved prior to release. All questionable data were investigated and revised where necessary prior to shipping. All sections were displayed with a vertical scale of 3.75 inches per second and a horizontal scale of 32 traces per inch.

  
\_\_\_\_\_  
Soule M. Mellette, Manager  
Marine Processing

  
\_\_\_\_\_  
Robert B. Martin, Assistant  
Supervisor Data Processing

Synthetic Seismograms:

Introduction

55

## SYNTHETIC SEISMOGRAMS

217075

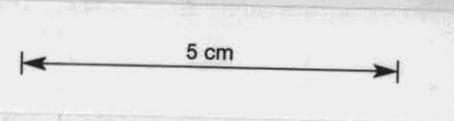
### Introduction

Sonic logs acquired of the Bass #2, Comorant #1, Durroon #1, Pelican #1 and Konkon #1 wells were sent to Geoscience Technology Services Corporation for editing and digitization. Within the Eastern View Coal Measures care had to be taken to edit the sharp spikes created by the individual coal beds, otherwise a high amplitude event would have been produced thereby effectively masking the immediate underlying reflectors, as the synthetic process requires a short recovery period. A series of synthetic seismograms were then produced from the calculated reflection coefficients by convolving the latter with Ricker wavelets of 20 hz, 30 hz and 40 hz respectively. Formation tops and ages were then plotted on the display, for ease in reflector identifications. They were then displayed on a vertical scale of 3.75 inches/second, comparable to the seismic sections on hand. In general, the 40 hz seismogram correlated more favorably with the seismic data which intersected the individual wells.

The units most easily correlated were the Oligocene/Eocene Shale contact and the Eocene Shale/Eastern View Coal Measures contact. All of the wells except Durroon #1 correlated favorably, the Eocene Shale providing an excellent marker along with the Eastern View Coal Measures. Where igneous rocks were encountered (Bass #2, Konkon #1, Durroon #1) a seismic event corresponding to the high increase in interval velocity was produced, amplitudes varying with each type of igneous rocks, particularly at the Durroon #1 well where basalts were encountered at the top of Lower Cretaceous.

In general, Synthetic Seismograms were a great aid in correlating seismic events throughout the section. They were especially helpful in identifying reflectors beneath the Eastern View Coal Measures which produced a series of multiples which effectively mask the underlying events.

# SYNTHETIC SEISMOGRAM



## GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

ESSO EXPLORATION BASS 2 WILDCAT AUSTRALIA TASMANIA

W

LOG DATUM = 31

SEISMIC DATUM = 0

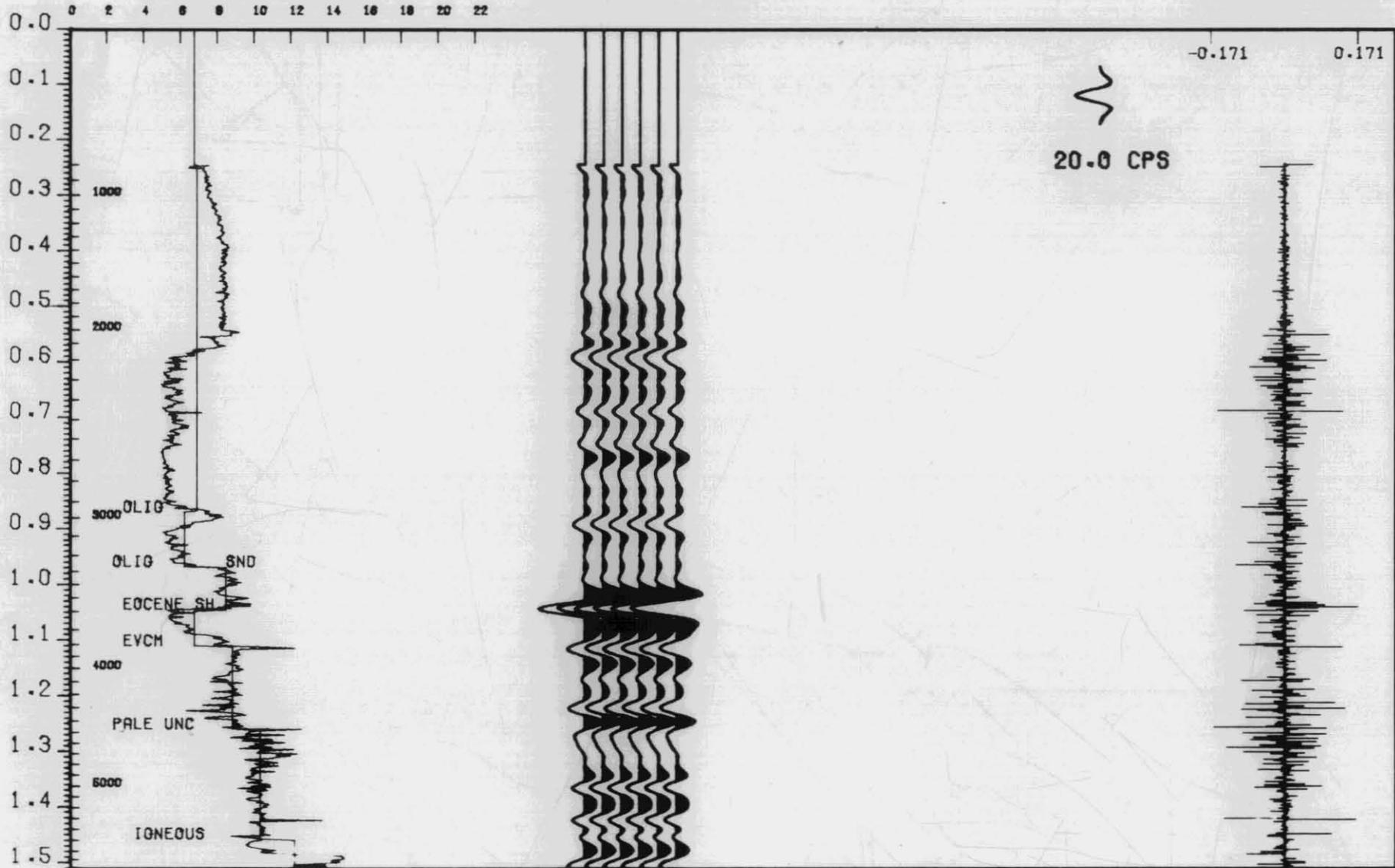
COMMENTS \_\_\_\_\_

PLATE 10

INTERVAL VELOCITY  
FT-SEC  $\times$  1000

SYNTHETIC SEIS  
(FROM SONIC LOG)

REFLECTION  
COEFFICIENTS



217076

# SYNTHETIC SEISMOGRAM

5 cm

## GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

ESSO EXPLORATION BASS 2 WILDCAT AUSTRALIA TASMANIA

W

LOG DATUM = 91

SEISMIC DATUM = 0

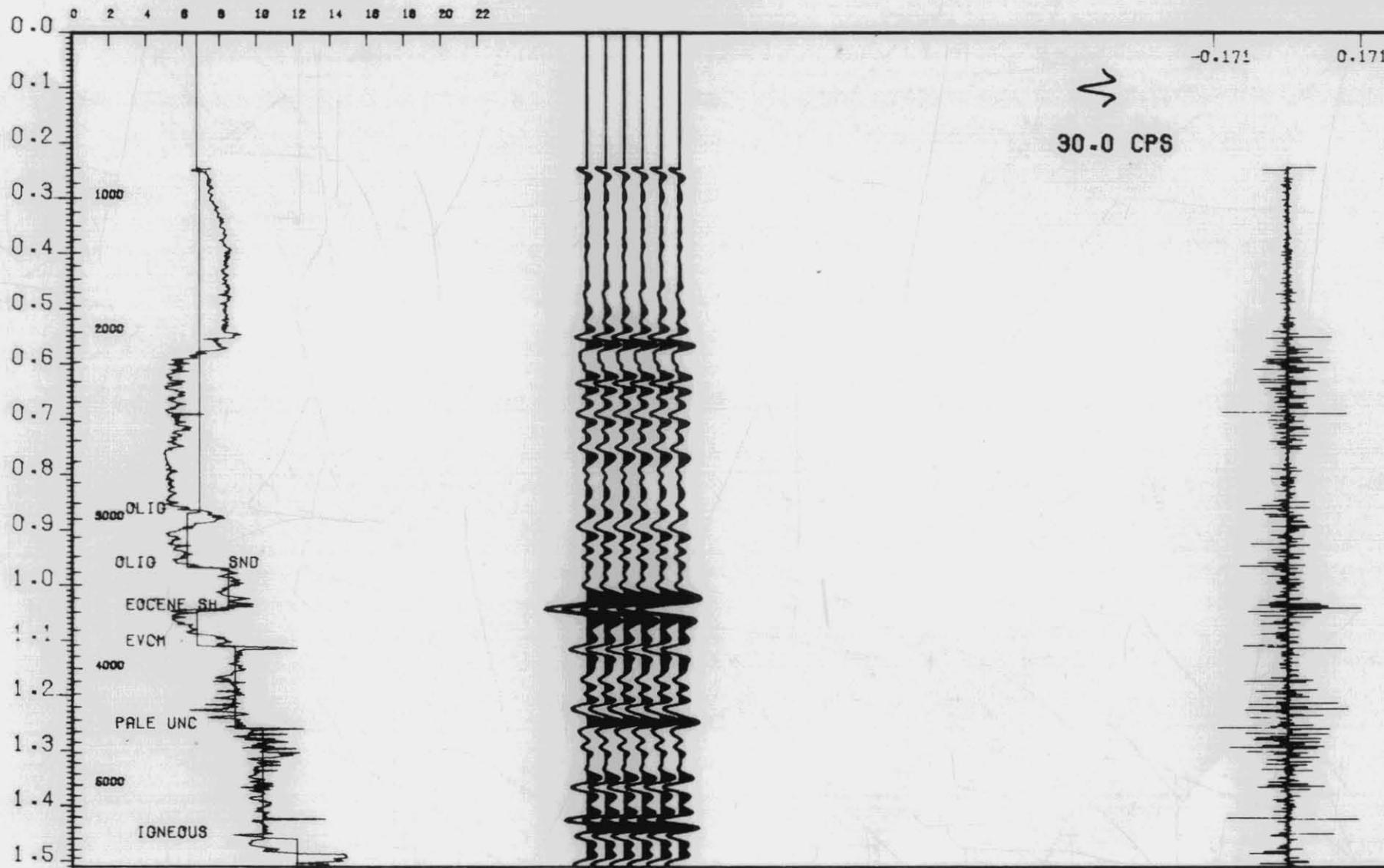
COMMENTS \_\_\_\_\_

PLATE 11

INTERVAL VELOCITY  
FT-SEC \* 1000

SYNTHETIC SEIS  
(FROM SONIC LOG)

REFLECTION  
COEFFICIENTS



217022

# SYNTHETIC SEISMOGRAM

5 cm

## GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

ESSO EXPLORATION BASS 2 WILDCAT AUSTRALIA TASMANIA

W

LOG DATUM = 31

SEISMIC DATUM = 0

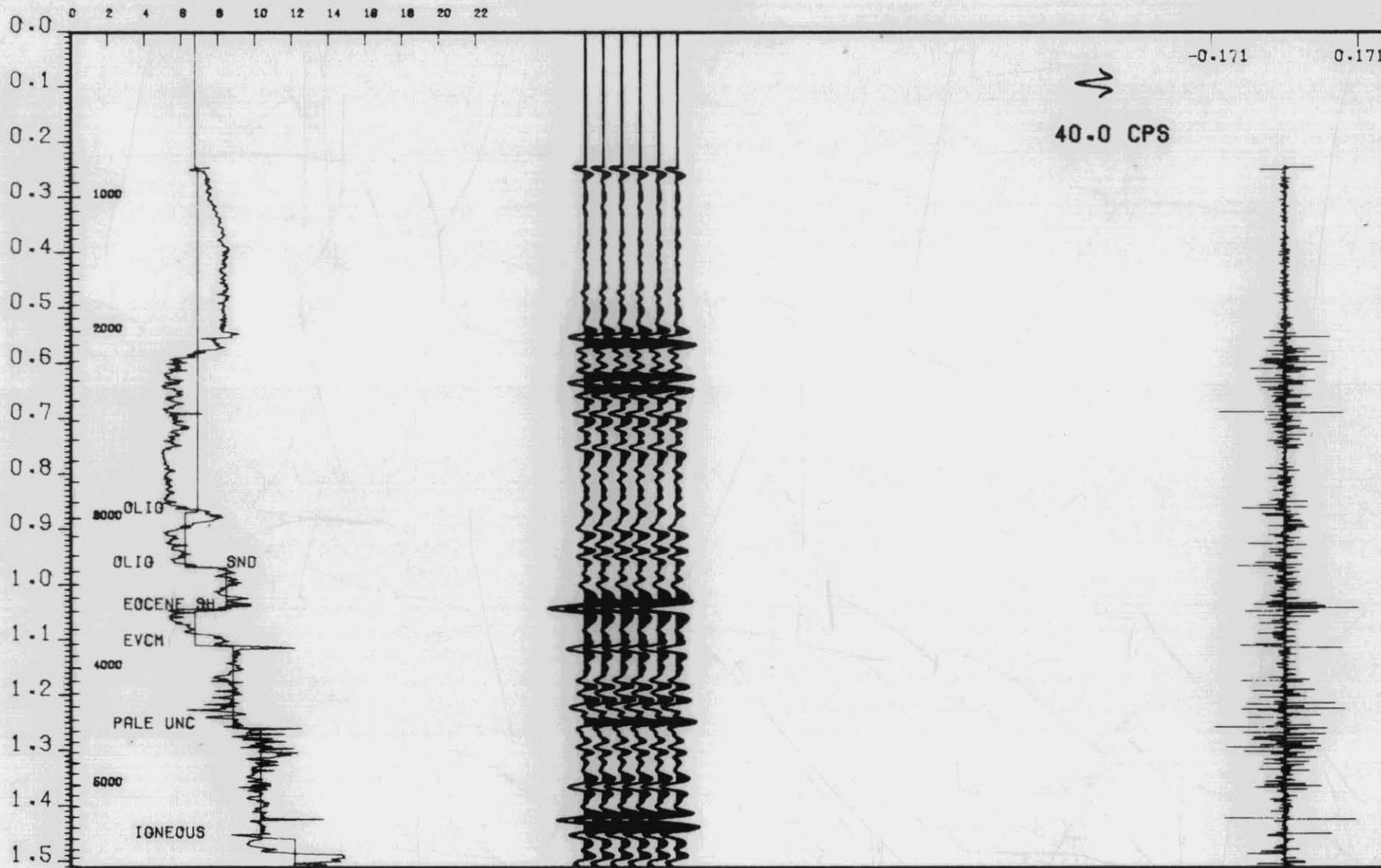
COMMENTS \_\_\_\_\_

PLATE 12

INTERVAL VELOCITY  
FT-SEC \* 1000

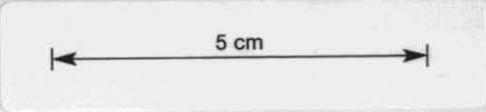
SYNTHETIC SEIS  
(FROM SONIC LOG)

REFLECTION  
COEFFICIENTS



217078

# SYNTHETIC SEISMOGRAM



## GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

ESSO AUSTRALIA LTD. KONKON 1 WILDCAT AUSTRALIA TASMANIA

W

LOG DATUM = 32

SEISMIC DATUM = 0

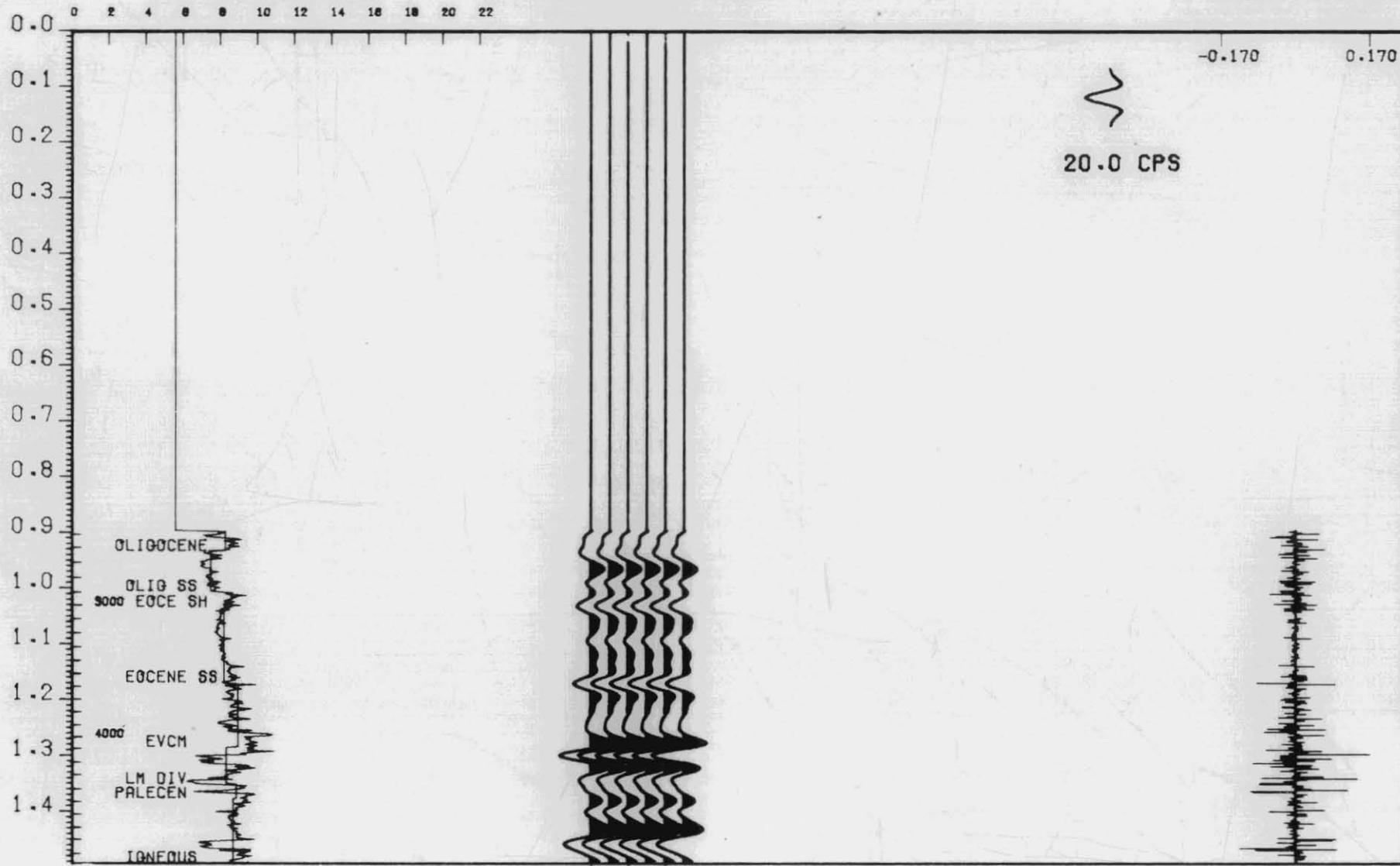
COMMENTS \_\_\_\_\_

PLATE 13

INTERVAL VELOCITY  
FT-SEC \* 1000

SYNTHETIC SEIS  
(FROM SONIC LOG)

REFLECTION  
COEFFICIENTS



217079



# SYNTHETIC SEISMOGRAM

5 cm

## GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

ESSO AUSTRALIA LTD. KONKON 1 WILDCAT AUSTRALIA TASMANIA

N

LOG DATUM = 32

SEISMIC DATUM = 0

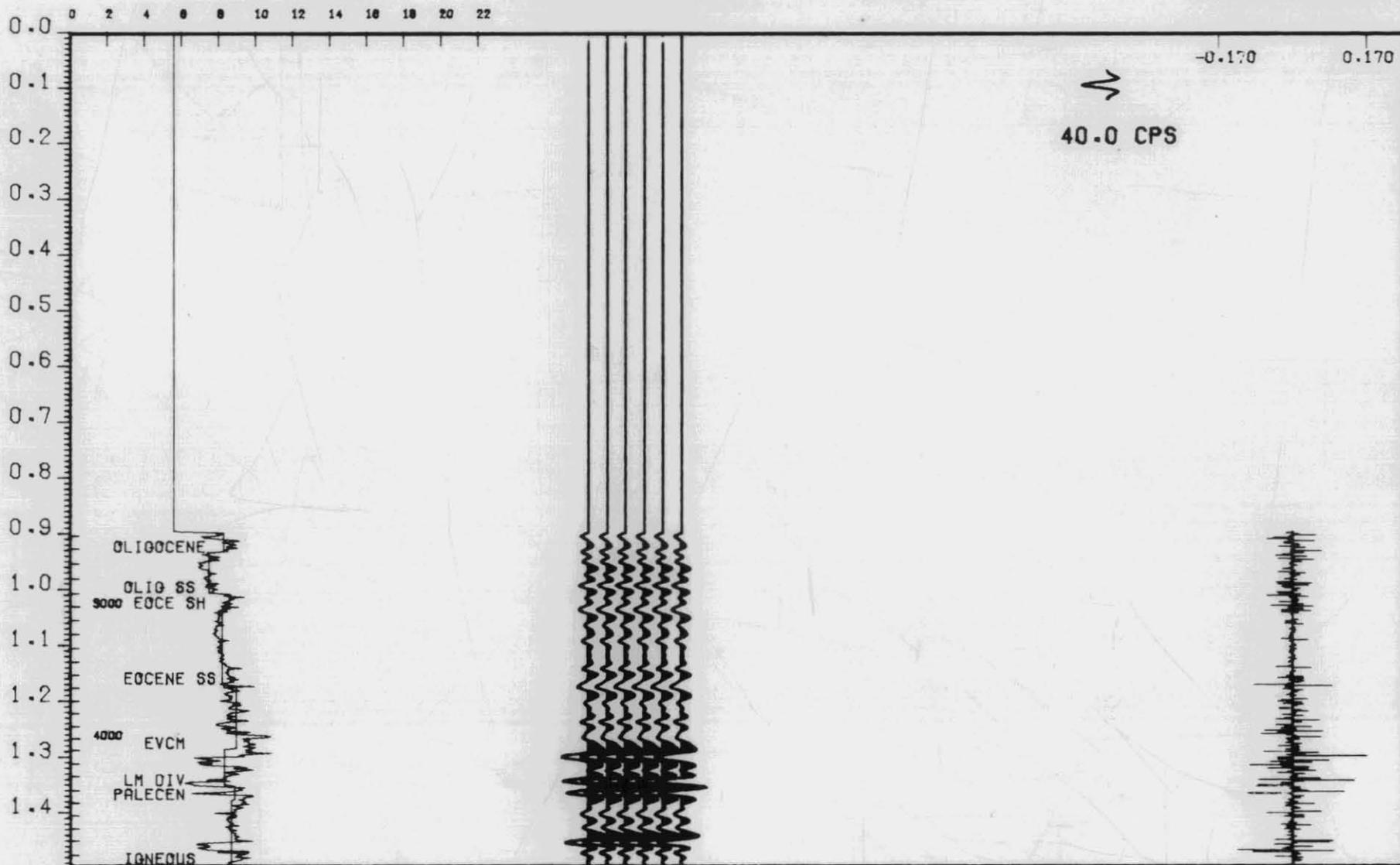
COMMENTS \_\_\_\_\_

PLATE 15

INTERVAL VELOCITY  
FT-SEC  $\times 1000$

SYNTHETIC SEIS  
(FROM SONIC LOG)

REFLECTION  
COEFFICIENTS



217081

# SYNTHETIC SEISMOGRAM

GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

ESSO AUSTRALIA LTD DURROON 1 WILDCAT AUSTRALIA TASMANIA

W

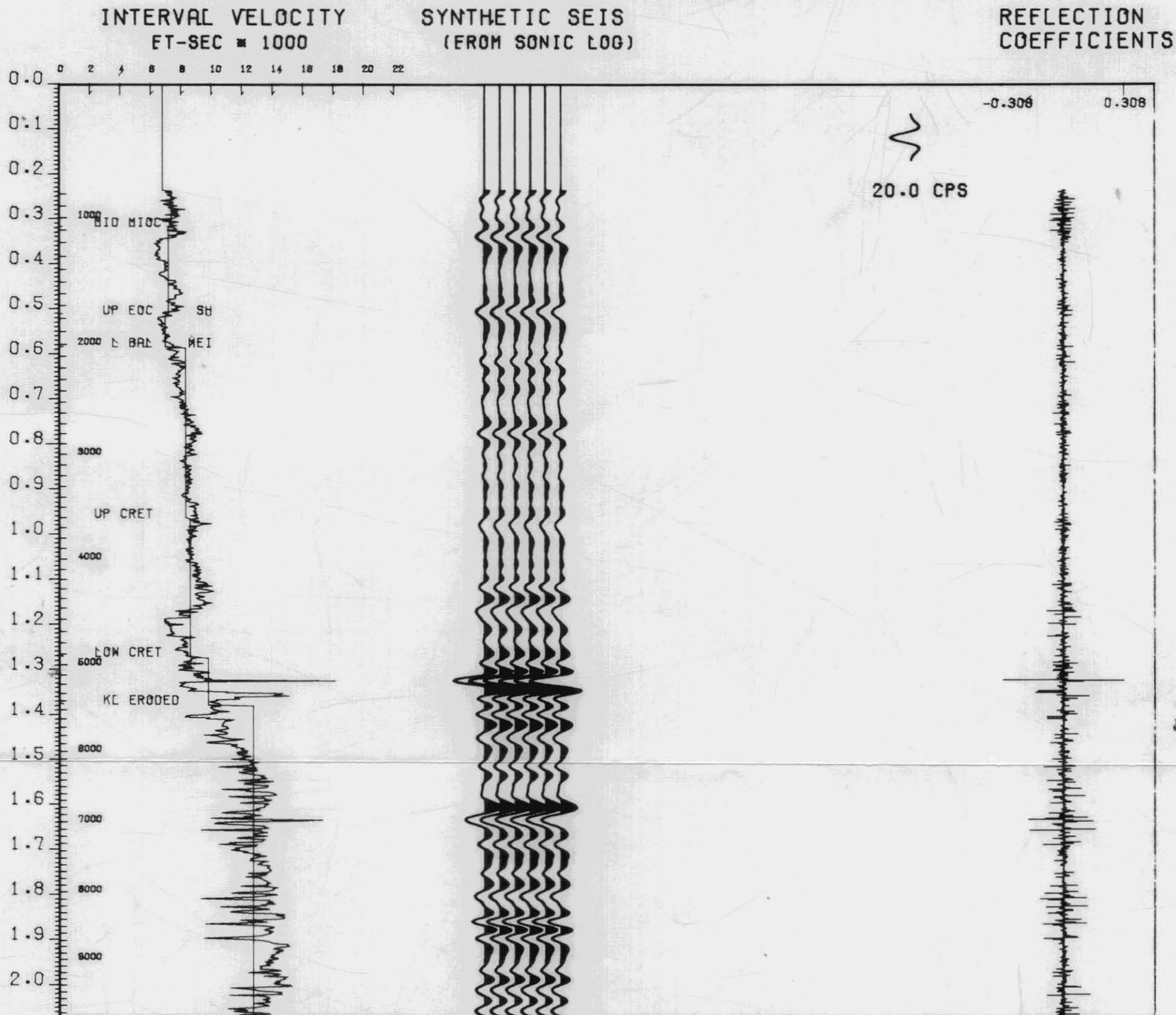
LOG DATUM = 32

SEISMIC DATUM = 0

COMMENTS \_\_\_\_\_

5 cm

PLATE 16



217082

# SYNTHETIC SEISMOGRAM

5 cm

## GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

ESSO AUSTRALIA LTD DURROON 1 WILDCAT AUSTRALIA TASMANIA

W

LOG DATUM = 32

SEISMIC DATUM = 0

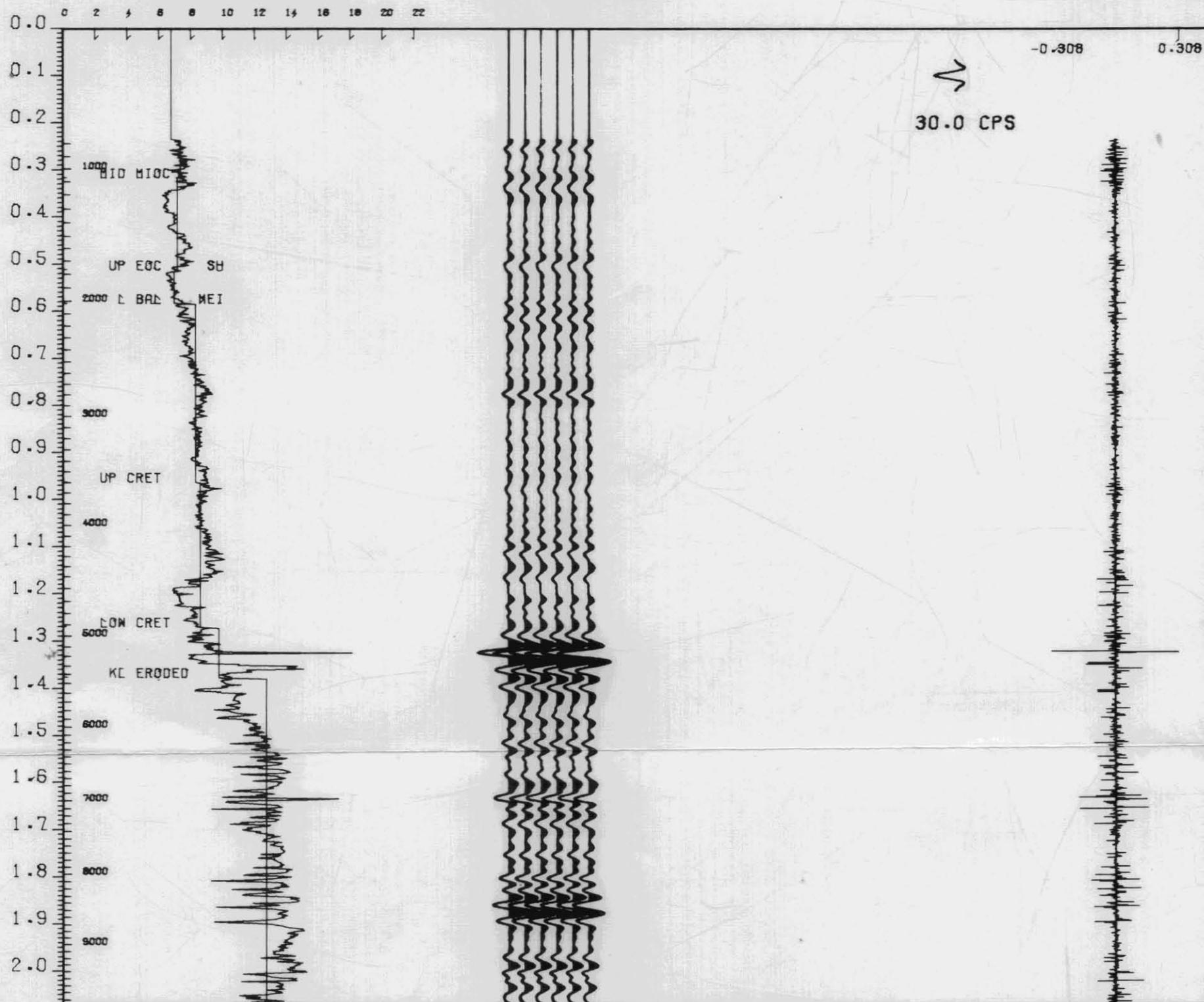
COMMENTS \_\_\_\_\_

PLATE 17

INTERVAL VELOCITY  
FT-SEC \* 1000

SYNTHETIC SEIS  
(FROM SONIC LOG)

REFLECTION  
COEFFICIENTS



217083

# SYNTHETIC SEISMOGRAM

5 cm

## GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

ESSO AUSTRALIA LTD DURROON 1 WILDCAT AUSTRALIA TASMANIA

W

LOG DATUM = 32

SEISMIC DATUM = 0

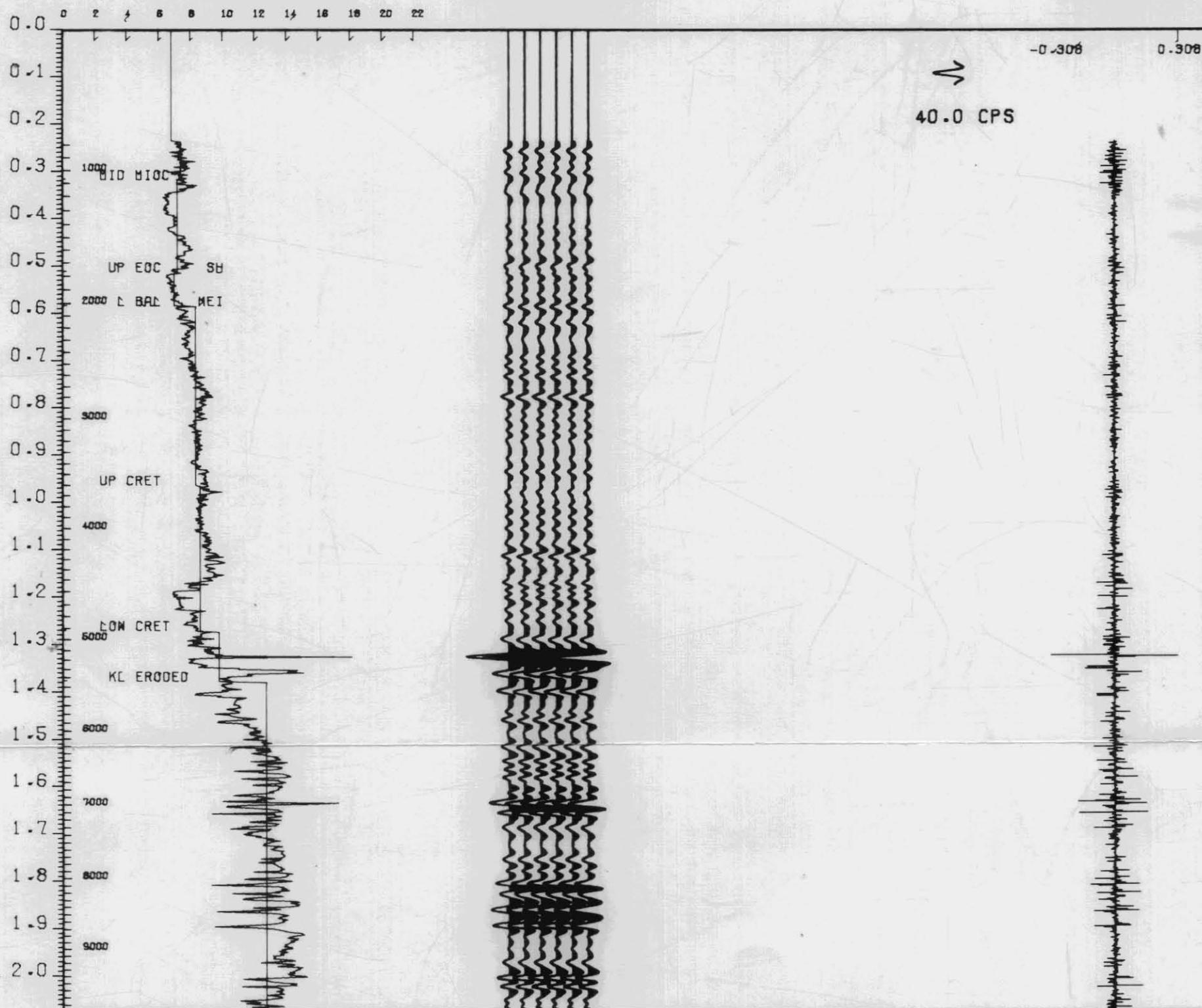
COMMENTS \_\_\_\_\_

PLATE 18

INTERVAL VELOCITY  
FT-SEC \* 1000

SYNTHETIC SEIS  
(FROM SONIC LOG)

REFLECTION  
COEFFICIENTS



# SYNTHETIC SEISMOGRAM

GTS CORP.

HOUSTON OFFICE 3 24 DDCBA 77018

5 cm

ESSO EXP & PROD AUSTRALIA INC CORMORANT 1 AUSTRALIA TASMANIA

W

LOG DATUM = 100

SEISMIC DATUM = 0

COMMENTS \_\_\_\_\_

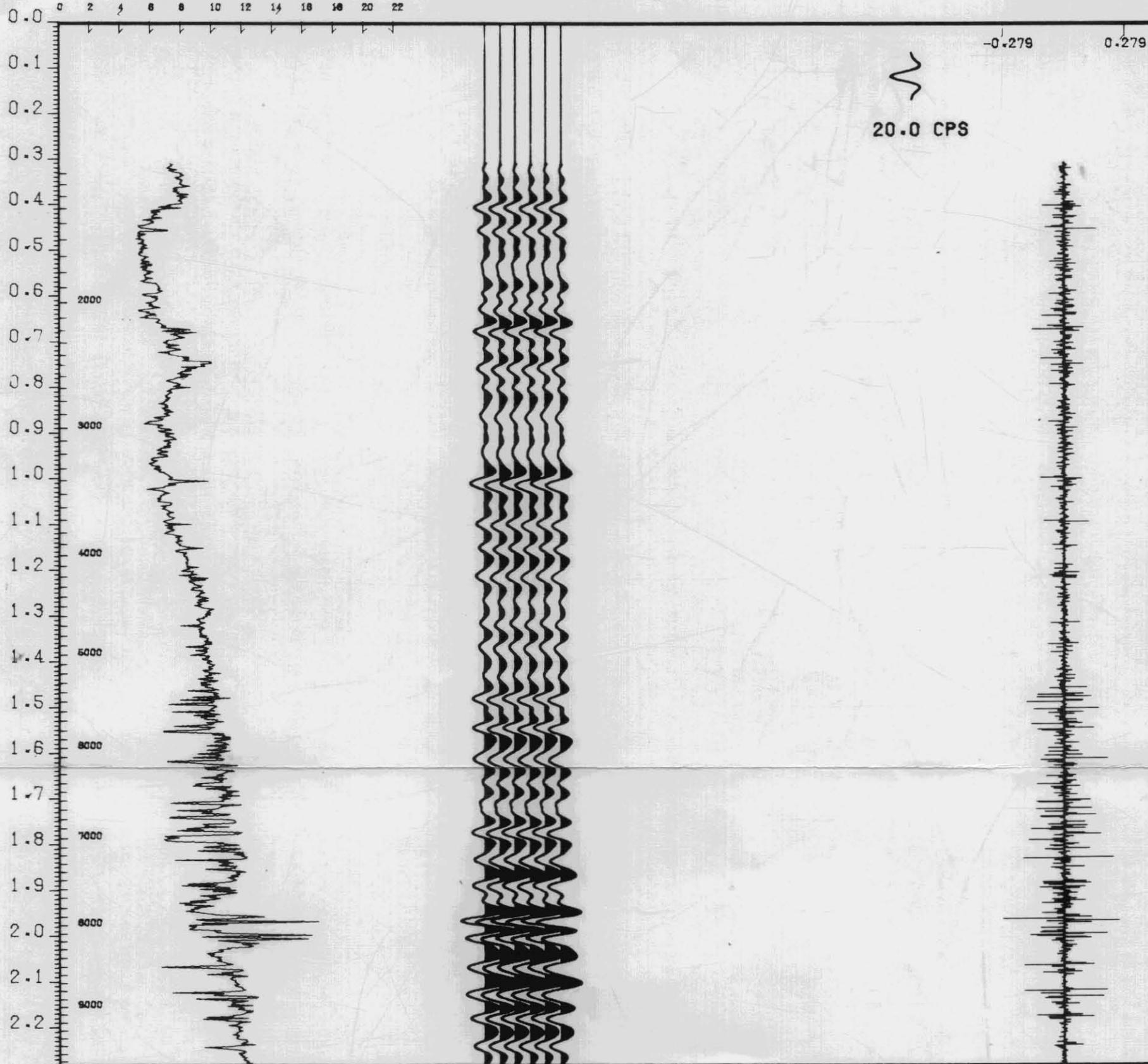
PLATE 19

INTERVAL VELOCITY  
FT-SEC \* 1000

SYNTHETIC SEIS  
(FROM SONIC LOG)

REFLECTION  
COEFFICIENTS

0 2 4 6 8 10 12 14 16 18 20 22



217085

# SYNTHETIC SEISMOGRAM

GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

ESSO EXP & PROD AUSTRALIA INC CORMORANT 1 AUSTRALIA TASMANIA

LOG DATUM = 100

SEISMIC DATUM = 0

COMMENTS \_\_\_\_\_

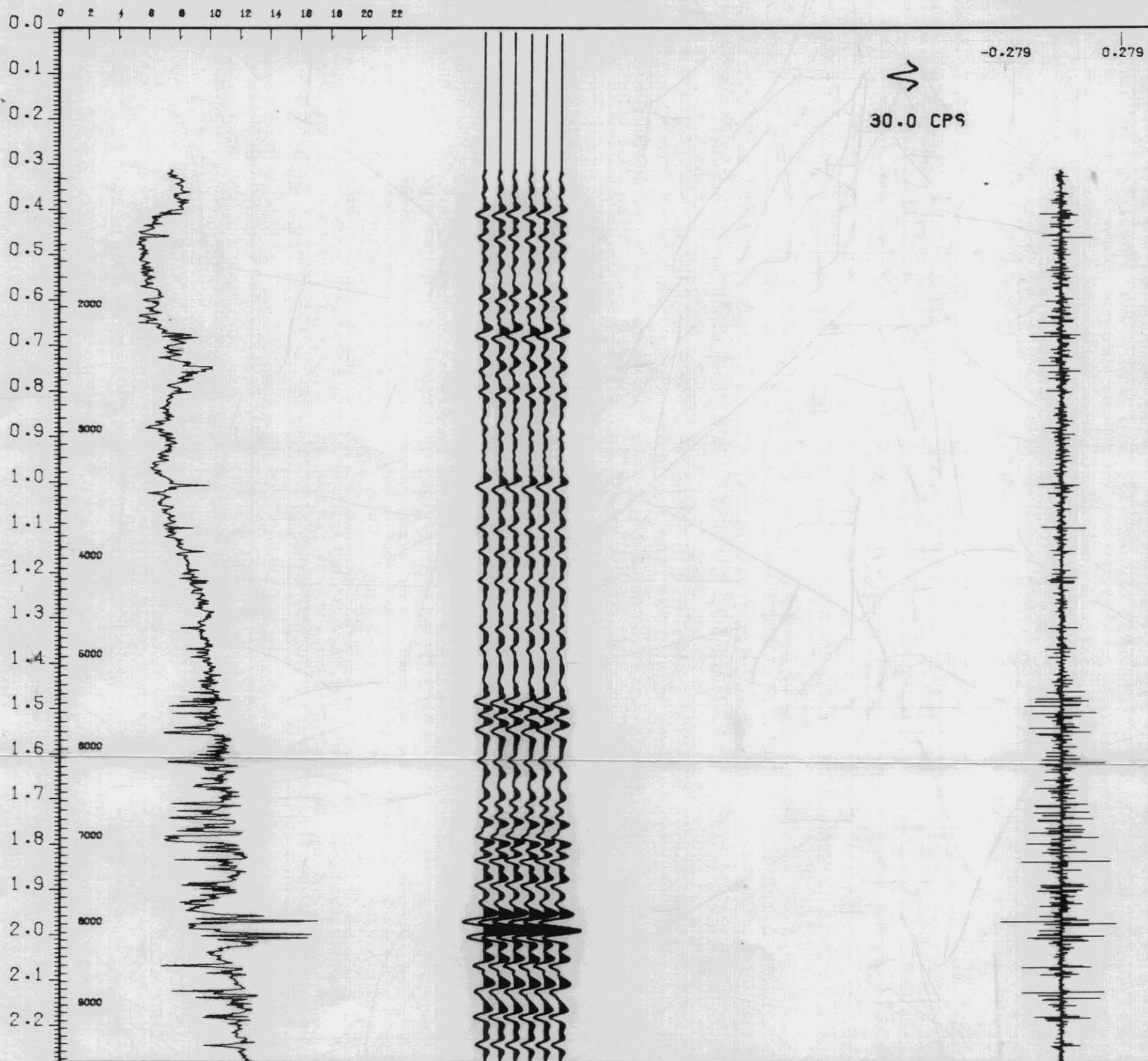
5 cm

PLATE 20

INTERVAL VELOCITY  
FT-SEC \* 1000

SYNTHETIC SEIS  
(FROM SONIC 100)

REFLECTION  
COEFFICIENTS



217086

# SYNTHETIC SEISMOGRAM

GTS CORP.

HOUSTON OFFICE 3/24 WACODH 77018

5 cm

ESSO EXP & PROD AUSTRALIA INC CORPORANT 1 AUSTRALIA TASMANIA

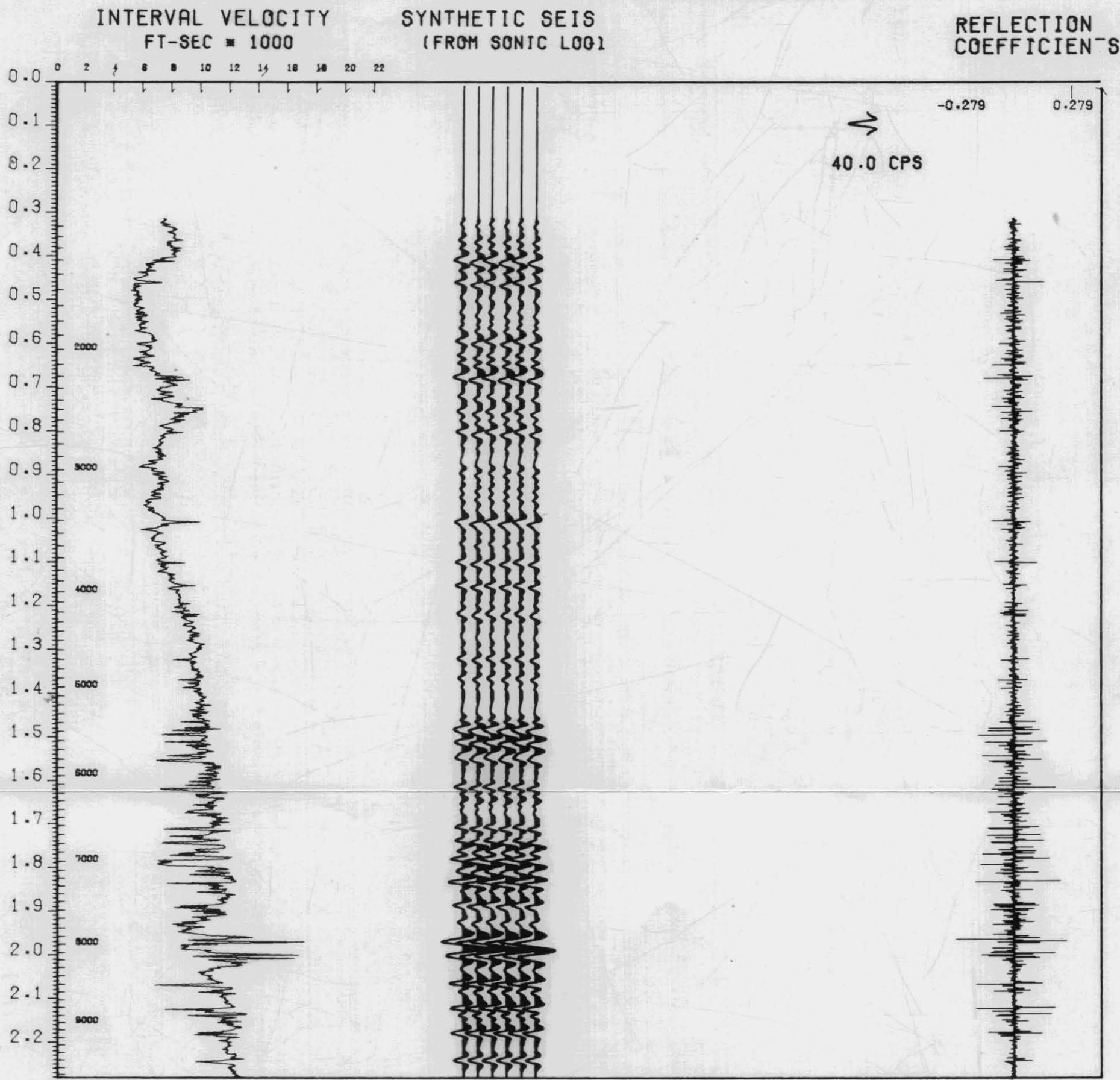
W

LOG DATUM = 100

SEISMIC DATUM = 0

COMMENTS \_\_\_\_\_

PLATE 21



217087

# SYNTHETIC SEISMOGRAM

GTS CORP.

HOUSTON OFFICE 3004 BROADWAY 0.8

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

LOG DATUM = 100

SEISMIC DATUM = 0

COMMENTS \_\_\_\_\_

5 cm

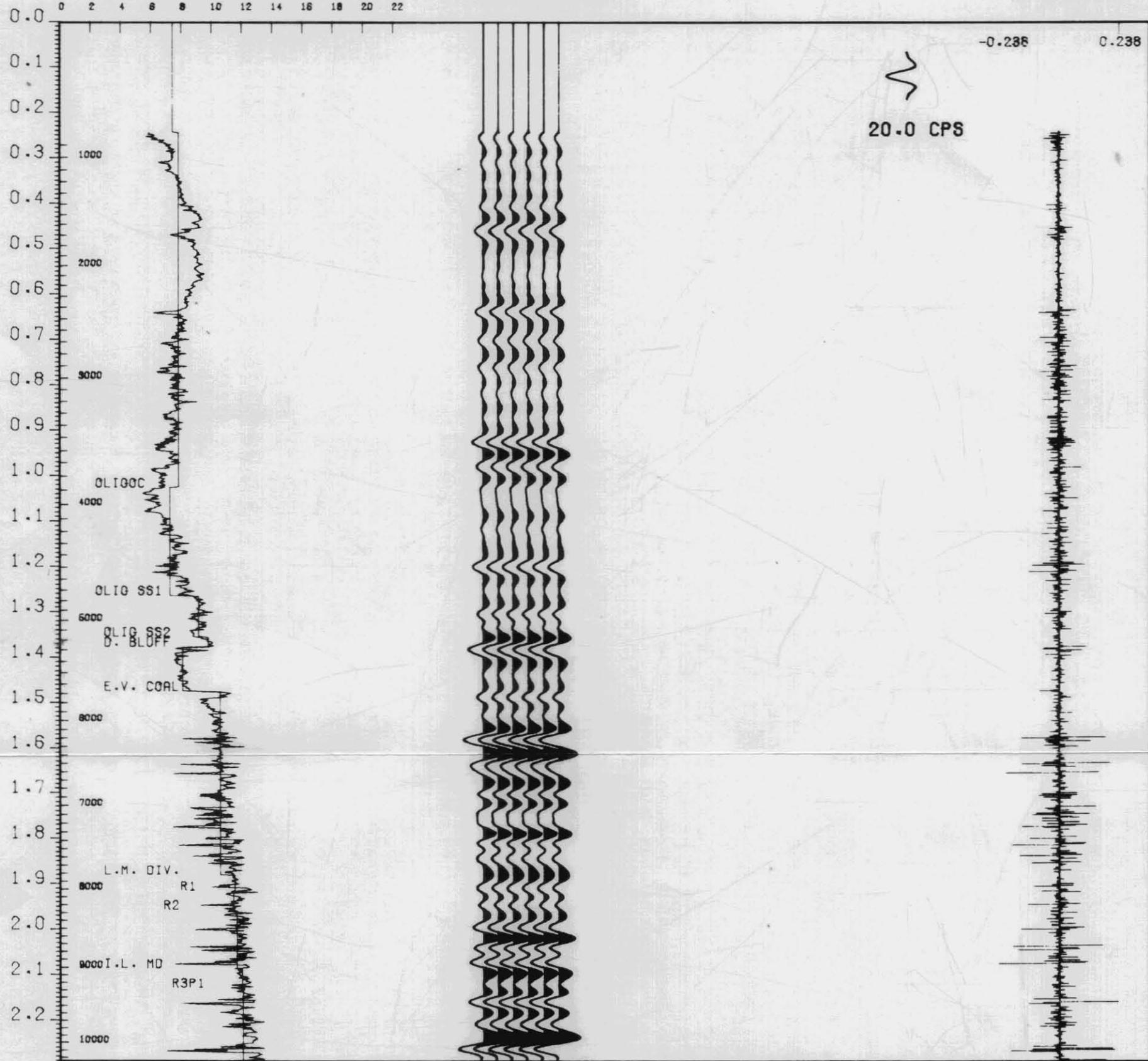
PLATE 22

INTERVAL VELOCITY  
FT-SEC \* 1000

SYNTHETIC SEIS  
(FROM SONIC LOG)

REFLECTION  
COEFFICIENTS

0 2 4 6 8 10 12 14 16 18 20 22



217088

# SYNTHETIC SEISMOGRAM

GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

5 cm

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

W

LOG DATUM = 100

SEISMIC DATUM = 0

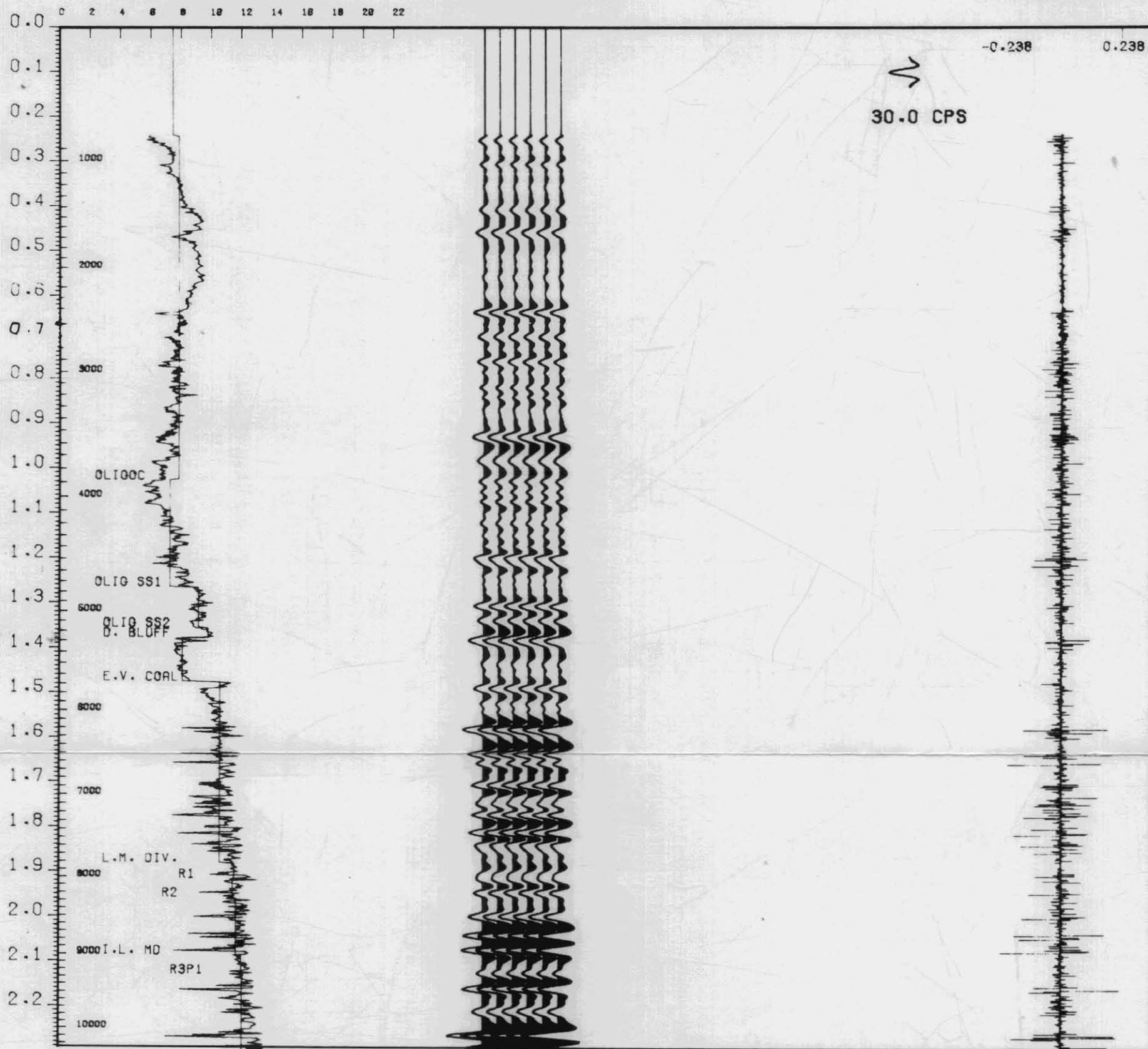
COMMENTS \_\_\_\_\_

P-ATE 23

INTERVAL VELOCITY  
FT-SEC \* 1000

SYNTHETIC SEIS  
(FROM SONIC LOG)

REFLECTION  
COEFFICIENTS



217089

# SYNTHETIC SEISMOGRAM

GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

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

LOG DATUM = 100

SEISMIC DATUM = 0

COMMENTS \_\_\_\_\_

5 cm

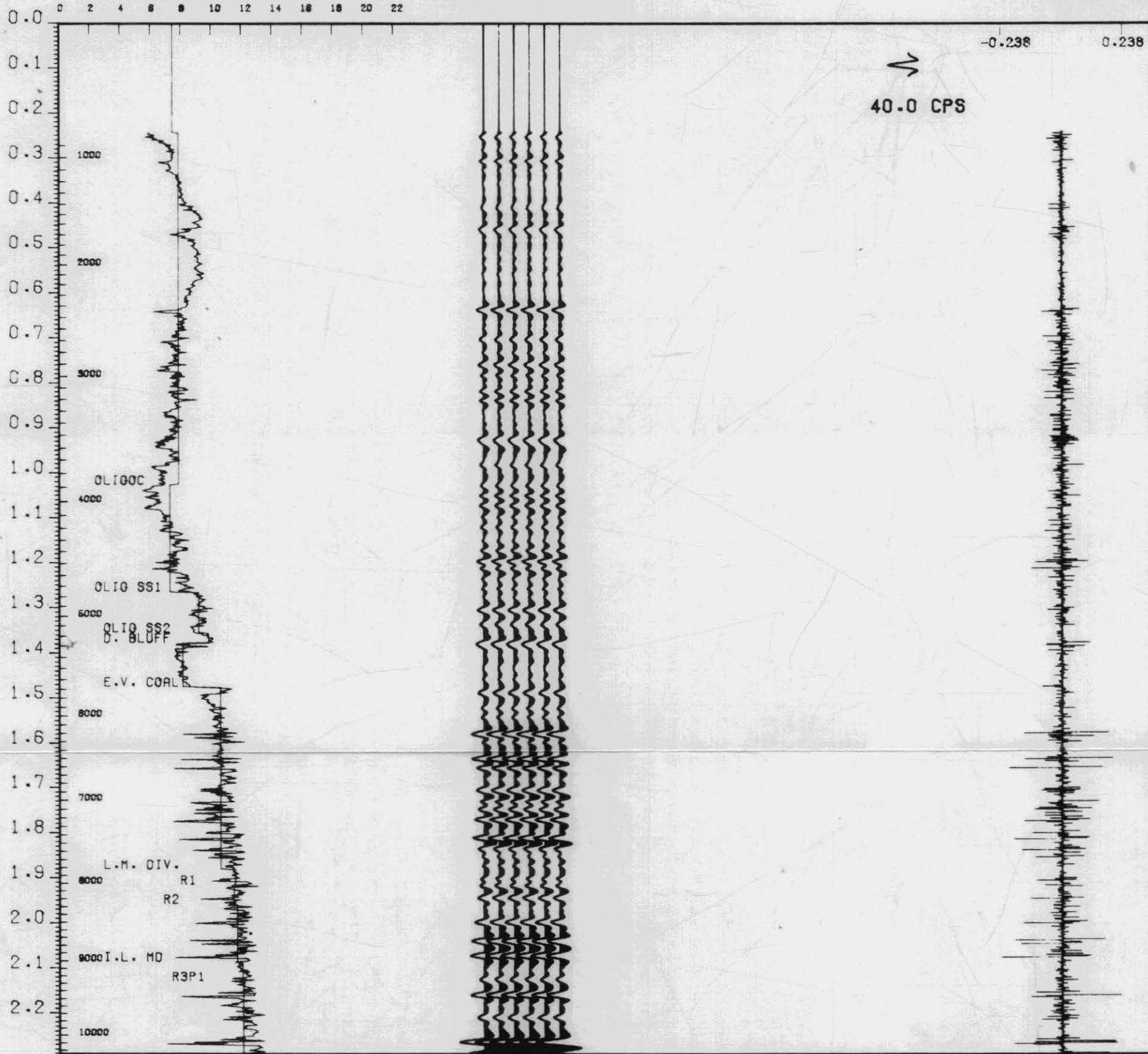
PLATE 24

INTERVAL VELOCITY  
FT-SEC \* 1000

SYNTHETIC SEIS  
(FROM SONIC LOG)

REFLECTION  
COEFFICIENTS

0.0 2 4 6 8 10 12 14 16 18 20 22



217090

SECTION IV<sub>b</sub>  
GRAVITY/MAGNETIC DATA PROCESSING

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Final Profiles	60

217092

GRAVITY/MAGNETIC DATA PROCESSING

IN

OFFSHORE TASMANIA  
CROCODILE ROCK  
AREA

FOR

PERTSHIRE PETROLEUM, LTD.

BY

AERO SERVICE DIVISION  
WESTERN GEOPHYSICAL COMPANY  
OF AMERICA

AUGUST, 1981

217093

## THE GRAVITY MAGNETIC SURVEY

The gravity/magnetic field survey was performed between April 5, 1981 and April 8, 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 980025.53 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.

## 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 the gravity meter had malfunctioned on line WB-81-3.

This 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 the 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 a 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,  $7.503 V \cos(\text{Latitude}) \times \sin(\text{Course}) + .004154 V^2$ , 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's survey. Upon completion, the data is then output onto a 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 corrections 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.

### 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 maps are bounded on the South by latitude  $39^{\circ} 35'S$  on the North by latitude  $39^{\circ} 10'S$  and extends eastward from longitude  $144^{\circ} 15'E$  to longitude  $145^{\circ} 15'E$ .

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 graded 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.

217098

GRAVITY-MAGNETICS GMI INTERMEDIATE RECORD FORMAT

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.

## SECTION V

Interpretation:

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General

The Crocodile Rock Survey is of a regional nature. Its main purpose is to compare resolution and penetration of new seismic versus the older data in areas where some interesting structural leads are indicated.

It will be obvious that the interpretation is mostly incomplete due to the complexity of the area and the generally poor data quality.

Map Horizon

A semi-continuous horizon, the M. diversus Reflector, has been mapped. Its exact stratigraphic position is not well known due to lack of stratigraphic control.

Structural Features of Interest

At this stage of the interpretation no major feature has been identified.

217101

SECTION VI

List of Plates:

- 1) Location Map
- 2) Lines Location
- 3) Vessel and Cable layout
- 4) Gun Array Configuration
- 5) Hydrophone Configuration
- 6) Group Cable Configuration
- 7) Main Cable Phase lead, Output  
Sensitivity, Frequency Spectrum
- 8) Recording Diagram
- 9) Sonar System Diagram
- 10/11/12) Synthetic Seismogram - Bass #2
- 13/14/15) Synthetic Seismogram - Konkon #1
- 16/17/18) Synthetic Seismogram - Durroon #1
- 19/20/21) Synthetic Seismogram - Cormorant #1
- 22/23/24) Synthetic Seismogram - Pelican #1

SECTION VII

217102

Basic Data Submitted

Velocity Analysis VELAN<sup>R</sup>

Time Variant Filtering

MIG, TVF

Seismic Lines with:

Magnetics Intensity (GAMMAS) &

Bouguer Gravity (MGALS) Profiles

Bouguer Gravity Profiles Showing:

Bouguer Gravity (MGALS)

Adj. Free Air Gravity (MGALS)

Filtered Eotvos Gravity (MGALS)

Water Depth (Meters)

Magnetics Profile Showing:

Total Magnetics Intensity (GAMMAS)

Raw Magnetics (GAMMAS)

Bouguer Gravity Map - C.1. = 1MGAL - Density = 2.2

Depth to Magnetic Basement Map

Shot Point Location With Water Depth in Feet Map

Shot Point Location Map

Total Magnetics Anomaly Map - C.1. = 10 GAMMAS

Velocity Analysis VELAN<sup>R</sup>

217103

Line PB-81-9M Sp 100-2849  
Line PB-81-10M Sp 100-523  
Line PB-81-10M Sp 460-1100  
Line PB-81-10M Sp 1051-2469  
Line PB-81-11M Sp 100-1645  
Line PB-81-12M Sp 100-1271  
Line PB-81-13M Sp 100-1494  
Line PB-81-15M Sp 100-1695

Time Variant Filtering

Line PB-81-09M Sp 100-2849  
Line PB-81-10M Sp 100-523, 460-1100- 1051-2469  
Line PB-81-11M Sp 100-1645  
Line PB-81-12M Sp 100-1271  
Line PB-81-13M Sp 100-1494  
Line PB-81-15M Sp 100-1695

MIG,TVF

Line PB-81-09M Sp 100-2849  
Line PB-81-10M Sp 100-523, 460-1100, 1051-2469  
Line PB-81-11M Sp 100-1645  
Line PB-81-12M Sp 100-1271  
Line PB-81-13M Sp 100-1494  
Line PB-81-15M Sp 100-1695

217104

SEISMIC LINES WITH:

Magnetics Intensity (GAMMAS) &  
Bouguer Gravity (MGALS) Profiles

Line PB-81-9M	Sp 95-2848
Line PB-81-10M	Sp 99-2465
Line PB-81-11M	Sp 99-1639
Line PB-81-12M	Sp 94-1265
Line PB-81-13M	Sp 119-1508
Line PB-81-15M	Sp 98-1689

BOUGUER GRAVITY PROFILES SHOWING:

Bouguer Gravity (MGALS)  
Adj. Free Air Gravity (MGALS)  
Filtered Eotvos Gravity (MGALS)  
Water Depth (Meters)

Line PB-81-9M	Sp 95-2848
Line PB-81-10M	Sp 99-2465
Line PB-81-11M	Sp 99-1639
Line PB-81-12M	Sp 94-1265
Line PB-81-13M	Sp 119-1508
Line PB-81-15M	Sp 98-1689

MAGNETICS PROFILE SHOWING:

Total Magnetics Intensity (GAMMAS)  
Raw Magnetics (GAMMAS)

Line PB-81-9M	Sp 95-2848
Line PB-81-10M	Sp 99-2465

217105

Line PB-81-11M Sp 99-1639

Line PB-81-12M Sp 94-1265

Line PB-81-13M Sp 119-1508

Line PB-81-15M Sp 98-1689

BOUGUER GRAVITY MAP - C.l. = 1MGAL - Density = 2.2

DEPTH TO MAGNETIC BASEMENT MAP

SHOT POINT LOCATION WITH WATER DEPTH IN FEET MAP

SHOT POINT LOCATION MAP

TOTAL MAGNETICS ANOMALY MAP - C.l. = 10 GAMMAS

SECTION VIII

217106

Interpretive Data Submitted:

- Seismic Time Structure Map
- M. diversus Reflector

