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STONEY HEAD

BASS STRAIT

TASMANIA

MARINE SEISMIC SURVEY

1981

FINAL REPORT

STONEY HEAD

MARINE SEISMIC SURVEY

1981

TASMANIA

PERMIT T-16/P

for

WEAVER OIL AND GAS CORPORATION
5599 SAN FELIPE, SUITE 1100
HOUSTON, TEXAS 77056-2795

and

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

by

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

Submitted by
Weaver Oil and Gas Corporation
Houston, Texas

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.

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

$IV)_a$ Synthetic Seismograms

$IV)_b$ Gravity/Magnetic Data Processing

V) Interpretation

VI) List of Plates

VII) Basic Data Submitted

VIII) Interpretive Data Submitted

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General Information:

GENERAL INFORMATION

Introduction

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

DATE	EVENT
April 2	In production, completed lines WB81-11, WB81-14 and WB81-13.
April 3	In production, completed lines WB81-12, WB81-15, WB81-21 and commenced WB81-19.
April 4	In production, completed lines WB81-19, WB81-20 and WB81-22. 2045 hrs - commenced bringing equipment on board. 2250 hrs - equipment and streamer cable on board, vessel began making way to Crocodile Rock Survey area.

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 northwestern-southeastern direction which is parallel or subparallel to the present basin axis.

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

Pelican #1

Pelican #2

Pelican #3

Pelican #4

Poonboon #1

Nangkero #1

Durroon #1

Narimba #1

Tarook #1A

Bass #3

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

Aroo #1

Bass #1

Cormorant #1

Toolka #1

Konkon #1

Bass #2

Yurongi

Dondu #1

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 siltstones and shales capable of sealing the trap.

The Pelican #2 well was drilled in 1970 to a measured depth of 10,066 feet (3,068.12 meters) penetrating a section ranging in age from Recent to Eocene. The well was located 2.5 miles northwest of the Pelican #1 discovery well. The first overpressured sand was encountered at 9,779 feet. Pelican #2 intersected numerous sands which are interpreted to contain gas-condensate. Sand bodies interpreted to contain hydrocarbons above 8,700 feet in the Pelican #1 well were either not present or water bearing in Pelican #2. The first hydrocarbon bearing sand was recognized at 9,096 feet and the well eventually bottomed in a high pressure zone without drilling through the hydrocarbon column into water bearing formations.

The Pelican #3 well was drilled in 1972 to a measured depth of 9,537 feet (2,906.88 meters) penetrating a section ranging in age from Recent to Paleocene. The prognozed pay section found in the Pelican #1 and #2 wells was not encountered. However, minor gas shows were reported whilst drilling the Paleocene section. Abnormal pressure was encountered at approximately 8,432 feet and the sands below this depth were tight.

The Pelican #4 well was drilled in 1979 to a measured depth of 10,009 feet (3,050.74 meters). Significant indications of hydrocarbons were recorded from 8,950 feet to total depth.

The Poonboon #1 well was drilled in 1972 to a measured depth of 10,715 feet (3,266 meters) penetrating a section ranging in age from Recent to Late Cretaceous. Abnormal pressure was encountered at approximately 9,300 feet. The only show recorded in the well was when the well kicked at 10,463 feet with a mud weight of 10.2 ppg. Log analysis indicated that the basal 6 feet of a sand interval from 10,416 to 10,450 feet may be hydrocarbon bearing; the well was abandoned as a dry hole due to excessive pressure imbalance.

The Nangkero #1 well was drilled in 1974 to a measured depth of 9,440 feet (2,877.3 meters) penetrating a section ranging in age from Recent to Upper Paleocene. No hydrocarbon shows were encountered in the well.

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 hydrocarbon shows reported nor was there abnormally pressured sections penetrated.

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 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 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 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 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 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 Bass #2 well was drilled in 1966 to a measured depth of 5,910 feet (1,801.36 meters) penetrating a section ranging in age from Recent to basement. Two hundred and fifty six feet of volcanic rocks of undeterminate age were encountered between the base of the Tertiary and the top of basement. Aside from normal background gas, no hydrocarbons were recorded in the well.

The Yurongi well was drilled in 1973 to a measured depth of 8,000 feet (2,438.4 meters) penetrating a section ranging in age from Recent to

Paleocene. No significant indications of hydrocarbons were recorded.

The Dondu #1 well was drilled in 1973 to a measured depth of 9,603 feet (2927 meters) penetrating a section ranging in age from Recent to Upper Paleocene. The well results were essentially as predicted. The relatively thick Eocene coal sequence is indicative of the amount of total organic matter present, and preliminary geochemical studies indicate that the sediments are mature enough to generate hydrocarbons below a depth of about 7,000 feet. Even though there were some hydrocarbon indications reported while drilling, subsequent electric log interpretation suggest that these shows were very minor and were dispersed rather than concentrated in any of the sandstones.

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 Seismic International 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 International 1966

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

Bass EF-68 seismic survey for Esso Australia by Western Geophysical 1968

Bass B69A sesimic 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 International 1970-1971

Bass B71A seismic and magnetic survey for Esso Australia by Geophysical Service International 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 International 1972

Bass HB75A seismic survey for Hematite Petroleum

by Geophysical Service International 1975

DESCRIPTION OF SURVEY AREA

The prospect was designed as T-16-P. The survey consisted of 9 lines comprising a total assigned program of 400 kilometers. The survey area is in the WEAVER's Stoney Head Survey area in the Bass Strait off the coast of Victoria, Australia.

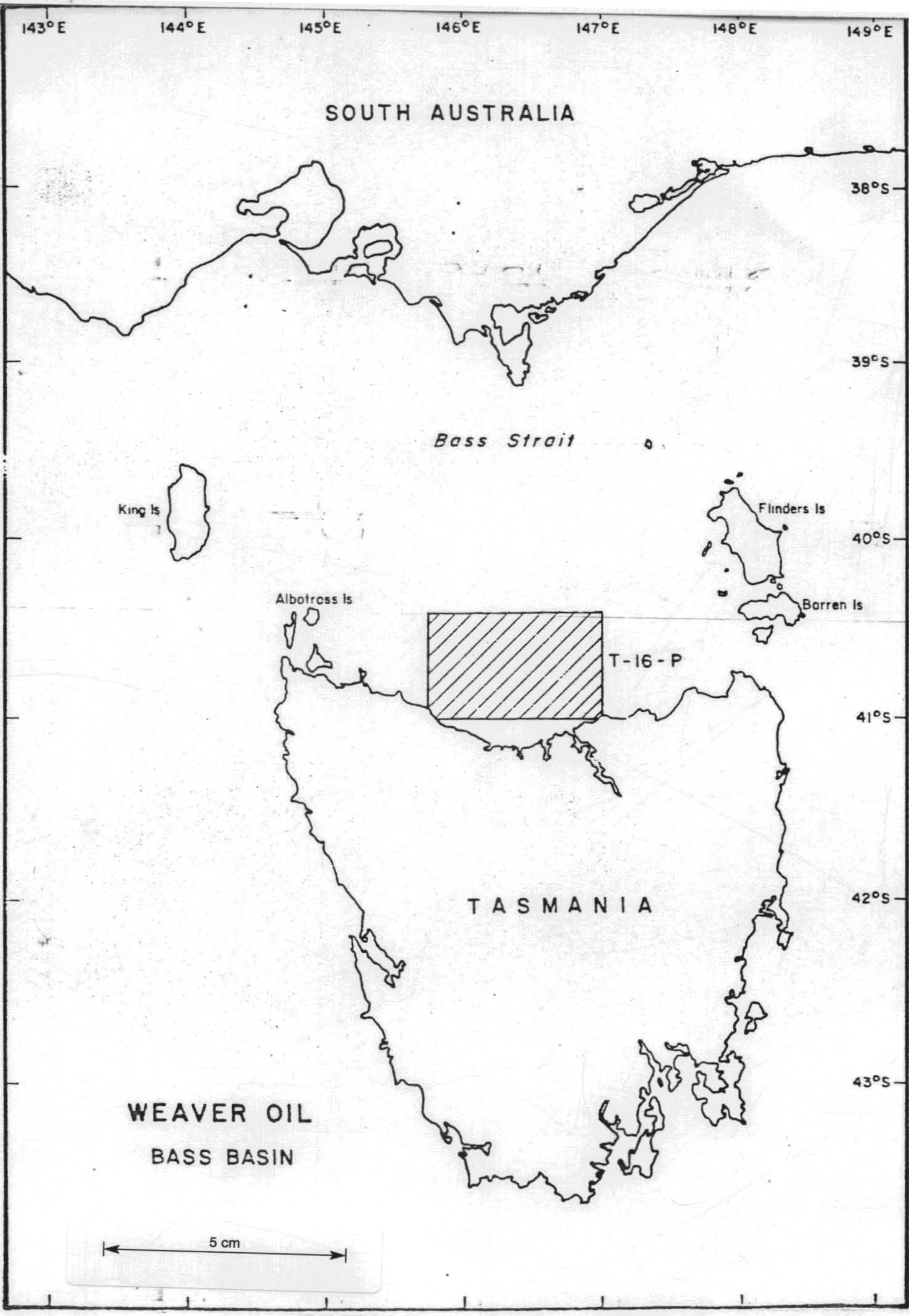


PLATE 1

WESTERN GEOPHYSICAL

200023

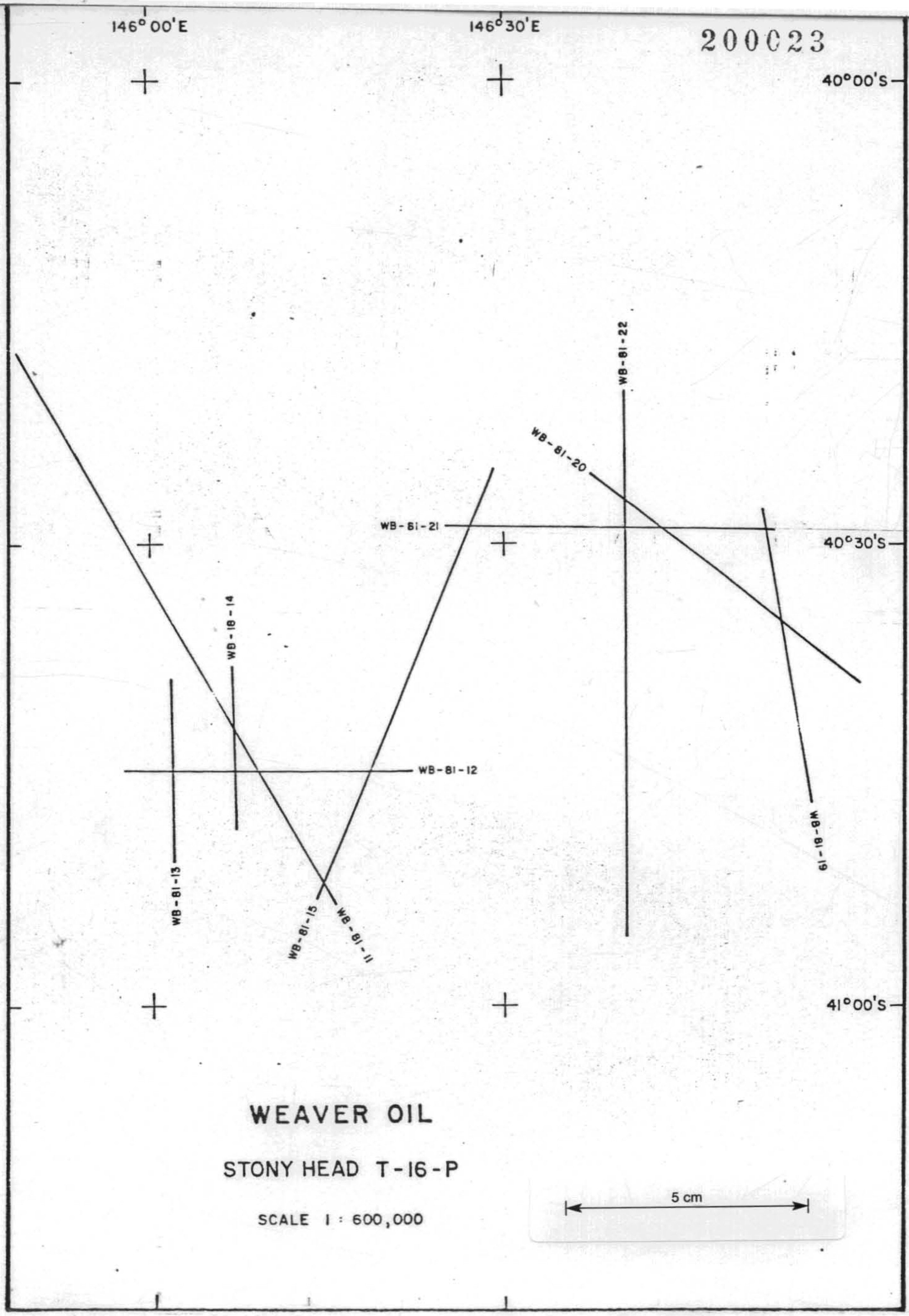


PLATE 2

SECTION II

Data Acquisition:

Contractors

The survey was conducted on behalf of WEAVER OIL AND GAS CORPORATION of Houston, Texas and Perth, West Australia.

To conduct the survey, WEAVER OIL AND GAS CORPORATION contracted WESTERN GEOPHYSICAL COMPANY OF AMERICA, a Delaware Corporation and a Division of LITTON INDUSTRIES.

Location of Headquarters

The principal office of WEAVER OIL AND GAS CORPORATION 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 WEAVER OIL AND GAS CORPORATION's 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

WEAVER OIL AND GAS CORPORATION

David Lowery	:	Exploration Manager based at Perth office, responsible for liaison between WESTERN GEOPHYSICAL and WEAVER'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 consistant with specifications.

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 Propellors
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

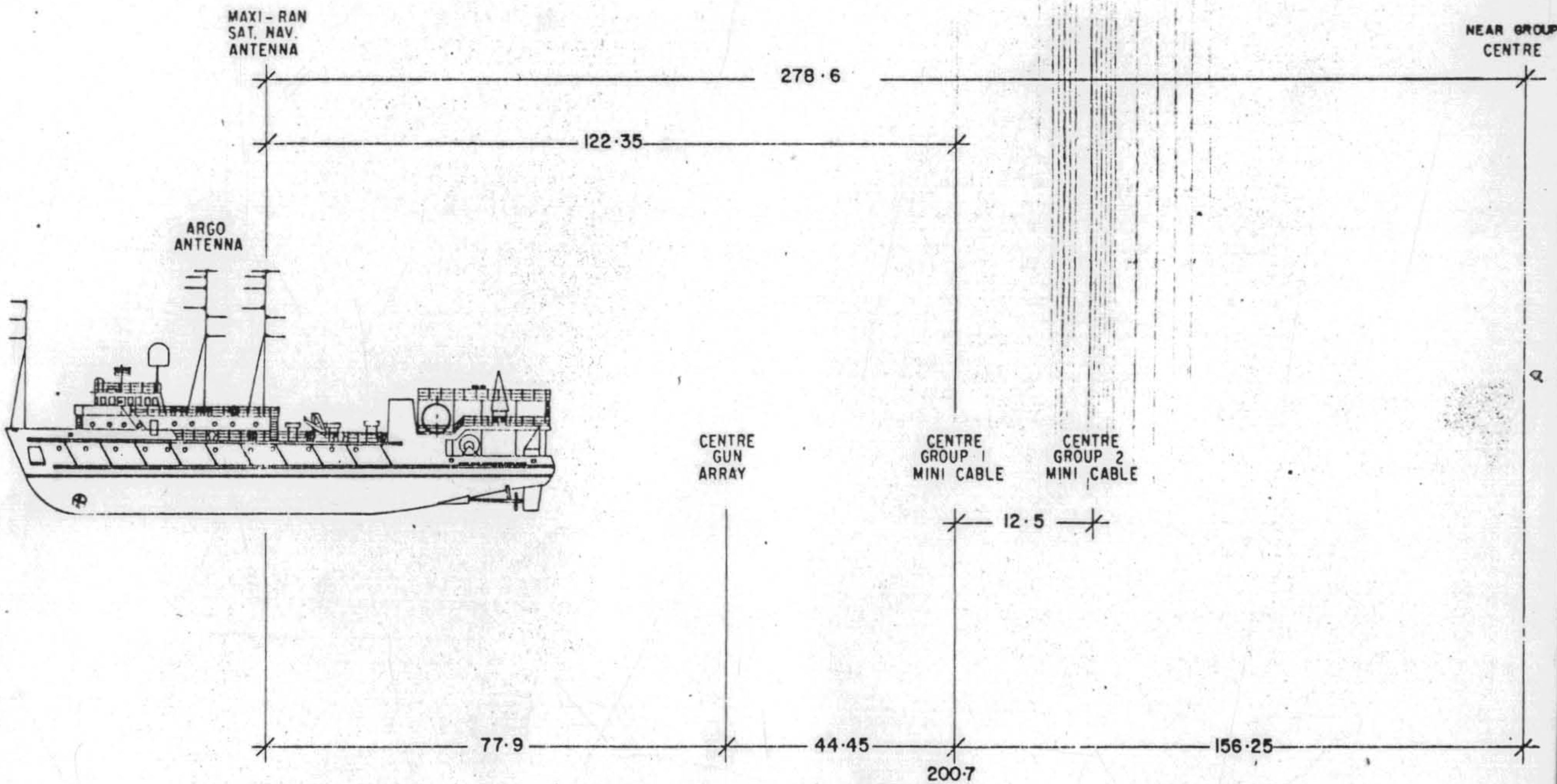
Instruments	:	DFS V 120 Channel
Main Cable	:	2400 Streamer, 96 groups 25 m Group spacing - 96 ch.mode 50 m Group spacing - 48 ch.mode
Mini Streamer*	:	6 or 12 groups, 12.5 m group spacing incorporated into main cable offset sections
Compressors	:	6 x Price 5000 psi electric drive compressors
Navigation		
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
		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

200035



WESTERN ODYSSEY PARTY 86

(DISTANCES IN METERS)

5 cm

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 it's 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 it's 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, labled 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 :

CHANNELS	1	2	3	4
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 containining 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 necesssary 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.

D. 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.

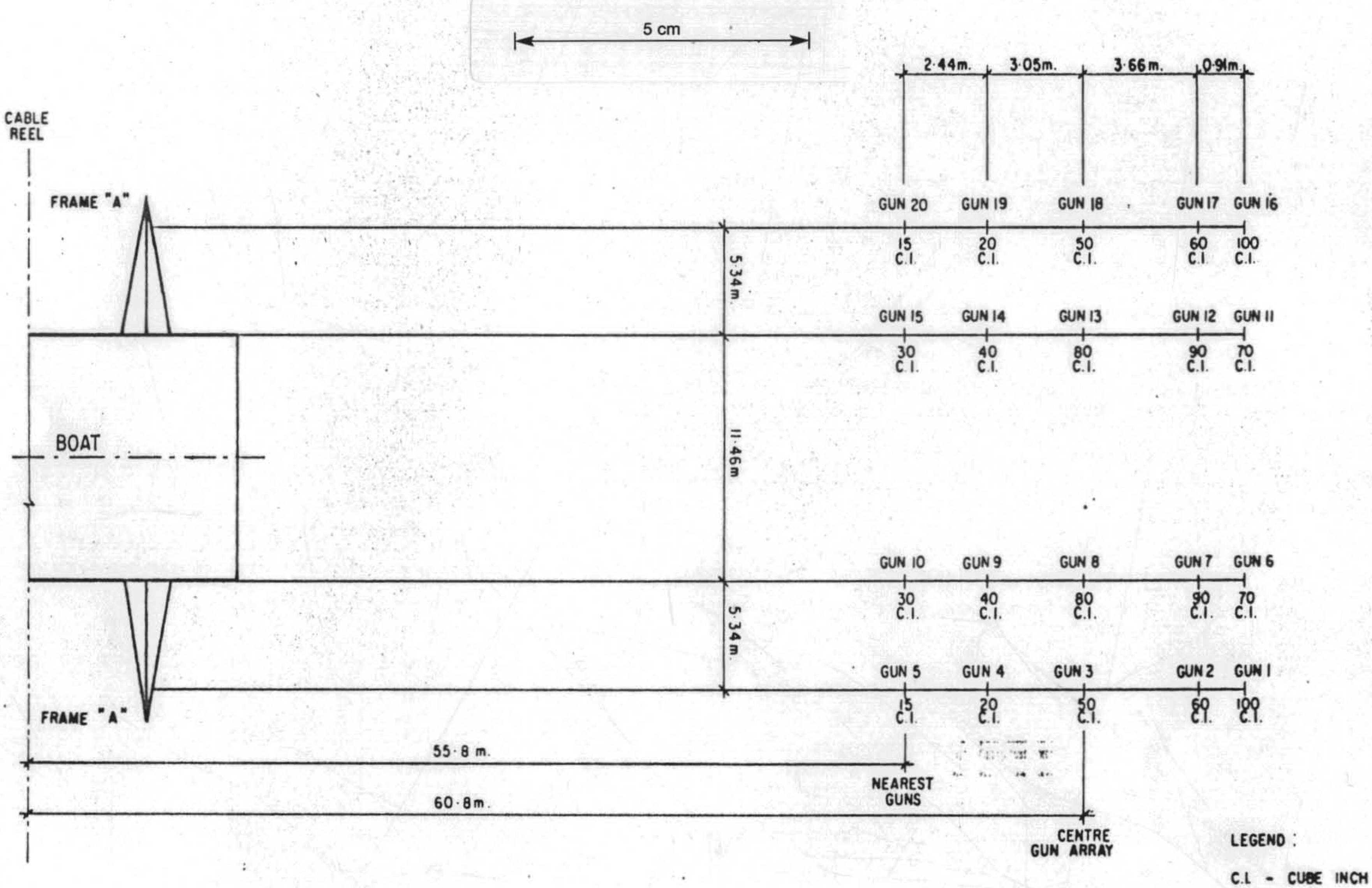
4. If the fire detect for any guns does not occur at the Aiming Point, the controller will correct the error by adjusting the time at which the next fire pulse is issued to the gun. These adjustments are computed from a filter applied to the previous error values.

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

PLATE 4

200046

WESTERN ODYSSEY PARTY 86
GUN ARRAY CONFIGURATION



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.

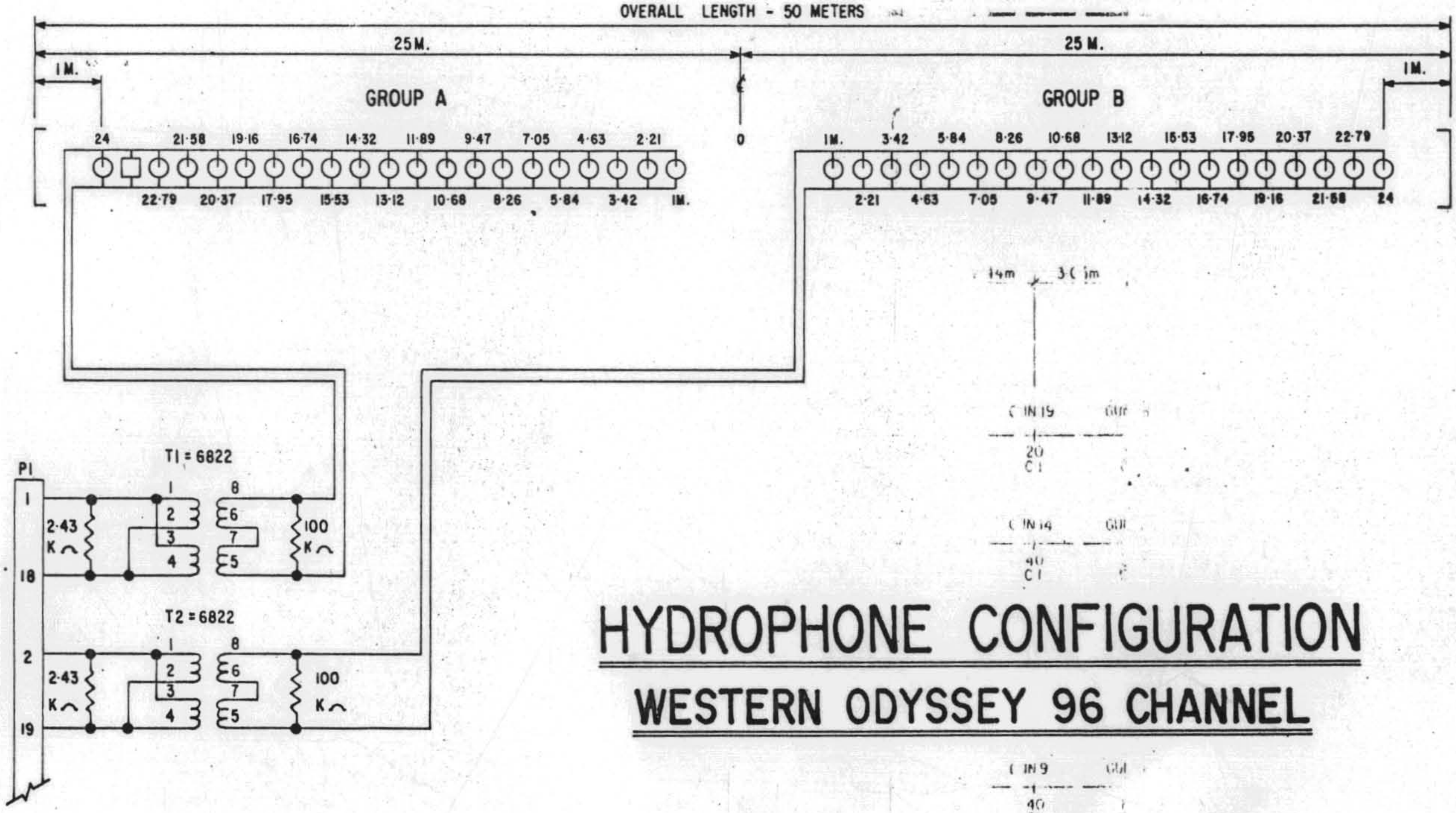
The 500 foot nylon reinforced neoprene lead-in is heavily weighted in order to depress the front end of the streamer cable to the desired operating depth. It is also outfitted with neoprene florings for noise reduction. In normal operation, two 75 meter elastic sections are attached at the tail of the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

PLATE 5



HYDROPHONE CONFIGURATION

WESTERN ODYSSEY 96 CHANNEL

RECORDING PARAMETERS

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	Gain Constant	Voltage(mV RMS)
Difference Mode:	24	327.68
	26	81.92
	8	20.48

Common Mode:	F. Range (Hz)	Voltage(Peak)
	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

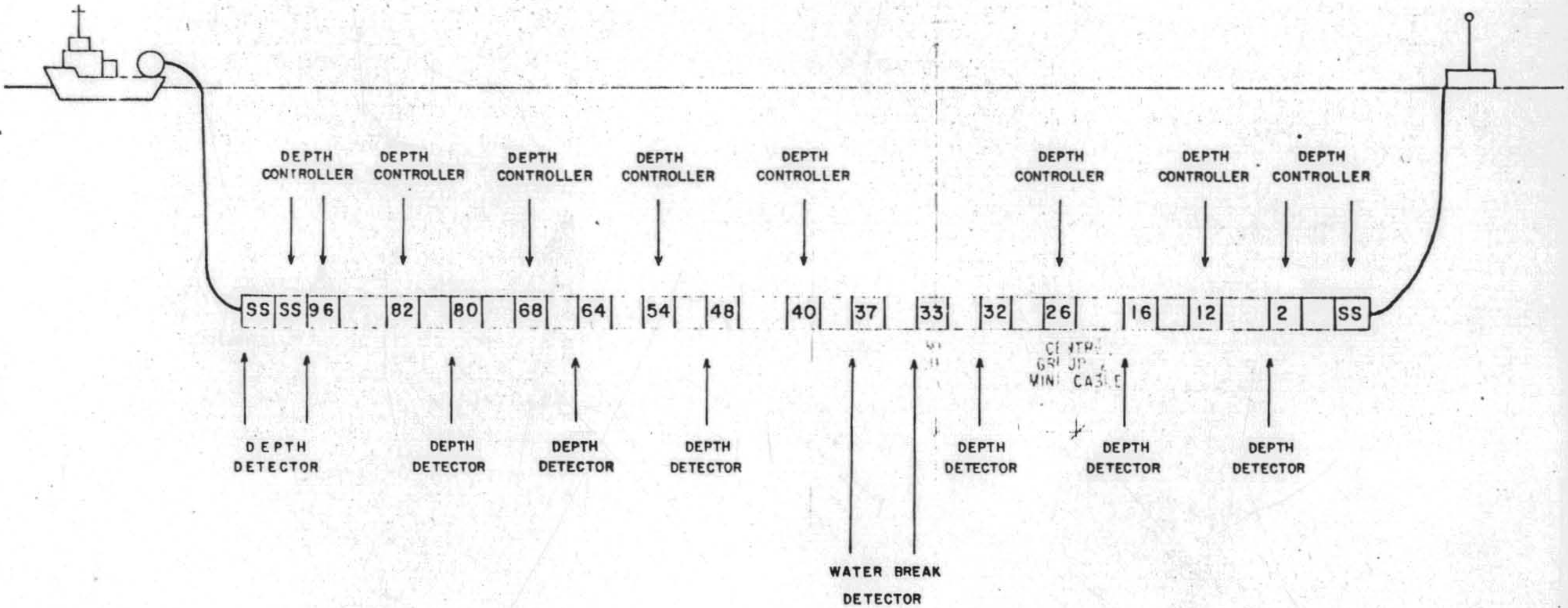
Percent Coverage	:	4800%
Pops per km	:	40
Number of Groups	:	96
Center Enery Source to Center Near Group	:	200.7 meters
Center Near Group to Center Far Group	:	2,375 meters
Group Center to Group Center	:	25 meters
Number of Phones per Group	:	20
Depth Detectors at Head of Groups	:	2, 16, 32, 48, 64, 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

PLATE 6

WESTERN ODYSSEY

96 GROUP CABLE CONFIGURATION

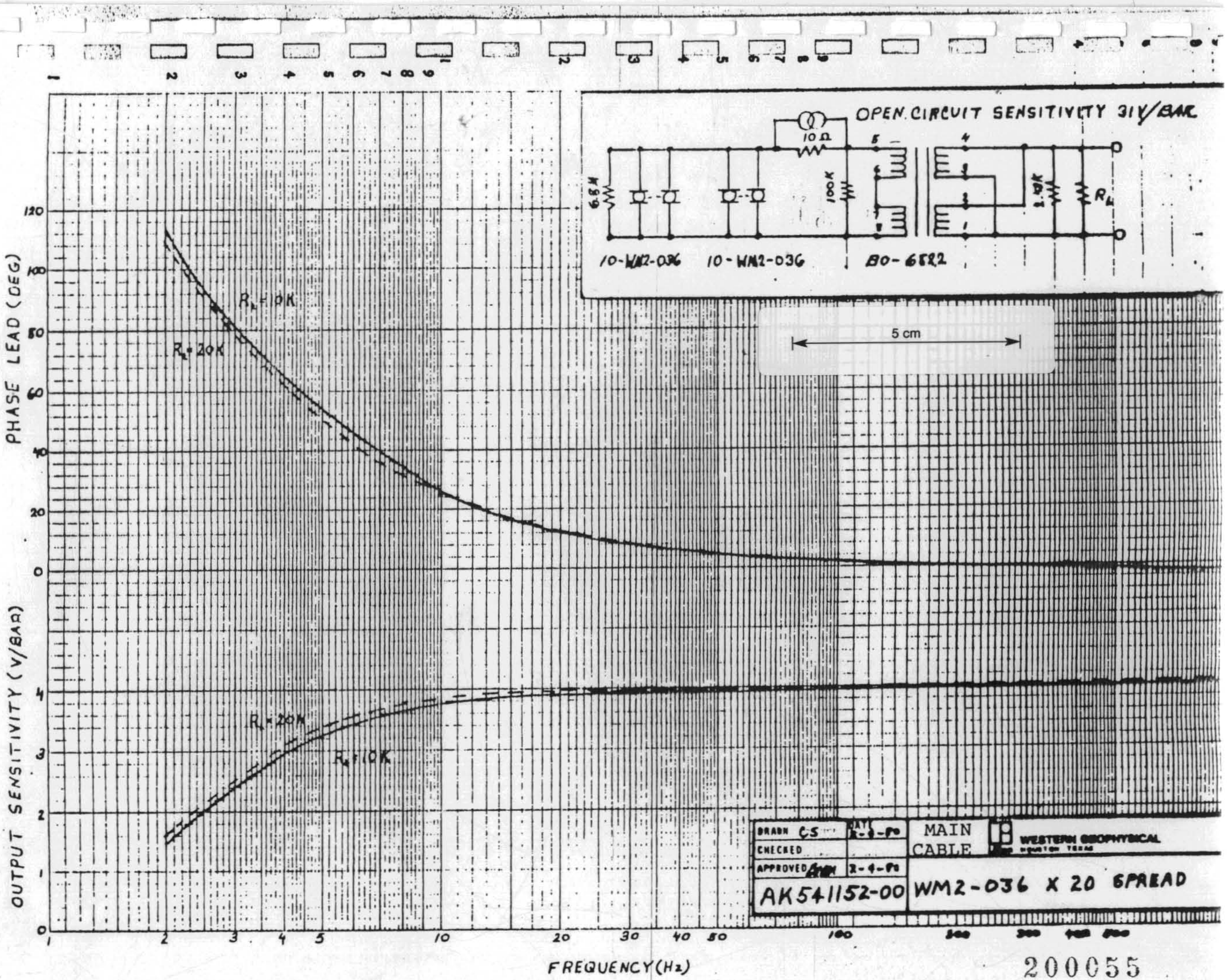
5 cm



<u>Airgun Configuration</u>

Array Volume	:	555 cu. inches
Number of Guns	:	10
Array Pressure	:	4500 psi
Shot Depth	:	6 meters
Shot Interval	:	25 meters

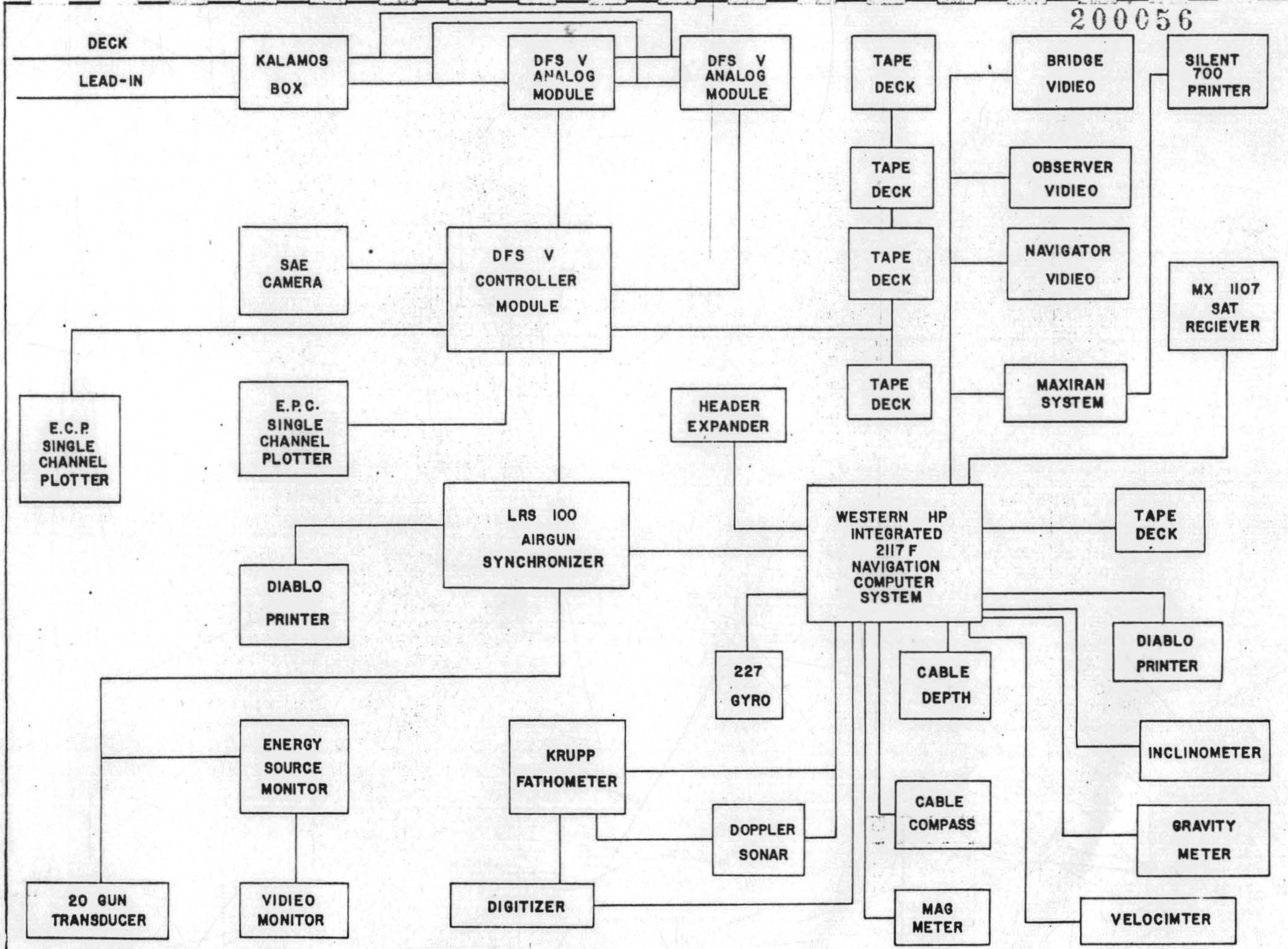
PLATE 7



200055

PLATE 8

200056



BLOCK DIAGRAM .

STATISTICAL SUMMARY

DATE	LINE	SP - SP	PROFILES	KMS
April 2	WB81-11	100 - 3195	3096	77.400
	WB81-14	100 - 910	811	20.275
	WB81-13	100 - 995	896	22.400
April 3	WB81-12	100 - 1499	1400	35.000
	WB81-15	100 - 2372	2273	56.825
	WB81-21	100 - 1686	1587	39.675
	WB81-19	100 - 159	60	1.500
April 4	WB81-19	160 - 1541	1382	34.550
	WB81-20	100 - 1685	1586	39.650
	WB81-22	100 - 2773	2674	66.850

Total Kilometers: 394.125

LINE SUMMARY

WB81 - 11 2nd April	Start of line, first reel - 089877, first shotpoint 100. End of line, reel 089906, last shotpoint 3195.
WB81 - 12 3rd April	Start of line, first reel - 089924, first shotpoint 100. End of line, reel 089937, last shotpoint 1499.
WB81 - 13 2nd April	Start of line, first reel - 089915, first shotpoint 100. End of line, reel 089923, last shotpoint 995.
WB81 - 14 2nd April	Start of line, first reel - 089907, first shotpoint 100. End of line, reel 089914, last shotpoint 910.
WB81 - 15 3rd April	Start of line, first reel - 089938, first shotpoint 100. End of line, reel 089959, last shotpoint 2372.
WB81 - 19 3rd April 4th April	Start of line, first reel - 089976, first shotpoint 100. Last shotpoint of day, 3rd April - 159, reel 089976. End of line, reel 089989, last shotpoint 1541.
WB81 - 20 4th April	Start of line, first reel - 089990, first shotpoint 100. Tape number series change from 090000 to 091501. End of line, reel 091505, last shotpoint 1685.

WB81 - 21 3rd April	Start of line, first reel - 089960, first shotpoint 100. End of line, reel 089975, last shotpoint 1686.
WB81 - 22 4th April	Start of line, first reel - 091506, first shotpoint 100. End of line, reel 091531, last shotpoint 2773.

SECTION III

Navigation:

NAVIGATION SYSTEM - WINS(R) PHASE IV

Western Geophysical's WINS(R) (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 SUBSYSTEM

Doppler 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^{o} 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 circile 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.

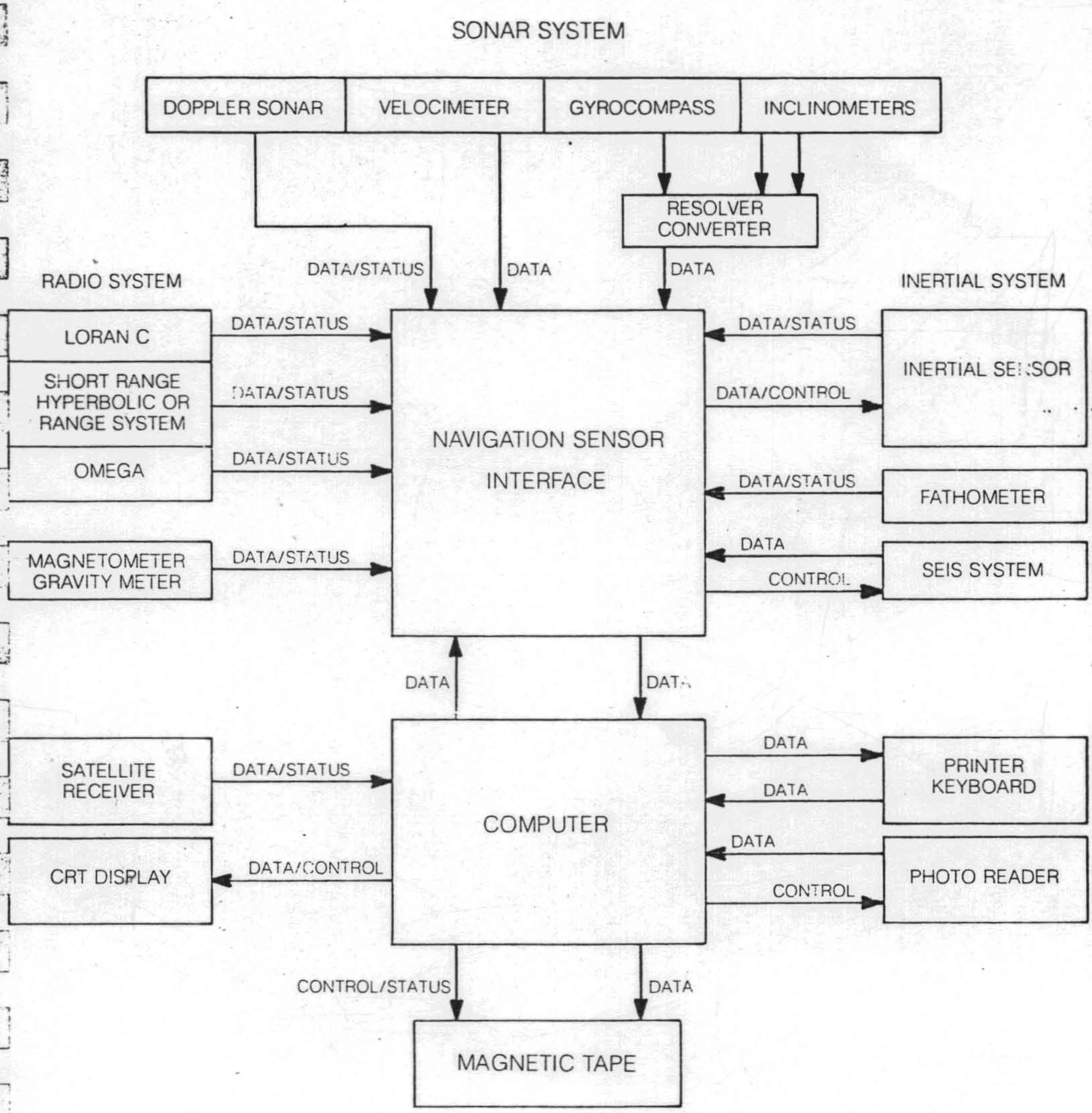

SONAR SYSTEM
DOPPLER SONAR
VELOCIMETER
GYROCOMPASS
INCLINOMETERS
RESOLVER CONVERTER
DATA/STATUS
DATA
DATA
RADIO SYSTEM
INERTIAL SYSTEM
LORAN C
DATA/STATUS
SHORT RANGE HYPERBOLIC OR RANGE SYSTEM
DATA/STATUS
OMEGA
DATA/STATUS
NAVIGATION SENSOR INTERFACE
DATA/STATUS
DATA/CONTROL
INERTIAL SENSOR
DATA/STATUS
FATHOMETER
DATA
CONTROL
SEIS SYSTEM
MAGNETOMETER GRAVITY METER
DATA/STATUS
DATA
DATA
SATELLITE RECEIVER
DATA/STATUS
COMPUTER
DATA
DATA
PRINTER KEYBOARD
DATA
CONTROL
PHOTO READER
CRT DISPLAY
DATA/CONTROL
CONTROL/STATUS
DATA
MAGNETIC TAPE

PLATE 9

SECTION IV

Data Processing:

General

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 2, and April 4, 1981, Western Geophysical Company shot nine marine seismic lines Offshore Australia, Bass Basin for Weaver Oil and Gas Corporation. This survey was recorded by Party 86 aboard the "Western Odyssey" and covered 245 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.

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

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.

VELOCITY ANALYSIS

Vertical velocities are automatically determined in the VELAN® (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.

NORMAL MOVEOUT APPLICATION AND CDP STACKING

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.

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.

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.

TIME VARIANT FILTERING

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.

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.

S M Mellette

Soule M. Mellette, Manager
Marine Processing

Robert B. Martin

Robert B. Martin, Assistant
Supervisor Data Processing

SECTION IV_a

SYNTHETIC SEISMOGRAMS

Introduction

Sonic logs 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 thus effectively masking the underlying events.

PLATE 10

SYNTHETIC SEISMOGRAM

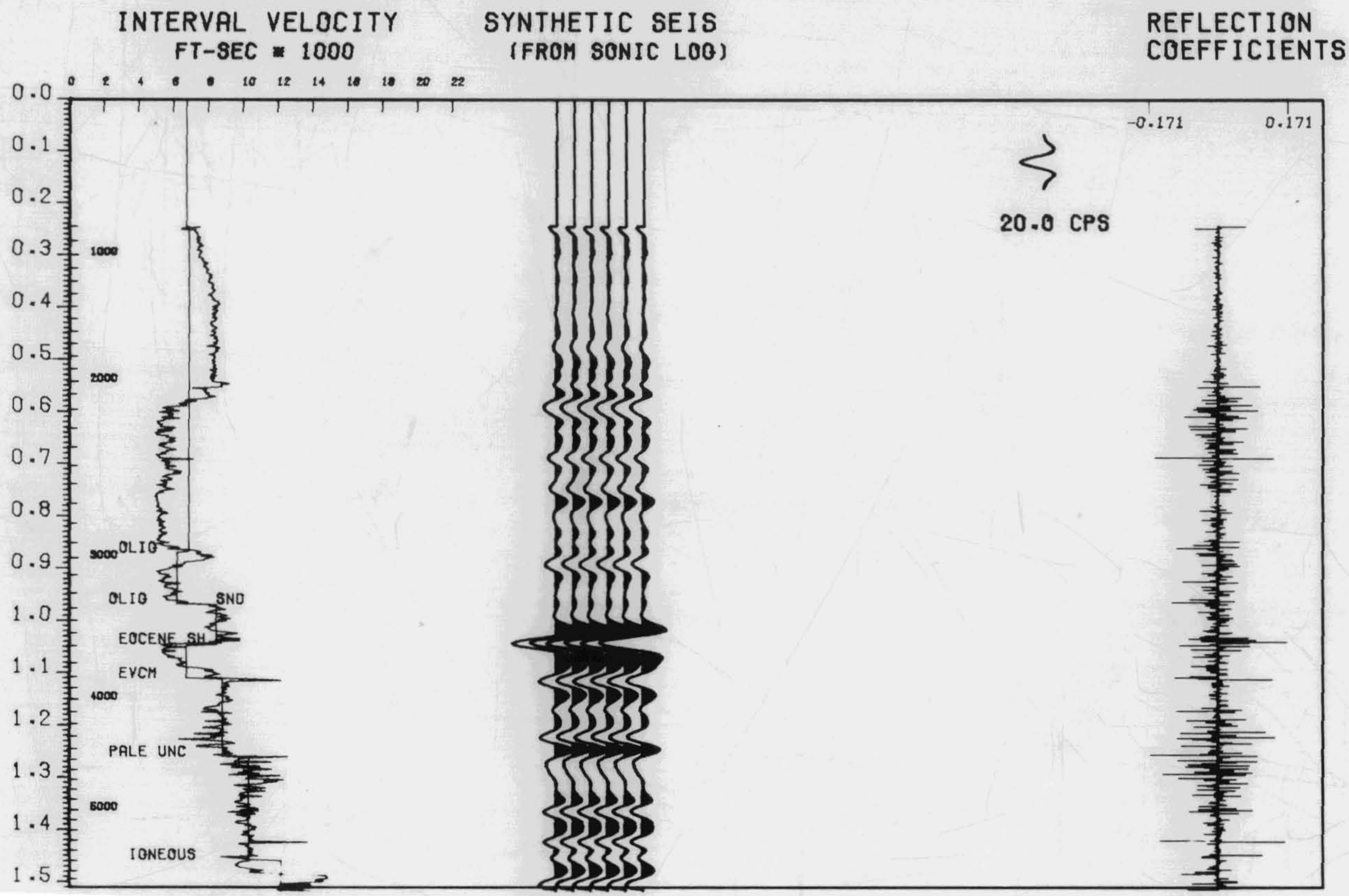
5 cm

GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

ESSO EXPLORATION BASS 2 WILDCAT AUSTRALIA TASMANIA W

LOG DATUM = 31 SEISMIC DATUM = 0 COMMENTS ____



200C79

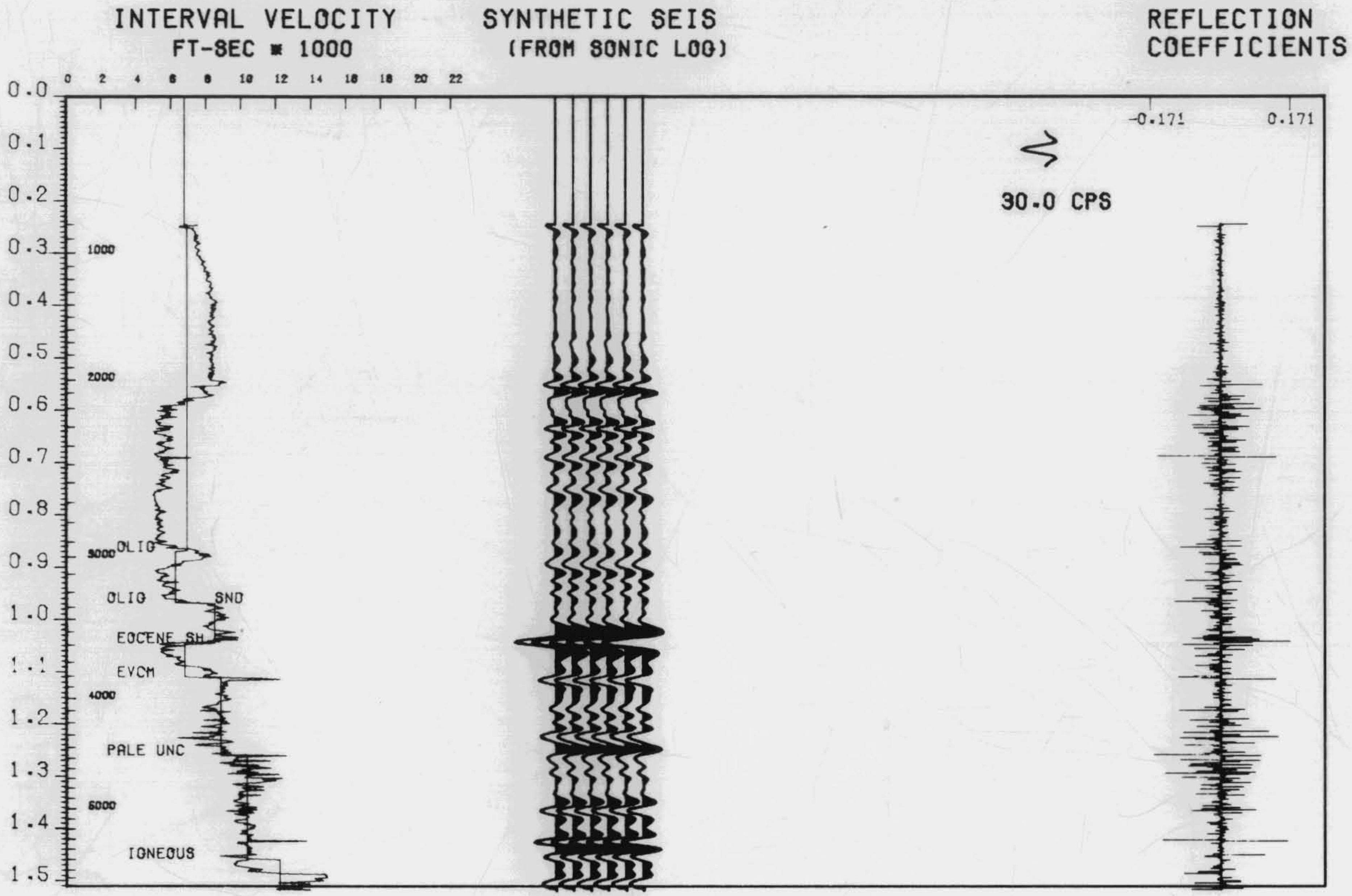
PLATE 11

SYNTHETIC SEISMOGRAM

GTS CORP. HOUSTON OFFICE 3724 DACOMA 77018

ESSO EXPLORATION BASS 2 WILDCAT AUSTRALIA TASMANIA W

LOG DATUM = 31 SEISMIC DATUM = 0 COMMENTS



20080

PLATE 12

SYNTHETIC SEISMOGRAM

5 cm

GTS CORP. HOUSTON OFFICE 3724 DACOMA 77018

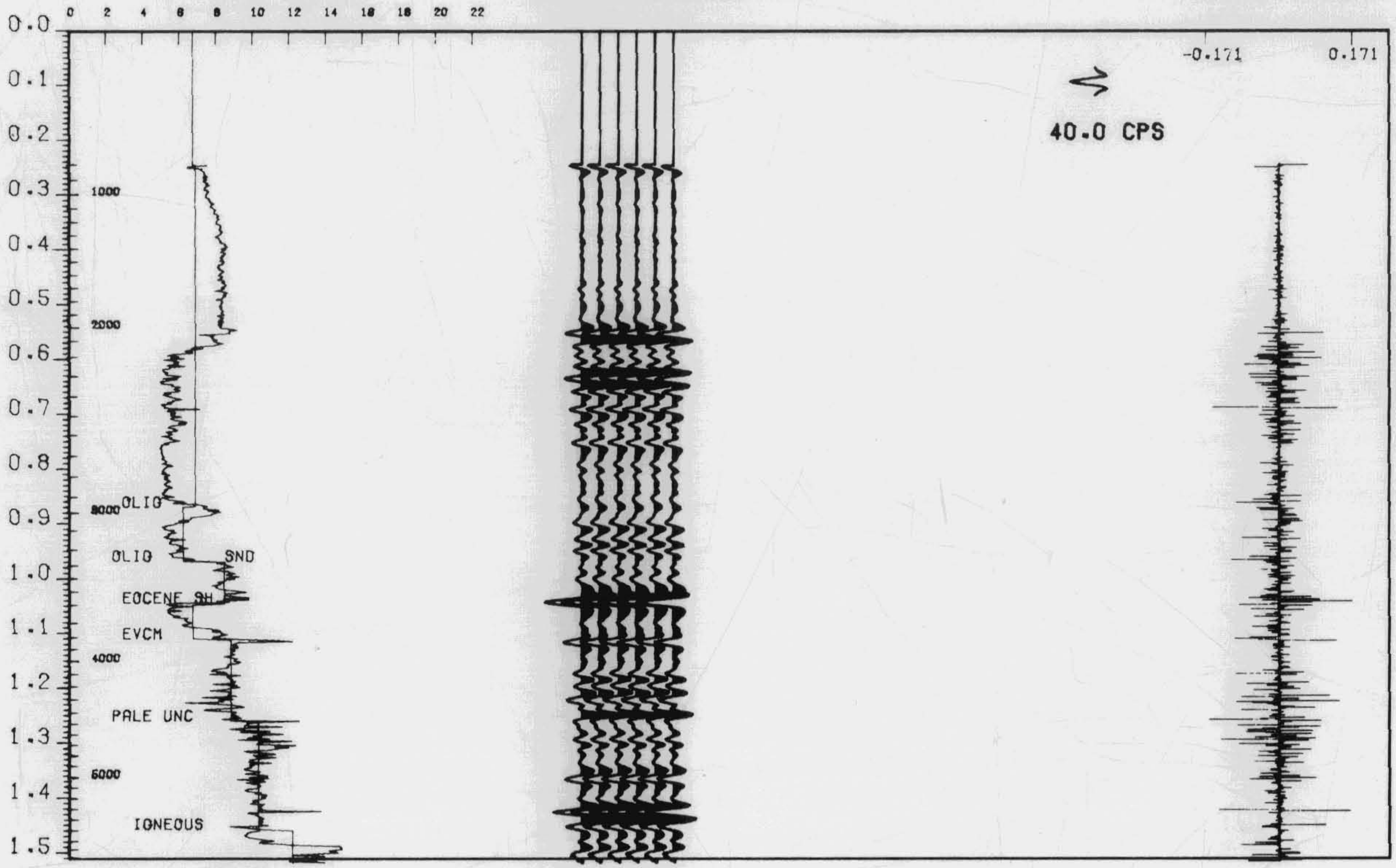
ESSO EXPLORATION BASS 2 WILDCAT AUSTRALIA TASMANIA W

LOG DATUM = 31 SEISMIC DATUM = 0 COMMENTS ______

INTERVAL VELOCITY FT-SEC * 1000

SYNTHETIC SEIS (FROM SONIC LOG)

REFLECTION COEFFICIENTS



200C81

PLATE 13

SYNTHETIC SEISMOGRAM

5 cm

GTS CORP. HOUSTON OFFICE 3724 DACOMA 77018

ESSO AUSTRALIA LTD. KONKON 1 WILDCAT AUSTRALIA TASMANIA W

LOG DATUM = 32 SEISMIC DATUM = 0 COMMENTS ______

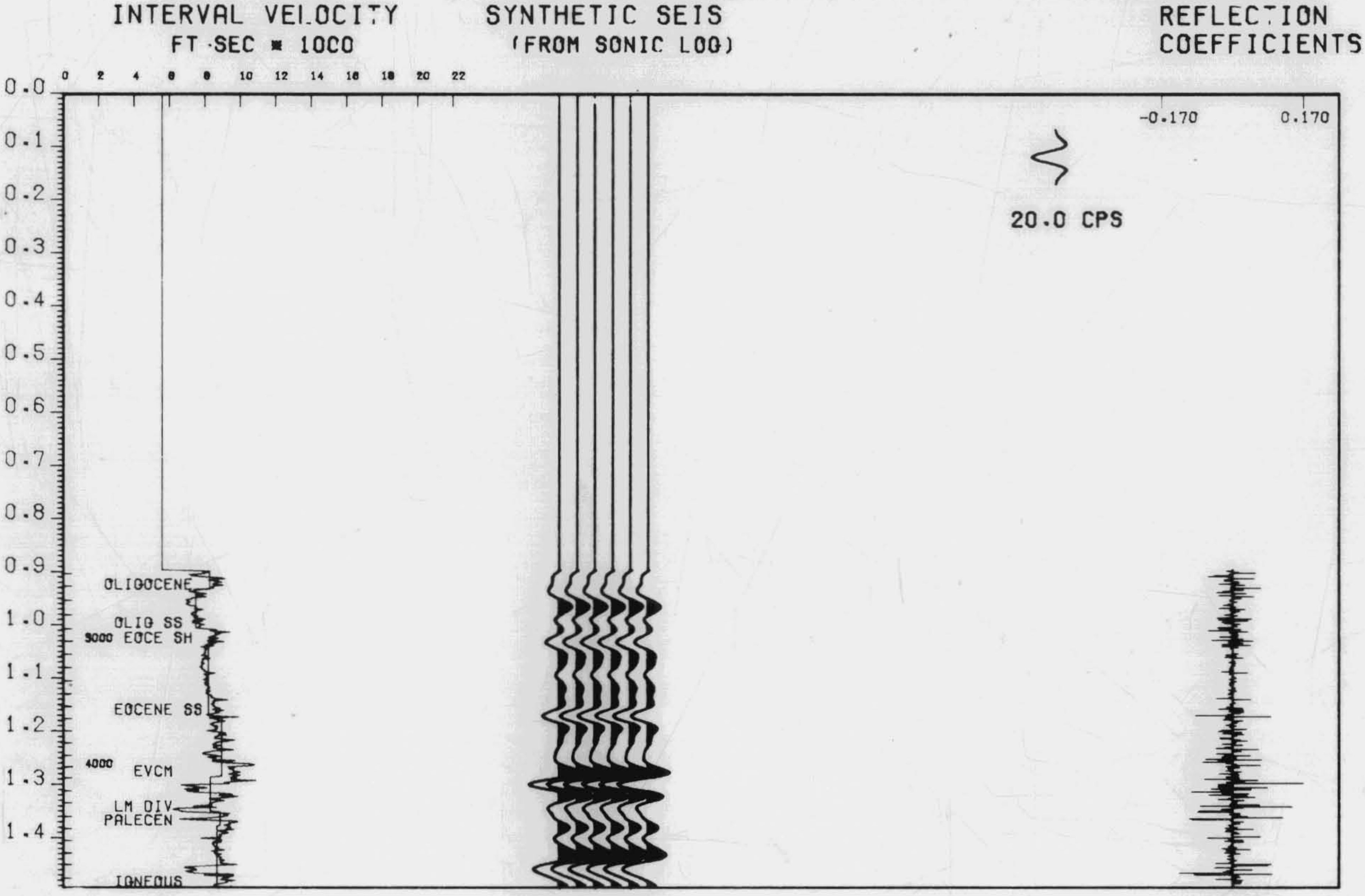


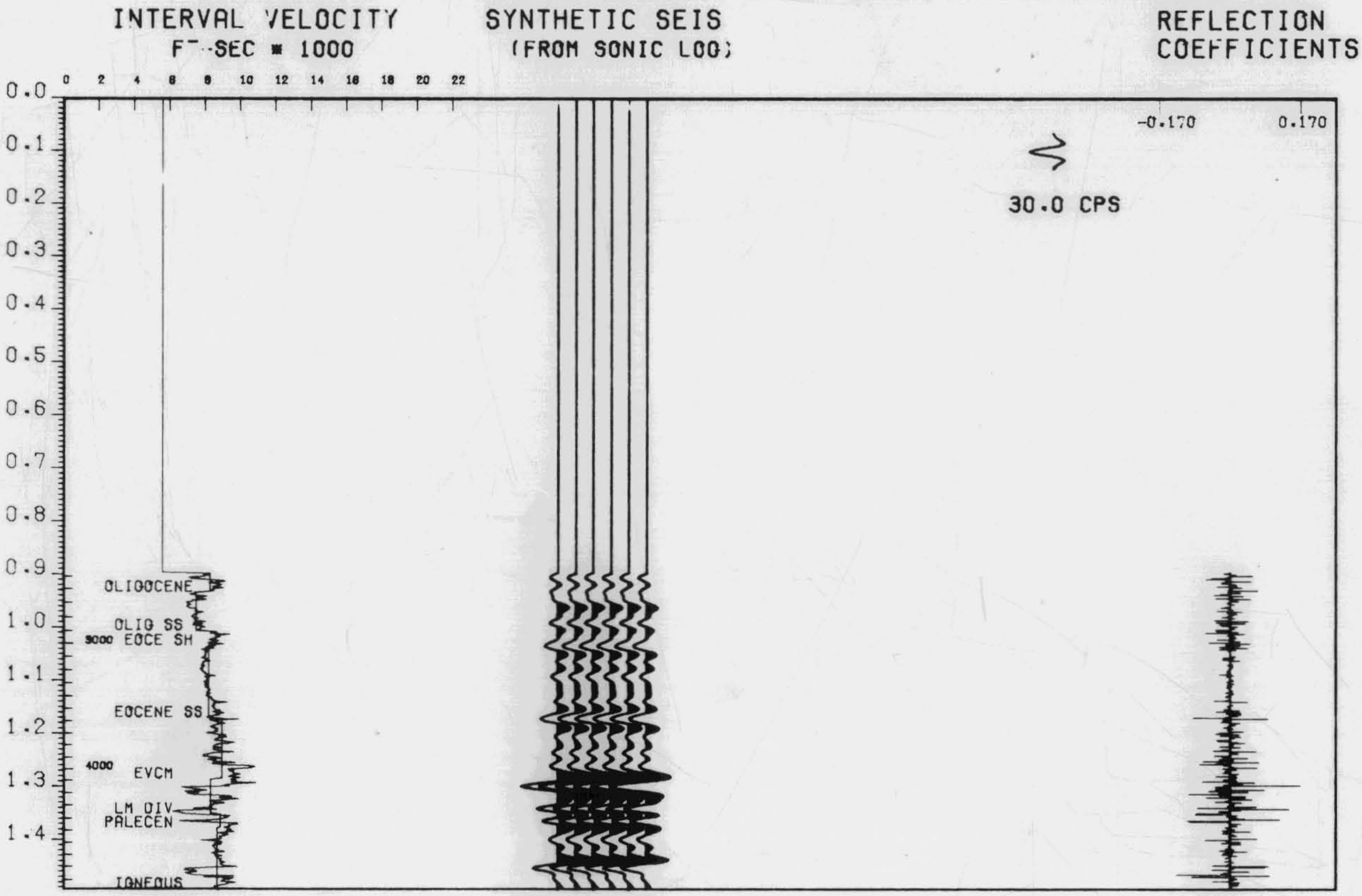
PLATE 14

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



200083

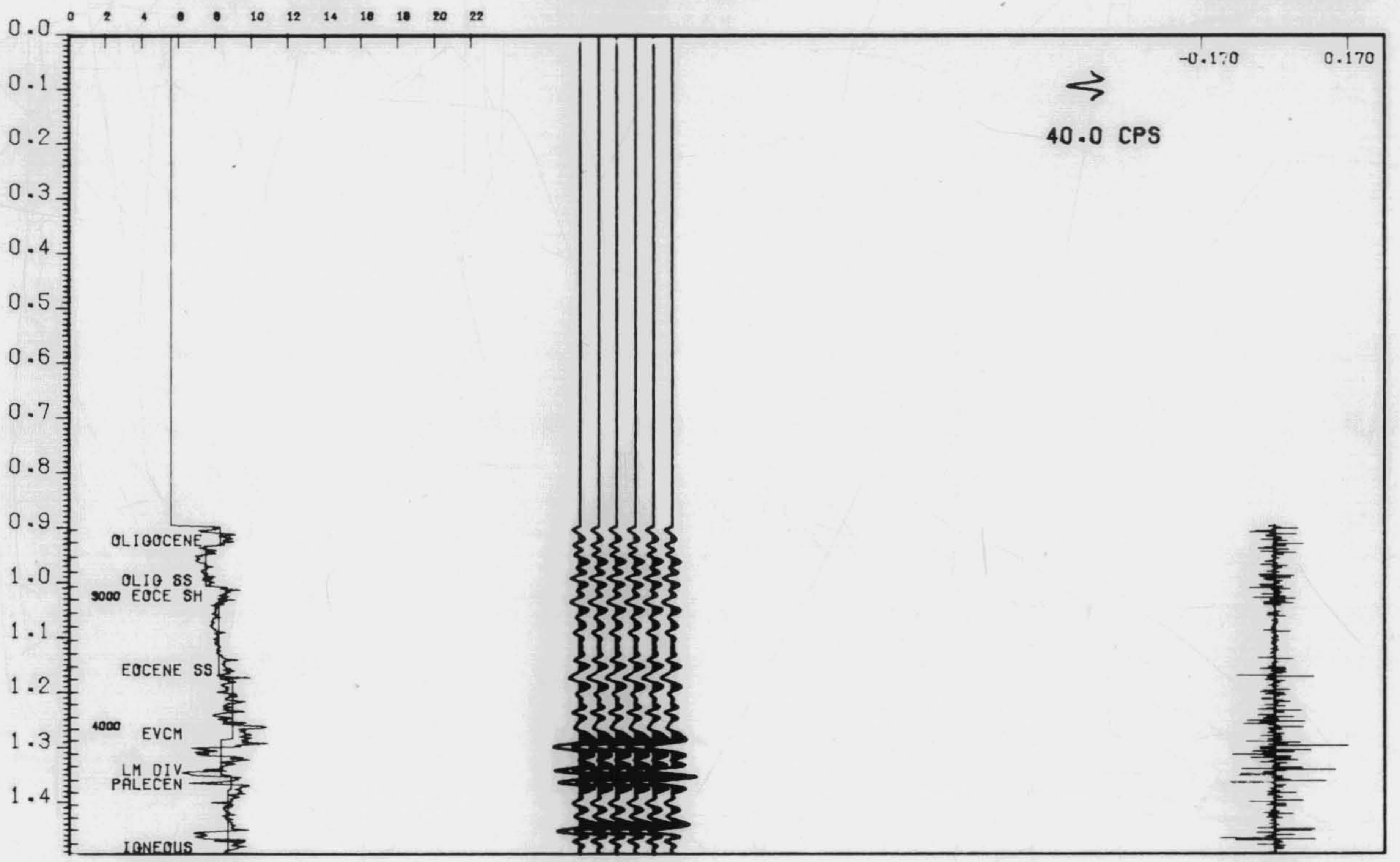
SYNTHETIC SEISMOGRAM

GTS CORP. HOUSTON OFFICE 3724 DACOMA 77018

PLATE 15

ESSO AUSTRALIA LTD. KONKON 1 WILDCAT AUSTRALIA TASMANIA W

LOG DATUM = 32 SEISMIC DATUM = 0 COMMENTS



200C84

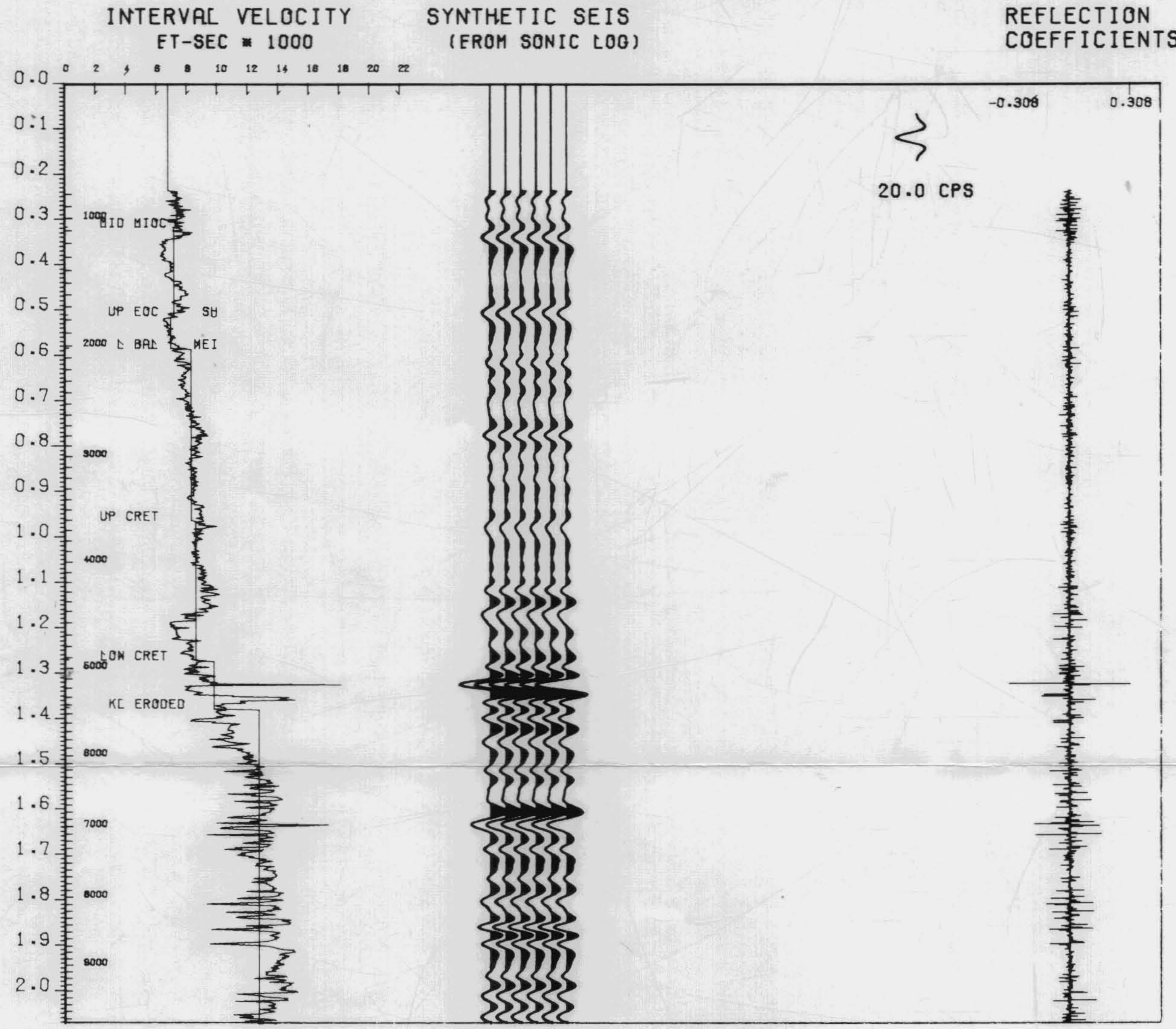
PLATE 16

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



200085

PLATE 17

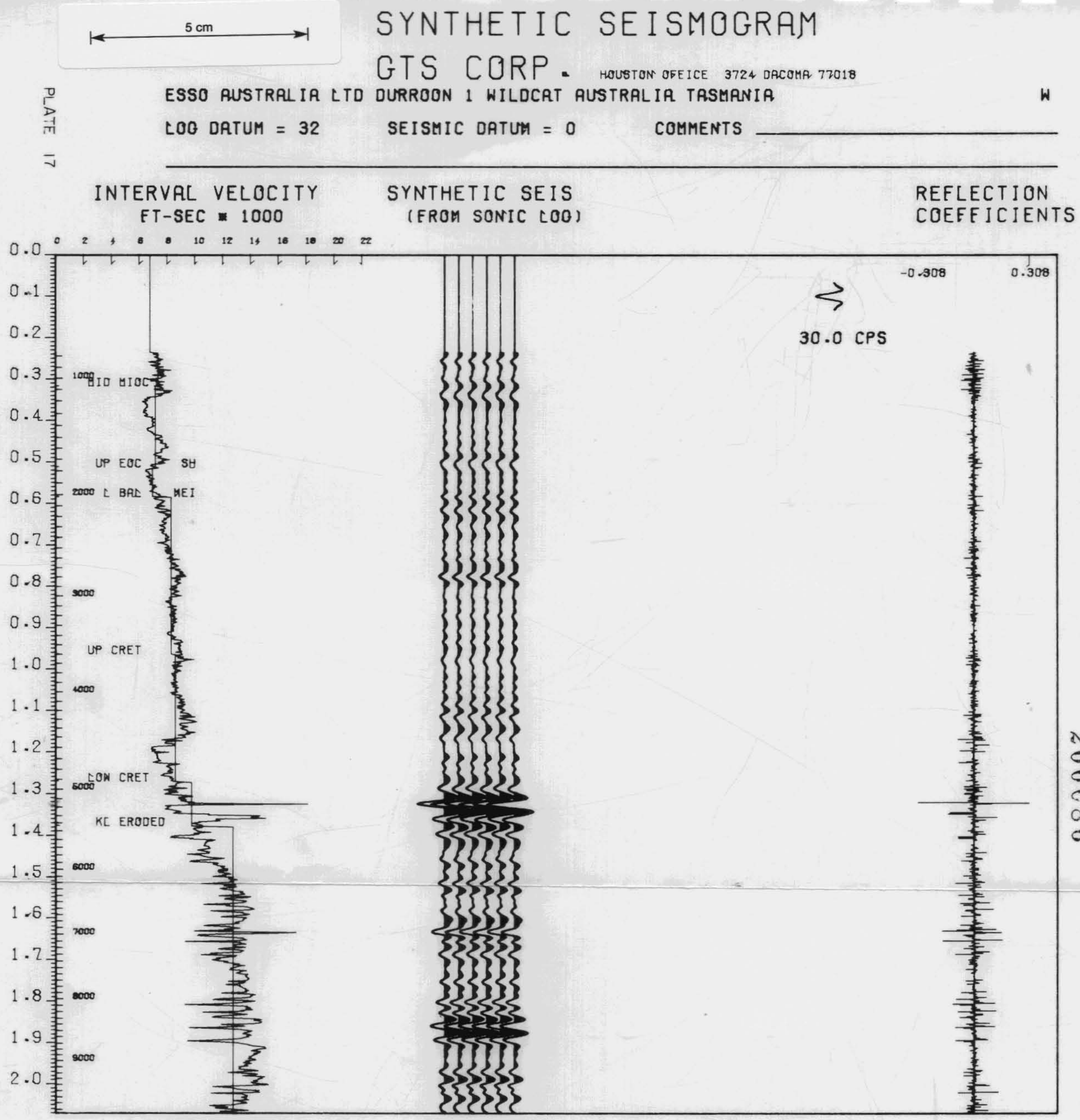
SYNTHETIC SEISMOGRAM

GTS CORP.

HOUSTON OFFICE 3724 DACOMA 77018

ESSO AUSTRALIA LTD DURROON 1 WILDCAT AUSTRALIA TASMANIA W

LOG DATUM = 32 SEISMIC DATUM = 0 COMMENTS



200C86

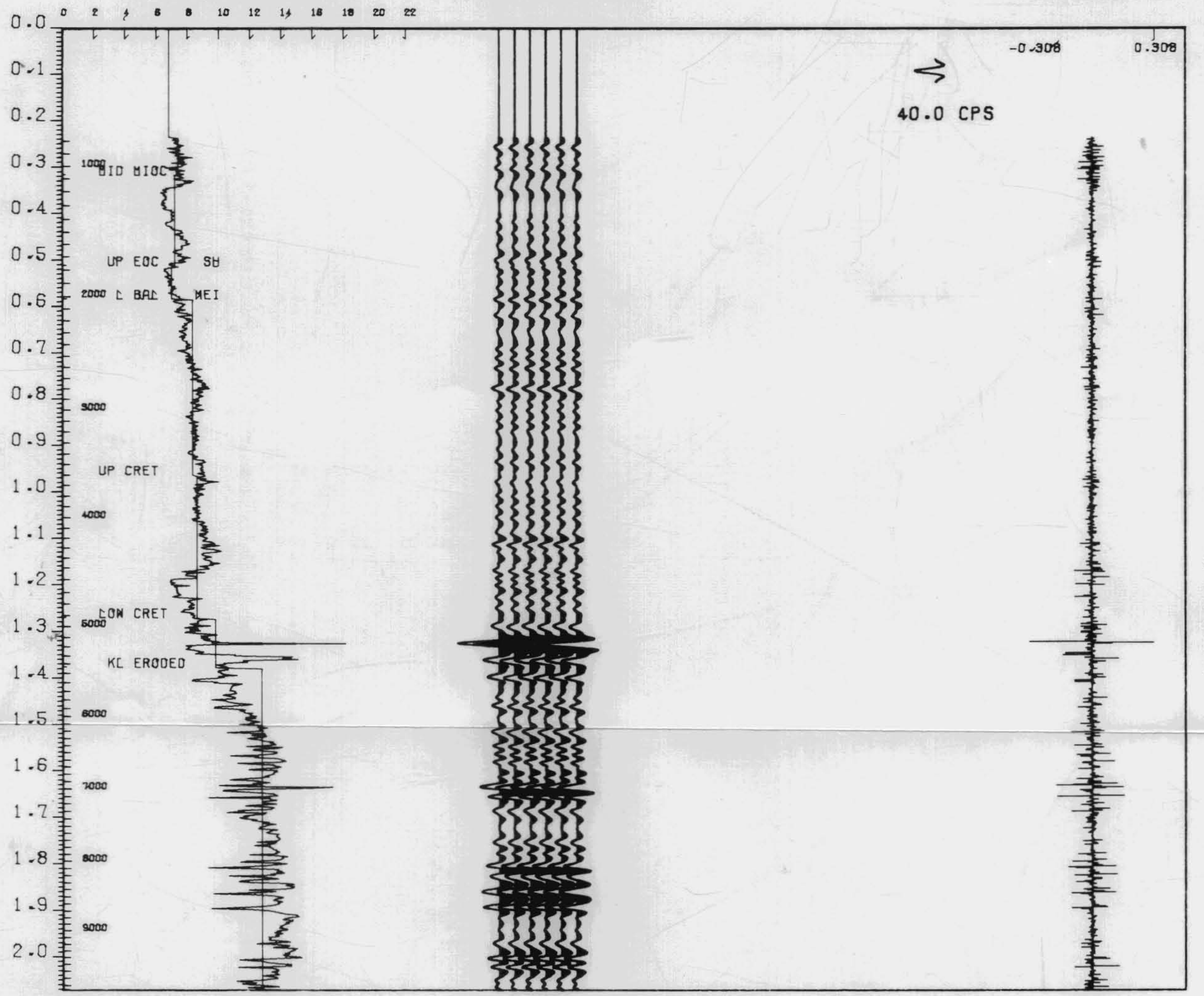
SYNTHETIC SEISMOGRAM

GTS CORP. HOUSTON OFFICE 3724 DACOMA 77018

PLATE 18

ESSO AUSTRALIA LTD DURROON 1 WILDCAT AUSTRALIA TASMANIA 1W

LOG DATUM = 32 SEISMIC DATUM = 0 COMMENTS



200C87

PLATE 19

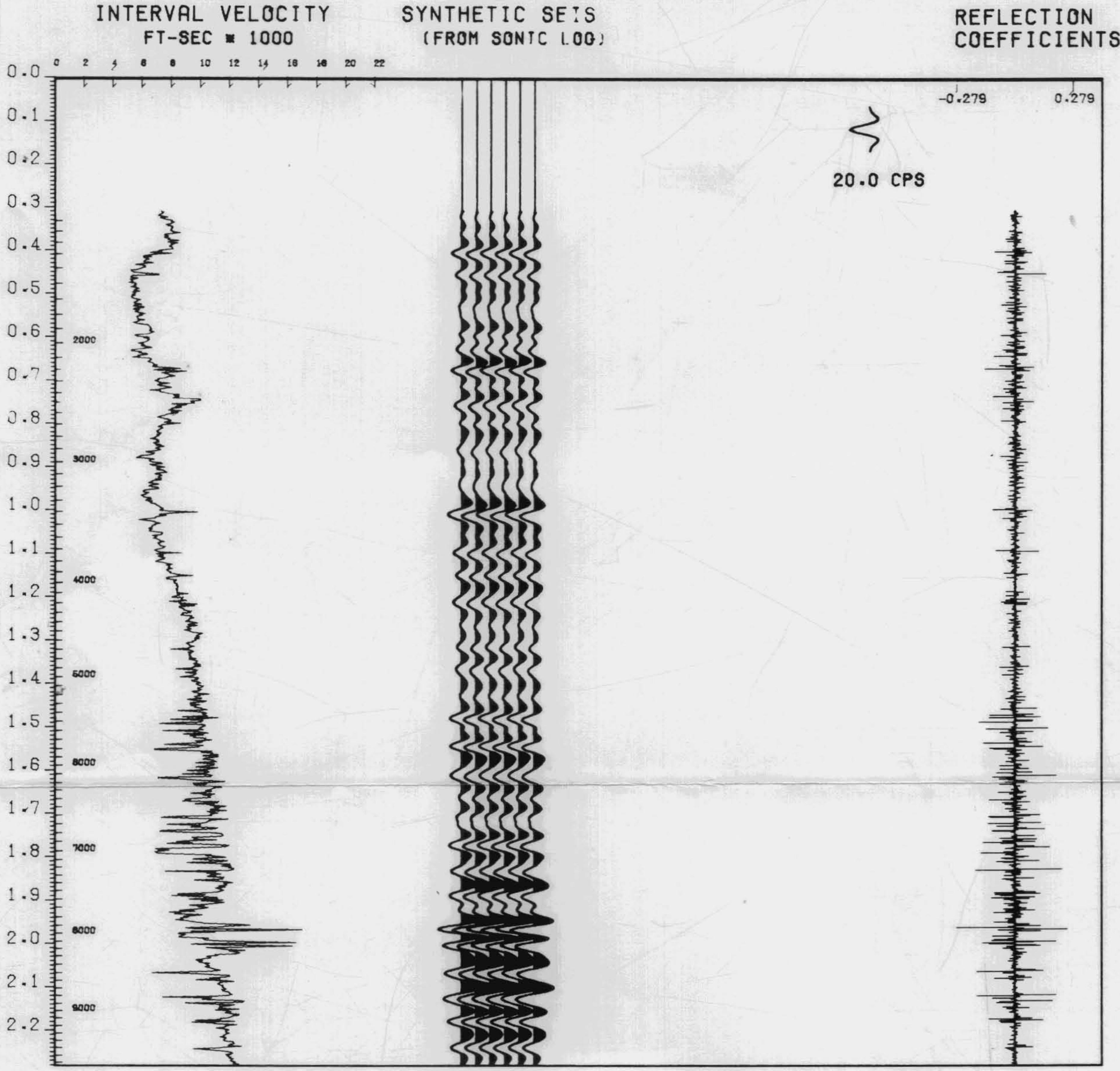
SYNTHETIC SEISMOGRAM

GTS CORP.

HOUSTON OFFICE ... 24 DACOMA 77018

ESSO EXP &PROD AUSTRALIA INC CORMORANT 1 AUSTRALIA TASMANIA W

LOG DATUM = 100 SEISMIC DATUM = 0 COMMENTS



200C88

SYNTHETIC SEISMOGRAM

GTS CORP.

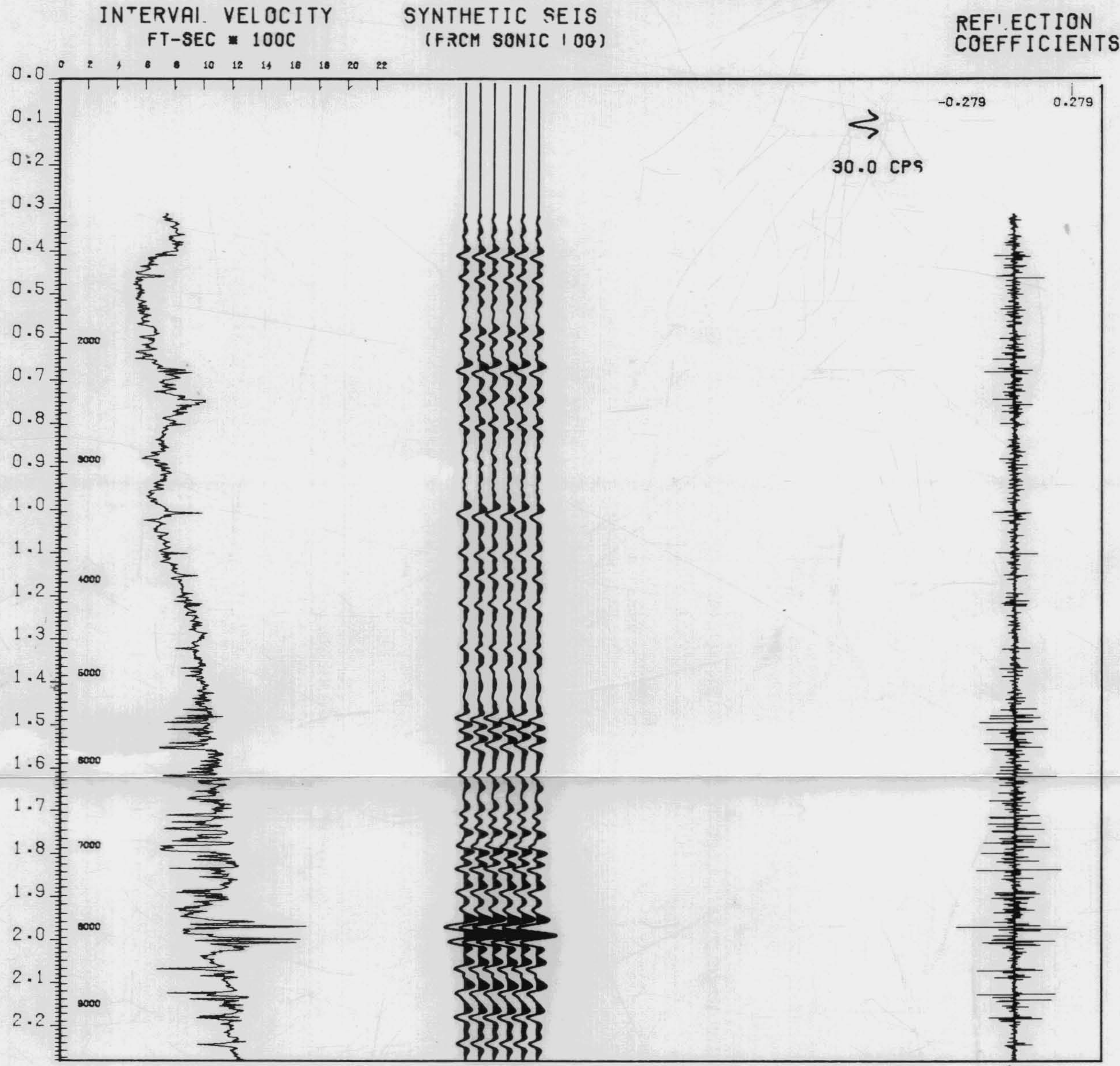
HOUSTON OFFICE 3724 DACOMA 77018

ESSO EXP &PROD AUSTRALIA INC CORMORANT 1 AUSTRALIA TASMANIA W

LOG DATUM = 100 SEISMIC DATUM = 0 COMMENTS

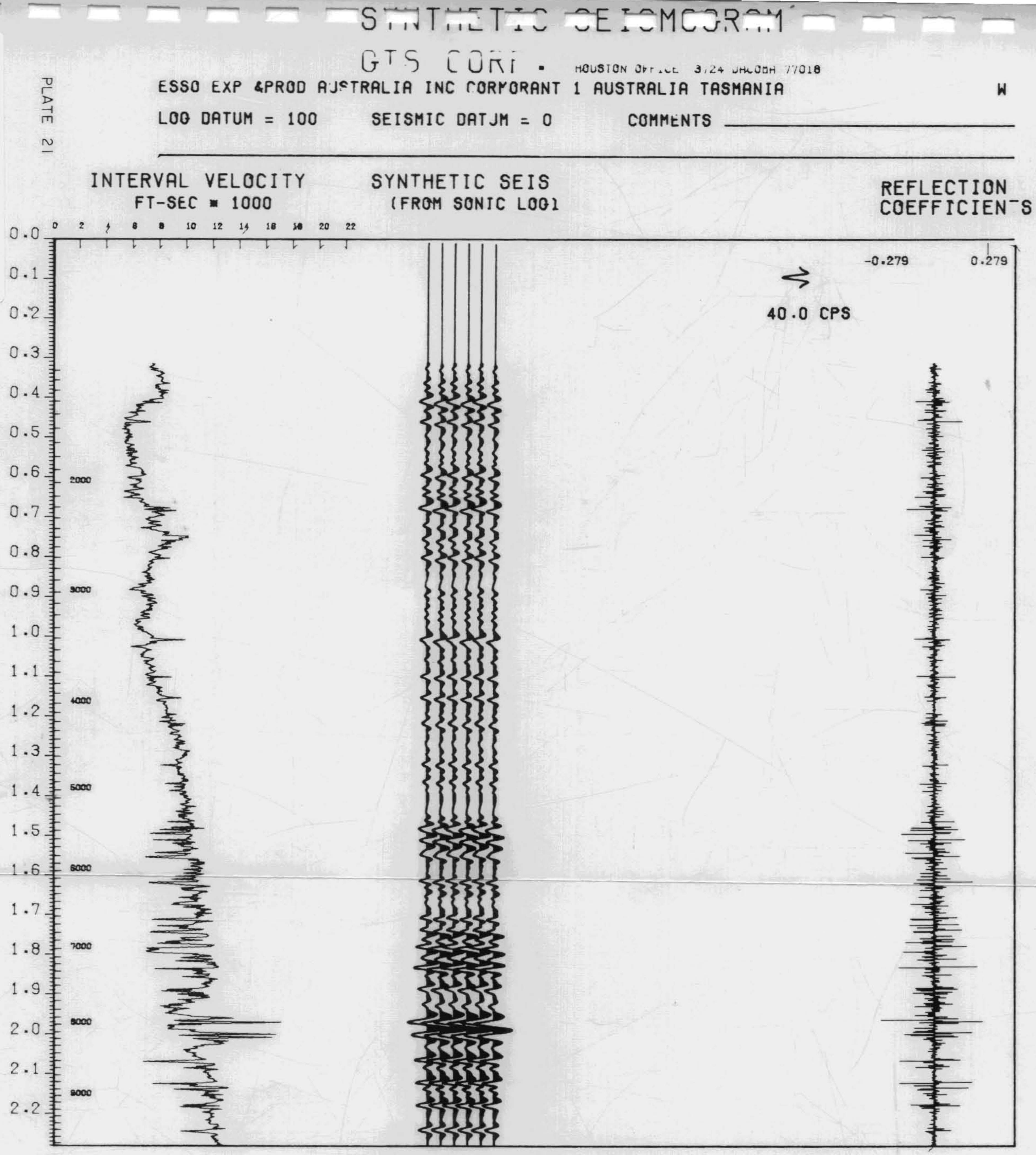
PLATE 20

5 cm



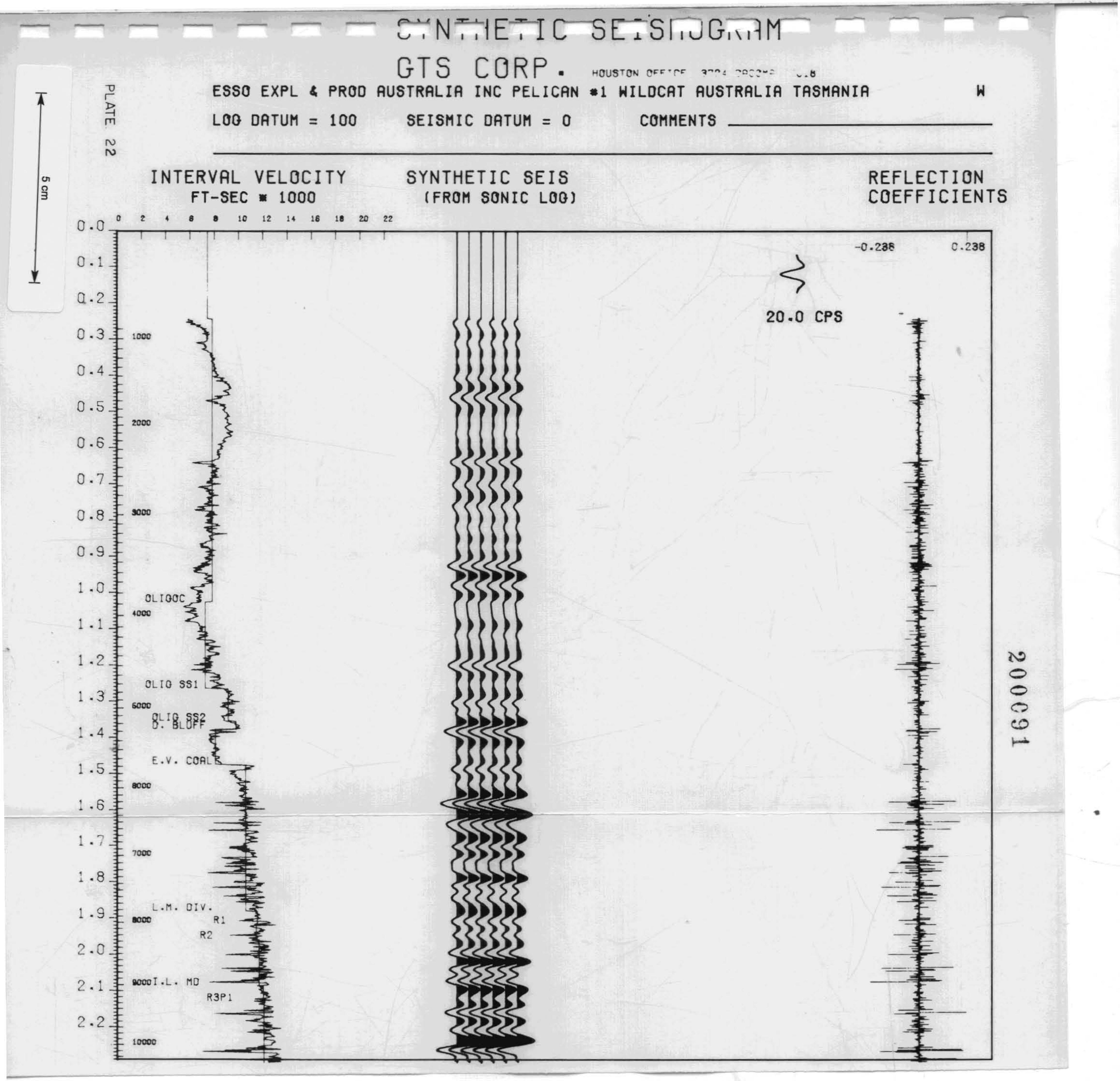
20089

PLATE 21



5 cm

200090



SYNTHETIC SEISMOGRAM
GTS CORP.
ESSO EXPL & PROD AUSTRALIA INC PELICAN #1 WILDCAT AUSTRALIA TASMANIA
W
LOG DATUM = 100
SEISMIC DATUM = 0
COMMENTS
PLATE 22
5 cm
INTERVAL VELOCITY
FT-SEC * 1000
SYNTHETIC SEIS
(FROM SONIC LOG)
REFLECTION COEFFICIENTS
-0.238
0.238
20.0 CPS
OLIGOC
OLIG SS1
OLIG SS2
O. BLUFF
E.V. COAL
L.M. DIV.
R1
R2
I.L. MD
R3P1
200C91

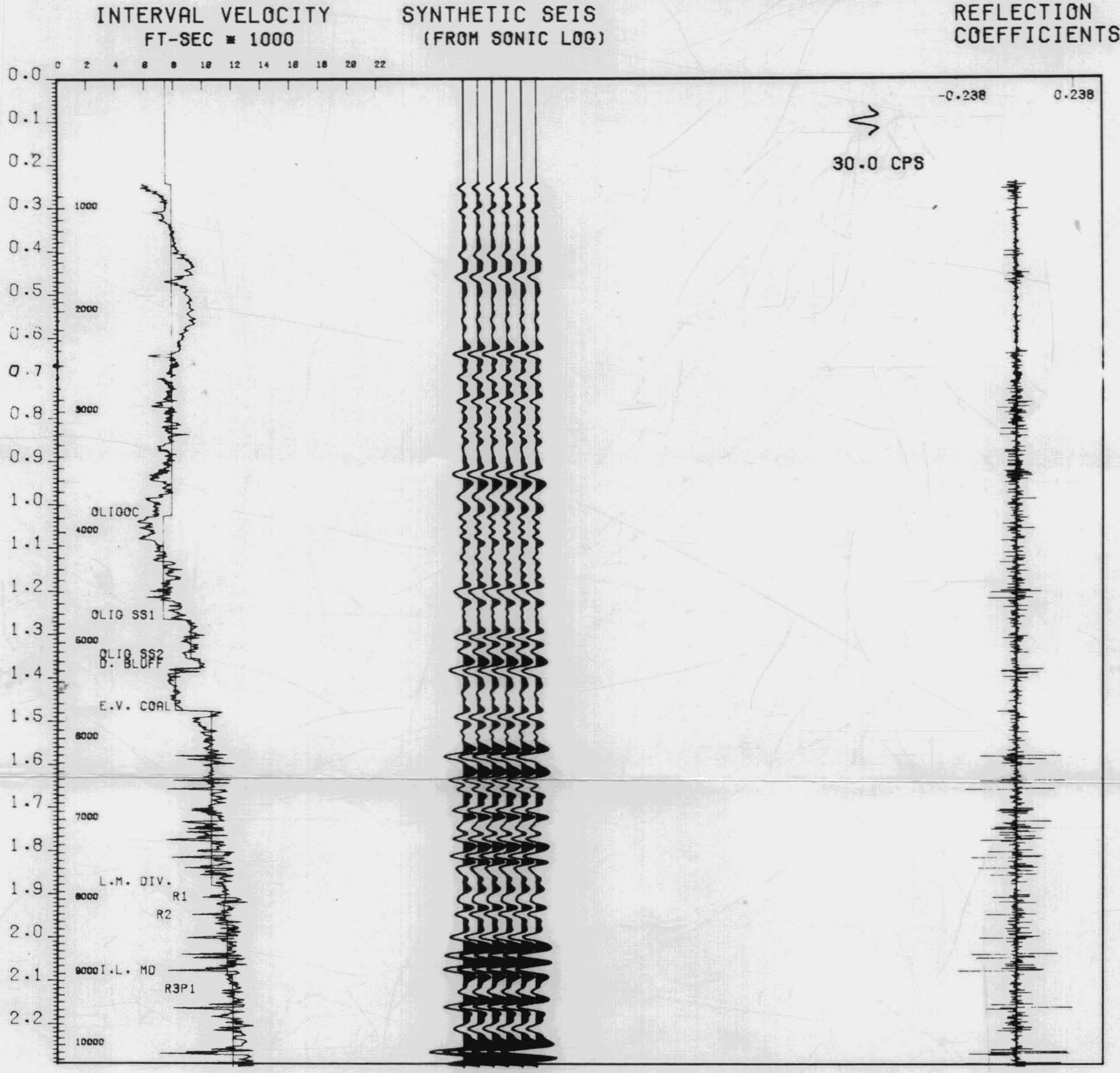
PLATE 23

SYNTHETIC SEISMOGRAM

GTS CORP. HOUSTON OFFICE 3724 DACOMA 77018

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

LOG DATUM = 100 SEISMIC DATUM = 0 COMMENTS



200C92

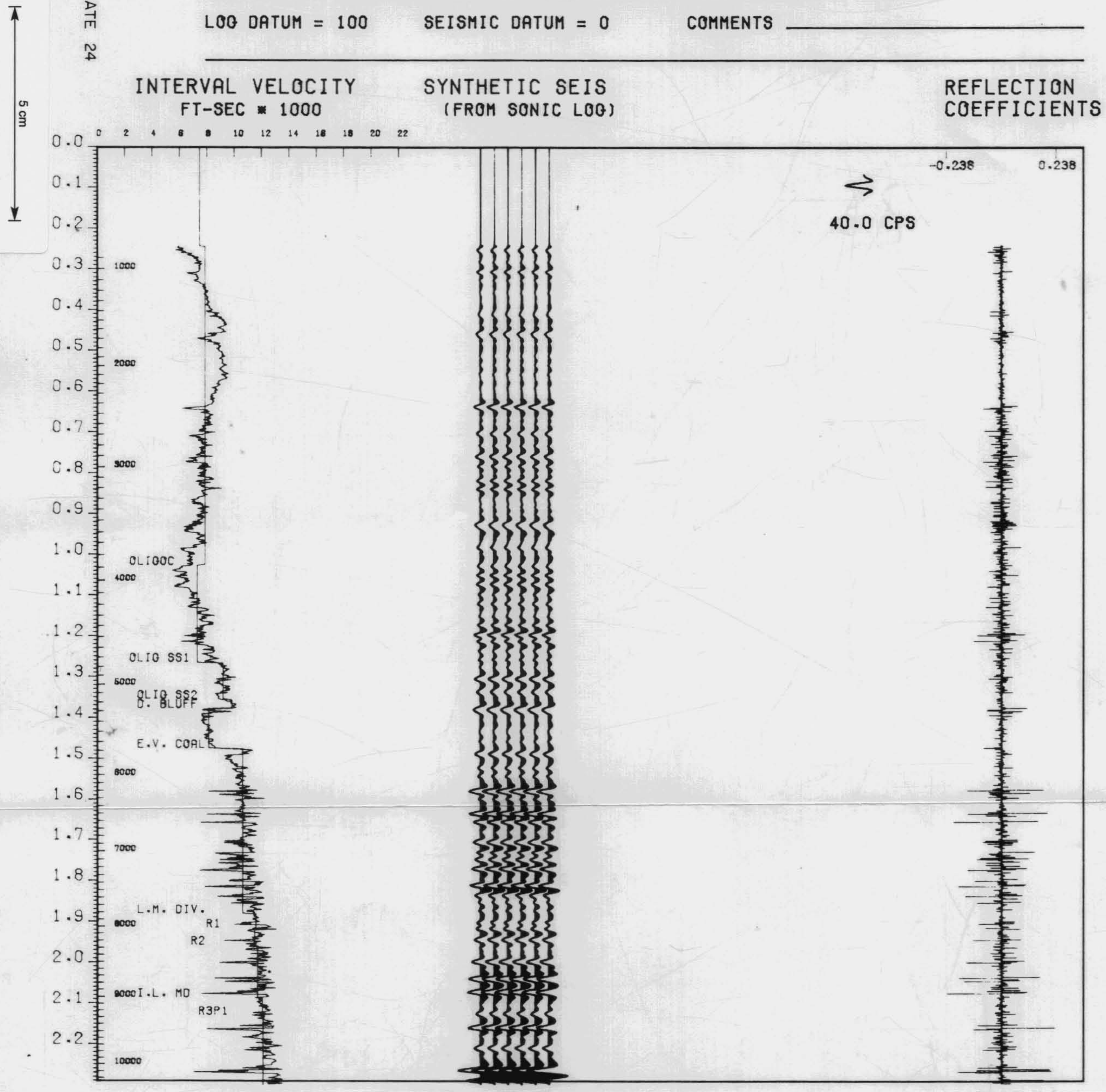
SYNTHETIC SEISMOGRAM

GTS CORP. HOUSTON OFFICE 3724 DACOMA 77018

PLATE 24

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

LOG DATUM = 100 SEISMIC DATUM = 0 COMMENTS ______



200093

SECTION IV_b

GRAVITY/MAGNETIC DATA PROCESSING

GRAVITY/MAGNETIC DATA PROCESSING

IN

OFFSHORE TASMANIA
STONEY HEAD AREA

FOR

WEAVER OIL COMPANY

BY

AERO SERVICE DIVISION
WESTERN GEOPHYSICAL COMPANY
OF AMERICA

AUGUST, 1981

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 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-81-11 from SP 1102-SP 1524.

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. Latitutde 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 (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 Earths main magnetic field (IGRF) from the observed data. Computation variables include the prospects location and Julian date of the prospects 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 prupose 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 41°00'S, on the North by latitude 40° 24'S and extends eastward from longitude 145° 45'E to longitude 147° 00'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.

16 November 78

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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:

General

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 have been mapped. The map horizons are the approximate top of the Eastern View Coal Measures and the approximate top of the M. diversus reflector levels. Their exact stratigraphic position is not always well known due to the lack of near by stratigraphic control as well as the magnitude and relief of the uplifted areas.

Structural Features of Interest

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

An extended area covering most of Permit T-16/P and a large portion of Permit T-15/P has also been mapped but failed to indicate additional features.

Tasmanian Devil Anomaly

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 adequately defined by existing seismic.

SECTION VI

List of Plates:

SECTION VII

Basic Data Submitted:

Velocity Analysis VELAN[R]

Time Variant Filtering

MIG, TVF

Seismic Lines with:

Magnetic Intensity (GAMMAS)

Bouguer Gravity (MGALS) Profiles

Magnetics Profile showing:

Total Magnetics Intensity (GAMMAS)

Raw Magnetics (GAMMAS)

Bouguer Gravity Profile showing:

Bouguer Gravity (MGALS)

Adj. Free Air Gravity (MGALS)

Filtered Eotvos Gravity (MGALS)

Water Depth (Meters)

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

Depth to Magnetic Basement Map

Shot Point Location Map

Shot Point Location Map with Water Depth in Feet

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

Velocity Analysis VELAN[R]

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

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 Magnetics Intensity (GAMMAS)

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

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

DEPTH TO MAGNETIC BASEMENT MAP

SHOT POINT LOCATION MAP

SHOT POINT LOCATION MAP WITH WATER DEPTH IN FEET

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

SECTION VIII

List of Interpretive Data Submitted:

- Seismic Time Structure Map

  M. diversus Reflector (regional map)

- Seismic Time Structure Map - Tasmanian

  Devil Anomaly

  Approximate M. diversus Reflector

- Seismic Time Structure Map - Tasmanian

  Devil Anomaly

  Approximate Top Eastern View Coal Measures

200112

STONEY HEAD
MARINE SEISMIC SURVEY

Bass Strait
Tasmania

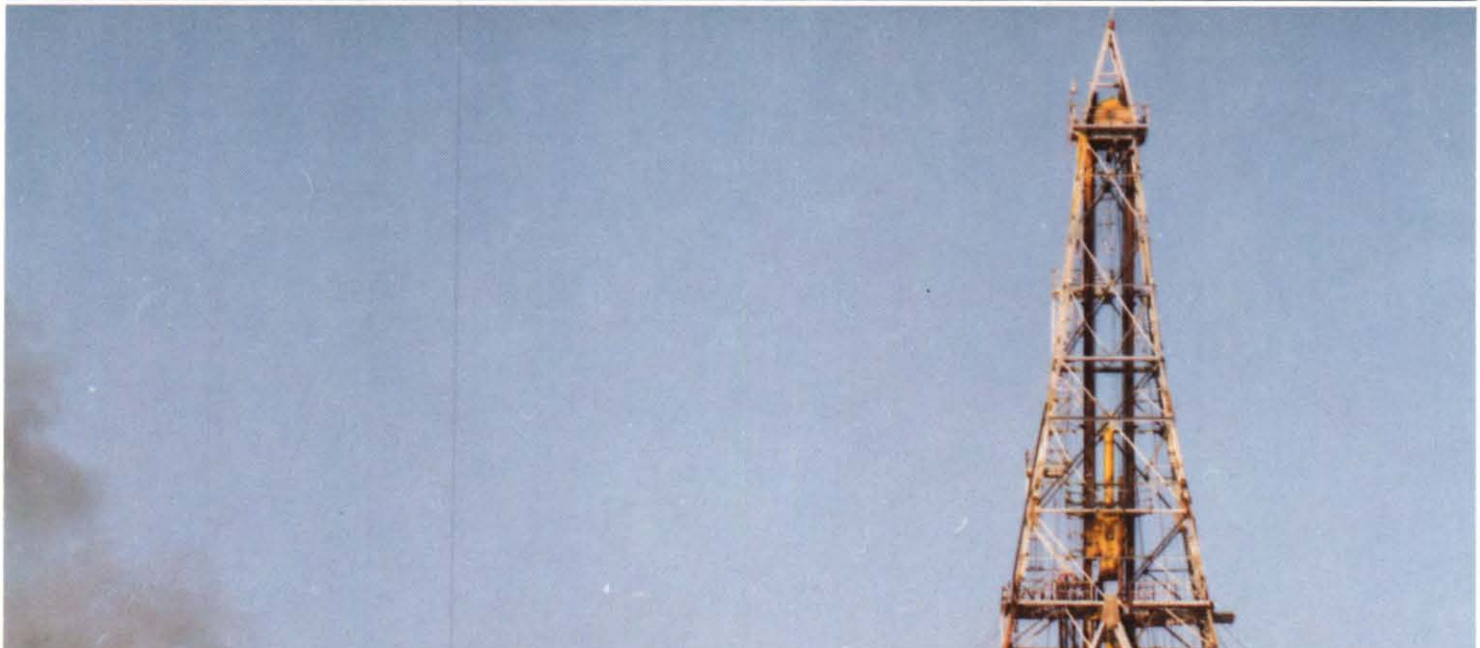
1981

Contents

TPR
OR-0189 Vol 2/2

OIL&GAS JOURNAL

BASS BASIN SET FOR NEW EXPLORATION



New wildcat campaign set for Australia's Bass basin, p. 154

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EXPLORATION

OIL & GAS JOURNAL

Bass basin set for new exploration

Dr. O.D. Weaver
Yvon Houde
Jack Downing
Jim Smitherman
Chris Nettels
Weaver Oil & Gas Corp.
Australia
A Kaneb company

Bass basin set for new exploration

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Recent leasing activity in three Mesozoic-Tertiary basins of the Bass Strait—the Gippsland, Bass, and Otway basins—has focused the attention of Australian and international explorationists on this area.

The Bass Strait, separating Tasmania from the Australian mainland, is the source of over 400,000 bbl of oil daily from its eastern portion, the Gippsland basin. The initial recoverable reserves in this basin alone exceeded 3 billion bbl of oil and 8 trillion cu ft of gas.

Fig. 1 shows the location of the productive areas and the outline of the present exploration permits in the Bass and Gippsland basins. Essentially all of the permits covering the prospective areas of both basins have now been awarded.

Recent work program bidding was heavy for the three Victoria permits, V80-1, V80-2, and V80-3, adjoining Esso-Hematite (BHP) Gippsland basin acreage. Three consortia made up of 13 companies bid $240 million in exploration programs for these permits. Following this, Esso-Hematite announced a $160 million exploration program of its own over the next 3 years.

The Hudbay, et al. 1 West Seahorse, a recent wildcat test well located near shore north of the Barracouta field, flowed oil at a rate of 1,900 bo/d. This is the first of a series of new test wells to be drilled on peripheral Gippsland basin acreage formerly held by Esso-Hematite.

This article summarizes the oil and gas potential of the Bass basin, which contains essentially the same reservoir section as the prolific Gippsland basin, by discussing the prospectiveness of certain structural features.

Water depths in the most prospective areas of the Bass basin are less than 220 ft and drilling depths to potential reservoirs range from 3,500 ft to 10,000 ft and beyond.

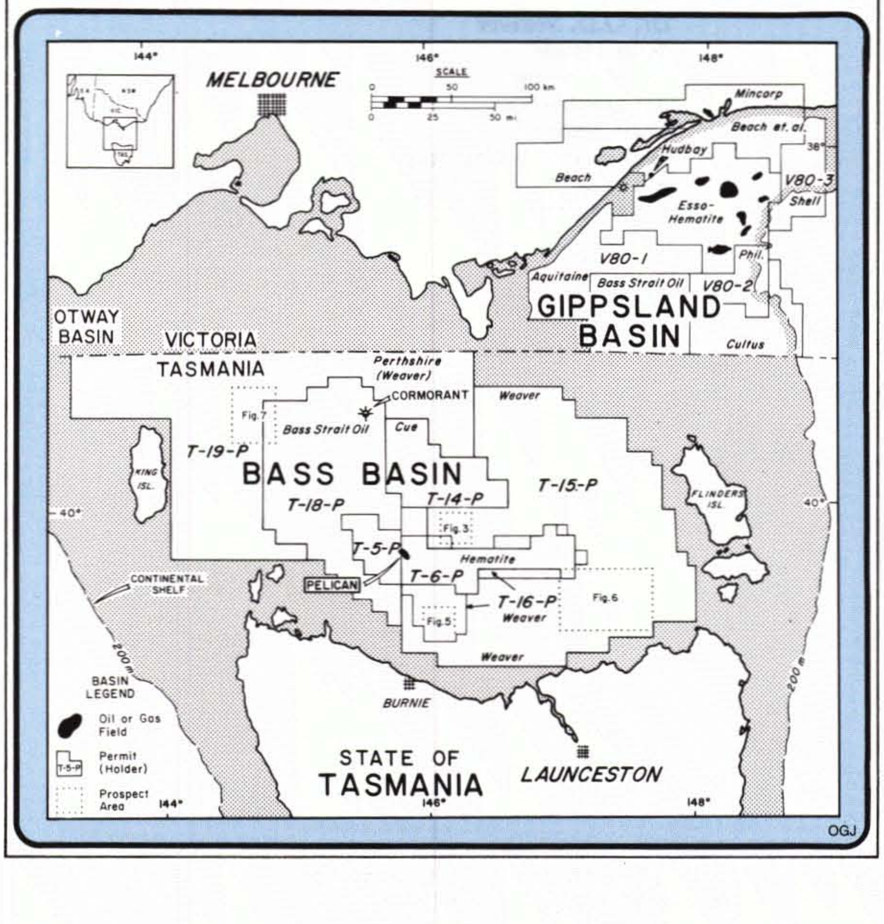
The Bass basin was essentially leased in 1979 and 1980 and the bulk of the exploration drilling will take place during the 1982-84 period.

In 1964-65 Esso and Hematite were the exclusive permit holders of almost the entire offshore area shown in Fig. 1, and drilled the first test wells in the Gippsland and Bass basins. Since three of the first four Gippsland basin wells resulted in two discoveries and one confirmation, the Bass basin, with one dry hole, quickly fell behind in well activity. Only three wells had been drilled in the Bass basin by 1970, whereas over 35 wells had been drilled, with seven fields discovered, in the Gippsland basin.

The first significant Bass basin discovery was at Pelican in 1970; however, this basin with a prospective area of over 15 million acres now has had only 18 wildcat and confirmation

Fig. 1

Bass Strait



wells drilled. Three of these wells are located within the potentially productive areas of the Pelican gas/condensate shutin field discovery. In addition, oil was recovered in the Cormorant well in the northern part of the Bass basin.

Hematite still holds about 1,300,000 acres in the central area of the Bass basin and plans to drill two test wells by early 1982—possibly one confirmation well in the Pelican field area, and one wildcat in the east half of their block which is outlined in Fig. 1.

A complete review and integration of all the previously acquired geological and geophysical information has been completed by the authors and combined with substantial amounts of new seismic data. This study has so far delineated a number of large structural features located in different geological provinces of the basin. A selected few of these features are illustrated and discussed in this article.

The Australian Bureau of Mineral Resources, in recognition of the untested potential of the Bass basin, has committed to a 4,500 km seismic program that centers in the Bass basin and ties to the Otway and Gippsland basins. This program reflects the Australian government's interest in evaluation of the Bass basin and will stimulate exploration activities within the entire Bass Strait geological province.

Stratigraphy. The Eastern View Coal Measures constitute the principal objective section of the Bass basin. The sediments included in this lithostratigraphic unit range from Upper Cretaceous through the basal Upper Eocene and, in a broad sense, are equivalent to the Latrobe Valley Group, which contains all of the prolific discoveries of the Gippsland basin.

Fig. 2 illustrates the most prospective portion of the stratigraphic sequence in both the Bass and Gippsland basins and compares the occurrences and distribution of the productive zones and hydrocarbon indications in each of the basins.

The Upper Cretaceous and Paleocene section of the Bass basin was deposited, in part, in fault controlled troughs where it reaches thicknesses of over 8,000 ft. At the basin margin, as well as in the intrabasin areas of major uplift, it rests unconformably on the Lower Cretaceous section. On the basis of limited well data the Upper Cretaceous and Paleocene are described as containing coarse to medium grained reservoir sands interbedded with black carbonaceous shales of source rock and seal quality, along with minor coal beds.

The boundary between the Paleocene and Eocene is interpreted, at least locally, as an unconformity on the basis of seismic data as well as the drastically reduced thickness, or complete absence, of section in certain wells.

The Lower, Middle, and basal Upper Eocene section is widely distributed and may be in excess of 3,000 ft thick. It consists of reservoir sands, black carbonaceous shales, and thick coal beds. Correlation between individual beds is difficult due to rapid, structurally induced, lateral facies changes.

Regional transgression from the

Fig. 2

Stratigraphy

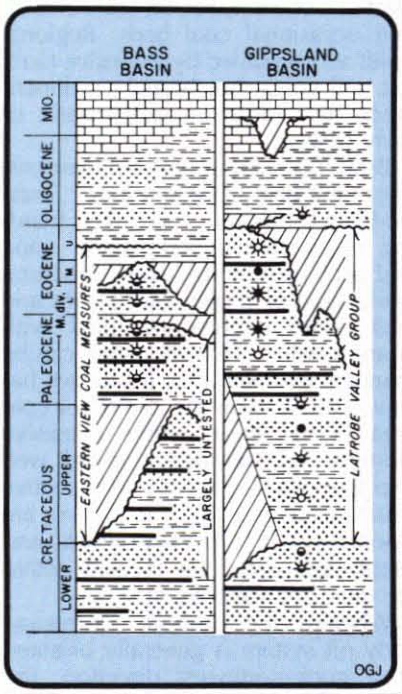


Fig. 3

Squid anomaly

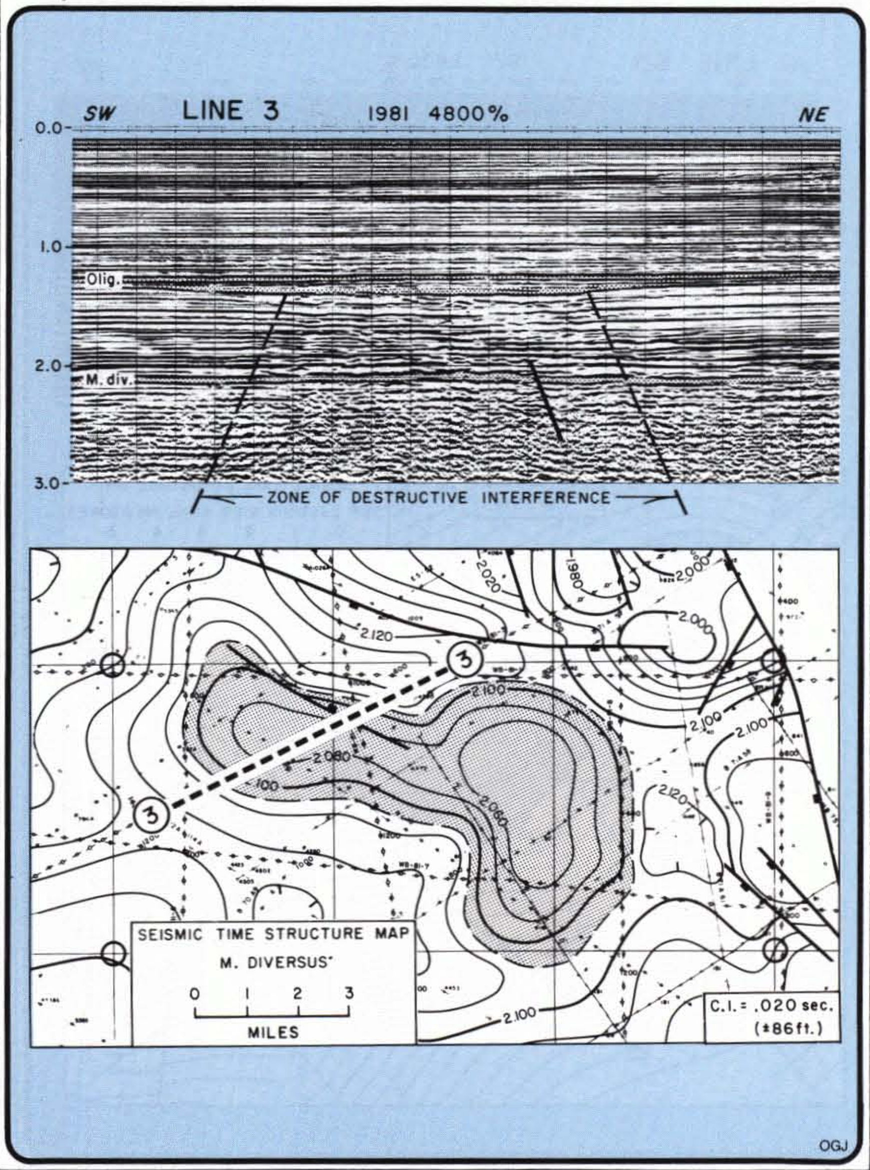


Fig. 4

Sand isochron-structure compared

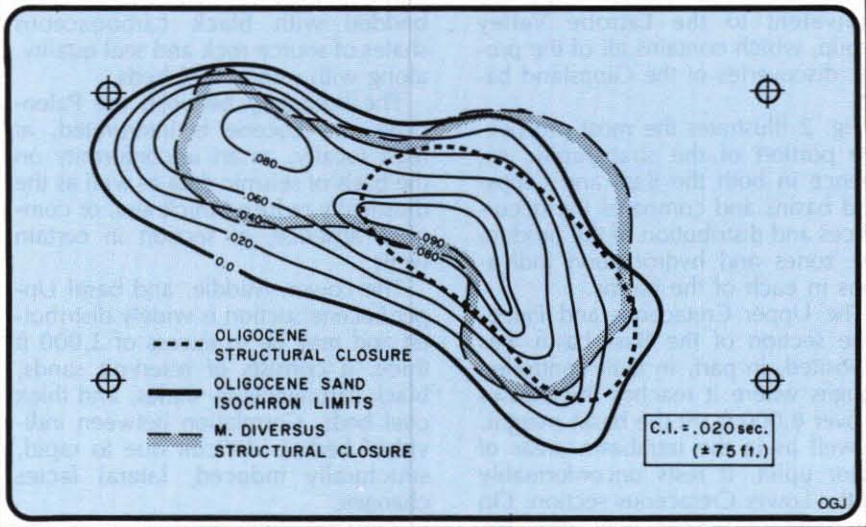
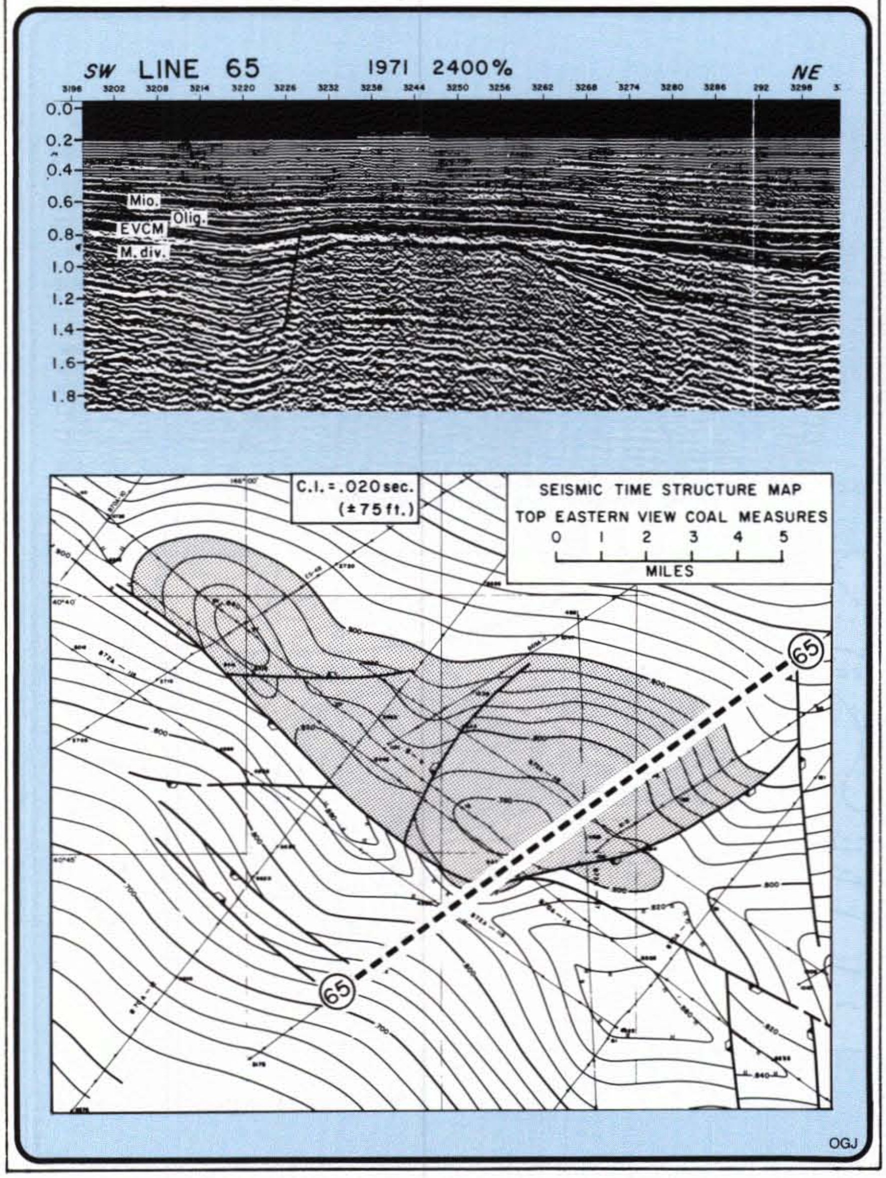


Fig. 5

Fault closure delineated



northwest led to restricted marine conditions during the Late Eocene and Oligocene. This sequence consists of a predominantly shale facies overlain by marine sands in the northwest half of the basin while in the cental portion of the basin it is mostly carbonaceous, pyritic, and silty shales. The late Eocene shale section constitutes the regional seal and, in part, source rock package to the underlying reservoir section.

Detailed palynological zonation of the Eastern View Coal Measures and the Latrobe Valley Group indicates that the Malvacipollis diversus assemblage zone ("M. diversus") is one of the most prospective portions of the section both in the Gippsland and Bass basins. The unconformity at or within this zone has been mapped seismically.

Open marine conditions prevailed during the rest of the Tertiary and sandstones and shales were deposited which offer potentially productive reservoirs.

Basin evolution. The earliest phase in the evolution of the Bass basin and other basins of the southeastern Australian continental margin is best illustrated on Tasmania where the Permian, Triassic, and Jurassic sequence occupies structural depressions in the central part of the state.

Where exposed, this sequence consists of a basal tillite overlain by marine and lacustrine carbonaceous mudstone, limestone, and fossiliferous siltstone characterized by occurrences of oil shales and cannel coal. The sequence evolves upwards towards lacustrine and fluviatile clastics and coal beds, and grades finally into marginal marine to nonmarine coarse clastics, black carbonaceous shales, and occasional coal beds. Regional uplift accompanied by extensive faulting and volcanism brought sedimentation to a close in Late Triassic or Early Jurassic.

Best illustrated in the southeast corner of the Bass basin is a major Jurassic-Early Cretaceous, northwest trending rift system superimposed upon and accompanied by major structural readjustments of preexisting faults and fault angle depressions filled with coarse clastics. This rift system can be mapped seismically as it plunges basinward and forms the central or core area of the basin where extensive faulting and subsidence lasted well into the Late Cretaceous. Prospective structures along this rift system are associated with tilted fault blocks and simple fold anticlines located within the fault bounded depression.

Whereas the onshore Tasmanian early rift system is generally oriented in a north-northwest direction, the younger offshore rift system is offset to the east and plunges in a northwest direction. Prospective structures associated with wrench fault type deformation are recognized throughout the Tertiary section of the Bass basin.

The structural evolution and sedimentary regime of the Bass Strait basins changed drastically in Late Cretaceous. The first stage in the evolution of these basins could be classified as aborted rift valley basins or failed arms associated with triple junctions and is characterized by great thicknesses of alluvial, fluviodeltaic, and organically rich lacustrine or marine sediments. The next stage is characterized by the presence of Late Cretaceous and Tertiary, the Eastern View Coal Measures, which consists of terrigenous clastics resulting from a second cycle of deposition over these deformed eugeosynclines which developed along the continental margin.

These two stage basins are further characterized by a high geothermal gradient (up to 2.5°F./100 ft) and heat flow (2.5 or more), thus promoting early and accelerated generation, expulsion, migration of hydrocarbons into favorable stratigraphic and structural traps such as have been found in the prolific Gippsland basin and are undoubtedly left to be found in the Bass basin.

The Paleocene to basal Early Eocene period was one of structural quiescense during which the still land locked basin area expanded. Structural movements intensified in later Early Eocene, and folding and faulting as well as widespread erosion of the section took place, thus forming the intra M. diversus unconformity. A more active period of stream erosion developed during the Middle and Late Eocene, although the basin was still mostly enclosed, and a cut and fill system developed across coal swamps. The beginning of a marine influence is recognized in the north part of the basin from wells in that area.

Basinwide transgression took place in Late Eocene and was accompanied by intermittent structural readjustments throughout the remainder of the Tertiary.

Untested potential. Four structural complexes have been selected to illustrate the untested hydrocarbon potential of diverse geological provinces of the Bass basin.

The Squid structural feature and anomaly (Fig. 3) is located in the central area of the Bass basin to the northeast by the Pelican gas/condensate field discovery in the Lower M. diversus zone of the Eocene Eastern View Coal Measures.

The feature was mapped as an anticline at the Lower M. diversus level by using both the old and new seismic data.

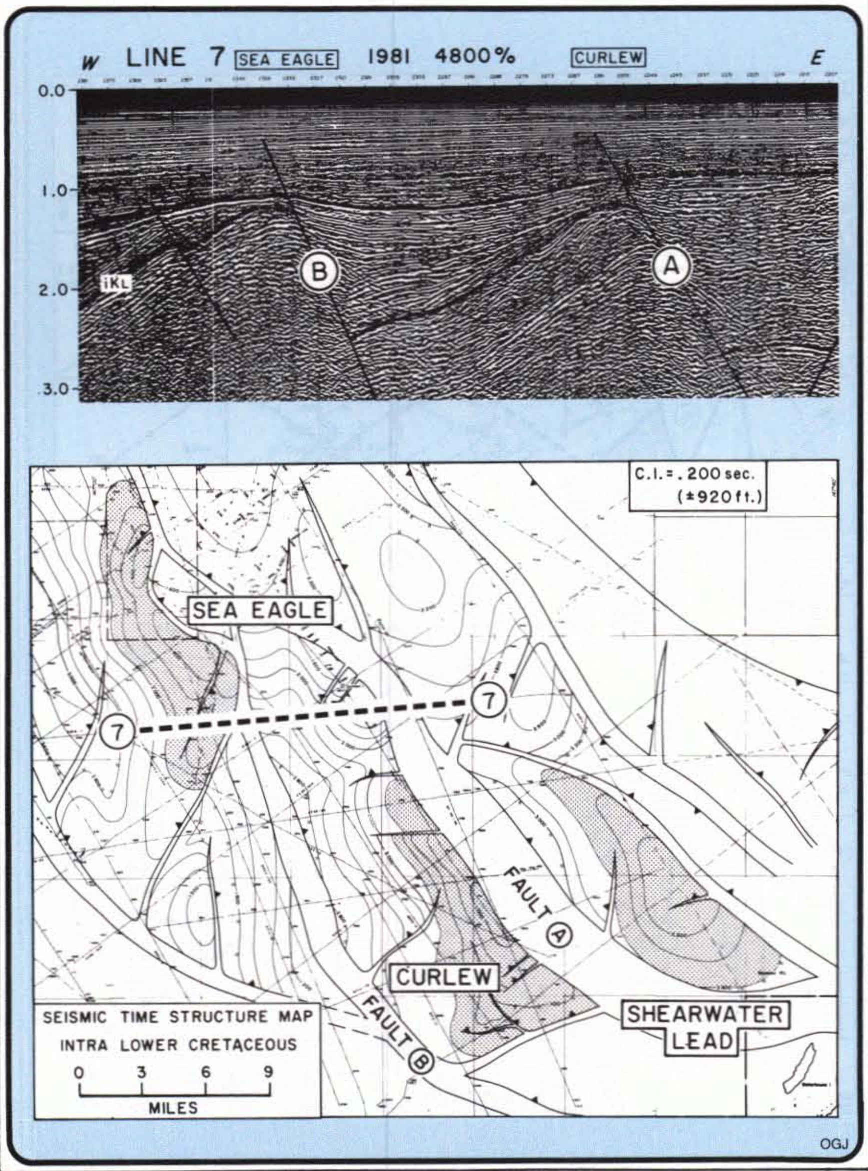
It is deep seated, with a demonstrated period of structural growth during deposition of its primary objective section, the Eastern View Coal Measures. A second period of growth is displayed through crestal convergence of the section between the Eastern View Coal Measures and the Oligocene reflector level. Of particular interest is the presence of an anomalous lens shaped event just below the Oligocene reflector. This anomaly is believed to be a hydrocarbon bearing sand development within the Oligocene section which is confined to the approximate area of closure of the underlying structure. Its seismic expression is characterized by polarity reversals and destructive interference, essentially within the area marked on Fig. 3. The lens and the M. diversus mapping zone have been indicated with a dot pattern for illustrative purposes.

Fig. 3 includes a 1981, 48 fold, seismic section (A-A') which trends northeast across the Squid anomaly. This section shows the lens shaped anomaly below the Oligocene horizon and the rollover at the Lower M. diversus reflector level.

Fig. 4 is an isochron of the Oligocene sand body which has an areal extent of 26,000 acres and a maximum thickness of approximately 400 ft. The outline of the closure at the M. diversus level from Fig. 3 is shown as a shaded outline on this figure. At the apex of the structure, the Oligocene objective is at a depth of 4,900 ft, and the Lower M. diversus at a depth of 7,900 ft. The area of closure for the Lower M. diversus zone is approxi-

Fig. 6

Rift system mapped



mately 18,000 acres and the relief is 0.060 sec or about 250 ft. The Squid anomaly has two objectives: the Oligocene sand body and the Lower M. diversus, or main objective, either of which could be a great oil field. A 9,000 ft well would test these two objectives.

Located halfway between the Pelican gas/condensate field discovery and the north coast of Tasmania is the Tasmanian Devil structure (Fig. 1). This feature, as illustrated in Fig. 5, is a northwest trending, tilted fault block bounded to the southwest and southeast by a down to the coast normal fault and accompanying synclinal areas.

The structure has been mapped at the approximate top of the Eastern View Coal Measures reflector level. The northeast trending seismic section in Fig. 5 illustrates the closure at the map level and the pronounced unconformity at the Mid. M. diversus level. It is similar to the Squid structure in that it shows a major period of structural growth during deposition of the Eastern View Coal Measures section. The presence of an early structure is indicated by multiple reflectors which terminate against or onlap its basinward flank. Persistence of the structure through the shallow section, as well as the presence of an effective seal, is indicated by arching, convergence, and drape of the predominantly shale section contained within the upper Eastern View Coal Measures to Mid-Miocene reflectors level. Additional closure of the underlying section is provided by updip termination against the bounding fault.

The top of the Eastern View Coal Measures objective section is at a depth of about 3000 ft, and its area of closure is approximately 32,000 acres. Relief is in excess of 500 ft.

Sea Eagle, Curlew, and Shearwater structures are part of the rift system which occupies the southeast corner of the basin (Fig. 1 and 6). The structures are the upthrown sides of tilted fault blocks adjacent to basin forming faults, and their areas of closure have been mapped at an intra-Cretaceous reflector level. The major period of structural growth took place during the Cretaceous, as illustrated by onlap and convergence of the section on their flanks as well as erosion of the crestal areas. The magnitude and rate of dip of each tilted fault block is such that it is rooted deeply in the basin, thus making it possible for long range migration of hydrocarbons and strong water drive.

The west to east seismic section in Fig. 6 crosses the southern flank of Sea Eagle and the bounding fault of Curlew. It shows the tilted fau' blocks, the mapped intra-Cretaceous reflector level, and the down to the east faults that bound the features.

Areal closure of Sea Eagle is approximately 27,000 acres with a relief of 0.600 sec or 3,100 ft. Curlew covers approximately 20,000 acres with a relief of 0.600 sec or 2,500 ft. Shearwater is considered a structural lead at this time and additional seismic will be required for further delineation.

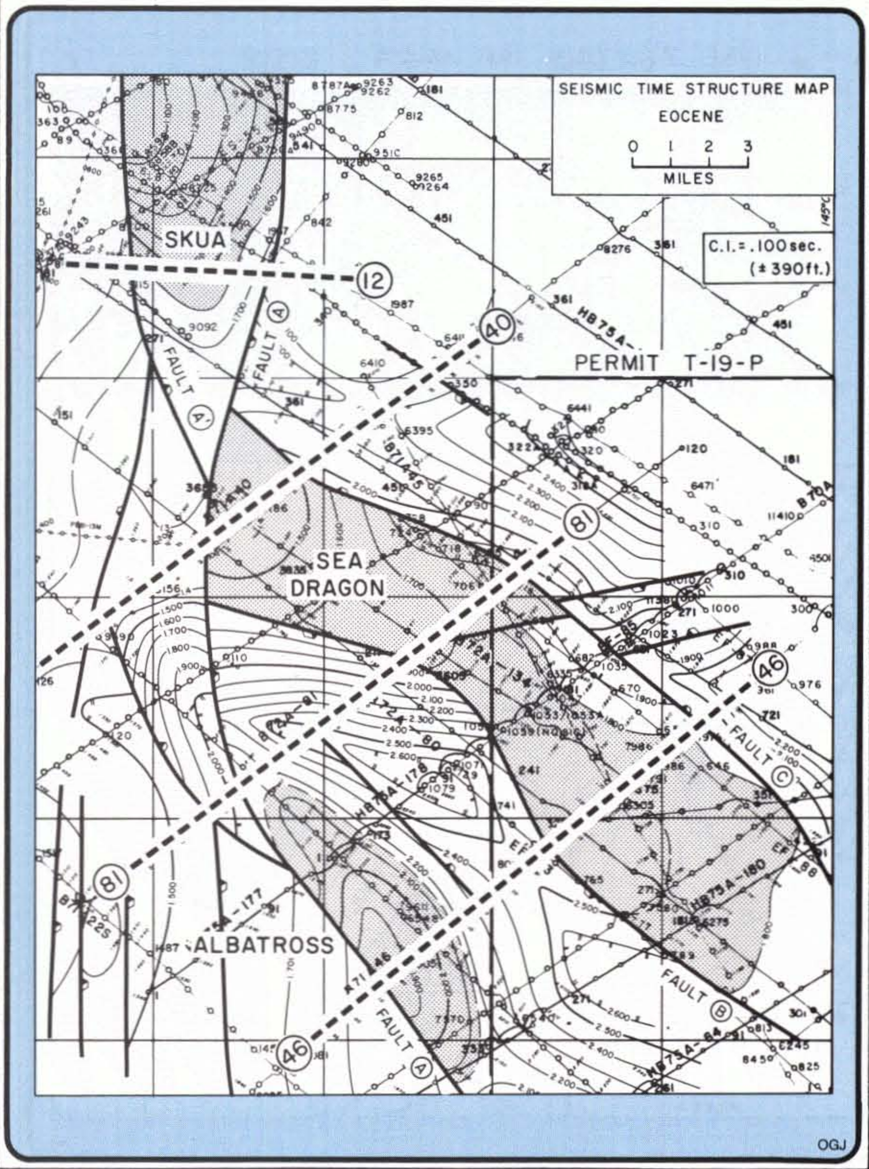
In the northwest portion of the basin (Fig. 1) structural mapping on pre-1974 data and recently acquired 4,800% seismic has uncovered a number of prospects and leads. Three structures have been mapped at the pre-M. diversus reflector within the Eastern View Coal Measures as shown on Fig. 7. The structural nature of the Skua, Sea Dragon, and Albatross features, their areas of closure, and the location of seismic lines 12, 40, 81 and 46 are shown on Fig. 7. The main faults are assigned letters for ease of identification on Fig. 7 and on Fig. 8, a north-south composite of essentially east-west seismic lines across this area.

Seismic line 12 (Fig. 8), acquired in 1981, illustrates the Skua lead which is a combination anticline and erosional remnant on the upthrown side of fault "A." Above the westward tilted erosional remnant are indications of onlap at the unconformity surface. With additional seismic data to be acquired in 1982, this structural lead may develop into a prospect very similar in geometry to those found productive in the Gippsland basin.

Sea Dragon is a northwest trending horst block bounded by depositional troughs. It terminates towards the northwest against the major transverse

Fig. 7

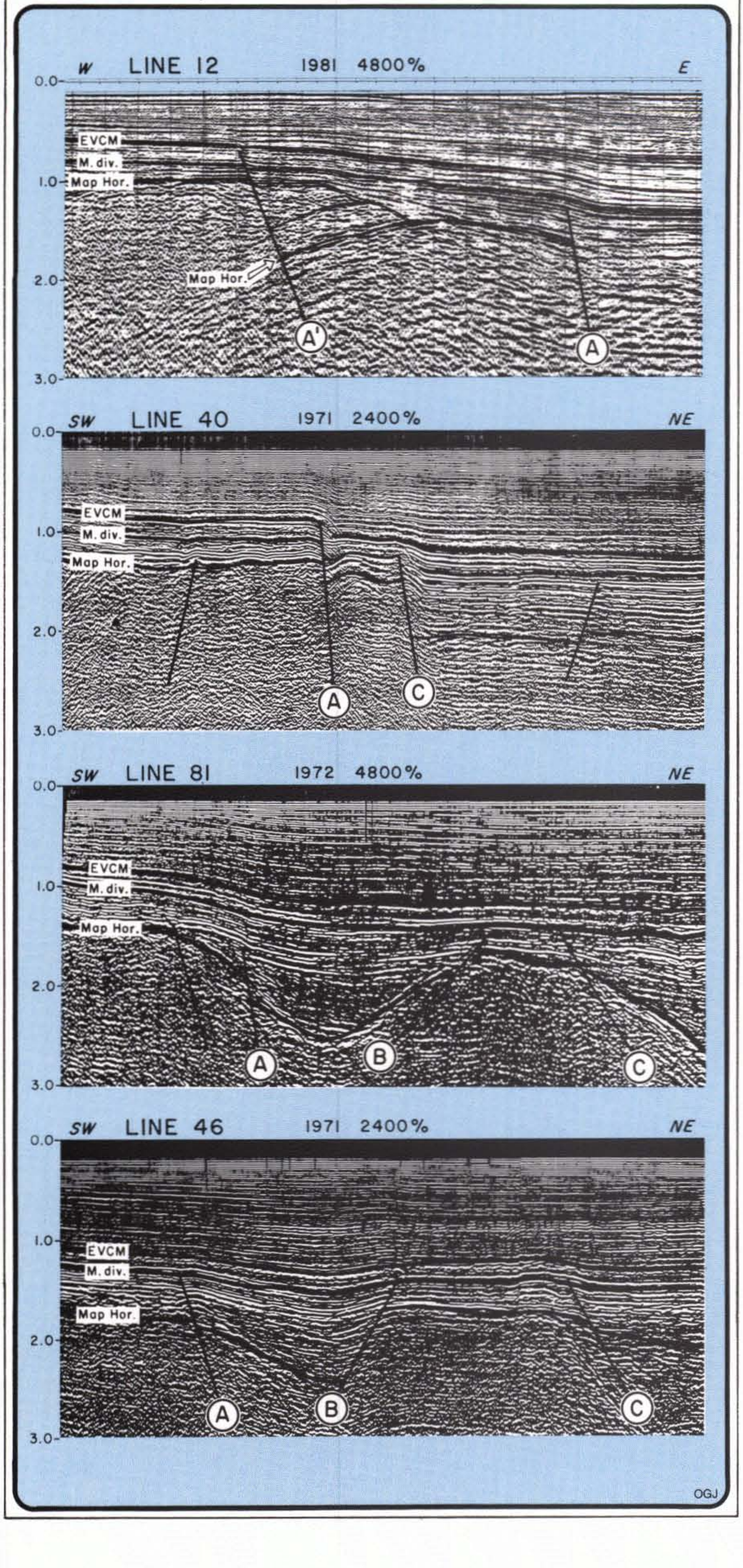
Prospective structures defined



200120

Fig. 8

Structural style illustrated



fault "A." Its area of closure is 41,000 acres. Seismic line 40 (Fig. 8) displays the rollover of the Sea Dragon structure into fault "A" and the position of fault "C" (on the northeast flank of the structure).

Seismic lines 81 and 46 show the Albatross structure, controlled by transverse fault "A" and separated by a synclinal area from the Sea Dragon horst block which is defined by faults "B" and "C." Its area of closure is 11,000 acres.

Summary. The Bass basin is sparcely tested, yet contains a thick, porous sedimentary section similar to the productive horizons in the nearby Gippsland basin.

A detailed seismic grid of over 14,000 km, much of it shot by Esso and Hematite during the period when these companies held exclusive permits on the entire Bass Strait area, is available to present day explorationists. A recent detailed study of this data plus new seismic has revealed numerous undrilled structural anomalies of significant size and reserve potential.

The selected structural features presented in this article illustrate the largely untested potential of the Bass basin. Exploration concepts derived in part from the Gippsland basin field studies have been utilized where applicable.

Prices of oil and gas have risen sharply in the past few years, bringing many undrilled structures within viable economic limits. The proximity of the shallow water Bass basin to markets in southeast Australia adds appreciably to its economic potential.

Long a stepchild to the Gippsland basin, the Bass basin is now fully leased and gives promise of major discoveries as the structure and stratigraphy of its over 15 million acres are unraveled.

The Australian Bureau of Mineral Resources newly commissioned seismic study of the Bass and adjoining basins will be available for all explorationists in 1982 and should contribute to the overall understanding of, and interest in, the Bass Strait basin complex.

The momentum of southeastern Australian exploration has now created in the Bass basin the interest and competition of Australian and international oil and gas companies so necessary for the discovery of world class reserves in this relatively untested basin. ▪

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Ross McDade, manager of Weaver Oil & Gas Corp.'s mapping section, illustrated the geological and geophysical data presented.

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TASMANIAN DEVIL PROSPECT

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T Devil NE-SW

TASMANIAN DEVIL PROSPECT

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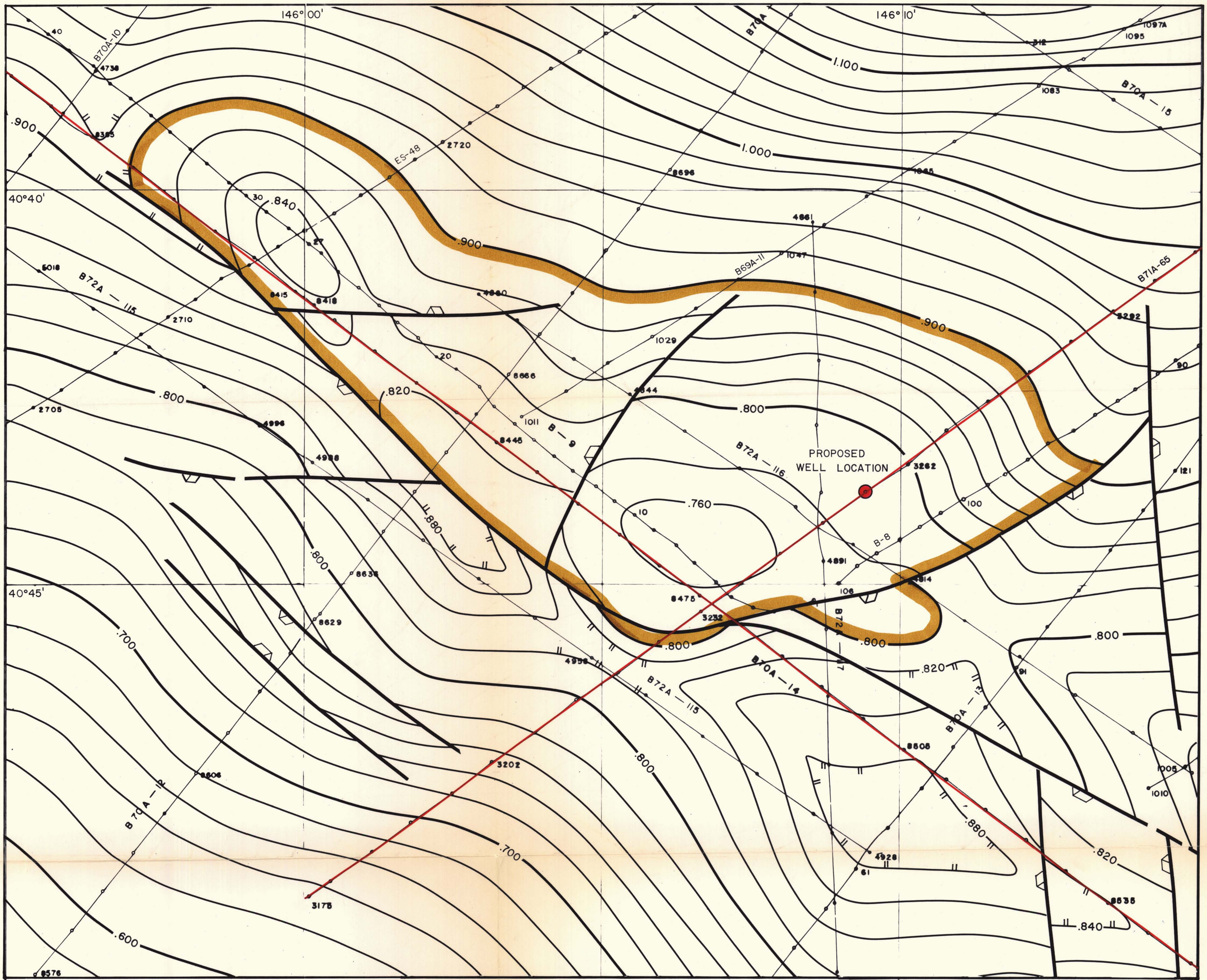

DEPTH TO MAIN OBJECTIVE SECTION: 0.760 sec., ± 2950'

AREA OF CLOSURE: 32,800 acres

RELIEF: .140 msec.

N

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TASMANIAN DEVIL

PERMIT T-16-P

APPROX. TOP EASTERN VIEW COAL MEASURES

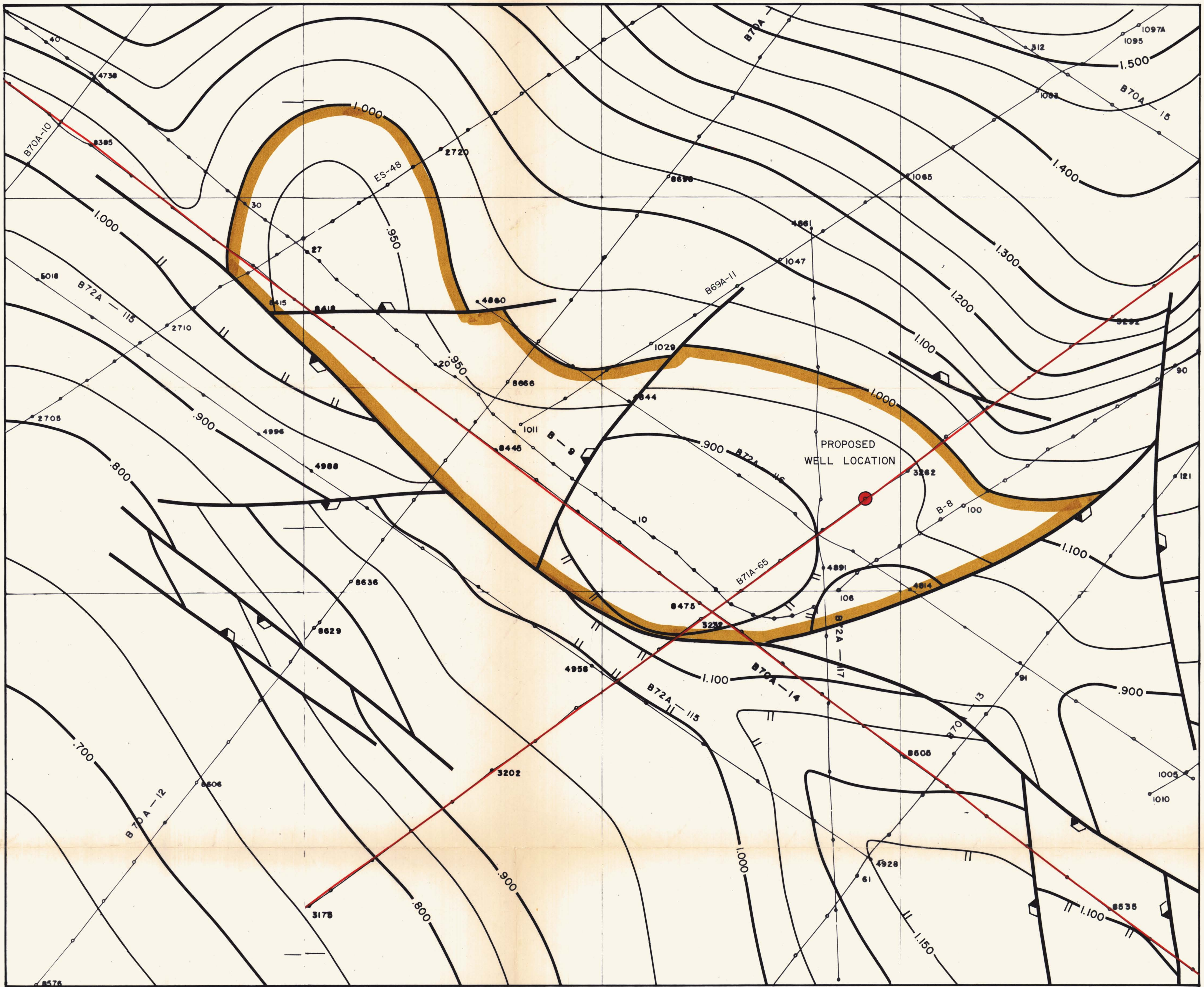
200124

GEOPHYSICIST: J.D. DOWNING

0 1 2 3mi
0 1 2 3 4 5km

C.I. 0.020 sec. SCALE 1:50,000 APRIL 1981

5 cm



DEPTH TO MAIN OBJECTIVE SECTION: 0.900 sec., ±3500'

AREA OF CLOSURE: 24,500 acres

RELIEF: .100 msec., ±400'

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TASMANIAN DEVIL

PERMIT T-16-P

APPROX. MID. M. diversus

200125

GEOPHYSICIST: J. D. DOWNING

C.I. 0.050 sec. SCALE 1:50,000 JUNE 1981

5 cm

OR-0189 VOL III