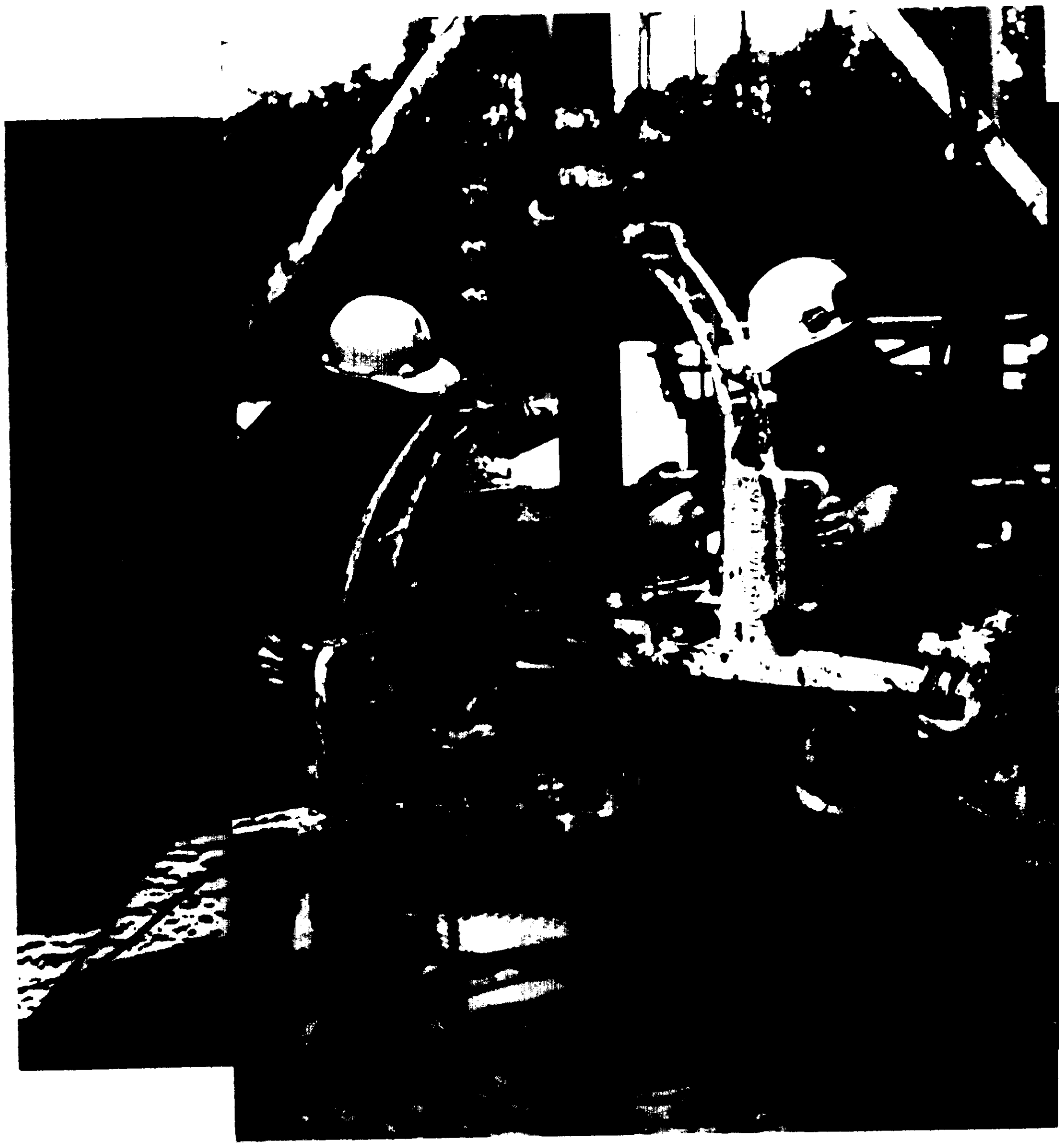
Bus Swamp 1

Well Completion Report



Bus Swamp 1

Geological Survey of Victoria
Basin Studies

1993 ***VOL. I: TEXT & APPENDICES***

Department of Energy and Mi

EXECUTIVE SUMMARY

Bus Swamp 1 was drilled as part of the Geological Survey of Victoria's (GSV) stratigraphic drilling programme in the Otway Basin. This programme is an important component of a major study being carried out by the Basin Studies Section of the GSV. The study involves a systematic review of all relevant data on the Otway Basin, including information held by government agencies and petroleum exploration companies. The study will increase the understanding of the evolution of the Otway Basin and will provide a better delineation of the source and reservoir rocks in the basin. It will provide an up to date regional framework for use by petroleum explorers in developing hydrocarbon plays.

The National Geoscience Mapping Accord's (NGMA) Otway Basin Project forms part of this study. The NGMA Project involves seismic interpretation of the onshore Otway Basin in order to improve knowledge of the tectonic events that resulted in basin development and evolution. The project involves contributions by Australian Geological Survey Organisation, Mines and Energy-South Australia, Victorian Institute of Earth and Planetary Sciences and GSV.

Bus Swamp 1 was drilled near the northern margin of the Penola Trough, part of the Late Jurassic - Early Cretaceous rift system which initiated the Otway Basin, in order to aid the seismic interpretation of the NGMA Project.

The well was drilled by the Rural Water Corporation Drilling Unit for the Geological Survey of Victoria, a division of the Victorian Department of Energy and Minerals. Drilling began on 19 November, 1992 and reached a total depth of 1850.5 m on 17 December, 1992.

Four conventional cores were recovered, in addition to a full suite of industry standard wireline logs being run and a velocity survey carried out. The target Otway Group sediments, including Eumeralla Formation, Crayfish Subgroup and Casterton Formation, were intersected, in addition to basement.

The well was monitored using a gas chromatograph and hot wire total gas detector with peak gas readings of 23.8 units and 21.8 units being detected. Hydrocarbon fluorescence was also noted at several depths. Bus Swamp 1 was plugged and abandoned as a dry hole following logging.

Bus Swamp 1 could not have been undertaken without financial support from the following organisations:

SANTOS (Formerly AGL Petroleum)	Ampolex
BHP Petroleum	Cultus Petroleum
Gas and Fuel Exploration N.L.	Lakes Oil Ltd
Minora Resources	Oil Company of Australia
Pan Pacific Petroleum	SAGASCO Resources

AGSO and SADME provided additional palynological and geochemical analyses. The contributions by all these organisations are gratefully acknowledged.

The GSV is pleased with the acquired data and considers that Bus Swamp 1 was successful in meeting the project's objectives, and believe that the results will stimulate increased exploration in this area of the Otway Basin.

B Simons 11/3/94

BRUCE SIMONS
Manager, Basin Studies

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APPENDICES

1. Details of Drilling Plant
2. Summary of Wellsite Operation
3. Drilling Fluid Recap
4. Cuttings Descriptions
5. Core Descriptions
6. Velocity Survey
7. Petrology Report
8. Geochemistry Reports
9. Palynology Reports and Review of the Bus Swamp Palynological Results by Charles Abele.

ENCLOSURES

			Scale
I.	Composite Well Log		1:200
II .	Mudlog		1:500
II I.	Wireline Logs		
	III.I.	BCS - CAL - GR	1:200
	III.II.	BCS - CAL - GR	1:500
	III.III	DLL - MSFL - GR	1:200
	III.IV	DLL - MSFL - GR	1:500
	III.V	CDL - CNS - GR	1:200
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IV.	Schematic Geological Cross Section Through Bus Swamp No. 1		
V.	Log Interpretation		
VI.	Well Montage (added by DNRE 20/11/99)		

DATA SUMMARY

Location:

Well Name: Bus Swamp 1	Province: Otway Basin
Status: Plugged and abandoned	Rig No: 04/92/001
Date Commenced: 19/11/92	Completed:17/12/92
Elevation: (GL): 88.00m (AHD) (KB): 91.53m (AHD)	Total Depth: 1850.5m
Location: AMG Sheet: Casterton	Number 7122 Zone: 54
Parish No: 3256 Nangeela	
Easting: 518073	Northing: 5847190
Latitude: 37° 31' 18"	Longitude: 141° 12' 00"
Seismic: HFD 89-10 V.P.470	

Drilling:

Engineering Data:

Hole Size	Casing	Plugs and Grouting
12-1/4in 0 - 216.30m	9-5/8in 0 - 205.42m	205.42 - Surface
8-1/2in 216.30 - 1849.46m		910.00 - 840.00
		235.00 - 169.00
		30.00 - Surface

Geophysical Logs: Logged by Halliburton Wireline Logging Services - 18/12/92

- Run 1: BCS (Borehole Compensated Sonic) - CAL (Caliper) - GR (Gamma Ray) (1851 - 0 m)
- Run 2: DLL (Dual Laterolog) - MSFL (MicroSpherically Focussed Log) - GR (1851 - 205.4 m)
- Run 3: CDL (Compensated Density Log) - CNL (Compensated Neutron Log) - GR (1851 - 1000 m)

BHT: 82° C after 7 hrs

A deviation survey was carried out during drilling.

A velocity survey was carried out by Velseis Pty Ltd.

Cuttings: 5m intervals from surface to 1850 m.

Cores: 4 conventional, 48 sidewall with 37 recovered.

Geology:

Depth	Formation	Lithology
0 - 95 m	Quaternary/ Tertiary	Undifferentiated sediments, unconsolidated sands and silts.
95 - 870 m	Eumeralla	Fine grained sandstone, siltstone, claystone and minor coal.
654 - 660 m	Heathfield Sst	Medium quartz sandstone.
870 - 1050 m	Laira	Siltstone and shale.
1050 - 1799 m	Pretty Hill	Interbedded garnetiferous sandstone and shale.
1799 - 1826 m	Casterton	Largely claystone and siltstone, some volcanolithics.
1826 - 1850 m	Basement	Metamorphosed siltstone.

Analyses:

Palynology:	36 samples
Geochemistry:	26 samples - source rock and Vr.
Petrology:	6 samples.

Hydrocarbon Indications:

Gas Readings: Two intervals (1575 m and 1820 m) where the peak gas reading was over twenty API units. A number of intervals were found to have readings of between 5 and 10 API units.

Fluorescence: Natural and Crush Cut fluorescence was noted at several depths.

1 INTRODUCTION

Bus Swamp No. 1 was drilled in the Penola Trough, in PEP 119, southwestern Victoria as part of the Geological Survey of Victoria's (GSV) stratigraphic drilling programme in the Otway Basin (See Figs 1.0, 1.1 & 1.2). The Penola Trough is part of the Late Jurassic - Early Cretaceous rift system which initiated the development of the Otway Basin. The well lies approximately 17 km northwest of Casterton and 37 km southeast of Penola at shotpoint 470 on the Beach Petroleum line HFD89-10. Drilling began on 19 November, 1992 and reached a total depth of 1850.5 m on 17 December, 1992. This drilling constitutes part of the GSV commitment to the National Geoscience Mapping Accord's (NGMA) Otway Basin Project.

One of the NGMA objectives is to establish a uniform rock unit nomenclature for the Otway Basin, in particular for the strata below the Eumeralla Formation. The Penola Trough, which is common to both Victoria and South Australia, is suitable for this purpose.

Bus Swamp 1 was sited near the northern margin of the Penola Trough to penetrate the Palaeozoic basement at relatively shallow depth. In the deep Penola Trough the only other bore reaching the basement is Casterton 1. The selected site was also chosen to tie the bore results in with the Australian Geological Survey Organisation's (AGSO) recent deep seismic line across the trough.

Other objectives included:

- definition of the seismic velocity of the basement in order to improve the precision of seismic and gravity modelling in the area;

- evaluation of the prospectivity, especially the reservoir potential of the basement rocks (hydrocarbons are present in basement rocks in the nearby Sawpit No. 1 well);

- evaluation of the seal, reservoir and source potential of the Casterton, Pretty Hill, Laira and Eumeralla formations;

- evaluation and comparison of palynology from the Casterton, Pretty Hill, Laira and Eumeralla formations.

Bus Swamp 1 was drilled by the Rural Water Corporation drilling unit. In addition to the GSV, the following companies provided financial support toward the cost of the mudlogging, wireline logging and velocity survey:

AGL Petroleum
Ampolex
BHP Petroleum
Cultus Petroleum
Gas and Fuel Exploration N.L.
Lakes Oil
Minora Resources
Oil Company of Australia
Pan Pacific Petroleum N.L.
SAGASCO Resources

AGSO and SADME provided palynological and geochemical analyses.

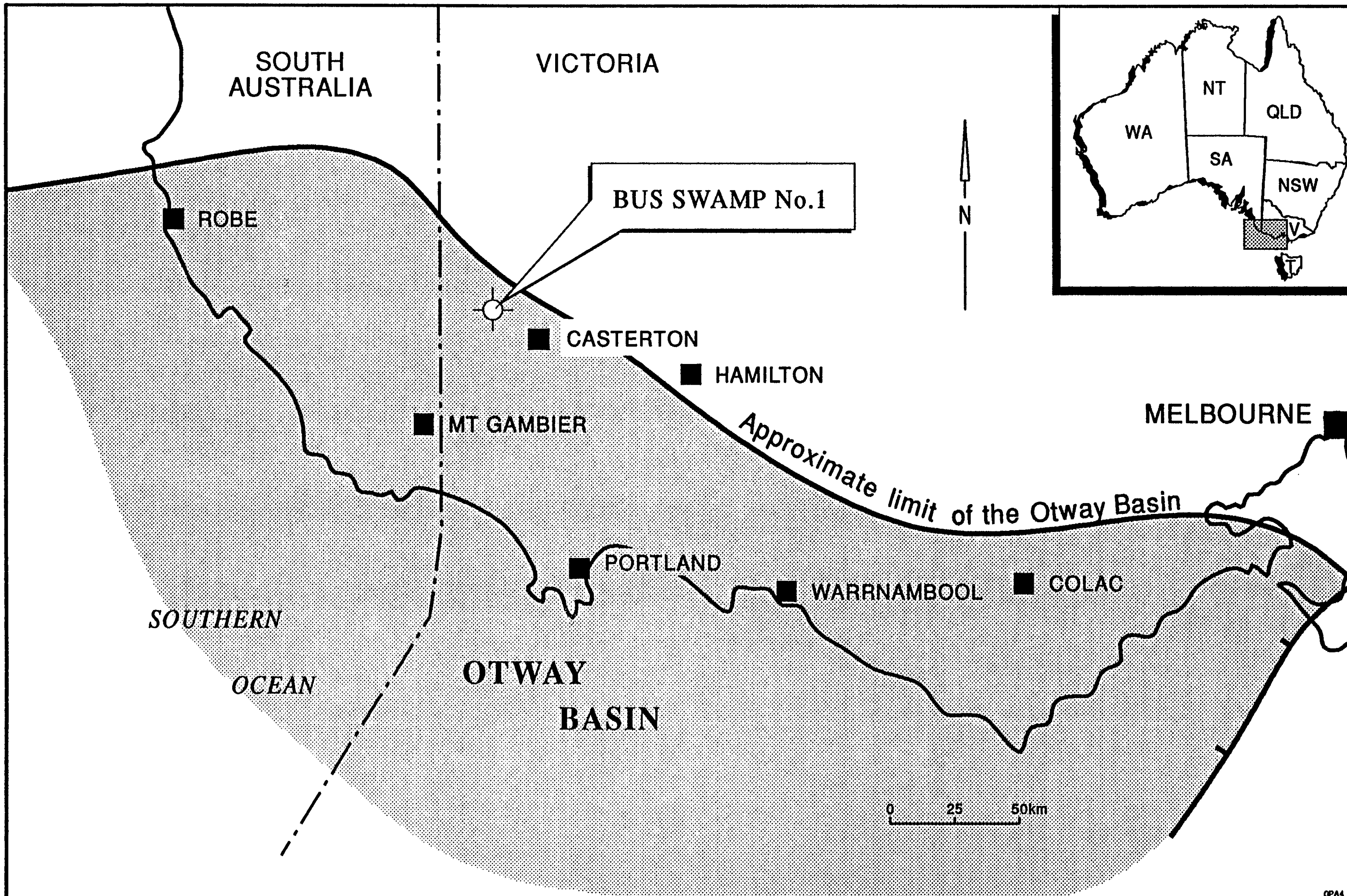

FIGURE 1.0: Otway Basin Location Map.

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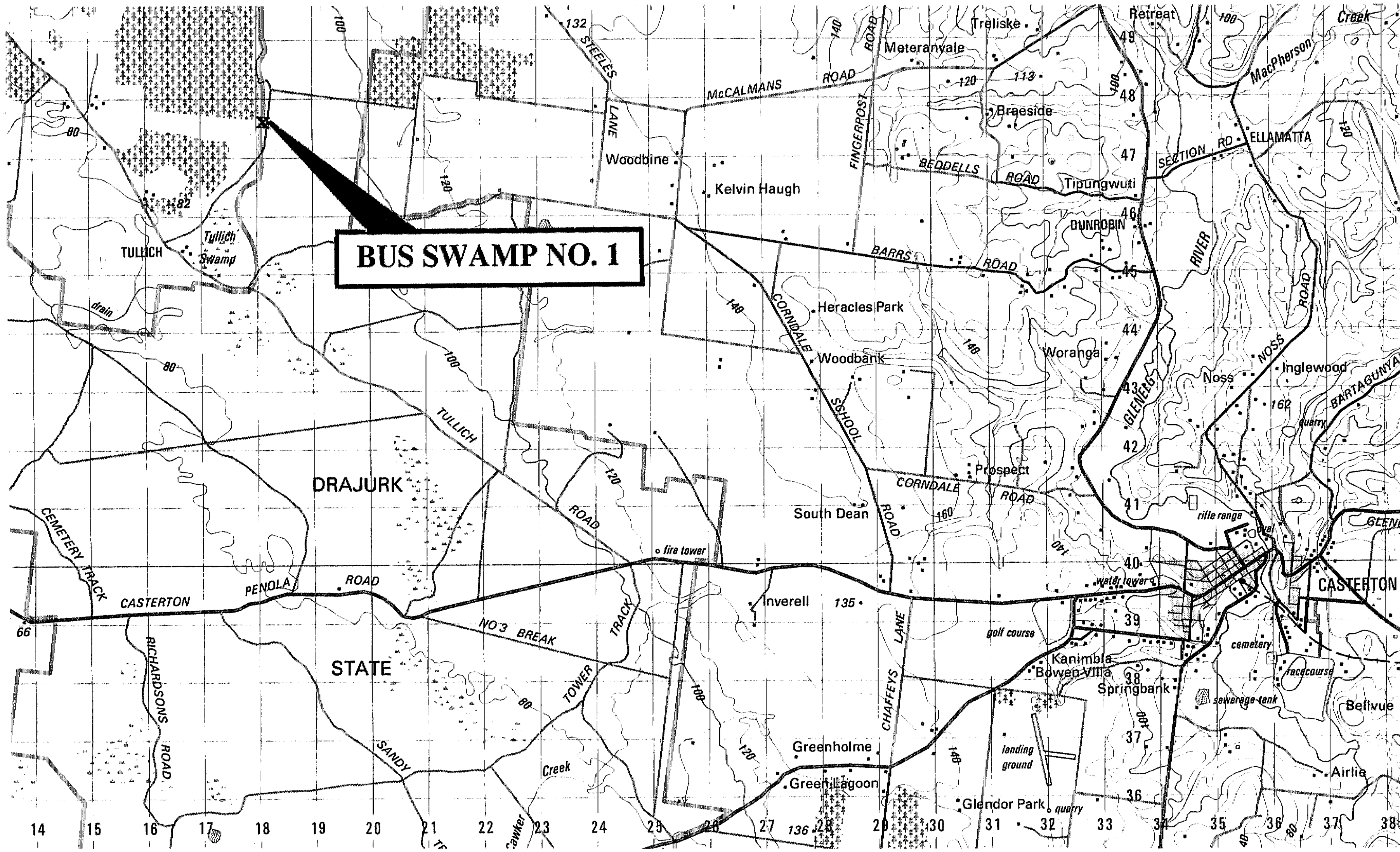

FIGURE 1.1 -- TOPOGRAPHIC LOCATION MAP

Casterton 1: 100,000 Sheet

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(Inserted by DNRE - Vic Govt Mines Dept)

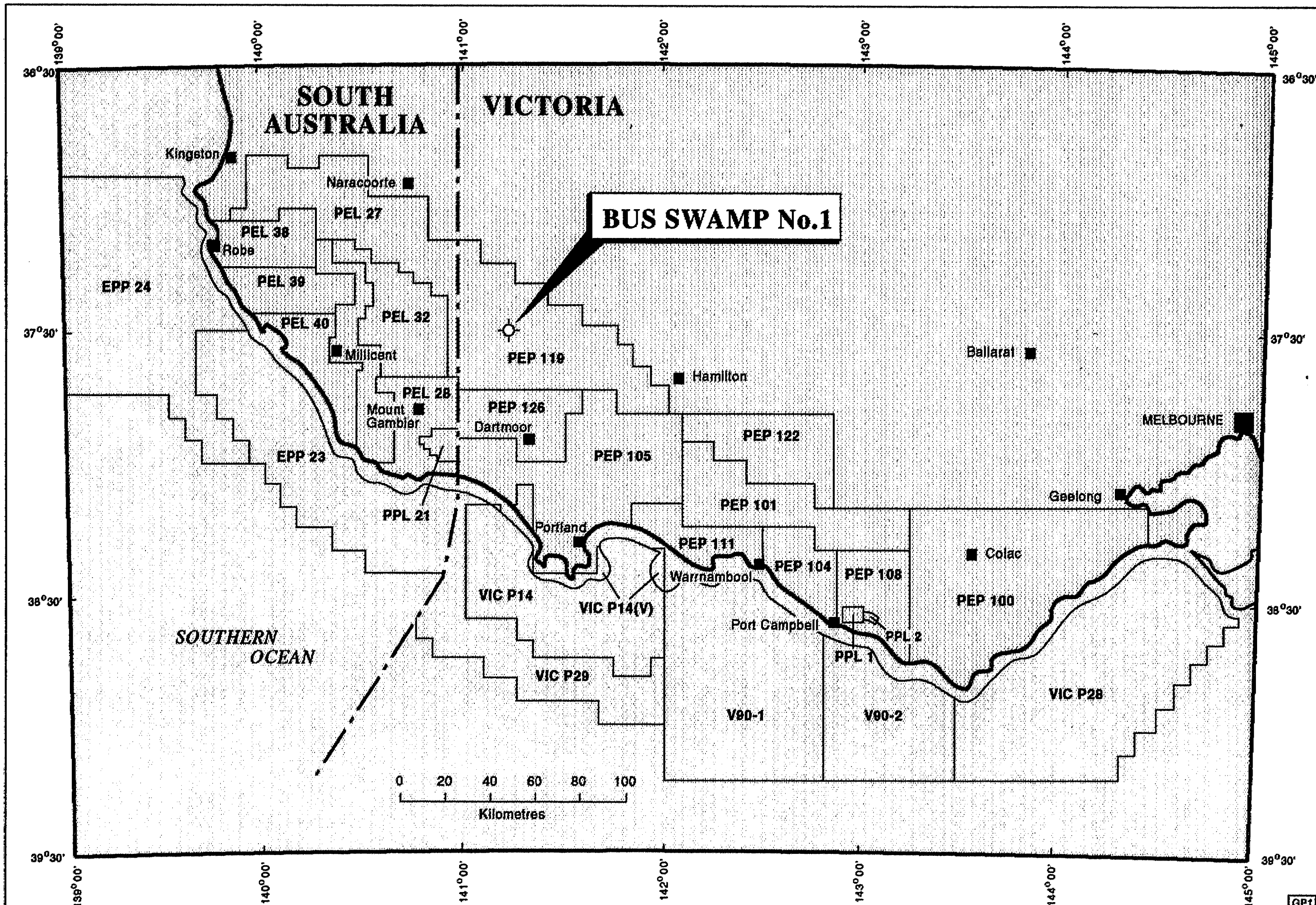

FIGURE 1.2: TENEMENT LOCATION MAP

2 WELL DETAILS

2.1 Location (see Figs 1.0, 1.1 & 1.2)

Co-ordinates:	Latitude	37° 31' 18"
	Longitude	141° 12' 00"
	Easting	518073
	Northing	5847190

Geophysical Control: Vibration Point: 470
Seismic Line: HFD 89-10

Property Description: County of Follett
Parish of Nangeela
Shire of Glenelg

Property Owner: Crown

2.2 General Data

Well Name: Bus Swamp No. 1

Operator: Geological Survey of Victoria

Participants: SANTOS (Formerly AGL Petroleum)

Ampolex

BHP Petroleum

Cultus Petroleum

Gas and Fuel Exploration N.L.

Lakes Oil Ltd

Minora Resources

Oil Company of Australia

Pan Pacific Petroleum N.L.

SAGASCO Resources

Elevation: Ground Level 88m ASL KB 91.40m ASL
(Unless otherwise stated all depths refer to Kelly Bushing)

Total Depth: 1849.46m Driller
1850.5m Logger

Drilling Commencement: 19th November 1992 at 1520 hrs.

Total Depth Reached: 17th December 1992 at 1300 hrs.

Status: Plugged and abandoned

2.3 Drilling Data (see Appendices 1,2 and 3)

2.3.1 Drilling Contractor

Rural Water Corporation of Victoria, Drilling Services Division

2.3.2 Drilling Rig

RWC Drilling Services Rig 4

2.3.3 Casing and Cementing Details

A 16" Conductor pipe was set at 2m GL before rig up

<u>Surface Casing</u>

Size:	$9^{5}/_{8}$"
Depth:	205.42m
Cement:	204 sacks Class "A" neat

<u>Cement Plugs</u>

Plug No 1:

Interval	910 - 840m
Cement	98 sacks class "A" neat
Method	Balanced

Plug No 2:

Interval	235 - 169m
Cement	95 sacks class "A" neat
Method	Balanced
Test	Tagged

Plug No 3:

Interval	30 - Surface
Cement	38 sacks class "A" neat

2.3.4 *Drilling Fluid*

The drilling fluid program was designed by Baroid Australia Pty Ltd. The program was structured to be monitored and maintained by the wellsite geologist and the rig crew.

The well was spudded with a 12-1/4" bit and drilled to the casing point of 205.43 metres using a lime flocculated bentonite mud. After the casing was set the well was then drilled to a total depth of 1850.5 metres using a potassium chloride - bentonite - polymer mud system.

Drilling and coring were completed to the total depth. Tight hole conditions were common, necessitating regular reaming back to bottom.

The wireline logging and velocity survey were run without incident. The sidewall coring programme was also without complication, although only 37 of the possible 48 sidewall cores were recovered. The caliper log indicated significant washout conditions and ledging over several intervals in both the Eumeralla Formation and Crayfish Subgroup.

2.3.5 *Water Supply*

Rig water was drawn from the nearby Bus Swamp and piped to the rig. There was an adequate supply of good quality water, of low salinity and hardness, available throughout the project.

3 FORMATION SAMPLING

3.1 Cuttings

Cuttings samples were collected at five metre intervals from surface to total depth. Each sample was washed, dried and stored in labelled polythene bags. Unwashed samples were also collected in calico bags and dried. All of these samples are stored in the DEM core laboratory, Port Melbourne. Cuttings descriptions are included in Appendix 4.

3.2 Cores

Four conventional cores were cut, the intervals and recoveries are listed in Table 1.

Table 1

Core Samples

Core No.	Interval (m)	(Recovery %)
1	830.4 - 836.4	43
2	1509.8 - 1515.8	92
3	1785.2 - 1790.1	91
4	1832.1 - 1835.2	71

These cores are held in the DEM Core Laboratory, Port Melbourne.

Core descriptions are included in Appendix 5.

3.3 Sidewall Cores.

Forty-eight sidewall cores were attempted, of which thirty-seven were successful. Depths and recoveries are detailed in Table 2. Sidewall core descriptions can be found in Appendix 5.

3.4 Testing

No formation testing was carried out on this well.

3.5 Sample Analyses

3.5.1 Petrology

Six samples, four sidewall core and two whole core, were selected for thin section and detailed petrological analysis. The results are presented in Appendix 7. The sample intervals are detailed in Table 3.

3.5.2 Source Rock Analysis

A total of twenty-six samples were submitted for source rock analyses. AGSO analysed some of the samples using their own resources, and samples were submitted to Amdel by the Geological Survey and also by SADME on behalf of the Geological Survey. Details of the sample analyses can be found in Table 4. The results of these analyses are presented in Appendix 8.

3.5.3 Palynology

Palynological analyses on samples from this well have been carried out by Morgan Palaeo Associates (1), AGSO (2) and SADME (3). A total of thirty-six samples were analysed, with some duplication. A listing of palynology samples for analysis can be found in Table 5. A review of the results and palynology reports can be found in Appendix 9.

GEOLOGICAL SURVEY OF VICTORIA

BASIN STUDIES

BUS SWAMP 1

WELL COMPLETION REPORT

Unpublished Report No. 1993/23

Volume 1

Text and Appendices

Prepared by:
Gregory Parker
Sean Rooney

Department of Energy and Minerals

Table 2

Sidewall Core Numbers, Depths and Recoveries

SWC No.	Depth m	Recovery mm	SWC No.	Depth m	Recovery mm
1	1840	25	25	1105	40
2	1824	15	26	1026	40
3	1822	15	27	982	35
4	1815	30	28	977	40
5	1803	10	29	957	40
6	1777	10	30	913	40
7	1767	20	31	886	15
8	1756	10	32	882	NR
9	1730	15	33	862	40
10	1709	15	34	845	40
11	1640	<10	35	822	35
12	1585	15	36	796	40
13	1560	15	37	756	40
14	1510	20	38	745	NR
15	1472	NR	39	700	<10mm
16	1445	30	40	672	40
17	1406	25	41	657	40
18	1331	NR	42	570	NR
19	1325	30	43	465	40
20	1292	NR	44	430	NR
21	1228	NR	45	345	NR
22	1190	35	46	300	35
23	1145	40	47	267	NR
24	1137	10	48	230	NR

Table 3

Core Thin Section Petrology Analysis

Sample No	Type	Interval (m)
1	SWC 41	756.0m
2	Core 2	1509.8 - 1515.8m
3	SWC 7	1767.0m
4	SWC 3	1822.0m
5	Core 4	1832.1 - 1835.2m
6	SWC 1	1840.0m

Table 4

Samples for Geochemical Analysis

RE: Rock Eval Pyrolysis TOC: Total Organic Carbon

VR: Vitrinite Reflectance

Amdel* : Sample submitted for analysis by SADME

NO.	ANALYST	INTERVAL (m)	TYPE	RE/ TOC	VR
(1)	Amdel	465.0m	SWC 43	x	x
(2)	AGSO	657.0m	SWC 41	x	
(3)	Amdel	756.0m	SWC 37	x	x
(4)	AGSO	830.4 - 836.4m	Core 1	x	
(5)	Amdel*	830.4 - 836.4m	Core 1	x	x
(6)	AGSO	862.0m	SWC 33	x	
(7)	Amdel	862.0m	SWC 33		x
(8)	AGSO	913.0m	SWC 30	x	
(9)	Amdel	913.0m	SWC 30		x
(10)	Amdel*	982.0m	SWC 27	x	x
(11)	Amdel*	1105.0m	SWC 25	x	x
(12)	Amdel*	1145.0m	SWC 23	x	x
(13)	Amdel	1190.0m	SWC 22	x	x
(14)	Amdel	1325.0m	SWC 19	x	
(15)	Amdel*	1406.0m	SWC 17	x	x
(16)	AGSO	1509.8 - 1515.8m	Core 2	x	
(17)	Amdel	1509.8 - 1515.8m	Core 2		x
(18)	Amdel	1585.0m	SWC 12	x	x
(19)	Amdel	1710.0m	SWC 10	x	x
(20)	AGSO	1756.0m	SWC 8	x	
(21)	AGSO	1785.2 - 1790.1m	Core 3	x	
(22)	Amdel*	1785.2 - 1790.1m	Core 3	x	x
(23)	Amdel*	1803.0m	SWC 5	x	
(24)	Amdel	1805.0 - 1810.0m	CUTTINGS	x	x
(25)	Amdel	1815.0m	SWC 4		x
(26)	AGSO	1815.0m	SWC 4	x	

Table 5

Palynology Samples

Sample	Analyst	Interval (m)	Type
(1)	Morgan	210.0 - 215.0m	CUTTINGS
(2)	Morgan	300.0m	SWC 46
(3)	Morgan	465.0m	SWC 43
(4)	AGSO	657.0m	SWC 41
(5)	Morgan	756.0m	SWC 37
(6)	SADME	830.0m	Core 1
(7)	AGSO	830.4 - 836.4m	Core 1
(8)	SADME	830.4 - 836.4m	Core 1
(9)	AGSO	862.0m	SWC 33
(10)	Morgan	862.0m	SWC 33
(11)	Morgan	865.0 - 870.0m	CUTTINGS
(12)	Morgan	886.0m	SWC 31
(13)	Morgan	886.0m	SWC 31
(14)	AGSO	913.0m	SWC 30
(15)	SADME	957.0m	SWC 29
(16)	SADME	982.0m	SWC 27
(17)	SADME	1105.0m	SWC 25
(18)	SADME	1145.0m	SWC 23
(19)	Morgan	1190.0m	SWC 22
(20)	Morgan	1325.0m	SWC 19
(21)	SADME	1406.0m	SWC 17
(22)	AGSO	1509.8 - 1515.8m	Core 2
(23)	SADME	1515.8m	Core 2
(24)	Morgan	1560.0m	SWC 13
(25)	Morgan	1640.0m	SWC 11
(26)	Morgan	1730.0m	SWC 10
(27)	AGSO	1756.0m	SWC 8
(28)	Morgan	1760.0 - 1765.0m	CUTTINGS

Table continued next page...

...continued.

Sample	Analyst	Interval (m)	Type
(29)	Morgan	1787.0m	Core 3
(30)	SADME	1785.2 - 1790.1m	Core 3
(31)	AGSO	1785.2 - 1790.1m	Core 3
(32)	SADME	1800.0 - 1805.0m	CUTTINGS
(33)	SADME	1803.0m	SWC 5
(34)	AGSO	1815.0m	SWC 4
(35)	Morgan	1840.0m	SWC 1
(36)	Morgan	1840.0m	SWC 1

3.6 Logging & Surveys

3.6.1 Mud Logging

A Halliburton SDL Mudlogging unit was used. The unit monitored cuttings gas, pit levels, rate of penetration, and pump strokes. The mud log is included as Enclosure 2.

3.6.2 Wireline Logging

Wireline logging was carried out by Halliburton Wireline Services using a standard truck mounted unit. The programmed suite of logs was run without complication and are included as Enclosure 3.

Table 6

Wireline Logging

Run	Log	Interval (m)
1	BCS - CAL - GR	1851 - 0 (Surface)
2	DLL - MSFL - GR	1851 - 205.4 (Casing Shoe)
3	CDL - CNS - GR	1851 - 1000
Sidewall Coring:	Two Guns	

BCS: Borehole Compensated Sonic Log
CAL: Caliper Log
GR: Gamma Ray Log
DLL: Dual Laterolog
MSFL: Micro Spherically Focussed Log
CDL: Compensated Density Log
CNS: Compensated Neutron Log

3.6.3 Deviation Surveys

Deviation surveys were conducted regularly with the following results.

Depth (m)	Deviation (deg)
582	0.5
824	1.0
1058	1.0
1208	1.0
1351	0.75
1784	1.0

3.6.4 Velocity Survey

A velocity survey was carried out by Velseis Pty Ltd. These data are included as Appendix 6.

4 GEOLOGY

4.1 TECTONIC SETTING AND GEOLOGICAL HISTORY

The Otway Basin (Fig. 1.0) forms part of the southern margin of the Australian continent, a passive margin resulting from the rifting and break-up of the Australian-Antarctic supercontinent. The basin extends along 500 km of the Victorian and South Australian coastline and has an aerial extent of approximately 20 000 km^2 onshore and over 25 000 km^2 offshore. The basin contains up to 10 km of post Palaeozoic sediments.

The Penola Trough (Fig. 4.1) is believed to be part of the Late Jurassic - Early Cretaceous rift system which initiated the development of the Otway Basin (Pettifer et al. 1991). The rift system extended from present day offshore South Australia to as far east as the Otway Ranges and also includes the Robe, Ardonachie and Gellibrand troughs (Tabassi & Menhennitt, 1991b).

The northern margin of the Penola Trough is bounded by the Kanawinka Fault (Figs 4.1 and 4.2), a southeast trending, southwest dipping normal fault with throws of up to 900 m. This can be seen in Figs 4.3 and 4.4, which show seismic line HFD89-10 and the parallel seismic line HF88-14. The South Kanawinka Fault Zone lies approximately 5 km south of and parallels the Kanawinka Fault (Perincek et al. 1994). Bus Swamp 1 was drilled on the fault block between these two faults, as was Casterton 1 (See Enclosure 4). The Bouger anomaly image (Fig. 4.2) shows the Penola Trough as a gravity low (blue) and the Merino High as a gravity high (red) adjacent to it. On the northeastern edge of the gravity low is a linear feature corresponding to the Kanawinka Fault. The South Kanawinka Fault Zone is not as easily observed on the Bouger anomaly image.

The southern margin of the Penola Trough is not as clear as the northern margin. The previously considered southern bounding fault, the southeast trending, northeast dipping South Penola Fault, is Tertiary in age. There are some minor Early Cretaceous faults which are on the southern flank of the Penola Trough but in general the Crayfish Subgroup is onlapping basement toward the south. The Penola Trough may therefore be considered to extend south to the Tartwaup Fault, the northern margin of the Portland Trough. The nearby Ardonachie Trough consists of a similar half-graben with opposite polarity, ie. its bounding fault dips roughly northeast (Perincek et al. 1994). From these observations it is possible to adopt a new model for the development of the northern Otway Basin, that of a series of half-grabens separated by complex transfer zones of faulting and folding.

In the earliest stages of rifting the area was dominated by lacustrine conditions and volcanic activity. Casterton Formation deposition began just prior to Early Cretaceous half-graben development, as indicated by the presence of the formation on Early Cretaceous structural highs as well as within the half-grabens, and continued for some time after rifting began.

The Pretty Hill Formation is observed only in the Early Cretaceous half-grabens. It is syndepositional with major bounding faults and onlaps onto basement away from these faults. The unit was deposited during rifting in the resultant half-grabens and was more or less continuous until rifting ceased midway through the Early Cretaceous.

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WELL_NAME =	Bus Swamp-1
CONTRACTOR =	Geological Survey of Victoria Basin Studies
CLIENT_OP_CO =	Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)

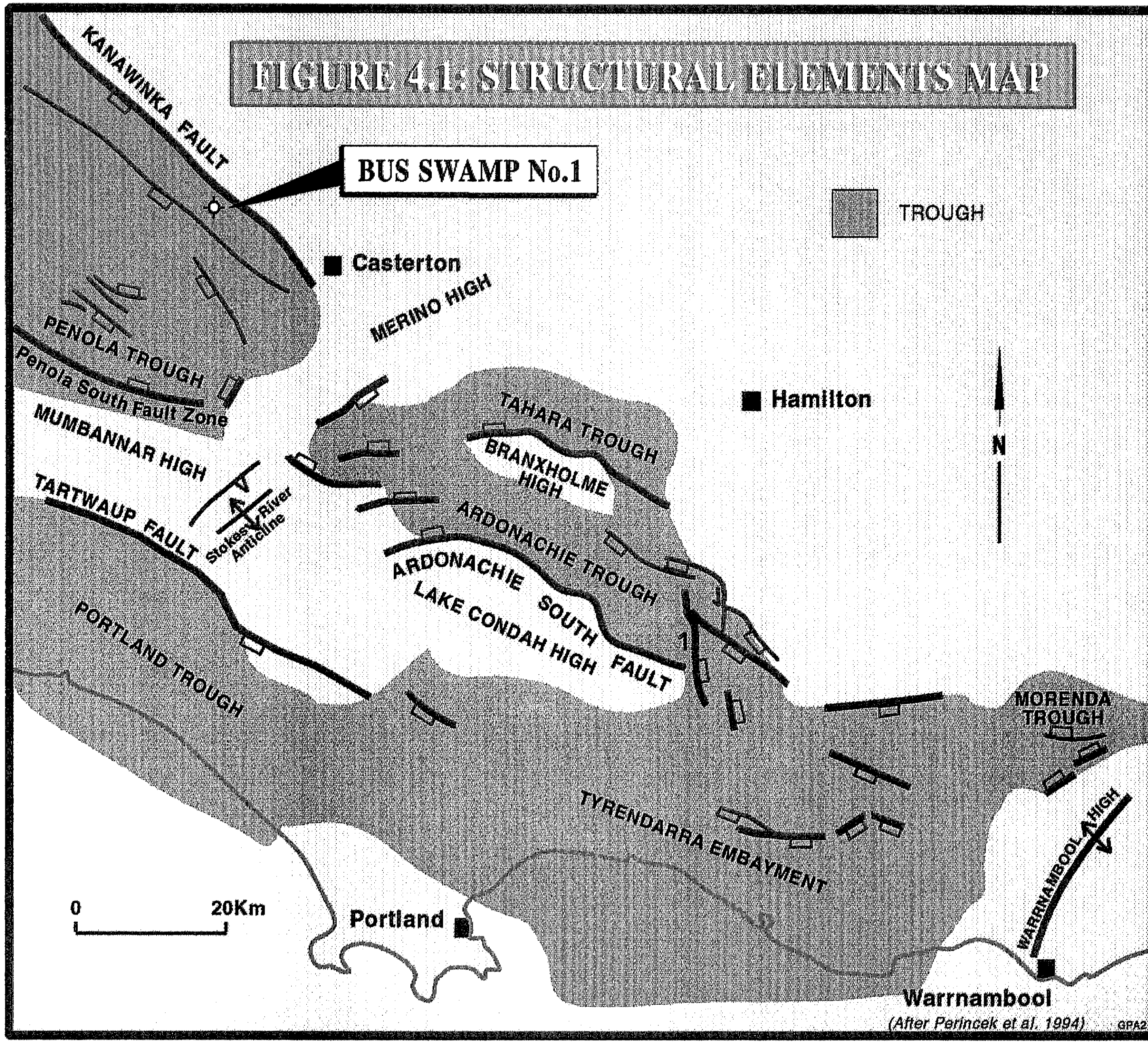

FIGURE 4.1: STRUCTURAL ELEMENTS MAP

PE907897

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The enclosure PE907897 has the following characteristics:

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           PERMIT = PEP119
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          SUBTYPE = MAP
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                    (enclosure from Well Completion Report
                    vol.1) for Bus Swamp-1
          REMARKS =
     DATE_CREATED =
    DATE_RECEIVED =
             W_NO = W1088
        WELL_NAME = Bus Swamp-1
       CONTRACTOR = Geological Survey of Victoria Basin
                    Studies
     CLIENT_OP_CO = Dept of Energy & Minerals
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(Inserted by DNRE - Vic Govt Mines Dept)

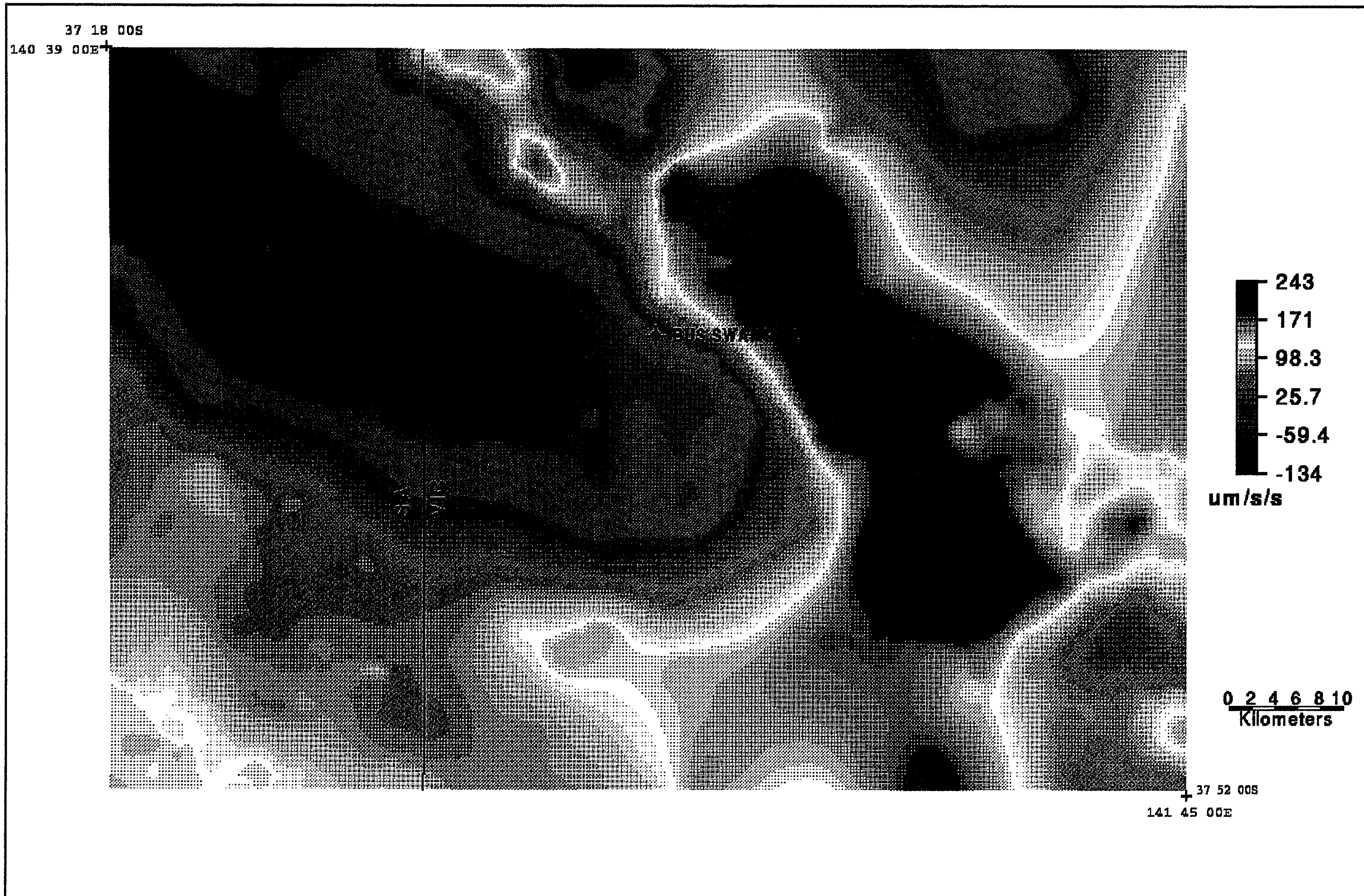

FIGURE 4.2 GRAVITY IMAGE OF THE PENOLA TROUGH AREA

PE907898

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The enclosure PE907898 has the following characteristics:

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                    Bus Swamp Location (enclosure from Well
                    Completion Report vol.1) for Bus
                    Swamp-1
          REMARKS = Seismic Line courtesy of Santos
     DATE_CREATED =
    DATE_RECEIVED =
             W_NO = W1088
        WELL_NAME = Bus Swamp-1
       CONTRACTOR = Geological Survey of Victoria Basin
                    Studies
     CLIENT_OP_CO = Dept of Energy & Minerals
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(Inserted by DNRE - Vic Govt Mines Dept)

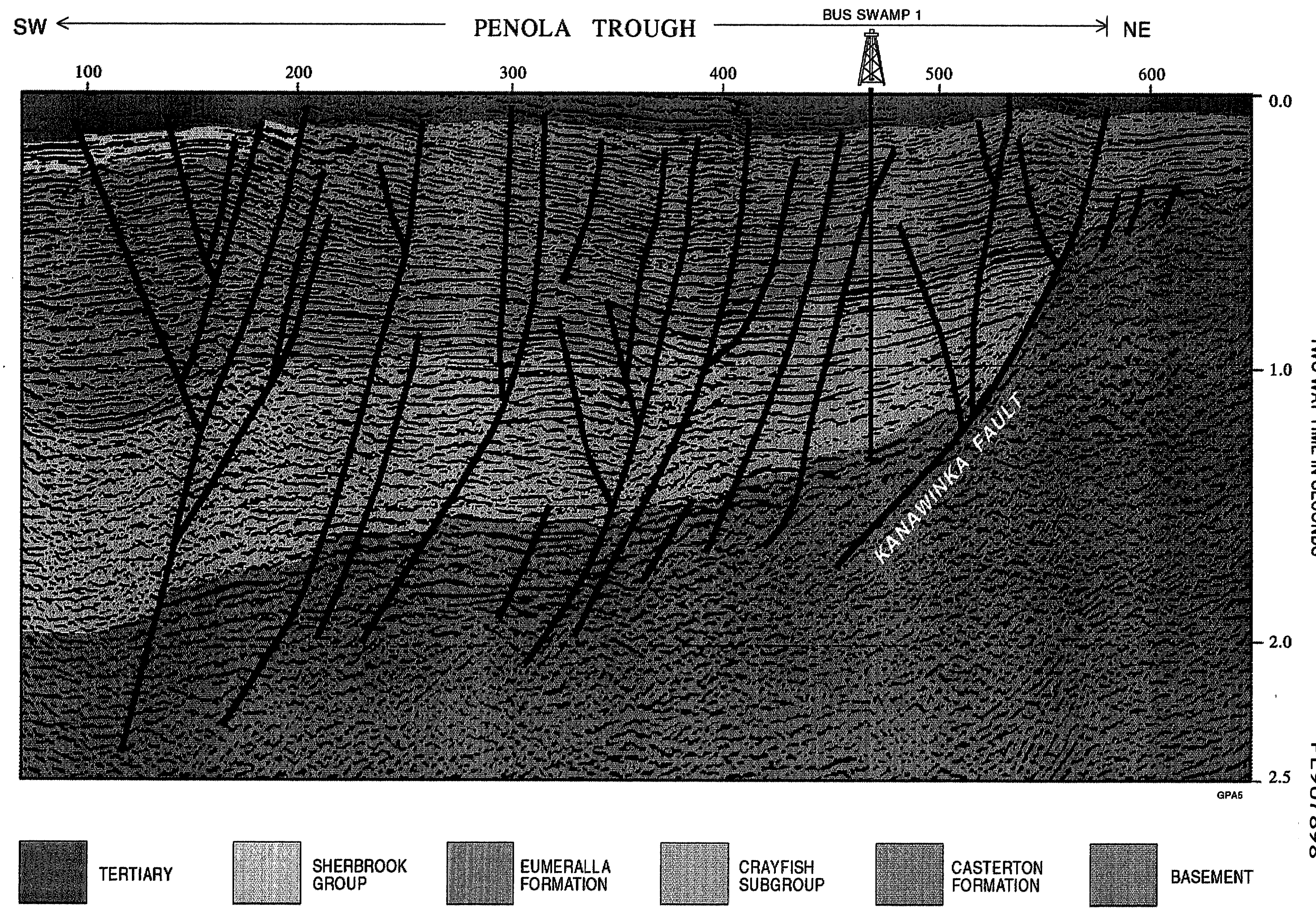

FIGURE 4.3: BEACH PETROLEUM SEISMIC LINE HFD89-10 SHOWING THE NORTHERN PENOLA TROUGH AND BUS SWAMP-1 LOCATION *(Seismic line courtesy of SANTOS)*

PE907899

This is an enclosure indicator page.
The enclosure PE907899 is enclosed within the container PE900967 at this location in this document.

The enclosure PE907899 has the following characteristics:

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SUBTYPE =	SECTION
DESCRIPTION =	Beach Petroeum Seismic Line HFD88-14 Showing the Northern Penola Trough (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =	Seismic Line courtesy of Santos
DATE_CREATED =	
DATE_RECEIVED =	
W_NO =	W1088
WELL_NAME =	Bus Swamp-1
CONTRACTOR =	Geological Survey of Victoria Basin Studies
CLIENT_OP_CO =	Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)

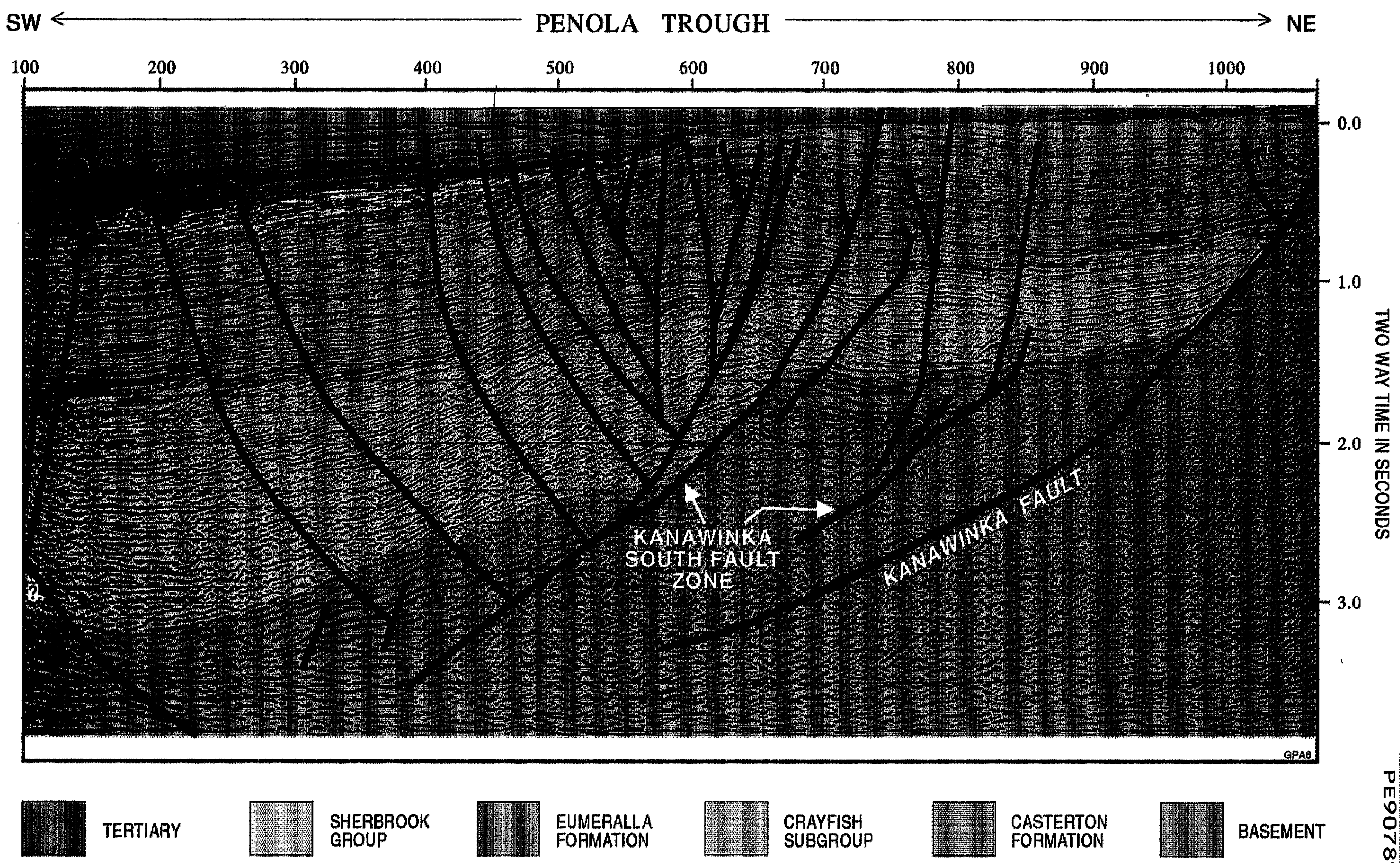


FIGURE 4.4: BEACH PETROLEUM SEISMIC LINE HF88-14 SHOWING THE NORTHERN PART OF THE PENOLA TROUGH

(Seismic line courtesy of SANTOS)

In the Bus Swamp 1 area the early northern boundary of the Penola Trough was the South Kanawinka Fault Zone. Movement on this fault zone began in the late Jurassic to Early Cretaceous, after Casterton Formation deposition had begun. It was not until midway through Pretty Hill Formation deposition that movement on this fault ceased and rifting resumed on the newly formed Kanawinka Fault. This produced a different depositional regime in the Bus Swamp 1 area to that in the centre of the Penola Trough. Seismic evidence shows that a substantial part of the lower Pretty Hill Formation was never deposited in the Bus Swamp area due to its elevation at the time. Casterton Formation is present on this elevated area due to deposition before movement on the South Kanawinka Fault Zone (See Enclosure 4). Palynology results from Bus Swamp 1 indicate the almost complete absence of lower *C. australiensis* in the Crayfish units, indicating an interval of non deposition corresponding to the lower Crayfish Subgroup. Deposition of the fine grained Laira Formation sediments was probably confined to the western part of the basin and is not observed in the Bus Swamp 1 area.

The end of rifting in this area is marked by an unconformity at the top of the Crayfish Subgroup. The consistent thickness of the overlying Eumeralla Formation, lack of syndepositional features and the more planar faulting style (Perincek et al. 1994) indicate that rifting ceased at the onset of Eumeralla Formation deposition. The Eumeralla Formation was deposited evenly across the basin in one of three possible tectonic regimes:

(1) At the end of the Crayfish deposition, extension in this incipient rift ceased and the rifting centre between Australia and Antarctica shifted south (Pettifer et al. 1991), forming an aborted rift in the northern part of the basin.

(2) The Eumeralla Formation marks the onset of a post rift, thermally controlled sag phase which precedes continental breakup.

(3) The Crayfish/Eumeralla boundary marks a change from rifting to spreading regimes.

Observations from Bus Swamp 1 indicate that the Eumeralla Formation is essentially a terrestrial, probably fluvial unit. This is inconsistent with early continental separation and marine incursion. The presence of glauconite in the unit is consistent with slow, fairly passive subsidence, implying sagging rather than rifting.

The top of the Eumeralla Formation is marked by an angular unconformity, indicating another episode of uplift and erosion in the Albian. Basin spreading became active from the Late Cretaceous. The Sherbrook and Wangerrip Groups were laid down in a juvenile sea. An unconformity at top Pember Mudstone (Perincek et al. 1994) level indicates the transition from slow to rapid seafloor spreading. A clastic sequence, the Dilwyn Formation, followed before widespread deposition of Eocene to Recent carbonate successions. The Late Cretaceous and Early Tertiary units extend into the Penola Trough but are not present in the northern wells (Bus Swamp 1 and Casterton 1) due either to stripping off of sediments or non-deposition. Since most of the uplift on the northern flank of the Penola Trough occurred during the Early Cretaceous it is most likely that these units, and the later Tertiary marine units, are condensed or were not deposited at all.

Miocene to Recent compression has reactivated many earlier faults and a number of northeast - southwest trending inversion features are observed throughout the basin.

4.2 STRATIGRAPHY

A summary of the rock units recognised, their depth, thickness and age is shown in Table 7, proposed and actual stratigraphy in Fig. 4.5.

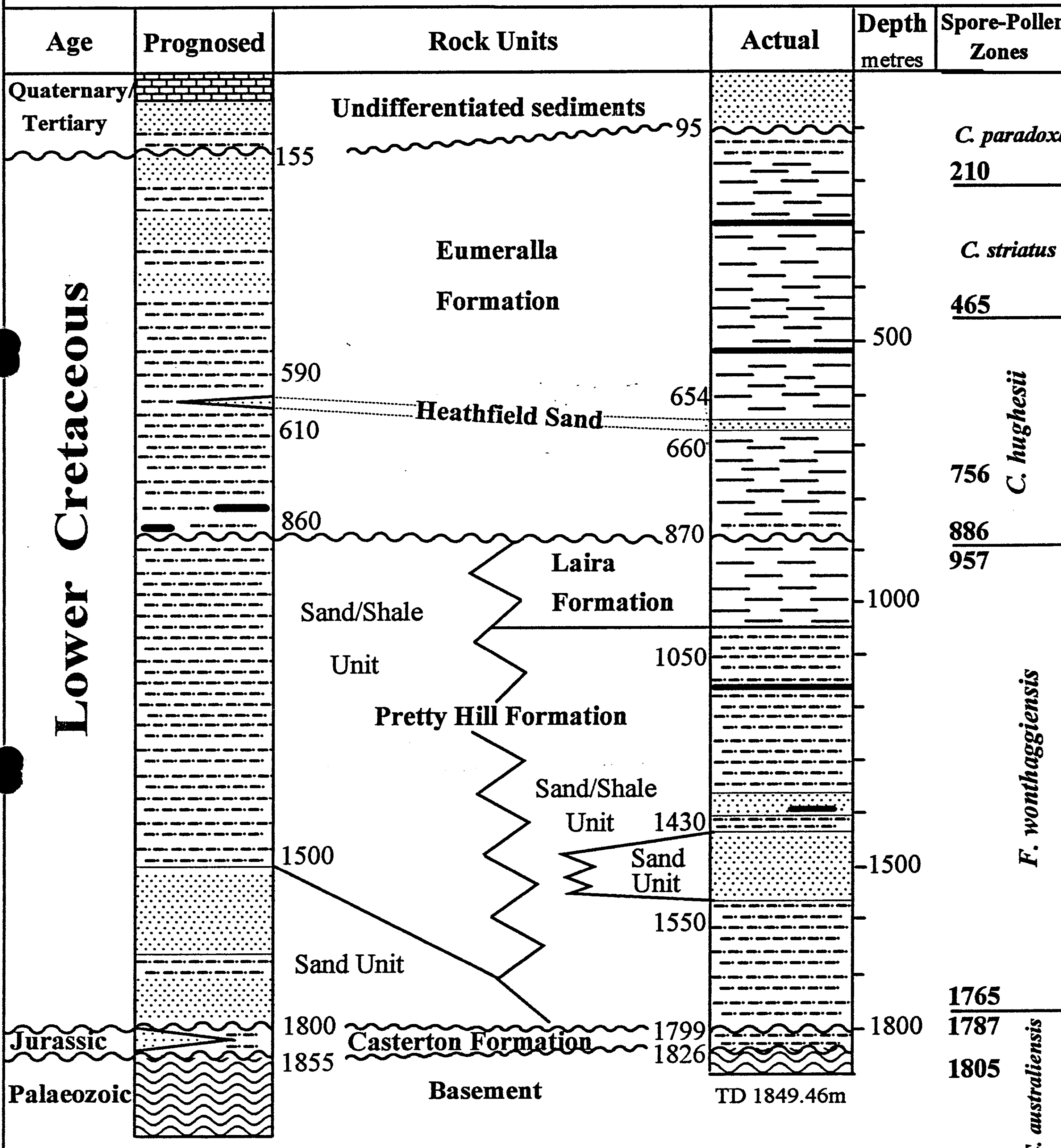
Table 7

Stratigraphy of Bus Swamp 1

Age	Group	Formation/Member	Depth (m)	Thickness (m)	Elevation (m)
Quaternary/ Tertiary		Undifferentiated sediments	Surface	95	88
Lower Cretaceous	Otway Group	Eumeralla Formation	95	775	-7
		Heathfield Sand Member	654	6	-556
	Crayfish Subgroup	Laira Formation	870	180	-782
		Pretty Hill Formation	1050	749	-962
Jurassic	Otway Group	Casterton Formation	1799	27	-1711
Pal.		Basement	1826	---	-1738

BUS SWAMP No. 1

Prognosed and Actual Stratigraphy



Drawn by D.J.Faul

Figure 4.5

4.3 GENERALISED LITHOLOGY

4.3.1. Quaternary and Tertiary

Undifferentiated Sediments Surface - 95 m

0 - 35 m: SANDSTONE

SANDSTONE: yellowish grey, occasionally light brown to brownish grey, friable with abundant loose grains, fine to medium grained, occasionally coarse grained, subangular to rounded, dominantly subrounded, moderately sorted, clear to milky white, occasionally iron stained quartz, no apparent matrix (possibly washed away), nil to trace moderately weak calcareous cement, common shell fragments, rare to occasionally common sedimentary and lithics, trace carbonaceous detritus, very good inferred porosity.

35 - 95 m: SANDSTONE

SANDSTONE: light olive grey to olive grey, friable with abundant loose grains, dominantly medium to coarse grained, occasionally very fine to fine grained, angular to dominantly subrounded, occasionally rounded, poorly to moderately sorted, clear, translucent to occasionally milky white quartz, trace to common light to medium grey, dispersive, argillaceous matrix (mostly washed away), trace moderately weak calcareous and pyrite cement, common shell fragments, rare to common lithics, trace to rare biotite, calcareous clay nodules and carbonaceous detritus, very good inferred porosity.

4.3.2. Lower Cretaceous

4.3.2.1 Eumeralla Formation 95 - 870 m

95 - 654 m: CLAYSTONE INTERLAMINATED WITH/ GRADING TO SILTSTONE & MINOR COAL

CLAYSTONE: light olive grey, greyish olive green to greenish grey in part, firm to moderately hard, dominantly blocky, abundantly micromicaceous, common carbonaceous specks and laminae, nil to trace calcareous in part, moderately silty in part. Interlaminated with and grading to:

SILTSTONE: pale olive to olive grey, greenish grey to dark greenish grey in part, soft to moderately hard, dispersive in part, subblocky to blocky in part, commonly to abundantly argillaceous common micromica, carbonaceous specks and laminae, trace to common very fine to fine quartz sand grains, rarely calcareous in part. Interlaminated with minor:

COAL: grey black to black, firm, blocky in part, subvitreous lustre, rarely argillaceous in part.

654 - 660 m: SANDSTONE INTERBEDDED WITH MINOR SILTSTONE (Heathfield Sandstone Member)

SANDSTONE: light grey to light olive grey, friable with common loose grains, medium to coarse grained, angular to subrounded, moderately sorted, clear to frosted, occasionally iron stained quartz, trace light grey dispersive argillaceous matrix (all washed away), trace carbonaceous and coaly detritus, very good visual/ inferred porosity. Interbedded with minor:

SILTSTONE: pale olive, firm, massive, non calcareous, commonly to abundantly argillaceous, micaceous in part, rarely arenaceous in part.

660 - 870 m: CLAYSTONE INTERLAMINATED WITH/ GRADING TO SILTSTONE, SANDSTONE AND MINOR COAL

CLAYSTONE: generally as above, light olive grey, greyish olive green to greenish grey in part, firm to moderately hard, dominantly blocky, abundantly micromicaceous, common carbonaceous specks and laminae, nil to trace calcareous in part, moderately silty in part. Interlaminated with/ grading to:

SILTSTONE: pale olive to olive grey, greenish grey to dark greenish grey in part, soft to moderately hard, dispersive in part, subblocky to blocky in part, commonly to abundantly argillaceous, common micromica, carbonaceous specks and laminae, trace to common very fine to fine quartz sand grains, rarely calcareous in part. Interlaminated with:

SANDSTONE: yellowish grey, light olive grey to greenish grey, friable to rarely moderately hard in part, very fine to medium grained, dominantly fine, occasionally coarse to very coarse grained, subangular to subrounded, poorly sorted, clear to translucent, occasionally light brown stained quartz, trace light grey, moderately dispersive argillaceous matrix, trace moderately weak to moderately strong calcareous and pyrite cement, trace to common partially altered feldspar, trace to rare non glauconitic green lithics, pyrite and shell fragments, trace carbonaceous and coaly detritus, poor to occasionally fair visual/ inferred porosity. Interlaminated with:

COAL: greyish black to black, firm, blocky in part, subvitreous lustre, rarely argillaceous in part.

4.3.2.2 Laira Formation

870 - 1050 m: CLAYSTONE INTERBEDDED/ INTERLAMINATED WITH SILTSTONE AND MINOR SANDSTONE

CLAYSTONE: light olive grey to olive grey, becoming medium grey with depth, soft to moderately hard, dominantly firm, dominantly blocky, non calcareous, trace to occasionally common micromica, trace carbonaceous specks and laminae, moderately to commonly silty. Interbedded/ interlaminated with:

SILTSTONE: light olive grey to olive grey, becoming dominantly medium grey with depth, moderately hard to hard, firm in part, commonly argillaceous, trace micromica and carbonaceous specks and laminae, rarely siliceous in part, abundant quartzose silt and very fine quartz sand grains. Interlaminated with/ grading to:

SANDSTONE: light grey to olive grey, dominantly moderately hard, hard in part, rarely friable in part, very fine grained, subangular to subrounded, well sorted dominantly clear quartz, trace light grey argillaceous matrix, trace moderately strong calcareous and siliceous cement, trace mica, coaly detritus, pyrite, partially altered feldspar, ?garnet and other lithic fragments, very poor visual porosity.

4.3.2.3 Pretty Hill Formation 1050 - 1799 m

1050 - 1430 m: CLAYSTONE INTERBEDDED/ INTERLAMINATED WITH SILTSTONE, MINOR SANDSTONE AND COAL

CLAYSTONE: light olive grey to olive grey, becoming medium grey with depth, soft to hard, blocky in part, moderately micromicaceous, trace carbonaceous specks and laminae, non-calcareous, moderately silty in part. Interbedded/ interlaminated with:

SILTSTONE: light olive grey to olive grey, medium grey in part, moderately hard to hard, occasionally firm in part, commonly argillaceous, trace carbonaceous specks, trace micromica, siliceous in part, trace to common very fine to fine grained quartz sand grains. Interlaminated with/ grading to:

SANDSTONE: light grey to light olive grey, dominantly moderately hard, hard in part, friable in part, dominantly very fine to fine grained, occasionally medium to very coarse grained in part, angular to dominantly subrounded, rarely rounded in part, moderate to well sorted clear to translucent to very light grey quartz, trace to occasionally common light grey argillaceous matrix, rare to occasionally common moderately weak to moderately strong calcareous and siliceous cement, trace to common partially altered feldspar, trace mica, red to pink garnet, pyrite, coaly detritus and lithic fragments, poor to very poor visual porosity, becoming fair in coarser grained portions. Interlaminated with:

COAL: black, firm, moderately hard in part, brittle, argillaceous in part, subvitreous lustre in part.

1430 - 1550 m: SANDSTONE INTERBEDDED WITH SILTSTONE AND MINOR CLAYSTONE & COAL

SANDSTONE: light grey to yellowish grey, friable to hard, dominantly moderately hard, very fine to medium grained, occasionally coarse grained, subangular to subrounded, rarely rounded in part, moderate to well sorted dominantly clear quartz, trace to common white kaolinitic argillaceous matrix, trace to common moderately weak to moderately strong siliceous and occasionally calcareous cement, common pink to red garnets, trace mica and lithic fragments, fair to occasionally good visual/ inferred porosity. Interbedded with:

SILTSTONE: medium light grey to light olive grey, moderately hard to hard, blocky, subfissile in part, moderately argillaceous, trace micromica, rare carbonaceous specks and laminae, rarely arenaceous in part, nil to slightly calcareous, Interlaminated with/ grading to:

CLAYSTONE: light olive grey, light to medium grey, firm to hard, dominantly moderately hard, dominantly blocky, trace micromica and carbonaceous specks/ laminae, moderately silty, Interbedded with:

COAL: black, firm to moderately hard, brittle, subvitreous lustre, rarely argillaceous in part.

1550 - 1799 m: CLAYSTONE INTERBEDDED WITH SILTSTONE AND SANDSTONE

CLAYSTONE: light medium grey to medium grey, occasionally dark grey to greenish black, firm to hard, dominantly moderately hard, dominantly blocky, rarely sticky in part, trace micromica, trace very fine quartz sand grains, trace carbonaceous specks and laminae, rarely siliceous in part, non calcareous. Interbedded with:

SILTSTONE: olive grey to light olive grey, occasionally greenish black, firm to hard, blocky to occasionally subfissile, commonly argillaceous, trace micromica, trace carbonaceous specks, trace very fine quartz sand grains, non calcareous. Interbedded with/ grading to:

SANDSTONE: yellowish grey to very light grey, moderately hard to hard, rarely friable in part, dominantly very fine to fine grained, occasionally medium to coarse grained, angular to rounded, poorly to dominantly moderately sorted clear to translucent quartz, trace to common white kaolinitic argillaceous matrix, trace moderately strong siliceous and calcareous cement, trace mica, garnets, carbonaceous detritus and lithic fragments, poor to fair inferred porosity.

4.3.3. Upper Jurassic to Lower Cretaceous

Casterton Formation

1799 - 1826 m: CLAYSTONE INTERBEDDED/ INTERLAMINATED WITH SILTSTONE AND MINOR SANDSTONE

CLAYSTONE: olive grey to medium grey, moderately hard to dominantly hard, blocky to fissile, dominantly subfissile, trace to common micromica and carbonaceous flecks/ laminae, non calcareous, chloritic in part, moderately silty, Interbedded/ interlaminated with:

SILTSTONE: light olive grey to very light grey, medium grey to dark greenish grey in part, hard to occasionally very hard, rarely firm in part, blocky to subfissile, trace micromica and carbonaceous specks, moderately argillaceous, rarely chloritic in part, non calcareous, trace very fine quartz sand grains. Interlaminated/ occasionally interbedded with:

SANDSTONE: white to light yellowish grey, moderately hard to hard, rarely friable, very fine to fine grained, rarely medium to very coarse grained in part, angular to rounded, dominantly subrounded, poorly to moderately sorted clear to frosted quartz, trace to occasionally common light grey argillaceous matrix, trace moderately strong siliceous cement and moderately weak calcareous cement, rare garnets, carbonaceous detritus and lithic (volcanogenic?) fragments, poor visual/ inferred porosity.

4.3.4. *Palaeozoic*

Basement

1826 - 1849 m (TD): METASILTSTONE & META-IGNEOUS ROCK

METASILTSTONE: medium grey to very light grey, greenish grey in part, (cored section), dominantly hard, blocky to sub fissile appearance, dominantly silt sized quartz, feldspar and mica, commonly argillaceous, weakly foliated and metamorphosed, (?greenschist facies), trace to occasionally common actinolite, chlorite and sericite, trace to occasionally common green to bluish green fine to medium grained meta-igneous greenschist grade lithics, trace calcite and quartz vein (See Appendix 7 for details).

META-IGNEOUS ROCK: greenish to blue green, fine to medium grained, meta-igneous rock with little or no deformational features. Common amphibole (actinolite), quartz, chlorite, feldspar, carbonate, opaques and lesser amounts of sericite and epidote. It is of intermediate composition, though its original, probably intrusive mineral assemblage cannot be determined. The rock has been slightly metamorphosed to lower greenschist facies.

4.4 ROCK UNIT NOMENCLATURE AND RECOGNITION

The names Casterton Formation and Pretty Hill Formation are used in the sense of Tabassi & Menhennitt (1991a,b) and Geological Survey of Victoria (1994). The Crayfish Subgroup (Morton, 1990) comprises the rock units between the Casterton and Eumeralla formations. The Laira Formation (Morton, 1990) was defined from South Australia; in Victoria it is confined to the westernmost Otway Basin and to the uppermost part of the Crayfish Subgroup.

The names Otway Group (Medwell, 1954), Eumeralla Formation (Reynolds et al., 1966) and Heathfield Sandstone Member (Hawkins and Dellenbach, 1971) have long been used for rock units in the Otway Basin (Parker, 1993).

The rock units in Bus Swamp 1 have been distinguished on the basis of wireline log interpretation, core and cuttings analyses and palynological studies.

Bus Swamp 1 penetrated the basement at 1826 m. Analysis of thin sections from 1832 m and 1840 m (Appendix 7) have identified a meta-igneous rock and a siltstone of greenschist grade. The mineral assemblage observed in the thin section from 1832m is similar to that of a basement core from Hawkesdale 1 (1752 - 1757 m), with "abundant chlorite and quartz with undulose extinction consistent with greenschist metamorphism." (Melinda Mitchell, personal communication.) Also, there is a high degree of sericitisation and chloritisation, along with folded quartz veins, a feature not observed in Otway Basin sediments. The sample also displayed very low amounts of apatite, indicating leaching of a top basement unconformity regolith zone. The overlying Otway Group sediments display significantly higher amounts of apatite and the fission tracks indicate a different source from the basement rocks (Melinda Mitchell, personal communication).

An approximate interval velocity for the basement rocks has been determined. Unfortunately the well only penetrated 23 m of basement. The time-depth curve shows the interval velocity to be slightly more than 5000 m/s. Calculations based on the interval between 1826 m and 1830 m, at the top of basement, have provided an interval velocity of 5098 m/s. This velocity is slightly higher than the 5000 m/s calculated for the nearby Casterton 1 well. It is possible that the velocity is even higher at deeper levels with increased metamorphism and compaction.

However, there is some evidence that these rocks could be Casterton Formation instead of basement. Observation of seismic line HFD89-10 (Fig. 4.3) shows that there are still reflectors below the bottom of the well. This could indicate that Bus Swamp 1 finished in Casterton Formation. Also, the degree of metamorphism observed in the sample at 1840 m is extremely weak. The meta-igneous rock at 1832 m is intrusive and very thin. It could be interpreted as being a sill, with contact metamorphism of the surrounding sediments. However, no evidence of contact metamorphism, such as the presence of hornfels, has been observed in the well.

The Casterton Formation (1799-1826 m) was distinguished from the overlying Pretty Hill Formation on unique log character, particularly resistivity logs and on the prominent continuous reflectors on seismic, typical of the formation. There is also a marked increase in clay and siltstone content. A lower *C. australiensis* to *R. watherooensis* zone assignment at 1787 m indicates, however, that the Crayfish/Casterton boundary may be placed slightly higher than this, at around 1775 m.

The Pretty Hill Formation is characterised by interbedded sandstone and shale. In Bus Swamp 1 (1050-1799 m) it was distinguished from surrounding units on logs which showed alternating sandy and shaly layers. Samples showed garnets in the sandstone units, indicative of the Pretty Hill Formation, and supported by palynological assignments of upper *C. australiensis* to *F. wonthaggiensis*.

The Laira Formation is the upper shaly unit of the Crayfish Subgroup. It consists of a fairly homogenous mixture of fine sandstone, siltstone and claystone. In Bus Swamp 1 (870-1050 m) it was distinguished from the underlying Pretty Hill Formation by the consistently high gamma log readings. Samples also showed higher clay content for the entire interval.

The Eumeralla Formation consists of relatively fine grained sandstones, siltstones and claystones with some coal bands. In Bus Swamp 1 (95-870 m) it is distinguishible from the underlying Laira Formation by its higher sand content. The gamma ray log shows a lower response than the Laira Formation. Samples contained a higher proportion of feldspathic material and glauconite, indicative of the Eumeralla Formation and supported by lower *C. hughesii* to lower *C. paradoxa* zone palynological results.

The Heathfield Sandstone Member is a relatively mature clean sandstone found in the Casterton area. It is present in Bus Swamp 1 from 654 m to 660 m and is distinguished by its high porosity and permeability in samples. It is also characterised by its dominantly quartzose content and by a distinctive perturbation on the gamma ray log.

The units above the Eumeralla Formation could not be identified positively but are assumed to be Quaternary/Tertiary sediments. No palynology samples were taken and the log character is obscured by the casing.

4.5 HYDROCARBON INDICATIONS

Two significant occurrences of gas (1575.5 m and 1820 m) were recorded and hydrocarbon fluorescence was noted at several depths.

4.5.1 Drilling Fluid Gas Readings

From casing shoe to total depth the well was monitored by a Halliburton SDL mudlogging unit using a gas chromatograph and hot wire total gas detector. The gas detector was regularly checked to verify its operation and accuracy. Calcium carbide was placed in the drilling fluid during connections and the gas trap was repositioned before taking the second core. See Table 8 for Bus Swamp 1 gas readings and Table 9 for a breakdown of peak gas readings.

Table 8

Bus Swamp Gas Readings

Interval (m)	Background (API units)	Peaks	Depths (m)	Trip
524 - 740	0.30	0.75	570	
740 - 825	0.35	1.13	742	
		1.30	782	
		1.60	822	
825 - 876	0.40	0.68	837	4.00
		1.78	876	1.48
876 - 1062	0.50	1.78	846	
		1.50	989	
		1.70	1010	
		1.60	1028	
		1.60	1054	
1062 - 1112	0.40 - 0.68	0.95	1075	
		0.80	1084	
		1.04	1094	
		0.45	1105	
1112 - 1180	0.30 - 0.75	2.75	1118	3.80
		1.65	1139	3.50
		2.83	1155	
		2.00	1160	
1180 - 1228	0.30	0.45	1194	2.30
1228 - 1305	0.20 - 0.40	1.63	1298	
		2.93	1299.5	
1305 - 1355	0.25 - 0.50	0.56	1332	

Table Continued...

...Continued

Interval (m)	Background (API units)	Peaks	Depths (m)	Trip
		0.88	1335	
		1.15	1342.5	
		10.40	1352.5	
1355 - 1483	0.50 - 1.00	1.20	1378	
		5.10	1395	
		3.90	1404	
		1.14	1454	
		1.00	1475	
1483 - 1509	0.20 - 0.30			
1509 - 1515	2.20 (Coring)	8.68	1511 (Swabbing)	
1509 - 1591	0.75 - 2.00	3.10	1540	
		7.56	1572	
		23.80	1575.5	
		7.56	1582	
1591 - 1648	1.00	4.30	1599	
		4.60	1619	
1648 - 1720	2.50 - 1.50	5.20	1684	
		8.00	1657	
		5.60	1690	
		3.90	1715	
1732 - 1785	0.90 - 2.20	4.50	1735	
		4.50	1741	
		2.57	1766	
		6.50	1774	
		5.10	1772	
1785 - 1790	Core taken			
1790 - 1822	2.50 - 5.50	3.90	1788	7.00
		6.40	1807	
		21.80	1820	
		7.50	1822	
1822 - 1832	5.00 - 1.50	4.20	1832	27.00
1832 - 1851	No Readings.			

Table 9

Breakdown of Peak Gas Readings.

Depth (m)	units	C_1 (ppm)	C_2	C_3	C_4	C_5	
742	1.13	207					
782	1.30	217					
822	1.60	296	Tr				
837	0.68	129	Tr				Tr CO_2
846	1.78	300	4				
989	1.65	303					
1010	1.62	300	3	Tr			
1028	1.70	307	4	2			
1054	1.52	296	2				
1075	0.97	190	1				
1084	0.87	173	2				
1094	1.04	205	2				
1105	0.60	115	2				
1118	2.8	555	7				
1139	1.61	313					
1155	2.83	563	2				
1160	1.92	379	1				
1298	1.63	300	6				
1299.5	2.93	450	6	1			
1332	0.56	110	2	1			
1335	0.88	177	3	Tr			
1342.5	1.15	218	2				
1352.5	10.4	1969	29	9	4	1	
1378	1.2	252	9				
1395	5.1	960	19	7	3		
1404	3.9	770	5	1			
1454	1.14	216	2	Tr			
1475	1.7	190	7				
1511	8.68	1596	27	11	6	2	
1540	3.1	581	18	5			
1572	7.56	1379	37	20	2	Tr	
1575.5	23.8	4312	93	33	12	8	
1582	7.56	1290	45	20	6	3	
1599	4.3	793	22	5	3	1	
1619	4.6	901	7	1			
1657	8	1512	24	8	4		
1684	5.2	1004	5	2			
1690	5.6	1056	9	2			
1715	3.9	758	3				
1735	4.5	846	21	4			
1741	4.5	867	15	4			
1766	2.57	501					
1772	5.1	981	11	2			
1774	6.5	1262	11	2			
1788	3.9	762	9	2			
1807	6.4	1196	14	6			
1820	21.8	4200	65	10			
1822	7.5	1450	18	5			

4.5.2 Sample Fluorescence

Core and cuttings samples were routinely checked for hydrocarbon fluorescence under ultraviolet light. Samples were also tested for trichloroethane cut and crush cut fluorescence. Fluorescence was confined to the sandstone intervals.

Fluorescence was first noted in cuttings samples from the interval 365 m to 385 m. Initially a dull yellow minor fluorescence was observed without cut fluorescence in cuttings samples from the interval 360 m to 370 m. From the interval 375 m to 380 m 20% of the cuttings sample showed a dull yellow natural fluorescence with an off white cut and residue ring. This dwindled to 5% at around 385 m.

A dull orange fluorescence without cut fluorescence was observed in cuttings samples between the interval 550 m to 620 m. This was presumed to be mineral fluorescence. Minor and trace dull orange fluorescence with no cut fluorescence was also detected at 975 m, 1200 m to 1220 m, 1345 m to 1365 m, and 1545 m to 1560 m.

Cuttings samples from the interval 1710 m to 1740 m generally displayed a dull orange to yellow mineral fluorescence. However, a trace show in cuttings samples of 2 to 5%, giving an occasional pale yellow to dull orange fluorescence with a trace yellow white crushcut and a yellow white residue ring, was also detected.

Fluorescence was observed on quartz grains from the interval 1815 m to 1820 m. This was recorded as 1 to 5% moderate yellow fluorescence with no cut fluorescence and a thin residue ring.

The core samples did not display fluorescence.

4.6 POTENTIAL RESERVOIRS

4.6.1 Heathfield Sandstone Member

This unit usually displays good porosity and permeability, and consists of quartz rich, extremely friable sandstone. The sandstone between 654 m and 660 m in Bus Swamp 1 consists of well sorted, unconsolidated quartz grains with some feldspathic and lithic content. No direct porosity or permeability measurements were done on this interval, though examination of sidewall core 41 (657 m) and cuttings indicates that visual porosity is good. However, the potential of the Heathfield Sand Member as a target for petroleum exploration should not be overstated. In Bus Swamp 1 it is only six metres thick and indications from other well data are that it is discontinuous. Also, in the Bus Swamp 1 samples there is a significant amount of argillaceous material which may reduce the unit's reservoir potential.

4.6.2 Crayfish Subgroup

This sequence has attracted recent interest because it contains sandstone layers with interbedded shaly layers and is near a possible source rock. Sandstone layers host the hydrocarbon shows in the Katnook gas field and the Ladbroke Grove 1 well in South Australia.

Pretty Hill Formation

There is potential for the Pretty Hill Formation to trap hydrocarbons within individual sandstone beds overlain by sealing shales. The sand intercalations in Bus Swamp 1 are generally thin, limiting the chance of large accumulations in this area. However, a reasonably thick sandy succession exists between 1430 m and 1550 m. AMDEL tested two samples, one from either end of core 2 (1509.8 - 1515.8 m), and found porosities of 19.4% and 19.1%. Permeabilities were low at 68.7 millidarcys and 49.7 millidarcys. There are other minor sandstone units below this but none have been tested and from the logs all show a corresponding decline in porosity.

4.6.3 Fractured Basement

One of the objectives of Bus Swamp 1 was to test the reservoir potential of fractured basement rocks, especially after the promising results from the nearby Sawpit 1 well. However, no gas shows were observed below 1822 m and the basement rocks did not appear to display the fracture based porosity observed in Sawpit 1. The log interpretation also indicates a lack of hydrocarbons in basement units.

4.7 SOURCE ROCK POTENTIAL

Thirteen samples were sent to Amdel for source rock analysis. This analysis included Vitrinite Reflectance, Rock Eval Pyrolysis, Total Organic Carbon (TOC) and Organic Petrology. Rock Eval Pyrolysis and Total Organic Carbon measurements were also carried out by AGSO and SADME as part of their commitment to Bus Swamp 1. The results are shown in Appendix 8 and are discussed below.

The vitrinite reflectance profile (Fig. 4.6) shows that Rvmax=0.5% can be reached at a depth of approximately 1350 m. However, AMDEL consider that oil generation in this well began at around 0.45% at a depth of approximately 1100 m. The results are significant as they are low compared with most other wells studied in the Otway Basin. Rvmax=0.7%, the peak of liquid hydrocarbon generation, was not reached in the well but its estimated depth is approximately 2100 m at the Bus Swamp 1 location.

These figures indicate a greater depth of burial here than in most other parts of the Otway Basin, a feature closely associated with the aborted rift (Pettifer et al. 1991). Warracbarunah 2 had similarly high temperatures, lying within the Gellibrand Trough, the eastern arm of the aborted rift.

Two sets of TOC versus depth data have been obtained from AMDEL and AGSO. The TOC versus depth profile constructed from both sets (Fig. 4.7) shows that out of twenty samples tested only four did not exceed 0.5% TOC, the minimum value required for source rock generation. However, the TOC values in general were modest, with the highest being 3.5% at 1815 m. The lowest value was 0.18% at 756 m.

The best samples for source rock potential in Bus Swamp 1 are from shales at the top of the Casterton Formation. Only a few samples were analysed from the Eumeralla Formation, the best result being 1.49% at around 830 m (AGSO). The Crayfish Subgroup was well tested and, except for two low values at 982 m and 1325 m, the results are consistently around the 1% mark.

Organic matter in the samples is estimated to be of Type II/III to Type IV kerogen from Tmax and hydrogen index data. The more suitable Type II/III kerogens are predominant in the lower part of the section, between 1585 and 1810 m.

AMDEL also suggest that there are migrated hydrocarbons at the intervals 830-835 m and 1406 m. The first of these is most likely sourced from somewhere in the Eumeralla Formation and the second from within the Crayfish Subgroup, possibly from the interval around 1575 m. This indicates that there is a degree of maturity in the sequence at this location. Also, the potential for hydrocarbons to occupy reservoir units is relatively good.

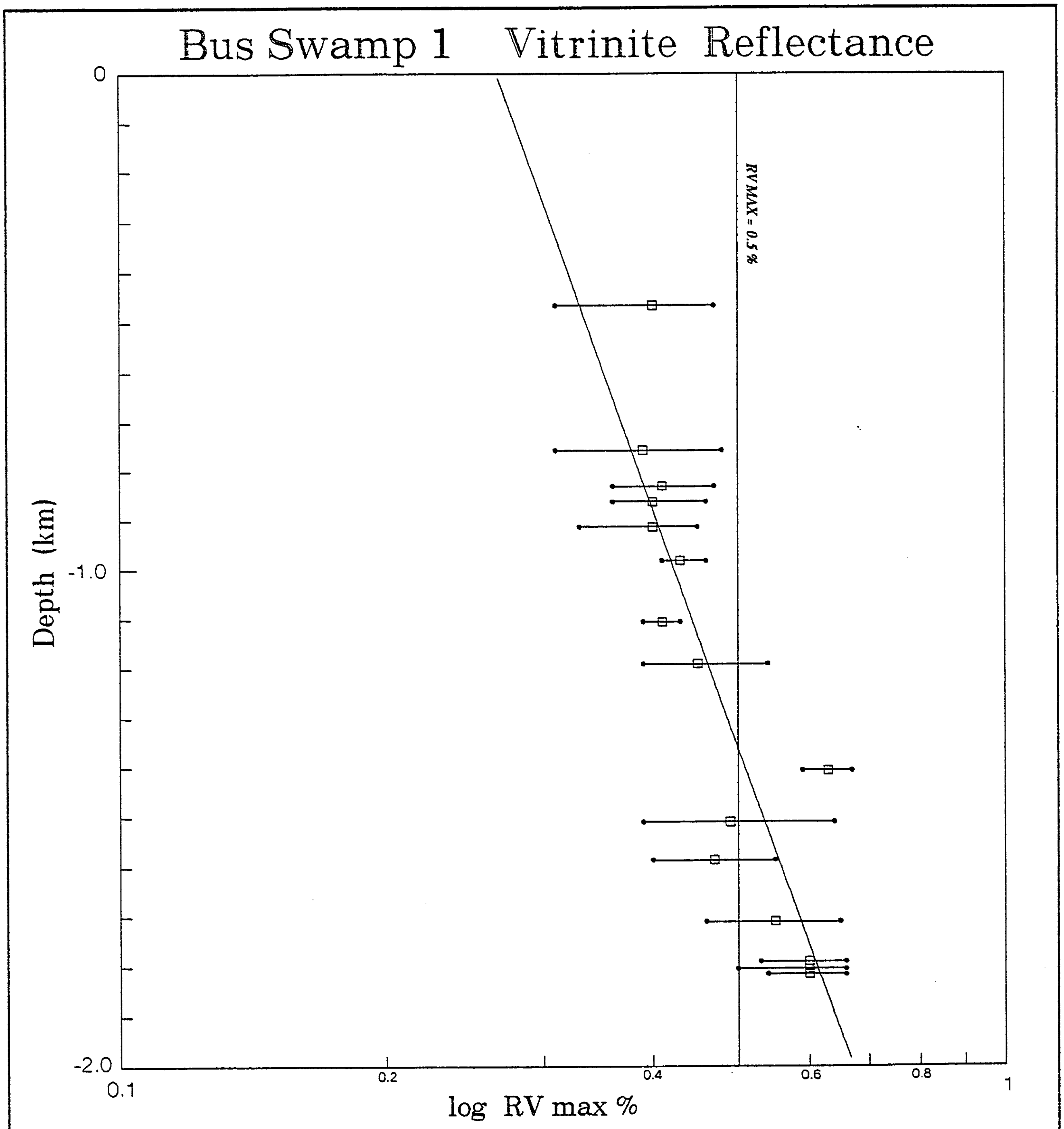


FIGURE 4.6 - VITRINITE REFLECTANCE PROFILE (AMDEL Data)

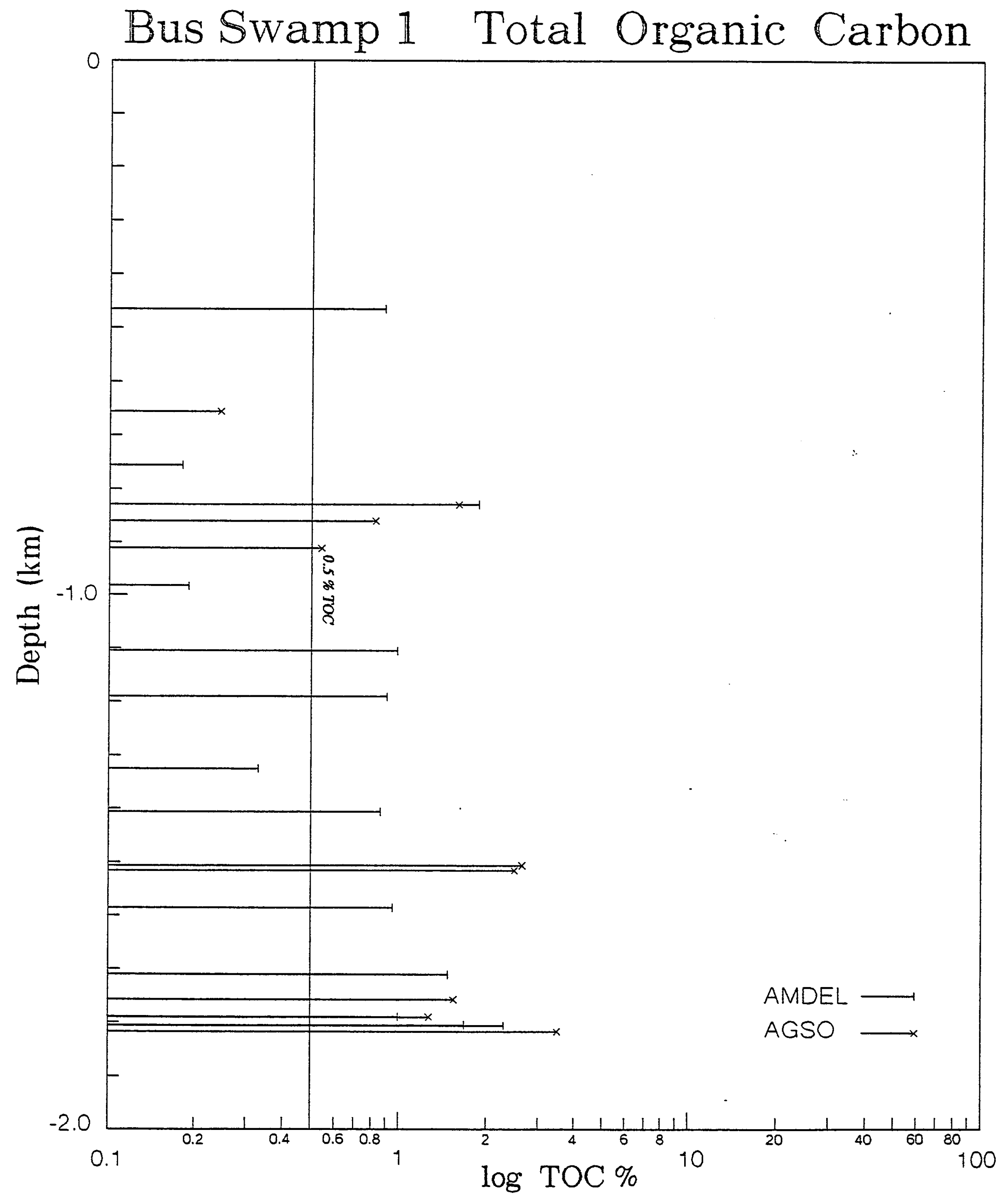


FIGURE 4.7- TOTAL ORGANIC CARBON CONTENT

5. CONCLUSIONS AND CONTRIBUTION TO KNOWLEDGE OF THE HYDROCARBON PROSPECTIVITY OF THE AREA

The Bus Swamp 1 stratigraphic well has met most of its objectives. Knowledge of the hydrocarbon prospectivity of the area has been increased through detailed analysis of the three main units in the well: the Casterton Formation, the Crayfish Subgroup and the Eumeralla Formation. Some insight into the nature of basement rocks has also been gained. Confidence in the area's prospectivity has been boosted by gas shows in the well.

As discussed in section 4.5.2 fluorescence was noted at several locations in Bus Swamp 1. The first instances were as shallow as 375 m to 380 m. Several other intervals displayed fluorescence, including the depth 1345 m at which Rvmax=0.5% is located. This also corresponds to a substantial peak gas reading of 10.4 units at 1352.5 m depth. Another significant gas reading was 8.68 units at 1511 m as shown in Table 9. However, no fluorescence was seen at this depth.

From 1572 m to 1582 m the peak gas readings were relatively high with 7.56 units each and a value of 23.8 units at 1575.5 m, including 93 ppm of C2, 33 ppm of C3 and smaller amounts of C4 and C5. The lower section, from 1511 m down, showed consistently higher peak gas readings than the upper section, averaging around 4 to 5 units per tested interval.

Another very high peak gas reading of 21.8 units at 1820 m corresponds roughly to the very high TOC values obtained from AMDEL and AGSO. Most of the hydrocarbons are considered to be generated in situ in non-reservoir rocks, with the possible exceptions of those at intervals 830-835 m and 1406 m (AMDEL). However, some of these hydrocarbons could have migrated into local sandstones very near the source material. This is particularly so in the Crayfish Subgroup. Only a relatively thin sandstone section was penetrated in the Crayfish Subgroup between 1430 m and 1550 m, and hydrocarbon shows were generally poor, except for 1511 m with 8.68 units.

These results indicate that the Crayfish Subgroup has the capacity to generate hydrocarbons in local shales and is able to migrate some amounts into local sandstones in the Bus Swamp 1 area. The shaly units appear to provide good seals. Some shows were observed in the Eumeralla Formation but no significant amounts were detected. It is unclear whether the formation has the capacity to generate a significant amount of hydrocarbons in this area.

Probably the most significant result is the 21.8 units found in the upper shales of the Casterton Formation, including 65 ppm of C2 and 10 ppm of C3. It is a very likely source for the accumulations in the lower Crayfish units. This has shown that there is source rock potential in the Casterton Formation.

Seismic data suggest that basement is downfaulted to the south toward the centre of the Penola Trough. It is expected that the early history of the Bus Swamp 1 area and the Penola Trough depocentre is much the same. However, the centre of the trough has undergone relatively continuous burial since the Early Cretaceous. We can therefore assume that rock temperatures will be higher there than those of equivalent units in the Bus Swamp 1 area. This means that the Penola Trough kitchen area is probably more prone to mature gas. It is also reasonable to assume that hydrocarbons from there have migrated into the more elevated Bus Swamp 1 area.

Quality plays may exist in the northern Penola Trough, though none have been delineated here. It is most likely that plays in this area will be fault controlled or exist as pinchouts.

In this location it was difficult to distinguish basement rocks from Casterton Formation due to their sometimes stratified appearance on seismic. Seismic and well log data could not positively identify them. The heavily sericitised volcanic rock present in the well could easily be interpreted as altered volcanics from the Casterton Formation. Only petrographic analysis and hand specimen examination showed that there was basement below 1826 m.

Basement rocks in the area are estimated to have an interval velocity slightly over 5000 m/s. A velocity of 5098 m/s was estimated for those rocks between 1826 m and 1830 m in Bus Swamp 1 and this is expected to increase with depth.

The information gathered from Bus Swamp 1, in addition to the seismic and stratigraphic work currently being undertaken by the GSV, AGSO and SADME, has exceeded expectations in testing for prospectivity in the Penola Trough. It has also improved our knowledge of the structural and stratigraphic history of an area of great interest to oil and gas exploration companies. The trough possesses mature source rocks and a number of potential reservoirs. A prominent kitchen area exists within the trough which has been proved to generate hydrocarbons and indications are that there is migration occurring in the area. However, more detailed seismic mapping is necessary to delineate potential plays. The results presented here contribute to our understanding of the hydrocarbon potential of the Penola Trough and provide positive evidence to continue hydrocarbon exploration within the trough.

REFERENCES

DOUGLAS, J.G., & FERGUSON, J.A. (Eds)), 1988: Geology of Victoria. *Geological Society of Australia*, Melbourne.

GEOLOGICAL SURVEY OF VICTORIA, 1994: The Stratigraphy, Structure, Geophysics and Hydrocarbon Potential of the Eastern Otway Basin, Victoria. *Geological Survey of Victoria Unpublished Report. (In prep.)*

GLENIE, R.C. (Ed.) 1985: Second South-eastern Australia Oil Exploration Symposium. *PESA*, Melbourne.

HARLAND, W.B., ARMSTRONG, R.L., COX, A.V., CRAIG, L.E., SMITH, A.G. & SMITH, D.G., 1990: *A Geologic Time Scale* 1989. Cambridge University Press.

HAWKINS, P.J. & DELLENBACH, J., 1971: Stratigraphy. In *A Review of the Otway Basin (Reynolds, M.A. Compiler). Report for the Bureau of Mineral Resources*, **134**, pp. 7-22.

MEDWELL, L.M., 1954a: A Review and Revision of the Flora of the Victorian Lower Jurassic. *Proceeedings of the Royal Society of Victoria*, **65**, pp. 63-111.

MORTON, J.G.D., 1990: Revisions to stratigraphic nomenclature of the Otway Basin, South Australia. *Quarterly Notes, Geological Survey of South Australia*, **116.**

PARKER, G.J., 1993: Development of Eastern Otway Rock Unit Nomenclature. *Geological Survey of Victoria Unpublished Report* **No. 1993/14.**

PERINCEK, D., SIMONS, B. & PETTIFER, G.R., 1994: The Tectonic Framework, and Associated Play Types of the Western Otway Basin, Victoria, Australia. *Australian Petroleum Exploration Association Journal* 1994., (In press).

PETTIFER, G., TABASSI, A., & SIMONS, B., 1991: A New Look at the Structural Trends in the Onshore Otway Basin, Victoria, Using Image Processing of Geophysical Data. *Australian Petroleum Exploration Association Journal,* 31(1). pp. 213-228.

REYNOLDS, M.A., EVANS, P.R., BRYAN, R. & HAWKINS, P.J., 1966: The Stratigraphic Nomenclature of Cretaceous Rocks in the Otway Basin. *Australian Oil and Gas Journal* 13(3), pp. 26-33.

TABASSI, A. & MENHENNITT C., 1991a: Mocamboro 11, Well Completion Report. *Geological Survey of Victoria Unpublished Report* **No. 1991/65.**

TABASSI, A. & MENHENNITT C., 1991b: Warracbarunah 2, Well Completion Report. *Geological Survey of Victoria Unpublished Report* **No. 1991/66.**

VEEVERS, J.J., 1984a: Phanerozoic Earth History of Australia. *Oxford University Press.*

WOPFNER, H., & DOUGLAS, J. G. (eds), 1971: The Otway Basin of South-eastern Australia. *Special Bulletin of Geological Surveys of South Australia and Victoria.*

APPENDIX 1

APPENDIX
1

DETAILS OF DRILLING PLANT

Rural Water Corporation
590 Orrong Road Armadale Victoria Australia 3143
Telephone (03) 508 2222 Facsimile (03) 508 2686 Ausdoc DX21

DRILLING RIG AND EQUIPMENT TO BE FURNISHED BY CONTRACTOR:

CONTRACTOR'S RIG NO 4

MAKE & TYPE OF RIG: Bourne 5,000 R

MAST: Bourne 97/300

KB TO GROUND: 3.53 metres

1. NOMINAL DEPTH CAPACITY:

2,500m with 4 1/2" Aluminium drill pipe

2. DRAWWORKS:

* Modified Ideco H-20 dual drum 1" drilling line, 9-16" sandline.

DRAWWORKS:

Deutz F12L 413 diesel engine, heavy duty intermittent rating 320 HP at 2,250 RPM.

TORQUE CONVERTER:

Allison TC 500.

TRANSMISSION:

4 speed Allison.

CLUTCHES:

Fawick 26 Cb525 on main drum. Fawick 22 Cb580 on sandline.

HYDRAMATIC BRAKE:

Parkersburg 122.

3. DERRICK:

Bourne 97/300 free standing open face telescopic mast.

WORKING HEIGHT:

97' above rotary table.

CAPACITY:

300,000 lbs

CROWN:

Bender type for 4, 6 or 8 lines.

FINGER BOARD:

2,500m (136 stands, range 2 doubles) 4 1/2" drill pipe.

ACCESSORIES:

- Crown saver
- Crown safety platform
- Integral ladder
- Tong counterbalance weight guides

4. SUBSTRUCTURE:

Set back capacity - 240,000 lbs.

5. ROTARY TABLE:

17 1/2" Ideco 325 Ton capacity powered through a heavy duty Lippe Rollway oil bath, adjustable slip clutch.

6. TRAVELLING BLOCKS:

Four sheave 100 Ton McKissick.

7. SWIVEL:

National N35, 112 Ton.

8. MUD PUMPS:

1 6" x 12" National powered by GM 671 440 H.P. diesel engines, Hydraulic HP 329.

1 7 1/4" x 12" Gardner denver powered by GM 671 440 H.P diesel engine. Hydraulic HP 226. Both fitted with spark arrestors and BCF shutdown.

9. MUD TANKS:

Shaker tank capacity 300 bbls. Suction tank capacity 228 bbls. Trip tank capacity 30 bbls.

10. MUD CLEANING EQUIPMENT:

Baroid 4 cone desander.
Dresser 4 cone desilter.

11. <u>SHALE SHAKERS</u>:

2 x Double Brandt

12. <u>MUD MIXING SYSTEM</u>:

5" x 4" mission centrifugal 12" impeller driven by 3 cylinder Deutz diesel engine.

PITT AGITATORS:

All pits fitted with submerged guns.

13. <u>BLOWOUT PREVENTERS</u>:

1-9" x 3,000 PSI Reagan Torus Annular Preventer.
1-9" x 3,000 PSI Shaffer Double Ram Preventer.

14. <u>KELLY</u>:

5 1/4" OD x 3 1/4" ID x 37 ft working length.

15. <u>DRILL PIPE</u>:

500' 4 1/2" 16.60 lb/ft Grade "E" 4" IF Tool Joints.

7,000' 4 1/2" 10.00 lb/ft Reynolds Aluminium drill pipe with 4 1/2 IF Tool Joints.

16. <u>HEAVY WEIGHT DRILL PIPE:</u>

16 joints 4 1/2 x 30' HWDP with 4 1/2 IF Tool Joints.

17. <u>DRILL COLLARS</u>:

4 joints 8" x 2 3/4" DC's with 6 5/8" Reg Tool Joints.

20 joints 6 1/2" x 2 12/16" DC's with 4" IF connections.

18. <u>ROTARY SUBSTITUTES</u>

As required to connecting all items of contractors drill string.

19. CASING HANDLING EQUIPMENT:

Single Joint Elevators	:	For 13 3/8:, 9 5/8", 7" & 5 1/2"
Side Door Elevators	:	For 13 3/8", 9 5/8", 7" & 5 1/2"
Slip and Bowls	:	For 13 3/8", 9 5/8", 5 1/2"
Rotary Table Slips	:	For 7" & 5 1/2"

20. FISHING EQUIPMENT

Overshots: 9 5/8" Bowen series 150 FS
8 1/8" Bowen series 150 FS
Above overshot equipped with grapples, controls and packoffs to catch all sizes of contractors drill string.

21. SURVEY INSTRUMENT:

Slim Hole Totco.

22. FUEL STORAGE:

20,000 litre capacity.

23. WATER STORAGE:

600 BBL tank.

Rural Water Corporation
590 Orrong Road Armadale Victoria Australia 3143
Telephone (03) 508 2222 Facsimile (03) 508 2686 Ausdoc DX21

OUR SPECIFICATION RIG 4

1.1 GENERAL DESCRIPTION: The BOURNE 5000R Trailer Mounted Rotary Table Type Drilling Rig is a multi-purpose rig suitable for water well, stratigraphic and production drilling and servicing by mud rotary and air drilling methods when fitted with suitable options.

CAPACITY:

The BOURNE 5000R in favourable drilling conditions has a depth capacity of 2500 metres when using 6 1/4" drill collars, 4 1/2" Hevi-wate, 4 1/2" Steel and 4 1/2" Aluminium drill pipe.

1.2 MAST:

MAST DESCRIPTION:

The free standing, open face telescopic mast, model BOURNE 97/300 is designed to the Australian Standards which exceeds API requirements. The basic structure consists of square and rectangular steel tubing electrically welded and reinforced for maximum strength.

CAPACITY

The mast has a working height above the rotary table of 30 metres (98'). The gross capacity rating is 300,000 lbs with a maximum hook load capacity of 200,000 lbs.

RAISING AND TELESCOPING:

The mast is raised from, and lowered to, the travelling position by multi-stage, double acting hydraulic cylinders fitted with safety check valves. The upper mast section is extended and telescoped using 2 wire line bridle attached to the travelling block.

LOCKING

The lower mast is held in the vertical position against heavy duty A-frame supports. Both A-frames and mast are secured to the permanently attached working platform, by quickly installed, tapered drive pins.

A remotely operated, heavy duty locking mechanism controlled from the driller's position secures the extended upper mast during the drilling operation.

CROWNS:

Bender type for 4, 6 and 8 line string up with conventional block to hang flat with mast face:

- Three 711mm (28") diameter sheaves in line, grooved 25mm (1").

- Three 609mm (24") diameter sheaves cross mounted, grooved 25mm (1".

- Two 356mm (14") diameter sandline sheaves in line, grooved 14mm (9/16").

Crown sheaves are cast steel to API specification and mounted on precision bearings.

PIPE RACKING:

Racking board is lowered into working position as mast is elevated vertically and raised into its folded position for transport when mast is brought horizontal.

Racking board height is set to handle double range 2 tubulars. Board fingers are set to suit 4 1/2" drill pipe while collar fingers can accommodate either 6 1/2" or 8" diameter collars. Capacity of rack for double range 2" - 4 1/2" tubulars is 2500 metres and 183 metres (600 feet) of 6 1/2" or 8" collars.

ACCESSORIES:

- Integral climbing ladder.
- Crown safety personnel platform.
- Two tong counterbalance weight guides.
- Feed through dead line anchor permits main hoist line storage.

1.3 DRAWWORKS:

Tandem style frame is of fabri-form construction for maximum rigidity. The main drum is of welded steel and keyed to the shafts which are mounted in self-aligning roller bearings with high torque main clutch on one end. The sandline drum is free-spooling and driven through on air clutch.

MAIN DRUM:

Barrel Length:	958.8mm (37-3/4")
Barrel Diameter:	323.8mm (12-3/4")
Brake Width:	177.8mm (7")
Brake Diameter:	863.6mm (34")
Brake Wrap:	330°
Brake Area:	88387mm^2 (1370" ^{2})

Line Pull 1st Layer:

1st Gear:	11,464 Kg (25,220 lb)
2nd Gear:	6,276 Kg (13,807 lb)
3rd Gear:	4,304 Kg (9,470 lb)
4th Gear:	3,103 Kg (6,827 lb)

Line Speed 1st Layer:

1st Gear:	100m/mm (327 ft./min)
2nd Gear:	182m/mm (598 ft./min)
3rd Gear:	265m/mm (871 ft./min)
4th Gear:	368m/mm (1210 ft./min)

Line Capacity 25mm (1")
786m (2580 ft.)
Grooved: Lebus 25mm (1")
Clutch: Fawick 28CB 525

SANDLINE:

Barrel Length:	958.8mm (37 3/4")
Barrel Diameter:	323.8mm (12 3/4")
Brake Width:	177.8mm (7")
Brake Diameter:	863.6mm (34")
Brake Wrap:	330^0
Brake Area:	$88387mm^2$ $(1370"^{\,2})$

Line Speed 1st Layer:

1st Gear:	7110 Kg (15643 lb)
2nd Gear:	3900 Kg (2582 lb)
3rd Gear:	2668 Kg (5870 lb)
4th Gear:	1970 Kg (4239lb)

Line Speed 1st Layer:

1st Gear:	161m/min (527 ft./min)
2nd Gear:	293m/min (962 ft./min)
3rd Gear:	428m/min (1406 ft./min)
4th Gear:	593m/min (1947 ft./min)

Line Capacity 14.2mm (9/16"):
2530m (8300 ft.)
Clutch: Fawick 22 CB 500

BRAKES:

Double brakes are self-energising, equalising with single point adjustment. Brake operating shafts are ball bearing mounted. Brake rims are splash water cooled.

DRIVES:

Main power input drive is fully enclosed in a chain case and oil bath lubrication. All other chain drives are protected with safety guards and have drip fed lubrication. Main shaft bearings and linkage bearings are pressure greased from a central point.

HYDROMATIC BRAKE:

The main drawworks shaft and bearings have been increased in size and capacity above standard to withstand the braking torque of the hydromatic brake.

A Parmac 122 model double rotor type hydromatic brake is provided and is driven via an oil bath chain with air operated dog engagement. All controls are provided at operator's position.

1.4 ROTARY TABLE:

A heavy duty oilfield rotary table with 444.5mm (17 1/2") API opening is fitted to the permanently attached working platform. The gear train comprises precision cut spiral bevel gears made from forged alloy steel, heat treated for maximum life.

The large diameter pinion shaft is mounted in a cartridge type housing, allowing easy bearing removal. The cast steel quill is mounted on high load capacity main ball bearings retained in the heavy duty main housing. Lubrication of the gears and bearing si by oil bath and splash. Split type API dimensioned mast bushing is fitted to the rotary table to enable use of rotary slips.

CAPACITY:

115 tons dynamic at 125 RPM
325 tons static loading.

DRIVES:

Venturetech hydraulic - model UHR-14K, driven by 6 cylinder Deutz motor.

1.5 ENGINE UNIT:

Deutz F12L 413F direct injection diesel engine heavy duty intermittent rating 320 HP at 2250 RPM. Mounted forward of the drawworks to power both drawworks and auxiliary hydraulic systems.

Power from the engine is delivered smoothly to the drawworks through an ALLISON HT 740 automatic transmission mounted directly to the engine, enabling more efficient use of drawworks speeds when operating with either minimum or maximum loads. The power-shift transmission has four (4) forward speeds which can be selected from the driller's control console.

Transmission fluid is cooled by water to oil heat exchanger fed from main fresh water tank by pressure pump.

1.6 HYDRAULICS:

The auxiliary hydraulic functions are supplied by a fixed displacement hydraulic pump driven from the engine unit. Capacity of the pump is 190 Litres per Min. (50 Gal/min) 140.6Kg/cm^2 (2000 PSI).

The hydraulic tank is fitted with filter cap, oil level/temperature gauge, return line 10 micron filter and has a capacity of 757 Litres (200 Gals).

1.7 AIR SYSTEM:

Compressed air for the operating controls is supplied by an auxiliary (24 CFM) piston compressor driven from the tool house. The air system comprises a reservoir, safety valve, filter, lubricator and regulator.

1.8 TRAILER:

Heavy duty goose neck type trailer mounted on tri-axle rear suspension. Electrically welded basic construction of wide flange 457mm (18") H-Bearn cross members. All open deck area covered with non-slip chequer plate.

Goose neck fitted with H.D. 3 1/2" SAE king pin, day fuel tank fitted to goose neck. Suspension ETE, 3-1, 11 leaf spring packs certified 27T capacity.

Hinged and removable walkways .9m (3 ft.) wide extend either side of the lower trailer frame. These walkways are supported on retractable arms and are covered with steel chequer plate. The walkways fold up for highway travelling with the 3m (9.8 ft.) overall width.

Walkways are fitted to either side of the permanent working platform. Four (4) stairways, fabricated from non-slip steel chequer plate, connect the upper and the lower walkway and provide access either side from the ground to lower walkways.

Handrails, provided with toe boards are attached to all walkways and stairways.

1.9 DETACHABLE PLATFORM: An additional detachable working and racking platform is supported against the rear permanent working platform by links and tapered drive pins to eliminate stress from rig main frame should detachable platform settle when maximum pipe and collar weight is racked.

This platform has hardwood timber inserts for standing tubulars when using the racking board.

Walkways .9m (3 ft.) wide are attached on the three (3) sides. Reinforcing struts support these walkways to accept the extra tooling weights.

The platform is fitted with handrails complete with toe boards. The handrails are all linked together for added strength.

The Vee-door section is reinforced with pipe slide and stairways attached and supported on the pipe trailer.

Clearance beneath both permanent and detachable platforms is 2.13m (7 ft.) x 2m (6.56 ft.) diameter to accept B.O.P. equipment.

1.10 JACKS: Six (6) heavy duty hydraulic stabilising jacks, enclosed in steel tubular housings for radial load protection and fitted with pilot operated locking valves, are mounted, Two (2) at either side of front goose neck and four (4) behind the rear axles on the main frame below the permanent working platform to speed initial set-up.

Two (2) additional support frames attached, one (1) on either side of the rear platform support columns are fitted with mechanical screw jacks. These support frames enable the greater mast height and loadings to comply with the turn over prevention regulations.

Heavy duty mechanical screw jacks are mounted on each of the four(4) main vertical columns of the detachable working platform to level and support the platforms maximum load capacity.

1.11 CONTROLS:

The complete console mounted at the drillers position, outside of the mast support A-frame on the extended walkway provides clear vision of the rotary table, racking board, derrickman,crown and the equipment on the machinery deck. The console has all the air controls for the drawworks, rotary table, main and auxiliary mud pump, transmission gear shift, main compound engine, main mud pump and remote auxiliary mud pump engines start, stop and throttles. Hydraulic controls for the catworks, spinning winch and accessories are mounted in the front of the console.

All engine tachometers, air pressure and hydraulic pressure gauges are mounted in the console.

Also mounted at the drillers console are the Koomey B.O.P. actuating and closing controls.

A remote hydraulic control for the kelly spinner and tugging winch is mounted at the rear of the detachable platform beside the pipe slide.

The console can be removed for major highway travelling by disconnecting hoses at the bulkhead and sealing with caps supplied. At the driller's position are the drawworks brakes which can also be removed for highway travelling.

The hydraulic controls for the stabilising jacks and mast lift are mounted on the lower rig frame. These controls are automatically isolated once the rig is set up, eliminating the accidental functioning during the drilling operation.

1.12 CATWORKS:

Precise tong torque for make-up and break-out is effected by the use of the hydraulic catworks with the operating cylinders mounted in the frame below the drawworks. Sheaves and pulleys relay the tong lines to the working platform.

1.13 STANDPIPE:

The 114mm (4 1/2") 210 Kg/cm^2 (3000 PSI) W.P. standpipe is mounted to the front of the lower mast and is complete with fabricated goose neck and 4" N.R.T. hammer unions top and bottom. A 3m (10 ft.) 280 Kg/cm^2 (4000 PSI) W.P. 76mm (3") I.D. jumper hose connects the standpipe to the manifold.

The 114mm (4 1/2") 210 Kg/cm^2 (3000 PSI) W.P. manifold is fitted each end with 4" N.P.T. hammer lock unions, one (1) 76mm (3") Demco main valve, two (2) 50mm (2") Demco auxiliary valves and one (1) Type "D" master mud gauge 420 Kg/cm^2 (6000 PSI). Another 3m (10 ft.) 280 Kg/cm^2 (4000 PSI) W.P. jumper hose connects the manifold to the main mud pump delivery line.

1.14 KELLY:

133.3mm (5 1/4") x 70mm (2 3/4") I.D. x 11.3m (37 ft.) working length A.P.I. hex kelly 4 1/2 API Reg. L.H. box upper connection and 4 1/2" API If pin kelly saver sub and A.P.I. roller type taper drive bushing capable of suiting kellys down to 88.9mm (3 1/2") square.

1.15 SWIVEL:

57mm (2 1/4") I.D. oil bath lubricated swivel working pressure 210 Kg/cm^2 (3000 PSI) API rated capacity, dynamic 92 tons static 184 tons. Lower connection 4 1/2" API Reg. L.H box goose neck 4" N.P.T. pin connection.

The swivel is complete with a 76mm (3") bail and has rubber bumpers fitted to protect the body from the elevator links.

1.16 ROTARY HOSE:

76.2mm (3") I.D. x 16.7m (55 ft.) double wire braid complete with high pressure 4" N.P.T. couplings, API rated working pressure 280 Kg/cm^2 (4000 PSI).

1.17 BLOCK:

A four (4) 762mm (30") diameter sheave travelling block complete with combination elevator and safety hook API rated capacity 100 ton.

1.18 AUXILIARY WINCH:

Auxiliary hydraulic winch for tool handling is mounted on the drawworks frame and has a capacity of 2 tonnes.

1.19 INSTRUMENTS:

Geolograph - Pioneer Type "G" weight indicator system consisting of 3048mm (12") gauge with single dial, and two (2) pointers - one (1) for hook load, the other adjustable use as reference to drill by or to pull to. Graduated in English using 4, 6 and 8 lines having 25,000 to 30,000 lb single line pull.

National type "G" deadline anchor with 16.1 sq. inch load cell, 25 ft. hose and gauge protection box.

1.20 DRILLING LINE:

609mm (2000 ft.) x 25.4mm (1") main line API 1828m (6000 ft.) x 14mm (9/16") sandline API.

APPENDIX 2

APPENDIX 2

SUMMARY OF WELLSITE OPERATION

Summary of Wellsite Operation

The well was spudded in unconsolidated sand on November 19th 1992. At a depth of fifteen metres the hole began to wash out around the conductor and also around the outside of the collar. A twenty sack cement plug was set and drilling continued. Large amounts of sand were displaced by the circulation, filling and overflowing the possum belly. At sixty five metres depth the hole again washed out around the conductor and collar and two further twenty sack cement plugs were set before it was possible to drill ahead. Casing point was reached without further incident.

The first attempt to run casing was unsuccessful, when a bridge was encountered at sixty five metres. After reaming back to bottom the casing was successfully run and cemented with two hundred sacks of cement.

The blowout preventers were then installed and successfully tested. The float collar and casing shoe were drilled out with an 8-1/2" bit. Following a leak off test the hole was deepened to 344 metres and the rig was then shut down for the weekend.

Following the weekend break, drilling resumed. The hole was deepened to a total depth of 1849.46 metres. Four cores were cut and wireline logs, including two guns of sidewall cores, were run. A velocity survey was also carried out. Following wireline logging operations the well was plugged and abandoned.

During the drilling of the 8-1/2" hole section the rig itself performed well, requiring little more than routine maintenance. Significant amounts of drilling time were lost due to regular breakdowns of the mud pumps.

Problems ranged from minor seal washouts to major mechanical failures which more often than not left the operation with only one operating pump, and at times no pump at all. Time lost due to regular drive chain breakage, particularly in the final week of drilling, was the fundamental reason the programmed total depth of 1950 metres was not achieved.

The Halliburton SDL logging unit performed well and also supplied pump stroke and pit level information to the drill floor. The Halliburton Logging Services wireline operation also performed efficiently, although the sidewall core recovery was poorer than expected. The Velocity Data velocity survey was performed very efficiently and without complication.

The drilling fluid programme supplied by Baroid proved relatively reliable, though the mud was a little too heavy due to absorption of clays from the formation. As outlined in Appendix 5, this is difficult to control and probably slowed drilling rates.

The well was then plugged and abandoned, and the rig was released.

APPENDIX 3

APPENDIX
3

DRILLING FLUID RECAP

DISCUSSION BY INTERVAL

12 1/4" Hole (Surface to 216 m) - 6 days
9 5/8" Casing Set at 205 m

The well was spudded with a freshwater bentonite mud and drilled to 15 metres when washing out around the conductor occurred. Large volumes of unconsolidated sand were displaced and quickly filled the possum belly and blocked shaker screens. Wash-out was also occurring around the outside of the collar and drilling mud flowed across the lease.

A twenty sack cement slurry with one sack of calcium chloride was mixed and pumped down the hole. Surface samples of the cement failed to harden within the expected time. It was eventually realised that the cement being used was Adelaide Brighton Class GB, a blended cement with 30% clinker to retard setting.

After a weekend break drilling resumed and at 65 metres the washouts occurred again. A second twenty sack plug of class GB cement was set and failed to harden. The problem with the cement was solved when the well site geologist phoned the Adelaide Brighton cement company for details of cement types. It should be noted that class A cement is the appropriate type for this application.

After further washout at 65 metres a third cement plug, of twenty sacks of class A cement, was set at the bottom of the conductor. Drilling resumed with a high viscosity bentonite mud mix and casing point was reached without further problems.

The first attempt to run casing was hung up by a bridge at 65 metres. The casing was pulled out and the tight section reamed.

The casing was then successfully run and cemented by Halliburton with 204 sacks of class A cement. There were no cement returns to surface.

DISCUSSION BY INTERVAL

8 1/2" Hole (216 m to 1849 m) - 21 days

After drilling out the cement with fresh water a KCL Polymer mud was used. Cement contamination caused high pH and viscosity problems which were successfully controlled by freshwater dilution and dumping the sand trap to allow further dilution with fresh premix.

Fluctuations in yield point and water loss were routinely treated with polymer. Viscosity was treated with bentonite gel.

Hole conditions remained relatively good throughout this section. The first trip back through drilled sections required some reaming, a common occurrence in the Eumeralla and Pretty Hill Formations. Minor over-pull also occurred sporadically when pulling out from a freshly drilled section.

After initial reaming no further problems were encountered.

Throughout most of this section the mud weight remained unfavourably high. The desilter was kept running continuously and was discharging mud up to 11ppb. The desander was not fully operational. The higher than expected mud weight contributed at least partially to the low rate of penetration. The high mud weight was caused by absorption of clays into the mud from the formation. This cannot be efficiently countered by the solids control equipment.

From 750 metres onwards connection gas and trip gas were significantly above average background levels. As mentioned previously the formation in this section are somewhat tight after initially being drilled. Because of the tightness some swabbing will occur resulting in elevated gas levels.

The mud formula used was satisfactory, resulting in good final hole conditions. The high mud weight, however, needs to be considered because of its effect on rate of penetration. A mud formula less likely to absorb clay from the formation would be more preferable.

Following drilling, logging and sidewall coring were successfully carried out before the well was plugged and abandoned.

CMenhennit2/cbb
23 March 1993

PROPERTY RECAP

COMPANY GEOLOGICAL SURVEY OF VICTORIA
WELL BUS SWAMP 1
LOCATION OTWAY BASIN

CONTRACTOR/RIG RWC RIG 4

DATE	DEPTH	HOLE SIZE	F'LN TEMP	MUD WT	VIS	PV	YP	GELS		FILTRATION		pH	Pf	Hf	Cl	Ca	SD	RETORT			MBC	REMARK/TREATMENT
1992	(m)	(in)	F	ppg	sec	op		10 sec	10 min	API ml	CAKE mm				mg/1	mg/1	%	SOL	H20	OIL	ppb	
27/11	271	$8^1/_2$		9.0	32	4	2	1	3	11	1	13			20k	320	0					
30/11	463	$8^1/_2$		9.3	67	7	49	45	-	12	1	11			16k	48	1					Dilute with water and
30/11	535	$8^1/_2$		9.2	45	7	28	30	45	11	1	11	0.84	1.33	15k	48	$^1/_2$					dextrid premix
30/11	555	$8^1/_2$		9.2	45	7	23	30	45	9.5	1	10	0.42	0.75	18k	50	1					
1/12	630	$8^1/_2$		9.6	60	3	57	60	82	14.5	1	11			24k	80	0					Dump sand trap
1/12	656	$8^1/_2$		9.3	36	6	10	10	18	9	1	10			25k	200	$^1/_4$					
1/12	745	$8^1/_2$		9.6	43	8	14	13	20	28	3	10			30k	320	0					
2/12	802	$8^1/_2$		9.5	39	8	7	14	20	20	4	10			30k		0					Gel, 3cmc, 2 Dextrid
2/12	830	$8^1/_2$		9.6	38	14	6	10	22	14	2	9.5	0.025	0.3	27k	488	0					
3/12	895	$8^1/_2$		9.4	37	8	4	3	5	7.5	1	9	0.4	0.6	22k	230	$^1/_4$					
3/12	950	$8^1/_2$		9.5	38	10	4	4	8	7	1	8			22k	320	$^1/_4$					Add caustic and 20 sack
3/12	977	$8^1/_2$		9.8	39	12	7	5	10	7	1	8	0.02	0.5		288	$^1/_4$					gel to active system
3/12	1003	$8^1/_2$		9.9	38	13	10	11	12	9	1	9	0.05	0.45		184	$^1/_2$					
4/12	1041	$8^1/_2$		9.9	38	13	10	11	12	9	1.5	9	0.05	0.45		184	$^1/_2$					Add 10 sacks gel
4/12	1077	$8^1/_2$		10.0	41	11	8	5	10	8	1	9	0.05	0.58	27k	212	$^1/_4$					
5/12	1096	$8^1/_2$		9.8	37	11	5	9	12	8	1	9	0.03	0.45	28k		0					
5/12	1114	$8^1/_2$		9.7	39	12	6	6	8	8	1	8	0.06	0.5		230	$^1/_4$					
5/12	1132	$8^1/_2$		9.7	39	12	6	6	9	8	1	9	0.05	0.65	30k	200	$^1/_2$					
5/12	1149	$8^1/_2$		9.8	38	9	7	12	13	9	1	9	0.025	0.5	28k		$^1/_4$					
6/12	1172	$8^1/_2$		9.8	36	15	8	13	16	9	1	9	0.05	0.5	23k	160	0					
6/12	1188	$8^1/_2$		9.7	43	13	11	9	16	8	1	9	0.05	0.055		180	$^1/_2$					
6/12	1209	$8^1/_2$		10.0	43	12	9	7	16	7	1	9.5	0.07	0.5	27k	208	$^1/_4$					
7/12	1216	$8^1/_2$		9.7	37	13	9	14	16	8	1	9	0.05	0.5	20k	208	0					
7/12	1250	$8^1/_2$		9.9	43	13	8	9	17	8	1	9			28k	200	0					
7/12	1270	$8^1/_2$		9.8	43	13	17	9	13	8	1	9			20k	160	$^1/_4$					
8/12	1292	$8^1/_2$		9.9	39	15	14	8	10	7	1	9			20k	160	0					
8/12	1301	$8^1/_2$		9.0	42	9	14	8	12	8	1	9	0.06	0.7	20k	160	$^1/_4$					

PROPERTY RECAP

COMPANY GEOLOGICAL SURVEY OF VICTORIA
WELL BUS SWAMP 1
LOCATION OTWAY BASIN

CONTRACTOR/RIG RWC RIG 4

DATE 1992	DEPTH (m)	HOLE SIZE (in)	F'LN TEMP F	MUD WT ppg	VIS sec	PV cp	YP	GELS 10 sec	GELS 10 min	FILTRATION API ml	FILTRATION CAKE mm	pH	Pf	Hf	Cl mg/1	Ca mg/1	SD %	RETORT SOL	RETORT H20	RETORT OIL	MBC ppb	REMARK/TREATMENT
8/12	1321	$8^1/_2$		9.5	48	13	19	12	22	6	1	9	0.07	0.5	20k	160	0					
8/12	1337	$8^1/_2$		9.4	39	11	11	8	15	8	1	9	0.05	0.47	18k	140						
9/12	1355	$8^1/_2$		9.4	43	15	18	9	12	9	1	9	0.16	0.55	18k	92						
9/12	1366	$8^1/_2$		9.4	46	13	18	12	25	8	1	9										
9/12	1385	$8^1/_2$		9.5	56	13	20	13	25	10	1	9			17k							Diluting with water
9/12	1408	$8^1/_2$		9.6	47	18	20	17	23	8	1	9	0.025	0.5	15k	92	$^1/_4$					
10/12	1446	$8^1/_2$		9.6	48	16	22	22	27	10	1	9			15k	90	$^1/_4$					
10/12	1507	$8^1/_2$		9.5	45	6	20	12	20	9	1	9	0.06	0.5	17k	108	0					Diluting with water
11/12	1551	$8^1/_2$		9.6	39	10	12	8	16	8	1	9	0.045	0.43	20k		$^1/_2$					
12/12	1587	$8^1/_2$		9.6	38	14	12	17	19	10	1.5	10			22k	80	0					
12/12	1605	$8^1/_2$		9.6	39	11	13	8	17	8	1	10	0.08	0.68	22k		$^1/_4$					
12/12	1633	$8^1/_2$		9.7	42	17	19	16	20	10	1.5	9			28k	96	$^1/_2$					
13/12	1668	$8^1/_2$		9.6	40	11	11	6	14	9	1	9	0.085	0.71	20k		$^1/_4$					
13/12	1690	$8^1/_2$		9.7	41	19	20	15	23	9	1.5	9			30k	116	0					
14/12	1731	$8^1/_2$		9.7	40	14	16	9	13	10	1	9	0.08	0.68	19k		$^1/_4$					
14/12	1752	$8^1/_2$		9.8	41	13	12	10	18	9	1	9			22k		$^1/_4$					
14/12	1766	$8^1/_2$		9.6	36	11	8	5	8	9	1	9			29k	96	0					
15/12	1796	$8^1/_2$		9.7	37	12	7	5	7	8	1	9			26k	112	$^1/_4$					
15/12	1811	$8^1/_2$		9.7	36	10	7	5	7	9	1	9	0.09	0.71	19k		0					
16/12	1834	$8^1/_2$		9.8	36	12	6	5	9	7	1	9			26k	110	0					
17/12	1844	$8^1/_2$		9.8	37	10	6	5	10	8	1	9	0.07	0.75	23k		0					

APPENDIX 4

APPENDIX

4

CUTTINGS DESCRIPTIONS

GEOLOGICAL SURVEY OF VICTORIA - BASIN STUDIES

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney

Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
0	5	100	SANDSTONE: yellowish grey 5Y 7/2, friable with abundant coarse grains, mostly quartz, rounded to subangular, medium grain size, opaque to translucent, moderately to well sorted, occasional muddy clasts, very good visual porosity.			
5	10	100	SANDSTONE: yellowish grey quartz, clear to milky white, friable with abundant coarse grains, medium to coarse grained, subangular to rounded, moderately to well sorted, occasional lithics and carbonaceous fragments, good visual porosity, some calcareous cement, rare garnets/rose colour quartz?			
10	15	100	SANDSTONE: quartz, friable with abundant loose grains, medium grained, opaque to clear, occasionally yellow quartz, very occasional pink tinge in some - probably quartz, well sorted, rounded to subangular, good visual porosity.			
15	20	100	SANDSTONE: yellowish grey quartz, clear to milky white, medium to coarse grained, occasionally subangular to rounded, occasionally very friable, occasional weathered lithic fragments, no apparent matrix, calcareous cement, good visual porosity moderately to well sorted, rare garnets/rose coloured quartz.			
20	25	100	SANDSTONE: quartz, medium to occasional. fine grained, rounded to subangular, occasionally very friable, opaque to clear, occasional very fine grained white clasts, no apparent matrix, non calcareous, occasional yellow and pink quartz, moderately sorted, good visual porosity.			
25	30	100	SANDSTONE: yellowish grey, friable with abundant loose grains, dominantly quartz, clear to translucent, medium to coarse grained, moderately to well sorted, subangular to rounded, rare lithic fragments of vesicular basalt, shell fragments, garnets/rose coloured quartz, carbonaceous material, no apparent matrix, good inferred porosity.			

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney

Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
30	35	90	SANDSTONE: quartz, yellowish grey 5Y 7/2, mostly opaque occasionally translucent, poorly sorted, mostly very friable with abundant loose grains, medium grainsize, shell fragments, rounded to subangular, occasional pink quartz, good inferred porosity,			
		10	CLAYSTONE: calcareous, white - forms subrounded fragments.			
35	40	100	SANDSTONE: olive grey quartz, medium to coarse, occasionally very coarse grained, poorly sorted, angular to sub-rounded, mostly very friable with abundant loose grains, common shell fragments and carbonaceous material, rare calcareous cement, good visual porosity,			
40	45	90	SANDSTONE: light olive grey 5Y 5/2, opaque to clear, mostly quartz, medium to occasional fine grained chunks, very friable with abundant loose grains, moderately sorted, some shell fragments, good inferred porosity.			
		10	COAL?: very small black fragments, and white clay (calcareous).			
45	50	100	SANDSTONE: olive grey quartz, clear, translucent, medium to coarse grained, moderately sorted, subangular to rounded, friable with abundant loose grains, occasional shell fragments, carbonaceous material and garnets, occasional calcareous cement, good visual porosity,			
50	55	90	SANDSTONE: medium quartz, light olive grey, highly porous, mostly opaque, some clear, moderately sorted, rounded to subangular, occasionally friable with abundant loose grains. Occasional lithic fragments (very fine to 3mm). Occasionally calcareous, trace coal, occasional shell fragments, occasional biotite, good inferred porosity.			
		10	CLAYSTONE: very white sugary fragments, non calcareous.			

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney Page: 3 of 94

Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
55	60	100	SANDSTONE: quartz, clear to translucent, medium to coarse grained, occasional coarse grains, poorly sorted, angular to subrounded, very friable with abundant loose grains, rare shell fragments, calcareous nodules, occasional carbonaceous material, calcareous cement growths, good visual porosity,			
60	65	100	SANDSTONE: light olive grey, medium to fine grained quartz, moderately sorted, rounded to subangular, argillaceous matrix, occasional calcareous mud clasts (5%), translucent to milky white, occasional clear quartz, trace dark lithic fragments, very friable with abundant loose grains, occasional fragments of cemented quartz, occasional biotite fragments, occasional medium size dark fragments, occasional clear pink mineral, good visual porosity.			
65	70	30	CLAYSTONE: light olive to grey, calcareous.			
		70	SANDSTONE: quartz, clear to translucent, fine to medium grained, very friable with abundant loose grains, occasionally very fine grained, poor to moderate sorting, subangular to rounded, rare carbonaceous material, calcareous cement and some argillaceous matrix, fair inferred porosity.			
70	75	80	SANDSTONE: quartz, mostly friable with abundant loose grains, light olive grey 5Y 6/1, medium to coarse, poorly sorted, rounded to subrounded quartz, calcareous matrix, occasional large black angular liths, good inferred porosity.			
		10	large shell fragments (including gastropods), very hard chunks, mostly unconsolidated, pink quartz 1-2%, no visual porosity in chunks.			
		10	CLAY: calcareous, (as matrix and dispersed through sample).			

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney

Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
75	80	100	SANDSTONE: light olive grey, quartz, clear to milky white, occasional iron staining, medium to very coarse grained, friable with abundant loose grains, occasional gravel, very poorly to poorly sorted, angular to subrounded, occasional well rounded medium sand sized grains, abundant shell and lithic fragments, fragments of sandstone, weathered basalt and volcanics, siltstones, coal and limestone, fair inferred porosity.			
80	85	100	SANDSTONE: light olive grey, quartz, clear to milky white, medium to coarse rare gravel, poorly to moderately sorted, subangular to rounded, friable with abundant loose grains, occasional shell and lithic fragments, limestone lithics containing pyrite. Pyrite also as a cement, calcareous cement, poor inferred porosity.			
85	90	100	SANDSTONE: light olive grey, quartz, clear to milky white, medium to coarse grained, subangular to rounded, moderately sorted, friable with abundant loose grains, occasional coarse to medium grained lithic fragments of siltstone, sandstones, limestone, occasional shell fragments, trace calcareous cement, fair inferred porosity.			
90	95	100	SANDSTONE: mostly quartz, fine to medium, occasionally coarse quartz, opaque to translucent, overall light olive grey, poorly sorted, shell fragments - occasionally subrounded to subangular, friable with abundant loose grains, iron staining on quartz, occasional biotite, dark carbonaceous fragments, occasional pink and yellow quartz, light, iron stained clay matrix, poor inferred porosity.			
95	100	100	SANDSTONE: olive grey, quartz, very fine to fine grained, occasional very coarse feldspar and quartz grains, poorly sorted, subangular, occasionally subrounded, lithic fragments, silty aggregates, limestone aggregates, carbonaceous material, greenish grey matrix, moderate visual porosity.			

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney Page: 5 of 94

Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
100	105	100	SILTSTONE: dusky yellow green, friable, well sorted, quartz, feldspar, quartz, blocky, occasional medium sand size grains.			
105	110	100	SANDSTONE: dark greenish grey, arkosic (feldspathic), quartzose, fine to medium grained, occasionally coarse grained, moderately sorted, subangular to rounded, rare mica, pyrite, rose coloured quartz? lithic and coally fragments, clay matrix, poor to moderate visual porosity.			
110	115	100	SANDSTONE: dark greenish grey, quartz, very fine to medium grained, occasionally coarse grained, poor to moderate sorting, subangular, occasional feldspars, limestone and clay, lithic fragments, mica, abundant argillaceous matrix, moderate visual porosity.			
115	120	100	SANDSTONE: greenish grey, quartz, fine to medium grained, occasionally coarse grained, moderate sorting, subangular to rounded, feldspars, rare carbonaceous and calcareous material, shell fragments, argillaceous matrix, moderate visual porosity.			
120	125	100	SANDSTONE: dark greenish grey, friable, quartzose, fine to medium grained, occasionally coarse to very coarse grained, poorly sorted, subangular to subrounded, occasionally well rounded, feldspar, clay clasts, lithic grains, pyrite, shell fragments, rare yellow clay/weathered sulphite? carbonaceous material, argillaceous matrix, pyrite cement, moderate visual porosity.			
125	130	100	SANDSTONE: dark greenish grey, very fine to fine grained quartz/feldspar, occasionally medium to coarse grained, angular to subangular, larger grains subrounded to rounded, poorly sorted, mica flakes, pyrite cement in places, clay matrix, slightly friable in parts, moderate visual porosity.			

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney Page: 6 of 94

Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
130	135	100	CLAYSTONE: light olive grey 5Y 5/2, quartz - felspar, micaceous, massive, friable to moderately firm, yellow weathering in parts, some large quartz grains-rounded, slightly silty, occasional large grains, relatively non calcareous, occasional carbonaceous flecks.			
135	140	100	SILTSTONE: dark greenish grey 5GY 4/1, occasional fine grained quartz, micromicaceous, argillaceous, slightly hard, non calcareous.			
140	145	100	SILTSTONE: greenish grey 5GY 6/1, contains quartz grains fine to medium grained, occasionally very coarse, fine to very fine mica flakes, rare yellow clay/weathered sulphide shell fragments, argillaceous, firm, consolidated.			
145	150	100	SILTSTONE: clayey in parts, pale olive 10Y 6/2, well sorted, brown carbonaceous bands, quartz-feldspar, very micaceous, blocky, laminated in parts moderately firm, occasional dark fleck - pyrite? or carbonaceous? Non calcareous.			
150	155	100	SILTSTONE: quartz-feldspar, very argillaceous, light olive grey 5Y 5/2, dark brown clay clasts, micaceous, partly laminated with clay clasts following lamination direction, moderately firm, fine pink grains - garnet?			
155	160	100	CLAYSTONE: greenish clay 5GY 6/1, very fine grained mica, blocky, firm, non calcareous.			
160	165	100	CLAYSTONE: pale olive 10Y 6/2, quartz and feldspar, micaceous (large flakes), occasional clear quartz grain, dark flecks (carbonaceous?), occasional large milky white quartz, blocky, moderately firm, occasional white pellets of clay, non calcareous.			

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney

Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
165	170	100	CLAYSTONE: olive grey, occasional mica and carbonaceous material, block, sticky, non calcareous.			
170	175	100	CLAYSTONE: as above.			
175	180	100	CLAYSTONE: pale olive to dark yellowish orange, (weathered) quartz grains, possibly feldspathic, micaceous, blocky moderately hard, non calcareous.			
180	185	100	CLAYSTONE: greenish grey, occasional mica and carbonaceous material, blocky, friable, non calcareous.			
185	190	70	CLAYSTONE: pale olive to dark yellowish orange, (weathered) quartz grains, possibly feldspathic, micaceous, blocky moderately hard, non calcareous.			
		30	Carbonaceous chunks-black, non calcareous.			
190	195	100	CLAYSTONE: greenish grey, occasional mica and carbonaceous material, blocky, friable, non calcareous.			
195	200	100	CLAYSTONE: pale olive to dark yellowish orange, possibly feldspathic, micaceous, blocky moderately hard, non calcareous.			
200	205	100	CLAYSTONE: greyish olive green, clasts of greenish black carbonaceous clay, rare mica flakes, blocky, slightly calcareous.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
205	210	100	CLAYSTONE: pale olive to dark yellowish orange, possibly feldspathic, micaceous, blocky moderately hard, non calcareous.			
210	215	100	SILTSTONE: greyish olive green, very fine to fine grained quartz and mica, very fine to fine grained carbonaceous material, argillaceous, non calcareous.			
215	220	100	CLAYSTONE: slightly silty, yellowish grey, some weathering (yellow), micaceous, moderately hard, slightly calcareous, quartzose, dark (carbonaceous?) flecks, massive.			
220	225	90	CLAYSTONE: light olive grey, abundant carbonaceous specks, micaceous, firm, calcareous.			
		10	SANDSTONE: clear to translucent, occasionally iron stained, fine to medium grained, well sorted, subrounded to well rounded, occasional coal fragment, fair inferred porosity.			
225	230	90	SILTSTONE: pale olive, medium size rounded quartz grains, angular carbonaceous flakes - weathered (yellowish), light clayey nodules, overall sand size clay pellets, calcareous, moderately hard, blocky.			
		10	SANDSTONE: mostly rounded to subangular quartz grains, translucent to milky white.			
230	235	70	CLAYSTONE: light olive grey, abundant mica and carbonaceous specks, moderately hard, blocky, calcareous.			
		30	SANDSTONE: clear to translucent, occasionally iron stained quartz, fine to medium grained, well sorted, subrounded to well rounded, micaceous, trace coal, slight calcareous cement, moderate visual porosity.			

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Depth (m)		%	Sample Description	Shows		
From	To			Gas (total)	Fluor Nat.	Fluor Cut
235	240	90	CLAYSTONE: light olive grey, overall coarse sand size pellets, moderately hard, blocky but with slight laminations, micaceous.			
		5	SANDSTONE: quartz and feldspar fragments - moderate grainsize, fair inferred porosity.			
		5	COAL: vitreous lustre, flakey, angular, sand size fragments. Some ironstone (heavily rusted), lithics.			
240	245	100	CLAYSTONE: as above, trace coal fragments, trace quartz grains, clear to translucent, iron stained, angular to subrounded, poorly sorted. moderately hard, calcareous, trace coal (sand size fragments), weathered feldspars, dark carbonaceous flecks.			
245	250	100	CLAYSTONE: pale olive, friable to moderately hard, silty, calcareous, dark laminae, trace coal, weathered feldspars, carbonaceous specks, rare medium quartz grains.			
250	255	90	CLAYSTONE: as above, trace coal fragments, trace quartz grains, clear to translucent, iron stained, angular to subrounded, poorly sorted. moderately hard, calcareous, trace coal (sand size fragments), weathered feldspars, dark carbonaceous flecks.),			
		10	SANDSTONE: quartzose, friable with abundant loose grains, clear to translucent, fine to medium grains, well sorted, subangular to rounded, micaceous, trace coal, shelly, fair inferred porosity.			
255	260	100	CLAYSTONE: silty, pale olive, overall medium sand sized pellets, medium sand sized quartz grains - rounded, clear, clay is moderately friable to moderately hard, generally blocky but with some laminations present, dark (carbonaceous?) flecks, rusted iron staining, moderately calcareous.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
260	265	80	CLAYSTONE: as above, trace coal fragments, trace quartz grains, clear to translucent, iron stained, angular to subrounded, poorly sorted. moderately hard, calcareous, trace coal (sand size fragments), weathered feldspars, dark carbonaceous flecks.			
		20	SILTSTONE: light greenish grey, occasional very fine grained quartz, micaceous, argillaceous, calcareous, consolidated.			
265	270		Not Present.			
270	275	80	CLAYSTONE: as above, trace coal fragments, trace quartz grains, clear to translucent, iron stained, angular to subrounded, poorly sorted. moderately hard, calcareous, trace coal (sand size fragments), weathered feldspars, dark carbonaceous flecks.			
		20	SILTSTONE: light greenish grey, occasional very fine grained quartz, micaceous, argillaceous, calcareous, consolidated.			
275	280	80	CLAYSTONE: pale olive, medium sand size pellets, moderately friable to moderately hard, dark flecks, blocky, calcareous cement, slightly micaceous.			
		20	SANDSTONE: fine grained, well sorted, yellowish, quartz and feldspar, fairly angular fragments, calcareous cement, occasional olive green mineral, occasional coally fragments - very small.			
280	285	80	CLAYSTONE: as above, trace coal fragments, trace quartz grains, clear to translucent, iron stained, angular to subrounded, poorly sorted. moderately hard, calcareous, trace coal (sand size fragments), weathered feldspars, dark carbonaceous flecks.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
		20	SANDSTONE: clear to translucent quartz grains, fine to medium grained, subangular to subrounded, moderately sorted, feldspathic, micaceous, pyrite cement.			
285	290		Not Present.			
290	295		Not Present.			
295	300		Not Present.			
300	305	70	CLAYSTONE: light olive grey, abundant mica flakes, carbonaceous specks, hard, blocky, friable, calcareous.			
		30	SILTSTONE: light olive grey, containing fine grained quartz, mica flakes, argillaceous, calcareous, trace fine to medium grained, clear to translucent quartz grains, trace coal fragments.			
305	310	80	CLAYSTONE: very silty, pale olive, medium sand sized pellets, moderately friable to moderately hard, micaceous, blocky, iron stained, slightly laminated, occasional dark (carbonaceous?) fleck, very slightly calcareous, some large quartz crystals.			
		10	SILTSTONE: white, blocky, moderately soft to moderately hard, dark flecks.			
		10	SANDSTONE: fine grained quartz - feldspar, moderately sorted with clay matrix, subangular grains, often weathered, moderately hard, poor visual porosity.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
310	315	70	CLAYSTONE: very silty, pale olive 10Y 6/2, medium sand sized pellets, moderately friable to moderately hard, micaceous, blocky, iron stained, slightly laminated, occasional dark (carbonaceous?) fleck, very slightly calcareous, some large quartz crystals.			
		30	SILTSTONE: white, blocky, moderately soft to moderately hard, dark flecks.			
315	320	80	CLAYSTONE: very silty, pale olive, medium sand sized pellets, moderately friable to moderately hard, micaceous, blocky, iron stained, slightly laminated, occasional dark (carbonaceous?) fleck, very slightly calcareous, some large quartz crystals.			
		20	SANDSTONE: fine grained quartz - feldspar, moderately sorted with clay matrix, subangular grains, trace coal, often weathered, moderately hard, poor visual porosity.			
320	325	70	CLAYSTONE: light olive grey, abundant mica, carbonaceous specks, hard, blocky, calcareous.			
		20	SILTSTONE: light olive grey, very fine grained quartz, micaceous, argillaceous, hard, slightly friable, carbonaceous.			
		10	SANDSTONE: clear to translucent, sometimes ironstained quartz grains, very fine to fine grained, angular to subangular, well sorted, feldspars, mica, rare glauconite, lithic fragments, trace calcite cement, clay matrix, good visual porosity, trace coal.			
325	330	70	CLAYSTONE: as above.			
		30	SILTSTONE: as above, trace sandstone, quartz, feldspar, very fine grained to medium grained, moderately sorted, subangular to subrounded, micaceous, argillaceous matrix, slightly friable, poor visual porosity, trace coal.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
330	335	60	CLAYSTONE: as above.			
		40	SILTSTONE: as above.			
335	340	60	CLAYSTONE: as above.			
		30	SILTSTONE: as above.			
		10	SANDSTONE: light grey, clear to translucent, sometimes iron stained quartz, very fine grained to fine grained occasionally medium grained, subangular to subrounded, poor to moderately sorted feldspars, carbonaceous fragments, mica, calcareous cement, argillaceous matrix, very friable in part, trace coally fragments.			
340	345	50	CLAYSTONE: as above.			
		30	SANDSTONE: as above.			
		20	SILTSTONE: as above.			
345	350	50	CLAYSTONE: as above.			
		40	SILTSTONE: as above.			
		10	SANDSTONE: as above.			
350	355	50	CLAYSTONE: as above.	Tr		
		40	SILTSTONE: as above.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
		10	SANDSTONE: as above.			
355	360	70	CLAYSTONE: as above.	Tr		
		30	SILTSTONE: light olive grey to olive grey, very fine grained quartz/feldspar, mica, calcite, carbonaceous laminae, calcite cement, argillaceous matrix, consolidated, hard to friable to soft in part, poor visual porosity.			
360	365	70	CLAYSTONE: as above.			
		30	SILTSTONE: as above.			
365	370	60	CLAYSTONE: as above.	Tr		
		40	SILTSTONE: as above.			
370	375	60	CLAYSTONE: moderate to pale brownish grey, trace carbonaceous specks, trace silty, sub blocky, soft to firm, trace calcareous.			x
		20	SILTSTONE: moderate, brownish grey occasional dark greyish green, occasional carbonaceous specks and laminae, blocky, trace pyrite, trace calcite, firm to soft, slightly friable.			
		20	SANDSTONE: off white to light brown, fine grained, moderately well sorted, arkosic, sub angular to sub rounded, trace calcite abundant off white to brown argillaceous matrix, common feldspars and lithics, friable, poor visual porosity.			

GEOLOGICAL SURVEY OF VICTORIA - BASIN STUDIES

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney

Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
375	380	70	CLAYSTONE: light olive grey, abundant mica flakes, carbonaceous specks, hard, blocky, friable, calcareous.			x
		20	SILTSTONE: light olive grey to olive grey, very fine grained quartz/feldspar, mica, calcite, carbonaceous laminae, calcite cement, argillaceous matrix, consolidated, hard to friable to soft in part, poor visual porosity.			
		10	SANDSTONE: yellowish grey to light olive grey, clear to translucent quartz, very fine to fine grained, angular to subangular, well sorted, feldspars, mica, lithics and carbonaceous fragments, calcite cement, clay matrix, hard, friable in part, moderate visual porosity.			
380	385	60	CLAYSTONE: as above.		x	x
		30	SILTSTONE: as above.			
		10	SANDSTONE: as above, contains occasional medium grains of quartz (could be contaminants?).			
385	390	60	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			
		20	SANDSTONE: as above.			
390	395	50	CLAYSTONE: as above.			
		30	SILTSTONE: as above.			
		20	SANDSTONE: as above, trace coal fragments.			

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney

Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
395	400	50	CLAYSTONE: as above.			
		30	SILTSTONE: as above.			
		20	SANDSTONE: as above.			
400	405	50	CLAYSTONE: as above.			
		30	SILTSTONE: as above.			
		20	SANDSTONE: as above.			
405	410	60	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			
		20	SANDSTONE: as above.			
410	415	70	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			
		10	SANDSTONE: as above.			
415	420	60	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			

GEOLOGICAL SURVEY OF VICTORIA - BASIN STUDIES

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney

Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
		20	SANDSTONE: as above.			
420	425	60	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			
		20	SANDSTONE: as above.			
425	430	50	CLAYSTONE: as above.			
		30	SANDSTONE: as above.			
		20	SILTSTONE: as above.			
430	435	60	CLAYSTONE: as above, slightly calcareous.			
		20	SANDSTONE: as above, slightly calcareous.			
		20	SILTSTONE: as above.			
435	440	60	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			
		20	SANDSTONE: as above.			
440	445	60	CLAYSTONE: as above.			

GEOLOGICAL SURVEY OF VICTORIA - BASIN STUDIES

Well: Bus Swamp #1			Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney Page: 18 of 94	Shows		
Depth (m)		%	Sample Description	Gas (total)	Fluor	
From	To				Nat.	Cut
		20	SILTSTONE: as above.			
		20	SANDSTONE: as above.			
445	450	60	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			
		20	SANDSTONE: as above, includes occasional medium to coarse grained quartz, clear, F_2O_2 stained.			
450	455	60	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			
		20	SANDSTONE: as above.			
455	460	50	CLAYSTONE: as above.			
		30	SANDSTONE: as above.			
		20	SILTSTONE: as above, trace coal fragments.			
460	465	50	CLAYSTONE: as above.			
		30	SANDSTONE: as above.			
		20	SILTSTONE: as above, trace coal fragments.			

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney

Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
465	470	60	CLAYSTONE: pale olive 10Y 6/2, silty, medium to coarse pellets, friable, massive, micaceous in part, slightly iron stained, non calcareous, consolidated.			
		20	SANDSTONE: subrounded to subangular quartz grains, fine grain size, poor sorting, many dark (carbonaceous) grains, clay cement, feldspar, minor calcite, very friable in part, micaceous in part, non calcareous, argillaceous, massive, some large coal fragments.			
		20	SILTSTONE: pale olive friable, micaceous in part, non calcareous, argillaceous, massive, some large coal fragments, unconsolidated.			
470	475	60	CLAYSTONE: pale olive 10Y 6/2, silty, medium to coarse pellets, friable, massive, micaceous in part, slightly iron stained, non calcareous, consolidated.			
		20	SANDSTONE: subrounded to subangular quartz grains, fine grain size, poor sorting, many dark (carbonaceous) grains, clay cement, feldspar, minor calcite, very friable in part, micaceous in part, non calcareous, argillaceous, massive, some large coal fragments, poor visual porosity			
		20	SILTSTONE: pale olive friable, micaceous in part, non calcareous, argillaceous, massive, some large coal fragments, unconsolidated.			
475	480	70	CLAYSTONE: as above.			
		10	SANDSTONE: as above.			
		20	SILTSTONE: as above, coal fragments.			
480	485	80	CLAYSTONE: as above.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
		20	SILTSTONE: as above.			
485	490	80	CLAYSTONE: as above.			
		20	SILTSTONE: as above, some large calcite crystals.			
490	495	80	CLAYSTONE: as above, slight laminations present.			
		20	SILTSTONE: as above, trace coal.			
495	500	70	CLAYSTONE: as above, slightly calcareous.			
		20	SILTSTONE: as above			
		5	SANDSTONE: rounded, clear to translucent quartz grains.			
		5	COAL: vitreous, laminated.			
500	505	70	CLAYSTONE: as above.			
		25	SILTSTONE: as above.			
		5	SANDSTONE: composed of dark lithic fragments or coal.			
505	510	70	CLAYSTONE: as above, slighter darker.			
		25	SILTSTONE: as above.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
		5	dark (carbonaceous?) fragments.			
510	515	70	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			
		10	SANDSTONE: as above. - more lithics.			
515	520	60	CLAYSTONE: as above. - more calcareous.	Tr		
		30	SILTSTONE: as above.			
		5	COAL: as above.			
		5	fibrous, dark carbonaceous material.			
520	525	60	CLAYSTONE: as above.	Tr		
		35	SILTSTONE: as above.			
		5	COAL: as above.			
525	530	60	CLAYSTONE: as above, only slightly calcareous.	0.70		
		40	SILTSTONE: as above.			
530	535	60	CLAYSTONE: as above.	Tr		

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		40	SILTSTONE: as above.			
535	540	70	CLAYSTONE: as above, non calcareous.	0.10		
		25	SILTSTONE: as above, no red fragments.			
		5	SANDSTONE: rounded sand size quartz grains and angular lithics, calcite fragments.			
540	545	70	CLAYSTONE: as above.			
		25	SILTSTONE: as above.			
		5	Dark, carbonaceous fragments.			
545	550	60	CLAYSTONE: as above.	0.11		
		30	SILTSTONE: as above.			
		10	COAL: as above.			
550	555	60	CLAYSTONE: as above.	0.25		
		30	SILTSTONE: as above.			
		10	COAL: as above.			
555	560	60	CLAYSTONE: as above, calcareous.	0.30		

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney

Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		40	SILTSTONE: as above, trace calcite, occasional large quartz grain.			
560	565	70	CLAYSTONE: as above, calcareous.	0.22		
		30	SILTSTONE: as above, with some cemented (calcareous) grains, moderately hard, trace coal.			
565	570	70	CLAYSTONE: as above, more carbonaceous material, moderately calcareous.	0.08		
		30	SILTSTONE: as above.			
570	575	70	CLAYSTONE: as above.	0.76		
		25	SILTSTONE: as above, occasional quartz aggregates with calcite cement.			
		5	COAL: laminated, silky, very dark.			
575	580	70	CLAYSTONE: as above, very calcareous.	0.16		
		30	SILTSTONE: as above, occasional quartz/ lithic aggregates (very hard), trace coal.			
580	585	70	CLAYSTONE: light olive grey 5Y 5/2, clearly banded, calcareous.	0.15		
		20	SILTSTONE: as above, iron stained fragments.			
		10	Dark carbonaceous fragments.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
585	590	70	CLAYSTONE: as above, non calcareous.	0.18		
		30	SILTSTONE: as above, some cemented aggregrates, occasional calcite fragments.			
590	595	60	CLAYSTONE: as above, moderately calcareous.	0.35		
		40	SILTSTONE: as above, quartz aggregrates with disseminated sulphide (partly weathered to sulphur colour on the outside of grains), carbonaceous fragments (weathered).			
595	600	60	CLAYSTONE: as above. but with dark brown clasts, very slightly calcareous.	0.26		
		40	SILTSTONE: as above. and also as cemented aggregates, some extremely weathered pellets.			
600	605	50	CLAYSTONE: as above, moderately calcareous.	0.11		
		40	SILTSTONE: as above.			
		10	SANDSTONE: some rounded quartz, clear but mostly as cemented aggregates.			
605	610	50	SILTSTONE: pale olive 10Y 6/2, friable aggregates with clay matrix or clasts made up of cemented quartz/ feldspar, very hard, massive, micaceous, consolidated, calcareous, poor visual porosity.			
		30	CLAYSTONE: pale olive 10Y 6/2, friable pellets or as calcareous or non calcareous cement, silty or sandy clasts, micromicaceous, firm to friable, poor visual porosity, occasional white clasts, common dark flecks.			

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney

Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		20	SANDSTONE: quartz/ feldspar and lithics, argillaceous matrix or calcreted, moderately-well sorted, greenish grey, very fine grained, subangular to subrounded very friable with abundant loose grains.			
610	615	60	SILTSTONE: as above, more lithic, slightly calcareous fragments.			
		40	CLAYSTONE; as above, as firm micromicaceous clasts or as soft clasts.			
615	620	50	SILTSTONE: as above.			
		40	CLAYSTONE: as above.			
		10	SANDSTONE: as above. with occasional garnets.			
620	625	70	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			
		10	SANDSTONE: as medium grain sized, angular to subangular lithic fragments.			
625	630	70	CLAYSTONE: as above.	0.2		
		20	SILTSTONE: as above.			
		10	SANDSTONE: as dark, angular to subangular lithic fragments.			
630	635	50	CLAYSTONE: as above.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		40	SILTSTONE: as above.			
		10	SANDSTONE: as above, garnets, some calcareous cemented.			
635	640	50	CLAYSTONE: as above, garnetiferous.			
		45	SILTSTONE: as above, partly calcareous.			
		5	SANDSTONE: as above, rounded garnets, quartz.			
640	645	60	CLAYSTONE: as above, non calcareous.			
		40	SILTSTONE: as above, occasional sand sized, rounded quartz grains.			
645	650	40	SILTSTONE: as above.	0.15		
		50	CLAYSTONE: as above.			
		10	SANDSTONE: rounded garnets, angular lithics, quartz fragments, friable with abundant loose grains, very weathered (ironstained), very hard, cemented clays present.			
650	655	80	SANDSTONE: mostly quartz, poor to moderately well sorted, light olive grey overall milky white to translucent grains, occasionally clear, angular to subrounded, very good visual porosity, some dark carbonaceous grains, some coal, some dark fibrous material with a silky lustre, some creamy fibrous material, occasional ironstaining.	0.06		
		10	SILTSTONE: as above.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		10	CLAYSTONE: as above, calcareous.			
655	660	70	CLAYSTONE: as above, dark in parts.	0.15		
		20	SILTSTONE: as above, slightly calcareous.			
		10	SANDSTONE: as above, with quartz, translucent, subrounded.			
660	665	50	CLAYSTONE: as above.	0.15		
		40	SILTSTONE: as above, some weathering, dark flecks, moderately calcareous.			
		10	SANDSTONE: as above, with quartz, some large grains rounded, unconsolidated, translucent.			
665	670	50	CLAYSTONE: as above, some carbonaceous material, non calcareous.			
		30	SILTSTONE: as above.			
		20	SANDSTONE: quartz/ feldspar, angular grains, cemented (non calcareous), moderately well sorted, lithics present, poor visual porosity.			
670	675	40	CLAYSTONE: light olive grey, micaceous, hard, blocky, non calcareous.			
		30	SILTSTONE: light olive grey, very fine grained to fine grained, quartz/feldspar, mica, hard to friable, argillaceous, slightly calcareous,			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		30	SANDSTONE: light olive grey, sometimes yellow grey quartz, clear to translucent, fine to medium grained, occasionally coarse grained, moderately sorted, angular to subangular, feldspar, lithic fragments, occasional mica, glauconite, rare garnets, argillaceous matrix, trace calcite, pyrite cement, hard to friable, moderate visual porosity, trace coal fragments.			
675	680	40	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering.			
		30	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard.			
		30	SANDSTONE: mostly quartz , some feldspar and lithics, moderately to poorly sorted, quartz, micaceous, grains rounded, translucent, some quite large; lithics angular, black vitreous hard.			
680	685	60	SANDSTONE: light olive grey to yellowish grey quartz, very fine to medium grained, occasionally coarse grained, moderately to well sorted, subangular to subrounded, feldspathic, micaceous, occasional lithic fragments, rare glauconite, calcite cement, trace argillaceous matrix, hard, occasionally soft to friable, poor to moderate visual porosity.			
		30	CLAYSTONE: light olive grey, micaceous, hard, blocky, non calcareous.			
		10	SILTSTONE: light olive grey, very fine grained to fine grained, quartz/feldspar, mica, hard to friable, trace coal, argillaceous, slightly calcareous,			
685	690	50	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, sometimes laminated, non calcareous.	0.79		

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		50	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, some glauconite, occasional large quartz grain.			
690	695	60	CLAYSTONE: light olive grey, micaceous, hard, blocky, slightly calcareous.	0.29		
		30	SILTSTONE: light olive grey, very fine grained to fine grained, quartz/feldspar, mica, hard to friable, argillaceous, slightly calcareous,			
		10	SANDSTONE: as above, with trace coally fragments.			
695	700	60	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard.	0.30		
		40	SILTSTONE: quartz/ feldspar, consolidated, friable, garnetiferous, ironstained weathering, non calcareous.			
700	705	40	CLAYSTONE: light olive grey, micaceous, hard, blocky, slightly calcareous.	0.31		
		30	SILTSTONE: light olive grey, very fine grained to fine grained, quartz/feldspar, mica, hard to friable, argillaceous, slightly calcareous,			
		30	SANDSTONE: light olive grey to yellow grey quartz, clear to translucent, very fine to fine grained, well sorted, subangular to subrounded, feldspar, mica, lithic fragments, argillaceous matrix, calcite cement, hard to friable, poor visual porosity.			
705	710	40	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard.	0.11		

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		30	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, slightly calcareous.			
		30	SANDSTONE: mostly quartz , some feldspar and lithics, moderately to poorly sorted, quartz, micaceous, grains rounded, translucent, some quite large; lithics angular, black vitreous hard.			
710	715	40	CLAYSTONE: light olive grey, micaceous, hard, blocky, slightly calcareous.	0.41		
		40	SILTSTONE: light olive grey, very fine grained to fine grained, quartz/feldspar, mica, hard to friable, argillaceous, slightly calcareous,			
		20	SANDSTONE: light olive grey to yellow grey quartz, clear to translucent, very fine to fine grained, well sorted, subangular to subrounded, feldspar, mica, lithic fragments, argillaceous matrix, calcite cement, hard to friable, poor visual porosity.			
715	720	40	CLAYSTONE: carbonaceous, moderately calcareous, pale olive overall 10Y 6/2, consolidated, friable to moderately hard.	0.20		
		40	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, glauconitic.			
		20	SANDSTONE: quartz/ feldspar, cemented lithics, ironstaining, trace coal, occasional calcite fragment.			
720	725	60	CLAYSTONE: light olive grey, micaceous, hard, blocky, slightly calcareous.	0.25		
		30	SILTSTONE: light olive grey, very fine grained quartz/feldspar, mica, hard, consolidated, occasionally friable, argillaceous, slight calcareous cement.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		10	SANDSTONE: as above, abundant coarse to very coarse grained, angular to subangular quartz grains, trace coally fragments.			
725	730	60	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard.	0.19		
		40	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, garnets, slightly calcareous, glauconitic.			
730	735	50	CLAYSTONE: light olive grey, micaceous, hard, blocky, slightly calcareous.	0.13		
		30	SILTSTONE: light olive grey, very fine grained quartz/feldspar, mica, hard, consolidated, occasionally friable, argillaceous, slight calcareous cement.			
		20	SANDSTONE: light olive grey to yellow grey quartz, clear to transparent, very fine to fine grained, occasional coarse to very coarse grains, moderately sorted, subangular to subrounded, feldspar, mica, occasional glauconite, calcareous cement, argillaceous matrix, hard, friable in part, moderate to poor visual porosity.			
735	740	40	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, garnets, slightly calcareous, glauconitic, partly as calcitic clasts.	0.38		
		30	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.			
		30	SANDSTONE: quartz/feldspar/lithics, subrounded, moderately sorted, friable with clay matrix or very hard with calcite cement, trace coal.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
740	745	40	CLAYSTONE: light olive grey, micaceous, carbonaceous specks, hard, blocky, slightly calcareous.	0.15		
		30	SILTSTONE: light olive grey, very fine grained quartz/feldspar, mica, hard, consolidated, occasionally friable, argillaceous, slight calcareous cement.			
		20	SANDSTONE: light olive grey to yellow grey quartz, clear to transparent, very fine to fine grained, occasional coarse to very coarse grains, moderately sorted, subangular to subrounded, feldspar, mica, occasional glauconite, calcareous cement, argillaceous matrix, hard, very friable in part with loose coarse to very coarse grains, moderate to poor visual porosity.			
		10	COAL: black, sub vitreous, blocky.			
745	750	50	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.	0.89		
		40	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, garnets, slightly calcareous, glauconitic.			
		10	SANDSTONE: quartz/feldspar/lithics, subrounded, moderately sorted, friable with clay matrix or very hard with calcite cement, trace coal.			
750	755	60	CLAYSTONE: light olive grey, micaceous, carbonaceous specks, contains occasional coal laminae, hard, consolidated, non calcareous.	0.68		
		20	SILTSTONE: light olive grey, very fine grained quartz/feldspar, mica, hard, consolidated, occasionally friable, argillaceous, slight calcareous cement.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
		20	SANDSTONE: light olive grey to yellow grey quartz, clear to transparent, very fine to fine grained, occasional coarse to very coarse grains, moderately sorted, subangular to subrounded, feldspar, mica, occasional glauconite, calcareous cement, argillaceous matrix, hard, very friable in part with loose coarse to very coarse grains, moderate to poor visual porosity, trace coal.			
755	760	60	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, garnets, slightly calcareous, glauconitic.	0.45		
		40	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered. occasional sand sized quartz grains.			
760	765	80	CLAYSTONE: light olive grey, micaceous, carbonaceous specks, contains occasional coal laminae, hard, consolidated, non calcareous.	0.38		
		20	SILTSTONE: light olive grey to yellow grey, very fine grained, feldspar, mica, hard, consolidated, calcareous cement, sometimes argillaceous matrix, poor visual porosity.			
765	770	60	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.	0.33		
		30	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, garnets, slightly calcareous, glauconitic.			
		10	SANDSTONE: quartz/feldspar/lithics, subrounded, moderately sorted, friable with clay matrix or very hard with calcite cement, trace coal.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
770	775	50	CLAYSTONE: light olive grey, micaceous, carbonaceous specks, contains occasional coal laminae, hard, consolidated, slightly calcareous.	0.53		
		30	SILTSTONE: light olive grey, very fine grained quartz, feldspar mica, hard, consolidated, slightly soft to friable, argillaceous, weakly calcareous.			
		20	SANDSTONE: light olive grey to yellow grey quartz, clear to transparent, very fine to fine grained, occasional coarse to very coarse grains, moderately sorted, subangular to subrounded, feldspar, mica, occasional glauconite, calcareous cement, argillaceous matrix, hard, very friable in part with loose coarse to very coarse grains, moderate to poor visual porosity.			
775	780	50	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, garnets, slightly calcareous, glauconitic.	0.47		
		40	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.			
		10	SANDSTONE: quartz/feldspar/lithics, subrounded, moderately sorted, friable with clay matrix or very hard with calcite cement, trace coal.			
780	785	40	CLAYSTONE: light olive grey, micaceous, carbonaceous specks, contains occasional coal laminae, hard, consolidated, non calcareous.	0.58		
		40	SILTSTONE: light olive grey, very fine grained quartz, feldspar mica, hard, consolidated, slightly soft to friable, argillaceous, weakly calcareous.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		20	SANDSTONE: light olive grey to yellow grey quartz, clear to transparent, very fine to fine grained, occasional coarse to very coarse grains, moderately sorted, subangular to subrounded, feldspar, mica, occasional glauconite, calcareous cement, argillaceous matrix, hard, very friable in part with loose coarse to very coarse grains, moderate to poor visual porosity.			
785	790	70	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.	0.98		
		20	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, garnets, slightly calcareous, glauconitic.			
		10	SANDSTONE: quartz/feldspar/lithics, subrounded, moderately sorted, friable with clay matrix or very hard with calcite cement, trace coal.			
790	795	40	SILTSTONE: light olive grey, very fine grained quartz, feldspar mica, hard, consolidated, slightly soft to friable, argillaceous, weakly calcareous.	0.55		
		50	CLAYSTONE: light olive grey, micaceous, carbonaceous specks, contains occasional coal laminae, hard, consolidated, non calcareous.			
		10	SANDSTONE: light olive grey to yellow grey quartz, clear to transparent, very fine to fine grained, occasional coarse to very coarse grains, moderately sorted, subangular to subrounded, feldspar, mica, occasional glauconite, calcareous cement, argillaceous matrix, hard, very friable in part with loose coarse to very coarse grains, moderate to poor visual porosity.			
795	800	70	CLAYSTONE: carbonaceous, calcareous in part, olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		25	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, garnets, slightly calcareous, glauconitic.			
		5	SANDSTONE: quartz/feldspar/lithics, subrounded, moderately sorted, friable with clay matrix or very hard with calcite cement, poor visual porosity, trace coal.			
800	805	50	CLAYSTONE: light olive grey, micaceous, carbonaceous specks, contains occasional coal laminae, hard, consolidated, non calcareous.	0.32		
		30	SILTSTONE: light olive grey, very fine grained quartz, feldspar mica, hard, consolidated, slightly soft to friable, argillaceous, weakly calcareous.			
		10	Coal fragment: dark, subvitreous, blocky.			
		10	SANDSTONE: light olive grey to yellow grey quartz, clear to transparent, very fine to fine grained, occasional coarse to very coarse grains, moderately sorted, subangular to subrounded, feldspar, mica, occasional glauconite, calcareous cement, argillaceous matrix, hard, very friable in part with loose coarse to very coarse grains, moderate to poor visual porosity.			
805	810	90	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.	0.33		
		10	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, garnets, slightly calcareous, glauconitic, calcite mud aggregates, weathered material, possibly coal.			
810	815	80	CLAYSTONE: light olive grey, micaceous, carbonaceous specks, contains occasional coal laminae, hard, consolidated, non calcareous.	0.35		

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		20	SILTSTONE: light olive grey, very fine grained quartz, feldspar, mica, hard, blocky, consolidated, slightly soft to friable, argillaceous, weakly calcareous, calcareous specks.			
815	820	90	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.	0.33		
		10	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, garnets, slightly calcareous, glauconitic, partly as calcitic clasts.			
820	825	70	CLAYSTONE: light olive grey to olive grey, micaceous, occasional carbonaceous specks, hard, blocky, calcareous.	0.36		
		20	SILTSTONE: light olive grey, very fine grained quartz, feldspar mica, hard, consolidated, slightly soft to friable, argillaceous, weakly calcareous.			
		10	SANDSTONE: light olive grey to yellow grey quartz, clear to transparent, very fine to fine grained, occasional coarse to very coarse grains, moderately sorted, subangular to subrounded, feldspar, mica, occasional glauconite, calcareous cement, argillaceous matrix, hard, very friable in part with loose coarse to very coarse grains, moderate to trace coal, poor visual porosity.			
825	830	40	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.	0.30		
		30	SILTSTONE: quartz/ feldspar, consolidated, friable, ironstained weathering, garnets, slightly calcareous, glauconitic.			
		30	SANDSTONE: as rounded translucent quartz grains or cemented quartz/feldspar lithic aggregates, trace coal, clay and silt and slightly calcareous, moderate visual porosity.			

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Depth (m)		%	Sample Description	Shows		
From	To			Gas (total)	Fluor Nat.	Fluor Cut
830	835	60	CLAYSTONE: light olive grey to olive grey, micaceous, occasional carbonaceous specks, hard, blocky, weakly calcareous.	0.27		
		20	SILTSTONE: light olive grey, very fine grained quartz, feldspar mica, hard, consolidated, slightly soft to friable, argillaceous, weakly calcareous.			
		20	SANDSTONE: light olive grey to yellow grey quartz, clear to transparent, very fine to fine grained, occasional coarse to very coarse grains, moderately sorted, subangular to subrounded, feldspar, mica, occasional glauconite, calcareous cement, argillaceous matrix, hard, very friable in part with loose coarse to very coarse grains, moderate to poor visual porosity.			
835	840	30	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.	0.20		
		30	SILTSTONE: white, powdery, friable, light olive grey 5Y 5/2, arkosic and quartzose, micaceous, calcareous in part.			
		30	SANDSTONE: quartz/feldspar, moderately to poorly sorted, friable, calcareous cement, garnets, glauconite, poor visual porosity.			
		10	COAL: laminated, silky, angular shards.			
840	845	50	CLAYSTONE: light olive grey to olive grey, micaceous, occasional carbonaceous specks, hard, blocky, calcareous.	0.43		
		35	SILTSTONE: light olive grey, very fine grained quartz, feldspar mica, hard, consolidated, slightly soft to friable, argillaceous, weakly calcareous.			
		10	SANDSTONE: quartz/feldspar/lithics, subrounded, moderately sorted, friable with clay matrix or very hard with calcite cement, trace coal.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		5	Coally fragments			
845	850	60	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.	1.30		
		20	SILTSTONE: white, powdery, friable, light olive grey 5Y 5/2, arkosic and quartzose, micaceous, calcareous in part.			
		20	SANDSTONE: quartz/feldspar, moderately to poorly sorted, friable, calcareous cement, garnets, glauconite, poor visual porosity ,more lithics, some calcite aggregates, some very large quartz crystals - rounded, translucent, moderate visual porosity.			
850	855	50	CLAYSTONE: light olive grey to olive grey, micaceous, occasional carbonaceous specks, hard, blocky, very weakly calcareous.	1.10		
		30	SILTSTONE: light olive grey, very fine grained quartz, feldspar mica, hard, consolidated, slightly soft to friable, argillaceous, very weakly calcareous.			
		20	SANDSTONE: quartz/feldspar/lithics, subrounded, moderately sorted, friable with clay matrix or very hard with calcite cement, trace coal.			
855	860	80	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.	0.79		
		20	SILTSTONE: white, powdery, friable, light olive grey 5Y 5/2, arkosic and quartzose, micaceous, calcareous in part, trace coal, occasional pellets of calcitic clay.			
860	865	50	CLAYSTONE: light olive grey to olive grey, micaceous, occasional carbonaceous specks, hard, blocky, calcareous.	0.83		

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		40	SILTSTONE: light olive grey, very fine grained quartz, feldspar mica, hard, consolidated, slightly soft to friable, argillaceous, calcareous.			
		10	SANDSTONE: quartz/feldspar/lithics, subrounded to angular, abundant coarse to very coarse, moderately sorted, friable with clay s matrix or very hard with calcite cement, trace coal.			
865	870	70	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.	0.80		
		20	SILTSTONE: white, powdery, friable, light olive grey 5Y 5/2, arkosic and quartzose, micaceous, calcareous in part.			
		10	SANDSTONE: as large, clear to translucent quartz crystals, trace coal, calcite aggregates, fair visual porosity.			
870	875	50	SILTSTONE: light olive grey, very fine grained quartz, feldspar mica, hard, consolidated, slightly soft to friable, argillaceous, very weakly calcareous.	0.30		
		40	CLAYSTONE: light olive grey to olive grey, micaceous, occasional carbonaceous specks, hard, blocky, calcareous.			
		10	SANDSTONE: quartz/feldspar/lithics, subrounded to angular, abundant coarse to very coarse, moderately sorted, friable with clay s matrix or very hard with calcite cement, trace coal.			
875	880	50	SANDSTONE: as large, clear to translucent quartz crystals, subangular to subrounded, trace coal, calcite aggregates, fair visual porosity.	0.50		

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		30	SILTSTONE: white, powdery, friable, light olive grey 5Y 5/2, arkosic and quartzose, micaceous, calcareous in part.			
		20	CLAYSTONE: carbonaceous, calcareous in part, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, also occurs as milky white calcitic clasts, often weathered.			
880	885	50	SANDSTONE: light grey to light olive grey quartz, clear to translucent, very fine grained, medium to coarse loose grains, moderately well sorted, feldspar, mica, lithic fragments, occasional glauconite, argillaceous matrix, calcite cement, hard, consolidated, poor to moderate porosity.	0.48		
		30	SILTSTONE: light olive grey, very fine grained quartz, feldspar mica, hard, consolidated, slightly soft to friable, argillaceous, very weakly calcareous.			
		20	CLAYSTONE: light olive grey to olive grey, micaceous, occasional carbonaceous specks, hard, blocky, non calcareous.			
885	890	60	SANDSTONE: light grey to light olive grey, extremely friable with abundant large loose quartz grains, moderately well sorted.	0.57		
		30	SILTSTONE: white, powdery, friable, light olive grey 5Y 5/2, arkosic and quartzose, micaceous, calcareous in part.			
		10	CLAYSTONE: carbonaceous, mildly calcareous, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, large lithic fragments, also occurs as milky white calcitic clasts, often weathered.			
890	895	60	SILTSTONE: olive grey to light olive grey, very fine quartz, feldspar, mica, argillaceous, occasionally calcareous, hard to friable, poor porosity.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		20	CLAYSTONE: light olive grey to olive grey, micaceous, occasional carbonaceous specks, hard, blocky, calcareous.			
		20	SANDSTONE: light grey to light olive grey quartz, clear to translucent, very fine grained, medium to coarse loose grains, moderately well sorted, feldspar, mica, lithic fragments, occasional glauconite, argillaceous matrix, calcite cement, hard, consolidated, poor to moderate porosity.			
895	900	50	CLAYSTONE: carbonaceous, mildly calcareous, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, large lithic fragments, also occurs as milky white calcitic clasts, often weathered.	0.50		
		50	SILTSTONE: white, powdery, friable, light olive grey 5Y 5/2, arkosic and quartzose, micaceous, calcareous in part.			
900	905	60	SILTSTONE: olive grey to light olive grey, very fine quartz, feldspar, mica, argillaceous, mildly calcareous, hard to friable, poor porosity.			
		30	CLAYSTONE: light olive grey to olive grey, micaceous, occasional carbonaceous specks, hard, blocky, calcareous.			
		10	SANDSTONE: light grey to light olive grey quartz, clear to translucent, very fine grained, medium to coarse loose grains, moderately well sorted, feldspar, mica, lithic fragments, occasional glauconite, argillaceous matrix, calcite cement, hard, consolidated, poor to moderate porosity.			
905	910	60	SILTSTONE: white, powdery, friable, light olive grey 5Y 5/2, arkosic and quartzose, micaceous, calcareous in part.	0.40		

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		30	CLAYSTONE: carbonaceous, mildly calcareous, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, large lithic fragments, also occurs as milky white calcitic clasts, often weathered.			
		10	SANDSTONE: large, rounded, translucent quartz clasts or quartz aggregates with calcareous cement, fair to moderate visual porosity.			
910	915	40	CLAYSTONE: light olive grey, micaceous, occasional carbonaceous specks, occasionally laminated, blocky, hard, occasionally soft.			
		30	SILTSTONE: light olive grey, occasionally yellowish grey ,very fine grained quartz, micaceous, argillaceous, occasionally calcareous, consolidated, hard, occasionally soft.			
		30	SANDSTONE: light olive grey to yellowish grey quartz grains, clear to milky white, very fine grained, occasional loose grains, medium to very coarse grains, moderately well sorted, angular to subangular, feldspathic, micaceous, occasional glauconite, calcareous cement, occasional pyrite, occasional argillaceous matrix, hard, friable, fair to moderate visual porosity.			
915	920	40	SANDSTONE: large, rounded, translucent quartz clasts or quartz aggregates with calcareous cement, sand size quartz crystals, rounded to subrounded, translucent grains with soft silt/clay matrix, very friable, dark subangular lithics, moderate visual porosity.	0.44		
		30	SILTSTONE: white, powdery, friable, light olive grey 5Y 5/2, arkosic and quartzose, micaceous, calcareous in part.			
		30	CLAYSTONE: carbonaceous, mildly calcareous, pale olive overall 10Y 6/2, consolidated, friable to moderately hard, large lithic fragments, also occurs as milky white calcitic clasts, often weathered.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
920	925	50	SILTSTONE: light olive grey, occasionally yellowish grey ,very fine grained quartz, micaceous, argillaceous, occasionally calcareous, consolidated, hard, occasionally soft.	0.60		
		30	SANDSTONE: yellowish grey to light olive grey quartz, clear to milky white, fine to coarse grained, moderately sorted, angular to subrounded, micaceous, calcareous cement, argillaceous matrix, hard, friable, poor visual porosity.			
		20	CLAYSTONE: light olive grey, micaceous, occasional carbonaceous specks, occasionally laminated, blocky, hard, occasionally soft, trace coally fragments.			
925	930	60	SILTSTONE: as above.	0.38		
		20	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
930	935	50	SILTSTONE: as above.	0.45		
		40	CLAYSTONE: as above.			
		10	SANDSTONE: as above, trace coal.			
935	940	60	SILTSTONE: as above.	0.40		
		30	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		10	SANDSTONE: light olive grey to yellowish grey quartz grains, clear to milky white, very fine grained, occasional loose grains, medium to very coarse grains, moderately well sorted, angular to subangular, feldspathic, micaceous, occasional glauconite, calcareous cement, occasional pyrite, occasional argillaceous matrix, hard, friable, fair to moderate visual porosity.			
940	945	60	SILTSTONE: as above.	0.40		
		40	CLAYSTONE: light olive grey, micaceous, occasional carbonaceous specks, occasionally laminated, blocky, hard, occasionally soft, trace coally fragments.			
945	950	50	SILTSTONE: as above, non calcareous.	0.30		
		30	CLAYSTONE: as above.			
		20	SANDSTONE: light olive grey quartz, clear to milky white, fine to coarse grained, poor to moderate sorting, angular to subrounded, mica, siliceous cement, occasional argillaceous matrix, friable, moderate visual porosity.			
950	955	30	SANDSTONE: quartz, rounded, extremely friable with abundant loose grains, mostly clayey matrix, possible garnets, fair to good visual porosity.	0.46		
		40	SILTSTONE: overall pale olive 10Y 6/2, friable, quartz, possibly feldspar, lithics, micaceous.			
		30	CLAYSTONE: soft to hard, micromicaceous, occasional orange quartz grains, occasional large subangular lithic.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
955	960	60	SANDSTONE: light olive grey quartz, clear to milky white, very fine to coarse grained, occasionally very coarse grained, poorly sorted, angular to subrounded, siliceous cement, occasional argillaceous matrix, good visual porosity.	0.38		
		30	SILTSTONE: light olive grey, occasionally yellowish grey ,very fine grained quartz, micaceous, argillaceous, occasionally calcareous, consolidated, hard, occasionally soft.			
		10	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			
960	965	50	SANDSTONE: quartz, some feldspar, rounded, extremely friable with abundant loose grains, mostly clayey matrix, possible garnets, fair to good visual porosity.	0.77		
		30	CLAYSTONE: soft to hard, micromicaceous, occasional orange quartz grains, occasional large subangular lithic.			
		20	SILTSTONE: overall pale olive 10Y 6/2, friable, quartz, possibly feldspar, occasional sand sized lithic fragments, slightly calcareous, micaceous.			
965	970	40	SILTSTONE: light olive grey, very fine grained quartz, micaceous, occasional carbonaceous specks, hard, blocky, occasionally calcareous.	0.46		
		30	SANDSTONE: clear to milky white quartz, fine to medium grained, occasionally coarse to very coarse grained, poorly sorted, angular to subangular, calcareous and siliceous cement, hard, friable, good visual porosity			
		30	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
970	975	50	CLAYSTONE: soft to hard, micromicaceous, occasional orange quartz grains, occasional large subangular lithic.	0.43		
		40	SILTSTONE: overall pale olive 10Y 6/2, friable, quartz, possibly feldspar, lithics, micaceous.			
		10	SANDSTONE: occasional quartz grains, non calcareous, occasional lithic, moderate visual porosity..			
975	980	50	SILTSTONE: olive grey to light olive grey, very fine grained quartz, mica, carbonaceous specks, hard, blocky, friable, occasionally slightly calcareous.	0.65	x	
		30	SANDSTONE: clear to milky white quartz, fine to medium grained, occasionally coarse to very coarse grained, poorly sorted, angular to subangular, calcareous and siliceous cement, hard, friable, good visual porosity			
		20	CLAYSTONE: light olive grey to medium grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			
980	985	50	SILTSTONE: as above, medium grey.	0.53		
		30	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
985	990	50	SILTSTONE: as above.	0.48		
		30	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
990	995	60	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.	0.90		
		20	SANDSTONE: very light yellowish grey, quartz, clear to milky white, fine to medium grained, coarse to very coarse grained, moderately to poorly sorted, angular to subrounded, occasional glauconite, feldspar, mica, calcareous, siliceous cement, hard, good visual porosity.			
		20	CLAYSTONE: as above.			
995	1000	60	CLAYSTONE: as above, with some lineations present, overall darker - light olive grey 5Y 6/1, soft, non calcareous, some darker carbonaceous fragments.	0.73		
		30	SILTSTONE: overall 5Y 6/1, light olive grey, soft, non calcareous, some pellets are highly siliceous, micaceous, hard white and non calcareously cemented, argillaceous overall, glauconitic.			
		10	SANDSTONE: angular to subangular quartz grains, extremely friable with abundant loose grains, some cemented aggregates, poorly sorted, translucent, good visual porosity.			
1000	1005	60	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.	0.91		
		30	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		10	SANDSTONE: very light yellowish grey, quartz, clear to milky white, fine to medium grained, coarse to very coarse grained, moderately to poorly sorted, angular to subrounded, occasional glauconite, feldspar, mica, calcareous, siliceous cement, hard, good visual porosity.			
1005	1010	50	SILTSTONE: overall 5Y 6/1, light olive grey, soft, non calcareous, some pellets are highly siliceous, micaceous, hard white and non calcareously cemented, argillaceous overall, glauconitic.	0.63		
		30	CLAYSTONE: as above, with some lineations present, overall darker - light olive grey 5Y 6/1, soft, non calcareous, some darker carbonaceous fragments.			
		15	SANDSTONE: angular to subangular quartz grains, extremely friable with abundant loose grains, some cemented aggregates, poorly sorted, translucent, good visual porosity.			
		5	COAL: laminated, silky, angular shards.			
1010	1015	60	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.	1.62		
		30	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			
		10	SANDSTONE: very light yellowish grey, quartz, clear to milky white, fine to medium grained, coarse to very coarse grained, moderately to poorly sorted, angular to subrounded, occasional glauconite, feldspar, mica, calcareous, siliceous cement, hard, good visual porosity.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1015	1020	40	SILTSTONE: overall 5Y 6/1, light olive grey, soft, non calcareous, some pellets are highly siliceous, micaceous, hard white and non calcareously cemented, argillaceous overall, glauconitic.	0.93		
		40	CLAYSTONE: as above, with some lineations present, overall darker - light olive grey 5Y 6/1, soft, non calcareous, some darker carbonaceous fragments.			
		20	SANDSTONE: angular to subangular quartz grains, extremely friable with abundant loose grains, some cemented aggregates, poorly sorted, translucent, good visual porosity.			
1020	1025	60	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.	1.20		
		30	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			
		10	SANDSTONE: very light yellowish grey, quartz, clear to milky white, fine to medium grained, coarse to very coarse grained, moderately to poorly sorted, angular to subrounded, occasional glauconite, feldspar, mica, calcareous, siliceous cement, hard, good visual porosity.			
1025	1030	60	CLAYSTONE: as above, with some lineations present, overall darker - light olive grey 5Y 6/1, soft, non calcareous, some darker carbonaceous fragments, very micromicaceous.	1.06		
		30	SILTSTONE: overall 5Y 6/1, light olive grey, soft, non calcareous, some pellets are highly siliceous, micaceous, hard white and non calcareously cemented, argillaceous overall, glauconitic.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		10	SANDSTONE: angular to subangular quartz grains, some yellow stained, occasional dark, very laminated, micaceous, metamorphic? grains, extremely friable with abundant loose grains, some cemented aggregates, poorly sorted, translucent, good visual porosity.			
1030	1035	70	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.	0.72		
		20	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			
		10	SANDSTONE: very light yellowish grey, quartz, clear to milky white, fine to medium grained, coarse to very coarse grained, moderately to poorly sorted, angular to subrounded, occasional glauconite, feldspar, mica, calcareous, siliceous cement, hard, good visual porosity.			
1035	1040	60	SILTSTONE: overall 5Y 6/1, light olive grey, soft, non calcareous, dark carbonaceous material, siliceous grains, argillaceous matrix, some evident weathering, some pellets are highly siliceous, micaceous, hard white and non calcareously cemented, argillaceous overall, glauconitic.	0.65		
		20	CLAYSTONE: as above, with some lineations present, overall darker - light olive grey 5Y 6/1, soft, non calcareous, some darker carbonaceous fragments, some calcitic chunks.			
		20	SANDSTONE: angular to subangular quartz grains, some yellow stained, occasional dark, very laminated, micaceous, metamorphic? grains, extremely friable with abundant loose grains, some cemented aggregates, poorly sorted, translucent, good visual porosity.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1040	1045	60	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.	0.48		
		30	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			
		10	SANDSTONE: very light yellowish grey, quartz, clear to milky white, fine to medium grained, coarse to very coarse grained, moderately to poorly sorted, angular to subrounded, occasional glauconite, feldspar, mica, calcareous, siliceous cement, hard, good visual porosity.			
1045	1050	60	SILTSTONE: light olive grey 5Y 6/1, soft to friable, quartz - feldspar, blocky, micaceous, argillaceous.	0.58		
		20	CLAYSTONE: light olive grey 5Y 6/1 moderately hard to friable, quartz - feldspar, blocky, micromicaceous, some calcite.			
		20	SANDSTONE: angular to subangular quartz grains, some yellow stained, occasional dark, very laminated, micaceous, metamorphic? grains, extremely friable with abundant loose grains, some cemented aggregates, poorly sorted, translucent, good visual porosity.			
1050	1055	50	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.	0.67		
		40	SANDSTONE: light grey to light olive grey quartz, clear to translucent, very fine to medium grained, occasionally coarse to very coarse grained, moderately well sorted, angular to subangular, mica, rare garnets, occasional glauconite, feldspar, siliceous and calcareous cement, occasional argillaceous matrix, good visual porosity, hard, friable.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		10	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			
1055	1060	50	CLAYSTONE: light olive grey 5Y 6/1 moderately hard to friable, quartz - feldspar, blocky, micromicaceous, some calcite.	1.30		
		35	SILTSTONE: light olive grey 5Y 6/1, soft to friable, quartz - feldspar, blocky, micaceous, argillaceous.			
		15	SANDSTONE: angular to subangular quartz grains, some yellow stained, occasional dark, very laminated, micaceous, metamorphic? grains, extremely friable with abundant loose grains, some cemented aggregates, poorly sorted, translucent, some coarse, blocky white quartz grains good visual porosity.			
1060	1065	60	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.	0.55		
		30	SANDSTONE: light grey to light olive grey quartz, clear to translucent, very fine to medium grained, occasionally coarse to very coarse grained, moderately well sorted, angular to subangular, mica, rare garnets, occasional glauconite, feldspar, siliceous and calcareous cement, occasional argillaceous matrix, good visual porosity, hard, friable.			
		10	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			
1065	1070	40	SILTSTONE: light olive grey 5Y 6/1, soft to friable, quartz - feldspar, blocky, micaceous, argillaceous.	0.51		

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
		40	CLAYSTONE: light olive grey 5Y 6/1 moderately hard to friable, quartz - feldspar, blocky, micromicaceous, some calcite.			
		20	SANDSTONE: angular to subangular quartz grains, some yellow stained, occasional dark, very laminated, micaceous, metamorphic? grains, extremely friable with abundant loose grains, some cemented aggregates, poorly sorted, translucent, good visual porosity.			
1070	1075	40	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.	0.32		
		40	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			
		20	SANDSTONE: light grey to light olive grey quartz, clear to translucent, very fine to medium grained, occasionally coarse to very coarse grained, moderately well sorted, angular to subangular, mica, rare garnets, occasional glauconite, feldspar, siliceous and calcareous cement, occasional argillaceous matrix, good visual porosity, hard, friable.			
1075	1080	40	SILTSTONE: light olive grey 5Y 6/1, soft to friable, quartz - feldspar, blocky, micaceous, argillaceous.	0.97		
		40	CLAYSTONE: light olive grey 5Y 6/1 moderately hard to friable, quartz - feldspar, blocky, micromicaceous, some calcite.			
		20	SANDSTONE: angular to subangular quartz grains, some yellow stained, occasional dark, very laminated, micaceous, metamorphic? grains, extremely friable with abundant loose grains, some cemented aggregates, poorly sorted, translucent, some coal, some sandstone aggregates with calcite cement, good visual porosity.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1080	1085	50	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.	0.41		
		40	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.			
		10	SANDSTONE: light grey to light olive grey quartz, clear to translucent, very fine to medium grained, occasionally coarse to very coarse grained, moderately well sorted, angular to subangular, mica, rare garnets, occasional glauconite, feldspar, siliceous and calcareous cement, occasional argillaceous matrix, good visual porosity, hard, friable.			
1085	1090	50	CLAYSTONE: light olive grey 5Y 6/1 moderately hard to friable, quartz - feldspar, blocky, micromicaceous, some calcite.	0.49		
		40	SILTSTONE: light olive grey 5Y 6/1, soft to friable, quartz - feldspar, blocky, micaceous, argillaceous.			
		10	SANDSTONE: angular to subangular quartz grains, some yellow stained, occasional dark, very laminated, micaceous, metamorphic? grains, extremely friable with abundant loose grains, some cemented aggregates, poorly sorted, translucent, good visual porosity.			
1090	1095	50	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.	0.85		

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		30	SANDSTONE: light grey to light olive grey quartz, clear to translucent, very fine to medium grained, occasionally coarse to very coarse grained, moderately well sorted, angular to subangular, mica, rare garnets, occasional glauconite, feldspar, siliceous and calcareous cement, occasional argillaceous matrix, good visual porosity, hard, friable.			
		20	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			
1095	1100	40	SILTSTONE: light olive grey 5Y 6/1, soft to friable, quartz - feldspar, blocky, micaceous, argillaceous.	0.36		
		50	CLAYSTONE: light olive grey 5Y 6/1 moderately hard to friable, quartz - feldspar, blocky, micromicaceous, some calcite.			
		10	SANDSTONE: angular to subangular quartz grains, some yellow stained, occasional dark, very laminated, micaceous, metamorphic? grains, extremely friable with abundant loose grains, some cemented aggregates, poorly sorted, translucent, good visual porosity.			
1100	1105	50	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.	0.48		
		30	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.			
		20	SANDSTONE: light grey to light olive grey quartz, clear to translucent, very fine to medium grained, occasionally coarse to very coarse grained, moderately well sorted, angular to subangular, mica, rare garnets, occasional glauconite, feldspar, siliceous and calcareous cement, occasional argillaceous matrix, good visual porosity, hard, friable.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1105	1110	60	CLAYSTONE: overall medium grey N5, soft to friable, quartz - feldspar, occasionally carbonaceous, blocky, can be calcareous.	0.60		
		20	SILTSTONE: medium grey N5, soft to friable, quartz feldspar, occasionally carbonaceous, blocky, calcareous.			
		20	SANDSTONE: fine quartz - feldspar, rounded to subrounded, well sorted, calcareous milky white clay matrix, some large rounded translucent quartz grains, occasionally dark, angular, carbonaceous - possibly coal, moderate to poor visual porosity.			
1110	1115	50	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.	0.37		
		40	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.			
		10	SANDSTONE: light grey to light olive grey quartz, clear to translucent, very fine to medium grained, occasionally coarse to very coarse quartz grains, some sandstone aggregates with calcareous cement, moderately well sorted, angular to subangular, mica, rare garnets, occasional glauconite, feldspar, siliceous and calcareous cement, occasional argillaceous matrix, good visual porosity, hard, friable.			
1115	1120	40	CLAYSTONE: overall medium grey N5, soft to friable, quartz - feldspar, occasionally carbonaceous, blocky, can be calcareous.	0.37		
		50	SILTSTONE: medium grey N5, soft to friable, quartz feldspar, occasionally carbonaceous, blocky, calcareous.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		10	SANDSTONE: fine quartz - feldspar, rounded to subrounded, well sorted, calcareous milky white clay matrix, some large rounded translucent quartz grains, occasionally dark, angular, carbonaceous - possibly coal, moderate to poor visual porosity.			
1120	1125	40	SILTSTONE: light olive grey to medium grey, very fine grained quartz, abundant mica, carbonaceous specks, argillaceous to arenaceous, occasionally laminated, slightly siliceous, hard, occasionally friable.	1.20		
		30	SANDSTONE: light grey to light olive grey quartz, clear to translucent, very fine to medium grained, occasionally coarse to very coarse grained, moderately well sorted, angular to subangular, mica, rare garnets, occasional glauconite, feldspar, siliceous and calcareous cement, occasional argillaceous matrix, good visual porosity, hard, friable.			
		30	CLAYSTONE: light olive grey, occasionally olive grey, micaceous, occasionally laminated, hard, blocky, non calcareous, sandstone.			
1125	1130	40	SILTSTONE: medium grey N5, soft to friable, quartz feldspar, occasionally carbonaceous, blocky, calcareous.	1.90		
		40	CLAYSTONE: overall medium grey N5, soft to friable, quartz - feldspar, occasionally carbonaceous, blocky, calcareous in part.			
		20	SANDSTONE: as above, includes siliciclastic grains as in interval 1115 - 1120m, trace coal, slightly calcareous.			
1130	1135	60	SILTSTONE: shaley, light olive grey to medium grey to light grey, very fine grained, quartz, mica, carbonaceous specks, argillaceous, hard to soft, blocky, occasionally calcareous.	0.40		

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
		20	SANDSTONE: light grey quartz, clear to milky white, very fine to fine grained, occasionally medium to coarse grained, moderately sorted, subangular to subrounded, occasionally well rounded, micaceous, occasional garnets, glauconite, calcareous, occasional siliceous cement, occasional argillaceous matrix, hard, occasionally soft, friable, moderate visual porosity.			
		20	CLAYSTONE: light olive grey to medium light grey, micaceous, occasionally siliceous, blocky, occasionally laminated, hard.			
1135	1140	50	SILTSTONE: as above.	0.35		
		30	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1140	1145	50	SILTSTONE: as above.	0.51		
		40	CLAYSTONE: as above.			
		10	SANDSTONE: as above, trace coal fragments.			
1145	1150	40	SILTSTONE: as above.	0.32		
		40	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
1150	1155	40	SILTSTONE: as above.	0.41		
		40	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1155	1160	60	SILTSTONE: as above.	2.83		
		30	CLAYSTONE: as above.			
		10	SANDSTONE: as above.			
1160	1165	50	SILTSTONE: as above.			
		30	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1165	1170	40	SILTSTONE: as above.			
		40	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1170	1175	50	CLAYSTONE: as above.	0.26		
		30	SILTSTONE: as above.			
		20	SANDSTONE: as above.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
1175	1180	40	SILTSTONE: as above.	0.31		
		30	CLAYSTONE: as above.			
		30	SANDSTONE: as above, medium coarse quartz grains, subrounded to well rounded, trace coally fragments.			
1180	1185	50	CLAYSTONE: medium light grey to medium grey, micaceous, occasionally laminated, blocky, firm to hard.	0.30		
		30	SILTSTONE: as above.			
		20	SANDSTONE: as above.			
1185	1190	50	SILTSTONE: as above.	0.35		
		30	SANDSTONE: as above.			
		20	CLAYSTONE: as above.			
1190	1195	40	SILTSTONE: light olive to medium grey, very fine grained quartz, mica, carbonaceous material, occasionally laminated, argillaceous, calcareous, hard to firm, blocky.	0.28		
		40	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
1195	1200	40	SILTSTONE: as above.			
		40	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1200	1205	40	SILTSTONE: as above.	0.25	x	
		40	SANDSTONE: light grey to medium light grey, clear to milky white quartz, very fine to fine grained, occasionally medium to coarse grained, moderate to poor sorting, angular to subrounded, occasionally well rounded, mica, occasional garnets, glauconite, calcareous, occasional siliceous cement, occasional argillaceous matrix, hard to friable, poor to moderate visual porosity.			
		20	CLAYSTONE: as above, light grey.			
1205	1210	50	SILTSTONE: as above.	0.33	x	
		30	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1210	1215	50	SILTSTONE: as above.	0.44	x	
		40	CLAYSTONE: as above.			
		10	SANDSTONE: as above.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1215	1220	50	SILTSTONE: as above.	0.16	x	
		40	CLAYSTONE: as above.			
		10	SANDSTONE: as above, trace coal fragments.			
1220	1225	50	SANDSTONE: light grey, clear to milky white quartz, very fine to fine grained, well sorted, subangular to subrounded, occasional mica, garnets, rare glauconite, calcareous cement, occasionally siliceous, hard, friable, poor visual porosity.	0.25	x	
		30	SILTSTONE: as above.			
		20	CLAYSTONE: as above.			
1225	1230	40	SANDSTONE: as above.	0.27		
		30	SILTSTONE: light olive grey to medium grey, very fine grained quartz, micaceous, argillaceous, arenaceous, carbonaceous specks, very hard to firm, blocky.			
		30	CLAYSTONE: light grey to medium grey, occasional mica flakes, carbonaceous specks, hard, blocky.			
1230	1235	40	SILTSTONE: as above.	0.25		
		40	CLAYSTONE: as above.			
		20	SANDSTONE: as above, quartz, occasionally coarse, subrounded.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
1235	1240	50	SILTSTONE: as above.	0.56		
		30	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1240	1245	50	SILTSTONE: as above.	0.10		
		30	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1245	1250	50	SILTSTONE: as above.	0.18		
		30	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1250	1255	40	SILTSTONE: as above.	0.18		
		40	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1255	1260	50	SANDSTONE: as above, no coarse quartz grains.	0.33		
		30	SILTSTONE: as above.			
		20	CLAYSTONE: as above.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1260	1265	50	SILTSTONE: as above.	0.96		
		40	CLAYSTONE: as above.			
		10	SANDSTONE: as above.			
1265	1270	50	SANDSTONE: very light grey to light grey, clear to milky white quartz, very fine to fine grained, occasionally medium grained, rare coarse grains, moderately well sorted, angular to sub rounded, mica, lithics (carbonaceous?), occasional garnets, glauconite, calcareous, occasional siliceous cement, occasional argillaceous matrix, very hard to firm, friable, poor to moderate visual porosity.	0.23		
		30	SILTSTONE: as above.			
		20	CLAYSTONE: as above.			
1270	1275	40	SILTSTONE: as above.	0.23		
		30	SANDSTONE: as above.			
		30	CLAYSTONE: as above.			
1275	1280	40	SILTSTONE: as above.	0.21		
		40	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
1280	1285	40	CLAYSTONE: as above.	0.14		
		30	SANDSTONE: as above.			
		30	SILTSTONE: as above.			
1285	1290	40	SILTSTONE: as above.	0.33		
		40	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1290	1295	50	SILTSTONE: as above.	0.46		
		30	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1295	1300	50	SILTSTONE: as above.	0.91		
		40	CLAYSTONE: as above.			
		10	SANDSTONE: as above.			
1300	1305	50	CLAYSTONE: as above	2.93		
		40	SILTSTONE: as above.			
		10	SANDSTONE: as above.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
1305	1310	40	CLAYSTONE: medium grey N5, moderately firm, carbonaceous, non calcareous, blocky, slightly silky lustre, micromicaceous, siliceous, micaceous chunks.	0.15		
		40	SILTSTONE: medium grey N5 to matted white, quartz - feldspar, carbonaceous, slightly calcareous, soft to friable, argillaceous matrix, blocky, micromicaceous.			
		20	SANDSTONE: rounded to subangular quartz, translucent, poorly sorted grains, some micas, occasional carbonaceous fleck, clay/silt matrix, non calcareous, poorly consolidated in parts, poorly consolidated in parts, matrix supported pellets in others, poor visual porosity.			
1310	1315	50	CLAYSTONE: as above.	0.52		
		30	SILTSTONE: as above.			
		20	SANDSTONE: as above.			
1315	1320	40	CLAYSTONE: as above.	0.60		
		30	SILTSTONE: as above, some moderately hard fragments, calcareously cemented.			
		30	SANDSTONE: as above.			
1320	1325	50	SILTSTONE: as above.	0.18		
		30	CLAYSTONE: as above.			
		20	SANDSTONE: quartz - feldspar, generally consolidated, large grains, well sorted, calcareous matrix, subangular to subrounded, moderate visual porosity, occasional garnets and dark lithics, some calcareous cement, one calcite fragment.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1325	1330	50	SILTSTONE: as above.	0.15		
		40	CLAYSTONE: as above.			
		10	SANDSTONE: as above, trace coal.			
1330	1335	50	SILTSTONE: as above, often platey.	0.21		
		40	CLAYSTONE: as above.			
		10	SANDSTONE: as above, very siliceous grains, some weathering, sand sized calcite grains, trace coal, occasional large, angular, platey, dark shaley fragments, poor visual porosity.			
1335	1340	40	CLAYSTONE: as above.	0.88		
		40	SILTSTONE: as above, weathered in parts.			
		20	SANDSTONE: as above, shaley fragments.			
1340	1345	40	SILTSTONE: as above, slightly calcareous.	1.15		
		30	CLAYSTONE: as above.			
		30	SANDSTONE: as above, trace coal.			
1345	1350	50	CLAYSTONE: as above, moderately calcareous.	0.58	x	
		30	SILTSTONE: as above, weathered in parts.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		20	SANDSTONE: as above, occasional large, yellow, rounded quartz grains.			
1350	1355	40	SILTSTONE: as above, moderately calcareous.	10.40	x	
		30	CLAYSTONE: as above, moderately calcareous.			
		30	SANDSTONE: as above, trace coal.			
1355	1360	50	SILTSTONE: as above.	1.28	x	
		30	CLAYSTONE: as above.			
		20	SANDSTONE: as above, trace coal.			
1360	1365	60	SILTSTONE: mostly quartz, medium light grey N6, carbonaceous grains and feldspar, argillaceous, very slightly calcareous overall, soft to friable, argillaceous matrix, moderate visual porosity, micaceous.	0.87	x	
		30	CLAYSTONE: dark, carbonaceous in part, soft, micromicaceous, slightly calcareous, laminated to blocky, some siliceous grains, silky lustre, with dark, rounded pellets.			
		10	SANDSTONE: as above, occasional large rounded to subangular quartz grains, extremely friable with abundant loose grains, occasional calcite grain.			
1365	1370	60	SILTSTONE: as above, very calcareous.	0.71	x	
		20	CLAYSTONE: as above, very calcareous.			
		20	SANDSTONE: as above, calcareous cement, calcite crystals, trace coal.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1370	1375	30	SILTSTONE: as above, very calcareous.	1.75		
		30	CLAYSTONE: as above, very calcareous.			
		40	SANDSTONE: as above, calcareous cement, trace coal.			
1375	1380	50	SILTSTONE: as above.	0.36		
		30	SANDSTONE: as above.			
		20	CLAYSTONE: as above, weathered in parts, some shaley material, white calcite cement, trace coal.			
1380	1385	40	SILTSTONE: as above, sandy, partly weathered.	0.48		
		30	CLAYSTONE: as above.			
		30	SANDSTONE: as above, some dark green mineral, small, possibly glauconite.			
1385	1390	40	SANDSTONE: as above, with calcareous cement.	0.56		
		35	SILTSTONE: as above, calcareous.			
		20	CLAYSTONE: as above, calcareous.			
		5	COAL: weathered, ironstained, moderately hard, laminated, angular.			
1390	1395	50	SANDSTONE: quartz - feldspar in calcite cement or calcareous clay matrix, moderately well sorted, angular to subrounded grains, poor visual porosity.	3.75		

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		30	CLAYSTONE: as above.			
		15	SILTSTONE: as above.			
		5	COAL: as above, with much more calcareous material.			
1395	1400	50	SANDSTONE: as above, non calcareous, some black, rounded lithic fragments, some coarse quartz grains, calcite aggregates, fair to moderate visual porosity.	5.10		
		25	SILTSTONE: as above, non calcareous.			
		25	CLAYSTONE: as above, non calcareous.			
1400	1405	50	SANDSTONE: as above.	1.10		
		30	SILTSTONE: as above.			
		20	CLAYSTONE: as above, trace coal, some calcite.			
1405	1410	50	SANDSTONE: as above, with more calcareous matrix.	3.90		
		30	SILTSTONE: as above.			
		20	CLAYSTONE: as above, dark, silty siliceous, micromicaceous pellets.			
1410	1415	60	SANDSTONE: as above.	1.20		
		20	CLAYSTONE: as above.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		20	SILTSTONE: as above, with siliceous pellets as above.			
1415	1420	50	SANDSTONE: as above, some coarse quartz, rounded, translucent.	1.50		
		30	SILTSTONE: as above.			
		20	CLAYSTONE: as above.			
1420	1425	50	SANDSTONE: as above, slightly calcareous.	0.80		
		30	SILTSTONE: as above, slightly calcareous, weathered in part, amethyst and garnet.			
		20	CLAYSTONE: as above, slightly calcareous, large, dark siliceous fragments.			
1425	1430	100	SANDSTONE: overall pale yellowish brown 10YR 6/2, clear to translucent quartz, moderately well sorted, mostly subrounded, non calcareous, argillaceous cement, consolidated in part, moderate visual porosity, accessory small, rounded green mineral - possibly glauconite, coal fragments, some oxidised material, garnets welded onto some quartz grains, friable quartz aggregates.	1.40		
1430	1435	90	SANDSTONE: overall very pale orange 10YR 6/2, moderately to well sorted, subangular to subrounded, medium sand size grains, garnets, minor coal, oxidised material, partly cemented, moderate visual porosity, partly matrix supported.	1.40		
		10	SILTSTONE: as dark matrix or as moderately firm pellets, description as above.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
1435	1440	90	SANDSTONE: medium quartz, subrounded to subangular, moderately sorted, overall very pale orange, clear to translucent grains, argillaceous matrix, consolidated in part, moderate visual porosity.	1.45		
		5	CLAYSTONE: pelletal, light olive grey 5Y 6/1, laminated, moderately soft, slightly calcareous.			
		5	COAL: as above.			
1440	1445	30	SILTSTONE: overall light olive grey 5Y 6/1, dominantly quartz, blocky, moderately soft, argillaceous matrix.	0.65		
		40	CLAYSTONE: as above, carbonaceous.			
		30	SANDSTONE: as above, garnets present.			
1445	1450	50	CLAYSTONE: as above.	0.20		
		30	SILTSTONE: as above.			
		20	SANDSTONE: as above, some fragments cemented with calcareous cement, calcite fragments.			
1450	1455	50	CLAYSTONE: as above, slightly calcareous.	0.80		
		30	SANDSTONE: as above.			
		20	SILTSTONE: as above.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Fluor Nat.	Fluor Cut
1455	1460	50	SANDSTONE: as above, garnetiferous.	1.14		
		30	SILTSTONE: as above.			
		20	CLAYSTONE: as above, sandstone with argillaceous matrix, some calcareously cemented, trace coal.			
1460	1465	30	SILTSTONE: as above, calcareous.	0.50		
		30	CLAYSTONE: as above, calcareous.			
		40	SANDSTONE: as above, garnetiferous, occasional pastel green mineral (chlorite?),			
1465	1470	30	SANDSTONE: as above, occasional large rounded quartz grains.	0.45		
		40	CLAYSTONE: as above.			
		30	SILTSTONE: as above.			
1470	1475	100	SANDSTONE: light grey to yellowish grey quartz, clear to milky white, very fine to medium grained, occasionally coarse grained, well sorted, subangular to sub rounded, occasionally rounded, garnets, lithics, occasional glauconite, mica, siliceous cement, trace calcareous cement, siliceous matrix, hard, friable with abundant loose grains, moderate visual porosity, trace siltstone, medium light grey, micaceous, carbonaceous specks, occasionally laminated, non calcareous, sub fissile, blocky, hard, trace coal.	0.45		
1475	1480	100	SANDSTONE: as above, trace siltstone, trace coal (cavings?).	1.00		
1480	1485	100	SANDSTONE: as above.	0.60		

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
1485	1490	100	SANDSTONE: as above, occasional well rounded quartz grains.	0.15		
1490	1495	95	SANDSTONE: light grey to yellowish grey quartz, clear to milky white, fine to medium grained, occasionally coarse grained, well sorted, subangular to subrounded, occasionally well rounded, garnets, lithics, calcareous and siliceous cement, white siliceous clay matrix, friable with abundant loose grains, moderately hard, moderate to good visual porosity.	0.30		
		5	CLAYSTONE: light olive grey, occasional mica, carbonaceous specks, hard, blocky, trace siltstone - as above.			
1495	1500	100	SANDSTONE: as above, trace siltstone and claystone as above.	0.30		
1500	1505	95	SANDSTONE: yellowish grey quartz, clear to translucent, medium to coarse grained, occasionally fine to very fine grained, moderately sorted, angular to sub rounded, garnets, lithics, siliceous cement, occasional calcareous cement, occasional siliceous matrix, friable with abundant loose grains, good to moderate visual porosity.	0.15		
		5	SILTSTONE: as above, trace claystone and coally fragments.			
1505	1510	100	SANDSTONE: as above, trace siltstone and claystone as above.	1.00		
1510	1515	50	CLAYSTONE: medium light grey to medium grey, occasional mica flakes, occasional carbonaceous specks, firm to hard, blocky.	8.68 (Swabbed Hole)		
		40	SILTSTONE: medium light grey to light olive grey, micaceous, argillaceous, occasional carbonaceous specks, hard to firm, blocky, sub fissile.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		10	SANDSTONE: yellowish grey quartz, clear to milky white, very fine to fine grained, medium to coarse grained, mica, garnets, lithics, moderately sorted, angular to sub rounded, calcite, siliceous cement, argillaceous matrix, hard, very friable with abundant loose grains, poor to moderate visual porosity.			
1515	1520	40	CLAYSTONE: as above.			
		40	SILTSTONE: as above.			
		20	SANDSTONE: as above.			
1520	1525	90	SANDSTONE: as above.	1.60		
		10	SILTSTONE: as above, trace claystone as above.			
1525	1530	95	SANDSTONE: as above.	0.90		
		5	SILTSTONE: as above.			
1530	1535	95	SANDSTONE: as above, rare epidote.	1.60		
		5	SILTSTONE: as above, trace claystone and coally fragments.			
1535	1540	95	SANDSTONE: as above.	0.90		
		5	SILTSTONE: as above.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1540	1545	90	SANDSTONE: as above.	3.10		
		10	SILTSTONE: as above.			
1545	1550	90	SANDSTONE: very light grey to yellowish grey quartz, clear to translucent, very fine to medium grained, occasionally coarse grained, moderately to well sorted, angular to subrounded, occasionally well rounded, garnets, micaceous, glauconitic, siliceous, calcareous cement, occasional argillaceous matrix, very hard, friable with abundant loose grains, poor to moderate visual porosity.	0.80	x	
		5	SILTSTONE: as above.			
		5	CLAYSTONE: as above.			
1550	1555	60	CLAYSTONE: as above.	1.75	x	
		20	SILTSTONE: as above.			
		20	CLAYSTONE: as above.			
1555	1560	40	SILTSTONE: as above, trace calcareous.	1.00	x	
		40	CLAYSTONE: as above.			
		20	SANDSTONE: as above.			
1560	1565	50	SILTSTONE: as above.	1.00	x	
		30	SANDSTONE: as above.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		20	CLAYSTONE: as above.			
1565	1570	50	SILTSTONE: as above.	1.00		
		40	CLAYSTONE: as above.			
		10	SANDSTONE: as above.			
1570	1575	40	SANDSTONE: as above.	7.56		
		30	SILTSTONE: as above.			
		30	CLAYSTONE: as above.			
1575	1580	40	CLAYSTONE: as above, occasional carbonaceous laminae, non calcareous.	23.80		
		30	SANDSTONE: as above.			
		30	SILTSTONE: as above, occasional very fine grained quartz, non calcareous.			
1580	1585	50	CLAYSTONE: as above.	7.56		
		40	SILTSTONE: as above.			
		10	SANDSTONE: yellowish grey quartz, clear to translucent, very fine to fine grained, occasionally medium grained, moderately to well sorted, angular to subrounded, garnets, mica, occasional lithics, siliceous and calcareous cement, hard, poor to moderate visual porosity.			

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Depth (m)		%	Sample Description	Gas (total)	Fluor	
From	To				Nat.	Cut
1585	1590	50	CLAYSTONE: as above, occasionally greenish black to dark grey in colour.	4.00		
		40	SILTSTONE: as above.			
		10	SANDSTONE: as above.			
1590	1595	40	SILTSTONE: as above.	2.00		
		30	SANDSTONE: as above.			
		30	CLAYSTONE: as above.			
1595	1600	40	SANDSTONE: as above.	1.00		
		40	SILTSTONE: as above.			
		20	CLAYSTONE: as above.			
1600	1605	50	CLAYSTONE: as above.	4.30		
		40	SILTSTONE: as above.			
		10	SANDSTONE: yellowish grey quartz, clear to translucent, very fine to fine grained, well sorted, angular to subrounded, garnets, mica, carbonaceous, occasional lithics, siliceous and calcareous cement, occasional white argillaceous matrix, firm to hard, moderate to poor visual porosity.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1605	1610	50	CLAYSTONE: as above.	1.00		
		30	SILTSTONE: as above.			
		20	SANDSTONE: as above.			
1610	1615	50	SANDSTONE: as above.	1.50		
		30	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			
1615	1620	60	SANDSTONE: as above.	2.00		
		20	SILTSTONE: as above.			
		20	CLAYSTONE: as above.			
1620	1625	60	SANDSTONE: yellowish grey to very light grey, quartz, clear to translucent, very fine to fine grained, occasionally medium grained, moderately sorted, subangular to subrounded, occasionally well rounded, occasional garnets, mica, lithics and carbonaceous specks, siliceous and calcareous cement, occasional white argillaceous matrix, hard, occasionally friable, moderate visual porosity.	4.60		
		20	SILTSTONE: olive grey to light olive grey, occasionally greenish black, micaceous, occasional very fine grained quartz, argillaceous, occasional carbonaceous specks, hard to firm, blocky, non calcareous.			
		20	CLAYSTONE: medium light grey to medium grey, occasional mica flakes, occasional carbonaceous specks and laminae, firm to hard, blocky, non calcareous.			

GEOLOGICAL SURVEY OF VICTORIA - BASIN STUDIES

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney

Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
1625	1630	40	CLAYSTONE: olive grey 5Y 4/1, moderately firm, micromicaceous, blocky to laminated, non calcareous. Some white, soft, non calcareous clay.	2.50		
		40	SANDSTONE: mostly quartz, rounded to subangular, white clay matrix, fine to medium sand grains, moderately well sorted, calcareous in part, micaceous.			
		20	SILTSTONE: greenish grey 5GY 6/1, friable, argillaceous, calcareous in part, quartzose. Some consolidated, dark, micaceous pellets.			
1630	1635	70	SANDSTONE: as above.	1.00		
		25	SILTSTONE: as above.			
		5	CLAYSTONE: as above.			
1635	1640	40	SILTSTONE: as above.	2.00		
		30	SANDSTONE: as above.			
		30	CLAYSTONE: as above.			
1640	1645	40	SILTSTONE: greenish grey 5GY 6/1, friable, argillaceous, calcareous in part, quartzose. Some consolidated, dark, micaceous pellets.	1.00		
		30	CLAYSTONE: olive grey 5Y 4/1, moderately firm, micromicaceous, blocky to laminated, slightly calcareous. Some white, soft, non calcareous clay.			
		30	SANDSTONE: mostly quartz, rounded to subangular, white clay matrix, fine to medium sand grains, garnetiferous, moderately well sorted, calcareous in part, micaceous.			

GEOLOGICAL SURVEY OF VICTORIA - BASIN STUDIES

Well: Bus Swamp #1 Date: 1/06/93 Geologist: Gregory Parker and Sean Rooney

Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1645	1650	40	SANDSTONE: yellowish grey to very light grey, quartz, clear to translucent, very fine to fine grained, occasionally medium grained, moderately sorted, subangular to subrounded, occasionally well rounded, occasional garnets, mica, lithics and carbonaceous specks, siliceous and calcareous cement, occasional white argillaceous matrix, hard, occasionally friable, moderate visual porosity.	0.50		
		30	SILTSTONE: olive grey to light olive grey, occasionally greenish black, micaceous, occasional very fine grained quartz, argillaceous, occasional carbonaceous specks, hard to firm, blocky, non calcareous.			
		30	CLAYSTONE: medium light grey to medium grey, occasional mica flakes, occasional carbonaceous specks and laminae, firm to hard, blocky, non calcareous.			
1650	1655	40	SILTSTONE: greenish grey 5GY 6/1, friable, argillaceous, calcareous in part, quartzose. Some consolidated, dark, micaceous pellets.	2.00		
		40	SANDSTONE: mostly quartz, rounded to subangular, white clay matrix, fine to medium sand grains, occasional garnets, moderately well sorted, calcareous in part, micaceous.			
		20	CLAYSTONE: olive grey 5Y 4/1, moderately firm, micromicaceous, blocky to laminated, non calcareous. Some white, soft, non calcareous clay.			
1655	1660	40	SANDSTONE: yellowish grey to very light grey, quartz, clear to translucent, very fine to fine grained, occasionally medium grained, moderately sorted, subangular to subrounded, occasionally well rounded, occasional garnets, mica, lithics and carbonaceous specks, siliceous and calcareous cement, occasional white argillaceous matrix, hard, occasionally friable, moderate visual porosity.	8.00		
		30	SILTSTONE: olive grey to light olive grey, occasionally greenish black, micaceous, occasional very fine grained quartz, argillaceous, occasional carbonaceous specks, hard to firm, blocky, non calcareous.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		30	CLAYSTONE: medium light grey to medium grey, occasional mica flakes, occasional carbonaceous specks and laminae, firm to hard, blocky, non calcareous.			
1660	1665	40	SANDSTONE: as above.	3.00		
		30	SILTSTONE: as above.			
		30	CLAYSTONE: as above.			
1665	1670	50	SANDSTONE: as above, occasional coarse grained quartz.	2.50		
		30	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			
1670	1675	40	SANDSTONE: mostly quartz, rounded to subangular, white clay matrix, fine to medium sand grains, garnetiferous, moderately well sorted, calcareous in part, micaceous.	1.50		
		40	SILTSTONE: greenish grey 5GY 6/1, friable, argillaceous, calcareous in part, quartzose. Some consolidated, dark, micaceous pellets.			
		20	CLAYSTONE: olive grey 5Y 4/1, moderately firm, micromicaceous, blocky to laminated, non calcareous. Some white, soft, non calcareous clay.			
1675	1680	50	SANDSTONE: yellowish grey to very light grey, quartz, clear to translucent, very fine to fine grained, occasionally medium grained, moderately sorted, subangular to subrounded, occasionally well rounded, occasional garnets, mica, lithics and carbonaceous specks, siliceous and calcareous cement, occasional white argillaceous matrix, hard, occasionally friable, moderate visual porosity.	4.00		

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Depth (m) From	Depth (m) To	%	Sample Description	Shows Gas (total)	Shows Fluor Nat.	Shows Fluor Cut
		30	SILTSTONE: olive grey to light olive grey, occasionally greenish black, micaceous, occasional very fine grained quartz, argillaceous, occasional carbonaceous specks, hard to firm, blocky, non calcareous.			
		20	CLAYSTONE: medium light grey to medium grey, occasional mica flakes, occasional carbonaceous specks and laminae, firm to hard, blocky, non calcareous.			
1680	1685	40	SILTSTONE: overall light olive grey 5Y 6/1, friable, argillaceous, moderately calcareous, garnetiferous.	3.50		
		30	SANDSTONE: mostly quartz, rounded to subangular, white clay matrix, fine to medium sand grains, moderately well sorted, calcareous in part, micaceous. , some pelletal fragments, with white argillaceous matrix, some with darker, greener silt and clay matrix, occasionally as coarse, rounded fragments suspended in matrix, occasional cemented fragments, occasionally calcareous.			
		30	CLAYSTONE: mostly dark, carbonaceous, occasionally laminated, occasional pellets are micromicaceous and very hard.			
1685	1690	60	SANDSTONE: yellowish grey quartz, clear to translucent, very fine to fine grained, well sorted, subangular to rounded, mica, occasional garnets, lithics, carbonaceous specks, siliceous and calcareous cement, occasional argillaceous matrix, hard, firm, poor visual porosity.	5.20		
		20	SILTSTONE: olive grey to light olive grey, occasionally greenish black, micaceous, occasional very fine grained quartz, argillaceous, occasional carbonaceous specks, hard to firm, blocky, non calcareous.			
		20	CLAYSTONE: medium light grey to medium grey, occasional mica flakes, occasional carbonaceous specks and laminae, firm to hard, blocky, non calcareous.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1690	1695	60	SANDSTONE: yellowish grey quartz, clear to translucent, very fine to fine grained, occasionally coarse grained, moderately sorted, subangular to rounded, mica, occasional garnets, lithics, carbonaceous specks, siliceous and calcareous cement, occasional argillaceous matrix, hard, firm in part, friable with abundant loose grains, poor visual porosity.	5.60		
		20	CLAYSTONE: as above.			
		20	SILTSTONE: as above.			
1695	1700	40	CLAYSTONE: dark, overall light to olive grey 5Y 6/2, very carbonaceous, soft to firm, arenaceous, blocky, some white, platey fragments.	1.50		
		40	SILTSTONE: dark with some whitish fragments, dispersive, oxidised in part, argillaceous.			
		20	SANDSTONE: mostly fine to medium grained, rounded to subangular quartz, dispersive, translucent to milky white.			
1700	1705	70	SANDSTONE: yellowish grey quartz, clear to translucent, very fine to fine grained, occasionally coarse grained, moderately sorted, subangular to rounded, mica, occasional garnets, lithics, carbonaceous specks, siliceous and calcareous cement, friable with abundant loose grains, occasional argillaceous matrix, hard, firm, poor visual porosity.	0.50		
		20	CLAYSTONE: medium light grey to medium grey, occasional mica flakes, occasional carbonaceous specks and laminae, siliceous, firm to hard, blocky, non calcareous.			
		10	SILTSTONE: olive grey to light olive grey, occasionally greenish black, micaceous, occasional very fine grained quartz, argillaceous, occasional carbonaceous specks, hard to firm, blocky, non calcareous.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1705	1710	80	SANDSTONE: as above.	1.50		
		10	SILTSTONE: as above.			
		10	CLAYSTONE: as above, siliceous.			
1710	1715	90	SANDSTONE: as above, occasionally well rounded.	2.50	x	
		10	SILTSTONE: as above, sub fissile, trace claystone as above.			
1715	1720	60	SANDSTONE: mostly rounded to subrounded quartz, calcareously cemented pellets, occasionally dispersive, fine to medium grained, moderately sorted, poor visual porosity.	3.90	x	
		30	SILTSTONE: overall, pale olive 10Y 6/2 and yellowish grey 5Y 8/1 and white N9, calcareous or non calcareous pellets, argillaceous material, friable, blocky, weathered.			
		10	CLAYSTONE: carbonaceous, soft to firm, oxidised, arenaceous.			
1720	1725	40	SILTSTONE: olive grey to light olive grey, occasionally greenish black, micaceous, occasional very fine grained quartz, argillaceous, occasional carbonaceous specks, subfissile, trace claystone as above, blocky, non calcareous.	2.40	x	
		30	SANDSTONE: yellowish grey quartz, clear to translucent, very fine to fine grained, occasionally coarse grained, moderately sorted, subangular to rounded, mica, occasional garnets, lithics, carbonaceous specks, siliceous and calcareous cement, friable with abundant loose grains, occasional argillaceous matrix, hard, firm, poor visual porosity.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
		30	CLAYSTONE: medium light grey to medium grey, occasional mica flakes, occasional carbonaceous specks and laminae, siliceous, firm to hard, blocky, non calcareous.			
1725	1730	40	SILTSTONE: as above.	1.00	x	
		40	SANDSTONE: as above.			
		20	CLAYSTONE: as above.			
1730	1735	40	SANDSTONE: mostly rounded to subrounded quartz, occasional very large coarse grains, aggregates with calcareous cement, poor visual porosity, very hard, occasionally dispersive.	1.00	x	x
		40	SILTSTONE: overall light olive grey 5Y 6/1, friable, argillaceous, quartzose.			
		20	CLAYSTONE: overall light olive grey, dispersive, occasionally calcareous, soft, white pellets.			
1735	1740	50	SANDSTONE: yellowish grey quartz, clear to translucent, very fine to fine grained, moderately sorted, subangular to rounded, mica, occasional garnets, lithics, carbonaceous specks, siliceous and calcareous cement, occasional argillaceous matrix, hard, firm, friable with abundant loose grains, poor visual porosity.	4.50	x	
		30	SILTSTONE: olive grey to light olive grey, occasionally greenish black, micaceous, occasional very fine grained quartz, argillaceous, occasional carbonaceous specks, hard to firm, blocky, non calcareous.			
		20	CLAYSTONE: medium light grey to medium grey, occasional mica flakes, occasional carbonaceous specks and laminae, siliceous, firm to hard, blocky, non calcareous.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1740	1745	80	SANDSTONE: overall pale yellowish brown 10YR 6/2 to dark yellowish brown 10YR 4/2, rounded to subrounded, occasionally angular quartz, moderately sorted, translucent to clear, dispersive in part, pellets with calcareous cement, argillaceous, oxidised in part around grains, some lithic fragments - dark, micromicaceous, dark red coating on some grains.	4.50	x	
		20	CLAYSTONE: dark, soft carbonaceous pellets or as matrix in sandstone aggregates.			
1745	1750	60	SANDSTONE: rounded to angular quartz, moderately sorted, dispersive, occasionally aggregated - slightly calcareous cement, pellets with (calcareous in part) argillaceous matrix, overall light olive grey 5Y 6/1, occasional large, angular, translucent grains.	1.80		
		20	SILTSTONE: light pinkish or yellowish grey, friable, quartzose, argillaceous.			
		20	CLAYSTONE: dark, soft, carbonaceous or very hard micromicaceous pellets			
1750	1755	40	SANDSTONE: as above, very micaceous.	1.00		
		40	SILTSTONE: as above.			
		20	CLAYSTONE: dark, carbonaceous, brownish grey 5YR 4/1, blocky pellets, soft to firm, non calcareous.			
1755	1760	40	CLAYSTONE: dark, overall light to olive grey 5Y 6/2, very carbonaceous, soft to firm, arenaceous, blocky, some white, platey fragments.	1.20		
		40	SILTSTONE: dark with some whitish fragments, dispersive, oxidised in part, argillaceous.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		20	SANDSTONE: rounded to subrounded, fine quartz, cemented, non calcareous, poor visual porosity, occasional large, translucent, rounded quartz grain.			
1760	1765	90	SANDSTONE: light olive grey 5Y 6/1, subrounded to subangular quartz, clear to translucent, moderately sorted, medium grain size, mostly friable with abundant loose grains but also occurs as aggregates with slightly calcareous argillaceous matrix, garnetiferous.	2.00		
		10	CLAYSTONE: as white powdery matrix or as darker medium grey N5 pellets, micromicaceous, firm, laminated, partly oxidised, silky, siliceous material also present as pellets.			
1765	1770	80	SANDSTONE: yellowish grey to very light grey quartz, clear to translucent, very fine to medium grained, occasionally coarse grained, moderately sorted, subangular to rounded, occasionally well rounded, mica, garnet, lithics, carbonaceous specks, trace pyrite, siliceous and calcareous cement, argillaceous matrix, hard to friable with abundant loose grains, poor visual porosity.	2.57		
		20	SILTSTONE: medium grey to medium light grey, micaceous, occasional very fine quartz grains, arenaceous, argillaceous, blocky, sub fissile, hard.			
1770	1775	40	SANDSTONE: light olive grey 5Y 6/1, subrounded to subangular quartz, clear to translucent, moderately sorted, medium grain size, mostly friable with abundant loose grains but also occurs as aggregates with slightly calcareous argillaceous matrix, garnetiferous.	5.10		
		40	SILTSTONE: dark with some whitish fragments, dispersive, oxidised in part, argillaceous.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		15	CLAYSTONE: as white powdery matrix or as darker medium grey N5 pellets, micromicaceous, firm, laminated, partly oxidised, silky, siliceous material also present as pellets.			
		5	COAL: vitreous, very black, aggregates of sand with dark (carbonaceous?) material as veins.			
1775	1780	40	CLAYSTONE: olive grey to medium grey, occasional mica flakes, occasional carbonaceous specks and laminae, hard, blocky, non calcareous.	6.50		
		40	SILTSTONE: medium grey to medium light grey, micaceous, occasional very fine quartz grains, arenaceous, argillaceous, blocky, sub fissile, hard.			
		20	SANDSTONE: yellowish grey to very light grey quartz, clear to translucent, very fine to medium grained, occasionally coarse grained, moderately sorted, subangular to rounded, occasionally well rounded, mica, garnet, lithics, carbonaceous specks, trace pyrite, siliceous and calcareous cement, argillaceous matrix, hard to friable with abundant loose grains, poor visual porosity.			
1780	1785	50	SILTSTONE: dark with some whitish fragments, dispersive, oxidised in part, calcareous, argillaceous.	2.10		
		30	CLAYSTONE: as white powdery matrix or as darker medium grey N5 pellets, micromicaceous, firm, laminated, partly oxidised, silky, siliceous material also present as pellets.			
		20	SANDSTONE: light olive grey 5Y 6/1, subrounded to subangular quartz, clear to translucent, moderately sorted, medium grain size, mostly friable with abundant loose grains but also occurs as aggregates with slightly calcareous argillaceous matrix, (silky, silty, siliceous pellets present), garnetiferous.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1785	1790	40	SILTSTONE: olive black to greenish black, medium grey to medium light grey, micaceous, occasional very fine quartz grains, arenaceous, argillaceous, blocky, sub fissile, hard.	2.50		
		40	CLAYSTONE: olive grey to medium grey, occasional mica flakes, occasional carbonaceous specks and laminae, hard, blocky, sticky, non calcareous.			
		20	SANDSTONE: yellowish grey to light olive grey quartz, clear to translucent, very fine to fine grained, occasionally medium grained, poor to moderate sorting, sub angular to rounded, lithics, carbonaceous specks, rare glauconite, siliceous and calcareous cement, occasional argillaceous matrix, hard to friable with abundant loose grains, poor visual porosity.			
1790	1795	50	CLAYSTONE: as white powdery matrix or as darker medium grey N5 pellets, micromicaceous, firm, laminated, partly oxidised, silky, siliceous material also present as pellets, overall pale to greenish olive 10Y 5/2, some hard pellets.	3.90		
		40	SILTSTONE: dark with some whitish fragments, dispersive, oxidised in part, argillaceous.			
		10	SANDSTONE: light olive grey 5Y 6/1, subrounded to subangular quartz, clear to translucent, moderately sorted, medium grain size, mostly friable with abundant loose grains but also occurs as calcareously cemented aggregates with slightly calcareous argillaceous matrix, garnetiferous.			
1795	1800	60	CLAYSTONE: olive grey to medium grey, occasional mica flakes, occasional carbonaceous specks and laminae, hard, fissile, blocky, non calcareous.	6.70		
		40	SILTSTONE: medium grey to medium light grey, micaceous, occasional very fine quartz grains, trace rounded medium quartz grains, arenaceous, argillaceous, blocky, sub fissile, hard.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
1800	1805		Not present.	5.00		
1805	1810		Not present.	6.40		
1810	1815	60	SILTSTONE: medium grey to medium light grey, micaceous, occasional very fine quartz grains, arenaceous, argillaceous, blocky, sub fissile, hard.	6.50		
		40	CLAYSTONE: olive grey to medium grey, occasional mica flakes, occasional carbonaceous specks and laminae, hard, blocky, trace medium, subangular quartz grains, non calcareous.			
1815	1820	70	SANDSTONE: angular to subangular, coarse quartz grains, clear to translucent, friable with abundant loose grains, non calcareous matrix on smaller grains.	6.50	x	
		20	SILTSTONE: dark with some whitish fragments, dispersive, oxidised in part, non calcareous, argillaceous.			
		10	CLAYSTONE: very dark, hard, micromicaceous, non calcareous, massive.			
1820	1825	50	SILTSTONE: medium grey to very light grey, mica, occasional very fine quartz, arenaceous, argillaceous, hard, blocky, sub fissile.	21.80	x	
		40	SANDSTONE: white yellowish grey quartz, clear to frosted, very fine to fine grained, occasionally medium to coarse to very coarse, poorly sorted, angular to sub angular, siliceous cement, argillaceous matrix, hard, friable with abundant loose grains, poor visual porosity.			
		10	CLAYSTONE: as above.			

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Depth (m) From	Depth (m) To	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
1825	1830	70	SILTSTONE: as above.	2.50	x	
		20	CLAYSTONE: as above, occasionally laminated.			
		10	SANDSTONE: as above.			
1830	1835	70	SILTSTONE: light olive grey to dark greenish grey, very light grey, mica, occasional very fine grained quartz, chlorite, argillaceous, arenaceous, very hard, sub fissile.	2.00		
		20	CLAYSTONE: very dark, hard, micromicaceous, non calcareous, occasionally laminated with dark material, occasionally chloritic, massive.			
		10	SANDSTONE: yellowish grey to light olive grey quartz, clear to translucent, very fine to fine grained, occasionally medium grained, poor to moderate sorting, sub angular to rounded, lithics, carbonaceous specks, rare glauconite, siliceous and calcareous cement, occasional argillaceous matrix, hard to friable with abundant loose grains, poor visual porosity.			
1835	1840	80	SILTSTONE: medium grey to medium light grey, micaceous, occasional very fine quartz grains, arenaceous, argillaceous, blocky, sub fissile, hard.			
		10	CLAYSTONE: very dark, hard, micromicaceous, non calcareous, occasionally laminated with dark material, occasionally chloritic, massive.			
		10	SANDSTONE: yellowish grey to light olive grey quartz, clear to translucent, very fine to fine grained, occasionally medium grained, poor to moderate sorting, sub angular to rounded, lithics, carbonaceous specks, rare glauconite, siliceous and calcareous cement, occasional argillaceous matrix, hard to friable with abundant loose grains, poor visual porosity.			

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Depth (m)		%	Sample Description	Shows		
				Gas (total)	Fluor	
From	To				Nat.	Cut
1840	1845	60	SILTSTONE: overall light to olive grey 5Y 5/1, brownish tinge, loosely consolidated, massive, dispersive, friable to soft, argillaceous.			
		20	SANDSTONE: subrounded, clear to translucent quartz, some rouded lithics, loosely consolidated, siltstone matrix, garnets, moderate sorting, medium grain size, oxidation on surfaces of some grains.			
		20	CLAYSTONE: dark carbonaceous pellets, soft to firm, generally non calcareous, trace coal.			
1845	1850	90	SILTSTONE: light olive grey to greenish grey, occasionally olive grey, mica, occasional very fine grained quartz, carbonaceous specks, chlorite, argillaceous, arenaceous, very hard, sub fissile, soft, blocky.			
		10	SANDSTONE: yellowish grey to light olive grey quartz, clear to translucent, very fine to fine grained, occasionally medium grained, poor to moderate sorting, sub angular to rounded, lithics, carbonaceous specks, rare glauconite, siliceous and calcareus cement, occasional argillaceous matrix, hard to friable with abundant loose grains, poor visual porosity.			

APPENDIX 5

APPENDIX 5

CORE & SIDE WALL CORE DESCRIPTIONS

SIDEWALL CORE

DESCRIPTIONS

GSV

GSV SIDEWALL CORE DESCRIPTIONS

BUS SWAMP # 1

SWC NO.	DEPTH (m)	REC. (mm)	MAJOR LITHOLOGY	SWC DESCRIPTION
1	1840m	25mm	Siltstone	light grey to light brownish grey, argillaceous, moderately firm, non calcareous. The sample has one greyish brown planar surface which has striations indicating some movement.
2	1824m	15mm	Siltstone	very light grey to light grey siltstone, grading to very fine grained quartzose sandstone, argillaceous, trace micromicaceous, soft to moderately firm, non calcareous. There are numerous very fine (< 1mm) carbonaceous laminae throughout the sample, and occasional carbonaceous blebs. There are also faint indications of lamination.
3	1822m	15mm	Sandstone	white to very light grey, occasionally medium grey, medium to very coarse grained quartz, poorly sorted, angular to very angular, low sphericity, abundant very light grey to white argillaceous matrix, common kaolinised feldspar grains, rare lithic grains, poor visual porosity.
4	1815m	30mm	Siltstone (Plate 1)	medium grey to dark grey, trace micromicaceous, firm to moderately hard, non calcareous. The sample also contains one coarse quartz grain. No apparent bedding or structure. (See also SWC 4 description from AGSO)
5	1803m	10mm	Siltstone	medium dark grey, firm to moderately hard, non calcareous. Poor recovery - the sample is broken up and contains filtercake.

SWC NO.	DEPTH (m)	REC. (mm)	MAJOR LITHOLOGY	SWC DESCRIPTION
6	1777m	10mm	Sandstone	very light grey to light grey, fine to very fine grained quartz, grading to siltstone in part, well sorted, angular to sub angular and occasionally sub rounded, trace calcite cement, common silty to argillaceous matrix, rare light pink to red garnets, occasional lithic grains, moderately hard to slightly friable, poor visual porosity, interlaminated with:
			Siltstone	medium grey to medium dark grey, grading to very fine sand, common argillaceous matrix, trace dispersed organic material, moderately firm, non calcareous. The two lithotypes are horizontally interlaminated, the siltstone laminae are generally finer (<1mm) than the sandstone.
7	1767m	20mm	Sandstone	very light grey to light grey, very fine to fine grained quartz, moderately well sorted, subrounded, common argillaceous matrix, common lithic grains, occasional light pink to red garnets, moderately hard to, friable, poor visual porosity. No apparent bedding or structure.
8	1756m	10mm	(Plate 2)	(See AGSO SWC 8 description)
9	1730m	15mm	Siltstone	medium grey to medium dark grey, very argillaceous, trace micromica, rare very fine quartz grains, moderately firm, non calcareous. No apparent bedding or structure.
10	1709m	15mm	Claystone	medium dark grey, slightly silty, slightly micaceous, slightly dispersive, moderately firm, non calcareous. No apparent bedding or structure.

SWC NO.	DEPTH (m)	REC. (mm)	MAJOR LITHOLOGY	SWC DESCRIPTION
11	1640m	<10mm	Claystone	medium light grey to medium grey, commonly silty, occasional very fine to fine grained quartz, slightly carbonaceous, moderately firm, non calcareous. No apparent bedding or structure.
12	1585m	15mm	Siltstone	medium light grey, grading to very light grained sandstone in part, common argillaceous matrix, slightly micaceous, moderately firm to firm, non calcareous. No apparent bedding or structure.
13	1560m	15mm	Siltstone	medium grey, grading to very fine to fine grained quartz, common argillaceous matrix, occasional lithic grains, trace carbonaceous material, soft to moderately firm, non calcareous. No apparent bedding or structure.
14	1510m	20mm	Sandstone	very light grey, predominantly fine to medium grained quartz, occasional very fine grains, moderately to well sorted, sub angular to occasionally sub rounded, common argillaceous matrix, common lithic grains, occasional to common light pink garnets, moderately hard, poor visual porosity.
16	1445m	30mm	Claystone	medium grey to medium dark grey, slightly to moderately silty, grading to very fine sand in parts, slightly micaceous, soft to moderately firm, non calcareous.
17	1406m	25mm	Siltstone	medium light grey, grading to very fine grained sandstone, trace to common argillaceous matrix, moderately micromicaceous, soft to moderately firm, non calcareous. There are faint indications of laminar bedding which are highlighted by the presence of wispy carbonaceous material. There are also two horizontal to sub horizontal laminae of carbonaceous to coaly claystone which are up to 2mm thick.

SWC NO.	DEPTH (m)	REC. (mm)	MAJOR LITHOLOGY	SWC DESCRIPTION
19	1325m	30mm	Claystone	medium light grey to medium grey, slightly to moderately silty, slightly micromicaceous, soft to moderately firm, non calcareous. The core has no apparent bedding or structural features.
22	1190m	35mm	Claystone	medium dark grey, slightly silty and micromicaceous, soft to moderately firm, non calcareous. The core has no bedding or structural features.
23	1145m	40mm	Claystone	medium dark grey, slightly silty and micromicaceous, soft to moderately firm, non calcareous. The core has no bedding or structural features.
24	1137m	10mm	Sandstone	very light grey to light grey, quartzose, very fine to fine grained, moderately to well sorted, angular to sub rounded, occasional to common calcite cement, common to abundant argillaceous matrix, common lithic grains, rare to occasional light pink garnets, moderately hard, poor visual porosity. The core has no apparent bedding or structural features.
25	1105m	40mm	Claystone	medium dark grey to dark grey, trace silt throughout, slightly micromicaceous, moderately firm, non calcareous. The core has no apparent structural or bedding features.
26	1026m	40mm	Claystone	medium grey to medium dark grey, slightly silty throughout, trace very fine grained quartz, trace mica, soft to moderately firm, non calcareous. The core has no apparent bedding or structural features.

SWC NO.	DEPTH (m)	REC. (mm)	MAJOR LITHOLOGY	SWC DESCRIPTION
27	982m	35mm	Claystone	medium grey to medium dark grey, slightly silty throughout, occasional small lenses and laminae of light brown very fine to fine grained quartz sand, slightly micacoues, soft to moderately firm, non calcareous.
28	977m	40mm	Claystone	medium light grey to medium grey, slightly silty throughout, occasional very fine grained quartz, trace mica, slightly dispersive, soft to moderately firm, non calcareous. The core has no apparent bedding or structural features.
29	957m	40mm	Claystone	medium light grey to medium grey, slightly silty, occasional fine to very fine grained quartz, trace mica, rare carbonaceous flecks, soft to moderately firm, non calcareous.
30	913m	40mm	Claystone (Plate 3)	medium grey to medium dark grey, common silt an very fine grained quartz, occasional to common mica, rare lithic grains, soft to moderately firm, non calcareous. The core has no apparent bedding or structural features. (See also AGSO SWC 30 description)
31	886m	15mm	Sandstone	medium light grey to light grey, predominantly medium grained quartz with common remnants of coarse grains, occasionally impregnated with light brown clay, well sorted, rounded to occasionally sub rounded, strongly calcite cemented, trace argillaceous matrix in parts, occasional lithic grains, hard, poor to very poor visual porosity. The core has no apparent bedding or structural features.

SWC NO.	DEPTH (m)	REC. (mm)	MAJOR LITHOLOGY	SWC DESCRIPTION
33	862m	40mm	Claystone (Plate 4)	dark grey, common carbonaceous flecks and laminae, soft to moderately firm, non calcareous, with interlaminated:
			Sandstone	light grey, very fine grained grading to silt, arkosic, well sorted, rounded, abundant light grey argillaceous matrix, friable, non calcareous, poor visual porosity.
				The sandstone is predominantly inter laminated with occasional lenticular features. The sandstone laminae are up to 2mm thick.
				(See also AGSO SWC 33 description)
34	845m	40mm	Sandstone	light grey to medium light grey, very 40mm fine to fine grained quartz, grading to silt in parts, well sorted, sub rounded to rounded, common very light grey argillaceous matrix, common lithic and feldspathic grains, friable to moderately hard, non calcareous, poor visual porosity, with flaser beds of:
			Claystone	medium dark grey, slightly silty with abundant micro laminae of dark grey to greyish black organic matter.
				Faint indications of cross bedding are visible in the sandstone while the claystone has a laminated appearance.
35	822m	35mm	Claystone	medium grey, commonly silty, occasional fine to medium grained lithics, moderately firm, non calcareous.
				The core has no apparent bedding or structural features.
36	796m	40mm	Claystone	medium grey to dark grey, moderately silty, occasional weathered lithic grain, moderately firm, non calcareous.
				The core has no apparent bedding or structural features.

SWC NO.	DEPTH (m)	REC. (mm)	MAJOR LITHOLOGY	SWC DESCRIPTION
37	756m	40mm	Silty claystone	medium grey, commonly silty, grading to very fine grained quartz sand in parts, occasional medium to coarse lithic grains, occasional very fine wispy organic laminations and clasts, moderately firm, non calcareous, in part grading to:
			Sandstone	light grey, very fine grained quartz, arkosic, well sorted, well rounded, abundant argillaceous matrix, silty in parts, non calcareous, poor visual porosity.
			Claystone	dark grey, slightly silty, moderately firm, non calcareous. Contacts between the different lithotypes, while clear, are not regular or laminar indicating some degree of post depositional deformation
39	700m	<10mm	Arenaceous claystone	medium grey to olive grey, abundant fine to very fine grained quartz, grading to siltstone in parts, occasional to common lithic and feldspathic grains, moderately firm to firm, slightly calcareous. The core has no apparent bedding or structural features.
40	672m	40mm	Argillaceous sandstone	light olive grey to olive grey, very fine to fine grained quartz, well sorted to very well sorted, sub round to round, abundant light olive grey argillaceous matrix, common lithic and feldspathic grains, friable to moderately hard, non calcareous, poor visual porosity.
41	657m	40mm	Argillaceous sandstone (Plate 5)	light olive grey to olive grey, predominantly very fine to fine grained quartz, becoming silty in parts, well sorted, angular to sub angular and occasionally sub rounded, abundant light grey argillaceous matrix, common lithic and feldspathic grains, rare very coarse grain size medium dark grey claystone clasts, friable to moderately hard, non calcareous, poor visual porosity. The core has no apparent bedding or structural features. (See also AGSO SWC 41 description)

SWC NO.	DEPTH (m)	REC. (mm)	MAJOR LITHOLOGY	SWC DESCRIPTION
43	465m	40mm	Argillaceous sandstone	olive grey, predominantly fine to medium grained quartz with occasional medium to coarse lithic grains, well sorted, sub angular to sub rounded, occasionally angular, occasional tabular grains, abundant olive grey argillaceous matrix, common lithic and feldspathic grains, occasional carbonaceous flecks, friable to moderately hard, non calcareous, poor visual porosity. The core has no apparent bedding or structural features.
46	300m	35mm	Argillaceous sandstone	olive grey, very fine to fine grained, well sorted, sub rounded to rounded, occasionally sub angular, predominantly quartzose with common lithic and feldspathic grains, abundant olive grey argillaceous matrix, moderately hard to friable, non calcareous, poor visual porosity. The core has no apparent bedding or structural features.

SIDEWALL CORE

DESCRIPTIONS

AGSO

DESCRIPTION OF SIDEWALL CORES FROM BUS SWAMP 1

(Dennis Burger, AGSO, 16 June 1993)

Sidewall core 4
(1815 m)

Consists of soft, brown-grey fragments of clayey, fine-grained, medium-sorted sandstone.

Half of the stub was taken for palynological examination by AGSO. After fragmentation red and yellow fragments (contaminated pieces) were picked out and discarded as contamination.

Sidewall core 8
(1756 m)

Consists of a solid piece of mud-caked, soft, light-coloured sandstone; fine-grained, well-sorted, mixed with black sandy mudstone, presumably drilling mud.

Half of the stub was taken for palynological examination by AGSO.

Sidewall core 30
(913 m)

Consists of a solid stub of lightly mud-caked, soft, sandy, black, slightly calcareous mudstone.

Half of the stub was taken for palynological examination by AGSO.

Sidewall core 33
(862 m)

Consists of a solid piece of lightly mud-caked, dark grey mudstone with thin veins of fine-grained sandstone.

Half of the stub was taken for palynological examination by AGSO.

Sidewall core 41
(657 m)

Consists of a solid piece of slightly mud-caked, soft, clayey sandstone, well-sorted and fine-grained.

Half of the stub was used for palynological examination by AGSO.

CORE

DESCRIPTIONS

BUS SWAMP #1

Core No 1 830.4 - 836.4 metres Recovery 43%

Eumeralla Formation

830.4 - 836.4m (Plate 7)

<u>Claystone</u>: Overall olive grey to light olive grey, massive, blocky, firm to hard, occasional mica, carbonaceous specks, non calcareous, occasionally laminated with dark coally material, common coally plant material toward the base of the core.

BUS SWAMP #1

Core No 2 1509.83 - 1515.83 metres Recovery 92%

McEachern Formation - Crayfish Subgroup

1509.83 - 1512.2m (Plate 9a)

Sandstone: Very light grey to light grey, moderately hard to friable, clear to translucent grains, fine to medium grained quartz, well sorted, subangular to subrounded, moderate to high sphericity, trace silica cement, trace calcite cement, trace argillaceous matrix, occasional to common lithic grains, occasional to common light pink to red garnets, fair visual porosity. No hydrocarbon fluorescence.

The core is massive. Very rare clay wisps are horizontally oriented. There are no discernible bedding features.

1512.2 - 1512.8m (Plate 8a, 8b)

Sandstone: Very light grey to light grey, massive, moderately hard to friable, clear to translucent grains, fine to medium grained quartz, well sorted, subangular to subrounded, moderate to high sphericity, trace silica cement, trace calcite cement, trace argillaceous matrix, occasional to common lithic grains, occasional light pink garnet, trace brown mica, fair to good visual porosity. No hydrocarbon fluorescence.

1512.8 - 1514.2m (Plate 8a)

Sandstone: Very light grey to light grey, moderately hard to friable, clear to translucent grains, fine to medium grained quartz, well sorted, subangular to subrounded, moderate to high sphericity, trace silica cement, trace calcite cement, trace argillaceous matrix, occasional to common lithic grains, occasional light pink garnet, trace brown mica, fair to good visual porosity. No hydrocarbon fluorescence.

The core contains common small clasts (up to 1.5cm), grading to abundant clasts with depth, of moderately brown, silty, slightly carbonaceous, slightly calcareous and moderately hard claystone. Wisps of claystone are apparently horizontally oriented. There are no discernible bedding features in the sandstone, however the orientation of clast aggregates suggests horizontal bedding. Clast occurrence increases with depth. The siltstone clasts tend to be rounded, indicating reworking.

1514.2 - 1515.83m (Plate 9b)

Sandstone: Very light grey, light brownish grey to light grey, hard to very hard, friable in part, clear to translucent grains, predominantly medium grained quartz, occasional fine grains in the upper section, well sorted, subangular to subrounded, low to moderate sphericity, trace to occasionally common silica cement, common white argillaceous matrix, occasional to common lithic grains and abundant light pink to red garnets in the lower part of the core, fair to moderate visual porosity. No hydrocarbon fluorescence.

The core has abundant clasts of medium grey claystone which are slightly calcareous, slightly carbonaceous and moderately hard. There are also occasional clasts of medium brown to grey brown siltstone which show some indications of bedding. The clasts are also rounded, indicating reworking. A section of silty claystone towards the base of the core exhibits a near vertical slickenside surface. There are no discernible bedding features in the sandstone.

BUS SWAMP #1

Core No 3 1785.23 - 1790.06 metres Recovery 91%

McEachern Formation - Crayfish Subgroup

1785.23 - 1785.9m

Siltstone: Medium grey to medium dark grey, hard, fissile to sub fissile, common mica, carbonaceous specks, argillaceous in part, arenaceous in part, non calcareous, occasional laminae of light grey very fine quartz sandstone , forming flame and squirt structures, occasional laminae of medium dark grey claystone.

1785.9 - 1786.2m (Plate 10/11a)

Siltstone: Medium dark grey, hard, fissile to sub fissile, very fine quartz, common mica, carbonaceous specks, occasionally argillaceous, occasionally arenaceous, common laminae of light grey sandstone forming flame structures, occasional laminae of medium dark grey claystone.

1786.2 - 1786.5m

Siltstone: Medium dark grey, moderately hard, fissile to sub fissile, friable in part, moderately micaceous, occasional carbonaceous specks, occasional laminae of light grey sandstone (very fine grained, subangular to subrounded grains, well sorted, argillaceous matrix), laminae of medium dark to dark grey claystone, slight flame structures.

1786.5 - 1787.1m (Plate 12a/ 12b)

Siltstone: Medium dark grey, hard to moderately hard, fissile to sub fissile, friable in part, very fine grained quartz, abundant mica, carbonaceous specks and fossil plant material, arenaceous in part, argillaceous in part, laminae of light grey quartz sandstone (very fine grained, subangular to subrounded, moderately well sorted), occasional garnets, lithic fragments, argillaceous matrix, forms flame structures, cross laminations, erosional surfaces, plastic deformation at approximately 1786.7m, occasional laminae of medium dark grey claystone.

1787.1 - 1788.4m (Plate 11b)

Siltstone: Medium grey to medium dark grey, massive to occasionally laminated, hard to moderately hard, fissile to subfissile, occasional very fine grained quartz, occasional carbonaceous specks, occasional fossilized plant specimens, commonly argillaceous to rarely arenaceous, micaceous in part, occasional medium to dark grey claystone or carbonaceous laminae, occasional sandstone laminae (light grey, very fine grained).

1788.4 - 1788.9m (Plate 12a)

Siltstone: Medium grey to medium dark grey, moderately hard, fissile to sub fissile, commonly micaceous, occasional very fine grained quartz, carbonaceous specks, occasional fossil plant pieces, occasionally argillaceous, occasionally arenaceous, The core contains sandstone laminae, occasional cross beds, occasional lenses of sandstone - light grey, clear to translucent, very fine grained to occasionally fine grained, angular to subrounded, moderately well sorted, abundant mica, occasional carbonaceous flakes, lithics, trace silica and calcite cement, argillaceous matrix, hard, poor porosity, occasional medium dark grey laminae.

1788.9 - 1789.5m

Siltstone: Medium grey to medium dark grey, moderately hard, fissile to sub fissile, commonly micaceous, occasional very fine grained quartz, occasional carbonaceous specks, occasional carbonaceous plant remains, argillaceous in part, occasionally arenaceous in part, occasional medium dark grey micaceous claystone laminae, occasionally carbonaceous, rare plant remains, non calcareous, hard, occasional light grey sandstone laminae.

1789.5 - 1789.8m (Plate 12b)

Siltstone: Medium grey, hard to moderately hard, fissile to sub fissile, occasional very fine grained quartz, occasional carbonaceous specks and plant material, occasionally arenaceous, occasionally argillaceous, commonly micaceous, occasional laminae of medium dark grey claystone, coarsening into light grey sandstone laminae, cross bedded, contains erosional surfaces and flame structures.

1789.8 - 1790.06m

Siltstone: Medium dark grey, moderately hard, fissile to sub fissile, occasional very fine grained quartz, occasional carbonaceous specks and plant remains, micaceous in part, occasionally argillaceous, occasionally arenaceous, occasional laminae of medium dark grey claystone and occasional light grey sandstone.

BUS SWAMP #1

Core No. 4 1833.09 - 1835.16 metres Recovery 71%

Basement

1833.09 - 1834.2m (Plate 13/14a/14b)

Andesite altered to greenschist: dark greenish grey, mottled dark yellowish orange, crystalline, sericitized and chloritized, common quartz, common mica, feldspars, amphibole, trace quartz and calcite veins thickening with depth. Some of the calcite veins displace other calcite veins. Thick calcite veining occurs around 1834.15m. Mottling increases towards the base. The veins also display folding in places.

1834.2 - 1834.6m

Andesite altered to greenschist: Mottled greyish olive, dusky yellow green, greyish orange, crystalline, sericitized and chloritized, common quartz, common mica, feldspars, amphibole, trace calcite veins thickening with depth. Some of the calcite veins displace other calcite veins.

1834.6 - 1835.16m

Andesite altered to greenschist: dark greenish grey, mottled dark yellowish orange, crystalline, sericitized and chloritized, common quartz, common mica, feldspars, amphibole, trace quartz and calcite veins thickening with depth. Some of the calcite veins displace other calcite veins. Thick calcite veining occurs around 1834.15m. Mottling increases towards the base. The veins also display folding in places.

PLATES

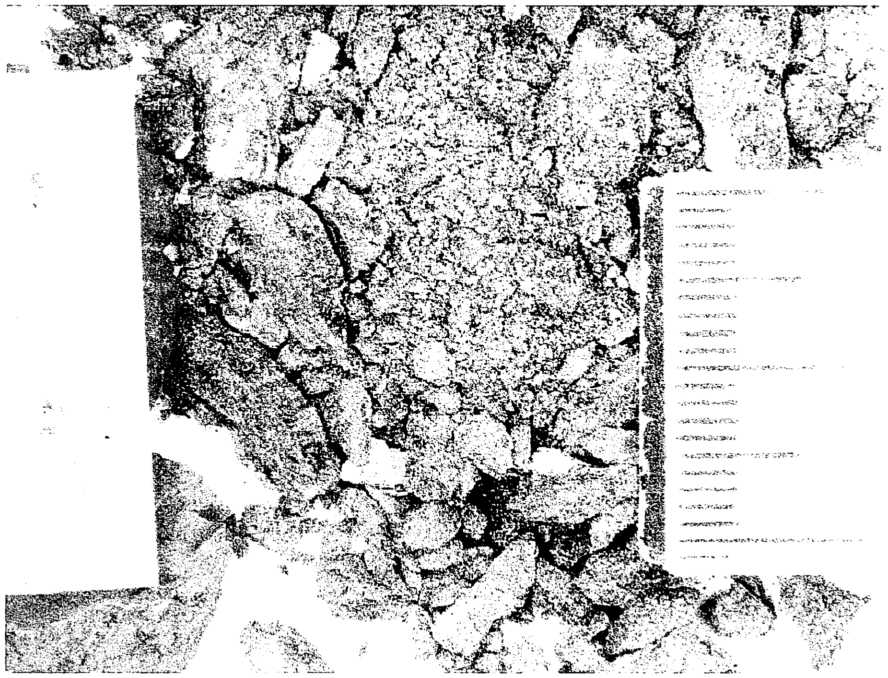
PE907900

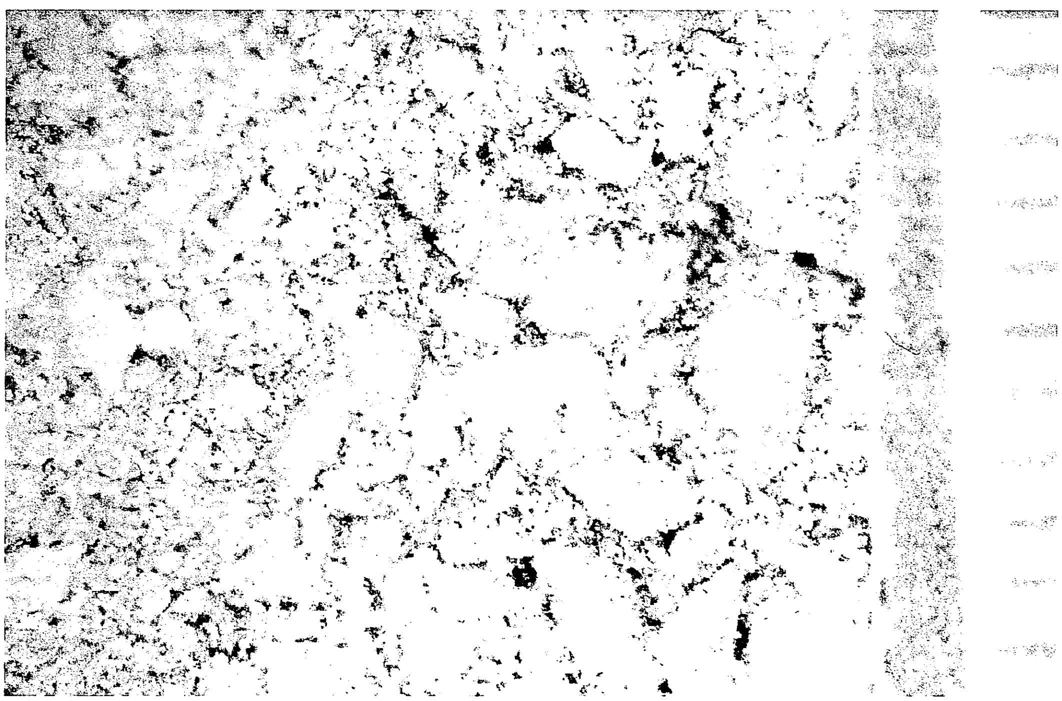
This is an enclosure indicator page.
The enclosure PE907900 is enclosed within the container PE900967 at this location in this document.

The enclosure PE907900 has the following characteristics:

ITEM_BARCODE =	PE907900
CONTAINER_BARCODE =	PE900967
NAME =	Sidewall Core Photograph
BASIN =	OTWAY
PERMIT =	PEP119
TYPE =	WELL
SUBTYPE =	CORE_PHOTO
DESCRIPTION =	Plate 1: Sidewall Core 4 Photograph, 1815m, (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	
W_NO =	W1088
WELL_NAME =	Bus Swamp-1
CONTRACTOR =	Geological Survey of Victoria Basin Studies
CLIENT_OP_CO =	Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)





Siltstone: medium grey to dark grey, trace micromicaceous, firm to moderately hard, non calcareous. No apparent bedding or structure.

PLATE 1: SIDEWALL CORE 4 (1815m)

PE907901

This is an enclosure indicator page.
The enclosure PE907901 is enclosed within the container PE900967 at this location in this document.

The enclosure PE907901 has the following characteristics:

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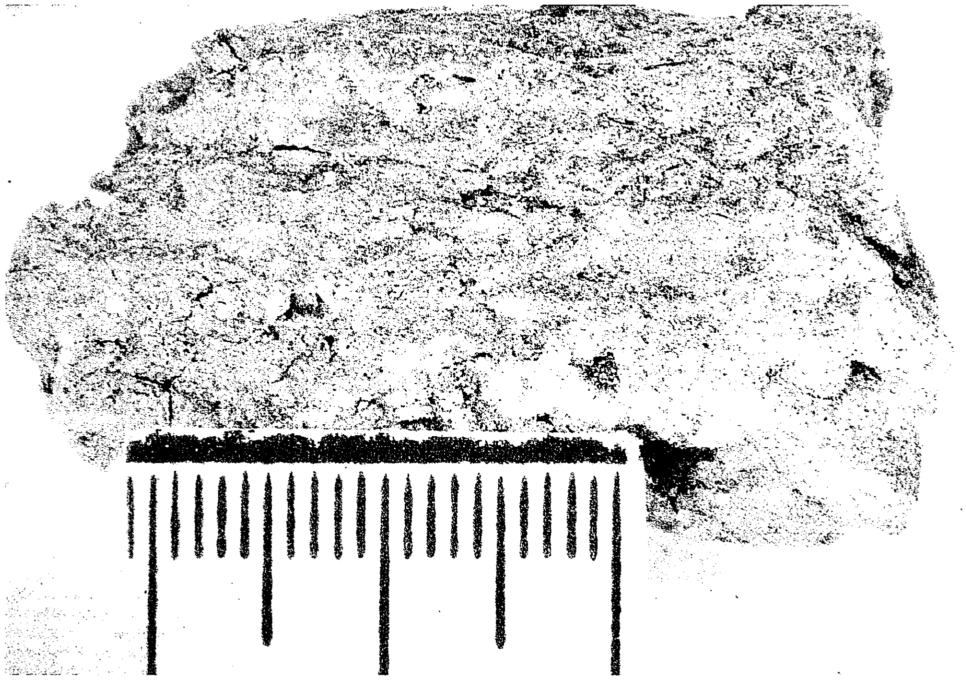
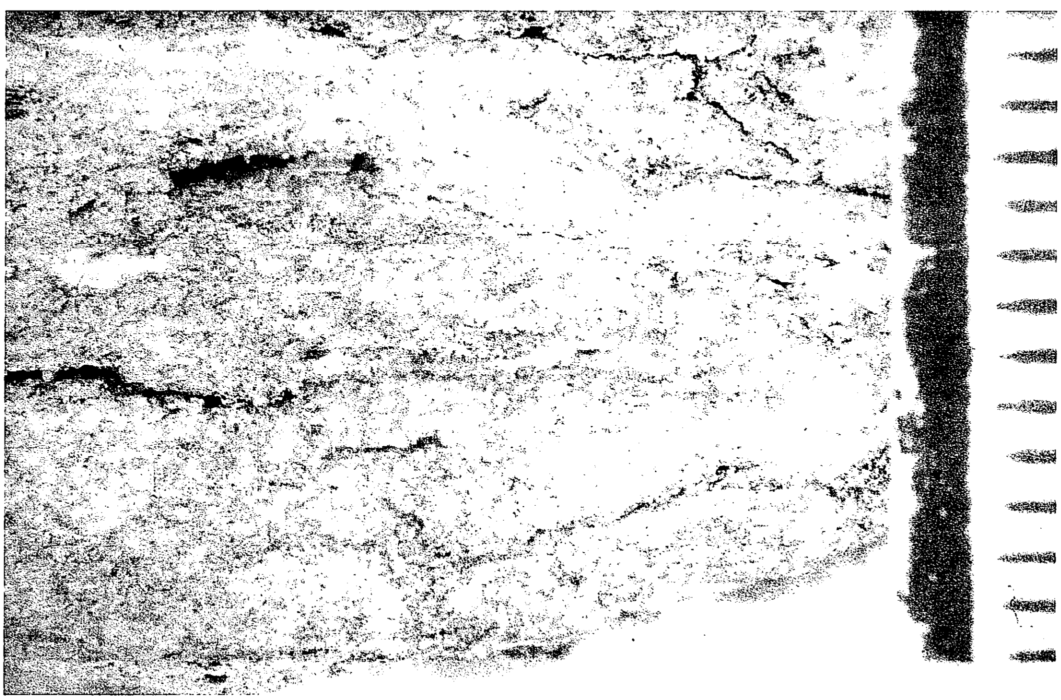
CONTAINER_BARCODE = PE900967
NAME = Sidewall Core Photograph
BASIN = OTWAY
PERMIT = PEP119
TYPE = WELL
SUBTYPE = CORE_PHOTO
DESCRIPTION = Plate 2: Sidewall Core 8 Photograph, 1756m, (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =
DATE_CREATED =
DATE_RECEIVED =
W_NO = W1088
WELL_NAME = Bus Swamp-1
CONTRACTOR = Geological Survey of Victoria Basin Studies
CLIENT_OP_CO = Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)





Sandstone: light, fine grained, well sorted, argillaceous, soft, mixed with drilling mud.

PLATE 2: SIDEWALL CORE 8 (1756m)

PE907902

This is an enclosure indicator page.
The enclosure PE907902 is enclosed within the container PE900967 at this location in this document.

The enclosure PE907902 has the following characteristics:

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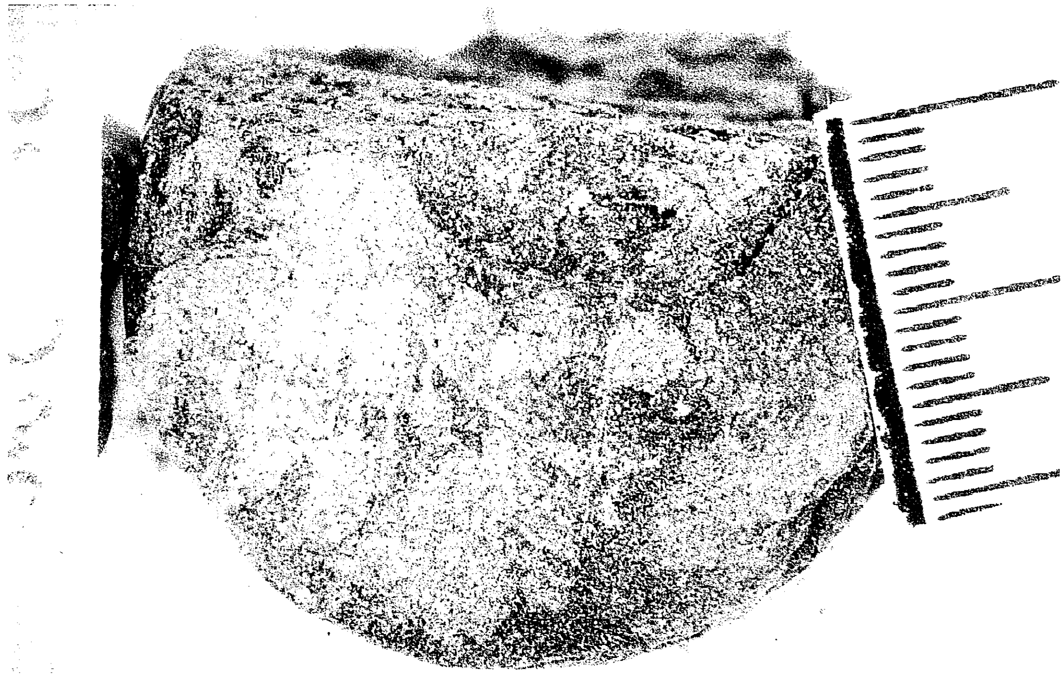
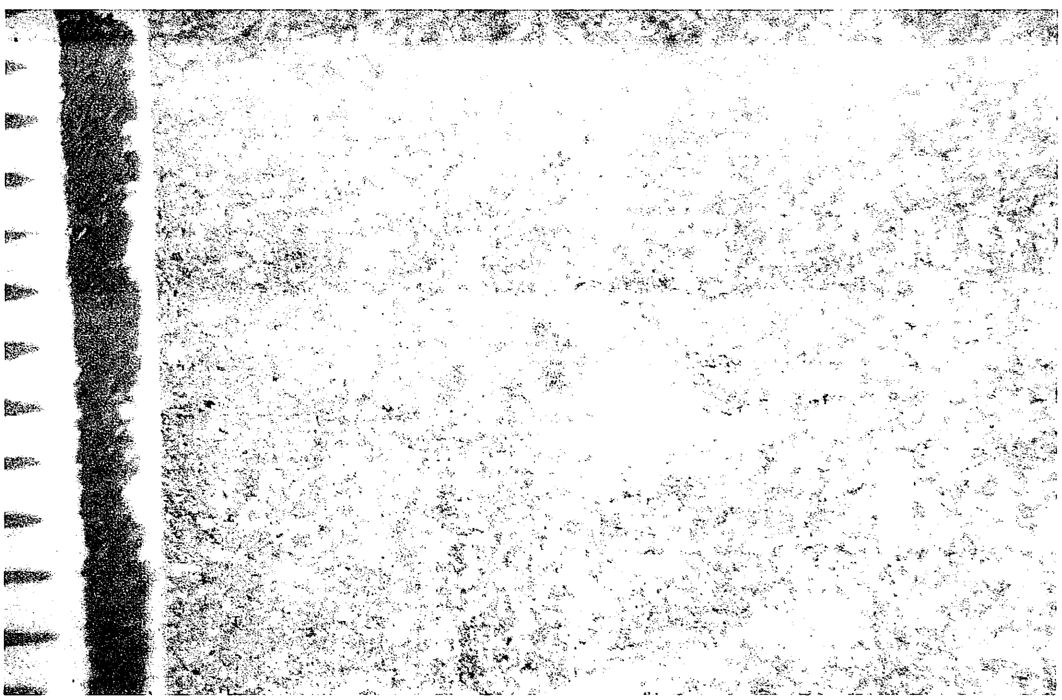
CONTAINER_BARCODE =	PE900967
NAME =	Sidewall Core Photograph
BASIN =	OTWAY
PERMIT =	PEP119
TYPE =	WELL
SUBTYPE =	CORE_PHOTO
DESCRIPTION =	Plate 3: Sidewall Core 30 Photograph, 913m, (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	
W_NO =	W1088
WELL_NAME =	Bus Swamp-1
CONTRACTOR =	Geological Survey of Victoria Basin Studies
CLIENT_OP_CO =	Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)





Claystone: medium grey to medium dark grey, silty, quartzose, micaceous, soft to moderately firm, non calcareous, rare lithics, no apparent bedding features.

PLATE 3: SIDEWALL CORE 30 (913m)

PE907903

This is an enclosure indicator page.
The enclosure PE907903 is enclosed within the container PE900967 at this location in this document.

The enclosure PE907903 has the following characteristics:

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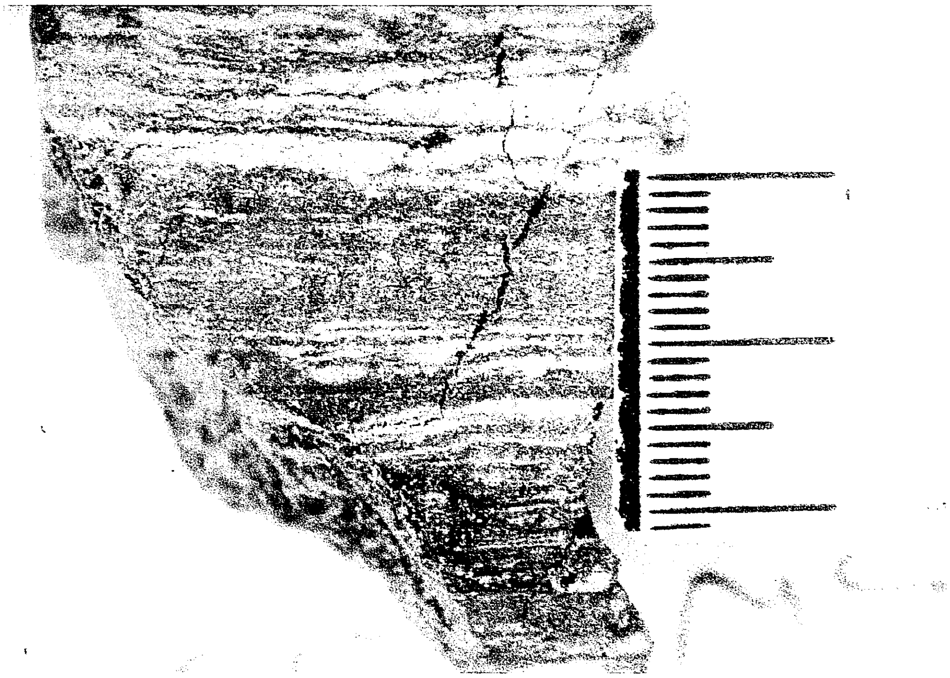
CONTAINER_BARCODE =	PE900967
NAME =	Sidewall Core Photograph
BASIN =	OTWAY
PERMIT =	PEP119
TYPE =	WELL
SUBTYPE =	CORE_PHOTO
DESCRIPTION =	Plate 4: Sidewall Core 33 Photograph, 862m, (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	
W_NO =	W1088
WELL_NAME =	Bus Swamp-1
CONTRACTOR =	Geological Survey of Victoria Basin Studies
CLIENT_OP_CO =	Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)



Claystone: dark grey, carbonaceous, soft to moderately firm, interlaminated with very fine sandstone (2mm), arkosic, well sorted, argillaceous, silty in part, contains lenticular features.

PLATE 4: SIDEWALL CORE 33 (862m)

PE907904

This is an enclosure indicator page.
The enclosure PE907904 is enclosed within the container PE900967 at this location in this document.

The enclosure PE907904 has the following characteristics:

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CONTAINER_BARCODE = PE900967
             NAME = Sidewall Core Photograph
            BASIN = OTWAY
           PERMIT = PEP119
             TYPE = WELL
          SUBTYPE = CORE_PHOTO
      DESCRIPTION = Plate 5: Sidewall Core 41 Photograph,
                    657m, (enclosure from Well Completion
                    Report vol.1) for Bus Swamp-1
          REMARKS =
     DATE_CREATED =
    DATE_RECEIVED =
             W_NO = W1088
        WELL_NAME = Bus Swamp-1
       CONTRACTOR = Geological Survey of Victoria Basin
                    Studies
     CLIENT_OP_CO = Dept of Energy & Minerals
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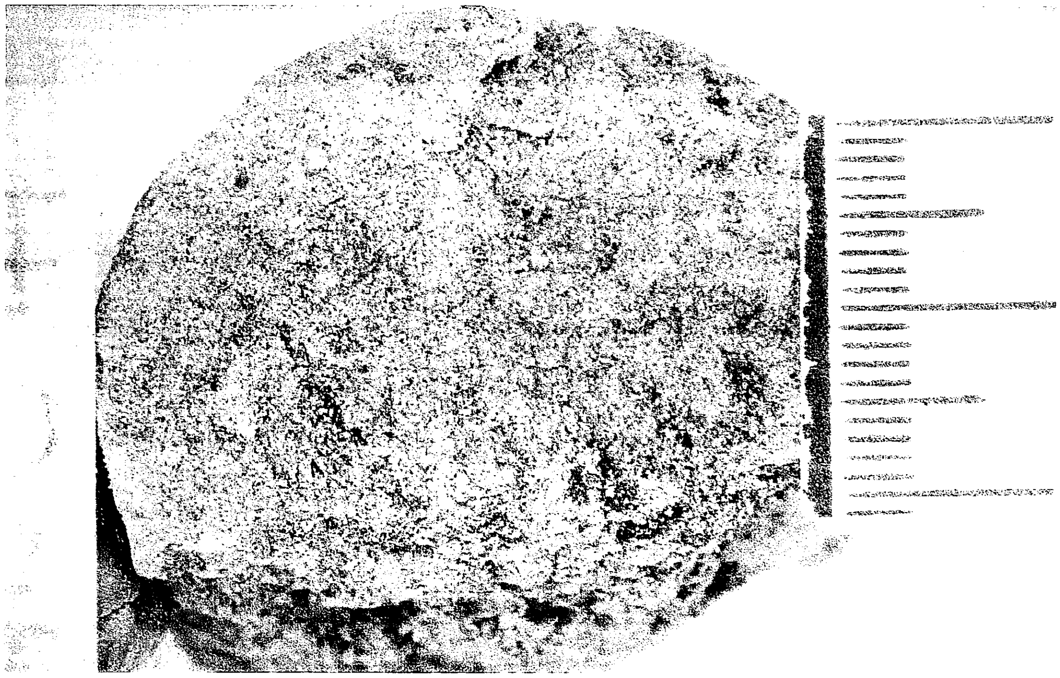
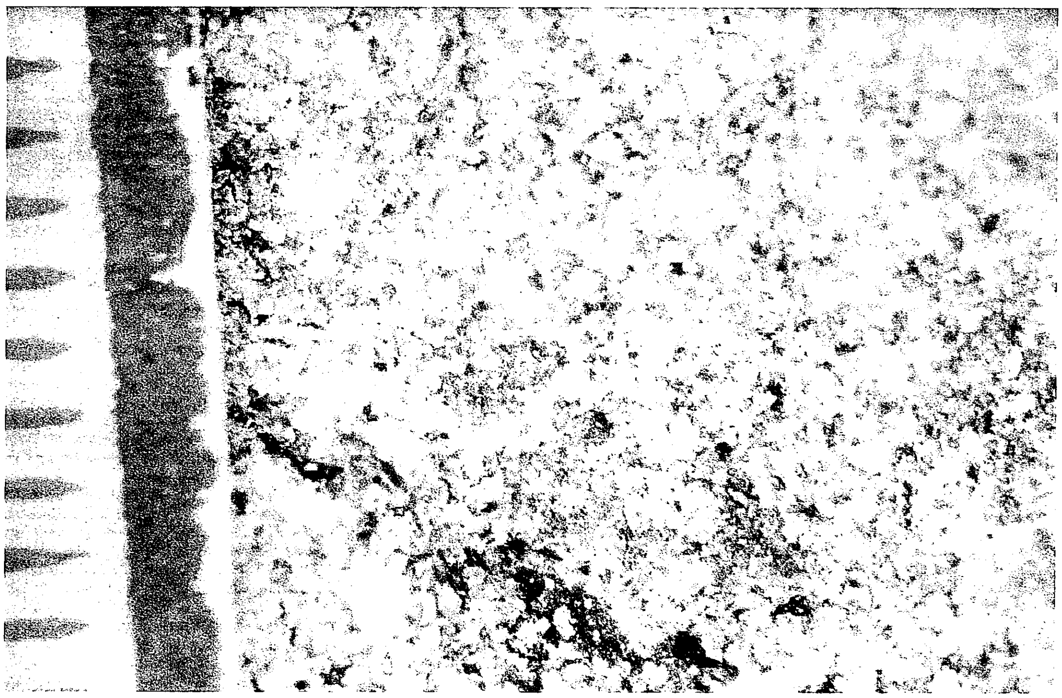
(Inserted by DNRE - Vic Govt Mines Dept)





Sandstone: light olive grey to olive grey, argillaceous, predominantly quartzose, well sorted, angular to subangular, occasionally subrounded, common lithics/ feldspathics, rare coarse quartz grain, claystone clasts, friable to moderately firm, non calcareous, no apparent bedding features

PLATE 5: SIDEWALL CORE 41 (657m)

PE907905

This is an enclosure indicator page.
The enclosure PE907905 is enclosed within the container PE900967 at this location in this document.

The enclosure PE907905 has the following characteristics:

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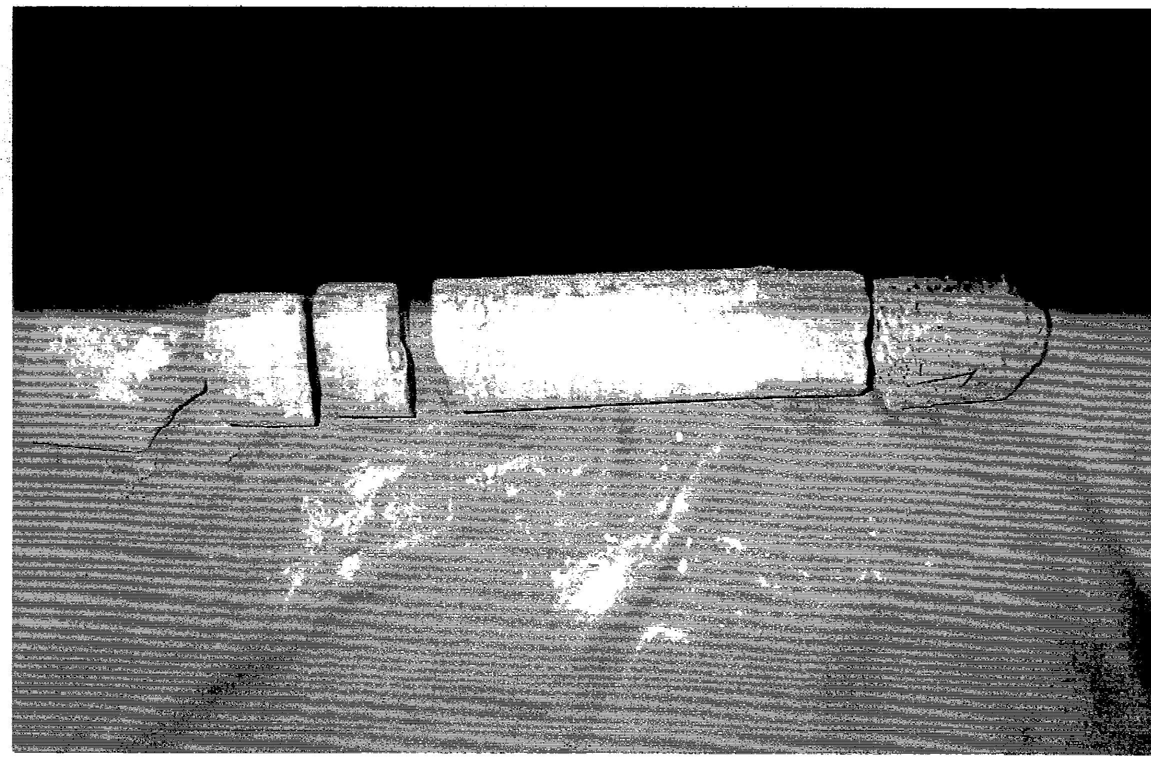
CONTAINER_BARCODE = PE900967
NAME = Core Photograph
BASIN = OTWAY
PERMIT = PEP119
TYPE = WELL
SUBTYPE = CORE_PHOTO
DESCRIPTION = Plate 6; Section of Core 1, 830.4m-836.4m: Eumeralla Formation (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =
DATE_CREATED =
DATE_RECEIVED =
W_NO = W1088
WELL_NAME = Bus Swamp-1
CONTRACTOR = Geological Survey of Victoria Basin Studies
CLIENT_OP_CO = Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)



<u>Section of Core 1 (830.4 - 836.4m)</u>: <u>Eumeralla Formation.</u>
Discontinuous section of massive claystone caked with mud. The only non massive section of core consists of approximately 7cm at the base (right side of photograph) and is described below.

PLATE 6

PE907906

This is an enclosure indicator page.
The enclosure PE907906 is enclosed within the container PE900967 at this location in this document.

The enclosure PE907906 has the following characteristics:

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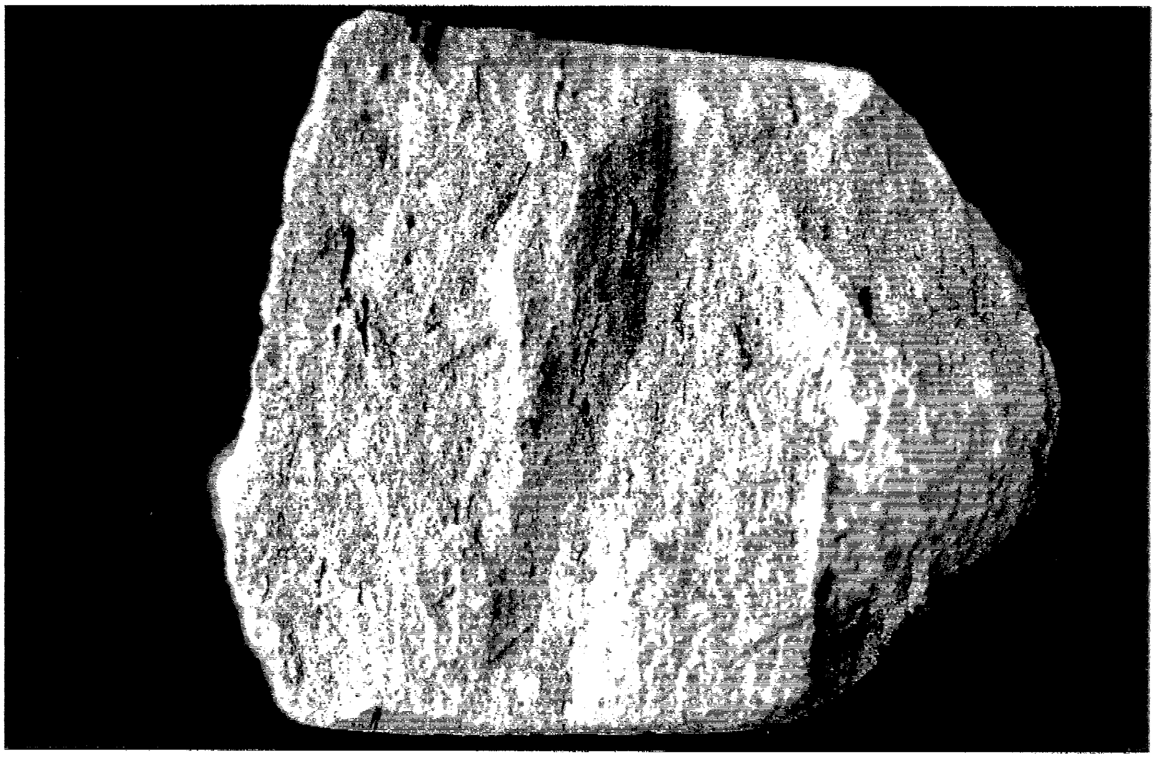
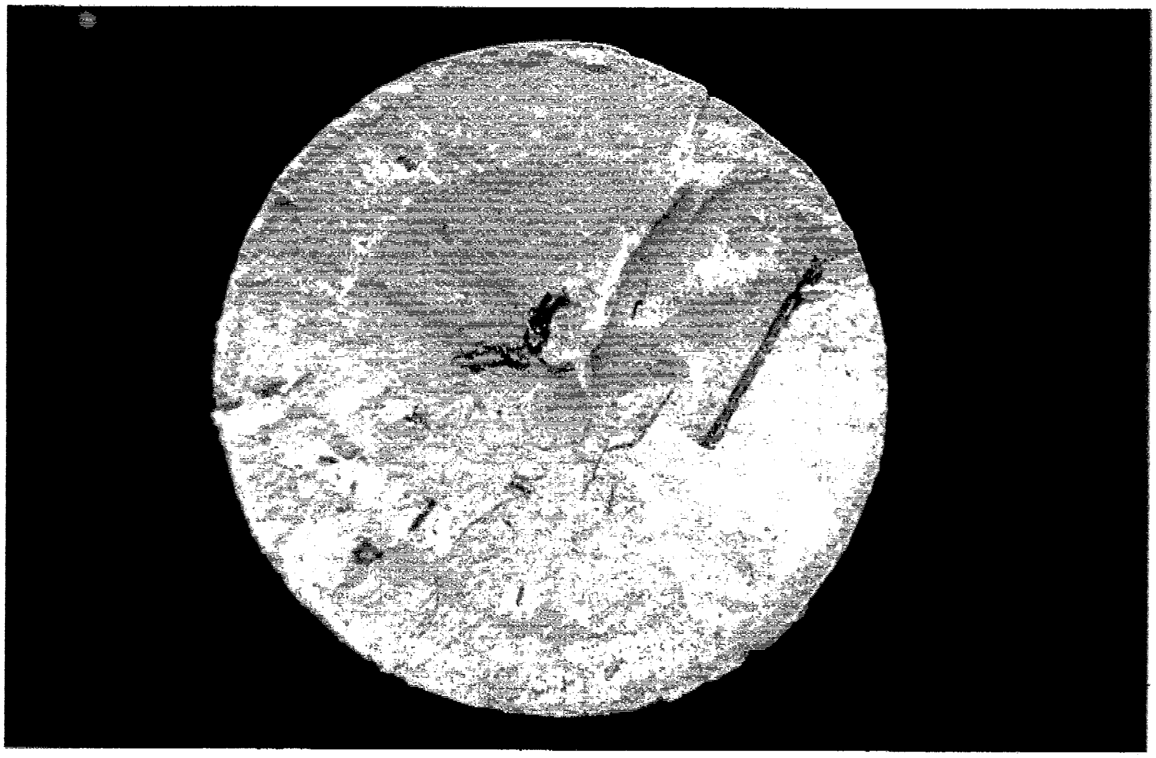
CONTAINER_BARCODE =	PE900967
NAME =	Core Photograph
BASIN =	OTWAY
PERMIT =	PEP119
TYPE =	WELL
SUBTYPE =	CORE_PHOTO
DESCRIPTION =	Plate 7: Detailed and Top Sections of Core 1 (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	
W_NO =	W1088
WELL_NAME =	Bus Swamp-1
CONTRACTOR =	Geological Survey of Victoria Basin Studies
CLIENT_OP_CO =	Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)



Detailed section of Core 1: Showing carbonaceous specks and plant/ coally material in claystone in the basal part of the core. Olive grey to light olive grey, argillaceous, non calcareous, micaceous, occasionally laminated.



Top of Section of Core 1: This slice through the top of core 1 shows well preserved plant material embedded in massive claystone.

PLATE 7

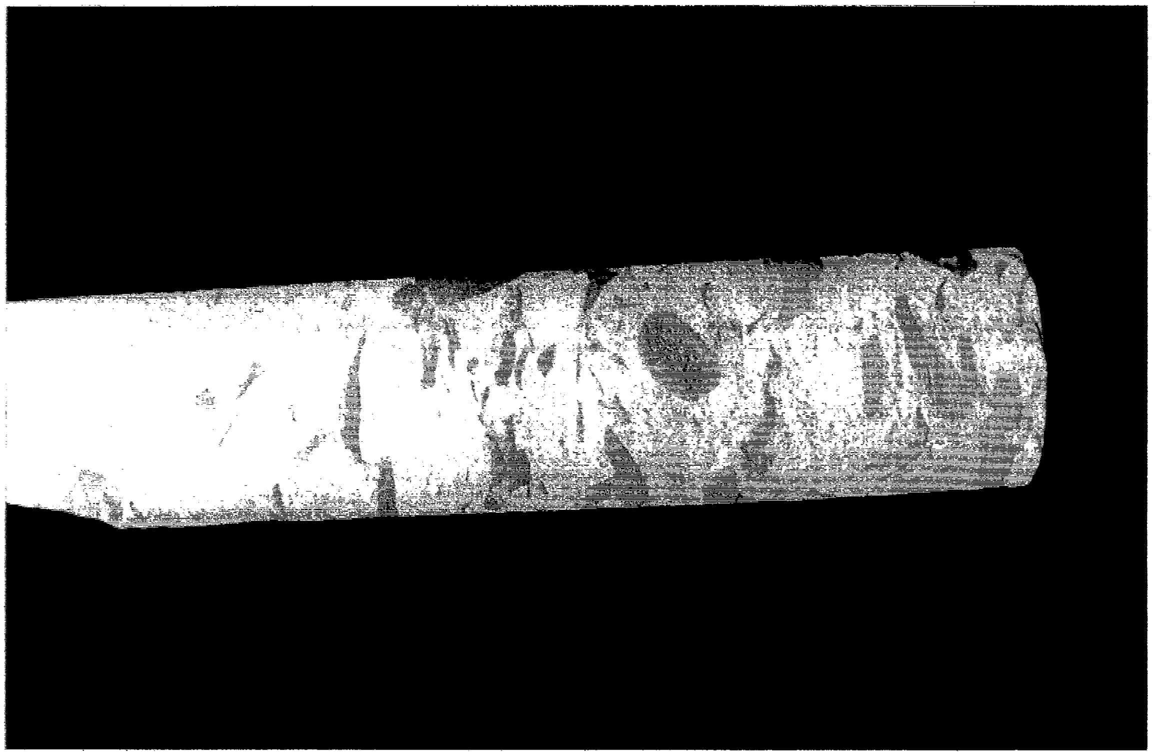
PE907907

This is an enclosure indicator page.
The enclosure PE907907 is enclosed within the container PE900967 at this location in this document.

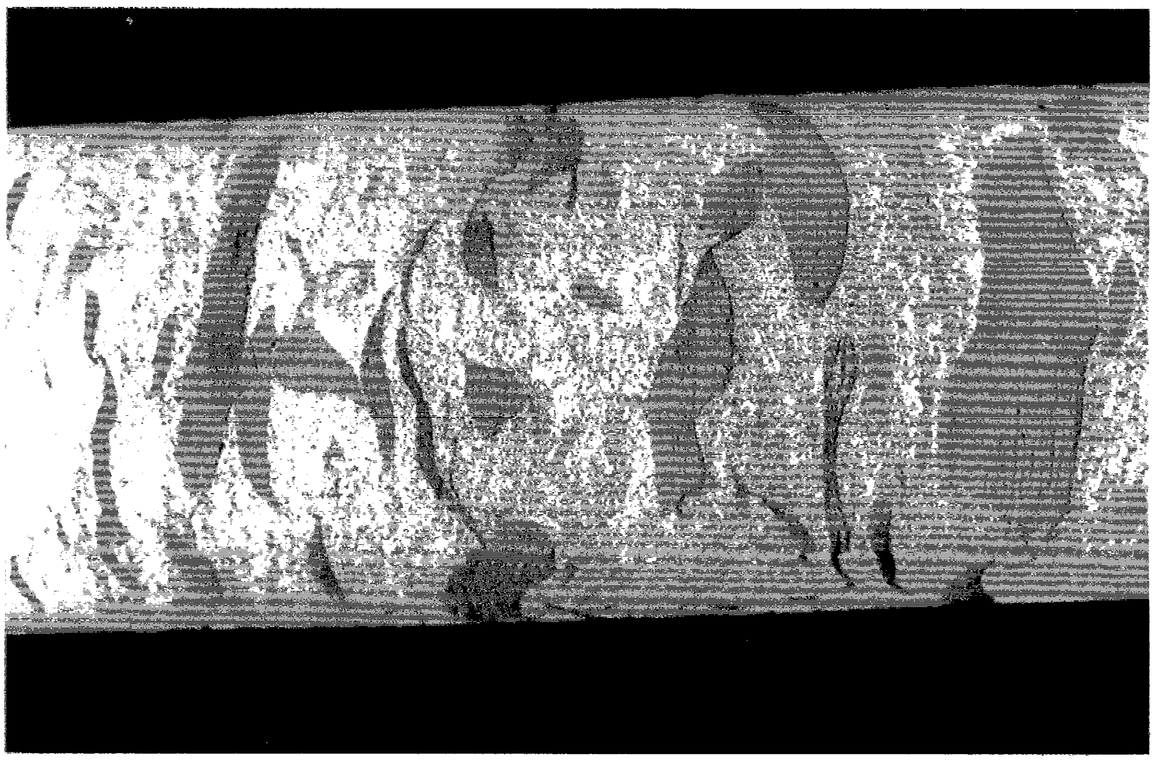
The enclosure PE907907 has the following characteristics:

ITEM_BARCODE =	PE907907
CONTAINER_BARCODE =	PE900967
NAME =	Core Photograph
BASIN =	OTWAY
PERMIT =	PEP119
TYPE =	WELL
SUBTYPE =	CORE_PHOTO
DESCRIPTION =	Plate 8; Section of Core 2, 1509.8m-1515.8m: Pretty Hill Formation (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	
W_NO =	W1088
WELL_NAME =	Bus Swamp-1
CONTRACTOR =	Geological Survey of Victoria Basin Studies
CLIENT_OP_CO =	Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)



Section of Core 2 (1509.8 - 1515.8m): Pretty Hill Formation - Crayfish Subgroup. Continuous section showing the transition from the upper massive sandstone with occasional clay lenses to a sandstone with occasional, increasing to common claystone clasts. There are no obvious bedding features, although clast orientation suggests horizontal bedding.



Detailed section of Core 2: Showing a lower part of the core with common claystone clasts. The clasts can be as large as 1.5cm across, are moderate to greyish brown, sometimes rounded, slightly calcareous and slightly carbonaceous.

PLATE 8

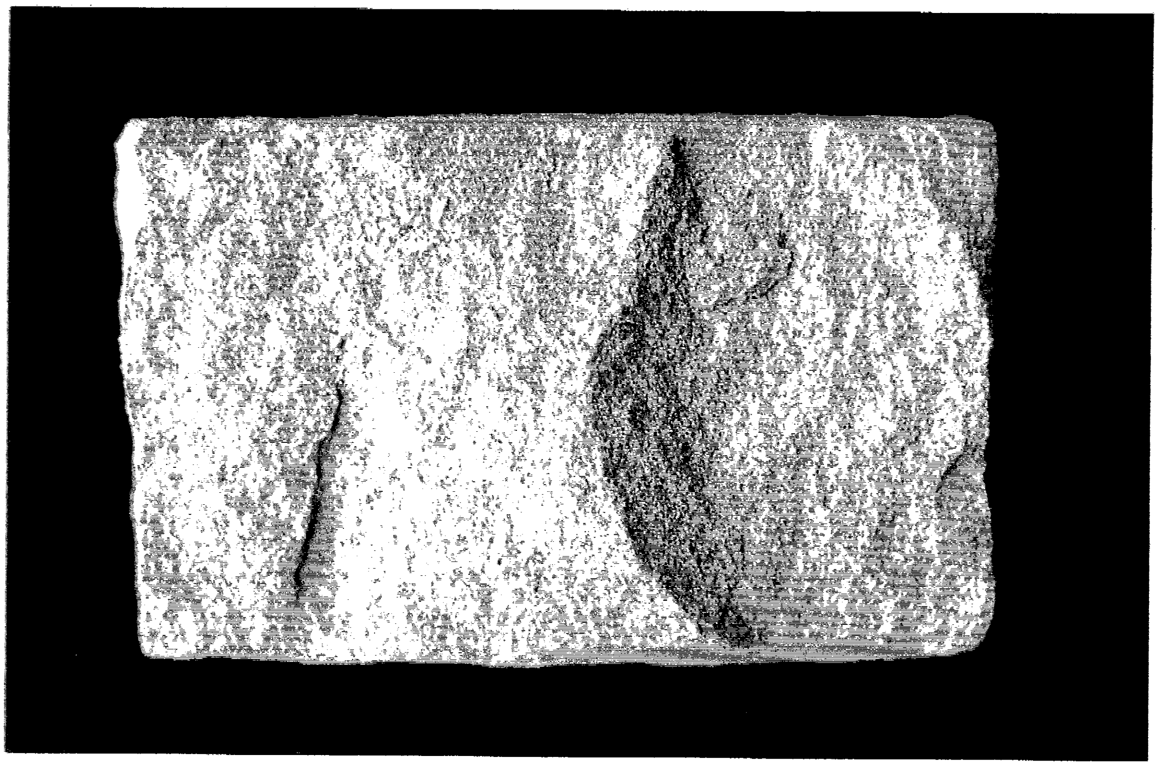
PE907908

This is an enclosure indicator page.
The enclosure PE907908 is enclosed within the container PE900967 at this location in this document.

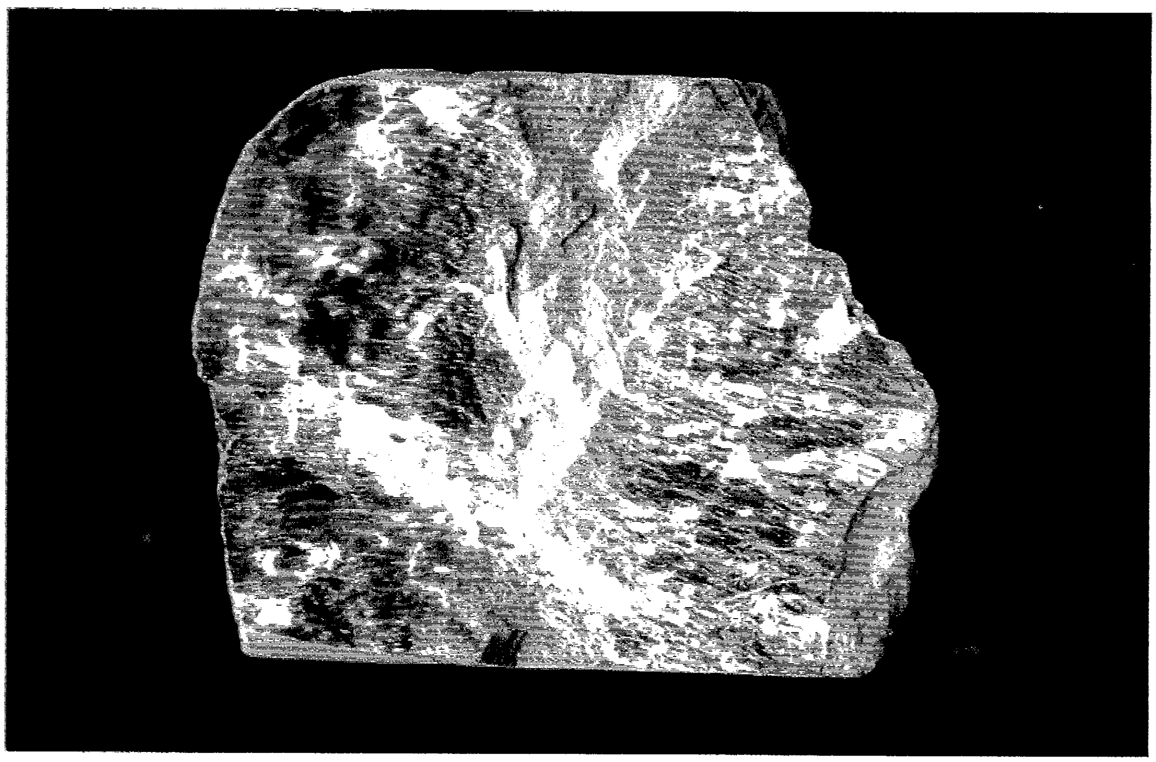
The enclosure PE907908 has the following characteristics:

```
       ITEM_BARCODE = PE907908
  CONTAINER_BARCODE = PE900967
               NAME =  Core Photograph
              BASIN = OTWAY
             PERMIT = PEP119
               TYPE = WELL
            SUBTYPE = CORE_PHOTO
        DESCRIPTION = Plate 9; Detailed Sections of Core 2
                      (enclosure from Well Completion Report
                      vol.1) for Bus Swamp-1
            REMARKS =
       DATE_CREATED =
      DATE_RECEIVED =
               W_NO = W1088
          WELL_NAME = Bus Swamp-1
         CONTRACTOR = Geological Survey of Victoria Basin
                      Studies
       CLIENT_OP_CO = Dept of Energy & Minerals
```

(Inserted by DNRE - Vic Govt Mines Dept)



Detailed section of Core 2: Showing a vertical cross section through an upper part of the core. The sandstone is light grey, massive, quartzose and well sorted. Also present is trace silica cement, trace calcite cement, argillaceous matrix and common lithic grains and garnets. The core has low visual porosity.



Section of Core 2: Shown is a vertical slickenside surface near the base of the core.

PLATE 9

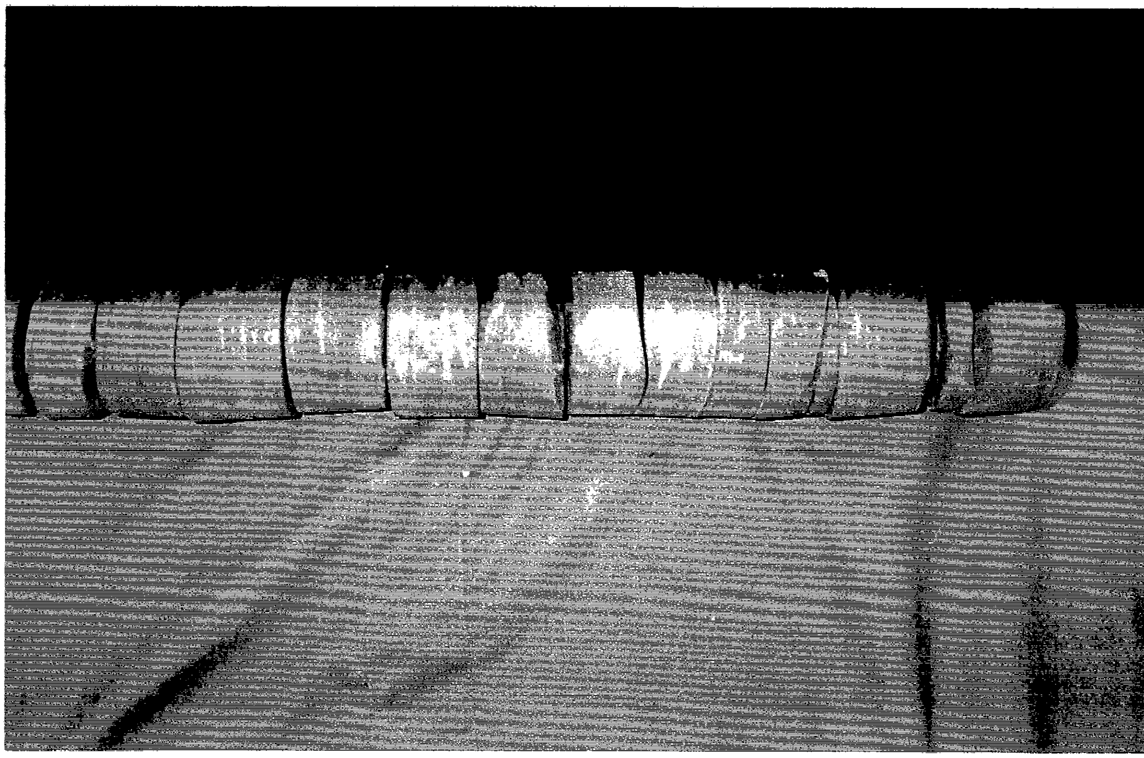
PE907909

This is an enclosure indicator page.
The enclosure PE907909 is enclosed within the container PE900967 at this location in this document.

The enclosure PE907909 has the following characteristics:

ITEM_BARCODE = PE907909
CONTAINER_BARCODE = PE900967
NAME = Core Photograph
BASIN = OTWAY
PERMIT = PEP119
TYPE = WELL
SUBTYPE = CORE_PHOTO
DESCRIPTION = Plate 10; Section of Core 3, 1785.2m-1790.1m: Pretty Hill Formation, Crayfish Subgroup (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =
DATE_CREATED =
DATE_RECEIVED =
W_NO = W1088
WELL_NAME = Bus Swamp-1
CONTRACTOR = Geological Survey of Victoria Basin Studies
CLIENT_OP_CO = Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)



Section of Core 3 (1785.2 - 1790.1m): Pretty Hill Formation - Crayfish Subgroup.
A typical section of core at this level. The rock is extremely friable siltstone and the core has fractured apart at regular intervals. Frequent laminae of light grey sandstone exist here with resultant flame structures evident throughout the core. Cross bedding and erosional surfaces can be observed, along with sections of more massive unfeatured siltstone.

PLATE 10

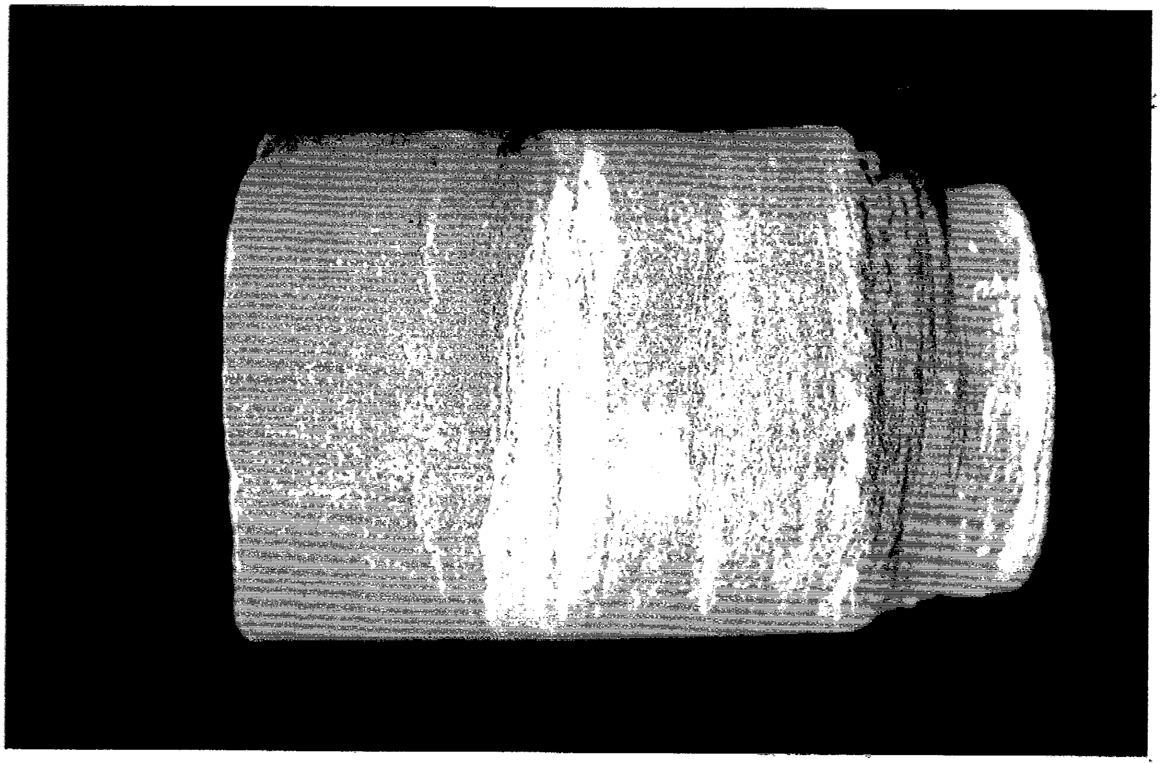
PE907910

This is an enclosure indicator page.
The enclosure PE907910 is enclosed within the container PE900967 at this location in this document.

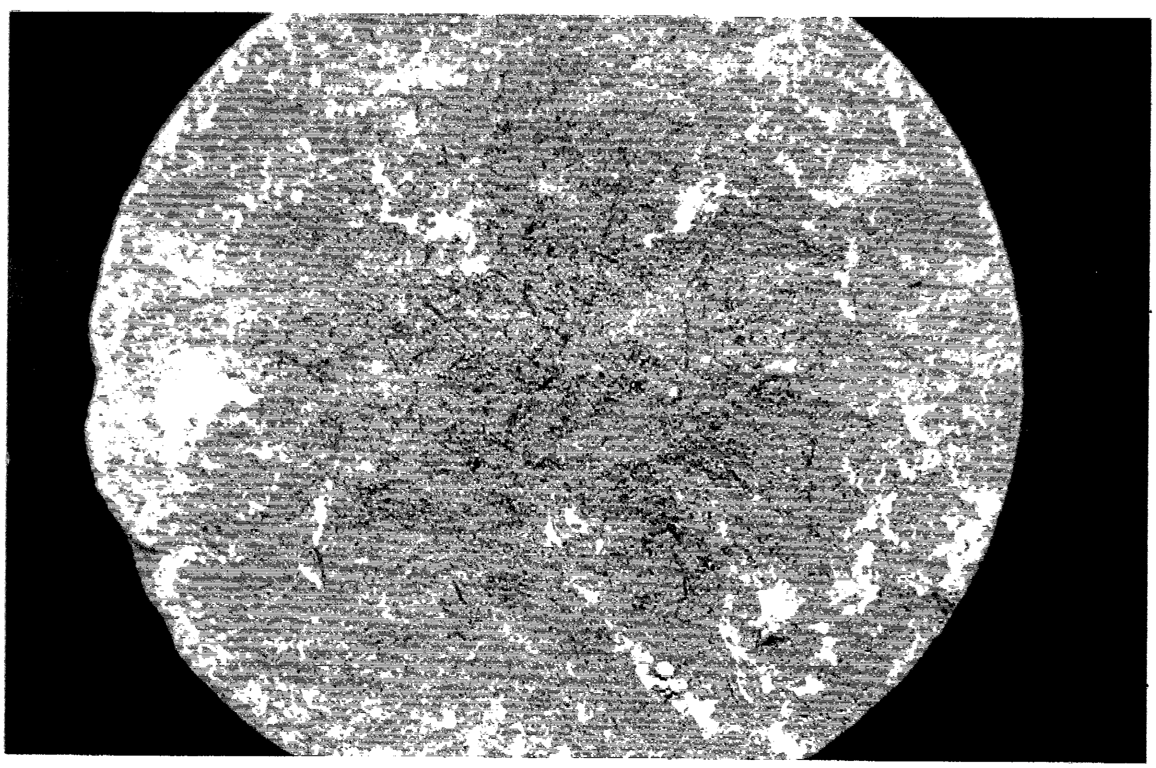
The enclosure PE907910 has the following characteristics:

ITEM_BARCODE = PE907910
CONTAINER_BARCODE = PE900967
NAME = Core Photograph
BASIN = OTWAY
PERMIT = PEP119
TYPE = WELL
SUBTYPE = CORE_PHOTO
DESCRIPTION = Plate 11; Detailed Sections of Core 3 (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =
DATE_CREATED =
DATE_RECEIVED =
W_NO = W1088
WELL_NAME = Bus Swamp-1
CONTRACTOR = Geological Survey of Victoria Basin Studies
CLIENT_OP_CO = Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)



Detailed section of Core 3: Showing a medium grey to medium dark grey siltstone, argillaceous to arenaceous, moderately hard, micaceous, quartzose, occasional large quartz grains, occasional light sandstone laminae, occasional claystone laminae, carbonaceous specks and occasional fossil plant material.



Section through Core 3: This slice through the core at approximately 1787m shows a clayey siltstone with embedded fossil plant material.

PLATE 11

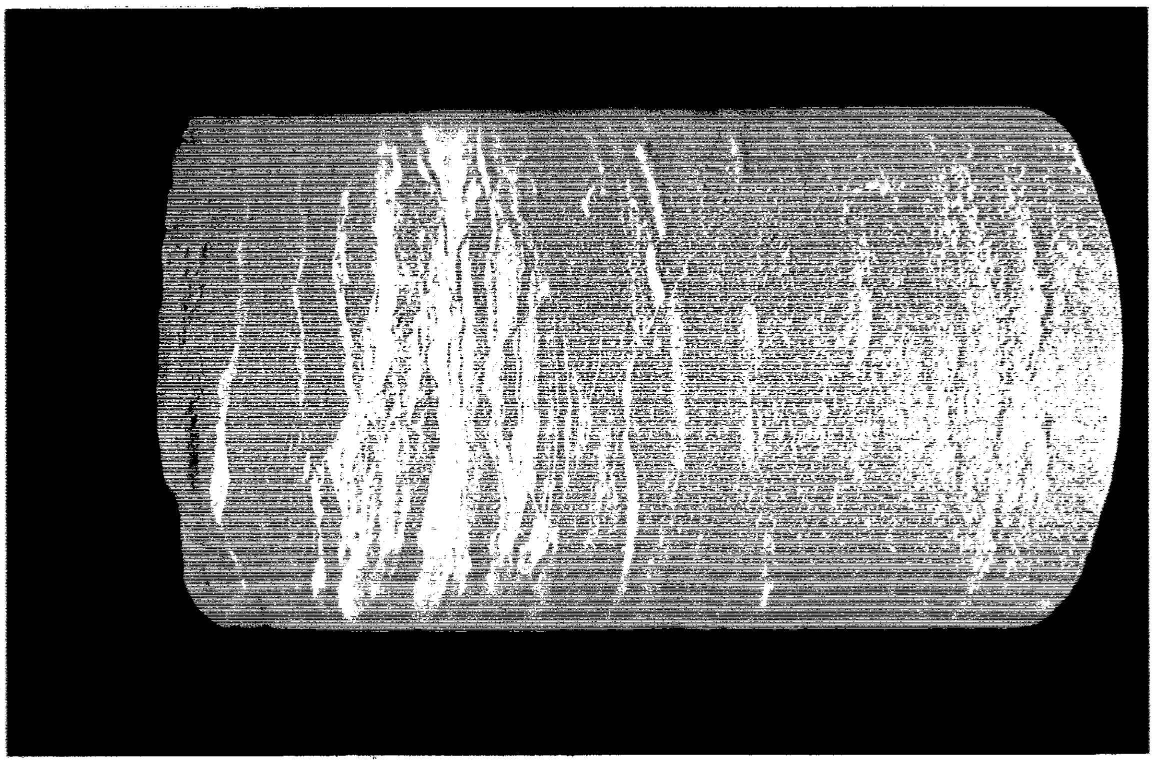
PE907911

This is an enclosure indicator page.
The enclosure PE907911 is enclosed within the container PE900967 at this location in this document.

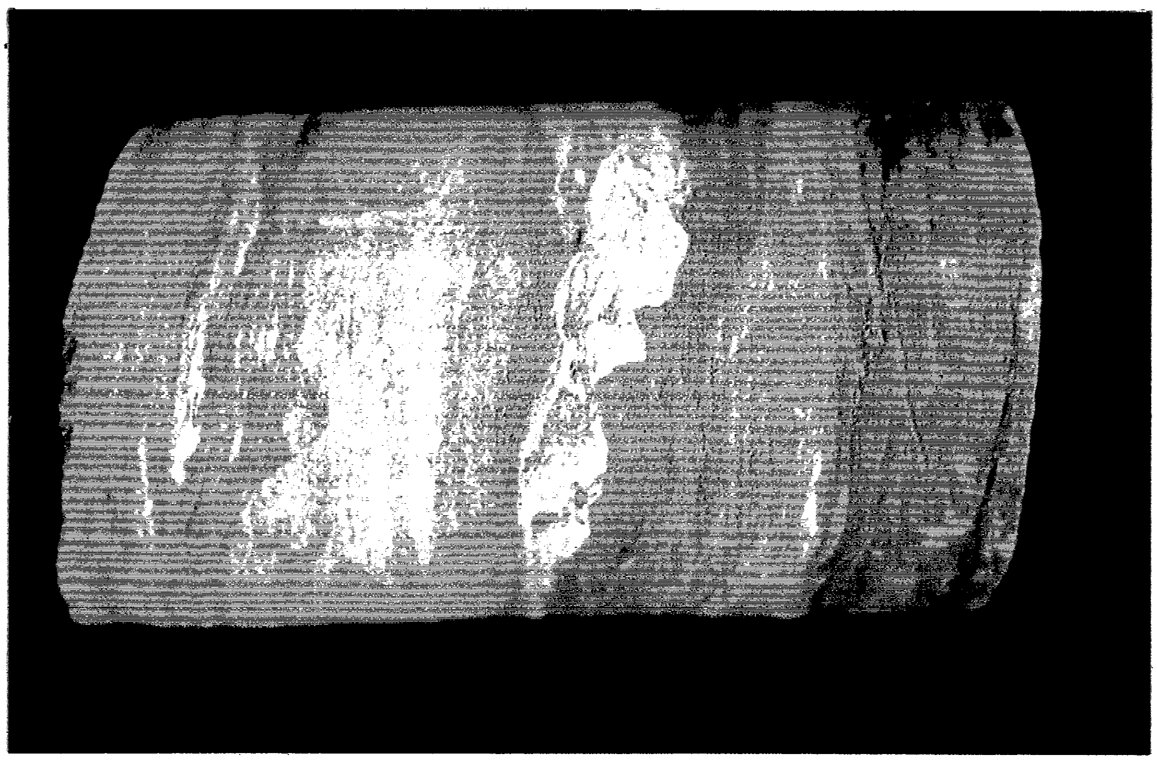
The enclosure PE907911 has the following characteristics:

ITEM_BARCODE =	PE907911
CONTAINER_BARCODE =	PE900967
NAME =	Core Photograph
BASIN =	OTWAY
PERMIT =	PEP119
TYPE =	WELL
SUBTYPE =	CORE_PHOTO
DESCRIPTION =	Plate 12; Detailed Sections of Core 3 (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	
W_NO =	W1088
WELL_NAME =	Bus Swamp-1
CONTRACTOR =	Geological Survey of Victoria Basin Studies
CLIENT_OP_CO =	Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)



<u>Detailed section of Core 3</u>: This section of core, approximately 10cm long, shows wavy bedding and microfaulting in fine siltstone and sandstone layers.



<u>Detailed section of Core 3</u>: Showing flame or squirt structures caused by loading of new sediment onto saturated clays and silts.

PLATE 12

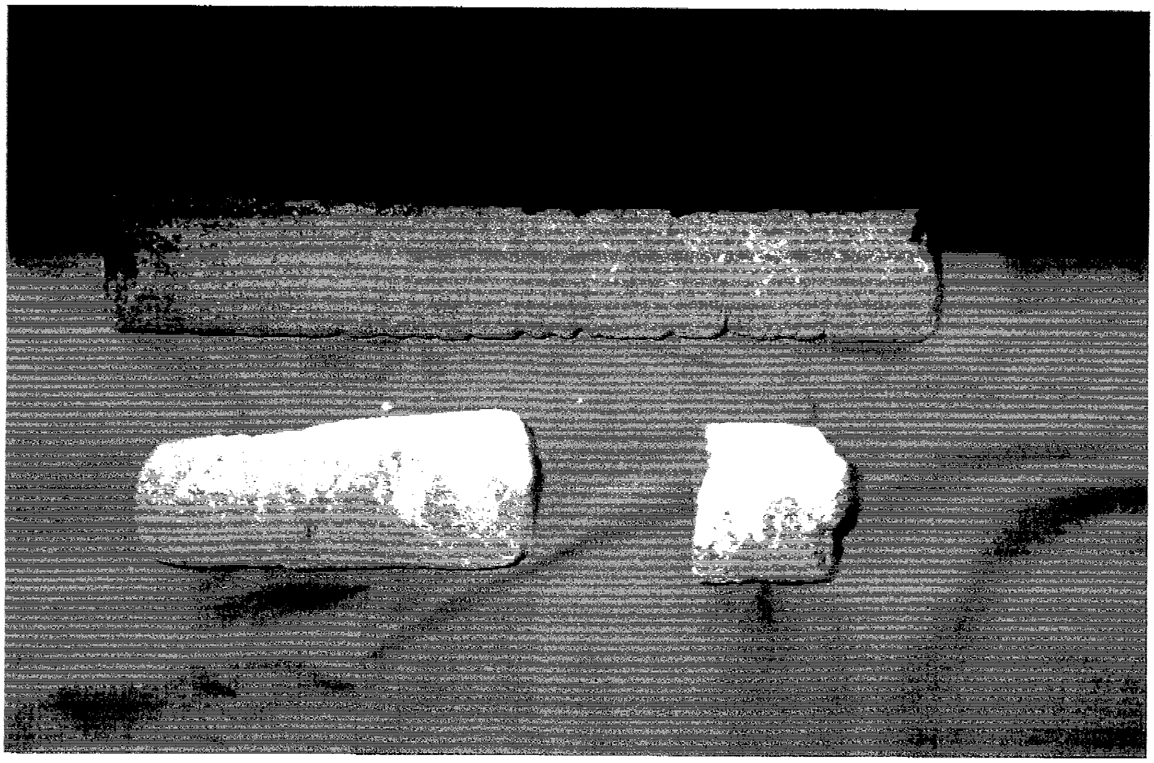
PE907912

This is an enclosure indicator page.
The enclosure PE907912 is enclosed within the container PE900967 at this location in this document.

The enclosure PE907912 has the following characteristics:

ITEM_BARCODE =	PE907912
CONTAINER_BARCODE =	PE900967
NAME =	Core Photograph
BASIN =	OTWAY
PERMIT =	PEP119
TYPE =	WELL
SUBTYPE =	CORE_PHOTO
DESCRIPTION =	Plate 13; Section of Core 4, 1832.1m-1835.2m: Basement (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	
W_NO =	W1088
WELL_NAME =	Bus Swamp-1
CONTRACTOR =	Geological Survey of Victoria Basin Studies
CLIENT_OP_CO =	Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)



Section of Core 4 (1832.1 - 1835.2m): Basement.
Showing a fairly continuous, unbroken core. The rock is a dark greenish grey to dusky blue green, massive altered volcanic.

PLATE 13

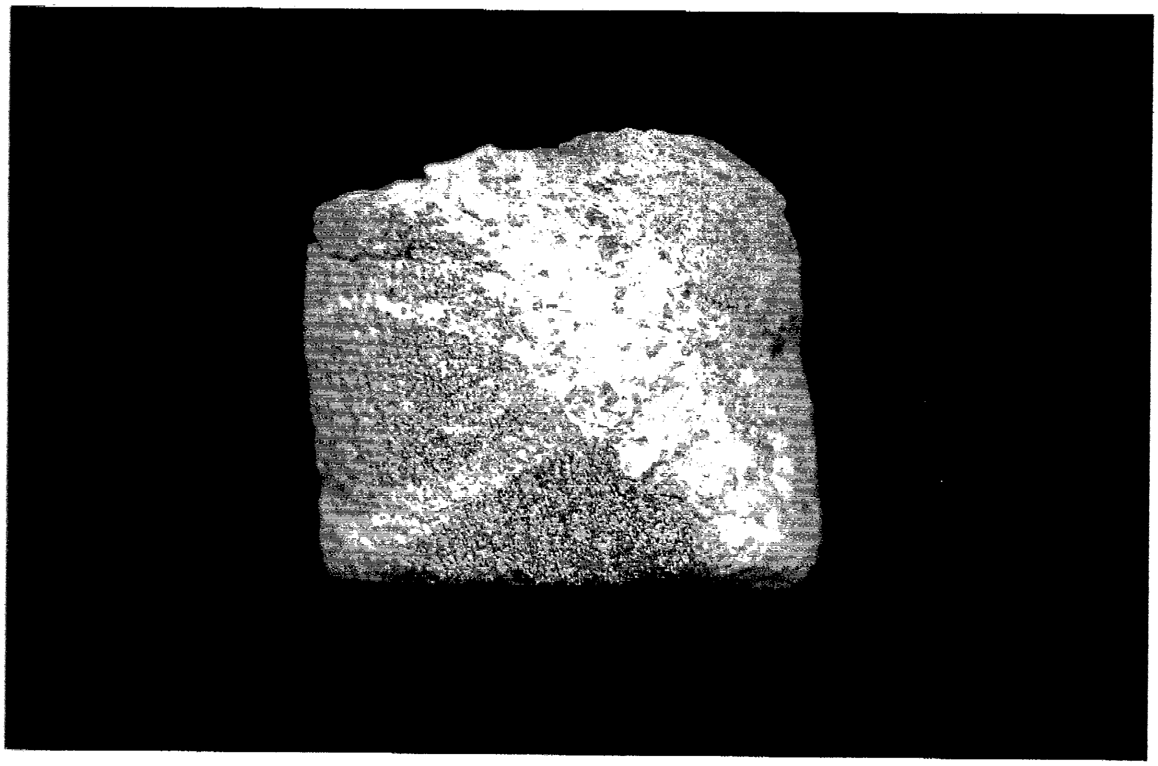
PE907913

This is an enclosure indicator page.
The enclosure PE907913 is enclosed within the container PE900967 at this location in this document.

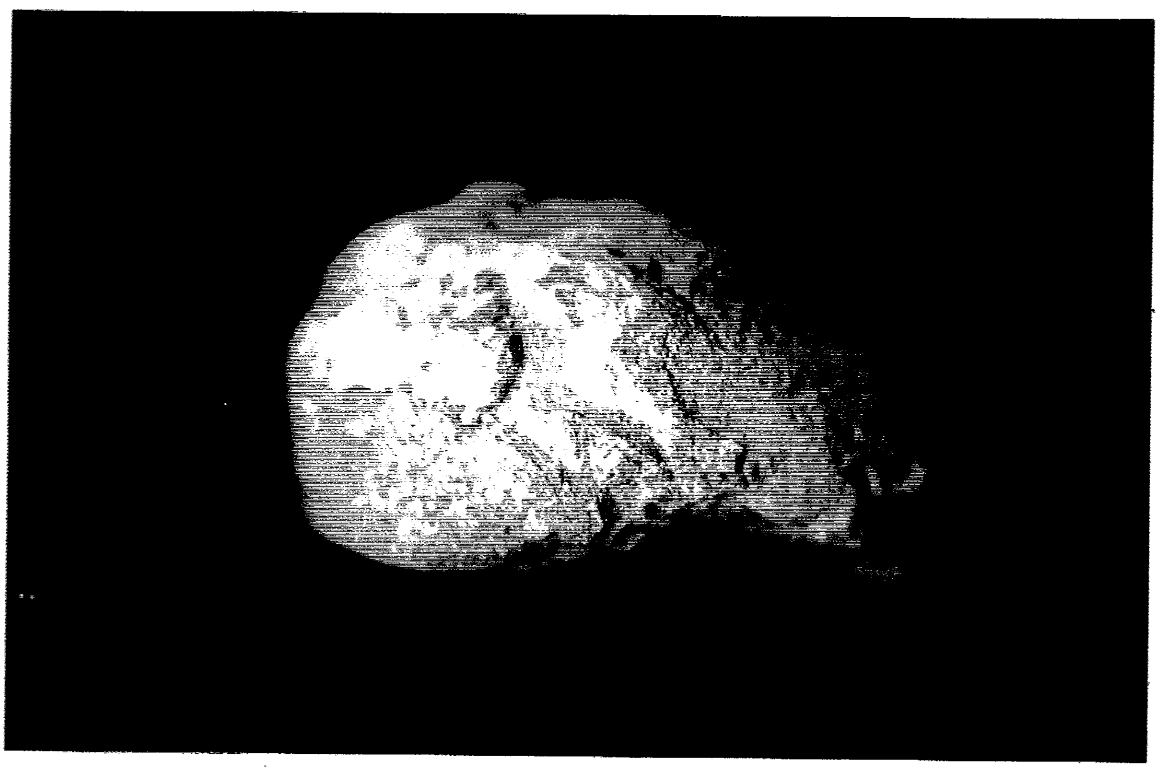
The enclosure PE907913 has the following characteristics:

ITEM_BARCODE =	PE907913
CONTAINER_BARCODE =	PE900967
NAME =	Core Photograph
BASIN =	OTWAY
PERMIT =	PEP119
TYPE =	WELL
SUBTYPE =	CORE_PHOTO
DESCRIPTION =	Plate 14; Detailed Sections of Core 4 (enclosure from Well Completion Report vol.1) for Bus Swamp-1
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	
W_NO =	W1088
WELL_NAME =	Bus Swamp-1
CONTRACTOR =	Geological Survey of Victoria Basin Studies
CLIENT_OP_CO =	Dept of Energy & Minerals

(Inserted by DNRE - Vic Govt Mines Dept)



Detailed section of Core 4: Showing a dark greenish grey to mottled white, massive holocrystalline altered volcanic rock. The rock is sericitized, chloritized and contains quartz, mica, feldspars and amphibole. Calcite veins are common. The photo shows that many of the calcite veins displace earlier calcite veins.



Detailed section of Core 4: Additional evidence for this core being basement is the appearance of folded veins within the rock.

PLATE 14

APPENDIX 6

APPENDIX
6

VELOCITY SURVEY REPORT

Velocity Data

WELL VELOCITY SURVEY

BUS SWAMP #1

PEP 119

Victoria

for

Geological Survey of Victoria

recorded by

VELOCITY DATA PTY. LTD.

processed by

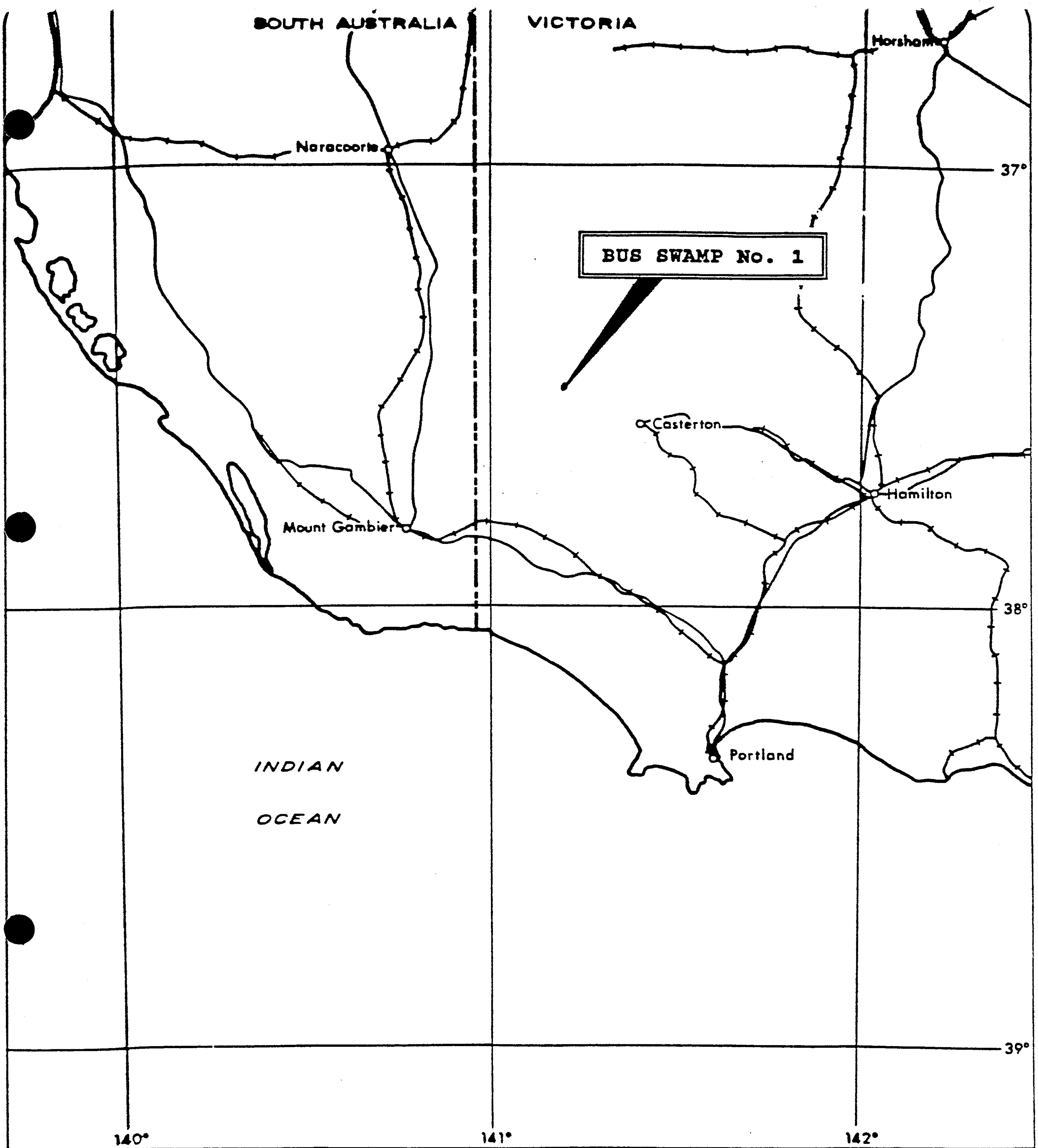
VELSEIS

Integrated Seismic Technologies

Brisbane, Australia

February 4, 1993

CONTENTS



BUS SWAMP No. 1

GEOLOGICAL SURVEY OF VICTORIA

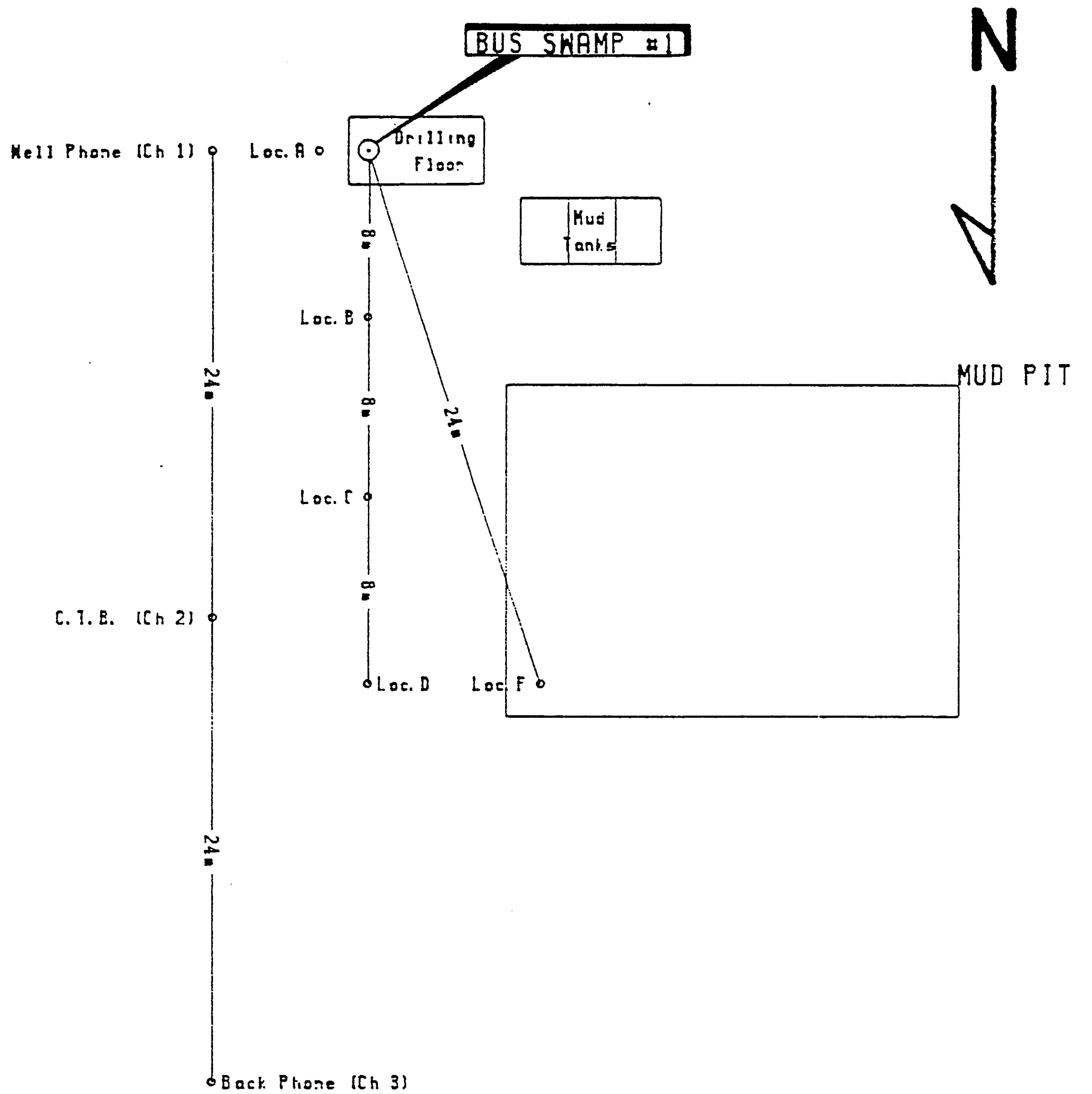
WELL LOCATION MAP

Scale 1: 1250 000 approx. (1 in. = 20 mi.)

0 5 10 20 30 40 50 MILES

0 5 10 20 30 40 50 60 KILOMETRES

Figure 1



BUS SWAMP #1

GEOLOGICAL SURVEY OF VICTORIA

SHOT POINT LOCATION SKETCH

Figure 2

SUMMARY

Velocity Data Pty Ltd conducted a velocity survey for Geological Survey of Victoria in the Bus Swamp No1 well , PEP 119, Otway Basin, Victoria.

The date of the survey was the 18th December 1992.

The results of the survey, which are considered to be reliable, have been used to calibrate the sonic log.

Explosives were used as an energy source with shots being fired in the mud pit in the majority of instances.

GENERAL INFORMATION

Name of Well	:	Bus Swamp #1
Location (Figure 1)	:	PEP 119, Otway Basin
Coordinates	:	Latitude 037 31 18
	:	Longitude 141 12 00
Date of Survey	:	December 18th, 1992.
Wireline Logging	:	Halliburton DDL #3
Weather	:	Fine
Operational Base	:	Brisbane
Operator	:	J. Larsen
Shooter	:	J. Brown
Client Representative	:	Mr. B. Simons

EQUIPMENT

Downhole Tool

Veldata Camlock 100 (90 mm)

Sensors:

6 HSI 4.5 Hz 215 ohm, high temperature (300 degrees F) detectors connected in series parallel. Frequency response 8-300 Hz within 3 dB.

Preamplifier:

48 dB fixed gain.
Frequency response 5-200 Hz within 3 dB.

Reference Geophone

Mark Products L1 4.5 Hz

Recording Instrument

VDLS 11/10 software controlled digital recording system utilising SIE OPA-10 floating point amplifiers for digital recording and SIE OPA-4 amplifiers for analog presentation. The system includes a DEC LSI-11 CPU,twin cassette tape unit and printer.

RECORDING

Energy Source	:	Explosive, Powergel
Shot Location	:	Mud pit
Charge Size	:	0.1 / 2.0 (125grm) sticks
Average Shot Depth	:	2.0 metre
Average Shot Offset	:	24.0 metres
Recording Geometry	:	Figure 2

Shots were recorded on digital cassette tape. Printouts of the shots used are included with this report.(Enclosure 2)

The sample rate was 1 ms with 0.5 ms sampling over a 200ms window encompassing the first arrivals. The scale of the graphic display varies with signal strength and is noted on each playout.

The times were picked from the printouts using the numerical value of the signal strength. (Enclosure 2)

PROCESSING

Elevation Data

Elevation of KB	:	91.4m above sea level
Elevation of Ground	:	88.0m above sea level
Elevation of Seismic Datum	:	0.0m above sea level
Depth Surveyed	:	1830.0m below KB
Total Depth	:	Unknown
Depth of Casing	:	205.4m below KB
Sonic Log Interval	:	0.2 to 1844.8m below KB

PROCESSING

Recorded Data

Number of Shots Used	:	30
Number of Levels Recorded	:	21
Data Quality	:	Good
Noise Level	:	Low
Rejected Shots	:	3

Correction for Instrument Delay and Shot Offset

The 'corrected' times shown on the calculation sheet have been obtained by:

(i) Subtraction of the instrument delay (4msec) from the recorded arrival times
(ii) geometric correction for non-verticality of ray paths resulting from shot offset.
(iii) shot static correction to correct for the depth of shot below ground level at the well head using a correction velocity of 1600 metres/sec
(iv) readdition of the instrument delay (4msec).

Correction to Datum

The datum chosen was 0.0 metres ASL that is 91.4 metres below ground. This level was shot five times during the survey four of which have been used to calculate an average effective datum correction time of 55.3 msec.

Please note that this time includes an instrumentation delay of 4msecs.

PROCESSING

Calibration of Sonic Log - Method

Sonic times were adjusted to checkshot times using a polynomial derived least squares fit correction of the sonic transient times.

These differences arise as the sonic tool measures the local velocity characteristics of the formation with a high frequency signal, whereas the downhole geophone records the bulk velocity character using a signal of significantly lower frequency.

Calibration of Sonic Log - Results (Enclosure 1)

The discrepancies between shot and sonic interval velocities were in general quite small. The largest adjustment 53.85 μsecs/m, occurred over the interval 1778.0m to 1830.0m below KB.

In aggregate, the shot and sonic interval times differed by 9.4 msec over the logged portion of the well.

Once the sonic had been calibrated with the velocity survey it was necessary to modify the raw pick time for shot 25. This revised pick has been calculated using a cross correlation algorithm with the calculated time slightly adjusted for pit fatigue.

Pit fatigue was observed across the surface channels and the appropriate correction times have been implemented to compensate for this effect.

PROCESSING

Trace Playouts (Figure 4)

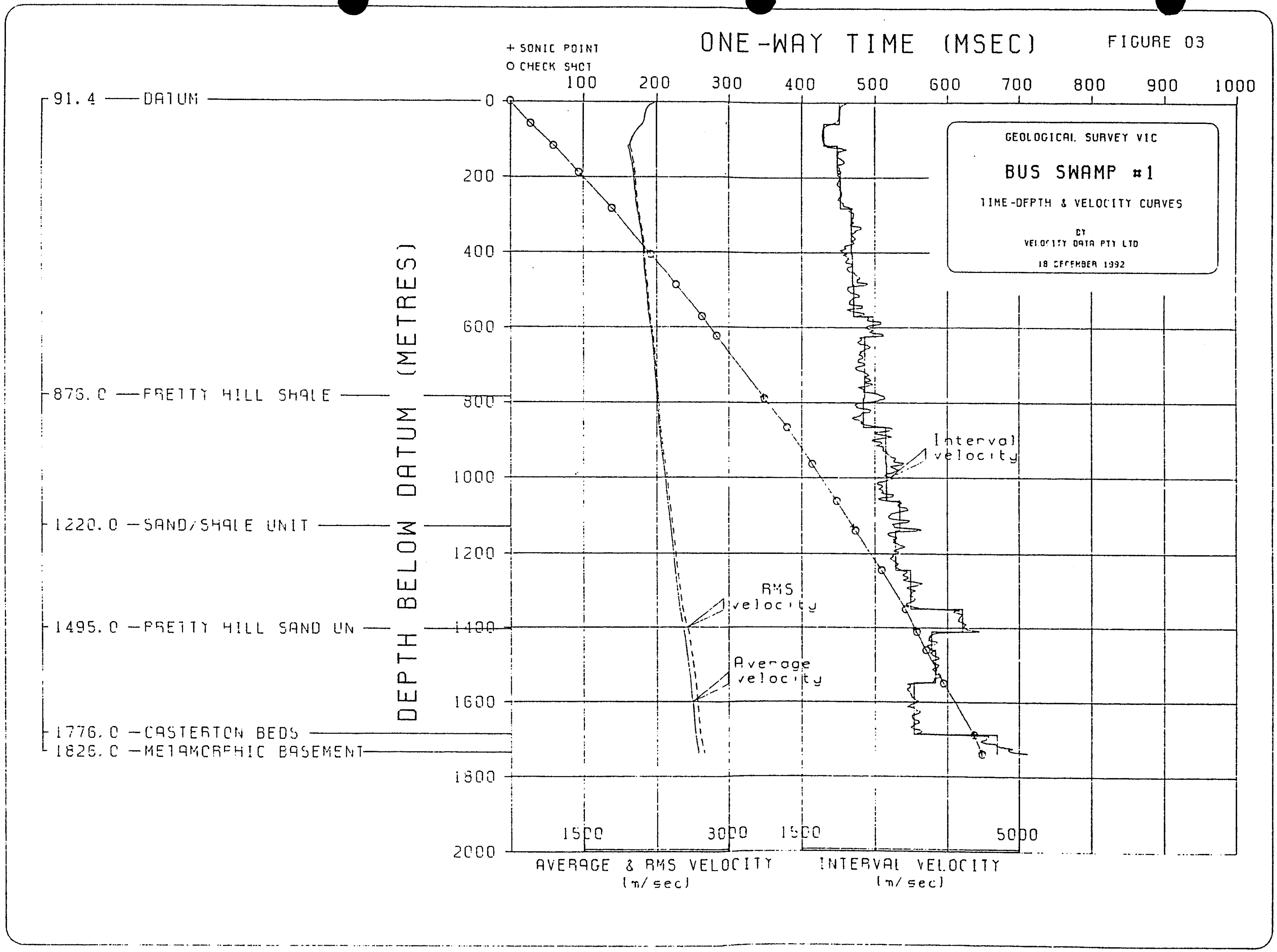
Figure 4A is a plot of all traces used. No filter or gain recovery has been applied.

Figure 4B is a plot to scale in depth and time of selected traces. No filter or gain recovery has been applied.

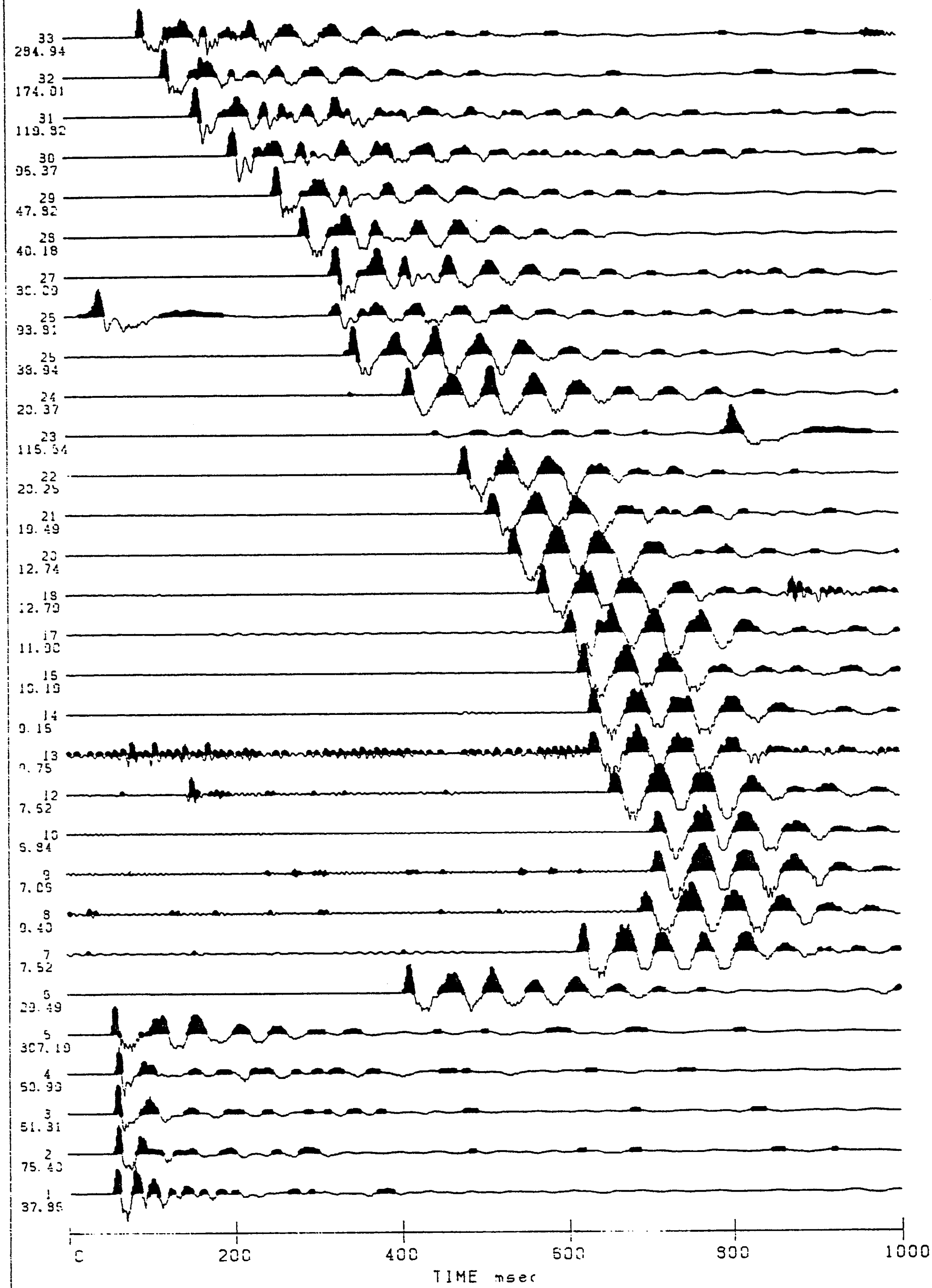
Figure 4C is a plot to scale in depth and time of selected traces with a 5 Hz - 40 Hz filter and a gain recovery function of t^2 applied.

Figure 4D is a plot of selected surface traces. No filter or gain recovery has been applied.

Troy Peters
Geophysical Analyst.



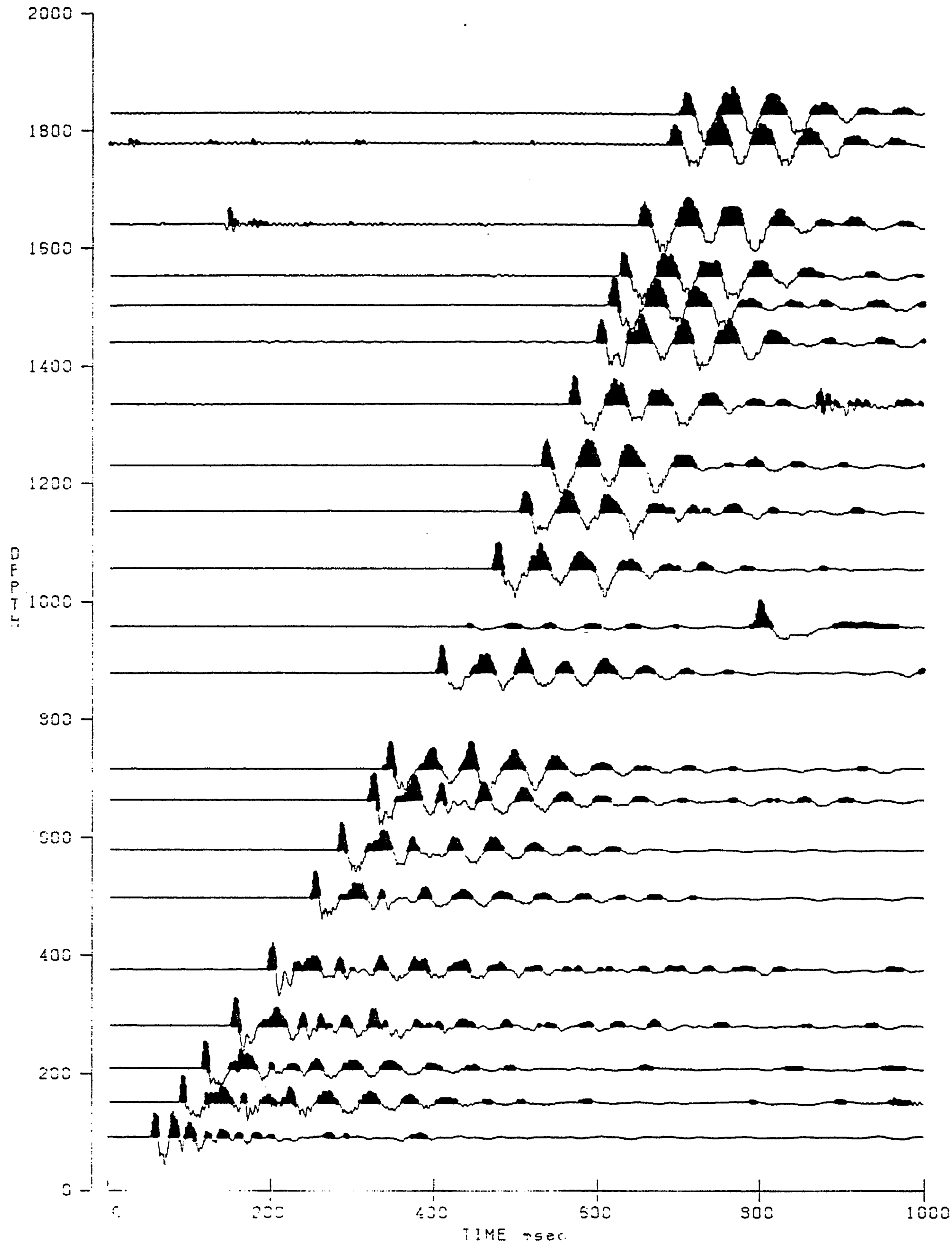
ONE-WAY TIME (MSEC)
FIGURE 03
+ SONIC POINT
O CHECK SHOT
GEOLOGICAL SURVEY VIC
BUS SWAMP #1
TIME-DEPTH & VELOCITY CURVES
BY
VELOCITY DATA PTY LTD
18 DECEMBER 1992
91.4 — DATUM
876.0 — PRETTY HILL SHALE
1220.0 — SAND/SHALE UNIT
1495.0 — PRETTY HILL SAND UN
1776.0 — CASTERTON BEDS
1826.0 — METAMORPHIC BASEMENT
DEPTH BELOW DATUM (METRES)
Interval velocity
RMS velocity
Average velocity
AVERAGE & RMS VELOCITY (m/sec)
INTERVAL VELOCITY (m/sec)



BUS SWAMP #1

VELOCITY SURVEY TRACE DISPLAY
Filter OUT-OUT
No gain recovery

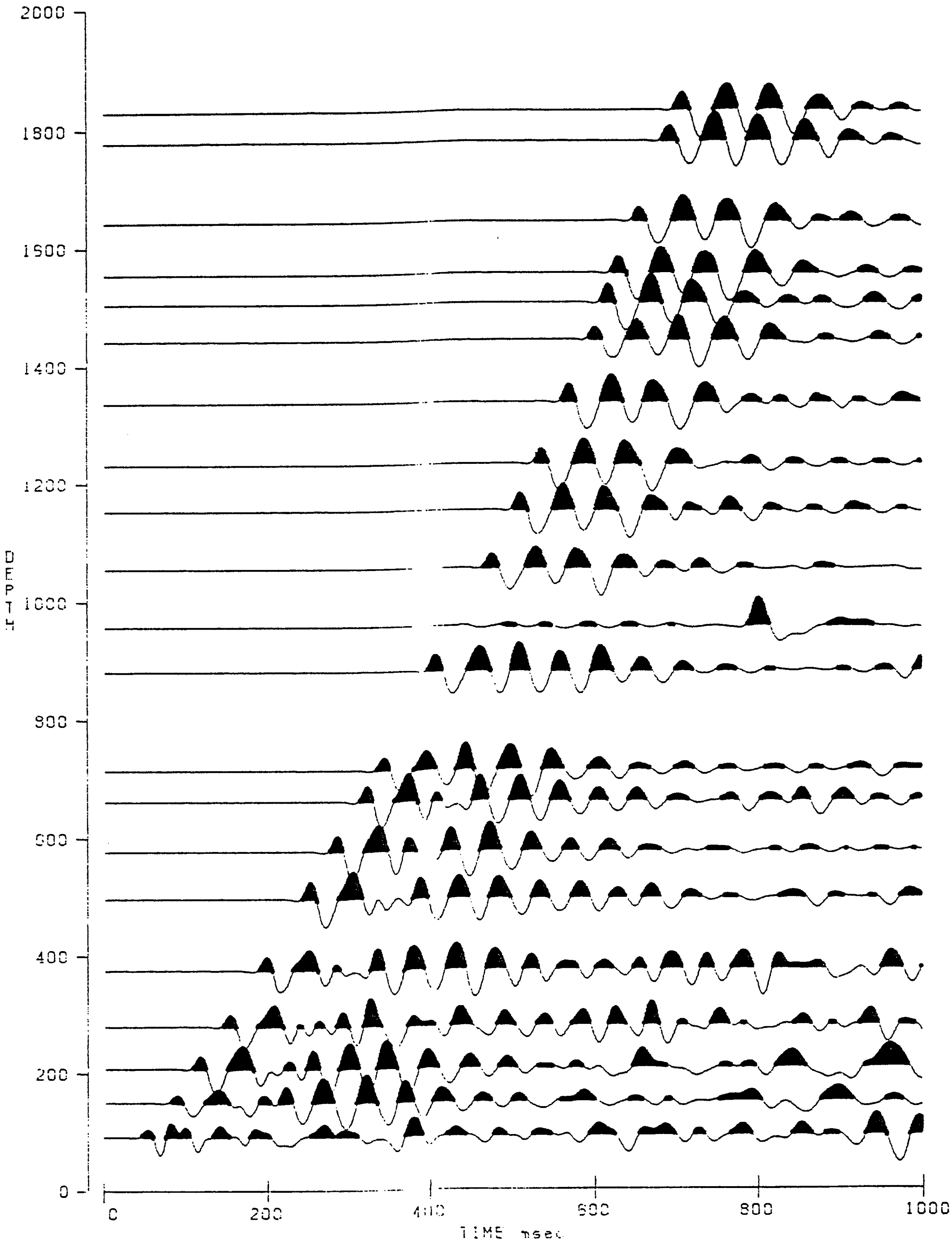
Figure 4A



BUS SWAMP #1

VELOCITY SURVEY TRACE DISPLAY
Filter OUT-OUT
No gain recovery

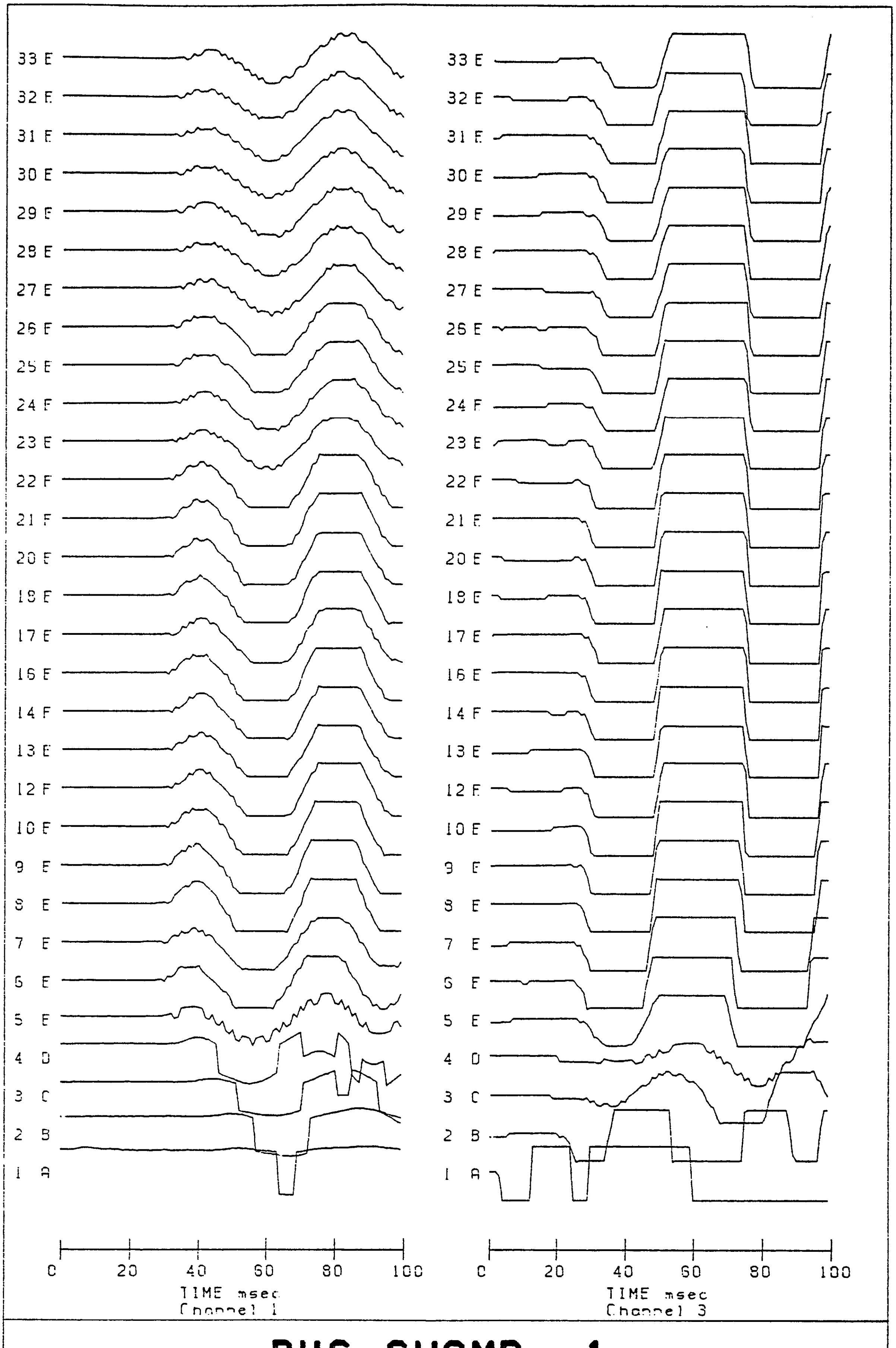
Figure 45



BUS SWAMP #1

VELOCITY SURVEY TRACE DISPLAY
Filter 5 - 40
Gain $T^{2.0}$

Figure 40



BUS SWAMP #1

VELOCITY SURVEY TRACE DISPLAY

Auxiliary channels

Filter OUT-OUT

Figure 4D

TABLE 1. Time-Depth curve values

Well : BUS SWAMP #1
Survey units : METRES
Calibrated sonic interval velocities used from 117.5 to 1737.5

Client : GEOLOGICAL SURVEY VIC
Datum : 0.0

Datum Depth	One-way time(ms)	VELOCITIES Average	RMS	Interval
2.5	1.1	2222	2222	2222
5.0	2.3	2200	2200	2178
7.5	3.4	2183	2183	2151
10.0	4.6	2171	2171	2134
12.5	5.8	2161	2161	2122
15.0	7.0	2153	2153	2115
17.5	8.2	2147	2147	2110
20.0	9.3	2142	2142	2107
22.5	10.5	2138	2138	2105
25.0	11.7	2134	2135	2104
27.5	12.9	2131	2132	2103
30.0	14.1	2129	2129	2102
32.5	15.3	2127	2127	2101
35.0	16.5	2125	2125	2100
37.5	17.7	2123	2123	2099
40.0	18.9	2121	2122	2097
42.5	20.0	2120	2120	2094
45.0	21.2	2118	2118	2090
47.5	22.4	2116	2117	2084
50.0	23.7	2114	2114	2074
52.5	24.9	2111	2112	2059
55.0	26.1	2108	2108	2036
57.5	27.3	2103	2103	2002
60.0	28.6	2096	2097	1953
62.5	29.9	2088	2089	1909
65.0	31.3	2079	2081	1880
67.5	32.6	2070	2072	1862
70.0	34.0	2062	2064	1851
72.5	35.3	2053	2056	1843
75.0	36.7	2045	2048	1839
77.5	38.0	2038	2041	1836
80.0	39.4	2031	2034	1834
82.5	40.8	2024	2028	1832
85.0	42.1	2018	2022	1832
87.5	43.5	2012	2016	1831
90.0	44.9	2006	2010	1831
92.5	46.2	2001	2005	1832
95.0	47.6	1996	2001	1832
97.5	48.9	1992	1996	1833
100.0	50.3	1988	1992	1835

Datum Depth	One-way time(ms)	VELOCITIES Average	RMS	Interval
102.5	51.7	1984	1988	1838
105.0	53.0	1980	1984	1842
107.5	54.4	1977	1981	1849
110.0	55.7	1974	1978	1859
112.5	57.1	1972	1976	1876
115.0	58.4	1970	1974	1901
117.5	59.9	1962	1974	1942
120.0	61.1	1964	1976	2080
122.5	62.4	1963	1974	1905
125.0	63.4	1971	1983	2481
127.5	64.5	1976	1988	2223
130.0	65.8	1977	1989	2062
132.5	67.0	1978	1989	2001
135.0	68.2	1980	1991	2096
137.5	69.4	1981	1993	2061
140.0	70.6	1982	1994	2056
142.5	71.9	1983	1994	2027
145.0	73.1	1984	1995	2020
147.5	74.3	1985	1996	2067
150.0	75.5	1987	1998	2108
152.5	76.7	1989	1999	2086
155.0	77.8	1991	2002	2175
157.5	79.0	1993	2004	2117
160.0	80.2	1996	2006	2178
162.5	81.3	1999	2009	2203
165.0	82.5	2000	2011	2117
167.5	83.7	2002	2012	2074
170.0	85.0	2001	2011	1962
172.5	86.2	2002	2012	2063
175.0	87.4	2003	2013	2099
177.5	88.6	2004	2014	2099
180.0	89.8	2006	2015	2085
182.5	91.0	2006	2016	2065
185.0	92.2	2007	2016	2050
187.5	93.3	2010	2019	2224
190.0	94.5	2010	2019	2067
192.5	95.7	2011	2020	2103
195.0	96.9	2012	2021	2082
197.5	98.1	2014	2023	2165
200.0	99.2	2016	2025	2160

TABLE 1. Time-Depth curve values

Well : BUS SWAMP #1
Survey units : METRES
Calibrated sonic interval velocities used from 117.5 to 1737.5

Client : GEOLOGICAL SURVEY VIC
Datum : 0.0

Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval	Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval
202.5	100.4	2017	2026	2134	302.5	146.3	2068	2076	2300
205.0	101.6	2019	2027	2147	305.0	147.4	2070	2077	2250
207.5	102.7	2020	2029	2185	307.5	148.5	2071	2079	2260
210.0	103.9	2021	2030	2079	310.0	149.6	2073	2080	2272
212.5	105.1	2022	2031	2140	312.5	150.7	2074	2082	2263
215.0	106.2	2024	2032	2116	315.0	151.8	2075	2083	2179
217.5	107.4	2025	2033	2131	317.5	152.9	2076	2084	2227
220.0	108.6	2025	2033	2050	320.0	154.0	2078	2085	2323
222.5	109.8	2026	2034	2119	322.5	155.1	2079	2087	2338
225.0	111.0	2027	2036	2160	325.0	156.2	2080	2088	2170
227.5	112.1	2029	2037	2169	327.5	157.4	2081	2089	2174
230.0	113.3	2030	2038	2143	330.0	158.5	2082	2090	2263
232.5	114.5	2031	2039	2163	332.5	159.6	2084	2091	2299
235.0	115.6	2032	2040	2094	335.0	160.5	2087	2095	2605
237.5	116.8	2034	2042	2238	337.5	161.6	2088	2097	2363
240.0	117.9	2035	2043	2149	340.0	162.7	2090	2098	2279
242.5	119.1	2037	2045	2202	342.5	163.8	2091	2099	2303
245.0	120.2	2038	2045	2131	345.0	164.9	2092	2101	2292
247.5	121.4	2039	2047	2210	347.5	165.9	2094	2102	2331
250.0	122.5	2040	2048	2171	350.0	167.1	2095	2103	2215
252.5	123.7	2042	2049	2155	352.5	168.2	2096	2104	2199
255.0	124.8	2043	2050	2148	355.0	169.3	2096	2105	2241
257.5	126.0	2043	2051	2080	357.5	170.4	2098	2106	2281
260.0	127.2	2044	2051	2148	360.0	171.5	2099	2107	2264
262.5	128.4	2044	2052	2111	362.5	172.6	2100	2108	2278
265.0	129.5	2046	2053	2185	365.0	173.7	2101	2109	2344
267.5	130.7	2047	2054	2185	367.5	174.8	2103	2111	2304
270.0	131.8	2048	2055	2176	370.0	175.9	2103	2111	2212
272.5	132.9	2050	2057	2275	372.5	177.0	2104	2112	2204
275.0	134.1	2051	2058	2157	375.0	178.1	2105	2113	2275
277.5	135.2	2052	2060	2223	377.5	179.2	2106	2114	2335
280.0	136.4	2054	2061	2196	380.0	180.3	2108	2116	2289
282.5	137.3	2057	2065	2624	382.5	181.5	2108	2116	2119
285.0	138.4	2059	2067	2215	385.0	182.7	2107	2115	2013
287.5	139.6	2060	2068	2199	387.5	183.9	2108	2115	2200
290.0	140.7	2060	2068	2127	390.0	185.0	2108	2116	2162
292.5	141.9	2062	2069	2222	392.5	186.2	2108	2116	2112
295.0	143.0	2064	2071	2297	395.0	187.4	2108	2115	2058
297.5	144.1	2065	2073	2289	397.5	188.7	2107	2114	1955
300.0	145.2	2067	2074	2237	400.0	189.8	2107	2115	2225

TABLE 1. Time-Depth curve values Page 3.

Well : BUS SWAMP #1 Client : GEOLOGICAL SURVEY VIC
Survey units : METRES Datum : 0.0
Calibrated sonic interval velocities used from 117.5 to 1737.5

Datum Depth	One-way time(ms)	VELOCITIES Average	RMS	Interval	Datum Depth	One-way time(ms)	VELOCITIES Average	RMS	Interval
402.5	190.9	2108	2116	2219	502.5	233.9	2149	2158	2326
405.0	192.2	2107	2115	2025	505.0	234.9	2150	2159	2416
407.5	193.3	2108	2116	2238	507.5	235.9	2151	2160	2377
410.0	194.4	2109	2116	2197	510.0	237.0	2152	2161	2360
412.5	195.5	2110	2117	2280	512.5	238.0	2153	2162	2444
415.0	196.6	2111	2118	2296	515.0	238.9	2156	2165	2776
[illegible]7.5	197.7	2111	2119	2265	517.5	239.9	2157	2166	2494
420.0	198.8	2113	2120	2297	520.0	241.0	2158	2167	2420
422.5	200.0	2113	2120	2186	522.5	242.0	2159	2168	2418
425.0	201.1	2114	2121	2226	525.0	243.0	2160	2170	2408
427.5	202.2	2114	2122	2227	527.5	244.1	2161	2171	2387
430.0	203.3	2115	2122	2218	530.0	245.1	2162	2171	2371
432.5	204.3	2117	2124	2498	532.5	246.2	2163	2172	2333
435.0	205.4	2118	2125	2336	535.0	247.3	2164	2173	2386
437.5	206.5	2119	2126	2264	537.5	248.3	2165	2174	2379
440.0	207.6	2119	2127	2253	540.0	249.4	2165	2175	2342
442.5	208.7	2120	2127	2240	542.5	250.4	2166	2176	2368
445.0	209.9	2121	2128	2235	545.0	251.2	2170	2180	3448
447.5	211.0	2121	2129	2241	547.5	252.2	2171	2181	2367
450.0	212.1	2122	2129	2268	550.0	253.3	2171	2182	2322
452.5	213.1	2123	2130	2324	552.5	254.3	2172	2183	2399
455.0	214.2	2124	2131	2277	555.0	255.4	2173	2183	2264
[illegible]7.5	215.2	2126	2133	2549	557.5	256.5	2174	2184	2363
460.0	216.3	2127	2134	2330	560.0	257.4	2175	2186	2647
462.5	217.4	2128	2135	2332	562.5	258.4	2177	2188	2649
465.0	218.4	2129	2137	2379	565.0	259.3	2179	2189	2594
467.5	219.3	2131	2139	2694	567.5	260.3	2180	2191	2647
470.0	220.4	2132	2140	2371	570.0	261.3	2181	2192	2439
472.5	221.5	2134	2142	2376	572.5	262.3	2182	2193	2419
475.0	222.5	2135	2143	2380	575.0	263.4	2183	2194	2396
477.5	223.5	2136	2144	2490	577.5	264.5	2184	2194	2317
480.0	224.6	2138	2146	2394	580.0	265.5	2184	2195	2321
482.5	225.6	2138	2147	2322	582.5	266.6	2185	2196	2388
485.0	226.5	2142	2150	3026	585.0	267.6	2186	2197	2469
487.5	227.4	2144	2152	2589	587.5	268.5	2188	2199	2862
490.0	228.5	2145	2153	2338	590.0	269.5	2189	2200	2483
492.5	229.6	2145	2154	2346	592.5	270.5	2190	2201	2382
495.0	230.6	2146	2155	2312	595.0	271.6	2191	2202	2406
[illegible]7.5	231.7	2147	2156	2373	597.5	272.6	2192	2203	2331
500.0	232.8	2148	2157	2298	600.0	273.8	2192	2203	2247

Well : BUS SWAMP #1
Client : GEOLOGICAL SURVEY VIC
Survey units : METRES
Datum : 0.0
Calibrated sonic interval velocities used from 117.5 to 1737.5

Datum Depth	One-way time(ms)	VELOCITIES Average	RMS	Interval	Datum Depth	One-way time(ms)	VELOCITIES Average	RMS	Interva
602.5	274.8	2192	2203	2316	702.5	315.4	2227	2239	2451
605.0	275.9	2193	2204	2421	705.0	316.5	2228	2239	2389
607.5	276.9	2194	2205	2479	707.5	317.5	2228	2240	2367
610.0	277.9	2195	2206	2380	710.0	318.6	2228	2240	2242
612.5	279.0	2196	2206	2382	712.5	319.6	2229	2241	2477
615.0	280.0	2196	2207	2341	715.0	320.7	2230	2241	2395
617.5	281.0	2197	2208	2501	717.5	321.7	2230	2242	2427
620.0	281.9	2199	2211	2925	720.0	322.7	2231	2243	2584
622.5	282.9	2200	2212	2504	722.5	323.7	2232	2244	2521
625.0	283.9	2201	2213	2411	725.0	324.6	2233	2245	2546
627.5	285.0	2202	2213	2402	727.5	325.6	2234	2246	2599
630.0	286.0	2203	2214	2367	730.0	326.6	2235	2247	2613
632.5	287.0	2204	2215	2649	732.5	327.6	2236	2248	2493
635.0	288.0	2205	2216	2402	735.0	328.6	2237	2248	2374
637.5	289.1	2205	2217	2356	737.5	329.6	2237	2249	2524
640.0	290.1	2206	2217	2386	740.0	330.4	2239	2251	3002
642.5	291.2	2207	2218	2417	742.5	331.5	2240	2252	2414
645.0	292.2	2207	2219	2426	745.0	332.5	2241	2253	2511
647.5	293.2	2208	2220	2430	747.5	333.4	2242	2254	2588
650.0	294.1	2210	2222	2909	750.0	334.4	2243	2255	2510
652.5	295.1	2211	2223	2489	752.5	335.4	2244	2256	2625
655.0	296.1	2212	2224	2537	755.0	336.3	2245	2258	2869
657.5	297.1	2213	2225	2500	757.5	337.3	2246	2258	2349
660.0	298.0	2215	2226	2607	760.0	338.4	2246	2258	2338
662.5	299.1	2215	2227	2365	762.5	339.4	2246	2259	2421
665.0	300.1	2216	2228	2504	765.0	340.4	2248	2260	2668
667.5	301.1	2217	2229	2448	767.5	341.4	2248	2260	2422
670.0	302.1	2218	2229	2415	770.0	342.4	2249	2261	2433
672.5	303.2	2218	2230	2414	772.5	343.4	2250	2262	2565
675.0	304.2	2219	2230	2401	775.0	344.4	2250	2262	2459
677.5	305.2	2220	2231	2501	777.5	345.3	2252	2264	2900
680.0	306.2	2221	2233	2566	780.0	346.2	2253	2266	2842
682.5	307.2	2221	2233	2391	782.5	347.1	2254	2267	2630
685.0	308.3	2222	2234	2433	785.0	348.0	2256	2268	2704
687.5	309.3	2223	2234	2411	787.5	348.8	2258	2271	3248
690.0	310.3	2223	2235	2401	790.0	349.7	2259	2272	2672
692.5	311.4	2224	2235	2340	792.5	350.6	2260	2274	2839
695.0	312.4	2225	2236	2457	795.0	351.5	2262	2275	2923
697.5	313.4	2226	2238	2667	797.5	352.4	2263	2277	2807
700.0	314.4	2227	2238	2451	800.0	353.3	2264	2278	2664

TABLE 1. Time-Depth curve values

Well : BUS SWAMP #1 Client : GEOLOGICAL SURVEY VIC
Survey units : METRES Datum : 0.0
Calibrated sonic interval velocities used from 117.5 to 1737.5

Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval	Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval
802.5	354.4	2265	2278	2363	902.5	392.6	2299	2314	2490
805.0	355.4	2265	2279	2447	905.0	393.5	2300	2315	2647
807.5	356.3	2266	2280	2593	907.5	394.4	2301	2317	2929
810.0	357.4	2266	2280	2313	910.0	395.3	2302	2318	2774
812.5	358.4	2267	2281	2538	912.5	396.3	2303	2318	2519
815.0	359.4	2268	2281	2510	915.0	397.2	2304	2319	2661
817.5	360.4	2268	2282	2474	917.5	398.1	2305	2320	2732
820.0	361.3	2269	2283	2790	920.0	399.0	2306	2322	2825
822.5	362.1	2271	2285	3097	922.5	399.9	2307	2323	2779
825.0	363.1	2272	2286	2454	925.0	400.8	2308	2323	2648
827.5	364.1	2273	2287	2537	927.5	401.8	2309	2324	2716
830.0	365.1	2273	2288	2629	930.0	402.6	2310	2326	2921
832.5	366.1	2274	2288	2538	932.5	403.6	2311	2327	2640
835.0	367.1	2275	2289	2422	935.0	404.4	2312	2328	2869
837.5	368.0	2276	2290	2629	937.5	405.3	2313	2329	2886
840.0	369.1	2276	2290	2362	940.0	406.2	2314	2330	2791
842.5	370.2	2276	2290	2338	942.5	407.1	2315	2332	2827
845.0	371.2	2276	2290	2392	945.0	407.9	2317	2333	2987
847.5	372.2	2277	2291	2568	947.5	408.8	2318	2334	2831
850.0	373.2	2278	2292	2594	950.0	409.7	2319	2336	2939
852.5	374.2	2278	2292	2464	952.5	410.5	2320	2337	3015
855.0	375.1	2279	2293	2610	955.0	411.3	2322	2339	2932
857.5	376.1	2280	2294	2519	957.5	412.2	2323	2340	2747
860.0	377.1	2281	2294	2535	960.0	413.1	2324	2341	2977
862.5	378.0	2282	2296	2725	962.5	413.9	2326	2343	3247
865.0	378.8	2283	2297	3037	965.0	414.6	2327	2345	3181
867.5	379.8	2284	2299	2760	967.5	415.5	2329	2346	2907
870.0	380.6	2286	2300	2937	970.0	416.3	2330	2348	2993
872.5	381.4	2287	2302	2979	972.5	417.2	2331	2349	2778
875.0	382.3	2289	2304	2875	975.0	418.1	2332	2350	2964
877.5	383.2	2290	2305	2746	977.5	418.8	2334	2352	3276
880.0	384.2	2291	2305	2605	980.0	419.7	2335	2354	2926
882.5	385.2	2291	2306	2520	982.5	420.5	2336	2355	3024
885.0	386.1	2292	2307	2649	985.0	421.4	2338	2356	2940
887.5	387.0	2293	2308	2753	987.5	422.2	2339	2358	2927
890.0	387.9	2295	2310	2968	990.0	423.1	2340	2359	2912
892.5	388.8	2296	2311	2793	992.5	424.0	2341	2360	2673
895.0	389.6	2297	2313	2948	995.0	424.9	2342	2361	2914
897.5	390.6	2298	2313	2577	997.5	425.8	2343	2362	2851
900.0	391.6	2298	2314	2559	1000.0	426.6	2344	2363	2932

Well : BUS SWAMP #1 Client : GEOLOGICAL SURVEY VIC
Survey units : METRES Datum : 0.0
Calibrated sonic interval velocities used from 117.5 to 1737.5

Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval	Datum Depth	One-way time(ms)	-----VELOCITIES---- Average	RMS	Interva
1002.5	427.5	2345	2365	2915	1102.5	462.3	2385	2407	2843
1005.0	428.3	2347	2366	3067	1105.0	463.3	2385	2407	2650
1007.5	429.1	2348	2367	2902	1107.5	464.2	2386	2408	2867
1010.0	430.1	2348	2368	2633	1110.0	465.0	2387	2409	2936
1012.5	430.9	2350	2369	2989	1112.5	465.8	2388	2410	2977
1015.0	431.9	2350	2370	2549	1115.0	466.5	2390	2413	3621
1017.5	432.8	2351	2371	2757	1117.5	467.3	2391	2414	3097
1020.0	433.7	2352	2371	2772	1120.0	468.3	2392	2415	2700
1022.5	434.6	2353	2372	2721	1122.5	469.1	2393	2415	2894
1025.0	435.5	2354	2374	2981	1125.0	470.0	2394	2416	2918
1027.5	436.4	2354	2374	2668	1127.5	470.9	2395	2417	2848
1030.0	437.4	2355	2375	2653	1130.0	471.7	2395	2418	2869
1032.5	438.3	2356	2376	2772	1132.5	472.6	2396	2419	2961
1035.0	439.1	2357	2377	2976	1135.0	473.4	2398	2421	3064
1037.5	440.0	2358	2378	2772	1137.5	474.0	2400	2424	4243
1040.0	440.9	2359	2379	2719	1140.0	474.8	2401	2425	3085
1042.5	441.8	2360	2380	2744	1142.5	475.6	2402	2426	2968
1045.0	442.7	2361	2381	2913	1145.0	476.5	2403	2427	3072
1047.5	443.4	2362	2383	3435	1147.5	477.3	2404	2429	3089
1050.0	444.3	2363	2384	2799	1150.0	478.2	2405	2429	2813
1052.5	445.2	2364	2384	2699	1152.5	479.0	2406	2430	2992
1055.0	446.2	2365	2385	2726	1155.0	479.8	2407	2432	3150
1057.5	447.0	2366	2386	2820	1157.5	480.6	2409	2433	3188
1060.0	448.0	2366	2387	2628	1160.0	481.4	2410	2434	3065
1062.5	448.8	2367	2388	2947	1162.5	482.2	2411	2436	3164
1065.0	449.6	2369	2389	3177	1165.0	483.0	2412	2437	3013
1067.5	450.5	2370	2391	2926	1167.5	483.8	2413	2438	2964
1070.0	451.3	2371	2392	2944	1170.0	484.6	2414	2440	3314
1072.5	452.2	2372	2393	2910	1172.5	485.4	2415	2441	3008
1075.0	453.0	2373	2394	2961	1175.0	486.3	2416	2442	2993
1077.5	453.9	2374	2395	2971	1177.5	487.0	2418	2444	3496
1080.0	454.7	2375	2396	3024	1180.0	487.8	2419	2445	3179
1082.5	455.4	2377	2398	3370	1182.5	488.6	2420	2446	3111
1085.0	456.3	2378	2400	2981	1185.0	489.3	2422	2448	3458
1087.5	457.1	2379	2401	3076	1187.5	490.1	2423	2449	3140
1090.0	457.9	2380	2402	3008	1190.0	490.9	2424	2450	2923
1092.5	458.8	2381	2403	2840	1192.5	491.8	2425	2451	3105
1095.0	459.7	2382	2404	2806	1195.0	492.5	2426	2453	3173
1097.5	460.6	2383	2405	2779	1197.5	493.3	2427	2454	3244
1100.0	461.5	2384	2406	2882	1200.0	494.1	2429	2455	3106

Well : BUS SWAMP #1 Client : GEOLOGICAL SURVEY VIC
Survey units : METRES Datum : 0.0
Calibrated sonic interval velocities used from 117.5 to 1737.5

Datum Depth	One-way time(ms)	VELOCITIES Average	RMS	Interval	Datum Depth	One-way time(ms)	VELOCITIES Average	RMS	Interval
1202.5	495.0	2430	2456	2999	1302.5	525.7	2477	2510	3380
1205.0	495.8	2431	2458	3068	1305.0	526.5	2479	2511	3369
1207.5	496.6	2432	2459	3086	1307.5	527.2	2480	2513	3386
1210.0	497.4	2433	2460	3081	1310.0	528.0	2481	2514	3422
1212.5	498.2	2434	2461	2935	1312.5	528.7	2482	2516	3329
1215.0	499.1	2434	2462	2983	1315.0	529.5	2484	2517	3315
1217.5	499.9	2436	2463	3145	1317.5	530.2	2485	2519	3542
1220.0	500.7	2437	2464	3131	1320.0	530.9	2486	2520	3469
1222.5	501.5	2438	2465	3048	1322.5	531.6	2488	2522	3387
1225.0	502.3	2439	2466	3059	1325.0	532.4	2489	2523	3360
1227.5	503.1	2440	2468	3323	1327.5	533.1	2490	2525	3610
1230.0	503.9	2441	2469	3158	1330.0	533.8	2491	2526	3310
1232.5	504.7	2442	2470	3002	1332.5	534.6	2493	2527	3246
1235.0	505.5	2443	2471	3036	1335.0	535.3	2494	2529	3366
1237.5	506.3	2444	2472	3211	1337.5	536.1	2495	2530	3296
1240.0	507.1	2445	2474	3212	1340.0	536.8	2496	2531	3303
1242.5	507.9	2446	2475	3043	1342.5	537.6	2497	2532	3386
1245.0	508.7	2448	2476	3234	1345.0	538.3	2499	2534	3535
1247.5	509.4	2449	2478	3401	1347.5	539.0	2500	2536	3518
1250.0	510.1	2450	2479	3334	1350.0	539.7	2501	2537	3593
1252.5	510.9	2452	2480	3298	1352.5	540.4	2503	2539	3428
1255.0	511.7	2453	2482	3211	1355.0	541.2	2504	2540	3183
1257.5	512.4	2454	2483	3266	1357.5	542.0	2505	2541	3298
1260.0	513.2	2455	2484	3212	1360.0	542.7	2506	2542	3396
1262.5	514.0	2456	2486	3385	1362.5	543.4	2507	2544	3379
1265.0	514.7	2458	2487	3414	1365.0	544.2	2508	2545	3506
1267.5	515.5	2459	2489	3298	1367.5	544.9	2510	2546	3441
1270.0	516.2	2460	2490	3199	1370.0	545.6	2511	2548	3314
1272.5	517.0	2461	2491	3214	1372.5	546.4	2512	2549	3440
1275.0	517.8	2462	2493	3317	1375.0	547.1	2513	2550	3383
1277.5	518.4	2464	2495	3840	1377.5	547.8	2514	2552	3386
1280.0	519.1	2466	2496	3430	1380.0	548.6	2516	2553	3348
1282.5	519.8	2467	2498	3568	1382.5	549.3	2517	2554	3376
1285.0	520.6	2468	2500	3471	1385.0	550.1	2518	2556	3435
1287.5	521.3	2470	2501	3466	1387.5	550.8	2519	2557	3502
1290.0	522.0	2471	2503	3298	1390.0	551.5	2520	2558	3466
1292.5	522.8	2472	2504	3166	1392.5	552.2	2522	2560	3497
1295.0	523.6	2473	2505	3323	1395.0	552.9	2523	2561	3410
1297.5	524.3	2475	2507	3736	1397.5	553.7	2524	2563	3430
1300.0	525.0	2476	2509	3337	1400.0	554.4	2525	2564	3483

Well : BUS SWAMP #1
Survey units : METRES
Calibrated sonic interval velocities used from 117.5 to 1737.5

Client : GEOLOGICAL SURVEY VIC
Datum : 0.0

Datum Depth	One-way time(ms)	VELOCITIES Average	RMS	Interval	Datum Depth	One-way time(ms)	VELOCITIES Average	RMS	Interv
1402.5	555.1	2527	2565	3476	1502.5	583.3	2576	2621	351[illegible]
1405.0	555.8	2528	2567	3501	1505.0	584.0	2577	2623	371[illegible]
1407.5	556.5	2529	2568	3504	1507.5	584.7	2578	2624	342[illegible]
1410.0	557.2	2531	2570	3780	1510.0	585.5	2579	2625	340[illegible]
1412.5	557.9	2532	2572	3804	1512.5	586.2	2580	2626	352[illegible]
1415.0	558.6	2533	2573	3576	1515.0	586.9	2581	2627	336[illegible]
1417.5	559.2	2535	2575	3634	1517.5	587.6	2582	2629	344[illegible]
1420.0	559.9	2536	2576	3605	1520.0	588.3	2584	2630	363[illegible]
1422.5	560.6	2537	2578	3619	1522.5	589.1	2585	2631	345[illegible]
1425.0	561.3	2539	2579	3473	1525.0	589.8	2586	2632	340[illegible]
1427.5	562.0	2540	2581	3667	1527.5	590.5	2587	2633	343[illegible]
1430.0	562.7	2541	2582	3564	1530.0	591.2	2588	2635	391[illegible]
1432.5	563.4	2542	2584	3510	1532.5	591.9	2589	2636	345[illegible]
1435.0	564.1	2544	2585	3573	1535.0	592.6	2590	2637	342[illegible]
1437.5	564.8	2545	2587	3582	1537.5	593.3	2591	2639	356[illegible]
1440.0	565.5	2546	2588	3694	1540.0	594.0	2592	2640	341[illegible]
1442.5	566.2	2548	2590	3934	1542.5	594.8	2593	2641	344[illegible]
1445.0	566.9	2549	2592	3554	1545.0	595.5	2595	2642	3488
1447.5	567.6	2550	2593	3481	1547.5	596.2	2596	2643	3421
1450.0	568.3	2552	2594	3578	1550.0	596.9	2597	2644	3451
1452.5	569.0	2553	2596	3478	1552.5	597.7	2598	2645	3450
1455.0	569.7	2554	2597	3649	1555.0	598.4	2599	2647	350[illegible]
1457.5	570.4	2555	2598	3489	1557.5	599.1	2600	2648	3530
1460.0	571.1	2557	2600	3741	1560.0	599.8	2601	2649	358[illegible]
1462.5	571.8	2558	2601	3525	1562.5	600.5	2602	2650	3445
1465.0	572.5	2559	2603	3417	1565.0	601.2	2603	2651	348[illegible]
1467.5	573.2	2560	2604	3359	1567.5	602.0	2604	2652	3434
1470.0	574.0	2561	2605	3383	1570.0	602.7	2605	2654	3507
1472.5	574.7	2562	2606	3498	1572.5	603.4	2606	2655	3476
1475.0	575.4	2563	2607	3459	1575.0	604.1	2607	2656	3524
1477.5	576.2	2564	2609	3398	1577.5	604.8	2608	2657	3545
1480.0	576.9	2566	2610	3475	1580.0	605.5	2609	2658	3508
1482.5	577.6	2567	2611	3701	1582.5	606.2	2610	2659	3519
1485.0	578.3	2568	2613	3564	1585.0	606.9	2612	2661	3608
1487.5	579.0	2569	2614	3352	1587.5	607.6	2613	2662	3491
1490.0	579.7	2570	2615	3469	1590.0	608.3	2614	2663	3562
1492.5	580.4	2571	2616	3449	1592.5	609.0	2615	2664	3577
1495.0	581.2	2572	2617	3441	1595.0	609.7	2616	2666	3747
1497.5	581.9	2574	2619	3497	1597.5	610.4	2617	2667	3541
1500.0	582.6	2575	2620	3452	1600.0	611.1	2618	2668	3794

Well : BUS SWAMP #1
Survey units : METRES
Calibrated sonic interval velocities used from 117.5 to 1737.5

Client : GEOLOGICAL SURVEY VIC
Datum : 0.0

Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval
1602.5	611.8	2619	2670	3513
1605.0	612.5	2621	2671	3659
1607.5	613.2	2622	2672	3496
1610.0	613.9	2623	2673	3426
1612.5	614.6	2624	2674	3480
1615.0	615.3	2625	2675	3688
1617.5	616.0	2626	2677	3636
1620.0	616.7	2627	2678	3521
1622.5	617.4	2628	2679	3763
1625.0	618.1	2629	2680	3607
1627.5	618.7	2630	2682	3660
1630.0	619.4	2632	2683	3822
1632.5	620.1	2633	2684	3533
1635.0	620.8	2634	2685	3527
1637.5	621.5	2635	2687	3651
1640.0	622.2	2636	2688	3502
1642.5	622.9	2637	2689	3498
1645.0	623.6	2638	2690	3574
1647.5	624.3	2639	2691	3633
1650.0	625.0	2640	2692	3546
1652.5	625.7	2641	2694	3832
1655.0	626.4	2642	2695	3652
1657.5	627.0	2643	2696	3650
1660.0	627.7	2644	2697	3531
1662.5	628.4	2645	2698	3627
1665.0	629.1	2646	2700	3539
1667.5	629.9	2647	2701	3514
1670.0	630.6	2648	2702	3494
1672.5	631.3	2649	2703	3594
1675.0	631.9	2651	2704	3665
1677.5	632.6	2652	2705	3826
1680.0	633.3	2653	2707	3663
1682.5	634.0	2654	2708	3724
1685.0	634.6	2655	2709	3644
1687.5	635.3	2656	2710	3541
1690.0	636.0	2657	2711	3626
1692.5	636.7	2658	2712	3534
1695.0	637.4	2659	2713	3616
1697.5	638.1	2660	2715	3507
1700.0	638.9	2661	2716	3513
1702.5	639.6	2662	2717	3550
1705.0	640.3	2663	2718	3527
1707.5	641.0	2664	2718	3296
1710.0	641.7	2665	2720	3641
1712.5	642.4	2666	2721	3689
1715.0	643.1	2667	2722	3764
1717.5	643.7	2668	2723	3623
1720.0	644.4	2669	2724	3615
1722.5	645.1	2670	2726	3923
1725.0	645.7	2671	2727	3890
1727.5	646.4	2673	2729	3931
1730.0	647.0	2674	2730	3688
1732.5	647.7	2675	2731	3840
1735.0	648.3	2676	2733	4011

/ESEIS PTY LTD

WELL SURVEY CALCULATIONS

Company : GEOLOGICAL SURVEY VIC
Well : BUS SWAMP #1
Elevations : Datum : 0.0 Ground : 88.0 Kelly : 91.4
Shot data :

Location	Elevation	Offset
A	88.0	7.0
B	88.0	8.0
C	88.0	16.0
D	88.0	24.0
E	88.0	24.0

Latitude : 037 31 18
Longitude : 141 12 00
Rig identification : RIG-4
Energy source : POWERGEL
Logger : DDL #3
Near surface velocity for shot statics: 1600
Instrument delay: 4.0 ms

Survey date : 18-DEC-92
Survey units : METRES
Times in milliseconds.

SHOT CALCULATIONS

Shot No	Geophone depth Kelly	Geophone depth Datum	Shot Locn	Shot Depth	TIMES Record	TIMES Corr.	TIMES Avg.	TIMES Below datum	Check shot interval Distance	Check shot interval Time	Velocities Average	Velocities RMS	Velocities Interval
DATUM													
1	91.4	0.0	A	0.5	55.0	55.2							
2	91.4	0.0	B	0.5	55.0	55.1							
3	91.4	0.0	C	0.5	56.0	55.5							
4	91.4	0.0	D	0.5	57.0	55.4							
5	91.4	0.0	E	2.0	52.0	51.5 N/U	55.3	0.0					
									58.6	27.9			2100.4
33	150.0	58.6	E	2.0	83.0	83.2	83.2	27.9			2100.4	2100.4	
									58.0	31.3			1853.0
32	208.0	116.6	E	2.0	114.0	114.5	114.5	59.2			1969.6	1973.5	
									72.0	34.7			2074.9
31	280.0	188.6	E	2.0	148.5	149.2	149.2	93.9			2008.5	2011.6	
									95.0	44.7			2125.3
30	375.0	283.6	E	2.0	193.0	193.9	193.9	138.6			2046.2	2048.9	
									122.0	53.1			2297.6
29	497.0	405.6	E	2.0	246.0	247.0	247.0	191.7			2115.8	2120.7	
									81.0	35.0			2314.3
28	578.0	486.6	E	2.0	281.0	282.0	282.0	226.7			2146.4	2151.7	
									84.0	36.0			2333.3
26	662.0	570.6	E	2.0	317.5	318.5							
27	662.0	570.6	E	2.0	316.5	317.5	318.0	262.7			2172.1	2177.5	
									53.0	20.1			2636.8
25	715.0	623.6	E	2.0	337.0	338.1	338.1	282.8			2205.1	2213.3	
									165.0	66.0			2500.0
6	880.0	788.6	E	2.0	402.0	403.1							
24	880.0	788.6	E	2.0	404.0	405.1	404.1	348.8			2260.9	2270.3	
									77.0	31.0			2483.9
23	957.0	865.6	E	2.0	434.0	435.1	435.1	379.8			2279.1	2288.5	
									98.0	34.5			2840.6
22	1055.0	963.6	E	2.0	468.5	469.6	469.6	414.3			2325.9	2339.5	
									97.0	34.0			2852.9
21	1152.0	1060.6	E	2.0	502.5	503.6	503.6	448.3			2365.8	2382.3	
									78.0	25.5			3058.8
20	1230.0	1138.6	E	2.0	528.0	529.1	529.1	473.8			2403.1	2423.5	
									105.0	35.1			2991.5
18	1335.0	1243.6	E	2.0	563.0	564.2	564.2	508.9			2443.7	2466.9	

VELSEIS PTY LTD

WELL SURVEY CALCULATIONS

Company : GEOLOGICAL SURVEY VIC
Well : BUS SWAMP #1
Elevations : Datum : 0.0 Ground : 88.0 Kelly : 91.4

Shot data : Location	Elevation	Offset
A	88.0	7.0
B	88.0	8.0
C	88.0	16.0
D	88.0	24.0
E	88.0	24.0

Latitude : 037 31 18
Longitude : 141 12 00
Rig identification : RIG-4
Energy source : POWERGEL
Logger : DDL #3
Near surface velocity
for shot statics: 1600
Instrument delay: 4.0 ms

Survey date : 18-DEC-92
Survey units : METRES
Times in milliseconds.

SHOT CALCULATIONS

Shot No	Geophone depth Kelly	Geophone depth Datum	Shot Locn	Shot Depth	TIMES Record	TIMES Corr.	TIMES Avg.	TIMES Below datum	Check shot interval Distance	Check shot interval Time	Velocities Average	Velocities RMS	Velocities Interval
18	1335.0	1243.6	E	2.0	563.0	564.2	564.2	508.9			2443.7	2466.9	
									105.0	32.5			3230.8
17	1440.0	1348.6	E	2.0	595.5	596.7	596.7	541.4			2490.9	2519.3	
									62.0	15.2			4078.9
7	1502.0	1410.6	E	2.0	611.5	612.7							
16	1502.0	1410.6	E	2.0	610.0	611.2	611.9	556.6			2534.3	2574.5	
									50.0	14.0			3571.4
13	1552.0	1460.6	E	2.0	625.5	626.7							
14	1552.0	1460.6	E	2.0	624.0	625.2	625.9	570.6			2559.8	2603.5	
									88.0	24.2			3636.4
12	1640.0	1548.6	E	1.0	649.5	650.1	650.1	594.8			2603.6	2653.4	
									138.0	42.1			3277.9
8	1778.0	1686.6	E	2.0	691.0	692.2	692.2	636.9			2648.1	2699.1	
									52.0	11.2			4642.9
9	1830.0	1738.6	E	2.0	702.5	703.7							
10	1830.0	1738.6	E	2.0	702.0	703.2	703.4	648.1			2682.6	2744.4	

Company : GEOLOGICAL SURVEY VIC
Well : BUS SWAMP #1
Elevations : Datum : 0.0 Ground : 88.0 Kelly : 91.4

Latitude : 037 31 18
Longitude : 141 12 00

Survey date : 18-DEC-92
Survey units : METRES
Times in milliseconds.

SONIC DRIFT

	Geophone depth Kelly	---- Datum	Check shot times Average	- Below datum	Check shot interval Distance	-- Time	Sonic Int. time	Interval sonic drift usec/m	--- msec	Cumulative drift msec
DATUM										
	91.4	0.0	55.3	0.0						
					58.6	27.9				
	150.0	58.6	83.2	27.9						
					58.0	31.3				
	208.0	116.6	114.5	59.2						
					72.0	34.7	34.1	8.33	0.6	0.6
	280.0	188.6	149.2	93.9						
					95.0	44.7	43.4	13.68	1.3	1.9
	375.0	283.6	193.9	138.6						
					122.0	53.1	53.9	-6.56	-0.8	1.1
	497.0	405.6	247.0	191.7						
					81.0	35.0	33.9	13.58	1.1	2.2
	578.0	486.6	282.0	226.7						
					84.0	36.0	33.9	25.00	2.1	4.3
	662.0	570.6	318.0	262.7						
					53.0	20.1	21.4	-24.53	-1.3	3.0
	715.0	623.6	338.1	282.8						
					165.0	66.0	64.4	9.70	1.6	4.6
	880.0	788.6	404.1	348.8						
					77.0	31.0	29.2	23.38	1.8	6.4
	957.0	865.6	435.1	379.8						
					98.0	34.5	34.3	2.04	0.2	6.6
	1055.0	963.6	469.6	414.3						
					97.0	34.0	33.2	8.25	0.8	7.4
	1152.0	1060.6	503.6	448.3						
					78.0	25.5	25.6	-1.28	-0.1	7.3
	1230.0	1138.6	529.1	473.8						
					105.0	35.1	33.1	19.05	2.0	9.3
	1335.0	1243.6	564.2	508.9						
					105.0	32.5	30.5	19.05	2.0	11.3
	1440.0	1348.6	596.7	541.4						
					62.0	15.2	17.7	-40.32	-2.5	8.8
	1502.0	1410.6	611.9	556.6						
					50.0	14.0	13.6	8.00	0.4	9.2
	1552.0	1460.6	625.9	570.6						
					88.0	24.2	25.0	-9.09	-0.8	8.4
	1640.0	1548.6	650.1	594.8						
					138.0	42.1	38.3	27.54	3.8	12.2
	1778.0	1686.6	692.2	636.9						
					52.0	11.2	14.0	-53.85	-2.8	9.4
	1830.0	1738.6	703.4	648.1						

Company : GEOLOGICAL SURVEY VIC
Well : BUS SWAMP #1
Elevations : Datum : 0.0 Ground : 88.0 Kelly : 91.4

Latitude : 037 31 18
Longitude : 141 12 00

Survey date : 18-DEC-92
Survey units : METRES
Times in milliseconds.

SONIC CALIBRATION

	Geophone depth Kelly	Geophone depth Datum	Interval Distance	Original sonic times Interval	Original sonic times Cumulative	Adjusted sonic times Interval	Adjusted sonic times Calibrated	Velocities Average	Velocities RMS	Velocities Interval
DATUM										
	91.4	0.0								
			58.6							2100.4
	150.0	58.6						2100.4	2100.4	
			58.0							1853.0
	208.0	116.6						1969.6	1973.5	
			72.0	34.1		34.7				2074.9
	280.0	188.6			34.1		93.9	2008.5	2011.6	
			95.0	43.4		44.7				2125.3
	375.0	283.6			77.5		138.6	2046.2	2048.9	
			122.0	53.9		53.1				2297.6
	497.0	405.6			131.4		191.7	2115.8	2120.7	
			81.0	33.9		35.0				2314.3
	578.0	486.6			165.3		226.7	2146.4	2151.7	
			84.0	33.9		36.0				2333.3
	662.0	570.6			199.2		262.7	2172.1	2177.5	
			53.0	21.4		20.1				2636.8
	715.0	623.6			220.6		282.8	2205.1	2213.3	
			161.0	63.1		64.7				2489.9
PRETTY HILL SHALE										
	876.0	784.6			283.7		347.5	2258.1	2267.3	
			4.0	1.3		1.3				2987.8
	880.0	788.6			285.0		348.8	2260.9	2270.5	
			77.0	29.2		31.0				2483.9
	957.0	865.6			314.2		379.8	2279.1	2288.7	
			98.0	34.3		34.5				2840.6
	1055.0	963.6			348.5		414.3	2325.9	2339.6	
			97.0	33.2		34.0				2852.9
	1152.0	1060.6			381.7		448.3	2365.8	2382.4	
			68.0	22.6		22.5				3020.5
SAND/SHALE UNIT										
	1220.0	1128.6			404.3		470.8	2397.1	2416.8	
			10.0	3.0		3.0				3347.6
	1230.0	1138.6			407.3		473.8	2403.1	2423.8	
			105.0	33.1		35.1				2991.5
	1335.0	1243.6			440.4		508.9	2443.7	2467.1	
			105.0	30.5		32.5				3230.8
	1440.0	1348.6			470.9		541.4	2490.9	2519.5	
			55.0	15.8		13.6				4049.4
PRETTY HILL SAND UN										
	1495.0	1403.6			486.7		555.0	2529.1	2567.9	
			7.0	1.9		1.6				4327.0
	1502.0	1410.6			488.6		556.6	2534.3	2574.7	
			50.0	13.6		14.0				3571.4
	1552.0	1460.6			502.2		570.6	2559.8	2603.7	

VELSEIS PTY LTD — WELL SURVEY CALCULATIONS

Company : GEOLOGICAL SURVEY VIC
Well : BUS SWAMP #1
Elevations : Datum : 0.0 Ground : 88.0 Kelly : 91.4

Latitude : 037 31 18
Longitude : 141 12 00

Survey date : 18-DEC-92
Survey units : METRES
Times in milliseconds.

SONIC CALIBRATION

Geophone depth Kelly	Datum	Interval Distance	Original sonic times Interval	Cumulative	Adjusted sonic times Interval	Calibrated	Velocities Average	RMS	Interval
1552.0	1460.6			502.2		570.6	2559.8	2603.7	
		88.0	25.0		24.2				3636.4
1640.0	1548.6			527.2		594.8	2603.6	2653.6	
		136.0	37.7		41.4				3281.5
CASTERTON BEDS									
1776.0	1684.6			564.9		636.2	2647.7	2698.9	
		2.0	0.6		0.7				3052.9
1778.0	1686.6			565.5		636.9	2648.1	2699.3	
		48.0	13.0		10.4				4608.6
METAMORPHIC BASEMENT									
1826.0	1734.6			578.5		647.3	2679.7	2740.6	
		4.0	1.0		0.8				5098.0
1830.0	1738.6			579.5		648.1	2682.6	2744.7	

Velocity Data Pty Ltd

WELL VELOCITY SURVEY

CLIENT : GEOLOGICAL SURVEY VIC
WELL IDENTIFICATION : BUS SWAMP #1
SURVEY DATE : 18-DEC-92
SURVEY TIME : 10:30:00
SURVEY UNITS : METRES
AUTHORITY TO PROSPECT : PEP 119

WELL LATITUDE : 037 31 18
WELL LONGITUDE : 141 12 00

KELLY ELEVATION : 91.4
GROUND ELEVATION : 88.0

WEATHER : FINE

ENERGY SOURCE : POWERGEL

CLIENT REP : MR. B. SIMMONDS
OBSERVER : J LARSEN
SHOOTER : J BROWN

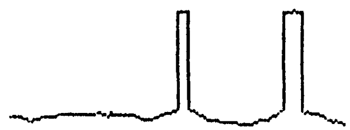
RIG IDENTIFICATION : RIG-4
CASING DEPTH : 205.4
LOGGING UNIT : DDL #3

RECORDING INSTRUMENTS : VDLS11/10
SYSTEM DELAY TIME 4 MSEC.

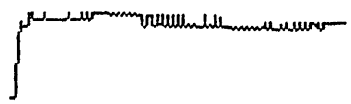
TRA[illegible]E DISPLAY.

SHOT 1 Time 10:35:20 Level : 91.4 Shot location : A
Shot depth : 0.5 Charge size : .1
No. surface samples : 128 Down hole sample nos : 0 400 1008
Sample rates : 500 1000 usec Delay : 0

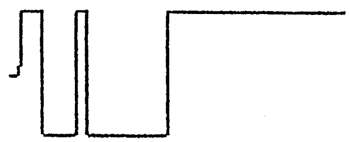
AUX. CHANNEL 1 Max. 791mV



AUX. CHANNEL 2 Max. 9370mV

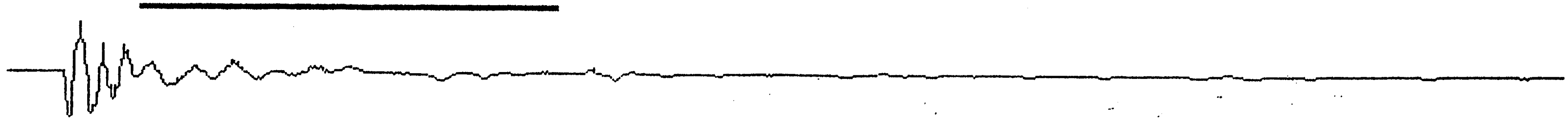


AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 2275mV

WELL PHONE CHANNEL - floating point amplifier

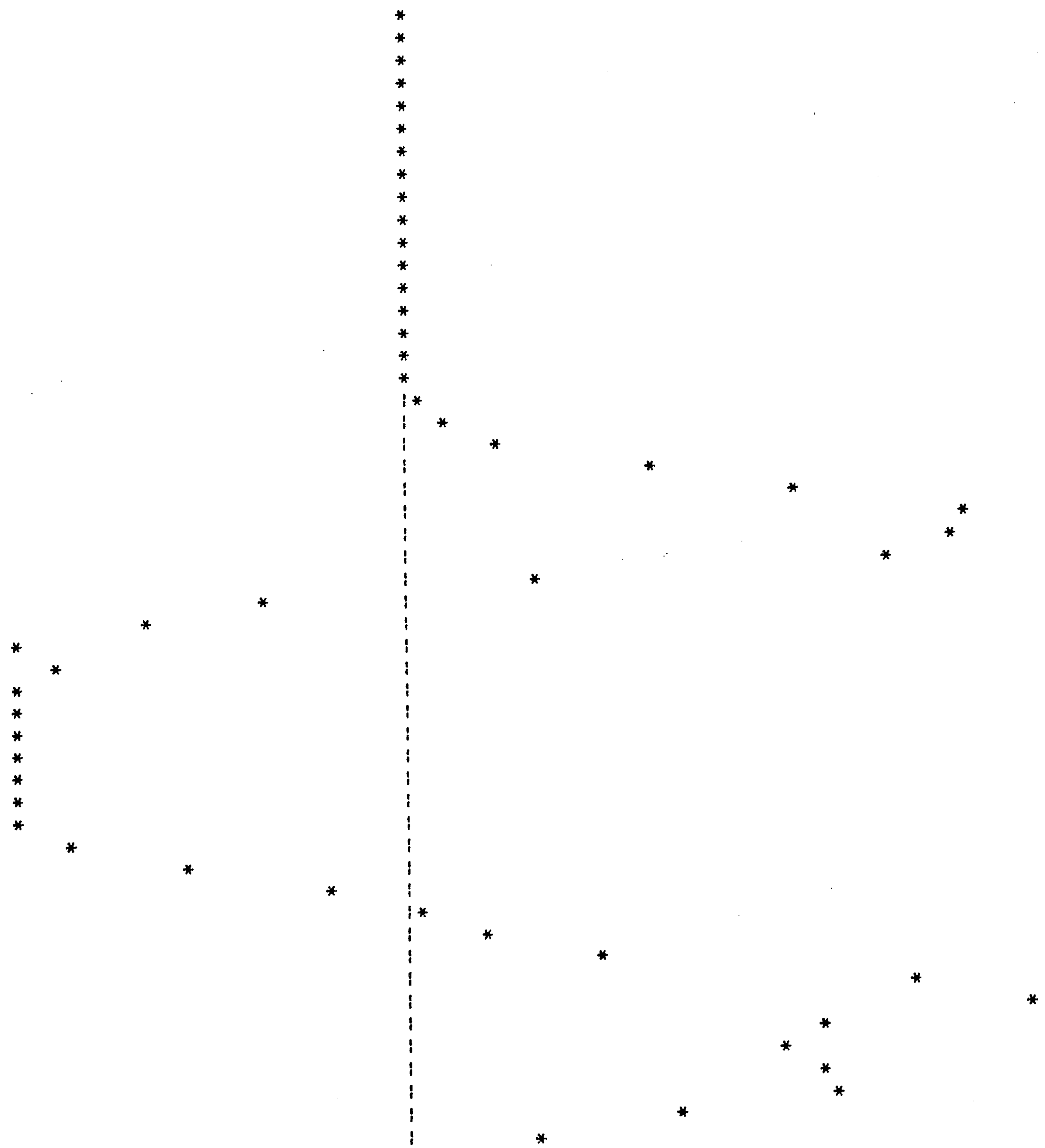


Data maximum (mV) : down hole channel - 36.738

FIRST ARRIVAL PLOT – Shot 1 Level 91.4

We phone data

Samp time	Value uV
38.0	94.
39.0	158.
40.0	91.
41.0	74.
42.0	29.
43.0	19.
44.0	64.
45.0	160.
46.0	132.
47.0	156.
48.0	160.
49.0	131.
50.0	99.
51.0	78.
52.0	88.
53.0	266.
54.0	300.
55.0	433.
56.0	1906.
57.0	5208.
58.0	14447.
59.0	22571.
60.0	32656.
61.0	32176.
62.0	28134.
63.0	7254.
64.0	-8744.
65.0	-15768.
66.0	-26973.
67.0	-21370.
68.0	-24172.
69.0	-23772.
70.0	-23892.
71.0	-36738.
72.0	-37859.
73.0	-23772.
74.0	-27493.
75.0	-20250.
76.0	-13307.
77.0	-5523.
78.0	724.
79.0	4252.
80.0	11686.
81.0	29454.
82.0	36018.
83.0	24372.
84.0	22331.
85.0	24372.
86.0	24652.
87.0	15768.
88.0	7194.



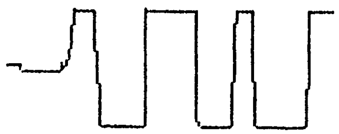
TRACE DISPLAY.

SHOT 2 Time 10:37:23 Level : 91.4 Shot location : B
Shot depth : 0.5 Charge size : .2
No. surface samples : 128 Down hole sample nos : 0 400 1008
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 1074mV

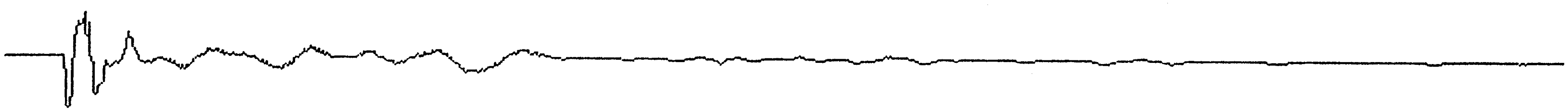
AUX. CHANNEL 2 Max. 9375mV

AUX. CHANNEL 3 Max. 9971mV



AUX. CHANNEL 4 Max. 6987mV

WELL PHONE CHANNEL - floating point amplifier

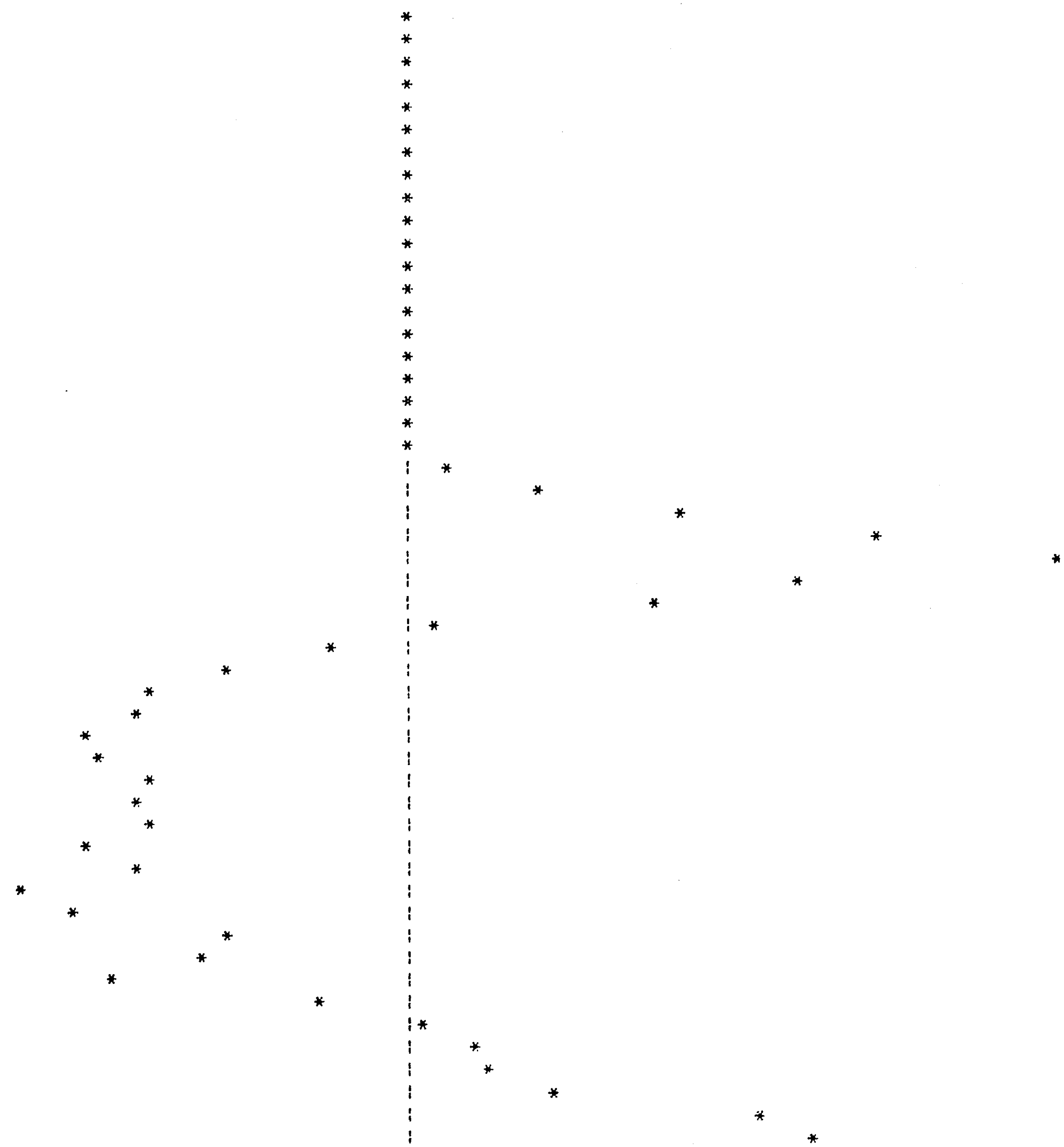


Data maximum (mV) : down hole channel - 53.826

FIRST ARRIVAL PLOT - Shot 2 Level 91.4

We[illegible]phone data

Sample time	Value uV
38.0	-74.
39.0	-51.
40.0	-31.
41.0	-39.
42.0	-56.
43.0	-61.
44.0	-115.
45.0	-89.
46.0	-118.
47.0	-68.
48.0	-101.
49.0	-109.
50.0	-100.
51.0	-73.
52.0	-75.
53.0	-59.
54.0	-24.
55.0	14.
56.0	164.
57.0	706.
58.0	4082.
59.0	14497.
60.0	31816.
61.0	53826.
62.0	75397.
63.0	44542.
64.0	28974.
65.0	3452.
66.0	-10735.
67.0	-22731.
68.0	-32176.
69.0	-32856.
70.0	-38739.
71.0	-37899.
72.0	-31055.
73.0	-33336.
74.0	-31335.
75.0	-39699.
76.0	-33256.
77.0	-46903.
78.0	-40380.
79.0	-22251.
80.0	-24892.
81.0	-36098.
82.0	-12746.
83.0	1066.
84.0	8004.
85.0	8374.
86.0	16988.
87.0	40380.
88.0	47223.

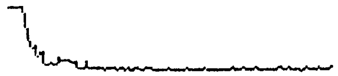


TRACE DISPLAY.

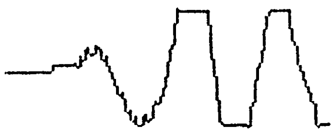
SHOT 3 Time 10:39:13 Level : 91.4 Shot location : C
Shot depth : 0.5 Charge size : .2
No. surface samples : 128 Down hole sample nos : 0 400 1008
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 1250mV

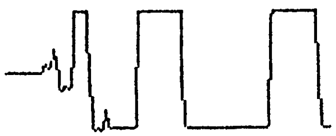
AUX. CHANNEL 2 Max. 9375mV



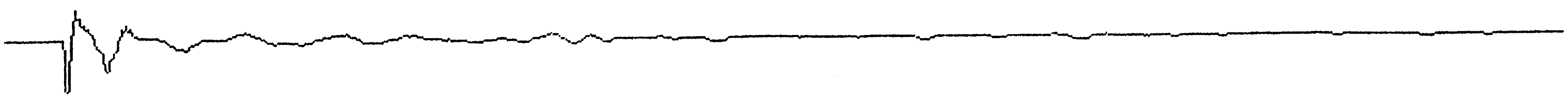
AUX. CHANNEL 3 Max. 9873mV



AUX. CHANNEL 4 Max. 9858mV



WELL PHONE CHANNEL - floating point amplifier

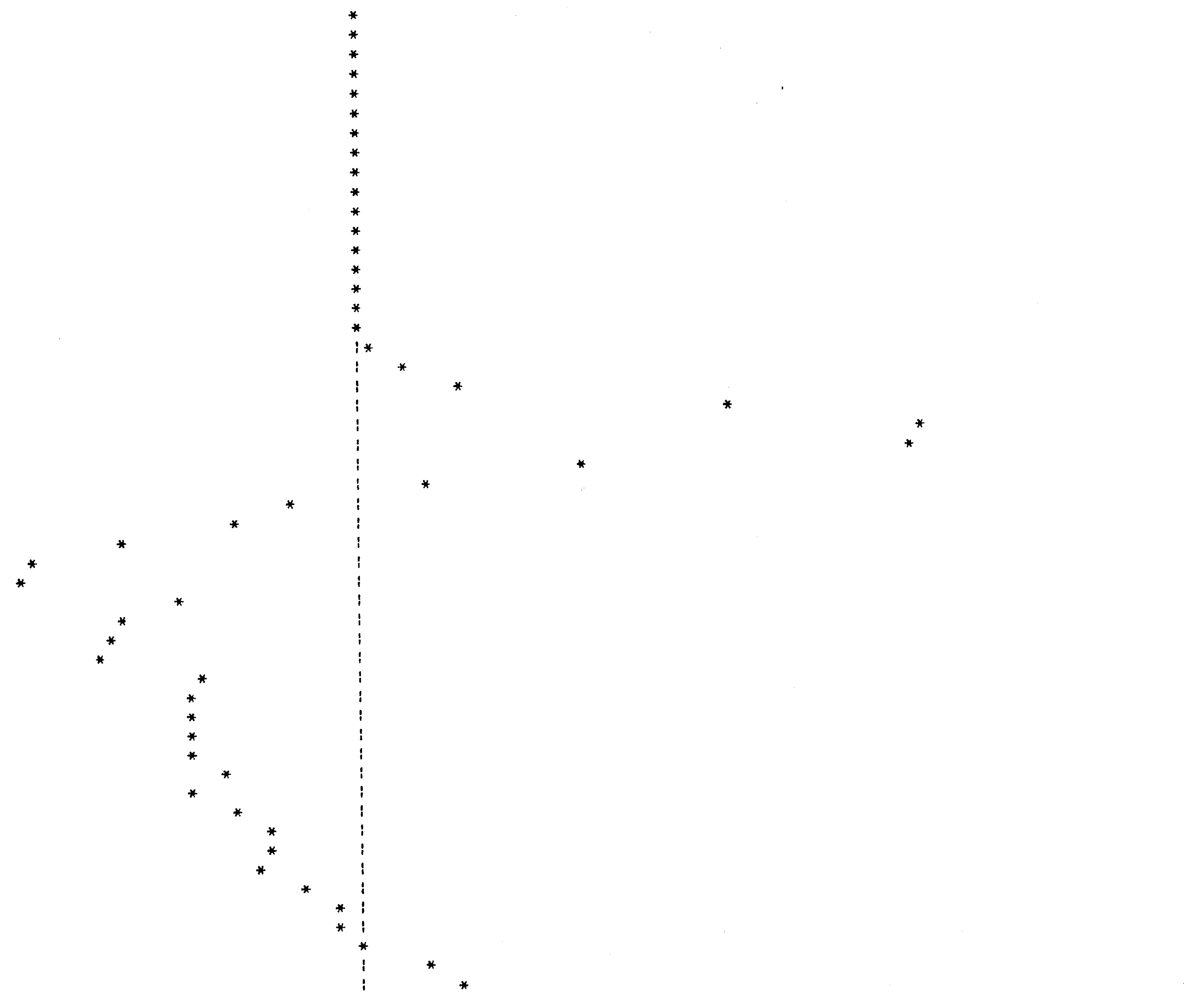


Data maximum (mV) : down hole channel - 61.310

FIRST ARRIVAL PLOT - Shot 3 Level 91.4

Well phone data

Sample time	Value uV
40.0	-32.
41.0	-55.
42.0	-43.
43.0	-23.
44.0	4.
45.0	38.
46.0	75.
47.0	64.
48.0	79.
49.0	52.
50.0	45.
51.0	24.
52.0	31.
53.0	53.
54.0	75.
55.0	54.
56.0	145.
57.0	622.
58.0	4522.
59.0	10505.
60.0	40580.
61.0	61310.
62.0	60550.
63.0	24732.
64.0	7073.
65.0	-8094.
66.0	-14637.
67.0	-26733.
68.0	-37378.
69.0	-38539.
70.0	-21330.
71.0	-27453.
72.0	-28654.
73.0	-28894.
74.0	-17809.
75.0	-19870.
76.0	-19369.
77.0	-19590.
78.0	-20150.
79.0	-15728.
80.0	-19229.
81.0	-15157.
82.0	-10505.
83.0	-10845.
84.0	-12146.
85.0	-7604.
86.0	-3952.
87.0	-3852.
88.0	244.
89.0	7494.
90.0	10755.

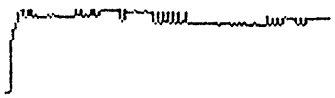


T●ACE DISPLAY.

SHOT 4 Time 10:42:33 Level : 91.4 Shot location : D
Shot depth : 0.5 Charge size : .2
No. surface samples : 128 Down hole sample nos : 0 400 1008
Sample rates : 500 1000 usec Delay : 0

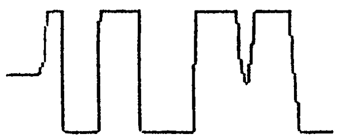
AUX. CHANNEL 1 Max. 1933mV

AUX. CHANNEL 2 Max. 9370mV

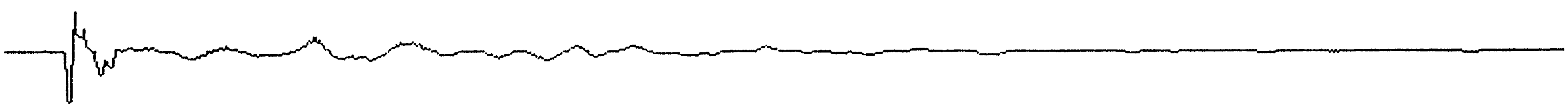


AUX. CHANNEL 3 Max. 9868mV

AUX. CHANNEL 4 Max. 9375mV



WELL PHONE CHANNEL - floating point amplifier

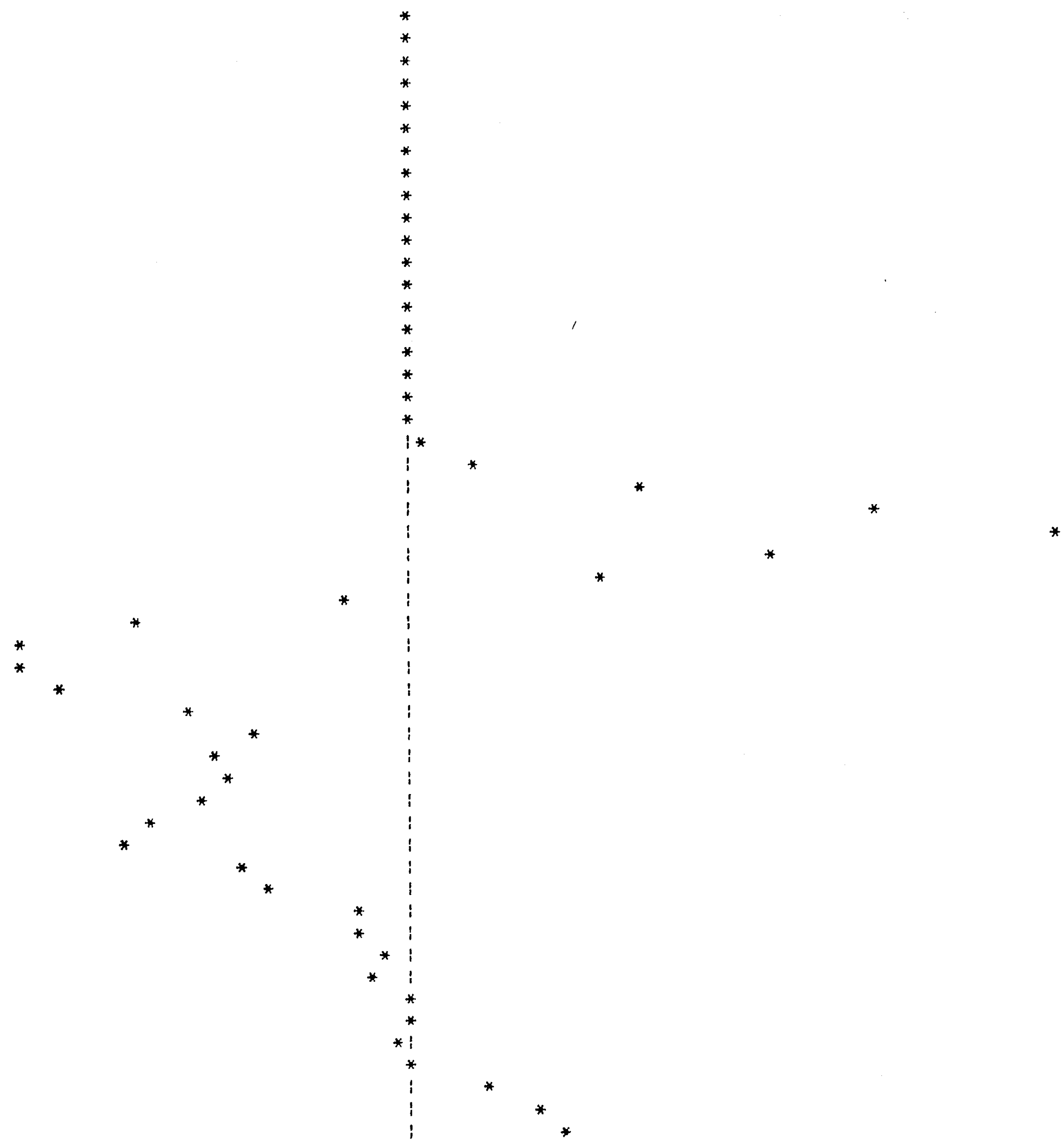


Data maximum (mV) : down hole channel - 60.990

FIRST ARRIVAL PLOT - Shot 4 Level 91.4

Wel phone data

Samp time	Value uV
40.0	-91.
41.0	-153.
42.0	-147.
43.0	-81.
44.0	-108.
45.0	-108.
46.0	-68.
47.0	-56.
48.0	-26.
49.0	-12.
50.0	-21.
51.0	-49.
52.0	-41.
53.0	-32.
54.0	-23.
55.0	-21.
56.0	-23.
57.0	-18.
58.0	275.
59.0	1573.
60.0	6303.
61.0	21651.
62.0	43541.
63.0	60990.
64.0	34097.
65.0	17689.
66.0	-6903.
67.0	-27253.
68.0	-40540.
69.0	-48824.
70.0	-34297.
71.0	-22091.
72.0	-16388.
73.0	-19389.
74.0	-18749.
75.0	-20450.
76.0	-26133.
77.0	-27934.
78.0	-16728.
79.0	-14847.
80.0	-6013.
81.0	-6643.
82.0	-4147.
83.0	-4352.
84.0	-1791.
85.0	-1523.
86.0	-2028.
87.0	-253.
88.0	7254.
89.0	12086.
90.0	14487.

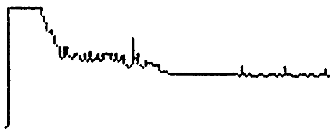


TRACE DISPLAY.

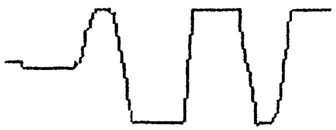
SHOT 5 Time 10:44:43 Level : 91.4 Shot location : E
Shot depth : 2.0 Charge size : .2
No. surface samples : 128 Down hole sample nos : 0 400 1008
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 4712mV

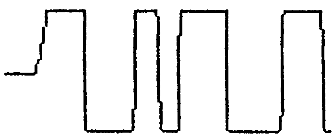
AUX. CHANNEL 2 Max. 9375mV



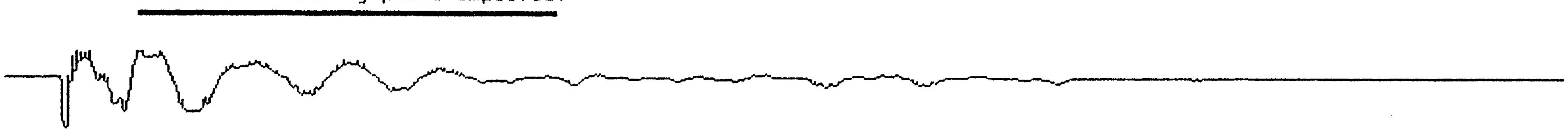
AUX. CHANNEL 3 Max. 9932mV



AUX. CHANNEL 4 Max. 9375mV



WELL PHONE CHANNEL - floating point amplifier

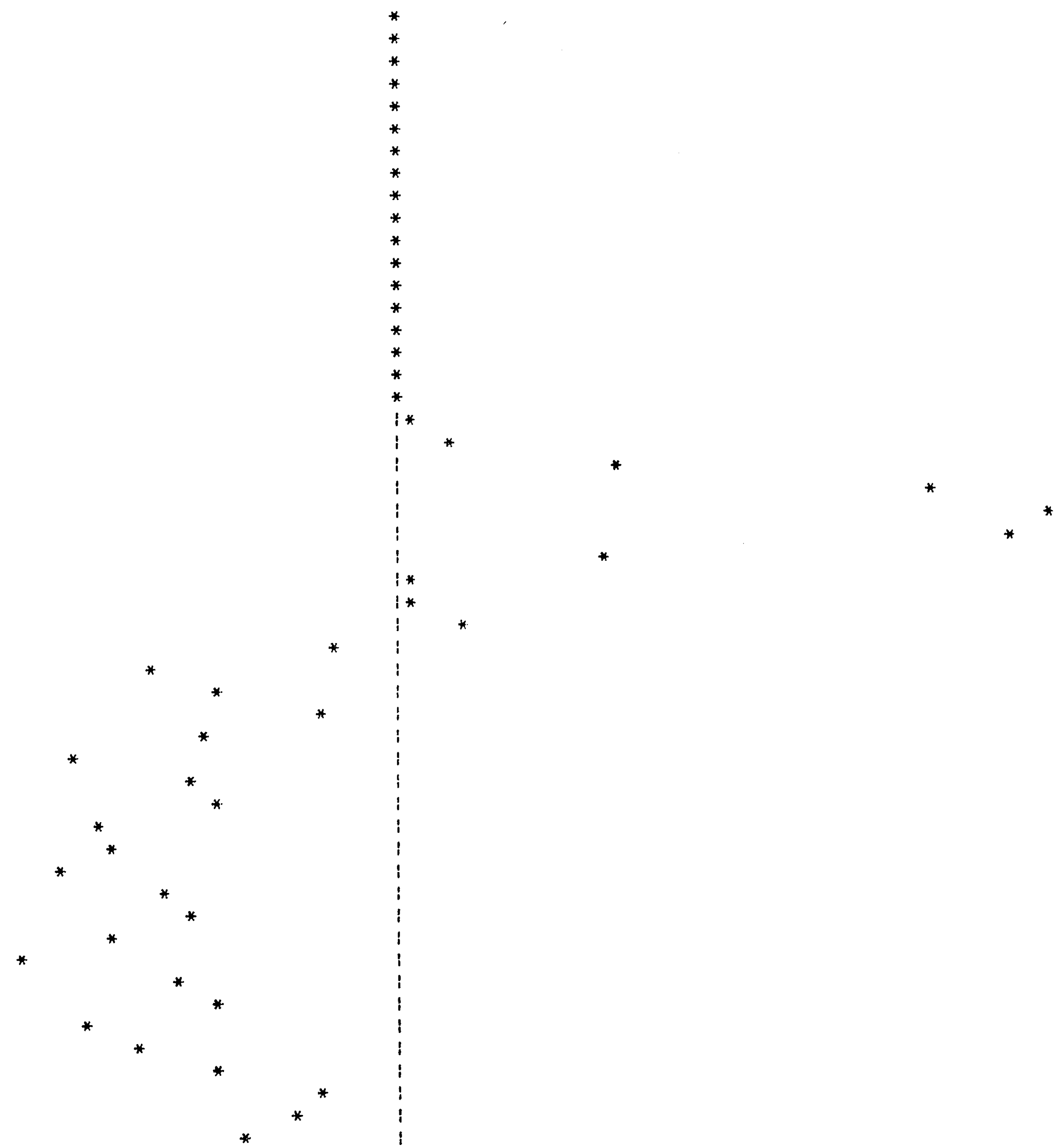


Data maximum (mV) : down hole channel - 291.022

FIRST ARRIVAL PLOT - Shot 5 Level 91.4

Well phone data

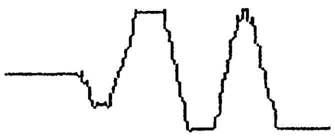
Sample time	Value uV
36.0	-56.
37.0	-41.
38.0	-45.
39.0	-16.
40.0	17.
41.0	-2.
42.0	-16.
43.0	-16.
44.0	-16.
45.0	-16.
46.0	-37.
47.0	-54.
48.0	-106.
49.0	-117.
50.0	-94.
51.0	-150.
52.0	-46.
53.0	451.
54.0	5763.
55.0	23892.
56.0	102850.
57.0	253564.
58.0	307190.
59.0	291022.
60.0	95247.
61.0	4132.
62.0	4800.
63.0	30175.
64.0	-34657.
65.0	-120539.
66.0	-93166.
67.0	-43781.
68.0	-98528.
69.0	-157517.
70.0	-101490.
71.0	-91405.
72.0	-146632.
73.0	-139908.
74.0	-163120.
75.0	-115577.
76.0	-102930.
77.0	-141989.
78.0	-185050.
79.0	-112455.
80.0	-91085.
81.0	-155436.
82.0	-126302.
83.0	-89964.
84.0	-44862.
85.0	-56988.
86.0	-80759.



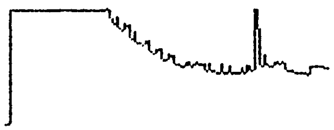
TRACE DISPLAY.

SHOT 6 Time 11:06:54 Level : 880.0 Shot location : E
Shot depth : 2.0 Charge size : .5
No. surface samples : 128 Down hole sample nos : 139 400 869
Sample rates : 500 1000 usec Delay : 0

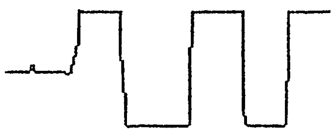
AUX. CHANNEL 1 Max. 9795mV



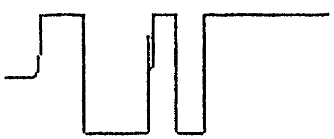
AUX. CHANNEL 2 Max. 9995mV



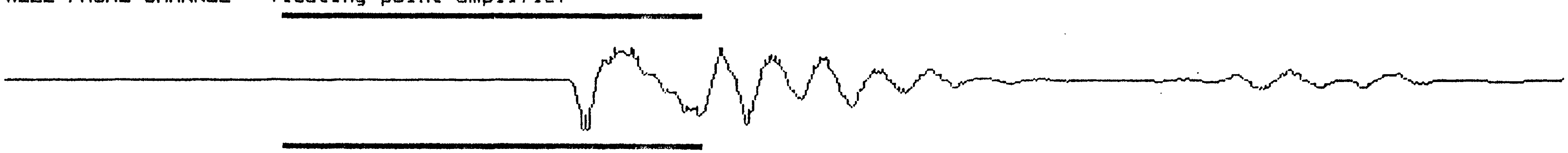
AUX. CHANNEL 3 Max. 9936mV



AUX. CHANNEL 4 Max. 9614mV



WELL PHONE CHANNEL - floating point amplifier



Data maximum (mV) : down hole channel - 29.494

FIRST ARRIVAL PLOT - Shot 6 Level 880.0

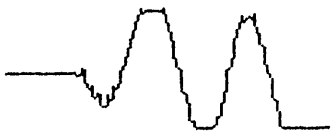
Well phone data

Sample time	Value uV
386.0	18.
386.5	15.
387.0	5.
387.5	-0.
388.0	-4.
388.5	-8.
389.0	-19.
389.5	-18.
390.0	-17.
390.5	-1.
391.0	7.
391.5	19.
392.0	19.
392.5	16.
393.0	-2.
393.5	-8.
394.0	-18.
394.5	-15.
395.0	2.
395.5	11.
396.0	25.
396.5	37.
397.0	35.
397.5	49.
398.0	40.
398.5	47.
399.0	33.
399.5	30.
400.0	31.
400.5	48.
401.0	52.
401.5	67.
402.0	84.
402.5	159.
403.0	254.
403.5	311.
404.0	407.
404.5	577.
405.0	693.
405.5	1716.
406.0	2446.
406.5	4342.
407.0	4082.
407.5	7324.
408.0	9345.
408.5	11766.
409.0	14367.
409.5	19790.
410.0	17288.
410.5	27293.
411.0	29214.

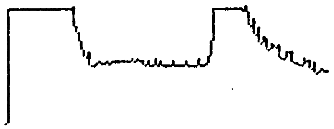
TRACE DISPLAY.

SHOT 7 Time 11:20:52 Level : 1502.0 Shot location : E
Shot depth : 2.0 Charge size : .5
No. surface samples : 128 Down hole sample nos : 335 400 673
Sample rates : 500 1000 usec Delay : 0

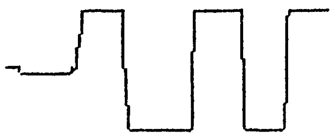
AUX. CHANNEL 1 Max. 9697mV



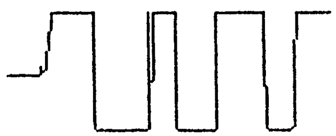
AUX. CHANNEL 2 Max. 9658mV



AUX. CHANNEL 3 Max. 9394mV



AUX. CHANNEL 4 Max. 9375mV



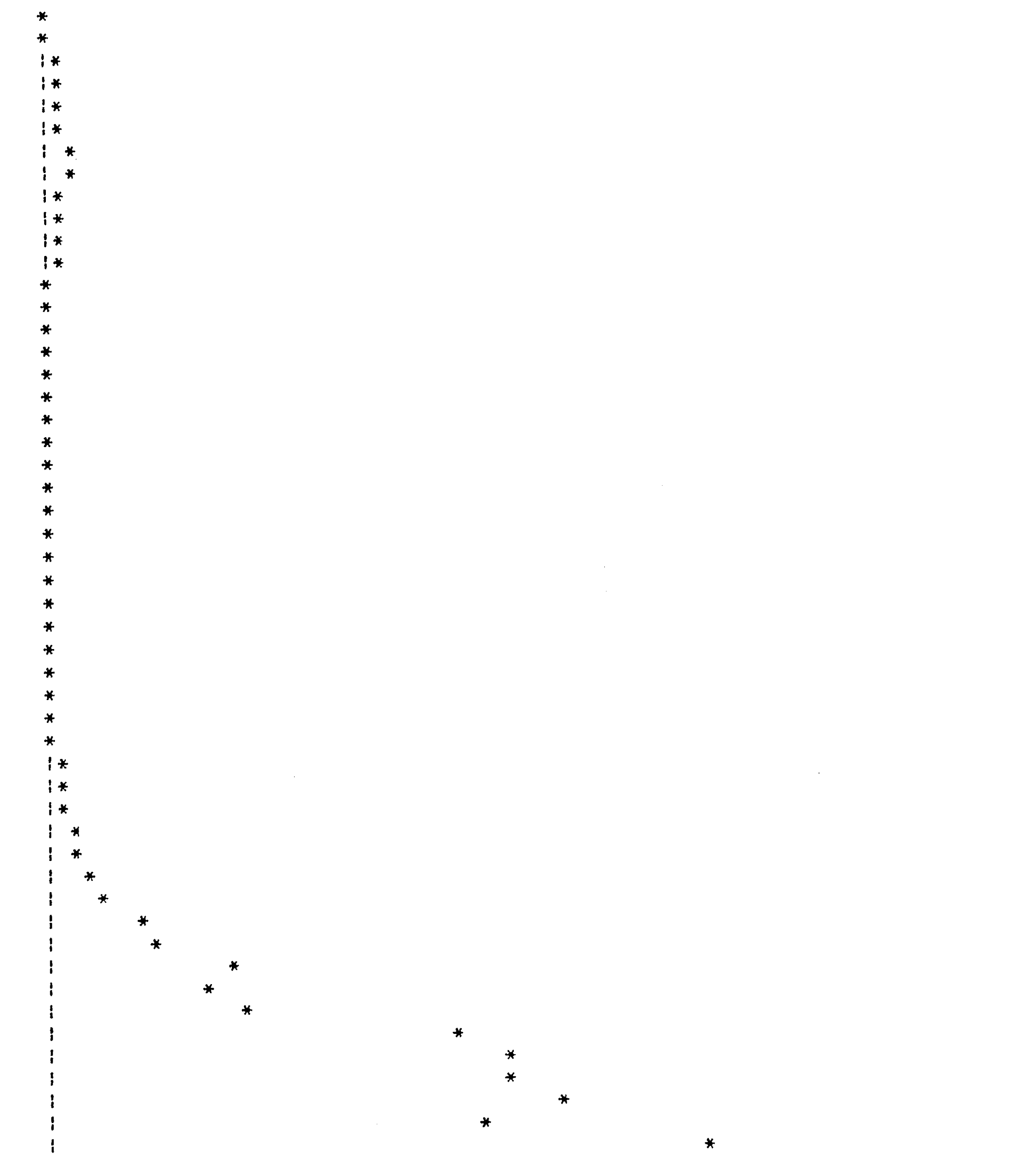
WELL PHONE CHANNEL - floating point amplifier

Data maximum (mV) : down hole channel - 7.524

FIRST ARRIVAL PLOT - Shot 7 Level 1502.0

Wel phone data

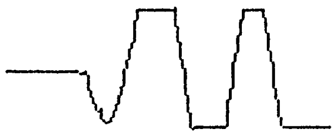
Sample time	Value uV
594.0	29.
594.5	55.
595.0	80.
595.5	147.
596.0	125.
596.5	134.
597.0	241.
597.5	244.
598.0	132.
598.5	152.
599.0	81.
599.5	74.
600.0	38.
600.5	2.
601.0	-22.
601.5	-50.
602.0	-78.
602.5	-107.
603.0	-83.
603.5	-92.
604.0	-96.
604.5	-95.
605.0	-82.
605.5	-63.
606.0	-64.
606.5	-37.
607.0	-16.
607.5	2.
608.0	8.
608.5	27.
609.0	45.
609.5	59.
610.0	61.
610.5	67.
611.0	115.
611.5	122.
612.0	281.
612.5	321.
613.0	375.
613.5	558.
614.0	936.
614.5	1053.
615.0	1833.
615.5	1583.
616.0	2031.
616.5	4122.
617.0	4632.
617.5	4607.
618.0	5107.
618.5	4302.
619.0	6583.



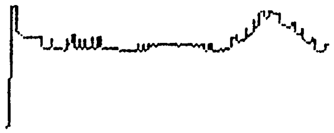
TRACE DISPLAY.

SHOT 8 Time 11:29:19 Level : 1778.0 Shot location : E
Shot depth : 2.0 Charge size : 1
No. surface samples : 128 Down hole sample nos : 408 400 600
Sample rates : 500 1000 usec Delay : 0

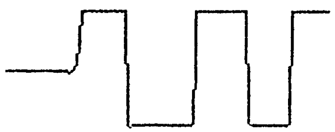
AUX. CHANNEL 1 Max. 9863mV



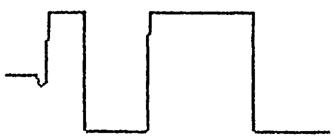
AUX. CHANNEL 2 Max. 9375mV



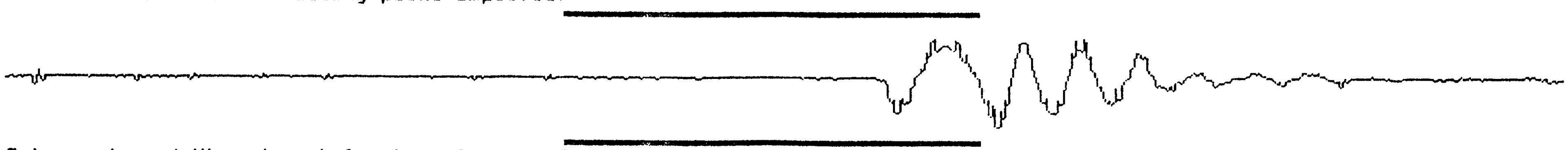
AUX. CHANNEL 3 Max. 9829mV



AUX. CHANNEL 4 Max. 9375mV



WELL PHONE CHANNEL - floating point amplifier

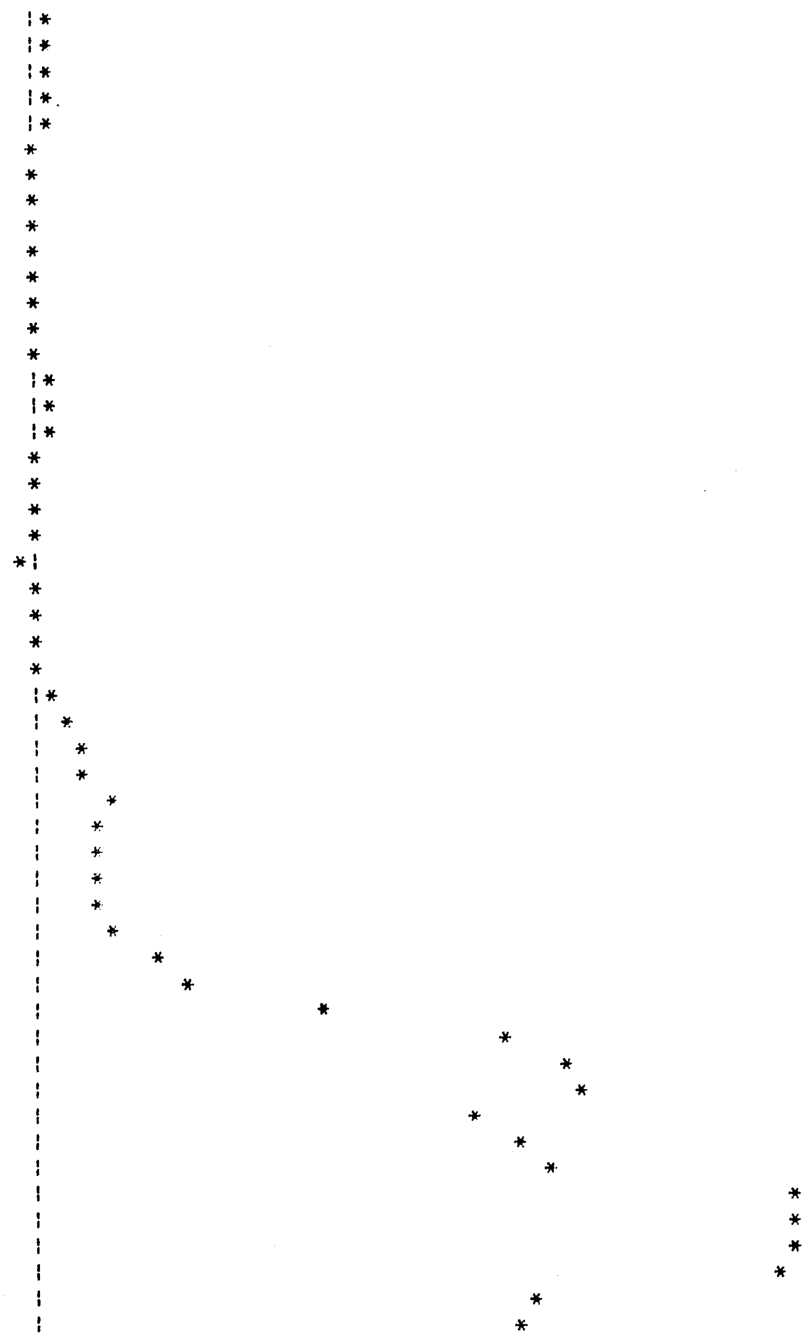


Data maximum (mV) : down hole channel - 9.345

FI[illegible]T ARRIVAL PLOT - S[illegible]ot 8 Level 177[illegible].0

Sample time	Value uV
674.0	143.
674.5	154.
675.0	154.
675.5	96.
676.0	79.
676.5	49.
677.0	-27.
677.5	-83.
678.0	-121.
678.5	-137.
679.0	-127.
679.5	-84.
680.0	-32.
680.5	38.
681.0	68.
681.5	106.
682.0	79.
682.5	35.
683.0	-40.
683.5	-141.
684.0	-184.
684.5	-249.
685.0	-155.
685.5	-73.
686.0	11.
686.5	66.
687.0	124.
687.5	301.
688.0	416.
688.5	376.
689.0	623.
689.5	500.
690.0	496.
690.5	491.
691.0	540.
691.5	690.
692.0	1036.
692.5	1281.
693.0	2474.
693.5	4062.
694.0	4662.
694.5	4682.
695.0	3862.
695.5	4207.
696.0	4447.
696.5	6523.
697.0	6583.
697.5	6573.
698.0	6503.
698.5	4387.
699.0	4242.

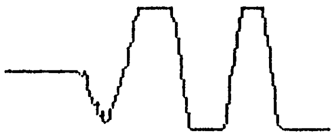
Well phone data



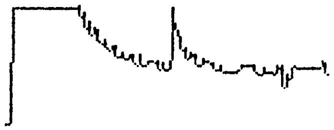
TRACE DISPLAY.

SHOT 9 Time 11:33:50 Level : 1830.0 Shot location : E
Shot depth : 2.0 Charge size : 1
No. surface samples : 128 Down hole sample nos : 422 400 586
Sample rates : 500 1000 usec Delay : 0

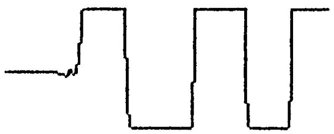
AUX. CHANNEL 1 Max. 9502mV



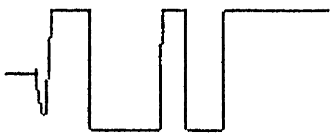
AUX. CHANNEL 2 Max. 9663mV



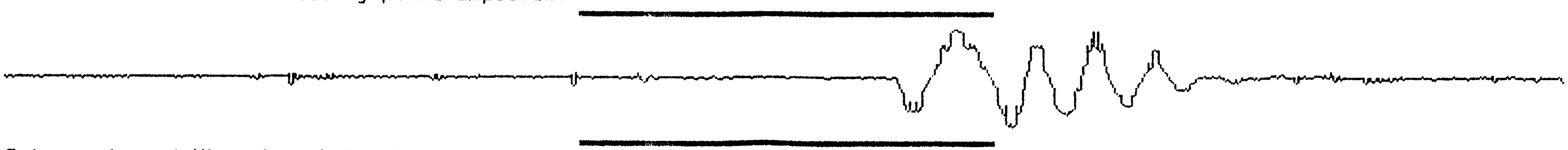
AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9375mV



WELL PHONE CHANNEL - floating point amplifier

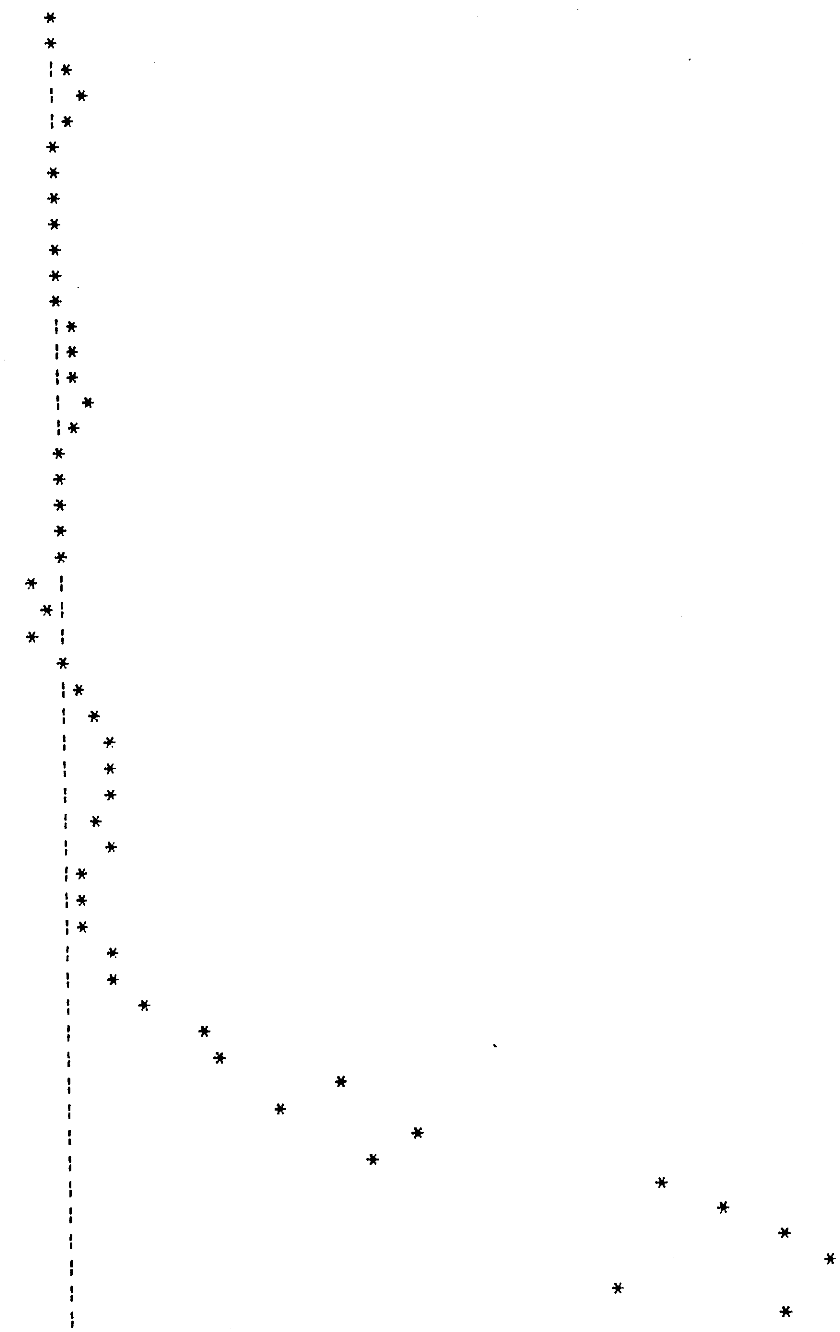


Data maximum (mV) : down hole channel - 7.043

FIRST ARRIVAL PLOT - Shot 9 Level [illegible]

Well phone data

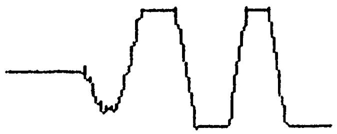
Sample time	Value uV
686.0	-18.
686.5	48.
687.0	143.
687.5	243.
688.0	122.
688.5	46.
689.0	-13.
689.5	-65.
690.0	-68.
690.5	-79.
691.0	-39.
691.5	9.
692.0	58.
692.5	94.
693.0	124.
693.5	150.
694.0	101.
694.5	46.
695.0	-1.
695.5	-20.
696.0	-52.
696.5	-130.
697.0	-288.
697.5	-196.
698.0	-273.
698.5	-57.
699.0	114.
699.5	241.
700.0	290.
700.5	316.
701.0	290.
701.5	212.
702.0	276.
702.5	92.
703.0	108.
703.5	120.
704.0	315.
704.5	321.
705.0	522.
705.5	897.
706.0	1019.
706.5	1748.
707.0	1391.
707.5	2299.
708.0	1941.
708.5	3882.
709.0	4242.
709.5	4602.
710.0	4922.
710.5	3504.
711.0	4632.



TRACE DISPLAY.

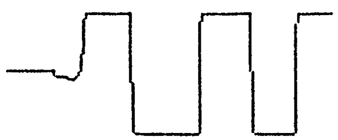
SHOT 10 Time 11:37:25 Level : 1830.0 Shot location : E
Shot depth : 2.0 Charge size : 1
No. surface samples : 128 Down hole sample nos : 422 400 586
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 9751mV

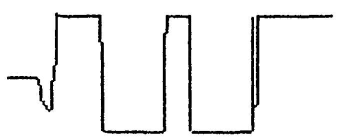


AUX. CHANNEL 2 Max. 9375mV

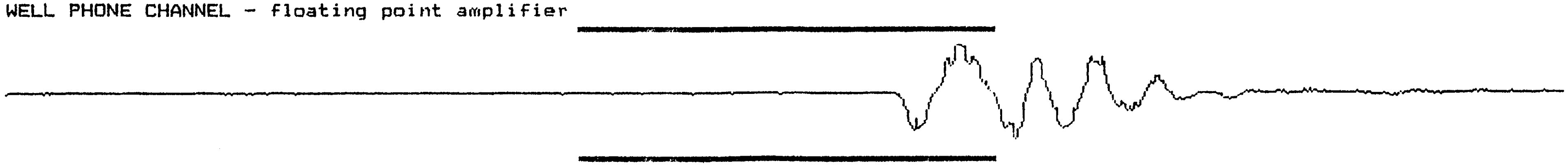
AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9966mV



WELL PHONE CHANNEL - floating point amplifier



Data maximum (mV) : down hole channel - 6.843

FIRST ARRIVAL PLOT - Shot 10 Level 1830.0

Well phone data

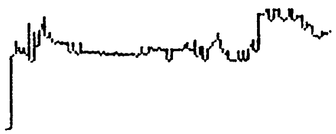
Sample time	Value uV
686.0	141.
686.5	87.
687.0	77.
687.5	46.
688.0	18.
688.5	-4.
689.0	-8.
689.5	-9.
690.0	-3.
690.5	7.
691.0	17.
691.5	9.
692.0	-4.
692.5	-5.
693.0	-2.
693.5	-6.
694.0	-20.
694.5	-105.
695.0	-156.
695.5	-181.
696.0	-129.
696.5	-95.
697.0	-66.
697.5	-59.
698.0	-11.
698.5	38.
699.0	109.
699.5	90.
700.0	102.
700.5	24.
701.0	-47.
701.5	-106.
702.0	-80.
702.5	-36.
703.0	55.
703.5	200.
704.0	377.
704.5	356.
705.0	513.
705.5	680.
706.0	828.
706.5	992.
707.0	1651.
707.5	1876.
708.0	1486.
708.5	2421.
709.0	2096.
709.5	4072.
710.0	4402.
710.5	4702.
711.0	4932.

TRACE DISPLAY.

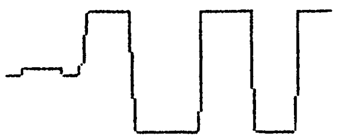
SHOT 12 Time 11:52:52 Level : 1640.0 Shot location : E
Shot depth : 1.0 Charge size : 2
No. surface samples : 128 Down hole sample nos : 372 400 636
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 9741mV

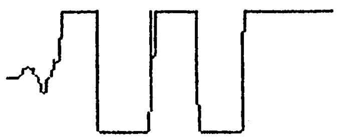
AUX. CHANNEL 2 Max. 9658mV



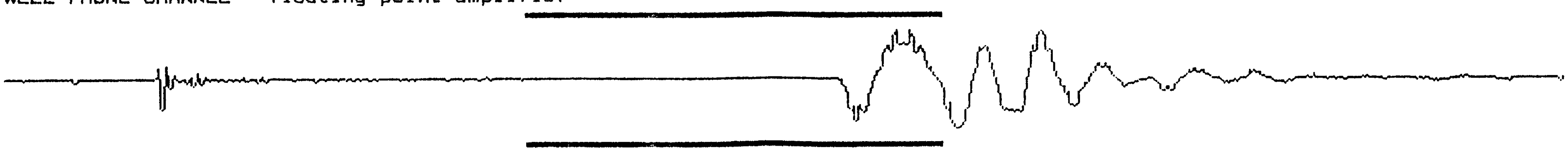
AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9375mV



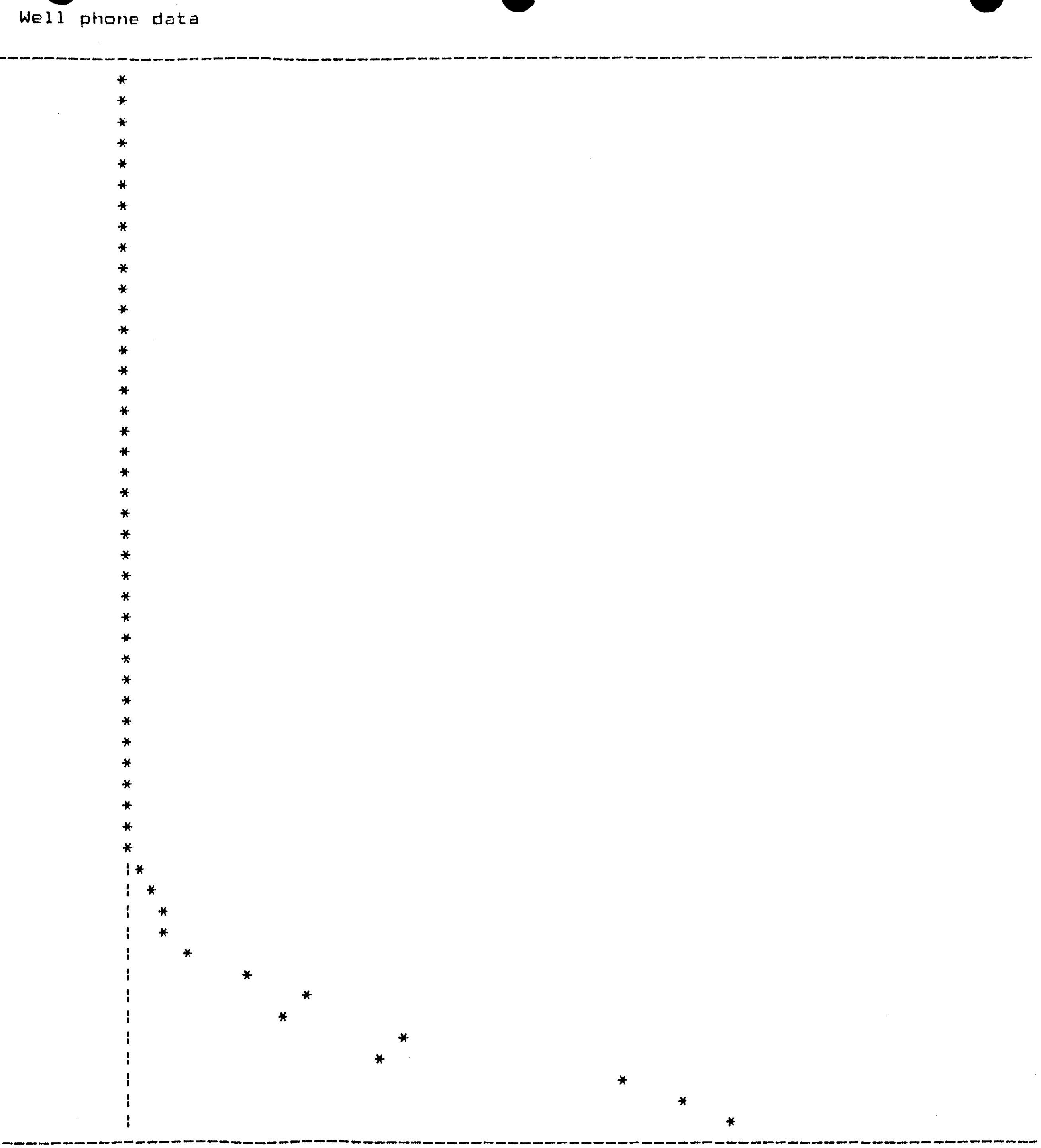
WELL PHONE CHANNEL - floating point amplifier



Data maximum (mV) : down hole channel - 7.554

FIRST ARRIVAL PLOT - Shot 12 Level 164[illegible].0

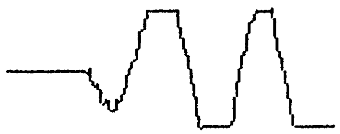
Sample time	Value uV
632.0	22.
632.5	31.
633.0	40.
633.5	29.
634.0	5.
634.5	-4.
635.0	-3.
635.5	5.
636.0	17.
636.5	22.
637.0	30.
637.5	15.
638.0	-16.
638.5	-25.
639.0	-32.
639.5	-39.
640.0	-29.
640.5	-17.
641.0	-5.
641.5	-6.
642.0	-17.
642.5	-22.
643.0	-50.
643.5	-54.
644.0	-78.
644.5	-79.
645.0	-79.
645.5	-80.
646.0	-63.
646.5	-65.
647.0	-65.
647.5	-63.
648.0	-61.
648.5	-77.
649.0	-79.
649.5	-48.
650.0	-19.
650.5	24.
651.0	115.
651.5	198.
652.0	278.
652.5	336.
653.0	534.
653.5	949.
654.0	1453.
654.5	1288.
655.0	2286.
655.5	2043.
656.0	4062.
656.5	4522.
657.0	4962.



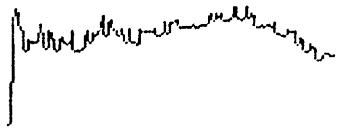
TRACE DISPLAY.

SHOT 13 Time 12:01:34 Level : 1552.0 Shot location : E
Shot depth : 2.0 Charge size : 1
No. surface samples : 128 Down hole sample nos : 349 400 659
Sample rates : 500 1000 usec Delay : 0

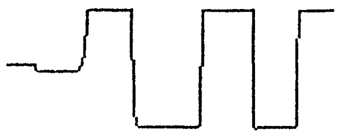
AUX. CHANNEL 1 Max. 9946mV



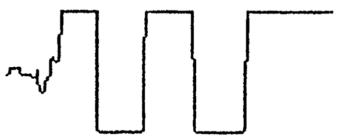
AUX. CHANNEL 2 Max. 9726mV



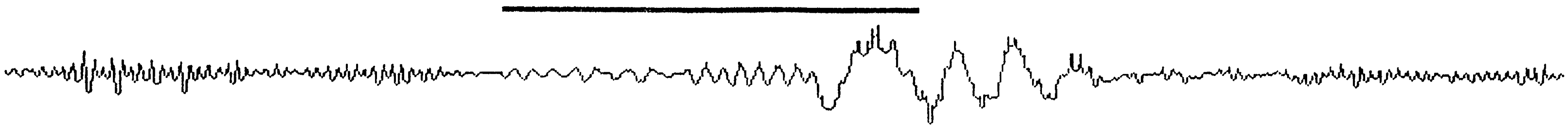
AUX. CHANNEL 3 Max. 9927mV



AUX. CHANNEL 4 Max. 9375mV



WELL PHONE CHANNEL - floating point amplifier

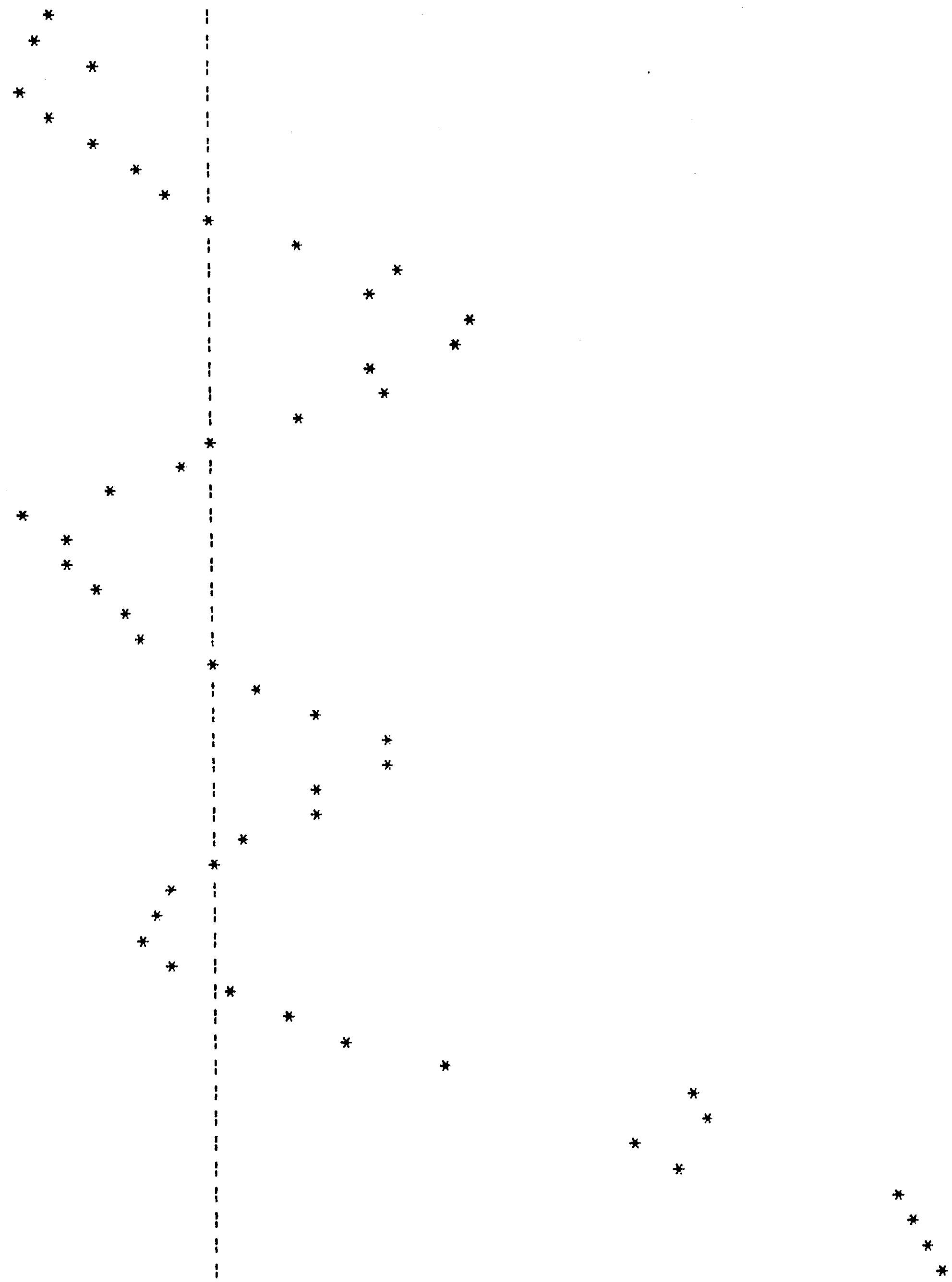


Data maximum (mV) : down hole channel - 9.755

FIRST ARRIVAL PLOT — Shot 13 Level 1552.0

Well phone data

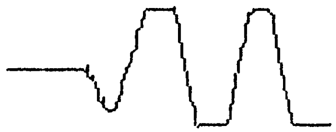
Sample time	Value uV
608.0	-1641.
608.5	-1851.
609.0	-1296.
609.5	-1891.
610.0	-1723.
610.5	-1267.
611.0	-875.
611.5	-573.
612.0	25.
612.5	770.
613.0	1816.
613.5	1583.
614.0	2424.
614.5	2381.
615.0	1488.
615.5	1693.
616.0	801.
616.5	-27.
617.0	-356.
617.5	-1054.
618.0	-1913.
618.5	-1513.
619.0	-1523.
619.5	-1308.
620.0	-997.
620.5	-819.
621.0	-90.
621.5	408.
622.0	925.
622.5	1608.
623.0	1661.
623.5	970.
624.0	940.
624.5	336.
625.0	-207.
625.5	-603.
626.0	-710.
626.5	-894.
627.0	-496.
627.5	70.
628.0	629.
628.5	1298.
629.0	2154.
629.5	4532.
630.0	4742.
630.5	3987.
631.0	4362.
631.5	6513.
632.0	6703.
632.5	6833.
633.0	6923.



TRACE DISPLAY.

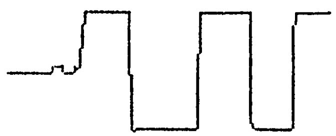
SHOT 14 Time 12:03:57 Level : 1552.0 Shot location : E
Shot depth : 2.0 Charge size : 1
No. surface samples : 128 Down hole sample nos : 349 400 659
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 9971mV



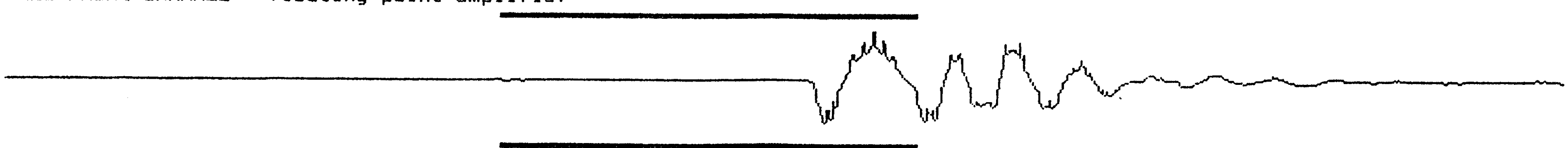
AUX. CHANNEL 2 Max. 9643mV

AUX. CHANNEL 3 Max. 9682mV



AUX. CHANNEL 4 Max. 9375mV

WELL PHONE CHANNEL - floating point amplifier

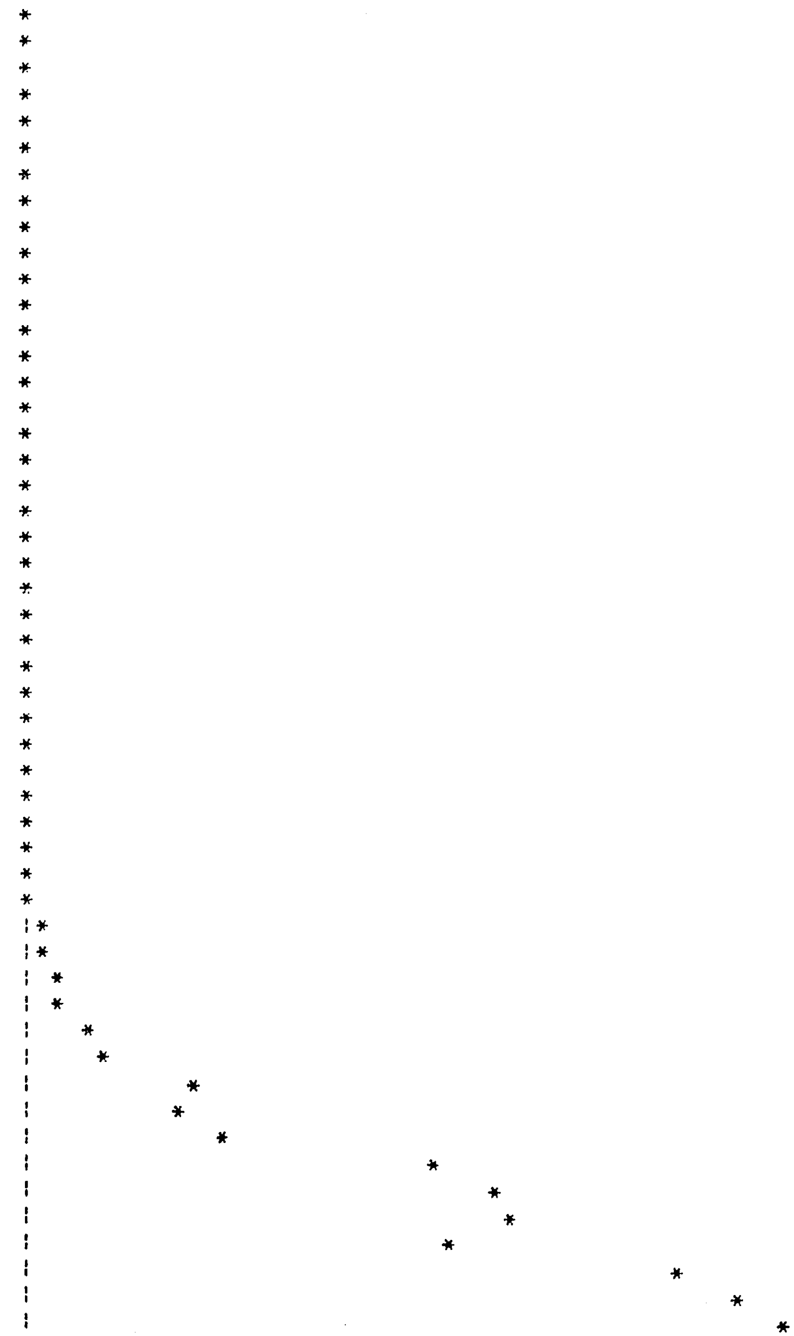


Data maximum (mV) : down hole channel - 9.164

FIRST ARRIVAL PLOT - Shot 14 Level 1552.0

Well phone data

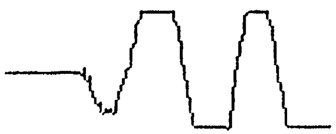
Sample time	Value uV
608.0	-25.
608.5	-17.
609.0	-20.
609.5	-18.
610.0	-4.
610.5	6.
611.0	19.
611.5	29.
612.0	39.
612.5	49.
613.0	58.
613.5	53.
614.0	54.
614.5	50.
615.0	44.
615.5	47.
616.0	36.
616.5	12.
617.0	-3.
617.5	-16.
618.0	-26.
618.5	-29.
619.0	-29.
619.5	-29.
620.0	-30.
620.5	-22.
621.0	-24.
621.5	-24.
622.0	-21.
622.5	-26.
623.0	-19.
623.5	0.
624.0	16.
624.5	36.
625.0	51.
625.5	111.
626.0	198.
626.5	361.
627.0	347.
627.5	550.
628.0	807.
628.5	1698.
629.0	1488.
629.5	1981.
630.0	4152.
630.5	4762.
631.0	4867.
631.5	4212.
632.0	6613.
632.5	7164.
633.0	7614.



TRACE DISPLAY.

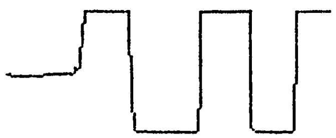
SHOT 16 Time 12:15:25 Level : 1502.0 Shot location : E
Shot depth : 2.0 Charge size : 1
No. surface samples : 128 Down hole sample nos : 335 400 673
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 9726mV

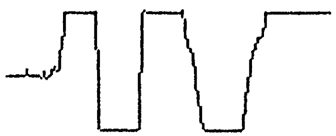


AUX. CHANNEL 2 Max. 9648mV

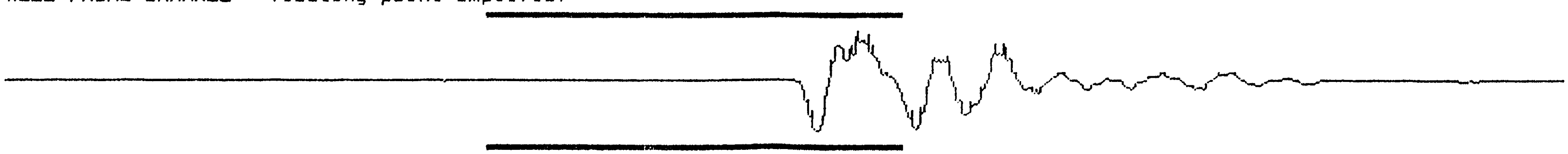
AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9839mV



WELL PHONE CHANNEL - floating point amplifier

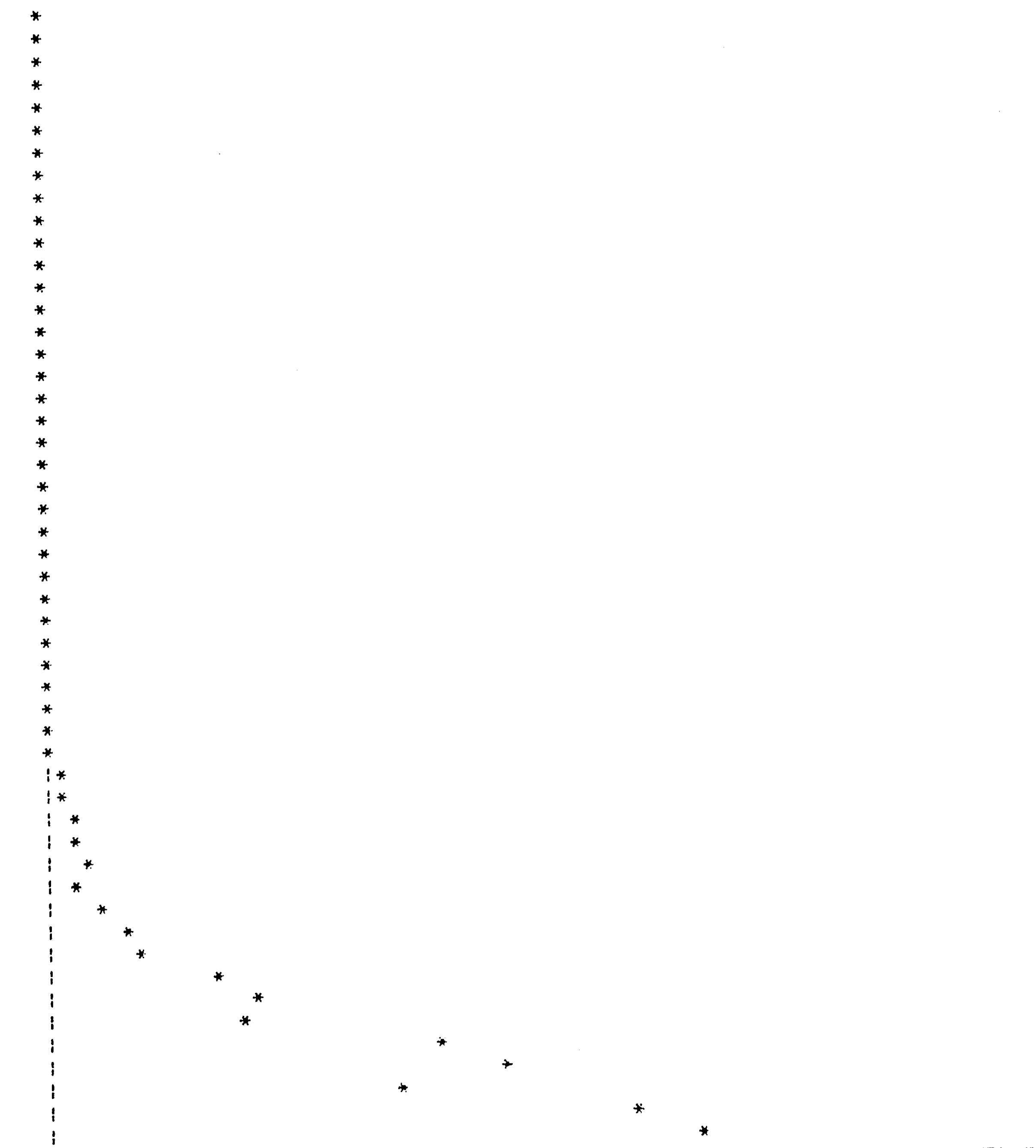


Data maximum (mV) : down hole channel - 10.195

FIRST ARRIVAL PLOT - Shot 16 Level 1502.0

Well phone data

Sample time	Value uV
594.0	6.
594.5	20.
595.0	37.
595.5	35.
596.0	33.
596.5	37.
597.0	21.
597.5	28.
598.0	20.
598.5	36.
599.0	30.
599.5	33.
600.0	32.
600.5	25.
601.0	11.
601.5	-2.
602.0	-12.
602.5	-19.
603.0	-15.
603.5	-16.
604.0	-23.
604.5	-28.
605.0	-30.
605.5	-26.
606.0	-16.
606.5	3.
607.0	17.
607.5	23.
608.0	29.
608.5	24.
609.0	39.
609.5	34.
610.0	41.
610.5	53.
611.0	84.
611.5	156.
612.0	250.
612.5	304.
613.0	384.
613.5	342.
614.0	509.
614.5	902.
615.0	1022.
615.5	1851.
616.0	2299.
616.5	2166.
617.0	4352.
617.5	5002.
618.0	3912.
618.5	6413.
619.0	7153.

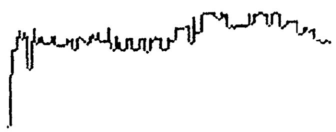


TRACE DISPLAY.

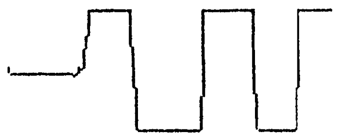
SHOT 17 Time 12:23:49 Level : 1440.0 Shot location : E
Shot depth : 2.0 Charge size : 1
No. surface samples : 128 Down hole sample nos : 317 400 691
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 9702mV

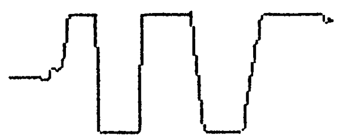
AUX. CHANNEL 2 Max. 9370mV



AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9731mV



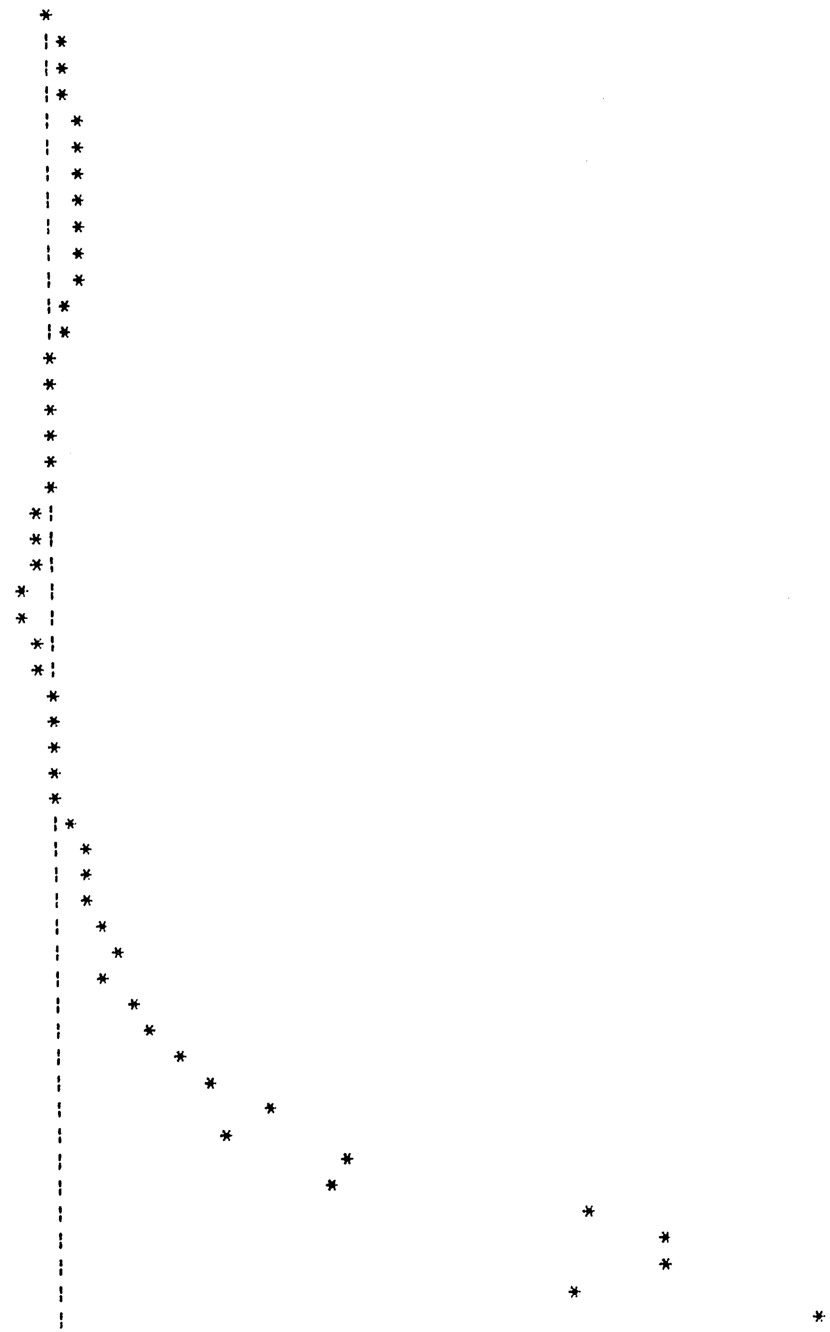
WELL PHONE CHANNEL - floating point amplifier

Data maximum (mV) : down hole channel - 11.846

FIRST ARRIVAL PLOT - Shot 17 Level 1440.0

Samp time	Value uV
578.0	41.
578.5	113.
579.0	141.
579.5	128.
580.0	249.
580.5	269.
581.0	284.
581.5	293.
582.0	293.
582.5	283.
583.0	263.
583.5	123.
584.0	85.
584.5	53.
585.0	17.
585.5	-39.
586.0	-63.
586.5	-83.
587.0	-156.
587.5	-186.
588.0	-261.
588.5	-283.
589.0	-296.
589.5	-298.
590.0	-288.
590.5	-266.
591.0	-132.
591.5	-93.
592.0	-70.
592.5	-30.
593.0	26.
593.5	83.
594.0	184.
594.5	291.
595.0	249.
595.5	406.
596.0	464.
596.5	373.
597.0	618.
597.5	737.
598.0	890.
598.5	1223.
599.0	1621.
599.5	1291.
600.0	2284.
600.5	2059.
601.0	4132.
601.5	4642.
602.0	4667.
602.5	3972.
603.0	5858.

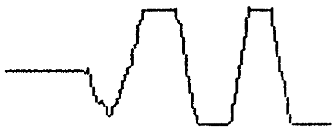
Wel phone data



TRACE DISPLAY.

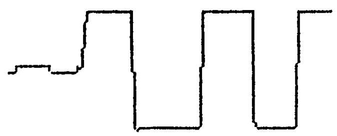
SHOT 18 Time 12:30:56 Level : 1335.0 Shot location : E
Shot depth : 2.0 Charge size : 1
No. surface samples : 128 Down hole sample nos : 286 400 722
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 9995mV

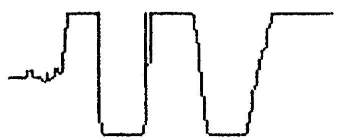


AUX. CHANNEL 2 Max. 9375mV

AUX. CHANNEL 3 Max. 9712mV



AUX. CHANNEL 4 Max. 9375mV

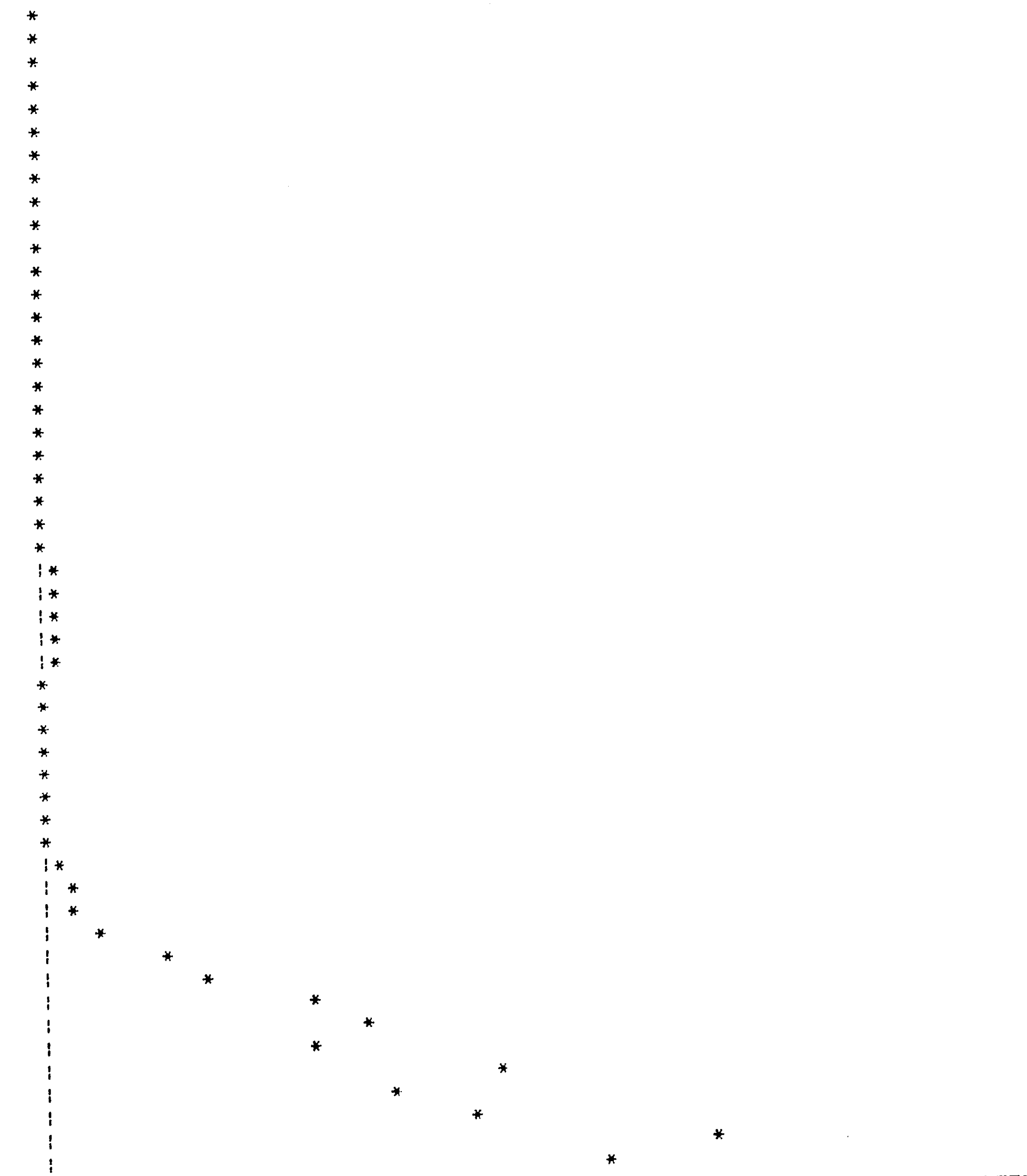


WELL PHONE CHANNEL - floating point amplifier

Data maximum (mV) : down hole channel - 12.676

FIRST ARRIVAL PLOT - Shot 18 Level 1335.0

Well phone data



Sample time	Value uV
546.0	75.
546.5	65.
547.0	71.
547.5	71.
548.0	66.
548.5	73.
549.0	68.
549.5	57.
550.0	23.
550.5	-4.
551.0	-29.
551.5	-43.
552.0	-92.
552.5	-149.
553.0	-122.
553.5	-127.
554.0	-121.
554.5	-142.
555.0	-52.
555.5	-28.
556.0	28.
556.5	53.
557.0	78.
557.5	85.
558.0	155.
558.5	131.
559.0	132.
559.5	124.
560.0	149.
560.5	88.
561.0	62.
561.5	62.
562.0	53.
562.5	39.
563.0	22.
563.5	41.
564.0	90.
564.5	166.
565.0	359.
565.5	485.
566.0	817.
566.5	1833.
567.0	2396.
567.5	4042.
568.0	4832.
568.5	4007.
569.0	6713.
569.5	5193.
570.0	6293.
570.5	9895.
571.0	8294.

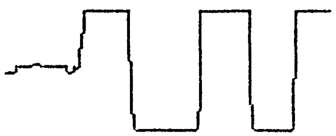
TRACE DISPLAY.

SHOT 20 Time 12:39:36 Level : 1230.0 Shot location : E
Shot depth : 2.0 Charge size : 1
No. surface samples : 128 Down hole sample nos : 255 400 753
Sample rates : 500 1000 usec Delay : 0

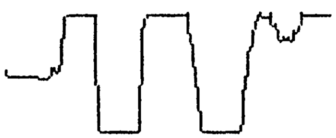
AUX. CHANNEL 1 Max. 9897mV

AUX. CHANNEL 2 Max. 9819mV

AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9975mV

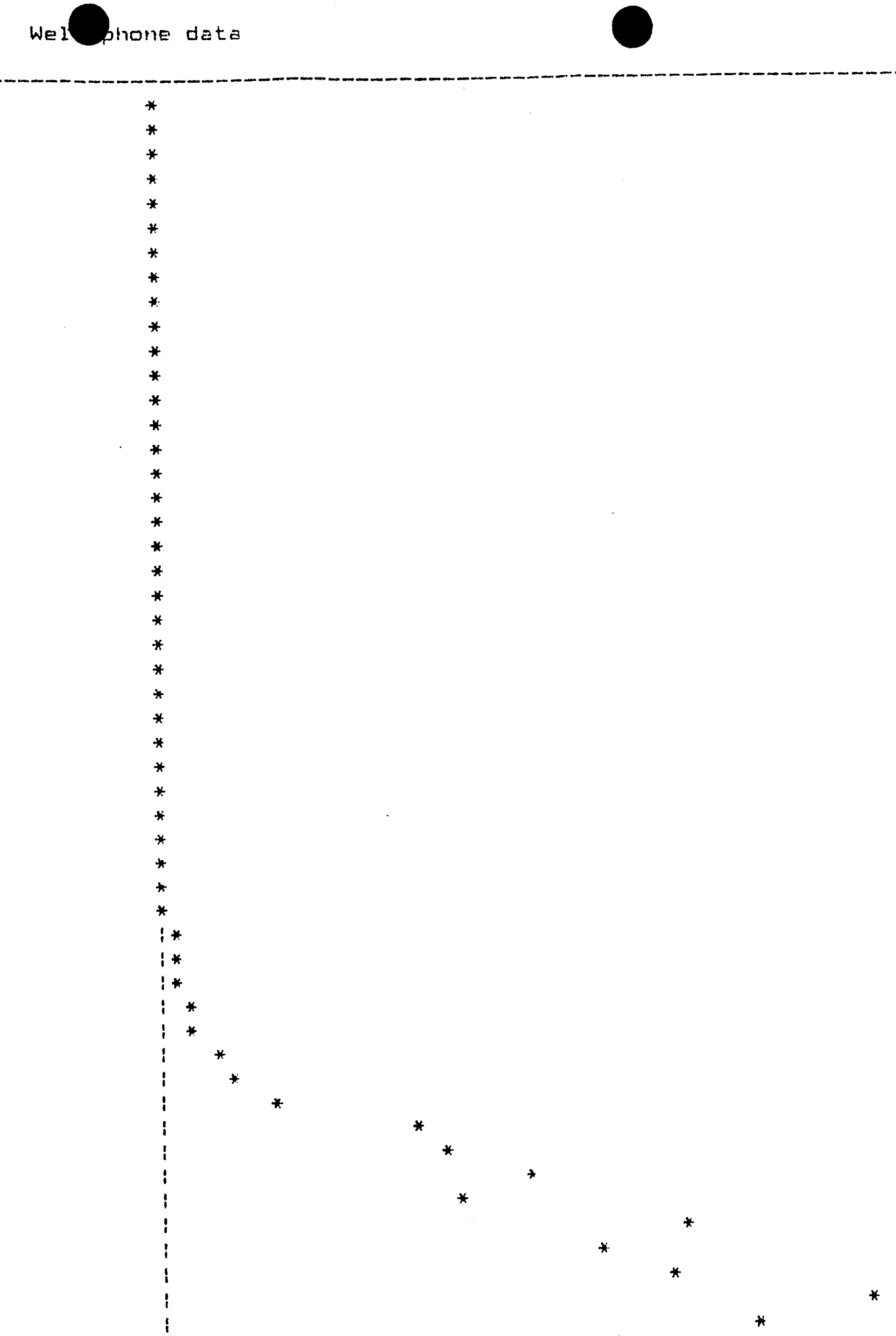


WELL PHONE CHANNEL - floating point amplifier

Data maximum (mV) : down hole channel - 12.736

FIRST ARRIVAL PLOT - Shot

Samp time	Value uV
512.0	22.
512.5	19.
513.0	-7.
513.5	-19.
514.0	-17.
514.5	5.
515.0	18.
515.5	17.
516.0	12.
516.5	9.
517.0	-3.
517.5	-12.
518.0	-16.
518.5	-26.
519.0	-19.
519.5	-7.
520.0	8.
520.5	27.
521.0	37.
521.5	34.
522.0	45.
522.5	32.
523.0	21.
523.5	2.
524.0	-24.
524.5	-38.
525.0	-33.
525.5	-36.
526.0	-13.
526.5	4.
527.0	24.
527.5	31.
528.0	53.
528.5	108.
529.0	141.
529.5	241.
530.0	248.
530.5	466.
531.0	540.
531.5	978.
532.0	1298.
532.5	1996.
533.0	4422.
533.5	5037.
534.0	6583.
534.5	5263.
535.0	9094.
535.5	7784.
536.0	8894.
536.5	12426.
537.0	10555.

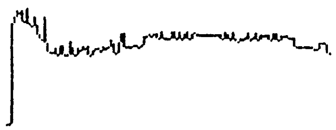


TRACE DISPLAY.

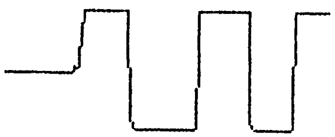
SHOT 21 Time 12:44:32 Level : 1152.0 Shot location : E
Shot depth : 2.0 Charge size : 1
No. surface samples : 128 Down hole sample nos : 230 400 778
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 9746mV

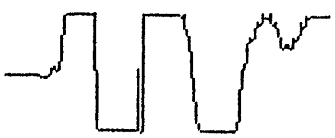
AUX. CHANNEL 2 Max. 9897mV



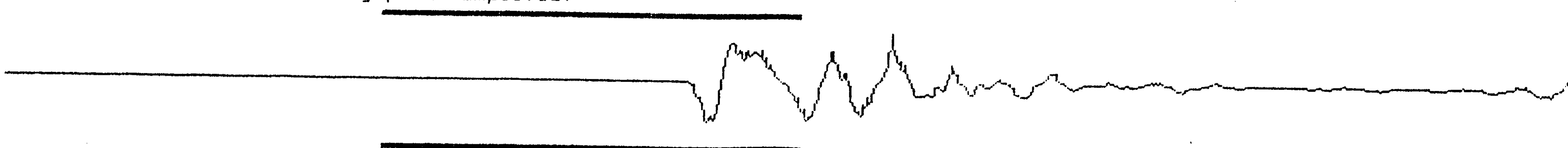
AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9805mV



WELL PHONE CHANNEL - floating point amplifier

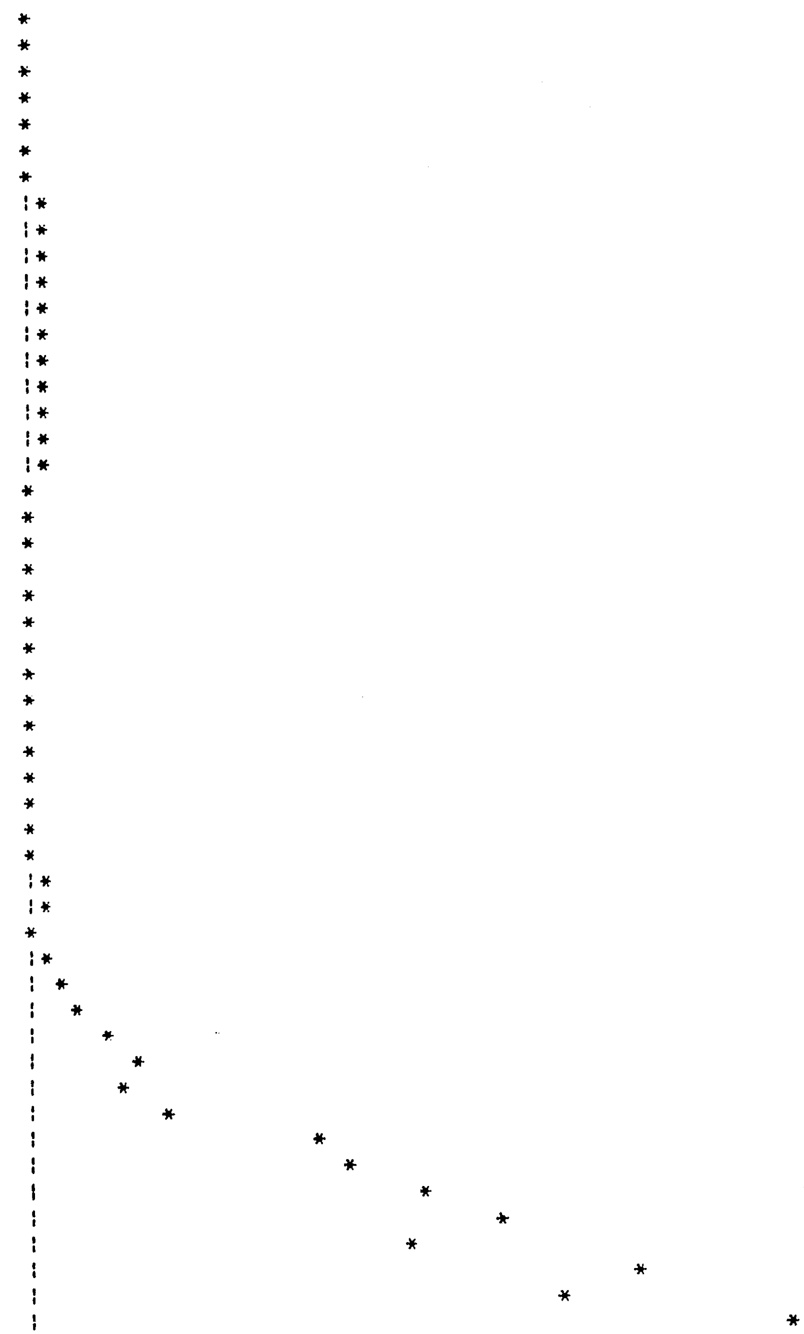


Data maximum (mV) : down hole channel - 19.490

FIRST ARRIVAL PLOT - Shot 21 Level 1152.

Well phone data

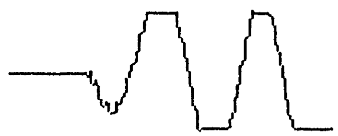
Sample time	Value uV
486.0	-20.
486.5	-6.
487.0	6.
487.5	6.
488.0	6.
488.5	6.
489.0	6.
489.5	243.
490.0	244.
490.5	244.
491.0	246.
491.5	251.
492.0	260.
492.5	267.
493.0	270.
493.5	265.
494.0	254.
494.5	241.
495.0	6.
495.5	6.
496.0	6.
496.5	6.
497.0	4.
497.5	-0.
498.0	-4.
498.5	-6.
499.0	-15.
499.5	-19.
500.0	-18.
500.5	-9.
501.0	5.
501.5	6.
502.0	6.
502.5	268.
503.0	319.
503.5	6.
504.0	336.
504.5	488.
505.0	698.
505.5	1271.
506.0	1683.
506.5	1586.
507.0	2234.
507.5	4592.
508.0	5032.
508.5	6473.
509.0	7554.
509.5	6153.
510.0	9935.
510.5	8564.
511.0	12266.



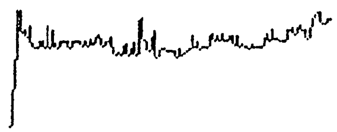
TRACE DISPLAY.

SHOT 22 Time 12:55:36 Level : 1055.0 Shot location : E
Shot depth : 2.0 Charge size : 1
No. surface samples : 128 Down hole sample nos : 198 400 810
Sample rates : 500 1000 usec Delay : 0

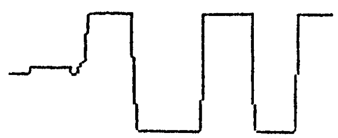
AUX. CHANNEL 1 Max. 9736mV



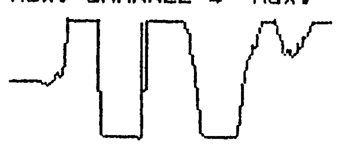
AUX. CHANNEL 2 Max. 9800mV



AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9853mV

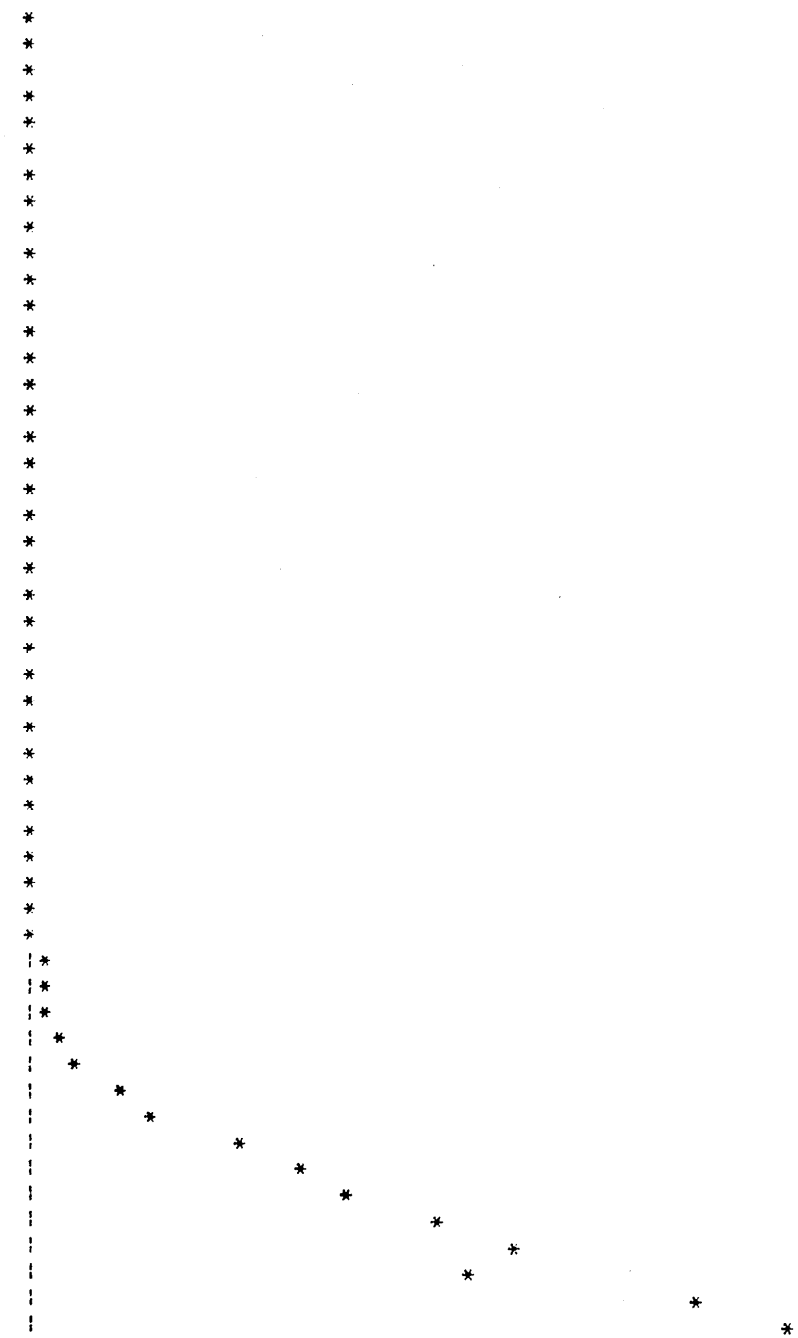


WELL PHONE CHANNEL - floating point amplifier

Data maximum (mV) : down hole channel - 73.236

FIRST ARRIVAL PLOT — Shot 22 Level 1055.0

Well phone data



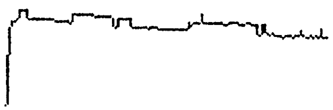
Sample time	Value uV
452.0	-1.
452.5	4.
453.0	4.
453.5	5.
454.0	1.
454.5	-2.
455.0	-2.
455.5	1.
456.0	4.
456.5	7.
457.0	5.
457.5	4.
458.0	2.
458.5	1.
459.0	1.
459.5	2.
460.0	0.
460.5	-2.
461.0	-4.
461.5	-6.
462.0	-9.
462.5	-6.
463.0	-6.
463.5	-9.
464.0	-15.
464.5	-29.
465.0	-37.
465.5	-40.
466.0	-35.
466.5	-26.
467.0	-6.
467.5	6.
468.0	23.
468.5	36.
469.0	55.
469.5	91.
470.0	181.
470.5	304.
471.0	423.
471.5	618.
472.0	903.
472.5	1681.
473.0	2284.
473.5	4012.
474.0	4992.
474.5	5813.
475.0	7534.
475.5	9074.
476.0	8174.
476.5	12446.
477.0	14137.

TRACE DISPLAY.

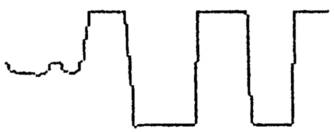
SHOT 23 Time 13:03:05 Level : 957.0 Shot location : E
Shot depth : 2.0 Charge size : 1
No. surface samples : 128 Down hole sample nos : 166 400 842
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 9990mV

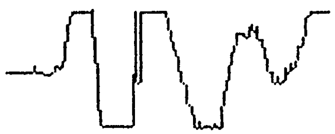
AUX. CHANNEL 2 Max. 9370mV



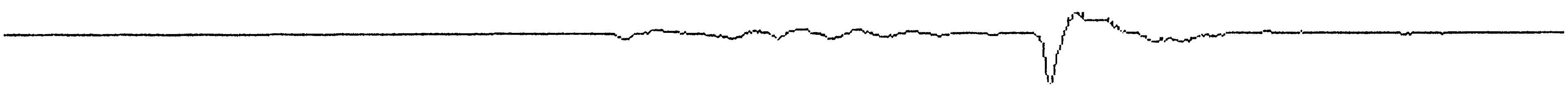
AUX. CHANNEL 3 Max. 9863mV



AUX. CHANNEL 4 Max. 9990mV



WELL PHONE CHANNEL - floating point amplifier

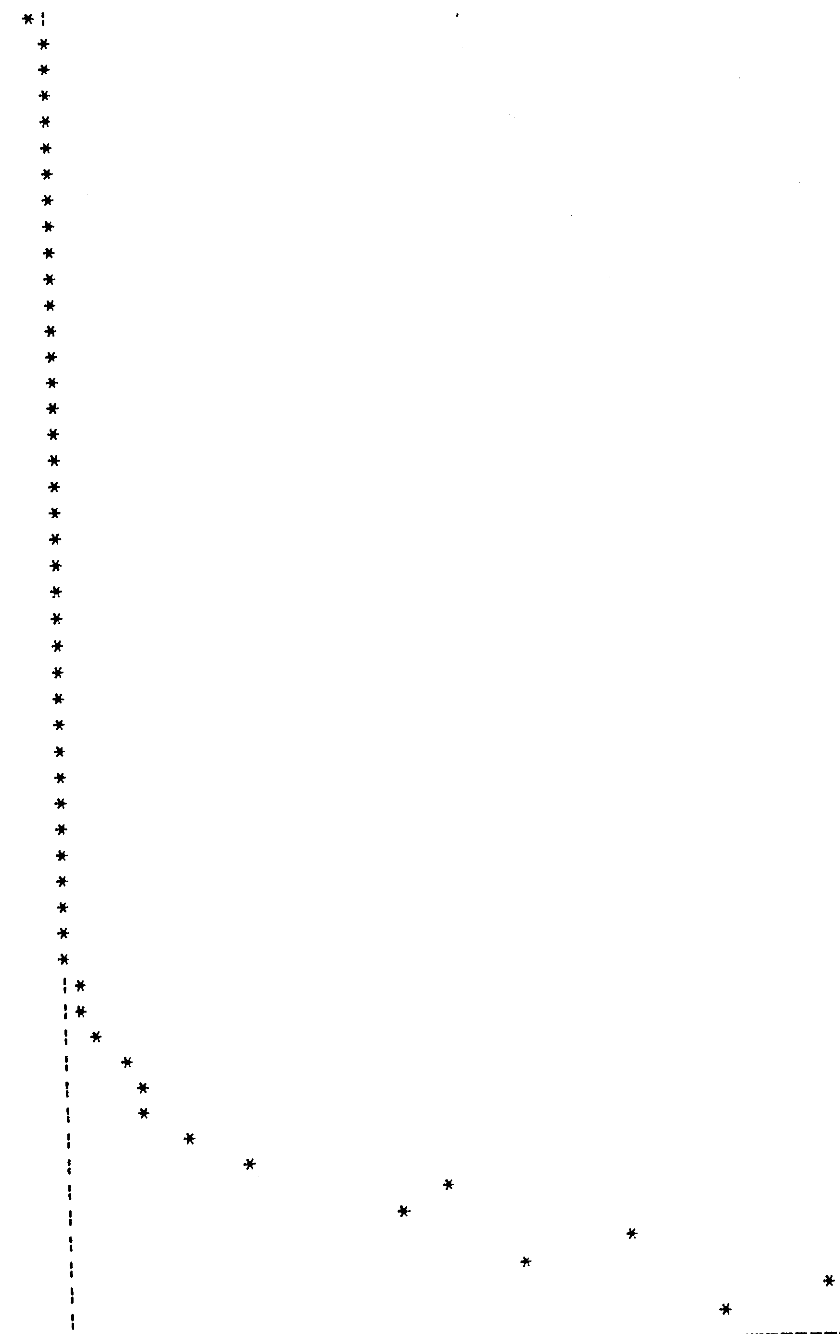


Data maximum (mV) : down hole channel - 116.537

FIRST ARRIVAL PLOT - Shot 23 Level

Wel phone data

Sample time	Value uV
418.0	-288.
418.5	-274.
419.0	-247.
419.5	-154.
420.0	-88.
420.5	-105.
421.0	-61.
421.5	-63.
422.0	-104.
422.5	-82.
423.0	-94.
423.5	-93.
424.0	-86.
424.5	-80.
425.0	-116.
425.5	-108.
426.0	-62.
426.5	-79.
427.0	-74.
427.5	-76.
428.0	-68.
428.5	-100.
429.0	-65.
429.5	-66.
430.0	-114.
430.5	-151.
431.0	-187.
431.5	-254.
432.0	-245.
432.5	-159.
433.0	-149.
433.5	-156.
434.0	-124.
434.5	-148.
435.0	-101.
435.5	-42.
436.0	22.
436.5	128.
437.0	257.
437.5	330.
438.0	747.
438.5	963.
439.0	1017.
439.5	1446.
440.0	2234.
440.5	4762.
441.0	4202.
441.5	7073.
442.0	5763.
442.5	9565.
443.0	8174.



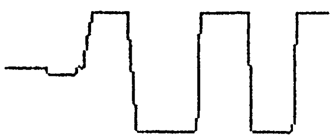
TRACE DISPLAY.

SHOT 24 Time 13:08:55 Level : 880.0 Shot location : E
Shot depth : 2.0 Charge size : .5
No. surface samples : 128 Down hole sample nos : 139 400 869
Sample rates : 500 1000 usec Delay : 0

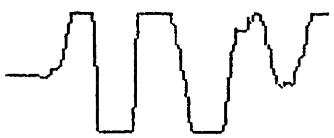
AUX. CHANNEL 1 Max. 9971mV

AUX. CHANNEL 2 Max. 9946mV

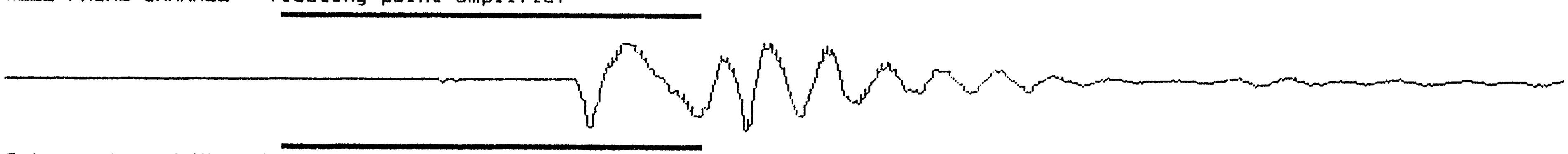
AUX. CHANNEL 3 Max. 9458mV



AUX. CHANNEL 4 Max. 9409mV



WELL PHONE CHANNEL - floating point amplifier

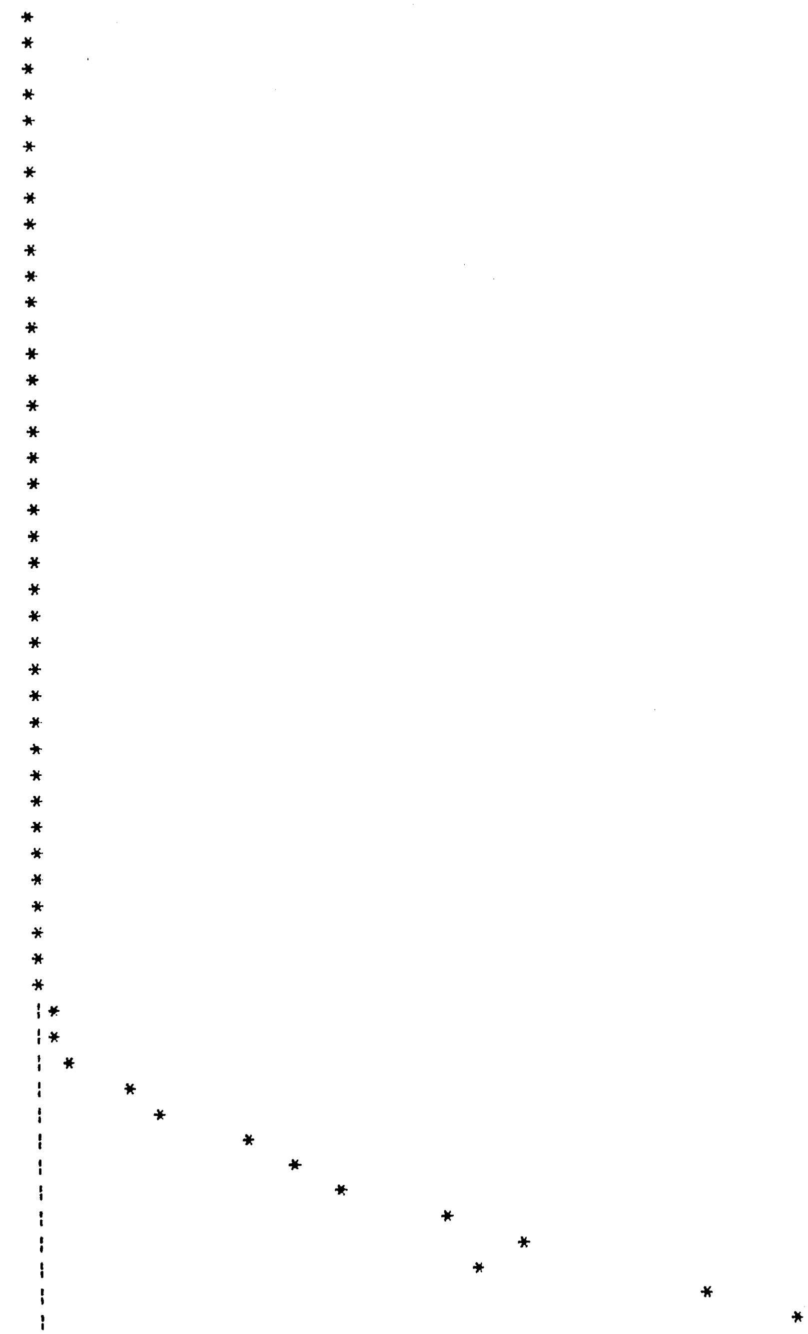


Data maximum (mV) : down hole channel - 20.370

FIRST ARRIVAL PLOT – Shot 24 Level 880.0

Well phone data

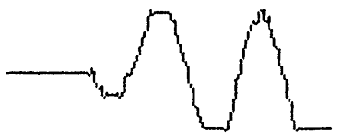
Sample time	Value uV
388.0	32.
388.5	45.
389.0	26.
389.5	-17.
390.0	-57.
390.5	-88.
391.0	-124.
391.5	-190.
392.0	-252.
392.5	-133.
393.0	-86.
393.5	-56.
394.0	8.
394.5	35.
395.0	55.
395.5	30.
396.0	-5.
396.5	-55.
397.0	-144.
397.5	-191.
398.0	-271.
398.5	-280.
399.0	-260.
399.5	-142.
400.0	-78.
400.5	12.
401.0	51.
401.5	66.
402.0	78.
402.5	53.
403.0	19.
403.5	-40.
404.0	-112.
404.5	-97.
405.0	-99.
405.5	-114.
406.0	-38.
406.5	108.
407.0	301.
407.5	374.
408.0	700.
408.5	1688.
409.0	2304.
409.5	4002.
410.0	4982.
410.5	5833.
411.0	7624.
411.5	9225.
412.0	8374.
412.5	12666.
413.0	14297.



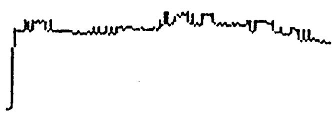
TRACE DISPLAY.

SHOT 25 Time 13:15:07 Level : 715.0 Shot location : E
Shot depth : 2.0 Charge size : .5
No. surface samples : 128 Down hole sample nos : 76 400 932
Sample rates : 500 1000 usec Delay : 0

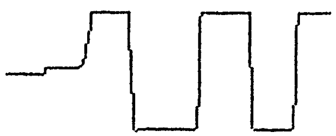
AUX. CHANNEL 1 Max. 9907mV



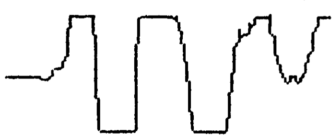
AUX. CHANNEL 2 Max. 9370mV



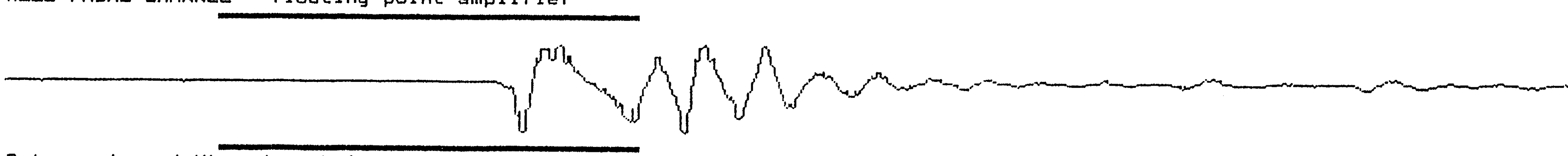
AUX. CHANNEL 3 Max. 9653mV



AUX. CHANNEL 4 Max. 9824mV



WELL PHONE CHANNEL - floating point amplifier

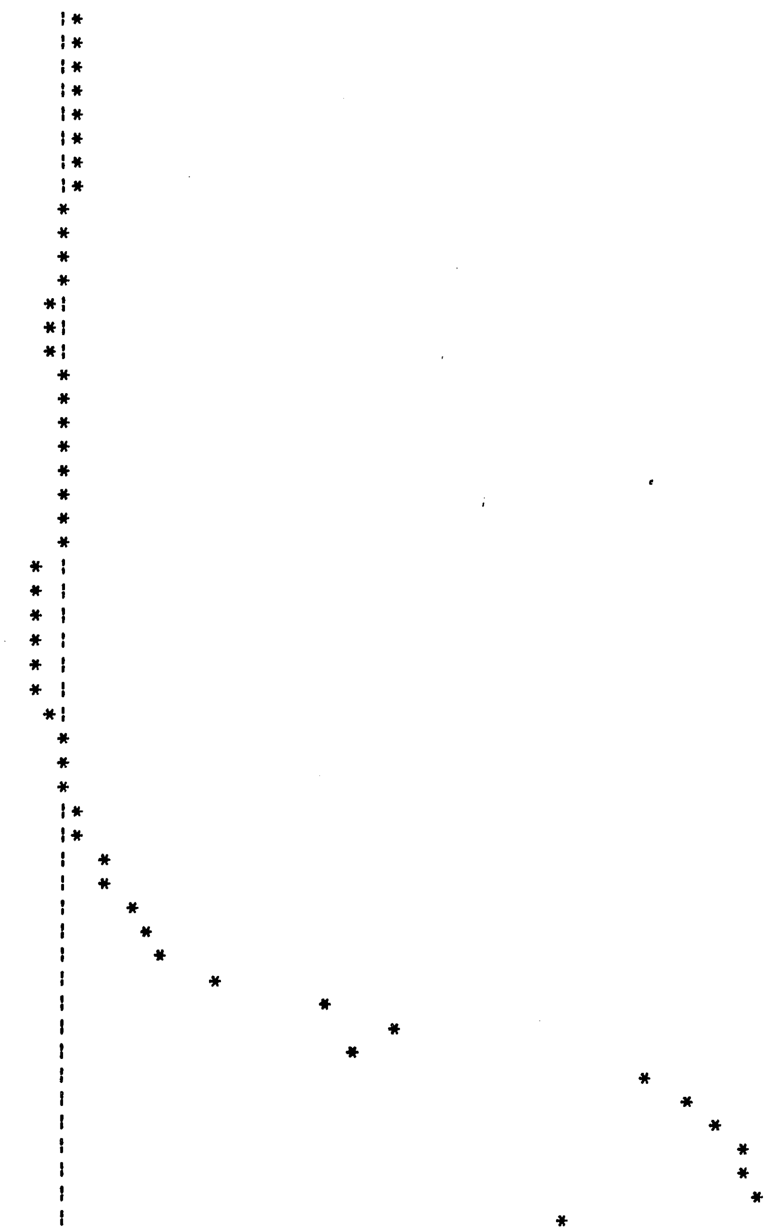


Data maximum (mV) : down hole channel - 38.939

FIRST ARRIVAL PLOT — Shot 25 Level 71[illegible].0

Well phone data

Sample time	Value uV
318.0	65.
318.5	114.
319.0	88.
319.5	93.
320.0	90.
320.5	117.
321.0	63.
321.5	68.
322.0	22.
322.5	-20.
323.0	-51.
323.5	-87.
324.0	-151.
324.5	-159.
325.0	-151.
325.5	-92.
326.0	-108.
326.5	-78.
327.0	-58.
327.5	-53.
328.0	-111.
328.5	-143.
329.0	-137.
329.5	-259.
330.0	-288.
330.5	-308.
331.0	-313.
331.5	-299.
332.0	-267.
332.5	-154.
333.0	-101.
333.5	-20.
334.0	40.
334.5	114.
335.0	133.
335.5	283.
336.0	268.
336.5	461.
337.0	618.
337.5	688.
338.0	1078.
338.5	1901.
339.0	2316.
339.5	2096.
340.0	4102.
340.5	4422.
341.0	4662.
341.5	4772.
342.0	4842.
342.5	4912.
343.0	3497.

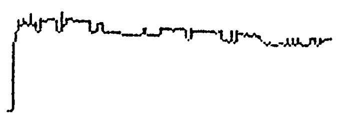


TRACE DISPLAY.

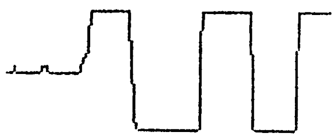
SHOT 26 Time 13:20:08 Level : 662.0 Shot location : E
Shot depth : 2.0 Charge size : .5
No. surface samples : 129 Down hole sample nos : 56 400 952
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 9756mV

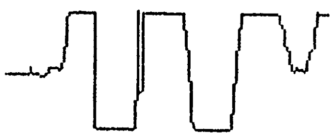
AUX. CHANNEL 2 Max. 9370mV



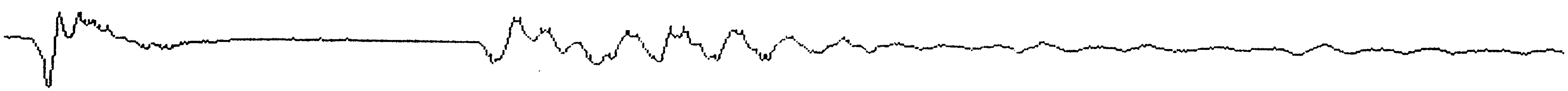
AUX. CHANNEL 3 Max. 9531mV



AUX. CHANNEL 4 Max. 9995mV



WELL PHONE CHANNEL - floating point amplifier

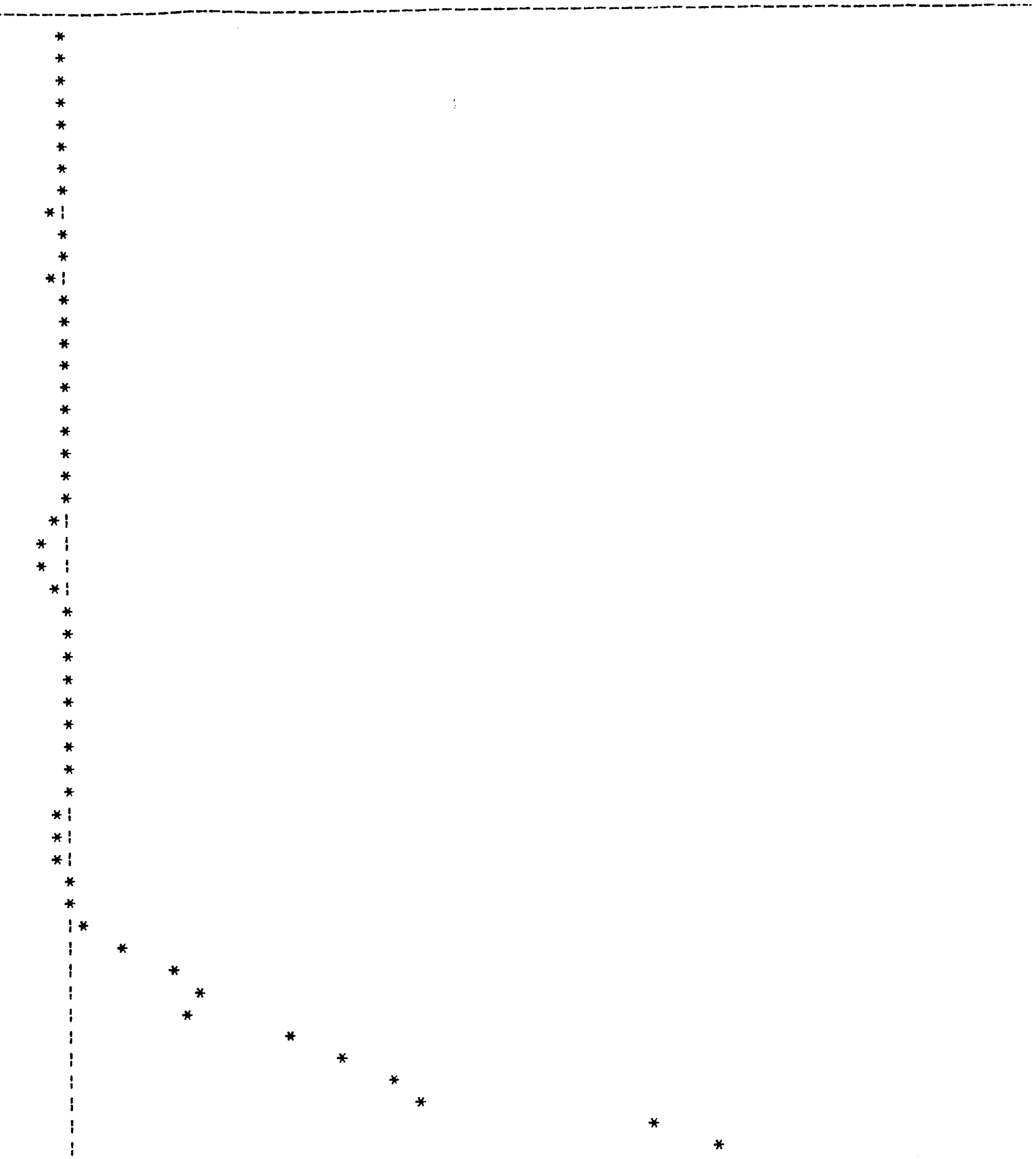


Data maximum (mV) : down hole channel - 93.306

FIRST ARRIVAL PLOT - Shot [illegible] Level [illegible]

Samp[illegible] time	Value uV
300.0	-849.
300.5	-762.
301.0	-571.
301.5	-462.
302.0	-446.
302.5	-354.
303.0	-482.
303.5	-793.
304.0	-925.
304.5	-842.
305.0	-836.
305.5	-899.
306.0	-730.
306.5	-358.
307.0	-306.
307.5	-51.
308.0	21.
308.5	-5.
309.0	-120.
309.5	-353.
310.0	-618.
310.5	-707.
311.0	-1058.
311.5	-1613.
312.0	-1621.
312.5	-1042.
313.0	-879.
313.5	-679.
314.0	-640.
314.5	-325.
315.0	-415.
315.5	-448.
316.0	-577.
316.5	-772.
317.0	-817.
317.5	-1101.
318.0	-1087.
318.5	-1206.
319.0	-737.
319.5	152.
320.0	697.
320.5	2346.
321.0	4582.
321.5	5943.
322.0	5493.
322.5	10105.
323.0	12396.
323.5	14917.
324.0	15828.
324.5	26413.
325.0	29494.

We[illegible]phone data



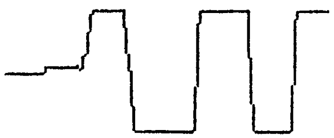
TRACE DISPLAY.

SHOT 27 Time 13:22:55 Level : 662.0 Shot location : E
Shot depth : 2.0 Charge size : .2
No. surface samples : 128 Down hole sample nos : 56 400 952
Sample rates : 500 1000 usec Delay : 0

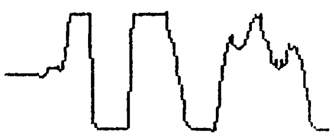
AUX. CHANNEL 1 Max. 9946mV

AUX. CHANNEL 2 Max. 9946mV

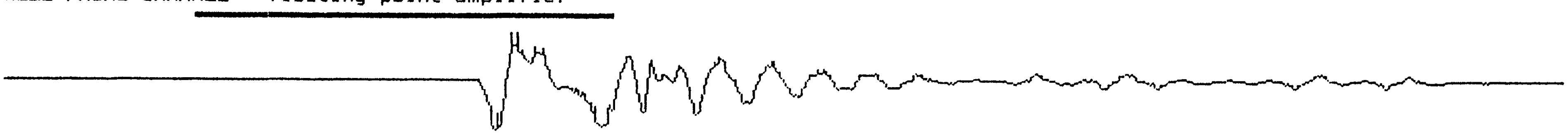
AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9995mV



WELL PHONE CHANNEL - floating point amplifier

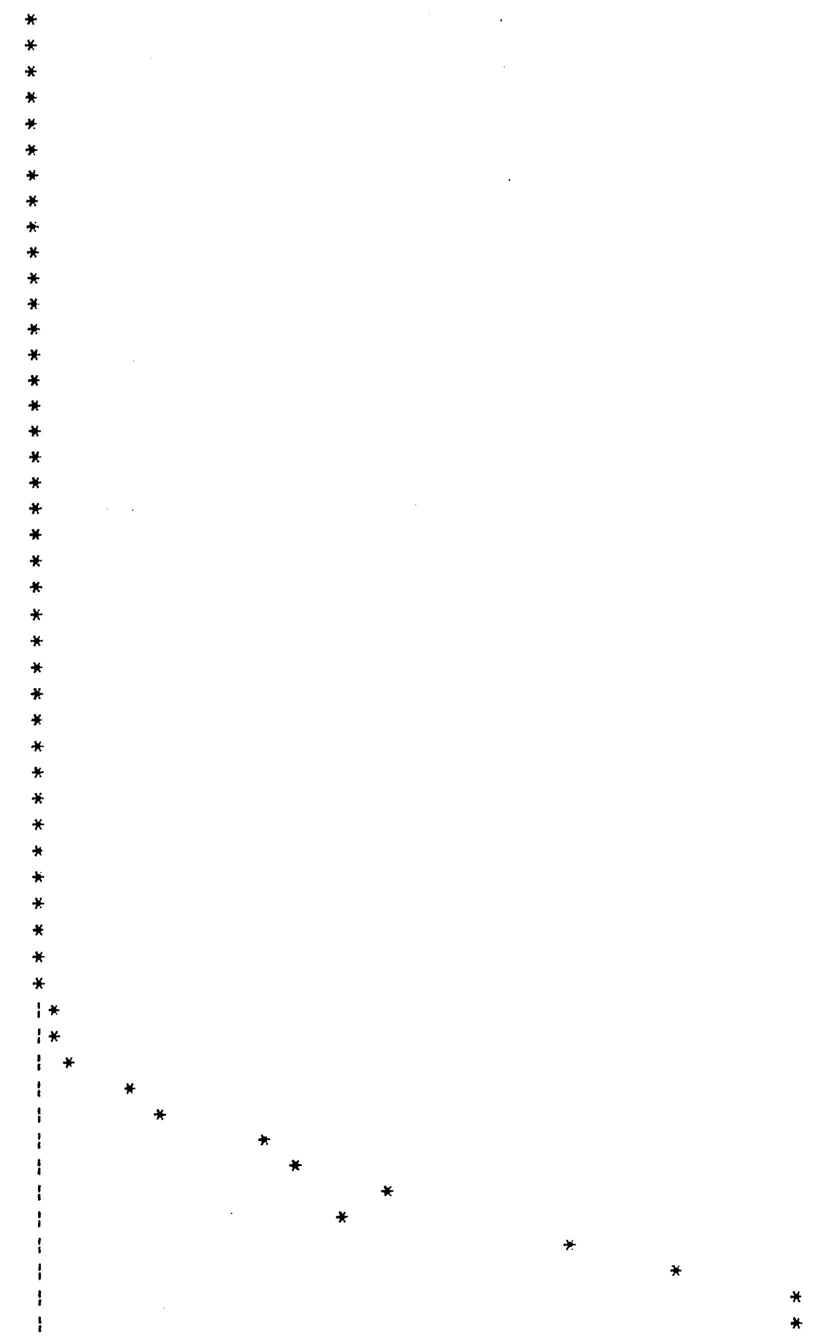


Data maximum (mV) : down hole channel - 30.615

FIRST ARRIVAL PLOT - Shot 27 Level 661.0

Sam[illegible]e time	Value uV
300.0	27.
300.5	28.
301.0	28.
301.5	27.
302.0	27.
302.5	28.
303.0	35.
303.5	46.
304.0	59.
304.5	74.
305.0	80.
305.5	62.
306.0	62.
306.5	61.
307.0	60.
307.5	79.
308.0	78.
308.5	80.
309.0	63.
309.5	69.
310.0	104.
310.5	105.
311.0	101.
311.5	61.
312.0	49.
312.5	58.
313.0	47.
313.5	37.
314.0	29.
314.5	19.
315.0	19.
315.5	17.
316.0	19.
316.5	16.
317.0	30.
317.5	46.
318.0	101.
318.5	136.
319.0	279.
319.5	373.
320.0	693.
320.5	1713.
321.0	2401.
321.5	4192.
322.0	4892.
322.5	6573.
323.0	5603.
323.5	9965.
324.0	11986.
324.5	14167.
325.0	14027.

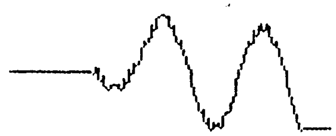
We[illegible] phone data



TRACE DISPLAY.

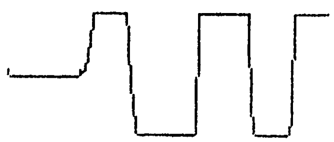
SHOT 28 Time 13:29:13 Level : 578.0 Shot location : E
Shot depth : 2.0 Charge size : .2
No. surface samples : 128 Down hole sample nos : 25 400 983
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 9961mV

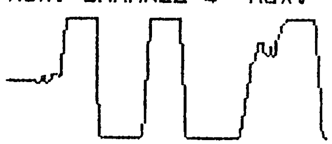


AUX. CHANNEL 2 Max. 9888mV

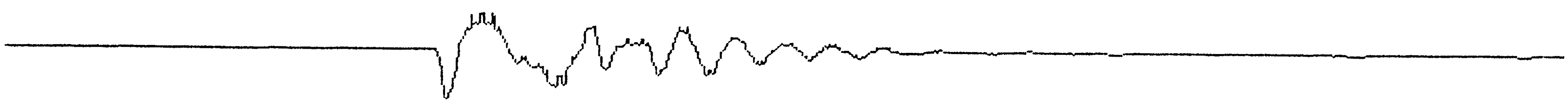
AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9512mV



WELL PHONE CHANNEL - floating point amplifier

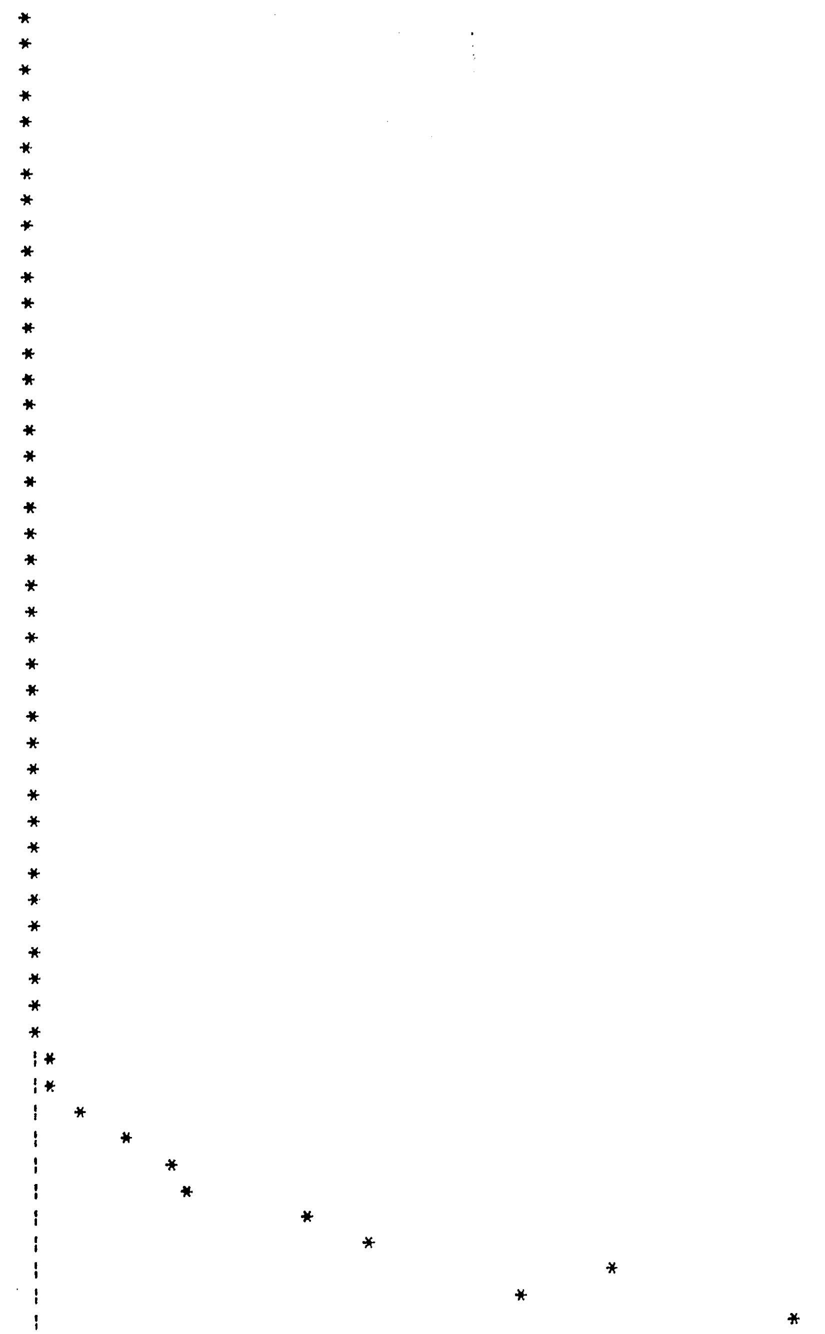


Data maximum (mV) : down hole channel - 40.180

FIRST ARRIVAL PLOT - Shot 28 Level 578.0

We[illegible] phone data

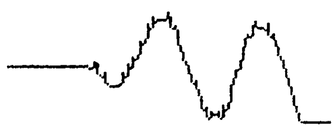
Sample time	Value uV
264.0	65.
264.5	53.
265.0	55.
265.5	34.
266.0	35.
266.5	30.
267.0	27.
267.5	16.
268.0	12.
268.5	16.
269.0	10.
269.5	16.
270.0	17.
270.5	30.
271.0	25.
271.5	36.
272.0	25.
272.5	22.
273.0	20.
273.5	21.
274.0	24.
274.5	37.
275.0	37.
275.5	21.
276.0	11.
276.5	5.
277.0	-10.
277.5	-17.
278.0	-21.
278.5	-31.
279.0	-41.
279.5	-51.
280.0	-51.
280.5	-51.
281.0	-51.
281.5	-56.
282.0	-31.
282.5	-4.
283.0	51.
283.5	189.
284.0	467.
284.5	803.
285.0	2496.
285.5	4922.
286.0	7184.
286.5	7744.
287.0	14307.
287.5	17769.
288.0	30335.
288.5	25332.
289.0	40180.



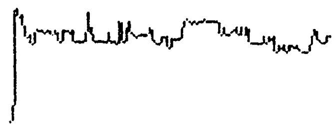
TRACE DISPLAY.

SHOT 29 Time 13:33:56 Level : 497.0 Shot location : E
Shot depth : 2.0 Charge size : .2
No. surface samples : 128 Down hole sample nos : 0 400 1008
Sample rates : 500 1000 usec Delay : 0

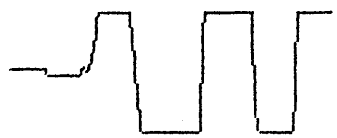
AUX. CHANNEL 1 Max. 9370mV



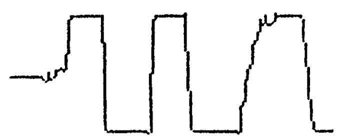
AUX. CHANNEL 2 Max. 9370mV



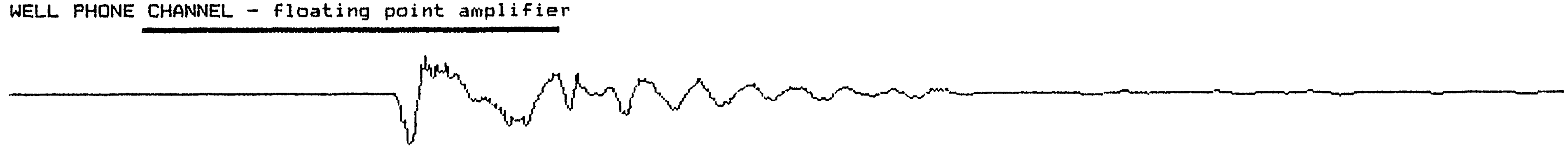
AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9726mV



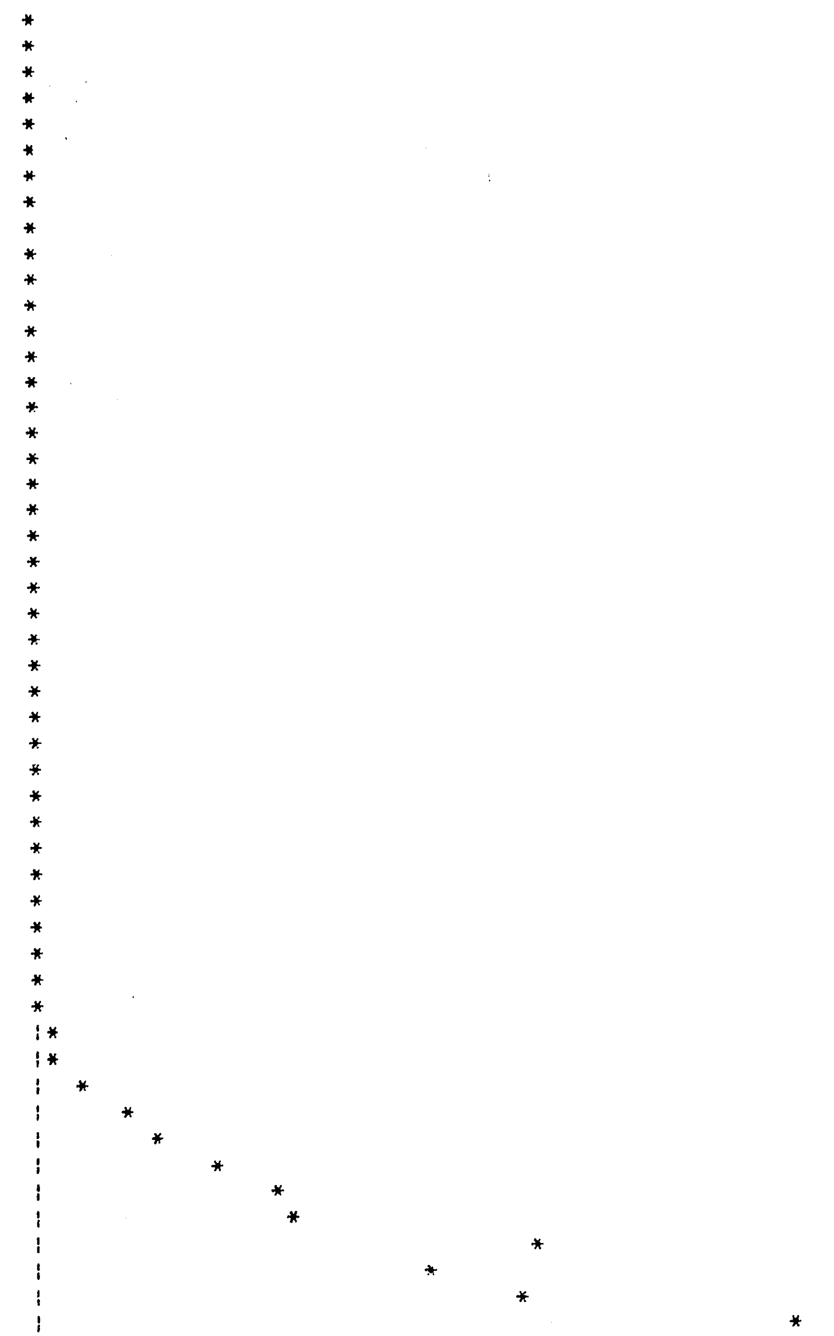
WELL PHONE CHANNEL - floating point amplifier



Data maximum (mV) : down hole channel - 47.703

FIRST ARRIVAL PLOT - Shot 29 Level 497.0

Well phone data

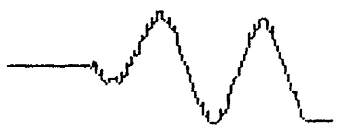


Sample time	Value uV
230.0	-23.
230.5	-28.
231.0	-23.
231.5	-24.
232.0	-24.
232.5	-24.
233.0	-24.
233.5	-24.
234.0	-24.
234.5	-24.
235.0	-24.
235.5	-24.
236.0	-24.
236.5	-24.
237.0	-24.
237.5	-24.
238.0	-21.
238.5	-28.
239.0	-16.
239.5	-19.
240.0	-9.
240.5	-10.
241.0	-8.
241.5	-20.
242.0	-27.
242.5	-23.
243.0	-24.
243.5	-24.
244.0	-24.
244.5	-24.
245.0	-24.
245.5	-24.
246.0	-24.
246.5	-24.
247.0	-24.
247.5	-24.
248.0	-24.
248.5	30.
249.0	157.
249.5	441.
250.0	935.
250.5	2554.
251.0	4822.
251.5	6733.
252.0	9275.
252.5	12456.
253.0	13687.
253.5	26133.
254.0	20610.
254.5	25292.
255.0	39779.

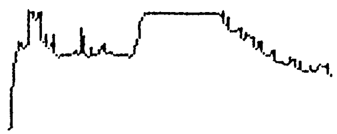
TRACE DISPLAY.

SHOT 30 Time 13:39:03 Level : 375.0 Shot location : E
Shot depth : 2.0 Charge size : .2
No. surface samples : 128 Down hole sample nos : 0 400 1008
Sample rates : 500 1000 usec Delay : 0

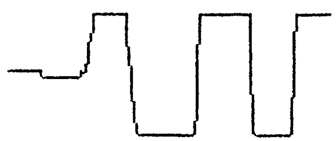
AUX. CHANNEL 1 Max. 9829mV



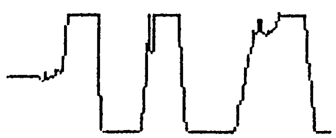
AUX. CHANNEL 2 Max. 9956mV



AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9902mV



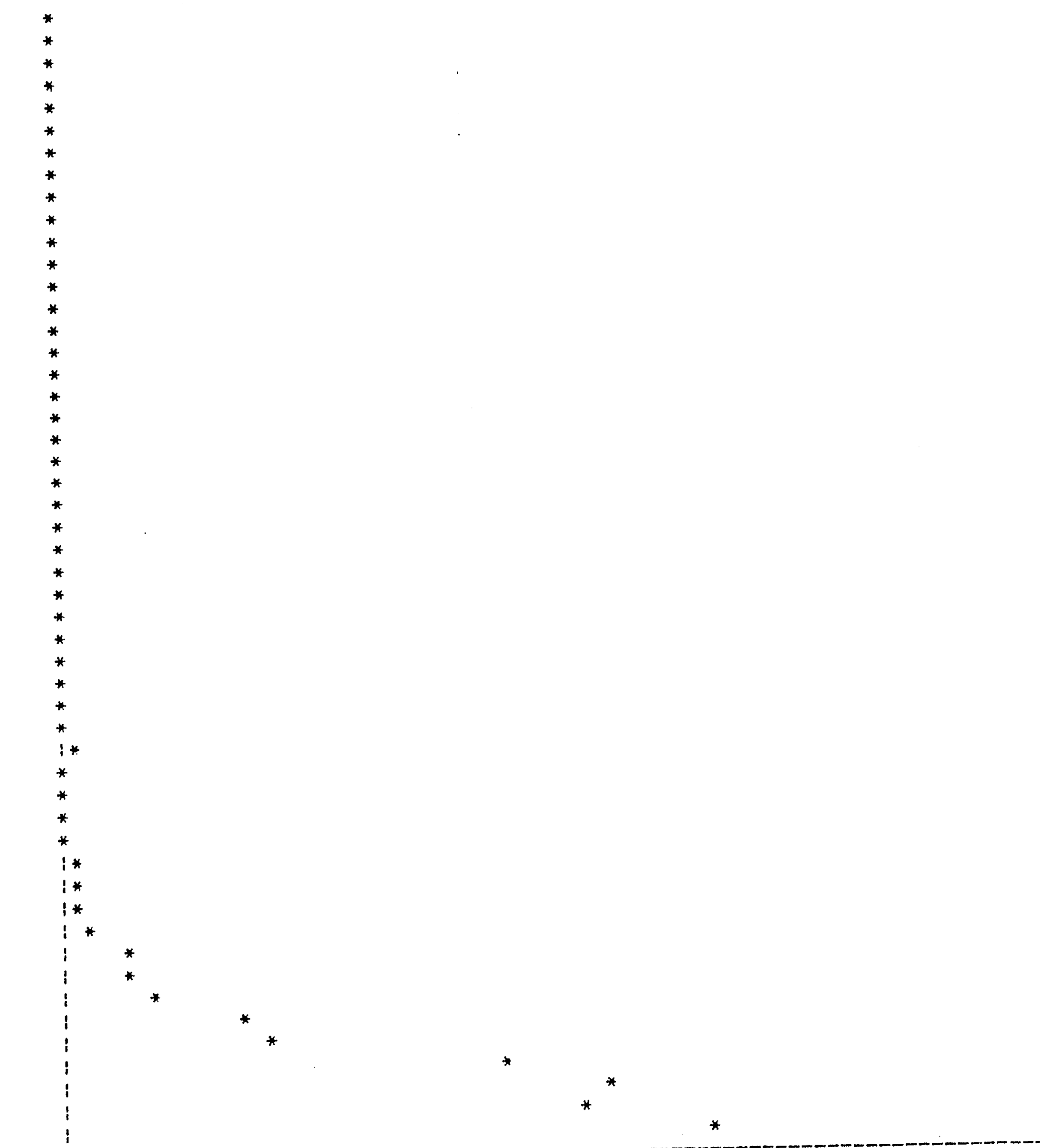
WELL PHONE CHANNEL - floating point amplifier

Data maximum (mV) : down hole channel - 97.888

FIRST ARRIVAL PLOT - Shot 30 Level 275.0

We[illegible] phone data

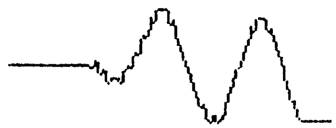
Sample time	Value uV
176.0	-413.
176.5	-268.
177.0	-245.
177.5	-301.
178.0	-196.
178.5	-299.
179.0	-278.
179.5	-261.
180.0	-248.
180.5	-138.
181.0	-127.
181.5	-153.
182.0	-97.
182.5	-116.
183.0	-80.
183.5	-48.
184.0	-17.
184.5	26.
185.0	60.
185.5	104.
186.0	96.
186.5	129.
187.0	256.
187.5	289.
188.0	289.
188.5	318.
189.0	262.
189.5	360.
190.0	411.
190.5	418.
191.0	423.
191.5	425.
192.0	428.
192.5	430.
193.0	428.
193.5	423.
194.0	418.
194.5	424.
195.0	467.
195.5	597.
196.0	898.
196.5	1361.
197.0	4042.
197.5	4402.
198.0	5803.
198.5	11916.
199.0	14017.
199.5	28814.
200.0	36098.
200.5	34057.
201.0	42861.



TRACE DISPLAY.

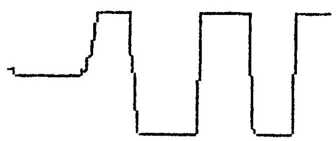
SHOT 31 Time 13:45:12 Level : 280.0 Shot location : E
Shot depth : 2.0 Charge size : .2
No. surface samples : 128 Down hole sample nos : 0 400 1008
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 9844mV

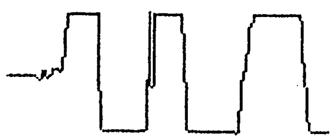


AUX. CHANNEL 2 Max. 9873mV

AUX. CHANNEL 3 Max. 9648mV



AUX. CHANNEL 4 Max. 9687mV



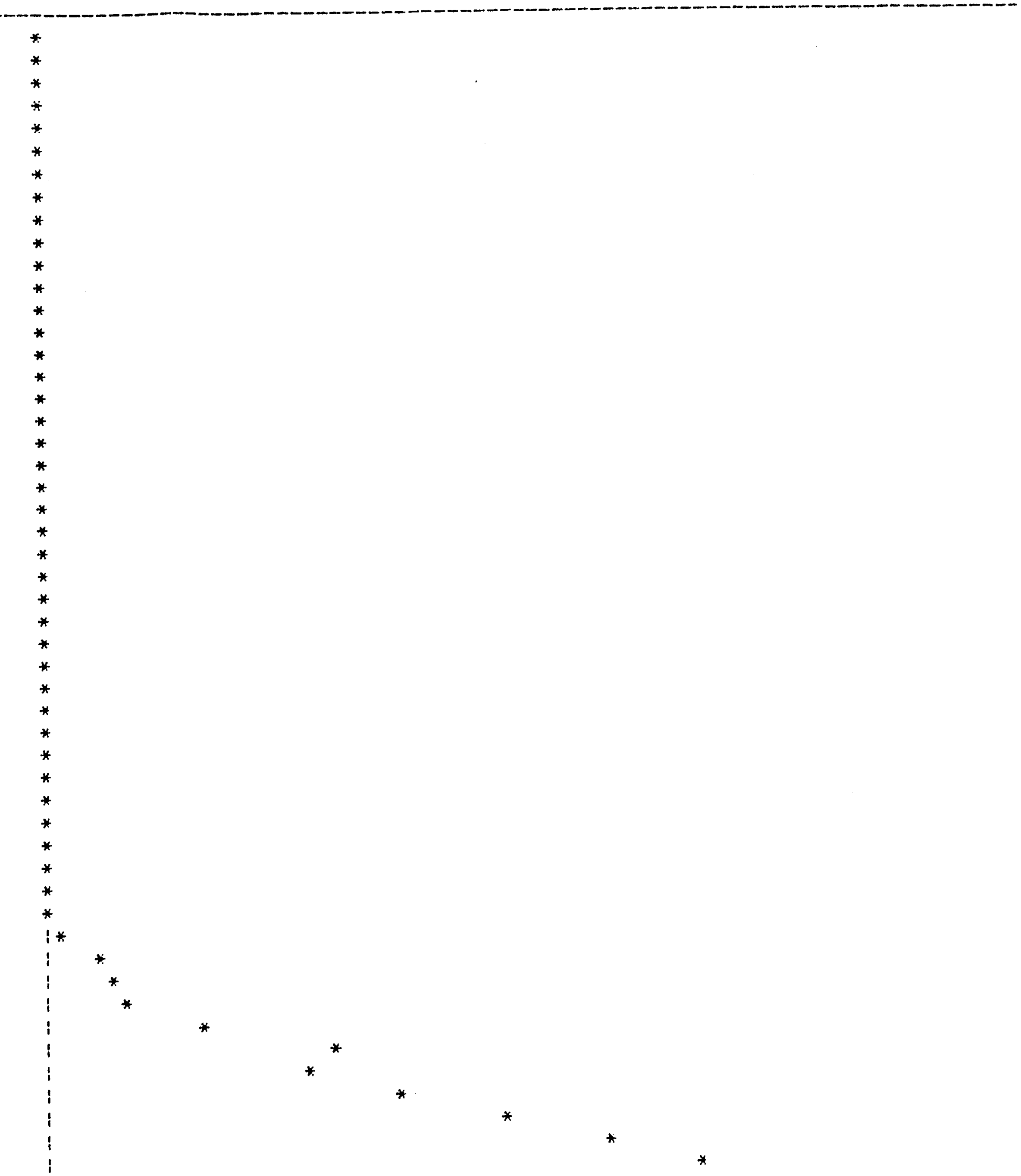
WELL PHONE CHANNEL - floating point amplifier

Data maximum (mV) : down hole channel - 120.859

FIRST ARRIVAL PLOT – Shot 31 Level 280.0

Well phone data

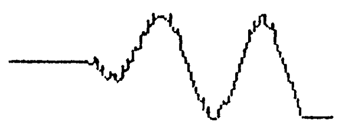
Sample time	Value uV
132.0	85.
132.5	141.
133.0	156.
133.5	132.
134.0	245.
134.5	261.
135.0	275.
135.5	286.
136.0	288.
136.5	281.
137.0	270.
137.5	257.
138.0	244.
138.5	160.
139.0	99.
139.5	119.
140.0	104.
140.5	63.
141.0	78.
141.5	73.
142.0	78.
142.5	72.
143.0	53.
143.5	52.
144.0	54.
144.5	71.
145.0	54.
145.5	57.
146.0	34.
146.5	27.
147.0	-3.
147.5	-24.
148.0	-32.
148.5	-53.
149.0	-107.
149.5	-117.
150.0	-104.
150.5	-26.
151.0	169.
151.5	592.
152.0	1376.
152.5	4432.
153.0	6843.
153.5	7754.
154.0	14967.
154.5	27373.
155.0	24772.
155.5	33696.
156.0	43461.
156.5	54427.
157.0	62591.



RACE DISPLAY.

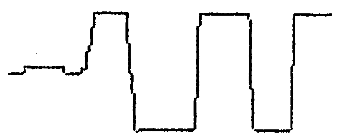
SHOT 32 Time 13:51:18 Level : 208.0 Shot location : E
Shot depth : 2.0 Charge size : .2
No. surface samples : 128 Down hole sample nos : 0 400 1008
Sample rates : 500 1000 usec Delay : 0

AUX. CHANNEL 1 Max. 9673mV

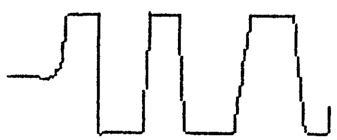


AUX. CHANNEL 2 Max. 9892mV

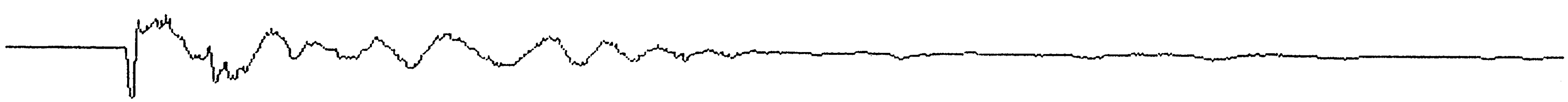
AUX. CHANNEL 3 Max. 9746mV



AUX. CHANNEL 4 Max. 10000mV



WELL PHONE CHANNEL - floating point amplifier

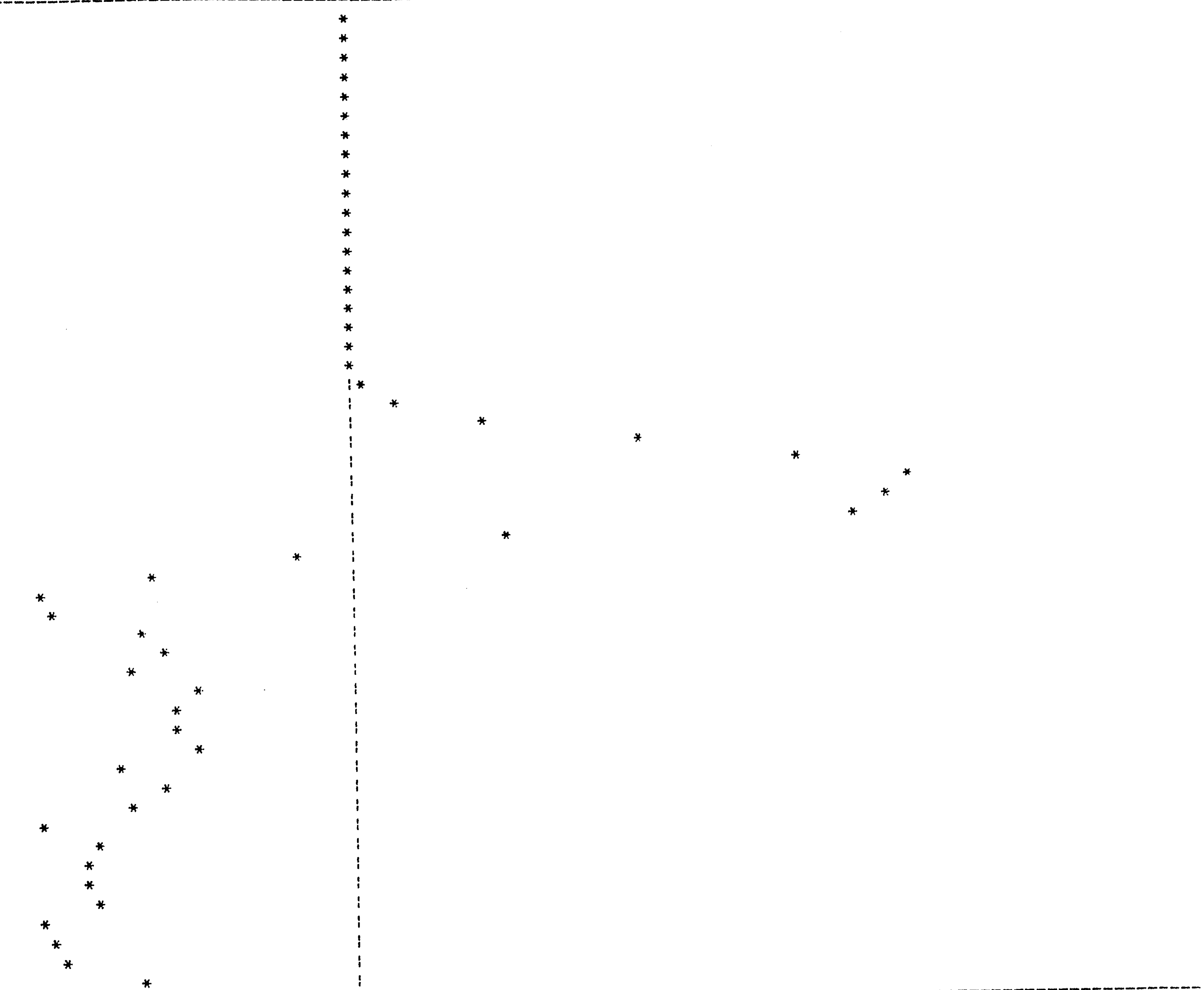


Data maximum (mV) : down hole channel - 168.402

FIRST ARRIVAL PLOT - Shot 32 Level 208.0

Well phone data

Sample time	Value uV
98.0	567.
99.0	344.
100.0	291.
101.0	99.
102.0	75.
103.0	89.
104.0	303.
105.0	413.
106.0	419.
107.0	278.
108.0	-93.
109.0	-411.
110.0	-371.
111.0	-460.
112.0	-248.
113.0	101.
114.0	132.
115.0	106.
116.0	413.
117.0	4622.
118.0	12946.
119.0	42421.
120.0	89164.
121.0	137667.
122.0	174005.
123.0	168402.
124.0	156076.
125.0	48344.
126.0	-19209.
127.0	-65632.
128.0	-101810.
128.5	-97808.
129.0	-71235.
129.5	-62991.
130.0	-74677.
130.5	-53826.
131.0	-60229.
131.5	-60109.
132.0	-53306.
132.5	-75797.
133.0	-63311.
133.5	-71395.
134.0	-99329.
134.5	-84041.
135.0	-86922.
135.5	-87163.
136.0	-85162.
136.5	-102130.
137.0	-97808.
137.5	-94046.
138.0	-71075.



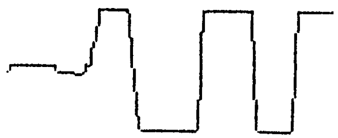
RACE DISPLAY.

SHOT 33 Time 13:56:20 Level : 150.0 Shot location : E
Shot depth : 2.0 Charge size : .2
No. surface samples : 128 Down hole sample nos : 0 400 1008
Sample rates : 500 1000 usec Delay : 0

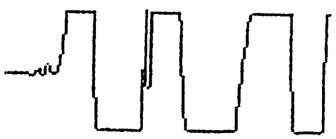
AUX. CHANNEL 1 Max. 9746mV

AUX. CHANNEL 2 Max. 9585mV

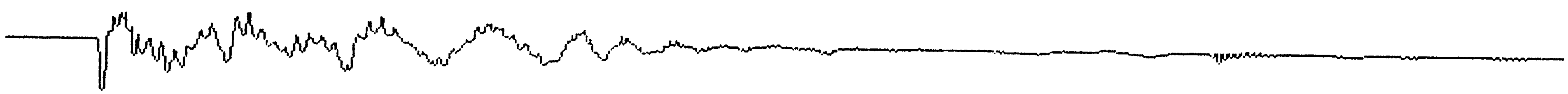
AUX. CHANNEL 3 Max. 9375mV



AUX. CHANNEL 4 Max. 9975mV



WELL PHONE CHANNEL - floating point amplifier

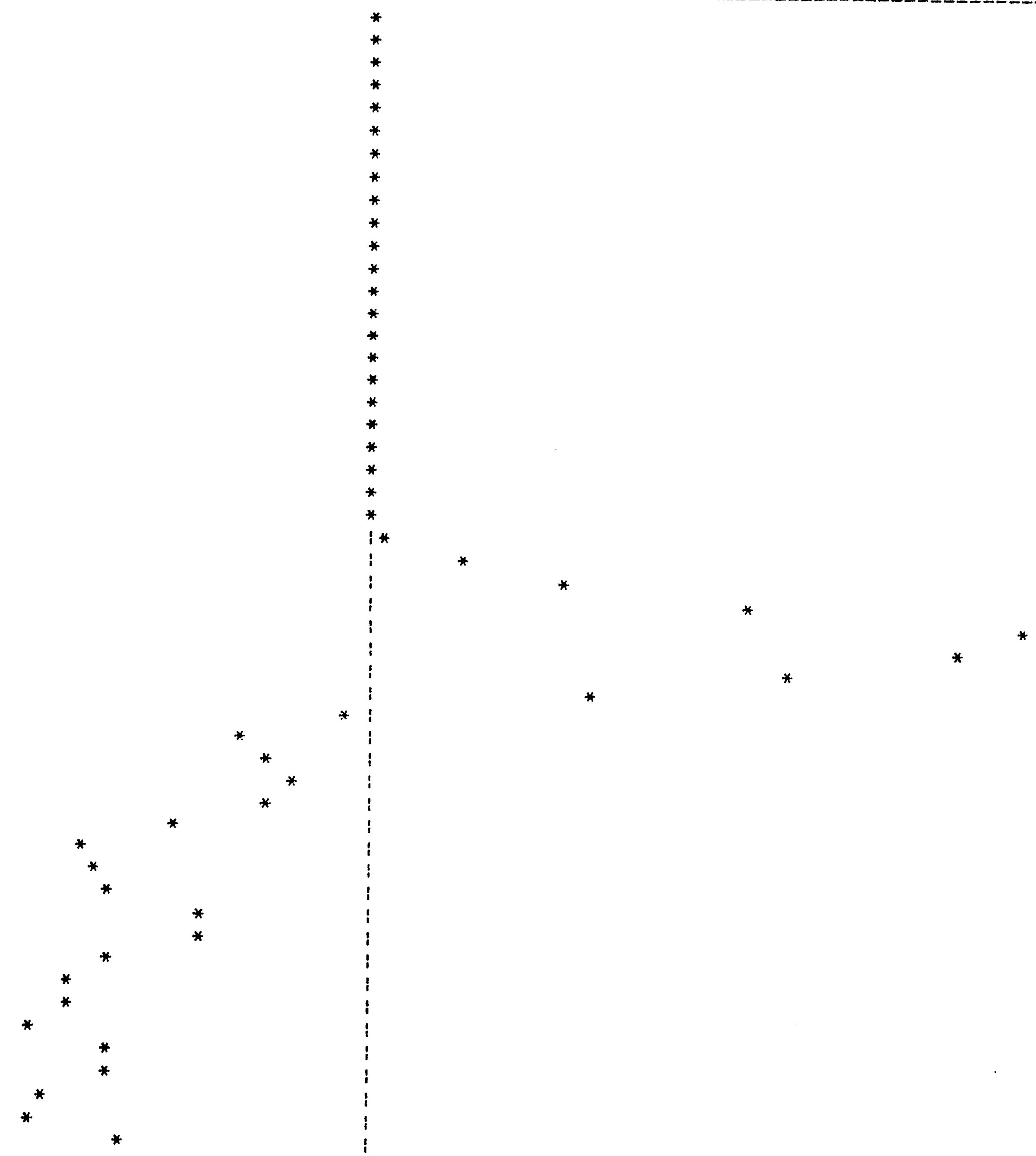


Data maximum (mV) : down hole channel - 284.939

FIRST ARRIVAL PLOT - Shot

Sam time	Value uV
66.0	-328.
67.0	-185.
68.0	-27.
69.0	113.
70.0	-43.
71.0	-261.
72.0	-308.
73.0	-258.
74.0	36.
75.0	253.
76.0	253.
77.0	44.
78.0	-51.
79.0	-42.
80.0	116.
81.0	303.
82.0	281.
83.0	153.
84.0	-19.
85.0	-108.
86.0	-108.
87.0	113.
88.0	1442.
89.0	7394.
90.0	37378.
91.0	82921.
92.0	166962.
93.0	284939.
94.0	256766.
95.0	181849.
96.0	94446.
97.0	-19209.
98.0	-63471.
99.0	-53386.
100.0	-37138.
101.0	-49544.
102.0	-89484.
103.0	-128703.
104.0	-127102.
105.0	-119739.
106.0	-79719.
107.0	-80840.
108.0	-122300.
109.0	-136067.
110.0	-139108.
111.0	-151594.
112.0	-119178.
113.0	-119899.
114.0	-149993.
115.0	-152875.
116.0	-113976.

We phone data



APPENDIX 7

APPENDIX 7

PETROGRAPHIC DESCRIPTIONS

PETROGRAPHIC DESCRIPTIONS OF SOME ROCKS FROM BUS SWAMP No. 1 WELL.

OTWAY BASIN STUDY

K. INAN

UNPUBLISHED REPORT 1993/3

INTRODUCTION

Two thin sections were submitted by Mr. C. Menhennitt for microscopic identification. The examination of the thin sections has shown that the rocks were metamorphosed siltstone and igneous rock of intermediate composition.

Keywords: Greenschist, siltstone, intrusive, andesitic

DESCRIPTIONS

SECTION No. 23862 CORE 4, BUS SWAMP 1

The rock in thin section is a greenish to blue-green, fine to medium grained meta-igneous rock. It shows little or no deformational features. Although the original igneous texture cannot be determined with accuracy, judging from the granular appearance it is possibly an intrusive rock.

The rock is composed of greenish pleochroic patches of amphibole (actinolite), quartz (both primary and secondary), chlorite, feldspar, carbonate, opaque (? magnetite) and lesser amounts of sericite and ?epidote.

The rock is intermediate in composition, possibly andesitic, and has undergone a lower grade metamorphism (greenschist) to produce the observed mineral assemblage.

SECTION No. 23863 SWC 1, Bus Swamp 1, 1840m.

The sample is a greenish grey coloured, very fine grained, weakly foliated and slightly metamorphosed siltstone.

The rock consists of quartz, feldspar, chlorite, amphibole, sericite ? epidote and opaques.

Amphibole (actinolite), together with chlorite and sericite, represent the clay fraction of the original siltstone. The rock has undergone a lower greenschist metamorphism.

K. Inan

PETROGRAPHIC REPORT ON SOME SAMPLES FROM BUS SWAMP 1 BORE

K. INAN

GEOLOGICAL SURVEY OF VICTORIA

UNPUBLISHED REPORT

1993/ 20

Keywords : Bus Swamp, siltstone,mudstone, feldspathic sandstone, arkosic sandstone, breccia

INTRODUCTION

This is the result of a microscopic examination of a total of four thin sections submitted for microscopic identification by Mr. G. Parker of the Basin Studies Section, the Geological Survey of Victoria .

Thin Section No. : Bus Swamp 1 (SWC 41) - 657.0 m .

This is a yellowish brown coloured siltstone/mudstone. The sample exhibits a matrix supported fabric, and is composed of relatively coarse grains of angular quartz and feldspar (K-feldspar and plagioclase) , partly chloritised detrital biotite , muscovite, ?volcanogenic lithic fragments and zircon. The coarse grains have a patchy distribution within a relatively finer matrix that is composed of sericitised and chloritised clay and some organic material.

Thin Section No. : Bus Swamp 1 , c2 (1) , 1515 m.

This a light coloured feldspathic / arkosic sandstone with a grain- supported fabric. It is well sorted, well compacted with little or no porosity . The rock is composed of quartz, feldspar, detrital mica, lithic fragments, zircon , garnet , some organic material and localized carbonate cement.

Quartz is the dominant mineral. It is subangular, usually clear but some grains have inclusions of zircon and muscovite.

Feldspar mainly consists of K- feldspar (microcline and perthitic orthoclase) and a few grains of plagioclase showing albite twinning. Some of the feldspar grains are partly or completely sericitised. Detrital biotite and muscovite occur as long laths .

Thin Section No. : Bus Swamp 1 (SWC 7) - 1767.0 m.

This is in many respects similar to the sample no. Bus Swamp 1, c2, (1), above but contains a lesser amount of carbonate cement.

Thin Section No. : Bus Swamp 1 (SWC 3) - 1822.0 m.

The rock is a fault breccia. It is composed of large and partly mylonitised quartz fragments (appears to be reef quartz), large polygenic lithic fragments and a siltstone/mudstone ? matrix composed of quartz and now sericitized /chloritised clay .

K. Inan

APPENDIX 8

APPENDIX
8

GEOCHEMISTRY
ANALYSIS

AMDEL
CORE
SERVICES

13 April 1993

Deparment of Energy and Minerals
Geological Survey of Victoria
Private Bag No 1
East Melbourne 3002

Attention: Cliff Menhennitt

REPORT: HH/2223

CLIENT REFERENCE:	022514
MATERIAL:	Rock Samples
LOCALITY:	Bus Swamp-1
WORK REQUIRED:	Source Rock Analysis

Please direct technical enquiries regarding this work to the signatory below under whose supervision the work was carried out.

BRIAN L WATSON
Laboratory Supervisor-Geochemistry
on behalf of Amdel Core Services Pty Ltd

ANTHONY M DRAKE
Laboratory Supervisor
Special Core Analysis

Adelaide Office: P.O. Box 109, Eastwood, SA 5063 Australia.
~~Telephone: (08) 372 2834 Facsimile: (08) 372 2851~~
Telephone: (08) 379 9888 Facsimile: (08) 379 9288

Amdel Core Services Pty Limited
(Incorporated in South Australia)
ACN: 008 273 005

1. INTRODUCTION

A total of twenty-two (22) samples were received for TOC analysis, Rock-Eval pyrolysis, vitrinite reflectance, helium injection porosity and ambient air permeability analysis along with preparation of two thin sections. This report is a formal presentation of results which were forwarded by facsimile as they became available.

2. ANALYTICAL PROCEDURES

2.1 Sample Preparation

Samples for TOC/Rock-Eval analysis (as received) were ground in a Siebtechnik mill for 20-30 seconds.

2.2 Total Organic Carbon (TOC)

Total organic carbon was determined by digestion of a known weight (approximately 0.2 g) of powdered rock in HCl to remove carbonates, followed by combustion in oxygen in the induction furnace of a Leco WR-12 Carbon Determinator and measurement of the resultant CO_2 by infra-red detection.

2.3 Rock-Eval Pyrolysis

A 100 mg portion of powdered rock was analysed by the Rock-Eval pyrolysis technique (Girdel IFP-Fina Mark 2 instrument; operating mode, Cycle 1).

2.4 Organic Petrology

Representative portions of each sample (crushed to -14+35 BSS mesh) were obtained with a sample splitter and then mounted in cold setting Glasscraft resin using a 2.5 cm diameter mould. Each block was ground flat using diamond impregnated laps and carborundum paper. The surface was then polished with aluminium oxide and finally magnesium oxide.

Reflectance measurements were made with a Leitz MPV1.1 microphotometer fitted to a Leitz Ortholux microscope and calibrated against synthetic standards. All measurements were taken using oil immersion (n = 1.518) and incident monochromatic light (wavelength 546 nm) at a temperature of 23±1°C. Fluorescence observations were made on the same microscope utilizing a 3 mm BG3 excitation filter, a TK400 dichroic mirror and a K510 suppression filter.

2.5 Warm Solvent Extraction and Humidity Drying

The samples undergoing porosity and permeability analysis were extracted using a chloroform/methanol azeotropic mixture to leach residual pore fluids. Prior to porosity and air permeability measurements, samples were dried at 50°C and 50% relative humidity. 50% relative humidity was achieved using a saturated solution of sodium nitrite.

2.6 Permeability to air

Air permeability was determined on the clean and dry plug samples. The samples were firstly placed in a Hassler cell with a confining pressure of 250 psi (1720 kPa). The confining pressure was used to prevent bypassing of air around the samples when the measurement was made. To determine permeability a known air pressure was applied to the upstream face of the sample, creating a flow of air through the core plug. Permeability for the samples was calculated using Darcy's Law through knowledge of the upstream pressure, flow rate, viscosity of air and the samples' dimensions.

2.7 Helium injection porosity

The porosity of the clean dry core plugs was determined as follows. The plugs were first placed in a sealed matrix cup. Helium held at 100 psi reference pressure was then introduced to the cup. From the resultant pressure change the unknown grain volume was calculated using Boyle's Law (ie, $P_1V_1 = P_2V_2$). The bulk volume of the sample is determined by mercury immersion. From the grain volume and the bulk volume porosity can be calculated (ie porosity = (Bulk Vol - Grain Vol)/Bulk Volume)).

3. RESULTS

TOC and Rock-Eval data are listed in Table 1. Figure 1 is a plot of T_{max} versus Hydrogen Index illustrating kerogen Type and maturity. Table 2 is a summary of the vitrinite reflectance measurements which are presented along with histograms in Appendix 1, while Figure 2 is a plot of measured vitrinite reflectance versus depth. Porosity and permeability data is presented in Table 3.

4. INTERPRETATION

4.1 Maturity

Reliable measured vitrinite reflectance values (Table 2, Figure 2) range from 0.39-0.60% over the section studied and indicate that the samples are marginally mature to mature for the generation of liquid hydrocarbons. Oil generation from thermally labile exinites (resinite, bituminite and suberinite) commences at VR = 0.45%. The maturity versus depth profile indicates that this maturity is reached at approximately 1200 metres depth in this location. Oil generation from the less thermally labile exinites (cutinite, sporinite, etc) commences at higher maturities (VR >0.7%). Extrapolation of the available data indicates that these maturities should be reached in the sedimentary interval below approximately 2000 metres depth. Rock-Eval T_{max} values correspond well with the measured vitrinite reflectance values, suggesting a maturity range of $VR_{EQUIV} \approx 0.40\text{-}0.60\%$ (Table 1, Figure 1).

Significant gas generation commences at a maturity level of approximately VR = 0.6%. Therefore, measured vitrinite reflectance data suggests that the sediments in Bus Swamp-1 below approximately 1790 metres are sufficiently mature for such gas generation.

A high production index (P.I. >0.2; Table 1) suggests the presence of migrated hydrocarbons in the samples at depths 830-835 and 1406 metres.

4.2 Source Richness

Both organic richness and source richness range from poor to fair in the samples studied (TOC = 0.18-2.19%, $S_1 + S_2$ = 0.45-2.65 kg of hydrocarbons/tonne; Table 1). The most organic and source rich samples occur in the interval 1710 - 1810 metres (TOC = 1.01-2.19%, $S_1 + S_2$ = 1.88-2.65 kg of hydrocarbons/tonne; Table 1).

4.3 Kerogen Type and Source Quality

Hydrogen Index and T_{max} values (Table 1, Figure 1) indicate that these samples contain organic matter which has a bulk composition of Type II/III to Type IV kerogen. The better quality samples containing organic matter with the bulk composition of Type II/III to Type III kerogen occur in the interval 1585 - 1810 metres.

TABLE 1

AMDEL CORE SERVICES

Rock-Eval Pyrolysis

03/08/93

Client: South Australian and Victorian Dept.of Minerals and Energy

Well: Bus Swamp-1

Depth (m)	T Max	S1	S2	S3	S1+S2	PI	S2/S3	PC	TOC	HI	OI
465	439	0.01	0.44	0.29	0.45	0.02	1.51	0.03	0.88	50	32
756									0.18		
830-835	402	0.17	0.41	0.59	0.58	0.29	0.69	0.04	1.79	22	32
982									0.19		
1105	428	0.02	0.43	0.33	0.45	0.05	1.30	0.03	0.98	43	33
1190	434	0.05	0.49	0.41	0.54	0.09	1.19	0.04	0.89	55	46
1325									0.33		
1406	303	0.25	0.50	0.27	0.75	0.34	1.85	0.06	0.86	58	31
1585	438	0.11	0.83	2.22	0.94	0.12	0.37	0.07	0.95	87	233
1710	436	0.16	1.97	2.32	2.13	0.08	0.84	0.17	1.48	133	156
1790	439	0.11	1.77	0.66	1.88	0.06	2.68	0.15	1.01	175	65
1803	437	0.34	2.31	1.47	2.65	0.13	1.57	0.22	1.61	143	91
1805-1810	437	0.15	2.29	1.48	2.44	0.06	1.54	0.20	2.19	104	67

TABLE 2

SUMMARY OF VITRINITE REFLECTANCE MEASUREMENTS, BUS SWAMP-1

Depth (m)	Mean Maximum Reflectance (%)	Standard Deviation	Range	Number of Determinations
465	0.40	0.05	0.31 - 0.47	8
756	0.39	0.05	0.31 - 0.48	12
830 - 835	0.41	0.05	0.36 - 0.47	6
862	0.40	0.03	0.36 - 0.46	22
913	0.40	0.03	0.33 - 0.45	14
982	0.43	0.02	0.41 - 0.46	3
1105	0.41	0.02	0.39 - 0.43	2
1190	0.45	0.05	0.39 - 0.54	14
1406	0.63 *	0.03	0.59 - 0.67	4
1509 - 15	0.49	0.10	0.39 - 0.64	6
1585	0.47	0.03	0.40 - 0.55	26
1709	0.55	0.06	0.46 - 0.65	25
1790	0.60	0.04	0.53 - 0.66	12
1805 - 10	0.60	0.04	0.50 - 0.66	15
1815	0.60	0.04	0.54 - 0.66	29

* Influenced by re-worked vitrinite

HYDROGEN INDEX vs T max

Client :South Australian and Victorian Dept.of Minerals and Energy
Location :Bus Swamp-1

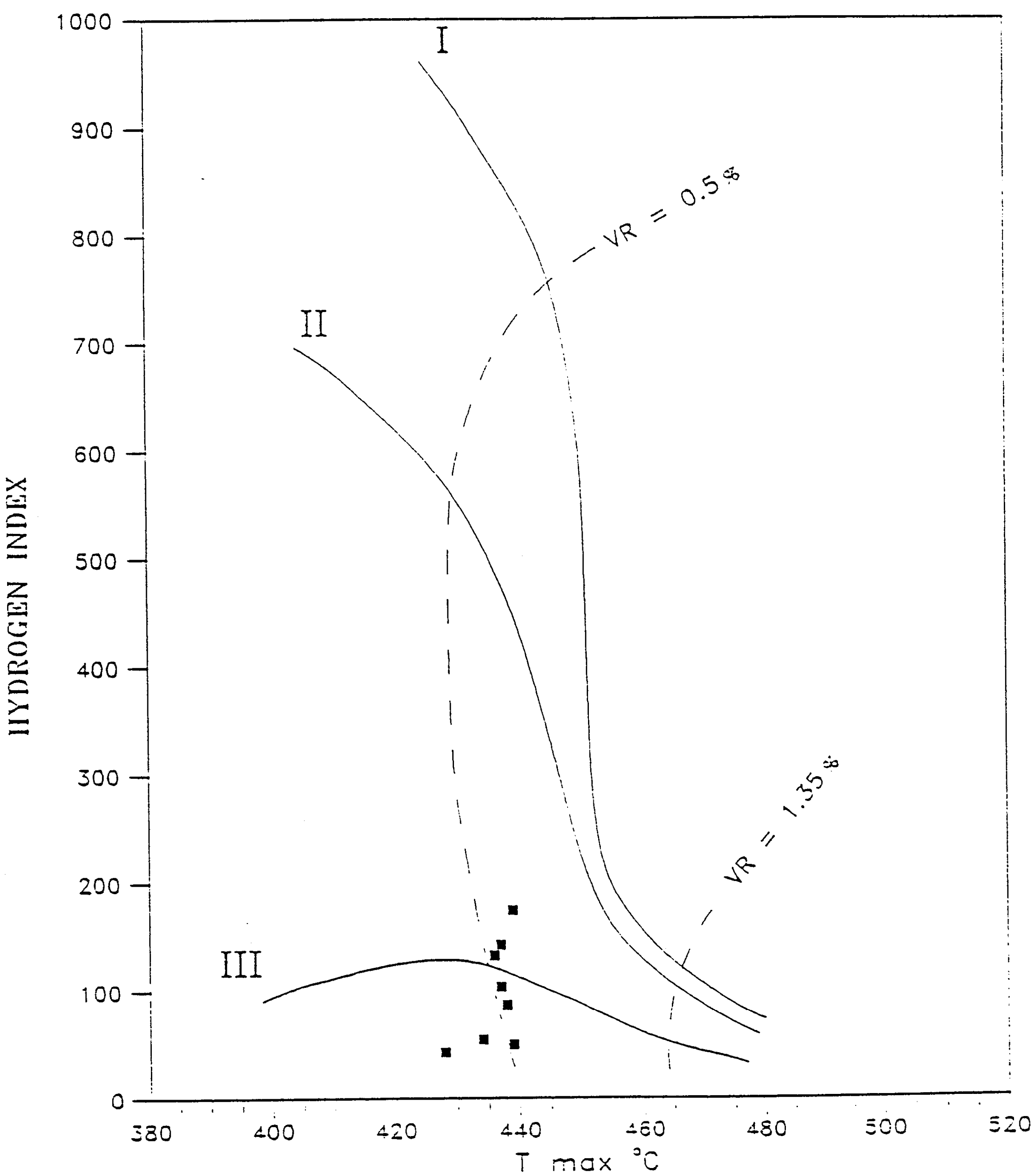
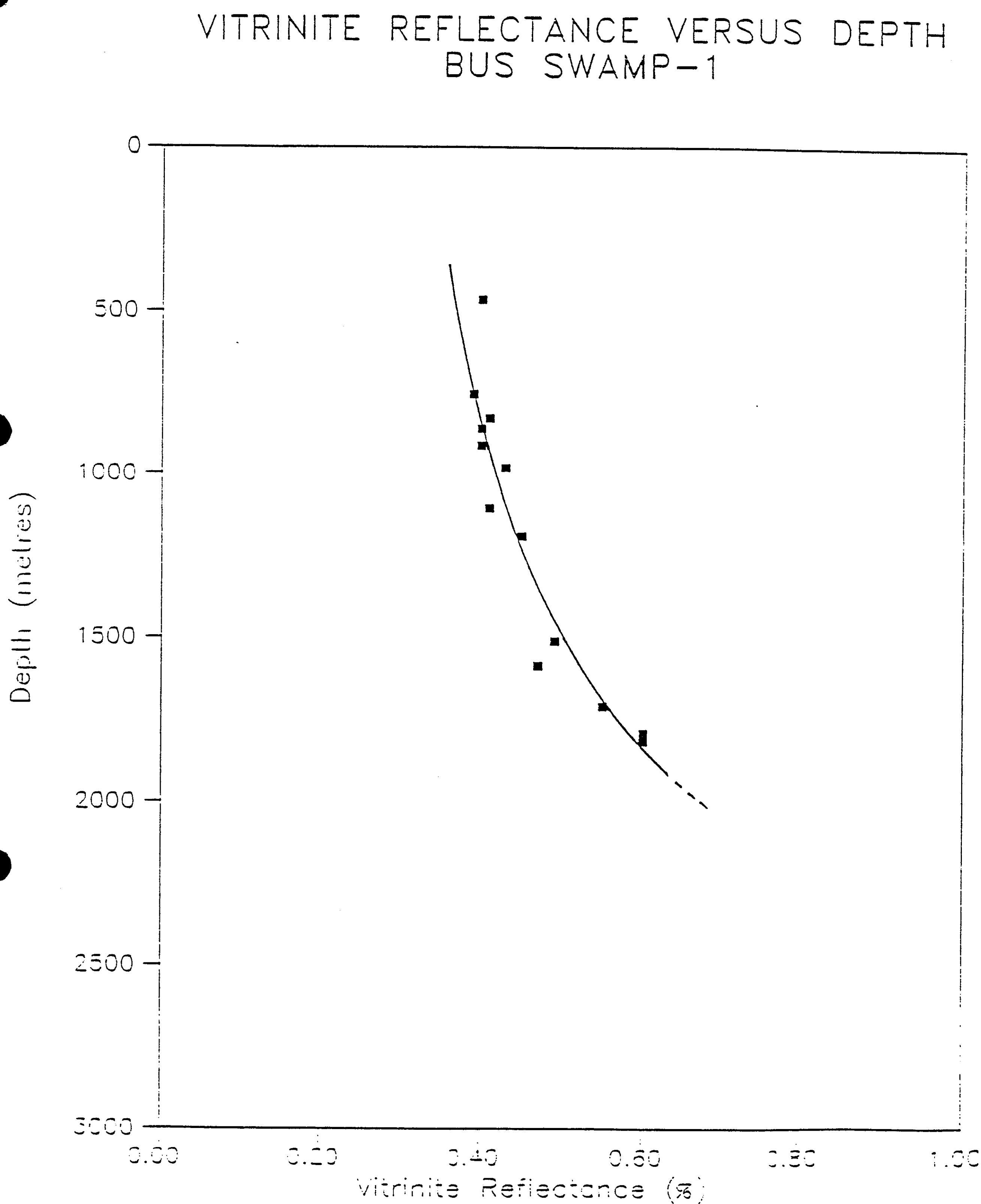


FIGURE 2



VITRINITE REFLECTANCE VERSUS DEPTH
BUS SWAMP-1
Depth (metres)
0
500
1000
1500
2000
2500
3000
0.00
0.20
0.40
0.60
0.80
1.00
Vitrinite Reflectance (%)

APPENDIX 1

HISTOGRAM PLOTS OF VITRINITE REFLECTANCE DATA

BUS SWAMP-1

VITRINITE REFLECTANCE VALUES

Well Name: Bus Swamp-1
Depth: 465 m

Sorted List

0.31
0.36
0.36
0.40
0.41
0.42
0.44
0.47

Number of values= 8

Mean of values 0.40
Standard Deviation 0.05

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

31-33	*
34-36	**
37-39	
40-42	***
43-45	*
46-48	*

VITRINITE REFLECTANCE VALUES

Well Name: Bus Swamp-1
Depth: 756 m

Sorted List

0.31	0.43
0.32	0.48
0.36	
0.37	
0.38	
0.39	
0.41	
0.42	
0.42	
0.42	

Number of values= 12

Mean of values 0.39
Standard Deviation 0.05

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

31-33	**
34-36	*
37-39	***
40-42	****
43-45	*
46-48	*

VITRINITE REFLECTANCE VALUES

Well Name: Bus Swamp-1
Depth: 830-835 m

Sorted List

0.36
0.36
0.38
0.43
0.46
0.47

Number of values= 6

Mean of values 0.41
Standard Deviation 0.05

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

36-38	***
39-41	
42-44	*
45-47	**

VITRINITE REFLECTANCE VALUES

Well Name: Bus Swamp-1
Depth: 862 m

Sorted List

0.36	0.40	0.45
0.36	0.41	0.46
0.36	0.41	
0.37	0.41	
0.38	0.42	
0.38	0.42	
0.39	0.43	
0.39	0.43	
0.39	0.43	
0.39	0.43	

Number of values= 22

Mean of values 0.40
Standard Deviation 0.03

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

36-38	******
39-41	********
42-44	******
45-47	**

VITRINITE REFLECTANCE VALUES

Well Name: Bus Swamp-1
Depth: 913 m

Sorted List

0.33	0.43
0.38	0.43
0.39	0.44
0.39	0.45
0.39	
0.39	
0.40	
0.40	
0.41	
0.42	

Number of values= 14

Mean of values 0.40
Standard Deviation 0.03

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

33-35	*
36-38	*
39-41	*******
42-44	****
45-47	*

VITRINITE REFLECTANCE VALUES

Well Name:	Bus Swamp-1
Depth:	982 m

Sorted List

0.41
0.42
0.46

Number of values=	3
Mean of values	0.43
Standard Deviation	0.02

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

41-43 **
44-46 *

VITRINITE REFLECTANCE VALUES

Well Name: Bus Swamp-1
Depth: 1105 m

Sorted List

0.39
0.43

Number of values= 2

Mean of values 0.41
Standard Deviation 0.02

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

39-41 *
42-44 *

VITRINITE REFLECTANCE VALUES

Well Name: Bus Swamp-1
Depth: 1190 m

Sorted List

0.39	0.48
0.39	0.49
0.40	0.53
0.42	0.54
0.42	
0.43	
0.45	
0.45	
0.47	
0.47	

Number of values= 14

Mean of values 0.45
Standard Deviation 0.05

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

```
39-41    ***
42-44    ***
45-47    ****
48-50    **
51-53    *
54-56    *
```

VITRINITE REFLECTANCE VALUES

Well Name:	Bus Swamp-1
Depth:	1406 m (Reworked)

Sorted List

0.59
0.61
0.65
0.67

Number of values=	4
Mean of values	0.63
Standard Deviation	0.03

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

59-61	**
62-64	
65-67	**

VITRINITE REFLECTANCE VALUES

Well Name:	Bus Swamp-1
Depth:	1509-15 m

Sorted List

0.39
0.40
0.40
0.53
0.60
0.64

Number of values=	6
Mean of values	0.49
Standard Deviation	0.10

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

39-41	***
42-44	
45-47	
48-50	
51-53	*
54-56	
57-59	
60-62	*
63-65	*

VITRINITE REFLECTANCE VALUES

Well Name: Bus Swamp-1
Depth: 1585 m

Sorted List

0.40	0.46	0.49
0.41	0.46	0.49
0.43	0.46	0.50
0.43	0.46	0.52
0.43	0.46	0.53
0.44	0.47	0.55
0.44	0.48	
0.45	0.48	
0.45	0.48	
0.45	0.48	

Number of values= 26

Mean of values 0.47
Standard Deviation 0.03

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

40-42	**
43-45	********
46-48	**********
49-51	***
52-54	**
55-57	*

VITRINITE REFLECTANCE VALUES

Well Name: Bus Swamp-1
Depth: 1709 m

Sorted List

0.46	0.56	0.60
0.47	0.57	0.61
0.47	0.57	0.62
0.49	0.57	0.63
0.49	0.58	0.65
0.49	0.58	
0.49	0.58	
0.49	0.59	
0.53	0.59	
0.55	0.60	

Number of values= 25

Mean of values 0.55
Standard Deviation 0.06

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

46-48	***
49-51	*****
52-54	*
55-57	*****
58-60	*******
61-63	***
64-66	*

VITRINITE REFLECTANCE VALUES

Well Name: Bus Swamp-1
Depth: 1790 m

Sorted List

0.53	0.64
0.55	0.66
0.55	
0.56	
0.56	
0.60	
0.61	
0.63	
0.63	
0.64	

Number of values= 12

Mean of values 0.60
Standard Deviation 0.04

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

53-55	*
56-58	****
59-61	**
62-64	****
65-67	*

VITRINITE REFLECTANCE VALUES

Well Name: Bus Swamp-1
Depth: 1805-1810 m

Sorted List

0.50	0.62
0.55	0.62
0.57	0.65
0.58	0.65
0.58	0.66
0.59	
0.59	
0.60	
0.60	
0.60	

Number of values= 15

Mean of values 0.60
Standard Deviation 0.04

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

50-52	*
53-55	
56-58	****
59-61	*****
62-64	**
65-67	***

VITRINITE REFLECTANCE VALUES

Well Name: Bus Swamp-1
Depth: 1815 m

Sorted List

0.54	0.58	0.63
0.55	0.58	0.63
0.56	0.59	0.64
0.56	0.59	0.64
0.56	0.60	0.64
0.56	0.61	0.64
0.56	0.61	0.65
0.56	0.62	0.66
0.57	0.62	0.66
0.58	0.62	

Number of values= 29

Mean of values 0.60
Standard Deviation 0.04

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

```
54-56    **
57-59    ************
60-62    ******
63-65    *******
66-68    **
```

GEOCHEMISTRY OF SEDIMENTS FROM BUS SWAMP-1

Data and analysis by:

R.E. Summons and I.A. Atkinson

Australian Geological Survey Organisation

Methods

Samples were hammered to chips which were subsequently crushed to 200-mesh in a ring crusher. Rock powders were stored in clean glass containers. Lids were lined with pre-baked aluminium foil. All items used to handle the samples were scrupulously washed with hot water and then distilled solvent between each use.

Total total organic carbon content was determined using a Leco IR-12 Carbon Determinator. Rock-Eval pyrolysis (Espitalié *et al.*, 1977) was carried out on 100 mg portions of powdered rock using a Girdel IFP-Fina Mark 2 instrument. Samples with less than 0.2 % TOC (i.e. 2mg/ g) are generally considered unsuitable for comprehensive hydrocarbon analysis because of the problems of contamination, although elemental and carbon isotopic analysis of their kerogens are considered to be reliable parameters at this low level of organic carbon. Samples with >0.2 % TOC were further assessed using Rock-Eval pyrolysis to establish the proportions of bitumen (S1 peak in kg/ Tonne) and kerogen (S2 peak in kg/ Tonne) and the relative maturity by Tmax (°C). If the S2 peak is above 0.5 (preferably >1) significant kerogen is present and a reliable indication of maturity can be established from the Tmax value. However, care must be exercised in the presence of a large S1 peak because this may lead to suppression of the pyrolysis temperature. Consistency of Tmax values within the range 420-470° over a large suite of samples from a particular unit is therefore considered to be a reliable indicator of the presence of immature to mature kerogens. Values of PI (S1/S1+S2) > 0.3 and Tmax in the range 440-470 are indicative of a sediment in the maturity phase for oil generation. Co-occurring bitumens in organic rich samples may be suitable for further hydrocarbon analysis to make more detailed palaeoenvironmental and maturity assessments.

Analysis of the Bus Swamp samples

The results of our analysis are shown in the accompanying table.

Core 2 samples from the well showed moderate TOC suggesting source rock potential. However, analysis of the Rock-Eval data show very high S3 (CO_2) generation and this is indicative of "dead" carbon or unstable carbonate minerals rather than kerogen (organic) carbon.

Samples toward the base of the hole (1756m, 1785m and SWC 4) show moderate levels of organic carbon accompanied by significant S2. Some minor source potential is suggested for the deepest sample (SWC 4) by the HI value of 150. The low HI values of the remainder of the samples suggest that the organic matter is probably gas-prone type III kerogen.

Where there is significant S2 (kerogen), the Tmax values are below all 440°. This indicates that the sediments intersected in this well have not yet reached the maturity zone for significant oil generation.

T&R 6434-43 v2

AGSO - ISOTOPE & ORGANIC GEOCHEMISTRY LABORATORY

AGSO No.	BASIN	INFORMATION	DEPTH	TMAX	S 1	S 2	S 3	P I	S2/S3	P C	TOC	H I	O I
6434		Batavia Downs	274-76m	440	0.03	0.6	0	0.05	0	0.05	0.63	95	0
6439	Otway	Bus Swamp SWC 41	657m	443	0	0.09	0	0	0	0	0.24	38	0
6435	Otway	Bus Swamp Core 1	830-35m	435	0.01	0.73	0	0.01	0	0.06	1.49	49	0
6440	Otway	Bus Swamp SWC 33	862m	436	0.01	0.49	0	0.02	0	0.04	0.8	61	0
6441	Otway	Bus Swamp SWC 30	913m	446	0	0.21	0	0	0	0.01	0.53	40	0
6436	Otway	Bus Swamp Core 2	1505-15m	439	0.06	0.54	15.15	0.1	0.03	0.05	2.7	20	561
6437	Otway	Bus Swamp Core 2 (base)	1509.8-15.8	439	0.06	0.56	17.33	0.1	0.03	0.05	2.5	22	693
6443	Otway	Bus Swamp 8 (SWC?)	1756m	438	0.1	2.08	3.93	0.05	0.52	0.18	1.61	129	244
6438	Otway	Bus Swamp Core 3	1785-90m	438	0.06	1.32	0.82	0.04	1.6	0.11	1.29	102	64
6442	Otway	Bus Swamp SWC 4	1815m	431	0.39	5.23	1.66	0.07	3.15	0.46	3.5	149	47

Data : Ian Atkinson 03/10/93

APPENDIX 9

APPENDIX
9

PALYNOLOGICAL
REPORTS

REVIEW OF THE BUS SWAMP 1 PALYNOLOGICAL RESULTS

C. Abele

Thirty six core, sidewall core and cuttings samples from Bus Swamp 1 were submitted for palynological analysis to R. Morgan (Morgan Palaeo Associates), D. Burger (AGSO) and N.F. Alley (SADME). A comparison of their results reveals significant differences, only partly explicable by the use of different zonation schemes.

The most generally accepted palynological zonation scheme for Australian Mesozoic strata is that established by Helby et al. (1987). This was used both by Morgan (with modifications) and Alley. Burger used the scheme of Dettmann & Douglas (1976), but his conclusions can be readily expressed in terms of the Helby et al. (1987) scheme, as done in Table 8.

Helby et al. (1987, p. 35,37) defined the *C. australiensis/F. wonthaggiensis* zone boundary as marked by the first appearance of *F. wonthaggiensis*, and the *F. wonthaggiensis/C. hughesii* zone boundary as marked by the first appearance of *F. asymmetricus.* In a range chart (Fig. 13, p.22) they showed the first appearance of *P. notensis* in eastern Australia as coinciding with that of *F. asymmetricus.*

In the Otway Basin, Morgan (1985, 1986 and later) recognises these zone boundaries according to different criteria. He equates the base of the *F. wonthaggiensis* Zone with the first appearance of *D. speciosus* (slightly earlier than *F. wonthaggiensis*) and the top of the zone with the first appearance of *P. notensis*. '...*F. asymmetricus* is consistent to base *C. striatus* Zone, then extremely rare down to, and just past, the oldest occurrence of *P. notensis*...' (R. Morgan, written comm., 25.11.93). Morgan (1985, 1986) regarded the differences as minor modifications which do not significantly alter the sense or usage of the existing zonation (essentially that of Helby et al., 1987). Alley disagrees, in particular regarding the *F. wonthaggiensis/ C. hughesii* zone boundary in Bus Swamp 1. He considers *F. asymmetricus* as a good indicator for the *C. hughesii* Zone; its absence in the presence of *P. notensis* and/or *T. reticulatus* is taken to indicate the *F. wonthaggiensis* Zone. *P. notensis* is shown to appear more than 5m.y. earlier than *F. asymmetricus.* The lower part of Morgan's *C. hughesii* Zone is equated with the upper part of the *F. wonthaggiensis* Zone of Helby et al. (1987) and other authors.

The disagreement between Alley and Morgan regarding the recognition and placement of the *F. wonthaggiensis/C. hughesii* zone boundary is essentially a question of whether in the Otway Basin the first appearance of *P. notensis* is distinctly older than that of *F. asymmetricus* (Alley) or whether this only appears so because *F. asymmetricus* is rare and sporadic near the base of its range (Morgan).

Examination of available Otway Basin palynological data reveals that in some bores *P. notensis* appears below *F. asymmetricus* (Tirrengowa 1, Woolsthorpe 1). or *P. notensis* is present whereas *F. asymmetricus* is not (South Caramut 1, Terang 1). In other bores, however, *P. notensis* and *F. asymmetricus* first appear at the same level (Casterton 1, Greenslopes 1, Lindon 1, Moyne Falls 1).

The pattern of distribution outlined above appears to support Morgan's view, and I have accepted his assignment of Bus Swamp 1 samples from 862 to 886m to the *C. hughesii* Zone, rather than to the *F. wonthaggiensis* Zone or its equivalent as done by Burger and Alley. Samples from 913 to 1765 m represent the *F. wonthaggiensis* Zone. Burger assigns samples from 913 m and below to the equivalent of the *C. australiensis* Zone, mainly because of the absence of *F. wonthaggiensis*; however, this palynomorph has been recorded from these levels by Alley. Samples from 1787 to 1805 m come from the *C. australiensis* Zone.

Differences in the placement of the *F. wonthaggiensis/C. hughesii* zone boundary are not merely of academic concern as they affect rock unit biostratigraphic age estimation. Largely on the basis of Morgan's work, we regarded the base of the Eumeralla Formation as well as the uppermost strata of the underlying Pretty Hill Formation as being within the *C. hughesii* Zone. According to Alley, however, the lowermost Eumeralla Formation beds (those not containing *F. asymmetricus)* should be assigned to the *F. wonthaggiensis* Zone.

Depth (m)	Morgan	Burger	Alley
210.0 -215.0	Lower paradoxa		
300	Lower paradoxa		
465	striatus		
657		Indeterminate	
756	Lower hughesii		
830			Upp. F. wonthaggiensis
830.4 - 836.4		Middle C. hughesii	Upp. F. wonthaggiensis
862	Lower hughesii	Middle C. hughesii	
865.0 - 870.0	Lower hughesii		
886	Lower hughesii		
913		Upper C. australiensis	
957			Lwr F. wonthaggiensis
982			Indeterminate
1105			Lwr F. wonthaggiensis
1145			Indeterminate
1190	Lwr F. wonthaggiensis		
1325	Lwr F. wonthaggiensis		
1406			Indeterminate
1509.8 - 1515.8		Upper C. australiensis	
1515			Lwr F. wonthaggiensis
1560	Lwr F. wonthaggiensis		
1640	Lwr F. wonthaggiensis		
1730	Lwr F. wonthaggiensis		
1756		Upper C. australiensis	
1760.0 - 1765.0	Lwr F. wonthaggiensis		
1787	Lwr C. australiensis - R. watherooensis		
1785.2 - 1790.1		Upper C. australiensis	Upp. C. australiensis
1800.0 - 1805.0			Upp. C. australiensis
1803			Younger than R. watherooensis
1815		Indeterminate	
1840	Indeterminate		

Table 10. Summary of Results of Palynology Analyses.

REFERENCES

DETTMANN, M.E. & DOUGLAS, J.G., 1976: Palaeontology - Mesozoic. In *Geology of Victoria.* (Eds. J.G. Douglas & J.A. Ferguson). *Geological Society of Australia Special Publication* **5**, pp. 164-169

HELBY, R., MORGAN, R. & PARTRIDGE, A.D., 1987: A Palynological Zonation of the Australian Mesozoic. *Memoir of the Association of Australasian Palaeontologists* **4**, pp. 1-94.

MORGAN, R., 1986: Otway Basin Drilling: A Selective Palynology. In Connard. P.D. (ed.). *The Petroleum Geology of the Otway Basin.*

MORGAN, R., 1985: Palynology of Selected Oil Drilling, Otway Basin, South Australia. *Ultramar Australia Unpublished Report.*

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UPDATED PALYNOLOGY OF BUS SWAMP #1,

OTWAY BASIN, VICTORIA, AUSTRALIA

BY

ROGER MORGAN

for VICTORIAN GEOLOGICAL SURVEY

August 1993

REF:W.OTW.RPUPPSWMP

UPDATED PALYNOLOGY OF BUS SWAMP #1

OTWAY BASIN, VICTORIA, AUSTRALIA

BY

ROGER MORGAN

CONTENTS **PAGE**

I SUMMARY

Seventeen samples were studied (two repeated) and yielded the following results

215m(cutts), 300.0m(swc) : lower *paradoxa* Zone : mid Albian : non-marine but with significant lacustrine influence : immature for hydrocarbons : usually Middle Eumeralla Formation in the sense of Kopsen and Scholefield

465.0m(swc) : very lean apparently *striatus* Zone without the key marker and with significant Triassic reworking : early Albian : slightly brackish : immature for hydrocarbons : usually upper part of thre lower Eumeralla Formation in the sense of Kopsen and Scholefield

756.0m(swc), 862.0m(swc) : lower *hughesi* Zone : early Aptian : non-marine : marginally mature for oil, but immature for gas/condensate : usually basal Eumeralla Formation

870m(cutts), 886.0m(swc) : apparently lower *hughesi* Zone but in cuttings : early Aptian : non-marine marginally mature for oil, but immature for gas/condensate : usually basal Eumeralla Formation

1190.0m(swc), 1325.0m(swc), 1560.0m(swc), 1640.0m(swc), 1730.0m(swc), 1765m(cutts) : lower *wonthaggiensis* Zone : late Neocomian : non-marine with some lacustrine influence at 1325 and 1640m : marginally mature for oil but immature for gas/condensate : usually Crayfish Formation including lower Laira Shale and upper Pretty Hill Sandstone. The absence of the upper *australiensis* Zone at the base suggests an incomplete section. The absence of the upper *wonthaggiensis* Zone at the top suggests significant erosional truncation of the topmost Crayfish Group including the Katnook Sandstone and upper Laira Shale equivalents

1787.0m(core) : lower *australiensis* to *watherooensis* Zones : early Neocomian to ?late Jurassic : non-marine : usually lower Pretty Hill Sandstone and Casterton Beds

1840.0m : extremely lean and indeterminate : very rare fossils are not significantly darker than those overlying and are attributed to minor mud contamination.

II INTRODUCTION

Cliff Menhennitt of the Victorian Geological Survey submitted 10 swcs from Bus Swamp #1 for palynological analysis initially. Later, Greg Parker submitted a further seven samples including repeats of 886.0m and 1840.0m.

Palynomorph occurrence data are shown as Appendix I and form the basis for the assignment of the samples to five spore-pollen units of Neocomian and Albian age. The Cretaceous spore-pollen zonation is essentially that of Dettmann and Playford (1969), but has been significantly modified and improved by various authors since, and most recently discussed in Helby et al (1987), as shown on Figure 1 and modified by Morgan (1985) for application in the Otway Basin.

Maturity data was generated in the form of Spore Colour Index, and is plotted on Figure 2 Maturity Profile of Bus Swamp #1. The oil and gas windows on Figure 2 follow the general consensus of geochemical literature. The oil window corresponds to spore colours of light-mid brown (Staplin Spore Colour Index of 2.7) to dark brown (3.6). These correspond to vitrinite reflectance values of 0.6% to 1.3%. Geochemists argue variations on kerogen type, basin type and basin history. The maturity interpretation is thus open to reinterpretation using the basic colour observations as raw data. However, the range of interpretation philosophies is not great, and probably would not move the oil window by more than 200 metres.

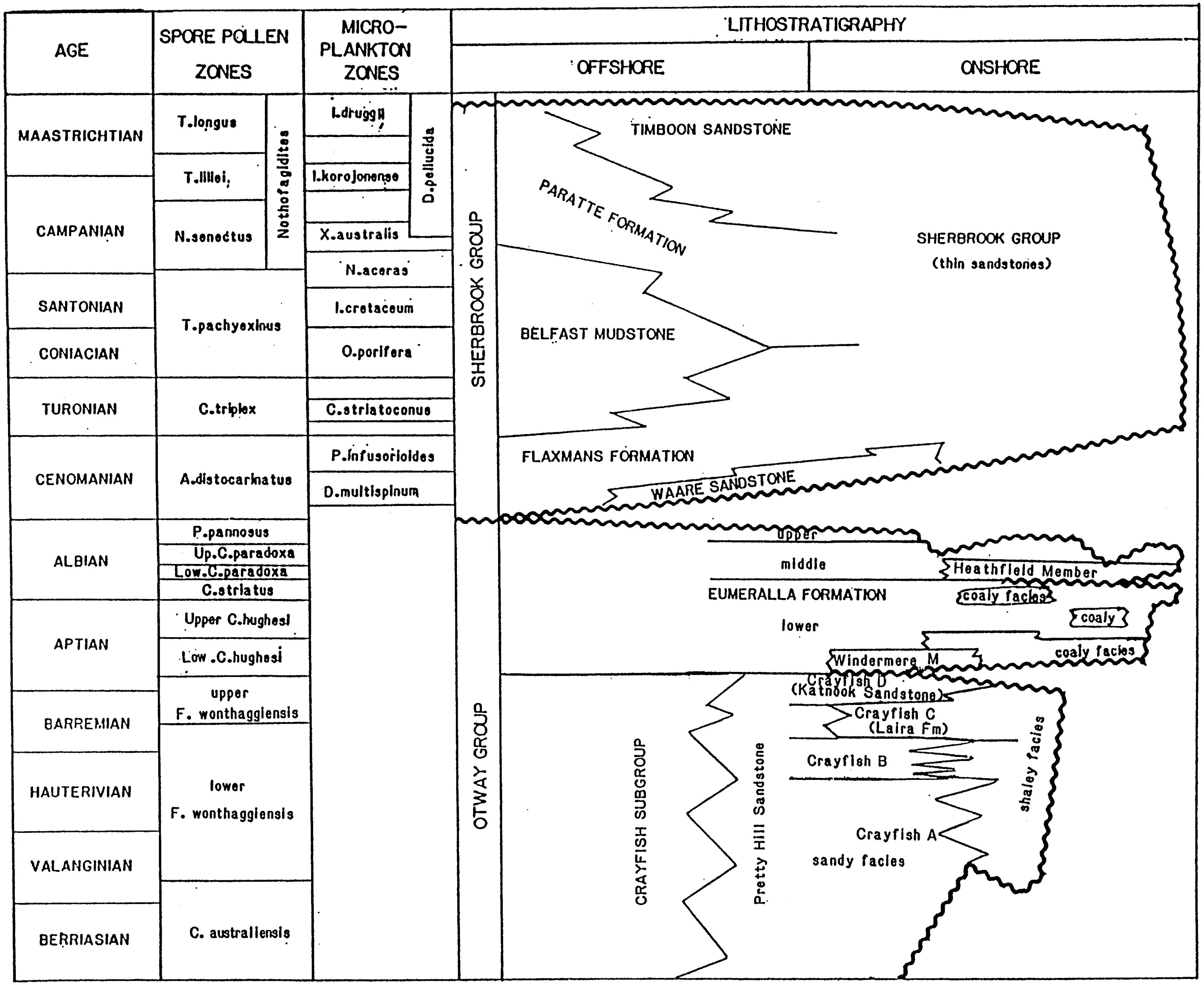

FIGURE 1. CRETACEOUS REGIONAL FRAMEWORK, OTWAY BASIN

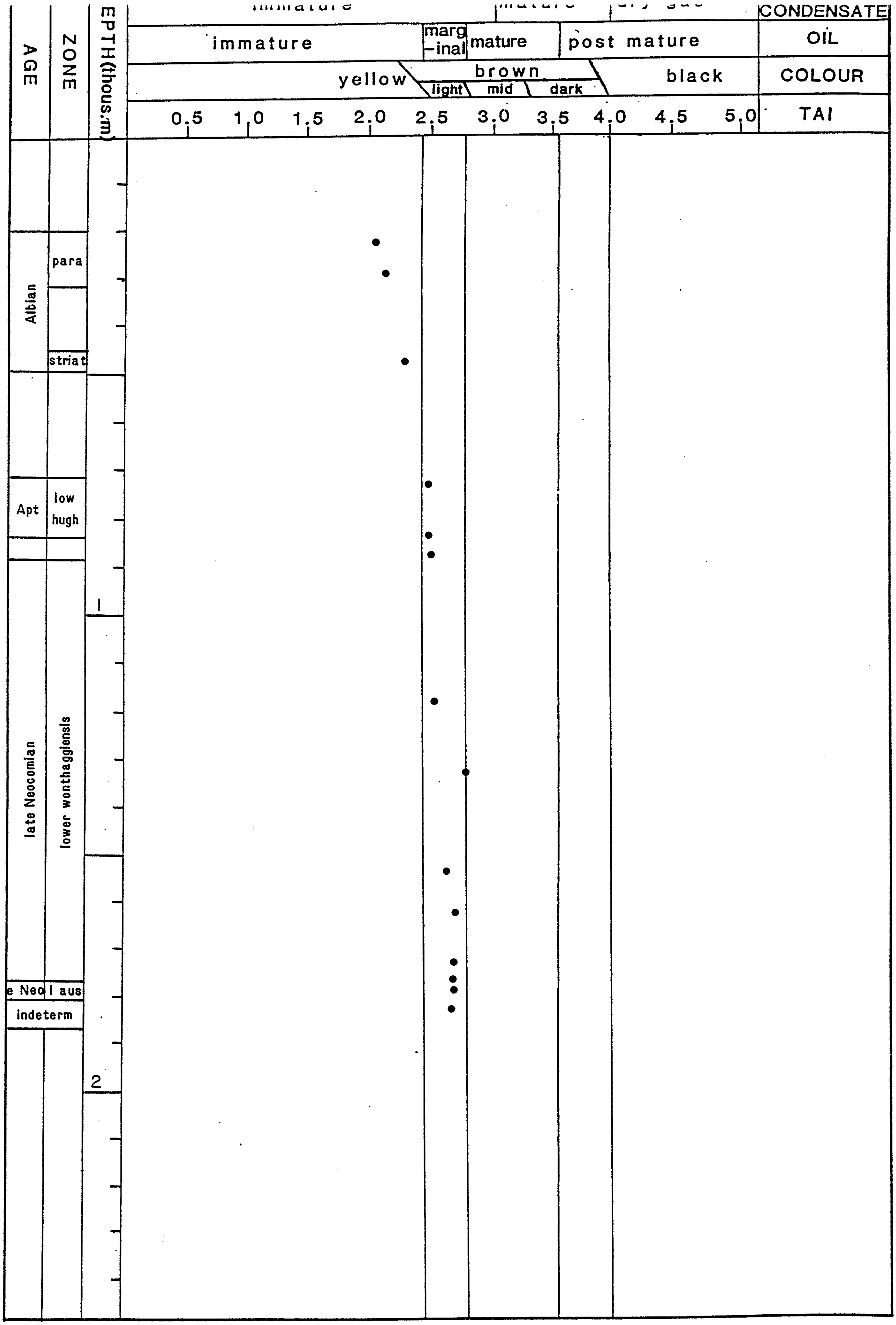

FIGURE 2 MATURITY PROFILE : BUS SWAMP

III PALYNOSTRATIGRAPHY

A 215m(cutts), 300.0m(swc) : lower *paradoxa* Zone

Assignment of the lower *Coptospora paradoxa* Zone of mid Albian age is indicated at the top by youngest *Dictyotosporites speciosus* and *Coptospora striata* and at the base by oldest *C. paradoxa*. The assemblage at 300.0m was very lean due to small sample size. At 215m, *Pilosisporites grandis* occurs, suggesting the upper *paradoxa* Zone, but must be caved, given the other data. Common taxa are *Falcisporites similis*, *Osmundacidites wellmanii* and *Cyathidites minor* with frequent taxa being *Microcachyidites antarcticus* and *Cyathidites australis*. Rare Triassic reworking was seen.

Non-marine environments are indicated by the dominant and diverse spore-pollen and absence of saline indicators. The freshwater algae *Botryococcus* comprises 1% of the assemblage at 215m and 5% at 300m and suggests significant lacustrine influence.

Yellow spore colours indicate immaturity for hydrocarbon generation.

These features are normally seen in the Middle Eumeralla Formation in the sense of Kopsen and Scholefield 1990.

B 465.0m(swc) : apparently *striatus* Zone

This assemblage is also very lean with abundant cuticle and significant Triassic (6%) and Permian (1%) reworking. Assignment to the *Crybelosporites striatus* Zone of early Albian age is most likely on oldest consistent *Foraminisporis asymmetricus* without *Cyclosporites hughesi*. Normally, *C. striatus* is seen at this level, but its absence from this sample may be due to the small yield and so few spore-pollen seen. The *striatus* Zone is most likely but cannot be proven beyond doubt. Common taxa are *F. similis* and *O. wellmanii* with *Cyathidites* spp frequent. The Triassic reworking is remarkable and suggests proximity to an erosional unconformity.

Slightly brackish environments are indicated by the extremely rare spiny acritarchs (*Veryhachium* sp) amongst the dominant and diverse spore/pollen. Lacustrine influence is very minor.

Yellow spore colours indicate immaturity for hydrocarbon generation.

These features are normally seen in the upper part of the Lower Eumeralla Formation of Kopsen and Scholefield (1990).

C 756.0m(swc), 862.0m(swc) : lower *hughesi* Zone

Assignment to the lower part of the *Cyclosporites hughesi* Zone of early Aptian age is indicated at the top by youngest *Cooksonites variabilis* and at the base by oldest *Pilosisporites notensis* (supported by oldest *P. parvispinosus*). *Cicatricosisporites australiensis*, *Foraminisporis wonthaggiensis* and *Triporoletes reticulatus* occur to the interval base but not in swcs beneath. Common taxa include *Cyathidites minor*, *F. similis* and *C. australis* with frequent taxa including *Retitriletes austroclavatidites*, *M. antarcticus* and *O. wellmanii.*

Non-marine environments are indicated by the dominant and diverse spore-pollen and absence of saline indicators. Very rare *Botryococcus* and *Schizosporis* indicate only minor lacustrine influence.

Light brown spore colours indicate marginal maturity for oil, but immaturity for gas/condensate

These features are normally seen in the lower part of the Lower Eumeralla Formation, often in coaly facies.

D 870m(cutts), 886.0m(swc) : apparently lower *hughesi* Zone

The cuttings sample contains *C. australiensis*, *F. wonthaggiensis*, *T. reticulatus* and *P. notensis* without *Microfasta evansii* and therefore appears to be lower *C. hughesi* Zone. It is possible, however, that *P. notensis* is caved along with other obvious caving including *C. paradoxa*, and that the sample might belong to the *F. wonthaggiensis* Zone. The swc is extremely lean but contains two specimens of *P. notensis* in the repeat preparation, suggesting the lower *hughesi* Zone. The original very lean preparation lacked *P. notensis* and so was assigned to the lower *wonthaggiensis* Zone and since this was the first sampling of the swc, it may be more reliable. The yield is so poor that mud contamination of the second preparation of the swc is quite possible. *M. evansii* was not seen.

Non-marine environments are indicated by the abundant and diverse spore-pollen, and absence of saline indicators. Rare *Schizosporis* indicates only minor lacustrine influence.

Light brown spore colours indicate marginal maturity for oil generation.

These features are normally seen in the basal Eumeralla Formation although topmost Crayfish Formation is possible if caving has confused the assignment.

E 1190.0m(swc), 1325.0m(swc), 1560.0m(swc), 1640.0m(swc), 1730.0m(swc), 1765m(cutts) : lower *wonthaggiensis* Zone

Assignment to the lower part of the *Foraminisporis wonthaggiensis* Zone is indicated by the consistent presence of *Dictyotosporites speciosus* without younger or older indicators. Common taxa include *O. wellmanii*, throughout, with *C. australis*, *F. similis*, *C. minor*, *M. antarcticus* and *R. austroclavatidites* intermittently common. *Murospora florida*, *Couperisporites tabulatus*, *D. speciosus* and *Foraminisporis dailyi* occur in most samples. Rare Triassic reworking was noted at 1640m only. *C hughesi* and *D. speciosus* are consistent to the base, although they could be caved at 1765m in cuttings. The absence of *M. evansii* is consistent with truncation of the Crayfish Group, as it is most common in the upper Crayfish Group in the upper *wonthaggiensis* Zone.

Non-marine environments are indicated by the common diverse spore-pollen and absence of saline indicators.

Cuticle fragments are common at 1190m, 1325m, and 1560m while rare *Botryococcus* suggests minor lacustrine influence at 1325m and 1640m.

Light brown spores colours indicate marginal maturity for oil but immaturity for gas/condensate. The lean sample at 1325m is light to mid brown suggesting higher maturity but this may be a local deviation caused by the organic facies.

These features are normally seen in the middle part of the Crayfish Formation. The absence of the upper *wonthaggiensis* Zone suggests the loss by erosional truncation of equivalents of the Katnook Sandstone and upper

Laira Shale. The absence of the upper *australiensis* Zone beneath suggests the absence of the basal Crayfish Formation by onlap onto a basement high.

F 1787.0m(swc) : lower *australiensis* to *watherooensis* Zones

Assignment to the lower *Cicatricosisporites australiensis* Zone or the *Retitriletes watherooensis* Zone is indicated at the top by the absence of younger markers (especially *D. speciosus* or *C. hughesi*) and at the base by oldest *Foraminisporis dailyi* and *R. watherooensis*. Other distinctive taxa include *Murospora florida*, *Matonisporites cooksoniae* and *Anapiculatisporites pristidentatus*. Common taxa are *F. similis* and *O. wellmanii* while frequent taxa are *Cyathidites* and *M. antarcticus*.

Non-marine environments are indicated by the abundant and diverse spore-pollen, common cuticle, and absence of saline indicators. Rare *Schizosporis* indicate only very minor lacustrine influence.

G 1840.0m(swc) : extremely lean and indeterminate

The first preparation yielded very rare fossils which are light brown and consistent of long ranging Mesozoic taxa common in overlying strata. These are attributed to minor mud contamination of barren rocks. No older indicators were seen. The repeat preparation was totally barren of palynomorphs.

V REFERENCES

Dettmann ME and Playford G (1969) Palynology of the Australian Cretaceous : a review **In** Stratigraphy and Palaeontology. Essays in honour of Dorothy Hill, **KSW Campbell ED.** ANU Press, Canberra 174-210

Helby RJ, Morgan RP and Partridge AD (1987) A palynological zonation of the Australian Mesozoic **In** Studies in Australian Mesozoic Palynology **Assoc. Australas. Palaeontols. Mem 4** 1-94

Kopsen E and Scholefield T (1990) Prospectivity of the Otway Supergroup in the central and western Otway Basin, **Apea Journal**, Volume 30 Part 1 263-279

Morgan RP (1985) Palynology review of selected oil drilling, Otway Basin, South Australia **unpubl. rept. for Ultramar Australia**

BUS SWAMP #1

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C L I E N T:VICTORIAN GEOLOGICAL SURVEY
W E L L:BUS SWAMP #1
F I E L D / A R E A:OTWAY BASIN, VICTORIA

A N A L Y S T:ROGER MORGAN D A T E: AUGUST 1993
N O T E S:ALL DEPTHS IN METRES
NUMBERS ARE % BASED ON 100 SPECIMEN COUNT
"X" INDICATES RARE PRESENCE OF SPECIMEN OUTSIDE THE COUNT

RANGE CHART OF OCCURRENCES BY LOWEST APPEARANCE: Dinos & S/P

		0210-15 cutts	0300.0 swc	0465.0 swc	0756.0 swc	0856-70 cutts	0862.0 swc	0886.0 SWC	0886.0 swc	1190.0 swc	1325.0 swc	1560.0 swc	1640.0 swc	1730.0 swc	1760-65 cutts	1787.0 core 3	1840.0 swc
1	SCHIZOSPORIS RETICULATIS	X	.	.	.	1	X	.	.	.	.	.	.	.	.	X	.
2	SCHIZOSPORIS PSILATUS	3	.	.	.	X	3	X	.	.	1	.	.	.	X	.	.
3	BOTRYOCOCCUS	1	.	.	1	.	X	.	.	.	1	.	2	.	.	.	.
4	VERYHACHIUM	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
5	PARALECANIELLA	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6	SCHIZOSPORIS PARVUS	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7	CALLIALASPORITES DAMPIERI	.	1	2	.	.	.	2	1	X	1	1	2	1	2	1	1
8	CALLIALASPORITES TURBATUS	X	1	3	.	2	.	.	.	1	.	6	5	4	1	1	1
9	CERATOSPORITES EQUALIS	1	2	2	4	1	7	1	4	4	10	1	2	6	3	1	1
10	COROLLINA TOROSUS	1	4	1	3	3	1	1	3	2	1	.	2	2	3	2	1
11	CYATHIDITES AUSTRALIS	2	6	5	15	15	6	11	25	7	5	9	8	10	7	5	16
12	CYATHIDITES MINOR	15	12	5	23	19	16	23	11	6	6	4	3	2	5	7	2
13	FALCISPORITES GRANDIS	10	5	11	7	8	8	4	.	5	3	7	5	7	6	11	1
14	FALCISPORITES SIMILIS	20	26	30	15	14	19	16	.	20	12	24	18	20	21	23	10
15	LEPTOLEPIDITES VERRUCATUS	.	.	.	2	2	2	1	2	3	5	X	1	1	2	X	1
16	MICROCACHRYIDITES ANTARCTICUS	20	8	.	10	11	6	2	1	12	.	1	4	6	12	7	1
17	OSMUNDACIDITES WELLMANII	4	17	24	7	6	7	27	24	25	6	25	22	17	20	22	3
18	RETITRILETES AUSTROCLAVATIDITES	2	2	1	9	3	10	8	7	9	28	8	8	15	9	11	1
19	RETITRILETES NODOSUS	X	.	.	.	X	1	.	.	X	1	.	.	X	X	X	1
20	ANAPICULATISPORIS PRISTIDENTATUS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.
21	ARAUCARIACITES AUSTRALIS	.	1	1	.	1	2	X	.	1	2	8	6	2	2	1	.
22	CONTIGNISPORITES COOKSONIAE	X	.	.	.	.	.	1	.	.	X	.	.	X	X	X	.
23	CORONATISPORA PERFORATA	.	.	.	.	.	.	X	.	.	X	.	X	.	.	X	.
24	CYCADOPITES FOLLICULARIS	1	.	2	X	2	X	1	2	X	2	1	3	1	1	2	.
25	DICTYOPHYLLIDITES	.	.	.	.	.	.	.	.	.	2	.	.	.	.	2	.
26	DICTYOTOSPORITES COMPLEX	X	1	.	.	.	.	.	.	X	.	.	2	X	.	X	.
27	FORAMINISPORIS DAILYI	.	2	.	1	1	1	.	.	.	.	.	X	X	X	1	.
28	GLEICHENIIDITES	X	1	2	1	.	X	X	.	X	2	X	2	X	.	1	.
29	KLUKISPORITES SCABERIS	X	.	.	.	1	1	X	.	.	3	X	X	.	.	X	.
30	LEPTOLEPIDITES MAJOR	.	.	.	X	X	1	X	.	X	7	X	X	3	1	X	.
31	LYCOPIACIDITES ASPERATUS	.	.	.	.	.	.	.	.	.	.	.	X	.	.	X	.
32	MATONISPORITES COOKSONIAE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.
33	MUROSPORA FLORIDA	.	.	.	.	.	.	.	.	X	X	1	X	X	.	X	.
34	NEORAISTRICKIA	.	.	.	.	1	.	.	.	4	1	2	2	2	.	2	.
35	PERINOPOLLENITES ELATOIDES	1	.	.	.	.	.	.	.	.	.	1	X	.	.	1	.
36	RETITRILETES CIRCOLUMENUS	.	.	.	1	2	1	1	.	.	X	.	X	X	X	X	.
37	RETITRILETES EMINULUS	.	.	.	.	.	2	.	.	.	.	.	.	.	X	X	.
38	RETITRILETES WATHAROOENSIS	.	.	.	.	.	.	X	.	.	.	X	X	1	X	X	.

No.	Species	0210-15 cutts	0300.0 swc	0465.0 swc	0756.0 swc	0856-70 cutts	0862.0 swc	0886.0 SWC	0886.0 swc	1190.0 swc	1325.0 swc	1560.0 swc	1640.0 swc	1730.0 swc	1760-65 cutts	1787.0 core 3	1840.0 swc
39	SESTROSPORITES PSEUDOALVEOLATUS	.	.	.	.	.	.	X	.	.	.	.	.	X	.	X	.
40	CONCAVISSIMISPORITES PENOLAENSIS	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.
41	CONTIGNISPORITES GLEBULENTUS	.	.	.	.	.	.	.	.	.	1	.	.	.	X	.	.
42	CYCLOSPORITES HUGHESI	.	.	.	X	1	X	.	.	X	1	.	X	X	X	.	.
43	DICTYOTOSPORITES SPECIOSUS	X	.	.	X	X	1	1	1	.	X	.	1	X	X	.	.
44	FOVEOTRILETES PARVIRETUS	X	.	.	.	.	.	.	.	.	X	.	.	.	2	.	.
45	RETITRILETES FACETUS	.	.	.	X	.	.	.	1	X	X	1	.	X	X	.	.
46	ISCHYOSPORITES PUNCTATUS	.	.	.	.	.	.	X	1	.	.	.	.	X	.	.	.
47	NEVESISPORITES VALLATUS	.	.	.	.	.	.	X	.	1	.	.	.	X	.	.	.
48	STERIESPORITES ANTIQUASPORITES	X	3	.	1	2	X	X	.	.	.	X	1	X	.	.	.
49	VELOSPORITES TRIQUETRUS	X	.	.	.	.	.	.	.	X	.	.	.	X	.	.	.
50	VITREISPORITES PALLIDUS	.	.	.	.	.	X	.	.	X	.	.	1	X	.	.	.
51	TRIASSIC REWORKING	.	1	1	.	.	.	.	.	.	.	.	X	.	.	.	.
52	COUPERISPORITES TABULATUS	.	.	.	1	X	.	.	.	X	.	X	.	.	.	.	.
53	AEQUITRIRADITES VERRUCOSUS	3	X	.	.	.	.	.	.	X	.	.	.	.	.	.	.
54	PODOSPORITES MICROSACCATUS	5	.	.	.	1	.	.	.	X	.	.	.	.	.	.	.
55	COOKSONITES VARIABILIS	.	.	.	X	X	1	X	.	.	.	.	.	.	.	.	.
56	PILOSISPORITES NOTENSIS	.	.	.	X	X	1	X	.	.	.	.	.	.	.	.	.
57	CICATRICOSISPORITES AUSTRALIENSIS	2	2	2	.	3	1	.	.	.	.	.	.	.	.	.	.
58	CRYBELOSPORITES STYLOSUS	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.
59	FORAMINISPORIS WONTHAGGIENSIS	.	.	.	.	X	1	.	.	.	.	.	.	.	.	.	.
60	PILOSISPORITES PARVISPINOSUS	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.
61	TRIPOROLETES RETICULATUS	X	.	.	.	X	X	.	.	.	.	.	.	.	.	.	.
62	COPTOSPORA PARADOXA	1	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
63	FORAMINISPORIS RETICULOWONTHAGGIENSIS	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
64	LAEVIGATOSPORITES OVATUS	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
65	STOVERISPORITES LUNARIS	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
66	AEQUITRIRADITES TILCHAENESIS	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.
67	TRIPOROLETES RADIATUS	1	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.
68	TRIPOROLETES SIMPLEX	1	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.
69	CICATRICOSISPORITES CUNEIFORMIS	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
70	FORAMINISPORIS ASYMMETRICUS	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
71	PERMIAN REWORKING	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
72	AEQUITRIRADITES SPINULOSUS	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
73	BALMEISPORITES HOLODICTYUS	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
74	CICATRICOSISPORITES LUDBROOKIAE	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
75	COPTOSPORA STRIATA	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
76	COPTOSPORA WRINKLY	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

No.	Species	0210-15 cutts	0300.0 swc	0465.0 swc	0756.0 swc	0856-70 cutts	0862.0 swc	0886.0 SWC	1190.0 swc	1325.0 swc	1560.0 swc	1640.0 swc	1730.0 swc	1760-65 cutts	1787.0 core 3	1840.0 swc
77	CRYBELOSPORITES STRIATUS	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
78	FOVEOSPORITES CANALIS	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
79	PHYLLOCLADIDITES MAWSONII	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.
80	PILOSISPORITES GRANDIS	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.
81	PROTEACIDITES	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.
82	TRILETES TUBERCULIFORMIS	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
83	TRILOBOSPORITES TRIORETICULOSUS	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.

0210-15 cutts
0300.0 swc
0465.0 swc
0756.0 swc
0856-70 cutts
0862.0 swc
0886.0 SWC
1190.0 swc
1325.0 swc
1560.0 swc
1640.0 swc
1730.0 swc
1760-65 cutts
1787.0 core 3
1840.0 swc

SPECIES LOCATION INDEX
Index numbers are the columns in which species appear.

INDEX NUMBER	SPECIES
72	AEQUITRIRADITES SPINULOSUS
66	AEQUITRIRADITES TILCHAENESIS
53	AEQUITRIRADITES VERRUCOSUS
20	ANAPICULATISPORIS PRISTIDENTATUS
21	ARAUCARIACITES AUSTRALIS
73	BALMEISPORITES HOLODICTYUS
3	BOTRYOCOCCUS
7	CALLIALASPORITES DAMPIERI
8	CALLIALASPORITES TURBATUS
9	CERATOSPORITES EQUALIS
57	CICATRICOSISPORITES AUSTRALIENSIS
69	CICATRICOSISPORITES CUNEIFORMIS
74	CICATRICOSISPORITES LUDBROOKIAE
40	CONCAVISSIMISPORITES PENOLAENSIS
22	CONTIGNISPORITES COOKSONIAE
41	CONTIGNISPORITES GLEBULENTUS
55	COOKSONITES VARIABILIS
62	COPTOSPORA PARADOXA
75	COPTOSPORA STRIATA
76	COPTOSPORA WRINKLY
10	COROLLINA TOROSUS
23	CORONATISPORA PERFORATA
52	COUPERISPORITES TABULATUS
77	CRYBELOSPORITES STRIATUS
58	CRYBELOSPORITES STYLOSUS
11	CYATHIDITES AUSTRALIS
12	CYATHIDITES MINOR
24	CYCADOPITES FOLLICULARIS
42	CYCLOSPORITES HUGHESI
25	DICTYOPHYLLIDITES
26	DICTYOTOSPORITES COMPLEX
43	DICTYOTOSPORITES SPECIOSUS
13	FALCISPORITES GRANDIS
14	FALCISPORITES SIMILIS
70	FORAMINISPORIS ASYMMETRICUS
27	FORAMINISPORIS DAILYI
63	FORAMINISPORIS RETICULOWONTHAGGIENSIS
59	FORAMINISPORIS WONTHAGGIENSIS
78	FOVEOSPORITES CANALIS
44	FOVEOTRILETES PARVIRETUS
28	GLEICHENIIDITES
46	ISCHYOSPORITES PUNCTATUS
29	KLUKISPORITES SCABERIS
64	LAEVIGATOSPORITES OVATUS
30	LEPTOLEPIDITES MAJOR
15	LEPTOLEPIDITES VERRUCATUS
31	LYCOPIACIDITES ASPERATUS
32	MATONISPORITES COOKSONIAE
16	MICROCACHRYIDITES ANTARCTICUS
33	MUROSPORA FLORIDA
34	NEORAISTRICKIA
47	NEVESISPORITES VALLATUS
17	OSMUNDACIDITES WELLMANII
5	PARALECANIELLA
35	PERINOPOLLENITES ELATOIDES
71	PERMIAN REWORKING
79	PHYLLOCLADIDITES MAWSONII
80	PILOSISPORITES GRANDIS
56	PILOSISPORITES NOTENSIS
60	PILOSISPORITES PARVISPINOSUS
54	PODOSPORITES MICROSACCATUS
81	PROTEACIDITES
18	RETITRILETES AUSTROCLAVATIDITES
36	RETITRILETES CIRCOLUMENUS
37	RETITRILETES EMINULUS
45	RETITRILETES FACETUS
19	RETITRILETES NODOSUS
38	RETITRILETES WATHAROOENSIS
6	SCHIZOSPORIS PARVUS
2	SCHIZOSPORIS PSILATUS
1	SCHIZOSPORIS RETICULATIS
39	SESTROSPORITES PSEUDOALVEOLATUS
48	STERIESPORITES ANTIQUASPORITES
65	STOVERISPORITES LUNARIS
51	TRIASSIC REWORKING
82	TRILETES TUBERCULIFORMIS
83	TRILOBOSPORITES TRIORETICULOSUS
67	TRIPOROLETES RADIATUS
61	TRIPOROLETES RETICULATUS
68	TRIPOROLETES SIMPLEX
49	VELOSPORITES TRIQUETRUS
4	VERYHACHIUM
50	VITREISPORITES PALLIDUS

PALYNOLOGICAL EXAMINATION OF DEM BUS SWAMP 1

STRATIGRAPHIC HOLE, OTWAY BASIN, VICTORIA

D. Burger

SUMMARY

Palynological examination of 5 sidewall cores and 3 drill-stem cores from Bus Swamp 1 Stratigraphic Hole, Otway Basin, allows dating of the local sedimentary sequence from 1785m to 830m depth as Early Cretaceous. The Casterton beds and Pretty Hill Sandstone are dated as Berriasian and the basal Eumeralla Formation Valanginian-Hauterivian, and probably Hauterivian. The boundary between Pretty Hill Sandstone and Eumeralla Formation at 876m depth is probably a significant unconformity. The fossil assemblages indicate nonmarine environments of deposition. Some assemblages include spores of Early Jurassic age, whose provenance is not yet clear.

INTRODUCTION

The Department of Energy and Minerals in Victoria drilled Bus Swamp no. 1 Stratigraphic Hole in the western Otway Basin (lat. 37°31'18" s, long. 141°12'00" e). The drill-bit penetrated the top of the Eumeralla Formation at 95m, the top of the Pretty Hill Sandstone at 876m, the top of the Casterton beds at 1,776m, and struck basement at 1,826m depth. Five sidewall cores shot between 657m and 1815m, plus splits from three drill-stem cores cut from that depth interval were forwarded to AGSO in Canberra for palynological and geochemical analysis.

The sidewall cores were described and photographed in the AGSO palynological laboratory, and a portion of each core was processed to extract its palynological contents. Recovery of fossils was poor to almost nil, but 6 of 8 samples yielded sufficient assemblages to be dated with reasonable confidence. Of each assemblage 2 or 3 slides were fully scanned, and contamination of the samples by drilling mud was not apparent. The results of the examination are summarised in Table 1, and distribution of identified taxa is given in Table 2.

Sample number	Palyn Doc number	Sample depth	Formation Bed	association with spore-pollen zones
swc 41	MFP9861	657m	Eumerella	unknown, poor recovery of fossils
core 1	MFP9864	830-5m	Eumerella	middle *Cyclosporites hughesii*
swc 33	MFP9863	862m	Eumerella	middle *Cyclosporites hughesii*
swc 30	MFP9860	913m	Pretty Hill	upper *Crybelosporites stylosus*
core 2	MFP9865	1510-16m	Pretty Hill	upper *Crybelosporites stylosus*
swc 8	MFP9859	1756m	Pretty Hill	upper *Crybelosporites stylosus*
core 3	MFP9880	1785-90m	Casterton	upper *Crybelosporites stylosus*
swc 4	MFP9862	1815m	Casterton	unknown, poor recovery of fossils

Table 1. Specification and palynological zonal association of samples

LITHOSTRATIGRAPHIC INTERVAL	Casterton Beds		Pretty Hill Sandstone			Eumeralla Formation		
SPORE-POLLEN ZONAL INTERVAL	?	upper *Crybelosporites stylosus*				middle *Cyclosporites hughesii*		?
SAMPLE No. (MFP)	9862	9880	9859	9865	9860	9863	9864	9861
SAMPLE DEPTH (m)	1815	1785	1756	1510	913	862	830	657
Aequitriradites hispidus					x			
Aequitriradites spinulosus					x			
Alisporites grandis			x		?	x		
Alisporites similis		x	x	x	x	x	x	
Araucariacites australis			x					
Baculatisporites comaumensis		x	x	x	x	x		
Biretisporites spectabilis			x	x	x			
Bisaccate pollen indet.			x	x				
Callialasporites dampieri		x	x	x				
Callialasporites trilobatus		x		x				
Callialasporites turbatus		x	x	x	x			
Ceratosporites equalis		x	x	x		x	x	
Cicatricosisporites spp. indet.		x			x			
Classopollis spp.				x		x	x	
Concavissimisporites spp.					x			
Concentrisporites hallei				x		x	x	
Contignisporites cooksoniae			x		x			
Contignisporites glebulentus					?			
Contignisporites spp. indet.					x			
Cooksonites variabilis					x			
Coronatospora perforata		x	x	?	x			
Crybelosporites stylosus			x	x		?		
Cyathidites australis					x		x	
Cyathidites minor		x	x	x	x	x	x	
Cyathidites punctatus					x			
Cyclosporites hughesii		x	x	x	x	x		
Dictyophyllidites crenatus			x		x	x	x	
Dictyotosporites speciosus		x	x	x		x	x	
Foraminisporis wonthaggiensis						?	?	
Inaperturopollenites spp. indet.				x		x		
Ischyosporites punctatus						x	x	
Klukisporites scaberis		x	x	x	x	x	x	
Laevigatosporites belfordii					x			
Laevigatosporites ovatus							x	
Leptolepidites major		x	x	x				
Leptolepidites verrucatus		x	x	x		x		
Lycopodiacidites asperatus			x					
Lycopodiumsporites circolumenus		x	x	x		x		
Matonisporites cooksoniae		x	x	?			x	
Microcachryidites antarcticus		x		x		x	x	
Murospora florida		?						
Neoraistrickia truncata		x	x	x				
Nevesisporites dailyi		x	x	x		x	x	
Osmundacidites senectus					?			
Osmundacidites wellmanii		x	x	x	x	x		
Pilosisporites notensis						x	x	
Pilosisporites parvispinosus						x	x	
Podocarpidites ellipticus				x		x	?	
Podocarpidites multesimus						?		
Punctatosporites scabratus					x			
Reticulatisporites pudens		?						
Retitriletes austroclavatidites		x	x	x		x	x	
Retitriletes clavatoides				?				
Retitriletes eminulus		x	x					
Retitriletes facetus						x	?	
Retitriletes nodosus			x	x	x	x	x	
Retitriletes solidus				x				
Retitriletes tenuis				?				
Retitriletes watherooensis		?	?					
Retitriletes spp.		x				x	x	
Ruffordiaspora australiensis			x		x	x	x	
Rugubivesiculites spp. indet.		x						
Stoverisporites lunaris						x	x	
Trilobosporites antiquus			?					
Trisaccate pollen indet.				x		x		
Velosporites triquetrus		x		x				
Vitreisporites pallidus						x		
Fromea amphora		?						
Fromea sp. indet.					?			
Microfasta evansii				x				
Nummus sp.			?					
Schizosporites reticulatus				x			x	
Jurassic elements								
Alisporites lowoodensis					x			
Anapiculatisporites pristidentatus		x		x				
Nevesisporites vallatus					x			

Table 2. Distribution of palynomorph species in Bus Swamp 1

SPORE-POLLEN ZONATIONS

The biostratigraphic aspect of Cretaceous palynology in the Otway Basin has been discussed in detail by Dettmann (1963) and Dettmann & Playford (1969), and subsequently refined informally by Dettmann & Douglas (1976). The concepts of those authors are used in this report in preference of later zonations formally proposed by several authors for the reasons given below (see Fig. 1).

Burger, 1973, 1989 Helby & others, 1987	Evans 1966, 1971	Dettmann & Playford, 1969 Dettmann & Douglas, 1976		Geological age
Cyclosporites hughesii	Unit K1b-c	upper	*Cyclosporites*	Barremian-Aptian
		middle		
Foraminisporis wonthaggiensis		lower	*hughesii*	Hauterivian Valanginian
Ruffordiaspora australiensis	Unit K1a	*Crybelosporites stylosus*		Berriasian
				JURASSIC

Figure 1. Palynological zonal nomenclatures for the Australian Early Cretaceous

The fossil sequence interval documented from Bus Swamp 1 includes the *Crybelosporites stylosus* Zone and the *Cyclosporites hughesii* Subzone of the *Dictyotosporites speciosus* Zone of Dettmann & Playford (1969). The *stylosus* Zone commences with the first appearance of the nominate index species, and the *hughesii* Subzone is characterised by the combined occurrence of *Dictyotosporites speciosus* and *Cyclosporites hughesii*, and ends with the first appearance of *Crybelosporites striatus*. Dettmann & Douglas (1976) further subdivided the subzone into a lower interval characterised by the combined occurrence of *Murospora florida* and *Cyclosporites hughesii*, a middle interval including *Triporoletes reticulatus*, *Dictyotosporites speciosus*, and *Cyclosporites hughesii*, and an upper interval which includes those species and commences with the first appearance of *Foraminisporis asymmetricus*.

Evans (1966, *in* Reynolds, 1971) examined the palynological sequences in a number of petroleum exploration wells drilled in the Otway Basin, and his findings are of relevance to this report. He subdivided the fossil sequence into a series of palynological «units». Within the basal Cretaceous sequence he distinguished Unit K1a, which he defined as the interval including *Ruffordiaspora australiensis*, *Cyclosporites hughesii*, *Dictyotosporites speciosus*, and *Murospora florida*, and Unit K1b-c, which includes those species except *Murospora florida*, and ends with the first appearance of *Crybelosporites striatus*.

From those criteria it follows that Unit K1a coincides with the *Crybelosporites stylosus* Zone and lower *Cyclosporites hughesii* Subzone, and Unit K1b-c with the middle and upper *hughesii* Subzone.

Evans' Unit K1a was recognised also in the Great Australian Basin in Queensland, where it includes a slightly more extended interval than in the Otway Basin. Burger (1973) subdivided Unit K1a into a lower *Ruffordiaspora* (*Cicatricosisporites*) *australiensis* Subzone, a middle *Foraminisporis wonthaggiensis* Subzone, and an upper *Foraminisporis asymmetricus* Subzone, each subzone commencing with the first appearance of its nominate species. Subsequent work in the Otway and Great Australian Basins proved the upper limit of Unit K1a to be too indeterminate (see Burger, 1989), and in their palynological scheme for Australia Helby & others (1987) combined the upper interval and Evans' Unit K1b-c into a revised *Cyclosporites hughesii* Zone. Those authors also raised the preceding intervals to zonal level.

It is clear that the *Ruffordiaspora australiensis* Zone equals the *Crybelosporites* *stylosus* Zone in the Otway Basin, the *Foraminisporis wonthaggiensis* Zone the lower and middle *Cyclosporites hughesii* Subzone (sensu Dettmann & Douglas, 1976), and the revised *Cyclosporites hughesii* Zone of Helby & others (1987) equals the upper *Cyclosporites hughsii* Subzone (sensu Dettmann & Douglas, 1976). The lower and middle *hughesii* Subzones are not identified as such in the Great Australian Basin, where *Triporoletes reticulatus* and *Pilosisporites parvispinosus* first appear at different levels than in the Otway Basin.

AGE OF FORMATIONS

Casterton beds

Swc 4 (MFP9862) yielded virtually no fossils. The assemblage from **core 3** (MFP9880) included *Cicatricosisporites* spp., *Dictyotosporites speciosus*, *Cyclosporites hughesii*, and cf. *Murospora florida*. The presence of those zone-indicative species, together with the apparent absence of *Pilosisporites notensis* and *Foraminisporis wonthaggiensis*, suggests that the assemblage represents the upper part of the *Crybelosporites stylosus* Zone. Evans (*in* Reynolds, 1971) recovered a very poor assemblage, which he dated Upper Mesozoic, from the equivalent beds («unnamed unit T») in Planet Casterton no. 1 well to the southeast. The evidence from Assemblage MFP9880 restricts the age of the beds in Bus Swamp 1 to the Early Cretaceous, and more specifically Berriasian to basal Valanginian (see Dettmann & others, 1992).

Pretty Hill Sandstone

Swc 8 (MFP9859), **core 2** (MFP9865), and **swc30** (MFP9860) all yielded similar assemblages, which included comparatively large spore fractions and varying pollen (mainly bisaccate) fractions. Swc 8 included the zone-indicative species *Ruffordiaspora australiensis*, *Cyclosporites hughesii*, *Dictyotosporites speciosus*, and *Crybelosporites stylosus*. All three assemblages apparently lack *Pilosisporites notensis*, *Foraminisporis wonthaggiensis*, and other species which are reported to appear later in the sequence, and the assemblages are taken to represent the upper part of the *Crybelosporites stylosus* Zone. Dettmann (1963) recovered a similar assemblage from the formation in ODNL Penola 1 well. Evans (*in* Reynolds, 1971) reported assemblages of Unit K1a from the correlative Geltwood Beach Formation («unit P») in Planet Heathfield 1 and Alliance Kalangadoo 1 wells.

On this zonal evidence the Pretty Hill Sandstone is dated Early Cretaceous, and more specifically Berriasian to basal Valanginian.

Eumeralla Formation

Swc 41 (MFP9861) was barren of microfossils, but **swc 33** (MFP9863) and **core 1** (MFP9864) yielded sufficient palynomorphs for age determination. The presence of *Pilosisporites parvispinosus*, in addition of several species mentioned above, indicates that the two assemblages are not significantly older than the middle *Cyclosporites hughesii* Subzone. No species have been found which first appear in the upper part of the subzone in the Otway Basin. Dettmann (1963) also reported assemblages which fall within this zonal interval from the lower part of the formation in ODNL Penola 1 Well. Evans (*in* Reynolds, 1971) recovered assemblages representing the upper part of his Unit K1a from the lower part of the formation («unit M») in Planet Heathfield 1 well, to the east of Bus Swamp 1.

This zonal association indicates that the lower *Cyclosporites hughesii* Subzone is either restricted to the interval between swcs 30 and 33, i.e. 862-913m depth, or absent altogether. In view of the narrowness of this depth interval it seems reasonable to assume that part of the sequence is missing, and the contact between the Pretty Hill Sandstone and Eumeralla Formation at 865m depth is therefore thought to be an appreciable (nondepositional or erosional) unconformity.

The basal Eumeralla Formation in Bus Swamp 1 is therefore dated Valanginian to Hauterivian, and probably Hauterivian.

PALAEOENVIRONMENTS

Several samples yielded aquatic palynomorphs but no dinoflagellates or acritarchs which might indicate saline or brackish conditions. The sampled strata horizons therefore represent nonmarine (non-saline) environments of deposition. The low numbers of organisms in the Bus Swamp 1 samples contrasts sharply with the often abundant acritarch assemblages found in nonmarine Lower Cretaceous sediments of the Great Australian Basin in Queensland, and may suggest comparatively rapid-current deposition.

Several assemblages from the Casterton beds and Pretty Hill Sandstone include (rare) species which have been described by De Jersey (1963), De Jersey & Paten (1964), and Reiser & Williams (1969) from Lower Jurassic strata of southeastern Queensland, and are found only very sporadically in the Early Cretaceous. Contemporaneous dispersed spores have been found also in mid-Cretaceous strata from the coastal belt of the Otway Basin, and Burger (1985, 1987) suspected them to originate possibly from Lower Jurassic inliers since removed by erosion.

REFERENCES

BURGER, D., 1973 - Spore zonation and sedimentary history of the Neocomian, Great Artesian Basin, Queensland. *Geological Society of Australia Special Publication* 4, 87-118.

BURGER, D., 1985 - Palynological report on samples from Holzers Quarry, Otway Basin, Victoria. *Bureau of Mineral Resources, Professional Opinion Geology* 85.004 (unpublished).

BURGER, D., 1987 - Palynological examination of samples from the Otway Group in the Otway Basin, Victoria. *Bureau of Mineral Resources, Professional Opinion Geology* 87.006 (unpublished).

BURGER, D., 1989 - Stratigraphy, palynology, and palaeoenvironments of the Hooray Sandstone, eastern Eromanga Basin, Queensland and New South Wales. *Queensland Department of Mines Report* 3, 28 p.

DE JERSEY, N.J., 1963 - Jurassic spores and pollen grains from the Marburg Sandstone. *Geological Survey of Queensland Publication* 313, 1-15.

DE JERSEY, N.J. & PATEN, R.J., 1964 - Jurassic spores and pollen grains from the Surat Basin. *Geological Survey of Queensland Publication* 322, 1-18.

DETTMANN, M.E., 1963 - Upper Mesozoic microfloras from south-eastern Australia. *Royal Society of Victoria Proceedings* 77, 1-148.

DETTMANN, M.E. & DOUGLAS, J.G., 1976 - Palaeontology. *In* Douglas, J.G. & others, Mesozoic. *Geological Society of Australia Special Publication* 5, 164-176.

DETTMANN, M.E. & PLAYFORD, G., 1969 - Palynology of the Australian Cretaceous: a review. *In* Campbell, K.S.W. (editor), *Stratigraphy and Palaeontology. Essays in honour of Dorothy Hill.* Australian National University Press, Canberra, 174-210.

DETTMANN, M.E., MOLNAR, R.E., DOUGLAS, J.G., BURGER, D., FIELDING, C., CLIFFORD, H.T., FRANCIS, J., JELL, P., RICH, T., WADE, M., RICH, P.V., PLEDGE, N., KEPM, A. & ROZEFELDS, A., 1992 - Australian terrestrial faunas and floras: biostratigraphic and biogeographic implications. *Cretaceous Research* 13, 207-262.

EVANS, P.R., 1966 - Mesozoic stratigraphic palynology of the Otway Basin. *Bureau of Mineral Resources Record* 1966/69, 45 p. (unpublished).

HELBY, R., MORGAN R. & PARTRIDGE, A.D., 1987 - A palynological zonation of the Australian Mesozoic. *Association of Australasian Palaeontologists Memoir* 4, 1-94.

REISER, R.F. & WILLIAMS, A.J., 1969 - Palynology of the Lower Jurassic sediments of the northern Surat Basin, Queensland. *Geological Survey of Queensland Publication* 339, 1-24.

REYNOLDS, M.A., 1971 - A review of the Otway Basin. *Bureau of Mineral Resources Report* 134, 69 p.

DEPARTMENT OF MINES AND ENERGY

GEOLOGICAL SURVEY

SOUTH AUSTRALIA

REPORT BOOK

No.93/43

PALYNOLOGICAL DATING AND CORRELATION OF SAMPLES FROM BUS SWAMP 1, OTWAY BASIN, VICTORIA

N F ALLEY

Biostratigraphy

OCTOBER 1993

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DEPARTMENT OF MINES AND ENERGY
GEOLOGICAL SURVEY
SOUTH AUSTRALIA

REPORT BOOK NO: 93/43

Palynological Dating and Correlation of Samples from Bus Swamp 1, Otway Basin, Victoria

NEVILLE F. ALLEY
BIOSTRATIGRAPHY BRANCH

Palynological examination of eight samples from Bus Swamp 1 Well, Otway Basin, western Victoria, was undertaken. The samples range in age from the upper part of the *Cicatricosisporites australiensis* Zone of Helby *et al.* (1987) to the upper part of the *Foraminisporis wonthaggiensis* Zone, ie. Berriasian to Barremian (Early Cretaceous).

Palynological data presented in unpublished reports by Morgan and Burger were examined and correlated with the Australian Mesozoic scheme of Helby *et al.* (1987). These additional data show the samples analysed from Bus Swamp 1 range in age from *Coptospora paradoxa* Zone (Middle Albian) through to *C. australiensis* Zone (Berriasian).

SAMPLE INFORMATION

BOREHOLE DATA SUMMARY :

Palynological No.	Depth (m)
7242	830
7243	830-835
7258	982
7246	1145
7247	1406
7260	1515.83
7248	1790
7249	1800-1805
7259	1803

Type of sample: core and sidewall core, cuttings

Submitter: A. Hill, Oil and Gas Division

LOCATION:

General location: Western Victoria

STRATIGRAPHIC INFORMATION:

Geological Province: Otway Basin

ANALYTICAL DATA:

Laboratory technique:
Standard palynological laboratory methods were employed including digestion in HF, heavy liquid separation (zinc bromide), controlled treatment with Schulze Solution, sieving with 129 um and 10 um filters and mounting the residues as strews in glycerine jelly.

Microscope used: Zeiss Photomicroscope 111

RESULTS:

The correlations made below follow the Mesozoic palynological zonal scheme of Helby, Morgan and Partridge (1987). This is the best synthesis available for palynological dating in the Australian Mesozoic and should be preferred above other more local schemes. My conclusions are primarily based on the first appearances of key species as determined by Helby *et al.* (1987), but in the absence of these, some evaluation of the general composition of the palynofloras is made.

A chart of the species distribution in Bus Swamp 1 from the samples analysed, and on which my conclusions are largely based, is attached.

To aid in understanding the time relationships between different palynological datings undertaken in the Otway Basin I have complied a correlation chart of the various schemes used and the key palynofloral events (first and last appearances).

Zonation:

Sample 830 m

Correlation - upper *F. wonthaggiensis* Zone of Helby *et al.*, (1987).

Contains common *Foraminisporis wonthaggiensis* but lacks *F. asymmetricus*. The presence of *Triporoletes reticulatus* and *Pilosisporites notensis* indicates a correlation with the upper part of the zone. The presence of *Pilsosporites parvispinosus* is intriguing because this species is thought to make its first appearance in the middle of the younger *Cyclosporites hughesii* Zone, but there is nothing else to suggest a younger age, particularly in the absence of the key zonal fossil *F. asymmetricus*.

A number of species are abundant including: *Ceratosporites equalis*, *Cyathidites australis*, *C. minor*, *Cycadopites nitidus*, *Microcachryidites antarcticus*, *Podocarpidites ellipticus* and *Stereisporites antiquasporites*.

The sample is nonmarine.

The assemblage is equivalent to the Lower (probably lowermost) *Cyclosporites hughesii* Zone as currently being employed by Morgan in the Otway Basin.

S 7243 830-835 m

Correlation - upper *F. wonthaggiensis* Zone on the basis of the presence of *F. wonthaggiensis* and *Pilosisporites notensis* in the absence of *F. asymmetricus*. In this sample *P. parvispinosus* is absent.

Abundant species include: *Cyathidites asper* (the most abundant), *C. australis*, *C. minor*, *Retitriletes austroclavatidites*, *Microcachryidites antarcticus* and *Podocarpidites ellipticus*.

The sample is nonmarine.

The assemblage is equivalent to the lower *C. hughesii* Zone of Morgan in the Otway Basin. I requested that Roger Morgan review the assemblage for me and he concluded that it correlates with the Lower *C. hughesii* Zone, as he uses it in the Otway Basin. We are in agreement with the age.

Burger (unpublished report) also examined a sample from this level (MFP9864) and concluded that on the basis of the presence of *Pilosisporites parvispinosus* the assemblage was not significantly older than the Middle *C. hughesii* Zone. While this is a reasonable conclusion to reach on the basis of the presence of *P. parvispinosus*, I feel that the absence of the zonal fossil *Foraminisporis asymmetricus* indicates that the assemblage is not correlative with the *C. hughesii* Zone (Helby *et al.*, 1987) nor the Middle *C. hughesii* Zone of Dettmann (1986). *F. asymmetricus* is a good indicator for the *C. hughesii* Zone.

S 7244 957 m

During laboratory processing this sample was accidently mixed in with a sample at 1105 m. There was sufficient sample to allow the sample at 1105 m to be reprocessed, but not enough for the sample at 957 m. Thus a reasonable assessment of the age of the sample at 957 m can still be made.

Yield and preservation of palynomorphs in the sample are very good.

Correlation - lowermost *F. wonthaggiensis* Zone on the basis of the presence of *F. wonthaggiensis* in the absence of *Triporoletes reticulatus* and *Pilosisporites notensis*. There are consistent occurrences of *Cyclosporites hughesii* and *Dictyotosporites speciosus*.

Rare recycled Permian pollen are present.

The sample is nonmarine.

S 7258 982 m

This sample contained no palynomorphs.

S 7245 1105 m

This sample gave quite good recovery of palynomorphs, but restricted species diversity. It contains consistent *Cyclosporites hughesii* and *Dictyotosporites speciosus*, but lacks *F. wonthaggiensis*, *Triporoletes reticulatus* and *Pilosisporites notensis*. On this evidence the assemblage should be correlated with the upper part of the *Cicatricosisporites australiensis* Zone. However, a sample at 1515.83 m contains rare *F. wonthaggiensis*, thus the sample at 1105 m cannot be older than that. On this basis the sample at 1105 m is correlated with the lowermost *F. wonthaggiensis* Zone.

Rare recycled Permian pollen are present.

The sample is nonmarine.

S 7246 1145 m

Correlation with a spore-pollen zone is not possible because the yield and preservation of palynomorphs are extremely poor and the sample lacks zonal fossils. At best all that can be concluded is that the assemblage contains *Ceratosporites equalis* and must be younger than middle *Retitriletes watherooensis* Zone.

The sample appears nonmarine.

S 7247 1406 m

Correlation not possible because the sample is virtually barren of palynomorphs and the preservation of those is extremely poor.

S 7260 1515.83 m

Correlation - lower *Foraminisporis wonthaggiensis* Zone on the basis of the presence of extremely rare *F. wonthaggiensis* and the absence of the younger *Triporoletes reticulatus* and *Pilosisporites notensis*.

The yield of the assemblage is fair and the preservation poor to fair.

One recycled Permian pollen, *Plicatipollenites densus*, was recorded.

The sample is nonmarine.

Burger examined a sample from within the interval (MFP9865) and made a correlation with the upper *Crybelosporites stylosus* Zone of Dettmann (1986) mainly on the basis of the absence of *F. wonthaggiensis*. However, the latter species is present in the interval and thus the assemblage should more correctly be correlated with that zone.

S 7248 1790 m

Correlation - upper part of the *Cicatricosisporites australiensis* Zone on the basis of the presence of *Cyclosporites hughesii* in the absence of *F. wonthaggiensis*, *Triporoletes reticulatus*, *Pilsosporites notensis* and *F. asymmetricus*. Interestingly, *C. australiensis* could not be found.

One specimen resembling *F. wonthaggiensis* was found but the preservation is poor (as is the whole assemblage) and confident identification is not possible. If *F. wonthaggiensis* is present then the lower part of the *F. wonthaggiensis* Zone may be present, since the nominate species is often very rare in this part of the zone.

However, in general the assemblage is more typical of *C. australiensis* Zone, especially the presence of consistent *Classopolis* spp., *Converrucosisporites rewanensis*, *Ischyosporites crateris*, *Kraueselisporites linearis*, *Retitriletes facetus*, *R. watherooensis*, *Matonisporites cooksonae*, *Murospora florida*, *Neoraistrickia densata*, *Staplinisporites caminus* and *Callialasporites* spp.

The sample is nonmarine.

The assemblage is equivalent to the upper *C. australiensis* Zone as used by Morgan in the Otway Basin and to the *Crybelosporites stylosus* Zone per Burger. The latter author examined a sample within the interval (MFP9880) and my designation agrees with his.

<u>S 7249 1800-1805 m</u>

Correlation - upper part of the *C. australiensis* Zone on the basis of the presence of *C. australiensis*, *C. ludbrookii* and *Cyclosporites hughesii* in the absence of *F. wonthaggiensis*, *Triporoletes reticulatus* and *Pilosisporites notensis*.

A specimen of *Foraminisporis asymmetricus* was found but its colour and general state of preservation suggests that it is a downhole contaminant.

The sample is nonmarine.

The assemblage is equivalent to the upper *C. australiensis* Zone of Morgan and the upper part of the *C. stylosus* Zone as used by Burger.

<u>S 7259 1803 m</u>

The yield and preservation of palynomorphs in this sample is very poor; it contains abundant plant matter and vitrinite exhibiting significant thermal alteration.

Correlation - none possible. All that can be concluded is that *Ceratosporites equalis* and *Retitriletes watherooensis* are present and thus the sample is younger than the upper part of the *Retitriletes watherooensis* Zone.

CORRELATION BETWEEN SAMPLES FROM OTHER ANALYSES UNDERTAKEN ON BUS SWAMP 1

This section correlates between other analyses undertaken by Morgan and Burger and the palynological zonal system of Helby *et al.* (1987) for the Australian Mesozoic. The correlations are based on the evidence presented by the authors in the unpublished reports on Bus Swamp 1.

An asterisk indicates that the age determination has been corrected.

BURGER	HELBY *ET AL.* (1987)	
657	-	
830-835	Upper	*F. wonthaggiensis**
862	Upper	*F. wonthaggiensis**
913	Upper	*C. australiensis*
1510-16	Upper	*C. australiensis*
1756	Upper	*C. australiensis*
1785-90	Upper	*C. australiensis*
1815	-	
MORGAN		
300	*Coptospora paradoxa*	
465	*Cyclosporites hughesii**	
756	Upper *F. wonthaggiensis*	
886	Upper *F. wonthaggiensis*	
1190	Upper *C. australiensis*	
1325	Upper *C. australiensis*	
1560	Upper *C. australiensis*	
1640	Upper *C. australiensis*	
1730	Upper *C. australiensis*	
1840	-	

CONCLUSIONS

The samples range in age from *Coptospora paradoxa* Zone (mainly Middle Albian) through to the upper part of the *Cicatricosisporites australiensis* Zone (mainly Berriasian).

There is no evidence for removal of the Upper *C. australiensis* Zone, either in the Morgan scheme or that of Helby *et al.* (1987). In any event, the sampling intervals are too broad and the palynomorph recovery too poor in many samples to be able to determine the presence of hiatuses with any confidence.

REFERENCES

Burger, D., 1980. Palynological studies in the Lower Cretaceous of the Surat Basin, Australia. *Australia. Bureau Mineral Resources, Geology & Geophysics. Bulletin 189.*

CSR/APG Consultants, 1985. Late Palaeozoic and Mesozoic Palynostratigraphical units. *Unpublished CSR Report 274/25.*

Dettmann, M.E., 1986. Early Cretaceous palynoflora of subsurface strata correlative with the Koonwarra Fossil Bed, Victoria. *Memoir of the Association of Australasian Palaeontologists 3*:79-110.

Dettmann, M.E. & Playford, G., 1969. Palynology of the Australian Dretaceous: a review. In *Stratigraphy and Palaeontology. Essays in Honour of Dorothy Hill*, K.S.W. Campbell, ed., A.N.U. Press, Canberra, 174-210.

Evans, P.R., 1966. Mesozoic stratigraphic palynology of the Otway Basin. *Australia. Bureau Mineral Resources, Geology & Geophysics. Record 1966/69* (unpublished).

Evans, P.R., 1971. Palynology. *Australia. Bureau Mineral Resources, Geology & Geophysics. Report 134*:30-35.

Harland, W.B, Cox, A.V., Llewellyn, P.G., Pickton, C.A.G., Smith, A.G. and Walters, R., 1982. A geological time scale. Cambridge University Press, Cambridge, 131 p.

Helby, R., Morgan, R. & Partridge, A.D., 1987. A palynological zonation of the Australian Mesozoic. *Memoir of the Association of Australasian Palaeontologists 4*, 1-94.

Morgan, R., 1980. Palynostratigraphy of the Australian Early and Middle Cretaceous. *New South Wales. Geological Survey. Memoir Palaeontology 18.*

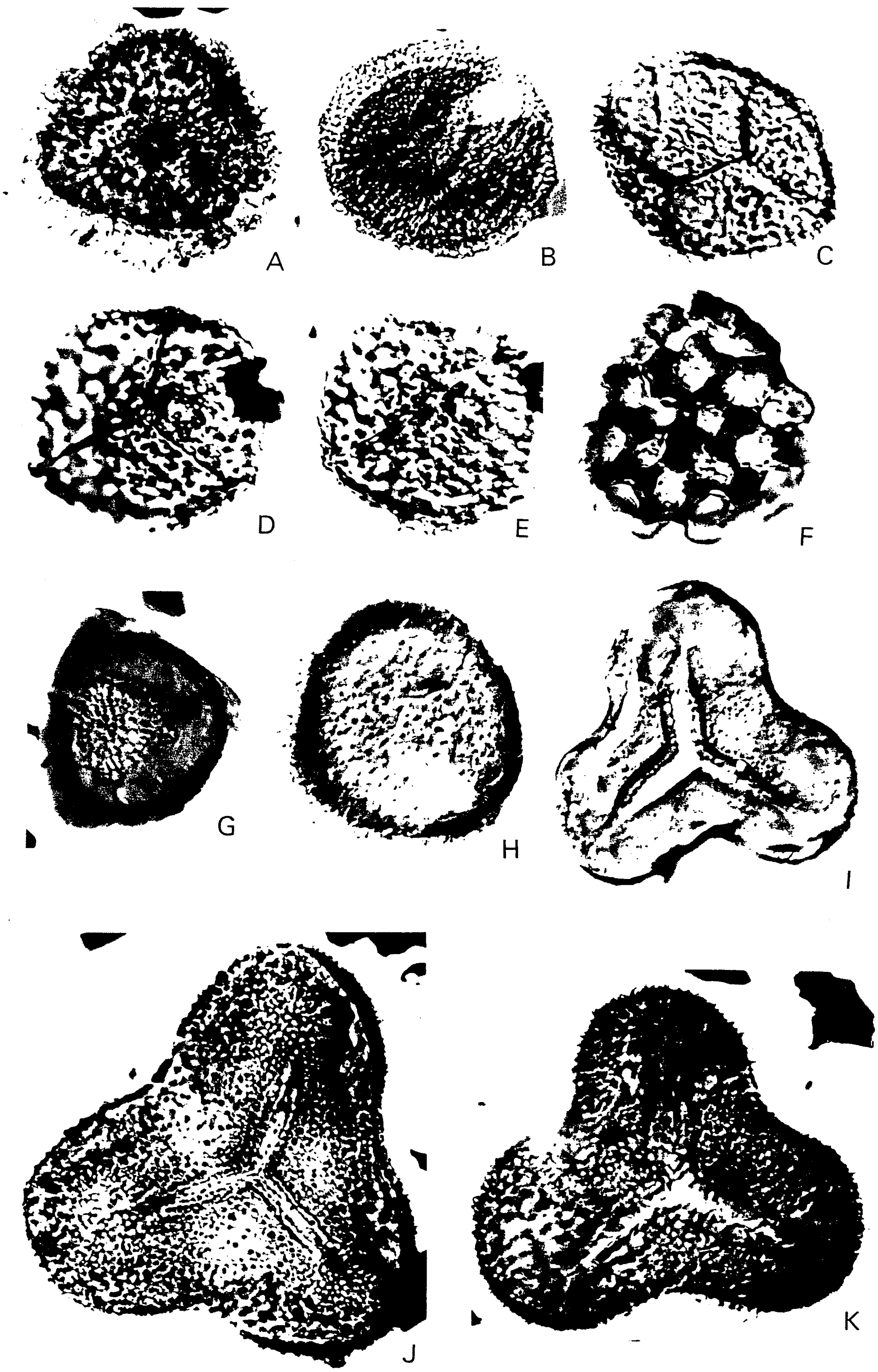
Morgan, R. 1985. Palynology review of selected oil drilling, Otway Basin, South Australia. *Unpublished Report* for Ultramar Australasia Inc.

Morgan, R., 1989. Well completion reports: Katnook 1 and 2. *Unpublished reports* for Ultramar Australasia Inc.

Morgan, R., 1993. Unpublished information.

Plate 1. Selected palynomorphs from Bus Swamp 1. Sample depth from which the palynomorphs were recovered shown in parentheses.

A. *Dictyotosporites speciosus* (830-835). B. *Dictyotosporites complex* (1790). C, D, E. *Foraminisporis wonthaggiensis* (830); photographs showing the variable ornamentation typical of the species; Plates D & E are the same specimen but at different focus levels, D. the proximal surface showing the trilete mark and E. a more distal focus showing details of spinose ornamentation. F. *Klukisporites scaberis* (830-835). G. *Cooksonites variabilis* (1790). H. Unnamed ?alga (830) which has a restricted range (*Foraminisporis wonthaggiensis* Zone) within the Cadna-owie Formation of the Eromanga Basin. I. *Pilosisporites parvispinosus* (830). J, K. *Pilosisporites notensis* (830-835), photos of different specimens showing variable size and ornamentation.


A
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PE907914

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DESCRIPTION =	Range Chart of Graphic Abundances by Lowest Appearances (enclosure from Well Completion Report vol.1) for Bus Swamp-1
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DATE_CREATED =	
DATE_RECEIVED =	
W_NO =	W1088
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CONTRACTOR =	
CLIENT_OP_CO =	Dept of Energy & Minerals

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BUS SWAMP 1

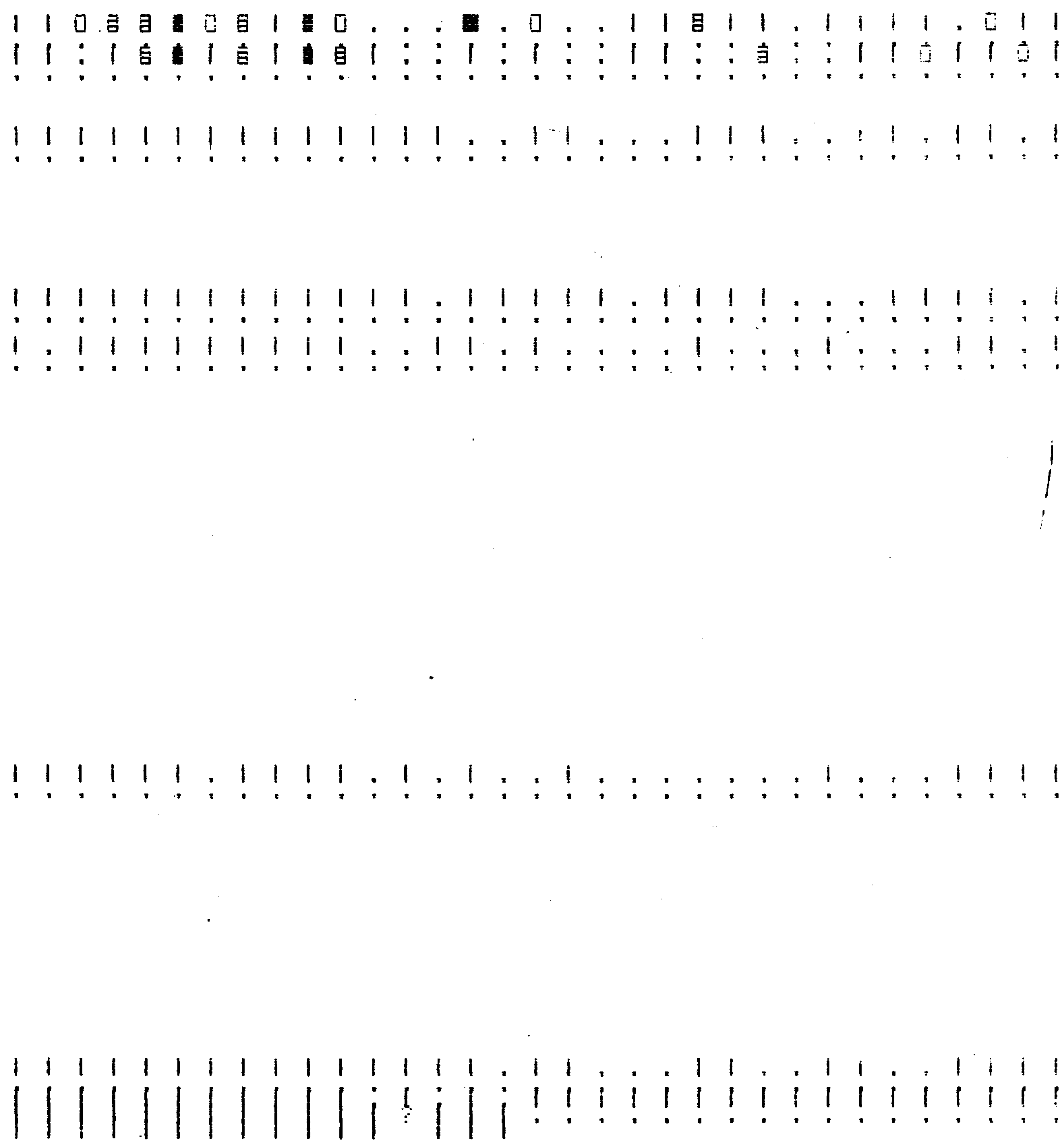
RANGE CHART OF GRAPHIC ABUNDANCES BY LOWEST APPEARANCE

Key to Symbols.

	= Present	(0- 1 Counts)
	= Rare	(2- 5 Counts)
	= Few	(6- 15 Counts)
	= Common	(16- 25 Counts)
	= Abundant	(26-99999 Counts)
?	= Questionably Present	
.	= Not Present	

1 Alisporites similis
2 Araucariacites australis
3 Baculatisporites comaumensis
4 Ceratosporites equalis
5 Cyathidites australis
6 Cyathidites minor
7 Dictyophyllidites harrisii
8 Microcachryidites antarcticus
9 Neoraistrickia truncatus
10 Podocarpidites ellipticus
11 Retitriletes austroclavatidites
12 Retitriletes nodosus
13 Retitriletes watherooensis
14 Staplinisporites caminus
15 Stereisporites antiquasporites
16 Vitreisporites pallidus
17 Aliisporites grandis
18 Callialasporites dampieri
19 Callialasporites trilobatus
20 Cicatricosisporites australiensis
21 Cicatricosisporites ludbrookiae
22 Cycadopites nitidus
23 Cyclosporites hughesii
24 Dictyophyllidites crenatus
25 Foraminisporis asymmetricus
26 Gleicheniidites circinidites
27 Ischyosporites crateris
28 Klukisporites scaberis
29 Laevigatosporites ovatus
30 Leptolepidites major
31 Leptolepidites verrucatus
32 Matonisporites cooksoniae
33 Osmundacidites wellmanii

S7242/1 Sa
S7243/1 Sb
S7244 Sg
S7245/1 Sf
S7246 Sc
S7260/1 Sd
S7248/1 Se
S7249/1
S7259/1



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CONTRACTOR =	
CLIENT_OP_CO =	Dept of Energy & Minerals

SCALE
1 inch = 175

Sample	Depth
S7242/1	830.00
Sa	831.00
S7243/1	832.50
Sb	833.50
S7244	957.00
Sg	958.00
S7245/1	1105.00
Sf	1106.00
S7246	1145.00
Sc	1146.00
S7260/1	1515.83
Sd	1516.83
S7248/1	1790.00
Se	1791.00
S7249/1	1802.50
S7259/1	1803.00

55 Aequitriradites spinulosus
66 Aequitriradites verrucosus
17 Alisporites grandis
1 Alisporites similis
2 Araucariacites australis
3 Baculatisporites comaumensis
56 Biretisporites spectabilis
18 Callialasporites dampierii
40 Callialasporites segmentatus
19 Callialasporites trilobatus
61 Callialasporites turbatus
57 Camarozonosporites clivosus
54 Camarozonosporites ramosus
4 Ceratosporites equalis
20 Cicatricosisporites australiensis
21 Cicatricosisporites ludbrookiae
41 Classopollis chateaunovi
42 Classopollis simplex
51 Contignisporites cooksoniae
43 Converrucosisporites rewanensis
74 Cooksonites variabilis
62 Couperisporites tabulatus
58 Crybelosporites stylosus
67 Cyathidites asper
5 Cyathidites australis
68 Cyathidites concavus
6 Cyathidites minor
22 Cycadopites nitidus
23 Cyclosporites hughesii
24 Dictyophyllidites crenatus
7 Dictyophyllidites harrisii
59 Dictyotosporites complex
69 Dictyotosporites filosus
60 Dictyotosporites speciosus
25 Foraminisporis asymmetricus
70 Foraminisporis dailyi
44 Foraminisporis wonthaggiensis
63 Foveosporites canalis
45 Foveotriletes parviretus
26 Gleicheniidites circinidites
80 INDET algae
27 Ischyosporites crateris
28 Klukisporites scaberis
46 Kraeuselisporites linearis
71 Kuylisporites lunaris
64 Laevigatosporites belfordii
29 Laevigatosporites ovatus
30 Leptolepidites major
31 Leptolepidites verrucatus
47 Lycopodiacidites asperatus
32 Matonisporites cooksonae
8 Microcachryidites antarcticus
48 Murospora florida
49 Neoraistrickia densata
9 Neoraistrickia truncatus
33 Osmundacidites wellmanii
82 Permian indet.
72 Pilosisporites notensis
75 Pilosisporites parvispinosus
81 Plicatipollenites densus
10 Podocarpidites ellipticus
34 Podocarpidites multesimus
52 Polycingulatisporites clavus
76 Polycingulatisporites densatus
53 Reticulatisporites pudens
11 Retitriletes australoclavatidite
35 Retitriletes circolumensus
77 Retitriletes eminulus
36 Retitriletes facetus
65 Retitriletes huttonensis
12 Retitriletes nodosus
37 Retitriletes reticulumsporites
38 Retitriletes rosewoodensis
13 Retitriletes watherooensis
14 Staplinisporites caminus
15 Stereisporites antiquasporites
39 Tricotomosulcites subgranulatis
73 Trilobosporites purverulentus
78 Triporoletes reticulatus
79 Triporoletes simplex
50 Velosporites triquetrus
16 Vitreisporites pallidus

PE907917

This is an enclosure indicator page.
The enclosure PE907917 is enclosed within the container PE900967 at this location in this document.

The enclosure PE907917 has the following characteristics:

```
    ITEM_BARCODE = PE907917
CONTAINER_BARCODE = PE900967
            NAME = Palynological Zonal Nomenclature Chart
           BASIN = OTWAY
          PERMIT = PEP119
            TYPE = WELL
         SUBTYPE = DIAGRAM
     DESCRIPTION = Palynological Zonal Nomenclature Chart
                   (enclosure from Well Completion Report
                   vol.1) for Bus Swamp-1
         REMARKS =
    DATE_CREATED =
   DATE_RECEIVED =
            W_NO = W1088
       WELL_NAME = Bus Swamp-1
      CONTRACTOR =
    CLIENT_OP_CO = Dept of Energy & Minerals
```

(Inserted by DNRE - Vic Govt Mines Dept)