MINORA
RESOURCES NL

A REVIEW OF SELECTED

LOWER CRETACEOUS / UPPER JURASSIC

CONVENTIONAL CORE MATERIAL

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VIC. OTWAY BASIN

JULY 1988

A REVIEW OF SELECTED LOWER CRETACEOUS / UPPER JURASSIC CONVENTIONAL CORE MATERIAL VICTORIAN OTWAY BASIN

REF : P111.88

A REPORT FOR

M I N O R A R E S O U R C E S N. L.

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JULY 1988

CONTENTS

1. INTRODUCTION

The study was conducted to further evaluate the LOWER CRETACEOUS / UPPER JURASSIC sequence of the Victorian Otway Basin. Cores and cuttings of six exploration and one D.I.T.R. stratigraphic wells were studied and/or sampled for the following purposes:

I- SOURCE ROCK EVALUATION OF THE UPPER JURASSIC CASTERTON BEDS

Four cutting samples in Woolsthorpe # 1 and three core and one cutting samples in Casterton # 1 were examined. Representative samples were collected for "TOTAL ORGANIC CARBON" determination followed by "ROCK-EVAL" analysis on the samples with source potential. The description of these samples are presented in the APPENDIX.

II- RESERVOIR EVALUATION OF THE EUMERALLA FORMATION, HEATHFIELD MEMBER, GELTWOOD BEACH AND PRETTY HILL FORMATIONS

A total of twenty cores from six exploration and one stratigraphic wells were examined and described in detail. Representative samples were collected for petrological studies and intervals with apparent reservoir potential were sampled for porosity-permeability determinations.

Although a detailed description of the cores were carried out, no conventional core description form was used and no attempt was made to draw the lithological column either. This is because the condition of the available cores in the D.I.T.R. Corestore is far from that of the original state.

It is almost impossible to accurately define the top and/or the bottom of the core. Where a piece of core is missing there is no note, or anything else, to indicate to which interval it belonged. Pieces which had apparently been taken for different purposes from different part of a core are now in a separate box without any depth tags, with only core number on the bags. As a result, guess work had to be applied almost on all cores examined during the course of this study.

This has further complicated the task in regards to environmental interpretations. The environment of deposition can only be accurately defined if the core is in acceptable condition and sufficient features can be recognised.

2. CASTERTON BEDS

AIM: Source-rock Potential

CONCLUSIONS:

—Casterton-1—moderate to very good source-rock potential

—mature

—Woolsthorpe-1—no significant oil source identified although patchy oil potential

—early mature

2.1

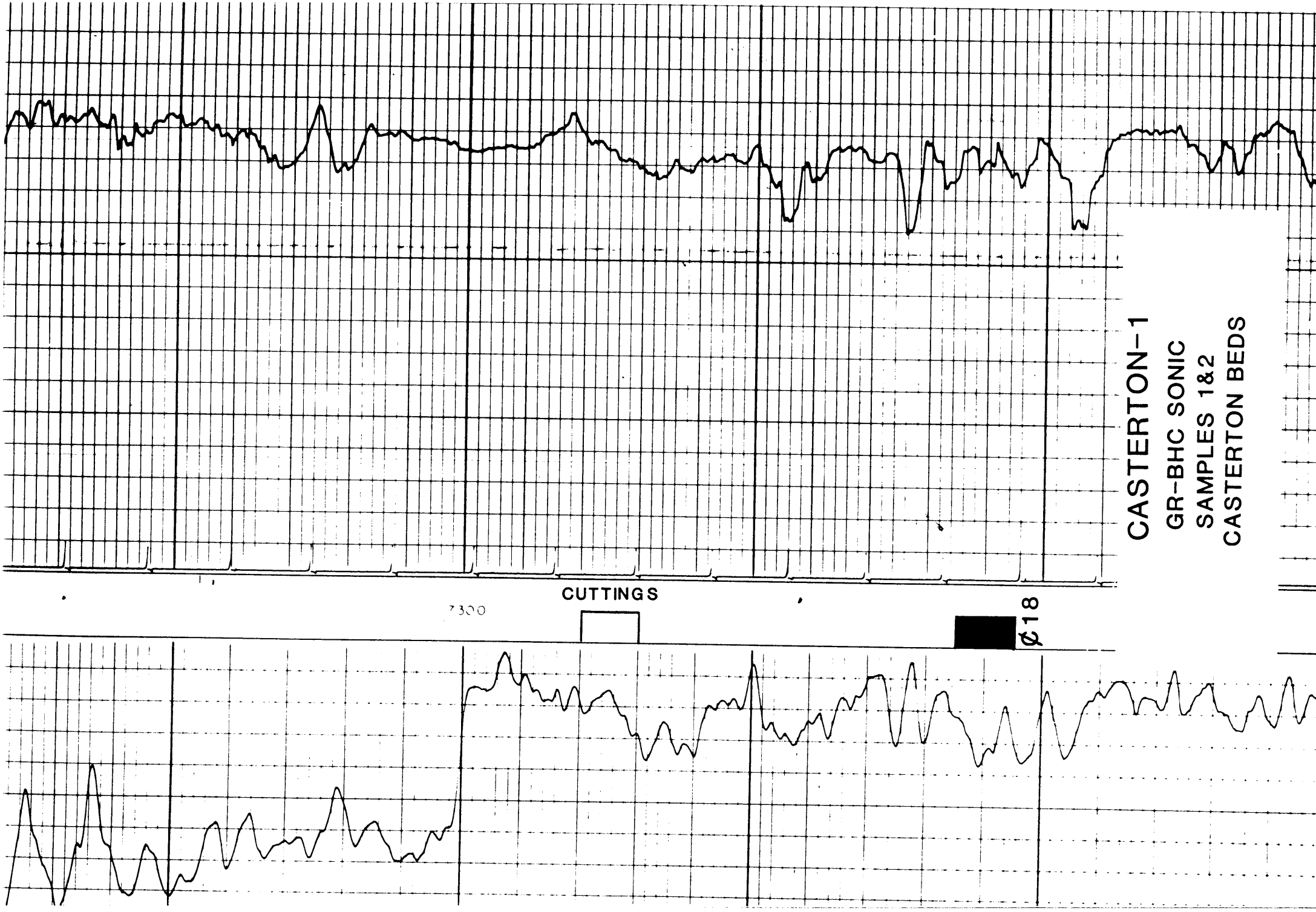
TABLE 1

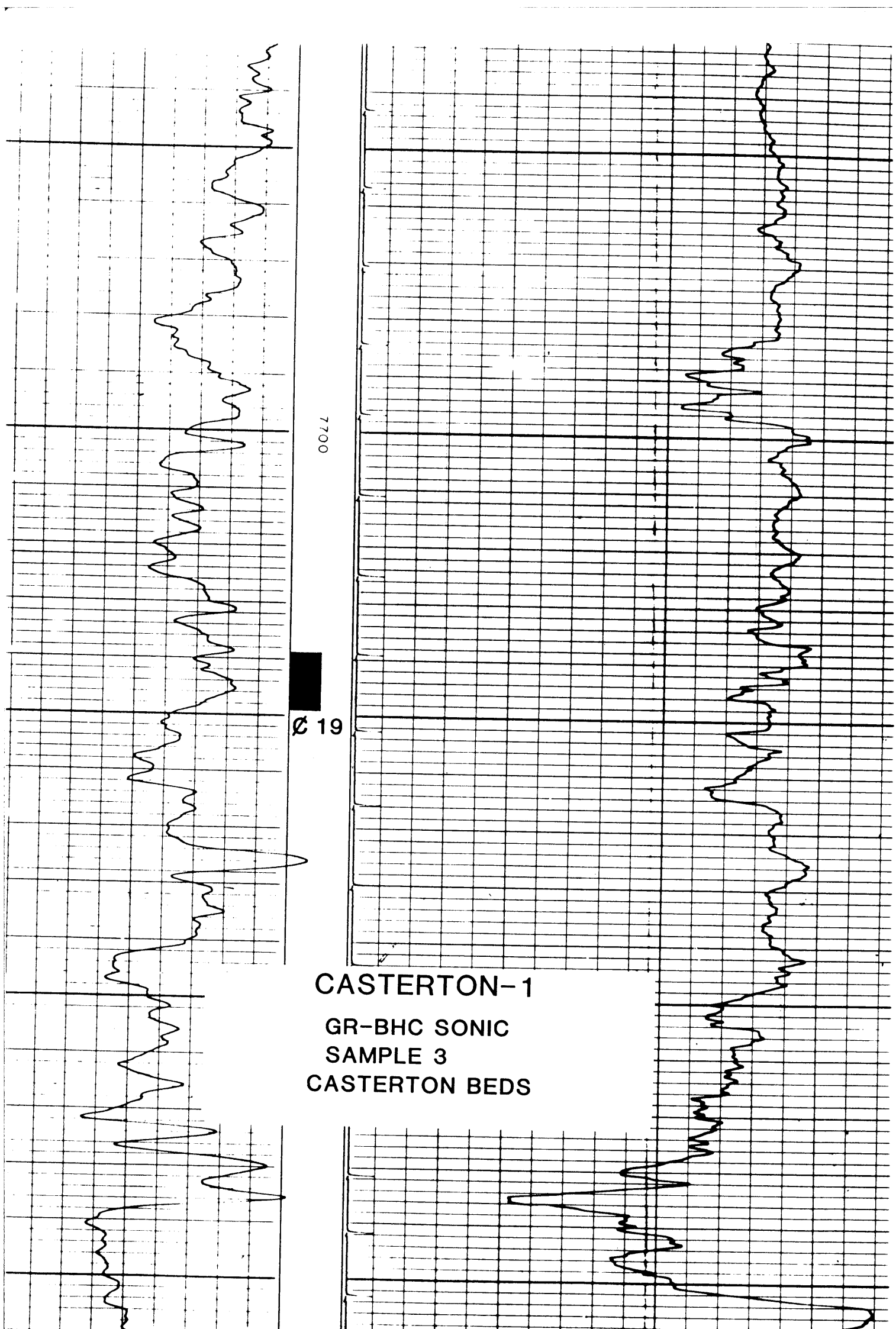
ROCK-EVAL PYROLYSIS DATA (one run)

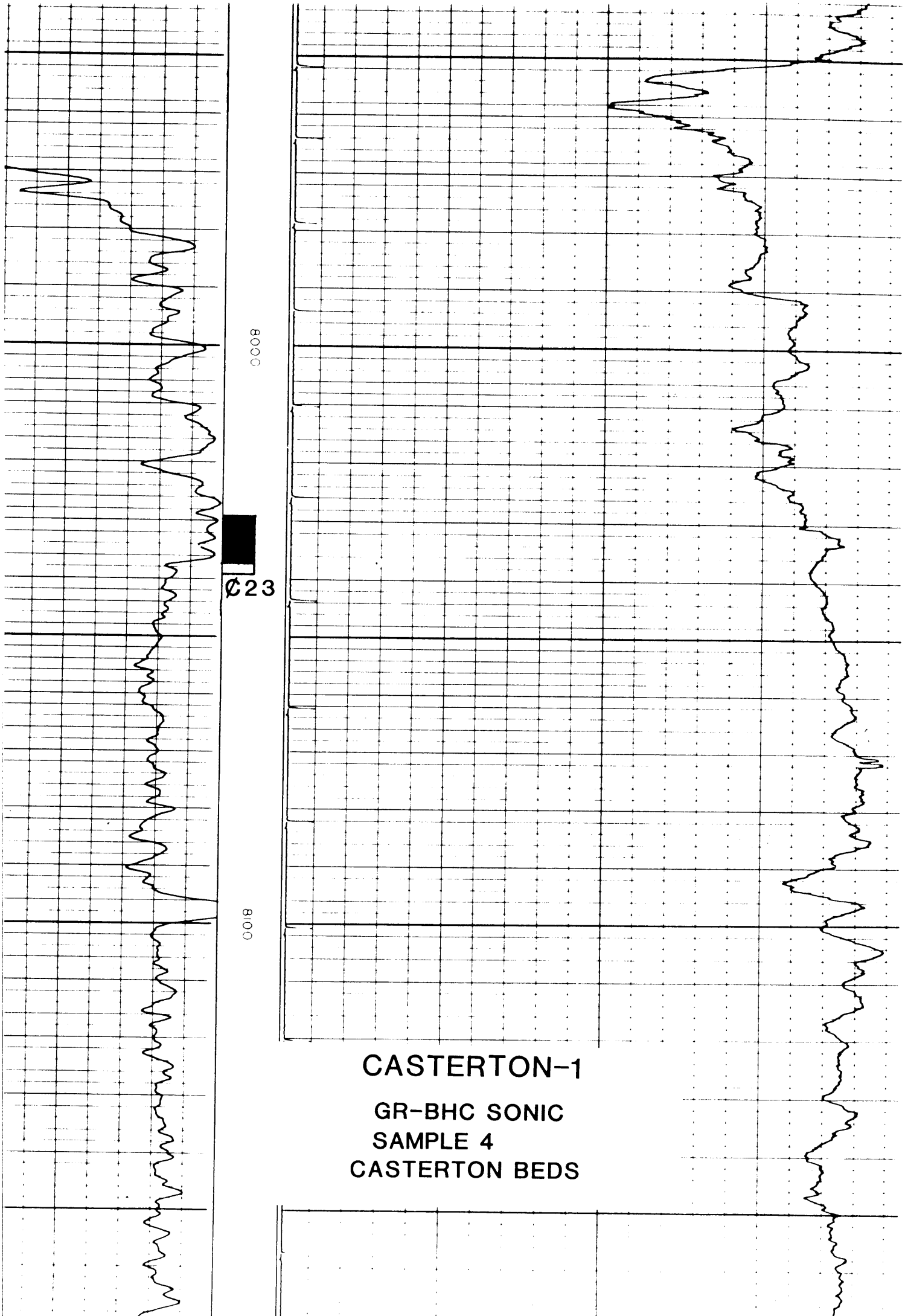
WELLNAME = CASTERTON 1 DATE OF JOB = MAY 1988

SAMPLE NO.	CORE NO.	DEPTH(ft)	TMAX	S1	S2	S3	S1+S2	S2/S3	PI	PC	TOC	HI	OI
1	CUTT.	7320.0- 7330.0	433	0.20	2.78	2.90	2.98	0.96	0.07	0.25	1.96	141	147
2	¢18	7385.0	438	3.65	15.00	5.45	18.65	2.75	0.20	1.55	10.13	148	53
3	¢19	7740.0	442	0.98	3.65	0.77	4.63	4.74	0.21	0.38	2.76	132	27
4	¢23	8030.0	nd	nd	nd	nd	nd	nd	nd	nd	0.17	nd	nd

TMAX = Max. temperature S2 S1 = Volatile hydrocarbons (HC) S2 = HC generating potential
S1+S2 = Potential yield S3 = Organic carbon dioxide PI = Production index
PC = Pyrolysable carbon TOC = Total organic carbon HI = Hydrogen index
OI = Oxygen Index nd = no data


CASTERTON-1
GR-BHC SONIC
SAMPLES 1&2
CASTERTON BEDS
CUTTINGS
7300
Ø18


7700
Ø 19
CASTERTON-1
GR-BHC SONIC
SAMPLE 3
CASTERTON BEDS



CASTERTON-1

GR-BHC SONIC
SAMPLE 4
CASTERTON BEDS

2.2

TABLE 1

ROCK-EVAL PYROLYSIS DATA (one run)

WELLNAME = WOOLSTHORPE 1

DATE OF JOB = MAY 1988

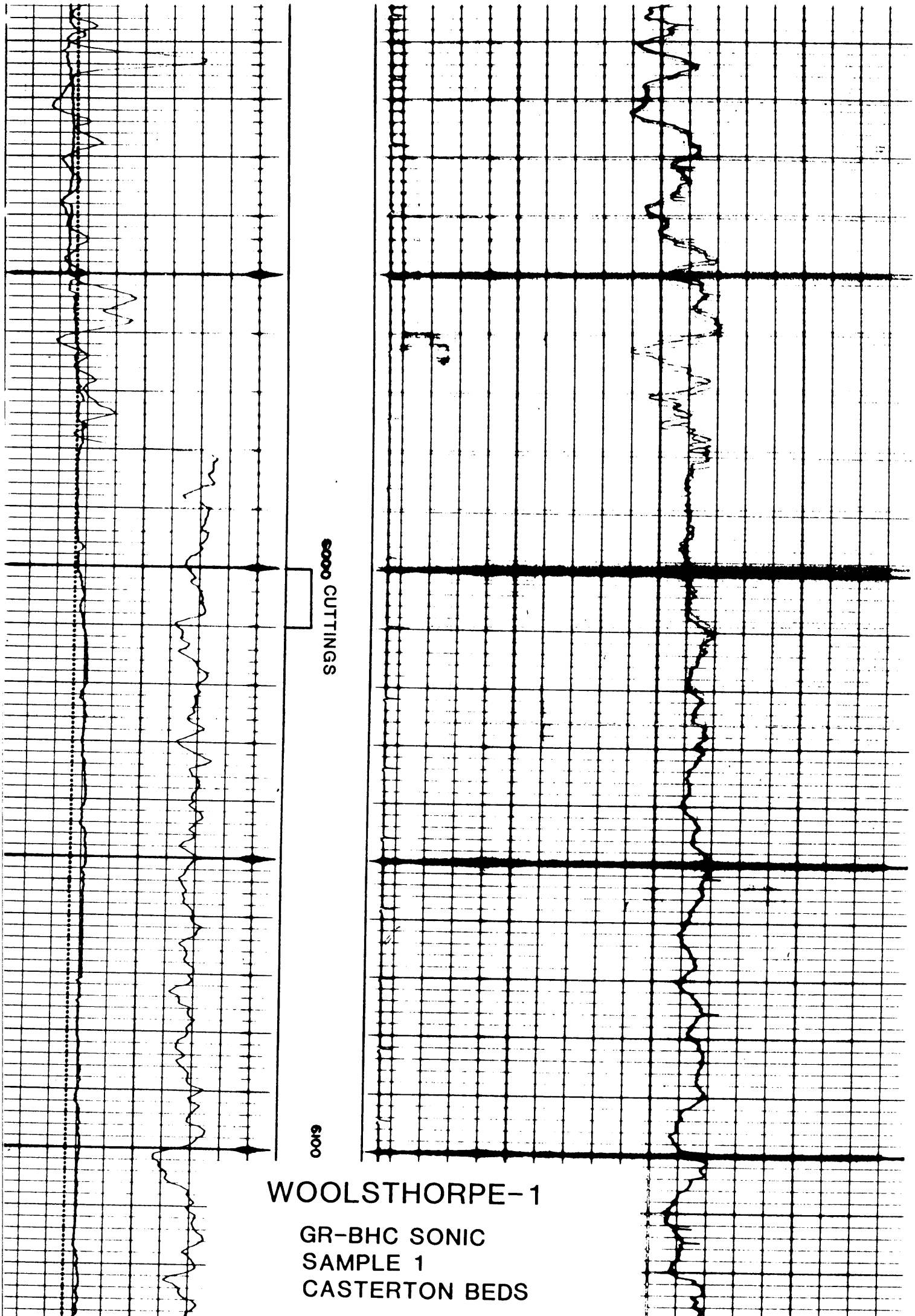
SAMPLE NO.	DEPTH(ft)	TMAX	S1	S2	S3	S1+S2	S2/S3	PI	PC	TOC	HI	OI
1-CUTT.	6000.0- 6010.0	431	0.22	2.58	1.49	2.80	1.73	0.08	0.23	2.87	89	51
2-CUTT.	6190.0- 6200.0	431	0.16	1.60	1.37	1.76	1.17	0.09	0.15	1.83	87	74
3-CUTT	6290.0- 6300.0	435	0.11	0.67	3.65	0.78	0.18	0.14	0.06	1.11	60	328
4-CUTT.	6390.0- 6400.0	434	0.09	0.62	5.80	0.71	0.11	0.13	0.06	1.14	54	508

NB GR-BHC SONIC LOG NOT AVAILABLE FOR SAMPLES 2-4.

TMAX = Max. temperature S2
S1+S2 = Potential yield
PC = Pyrolysable carbon
OI = Oxygen Index

S1 = Volatile hydrocarbons (HC)
S3 = Organic carbon dioxide
TOC = Total organic carbon
nd = no data

S2 = HC generating potential
PI = Production index
HI = Hydrogen index



WOOLSTHORPE-1

GR-BHC SONIC
SAMPLE 1
CASTERTON BEDS

3. PRETTY HILL FORMATION

AIM: Reservoir Study

CONCLUSIONS:—Heterogeneous porosity and permeability

—Framework of quartz grains with patchy matrix of dominantly authigenic kaolinite

—Minor quartz overgrowths and microstylolite development

—Minor lithic constituents–sedimentary and metasedimentary origin

—Moderately abundant feldspar of mostly microcline

—Diagenetic sequence:

silica→kaolinite→carbonate

3.1 PRETTY HILL # 1

CORE DESCRIPTION

CORE NO. 18 PRETTY HILL FORMATION CORED INTERVAL 6376' - 6388'

Length of Core: 12' Recovery: 4' Available: 2½' in small pieces

The remnant consists of:

SANDSTONE; light grey-white, very light brown grey in part, friable-firm, medium-granule, occasionally pebble size, dominantly coarse-granule, angular-subrounded, dominantly subangular, poorly sorted clear to translucent quartz, trace to occasionally common kaolinite and light brown grey clay matrix, no apparent calcareous cement, trace to common siliceous cement, common to abundant light pink-medium orange garnet, trace medium to dark grey and black lithics, rare muscovite, trace thin streaks of carbonaceous matter, rare carbonaceous detritus, good-very good visual porosity.

*ENVIRONMENTAL INTERPRETATION

No Environmental Interpretation was carried out on this core due to the following;

- core pieces are mixed up and there is no way to identify the top of the cored interval,
- core pieces are too small to allow recognition of any sedimentary structures,

however, minor flat bedding and few planar cross beddings were observed in few relatively larger pieces.

Sample: Pretty Hill-1; Core 18; 6376-6388 ft

Rock Name:
Porous sandstone

Thin Section:
An optical estimate of the constituents gives the following:

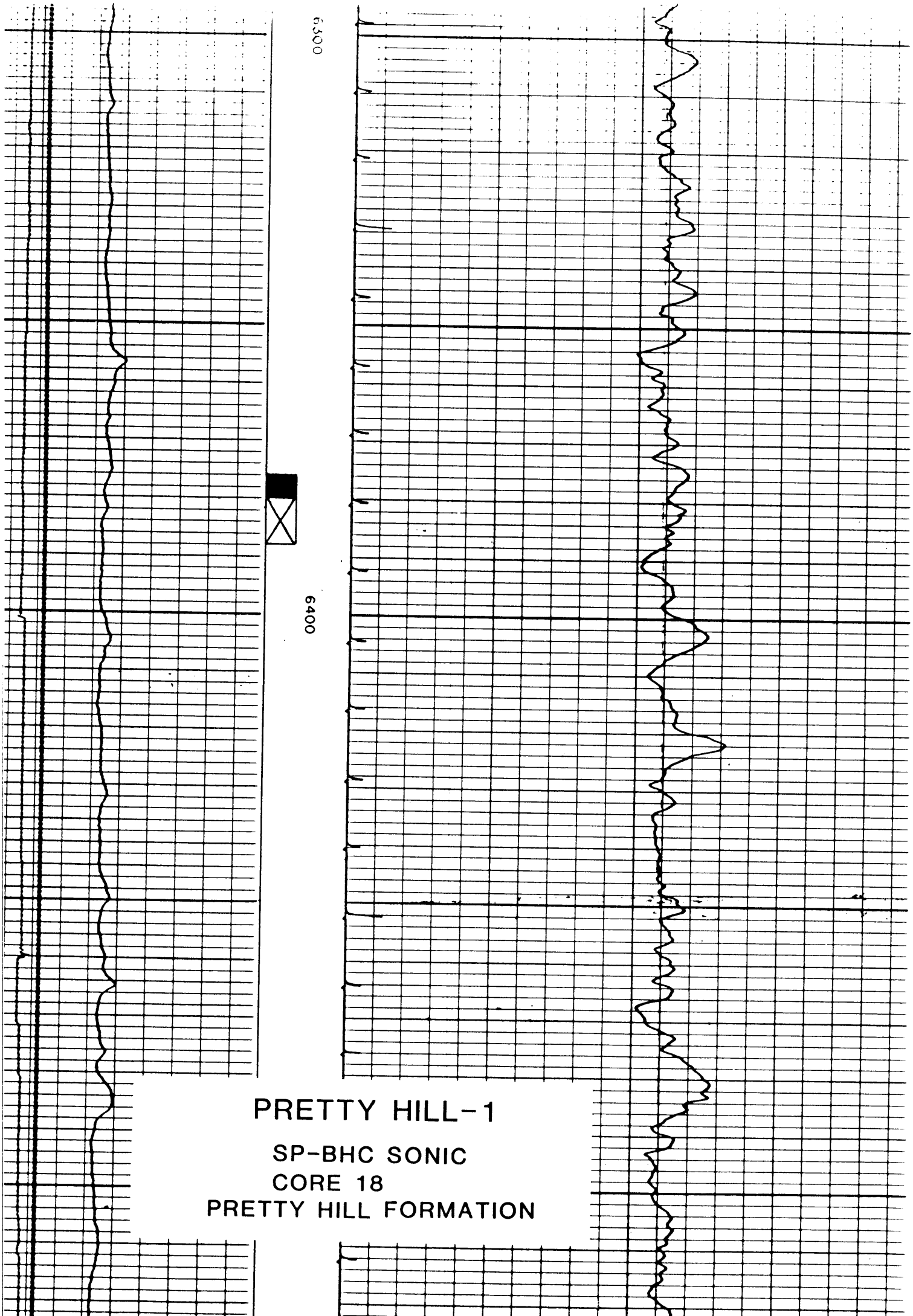
Constituent	%
Quartz	70
Feldspar	3
Lithic fragments	1
Clay/matrix	1
Pores	25
Authigenic kaolinite	2(+)
Garnet	1

Over most of the area of the thin section this rock shows simply a framework of quartz grains with abundant void space in between. Some of the quartz grains show small overgrowths. There is, in addition, a patchy development of authigenic kaolinite. Most fields of view are completely free from this mineral but there are areas of the rock of the order of 1-3 mm in size in which virtually all of the intergranular space is occupied by kaolinite. Presumably this patchy distribution is a function of the circulation of pore waters through the rock. Its presence probably inhibits the permeability of the rock and, to a small extent, the porosity.

Quartz, feldspar and lithic grains are moderately sorted and most range in size from 0.3 mm to about 0.8 mm. The quartz grains show some evidence of a pressure solution effect due to compaction and there are very thin and discontinuous overgrowths on perhaps 10% of the grains. The feldspar is generally either fairly fresh microcline or is represented by extremely altered grains so clouded with secondary minerals that it is not possible to tell whether these are plagioclase or potassium feldspar.

Specifically identifiable lithic fragments are not abundant in this rock and are generally either quartzofeldspathic aggregates showing some considerable alteration or rather indeterminate fine-grained grains probably of sedimentary or metasedimentary origin. Some of the latter show considerable alteration and there is some secondary porosity within partly dissolved lithic grains. The fine-grained material in the rock is essentially authigenic kaolinite. This mineral forms monomineralic aggregates and where they occur in the thin section they tend to completely fill the intergranular space. In one part of the thin section the kaolinite is uncommonly coarse-grained and there are stacks of this clay mineral as much as 0.05 mm in size. One of the largest aggregates of the kaolinite is also associated with a little chloritic material. Other patches of kaolinite tend to be relatively small and few exceed 0.4 mm in size. Where kaolinite is absent (and this applies to most of the area of the thin section) the rock is extremely porous and, as indicated above, simply consists of quartz and pores.

As noted in some of the other rocks in this collection, the sample contains an unusually large amount of the detrital heavy mineral garnet.



PRETTY HILL-1

SP-BHC SONIC
CORE 18
PRETTY HILL FORMATION

3.2 PRETTY HILL # 1

CORE DESCRIPTION

CORE NO. 19 PRETTY HILL FORMATION CORED INTERVAL 6690' - 6702'

Length of Core: 12' Recovery: 7' 6" Available: 3½'

The top part of the core consists of:

SANDSTONE; medium brown to medium grey brown, hard to very hard, fine to medium occasionally coarse, subangular to subrounded, poor-moderately sorted dominantly clear quartz, trace to common light to medium brown argillaceous matrix, trace kaolinite, trace altered feldspar, trace to common yellow to medium orange garnet, trace calcite cement, trace to common other calcareous and/or siliceous cement, trace lithics, rare carbonaceous detritus, poor-nil visual porosity. The sandstone appears to be predominantly massive with very minor flat bedding towards the top.

The bottom part of the core consists of:

SANDSTONE; white at the top, becoming light to medium grey with depth, friable-firm, fine-coarse, dominantly medium at the top, medium-very coarse, dominantly coarse-very coarse towards the base, subangular to subrounded, moderately sorted clear and frosty quartz, common kaolinite and light grey clay matrix, matrix decreases with depth, trace very weak calcareous cement at the base, common light yellow to medium pink and orange garnet, trace dark grey and black lithics, trace quartz overgrowth, rare carbonaceous detritus, rare mica, good visual porosity at the top, very good at the base. Some cross stratifications are present in this part of the core. The maximum apparent dip is approximately 30°.

*ENVIRONMENTAL INTERPRETATION

The absence of overbank deposits and the presence of fining upwards sequence together with the grain size could be indicative of a channel bar in an alluvial plain environment. However, this interpretation is questionalbe because;

a- no flat bedded silt and clay was observed at the top of the cored interval,

b- no lag deposit was present at the base, and

c- the possibility that the core pieces have been mixed up.

Sample: Pretty Hill-1; Core 19; 6690-6702 ft

Rock Name:
Compact sandstone

Thin Section:
An optical estimate of the constituents gives the following:

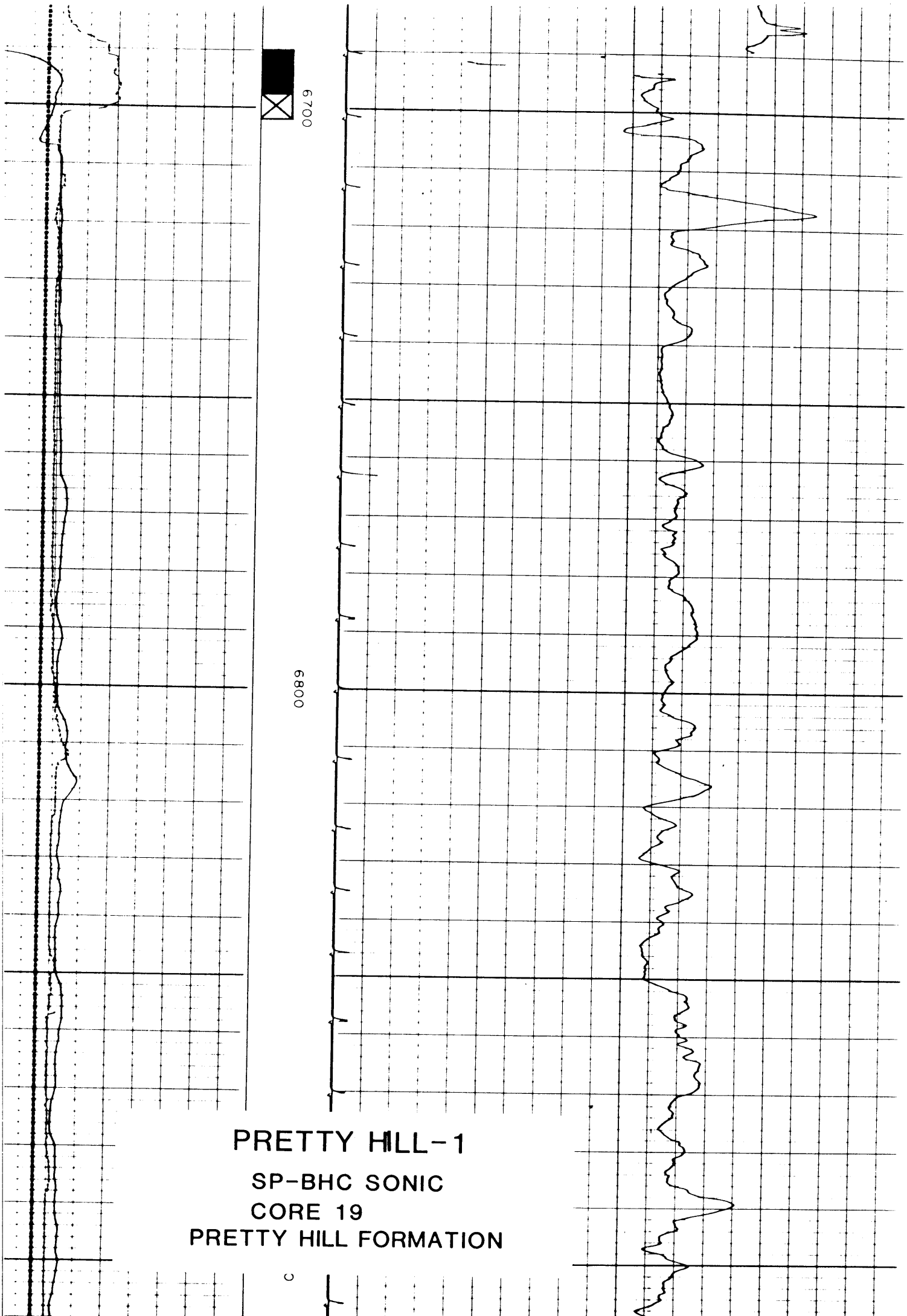
Constituent	%
Quartz	80
Feldspar	5
Lithics and clays	5
Pores	7
Authigenic kaolinite	3
Siderite	1
Carbonate and garnet	Trace

In many respects this sample is very similar to that from Core 18 in this well and this applies particularly to the more porous parts of the thin section. The rock does in fact show considerable heterogeneity and this can be seen particularly when the thin section is observed macroscopically; the sample is banded on a scale of approximately 5-15 mm and there are clear variations in the amount of porosity in these different laminar bands. When viewed microscopically it can be seen that the least porous parts of the rock contain more authigenic kaolinite and are characterised particularly by the presence of microstylolitic features.

The bulk of the rock is relatively coarse-grained and the average size of the quartz, feldspar and lithic fragments is about 0.4 mm. This is the more porous part of the rock and there are numerous primary pores up to about 0.3 mm in size. Quartz shows some evidence of pressure solution effects and there are many grains with long and curved contacts. Overgrowths are present only to a very small extent however. As in the sample described above, authigenic kaolinite is present but tends to have a patchy distribution. Where it does occur, however, it tends to fill the intergranular spaces and there are patches of kaolinite commonly 0.2-0.3 mm in size. In this samples there are also one or two aggregates of carbonate and this, too, is probably an authigenic phase.

The sample differs from that in Core 18 in that it contains significantly different zones which are characterised as less porous, finer grained and containing relatively well defined microstylolitic features. In these parts of the rock the quartz appears to be less well sorted and there are numerous grains less than 0.2 mm in size. Adjacent to the microstylolitic features themselves, the quartz shows irregular outlines against dark minerals which include opaques, siderite and indeterminate clay aggregates which have been concentrated in the microstylolites. In these parts of the rock there are numerous smaller patches of kaolinite and aggregates of rather indeterminate fine-grained material which is probably essentially of lithic origin.

These microstylolitic features contain porosity probably to the extent of less than 10% and the pores are commonly less than 0.1 mm in size. It is likely therefore that the rock may show some heterogeneity in permeability in that the horizontal permeability may be significantly greater than the vertical permeability. Some of the pores in this part of the rock can also be seen to be of secondary origin particularly in one instance where a perthite grain shows dissolution of one type of feldspar and not another and small pores have developed where one of the phases has been removed.



PRETTY HILL-1

SP-BHC SONIC
CORE 19
PRETTY HILL FORMATION

3.3 PRETTY HILL # 1

CORE DESCRIPTION

CORE NO. 20 PRETTY HILL FORMATION CORED INTERVAL 7200' - 7214'

Length of Core: 14' Recovery: 14' Available: 10' only

In general four different lithologies were recognised;

1- SANDSTONE; white to very light grey, friable to firm, medium-coarse subangular to subrounded, moderately sorted quartz, trace to occasionally common kaolinite matrix, trace siliceous cement, common pink and medium orange garnet, trace medium green (non-glauconitic), medium to dark grey lithics, rare altered feldspar(?), fair visual porosity. No sedimentary structure was recognised.

11- SANDSTONE; white to very light grey, firm-hard, coarse-granule, dominantly coarse-very coarse, subangular-subrounded, poor-moderately sorted dominantly frosted quartz, trace light grey argillaceous matrix silty in part, strong siliceous(?) cement, common quartz overgrowth, trace carbonaceous detritus, rare kaolinite grains!, fair visual porosity. No recognisable sedimentary structure appears to be present.

111- SANDSTONE; light grey, firm, very fine-fine, very occasionally medium subangular-subrounded, poorly sorted quartz, common light grey argillaceous matrix, trace to common siliceous cement, common pink and medium orange garnet, trace multi-coloured lithics, trace carbonaceous detritus poor visual porosity. Minor flat bedding with coally streaks on the bedding planes were recognised in this section.

IV- SANDSTONE; medium brown, hard, medium-very coarse, dominantly medium-coarse, subangular-subrounded, poorly sorted light-medium brown quartz with minor opaque and translucent quartz, common to abundant kaolinite clay matrix, common calcareous (non-calcitic) and siliceous cement, trace pink garnet, rare lithics and carbonaceous detritus, very poor visual porosity. Minor flaser bedding was recognised in this part.

PRETTY HILL # 1

CORE DESCRIPTION

CORE NO. 20 Cont'd. from previous page.

*ENVIRONMENTAL INTERPRETATION

Assuming that core pieces were not mixed the following environment of depositions are suggested for this core; (from bottom to the top)

- section IV is believed to have been deposited in the lower part of the point bar channel.
- section III appears to have resulted from lateral migration from point bar to the natural levee. This is supported by the presence of finer sediments as well as minor peat formation.
- section II is believed to have deposited in the lower part of a channel bar of the braided river system. The granular nature of part of this section appears to be the lag deposit usually associated with this environment of deposition.
- section I is probably the middle part of a channel bar.

It should be noted:

a- The author believes that the present arrangement of the core pieces is not the original one. This is because the original core description (in the Well Completion Report) does not fit this arrangement

b- The majority of the core pieces are still covered with drilling mud, which prevents recognition of any structure present in the core.

Sample: Pretty Hill-1; Core 20; 7200-7214 ft

Rock Name:
Porous lithic sandstone

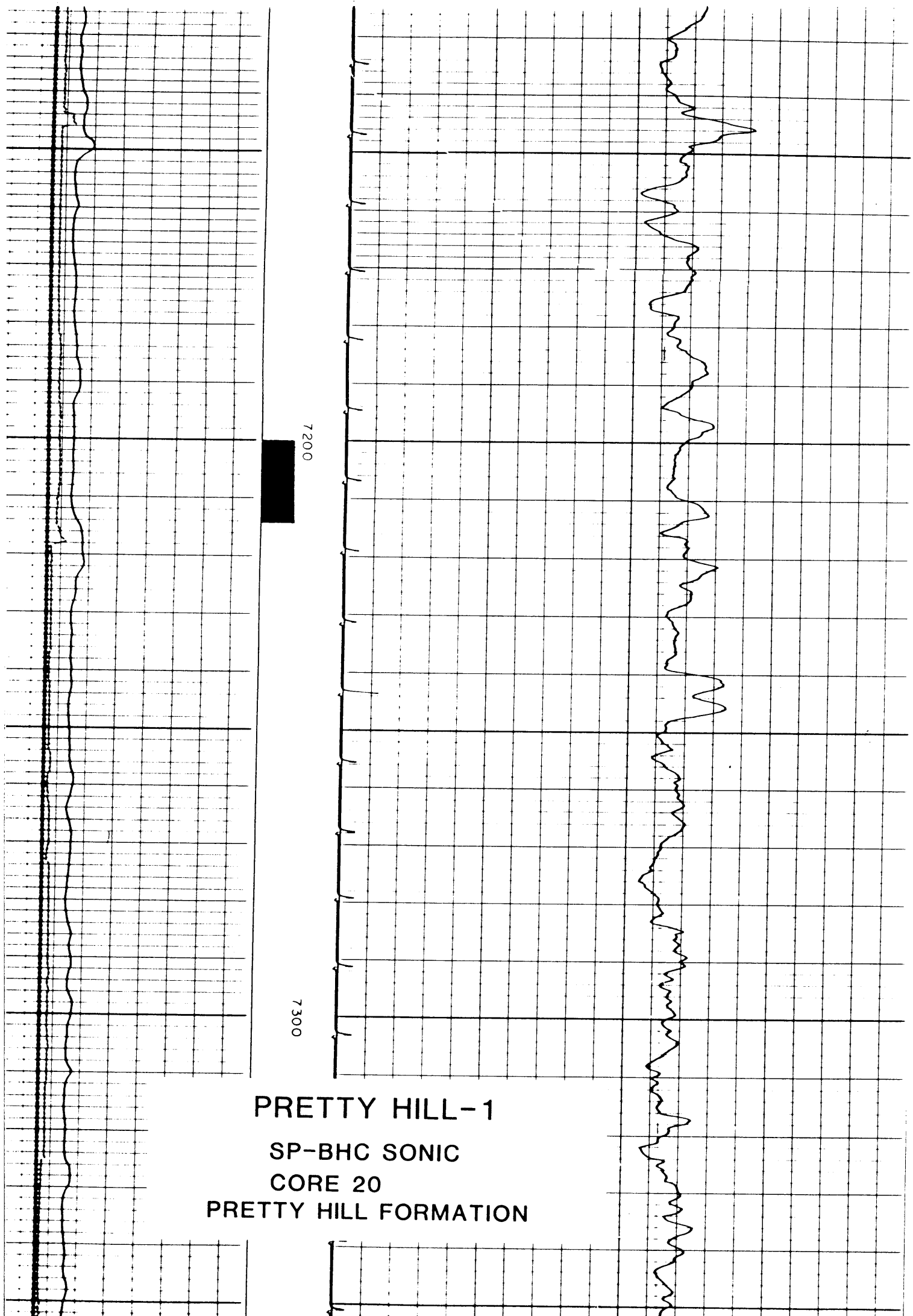
Thin Section:
An optical estimate of the constituents gives the following:

Constituent	%
Quartz	70-75
Feldspar	5
Lithics	8
Pores	10
Authigenic kaolinite	3
Carbonate and garnet	Trace

This sandstone has an average grain size of about 0.3 mm and the grains are moderately well sorted. Some show fairly well rounded vertices but, for the most part, the detrital material can be described as subangular to subround in shape. Some angularity has been introduced by pressure solution effects on the quartz grains by which long and concavo-convex boundaries have replaced the original tangential boundaries. In addition there is a localised development of sutured boundaries and microstylolitic zones but these are by no means as well developed as in the sample described immediately above. Feldspar is generally clear, fresh microcline with only rare instances of what may be extremely altered plagioclase. The rock contains some fairly rigid and strong lithic fragments which are chert and quartzites and even fine-grained quartz/clay aggregates retain considerable evidence of their original detrital shapes. There is a gradation, however, to more plastically deformable grains which tend to fill the intergranular spaces where they occur where they have been squeezed into pore throats.

Authigenic kaolinite is a relatively abundant authigenic mineral and is present in most fields of view although it has a somewhat patchy distribution when the thin section is regarded as a whole. Monomineralic aggregates of relatively coarse kaolinite are as much as 0.4 mm in size and the shape of these aggregates is of course determined by the shape of adjacent grains. A second authigenic phase is a carbonate mineral which forms fairly clear well defined plates 0.1-0.2 mm in size. This mineral is either dolomite or calcite and probably represents a relatively late authigenic phase.

In brief, therefore, the sample shows many of the characteristics described in the two samples above and is characterised by both pressure solution effects on the quartz grains and the development of authigenic kaolinite as significant features in occluding the original porosity. Minor factors are the development of quartz overgrowths and the formation of a late carbonate phase.



PRETTY HILL-1

SP-BHC SONIC

CORE 20

PRETTY HILL FORMATION

3.4 PRETTY HILL # 1

CORE DESCRIPTION

CORE NO. 21 PRETTY HILL FORMATION CORED INTERVAL 7585' - 7597'

Length of Core: 12' Recovery: 12' Available: 10' (approx.)

The core pieces are badly mixed up and any description, other than a generalised one, may cause confusion:

SANDSTONE; light grey, occasionally white, light brown grey in part, hard-very hard, fine-coarse, occasionally very coarse, dominantly fine-medium and medium-coarse (bimodal distribution), angular-subrounded poor-moderatly sorted, clear to opaque quartz, light-medium brown in part, trace light grey argillaceous and white kaolinite clay matrix which becomes more abundant with depth, strong siliceous and trace calcareous cement, trace-common pink-rose garnet, trace lithics, trace quartz overgrowths in part, trace coally streaks on the minor bedding planes, occasional major quartz veining in part of the core, very poor to nil visual porosity. Minor flat bedding is the only recognisable structure in part of the core.

*ENVIRONMENTAL INTERPRETATION

Due to the uncertainty of the core pieces arrangement and lack of the sufficient recognisable structure no environmental interpretation was attempted. However, the following comments are worthwhile to note:

- It appears that the introduction of the quartz vein in this sandstone not only contributed to the silicification of probably once a porous rock, it has probably destroyed some of the sedimentary structures,
- The finer sandstone shows less secondary silicification, but appears to have more argillaceous matrix. Hence the uniformity in imperviousness of the whole core.

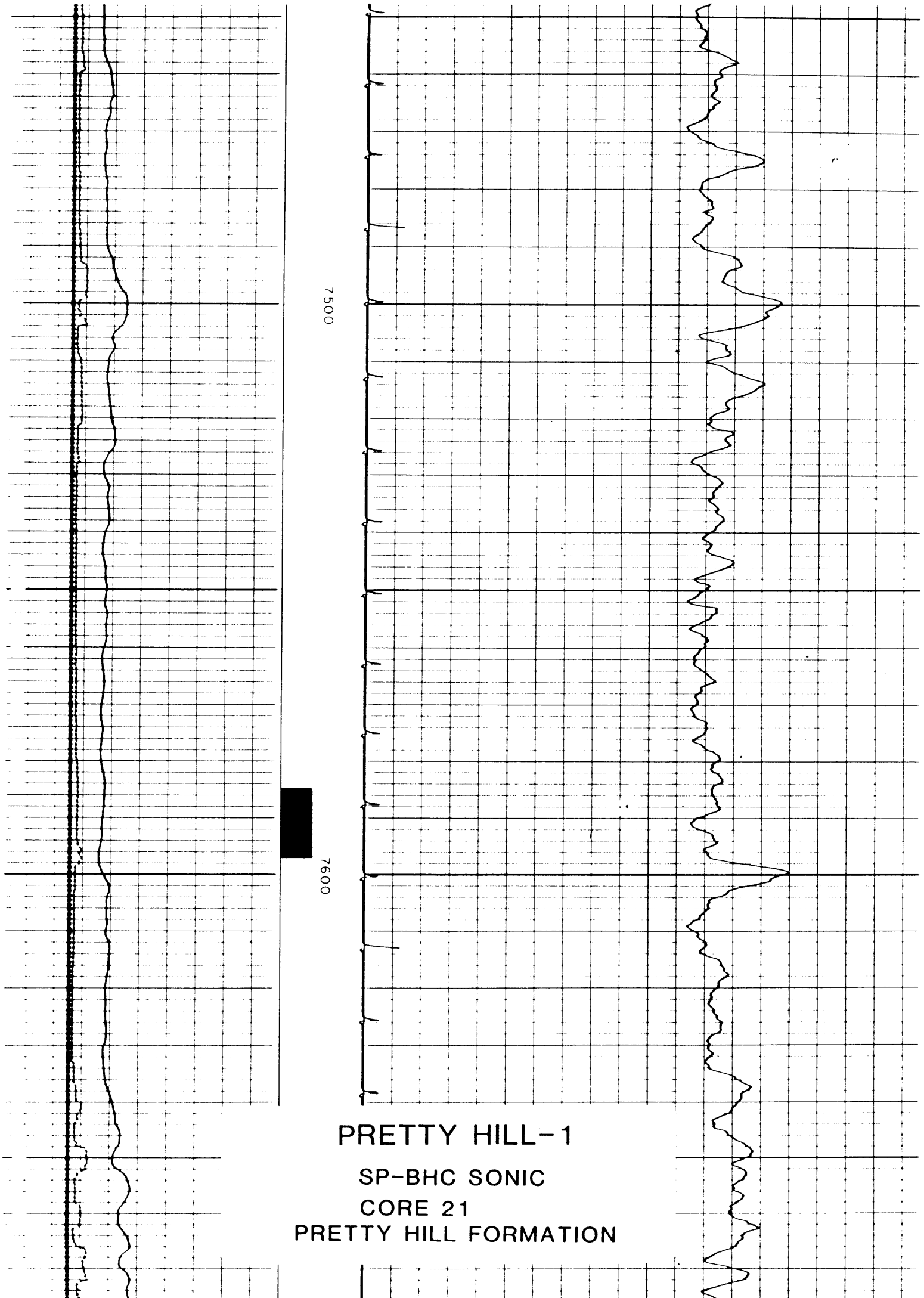
Sample: Pretty Hill-1; Core 21; 7585-7597 ft

Rock Name:
Porous sandstone

Thin Section:
The sample is very similar to that described from Core 20 and hence a detailed description will not be given. The rock probably shows less well developed stylolitic zones and has, overall, somewhat larger average grain size (0.4 mm).

Many fields of view contain of the order of 15-25% porosity and some of the pores are as large as adjacent grains so that there is some evidence of the development of secondary porosity by dissolution of some detrital mineral. A few of the quartz grains show overgrowths but for the most part the pores are bounded by the original detrital grain surfaces. Kaolinite has a patchy distribution but where it occurs it tends to completely fill the intergranular space and porosity is therefore completely removed. In some places there are remnants of pores up to about 0.1 mm in size in intergranular spaces which are otherwise completely filled by kaolinite. Scanning Electron Microscopy (SEM) of kaolinite aggregates such as these indicates that there may well be fine-grained porosity within the kaolinite aggregates. This is shown in a few places in this thin section where a small amount of faint blue staining can be seen in kaolinite aggregates. In this rock, however, it is unlikely that this porosity represents more than a very small proportion of the total porosity in the sample.

Lithic fragments are generally fairly well defined in this rock and tend to be a moderate brown colour and they consist essentially of fine-grained clays more or less stained with secondary ferruginous material. There are rare instances of what can be specifically identified as volcanic rock fragments but most are probably best ascribed, by default, to sedimentary or metasedimentary lithologies.



PRETTY HILL-1

SP-BHC SONIC

CORE 21

PRETTY HILL FORMATION

GEARHART CORE DATA

GEARHART CORE DATA PTY. LTD.
UNIT 2, 17-19 MUSGRAVE AVENUE
WELLAND, S.A.
TELEPHONE: (08) 46 4759. FAX: (08) 46 0995

Page No.

3.5

CORE ANALYSIS RESULTS

Company MINORA RESOURCES N.L.
Well PRETTY HILL No. 1
Field
State VICTORIA

Formation

Location OTWAY BASIN

File CD-SA-282
Date Report 24.05.1988
Analysts DS

Lithological Abbreviations

SAND – SD SHALE – SH LIME – LM	DOLOMITE – DOL CHERT – CH GYPSUM – GYP	ANNHYDRAITE – ANHY CONGLOMERATE – CONG FOSSILIFEROUS – FOSS	SANDY – SDY SHALY – SHY LIMY – LMY	FINE – FN MEDIUM – MED COARSE – CSE	CRYSTALLINE – XLN GRAIN – GRN GRANULAR – GRNL	BROWN – BRN GRAY – GY VUGGY – VGY	FRACTURED – FRAC LAMINATION – LAM STYLOLITIC – STY	SLIGHTLY – SL VERY – VI WITH – WI

CORE NO.	DEPTH Feet	PERMEABILITY MILLIDARCYS K.A.	POROSITY % He inj	RESIDUAL SATURATION % PORE		GRAIN DENSITY	VERT PERM	SAMPLE DESCRIPTIONS AND REMARKS
				OIL	WATER			

PRETTY HILL No. 1

18	6376' - 6388'	2997	20.5
19	6690' - 6702'	1183	18.0
20	7200' - 7214'	105	16.8
21	7585' - 7592'	340	17.2

3.6 WOOLSTHORPE # 1

CORE DESCRIPTION

CORE NO. 3 PRETTY HILL FORMATION CORED INTERVAL 5708' - 5727'

Length of Core: 19' Recovery: 13' 6" Available: 10' (approx.)

From: 5708' - 5712'

SANDSTONE; very light green grey to light grey, very friable (loosely consolidated), medium-coarse, subangular-subrounded, occasionally rounded, well sorted, clear-frosty quartz, trace to occasionally common white-light grey dispersive clay matrix, trace medium-dark grey lithics trace pink-medium red garnet, rare mica, good-very good visual porosity.

From: 5712' - 5714'

SANDSTONE; as above, fine-medium, firm, friable in part, with more argillaceous matrix, good visual porosity.

From: 5714' - 5727'

SANDSTONE; as per interval 5708' - 5712' with good-very good visual porosity.

The entire core is crumbly and perhaps that is why no attempt has been made to remove drilling mud from it. Pieces cleaned of mud are too small to exhibit any structure.

*ENVIRONMENTAL INTERPRETATION

The apparent lack of overbank deposit and the massive nature of the core suggest a depositional environment similar to that of the middle part of the point bar. The fine-medium sandstone (5712' - 5714') could be due to lateral migration and becoming more distal to the channel centre.

Sample: Woolsthorpe-1; Core 3; 5708-5727 ft

Rock Name:
Porous sandstone

Thin Section:
An optical estimate of the constituents gives the following:

Constituent	%
Quartz	55
Feldspar	10
Lithic fragments	7
Clay/matrix	3
Pores	25
Garnet	Trace

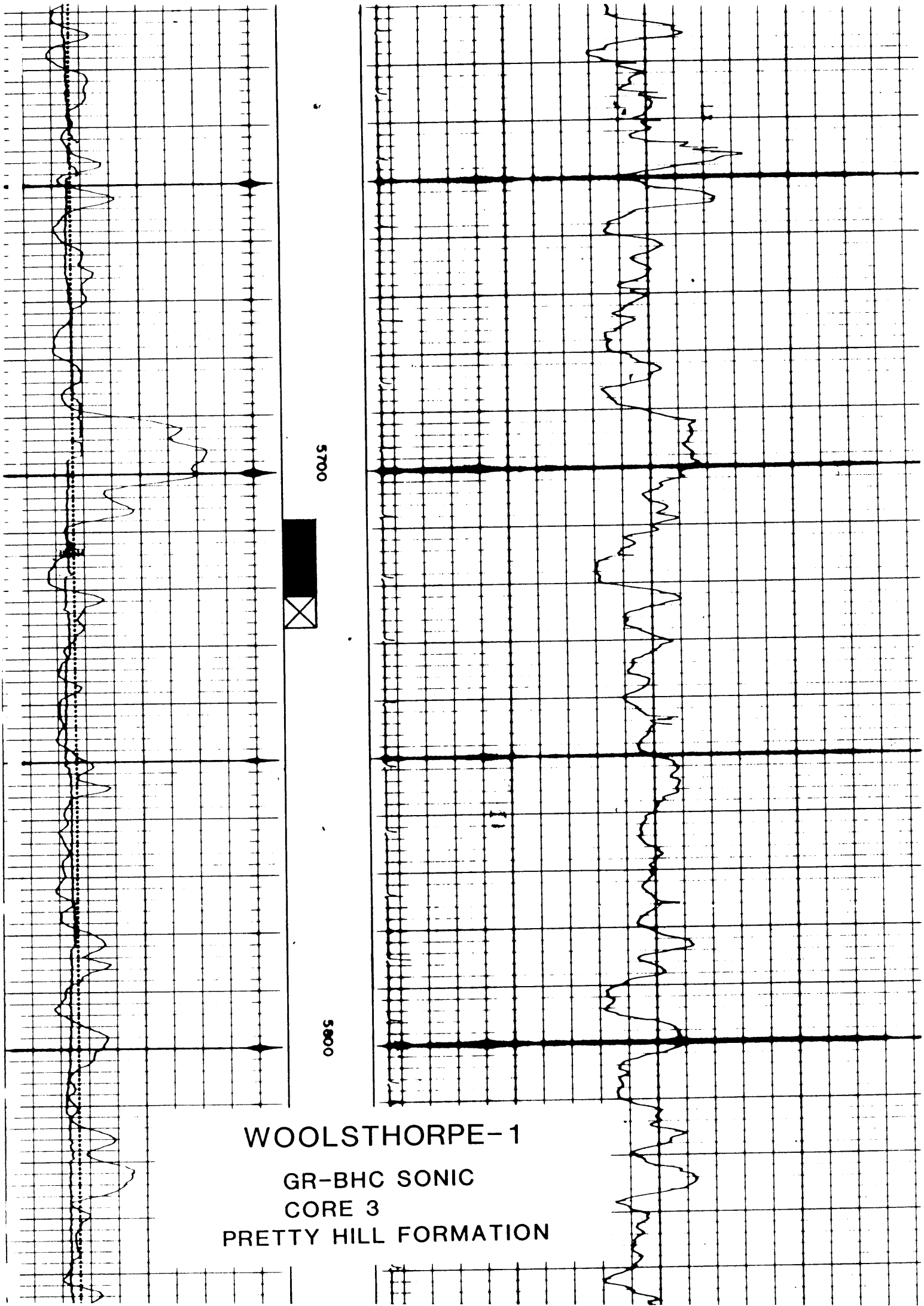
A small proportion of the thin section shows a broken sandstone with a considerable amount of fine-grained debris between the fragments but this has been taken to be unrepresentative of the rock in situ and the description refers to the bulk of the thin section in which the quartz grains have not been so fragmented. In many fields of view in this part of the section the sample essentially consists of a framework of quartz grains with void space in between. Intergranular constituents have only a patchy distribution.

The quartz grains are moderately sorted and commonly range in size from 0.25 mm to 0.8 mm. Most of the grains are subround to subangular in shape and they show only a small amount of pressure solution effects and the development of long and curved junctions. This being the case, much of the porosity is of a primary type and is probably well interconnected in three dimensions. The rock contains relatively abundant potassium feldspar and plagioclase and both minerals are generally more or less fresh or slightly turbid. Potassium feldspar occurs both as water-clear microcline grains and in perthitic aggregates derived from plutonic rocks.

The fine-grained material in the rock is somewhat difficult to describe coherently and it is thought to consist largely of lithic fragments with a smaller amount of matrix and authigenic clays. The lithic fragments generally show some evidence of their original outline even though slightly compressed and squeezed into pore throats. The grains range from rigid cherts to more abundant fine-grained clay rocks best ascribed to sedimentary or metasedimentary types. As well as these there is a smaller amount of colourless fine-grained material which generally partly fills intergranular spaces where it occurs. Some of this material may well be a genuine muddy matrix now probably consisting of kaolinite. In addition, however, there are patches of coarser grained kaolinite which is normally assumed to be of authigenic origin on the basis of the fact that such large flakes of kaolinite would not survive significant transportation. In this case it may well be that these larger flakes and aggregates of kaolinite are derived from diagenetic neo-formation of original kaolinite matrix. In summary, therefore, the patches of dark fine-grained material in the rock are thought to be genuine lithic material, recrystallised kaolinitic matrix and remnants of the original matrix in decreasing order of abundance. This material now forms patches between the grains sparsely distributed over the surface of the thin section and rarely filling intergranular spaces.

There is a little secondary porosity where feldspar has been partly dissolved and the rock does contain an unusually large amount of detrital garnet. The most notable feature of the sample from a petrographic point of view, however, is the abundance of primary pores and this derives from the apparent lack of pressure solution effect on the quartz grains and the lack of any abundant matrix or deformable lithic types.

A final feature of the rock is that some of the quartz grains contain a very thin rim of what is presumably an authigenic clay. This is present in negligible amounts from a quantitative point of view but may effect some of the petrophysical properties in the rock in that a substantial proportion of the pores are lined with this clay rather than with clean surfaces of quartz.



WOOLSTHORPE-1

GR-BHC SONIC
CORE 3
PRETTY HILL FORMATION

4. GELTWOOD BEACH FORMATION

AIM: Reservoir Study

CONCLUSIONS: —Heterogeneous porosity and permeability distribution

—Minor quartz overgrowths and dissolution

—Reduced porosity due to authigenic mineral and deformed lithic fragment development

—Variable intergranular constituents; authigenic minerals, deformed lithic fragments, homogeneous clay

— Sedimentary, metasedimentary, and volcanic lithic fragments

— Diagenetic sequence:

silica → kaolinite → siderite → dolomite

4.1 PRETTY HILL # 1

CORE DESCRIPTION

CORE NO. 17 GELTWOOD BEACH FORMATION CORED INTERVAL 6070' - 6080'

Length of Core: 10' Recovery: 6' Available: 4½'

The available core is described as follows:

SANDSTONE; white to light grey, friable-firm, medium-very coarse, dominantly medium-coarse, subangular-subrounded, moderately sorted mainly clear quartz, white-very light grey kaolinitic clay matrix, common altered feldspar, common medium-dark grey lithics/chert, trace to rare pink-medium orange brown garnet, common medium brown specks ? rare coal particles, poor visual porosity. Generally massive, minor fine flat bedding/lamination. The sandstone is interbedded with;

SANDSTONE; dominantly as above, rare large medium bluish grey shale clasts, trace carbonaceous detritus and streaks on the bedding planes, concentration of medium orange brown garnet on the bedding planes, trace to common muscovite, poor visual porosity. In places the sandstone is finely bedded with similar sandstone, light-medium brown, with abundant medium brown clay matrix. Minor fine flat beddings. Towards the base? the fine flat bedding is more pronounced with;

SANDSTONE; dark brown, gradually becoming light grey brown, hard, very hard at the contact with the above sandstone, very fine, subrounded, well sorted, multi-coloured lithic sand grains, occasional kaolinite grains, common siliceous cement, trace fine garnet, no visual porosity. Only minor cross lamination was evident in one small piece of core.

*ENVIRONMENTAL INTERPRETATION

The top and bottom of the core does not seem to be in a correct order, as a result any environmental interpretation should be treated with caution;

- The bottom? of the core intersected a sequence of floodplain or abandoned channel fill deposits.
- The rest of the core appears to have intersected middle part of a point bar channel deposit with occasional short lateral migration to the natural levee of a main meandering channel system.

Sample: Pretty Hill-1; Core 17; 6070-6080 ft

Rock Name:
Tight lithic sandstone

Thin Section:
An optical estimate of the constituents gives the following:

Constituent	%
Quartz	70
Feldspar	7
Mica	Trace
Lithics	10
Pores	3
Authigenic kaolinite	5
Siderite	3
Carbonate	1-2

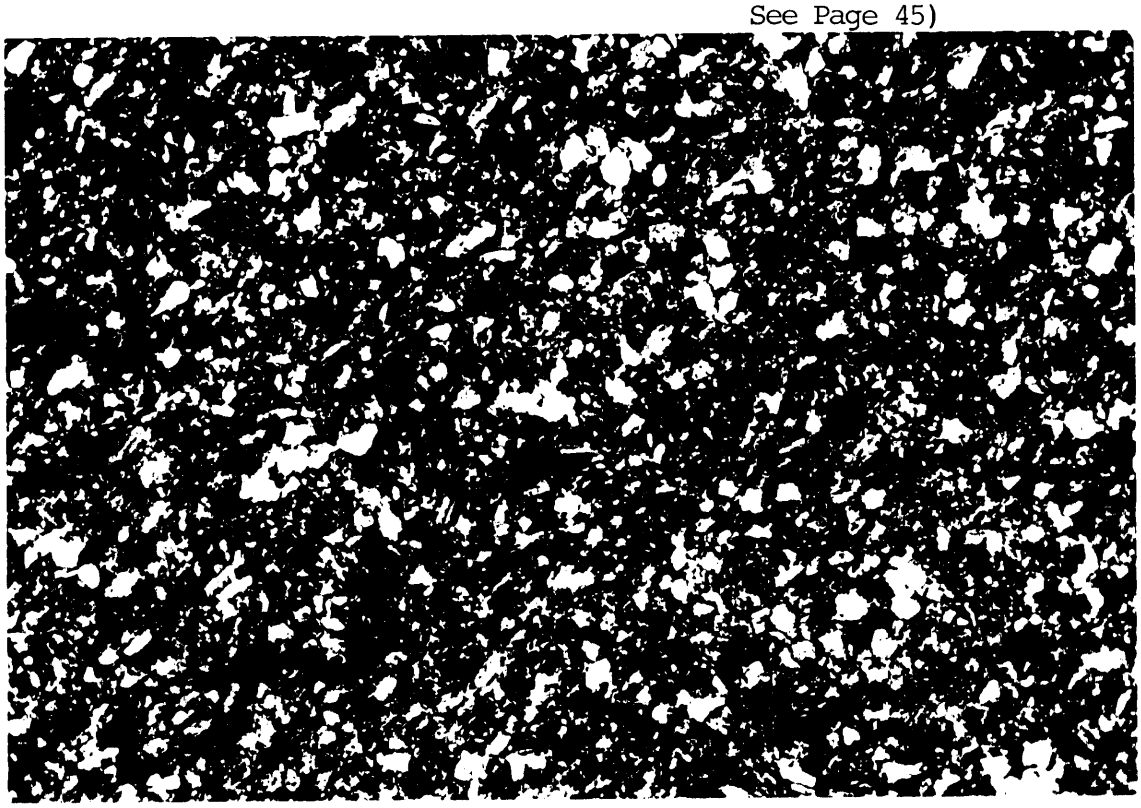
This sample is quite different from all of the others in this collection in that it contains a suite of authigenic minerals including siderite, quartz, authigenic kaolinite and a second carbonate mineral. The abundance of these phases and the presence of some lithic fragments are responsible for the limited porosity shown in the thin section.

Detrital grains are moderately well sorted but commonly range in size from 0.15 mm to as much as 0.8 mm and the average grain size is of the order of 0.25 mm. Quartz grains show some long contacts and evidence of pressure solution and a few even have discontinuous overgrowths. As far as can be determined these are relatively early in the diagenetic sequence. Feldspar is moderately abundant and characteristically is present as water-clear grains of both microcline and plagioclase. There are one or two turbid non-twinned grains which are probably a potassium feldspar mineral of some kind. Lithic material is generally relatively easy to identify since most of the grains retain some coherence and can be distinguished one from another and from the surrounding fine-grained kaolinite. A significant proportion of the lithic material appears to consist of relatively rigid grain types such as chert and very fine-grained sandstones or siltstones. There are also some very fine-grained quartzofeldspathic rocks which may be of volcanic origin. There are instances where lithic fragments can be seen compressed and squeezed into pore throats but this is not the typical occurrence of lithic grains in this rock.

As the list of minerals given above indicates the rock contains a significant suite of authigenic minerals. Kaolinite is the most abundant of these and it is present as essentially monomineralic patches which tend to fill intergranular spaces where they occur and the kaolinite is widely distributed over the area of the thin section. There are aggregates of this mineral as much as 0.3 mm in diameter. As widespread as the kaolinite is siderite which forms small dark granules. These are typically not more than 0.05 mm in size and they are speckled throughout the thin section with some concentration along grain margins. Elsewhere the small granules of siderite are scattered within aggregates of kaolinite. In some cases lithic fragments can in fact be identified and distinguished from each other by the presence of a discontinuous selvage of the fine-grained sideritic material. The siderite tends to occur outside the quartz overgrowths and therefore probably postdates these and the kaolinite. As well as siderite the rock does contain some coarser grained carbonate which is present as tabular crystals which are characteristically clear; these are probably dolomite.

In brief, therefore, this sample has a much reduced porosity and permeability largely as a result of the abundance of authigenic minerals and to a smaller extent due to the presence of lithic fragments and some pressure solution and compaction effect on these.

PHOTO 1 P.CAMPBELL 4 CORE 22 7183-7191FT.FELDSPATHIC SILTSTONE. NIC CROS. FIELD WIDTH 1.8MM (Upper Eumeralla Formation - See Page 45)



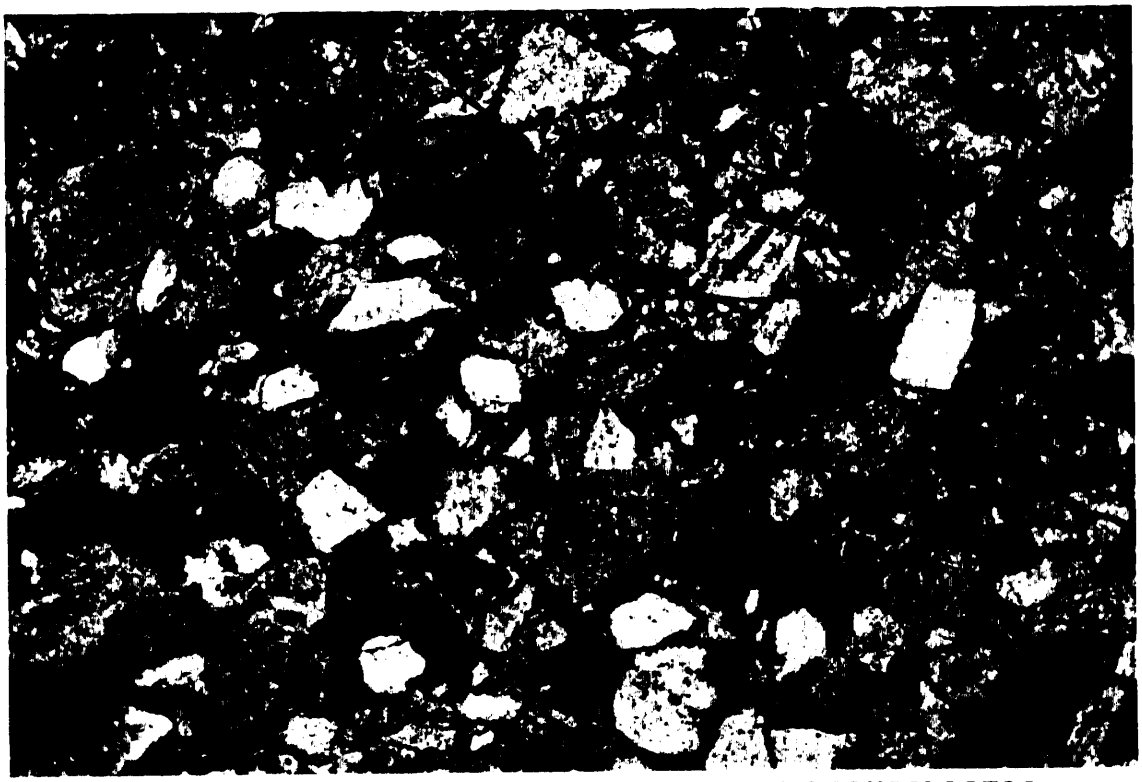
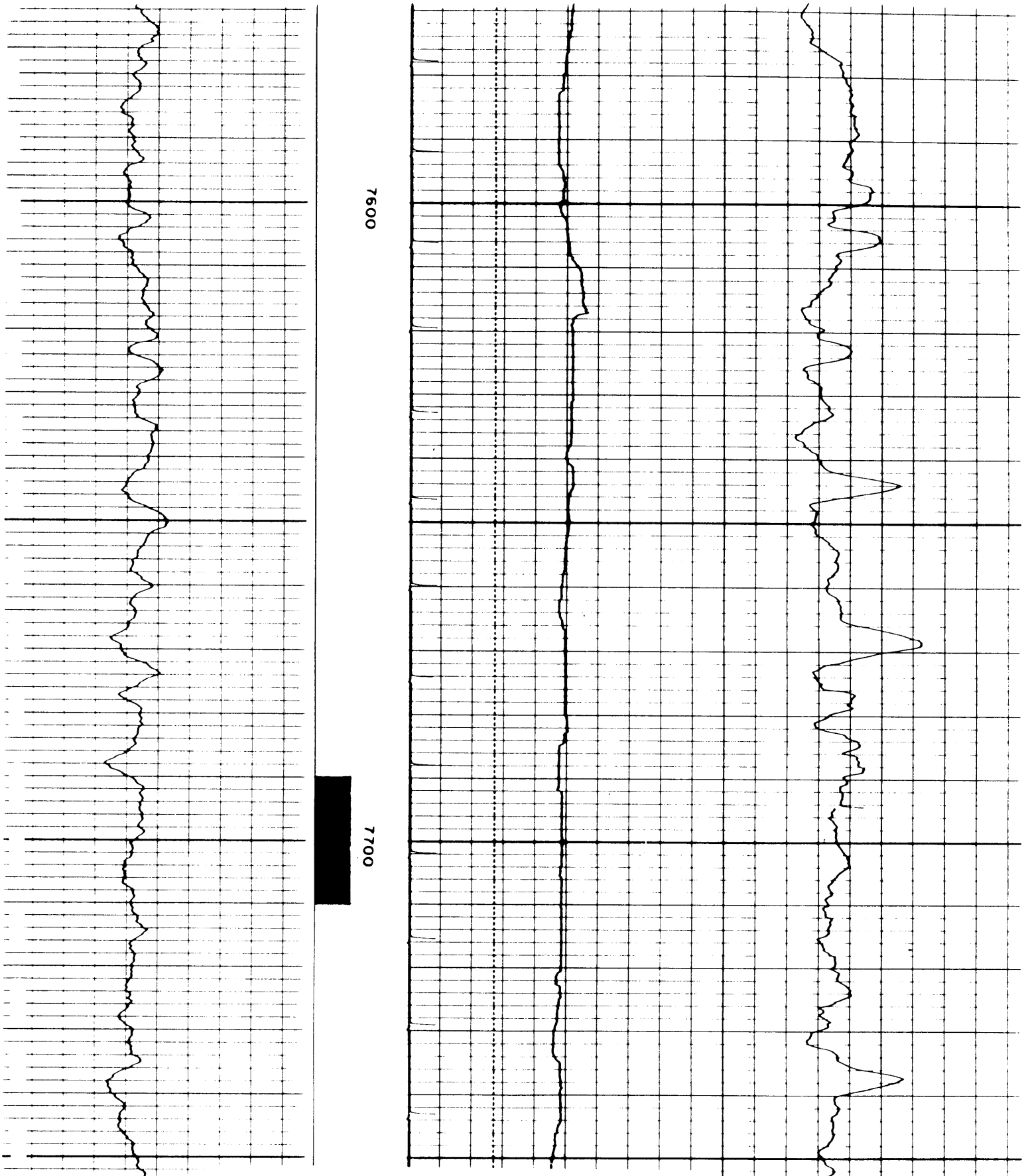


PHOTO 2 P. CAMPBELL 4. CORE 23 7690-7710FT. VOLCANOCLASTIC SHOWING SPORADIC SECONDARY POROSITY.NIC UNC. FIELD WIDTH 1.8MM



PORT CAMPBELL-4

GR-BHC SONIC
CORE 23
HEATHFIELD MEMBER

GEARHART CORE DATA

GEARHART CORE DATA PTY. LTD.
UNIT 2, 17-19 MUSGRAVE AVENUE
WELLAND, S.A.
TELEPHONE: (08) 46 4759. FAX: (08) 46 0995

Page No.

CORE ANALYSIS RESULTS

Company MINORA RESOURCES N.L.
Well PRETTY HILL No. 1
Field
State VICTORIA

Formation

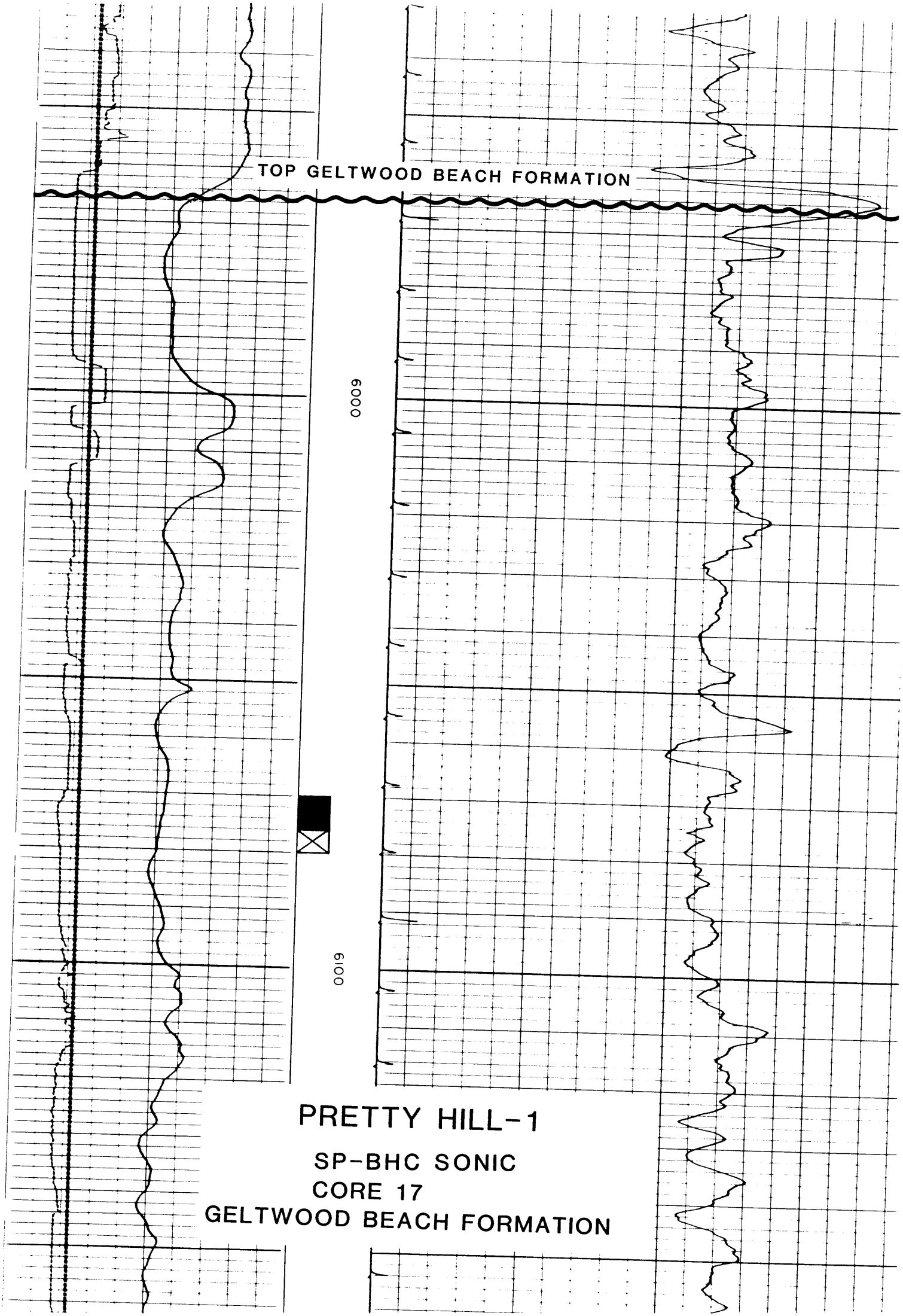
Location OTWAY BASIN

File CD-SA-282
Date Report 24.05.1988
Analysts DS

Lithological Abbreviations

SAND – SD, SHALE – SH, LIME – LM
DOLOMITE – DOL, CHERT – CH, GYPSUM – GYP
ANNHYDRAITE – ANHY, CONGLOMERATE – CONG, FOSSILIFEROUS – FOSS
SANDY – SDY, SHALY – SHY, LIMY – LMY
FINE – FN, MEDIUM – MED, COARSE – CSE
CRYSTALLINE – XLN, GRAIN – GRN, GRANULAR – GRNL
BROWN – BRN, GRAY – GY, VUGGY – VGY
FRACTURED – FRAC, LAMINATION – LAM, STYLOLITIC – STY
SLIGHTLY – SL, VERY – VI, WITH – WI

CORE NO.	DEPTH Feet	PERMEABILITY MILLIDARCYS K.A.	POROSITY % He inj	RESIDUAL SATURATION % PORE		GRAIN DENSITY	VERT PERM	SAMPLE DESCRIPTIONS AND REMARKS
				OIL	WATER			
PRETTY HILL No. 1								
17	6070' - 6080'	15.1	13.0					



PRETTY HILL-1

SP-BHC SONIC
CORE 17
GELTWOOD BEACH FORMATION

4.2 WOOLSTHORPE # 1

CORE DESCRIPTION

CORE NO. 1 GELTWOOD BEACH FORMATION CORED INTERVAL 4790' - 4799'

Length of Core: 9' Recovery: 8' 6" Available: 7' (approx.)

From: 4790' - 4795'

SANDSTONE; medium grey, medium brown grey in part, firm, hard in part, fine-very coarse, dominantly medium-coarse, angular-subrounded, dominantly subrounded, poorly sorted, clear, frosty, opaque and occasionally lt brown and lt green grey quartz, occasionally abundant dark grey lithics abundant lt grey, occasionally lt brown grey argillaceous matrix, which is silty in part, trace kaolinite clay matrix, few bands with very strong siliceous cement, trace pink-medium red garnet, trace other multi-coloured lithics, rare large shale clasts; medium green grey, silty in part, trace large coally particles; black, soft, subfissile, moderately argillaceous, earthy. The sandstone has poor-nil visual porosity in the cemented bands and poor-fair visual porosity in the remainder.

From: 4795' - 4799' the sandstone becomes gradually finer:

SANDSTONE; dominantly as above, but fine and dark grey, becoming very fine, then grading into;

SILTSTONE; medium-dark grey, firm-hard, abundant very fine quartz sand grains, trace mica, trace very fine lithics, trace carbonaceous detritus grading into;

CLAYSTONE; dark grey, moderately silty, moderately micaceous, trace-moderately carbonaceous, few slickensides.

The large portion of the core is covered by the drilling mud. However, few irregular current bedding in the sandstone and minor gentle flat bedding were evident in the uncovered portion.

*ENVIRONMENTAL INTERPRETATION

Although the available features are not sufficient to enable detail environmental analysis, the following comment is worthwhile:

- The core appears to have intersected (from bottom) floodplain deposits and gradually laterally migrated (without any interruption) into natural levee and then the meandering channel within the lower and middle part of a point bar channel units.

Sample: Woolsthorpe-1; Core 1; 4790-4799 ft

Rock Name:
Argillaceous sandstone

Thin Section:
An optical estimate of the constituents gives the following:

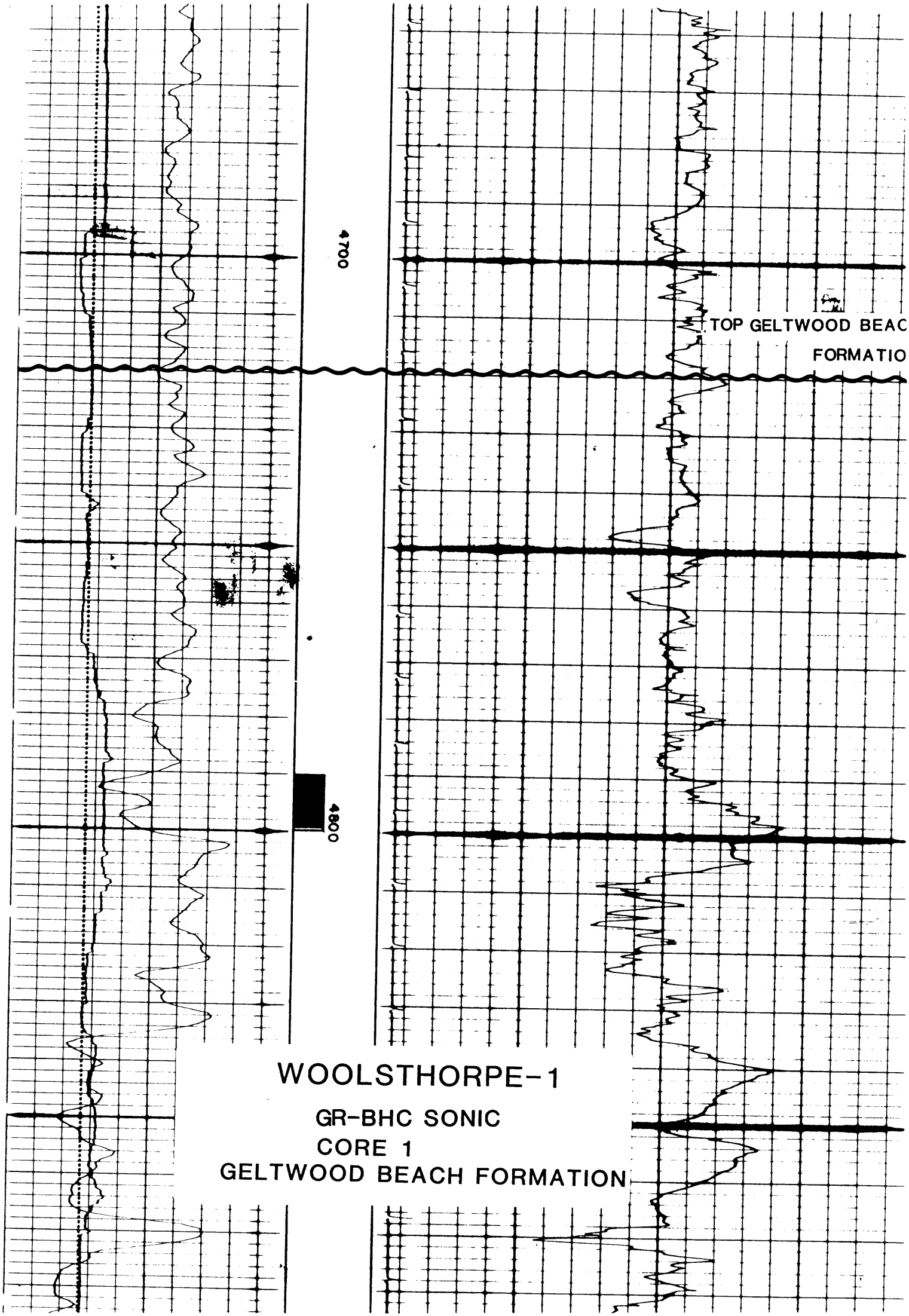
Constituent	%
Quartz	70
Feldspar	<3
Lithic fragments	7
Clay/matrix	15-20
Pores	2-3

This sample contains a homogeneous brown matrix which is interpreted as being a genuine muddy matrix which infiltrated between the framework grains as the sandstone was deposited or very soon afterwards. The material is characterised by its homogeneity which served to distinguish it from, say, material derived from lithic fragments. Pores in this rock are generally confined to a narrow zone around the quartz grains. These pores probably result from shrinkage of the matrix presumably during a drying process. The pores are therefore commonly not more than about 0.02 mm in width. There are one or two places where there is somewhat coarser grained porosity where lithic fragments have been partly dissolved.

Quartz, feldspar and lithic fragments are moderately to moderately-well sorted and commonly range in size from 0.25 mm to about 1 mm with an average size of (very approximately) 0.6 mm. The grains are subangular to round in shape and most show what are essentially tangential contacts. There has been a little pressure solution of the quartz and there is a small number of elongate contacts between quartz grains. It seems likely, however, that at a very early stage the rock underwent percolation of clays between the quartz grains and the presence of this clay probably inhibited much movement of ions within the sedimentary environment and therefore inhibited much pressure solution effect.

Detrital feldspars are as large as adjacent quartz grains but tend to show considerable alteration. Plagioclase can be specifically identified in several places but more altered feldspar may well be potassium feldspar. Lithic fragments are generally medium to fine-grained rocks which contain a mixture of quartz and clays. Many of these rocks are probably of igneous origin but they show some alteration and fragmentation due to compaction effects during diagenesis. As well as these there are clearly sedimentary lithic fragments some of which are compact sandstone whereas most are fine-grained silts or shales. In general the lithic fragments are relatively coarse-grained and strong rather than the more labile shaly types observed in the samples above.

As indicated above, the rock contains a homogeneous matrix which essentially completely fills the intergranular spaces. This matrix is brown in plane polarised light and shows moderate birefringence. From a mineralogical point of view it is likely that the material is probably iron-stained illitic clays but an X-ray diffraction analysis would be necessary to obtain a specific, certain identification. The presence of this matrix distinguishes this rock from all of those described above.



WOOLSTHORPE-1

GR-BHC SONIC
CORE 1
GELTWOOD BEACH FORMATION

4.3 WOOLSTHORPE # 1

CORE DESCRIPTION

CORE NO. 2 GELTWOOD BEACH FORMATION CORED INTERVAL 4860' - 4883'

Length of Core: 23' Recovery: 11' 6" Available: 7½' (approx.)

Five relatively distinct lithologies were recognised:

SANDSTONE; medium grey green-green grey, firm-hard, fine-medium, occasionally coarse, subangular-subrounded, moderately sorted, clear and frosty quartz and medium green and medium green grey lithics, abundant medium blue grey and blue green argillaceous matrix, rare partially altered feldspar, rare mica, very rare light pink garnet, poor visual porosity, interbedded with;

SILTSTONE; medium-dark grey, medium green grey, hard, abundantly micaceous, moderately carbonaceous, moderately argillaceous at the top, strongly arenaceous, in part grading into very fine SANDSTONE. A large portion of this section consists of slickensides with no other apparent structures. The siltstone is interbedded with;

SANDSTONE; light green grey, light grey in part, hard, very fine-fine subangular-subrounded, moderately-well sorted, clear-frosty quartz, abundant light grey-white argillaceous matrix, abundant multi-coloured lithics, trace mica, rare carbonaceous detritus, trace siliceous ? cement, poor-nil visual porosity, interbedded with;

SANDSTONE; white-light grey, light green grey in part, hard, medium-coarse, occasionally fine-coarse, angular-subrounded, poor-moderately sorted clear-frosty quartz, abundant very light grey and white clay matrix, trace weak calcareous cement, trace-common dark grey-dark green grey lithics, becoming abundant (concentrated) on minor bedding planes, occasionally interlaminated with; CLAYSTONE; dark grey. The sandstone also has trace dark pink garnet, trace mica, few small scale scour and fill structures filled with white siltstone. The sandstone has poor visual porosity, interbedded with;

SANDSTONE; white-very light grey, occasionally light brown grey, friable firm in part, medium-coarse, very coarse in part, subangular-subrounded moderately sorted, clear-frosty quartz, abundant light grey argillaceous matrix, common white kaolinite clay matrix, trace very weak calcareous cement, common medium grained dark grey lithics, trace-common pink-medium orange garnet, fair to occasionally good visual porosity. It is poorly bedded, generally massive.

WOOLSTHORPE # 1

CORE DESCRIPTION

CORE NO. 2 Cont'd. from previous page.

*ENVIRONMENTAL INTERPRETATION

Very few features are available in this core to be indicative of its environment of deposition(s). Furthermore a number of fault zones have possibly destroyed most of the sedimentary structures. However, the presence of a few minor features recognised in this core could be indicative of a point bar channel deposits with minor lateral excursion to the outer channel possibly into floodplain or abandoned channel away from the active channel. It appears that the core had eventually returned to the point bar unit systems, possibly to the upper part of the point bar sand.

Sample: Woolsthorpe-1; Core 2; 4860-4883 ft

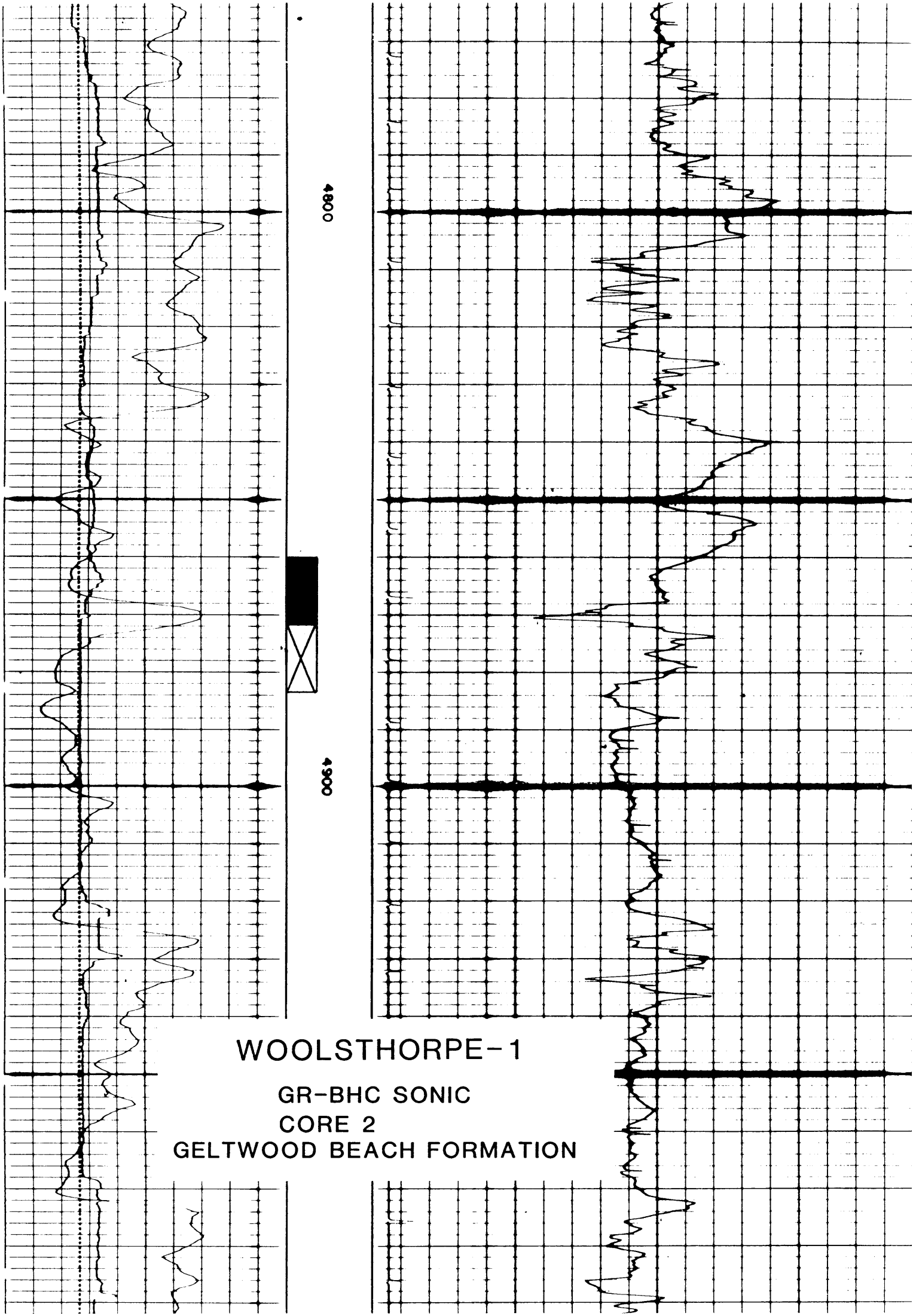
Rock Name:
Lithic sandstone

Thin Section:
An optical estimate of the constituents gives the following:

Constituent	%
Quartz	65
Feldspar	3
Lithic fragments	20
Clay/matrix	<3
Pores	10-15
Garnet, carbonate	Trace

This is a somewhat heterogeneous sample and rather different from most of those described above. The sample is generally well sorted and the quartz grains have an average size of approximately 0.25 mm. There are a few grains up to 1 mm in size and all of the grains show some variation in the extent of rounding with most being subround to subangular in shape. For the most part the quartz grains show tangential contacts with little evidence of pressure solution and it seems likely that compaction forces have been absorbed by the more deformable lithic fragments and in many instances these now completely fill the irregular intergranular spaces where they occur. However, there appears to have been a patchy distribution of lithic fragments in the original sand so that there are now some fields of view in which most of the intergranular space is occupied by deformed lithic fragments and other areas where the rock simply consists of quartz grains surrounded by pores. The lithic material is generally almost colourless in plane polarised light but tends to show variations under crossed Nicols and it is because of this that the lithic nature of the material can be ascertained. Most of the lithic fragments are extremely fine-grained lithologies with a considerable proportion of phyllosilicate minerals. Many show only weak birefringence and it seems likely that they are quartz/kaolinite/feldspar lithologies. There is a small proportion of more illitic rocks and some of these are silts or fine-grained sandstones. More rigid lithic fragments are cherts and some rocks which may be interpreted as medium to fine-grained igneous types such as microgranites or granophyres. Amongst the weakly birefringent intergranular material it is at least possible that there is some kaolinitic matrix and a small amount of this material has been assumed although very few instances of specifically identifiable matrix can be pointed to in the thin section. Suffice it to say that, in petrophysical terms, the rock does contain patchy material which fills the original detrital pores where it occurs. It is likely therefore that the permeability of the rock may not be as great as might be thought from the porosity. Also, the porosity is essentially of the primary type with some evidence of dissolution of some detrital material giving a small proportion of somewhat larger secondary pores.

The rock contains very small amounts of well crystallised carbonate and detrital garnet. These are insignificant in petrophysical terms but are an unusual feature of this rock not identified, for example, in any of the rocks described above.



WOOLSTHORPE-1

GR-BHC SONIC
CORE 2
GELTWOOD BEACH FORMATION

5. HEATHFIELD MEMBER

AIM: Reservoir Study

CONCLUSIONS:— Nil to fair visual porosity due to the presence of deformed lithic fragments and fine-grained clay matrix

— Sedimentary and metasedimentary lithic fragments of mostly fine-grained material

— Abundant feldspar-fresh and diagenetically altered

— Diagenetic sequence: clay formation

5.1 CASTERTON # 1

CORE DESCRIPTION

CORE NO. 1 HEATHFIELD MEMBER CORED INTERVAL 2016' - 2027'

Length of Core: 11' Recovery: 8' Available: 7' (approx.)

The core consists of interlaminated SILTSTONE, CLAYSTONE AND SANDSTONE:

SILTSTONE; medium grey, occasionally dark grey, firm, subfissile, moderately arenaceous, carbonaceous, micaceous and argillaceous, finely interlaminated with:

CLAYSTONE; medium grey, firm, blocky in part, subfissile in part, moderately carbonaceous and micaceous, finely interlaminated with:

SANDSTONE; light grey, firm-hard, very fine, well sorted quartz and multi- coloured lithics, light grey argillaceous matrix, trace carbonaceous detritus and flecks, no visual porosity.

Laminaes are as thin as 0.2 mm with minor interbedding of 1.5 cm in places. Minor cross lamination is present throughout the core together with flaser and lenticular beddings and few scour-fill structures. The latter were filled with poorly sorted sandstone with no apparent bedding.

*ENVIRONMENTAL INTERPRETATION

The cored interval is interpreted as crevasse-splay deposits and/or floodplain deposits, during a high flood where large quantities of flood water and sediments were cut into natural levee and into the floodplain.

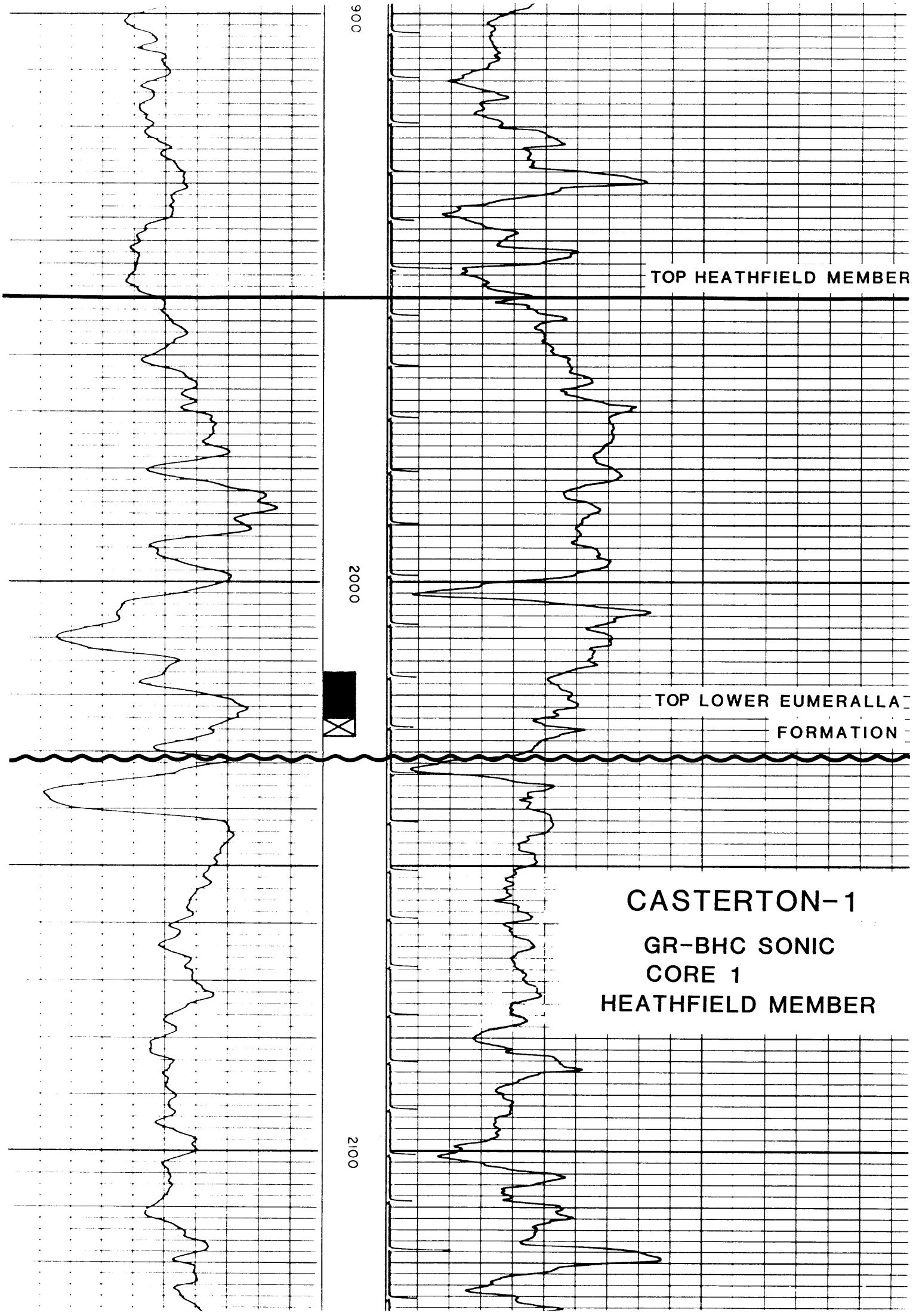
Sample: Casterton-1; Core 1; 2016-2027 ft

Rock Name:
Shale

Thin Section:
The sample is a clay and phyllosilicate-rich siltstone with a considerable amount of dispersed secondary ferruginous material. No porosity can be distinguished in the thin section and it is thought that the rock does not justify a detailed description in terms of its petrophysical properties and diagenetic history.

As far as can be determined there are quartz grains as much as 0.05 mm in size but the bulk of the rock is composed of much finer grained material in which small flakes of phyllosilicates (clays and micas) show some preferred orientation parallel to that of numerous wisps of secondary ferruginous material. There is probably a significant amount of very fine-grained quartz and feldspar in this part of the rock but it is obscured by the phyllosilicate component. There is some evidence of bedding on a scale of the order of 1-2 mm and slightly coarser beds contain quartz grains up to 0.15 mm in size and these are somewhat cleaner lithologies. Even so, there is no identifiable porosity and the lithology is dominated by fine-grained clays between the quartz grains.

As far as can be determined diagenetic minerals are absent but it is possible that there has been some recrystallisation of the detrital clay constituents in the diagenetic environment but such a recrystallisation is likely to have led to some coarsening of the texture and no significant modifications to the petrophysical properties of the rock.


900
2000
2100
TOP HEATHFIELD MEMBER
TOP LOWER EUMERALLA
FORMATION
CASTERTON-1
GR-BHC SONIC
CORE 1
HEATHFIELD MEMBER

5.2 HEATHFIELD # 1

CORE DESCRIPTION

CORE NO. 10 HEATHFIELD MEMBER CORED INTERVAL 4144' - 4154'

Length of Core: 10' Recovery: 10' Available: 9'

The original core description does not match the present arrangement of the core pieces. This means that (possibly) the depth of the core is not necessarily accurate. As a result a generalised description is given here only:

SILTY CLAYSTONE/CLAYEY SILTSTONE; medium-dark green grey, medium-dark grey, firm-hard, laminated/fissile, very occasionally blocky, rarely to moderately micaceous, moderately carbonaceous, common fine quartz sand grains in part, grading into/finely laminated with:

SANDSTONE; light grey, firm, very fine, well sorted quartz and minor lithics, trace light grey argillaceous matrix, trace fine mica, nil visual porosity.

The above sequence is interbedded with:

SANDSTONE; light-medium grey, firm, fine, fine-medium in part, subangular to subrounded, well sorted, frosty and occasionally clear quartz (70%) and multi-coloured lithics (30%), common light grey argillaceous matrix, the latter is occasionally silty, common mica, trace-common altered feldspar, trace medium grey-medium green grey mud clast, poor visual porosity. Towards the base of this section a 3 mm, coarsely crystalline calcite vein cuts through the core. This is possibly responsible for both hardness and strong calcite cementation of the base of this section.

Fine flat bedding and flat lamination as well as irregular lamination in places are amongst the recognisable features in this core. Abundant slickensides in different parts of the core may be indicative of an active tectonism in this area.

*ENVIRONMENTAL INTERPRETATION

The available data is indicative of possibly levee deposit. The sandy unit may be abandoned channel fill or the very upper part of a point bar channel system.

Sample: Heathfield-1; Core 10; 4144-4154 ft

Rock Name:
Lithic siltstone

Thin Section:
This is a relatively fine-grained rock and the average grain size is of the order of 0.06-0.08 mm so that the rock is on the boundary between a coarse silt and a very fine-grained sandstone. The rock contains of the order of 30% of detrital quartz and possibly 10-20% of feldspar but the bulk of the sample consists of turbid dark material which is probably largely fine-grained lithic fragments but may well contain a significant proportion of genuine argillaceous muddy matrix. On the other hand very fine-grained material which fills the pore spaces may be derived from squeezing and fragmentation of the lithic grains during compaction of the rock. It is difficult to distinguish these two factors from an optical examination but it seems likely to the author that a rock such as this would contain a significant proportion of fine-grained muddy matrix.

The result is that there is scarcely any porosity visible in the thin section and, to reiterate, this is due principally to the effects of compaction on the lithic fragments, the abundance of lithic material and the presence of fine-grained clay matrix.

The rock is well sorted and the grains of quartz tend to be compact in outline and distinctly angular. Feldspar is occasionally present as fresh grains of twinned plagioclase but, more frequently is seen as rather dark and turbid grains in which twinning can barely be detected. No doubt there is even more altered plagioclase and the dissolution and alteration of this in the diagenetic environment may have contributed some of the fine-grained clay constituents. Lithic material is distinctly heterogeneous and contains mainly argillaceous fragments, which, in the absence of specifically volcanic features, must be ascribed to metasedimentary or sedimentary lithologies related to shale, slate and mudstone types. Some of the lithic fragments which contain relatively abundant sericitic or illitic material can be seen in outline but where the lithic material contains only weakly birefringent constituents it is not possible even to distinguish one lithic fragment from another.

5.3 PORT CAMPBELL-4
CORE DESCRIPTION

CORE NO. 23 HEATHFIELD MEMBER CORED INTERVAL 7690'-7710'

Length of Core: 20' Recovery 20' Available: 16' (approx)

Present Status of the Core:

Boxes are not numbered, the top and the bottom of the core are not clear, apprxoimately 1' of the core is sealed in a metal container. The accessable core pieces are relatively large.

Generalised Core Description:

FELDSPATHIC/LITHIC SANDSTONE: medium to dark green grey, firm, occasionally hard, fine to medium, dominantly fine, subangular to subrounded, well sorted feldspar (50-60%), off white, light grey, occasionally pink, translucent in part, lithics (25-25%), medium to very dark grey, occasionally medium green, (possibly of volcanogenic origin), quartz (5-15%), clear to very light grey, trace to common argillaceous matrix, light to medium grey green (possibly chloritic), light grey in part, rare biotite and muscovite flakes, rare carbonaceous detritus and flecks, poor to occasionally fair visual porosity.

Recognised Structures:

The entire core consists of a massive sandstone with no apparent structures. Minor flat-laminations occur where the carbonaceous materials are concentrated.

ENVIRONMENTAL INTERPRETATION:

The core appears to have intersected a natural levee environment with minor excursions to either floodplain environment or the uper part of a point bar channel system.

Sample Port Campbell No 4 core 23 7690-7710ft.

Lithology	TUFFACEOUS SANDSTONE	
Sorting	V.good	
Grainsize	fine to medium sand	
Grainshape	euhedral to subangular	
Constituents		
Clasts	dominant	
QUARTZ	major	monocrystalline subangular,0.15-0.4mm. equant and elongate,not well oriented.
FELDSPAR	major	K feldspar and albite both abundant. dimensions as for quartz.Habits are subrhombic to subhedral, commonly fresh.
LITHICS	major	Pelitic sediments and igneous clasts. former are semischistose quartz mica rocks.Volcanics are alkali feldspar rich,some porphyritic,and /or trachytic. Rare intrusives.
MICAS	trace	Biotite deformed fresh.
HEAVIES	trace	zircon,sphene,rutile,opaques.
Matrix	minor	
CHLORITE	major	authigenic radial chlorite lining clasts ubiquitous.
ZEOLITE	major	sporadic as infilling cement,prismatic crystals sometimes semi radial,possibly LAUMONITE.(SEM).
CLAY	minor	possible KAOLIN as remnants of replaced ?feldspar

Discussion

A low quartz sandstone with abundant feldspar and lithic fragments mostly of a volcanic texture.This composition combined with the chlorite and zeolite cement indicates a volcanoclastic.There is very sporadic porosity probably of a secondary nature ex dissolved feldspars.It experienced considerable diagenetic activity and is regarded as of poor reservoir potential.

	Port Campbell No. 4.
%	23/7690-7710
CLASTS	78.4
QUARTZ	17.5
FELDSPAR	25.9
LITHICS	56.6
MATRIX	21.6
CHLORITE	51.5
CLAY	16.7
ZEOLITE	31.8
POROSITY	5.6

P O R T C A M P B E L L - 4

FIELD DATA CORE ANALYSIS REPORT

Core Number	Depth Feet	Permeability Millidarcys	Porosity Percent	Grain Density
℄ 23	7690 - 7710	0.29	11.6	2.65

5.4 PORT CAMPBELL-4 CORE DESCRIPTION

CORE NO. 24 HEATHFIELD MEMBER CORED INTERVAL 7889'-7907'
Length of Core: 18' Recovery 18' Available: 12' (approx)

Present Status of the Core:

Boxes are not numbered and the top and/or the bottom of the core are not clear. However, representative samples of every 2' are kept in the cloth bags from which the top and bottom of the core can be recognised for the purpose of core description only.

Generalised Core Description:

FELDSPATHIC/LITHIC SANDSTONE: medium grey, medium green grey in part, firm to hard, very fine to fine, dominantly fine, subangular to subrounded, well sorted feldspar (45%), translucent to very light grey, occasionally pale pink, partially altered in part, lithics (45%), medium to dark grey, occasionally pale green and pink (possible of volcanogenic origin), quartz (10%), clear to very light grey, common very light grey glassy matrix (possibly zeolite?), non dispersive and very compact, abundant large biotite flakes, strongly curved (as a result of strong compaction), rare muscovite flakes, common large coally particles and occasionally coalified plant remains/rootlet concentrated on the minor laminae, poor to nil, occasionally fair visual porosity.

Recognised Structures:

The entire core is massive sandstone with only minor flat-lamination (sub-horizontal) exhibited by concentration of mica and carbonaceous flakes.

ENVIRONMENTAL INTERPRETATION:

The entire cored interval is interpreted as stacked natural levee deposits with short lateral migration to the floodplain (minor peat formation) and possibly to the upper part of the point bar channel system.

Sample Port Campbell No 4 core 24 7889-7907ft

Lithology TUFFACEOUS SANDSTONE

Sorting V. good

Grainsize fine to medium sand.

Grainshape euhedral to subangular

Constituents

Clasts	dominant	
QUARTZ	major	monocrystalline,subangular,0.2-0.3mm equant >> elongate, rare evidence of epitaxial growth.
FELDSPAR	major	K feldspar and albite equally common. both commonly tabular to rhombic euhedra fresh,long dimensions 0.2-0.35mm.Some two feldspar composites. K feldspar is microcline perthite in part.
LITHICS	major	sediments and igneous , former include fine shaley masses,and possible cherty quartzites.Dominant are igneous rocks of an alkali feldspar microlite rich nature with trachytic texture, some alkali feldspar phenocrysts.Also there are hypabyssal and ?plutonic feldspar +-quartz lithics,with a rare granophyric quartz/feldspar clast visible.Altn. of feldspars in lithics is v minor.
MICAS	access.	uncommon muscovite and biotite,as elongate distorted oriented 0.25mm fresh flakes.
HEAVIES	trace	zircon,apatite,sphalerite,leucoxene.
OPAQUES	trace	includes iron oxides,and ?carbonaceous wisps.
Matrix	minor	
CHLORITE	major	authigenic radial crusts lining clasts, less ubiquitous than other sands, some chlorite infills pores.
ZEOLITE	minor	sporadic infilling as semi radial bladed crystals,?LAUMONTITE.
CLAY	access.	occasional ?kaolin pockets ex ?feldspar

Discussion

Identical to the 7690ft sample.

	Port Campbell No. 4.
%	24/7889-7907
CLASTS	83.3
QUARTZ	13.8
FELDSPAR	21.2
LITHICS	65.0
MATRIX	16.7
CHLORITE	66.7
CLAY	13.7
ZEOLITE	19.6
POROSITY	1.0

PHOTO 3 P. CAMPBELL 4 CORE 24 7889-7907FT SLIGHTLY FOLIATED VOLCANOCLASTIC SHOWING MODERATE QUARTZ CONTENT.(CLEAR) NIC UNC. FIELD WIDTH 1.8MM

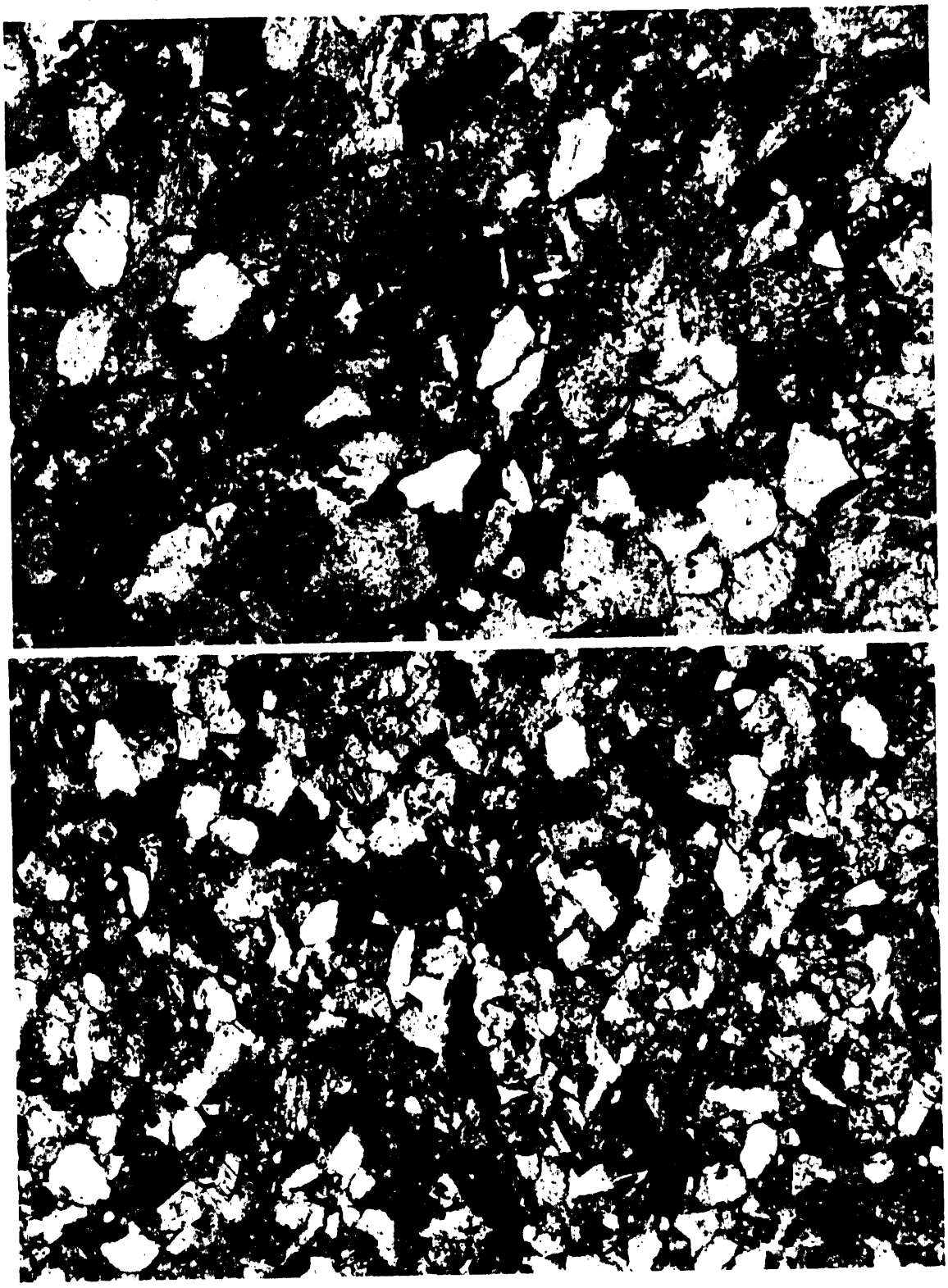
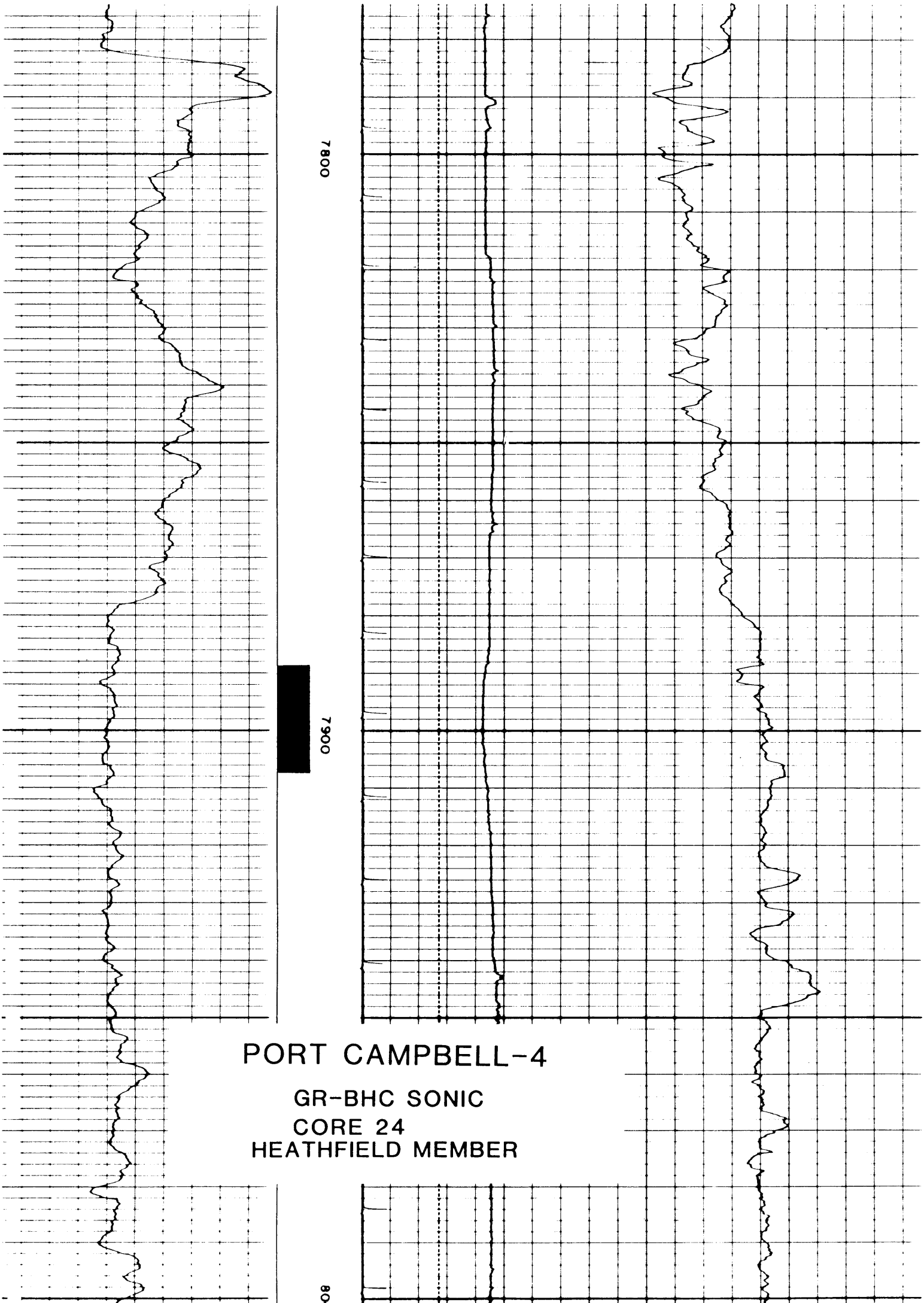


PHOTO 4 P.CAMPBELL 4 CORE 26 8279-8299FT WELL SORTED TUFFACEOUS SANDSTONE WITH CARBONACEOUS STRIP. NIC UNC. FIELD WIDTH 1.8MM.(Lower Eumeralla Formation - see Page 52)



PORT CAMPBELL-4

GR-BHC SONIC
CORE 24
HEATHFIELD MEMBER

P O R T C A M P B E L L - 4

FIELD DATA CORE ANALYSIS REPORT

Core Number	Depth Feet	Permeability Millidarcys	Porosity Percent	Grain Density
¢ 24	7889 - 7907	0.13	9.2	2.67

5.5 PORT CAMPBELL-4
CORE DESCRIPTION

CORE NO. 25 HEATHFIELD MEMBER CORED INTERVAL 7907'-7910'

Length of Core: 3' Recovery 3' Available: 2' (approx)

Present Status of the Core:

The remnant core pieces are too small and do not appear to be in their original state.

Generalised Core Description:

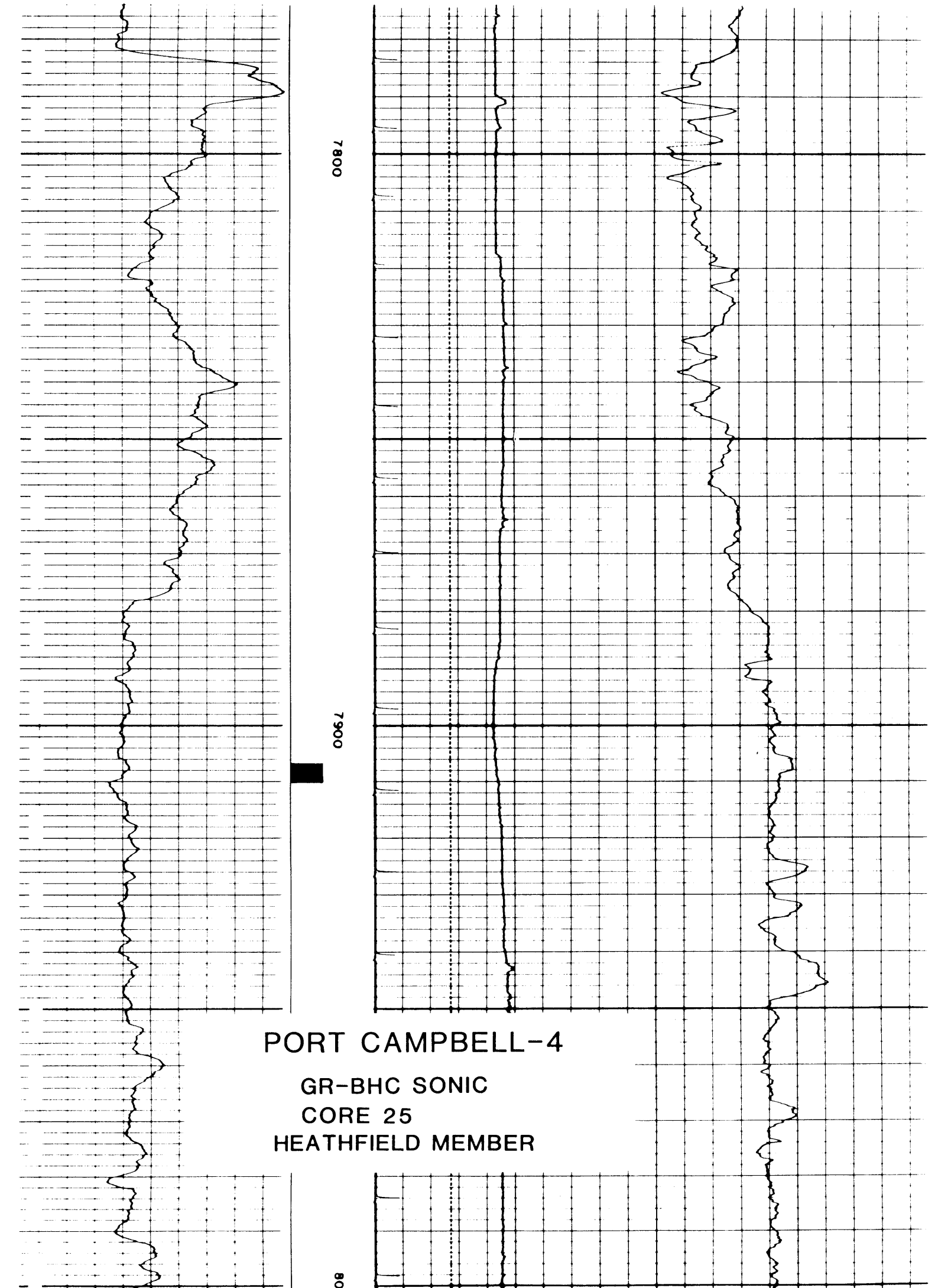
FELDSPATHIC/LITHIC SANDSTONE: as per core No. 24

Recognised Structures:

None

ENVIRONMENTAL INTERPRETATION:

As per Core No. 24


7800
7900
PORT CAMPBELL-4
GR-BHC SONIC
CORE 25
HEATHFIELD MEMBER

6. EUMERALLA FORMATION

AIM: Reservoir Study

CONCLUSIONS:—Poor to nil visual porosity

—Common feldspar

—Sedimentary, metasedimentary, and volcanic lithic fragments of fine-grained material

—Argillaceous matrix

—Diagenetic sequence: chlorite/smectite

6.1 PORT CAMPBELL # 4

CORE DESCRIPTION

CORE NO. 18 UPPER EUMERALLA FORMATION CORED INTERVAL 6070' - 6084'

Length of Core: 14' Recovery: 13' 9" Available: 6' (approx.)

The core pieces are completely mixed up and part of it (may be 1' or more) is sealed in a metal container and unaccessable. The depth of the sealed core is not clear due to the rust on the container. The rest of the core has no depth tag and required some guess work to predict its depth. The following is a generalised description:

SANDSTONE; light-medium green grey, light-medium grey, firm, friable in part, fine-medium, subangular-subrounded, dominantly subangular, well sorted, clear and opaque quartz (40%) and dark grey and black lithics (60%), common light-medium grey dispersive clay matrix, silty in part, trace-common large biotite flakes, rare altered feldspar, trace fine muscovite, common large carbonised plant fragments, common fine laminae of carbonaceous detritus and coally material, fair-good visual porosity, interbedded with:

CLAYSTONE; medium brown grey, hard, subfissile, trace micromica, common very thin and discontinuous laminae of coal streaks, rare very thin lenses of siltstone, very silty in part grading into:

SILTSTONE; medium green-grey, firm, hard in part, common-abundant medium-coarse biotite flakes, rare muscovite, trace carbonaceous detritus, rare fine quartz sand grains.

Few planar cross lamination and some flat lamination as well as minor lenticular bedding are recognised in this core. Abundant slickensides, particularly within the claystone unit, destroyed possibly a large portion of the core's structures.

*ENVIRONMENTAL INTERPRETATION

Available data suggests that the core might have intersected a sequence of crevasse splay deposits. The upper part of the core may be part of the distal point bar channel.

Sample: Port Campbell-4; Core 18; 6070-6084 ft

Rock Name:
Lithic arkose

Thin Section:
An optical estimate of the constituents give the following:

Constituent	%
Quartz	30
Feldspar	10
Mica	1
Lithic fragments	55
Clay/matrix	2
Pores	5

This is a moderately well sorted to well sorted sandstone which has an average grain size of approximately 0.25-0.3 mm. Most of the grains are more or less equant in shape but distinctly angular. There has been some compaction of the rock and consequently some deformation of the lithic fragments so that they fit closely together and show some evidence of having been squeezed into pore throats. As a result of this compaction effect the porosity of the rock has been reduced to a level of approximately 5%. The pores are interpreted as being essentially primary in origin with possibly 30% of the pores derived from dissolution of some kinds of detrital grains. The pores are unlikely to be interconnected in three dimensions.

Feldspar is relatively abundant in this rock and forms angular grains very largely of plagioclase. The material ranges from being water-clear to rather turbid and altered. Lithic grains are fine-grained and rather turbid and dark in plane polarised light. Most cannot be specifically attributed to igneous lithologies but consist of somewhat foliated fine-grained aggregates of clays, sericite and quartz. Some of these may be altered igneous rocks but it is more reasonable to assign them to metasedimentary and sedimentary lithologies. Volcanic fragments can be seen, however, and comprise possibly of the order of 10-25% of the lithic fragments. Most of these volcanic rocks appear to be fine-grained feldspathic types and some show some foliation. Some of the fragments show small crystals of epidote possibly derived from primary pyroxene in basic igneous rocks. It seems likely, also, that the detrital plagioclase is an indication of abundant intermediate or basic igneous rocks in the provenance area.

There are small amounts of detrital biotite which shows some pleochroism but also evidence of having been somewhat discoloured during diagenesis.

The sample does show one clear evidence of authigenesis in that virtually all of the grains show a narrow (0.02 mm) rim of a pale green phyllosilicate mineral. This essentially covers every grain and lines most of the pores; it is not possible to be sure of the mineralogical nature of this phase but chlorite or smectite would be best identifications on optical means alone. This mineral is quantitatively perhaps not very important but it is worth emphasising that the reactivity of the rock and its reservoir properties are probably very highly affected by the fact that this mineral lines all the pores and probably has contributed to choking many of the smaller pore throats. Apart from the presence of this mineral and some compaction, the rock shows no diagenetic effects.

GEARHART CORE DATA

GEARHART CORE DATA PTY. LTD.
UNIT 2, 17-19 MUSGRAVE AVENUE
WELLAND, S.A.
TELEPHONE: (08) 46 4759. FAX: (08) 46 0995

Page No.

CORE ANALYSIS RESULTS

Company MINORA RESOURCES N.L.
Well PORT CAMPBELL No. 4
Field
State VICTORIA

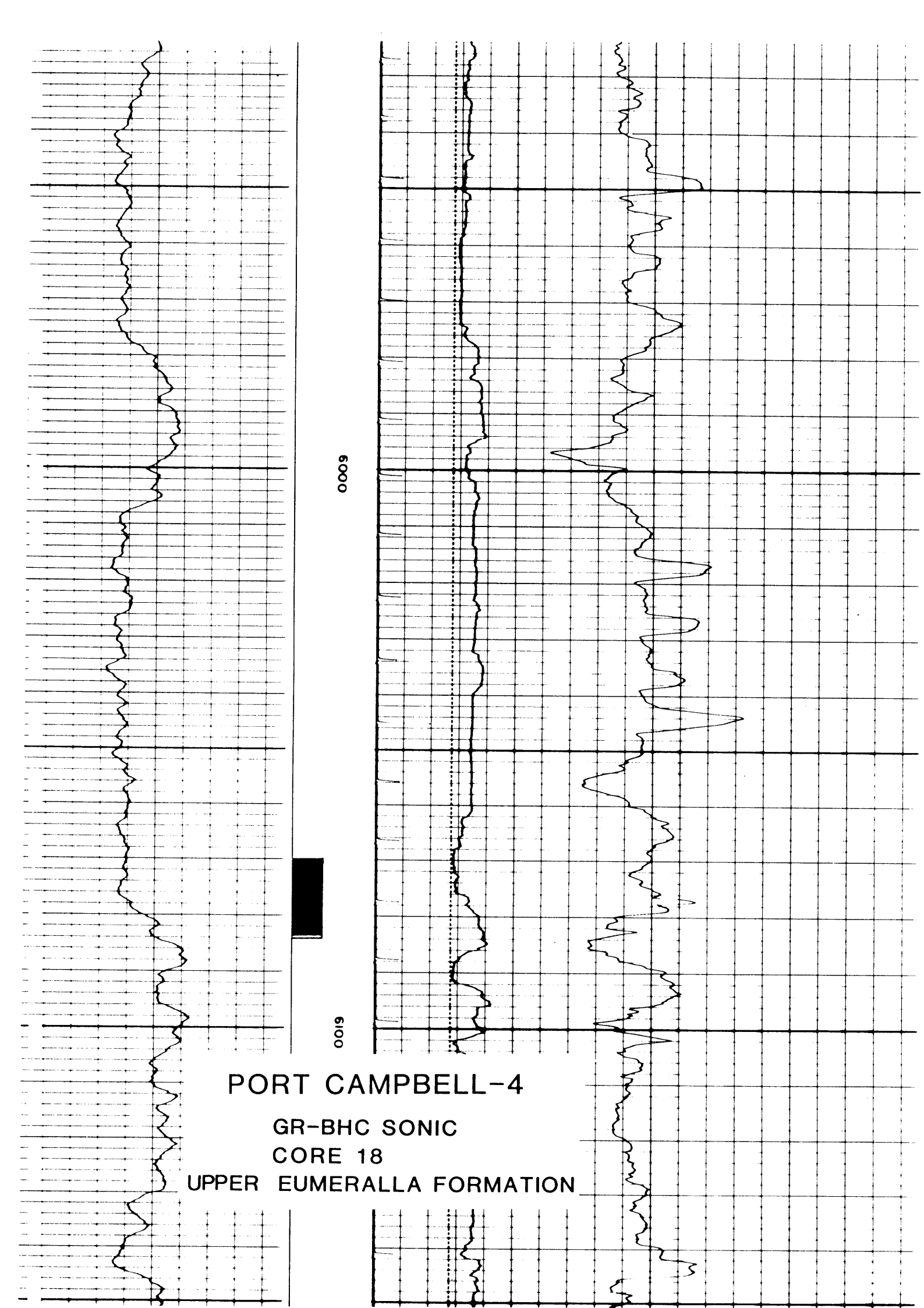
Formation
Location OTWAY BASIN

File CD-SA-282
Date Report 24.05.1988
Analysts DS

Lithological Abbreviations

SAND – SD	DOLOMITE – DOL	ANNHYDRAITE – ANHY	SANDY – SDY	FINE – FN	CRYSTALLINE – XLN	BROWN – BRN	FRACTURED – FRAC	SLIGHTLY – SL
SHALE – SH	CHERT – CH	CONGLOMERATE – CONG	SHALY – SHY	MEDIUM – MED	GRAIN – GRN	GRAY – GY	LAMINATION – LAM	VERY – VI
LIME – LM	GYPSUM – GYP	FOSSILIFEROUS – FOSS	LIMY – LMY	COARSE – CSE	GRANULAR – GRNL	VUGGY – VGY	STYLOLITIC – STY	WITH – WI

CORE NO.	DEPTH Feet	PERMEABILITY MILLIDARCYS K.A.	POROSITY % He inj	RESIDUAL SATURATION % PORE		GRAIN DENSITY	VERT PERM	SAMPLE DESCRIPTIONS AND REMARKS
				OIL	WATER			
	PORT CAMPBELL No. 4							
18	6070' - 6084'	6.0	20.0					



PORT CAMPBELL-4

GR-BHC SONIC

CORE 18

UPPER EUMERALLA FORMATION

6.2 PORT CAMPBELL # 4

CORE DESCRIPTION

CORE NO. 19 UPPER EUMERALLA FORMATION CORED INTERVAL 6355' - 6367'

Length of Core: 12' Recovered: 7' Available: 5' (approx.)

The core pieces are mixed up and no depth tag/mark can be found. A generalised description is given below:

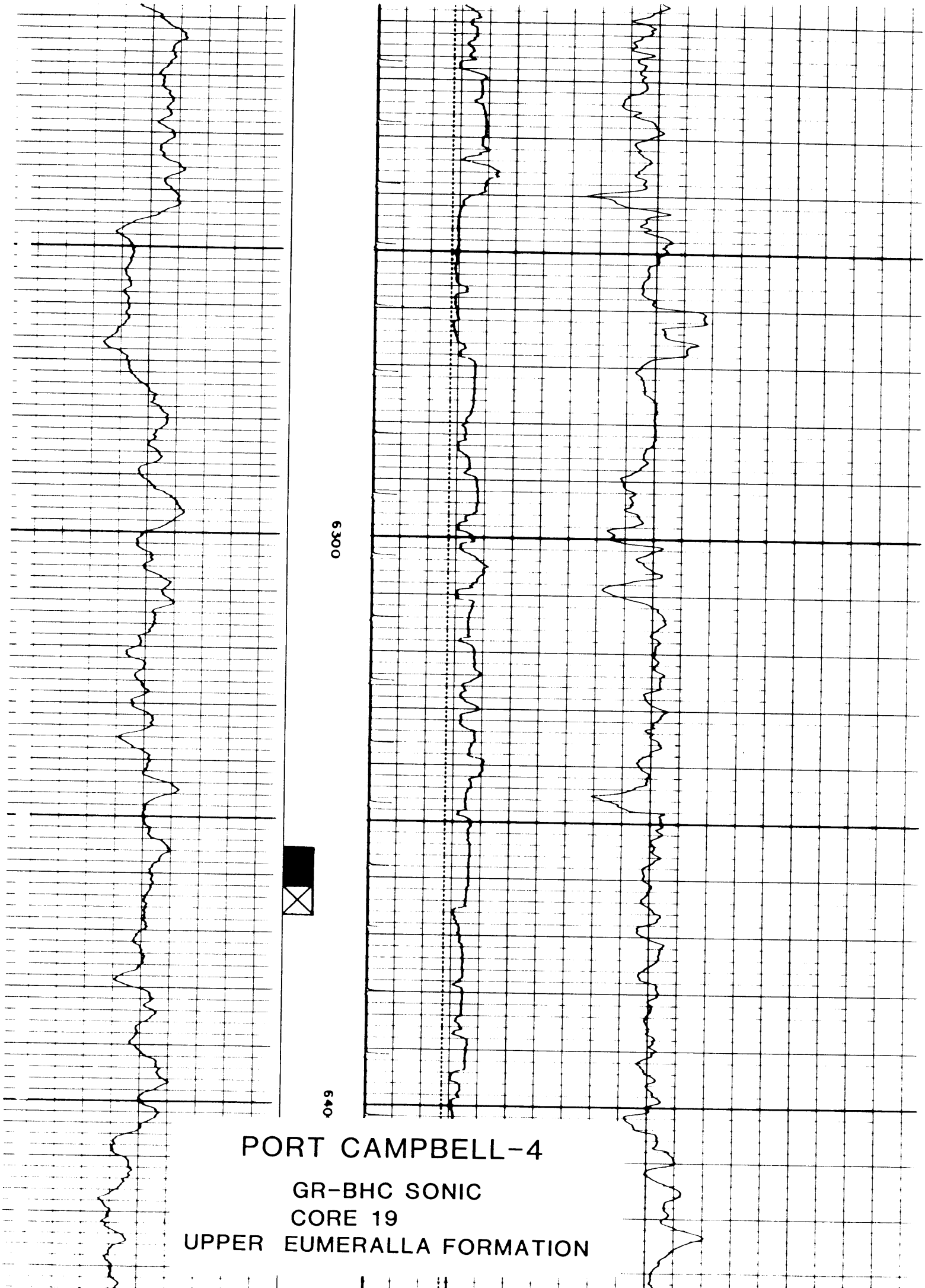
SILTSTONE; medium grey, medium brown grey, medium-dark grey in part, medium green-grey in part, firm, moderately argillaceous, abundantly micaceous, trace carbonaceous detritus, abundant large coally particle on some bedding planes, very finely interlaminated with:

SANDSTONE; light grey, occasionally white, firm, very fine to silt size, subrounded, well sorted quartz and abundant multi-coloured lithics trace light grey silty clay matrix, common mica, common carbonaceous detritus, nil visual porosity.

Minor flat lamination in the siltstone unit and occasional planar cross lamination in the sandstone are only recognisable features in this core.

*ENVIRONMENTAL INTERPRETATION

Although there is insufficient data to interpret detail environment of deposition, a natural levee deposit appears to resemble the lithology and sedimentary structures of this core. The core data indicates that its environment of deposition was away from the main meandering river system. However, a floodplain environment can not be ruled out entirely.



PORT CAMPBELL-4

GR-BHC SONIC
CORE 19
UPPER EUMERALLA FORMATION

6.3 PORT CAMPBELL # 4

CORE DESCRIPTION

CORE NO. 20 UPPER EUMERALLA FORMATION CORED INTERVAL 6663' - 6683'

Length of Core: 20' Recovery: 7' Available: 3' (approx.)

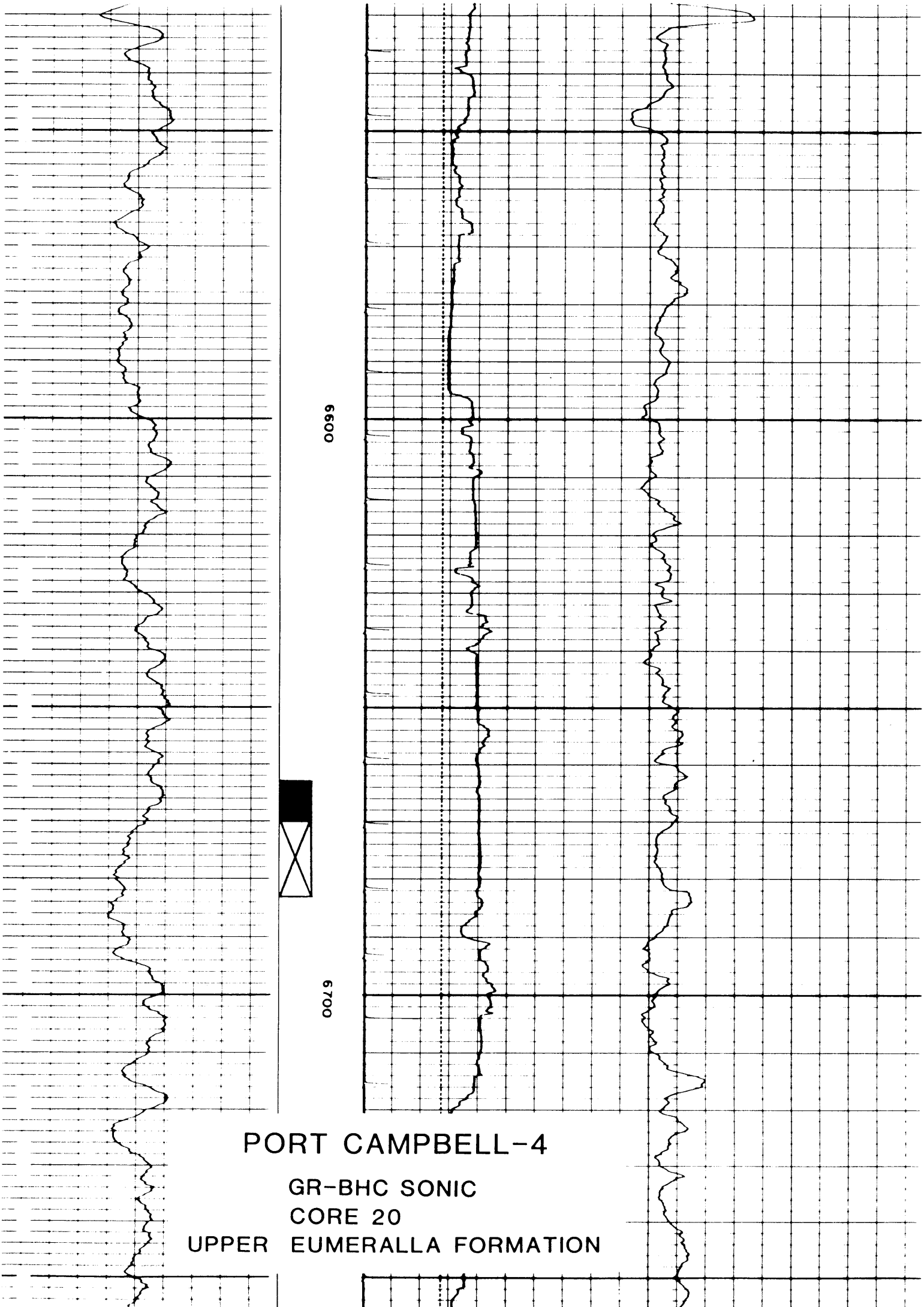
The entire core remnant consists of:

SILTSTONE; medium-dark green grey, occasionally dark grey, hard, sub-fissile, massive in part, common mica, trace carbonaceous detritus, trace fine quartz sand grains, trace to common multi-coloured lithics, trace medium-bluish grey, medium-coarse grained mud clast, rare carbonised plant fragments, moderately argillaceous in part, occasionally grading into: SILTY CLAYSTONE.

Sedimentary structure is rare in this core and is restricted to minor flat and very few cross laminations. Occasional mud clast and rootlets are also recognised.

*ENVIRONMENTAL INTERPRETATION

With the available data can only suggest an environment of deposition away from the active channels. This includes a floodplain, part of a crevasse splay or even the distal part of a natural levee.



PORT CAMPBELL-4

GR-BHC SONIC
CORE 20
UPPER EUMERALLA FORMATION

6.4 PORT CAMPBELL-4
CORE DESCRIPTION

CORE NO. 22 UPPER EUMERALLA FORMATION CORED INTERVAL 7183'-7191'

Length of Core: 8' Recovery 8' Available: 5' (approx)

Present Status of the Core:

Boxes are not numbered and there is no mark to identify the top and/or the bottom of the core. There is no gap for missing pieces and the remnant of the core does not appear to be in its original state. Furthermore, most of the available core pieces are too small to allow the recognition of any present structure.

Generalised Core Description:

SILTSTONE: medium to dark grey, medium to dark brown grey, hard, firm in part, massive, very rarely subfissile, occasionally carbonaceous & micaceous, trace to common multi-coloured lithics & partially altered feldspar, moderately argillaceous in part, trace to common medium to dark grey brown bentonitic(?) clay pebble and streaks (laminae), interbedded and/or interlaminated with;

SANDSTONE: medium grey to medium green grey, medium brown grey in part, firm to hard, very fine to fine, subangular to subrounded, moderately to well sorted clear to very light grey quartz and abundant multi-coloured lithics, abundant weathered feldspar, trace lgiht grey to white argillaceous matrix, trace carbonaceous detritus & streaks, trace to common biotite and muscovite, poor to nil visual porosity, interbedded with;

CLAYSTONE: medium to dark grey, medium to dark brown grey in part, firm to hard, massive, moderately micromicaceous, rarely carbonaceous, common to abundant coalified plant remains/rootlet in part, common multi-coloured lithics, trace very fine sand grains, moderately silty in part, grading into CLAYEY SILTSTONE in part, trace slickensides in part.

Recognised Structures:

Minor cross-lamination and cross-bedding are recognised in the Siltstone/Sandstone section. Trace to common clay pebbles and very few scour and fill are also present in this section. The Claystone section is massive with no recognisable structure. The minor slickenside is interpreted as being the product of the local faulting.

ENVIRONMENTAL INTERPRETATION

The available data suggests that the lower part of the core might have intersected a sequence of floodplain deposits. The upper part of the core may be part of the natural levee deposit with short lateral migration to the upper part of a point bar channel system.

Sample Port Campbell No 4 core 22 7183-7191ft.

Lithology TUFFACEOUS SILTSTONE

Grainsize silt.

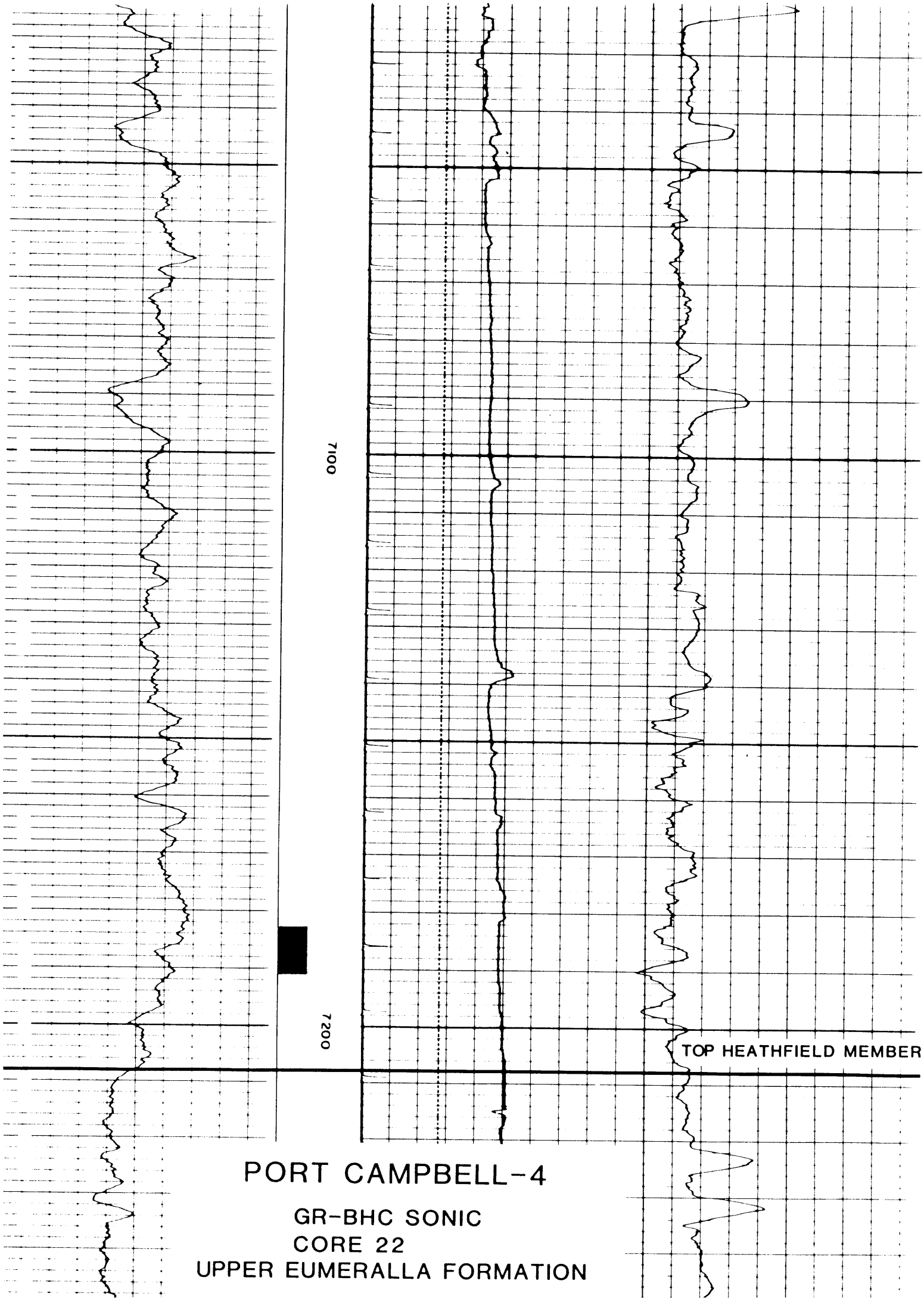
Grainshape subangular to subhedral

Constituents

QUARTZ	major	angular,0.1 to <0.05mm.
FELDSPAR	major	subangular to subhedral K feldspar , often elongate,some perfect rhombs, fresh,0.1-<0.05mm.Plagioclase fresh subhedral.
MICAS	minor	Biotite >>Muscovite.Fresh semi-oriented biotite both long strips, and equant mass. Occasional coarse single muscovite flake, otherwise sericitic ex ?feldspars.
CHLORITE	major	Ubiquitous, appears as interstitial matrix to clasts, some ex biotite.
OPAQUES	access.	strips that are slightly concentrated in a "layer"plus occasional angular grains,both carbonaceous(SEM).
HEAVIES	trace	zircon,apatite.

Discussion

A siltstone containing a major alkali feldspar content that may relate it to the three tuffaceous sandstones.



PORT CAMPBELL-4

GR-BHC SONIC
CORE 22
UPPER EUMERALLA FORMATION

P O R T C A M P B E L L - 4

FIELD DATA CORE ANALYSIS REPORT

Core Number	Depth Feet	Permeability Millidarcys	Porosity Percent	Grain Density
¢ 22	7183 - 7192	0.03	11.5	2.70

6.5 EUMERALLA # 1

CORE DESCRIPTION

CORE NO. 10 | HEATHFIELD MEMBER / LOWER EUMERALLA FORMATION | CORED INTERVAL 5799' - 5816'

Length of Core: 17' Recovery: 12' Available: 8½' (approx.)

Due to the uncertainty of the original core pieces arrangement, only generalised description was carried out in this core:

SANDSTONE; medium green grey medium grey in part, firm-hard, very fine-fine, very silty in part, subangular-subrounded, moderately to well sorted, clear-frosty quartz, abundant multi-coloured lithics, common light medium grey, occasionally medium green grey argillaceous matrix, silty in part, common large biotite flakes, rare fine muscovite, rare fine carbonaceous flecks, poor-nil visual porosity, grading into and interlaminated with:

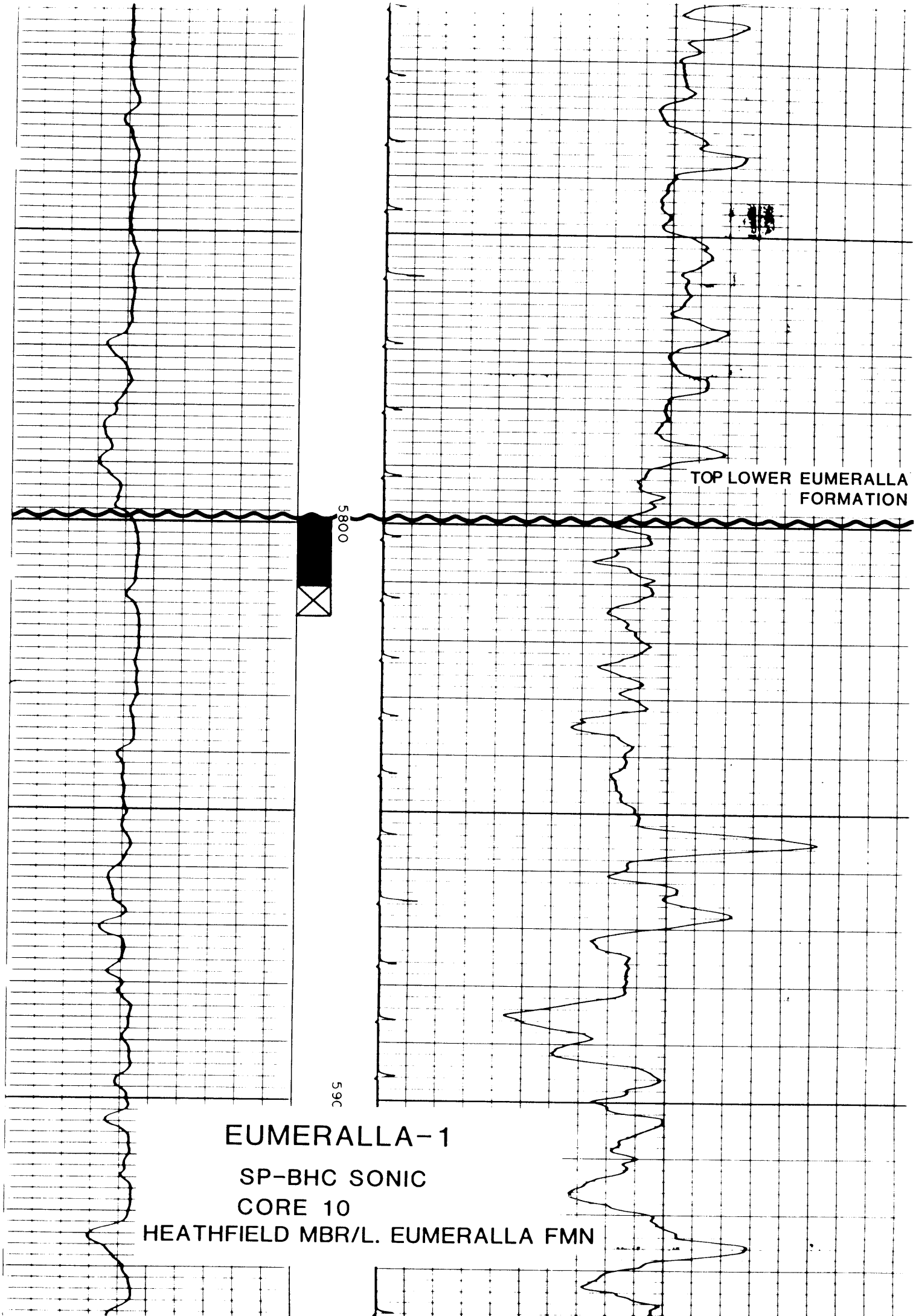
SILTSTONE; medium green grey, firm-hard, moderately-strongly argillaceous, trace-common very fine quartz sand and lithic grains, moderately micaceous, finely interbedded/interlaminated with:

CLAYSTONE; medium-dark grey, firm-hard, subfissile-fissile, moderately silty, slightly micaceous, common carbonaceous detritus and flecks, rare carbonised plant fragments with their cavities filled with cryptocrystalline pyrite (in places pyrite has been oxidized to haematite).

Few cross laminations occur in the sandstone portion with some flat lamination within the finer sediments. Numerous faults in this core resulted in slickensiding a large portion of the core.

*ENVIRONMENTAL INTERPRETATION

The lower claystone unit displays characteristic features of a back-swamp sequence of the floodplain environment. The sandstone/siltstone units resembling the levee and/or the upper part of the point bar sands.



EUMERALLA-1

SP-BHC SONIC

CORE 10

HEATHFIELD MBR/L. EUMERALLA FMN

6.6 CODRINGTON # 1

CORE DESCRIPTION

CORE NO. 18 EUMERALLA FORMATION CORED INTERVAL 3937' - 3957'

From: 3937' to 3952'

SANDSTONE; medium green grey, friable, fine to medium at the top, medium to coarse, dominantly medium in middle, medium to coarse, dominantly coarse towards the base, angular to subrounded, dominantly subangular to subrounded, moderately sorted lithics (60% - 70%) and clear to frosty quartz (40% - 30%), lithics primarily consist of medium to dark grey, medium grey green and trace of pink, medium brown grey and black, the majority of the lithics appear to be volcanogenic in origin. The SANDSTONE has trace - common, light medium grey and green grey, dispersive argillaceous matrix silty in part, with no apparent cement, trace muscovite and biotite, rare streaks of carbonaceous matter on some bedding planes in the middle of the core, visual porosity improving with depth; good at the top, very good in the middle, and very good to excellent towards the base.

From: 3952' - 3957'

SILTSTONE; medium green grey, medium to dark grey in part, hard, massive trace carbonaceous detritus, trace micromica, moderately arenaceous in part, extremely argillaceous, in part grading into SILTY CLAYSTONE, with abundant multi-coloured lithics.

*ENVIRONMENTAL INTERPRETATION

The fining-upward nature of this core is interpreted as a POINT BAR sand of a meandering river. The presence of minor peat deposit in middle of the sand may be interpreted as marginal lateral migration from the river bank to the flood-plain.

The bottom section of the core is believed to have been deposited in a floodplain environment.

Sample: Codrington-1; Core 18; 3937-3957 ft

Rock Name:
Immature lithic sandstone

Thin Section:
An optical estimate of the constituents gives the following:

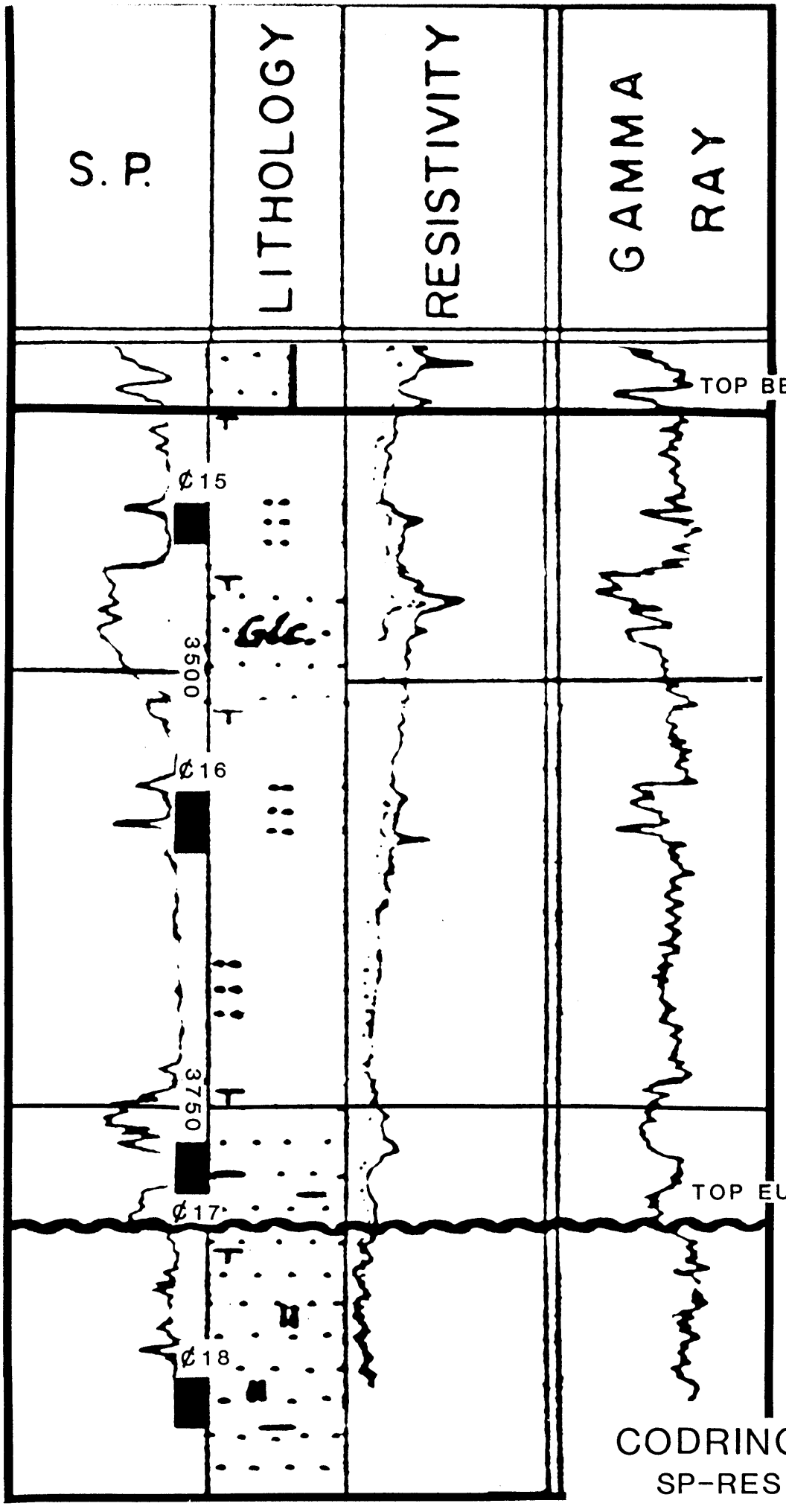
Constituent	%
Quartz	35
Feldspar	3
Mica	1
Lithic fragments	50
Clay/matrix	<2
Pores	10-15

This sample is described as immature on the basis of the abundance of labile detrital components; the rock does not, however, contain significant amounts of matrix or clay and, indeed, shows very little evidence of any diagenetic effects whatsoever. This being the case, the pores are very largely primary in origin with only a small proportion of secondary pores formed by the dissolution of original framework grains. These latter can be seen in a few places in the thin section where there are remnants of the outlines of the grains which have been almost completely dissolved. For the most part the pores are of the order of 0.1 mm in size and are probably reasonably well interconnected in three dimensions.

The rock shows moderate to poor sorting which tends to vary somewhat from place to place in the section. Better sorted parts of the rock have an average grain size of about 0.4 mm whereas more poorly sorted rocks contain more finer grained material and have an average size of approximately 0.2 mm. Quartz grains are usually among the larger of any field of view and are generally compact grains distinctly angular in shape. There is a very small proportion of subround quartz grains, also. Feldspar is generally fresh and consists predominantly of angular grains of plagioclase. Some feldspar is also present in micrographic grains clearly derived from high level igneous rocks.

Mica forms fresh flakes of biotite some of which are as much as 0.8 mm in length. The biotite shows a well marked pleochroism and this is evidence of the lack of chemical alteration of the detrital components.

Lithic fragments are the most abundant constituent of the rock and generally consist of fine-grained grey to brown turbid grains which are commonly dark between crossed Nicols. A small proportion of the grains are clearly of volcanic origin and consist of micrographically intergrown quartz and feldspar and very fine-grained feldspar-rich rocks (presumably intermediate or basic lavas). Many of the lithic grains are indeterminate in origin and consist of fine-grained quartz/clay/sericite aggregates which, in the absence of any more specific evidence, are probably best regarded as metasedimentary in origin. The lithic fragments show little evidence of distortion or physical effects of compaction nor, indeed, any evidence of recrystallisation in a diagenetic environment. The rock also lacks typical authigenic minerals such as kaolinite or carbonate and there is every evidence that the sample has simply been deposited, slightly compacted and there has been a minor amount of dissolution of some of the lithic material. The apparently high porosity is a result of the lack of diagenesis and of extreme compaction effects.



CODRINGTON-1
SP-RES.-GR
CORE 18
EUMERALLA FORMATION

6.7 PORT CAMPBELL-4
CORE DESCRIPTION

CORE NO. 26 LOWER EUMERALLA FORMATION CORED INTERVAL 8279'-8299'

Length of Core: 20' Recovery 20' Available: 15' (approx)

Present Status of the Core:

Boxes are not numbered and core pieces appear to have been mixed up. A representative sample of every 2' kept in the cloth bag can be relied upon to determine the top and bottom of the core for the purpose of core description only.

Generalised Core Description:

From 8279'-8286':

SANDSTONE: medium grey, medium green grey and medium brown grey in part, hard, very fine, occasionally very fine-silt size, subangular to subrounded, dominantly subrounded, well sorted feldspar, lithics and quartz in approximately equal proportions, feldspar is very light grey to white, very occasionally light pink, lithics are multi-coloured and include some pale green, quartz is clear to very light grey and light brown grey, common to abundant light grey and light brown grey argillaceous matrix, trace to common calcareous cement, very strong in part, trace to common biotite flakes, trace muscovite flakes, trace white to light grey calcite crystals, trace chlorite, trace large carbonaceous detritus, poor to nil visual porosity, interbedded with;

From 8286'-8299'

SILTSTONE: medium to dark grey, medium to dark brown grey in part, hard to very hard, massive, commonly micromicaceous and carbonaceous, moderately argillaceous, common multi-coloured lithics, trace coalified rootlet, occasionally becomes sandy and grading into very fine SANDSTONE: as above.

Recognised Structures:

In the Sandstone unit only minor flat-laminations occur (the Sandstone is massive), whilst in the Siltstone unit cross-laminations and flaser beddings are the dominant structures.

ENVIRONMENTAL INTERPRETATION:

The lower siltstone unit resembles the natural levee deposits, whilst the upper sandstone unit appears to have intersected the most upper part of the point bar channel system.

Port Campbell No 4 core 26 8279-8299ft.

Lithology TUFFACEOUS SANDSTONE

Sorting v. good

Grainsize fine sand

Grainshape euhedral to subangular.

Constituents

Clasts	dominant	
QUARTZ	major	monocrystalline,subangular to sub-rounded.,0.15-0.25mm.
FELDSPAR	major	K feldspar and albite,tabular euhedral to sub angular,lengths 0.2-0.3mm,fresh microcline and well twinned albite.
LITHICS	major	Sediments, and igneous clasts,dimensions as quartz.Former micaceous shales. Volcanic material ?dominant varies from feldspar microlite-rich and more micro-crystalline types.Dimensions as quartz.
MICAS	access.	Biotite and muscovite.Rare 0.3mm clots of fresh biotite,narrow strips of oriented muscovite.
HEAVIES	trace	zircon,tourmaline,apatite, plus spots of barite.(SEM).,some opaques probably part carbonaceous.
Matrix	minor	
CHLORITE	major	ubiquitous authigenic chlorite lining clasts as radial crusts,rarely filling cavity.
CLAY	minor	a few pores have a clay -like filling, not optically typical kaolin.
CARBONATE	access.	rare replacement.

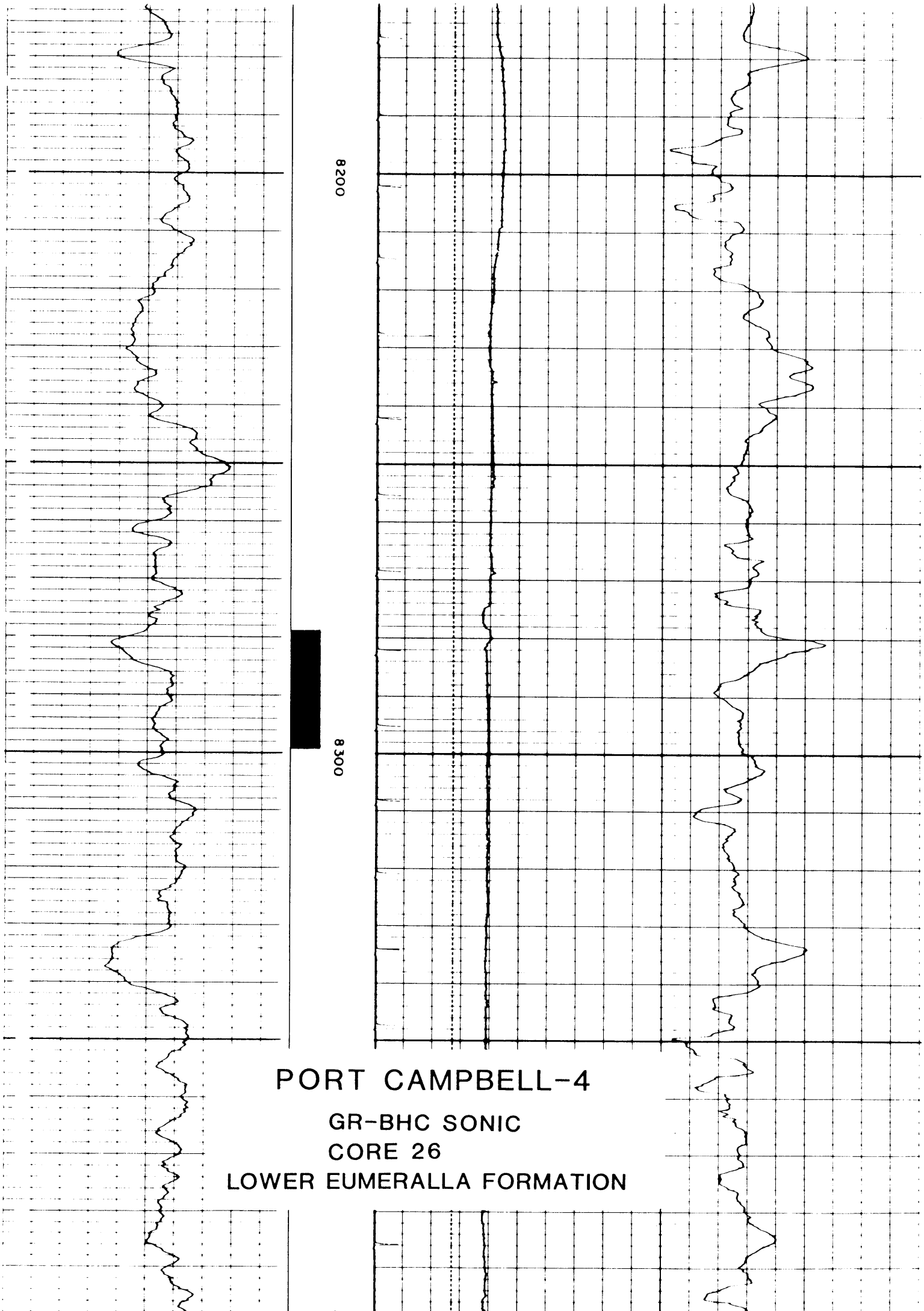
Discussion

This is a low quartz "sandstone" that differs from the other sands above by the apparent lack of the zeolitic cement. It has isolated porosity of a dissolution nature, with porous clay patches ex feldspar.The major diagenetic activity was the precipatation of the chlorite

Port Campbell No. 4.

%	26/8279-8299
CLASTS	76.3
QUARTZ	32.7
FELDSPAR	24.4
LITHICS	42.0
MATRIX	23.7
CHLORITE	87.3
CLAY	7.0
POROSITY	4.1

26/8279-99 HAS ALSO 0.9% MICA, AND 5.7% CARBONATE IN THE MATRIX.



PORT CAMPBELL-4

GR-BHC SONIC
CORE 26
LOWER EUMERALLA FORMATION

P O R T C A M P B E L L - 4

FIELD DATA CORE ANALYSIS REPORT

Core Number	Depth Feet	Permeability Millidarcys	Porosity Percent	Grain Density
¢ 26	8279 - 8299	0.01	10.3	2.71

7. OIL CORRELATION

AIM: Comparison of recovered oils

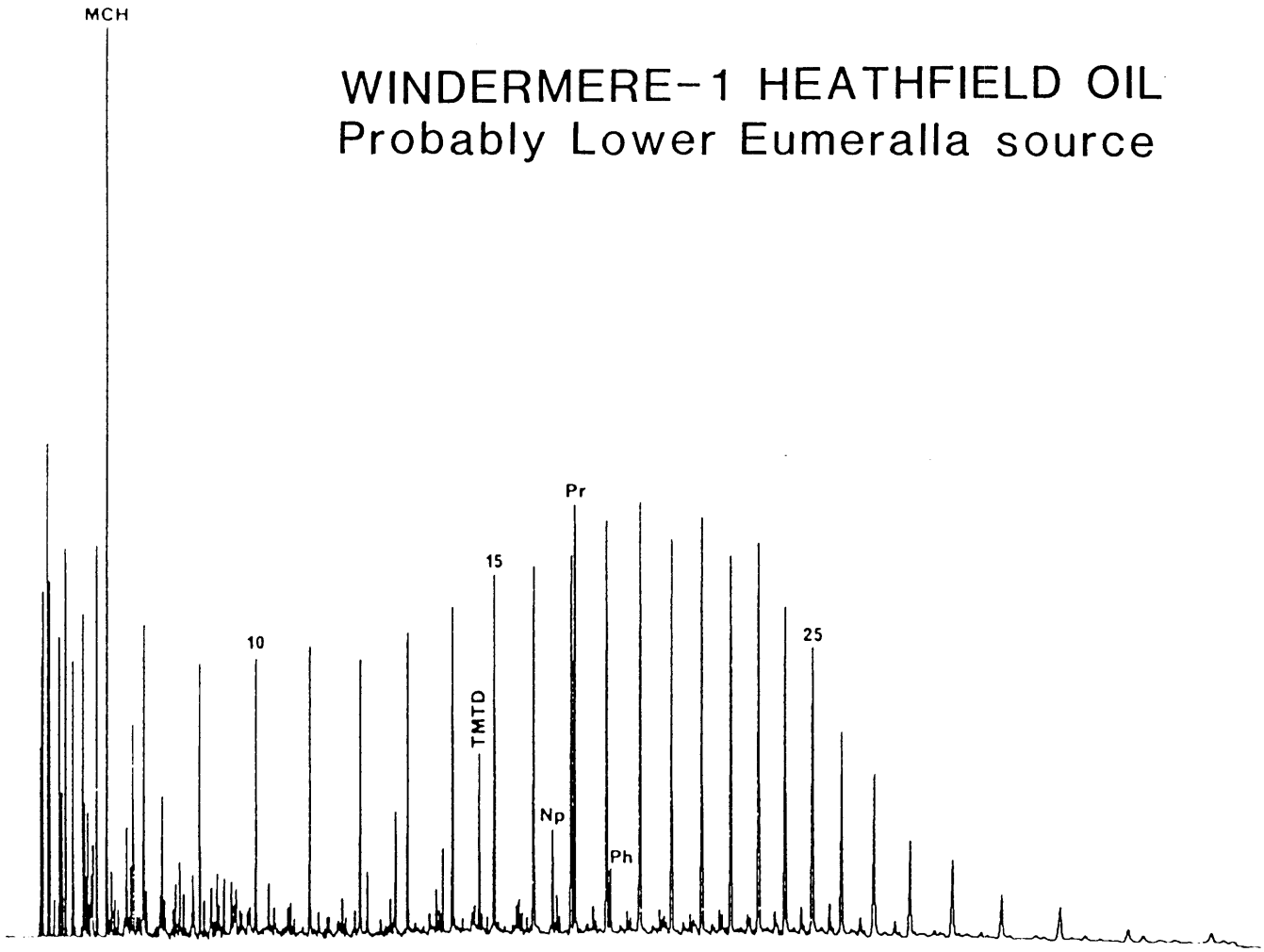
CONCLUSIONS:

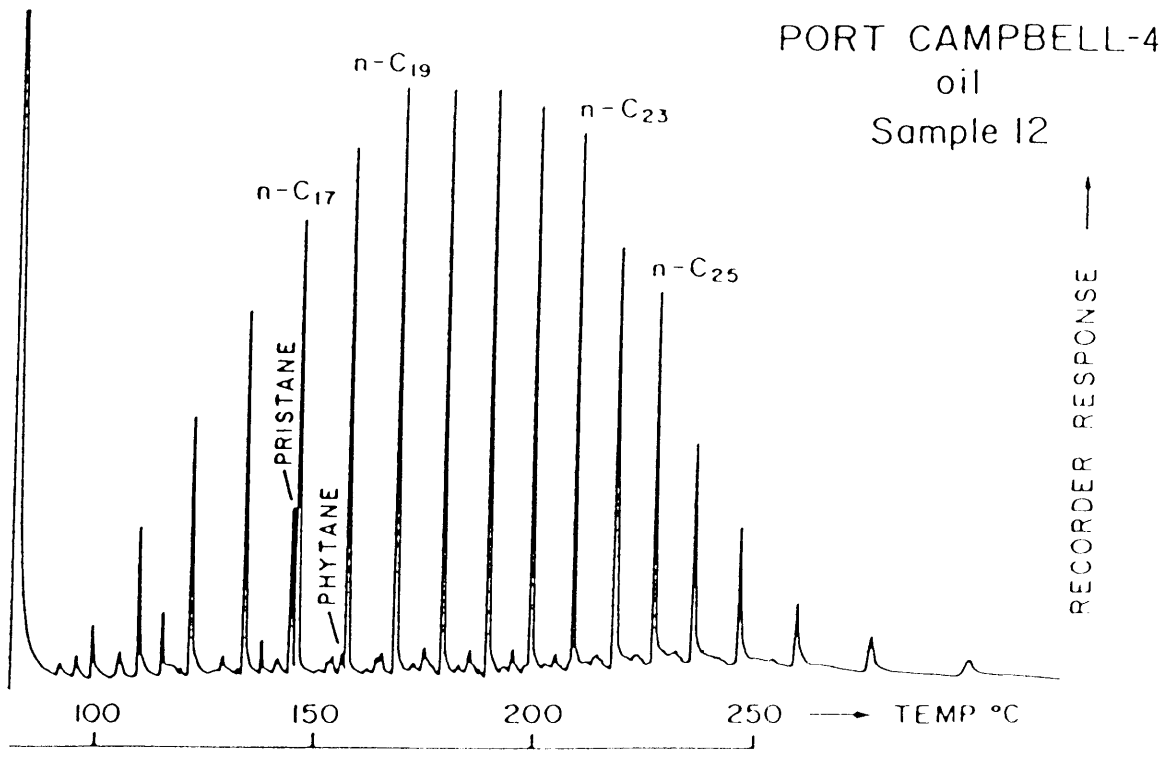
- Attached comparison of three oils recovered from three reservoirs in the basin

- No attempt has been made to manipulate the data

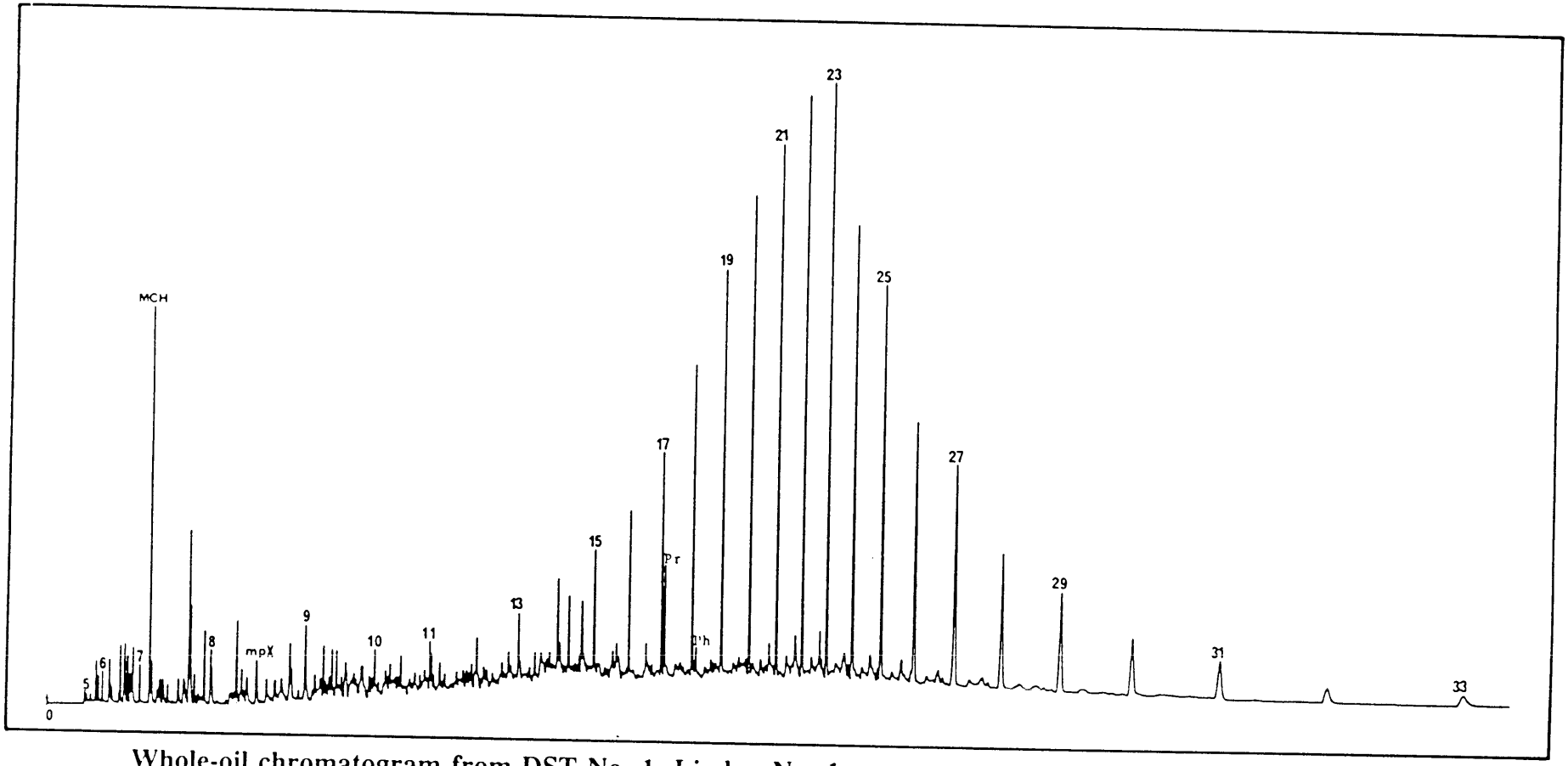
- All three oils show a strong waxy hump and all are believed to have been sourced from the Lower Eumeralla Coal Measures

- The Lindon-1 oil is depleted in lighter hydrocarbon fractions as a result of water washing


MCH
WINDERMERE-1 HEATHFIELD OIL
Probably Lower Eumeralla source
Pr
15
10
25
TMTD
Np
Ph


?UPPER EUMERALLA OIL
Probably Lower Eumeralla source
PORT CAMPBELL-4
oil
Sample 12
n-C19
n-C23
n-C17
n-C25
PRISTANE
PHYTANE
RECORDER RESPONSE
100
150
200
250
TEMP °C

LINDON-1 PEBBLE POINT OIL
Probably Lower Eumeralla source



Whole-oil chromatogram from DST No. 1, Lindon No. 1.

A P P E N D I X

DESCRIPTION OF THE CORES & CUTTINGS SAMPLED

FOR

SOURCE ROCK EVALUATION

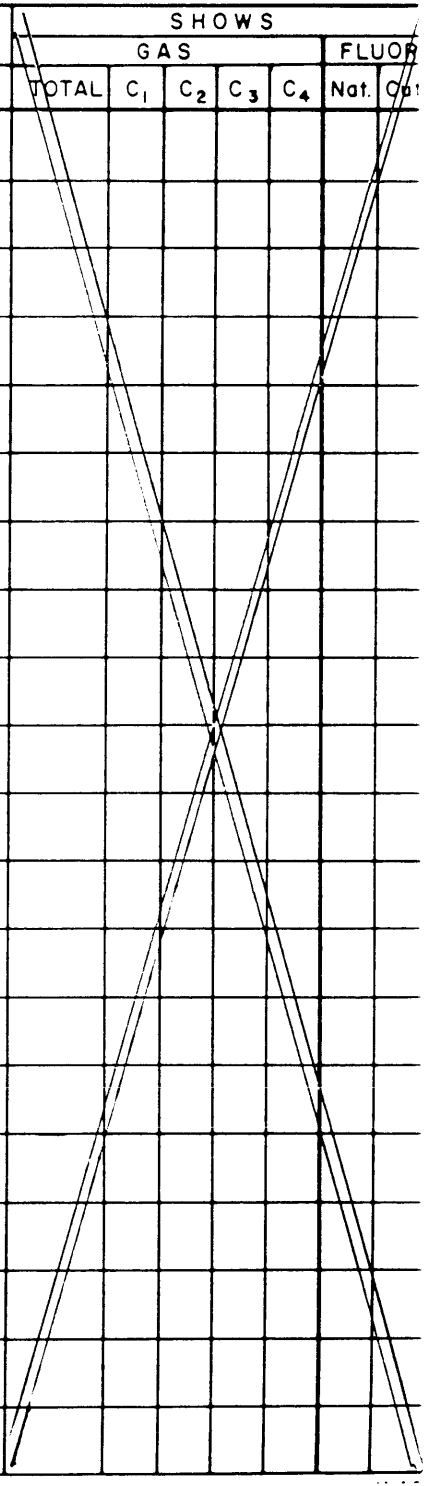
DEPTH (m)	%	WELL NAME.: WOOLSTHORPE # 1	Date.: 2/5/88	Geol.: TABASSI
		SAMPLE DESCRIPTION		

SHOWS

GAS					FLUO	
TOTAL	C_1	C_2	C_3	C_4	Nat.	Cut

DEPTH (m)	%	SAMPLE DESCRIPTION
6000'- 6010'	45	CLAYSTONE; dark grey, medium-dark brown grey, medium green-grey in part, firm, hard in part,
		fissile-subfissile, occasionally blocky, slightly silty in part, slightly carbonaceous,
		rarely micaceous, rare amber, medium brown, translucent, hard, trace fissil fragments;
	50	SILTSTONE; medium-dark grey, medium dark brown, occasionally medium brown grey, firm-hard,
		subfissile in part, moderately argillaceous, trace-common multi-coloured lithics, trace to
		common muscovite, trace-common carbonaceous detritus, moderately arenaceous, interlaminated/
		grading into:
	5	SANDSTONE; clear-off white, very light grey, light green grey in part, loose?, medium-coarse,
		subangular-subrounded, moderately-well sorted quartz,no apparent matrix,trace medium-dark grey
		lithics, trace biotite, very good visual porosity;
	tr	COAL; black, firm, slightly argillaceous,vitreous lustre, occasionally earthy, conchoidal
		fracture.
6190'- 6200'	55	CLAYSTONE; as per 6000'-6010'
	40	SILTSTONE; as per 6000'-6010'
	5	SANDSTONE; as per 6000'-6010'
	tr	COAL; as per 6000'-6010'
6290'- 6300'	65	CLAYSTONE; as per 6000'-6010', firm-hard, soft-firm & dispersive in part,moderately carbonaceous.
	35	SILTSTONE; as per 6000'-6016', dark grey, dark brown-grey.
	tr	SANDSTONE; as per 6000'-6010', medium grained.
		CONT"D...

DEPTH (m)	%	WELL NAME.: WOOLSTHORPE # 1	Date.: 2/5/88	Geol.: TABASSI
		SAMPLE DESCRIPTION		
6390'- 6400'		Claystone possibly to 6398'. Volcanics top @ 6398'		
	80	CLAYSTONE; dark grey-black, firm,-hard, fissile, strongly carbonaceous, trace silt, trace		
		amber.		
	20	SILTSTONE; as per 6000'-6010'		
	tr	SANDSTONE; as per 6000'-6010'		
	tr	COAL; as per 6000'-6010'		



DEPTH (m)	%	WELL NAME.: CASTERTON # 1	Date.: 2/5/88	Geol.: TABASSI
		SAMPLE DESCRIPTION		

SHOWS

GAS					FLUO	
TOTAL	C_1	C_2	C_3	C_4	Nat.	Cu

DEPTH (m)	%	SAMPLE DESCRIPTION
Core Sample @ 7385'	100	CLAYSTONE; medium-dark brown grey, dark grey-black in part, hard, common carbonised/coalified plant fragments, extremely carbonaceous, commonly micromicaceous, occasionally silty.
Core Sample @ 7740'	100	CLAYSTONE; medium-dark grey, hard, extremely micromicaceous, moderately silty in part, slightly-moderately carbonaceous.
Core Sample @ 8030'	100	CLAYSTONE; medium grey-medium green grey, hard, massive, trace micromicaceous & green chlorite(?) flecks, smooth feeling on touch (tuffaceous shale?).
7320'- 7330' Cutting Sample	50	CLAYSTONE; medium-dark grey, medium-dark brown grey, hard, occasionally firm, massive, occasionally subfissile, moderately carbonaceous & micaceous, slightly silty, interbedded with:
	50	SILTSTONE; medium-dark grey, medium brown grey, hard, moderately argillaceous in part, trace fine quartz sand & multi-coloured lithics, trace mica, in part grading into fine SANDSTONE.