Palynology, Petrology, Geochemistry and Source Rock Evaluation of Cape Sorell 1.

Amoco Australia Petroleum Company

OR-0358E

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SECTION 1.

464004

ROBERTSON RESEARCH (SINGAPORE) PRIVATE LIMITED

Report No. 1170

A BASIC GEOCHEMICAL EVALUATION OF EIGHT SIDEWALL CORES FROM THE CAPE SORELL-1 WELL DRILLED IN AUSTRALIA

by

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Project No. S/II/823/38
January 1983

Prepared for

Amoco Australia Petroleum Company
Amoco Building
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CONTENTS

SUMMARY

Eight sidewall cores for the Cape Sorell-1 well have been analysed for thermal maturity and source rock potential. The results of the maturity study, although not fully conclusive, indicate that the section analysed is thermally early mature, approaching full maturity for liquid hydrocarbon generation from oil-prone kerogen. Source rock potential study reveals that the samples from 10313, 10608, 10771 feet have fair to good gas or gas/oil source potential. Visual kerogen analysis reveals that humic material (gas-prone) dominates but minor amounts of liptinitic material (oil-prone) have also been identified.

I

INTRODUCTION

A total of eight sidewall cores from the 10180 to 10974 feet section of the Cape Sorell-1 well were utilized in a basic geochemical evaluation of thermal maturity and hydrocarbon source potential. In two cases differing lithologies were selected from the sidewall cores and examined for hydrocarbon source potential separately. The results of the thermal maturation analyses are given in Table 1. Hydrocarbon source potential results can be found in Table 1 and 2.

II

RESULTS AND DISCUSSION

(1) THERMAL MATURITY EVALUATION

(a) Vitrinite Reflectance (Table 1)

Vitrinite reflectance analyses were carried out on six of the sidewall cores, however, only two of these produced fair quality data, one gave poor data and the remaining three could not be determined for thermal maturity using this method. Samples taken from 10437 feet and 10608 feet gave average reflectance values of 0.46% R_o (8 readings) and 0.47% R_o (10 readings) respectively. The sample taken from 10771 feet gave one reading of 0.54% R_o and this is not considered to be as reliable as those obtained from the previous samples mentioned. The remaining three samples yielded only very minor amounts of kerogen and no accurate determination of vitrinite reflectance could be made.

(b) Spore Colour Index (Table 1)

Spore colour index determinations were attempted on six sidewall cores. Poor sporomorph recovery precluded any determination in three samples. In the first two samples analysed (10180', 10437') two populations of spores, according to spore colour index, were recorded. The lower population was in the range 3½-4 whereas the higher population was less well developed in terms of numbers of spores and gave more scattered results. In the first samples (10180') the higher population was in the range 5½-6, while in the

second sample (10437') a determination of 5 was made for the second population. The final sample gave poor sporomorph recovery and only a tentitive estimation of spore colour index was possible, a value of 4½-5.

The thermal maturity evaluation data may be summarized as follows:

- Relatively poor kerogen and sporomorph recovery has precluded the establishment of good reliable data, only 'fair' determinations could be made for some samples.

- The vitrinite reflectance values of 0.46% R_o and 0.47% R_o obtained at 10437 feet and 10608 feet suggest that this part of the analysed section is at an early stage of thermal maturity for hydrocarbon generation from oil-prone kerogen.

- Spore colour index determinations made at 10180 feet and 10437 feet with values of 4 and 3½-4 respectively, also suggest early maturity and show reasonable agreement with the vitrinite reflectance determinations.

- High spore colour index values obtained for the above mentioned samples are not considered to be indicative of the present thermal maturity and are thought to be a result of reworking.

- Only tentative estimates of thermal maturity were possible below 10608 feet of 0.54% R_O at 10771 feet and S.C.I. ?4½-5 at 10974. Both readings indicate that the samples are just mature for liquid hydrocarbon generation from oil-prone kerogen.

(2) HYDROCARBON SOURCE POTENTIAL

(a) Total Organic Carbon (Table 2, Figure 1)

Total organic carbon determination were performed on all side-wall cores received, in some depth differing lithologies were selected from the same core and analysed separately. The results show that with only two exceptions the samples analysed are organically 'rich' with 'average' to 'above average' TOC contents (in the range 1.07% to 18.60%). The two exceptions are at 10437 and 10974 feet with total organic carbon contents of 0.97% and 0.80% respectively, these are considered to be organically 'fair'.

(b) "Rock-Eval" Pyrolysis Analysis (Table 2, Figure 1)

"Rock-Eval" pyrolysis analysis was performed on all samples. The data obtained shows variable hydrogen indices (HI) ranging from 61 to 349. Hydrogen indices greater than 250, in general, indicate that the analysed rock has some liquid hydrocarbon generating potential. Those samples with H.I. values in the range 274 to 349 are considered to be typical of mixed gas/oil-prone kerogens. Hydrogen poor (gas-prone) kerogen has also been identified in some samples, particular those from the 10892 to 10974 feet interval. Hydrogen indices in these samples range from 61 to 112.

Potential yield is variable throughout, but a distinct division between 'very poor' and 'fair' to 'very good' can be made.It is noticable that the analysed rocks with the 'fair' to 'very good' potential (6.16 to 71.60 kg/ton) are those with relatively high hydrogen indices.

Production indices (PI) are also variable, particularly towards the base of the analysed section where a significant 'increase' in P.I. can be observed between 10771 and 10974 feet. It is considered that the relatively 'high' production indices found within the analysed section are a relection of the relatively lean nature of the some samples rather than a significant oil show. This arises through the calculation of P.I.: S_1 (free hydrocarbons)/S_1 (free hydrocarbons) plus S_2 (bound hydrocarbons) where quantities of S_1 and S_2 became lean (i.e. P.Y. less than 2 kg/ton).

(c) Visual Kerogen Analysis (Table 1)

Visual kerogen analysis was completed on six samples. All samples showed dominant humic kerogen (Vitrinite and Inertinite) with four samples principly inertinitic and two (10437 and 10608 feet) vitrinitic. The humic material is generally degraded and only minor amounts of liptinite are observed in most samples. One sample (10771') shows moderate amounts of liptinite and the overall kerogen composition determined indicates that it is of a mixed humic/liptinitic type.

III

CONCLUSIONS

Based on the data obtained from the geochemical analysis of eight sidewall core samples from the Cape Sorell-1 well the following conclusions have been drawn:

- The section analysed is considered to be early mature to just mature for liquid hydrocarbon generation from suitable oil-prone kerogen. The thermal maturity data is not fully conclusive on this however, pyrolysis Tmax also indicates early mature sediments.

- The analysed section is organically relatively 'rich' overall with 'average' to 'above average' TOC contents in the majority of samples. Only two samples are considered to be organically 'fair'.

- "Rock-Eval" pyrolysis indicates a mixing of kerogen in some samples, particularly those of a carbonaceous or coaly nature. Relatively 'high' hydrogen indices suggest some liptinite present in these samples (particularly those with H.I. values of between 274 and 349).

- Visual kerogen analyses confirms the presence of minor amounts of liptinite (oil-prone) in most samples but with humic (gas-prone) kerogens prevailing throughout. In the 10771 sidewall

core sample, liptinite quite significant in the kerogen composition of the sample.

- Potential yield values indicate that Coals and carbonaceous siltstones/shales from 10313, 10608 and 10771 feet have 'fair' to 'good' hydrocarbon source potential (possibly gaseous hydrocarbon) at the optimum level of thermal maturity.

464015

TABLE 1

THERMAL MATURITY AND KEROGEN COMPOSITION DATA

COMPANY: AMOCO AUSTRALIA WELL: CAPE SORELL-1 LOCATION: TASMANIA

DEPTH (FEET)	VR (%)	SCI	KEROGEN COMPOSITION			
			VITRINITE	INERTINITE	AMORPHOUS	LIPTINITE
10180	NDP	$\frac{4}{5\frac{1}{2}\text{-}6}$	Modetate	Common	-	Minor
10437	0.46(8)	$\frac{3\frac{1}{2}\text{-}4}{5}$	Common	Moderate	-	Minor
10608	0.47(10)	NDP	Rich	Lean	-	Minor
10771	0.54(1)	NDP	Moderate	Moderate	-	Moderate
10892	NDP	NDP	-	Rich	-	-
10974	NDP	?$4\frac{1}{2}$-5	-	Rich	-	Minor

Trace	if	observed
Minor	if	$<$0.5%
Lean	if	5-20%
Moderate	if	20-50%
Common	if	50≃80%
Rich	if	80/90+→100%

COMPANY: AMOCO AUSTRALIA WELL: CAPE SORELL-1 LOCATION: TASMANIA

	DEPTH (FEET)	ANALYSED LITHOLOGY	TOC %	PYROLYSIS DATA T MAX°C	HI (mg/g TOC)	OI (mg/g TOC)	S1 FREE HYDROCARBON (mg/g OF ROCK)	S2 BOUND HYDROCARBON (mg/g OF ROCK)	S3 CO_2 (mg/g OF ROCK)	PRODUCTION INDEX	POTENTIAL YIELD (kg/ton)
(SWC)	10180	Sltst, med gy, f. sndy, sl. coaly + coal particles	1.07	436	61	37	0.14	0.65	0.40	0.18	0.79
"	10313	Sltst, med dk gy, f. sndy, coaly lam	3.97	421	325	20	1.92	12.90	0.79	0.13	14.82
"	10437	Sltst, blk, sndy, sl. shly	0.96	440	65	69	0.22	0.62	0.66	0.26	0.84
"	10608	Sltst, dk gy, f. sndy, sl.coaly	3.83	420	318	27	1.75	12.18	1.05	0.13	13.93
"	"	Coal + Sh, mnr. lam	18.60	422	349	24	6.75	64.85	4.55	0.09	71.60
"	10771	Sh, gy-blk, slty, sl. carb	4.46	428	345	19	1.63	15.37	0.84	0.10	17.00
"	"	Sh, dk gy, f. slty + coal particles	1.99	432	274	18	0.71	5.45	0.35	0.12	6.16
"	10892	Sst, gy, slty + Qtz grains + Coal frags	1.34	435	79	31	0.48	1.06	0.42	0.31	1.54
"	10914	Sltst, gy-blk, sndy, sl. carb	1.14	438	112	34	0.32	1.28	0.39	0.20	1.60
"	10974	Sltst, gy-blk, sndy, shly, sl. coaly	0.80	436	106	16	0.27	0.85	0.13	0.24	1.12

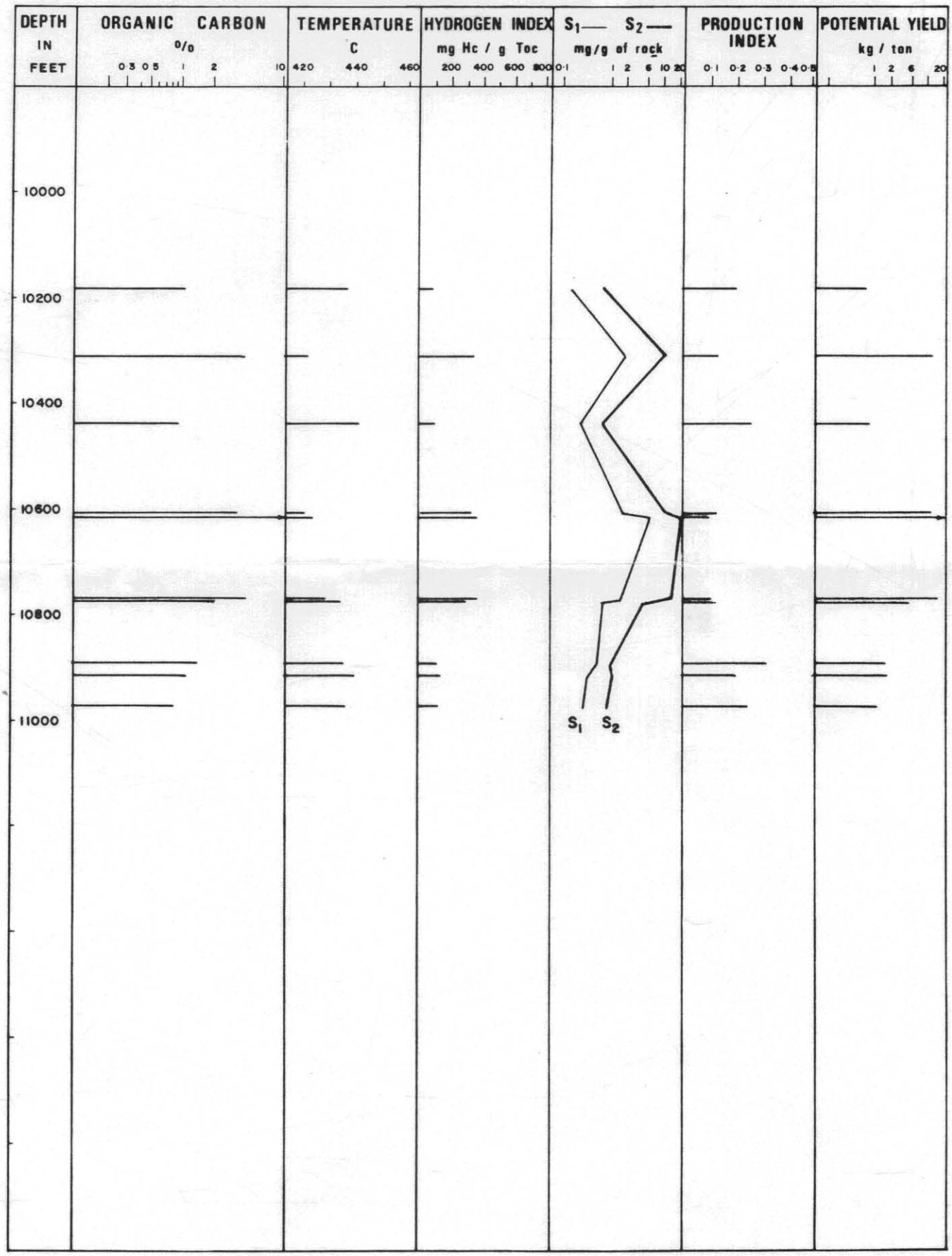
TABLE 2 : TOTAL ORGANIC CARBON CONTENTS & "ROCK EVAL" PYROLYSIS DATA

464017

FIGURE 1

PYROLYSIS SUMMARY CHART

COMPANY: AMOCO AUSTRALIA WELL: CAPE SORELL-1 LOCATION: TASMANIA



5 cm

APPENDIX

ABBREVIATIONS USED IN ANALYTICAL DATA SHEETS

-	-	Sample not analysed
*	-	No results obtained
N.D.P.	-	No Determination Possible
N.O.F.	-	No Organic Fluorescence
N.D.O.F.	-	No Determination Organic Fluorescence

LITHOLOGY

Aren	-	Arenaceous
Arg	-	Argillaceous
Calc	-	Calcareous
Carb	-	Carbonaceous
Cmt	-	Cement
Chk	-	Chalk
Cht	-	Chert
Cly	-	Clay
Clyst	-	Claystone
Crs	-	Coarse
Cgl	-	Conglomerate
Dol	-	Dolomite
Fer	-	Ferruginous
F	-	Fine
Frags	-	Fragments
Hd	-	Hard
Lam	-	Laminae/laminated
Lig	-	Lignite
Lmst	-	Limestone
Med	-	Medium
Mic	-	Micaceous
Mnr	-	Minor
Mdst	-	Mudstone
Musc	-	Muscovite
Ool	-	Oolitic
Pyr	-	Pyrite/pyritic
Qtz	-	Quartz
Snd	-	Sand
Sst	-	Sandstone
Sndy	-	Sandy
Sh	-	Shale
Shly	-	Shaley
Sil	-	Siliceous
Slt	-	Silt
Sltst	-	Siltstone
Slty	-	Silty
Sft	-	Soft
Tr	-	Trace

COLOUR

Blk	-	Black
Bl	-	Blue
Brn	-	Brown
Dk	-	Dark
Gn	-	Green
G	-	Gold
Gy	-	Grey
Lt	-	Light
Mtl	-	Mottled
Ol	-	Olive
O	-	Orange
Ppl	-	Purple
Rd	-	Red
Wht	-	White
Yel	-	Yellow
Vgt	-	Variegated
Pk	-	Pinkish

GENERAL

Ctg	-	Ditch cuttings
L.C.M.	-	Lost Circulation Material
S.W.C.	-	Sidewall Core
Sl	-	Slightly
V	-	Very
Occ	-	Occasional

Gy-gn	-	Greyish green
Gn/gy	-	Green and/to grey
Gn-gy	-	Greenish grey

SECTION 2.

464019

AMOCO PRODUCTION COMPANY
Tulsa, Oklahoma
January 10, 1983

83010ART0126

FILE: Technical Service 5371 PF
Locality 12,384

TO: D. B. Felio, APC (Int'l), Houston

ATTN: M. J. Fockler

SUBJECT: Palynologic Analysis of the Amoco Australia Cape Sorell No. 1 Well, Offshore Western Tasmania

Attached is a memorandum reporting results of a palynologic study of cuttings samples from the subject well. Preliminary relative ages of Eocene, Paleocene and undifferentiated Late Cretaceous were determined. This completes the technical service request.

ERIC R. MICHAELIS

By R. W. Hedlund

RWH:ceh
Attachment (Cron No. 83010ART0125)

cc: M. J. Fryer, APC (Int'l), M/C 4703
I. W. Herrick, APC (Int'l), Houston

464020

AMOCO PRODUCTION COMPANY
Tulsa, Oklahoma
January 10, 1983

83010ART0125

FILE: Technical Service 5371 PF
Locality 12,384

TO: D. B. Felio, APC (Int'l), Houston

ATTN: M. J. Fockler

SUBJECT: Palynologic Analysis of Cuttings Samples from the Amoco Australia Cape Sorell No. 1, Offshore Western Tasmania

Summary

Forty-four cuttings samples (810 ft-11,576 ft) from the subject well were completely analyzed for palynologic content and relative age-dating. All samples yielded palynomorphs in varying stages of preservation, with abundances ranging from low to high. One hundred and seven taxa were observed throughout the studied interval which were Mesozoic through Paleogene in age. Reworked late Paleozoic and early Cretaceous taxa were present in varying abundances in all samples. An interval of poor recovery between 7,850 ft and 9,990 ft is approximately equivalent to the lower half of a thick sand sequence in the well.

Three relative age subdivisions have been determined, based on palynomorph assemblages. Data from the subject well have been compared to the Cenozoic Composite Standard and to palynologic data from studies in the Austral Basin of Southern Argentina (Hedlund, 1972). The subdivisions are based on taxa considered to be in situ, but results are considered to be preliminary because of the large numbers of reworked palynomorphs, as follows:

Eocene (810 ft to 3,540-?4,050 ft)

This interval contains an abundant and diverse shallow water marine Eocene dinocyst assemblage, including Wetzeliella-1,-3,-9, Homotryblium-3,-4,-5, Eocladopyxis-2, Kenleyia lophophora and Homotryblium tasmaniense. Abundant terrestrial palynomorphs are also present, including species of Nothofagidites.

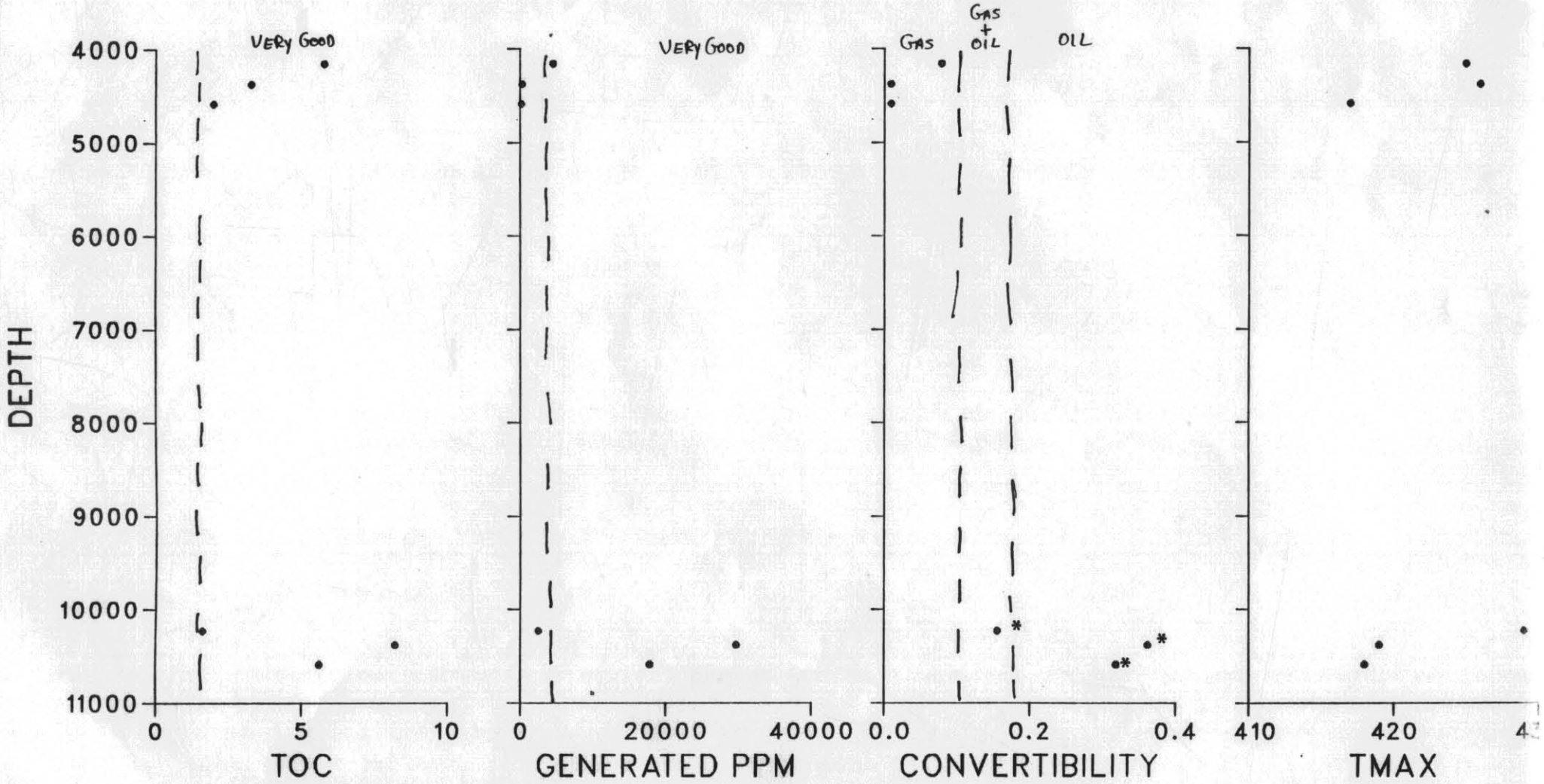
Paleocene (3,540-?4,050 ft to ?9,990 ft)

The total ranges of Deflandrea-30, Cyclonepheluim-6 and Trisacocladus-1 are within the interval. It also contains the oldest occurrences of

464021

FIGURE 1.

Technical Service 825385CF



* Coaly intervals therefore these samples are not really as liquid prone as the position of data on the plot may infer.

5 cm

Nothofagidites-3, Verrumonoletes-2 and Cannosphaeropsis-2. The presence of dinocysts between 3,540 ft and 6,450 ft suggests a shallow water marine depositional environment. Small numbers and low diversity of palynomorphs from 6,450 ft to 9,990 ft preclude a more precise relative age subdivision of the Paleocene.

Cretaceous (?9,990 ft to 11,576 ft)

Rare specimens of the Cretaceous marine dinocysts Deflandrea-6, Nelsoniella-1 and Odontochitina-1, along with the terrestrial palynomorphs Ceratosporites-4, Dictyophyllidites-1 and Beaupreaidites-1 indicate an undifferentiated Late Cretaceous age for this interval. A more precise subdivision is not possible based on these taxa.

R. W. Hedlund

RWH:ceh

SECTION 3.

464023

AMOCO PRODUCTION COMPANY
Tulsa, Oklahoma
December 13, 1982

82347ART0044

FILE: Technical Service 5466SF

TO: D. B. Felio, APC (Int'l), Houston

ATTN: Meridee J. Fockler

SUBJECT: Transmittal of Report by T. C. Mowatt (Mineralogy, Inc.) on Petrography and Mineralogy of Conglomerate Samples, Amoco Cape Sorell No. 1, Australia (Final Report)

Accompanying this memo is Mowatt's report describing and depicting the samples submitted (11,420-11,427 ft), with X-ray diffraction data on matrix-cement compositions. Porosity is estimated visually to be very low. Questions should be directed to Dr. Mowatt at (918) 744-8284.

ERIC R. MICHAELIS

By Laurel C. Babcock
Laurel C. Babcock

LCB:ch
Attachment

cc: M. J. Fryer, APC (Int'l), Chicago, w/o Attachment
I. W. Herrick, APC (Int'l), Houston, w/o Attachment
C. F. Upshaw, w/o Attachment

MINERALOGY
INCORPORATED

3228 East 15th Street/Tulsa, Oklahoma 74104/(918) 744-8284

Where Science Gets Down to Earth

464024

December 8, 1982

Dr. L. C. Babcock
Research Group Supervisor
Amoco Production Company
Research Center
Tulsa, OK 74102

Dear Dr. Babcock:

Enclosed is our report dealing with megascopic, thin-section, and x-ray diffraction examination of core samples from the 11420-11427 foot interval, Cape Sorell-1 well, Australia. This request was discussed with the originator, M. F. Fockler, Amoco Production Company (International), Houston, prior to carrying out the work.

Please let me know if we can be of further assistance.

Thank you for your courtesy.

Sincerely,

Thomas C. Mowatt

aw

Enc.

464025

SUBJECT:

Megascopic, thin-section, and x-ray diffraction examination of core samples from the interval 11420-11427 feet, Cape Sorell-1 well, Australia.

SUMMARY

The materials examined consist of polymictic clast-supported conglomerates. Megascopically, the clasts are rounded, and very poorly sorted, with maximum dimensions of 10+cm and less. Minor amounts of matrix material, in the sand-and smaller-size range, occur between the larger clasts. The clasts encompass a spectrum of lithologies, including igneous, sedimentary, and metamorphic rocks, as well as discrete quartz fragments. The interval 11424-1125 feet is somewhat "better" sorted, with smaller (≅ 4cm maximum dimension) clasts.

Visual porosity in thin-section is estimated to be very low to essentially nil. Matrix materials between the clasts consist principally of clays - allogenic, recrystallized, ± authigenic, calcite, and quartz cement, with silt-sized grains of quartz and feldspar as well. Fractures infilled with blue-dyed epoxy are present in thin-section, but most likely represent relicts of sample handling/preparation.

DISCUSSION

For descriptive purposes, and due to the broken and discontinuous nature of the core, the materials are discussed in terms of several more or less arbitrarily-selected intervals. Samples were taken of bulk material for thin-section study. Matrix-cement material was physically separated from areas between the framework clasts, and analyzed by x-ray diffraction. Figures 1-6 are photomicrographs of selected specimens illustrating salient features. Table 1 presents semi-quantitative x-ray diffraction analyses of matrix-cement materials from selected specimens.

The actual geologic in-situ porosity of these samples is difficult to quantitatively assess, principally due to their textures. In thin-section, little porosity is apparent other than that associated with fractures, and these appear more likely to have been induced during sample recovery, handling, and preparation. In general, the strong degree of apparent compaction, as well as the pervasive authigenic ± recrystallized matrix-cement suggests that the in-situ porosity of these intervals is very low to essentially nil. The intensity of apparent compaction/deformational stresses which these samples have undergone can be appreciated by the significant amount of mutual interpenetration and/or deformation of framework clasts, as well as those fractures which are followed by sealing with "matrix" ± cement.

The intervals distinguished and examined are as follows:

1. Approximate interval: 11421-11422 feet. Polymictic conglomerate, clast-supported, angular to well rounded clasts; maximum measured clast was ≅ 10cm, with essentially serial gradation of smaller-sized materials. Very poorly sorted. Matrix minor, made up of allogenic, authigenic ± recrystallized clays (chlorite, illite-mica, mixed-layer smectite/chlorite, and kaolinite) and quartz, as well as sand-to silt-sized grains of quartz and feldspar. Calcite cement is a later stage, infilling voids and fractures. Some of the carbonate also consists of fossil material, suggestive of a marine influence in the depositional environment. Clasts include a spectrum of lithologies, including

meta-sedimentary rocks of varying grades, (principally siliciclastics); igneous rocks, principally of volcanic/diabasic aspect, variously metamorphosed/altered, and sedimentary rocks. Figures 1-3 (photomicrographs) show salient features. The specimens have undergone moderate to strong apparent compaction.

2. Approximate interval: 11422-11423 feet. Polymictic conglomerate, as previous interval, maximum measured clast size $\cong$ 9cm.

3. Approximate interval: 11423-11424 feet. Polymictic conglomerate, as previous interval, maximum measured clast size $\cong$ 10+cm (broken clast). This sample includes a minor amount of pyrite associated with the matrix materials, apparently developed in-situ. Some of the igneous lithic fragments are altered along their margins (chlorite, $\pm$ other phases?). This sample seens to reflect a moderate degree of post-depositional alteration/metamorphism. Figure 4 (photomicrograph) shows salient features of a sample from this interval.

4. Approximate interval: 11424-11425 feet. Polymictic conglomerate, as previous intervals, but somewhat "better" sorted, with smaller (maximum measured size $\cong$ 4cm) clasts.

5. Approximate interval: 11425-11426.5 feet. Polymictic conglomerate, as per intervals 1, 2, 3 above. Maximum measured clast size $\cong$ 8+cm (broken clast). This sample reflects very strong apparent compaction, with apparent shearing along preferred zones. Figures 5, 6 (photomicrographs) show salient features of a sample from this interval.

6. Approximate interval: 11426.5-11427 feet. Pieces of polymictic conglomerate, as above. Maximum measured clast size $\cong$ 10+cm (broken clasts).

Cape Sorell #1-Australia

T.S. 5466 SF

TABLE 1

MINERALOGY, INC.

3228 E. 15th St.
Tulsa, Oklahoma 74104

X-RAY DIFFRACTION MINERAL PERCENTAGES

M.J. Fockler

APC (Int'l.)

464028

Job 82-669

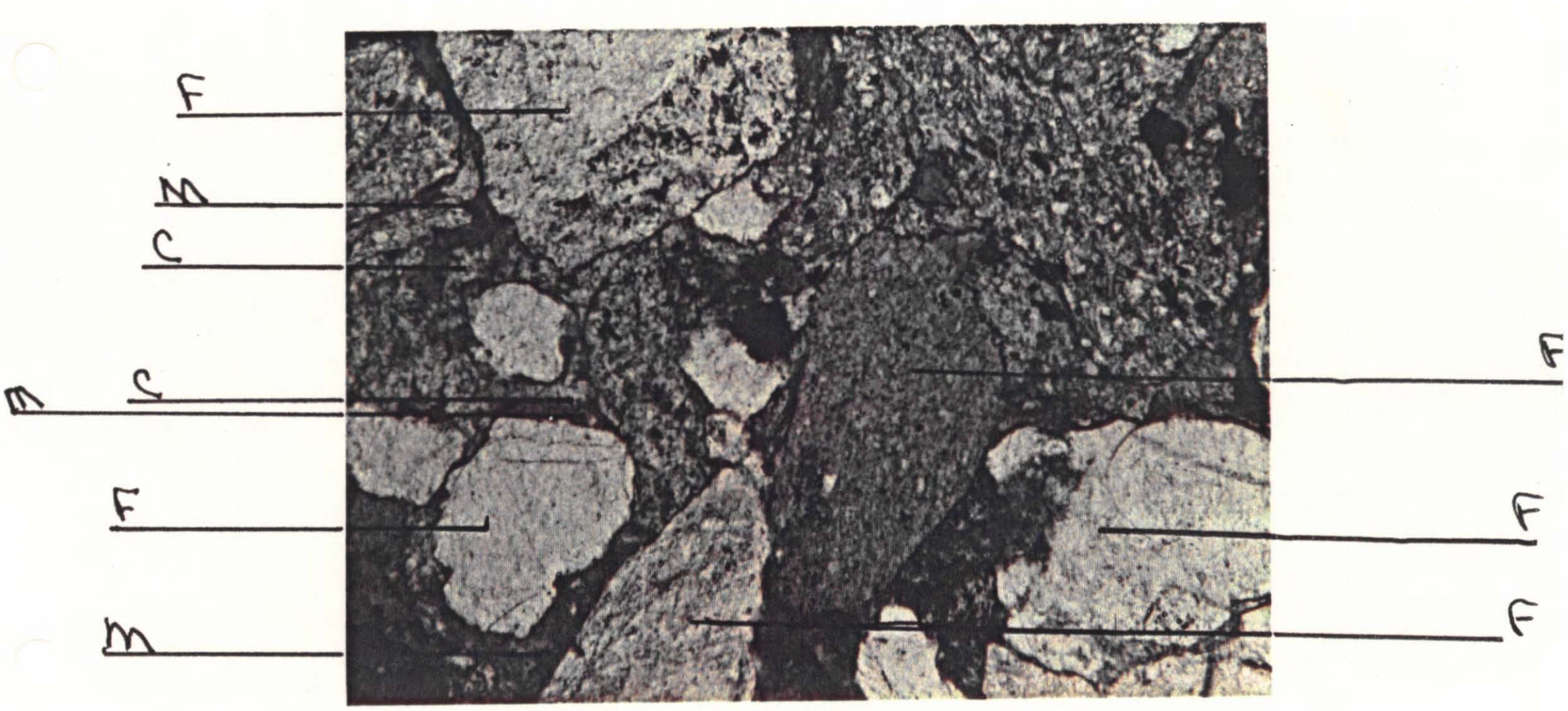
SAMPLE IDENTIFICATION NUMBER CAPE SORELL #1	QUARTZ	FELDSPAR	CALCITE	PYRITE	KAOLINITE	CHLORITE	ILLITE/MICA	MIXED-LAYER CHLORITE/SMECTITE												TOTAL
11,421 (Matrix)	43	2	15		8	4	19	9												
11,424 (Matrix)	49	5	11	2	5	4	20	4												
11,426 (Matrix)	45	2	13	3	6	6	15	11												
11,427 (Matrix)	29	2	24		7	8	21	9												

464029

FIGURE 1

CAPE SORELL-1 WELL, AUSTRALIA

11421.5



THIN SECTION PHOTO
50X
PLANE LIGHT

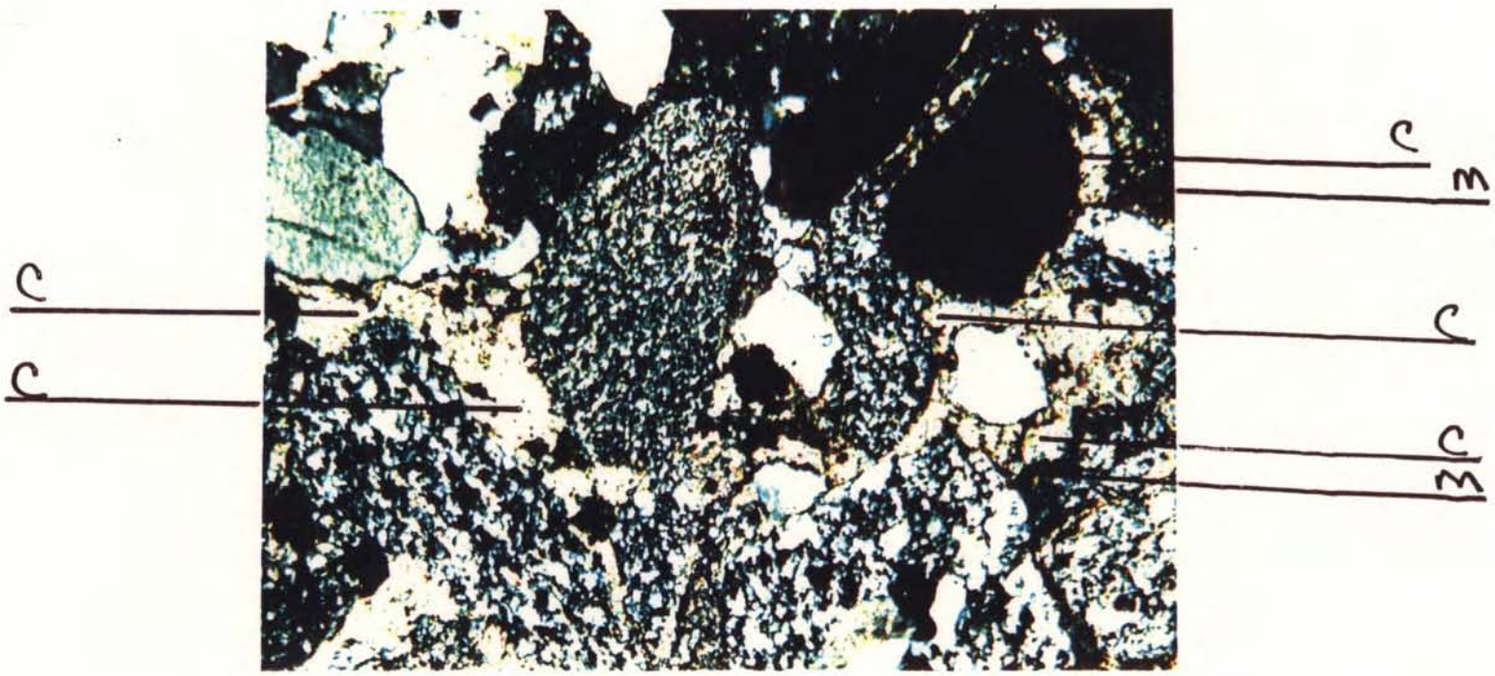
Shows general character of framework clasts ("F") and matrix ("M") - cement ("C").

5 cm

FIGURE 2

CAPE SORELL-1 WELL, AUSTRALIA

11421.5



THIN SECTION PHOTO
50X
CROSSED POLARIZERS

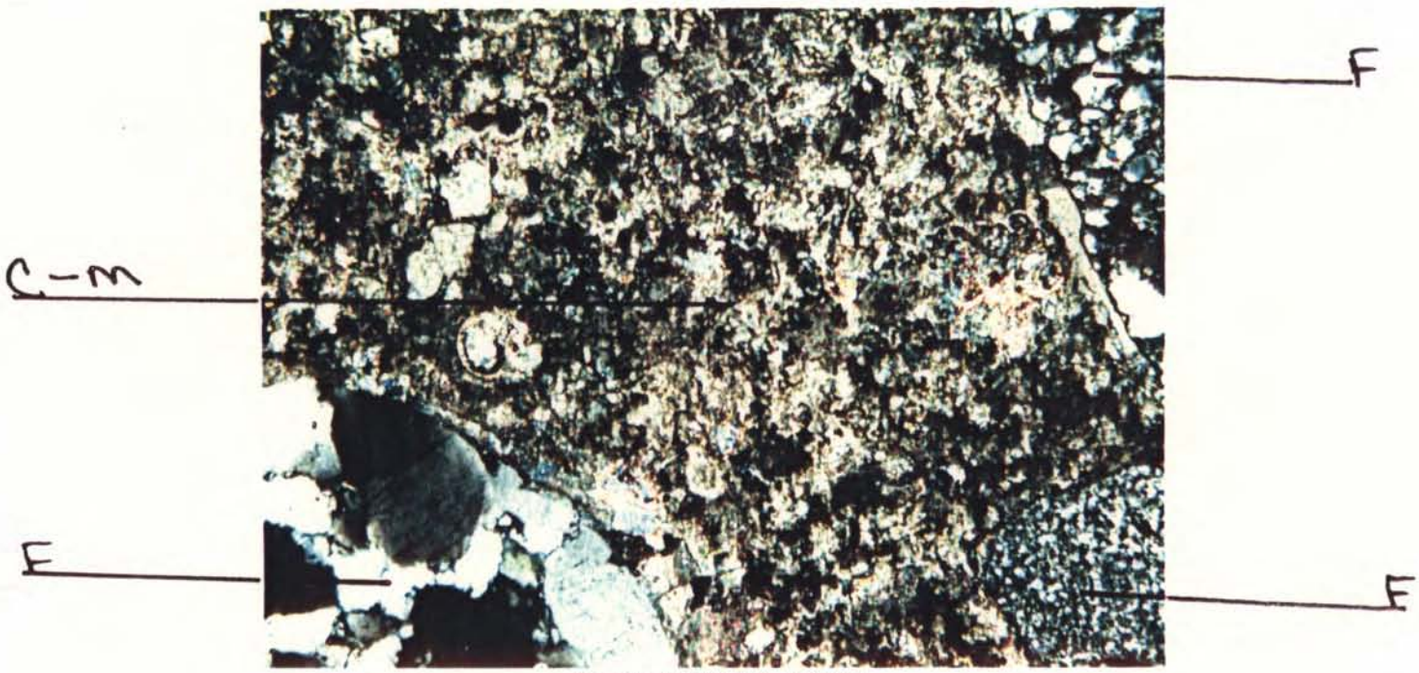
Same field of view as Figure 1, showing calcite cement ("C") and clay-silt matrix ("M").

5 cm

FIGURE 3

CAPE SORELL-1 WELL, AUSTRALIA

11421



THIN SECTION PHOTO
50X
CROSSED POLARIZERS

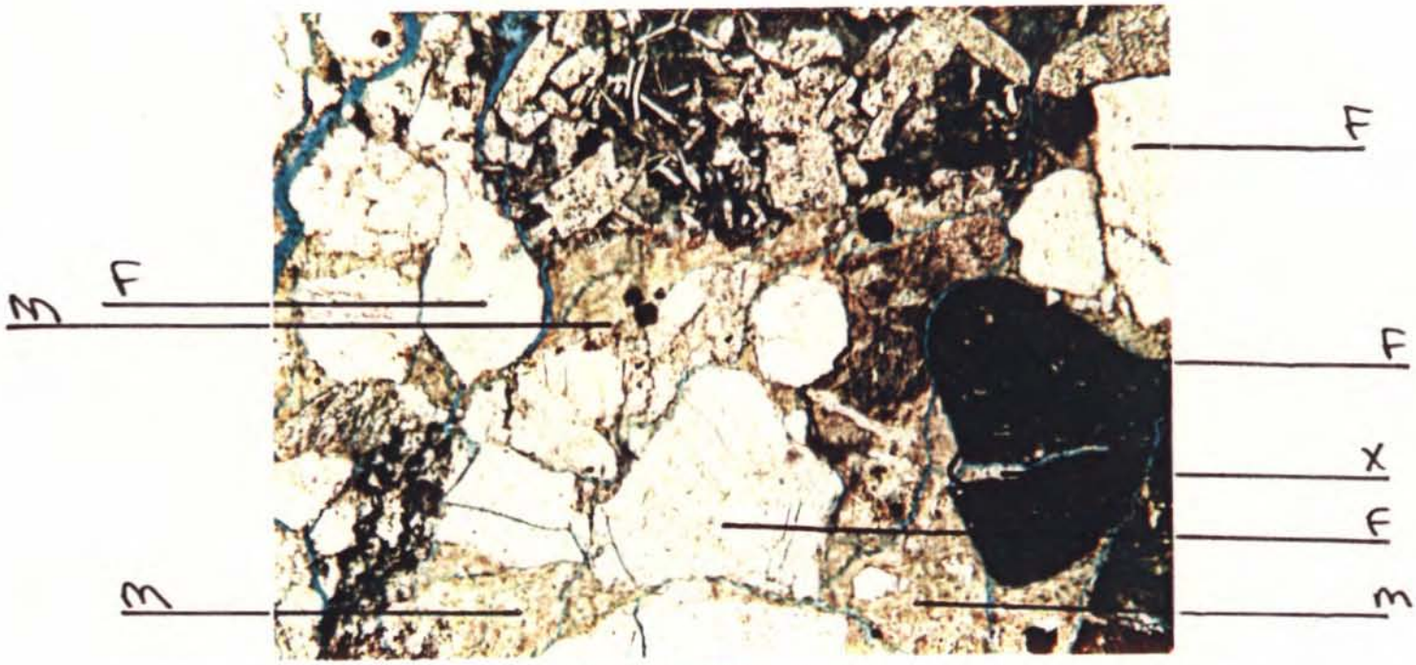
Shows clasts ("F") and calcite cement ("C")- matrix ("M"). Fossils can be seen in the calcite-rich zones.

5 cm

FIGURE 4

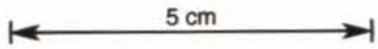
CAPE SORELL-1 WELL, AUSTRALIA

11424



THIN SECTION PHOTO
50X
PLANE LIGHT

Shows clasts ("F") and clay-rich matrix ("M") areas; note apparent fracture - "matrix" relationships, particularly in area designated "X". Relationships in this specimen indicate that at least a portion of the matrix crystallized-recrystallized after some of the fracturing.

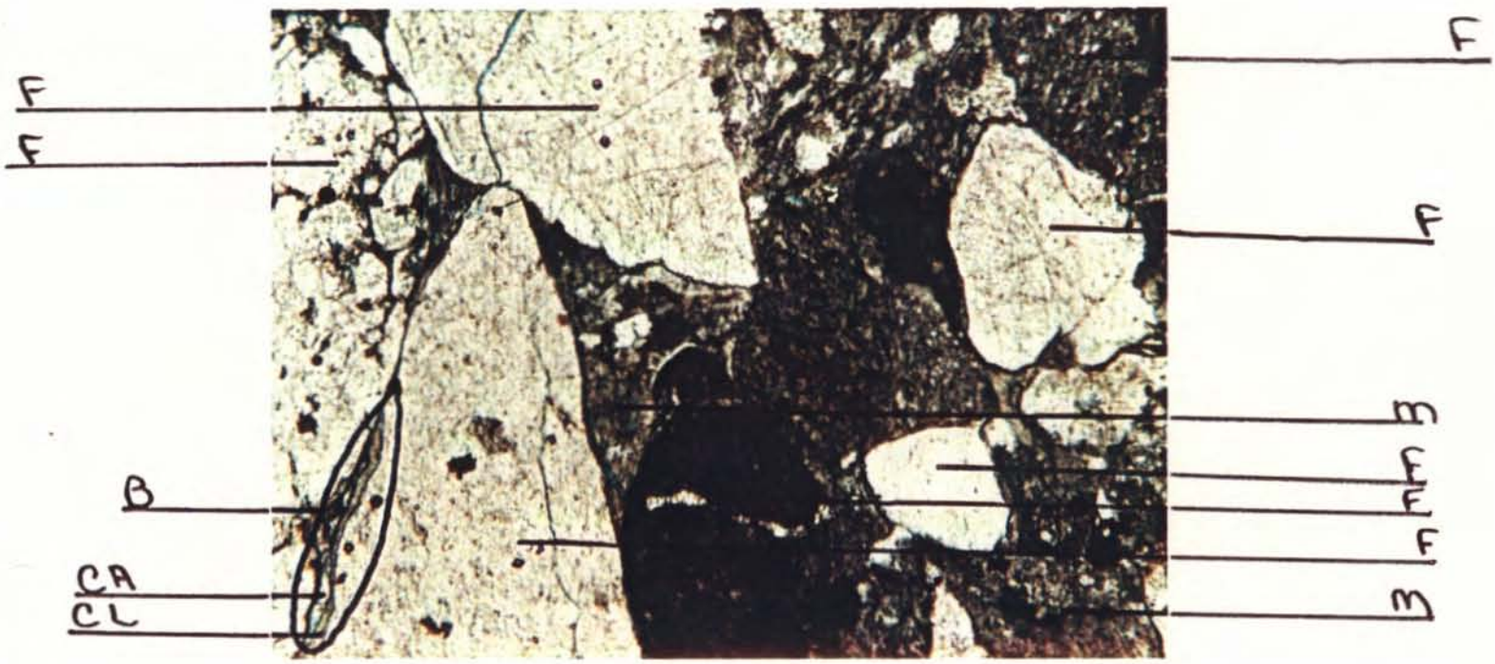


464033

FIGURE 5

CAPE SORELL-1 WELL, AUSTRALIA

11426.2



THIN SECTION PHOTO
50X
PLANE LIGHT

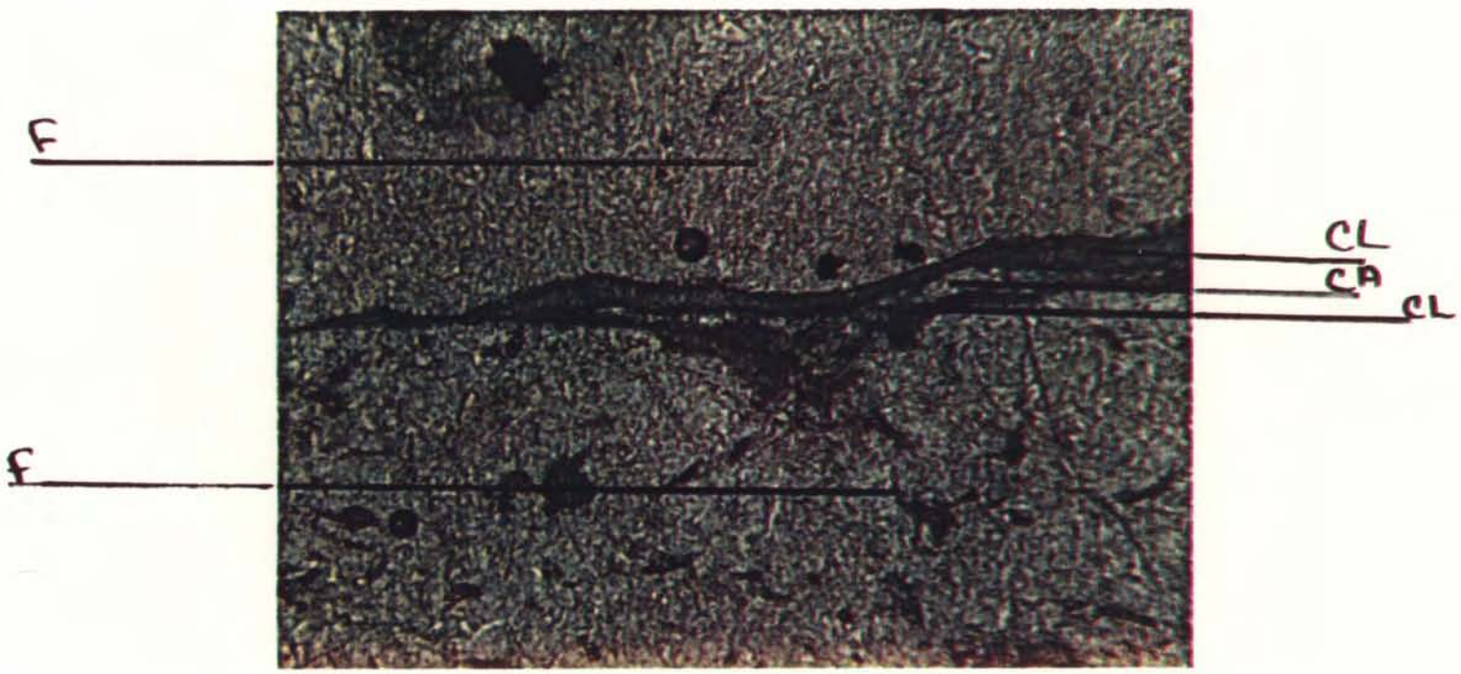
Shows clasts ("F"), matrix ("M"); noteworthy is an inter-clast zone ("B") lined with authigenic clay material ("CL"), followed paragenetically by calcite ("CA"). This is the same sequence of deposition commonly indicated/observed elsewhere in these samples, in the "matrix" - "cement".

5 cm

FIGURE 6

CAPE SORELL-1 WELL, AUSTRALIA

11426.2



THIN SECTION PHOTO
140X
PLANE LIGHT

Closer view of the zone ("B") discussed in Figure 5; "CL" is authigenic clay material, "CA" is calcite.

5 cm

CONCLUSIONS

There is little to no visually apparent porosity associated with either inter-clast matrix-cement, or within the clasts themselves, in the specimens examined. Although considerable fracturing is present in these specimens, in thin-sections, at least much of that which has imbibed blue-dyed epoxy appears to be relict from sample handling-preparation. It cannot be ruled out that at least a portion of these fractures were in fact present in-situ prior to sampling, and hence might well represent potentially significant porosity-permeability factors for these intervals at depth. However, the overall aspect of these rocks, in terms of having been subjected to moderate to strong apparent compaction during their diagenetic history, together with the character and pervasiveness of the matrix-cement material (itself largely devoid of appreciable porosity), seem to weigh against this.

Elucidation of source terrane(s) for the clasts which comprise these conglomerates should consider the spectrum of lithologies described above. Particularly important in this respect would be the relatively less durable lithologies, such as the mafic igneous rocks, some of which appear to be weathered/altered.

SECTION 4

464036

AMOCO PRODUCTION COMPANY
Tulsa, Oklahoma
December 2, 1982

82336ART0038

FILE: Technical Service 825385CF

TO: W. R. Moehl, APC (Int'l), Houston (Greenspoint)

ATTN: M. J. Fockler

SUBJECT: Source Rock Evaluation, Amoco No. 1, Cape Sorell Well, Offshore Tasmania, Australia

Organic material in both the shallow (4162-4590 ft) and deep zones (10,230-10,610 ft) is in a pregeneration stage. The shallow section appears to be oxidized and gas prone; the deeper interval is unoxidized, good to very good quality, and has kerogen with gas + oil potential. The deep zone requires deeper burial or higher geothermal gradients before the organic material will reach the oil generation window.

ERIC R. MICHAELIS

By R R Thompson
R. R. Thompson

19

LMR:lmw

cc: D. B. Felio, APC (Int'l), Houston (Greenspoint)
M. J. Fryer, APC (Int'l), Chicago
I. W. Herrick, APC (Int'l), Houston (Greenspoint)

464037

82336ART0041

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

SOURCE ROCK EVALUATION

Amoco No. 1 Cape Sorell Well, Offshore Tasmania, Australia

Geochemistry Services Group

L. M. Ross

Technical Service 825385CF
Requested by Meridee J. Fockler (12/6/82)
APC (INT'L), HOUSTON

Distribution: W. R. Moehl, Attn: M. J. Fockler, APC (Int'l), Houston
I. W. Herrick, APC (Int'l), Houston
D. B. Felio, APC (Int'l), Houston
M. J. Fryer, APC (Int'l), Chicago
R. R. Thompson/E. R. Michaelis

Subject: Amoco No. 1 Cape Sorell Well, Offshore Tasmania, Australia

INTRODUCTION

Six cuttings samples from two widely spaced intervals (4162-4590 ft; 10,230-10,610 ft) in the Amoco No. 1 Cape Sorell well were submitted for geochemical characterization. Visual examination of the cuttings samples found the 4162-4590 ft (shallow) interval to contain dark gray and black organic-rich appearing shales; whereas the 10,230-10,610 ft (deep) zone contained medium to dark grey shales and coaly material. The coaly material from our experience will impart an untrue oil prone character to the interval if the pyrolysis data (Table 2, gen HC/TOC) is used to characterize the kerogen type. In this instance, elemental analysis and kerogen morphology will be the diagnostic tools for interpreting the type of hydrocarbons to be generated.

SUMMARY

Organic material in both the shallow and deep zones is immature and ranked at a pregeneration stage. The shallow zone (4162 ft) rates as very good but the organic material is oxidized and has only a gas potential; the deeper zone (10,230 ft-10,610 ft) does not look oxidized, is good-very good quality, and is gas + oil prone. Deeper burial or higher geothermal gradients are required before organic material in the deeper zone will reach peak oil generation.

EVALUATION

The analyzed interval contains organic material interpreted to be in a pregeneration stage. This immature character is interpreted from a low vitrinite reflectance (0.45-0.55% R_o, Table 4, Fig. 2), strong odd-carbon predominance of the distribution of hydrocarbons on the total extract chromatograms (Fig. 1), and position of data on the H/C vs O/C plot (Fig. 3).

The types of hydrocarbons that the organic material should generate are interpreted from the position of data on the H/C vs O/C plot (Fig. 3), morphology of the kerogen determined by visual analysis, and convertibility (gen HC/TOC, Table 2). Based on a combination of amorphous kerogen morphology and position of data on the H/C vs O/C plot (Fig. 3), the kerogen in the 4162-4380 ft interval appears to be oxidized and the 4162 ft sample even though it contains amorphous kerogen is only a source for gaseous hydrocarbons. The 10,230-10,610 ft section is coaly (which imparts an overly optimistic liquid character, shown by the convertibility), contains mixed-type kerogen and plots close to the gas generating Type III kerogen track. All of these data suggest this section will generate gas and perhaps minor quantities of oil.

The richness rating of these beds is based on the amount of hydrocarbons generated by Rock-Eval pyrolysis, and they are classified either nonsource (4380 ft, 4590 ft) or good to very good (4162 ft, 10,230-10,610 ft).

Larry M Ross

L. M. Ross

LMR:lmw

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

OFFICE APC (INTL) DISTRICT CEN/S AMER/FAR EAST
AUTHORIZED BY MERIDEE J FOCKER
TECHNICAL SERVICE NUMBER 825385

SOURCE ROCK SUMMARY
TABLE 1.
DATE 11/24/82

464040

STATE AUSTRALI COUNTY TASMANIA WELL LOCATION
WELL NAME AMOCO AUSTRALIA PET. LEASE CAPE SORELL #1

SAMPLE NUMBER / LAB NO.	SMPL TYPE	FORMATION	AGE	LITHOLOGY	FIELD NO. OR DEPTH FEET TOP***BASE		PETROLEUM GENERATION CAPABILITY	KEROGEN TYPE (OIL/GAS)	STAGE OF DIAGENESIS
F-1210	CT		PALEOGENE		4162		VERY GOOD	GAS	PREGENERATION
F-1211	CT				4380		NON SOURCE		
F-1212	CT				4590		NON SOURCE		
F-1213	CT			?	10230	10250	GOOD	GAS+OIL	PREGENERATION
F-1214	CT			?	10380	10400	VERY GOOD	GAS+OIL	PREGENERATION
F-1215	CT			?	10590	10610	VERY GOOD	GAS+OIL	PREGENERATION

Fm Temperature 4144 ft = 102°F

BHT 11576 ft = 186°F

Current geothermal gradient about 11.3°F/1000 ft.

464041

Table 2

15:55 MONDAY, NOVEMBER 22, 1982

R825385 ROCKEVAL PYROLYSIS DATA

SAMPLE NO.	TOP OF ANALYZED INTERVAL	FORMATION	TOTAL ORGANIC CARBON WT% (TOC)	PPM VOLATILE HYDROCARBONS (S1 X 1000)	VOL/ TOC	PPM GENERATED HYDROCARBONS (S2 X 1000)	GEN/ TOC	TEMP OF MAX GEN	VOL/ VOL + GEN
F-1210	4162		5.8	120	0.00	4550	0.08	425	0.03
F-1211	4380		3.3	40	0.00	290	0.01	426	0.12
F-1212	4590		2.0	70	0.00	180	0.01	417	0.28
F-1213	10230		1.6*	230	0.01	2490*	0.16*	429	0.08
F-1214	10380		8.2*	2790	0.03	29680*	0.36*	419	0.09
F-1215	10590		5.6*	1330	0.02	17830*	0.32*	418	0.07

* Samples contain coal which imparts an inaccurate oil prone character (gen/TOC).

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

FICE APC (INTL) DISTRICT CEN/S AMER/FAR EAST
CHNICAL SERVICE NUMBER 825385

SOURCE ROCK DATA
TABLE 3.
DATE 11/24/82

464042

SAMPLE NUMBER	FIELD NO. OR DEPTH FEET TOP	BOTTOM	GEOL. AGE	INSOL RESID%	TOTAL ORG C WT%	BITUMEN BBL/AF	BITUMEN PPM	SAT HC BBL/AF	SAT HC PPM	SAT HC/BITUMEN	BITUMEN/TL ORG C	REMARKS
												BBL/AF = (PPM X .0180)
ATE AUSTRALI COUNTY TASMANIA					WELL LOCATION							
ELL NAME AMOCO AUSTRALIA PET.					LEASE CAPE SORELL #1							
F-1210	4162		PALE	88	5.8	6	339				.01	
F-1211	4380		PALE	72	3.3	3	151				<.01	
F-1212	4590		PALE	72	2.0	8	417				.02	
F-1213	10230	10250	PALE	88	1.6	11	606				.04	
F-1214	10380	10400	PALE	90	8.2	78	4339				.05	
F-1215	10590	10610	PALE	89	5.6	9	515				.01	

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OFFICE APC (INTL) DISTRICT CEN/S AMER/FAR EAST
TECHNICAL SERVICE NUMBER 825385

KEROGEN DATA
TABLE 4.
DATE 11/24/82

464043

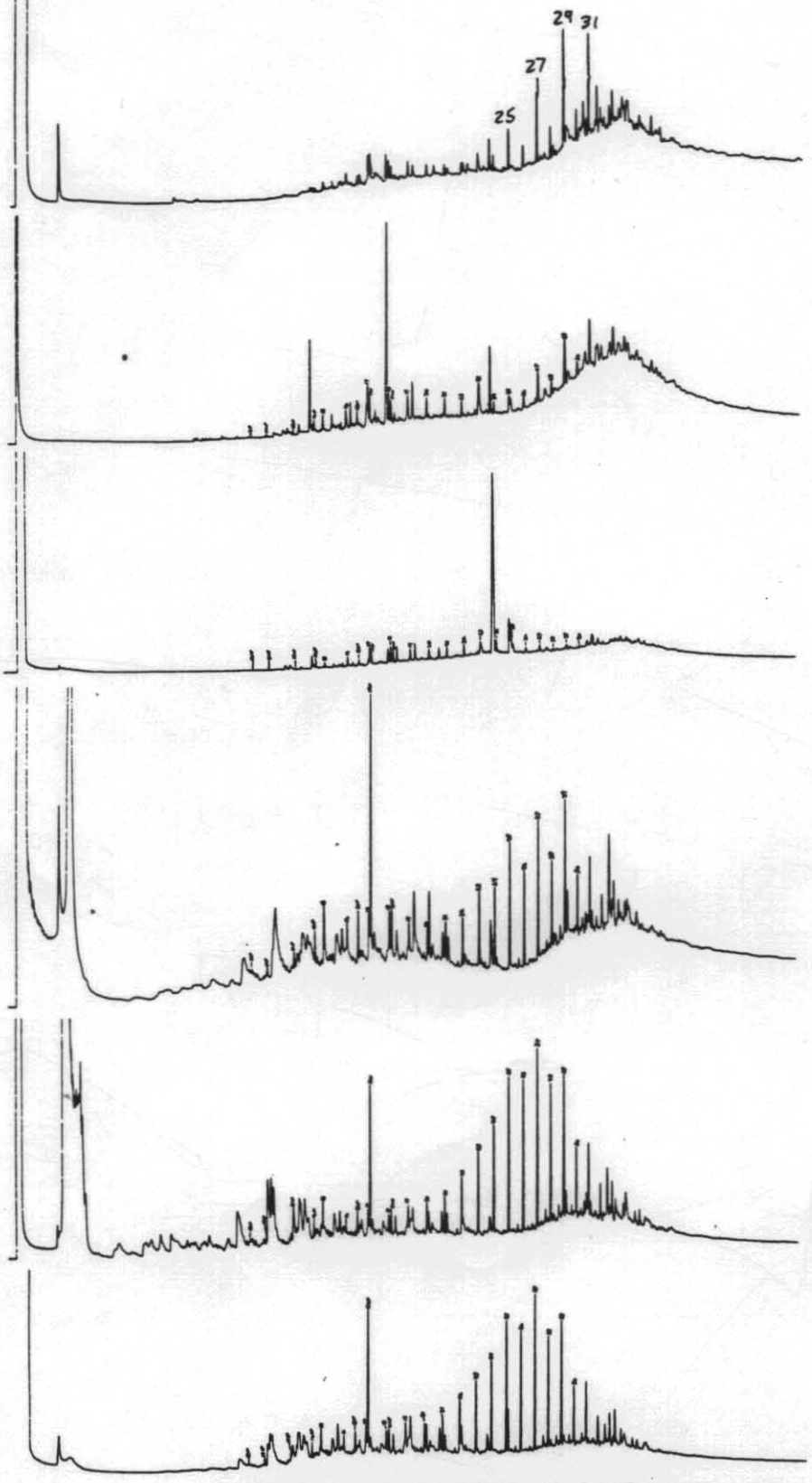
LAB SAMPLE NUMBER	FIELD NO. OR DEPTH FEET TOP***BOTTOM		GEOL. AGE	NORM. ELEMENTAL ANALYSIS,WT. CARBON	HYDROGEN	OXYGEN	NITROGEN	ATOMIC RATIO O/C	ATOMIC RATIO H/C	VISUAL KEROGEN TYPE	CARBNZ. SCALE	VIT REFLECT %RO
STATE AUSTRALI COUNTY TASMANIA				WELL LOCATION								
WELL NAME AMOCO AUSTRALIA PET.				LEASE CAPE SORELL #1								
F-1210	4162		PALE	72	4.5	22	1.5	.22	.75	AMORPHOUS		.48
F-1211	4380		PALE	70	4.1	24	2.0	.25	.70	AMORPHOUS		.55
F-1212	4590		PALE									
F-1213	10230	10250	PALE									
F-1214	10380	10400	PALE	80	6.0	13	1.3	.12	.91	MIXED		.45
F-1215	10590	10610	PALE	80	5.9	13	1.4	.11	.89	MIXED		.45

Total Extract Chromatograms

Amoco #1 Cape Sorell - Tasmania

5 cm

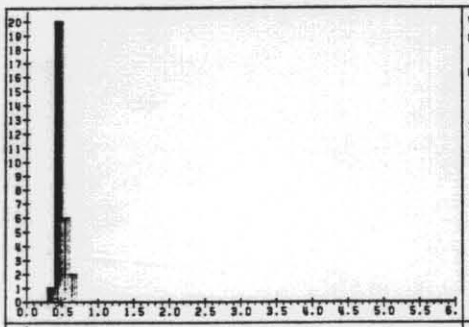
464044



TS 825385CF
Figure 1

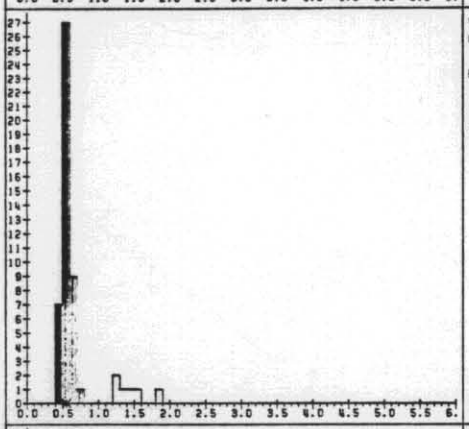
LOCALITY 5385 TECH SVC NO.5385

464045



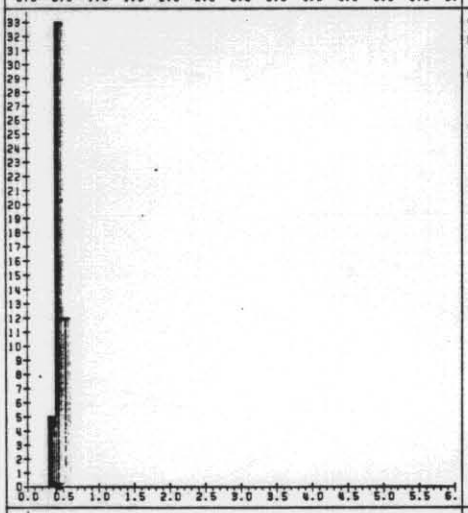
V-1210 9182.00 FT RL
CUTTINGS 11-16-82
KERO-ANOR
FLUORESCENCE YES POOR

	AVG.XRO	MEDIAN	S.DEV.	POINTS
1) R	0.48	0.47	0.065	29



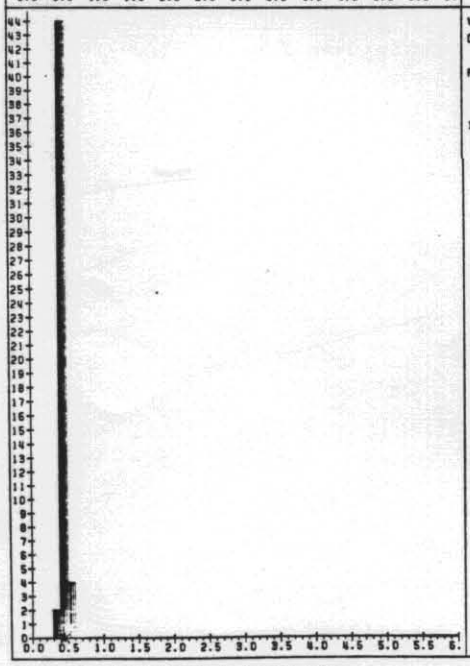
V-1211 9380.00 FT RL
CUTTINGS 11-16-82
KERO-ANOR
FLUORESCENCE YES POOR

	AVG.XRO	MEDIAN	S.DEV.	POINTS
1) R	0.55	0.56	0.061	64



V-1214 10380.00-10400.00 FT RL
CUTTINGS 11-16-82
KERO-MIX
FLUORESCENCE YES FAIR

	AVG.XRO	MEDIAN	S.DEV.	POINTS
1) R	0.45	0.46	0.045	50



V-1215 10590.00-10610.00 FT RL
CUTTINGS 11-16-82
KERO-MIX
FLUORESCENCE YES FAIR

	AVG.XRO	MEDIAN	S.DEV.	POINTS
1) R	0.45	0.45	0.031	50

X-AXIS = PERCENT REFLECTANCE OF VITRINITE (XRO)
Y-AXIS = FREQUENCY
AVERAGE XRO FOR POP.1 = 0.49

5 cm

FIG. 2
TS825385CF

tary - To Be Maintained In Confidence

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

464046

KERODGEN EVOLUTION PATHS

——— TYPE I

- - - - TYPE II

— — TYPE III

WELL LEGEND Amoco #1 CAPE SORELL

TECH SERVICE

■ 4162-4380 ft.

● 10380-10610 ft.

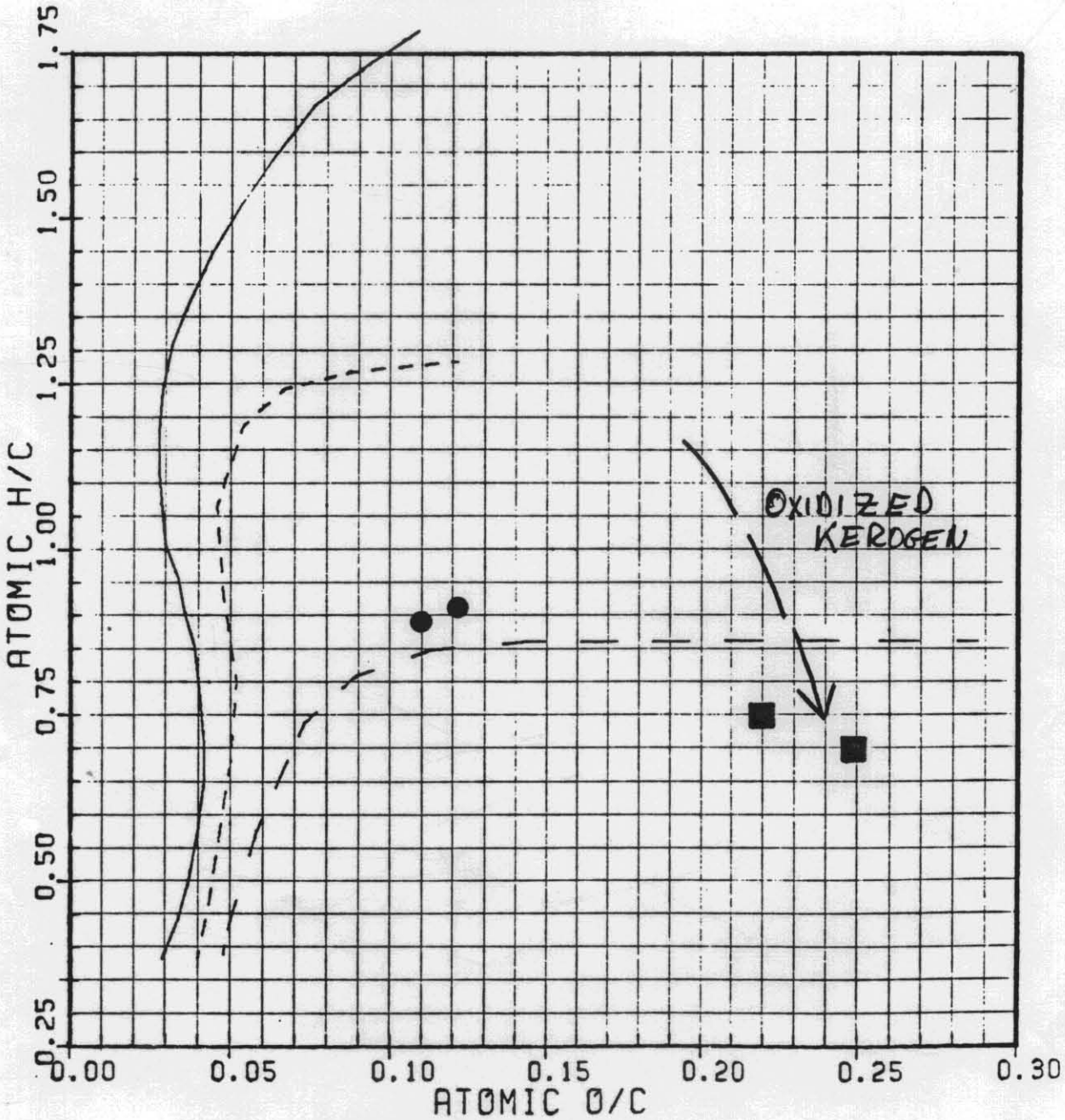


FIG. 3
TS 825385CF

5 cm