ORIGINAL

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Alaska Oil & Gas Cons. Commission
Anchorage

```
••COMMAND = LD
..FIRST SAMPLE NO. = 18715
..LAST SAMPLE NO.  = 18742
..LOAD COMMAND =  LT
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1	18715	50	1300	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/06/81PT
2	18716	50	4900	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/06/81PT
[illegible]	[illegible]	50	[illegible]	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/06/81PT
[illegible]	[illegible]	50	[illegible]	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/06/81PT
[illegible]	[illegible]	50	[illegible]	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/06/81PT
6	18720	50	14?0	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
7	18721	50	3390	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
8	18722	50	2740	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
9	18723	50	3100	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
10	18724	50	3460	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
11	18725	50	3960	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
12	18726	50	4190	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
13	18727	50	4540	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
14	18728	50	4400	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/10/81PT
15	18730	50	5620	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
16	18731	50	5980	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
17	18732	50	6340	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
18	18733	50	6670	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
19	18734	50	7060	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/09/81PT
20	18735	50	7420	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/10/81PT
21	18736	50	7780	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/10/81PT
22	18737	50	8140	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/10/81PT
23	18738	50	8320	4	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/10/81PT
24	18739	50	8000	2	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/10/81PT
25	18740	50	5026	2	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/10/81PT
26	18741	50	7705	2	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/10/81PT
27	18742	50	8361	2	STANDARD OF CALIF.CAPE ESPENBERG#1.AK 11/10/81PT

```
••COMMAND = LD
..FIRST SAMPLE NO. = 18715
..LAST SAMPLE NO.  = 18742
..LOAD COMMAND =  LP
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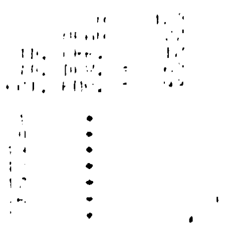
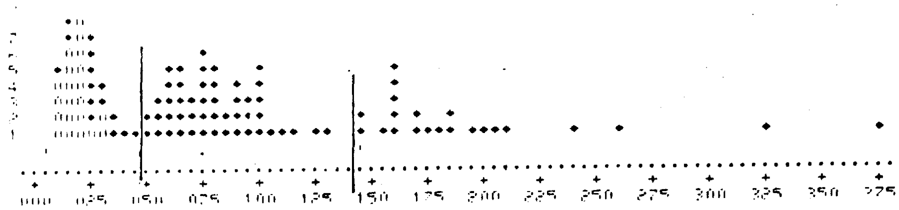
11 13 81 18715 50 1300 4 STANDARD OF CALIF.CAPE ESPENBERG#1.AK

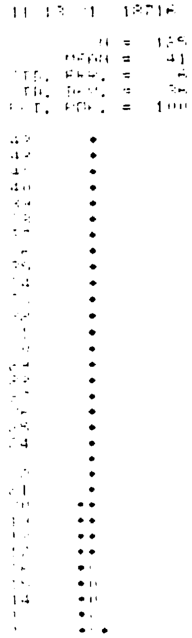


000 - 049 = 0.22 (28%)
050 - 144 = 0.81 (48%)
145 - 375 = 1.89 (21%)

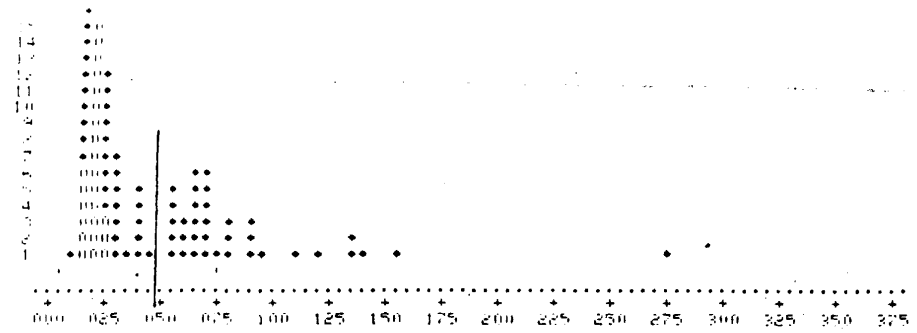


11 13 81 18716 50 4900 4 STANDARD OF CALIF.CAPE ESPENBERG#1.AK

N = 135
MEAN = 41

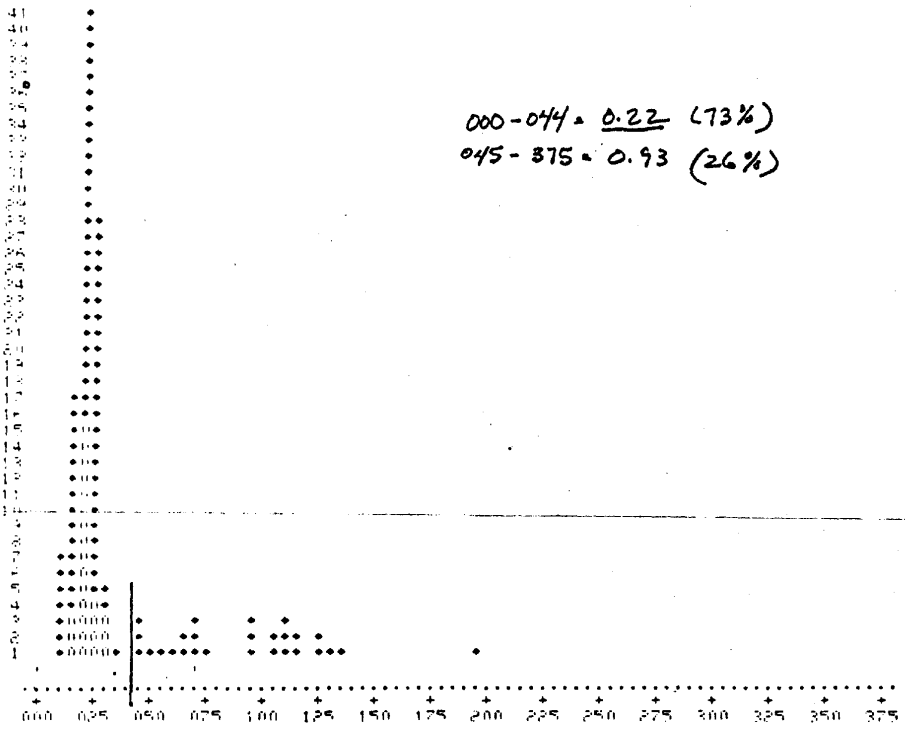


000 - 049 = 0.23 (65%)
050 - 375 = 0.87 (35%)



11 13:81 19717 50 850' 4 STANDARD DF CALIF.CAPE EISENBERG#1.AP

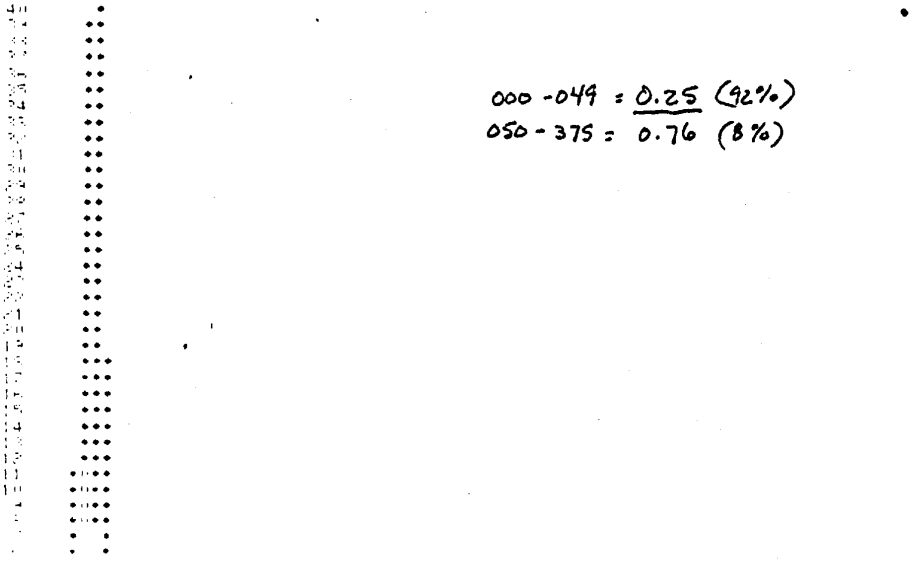
```
       N =  125
    MEAN =   37
STD. ERR. =    5
STD. DEV. =   33
PCT. POP. =  100
```



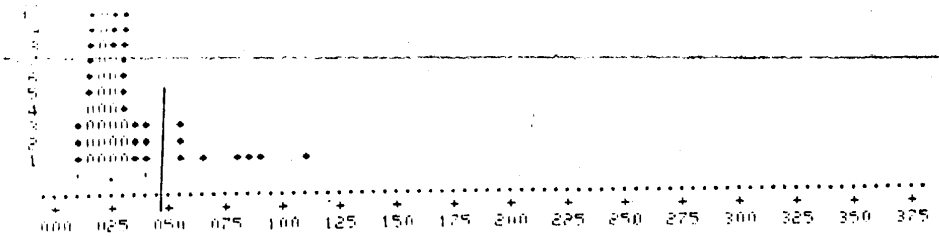
000-044 = 0.22 (73%)
045-375 = 0.93 (26%)

11 13:81 19718 50 1210' 4 STANDARD DF CALIF.CAPE EISENBERG#1.AP

```
       N =  125
    MEAN =   38
STD. ERR. =    2
STD. DEV. =   14
PCT. POP. =  100
```

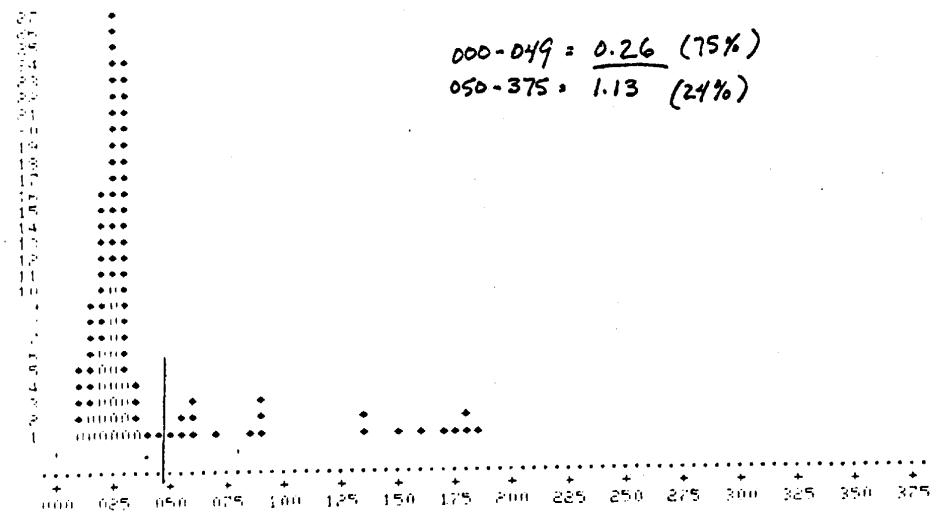


000-049 = 0.25 (92%)
050-375 = 0.76 (8%)



11 13:81 18219 50 1570 4 STANDARD DF CALIF.CAPE ESPENBERG#1•AP

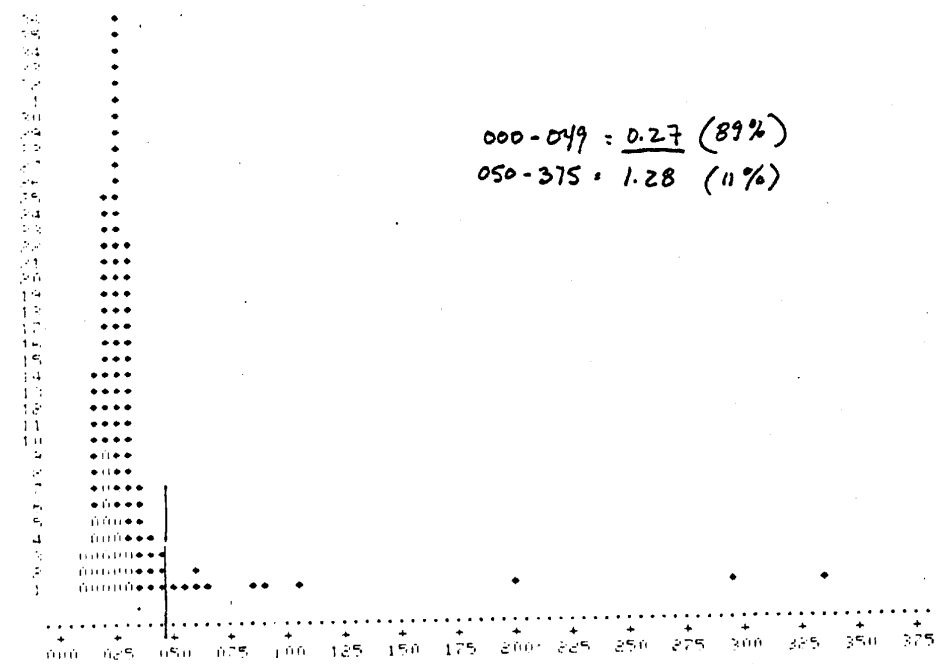
```
       N =  107
    MEAN =   42
STD. ERR. =    7
STD. DEV. =   40
PCT. POP. =  100
```



000-049 = 0.26 (75%)
050-375 = 1.13 (24%)

11 13:81 18220 50 1930 4 STANDARD DF CALIF.CAPE ESPENBERG#1•AP

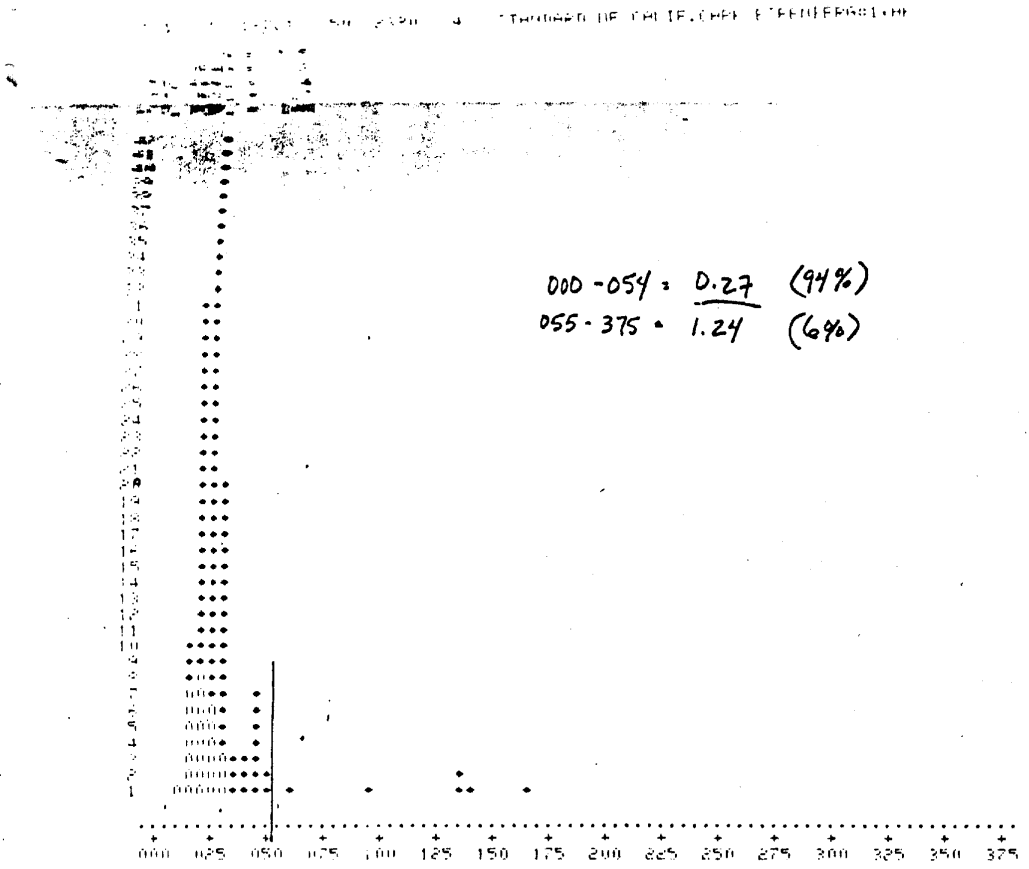
```
       N =  105
    MEAN =   35
STD. ERR. =    7
STD. DEV. =   41
PCT. POP. =  100
```



000-049 = 0.27 (89%)
050-375 = 1.28 (11%)

11 13:81 18221 50 2390 4 STANDARD DF CALIF.CAPE ESPENBERG#1•AP

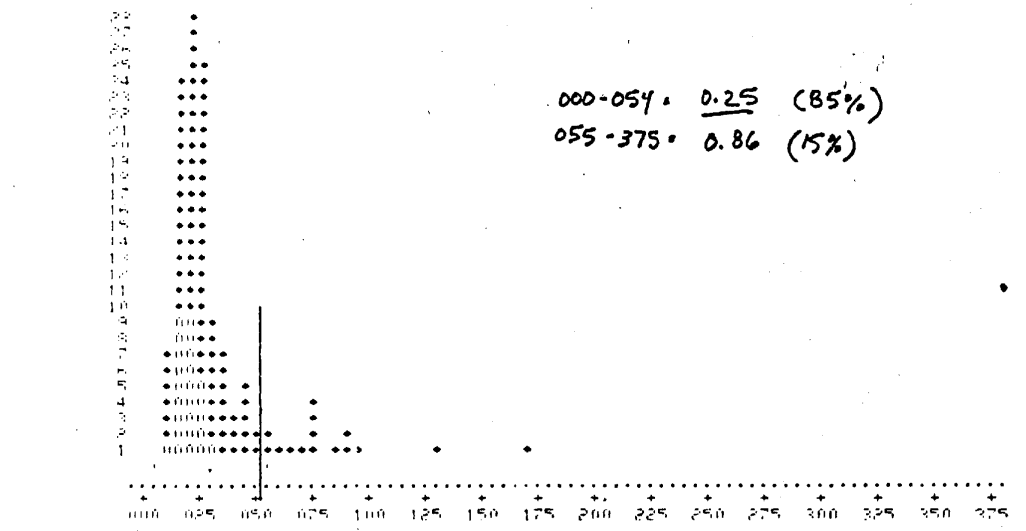
```
       N =  105
    MEAN =   40
STD. ERR. =    4
STD. DEV. =   37
PCT. POP. =  100
```



000 - 054 = 0.27 (94%)
055 - 375 = 1.24 (6%)

11 13 81 18:22 50 2740 4 STANDARD DF CALIF.CAPE ESPENBERG#1.AK

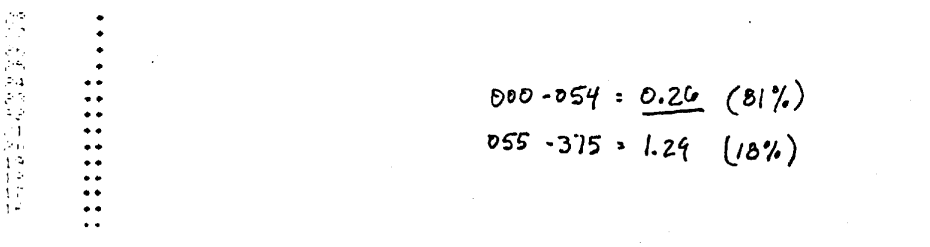
N = 126
MEAN = 32
STD. ERR. = 4
STD. DEV. = 23
PCT. POP. = 100



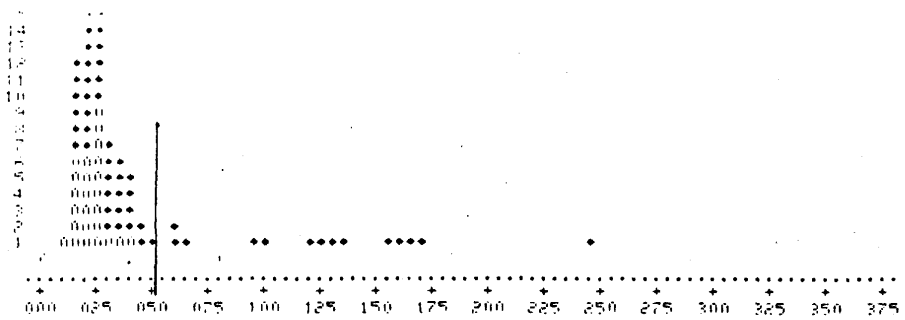
000-054 = 0.25 (85%)
055-375 = 0.86 (15%)

11 13 81 18:22 50 3100 4 STANDARD DF CALIF.CAPE ESPENBERG#1.AK

N = 100
MEAN = 41
STD. ERR. = 7
STD. DEV. = 40
PCT. POP. = 100



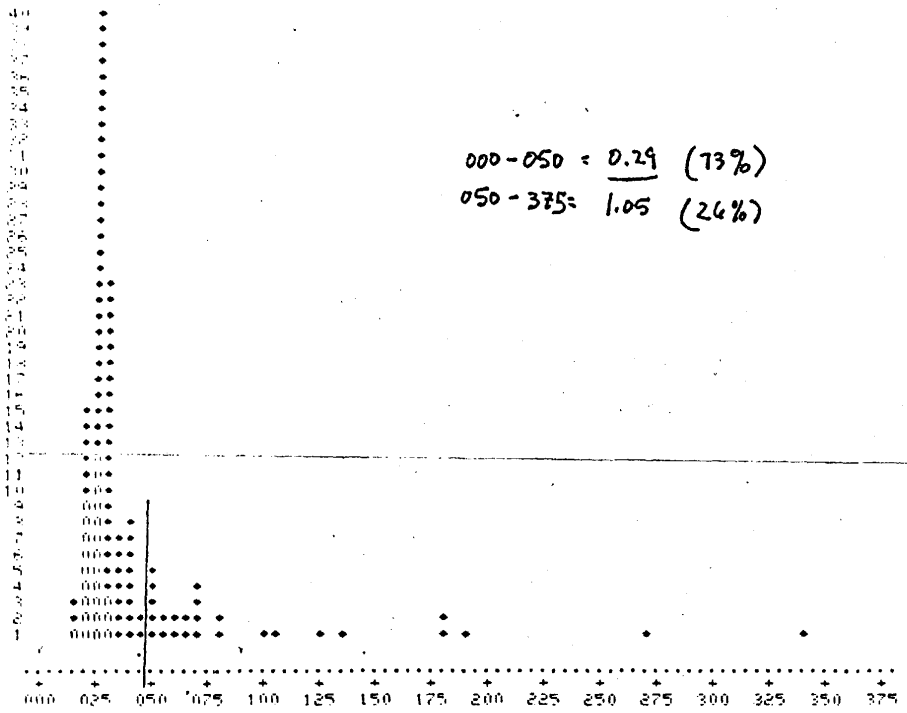
000-054 = 0.26 (81%)
055-375 = 1.29 (18%)



11-13-81 18724 50 34.0' 4 STANDARD OF CALIF.CAPE ESPENBERG#1.AK

N = 124
MEAN = 45
STD. ERR. = 0
STD. DEV. = 45
PCT. POP. = 99

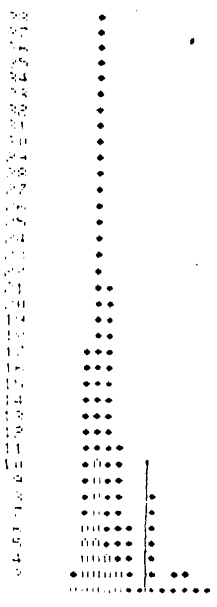
000-050 = 0.29 (73%)
050-375 = 1.05 (26%)

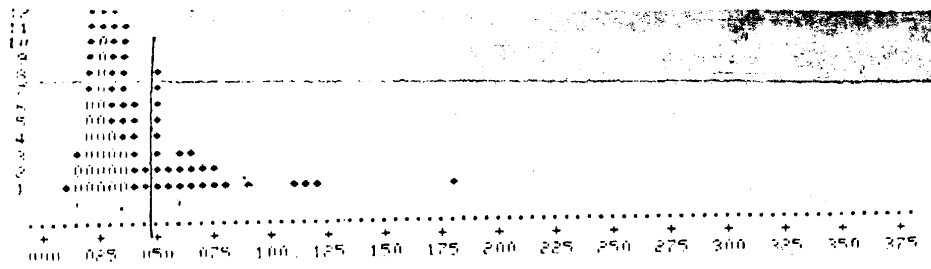


11-13-81 18725 50 3820' 4 STANDARD OF CALIF.CAPE ESPENBERG#1.AK

N = 125
MEAN = 38
STD. ERR. = 4
STD. DEV. = 23
PCT. POP. = 100

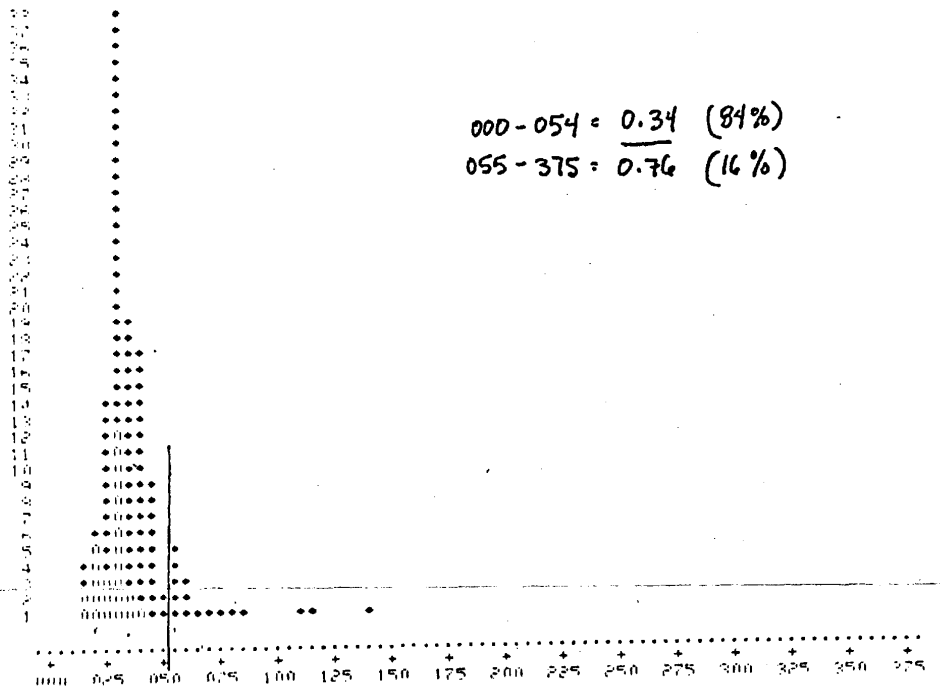
000-049 = 0.29 (74%)
050-375 = 0.74 (26%)





11-13-81 19725 50 4130' 4 STANDARD OF CALIF.CAPE ETRENBERG#1-AK

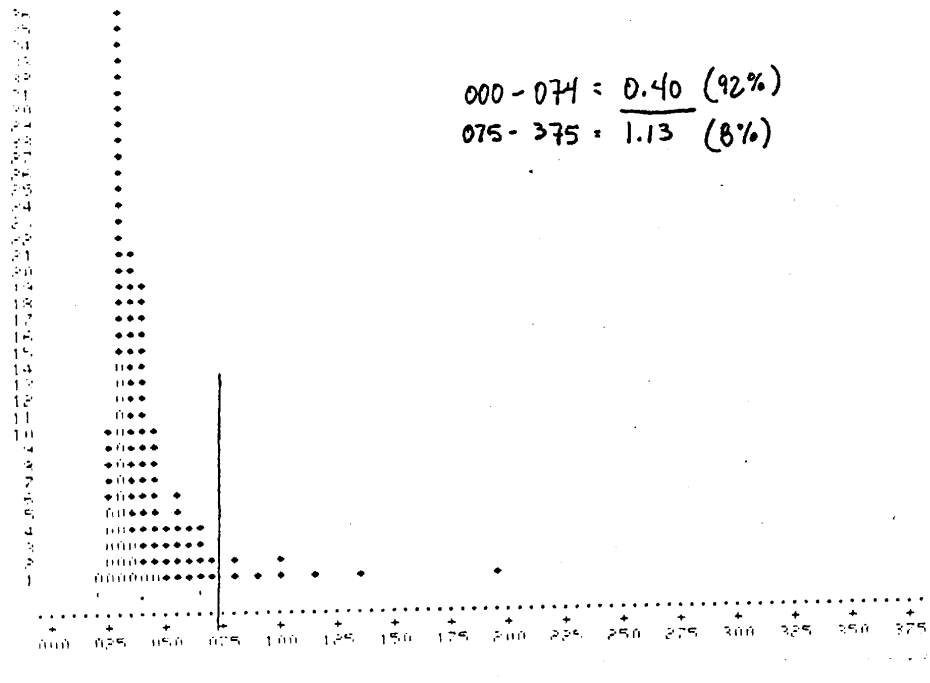
N = 125
MEAN = 39
STD. ERR. = 3
STD. DEV. = 18
PCT. POP. = 100



000 - 054 = 0.34 (84%)
055 - 375 = 0.76 (16%)

11-13-81 19727 50 4540' 4 STANDARD OF CALIF.CAPE ETRENBERG#1-AK

N = 125
MEAN = 44
STD. ERR. = 3
STD. DEV. = 22
PCT. POP. = 100

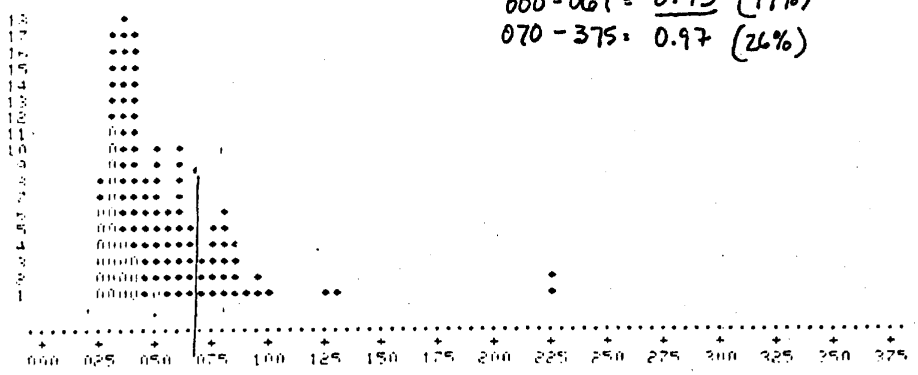


000 - 074 = 0.40 (92%)
075 - 375 = 1.13 (8%)

11/13/81 18729 50 4900' 4 STANDARD OF CALIF,CAPE EIPENBERG#1.AK

N = 125
MEAN = 54
STD. ERR. = 6
STD. DEV. = 30
PCT. POP. = 100

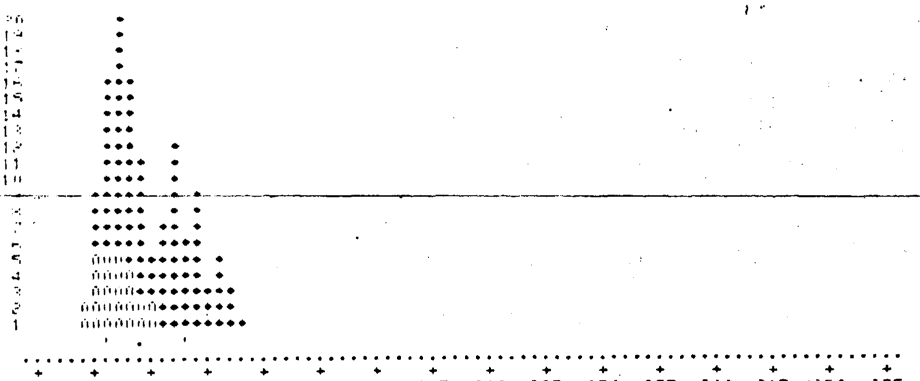
000-069 = 0.43 (74%)
070-375 = 0.97 (26%)



BASALT AT 5000' - 5650'

11/13/81 18730 50 5620' 4 STANDARD OF CALIF,CAPE EIPENBERG#1.AK

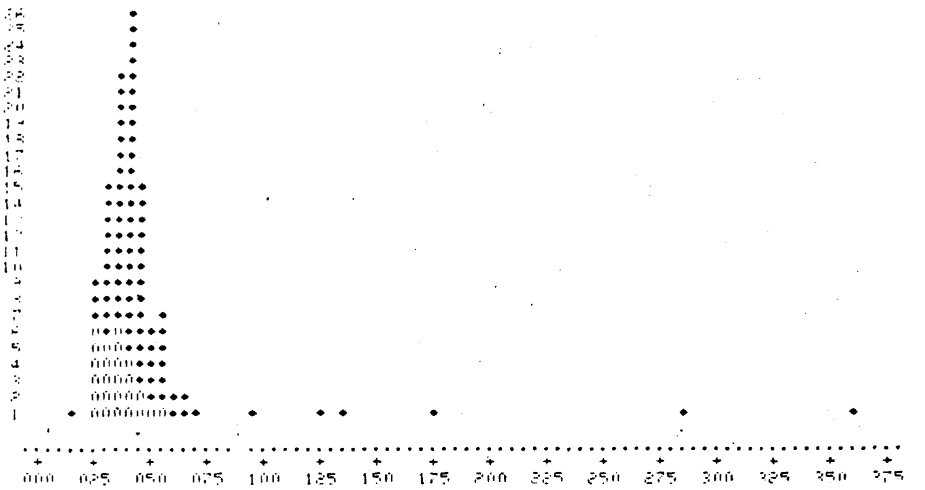
N = 135
MEAN = 42
STD. ERR. = 3
STD. DEV. = 17
PCT. POP. = 100



VOLCANIC WELDED TUFF FROM 5800' - 7400'

11/13/81 18731 50 5480' 4 STANDARD OF CALIF,CAPE EIPENBERG#1.AK

N = 112
MEAN = 44
STD. ERR. = 7
STD. DEV. = 42
PCT. POP. = 100



11/13/81 18732 50 4940' 4 STANDARD OF CALIF,CAPE EIPENBERG#1.AK

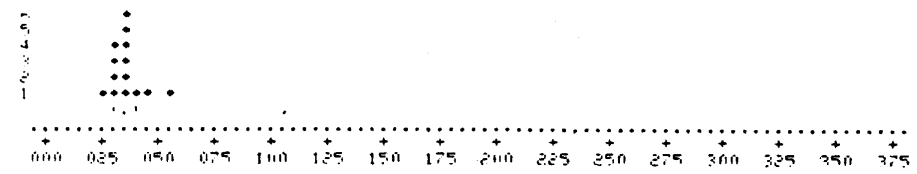
INSUFFICIENT DATA

N = 14
MEAN = 37
STD. ERR. = 9

11 13 81 18732 50 6340' 4 STANDARD OF CALIF,CAPE ESPENBERG#1,AK

INSUFFICIENT DATA

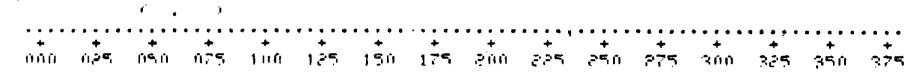
```
        N =   14
     MEAN =   37
STD. ERR. =    3
STD. DEV. =   12
PCT. POP. =  100
```



11 13 81 18733 50 6870' 4 STANDARD OF CALIF,CAPE ESPENBERG#1,AK

INSUFFICIENT DATA

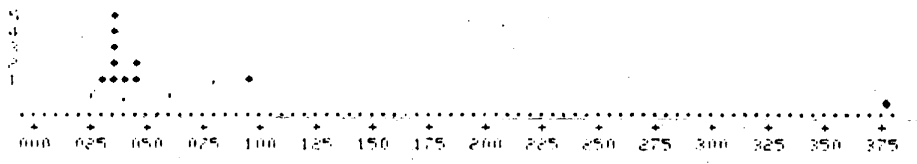
```
        N =    9
     MEAN =   64
STD. ERR. =   12
STD. DEV. =   19
PCT. POP. =  100
```



11 13 81 18734 50 7060' 4 STANDARD OF CALIF,CAPE ESPENBERG#1,AK

INSUFFICIENT DATA

```
        N =   10
     MEAN =   44
STD. ERR. =   11
STD. DEV. =   17
PCT. POP. =  100
```

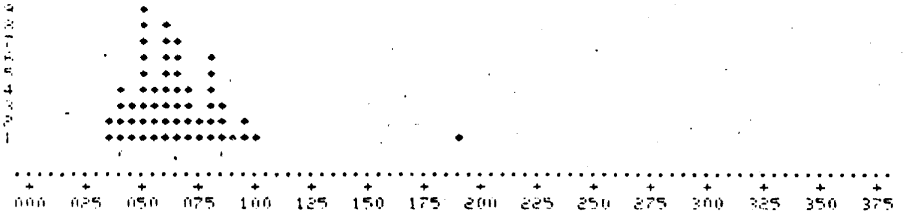


VOLCANIC AGGLOMERATE FROM ~7400' - 7900'

11 13 81 18735 50 7420' 4 STANDARD OF CALIF,CAPE ESPENBERG#1,AK

```
        N =   52
     MEAN =   66
STD. ERR. =    5
STD. DEV. =   32
PCT. POP. =  100
```

0.66



11 13 81 18736 50 7780' 4 STANDARD OF CALIF,CAPE ESPENBERG#1,AK

```
        N =   39
     MEAN =  125
STD. ERR. =   20
STD. DEV. =   64
PCT. POP. =  100
```

000-124 = 0.46 (35%)
125-375 = 1.70 (64%)

META SEDIMENTS FROM 8000' TO T.D.

11 13 81 18737 50 8140' 4 STANDARD OF CALIF,CAPE ESPENBERG#1,AK

```
        N =  135
     MEAN =  144
STD. ERR. =   15
```

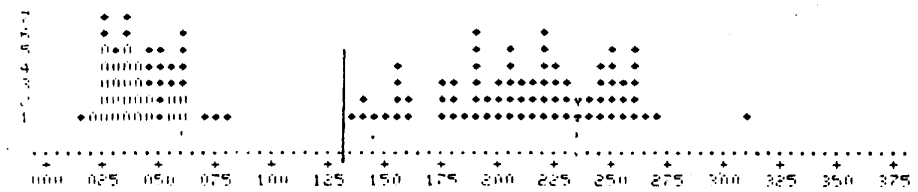
000-134 = 0.44 (23%)
135-375 = 2.13 (77%)

META SEDIMENTS FROM 8000 TO I.D.

11 1 81 18738 50 83204 4 STANDARD OF CALIF,CAPE ESPENBERG#1•AK

N = 135
MEAN = 143
STD. ERR. = 15
STD. DEV. = 87
PCT. POP. = 100

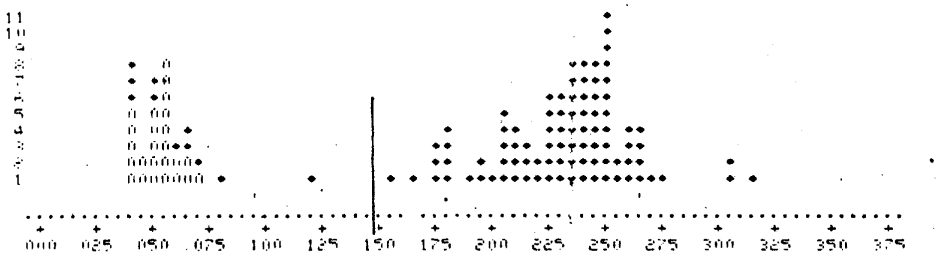
000 - 134 • 0.44 (23%)
135 - 375 • 2.13 (77%)



11 1 81 18738 50 83204 4 STANDARD OF CALIF,CAPE ESPENBERG#1•AK

N = 135
MEAN = 183
STD. ERR. = 14
STD. DEV. = 84
PCT. POP. = 100

000 - 149 • 0.56 (11%)
150 - 375 • 2.33 (89%)

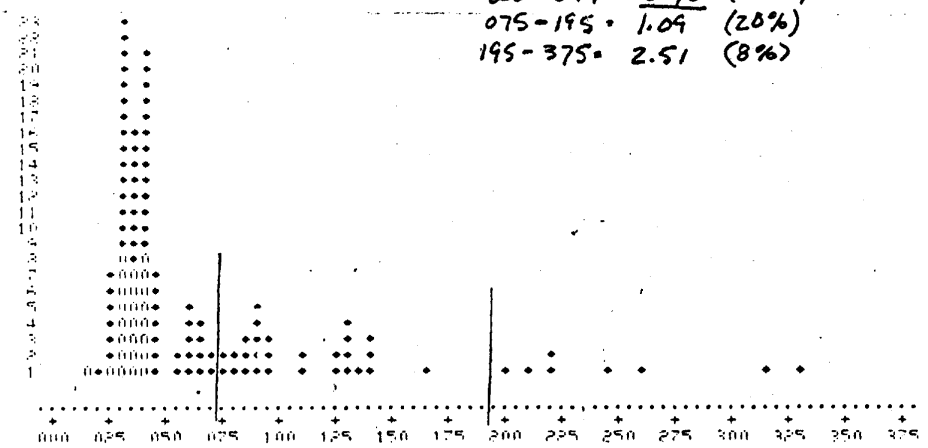


CORE

11 13 81 18739 50 50004 2 STANDARD OF CALIF,CAPE ESPENBERG#1•AK

N = 135
MEAN = 69
STD. ERR. = 10
STD. DEV. = 58
PCT. POP. = 100

000 - 074 • 0.40 (64%)
075 - 195 • 1.09 (28%)
195 - 375 • 2.51 (8%)

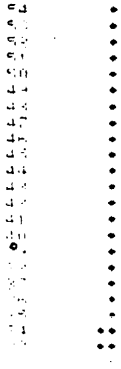


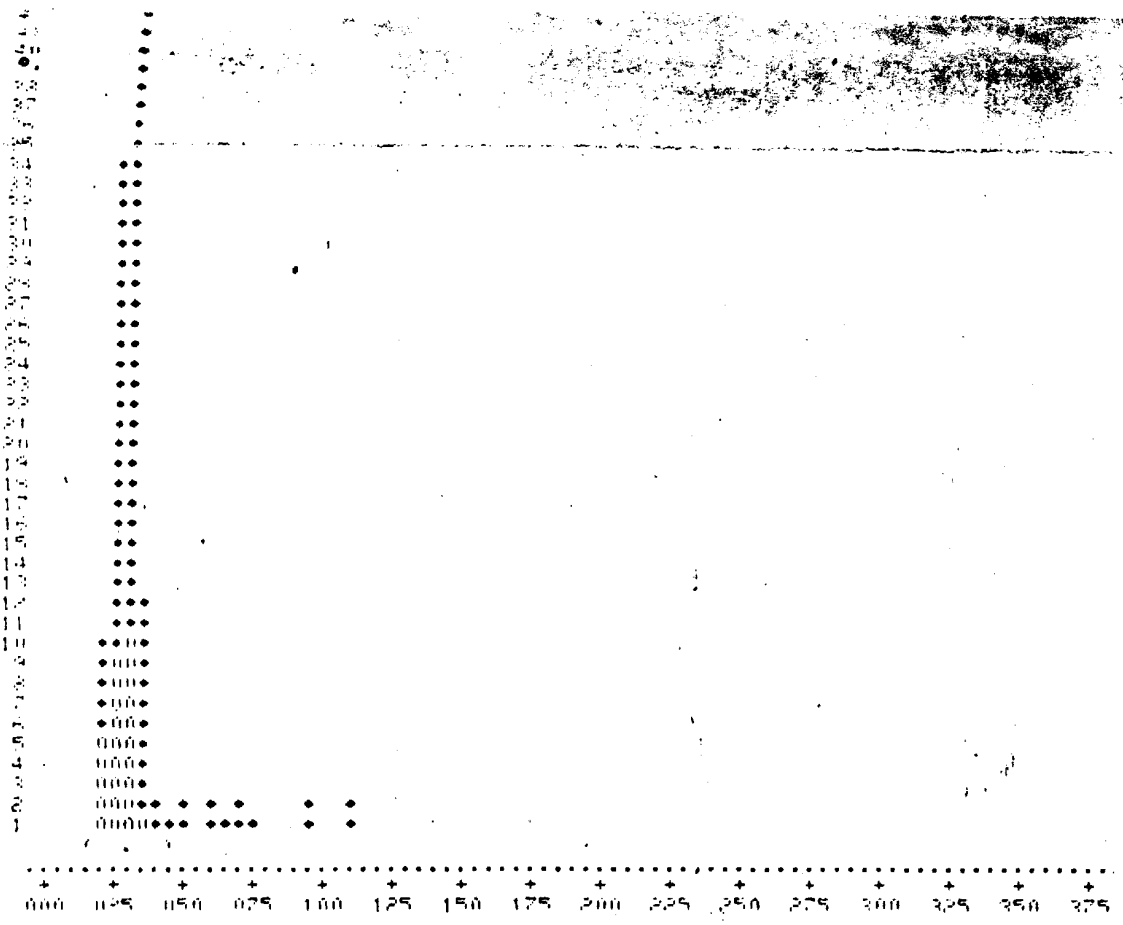
CORE

11 13 81 18740 50 50264 2 STANDARD OF CALIF,CAPE ESPENBERG#1•AK

N = 135
MEAN = 84
STD. ERR. = 2
STD. DEV. = 15
PCT. POP. = 100

0.34



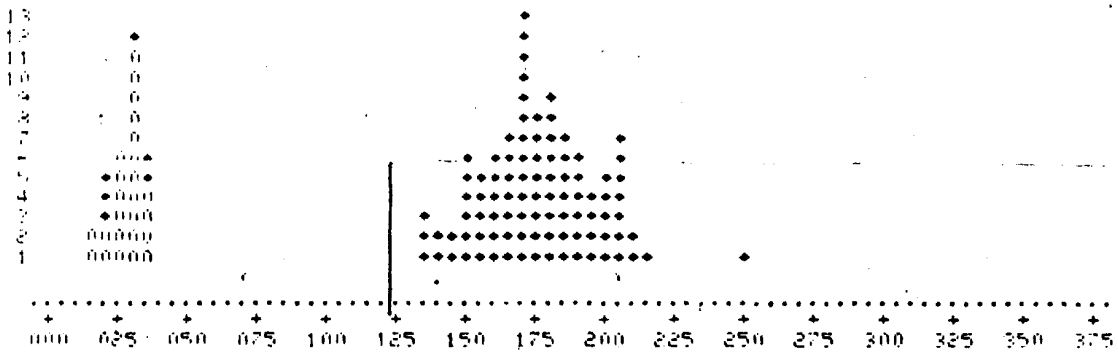


VOLCANIC AGGLOMERATE

11 13 81 18741 50 7705 2 STANDARD OF CALIF,CAPE ESPENBERG#1.AI

N = 155
MEAN = 140
STD. ERR. = 11
STD. DEV. = 44
PCT. POP. = 100

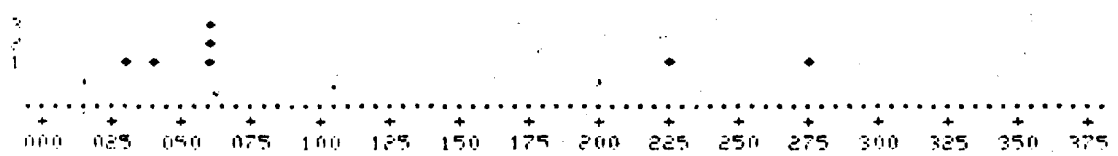
000-124 = 0.29 (6%)
125-375 = 1.77 (94%)



11 13 81 18742 50 8361 2 STANDARD OF CALIF,CAPE ESPENBERG#1.AI

INSUFFICIENT DATA.

N = 7
MEAN = 109
STD. ERR. = 53
STD. DEV. = 92
PCT. POP. = 100



COMMAND =

original

(3)

Mobil Exploration and Producing Services Inc.

P.O. BOX 900
DALLAS, TEXAS 75221

November 23, 1981

Mr. William Van Alen
State of Alaska
Alaska Oil & Gas Conservation Commission
3001 Porcupine Drive
Anchorage, Alaska 99501

ESC REQUEST NO. 311A78
VISUAL KEROGEN, THERMAL MATURATION,
TOC AND ROCK-EVAL ANALYSES,
SOCAL CAPE ESPENBERG #1,
KOTZEBUE, ALASKA

Dear Mr. Alen:

This report discribes the visual kerogen, thermal maturation, TOC and Rock-Eval results from the SOCAL Cape Espenberg #1 well, Kotzebue, Alaska. Visual kerogen and vitrinite reflectance analyses are based on 24 ditch samples taken at 300' intervals between 130' and 8320' (TD). Four core samples are also included in these studies. TOC and Rock-Eval analyses are based on 24 ditch samples taken at 90' intervals between 190' and 3970', and 510' intervals between 3970' and 7750'. A plot of the low-gray Ro means (figure 1), a kerogen analysis sheet (table 1), a summary of the thermal maturity and hydrocarbon potential (table 2), histogram plots, and a copy of the TOC and Rock-Eval report are included.

Results from TAI analysis of the SOCAL Cape Espenberg #1 indicate that the section penetrated from 130' to 1570' is transitionally mature, and the interval between 2380' and 4540' is slightly mature. The TAI results and vitrinite reflectance results are in conflict. The vitrinite data indicate the 130' to 4540' interval is thermally immature. The TAI values were taken from spores which tend to be thicker walled, therefore, darker than the preferred bissacates. It is possible that the dark color of the spores was caused by oxidation. In either event, the sparseness of palynomorphs inhibits any further breakdown of maturity by TAI analysis.

Results from visual kerogen analysis of the SOCAL Cape Espenberg #1 samples are listed on the attached kerogen analysis sheet (table 1). It should be noted that all of the samples analyzed from this well are dominated by cellulosic (gas type) kerogens. Fluorescence analysis of these samples supports this interpretation.

Results from vitrinite reflectance studies on the SOCAL Cape Espenberg #1 well indicate that the interval between 130' and 5000' is thermally immature. The interval between 5000' and 7420' contains no in situ vitrinite. The interval from 7705' to 8320' is overmature. Lithologies indicate a section of volcanic rocks from 5000' to approximately 7400' with pyroclastic rocks and metamorphic sediments from about 7400' to 8373' (TD). A plot of the low-gray Ro means from the Cape Espenberg #1 samples is attached (figure 1). A summary of the thermal maturity and hydrocarbon potential of the Cape Espenberg #1 samples is also included with the report (table 2). Histogram plots of the Ro readings from each sample are attached. The reflectance measurements used in this study were made by R. R. Taylor.

Results from TOC analysis range from "poor" below 5860' to "very good" for samples between 1030' and 1450'. Pyrolysis indicates "poor" to "marginal" hydrocarbon potential for the samples that have TOC's over 1% and gas as the most likely hydrocarbon they would generate.

Time requirements for this job were charged to ESC Request No. 311A78. If you have any questions concerning the results or interpretations, please do not hesitate to contact me.

Very truly yours,

Timothy A. Timmcke

T. A. Timmcke
Exploration Services Center
Applied Stratigraphy

TAT/jg
Attachments

TABLE 1

ORGANIC RESIDUE (KEROGEN) ANALYSIS

M-005 (Rev. 01-80)

SCALE: T = TRACE (<1%)
1 = 1 – 10%, 2 = 11 – 20%, 3 = 21 – 30%, 4 = 31 – 40%, 5 = 41 – 50%, 6 = 51 – 60%, 7 = 61 – 70%, 8 = 71 – 80%, 9 = 81 – 90%, 10 = 91 – 100%

DATE: 9/23/81

PROJECT:
SOCAL CAPE ESPENBERG #1
KOTZEBUE, ALASKA

ESC NO. 311A78
ANALYST: T. A. Timmcke

DEPTH OR NO.	TYPE OF ORGANIC MATTER: AMORPHOUS (OIL RICH)	CUTICLE	PALYNOMORPHS	AMORPHOUS (GAS or OIL)	BARK & WOODY DEBRIS	INERTINITE	FUNGAL MATERIAL - CHITIN	% OF RESIDUE	FLUOR.: STRONG FLUORESCENCE	MODERATE FLUORESCENCE	WEAK FLUORESCENCE	POLLEN COLOR, TAI AND MATURATION: LIGHT YELLOW (1) IMMATURE	MEDIUM YELLOW (1+) IMMATURE	YELLOW BROWN (2) TRANSITIONAL	LIGHT BROWN (2+) SLIGHTLY MATURE	MEDIUM BROWN (3) MOD. MATURE	DARK BROWN (3+) MATURE	VERY DARK BROWN (4) FULLY MATURE	BLACKISH BROWN (4+) OVERMATURE	BLACK (4 to 4+) TRANSITIONAL	METAMORPHOSED ROCK (5)	NO PALYNOMORPHS	PRESRV: GOOD	FAIR	POOR	DEPOSITIONAL ENVIRONMENT: MARINE	MARGINAL MARINE	NO MARINE PALYNOMORPHS	UNKNOWN	REMARKS:
130' - 190'	1	T	3	2	4	1	✓	✓			✓								✓										✓		SPORE
490' - 550'	1	T		7	2	1		✓			✓								✓										✓		SPORE
850 - 910	1			7	2	1	✓	✓											✓										✓		
1210 - 1270	1		2	6	1	1		✓											✓										✓		
1570 - 1630	1				9	1		✓											✓										✓		MINERAL
1930 - 1990	1	T		6	3	1		✓			✓									✓									✓		SPORE
2340 - 2440	1		2	4	3	1		✓											✓										✓		
2740 - 2800	1		3	3	3	1	✓	✓											✓										✓		
3110 - 3160	T		2	1	7	T	✓												✓										✓		
3460 - 3520	T		4	3	3	T		✓											✓										✓		
3820 - 3880	T		3	1	4	T	✓	✓											✓										✓		
4180 - 4240	T	T	6	3	2	T		✓			✓									✓									✓		SPORE
4540 - 4600	1		5	1	3	1	✓	✓											✓										✓		
4900 - 4960	T		7	1	2	T		✓											✓										✓		
5260 - 5320																															SAMPLE LOST
5620 - 5680																															BARREN
5980 - 6040	T		1		9	T		✓											✓										✓		MINERAL
6340 - 6400					10	0													✓										✓		MINERAL
6700 - 6760																															BARREN
7060 - 7120					10	0													✓										✓		MINERAL
7420 - 7480					10	0													✓										✓		MINERAL
7780 - 7840				1	9	0													✓										✓		MINERAL
8140 - 8200	T		2	2	6	T		✓											✓										✓		
8320 - 8370			3		7	0													✓										✓		
CORE 5000'	1		5	2	2	1	✓	✓											✓										✓		
CORE 5026	1	T	5	2	2	1	✓	✓											✓										✓		
CORE 7705			1		9	0													✓										✓		
CORE 8361					10	0													✓										✓		MINERAL
IN FEET																															

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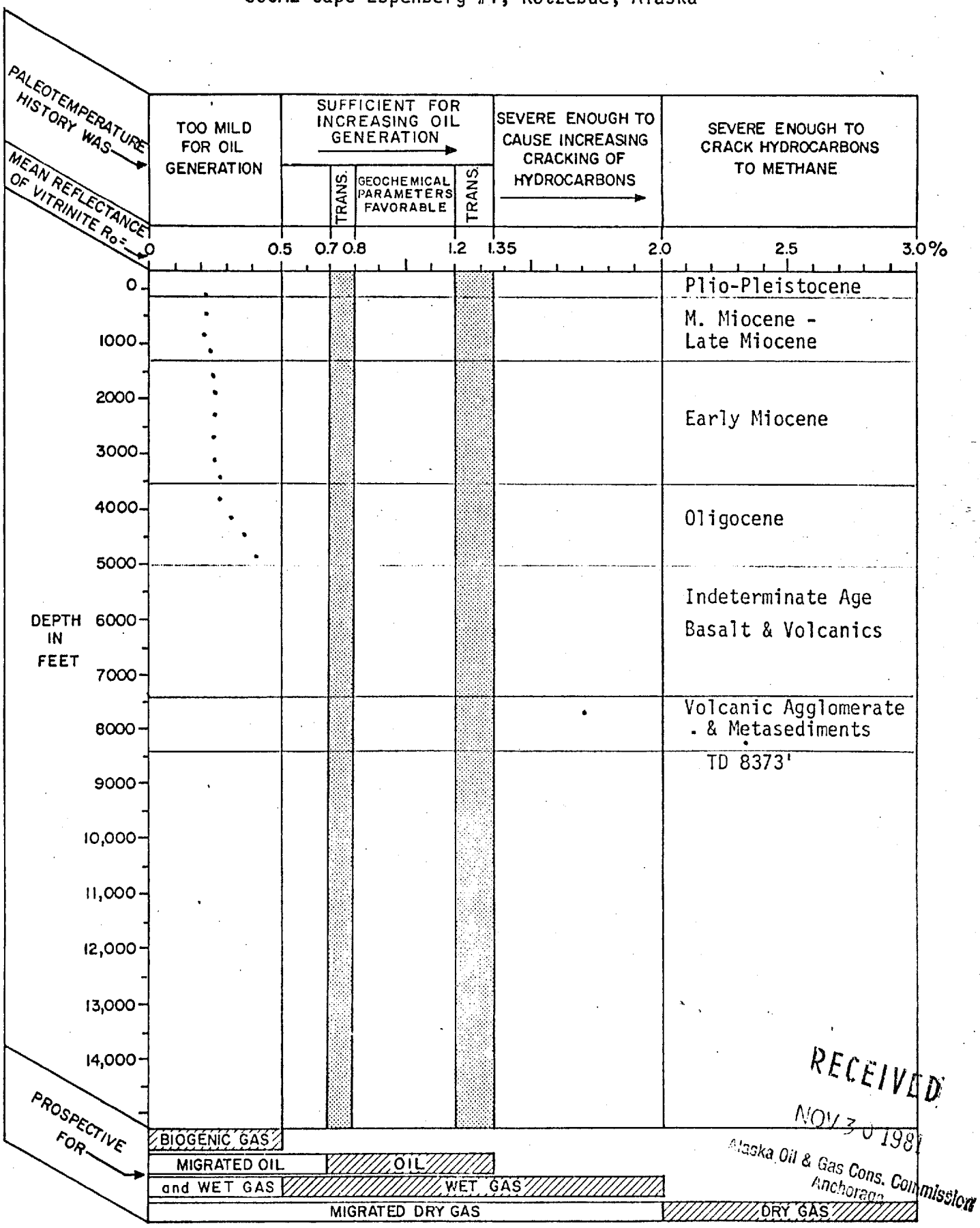
FIGURE 1
Plot of Low-Gray Ro Means
SOCAL Cape Espenberg #1, Kotzebue, Alaska



ESC No. 311A78

TABLE 2
Thermal Maturation and Visual Kerogen Analyses
Socal Cape Espenberg No. 1, Kotzebue, Alaska

DEPTH OR SPL. NO.	LOW-GRAY Ro MEAN	% POP.	FIRST HIGH-GRAY Ro MEAN	% POP.	TAI	THERMAL MATURITY	KEROGEN TYPE	HYDROCARBON POTENTIAL/REMARKS
130'	0.22	28	0.81	48	2	Immature	Cellulosic	Gas type kerogen
490'	0.23	65	0.87	35	2	Immature	Cellulosic	Gas type kerogen
850'	0.22	73	0.93	26		Immature	Cellulosic	Gas type kerogen
1210'	0.25	92	0.76	8		Immature	Cellulosic	Gas type kerogen
1570'	0.26	75	1.13	24		Immature	Cellulosic	Gas type kerogen
1930'	0.27	89	1.28	11	2+	Immature	Cellulosic	Gas type kerogen
2380'	0.27	94	1.24	6		Immature	Cellulosic	Gas type kerogen
2740'	0.25	85	0.86	15		Immature	Cellulosic	Gas type kerogen
3110'	0.26	81	1.29	18		Immature	Cellulosic	Gas type kerogen
3460'	0.29	73	1.05	26		Immature	Cellulosic	Gas type kerogen
3820'	0.29	74	0.74	26		Immature	Cellulosic	Gas type kerogen
4180'	0.34	84	0.76	16	2+	Immature	Cellulosic	Gas type kerogen
4540'	0.40	92	1.13	8		Immature	Cellulosic	Gas type kerogen
4900'	0.43	74	0.97	26		Immature	Cellulosic	Gas type kerogen
5260'	-	-	-	-		-	-	Sample lost
5620'	0.49	100				Immature	Cellulosic	Basalt-caved vitrinite
5980'	0.49	100				Immature	Cellulosic	Welded tuff-caved vit.

TABLE 2
Thermal Maturation and Visual Kerogen Analyses
Socal Cape Espenberg No. 1, Kotzebue, Alaska

DEPTH OR SPL. NO.	LOW-GRAY Ro MEAN	% POP.	FIRST HIGH-GRAY Ro MEAN	% POP.	TAI	THERMAL MATURITY	KEROGEN TYPE	HYDROCARBON POTENTIAL/REMARKS
6340'	-	-	-	-		-	-	Insufficient data
6670'	-	-	-	-		-	-	Insufficient data
7060'	-	-	-	-		-	-	Insufficient data
7420'	0.66	100				Immature	Cellulosic	Volcanic Agglomerate-Probable caved vit.
7780'	1.70	64				Overmature	Cellulosic	Volcanic Agglomerate
8140'	2.13	77				Overmature	Cellulosic	Gas-metasediments
8320'	2.33	89				Overmature	Cellulosic	Gas-metasediments
Cores								
5000'	0.40	65	1.09	28		Immature	Cellulosic	Gas type kerogen
5026'	0.34	100				Immature	Cellulosic	Basalt-caved vitrinite
7705'	1.77	94				Overmature	Cellulosic	Volcanic Agglomerate
8361'	-	-	-	-		-	-	Insufficient data

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REPORT NO. 489

GEOCHEMICAL EVALUATION OF TWENTY-FOUR SAMPLES FROM THE SOCAL CAPE ESPENBERG #1 WELL

by
Mary Michael Page

Project No. RRUS/812/II/T/51

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September 25, 1981

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RESEARCH (U.S.) INC.

INTRODUCTION

Twenty-four samples were forwarded for Total Organic Carbon (TOC) analysis and Rock-Eval pyrolysis. The Rock-Eval pyrolysis was to be run regardless of the TOC value. Two of the samples exhibited high amounts of bitumen, as evidenced by the coalescence of the pyrolysis S1 and S2 into a single peak. The suggestion was made to, and accepted by, the client to extract these samples and evaluate both the extracted sample and the recovered extract.

SUMMARY

The source richness based on TOC range from "non-source" below 5,860 feet to "very good" for samples between 1030 and 1450 ft. Pyrolysis generally indicates "nonsource" to "marginal" amounts of hydrogen-poor kerogen. The T-max values indicate immature material but are probably not representative for the samples with the single S1 + S2 peak. For samples 1450 and 2290, the S1 and S2 peaks merge, suggesting the presence of significant amounts of bitumen. A portion of the sample was extracted and rerun; however the general shape of the pyrogram did not change. The extract consists of moderate amounts of immature bitumen, and gives no indication of the type of material responsible for the anomalous Rock-Eval response.

The increase in TOC for sample 1450 is reproducible and probably due to the removal of sulfur together with the bitumen during extraction. The high per cent carbon and character of the chromatogram are consistent with a coaly type material, which accumulates in an environment conducive to high sulfur concentrations.

SOCAL CAPE ESPENBERG #1

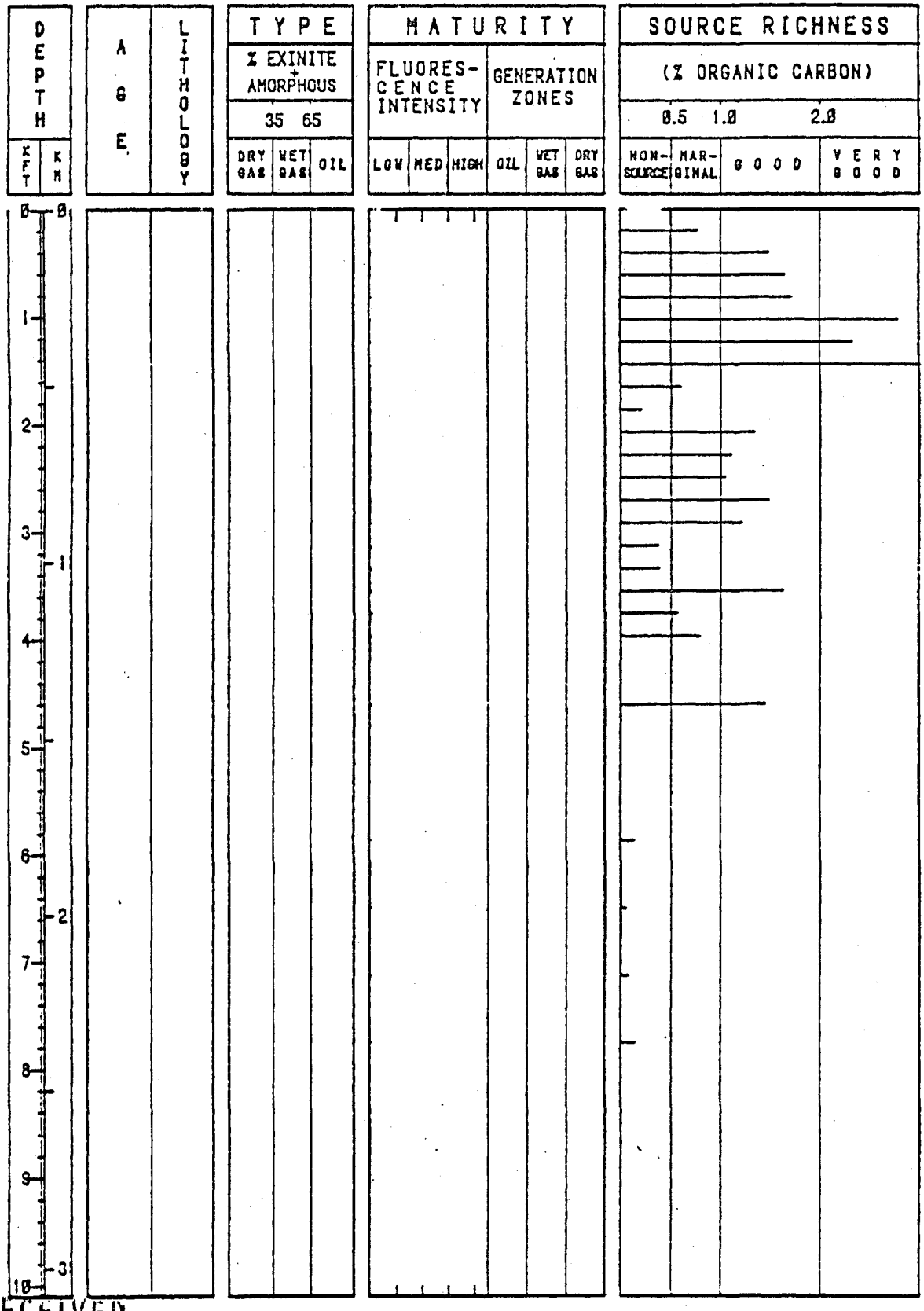

FIGURE 1: SUMMARY PLOTS SHOWING KEROGEN TYPES, MATURITY, AND SOURCE RICHNESS (SEE APPENDICES IV AND II)

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SOCAL CAPE ESPENBERG #1

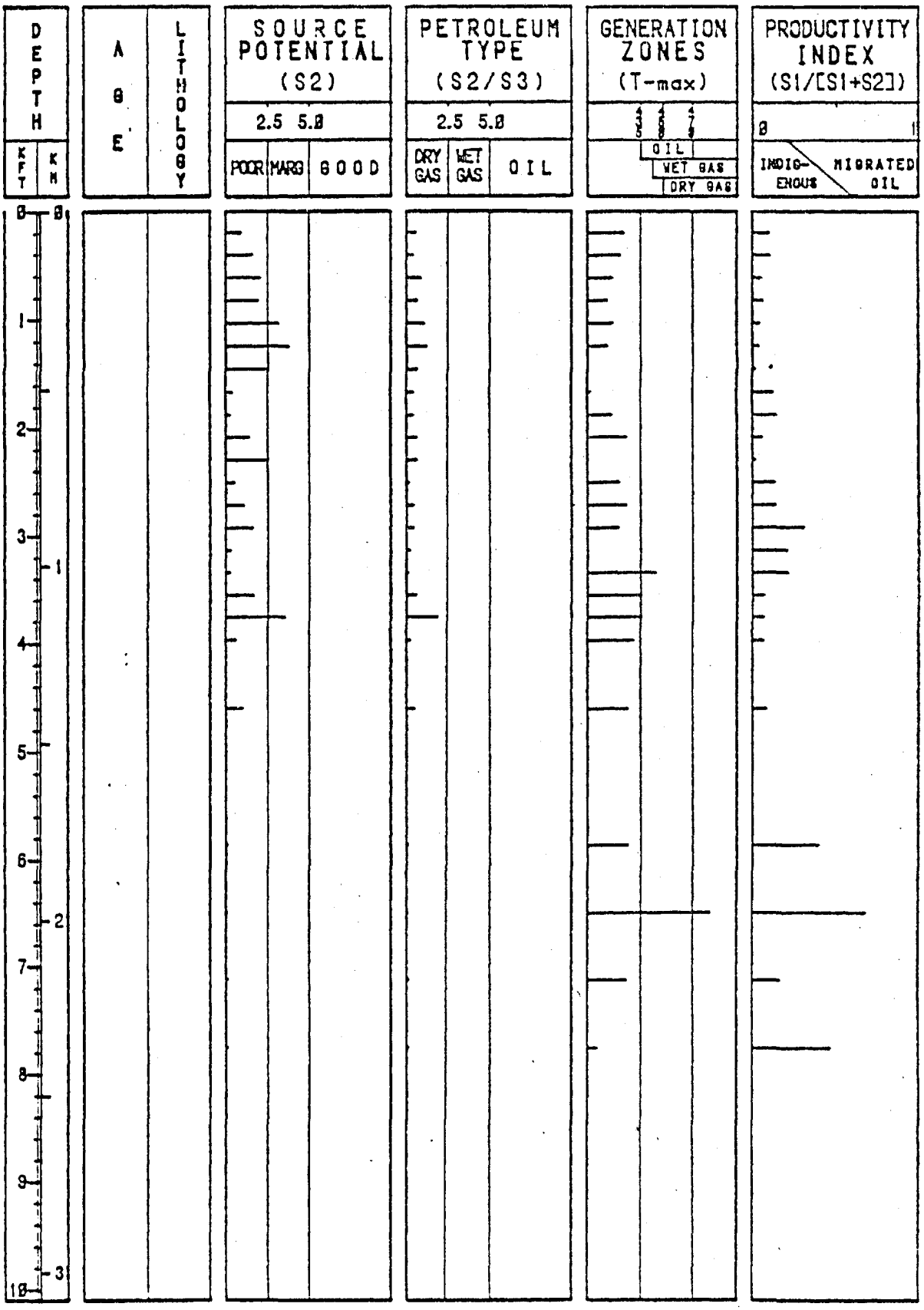

FIGURE 2: SUMMARY PLOTS OF ROCK-EVAL PYROLYSIS DATA (APPENDIX II)

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APPENDIX I

TOTAL ORGANIC CARBON DATA

Total organic carbon is determined by pulverizing the sample, treating a carefully weighed portion with warm hydrochloric acid to remove carbonate minerals, and analysing the residue for carbon content with a Leco carbon analyser. It is generally accepted that samples with less than about 0.5 percent TOC cannot yield sufficient petroleum to form commercial deposits and are therefore considered nonsources; samples with between 0.5 and 1.0 TOC are rated as marginal in source quality; and samples with more than 1.0 TOC are considered to be good in source quality.

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TOTAL ORGANIC CARBON DATA

SOCAL CAPE ESPENBERG #1

Sample Interval	DEPTH (FEET)	TOC (%)
130- 250	190	0.76
340- 460	400	1.48
550- 670	610	1.64
760- 880	820	1.70
970-1090	1030	2.78
1180-1300	1240	2.32
1390-1510	1450	17.17
1600-1720	1660	0.59
1810-1930	1870	0.19
2020-2140	2080	1.33
2230-2350	2290	1.10
2440-2560	2500	1.04
2650-2770	2710	1.48
2860-2980	2920	1.20
3070-3190	3130	0.36
3280-3400	3340	0.37
3490-3610	3550	1.62
3700-3820	3755	0.55
3910-4030	3970	0.78
4540-4660	4600	1.44
5800-5920	5860	0.12
6430-6550	6490	0.04
7060-7180	7120	0.06
7690-7810	7750	0.13

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APPENDIX II

ROCK-EVAL PYROLYSIS DATA

Rock-Eval data are expressed as mg/g of rock and include four basic parameters: 1) S_1 represents the quantity of free hydrocarbons present in the rock and is roughly analogous to the solvent extractable portion of the organic matter; 2) S_2 represents the quantity of hydrocarbons released by the kerogen in the sample during pyrolysis; 3) S_3 is related to the amount of oxygen present in the kerogen; and 4) T-max, in °C, is the temperature at which the maximum rate of generation (of the S_2 peak) occurs and can be used as an estimate of thermal maturity.

In addition, the ratio S_2/S_3 provides a general indication of kerogen quality (type) and reveals whether oil or gas are likely to be generated. The ratio $S_1/(S_1+S_2)$, or the productivity index, is an indication of the relative amount of free hydrocarbons (in place or migrated) present in the sample. Hydrogen and oxygen index values are in mg of hydrocarbons (S_2 peak) or carbon dioxide (S_3 peak) per gram of organic carbon. When plotted against each other on a van Krevelen-type diagram, information on kerogen type and maturity can be obtained.

Data are interpreted in the following manner:

Source Potential - values of S2	<2.5	: poor
	2.5-5.0	: marginal
	>5.0	: good
Petroleum Type - value of S2/S3	<2.5	: dry gas
	2.5-5.0	: wet gas
	>5.0	: oil
Generation Zones - values of T-max	<435	: immature
	435-470	: oil
	450 +	: gas

Productivity Index - high values of S1/(S1+S2) indicate migrated hydrocarbons.

ROCK-EVAL PYROLYSIS RAW DATA

SOCAL CAPE ESPENBERG #1

DEPTH (FEET)	S1	S2	S3	S2/S3	S1/(S1+S2)	T-MAX
190	0.081	0.820	1.768	0.464	0.090	423
400	0.157	1.514	4.284	0.354	0.094	421
610	0.082	1.982	2.487	0.797	0.040	415
820	0.110	1.855	3.106	0.597	0.056	412
1030	0.102	3.105	3.113	0.997	0.032	416
1240	0.114	3.747	3.266	1.147	0.030	412
1450	---	---	---	---	---	---
1660	0.043	0.328	0.927	0.354	0.115	401
1870	0.025	0.163	0.498	0.328	0.131	415
2080	0.069	1.349	2.493	0.541	0.048	425
2290	---	---	---	---	---	---
2500	0.057	0.416	3.818	0.109	0.121	420
2710	0.148	1.004	2.835	0.354	0.129	425
2920	0.664	1.551	4.397	0.353	0.300	420
3130	0.050	0.204	1.478	0.138	0.198	362
3340	0.041	0.162	3.893	0.042	0.203	445
3550	0.096	1.598	3.457	0.462	0.057	434
3755	0.210	3.466	1.949	1.779	0.057	435
3970	0.033	0.510	3.246	0.157	0.061	430
4600	0.070	0.886	2.267	0.391	0.073	426
5860	0.018	0.029	1.151	0.025	0.387	426
6490	0.017	0.008	0.550	0.015	0.674	481
7120	0.015	0.083	1.069	0.077	0.155	425
7750	0.038	0.044	0.641	0.069	0.458	405

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HYDROGEN AND OXYGEN INDICES FROM ROCK-EVAL PYROLYSIS DATA, WITH TOC DATA

SOCAL CAPE ESPENBERG #1

DEPTH (FEET)	HYDROGEN INDEX (mg HC/g TOC)	OXYGEN INDEX (mg CO2/g TOC)	TOC (%)
190	108	233	0.76
400	102	289	1.48
610	121	152	1.64
820	109	183	1.70
1030	112	112	2.78
1240	162	141	2.32
1450	13	24	17.17
1660	56	157	0.59
1870	86	262	0.19
2080	101	187	1.33
2290	211	377	1.10
2500	40	367	1.04
2710	68	192	1.48
2920	129	366	1.20
3130	57	411	0.36
3340	44	1052	0.37
3550	99	213	1.62
3755	630	354	0.55
3970	65	416	0.78
4600	62	157	1.44
5860	24	959	0.12
6490	20	1374	0.04
7120	138	1781	0.06
7750	34	493	0.13

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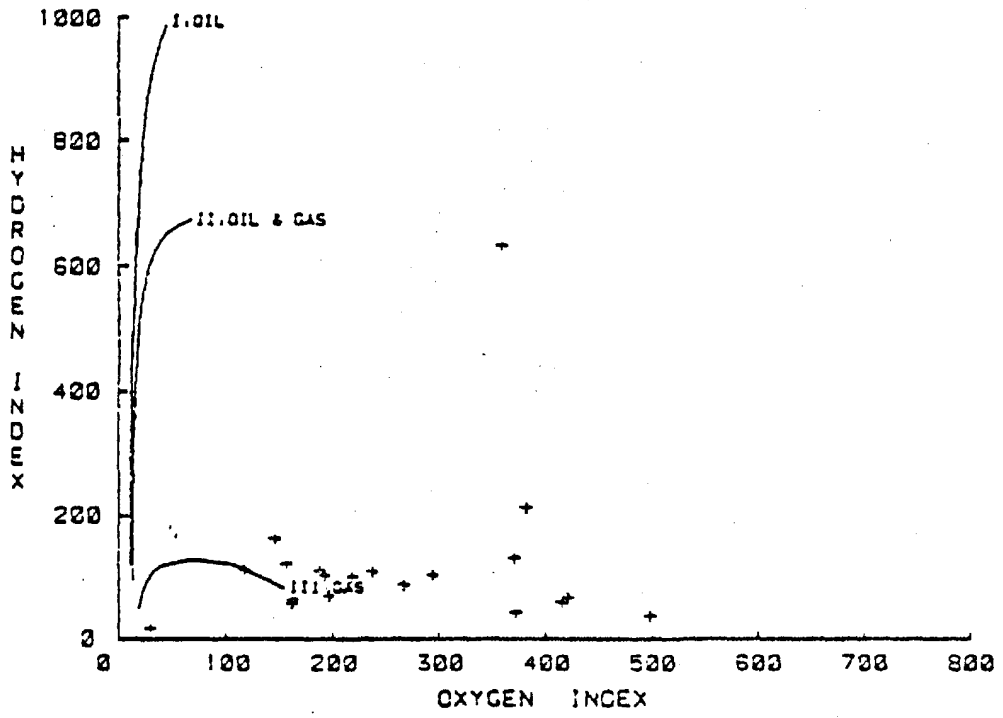
SOCAL CAPE ESPENBERG #1



KEROGEN TYPE DETERMINATION FROM ROCK-EVAL. PYROLYSIS DATA (APPENDIX II).

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ROCK-EVAL PYROLYSIS RAW DATA

SOCAL CAPE ESPENBERG #1

DEPTH (FEET)	S1+S2	S3	S2/S3	S1/(S1+S2)	T-MAX
1450	23.548	13.384	1.759	0.000	362
2290	3.610	2.765	0.000	1.000	---

HYDROGEN AND OXYGEN INDICES FROM ROCK-EVAL PYROLYSIS DATA, WITH TOC DATA

SOCAL CAPE ESPENBERG #1

DEPTH (FEET)	HYDROGEN INDEX (mg HC/g TOC)	OXYGEN INDEX (mg CO2/g TOC)	TOC (%)
1450	137	78	17.17
2290	0	251	1.10

SOCAL CAPE ESPENBERG #1

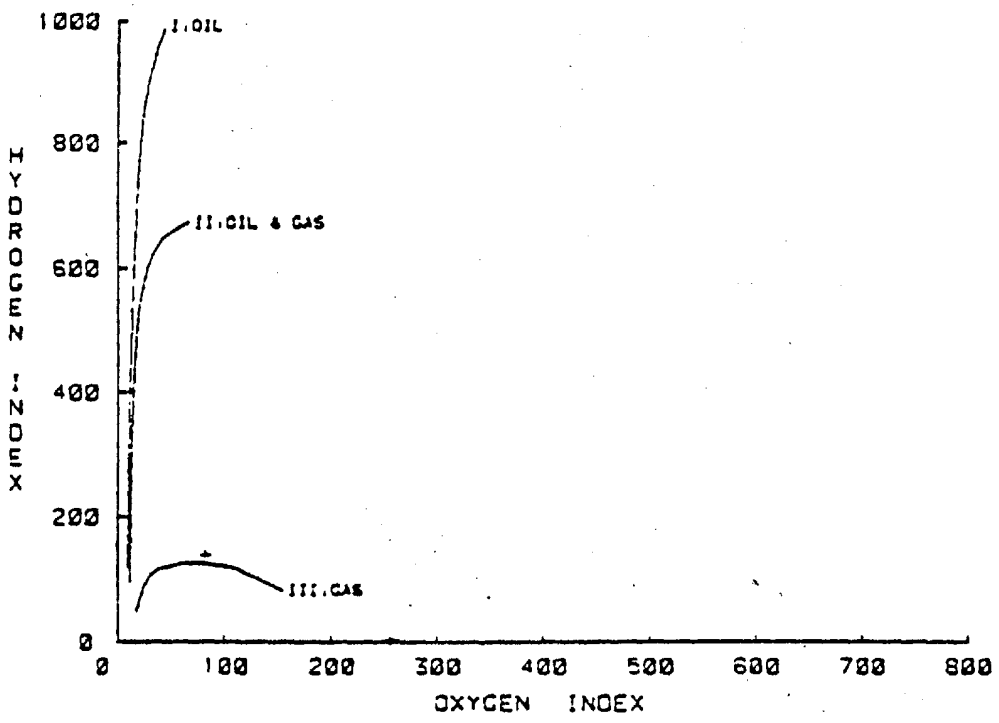

FIGURE 3: KEROGEN TYPE DETERMINATION FROM ROCK-EVAL PYROLYSIS DATA (APPENDIX II).

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ROCK-EVAL PYROLYSIS RAW DATA

SOCAL CAPE ESPENBERG #1 - EXTRACTED

DEPTH (FEET)	S1+S2	S3	S2/S3	S1/(S1+S2)	T-MAX
1450	16.745	15.649	1.056	0.013	393
2290	0.516	3.693	0.132	0.058	410

HYDROGEN AND OXYGEN INDICES FROM ROCK-EVAL PYROLYSIS DATA, WITH TOC DATA

SOCAL CAPE ESPENBERG #1 - EXTRACTED

DEPTH (FEET)	HYDROGEN INDEX (mg HC/g TOC)	OXYGEN INDEX (mg CO2/g TOC)	TOC (%)
1450	92	88	18.12
2290	62	471	0.83

SOCAL CAPE ESPENBERG #1 - EXTRACTED

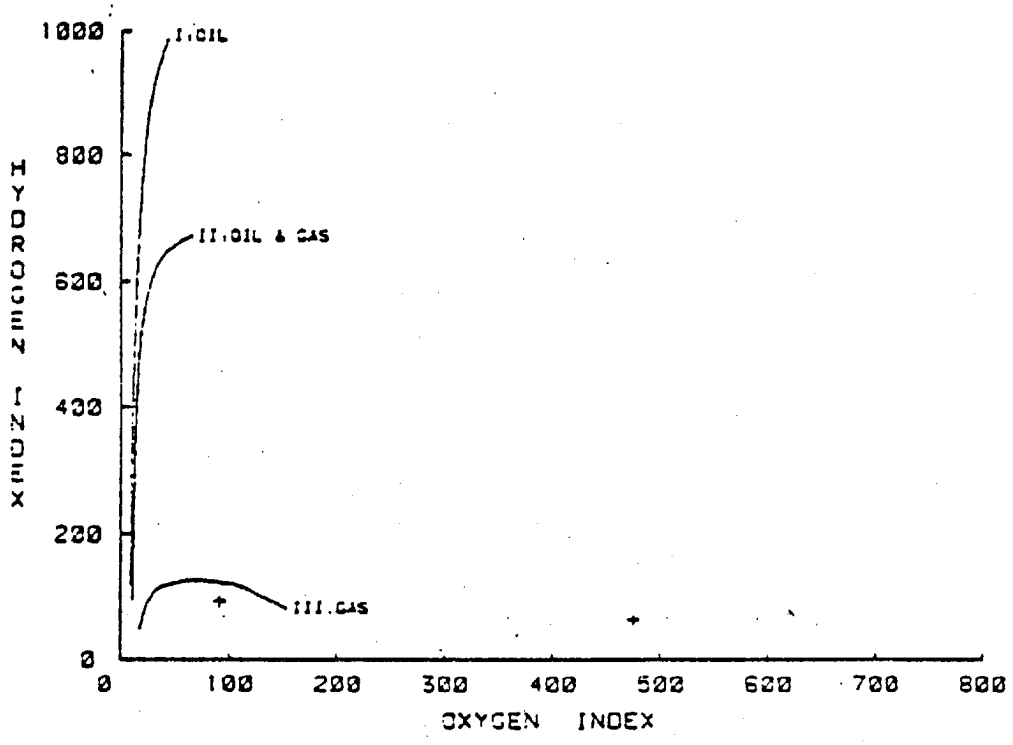

FIGURE 3: KEROGEN TYPE DETERMINATION FROM ROCK-EVAL PYROLYSIS DATA (APPENDIX II).

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APPENDIX III

ORGANIC EXTRACT DATA

Fifty grams of each sample is pulverized and soxhlet extracted for 18 hours with dichloromethane to obtain the total amount of extractable material. The extract is first deasphaltened by precipitation with hexane. The soluble fraction is then separated into saturates, aromatics, and NSO compounds on a silica-alumina chromatographic column by successive elutions with hexane, benzene, and benzene-methanol solvents respectively. The total extract is expressed in parts per million of total sample extracted and the functional groups are expressed as weight percent of total extract.

Gas chromatograms of the $C_{15}+$ saturate fraction were produced with a Perkin-Elmer, Sigma 3 gas chromatograph fitted with a 12 foot, $NaNO_3/LiNO_3/KNO_3$ eutectic column. The chromatograph was programmed from 40°C to 360°C at 12°C/min. using helium carrier gas at the rate of 25 ml/min.

Straight chain paraffins (n-alkanes) are normalized between C_{15} and C_{40} to a sum of 100% and the percent of individual components plotted on bargraphs. Several ratios involving pristane (Pr) and phytane (Ph) are also calculated and plotted. Carbon preference index (CPI) values are calculated with the original Bray and Evans formula.

COMPOSITION OF SOURCE ROCK EXTRACT

SOCAL CAPE ESPENBERG #1

DEPTH(FEET)	EXTRACT PPM	% SAT	% AROM	% NSO	% ASPH
1450	480	19.50	18.30	8.50	53.70
2270	3536	10.70	33.50	31.40	24.40

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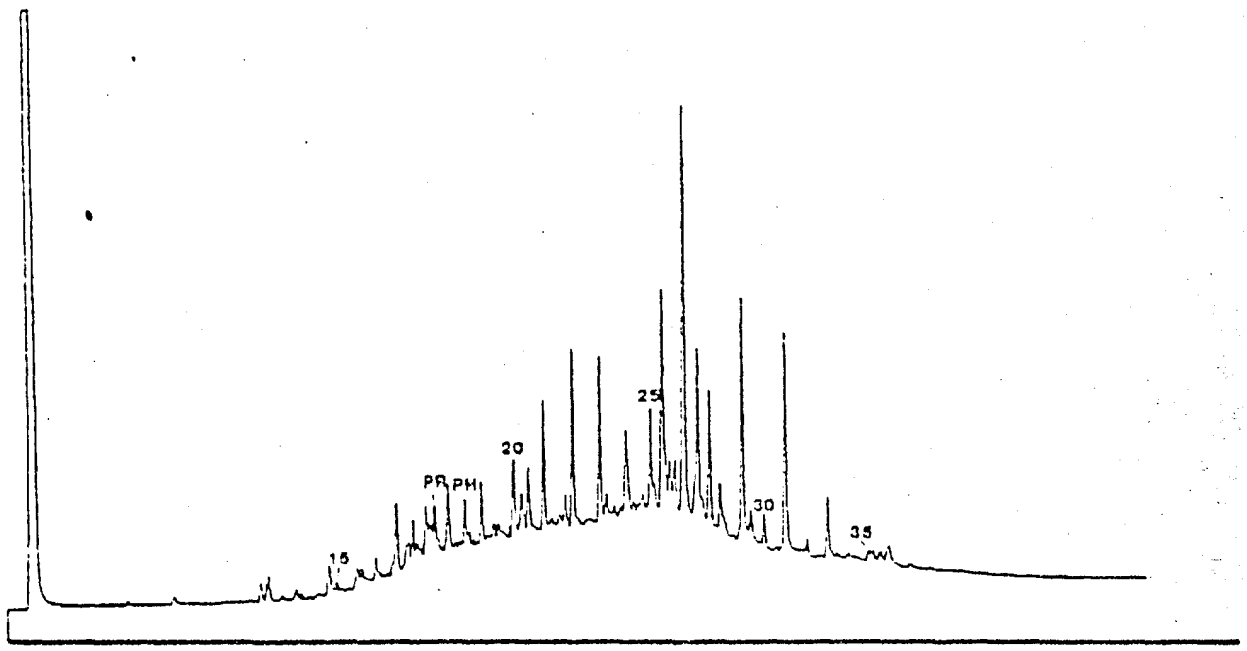
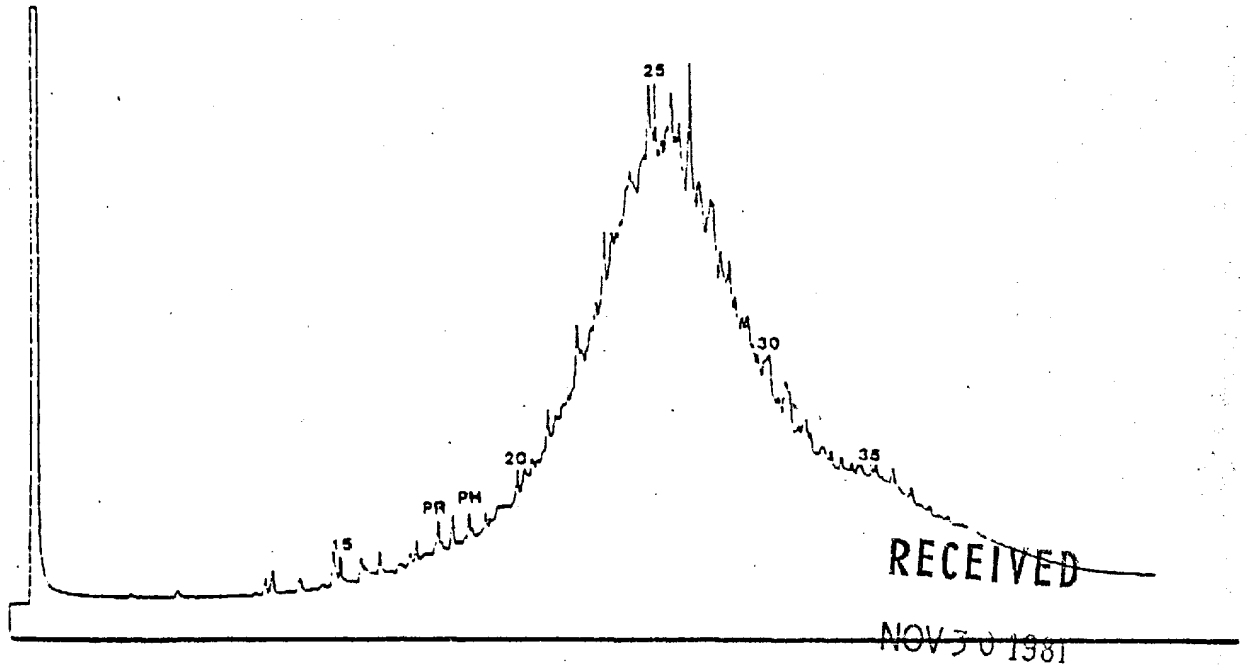
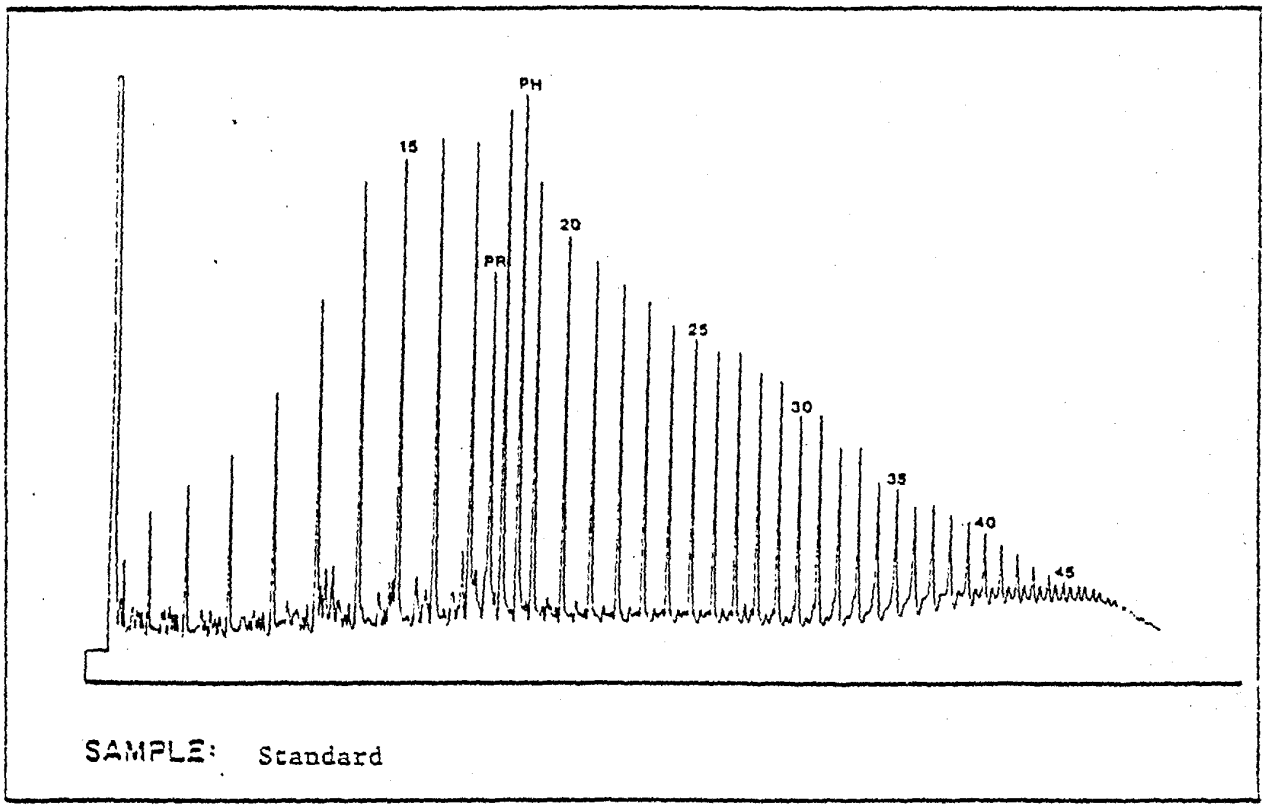


SAMPLE: 1450 feet.



SAMPLE: 2290 feet.

GAS CHROMATOGRAMS OF C15+ SATURATE HYDROCARBONS



GAS CHROMATOGRAMS OF C15+ SATURATE HYDROCARBONS

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ROCK-EVAL PYROLYSIS RAW DATA

SOCAL MIMIUK PT. #1 - EXTRACTED

DEPTH (FEET)	S1+S2	S3	S2/S3	S1/(S1+S2)	T-MAX
790	1.535	2.023	0.758	0.000	332
1420	14.542	2.589	5.617	0.000	331

HYDROGEN AND OXYGEN INDICES FROM ROCK-EVAL PYROLYSIS DATA, WITH TOC DATA

SOCAL MIMIUK PT. #1 - EXTRACTED

DEPTH (FEET)	HYDROGEN INDEX (mg HC/g TOC)	OXYGEN INDEX (mg CO2/g TOC)	TOC (%)
790	98	130	1.56
1420	156	28	9.32

SOCAL MIMIUK PT. #1 - EXTRACTED

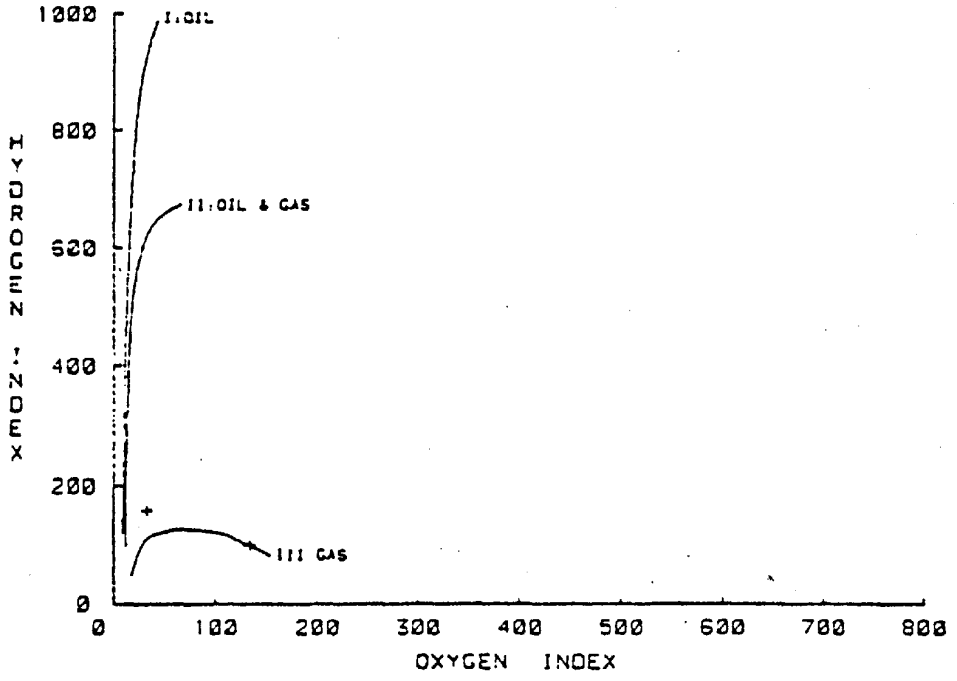

FIGURE 3. KEROGEN TYPE DETERMINATION FROM ROCK-EVAL PYROLYSIS DATA (APPENDIX II).

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APPENDIX III

ORGANIC EXTRACT DATA

Fifty grams of each sample is pulverized and soxhlet extracted for 18 hours with dichloromethane to obtain the total amount of extractable material. The extract is first deasphaltened by precipitation with hexane. The soluble fraction is then separated into saturates, aromatics, and NSO compounds on a silica-alumina chromatographic column by successive elutions with hexane, benzene, and benzene-methanol solvents respectively. The total extract is expressed in parts per million of total sample extracted and the functional groups are expressed as weight percent of total extract.

Gas chromatograms of the C_{15+} saturate fraction were produced with a Perkin-Elmer, Sigma 3 gas chromatograph fitted with a 12 foot, $NaNO_3/LiNO_3/KNO_3$ eutectic column. The chromatograph was programmed from 40°C to 360°C at 12°C/min. using helium carrier gas at the rate of 25 ml/min.

Straight chain paraffins (n-alkanes) are normalized between C_{15} and C_{40} to a sum of 100% and the percent of individual components plotted on bargraphs. Several ratios involving pristane (Pr) and phytane (Ph) are also calculated and plotted. Carbon preference index (CPI) values are calculated with the original Bray and Evans formula.

COMPOSITION OF SOURCE ROCK EXTRACT

SOCAL MIMIUK PT. #1

DEPTH(FEET)	EXTRACT PPM	% SAT	% AROM	% NSO	% ASPH
790	181	6.50	19.60	58.70	15.20
1420	200	20.60	12.70	50.80	15.90

DEPTH (Feet)	EXT/TOC	RELATIVE COMPOSITION %SAT	%ARO	%NSO+ ASPH	PR/PH	CPI
790	0.011	6.5	19.6	73.9	0.42	2.42
1420	0.002	20.6	12.7	66.7	0.94	3.13

HEAVY HYDROCARBONS NORMALIZED TO 100%

SOCAL MIMIUK PT. #1

ID	C-10	C-11	C-12	C-13	C-14	C-15	C-16	C-17	C-18	C-19	C-20
790	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	2.80	4.30	5.11
1420	0.00	0.00	0.00	0.00	0.00	0.10	0.50	2.50	3.89	3.79	4.39

ID	C-21	C-22	C-23	C-24	C-25	C-26	C-27	C-28	C-29	C-30
790	8.91	16.72	14.71	7.71	8.11	3.82	8.71	2.20	4.60	1.40
1420	8.18	14.77	14.87	9.98	9.08	3.99	9.89	1.80	8.09	1.00

ID	C-31	C-32	C-33	C-34	C-35	C-36	C-37	C-38	C-39	C-40
790	4.10	1.20	2.80	0.50	0.70	0.50	0.50	0.00	0.00	0.00
1420	2.50	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ID	C-41	C-42	C-43	C-44	C-45	C-46	C-47	C-48	C-49	C-50
790	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1420	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ID	PR/T X100	PH/T X100	PR/17	PH/18	PR/PH	CPI	C-MAX
790	1.10	2.60	1.83	0.93	0.42	2.42	C-22
1420	3.09	3.29	1.24	0.85	0.94	3.13	C-23

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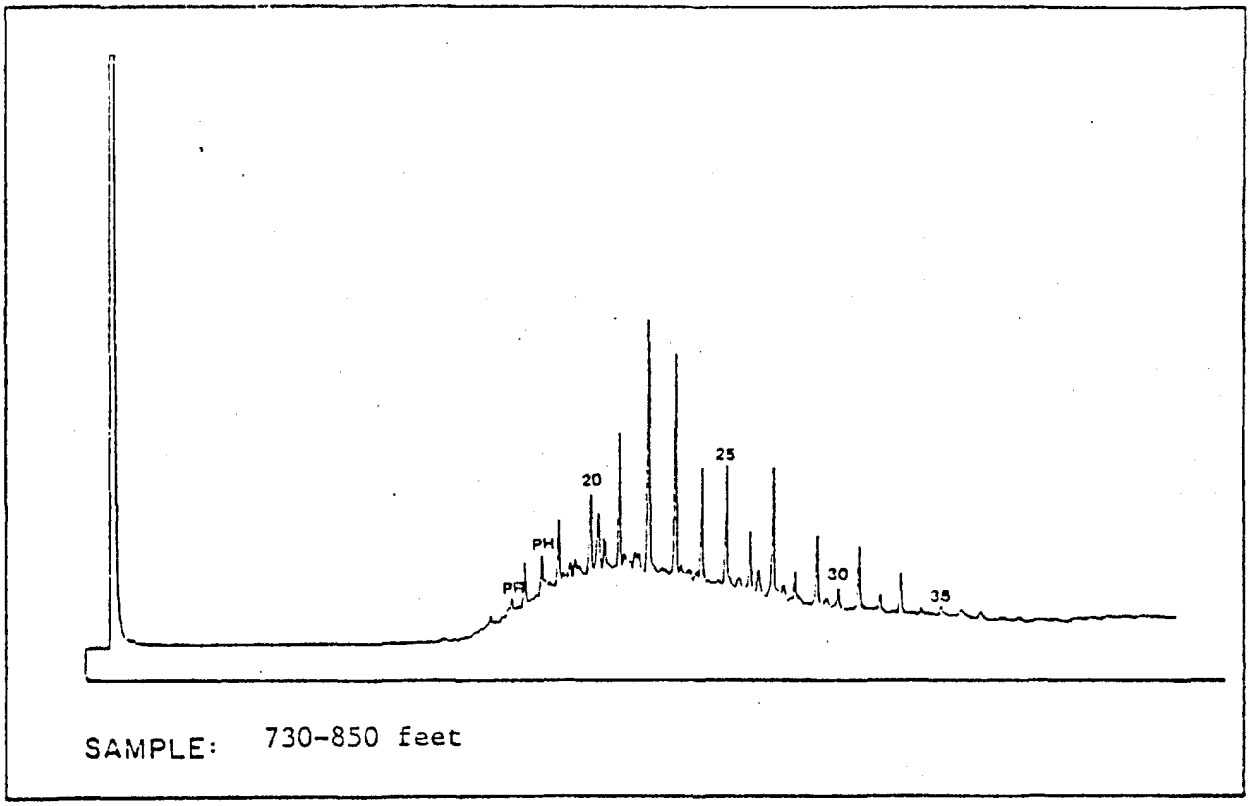
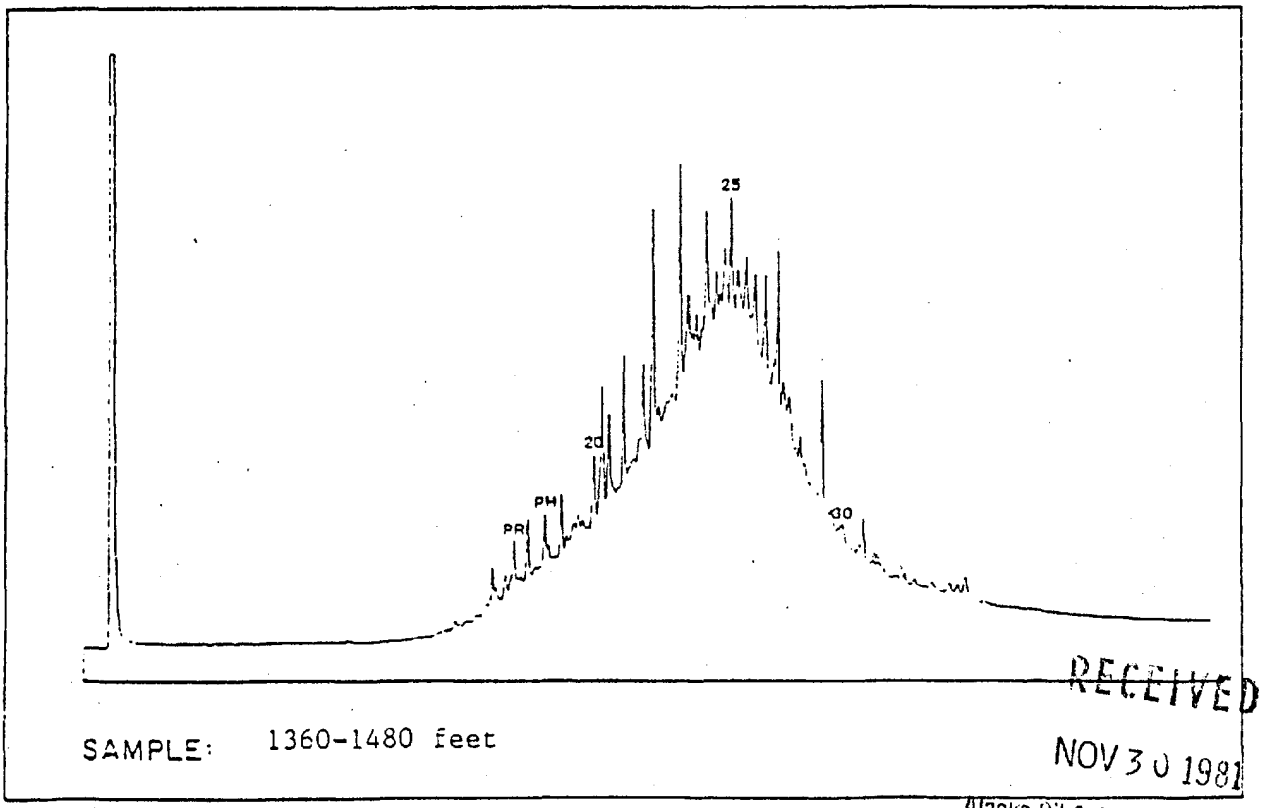


SAMPLE: 730-850 feet



SAMPLE: 1360-1480 feet

GAS CHROMATOGRAMS OF C15+ SATURATE HYDROCARBONS

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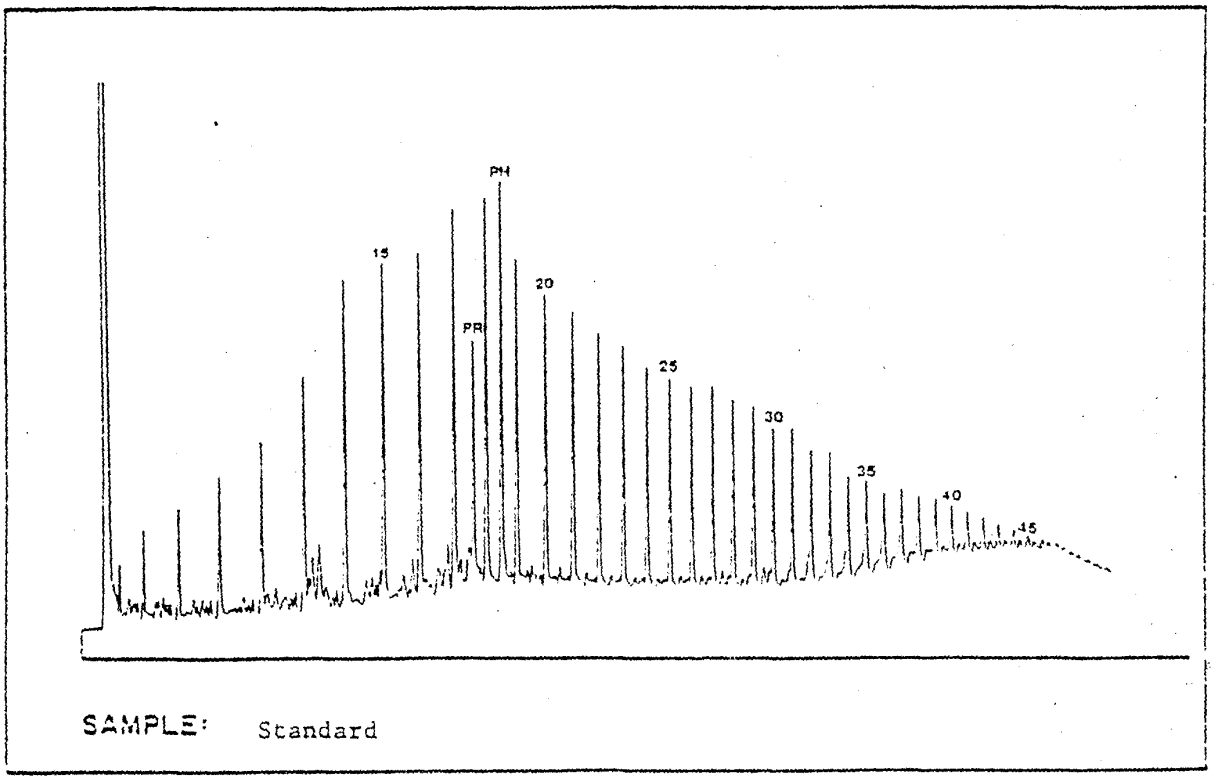

GAS CHROMATOGRAMS OF C15+ SATURATE HYDROCARBONS

ROBERTSON
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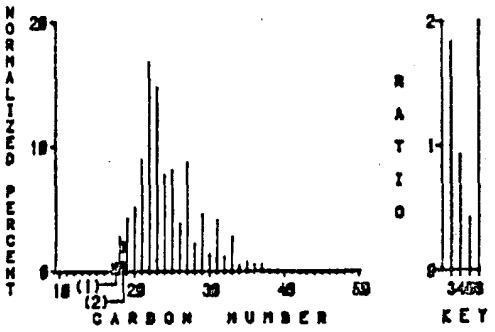
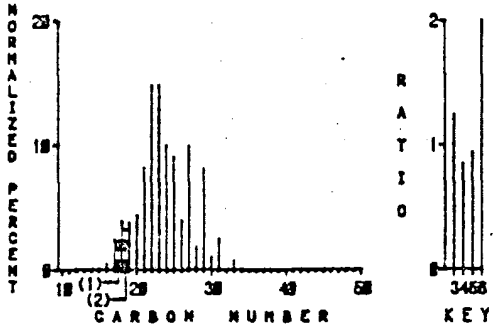
SAMPLE DEPTH : 798 feet



SAMPLE DEPTH : 1428 feet



SOCAL MIMIUK PT. #1

1=100xPristane/Total 3=Pristane/n-C-17 5=Pristane/Phytane
2=100xPhytane/Total 4=Phytane/n-C-18 6=Carbon Pref.Index

NORMALIZED DISTRIBUTION OF n-ALKANES

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TOTAL ORGANIC CARBON DATA

SOCAL MIMIUK PT. #1

Sample Interval	DEPTH (Feet)	TOC (%)	Sample Interval	DEPTH (Feet)	TOC (%)
100- 220	160	0.18	3880-4000	3940	0.14
730- 850	790	1.61	4510- 630	4570	0.12
1360- 480	1420	8.34	5140- 260	5200	0.06
1990-2110	2050	0.31	5770- 890	5830	0.12
2620- 740	2680	1.11	6211- 310	6261	0.18
3250- 370	3310	0.57			

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Mobil Exploration and Producing Services Inc.

P.O. BOX 900
DALLAS, TEXAS 75221

November 23, 1981

Mr. William Van Alen
State of Alaska
Alaska Oil & Gas Conservation Commission
3001 Porcupine Drive
Anchorage, Alaska 99501

ESC REQUEST NO. 311A78
VISUAL KEROGEN, THERMAL MATURATION,
TOC AND ROCK-EVAL ANALYSES,
SOCAL NIMIUK PT. #1,
KOTZEBUE, ALASKA

Dear Mr. Van Alen:

This report describes the visual kerogen, thermal maturation, TOC and Rock-Eval results from the SOCAL Nimiuk Pt. #1, Kotzebue, Alaska. Visual kerogen and vitrinite reflectance analyses are based on 19 ditch samples taken at 300' intervals between 100' and 6310' (TD). TOC and Rock-Eval analyses are based on 11 ditch samples taken at 510' intervals between 100' and 6310' (TD). A plot of the low-gray Ro means (figure 1), a summary of the thermal maturity and hydrocarbon potential (table 1), a kerogen analysis sheet (table 2), edited Ro histogram plots, and a copy of the TOC and Rock-Eval reports are included.

Results from TAI analysis of the SOCAL Nimiuk Pt. #1 indicate that the section penetrated from 100' to 5770' is transitionally mature. The vitrinite data indicate that the 100' to 5770' interval is thermally immature. It is possible the dark color of the spores was caused by oxidation or by the fact that spores tend to be thicker walled than the preferred bissacates.

Results from visual kerogen analysis of the SOCAL Nimiuk Pt. #1 samples are listed on the attached kerogen analysis sheet (table 2). It should be noted that all of the samples analyzed are dominated by cellulosic (gas type) kerogens. Fluorescence analysis indicates traces of lipid rich kerogens are present down to about 2600'.

Results from vitrinite reflectance studies on the SOCAL Nimiuk Pt. #1 well indicate that the sediments penetrated down to 5830' are all thermally immature. Igneous and metamorphic rock fragments are found below 5900'. A summary of the thermal maturity and hydrocarbon potential of the SOCAL Nimiuk Pt. #1 samples are listed in Table 1. Edited histogram plots of the Ro readings from each sample are enclosed. The vitrinite reflectance measurements were made by R. R. Taylor.

Results from TOC analysis range from "poor" below 3940' to "very good" for the 1420' sample. Pyrolysis indicates little hydrocarbon potential for any of the samples, and gas as the most likely hydrocarbon they could generate during maturation.

Time requirements for this job were charged to ESC Request No. 311A78. If you have any questions concerning the results or interpretations, please do not hesitate to contact me.

Very truly yours,

Timothy A. Timmcke

T. A. Timmcke
Exploration Services Center
Applied Stratigraphy

TAT/jg
Attachments

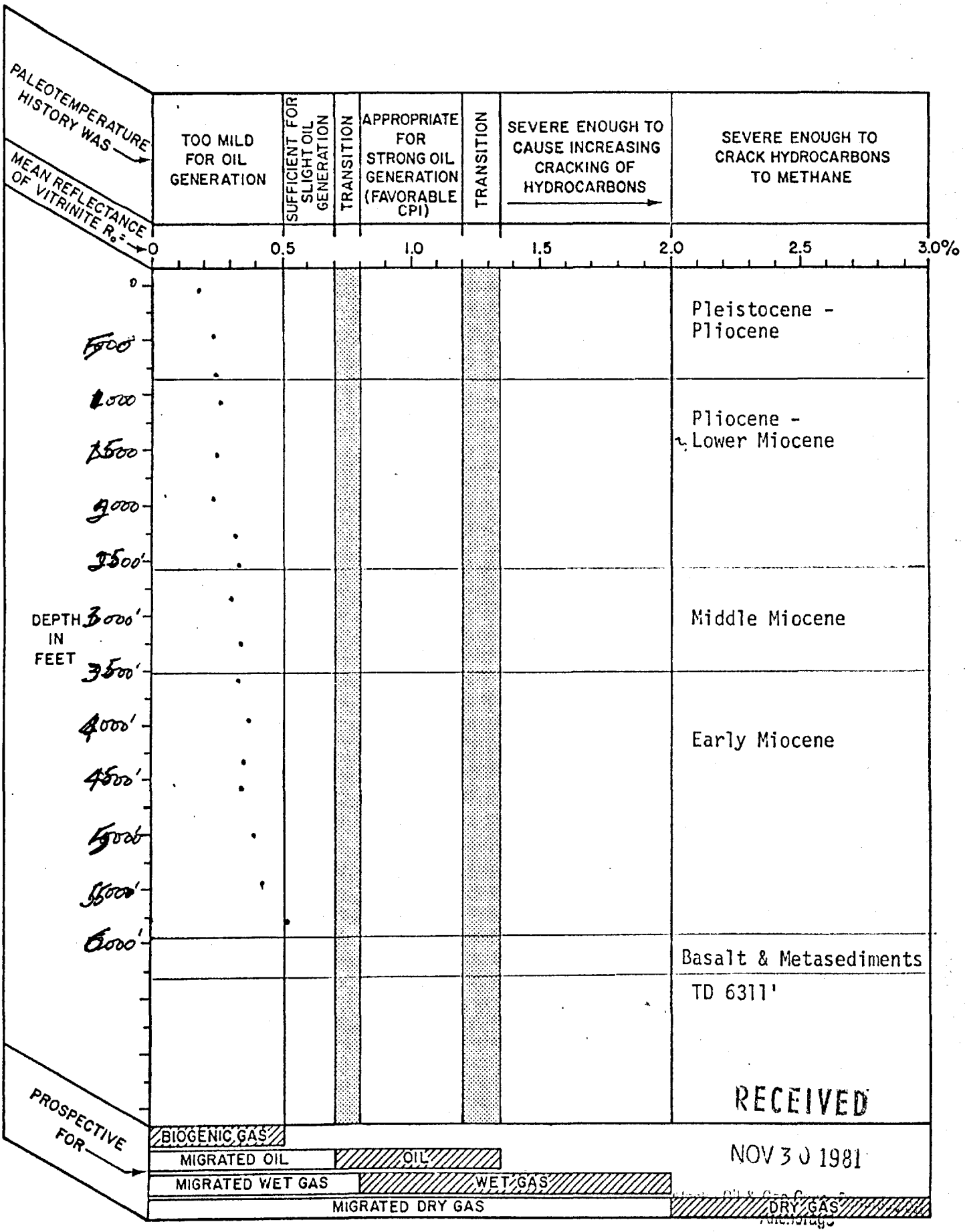
TABLE 1
Thermal Maturation and Visual Kerogen Analyses
Socal Nimiuk Pt. No. 1, Kotzebue, Alaska

DEPTH OR SPL. NO.	LOW-GRAY Ro MEAN	% POP.	FIRST HIGH-GRAY Ro MEAN	% POP.	TAI	THERMAL MATURITY	KEROGEN TYPE	HYDROCARBON POTENTIAL/REMARKS
100'	0.19	18	0.36	37		Immature	Cellulosic	Gas type kerogen
460'	0.23	65	0.69	33		Immature	Cellulosic	Gas type kerogen
820'	0.25	85	1.64	15		Immature	Cellulosic	Gas type kerogen
1180'	0.28	36	0.58	37	2	Immature	Cellulosic	Gas type kerogen
1540'	0.25	69	0.99	31	2	Immature	Cellulosic	Gas type kerogen
1900'	0.25	74	1.10	26	1+	Immature	Cellulosic	Gas type kerogen
2260'	0.34	85	1.75	15		Immature	Cellulosic	Gas type kerogen
2530'	0.35	80	0.91	20		Immature	Cellulosic	Gas type kerogen
2890'	0.31	74	2.29	17		Immature	Cellulosic	Gas type kerogen
3250'	0.37	66	0.72	34		Immature	Cellulosic	Gas type kerogen
3650'	0.35	100	-	-		Immature	Cellulosic	Gas type kerogen
3970'	0.39	45	0.59	32		Immature	Cellulosic	Gas type kerogen
4330'	0.36	100	-	-		Immature	Cellulosic	Gas type kerogen
4690'	0.37	72	1.36	25		Immature	Cellulosic	Gas type kerogen
5050'	0.41	47	0.74	38		Immature	Cellulosic	Gas type kerogen
5410'	0.44	85	0.87	15	2	Immature	Cellulosic	Gas type kerogen

TABLE 1
Thermal Maturation and Visual Kerogen Analyses
Socal Nimiuk Pt. No. 1, Kotzebue, Alaska

DEPTH OR SPL. NO.	LOW-GRAY Ro MEAN	% POP.	FIRST HIGH-GRAY Ro MEAN	% POP.	TAI	THERMAL MATURITY	KEROGEN TYPE	HYDROCARBON POTENTIAL/REMARKS
5770'	0.51	68	1.03	32	2,2+	Immature	Cellulosic	Gas type kerogen
6130'	-	-	-	-		-	-	Metamorphic rocks
6250'	-	-	-	-		-	-	Metamorphic rocks

FIGURE 1
Plot of Low-Gray Ro Means
SOCAL Nimiuk Pt. #1, Kotzebue, Alaska



ESC No. 311A78

TABLE 2

ORGANIC RESIDUE (KEROGEN) ANALYSIS

M-005
(Rev. 01-80)

SCALE:	T = TRACE (<1%)		
1 =	1 – 10%	6 =	51 – 60%
2 =	11 – 20%	7 =	61 – 70%
3 =	21 – 30%	8 =	71 – 80%
4 =	31 – 40%	9 =	81 – 90%
5 =	41 – 50%	10 =	91 – 100%

DATE: 9/24/81

PROJECT:
SOCAL NIMIUK PT #1
KOTZEBUE ALASKA

ESC NO. 311478
ANALYST: T.A. Tunnicliffe

(DEPTH) OR NO.	TYPE OF ORGANIC MATTER: AMORPHOUS/OIL RICH	CUTICLE	PALYNOMORPHS	AMORPHOUS/GAS or OIL	BARK & WOODY DEBRIS	INERTINITE	FUNGAL MATERIAL - CHITIN	%OF RESIDUE FLUORESCING	STRONG FLUORESCENCE	MODERATE FLUORESCENCE	WEAK FLUORESCENCE	LIGHT FLUORESCENCE	MEDIUM YELLOW FLUORESCENCE	YELLOW FLUORESCENCE	OIL TYPE	GAS TYPE	FLUOR.	LIGHT BROWN 1+ IMMATURE	MEDIUM BROWN 2+ IMMATURE	DARK BROWN 2+ TRANSITIONAL	VERY DARK BROWN 3- SLIGHTLY MATURE	BLACKISH BROWN 3- MOD. MATURE	BLACK 4 to 4+ FULLY MATURE	METAMORPHOSED ROCK 5+	NO PALYNOMORPHS	GOOD	FAIR	POOR	PRESRV	MARGINAL MARINE	NO MARINE PALYNOMORPHS	UNKNOWN PALYNOMORPHS	REMARKS:
100 - 1100	T			6	2	2									1																		
4160 - 5200	1			5	3	1									1																		
8200 - 8800	T	T		1	4	5									1																		
11400 - 12400	1		T	4	2	3									1																		SPORE
15400 - 16000	T		T	4	3	3									T																		SPORE FRAGMENT
19000 - 19600	T	T		3	4	3									T																		SPORE
22600 - 23200	T			4	3	3									1																		
25300 - 25900	T			5	3	2									T																		
28400 - 29000				1		9									0																		
32500 - 33100				5	2	3									C																		
36500 - 37000																																	INSUFFICIENT RESIDUE
39700 - 40300				T		10									0																		
43300 - 43900				3	2	4									0																		
46900 - 47500	T			5	3	2									T																		
50500 - 51100				1		9									0																		
54100 - 54700	T			5	2	3									T																		SPORE FRAGMENT
57700 - 58300				1	2	4									0																		SPORE
61300 - 61900				T		10									0																		PUNCAL
64900 - 65310 TD				T		10									0																		MINERAL
NO FLOAT																																	

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Alaska Oil & Gas Cons. Commission
Anchorage

ROBERTSON RESEARCH (U.S.) INC.

REPORT NO. 488

GEOCHEMICAL EVALUATION OF ELEVEN SAMPLES FROM THE SOCAL NIMIUK POINT #1 WELL

by
Mary Michael Page

Project No. RRUS/812/II/T/50

Prepared by:
Robertson Research (U.S.) Inc.
16730 Hedgecroft, Suite 306
Houston, Texas 77060

Prepared for:
Mobil Exp. & Pro. Serv.Inc
P. O. Box 900
Dallas, Texas 75221

September 25, 1981

ROBERTSON
RESEARCH (U.S.) INC.

INTRODUCTION

Eleven samples were forwarded for Total Organic Carbon (TOC) analysis and Rock-Eval pyrolysis. The Rock-Eval pyrolysis was to be run regardless of the TOC value. Two of the samples exhibited high amounts of bitumen, as evidenced by the coalescence of the pyrolysis S1 and S2 into a single peak. The suggestion was made to, and accepted by, the client to extract these samples and evaluate both the extracted sample and the recovered extract.

SUMMARY

The source richness based on TOC ranges from "non-source" below 3,940 feet to "very good" for sample 1420. Pyrolysis generally indicates "nonsource" amounts of hydrogen-poor kerogen. The T-max values indicate very immature material but may not be representative for the samples with the very low S2 values or with the single S1 + S2 peak. For samples 790 and 1420, the S1 and S2 peaks merge, suggesting the presence of significant amounts of bitumen. A portion of the sample was extracted and rerun; however the general shape of the pyrogram did not change. The extract consists of moderate amounts of immature bitumen, and gives no indication of the type of material responsible for the anomalous Rock-Eval response.

The increase in TOC for sample 1420 is reproducible and probably due to the removal of sulfur together with the bitumen during extraction. The high per cent carbon and character of the chromatogram are consistent with a coaly type material, which accumulates in an environment conducive to high sulfur concentrations.

SOCAL MIMIUK PT. #1

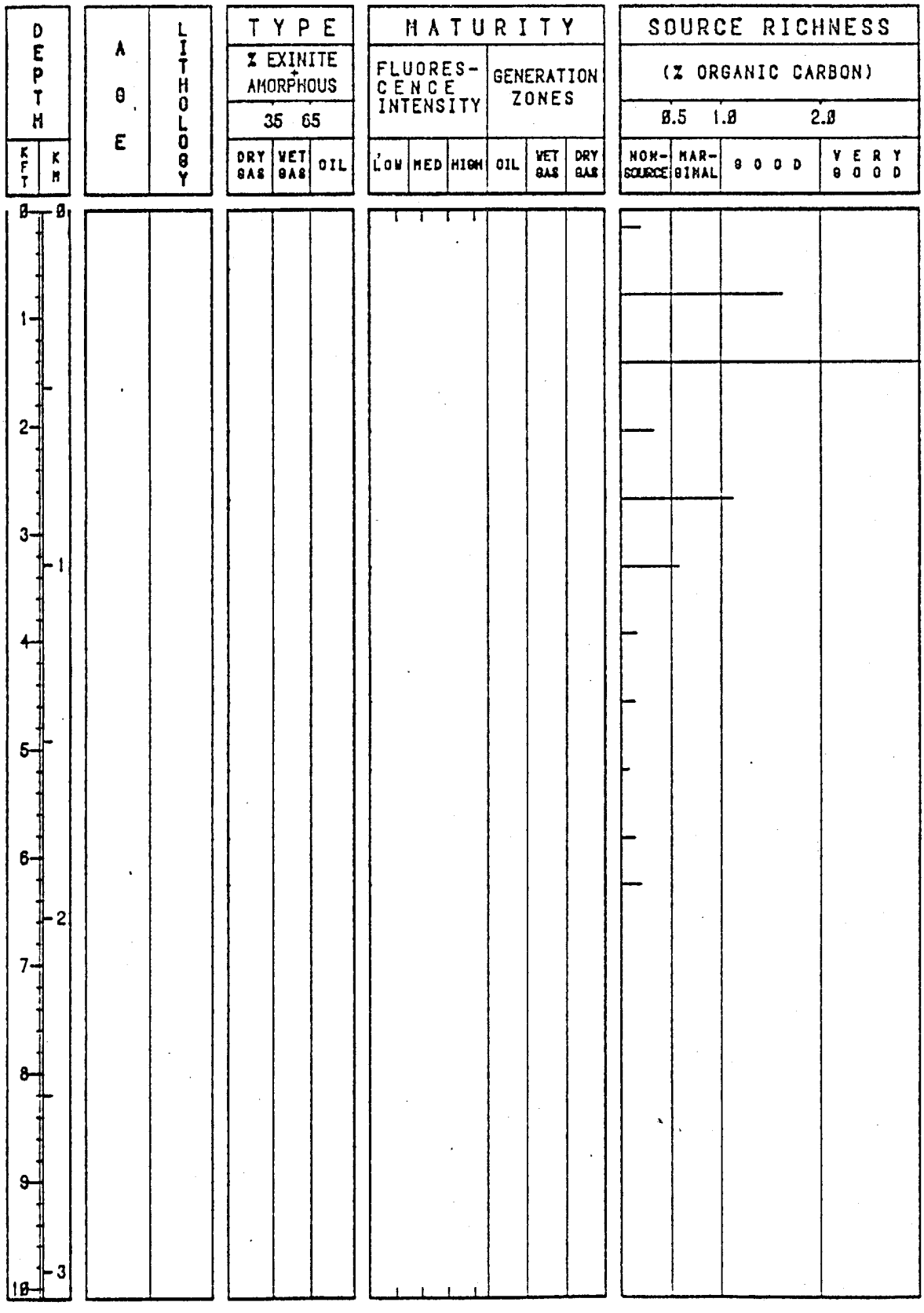

FIGURE 1: SUMMARY PLOTS SHOWING KEROGEN TYPES, MATURITY, AND SOURCE RICHNESS (SEE APPENDICES I AND III)

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SOCAL MIMIUK PT. #1

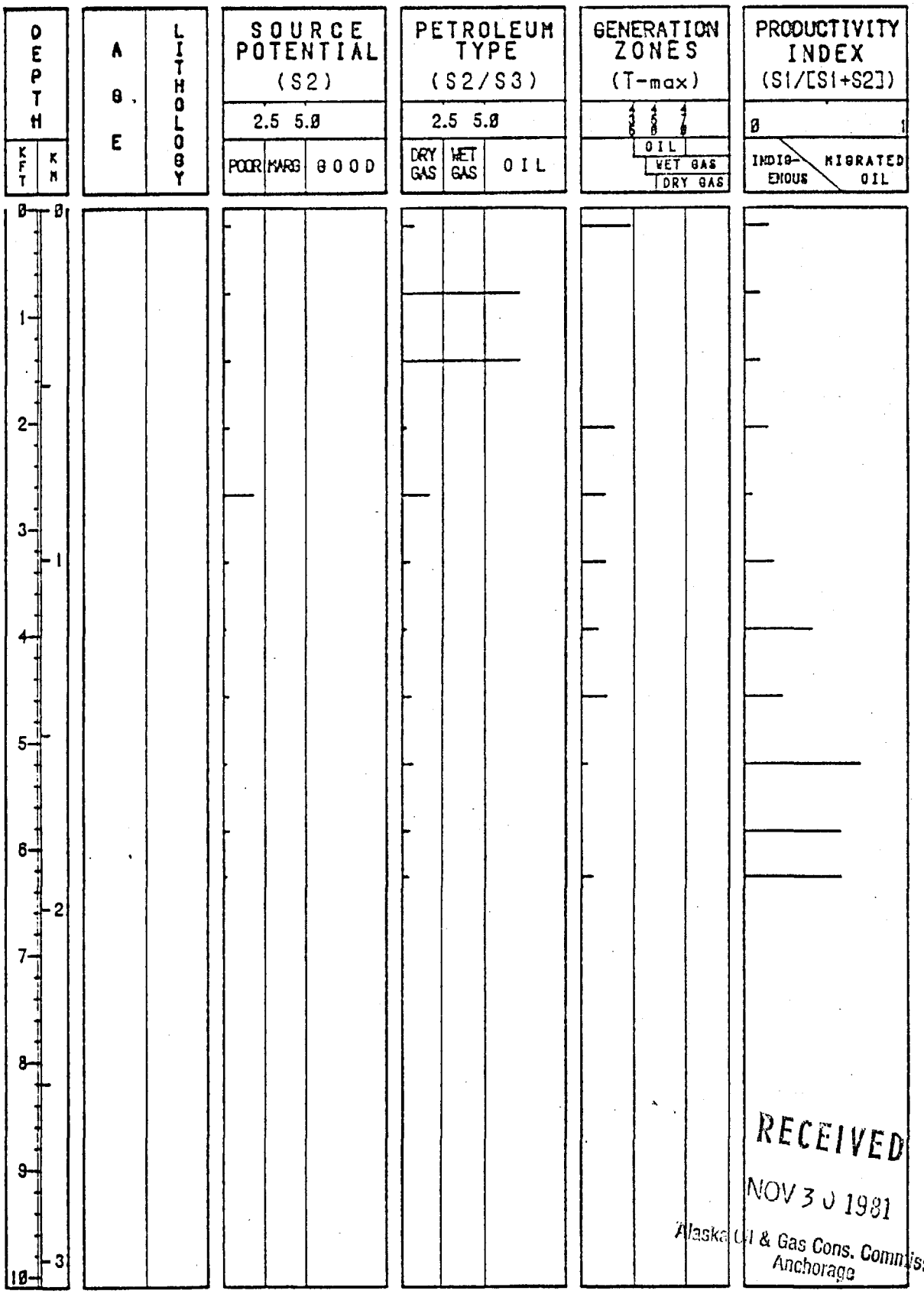

FIGURE 2: SUMMARY PLOTS OF ROCK-EVAL PYROLYSIS DATA (APPENDIX II)

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APPENDIX I

TOTAL ORGANIC CARBON DATA

Total organic carbon is determined by pulverizing the sample, treating a carefully weighed portion with warm hydrochloric acid to remove carbonate minerals, and analysing the residue for carbon content with a Leco carbon analyser. It is generally accepted that samples with less than about 0.5 percent TOC cannot yield sufficient petroleum to form commercial deposits and are therefore considered nonsources; samples with between 0.5 and 1.0 TOC are rated as marginal in source quality; and samples with more than 1.0 TOC are considered to be good in source quality.

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APPENDIX II

ROCK-EVAL PYROLYSIS DATA

Rock-Eval data are expressed as mg/g of rock and include four basic parameters: 1) S_1 represents the quantity of free hydrocarbons present in the rock and is roughly analogous to the solvent extractable portion of the organic matter; 2) S_2 represents the quantity of hydrocarbons released by the kerogen in the sample during pyrolysis; 3) S_3 is related to the amount of oxygen present in the kerogen; and 4) T-max, in °C, is the temperature at which the maximum rate of generation (of the S_2 peak) occurs and can be used as an estimate of thermal maturity.

In addition, the ratio S_2/S_3 provides a general indication of kerogen quality (type) and reveals whether oil or gas are likely to be generated. The ratio $S_1/(S_1+S_2)$, or the productivity index, is an indication of the relative amount of free hydrocarbons (in place or migrated) present in the sample. Hydrogen and oxygen index values are in mg of hydrocarbons (S_2 peak) or carbon dioxide (S_3 peak) per gram of organic carbon. When plotted against each other on a van Krevelen-type diagram, information on kerogen type and maturity can be obtained.

Data are interpreted in the following manner:

Source Potential - values of S2	<2.5	: poor
	2.5-5.0	: marginal
	>5.0	: good
Petroleum Type - value of S2/S3	<2.5	: dry gas
	2.5-5.0	: wet gas
	>5.0	: oil
Generation Zones - values of T-max	<435	: immature
	435-470	: oil
	450 +	: gas

Productivity Index - high values of S1/(S1+S2) indicate migrated hydrocarbons.

ROCK-EVAL PYROLYSIS RAW DATA

SOCAL MIMIUK PT. #1

DEPTH (FEET)	S1	S2	S3	S2/S3	S1/(S1+S2)	T-MAX
160	0.051	0.326	0.519	0.629	0.135	432
790	---	---	---	---	---	---
1420	---	---	---	---	---	---
2050	0.040	0.261	1.746	0.150	0.132	421
2680	0.062	1.719	1.121	1.533	0.035	415
3310	0.236	0.181	0.589	0.307	0.164	415
3940	0.025	0.038	0.378	0.100	0.402	410
4570	0.063	0.218	0.533	0.409	0.223	416
5200	0.297	0.129	0.242	0.532	0.698	403
5830	0.353	0.259	0.877	0.295	0.577	392
6260	0.111	0.080	0.351	0.227	0.582	406

HYDROGEN AND OXYGEN INDICES FROM ROCK-EVAL PYROLYSIS DATA, WITH TOC DATA

SOCAL MIMIUK PT. #1

DEPTH (FEET)	HYDROGEN INDEX (mg HC/g TOC)	OXYGEN INDEX (mg CO2/g TOC)	TOC (%)
160	181	288	2.18
790	---	---	1.61
1420	---	---	8.34
2050	84	563	0.31
2680	155	101	1.11
3310	32	103	0.57
3940	27	270	0.14
4570	182	444	0.12
5200	215	403	0.06
5830	216	731	0.12
6260	44	195	0.18

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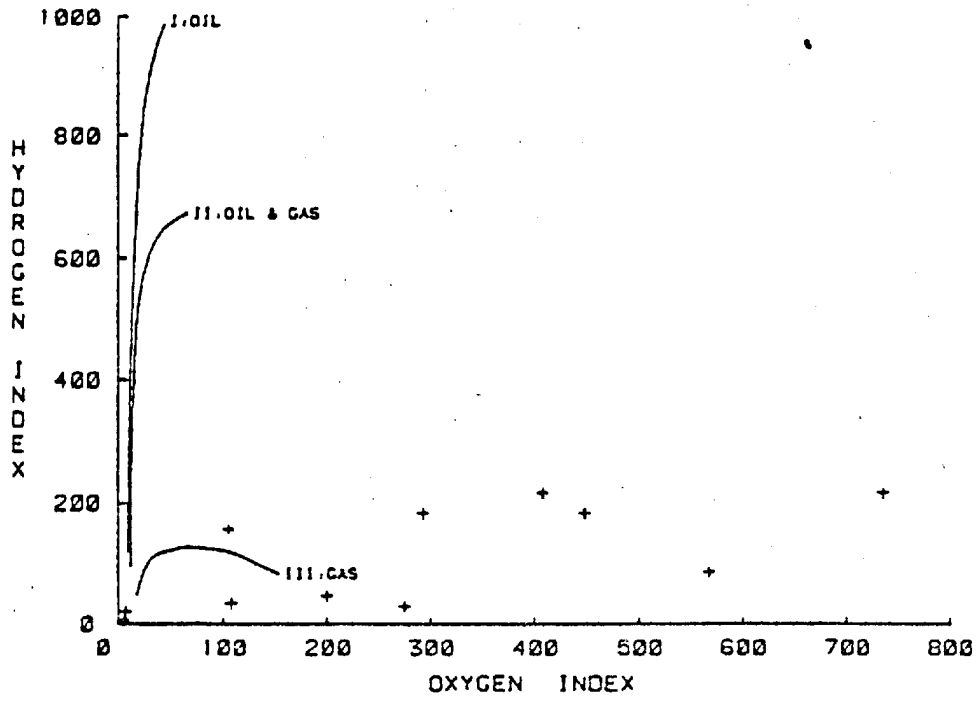
SOCAL MIMIUK PT. #1



KEROGEN TYPE DETERMINATION FROM ROCK-EVAL. PYROLYSIS DATA (APPENDIX II).

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ROCK-EVAL PYROLYSIS RAW DATA

SOCAL MIMIUK PT. #1

DEPTH (FEET)	S1+S2	S3	S2/S3	S1/(S1+S2)	T-MAX
790	1.949	2.874	0.678	0.000	393
1420	11.512	7.731	1.489	0.000	392

HYDROGEN AND OXYGEN INDICES FROM ROCK-EVAL PYROLYSIS DATA, WITH TOC DATA

SOCAL MIMIUK PT. #1

DEPTH (FEET)	HYDROGEN INDEX (mg HC/g TOC)	OXYGEN INDEX (mg CO2/g TOC)	TOC (%)
790	121	179	1.61
1420	138	93	8.34

SOCAL MIMIUK PT. #1

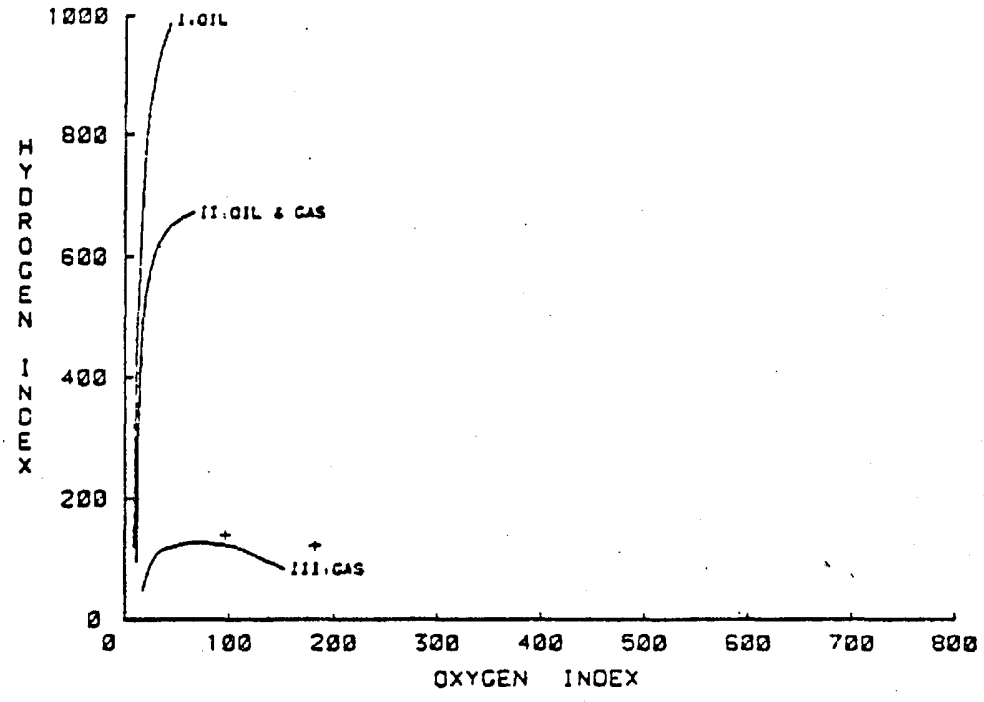

FIGURE 3: KEROGEN TYPE DETERMINATION FROM ROCK-EVAL PYROLYSIS DATA (APPENDIX II).

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ORIGINAL

2.

```
**COMMAND = LO
..FIRST SAMPLE NO. = 0
..LAST SAMPLE NO.  = 99999
..LOAD COMMAND =  LT
     1 18747   50   100'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/11/81PT
     2 18748   50   460'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/11/81PT
     3 18749   50   820'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/11/81RT
     4 18750   50  1180'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/11/81PT
     5 18751   50  1540'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/11/81RT
     6 18752   50  1900'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/11/81PT
     7 18753   50  2260'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/11/81PT
     8 18754   50  2530'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/11/81RT
     9 18755   50  2890'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/12/81PT
    10 18756   50  3250'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/12/81RT
    11 18757   50  3650'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/12/81PT
    12 18758   50  3970'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/12/81PT
    13 18759   50  4330'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/12/81RT
    14 18760   50  4690'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/12/81PT
    15 18761   50  5050'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/12/81RT
    16 18762   50  5410'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/12/81RT
    17 18763   50  5770'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/12/81PT
    18 18764   50  6130'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/12/81RT
    19 18765   50  6250'  4   STANDARD OF CALIF. NIMIUK PT.#1,AK   11/12/81PT
    20 99999 EOT

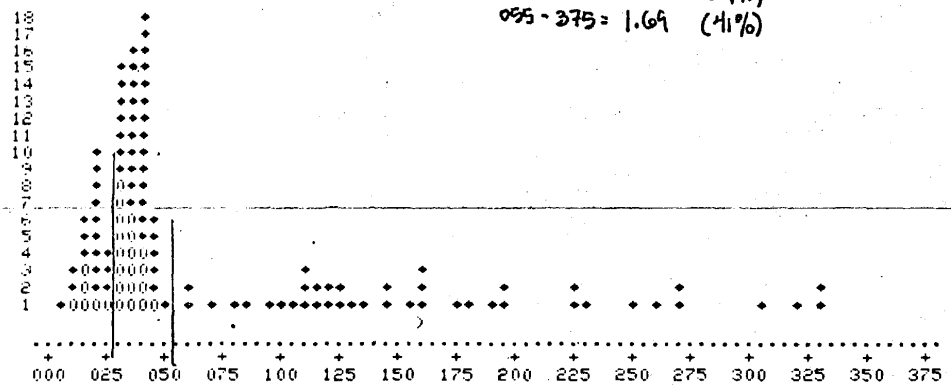
**COMMAND = LO
..FIRST SAMPLE NO. = 0
..LAST SAMPLE NO.  = 99999
..LOAD COMMAND =  LP
```

RECEIVED
NOV 30 1981

11/13/81 18747 50 100' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

```
      N =  122
   MEAN =   81
STD. ERR. =   14
STD. DEV. =   82
PCT. POP. =   97
```

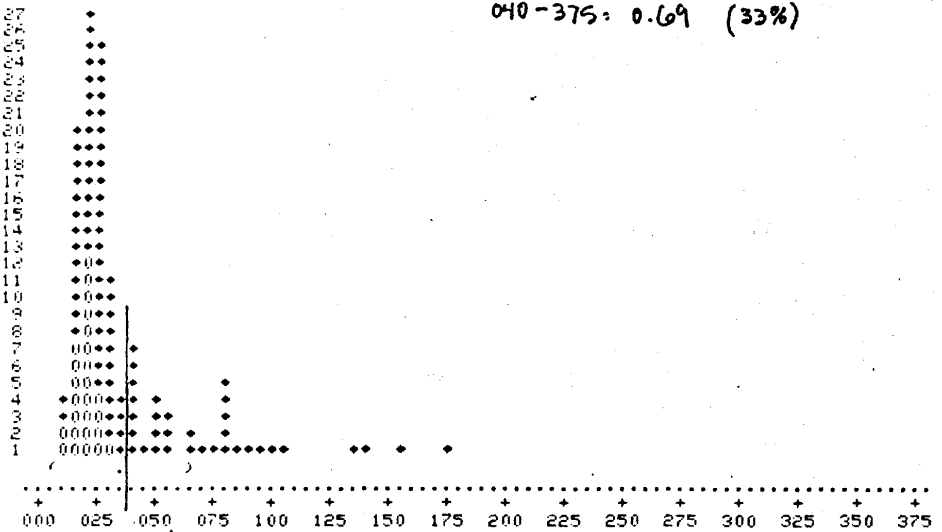
000-029 = 0.19 (18%)
030-054 = 0.38 (37%)
055-375 = 1.69 (41%)



11/13/81 18748 50 460' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

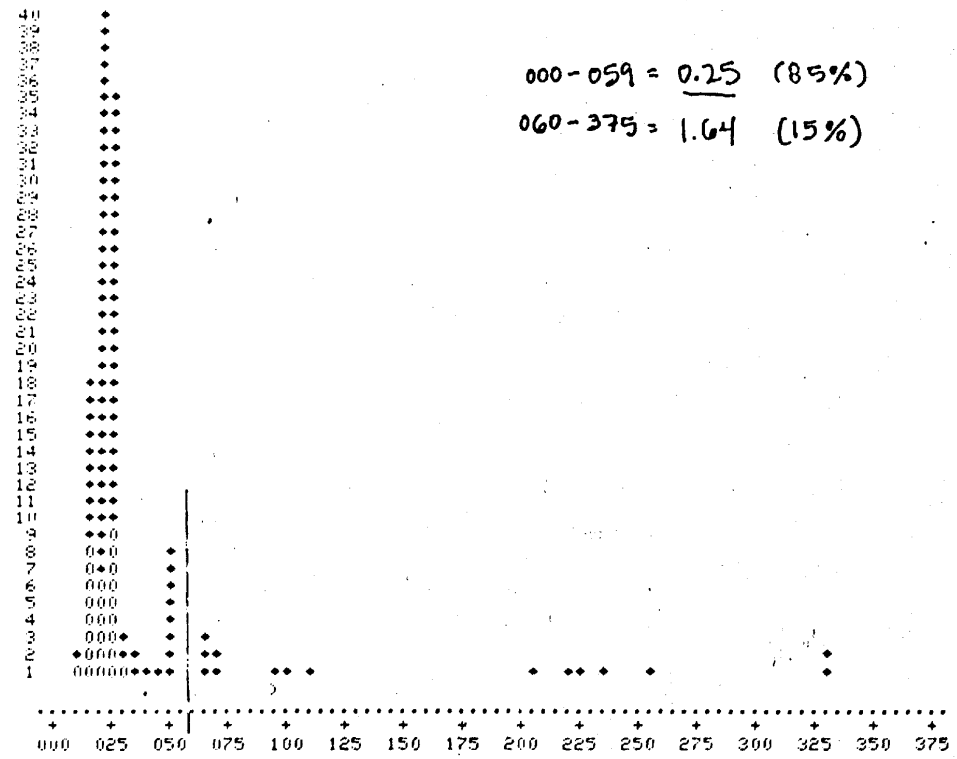
```
      N =  124
   MEAN =   37
STD. ERR. =    5
STD. DEV. =   29
PCT. POP. =   98
```

000-039 = 0.23 (65%)
040-375 = 0.69 (33%)



11/13/81 18749 50 820' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

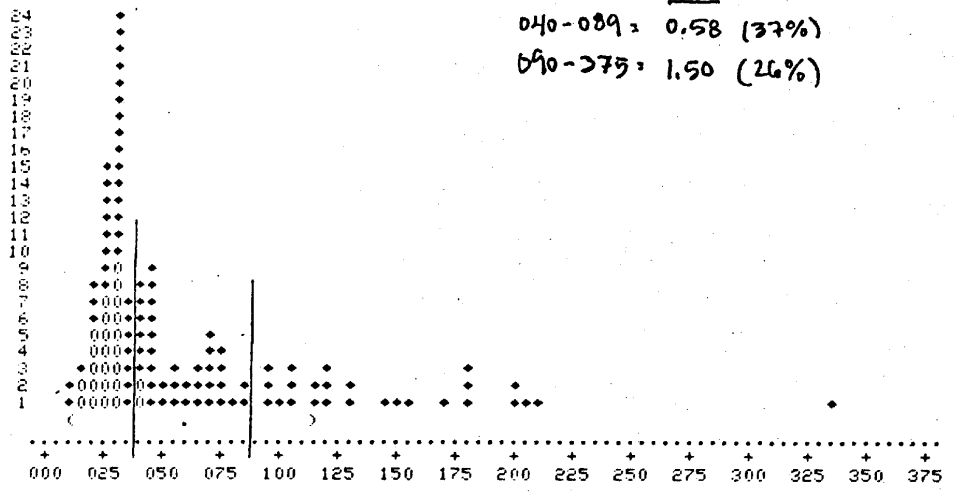
N = 125
MEAN = 42
STD. ERR. = 9
STD. DEV. = 56
PCT. POP. = 100



000-059 = 0.25 (85%)
060-375 = 1.64 (15%)

11/13/81 18750 50 1180' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

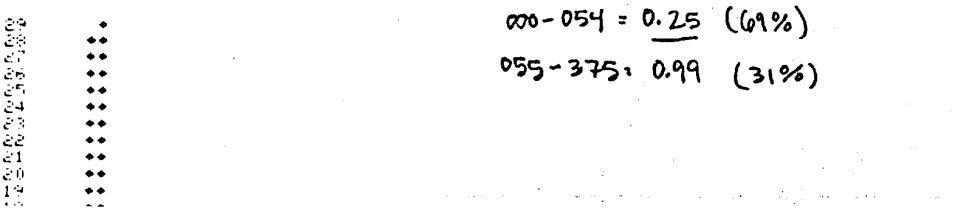
N = 124
MEAN = 63
STD. ERR. = 9
STD. DEV. = 53
PCT. POP. = 99



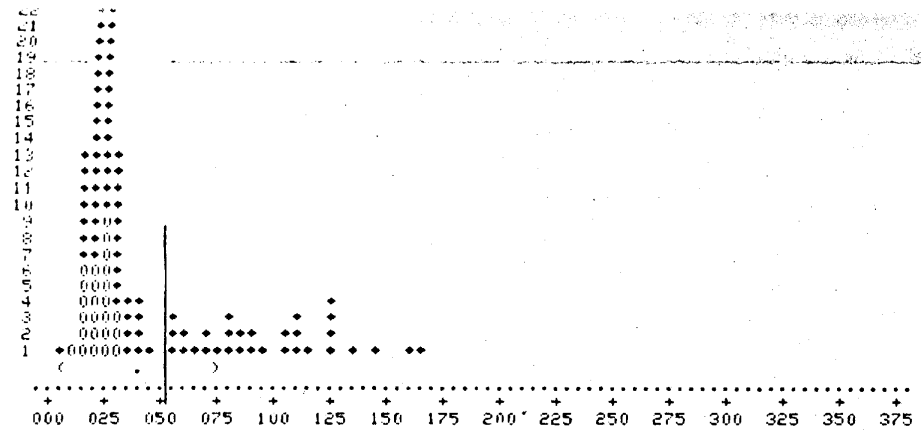
000-039 = 0.28 (36%)
040-089 = 0.58 (37%)
090-375 = 1.50 (26%)

11/13/81 18751 50 1540' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 125
MEAN = 43
STD. ERR. = 6
STD. DEV. = 35
PCT. POP. = 100



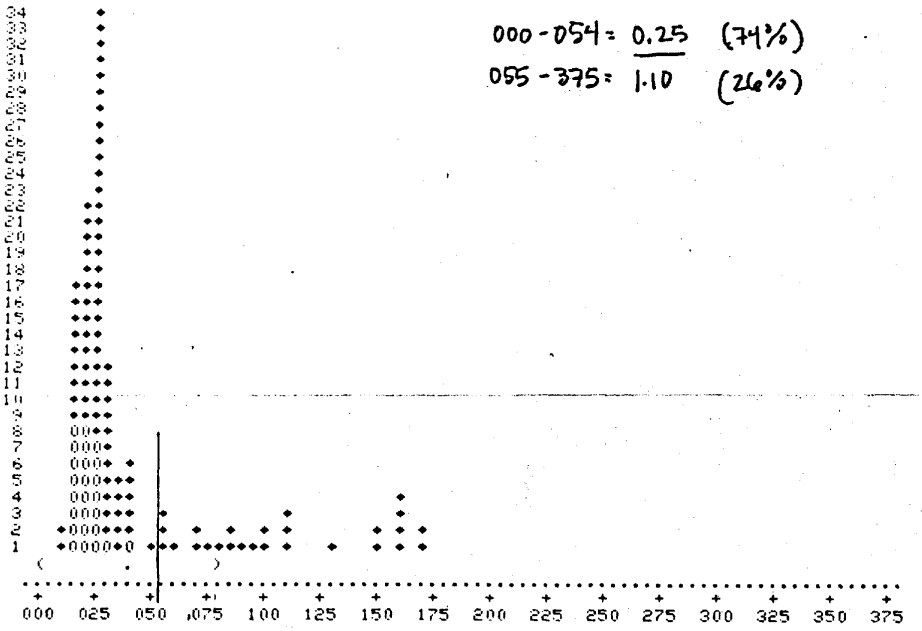
000-054 = 0.25 (69%)
055-375 = 0.99 (31%)



11/13/81 18752 50 1900' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 125
MEAN = 43
STD. ERR. = 6
STD. DEV. = 39
PCT. POP. = 100

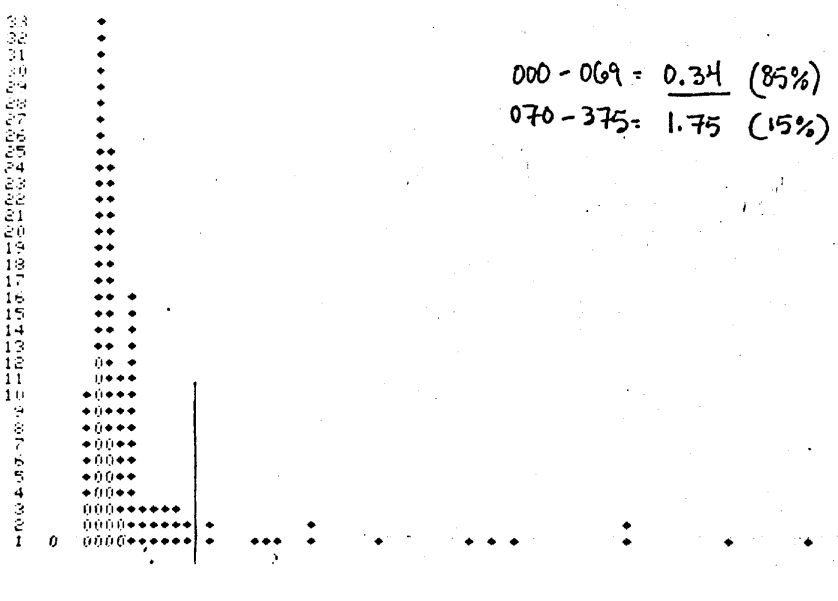
000-054 = 0.25 (74%)
055-375 = 1.10 (26%)

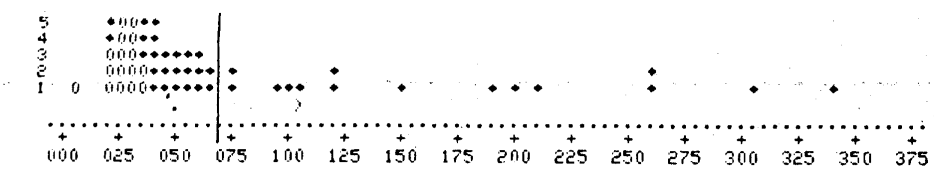


11/13/81 18753 50 2260' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 125
MEAN = 51
STD. ERR. = 9
STD. DEV. = 54
PCT. POP. = 100

000-069 = 0.34 (85%)
070-375 = 1.75 (15%)

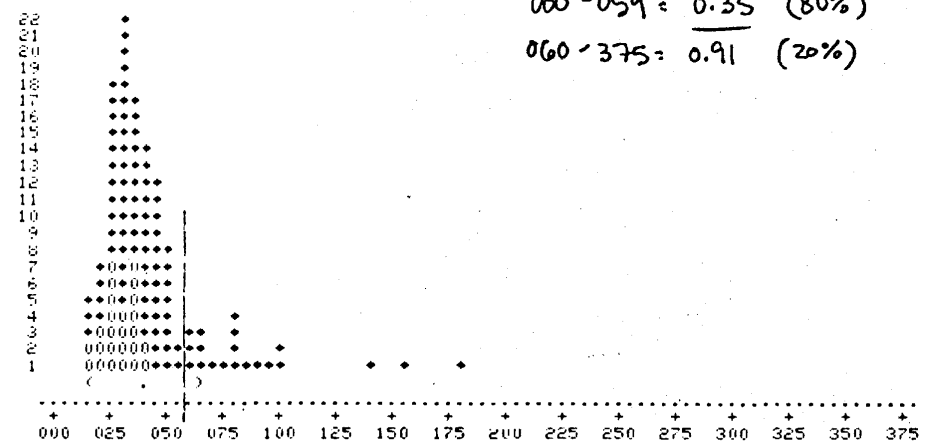




11/13/81 18754 50 2530' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 125
MEAN = 44
STD. ERR. = 4
STD. DEV. = 25
PCT. POP. = 100

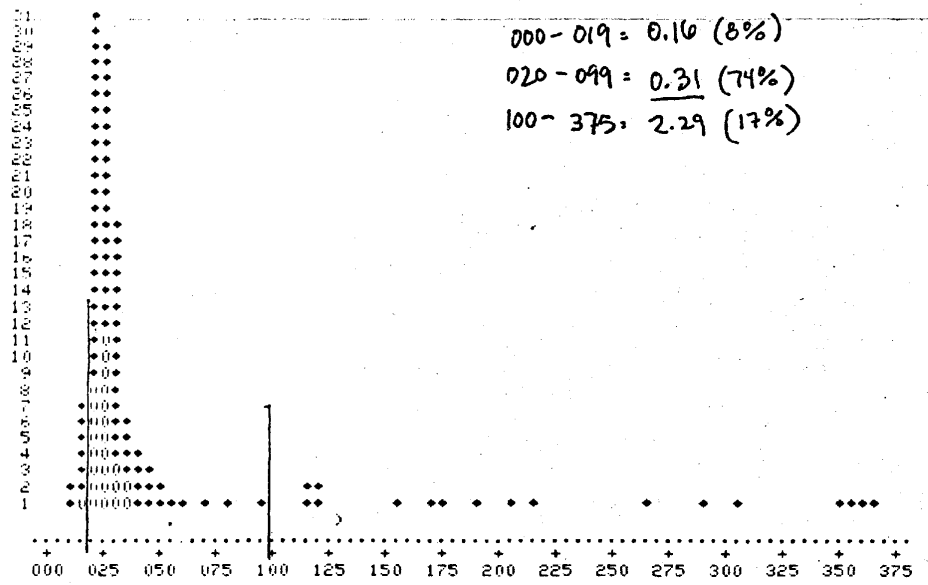
000 - 059 = 0.35 (80%)
060 - 375 = 0.91 (20%)



11/13/81 18755 50 2890' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 124
MEAN = 57
STD. ERR. = 13
STD. DEV. = 77
PCT. POP. = 99

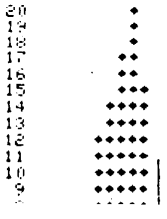
000 - 019 = 0.16 (8%)
020 - 099 = 0.31 (74%)
100 - 375 = 2.29 (17%)

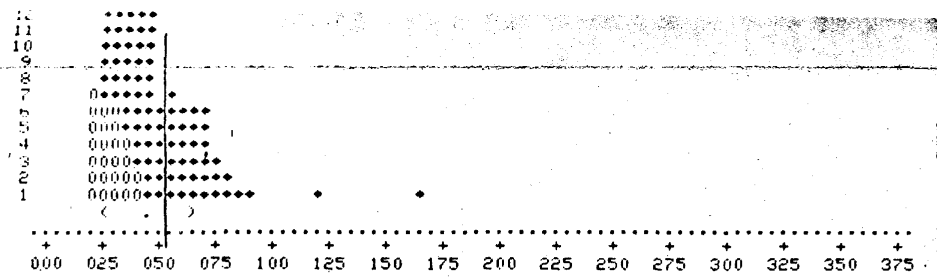


11/13/81 18756 50 3250' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 125
MEAN = 46
STD. ERR. = 3
STD. DEV. = 20
PCT. POP. = 100

000 - 054 = 0.37 (66%)
055 - 375 = 0.72 (34%)

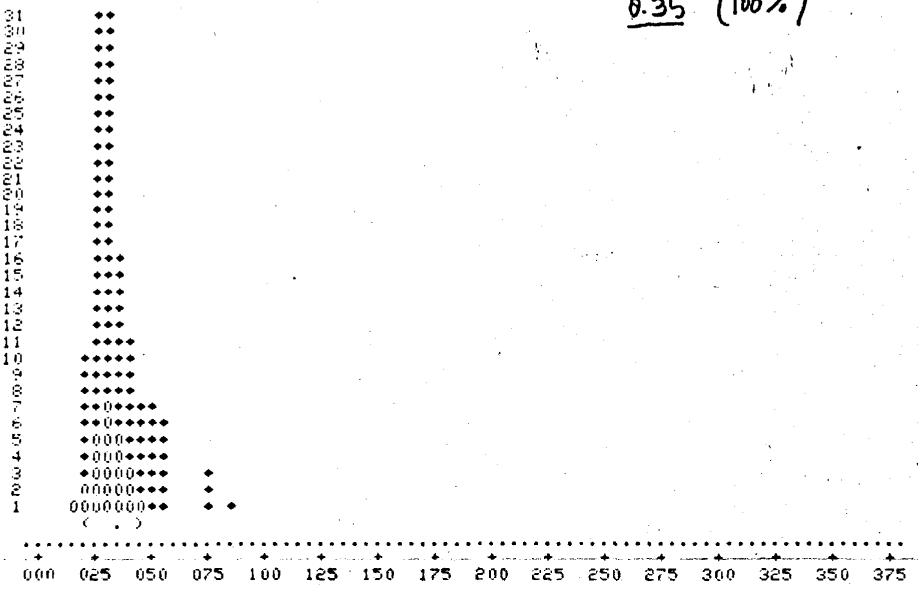




11/13/81 18757 50 3650' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 124
MEAN = 35
STD. ERR. = 3
STD. DEV. = 12
PCT. POP. = 100

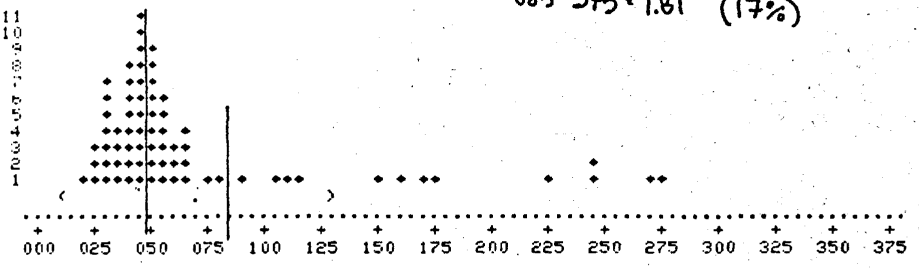
0.35 (100%)



11/13/81 18758 50 3970' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 71
MEAN = 72
STD. ERR. = 13
STD. DEV. = 59
PCT. POP. = 95

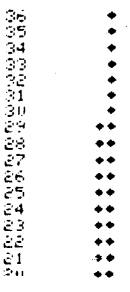
000-049 = 0.39 (45%)
050-084 = 0.59 (32%)
085-375 = 1.81 (17%)

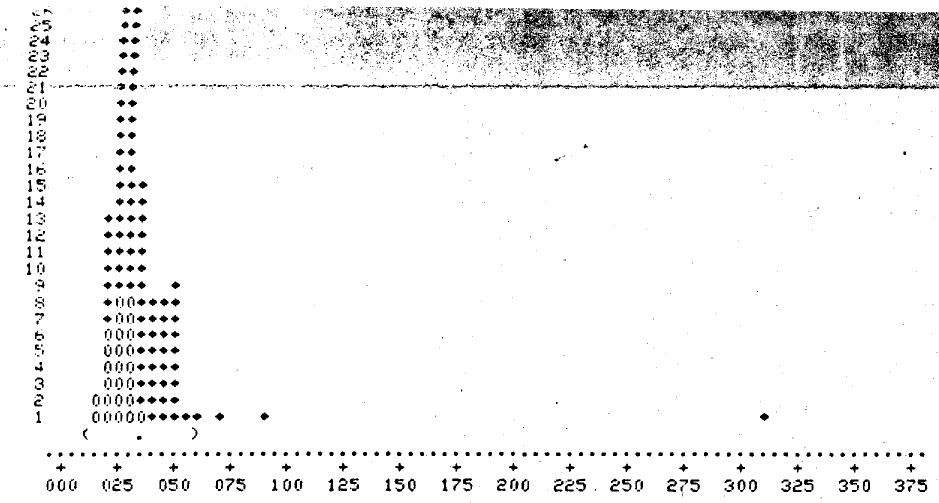


11/13/81 18759 50 4330' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 125
MEAN = 36
STD. ERR. = 4
STD. DEV. = 26
PCT. POP. = 100

0.36 (100%)

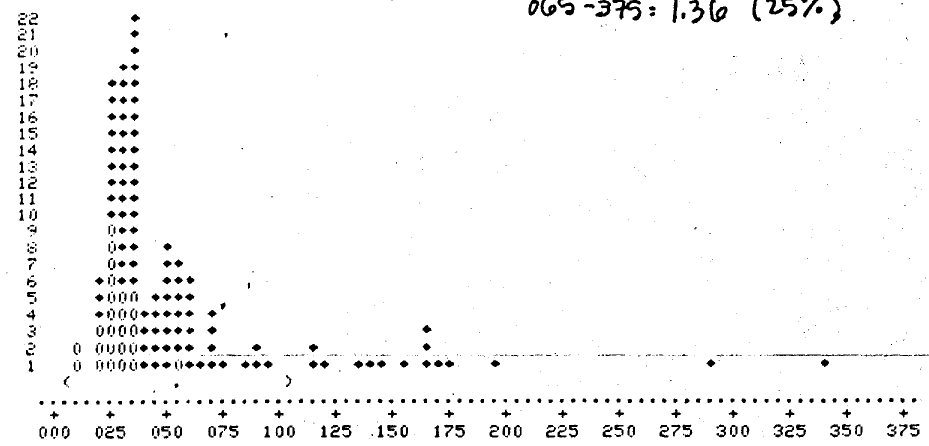




11/13/81 18760 50 4690' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 122
MEAN = 57
STD. ERR. = 8
STD. DEV. = 50
PCT. POP. = 97

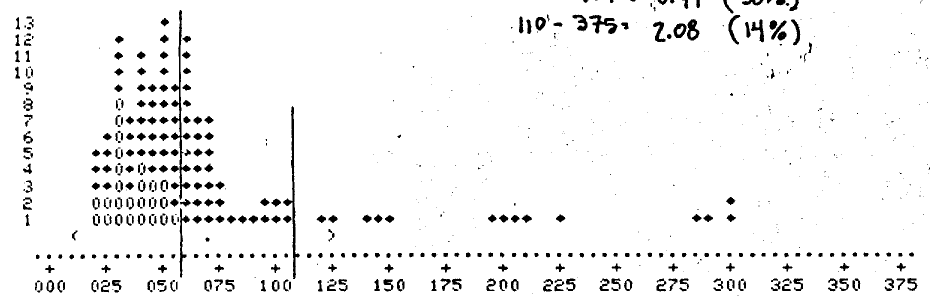
000-064 = 0.37 (72%)
065-375 = 1.36 (25%)



11/13/81 18761 50 5050' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 124
MEAN = 70
STD. ERR. = 9
STD. DEV. = 56
PCT. POP. = 99

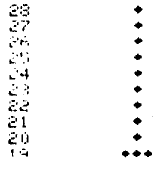
000-059 = 0.41 (47%)
060-109 = 0.74 (38%)
110-375 = 2.08 (14%)



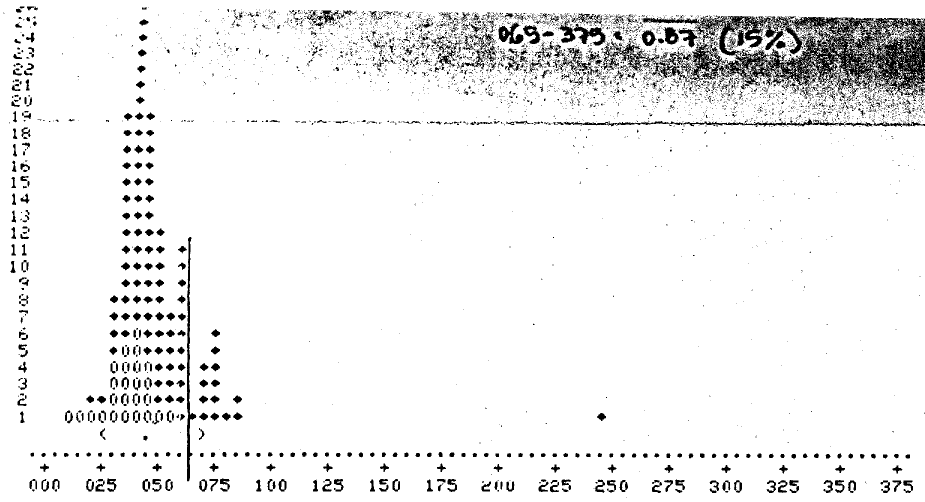
11/13/81 18762 50 5410' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 125
MEAN = 49
STD. ERR. = 3
STD. DEV. = 22
PCT. POP. = 100

000-064 = 0.44 (85%)
065-375 = 0.87 (15%)



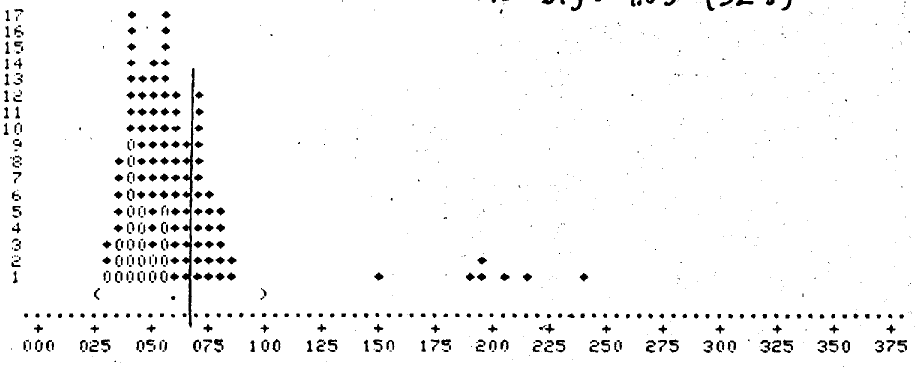
069-375 = 0.87 (15%)



11/13/81 18763 50 5770' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

N = 125
MEAN = 64
STD. ERR. = 6
STD. DEV. = 36
PCT. POP. = 100

000-069 = 0.51 (68%)
070-375 = 1.03 (32%)

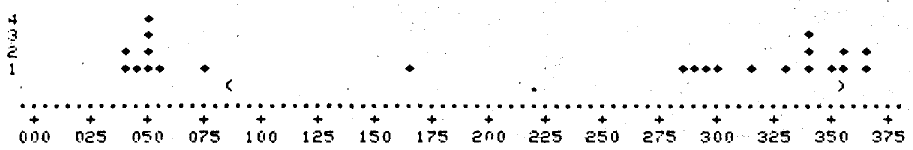


METAMORPHIC ROCKS FROM ~ 5950' to T.D.

11/13/81 18764 50 6130' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

INSUFFICIENT DATA

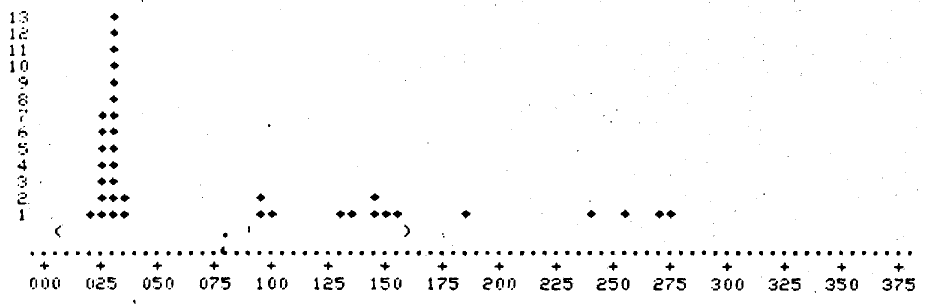
N = 24
MEAN = 220
STD. ERR. = 55
STD. DEV. = 135
PCT. POP. = 64



11/13/81 18765 50 6250' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

INSUFFICIENT DATA

N = 37
MEAN = 83
STD. ERR. = 25
STD. DEV. = 78
PCT. POP. = 97

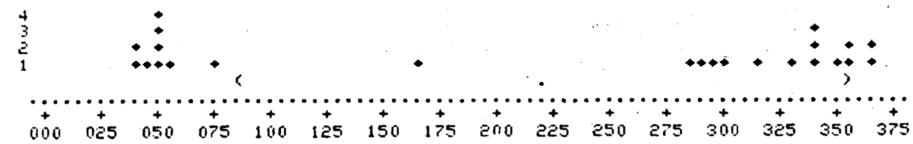


METAMORPHIC ROCKS FROM ~ 5950' to T.D.

11/13/81 18764 50 6130' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

INSUFFICIENT DATA

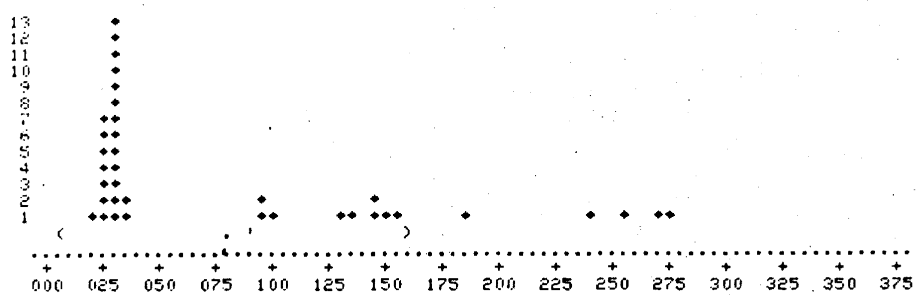
N = 24
MEAN = 220
STD. ERR. = 55
STD. DEV. = 135
PCT. POP. = 64



11/13/81 18765 50 6250' 4 STANDARD OF CALIF. NIMIUK PT.#1,AK

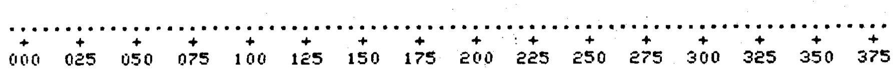
INSUFFICIENT DATA

N = 37
MEAN = 83
STD. ERR. = 25
STD. DEV. = 78
PCT. POP. = 97



11/13/81 99999 EOT

N = 0
MEAN = 0
STD. ERR. = 0
STD. DEV. = 0
PCT. POP. = 0



**COMMAND =

original

Mobil Exploration and Producing Services Inc.

P.O. BOX 900
DALLAS, TEXAS 75221

November 24, 1981

Mr. William Van Alen
State of Alaska
Alaska Oil & Gas Conservation Commission
3001 Porcupine Drive
Anchorage, Alaska 99501

ESC REQUEST NO. 311A78
VISUAL KEROGEN AND
THERMAL MATURATION ANALYSES,
BENEDUM NULATO UNIT NO. 1,
NORTON SOUND, ALASKA

Dear Mr. Van Alen:

This report describes the visual kerogen and thermal maturation results from the Benedum Nulato Unit No. 1, Norton Sound, Alaska. Visual kerogen and vitrinite reflectance analyses are based on 31 ditch samples taken at 300' intervals between 0' and 11800' (TD). A summary of the thermal maturity and hydrocarbon potential (table 1), a kerogen analysis sheet (table 2), and histogram plots of the Ro measurements are included.

Results from visual kerogen analysis of the Benedum Nulato Unit No. 1 samples are listed on the attached kerogen analysis sheet (table 2). It should be noted that all of the samples analyzed are dominated by cellulosic (gas type) kerogens. Fluorescence analysis supports this observation. Kerogen slides prepared from these samples were barren of palynomorphs, hence, TAI analysis was not possible.

Results from vitrinite reflectance studies on the Nulato Unit No. 1 well indicate that all the sediments penetrated to a depth of 11800' (TD) are thermally overmature. Only the first sample from 0'-100' contains a low-gray Ro population which can be attributed to surface contamination. A summary of the thermal maturity and hydrocarbon potential of the Nulato Unit No. 1 samples is also included with the report (table 1). Histogram plots of the Ro readings from each sample are attached. No plot was made of the low-gray Ro means because the means are too high and plot off scale. The reflectance measurements used in this study were made by R. R. Taylor.

ORGANIC RESIDUE (KEROGEN) ANALYSIS

M-005
(Rev. 01-80)

SCALE:	T : TRACE (<1%)	
1 : 1 – 10%	6 : 51 – 60%	
2 : 11 – 20%	7 : 61 – 70%	
3 : 21 – 30%	8 : 71 – 80%	
4 : 31 – 40%	9 : 81 – 90%	
5 : 41 – 50%	10 : 91 – 100%	

DATE: 9/21/81

PROJECT: [illegible]

ESC NO. [illegible]

ANALYST: [illegible]

DEPTH OR NO.

TYPE OF ORGANIC MATTER (OIL TYPE / GAS TYPE) · FLUOR.

DEPTH OR NO.	AMORPHOUS (OIL RICH)	CUTICLE	PALYNOMORPHS	AMORPHOUS (GAS or OIL)	BARK & WOODY DEBRIS	INERTINITE	FUNGAL MATERIAL - CHITIN	% OF RESIDUE FLUORESCING	STRONG FLUORESCENCE	MODERATE FLUORESCENCE	WEAK FLUORESCENCE
[illegible]				2	1	7		0			
[illegible]				1		7		0			
[illegible]				1	1	4		0			
[illegible]				1				0			
[illegible]				1		10		0			
[illegible]								0			
[illegible]						3		0			
[illegible]500 - [illegible]600'				1		7		0			
[illegible] - 2000				1		10		0			
[illegible] - 2400'				1		10		0			
3100 - 3200'				1		7		0			
4100 - 4200'				1		10		0			
[illegible] - 4[illegible]00'				1		7		0			
4900 - 5000'				1		10		0			
5[illegible]00 - 5[illegible]00				1		10		0			
[illegible] - [illegible]00				1		7		0			
6100 - 6200				1		7		0			
6500 - 6600				1		7		0			
[illegible] - 7000				1		7		0			
7300 - 7400				1		7		0			
[illegible]				1		10		0			
8100 - 8200				1		10		0			
8500 - 8600				1		10		0			
[illegible] - [illegible]900				1		10		0			
9300 - 9400				1		10		0			
9700 - 9800				T		10		0			
10100 - 10200				T		10		0			
10500 - 600				1		10		0			
10900 - 11000				1		10		0			
11300 - 400						10		0			
11700 - 11800 TD				T		10		0			
IN FEET											

POLLEN COLOR, TAI AND MATURATION · PRESRV · DEPOSITIONAL ENVIRONMENT

DEPTH OR NO.	LIGHT YELLOW	MEDIUM YELLOW [1] IMMATURE	YELLOW [1+] IMMATURE	LIGHT BROWN [2] TRANSITIONAL	MEDIUM BROWN [2+] SLIGHTLY MATURE	DARK BROWN [3-] MOD. MATURE	VERY DARK BROWN [3] MATURE	BLACKISH BROWN [3+] FULLY MATURE	BLACK [4-] TRANSITIONAL [4 to 4+] OVERMATURE	METAMORPHOSED ROCK [5]	NO PALYNOMORPHS	GOOD	FAIR	POOR	MARINE	MARGINAL MARINE	NO MARINE PALYNOMORPHS	UNKNOWN	REMARKS
[illegible]											✓							✓	
[illegible]											✓							✓	
[illegible]											✓							✓	
[illegible]											✓							✓	
[illegible]											✓							✓	
[illegible]											✓							✓	
[illegible]											✓							✓	
[illegible]500 - [illegible]600'											✓							✓	
[illegible] - 2000											✓							✓	
[illegible] - 2400'											✓							✓	
3100 - 3200'											✓							✓	
4100 - 4200'											✓							✓	
[illegible] - 4[illegible]00'											✓							✓	
4900 - 5000'											✓							✓	
5[illegible]00 - 5[illegible]00											✓							✓	
[illegible] - [illegible]00											✓								
6100 - 6200											✓								
6500 - 6600																			
[illegible] - 7000																			
7300 - 7400																			
[illegible]																			
8100 - 8200																			
8500 - 8600																			
[illegible] - [illegible]900																		✓	
9300 - 9400																		✓	
9700 - 9800																		✓	
10100 - 10200											✓							✓	
10500 - 600											✓							✓	
10900 - 11000											✓							✓	
11300 - 400											✓							✓	
11700 - 11800 TD											✓							✓	
IN FEET																			

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Alaska Oil & Gas Cons. Commission
Anchorage

Time requirements for this job were charged to ESC Request No. 311A78. If you have any questions concerning our results or interpretations, please do not hesitate to contact us.

Very truly yours,

Timothy A. Timmcke

T. A. Timmcke
Exploration Services Center
Applied Stratigraphy

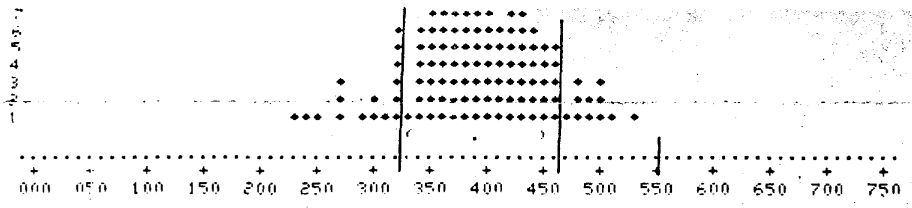
TAT/jg
Attachments

TABLE 1
Ro Means, TAI, and Kerogen Type
Benedum Nulato Unit No. 1, Norton Sound, Alaska

DEPTH OR SPL. NO.	LOW-GRAY Ro MEAN	% POP.	FIRST HIGH-GRAY Ro MEAN	% POP.	TAI	THERMAL MATURITY	KEROGEN TYPE	HYDROCARBON POTENTIAL/REMARKS
50'	2.62	62	-		-	Overmature	Cellulosic	Gas type kerogen
400'	2.70	92	-		-	Overmature	Cellulosic	Gas type kerogen
750'	3.28	91	4.07	8	-	Overmature	Cellulosic	Gas type kerogen
1100'	3.21	82	3.97	13	-	Overmature	Cellulosic	Gas type kerogen
1450'	3.18	94	4.34	1	-	Overmature	Cellulosic	Gas type kerogen
1800'	3.27	72	4.12	16	-	Overmature	Cellulosic	Gas type kerogen
2150'	3.44	80	4.21	16	-	Overmature	Cellulosic	Gas type kerogen
2500'	3.38	84	4.52	7	-	Overmature	Cellulosic	Gas type kerogen
2900'	3.45	92	4.82	5	-	Overmature	Cellulosic	Gas type kerogen
3300'	3.62	76	4.59	20	-	Overmature	Cellulosic	Gas type kerogen
3700'	3.77	72	4.59	22	-	Overmature	Cellulosic	Gas type kerogen
4100'	3.61	92	-		-	Overmature	Cellulosic	Gas type kerogen
4500'	3.98	78	4.98	8	-	Overmature	Cellulosic	Gas type kerogen
4900'	4.07	93	5.45	3	-	Overmature	Cellulosic	Gas type kerogen
5300'	3.91	74	5.04	6	-	Overmature	Cellulosic	Gas type kerogen
5700'	3.91	92	5.52	5	-	Overmature	Cellulosic	Gas type kerogen
6100'	4.10	83	5.63	12	-	Overmature	Cellulosic	Gas type kerogen

TABLE 1
Ro Means, TAI, and Kerogen Type
Benedum Nulato Unit No. 1, Norton Sound, Alaska

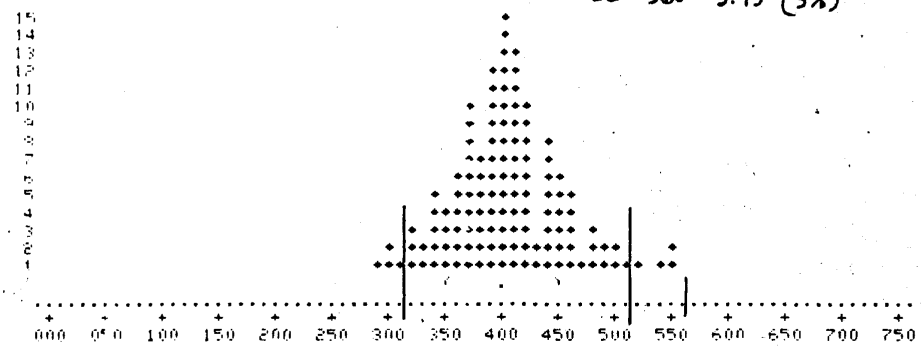
DEPTH OR SPL. NO.	LOW-GRAY Ro MEAN	% POP.	FIRST HIGH-GRAY Ro MEAN	% POP.	TAI	THERMAL MATURITY	KEROGEN TYPE	HYDROCARBON POTENTIAL/REMARKS
6500'	4.09	88	5.92	1	-	Overmature	Cellulosic	Gas type kerogen
6900'	4.10	71	5.17	13	-	Overmature	Cellulosic	Gas type kerogen
7300'	4.07	65	5.09	9	-	Overmature	Cellulosic	Gas type kerogen
7700'	4.22	70	5.41	14	-	Overmature	Cellulosic	Gas type kerogen
8100'	4.23	79	5.45	12	-	Overmature	Cellulosic	Gas type kerogen
8500'	4.32	76	5.39	21	-	Overmature	Cellulosic	Gas type kerogen
8900'	4.28	86	5.61	7	-	Overmature	Cellulosic	Gas type kerogen
9300'	4.28	85	5.35	12	-	Overmature	Cellulosic	Gas type kerogen
9700'	4.33	77	5.50	17	-	Overmature	Cellulosic	Gas type kerogen
10100'	4.30	80	5.64	5	-	Overmature	Cellulosic	Gas type kerogen
10500'	4.39	80	5.58	5	-	Overmature	Cellulosic	Gas type kerogen
10900'	4.39	63	5.61	17	-	Overmature	Cellulosic	Gas type kerogen
11300'	4.42	47	5.39	18	-	Overmature	Cellulosic	Gas type kerogen
11700'	4.43	80	5.72	8	-	Overmature	Cellulosic	Gas type kerogen



11/19/81 18779 50 4900' 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 408
STD. ERR. = 8
STD. DEV. = 50
PCT. POP. = 100

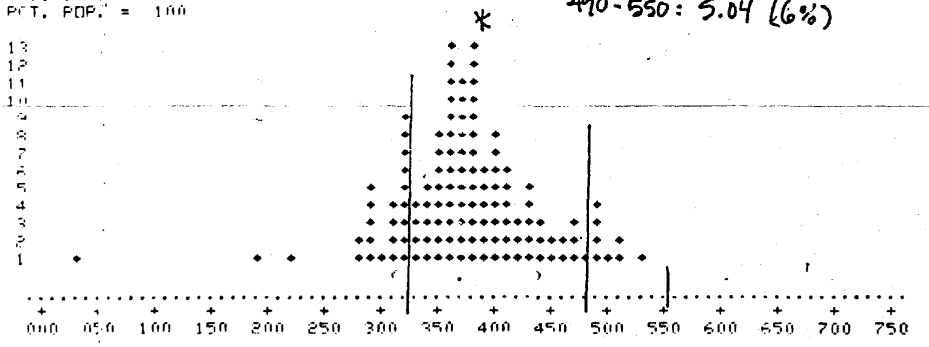
000-319 = 3.04 (3%)
* 320-519 = 1.07 (93%)
520-560 = 5.45 (3%)



11/19/81 18780 50 5300' 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 378
STD. ERR. = 11
STD. DEV. = 65
PCT. POP. = 100

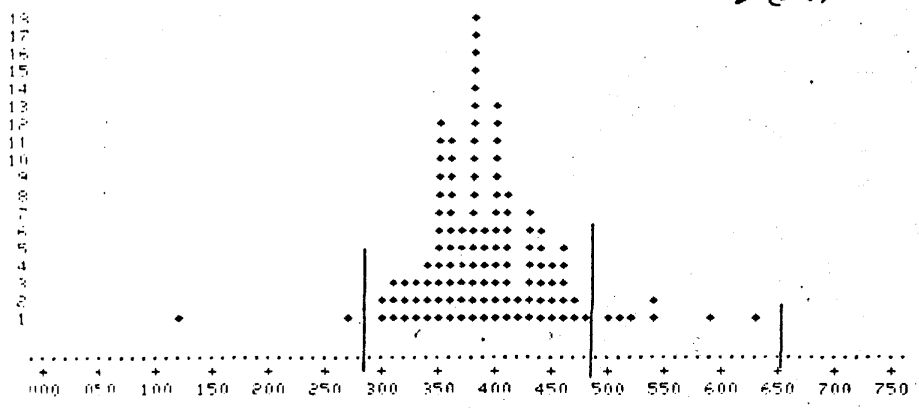
000-329 = 2.89 (19%)
* 330-489 = 3.91 (74%)
490-550 = 5.04 (6%)



11/19/81 18781 50 5700' 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 397
STD. ERR. = 10
STD. DEV. = 61
PCT. POP. = 100

000-289 = 1.99 (1%)
* 290-489 = 3.91 (92%)
490-650 = 5.52 (5%)



ORIGINAL


```
ED
..FIRST SAMPLE NO. = 18766
..LAST SAMPLE NO.  = 18768
..LOAD COMMAND =  LP
```

```
11/19/81  18766   50    50'  4   BENEDUM NULATO UNIT NO.1,ALASKA

        N =  125
     MEAN =  180
STD. ERR. =   14
STD. DEV. =   84
PCT. POP. =  100
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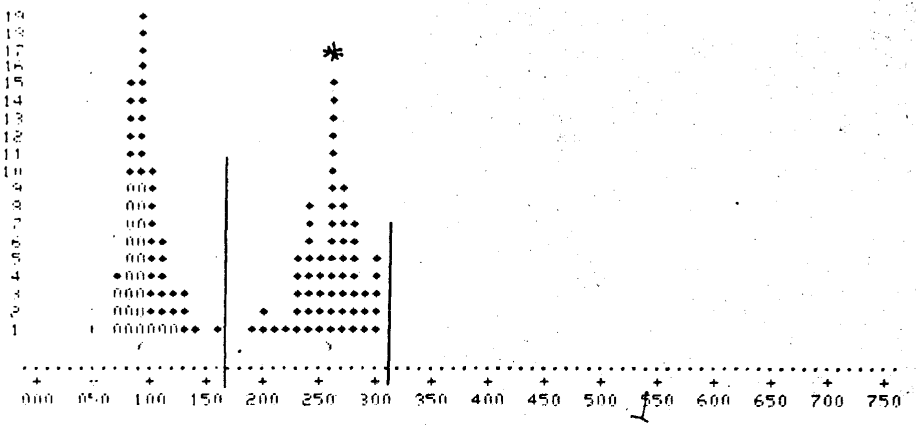
000 - 169 = 0.98 (38%)
* 170 - 310 = 2.62 (62%)

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11/19/81  18767   50   100'  4   BENEDUM NULATO UNIT NO.1,ALASKA

        N =  124
     MEAN =  263
STD. ERR. =    6
STD. DEV. =   39
PCT. POP. =   99
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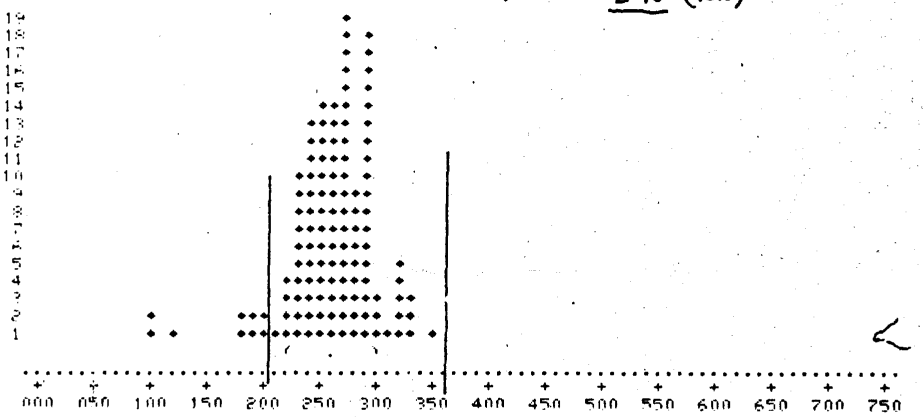
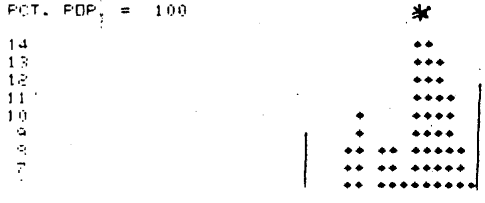
000 - 209 = 1.67 (7%)
* 210 - 360 = 2.70 (92%)

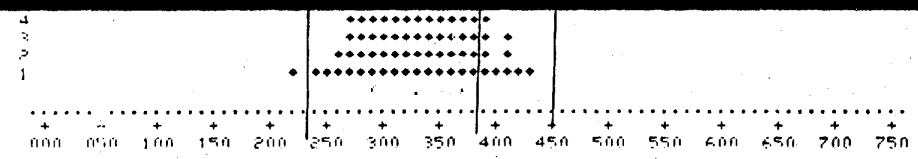



```
11/19/81  18768   50   750'  4   BENEDUM NULATO UNIT NO.1,ALASKA

        N =  125
     MEAN =  334
STD. ERR. =    7
STD. DEV. =   40
PCT. POP. =  100
```

000 - 239 = 2.20 (0%)
* 240 - 389 = 3.28 (91%)
390 - 450 = 4.07 (8%)

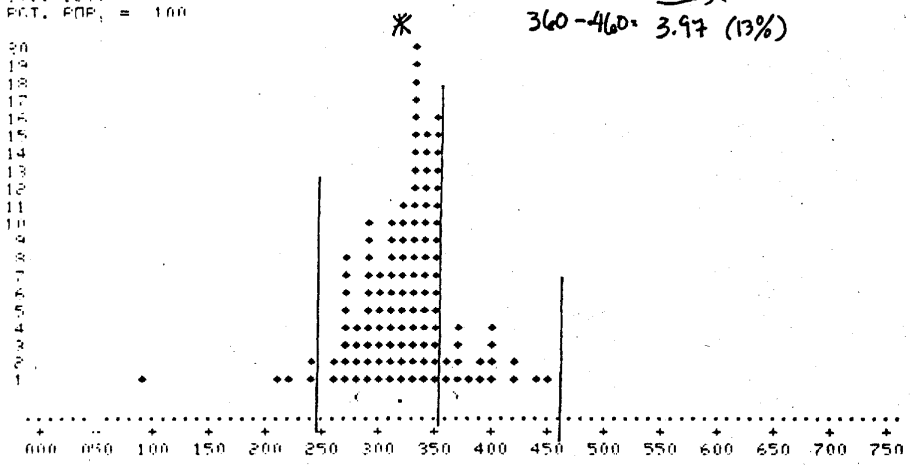




11/19/81 18769 50 1100' 4 BENETNUM NULATO UNIT NO.1,ALASKA

N = 125
MEAN = 327
STD. ERR. = 7
STD. DEV. = 44
PCT. POP. = 100

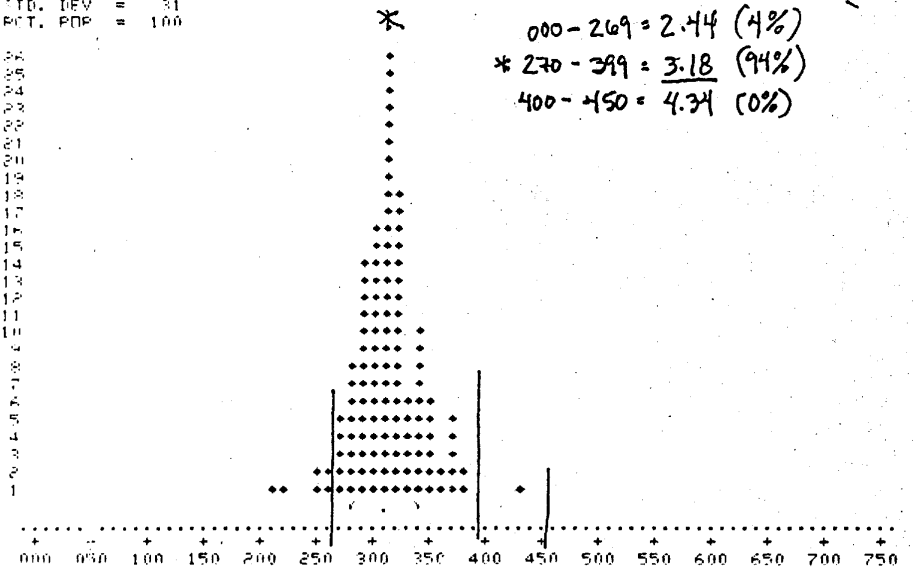
000-249 = 2.06 (4%)
* 250-359 = 3.21 (82%)
360-460 = 3.97 (13%)



11/19/81 18770 50 1450' 4 BENETNUM NULATO UNIT NO.1,ALASKA

N = 125
MEAN = 315
STD. ERR. = 6
STD. DEV. = 31
PCT. POP. = 100

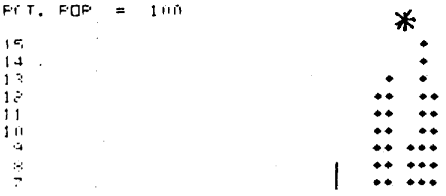
000-269 = 2.44 (4%)
* 270-399 = 3.18 (94%)
400-450 = 4.34 (0%)

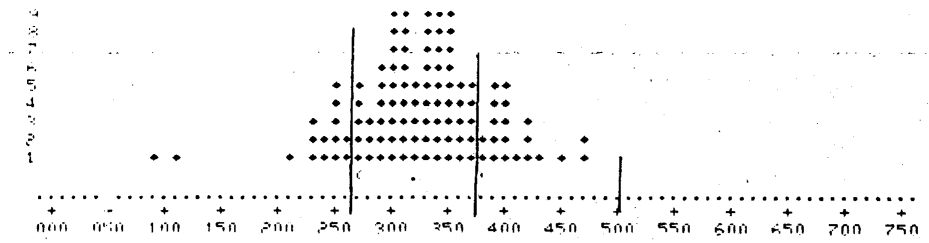


11/19/81 18771 50 1800' 4 BENETNUM NULATO UNIT NO.1,ALASKA

N = 125
MEAN = 328
STD. ERR. = 10
STD. DEV. = 57
PCT. POP. = 100

000-269 = 2.26 (12%)
* 270-379 = 3.27 (72%)
380-500 = 4.12 (16%)

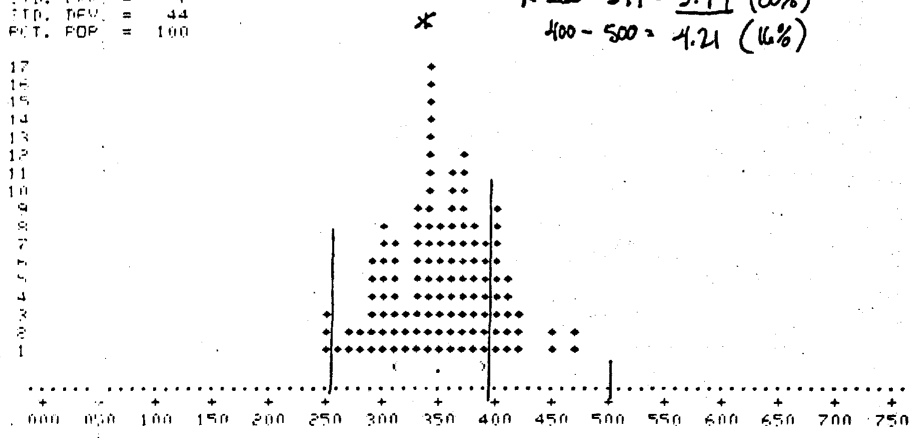




11/19/81 18772 50 2150' 4 BENEDUM NULATO UNIT NO.1•ALASKA

N = 125
MEAN = 355
STD. ERR. = 7
STD. DEV. = 44
PCT. POP. = 100

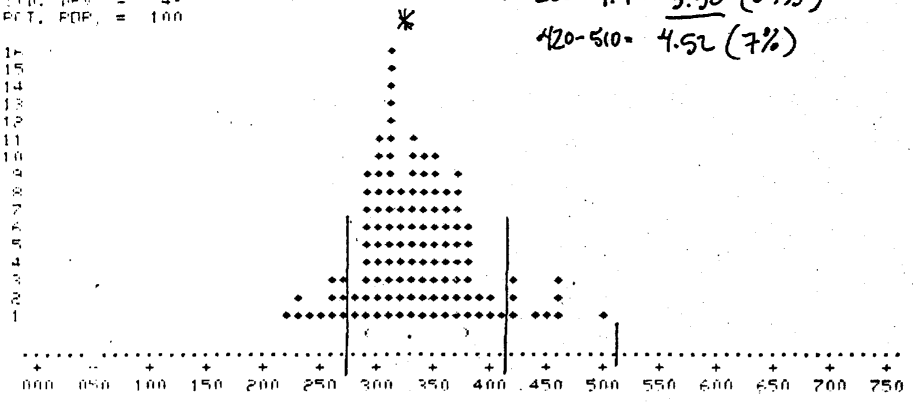
000-259 = 2.51 (2%)
* 260-399 = 3.44 (80%)
400-500 = 4.21 (16%)



11/19/81 18773 50 2500' 4 BENEDUM NULATO UNIT NO.1•ALASKA

N = 125
MEAN = 339
STD. ERR. = 8
STD. DEV. = 49
PCT. POP. = 100

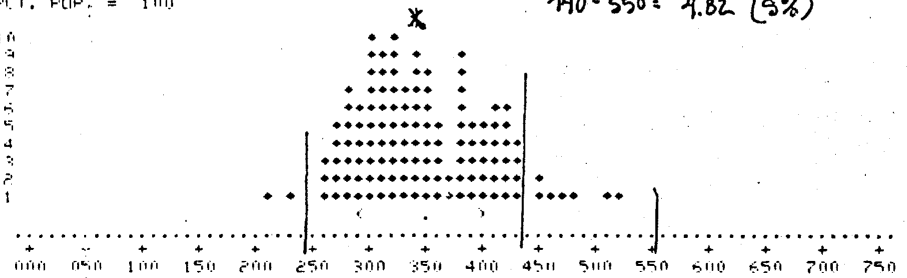
000-279 = 2.56 (8%)
* 280-419 = 3.38 (84%)
420-510 = 4.52 (7%)



11/19/81 18774 50 2900' 4 BENEDUM NULATO UNIT NO.1•ALASKA

N = 125
MEAN = 351
STD. ERR. = 10
STD. DEV. = 58
PCT. POP. = 100

000-249 = 2.27 (1%)
* 250-439 = 3.45 (92%)
440-550 = 4.82 (5%)

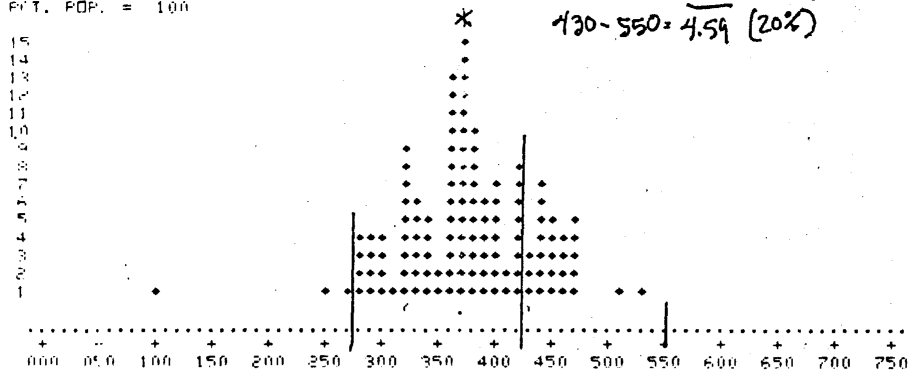


11/19/81 18775 50 3300' 4 BENEDUM NULATO UNIT NO.1•ALASKA

11/19/81 18775 50 3300' 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 379
STD. ERR. = 10
STD. DEV. = 59
PCT. POP. = 100

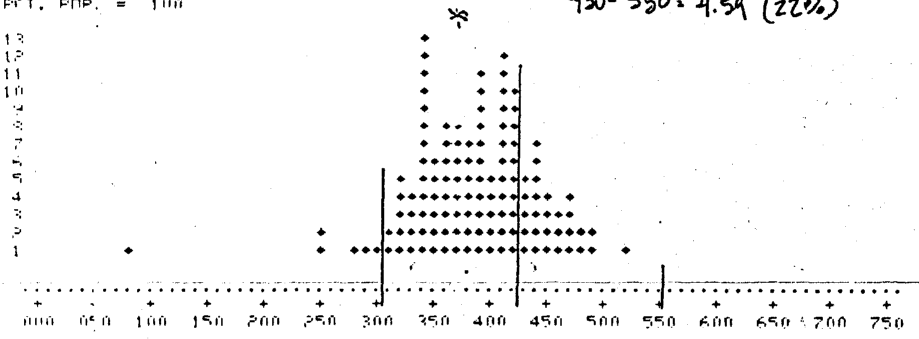
000-279 = 2.11 (2%)
* 280-429 = 3.62 (76%)
430-550 = 4.59 (20%)



11/19/81 18776 50 3700' 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 389
STD. ERR. = 10
STD. DEV. = 57
PCT. POP. = 100

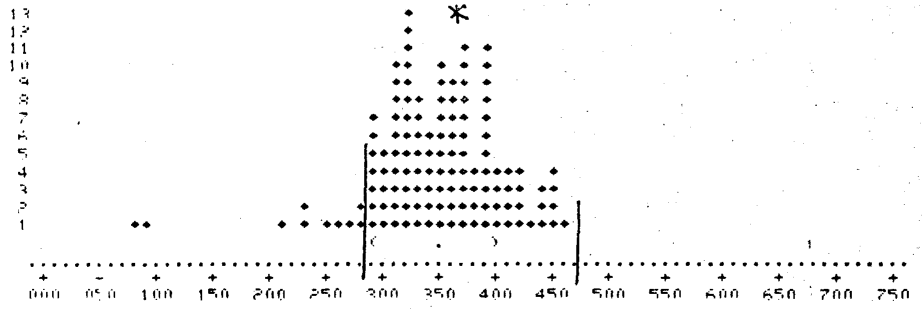
000-309 = 2.48 (4%)
* 310-429 = 3.77 (72%)
430-550 = 4.59 (22%)



11/19/81 18777 50 4100' 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 350
STD. ERR. = 10
STD. DEV. = 59
PCT. POP. = 100

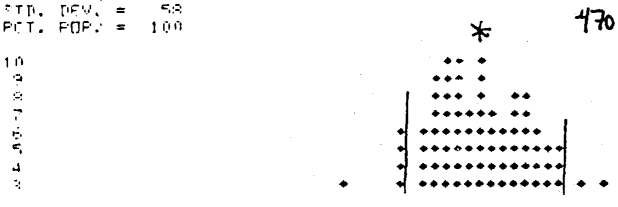
000-289 = 2.23 (8%)
* 290-470 = 3.61 (92%)



11/19/81 18778 50 4500' 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 394
STD. ERR. = 10
STD. DEV. = 58
PCT. POP. = 100

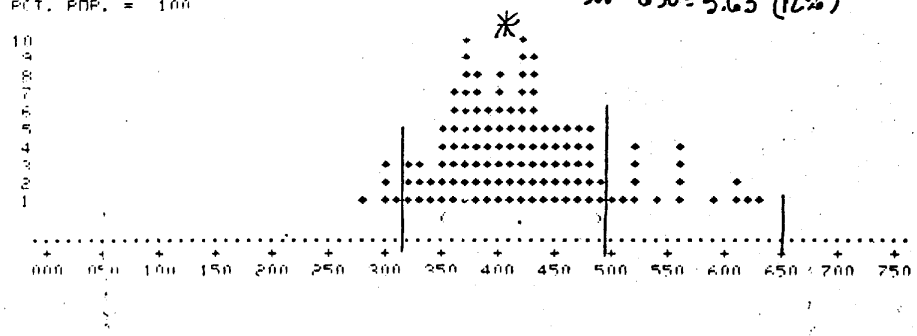
000-329 = 2.95 (12%)
* 330-469 = 3.98 (78%)
470-550 = 4.98 (8%)



11/19/81 18782 50 6100' 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 425
STD. ERR. = 12
STD. DEV. = 70
PCT. POP. = 100

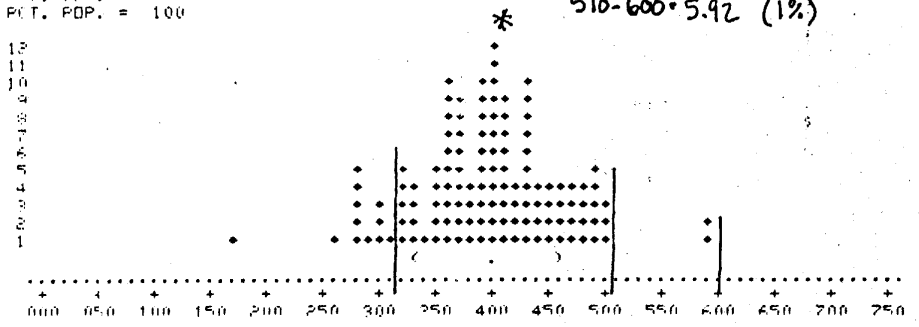
000-319 = 3.05 (4%)
* 320-499 = 4.10 (83%)
500-650 = 5.63 (12%)



11/19/81 18783 50 6500' 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 400
STD. ERR. = 11
STD. DEV. = 64
PCT. POP. = 100

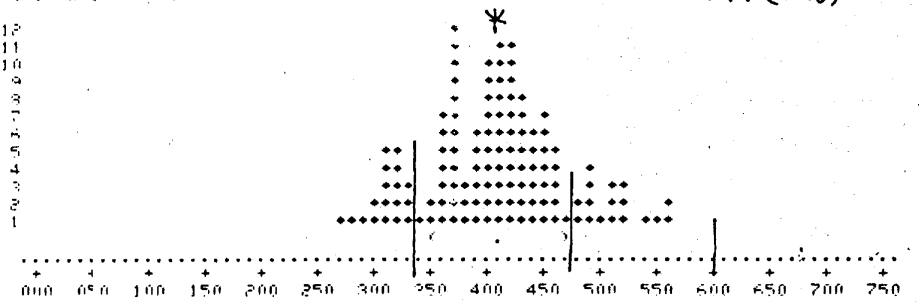
000-319 = 2.82 (9%)
* 320-509 = 4.09 (88%)
510-600 = 5.92 (1%)



11/19/81 18784 50 6900' 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 411
STD. ERR. = 10
STD. DEV. = 60
PCT. POP. = 99

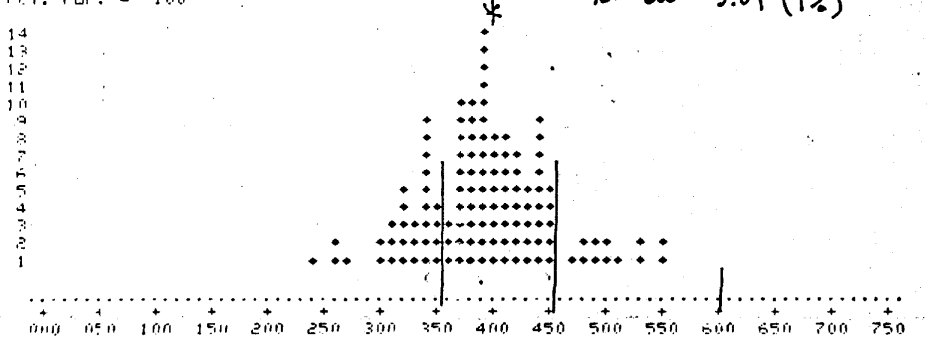
000-339 = 3.15 (14%)
* 340-479 = 4.10 (71%)
480-600 = 5.17 (13%)

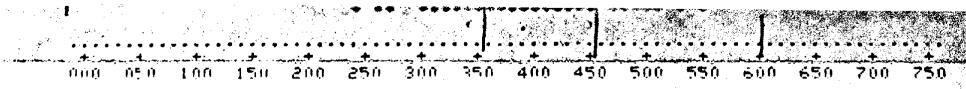


11/19/81 18785 50 7300' 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 121
MEAN = 397
STD. ERR. = 10
STD. DEV. = 57
PCT. POP. = 100

000-359 = 3.25 (24%)
* 360-459 = 4.07 (65%)
460-600 = 5.09 (9%)

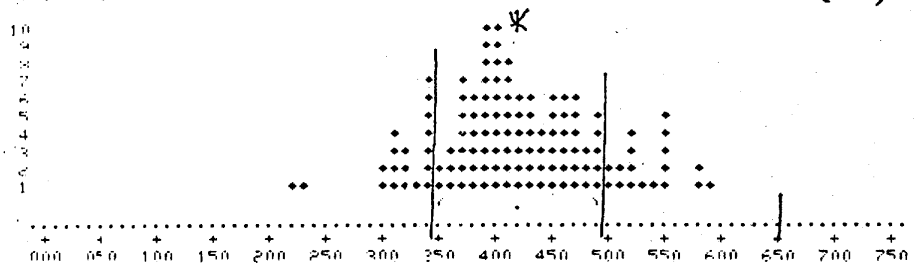




11/19/81 18786 50 7700' 4 BENEDUM NULATO UNIT NO.1•ALASKA

N = 125
MEAN = 424
STD. ERR. = 12
STD. DEV. = 70
PCT. POP. = 100

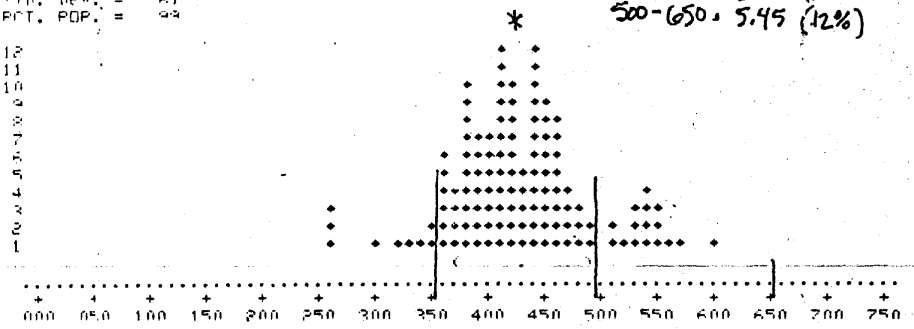
000-349 = 3.28 (13%)
* 350-499 = 4.22 (70%)
500-650 = 5.41 (14%)



11/19/81 18787 50 8100' 4 BENEDUM NULATO UNIT NO.1•ALASKA

N = 124
MEAN = 431
STD. ERR. = 10
STD. DEV. = 61
PCT. POP. = 99

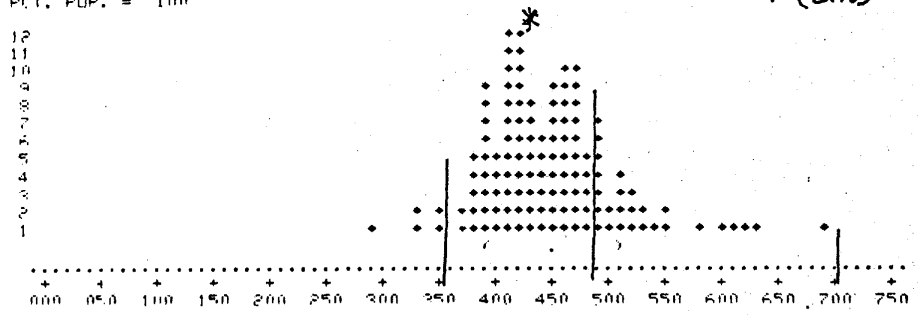
000-359 = 3.12 (7%)
* 360-499 = 4.23 (79%)
500-650 = 5.45 (12%)



11/19/81 18788 50 8500' 4 BENEDUM NULATO UNIT NO.1•ALASKA

N = 125
MEAN = 453
STD. ERR. = 10
STD. DEV. = 60
PCT. POP. = 100

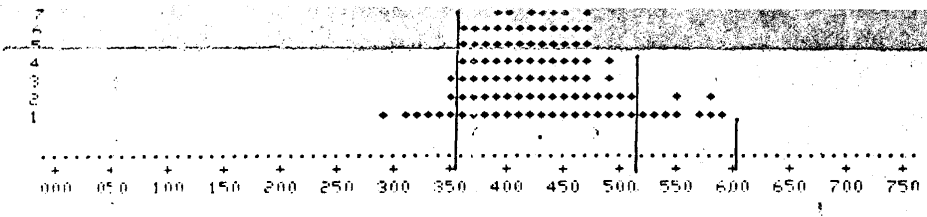
000-359 = 3.36 (4%)
* 360-489 = 4.32 (76%)
490-700 = 5.39 (21%)



11/19/81 18789 50 8900' 4 BENEDUM NULATO UNIT NO.1•ALASKA

N = 125
MEAN = 432
STD. ERR. = 9
STD. DEV. = 56
PCT. POP. = 100

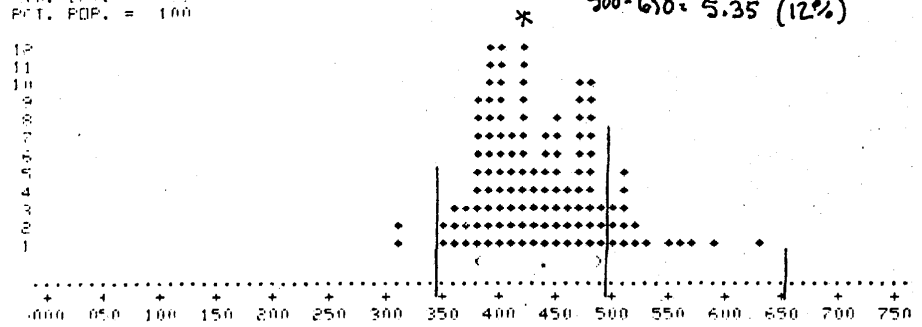
000-359 = 3.35 (6%)
* 360-519 = 4.28 (86%)
520-600 = 5.61 (7%)



11/19/81 18790 50 93002 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 440
STD. ERR. = 5
STD. DEV. = 53
PCT. POP. = 100

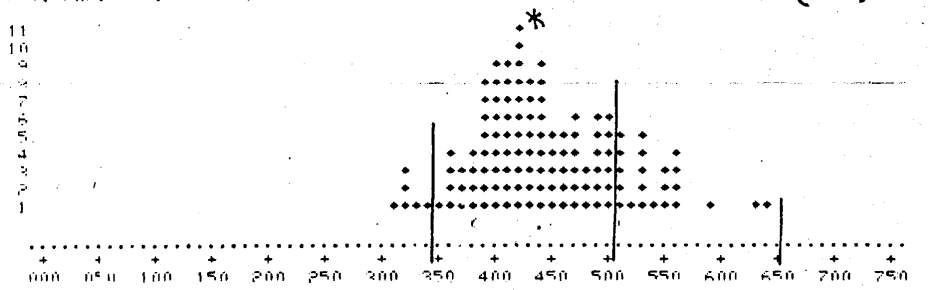
000-349 = 3.14 (1%)
* 350-499 = 4.28 (85%)
500-650 = 5.35 (12%)



11 19 81 18791 50 97002 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 448
STD. ERR. = 11
STD. DEV. = 64
PCT. POP. = 100

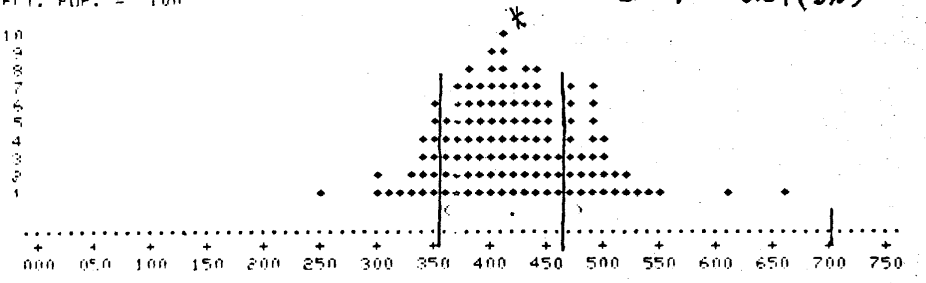
000-349 = 3.27 (4%)
* 350-509 = 4.33 (77%)
510-650 = 5.50 (17%)



11/19/81 18792 50 101002 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 424
STD. ERR. = 10
STD. DEV. = 61
PCT. POP. = 100

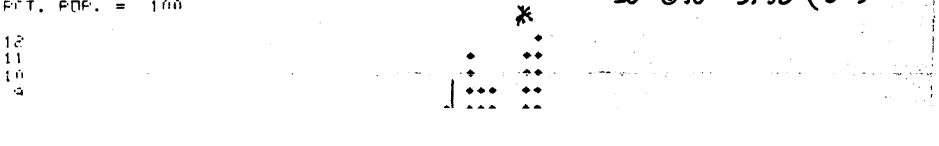
000-359 = 3.34 (13%)
* 360-519 = 4.30 (80%)
520-700 = 5.64 (5%)

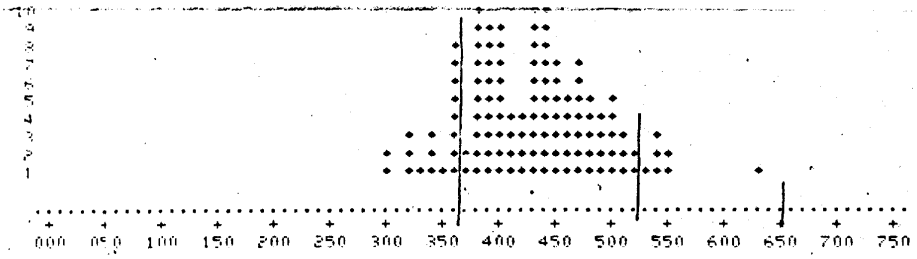


11/19/81 18793 50 105002 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 432
STD. ERR. = 10
STD. DEV. = 58
PCT. POP. = 100

000-369 = 3.45 (14%)
* 370-529 = 4.39 (80%)
530-650 = 5.58 (5%)

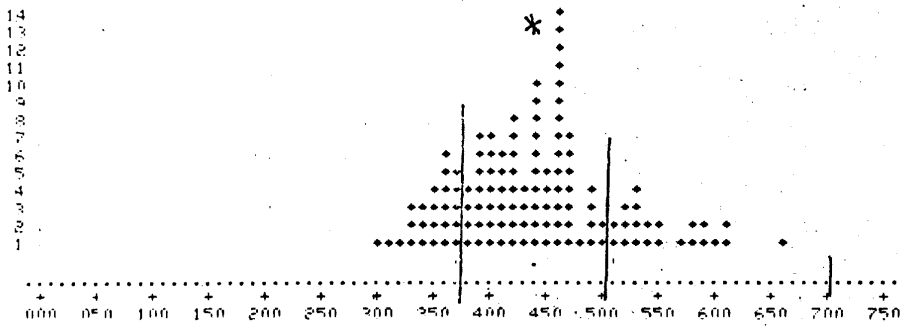




11/19/81 18794 50 109002 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 444
STD. ERR. = 12
STD. DEV. = 71
PCT. POP. = 100

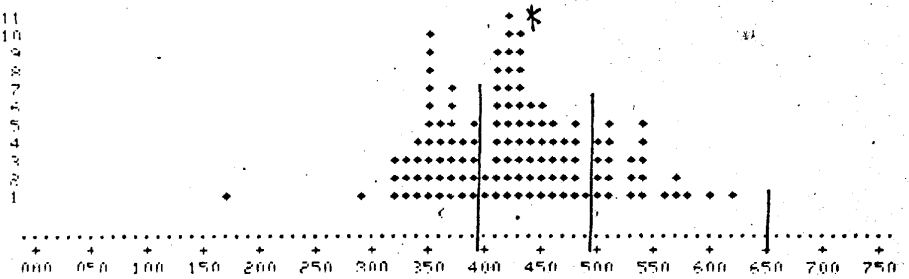
000-379 = 3.51 (19%)
*380-509 = 4.39 (63%)
510-700 = 5.61 (17%)



11/19/81 18795 50 113002 4 BENEDUM NULATO UNIT NO.1-ALASKA

N = 125
MEAN = 430
STD. ERR. = 13
STD. DEV. = 70
PCT. POP. = 100

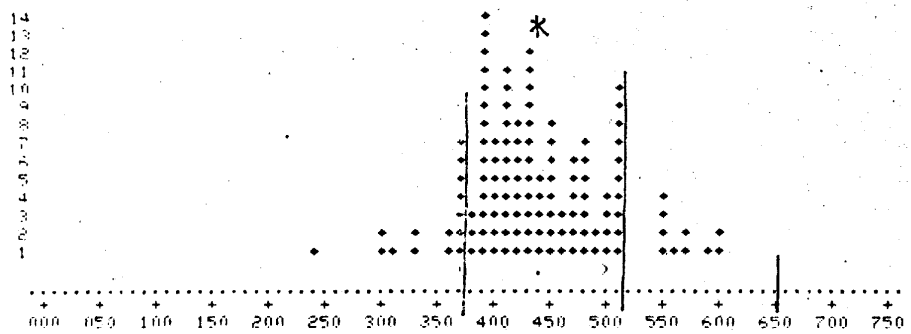
000-399 = 3.56 (34%)
*400-499 = 4.42 (47%)
500-650 = 5.39 (18%)



11/19/81 18796 50 117002 4 BENEDUM UNIT NO.1-ALASKA

N = 125
MEAN = 441
STD. ERR. = 11
STD. DEV. = 63
PCT. POP. = 100

000-379 = 3.45 (12%)
*380-519 = 4.43 (80%)
520-650 = 5.72 (8%)



**COMMAND =