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ORGANIC GEOCHEMISTRY, LITHOLOGY, AND PALEONTOLOGY OF
TERTIARY AND MESOZOIC ROCKS FROM WELLS ON THE ALASKA PENINSULA

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ABSTRACT

Core chips and drill cuttings from eight of the nine wells drilled along the Bering Sea lowlands of the Alaska Peninsula were subjected to lithologic and paleontologic analyses. Results suggest that at least locally, sedimentary rocks of Tertiary age contain oil and gas source and reservoir rocks capable of generating and accumulating liquid and gas hydrocarbons.

Paleogene strata rich in organic carbon are immature. However, strata in offshore basins to the north and south may have been subjected to a more productive thermal environment. Total organic carbon content of fine grained Neogene strata appears to be significantly lower than in Paleogene rocks, possibly reflecting nonmarine or brackish water environments of deposition. Neogene sandstone beds locally yield high values of porosity and permeability to depths of about 8,000 feet (2,439 m). Below this depth, reservoir potential rapidly declines.

The General Petroleum, Great Basins No. 1 well drilled along the shore of Bristol Bay reached granitic rocks. Other wells drilled closer to the axis of the present volcanic arc indicate that both Tertiary and Mesozoic sedimentary rocks have been intruded by dikes and sills of andesite and basalt. Although the Alaska Peninsula has been the locus of igneous activity throughout much of Mesozoic and Tertiary time, thermal maturity indicators such as vitrinite reflectance and coal rank suggest, that on a regional scale, sedimentary rocks have not been subjected to abnormally high geothermal gradients.

INTRODUCTION

Core chips and washed cuttings from several wells drilled on the Alaska Peninsula were studied to determine the petroleum potential, lithology, and age relations of subsurface rocks on the peninsula and in adjacent offshore sedimentary basins. The Bristol basin is to the north and the Shumagin Shelf is to the south. This study reports on the paleontology, and lithology of rock samples from wells drilled mainly along the Bristol Bay coastal lowlands from Lake Becharof to the Black Hills (Fig. 1).

The first part of the study investigated the oil and gas source rock potential of this area. Three wells were selected for detailed source rock analyses, but cuttings from the AMOCO Cathedral River No. 1 well were found to be contaminated from 8,600 feet to T.D. with a petroleum based mud additive that could not be removed. The contaminated part of the well was eliminated from the study. Supplemental data (thermal analysis/pyrolysis-FID) on coal and black shale from five wells was provided by George Claypool of the U.S. Geological Survey in Denver, Colorado.

The second part of the study involved petrographic examination of selected intervals in seven wells. Fifty-one grain mount thin sections were made where sandstone or crystalline rocks were observed in the washed cuttings. Eight thin sections of sandstone from selected core chips were cut for petrographic examination. Thin sections were studied to determine sandstone texture, composition, and degree of alteration, as these parameters can be helpful in predicting reservoir characteristics. The effects of intrusive igneous activity on sedimentary rocks were noted to determine the extent to which petroleum potential has been affected by contact metamorphism.

The third part of the study deals with paleontology, principally foraminifera, and the palynology of carbonaceous intervals. It was hoped that

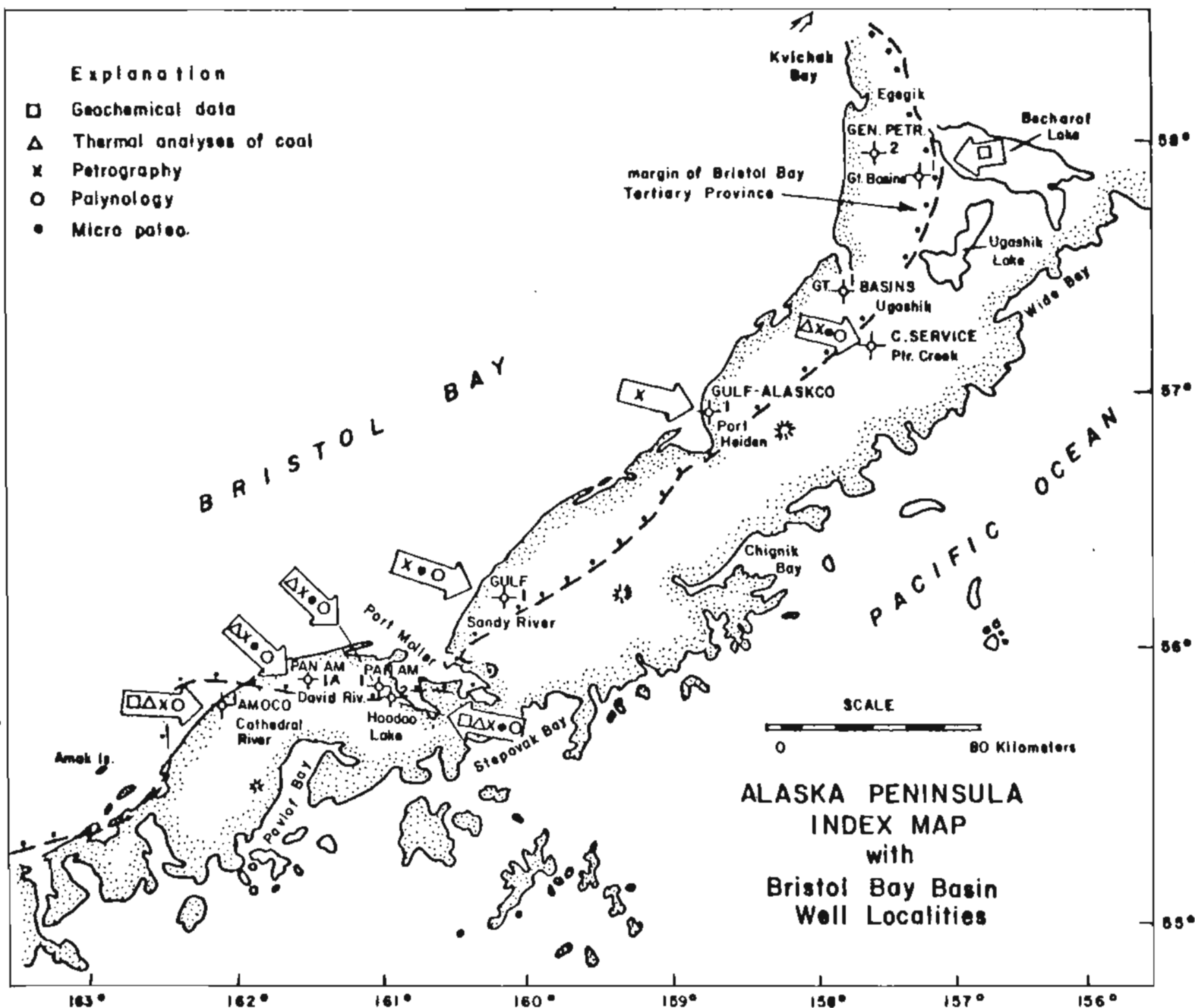


Figure 1

the microfauna would provide additional information on the ages of rocks which now rely mainly on reconnaissance field work by Burk (1965) and a stratigraphic section published by Brockway and others (1975). Unfortunately, fossil recovery was poor, probably because only washed cuttings were available from most of the wells. Better microfaunal control might be possible if outcrop or core samples were available. In Tertiary rocks recovery of palynomorphs was more encouraging and age calls were possible in several sequences.

ACKNOWLEDGMENTS

The study was made possible through the cooperation and financial assistance of the General Crude Oil Company, Houston, Texas and coordinated by Dr. Claude C. Rust. Additional geochemical data were provided by George E. Claypool, U.S. Geological Survey, Denver, Colorado. Foraminifera were identified by Kristen McDougall, and palynomorphs by Jack A. Wolfe, both of the U.S. Geological Survey, Menlo Park, California. Paleontological samples were prepared by Milton Randall.

GEOCHEMISTRY

Oil and gas source rock analyses of washed cuttings were run on two wells from the Alaska Peninsula. Cuttings from the General Petroleum Corporation Great Basins No. 1 (2-27S-49W) were examined from a depth of 1,300 to 11,080 feet (total depth). Material from the Pan American Hoodoo Lake No. 2 well (35-50S-76W) was analyzed between 227 and 11,243 feet (T.D.).

At GeoChem Laboratories, Inc. in Houston, Texas, cuttings were hand-picked by a geologist and a small sample (approximately 5 grams) was collected at 150 feet intervals. Each sample was analyzed for organic carbon content. Based on these results, various single, or composite samples were selected for more detailed study. The analytical data for this study are documented in Appendix 1 for the Great Basin well and Appendix 2 for the Hoodoo Lake well.

Summary of Results

General Petroleum Corporation, Great Basins No. 1: The stratigraphic intervals penetrated by the Great Basins No. 1 are as follows: (Data from Brockway and others, 1975).

<u>Age</u>	<u>Formation</u>	<u>Formation Top</u>	<u>Geochemical Subunit</u>
Pliocene	Milky River	?	
Miocene	Bear Lake	2,110 feet	a1
Oligocene	Stepovak	5,600 feet	a2
Jurassic	Granitic basement	10,970 feet	
	Total Depth	11,080 <u>±</u> feet	

In terms of organic richness, source rock maturity, type of organic matter, and lithology, the Bear Lake and Stepovak formations can be summarized in the following manner. The Bear Lake Formation consists of tuffaceous shale, carbonaceous shale, and coal, with secondary amounts of siltstone and sandstone. Organic carbon averages 13%, extractable bitumen averages 5,000 ppm, and kerogen is predominantly woody with a minor amount of amorphous-sapropel. The high extractable bitumen content with a correspondingly low hydrocarbon fraction is interpreted to reflect the coal-rich and/or woody character of the organic material in the formation.

Vitrinite reflectance values (R_o) average 0.29%, suggesting that the Bear Lake Formation is immature. Significant amounts of steranes and terpanes, a pronounced odd carbon preference in the C_{22} - C_{33} normal paraffins, and a low paraffin-naphthene/aromatic hydrocarbon ratio (average 0.55) also suggest immature source rock.

Source rocks in the underlying Stepovak Formation are characterized by an average organic carbon content of 11%, a mean value of extractable bitumen

6,600 ppm, and a predominance of woody kerogen with minor amounts of herbaceous kerogen.

Maturation indices suggest immature source rocks. R_o averages 0.51% and steranes and terpanes are present in significant amounts. Odd-even carbon ratios and paraffin-naphthene/aromatic hydrocarbon ratios are similar to those reported in the overlying Bear Lake Formation.

The hydrocarbon potential of the Bear Lake and Stepovak formations are similar. Organic carbon is abundant but immature. Presumably, if source rocks similar to those in the Great Basins No. 1 well were present in deeper offshore parts of Bristol basin, probably at depths of 15,000 feet or greater, then chances of petroleum generation would be greatly improved because of higher temperatures.

Pan Am-Socal, Hoodoo Lake No. 2: The stratigraphic interval penetrated by the Hoodoo Lake No. 2 well includes seven geologic formations. Specific tops of the formations reported by Brockway and others, (1975) are as follows:

<u>Age</u>	<u>Formation</u>	<u>Formation top</u>	<u>Geochemical Subunit</u>
Pliocene	Milky River	?	
Miocene	Bear Lake	1,000 $\pm$ feet	A 200- 5,500 feet
Oligocene	Stepovak	2,160 feet	
Eocene	Tolstoi	5,780 feet	
Upper Cretaceous	Chignik	7,700 feet	B 5,500- 7,700 feet
Lower Cretaceous	Herendeen Limestone	8,650 feet	C 7,700-11,243 feet
Lower Cretaceous- Upper Jurassic	Staniukovich	9,670 feet	
	Total Depth	11,243 feet	

The stratigraphic section of the Hoodoo Lake No. 2 well can be subdivided into 3 subunits based on percentage of total organic carbon, type of kerogen, abundance and composition of the extractable bitumen. The zonation is independent of formation tops and is as follows:

Subunit A 200 $\pm$ to 5,500 $\pm$ feet

Subunit B 5,500 $\pm$ to 7,700 $\pm$ feet

Subunit C 7,700 $\pm$ to 11,243 $\pm$ feet (Total Depth)

Subunit A (200 $\pm$ to 5,500 $\pm$ feet) roughly correlates with the Milky River, Bear Lake, and Stepovak formations. The section comprises light colored claystone, shale, siltstone and sandstone. Near the base, the light colored rocks grade downward into darker strata higher in organic content. Geochemically, subunit A is characterized by generally low organic carbon contents (average 0.26%) and low values of extractable bitumen (average 36 ppm). Kerogen is predominantly woody with lesser amounts of amorphous-sapropel and coal. Maturity indices indicate the sequence is immature. R_o averages 0.65%.

Compared with the organic richness of the Bear Lake and Stepovak formations in the Great Basins No. 1 well, subunit A has little potential of generating substantial quantities of petroleum.

Subunit B occurs within the Tolstoi Formation of Eocene age. The section consists of carbonaceous, dark gray to black siltstone, shale, and mudstone with minor thicknesses of coal. Zone B is characterized by high organic carbon content (average 9.69%), a moderate amount of extractable bitumen (average 469 ppm) and an average hydrocarbon fraction of 225 ppm. The kerogen type is predominantly woody with some accessory amounts of amorphous-sapropel.

Maturity indicators in subunit B suggest that the rocks are mature. Vitrinite reflectance values average 1.15%. Other indicators include an absence of any apparent odd carbon dominance in the C_{22} - C_{33} normal paraffins, and a

paraffin-naphthene (P-N) hydrocarbon curve skewed toward more mature C_{15} - C_{22} hydrocarbons. Whether or not a significant amount of petroleum has been generated and entrapped in the local area is problematic.

Subunit C includes the Chignik Formation (Upper Cretaceous), Herendeen Limestone (Upper Jurassic-Lower Cretaceous), and Staniukovich Formation (Upper Jurassic). Strata in subunit C include sandstone, conglomerate, carbonaceous shale, and limestone, all locally cut by intrusive rocks. This zone is characterized by a variable organic carbon content averaging 4%, by low values of extractable bitumen (average 41 ppm), and by a low hydrocarbon fraction averaging about 16 ppm. Kerogen type includes wood and coal with a minor constituent of amorphous-sapropel.

Analyses indicate that organic matter in subunit C is mature. R_o values average 1.76%, and an odd carbon preference index is apparently absent. Also, hydrocarbons in the C_{15} - C_{22} range are more common. The woody-coaly character of subunit C organic matter suggests that these rocks have not generated liquid hydrocarbons and very little gas. The extent to which nearby intrusive bodies have affected maturity and reservoir rock properties is unknown.

AMOCO, Cathedral River No. 1: A third well, the AMOCO Cathedral River No. 1 (Sec. 29-51S-83W) with a total depth of 14,300 feet, was included in the source rock and maturity study. Formation tops reported in the well history released by AMOCO are as follows:

<u>Age</u>	<u>Formation</u>	<u>Formation Tops</u>	<u>Geochemical Subunit</u>
Upper Jurassic	Naknek Fm.	surface	
Middle Jurassic	Shelikof Fm.	3,600 feet	0-8,600 feet
Lower Jurassic	Kialagvik Fm.	10,240 feet	--
Lower Jurassic		11,980 feet	8,600 feet
Triassic		14,200 feet	

Due to contamination (gilsonite? was added to the drilling mud) reliable data could only be obtained from samples collected above 8,600 feet. Only the percentage of organic carbon was measured on samples from 50 + feet to T.D. Percentage of organic carbon between 50 $\pm$ and 8,600 feet is low, averaging 0.20%. Although contamination was present from 8,600 $\pm$ to 14,300 $\pm$ feet, percentages of organic carbon remained low, averaging 0.68%.

Detailed analyses of six samples selected between 12,400 and 13,650 feet were made to determine the type of mud contaminant, and whether or not the contamination could be washed from samples to permit further work. It was concluded that the contaminant could not be washed from the samples and additional analyses were suspended.

Thermal Analyses of Coal and Black Shale

Twenty hand picked samples of coal and black shale were analyzed from five wells to determine coal rank and level of organic maturity. Results of thermal analysis and pyrolysis-FID measurements are listed in tabular form in Appendix 3. The following observations were made by George E. Claypool, Research Chemist with the Branch of Oil and Gas Resources, U.S. Geological Survey, Denver, Colorado: (1) In the Pan Am Hoodoo Lake No. 1 well the samples are immature throughout; coals are lignite rank above 5,000 feet, and subbituminous below, (2) the Pan Am Hoodoo Lake No. 2 coal samples are mature, ranging from medium to low-volatile bituminous rank. The two Hoodoo Lake wells are separated by an east-west trending fault with several thousand feet of vertical displacement. The north side has moved down with respect to the south side, (3) the Pan Am David River 1-A has immature low rank (subbituminous) coal at 4,250 and 7,230 feet, and mature high-volatile to low-volatile bituminous coals between 8,500 and 10,250 feet, (4) the single sample from the Cities Service Painter Creek well

(1,018-1,019 feet) is a mature, medium-volatile bituminous coal, (5) samples from the AMOCO Cathedral River No. 1 well are contaminated with gilsonite, but otherwise appear to be mature coals of high-volatile bituminous rank.

LITHOLOGY

Washed cuttings from several wells were examined to determine depths of major changes in lithology and to correlate the lithologies of the cuttings with the published stratigraphic cross section of Brockway and others (1975). Selected intervals containing sandstone and siltstone were sampled for grain mount thin section petrography. Brief lithologic descriptions of grain-mount and core chip thin sections are included in Appendix 4.

The following summary discusses the major rock types observed in seven Alaska Peninsula wells. In some wells, good correlations exist between published formation boundaries and lithologic changes observed in cuttings. In other cases however, there appears to be little or no correlation. General stratigraphic relations are shown in Figure 2.

Mesozoic Rocks

Sedimentary rocks of Mesozoic age were drilled in only three wells outside of the Wide Bay area on the Alaska Peninsula. The lithology of each well will be discussed below on a well-by-well basis.

AMOCO Cathedral River No. 1: The oldest rocks drilled south of Wide Bay on the Alaska Peninsula occur in the AMOCO Cathedral River No. 1 well that spudded in the Upper Jurassic Naknek Formation and reached total depth in Triassic age rocks. These rocks are calcareous arkosic sandstone interbedded with carbonaceous siltstone, and fine grained calcarenite. The Triassic age is apparently based on a radiolarian fauna. Lithologies studied in thin section agree reason-

STRATIGRAPHIC CROSS SECTION
BRISTOL BAY REGION
ALASKA PENINSULA



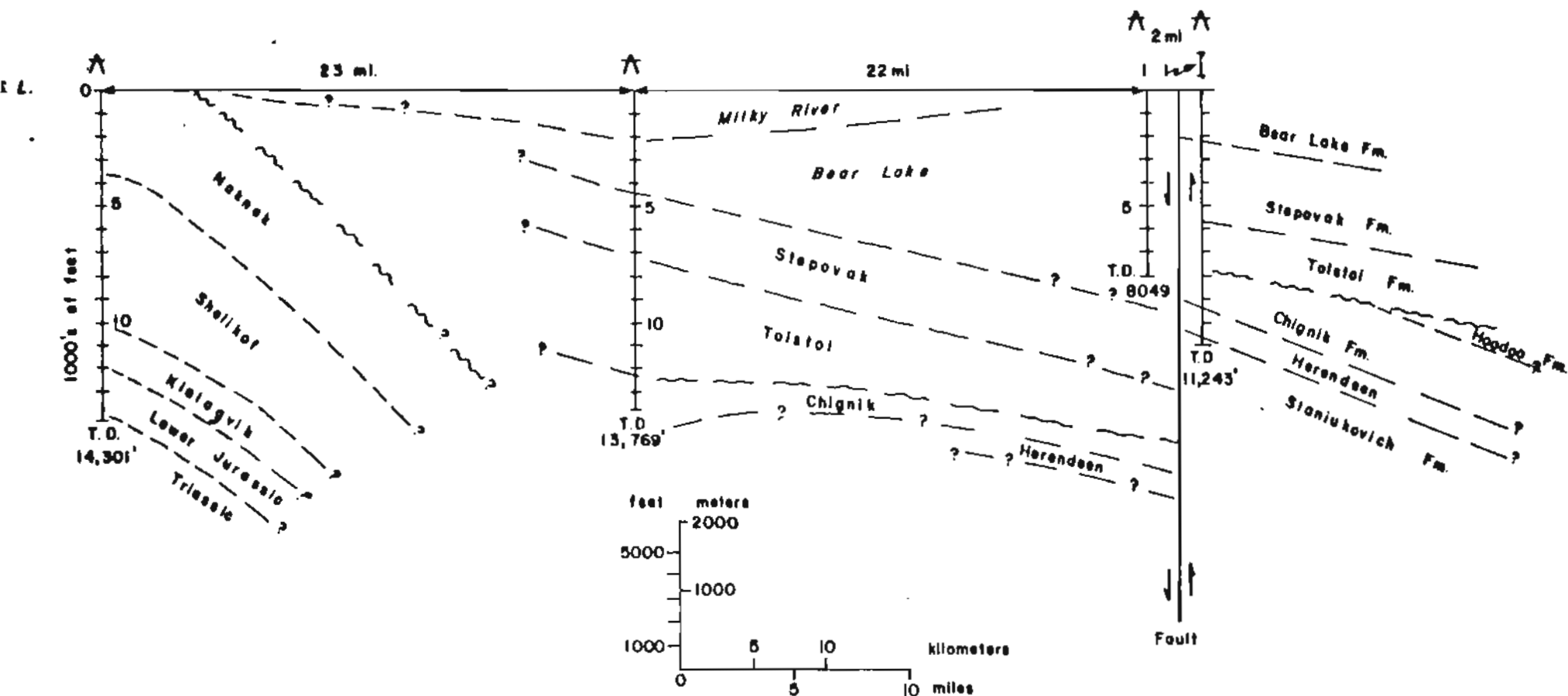
Figure 28

STRATIGRAPHIC CROSS SECTION BRISTOL BAY REGION ALASKA PENINSULA

SW
+
AMOCO
Cathedral River 1
Sec. 29, 518, 83 W

+
PAN AM
David River 1-A
Sec. 12, 505, 80 W

NE
PAN AM + + PAN AM
Hoodoo Lake 1 Hoodoo Lake 2
Sec. 21, 503, 76 W Sec. 35, 503, 76 W



modified from Brockway and others (1975)

ably well with formation tops reported in the well history. However, arkosic sandstone similar to that of the Naknek Formation was observed at 5,500 feet, considerably deeper than the base of the formation reported in the well history at 3,598 feet.

Pan American-David River No. 1-A: Published data on the age of the rocks in the Pan American-David River No. 1-A well conflicts with palynological ages presented herein (see Appendix 5). Palynomorphs from 3,270 to 11,300 feet suggest an early to middle Eocene age, whereas Brockway and others (1975) list the following formation tops:

		<u>Brockway and others (1975)</u>	<u>This report</u>
Bear Lake Formation	(Miocene)	2,430 feet	
Stepovak Formation	(Oligocene)	4,400 feet	3,200 feet
Tolstoi Formation	(Eocene)	7,240 feet	
Chignik Formation	(Upper Cret.)	12,200 feet	11,300 feet

No change in lithology of cuttings was noted at 4,400 feet although coal content increases in the cuttings downward in the section between 3,500 and 4,400 feet. At a depth of 7,200 feet arkosic sandstone is interbedded with carbonaceous siltstone. A major change in lithology occurs at 11,640 feet where chert bearing arkosic sandstone of probable Upper Cretaceous age becomes abundant. Sandstone of similar composition occurs in the Chignik Formation, drilled by the Pan American Hoodoo Lake No. 2 well and in the Gulf Sandy River well between 13,003 and 13,110 feet in rocks of uncertain age.

The David River 1-A well contains volcanic derived siltstone and sandstone with thin coal stringers from about 2,540 feet down to 11,640 feet where early to middle Eocene strata appear to either unconformably overlie, or be in fault

contact with arkosic sandstone and mudstone of the Chignik Formation.

Pan American Hoodoo Lake No. 2: Rocks of Mesozoic age were also drilled in the Pan American Hoodoo Lake No. 2 well. Arkosic sandstone and limy siltstone presumably correlate with the Staniukovich Formation from 9,670 to 11,250 feet (T.D.). This section is cut by several diabase intrusions and appears to have minimal porosity and permeability. The Herendeen Limestone (8,650-9,670 feet) conformably overlies the Staniukovich Formation. It consists of gray, silty limestone with locally abundant *Inoceramus* prisms and contains numerous calcite filled veinlets. Herendeen strata are in turn overlain by the Chignik Formation (7,770-8,650 feet), which consists of interbedded siltstone, coal, and volcanic derived sandstone and pebble conglomerate.

Cities Service, Painter Creek No. 1: Conglomerate and sandstone of the Chignik Formation was drilled in the Cities Service-Painter Creek No. 1 well from approximately 200 to 1,260 feet. Sandstone framework grains consist mainly of chloritic basalt and andesite. Fractures are filled with a zeolite mineral that is probably laumontite.

The Staniukovich Formation (1,260 to 2,040 feet) consists mainly of polymict conglomerate containing clasts of metachert, dacite porphyry, granodiorite, altered mafic volcanic porphyry, and pyroxene diabase. Sandstone in this interval consists of fine- to medium-grained, poorly sorted quartz-lithic subwacke. Some chips are well sorted and tightly packed whereas others are poorly sorted and have abundant matrix.

The Naknek Formation (2,040 to 6,510 feet) consists primarily of polymictic conglomerate that contains an abundance of granitic and granulitic metamorphic rocks. Much of the granitic material is presumably derived from nearby Jurassic

plutonic rocks (Naknek Lake Batholith). Naknek conglomerate overlies conglomerate of the Shelikof Formation (6,750 feet to T.D.). Clasts in the Shelikof conglomerate sequence contain a significantly higher percentage of porphyritic volcanic rocks than in the Naknek Formation, particularly epidote and chlorite-prehnite bearing andesites. At 7,800 feet, volcanic clasts consist of altered diabase, granitic fragments are highly sericitized and a variety of metamorphic clasts includes amphibolite, quartzite, and jadeite bearing granulite. It should be noted that palynomorphs from coal beds between 1,800 and 2,300 feet are reported to be Paleocene or Eocene (see Appendix 5). This age conflicts with the Late Cretaceous (Chignik Formation) age assignment of Brockway and others (1975).

Gulf, Sandy River Federal No. 1:

A pronounced change in sandstone composition and a 30° increase in the angle dip suggests that rocks below about 12,525 feet in the Sandy River well may be correlative with the Upper Cretaceous Chignik Formation in the David River 1-A well. A core sample at 13,003-13,009 feet consists of medium to coarse grained pebbly sandstone containing grains of quartz, plagioclase, dacite, porphery, and rare granitic rock fragments. Quartz and dacite are more abundant, giving the rock a light color. Core descriptions in the well history describe the rocks as "granite wash sandstone" which is a misnomer.

Tertiary Rocks

Thin sections from grain mounts and core chips of Tertiary rocks were studied petrographically from the following five wells:

Cities Service, Painter Creek No. 1

Gulf-Alaskco, Port Heiden No. 1

Gulf, Sandy River Federal No. 1

Pan American, Hoodoo Lake No. 1

Pan American, David River No. 1A

Brief descriptions of each thin section are listed in Appendix 4. Tertiary strata in the five wells consist of tuffaceous and/or carbonaceous siltstone, arkosic and volcanolithic sandstone, and coal stringers. In the section below the general lithology of the Tolstoi, Stepovak, and Bear Lake formations is described following the correlations of Brockway and others (1975).

Tolstoi Formation: The Tolstoi Formation (Eocene) contains abundant coal stringers and disseminated carbonaceous material in siltstone laminae. Sandstone framework grains consist of andesite and basaltic rock fragments with nearly equal amounts of quartz and plagioclase. Porosity values appear to be quite low, primarily because of grain interpenetration or an abundance of zeolite cement.

Stepovak Formation: Lithologically the Stepovak Formation (Oligocene) is similar to the Tolstoi Formation; at least, in the Port Moller area where the two formations may interfinger. Stepovak strata appear to grade imperceptibly into the overlying Bear Lake Formation. This gradation is indicated by electric logs and cuttings which show no observable changes at formation boundaries shown in Figure 2. The Bear Lake and Stepovak formations are generally lighter colored and contain less carbonaceous material than the Tolstoi Formation.

Bear Lake Formation: Porosity and permeability data reported in the well history of the Gulf Sandy River well indicate the upper part of the Bear Lake Formation (Miocene) has the best reservoir characteristics of the three principal sedi-

mentary formations of Tertiary age on the Alaska Peninsula. In the Gulf Sandy River No. 1 well, Bear Lake sandstone above 6,300 feet has porosity values as high as 36.5% and permeability as high as 1,268 mds. Below 6,300 feet, high values for porosity and permeability are 29% and 43 mds, respectively.

The Bear Lake Formation contains an abundance of tuffaceous siltstone and the ratio of quartz and feldspar grains to volcanic rock fragments in sandstone is higher than in the Tolstoi and Stepovak formations. This difference in lithology was first noted by Burk (1965).

Igneous Rocks

Drilling logs from the Gulf-Alaskco, Port Heiden No. 1 and Pan Am Hoodoo Lake No. 2 indicate that igneous rocks were drilled in each well.

Gulf-Alaskco Port Heiden No. 1: Data from the Gulf-Alaskco, Port Heiden No. 1 well indicates that volcanic rocks were drilled from approximately 9,300 to 15,000 feet. Thin sections of core samples from 11,833-11,834 feet and 11,955-11,956 feet consist of mildly altered dacite microbreccia, sandy tuff, and porphyritic dacite flow rocks. Hornblende phenocrysts in the dacite are replaced by chlorite and epidote. Plagioclase is partly altered to calcite and sericite. Radiometric dates reported by Brockway and others (1975) in the volcanic section of the Port Heiden well are 42 ± 4 m.y. (11,832-11,850 feet) and 36 ± 8 m.y. (13,980 feet).

Two thin sections were cut from core samples near the bottom of the well at 15,001 and 15,015 feet. The textures of these samples suggest a granitic rock. Both are medium grained, salt and pepper colored quartz diorite or granodiorite. Phenocrysts include plagioclase and quartz with local graphic intergrowths, green hornblende and biotite. The age of the granitic rocks in the

Port Heiden well is unknown, as is their stratigraphic relation to the overlying volcanic sequence. Granitic and metamorphic rocks were also drilled in the bottom of the General Petroleum Great Basins Nos. 1 and 2 wells. The age of these granitic rocks is reported to be Jurassic.

Pan American Hoodoo Lake No. 2: Cuttings with crystalline textures were studied from two intervals in the Pan American Hoodoo Lake No. 2. The lithologies from intervals of 1,210 to 10,220 feet and 1,480 to 10,490 feet deep consists of basalt, diabase, and coarser grained fragments that may be gabbro. The rocks are interpreted as hyabyssal bodies that have intuded the Staniukovich Formation. It should be noted that dikes and sills cutting rocks as young as Miocene are widespread all along the Alaska Peninsula, especially in the Port Moller area, as indicated on the geologic map of Burk (1965).

PALEONTOLOGY AND PALYNOLOGY

In an attempt to better document published stratigraphic correlations of wells drilled on the Alaska Peninsula, samples of washed well cuttings were analyzed for foraminifera by Kristin McDougall and palynomorphs by Jack Wolfe (Appendix 5). Forty-two samples from six wells were selected for paleontological studies. Thirty-nine of these samples were found to be barren of foraminifera. Fossils of probable early Tertiary age were recovered from only one well, the Pan Am Hoodoo Lake No. 2, where forams were found between 2,100 and 7,690 feet.

Because of the poor percentage of foram recovery, additional sample material was examined for palynomorphs. A total of 27 samples from five wells were analyzed. Thirteen samples from four wells contained palynomorphs.

The palynomorphs from the Gulf Sandy River No. 1 (11,686-11,691 feet) and those from the Pan Am Hoodoo Lake No. 1 (4,010-4,180 feet and 2,590-2,840 feet) are very similar to one another and resemble the Alaskan Neogene (especially

Miocene) reported from other areas. The similarities in the two wells include (1) dominance of PICEA, (2) common representation of TSUGA, (3) low representation of broadleaved exotics (PTEROCARYA, ULMUS/ZELKOVA), and (4) presence of some herbaceous types (Centrospermae, Cyperaceae). These palynomorphs are of Neogene age and are thus probably from the Bear Lake Formation.

However, palynomorphs in the David River 1-A well from 3,200 to 9,100 feet are dominated by broadleaved exotics while TSUGA is absent suggesting an Eocene age. It should be emphasized however, that there is almost no palynological control material available for the Alaskan Eocene (J. A. Wolfe, written commun., 1977).

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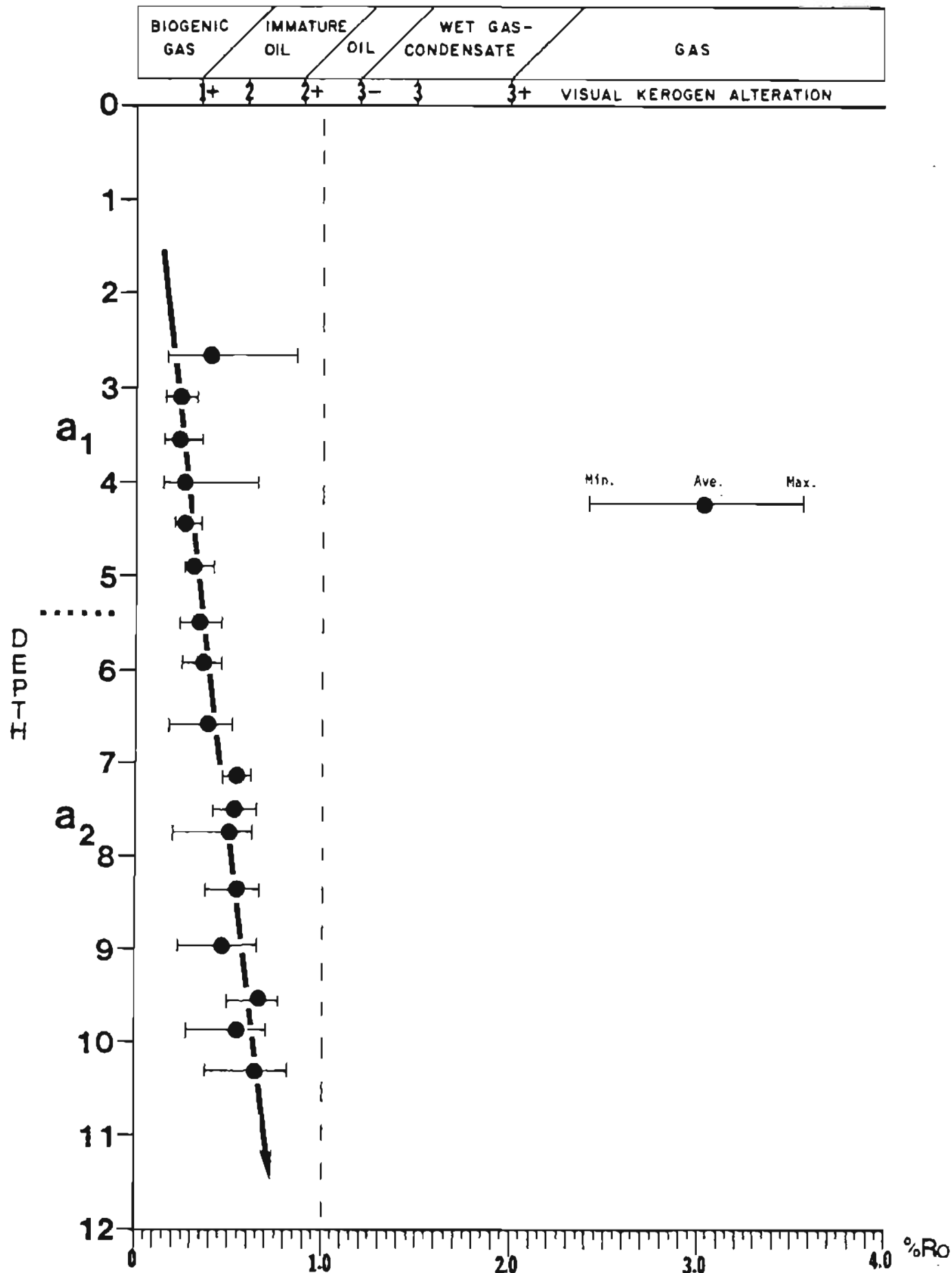
APPENDIX 1

Geochemical Data for General
Petroleum Great Basins No. 1 Well

_____ 1976c, Hydrocarbon source rock evaluation study organic geochemical analyses of dry well cuttings AMOCO Production Company, Cathedral River Unit No. 1 well, sec. 29-51S-83W, Cold Bay County, Alaska: Confidential Geochemical Service Report prepared by GeoChem Labs., Inc., 1143-C Brittmore Rd., Houston, Texas, 8 p.

GENERAL PETROLEUM, - GREAT BASINS NO. 1

VITRINITE REFLECTANCE DATA



GENERAL PETROLEUM-GREAT BASINS NO. 1 WELL

SUMMARY OF ORGANIC ANALYSES

SOURCE CHARACTER

VISUAL KEROGEN

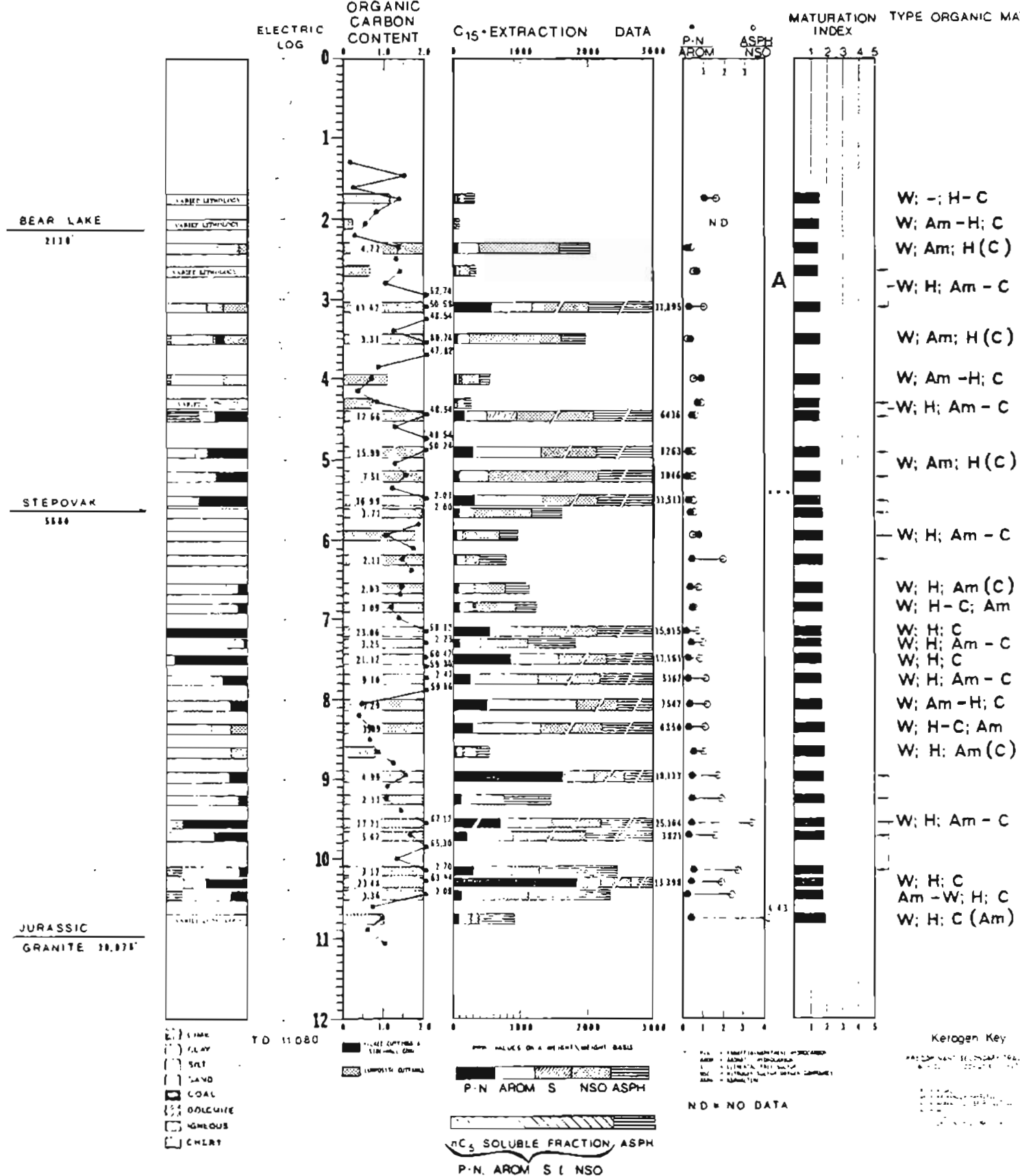


Table I
Organic Carbon and Lithology Screen Analyses

GeoChem Sample Number	Well Depth Interval	Description	Percent Organic Carbon
788-001	1300' - 1310'	Composite.	0.18
788-002	1450' - 1460'	Composite.	1.52
788-003	1600' - 1610'	Dark gray shale.	0.25
788-004	1750' - 1760'	Dark gray shale.	1.40; 1.39 R
788-005	1900' - 1920'	Composite.	0.83
788-006	2050' - 2060'	Medium dark gray shale.	0.56
788-007	2200' - 2210'	Medium dark gray shale, chert, sand, sandstone.	0.29
788-008	2350' - 2360'	Claystone.	1.37; 1.36 R
788-009	2500' - 2510'	Dark gray shale.	1.32
788-010	2650' - 2660'	Dark gray shale.	1.42
788-011	2800' - 2810'	Claystone.	1.06
788-012	2950' - 2960'	Coal.	52.74
788-013	3100' - 3110'	Coal.	50.58; 50.82 R
788-014	3250' - 3260'	Coal.	48.54
788-015	3400' - 3410'	Claystone.	1.23
788-016	3550' - 3560'	Coal.	80.74
788-017	3700' - 3710'	Coal.	47.82
788-018	3850' - 3860'	Claystone.	0.86; 0.83 R
788-019	4000' - 4010'	Claystone.	0.70
788-020	4150' - 4160'	Sandstone.	0.34
788-021	4300' - 4310'	Claystone.	0.84
788-022	4450' - 4460'	Coal.	48.54
788-023	4600' - 4610'	Siltstone.	1.28; 1.21 R
788-024	4750' - 4760'	Coal.	48.54
788-025	4900' - 4910'	Coal.	50.24
788-026	5050' - 5060'	Siltstone.	1.25
788-027	5200' - 5210'	Siltstone.	1.56
788-028	5350' - 5360'	Siltstone.	1.21; 1.21 R
788-029	5500' - 5510'	Siltstone.	2.01
788-030	5650' - 5660'	Siltstone.	2.00
788-031	5800' - 5810'	Siltstone.	1.87
788-032	5940' - 5950'	Siltstone.	1.07
788-033	6100' - 6110'	Siltstone.	1.75; 1.78 R

Table I
Organic Carbon and Lithology Screen Analyses

GeoChem Sample Number	Well Depth Interval	Description	Percent Organic Carbon
788-034	6250' - 6260'	Siltstone.	1.47
788-035	6400' - 6410'	Siltstone.	1.70
788-036	6600' - 6610'	Silty gray shale.	1.45
788-037	6700' - 6710'	Silty gray shale.	1.42
788-038	6850' - 6860'	Silty gray shale.	1.19; 1.19 R
788-039	7000' - 7010'	Silty gray shale.	1.39
788-040	7150' - 7160'	Coal.	58.12
788-041	7300' - 7310'	Silty gray shale.	2.23
788-042	7500' - 7510'	Coal.	60.42
788-043	7600' - 7610'	Coal.	59.80; 60.04 R
788-044	7750' - 7760'	Silty gray shale.	2.47
788-045	7900' - 7910'	Coal.	59.86
788-046	8050' - 8060'	Greenish gray siltstone.	0.46
788-047	8200' - 8210'	Medium gray-medium light gray siltstone.	0.38
788-048	8350' - 8360'	Medium light gray siltstone.	0.67; 0.69 R
788-049	8500' - 8510'	Medium light gray siltstone.	0.67
788-050	8650' - 8660'	Medium light gray siltstone.	0.87
788-051	8800' - 8810'	Medium gray silty shale.	1.24
788-052	8950' - 8960'	Medium gray silty shale.	1.57
788-053	9100' - 9110'	Medium gray silty shale.	1.09; 1.10 R
788-054	9240' - 9250'	Medium gray silty shale.	1.08
788-055	9400' - 9410'	Medium gray silty shale.	1.45
788-056	9540' - 9550'	Coal.	67.12
788-057	9700' - 9710'	Medium gray silty shale.	1.67
788-058	9840' - 9850'	Coal.	65.30; 66.08 R
788-059	10000' - 10010'	Medium gray silty shale.	1.33
788-060	10140' - 10150'	Medium gray silty shale.	2.70
788-061	10300' - 10310'	Coal.	63.94
788-062	10440' - 10450'	Medium dark gray silty shale.	2.08
788-063	10600' - 10610'	Medium dark gray silty shale.	0.73; 0.71 R
788-064	10740' - 10750'	Medium dark gray silty shale.	0.98
788-065	10900' - 10910'	Medium dark gray silty shale.	0.60
788-066	11060' - 11070'	Medium dark gray silty shale.	1.04

Table 2

Organic Carbon Analyses and Gross Lithological Description

GeoChem Sample Number	Well Interval	Gross Lithological Description	GSA Color Code	Total Organic Carbon (% of Rock)
788-004D	1760'	Varied lithology consisting of chert, reworked material, siliceous shale, shale and sand.		1.15; 1.10
788-006D	2060'	Varied lithology consisting of chert, reworked material, siliceous shale, shale and sand.		0.23
788-008D -A -B	2360'	90% Shale, noncalcareous, very silty, blocky, soft, light gray. 10% Coal.	N7	4.72
788-010D	2660'	Varied lithology consisting of chert, reworked material, siliceous shale, and sand.		0.66
788-013D -A	3110'	100% Shale, noncalcareous, silty, very carbonaceous, blocky, black.	N1	41.42
788-016D -A -B -C	3560'	60% Shale, slightly calcareous, very silty, blocky, soft, light gray. 30% Reworked material. 10% Coal.	N7	3.31; 3.32
788-019D -A	4010'	100% Shale, very slightly calcareous, very silty, blocky, soft, light gray. Trace of reworked material.	N7	1.10
788-021D	4310'	Varied lithology consisting of chert, reworked material, shale and sand.		0.71
788-022D -A -B	4460'	60% Shale, noncalcareous, very silty, blocky, soft, light gray. 40% Coal.	N7	12.66

Table 2

Organic Carbon Analyses and Gross Lithological Description

GeoChem Sample Number	Well Interval	Gross Lithological Description	GSA Color Code	Total Organic Carbon (% of Rock)
788-025D -A -B	4910'	50% Shale, noncalcareous, very silty, blocky, soft, light gray. 50% Coal.	N7	15.99
788-027D -A -B	5210'	60% Shale, noncalcareous, very silty, blocky, soft, light gray. 40% Coal.	N7	7.51; 7.59
788-029D -A -B	5510'	60% Coal and carbonaceous shale. 40% Shale, noncalcareous, very silty, blocky, soft, light gray.	N7	36.99
788-030D -A	5660'	100% Shale, noncalcareous, very silty, blocky, soft, light gray. Coal associated.	N7	3.71
788-032D -A	5950'	100% Shale, noncalcareous, very silty, blocky, soft, light gray.	N7	1.76
788-034D -A	6260'	100% Shale, noncalcareous, very silty, blocky, soft, light gray. Trace of coal.	N7	2.11
788-036D -A -B	6610'	90% Shale, noncalcareous, silty, blocky, soft, medium light gray. 10% Coal.	N6	2.03; 2.03
788-038D -A -B	6860'	90% Shale, noncalcareous, silty, blocky, soft, medium light gray. 10% Coal.	N6	3.09
788-040D -A	7160'	100% Coal.		23.06

Table 2

Organic Carbon Analyses and Gross Lithological Description

GeoChem Sample Number	Well Interval	Gross Lithological Description	GSA Color Code	Total Organic Carbon (% of Rock)
788-041D -A -B	7310'	80% Shale, noncalcareous, silty, blocky, soft, medium light gray. 20% Shale, noncalcareous, silty, carbonaceous, blocky, moderately hard, dark gray.	N6 N3	3.25
788-042D -A -B	7510'	90% Coal. 10% Shale, noncalcareous, silty, blocky, soft, medium light gray.	N6	21.12
788-044D -A -B -C	7760'	60% Shale, noncalcareous, silty, blocky, soft, medium light gray. 30% Coal. 10% Bentonite.	N6	9.10; 8.85
788-046D -A -B -C	8060'	50% Siltstone, noncalcareous, argillaceous, soft, fair porosity, no show, greenish gray. 30% Shale, noncalcareous, silty, blocky, moderately hard, medium light gray. 20% Coal. Trace of sandstone.	5GY6/1 N6	7.29
788-048D -A -B	8360'	80% Shale, noncalcareous, very silty, blocky, soft, medium light gray. 20% Coal.	N6	3.89
788-050D -A -B	8660'	50% Shale, noncalcareous, very silty, blocky, soft, medium light gray. 50% Sandstone, carbonate cement, silty, argillaceous, very fine to fine grain, subrounded to subangular, frosted to clear, fair porosity, no show.	N6	0.80

Table 2

Organic Carbon Analyses and Gross Lithological Description

GeoChem Sample Number	Well Interval	Gross Lithological Description	GSA Color Code	Total Organic Carbon (% of Rock)
788-052D	8960'			4.99
-A		50% Shale, noncalcareous, silty, blocky, moderately hard, medium light gray.	N6	
-B		30% Siltstone, noncalcareous, very argillaceous, blocky, moderately hard, poor porosity, no show, medium light gray.	N6	
-C		20% Coal. Trace of sandstone.		
788-054D	9250'			2.11; 2.1
-A		90% Shale, noncalcareous, very silty, blocky, moderately hard, medium light gray.	N6	
-B		10% Coal. Trace of sandstone.		
788-056D	9550'			17.21
-A		80% Coal.		
-B		10% Shale, noncalcareous, very silty, blocky, moderately hard, medium light gray.	N6	
-C		10% Sandstone, carbonate cement, silty, argillaceous, very fine to fine grain, subrounded to subangular, frosted to clear, good porosity, no show.		
788-057D	9710'			5.62
-A		60% Shale, noncalcareous, silty to very silty, blocky, moderately hard, light gray.	N7	
-B		40% Coal and very carbonaceous shale.		
788-060D	10150'			3.12
-A		70% Shale, noncalcareous, silty, blocky, moderately hard, medium dark gray.	N4	
-B		20% Limestone, chalk, moderately hard, poor porosity, no show, white.	N9	
-C		10% Coal.		

Table 2

Organic Carbon Analyses and Gross Lithological Description

GeoChem Sample Number	Well Interval	Gross Lithological Description	GSA Color Code	Total Organic Carbon (% of Rock)
788-061D	10310'			23.48;23.54
-A		50% Coal.		
-B		30% Siltstone, noncalcareous, argillaceous, hard, little porosity, no show, light gray.	N7	
-C		20% Shale, noncalcareous, silty, blocky, hard, medium dark gray.	N4	
788-062D	10450'			3.36
-A		60% Shale, noncalcareous, silty to very silty, blocky, hard, medium dark gray.	N4	
-B		20% Coal.		
-C		20% Limestone, chalk, moderately hard, poor porosity, no show, white.	N9	
788-064D	10750'			1.01
		Varied lithology consisting of shales, siltstone, limestone and coal.		

Table 3

Summary of Organic Carbon and Visual Kerogen Analysis

GeoChem Sample Number	Well Depth Interval	Organic Carbon (% of Rock)	Visual Kerogen	
			Type	Alteration (1-5 Scale)
788-004D	1750- 1760	1.15; 1.10R	W;-;H-C	<u>1+</u> to 2-
788-006D	2050- 2060	0.23	W;Am-H;C	<u>1+</u> to 2-
788-008D	2350- 2360	4.72	W;Am;H (C)	1+ (2-)*
788-010D	2650- 2660	0.66	W;H;Am-C	1+ (2-)*
788-013D	3100- 3110	41.42	W;H;Am-C	<u>1+</u> to 2-
788-016D	3550- 3560	3.31; 3.32R	W;Am;H (C)	<u>1+</u> to 2-
788-019D	4000- 4010	1.10	W;Am-H;C	<u>1+</u> to 2- (2- to 2)*
788-021D	4300- 4310	0.71	W;H;Am-C	<u>1+</u> to 2- (2- to 2)*
788-022D	4450- 4460	12.66	W;H;Am-C	<u>1+</u> to 2-
788-025D	4900- 4910	15.99	W;Am;W (C)	<u>1+</u> to 2-
788-027D	5200- 5210	7.51; 7.59R	W;Am;H (C)	1+ to 2-
788-029D	5450- 5560	36.99	W;H;Am-C	1+ to 2-
788-030D	5650- 5660	3.71	W;H;Am-C	1+ to <u>2-</u>
788-032D	5900- 5950	1.76	W;H;Am-C	2- (1+)*
788-034D	6250- 6260	2.11	W;H;Am-C	2- to 2 (1+)*
788-036D	6600- 6610	2.03; 2.03R	W;H;Am (C)	2- to 2 (1+)*
788-038D	6850- 6860	3.09	W;H-C;Am	2- (1+)*
788-040D	7150- 7160	23.06	W;H;C	1+ to <u>2-</u>
788-041D	7300- 7310	3.25	W;H;Am-C	1+ to <u>2-</u>
788-042D	7500- 7510	21.12	W;H;C	1+ to <u>2-</u>
788-044D	7750- 7760	9.10; 8.85R	W;H;Am-C	1+ to <u>2-</u>
788-046D	8050- 8060	7.29	W;Am-H;C	1+ to <u>2-</u>
788-048D	8350- 8360	3.89	W;H-C;Am	2-
788-050D	8650- 8660	0.80	W;H;Am (C)	2-
788-052D	8950- 8960	4.99	W;H;Am-C	2-
788-054D	9240- 9250	2.11; 2.11R	W;H;Am-C	2-
788-056D	9540- 9550	17.21	W;H;Am-C	2-
788-057D	9700- 9710	5.62	W;H;Am-C	2-
788-060D	10140-10150	3.12	W;H;Am-C	2-
788-061D	10300-10310	23.48; 23.54R	W;H;C	2-
788-062D	10440-10450	3.36	Am-W;H;C	2-
788-064D	10740-10750	1.01	W;H;C (Am)	2- to 2 (1+ to 2-)*

Table 4

Summary of C15+ Soxhlet Extraction, Deasphalting
and Liquid Chromatography

A. Weights of Extracts and Chromatographic Fractions

GeoChem Sample Number	Well Interval*	Weight of Rock Extd. (grams)	Total Extract (grams)	Precipitated Asphaltenes (grams)	N-C5 Soluble (grams)	Sulfur (grams)	Paraffins- Naphthenes (grams)	Aromatics (grams)	Eluted NSO'S (grams)	NonEluted NSO'S (grams)
788-0040	1750- 1760	80.0	0.0262	0.0118	0.0144	0.0021	0.0028	0.0025	0.0041	0.0029
788-0060	2050- 2060	100.0	0.0094	0.0058	0.0036	N.D.	N.D.	N.D.	N.D.	N.D.
788-0080	2350- 2360	80.0	0.1625	0.0362	0.1263	N.D.	0.0060	0.0241	0.0553	0.0409
788-0100	2650- 2660	85.0	0.0285	0.0079	0.0207	N.D.	0.0029	0.0038	0.0068	0.0072
788-0130	3100- 3110	85.0	2.7111	1.2753	1.4358	N.D.	0.0479	0.1595	0.5690	0.6594
788-0160	3550- 3560	85.0	0.1678	0.0311	0.1367	N.D.	0.0055	0.0146	0.0583	0.0583
788-0190	4000- 4010	85.0	0.0459	0.0129	0.0330	0.0025	0.0035	0.0038	0.0175	0.0057
788-0210	4300- 4310	80.0	0.0208	0.0075	0.0133	0.0020	0.0014	0.0019	0.0063	0.0017
788-0220	4450- 4460	90.0	0.5792	0.1803	0.3989	0.0397	0.0146	0.0292	0.1608	0.1546
788-0250	4900- 4910	90.0	0.7437	0.2113	0.5324	N.D.	0.0261	0.0913	0.2166	0.1984
788-0270	5200- 5210	50.0	0.1523	0.0448	0.1075	N.D.	0.0046	0.0211	0.0571	0.0247
788-0290	5450- 5560	90.0	1.0362	0.3170	0.7192	N.D.	0.0284	0.0910	0.2843	0.3155
788-0300	5650- 5660	80.0	0.1292	0.0361	0.0931	N.D.	0.0068	0.0170	0.0497	0.0196
788-0320	5900- 5950	90.0	0.0872	0.0241	0.0631	0.0039	0.0058	0.0070	0.0304	0.0160
788-0340	6250- 6260	95.0	0.0746	0.0388	0.0358	N.D.	0.0053	0.0113	0.0147	0.0045
788-0360	6600- 6610	85.0	0.0962	0.0307	0.0655	N.D.	0.0076	0.0189	0.0291	0.0099
788-0380	6850- 6860	80.0	0.0993	0.0251	0.0742	0.0026	0.0077	0.0157	0.0371	0.0111
788-0400	7150- 7160	80.0	1.2732	0.4427	0.8305	N.D.	0.0437	0.2131	0.3415	0.2322
788-0410	7300- 7310	80.0	0.1457	0.0577	0.0880	N.D.	0.0095	0.0225	0.0481	0.0079
788-0420	7500- 7510	90.0	1.5445	0.5581	0.9864	N.D.	0.0771	0.2801	0.3369	0.2923
788-0440	7750- 7760	85.0	0.4392	0.1768	0.2624	N.D.	0.0211	0.0846	0.1069	0.0498
788-0460	8050- 8060	55.0	0.4151	0.1731	0.2420	N.D.	0.0268	0.0736	0.0970	0.0446
788-0480	8350- 8360	80.0	0.5080	0.2114	0.2966	N.D.	0.0233	0.0805	0.1112	0.0816
788-0500	8650- 8660	70.0	0.0375	0.0134	0.0241	0.0023	0.0034	0.0060	0.0097	0.0027
788-0520	8950- 8960	100.0	1.8133	0.8269	0.9864	N.D.	0.1626	0.3547	0.3805	0.0886
788-0540	9240- 9250	85.0	0.1227	0.0591	0.0636	N.D.	0.0107	0.0224	0.0256	0.0049
788-0560	9540- 9550	80.0	2.0131	1.1363	0.8768	N.D.	0.1635	0.3827	0.2192	0.1114
788-0570	9700- 9710	75.0	0.2866	0.1377	0.1489	N.D.	0.0154	0.0502	0.0567	0.0266
788-0600	10140-10150	85.0	0.2073	0.0978	0.1095	N.D.	0.0257	0.0480	0.0266	0.0092
788-0610	10300-10310	80.0	1.0718	0.3957	0.6761	N.D.	0.1471	0.3225	0.1584	0.0481
788-0620	10440-10450	80.0	0.1868	0.0980	0.0888	N.D.	0.0102	0.0387	0.0367	0.0032
788-0640	10740-10750	90.0	0.0820	0.0483	0.0337	N.D.	0.0070	0.0158	0.0108	0.0001

* In feet

Table 4 (continued)

B. Concentration of Extracted Materials in Rock

GeoChem Sample Number	Well Interval*	Total Extract (ppm)	-----Hydrocarbons-----			-----Nonhydrocarbons-----				
			Paraffin- Naphthene (ppm)	Aromatic (ppm)	Total (ppm)	Sulfur (ppm)	Preci p'd. Asphaltene (ppm)	Eluted NSO'S (ppm)	NoneIuted NSO'S (ppm)	Total (ppm)
788-0040	1750- 1760	328	35	31	66	26	148	51	36	261
788-0060	2050- 2060	94	-	-	-	-	58	-	-	-
788-0080	2350- 2360	2031	75	301	376	-	453	691	511	1655
788-0100	2650- 2660	335	34	45	79	-	93	80	85	256
788-0130	3100- 3110	31895	564	1876	2440	-	15004	6694	7758	29455
788-0160	3550- 3560	1974	65	172	236	-	366	686	686	1738
788-0190	4000- 4010	540	41	45	86	29	152	206	67	454
788-0210	4300- 4310	260	18	24	41	25	94	79	21	219
788-0220	4450- 4460	6436	162	324	487	441	2003	1787	1718	5949
788-0250	4900- 4910	8263	290	1014	1304	-	2348	2407	2204	6959
788-0270	5200- 5210	3046	92	422	514	-	896	1142	494	2532
788-0290	5450- 5560	11513	316	1011	1327	-	3522	3159	3506	10187
788-0300	5650- 5660	1615	85	213	298	-	451	621	245	1318
788-0320	5900- 5950	969	64	78	142	43	268	338	178	827
788-0340	6250- 6260	785	56	119	175	-	408	155	47	611
788-0360	6600- 6610	1132	89	222	312	-	361	342	116	820
788-0380	6850- 6860	1241	96	196	293	33	314	464	139	949
788-0400	7150- 7160	15915	546	2664	3210	-	5534	4269	2903	12705
788-0410	7300- 7310	1821	119	281	400	-	721	601	99	1421
788-0420	7500- 7510	17161	857	3112	3969	-	6201	3743	3248	13192
788-0440	7750- 7760	5167	248	995	1244	-	2080	1258	586	3924
788-0460	8050- 8060	7547	487	1338	1825	-	3147	1764	811	5722
788-0480	8350- 8360	6350	291	1006	1298	-	2643	1390	1020	5053
788-0500	8650- 8660	536	49	86	134	33	191	139	39	401
788-0520	8950- 8960	18133	1626	3547	5173	-	8269	3805	886	12960
788-0540	9240- 9250	1444	126	264	389	-	695	301	58	1054
788-0560	9540- 9550	25164	2044	4784	6828	-	14204	2740	1393	18336
788-0570	9700- 9710	3821	205	669	875	-	1836	756	355	2947
788-0600	10140-10150	2439	302	565	867	-	1151	313	108	1572
788-0610	10300-10310	13398	1839	4031	5870	-	4946	1980	601	7528
788-0620	10440-10450	2335	128	484	611	-	1225	459	40	1724
788-0640	10740-10750	911	78	176	253	-	537	120	1	658

* In feet

C. Composition of Extracts

Table 4 (Continued)

GeoChem Sample Number	Well Interval*	-----Hydrocarbons-----			Sulfur %	-----Nonhydrocarbons-----				HC'S %	HC/Non HC
		Paraffin- Naphthene %	Aromatic %	PN/Arom		Eluted NSO'S %	Noneluted NSO'S %	Asphaltene %	Asph/NSO		
788-0040	1750- 1760	10.7	9.5	1.12	8.0	15.6	11.1	45.0	1.69	20.2	0.25
788-0060	2050- 2060	-	-	-	-	-	-	61.7	-	-	-
788-0080	2350- 2360	3.7	14.8	0.25	-	34.0	25.2	22.3	0.38	18.5	0.23
788-0100	2650- 2660	10.2	13.3	0.76	-	23.9	25.3	27.7	0.56	23.5	0.31
788-0130	3100- 3110	1.8	5.9	0.30	-	21.0	24.3	47.0	1.04	7.7	0.08
788-0160	3550- 3560	3.3	8.7	0.38	-	34.7	34.7	18.5	0.27	12.0	0.14
788-0190	4000- 4010	7.6	8.3	0.92	5.4	38.1	12.4	28.1	0.56	15.9	0.19
788-0210	4300- 4310	6.7	9.1	0.74	9.6	30.3	8.2	36.1	0.94	15.9	0.19
788-0220	4450- 4460	2.5	5.0	0.50	6.9	27.8	26.7	31.1	0.57	7.6	0.08
788-0250	4900- 4910	3.5	12.3	0.29	-	29.1	26.7	28.4	0.51	15.8	0.19
788-0270	5200- 5210	3.0	13.9	0.22	-	37.5	16.2	29.4	0.55	16.9	0.20
788-0290	5450- 5560	2.7	8.8	0.31	-	27.4	30.4	30.6	0.53	11.5	0.13
788-0300	5650- 5660	5.3	13.2	0.40	-	38.5	15.2	27.9	0.52	18.4	0.23
788-0320	5900- 5950	6.7	8.0	0.83	4.5	34.9	18.3	27.6	0.52	14.7	0.17
788-0340	6250- 6260	7.1	15.1	0.47	-	19.7	6.0	52.0	2.02	22.3	0.29
788-0360	6600- 6610	7.9	19.6	0.40	-	30.2	10.3	31.9	0.79	27.5	0.38
788-0380	6850- 6860	7.8	15.8	0.49	2.6	37.4	11.2	25.3	0.52	23.6	0.31
788-0400	7150- 7160	3.4	16.7	0.21	-	26.8	18.2	34.8	0.77	20.2	0.25
788-0410	7300- 7310	6.5	15.4	0.42	-	33.0	5.4	39.6	1.03	22.0	0.28
788-0420	7500- 7510	5.0	18.1	0.28	-	21.8	18.9	36.1	0.89	23.1	0.30
788-0440	7750- 7760	4.8	19.3	0.25	-	24.3	11.3	40.3	1.13	24.1	0.32
788-0460	8050- 8060	6.5	17.7	0.36	-	23.4	10.7	41.7	1.22	24.2	0.32
788-0480	8350- 8360	4.6	15.8	0.29	-	21.9	16.1	41.6	1.10	20.4	0.26
788-0500	8650- 8660	9.1	16.0	0.57	6.1	25.9	7.2	35.7	1.08	25.1	0.33
788-0520	8950- 8960	9.0	19.6	0.46	-	21.0	4.9	45.6	1.76	28.5	0.40
788-0540	9240- 9250	8.7	18.3	0.48	-	20.9	4.0	48.2	1.94	27.0	0.37
788-0560	9540- 9550	8.1	19.0	0.43	-	10.9	5.5	56.4	3.44	27.1	0.37
788-0570	9700- 9710	5.4	17.5	0.31	-	19.8	9.3	48.0	1.65	22.9	0.30
788-0600	10140-10150	12.4	23.2	0.54	-	12.8	4.4	47.2	2.73	35.6	0.55
788-0610	10300-10310	13.7	30.1	0.46	-	14.8	4.5	36.9	1.92	43.8	0.78
788-0620	10440-10450	5.5	20.7	0.26	-	19.6	1.7	52.5	2.46	26.2	0.35
788-0640	10740-10750	8.5	19.3	0.44	-	13.2	0.1	58.9	4.43	27.8	0.39

* In feet

Table 5-A

Saturate Hydrocarbon Analyses

Summary of Paraffin-Naphthene Distribution

GeoChem Sample Number	Well Interval*	% Paraffin	% Isoprenoid	% Naphthene	C-P Index A	C-P Index B	ip19/ip20
788-0040	1750- 1760	5.6	0.1	94.3	1.07	1.12	4.00
788-0060	2050- 2060	4.3	0.1	95.5	1.24	2.26	7.00
788-0080	2350- 2360	16.3	2.3	81.4	2.37	4.21	8.69
788-0100	2650- 2660	6.4	1.1	92.5	1.39	1.72	45.50
788-0130	3100- 3110	18.9	14.5	66.7	-	-	94.00
788-0160	3550- 3560	7.7	2.5	89.8	-	-	17.00
788-0190	4000- 4010	5.8	1.4	92.8	-	-	32.67
788-0210	4300- 4310	7.3	0.3	92.4	1.09	1.25	12.50
788-0220	4450- 4460	11.9	6.9	81.2	-	-	26.50
788-0250	4900- 4910	18.1	22.5	59.3	-	-	72.67
788-0270	5200- 5210	12.5	8.6	78.9	-	-	36.17
788-0290	5450- 5560	15.7	8.0	76.2	-	-	15.25
788-0300	5650- 5660	9.5	2.9	87.6	-	-	9.86
788-0320	5900- 5950	11.7	1.8	86.6	-	-	3.20
788-0340	6250- 6260	15.0	0.8	84.2	-	-	2.53
788-0360	6600- 6610	23.2	3.6	73.2	-	-	5.83
788-0380	6850- 6860	10.2	3.3	86.4	-	-	11.29
788-0400	7150- 7160	22.5	13.4	64.1	-	-	21.64
788-0410	7300- 7310	9.2	2.8	88.0	-	-	9.29
788-0420	7500- 7510	28.4	18.8	52.8	-	-	22.92
788-0440	7750- 7760	19.7	7.3	73.0	-	-	20.14
788-0460	8050- 8060	8.0	4.5	87.4	-	-	7.81
788-0480	8350- 8360	7.8	3.8	88.4	-	-	5.66
788-0500	8650- 8660	8.5	0.8	90.7	1.46	1.69	9.40
788-0520	8950- 8960	2.9	1.3	95.9	-	-	5.58
788-0540	9240- 9250	8.7	2.9	88.4	-	-	6.13
788-0560	9540- 9550	20.9	7.0	72.1	1.22	1.50	8.53
788-0570	9700- 9710	19.8	5.2	75.0	1.25	1.48	8.77
788-0600	10140-10150	13.4	3.2	83.3	1.26	1.55	4.23
788-0610	10300-10310	17.9	5.8	76.3	1.12	1.27	7.24
788-0620	10440-10450	22.1	3.4	74.6	1.19	1.44	4.37
788-0640	10740-10750	14.9	1.0	84.2	1.24	1.51	3.28

* In feet

Table 5-B

Saturate Hydrocarbon Analyses

Normalized Paraffin Distribution

GeoChem Sample Number	Well Interval*	nC15	nC16	nC17	tp19	nC18	tp20	nC19	nC20	nC21	nC22	nC23	nC24	nC25	nC26	nC27	nC28	nC29	nC30	nC31	nC32	nC33	nC34	nC35
788-004D	1750- 1760	1.1	1.1	0.7	1.5	1.1	0.4	3.3	8.5	12.6	19.3	24.8	14.1	4.8	2.2	0.7	1.1	1.1	0.4	0.7	0.4	0.0	0.0	0.0
788-006D	2050- 2060	7.1	4.4	2.4	2.4	1.4	0.3	2.4	5.1	8.5	13.9	18.6	11.9	9.8	2.7	2.4	1.4	3.1	0.3	1.4	0.3	0.3	0.0	0.0
788-008D	2350- 2360	2.5	2.5	4.1	11.0	3.6	1.3	5.9	4.4	7.1	5.6	10.5	2.9	9.6	3.8	10.2	2.5	10.2	0.1	2.0	0.1	0.2	0.0	0.0
788-010D	2650- 2660	0.8	0.6	0.8	14.1	0.8	0.3	2.0	2.8	5.7	8.2	15.5	8.2	11.0	8.8	7.3	3.6	6.4	0.2	2.5	0.2	0.3	0.0	0.0
788-013D	3100- 3110	1.8	0.9	5.5	42.9	5.7	0.5	6.2	2.5	8.0	2.3	7.1	0.9	0.0	0.0	0.0	0.0	11.6	0.2	3.4	0.2	0.2	0.0	0.0
788-016D	3550- 3560	1.1	1.1	3.0	23.3	2.7	1.4	6.3	3.3	5.5	5.5	11.8	11.0	11.2	0.0	0.0	0.0	9.3	0.3	2.7	0.3	0.3	0.0	0.0
788-019D	4000- 4010	0.6	0.2	2.1	19.1	2.1	0.6	4.1	2.9	6.6	7.0	13.8	8.0	14.2	0.0	0.0	0.0	13.8	0.2	4.1	0.2	0.4	0.0	0.0
788-021D	4300- 4310	0.6	0.5	1.3	3.9	0.8	0.3	2.5	4.4	8.4	12.0	15.3	9.5	12.3	13.4	5.4	2.1	5.4	0.3	1.4	0.2	0.2	0.0	0.0
788-022D	4450- 4460	1.3	2.3	8.6	35.2	12.5	1.3	5.3	2.3	5.3	3.0	14.3	1.7	4.3	0.0	0.0	0.0	1.3	0.3	0.7	0.0	0.0	0.0	0.0
788-025D	4900- 4910	0.5	0.5	4.5	54.6	5.0	0.8	2.8	1.3	4.3	1.3	21.1	0.8	1.8	0.0	0.0	0.0	0.5	0.3	0.3	0.0	0.0	0.0	0.0
788-027D	5200- 5210	0.4	0.5	8.6	39.7	18.6	1.1	4.0	3.1	4.6	4.2	7.9	2.9	2.7	0.0	0.0	0.5	0.5	0.2	0.4	0.0	0.0	0.0	0.0
788-029D	5450- 5560	0.8	1.0	15.1	31.7	6.2	2.1	6.5	3.4	6.8	4.2	16.4	2.3	1.8	0.0	0.0	0.8	0.5	0.3	0.3	0.0	0.0	0.0	0.0
788-030D	5650- 5660	0.5	0.3	6.8	21.4	4.8	2.2	7.3	6.5	8.8	8.2	19.0	4.6	6.5	0.0	0.0	0.6	1.7	0.3	0.5	0.0	0.0	0.0	0.0
788-032D	5900- 5950	0.1	0.2	3.3	10.1	8.1	3.2	13.7	11.5	10.1	7.6	15.4	5.6	6.8	0.0	0.0	0.0	2.6	0.5	0.8	0.1	0.2	0.0	0.0
788-034D	6250- 6260	0.1	0.2	1.4	3.6	3.6	1.4	7.1	6.6	8.3	6.4	17.3	6.0	11.8	0.0	0.0	0.0	15.9	1.8	7.6	0.1	0.8	0.0	0.0
788-036D	6600- 6610	5.2	7.2	9.9	11.4	9.8	2.0	10.3	8.7	8.3	6.8	8.1	3.8	4.6	0.0	0.0	0.0	2.5	0.4	1.0	0.1	0.1	0.0	0.0
788-038D	6850- 6860	1.1	1.3	9.5	22.5	3.6	2.0	5.6	4.7	6.8	7.1	12.1	5.4	8.5	0.0	0.0	0.0	6.0	0.6	2.7	0.1	0.3	0.0	0.0
788-040D	7150- 7160	1.9	1.6	25.9	35.6	10.3	1.6	4.6	3.1	4.0	3.4	4.5	1.9	0.0	0.0	0.0	0.0	0.6	0.1	0.3	0.1	0.0	0.0	0.0
788-041D	7300- 7310	0.3	0.5	12.1	20.8	5.9	2.2	4.9	4.3	7.5	7.6	12.7	5.4	8.5	0.0	0.0	0.0	4.9	0.1	1.8	0.1	0.3	0.0	0.0
788-042D	7500- 7510	1.8	1.4	36.3	38.2	4.2	1.7	3.3	2.5	3.5	2.4	3.1	1.3	0.0	0.0	0.0	0.0	0.3	0.1	0.1	0.0	0.0	0.0	0.0
788-044D	7750- 7760	0.6	1.1	46.1	25.9	4.2	1.3	3.5	2.8	4.0	3.3	4.4	1.8	0.0	0.0	0.0	0.0	0.6	0.2	0.4	0.0	0.0	0.0	0.0
788-046D	8050- 8060	1.7	2.4	14.8	32.0	5.6	4.1	7.1	5.3	6.7	5.8	7.3	3.9	0.0	0.0	0.0	0.0	2.0	0.3	0.8	0.2	0.2	0.0	0.0
788-048D	8350- 8360	0.3	1.5	9.3	27.6	8.8	4.9	10.4	7.1	6.7	6.1	8.4	4.7	0.0	0.0	0.0	0.0	2.0	0.5	1.2	0.3	0.2	0.0	0.0
788-050D	8650- 8660	0.2	0.2	3.6	7.7	1.2	0.8	2.6	2.1	7.1	9.2	16.6	11.2	13.0	6.7	7.6	4.1	3.8	0.5	1.5	0.2	0.2	0.0	0.0
788-052D	8950- 8960	1.0	1.6	12.7	26.1	4.1	4.7	4.9	4.3	5.3	5.5	8.0	3.3	0.0	0.0	0.0	0.0	5.7	3.1	5.8	2.5	1.6	0.0	0.0
788-054D	9240- 9250	0.3	1.2	5.1	21.2	4.8	3.5	7.2	6.8	9.7	8.7	12.0	6.5	8.8	0.0	0.0	0.0	2.6	0.3	1.0	0.1	0.3	0.0	0.0
788-056D	9540- 9550	2.6	2.4	5.0	22.5	4.6	2.6	4.8	4.8	6.5	7.1	8.1	6.6	6.9	4.0	4.9	3.2	2.1	0.3	0.8	0.1	0.1	0.0	0.0
788-057D	9700- 9710	0.5	1.0	4.8	18.6	3.5	2.1	5.2	5.6	7.4	7.9	9.5	7.2	7.7	4.5	5.9	4.2	3.0	0.4	0.8	0.1	0.1	0.0	0.0
788-060D	10140-10150	0.5	1.0	3.9	15.8	5.0	3.7	7.1	7.2	7.7	7.6	8.4	5.9	6.0	5.0	6.1	3.3	2.8	0.6	0.8	0.1	0.1	0.0	0.0
788-061D	10300-10310	3.4	3.3	6.5	21.5	5.0	3.0	5.1	5.6	6.9	7.6	8.0	6.8	6.0	3.2	3.2	2.7	0.9	0.2	0.5	0.2	0.1	0.2	0.0
788-062D	10440-10450	0.4	1.1	3.0	10.8	5.5	2.5	8.2	8.3	9.0	8.8	9.9	7.7	7.8	4.9	5.4	3.3	2.3	0.4	0.6	0.1	0.1	0.0	0.0
788-064D	10740-10750	0.6	0.5	1.4	4.6	2.5	1.4	4.8	6.4	8.5	9.5	11.4	9.1	9.9	6.8	8.9	5.3	4.7	1.3	2.0	0.2	0.2	0.0	0.0

* In feet

Visual Kerogen Assessment Worksheet

+ 2 or more maturation pop-ulations ~2% to 20% 20% to 45% 45% to 80% 80% +	TYPE OF ORGANIC MATTER	COLOR OF ORGANIC MATTER	STATE OF ORGANIC MATTER	MATURATION INDEX	DEPOSITIONAL ENVIRONMENT
   	788-0040	1760'	W ₂ -N-C		
	788-0060	2060'	W ₂ -Am-H ₂ C		
	788-0080	2360'	W ₂ -Am; H (C)		
	788-0100	2660'	W ₂ -H ₂ -Am-C		
	788-0130	3110'	W ₂ -N ₂ -Am-C		
	788-0160	3560'	W ₂ -Am; H (C)		
	788-0190	4010'	W ₂ -Am-H ₂ C		
	788-0210	4310'	W ₂ -H ₂ -Am-C		
	788-0220	4460'	W ₂ -H ₂ -Am-C		
	788-0250	4910'	W ₂ -Am; H (C)		
	788-0270	5210'	W ₂ -Am; H (C)		
	788-0290	5560'	W ₂ -H ₂ -Am-C		
	788-0300	5560'	W ₂ -H ₂ -Am-C		
	788-0320	5950'	W ₂ -H ₂ -Am-C		
	788-0340	6260'	W ₂ -H ₂ -Am-C		
	788-0360	6610'	W ₂ -H ₂ -Am (C)		
	788-0380	6860'	W ₂ -H-C; Am		
	788-0400	7160'	W ₂ -H ₂ C		
	788-0410	7310'	W ₂ -H ₂ -Am-C		
	788-0420	7510'	W ₂ -H ₂ C		
788-0440	7760'	W ₂ -H ₂ -Am-C			
788-0460	8060'	W ₂ -Am-H ₂ C			
788-0480	8360'	W ₂ -H-C; Am			
788-0500	8660'	W ₂ -H ₂ -Am (C)			
788-0520	8960'	W ₂ -H ₂ -Am-C			
788-0540	9250'	W ₂ -H ₂ -Am-C			
788-0560	9550'	W ₂ -H ₂ -Am-C			
788-0570	9710'	W ₂ -H ₂ -Am-C			
788-0600	10150'	W ₂ -H ₂ -Am-C			
788-0610	10310'	W ₂ -H ₂ -Am-C			
788-0620	10450'	W ₂ -H ₂ C			
788-0620	10450'	Am-W ₂ -H ₂ C			
788-0620	10450'	W ₂ -H ₂ C (Am)			

Table 7
Vitrinite Reflectance Summary

GeoChem Sample Number	Depth (feet)	Number of Readings	Minimum Reflectance (% Ro)	Maximum Reflectance (% Ro)	Average Reflectance (% Ro)
788-004D	1750-1760	*	-	-	-
788-010D	2650-2660	14	0.17	0.87	0.40
788-013D	3100-3110	40	0.17	0.34	0.24
788-016D	3550-3560	40	0.16	0.36	0.24
788-019D	4000-4010	27	0.15	0.67	0.28
788-022D	4450-4460	40	0.20	0.35	0.27
788-025D	4900-4910	40	0.27	0.42	0.32
788-029D	5450-5560	41	0.24	0.47	0.35
788-032D	5900-5950	37	0.25	0.47	0.37
788-036D	6600-6610	40	0.19	0.54	0.40
788-040D	7150-7160	40	0.48	0.63	0.55
788-042D	7500-7510	40	0.43	0.66	0.54
788-044D	7750-7760	40	0.21	0.63	0.52
788-048D	8350-8360	40	0.38	0.68	0.55
788-052D	8950-8960	40	0.23	0.67	0.48
788-056D	9540-9550	40	0.50	0.78	0.67
788-058D	9840-9850	40	0.29	0.71	0.55
788-061D	10300-10310	40	0.39	0.83	0.65

Note:

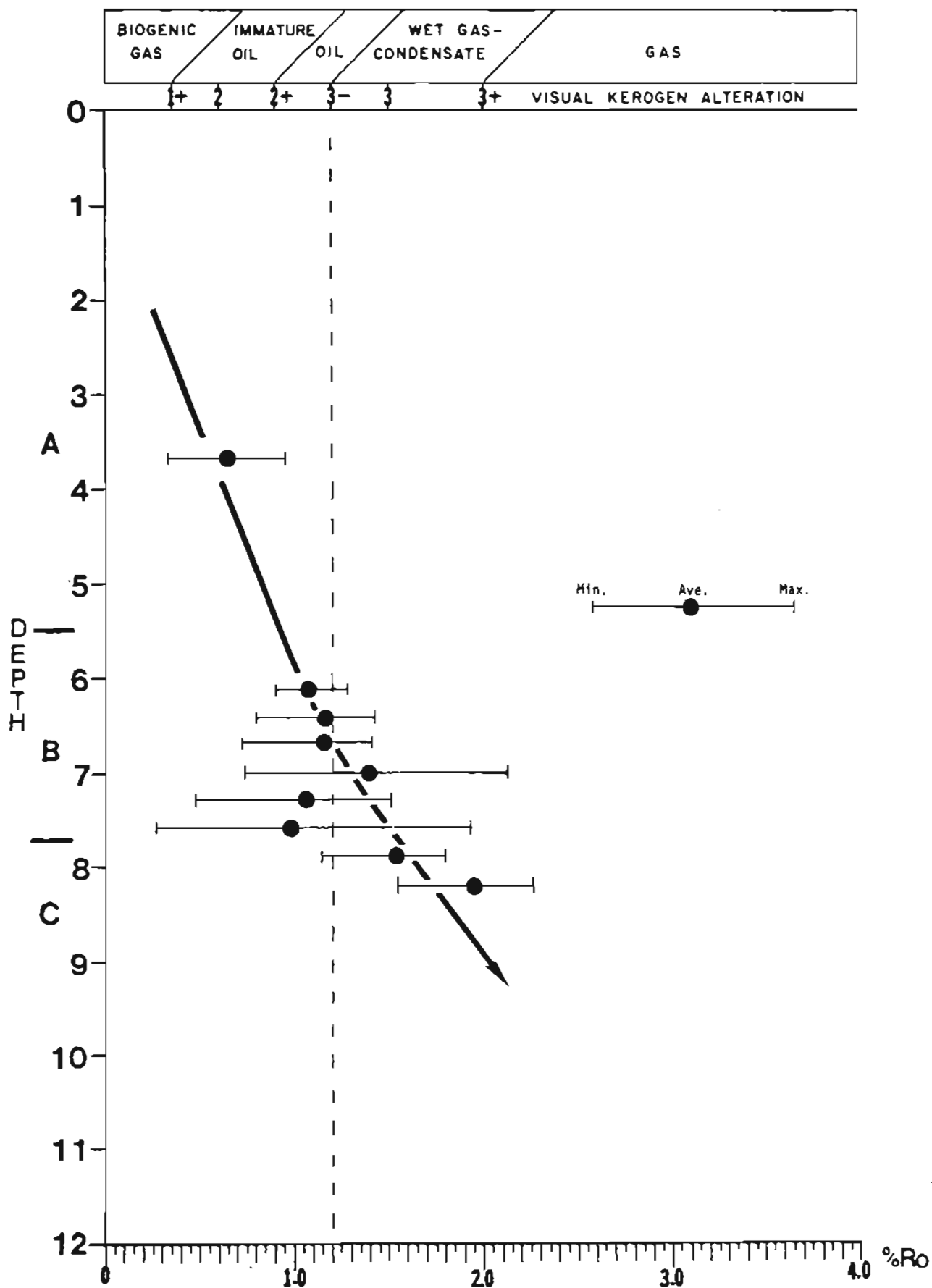
* Insufficient kerogen return to prepare plug.

APPENDIX 2

Geochemical Data for Pan
American Hoodoo Lake Unit No. 2

PAN AM - SOCAL - HOODOO LAKE NO. 2

VITRINITE REFLECTANCE DATA



PAN AM - Socad USA HOODOO LAKE UNIT #2 WELL SUMMARY OF ORGANIC ANALYSES SOURCE CHARACTER

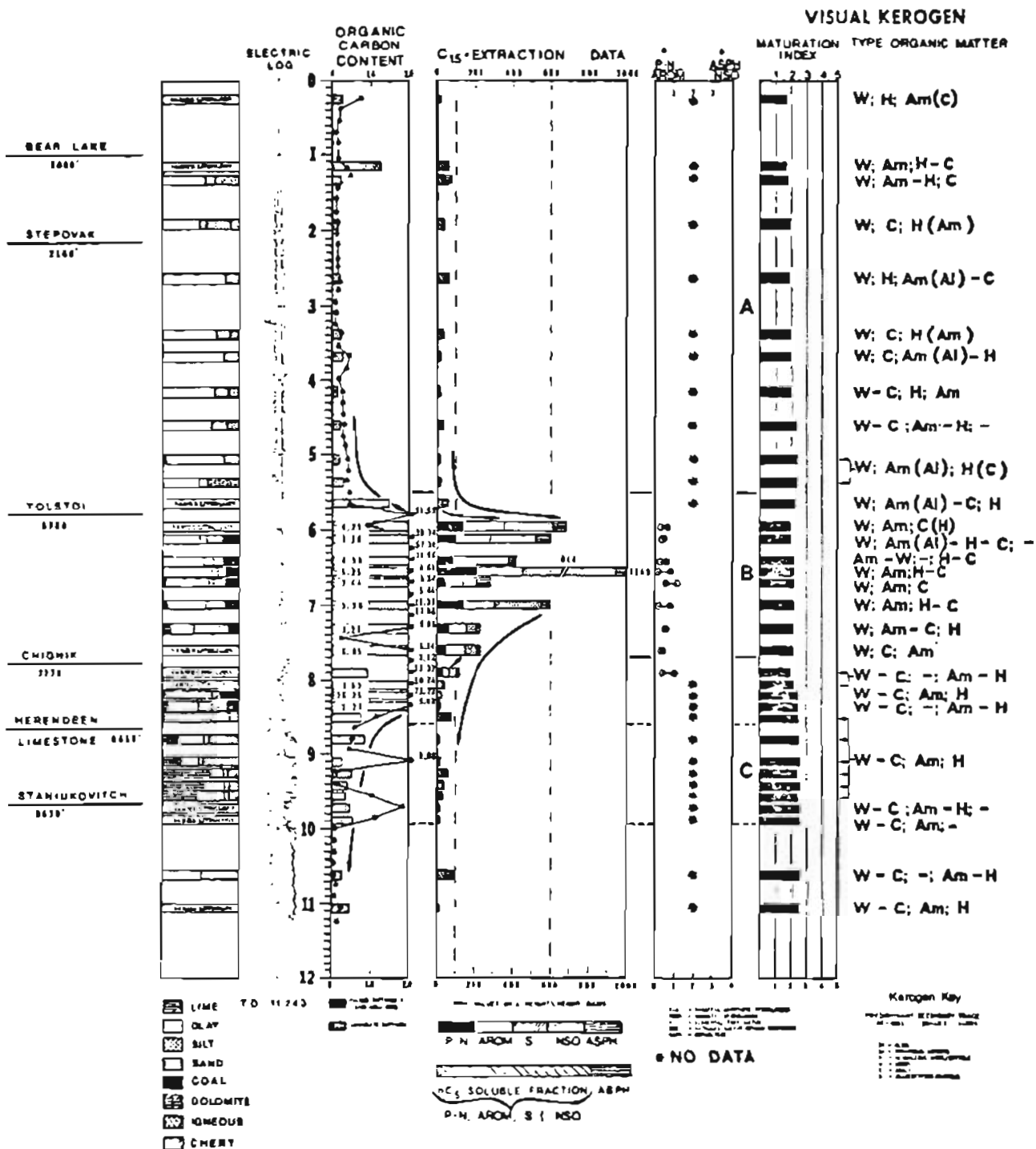


Table 8

Organic Carbon and Lithology Screen Analyses

GeoChem Sample Number	Well Depth Interval	Description	Percent Organic Carbon
787-001	227' - 240'	Silty claystone, light gray.	0.76
787-002	390' - 420'	Composite, reworked material.	0.21
787-003	540' - 570'	Composite, reworked material.	0.19
787-004	690' - 720'	Composite, sand and reworked.	0.10
787-005	840' - 870'	Composite, sand and reworked.	0.14; 0.10 R
787-006	1050' - 1080'	Composite, sand and reworked.	0.14
787-007	1170' - 1200'	Silty claystone, light olive gray.	0.37
787-008	1290' - 1320'	Claystone, light gray.	0.49
787-009	1440' - 1470'	Composite, clay, carbonate, sand, s.s., reworked.	0.14
787-010	1590' - 1620'	Composite, clay, carbonate, sand, ss. reworked.	0.11; 0.13 R
787-011	1740' - 1770'	Composite, claystone, limestone, ss. sand, rewkd.	0.11
787-012	1890' - 1920'	Claystone, very sandy w/glaucinite	0.14
787-013	2040' - 2070'	Sandstone, very clayey, light olive gray.	0.11
787-014	2190' - 2220'	Composite, sandstone, claystone, siderite.	0.16
787-015	2340' - 2370'	Sandstone, very clayey, light olive gray.	0.15; 0.20 R
787-016	2490' - 2520'	Composite, sandstone, claystone, siderite.	0.14
787-017	2640' - 2670'	Sandstone, very argillaceous, light olive gray.	0.22
787-018	2790' - 2820'	comp., lmst, sandstone, calcite, siderite.	0.16
787-019	2940' - 2970'	Comp. siltstone, s.s., lt. olive gray, tr. calc.	0.09
787-020	3090' - 3120'	Comp. siltstone, s.s., lt. olive gray, tr. calc.	0.10; 0.09 R
787-021	3240' - 3270'	Comp. siltstone, s.s., lt. olive gray, tr. calc.	0.08
787-022	3390' - 3420'	Sandstone.	0.24
787-023	3540' - 3570'	Composite, sandstone, siderite, trace calcite.	0.16
787-024	3690' - 3720'	Medium dark gray siltstone.	0.45
787-025	3840' - 3870'	Medium dark gray siltstone.	0.38; 0.39 R
787-026	3990' - 4020'	Greenish gray silty shale	0.18
787-027	4140' - 4160'	Silty shale.	0.27
787-028	4300' - 4320'	Silty shale, medium dark gray.	0.29
787-029	4440' - 4460'	Silty shale, medium dark gray.	0.30
787-030	4600' - 4620'	Silty shale, medium dark gray.	0.32; 0.34 R
787-031	4740' - 4760'	Silty shale, medium dark gray.	0.29
787-032	4880' - 4900'	Slightly silty shale, medium dark gray.	0.34
787-033	5040' - 5060'	Silty shale, medium dark gray.	0.39
787-034	5200' - 5220'	Silty shale, medium dark gray.	0.42
787-035	5340' - 5360'	Slightly silty shale, medium dark gray.	0.38; 0.42 R
787-036	5500' - 5520'	Shale, medium dark gray.	0.45
787-037	5640' - 5660'	Shale, medium dark gray.	0.47

Table 8
Organic Carbon and Lithology Screen Analyses

GeoChem Sample Number	Well Depth Interval	Description	Percent Organic Carbon
787-038	5800' - 5820'	Silty coal.	21.52
787-039	5940' - 5960'	Siltstone, medium gray.	0.90
787-040	6100' - 6120'	Silty coal.	30.74; 29.96 F
787-041	6240' - 6260'	Coal.	57.30
787-042	6400' - 6420'	Silty coal.	16.90
787-043	6540' - 6560'	Silty shale, black, carbonaceous.	6.58
787-044	6700' - 6720'	Silty shale, black, carbonaceous.	5.84
787-045	6840' - 6860'	Silty shale, black, carbonaceous.	5.46; 5.38 F
787-046	7000' - 7020'	Shale, black, carbonaceous.	11.38
787-047	7140' - 7160'	Shale, black, carbonaceous.	17.08
787-048	7300' - 7320'	Shale, black, carbonaceous.	9.08
787-049	7440' - 7460'	Sandstone	0.25
787-050	7600' - 7610'	Shale, black, carbonaceous.	5.14; 5.22 F
787-051	7750' - 7760'	Shale, black.	3.92
787-052	7900' - 7910'	Shale, black, carbonaceous.	13.32
787-053	8050' - 8060'	Shale, black, carbonaceous.	10.74
787-054	8200' - 8210'	Coal.	73.72
787-055	8350' - 8360'	Shale, black, slightly carbonaceous.	5.42; 5.30 F
787-056	8500' - 8510'	Shale, slightly silty, grayish black.	1.17
787-057	8660' - 8670'	Shale, medium dark gray.	0.59
787-058	8800' - 8810'	Shale, slightly silty, dark gray.	0.54
787-059	8950' - 8960'	Shale, slightly silty, dark gray.	0.46
787-060	9100' - 9110'	Shale, slightly silty, dark gray.	2.08; 2.07 F
787-061	9250' - 9260'	Limestone.	0.12
787-062	9400' - 9410'	Limestone.	0.13
787-063	9550' - 9560'	Shale, silty, dark gray.	1.03
787-064	9700' - 9710'	Shale, silty, dark gray.	1.85
787-065	9860' - 9870'	Shale, silty, dark gray.	1.11; 1.10 F
787-066	10000' - 10010'	Sandstone.	0.08
787-067	10150' - 10160'	Tuffaceous sandstone.	0.06
787-068	10300' - 10310'	Tuffaceous sandstone.	0.08
787-069	10450' - 10460'	Sandstone	0.05
787-070	10600' - 10610'	Shale, silty, medium dark gray.	0.05; 0.06 F
787-071	10750' - 10760'	Sandstone.	0.11
787-072	10900' - 10910'	Intrusives, igneous.	0.06
787-073	11050' - 11060'	Composite, intrusives, igneous.	0.21
787-074	11240' - 11243'	Composite, intrusives, igneous.	0.13

Table 9

Organic Carbon Analyses and Gross Lithological Description

GeoChem Sample Number	Well Interval	Gross Lithological Description	GSA Color Code	Total Organic Carbon (% of Rock)
787-001D	270'	Varied lithology consisting of shale, reworked shale, chert, and unconsolidated sand.		0.29
787-007D -A	1260'	Varied lithology consisting of shale, reworked shale, chert, and unconsolidated sand.		1.27
787-008D -A -B	1410'	70% Shale, noncalcareous, silty, blocky, moderately hard, light gray. 30% Reworked chert and siliceous shale. Trace of sand grains.	N7	0.22
787-012D -A -B -C	1950'	50% Shale, noncalcareous, silty, blocky, moderately hard, light gray. 40% Sandstone, argillaceous cement, very fine to fine grain, subrounded to sub- angular, frosted to clear, fair porosity, no show. 10% Reworked chert and siliceous shale.	N7	0.15
787-017D -A -B -C	2670'	60% Shale, noncalcareous, very silty, blocky, moderately hard, olive gray. 30% Shale, noncalcareous, blocky, moderately hard, greenish gray. 10% Bentonite.	5Y4/1 5G6/1	0.19; 0.19
787-022D -A -B -C	3420'	50% Shale, noncalcareous, silty, blocky, moderately hard, medium dark gray. 40% Shale, noncalcareous, silty, very sandy, fine grain, subrounded, frosted; blocky, moderately hard, dark gray. 10% Bentonite.	N4 N4	0.22

Table 9

Organic Carbon Analyses and Gross Lithological Description

GeoChem Sample Number	Well Interval	Gross Lithological Description	GSA Color Code	Total Organic Carbon (% of Rock)
787-024D -A	3720'	70% Shale, noncalcareous, silty, blocky, moderately hard, medium dark gray.	N4	0.28
-B		30% Shale, noncalcareous, silty, very sandy; fine grain, subrounded, frosted; blocky, moderately hard, medium dark gray.	N4	
787-027D -A	4180'	50% Shale, noncalcareous, silty, very sandy; fine grain, subrounded, frosted; blocky, moderately hard, medium dark gray.	N4	0.14
-B		40% Shale, noncalcareous, silty, blocky, moderately hard, medium dark gray.	N4	
-C		10% Bentonite.		
787-030D -A	4640'	60% Shale, noncalcareous, silty, very sandy; fine grain, subrounded, frosted; blocky, moderately hard, medium dark gray.	N4	0.21
-B		40% Shale, noncalcareous, silty, blocky, moderately hard, medium dark gray.	N4	
787-033D -A	5060'	60% Shale, slightly calcareous, silty, blocky, hard, medium light gray.		0.20; 0.17
-B		40% Shale, noncalcareous, silty, blocky, moderately hard, medium dark gray.	N4	
787-035D -A	5380'	60% Shale, noncalcareous, silty, blocky, moderately hard, medium dark gray.	N4	0.29
-B		40% Igneous,? diorite, gabbro. Mud additives associated.		
787-037D	5680'	Varied lithology consisting of shale, siltstone, sandstone, weathered igneous, coal and mud additive.		1.48

Table 9

Organic Carbon Analyses and Gross Lithological Description

GeoChem Sample Number	Well Interval	Gross Lithological Description	GSA Color Code	Total Organic Carbon (% of Rock)
787-039D	5980'	Varied lithology consisting of shale, carbonaceous shale, coal, sandstone and siltstone.		4.25
787-040D	6140'			7.28
-A		50% Shale, noncalcareous, silty, blocky, moderately hard, medium dark gray.	N4	
-B		30% Sandstone, silica cement, very argillaceous, very fine to fine grain, subangular to subrounded, clear to frosted, fair porosity, no show.		
-C		20% Coal.		
787-042D	6440'			4.39; 4.44
-A		60% Shale, noncalcareous, silty, blocky, hard, medium dark gray.	N4	
-B		20% Sandstone, silica cement, very argillaceous, fine grain, subangular to subrounded, clear to frosted, fair porosity, no show.		
-C		20% Coal.		
787-043D	6560'			5.25
-A		60% Shale, noncalcareous, very carbonaceous, grading into a coal, blocky, hard, dark gray to black.	N3 to N1	
-B		30% Shale, noncalcareous, very silty, blocky, hard, medium dark gray.	N4	
-C		10% Sandstone, carbonate cement, fine grain, subrounded to subangular, frosted to clear, good porosity, no show.		
787-044D	6740'			7.44
-A		60% Shale, same as 787-043D-A.		
-B		20% Shale, same as 787-043D-B.		
-C		20% Sandstone, same as 787-043D-C.		

Table 9

Organic Carbon Analyses and Gross Lithological Description

GeoChem Sample Number	Well Interval	Gross Lithological Description	GSA Color Code	Total Organic Carbon (% of Rock)
787-046D -A	7040'	60% Shale, noncalcareous, very carbonaceous, grading into a coal, blocky, hard, dark gray to black.	N3 to N1	3.38
-B		40% Sandstone, carbonate cement, argillaceous, very fine to fine grain, subrounded to subangular, frosted to clear, fair porosity, no show. Mud additives associated.		
787-048D -A	7360'	60% Sandstone, carbonate cement, very fine to fine grain, subrounded to subangular, frosted to clear, fair porosity, no show.		3.23
-B		40% Shale, noncalcareous, very carbonaceous, grading into a coal, blocky, hard, dark gray to black. Mud additives associated.	N3 to N1	
787-050D	7640'	Varied lithology consisting of shale, coal, siltstone, sandstone and mud additives.		6.85; 6.92 F
787-052D	7920'	Varied lithology consisting of shale, siliceous shale, sandstone, siltstone, igneous and mud additives.		0.92
787-053D	8070'	Varied lithology consisting of shale, siliceous shale, sandstone, coal, igneous and mud additives.		3.63
787-054D -A	8220'	80% Shale, noncalcareous, very carbonaceous, grading into a coal, blocky, hard, dark gray to black.	N3 to N1	26.25
-B		20% Sandstone, carbonate cement, argillaceous, fine grain, subrounded to subangular, frosted to clear, fair porosity, no show. Mud additives associated.		

Table 9

Organic Carbon Analyses and Gross Lithological Description

GeoChem Sample Number	Well Interval	Gross Lithological Description	GSA Color Code	Total Organic Carbon (% of Rock)
787-055	8370'			2.27
-A		50% Shale, same as 787-054D-A.		
-B		30% Sandstone, same as 787-054D-B.		
-C		20% Igneous. Mud additives associated.		
787-056D	8520'			0.76; 0.78 F
-A		80% Shale, noncalcareous, very silty, blocky, hard, dark gray.	N3	
-B		20% Sandstone, carbonate cement, very argillaceous, fine grain, subrounded to subangular, frosted to clear, no show. Mud additives associated.		
787-058D	8820'			0.85
-A		50% Sandstone, carbonate cement, very fine to fine grain, subrounded to sub- angular, frosted to clear, good porosity, no show.		
-B		40% Shale, slightly calcareous, silty, blocky, hard, dark gray.	N3	
-C		10% Calcite. Mud additives associated.		
787-060D	9130'			0.26
-A		60% Sandstone, carbonate and silica cement, limy, fine grain, subrounded to sub- angular, frosted to clear, fair porosity, no show.		
-B		30% Shale, slightly calcareous, silty, blocky, hard, dark gray.	N3	
-C		10% Calcite. Mud additives associated.		

Table 9

Organic Carbon Analyses and Gross Lithological Description

GeoChem Sample Number	Well Interval	Gross Lithological Description	GSA Color Code	Total Organic Carbon (% of Rock)
787-061D -A	9270'	80% Limestone, chalk, sandy; very fine to fine grain, subrounded to subangular, frosted to clear; good porosity, no show, very light gray.	N8	0.51
-B		20% Shale, noncalcareous, silty, blocky, hard, dark gray. Mud additives associated.	N3	
787-062D -A	9420'	70% Limestone, same as 787-061D-A.		0.40
-B		30% Shale, same as 787-061D-B. Mud additives associated.		
787-063D -A	9570'	70% Limestone, chalk, argillaceous, very fine to fine grain, subrounded to subangular, frosted to clear, blocky, moderately hard, light gray.	N7	0.35; 0.32
-B		30% Shale, slightly calcareous, silty, blocky, hard, dark gray. Mud additives associated.	N3	
787-064D	9720'	Varied lithology consisting of weathered igneous, shale, sandstone, and mud additives.		0.48
787-065D	9890'	Varied lithology consisting of igneous, shale, sandstone, and mud additives.		0.55
787-070D -B	10610'	60% Shale, noncalcareous, very silty, blocky, hard, dark gray. 40% Siltstone, noncalcareous, argillaceous, hard, little porosity, no show, light gray.	N3 N7	0.27
787-073D	11060'	Varied lithology consisting of igneous, shale, sandstone and mud additives.		0.46

Table 10

Summary of Organic Carbon and Visual Kerogen Analysis

GeoChem Sample Number	Well Depth Interval	Organic Carbon (% of Rock)	Visual Kerogen	
			Type	Alteration (1-5 Scale)
787-001D	227- 270	0.29	W;H;Am (C)	2-
787-007D	1080- 1260	1.27	W;Am;H-C	1+ to 2- (2)*
787-008D	1260- 1410	0.22	W;Am-H;C	2- to 2 (1)
787-012D	1890- 1950	0.15	W;C;H (Am)	2- to 2 (1)
787-017D	2610- 2670	0.19; 0.19R	W;H;Am (Al)-C	2- to 2 (1)
787-022D	3360- 3420	0.22	W;C;H (Am)	2
787-024D	3660- 3720	0.28	W;C;Am (Al)-H	2 (1+ to 2-)*
787-027D	4140- 4180	0.14	W-C;H;Am	2 (1)*
787-030D	4580- 4640	0.21	W-C;Am-H;-	2 to 2+ (1+ to 2-)*
787-033D	5020- 5060	0.20; 0.17R	W;Am (Al);H (C)	2 to 2+ (1+ to 2-)*
787-035D	5320- 5380	0.29	W;Am (Al);H (C)	2 to 2+ (1+ to 2-)*
787-037D	5620- 5680	1.48	W;Am (Al)-C;H	2 to 2+ (1+ to 2-)*
787-039D	5940- 5980	4.25	W;Am;C (H)	2
787-040D	6080- 6140	7.28	W;Am(Al)-H-C;-	2 (1+ to 2-)*
787-042D	6380- 6440	4.39; 4.44R	Am-W;-;H-C	2 to 2+
787-043D	6520- 6560	5.25	W;Am;H-C	2 to 2+
787-044D	6640- 6740	7.44	W;Am;C	2 to 2+
787-046D	6960- 7040	3.38	W;Am;H-C	2 to 2+
787-048D	7240- 7360	3.23	W;Am-C;H	2 to 2+
787-050D	7570- 7640	6.85; 6.92R	W;C;Am	2 to 2+
787-052D	7870- 7920	0.91	W-C;-;Am-H	2
787-053D	8050- 8070	3.63	W-C;-;Am-H	2 to 2+
787-054D	8190- 8220	26.25	W-C;Am;H	2 to 2+
787-055D	8350- 8370	2.27	W-C;-;Am-H	2 to 2+ (2- to 2)*
787-056D	8490- 8520	0.76; 0.78R	W-C;Am;H	2+
787-058D	8790- 8820	0.85	W-C;Am;H	2+
787-060D	9080- 9130	0.26	W-C;Am;H	2+ to 3- (2- to 2)*
787-061D	9250- 9270	0.51	W-C;Am;H	2 to 2+ (2- to 2)*
787-062D	9390- 9420	0.40	W-C;Am;H	2+ to 3- (2-)*
787-063D	9540- 9570	0.35; 0.32R	W-C;Am;H	2 to 2+
787-064D	9700- 9720	0.48	W-C;Am-H;-	2+ to 3- (1)*
787-065D	9860- 9890	0.55	W-C;Am;-	2+ to 3-
787-070D	10590-10610	0.27	W-C;-;Am-H	2+ to 3- (1+)*
787-073D	11040-11060	0.46	W-C;Am;H	2 to 2+

Table 11

Summary of C15+ Soxhlet Extraction, Deasphalting
and Liquid Chromatography

A. Weights of Extracts and Chromatographic Fractions

GeoChem Sample Number	Well Interval*	Weight of Rock Extd. (grams)	Total Extract (grams)	Precipitated Asphaltenes (grams)	N-C5 Soluble (grams)	Sulfur (grams)	Paraffins- Naphthenes (grams)	Aromatics (grams)	Eluted NSO'S (grams)	Noneluted NSO'S (grams)
787-001D	227- 270	80.0	0.0014	0.0008	0.0006	N.D.	N.D.	N.D.	N.D.	N.D.
787-007D	1080- 1260	60.0	0.0035	0.0014	0.0021	N.D.	N.D.	N.D.	N.D.	N.D.
787-008D	1260- 1410	55.0	0.0040	0.0024	0.0016	N.D.	N.D.	N.D.	N.D.	N.D.
787-012D	1890- 1950	80.0	0.0031	0.0011	0.0020	N.D.	N.D.	N.D.	N.D.	N.D.
787-017D	2610- 2670	75.0	0.0045	0.0015	0.0030	N.D.	N.D.	N.D.	N.D.	N.D.
787-022D	3360- 3420	70.0	0.0024	0.0009	0.0015	N.D.	N.D.	N.D.	N.D.	N.D.
787-024D	3660- 3720	70.0	0.0015	0.0009	0.0006	N.D.	N.D.	N.D.	N.D.	N.D.
787-027D	4140- 4180	75.0	0.0014	0.0001	0.0013	N.D.	N.D.	N.D.	N.D.	N.D.
787-030D	4580- 4640	85.0	0.0030	0.0010	0.0020	N.D.	N.D.	N.D.	N.D.	N.D.
787-033D	5020- 5060	70.0	0.0011	0.0001	0.0010	N.D.	N.D.	N.D.	N.D.	N.D.
787-035D	5320- 5380	85.0	0.0017	0.0005	0.0012	N.D.	N.D.	N.D.	N.D.	N.D.
787-037D	5620- 5680	65.0	0.0036	0.0020	0.0016	N.D.	N.D.	N.D.	N.D.	N.D.
787-039D	5940- 5980	75.0	0.0508	0.0053	0.0455	N.D.	0.0102	0.0160	0.0071	0.0122
787-040D	6080- 6140	75.0	0.0446	0.0058	0.0388	N.D.	0.0072	0.0136	0.0071	0.0109
787-042D	6380- 6440	95.0	0.0393	0.0041	0.0352	N.D.	0.0077	0.0118	0.0061	0.0098
787-043D	6520- 6560	80.0	0.0918	0.0044	0.0874	N.D.	0.0164	0.0195	0.0095	0.0420
787-044D	6640- 6740	60.0	0.0170	0.0048	0.0122	N.D.	0.0028	0.0052	0.0039	0.0003
787-046D	6960- 7040	65.0	0.0384	0.0032	0.0352	N.D.	0.0090	0.0103	0.0060	0.0099
787-048D	7240- 7360	60.0	0.0136	0.0016	0.0120	N.D.	0.0035	0.0055	0.0027	0.0003
787-050D	7570- 7640	75.0	0.0172	0.0015	0.0157	N.D.	0.0034	0.0074	0.0045	0.0004
787-052D	7870- 7920	95.0	0.0115	0.0016	0.0099	N.D.	0.0031	0.0030	0.0033	0.0005
787-053D	8050- 8070	85.0	0.0036	0.0016	0.0020	N.D.	N.D.	N.D.	N.D.	N.D.
787-054D	8190- 8220	75.0	0.0020	0.0006	0.0014	N.D.	N.D.	N.D.	N.D.	N.D.
787-055D	8350- 8370	70.0	0.0014	0.0010	0.0004	N.D.	N.D.	N.D.	N.D.	N.D.
787-056D	8490- 8520	85.0	0.0065	0.0043	0.0022	N.D.	N.D.	N.D.	N.D.	N.D.
787-058D	8790- 8820	80.0	0.0011	0.0007	0.0004	N.D.	N.D.	N.D.	N.D.	N.D.
787-060D	9080- 9130	75.0	0.0013	0.0005	0.0008	N.D.	N.D.	N.D.	N.D.	N.D.
787-061D	9250- 9270	85.0	0.0050	0.0008	0.0042	N.D.	N.D.	N.D.	N.D.	N.D.
787-062D	9390- 9420	80.0	0.0029	0.0003	0.0026	N.D.	N.D.	N.D.	N.D.	N.D.
787-063D	9540- 9570	80.0	0.0023	0.0007	0.0016	N.D.	N.D.	N.D.	N.D.	N.D.
787-064D	9700- 9720	80.0	0.0011	0.0002	0.0009	N.D.	N.D.	N.D.	N.D.	N.D.
787-065D	9860- 9890	85.0	0.0014	0.0008	0.0006	N.D.	N.D.	N.D.	N.D.	N.D.
787-070D	10590-10610	80.0	0.0069	0.0032	0.0037	N.D.	N.D.	N.D.	N.D.	N.D.
787-073D	11040-11060	85.0	0.0012	0.0005	0.0007	N.D.	N.D.	N.D.	N.D.	N.D.

Table 11

B. Concentration of Extracted Materials in Rock

GeoChem Sample Number	Well Interval*	Total Extract (ppm)	-----Hydrocarbons-----			Sulfur (ppm)	-----Nonhydrocarbons-----			
			Paraffin- Naphthene (ppm)	Aromatic (ppm)	Total (ppm)		Precipd. Asphaltene (ppm)	Eluted NSO'S (ppm)	Noneluted NSO'S (ppm)	Total (ppm)
787-001D	227- 270	18	-	-	-	-	10	-	-	-
787-007D	1080- 1260	58	-	-	-	-	23	-	-	-
787-008D	1260- 1410	73	-	-	-	-	44	-	-	-
787-012D	1890- 1950	39	-	-	-	-	14	-	-	-
787-017D	2610- 2670	60	-	-	-	-	20	-	-	-
787-022D	3360- 3420	34	-	-	-	-	13	-	-	-
787-024D	3660- 3720	21	-	-	-	-	13	-	-	-
787-027D	4140- 4180	19	-	-	-	-	1	-	-	-
787-030D	4580- 4640	35	-	-	-	-	12	-	-	-
787-033D	5020- 5060	16	-	-	-	-	1	-	-	-
787-035D	5320- 5380	20	-	-	-	-	6	-	-	-
787-037D	5620- 5680	55	-	-	-	-	31	-	-	-
787-039D	5940- 5980	677	136	213	349	-	71	95	163	328
787-040D	6080- 6140	595	96	181	277	-	77	95	145	317
787-042D	6380- 6440	414	81	124	205	-	43	64	101	208
787-043D	6520- 6560	1148	205	244	449	-	55	119	525	699
787-044D	6640- 6740	283	47	87	133	-	80	65	5	150
787-046D	6960- 7040	591	138	158	297	-	49	92	152	294
787-048D	7240- 7360	227	58	92	150	-	27	45	5	77
787-050D	7570- 7640	229	45	99	144	-	20	60	5	85
787-052D	7870- 7920	121	33	32	64	-	17	35	5	57
787-053D	8050- 8070	42	-	-	-	-	19	-	-	-
787-054D	8190- 8220	27	-	-	-	-	8	-	-	-
787-055D	8350- 8370	20	-	-	-	-	14	-	-	-
787-056D	8490- 8520	76	-	-	-	-	51	-	-	-
787-058D	8790- 8820	14	-	-	-	-	9	-	-	-
787-060D	9080- 9130	17	-	-	-	-	7	-	-	-
787-061D	9250- 9270	59	-	-	-	-	9	-	-	-
787-062D	9390- 9420	36	-	-	-	-	4	-	-	-
787-063D	9540- 9570	29	-	-	-	-	9	-	-	-
787-064D	9700- 9720	14	-	-	-	-	3	-	-	-
787-065D	9860- 9890	16	-	-	-	-	9	-	-	-
787-070D	10590-10610	86	-	-	-	-	40	-	-	-
787-073D	11040-11060	14	-	-	-	-	6	-	-	-

* In feet

Table 11 (Continued)

C. Composition of Extracts

GeoChem Sample Number	Well Interval *	-----Hydrocarbons-----			Sulfur %	-----Nonhydrocarbons-----				HC'S %	HC/Non HC
		Paraffin- Naphthene %	Aromatic %	PN/Arom		Eluted NSO'S %	Noneluted NSO'S %	Precipitd. Asphaltene %	Asph/NSO		
787-0010	227- 270	-	-	-	-	-	-	57.1	-	-	-
787-0070	1080- 1260	-	-	-	-	-	-	40.0	-	-	-
787-0080	1260- 1410	-	-	-	-	-	-	60.0	-	-	-
787-0120	1890- 1950	-	-	-	-	-	-	35.5	-	-	-
787-0170	2610- 2670	-	-	-	-	-	-	33.3	-	-	-
787-0220	3360- 3420	-	-	-	-	-	-	37.5	-	-	-
787-0240	3660- 3720	-	-	-	-	-	-	60.0	-	-	-
787-0270	4140- 4180	-	-	-	-	-	-	7.1	-	-	-
787-0300	4580- 4640	-	-	-	-	-	-	33.3	-	-	-
787-0330	5020- 5060	-	-	-	-	-	-	9.1	-	-	-
787-0350	5320- 5380	-	-	-	-	-	-	29.4	-	-	-
787-0370	5620- 5680	-	-	-	-	-	-	55.6	-	-	-
787-0390	5940- 5980	20.1	31.5	0.64	-	14.0	24.0	10.4	0.27	51.6	1.07
787-0400	6080- 6140	16.1	30.5	0.53	-	15.9	24.4	13.0	0.32	46.6	0.87
787-0420	6380- 6440	19.6	30.0	0.65	-	15.5	24.4	10.4	0.26	49.6	0.98
787-0430	6520- 6560	17.9	21.2	0.84	-	10.3	45.8	4.8	0.09	39.1	0.64
787-0440	6640- 6740	16.5	30.6	0.54	-	22.9	1.8	28.2	1.14	47.1	0.89
787-0460	6960- 7040	23.4	26.8	0.87	-	15.6	25.8	8.3	0.20	50.3	1.01
787-0480	7240- 7360	25.7	40.4	0.64	-	19.9	2.2	11.8	0.53	66.2	1.96
787-0500	7570- 7640	19.8	43.0	0.46	-	26.2	2.3	8.7	0.31	62.8	1.69
787-0520	7870- 7920	30.0	26.1	1.03	-	28.7	4.3	13.9	0.42	53.0	1.13
787-0530	8050- 8070	-	-	-	-	-	-	44.4	-	-	-
787-0540	8190- 8220	-	-	-	-	-	-	30.0	-	-	-
787-0550	8350- 8370	-	-	-	-	-	-	71.4	-	-	-
787-0560	8490- 8520	-	-	-	-	-	-	66.2	-	-	-
787-0580	8790- 8820	-	-	-	-	-	-	63.6	-	-	-
787-0600	9080- 9130	-	-	-	-	-	-	38.5	-	-	-
787-0610	9250- 9270	-	-	-	-	-	-	16.0	-	-	-
787-0620	9390- 9420	-	-	-	-	-	-	10.3	-	-	-
787-0630	9540- 9570	-	-	-	-	-	-	30.4	-	-	-
787-0640	9700- 9720	-	-	-	-	-	-	18.2	-	-	-
787-0650	9860- 9890	-	-	-	-	-	-	57.1	-	-	-
787-0700	10590-10610	-	-	-	-	-	-	46.4	-	-	-
787-0730	11040-11060	-	-	-	-	-	-	41.7	-	-	-

Table 12-A

Saturate Hydrocarbon Analyses

Summary of Paraffin-Naphthene Distribution

GeoChem Sample Number	Well Interval*	% Paraffin	% Isoprenoid	% Naphthene	C-P Index A	C-P Index B	ip19/ip20
787-0010	227- 270	12.7	2.3	85.1	1.31	-	1.30
787-0070	1080- 1260	10.0	1.2	88.8	1.15	-	0.55
787-0080	1260- 1410	8.5	1.1	90.5	1.25	-	0.74
787-0120	1890- 1950	6.6	0.6	92.9	1.23	1.79	0.47
787-0170	2610- 2670	5.9	1.1	93.0	1.25	2.10	1.46
787-0220	3360- 3420	6.0	1.0	93.0	1.18	1.59	1.23
787-0240	3660- 3720	9.2	1.1	89.7	1.12	1.61	0.84
787-0270	4140- 4180	9.3	1.9	88.8	1.08	1.22	0.90
787-0300	4580- 4640	6.9	1.2	91.9	1.11	1.59	0.90
787-0330	5020- 5060	8.6	1.3	90.0	1.10	1.31	1.74
787-0350	5320- 5380	11.2	2.3	86.5	1.07	1.27	1.34
787-0370	5620- 5680	30.8	5.1	64.1	1.09	1.29	4.65
787-0390	5940- 5980	38.6	6.3	55.1	1.07	-	7.74
787-0400	6080- 6140	31.7	9.4	58.8	1.08	-	13.31
787-0420	6380- 6440	33.7	3.8	62.5	1.10	-	6.00
787-0430	6520- 6560	48.3	4.7	47.0	1.09	-	5.79
787-0440	6640- 6740	39.1	3.4	57.5	1.07	1.28	4.09
787-0460	6960- 7040	43.6	3.5	52.9	1.07	-	4.28
787-0480	7240- 7360	34.8	3.5	61.7	1.07	-	3.37
787-0500	7570- 7640	32.0	3.2	64.9	1.08	-	3.39
787-0520	7870- 7920	12.9	1.9	85.3	1.16	1.35	1.40
787-0530	8050- 8070	7.6	0.8	91.6	1.12	1.34	0.49
787-0540	8190- 8220	12.4	1.8	85.8	1.08	1.40	1.15
787-0550	8350- 8370	6.7	0.6	92.7	1.08	1.16	0.23
787-0560	8490- 8520	11.7	1.8	86.6	1.07	-	0.76
787-0580	8790- 8820	14.1	1.2	84.7	1.06	-	0.58
787-0600	9080- 9130	9.1	1.1	89.8	1.08	1.43	0.58
787-0610	9250- 9270	9.2	1.4	89.4	1.18	1.37	0.90
787-0620	9390- 9420	12.1	1.9	86.0	1.20	-	0.55
787-0630	9540- 9570	8.3	1.4	90.2	1.08	1.31	0.74
787-0640	9700- 9720	6.0	0.5	93.5	1.11	1.36	0.15
787-0650	9860- 9890	6.0	0.4	93.6	1.09	1.38	0.09
787-0700	10590-10610	9.3	1.2	89.5	1.04	-	0.63
787-0730	11040-11060	9.9	1.6	88.5	1.09	1.30	0.51

* In feet

Table 12-B

Saturate Hydrocarbon Analyses

Normalized Paraffin Distribution

GeoChem Sample Number	Well Interval*	% nC15	% nC16	% nC17	% ip19	% nC18	% ip20	% nC19	% nC20	% nC21	% nC22	% nC23	% nC24	% nC25	% nC26	% nC27	% nC28	% nC29	% nC30	% nC31	% nC32	% nC33	% nC34	% nC35
787-0010	227- 270	0.9	4.6	12.5	8.6	14.8	6.6	15.0	13.6	11.2	6.3	3.3	1.3	0.6	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
787-0070	1080- 1260	0.3	0.2	5.6	3.9	14.2	7.1	17.2	15.5	13.0	9.3	6.6	3.7	1.9	0.8	0.3	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
787-0080	1260- 1410	0.1	0.4	6.8	4.8	14.0	6.4	17.1	16.0	14.1	9.2	5.8	2.5	1.5	0.6	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
787-0120	1890- 1950	0.3	0.2	2.8	2.5	12.2	5.3	16.5	16.6	15.1	11.3	7.2	3.1	3.0	1.1	0.8	0.3	0.6	0.3	0.5	0.2	0.0	0.0	0.0
787-0170	2610- 2670	0.1	3.0	10.2	9.6	10.8	6.6	10.9	11.6	9.3	7.5	6.9	4.0	3.4	1.4	1.9	0.4	1.0	0.3	0.7	0.1	0.0	0.0	0.0
787-0220	3360- 3420	0.1	1.7	7.9	7.6	10.8	6.2	10.8	9.2	8.5	7.8	7.8	5.9	6.3	3.1	2.6	1.2	1.1	0.5	0.8	0.2	0.0	0.0	0.0
787-0240	3660- 3720	0.1	0.1	3.8	4.9	9.8	5.8	11.4	10.3	9.8	10.2	9.8	6.9	6.0	3.5	3.0	1.2	1.8	0.4	0.9	0.1	0.1	0.0	0.0
787-0270	4140- 4180	0.1	1.7	9.1	8.1	15.0	8.9	15.6	12.8	9.1	7.6	5.8	2.9	1.4	0.6	0.3	0.1	0.1	0.3	0.3	0.1	0.0	0.0	0.0
787-0300	4580- 4640	0.2	2.7	9.2	6.9	13.7	7.8	14.1	11.8	9.4	8.2	6.3	3.6	2.6	1.0	0.6	0.3	0.5	0.3	0.5	0.2	0.2	0.0	0.0
787-0330	5020- 5060	0.5	3.4	9.0	8.5	11.2	4.9	11.4	10.3	8.9	8.0	7.1	5.1	4.7	3.0	1.8	0.6	0.6	0.5	0.4	0.1	0.0	0.0	0.0
787-0350	5320- 5380	0.2	2.0	10.5	9.9	14.4	7.4	13.1	10.7	8.7	7.5	5.9	3.8	2.5	1.2	0.7	0.4	0.3	0.2	0.2	0.1	0.0	0.0	0.0
787-0370	5620- 5680	0.6	2.4	6.0	11.7	7.2	2.5	8.2	8.5	9.2	9.6	9.2	7.6	6.6	4.2	3.3	1.6	1.0	0.3	0.2	0.1	0.1	0.0	0.0
787-0390	5940- 5980	4.6	4.9	14.3	12.5	8.1	1.6	8.7	8.8	8.7	6.3	7.0	5.2	3.7	2.0	1.0	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
787-0400	6080- 6140	2.2	3.2	19.5	21.3	7.9	1.6	8.6	8.7	8.1	6.9	5.3	3.4	1.8	0.7	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
787-0420	6380- 6440	6.0	6.9	13.7	8.8	9.9	1.5	10.3	10.2	9.3	8.1	6.3	4.1	2.6	1.2	0.6	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
787-0430	6520- 6560	7.5	9.1	11.2	7.5	11.1	1.3	11.0	10.3	9.1	7.6	5.7	3.7	2.5	1.2	0.7	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
787-0440	6640- 6740	2.1	5.3	9.0	6.5	10.5	1.6	11.3	11.0	10.4	9.4	7.7	5.6	4.0	2.3	1.6	0.7	0.5	0.2	0.1	0.1	0.0	0.0	0.0
787-0460	6960- 7040	3.1	5.5	9.0	6.0	10.5	1.4	11.3	11.0	10.6	9.7	7.9	5.7	4.0	2.1	1.2	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0
787-0480	7240- 7360	5.1	7.1	9.4	7.0	10.3	2.1	11.0	10.5	9.9	8.9	7.0	5.0	3.4	1.8	1.0	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0
787-0500	7570- 7640	4.4	6.9	10.4	6.9	11.6	2.0	12.1	11.7	10.4	8.9	6.6	4.2	2.3	0.9	0.4	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
787-0520	7870- 7920	2.0	7.1	12.9	7.4	14.7	5.3	14.2	11.5	8.2	5.8	3.8	2.0	2.0	1.1	0.7	0.4	0.4	0.2	0.2	0.1	0.0	0.0	0.0
787-0530	8050- 8070	1.0	0.6	5.0	3.1	10.9	6.3	13.8	14.1	12.8	10.6	7.8	4.9	3.5	1.8	1.7	0.8	0.7	0.4	0.3	0.1	0.0	0.0	0.0
787-0540	8190- 8220	1.0	6.9	11.7	6.6	12.3	5.7	13.0	11.3	8.9	7.2	5.8	4.1	2.7	1.3	0.6	0.3	0.3	0.1	0.2	0.1	0.0	0.0	0.0
787-0550	8350- 8370	0.2	0.2	1.8	1.5	10.3	6.8	16.7	17.1	15.4	13.0	8.1	4.0	1.8	0.7	0.4	0.4	0.4	0.4	0.4	0.2	0.0	0.0	0.0
787-0560	8490- 8520	0.5	2.8	8.7	5.7	12.9	7.4	14.0	11.7	10.2	9.0	8.1	5.4	2.3	0.8	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
787-0580	8790- 8820	0.3	0.1	3.6	2.9	10.3	5.1	13.7	12.6	11.5	10.5	9.4	7.4	5.5	3.3	1.9	0.9	0.5	0.3	0.1	0.0	0.0	0.0	0.0
787-0600	9080- 9130	0.1	0.7	6.2	4.1	12.5	7.0	15.6	13.6	11.1	9.6	7.7	4.8	2.8	1.2	0.8	0.5	0.7	0.3	0.5	0.2	0.1	0.0	0.0
787-0610	9250- 9270	0.3	1.8	8.7	6.3	15.0	7.0	17.8	15.9	10.7	7.0	3.8	1.9	1.3	0.4	0.4	0.1	0.3	0.4	0.4	0.3	0.0	0.0	0.0
787-0620	9390- 9420	0.3	1.1	8.3	4.7	16.2	8.7	19.3	16.7	11.6	7.2	3.4	1.3	0.5	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
787-0630	9540- 9570	0.1	1.3	7.4	6.3	13.0	8.5	15.9	17.2	11.1	8.0	5.0	2.7	1.2	0.5	0.4	0.3	0.5	0.3	0.3	0.1	0.0	0.0	0.0
787-0640	9700- 9720	0.5	0.2	1.1	0.9	9.6	6.2	16.7	17.0	14.9	11.9	7.8	4.4	3.4	1.8	0.9	0.5	0.9	0.5	0.5	0.2	0.0	0.0	0.0
787-0650	9860- 9890	0.2	0.2	0.2	0.5	8.7	5.5	19.0	19.5	15.4	12.5	7.9	3.8	2.2	1.2	1.0	0.5	0.7	0.2	0.5	0.2	0.0	0.0	0.0
787-0700	10590-10610	0.1	1.1	6.2	4.3	10.0	6.7	10.5	8.8	9.1	12.1	13.5	9.4	4.8	1.7	0.7	0.1	0.4	0.1	0.4	0.0	0.0	0.0	0.0
787-0730	11040-11060	0.1	0.4	5.9	4.6	15.0	9.1	17.7	16.0	10.8	8.2	5.7	2.9	1.5	0.7	0.4	0.3	0.3	0.1	0.3	0.1	0.0	0.0	0.0

* In feet

Table 13

Visual Kerogen Assessment Worksheet

		TYPE OF ORGANIC MATTER		COLOR OF ORGANIC MATTER		STATE OF ORGANIC MATTER		MATURATION INDEX		DEPOSITION ENVIRONMENT		REMARKS

Table 14
Vitrinite Reflectance Summary

GeoChem Sample Number	Depth (feet)	Number of Readings	Minimum Reflectance (% Ro)	Maximum Reflectance (% Ro)	Average Reflectance (% R
787-008D	1260-1410	*	-	-	-
787-024D	3660-3720	40	0.33	0.96	0.65
787-030D	4580-4640	*	-	-	-
787-035D	5320-5380	*	-	-	-
787-040D	6080-6140	40	0.90	1.29	1.09
787-042D	6380-6440	44	0.80	1.42	1.18
787-044D	6640-6740	40	0.74	1.41	1.17
787-046D	6960-7040	43	0.74	2.14	1.40
	Population 1	2	0.74	0.96	0.85
	Population 2	16	1.14	1.54	1.34
	Population 3	25	1.63	2.14	1.89
787-048D	7240-7360	40	0.49	1.52	1.07
787-050D	7570-7640	47	0.27	1.94	0.99
	Population 1	4	0.27	0.42	0.35
	Population 2	11	0.69	0.99	0.87
	Population 3	32	1.00	1.94	1.52
787-052D	7870-7920	28	1.15	1.80	1.56
787-054D	8190-8220	41	1.56	2.26	1.95
787-056D	8490-8520	*	-	-	-
787-060D	9080-9130	*	-	-	-
787-063D	9540-9570	*	-	-	-
787-065D	9860-9890	*	-	-	-

Note:

* Insufficient kerogen return to prepare plug.

APPENDIX 3

Analytical Data on Maturity of Coal Samples

Alaska Peninsula Coals

<u>Item</u>	<u>Depth Fm. Interval (ft.)</u>	<u>Organic Carbon wt. %</u>	<u>Pyrolytic HC yield wt. %</u>	<u>Volatile HC content ppm</u>	<u>Pyrol. HC Org. Carbon %</u>	<u>Tmax °C</u>
Pan Am Hoodoo Lake No. 1						
1	1,220-50	54.6	9.34	n.d.*	17.1	399
2	1,940-70	58.4	7.35	"	12.6	395
3	3,440-70	47.0	5.17	"	11.0	391
4	4,430-90	58.8	6.82	"	11.6	393
5	5,840-70	51.3	2.84	"	5.54	455
6	7,460-90	36.8	4.30	"	11.7	458
7	8,030-40	59.3	10.37	"	17.5	453
Pan Am Hoodoo Lake No. 2						
8	5,620-40	40.1	6.96	4,230	17.4	490
9	6,780-6,800	49.1	5.76	7,500	11.7	509
10	7,580-90	76.6	7.79	5,250	10.17	511
Pan Am David River No. 1-A						
11	4,220-50	43.2	9.59	5,260	22.2	455
12	7,220-30	63.0	14.97	9,090	23.4	453
13	8,490-8500	13.4	0.39	200	2.9	481
14	9,660-70	59.4	7.95	9,870	13.4	506
15	10,240-40	13.8	2.66	1,830	19.3	478
16	12,240-50	0.25				
Cities Service Painter Creek No. 1						
17	1,018-19	29.1	4.41	830	15.2	489

APPENDIX 3 (continued)

<u>Item</u>	<u>Depth Fm. Interval (ft.)</u>	<u>Organic Carbon wt. %</u>	<u>Pyrolytic HC yield wt. %</u>	<u>Volatile HC content ppm</u>	<u>Pyrol. HC Org. Carbon %</u>	<u>Tmax °C</u>
AMOCO Cathedral River No. 1						
18	9,400-10	7.5	4.76	17,380	63.5	471
19	12,200-10	5.7	2.45	1,690	(40.3)	461
20	14,100-10	1.5	0.34	110		467

*n.d. = no data

Data supplied by George Claypool, U.S. Geological Survey, Denver, Colorado.

APPENDIX 4

Thin Sections

All thin sections are grain mounts of representative grains selected from bags of washed cuttings except core chips denoted by C after depth.

Cities Service Painter Creek No. 1

500-530	SS & SLST., Volcaniclastic.
1035-1036	Cgl. with clasts of vfg basalt and andesite.
1037-1038	SS, Volcanolithic subwacke, laumontite? vein filling.
1310-1340	Cgl. - With alt. basalt & andesite, granodiorite, stretched metachert.
1700-1710	SS - Qtz. & chert & aphanitic volcs., SLST.
2700-2710	Cgl. - Alt. basalt, granodiorite, qtz-hbl. schist, epidote granulite.
3940-3950	Cgl. - as above.
3980-3990	Cgl. - as above.
5340-5350	Cgl. - alt. basalt & diabase, granodiorite & gabbro, volc. SS
6050-6060	Cgl. - chert, qtzite, granodiorite, alt. mafics?, rare SS.
6070-6080	Cgl. - as above: higher % of alt. mafic volcs.
7000-7010	Cgl. - mafic volcs. alt. to Ab-Ep; granodiorite, jadeitized sed. rocks?
7410-7420	Cgl. - Alt. volcs.; chert, qtzite, lithic subwacke SS.
7800-7810	Cgl. - Alt. volcs. & granodiorite; jadeite granulite, chlorit prehnite bearing porphyry.

Gulf-Alaskaco Port Heiden No. 1

11,833-34	C Lt. gray alt. dacite microbreccia or crs. sandy tuff.
11,955-56	C Alt. vfg vesicular dacite porphyry.
15,000-01	C Hbl. - qtz. diorite, med. grd., equigranular.
15,014-15	C Hbl. - Biot. qtz. diorite, slightly altered.

Gulf Sandy River Federal No. 1

11,681-11,686	C SS - Qtz. - lithic arenite (liths. = chert, slst. & volc. porph.).
12,100-13,105	C SS - Qtz. lithic subwacke, heulandite? cement.
13,003-13,009	C SS - med. grd. feldspathic arenite, minor qtz. & volc. lith.
13,009-13,015	C Mudstone, v. dark gray, sheared, w/calcite veins.

Pan American Hoodoo Lake No. 1

1040-1070	SS and SLST., tuffaceous matrix, angular plag., pumice and glass shards.
3140-3170	SS and SLST., as above but contains rare diatoms.
4190-4220	Loose sand grains; Qtz., chert, plag., qtzite, volc. porph., garnet, m'cline, biot., brn.- hbl., slst.

Pan American David River No. 1A

3270-3480	SLST. - Dark brown, rare rounded sand-size qtz. grains.
4410-4740	SLST. - As above, carbonaceous; rare med. grd. volc. lith. SS
6750-7100	SS - silty, v.f.g. to med. grd.; some tuffaceous matrix.
7220-7500	SLST. - sandy, abundant carbonaceous laminae.
7950-8000	SS, f-med. grd., volc. liths. > Qtz. > chert, (volc. lith. arenite)
9320-9330	SS - Albitized, chloritized volcano-lithic arenite.

APPENDIX 4 (continued)

Pan American David River No. 1A

10,680-10690	SLST. - dark brown, laminated, carbonaceous.
11,640-11,710	SS - med. - crs. grd.; chert>plutonic liths.>qtz., CO ₃ cement.
11,740-11,750	SLST. - lt. brn., carbonaceous>SS, feldspathic-volc. lith. wa
11,880-11,890	SS - crs. - v. crs. grd., Qtz.>plag.>chert>volc. liths.
11,980-11,990	SS - as above, recrystallized qtz. cement & abundant zeolites
12,120-12,130	Sandy SLST - carbonaceous; probably volc. derived.
12,210-12,220	SS crs. - v.crs. grd., plag.>volc. liths>qtz., chloritic ceme
12,870-12,880	SLST. - and f. grd. SS; strongly sericitized.
13,350-13,360	Sandy SLST. - brownish green chlorite?, volc. derived.
13,430-13,440	SS, similar to 12,210-12,220.

AMOCO Cathedral River No. 1

690-700	Sandy SLST. - massive, quartzofeldspathic.
2800-2810	SS - med. grd., arkose w/grn. hbl. laumontite veins & cement.
3700-3710	Sandy SLST. - same as 690-700.
4900-4910	SLST. - gray, massive; SS-v.f.g., arkosic wacke and arenite.
5500-5510	SS - f. grd., feldspathic wacke, angular grains.
7400-7410	SS - f. grd., volc.-lithic feldspathic wacke, abund. hbl. & C
7600-7610	SS - same as 7400-7410; lithics altering to clay minerals.
8600-8610	Calcareous mudstn. - sandy, dark brown, carbonaceous.
11,690-11,700	Sandy mudstn. - carbonaceous laminae.
13,300-13,310	SS - volcanolithic subwacke & pebble cgl.; sparry CO ₃ veins.
14,290-14,300	Mixed liths. - sandy calcarenite, lam. carbonaceous SLST., calcareous arkosic SS.

Pan Am Hoodoo Lake No. 2

1980-2010	SS - well sorted, med. grd., f'spathic-volc'lithic subwacke.
4480-4680	SS - mostly basaltic lithic frags., various grain sizes, subwacke texture.
7510-7600	SS - well sorted, f. grd., volcanolithic wacke & subwacke.
8100-8200	SS - volcanoclastic, with abund. CO ₃ matrix, basalt, diabase.
10,210-10,220	Diabase & SS/med. to f. grd., qtz.-feldspar arenite, SLST.
10,480-10,490	Diabase, gabbro, rare sandy SLST., and arkose SS.
11,240-11,243	(T.D.) Tightly packed arkosic SS, SLST., diabase, rare basalt

Abbreviation Key

Ab	albite
alt.	altered
biot.	biotite
c	core sample
cgl.	conglomerate
CO ₃	calcite
Cpx	clinopyroxene
crs. grd.	coarse grained
Ep.	epidote
hbl.	hornblende
liths.	lithic or rock fragments
m'cline	microcline
qtz.	quartz
qtzite	quartzite
sed. rxs.	sedimentary
SLST.	siltstone
SS	sandstone
vfg.	very fine grained
volc. SS	volcaniclastic sandstone

APPENDIX 5

Paleontology

Sample intervals (in feet)	Section-Township-Range (Seward Meridian)
Cities Service Painter Creek No. 1	14-35S-51W
1800-1810	Barren
2280-2310	Barren
Gulf, Sandy River Federal No. 1	10-46S-70W
11,686-11,691	Barren
Pan Am, Hoodoo Lake No. 1	21-50S-76W
2590-2840	Barren
4010-4180	Barren
Pan Am, Hoodoo Lake No. 2	35-50S-76W
1519-1710	Barren
1710-1830	Barren
2100-2250	BATHYSIPHON sp. Sponge Spicules
3690-3930	ELPHIDIUM CALIFORNICUM Cook GLOBOBULIMINA PACIFICA? Cushman
Age:	Probably Early Tertiary
5400-5600	Barren
5800-6000	Barren
6600-6800	Barren
7510-7700	Barren
7680-7690	ELPHIDIUM CALIFORNICUM Cook Diatom (pyritized)
Age:	Probably Early Tertiary
8350-8540	Barren
8650-8660	Barren
9480-9490	Barren
9900-9910	Barren
11,090-11,100	Barren
Pan Am David River No. 1-A	12-50S-80W
3270-3480	Plant and wood debris Bivalve fragments
4410-4740	Coaly
6750-7100	Coaly
7270-7500	Barren
9000-9100	Barren
11,290-11,300	Barren
12,110-12,120	Barren
12,370-12,380	Barren
12,970-12,980	Barren
13,180-13,190	Barren
13,290-13,300	Barren
13,360-13,370	Barren
13,650-13,660	Barren

APPENDIX 5 (continued)

AMOCO Cathedral River No. 1	29-51S-83W
100-1000	Barren
1100-1930	Barren
3700-4700	Barren
6500-7400	Barren
8600-9600	Barren
9700-10,600	Barren
10,700-11,700	Barren
11,800-12,800	Barren
12,900-14,000	Barren
14,220-14,300	Barren

Palynomorphs

Cities Service Painter Creek No. 1
1800-1810

ALNUS
MOMIPITES

2280-2330

MOMIPITES
NYSSAEPOLLENITES

Age: Paleocene or Eocene

Gulf Sandy River Federal No. 1
11,686-11,691

LARIX/PSEUDOTSUGA
PICEA
PINUS
TSUGA
ALNUS
BETULA
PTEROCARYA

Age: Neogene, probably from Bear Lake Formation

Pan Am Hoodoo Lake No. 1
2590-2840 feet

LARIX/PSEUDOTSUGA
PICEA
PINUS
TSUGA
Taxodiaceae/Cupressaceae
ALNUS
BETULA
ULMUS/ZELKOVA
CENTROSPERMAE
LONICERA
Cyperaceae

4010-4180 feet

PICEA
PINUS
Taxodiaceae/Cupressaceae
TSUGA
ALNUS
BETULA
PIEROCARYA
Cyparaceae

Pan Am David River 1-A (continued)

6750-7100 feet

PICEA
 PINUS
 Taxodiaceae/Cupressaceae
 ALNUS
 BETULA
 FAGUS
 cf. QUERCUS
 PTEROCARYA
 ILEX

9000-9100 feet - Pollen sparse

PINUS
 TSUGA?
 ALNUS
 CARYA
 cf. QUERCUS

Age: 3270-9100 feet Eocene? Tolstoi or possibly Stepovak Formation

11,290-11,300 feet

PICEA
 ALNUS
 CARYA
 PTEROCARYA
 MOMIPITES
 TILIAEPOLLENITES
 PISTILIPOLLENITES

Age: Early to middle Eocene

12,110-12,120	Barren
12,370-12,380	Barren
12,970-12,980	Barren
13,180-13,190	Barren
13,290-13,300	Barren
13,360-13,370	Barren
13,650-13,660	Barren

APPENDIX 5 (continued)

Pan Am Hoodoo Lake No. 1 (continued)

7460-7550 feet

PICEA
PINUS
TSUGA
ALNUS
BETULA
ILEX?
Ericales

8000-8030 feet

PICEA
PINUS
TSUGA
ALNUS
BETULA
Ericales

Age: Later half of Miocene

Pan Am Hoodoo Lake No. 2

7680-7690 feet

8530-8540

8650-8660

9480-9490

9850-9860

9900-9910

11,090-11,100

All barren, except for 7680-7690 that contained non-diagnostic rare
palynomorphs.

Pan Am David River 1A

3270-3450 feet

PICEA
PINUS
Taxodiceae/Cupressaceae
ALNUS
cf. QUERCUS
PTEROCARYA
ULMUS/ZELKOVA
TILIA
HALESIA?

4410-4740 feet

PICEA
PINUS
Taxodiaceae/Cupressaceae
ALNUS
cf. QUERCUS
CARYA
ULMUS/ZELKOVA
Ericales