TERTIARY FORMATIONS AND ASSOCIATED MESOZOIC ROCKS IN THE ALASKA PENINSULA AREA, ALASKA, AND THEIR PETROLEUM-RESERVOIR AND SOURCE-ROCK POTENTIAL

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W. M. LYLE and J. A. MOREHOUSE
Alaska Division of Geological and Geophysical Surveys,

and

IRVEN F. PALMER, JR., and J. G. BOLM,
U.S. Geological Survey

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W. M. Lyle and J. A. Morehouse,[1]
and Irven F. Palmer, Jr., and J. G. Bolm[2]

ABSTRACT

Fourteen stratigraphic sections totaling over 16,000 feet (5,000 m) were measured in a 1977 joint State-Federal project to determine the petroleum-reservoir and source-rock potential of the Alaska Peninsula. The percentage of potential Tertiary reservoir sandstone to the total stratigraphic section measured ranges from less than one to 100 percent, with an average of 63 percent. Sandstones range from less than 3 feet to over 100 feet in thickness. Porosities and permeabilities are low in most areas as a result of pervasive pore-filling mineralization. Laboratory analyses indicate that potential reservoir rocks have been preserved in certain instances; however, their offshore extension is unknown.

Hydrocarbon C_{15+} extracts range from 37 ppm (parts per million) to 2,984 ppm; the average for 69 samples is 362 ppm, which is above the generally accepted level for petroleum source rock. Organic carbon ranges from less than 0.2 to more than 8.0 percent. Thermal alteration index (TAI), based on kerogen assessment, ranges from 1+ to 3+; most samples have a TAI of 2- to 2+. Major constituents are herbaceous-spore debris with lesser amounts of woody and amorphous-sapropel grains. Dry gas is the most probable hydrocarbon to form in these source rocks.

INTRODUCTION

A stratigraphic field project was conducted on the Alaska Peninsula during a 24-day period in June and July of 1977 by the U.S. Geological Survey (USGS) and the State of Alaska, Division of Geological and Geophysical Surveys (DGGS) (fig. 1). The project was similar in scope to previous cooperative State-Federal field projects completed in 1975 in the Gulf of Alaska Tertiary province and in 1976 in the uplands near lower Cook Inlet and Kodiak Island.

Both State and Federal agencies are responsible for the evaluation of petroleum potential of all submerged lands under their jurisdictions. Collaboration of State and Federal geologists on these projects results in uniformity in the collecting and processing of geological data and eliminates (or greatly reduces) duplication of effort.

Data are extrapolated into the adjacent submerged areas and serve as input to evaluation programs being conducted in all areas that have any future offshore lease-sale potential.

Two main bases of operation were used during the 1977 season: Cold Bay from June 14 to 18 and Bear Lake Lodge at Port Moller from June 18 to July 8.

Major emphasis was placed on measuring and sampling Tertiary stratigraphic sections, with a concentration on Miocene and Pliocene exposures. Some older Tertiary and Mesozoic exposures were also examined. Samples were collected for both a general areal resource evaluation and more detailed studies in relation to possible petroleum occurrences.

PERSONNEL AND LOGISTICS

This report combines two sets of data. In 1974 W. M. Lyle and P. L. Dobey (DGGS) collected data mostly in the Port Heiden-Chignik area; C. N. Conwell, R. M. Klein, and F. Larson (DGGS) joined this field party for a few days. In 1977 I. F. Palmer and J. G. Bolm (USGS) and W. M. Lyle and J. A. Morehouse (DGGS) collected data from the Cold Bay area northward along the Alaska Peninsula to Unga Island, Port Moller, Chignik, and Port Heiden. Ross Schaff, Alaska State Geologist, and D. L. McGee visited the project area in 1977.

The 1977 crew flew to Cold Bay on Reeve Aleutian Airways on June 14. The move to Port Moller area was made on Peninsula Airways June 17. Fuel was transported from Seattle to Sand Point, Alaska, by ship and then moved to work areas with a DeHavilland Otter.

The authors thank Louie Marincovich (USGS) for his identification of the macrofossils.

1 Alaska Division of Geological and Geophysical Surveys.
2 U.S. Geological Survey.

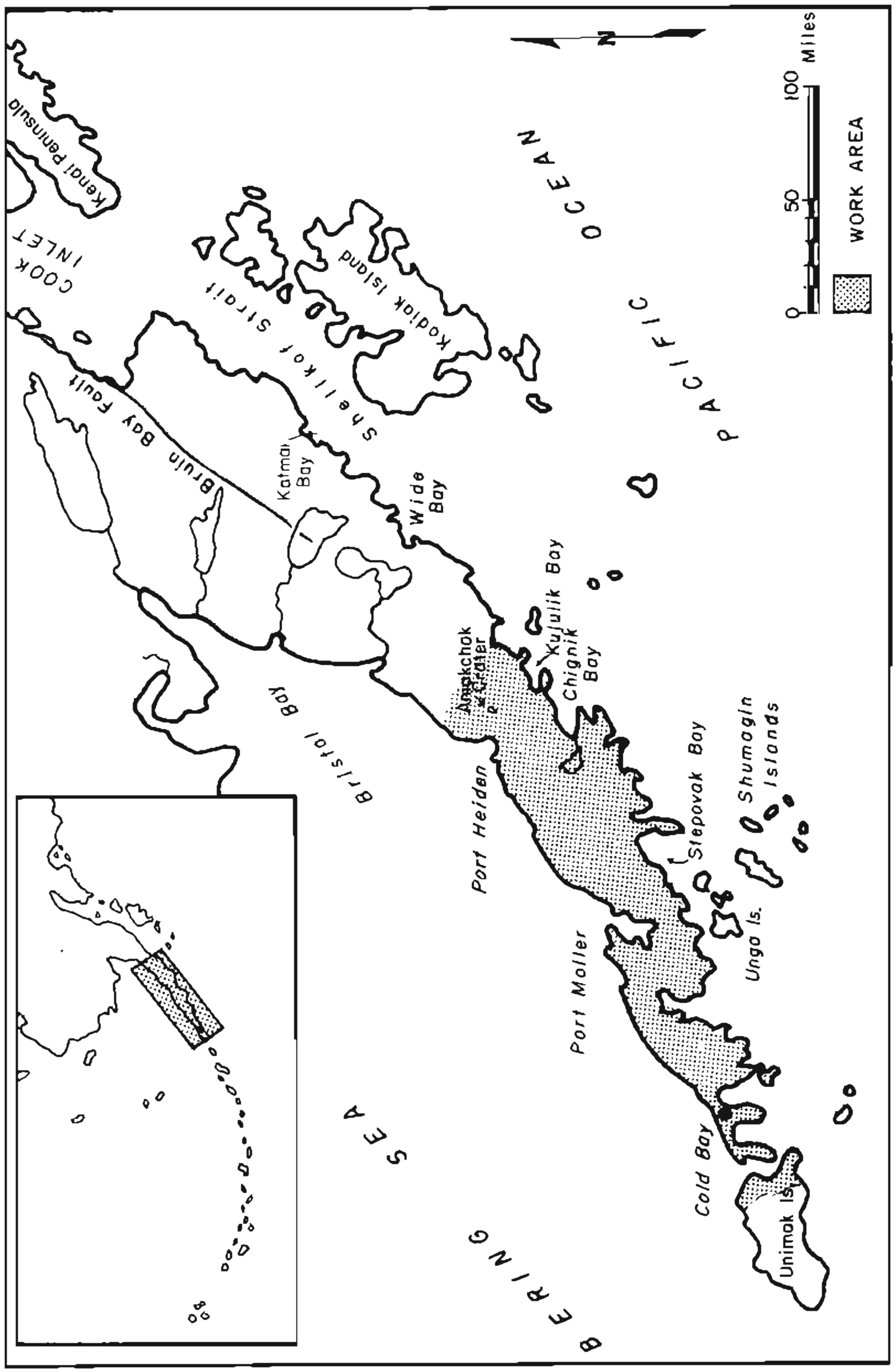

Figure 1. Index map showing the area of the 1977 State-Federal Alaska Peninsula stratigraphic projects.

FIELD METHODS

MEASUREMENT OF STRATIGRAPHIC SECTIONS

Stratigraphic sections were measured primarily with Brunton compass and tape. Occasionally it was necessary to use the helicopter altimeter to determine thickness. All stratigraphic thicknesses recorded on the stratigraphic sections are true thicknesses that were corrected for dip and slope directly in the field or at base camp prior to rough field drafting of sections. All field measurements are in feet and inches to be compatible with geological logs in common use by industry. A metric conversion scale is provided on each stratigraphic section.

LITHOLOGIC DESCRIPTIONS

Lithologic descriptions on the stratigraphic sections generally follow the accepted format listed below:

Rock type, descriptive modifier, color (from GSA Rock Color Chart), grain size (either Wentworth grade name or in actual metric measurements), sorting, lithologic constituents, statements concerning degree of induration, porosity, and sedimentary structures.

Abbreviations are commonly used to save time and space; notations such "as above" are freely used when there is little obvious difference between units.

SAMPLING

Samples from stratigraphic sections and spot sample localities were collected in 7 by 12-inch or 5 by 7-inch sample bags to provide enough material for laboratory analyses and for sample cuts for permanent library reference for both agencies. The "freshest" (least oxidized) samples available were taken by digging small pits into the outcrops or taking samples below the weathering "rind."

The numbering system included the sequence, collector's initials, and year (1-IP-77; 2-WL-77; 3-JB-77; etc.). The 1974 samples had one exception: all the samples on the Black Lake section had a 207 prefix, i.e., 207.21-WL-74; 207.22-WL-74; etc. On a few samples the letters A and B were used to denote that more than one sample was taken at the same locality.

Sample locations are numbered on the quadrangle maps (plates A through F), and cross referenced (tables 1A and 1B).

A total of 269 samples were collected: 79 for porosity and permeability determinations, 39 for hydrocarbon analyses, 39 for basin maturity determination, 34 for palynological age determination, 34 for micropaleontological age determination, 36 for geochemical analyses, 2 for lithology, 2 for orientation of sandstones, and 4 for macrofossil age determination.

STRATIGRAPHY

Rocks of Jurassic, Cretaceous, and Tertiary age crop out in the mountainous area along the Pacific coast of the study area. Stratigraphic sections in the area are interrupted by unconformities beneath formations that are Late Cretaceous, Paleocene, Miocene, and Pliocene in age.

Outcrop patterns of individual formations are controlled by large northeast-trending folds, which are the principal features in the area. In the northern part, bedrock is buried beneath the Quaternary glacial and alluvial deposits of the Bering Sea lowlands.

The following descriptions of the various formations that crop out in the study area are based on Burk's memoir of 1965.

NAKNEK FORMATION

The Naknek Formation is exposed extensively throughout the study area and consists of well to poorly bedded arkosic sandstones, conglomerates, siltstones, and mudstones, which either are interbedded or form relatively thick exposures of a single lithology. Sandstones and conglomerate matrices are typically feldspar, quartz, volcanic rock fragments, and chert. Granitic and metamorphic rocks are abundant among coarser clasts in conglomerates, and quartz and feldspar are predominant among coarser clasts in the siltstones and mudstones. Quartz is generally more abundant than feldspar in the fine-grained rock types, whereas feldspar is commonly more abundant than quartz in the sandstones and conglomerates.

The base of the Naknek Formation is not exposed anywhere in the study area. The maximum exposed thickness of the formation is about 5,000 feet near Amber Bay, but exposed thicknesses of more than 9,000 feet are known for the formation in areas northwest of the study area.

The Naknek is the oldest rock unit exposed in the study area. Sporadically abundant marine pelecypods, belemnites, gastropods, and ammonites indicate an Oxfordian to Kimmeridgian age for the formation. The common presence of carbonaceous plant debris and marine fossils suggests a nearshore marine environment of deposition for the formation.

CHIGNIK FORMATION

The Chignik Formation, well exposed at many locations, is unconformable to underlying rocks and grades from predominantly nonmarine near its base to marine in its upper part. The Chignik Formation and locally overlying siltstones of the Hoodoo Formation were interpreted by Burk (1965) to be a typical transgressive marine lithologic sequence, but more recently Mancini and others (1978) have reinterpreted the two formations to be time-equivalent lithofacies representative of deposition in nonmarine to inner neritic and outer neritic to bathyal environments, respectively.

The largely nonmarine Coal Valley Member of the Chignik Formation has been interpreted by Burk (1965) to be the basal part of the formation and by Mancini and others (1978) to be a nonmarine facies deposited simultaneously with the rest of the Chignik and Hoodoo Formations. The Coal Valley Member is composed primarily of well-bedded sandstones in which large carbonaceous plant fragments are common, often in association with abundant marine fossils. Sedimentary and volcanic rock fragments are major components of these sandstones; carbonate occurs commonly as cement and as a replacement of silicate clasts and may make up as much as 50 percent of the rock. Minor conglomerates, carbonaceous shales, and coal streaks are interbedded with the sandstones of the marine portions of the Chignik Formation.

The Coal Valley Member displays a maximum thickness of about 1,200 feet in Coal Valley and the area southeast of Staniukovich Mountain; it is absent in some locations. The upper marine portion of the Chignik Formation reaches a maximum thickness of about 2,000 feet near Herendeen Bay.

An irregularly abundant marine fauna dominated by pelecypods, principally Inoceramus schmidti, indicates that the Chignik Formation is Campanian.

HOODOO FORMATION

The Hoodoo Formation (Burk, 1965) is widely exposed and consists predominantly of well-bedded black and dark gray siltstones and shales with some interbedded fine-grained sandstones and conglomerates. Although slaty cleavage is not developed in the formation, abundant pencil-slate-like prismatic splinters are commonly formed by weathering of siltstones (fig. 2). Conglomerates contain typically well-rounded chert and volcanic, granitic, and argillitic pebbles and cobbles and have black siltstone or fine-grained sandstone matrices. Because of the incompetence of the predominant lithologies of the Hoodoo Formation, deformation of the formation is characterized by extreme folding and shearing which together account for the absence of any known complete and undisturbed stratigraphic section.

The contact between the Hoodoo and Chignik Formations is gradational, and the Hoodoo Formation was interpreted by Burk (1965) to be a more distal facies than the Chignik Formation in a single marine-transgressive sequence; Mancini and others (1978) reinterpreted the Hoodoo Formation as a more distal time-equivalent lithofacies in the same stratigraphic interval as the Chignik Formation. D. L. McGee (DGGS report in preparation) accepts both Burk's and Mancini's interpretations and suggests that the lower part of the Chignik Formation is time-equivalent to both the lower part of the Hoodoo Formation and the Coal Valley Member followed by a transgressive event in which the marine Chignik and Hoodoo Formations overlapped the previously deposited nonmarine Coal Valley Member. This order of deposition best fits the lateral interfingering of the formations and the upward grading of the Coal Valley Member into the Chignik marine sequence. The greatest known thickness of the Hoodoo Formation is more than 2,000 feet and perhaps as much as 3,000 feet in the area between Herendeen and Pavlof Bays.

Fossils are extremely rare in the Hoodoo Formation, but the few marine pelecypods, cephalopods, and ammonites that are found in the formation suggest an age of Campanian to early Maestrichtian.

TOLSTOI FORMATION

The Tolstoi Formation (Burk, 1965) crops out extensively north of Pavlof Bay and consists largely of brittle black siltstones made up of poorly sorted andesitic and basaltic volcanic debris with interbedded mafic volcanic flows and sills in some localities. The formation unconformably overlies older formations and has a thickness of about 5,000 feet everywhere except in the area south of Mt. Veniaminof, where it is about twice that thickness.

Although a rich Paleocene to possibly early Eocene fossil flora was found in this essentially nonmarine formation, middle and late Eocene marine mollusks were found in two localities. The Tolstoi Formation represents the early part of a marine-transgressive lithologic sequence (fig. 3).

STEPOVAK FORMATION

The Stepovak Formation (Burk, 1965) consists of an alternating sequence of thin-bedded mudstones and massively bedded mudstones and siltstones. It contains several thin coals and many carbonaceous zones throughout the section and also some thin petrified wood zones.

The formation was deposited in the Oligocene under conditions ranging from swampy (as suggested by thin coals and coaly zones) to marine (questionable Foraminifera and shell fragments).

The contact between the underlying Tolstoi Formation and the Stepovak Formation is gradational. The Tolstoi is massively bedded, whereas the Stepovak is thin-bedded. The detrital grains of the Stepovak and the Tolstoi Formations are similar; volcanic rock fragments make up about 50 percent of the detrital grains: plagioclase feldspar (more than 20 percent), quartz (less than 10 percent), and other rock fragments (more than 20 percent).

BEAR LAKE FORMATION

The Bear Lake Formation consists of a sequence of rocks ranging from nonmarine to shallow marine. Thickness estimates vary from 5,000 to 10,000 feet. The oldest rocks of the formation are exposed in the Unga Island-Cape Aliaksin area (Wisehart, 1971). These rocks are dominantly volcanic and volcanically derived sediments. This basal part of the formation is Burk's Unga Conglomerate Member of the Bear Lake Formation and has been assigned a middle(?) Miocene age from marine invertebrate fossil data. Upper Oligocene(?) plants have also been reported from Unga Island (Burk, 1965).

In general, the Bear Lake Formation is a transgressive sequence with nonmarine beds, including coal, in the basal part of the section and fossiliferous, marine sandstones in the upper part of the section. Local regressive cycles can also be identified. The section contains zones of marine and nonmarine conglomerates. On the Bering Sea side of the study area near Port Moller and Milky River, the section is predominantly clayey sandstone with lesser amounts of siltstone and conglomerate. For the most part these sandstones are too friable to permit collection of representative samples for porosity and permeability evaluation.

The amount of plutonic detritus in the Bear Lake Formation increases to the north on the Bering Sea side of the study area and is interpreted as the initiation of erosion of the mid-Tertiary plutons which had not been unroofed yet during the deposition of the Unga Member. Therefore, the Port Moller-Milky River rocks are younger than those in the Unga Island-Cape Aliaksin area (Wisehart, 1971). Burk (1965) came to a similar conclusion using macrofossil and stratigraphic data.

The Port Moller area rocks represent a regressive sequence that grades upward from coarse-grained, large-scale crossbedded sandstone and flaser-bedded siltstones to pyritic siltstones and highly fossiliferous conglomerates (Wisehart, 1971).

Rocks of the Bear Lake Formation suggest deposition at the seaward edges of two geographically distinct accreting and subsiding alluvial plains in a tidal delta-barrier bar environment. The sediments deposited on the older of these two plains represent the lower Miocene basal Unga Member of the Bear Lake Formation. They consist of a thick sequence of rapidly deposited debris to the north of the uplifted Shumagin batholith. The younger of the two plains was built northward from a series of quartz diorite plutons that intruded the Unga Member and other sedimentary rocks during the Miocene along a line approximating the present Pacific coastline of the Alaska Peninsula.

The depositional environment for most of the Bear Lake sediments appears to have been that of tidal flats and tidal channels formed in lieu of an offshore barrier bar complex. Quiet water, backshore paludal and fluviatile deposition are indicated by the sediments (Wisehart, 1971). Overall age for the Bear Lake Formation is middle(?) and late Miocene.

TACHILNI FORMATION

The Tachilni Formation crops out in sea cliffs along the southeast coast of the Alaska Peninsula west of Cold Bay. The formation consists of poorly consolidated, brown to greenish gray sandstones and conglomerates with minor black shales; volcanic rock fragments and chert are predominant among clasts in the sand and coarser size grades.

The base of the Tachilni Formation is not exposed, and the top of the formation is gradational with overlying volcanic rocks. A marine fossil fauna, dominated by early Pliocene mollusks, is abundant locally in the formation. The overall age of the Tachilni, on the basis of gastropods, is considered to be late Miocene to early Pliocene (Nelson, 1978).

MEASURED STRATIGRAPHIC SECTIONS

BLACK LAKE (plate I)

The Black Lake stratigraphic section is located in sec. 3, T. 43 S., R. 60 W., Seward Meridian. The upper 600-plus feet of the Bear Lake Formation in this section is an alternating sequence of siltstone and sandstone (figs. 4 and 5). The topmost 100-plus feet has been oxidized dark reddish brown and appears to have been heated by contact with nearby intrusive igneous rocks. A 500-foot-thick massive sandstone unit with some reed imprints and floating pebbles occurs 687 feet below the base of the Milky River Formation (Galloway, 1974). This unit caps a series of 5- to 25-foot-thick alternating sandstone and conglomerate, which in turn overlie a 270-foot-thick conglomeratic sandstone with oscillation ripple marks and carbonaceous trash. The basal 640 feet is a series of massive sandstone and shales with some conglomerate and mudstone.

MILKY RIVER (plate II)

The Milky River stratigraphic section is in secs. 33 and 34, T. 48 S., R. 69 W., Seward Meridian. It contains more than 80 percent sandstone, sandy conglomerate, and sandy mudstone. The beds are predominantly massive. The upper section is capped unconformably by volcanic layers, tuffs, and water-deposited volcanically-derived sandstone (figs. 6 and 7). Pelecypods and gastropods are commonly present in the upper 158 feet of the section. Several other thin zones also have pelecypods, and some thin zones are coaly or contain petrified wood. The presence of marine fossils and of channel cut-and-fill sandstones and conglomerates (fig. 8) suggest that the depositional environment ranged from shallow marine to fluvial.

There are few mudstones or shales in this measured section. In general, the C_{15+} extracts from the limited hydrocarbon source beds of the Bear Lake Formation are moderately high (over 500 ppm average).

SOUTHEAST BEAR LAKE (plate III)

This measured section is located at the east end of Bear Lake along a prominent ridge in secs. 20 and 29, T. 49 S., R. 70 W., Seward Meridian (fig. 9), where the Miocene Bear Lake Formation consists almost entirely of friable sandstone and is capped and preserved by lava flows, mudflows, and ash beds. Locally the section is conglomeratic. Cut-and-fill channel deposits, lenticular sandstone beds, high-angle festoon crossbeds, and the presence of wood and coaly debris indicate a fluvial environment of deposition for most of the measured section. At least 143 feet of the section contains numerous pelecypods, including pectins, and gastropods, which indicate that the depositional environment for this part of the section was marine, probably in the shore-face regime. Zones of fossil hash are also present.

HEREN I and II (plates IV and V)

The Heren stratigraphic sections are exposed in a sea cliff along the south side of Herendeen Bay near the Heren triangulation station in sec. 9, T. 51 S., R.74 W., Seward Meridian (fig. 10). Heren I stratigraphic section is composed of interbedded sandstone and mudstone of the Tolstoi Formation that total 143 feet. The basal part of this section is grass covered near the beach, and the upper part terminates at a fault that separates Heren I from Heren II. Palynological data indicate a Paleocene(?) or early Eocene(?) age and suggest a marine environment of deposition. Numerous burrows in one thin sandstone and the presence of coaly streaks and carbonaceous debris suggest a shallow marine to transitional environment.

The Heren II stratigraphic section, which overlies Heren I across a fault contact, is 172 feet thick and consists of unnamed interbedded sandstone, mudstone, carbonaceous mudstone, and coal. This section is also Paleocene to early Eocene in age. If the throw on the fault separating the two sections is small (as indicated by limited drag features), then a stratigraphic sequence is suggested that begins with shallow marine in Heren I and becomes nonmarine upward into Heren II. These outcrops have previously been mapped as Pliocene by Burk (1965), probably on lithologic characteristics only.

Porosity ranges from 0.3 to 11.8 percent and averages 7.3 percent; permeability ranges from 0.06 to 8.50 mD and averages 0.95 mD.

WATERFALL POINT (Plate VI)

This measured section is located in secs. 30 and 31, T. 51 S., R 69 W., Seward Meridian, where the Oligocene Stepovak Formation is well exposed in cliffs at Waterfall Point on the west side of Stepovak Bay.

The predominant lithologies in this section are olive or greenish gray, fine to coarse sandstone, dark-gray to black or brownish-black mudstones, and grayish or greenish black siltstones. Sandstones tend to be pebbly, and crossbedding is common. Calcareous concretions, commonly with ragged surfaces, occur along some bedding surfaces in sandstones, and some sandstone layers are carbonate cemented. Fossil marine pelecypods and to a lesser extent gastropods are abundant in some sandstone horizons.

Sandstone samples from this section have porosities of 1.7 to 12.1 percent; the sample that tested 12.1 percent porosity is calcareous, and petrographic examination suggests that pore spaces are largely of solution origin and not well connected (permeability for this sample is 0.06 mD). Organic carbon content of mudstones in this section is very low (0.26 to 0.42 percent).

LEFTHAND BAY–BALBOA BAY (plate VII)

This stratigraphic section is located in sec. 29, T. 53 S., R. 73 W., Seward Meridian, where the Stepovak Formation is exposed in a ridge that extends northward from the mouth of Lefthand Bay (fig. 11). The line along which the section was measured is offset across a covered interval of about 300 feet stratigraphic thickness near the center of the section.

Mudstone and siltstone are the predominant lithologies in the section; these rocks are various shades of olive or greenish gray. Thin sandstone and carbonate beds and carbonate nodules are located in the lower half of the section, and thin bentonite beds and a tuff bed occur in the upper half.

Organic carbon content in samples from this section is very low (0.23 to 0.86 percent), and a single sample that was tested had a porosity of 1.7 percent and a permeability of 0.02 mD.

BEAVER BAY AND BEAVER BAY EAST (plates VIII and IX)

The Beaver Bay and Beaver Bay East stratigraphic sections are located in secs. 13, 14, and 24 and secs. 32

and 33, respectively, in T. 54 S., R. 77 W., Seward Meridian (fig. 12). Siltstone and mudstone, typical of the Stepovak Formation, predominate. Locally thin sandstones and conglomerates are present. Carbonaceous debris and petrified wood occur in the nonmarine portion of the section. A minor part of the section contains symmetrical ripple marks and burrows. The environment of deposition ranges from mudflats to shallow water marine. The sandstones are generally thin, silty, and of poor reservoir quality.

ALIAKSIN PENINSULA (plate X)

This measured section is exposed in a prominent sea cliff and is located in sec. 18, T. 54 S., R. 75 W., Seward Meridian (figs. 13-17). The sandstone, conglomerate, and conglomeratic sandstone section is equivalent to the Unga Conglomerate Member of the Bear Lake Formation. The environments of deposition range from shallow marine (as attested by burrows, pelecypods, pectins, and gastropods) to fluvial or delta-plain stream cut-and-fill deposits with cross-laminations, conglomerate pods, and many boulder and cobble zones. Coal fragments and carbonaceous debris are common in the nonmarine deposits. A large percentage of the clasts are volcanogenic. The sands are friable and generally yellowish brown to dark gray.

WHITE BLUFF (plate XI)

The White Bluff stratigraphic section is located in sec. 5, T. 56 S., R. 74 W. and in sec. 32, T. 55 S., R. 74 W., along east-facing cliff exposures bordering Zachary Bay on Unga Island (figs. 18-21).

The section totals 948 feet and consists of interbedded mudstones, sandstones, and conglomerates with minor amounts of coal, tuff, and conglomerate. One coaly zone is near the base of the section and the other is about 334 feet up in the section. Individual coal beds range from a few inches to 2 feet thick.

Palynological determinations indicate a nonmarine depositional environment during a warm paleoclimate in Tertiary time (possible Eocene, Oligocene, or middle Miocene). Small evolutionary changes in the Tertiary pollen spectrum preclude assignment to a single epoch; lithologic similarities favor assignment of these beds to the Unga Conglomerate member of the Miocene Bear Lake Formation, however. Approximately one-third of the total section is sandstone and conglomerate that can be considered potential reservoir rock. Some sandstones are too friable to permit sampling for porosity and permeability. The only sample that survived transport and handling had 4.2 percent porosity and 0.06 mD permeability.

EAST MORZHOVOI BAY (plate XII)

This stratigraphic section is located in sec. 35, T. 60 S., R. 90 W., Seward Meridian, where the Miocene to Pliocene Tachilni Formation is exposed in cliffs north of Cape Tachilni on the east side of the mouth of Morzhovoi Bay (figs. 22-24).

The measured section, which is offset about ¼ mile with an overlap near its center, is predominantly poorly consolidated sandstones, mudstones, and conglomerates; individual beds are so discontinuous laterally that the exact amount of overlap between the two parts of the section cannot be determined. Sandstones in the section are locally calcareous, commonly pebbly, crossbedded, and, on weathered surfaces, jarosite-stained. Calcareous concretions are common in the sandstones and conglomerates. Petrified wood is present in the section, and fossil marine mollusks are abundant in some layers. Minor thin, light brownish or greenish gray claystone beds in the section are probably altered volcanic ash.

Organic carbon content in mudstone samples from this section is very low (0.28 to 0.69 percent). Much of the sandstone in the section is too friable for porosity and permeability measurements. Two samples collected had porosities of 11.6 and 20.1 percent and permeabilities of 2.42 and 2.0 mD. However, there is almost no visible porosity in these samples.

WEST MORZHOVOI BAY (plate XIII)

This section is located in secs. 19 and 30, T. 61 S., R. 92 W., Seward Meridian. The Tachilni Formation section is topped by a 400- to 500-foot-thick series of resistant volcanic flows and breccias. Angular volcanic clasts are found in the conglomerates, conglomeratic sandstones, and the 35-foot-thick breccia that make up the rest of the section. Broken shells are found in a 95-foot-thick sandy conglomerate, and some pelecypods in a 45-foot-thick bed of massive sandstone. Several andesite dikes occur in the lower half of the section.

This exposure is considered to be Pliocene by Burk (1965) and late Miocene to early Pliocene by Nelson (1978).

RESERVOIR CHARACTERISTICS

Significant thicknesses of potential reservoir rock occur throughout the Alaska Peninsula. Pore-filling cements are pervasive throughout most of the outcrop samples examined, but selected outcrop samples and well log analyses indicate that the porosity of some of the potential reservoir rock has been preserved. This preservation could have resulted from early migration of hydrocarbons, although there is no evidence to support this.

RESERVOIR GEOMETRY AND SIZE

Measured sections and well data indicate that thick reservoirs should be present in the Miocene Bear Lake Formation. Greater quartz content and types of depositional environments of deposition make this formation a primary drilling objective. Potential reservoirs should have the large areal extent typical of tabular sand bodies that result from linear clastic shoreline deposition. Geometry consistent with beaches, upper and middle shoreface deposits, and offshore bars should be present in the subsurface.

The Stepovak Formation has very thin sandstones and sandstone stringers that are not expected to have good reservoir characteristics.

Some massive sandstones that are present in the Tolstoi and Chignik Formations are of poor quality onshore but cannot be ruled out as possible reservoir rock in nearby submerged lands. One or more stratigraphic tests will be needed offshore to evaluate the reservoir quality of these rocks.

Discrete sandstone thickness determinations and sandstone percentage determinations have been made for the stratigraphic sections measured. These determinations are all for Tertiary sandstones ranging in age from Paleocene(?) or Eocene(?) to Pliocene. Sandstone thicknesses have been grouped into three thickness categories: 0-15 meters, 15-30 meters, and greater than 30 meters. These data are tabulated on Table 2.

The percentage of sandstone in the total stratigraphic section measured ranges from less than 1 percent to 100 percent and averages 62.8 percent for all ages (table 2).

RESERVOIR POROSITIES AND PERMEABILITIES

The porosities and permeabilities (table 3) range from low to fair in the Tolstoi and Stepovak Formations to fair to good in the Bear Lake Formation. The Bear Lake Formation is friable and difficult to sample. Permeability is very low to nonexistent in the Tolstoi and Stepovak Formations and low in the Bear Lake Formation except for three high permeabilities of 990, 72, and 53 mD. Most samples had permeabilities of less than 1 millidarcy.

RESERVOIR STRUCTURE AND SPATIAL RELATIONSHIP

All the stratigraphic sections in this report were measured in either homoclinal dip areas or on the limbs of folds where comparison of units or bed sequences was not possible between the different flanks of a structure. Deposition during the Tertiary was sporadic and complex.

General observations indicate that there are no preferential areas, directions, or flank positions where reservoir rocks are preserved. Transitional and strandline sand bodies should be oriented roughly parallel to the existing Alaska Peninsula shoreline (Selley, 1970). Fluvial sand bodies should have an orientation normal to the existing coastline, as should offshore deepwater turbidite deposits (Middleton and others, 1973). In general, all surface structure post-dates reservoir deposition.

BASIN MATURITY

Kerogen-type assessment and thermal alteration index (TAI) determinations were run on the 69 samples collected from stratigraphic sections and spot sample locations. Fifty-eight samples are from Tertiary exposures, and 11 samples are from Cretaceous outcrops. The Tertiary samples have a TAI level that ranges from 1 to 3- with an average of 2. (A TAI level of 2 equates to a moderately mature hydrocarbon-maturation level.) Cretaceous samples have a range of 2- to 3+. These alteration levels equate to a moderately mature to a very mature maturation level.

Kerogen constituents in all samples are dominantly herbaceous-spore/cuticle with secondary, amphorous, woody, or coaly grains. Thus, the most likely hydrocarbon to be generated is dry gas. There are, however, significant amounts of amphorous material present in most of the samples, which suggest the capability for generation of some liquid hydrocarbons.

Table 4 shows the kerogen assessment as processed by Geochemical Laboratories Incorporated.

HYDROCARBON SOURCE ROCKS

Source rocks on the Alaska Peninsula range from fair to good, from 37 to 2,984 ppm hydrocarbon. The average for 69 samples is 362.3 ppm hydrocarbon.

An analysis of hydrocarbon content by rock age indicates that hydrocarbon content is higher in younger rocks:

Jurassic and Cretaceous	105 ppm (11 samples)
Eocene	No data
Oligocene	290 ppm (26 samples)
Miocene	550.5 ppm (27 samples)
Pliocene	627 ppm (4 samples)

The highest values of 2,984, 1,947, and 1,372 ppm occurred in the Miocene Bear Lake Formation. The lowest values 55 through 89 were in the Cretaceous Hoodoo Formation.

STRUCTURAL GEOLOGY

The study area is the site of extensive volcanism, and the sedimentary rocks of the area have been folded, faulted, and intruded by plutonic and hypabyssal rocks. The general structural relationships in the area have been described by Burk (1965), and the following outline is based on his work.

Three en echelon anticlinal complexes that deform rocks of Middle or Late Jurassic to Pliocene age are the principal structures in the study area. These anticlinal complexes are located between Katmai Bay and Aniakchak Crater, between Kujulik Bay and Stepovak Bay, and between Stepovak Bay and Cold Bay. Fold axes in these complexes trend generally northeastward and diverge slightly in a clockwise sense from the axis of the peninsula; fold style seems to vary in relation to rock competence, with shales and siltstones more tightly folded than sandstones and conglomerates.

Major steeply dipping reverse longitudinal faults are located in the southern flanks of most anticlines. Displacement across these faults is generally greatest near the culminations and decreases toward the noses of the folds. Smaller steeply dipping normal longitudinal faults are located in the northern flanks of some anticlines.

The abundance of steeply dipping reverse and normal faults and a tendency of anticlines to have broad crests and monoclinal flanks suggest that basement faulting may have played an important role in the structural development of the study area. Plutons of Jurassic, early Tertiary, and middle Tertiary age crop out in or adjacent to the study area, and it is evident that extensive differential vertical movements have occurred in the area following each period of plutonism.

Outcrops of plutonic rocks of various ages are located along discernible trends: Jurassic plutons crop out along the peninsular axis, lower Tertiary plutons crop out in islands southeast of the peninsula, and middle Tertiary plutons crop out along the southeastern coast of the peninsula. Similarly, recent volcanoes tend to be aligned along and older volcanoes somewhat southeast of the axis of the peninsula. No consistent general relationship between plutonic or volcanic igneous activity and structural configuration has been detected in the study area, however.

PETROGRAPHY

Forty-six samples of sandstones from measured stratigraphic sections and spot localities in the study area were examined petrographically. Of these 46 samples, 2 were from the Naknek Formation at Bold Bluff Point on Herendeen Bay; 5 were from the Chignik Formation at Gull Point on Herendeen Bay and the low sea cliff of Staniukovich Mountain; 14 were from the Tolstoi Formation in the Heren I and II stratigraphic sections and at an unnamed mountain northwest of Beaver Bay; 9 were from the Stepovak Formation in the Beaver Bay and Waterfall Point stratigraphic sections; 12 were from the Bear Lake Formation in the Black Lake and Milky River stratigraphic sections; and 4 were from the Tachilni Formation in the East and West Morzhovoi Bay stratigraphic sections. Sample locations and a summary of petrographic data for representative samples are presented in Table 5.

Framework clasts in all the samples are dominated by chemically unstable constituents indicative of derivation from predominantly igneous source terranes, variations in which are reflected in differences in the clastic compositions of samples from the various studied formations. The arkoses of the Naknek Formation are compositionally similar to typical quartzose intermediate granitic rocks with a slight admixture of volcanic clasts, and it is evident that Naknek sediments were derived from a predominantly plutonic source. The sandstones of the Chignik Formation are characteristically litharenites in which volcanic and fine-grained sedimentary clasts predominate, and a mixed volcanic and sedimentary source terrane is indicated. Sandstones in the Tertiary formations are volcanic arenites dominated by volcanic clasts, which indicates a volcanic source area; a particular abundance of quartz in samples from the Bear Lake Formation suggests that significant recycling of older sedimentary rocks may have played a role in the deposition of that formation. Pumpellyite was observed among clasts in samples from the Tolstoi and Tachilni Formations, and a glaucophane clast was seen in one sample from the Stepovak Formation; some zeolite- and blueschist-facies rocks must have cropped out somewhere in the source terranes of these formations.

There is little visible pore space in any of the samples examined; most samples have no visible pore space. This lack of visible porosity is the result of deformation of ductile clasts, primarily volcanic or sedimentary rock fragments, during compaction and filling of any remaining potential pore spaces with various ferruginous, phyllosilicate, tectosilicate, and carbonate materials. These features, which have caused the low visible porosities (and low measured permeabilities) of the samples, have resulted from diagenesis of the rocks; there may be better porosity in similar sandstones in the subsurface or offshore in adjacent OCS (Outer Continental Shelf) areas.

For every formation studied, except the Naknek (from which only two samples were examined), there are samples in which porosity has been reduced either by ductile grain deformation or by filling of potential pore spaces. The more authigenic pore-filling material there is in a sample, the less deformed are the ductile grains in that sample. In these samples compaction was accomplished largely by ductile grain deformation after burial; the introduction of authigenic pore-filling material arrested such grain deformation and prevented further compaction.

Pore-filling phases in the samples include amorphous ferruginous material, authigenic clays (including chlorite), carbonate, zeolite, quartz, and authigenic albite. Amorphous ferruginous material and authigenic clay commonly coat clasts and generally underlie and thus predate any other pore-filling phases that may be present; these two materials and carbonate are the only pore-filling phases that were observed alone in any of the samples. Quartz was observed in partial syntaxial overgrowths on some quartz clasts but was never seen to form a complete cement in any samples; such syntaxial overgrowths may have formed during a previous sedimentary cycle.

In several samples where two or more pore-filling phases coexist, textural evidence such as embayments indicates a replacement relationship among the phases; replacement or partial replacement of framework clasts by pore-filling materials is common in the samples, too.

Intragranular fractures were observed in many of the samples. Such fractures are filled with the same pore-filling materials as fills potential intergranular pore spaces in the same sample; thus fracturing occurred prior to emplacement of the pore-filling materials. In several of these samples ductile grains are little deformed, and fracturing must have occurred as a result of partial dissolution of the rock after cementation had arrested deformation of ductile clasts. Further cementation after fracturing brought rocks to their present configuration. The past existence of secondary porosity is further indicated in some samples by the occurrence within pore-filling carbonate or zeolite of fragments of clay coats broken away from clast surfaces, and the large size of some intergranular spaces suggests that they were formed by dissolution after primary compaction had ceased. In none of the samples where compaction by ductile grain deformation was completed is there any evidence of secondary porosity ever having existed.

The formation of secondary porosity results from changes in the physical and chemical conditions in a rock such that a material that was once stable becomes unstable and is dissolved away. Similarly the filling of secondary porosity requires certain physical and chemical conditions to precipitate the pore-filling phase. Both these types of changes have occurred in at least some of the samples studied, and burial and uplift probably figured significantly in achieving and changing physical and chemical conditions in the samples. In one sample (23-WL-77, Stepovak Formation, Beaver Bay) there are two generations of carbonate cement separated by a layer of authigenic chlorite, which also fills intragranular fractures. Early carbonate cementation prevented complete destruction of intergranular spaces by ductile grain deformation, and subsequently, secondary porosity was formed by dissolution of carbonate. As secondary porosity became more extensive, renewed compaction led to the formation of intragranular fractures, but infilling of secondary pores and intragranular fractures with chlorite prevented completion of compaction. Finally chlorite was replaced by carbonate, but the process was not completed. The change from conditions where carbonate was precipitated to those where it was dissolved and finally to where chlorite was precipitated all probably resulted from increasing depth of burial. Similarly the return to conditions favoring the precipitation of carbonate probably resulted from uplift. This sample might have had significant porosity today had it remained at some depth where carbonate was soluble and chlorite not yet stable. Such secondary porosity may exist at least locally in similar rocks at depths favorable for the formation of petroleum reservoirs in offshore areas adjacent to the study area.

GEOCHEMICAL ANALYSES

One hundred and eight stream sediment and two whole rock samples were analyzed for the presence of gold, silver, copper, lead, zinc, molybdenum and antimony (table 6). Sample 55-IP-77, from Unga mine tailings, is not a stream-sediment sample.

PALEONTOLOGICAL DETERMINATIONS

A total of 19 outcrop samples were processed and analyzed for palynological age determinations (table 7). All samples with definable ages were from Tertiary strata.

As the results in Table 7 show, the nonmarine Tertiary samples are difficult to place in any defined age subdivision. In the Alaska Peninsula study area, the nonmarine Tertiary section displays slight or no evolutionary changes in the pollen spectrum. In Oligocene and younger strata, we are dealing mainly with climatic fluctuations, whereas a few unique species may be used in distinguishing Paleocene or Eocene strata. Due to these factors, it is impossible to assign any given sample to a single epoch. Other information, such as sample location on columnar sections or geologic maps, could assist in age interpretations of floras. It is also desirable to have sufficient section coverage in sampling so that a known or reliably definable age boundary is crossed; this boundary can then be used as a datum to which the other unknowns may be related.

Table 8 lists the macrofossils found in samples from the Bear Lake, Stepovak, and Talchilni Formations.

GRAVITY CONTROL

Gravity values from over 200 newly occupied stations during the 1977 field season are currently being reduced and integrated with previous gravity surveys conducted by the Alaska DGGS in 1974 and by the U.S. Geological Survey. Bouguer gravity will be determined with a common datum for all gravity surveys conducted over the project area. Gravity data and interpretation maps will be published when computer programming and data compilation are completed.

CONCLUSIONS

During the 1977 State-Federal Alaska Peninsula field project, stratigraphic sections totaling 16,000 feet (5,000 m) were measured and 269 samples were collected and analyzed. Significant new data were obtained on petroleum-reservoir and source-rock potential, depositional environments, paleontological age dating, structural geology, petrographic and diagenetic characteristics, geochemical control, and gravity control.

Porosity and permeability analyses on most samples indicate a range of poor to fair reservoir potential. A few samples of Miocene age have good porosity and permeability. Thick potential reservoir sands were measured at several locations; however, the offshore extensions of porous sandstones are unknown.

Source-rock potential is considered good. Kerogen assessment favors the generation of gas as the major hydrocarbon type. Most samples analyzed for maturity (TAI method) indicate a submature to mature range of maturation.

We conclude that the offshore area adjacent to the Alaska Peninsula is a good place to explore for hydrocarbons.

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TABLE 1A AND 1B—CROSS REFERENCE

TABLE 1A—MAP NUMBERS TO SAMPLE OR STATION NUMBERS

USHAGIK QUADRANGLE (PLATE A)

Random Sampling

Map No.	Sample or Station No.	Analysis or Measurement
1	65-IP-77	Palynology
1	66-IP-77	Hydrocarbon
1	67-IP-77	Porosity and permeability
2	62-IP-77	Palynology
2	63-IP-77	Hydrocarbon
2	64-IP-77	Porosity and permeability

CHIGNIK QUADRANGLE (PLATE B)

Random Sampling

Map No.	Sample or Station No.	Analysis or Measurement
3	PH Base	Gravity
4	PH12	Gravity
5	PH11	Gravity
6	PH10	Gravity
7	PH09	Gravity
8	PH13	Gravity
9	PH06	Gravity
10	PH07	Gravity
11	PH08	Gravity
12	TRI.#213*	Gravity
13	TRI.#211	Gravity
14	38-JB-77	Geochemical
15	39-JB-77	Geochemical
16	40-JB-77	Geochemical
17	41-JB-77	Geochemical
18	42-JB-77	Geochemical
19	43-JB-77	Geochemical
20	PH03	Gravity
21	PH04	Gravity
22	PH05	Gravity
23	PH06	Gravity
24	TRI.#211	Gravity
25	TRI.#210	Gravity
26	33-JBO-77	Geochemical
27	34-JB-77	Geochemical
27	35-JB-77	Geochemical
28	36-JB-77	Geochemical
28	36-JB-77	Geochemical
29	32-JB-77	Geochemical
30	45-JB-77	Geochemical
31	46-JB-77	Geochemical
32	47-JB-77	Geochemical
33	PH01	Gravity
34	PH02	Gravity
35	48-JB-77	Geochemical
36	PH14	Gravity
37	TRI.#189	Gravity
38	31-JB-77	Geochemical
39	30-JB-77	Geochemical
40	29-JB-77	Geochemical
41	TRI.#197	Gravity
41	283-WL-74	Density; magnetic susceptibility
41	284-WL-74	Geochemical
42	TRI.#205	Gravity
Black Lake Stratigraphic Section (Plate I) Samples		
43	5-WL-77	Lithology
43	6-WL-77	Paleontology
43	7-WL-77	Paleontology
43	8-WL-77	Hydrocarbon
43	9-WL-77	Paleontology
43	10-WL-77	Paleontology
43	11-WL-77	Hydrocarbon
43	12-WL-77	Porosity and permeability
43	13-WL-77	Porosity and permeability
43	14-WL-77	Porosity and permeability
43	15-WL-77	Macrofossil
43	16-WL-77	Macrofossil
43	17-WL-77	Porosity and permeability
43	18-WL-77	Porosity and permeability
43	19-WL-77	Lithology
43	20-WL-77	Porosity and permeability
43	207.1-WL-74	Lithology
43	207.2-WL-74	Lithology
43	207.3-WL-74	Geochemical
43	207.4-WL-74	Geochemical
43	207.5-WL-74	Porosity and permeability
43	207.6-WL-74	Hydrocarbon

Map No.	Sample or Station No.	Analysis or Measurement
43	207.8-WL-74	Porosity and permeability
43	207.9-WL-74	Porosity and permeability
43	207.10-WL-74	Lithology
43	207.11-WL-74	Porosity and permeability
43	207.12-WL-74	Porosity and permeability
43	207.13-WL-74	Macrofossil
43	207.14-WL-74	Macrofossil
43	207.15-WL-74	Macrofossil
43	207.16-WL-74	Macrofossil
43	207.17-WL-74	Lithology
43	207.18-WL-74	Porosity and permeability
43	207.19-WL-74	Lithology
43	207.20-WL-74	Porosity and permeability
43	207.21-WL-74	Lithology
43	207.22-WL-74	Porosity and permeability
43	207.23-WL-74	Density; magnetic susceptibility
43	207.24-WL-74	Porosity and permeability
43	207.25-WL-74	Porosity and permeability
43	207.26-WL-74	Lithology
43	207.27-WL-74	Porosity and permeability
43	207.28-WL-74	Porosity and permeability
43	207.29-WL-74	Hydrocarbon
43	207.30-WL-74	Hydrocarbon
43	207.31-WL-74	Porosity and permeability
43	207.32-WL-74	Lithology
43	207.33-WL-74	Hydrocarbon
	Random Sampling	
44	318-WL-74	Geochemical
45	TRI.#192	Gravity
45	268-WL-74	Geochemical
46	MR06	Gravity
47	MR07	Gravity
48	MR08	Gravity
49	MR09	Gravity
50	TRI.#223	Gravity
50	315-WL-74	Geochemical
51	TRI.#224	Gravity
52	TRI.#196	Gravity
52	275-WL-74	Office sample
54	274-WL-74	Office sample
55	TRI.#225	Gravity
56	263-WL-74	Geochemical
56	264-WL-74	Porosity and permeability
56	265-WL-74	Density; magnetic susceptibility
56	266-WL-74	Office sample
56	267-WL-74	Hydrocarbon
57	TRI.#193	Gravity
57	269-WL-74	Geochemical
58	MR03	Gravity
59	MR05	Gravity
60	TRI.#178	Gravity
61	MR10	Gravity
62	49-JB-77	Geochemical
63	MR11	Gravity
64	MR12	Gravity
65	PH15	Gravity
66	TRI.#198	Gravity
66	276-WL-74	Geochemical
67	TRI.#199	Gravity
67	277-WL-74	Geochemical
68	TRI.#200	Gravity
68	278-WL-74	Geochemical
69	TRI.#206	Gravity
69	285-WL-74	Geochemical
70	TRI.#209	Gravity
70	292-WL-74	Geochemical
70	293-WL-74	Age date
70	294-WL-74	Geochemical
70	295-WL-74	Density
70	296-WL-74	Magnetic susceptibility
70	DT 74-6	Density; magnetic susceptibility
70	DT 74-5	Density; magnetic susceptibility
70	297-WL-74	Density; magnetic susceptibility
70	298-WL-74	Geochemical
70	299-WL-74	Density; magnetic susceptibility
70	300-WL-74	Geochemical
71	288-WL-74	Geochemical
71	289-WL-74	Age date
71	290-WL-74	Density

Map No.	Sample or Station No.	Analysis or Measurement
71	291-WL-74	Magnetic susceptibility
72	TRI.#204	Gravity
72	285-WL-74	Geochemical
73	TRI.#190	Gravity
73	259-WL-74	Geochemical
73	261-WL-74	Density
73	262-WL-74	Office sample
74	314.12-WL-74	Geochemical
74	314.13-WL-74	Geochemical
75	314-WL-74	?
75	314.1-WL-74	Density
75	314.2-WL-74	Office sample
75	314.3-WL-74	Porosity and permeability
75	314.4-WL-74	Density
75	314.5-WL-74	Paleontology
75	314.6-WL-74	Geochemical
76	314.7-WL-74	Porosity and permeability
76	314.8-WL-74	Density
76	314.9-WL-74	Magnetic susceptibility
76	314.10-WL-74	Density
76	DT-74-15	Age date
76	314.11-WL-74	Geochemical
77	TRI.#183	Gravity
78	MR04	Gravity
79	TRI.#179	Gravity
80	TRI.#180	Gravity
81	TRI.#181	Gravity
82	MR13	Gravity
83	MR14	Gravity
84	MR15	Gravity
85	TRI.#201	Gravity
85	279-WL-76	Geochemical
86	TRI.#203	Gravity
86	280-WL-74	Density; magnetic susceptibility
86	281-WL-74	Quartz diorite
86	282-WL-74	Age date
87	TRI.#202	Gravity
87	280-WL-74	Geochemical
88	301-WL-74	Density
88	302-WL-74	Geochemical
88	303-WL-74	Magnetic susceptibility
88	DT-74-11	Age date
89	304-WL-74	Density?
89	305-WL-74	Magnetic susceptibility?
89	306-WL-74	Geochemical?
90	307-WL-74	Density
90	308-WL-74	Magnetic susceptibility
90	309-WL-74	Geochemical
90	310-WL-74	Geochemical
91	311-WL-74	Density
91	312-WL-74	Geochemical
91	313-WL-74	Magnetic susceptibility
92	MR02	Gravity
93	TRI.#147	Gravity
94	TRI.#182	Gravity
95	TRI.#184	Gravity
95	248-WL-74	Geochemical
96	PH16	Gravity
97	MR16	Gravity
98	TRI.#5	Gravity?
99	TRI.#185	Gravity
99	249-WL-74	Geochemical
99	250-WL-74	Geochemical
100	TRI.#186	Gravity
100	251-WL-74	Geochemical
100	252-WL-74	Hydrocarbon
100	253-WL-74	Office sample
100	254-WL-74	Age date; density; magnetic susceptibility
101	TRI.#187	Gravity
101	255-WL-74	Float
101	256-WL-74	Geochemical
102	TRI.#188	Gravity
102	257-WL-74	Magnetic susceptibility
102	258-WL-74	Density
102A	319-WL-74	Geochemical
102B	320-WL-74	Office sample
102C	321-WL-74	Geochemical
102C	322-WL-74	Rock sample
102C	323-WL-74	Office sample
102C	324-WL-74	Geochemical
102C	325-WL-74	Geochemical
102C	326-WL-74	Geochemical
102D	358-WL-74	Geochemical
102D	359-WL-74	Geochemical
102E	360-WL-74	Geochemical
102F	361-WL-74	Geochemical
102G	330-WL-74	Geochemical

Map No.	Sample or Station No.	Analysis or Measurement
102H	331-WL-74	Geochemical
102H	332-WL-74	Geochemical
102I	350-WL-74	Office sample
102I	351-WL-74	Magnetic susceptibility
102I	352-WL-74	Office sample
102I	353-WL-74	Density
102I	354-WL-74	Geochemical
102J	355-WL-74	Office sample
102J	356-WL-74	Geochemical
102J	357-WL-74	Geochemical
102K	327-WL-74	Geochemical
102K	328-WL-74	Geochemical
102K	329-WL-74	Office sample
102L	333-WL-74	Geochemical
102L	334-WL-74	Geochemical
102L	335-WL-74	Geochemical
102L	336-WL-74	Age date
102L	337-WL-74	Intrusive
102L	338-WL-74	Density; magnetic susceptibility
102L	339-WL-74	Geochemical
102L	340-WL-74	Geochemical
102L	341-WL-74	Age date
102L	342-WL-74	Density
102L	343-WL-74	Magnetic susceptibility
102L	344-WL-74	Thin sections
102M	362-WL-74	Age date
102M	363-WL-74	Geochemical
102M	364-WL-74	Density
102M	365-WL-74	Magnetic susceptibility
102M	366-WL-74	Geochemical

COLD BAY QUADRANGLE (PLATE C)

Random Sampling

Map No.	Sample or Station No.	Analysis Measurement
103	BS09	Gravity
104	TRI.#71	Gravity
105	BS10	Gravity
106	BS11	Gravity
107	BS12	Gravity
108	BS13	Gravity
109	BS14	Gravity
110	TRI.#124	Gravity

Map No.	Sample or Station No.	Analysis or Measurement
110	144-WL-74	Geochemical
111	60-WL-74	Geochemical
112	60A-WL-74	Geochemical
112	TRI.#70	Gravity
113	BS23	Gravity
114	BS15	Gravity
115	TRI.#61	Gravity
116	BS16	Gravity
117	TRI.#68	Gravity
117	59-WL-74	Geochemical
119	TRI.#60	Gravity
120	BS17	Gravity
121	TRI.#59	Gravity
122	TRI.#58	Gravity
123	TRI.#62	Gravity
124	TRI.#67	Gravity
124	58-WL-74	Geochemical
125	BS20	Gravity
126	BS22	Gravity
127	NONE	NONE
128	TRI. #58	Gravity
129	TRI.#56	Gravity
130	TRI.#55	Gravity
131	TRI.#66	Gravity
132	TRI.#63	Gravity
133	TRI.#19	Gravity
134	TRI.#54	Gravity
135	TRI.#47	Gravity
136	TRI.#46	Gravity
137	TRI.#53	Gravity
138	IZ24	Gravity
139	IZ23	Gravity
140	SB2	Gravity (IZ22)
141	IZ21	Gravity
142	IZ20	Gravity
143	IZ19	Gravity
144	TRI.#52	Gravity
145	IZ16	Gravity
146	IZ15	Gravity
147	IZ14	Gravity
148	IZ17	Gravity
149	IZ13	Gravity
150	IZ18	Gravity
151	IZ12	Gravity
152	TRI.#65	Gravity
152A	TRI.#64	Gravity
153	BS18	Gravity
154	BS19	Gravity
155	42-WL-74	Geochemical

Map No.	Sample or Station No.	Analysis or Measurement
155	43-WL-74	Geochemical
156	44-WL-74	Geochemical
157	TRI.#44	Gravity
158	TRI.#45	Gravity
159	TRI.#33	Gravity
159	53-WL-74	Geochemical
160	TRI.#32	Gravity
160	52-WL-74	Geochemical
161	IZ06	Gravity
162	IZ07	Gravity
162	3-JBM-77	Geochemical
163	IZ05	Gravity
163	2-JB-77	Geochemical
164	IZ08	Gravity
165	IZ09	Gravity
166	IZ10	Gravity
167	4-JM-77	Geochemical
168	IZ11	Gravity
169	IZ04	Gravity
170	Site Cold Bay	Gravity
171	NONE	NONE
172	IZ03	Gravity
173	IZ02	Gravity
173	5-JM-77	Geochemical
174	IZ01	Gravity
174	1-JM-77	Geochemical
175	FP01	Gravity
176	TRI.#20	Gravity
176	37-WL-74	Geochemical
177	UN15	Gravity
177	3-WL-77	Geochemical
178	UN14	Gravity
178	2-WL-77	Geochemical
179	UN13	Gravity
179	1-WL-77	Geochemical
180	UN01	Gravity
181	UN02	Gravity
182	TRI.#40	Gravity
183	TRI.#41	Gravity
184	TRI.#42	Gravity
185	TRI.#43	Gravity
186	TRI.#39	Gravity
187	UN11	Gravity
187	15-JM-77	Geochemical
189	56-WL-74	Geochemical
190	TRI.#36	Gravity
191	TRI.#34	Gravity
192	TRI.#35	Gravity
192	55-WL-74	Geochemical
193	FP02	Gravity
193	A1-JB-77	Geochemical
194	FP03	Gravity
194	A2-JB-77	Geochemical
195	FP04	Gravity
195	A3-JB-77	Geochemical
196	TRI.#21	Gravity
196	38-WL-74	Geochemical
197	TRI.#22	Gravity
197	39-WL-74	Geochemical
197	40-WL-74	Rock sample
198	TRI.#23	Gravity
198	41-WL-74	Geochemical

PORT MOLLER QUADRANGLE (PLATE D)

Random Sampling

Map No.	Sample or Station No.	Analysis or Measurement
199	BS05	Gravity
200	PB10	Gravity
201	BS04	Gravity
202	BS03	Gravity
203	BS02	Gravity
203A	MR01	Gravity
204	TRI.#150	Gravity
204	199-WL-74	Geochemical

Milky River Stratigraphic Section (Plate II) Samples

Map No.	Sample or Station No.	Analysis or Measurement
205	29-GB-77	Porosity and permeability
205	30-GB-77	Porosity and permeability
205	31-GB-77	Hydrocarbon
205	32-GB-77	Paleontology
205	33-GB-77	Hydrocarbon
205	34-GB-77	Paleontology
205	35-GB-77	Hydrocarbon
205	36-GB-77	Paleontology
205	37-GB-77	Hydrocarbon
205	38-GB-77	Paleontology
205	39-GB-77	Porosity and permeability
205	40-GB-77	Hydrocarbon
205	41-GB-77	Paleontology
205	42-GB-77	Macrofossil

Map No.	Sample or Station No.	Analysis or Measurement
205	72A-WL-77	Porosity and permeability
205	73-WL-77	Paleontology
205	74-WL-77	Hydrocarbon
205	75-WL-77	Lithology
205	76-WL-77	Palynology
205	77-WL-77	Porosity and permeability
205	78-WL-77	Porosity and permeability
205	79-WL-77	Paleontology
205	80-WL-77	Hydrocarbon
205	81-WL-77	Paleontology
205	82-WL-77	Paleontology
205	83-WL-77	Hydrocarbon
205	84-WL-77	Porosity and permeability
205	85-WL-77	Hydrocarbon
205	86-WL-77	Macrofossil
205	87-WL-77	Paleontology
205	88-WL-77	Paleontology
205	89-WL-77	Hydrocarbon
205	90-WL-77	Porosity and permeability
205	91-WL-77	Paleontology
205	92-WL-77	Hydrocarbon
205	93-WL-77	Porosity and permeability
205	94-WL-77	Macrofossil
205	95-WL-77	Porosity and permeability
205	96-WL-77	Paleontology
205	97-WL-77	Hydrocarbon
205	98-WL-77	Macrofossil
205	99-WL-77	Paleontology
205	100-WL-77	Hydrocarbon
205	101-WL-77	Paleontology
205	102-WL-77	Hydrocarbon
205	103-WL-77	Macrofossil
205	103A-WL-77	Paleontology
205	104-WL-77	Hydrocarbon
205	105-WL-77	Macrofossil

Random Sampling

Map No.	Sample or Station No.	Analysis or Measurement
206	BS06	Gravity
207	PB31	Gravity
208	NO DATA	
209	SR12	Gravity
210	TRI.#125	Gravity
211	ST02	Gravity
211	19-JM-77	Geochemical
212	NO DATA	
213	TRI.#3	Gravity
213	16-WL-77	Geochemical
214	PB05	Gravity
215	BS01	Gravity
216	PB02	Gravity
217	TRI.#74	Gravity
218	PB01	Gravity
219	TRI.#73	Gravity
220	TRI.#75	Gravity
221	TRI.#76	Gravity?
221	61-WL-74	Geochemical
222	TRI.#148	Gravity
223	TRI.#149	Gravity
223	198-WL-74	Geochemical
224	TRI.#81	Gravity
224	65-WL-74	Geochemical
225	TRI.#151	Gravity
226	TRI.#153	Gravity
226	201-WL-74	Geochemical
227	TRI.#152	Gravity
227	200-WL-74	Geochemical
228	TRI.#93	Gravity
228	79-WL-74	Geochemical
229	TRI.#94	Gravity
229	80-WL-74	Geochemical
229	81-WL-74	Geochemical

Southeast Bear Lake Stratigraphic Section (Plate III) Samples

Map No.	Sample or Station No.	Analysis or Measurement
230	34-JM-77	Office sample
230	35-JM-77	Porosity and permeability
230	36-JM-77	Porosity and permeability
230	37-JM-77	Paleontology
230	38-JM-77	Hydrocarbon
230	39-JM-77	Porosity and permeability
230	40-JM-77	Paleontology
230	41-JM-77	Hydrocarbon
230	42-JM-77	Macrofossil
230	43-JM-77	Macrofossil
230	44-JM-77	Macrofossil
230	45-JM-77	Macrofossil
230	46-JM-77	Paleontology
230	47-JM-77	Hydrocarbon

Map No.	Sample or Station No.	Analysis or Measurement
	Random Sampling	
231	TRI.#97	Gravity
231	84-WL-74	Geochemical
232	TRI.#96	Gravity
232	83-WL-74	Geochemical
233	TRI.#95	Gravity
233	82-WL-74	Geochemical
234	NO DATA	
235	PB30	Gravity
236	BS07	Gravity
237	TRI.#72	Gravity
237A	TRI.#126	Gravity
238	SR13	Gravity
239	SR11	Gravity
239	30-JM-77	Geochemical
240	SR10	Gravity
240	29-JM-77	Geochemical
241	PB11	Gravity
242	SR03	Gravity
242	20-JM-77	Geochemical
243	SR01	Gravity
243	18-JM-77	Geochemical
244	SR04	Gravity
244	21-JM-77	Geochemical
245	TRI.#127	Gravity
246	PB06	Gravity
247	PB07	Gravity
248	PB09	Gravity
249	PB08	Gravity
250	PB04	Gravity
251	TRI.#138	Gravity
251	162-WL-74	Geochemical
251	163-WL-74	Geochemical
252	NO DATA	
253	PB03	Gravity
254	TRI.#173	Gravity
254	237-WL-74	Geochemical
255	160-WL-74	Rock sample
255	161-WL-74	Geochemical
256	158-WL-76	Geochemical
256	159-WL-74	Density; magnetic susceptibility
257	73-GB-77	Porosity and permeability
258	74-GB-77	Paleontology
259	TRI.#134	Gravity
259	157-WL-74	Geochemical
260	143-WL-74	Geochemical

Map No.	Sample or Station No.	Analysis or Measurement
261	NO DATA	
262	TRI.#175	Gravity
262	239-WL-74	Geochemical
262	240-WL-74	Geochemical
262	241-WL-74	Office sample
262	242-WL-74	Density; magnetic susceptibility
262	243-WL-74	Office sample
263	TRI.#176	Gravity
263	244-WL-74	Geochemical
264	TRI.#160	Gravity
265	TRI.#177	Gravity
265	245-WL-74	Geochemical
265	246-WL-74	Density
265	247-WL-74	Magnetic susceptibility
265	248-WL-74	Office sample
266	TRI.#157	Gravity
266	212-WL-74	Geochemical
266	142-WL-74	Office sample
267	TRI.#133	Gravity?
267	153-WL-77	Porosity and permeability
267	154-WL-77	Density
267	155-WL-77	Office sample
267	156-WL-77	Volcanic flow
268	NO DATA	
269	62-WL-74	Macrofossil
270	TRI.#84	Gravity
270	69-WL-74	Geochemical
271	66-WL-74	Office sample
272	TRI.#85	Gravity
272	70-WL-74	Geochemical
272	TRI.#79	Gravity
272	63-WL-74	Geochemical
273	TRI.#89	Gravity
273	75-WL-74	Geochemical
274	TRI.#91	Gravity
275	TRI.#90	Gravity
275	76-WL-74	Geochemical
275	77-WL-74	Macrofossil
276	TRI.#86	Gravity
276	71-WL-74	Geochemical
277	TRI.#88	Gravity
277	74-WL-74	Geochemical
278	TRI.#87	Gravity
278	72-WL-74	Geochemical
279	TRI.#80	Gravity
280	TRI.#83	Gravity

Map No.	Sample or Station No.	Analysis or Measurement
280	67-WL-74	Geochemical
280	68-WL-74	Geochemical
281	TRI.#92	Gravity
281	78-WL-74	Geochemical
282	TRI.#152	Gravity
282	202-WL-74	Geochemical
282	203-WL-74	Geochemical
283	TRI.#155	Gravity
283	204-WL-74	Geochemical
283	205-WL-74	Geochemical
283	206-WL-74	Density; magnetic susceptibility
283	207-WL-74	Office sample
283	208-WL-74	Density
283	209-WL-74	Density
283	210-WL-74	Office sample
284	BS08	Gravity
285	PB29	Gravity
286	BS24	Gravity
287	SR14	Gravity
287	31-JM-77	Geochemical
288	SR09	Gravity
288	28-JM-77	Geochemical
289	PB12	Gravity
290	SR07	Gravity
290	25-JM-77	Geochemical
290	26-JM-77	Geochemical

Heren I and II Stratigraphic Sections (Plates IV and V) Samples

Map No.	Sample or Station No.	Analysis or Measurement
291	26-IP-77	Paleontology
291	27-IP-77	Paleontology
291	28-IP-77	Porosity and permeability
291	29-IP-77	Paleontology
291	30-IP-77	Coal
291	31-IP-77	Porosity and permeability
291	32-IP-77	Porosity and permeability
291	33-IP-77	Paleontology
291	34-IP-77	Porosity and permeability
291	35-IP-77	Porosity and permeability
291	36-IP-77	Paleontology
291	37-IP-77	Hydrocarbon
291	38-IP-77	Porosity and permeability
291	39-IP-77	Porosity and permeability
291	40-IP-77	Paleontology
291	41-IP-77	Paleontology
291	42-IP-77	Hydrocarbon
291	43-IP-77	Porosity and permeability
291	44-IP-77	Paleontology
291	45-IP-77	Hydrocarbon
291	46-IP-77	Porosity and permeability
291	47-IP-77	Paleontology
291	48-IP-77	Coal
291	49-IP-77	Paleontology
291	50-IP-77	Hydrocarbon
291	51-IP-77	Porosity and permeability
291	52-IP-77	Porosity and permeability
291	53-IP-77	Porosity and permeability

Random Sampling

Map No.	Sample or Station No.	Analysis or Measurement
292	158-JB-77	Geochemical
293	157-JB-77	Geochemical
294	64-GB-77	Porosity and permeability
294	65-GB-77	Lithology
294	66-GB-77	Porosity and permeability
295	TRI.#11	Gravity
295	26-WL-74	Age date
295	27-WL-74	Age date
296	TRI.#29	Gravity
296	TRI.#29	Gravity
296	50-WL-74	Geochemical
297	58-GB-77	Porosity and permeability
297	59-GB-77	Porosity and permeability
297	60-GB-77	Porisity and permeability
297	61-GB-77	Porosity and permeability
297	62-GB-77	Porosity and permeability
297	63-GB-77	Hydrocarbon
298	28-WL-74	Geochemical
299	29-WL-74	Geochemical

Map No.	Sample or Station No.	Analysis or Measurement
300	164-WL-74	Geochemical
300	165-WL-74	Geochemical
301	TRI.#174	Gravity
301	238-WL-74	Geochemical
302	TRI.#140	Gravity
302	166-WL-74	Geochemical
303	TRI.#166	Gravity
303	255-WL-74	Porosity and permeability
303	226-WL-74	Density
303	227-WL-74	Office sample
304	TRI.#141	Gravity
304	167-WL-74	Geochemical
305	219-WL-74	Office sample
306	216-WL-74	Geochemical
306	217-WL-74	Age date
306	218-WL-74	Magnetic susceptibility
307	TRI.#158	Gravity
307	213-WL-74	Age date
307	214-WL-74	Geochemical
307	215-WL-74	Density; magnetic susceptibility
308	TRI.#102	Gravity
308	115-WL-74	Geochemical
309	141-WL-74	Geochemical
310	138-WL-74	Geochemical
311	TRI.#146	Gravity
311	194-WL-74	Rock sample
311	195-WL-74	Burned
312	139-WL-74	Geochemical
312	140-WL-74	Geochemical
313	151-WL-74	Geochemical
314	149-WL-74	Geochemical
315	TRI.#130	Density
315	148-WL-74	Geochemical
316	TRI.#129	Gravity
316	146-WL-74	Density; magnetic susceptibility
316	147-WL-74	Geochemical
317	TRI.#103	Gravity
318	TRI.#128	Gravity
318	145-WL-74	Geochemical
319	116-WL-74	Geochemical
320	TRI.#156	Gravity
320	211-WL-74	Geochemical
321	77-SWH-11	Density; magnetic susceptibility
321	77-SWH-12	Paleontology

Map No.	Sample or Station No.	Analysis or Measurement
	Waterfall Pt. Stratigraphic Section (Plate VI) Samples	
322	1-GB-77	Porosity and permeability
322	2-GB-77	Lithology
322	3-GB-77	Paleontology
322	4-GB-77	Porosity and permeability
322	5-GB-77	Paleontology
322	6-GB-77	Hydrocarbon
322	7-GB-77	Paleontology
322	8-GB-77	Lithology
322	9-GB-77	Porosity and permeability
322	10-GB-77	Hydrocarbon
322	11-GB-77	Paleontology
322	12-GB-77	Macrofossil
322	13-GB-77	Porosity and permeability
322	14-GB-77	Hydrocarbon
322	15-GB-77	Paleontology
	Random Sampling	
323	PB28	Gravity
324	SR16	Gravity
324	33-JM-77	Geochemical
325	SR15	Gravity
325	32-JM-77	Geochemical
326	PB15	Gravity
327	TRI.#30	Gravity
328	PB14	
329	SR08	Gravity
329	27-JM-77	Geochemical
330	SR06	Gravity
330	23-JM-77	Geochemical
331	SR05	Gravity
331	22-JM-77	Geochemical
332	155-JM-77	Geochemical
333	156-JMB-77	Geochemical
333	156-JB-77	Geochemical
334	153-JB-77	Geochemical
335	154-JB-77	Geochemical
335A	22-WL-74	Age date
335A	23-WL-74	Age date
335A	24-WL-74	Hydrocarbon
335A	25-WL-74	Rock sample
336	133A-WL-74	Geochemical
336	133B-WL-74	Geochemical

Map No.	Sample or Station No.	Analysis or Measurement
337	TRI.#114	Gravity
337	132-WL-74	Geochemical
338	TRI.#111	Gravity
338	127-WL-74	Geochemical
339	TRI.#112	Gravity
339	128-WL-74	Geochemical
340	75-GB-77	Paleontology
340	76-GB-77	Hydrocarbon
340	77-GB-77	Paleontology
340	78-GB-77	Hydrocarbon
340	79-GB-77	Paleontology
340	80-GB-77	Hydrocarbon
340	81-GB-77	Paleontology
340	82-GB-77	Hydrocarbon
340	83-GB-77	Paleontology
340	84-GB-77	Hydrocarbon
340	85-GB-77	Paleontology
340	86-GB-77	Hydrocarbon
340	87-GB-77	Paleontology
340	88-GB-77	Hydrocarbon
340	89-GB-77	Paleontology
340	90-GB-77	Hydrocarbon
341	TRI.#113	Gravity
341	130-WL-74	Geochemical
341	131-WL-74	Geochemical
342	TRI.#145	Gravity?
342	192-WL-74	Age date
342	193-WL-74	Burned
343	TRI.#116	Gravity
343	134-WL-74	Geochemical
344	TRI.#110	Gravity
344	126-WL-74	Geochemical
345	30-WL-74	Geochemical
346	TRI.#117	Gravity
346	135-WL-74	Geochemical
347	TRI.#7	Gravity
347	19-WL-74	Density
348	136-WL-74	Geochemical
348	137-WL-74	Geochemical
349	31-WL-74	Geochemical
349	32-WL-74	Geochemical
350	34-WL-74	Geochemical
350	35-WL-74	Geochemical
350	36-WL-74	Geochemical
351	TRI.#107	Gravity
351	120-WL-74	Geochemical
351	121-WL-74	Geochemical
352	TRI.#108	Gravity
352	122-WL-74	Rock sample
353	123-WL-74	Lithology
353	124-WL-74	Density
353	125-WL-74	Magnetic susceptibility
354	TRI.#106	Gravity
354	119-WL-74	Geochemical
355	33-WL-74	Age date
355A	18-WL-74	Age date
356	TRI.#101	Gravity
356	114-WL-74	Geochemical
357	TRI.#165	Gravity
357	224-WL-74	Geochemical
358	TRI.#162	Gravity
358	220-WL-74	Geochemical
359	TRI.#163	Gravity
359	221-WL-74	Geochemical
360	TRI.#164	Gravity
360	222-WL-74	Geochemical
360	223-WL-74	Geochemical
361	TRI.#167	Gravity
361	228-WL-74	Geochemical
362	PB27	Gravity
363	PB16	Gravity
364	TRI.#26	Gravity
364	45-WL-74	Geochemical
365	PB13	Gravity
365	TRI.#9	Gravity
365	21-WL-74	Geochemical
366	150-JB-77	Geochemical
367	TRI.#142	Gravity
367	168-WL-74	Geochemical
368	152-JB-77	Geochemical

Lefthand Bay-Balboa Bay Stratigraphic Section (Plate VII) Samples

Map No.	Sample or Station No.	Analysis or Measurement
369	16-GB-77	Hydrocarbon
369	17-GB-77	Paleontology
369	18-GB-77	Hydrocarbon
369	18-GB-77	Hydrocarbon
369	19-GB-77	Paleontology
369	20-GB-77	Lithology
369	21-GB-77	Hydrocarbon
369	22-GB-77	Paleontology
369	23-GB-77	Lithology
369	24-GB-77	Hydrocarbon
369	25-GB-77	Paleontology
369	26-GB-77	Hydrocarbon
369	27-GB-77	Paleontology
369	28-GB-77	Lithology
369	9-IP-77	Paleontology

Map No.	Sample or Station No.	Analysis or Measurement
369	10-IP-77	Hydrocarbon
369	11-IP-77	Paleontology
369	12-IP-77	Paleontology
369	13-IP-77	Hydrocarbon
369	14-IP-77	Hydrocarbon
369	15-IP-77	Paleontology
369	16-IP-77	Paleontology
369	17-IP-77	Hydrocarbon
369	18-IP-77	Paleontology
369	19-IP-77	Hydrocarbon
369	20-IP-77	Porosity and permeability
369	21-IP-77	Paleontology
369	22-IP-77	Hydrocarbon
369	23-IP-77	Lithology
369	24-IP-77	Paleontology
369	25-IP-77	Hydrocarbon
369	46-WL-74	Hydrocarbon
369	47-WL-74	Hydrocarbon
369	48-WL-74	Hydrocarbon
369	49-WL-74	Hydrocarbon
369	77-SWH-12A	Macrofossil
369	77-SWH-13	Macrofossil
370	TRI.#100	Gravity
371	TRI.#105	Gravity
371	117-WL-74	Geochemical
371	118-WL-74	Geochemical
372	TRI.#168	Gravity
372	229-WL-74	Geochemical
373	TRI.#169	Gravity
373	230-WL-74	Geochemical
374	TRI.#4	Gravity
374	17-WL-74	Office sample
375	PB26	Gravity
376	PB17	Gravity

Beaver Bay Stratigraphic Section (Plate VIII) Samples

Map No.	Sample or Station No.	Analysis or Measurement
377	21-WL-77	Paleontology
377	22-WL-77	Hydrocarbon
377	23-WL-77	Porosity and permeability
377	24-WL-77	Porosity and permeability
377	25-WL-77	Paleontology
377	26-WL-77	Macrofossil
377	27-WL-77	Porosity and permeability
377	28-WL-77	Paleontology
377	29-WL-77	Hydrocarbon
377	30-WL-77	Porosity and permeability
377	31-WL-77	Lithology
377	32-WL-77	Paleontology
377	33-WL-77	Hydrocarbon
377	33A-WL-77	Hydrocarbon
377	34-WL-77	Paleontology
377	35-WL-77	Hydrocarbon
377	36-WL-77	Porosity and permeability
377	37-WL-77	Hydrocarbon
377	38-WL-77	Paleontology
377	39-WL-77	Hydrocarbon
377	40-WL-77	Porosity and permeability
378	85-WL-74	Shale
378	86-WL-74	Sandstone
378	87-WL-74	Sandstone
378	88-WL-74	Shale
378	89-WL-74	Coal
378	90-WL-74	Porosity and permeability
378	91-WL-74	Paleontology
378	92-WL-74	Siltstone
378	91A-WL-74	Shale
378	92A-WL-74	?
378	93-WL-74	Siltstone
378	94-WL-74	Siltstone
378	95-WL-74	Sandstone
378	96-WL-74	Shale
378	97-WL-74	Paleontology
378	98-WL-74	Source
378	99-WL-74	Porosity and permeability
378	100-WL-74	Sandstone
378	101-WL-74	Conglomerate
378	102-WL-74	Geochemical
378	103-WL-74	Source
378	104-WL-74	Source
378	105-WL-74	Macrofossil
378	106-WL-74	?
378	107-WL-74	Coal
378	108-WL-74	Conglomerate
378	109-WL-74	Shale
378	110-WL-74	Paleontology
378	111-WL-74	Sandstone
378	112-WL-74	Source

Map No.	Sample or Station No.	Analysis or Measurement
378	113-WL-74	Conglomerate
378	169-WL-74	Thin section
378	170-WL-74	Age date
378	171-WL-74	Magnetic susceptibility
378	172-WL-74	Source
378	173-WL-74	Source
378	174-WL-74	Porosity and permeability
378	175-WL-74	Density; magnetic susceptibility
378	176-WL-74	Sandstone
378	177-WL-74	Conglomerate
378	178-WL-74	Porosity and permeability
378	179-WL-74	Source
378	180-WL-74	Sandstone
378	181-WL-74	Conglomerate clasts
378	182-WL-74	Source
378	183-WL-74	Sandstone
378	184-WL-74	Macrofossil
378	185-WL-74	Source
378	186-WL-74	Lithology
378	187-WL-74	Lava
378	188-WL-74	Source
378	189-WL-74	Lithology
	Random Sampling	
379	TRI.#99	Gravity
380	67-GB-77	Paleontology
380	68-GB-77	Hydrocarbon
380	69-GB-77	Paleontology
380	70-GB-77	Hydrocarbon
380	71-GB-77	Porosity and permeability
380	72-GB-77	Porosity and permeability
381	TRI.#144	Gravity
381	191-WL-74	Geochemical
	Aliaksin Peninsula Stratigraphic Section (Plate X) Samples	
382	41-WL-77	Paleontology
382	42-WL-77	Hydrocarbon
382	43-WL-77	Paleontology
382	44-WL-77	Paleontology
382	45-WL-77	Paleontology
382	46-WL-77	Porosity and permeability
382	47-WL-77	Paleontology
382	48-WL-77	Paleontology
382	49-WL-77	Porosity and permeability
382	50-WL-77	Paleontology
382	51-WL-77	Lithology
	Random Sampling	
383	236-WL-74	Geochemical
384	TRI.#171	Gravity
384	231-WL-74	Geochemical
384	232-WL-74	Office sample
384	233-WL-74	Density
384	234-WL-74	Magnetic susceptibility
384	235-WL-74	Office sample
385	20-WL-74	Office sample
386	PB18	Gravity
387	PB19	Gravity
388	190-WL-74	Geochemical
389	PB22	Gravity
390	PB21	Gravity
390A	PB20	Gravity
391	61-IP-77	Geochemical
	White Bluff Stratigraphic Section (Plate XI) Samples	
391A	52-WL-77	Paleontology
391A	53-WL-77	Hydrocarbon
391A	54-WL-77	Coal
391A	55-WL-77	Paleontology
391A	56-WL-77	Palynology
391A	57-WL-77	Lithology
391A	58-WL-77	Paleontology
391A	59-WL-77	Palynology
391A	60-WL-74	Paleontology
391A	61-WL-74	Hydrocarbon
391A	62-WL-77	Coal
391A	63-WL-77	Palynology
391A	64-WL-77	Paleontology
391A	65-WL-77	Hydrocarbon
391A	66-WL-77	Paleontology
391A	67-WL-77	Hydrocarbon
391A	68-WL-77	Paleontology
391A	69-WL-77	Hydrocarbon
391A	70-WL-77	Porosity and permeability
391A	71-WL-77	Porosity and permeability
391A	72-WL-77	Lithology

Map No.	Sample or Station No.	Analysis or Measurement
	Random Sampling	
392	PB24	Gravity
393	PB23	Gravity
394	60-IP-77	Geochemical
395	59-IP-77	Geochemical
396	58-IP-77	Geochemical
397	57-IP-77	Geochemical
398	54-IP-77	Geochemical
399	56-IP-77	Geochemical
400	PB25	Gravity
401	55-IP-77	Geochemical

STEPOVAK QUADRANGLE (PLATE E)

Random Sampling

Map No.	Sample or Station No.	Analysis or Measurement
402	55-JM-77	Geochemical
402	56-JM-77	Geochemical
403	53-JM-77	Geochemical
403	54-JM-77	Geochemical
404	104-JB-77	Geochemical
405	105-JB-77	Geochemical
406	102-JB-77	Geochemical
407	101-JB-77	Geochemical
408	99-JB-77	Geochemical
409	100-JB-77	Geochemical
410	48-JB-77	Geochemical
410	49-JB-77	Geochemical
410	50-JM-77	Geochemical
410	51-JM-77	Lithology
410	52-JM-77	Geochemical
411	98-JB-77	Geochemical
412	106-JB-77	Geochemical
413	102-JB-77	Geochemical

FALSE PASS QUADRANGLE (PLATE F)

Random Sampling

Map No.	Sample or Station No.	Analysis or Measurement
414	UN03	Gravity
414	7-JM-77	Geochemical
415	UN10	Gravity
416	UN12	Gravity
416	25-JB-77	Geochemical
416	16-JM-77	Geochemical
417	24-JB-77	Geochemical
418	FP11	Gravity
419	FP10	Gravity
420	FP09	Gravity
420	A7-JB-77	Geochemical
420	77-SWH-01	Oriented basalt
	East Morzhovoi Bay Stratigraphic Section (Plate XII) Samples	
421	43-GB-77	Hydrocarbon
421	44-GB-77	Paleontology
421	45-GB-77	Hydrocarbon
421	46-GB-77	Paleontology
421	47-GB-77	Macrofossil
421	48-GB-77	Hydrocarbon
421	49-GB-77	Paleontology
421	50-JB-77	Paleontology
421	51-GB-77	Macrofossil
421	52-GB-77	Porosity and permeability
421	53-GB-77	Macrofossil
421	54-GB-77	Lithology
421	55-GB-77	Macrofossil
421	56-GB-77	Porosity and permeability
421	57-GB-77	Lithology
	Random Sampling	
421A	FP08	Gravity
422	6-JB-77	Geochemical
422	7-JB-77	Geochemical
422	9-JB-77	Geochemical
422	77-SWH-1A	Geochemical
422	77-SWH-2A	Geochemical
422	77-SWH-3A	Geochemical
422	77-SWH-4A	Geochemical
422	77-SWH-5A	Geochemical
423	FP07	Gravity
423	A6-JB-77	Geochemical
424	FP06	Gravity
424	A5-JB-77	Geochemical
424	77-SWH-01B	Bulk rock
424	77-SWH-02	Bulk rock
424	77-SWH-03	Bulk rock
424	77-SWH-04	Bulk rock
424	77-SWH-05	Bulk rock
424	77-SWH-06	Bulk rock
424	77-SWH-07	Bulk rock

Map No.	Sample or Station No.	Analysis or Measurement
424	77-SWH-08	Bulk rock
425	FP05	Gravity
425	A4-JB-77	Geochemical
426	UN04	Gravity
426	8-JM-77	Geochemical
427	FP19	Gravity
427	9-JM-77	Geochemical
428	FP19	Gravity
428	A10-JB-77	Geochemical
429	FP18	Gravity
430	FP20	Gravity

West Morzhovoi Bay Stratigraphic Section (Plate XIII) Samples

431	1-IP-77	Porosity and permeability
431	2-IP-77	Porosity and permeability
431	3-IP-77	Paleontology
431	4-IP-77	Macrofossil
431	5-IP-77	Paleontology
431	6-IP-77	Paleontology
431	7-IP-77	Paleontology
431	8-IP-77	Porosity and permeability
431	1-WL-74	Age date
431	2-WL-74	Geochemical
431	3-WL-74	Porosity and permeability
431	4-WL-74	Thin section
431	5-WL-74	Porosity and permeability
431	6-WL-74	Office sample
431	7-WL-74	Office sample
431	8-WL-74	Porosity and permeability
431	9-WL-74	Age date
431	10-WL-74	Porosity and permeability
431	11-WL-74	Hydrocarbon
431	12-WL-74	Porosity and permeability
431	13-WL-74	Age date
431	14-WL-74	Age date
431	15-WL-74	Lithology

Random Sampling

Map No.	Sample or Station No.	Analysis or Measurement
432	FP13	Gravity
432	A8-JB-77	Geochemical
433	FP12	Gravity
434	UN06	Gravity
434	10-JM-77	Geochemical
435	FP17	Gravity
436	FP16	Gravity
437	UN07	Gravity
438	TRI.#48	Gravity
438	57-WL-74	Geochemical
439	FP15	Gravity
439	A9-JB-77	Geochemical
440	FP14	Gravity
441	UN08	Gravity
441	11-JN-77	Geochemical
442	TRI.#51	Gravity?
443	TRI.#49	Gravity
443	57A-WL-74	Density
444	TRI.#50	Gravity
445	UN09	Gravity
445	12-JM-77	Geochemical
445	13-JM-77	Geochemical
445	14-JM-77	Geochemical

TABLE 1B—SAMPLE OR STATION NUMBERS TO MAP NUMBERS

SAMPLING BY J. A. MOREHOUSE

Random Sampling

Sample No.	Map No.
1-JM-77	174
2-JM-77	163
3-JM-77	162
4-JM-77	167
5-JM-77	173
6-JM-77	181
7-JM-77	414
8-JM-77	426
9-JM-77	427
10-JM-77	434

Sample No.	Map No.
11-JM-77	441
12-JM-77	445
13-JM-77	445
14-JM-77	445
15-JM-77	187
16-JM-77	416
17-JM-77	None
18-JM-77	243
19-JM-77	211
20-JM-77	242
21-JM-77	244
22-JM-77	331
23-JM-77	330
24-JM-77	330
25-JM-77	290
26-JM-77	290
27-JM-77	329

S. E. Bear Lake Stratigraphic Section (Plate III) Samples

35-JM-77	230
36-JM-77	230
37-JM-77	230
38-JM-77	230
39-JM-77	230
40-JM-77	230
41-JM-77	230
42-JM-77	230
43-JM-77	230
44-JM-77	230
45-JM-77	230
46-JM-77	230
47-JM-77	230

Random Sampling

48-JM-77	410
49-JM-77	410
50-JM-77	410
51-JM-77	410
52-JM-77	410
53-JM-77	403
54-JM-77	403
55-JM-77	402
56-JM-77	402

SAMPLING BY W. M. LYLE

Random Sampling

Sample No.	Map No.
1-WL-77	179
2-WL-77	178
3-WL-77	177
4-WL-77	None

Black Lake Stratigraphic Section (Plate I) Samples

5-WL-77	43
6-WL-77	43
7-WL-77	43
8-WL-77	43
9-WL-77	43
10-WL-77	43
11-WL-77	43
12-WL-77	43
13-WL-77	43
14-WL-77	43
15-WL-77	43
16-WL-77	43
17-WL-77	43
18-WL-77	43
19-WL-77	43
20-WL-77	43

Beaver Bay Stratigraphic Section (Plate VIII) Samples

21-WL-77	377
22-WL-77	377
23-WL-77	377
24-WL-77	377
25-WL-77	377
26-WL-77	377
27-WL-77	377
28-WL-77	377
29-WL-77	377
30-WL-77	377
31-WL-77	377
32-WL-77	377
33-WL-77	377
33A-WL-77	377
34-WL-77	377
35-WL-77	377
36-WL-77	377
37-WL-77	377
38-WL-77	377
39-WL-77	377
40-WL-77	377

Sample No.	Map No.
Aliaksin Peninsula Stratigraphic Section (Plate X) Samples	
42-WL-77	382
43-WL-77	382
44-WL-77	382
45-WL-77	382
46-WL-77	382
47-WL-77	382
48-WL-77	382
49-WL-77	382
50-WL-77	382
51-WL-77	382
White Bluff Stratigraphic Section (Plate XI) Samples	
52-WL-77	391
53-WL-77	391
54-WL-77	391
55-WL-77	391
56-WL-77	391
57-WL-77	391
58-WL-77	391
59-WL-77	391
60-WL-77	391
61-WL-77	391
62-WL-77	391
63-WL-77	391
64-WL-77	391
65-WL-77	391
66-WL-77	391
67-WL-77	391
68-WL-77	391
69-WL-77	391
70-WL-77	391
71-WL-77	391
72-WL-77	391
Milky River Stratigraphic Section (Plate II) Samples	
72A-WL-77	205
73-WL-77	205
74-WL-77	205
75-WL-77	205
76-WL-77	205
77-WL-77	205
78-WL-77	205
79-WL-77	205
80-WL-77	205
81-WL-77	205

Sample No.	Map No.
82-WL-77	205
83-WL-77	205
84-WL-77	205
85-WL-77	205
86-WL-77	205
87-WL-77	205
88-WL-77	205
89-WL-77	205
90-WL-77	205
91-WL-77	205
92-WL-77	205
93-WL-77	205
94-WL-77	205
95-WL-77	205
96-WL-77	205
97-WL-77	205
98-WL-77	205
99-WL-77	205
100-WL-77	205
101-WL-77	205
102-WL-77	205
103-WL-77	205
103A-WL-77	205
104-WL-77	205
105-WL-77	205

SAMPLING BY J. G. BOLM

Random Sampling

Sample No.	Map No.
A1-JB-77	193
A2-JB-77	194
A3-JB-77	195
A4-JB-77	425
A5-JB-77	424
A6-JB-77	423
A7-JB-77	420
A8-JB-77	432
A9-JB-77	439
A10-JB-77	428
6-JB-77	422
7-JB-77	422
9-JB-77	422
24-JB-77	417
25-JB-77	416

Sample No.	Map No.
29-JB-77	40
30-JB-77	39
31-JB-77	38
32-JB-77	29
33-JB-77	26
34-JB-77	27
35-JB-77	27
36-JB-77	28
37-JB-77	28
38-JB-77	14
39-JB-77	15
40-JB-77	16
41-JB-77	17
42-JB-77	18
43-JB-77	19
44-JB-77	20
45-JB-77	30
46-JB-77	31
47-JB-77	32
48-JB-77	35
49-JB-77	62
98-JB-77	411
99-JB-77	408
100-JB-77	409
101-JB-77	407
102-JB-77	406
103-JB-77	413
104-JB-77	404
105-JB-77	405
106-JB-77	412
150-JB-77	366
151-JB-77	366
152-JB-77	368
153-JB-77	334
154-JB-77	335
155-JB-77	332
156-JB-77	333
157-JB-77	293
158-JB-77	292

SAMPLING BY STEVE HACKETT

Random Sampling

Sample No.	Map No.
77-SWH-01A	422
77-SWH-02A	422
77-SWH-03A	422
77-SWH-04A	422
77-SWH-05A	422
77-SWH-01	420
77-SWH-01B	420
77-SWH-02	424
77-SWH-03	424
77-SWH-04	424
77-SWH-05	424
77-SWH-06	424
77-SWH-07	424
77-SWH-08	424
77-SWH-09	424
77-SWH-11	321
77-SWH-12	321
77-SWH-12A	369
77-SWH-13	369
77-SWH-14	59

SAMPLING BY J. G. BOLM

Waterfall Point Stratigraphic Section (Plate VI) Samples

Sample No.	Map No.
1-GB-77	322
2-GB-77	322
3-GB-77	322
3-GB-77	322
4-GB-77	322
5-GB-77	322
6-GB-77	322
7-GB-77	322
8-GB-77	322
9-GB-77	322
10-GB-77	322
11-GB-77	322
12-GB-77	322
13-GB-77	322
14-GB-77	322
15-GB-77	322

Balboa Bay Stratigraphic Section (Plate VII) Samples

Sample No.	Map No.
16-GB-77	369
17-GB-77	369
18-GB-77	369
19-GB-77	369
20-GB-77	369

Sample No.	Map No.
21-GB-77	369
22-GB-77	369
23-GB-77	369
24-GB-77	369
25-GB-77	369
26-GB-77	369
27-GB-77	369
28-GB-77	369

Milky River Stratigraphic Section
(Plate II) Samples

29-GB-77	205
30-GB-77	205
31-GB-77	205
32-GB-77	205
33-GB-77	205
34-GB-77	205
35-GB-77	205
36-GB-77	205
37-GB-77	205
38-GB-77	205
39-GB-77	205
40-GB-77	205
41-GB-77	205
42-GB-77	205

East Morzhovoi Bay Stratigraphic Section
(Plate XII) Samples

43-GB-77	421
44-GB-77	421
45-GB-77	421
46-GB-77	421
47-GB-77	421
48-GB-77	421
49-GB-77	421
50-GB-77	421
51-GB-77	421
52-GB-77	421
53-GB-77	421
54-GB-77	421
55-GB-77	421
56-GB-77	421
57-GB-77	421

Random Sampling

58-GB-77	297
59-GB-77	297
60-GB-77	297
61-GB-77	297
62-GB-77	297

Sample No.	Map No.
63-GB-77	297
64-GB-77	294
65-GB-77	294
66-GB-77	294
67-GB-77	380
68-GB-77	380
69-GB-77	380
70-GB-77	380
71-GB-77	380
72-GB-77	380
73-GB-77	257
74-GB-77	258
75-GB-77	340
76-GB-77	340
77-GB-77	340
78-GB-77	340
79-GB-77	340
80-GB-77	340
81-GB-77	340
82-GB-77	340
83-GB-77	340
84-GB-77	340
85-GB-77	340
86-GB-77	340
87-GB-77	340
88-GB-77	340
89-GB-77	340
90-GB-77	340

SAMPLING BY IRVEN F. PALMER, JR.

West Morzhovoi Stratigraphic Section
(Plate XIII) Samples

Sample No.	Map No.
1-IP-77	431
2-IP-77	431
3-IP-77	431
4-IP-77	431
5-IP-77	431
6-IP-77	431
7-IP-77	431
8-IP-77	431

Sample No.	Map No.
Lefthand Bay-Balboa Bay Stratigraphic Section (Plate VII) Samples	
9-IP-77	369
10-IP-77	369
11-IP-77	369
12-IP-77	369
13-IP-77	369
14-IP-77	369
15-IP-77	369
16-IP-77	369
17-IP-77	369
18-IP-77	369
19-IP-77	369
20-IP-77	369
21-IP-77	369
22-IP-77	369
23-IP-77	369
24-IP-77	369
25-IP-77	369
Heren I and II Stratigraphic Sections (Plates IV and V) Samples	
26-IP-77	291
27-IP-77	291
28-IP-77	291
29-IP-77	291
30-IP-77	291
31-IP-77	291
32-IP-77	291
33-IP-77	291
34-IP-77	291
35-IP-77	291
36-IP-77	291
37-IP-77	291
38-IP-77	291
39-IP-77	291
40-IP-77	291
41-IP-77	291
42-IP-77	291
43-IP-77	291
44-IP-77	291
45-IP-77	291
46-IP-77	291
47-IP-77	291
48-IP-77	291
49-IP-77	291
50-IP-77	291
51-IP-77	291
52-IP-77	291
53-IP-77	291

Sample No.	Map No.
54-IP-77	398
55-IP-77	401
56-IP-77	399
57-IP-77	397
58-IP-77	396
59-IP-77	395
60-IP-77	394
61-IP-77	390
62-IP-77	2
63-IP-77	2
64-IP-77	2
65-IP-77	1
66-IP-77	1
67-IP-77	1

SAMPLING BY W. M. LYLE

West Morzhovoi Bay Stratigraphic Section (Plate XIII) Samples

Sample No.	Map No.
1-WL-74	431
2-WL-74	431
3-WL-74	431
4-WL-74	431
5-WL-74	431
6-WL-74	431
7-WL-74	431
8-WL-74	431
9-WL-74	431
10-WL-74	431
11-WL-74	431
12-WL-74	431
13-WL-74	431
14-WL-74	431
15-WL-74	431
16-WL-74	188A
17-WL-74	374
18-WL-74	355A
19-WL-74	347
20-WL-74	385
21-WL-74	365
22-WL-74	335A
23-WL-74	335A
24-WL-74	335A
25-WL-74	335A

Sample No.	Map No.
26-WL-74	295
27-WL-74	295
28-WL-74	298
29-WL-74	299
30-WL-74	345
31-WL-74	349
32-WL-74	349
33-WL-74	355
34-WL-74	350
35-WL-74	350
36-WL-74	350
37-WL-74	176
38-WL-74	196
39-WL-74	197
40-WL-74	197
41-WL-74	198
42-WL-74	155
43-WL-74	155
44-WL-74	156
45-WL-74	364

Balboa Bay Stratigraphic Section
(Plate VII) Samples

46-WL-74	369
47-WL-74	369
48-WL-74	369
49-WL-74	369

Random Sampling

Sample No.	Map No.
50-WL-74	296
51-WL-74	160
52-WL-74	159
53-WL-74	191
54-WL-74	192
55-WL-74	189
56-WL-74	438
57-WL-74	438
57A-WL-74	443
58-WL-74	124
59-WL-74	117
60-WL-74	111
60A-WL-74	112
61-WL-74	221
62-WL-74	269

Sample No.	Map No.
63-WL-74	272
64-WL-74	279
65-WL-74	224
66-WL-74	271
67-WL-74	280
68-WL-74	280
69-WL-74	270
70-WL-74	272
71-WL-74	276
72-WL-74	278
73-WL-74	278
74-WL-74	277
75-WL-74	273
76-WL-74	275
77-WL-74	275
78-WL-74	281
79-WL-74	228
80-WL-74	229
81-WL-74	229
82-WL-74	233
83-WL-74	232
84-WL-74	231

Beaver Bay East Stratigraphic Section
(Plate IX) Samples

85-WL-74	378
86-WL-74	378
87-WL-74	378
88-WL-74	378
89-WL-74	378
90-WL-74	378
91A-WL-74	378
92-WL-74	378
92A-WL-74	378
93-WL-74	378
94-WL-74	378
95-WL-74	378
96-WL-74	378
97-WL-74	378
98-WL-74	378
99-WL-74	378
100-WL-74	378
101-WL-74	378
102-WL-74	378
103-WL-74	378
104-WL-74	378
105-WL-74	378
106-WL-74	378
107-WL-74	378
108-WL-74	378

Sample No.	Map No.
109-WL-74	378
110-WL-74	378
111-WL-74	378
112-WL-74	378
113-WL-74	378

Random Sampling

Sample No.	Map No.
114-WL-74	356
115-WL-74	308
116-WL-74	319
117-WL-74	371
118-WL-74	371
119-WL-74	354
120-WL-74	351
121-WL-74	351
122-WL-74	352
123-WL-74	353
124-WL-74	353
125-WL-74	353
126-WL-74	344
127-WL-74	338
128-WL-74	339
129-WL-74	339
130-WL-74	341
131-WL-74	341
132-WL-74	337
133-WL-74	336
133B-WL-74	336
134-WL-74	343
135-WL-74	346
136-WL-74	348
137-WL-74	348
138-WL-74	310
139-WL-74	312
140-WL-74	312
141-WL-74	309
142-WL-74	266
143-WL-74	260
144-WL-74	110
145-WL-74	318
146-WL-74	316
147-WL-74	316
148-WL-74	315
149-WL-74	314
150-WL-74	314
151-WL-74	313
152-WL-74	313
153-WL-74	267
154-WL-74	267
155-WL-74	267
156-WL-74	267
157-WL-74	259
158-WL-74	256
159-WL-74	256
160-WL-74	255
161-WL-74	255
162-WL-74	251
163-WL-74	251
164-WL-74	300
165-WL-74	300
166-WL-74	302
167-WL-74	304
168-WL-74	367

Beaver Bay East Stratigraphic Section (Plate IX) Samples

Sample No.	Map No.
169-WL-74	378
170-WL-74	378
171-WL-74	378
172-WL-74	378
173-WL-74	378
174-WL-74	378
175-WL-74	378
176-WL-74	378
177-WL-74	378
178-WL-74	378
179-WL-74	378
180-WL-74	378
181-WL-74	378
182-WL-74	378
183-WL-74	378
184-WL-74	378
185-WL-74	378
186-WL-74	378
187-WL-74	378
188-WL-74	378
189-WL-74	378

Random Sampling

Sample No.	Map No.
190-WL-74	378
191-WL-74	381
192-WL-74	342
193-WL-74	342
194-WL-74	311
195-WL-74	311
197-WL-74	222
198-WL-74	223
199-WL-74	204
200-WL-74	227

Sample No.	Map No.	Sample No.	Map No.
201-WL-74	226	250-WL-74	99
202-WL-74	282	251-WL-74	100
203-WL-74	282	252-WL-74	100
204-WL-74	283	253-WL-74	100
205-WL-74	283	254-WL-74	100
206-WL-74	283	255-WL-74	101
207-WL-74	283	256-WL-74	101
208-WL-74	283	257-WL-74	102
209-WL-74	283	258-WL-74	102
210-WL-74	283	259-WL-74	73
211-WL-74	320	260-WL-74	73
212-WL-74	266	261-WL-74	73
213-WL-74	207	262-WL-74	73
214-WL-74	207	263-WL-74	56
215-WL-74	307	264-WL-74	56
216-WL-74	206	265-WL-74	56
217-WL-74	206	266-WL-74	56
218-WL-74	306	267-WL-74	56
219-WL-74	305	268-WL-74	45
220-WL-74	258	269-WL-74	57
221-WL-74	359	270-WL-74	57
222-WL-74	360	271-WL-74	57
223-WL-74	360	272-WL-74	57
224-WL-74	357	273-WL-74	53
225-WL-74	303	274-WL-74	54
226-WL-74	303	275-WL-74	52
227-WL--74	303	276-WL-74	66
228-WL-74	361	277-WL-74	67
229-WL-74	373	278-WL-74	68
230-WL-74	373	279-WL-74	85
231-WL-74	384	280-WL-74	87
232-WL-74	384	281-WL-74	86
233-WL-74	384	282-WL-74	86
234-WL-74	384	283-WL-74	41
235-WL-74	384	284-WL-74	41
236-WL-74	383	285-WL-74	69
237-WL-74	254	286-WL-74	72
238-WL-74	301	287-WL-74	71
239-WL-74	262	288-WL-74	71
240-WL-74	262	289-WL-74	71
241-WL-74	262	290-WL-74	71
242-WL-74	262	291-WL-74	71
243-WL-74	262	292-WL-74	70
244-WL-74	263	293-WL-74	70
245-WL-74	265	294-WL-74	70
246-WL-74	265	295-WL-74	70
247-WL-74	265	296-WL-74	70
248-WL-74	265	297-WL-74	70
248-WL-74	95	298-WL-74	70
249-WL-74	99	299-WL-74	70

Sample No.	Map No.
300-WL-74	70
301-WL-74	88
302-WL-74	88
303-WL-74	88
304-WL-74	89
305-WL-74	89
306-WL-74	89
307-WL-74	90
308-WL-74	90
309-WL-74	90
310-WL-74	90
311-WL-74	91
312-WL-74	91
313-WL-74	91
314-WL-74	75
314.1-WL-74	75
314.2-WL-74	75
314.3-WL-74	75
314.4-WL-74	75
314.6-WL-74	75
314.7-WL-74	76
314.8-WL-74	76
314.9-WL-74	76
314.10-WL-74	76
314.11-WL-74	76
314.12-WL-74	74
314.13-WL-74	74
315-WL-74	50
316-WL-74	55
317-WL-74	72 or 43
318-WL-74	44
319-WL-74	102A
320-WL-74	102B
321-WL-74	102C
322-WL-74	102C
323-WL-74	102C
324-WL-74	102C
325-WL-74	102C
326-WL-74	102C
327-WL-74	102K
328-WL-74	102K
329-WL-74	102K
330-WL-74	102G
331-WL-74	102H
332-WL-74	102H
333-WL-74	102L
334-WL-74	102L
335-WL-74	102L
336-WL-74	102L
337-WL-74	102L
338-WL-74	102L
339-WL-74	102L
340-WL-74	102L
341-WL-74	102L
342-WL-74	102L
343-WL-74	102L
344-WL-74	102L
345-WL-74	None
350-WL-74	102I
351-WL-74	102I
352-WL-74	102I
353-WL-74	102I
354-WL-74	102I
355-WL-74	102J
356-WL-74	102J
357-WL-74	102J
358-WL-74	102D
359-WL-74	102D
360-WL-74	102E
361-WL-74	102F
362-WL-74	102M
363-WL-74	102M
364-WL-74	102M
365-WL-74	102M
366-WL-74	102M

TABLE 1C—GRAVITY STATION NUMBERS TO MAP NUMBERS

TABLE 1C—GRAVITY STATION NUMBERS TO MAP NUMBERS

FALSE PASS TRAVERSE

Gravity Station No.	Map No.
FP01	175
FP02	193
FP03	194
FP04	195
FP05	425
FP06	424
FP07	423
FP08	421A
FP09	420
FP10	419

Gravity Station No.	Map No.
FP11	418
FP12	433
FP13	432
FP14	440
FP15	439
FP16	436
FP17	435
FP18	429
FP19	428
FP20	430

IZEMBEK TRAVERSE

Gravity Station No.	Map No.
IZ01	174
IZ02	173
IZ03	172
IZ04	169
IZ05	163
IZ06	161
IZ07	162
IZ08	164
IZ09	165
IZ10	166
IZ11	168
IZ12	151
IZ13	149
IZ14	147
IZ15	146
IZ16	145
IZ17	148
IZ18	150
IZ19	143
IZ20	142
IZ21	141
IZ22	140
IZ23	139
IZ24	138

UNIMAK TRAVERSE

Gravity Station No.	Map No.
UN01	180
UN02	181
UN03	414
UN04	426
UN05	427
UN06	434
UN07	437
UN08	441
UN09	445
UN10	415
UN11	187
UN12	416
UN13	179
UN14	178
UN15	177

PAVLOV BAY TRAVERSE

Gravity Station No.	Map No.
PB01	218
PB02	216
PB03	253
PB04	250
PB05	214
PB06	246
PB07	247
PB08	249
PB09	248
PB10	200
PB11	241
PB12	289
PB13	365
PB14	328
PB15	326
PB16	363
PB17	376
PB18	386
PB19	387
PB20	390A
PB21	390
PB22	389
PB23	393
PB24	392
PB25	400
PB26	375
PB27	362
PB28	323
PB29	285
PB30	235
PB31	207

MUDDY RIVER TRAVERSE

Gravity Station No.	Map No.
MR01	203A
MR02	92
MR03	58
MR04	78
MR05	59
MR06	46
MR07	47
MR08	48
MR09	49
MR10	61
MR11	63
MR12	64
MR13	82
MR14	83
MR15	84
MR16	97

SAPSUK RIVER TRAVERSE

Gravity Station No.	Map No.
SR01	243
SR02	211
SR03	242
SR04	244
SR05	331
SR06	330
SR07	290
SR08	329
SR09	288
SR10	240
SR11	239
SR12	209
SR13	238
SR14	287
SR15	325
SR16	324

BERING SEA TRAVERSE

Gravity Station No.	Map No.
BS01	215
BS02	203
BS03	202
BS04	201
BS05	199
BS06	206
BS07	236
BS08	284
BS09	103
BS10	105
BS11	106
BS12	107
BS13	108
BS14	109
BS15	114
BS16	116
BS17	120
BS18	153
BS19	154
BS20	125
BS21	118
BS22	126
BS23	113
BS24	286

PORT HEIDEN TRAVERSE

Gravity Station No.	Map No.
PH01	33
PH02	34
PH03	21
PH04	22
PH05	23
PH06	9
PH07	10
PH08	11
PH09	7
PH10	6
PH11	5
PH12	4
PH13	8
PH14	36
PH16	96

TABLE 1D—TRIANGLE NUMBERS TO MAP NUMBERS

1974 TRIANGLE SECTIONS	
Triangle No.	Map No.
1	170
2	431
3	213
4	374
5	98
6	355A
7	347
8	385
9	365
10	335A
11	295
12	298
13	299
14	431
15	349
16	349
17	355
18	350
19	133
20	176
21	196
22	197
23	198
24	155
25	156
26	364
27	269
28	None
29	296
30	296
31	?
32	160
33	159
34	191
35	192
36	190
37	189
37	189
38	188
39	186
40	182
41	183
42	184
43	185
44	157
45	158
46	136
45	135
46	136
47	135
48	438
49	443
50	444
51	442
52	144
53	137
54	134
55	130
56	129
57	128
58	122
59	121
60	119
61	115
62	123
63	132
64	152A
65	152
66	131
67	124
68	117
69	111
70	112
71	104
72	237
73	219
74	217
75	220
76	221
77	268
78	269
79	272
80	279
81	224
82	271
83	280
84	270
85	272
86	276
87	278
88	277
89	273
90	275
91	274
92	281

Triangle No.	Map No.	Triangle No.	Map No.
93	228	143	388
94	229	144	381
95	233	145	342
96	232	146	311
97	231	147	93
98	278	148	222
99	379	149	223
100	370	150	204
101	356	151	225
102	208	152	227
103	317	153	226
104	319	154	282
105	371	155	283
106	354	156	320
107	351	157	266
108	352	158	307
109	353	159	306
110	344	160	264
111	338	161	305
112	339	162	358
113	341	163	359
114	337	164	360
115	336	165	357
116	343	166	303
117	346	167	361
118	348	168	372
119	310	169	373
120	312	170	384
121	309	171	384
122	266	172	383
123	260	173	254
124	110	174	301
125	210	175	262
126	237A	176	263
127	245	177	265
128	318	178	59
129	316	179	79
130	315	180	80
131	314	181	81
132	313	182	94
133	267	183	77
134	259	184	95
135	256	185	99
136	255	186	100
137	252	187	101
138	251	188	102
139	300	189	37
140	302	190	73
141	304	191	56
142	367	192	45

Triangle No.	Map No.
193	57
194	53
195	54
196	52
197	41
198	66
199	67
200	68
201	85
202	87
203	86
204	72
205	42
206	69
207	43
208	71
209	70
210	25
211	24
212	13
213	12
214	88
215	89
216	90
217	91
218	75
219	75
220	76
221	76
222	74
223	50
224	51
225	55
226	72 or 43
227	44
228	102A
229	102B
230	102C
231	102C
232	102C
234	102K
235	102G
236	102H
237	102L
238	102L
239	102L
240	102I
241	102I
242	102J
243	102D
244	102E
245	102F
246	102M

TABLE 2—THICKNESS OF STRATIGRAPHIC SECTIONS AND THICKNESS AND PERCENTAGE OF SANDSTONE

Age and Stratigraphic Section	Total Thickness in feet	Percent Sandstone	Number of Sands	Discrete Sandstone thickness—meters 0-15	15-30	>30
PLIOCENE–MIOCENE						
East Morzhovoi Bay	455	45%	34	34	0	0
West Morzhovoi Bay	1,221	92%	29	26	2	1
MIOCENE						
Aliaksin Peninsula	499	100%	12	8	3	1
Southeast Bear Lake	1,175	96%	31	22	7	2
Black Lake	2,152	61%	34	27	2	5
Milky River	2,658	89%	72	57	14	1
White Bluff	948	38%	19	18	1	0
OLIGOCENE–EOCENE						
Beaver Bay	1,936	61%	44	44	0	0
Beaver Bay East*	2,798	25%	Unknown	?	4	1
Lefthand Bay—Balboa Bay	1,668	.78%	4	4	0	0
Waterfall Point*	378	53%	Unknown	All	0	0
EOCENE(?) OR PALEOCENE(?)						
Heren I	146	66%	6	6	0	0
Heren II	172	43%	13	13	0	0
Average percent		62.8%				
Totals	16,206		298	240	29	10

*Not all the sands in this section were measured; thus percentage of sandstone is estimated.

TABLE 3--POROSITY AND PERMEABILITY ANALYSES

(Analyses by Chemical and Geological Laboratories of Alaska, Inc.)

Sample Number	Effective Porosity %	Permeability (mD)
Waterfall Point: Stepovak Formation[a]		
2-GB-77	1.7	0.04
4-GB-77	4.1	0.60
9-GB-77	3.0	0.04
13-GB-77	12.1	0.06
Milky River: Bear Lake Formation		
29-GB-77	10.1	0.12
30-GB-77	6.4	2.61
39-GB-77	4.0	1.83
95-WL-77	17.7	53.00
84-WL-77	17.5	0.86
93-WL-77	unconsolidated sand	
A72-WL-77	12.8	0.26
76-WL-77	16.8	0.05
77-WL-77	17.6	72.00
78-WL-77	4.5	10.00
90-WL-77	unconsolidated sand	
East Morzhovoi Bay: Tachilni Formation		
52-GB-77	20.1	2.00
56-GB-77	11.6	2.42
Gull Point on Herendeen Bay: Chignik Formation		
58-GB-77	8.7	0.21
59-GB-77	7.8	0.21
60-GB-77	5.7	0.10
61-GB-77	7.1	0.09
Bold Bluff Point on Herendeen Bay: Naknek Formation		
64-GB-77	6.9	0.02
66-GB-77	6.8	0.33
Tolstoi Formation[a] NE¼, Sec. 6, T. 54 S., R. 76 W.		
71-GB-77	1.6	0.09
72-GB-77	2.4	0.02
Gas Rocks (see location map)		
73-GB-77	2.8	0.11
West Morzhovoi Bay: Tachilni Formation		
1-IP-77	15.1	2.87
2-IP-77	13.6	1.17
8-IP-77	6.2	5.00

[a]Burk (1965)

Sample Number	Effective Porosity %	Permeability (mD)
Lefthand Bay: Stepovak Formation[a]		
20-IP-77	1.7	0.02
Heren I: Tolstoi Formation[a]		
28-IP-77	11.2	0.82
31-IP-77	11.5	0.42
32-IP-77	8.5	0.23
34-IP-77	7.5	0.43
35-IP-77	11.8	0.21
Heren II: Unnamed formation		
38-IP-77	0.3	0.23
39-IP-77	11.0	0.48
43-IP-77	7.8	0.11
46-IP-77	3.8	0.06
51-IP-77	4.5	0.08
52-IP-77	5.9	0.78
53-IP-77	11.7	8.50
Mother Goose Area: Cretaceous		
64-IP-77	1.7	0.01
Mother Goose Area: Tertiary		
67-IP-77	6.8	0.02
White Bluff: Bear Lake Formation		
71-WL-77	4.2	0.06
Beaver Bay: Stepovak Formation[a]		
33-WL-77	19.6	990.00
24-WL-77	16.3	3.79
23-WL-77	15.0	0.07
40-WL-77	15.3	0.03
30-WL-77	1.7	0.05
Black Lake: Bear Lake Formation		
18-WL-77	5.6	0.21
12-WL-77	12.5	0.18
14-WL-77	8.7	0.06
20-WL-77	2.4	2.28
Aliaksin Peninsula: Bear Lake Formation		
46-WL-77	unconsolidated sand	
49-WL-77	16.0	10
S. E. Bear Lake: Bear Lake Formation		
36-JM-77	6.6	1.04

[a]Burk (1965)

TABLE 4--ORGANIC GEOCHEMICAL DATA

(Analyses by Geochem Laboratories, Inc., Houston, Texas)

Sample Number	Organic Carbon Content (Weight Percent)	Kerogen Type[a]	Kerogen TAI[b]	C_{15+} Extract Total (ppm)	C_{15+} Extract Asphaltenes (ppm)
06-GB-77	0.42 (0.44)	H;W;Am	2- to 2	179	106
10-GB-77	0.33	H;C;Am-W	2 to 2+	148	97
14-GB-77	0.26	H;W;Am-C	2+ to 3-	483	380
16-GB-77	0.58	H;Am;W(C)	2- to 2	272	81
18-GB-77	0.42	Am;H;C	2- to 2	276	91
21-GB-77	0.43 (0.46)	H;W-C;Am	2- to 2	266	76
24-GB-77	0.62	Am-H;-;C	1+ to 2-	382	98
26-GB-77	0.25	H;W;C	2 to 2+	103	74
33-GB-77	0.37	H;Am;W-C	2- to 2	124	61
35-GB-77	0.53 (0.56)	H;Am;-	1+ to 2-	172	98
37-GB-77	0.67	H;W;Am-C	1 to 1+	152	96
40-GB-77	0.96	H;-;Am-C	1 to 1+	273	152
43-GB-77	0.35	H;C;W	2- to 2	457	142
45-GB-77	0.69	H;W;C	2- to 2	520	208
48-GB-77	0.28 (0.30)	H;Am;W	2- to 2	298	152
63-GB-77	0.82	H;Am;W	2- to 2	246	111
68-GB-77	0.18	Am;H;W-C	2 to 2+	131	67
70-GB-77	1.24	Am;H;-	2 to 2+	200	88
76-GB-77	0.72	W-C;Am-H;-	3- to 3	89	71
78-GB-77	0.79 (0.78)	H-C;W;Am	3 to 3+	55	38
80-GB-77	0.60	W-C;H;Am	3 to 3+	73	43
82-GB-77	0.69	H-C;W;-	3 to 3+	95	66
84-GB-77	0.69	H-C;W;-	3 to 3+	37	30
86-GB-77	0.62	W-C;H;Am	3 to 3+	88	55
88-GB-77	0.71 (0.68)	W-C;H;Am	3 to 3+	85	52
90-GB-77	0.80	W-C;H;Am	3- to 3	83	47
8-WL-77	0.15	H;C;Am	2- to 2?	185	55
11-WL-77	0.14	H;C;Am	2?	464	107
22-WL-77	1.23	H;Am;W	2- to 2	266	123
26-WL-77	0.87 (0.86)	H;W;Am	2 to 2+	189	62
29-WL-77	1.17	H;Am;W	2 to 2+	176	76
33A-WL-77	1.91	H;Am;W-C	2+ to 3-	107	60
35-WL-77	1.94	H;C;Am-W	2 to 2+	462	149
38-WL-77	1.10	H;Am-W;C	2 to 2+	398	83
39-WL-77	3.94 (3.91)	H;Am;W	2 to 2+	939	251
42-WL-77	0.39	H;W-C;Am	2- to 2	1947	1788
43-WL-77	0.18	H;W;Am	2- to 2	967	896

a. Kerogen key (in order listed): Predominant—60 to 100%; Secondary--20 to 40%; Trace—1 to 20%.
Al = Algal, Am = Amorphous-Sapropel, H = Herbaceous-Spore/Cuticle, W = Woody, C = Coaly, U = Unidentified Material.

b. Scale from 1 = unaltered to 4 = severely altered; underlined number indicates dominant rank of alteration.

Sample Number	Organic Carbon Content (Weight Percent)	Kerogen Type[a]	Kerogen TAI[b]	C_{15+} Extract Total (ppm)	C_{15+} Extract Asphaltenes (ppm)
53-WL-77	8.73	H;Am;W	1 to 1+	2984	1215
61-WL-77	3.22	H;W;C	1+ to 2-	1372	1146
65-WL-77	1.21 (1.22)	H;W;Am	2- to 2	372	200
67-WL-77	0.69	H;Am;C	2- to 2	266	143
69-WL-77	0.14	H;C;Am	2- to 2	98	54
74-WL-77	0.67	H;W;Am-C	2- to 2	141	86
80-WL-77	0.82	H;W;Am(C)	2- to 2	270	86
83-WL-77	1.88 (1.89)	H;W;Am	2- to 2	619	259
85-WL-77	0.87	H;W;Am-C	2- to 2	317	147
89-WL-77	0.66	H;Am;W	2- to 2	293	144
92-WL-77	0.57	H;C;Am-W	2-	628	147
97-WL-77	0.85	H;Am;W	1+ to 2-	273	119
100-WL-77	0.57 (0.56)	H;Am;W-C	1+ to 2-	345	196
102-WL-77	0.72	H;W;Am-C	2- to 2	343	98
104-WL-77	0.26	H;W-C;Am	2- to 2	127	41
10-IP-77	0.32	Am;H-W;-	2- to 2	93	23
13-IP-77	0.23	H;Am;W	2- to 2	156	59
14-IP-77	0.54 (0.54)	Am;H;W	2- to 2	375	73
17-IP-77	0.38	H-W;Am;C	2- to 2	180	72
19-IP-77	0.46	H;Am;W-C	2-	241	77
22-IP-77	0.86	H;Am;W-C	2- to 2	196	60
25-IP-77	0.39	H;W;Am-C	2- to 2	331	163
37-IP-77	1.08 (1.02)	H;W;Am	2- to 2	646	247
42-IP-77	0.98	H;Am;W	2- to 2	927	701
45-IP-77	2.29	H;Am;W	2- to 2	623	435
50-IP-77	2.03	H;Am;W	2- to 2	313	133
63-IP-77	1.11	W-C;H;-	3 to 3+	83	45
66-IP-77	0.19 (0.18)	H-W;-;C	2 to 2+	223	167
38-IP-77	0.41	H;W;C	2- to 2	125	76
41-JM-77	0.16	H;Am;W-C	2- to 2	227	169
46-JM-77	0.98	H;W;Am	2 to 2+	282	186

a. Kerogen key (in order listed): Predominant—60 to 100%; Secondary—20 to 40%; Trace—1 to 20%.
Al = Algal, Am = Amorphous-Sapropel, H = Herbaceous-Spore/Cuticle, W = Woody, C = Coaly, U = Unidentified Material.

b. Scale from 1 = unaltered to 4 = severely altered; underlined number indicates dominant rank of alteration.

TABLE 5—PETROGRAPHIC DATA

FORMATION	SAMPLE	GRADE-SIZE CLASSIFICATION	FRAMEWORK CLAST COMPOSITION: % QUARTZ + CHERT	FRAMEWORK CLAST COMPOSITION: % FELDSPAR	FRAMEWORK CLAST COMPOSITION: % ROCK FRAGMENTS	% CEMENT	CEMENT PARAGENESIS	REMARKS
Naknek	64-GB-77	Pebbly fine to very coarse sandstone	20	70	10	5	Authigenic clay, zeolite	Abundant hornblende, ductile grain deformation, compaction-broken clasts
Naknek	66-GB-77	Fine to medium sandstone	10	85	5	10	Authigenic clay, zeolite	Abundant hornblende, ductile grain deformation, compaction-broken clasts
Chignik	58-GB-77	Fine to medium sandstone	40	15	45	5	Authigenic clay, carbonate	Ductile grain deformation, partial replacement of clasts by carbonate
Chignik	59-GB-77	Fine to medium sandstone	40	10	50	3	Authigenic clay, quartz, authigenic albite	Ductile grain deformation.
Chignik	60-GB-77	Very fine to fine sandstone	30	5	65	5	Authigenic clay	Ductile grain deformation
Tolstoi	71-GB-77	Medium to coarse sandstone	5	25	70	15	Iron oxide, zeolite (?), authigenic chlorite	Ductile grain deformation, compaction-broken clasts.
Tolstoi	72-GB-77	Medium to coarse sandstone	5	25	70	15	Iron oxide, zeolite (?), authigenic chlorite, carbonate, iron oxide	Ductile grain deformation, compaction-broken clasts.
Tolstoi	34-IP-77	Very fine to fine sandstone	35	50	15	12	Authigenic clay, carbonate	Ductile grain deformation, compaction-broken clasts, partial replacement of clasts by carbonate.
Tolstoi	46-IP-77	Medium to coarse sandstone	60	30	10	40	Carbonate	Detrital pumpellyite, partial replacement of clasts by carbonate
Stepovak[1]	2-GB-77	Pebbly fine to coarse sandstone	20	15	65	3	Clay, authigenic chlorite	Glauconite, ductile grain deformation, compaction-broken clasts.
Stepovak[1]	4-GB-77	Pebbly fine to medium sandstone	10	15	75	2	Clay, authigenic chlorite, zeolite	Ductile grain deformation, compaction-broken clasts
Stepovak[1]	9-GB-77	Coarse to very coarse sandstone	15	20	65	50	Clay, carbonate	Minor ductile grain deformation, partial to complete replacement of clasts by carbonate
Stepovak[1]	13-GB-77	Medium to coarse sandstone	10	20	70	50	Clay, carbonate	Minor ductile grain deformation, partial to complete replacement of clasts by carbonate
Stepovak[1]	23-WL-77	Fine to very coarse sandstone	-	20	80	5	Carbonate, authigenic chlorite, carbonate	Ductile grain deformation, compaction-broken clasts, partial to complete replacement of clasts by carbonate
Stepovak[1]	24-WL-77	Fine to medium sandstone	30	20	50	45	Carbonate	Compaction-broken clasts.
Stepovak[1]	30-WL-77	Medium to very coarse sandstone	-	15	85	10	Quartz, carbonate	Ductile grain deformation, partial replacement of clasts by carbonate
Stepovak[1]	33-WL-77	Fine to coarse sandstone	20	15	65	5	Iron oxide, authigenic clay	~2% secondary porosity, minor ductile grain deformation, compaction-broken clasts, abundant diatoms including two species of Stephanopyxis and one species of each of Melosira, Coscinodiscus ?, and ? Biddulphia.[4]
Stepovak[2]	40-WL-77	Medium to coarse sandstone		10	90	10	Carbonate, authigenic chlorite, carbonate	Ductile grain deformation, partial replacement of clasts by carbonate.
Bear Lake	12-WL-77	Fine to medium sandstone	35	25	40	7	Iron oxide, authigenic clay	Ductile grain deformation, iron oxide concentrated in patches.
Bear Lake	14-WL-77	Pebbly fine to very coarse sandstone	45	5	50	3	Iron oxide	Ductile grain deformation.
Bear Lake	18-WL-77	Pebbly fine to coarse sandstone	50	15	35	8	Au genic clay, authigenic kaolinite/carbonate[3]	Abundant chert, ductile grain deformation, minor compaction broken clasts, minor partial replacement of clasts by carbonate.
Bear Lake	29-GB-77	Medium sandstone	65	15	20	15	Au genic chlorite, carbonate	Glauconite partial replacement of clasts by carbonate.
Bear Lake	30-GB-77	Fine to medium sandstone	45	25	30	48	Cl carbonate	Ductile grain deformation, minor compaction-broken clasts, partial to complete replacement of clasts by carbonate.
Bear Lake	39-GB-77	Pebbly fine to very coarse sandstone	60	5	35	20	Au genic chlorite, carbonate	Ductile grain deformation, minor compaction-broken clasts, partial replacement of clasts by carbonate.
Bear Lake	71-WL-77	Medium to very coarse sandstone	35	10	55	15	Au genic clay	Ductile grain deformation, compaction-broken clasts
Bear Lake	A72-WL-77	Medium to coarse sandstone	60	5	35	15	Au genic chlorite, iron oxide	Glauconite, ductile grain deformation, compaction-broken clasts
Bear Lake	77-WL-77	Fine to medium sandstone	45	5	50	5	Au enic chlorite	Glauconite, ductile grain deformation, compaction-broken clasts
Bear Lake	84-WL-77	Very fine to medium sandstone	50	10	40	10	A enic clay	Ductile grain deformation, compaction-broken clasts
Bear Lake	95-WL-77	Medium to very coarse sandstone	45	--	55	10	A enic clay, zeolite	Ductile grain deformation, compaction-broken clasts.
Tachilni	52-GB-77	Medium to very coarse sandstone	10	5	85	2	Ir ide, authigenic chlorite	Glauconite ferruginous pellets, ductile grain deformation
Tachilni	56-GB-77	Fine to coarse sandstone	20	40	40	40	Ir ide, carbonate	Extensive partial and complete replacement of clasts by carbonate.
Tachilni	1-IP-77	Fine to coarse sandstone	20	10	70	2	A enic chlorite, authigenic clay	Ductile grain deformation
Tachilni	8-IP-77	Very fine to medium sandstone	15	10	75	10	C ate, authigenic clay	Detrital pumpellyite, partial and complete replacement of clasts by carbonate.

1 Burk (1965). 2 Galloway (1974) 3 Age relationship of kaolinite and carbonate uncertain 4 Diatom identifications by Don Olson, USGS [redacted]

[redacted]

TABLE 6—GEOCHEMICAL ANALYSES

Stream-sediment samples were analyzed for gold, silver, copper, lead, zinc, molybdenum, and tin. The results are in parts per million.

Sample No.	Gold	Silver	Copper	Lead	Zinc	Molybdenum	Antimony
1-JM-77	0.24	0.00	19.2	3.0	43	0	0
2-JM-77	0.10	0.00	17.8	3.8	44	0	0
3-JM-77	0.08	0.00	27.7	12.4	33	0	0
4-JM-77	0.14	1.00	19.6	7.1	73	0	0
5-JM-77	0.20	0.00	24.6	24.0	78	0	0
6-JM-77	0.10	0.00	19.6	3.1	51	0	0
7-JM-77	0.08	0.00	16.2	7.8	53	0	0
8-JM-77	0.04	0.00	16.0	3.7	65	0	0
9-JM-77	0.06	0.00	16.6	3.1	58	0	0
10-JM-77	0.12	0.00	23.0	2.0	56	0	0
11-JM-77	0.14	0.00	19.4	0.0	73	0	0
12-JM-77	0.24	0.04	13.8	56.0	56	0	35
13-JM-77	0.18	0.00	10.9	11.5	32	0	0
14-JM-77	0.24	0.00	16.3	0.6	38	0	0
15-JM-77	0.34	0.05	19.8	0.0	38	0	0
16-JM-77	0.34	0.07	18.0	3.1	48	0	0
18-JM-77	0.12	0.00	11.1	8.6	45	0	0
19-JM-77	0.24	0.00	22.2	12.4	52	0	0
20-JM-77	0.30	0.11	4.3	1.1	27	0	0
21-JM-77	0.10	0.00	17.4	1.3	60	0	0
22-JM-77	0.16	2.84	19.7	874	68	0	526
23-JM-77	0.14	0.02	12.0	7.8	58	0	0
24-JM-77	0.12	0.00	17.7	4.6	50	0	0
25-JM-77	0.24	0.00	16.9	2.7	59	0	0
26-JM-77	0.24	0.00	19.8	1.7	68	0	0
27-JM-77	0.34	0.00	18.2	6.9	60	0	0
28-JM-77	0.26	0.00	15.7	13.1	32	0	0
29-JM-77	0.20	0.00	17.7	1.9	27	0	0
30-JM-77	0.16	0.00	12.4	16.0	23	0	0
31-JM-77	0.16	0.03	15.7	1.7	40	0	0
32-JM-77	0.26	0.00	15.2	0.8	29	0	0
33-JM-77	0.14	0.00	36.8	14.8	40	0	0
48-JM-77	0.14	0.28	49.2	51.7	153	0	0
49-JM-77	0.32	0.22	57.6	31.2	132	0	0
50-JM-77	0.28	0.22	21.4	13.8	45	0	0
52-JM-77	0.78	0.76	46.2	267.0	610	0	46
53-JM-77	0.24	0.00	67.3	8.3	85	0	0
54-JM-77	0.24	0.00	25.7	75.3	55	0	0
55-JM-77	0.38	0.00	37.3	8.3	42	2	0
56-JM-77	0.36	0.00	51.3	4.0	29	2	0

Sample No.	Gold	Silver	Copper	Lead	Zinc	Molybdenum	Antimony
1-WL-77	0.46	0.05	33.2	3.2	209	0	0
2-WL-77	0.44	0.00	19.3	0.0	177	0	0
3-WL-77	0.00	0.00	30.2	3.8	44	0	0
A1-JB-77	0.10	0.00	18.5	8.2	75	0	0
A2-JB-77	0.24	0.00	21.4	3.0	66	0	0
A3-JB-77	0.04	0.02	17.8	1.4	66	0	0
A4-JB-77	0.02	0.00	7.1	1.2	48	0	0
A5-JB-77	0.00	0.00	20.0	11.0	66	0	0
A6-JB-77	0.29	0.06	13.6	1.8	143	0	0
A7-JB-77	0.34	0.00	19.0	1.0	228	0	0
A8-JB-77	0.19	0.00	11.7	0.6	317	0	0
A9-JB-77	0.04	0.00	7.3	0.5	73	0	0
A10-JB-77	0.14	0.00	21.4	2.3	63	0	0
6-JB-77	0.06	0.12	38.3	23.7	146	0	0
7-JB-77	0.08	0.06	43.9	60.3	0		
24-JB-77	0.04	0.06	29.5	0.7	64	0	0
25-JB-77	0.14	0.00	18.5	1.9	47	0	0
29-JB-77	0.06	0.00	34.0	6.9	71	1	0
30-JB-77	0.00	0.00	21.8	3.3	52	0	0
31-JB-77	0.12	0.00	23.3	4.3	62	0	0
32-JB-77	0.10	0.00	17.4	2.6	41	0	0
33-JB-77	0.00	0.00	16.2	0.0	123	0	0
34-JB-77	0.04	0.00	27.9	0.7	186	0	0
35-JB-77	0.12	0.00	30.3	0.8	0.8	0	222
36-JB-77	0.06	0.00	27.6	0.0	258	0	0
37-JB-77	0.06	0.00	37.2	2.1	97	0	0
38-JB-77	0.12	0.00	23.0	1.6	65	0	0
39-JB-77	0.14	0.00	27.1	1.6	114	0	0
40-JB-77	0.04	0.00	30.6	6.6	56	0	0
41-JB-77	0.32	0.00	24.3	3.1	143	0	0
42-JB-77	0.12	0.00	17.8	3.6	82	0	0
43-JB-77	0.37	0.00	15.2	3.3	108	0	0
44-JB-77	0.64	0.00	14.2	0.7	73	0	0
45-JB-77	0.50	0.00	37.9	5.9	72	0	0
46-JB-77	0.48	0.00	99.9	12.7	111	0	0
47-JB-77	0.38	0.00	24.8	1.7	53	0	0
48-JB-77	0.42	0.00	12.3	0.0	52	0	0
49-JB-77	0.20	0.00	15.6	0.0	48	0	0
98-JB-77	0.42	0.00	22.7	0.3	36	0	0
99-JB-77	0.28	0.00	21.4	0.4	38	0	0
100-JB-77	0.14	0.00	20.2	0.0	2.8	0	0
101-JB-77	0.36	0.00	25.7	0.0	27	0	0
102-JB-77	0.30	0.00	14.2	0.0	27	0	0
103-JB-77	0.40	0.00	24.7	2.6	58	0	0
104-JB-77	0.44	0.00	57.3	0.7	57	0	0

Sample No.	Gold	Silver	Copper	Lead	Zinc	Molybdenum	Antimony
105-JB-77	0.44	0.00	26.5	2.1	63	0	0
106-JB-77	0.48	0.00	17.4	0.0	38	0	0
55-IP-77	0.66	14.90	2470.0	3770.0	8700	1	0
55-IP-77	2.74	13.50	1060.0	2190.0	3300	0	0
77-SWH-02A	0.22	0.00	28.8	9.8	53	3	0
77-SWH-03A	0.53	0.00	8.5	5.2	19	6	0
77-SWH-04A	0.44	0.00	4.6	6.7	137	0	0
77-SWH-05A	0.44	0.06	19.6	47.6	40	0	0
77-SWH-14	0.24	0.00	22.8	4.2	97	0	0
54-IP-77	0.13	0.00	61.4	22.7	133	0	0
56-IP-77	0.99	5.44	390.0	747.0	380	0	0
57-IP-77	0.23	0.00	32.3	10.0	43	0	0
58-IP-77	0.15	0.00	43.9	23.6	64	0	0
59-IP-77	0.22	0.00	16.8	7.1	58	0	0
60-IP-77	0.33	0.00	21.8	3.6	62	0	0
61-IP-77	0.20	0.00	15.3	1.2	49	0	0
150-JB-77	0.17	0.00	27.7	7.9	75	0	0
151-JB-77	0.16	0.00	26.4	3.9	79	0	0
152-JB-77	0.39	0.05	30.3	11.9	90	0	0
153-JB-77	0.32	0.11	10.7	16.8	157	0	0
154-JB-77	0.40	0.11	41.9	20.1	51	2	0
155-JB-77	0.39	0.25	50.0	37.3	224	1	0
156-JB-77	0.35	0.00	21.2	4.1	68	0	0
157-JB-77	0.22	0.00	30.4	7.1	88	0	0
158-JB-77	0.30	0.00	22.6	5.0	67	0	0

TABLE 7—PALYNOLOGY DETERMINATIONS
(Analyses by Anderson, Warren and Associates, Inc.)

Fossil assemblages: A = abundant, C = common, F = frequent, and R = rare.

26-IP-77

Gymnosperm pollen (A), Osmundacidites sp. (R), Lycopodiumsporites sp. (R), Taxodiaceae (R).

Deflandrea denticulata (F), Palaeocystodinium golzowense (R), Spiniferites spp. (R).

AGE: Paleogene (Paleocene-early Eocene)
ENVIRONMENT: Marine.

27-IP-77

Gymnosperm pollen (F).

Deflandrea denticulata (R), Spiniferites septatus (R), Spiniferites spp. (R).

AGE: Paleogene (Paleocene)
ENVIRONMENT: Marine.

29-IP-77

Gymnosperm pollen (C).

Deflandrea denticulata (R), Palaeocystodinium golzowense (F), Spiniferites spp. (R).

AGE: Paleogene (Paleocene-early Eocene)
ENVIRONMENT: Marine

33-IP-77

Gymnosperm pollen (F).

Deflandrea denticulata (R), Palaeocystodinium golzowense (R).

AGE: Paleogene (Paleocene-early Eocene)
ENVIRONMENT: Marine.

44-IP-77

Gymnosperm pollen (F), Betulaceae (R).

AGE: Tertiary
ENVIRONMENT: Nonmarine.

47-IP-77

Gymnosperm pollen (F), Aquilapollenites quadrilobus (R, reworked).

Deflandrea denticulata (R), Palaeocystodinium golzowense (R), Sirmiodinium grossi (single, reworked).

AGE: Paleogene (Paleocene-early Eocene)
ENVIRONMENT: Marine

49-IP-77

Gymnosperm pollen (C).

AGE: Indeterminate
ENVIRONMENT: Nonmarine.

62-IP-77

No identifiable palynomorphs. Poorly preserved organics, very dark brown color.

AGE: Indeterminate
ENVIRONMENT: Probable nonmarine.

65-IP-77

Laevigatosporites sp. (R), Fungal spores (R).

AGE: Indeterminate
ENVIRONMENT: Nonmarine.

52-WL-77

Gymnosperm pollen (F), Lycopodiumsporites sp. (R), Osmundacidites (A), Laevigatosporites sp. (A), Alnus (R).

AGE: Tertiary
ENVIRONMENT: Nonmarine.

56-WL-77

Gymnosperm pollen (C), Tsuga (R), Osmundacidites sp. (F), Laevigatosporites sp. (F), Taxodiaceae (F), Juglans (R), Ulmus (R), Nyssa (R).

Areosphaeridium diktyoplokus (single, reworked?)

AGE: Tertiary (possible Eocene, Oligocene, or middle Miocene)
ENVIRONMENT: Probable nonmarine, warm temperate paleoclimate.

58-WL-77

Gymnosperm pollen (A), Tsuga (C), Osmundacidites sp. (A), Pterocarya (C), Juglans (F), Betulaceae (R), Alnus (R), Ulmus (R), Tilia (R).

AGE: Tertiary (possible Eocene, Oligocene, or middle Miocene)
ENVIRONMENT: Nonmarine, warm temperate paleoclimate.

59-WL-77

Gymnosperm pollen (C), Tsuga (F), Laevigatosporites sp. (F), Polypodiaceae (R), Osmundacidites sp. (R), Betulaceae (R), Alnus (R), Fagus [single, Tilia (single)]

AGE: Tertiary (possible Eocene, Oligocene, or middle Miocene)
ENVIRONMENT: Nonmarine, warm temperate paleoclimate.

60-WL-77

Gymnosperm pollen (A), Tsuga (C), Laevigatosporites sp. (C), Polypod iaceae (F), Pterocarya (C), Betulaceae (F), Alnus (F), Carya (R), Ulmus (R), Nyssa (R), Tilia (F), Momipites (R), Fagus (R), Boisduvalia sp. (R).

AGE:	Tertiary (possible Eocene, Oligocene, or middle Miocene)
ENVIRONMENT:	Non marine, warm temperate paleoclimate.

63-WL-77

Gymnosperm pollen (A), Tsuga (F), Osmundacidites sp. (F), Lycopodiumsporites sp. (R), Polypodiaceae (F), Laevigatosporites sp. (F), Boisduvalia sp. (R).

AGE:	Tertiary
ENVIRONMENT:	Nonmarine, temperate paleoclimate.

64-WL-77

Gymnosperm pollen (A), Tsuga (F), Laevigatosporites sp. (F), Lycopodiumsporites sp. (R), Osmundacidites sp. (R), Betulaceae (R), Pterocarya (R).

?Oligosphaeridium complex (single, reworked?).

AGE:	Tertiary
ENVIRONMENT:	Probable nonmarine, temperate paleoclimate.

66-WL-77

Gymnosperm pollen (A), Tsuga (C), Laevigatosporites sp. (F), Lycopodiumsporites sp. (R), Betulaceae (R), Ulmus (R), Fagus (R).

AGE:	Tertiary
ENVIRONMENT:	Nonmarine, possible warm temperate paleoclimate

68-WL-77

Gymnosperm pollen (A), Tsuga (A), Osmundacidites sp. (R), Lycopodiumsporites sp. (R), Polypodiaceae (R), Betulaceae (R), Alnus (F).

AGE:	Tertiary
ENVIRONMENT:	Nonmarine, temperate paleoclimate

76-WL-77

Gymnosperm pollen (C), Tsuga (C), Osmundacidites sp. (F), Pterocarya (R), Carya (R), Ulmus (R), Juglans (R), Alnus (F), Boisduvalia sp. (R).

Micrhystridium sp. (R), Spiniferites sp. (C), Tuberculodinium vancampoae (R), Lejeunia hyalina (single), ?Operculodinium sp. (R).

AGE:	Tertiary (probable early to middle Miocene)
ENVIRONMENT:	Marine (probable warm temperate paleoclimate)

TABLE 8--MACROPALEONTOLOGY DETERMINATIONS

All macrofossils listed below are in the collections of the U.S. Geological Survey, Branch of Paleontology and Stratigraphy, Menlo Park, California. Identifications were made by Louie Marincovich.

Field locality 15-WL-77 (USGS Cenozoic loc. M7186).—Black Lake measured section, east of Black Lake near Range Peak, Chignik (B-3) Quadrangle; NW¼, Section 3, T. 43 S., R. 60 W.; latitude 56°30' N., longitude 158°43' W. Bear Lake Formation.

Bivalves:	?Clinocardium sp. ?Chione sp.
COMMENT:	Specimens are all molds and casts, poorly preserved.

Field locality 16-WL-77 (USGS Cenozoic loc. M7187).—Same locality as 15-WL-77 above but about 23 meters (75 feet) stratigraphically lower in section.

Bivalves:	Clinocardium sp. Mya sp.
COMMENT:	Mya is known in shallow water. 0-50 m in depth. Clinocardium in 0-200 m depths. Age is indeterminate.

Field locality 47-WL-77 (USGS Cenozoic loc. M7188).–68 m (225 feet) above base of measured section in sea cliff, west side of Beaver Bay north of Point Aliaksin, Aliaksin Peninsula, Port Moller Quadrangle; S½, Section 18, T. 54 S., R. 75 W.; latitude 55°30'N., longitude 161°W.; Unga Conglomerate Member of Bear Lake Formation.

Bivalve:	Chlamys (Swiftopecten) donmilleri MacNeil
Gastropod:	Beringius hataii MacNeil
AGE:	Middle Miocene
ENVIRONMENT:	Probably inner neritic (0-100 m depth); temperate marine climate.

Field locality 103-WL-77 (USGS Cenozoic loc. M7189).—Milky River measured section, 760 m (2,500 feet) above base of section; on north slope of valley above headwaters of Milky River, east of Bear Lake, Port Moller (D-1) Quadrangle; Sections 33 and 34, T. 48 S., R. 69 W.; latitude 55°59' N., longitude 160°03' W. Bear Lake Formation.

Bivalves:	Mytilus (Plicatomytilus) sp.
	?Glycymeris sp.
	?Cyclocardia sp.
Gastropod:	Natica or Polinices sp.
AGE:	Miocene
ENVIRONMENT:	Water depth 0-50 m.

Field locality 98-WL-77 (USGS Cenozoic loc. M7190).—Same locality as 103-WL-77 above but 143 m (472 feet) stratigraphically lower in Milky River section.

Bivalve:	?Clinocardium sp.
COMMENT:	Age and environment indeterminate.

Field locality 94-WL-77 (USGS Cenozoic loc. M7191).—Same locality as 98-WL-77 above but about 18 m (59 feet) stratigraphically lower in Milky River section.

Gastropods:	Neptunea (Neptunea) plafkeri Kanno
	Neptunea (Neptunea) lyrata (Gmelin) subspecies
AGE:	Late early Miocene to late Miocene.
ENVIRONMENT:	Indeterminate.

Field locality 86-WL-77 (USGS Cenozoic loc. M7192).—Same locality as 94-WL-77 above but about 82 m (270 feet) stratigraphically lower in Milky River section.

Gastropod:	Neptunea (Neptunea) lyrata (Gmelin) subspecies
Bivalve:	?Mya sp.
Plant debris:	Carbonized leaf fragments occur as very thin laminations in matrix.
AGE:	Indeterminate.
ENVIRONMENT:	Mya inhabits depths of 0-50 meters in modern seas.

Field locality 105-WL-77 (USGS Cenozoic loc. M7193).—Same locality as 86-WL-77 above but about 152 m (500 feet) stratigraphically lower in Milky River section.

Bivalves:	Acila sp. Indeterminate bivalve.
COMMENT:	Age and environment indeterminate.

Field locality 42-GB-77 (USGS Cenozoic loc. M7194).—Same locality as 105-WL-77 above but about 51 m (170 feet) stratigraphically lower in Milky River section.

Gastropod:	Crepidula ungana Dall
AGE:	Miocene.
ENVIRONMENT:	Crepidula inhabits depths of 0-165 meters in modern seas.

Field locality 42-JM-77 (USGS Cenozoic loc. M7195).—Southeast Bear Lake measured section, about 250 m (830 feet) above base of section; on west slope of Bear River valley, south of Bear Lake, Port Moller (D-1) Quadrangle; Section 20, T. 49 S., R 70 W.; latitude 55° 55' N., longitude 106°10' W. Bear Lake Formation.

Bivalves:	Clinocardium sp.
	?Spisula sp.
	?Pododesmus sp.
	Macoma sp.
Gastropod:	?Neptunea sp.
COMMENT:	Age and environment indeterminate.

Field locality 43-JM-77 (USGS Cenozoic loc. M7196).—Same locality as 42-JM-77 above but about 23 m (75 feet) stratigraphically higher in southeast Bear Lake measured section.

Bivalves:	Clinocardium sp.
	Ostrea sp.
	?Mya sp.
	?Protothaca sp.
AGE:	Indeterminate.
ENVIRONMENT:	Ostrea (oysters) inhabit depths of 0-35 meters in modern seas.

Field locality 45-JM-77 (USGS Cenozoic loc. M7197).—Same locality as 43-JM-77 above but about 30 m (100 feet) stratigraphically higher in Southeast Bear Lake measured section.

Bivalve:	Ostrea sp.
Gastropod:	?Turritella sp.
COMMENT:	Age indeterminate; Ostrea (oysters) inhabit depths of 0-35 meters in modern seas.

Field locality 12-GB-77 (USGS Cenozoic loc. M7198).—Waterfall point stratigraphic section, about 108 m (355 feet) stratigraphically above base of section; along beach of Clarks Bay, near Waterfall Point, Port Moller (C-1) Quadrangle; Section 30, T. 53 S., R. 74 W., latitude 53°43' N., longitude 160°01' W. Stepovak Formation (Burk, 1965).

Bivalves:	Macrocallista sp.
	?Macoma sp.
AGE:	Tertiary
ENVIRONMENT:	Indeterminate.

Field locality 77-SWH-13 (USGS Cenozoic loc. M7199).–Same locality as 12-GB-77 above but stratigraphic position of sample was not provided.

Sediment-filled burrow of unknown origin.

Field locality 47-GB-77 (USGS Cenozoic loc. M7200).–Measured section at Cape Tachilni, locality 5 m (16 feet) above base of section; False Pass (D-3) Quadrangle; Section 35, T. 60 S., R. 90 W.; latitude 54° 56' N., longitude 162°52' W. Tachilni Formation.

Bivalves:	Venerid–mold of interior shell features
	Clinocardium sp.
	Mytilus sp.
AGE:	Indeterminate.
ENVIRONMENT:	Mytilus inhabits depths of 0-40 meters in the modern northeastern Pacific.

Field locality 51-GB-77 (USGS Cenozoic loc. M7201).–Same locality as 47-GB-77 above but 47 m (155 feet) higher stratigraphically in same section.

Bivalves:	Glycymeris sp.
	Clinocardium sp.
	Chlamys (Swiftopecten) cf. C. (S.) leohertleini MacNeil Venerid sp.
Gastropods:	Natica (Cryptonatica) clause Broderip & Sowerby
	?Neptunea sp.
Echinoderm:	Fragment of sand dollar echinoid.
AGE:	Pliocene
ENVIRONMENT:	Cool-temperature or colder hydroclimate.

Field locality 53-GB-77 (USGS Cenozoic loc. M7202).–Same locality as 51-GB-77 above but located stratigraphically higher and 0.2 m (2 feet) above a break in the section.

Bivalves:	Thyasira disjuncta (Gabb)
	Mya sp.
AGE:	Oligocene to Holocene.
ENVIRONMENT:	Mya inhabits depths of 0-50 meters in the modern northeastern Pacific. Thyasira is a cool-temperature or colder water inhabitant.

Field locality 55-GB-77 (USGS Cenozoic loc. M7203).–Same locality as 53-GB-77 above but 2.4 m (8 feet) higher stratigraphically in the same section.

Bivalves:	Clinocardium sp.
	Nemocardium sp.
	Macoma sp.
	?Cyrtodaria sp.
Gastropods:	Natica (Cryptonatica) clausa Broderip & Sowerby
	Margarites cf. M. costalis (Gould)
AGE:	Pliocene
ENVIRONMENT:	Inner neritic (0-100 meters), cool-temperature hydroclimate.

Field locality 4-IP-77 (USGS Cenozoic loc. M7204).–Float specimens from West Morzhovoi Bay stratigraphic section, False Pass Quadrangle; Section 35, T. 60 S., R. 90 W.; latitude 54°56' N., longitude 162°52' W. Tachilni Formation.

Bivalves:	Clinocardium sp.
	Macoma sp.
	Mya (Arenomya) cf. M. (A.) arenaria Linnaeus.
AGE:	Miocene or younger.
ENVIRONMENT:	Inner part of inner neritic (0-50 meters depth), cool-temperature or colder hydroclimate.

Figure 2. Splintery-weathering habit typical of Hoodoo Formation (Burk, 1965) exposures.

Figure 3. Upward-thickening sequence of Tolstoi Formation (Burk, 1965) sandstone beds exposed in the northeast quarter of sec. 6, T. 54 S., R. 76 W., S.M. (plate D).

Figure 4. Black Lake stratigraphic section exposed east of Black Lake. The light-colored bands in this Bear Lake Formation exposure are generally sandstone.

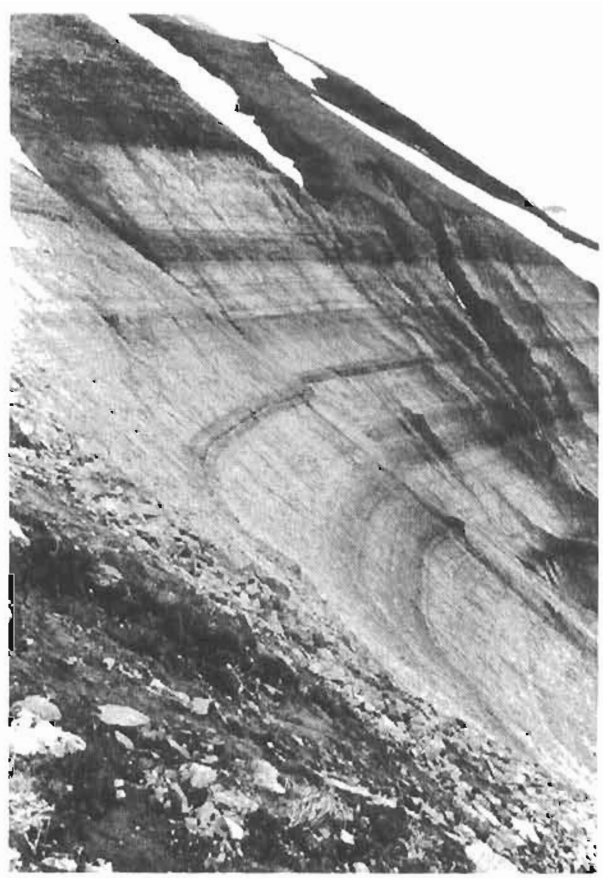

Figure 5. Upper sandy unit (light-colored) of Black Lake stratigraphic section (see fig. 4).

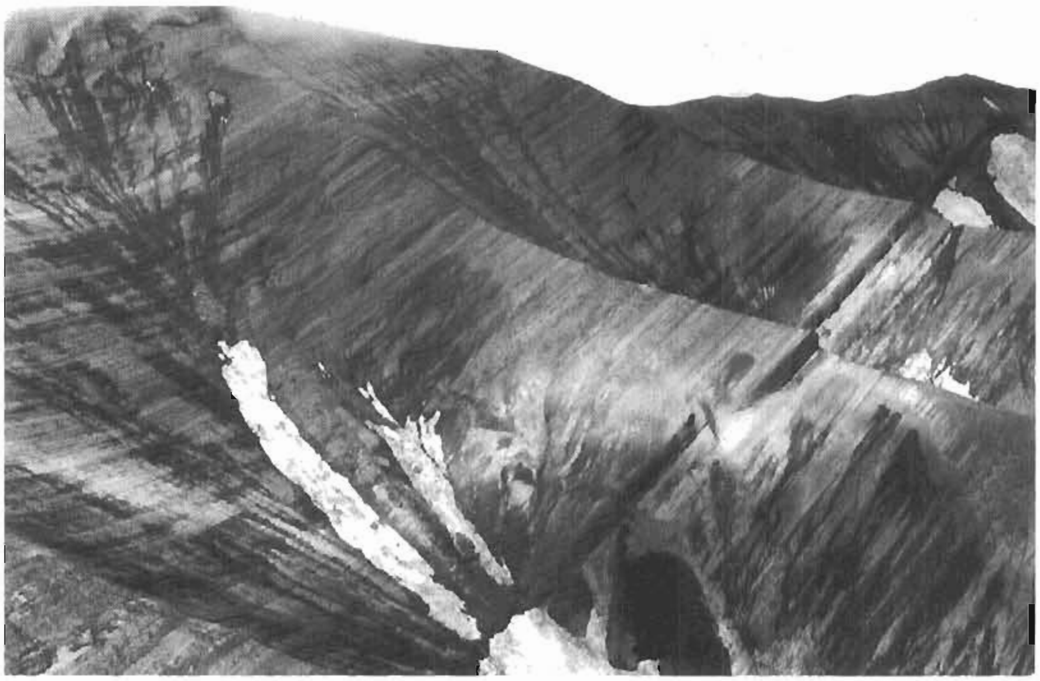

Figure 6. Upper part of the Milky River stratigraphic section. These Miocene strata of the Bear Lake Formation are unconformably overlain by younger volcanics (shown in the upper left).

Figure 7. Lower part of the Milky River stratigraphic section of the Bear Lake Formation. Arrow indicates correlation marker with upper part of section.

Figure 8. Crossbedded sandstone of the Bear Lake Formation common in upper part of Milky River stratigraphic section.

Figure 9. Southeast Bear Lake stratigraphic section. These Bear Lake Formation beds are overlain by volcanics (shown in upper part of photograph).

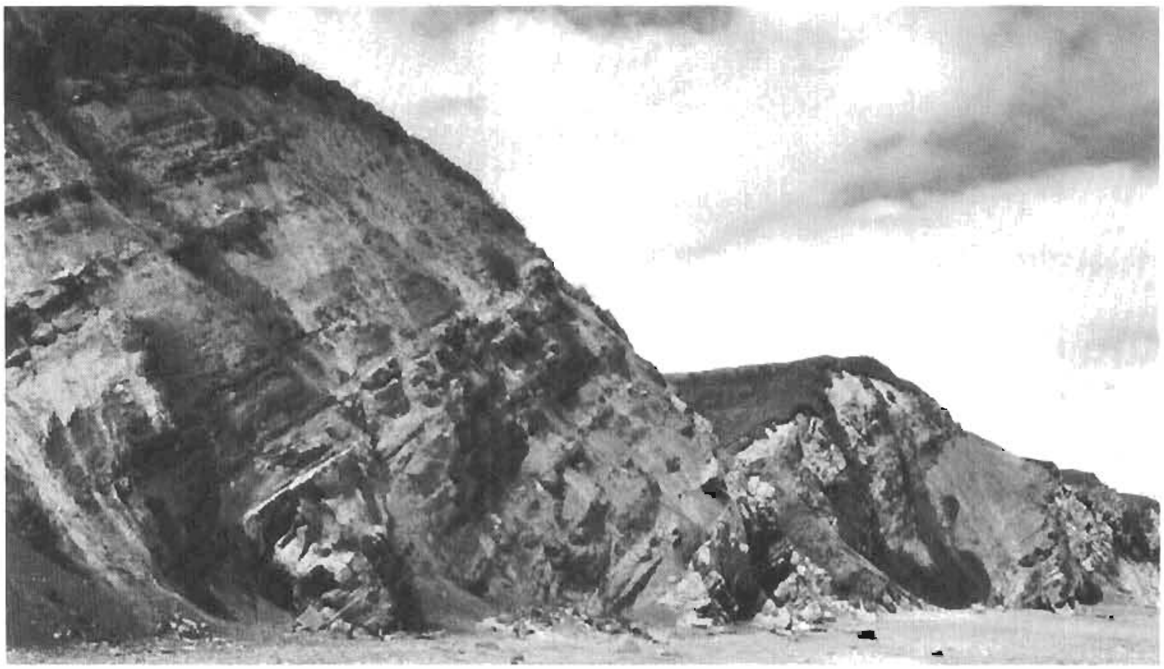

Figure 10. Heren stratigraphic sections showing beds of the Tolstoi Formation (Burk, 1965) exposed along west Herendeen Bay. The sections are separated by a fault of unknown throw.

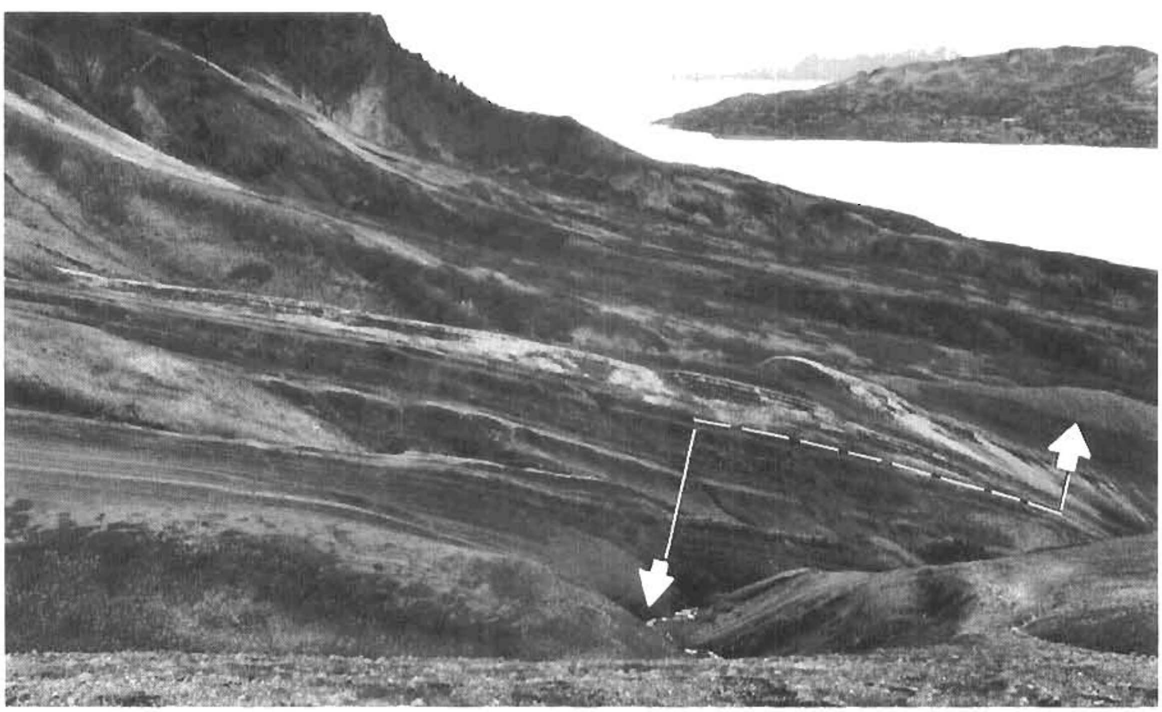

Figure 11. Upper part of Lefthand Bay-Balboa Bay stratigraphic section showing beds of the Stepovak Formation (Burk, 1965). View is to the south.

Figure 12. Beaver Bay stratigraphic section exposing strata of the Oligocene Stepovak Formation (Burk, 1965).

Figure 13. Aliaksin Peninsula stratigraphic section showing strata of the Bear Lake Formation.

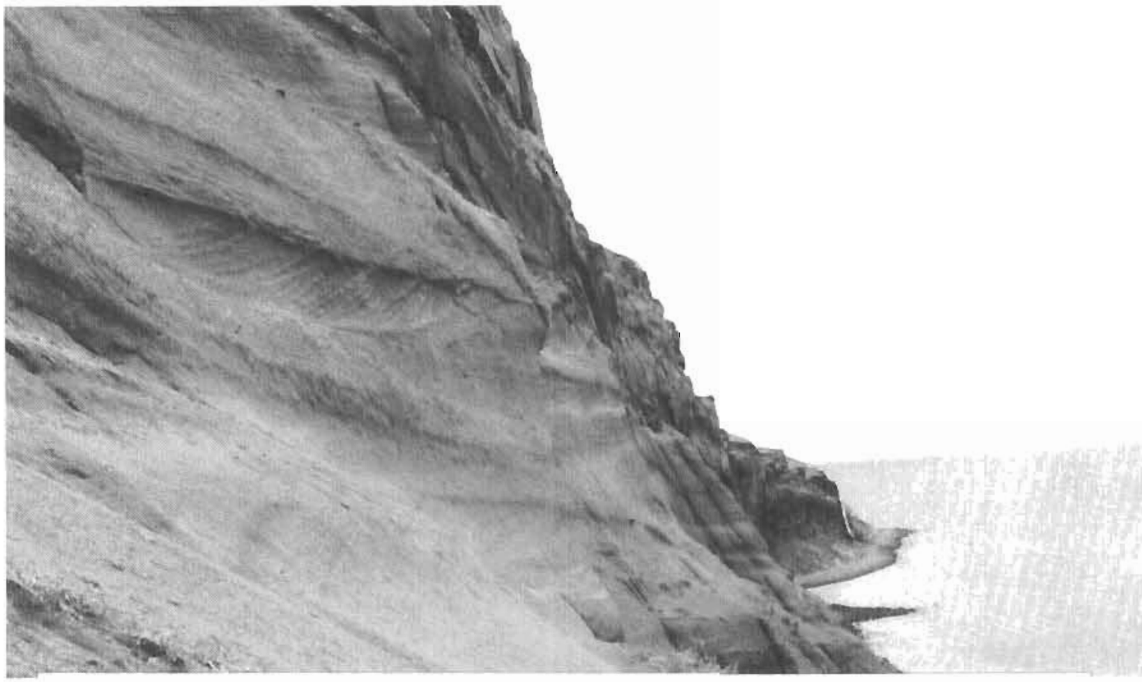

Figure 14. Massive crossbedded unit in the Bear Lake Formation, Aliaksin Peninsula stratigraphic section. View is to the south

Figure 15. South-looking view of conglomerate tipping a sandstone unit of the Bear Lake Formation, Aliaksin Peninsula stratigraphic section.

Figure 16 "Fossil-hash" sandstone unit in the Bear Lake Formation, Aliaksin Peninsula stratigraphic section

Figure 17. Burrowed unit in Bear Lake Formation, Aliaksin Peninsula stratigraphic section

Figure 18. Lower part of the White Bluff stratigraphic section showing Bear Lake Formation strata, Unga Island.

Figure 19. Middle part of the White Bluff stratigraphic section, showing Bear Lake Formation strata, Unga Island.

Figure 20. Upper part of the White Bluff stratigraphic section showing Bear Lake Formation strata, Unga Island. View is to the north.

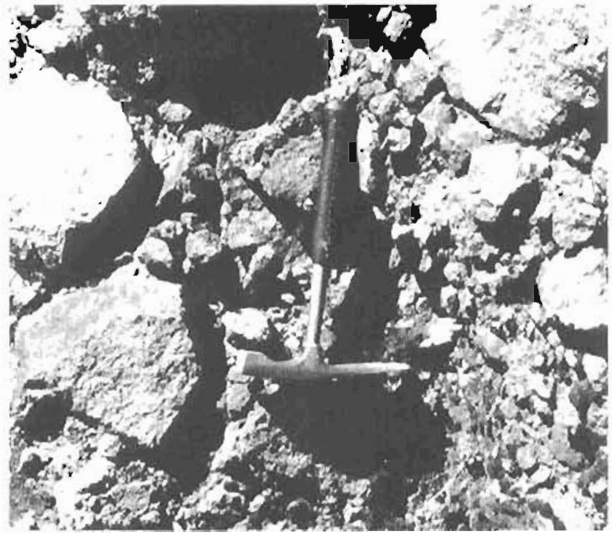

Figure 21. Agglomerate unit in the Bear Lake Formation capping the White Bluff stratigraphic section.

Figure 22. East Morzhovoi Bay stratigraphic section showing the Tachilni Formation. This formation is exposed in several places along the bay.

Figure 23. Authors Bolm (left) and Lyle working on a fossiliferous ledge in the Tachilni Formation, East Morzhovoi Bay section.

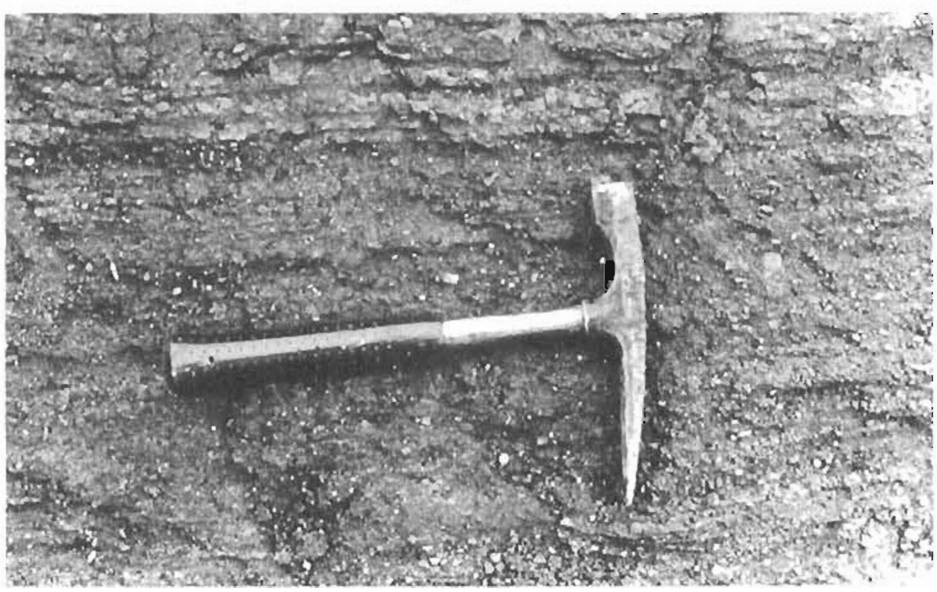

Figure 24. Shale rip-up layers in the Tachilni Formation, East Morzhovoi Bay stratigraphic section.