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Oil and Gas Seeps in Alaska

North-Central Gulf of Alaska

UNITED STATES DEPARTMENT OF THE INTERIOR

Report of Investigations 8136

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North-Central Gulf of Alaska

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OIL AND GAS SEEPS IN ALASKA

North-Central Gulf of Alaska

by

Donald P. Blasko[1]

ABSTRACT

The Bureau of Mines investigated two areas of oil and gas seeps in the north-central Gulf of Alaska--Katalla River to Bering River and Cape Yakataga to Yakutat Bay to determine (1) whether previously reported seeps are still active, (2) the characteristics of the seeping hydrocarbons, and (3) the amount of bitumen contained in the drainage leaving the seeps and entering the Gulf of Alaska.

Thirteen separate oil seeps, six bitumen deposits, and eight gas seeps were located, sampled, and analyzed. The oils ranged from 35.2° to 14.1° API gravity and had sulfur contents from 0.53 to 1.31 wt-pct. Bitumen samples had API gravities from 2.4° to 14.6° and sulfur contents from 0.28 to 0.88 wt-pct. Gas samples had specific gravities ranging from 0.577 to 0.883 and caloric values from 724 to 1,427 Btu/cu ft.

A total of 63 water samples obtained from seep locations and seep drainages were analyzed by atomic absorption spectrophotometry for ionic content and by solvent extraction for hydrocarbon content. Although some of the water at the oil seeps had a bitumen content as high as 246,000 mg/l, the amount of hydrocarbons actually reaching the Gulf of Alaska averaged <0.2 mg/l.

INTRODUCTION

As part of an ongoing program in mineral resources and environmental evaluation, the Federal Bureau of Mines conducted field investigations during June, July, and August of 1973 and 1974 around the Gulf of Alaska. The investigations were aimed at locating and sampling oil and gas seeps to establish the occurrences, document the locations, and sample and analyze the seep oil and gas.

This report deals with oil and gas seeps in two separate areas of the north-central Gulf of Alaska: (1) the area between the Katalla River and the Bering River, (2) the area between Cape Yakataga and Yakutat Bay. The area

[1]Petroleum engineer.

between the Katalla River and Bering River contains the abandoned Katalla oilfield, the first productive field in the State of Alaska. The Cape Yakataga to Yakutat Bay area contains some of the more spectacular and prolific seeps in the Gulf of Alaska. The results of similar oil and gas seep investigations conducted on the Alaska Peninsula, western Gulf of Alaska, are being published in a separate report.

The entire area between the Katalla River and Yakutat Bay is located in what is geologically referred to as the Gulf of Alaska Tertiary province. Active oil and natural gas seeps have been reported on upland areas between the Copper River and Lituya Bay since the turn of the centruy. Alaska's first commercially productive oilfield near Katalla was established because of oil seeps. Oil and gas seeps still abound today. Although some old seeps have gone dry, their locations can still be found. At one time or another, oil seeps have been reported in the Mirror Slough area, Nichawak area, Miller Hills area, and at the head of Katalla Slough. Gas seeps are also prevalent in that area along the shores of Bering Lake and Bering River. The Katalla oilfield still has seeps of crude oil throughout, and gas seeps are also found. Seep areas on Bering River and Bering Lake were easily spotted from the air by their characteristic white scum spots.

SAMPLING PROCEDURES

At each seep, an attempt was made to obtain enough of a sample of the oil at the site to perform a routine distillation analysis. Failing this, an oil-water sample was obtained. Regardless of whether oil or oil-water was obtained, additional samples of water were obtained at intervals in the drainage of the seep. These samples were then analyzed routinely for cation-anion qualities. In addition, values were obtained for total dissolved solids and pH. Of prime interest was the value for the oil content of the water, expressed in milligrams per liter.

When a seep was located, the sampling procedure was to locate the mouth of the drainage stream and take the first water sample from the mouth of the creek. Then, two to five additional water samples were obtained upstream from the mouth of the creek at indiscriminate intervals, depending on the length of drainage between the seep and the mouth. Normally, a sample of drainage water was obtained in agitated or freely flowing current, and another was taken in a calm, standing pool. The seep fluid was then sampled. If possible, enough free oil was skimmed off the top to constitute an oil sample for analysis. If it appeared that insufficient oil was present for a free-oil sample, an oil-water sample was taken. The last sample taken would be upstream of the seep area, far enough removed to be out of the influence of the seep. The purpose of sampling from the mouth of the creek upstream to the seep, rather than sampling the seep first and progressing downstream, was to insure that representative samples were obtained. Sampling the seep first would agitate the collected bitumen in the seep area; this would allow additional bitumen to flow into the drainage, which would not normally occur under undisturbed or natural conditions. Subsequent downstream sample collection could then result in an unrepresentative amount of oil in the drainage water.

The amount of liquid sample obtained was usually 1 gallon. Samples were obtained by immersing the entire sample receptacle, where possible, into the stream or pond, with the top of the receptacle opening resting on the surface of the water. The fluid was then allowed to drain into the receptacle. This resulted in collecting surface water to a depth of approximately 1 inch.

Gas samples were obtained by completely filling a stoppered bottle with available water and immersing the top of the inverted bottle in the water surrounding the gas seep. Gas bubbles then enter the opening in the bottle, displacing the water in the bottle. The bottle was stoppered while the top of the inverted bottle was still immersed in the water, thus preventing atmospheric contamination and loss of the gas sample.

Owing to the large number of samples obtained and the commercial cost of analysis, duplicate samples were not sent to different laboratories to establish indisputable results.

ANALYTICAL PROCEDURES

The water analyses contained in this report resulted as a secondary benefit derived from the primary objective of the analysis--determining how much oil was present in the water. The water analyses were obtained by atomic absorption spectrophotometry. The oil content of the water was determined by solvent extraction as described in the appendix.

The oil was analyzed by routine distillation. The distillation recovers up to the point of thermal cracking. As a further explanation, 300° end point (E.P.) gasoline is good-grade gasoline; the 392° E.P. gasoline is regular-grade gasoline; and the 500° E.P. distillates include diesel fuels, fuel oils, etc.

All of the gas analyses were performed by the Bureau's Helium Operations in Amarillo, Tex., utilizing standard gas-analysis methods.

KATALLA RIVER TO BERING RIVER

Hydrocarbon Exploration

Petroleum exploration had its beginning in the Gulf of Alaska near Katalla in 1901. During that year, Alaska Steam, Coal, and Petroleum Syndicate drilled a well in the Katalla Slough to 270 feet. This first well in the Controller Bay area was abandoned after the drilling tools were lost. In 1902, the same company started another well in the area. Oil was struck at about 370 feet. The well was deepened to 550 feet during 1903, but production was from the shallower depth. This was the discovery well in the Katalla field. Exploration activity continued in this area during the early 1900's; wells were drilled on the east shore of the Bering River, on Chilkat Creek, near the mouth of Chilkat Creek, near Point Hay, on the west shore of Bering Lake, on Mirror Slough, and near Nichawak Mountain. Yearly drilling activity took place until 1925. A total of 44 wells were drilled between 1900 and 1930 in the Katalla area.

Almost all the 44 drilled wells had oil shows, some had gas shows, and 18 produced oil commercially at one time or another. Of the wells abandoned, drilling troubles such as caving holes and lost tools were the most prevalent causes. Some difficulty was encountered in drilling wells in the mudflats off the mainland. In some cases, the drill pipe never drilled out of mud.

Production from the Katalla field in the first decade of the 1900's was great enough that a small refinery was built to process the crude oil. From 1911 until 1933, the refinery operated under different owners (usually the major holder of wells in the Katalla field). The refined products were marketed locally to the fishing fleet in the area, although the demand was much greater than the supply. The refinery burned down in 1933 and production ceased in the Katalla field.

A test well was started in 1969 about 3 miles west of the old Katalla field just offshore of the mouth of the Katalla River. It was abandoned at a depth of 421 feet when the drilling barge became damaged by a storm. This was the only drilling to take place in the Katalla-Bering River area since 1962. During that year, Richfield Oil Co. (now Atlantic Richfield Co.) plugged and abandoned the Bering River Unit No. 2 after drilling to 6,019 feet. No hydrocarbon shows were encountered in that well.

The previously mentioned wells were the only petroleum exploratory wells drilled on the Gulf of Alaska shorelands between Seward and the Bering Glacier, and the Katalla field was the only commercially productive area in the whole of the Gulf of Alaska region. Pertinent data regarding the wells drilled in the area between the Copper River and Cape Suckling (Cordova quadrangle) are given in table 1.

Katalla Oilfield

The abandoned Katalla oilfield is located in portions of NW1/4 sec 31, T 19 S, R 6 E, Copper River Meridian. The field can be located in the U.S. Geological Survey topographic map series on the Cordova quadrangle. The Katalla field, which is patented and privately owned, is surrounded by lands of the Chugach National Forest. The field itself is approximately 3-1/4 miles southeast of the abandoned town of Katalla. Cordova, 50 miles to the northwest, is the closest inhabited town. The oilfield lies in a southwest-dipping saddle between a 1,015-foot unnamed mountain bordering the Gulf of Alaska to the south and 1,700-foot Mount Hazelet to the north. Drainage from Oil Creek, which originates on the 1,015-foot mountain, and from Arvesta Creek, which originates on Mount Hazelet is to the head of Katalla Slough, southwest of the saddle. The other side of the saddle to the northeast opens up the Redwood Bay lowlands.

The geology of the Katalla area as well as the geologic potential of the Katalla oilfield has been described in previous publications.[2] The discovery well in the Katalla field was drilled in 1902 as a result of the discovery of oil seeps at the head of Katalla Slough in 1896.

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[2] Miller D. J. Geology of the Katalla District, Gulf of Alaska Tertiary Province, Alaska. U.S. Geol. Survey Preliminary Rept. No. 206, 1961, 2 maps.

_____. Preliminary Report on the Geology and Oil Possibilities at the Katalla District, Alaska. U.S. Geol. Survey Open File Rept. No. 50, 1951, 66 pp.

_____. Geologic and Topographic Map and Sections of the Katalla Area, Alaska. U.S. Geol. Survey War Miner. Inv. 1945, 1 map.

Plafker, G. Geologic Map of the Gulf of Alaska Tertiary Province, Alaska. U.S. Geol. Survey Misc. Geol. Inv. I-484, 1967, 1 map.

TABLE 1. - Wells drilled between the Copper River and Cape Suckling

Company	Well	Location[1]	Spudded	Completed	Total depth, feet	Status
KATALLA OILFIELD						
Alaska Petroleum and Coal Co.	No. 1 (110).	NE1/4 sec 1, T 20 S, R 5 E.	1903	1903	1,710	Plugged and abandoned.
Alaska Steam Coal and Petroleum Syndicate.	A.....	SW1/4NE1/4 sec 36, T 19 S, R 5 E.	1901	1901	270	Do.
Do.....	No. 1..	NE1/4 sec 36, T 19 S, R 5 E.	1902	1903	550	Oil well discovery (abandoned in 1933).
Do.....	No. 2..	.....do.....	1903	1904	1,000±	Oil well (abandoned in 1933).
Do.....	No. 3..	.....do.....	1904	1904	900	Plugged and abandoned.
Do.....	B.....	.....do.....	1904	1904	(2)	Do.
Do.....	C.....	.....do.....	1904	1904	(2)	Do.
Amalgamated Development Co.	No. 4..	.....do.....	1912	1912	690	Oil well (abandoned in 1933).
Do.....	No. 5..	.....do.....	1912	1912	1,000	Do.
Do.....	No. 6..	.....do.....	1912	1912	100	Plugged and abandoned.
Do.....	No. 7..	NE1/4 sec 36, T 19 S, R 5 E.	1912	1912	645	Oil well (abandoned in 1933).
Do.....	No. 8..	.....do.....	1913	1913	1,100	Oil well (abandoned in 1918).
Chilkat Oil Co.....	No. 16.	Sec 36, T 19 S, R 5 E.	1920	1920	740	Oil well (abandoned in 1933).
Do.....	No. 17.	.....do.....	1920	1920	903	Do.
Do.....	No. 18.	.....do.....	1921	1921	1,000	Do.
Do.....	No. 19.	.....do.....	1922	1922	1,465	Do.
Do.....	No. 20.	.....do.....	1922	1922	1,202	Do.
Do.....	No. 21.	.....do.....	1922	1922	1,750	Do.
Do.....	No. 22.	.....do.....	1923	1923	1,280	Do.
Do.....	No. 23.	.....do.....	1925	1925	1,160	Do.
Do.....	No. 24.	.....do.....	1925	1926	2,350	Plugged and abandoned.
Do.....	No. 25.	.....do.....	Aug. 1931	1932	2,005	Do.
St. Elias Oil Co...	No. 9..	.....do.....	1917	1917	1,810	Do.
Do.....	109....	NW1/4 sec 31, T 19 S, R 6 E.	1917	1917	1,613	Do.
Do.....	No. 11.	Sec 36, T 19 S, R 5 E.	1918	1918	1,130	Oil well (abandoned in 1933).
Do.....	No. 12.	.....do.....	7/27/18	9/7/18	903	Do.
Do.....	No. 13.	.....do.....	Sept. 1918	June 1919	900	Do.
Do.....	No. 14.	.....do.....	July 1919	1920	2,265	Plugged and abandoned.

See footnotes at end of table.

TABLE 1. - Wells drilled between the Copper River and Cape Suckling--Continued

Company	Well	Location[1]	Spudded	Completed	Total depth, feet	Status
OTHER AREAS						
Alaska Coal Co.....	No. 1 (115).	Sec 11, T 19 S, R 4 E.	1911	1917	1,040	Plugged and abandoned.
Do.....	No. 2 (116).	.....do.....	1911	1911	272	Do.
Do.....	No. 3..	.....do.....	1911	1911	250	Do.
Alaska Gulf Syndicate.	Johnson No. 1 (118).	NW1/4 sec 4, T 19 S, R 8 E.	1930	1930	190	Do.
Alaska Petroleum and Coal Co.	No. 2 (111).	SE1/4 sec 22, T 19 S, R 5 E.	1903	1904	280	Do.
Do.....	No. 3 (112).	.....do.....	1904	1904	1,500	Do.
Do.....	No. 4 (113).	.....do.....	1905	1906	1,500	Do.
Do.....	No. 5 (114).	SE1/4 sec 26, T 19 S, R 5 E.	1907	1907	1,600	Do.
Alaska Steam Coal and Petroleum Syndicate.	No. 103	Sec 30, T 19 S, R 7 E.	1904	1904	400	Do.
Do.....	No. 104	.....do.....	1904	1904	650	Do.
Do.....	No. 105	.....do.....	1904	1904	800	Do.
Do.....	No. 108	.....do.....	1904	1904	1,000±	Do.
Atlantic Richfield Co.	Bering River unit No. 1.	66' N, 3,000' E fr SW1/4 sec 32, T 18 S, R 7 E.	9/9/61	11/2/61	6,175	Do.
Do.....	Bering River unit No. 2.	SW1/4 sec 22, T 19 S, R 7 E.	11/19/61	1/20/62	6,019	Do.
Clarence Cunningham.	No. 1 (106).	Sec 5, T 20 S, R 6 E.	1904	1904	(2)	Do.
Do.....	No. 2 (107).	.....do.....	1904	1904	(2)	Do.
Panoil--Arabian Shield.	Katalla state No. 1.	1,785' S, 550' W NE1/4 sec 33, T 19 S, R 5 E.	8/16/69	8/21/69	421	Do.
Rathbun.....	101....	NW1/4 sec 15, T 18 S, R 6 E.	1905	1906	1,700	Do.
Unknown.....	No. 102	Sec 16, T 19 S, R 7 E.	1903	1903	580	Do.

[1] Based on Copper River meridian.
[2] Unrecorded.

In a report prepared in 1922,[3] a Bureau of Mines engineer who visited the Katalla oilfield described the field operations as follows:

"About thirty-five wells have been drilled in the Katalla oil field. Of this number, 20 have been drilled on the patented claim of 151 acres, which claim has been the only place of petroleum prosperity and production in Alaska, since the withdrawal of entry of oil lands on November 5, 1910.

"Some of the wells drilled years ago on other claims discovered oil but whether in economic quantities remains to be determined by further tests. The writer recently visited several of these oil wells and saw ample evidence of the discovery of petroleum.

"The Chilkat Oil Company own the patented claim and operate the thirteen producing wells located on it. These wells are being pumped by steam, and the production of about 1,000 barrels a month of 44 degrees Baume gravity paraffin-base petroleum is piped to the small refinery, owned and operated by the same company, and located about half of mile to the west on Katalla Slough.

"The oil production from this claim from 1904 to 1919, inclusive, was 56,000 barrels. For 1920 it was 10,745 barrels, valued at $77,479.46, and for 1921 it was 10,280 barrels, valued at $82,454.55. The above values are based upon the receipts from sale of refined products. The production per well varies from 15 to 240 barrels per month. The better wells are pumped regularly every day, but the oil is allowed to accumulate in the smaller ones which are pumped about once a week. The producing wells vary in depth from 366 feet to 1,500 feet. One well was completed to a depth of 2,300 feet, but showed no oil and was abandoned.

"All of the wells drilled on the patented claim, both producing and abandoned, are rather closely grouped and would all fall within a forty-acre tract.

"Even the deepest well drilled did not penetrate the shale which seems to be the only rock outcropping within the limits of the producing area and from the crevices of which the oil finds its way by seepage into the wells. There seems to be no relation in the different wells as to the horizon at which these oil-carrying crevices will be encountered. The drilling of a new well and the encountering of petroleum at greater depths does not seem to affect or be affected by the adjoining wells, some of which produce oil from a much shallower depth.

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[3] George, H. C. Preliminary Report on the Alaska Oil Fields. BuMines 1922, 18 pp.; available upon request from D. P. Blasko, Bureau of Mines, Anchorage, Alaska.

"All of the wells of this field have been drilled with standard tools. Well No. 19 on the patented claim was completed at a depth of 1,500 feet during the writer's recent trip to the Katalla oil field. This well has 8-inch casing to 900 feet and a 6-inch perforated liner to 1,500 feet, where the principal producing horizon occurs. This well, like all of the others in the Katalla oil field, was drilled with standard tools and, like the other wells, it was not cemented, as no water occurs in the formation. Two or three hundred feet of 10-inch casing is used as a conductor and also serves to keep out the surface water. This well with its proportion of overhead costs about $10,000.00.

"Refining as conducted at Katalla is a simple fire-still process where operations are directed towards producing the maximum amount of distillate. The residuum from the refining process is kept in tanks for treatment at a later date, with improved methods and equipment.

"An idea of the proportion of the different refined products is obtained from the statement of oil sales of the Chilkat Oil Company for 1921, as follows:

Gasoline.....	51,671 gallons
Distillate....	249,212 "
Diesel oil.....	8,269 "
Kerosene.....	8,814 "

"All of the refined products, run into 100-gallon steel drums, are disposed of along the Alaska coast to operators of gas boats, canneries and mining companies. A 30-ton gas boat makes a trip with a load of about sixty 100-gallon drums about once a week, delivering at Cordova and various canneries along the coast.

"In this way, the refined product is readily handled, entrance being made to the slough and wharf at the refinery at high tide and loading being done between tides, and the load being taken out on the next tide. Handling the refined products in this way costs five cents per gallon delivered at Cordova or other wharfs in the same general region.

"The maximum number of men required in the operations of the Chilkat Oil Company is sixteen. This includes operation of sawmill, rig building, drilling, pumping and refining."

According to figures found in the archives of the Bureau of Mines office in Juneau, Alaska, the total production from the Katalla field between 1904 and 1933 was 153,922 barrels of oil valued at $736,501 (table 2). There are no records of gas production.

TABLE 2. - Hydrocarbon production from the Katalla field

Year	Oil, bbl	Value	Year	Oil, bbl	Value
1904.....	500	$1,000	1920.....	10,746	$53,730
1905.....	-	-	1921.....	10,280	51,400
1906.....	-	-	1922.....	10,047	30,000
1907.....	1,500	3,000	1923.....	10,653	26,633
1908.....	500	1,000	1924.....	7,299	36,500
1909.....	-	-	1925.....	7,963	34,000
1910.....	500	1,000	1926.....	7,600	38,000
1911.....	500	1,000	1927.....	6,245	32,600
1912.....	4,057	20,285	1928.....	5,470	35,000
1913.....	6,000	30,000	1929.....	5,226	36,000
1914.....	6,000	30,000	1930.....	4,611	27,500
1915.....	6,500	32,500	1931.....	4,290	23,000
1916.....	4,555	22,775	1932.....	3,410	18,200
1917.....	7,300	36,500	1933.....	3,774	20,200
1918.....	7,543	37,715	Total.....	153,922	736,501
1919.....	10,853	56,963			

A search for oil seeps in the Katalla field is very difficult. Dense growth or regrowth of vegetation hampers visibility as well as mobility. The marshy, grassy wetland character of most of the field area is worsened during periods of rainy weather, which are frequent.

Oil and gas seeps in the Katalla field have been reported by Miller and Plafker.[4] It was not possible to determine if all the oil-saturated locations suspected of being seeps were actually oil seeps or the remains of previous spillages of oil and/or grease from industrial operations in the field years ago.

A good portion of the field area is a marshy, poorly drained wetland. However, the water eventually drains either into Oil Creek or Arvesta Creek, both of which empty into the Katalla Slough. On close examination, this marsh exhibited a sheen indicative of oil or hydrocarbon cover. Without lengthy surveillance, it was impossible to determine if the sheen or oil originated from oil seeps, leaking wells, or from previous industrial operations. It is possible that the sheen is the result of all these factors.

One of two locations were found that were unquestionably oil seeps or the remains of previous seeps. Again, it was impossible to determine if these seeps were active or dormant because of the steady runoff and agitation of the surrounding water caused by the rains. For lack of attendant gushing oil fluid from these locations, it was assumed, but not proven, that these seeps were dormant.

It was impossible to obtain a sample of fluid for hydrocarbon analysis from around suspected seeps throughout the marshland because of the rainfall and inadequate methods and equipment for skim samples.

[4]Work cited in footnote 2.

The search for active natural gas seeps in the Katalla field was incidental to the search for oil seeps, but more successful. Two such seeps were discovered by locating the distinctive gurgling sound of the gas surfacing through the water cover. On one occasion, the exact location of the gas seep was elusive, but a search continued within the radius of the gurgling sound. Finally, a group of frogs was observed concentrated in one spot. Closer observation revealed that the frogs were hopping in and out of a hole about 6 inches deep and half filled with water. It was from this hole that the gas was escaping.

The gas from the located seeps had no odor. However, the inclement weather could have dispersed the vapors and interfered with the sense of smell. High winds at the time made futile any attempts to determine if the gas was flammable.

As far as can be determined, the wells in the Katalla field were shut in and abandoned in 1933 after the refinery burned down. There are no records indicating that any wells were plugged; indeed, there is evidence that they were not plugged.

It was difficult to locate the old wells. Dense regrowth of vegetation hid some of the wells so that they were not visible until only a few steps away. Maps from old reports could be utilized at best only as general direction finders in locating wells.

The wooden derricks and well platforms have collapsed and are in various stages of deterioration. The surface casing is surrounded by wood beams and lengths of rusting pipe along with other rubble. Most of the well casings are surrounded by pools of water and/or oil. It was difficult to tell whether this oil was industrial oil, old oil, or fresh seep oil.

At wells that were possible to investigate closely, there did not seem to be any active seepage of either oil, water, or gas from around the casing. In fact, the condition of the surface casing was surprisingly good. No corrosion or deterioration at the surface level was detected.

At two of the wells located, there was a very definite fresh petrolic odor resembling that of kerosine. At one well, the odor is accompanied by evidence of fresh oil on the water surrounding the well. The amount of oil on the water was more than a sheen, but not enough to constitute a sample. It could not be determined if the oil was oozing up from outside the casing, leaking through the casing, or coming from a leaking valve.

On approaching the site of the second well, a very strong gaseous odor was noted some distance before the well was actually spotted. Upon reaching the well, the surface area around the casing was thoroughly inspected to determine if any leaks or seeps were prevalent. None were spotted. A "sniffing" check was then made around all valves, connections, etc., of the well itself. A check was made of a horizontal pipe attached to the casing about 4 feet above ground level and protruding about 2 feet from the well. The gas was emanating a distance of about 6 inches from the mouth of the pipe,

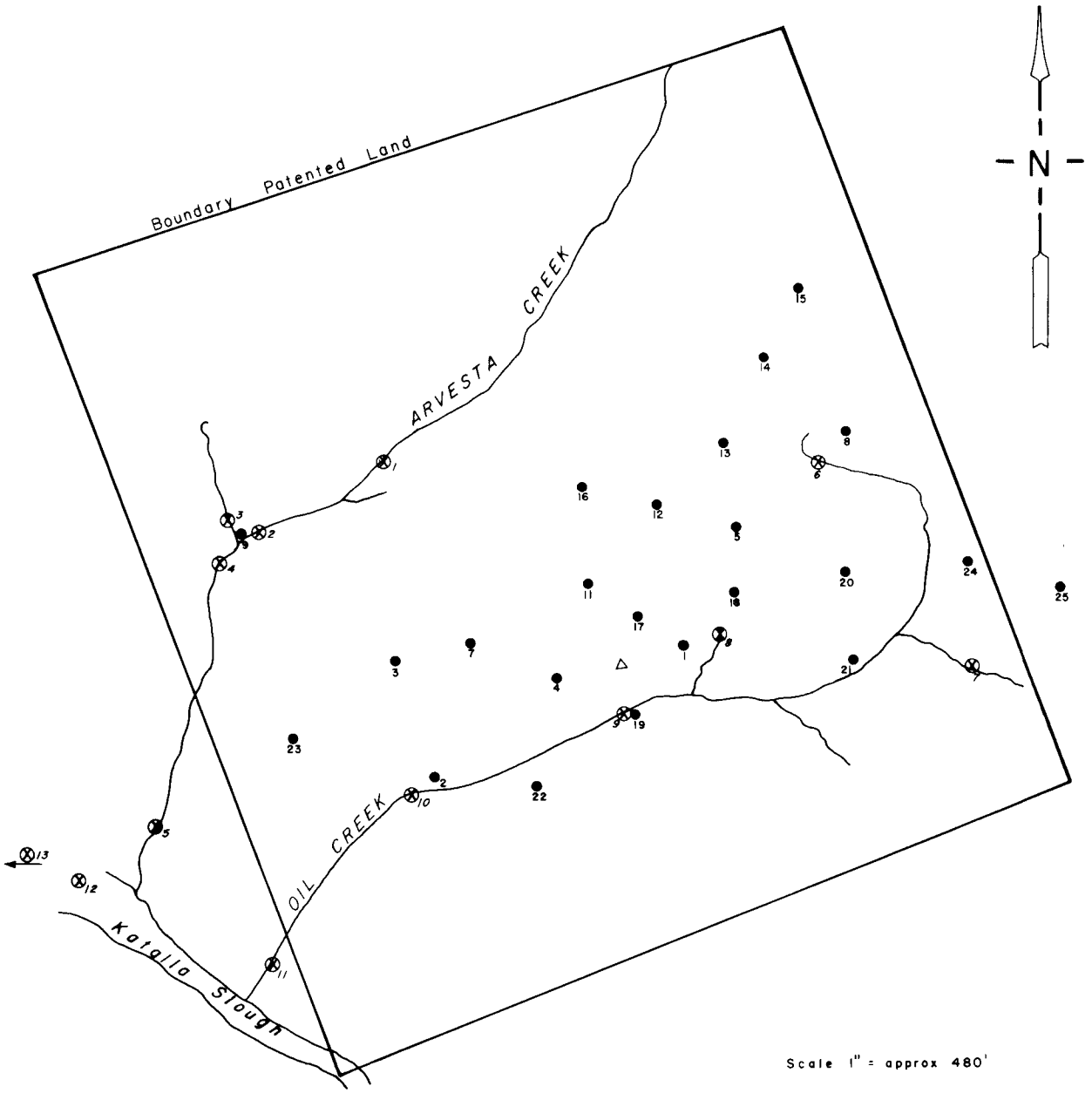

FIGURE 1. - Katalla oilfield.

obviously under pressure. The weather at the time was inclement--raining and windy--yet, the gas odor about the mouth of the pipe was vivid.

No attempt was made to light or flare the escaping gas owing to a lack of additional assistance should the act go awry. No attempt was made to either tighten or loosen any of the rusty valves on the wellhead for the same precautionary reason. The odor of the gas would seem to indicate that heavier fractions are prevalent and could be extracted.

The locations of what appeared to be old well sites were found, but no wellhead equipment was located. The sites were identified by deep, large pools of stagnant water and/or oil-soaked tussocks of marshy grass and debris. Because of the lack of wellhead equipment normally surrounding a well site, it was decided that these were either seep areas or well sites that had been abandoned completely.

During 1972, the company holding the patent on the land on which the Katalla oilfield is located systematically sampled the drainage area of the oilfield. Water samples were taken from the creeks above, near, and below areas of suspected seeps and well leakage (fig. 1). Analyses of water from this activity are found in tables 3-5. It is significant that the oil content of samples obtained in Katalla Slough was less than that of those taken from the rapidly running water of Arvesta and Oil Creeks. This would indicate that the oil is broken up and dispersed by the running water. Another interesting aspect observed in the field was that the profuse growth of long grass (species unknown) acted as a barrier that collected the bitumen flowing through the swamp to the drainage creeks. This bitumen is readily identifiable by the characteristic rainbow sheen.

A sample of crude oil was taken from the casing of well No. 24 (fig. 1). Analysis is given in table 6. The muck and water on the surface of the oil were cleaned out prior to sampling. Results indicate that light gasoline fractions were missing, supposedly owing to atmospheric exposure. Other characteristics of the crude oil tended to substantiate the potential quality of the reservior oil.

Several natural gas seeps have been observed in the area of the Katalla oilfield. A sample of gas bubbling up through a distinct marshy area was obtained and analyzed (fig. 1). Results are given in table 7.

TABLE 3. - Analyses of water from Arvesta Creek

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by Private industry

Location NE 1/4, Sec. 36 Date Sampled 9-72

T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

No. 1 Sample obtained about 150 yds. upstream of well No. 9

Analysis: Performed by _____

Provided by Private industry

Special Results:

Oil Content, mg/l - 0.3

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	16	0.70	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	49	0.80
Magnesium	4	0.33	Sulfate	11	0.23
Calcium	5	0.25	Sulfide	--	--
Iron	--	--	Chloride	10	0.28
			Hydroxide	--	--
Total Cation		1.31	Total Anion		1.31

Total Dissolved Solids, Mg/liter 71

Observed pH 6.3

Specific Resistance at 68°F. 134.0 ohm meters

TABLE 3. - Analyses of water from Arvesta Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by Private industry

Location NE 1/4, Sec. 36 Date Sampled 9-72

T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

No. 2 Sample obtained from Arvesta Creek 10 yards upstream of well No. 9.

Analysis: Performed by _____

Provided by Private industry

Special Results:

Oil Content, mg/l - 0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	14	0.62	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	37	0.61
Magnesium	2	0.16	Sulfate	8	0.17
Calcium	5	0.25	Sulfide	--	--
Iron	--	--	Chloride	10	0.28
			Hydroxide	--	--
Total Cation		1.06	Total Anion		1.06

Total Dissolved Solids, Mg/liter 58

Observed pH 6.4

Specific Resistance at 68°F. 131.0 ohm meters

TABLE 3. - Analyses of water from Arvesta Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by Private industry

Location NE 1/4, Sec. 36 Date Sampled 9-72

T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

No. 3 Sample obtained from a small stream feeding Arvesta Creek west of well No. 9.

Analysis: Performed by _____

Provided by Private industry

Special Results:

Oil Content, mg/l - <0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	20	0.88	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	49	0.80
Magnesium	3	0.25	Sulfate	23	0.48
Calcium	7	0.35	Sulfide	--	--
Iron	--	--	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		1.51	Total Anion		1.51

Total Dissolved Solids, Mg/liter 86

Observed pH 6.4

Specific Resistance at 68°F. 87.0 ohm meters

TABLE 3. - Analyses of water from Arvesta Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by Private industry

Location NE 1/4, Sec. 36 Date Sampled 9-72

T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample No. 4 obtained from Arvesta Creek approx. 50 yards downstream of well No. 9.

Analysis: Performed by _____

Provided by Private industry.

Special Results:

Oil Content, mg/l - 0.2

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	18	0.79	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	49	0.80
Magnesium	2	0.16	Sulfate	12	0.25
Calcium	6	0.30	Sulfide	--	--
Iron	--	--	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		1.28	Total Anion		1.28

Total Dissolved Solids, Mg/liter 71

Observed pH 6.4

Specific Resistance at 68°F. 108.0 ohm meters.

TABLE 3. - Analyses of water from Arvesta Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by Private industry

Location NE 1/4, Sec. 36 Date Sampled 9-72

T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

No. 5 Sample obtained from mouth of Arvesta Creek. (Katalla Slough)

Analysis: Performed by _____

Provided by Private industry

Special Results:

Oil Content, mg/1 - <0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	10	0.44	Carbonate	--	--
Potassium	2	0.05	Bicarbonate	37	0.61
Magnesium	5	0.41	Sulfate	15	0.31
Calcium	6	0.30	Sulfide	--	--
Iron	--	--	Chloride	10	0.28
			Hydroxide	--	--
Total Cation		1.20	Total Anion		1.20

Total Dissolved Solids, Mg/liter 66

Observed pH 6.4

Specific Resistance at 68°F. 110.0 ohm meters

TABLE 4. - Analyses of water from Oil Creek

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by Private industry

Location NE 1/4, Sec. 36 Date Sampled 9-72

T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample No. 6 obtained from near head of Oil Creek southwest of well No. 8.

Analysis: Performed by _____

Provided by Private industry

Special Results:

Oil Content, mg/l - 0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	10	0.45	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	37	0.61
Magnesium	4	0.33	Sulfate	3	0.06
Calcium	4	0.20	Sulfide	--	--
Iron	--	--	Chloride	12	0.34
			Hydroxide	--	--
Total Cation		1.01	Total Anion		1.01

Total Dissolved Solids, Mg/liter 52

Observed pH 6.8

Specific Resistance at 68°F. 142.0 ohm meters

TABLE 4. - Analyses of water from Oil Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by Private industry

Location NE 1/4, Sec. 36 Date Sampled 9-72

T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample No. 7 obtained about 50 yards south of well No. 24 on a south Fork of Oil Creek.

Analysis: Performed by _____

Provided by Private industry

Special Results:

Oil Content, mg/l - <0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	13	0.55	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	61	1.00
Magnesium	5	0.41	Sulfate	6	0.12
Calcium	6	0.30	Sulfide	--	--
Iron	--	--	Chloride	6	0.17
			Hydroxide	--	--
Total Cation		1.29	Total Anion		1.29

Total Dissolved Solids, Mg/liter 67

Observed pH 6.7

Specific Resistance at 68°F. 100.0 ohm meters

TABLE 4. - Analyses of water from Oil Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by Private industry

Location NE 1/4, Sec. 36 Date Sampled 9-72

T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample No. 8 obtained from drainage creek near train crossing which drains into Oil Creek.

Analysis: Performed by _____

Provided by Private industry

Special Results:

Oil Content, mg/l - 0.3

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	10	0.42	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	37	0.61
Magnesium	3	0.25	Sulfate	3	0.06
Calcium	4	0.20	Sulfide	—	—
Iron	--	—	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		0.90	Total Anion		0.90

Total Dissolved Solids, Mg/liter 47

Observed pH 6.7

Specific Resistance at 68°F. 156.0 ohm meters

TABLE 4. - Analyses of water from Oil Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by Private industry

Location NE 1/4, Sec. 36 Date Sampled 9-72
T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample No. 9 obtained from Oil Creek at well No. 19.

Analysis: Performed by _____

Provided by Private industry

Special Results:

Oil Content, mg/l - 0.2

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	12	0.54	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	37	0.61
Magnesium	2	0.16	Sulfate	2	0.04
Calcium	3	0.15	Sulfide	--	--
Iron	--	--	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		0.88	Total Anion		0.88

Total Dissolved Solids, Mg/liter 46

Observed pH 6.7

Specific Resistance at 68°F. 133.0 ohm meters

TABLE 4. - Analyses of water from Oil Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by Private industry

Location NE 1/4, Sec. 36 Date Sampled 9-72

T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample No. 10 obtained from Oil Creek 10 yards downstream from well No. 2.

Analysis: Performed by _____

Provided by Private industry

Special Results:

Oil Content, mg/l - 0.3

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	10	0.42	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	37	0.61
Magnesium	3	0.25	Sulfate	3	0.06
Calcium	4	0.20	Sulfide	--	--
Iron	--	--	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		0.90	Total Anion		0.90

Total Dissolved Solids, Mg/liter 47

Observed pH 6.6

Specific Resistance at 68°F. 152.5 ohm meters

TABLE 4. - Analyses of water from Oil Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by Private industry

Location NE 1/4, Sec. 36 Date Sampled 9-72

T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample No. 11 obtained from mouth of Oil Creek, (Katalla Slough)

Analysis: Performed by _____

Provided by Private industry

Special Results:

Oil Content, mg/l - <0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	17	0.72	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	49	0.80
Magnesium	2	0.16	Sulfate	4	0.08
Calcium	4	0.20	Sulfide	--	--
Iron	--	--	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		1.11	Total Anion		1.11

Total Dissolved Solids, Mg/liter 60

Observed pH 6.4

Specific Resistance at 68°F. 157.0 ohm meters

TABLE 5. - Analyses of water from Katalla Slough

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Field Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 36 Date Sampled 7-74

T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample No. 12 taken from small drainage Creek below where Arvesta and Oil Creek flow into Katalla Slough.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.4

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	79	3.44	Carbonate	--	--
Potassium	7	0.18	Bicarbonate	110	1.80
Magnesium	8	0.66	Sulfate	20	0.42
Calcium	14	0.70	Sulfide	--	--
Iron	--	--	Chloride	98	2.76
			Hydroxide	--	--
Total Cation		4.98	Total Anion		4.98

Total Dissolved Solids, Mg/liter 280

Observed pH 7.5

Specific Resistance at 68°F. 21.6 ohm meters

TABLE 5. - Analyses of water from Katalla Slough--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 27 Date Sampled 7-74

T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample No. 13 obtained from Creek-Slough where Katalla Slough drains into Katalla River.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	425	18.41	Carbonate	--	--
Potassium	8	0.20	Bicarbonate	159	2.61
Magnesium	15	1.23	Sulfate	72	1.50
Calcium	17	0.85	Sulfide	--	--
Iron	--	--	Chloride	590	16.64
			Hydroxide	--	--
Total Cation		20.75	Total Anion		20.75

Total Dissolved Solids, Mg/liter 1205

Observed pH 7.1

Specific Resistance at 68°F. 4.98 ohm meters

TABLE 6. - Analysis of oil from Katalla oilfield

Sample From: Well X Stream _____ Seep _____ Other _____

Area Katalla Oilfield Sampled by U.S. Bureau of Mines

Location NE 1/4 Sec. 36 Date Sampled 9-72
T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Oil Sample obtained from Well No. 5

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60°F.	0.8658
A.P.I. gravity @ 60°F.	31.9
Saybolt Universal Viscosity @ 70°F., seconds	Not Determined
Saybolt Universal Viscosity @ 100°F., seconds	455 cc
B. s. and water, % by volume	Not Determined
Pour point, °F.	20
Total sulphur, % by weight	0.52

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP		55	
5		60	
10		65	
15		70	
20		75	
25	NOT DETERMINED	80	NOT DETERMINED
30		85	
35		90	
40		95	
45		E.P.	
50			

Approximate Recovery

300° E.P. gasoline, %	70.0	Recovery, %
392° E.P. gasoline, %	30.0	Residue, %
500° E.P. distillate, %	0.0	Loss, %

TABLE 7. - Analysis of gas from Katalla oilfield

Sample From: Well _____ Stream _____ Seep X Other _____

Area Katalla Oilfield Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 36 Date Sampled 9-72
T. 19 S., R. 5 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Gas Sample obtained from natural seep about 40 yards north of Well No. 19.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

Special Results:

Analysis:

Methane	64.3 %	Normal Pentane	0.6 %	Oxygen	0.0 %
Ethane	13.4 %	Isopentane	0.4 %	Argon	0.0 %
Propane	10.6 %	Cyclopentane	0.1 %	Hydrogen	0.0 %
Normal Butane	3.1 %	Hexanes Plus	0.3 %	H2S	0.0 %
Isobutane	2.8 %	Nitrogen	0.8 %	CO2	3.6 %
				Helium	Trace %
			Total		100 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 1427

Specific Gravity 0.883

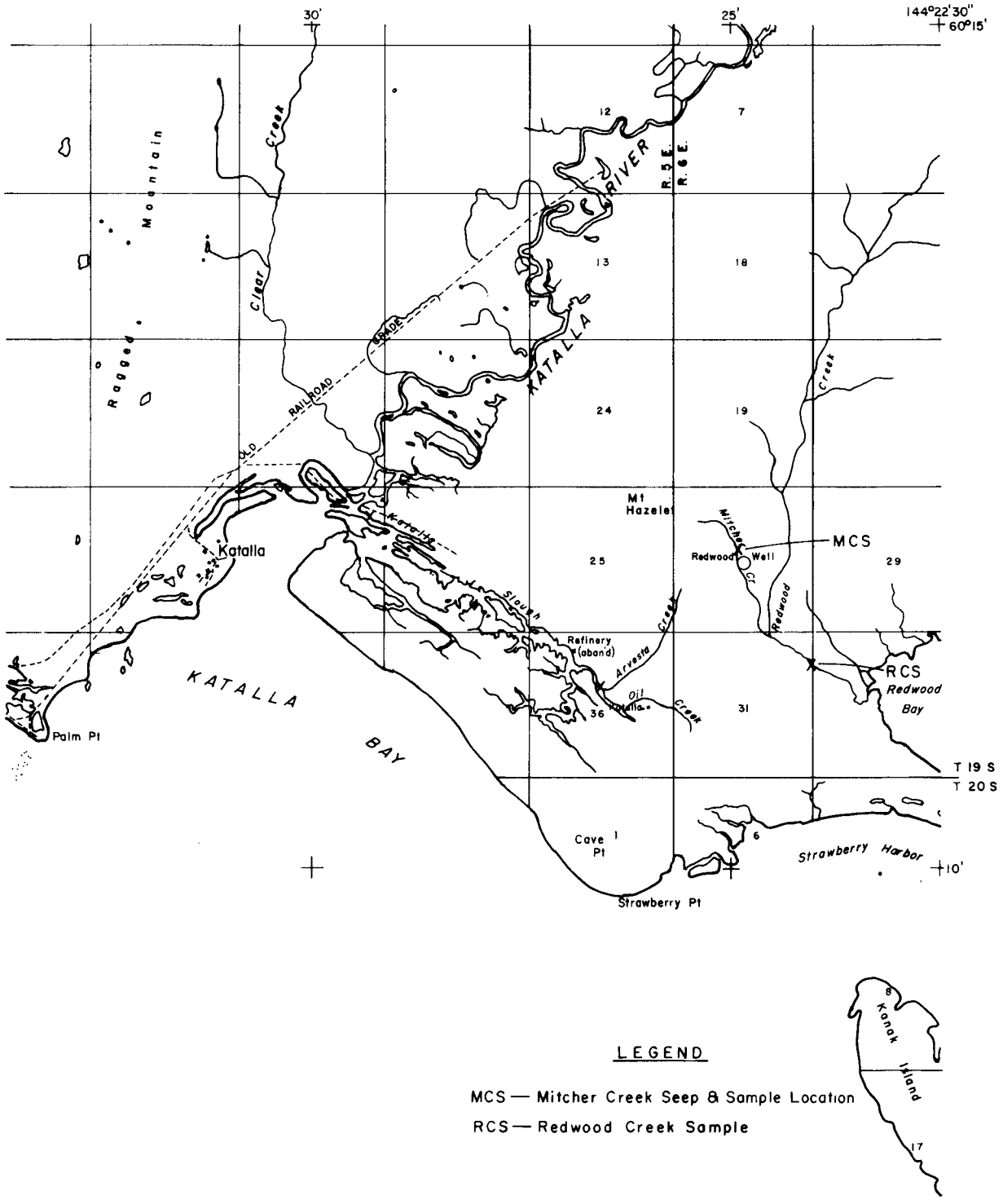

FIGURE 2. - Mitcher Creek (adapted from the U.S. Geological Survey Map of the Cordova quadrangle).

Mitcher Creek

Mitcher Creek (T 19 S, R 5 E, Copper River Meridian) is a small creek, the head of which is approximately 1 mile north of the Katalla oilfield. The creek begins on the east flank of Mount Hazelet and flows in a southeasterly direction into Redwood Creek and eventually into Redwood Bay.

A well was drilled on Mitcher Creek during 1904 in approximately the center of sec 30, T 19 S, R 6 E, Copper River Meridian (fig. 2). The well encountered oil but never produced. According to a report written in 1922,[5] "the well was full of fluid and oil was trickling over the top of the open casing." During 1973, the old well was located. All remains of the drilling equipment is some rotted timber, an old bailer, and some rails laying in the creek. The 10-inch surface casing is still intact. Oil could be seen about 20 feet down the casing, and it appeared that gas bubbles were emanating through the fluid. A sample of the oil was obtained by lowering a 1-gallon can down the casing by rope and sinking the can in the oil. An analysis of this oil is given in table 8.

The seep on Mitcher Creek is located about 100 feet upstream from the well location. The seep appeared to be active; fresh oil was observed trapped by rocks near the edge of the creek. However, no oil was observed escaping from the creek bottom to the surface. Analyses of water from the seep, 100 feet upstream of the seep, 200 feet below the seep, and near the mouth of Redwood Creek are given in table 9.

[5]Work cited in footnote 3.

TABLE 8. - Analysis of oil from Redwood well

Sample From: Well X Stream _____ Seep _____ Other _____

Area Katalla Oilfield Sampled by U.S. Bureau of Mines

Location C Sec. 30 Date Sampled 8-73

T. 19 S., R. 6 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample obtained from open casing of well.

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.8487
A.P.I. gravity @ 60°F.	35.2
Saybolt Universal Viscosity @ 70°F., seconds	53.3
Saybolt Universal Viscosity @ 100°F., seconds	44.9
B. s. and water, % by volume	< 0.1
Pour point, °F.	-10
Total sulphur, % by weight	0.53

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	196	55	570
5	226	60	594
10	264	65	614
15	300	70	620
20	332	75	624
25	370	80	--
30	404	85	--
35	432	90	--
40	468	95	--
45	500	E.P.	626
50	532		

Approximate Recovery

300° E.P. gasoline, %	15	Recovery, %	76.0
392° E.P. gasoline, %	29	Residue, %	24.0
500° E.P. distillate, %	16	Loss, %	0

TABLE 9. - Analyses of water from Mitcher Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Katalla Oilfield Sampled by U.S. Bureau of Mines

Location (approx) C. Sec. 30 Date Sampled 8-73

T. 19 S., R. 6 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample obtained from pool of water at edge of Creek about 100 feet upstream from Redwood well, near seep.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/1 - 7,130

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	25	1.08	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	90	1.48
Magnesium	2	0.16	Sulfate	8	0.17
Calcium	11	0.55	Sulfide	--	--
Iron	--	--	Chloride	6	0.17
			Hydroxide	--	--
Total Cation		1.82	Total Anion		1.82

Total Dissolved Solids, Mg/liter 97

Observed pH 6.7

Specific Resistance at 68°F. 71.8 ohm meters

TABLE 9. - Analyses of water from Mitcher Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by U.S. Bureau of Mines

Location (approx) C, Sec. 30 Date Sampled 8-73
T. 19 S., R. 6 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample obtained 100 feet upstream of seep on Mitcher Creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - <0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	15	0.66	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	37	0.61
Magnesium	3	0.25	Sulfate	17	0.35
Calcium	5	0.25	Sulfide	--	--
Iron	--	--	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		1.19	Total Anion		1.19

Total Dissolved Solids, Mg/liter 67

Observed pH 6.6

Specific Resistance at 68°F. 128.0 ohm meters

TABLE 9. - Analyses of water from Mitcher Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by U.S. Bureau of Mines

Location (approx) C, Sec. 30 Date Sampled 8-73

T. 19 S., R. 6 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample obtained from Mitcher Creek approximately 200 feet downstream from Redwood well.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 10.7

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	7	0.32	Carbonate	--	--
Potassium	Trace		Bicarbonate	29	0.48
Magnesium	2	0.16	Sulfate	11	0.23
Calcium	8	0.40	Sulfide	--	--
Iron	--	--	Chloride	6	0.17
			Hydroxide	--	--
Total Cation		0.88	Total Anion		0.88

Total Dissolved Solids, Mg/liter 48

Observed pH 6.7

Specific Resistance at 68°F. 115.0 ohm meters

TABLE 9. - Analyses of water from Mitcher Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Katalla Oilfield Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 31 Date Sampled 7-74

T. 19 S., R. 6 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample obtained from mouth of Redwood Creek before draining into Redwood Bay.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - <0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	14	0.59	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	37	0.61
Magnesium	1	0.08	Sulfate	8	0.17
Calcium	5	0.25	Sulfide	--	--
Iron	--	--	Chloride	6	0.17
			Hydroxide	--	--
Total Cation		0.95	Total Anion		0.95

Total Dissolved Solids, Mg/liter 53

Observed pH 7.1

Specific Resistance at 68°F. 144.0 ohm meters

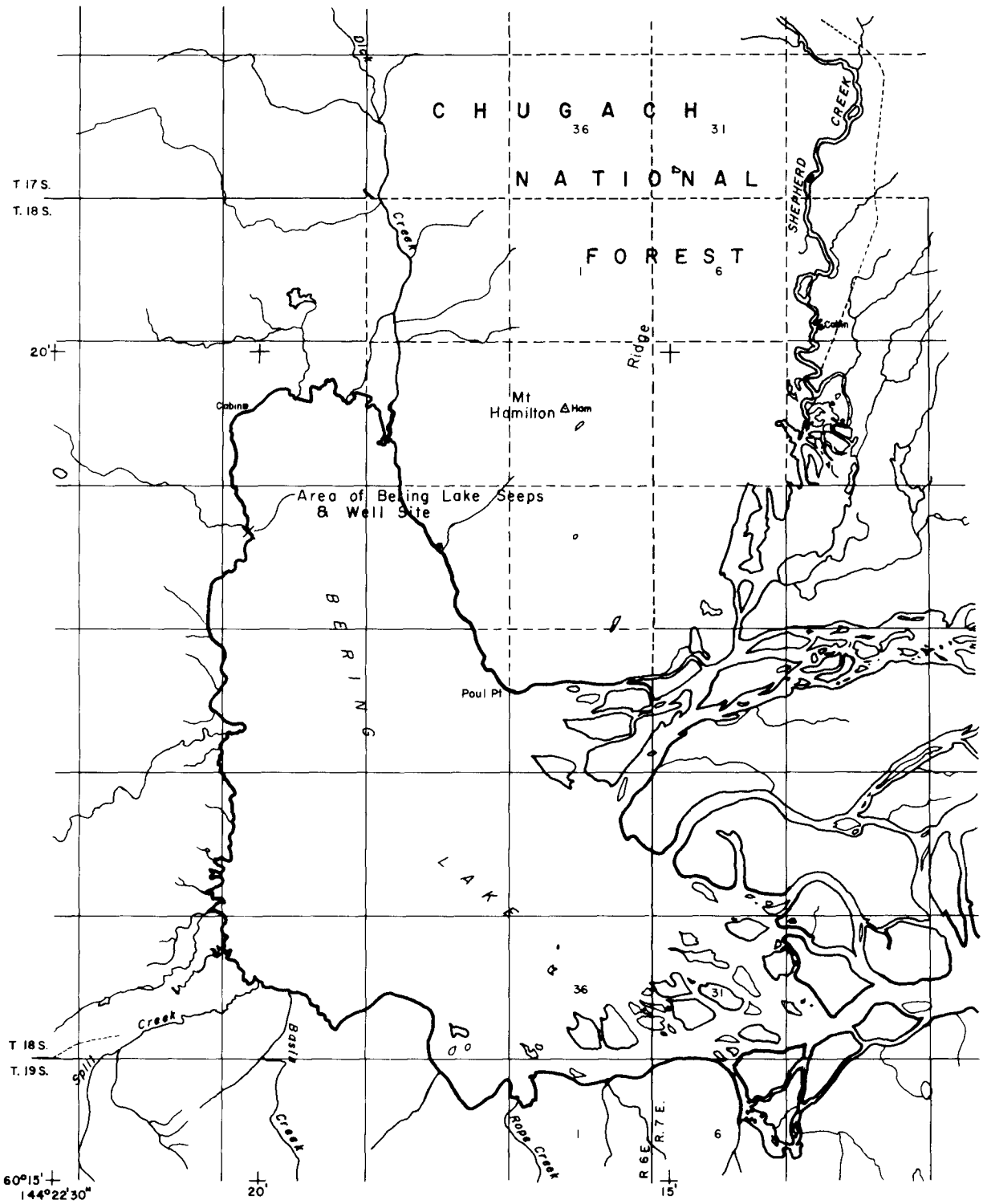

FIGURE 3. - Bering Lake (adapted from the U.S. Geological Survey map of the Cordova quadrangle).

Bering Lake

Gas seeps were located and sampled on the west shore of Bering Lake in sec. 15, T 18 S, R 6 E, Copper River Meridian (fig. 3). Two surface seeps were discernable by a white substance, which precipitated out of the water that comes to the surface with the seep gas. These two areas are located approximately 10 feet from the shore of the lake, and the seep-spring water drains into the lake. The gas is flammable and odorless. Analyses of the gas and water taken from one of the surface seeps is given in tables 10-11.

In 1905-06, the Rathbun No. 101 well was drilled about 200 feet southwest of the surface gas seeps on Bering Lake. During 1972, the 12-inch surface casing of the old well was located. Water was flowing over the casing top at the rate of about 2 gal/min. The water had a slightly salty taste. Gas was seeping up through the water and smelled of sulfur. The gas was flammable. The water entered a small creek and drained into Bering Lake. Analyses of the water and gas emanating from the Rathbun well is found in tables 12-13.

TABLE 10. - Analysis of water from Bering Lake

Sample From: Well _____ Stream _____ Seep X Other _____

Area Bering Lake Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 15 Date Sampled 8-73
T. 18 S., R. 6 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Water sample obtained from gas seep on west shore of Bering Lake.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.8

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	75	3.26	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	171	2.80
Magnesium	1	0.08	Sulfate	9	0.19
Calcium	6	0.30	Sulfide	--	--
Iron	--	--	Chloride	24	0.68
			Hydroxide	--	--
Total Cation		3.67	Total Anion		3.67

Total Dissolved Solids, Mg/liter 200

Observed pH 7.7

Specific Resistance at 68°F. 32.4 ohm meters

TABLE 11. - Analysis of gas from Bering Lake

Sample From: Well _____ Stream _____ Seep X Other _____

Area Bering Lake Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 15 Date Sampled 8-72

T. 18 S., R. 6 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Gas sample obtained from seep on west shore of Bering Lake.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

Special Results:

Analysis:

Methane	94.8 %	Normal Pentane	0.0 %	Oxygen	0.5 %
Ethane	Trace %	Isopentane	0.0 %	Argon	0.1 %
Propane	Trace %	Cyclopentane	0.0 %	Hydrogen	0.0 %
Normal Butane	0.0 %	Hexanes Plus	0.0 %	H2S	0.0 %
Isobutane	0.0 %	Nitrogen	4.3 %	CO2	0.2 %
				Helium	Trace %
			Total		99.9 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 960

Specific Gravity 0.577

TABLE 12. - Analysis of water from Rathbun well

Sample From: Well X Stream ____ Seep ____ Other ____

Area Bering Lake Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 15 Date Sampled 8-73

T. 18 S., R. 6 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample obtained from water-filled casing of Rathbun well. Water was flowing.

Analysis: Performed by Commercial Firm

Provided by ____

Special Results:

Oil Content, mg/l - 0.6

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	1460	63.52	Carbonate	--	--
Potassium	4	0.10	Bicarbonate	281	4.61
Magnesium	21	1.73	Sulfate	3	0.06
Calcium	112	5.59	Sulfide	--	--
Iron	--	--	Chloride	2350	66.27
			Hydroxide	--	--
Total Cation		70.94	Total Anion		70.94

Total Dissolved Solids, Mg/liter 4088

Observed pH 7.8

Specific Resistance at 68°F. 1.4 ohm meters

TABLE 13. - Analysis of gas from Rathbun well

Sample From: Well X Stream _____ Seep _____ Other _____

Area Bering Lake Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 15 Date Sampled 8-72

T. 18 S., R. 6 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Gas Sample taken from water-filled casing of old Rathbun Well.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

Special Results:

Analysis:

Methane	71.3 %	Normal Pentane	Trace %	Oxygen	0.8 %
Ethane	0.1 %	Isopentane	Trace %	Argon	0.5 %
Propane	Trace %	Cyclopentane	Trace %	Hydrogen	0.0 %
Normal Butane	Trace %	Hexanes Plus	Trace %	H2S	0.0 %
Isobutane	Trace %	Nitrogen	27.2 %	CO2	0.1 %
				Helium	0.01 %
			Total	100	%

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 724

Specific Gravity 0.677

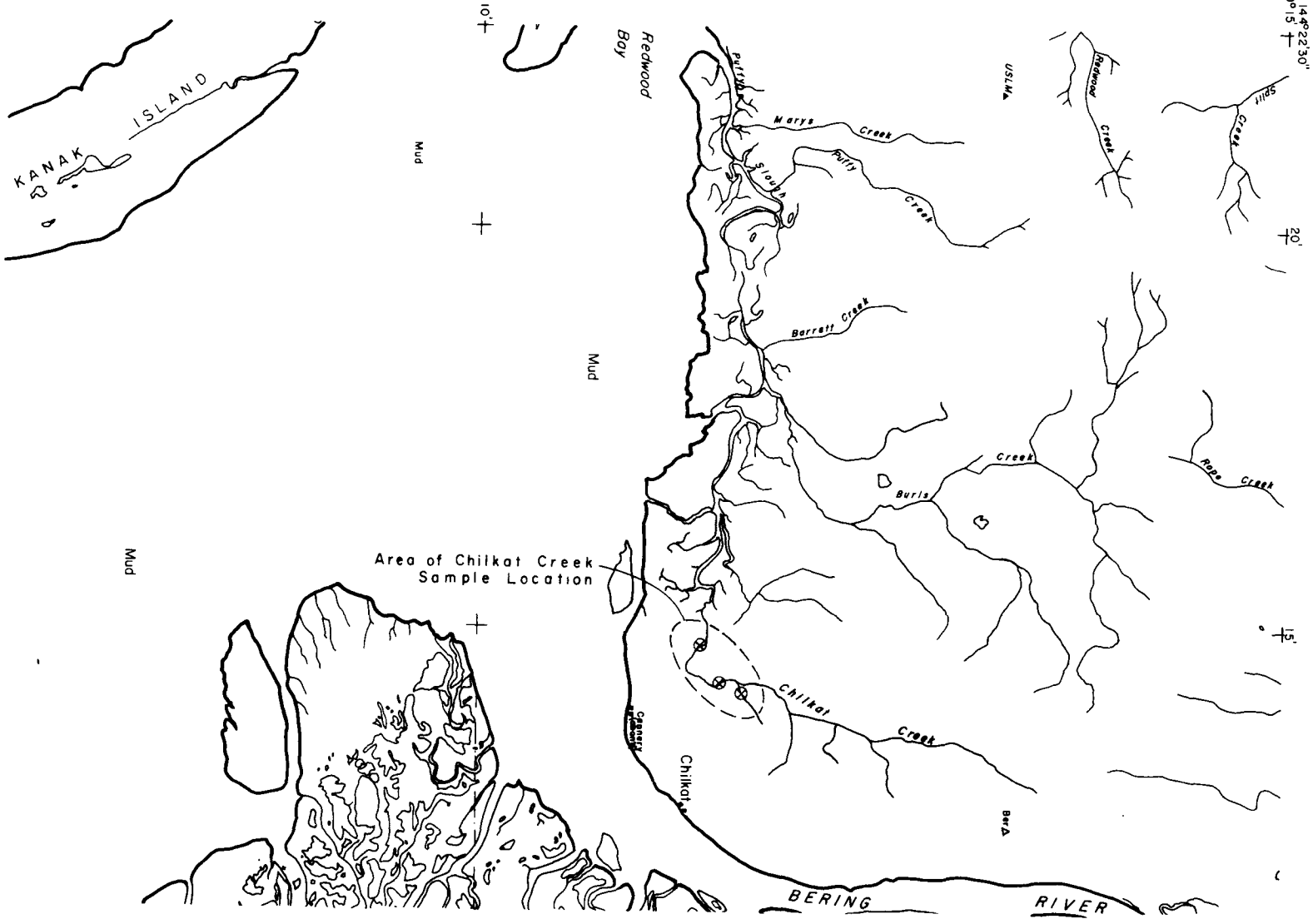

FIGURE 4. - Chilkat Creek (adapted from the U.S. Geological Survey map of the Cordova quadrangle).

Chilkat Creek

Chilkat Creek is the first drainage creek paralleling and west of the Bering River (fig. 4). Chilkat Creek drains a narrow valley with steeply sloping canyon walls. The creek drains into Controller Bay.

Three exploratory wells were drilled on Chilkat Creek during 1904. Depths reached were 400 feet, 700 feet, and 800 feet. Although the two deepest wells reported shows of oil and/or gas, all were plugged and abandoned as noncommerical. Casing and rotted timber, presumably from the drilling operations, were found laying in a creek.

Active oil seeps are still prevalent on Chilkat Creek. One seep can be found approximately one-half mile upstream from where the creek emerges from the canyon into the slough area. The seep is located in the west side of the creekbed. The seep disperses oil into the creek, and the oil is visible as a sheen over a 15-foot area below the seep. It is possible that the seep itself might be concealed under water at times of high water due to rain or other runoff. However, the ground around the seep on the west edge is an oily rainbow color. The creek is normally ankle deep, 15 feet wide running fast, clear water. The creek bottom from the seep downstream to its mouth is covered with a waxy material that has precipitated out of the oil. The creekbed is very slippery and difficult to walk on. No gas seeps were observed on the creek.

Samples of water were taken at the seep, about 1,000 feet downstream of the seep near the location of one of the old wells, and near the mouth of the creek where it emerges from the wooded area into the flat slough area. These analyses are found in table 14.

TABLE 14. - Analyses of water from Chilkat Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Chilkat Creek Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 31 Date Sampled 8-73
T. 19 S., R. 7 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample obtained from seep area on west side of Chilkat Creek about one-half mile upstream of mouth.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 73.9

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	17	0.73	Carbonate	--	--
Potassium	2	0.05	Bicarbonate	62	1.02
Magnesium	3	0.25	Sulfate	18	0.37
Calcium	14	0.70	Sulfide	--	--
Iron	--	--	Chloride	12	0.34
			Hydroxide	--	--
Total Cation		1.73	Total Anion		1.73

Total Dissolved Solids, Mg/liter 97

Observed pH 7.0

Specific Resistance at 68°F. 61.3 ohm meters

TABLE 14. - Analyses of water from Chilkat Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Chilkat Creek Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 31 Date Sampled 8-73

T. 19 S., R. 7 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample obtained in Chilkat Creek near remains of old well about 1,000 feet downstream of seep area.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 182

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	20	0.88	Carbonate	--	--
Potassium	2	0.05	Bicarbonate	62	1.02
Magnesium	3	0.25	Sulfate	18	0.37
Calcium	11	0.55	Sulfide	--	--
Iron	--	--	Chloride	12	0.34
			Hydroxide	--	--
Total Cation		1.73	Total Anion		1.73

Total Dissolved Solids, Mg/liter 97

Observed pH 6.5

Specific Resistance at 68°F. 64.0 ohm meters

TABLE 14. - Analyses of water from Chilkat Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Chilkat Creek Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 36 Date Sampled 8-73

T. 19 S., R. 6 E., (CRM)

Quadrangle Cordova

Pertinent Data Regarding Sample:

Sample obtained from near mouth of Chilkat Creek approximately one-half mile downstream from seep.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 6.5

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	19	0.84	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	62	1.02
Magnesium	3	0.25	Sulfate	15	0.31
Calcium	11	0.55	Sulfide	--	--
Iron	--	--	Chloride	12	0.34
			Hydroxide	--	--
Total Cation		1.67	Total Anion		1.67

Total Dissolved Soldis, Mg/liter 92

Observed pH 7.0

Specific Resistance at 68°F. 66.9 ohm meters

CAPE YAKATAGA TO ICY BAY

East of the Katalla area in the coastal area of the Robinson Mountains (more specifically, along the Sullivan anticline), oil and gas seeps are found on almost all of the rivers draining the anticline southward into the sea. Most of the seeps are found in a narrow belt along the fault plane of the anticline. Active seeps have been reported at one time or another on One Mile Creek, Oil Creek, Hamilton Creek, Crooked Creek, Lawrence Creek, Poul Creek, Munday Creek, and Johnston Creek.[6] Other indications of hydrocarbons in this area are siltstone outcrops with a petrolic odor.

Further east, oil seeps have been reported near Yakatat, but no surface indications of hydrocarbons have been substantiated. Northwest of Yakutat, in the Samovar Hills, is Oily Lake, a glacial lake bed surrounded by Malaspina Glacier, Agassiz Glacier, and Seward Glacier. This area is sourrounded by numerous and prolific seeps.

Near Lituya Bay, the U.S. Geological Survey at one time reported finding an oily film and petrolic odor on Topsy Creek near the crest of the anticline about 5 miles southeast of Lituya Bay.[7]

Hydrocarbon Exploration

Petroleum exploration began in the previously discussed Katalla area on the Gulf of Alaska in the early 1900's and spread eastward. During the 1926-27 drilling season, General Petroleum Co. drilled the Sullivan No. 1 in sec 7, T 22 S, R 19 E, Copper River Meridian. This well was located on the Sullivan anticline, south of the Sullivan fault, and was drilled to 2,005 feet. The well had shows of oil and gas, but was plugged and abandoned.

No further exploratory work was done in the area between the Bering Glacier and the Malaspina Glacier until 1954. Phillips Petroleum Co. drilled a stratigraphic test in sec 20, T 22 S, R 22 E, Copper River Meridian, during April and May of 1954. This well went to 4,837 feet.

Phillips Petroleum also drilled the Sullivan Unit No. 1, spudded in 1954, and completed in December 1955. This well was 10,013 feet deep and was plugged and abandoned. From January 1956 to March 1957, Phillips was intermittently engaged in drilling the Sullivan Unit No. 2 in NE1/4 sec 9, T 22 S, R 21 E, Copper River Meridian. This well went to 12,052 feet before being plugged and abandoned. Some shows of oil and gas were encountered.

Between 1959 and the end of 1962, nine wells were drilled in this part of the Gulf of Alaska. All the wells drilled were dry holes, and all but one were drilled to 10,000 feet or more. All were abandoned as noncommerical. There has been no drilling in this area since October 1962.

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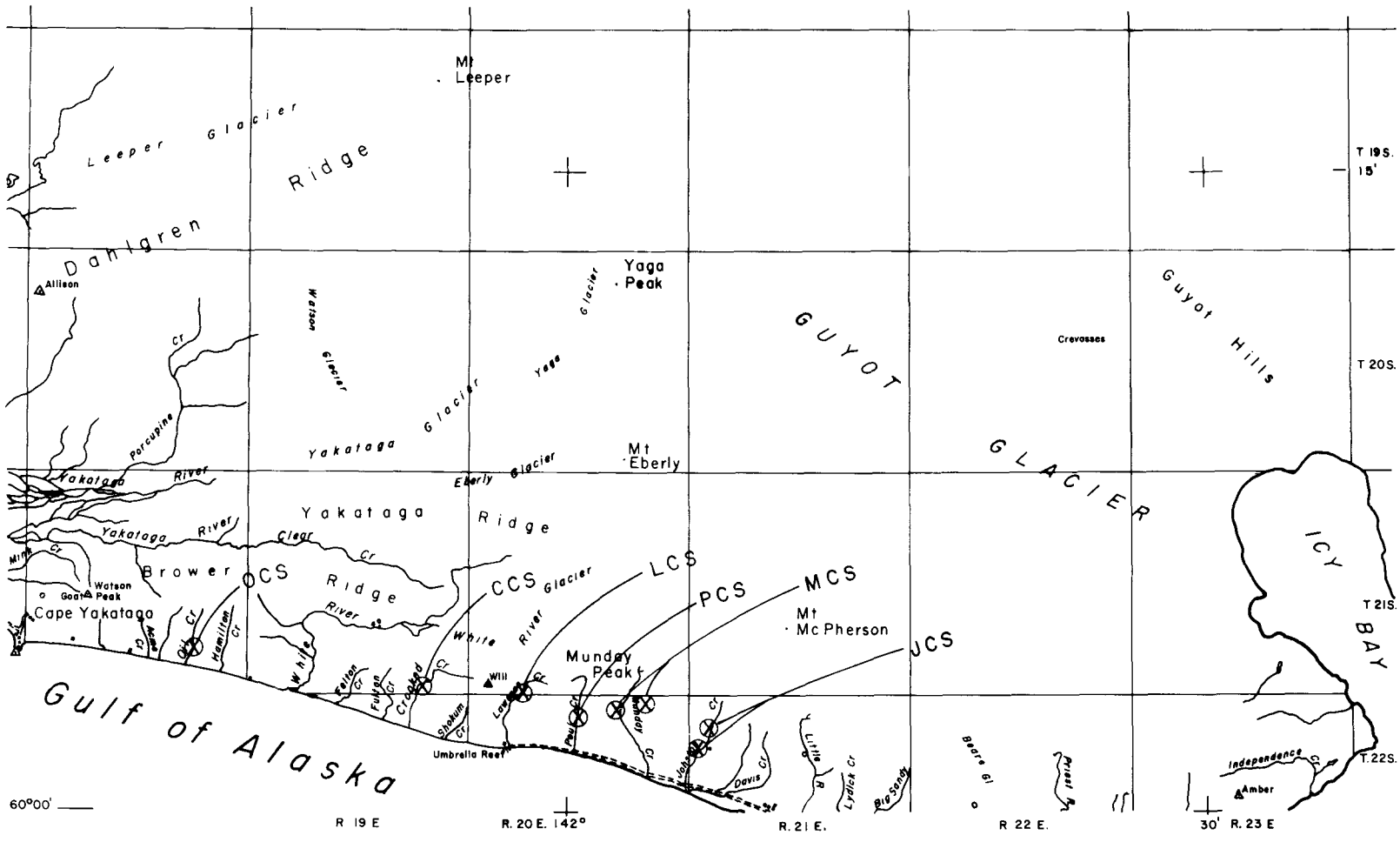
[6] Miller, D. J., and G. Plafker. Geology of the Yakataga District, Gulf of Alaska Tertiary Province, Alaska. U.S. Geol. Survey Misc. Geol. Inv. I-610, 1963, 6 pp., 1 map.

[7] Miller, D. J., T. Payne, and G. Gryc. Geology of Possible Petroleum Provinces in Alaska. U.S. Geol. Survey Bull. 1094, 1959, 132 pp.



OCS — Oil Creek Sample
CCS — Crooked Creek Seep Samples
LCS — Lawence Creek Seep Samples
MCS — Munday Creek Seep Samples
PCS — Poul Creek Seep Samples
JCS — Johnston Creek Seeps

FIGURE 5. - Creeks draining the Sullivan anticline (adapted from the U.S. Geological Survey map of the Bering Glacier quadrangle).

The other area of exploratory activity along the Gulf of Alaska is the area east of the Malaspina Glacier and extending to Dry Bay. Colorado Oil and Gas Corp. began exploration in this area during March 1957. The Yakutat Unit No. 1 was drilled to 9,314 feet in sec 5, T 28 S, R 34 E, Copper River Meridian, before being abandoned. Colorado Oil and Gas drilled several more holes in this area, including four core holes for information. Some gas shows were encountered in the deeper holes. Data regarding these exploratory holes are given in table 15.

Oil Creek

Oil Creek is located approximately 4-1/2 miles east of Cape Yakataga, (fig. 5). During the summer of 1974, Oil Creek was flowing only a trickle of water from the head to the mouth of the creek. The creek was walked and searched for seeps, but none were found. A sample of water was obtained about one-half mile upstream from the mouth of the creek, where it enters meadow-like terrain, splits, and loses its identity as a singular creekbed. The analysis is given in table 16.

Crooked Creek

Active oil and gas seeps were located on Crooked Creek approximately 1-1/2 miles upstream from its mouth (fig. 5). The seeps are located on the west side of Crooked Creek about 30 feet from the creek bank. Light-green oil emerges with water in the seep spring. Gas bubbles are discernible. An additional gas seep is located in what appears to be a dry creekbed about 10 feet east of the oil seep. Samples of oil and water were taken at the oil seep and a gas sample was obtained from the isolated gas seep. Of particular note is the caloric value of the gas from this seep. The 1,000-Btu/cu ft rating is comparable to the natural gas being produced from the Kenai gasfield on the Kenai Peninsula. Analyses of the oil, gas, and water are given in tables 17-19.

TABLE 15. - Wells drilled between the Bering Glacier and Yakutat

Company	Well	Location[1]	Spudded	Completed	Total depth, feet	Status
Atlantic Richfield Co.	Duktoth River Unit No. 1.	SE1/4 sec 24, T 20 S, R 15 E.	4/11/61	8/18/61	10,390	Plugged and abandoned.
Do.....	White River No. 1.	NW1/4SW1/4 sec 19, T 21 S, R 18 E.	8/14/61	10/31/61	7,892	Do.
Do.....	White River Unit No. 1.	NW1/4NE1/4 sec 27, T 21 S, R 19 E.	5/24/62	10/25/62	12,417	Do.
British Petroleum Exploration Co. (Alaska), Inc.[2]	White River Unit No. 3.	SE1/4 sec 29, T 21 S, R 19 E.	3/20/63	7/10/63	6,984	Do.
Colorado Oil and Gas Corp.	Yakutat No. 1.	350' N, 200' E of SW1/4 sec 33, T 27 S, R 34 E.[3] NE1/4 sec 5, T 28 S, R 34 E.[4]	3/2/57	5/19/57	9,314	Do.
Do.....	Yakutat No. 2.	1,100' N, 600' E of SW1/4 sec 1, T 28 S, R 34 E.[3] SE1/4 sec 2, T 28 S, R 34 E.[4]	7/17/57	3/1/58	11,765	Do.
Do.....	Yakutat No. 3.	2,000' S, 1,250' W, NE1/4 sec 3, T 28 S, R 34 E.[3] NE1/4SE1/4 sec 3, T 28 S, R 23 E.[4]	7/21/58	4/23/59	10,848	Do.
Do.....	Dangerous River No. 1.	990' S, 1,650' W, NE1/4 sec 17, T 29 S, R 37 E.[3] NE1/4 sec 17, T 29 S, R 37 E.[4]	6/28/60	11/19/60	8,634	Do.
Do.....	Yakutat Core Hole No. 1.	75' S, 3,000' W, NE1/4 sec 20, T 27 S, R 35 E.[3] SW1/4 sec 17, T 27 S, R 35 E.[4]	5/18/61	6/3/61	3,230	Do.
Do.....	Yakutat Core Hole No. 2.	1,750' N, 900' W of SE1/4 sec 28, T 29 S, R 36 E.[3] SE1/4 sec 28, T 29 S, R 36 E.[4]	6/26/61	7/21/61	5,690	Do.
Do.....	Yakutat Core Hole No. 3.	2,200' N, 1,400' E of SW1/4 sec 6, T 31 S, R 39 E.[3] SW1/4 sec 6, T 31 S, R 39 E.[4]	8/15/61	9/11/61	5,484	Do.
Do.....	Yakutat Core Hole No. 4.	2,200' N, 200' W of SE1/4 sec 27, T 32 S, R 41 E.[3] SE1/4 sec 27, T 32 S, R 41 E.[4]	10/3/61	11/5/61	5,326	Do.

See footnotes at end of table.

TABLE 15. - Wells drilled between the Bering Glacier and Yakutat--Continued

Company	Well	Location[1]	Spudded	Completed	Total depth, feet	Status
Colorado Oil and Gas Corp.	Malaspina Unit No. 1.	1,050' FNL & 330' FEL, sec 31, T 24 S, R 32 E.	5/17/62	5/28/62	1,802	Plugged and abandoned.
Do.....	Malaspina Unit No. 1-A.	1,027' S, 330' E of NW1/4 sec 31, T 24 S, R 32 E.	6/12/62	10/21/62	13,823	Do.
General Petroleum Co.[5]	Sullivan No. 1.	SE1/4 sec 4, T 22 S, R 20 E.[3] NE1/4 sec 7, T 22 S, R 21 E.[4]	6/28/26	10/20/27	2,005	Do.
Phillips Petroleum Co.	Sullivan Strat No. 1.	NW1/4NE1/4 sec 20, T 22 S, R 22 E.	4/11/54	5/19/54	4,837	Do.
Do.....	Sullivan No. 1.	S1/2NW1/4 sec 10, T 22 S, R 21 E.	6/19/54	12/28/55	10,013	Do.
Do.....	Sullivan No. 2.	NE1/4 sec 9, T 22 S, R 21 E.	1/23/56	3/21/57	12,054	Do.
Richfield Oil Corp.[6]	Kaliakh River Unit No. 1.	SW1/4 sec 34, T 20 S, R 14 E.	12/3/59	8/18/61	14,699	Do.
Do.....	Kaliakh River Unit No. 2	NE1/4 sec 28, T 20 S, R 14 E.	6/14/60	8/30/60	9,575	Do.
Do.....	Kaliakh River Unit No. 2(RD).	NE1/4 sec 28, T 20 S, R 14 E.	9/1/60	9/17/61	12,135	Do.
Standard Oil Co. of California	Chaix Hills Unit No. 1.	2,200' N, 400' E of SW corner sec 4, T 22 S, R 25 E.	8/10/61	11/10/61	10,017	Do.
Do.....	Chaix Hills Unit 1A.	2,200' N, 400' E of SW corner sec 4, T 22 S, R 25 E.[3] 51' E, 1,434 W of NE corner sec 5, T 22 S, R 25 E.[4]	11/11/61	3/3/62	10,121	Do.
Do.....	Riou Bay No. 1.	1,600' S, 2,100' W of NE corner sec 26, T 23 S, R 23 E.	3/23/62	9/2/62	14,107	Do.

[1] Based on Copper River meridian.
[2] Now BP Alaska, Inc.
[3] Surface location.
[4] Bottom-hole location.
[5] Now Mobil Oil Corp.
[6] Now Atlantic Richfield Corp.

TABLE 16. - Analysis of water from Oil Creek

Sample From: Well _____ Stream X Seep _____ Other _____

Area Oil Creek Sampled by U.S. Bureau of Mines

Location Sec. 26 Date Sampled 7-74

T. 21 S., R. 18 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from Oil Creek about one-half mile upstream from beach.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	46	2.01	Carbonate	--	--
Potassium	3	0.08	Bicarbonate	98	1.61
Magnesium	5	0.41	Sulfate	56	1.16
Calcium	20	1.00	Sulfide	--	--
Iron	--	--	Chloride	26	0.73
			Hydroxide	--	--
Total Cation		3.50	Total Anion		3.50

Total Dissolved Solids, Mg/liter 204

Observed pH 7.6

Specific Resistance at 68°F. 39.7 ohm meters

TABLE 17. - Analysis of oil from Crooked Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Crooked Creek Sampled by U.S. Bureau of Mines

Location Sec. 35 Date Sampled 7-74

T. 21 S., R. 19 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from bitumen deposit surrounding oil seep.

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.927
A.P.I. gravity @ 60°F.	21.0
Saybolt Universal Viscosity @ 70°F., seconds	89.0
Saybolt Universal Viscosity @ 100°F., seconds	63.2
B. s. and water, % by volume	85
Pour point, °F.	-15
Total sulphur, % by weight	0.90

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	320	55	--
5	360	60	--
10	410	65	--
15	454	70	--
20	494	75	--
25	536	80	--
30	572	85	--
35	596	90	--
40	610	95	--
45	624	E.P.	--
50	630		

Approximate Recovery

300° E.P. gasoline, %	0	Recovery, %	50.0
392° E.P. gasoline, %	8.5	Residue, %	50.0
500° E.P. distillate, %	12.5	Loss, %	0

TABLE 18. - Analysis of gas from Crooked Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Crooked Creek Sampled by U.S. Bureau of Mines

Location Sec. 35 Date Sampled 7-74

T. 21 S., R. 19 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from gas seep on Crooked Creek.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

Special Results:

Analysis:

Methane	93.1 %	Normal Pentane	0.0 %	Oxygen	0.1 %
Ethane	2.0 %	Isopentane	0.1 %	Argon	Trace %
Propane	0.5 %	Cyclopentane	Trace %	Hydrogen	0.0 %
Normal Butane	Trace %	Hexanes Plus	Trace %	H2S	0.0 %
Isobutane	0.1 %	Nitrogen	0.7 %	CO2	3.3 %
				Helium	Trace %
			Total		99.9 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 1,000

Specific Gravity 0.608

TABLE 19. - Analyses of water from Crooked Creek

Sample From: Well _____ Stream X Seep _____ Other _____

Area Crooked Creek Sampled by U.S. Bureau of Mines

Location Sec. 35 Date Sampled 7-74

T. 21 S., R. 19 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from small stream which drains the seep area into Crooked Creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 3.2

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	139	6.05	Carbonate	--	--
Potassium	6	0.15	Bicarbonate	110	1.80
Magnesium	11	0.90	Sulfate	2	0.04
Calcium	71	3.54	Sulfide	--	--
Iron	--	--	Chloride	312	8.80
			Hydroxide	--	--
Total Cation		10.94	Total Anion		10.94

Total Dissolved Solids, Mg/liter 595

Observed pH 6.7

Specific Resistance at 68°F. 9.8 ohm meters

TABLE 19. - Analyses of water from Crooked Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Crooked Creek Sampled by U.S. Bureau of Mines

Location Sec. 35 Date Sampled 7-74

T. 21 S., R. 19 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained about 200 feet below where oil seep drainage drains into Crooked Creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 1.6

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	21	0.90	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	54	0.89
Magnesium	4	0.33	Sulfate	11	0.23
Calcium	8	0.40	Sulfide	--	--
Iron	--	--	Chloride	19	0.54
			Hydroxide	--	--
Total Cation		1.66	Total Anion		1.66

Total Dissolved Solids, Mg/liter 91

Observed pH 7.2

Specific Resistance at 68°F. 69.3 ohm meters

TABLE 19. - Analyses of water from Crooked Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Crooked Creek Sampled by U.S. Bureau of Mines

Location Sec. 2 Date Sampled 7-74

T. 22 S., R. 19 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from mouth of Crooked Creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - <0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	19	0.84	Carbonate	—	--
Potassium	1	0.03	Bicarbonate	37	0.61
Magnesium	2	0.16	Sulfate	9	0.19
Calcium	9	0.45	Sulfide	--	--
Iron	--	--	Chloride	24	0.68
			Hydroxide	--	--
Total Cation		1.48	Total Anion		1.48

Total Dissolved Solids, Mg/liter 82

Observed pH 7.1

Specific Resistance at 68°F. 73.8 ohm meters

Lawrence Creek

Numerous oil seeps, active and inactive, covering large and small areas, exist in a 600-foot area of talus rubble on the east side of Lawrence Creek about 1-1/2 miles upstream from the mouth of Lawrence Creek (fig. 5). Some seeps are highly active, and evidence indicates that oil continually runs into the creek. The sides of the creek and the creek banks downstream of the seeps are oily and a brown bitumen deposit can be detected in areas nearly to the mouth of the creek. Rainbow sheen can be detected on the water surface and in still pools for a considerable distance downstream of the seeps. This particular creek shows more evidence of oil seep and transportation than any other along the anticline between Cape Yakataga and Johnston Creek.

Samples of oil were taken at the seep. Samples of water from the seep area and downstream to the mouth of the creek were also obtained. Analyses of these oil and water samples are found in table 20-21.

Munday Creek

Two separate areas of oil and gas seeps were located on Munday Creek, one on the main creek and one on a fork of the creek feeding it from the east (fig. 5).

An oil and gas seep was located and sampled on the main creek about 2 miles upstream from the mouth. The seeps are on the west side of the creek. Several greenish-black oil pools were spread over a 50-foot area. There was no evidence of seeping oil while the area was being examined, but bubbles of gas were emerging over a 20-foot area. It was assumed that oil is being brought to the surface with the gas. Some pools of oil looked weathered, whereas other pools looked fresh. Analyses of the oil and gas samples appear in tables 22-23.

Further upstream, a feeder stream meets the main creek on the east side. Approximately one-fourth mile up this east fork of Munday Creek is a very active oil seep. Bubbles of oil emerge from the creekbed on the south edge of the creek. The oil appears green, and the bubbles occurred at a very steady rate of about one per 30 seconds. Enough oil was being transported down the creek to cause a rainbow sheen to be quite noticeable all along the route of the creek, even though the water is fast running and boils over rocks. The creek bottom is very slippery. After the water from this east fork of Munday Creek reaches the creek itself, the rainbow sheen disappears rapidly. Analyses of waters sampled at the seep and on Munday Creek are given in table 24.

An interesting aspect regarding the transportation of oil from seeps to the Gulf of Alaska by creeks is the fact that the only instance of actually observing oil on the beach of the Gulf was near the mouth of Munday Creek. On a particularly calm, sunny morning, a 6-inch-diameter oil sheen was spotted about 150 feet west of the mouth of Munday Creek. It could not be visually determined whether the oil was actually transported to the beach by the waters of Munday Creek.

TABLE 20. - Analysis of oil from Lawrence Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Lawrence Creek Sampled by U.S. Bureau of Mines

Location Sec. 32 Date Sampled 7-74

T. 21 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from seep on east side of Lawrence Creek about 1 1/2 miles upstream from mouth of Creek.

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9800
A.P.I. gravity @ 60°F.	12.9
Saybolt Universal Viscosity @ 70°F., seconds	1876
Saybolt Universal Viscosity @ 100°F., seconds	598
B. s. and water, % by volume	75
Pour point, °F.	-10
Total sulphur, % by weight	0.82

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	440	55	--
5	482	60	--
10	522	65	--
15	560	70	--
20	600	75	--
25	620	80	--
30	630	85	--
35	--	90	--
40	--	95	--
45	--	E.P.	--
50	--		

Approximate Recovery

300° E.P. gasoline, %	0	Recovery, %	30.5
392° E.P. gasoline, %	0	Residue, %	69.5
500° E.P. distillate, %	7.0	Loss, %	0

TABLE 21. - Analyses of water from Lawrence Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Lawrence Creek Sampled by U.S. Bureau of Mines

Location Sec. 32 Date Sampled 7-74

T. 21 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from small stream which drains the oil seep into Lawrence Creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 18.0

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	60	2.60	Carbonate	--	--
Potassium	3	0.08	Bicarbonate	183	3.00
Magnesium	3	0.25	Sulfate	4	0.08
Calcium	21	1.05	Sulfide	--	--
Iron	--	--	Chloride	32	0.90
			Hydroxide	--	--
Total Cation		3.98	Total Anion		3.98

Total Dissolved Solids, Mg/liter	213
Observed pH	7.8
Specific Resistance at 68°F.	33.0 ohm meters

TABLE 21. - Analyses of water from Lawrence Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Lawrence Creek Sampled by U.S. Bureau of Mines

Location Sec. 32 Date Sampled 7-74

T. 21 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained below the falls on Lawrence Creek downstream of the seep.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 1.6

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	14	0.63	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	49	0.80
Magnesium	2	0.16	Sulfate	14	0.29
Calcium	11	0.55	Sulfide	--	--
Iron	--	--	Chloride	10	0.28
			Hydroxide	--	--
Total Cation		1.37	Total Anion		1.37

Total Dissolved Solids, Mg/liter 76

Observed pH 7.4

Specific Resistance, at 68°F. 104.0 ohm meters

TABLE 21. - Analyses of water from Lawrence Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Lawrence Creek Sampled by U.S. Bureau of Mines

Location Sec. 8 Date Sampled 7-74

T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained at mouth of Lawrence Creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	12	0.53	Carbonate	--	--
Potassium	2	0.05	Bicarbonate	49	0.80
Magnesium	3	0.25	Sulfate	12	0.25
Calcium	10	0.50	Sulfide	--	--
Iron	--	--	Chloride	10	0.28
			Hydroxide	--	--
Total Cation		1.33	Total Anion		1.33

Total Dissolved Solids, Mg/liter 73

Observed pH 7.5

Specific Resistance at 68°F. 84.7 ohm meters

TABLE 22. - Analysis of oil from Munday Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Munday Creek Sampled by U.S. Bureau of Mines

Location W 1/2, Sec. 2 Date Sampled 8-73

T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from seep area located on west bank of Munday Creek about 2 miles upstream of mouth of Munday Creek.

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60°F.	0.9515
A.P.I. gravity @ 60°F.	17.2
Saybolt Universal Viscosity @ 70°F., seconds	188
Saybolt Universal Viscosity @ 100°F., seconds	108
B. s. and water, % by volume	68
Pour point, °F.	-15
Total sulphur, % by weight	0.96

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	390	55	620
5	420	60	--
10	445	65	--
15	470	70	--
20	490	75	--
25	514	80	--
30	534	85	--
35	556	90	--
40	568	95	--
45	590	E.P.	--
50	610		

Approximate Recovery

300° E.P. gasoline, %	0	Recovery, %	63.0
392° E.P. gasoline, %	0.5	Residue, %	37.0
500° E.P. distillate, %	21.5	Loss, %	0

TABLE 23. - Analysis of gas from Munday Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Munday Creek Sampled by U.S. Bureau of Mines

Location W 1/2, Sec. 2 Date Sampled 8-73

T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from seep area located on west bank of Munday Creek about 2 miles upstream of mouth of Munday Creek.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

Special Results:

Analysis:

Methane	96.4 %	Normal Pentane	0.0 %	Oxygen	Trace %
Ethane	0.7 %	Isopentane	0.0 %	Argon	Trace %
Propane	Trace %	Cyclopentane	0.0 %	Hydrogen	0.0 %
Normal Butane	0.0 %	Hexanes Plus	0.0 %	H2S	0.0 %
Isobutane	0.0 %	Nitrogen	1.2 %	CO2	1.6 %
				Helium	Trace %
			Total		99.9 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 989

Specific Gravity 0.578

TABLE 24. - Analyses of water from Munday Creek

Sample From: Well _____ Stream X Seep _____ Other _____

Area Munday Creek Sampled by U.S. Bureau of Mines

Location W 1/2, Sec. 2 Date Sampled 8-73
T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained about 100 feet downstream from where seep on Munday Creek drains into Munday Creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 3.7

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	47	2.03	Carbonate	--	--
Potassium	2	0.05	Bicarbonate	98	1.61
Magnesium	4	0.33	Sulfate	3	0.06
Calcium	19	0.95	Sulfide	--	--
Iron	--	--	Chloride	60	1.69
			Hydroxide	--	--
Total Cation		3.36	Total Anion		3.36

Total Dissolved Solids, Mg/liter 183

Observed pH 6.8

Specific Resistance at 68°F. 32.6 ohm meters

TABLE 24. - Analyses of water from Munday Creek--Continued

Sample From: Well _____ Stream X Seep X Other _____

Area Munday Creek Sampled by U.S. Bureau of Mines

Location Sec. 2 Date Sampled 7-74

T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from oil seep on the east fork stream of Munday Creek.

Analysis; Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 1,336

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	12	0.53	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	48	0.79
Magnesium	2	0.16	Sulfate	7	0.15
Calcium	9	0.45	Sulfide	--	--
Iron	--	--	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		1.17	Total Anion		1.17

Total Dissolved Solids, Mg/liter 63

Observed pH 7.0

Specific Resistance at 68°F. 114.0 ohm meters

TABLE 24. - Analyses of water from Munday Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Munday Creek Sampled by U.S. Bureau of Mines

Location Sec. 2 Date Sampled 7-74

T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained at mouth of east fork of Munday Creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	16	0.68	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	49	0.80
Magnesium	2	0.16	Sulfate	9	0.19
Calcium	8	0.40	Sulfide	--	--
Iron	--	--	Chloride	10	0.28
			Hydroxide	--	--
Total Cation		1.27	Total Anion		1.27

Total Dissolved Solids, Mg/liter 70

Observed pH 7.2

Specific Resistance at 68°F. 118.0 ohm meters

TABLE 24. - Analyses of water from Munday Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Munday Creek Sampled by U.S. Bureau of Mines

Location Sec. 14 Date Sampled 7-74

T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from mouth of Munday Creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results :

Oil Content, mg/l - 0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	44	1.93	Carbonate	--	--
Potassium	12	0.31	Bicarbonate	73	1.20
Magnesium	4	0.33	Sulfate	36	0.75
Calcium	17	0.85	Sulfide	--	--
Iron	--	--	Chloride	52	1.47
			Hydroxide	--	--
Total Cation		3.42	Total Anion		3.42

Total Dissolved Solids, Mg/liter 201

Observed pH 7.2

Specific Resistance at 68°F. 34.0 ohm meters

Poul Creek

Poul Creek contains numerous oil seeps in an area approximately 1-3/4 miles upstream from the mouth of the creek (fig. 5). The seeps discharge light-green oil directly into the creek at the water's edge. No gas seeps were observed. Analyses of oil and water from Poul Creek are given in tables 25-26.

Johnston Creek

Johnston Creek is a glacier-silt-laden, fast-running, turbulent stream. The creek is narrow and in some places about hip deep. It can be crossed on foot, but water velocity and depth make the crossing risky. Stream flow during the summer months is dependent on precipitation.

There are two areas of seeps on Johnston Creek (fig. 5). One area is located approximately 1-1/2 miles upstream from the mouth of Johnston Creek on the west side of the creekbed. This particular seep area is one of the more spectacular ones, in terms of the volume of oil apparently being transmitted to the Gulf of Alaska. The area is located in a marshy pond about 16 feet above the creek on the west bluff. There are actually two ponds and meadows; the upper pond is about 5 feet higher than the lower pond, and drains into it. The upper pond contains active gas seeps as well as oil seeps. The lower pond is characterized by deep pools of water covered with an oily froth. It is difficult to determine the exact location of the oil seeps because of the deep pools of water as well as the lush growth of grass and other vegetation. However, at the upper part of the lower pool is an area where water is emanating from the ground, and this area appears to have fresh standing oil pools. These oil pools are surrounded by large trees and skunkcabbage fronds. The earth is tarry and oily all around, yet it supports a substantial growth of wild blueberries and other vegetation. The water and oil from both ponds drain into Johnston Creek.

The lower pond is about 200 feet by 100 feet with innumerable areas of seepage, but the main seepage area seems to be near the head of the pond. The upper area is about 100 feet from the lower area. The area covers about 1 acre. Innumerable pot holes were seeping gas, and probably oil. The gas was combustible, but would not sustain a flame. It was impossible to tell how much oil was actually flowing.

For several hundred feet downstream from where the seep oil enters the main channel of Johnston Creek, the rocks of the creekbed are covered with a thick layer of light-brown paraffin and a cover of black oil. In areas where the flow of water is abated, spectacular rainbow-colored sheens are found. Sometimes a paraffin residue froth is collected between rocks and twigs in slow-moving pools of water.

TABLE 25. - Analysis of oil from Poul Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Poul Creek Sampled by U.S. Bureau of Mines

Location Sec. 4 Date Sampled 7-74

T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from seep on Poul Creek.

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9051
A.P.I. gravity @ 60°F.	24.8
Saybolt Universal Viscosity @ 70°F., seconds	57.1
Saybolt Universal Viscosity @ 100°F., seconds	48.7
B. s. and water, % by volume	70
Pour point, °F.	-20
Total sulphur, % by weight	0.68

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	302	55	634
5	340	60	--
10	380	65	--
15	410	70	--
20	444	75	--
25	476	80	--
30	508	85	--
35	550	90	--
40	590	95	--
45	610	E.P.	--
50	622		

Approximate Recovery

300° E.P. gasoline, %	0	Recovery, %	55.5
392° E.P. gasoline, %	12.0	Residue, %	44.5
500° E.P. distillate, %	17.0	Loss, %	0

TABLE 26. - Analyses of water from Poul Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Poul Creek Sampled by U.S. Bureau of Mines

Location Sec. 4 Date Sampled 7-74

T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from oil seep on Poul Creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 114,800

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	78	3.41	Carbonate	--	--
Potassium	7	0.18	Bicarbonate	256	4.20
Magnesium	10	0.82	Sulfate	50	1.04
Calcium	29	1.45	Sulfide	--	--
Iron	--	--	Chloride	22	0.62
			Hydroxide	--	--
Total Cation		5.86	Total Anion		5.86

Total Dissolved Solids, Mg/liter 322

Observed pH 7.7

Specific Resistance at 68°F. 21.3 ohm meters

TABLE 26. - Analyses of water from Poul Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Poul Creek Sampled by U.S. Bureau of Mines

Location Sec. 4 Date Sampled 7-74

T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained about 200 feet downstream of Poul Creek seep.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 8.3

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	20	0.85	Carbonate	--	--
Potassium	2	0.05	Bicarbonate	49	0.80
Magnesium	2	0.16	Sulfate	23	0.48
Calcium	10	0.50	Sulfide	--	--
Iron	--	--	Chloride	10	0.28
			Hydroxide	--	--
Total Cation		1.56	Total Anion		1.56

Total Dissolved Solids, Mg/liter 91

Observed pH 6.9

Specific Resistance at 68°F. 75.0 ohm meters

TABLE 26. - Analyses of water from Poul Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Poul Creek Sampled by U.S. Bureau of Mines

Location Sec. 9 Date Sampled 7-74

T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from mouth of Poul Creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	15	0.67	Carbonate	--	--
Potassium	3	0.08	Bicarbonate	49	0.80
Magnesium	3	0.25	Sulfate	22	0.46
Calcium	13	0.65	Sulfide	--	--
Iron	--	--	Chloride	14	0.39
			Hydroxide	--	--
Total Cation		1.65	Total Anion		1.65

Total Dissolved Solids, Mg/liter 94

Observed pH 7.1

Specific Resistance at 68°F. 77.0 ohm meters

It is quite evident that the amount of seep oil that reaches the water of the Gulf of Alaska is dependent on the amount of precipitation. On one occasion during particularly rainy and windy weather, an inspection at the mouth of the creek revealed higher-than-normal water flow coming down the creek. A pearl-gray sheen was observed on the surface of the muddy glacier water although the flow was rapid and turbulent. In ponds of still water near the edge of the stream, an oily, rainbow-colored sheen was detected. Small twigs and plant parts were oil covered. Although the wind was blowing and gusting, a kerosene odor was prevalent. On another occasion, during a particularly dry and calm spell, no evidence of oil could be detected in the creek. No pearly sheen was observed, and very little evidence of oil could be detected in still pools of water. Occasionally, a rainbow sheen could be formed by stirring up sand in quiet pools of water. Seals were observed in the mouth of Johnston Creek on several occasions, during both stormy periods and fair weather. Analyses of oil and water from the lower seep area are found in tables 27-28.

Directly across the creek from the seep area on the east bank of the river is an old dry-hole exploratory well that was drilled in 1927. The well was undoubtedly drilled on the basis of seeps. Water could be observed about 2 feet below the top of the open 6-inch tubing. Gas was bubbling up through the water. A water sample from the well was obtained and analyzed (table 29). An attempt was then made to raise the water level so a gas sample could be obtained, but several gallons of water were poured into the tubing without effectively raising the fluid level.

Other seeps were located on Johnston Creek about one-fourth mile upstream from the abandoned well. The seep is on the west bank of the creek about 20 feet from the creekbed proper. This seep also had oil and gas seeping in several different spots. Analyses of oil, gas, and water from these areas are given in tables 30-33.

Other Areas

Additional drainages and creeks were investigated for oil and/or gas seeps. Included in these were Little River, Yakataga River, White River, Felton Creek, and Duktoth River. No seeps were located. Samples of water were obtained from these creeks. Since analyses of these waters do not show significant oil content, they were not included in this report.

A vigorous gas seep was observed in the middle of a deep mountain lake called Hanna Lake (T 19 S, R 13 E, Copper River Meridian). No sample was obtained owing to inadequate access equipment.

TABLE 27. - Analysis of oil from lower seep of Johnston Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Johnston Creek Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 7 Date Sampled 8-73

T. 22 S., R. 21 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from the west end of the lower seep pond above Johnston Creek (Lower Seep Area).

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9631
A.P.I. gravity @ 60°F.	15.4
Saybolt Universal Viscosity @ 70°F., seconds	733
Saybolt Universal Viscosity @ 100°F., seconds	613
B. s. and water, % by volume	50
Pour point, °F.	-15
Total sulphur, % by weight	0.73

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	360	55	641
5	444	60	--
10	488	65	--
15	520	70	--
20	544	75	--
25	562	80	--
30	582	85	--
35	600	90	--
40	614	95	--
45	626	E.P.	--
50	638		

Approximate Recovery

300° E.P. gasoline, %	0	Recovery, %	56.0
392° E.P. gasoline, %	2	Residue, %	44.0
500° E.P. distillate, %	10	Loss, %	0

TABLE 28. - Analyses of water from lower seep of Johnston Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Johnston Creek Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 7 Date Sampled 7-73

T. 22 S., R. 21 E., (CRM)
Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from seep pond at spillout point at the top of the falls. (Johnston Creek Lower Seep)

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 2,341

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	25	1.09	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	88	1.44
Magnesium	4	0.33	Sulfate	10	0.21
Calcium	13	0.65	Sulfide	--	--
Iron	--	--	Chloride	16	0.45
			Hydroxide	--	--
Total Cation		2.10	Total Anion		2.10

Total Dissolved Solids, Mg/liter 162

Observed pH 6.7

Specific Resistance at 68°F. 55.7 ohm meters

TABLE 28. - Analyses of water from lower seep of Johnston Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Johnston Creek Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 7 Date Sampled 8-73

T. 12 S., R. 21 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from small stream draining into Johnston Creek from seep pond.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 92.0

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	20	0.87	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	62	1.02
Magnesium	3	0.25	Sulfate	3	0.06
Calcium	11	0.55	Sulfide	--	--
Iron	--	--	Chloride	22	0.62
			Hydroxide	--	--
Total Cation		1.70	Total Anion		1.70

Total Dissolved Solids, Mg/liter 91

Observed pH 7.2

Specific Resistance at 68°F. 68.0 ohm meters

TABLE 28. - Analyses of water from lower seep of Johnston Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Johnston Creek _____ Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 13 _____ Date Sampled 8-73 _____

T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier _____

Pertinent Data Regarding Sample:

Sample obtained from Johnston Creek about 300 yards upstream from mouth.

Analysis: Performed by Commercial Firm _____

Provided by _____

Special Results:

Oil Content, mg/l - 1.0

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	14	0.61	Carbonate	--	--
Potassium	2	0.05	Bicarbonate	43	0.71
Magnesium	1	0.08	Sulfate	11	0.23
Calcium	9	0.45	Sulfide	--	--
Iron	--	--	Chloride	9	0.25
			Hydroxide	--	--
Total Cation		1.19	Total Anion		1.19

Total Dissolved Solids, Mg/liter 67

Observed pH 6.9

Specific Resistance at 68°F. 82 ohm meters

TABLE 29. - Analysis of water from Johnston Creek well

Sample From: Well X Stream _____ Seep _____ Other _____

Area Johnston Creek Sampled by U.S. Bureau of Mines

Location Sec. 7 Date Sampled 7-74

T. 22 S., R. 21 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from old abandoned exploratory well on Johnston Creek. (Sullivan No. 1 - 1927)

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 129,400

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	5093	211.52	Carbonate	--	--
Potassium	147	3.76	Bicarbonate	769	12.61
Magnesium	727	59.76	Sulfate	Trace	--
Calcium	1322	65.97	Sulfide	--	--
Iron	--	--	Chloride	12,000	338.40
			Hydroxide	--	--
Total Cation		351.01	Total Anion		351.01

Total Dissolved Solids, Mg/liter 19,668

Observed pH 6.8

Specific Resistance at 68°F. 0.35 ohm meters

TABLE 30. - Analysis of water from Johnston Creek

Sample From: Well _____ Stream X Seep _____ Other _____

Area Johnston Creek Sampled by U.S. Bureau of Mines

Location Sec. 13 Date Sampled 8-73

T. 22 S., R. 20 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from mouth of Johnston Creek

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	27	1.16	Carbonate	--	--
Potassium	6	0.15	Bicarbonate	49	0.80
Magnesium	2	0.16	Sulfate	18	0.37
Calcium	11	0.55	Sulfide	--	--
Iron	--	--	Chloride	30	0.85
			Hydroxide	--	--
Total Cation		2.02	Total Anion		2.02

Total Dissolved Solids, Mg/liter 118

Observed pH 7.1

Specific Resistance at 68°F. 56.8 ohm meters

TABLE 31. - Analysis of oil from upper seep of Johnston Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Johnston Creek Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 7 Date Sampled 7-74

T. 22 S., R. 21 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from upper seep area on Johnston Creek.

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9401
A.P.I. gravity @ 60°F.	19.0
Saybolt Universal Viscosity @ 70°F., seconds	163
Saybolt Universal Viscosity @ 100°F., seconds	94.7
B. s. and water, % by volume	57
Pour point, °F.	-10
Total sulphur, % by weight	0.70

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	350	55	626
5	372	60	--
10	414	65	--
15	442	70	--
20	472	75	--
25	504	80	--
30	542	85	--
35	572	90	--
40	594	95	--
45	610	E.P.	--
50	620		

Approximate Recovery

300° E.P. gasoline, %	0	Recovery, %	55.5
392° E.P. gasoline, %	7.0	Residue, %	44.5
500° E.P. distillate, %	17.0	Loss, %	0

TABLE 32. - Analyses of gas from upper seep of Johnston Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Johnston Creek Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 7 Date Sampled 7-74
T. 22 S., R. 21 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from upper seep area on Johnston Creek.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

Special Results:

Analysis:

Methane	84.1 %	Normal Pentane	Trace %	Oxygen	1.3 %
Ethane	0.5 %	Isopentane	0.0 %	Argon	0.1 %
Propane	0.1 %	Cyclopentane	Trace %	Hydrogen	Trace %
Normal Butane	Trace %	Hexanes Plus	Trace %	H2S	0.0 %
Isobutane	Trace %	Nitrogen	5.9 %	CO2	8.0 %
				Helium	Trace %
			Total		100.0 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 863

Specific Gravity 0.668

TABLE 32. - Analyses of gas from upper seep of Johnston Creek--Continued

Sample From: Well _____ Stream _____ Seep X Other _____

Area Johnston Creek Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 7 Date Sampled 7-74
T. 22 S., R. 21 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from upper seep area on Johnston Creek.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

Special Results:

Analysis:

Methane	96.0 %	Normal Pentane	0.0 %	Oxygen	0.0 %
Ethane	Trace %	Isopentane	0.0 %	Argon	Trace %
Propane	Trace %	Cyclopentane	0.0 %	Hydrogen	Trace %
Normal Butane	0.0 %	Hexanes Plus	0.0 %	H2S	0.0 %
Isobutane	0.0 %	Nitrogen	2.0 %	CO2	1.9 %
				Helium	Trace %
			Total		99.9 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 972

Specific Gravity 0.581

TABLE 33. - Analyses of water from upper seep of Johnston Creek

Sample From: Well _____ Stream _____ Seep X Other _____

Area Johnston Creek Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 7 Date Sampled 7-74

T. 22 S., R. 21 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from oil seep pond at upper seep area on Johnston Creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 246,000

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	179	7.77	Carbonate	--	—
Potassium	10	0.26	Bicarbonate	207	3.39
Magnesium	10	0.82	Sulfate	20	0.42
Calcium	74	3.70	Sulfide	--	—
Iron	--	--	Chloride	310	8.74
			Hydroxide	--	--
Total Cation		12.55	Total Anion		12.55

Total Dissolved Solids, Mg/liter 705

Observed pH 6.8

Specific Resistance at 68°F. 8.5 ohm meters

TABLE 33. - Analyses of water from upper seep of Johnston Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Johnston Creek Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 7 Date Sampled 7-74
T. 22 S., R. 21 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from drainage stream draining seep area into Johnston Creek. (Upper area)

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 8.5

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	17	0.75	Carbonate	--	--
Potassium	2	0.05	Bicarbonate	24	0.39
Magnesium	1	0.08	Sulfate	2	0.04
Calcium	8	0.40	Sulfide	--	--
Iron	--	--	Chloride	30	0.85
			Hydroxide	--	--
Total Cation		1.28	Total Anion		1.28

Total Dissolved Solids, Mg/liter 72

Observed pH 6.9

Specific Resistance at 68°F. 110.0 ohm meters

TABLE 33. - Analyses of water from upper seep of Johnston Creek--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Johnston Creek Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 7 Date Sampled 7-74
T. 22 S., R. 21 E., (CRM)

Quadrangle Bering Glacier

Pertinent Data Regarding Sample:

Sample obtained from Johnston Creek (Upper seep) about 100 feet below where upper seep drains into creek.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 1.6

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	247	10.74	Carbonate	--	--
Potassium	8	0.21	Bicarbonate	268	4.40
Magnesium	12	0.99	Sulfate	Trace	--
Calcium	75	3.74	Sulfide	--	--
Iron	--	--	Chloride	400	11.28
			Hydroxide	--	--
Total Cation		15.68	Total Anion		15.68

Total Dissolved Solids, Mg/liter 874

Observed pH 7.0

Specific Resistance at 68°F. 7.2 ohm meters

OILY LAKE

Active oil, gas, oil-water, and gas-water seeps were investigated in an area known as Oily Lake at the head of Malaspina Glacier. Oily Lake, bounded on the south by the Malaspina Glacier and on the north by the Samovar Hills, was not recognized by the U.S. Geological Survey until 1959. It is identified in the 1959 edition of the Mount Saint Elias quadrangle topographic map as the body of water that was apparently backed up by the Malaspina Glacier onto the Samovar Hills. During the field investigations of 1973 and 1974, the lake was dry, exposing a well-defined lakebed. The U.S. Geological Survey surmises that the lake is relatively new or intermittent. The latest it was known to exist was 1963. It is surmised that the great Alaska earthquake of March 1964 caused the lake to "dump."

Hydrocarbon Exploration

There has been unsuccessful exploratory oil-gas drilling on the forelands of the foot of the Malaspina Glacier in the vicinity of the Samovar Hills and Oily Lake. The drilling closest to the seeps at Oily Lake took place approximately 15 miles to the southwest along the south face of the Chaix Hills. Here Standard Oil Co. of California drilled the Chaix Hill Unit No. 1 to a depth of 10,017 feet, plugged back to 1,500 feet, and directionally drilled the Chaix Hill Unit 1-A to a depth of 10,121 feet. The well was eventually plugged as a dry hole. This exploration took place during the last part of 1961 and the first quarter of 1962. Both wells can be located in the Bering Glacier quadrangle.[8]

Another well in the general vicinity of the Samovar Hills-Oily Lake area is the Riou Bay No. 1 well, which was drilled as a dry hole in 1962 by Standard Oil Co. of California. Hydrocarbons were encountered in that well, but reservoir characteristics precluded commercial production. About 36 miles to the southeast, on the forelands of the Malaspina Glacier and bordering Yakutat Bay, Colorado Oil and Gas Co. drilled the Malaspina Unit No. 1 and the Malaspina Unit No. 1-A in 1962. The No. 1 unit was a shallow hole and was abandoned at 1,800 feet. The Unit 1-A was drilled to a depth of 13,823 feet before it was plugged and abandoned. These wells can be located in the Yakutat, Alaska-Canada quadrangles.

Seeps

A well-defined seepage area consisting of several oil and gas seeps was observed at the north limit of Oily Lake near the shoreline on the Samovar Hills and at the lake bottom near the banks of the Samovar Hills (fig. 6). The approximate geographical location of these series of seeps is in the

[8] U.S. Bureau of Mines. Alaska 1/250,000 Scale Quadrangle Map Overlays Showing Exploratory Oil and Gas Well Drilling Locations and Productive Oil--and Gasfield Locations. BuMines OFR 69-73, 1973, 87 overlays; available for examination at Bureau of Mines offices in Juneau and Anchorage, Alaska, and at the Office of Wilderness and River Basins, Washington, D.C.

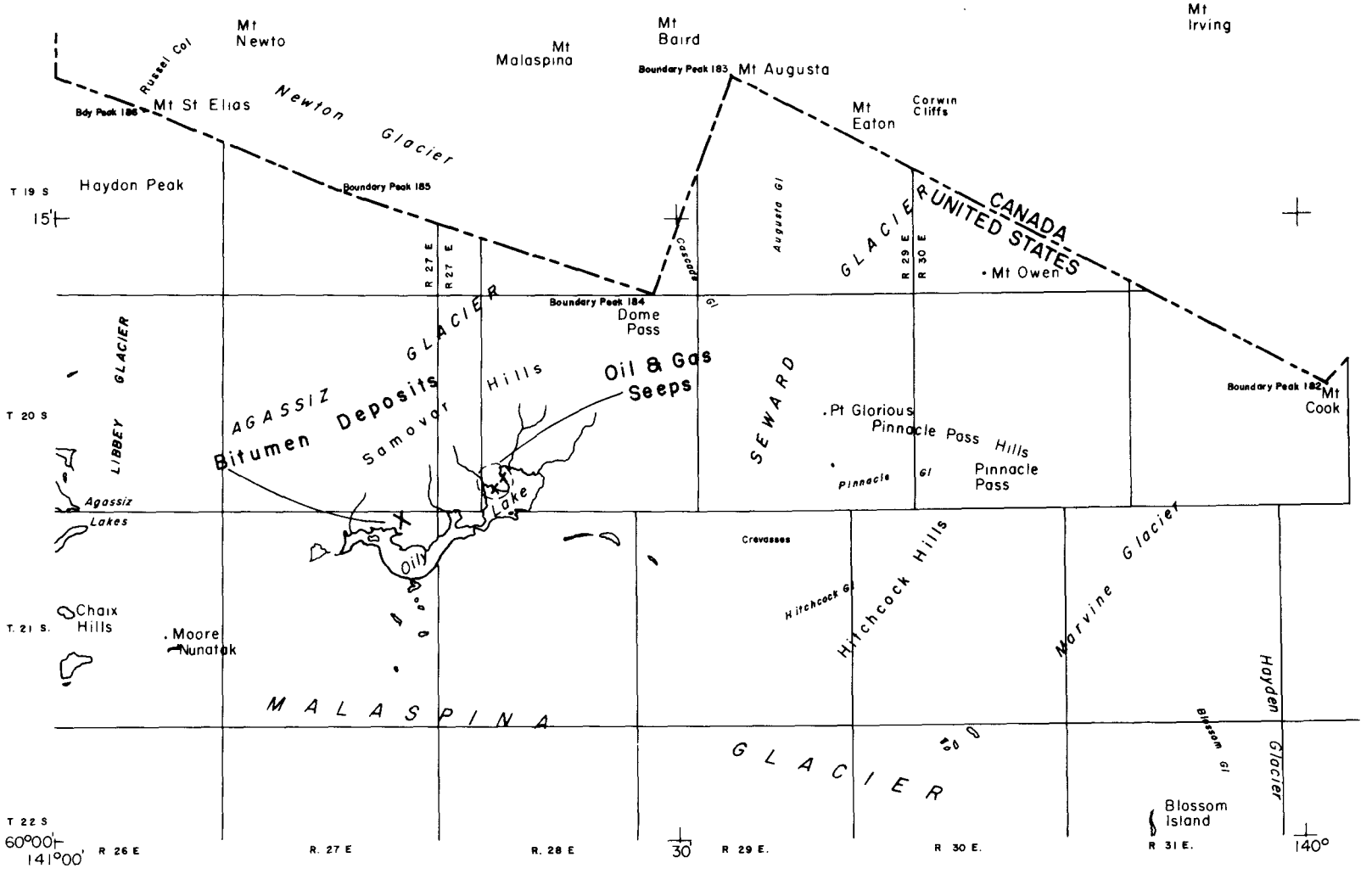


FIGURE 6. - Oily Lake (adapted from the U.S. Geological Survey map of the Mt. St. Elias quadrangle).

portions of secs 29-32, T 20 S, R 28 E, Copper River Meridian. During the first visit to the area, several pools of free-standing oil were noted on the lakebed. Small streams of water emanating from spring areas drained the general area. After a period of heavy rains, the general makeup of the drainage system was markedly different. Two previously noted oil pools had disappeared, but the dominant seeps were still identifiable. Two separate seeps were observed above what might have been the shoreline. Seeps trickle out of sandstone about 125 feet above the dry lakebed floor and trickle down the embankment into small streams that eventually disappear underneath the glacier. The trickle streams exhibit an oil sheen and are quite colorful.

Oil and gas seeps on the lakebed floor near the north shoreline of the lake were colorful and very active. Water draining from the seeps was exceptionally clear and exhibited an iridescent sheen and rainbow color even though the flow was ripply and rapid. A yellow paraffin oil floated on top of the water and accumulated in areas where the flow was less rapid or impeded. A yellow paraffin material was also deposited on the streambeds and collected on rocks and moss. Vigorous gas seeps were also in the area. Gas allowed to accumulate in an inverted funnel flamed to about 10 inches when lit.

The myriad of drainages from the seeps, springs, and other runoff formed little streams and rivulets and eventually joined, constituting a major stream on the lakebed floor. This stream then flowed southwest until it disappeared under the Malaspina Glacier. Analyses of oil, gas, and water from this area are found in tables 34-36.

Bitumen Deposits

Approximately 2 miles southwest of the seepage area near Oily Lake is another area of seeps, which has resulted in the deposition of tar or asphalt bitumen deposits on the surface of the hills (fig. 6).

This area is geographically located approximately in the northern portion of T 21 S, R 28 E, Copper River Meridian. Four large deposits occur at nearly the same horizontal elevation over a distance of about 1,000 feet. The largest of these was estimated to be 50 by 20 feet. Two others were about one-half that size, and one was only about 10 by 5 feet. The bitumen thickness ranges from 1 to 6 inches, and seems to average about 4 inches. Several smaller insignificant deposits surround the larger ones. These bitumen deposits cover the ground and spill over the sides of ravines. The bitumen is very colorful--rainbow colored. The deposits are quite discernible from the air.

Of particular note and quite evident from a distance from the air is that the seepage plane (that is, the "head" of top of the deposits) appears to coincide with what is probably a fault plane. This distinction is recognizable by a noticeable change in vegetation coloration. Growth of grass, skunk-cabbage, and small bushes partially obscure the location and existence of these seeps. Drainage out from and over these seeps all meet in a common stream before disappearing underneath the glacier.

TABLE 34. - Analyses of oil from Oily Lake

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location S 1/2, Sec. 29 Date Sampled 8-73

T. 20 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from oil residue floating on top of water pool from floor of Oily Lake.

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9707
A.P.I. gravity @ 60°F.	14.3
Saybolt Universal Viscosity @ 70°F., seconds	Not Determined
Saybolt Universal Viscosity @ 100°F., seconds	Not Determined
B. s. and water, % by volume	90
Pour point, °F.	Not Determined
Total sulphur, % by weight	1.08

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	400	55	--
5	460	60	--
10	510	65	--
15	550	70	--
20	584	75	--
25	614	80	--
30	638	85	--
35	648	90	--
40	650	95	--
45	--	E.P.	652
50	--		

Approximate Recovery

300° E.P. gasoline, %	0	Recovery, %	40.5
392° E.P. gasoline, %	0	Residue, %	59.5
500° E.P. distillate, %	9.5	Loss, %	0

TABLE 34. - Analyses of oil from Oily Lake--Continued

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location S 1/2, Sec. 29 Date Sampled 8-73

T. 20 S., R. 28 E., (CRM)

Ouadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from several small oil seep pools on floor of Oily Lake

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9679
A.P.I. gravity @ 60°F.	14.7
Saybolt Universal Viscosity @ 70°F., seconds	1026
Saybolt Universal Viscosity @ 100°F., seconds	413
B. s. and water, % by volume	22
Pour point, °F.	-10
Total sulphur, % by weight	1.31

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	242	55	--
5	400	60	--
10	492	65	--
15	530	70	--
20	568	75	--
25	598	80	--
30	620	85	--
35	636	90	--
40	644	95	--
45	--	E.P.	646
50	--		

Approximate Recovery

300° E.P. gasoline, %	1.0	Recovery, %	40.5
392° E.P. gasoline, %	4.0	Residue, %	59.5
500° E.P. distillate, %	6.5	Loss, %	0

TABLE 34. - Analyses of oil from Oily Lake--Continued

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location S 1/2, Sec. 31 Date Sampled 8-73
T. 20 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from seep emanating from sandstone above old lake shoreline.

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9716
A.P.I. gravity @ 60°F.	14.1
Saybolt Universal Viscosity @ 70°F., seconds	Not Determined
Saybolt Universal Viscosity @ 100°F., seconds	Not Determined
B. s. and water, % by volume	53
Pour point, °F.	-10
Total sulphur, % by weight	1.20

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	498	55	--
5	528	60	--
10	560	65	--
15	588	70	--
20	604	75	--
25	640	80	--
30	644	85	--
35	--	90	--
40	--	95	--
45	--	E.P.	646
50	--		

Approximate Recovery

300° E.P. gasoline, %	0	Recovery, %	42.0
392° E.P. gasoline, %	0	Residue, %	58.0
500° E.P. distillate, %	0	Loss, %	0

TABLE 34. - Analyses of oil from Oily Lake--Continued

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 31 Date Sampled 8-73

T. 20 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from seep emanating from rock formation above old lake shoreline.

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9665
A.P.I. gravity @ 60°F.	14.9
Saybolt Universal Viscosity @ 70°F., seconds	Not Determined
Saybolt Universal Viscosity @ 100°F., seconds	Not Determined
B. s. and water, % by volume	98
Pour point, °F.	-10
Total sulphur, % by weight	0.90

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	444	55	--
5	558	60	--
10	588	65	--
15	598	70	--
20	604	75	--
25	--	80	--
30	--	85	--
35	--	90	--
40	--	95	--
45	--	E.P.	--
50	--		

Approximate Recovery

300° E.P. gasoline, %	--	Recovery, %	22.0
392° E.P. gasoline, %	--	Residue, %	78.0
500° E.P. distillate, %	2	Loss, %	0

TABLE 35. - Analyses of gas from Oily Lake

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location S 1/2, Sec. 29 Date Sampled 8-73
T. 20 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from seep bubbling oil and gas to surface on floor of Oily Lake.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

Special Results:

Analysis:

Methane	74.3 %	Normal Pentane	0.0 %	Oxygen	2.3 %
Ethane	2.9 %	Isopentane	0.0 %	Argon	0.3 %
Propane	0.6 %	Cyclopentane	0.0 %	Hydrogen	0.0 %
Normal Butane	0.0 %	Hexanes Plus	0.0 %	H2S	0.0 %
Isobutane	0.0 %	Nitrogen	19.3 %	CO2	0.5 %
				Helium	Trace %
			Total		100.2 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 820

Specific Gravity 0.676

TABLE 35. - Analyses of gas from Oily Lake--Continued

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location Sec. 29 Date Sampled 8-73

T. 20 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from small gas seep on floor of Oily Lake.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

Special Results:

Analysis:

Methane	91.3 %	Normal Pentane	0.0 %	Oxygen	0.0 %
Ethane	0.1 %	Isopentane	0.0 %	Argon	0.1 %
Propane	Trace %	Cyclopentane	0.0 %	Hydrogen	0.0 %
Normal Butane	0.0 %	Hexanes Plus	0.0 %	H2S	0.0 %
Isobutane	0.0 %	Nitrogen	7.2 %	CO2	1.3 %
				Helium	Trace %
			Total		100.0 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 927

Specific Gravity 0.598

TABLE 36. - Analyses of water from Oily Lake

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location S 1/2, Sec. 29 Date Sampled 8-73

T. 20 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from seep bubbling oil and gas to surface on floor of Oily Lake.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 3.3

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	39	1.69	Carbonate	--	--
Potassium	1	0.03	Bicarbonate	207	3.39
Magnesium	9	0.74	Sulfate	4	0.08
Calcium	27	1.35	Sulfide	--	--
Iron	—	--	Chloride	12	0.34
			Hydroxide	--	--
Total Cation		3.81	Total Anion		3.81

Total Dissolved Solids, Mg/liter 194

Observed pH 7.7

Specific Resistance at 68°F. 35.6 ohm meters

TABLE 36. - Analyses of water from Oily Lake--Continued

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location S 1/2, Sec. 29 Date Sampled 8-73

T. 20 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from drainage about 50 feet downstream from oil seeps, Oily Lake lake bottom.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 50.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	36	1.55	Carbonate	--	--
Potassium	2	0.05	Bicarbonate	195	3.20
Magnesium	8	0.66	Sulfate	4	0.08
Calcium	26	1.30	Sulfide	--	--
Iron	--	--	Chloride	10	0.28
			Hydroxide	--	--
Total Cation		3.56	Total Anion		3.56

Total Dissolved Solids, Mg/liter 182

Observed pH 7.6

Specific Resistance at 68°F. 37.5 ohm meters

TABLE 36. - Analyses of water from Oily Lake--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location S 1/2, Sec. 31 Date Sampled 8-73

T. 20 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from small trickle stream about 100 feet downstream from oil seep above old shoreline.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 26.7

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	19	0.84	Carbonate	--	--
Potassium	2	0.05	Bicarbonate	146	2.39
Magnesium	13	1.07	Sulfate	17	0.35
Calcium	19	0.95	Sulfide	--	--
Iron	--	--	Chloride	6	0.17
			Hydroxide	--	--
Total Cation		2.91	Total Anion		2.91

Total Dissolved Solids, Mg/liter 148

Observed pH 7.2

Specific Resistance at 68°F. 44.0 ohm meters

TABLE 36. - Analyses of water from Oily Lake--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location S 1/2, Sec. 29 Date Sampled 8-73

T. 20 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from drainage of seeps on floor of Oily Lake bed about 200 yards downstream from seeps.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 4.4

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	42	1.84	Carbonate	--	--
Potassium	2	0.05	Bicarbonate	220	3.61
Magnesium	9	0.74	Sulfate	4	0.08
Calcium	28	1.40	Sulfide	--	--
Iron	--	--	Chloride	12	0.34
			Hydroxide	--	--
Total Cation		4.03	Total Anion		4.03

Total Dissolved Solids, Mg/liter 205

Observed pH 7.5

Specific Resistance at 68°F. 35.0 ohm meters

TABLE 36. - Analyses of water from Oily Lake--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 31 Date Sampled 8-73

T. 20 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from seep drainage stream about 200 feet upstream of its desappearance under Malaspina Glacier.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 10.0

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	17	0.76	Carbonate	--	--
Potassium	4	0.10	Bicarbonate	110	1.80
Magnesium	8	0.66	Sulfate	9	0.19
Calcium	15	0.75	Sulfide	--	--
Iron	--	--	Chloride	10	0.28
			Hydroxide	--	--
Total Cation		2.27	Total Anion		2.27

Total Dissolved Solids, Mg/liter 117

Observed pH 7.4

Specific Resistance at 68°F. 54.0 ohm meters

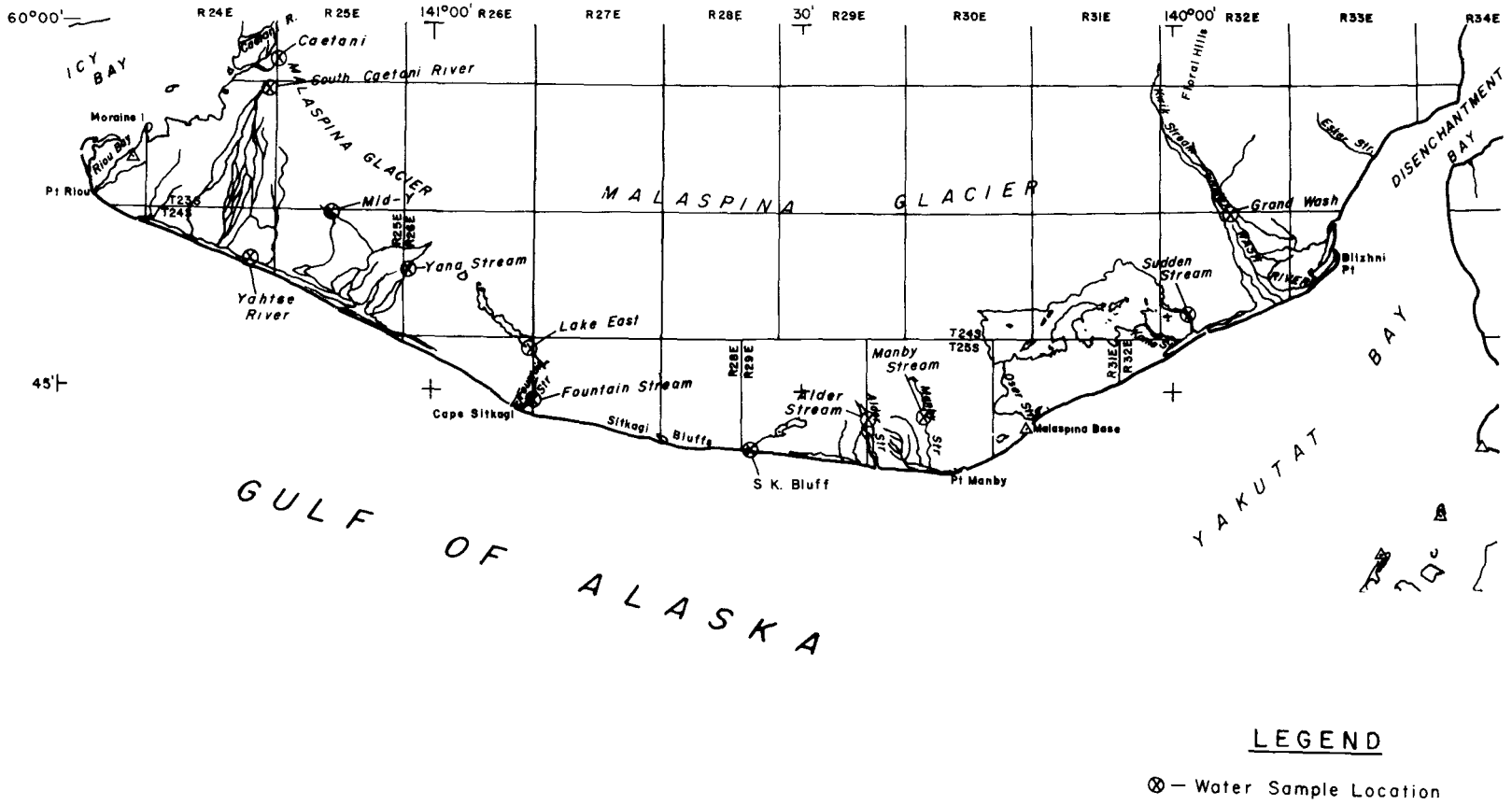


FIGURE 7. - Malaspina forelands (adapted from U.S. Geological Survey map of the Icy Bay and Yakutat quadrangle).

It is difficult to ascertain whether these seeps are active or inactive. During one visit when the weather was overcast and cool, no activity indicating that the seeps were active was noted. The bitumen was firm but malleable, and was able to support a man's weight without breaking through the weathered crust. At the head of the deposits, no seeps could be found. Water pools occurred on the surface of the deposits.

Another visit was made during unusually warm, dry weather. The appearance and behavior of the bitumen deposits varied remarkably from the previous visit. The bitumen was soft and viscous. Rivulets of oil continuously ran for short distances across the surface of the deposits. Footing was impossible; the weight of a man was enough to break through the surface. Oil appeared to be emanating from several spots near the head of the deposits. It was possible to obtain a sample of the bitumen by laying a bottle on its side and letting the fluid run directly into it. During the previous visit, samples were obtained by digging a chunk of the bitumen out with a shovel. The bitumen fluid obtained in a warm weather period has remained a fluid rather than solidifying again. Analyses of the bitumen and waters draining the bitumen appear in tables 37-38. No gas seeps were observed in the area.

Malaspina Forelands

The waters draining the oil and gas seeps of Oily Lake disappear underneath the Malaspina Glacier (fig. 7). Without establishing an elaborate tracer program, it is impossible to determine whether the water emerging from underneath the face of the glacier on the Malaspina forelands is made up of any water that originated in the Oily Lake seeps. However, samples of water were obtained from all of the major and discernible drainage emanating from the Malaspina Glacier from Icy Bay to Yakutat Bay. Analyses are found in table 39.

TABLE 37. - Analyses of bitumen from surface bitumen deposits, Oily Lake

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 6 Date Sampled 8-73
T. 21 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from surface deposit of bitumen near Oily Lake. Sample solid specimen.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	1.040
A.P.I. gravity @ 60°F.	4.6
Saybolt Universal Viscosity @ 70°F., seconds	Not Determined
Saybolt Universal Viscosity @ 100°F., seconds	Not Determined
B. s. and water, % by volume	Not Determined
Pour point, °F.	Not Determined
Total sulphur, % by weight	0.29
Nitrogen, %	0.50

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperatue, °F.
IBP		55	
5		60	
10		65	
15	NOT DETERMINED	70	
20		75	
25		80	NOT DETERMINED
30		85	
35		90	
40		95	
45		E.P.	
50			

Approximate Recovery

300° E.P. gasoline, %		Recovery, %	
392° E.P. gasoline, %		Residue, %	
500° E.P. distillate, %		Loss, %	

TABLE 37. - Analyses of bitumen from surface bitumen deposits, Oily Lake--Continued

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 6 Date Sampled 8-73

T. 21 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from surface deposit of bitumen near Oily Lake. Sample solid specimen.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	1.057
A.P.I. gravity @ 60°F.	2.4
Saybolt Universal Viscosity @ 70PF., seconds	Not Determined
Saybolt Universal Viscosity @ 100°F., seconds	Not Determined
B. s. and water, % by volume	Not Determined
Pour point, °F.	Not Determined
Total sulphur, % by weight	0.31
Nitrogen, %	0.73

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP		55	
5		60	
10		65	
15	NOT DETERMINED	70	
20		75	
25		80	NOT DETERMINED
30		85	
35		90	
40		95	
45		E.P.	
50			

Approximate Recovery

300° E.P. gasoline, %		Recovery, %	
392° E.P. gasoline, %		Residue, %	
500° E.P. distillate, %		Loss, %	

TABLE 37. - Analyses of bitumen from surface bitumen deposits, Oily Lake--Continued

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 6 Date Sampled 8-73

T. 21 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from surface deposit of bitumen near Oily Lake. Sample solid specimen.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	1.057
A.P.I. gravity @ 60°F.	2.4
Saybolt Universal Viscosity @ 70°F., seconds	Not Determined
Saybolt Universal Viscosity @ 100°F., seconds	Not Determined
B. s. and water, % by volume	Not Determined
Pour point, °F.	Not Determined
Total sulphur, % by weight	0.31
Nitrogen, %	0.73

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP		55	
5		60	
10		65	
15		70	
20	NOT DETERMINED	75	
25		80	
30		85	NOT DETERMINED
35		90	
40		95	
45		E.P.	
50			

Approximate Recovery

300° E.P. gasoline, %		Recovery, %	
392° E.P. gasoline, %		Residue, %	
500° E.P. distillate, %		Loss, %	

TABLE 37. - Analyses of bitumen from surface bitumen deposits, Oily Lake--Continued

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 6 Date Sampled 8-73
T. 21 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:
Sample obtained from surface deposit of bitumen near Oily Lake.
Sample solid specimen.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	1.031
A.P.I. gravity @ 60°F.	5.7
Saybolt Universal Viscosity @ 70°F., seconds	Not Determined
Saybolt Universal Viscosity @ 100°F., seconds	Not Determined
B. s. and water, % by volume	Not Determined
Pour point, °F.	Not Determined
Total sulphur, % by weight	0.28
Nitrogen, %	0.24

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP		55	
5		60	
10		65	
15		70	
20		75	
25	NOT DETERMINED	80	
30		85	NOT DETERMINED
35		90	
40		95	
45		E.P.	
50			

Approximate Recovery

300° E.P. gasoline, % _____ Recovery, % _____

TABLE 37. - Analyses of bitumen from surface bitumen deposits, Oily Lake--Continued

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 6 Date Sampled 8-73
T. 21 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:
Sample obtained from surface deposits of bitumen near Oily Lake. Sample solid specimen.

Analysis: Performed by Commercial Firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9686
A.P.I. gravity @ 60°F.	14.6
Saybolt Universal Viscosity @ 70°F., seconds	2525
Saybolt Universal Viscosity @ 100°F., seconds	730
B. s. and water, % by volume	51
Pour point, °F.	-10
Total sulphur, % by weight	0.72

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	438	55	--
5	478	60	--
10	520	65	--
15	554	70	--
20	584	75	--
25	616	80	--
30	--	85	--
35	--	90	--
40	--	95	--
45	--	E.P.	620
50	--		

Approximate Recovery

300° E.P. gasoline, %	_____	Recovery, %	_____
392° E.P. gasoline, %		Residue, %	

TABLE 37. - Analyses of bitumen from surface bitumen deposits, Oily Lake--Continued

Sample From: Well _____ Stream _____ Seep X Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 6 Date Sampled 7-74

T. 21 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from surface of bitumen deposit by setting bottle on side and allowing fluid to run in during period of warm weather. Sample obtained from approximate location of solid sample obtained at earlier date.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9801
A.P.I. gravity @ 60°F.	12.8
Saybolt Universal Viscosity @ 70°F., seconds	10,000 +
Saybolt Universal Viscosity @ 100°F., seconds	2,790
B. s. and water, % by volume	35
Pour point, °F.	-10
Total sulphur, % by weight	0.88

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	488	55	--
5	534	60	--
10	580	65	--
15	602	70	--
20	614	75	--
25	624	80	--
30	632	85	--
35	--	90	--
40	--	95	--
45	--	E.P.	--
50	--		

Approximate Recovery

300° E.P. gasoline, %	0	Recovery, %	30.0
392° E.P. gasoline, %	0	Residue, %	70.0
500° E.P. distillate, %	1.5	Loss, %	0-

TABLE 38. - Analyses of water from bitumen deposits, Oily Lake

Sample From: Well _____ Stream X Seep _____ Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 6 Date Sampled 8-73

T. 21 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from creek draining water from surface deposits of bitumen.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 119

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	68	2.96	Carbonate	--	--
Potassium	3	0.08	Bicarbonate	354	5.81
Magnesium	14	1.15	Sulfate	--	--
Calcium	37	1.85	Sulfide	Trace	--
Iron	--	--	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		6.04	Total Anion		6.04

Total Dissolved Solids, Mg/liter 304

Observed pH 7.4

Specific Resistance at 68° F. 22.5 ohm meters

TABLE 38. - Analyses of water from bitumen deposits, Oily Lake--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Oily Lake Sampled by U.S. Bureau of Mines

Location N 1/2, Sec. 6 Date Sampled 7-74
T. 21 S., R. 28 E., (CRM)

Quadrangle Mt. St. Elias

Pertinent Data Regarding Sample:

Sample obtained from stream draining bitumen deposits.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 4.2

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	55	2.41	Carbonate	--	--
Potassium	3	0.08	Bicarbonate	183	3.00
Magnesium	10	0.82	Sulfate	12	0.25
Calcium	18	0.90	Sulfide	--	--
Iron	--	--	Chloride	34	0.96
			Hydroxide	--	--
Total Cation		4.21	Total Anion		4.21

Total Dissolved Solids, Mg/liter 222

Observed pH 7.9

Specific Resistance at 68°F. 35.0 ohm meters

TABLE 39. - Analyses of water from Malaspina forelands

Sample From: Well _____ Stream X Seep _____ Other _____

Area Malaspina Forelands Sampled by U.S. Bureau of Mines

Location Sec. 36 Date Sampled 7-74

T. 22 S., R. 24 E., (CRM)

Quadrangle Icy Bay

Pertinent Data Regarding Sample:

Sample obtained from Caetani River approximately 3/4 mile from face of Malaspina Glacier.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.2

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	17	0.73	Carbonate	--	--
Potassium	6	0.15	Bicarbonate	78	1.28
Magnesium	4	0.33	Sulfate	7	0.15
Calcium	10	0.50	Sulfide	--	--
Iron	--	--	Chloride	10	0.28
			Hydroxide	--	--
Total Cation		1.71	Total Anion		1.71

Total Dissolved Solids, Mg/liter 92

Observed pH 7.4

Specific Resistance at 68°F. 80.0 ohm meters

TABLE 39. - Analyses of water from Malaspina forelands--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Malaspina Forelands Sampled by U.S. Bureau of Mines

Location Sec. 1 Date Sampled 7-74

T. 23 S., R. 24 E., (CRM)

Quadrangle Icy Bay

Pertinent Data Regarding Sample:

Sample obtained near Malaspina Glacier, 3 miles south of the Caetani River. (South Caetani River)

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - NOT DETERMINED

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	17	0.74	Carbonate	--	--
Potassium	3	0.08	Bicarbonate	37	0.61
Magnesium	1	0.08	Sulfate	19	0.40
Calcium	5	0.25	Sulfide	--	--
Iron	--	--	Chloride	5	0.14
			Hydroxide	--	--
Total Cation		1.15	Total Anion		1.15

Total Dissolved Solids, Mg/liter 68

Observed pH 7.4

Specific Resistance at 68°F. 191.0 ohm meters

TABLE 39. - Analyses of water from Malaspina forelands--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Malaspina Forelands Sampled by U.S. Bureau of Mines

Location Sec. 4 Date Sampled 7-74

T. 24 S., R. 25 E., (CRM)

Quadrangle Icy Bay

Pertinent Data Regarding Sample:

Sample obtained about 1/2 mile from Malaspina Glacier from unnamed Creek. (Mid-Y)

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.2

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	7	0.31	Carbonate	--	--
Potassium	3	0.08	Bicarbonate	37	0.61
Magnesium	1	0.08	Sulfate	Trace	--
Calcium	5	0.25	Sulfide	--	--
Iron	--	--	Chloride	4	0.11
			Hydroxide	--	--
Total Cation		0.72	Total Anion		0.72

Total Dissolved Solids, Mg/liter 38

Observed pH 7.6

Specific Resistance at 68°F. 220.0 ohm meters

TABLE 39. - Analyses of water from Malaspina forelands--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Malaspina Forelands Sampled by U.S. Bureau of Mines

Location Sec. 13 Date Sampled 7-74

T. 24 S., R. 24 E., (CRM)

Quadrangle Icy Bay

Pertinent Data Regarding Sample:

Sample obtained from Yahtse River about 6 miles upstream from the mouth.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/1 - 0.4

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	9	0.39	Carbonate	--	--
Potassium	5	0.13	Bicarbonate	49	0.80
Magnesium	2	0.16	Sulfate	3	0.06
Calcium	7	0.35	Sulfide	--	--
Iron	--	--	Chloride	6	0.17
			Hydroxide	--	--
Total Cation		1.03	Total Anion		1.03

Total Dissolved Solids, Mg/liter 56

Observed pH 7.4

Specific Resistance at 68°F. 134 ohm meters

TABLE 39. - Analyses of water from Malaspina forelands--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Malaspina Forelands Sampled by U.S. Bureau of Mines

Location Sec. 18 Date Sampled 7-74

T. 24 S., R. 26 E., (CRM)

Quadrangle Icy Bay

Pertinent Data Regarding Sample:

Sample taken from Yana Stream 3 1/2 miles upstream from beach.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - <0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	16	0.70	Carbonate	--	--
Potassium	5	0.13	Bicarbonate	61	1.00
Magnesium	2	0.16	Sulfate	6	0.12
Calcium	6	0.30	Sulfide	--	--
Iron	--	--	Chloride	6	0.17
			Hydroxide	--	--
Total Cation		1.29	Total Anion		1.29

Total Dissolved Solids, Mg/liter 71

Observed pH 7.5

Specific Resistance at 68°F. 124.0 ohm meters

TABLE 39. - Analyses of water from Malaspina forelands--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Malaspina Foreland Sampled by U.S. Bureau of Mines

Location Sec. 6 Date Sampled 7-74

T. 25 S., R. 27 E., (CRM)

Quadrangle Yakutat

Pertinent Data Regarding Sample:

Sample obtained from east end of unnamed lake about 3 miles north of Cape Sitkagi. (Lake East)

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	11	0.50	Carbonate	--	--
Potassium	3	0.08	Bicarbonate	49	0.80
Magnesium	1	0.08	Sulfate	2	0.04
Calcium	7	0.35	Sulfide	--	---
Iron	--	--	Chloride	6	0.17
			Hydroxide	--	--
Total Cation		1.01	Total Anion		1.01

Total Dissolved Solids, Mg/liter 54

Observed pH 7.3

Specific Resistance at 68°F. 167.0 ohm meters

TABLE 39. - Analyses of water from Malaspina forelands--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Malaspina Forelands Sampled by U.S. Bureau of Mines

Location Sec. 24 Date Sampled 7-74

T. 25 S., R. 26 E., (CRM)

Quadrangle Yakutat

Pertinent Data Regarding Sample:

Sample obtained from Fountain Stream about 1/2 mile upstream of mouth.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.2

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	14	0.62	Carbonate	--	--
Potassium	8	0.20	Bicarbonate	49	0.80
Magnesium	3	0.25	Sulfate	22	0.46
Calcium	10	0.50	Sulfide	--	--
Iron	--	--	Chloride	11	0.31
			Hydroxide	--	--
Total Cation		1.57	Total Anion		1.57

Total Dissolved Solids, Mg/liter 92

Observed pH 7.8

Specific Resistance at 68°F. 71.7 ohm meters

TABLE 39. - Analyses of water from Malaspina forelands--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Malaspina Foreland Sampled by U.S. Bureau of Mines

Location Sec. 31 Date Sampled 7-74

T. 25 S., R. 29 E., (CRM)

Quadrangle Yakutat

Pertinent Data Regarding Sample:

Sample obtained from small stream east of Sitkagi Bluffs. (S.K. Bluff)

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.7

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	20	0.87	Carbonate	--	--
Potassium	4	0.10	Bicarbonate	61	1.00
Magnesium	1	0.08	Sulfate	3	0.06
Calcium	7	0.35	Sulfide	--	--
Iron	--	--	Chloride	12	0.34
			Hydroxide	--	--
Total Cation		1.4	Total Anion		1.4

Total Dissolved Solids, Mg/liter 77

Observed pH 7.9

Specific Resistance at 68°F. 115.0 ohm meters

TABLE 39. - Analyses of water from Malaspina forelands--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Malaspina Forelands Sampled by U.S. Bureau of Mines

Location Sec. 19 Date Sampled 7-74

T. 25 S., R. 30 W., (CRM)

Quadrangle Yakutat

Pertinent Data Regarding Sample:

Sample obtained from head of Alder Stream.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 20.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	31	1.33	Carbonate	--	--
Potassium	4	0.10	Bicarbonate	73	1.20
Magnesium	1	0.08	Sulfate	--	--
Calcium	5	0.25	Sulfide	--	--
Iron	--	--	Chloride	20	0.56
			Hydroxide	--	--
Total Cation		1.76	Total Anion		1.76

Total Dissolved Solids, Mg/liter 97

Observed pH 8.2

Specific Resistance at 68°F. 140 ohm meters

TABLE 39. - Analyses of water from Malaspina forelands--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Malaspina Foreland Sampled by U.S. Bureau of Mines

Location Sec. 19 Date Sampled 7-74
T. 25 S., R. 30 W., (CRM)

Quadrangle Yakutat

Pertinent Data Regarding Sample:

Sample obtained from head of Manby stream.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.2

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	41	1.80	Carbonate	--	--
Potassium	3	0.08	Bicarbonate	49	0.80
Magnesium	1	0.08	Sulfate	16	0.33
Calcium	6	0.30	Sulfide	--	--
Iron	--	--	Chloride	40	1.13
			Hydroxide	--	--
Total Cation		2.26	Total Anion		2.26

Total Dissolved Solids, Mg/liter 131

Observed pH 7.8

Specific Resistance at 68°F. 90.0 ohm meters

TABLE 39. - Analyses of water from Malaspina forelands--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Malaspina Forelands Sampled by U.S. Bureau of Mines

Location Sec. 29 Date Sampled 7-74

T. 24 S., R. 32 E., (CRM)

Quadrangle Yakutat

Pertinent Data Regarding Sample:

Sample obtained from head of Sudden Stream.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Coantent, mg/l - 0.2

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	49	2.14	Carbonate	--	--
Potassium	3	0.08	Bicarbonate	73	1.20
Magnesium	2	0.16	Sulfate	14	0.29
Calcium	11	0.55	Sulfide	--	--
Iron	--	--	Chloride	50	1.41
			Hydroxide	--	--
Total Cation		2.90	Total Anion		2.90

Total Dissolved Solids, Mg/liter 165

Observed pH 7.5

Specific Resistance at 68°F. 79.8 ohm meters

TABLE 39. - Analyses of water from Malaspina forelands--Continued

Sample From: Well _____ Stream X Seep _____ Other _____

Area Malaspina Forelands Sampled by U.S. Bureau of Mines

Location Sec. 3 Date Sampled 7-74

T. 24 S., R. 32 E., (CRM)

Quadrangle Yakutat

Pertinent Data Regarding Sample:

Sample obtained from Grand Wash Creek just below where Kwik Stream and Lucia Stream merge.

Analysis: Performed by Commercial Firm

Provided by _____

Special Results:

Oil Content, mg/l - 0.5

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	12	0.54	Carbonate	--	--
Potassium	2	0.05	Bicarbonate	61	1.00
Magnesium	2	0.16	Sulfate	16	0.33
Calcium	15	0.75	Sulfide	--	--
Iron	—	--	Chloride	6	0.17
			Hydroxide	--	--
Total Cation		1.50	Total Anion		1.50

Total Dissolved Solids, Mg/liter 83

Observed pH 7.7

Specific Resistance at 68°F. 88.0 ohm meters

CONCLUSIONS

Most of the natural seeps in the Katalla area, the Sullivan anticline area between Cape Yakataga and Icy Bay, and the Oily Lake area of the Malaspina Glacier that have been reported in the literature were found to be active during field investigations in 1973-74. The degree of activity varied from seep to seep. Although some seeps appeared to be dormant, surrounding evidence indicated at least sporadic activity. Seep activity in the Katalla oilfield was perhaps the most difficult to determine because of past producing activities, which resulted in most of the field area containing oil from industrial operations. Although the field area which is covered with water most of the time is covered with a rainbow sheen that would indicate the presence of bitumen, the grass and shrub growth is lush and prolific. Bear paw prints in the oily sand are common, signifying the presence of these animals. Skunkcabbage fronds the size of desk tops are ubiquitous. Blueberries and raspberries can be found without trouble. Frogs leap in and out of bubbling gas-seep ponds.

The seeps between Yakataga and Icy Bay are active at their source, but water analysis shows that bitumen content reaching the Gulf of Alaska is relatively small. All drainage creeks between Cape Yakataga and Johnston Creek were walked from head to mouth, and the entire beachline from Yakataga to Icy Bay was observed in segments on foot many times. Only once was any oil found on the beach, or near any creek mouth. In fact, although the seeps on Johnston Creek appear to be the most prolific, sea lions were observed on several occasions bobbing around at the mouth of the creek. Also, vegetation was lush, and sometimes prohibited access to the seeps that it surrounded.

In the case of Johnston Creek, precipitation definitely has an influence on the amount of bitumen entering the drainage from the seep area. Most of the creeks have seeps located right in the creekbeds or near the banks of running water. The spectacular seeps on Johnston Creek were actually located in a pond of water about 15 feet above the creekbed. In times of light precipitation, the water level of the pond diminishes, and drainage is minimal. During heavy precipitation, the water level rises, and the oil accumulating on top of the water spills over the top of the pond and into Johnston Creek. On one rainy occasion, an oil sheen could readily be seen on top of the turbulent, glacier-gray water as it reached the mouth of the stormy gulf. A petrolic odor was also prevalent.

At Oily Lake, oil-carrying water disappears under the Malaspina Glacier. Samples of water were taken from the Malaspina forelands where water emerges from underneath the Glacier. Alder Stream was the only stream that contained a significant amount of oil. There was no way to tell if this oil originated in Oily Lake, or from additional seeps underneath the Glacier.

APPENDIX.--METHOD OF DETERMINING AMOUNT OF OIL IN WATER[1]

Preparation of sample: Place the sample, usually 1,000 ml, in a separatory funnel of sufficient size to allow the addition of acid and solvent while still leaving space for proper agitation. Acidify the sample with 5 ml sulfuric acid per liter of sample.

Extraction with organic solvent:[2] Rinse the sample bottle carefully with 15 ml organic solvent and add the solvent washings to the separatory funnel. Add an additional 25 ml solvent to the separatory funnel; shake vigorously for 2 min. Allow the organic layer to separate. Withdraw the aqueous portion of the sample into a clean container and transfer the solvent layer into a clean, tared distilling flask capable of holding at least three volumes of solvent. If a clear solvent layer cannot be obtained, filter the solvent layer into the tared distilling flask through a funnel containing a solvent-moistened Whatman No. 40[3] (or equivalent) filter paper. Use as small a funnel and filter paper as practical. After all the solvent from the two extractions and the final rinsing have been added, wash down the funnel and filter paper twice with fresh 5-ml increments of solvent. Return the sample to the separatory funnel and rinse the container with 15 ml solvent. Add the solvent washings and an additional 25 ml solvent to the separatory funnel, and agitate for another 2 min. Allow the solvent layer to separate, and discard the aqueous phase. Add the organic extract to the tared distilling flask, and rinse the separatory funnel with 20 ml solvent. Add the solvent washings to the tared distilling flask.

Solvent removal: Distill off all but approximately 10 ml of the solvent extract by a water bath or electric heating mantle, observing all necessary safety precautions and keeping the heat source at the proper boiling point. Disconnect the condenser and boil off the remaining solvent from the tared flask at the same temperature. Dry on a water or steam bath. When dry, lay the flask on its side to facilitate the removal of solvent vapor. Introduce approximately three volumes of dry illuminating gas into the flask to displace the solvent vapor. Cool in a desiccator for 30 min and weigh.

Calculation: If the organic solvent used is known to be free of residue, the gain in weight of the tared distilling flask is mainly due to oil and grease. The total gain in weight, A, of the tared flask less the calculated residue, B, from the solvent, as determined by the distillation or evaporation of a measured quantity, indicates the amount of oil or grease in the water sample:

$$\text{mg/l oil or grease} = \frac{(A-B) \times 1{,}000}{\text{ml sample}}.$$

[1] American Public Health Association. Standard Methods for the Examination of Water and Wastewater. New York, 13th ed., 1971, 874 pp.

[2] Solvent used was trichlorotrifluoro ethane.

[3] Reference to specific trade names is made for identification only and does not imply endorsement by the Bureau of Mines.

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