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Oil and Gas Seeps in Alaska

Alaska Peninsula, Western Gulf of Alaska

UNITED STATES DEPARTMENT OF THE INTERIOR

Report of Investigations 8122

Oil and Gas Seeps in Alaska

Alaska Peninsula, Western Gulf of Alaska

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OIL AND GAS SEEPS IN ALASKA

Alaska Peninsula, Western Gulf of Alaska

by

Donald P. Blasko[1]

ABSTRACT

The Bureau of Mines investigated two areas of the Alaska Peninsula (Iniskin Peninsula and Becharof Lake) where oil and gas seeps were known to occur in an attempt to determine (1) whether the seeps are still active and (2) the amount of bitumen contained in the drainage leaving the seeps. The oil, water, oil-water, and gas were sampled and analyzed.

Five oil samples were taken at four separate oil seeps. The API gravity of the oil ranged from 8.9° to 21.4° and the sulfur content was from 0.12 percent to 0.59 percent. Four of the seven gas samples obtained revealed fairly high caloric values, ranging from 746 to 924 Btu/cu ft, and averaging 844 Btu/cu ft. A total of 44 water samples were obtained. Bitumen content of the water was as high as 9,773 mg/l at one seep, but averaged less than 1 mg/l where the seep-drainage water entered the Gulf of Alaska.

INTRODUCTION

As part of an ongoing program in mineral resource 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 investigations conducted by the Bureau of Mines on oil and gas seeps on the Alaska Peninsula (1) in the Iniskin Peninsula area and (2) in the Becharof Lake area from Puale Bay south to Wide Bay and west to the Ugashik Lakes. Similar investigations of oil and gas seeps are being conducted between the Copper River and Yakutat in the north-central Gulf of Alaska and will be published in a separate report.

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[1] Petroleum engineer.

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 various 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. 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.

INISKIN PENINSULA AREA

The Iniskin Peninsula is described by the U.S. Geological Survey as being located "on SE coast of Alaska Peninsula between Chinitna and Iniskin Bays, 30 miles NE of Augustine Island."[2] The peninsula juts out into Cook Inlet and can be located in the U.S. Geological Survey topographic map series on the Iliamna quadrangle (fig. 1).

The Iniskin Peninsula area falls within a geologic province known as the Cook Inlet Mesozoic Province. This province produces oil and gas in commercial quantities further to the north in the upper Cook Inlet Basin.[3]

According to the U.S. Geological Survey,[4] "Oil and gas seeps in the Iniskin Peninsula area of the Chinitna district, on the west shore of Cook Inlet, were discovered by the Russians about 1853...." It is believed that the hydrocarbons that occur on the surface migrate updip through fault zones.

Supposedly, the seeps were initially staked in 1882 for oil exploration and development, but actual drilling did not take place on the peninsula until 1900. The first exploratory well, drilled near Bowser Creek, had shows of oil, but was plugged and abandoned in 1903. Five additional wells were drilled on the peninsula by the end of 1906.[5] All were nonproductive.

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[2]Orth, D. Dictionary of Alaska Place Names. U.S. Geol. Survey Prof. Paper 567, 1967, 1084 pp.

[3]Blasko, D. P. Natural Gas Fields--Cook Inlet Basin, Alaska. BuMines OFR 35-74, 1974, 24 pp.; available for examination at the Alaska Field Operation Center offices in Juneau and Anchorage, Alaska, and in the office of the Associate Director, Mineral and Materials Supply/Demand Analysis, and the Central Library, U.S. Department of the Interior, Washington, D.C.
Blasko, D. P., W. J. Wenger, and J. C. Morris. Oilfields and Crude Oil Characteristics--Cook Inlet Basin, Alaska. BuMines RI 7688, 1972, 44 pp.

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

[5]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.

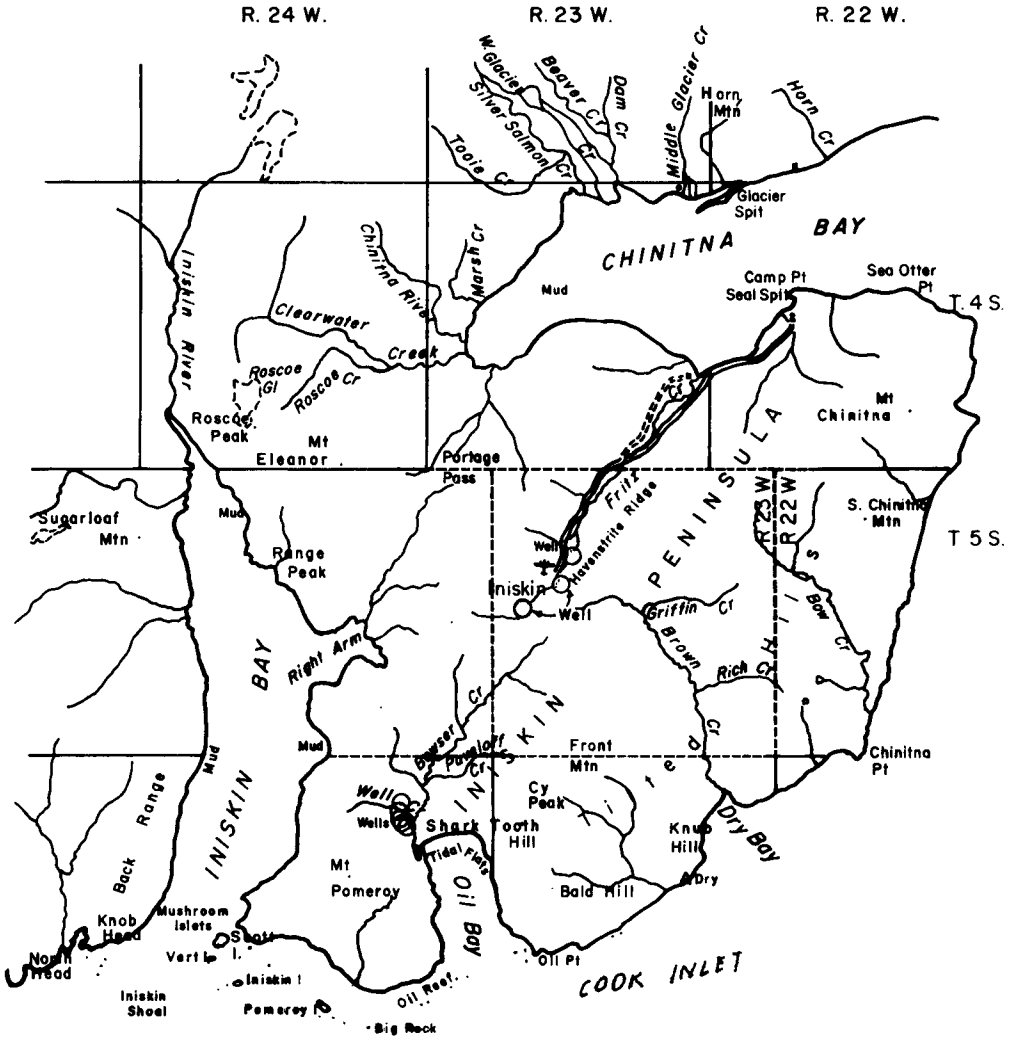

FIGURE 1. - Iniskin Peninsula, Alaska (adapted from U.S. Geological Survey map of the Iliamna quadrangle).

In September 1936, the Iniskin Drilling Co. spudded the IBA No. 1 (Iniskin Bay Association) south of Chinitna Bay. During 1936, the well was drilled to 2,540 feet and suspended for the winter. Gas shows were encountered at three different intervals. In 1938, the well was reentered and deepened to 6,156 feet. Several zones were tested between 5,600 feet and 7,156 feet, resulting in a recovery of about 15 barrels of light-green, high-gravity oil. After testing, the well was again shut in for the winter season. Upon reentering the well and drilling to total depth of 8,775 feet, additional shows of oil and gas were encountered. The well was eventually plugged and abandoned as noncommercial.

Other wells drilled on the Alaska Peninsula offered encouragement, but were eventually plugged and abandoned. In 1954, Alaska Consolidated Oil Co., Inc., began drilling the Iniskin Unit No. 1 on the Iniskin Peninsula. Drilling was suspended in November 1959, and the well was finally plugged and

abandoned in 1964. Total depth of the well was 9,476 feet. The bit was reportedly drilling in Jurassic volcanics when the well was abandoned. Between 6,000 feet and 9,300 feet, the drilling records indicate oil saturation, but no recovery was made owing to lack of permeability.

Another semideep well drilled on the Iniskin Peninsula during 1958-59 was the Alaska Consolidated Oil Co. Antonio Zappa No. 1 well, which had oil and gas shows, but was eventually abandoned. An interesting feature of this well is that the drilling records show that flowing hot salt water and steam were encountered on a drill-stem test at a depth of about 8,500 feet. There has been no drilling since that time, although the area still retains interest in terms of geologic prospecting.

Pertinent data regarding the wells drilled on the Iniskin Peninsula are given in table 1.

TABLE 1. - Wells drilled on Iniskin Peninsula

Company	Well	Location[1]	Spudded	Completed	Total depth, feet	Status
Alaska Consolidated Oil Co., Inc.	Iniskin Unit, Beal No. 1.	2,000' W, 1,700' N of SE corner sec 17, T 5 S, R 23 W.	8/4/54	1959	9,746	Plugged and abandoned.
Do.....	Iniskin Unit, Zappa No. 1.	2,370' S, 290' W of NE corner, sec 18, T 5 S, R 23 W.	12/25/58	11/7/61	11,231	Do.
Alaska Oil Co.....	No. 1..	SE1/4NW1/4 sec 35, T 5 S, R 23 W.	1902	1902	320	Do.
Do.....	No. 2..	NE1/4SW1/4 sec 35, T 5 S, R 23 W.	1903	1903	([2])	Do.
Alaska Petroleum Co.	No. 1..	NE1/4SW1/4 sec 11, T 6 S, R 24 W.	1900	1903	1,000	Do.
Do.....	No. 2..	SW1/4NW1/4 sec 11, T 6 S, R 24 W.	1904	1904	450	Do.
Do.....	No. 3..	SW1/4NW1/4NW1/4 sec 11, T 6 S, R 24 W.	1904	1904	930	Do.
Do.....	No. 4..	NW1/4SW1/4NW1/4 sec 11, T 6 S, R 24 W.	1906	1906	1,905	Do.
Iniskin Drilling Co.	IBA No. 1.	1,500' W, 1,125' N of SW corner sec 8, T 5 S, R 23 W.	9/7/36	1939	8,775	Do.

[1] Based on Seward meridian.
[2] Abandoned at shallow depth.

Well Creek, Bowser Creek, and Oil Bay

Active gas seeps and suspected active oil seeps were observed in the area of the junction of Well Creek and Bowser Creek (fig. 2) in secs 10-11, T 6 S, R 24 W, Seward meridian (Iliamna quadrangle). Since it was the custom in early exploration for oil in Alaska to drill wells near, at, or on oil seeps, the seep area was located by surface evidence of oil-well drilling (that is, abandoned wells, boiler

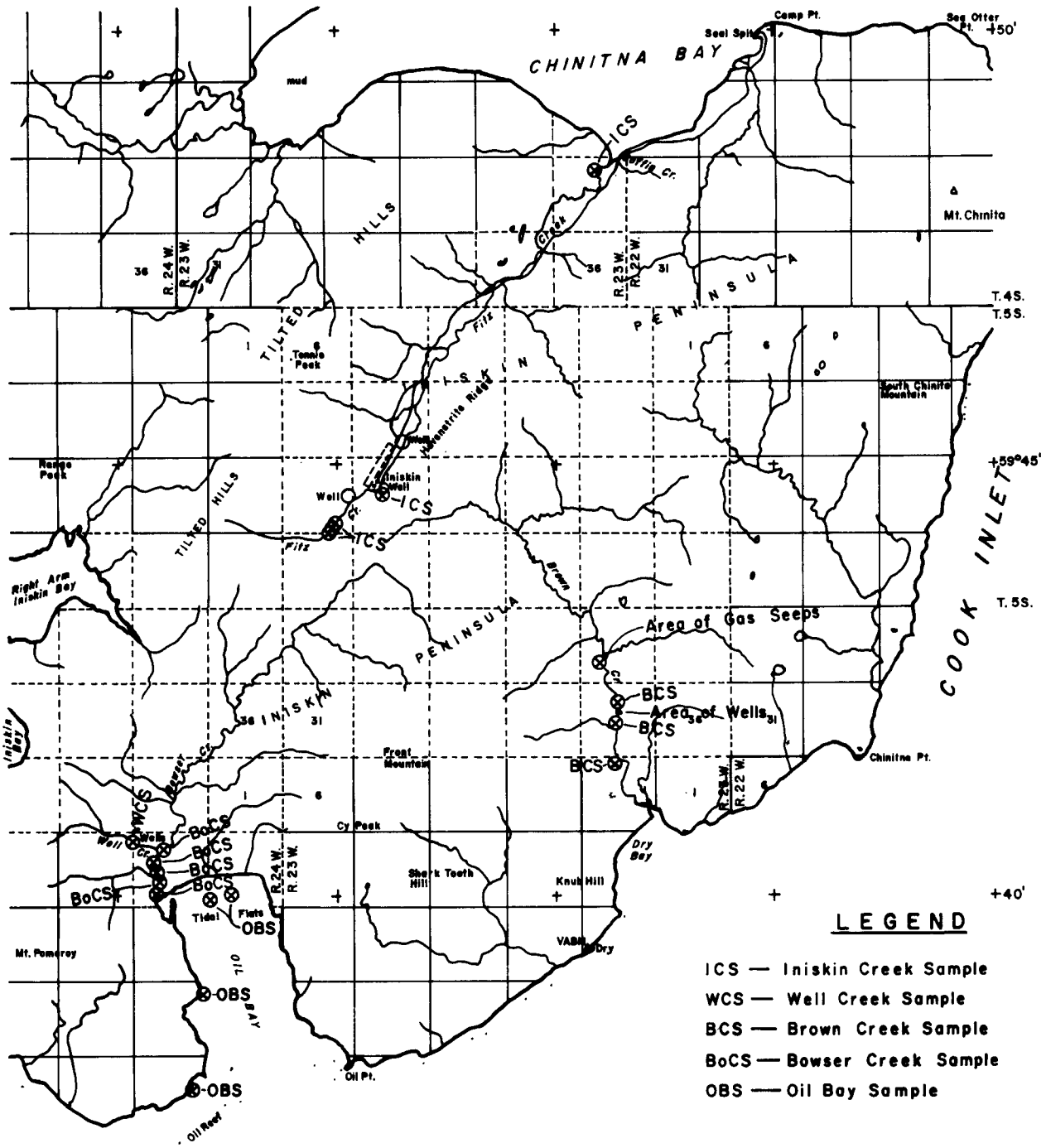

FIGURE 2. - Oil, gas, and water sampling locations on the Iniskin Peninsula (adapted from the U.S. Geological Survey map of the Iliamna quadrangle).

equipment, etc.). In this instance, an old boiler was spotted, partially hidden by trees and other plant growth. Two abandoned wells were located nearby, near the west bank of Bowser Creek. The wells were drilled by the Alaska Petroleum Co. between 1900 and 1906; the deepest went to approximately

1,900 feet. One well was situated on dry ground and the surface casing stuck up out of the ground about 2 feet, encased in what appeared to be cement and barrel staves. A wooden plug was wedged into the casing. No oil, gas, or water appeared to be escaping from this well or the area surrounding the well. Another well was located about 70 feet to the north. The surface casing protruded about 1 foot above the pool of water surrounding it. The casing was full of water, but the water did not appear to be flowing under pressure. Gas was bubbling up through the water inside the casing, and a sample of the gas and water in the casing was obtained. The gas displaced the water inside the sample bottle within about 1 minute. The gas would flame an ignited match, but would not sustain the flame. An analysis of the gas and water from this well is given in tables 2-3. There did not appear to be any discharge of water or oil attendant with the bubbling gas well.

Another well (fig. 2), believed to be drilled by the Alaska Petroleum Co. in 1906, was located on the south bank of Well Creek about one-half mile upstream from the juncture of Well Creek and Bowser Creek. The well casing sticks up approximately 2-1/2 feet out of the surrounding pool of water. Oil was observed inside the casing, which was badly corroded on one side, and on the pool of water surrounding the casing. This pool of water drains directly into Well Creek. A sample of the water from the pool was obtained.

Directly across the creek from the well were several oil seep areas. Four distinct seeps were spread over a distance of approximately 375 feet. The ponds containing suspected seep oil were located at the base of a well-defined, northeast-trending ridge. The oil on top of the pools of water appeared to be thick and weathered, and clung to the edges of the pool and adhered to the vegetation. Vegetation growth did not seem to be affected. When draining from the pools into Well Creek, the bitumen broke up and floated a sheeny rainbow from the pools into Well Creek. Oil sheen and oil residue were evident on almost all standing water in the grassy swamp. There were no indications that the oil seeps were vigorously active, such as gas bubbles, oil flow, etc.; however, the presence of relatively fresh oil droplets indicated that the seeps were at least occasionally active.

One Well Creek water sample was taken at a point above the drainage from the oil seep areas. Another Well Creek water sample was obtained at a point just below the last drainage from the observed seeps. Well Creek seep samples were taken at what appeared to be the seep locations. Figure 3 illustrates the relative position of the area and the sample locations. Analyses of samples from the well, stream, and seep of Well Creek are found in table 4. No indications of gas seeps were observed.

In order to determine what effect, if any, the natural seeps have on the surrounding drainages, samples of water were taken on Bowser Creek at the following points: above the point where Well Creek joins Bowser Creek, immediately below where Well Creek joins Bowser Creek, at Bowser Creek below where the drainage from the gassy Bowser Creek well enters, and at the mouth of Bowser Creek at low tide. The analyses of these samples appear in table 5. Since Bowser Creek drains into the head of Oil Bay, water samples were also obtained from Oil Bay. Analyses appear in table 6.

TABLE 2.- Analysis of water from Bowser Creek well

Sample from: Well X Stream _____ Seep _____ Other _____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 11, T6S, R24W (SM) Date sampled 6/73

Quadrangle Iliamna

Pertinent data regarding sample: Dry hole well. Gas bubbling up through water in surface casing.

Analysis: Performed by Commercial firm

Provided by _____

Special results: Oil content, mg/l---5.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	1109	48.23	Carbonate	0	--
Potassium	2	0.05	Bicarbonate	67	1.10
Magnesium	5	0.41	Sulfate	30	0.62
Calcium	625	24.94	Sulfide	--	--
Iron	--	--	Chloride	2550	71.91
			Hydroxide	--	--
Total Cation		73.63	Total Anion		73.63

Total dissolved solids, Mg/liter 4354

Observed pH 7.3

Specific resistance at 68 °F 1.48 ohm meters

TABLE 3.- Analysis of gas from Bowser Creek well

Sample from: Well X Stream _____ Seep _____ Other _____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 11, T6S, R24W (SM) Date sampled 6/73

Quadrangle Iliamna

Pertinent data regarding sample: Dry hole well. Gas bubbling up through water in surface casing.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

Special results:

Analysis:

Methane	79.2 %	Normal Pentane	0.0 %	Oxygen	0.0 %
Ethane	0.0 %	Isopentane	0.0 %	Argon	0.2 %
Propane	Trace %	Cyclopentane	0.0 %	Hydrogen	0.0 %
Normal Butane	0.0 %	Hexanes Plus	0.0 %	H2S	0.0 %
Isobutane	0.0 %	Nitrogen	20.4 %	CO2	0.1 %
				Helium	0.01%
			Total		99.9 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 802

Specific Gravity 0.641

TABLE 4. - Analyses of water from Well Creek

Sample from: Well_____ Stream_____ Seep_____ Other See pertinent data

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 11, T6S, R24W (SM) Date sampled 6/73

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from pond of water surrounding old abandoned well.

Analysis: Performed by Commercial firm

Provided by

Special results:

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	1204	52.38	Carbonate	0	--
Potassium	6	0.15	Bicarbonate	256	4.20
Magnesium	25	2.06	Sulfate	5	0.10
Calcium	860	34.31	Sulfide	--	--
Iron	--	--	Chloride	3000	84.60
			Hydroxide	--	--
Total Cation		88.90	Total Anion		88.90

Total dissolved solids, Mg/liter 5226

Observed pH 7.0

Specific resistance at 68 °F 1.40 ohm meters

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

Sample from: Well _____ Stream X Seep _____ Other _____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 10, T6S, R24W (SM) Date sampled 6/73

Quadrangle Iliamna

Pertinent data regarding sample: Well Creek water sample upstream of oil seep area.

Analysis: Performed by Commercial firm

Provided by _____

Special results:

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	72	3.12	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	49	0.80
Magnesium	2	0.16	Sulfate	94	1.96
Calcium	4	0.16	Sulfide	--	--
Iron	--	--	Chloride	24	0.68
			Hydroxide	--	--
Total Cation		3.44	Total Anion		3.44

Total dissolved solids, Mg/liter 220

Observed pH 6.5

Specific resistance at 68 °F 90.0 ohm meters

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

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 10, T6S, R24W (SM) Date sampled 6/73

Quadrangle Iliamna

Pertinent data regarding sample: Well Creek water sample below drainage of observed seeps.

Analysis: Performed by Commercial firm

Provided by

Special results: Oil content, mg/l---8.4

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	24	1.04	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	49	0.80
Magnesium	1	0.08	Sulfate	Trace	--
Calcium	4	0.16	Sulfide	--	--
Iron	--	--	Chloride	17	0.48
			Hydroxide	--	--
Total Cation		1.28	Total Anion		1.28

Total dissolved solids, Mg/liter 70

Observed pH 6.7

Specific resistance at 68 °F 100 ohm meters

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

Sample from: Well_____ Stream_____ Seep X Other_____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 10, T6S, R24W (SM) Date sampled 6/73

Quadrangle Iliamna

Pertinent data regarding sample: Sample from seep pond.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---9773

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	23	1.02	Carbonate	0	--
Potassium	1	0.03	Bicarbonate	49	0.80
Magnesium	1	0.08	Sulfate	2	0.04
Calcium	4	0.16	Sulfide	--	--
Iron	--	--	Chloride	16	0.45
			Hydroxide	--	--
Total Cation		1.29	Total Anion		1.29

Total dissolved solids, Mg/liter 71

Observed pH 6.3

Specific resistance at 68 °F 6.3 ohm meters

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

Sample from: Well_____ Stream_____ Seep X Other_____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 10, T6S, R24W (SM) Date sampled 6/73

Quadrangle Iliamna

Pertinent data regarding sample: Sample from seep pond.

Analysis: Performed by Commercial firm

Provided by

Special results: Oil content, mg/l---6938

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	21	0.90	Carbonate	0	--
Potassium	1	0.03	Bicarbonate	49	0.80
Magnesium	1	0.08	Sulfate	4	0.08
Calcium	3	0.12	Sulfide	--	--
Iron	--	--	Chloride	9	0.25
			Hydroxide	--	--
Total Cation		1.13	Total Anion		1.13

Total dissolved solids, Mg/liter 63

Observed pH 6.2

Specific resistance at 68 °F 145 ohm meters

TABLE 5.- Analyses of water from Bowser Creek

Sample from: Well _____ Stream X Seep _____ Other _____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 11, T6S, R24W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained in Bowser Creek 100 feet upstream of juncture of Well Creek and Bowser 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	43	1.86	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	48	0.79
Magnesium	Trace	--	Sulfate	12	0.25
Calcium	5	0.25	Sulfide	--	--
Iron	--	--	Chloride	38	1.07
			Hydroxide	--	--
Total Cation		2.11	Total Anion		2.11

Total dissolved solids, Mg/liter 122

Observed pH 7.2

Specific resistance at 68 °F 49.7 ohm meters

TABLE 5. - Analyses of water from Bowser Creek--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 11, T6S, R24W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained about 100 feet downstream of Well Creek and Bowser Creek.

Analysis: Performed by Commercial firm

Provided by

Special results: Oil content, mg/l---377

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	36	1.55	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	41	0.67
Magnesium	Trace	--	Sulfate	8	0.17
Calcium	5	0.25	Sulfide		
Iron	--	--	Chloride	34	0.96
			Hydroxide	--	--
Total Cation		1.80	Total Anion		1.80

Total dissolved solids, Mg/liter 103

Observed pH 6.9

Specific resistance at 68 °F 56.7 ohm meters

TABLE 5. - Analyses of water from Bowser Creek--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 11, T6S, R24W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained about 100 feet downstream from bubbly gas well.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---4.0

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	39	1.71	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	41	0.67
Magnesium	Trace	--	Sulfate	13	0.27
Calcium	5	0.25	Sulfide	--	--
Iron	--	--	Chloride	36	1.02
			Hydroxide	--	--
Total Cation		1.96	Total Anion		1.96

Total dissolved solids, Mg/liter 113

Observed pH 6.8

Specific resistance at 68 °F 56.9 ohm meters

TABLE 5. - Analyses of water from Bowser Creek--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location SW 1/4, Sec. 11, T6S, R24W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from Bowser Creek about 200 feet upstream of mouth at low tide.

Analysis: Performed by Commercial firm

Provided by

Special results: Oil content, mg/l---14

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	285	12.39	Carbonate	0	--
Potassium	11	0.28	Bicarbonate	49	0.80
Magnesium	16	1.32	Sulfate	66	1.37
Calcium	5	0.25	Sulfide	--	--
Iron	--	--	Chloride	428	12.07
			Hydroxide	--	--
Total Cation		14.24	Total Anion		14.24

Total dissolved solids, Mg/liter 835

Observed pH 6.7

Specific resistance at 68 °F 7.13 ohm meters

TABLE 6.- Analyses of water from Oil Bay

Sample from: Well_____ Stream_____ Seep_____ Other See pertinent data

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 23, T6S, R24W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from seawater of coastal bay called Oil 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	2584	112.38	Carbonate	0	--
Potassium	187	4.79	Bicarbonate	111	1.82
Magnesium	230	18.91	Sulfate	7	0.15
Calcium	25	1.25	Sulfide	--	--
Iron	--	--	Chloride	4800	135.36
			Hydroxide	--	--
Total Cation		137.33	Total Anion		137.33

Total dissolved solids, Mg/liter 7888

Observed pH 6.9

Specific resistance at 68 °F 0.405 ohm meters

TABLE 6. - Analyses of water from Oil Bay--Continued

Sample from: Well_____ Stream_____ Seep_____ Other See pertinent data

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 26, T6S, R24W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from seawater of coastal bay at the mouth of Oil Bay near Oil Reef.

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	9754	424.29	Carbonate	0	--
Potassium	430	11.01	Bicarbonate	134	2.20
Magnesium	498	40.94	Sulfate	12	0.25
Calcium	56	2.79	Sulfide	--	--
Iron	--	--	Chloride	16900	476.58
			Hydroxide	--	--
Total Cation		479.03	Total Anion		479.03

Total dissolved solids, Mg/liter 27716

Observed pH 7.2

Specific resistance at 68 °F 0.24 ohm meters

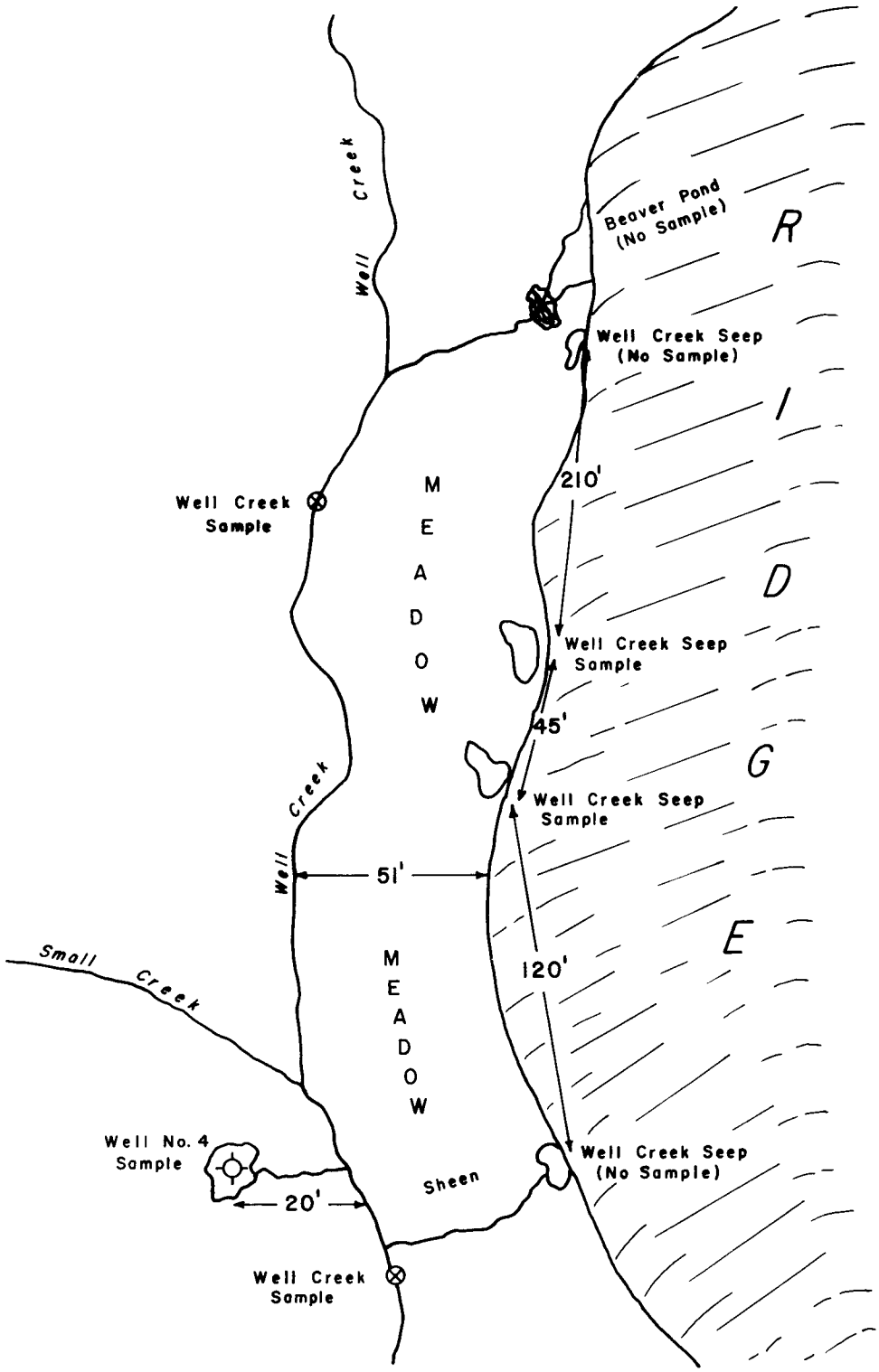

FIGURE 3. - Well Creek sampling locations.

Samples of the surface beach sand at the head of Oil Bay were taken. One sample, taken about 100 yards east of the mouth of Bowser Creek on the west side of the tidal flats, had a bitumen content of 8.0 mg/l.

A reconnaissance of the beaches was made at both high and low tides from the mouth of Oil Bay near Oil Reef, extending across the tidal flat and over to Oil Point. It did not reveal any additional seeps or any unusual deposits of oil, tar, slick, scum, etc.

Brown Creek and Dry Bay

Brown Creek was reconnoitered from a point above Rich Creek to Dry Bay in an effort to locate oil and gas seeps. Gas seeps were located during the reconnaissance (fig. 2). Several were sampled, but the results are not included because of the possibility of contaminated samples and unreliable analyses.

In SW1/4 sec 26, T 5 S, R 23 W, Seward meridian, two distinct areas of gas seeps were found. On the west side of Brown Creek, a calm-water pond, fed by small springs and measuring about 15 feet wide, 35 feet long, and approximately 2 feet deep, contained a substantial gas seep. Gas bubbles emerged intermittently throughout the pond in about 15 or 20 different and scattered places at approximately 30-second intervals. No attempt was made to sample the gas because of the inconsistency of the seep location. Another gas seep was located nearby in fast-moving Brown Creek near the west bank. Gas bubbles emerging from the creekbed would be swept downstream about 15 to 20 feet before emerging at the surface. The gas appeared to be continuous and consistent.

In SW1/4NE1/4 sec 35, T 5 S, R 23 W, Seward meridian, the remains of the equipment that Alaska Oil Co. used in 1902 to drill wells on Brown Creek were located. An old bailer, an old stove, and rotted lumber were evident, but the remains of the oil wells were not located. The area was looked over very closely, but there were no indications of oil or gas seeps. Samples of water were obtained from Brown Creek immediately above and immediately below the remains of the drilling equipment. The analyses appear in table 7.

Another gas seep in Brown Creek was located about 1,500 yards upstream from the beachline of Dry Bay. Analyses of water samples upstream and downstream from the gas seep are also found in table 7.

TABLE 7.- Analyses of water from Brown Creek

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 35, T5S, R23W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from Brown Creek upstream of old drilling area.

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	0.61	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	26	0.43
Magnesium	Trace	--	Sulfate	7	0.15
Calcium	4	0.20	Sulfide		
Iron	--	--	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		0.81	Total Anion		0.81

Total dissolved solids, Mg/liter 46

Observed pH 6.8

Specific resistance at 68 °F 120 ohm meters

TABLE 7. - Analyses of water from Brown Creek--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 35, T5S, R23W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from Brown Creek downstream from old drilling area.

Analysis: Performed by Commercial firm

Provided by

Special results: Oil content, mg/l---5.2

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	19	0.81	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	37	0.61
Magnesium	Trace	--	Sulfate	8	0.17
Calcium	4	0.20	Sulfide	--	--
Iron	--	--	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		1.01	Total Anion		1.01

Total dissolved solids, Mg/liter 57

Observed pH 6.8

Specific resistance at 68 °F 149 ohm meters

TABLE 7. - Analyses of water from Brown Creek--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 2, T6S, R23W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from Brown Creek upstream of lower gas seep.

Analysis: Performed by Commercial firm

Provided by

Special results: Oil content, mg/l---1.5

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	17	0.73	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	39	0.64
Magnesium	Trace	--	Sulfate	6	0.12
Calcium	4	0.20	Sulfide	--	--
Iron	--	--	Chloride	6	0.17
			Hydroxide	--	--
Total Cation		0.93	Total Anion		0.93

Total dissolved solids, Mg/liter 52

Observed pH 7.1

Specific resistance at 68 °F 129 ohm meters

TABLE 7. - Analyses of water from Brown Creek--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 2, T6S, R23W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from Brown Creek downstream of lower gas seep.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---2.4

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	19	0.84	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	39	0.64
Magnesium	Trace	--	Sulfate	8	0.17
Calcium	4	0.20	Sulfide	--	--
Iron	--	--	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		1.04	Total Anion		1.04

Total dissolved solids, Mg/liter 58

Observed pH 6.8

Specific resistance at 68 °F 128 ohm meters

Iniskin Camp Area

As part of the project to determine the source and amount of bitumen that may be entering the Gulf of Alaska waters, it is normal procedure to seek out and inspect any known abandoned exploratory wells in the area of interest. To this end, three wells previously discussed were investigated: Beal No. 1, IBA No. 1, and Zappa No. 1. One well, IBA No. 1, drilled and abandoned in 1939, was found to be in good condition. No sign of bitumen was in evidence. No oil or gas seeps were found.

At the drilling site of Zappa No. 1, abandoned in 1961, water with a rainbow sheen was emanating from a spring area near a built-up pad housing a test tank. It has not been determined whether the bitumen is from an oil seep or from past industrial operations. The bitumen enters a small creek that drains into upper Fitz Creek. The rainbow is evident throughout the small creek drainage, as is a petrolic odor. However, the well is in good shape and shows no sign of contributing pollution. The same is true at the Beal No. 1 well. Rainbow-colored sheen was seen on small ponds that surround the drilling pad and drain into Fitz Creek, but no particular natural oil seeps were identifiable.

The observance of these bitumen occurrences took place in early summer of 1973 when the last of the winter snows were thawing rapidly and drainages were running swift and high. Another visit was made to the area during a relatively dry period in 1974 when creeks were noticeably low. Standing pools of water exhibited the rainbow sheen when disturbed, but no bitumen was observed oozing out of earth in places previously noted. Comparisons of water samples taken during the wet and dry periods leads to the conclusion that it is quite possible that the only time bitumen (whether from natural seeps or past industrial operations) enters the drainage in the Iniskin camp area (fig. 2) is during periods of runoff caused by rain or snow melt. The water analyses from the Iniskin camp area are found in table 8.

TABLE 8.- Analyses of water from Iniskin camp seep area

Sample from: Well_____ Stream_____ Seep X Other_____

Area Iniskin Peninsula-Zappa Well Sampled by U.S. Bureau of Mines

Location SE 1/4, Sec. 18, T5S, R23W (SM) Date sampled 6/73

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from soil surrounding suspected seepage.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---943

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	456	19.82	Carbonate	0	--
Potassium	41	1.05	Bicarbonate	2208	36.21
Magnesium	63	5.18	Sulfate	25	0.52
Calcium	317	12.65	Sulfide	--	--
Iron	--	--	Chloride	70	1.97
			Hydroxide	--	--
Total Cation		38.70	Total Anion		38.70

Total dissolved solids, Mg/liter 2059

Observed pH 8.1

Specific resistance at 68 °F 3.6 ohm meters

TABLE 8. - Analyses of water from Iniskin camp seep area--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula-Zappa Well Sampled by U.S. Bureau of Mines

Location SE 1/4, Sec. 18, T5S, R23W (SM) Date sampled 6/73

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from Fitz Creek upstream of observed seepage during wet period.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---7.4

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	26	1.14	Carbonate	0	--
Potassium	1	0.03	Bicarbonate	49	0.80
Magnesium	1	0.08	Sulfate	12	0.25
Calcium	2	0.08	Sulfide	--	--
Iron	--	--	Chloride	10	0.28
			Hydroxide	--	--
Total Cation		1.33	Total Anion		1.33

Total dissolved solids, Mg/liter 76

Observed pH 7.0

Specific resistance at 68 °F 105 ohm meters

TABLE 8. - Analyses of water from Iniskin camp seep area--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula-Zappa Well Sampled by U.S. Bureau of Mines

Location SE 1/4, Sec. 18, T5S, R23W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from Fitz Creek upstream of observed seepage during dry period.

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	28	1.23	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	41	0.67
Magnesium	Trace	--	Sulfate	12	0.25
Calcium	5	0.25	Sulfide	--	--
Iron	--	--	Chloride	20	0.56
			Hydroxide	--	--
Total Cation		1.48	Total Anion		1.48

Total dissolved solids, Mg/liter 85

Observed pH 6.8

Specific resistance at 68 °F 83.90 ohm meters

TABLE 8. - Analyses of water from Iniskin camp seep area--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula-Zappa Well Sampled by U.S. Bureau of Mines

Location SE 1/4, Sec. 18, T5S, R23W (SM) Date sampled 6/73

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from Fitz Creek downstream from observed seepage during wet period.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---5.3

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	98	4.28	Carbonate	0	--
Potassium	1	0.03	Bicarbonate	61	1.00
Magnesium	2	0.16	Sulfate	20	0.42
Calcium	1	0.05	Sulfide	--	--
Iron	--	--	Chloride	110	3.10
			Hydroxide	--	--
Total Cation		4.52	Total Anion		4.52

Total dissolved solids, Mg/liter 262

Observed pH 6.7

Specific resistance at 68 °F 83 ohm meters

TABLE 8. - Analyses of water from Iniskin camp seep area--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula-Zappa Well Sampled by U.S. Bureau of Mines

Location SE 1/4, Sec. 18, T5S, R23W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from Fitz Creek downstream from observed seepage during dry period.

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	26	1.12	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	40	0.66
Magnesium	Trace	--	Sulfate	7	0.15
Calcium	4	0.20	Sulfide	--	--
Iron	--	--	Chloride	18	0.51
			Hydroxide	--	--
Total Cation		1.32	Total Anion		1.32

Total dissolved solids, Mg/liter 75

Observed pH 6.7

Specific resistance at 68 °F 84 ohm meters

TABLE 8. - Analyses of water from Iniskin camp seep area--Continued

Sample from: Well_____ Stream_____ Seep X Other_____

Area Iniskin Peninsula-Beal Well Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 17, T5S, R23W (SM) Date sampled 6/73

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from soil surrounding suspected seepage.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---148

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	1950	84.81	Carbonate	0	--
Potassium	23	0.59	Bicarbonate	634	10.40
Magnesium	63	5.18	Sulfate	15	0.31
Calcium	1108	44.21	Sulfide	--	--
Iron	--	--	Chloride	4400	124.08
			Hydroxide	--	--
Total Cation		134.79	Total Anion		134.79

Total dissolved solids, Mg/liter 7871

Observed pH 6.4

Specific resistance at 68 °F 78.5 ohm meters

TABLE 8. - Analyses of water from Iniskin camp seep area--Continued

Sample from: Well_____ Stream__X__ Seep_____ Other_____

Area Iniskin Peninsula-Beal Well Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 17, T5S, R23W (SM) Date sampled 6/73

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from pond drainage near suspected seep during wet period.

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	1199	52.17	Carbonate	0	--
Potassium	14	0.36	Bicarbonate	37	0.61
Magnesium	5	0.41	Sulfate	20	0.42
Calcium	890	35.31	Sulfide	--	--
Iron	--	--	Chloride	3100	87.42
			Hydroxide	--	--
Total Cation		88.45	Total Anion		88.45

Total dissolved solids, Mg/liter 5246

Observed pH 6.5

Specific resistance at 68 °F 1.25 ohm meters

TABLE 8. - Analyses of water from Iniskin camp seep area--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula-Beal Well Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 17, T5S, R23W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from pond drainage near suspected seep during wet period.

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	24	1.03	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	37	0.61
Magnesium	Trace	--	Sulfate	8	0.17
Calcium	4	0.20	Sulfide	--	--
Iron	--	--	Chloride	16	0.45
			Hydroxide	--	--
Total Cation		1.23	Total Anion		1.23

Total dissolved solids, Mg/liter 70

Observed pH 6.7

Specific resistance at 68 °F 83.8 ohm meters

TABLE 8. - Analyses of water from Iniskin camp seep area--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Iniskin Peninsula Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 25, T4S, R23W (SM) Date sampled 6/74

Quadrangle Iliamna

Pertinent data regarding sample: Sample obtained from mouth of Fitz 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	26	1.12	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	43	0.71
Magnesium	Trace	--	Sulfate	13	0.27
Calcium	4	0.20	Sulfide	--	--
Iron	--	--	Chloride	12	0.34
			Hydroxide	--	--
Total Cation		1.32	Total Anion		1.32

Total dissolved solids, Mg/liter 76

Observed pH 6.9

Specific resistance at 68 °F 86.0 ohm meters

BECHAROF LAKE

There are essentially three areas around Becharof Lake where oil and gas seeps have been known to exist. One area is the dominant anticlinal feature extending from the east end of Becharof Lake eastward to the ocean waters bordered by Puale Bay on the north and Portage Bay on the south. Demian Hills, located west of the very southern portion of Becharof Lake, is another area, and Gas Rocks, on the southern shore of Becharof Lake approximately midpoint of the lake, is the third. All three areas fall within the Cook Inlet Mesozoic Province.

The anticlinal feature between Becharof Lake and the Pacific Ocean (fig. 4), commonly called the Bear Creek anticline, can be located on the U.S. Geological Survey topographic map series on the Karluk quadrangle. The area, bounded by Puale Bay and Portage Bay, was the site of early drilling, probably on the basis of surface indications of hydrocarbons. During 1903-04, four wells were drilled near the head of Oil Creek, which drains to the Pacific Ocean. All the wells were drilled near seep areas, but were unsuccessful in establishing commercial production. Drilling depths ranged from 728 feet to 1,542 feet.

A 7,596-foot dry hole was drilled on Salmon Creek during 1938-40 (fig. 5). The most recent well to be drilled in the area was spudded in 1957 and completed in 1959 as a 14,375-foot dry hole. This well was drilled upstream of the Bear Creek seeps.

Data regarding the wells drilled between Puale Bay and Portage Bay (Karluk quadrangle) are found in table 9.

TABLE 9. - Wells drilled in Becharof Lake-Puale Bay area

Company	Well	Location[1]	Spudded	Completed	Total depth, feet	Status
J. H. Costello.	No. 1.....	NW1/4 sec 10, T 29 S, R 40 W.	1903	1903	728	Plugged and abandoned.
Do.....	No. 2.....	SE1/4 sec 10, T 29 S, R 40 W.	1904	1904	([2])	Do.
Humble Oil and Refining Co.[3]	Bear Creek Unit No. 1.	510' S, 1,280' W of NE corner, sec 36, T 29 S, R 41 W.	9/23/57	3/4/59	14,375	Do.
Pacific Oil and Commercial Co.	No. 1.....	SW1/4 sec 36, T 28 S, R 40 W.	1903	1904	1,421	Do.
Do.....	No. 2.....	S1/2 sec 2, T 29 S, R 40 W.	1904	1904	1,542	Do.
Standard Oil Co. of California.	Grammer No. 1.	600' N, 2,050' W of SE corner, sec 10, T 30 S, R 41 W.	7/17/38	3/30/40	7,596	Do.

[1] Based on Seward meridian.
[2] Unknown.
[3] Now Exxon Co., U.S.A.

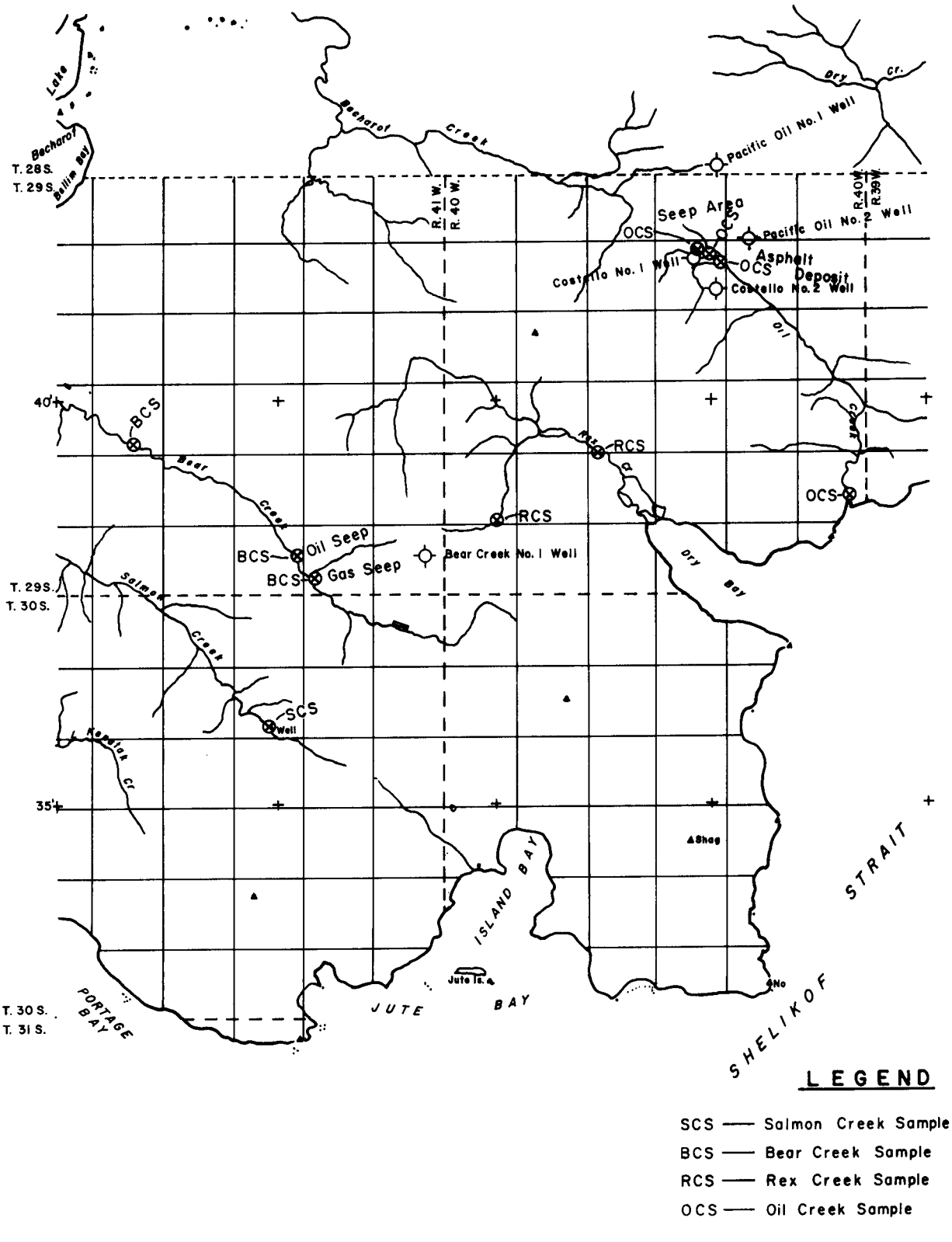

FIGURE 4. - Bear Creek anticline sampling locations (adapted from U.S. Geological Survey map of the Karluk quadrangle).

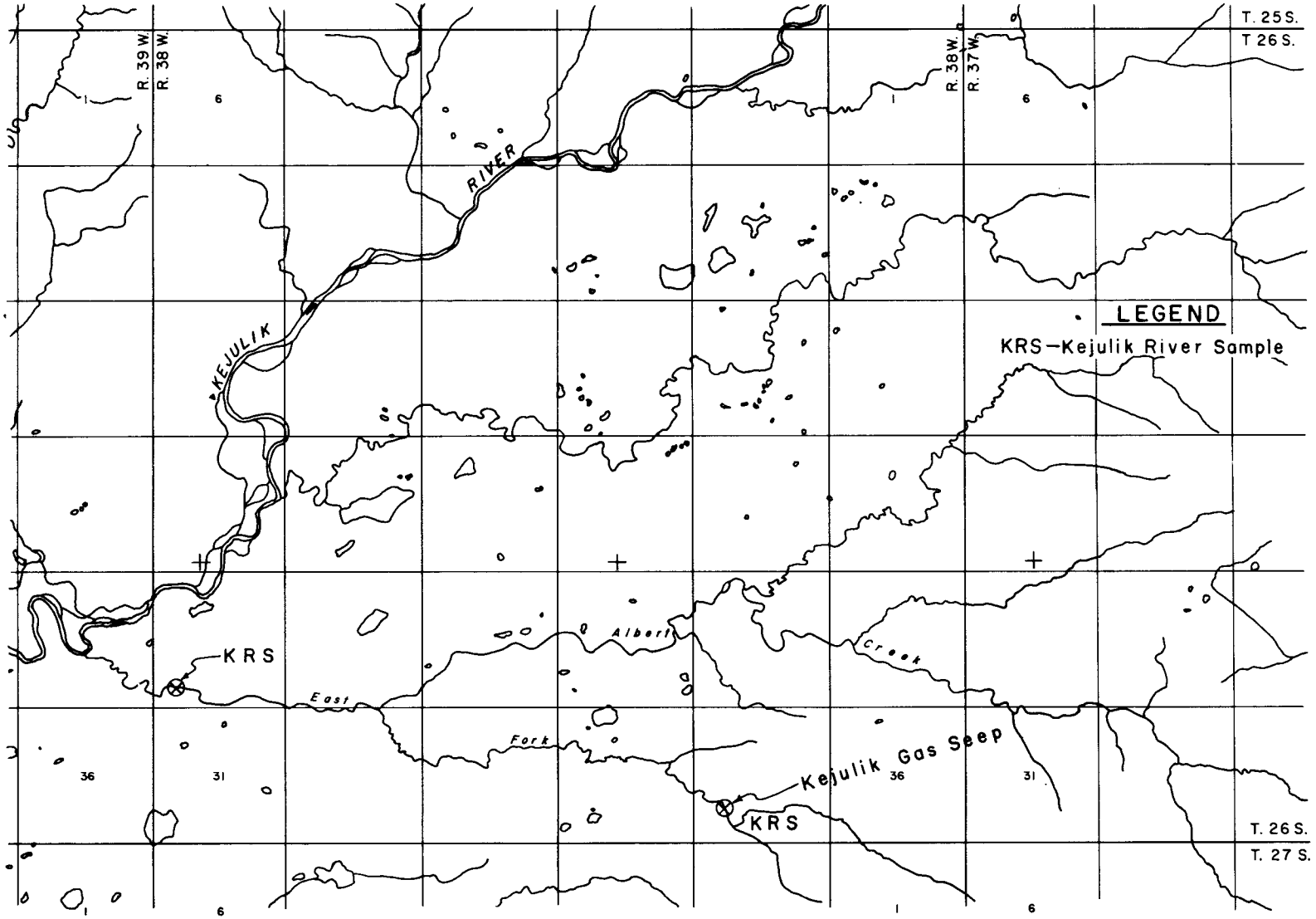

FIGURE 5. - Kejulik River gas sampling locations (adapted from U.S. Geological Survey map of the Karluk quadrangle).

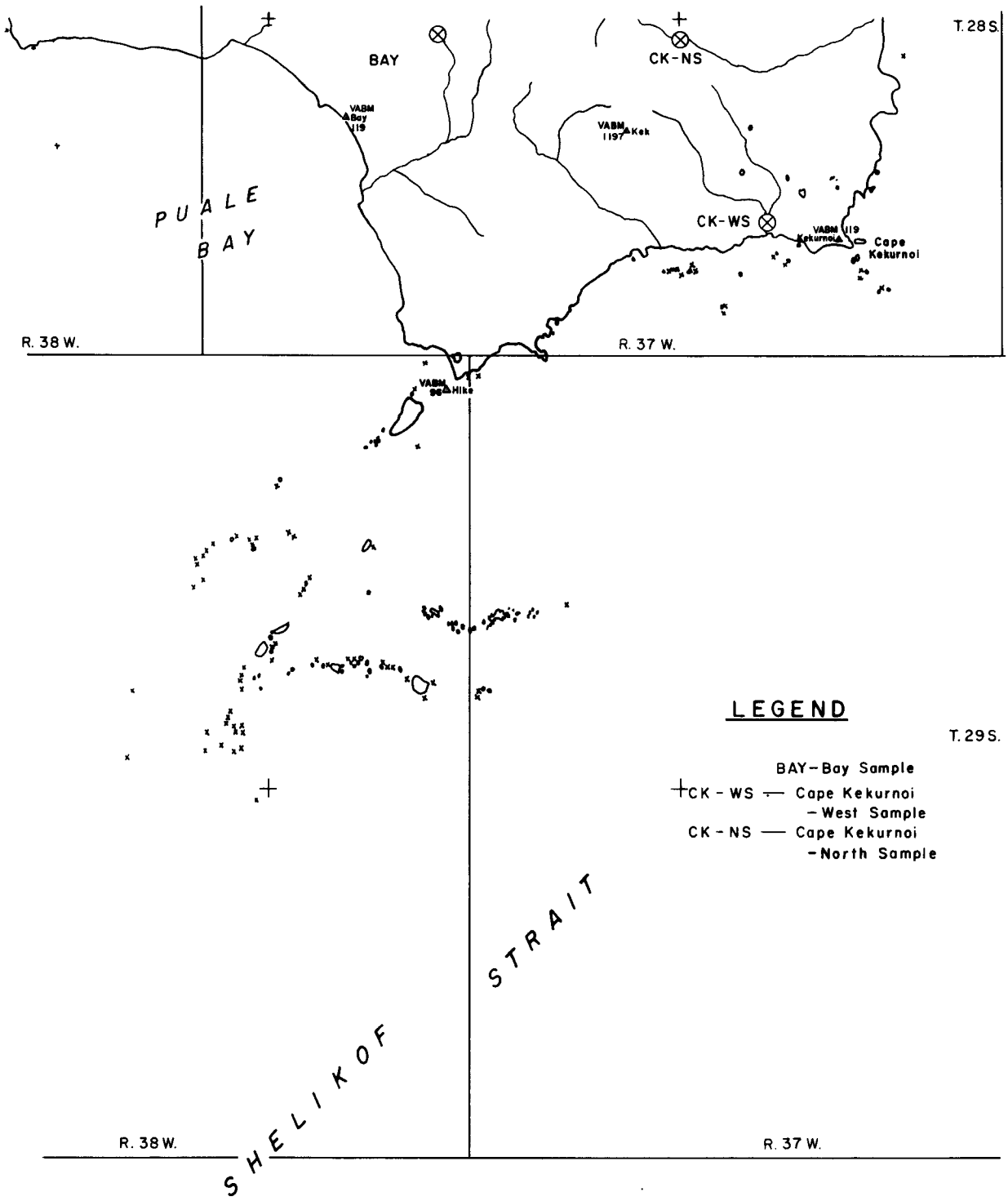

FIGURE 6. - Cape Kekurnoi sampling locations (adapted from U.S. Geological Survey map of the Karluk quadrangle).

The U.S. Geological Survey[6] references the oil and gas seeps in the area between Becharof Lake and Puale Bay as follows: "In the Kanatak district active oil and gas seeps and oil residues are found principally in two areas: southwest of Puale Bay in the vicinity of Oil Creek and on the Bear Creek-Salmon Creek anticline... The flow of oil at the largest of these seeps was estimated in 1921 to be about half a barrel per day."

Becharof Lake-Kejulik River

A significant gas seep was located and sampled on the East Fork of the Kejulik River (fig. 5). This seep is notable because the analysis indicates a relatively high Btu value. The seep itself was located on the north side of the main stream, a 6-foot-diameter water pool with gas emanating vigorously. The gas would flame upon ignition. Samples of the gas and water were obtained from this location, and an additional water sample was obtained near the junction of the East Fork and mainstream Kejulik River. The analyses for these samples are found in tables 10-12.

The peninsula between Puale Bay and Alinchak Bay (fig. 6) has a number of unnamed, short-length creeks. Several of the creeks were investigated in an attempt to establish seep locations. Definite seeps were not observed, but areas suspected of being seeps were found. Samples were taken from three creeks and analyses are given in table 13.

Other creeks draining directly into Puale Bay were reconnoitered, but visual inspection revealed no seeps on Helen Creek, Portage Creek, Teresa Creek, Dry Creek, Train Creek, and Katie Creek. According to the analyses, water from these creeks did not contain significant amounts of oil.

Oil Creek-Puale Bay

The oil and gas seeps at the head of Oil Creek (fig. 4) are the most prolific of those observed on the Alaska Peninsula. Oil and gas issue from two separate springs situated at the foot of a small knoll on the southern side of Oil Creek.

---

[6]Work cited in footnote 5.

TABLE 10. - Analysis of gas from East Fork, Kejulik River

Sample from: Well_____ Stream_____ Seep__X__ Other_____

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

Location SW 1/4, Sec. 35, T26S, R38W (SM) Date sampled 6/74

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained from vigorous gas seep near the headwaters of East Fork of Kejulik River, south of Katmai National Monument.

Analysis: Performed by U.S. Bureau of Mines

Provided by_____

Special results:

Analysis:

Methane	73.6 %	Normal Pentane	0.0 %	Oxygen	0.0 %
Ethane	Trace %	Isopentane	0.0 %	Argon	0.5 %
Propane	Trace %	Cyclopentane	0.0 %	Hydrogen	0.0 %
Normal Butane	0.0 %	Hexanes Plus	0.0 %	H2S	0.0 %
Isobutane	0.0 %	Nitrogen	25.8 %	CO2	Trace %
				Helium	0.01 %
				Total	99.9 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 746

Specific Gravity 0.664

TABLE 11.- Analysis of water from gas seep on East Fork, Kejulik River

Sample from: Well_____ Stream_____ Seep X Other_____

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

Location SW 1/4, Sec. 35, T26S, R38W (SM) Date sampled 6/74

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained from vigorous gas seep near the headwaters of the East Fork of Kejulik 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	48	2.08	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	67	1.10
Magnesium	Trace	--	Sulfate	Trace	--
Calcium	4	0.20	Sulfide	--	--
Iron	--	--	Chloride	42	1.18
			Hydroxide	--	--
Total Cation		2.28	Total Anion		2.28

Total dissolved solids, Mg/liter 127

Observed pH 7.5

Specific resistance at 68°F 54.7 ohm meters

TABLE 12.- Analysis of water from Kejulik River

Sample from: Well_____ Stream X Seep_____ Other_____

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

Location SW 1/4, Sec. 30, T26S, R38W (SM) Date sampled 6/74

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained from East Fork of Kejulik River near its juncture with the mainstream Kejulik 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	13	0.56	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	24	0.39
Magnesium	Trace	--	Sulfate	Trace	--
Calcium	Trace	--	Sulfide	--	--
Iron	--	--	Chloride	6	0.17
			Hydroxide	--	--
Total Cation		0.56	Total Anion		0.56

Total dissolved solids, Mg/liter 31

Observed pH 6.9

Specific resistance at 68 °F 239 ohm meters

TABLE 13.- Analyses of water from Cape Kekurnoi area

Sample from: Well_____ Stream_____ Seep X Other_____

Area Puale Bay Sampled by U.S. Bureau of Mines

Location SE 1/4, Sec. 20, T28S, R38W (SM) Date sampled 6/73

Quadrangle Karluk

Pertinent data regarding sample: Sample taken from small seep at head of creek with mouth entering Puale Bay near VABM-Bay.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---44.7

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	128	5.55	Carbonate	0	--
Potassium	2	0.05	Bicarbonate	305	5.00
Magnesium	6	0.49	Sulfate	30	0.62
Calcium	2	0.80	Sulfide	--	--
Iron	--	--	Chloride	45	1.27
			Hydroxide	--	--
Total Cation		6.89	Total Anion		6.89

Total dissolved solids, Mg/liter 363

Observed pH 7.2

Specific resistance at 68 °F 30.0 ohm meters

TABLE 13. - Analyses of water from Cape Kekurnoi area--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Puale Bay Sampled by U.S. Bureau of Mines

Location Sec. 35, T28S, R37W (SM) Date sampled 6/74

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained from mouth of Creek having mouth just west of Cape Kekurnoi.

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	21	0.90	Carbonate	0	--
Potassium	1	0.03	Bicarbonate	39	0.64
Magnesium	Trace	--	Sulfate	8.	0.17
Calcium	6	0.30	Sulfide	--	--
Iron	--	--	Chloride	15	0.42
			Hydroxide	--	--
Total Cation		1.23	Total Anion		1.23

Total dissolved solids, Mg/liter 70

Observed pH 7.4

Specific resistance at 68 °F 87.0 ohm meters

TABLE 13. - Analyses of water from Cape Kekurnoi area--Continued

Sample from: Well_____ Stream_____ Seep X Other_____

Area Puale Bay Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 21, T28S, R37W (SM) Date sampled 6/73

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained from suspected seep at head of creek which drains into Shelikof Strait about 1 mile north of Cape Kekurnoi.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---33.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	221	9.63	Carbonate	0	--
Potassium	5	0.13	Bicarbonate	476	7.81
Magnesium	5	0.41	Sulfate	10	0.21
Calcium	1	0.05	Sulfide	--	--
Iron	--	--	Chloride	78	2.20
			Hydroxide	--	--
Total Cation		10.22	Total Anion		10.22

Total dissolved solids, Mg/liter 555

Observed pH 6.3

Specific resistance at 68 °F 20.0 ohm meters

Seep A (fig. 4) was found in a water-oil pond about 18 inches in diameter and 5 inches deep, which bubbled intermittently but constantly. A frothy oil covered the seep area. The water and oil from this seep flow into a pond about 20 feet by 40 feet. The base and sides of this pond are covered by a tarlike substance where the oil has settled out over a number of years. The water and oil from the seep run over this substance and continue on toward Oil Creek. It appears that the heavier fractions have filtered out throughout the years, aided by the vegetation; an area approximately 350 feet wide and 800 feet long is covered by a bitumen deposit ranging from 6 inches to 13 inches thick. This bitumen is also aided in deposition by seep B. The deposit is weathered dry on the surface, but the substance displays a moist, malleable, asphalt-type characteristic when penetrated. One strikingly noticeable aspect of this bitumen deposit was that the grass vegetation growing in the bitumen exhibited greener, more consistent growth than that of the surrounding countryside. Gas bubbling up through the seep burst into flame when lit with a match. The flame was sustained as long as the emission was constant.

Seep B (fig. 4) was located approximately 45 feet west of seep A. The seep was not as readily discernable as seep A, since it lacked the physical activity of a bubbling spring. The head of the seep area is a series of approximately five small water trickles that cover an area with a radius of 4 feet and collect at one point. The water-collection pond widens into a pool and then narrows down once more into a small running creek about 18 inches wide and 8 inches deep. Flow of water in this creek at the time of observation was estimated to be about 6 gal/min. The oil stained the side of the creekbed and adjacent vegetation, and what appeared to be a paraffin was evident in areas of slow running water and where twigs and branches of small willows hung across the creek.

At the time of observation of the seeps on Oil Creek, most of the snow had melted, although snow banks still persisted in cut banks and hollows. Little rainfall had been received. However, it is evident that the flow of the springs and creeks carrying bitumen would vary markedly depending upon runoff from snow melt and rain. This is illustrated by the fact that the bitumen was spread high about and along the small creek banks and on the vegetation. Whether the amount of seep oil emerging from the springs is influenced by variance in precipitation was not determined.

Two of the four wells drilled on Oil Creek were found by locating the rusting remains of drilling equipment. Although mounds of the tarlike substance (undoubtedly used as boiler fuel) were found near the well locations, no active seeps were found nearby, nor were leaks detected from the wells.

Of significance is the minimal amount of oil that seemed to be in the water in relation to the large amount that seemed to be issuing from the seeps.

Analyses of the gas, oil, water, and bitumen from the Oil Creek seeps are given in tables 14-20.

TABLE 14.- Analysis of gas from Oil Creek seep A

Sample from: Well_____ Stream_____ Seep X Other_____

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

Location NE 1/4, Sec. 10, T29S, R40W (SM) Date sampled 6/74

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained at Seep A at head of Oil Creek.

Analysis: Performed by U.S. Bureau of Mines

Provided by_____

Special results:

Analysis:

Methane	91.2 %	Normal Pentane	0.0 %	Oxygen	Trace %
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	6.7 %	CO2	1.9 %
				Helium	Trace %
			Total		99.9 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 924

Specific Gravity 0.601

TABLE 15.- Analysis of oil from Oil Creek seep A

Sample From: Well _____ Stream _____ Seep X Other _____

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

Location NE 1/4, Sec. 10, T29S, R40W (SM) Date Sampled 6/73

Quadrangle Karluk

Pertinent Data Regarding Sample: Sample obtained from Seep A at the head of Oil Creek.

Analysis: Performed by Commercial firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9616
A.P.I. gravity @ 60°F.	15.7
Saybolt Universal Viscosity @ 70°F., seconds	Not determined
Saybolt Universal Viscosity @ 100°F., seconds	Not determined
B. s. and water, % by volume	73
Pour point, °F.	Not determined
Total sulphur, % by weight	0.58

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	180	55	578
5	242	60	580
10	292	65	
15	330	70	
20	382	75	
25	425	80	
30	468	85	
35	502	90	
40	534	95	
45	552	E.P.	
50	568		

Approximate Recovery

300° E.P. gasoline, %	11.0	Recovery, %	61.0
392° E.P. gasoline, %	21.0	Residue, %	39.0
500° E.P. distillate, %	15.0	Loss, %	0

TABLE 16.- Analysis of water from Oil Creek seep A

Sample from: Well_____ Stream X Seep_____ Other_____

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

Location NE 1/4, Sec. 10, T29S, R4OW (SM) Date sampled 6/73

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained in drainage creek about 100 yards downstream from Oil Seep A at head of Oil Creek.

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	26	1.11	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	37	0.61
Magnesium	Trace	--	Sulfate	5	0.10
Calcium	2	0.08	Sulfide	--	--
Iron	--	--	Chloride	17	0.48
			Hydroxide	--	--
Total Cation		1.19	Total Anion		1.19

Total dissolved solids, Mg/liter 68

Observed pH 6.3

Specific resistance at 68 °F 195.0 ohm meters

TABLE 17.- Analysis of oil from Oil Creek seep B

Sample From: Well _____ Stream _____ Seep X Other _____

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

Location NE 1/4, Sec. 10, T29S, R40W (SM) Date Sampled 6/73

Quadrangle Karluk

Pertinent Data Regarding Sample: Sample obtained from prominent trickle stream making up Seep B at head of Oil Creek.

Analysis: Performed by Commercial firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9254
A.P.I. gravity @ 60°F.	21.4
Saybolt Universal Viscosity @ 70°F., seconds	Not determined
Saybolt Universal Viscosity @ 100°F., seconds	Not determined
B. s. and water, % by volume	73
Pour point, °F.	Not determined
Total sulphur, % by weight	0.21

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	456	55	
5	504	60	
10	538	65	
15	542	70	
20	546	75	
25	548	80	
30	550	85	
35		90	
40		95	
45		E.P.	
50			

Approximate Recovery

300° E.P. gasoline, %	0	Recovery, %	31.0
392° E.P. gasoline, %	0	Residue, %	69.0
500° E.P. distillate, %	4.5	Loss, %	0.0

TABLE 18.- Analysis of water from Oil Creek seep B

Sample from: Well_____ Stream X Seep_____ Other_____

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

Location NE 1/4, Sec. 10, T29S, R40W (SM) Date sampled 6/73

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained from creek about 300 yards downstream from Seep B at head of Oil Creek.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---3.6

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	26	1.12	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	31	0.51
Magnesium	Trace	--	Sulfate	10	0.21
Calcium	1	0.05	Sulfide	--	--
Iron	--	--	Chloride	16	0.45
			Hydroxide	--	--
Total Cation		1.17	Total Anion		1.17

Total dissolved solids, Mg/liter 68

Observed pH 6.8

Specific resistance at 68 °F 220.0 ohm meters

TABLE 19. - Analyses of water from Oil Creek

Sample from: Well_____ Stream X Seep_____ Other_____

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

Location NE 1/4, Sec. 10, T29S, R40W (SM) Date sampled 6/74

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained about 50 feet below juncture of drainage from Seep A and Seep B at head of Oil Creek.

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	37	1.61	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	67	1.10
Magnesium	Trace	--	Sulfate	Trace	--
Calcium	1	0.05	Sulfide		
Iron	--	--	Chloride	20	0.56
			Hydroxide		
Total Cation		1.66	Total Anion		1.66

Total dissolved solids, Mg/liter 91

Observed pH 6.9

Specific resistance at 68 °F 124.0 ohm meters

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

Sample from: Well_____ Stream X Seep_____ Other_____

Area SE 1/4, Sec. 25, T29S, R40W (SM) Sampled by U.S. Bureau of Mines

Location Karluk Date sampled 6/74

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained at mouth of Oil 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	18	0.78	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	24	0.39
Magnesium	Trace	--	Sulfate	Trace	--
Calcium	Trace	--	Sulfide	--	--
Iron	--	--	Chloride	14	0.39
			Hydroxide	--	--
Total Cation		0.78	Total Anion		0.78

Total dissolved solids, Mg/liter 44

Observed pH 6.7

Specific resistance at 68 °F 164.0 ohm meters

TABLE 20. - Analyses of oil from Oil Creek bitumen

Sample From: Well _____ Stream _____ Seep X Other _____

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

Location NE 1/4, Sec. 10, T29S, R40W (SM) Date Sampled 6/73

Quadrangle Karluk

Pertinent Data Regarding Sample: Sample obtained from bitumen deposit buildup near Seep A.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.977
A.P.I. gravity @ 60°F.	13.3
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	0.12
Nitrogen	0.27

Distillation

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

NOT DETERMINED

Approximate Recovery

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

TABLE 20. - Analyses of oil from Oil Creek bitumen--Continued

Sample From: Well _____ Stream _____ Seep _____ Other (See pertinent data) _____

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

Location SE 1/4, Sec. 10, T29S, R40W (SM) Date Sampled 6/73

Quadrangle _____

Pertinent Data Regarding Sample: Sample obtained from mound suspected of being transported to well site from main bitumen deposit for purpose of fueling boiler.

Analysis: Performed by U.S. Bureau of Mines

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	1.008
A.P.I. gravity @ 60°F.	8.9
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	0.24
Nitrogen, %	0.27

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP		55	
5		60	
10		65	
15		70	
20		75	
25		80	
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, %	

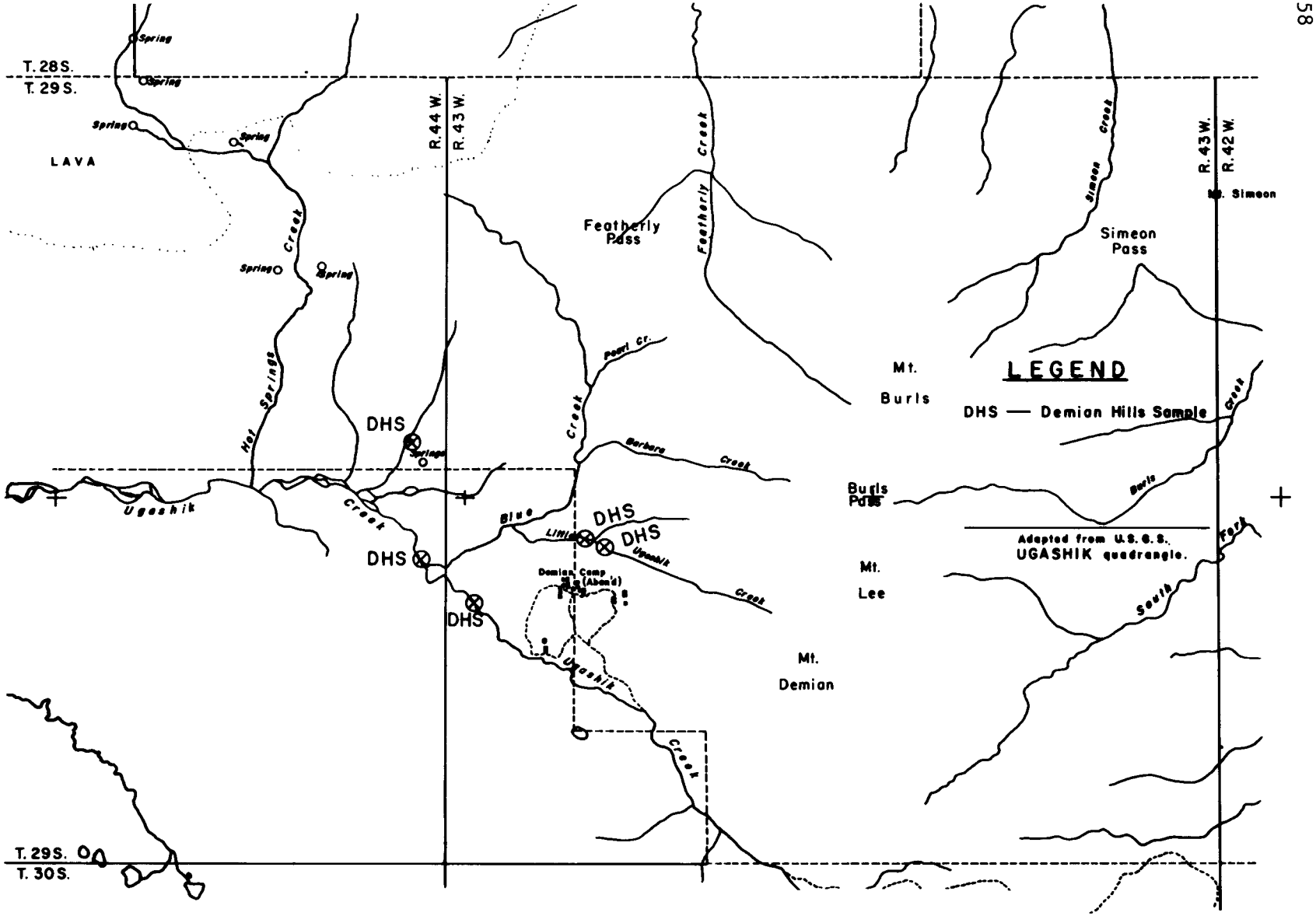

FIGURE 7. - Demian Hills sampling locations (adapted from U.S. Geological Survey map of the Ugashik quadrangle).

Rex Creek-Puale Bay

Although no noticeable oil or gas seeps were observed on any of the forks or mainstream of Rex Creek, a blue-sheened water seep was observed near the south fork of Rex Creek. This seep was sampled, and the creek was sampled near its mouth. Analyses from Rex Creek waters are found in table 21.

All of the creeks affected by the seeps previously discussed drain into the Pacific Ocean, on the western Gulf of Alaska. Two creeks with oil and/or gas seeps drain westward into Becharof Lake. The occurrence of these seeps is probably controlled by the same geologic conditions.

Bear Creek-Becharof Lake

A gas seep was located on Bear Creek downstream from the landing strip that serviced the drilling operations of the Bear Creek No. 1 exploratory well drilled in 1957-59. The seep was vigorous and the bubbles emerging from the base of the water pool were sufficient to ignite a flame despite a moderately strong west wind.

An oil seep was also located on Bear Creek (fig. 4). The seep covers an area of about 100 feet by 150 feet. There are two separate seep ponds about 60 feet apart. There was no indication that oil was actively being seeped to the surface, although oil scum floated on the surface of the water and clung to the grass along the seep drainage. Occasionally, gas bubbles rose sporadically to the surface through the water.

The analyses of the gas and fluids from the Bear Creek seeps are found in tables 22-25.

At the time of observation, the abandoned well site was found to be in excellent condition, with no seep of any kind emitting from the plugged hole.

Salmon Creek-Becharof Lake

No active discernable oil or gas seeps were observed on Salmon Creek (fig. 4). However, a sample of gas was obtained from a pool of water surrounding the surface casing of a plugged and abandoned well near the head of Salmon Creek. The emerging gas bubbles would not ignite. The gas and water analyses are given in tables 26-27.

Demian Hills

The Demian Hills area can be located on the U.S. Geological Survey topographic map series on the Ugashik quadrangle. The western flank of Mount Demian also had early-day oil exploration. Between 1923 and 1926, five wells were drilled near the oil seeps between Ugashik Creek and Little Ugashik Creek. This area is often referred to as the Pearl Creek dome (fig. 7). Information regarding these wells is given in table 28.

TABLE 21.- Analyses of water from Rex Creek

Sample from: Well_____ Stream X Seep_____ Other_____

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

Location SE 1/4, Sec. 30, T29S, R40W (SM) Date sampled 6/73

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained near the head of the South Fork of Rex Creek

Analysis: Performed by Commercial firm

Provided by

Special results: Oil content, mg/l---9.6

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	22	0.94	Carbonate	0	--
Potassium	1	0.03	Bicarbonate	38	0.62
Magnesium	1	0.08	Sulfate	Trace	--
Calcium	2	0.08	Sulfide	--	--
Iron	--	--	Chloride	18	0.51
			Hydroxide	--	--
Total Cation		1.13	Total Anion		1.13

Total dissolved solids, Mg/liter 63

Observed pH 6.5

Specific resistance at 68 °F 220.0 ohm meters

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

Sample from: Well_____ Stream X Seep_____ Other_____

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

Location NW 1/4, Sec. 21, T29S, R40W (SM) Date sampled 6/73

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained about 1 mile upstream from mouth of Rex Creek.

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	23	0.98	Carbonate	0	--
Potassium	1	0.03	Bicarbonate	43	0.71
Magnesium	1	0.08	Sulfate	2	0.94
Calcium	1	0.05	Sulfide	--	--
Iron	--	--	Chloride	14	0.39
			Hydroxide	--	--
Total Cation		1.14	Total Anion		1.14

Total dissolved solids, Mg/liter 63

Observed pH 6.5

Specific resistance at 68 °F 140.0 ohm meters

TABLE 22.- Analysis of gas from Bear Creek gas seep

Sample from: Well_____ Stream_____ Seep X Other_____

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

Location SW 1/4, Sec. 35, T29S, R41W (SM) Date sampled 6/74

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained from active gas seep on Bear Creek downstream from Bear Creek well drilling site.

Analysis: Performed by U.S. Bureau of Mines

Provided by_____

Special results:

Analysis:

Methane	85.3%	Normal Pentane	0.0 %	Oxygen	0.0 %
Ethane	0.0%	Isopentane	0.0 %	Argon	0.2 %
Propane	0.1%	Cyclopentane	0.0 %	Hydrogen	0.0 %
Normal Butane	0.0%	Hexanes Plus	0.0 %	H2S	0.0 %
Isobutane	0.0%	Nitrogen	14.3 %	CO2	0.1 %
				Helium	0.01%
			Total		100.0 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 867

Specific Gravity 0.622

TABLE 23.- Analyses of water from Bear Creek oil seep

Sample from: Well_____ Stream_____ Seep X Other_____

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

Location NE 1/4, Sec. 34, T29S, R41W (SM) Date sampled 6/73

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained from pond area of dormant oil and gas seep on Bear Creek.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---18.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	28	1.21	Carbonate	0	--
Potassium	1	0.03	Bicarbonate	73	1.20
Magnesium	2	0.16	Sulfate	Trace	--
Calcium	9	0.36	Sulfide	--	--
Iron	--	--	Chloride	20	0.56
			Hydroxide	--	--
Total Cation		1.76	Total Anion		1.76

Total dissolved solids, Mg/liter 96

Observed pH 6.7

Specific resistance at 68 °F 95 ohm meters

TABLE 23. - Analyses of water from Bear Creek oil seep--Continued

Sample from: Well_____ Stream_____ Seep_____ Other X

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

Location NE 1/4, Sec. 34, T29S, R41W (SM) Date sampled 6/73

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained from small trickle stream which drains the seep area into Bear Creek.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---4.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	26	1.14	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	50	0.82
Magnesium	1	0.08	Sulfate	5	0.10
Calcium	3	0.12	Sulfide	--	--
Iron	--	--	Chloride	15	0.42
			Hydroxide	--	--
Total Cation		1.34	Total Anion		1.34

Total dissolved solids, Mg/liter 75

Observed pH 7.2

Specific resistance at 68 °F 170.0 ohm meters

TABLE 24.- Analysis of oil from Bear Creek oil seep

Sample From: Well _____ Stream _____ Seep X Other _____

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

Location NE 1/4, Sec. 34, T29S, R41W (SM) Date Sampled 6/73

Quadrangle Karluk

Pertinent Data Regarding Sample: Sample obtained from heavy tar-like substance clinging to vegetative debris floating on pond of seep area.

Analysis: Performed by Commercial firm

Provided by _____

General Characteristics:

Specific gravity @ 60/60 °F.	0.9705
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	56
Pour point, °F.	Not determined
Total sulphur, % by weight	0.59

Distillation

Recovery, %	Temperature, °F.	Recovery, %	Temperature, °F.
IBP	550	55	
5	564	60	
10	578	65	
15	588	70	
20	590	75	
25	600	80	
30		85	
35		90	
40		95	
45		E.P.	
50			

Approximate Recovery

300° E.P. gasoline, %	0	Recovery, %	25.0
392° E.P. gasoline, %	0	Residue, %	75.0
500° E.P. distillate, %	0	Loss, %	0

TABLE 25.- Analysis of water from Bear Creek

Sample from: Well_____ Stream X Seep_____ Other_____

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

Location SE 1/4, Sec. 20, T29S, R41W (SM) Date sampled 6/74

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained in Bear Creek about 4 miles upstream from Bear Creek mouth.

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	0.61	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	24	0.39
Magnesium	Trace	--	Sulfate	2	0.04
Calcium	1	0.05	Sulfide	--	--
Iron	--	--	Chloride	8	0.23
			Hydroxide	--	--
Total Cation		0.66	Total Anion		0.66

Total dissolved solids, Mg/liter 37

Observed pH 6.8

Specific resistance at 68 °F 173.0 ohm meters

TABLE 26.- Analysis of gas from Salmon Creek gas seep

Sample from: Well_____ Stream_____ Seep_____ Other See pertinent data

Area Becharof Lake-Salmon Creek Sampled by U.S. Bureau of Mines

Location SE 1/4, Sec. 10, T30S, R41W (SM) Date sampled 6/73

Quadrangle Karluk

Pertinent data regarding sample: Sample obtained from pool of water surrounding surface casing of abandoned exploratory well.

Analysis: Performed by U.S. Bureau of Mines

Provided by_____

Special results:

Analysis:

Methane	18.9 %	Normal Pentane	0.0 %	Oxygen	0.4 %
Ethane	0.2 %	Isopentane	0.0 %	Argon	0.0 %
Propane	0.1 %	Cyclopentane	0.0 %	Hydrogen	0.0 %
Normal Butane	0.0 %	Hexanes Plus	0.0 %	H2S	0.0 %
Isobutane	0.0 %	Nitrogen	3.0 %	CO2	77.3 %
				Helium	0.01 %
			Total		99.9 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 198

Specific Gravity 1.324

TABLE 27.- Analysis of water from Salmon Creek gas seep

Sample from: Well_____ Stream_____ Seep_____ Other See pertinent data

Area Becharof Lake-Salmon Creek Sampled by U.S. Bureau of Mines

Location SE 1/4, Sec. 10, T30S, R41W (SM) Date sampled 6/73

Quadrangle Karluk

Pertinent data regarding sample: Water sample obtained from pool of water surrounding surface casing of abandoned exploratory well.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---7.6

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	116	5.03	Carbonate	0	--
Potassium	3	0.08	Bicarbonate	183	3.00
Magnesium	5	0.41	Sulfate	Trace	--
Calcium	9	0.36	Sulfide	--	
Iron	--	--	Chloride	102	2.88
			Hydroxide	--	--
Total Cation		5.88	Total Anion		5.88

Total dissolved solids, Mg/liter 325

Observed pH 7.0

Specific resistance at 68 °F 25.0 ohm meters

TABLE 28. - Wells drilled in Demian Hills area

Company	Well	Location[1]	Spudded	Completed	Total depth, feet	Status
Standard Oil Co. of California.	Lathrop No. 1.	SE1/4SE1/4 sec 17, T 29 S, R 43 W.	1923	1923	500	Plugged and abandoned.
Do.....	Lee No. 1.	1,600' E of SW corner, sec 20, T 29 S, R 43 W.	3/19/23	1/16/26	5,034	Do.
Do.....	McNally No. 1.	2,000' S, 500' E of NW corner, sec 29, T 29 S, R 43 W.	1925	1925	510	Do.
Tidewater Associated Oil Co.	Alaska Well No. 1.	800' N of SW corner, sec 20, T 29 S, R 43 W.	1/18/23	1/16/26	3,033	Do.
Do.....	Finnegan No. 1.	1,854' S, 1,074' W of NE corner, sec 30, T 29 S, R 43 W.	4/6/23	6/30/23	560	Do.

[1] Based on Seward meridian.

The old oil exploration camp on the west flank of Mount Demian was checked for active oil seeps. None were found. Several mounds of a tarlike substance were found near the remains of the drilling equipment. Since no other evidence of oil seeps were discovered, it was surmised that the bitumen was transported from other areas, perhaps the Oil Creek seeps to the east, and used as boiler fuel. Analysis of water taken in and near the Demian Hills camp and analysis of a gas seep found west of Demian Hills camp are found in tables 29-30.

Gas Rocks

Gas Rocks is located on the south shore of Becharof Lake (fig. 8). The area can be found in the U.S. Geological Survey topographic map series on the Ugashik quadrangle. This area has gas seeps emanating underwater offshore. No wells have been drilled near the area.

An interesting seep area was observed just offshore of Gas Rocks on the south shore of Becharof Lake. A vigorous natural gas seep was observed at this location, obviously the reason for the geographic nomenclature of the area. Numerous fractures or cracks can be seen on the lake bottom in an area the size of which could not be definitely determined because of wave and wind action on the water. Bubbles are emitted continuously, and can even be observed on a relatively windy day. It is difficult to determine the areal extent of the seep area. Local residents claim that in the winter, the bubbles of gas keep the area free of ice. A sample was obtained and the analysis is found in table 31.

TABLE 29.- Analyses of water from Demian Hills area

Sample from: Well_____ Stream_____ Seep_____ Other X

Area Mt. Demian Sampled by U.S. Bureau of Mines

Location NE 1/4, Sec. 29, T29S, R43W (SM) Date sampled 6/73

Quadrangle Ugashik

Pertinent data regarding sample: Sample obtained from spring area about 500 yards NW of camp.

Analysis: Performed by Commercial firm

Provided by

Special results: Oil content, mg/l---23.3

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	166	7.22	Carbonate	0	--
Potassium	3	0.08	Bicarbonate	317	5.20
Magnesium	3	0.25	Sulfate	34	0.71
Calcium	1	0.05	Sulfide	--	--
Iron	--	--	Chloride	60	1.69
			Hydroxide	--	--
Total Cation		7.60	Total Anion		7.60

Total dissolved solids, Mg/liter 423

Observed pH 7.2

Specific resistance at 68 °F 31.0 ohm meters

TABLE 29. - Analyses of water from Demian Hills area--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Mt. Demian Sampled by U.S. Bureau of Mines

Location SW 1/4, Sec. 20, T29S, R43W (SM) Date sampled 6/73

Quadrangle Ugashik

Pertinent data regarding sample: Sample obtained from spring seep area feeding into Little Ugashik Creek.

Analysis: Performed by Commercial firm

Provided by_____

Special results: Oil content, mg/l---3.1

Analysis:

Cations	Mg/liter	Meq/liter	Anions	Mg/liter	Meq/liter
Sodium	25	1.08	Carbonate	0	--
Potassium	1	0.03	Bicarbonate	43	0.71
Magnesium	1	0.08	Sulfate	2	0.04
Calcium	3	0.12	Sulfide	--	--
Iron	--	--	Chloride	20	0.56
			Hydroxide	--	--
Total Cation		1.31	Total Anion		1.31

Total dissolved solids, Mg/liter 73

Observed pH 6.5

Specific resistance at 68°F 170.0 ohm meters

TABLE 29. - Analyses of water from Demian Hills area--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Mt. Demian Sampled by U.S. Bureau of Mines

Location Sec. 30, T29S, R43W (SM) Date sampled 6/74

Quadrangle Ugashik

Pertinent data regarding sample: Sample obtained in Ugashik Creek below Demian Oil camp.

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	0.54	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	21	0.34
Magnesium	Trace	--	Sulfate	Trace	--
Calcium	Trace	--	Sulfide	--	--
Iron	--	--	Chloride	7	0.20
			Hydroxide	--	--
Total Cation		0.54	Total Anion		0.54

Total dissolved solids, Mg/liter 29

Observed pH 6.7

Specific resistance at 68 °F 394.0 ohm meters

TABLE 29. - Analyses of water from Demian Hills area--Continued

Sample from: Well_____ Stream X Seep_____ Other_____

Area Mt. Demian Sampled by U.S. Bureau of Mines

Location Sec. 24, T29S, R44W (SM) Date sampled 6/74

Quadrangle Ugashik

Pertinent data regarding sample: Sample obtained about 1,000 feet below fork of Ugashik and Blue Creeks.

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	1.91	Carbonate	0	--
Potassium	Trace	--	Bicarbonate	26	0.43
Magnesium	Trace	--	Sulfate	2	0.04
Calcium	1	0.05	Sulfide	--	--
Iron	--	--	Chloride	53	1.49
			Hydroxide	--	--
Total Cation		1.96	Total Anion		1.96

Total dissolved solids, Mg/liter 113

Observed pH 6.5

Specific resistance at 68 °F 59.5 ohm meters

TABLE 30.- Analysis of gas from Demian Hills area

Sample from: Well_____ Stream_____ Seep__X__ Other_____

Area Mt. Demian Sampled by U.S. Bureau of Mines

Location Sec. 13, T29S, R44W (SM) Date sampled 6/74

Quadrangle Ugashik

Pertinent data regarding sample: Sample obtained about 1/4 mile west of Blue Creek.

Analysis: Performed by U.S. Bureau of Mines

Provided by_____

Special results:

Analysis:

Methane	7.2 %	Normal Pentane	0.0 %	Oxygen	1.8 %
Ethane	9.0 %	Isopentane	0.0 %	Argon	0.3 %
Propane	Trace	Cyclopentane	0.0 %	Hydrogen	0.0 %
Normal Butane	0.0 %	Hexanes Plus	0.0 %	H2S	0.0 %
Isobutane	0.0 %	Nitrogen	20.6 %	CO2	70.1 %
				Helium	Trace %
			Total		100.0 %

Calculated gross Btu/cu.ft., dry at 60°F. and 30" mercury 73

Specific Gravity 1.335

TABLE 31.- Analysis of gas from Gas Rocks seep

Sample from: Well_____ Stream_____ Seep X Other_____

Area Gas Rocks, Becharof Lake Sampled by U.S. Bureau of Mines

Location NW 1/4, Sec. 9, T27S, R44W (SM) Date sampled 6/74

Quadrangle Ugashik

Pertinent data regarding sample: Sample obtained from vigorous widespread seep offshore from Gas Rocks in Becharof Lake.

Analysis: Performed by U.S. Bureau of Mines

Provided by_____

Special results:

Analysis:

Methane	0.1 %	Normal Pentane	0.0 %	Oxygen	3.0 %
Ethane	0.0 %	Isopentane	0.0 %	Argon	0.2 %
Propane	Trace %	Cyclopentane	0.0 %	Hydrogen	0.0 %
Normal Butane	0.0 %	Hexanes Plus	0.0 %	H2S	0.0 %
Isobutane	0.0 %	Nitrogen	12.3 %	CO2	84.5 %
				Helium	Trace %
			Total		100.1 %

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

Specific Gravity 1.447

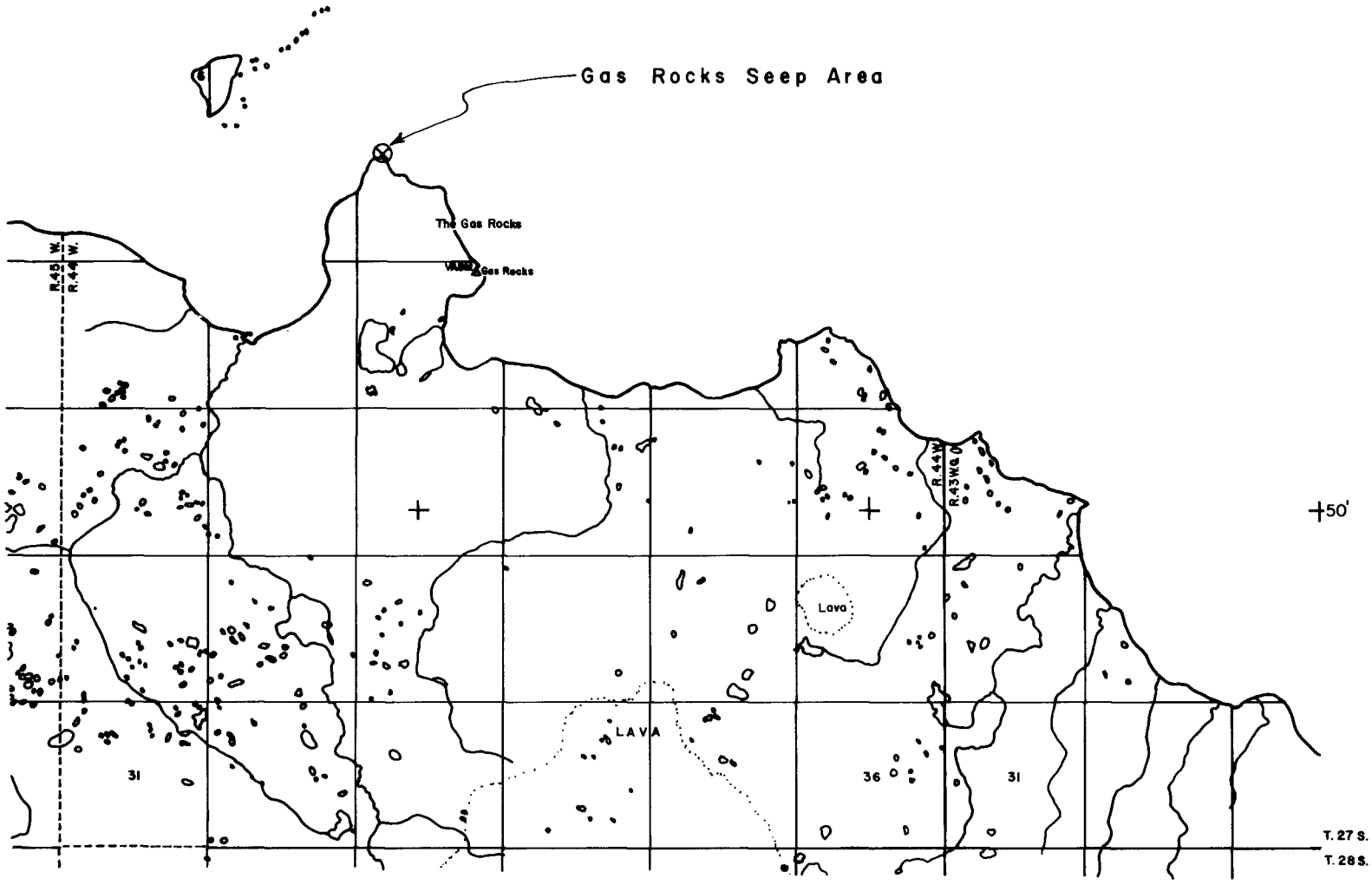

FIGURE 8. - Gas Rocks.

OBSERVATIONS

Of the areas investigated for oil and gas seeps on the Alaska Peninsula, only the seeps at the head of Oil Creek between the Pacific Ocean and Becharof Lake were active enough to be deemed significant. The seeps found on the creeks of the Iniskin Peninsula probably are active, as evidenced by fresh oil floating on seep ponds and a continual rainbow sheen being swept into the drainage creek, Well Creek. However, there was no visual sign, such as gas bubbling or a fresh froth floating on the ponds.

Although bitumen content in some analyses ran quite high at the site of the seep, analyses of the water at the mouth of the creeks draining seeps did not indicate a high degree of bitumen being carried to the terminal water; that is, Pacific Ocean, Becharof Lake, etc. No oil was found on the beach of Puale Bay.

Lush, green growth at seep sites often obscured the seep itself. In particular, the growth of grass through and on top of the asphalt deposit at Oil Creek was a stark and colorful contradiction to the barren surroundings. No attempt was made to determine whether the resultant growth on or near seeps was because of or in spite of the bitumen escaping.

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:

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

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[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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