OIL AND GAS EXPLORATION ON THE INISKIN PENINSULA, ALASKA

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by

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ABSTRACT

Oil and gas exploratory drilling was initiated in the Iniskin Peninsula area in 1900 on the basis of oil and gas seeps which had been found there. Between 1900 and 1906, six holes were drilled in the Oil Bay-Dry Bay drainage area, the deepest going to 1,905 feet. All holes encountered oil and/or gas but commercial production was never attained. Between 1936 and 1939, a well was drilled on the Fitz Creek anticline to a total depth of 8,775 feet. That well produced enough gas to run the camp power plant and had good shows of oil. However, it was plugged and abandoned after strongly flowing salt water shut-off the potentially productive formations.

Another well was drilled and tested at various times between 1954 and 1959. The Beal well was drilled to a total depth of 9,745 feet and again oil and gas shows were encountered throughout the hole. It was suspected that a heavy mud column adversely affected the potential reservoir sands by effectively plugging them and destroying permeability. The hole was plugged and abandoned.

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A well drilled in 1958-59, the Zappa No. 1, also encountered encouraging oil and gas shows but never attained commercial production. Flowing hot salt water and steam were encountered in the drilling of this well, and this may well have been the first well encounter with geothermal potential in the State of Alaska.

The Iniskin Peninsula remains an interesting area for possible hydrocarbon production as well as a promising geothermal resource area.

INTRODUCTION

Natural oil and gas seeps on the Alaska Peninsula led to "early-day" oil drilling in several areas of the Peninsula. One such area was the Iniskin Peninsula, located on lower Cook Inlet near the northern portion of the Alaska Peninsula. By 1975, nine wells had been drilled on the Iniskin Peninsula; all encountered encouraging oil and gas shows but none attained commercial production. Logs and drilling records were studied and it appears that all wells experienced common problems, including trouble with hole caving. All wells encountered encouraging gas formations at shallow depths, and the deeper wells encountered strong flows of salt water at depth. The last well drilled on the Iniskin Peninsula encountered hot salt water and steam.

ACKNOWLEDGMENTS

The author wishes to express thanks to Robert G. Bottge, mining engineer and minerals economist, Bureau of Mines Alaska Field Operation Center (Juneau), for his candid suggestions regarding the preparation of this report and his contribution concerning mineral processing by exploiting geothermal and natural gas resources.

LOCATION

The Iniskin Peninsula lies on the west side of lower Cook Inlet approximately 30 miles west of Homer on the Kenai Peninsula. It is located on the Iliamna quadrangle in the U.S. Geological Survey topographic map series (fig. 1). The Iniskin Peninsula is within a geologic province known as the Cook Inlet Mesozoic Province.2/

LAND STATUS

Under the Alaska Native Claims Settlement Act (Public Law 92-203, Section 11.(a)(3)), the Iniskin Peninsula was withdrawn for Native selection under the definition of "Village Deficiency" lands. According to terms of the Act, villages were to make their selections by December 18, 1974. Most of the land on the Iniskin Peninsula has been selected by villages in the Cook Inlet region, although title to the land has not yet been conveyed (December, 1975).

GEOLOGIC POTENTIAL

The earliest accounts of petroleum activity in the Iniskin area are to be found in U.S. Geological Survey reports.3/ In addition, geologic investigations which resulted in a detailed stratigraphic section description of the area concluded that the Fitz Creek anticline was a structure favorable

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

3/ Martin, G. C. The Petroleum Fields of the Pacific Coast of Alaska, with an account of the Bering River coal deposits. U.S. Geol. Survey Bull. 250, 1905, 64 pp.

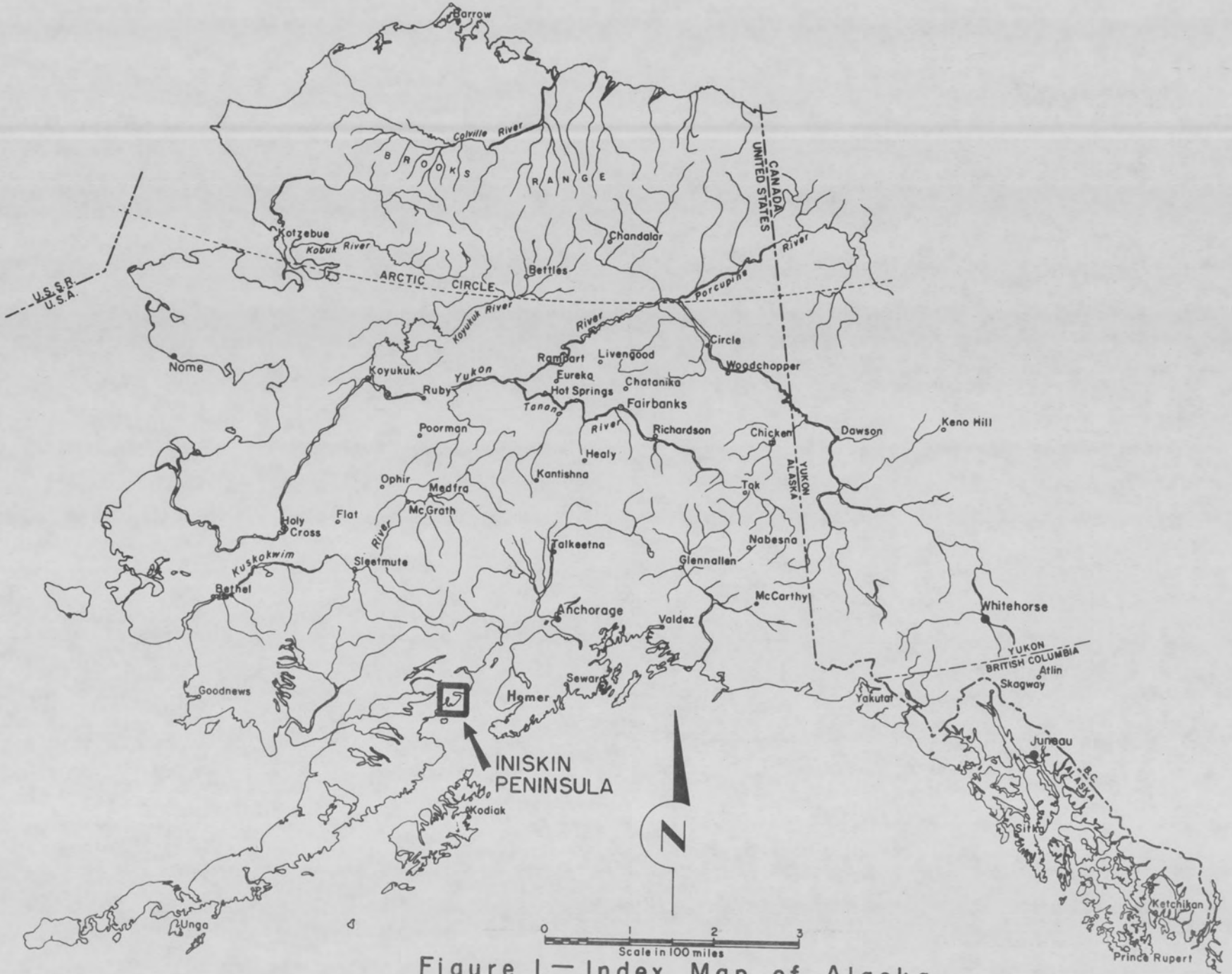

Figure I.— Index Map of Alaska

for the accumulation of oil.4/ In 1966, Detterman reviewed the work of previous geologic investigations and reported on the results of more recent field work on the Alaska Peninsula, as well as interpreting the geologic data obtained from wells drilled in the Iniskin Peninsula.5/ Although the Jurassic rocks could be considered good source rocks, and do contain oil and gas in the wells drilled, commercial production has not been attained.

SEEPS

Oil seeps were first noted on the Iniskin Peninsula during 1882.6/ Claims were staked near the headwaters of Bowser Creek and Brown Creek in 1892, but drilling never took place and claims were abandoned. During 1896, more claims were staked in the Oil Bay area and work was reportedly begun in 1898 by the Alaska Petroleum Company.7/

DRILLING, OIL BAY AND DRY BAY

The earliest drilling on the Iniskin Peninsula began around the turn of the century near the seep areas. The first well was drilled to about

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4/ Kirschner, C. E. and D. L. Minard. Geology of the Iniskin Peninsula, Alaska. U.S. Geol. Survey Oil and Gas Investigations Preliminary Map 95, 1949, 1 p.

5/ Detterman, R. L. and J. K. Hartsock. Geology of the Iniskin-Tuxedni Region, Alaska. U.S. Geol. Survey Professional Paper 512, 1966, 78 pp., 5 plates.

6/ Work cited in footnote 5.

7/ Work cited in footnote 5.

1,000 feet and encountered natural gas in several zones all the way to total depth (table 1). Oil was encountered at around 700 feet, but a water zone below the oil-bearing strata had enough pressure to cut-off the oil flow. The well was subsequently plugged and abandoned. Three additional wells were drilled by the Alaska Petroleum Company between 1904 and 1906. One of the wells was drilled to only 450 feet and then abandoned. The other two wells had oil and gas shows, but were never completed as producers because of hole caving above the potentially productive zone.

The Alaska Oil Company was formed in 1901, and began drilling on Brown Creek near some gas seeps in 1902. Two wells were drilled to shallow depths without success. It is assumed mechanical difficulties played a part in these drilling operations.8/

All of these "early-day" wells were drilled to the south and east of the Fitz Creek anticline about 5 miles south of Chinitna Bay (fig. 2).

During 1973 and 1974, U.S. Bureau of Mines personnel located and observed remnants of oil wells drilled in the early 1900's. Seeps and seep areas were also investigated near what is now known as Well Creek (Iliamna C-1 quadrangle). A definite determination could not be made as to the activeness of the oil seeps. However, oil was seen rising to the surface of ponds and streams, and the waters draining the seep areas continually carried a rainbow sheen indicative of bitumen. Also, free oil was found floating on still ponds. The greenish-colored oil varied

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8/ Work cited in footnote 5.

TABLE 1.- Wells drilled on the Iniskin Peninsula

DRILLED BY	ALASKA PETROLEUM COMPANY
WELL NAME	NO. 1
LOCATION	NE 1/4, SW 1/4, Sec. 11 T. 6 S., R. 24 W., (SM)
SPUD	1900
COMPLETED	1903
TOTAL DEPTH	1,000'
STATUS	Plugged and Abandoned

DRILLED BY	ALASKA PETROLEUM COMPANY
WELL NAME	NO. 2
LOCATION	SW 1/4, NW 1/4, Sec. 11 T. 6 S., R. 24 W., (SM)
SPUD	1904
COMPLETED	1904
TOTAL DEPTH	450'
STATUS	Plugged and Abandoned

DRILLED BY	ALASKA PETROLEUM COMPANY
WELL NAME	NO. 3
LOCATION	SW 1/4, NW 1/4, NW 1/4, Sec. 11 T. 6 S., R. 24 W., (SM)
SPUD	1904
COMPLETED	1904
TOTAL DEPTH	930'
STATUS	Plugged and Abandoned

DRILLED BY	ALASKA PETROLEUM COMPANY
WELL NAME	NO. 4
LOCATION	NW 1/4, SW 1/4, NW 1/4, Sec. 11 T. 6 S., R. 24 W., (SM)
SPUD	1906
COMPLETED	1906
TOTAL DEPTH	1,905'
STATUS	Plugged and Abandoned

TABLE 1.- Wells drilled on the Iniskin Peninsula - Continued

DRILLED BY	ALASKA OIL COMPANY
WELL NAME	NO. 1
LOCATION	SE 1/4, NW 1/4, Sec. 35 T. 5 S., R. 23 W., (SM)
SPUD	1902
COMPLETED	1902
TOTAL DEPTH	320'
STATUS	Plugged and Abandoned

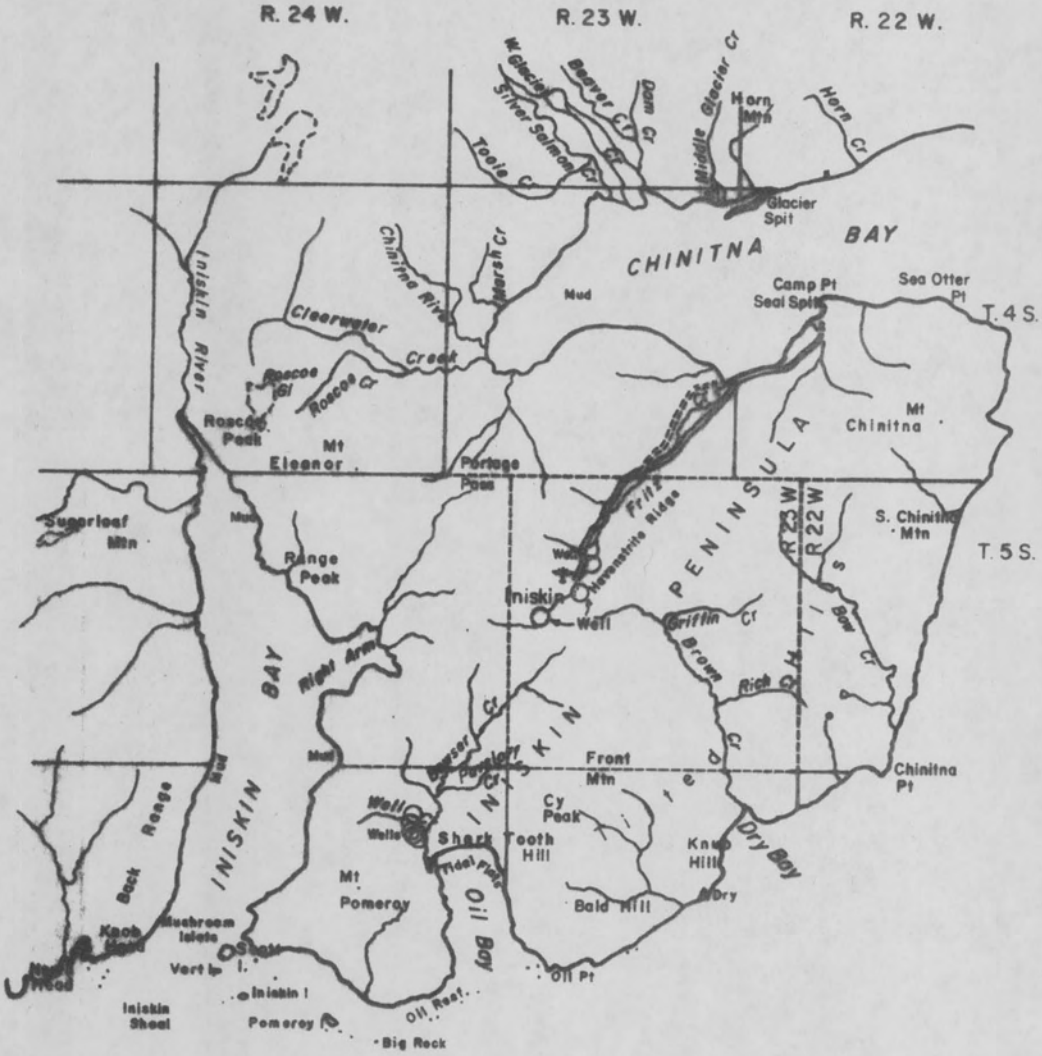
DRILLED BY	ALASKA OIL COMPANY
WELL NAME	NO. 2
LOCATION	NE 1/4, SW 1/4, Sec. 35 T. 5 S., R. 23 W., (SM)
SPUD	August, 1903
COMPLETED	1903
TOTAL DEPTH	Abandoned shallow depth
STATUS	Plugged and Abandoned

DRILLED BY	INISKIN DRILLING COMPANY
WELL NAME	IBA NO. 1
LOCATION	1,500' W., 1125' N. of SW Corner Sec. 8, T. 5 S., R.23 W., (SM)
SPUD	9/7/36
COMPLETED	1939
TOTAL DEPTH	8,775'
STATUS	Plugged and Abandoned

DRILLED BY	ALASKA CONSOLIDATED OIL COMPANY, INC.
WELL NAME	INISKIN UNIT BEAL NO. 1
LOCATION	2,000' W., 1,700' N. of SE Corner Sec. 17, T. 5 S., R. 23 W., (SM)
SPUD	8/4/54
COMPLETED	1959
TOTAL DEPTH	9,746'
STATUS	Plugged and Abandoned

TABLE 1.- Wells drilled on the Iniskin Peninsula - Continued

DRILLED BY ---------	ALASKA CONSOLIDATED OIL COMPANY
WELL NAME ----------	INISKIN UNIT - ZAPPA NO. 1
LOCATION ----------	2,370' S., 290' W. of NE Corner Sec. 18, T. 5 S., R. 23 W., (SM)
SPUD ---------	12/25/58
COMPLETED ----------	11/7/61
TOTAL DEPTH --------	11,231'
STATUS ----------	Plugged and Abandoned



Adapted from U.S.G.S. Iliamna quadrangle

Figure 2.— Iniskin Peninsula, Alaska

in weathering characteristics, but some of the oil definitely looked "fresh." Active gas seeps were also found near the wells drilled on Bowser Creek and Brown Creek. Gas was observed bubbling up through the water inside the surface casing of an abandoned well on Bowser Creek and a sample was obtained. The analysis of this gas appears in table 2.9/

DRILLING, FITZ CREEK

During 1936, a well was spud along Fitz Creek. The location of this well presumably was picked on the basis of the identification of a geologic anticline (Fitz Creek anticline). The well, called the Iniskin Bay Association No. 1 (IBA No. 1), was drilled by the Iniskin Drilling Company (sometimes referred to as the Havenstrite Oil Company). Drilling was done only during the summer and fall months, and it took three years to complete the well as a dry hole. However, oil and gas shows were encountered at intervals below a depth of about 4,700 feet to total depth of 8,775 feet. Near the end of the drilling year of 1938, several zones were tested in the interval between 5,604 feet and 7,156 feet. According to the log, the well "produced enough gas (10 p.s.i. per day) each day to run electric power plant." In successive shut-in and bleed-off periods, the well produced 15 barrels of light-green oil in one hour. An analysis of that oil was accompanied by the following comment on the analysis sheet: "This is a very high gravity (46.8° API) paraffin base crude, very rich in gasoline

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9/ Blasko, D. P. Oil and Gas Seeps in Alaska. Alaska Peninsula, Western Gulf of Alaska. BuMines RI 8122, 1975 (in press).

TABLE 2.- Gas analysis from Bowser Creek well

Sample From: Well X Stream ____ Seep ____ Other ____

Area Iniskin Peninsula Sampled By US Bureau of Mines

Location NW 1/4, sec. 11
T 6 S, R 24 W. (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 Helium Operations, Amarillo, Texas

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

with exceptionally low sulfur content." At the conclusion of this test, the well was shut-in for the year and bled once a month from December, 1938 to May, 1939. During these bleed-off periods, the well usually flowed salt water with some gas. Upon re-entering the well in May, 1939 and cleaning it out, the well flowed some gas and a little oil. Before drilling commenced, however, the oil and gas production ceased and the well flowed salt water at a rate of about three barrels per day. Additional drilling from 7,156 feet to a total depth of 8,775 feet encountered more oil and gas shows. Final testing of the well resulted in the well flowing only salt water. The well was plugged and abandoned.

The log of the IBA No. 1 well also reveals that coal was encountered in thin veins. First encounter of coal veinlets occurred while drilling the interval between 1,519 feet to 2,501 feet. In one 3-foot section of a core taken between 5,078 feet to 5,094 feet, the log reported "much coal, gas and small globules of black oil." That depth was the last mention of coal in the log.

Another well on upper Fitz Creek was started during 1954 by a group called the Iniskin Unit Operators. This well, called the Beal No. 1, was located to the southwest of the IBA No. 1 well. The well was drilled and tested during various periods between 1954 and 1959. Gas and oil shows began below 2,450 feet, and an operations report states that the interval from 2,454 feet to 2,585 feet was tested for gas production but was eventually cemented off in favor of attempting to establish oil production from lower depths. By the end of 1955, the well had been drilled to a total depth of 9,746 feet, with encouraging oil shows below 6,000 feet.

Testing took place during 1956 and 1957. Operations during 1957 consisted of cleaning out, perforating and testing selected intervals in the oil-saturated sediments between 6,300 and 9,600 feet, although the saturated interval extended to a total depth of 9,746 feet. A lack of permeability was thought to be the reason for not attaining commercial production. The operation report concluded that the lack of permeability could have been caused by adverse drilling methods. The report states that of the damaging factors, one was

> "....the high mud weight used in drilling the well and the excessive time during which this mud stood on the formations. Because of the caving shale condition, it was necessary to drill the hole with 105-pound mud and the weight material used was Baroid. Baroid is a completely inert and insoluble substance with a high specific gravity (Ba SO_4). It settles out of any fluid if given sufficient time and it is extremely difficult to remove it from the face of the formation or from any porous beds into which it has penetrated. The zones in Beal No. 1 were subjected to this action for two years prior to the current test.
>
> The second factor is the apparent high clay content in the sandstones in this area. Certain types of clay swell on contact with fresh water and seal any porosity that may be present. This is particularly true of clays associated with or derived from volcanic rocks. Sediments containing such clays have a tendency to slack and cave, and this was found to be true of the shales in the Beal well. The 9,100 foot zone contains volcanic tuff. For those reasons it may be that any potentially productive sands may have been sealed off by the water-base drilling fluid before the tests were made."

On the basis of that possibility it was felt that production may have been attained if an oil base mud had been used. Recommendations were made to either hydra-frac the promising formations in the well or to deepen the

well using a different circulating medium such as an oil base mud or air. On the basis of the recommendations, a hydraulic fracture job was undertaken in 1959 by Alaska Consolidated Oil Company, Inc., who had taken over the operation from the original company. The fracturing job was confined to three zones: 9,131 feet to 9,442 feet, 6,871 feet to 7,350 feet, and 6,270 feet to 6,500 feet. No commercial production was attained, although the middle zone showed a small increase in high gravity black oil. The well was finally plugged and abandoned in 1963.

On Christmas Day, 1958, the Antonio Zappa No. 1 well was spud at a location approximately one-half mile south and east of the Beal well. The well was being drilled for the Iniskin Unit Operators by Alaska Consolidated Oil Company, Inc. Taking advantage of knowledge gained when drilling the Beal well, several drilling procedures were utilized to maximize the possibility of attaining production. Foremost of these was continuous drilling during winter as well as summer months so as not to leave mud in the hole which could possibly damage the potential oil-bearing formations such as was suspected in the Beal well. Shows of oil and gas were prevalent from 1,600 feet down to total depth of 11,231 feet, but commercial production was not attained. The well encountered strongly flowing salt water at 9,740 feet.

A situation which at the time of drilling was nothing more than "hole trouble" can be looked at today with more than passing interest. The log of the Zappa well notes that on a drill stem test at 8,499 feet

> "....reopened and well flowed mud for 4-1/2 hours at 400 pounds. At end of 4-1/2 hours started

flowing hot salt water and steam at 375 pounds. Flowed steadily for 2 hours and shut-in. Killed well with 115 pounds mud ..."

The Zappa No. 1 could be the first well drilled in Alaska to encounter geothermal potential, although this was thought to be of little significance at the time.

The well was plugged and abandoned by Belco Petroleum Corporation who had taken over operations from Alaska Consolidated Oil Company, Inc.

VULCANISM

Iliamna volcano is located approximately 20 miles north of the Iniskin Peninsula and has itself contributed to the geology and stratigraphy of the Iniskin Peninsula.[10/] Augustine Island, also a volcano, is located about 20 miles to the south and a little west of the Iniskin Peninsula. The effect of the actions of this volcano on the Iniskin Peninsula is relatively unknown. Mention is made of these volcanoes only because of the unusual encounter of hot water and steam in the Zappa well. The proximity of these volcanoes and their potential influence on the surrounding area might enhance the geothermal resources of the area. A similar situation occurs in Northern Mexico at Cerro Prieto, about 14 miles south of Mexicali, Baja California, where a geothermal power plant is in operation.[11/] This plant flashes hot water to steam and, in 1975, had a rated capacity of 75 MW. The wells supplying the power plant are located to the northeast of

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10/ Work cited in footnote 5.

11/ Comision Federal de Electricidad. Cerro Prieto Underground Power. A CFE Editorial Booklet. 1974, 25 pp.

Laguna Volcano and to the southeast of Cerro Prieto Volcano. There is no doubt that these two manifestations cause and influence the underground geothermal resource.

EXPLOITATION POSSIBILITIES

The utilization of resources found on the Iniskin Peninsula, specifically oil, gas or geothermal, should pose no great difficultues.

Should oil be encountered in commercial quantities, several alternatives are available. A loading dock could conceivably be constructed from shore into Chinitna Bay where tankers could pick up the oil. Also, the oil could easily be barged from Chinitna Bay to several places such as the Drift River oil loading terminal, the Standard Oil Company of California oil loading terminal at North Kenai, or even to the refineries located at that point. Another possibility is barging from Chinitna Bay to Homer. A pipeline from the Iniskin Peninsula to any of the above mentioned areas is also feasible.

If natural gas were to be found, again several possibilities exist for transmission and disposition. Depending, of course, on the reserves, a liquefaction plant could be built on the Iniskin Peninsula for shipping the liquefied gas elsewhere. A mine-mouth power generation plant is an alternative. Another alternative is pipeline transmission to the Kenai Peninsula where the gas could be liquefied at existing facilities or used to augment feedstock supply to the petrochemical plant and/or commercial distribution system.

If geothermal potential is realized, several interesting possibilities exist for its development. Should the temperature be appropriate, power generation either by steam, fluid flashing to steam or binary system would be possible. Markets for electricity might be strictly local, such as a mineral processing plant built on the Iniskin Peninsula. The development of iron and copper deposits within forty miles of the Iniskin Peninsula may be enhanced by the existence of geothermal resources on the Iniskin Peninsula. Iron ore claims exist on both sides of Iliamna Bay, near old Iliamna at the head of Iliamna Lake, and on the northeast and west sides of Meadow Lake which is just east of Iliamna Lake. Copper ore claims exist at Kasna Creek on the south side of Kontrashibuna Lake.

An iron ore complex producing 2 million tons of pellets each year would require about 27,500 kW-hr per hour plus 150 Mcf of natural gas per hour.12/ A copper ore complex processing 40,000 tpd would require about 38,600 kW-hr per hour plus 684.6 Mcf per hour of natural gas.13/ The power requirements would require 10 and 12 wells for the iron and copper complexes, respectively, based upon 5,000 kW per well plus one disposal well for every two wells used for power.14

12/ U.S. BuMines. An Economic Evaluation of the Production of Iron Oxide Pellets from Magnetic Taconite Ore, Two-Million-Ton per year Plant. Process Evaluation Group Report No. 70-9-A, 1970, 33 pp.

13/ Bottge, R. G. Comparative Porphyry Copper Mining and Processing Costs - Alaska Versus Arizona. BuMines IC 8656, 1974, 83 pp.

14/ Rosenbruch, J. C. and R. G. Bottge. Geothermal Energy: Economic Potential of Three Sites in Alaska. BuMines IC 8692, 1975, 40 pp.

Electricity could also be transmitted to tie-in with existing facilities either by laying cable from the Iniskin Peninsula across Cook Inlet to Homer, or by tying-in at the Beluga Power Plant on the west side of the Inlet. Another possibility of geothermal utilization is for agricultural greenhouses built and operated on the Iniskin Peninsula. A combination of power generated from local natural gas and geothermal hot water for greenhouses would be an ideal situation for a viable industry. Such a possibility was determined feasible in a hypothetical case in other areas of Alaska.15/

CONCLUSION

On the basis of available geologic literature, logs and well drilling histories, the Iniskin Peninsula appears to be a unique area to explore for oil, gas, geothermal resources and, to a lesser degree, even coal. Should any one of these resources be found in commercial quantities, transmission in kind or in the form of energy poses less difficulty than in most other areas of the State. This is true because the Iniskin Peninsula is near populated and industrial areas already containing facilities for resource utilization.

The region's vulcanism and its effects, although basically unknown, have nonetheless already demonstrated a potential for geothermal potential. In particular, this area provides an opportunity to determine whether geothermal resources can be developed in Alaska.

15/ Work cited in footnote 14.