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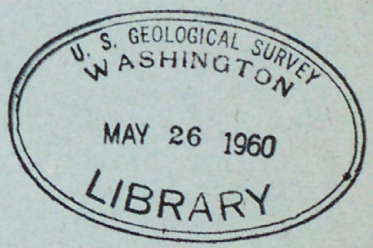
U.S. Geological Survey

Washington

Geological Investigations

Naval Petroleum Reserve No. 4

Alaska



Report No. 22

GEOLOGICAL RESULTS OF TEST PIT OPERATIONS AT CAPE SIMPSON, ALASKA.

1948

Previous reports on investigations by the Geological Survey in Naval Petroleum Reserve No. 4, Alaska

No. 1. Stratigraphy and structure of the area of the Killik, Chandler, Anaktuvuk, and Colville Rivers, Alaska. (1946)
No. 2. Magnetic survey of part of Naval Petroleum Reserve No. 4 by airborne magnetometer. (1946)
No. 3. Stratigraphy and structure of the Umiat anticline. (1947)
No. 4. Stratigraphy and structure of the area of Maybe Creek. (1947)
No. 5. Stratigraphy and structure of the area of the Kurupa, Oolamnagavik, Killik, and Colville Rivers. (1947)
No. 6. Stratigraphy and structure of the area of the Meade and Kuk Rivers and Point Barrow. (1947)
No. 7. Progress report on taxonomic and stratigraphic study of macrofossils. (1947)
No. 8. Progress of microfossil investigations, Naval Petroleum Reserve No. 4, Alaska. (Revised) (1947)
No. 9. Reservoir characteristics indicated by thin section analyses of sand cores from Umiat Test No. 1. (1947)
No. 10. Aeromagnetic survey of Naval Petroleum Reserve No. 4 and adjacent areas. (1947)
No. 11. Core analyses report on Simpson Test Well No. 1. (1948)
No. 12. Stratigraphy and structure of the area of the Colville River north of Umiat, Alaska. (1948)
No. 13. Stratigraphy and structure of the Wolf Creek anticline, Alaska. (1948)
No. 14. Stratigraphy and structure of the area of the Ipnavik River, Alaska. (1948)
No. 15. Stratigraphy and structure of the area of the Colville River between Ninuluk Creek and Umiat Mountain, Alaska. (1948)
No. 16. Stratigraphy and structure of the area of the Titaluk River and upper part of Ikpikpuk River, Alaska. (1948)
No. 17. Stratigraphy and structure of the area of the Kigalik and Awuna Rivers, Alaska. (1948)
No. 18. Stratigraphy and structure of the area of the Utukok River with notes on the Corwin-Cape Beaufort region, Alaska. (1948)
No. 19. Petrographic study of some Lisburne limestone samples. (1948)
No. 20. Petrography and reservoir characteristics of selected Tertiary and Cretaceous sandstone cores from Naval Petroleum Reserve No. 4. (1948)
No. 21. Progress report of microfossil investigations, Naval Petroleum Reserve No. 4. (1948)

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GEOLOGICAL RESULTS OF TEST PIT OPERATIONS AT CAPE SIMPSON, ALASKA.

By

W. W. Patton, Jr.

November 1948

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GEOLOGICAL RESULTS OF THE TEST PIT OPERATIONS

AT CAPE SIMPSON, ALASKA

By

William W. Patton, Jr.

INTRODUCTION

Between August 31 and September 11, 1948, ten shallow test pits were opened near and on three different oil seeps in the vicinity of Cape Simpson on the Arctic coast of Alaska. It was hoped that these pits might provide information about the geologic conditions of the seeps.

The presence of oil seepages at Cape Simpson has been known for some time. They have been mapped and their surficial features described in several reports (1/, 2/, 3/).

From Cape Simpson, seep No. 1 is three miles to the northwest, seep No. 2 two miles to the west and seep No. 3 about five miles to the southwest (see appended map). All three of these seeps are located upon prominent mounds which rise 15 to 40 feet above the monotonously flat coastal plain. The long dimensions of these mounds are roughly aligned in a north-south direction.

1/ Paige, Sidney, Foran, W. T., and Gilluly, James, A reconnaissance of the Point Barrow region, Alaska: U. S. Geol. Survey Bull. 772, pp. 23-25, 1925.

2/ Ebbley, Norman, Jr., and Joesting, H. R., Report of investigation of petroleum seepage, Arctic slope area, Alaska: U. S. Bur. Mines and Territorial Dept. Mines, pp. 10-11, 1943.

3/ Smith, P. S., and Mertie, J. B., Jr., Geology and mineral resources of northwestern Alaska: U. S. Geol. Survey Bull. 815, pp. 276-280, 1930.

OPERATIONS

Seven pits ranging in depth from 9 to 13 feet were opened on the seeps. Two pits were excavated on seep No. 1, four on seep No. 2, and one on seep No. 3. All were located near the crest of the mounds where the seeps apparently have their source. Most of the pits were placed where a fresh green oil scum appeared at the surface.

In addition to these large pits, three five-foot holes were opened outside the seeps for the purpose of investigating other mounds in the vicinity.

GEOLOGY

Stratigraphy

Below the frost line three types of material were encountered: blue-grey clay, yellow-brown silt commonly containing rounded chert and quartzite pebbles, and ice. The clay and silt appeared to be interbedded. Above the frost, which occurred at a depth of two feet, was a cover of pitch, pitch-bound silt and moss.

Some limey shale, limestone and ironstone float on several of the mounds has prompted several geologists 1/ to suggest that these peculiar topographic features are directly underlain by hardrock. However, no consolidated bedrock in place was encountered in any of the test pits. An occasional isolated fragment of shale or limestone was unearthed. It seems probable that these as well as the surface float were brought up from some depth by frost action.

At the northern end of the mound from which seep No. 1 emerges, a 20-foot section through the mound is exposed in a beach bluff. The mound-forming material here is a blue-grey clay and massive blocks and wedges of ice. No consolidated bedrock was found.

Eight samples of clay and silt from the test pits were submitted to H. N. Loeblich for microfossil determinations. Of the eight, six were found barren. The other two contained the following species:

1/ Op. cit. (Bull. 772), p. 23.

48A Pa 29 Brown silt, pit No. 6, seep No. 2	Elphidium A Elphidium D Elphidium F Elphidium G Cornuspira A Eponides B [illegible]lina D Nonion B
48A Pa 31 Clay, pit No. 3, seep No. 1	Elphidium A Elphidium F Cornuspira A [illegible]lina D Quinqueloculina B

Mrs. Loeblich states that these forms are late Tertiary-Quaternary undifferentiated.

Oil Seepages

Below the surficial cover of pitch, fresh green oil was found to be oozing up through steeply dipping fissures in the frozen ground. These fissures vary in width from several inches to a foot and are filled with loosely compacted, oil saturated silt or clay. Both down-dip and along the strike the fissures are highly irregular and do not appear oriented in any particular direction. There is evidence that a small amount of movement may have taken place along some of these fractures. When the pits were first opened, oil flowed freely from small pockets along the fissures but, in most cases, ceased after several hours. Gas bubbles accompanied some of the flowing oil. A gallon sample was collected in 15 minutes from one of the larger flows.

CONCLUSIONS

From the test-pit operations it is concluded that the mounds on which the oil seeps are located as well as the other mounds in the vicinity are not erosional remnants of consolidated bedrock. It is probable that they result from local frost action. Fissuring of the frozen ground accompanying the upheavals provided channels through which oil could escape from a reservoir below.

Nothing about the nature of the reservoir or the depth to bedrock could be determined from the test-pit studies. It is of interest here to note that seismograph profiles 1/ indicate a small anticlinal and, in part,

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1/ Legge, J. A., Jr., Seismograph results, Cape Simpson prospect: United Geophysical Co., NOy-13360, 1946.

monoclinal flexure underlying the seeps below 1500 feet. No record was obtained between 1500 feet and sea level. The profiles show closures up to 80 feet. It is possible that this structure may have influenced the localization of the seeps.

The drilling of one or more core holes near or on the seeps should furnish more complete information about the geologic conditions of the seeps.

A. FRESH OIL AT THE SURFACE ON SEEP NO. 1

B. FISSURE (INDICATED BY SHOVEL) FILLED WITH LOOSELY COMPACTED, OIL SATURATED CLAY AND BORDERED BY FROZEN CLAY. BLASTING HAS REMOVED THE SURFACE COVER OF PITCH

A. VERTICAL VIEW OF OIL OOZING FROM FISSURE (DOTTED LINE) FIVE FEET BELOW THE SURFACE.

B. OIL FROM FISSURE (DOTTED LINE) COLLECTING IN THE BOTTOM OF A TEST PIT.