NATIONAL PETROLEUM RESERVE IN ALASKA

GEOLOGICAL REPORT

U. S. NAVY

SOUTH BARROW WELL NO. 14

HUSKY OIL NPR OPERATIONS, INC.
Prepared by: Gordon W. Legg

For the

U. S. GEOLOGICAL SURVEY
Office of the National Petroleum Reserve in Alaska
Department of the Interior
AUGUST 1983

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GEOLOGIC SUMMARY

INTRODUCTION

The U. S. Navy, South Barrow Well No. 14 is located in the NW 1/4 of protracted Section 25, T22N, R17W, Umiat Meridian, North Slope Borough, Alaska. The surveyor's plat locates the well 2300' FWL and 1800' FNL of the section (see Figures 1 & 2). The well was drilled in early 1977 by the U. S. Navy to provide additional gas reserves for the village of Barrow, and secondarily, to investigate at this location oil shows which had been encountered in the Sag River Sandstone in the South Barrow Well No. 12.

Drilling operations commenced on January 28, 1977. The well was completed as a suspended gas producer in the Lower Barrow sand on March 1, 1977.

Good visual sample shows were encountered in several sandstones of the lower part of the "Pebble Shale", in the Lower Barrow sand of the Kingak Formation; and in the Sag River Sandstone. One drill-stem test was conducted in the Lower Barrow sand from 1947-2100' (see Appendix C). No conventional cores were taken although 21 sidewall cores were shot and recovered.

In each of the South Barrow wells drilled after South Barrow No. 13, an inhibitive mud system, containing calcium chloride, was used below the intermediate casing (9-5/8" to approximately 1,500 feet, except for 7" in South Barrow No. 14 at 1,947 feet). This was done in order to minimize damage by the swelling of clays, which were known to exist in the Barrow sandstones and the Sag River Sandstone (determined by water susceptibility tests on cores from the South Barrow Nos. 12 and 13 wells).

PRE-DRILLING PROGNOSIS

The South Barrow No. 14 well was drilled with a primary objective of further evaluating the discovery of gas production in the Lower Barrow sandstone established in South Barrow Well No. 12 in March and April of 1974. The secondary objective was to core and test the oil shows which had been found in the Sag River Sandstone of South Barrow Well No. 12. This well was reported to have swabbed an unspecified amount of oil from the Sag River Sandstone before being swabbed dry.

Another objective in drilling South Barrow No. 14, was to drill the well using a calcium chloride based mud system in order to minimize formation damage from swelling clays. The presence of swelling clays in potential reservoir sandstones in South Barrow No. 12 had been confirmed by water-susceptibility tests, which were performed on core chips from the Lower Barrow sand, and from the Sag River Sandstone. Damage from fresh-water mud was suspected as being responsible for the poor performance of the Lower Barrow sand in South Barrow No. 12 (360 MCFPD). Core analysis and log calculations had indicated that the sandstone should have been capable of higher flow rates.

POST-DRILLING SUMMARY

The primary objective of the well was satisfactorily met, since the Lower Barrow sandstone tested gas at a rate of 2.5 MMCFPD, substantiating the use of the calcium chloride mud system and providing additional gas reserves in the Barrow area.

The secondary objective in drilling the South Barrow No. 14 well was not fulfilled, since lost circulation at 2,257 feet, while preparing to core (the lost circulation presumably occurred in the Sag River Sandstone, which had been topped at 2,240 feet, according to the drilling time), forced the aborting of further drilling, coring, or testing in the Sag River Sandstone. Furthermore, no electric log was obtained through the section, since a cement plug had to be set, sealing off the Sag River Sandstone.

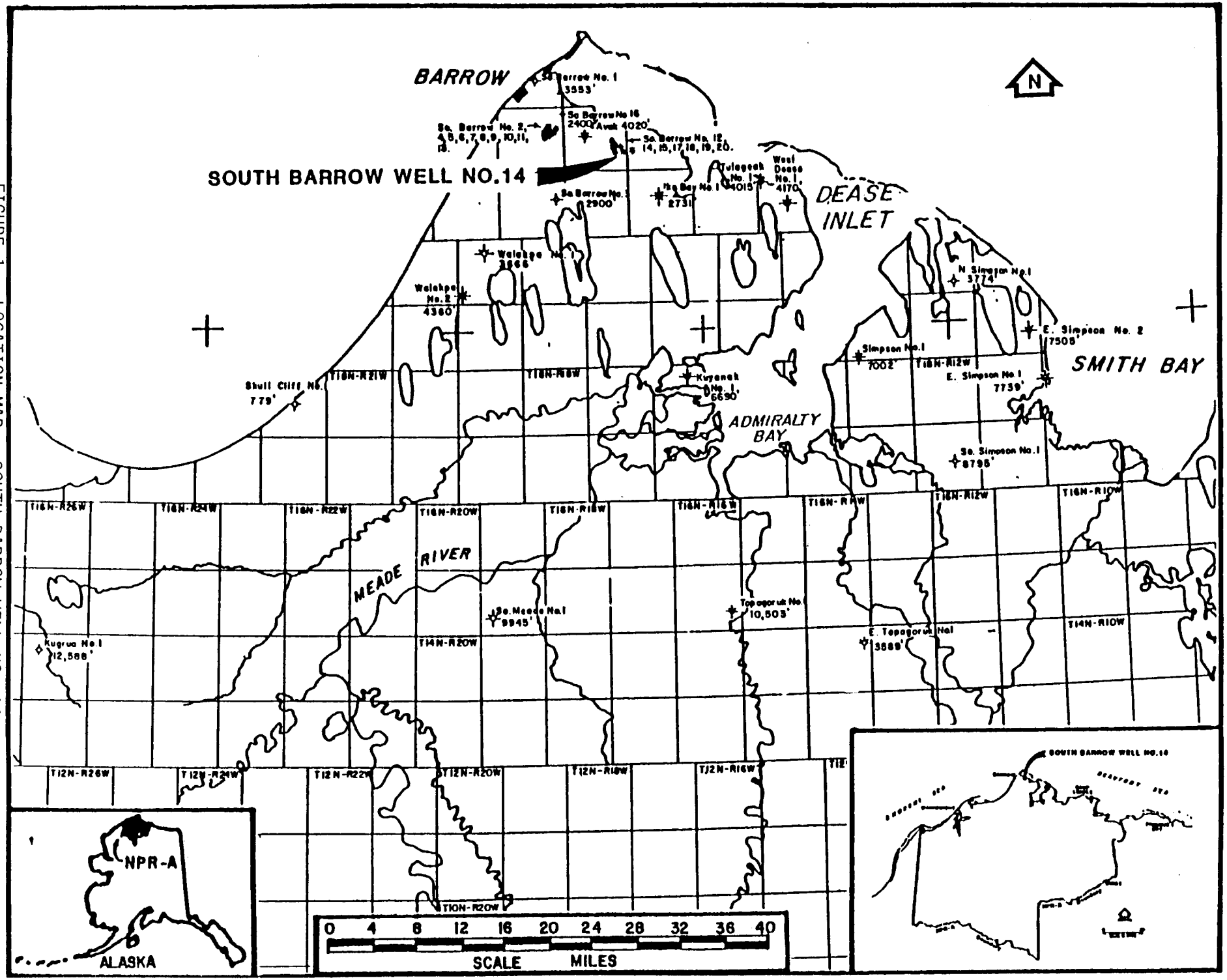
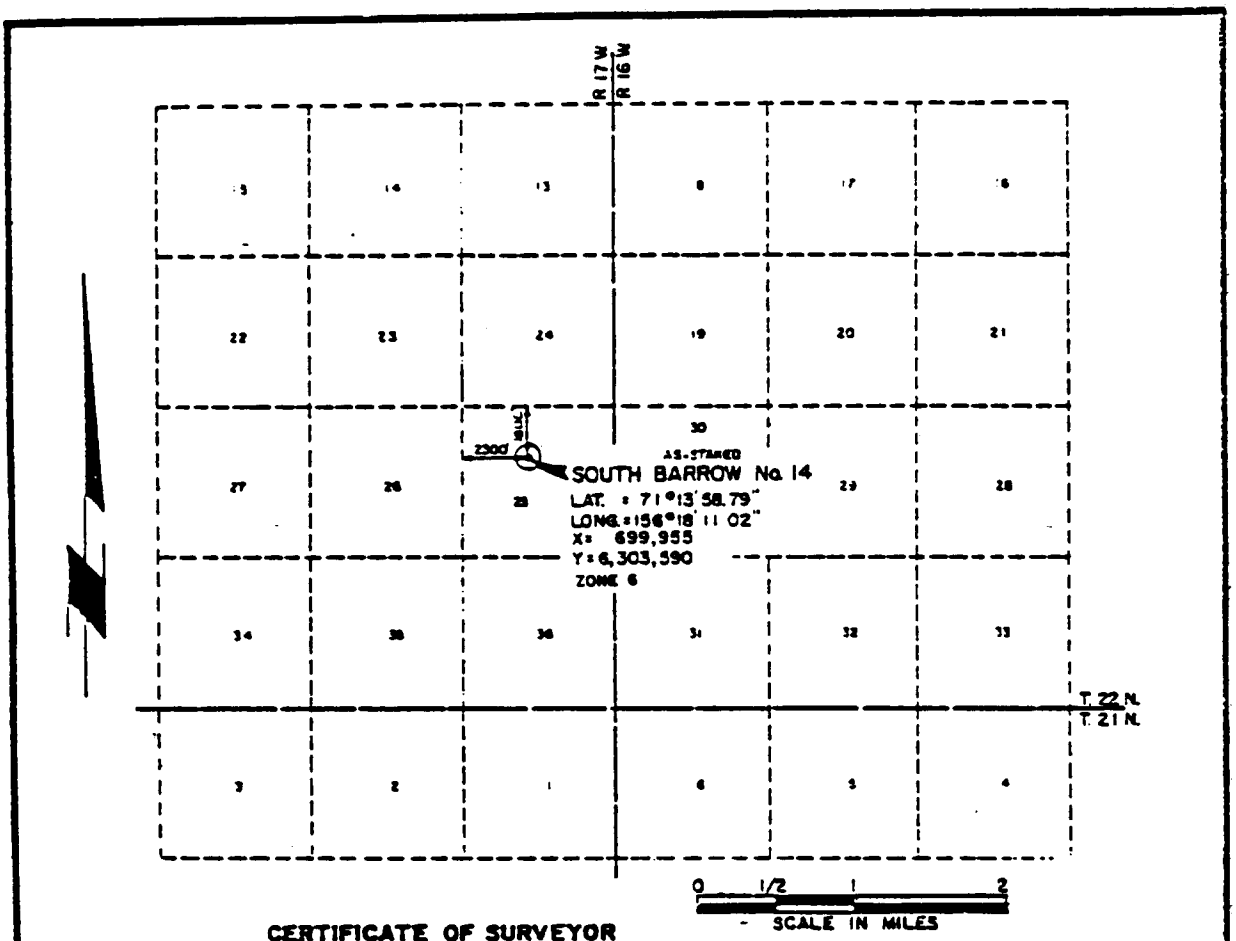


FIGURE 1 - LOCATION MAP - SOUTH BARROW WELL NO. 14



CERTIFICATE OF SURVEYOR

I hereby certify that I am properly registered and licensed to practice land surveying in the State of Alaska and that this plat represents a location survey made by me or under my supervision, and that all dimensions and other details are correct.

STATE OF ALASKA 49TH REGISTERED LAND SURVEYOR

Aug. 15-76
Date

SURVEYOR

C J R

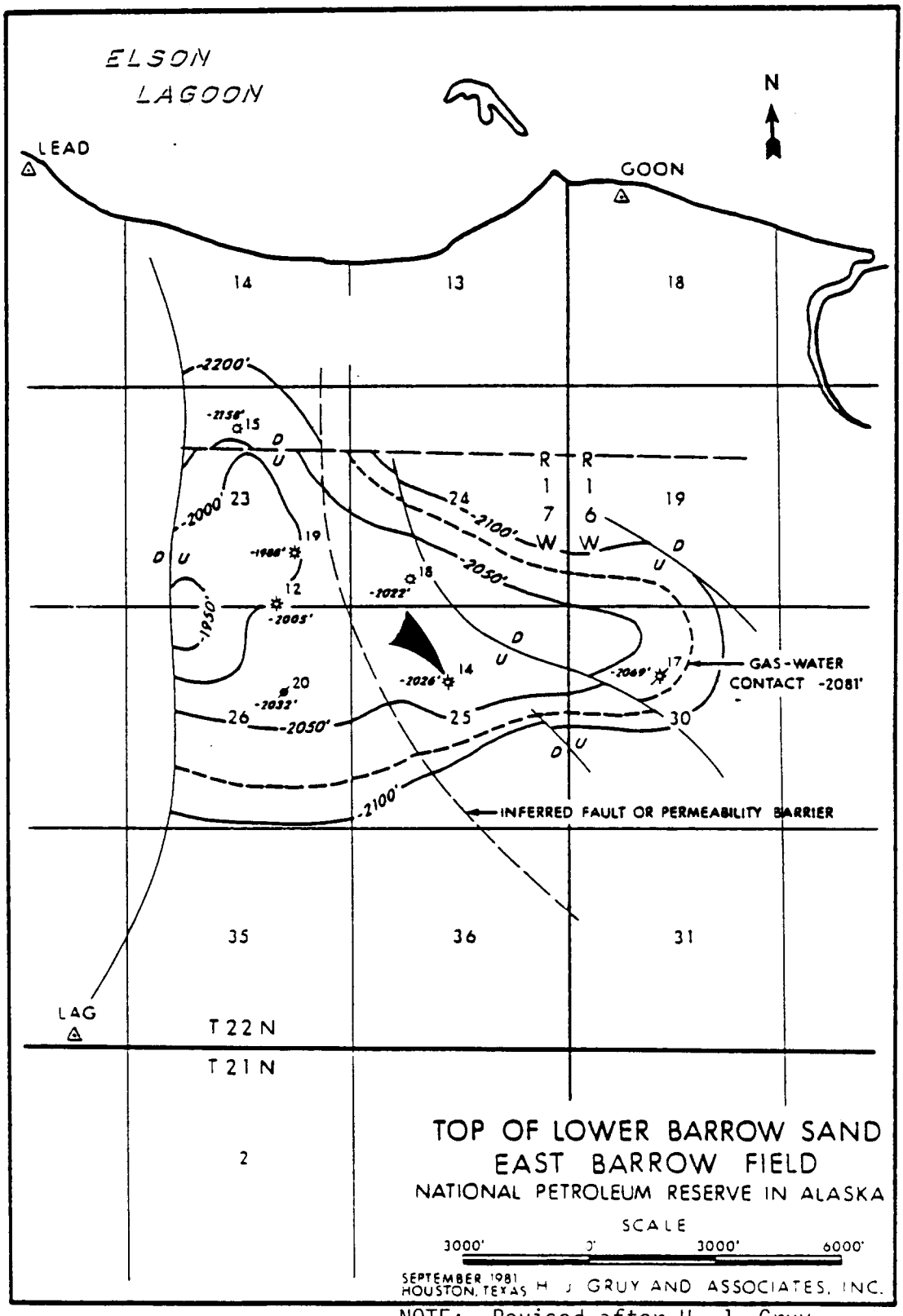
AS-STAKED
SOUTH BARROW No. 14
Located in
NW ¼ PROTRACTED SEC. 23, T. 22 N., R. 17 W., U.M., ALASKA

Surveyed for
HUSKY OIL
N.P.R. OPERATIONS

Surveyed by
F. M. LINDSEY & ASSOC.
LAND & HYDROGRAPHIC SURVEYORS
2502 West Northern Lights Boulevard Box 4 081
Anchorage Alaska

REVISED RANGE LINE & WELLS

FIGURE 2 - CERTIFICATE OF SURVEYOR - SOUTH BARROW WELL NO. 14



NOTE: Revised after H. J. Gruy

FIGURE 3 - STRUCTURE, TOP OF LOWER BARROW SAND

WELLSITE GEOLOGIST'S REPORT
(NO REPORT IN FILES)
LATER REPORT BY: GORDON W. LEGG

INTRODUCTION

The South Barrow Well No. 14 was drilled in early 1977 by Husky Oil NPR Operations, Inc. under contract to the U. S. Navy. This was one of two Barrow wells (the other was the South Barrow No. 13 well) to be drilled in the final drilling effort of the U. S. Navy before relinquishing the Naval Petroleum Reserve No. 4 to the administration of the Department of the Interior.

The objective, in drilling the South Barrow No. 14 well, was to complete the well as a gas producer in the Lower Barrow sandstone for eventual delivery of gas to the village of Barrow. The secondary objective of the well was to evaluate the Sag River Sandstone to ascertain its potential as a possible productive reservoir. An unspecified amount of oil had reportedly been swabbed from the Sag River Sandstone in South Barrow No. 12 well. Apparently, no serious attempt to complete the well in the Sag River Sandstone had been made at that time, partly because of suspected formation damage from swelling clays.

Drilling was commenced on January 28, 1977, and the well was drilled to 2,257 feet (driller), losing circulation at that depth while attempting to core in the Sag River Sandstone. The well was completed as a suspended gas producer in the Lower Barrow Gas sand after lost-circulation problems made it necessary to cement-off the Sag River Sandstone, and plug-back for the gas completion. The well was completed, suspended, and the rig was released on March 1, 1977.

STRATIGRAPHY

WIRELINE TOPS*

No samples caught	0-53'
PLEISTOCENE	53'
CRETACEOUS	
Torok Formation	80'
"Pebble Shale"	1364'
JURASSIC	
Kingak Formation	1723'
Lower Barrow sandstone	2057'
TRIASSIC	2130'
Sag River Sandstone	2240'

* Tops above the "Pebble Shale" are paleontological, those from the "Pebble Shale" through the Lower Barrow sandstone are wireline tops, and the Sag River Sandstone top is based only upon lithology from sample descriptions and drilling time.

PLEISTOCENE

Pleistocene: 53-80'

Lithologies in this interval are primarily sands, containing some carbonaceous fragments and several mollusk shell fragments. The sands are light gray to dark gray, fine to coarse grained and quartzose. Interbedded with the sands are beds of clay. The clay is gray, sandy, silty, pyritic, and carbonaceous. Shell fragments are present in the clays.

Sediments of the Pleistocene are present in the South Barrow No. 14 well from the base of the conductor pipe (53') down to a depth of 80 feet, according to the micropaleontological analysis by Anderson, Warren & Associates, Inc.

CRETACEOUS

Torok Formation: 80-1364'

The Torok Formation is composed, for the most part, of claystones down to approximately 485 feet, where several thin, interbedded sandstones are present. The claystones are gray, gray-brown, and brown, and are typically sandy, silty, frequently contain chert pebbles, and are usually carbonaceous; occasional to rare, thin beds of coal are also present. From approximately 485 to 530 feet is sandstone, which is brown, very fine grained, very argillaceous and silty, typically grading to claystones and shaly siltstones. The sandstones are also micaceous and carbonaceous. No show was observed.

Between depths of 530 and 710 feet, the Torok is principally claystone. A thin sandstone, associated with thin coal beds and stringers, is present from 710 to 720 feet. The sandstone is gray to brown, very fine to fine grained, and devoid of any shows.

Below 720 feet, the claystones of the Torok become more lithified and alternate with, and grade into, dark gray to black shales. The shales contain frequent pyrite inclusions and are generally silty, grading into and interbedded with very argillaceous siltstones.

The lower part of the Torok (1230-1310') includes several thin beds of sandstone. These sandstones are light gray, very fine grained, carbonaceous and micaceous. The sandstones are argillaceous and silty, and grade to siltstone and shale. No shows were observed in the sandstones.

Anderson, Warren & Associates, Inc. picks the top of the Aptian-Albian age, Torok Formation, at 80 feet. The base of the interval is picked at 1,370 feet, which is in very close agreement with the electric-log pick at 1,364 feet.

"Pebble Shale": 1364-1723'

From 1,364 feet, down to a depth of approximately 1,520 feet, the "Pebble Shale" is primarily a dark gray to black shale, grading from flaky to

finely fissile, and containing rounded, "floating", frosted quartz grains, which are characteristic of this unit.

At 1,520 feet, and persisting down to the base of the "Pebble Shale" at 1,723 feet, is an interbedded sequence of sandstones, siltstones, and shales. The sandstones are gray and brown-gray, very fine to fine grained, silty, argillaceous, and carbonaceous. There is oil staining in the sandstones, ranging from light stain to good overall staining. These shows yielded cuts ranging from very weak to very good. Electric logs reveal these sandstones to be very thin, totaling only 23', for the three best developed sandstones which exhibit high resistivity (interpreted as oil or gas).

There is a distinctive gamma-ray increase at a depth of 1,364 feet; this gamma-ray response defines the top of the "Pebble Shale". Anderson, Warren & Associates, Inc. picks the Early Cretaceous, Neocomian age, as beginning at a depth of 1,370 feet, which is in close agreement with the electric-log pick.

JURASSIC

Kingak Formation: 1723-2130'

The Upper Barrow sand has "shaled out" in South Barrow Well No. 14. Producible gas is present in the Lower Barrow sandstone, as evidenced by the drilling of South Barrow Well No. 12 and confirmed in South Barrow Well No. 14.

The Kingak Formation, starting at 1,723 feet, is composed of shale, which is dark gray and brown-gray, slightly fissile, silty, frequently sandy, and often contains siderite nodules and chert pebbles. A predominant shale lithology persists down to a depth of approximately 1,910 feet, where the Kingak becomes slightly sandy (correlating to the Upper Barrow sandstone interval). An interbedded sequence of shaly, silty sandstones, siltstones and shales, then persist all the way to the base of the Kingak at 2,130 feet. The shales are similar to those in the upper part of the Kingak with the sandstones being generally very thin (the exception being the Lower Barrow sandstone, which will be discussed separately), both silty and shaly, and very fine to fine grained. The siltstones are usually gray to brown, very sandy, grading to sandstone, and contain numerous claystone and shale stringers. This entire sequence of sandstones, siltstones and shales, appears to be completely gradational, each grading into the other.

Economically, rocks within the Kingak Formation are the most important sequence in the sedimentary section in the South Barrow wells. Gas productive sandstones in the Kingak, specifically, the Upper and Lower Barrow sands, are the units that provide the gas which is so necessary to the village of Barrow. The top of the Kingak Formation is picked on the basis of electric-log correlations where the datum of 1,723 feet agrees fairly closely with the micropaleontological pick at 1,750 feet. The base of the Kingak, according to micropaleontology, is at 2,130 feet. There is general agreement with the electric logs.

Lower Barrow sandstone: 2057-2083'

The Lower Barrow sandstone is represented on the Dual Induction Laterolog by a positive spontaneous-potential (S.P.) development and by a modest resistivity increase, which would not, at first glance, appear to indicate hydrocarbons. The positive S.P. development is caused by the low resistivity of the calcium-chloride drilling mud. The resistivity of the mud is lower than the resistivity of the connate water in the sandstone, hence a positive S.P. deflection. The rather low resistivity in the sandstone is probably a function of invasion by the saline mud filtrate, augmented by the shaliness of the sandstone matrix.

Lithologically, the sandstone is light tan, very fine to fine grained, silty, and clayey; it exhibited poor to fair scattered staining, with a fair cut. Log porosities are 24-30%, which is high and is probably optimistically affected by formation gas content and the shaly matrix. The actual porosity is probably around 20%.

TRIASSIC

Triassic: 2130-2257'

The Triassic section, down to the Sag River Sandstone at 2,240 feet, is represented by shales and siltstones. The shales are typically gray, soft, silty to sandy, with sandstone laminae, and with frequent siderite nodules. The siltstones are gray, shaly and sandy, hard, and contain numerous chert fragments.

Anderson, Warren & Associates, Inc. have assigned a Triassic age to the sedimentary section below 2,130 feet and continuing down to the total depth of 2,257 feet. Within the Triassic section is the Sag River Sandstone (encountered at 2,240 feet by samples and drilling time).

Sag River Sandstone: 2240-2257' (Total Depth)

On the bases of drilling time and sample lithology, the Sag River Sandstone was encountered at 2,240 feet. The sandstone is gray, very fine to fine grained, occasional medium grained, rounded, frosted to clear quartz. Good oil staining was reported from the wellsite. There were some traces of a brown, sideritic sandstone, which is very fine to fine grained, shaly and silty, and with a few inclusions of glauconite. Unfortunately, there were no samples from 2250-2257', because the well lost circulation at 2257'. There are also no electric logs below 2128', because the well was plugged back in order to cure the lost-circulation problem.

HYDROCARBON SHOWS AND DRILL-STEM TESTS

As mentioned under the various stratigraphic descriptions, there were several zones of show noted in the South Barrow No. 14 well. Fair to good apparent oil shows were noted in several thin somewhat shaly sandstones in the lower part of the "Pebble Shale". From an examination of the electric logs, in conjunction with observed sample shows, the following zones could merit further evaluation in either this well or some future offset well:

(1) Sandstone: 1576-1582' (6' net); 21% density porosity; 31% neutron porosity; neutron has "gas effect" and shaliness effect; probable hydrocarbons, likely gas.

(2) Sandstone: 1612-1621' (9' net); 27% density porosity; 33% neutron porosity; obvious "gas effect" with neutron and density "cross-over"; definite gas.

(3) Sandstone: 1646-1654' (8'); 30% density porosity; 37% neutron porosity; good gas separation between neutron and density curves; obvious gas.

The Lower Barrow sand has porosities of 24-30% on the density and 33-37% on the neutron log. The sandstone is fairly shaly, and this factor, plus the "gas effect", particularly on the neutron, would reduce the apparent porosity to an actual value nearer 20%. There is good "cross-over" separation between the neutron and density curves, indicating probable gas. The Barrow gas sand was drill-stem tested from 1,947 to 2,100 feet with the recovery of gas at a rate of approximately 200 MCFPD. A later production test established a gas potential of approximately 2.5 MMCFPD (see appendix on drill-stem test).

The Sag River Sandstone had hydrocarbon shows, as reported from the wellsite. Only 17 feet of the sandstone was penetrated, and lost-circulation conditions prevented coring, testing, or logging of the interval.

CONCLUSIONS

The South Barrow No. 14 well failed to achieve one of the major objectives. By losing circulation, and thereby failing to core, test or log the Sag River Sandstone in South Barrow No. 14, the question of possible oil production from that formation must await further evaluation by the drilling of an additional well.

There is likely additional gas production which could be obtained from three sandstones in the lower part of the "Pebble Shale"; however, the thinness of the sandstones and their shallow depths (1576-1654') would likely suppress both the reserves and the deliverability. Additionally, gas hydrate problems, associated with low reservoir temperature, might create production problems.

The production test of the Lower Barrow sandstone (2.5 MMCFPD) confirms that this zone is capable of providing an additional source of gas for the village of Barrow.

PERTINENT DATA AND APPENDICES

SUMMARY OF PERTINENT DATA *

WELL NAME:	South Barrow Well No. 14
API NO.:	50-023-20009
OPERATOR:	Husky Oil NPR Operations, Inc.
LOCATION:	2300' FWL, 1800' FNL, NW 1/4, protracted Section 25, T22N, R17W, Umiat Meridian, North Slope Borough, Alaska
COORDINATES:	Latitude: 71°13'58.79"N Longitude: 156°18'11.02"W X = 699,955 Y = 6,303,590 Zone 6
ELEVATION:	31' Kelly Bushing, 12' Ground
DATE SPUDDED:	January 28, 1977
TOTAL DEPTH:	2257' (driller) 2150' (Schlumberger) **
DATE REACHED TOTAL DEPTH:	February 13, 1977
RIG RELEASED:	March 1, 1977
STATUS:	Suspended gas well
CASING:	20" @ 53' 10-3/4" @ 1042' 7" @ 1947' 5-1/2" liner @ 1822-2125'

LOGGING RECORD:

DIL/SP	54- 910' 1034-1934' 1946-2144'
DLL/SP	1946-2140'
BHC/GR/CAL	50- 838'
BHC/GR	1034-1936' 1946-2146'
CNL/FDC/GR/CAL	1034-1939' 1946-2150'
HDT	1040-1940' 1946-2150'
HDT Arrow Plot	1054-1865' 1954-2104'
CBL/VDL	26-1929'

Saraband	1040-1920' 1950-2140'
Mudlog	53-2257'
Geologist's Lithology Log	53-2257'

SIDEWALL CORES: ***	Run No. 1, 10 shot, 10 recovered. Run No. 2, 11 shot, 11 recovered.
CONVENTIONAL CORES:	None taken.
DRILL STEM TESTS:	DST No. 1, 1947-2100 (see Appendix C)
WELLSITE GEOLOGIST:	R. R. Simonson
LOG ANALYST:	None
DRILLING CONTRACTOR:	Husky Oil NPR Operations, Inc. PARCO, Inc., Labor Contractor, U. S. Navy Cardwell Model H Rig
MUDLOGGERS:	Petro-Tec
BIOSTRATIGRAPHIC ANALYSIS:	Anderson, Warren & Associates, Inc.

* Copies and/or reproducibles of all geologic data are available from:

National Oceanic and Atmospheric Administration
EDIS/NGSDC (D62)
325 Broadway
Boulder, CO 80303

** After reaching a total depth of 2257' (driller), circulation was lost and finally the hole was cemented back to 2128' (driller). Schlumberger logged at that point, obtaining a total depth of 2150'.

*** Sidewall cores were utilized for various analyses, including: lithology, paleontology, and geochemistry.

SOUTH BARROW WELL NO. 14
DRILL CUTTING DESCRIPTIONS

NOTE: Drill cutting descriptions adopted, for most part, from American Stratigraphic Co. lithology log, because of incomplete descriptions from wellsite.

DRILLED DEPTH (FEET BELOW KELLY BUSHING)	
0- 53	No samples caught.
53- 60	Sands: dull olive gray, silty, micaceous; few carbonaceous fragments; several mollusk shell fragments; Clay: gray, sandy, silty, pyrite, carbonaceous material and shell fragments as inclusions.
60- 70	Sands: light gray to dark gray, fine to coarse grained, quartzose, very porous and permeable; dark chert granules common; scattered forams; Clay: as above.
70- 90	Sands: as above, but more silty; some small Pelecypod shells; Clay: as above.
90- 120	Claystone: light gray, sandy, silty, carbonaceous, with minor Sandstone: as above.
120- 130	Claystone: light gray to brown, silty, carbonaceous, some fossil fragments, with Claystone: as above, but becoming less sandy, slightly bentonitic.
130- 200	Claystone: gray, sandy, silty, occasional irregular rounded sand grains, carbonaceous.
200- 250	Claystone: light tan to gray, slightly silty, bentonitic, some Pelecypods and dark gray chert pebbles.
250- 400	Claystone: brown, silty, carbonaceous material, pyritic, with a trace of Sandstone: slightly bentonitic, and with Claystone: gray, bentonitic; some dark gray chert pebbles; trace of Siltstone: gray, sandy, micaceous, calcareous, carbonaceous.
400- 420	Claystone: gray-brown, coal stringers, sandy, silty, slightly bentonitic, trace of large sand grains with Claystone: as above, and with a trace of coal.

420- 450	Claystone: brown-gray, silty, carbonaceous, slightly bentonitic, with a trace of Sandstone: irregular, large, rounded sand grains.
450- 485	Claystone: gray-brown, sandy, silty, carbonaceous, micaceous, occasional large, rounded sand grains.
485- 550	Claystone: as above, with some interbedded Sandstone: brown, very argillaceous, very fine to fine grained, micaceous and carbonaceous.
550- 600	Claystone: gray-brown, slightly sandy, silty, carbonaceous, very slightly bentonitic.
600- 710	Claystone: gray-brown to gray, sandy, occasional siderite nodules, silty and carbonaceous.
710- 720	Shale: dark gray to black, carbonaceous partings, fossil fragments, dark gray chert pebbles; Coal: black, shiny, very thinly bedded; Sandstone: gray-brown, very fine grained, loose.
720- 760	Shale: dark gray to black, carbonaceous, scattered chert pebbles and irregular large quartz grains; Inoceramus and other fossils.
760- 800	Claystone: brown-gray, scattered dark gray chert pebbles, and irregular, rounded, sand grains, carbonaceous, slightly fossiliferous, some white, bentonite inclusions.
800- 850	Claystone: gray, very silty, thin coal stringers, occasional fossil fragments, and irregular, large sand grains.
850- 910	Shale: dark gray, interbedded with Claystone: as above.
910- 920	Shale and Claystone: as above, with Sandstone: gray, very fine grained, very argillaceous, silty, carbonaceous.
920-1060	Shale: as above, with Claystone: as above.
1060-1130	Siltstone: gray, very sandy, argillaceous, carbonaceous flakes, with Claystone: as above.
1130-1220	Claystone: gray, silty, carbonaceous, soft, in part, slightly bentonitic, in part, carbonaceous.
1220-1310	Sandstone: light gray, very fine grained, loose, very silty, argillaceous, slightly micaceous, carbonaceous, interbedded with Claystone: as above, and with some loose sand grains.

1310-1370	Claystone: gray, silty, slightly carbonaceous, with traces of Sandstone: as above.
1370-1400	Shale: dark gray to black, flaky, rare inclusions of clear, rounded, sand grains, carbonaceous material, occasional pyrite inclusions and fossil fragments; some glauconite.
1400-1480	Shale: very dark gray to black, grading from flaky to finely fissile, occasional inclusions of clear, rounded sand grains, pyrite inclusions, occasional fossil fragments and carbonaceous material.
1480-1500	Shale: as above, with some siderite stringers, and with a trace of Sandstone; becoming slightly brown.
1500-1540	Shale: dark gray-brown, fissile, thin sandstone laminae, siderite nodules, rare carbonaceous material, pyrite, trace of glauconite, with Sandstone: gray, very fine grained, silty, argillaceous, and with Siltstone: brown-gray, siderite inclusions, sandy.
1540-1550	Sandstone: brown-gray, very fine grained, very argillaceous, siderite inclusions, slight stain, dull gold fluorescence, very weak cut; Shale: as above; Siltstone: as above.
1550-1570	Sandstone: as above, but with slightly better show, good cut, with Shale and Siltstone: as above.
1570-1580	Sandstone: dark brown, very argillaceous, sideritic, trace of stain and fluorescence, very good cut, with Shale and Siltstone: as above.
1580-1610	Shale: dark brown, fissile, some dark gray chert pebbles, with Siltstone: dark brown, shaly, sandy, sideritic.
1610-1620	Sandstone: tan to gray, very fine grained to fine grained, finely scattered carbonaceous flakes, argillaceous, some dull gold fluorescence, good cut, with Siltstone and Shale: as above.
1620-1640	Shale: dark gray, fissile, some sand grains; Siltstone: brown-gray, shaly, sandy, with trace of Sandstone: brown-gray, shaly, carbonaceous, very silty.
1640-1660	Sandstone: tan, fine grained, very argillaceous, silty, carbonaceous, dull to bright gold fluorescence, good cut, with Shale: as above, and with Siltstone: dark brown, shaly, sandy, carbonaceous.

1660-1670	Shale and Siltstone: as above.
1670-1700	Shale: dark brown, bentonite inclusions, silty, with Siltstone: as above, and with some Sandstone: brown, very fine grained to fine grained, carbonaceous stringers, very argillaceous, some stain and fluorescence, good cut.
1700-1720	Shale: dark brown, fissile, occasional sand grains, pyritic, with Siltstone: brown, shaly, sandy, and with Sandstone: tan, fine grained, silty, some dark gray chert pebbles and shale partings.
1720-1760	Predominantly Shale: dark gray, silty, sandy, some dark gray chert pebbles, and Shale: very dark gray to black, siliceous, with some Siltstone: as above, and traces of Sandstone: as above.
1760-1770	Shale and Siltstone: as above, with Sandstone: tan, very fine grained, argillaceous, silty, oil staining, good cut.
1770-1780	Shale: dark brown-gray, chert pebbles and fragments, sandy, silty, siderite nodules.
1780-1790	Sandstone: tan, very fine grained, shaly, carbonaceous, trace of glauconite, with Shale: as above.
1790-1820	Shale: as above, with Shale: dark gray, some chert pebbles and siderite nodules, and with Siltstone: tan to gray, sandy, dark gray chert pebbles, siderite inclusions, rare glauconite.
1820-1870	Shale: dark brown to gray, silty, siderite inclusions, occasional chert pebbles; trace of Sandstone, with inclusions of pyrite, bentonite, and carbonaceous material.
1870-1910	Shale: dark gray to brown-gray, fissile, silty, scattered chert pebbles and siderite nodules, with Siltstone: brown-gray, very sandy, shaly, scattered chert pebbles.
1910-1940	Shale: dark gray, sideritic; Siltstone: gray, slightly sandy, shaly, sideritic, and with interbedded Sandstone: gray, very fine grained, very shaly, silty, some loose, large grains.
1940-2000	Shale and Siltstone: as above, interbedded with Sandstone: tan-gray, very silty, clay stringers.

2000-2030	Claystone: gray, soft, siltstone laminae, occasional chert pebbles, with Siltstone: gray, clay stringers, slightly sandy, and with Sandstone: gray, very fine grained, silty, clay stringers.
2030-2040	Sandstone: gray, very argillaceous, silty, slightly friable, siderite nodules, with Siltstone: as above.
2040-2070	Siltstone: as above, with Claystone: gray, sandy, silty, siderite nodules, and with Shale: gray, very sandy and silty.
2070-2100	Sandstone: light tan, fine grained, some loose grains, occasional clay stringers, trace of fluorescence and cut, and with Sandstone: gray, brown siderite cement, silty, argillaceous, trace of fluorescence and cut; Shale and Siltstone: as above.
2100-2150	Shale: gray, sandy, silty, siderite inclusions; Siltstone: tan-gray, sandy, sideritic; Sandstone: gray, very shaly and silty, slightly sideritic.
2150-2180	Shale: gray, very soft, silty, occasional siderite nodules; Siltstone: gray, shaly, sandy, siderite inclusions.
2180-2240	Shale: gray, very soft, becoming very sandy, silty, trace of siderite nodules and sandstone laminae, and with some Sandstone: gray, fine to medium grained, mostly loose grains, fragments with light to dark brown oil stain gives pale straw cut, strong, light yellow fluorescent cut; common shell fragments; Monotis sp. fragments.
2240-2257	Shale: as above, with Sandstone: gray to dark brown, fine to medium grained, fragments with dark brown oil stain that give bright lemon-yellow fluorescence and pale straw cuts; Monotis sp. and shell fragments not as common as above.

2,257 Feet Total Depth

HUSKY OIL NPR OPERATIONS, INC.

OFFICE OF NAVAL PETROLEUM AND OIL SHALE RESERVES

DRILL STEM TEST REPORT FORM

WELL NAME South Barrow No. 14 DST. NO. 1 DATE 2/11/77

Formation Tested Barrow Gas Sand

Hole Size 6"

Test Interval 1947-2100'

Drill Collar Length 460' I.D. --

Total Depth 2100'

Drill Pipe Length 1370' I.D. 2.764"

Choke Size: Surface 3/8" & 1" Bottom Hole 5/8"

Packer Depth(s) 1890 Ft.

Depth Tester Valve 1865 Ft.

Cushion Type nitrogen Amount 1855'

TEST DATA

Tool open at 0937 hrs.
Initial flow period 24 min.
Initial shut-in period 30 min.
Final flow period 125 min.
Final shut-in period 259 min.
Unseated packer at 1712 hrs.

RESISTIVITY CHLORIDE DATA

	Resistivity	Chloride Content
Recovery Water	@ °F.	ppm
Recovery Mud	@ °F.	ppm
Recovery Mud Filtrate	@ °F.	ppm
Mud Pit Sample	@ °F.	ppm
Mud Pit Samole Filtrate	@ °F.	ppm
Mud Weight	vis	cp

Description of initial flow period Opened on 1" choke; pressure 180 psi; changed to 3/8" choke; pressure increased to 700 psi; stable last 15 minutes of flow.

Description of final flow period

PRESSURE DATA

TEMPERATURE	Gauge No. 1249 Depth: 1901 ft.		Gauge No. 2137 Depth: 1876 ft.		Gauge No. 2781 Depth: 1871 ft.		TIME	
	48 Hour Clock		24 Hour Clock		48 Hour Clock		Tool Opened	0934 A.M. P.M.
Est. °F.	Blanked Off	Yes	Blanked Off	No	Blanked Off	No		
Actual N.A. °F.	Pressures		Pressures		Pressures		Bypass Opened	1712 A.M. P.M.
	Field	Office	Field	Office	Field	Office	Reported Minutes	Computed Minutes
Initial Hydrostatic	1258		1240		1233			
First Period FLOW Initial	670		661		630		—	—
First Period FLOW Final	577		569		552			
First Period Closed In	937		925		918			
Second Period FLOW Initial	564		635		552		—	—
Second Period FLOW Final	697		688		683			
Second Period Closed In	937		925		918			
Third Period FLOW Initial							—	—
Third Period FLOW Final								
Third Period Closed In								
Final Hydrostatic	1338		1319		1312		—	—

RECOVERY DATA

				Depth Back Pres. Valve	Surface Choke	Bottom Choke
Cushion	Nitrogen Type	Amount	1855'		3/8" & 1"	5/8"
Recovered	1855	Feet/bbl of	nitrogen cushion			
Recovered	210	Feet/bbl of	rat hole mud			
Recovered		Feet/bbl of				
Recovered		Feet/bbl of				

Remarks

* Mud to surface in 6 minutes; gas to surface, flowing at an approximate rate of 200,000 CFPD.

* On production test on 2/25/77, well flowed at rate of approximately 2.5 MMCFGPD, from 5-1/2" liner, perforated from 1916-2083'.

Prepared by G. W. Legg

11-78

M E M O R A N D U M

May 17, 1979

TO: J. M. McCarthy

FROM: S. K. Lewis

SUBJ: Production Test, Upper Barrow Sand, South Barrow Well No. 17

The Upper Barrow Sand was perforated in Barrow No. 17 from 2038' to 2048', from 2054' to 2065', and from 2080' to 2088'. Perforations were at four shots per foot, using a 4" Hyperjet II gun.

After clean up, the well was tested. Testing consisted of an 8-hour Stabilized One-Point flow, a 24-hour buildup, an Equal Time Two-Point flow, and a 72-hour buildup.

Back pressure analysis was performed on the three flow periods.

Reservoir analysis was prepared on the stabilized drawdown. Data, calculations, and resultant calculated values are presented below.

Back Pressure Analysis

The backpressure slope was established from the Equal Time Two Point flow data. Absolute Open Flow was based on the Stabilized One-Point flow.

Backpressure Parameters

n = 0.659
AOF = 132 McF/D

Drawdown Analysis

The drawdown analysis technique was based on the semilog plot of Pwf vs log Tp and the pressure equation:

$$Pwf = P_i - \frac{28984\ q\ \mu g B g}{kh}\left[\log Tp + \log \frac{k}{\emptyset \mu g C_t r_w^2} - 3.2275 + 0.86859\ S\right]$$

Reservoir parameter analysis was based on test results and values of $\emptyset$, S_w, and h derived from the H. J. Gruy log analysis as published in the Reservoir Engineering and Geologic Study of the East Barrow Field on December 20, 1978.

Calculated Reservoir Parameters

Flow Capacity = kh = 1.233145 md.ft.
Permeability = k = 0.0616527 md
Skin Factor = S = -2.496
Productivity Index = J = 0.240 McF/d psi
Gas Mobility = M = 5.0727 md/cp
Effective Wellbore Radius = r_w^1 = 51.568 inch
Radius of Investigation = 20. 747 ft

Conclusions

Based on well performance while being tested and the attached test analysis, it is concluded that the Upper Barrow Sand, as penetrated in Barrow Well No. 17, is not a commercially producable zone.

All estimated ultimate Recoverable Reserves in the Upper Barrow Sand which have been assigned to Barrow No. 17 should be removed from current reserve estimates. Based on 640 acre spacing, this would result in a Recoverable Reserve cut of 1.440 BCF.

S. K. Lewis
Senior Engineer

Copy to: Bob Lantz

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

Company Husky Oil Company UONPR Formation _____ Page 1 of 1
Well S. Barrow #14 Cores Side Wall File BP-3-422
Field S. Barrow Drilling Fluid Water Base Date Report 2-22-77
County N. Slope State AK Elevation _____ Analysts WSP
Location _____ Remarks Dean Stark Core Analysis

CORE ANALYSIS RESULTS

(Figures in parentheses refer to footnote remarks)

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS			POROSITY PERCENT	GRAIN DENSITY	RESIDUAL SATURATION		REMARKS
		Horizontal Maximum	Horizontal 90°	Vertical			Oil % Pore	Total Water % Pore	
1	1578	49			23.8	2.64	3.2	52.6	ss, vfgr cly
2	1614	21			18.5	2.56	1.4	62.9	ss, vfgr. inbd slst, cly
3	1616	68			29:5	2.63	4.6	37.2	ss vf-fgr, cly
4	1618	143			25.7	2.58	3.7	43.7	same
5	1647	5.4			9.5	2.55	1.1	58.0	sltst, v cly
6	1650	362			31.8	2.58	6.3	46.6	ss. vf-fg, cly
7	1652	133			28.6	2.60	5.2	43.1	same
8	1964	9.8			15.3	2.58	4.1	68.3	ss, vfg, vcly
9	2003	177			25.2	2.55	5.1	66.7	same
10	2020	119			26.3	2.60	2.8	69.2	ss, vf-fg, v cly
11	2038	124			19.5	2.57	1.8	73.0	ss, vfg, v cly
12	2050	109			21.5	2.57	1.5	69.7	same
13	2058	122			22.6	2.62	0.7	65.4	ss, vf-fg, vcly
14	2066	24			15.7	2.70	4.0	70.0	same/cly
15	2080	14			16.2	2.59	1.4	71.8	same
16	2113	112			16.5	2.58	3.2	70.4	ss, vfg, v cly
17	2120	23			15.3	2.60	2.3	87.0	same
18	2133	10			13.1	2.57	0.0	93.8	same

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907) 279-4014 P.O.BOX 4-1276 ANCHORAGE, ALASKA 99509 4649 BUSINESS PARK BLVD.

WATER ANALYSIS REPORT

OPERATOR Husky Oil Company
WELL NO. South Barrow Number 14
FIELD South Barrow
COUNTY
STATE Alaska

DATE February 14, 1977 LAB NO. 5433
LOCATION
FORMATION
INTERVAL DST #1
SAMPLE FROM Top of test tool

REMARKS & CONCLUSIONS: light brown filtrate from mud sample

Cations	mg/l	meq/l	Anions	mg/l	meq/l
Sodium	5108	222.18	Sulfate	790	16.43
Potassium	207	5.30	Chloride	67000	1889.40
Calcium	35600	1776.44	Carbonate	3	0.10
Magnesium	5	0.41	Bicarbonate	6000	98.40
Iron	---	---	Hydroxide	---	---
Total Cations		2004.33	Total Anions		2004.33

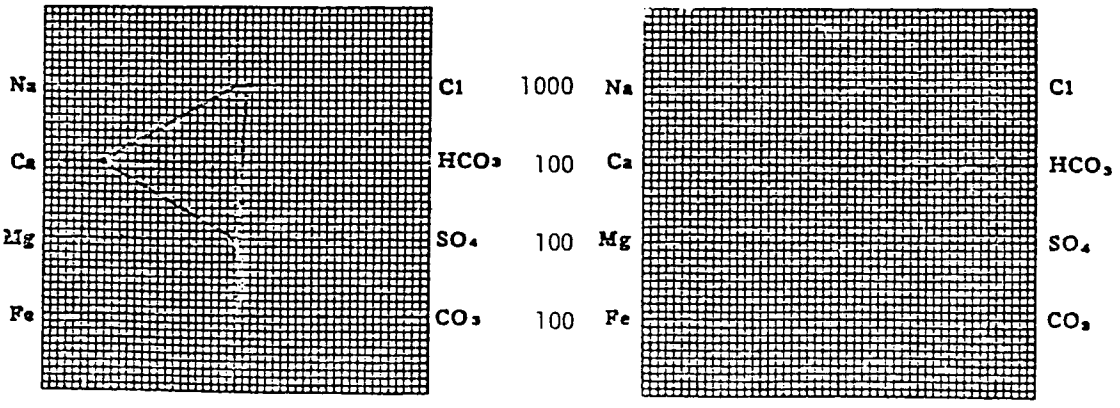
Total dissolved solids, mg/l 111662
NaCl equivalent, mg/l 107809
Observed pH 9.0

Specific resistance @ 68°F.:
Observed 0.08 ohm-meters
Calculated 0.08 ohm-meters

WATER ANALYSIS PATTERN

Sample above described

Scale MEQ per Unit



(Na value is above graphs including Na, K, and Li)
NOTE: Mg/l = Milligrams per liter Meq/l = Milligram equivalents per liter
Sodium chloride equivalent by Dunlap & Hawthorne calculation from components

HA - 1 (2/2/68)

GAS ANALYSIS

REPORT OF ANALYSIS

F. S. - 15892 M.S. N-67896 ,H. 0.07 OBS. PRES. 62.8 CAL. PRES. 63.2

STATE- ALASKA COUNTY- NORTHWESTERN

FIELD- BARROW E WELL NAME- WELL NO. 14

LOCATION- NOT GIVEN 2300'FWL; 1800'FNL SEC. 25, T. 22N, R. 17W OWNER- HUSKY OIL NPR OPERATIONS INC

DATE COMPLETED- ~~NOT GIVEN~~ 3 MARCH, 1977 DATE SAMPLED- 01/17/80

SAMPLED BY- NICHOLLS & CRANE

NAME OF PRODUCING FORMATION- NOT GIVEN

DEPTH IN FEET- NOT GIVEN ±2050 THICKNESS IN FEET- NOT GIVEN 20'

SHUT IN WELLHEAD PRES., PSIG- 1000 OPEN FLOW, MCF/D- NOT GIVEN CAOF 3,700 MCFPD

CHECK OF DATA-
THE WELL DATA ARE ACCURATE, (_____) WITHOUT CORRECTION, (_____) AS CORRECTED ABOVE.

REMARKS-

ANALYSIS-

METHANE	94.3	%	NORMAL PENTANE	0.0	%	OXYGEN	0.6	%
ETHANE	2.2	%	ISOPENTANE	0.0	%	ARGON	TRACE	%
PROPANE	2.0	%	CYCLOPENTANE	0.0	%	HYDROGEN	0.0	%
NORMAL BUTANE	0.8	%	HEXANES PLUS	0.0	%	H2S *	0.0	%
ISOBUTANE	0.0	%	NITROGEN	0.0	%	CO2	0.0	%
SPECIFIC GRAV 0.600						HELIUM	0.05	%
						TOTAL	99.90	%

CALCULATED GROSS BTU/CU. FT., DRY AT 60 DEG. F AND 30 IN. MERCURY- 1074

* DUE TO THE ABSORPTION OF H2S DURING SAMPLING, THE REPORTED RESULTS MAY NOT BE RELIABLE

PERMISSION FOR RELEASE:

Permission is hereby granted for the Bureau of Mines to release the above data, together with similar data released by other operators as public information and as parts of a series of papers on analyses of gases from various fields, states, or regions.

COMPANY U. S. Geological Survey

BY Robert J. Cady

TITLE Geologist