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Subject: USGS/NPR-A (Husky Oil, Operator), "Ikpikpuk" No. 1 well, Sec. 25, T13N, R10W, UM.

This report is a review of the geology of the subject well up to present depth 14,210' where the well is currently suspended for the summer. The well spudded on November 28, 1978, and reached present depth on April 8, 1979.

Drilling to date has penetrated sediments of recent to late Mississippian, with the well currently suspended in the Lower Limy unit of the Lisburne Group.

No significant hydrocarbon deposits have been encountered.

David B. Young

David B. Young
Consulting Geologist

GEOLOGICAL REPORT (INTERIM)

USGS/NPR-A (HUSKY OIL, OPERATOR)

IKPIKPUK NO. 1

1306' FNL, 785' FEL, Sec. 25,

T13N, R10W, UM

NORTH SLOPE BOROUGH, ALASKA

BY

D. B. Young
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Star Route
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DATA SHEET

Operator: Husky Oil USGS/NPR-A

Well Name: Ikpikpuk No. 1

Area: National Petroleum Reserve, Alaska

Location: 1306' FNL, 785' FEL, Sec. 25, T13N, R10W, UM
North Slope Borough, Alaska

Elevation: 52' K.B.
32' Ground

Spud Date: November 28, 1978

Casing: 30" @ 100'
20" @ 521'
13-3/8" @ 2603'
9-5/8" @ 9873'

Status: Suspended for summer.

Present Drilled Depth: 14,210'

Date Present Depth Reached: April 8, 1979

Contractor: Parker Drilling Rig No. 96

Mud Loggers: Exlog

Drilling Foremen: Bret Allard
Gene Harmon

Geologists: D. B. Young
John Green

Well Log Analyst: Armour Kane

SCHLUMBERGER LOGGING RUNS

DIL-SP-GR

Run No. 1	101 - 530'
Run No. 2	521 - 2610'
Run No. 3	2603 - 9904'
Run No. 4	9600 -14202'

BHC Sonic - GR

Run No. 1	101 - 530'
Run No. 2	521 - 2610'
Run No. 3	2603 - 9904'
Run No. 4	9600 - 14190'

CNI-FDC-CAL-GR

Run No. 1	2606 - 9908'
Run No. 2	9600 - 14198'

HRD Dipmeter

Run No. 1	2603 - 9909'
Run No. 2	9867 - 14205'

Velocity Survey

Run No. 1	2880 - 14210'

WIRELINE (Schlumberger) LOG TOPS

	Log Depth 100' (1st sample)	Subsea Depth (-48')
LATE CRETACEOUS: Cenomanian		
Colville Group		
EARLY CRETACEOUS: Albian		
Nanushuk Group (paleo)	560'	(-508')
EARLY CRETACEOUS: Aptian		
Torok Formation	3750'	(-3698')
EARLY CRETACEOUS: Neocomian		
Pebble Shale Formation	7235'	(-7183')
Kuparuk River Sand	7440'	(-7388')
EARLY CRETACEOUS - JURASSIC		
Kingak Formation	7478'	(-7426')
EARLY JURASSIC - UPPER-MIDDLE TRIASSIC		
Sag River Sand/Shublik	9845'	(-9793')
LOWER TRIASSIC - PERMIAN:		
Sadlerochit Group		
Ivishak Formation	10440'	(-10388')
Kavik Member	11096'	(-11044')
Echooka Formation	11290'	(-11238')

PERMIAN - PENNSYLVANIAN - MISSISSIPPIAN:

Lisburne Group

Lisburne (Transitional)	11420'	(-11368')
Lisburne (Massive)	11698'	(-11646')

Note:
At present depth, 14210', paleontological and lithologic information verify placement in the "Lower Limy unit" of the Lisburne Group.

CORING PROGRAM

Conventional Cores:

12 cores were cut, total footage cut, 238'; total footage recovered, 237'; 99.6% success.

Sidewall Cores:

99 shot	55 recovered	55.5% success

TESTING

No Drillstem tests have been made down to 14210'.

INTRODUCTION

Ikpikpuk Test Well No. 1 is being drilled as a Pre-Devonian test in the northern part of the Ikpikpuk basin. The well has thus far tested the stratigraphic possibilities of the Cretaceous-Jurassic, and the interpreted fault closure of the Triassic to Late Mississippian. Further drilling will test the rest of the Mississippian to Pre-Devonian sediments when drilling resumes in the "79-80" drilling season.

STRATIGRAPHY

Late Cretaceous - Colville Group

100' (1st sample) - 560'

The Colville Group is represented at this location by about 500' of non-marine, probable delta plain sediments. The interval consists of an interbedded sequence of shaly sands; gray, carbonaceous siltstones; gray, silty, carbonaceous, water soluable claystones; and thin lignite and coal beds.

Oil and Gas Shows - Minor methane gas shows apparently associated with coal beds were noted beginning at 200'.

Early Cretaceous - Albian

Nanushuk Group

Corwin - Grandstand Formations (undifferentiated)

Interval 560' - 3750' Thickness 3190'

The Corwin - Grandstand interval at this location is marginal marine (with rare Inoceramus prisms) to non marine.

Deposition is interpreted to be alternately transgressive and regressive with higher sand content in the upper part of the sequence. The general lithology is gray, water soluable claystone; interbedded with gray carbonaceous siltstone; light gray, medium-fine grained, occasionally coarse-grained sandstone with minor coal and siderite occurrences. Net clean sand is approximately 300'.

Oil and Gas Indications - Minor methane gas was encountered throughout this interval and is thought to be associated with coal beds. Minor sample fluorescence and slight cut fluorescence were noted from sands between 1210' and 1300', although no oil stain or gas shows were indicated.

Early Cretaceous - Aptian

Torok Formation

Interval 3750' - 7235' Thickness 3485'

The top of the Torok was placed at the top of a thick sequence of shale directly under a sandstone interval. Paleontological information would put the Torok top approximately 200' higher than picked in the middle of a claystone, siltstone, sandstone interval. Regional correlations with Topogoruk No. 1, and East Teshepuk No. 1 are in general agreement with the log pick. Down to 6000' the lithology is dark gray, micaceous shale with pyrite inclusions, minor carbonaceous material and thin siltstone beds and laminations. The lower part of the Torok from 6000' becomes silty to sandy with gray-brown fissile shale and medium-dark gray, firm shale.

Net clean sand in the Torok is approximately 170' based on a cut-off of 60 API Gamma Ray units.

Oil and Gas Indications - Sands between 6000' and 6330' are generally silty and shaly with no shows of oil or gas.

Sands between 6675' and 6820' are light gray, fine-medium grained, quartzose, poorly sorted, sub-rounded,- sub-angular, in part with white clay-filled matrix. Fair SP log character is developed on the sands. No visible hydrocarbon indications were noted, although gas increased to 104 units at 6820'. Chromatograph breakdown was 17,300 ppm C_1, 550 ppm C_2.

The interval 6872' - 6978' consists of light-gray quartz sandstone with varying amounts of clay. Good gassy odor and bright yellow fluorescence were present throughout the interval. No visible staining was observed. Maximum gas recorded was 1210 units with chromatograph readings of 22,000 ppm C_1, 1500 C_2, 4000 C_3, 1020 C_4, and 81 C_5.

From 6978' - 7235' interbedded sandstone and gray-brown shales occur. The sandstones are light gray - gray, very fine - fine-grained, with water soluable clay in the matrix. No visible oil staining was noted although a bright yellow-white fluorescence was observed on fresh breaks. Maximum gas noted was 91 units.

Early Cretaceous - Neocomian

"Pebble Shale" Formation

Interval 7235' - 7440' Thickness 205'

The "Pebble Shale" Formation was picked at the top of a highly radioactive shale unit that characteristically goes off scale on the gamma ray log response. Additional support comes from paleontological age determinations and rare frosted quartz grains as floaters in a predominantly dark-gray, micaceous, splintery shale with a brownish cast.

Oil and Gas Indications - Several thin shaly sand stringers occur in the "Pebble Shale". No SP development is associated with them. Maximum gas recorded was 120 units at 7280' in a shale section. Chromatograph analysis was 22,000 ppm C_1, 1200 ppm C_2, 780 ppm C_3, 170 ppm C_4. No visible staining, but a slow, streaming, bright yellow cut fluorescence was observed.

Kuparuk River Sand

Interval 7440' - 7478' Thickness 38'

Directly below the "Pebble Shale" lies the transgressive marine sands of the Kuparuk River. The sand is white-light brown, very fine grained, sub-angular-angular, slightly friable, with rare glauconite. The Kuparuk River is the basal member of a marine transgression that apparently started in late Jurassic time and carried on into the Early Cretaceous Neocomian. Paleontological studies on Ikpikpuk samples indicate the Kuparuk overlies marine shale of Early Cretaceous to late Jurassic.

Oil and Gas Indications - Kuparuk River log porosities average 11% with very high water saturations.

A maximum of 125 units of total gas was recorded with the gas chromatograph recording 22,000 ppm C1, 1000 ppm C2, 350 ppm C3, 100 ppm C4. Approximately 10-15% of the sample from 7440' - 7445' exhibited a yellow sample fluorescence. No visible stain or visible cut were noted.

Early Cretaceous -(late-Middle-Early Jurassic)- Triassic

Kingak Formation

Interval 7478' - 9845' Thickness Drilled 2367'

The Kingak Formation from 7478' - 9035' consists principally of dark gray to black marine shales, commonly micaceous, silty, fissile, glauconite, pyritic, slightly fossiliferous, with occasional floating quartz gains and siderite concretions. The Kingak top is not well defined paleontologically or lithologically. For log purposes and lithologically where the Kuparuk River Sand is present it seems best to pick the Kingak at the sand - shale boundary as is done here and at the Kugrua No. 1 well.

From 9035' to 9103' a sandstone unit (Kugrua Sand) is present that is the age equivalent (basal Oxfordian) of thick, porous, massive sands that were found at the Kugrua No. 1 well at a depth of 8713' and at South Meade No. 1 at 7878'. This sand is gray-light gray, very fine grained, silty, well sorted with rare glauconite and pyrite. Samples and mechanical

logs indicate the sand to be shaly with low permeability. Losses to this sand zone were present at Kugrua and South Meade and to a lesser extent on Ikpikpuk, where they occurred in a silty transitional section at 9150'.

The interval from 9103' - 9624' consists of marine shales, dark gray, black, gray-brown, with rare glauconite, rare floating quartz grains, and in part silty to sandy with some thin stringers of siltstone.

From 9624' - 9672' a sandstone bed is present. This sandstone is medium gray-brown, dark gray, very fine grained, silty, slightly argillaceous, subangular, well sorted, with slight porosity and slight cut.

The interval from 9672' to the base of the Kingak at 9845' consists of marine shales interbedded with siltstone. The shale is dark gray, dark gray-brown, slightly micaceous, fissile to splintery, pyritic, rarely fossiliferous. Paleontological age determinations indicate Triassic to Early Jurassic.

Oil and Gas Indications - The sand interval from 9035' - 9103' (Kugrua Sand) is shaly and tight. The maximum gas recorded was 53 units with chromatograph readings of 5400 ppm C1, 800 ppm C2, 350 ppm C3, 120 ppm C4. No visible staining was present although a very slight cut was observed.

The lower sand interval from 9624' - 9672' is also shaly and tight. No visible staining was observed but a very slight cut was noted. Maximum gas recorded was 120 units with

chromatograph reading of 16,000 ppm Cl only. No other potential hydrocarbon reservoirs were present in the Kingak Formation.

Early Jurassic - Triassic / Triassic

Sag River/Shublik Formations (Undifferentiated)

Interval 9845' - 10,378' Thickness 533'

The Sag River/Shublik was picked on the top of a sandy-silty interval that correlates roughly with the normal pick. No clear top for the Shublik can be picked, although normal elements of the Shublik and the basal contact with the Sadlerochit are present. No evidence of unconformity is discernible from the logs, and the character of the Sag River is not that of the barrier bar and beach complex that are found in wells to the north of Ikpikpuk, i.e., East Teshekpuk No. 1, South Simpson No. 1, Fugrua No. 1. The Sag River deposited at Ikpikpuk is interpreted to be near-shore marine conditions with interbedded siltstone, sand and shale.

The sand interval of the Sag River is from 9845' - 9868'. It is dark gray-brown, very fine grained, silty, subangular, well sorted, hard, slightly siliceous, slightly calcareous with rare glauconite.

The Shublik top is thought to be at approximately 10,140' - 10,180', based on a combination of increased $CaCO_3$, paleontology, and lithology. The Shublik consists of near-shore

marine deposits consisting of calcareous shale with common pelecypods and crinoids: thin dark-gray, tan, fossiliferous limestone beds with black phosphate pellets; and thin siltstone beds with rare glauconite, pyrite and carbonized wood fragments.

Oil and Gas Indications - No significant oil or gas indications were observed and no favorable reservoir rock are developed in the Sag River/Shublik interval.

Permo-Triassic - Sadlerochit Group

Ivishak Formation

Interval 10,440' - 11,290' Thickness Drilled 850'

The Ivishak Formation is picked on the basis of sandstone occurrence and Schlumberger log response.

The interval from 10,440' - 10,602' is interpreted to be pro-delta to near-shore marine. Lithology is quartz, sandstone, light gray, tan, very fine grained. silty, siliceous, with minor occurrences of black phosphate pellets, rare glauconite, and finely disseminated pyrite: interbedded with brown-gray flakey shale and gray-brown firm siltstone.

From 10,602' - 10,732' a clean bioturbated quartz sand is developed that is thought to represent deposition in a prograding delta. The lithology is quartz sandstone, fine-medium grained at the top, decreasing in grain size to fine-very fine grained at 10,620', and consists of white, clear quartz, well compacted, in part siliceous, subrounded-rounded, well sorted, commonly bioturbated; and has thin horizontal shale

partings and rare siliceous shale nodules. The best log porosity is developed between 10,610' and 10,670' averaging 15%, and is calculated to be water bearing.

Formation losses of 200 barrels were encountered at 10,651'.

From 10,732' to 11,096' deposition is interpreted to be continental to marginal marine. Red-pink silty shale and siltstone are common and are interbedded with carbonaceous sandstone beds representing probable bar or distributary channel deposits. Two sand units are present in this interval. The first from 10,810' - 10,847' consists of light-gray, very fine-fine grained, siliceous sandstone with a middle section of fine-medium grained poorly sorted, pebbly, varicolored, slightly argillaceous, carbonaceous, siliceous sandstone with thin shale partings and shale clasts. The second interval from 10,948' - 11,001' consists of sandstone, red, gray with reddish cast, fine-very fine grained, slightly friable, subrounded-subangular, clear, white, orange, pink quartz grains, carbonaceous, in part siliceous. Maximum log porosity developed in these sands is 14% with calculations indicating high water saturation. Formation losses of 400 barrels occurred at 11,001' but may be to loss zone at 10,651'.

Kavik Member

The Kavik Member was topped at 11,096' and is interpreted to be marine. Lithology of the Kavik is dark gray brittle shale

with thin siltstone stringers and rare carbonized plant fragments.

Oil and Gas Indications - No hydrocarbon indications were found in the Ivishak Formation. Net clean sand in the Ivishak is 153', however much of the sand is siliceous and in part grades to quartzite. The sands are very similar to those found in Inigok No. 1.

Echooka Formation

Interval 11,290' - 11,420' Thickness Drilled 130'

The Permo-Triassic Echooka Formation was deposited as a transgressive to the north, marine to non-marine deposit. Lithology of the Echooka is dark gray-green, shaly, siliceous, glauconitic, very fine-fine grained, subangular quartz sandstone with interbedded gray siltstone and dark gray-green, dark gray and red mottled shales. No significant reservoir rock was encountered in the Echooka. The best porosity development was from 11,321' - 11,334' with neutron porosity of 6%.

Oil and Gas Indications - At 11,325' a slight gas show was observed with 35 units of total gas indicated. Maximum chromatograph readings were 6950 ppm C1, 785 ppm C2, 210 ppm C3, 75 ppm C4.

Permian - Mississippian Lisburne Group

Interval 11,420' - Present Depth Thickness Drilled 2790'

A "Lisburne transitional", shallow marine carbonate-clastic depositional regime exists at Ikpikpuk that is very similar to that found at Inigok No. 1. The "transitional" section is composed of interbedded gray, tan, gray-brown chemical limestone; dark-gray, silty, calcareous, micaceous shale and dark-gray siltstone with rare fossils. 278' of "Lisburne transitional" was present.

The massive Lisburne "upper limestone unit" was encountered at 11,698'. The deposits of the "massive Lisburne" are shallow marine carbonate shelf with occasional shale and siltstone beds. The carbonates are primarily clean bioclastic and allochemical limestone composed of crinoids, bryozoans, foraminifera, brachiopods, spines, oolites and pellets with calcspar and occasionally micrite cement. It is generally recrystallized to the point that fossil grains are indistinct to ghosts. The rare occurrence of dolomite and lack of evaporites, coupled with the recrystallized tight limestone points to an environment of carbonate deposition with unrestricted marine waters.

The late Mississippian "dolomite unit" was encountered from 13,780' - 14,075'. This unit consists of basically the same type of limestone encountered in the upper unit with some thin beds of dolomite present. No evaporites occur with the unit and as such it is thought to represent a period of carbonate deposition in which the waters were somewhat restricted, although

not to the point of being a "sebka." Slight pinpoint porosity to small vugs occur in the dolomite, but no effective permeability exists. The maximum log porosity developed in the dolomite unit was 6% at 13,784' - 13,788'.

The lower limestone unit was encountered at 14,075' and continues at present depth 14,210'. Lithology continues as partly recrystallized bioclastic and allochemical limestone with thin siltstone and shale beds.

The Lisburne Group overall is very tight with log porosities of 0 - 3% indicated. No Lisburne reservoir exists at this location unless it is in the remaining undrilled Mississippian "lower limestone unit."

Oil and Gas Indications - No significant indication of oil or gas was noted in the Lisburne Group drilled thus far. Maximum total gas observed was 335 units at 11,839' with chromatograph gas readings of 88,900 ppm C1, 1500 ppm C2, 25 ppm C3. No potential reservoir rock accompanied the gas.

STRUCTURE

Dipmeter data indicate low formation dips at Ikpikpuk.

From 2620' to 3300' dip is to the northeast averaging 2°. From 3300' to 3750' dip is to the west southwest at 1 to 2°.

Dips at the top of the Torok range up to 6° and average 3° with preferred orientation to the northeast and east down to

5320'. From 5320' down to 7500' in the Kingak direction of dip shows a preference to the northeast and with low dips averaging 2^{o}.

From 7500' down to 9800' dips are low averaging 2^{o} with variable southwest to southeast orientation.

From 9800' down to present depth 14,210' dips average 2^{o} with consistent direction to the southwest.

CONCLUSIONS

The subject well has tested the stratigraphic possibilities of the Cretaceous to Triassic rocks. No significant oil, gas, or coal deposits occur in these rocks. While some of the sandstone deposits give gas indications, they appear to be discontinuous (small limited reservoirs), and commonly have water soluable clay in the matrix.

The structural-stratigraphic potential of the Sag River - Lisburne has been tested. The sandstones of the Sag River and Sadlerochit Group are generally of low porosity, are calculated to be water wet and have no hydrocarbon shows. The Lisburne carbonates down to present depth are very tight (0 - 3% porosity), and display no to very slight hydrocarbon shows.

Continuation of the well in the fall should further test the potential of the Mississippian - Pre-Devonian section at Ikpikpuk No. 1 well.