NATIONAL PETROLEUM RESERVE IN ALASKA

GEOLOGICAL REPORT

AWUNA TEST WELL NO. 1

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
JULY 1983

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COMPOSITE LITHOLOGY LOG (In Pocket)

GEOLOGIC SUMMARY

INTRODUCTION

The Awuna Test Well No. 1 is located in the SE 1/4 of protracted Section 30, T3S, R25W, Umiat Principal Meridian, approximately 145 miles west of Umiat, Alaska (see Figures 1 and 2). Drilling of the well commenced on February 29, 1980. The well was suspended on May 7, 1980 at a depth of 5,300 feet and recommenced on December 5, 1980. The well reached a total depth of 11,200 feet on April 16, 1981, and the rig was released on April 20, 1981 after logging and plugging operations.

Minor oil shows occurred in sands from 1,840 to 2,070 feet, 2,380 to 2,600 feet, and from 3,655 to 3,666.5 feet. These shows were in thin, shaly sandstones of very low porosity. Gas shows were scattered from 3,185 to 4,500 feet and became quite common from 4,500 feet to total depth. All of the gas shows above 7,890 feet were restricted to low porosity sandstones and were associated with mildly over-pressured conditions. The gas shows in the Fortress Mountain Formation from 7,890 feet to 11,200 feet also occurred under over-pressured conditions, but were of greater significance because of their presence in a fracture system. A decision was made to conduct a drill-stem test below the casing at 8,297 feet in order to test the potential reservoir and possible gas-producing capabilities of the fractured sandstones. None of the shows warranted any further testing or evaluation after obtaining the results of DST No. 1.

PRE-DRILLING PROGNOSIS

The Awuna Test Well No. 1 was drilled in order to test sandstones of the Lower Cretaceous Fortress Mountain Formation. The location was chosen on the basis of demonstrated four-way seismic closure created by a thrust fault on the south flank of the Carbon Creek Anticline. Seismic data did not indicate any closure on the upper thrust plate above 9,500 feet.

The Carbon Creek Anticline is the most northerly in a series of elongate east-west trending structures created by thrusting and sliding off the Brooks Range. Texaco had earlier tested the general trend by drilling the East Kurupa No. 1 and West Kurupa No. 1, both of which encountered reservoir quality sands in the Fortress Mountain Formation. The East Kurupa No. 1 had good gas shows and is potentially capable of gas production. The West Kurupa well is approximately 70 miles east of Awuna (Figure 3), and the East Kurupa well is about 48 miles farther east.

POST-DRILLING SUMMARY

The Awuna Test Well No. 1 was drilled to a total depth of 11,200 feet (driller) and was still in the Fortress Mountain Formation. Slow drilling progress on the well and approaching warm weather forced curtailing drilling operations short of the proposed total depth of 15,000 feet.

The postulated thrust fault at 9,500 feet was not confirmed by lithological or paleontological data. The dipmeter data suggests that a possible fault was encountered in the section from 8,300 to 10,146 feet. Although the section from 8,300 to 10,146 feet was not logged by the dipmeter, data above 8,300 feet and the data below 10,146 feet are radically different in direction (see discussion in Wellsite Geologist's Report).

The presence of well developed euhedral quartz crystals in the Fortress Mountain sandstones indicated either vugs or fractures with open fracturing being the most likely. A drill-stem test of the interval from 8,297 to 8,412 feet confirmed open fracturing since the zone flowed water at more than 2,000 barrels per day and had excellent pressures. The sandstone matrix had poor porosities and could not have yielded significant amounts of fluid without secondary (fractured) porosity.

Only minor shows of oil were encountered in tight, thin, shaly sandstones. Numerous gas shows related to over-pressure were recorded, but none indicated potential production.

Additional and more detailed information of log and core analysis is available in the appendices of this report.

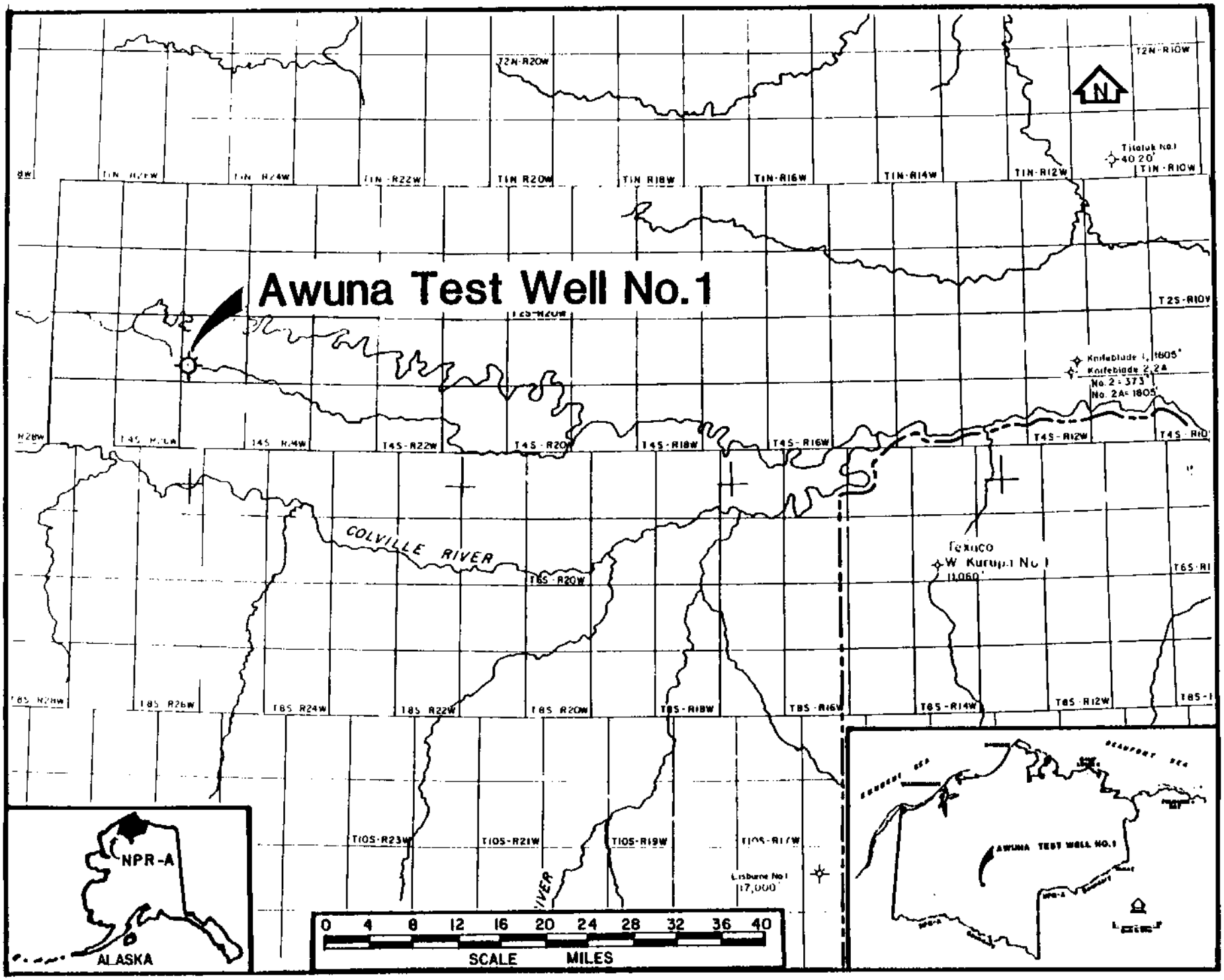
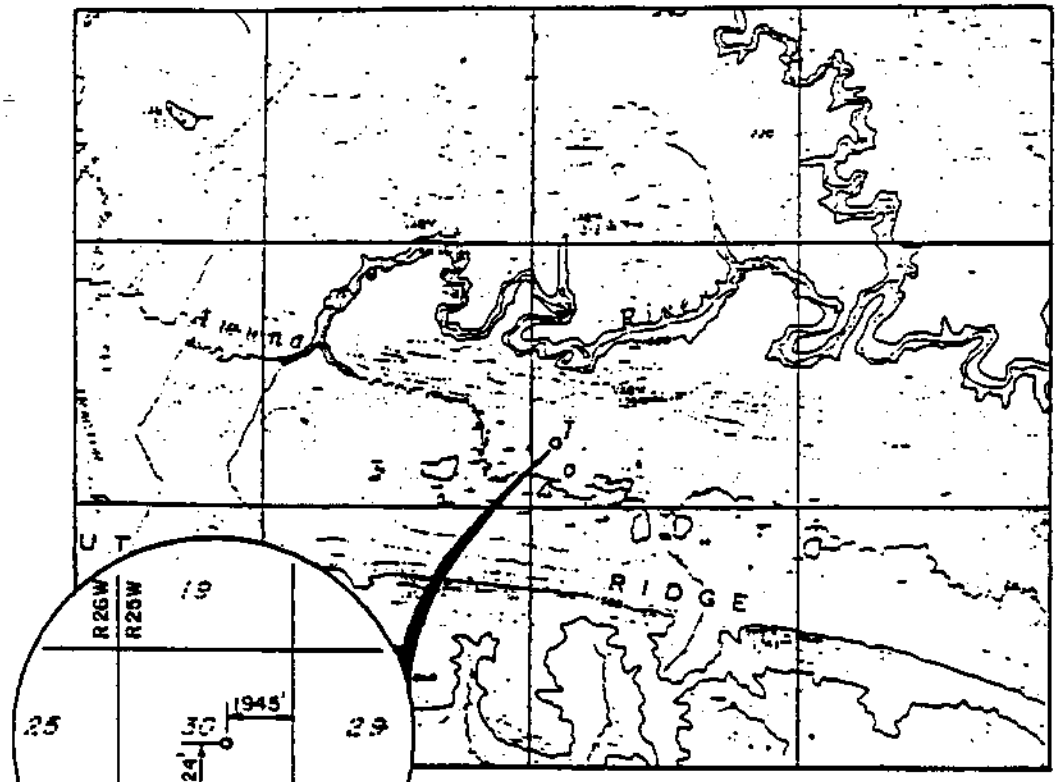


FIGURE 1 - LOCATION MAP - AWUNA TEST WELL NO. 1



Computed location based on data from Barr Automated Surveys, Inc. to Husky Oil NPR Operations, Inc. dated Aug. 11, 1979, a copy of which is on file with Tectonics, Inc., Anchorage, AK.

AWUNA 5-80

LAT. = 69° 09' 11.58"
LONG. = 158° 01' 21.27"
Y = 5,539,587.38
X = 497,057.45
ZONE 6

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.

0 2 4 6
SCALE MILES

STATE OF ALASKA
49TH
James B. Roberts
Lic. 3260-S
REGISTERED PROFESSIONAL LAND SURVEYOR

AS STAKED

AWUNA TEST WELL No. 1

LOCATED IN

SE 1/4 PROTRACTED SEC. 30, T3S, R25W, UMIAT MERIDIAN, AK.

SURVEYED FOR

HUSKY OIL

N.P.R. OPERATIONS, INC.

TECTONICS INC.

P.O. BOX 4-2265, ANCHORAGE, AK 99509

FIGURE 2 - SURVEYOR'S CERTIFICATE - AWUNA TEST WELL NO. 1

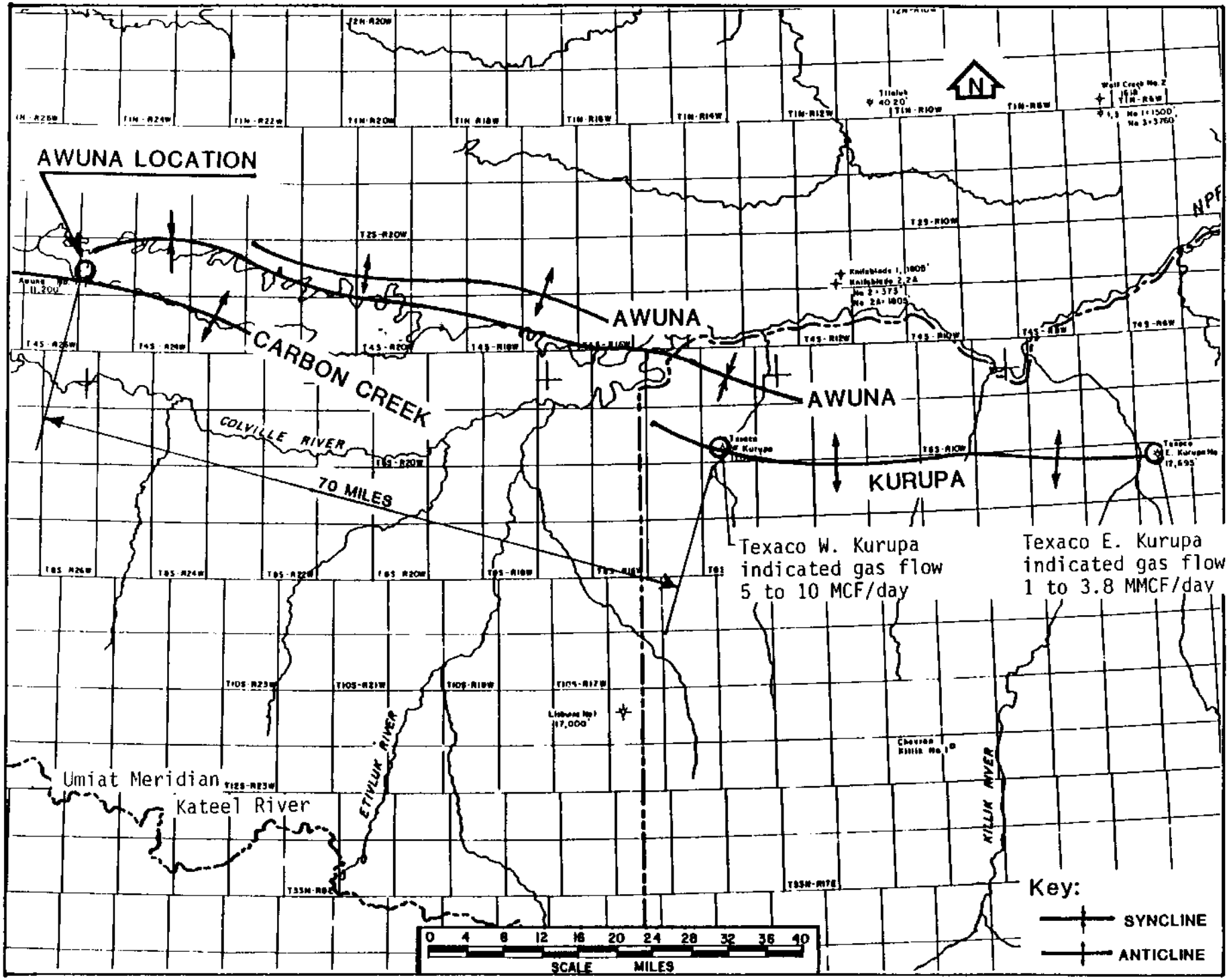


FIGURE 3 - STRUCTURAL TRENDS MAP - AWUNA TEST WELL NO. 1
(from Tetra Tech, December 1978)

WELL LOCATION
AWUNA TEST WELL NO. 1

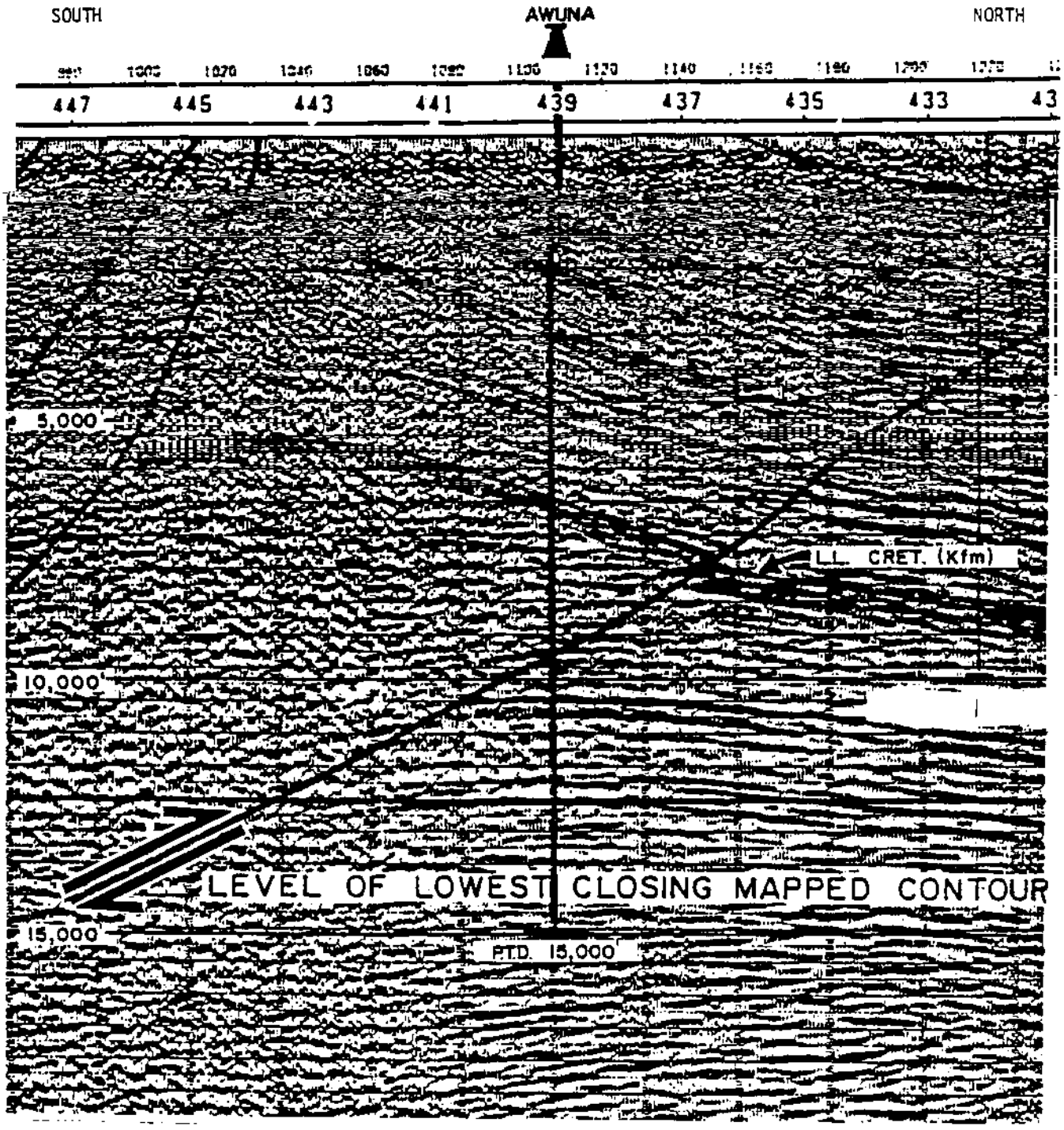


FIGURE 4 - FY80 SHALLOW WELL PROPOSAL -
AWUNA NO. 1
SEISMIC LINE - GSI
89X-78-G-1184 (partial reproduction)
From Tetra Tech, February 1979

WELLSITE GEOLOGIST'S REPORT
BY
GORDON W. LEGG

SUMMARY

The Awuna Test Well No. 1 is located in the northern foothills of the Brooks Range a few miles north of the Colville River and adjacent to one of its tributaries, the Awuna River. Geologically, the well is located on what is probably the northernmost thrustal zone of the east-west trending thrustal folds developed on the south flank of the Colville Basin from compressional forces associated with the Brooks Range orogeny and from likely gravity sliding and slumping from the range into the trough of the sedimentary basin. The well was drilled to test the Fortress Mountain sandstones associated with a large anticlinal flexure with an interpreted low angle thrust fault up-thrown to the south (Figure 4). The plane of the thrust fault was interpreted to be at an approximate depth of 9,500 feet. Seismic interpretations did not indicate any structural closure above 9,500 feet at the well location. The well was proposed as a two-season drilling prospect (drilling to be done in the winters of 1980 and 1981 with a suspension during the summer of 1980).

STRATIGRAPHY

Since both paleontological and palynological determinations indicated an age of Early Cretaceous (probably Aptian to Early Albian) from near surface to their lowermost definitive limits (8,740 feet for paleontology and 10,720 feet for palynology) and, furthermore, since even these determinations appear to be imprecise and accompanied by many "probables" and "inferreds", the stratigraphy shall be discussed on a lithological basis rather than an age-related one.

Generally, the lithological units can be broken into only two major subdivisions with a dominant silty shale and siltstone unit with occasional sandy zones and sandstone bodies above 7,890 feet and a dominant very fine-grained silty sandstone interbedded with numerous siltstones and occasional shales from 7,890 feet to the total depth of 11,200 feet. The zone from the surface down to 7,890 feet is likely rocks of Torok Age with rocks of the Fortress Mountain Formation being present from 7,890 to 11,200 feet.

CRETACEOUS

Torok Formation: 0-7890'

The Torok may be further subdivided into two units of unequal thickness on the basis of lithology and probable depositional environment.

The upper subdivision is from the surface to approximately 2,960 feet. The rocks are mostly shales and siltstones which are gray and typically calcareous, occasionally micaceous, and contain persistent distributions of pyrite. There are some rather silty gray and tan, fine-grained sandstones

from about 1,850 to 2,050 feet. The depositional environment for this suite of rocks appears to be shallow water, near shore, and in a relatively quiet, slightly reducing state.

The lower subdivision of the Torok extends from 2,960 to 7,890 feet. The strata are characterized by alternating sequences of shales, siltstones and sandstones. The shales are invariably micromicaceous to very finely micaceous and are typically silty, carbonaceous and calcareous. The siltstones are shaly to sandy and are mostly carbonaceous. The sandstones are generally very fine grained, with occasional fine grained beds and some rare medium grained lenses. The sandstones are frequently glauconitic, micaceous, and carbonaceous. Abundant weathered feldspar grains were noted in some of the sandstones. Each of the lithologies appears to be gradational with the others in a somewhat cyclical deposition sequence.

The presence of the glauconite in the sandstones and its occasional appearance in the siltstones points to a shallow marine environment for the interval from 2,960 to 7,890 feet. The presence of coaly lenses, carbonaceous material, carbonized wood, and plant remains points strongly to a near shore, possibly alternating shallow marine to deltaic condition. The observed crossbedding (Core No. 2) and the persistence of the glauconite suggest occasional periods of higher energy.

Fortress Mountain Formation: 7890-11,200'

The Fortress Mountain Formation consists predominantly of sandstone interbedded with frequent siltstones and with only occasional beds of shale. The sandstones are typically very fine to fine grained and commonly feldspathic. The presence of altered and decomposed feldspars in the matrix has greatly reduced the porosity. The sandstone is usually quite calcareous and frequently contains heavy silica cement further reducing the porosity; shaliness and siltiness are common. It is noteworthy that the siliceous zones are invariably accompanied by the presence of well developed euhedral quartz crystals and broken quartz (presumed to be larger crystals). This selective zonation suggests a partial silicification adjacent to open fractures which provided a conduit for secondary low-temperature silica impregnation.

Mica is occasionally present in the sandstones, siltstones and shales, though not in the abundance that was noted in the overlying Torok. There is a marked reduction in carbonaceous material and little or no pyrite.

The Fortress Mountain rocks appear to be primarily sub-graywacke sandstones with frequent interbedded sandy siltstones and some rather silty shales. This sequence (7,890-11,200 feet) was probably generated from fairly rapid decomposition and subsequent transportation to deeper water through submarine slumping and turbidity currents. The deposition of the Fortress Mountain was probably accompanied by orogenic activity in the form of emergence of the contributing landmass and/or subsidence of the basin. The scarcity of marine fauna lends support to this hypothesis.

An attitude of caution should be observed when examining the lithology log for an apparent change in lithology from predominantly sandstone and siltstone to a sequence of siltstone and shale below 9,950 feet. This apparent change in lithology is not supported by the electric logs. It is believed that changing to a diamond bit with a turbodrill assembly has pulverized and "burned" the cuttings making accurate identification impossible. An important consideration is the fact that in short intervals below 9,950 feet, where conventional bits were used, the percentage of sandstone increases remarkably.

STRUCTURE

The Awuna prospect was drilled on a large anticline, which is part of an east-west trend of anticlines extending for miles and is generally parallel to the trend of the Brooks Range. The Carbon Creek and Awuna anticlines along with other generally parallel anticlinal folds persist from the Brooks Range to just north of the Colville River and were likely formed from compression accompanied by Brooks Range orogeny, and from probable slumping and thrusting from the mountains into the subsiding Colville Trough. Seismic interpretations postulated a thrust fault at approximately the 9,500 feet level in the Awuna well. No lithological evidence for the fault was encountered. The dipmeter reveals consistent dips of approximately 30° in a slightly east of north direction down to 5,900 feet. The 30° dip was confirmed in Core No. 2, 3,664-3,680 feet. There was a scattering of values for both rate and direction from 5,900 to 7,900 feet and then very consistent rates of 40-50° were recorded from 7,900 to 8,300 feet. The direction was slightly east of north. There was no dipmeter survey from 8,300 to 10,146 feet. Dip values from 10,146 feet to total depth (11,200 feet) start at 30° and decrease to 20-30°, but maintain a direction slightly east of south and becoming nearly southeast for the last 300 feet. The dramatic reversal in dip direction strongly suggests a fault.

It is apparent from the dipmeter data that a change in the structure occurred between 8,300 and 10,146 feet. This could have been caused by the interpreted thrust fault. At any rate, it is difficult to explain 11,000 feet of high dip rates (25-50°) without the presence of one or more thrust faults.

OIL AND GAS SHOWS AND POTENTIAL RESERVOIRS

There were a few minor oil shows from 1,840 to 2,070 feet in several thin shaly sands interbedded with siltstones. Electric logs revealed the sandstones to be shaly and tight with low porosities (5-10%). Other minor shows of oil were encountered from 2,380-2,600 feet (again low porosity and very shaly) and from 3,655-3,666.5 feet (the last 2.5 feet is described in Core No. 2). The porosity in this thin zone was 10-12%, which is still quite low.

There were a few scattered gas shows from 3,185 to 4,500 feet and then gas shows became quite common from 4,500 feet all the way to total depth. In each case, gas shows above 7,890 feet were restricted to low porosity sandstones, and were definitely associated with over-pressured conditions.

The gas shows in the Fortress Mountain Formation from 7,890 to 11,200 feet were of a different nature than those above. Even though the shows were associated with over-pressure, they were invariably coincident with the appearance of the previously mentioned euhedral quartz crystals. Of interest is the fact that the crystals and the subsequent silicification apparently came from waters in the already created fractures since the sandstone was only silicified in fractured zones and then was a minor part of the sandstone percentage, indicating mineralization came from the fractures and persisted only a short distance in the relatively impermeable sandstone matrix. Since euhedral crystals with perfect terminations can only evolve in a fluid medium (vugs, fractures, etc.), open fractures were strongly suspected and then proved by a drill-stem test taken from the base of the 9-5/8" casing (8,300 feet) to 8,412 feet (drilling depth at the time of the test).

This drill-stem test flowed salty formation water at a rate of more than 2,000 barrels per day. The significance of a flowing water test and the prolific rate of recovery coupled with excellent observed formation pressures conclusively proves an extensive open fracture system in the Fortress Mountain. This conclusion is inescapable since the primary porosities in the sandstone were very low and incapable of yielding significant amounts of fluid.

The Fortress Mountain Formation at the Awuna location has been proven to be extensively fractured by the consistent appearances of quartz crystals and by the previously mentioned drill-stem test. Even though the primary porosity was low, the presence of the fracture system would create an excellent reservoir if encountered in a closed structure.

CONCLUSIONS

The Awuna well has likely tested the objective at its location even though the prognosed total depth of 15,000 feet was not reached. The objective was to have been below the thrust fault and into a closure on the lower plate. The unexpected presence, however, of extensive open fractures above the thrust fault and, therefore, above the closure enhances the possibility for a prospect to be relocated to test a possible closure on the upper plate.

The single most significant fact to emerge from the Awuna Test Well was the discovery of a possible prolific reservoir in the Fortress Mountain Formation from porosity and permeability developed through fracturing. Throughout the drilling history on the National Petroleum Reserve, the most serious detriment to commercial oil or gas production has been a general lack of porous and permeable reservoir beds of sufficient thickness. With the drilling of the Awuna test well, at least, a new approach to drilling objectives can now be formulated.

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SUMMARY PERTINENT DATA, OPERATIONS & ANALYSIS*

WELL NAME:	Awuna Test Well No. 1
API NO.:	50-155-20001
OPERATOR:	Husky Oil NPR Operations, Inc.
LOCATION:	2519' FSL and 1936' FEL** SE 1/4, protracted Section 30, T3S, R25W Umiat Meridian, Alaska
COORDINATES:	Latitude: 69°09'11.58" North Longitude: 158°01'21.27" West

X 497,057.45; Y 6,539,587.38
Zone 6

1,127 feet Kelly Bushing (KB)
1,103 feet Pad

ELEVATION:

30" @ 108'
20" @ 1500'
13-3/8" @ 5292'
9-5/8" @ 8297'
7-5/8" @ 10,126'

CASING:

February 29, 1980	DATE SPUDDED:
May 7, 1980	DATE SUSPENDED:
5,300 feet	DEPTH AT RE-ENTRY:
December 5, 1980	DATE RE-ENTERED:
11,200 feet (Driller) 11,193 feet (Schlumberger)	TOTAL DEPTH:
April 16, 1981	DATE REACHED TOTAL DEPTH:
April 20, 1981	DATE RIG RELEASED:

LOGGING RECORD:	GR/SP/DIL	116- 8,299'
	GR/SP/DIL/SFL	10,119-11,186'
	GR/BHC	116- 5,290'
		5,280- 8,299'
		10,119-11,187'
	SP/GR/DIL/BHC	8,311-10,116'
	GR/CAL/CNL/FDC	116- 8,301'
		10,119-11,193'
	HDT-Dipmeter	5,280- 8,303'
		10,119-11,150'
	HRT-Temperature	100-11,185'
	Birdwell Velocity Survey	500- 5,250'
		6,180-11,170'
	CST Sidewall Cores	5,332- 8,157'
	Shot 30, recovered 6	
		10,139-11,150'
	Shot 24, 10 misfires, recovered 2	
	Mudlog	105-11,200'

CONVENTIONAL CORES:

No.	Interval	Recovery
1	2447-2477'	29.5'
2	3664-3680'	15'
3	6010-6040'	30'

TESTS: 8297-8412'; flowed at rate of 2,057 BWPD, 6,800 ppm chloride

STATUS: Dry and abandoned

WELLSITE GEOLOGISTS: Steve Reid
Gordon W. Legg
Dave Young

MUD LOGGING: Exploration Logging

WELL LOG ANALYST: Armour Kane

DRILLING CONTRACTOR: Parker Drilling Company, Rig 95

BIOSTRATIGRAPHIC ANALYSIS: BioStratigraphics

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

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

** (Original Survey Certificate carried 2524' FSL and 1945' FEL, but actual location was moved several feet when rig was positioned.)

AWUNA TEST WELL NO. 1
DRILL CUTTINGS AND CORE DESCRIPTIONS
BY

S. REID	-	108- 2,930'
G. LEGG	-	2,930- 7,430'
	-	8,304- 9,940'
D. YOUNG	-	7,430- 8,304'
	-	9,940-11,200'

DEPTH DRILLED (FEET BELOW KELLY BUSHING)	
0 - 108	No recovery.
108 - 190	Shale: medium to dark gray, firm to hard, silty, blocky, finely micaceous, slightly calcareous, grading to Siltstone: light gray, micaceous, hard, calcareous.
190 - 250	Shale: as above, with trace disseminated pyrite; grading to Siltstone: as above.
250 - 760	Shale: medium to dark gray, firm to hard, very silty, blocky, finely micaceous, calcareous, grading to Siltstone: light gray, micaceous, hard, calcareous, with occasional disseminated pyrite.
760 - 940	Shale: as above, with increase in Siltstone: light to medium gray, hard, micaceous, calcareous, with trace of disseminated pyrite.
940 - 970	Shale and Siltstone: as above, with trace of fracture-filled calcite and pyrite.
970 - 1150	Shale: medium to dark gray, firm to hard, very silty, blocky, finely micaceous, calcareous, grading to Siltstone: light to medium gray, hard, blocky, micaceous, calcareous, with trace of disseminated pyrite.
1150 - 1240	Shale: as above, grading to Siltstone: as above, with trace Sandstone: light gray to gray, very fine grained, silty, tight and hard, slightly calcareous, pyritic.
1240 - 1390	Shale and Siltstone: as above.
1390 - 1514	Shale: medium to dark gray, firm to hard, very silty, pyritic, calcareous, micaceous, grading to Siltstone: gray, hard, micaceous, calcareous, pyritic, interbedded with thin stringers Sandstone: light gray, very fine grained, silty, clay-filled, calcareous, hard, tight.

NOTE: Total depth - 1514' - prepared to log.
Set 20" casing to 1500'.

1514 - 1600 Shale: medium to dark gray, firm to hard, very silty, slightly calcareous, blocky, pyritic, interbedded with Siltstone: gray, hard, blocky, slightly sandy, slightly calcareous, pyritic.

NOTE: 59' downhole correction from 1604' to 1663'.

1660 - 1680 Shale and Sandstone: as above.

1680 - 1690 Shale and Siltstone: as above, interbedded with trace Sandstone: light gray to gray, very fine grained, very silty, poorly sorted, calcareous, hard, tight.

1690 - 1810 Shale and Siltstone: as above, Shale: occasionally becoming slightly fissile.

1810 - 1840 Shale: as above, interbedded with Siltstone: as above, grading to Sandstone: light gray to gray, very fine grained, silty, "salt and pepper", clay filled, poor sorting, hard, tight.

1840 - 1850 Shale and Siltstone: as above, with increase in Sandstone: as above, hard and tight, no fluorescence, no ring in tray, no stain, no odor.

1850 - 1890 Shale and Siltstone with Sandstone: as above, with trace (1%) pale straw fluorescence, cut as above, no stain, no odor.

1890 - 1950 Sandstone: light gray, very fine grained, very silty, subrounded, poor sorting, clay filling, "salt and pepper", calcareous, siliceous, well cemented, no visible porosity, hard, interbedded with Shale: gray to dark gray, very silty, blocky, hard, grading to Siltstone: light gray to gray, sandy, micaceous, pyritic, calcareous, hard, sandstone has trace pale straw fluorescence, very slow cut when crushed, no stain, no odor.

1950 - 2070 Sandstone: as above, with shows as above, becoming finer grained, more silty, very hard and tight, with increase in Siltstone and Shale: as above.

2070 - 2100 Shale: gray to dark gray, very silty, micaceous, pyritic, hard, blocky, interbedded with Siltstone: gray, sandy, micaceous, pyritic, hard, calcareous, blocky, grading to Sandstone (decreasing amounts): light gray to gray, very fine grained, very silty, very poorly sorted, subrounded, "salt and pepper",

well cemented, calcareous, siliceous, micaceous, hard, tight, scattered traces of pale yellow fluorescence, very slow pale straw cut when crushed, no odor or stain.

2100 - 2220 Shale: as above, interbedded with thin bedded Siltstone: as above, grading to trace amounts of Sandstone: as above, no shows.

2220 - 2320 Shale: medium to dark gray, firm to hard, blocky to occasionally slightly fissile, micaceous, pyritic, very silty, interbedded with Siltstone: gray, hard, blocky, occasionally very sandy, micaceous, pyritic, grading to Sandstone: gray, very fine grained, very silty, very poor sorting, "salt and pepper", micaceous, clay filled, siliceous, well cemented, hard and tight.

2320 - 2380 Shale: interbedded with Siltstone: as above, with Sandstone: as above, decreasing to trace amounts.

2380 - 2400 Shale and Siltstone: as above, with minor amounts of Sandstone: gray, very fine grained, poorly sorted, very silty, subrounded, "salt and pepper", calcareous, hard to slightly friable, no fluorescence, very slow pale straw cut when crushed, no residue, no odor, no stain.

2400 - 2440 Sandstone: as above, light gray, occasionally fine grained, friable, no visible porosity, trace of pale straw fluorescence, slow streaming cut, pale straw to dark straw, light brown residue on dish, no odor, no stain.

2440 - 2447 Sandstone: as above, with shows, as above, with decreasing amounts of Siltstone and Shale: as above.

2447 - 2477 <u>Core No. 1: Cut 30', Recovered 29.5'</u>

2447.0-2476.5' (29.5') Interbedded, thinly laminated sandstone and shale; abundant cut and fill structures, no bioturbation, sandstone content decreasing toward bottom of core; Sandstone: light gray to gray, very fine grained, very silty, "salt and pepper" texture, poor sorting, subrounded, hard, well cemented, siliceous, calcareous, tight, no fluorescence, very slow cut, pale to dark straw, streaming when crushed, no odor or stain, interbedded with Shale: dark gray, very silty, micaceous, trace of pyrite, well

laminated, well bedded, cut and fill structures, becoming less sandy toward bottom, apparent dip 23°.

2476.5-2477.0' (0.5') No recovery.

2477 - 2480 Shale: dark gray, as above, with decreasing amounts of Sandstone: as above.

2480 - 2530 Shale: as above, with decreasing amounts of Sandstone: as above.

2530 - 2570 Sandstone: light gray to gray, fine to very fine grained, very poor sorting, subrounded to angular, silty, clay filled, rock fragments, hard, siliceous, calcareous, trace

glauconite, tight, with Shale: as
nor amounts of Siltstone: gray,
y, hard, blocky, all samples with
low cut, pale straw, no odor, no
tain.

bove, very poorly sorted, abundant
nd silt, with Shale and Siltstone: as

ay, blocky to slightly fissile, silty,
of pyrite, with minor amounts of
dstone: as above.

, with trace amounts of Siltstone and
ove, possible cavings.

gray, micromicaceous, very slightly
tly silty in part, grading to siltstone

, with Sandstone: gray, very fine
lt, grading to Siltstone: very
ry finely carbonaceous, moderately
indurated, nil visible porosity, no

with Sandstone: as above, but not

but more silty, grading to Siltstone
dstone: very silty, as above, very
nd argillaceous with some calcite
fracture filling.

above, and mi
occasionally sand
trace of very s
fluorescence, no s

2570 - 2600 Sandstone: as a
rock fragments a
above.

2600 - 2770 Shale: dark gr
micaceous, trace
Siltstone and San

2770 - 2930 Shale: as above
Sandstone: as ab

2930 - 2970 Shale: medium
calcareous, sligh
in part.

2970 - 2980 Shale: as above
grained to si
argillaceous, ve
calcareous, well
show.

2980 - 3010 Shale: as above
quite so silty.

3010 - 3080 Shale: as above
in part with San
carbonaceous a
crystals, may be

3080 - 3130	Shale: as above, becoming slightly darker, appears to be slightly organic.
3130 - 3170	Shale: becoming light to medium gray, mostly as above, but more silty, grades to siltstone in part.
3170 - 3180	Shale: as above, with Sandstone: gray, occasionally "salt and pepper", with carbonaceous material, very fine grained to silt, argillaceous, calcareous, well indurated.
3180 - 3230	Sandstone: as above, but with increase in grain size to very fine grained to fine grained, very carbonaceous, occasional poor porosity, with Shale: as above.
3230 - 3250	Shale: becoming gray-brown in part, blocky to lumpy, with Sandstone: as above.
3250 - 3340	Shale: as above, with Sandstone: as above, and with occasional loose, massive pyrite.
3340 - 3370	Shale: dirty gray, silty, calcareous, subfissile to fissile.
3370 - 3390	Shale: as above, with occasional free pyrite.
3390 - 3560	Shale: as above, with trace of Sandstone: as above, with rare very fine grained glauconite inclusions.
3560 - 3570	Shale: as above, with occasional free pyrite.
3570 - 3580	Shale: as above, with minor Siltstone: gray, sandy, grades to Sandstone: very argillaceous, carbonaceous.
3580 - 3650	Shale: as above, with Sandstone: gray, very fine grained to silt, grades to Siltstone: calcareous, argillaceous, well indurated, with Siltstone: as above.
3650 - 3664	Sandstone: gray-brown, mottled black and tan, fine grained, some medium grained, abundant weathered feldspar, black carbonaceous inclusions, resembles gilsonite, red-brown resinous mineral, appear to be organic, slight to moderately calcareous, argillaceous, rare glauconite, dull gold crushed cut, fair dull gold residue.
3664 - 3680	Core No. 2: Cut 16', Recovered 15'
3664.0-3666.5' (2.5')	Sandstone: medium gray, mottled dark gray-black, fine grained and medium grained, subangular quartz,

	and weathered Feldspar: dark gray, very carbonaceous shale fragments, occasional flakes of muscovite, red-brown resinous mineral, could be phlogopite, probably organic, very rare glauconite, heavily cemented with calcite and white clay from weathered feldspar, well indurated, poor porosity, speckled very dull gold-brown fluorescence, slight cut, good crushed cut, very good odor, some tarry "gilsonite" inclusions near bottom, crossbedding evident.
3666.5-3679.0' (12.5')	Shale: dark gray to medium gray, very finely micaceous to micromicaceous, fissile, organic, interlaminations and lenses of gray siltstone and silty sandstone; measured apparent dip of 30°.
3679.0-3680.0' (1.0')	No recovery.
3680 - 3710	Shale: as in Core No. 2.
3710 - 3750	Sandstone: off-white to light gray, very fine grained to fine grained, "salt and pepper" with carbonaceous inclusions, abundant white clay from weathered feldspar, calcareous, poor porosity, no show, with Shale: as above.
3750 - 3790	Sandstone: as above, with Sandstone: as above, but becoming more fine grained, dark gray, very "dirty", and argillaceous, grading to siltstone, with Siltstone: gray to dark gray, very argillaceous, grading to shale, with Shale: as above.
3790 - 3800	Shale: as above, with Sandstone: as above, but becoming more fine grained, dark gray, very "dirty", and argillaceous, grading to siltstone, with Siltstone: gray to dark gray, very argillaceous, grading to Shale.
3800 - 3840	Sandstone: as above, slightly less argillaceous, with Shale and Siltstone: as above.
3840 - 3900	Shale: as above, with Sandstone: becoming more silty, grading to siltstone.
3900 - 3980	Shale: as above, with trace of sandstone, becoming more silty, argillaceous.

3980 - 4030	Shale: as above, with Sandstone: mostly as above, but occasional very fine grained glauconite, some asphalt in matrix.
4030 - 4100	Shale: becoming more light gray, silty, less organic.
4100 - 4110	Shale: as above, with Sandstone: mostly very "dirty", argillaceous and silty, grading to siltstone.
4110 - 4120	Shale: as above, with Sandstone: as above, with Siltstone: gray, very argillaceous and sandy, grading to Sandstone: well indurated.
4120 - 4170	Shale: as above, with few thin laminations of coal.
4170 - 4200	Shale: as above, with occasional free pyrite.
4200 - 4280	Shale: becoming very earthy, silty with trace of Siltstone: as above.
4280 - 4340	Shale: light gray, fissile, very silty, grading to siltstone, with traces of siltstone, grading to shale.
4340 - 4410	Shale: as above, with minor Sandstone: gray, very fine grained to silt, "salt and pepper", with carbonaceous inclusions, very argillaceous, well indurated, poor to nil porosity, no show, with traces of Siltstone: as above.
4410 - 4490	Shale: as above, with Siltstone: dirty gray, very argillaceous, grading to shale, occasionally very sandy, grading to Sandstone: carbonaceous, well indurated.
4490 - 4530	Shale: as above, with trace of Sandstone: brown, very fine grained to fine grained, carbonaceous streaks, inclusions and laminations, argillaceous, poor porosity, no show.
4530 - 4540	Shale: medium gray, very silty, grading to Siltstone: blocky to fissile, abundant free pyrite.
4540 - 4680	Shale: as above, with Sandstone: off-white to light gray, very fine grained to silt, mottled "salt and pepper", with carbonaceous material, very heavy white clay matrix from weathered feldspar, rare pale green glauconite, silty, grading to siltstone in part, poor porosity, no show.
4680 - 4700	Sandstone: gray, very silty in part, poorly sorted, silty to very fine grained to fine grained, some medium grained, calcareous with occasional free calcite,

	generally poor porosity, some fair porosity, no fluorescence, very slow, very slight cut, slight residue, with Shale: as above.
4700 - 4720	Sandstone: becoming more "dirty", argillaceous, carbonaceous, grain size from silt to occasional medium grained, with Shale: as above.
4720 - 4730	Sandstone: as above, with Shale: very silty, grading to siltstone.
4730 - 4850	Sandstone: very silty and argillaceous, with Shale: as above.
4850 - 4910	Sandstone: off-white to gray, very fine grained to fine grained, mottled black and green with carbonaceous material and glauconite, argillaceous with heavy white clay matrix, calcareous, poor porosity, no show.
4910 - 4960	Shale: as above, with Sandstone: as above, becoming more silty, grading to siltstone.
4960 - 4990	Shale: as above, with Sandstone: becoming very silty and argillaceous, grading to very sandy Siltstone: very calcareous, tight.
4990 - 5000	Shale: becoming more well indurated, blocky, with Sandstone: as above.
5000 - 5050	Shale: as above, with Sandstone: becoming essentially siltstone in part.
5050 - 5140	Shale: as above, with Sandstone: as above, and with occasional free calcite.
5140 - 5190	Shale: as above, very finely micaceous, generally very silty, occasional free pyrite, with Sandstone: as above.
5190 - 5210	Shale: as above, with Sandstone: white to gray, mottled black with carbonaceous material, hard, siliceous in part, heavy clay matrix, calcareous, poor porosity.
5210 - 5300	Shale: as above, with Siltstone: gray to dark gray, sandy, grading to sandstone and argillaceous, grading to shale, with Sandstone: as above, with trace (approaches 10%) of well developed calcite crystals, probably from open fractures.
5300 - 5310	No sample.

5310 - 5330	Predominantly cement and metal filings contamination, with Shale: dark gray to black, very argillaceous and silty, grading to siltstone, slightly splintery in part.
5330 - 5370	Shale: as above, with Sandstone: gray to off-white, mottled black with carbonaceous material, very fine grained to fine grained, very argillaceous and silty, grading to siltstone and shale, very poor to nil porosity, no show.
5370 - 5380	Shale: becoming very micromicaceous, carbonaceous, with Sandstone: as above.
5380 - 5400	Shale: as above, with Sandstone: as above, but some with vitreous appearance, very well indurated and cemented in part with silica.
5400 - 5480	Shale: as above, with Sandstone: as above, but becoming very fine grained to silt, grading to siltstone, quartzite in part.
5480 - 5500	Shale: as above, with Sandstone: becoming more silty, grading to siltstone.
5500 - 5550	Shale: as above, with Siltstone: gray, very argillaceous, sandy, well indurated, carbonaceous.
5550 - 5590	Shale and Siltstone: as above, with traces of free pyrite.
5590 - 5620	Shale: becoming more micaceous.
5620 - 5660	Shale: becoming more silty, grading more to siltstone, with Siltstone: as above, and with traces of Sandstone: as above.
5660 - 5750	Shale and Siltstone: as above, with Sandstone: some white to clear, very fine grained, white clay matrix in part, poor to nil porosity.
5750 - 5810	Shale: as above, with Sandstone: mostly as above, but more well indurated, slightly calcareous, mostly silica cement, with Siltstone: as above.
5810 - 5870	Shale: as above, with Sandstone: dark gray, very dirty, argillaceous and silty, grading to siltstone, with minor Siltstone: as above.
5870 - 5910	Shale: as above, with Siltstone: becoming very hard, appears siliceous, slightly calcareous, with Sandstone: as above.

5910 - 5970 Shale and Siltstone: as above, with Sandstone: white to gray, very fine grained, black shale inclusions, well indurated, part silica cement, slightly calcareous, poor to nil porosity, no show.

5970 - 5980 Shale and Siltstone: as above, with Sandstone: very dirty, grading to siltstone.

5980 - 5990 Shale and Siltstone: as above, with Sandstone: as above, and with some Siltstone: very argillaceous and carbonaceous, grading to shale.

5990 - 6010 Shale and Siltstone: as above, with Sandstone: mostly as above, with increase in carbonaceous material.

6010 - 6040 Core No. 3: Cut 30', Recovered 30'

6010.0-6040.0' (30.0') Shale: medium gray, very finely micaceous, slightly calcareous, occasionally silty, finely carbonaceous and with occasional carbonized plant remains and wood fragments, no distinct bedding, breaks with irregular fracture at random angles, occasional fractures predominantly 30°, some approximately 10°, and with occasional horizontal fractures, some fractures with slickensides and drusy calcite, rare irregular, frequently marbled, lenses and pods of Sandstone: gray, very fine grained, argillaceous, silty, hard, dense, calcareous, nil visible porosity, no show, very rare pyrite in some sandstone lenses.

6040 - 6110 Shale: as in Core No. 3.

6110 - 6190 Shale and Siltstone: as above, with Sandstone: gray, very fine grained, very argillaceous and silty, carbonaceous, poor to nil porosity, no show.

6190 - 6200 Shale: as above, with Sandstone: becoming slightly less argillaceous and silty.

6200 - 6240 Sandstone: gray, very fine grained, slightly argillaceous and silty, calcareous, carbonaceous, mottled with carbonaceous material and shale fragments, occasional white clay, poor porosity, no show, with Shale: as above.

6240 - 6270	Sandstone and Shale: as above, with occasional free pyrite.
6270 - 6320	Shale: as above, with Sandstone: as above, but siliceous in part, with Siltstone: hard, appears siliceous.
6320 - 6340	Sandstone: white to gray, very fine grained to fine grained, occasional medium grained inclusions of frosted quartz, poorly sorted, abundant white clay as grains and in matrix, abundant carbonaceous fragments, very calcareous, poor intergranular porosity, no show, some well developed calcite crystals, could be fractures, with Shale: as above.
6340 - 6350	Sandstone: as above, with rare to occasional grains of glauconite, with Shale: as above.
6350 - 6360	Sandstone: mostly as above, but more well indurated, occasional loose calcite, with Shale: as above.
6360 - 6430	Sandstone: becoming more argillaceous, with Shale: as above.
6430 - 6480	Shale: as above, with Sandstone: becoming very argillaceous and silty, grading to siltstone.
6480 - 6510	Shale: as above, with Sandstone: becoming essentially siltstone.
6510 - 6550	Shale: as above, with Shale: dirty gray-brown, silty.
6550 - 6590	Shale: as above, with minor Sandstone: very silty and with occasional free milky white calcite.
6590 - 6640	Shale: as above, with minor Siltstone: dark gray, very argillaceous, grading to Shale: calcareous, with trace of Sandstone: as above.
6640 - 6660	Shale: becoming more silty, grading to siltstone, with minor Siltstone and Sandstone: as above.
6660 - 6750	Shale, Siltstone and Sandstone: as above, with occasional loose milky white calcite.
6750 - 6860	Shale: as above, with Sandstone: gray, very fine grained, very calcareous, very dense matrix, nil visible porosity, no show, with minor Siltstone: as above, and with occasional free pyrite.

6860 - 6880	Shale: as above, with some Shale: dark gray, submetallic luster with traces of sandstone and siltstone.
6880 - 6920	Shale: as above, with Sandstone: medium gray, mottled black with very fine carbonaceous flakes, very silty, grading to siltstone, argillaceous, calcareous, poor visible porosity, no show.
6920 - 6940	Sandstone: light gray to gray-brown, white matrix in part, very fine grained, silty, argillaceous, very calcareous, slightly carbonaceous, hard and dense, siliceous in part, poor to nil porosity, no show, with Shale: as above.
6940 - 6970	Sandstone: as above, very tight and hard, appears to be partly siliceous, with Shale: as above.
6970 - 6980	Sandstone: becoming slightly more silty, mottled with carbonaceous inclusions, generally poor porosity, no show, with Shale: as above.
6980 - 7000	Sandstone: becoming slightly friable in part, generally poor porosity, some fair porosity, no show, with Shale: as above.
7000 - 7030	Shale: as above, with Sandstone: becoming very silty, grading to siltstone.
7030 - 7110	Shale and Sandstone: as above, with loose clear broken quartz and some broken milky white calcite.
7110 - 7140	Shale: as above, with Siltstone: dark gray, argillaceous, occasionally sandy and grading to sandstone, with Sandstone: dark gray, very argillaceous and silty, occasional calcite veinlets, occasional free pyrite.
7140 - 7160	Shale: as above, but some with very reflective surfaces, with Sandstone and Siltstone: as above, and with increase in calcite, some appears to be replacement of pelecypods.
7160 - 7220	Shale, Sandstone and Siltstone: as above, with increase in calcite and with some anhydrite and clear quartz, occasional quartz crystals, probably drusy fracture lining.
7220 - 7310	Shale, Siltstone and Sandstone: as above, with abundant quartz and calcite from apparent vein filled fractures.

7310 - 7330	Shale, Siltstone and minor Sandstone: as above, with some broken clear quartz and rare quartz crystals.
7330 - 7360	Shale: mostly as above, but becoming less silty, more carbonaceous, with traces of Siltstone and Sandstone: as above.
7360 - 7430	Shale: as above, with traces of Sandstone and Siltstone: as above, and with increase in vein quartz.
7430 - 7480	Shale: medium gray, dark gray, firm, noncalcareous, with occasional trace of carbonaceous material, slightly micromicaceous, occasionally becoming silty, with minor thin stringers of medium gray siltstone and silty Sandstone: light gray, very fine grained to silty, moderately hard, carbonaceous, micaceous, and with rare quartz and/or calcite filled veins.
7480 - 7500	Shale, Siltstone and Sandstone: as above, with minor Claystone: medium gray, soft and with very rare quartz vein filling; some lignite found in samples is thought to be contamination from drilling additives.
7500 - 7590	Shale, Siltstone and Sandstone: as above, but with some shale having a brownish cast.
7590 - 7620	Shale: as above, with occasional shiny face, occasional thin siltstone stringers.
7620 - 7680	Shale: medium gray, dark gray, firm, medium hard micromicaceous, occasional slickenside face, rare calcite and quartz filled veins.
7680 - 7750	Shale: as above, occasionally becoming soft gray-brown claystone, with thin stringers of Siltstone: medium gray, firm, argillaceous, and trace of Sandstone: light gray, very fine grained, hard, tight.
7750 - 7780	Shale: as above.
7780 - 7880	Shale: as above, with thin stringers of siltstone and sandstone.
7880 - 7890	Sandstone: light gray-white, very fine to fine grained, quartzose, medium hard, moderately well sorted, subangular to subrounded, slightly calcareous, carbonaceous, "salt and pepper", tight, no shows, no fluorescence, interbedded with Shale and Siltstone: as above.

7890- 7900	Sandstone: as above, with common (10%) clear glassy quartz euhedral and drusy in part filling large veins, no shows.
7900 - 7920	Sandstone: as above, without vein quartz, no shows.
7920 - 7930	Shale: medium gray, firm, micromicaceous, in part flaky.
7930 - 7950	Sandstone: light gray, silty to fine grained, subrounded, quartzose, "salt and pepper", bitumen flecks, medium hard to friable, tight to slight porosity, in part with calcareous cement, no visible shows, but well kicked gas and cuttings; gas was noted from a depth of 7938', no oil shows.
7950 - 8020	Sandstone: light gray, silty to fine grained, quartzose and feldspathic, slightly calcareous, carbonaceous, in part clay filled, tight, medium hard to hard, no shows; interbedded with and in part grading to Siltstone: medium gray, medium hard, argillaceous; and with thin Shale beds: medium gray, black, medium hard, splintery to platy with waxy luster.
8020 - 8060	Shale: medium gray, medium hard, micromicaceous, black, medium hard, splintery to platy, in part subfissile, waxy luster may be slickenside; with thin beds of Sandstone and Siltstone: as above.
8060 - 8100	Sandstone: as above, with muscovite becoming common, tight, no shows.
8100 - 8180	Sandstone: light gray, silty, fine grained, medium hard, predominantly quartzose, slightly calcareous, rounded, muscovite, carbonaceous, tight, in part clay filled, no shows, with thin stringers of Siltstone and Shale: as above.
8180 - 8215	Sandstone: light gray, silty, very fine grained, medium hard, slightly calcareous, in part very hard siliceous, with common euhedral clear quartz, and milky quartz in fractures, common drusy faces, no intergranular porosity, but probable fracture porosity; gas show of 490 units was encountered at 8189'.
8215 - 8235	Siltstone: medium gray, medium hard, siliceous, argillaceous, grades in part to silty argillaceous sandstone; interbedded with Shale: medium gray, dark gray, medium hard, flaky, blocky, and Sandstone: as above, with trace to common euhedral and vein filled quartz, tight, gas show of 110 units at 8223'.

8235 - 8255	Sandstone: light gray, silty, fine grained, hard to medium hard, slightly argillaceous, siliceous and in part calcareous cement, slightly carbonaceous, tight, no shows, trace 5% Quartz: as above, with thin interbeds of shale and siltstone.
8255 - 8270	Siltstone: medium gray, medium hard, argillaceous, in part grading to sandstone.
8270 - 8304	Sandstone: light gray, medium gray, silty, fine grained, medium hard to hard, slightly calcareous, carbonaceous, grades in part to siltstone; and interbedded with Siltstone: medium gray, medium hard, argillaceous, and Shale: medium gray, dark gray, medium hard, noncalcareous, blocky to splintery, no shows, no porosity.
8304 - 8330	Siltstone: light gray to gray-brown, argillaceous and sandy, grading to sandstone, with Sandstone: light gray to gray-brown, very argillaceous and silty, grading to siltstone, very fine grained to silt, slightly calcareous, carbonaceous, with Shale: gray, silty, calcareous.
8330 - 8360	Sandstone and Siltstone: becoming siliceous and hard, with some Shale: as above, and with 20% Quartz: clear to smoky, broken fragments, occasional crystals from fractures.
8360 - 8380	Sandstone: mostly as above, but slightly less silty, more carbonaceous, with "salt and pepper" appearance, with Shale: as above, and Shale: rust-brown, moderately calcareous, fissile with trace of euhedral crystals of drusy quartz.
8380 - 8390	Sandstone: off-white to gray, very calcareous with occasional very heavy chalky limestone matrix, grading to limestone, in part, occasionally soft to friable, very fine grained to fine grained, "salt and pepper" with carbonaceous material, poor porosity, no show, with Shale and Quartz: as above.
8390 - 8400	Sandstone: as above, but with 10% quartz crystals at 8390-8395'.
8400 - 8420	Sandstone: as above, very calcareous in part and very silty in part with 10% quartz crystals.
8420 - 8430	Sandstone: as above, but becoming darker, more carbonaceous with 10% Shale: rust-brown, silty, calcareous.

8430 - 8450	Sandstone: as above, with 10% quartz crystals at 8435'. very finely crystalline with sucrosic texture in part, drusy, fracture lining.
8450 - 8460	Sandstone: as above, with 5% quartz crystals. (NOTE: Quartz percentages coincide with small, sharp gas peaks, obvious fracture.)
8460 - 8490	Sandstone: mostly off-white to gray, very calcareous, grading to limestone; heavy matrix of chalky limestone and white clay, 20% gray Sandstone: very slightly calcareous, siliceous cement, very hard with 10% quartz.
8490 - 8500	Sandstone: becoming more argillaceous and silty, grading to siltstone with 10% drusy quartz and quartz crystals.
8500 - 8510	Sandstone: as above, but more shaly, with Shale: mostly rust-brown, some gray, silty.
8510 - 8520	Sandstone: as above, with minor Shale: now mostly dark gray, blocky, micromicaceous with 5% broken quartz, increase to 10% and becoming crystalline at 8515'.
8520 - 8550	Sandstone and minor Shale: as above, with 30% quartz, mostly crystals and drusy crystals with some broken quartz.
8550 - 8560	Sandstone: as above, with 10% quartz and quartz crystals from fractures.
8560 - 8590	Sandstone: as above, with 5% quartz, increase to 10% at 8572' from fractures.
8590 - 8600	Sandstone: gray, very fine grained to fine grained, silty and argillaceous, very calcareous, slightly friable, occasionally soft, heavy calcareous and clay matrix, generally poor porosity, no show, with minor Shale: as above, and with trace of Quartz: as above.
8600 - 8630	Sandstone: becoming more shaly, grading to shale in part, with minor Shale: as above.
8630 - 8650	Sandstone: as above, but becoming more silty, grading to siltstone at 8645' with traces of Shale and Quartz: as above.
8650 - 8690	Sandstone: as above, with Siltstone: dark gray, very calcareous, sandy, argillaceous, siliceous in part, with minor Shale: as above.

8690 - 8700	Sandstone: mostly as above, but becoming slightly less silty, with minor Siltstone and Shale: as above, and with trace to 5% clear, broken and crystalline Quartz: as above.
8700 - 8750	Sandstone: as above, but becoming siliceous in part with 10% quartz and quartz crystals, some crystals of calcite (30%), quartz at 8707', with some Shale: as above.
8750 - 8760	Sandstone: becoming slightly cleaner, very slight increase in grain size, very slight increase in porosity, generally poor porosity, no show, with trace of Shale: as above.
8760 - 8780	Sandstone: as above, with trace of Quartz: now mostly milky, broken, probably vein filled fractures, with trace of Shale: as above.
8780 - 8800	Sandstone: very calcareous in part, approaches a sandy, silty limestone, with minor Shale: as above.
8800 - 8810	Sandstone: as above, but becoming argillaceous and silty in part, with trace of Shale: as above.
8810 - 8830	Sandstone: as above, with some flakes of carbonaceous material, with trace of Shale: as above.
8830 - 8850	Sandstone: as above, with Siltstone: dark gray, argillaceous, calcareous, sandy in part.
8850 - 8870	Sandstone: appears to be less well sorted, some feldspar grains, still very calcareous, some slight matrix porosity, ranging to poor intergranular porosity, no show, with Siltstone: as above.
8870 - 8880	Sandstone: increasing feldspathic, some siliceous cement, poor intergranular porosity, no show.
8880 - 8900	Sandstone: becoming dark gray, very fine grained, very feldspathic, increasingly siliceous, hard and dense, very poor to nil porosity, no show, with Shale: dark gray to black, blocky.
8900 - 8920	Sandstone: gray to gray-brown, very fine grained, argillaceous, very calcareous, feldspathic, slightly siliceous in part, some very poor intergranular porosity, no show, with minor Shale: as above.
8920 - 8930	Sandstone: now light gray to gray, slightly friable, slightly more porous, poor intergranular porosity, no show.

8930 - 8940	Sandstone: as above, but now becoming poor to fair porosity.
8940 - 8950	Sandstone: becoming more argillaceous, siliceous in part, decrease in porosity, very poor to poor intergranular porosity, no show, with minor Shale: as above.
8950 - 9000	Sandstone: grading in part to siliceous siltstone, with minor Shale: as above.
9000 - 9010	Sandstone: becoming dark gray, slightly argillaceous, generally siliceous, with trace of Shale: as above.
9010 - 9030	Sandstone: now light gray to gray-brown, less argillaceous, with trace of Shale: as above.
9030 - 9060	Sandstone: becoming silty, grading to siltstone in part, with minor Shale: as above.
9060 - 9080	Sandstone: becoming more siliceous, hard, with minor Shale: becoming silty, grading to siltstone, with crystalline calcite and some, mostly milky, broken quartz.
9080 - 9090	Sandstone: light gray, occasionally "salt and pepper", with carbonaceous material, calcareous, feldspathic, very fine grained to fine grained, some medium grained, poorly sorted, poor intergranular porosity, no show, with minor Shale: as above.
9090 - 9140	Sandstone: as above, poor to fair porosity, no show.
9140 - 9180	Sandstone: as above, but with increase in matrix of calcite and clay.
9180 - 9230	Sandstone: as above, with trace of broken Quartz: clear and milky, probably vein filled fracture.
9230 - 9260	Sandstone: as above, with trace of pyrite, granular and crystalline.
9260 - 9290	No samples.
9290 - 9300	Sandstone: as above, but becoming silty in part, with minor Shale: dark gray to black, blocky.
9300 - 9310	No samples.
9310 - 9320	Sandstone: as above, with Siltstone: dark gray, very argillaceous and sandy, grading to both Sandstone and Shale: very finely micaceous.

9320 - 9330	No sample.
9330 - 9340	Sandstone, Siltstone and Shale: as above.
9340 - 9350	Sandstone: becoming dark gray, very fine grained, more argillaceous and silty, grading to siltstone, with Siltstone: as above.
9350 - 9360	Sandstone and Siltstone: as above, with trace of pyrite.
9360 - 9380	Sandstone: becoming slightly siliceous in part, with some Siltstone: as above, with minor Shale: dark gray to black, blocky, very finely micaceous.
9380 - 9410	Sandstone: becoming less silty, with Clay: white to off-white, silty to sandy, calcareous, appears to be pulverized, fault gouge(?).
9410 - 9420	Sandstone: as above, with Clay: as above, pulverized appearance.
9420 - 9430	Sandstone: light gray-brown, very fine grained to fine grained, mottled black, with carbonaceous material, some feldspar, moderately well sorted, calcareous, poor to fair porosity, no show.
9430 - 9450	Sandstone: as above, with some drusy quartz crystals.
9450 - 9460	No sample.
9460 - 9480	Sandstone: becoming more fine grained, very poor to nil porosity, no show, with Shale: as above, with 5% quartz crystals.
9480 - 9490	Sandstone: becoming very fine grained, very argillaceous, and silty, grading to siltstone, siliceous in part, with Shale: black, becoming very

caceous, splintery. carbonaceous, micromi

e, with Siltstone: dark gray, grading to sandstone in part,

but more argillaceous and silty, le: as above.

and Shale: as above, with trace

9490 - 9520	Sandstone: as abov sandy, argillaceous, with Shale: as above.
9520 - 9530	No sample.
9530 - 9550	Sandstone: as above with Siltstone and Sha
9550 - 9650	Sandstone, Siltstone of quartz.

9650 - 9670	Sandstone: as above, with minor Siltstone: as above, and with 5% quartz crystals.
9670 - 9690	Sandstone: with heavy calcareous and clay matrix in part.
9690 - 9740	Sandstone: as above, becoming very "dirty", argillaceous, silty, with increase in Siltstone: as above.
9740 - 9750	Sandstone: off-white to light brown, heavy clay matrix, very fine grained to fine grained, silty and argillaceous, calcareous, very poor to nil porosity, no show, with trace of Shale: as above.
9750 - 9760	Sandstone: becoming more white and off-white, matrix becoming chalky in part.
9760 - 9770	Sandstone: as above, with 20% becoming slightly friable, poor to fair porosity, some carbonaceous flakes, less chalky, with Siltstone: dark gray, argillaceous, well indurated.
9770 - 9780	Sandstone: appears to be becoming slightly siliceous in part, no longer with heavy chalky matrix, slight decrease in porosity, with Siltstone: as above.
9780 - 9790	Sandstone: as above, but decrease in porosity, now very poor to nil porosity, with minor Siltstone: as above.
9790 - 9800	No sample.
9800 - 9830	Sandstone: mostly as above, but now with recrystallized appearance, with Shale: charcoal gray, micromicaceous, submetallic luster, with Siltstone: as above.
9830 - 9850	Shale: becoming silty, with Sandstone and Siltstone: as above.
9850 - 9870	Sandstone: gray, very fine grained to fine grained, weathered feldspar and white clay, slightly friable in part, slightly siliceous and recrystallized in part, some poor intergranular porosity, no show, with Shale and Siltstone: as above.
9870 - 9920	Sandstone: becoming more siliceous, some secondary quartz overgrowths, with Siltstone and Shale: as above, and with trace of euhedral quartz crystals.

9920 - 9940	Sandstone: as above, with some Siltstone and minor Shale: as above, and with trace to 5% Quartz: mostly clear, broken, some crystals.
9940 - 9950	No sample.
9950-10,110	Siltstone: dark gray-black, gray-brown, medium hard, argillaceous, sandy, in part grading to silty shale and with some black shale interbeds, diamond bit cuttings give a corn curl shape, no quartz crystals, rare small subrounded pebble.
10,110-10,130	Siltstone: light to medium gray, medium hard, argillaceous, sandy, with minor Shale: dark gray, hard, micaceous, and trace of 5% Quartz: clear, euhedral and broken.
10,130-10,150	Sandstone: light gray, very fine grained, silty, medium hard, calcareous, argillaceous, in part with white clay filled matrix, tight, no shows.
10,150-10,205	Siltstone: as above, with interbedded Shale: dark gray, black, medium hard, micaceous, flaky, subfissile, and Sandstone: as above, no shows, to trace asphalt.
10,205-10,310	Siltstone: dark gray, medium hard, calcareous, argillaceous, with interbedded Shale: black, hard, micaceous, flaky, splintery and with occasional stringer of sandstone, trace of asphalt on samples, diamond bit cuttings.
10,310-10,400	Siltstone: as above, with interbedded shale and with occasional sandstone stringer, with trace to 10% clear quartz, euhedral and broken, trace asphalt on samples, diamond bit cuttings.
10,400-10,500	Siltstone: dark gray, medium hard, argillaceous, with interbedded Shale: black, dark gray, hard, micromicaceous, splintery.
10,500-10,560	Shale: dark gray, black, hard, noncalcareous, micaceous, splintery, with interbedded Siltstone: as above, diamond bit cuttings.
10,560-10,630	Siltstone: dark gray, medium hard, argillaceous, with interbedded Shale: as above, in part light gray, firm, calcareous, microlaminated.
10,630-10,670	Shale: dark gray, black, hard, micaceous, flaky, splintery, with interbedded Siltstone: as above, trace to 5% clear quartz, euhedral crystals and broken, trace asphalt on samples, diamond bit cuttings.

10,670-10,730	Siltstone and Shale: as above, interbedded with 5-10% loose medium grained sand, subangular to subrounded, clear, white, pink (possibly contaminated mud additive, barite), trace clear quartz crystals.
10,730-10,770	Shale: dark gray, black, light gray, as above, with thin stringers of Sandstone: light gray, very fine grained, silty, hard, siliceous, tight, and siltstone, 10-30% lignite, trace to 10% clear quartz, broken and euhedral crystals.
10,770-10,795	Shale: dark gray-black, slightly micaceous, slightly pyritic, in part slickensided, highly splintery, with shale density dropping from 2.68 to 2.48, with common vein calcite and common clear euhedral crystals of both quartz and calcite.
10,795-10,820	Sandstone: light gray-white, very fine grained, silty, medium hard, siliceous, slightly calcareous, subangular, subrounded, clear, white, black, with clay filled matrix, tight, no shows, trace to 5% quartz, clear and white euhedral crystals and broken.
10,820-10,830	Siltstone: dark gray, medium hard, argillaceous, sandy.
10,830-10,935	Shale: dark gray, medium hard, slightly calcareous, rounded, lumpy, occasionally black, hard, splintery, locally becomes silty in part, grading to argillaceous siltstone, diamond bit cuttings, fair to poor quality samples.
10,935-10,975	Siltstone: medium gray, dark gray, medium hard, argillaceous, slightly calcareous, grading in part to silty shale, with thin beds of black to dark gray, hard, splintery shale, and light to medium gray, very fine grained to silty, hard, siliceous, tight sandstone, diamond bit cuttings are of fair to poor quality.
10,975-11,010	Shale: dark gray-black, hard, micaceous, splintery, blocky, in part dark gray, medium hard, calcareous, silty, lumpy with local sandstone and siltstone stringers, trace quartz crystals and occasional piece of free asphalt (trace to 5%).
11,010-11,110	Shale: dark gray, medium hard, slightly silty, slightly calcareous, lumpy, blocky, in part hard, black, splintery, with interbedded Siltstone: dark gray, medium hard, highly argillaceous, and Sandstone: light gray, very fine grained, hard, siliceous, slightly calcareous, tight with no shows, sample quality is poor owing to diamond bit which tends to burn and crush the samples.

11,110-11,130	Sandstone: light gray-white, fine grained to medium grained, medium hard, calcareous, subangular to subrounded, moderately sorted, Quartz and Feldspar: clear, white, gray, black, tight, no shows, in part with white clay filled matrix.
11,130-11,160	Sandstone: white to light gray, becoming very fine grained to silty, medium hard, firm, calcareous, in part grading to a pulverized looking sandy claystone, tight, no shows.
11,160-11,190	Sandstone: light gray-white, as above, with thin stringers of Shale: dark gray, hard, blocky, splintery, in part silty, micaceous, and Siltstone: light gray, medium gray, hard, calcareous, in part gradational with silty sandstone, no shows, tight.
11,190-11,200	Siltstone: light gray-white, medium gray, firm, with white clay filled matrix, in part grades to silty sandstone, tight, no shows.

11,200' Total Depth

Log Analysis

ARMOUR KANE
Well Log Analyst
18360-6 Cantara St.
Reseda, Ca. 91335
(213) 993-0586

Formation Evaluation

May 5, 1980

Mr. S. L. Hewitt
Husky Oil/NPR Operations, Inc.
2525 C Street
Anchorage, Ak 99503

Dear Mr. Hewitt:

Logging was begun by Shchlumberger at Awuna Test Well No. 1 at 1900 hours on April 30, 1980, and Dll, CNL/FDC, BHC and Birdwell Velocity Survey were completed at 0900 hours on May 1. Total depth was 5300 feet. Log quality was good considering the badly washed out condition of the bore hole. The CNL/FDC caliper was recorded on a scale of 10"-20" and except for a few feet was off scale beyond 20". In some intervals the recorded bulk density was approximately equal to the mud density indicating a very large hole indeed. For this reason no HRD or CST was attempted and the Birdwell records were invalid due to their inability to "lock on" in the big hole.

No zones of interest were encountered, the sandy zones being shaly and of low porosity. The formation is apparently still Torok.

Very truly yours,

A. Kane

A. Kane

Log Analysis

COMPANY: HUSKY OIL/NPR, INC. | WELL: AWUNA No 1

FIELD: NORTH SLOPE | COUNTY: | STATE: ALASKA

DEPTH	ϕ_{CT}	ϕ_D	ϕ_N	ΔT	ϕ_S	REMARKS
6320-30	41	1.5	9	63	9	
6330-40	55	3	11	63	9	
6344-50	40	3.5	10	65	10	
6350-56	30	4	11	70	13	
6940-52	40	4	6	60	6	
6954-60	23	5	9	61	7	
6961-65	30	3	5	56	4	
6970-80	25	7	11	67	11	
6980-90	20	9	12	70	13	

DEPTHS ARE FROM CNL/FDC AND BHC. FOR DIL DEPTHS ADD TWO FEET

Log Analysis

ARMOUR KANE

Formation Evaluation

Well Log Analyst
18360-6 Cantara St.
Reseda, Ca. 91335
(213) 993-0586

February 9, 1981

Mr. S. L. Hewitt
Husky Oil/NPR Operations, Inc.
2525 C Street
Anchorage, Ak. 99503

Dear Mr. Hewitt:

At Awuna No. 1 Schlumberger began logging at 2330 hours, January 24, 1981, and after a number of tool failures finished DIL, CNL/FDC, BHC, HRD and CST at 0500 hours, January 26. Two sets of DIL tools failed requiring a third try which was successful. The caliper arm on the FDC became jammed with shale and opened only partially on two runs but the third attempt was successful. This cannot be considered a tool failure. Total lost time for these two logs is estimated at about 12 hours plus or minus. The BHC and HRD were trouble free. Log quality is good except for some very thin skips on the BHC which are much too thin to indicate the presence of gas. The hole is badly washed out beyond 20 inches for some 1950 feet out of the 3,000 feet of open hole. Only six of 30 sidewall cores were recovered which is not surprising considering the hole size and very hard formation. A number of bullets were shattered.

Top of the Fortress Mountain formation was tentatively picked at 7886.

No zones of interest were found but I have attached porosity calculations for four sand intervals: 6180-6210, 6320-56, 6940-70 and 6970-90. The latter interval indicates the highest porosity on the log. Since there is no SP and no other way to calculate Rw no Sw figures were obtained.

Very truly yours,

A. Kane

A. Kane

Log Analysis

ARMOUR KANE
Well Log Analyst
18360-6 Cantara St.
Reseda, Ca. 91335
(213) 993-0586

Formation Evaluation

April 4, 1981

Mr. S. L. Hewitt
Husky Oil/NPR Operations, Inc.
2525 C Street
Anchorage, Ak 99503

Dear Mr. Hewitt:

Schlumberger began logging at Awuna No. 1 at 1900 hours on March 23, 1981, and after approximately two hours of lost rig time due to a DIL Failure, completed a combination DIL/BHC log on one trip in the hole.

No zones of interest were encountered and the logs do not appear to have been adversely affected by the cement in the hole. No log tops were seen and it appears that we are apperently still in the Torok formation.

Very truly yours,

A. Kane

A. Kane

Log Analysis

ARMOUR KANE
Well Log Analyst
18360-6 Cantara St
Reseda, Ca. 91335
(213) 993-0586

Formation Evaluation

April 24, 1981

Mr. S. L. Hewitt
Husky Oil/NPR Operations, Inc.
2525 C Street
Anchorage, Ak 99503

Dear Mr. Hewitt:

Logging operations were begun by Schlumberger at Awuna Test Well No. 1 at 0300 hours on April 16, 1981 and finished the first temperature log, BHC and DIL at 1430 hours, April 16, but the hole was quite sticky so a clean-out run was made. Schlumberger re-entered the hole at 0600 hours on April 17 and completed CNL/FDC, HRD, Birdwell Velocity Survey and CST at 0300 hours April 18. No lost rig time was experienced and all log quality was good. Only 2 of 24 sidewall cores were recovered, there were 10 misfires and the rest of the bullets were shattered due to the very hard formation. All of the open hole exhibited very high bulk densities with an average of 2.65 g/cc and some densities were greater than 2.7 g/cc precluding any possibility of reservoir rock since the indicated porosities were practically zero.

The CNL/FDC was recorded up into the 9-5/8" casing and it appears that the CNL can be used qualitatively in the 7-5/8" casing but is practically useless in the larger pipe where the hole was enlarged and rugose. No zones of interest were found.

Apparently the well was still in Torok/Fortress Mountain formations and no other log tops were found.

Very truly yours,

A. Kane

HUSKY OIL NPR OPERATIONS, INC.
U.S. GEOLOGICAL SURVEY/ONPRA

LOGGING REPORT

WELL NAME AWUNA #1

Date 3-4-80 Driller Depth 1514'

Elevation Grd 1103' 1127' KB Logger Depth 1511'

Logs Run and Intervals

DIL/GR/SP 1505-116'
BHCS/GR/TTI 1496-116'
FDC/CNL/GR/CAL 1502-116' (Caliper was reading its limit, therefore not valid)

Additional Logs to Run

None. Could not run HDT Dipmeter due to hole size.

Zones of Interest

Depth	Gross Thickness	Net Feet of Porosity	Lith	Porosity	Probable Fluid Content
NO ZONES OF INTEREST					

Discussion:

Surface hole, w/no zones of interest encountered.

Log Tops & Correlations:

TOROK Surface-TD

Additional Evaluation Plans:

NONE

STEVEN G. REID
Wellsite Geologist

Log Analyst

12/77

HUSKY OIL NPR OPERATIONS, INC.
U.S. GEOLOGICAL SURVEY/ONPRA

LOGGING REPORT

WELL NAME AWUNA #1

Date April 30, May 1, 1980 Driller Depth 5300'

Elevation 1127' KB Logger Depth 5294'

Logs Ran and Intervals

GR/SP/DIL	1504-5288'
GR/CAL/CNL/FDC	1504-5293'
GR/BHCS	1504-5290'
Birdwell Velocity Survey	500-5250'

Additional Logs to Run

None

Zones of Interest

Depth	Gross Thickness	Net Feet of Porosity	Lith	Porosity	Probable Fluid Content
NO ZONES OF INTEREST - SANDY INTERVALS ARE SHALY AND OF LOW POROSITY.					

Discussion:

Borehole very badly washed out beyond 20" and in some intervals is so large the recorded bulk density about equals that of the mud. HRD and CST cancelled because of hole size.

Log Tops & Correlations:

Apparently still in Torok.

Additional Evaluation Plans:

GORDON LEGG
Wellsite Geologist

ARMOUR KANE
Log Analyst

12/77

HUSKY OIL NPR OPERATIONS, INC.
U.S. GEOLOGICAL SURVEY/ONPRA

LOGGING REPORT

WELL NAME AWUNA #1

Date Jan. 24, 25, 26, 1981 Driller Depth 8305'

Elevation 1127' KB Logger Depth 8305'

Logs Ran and Intervals

DIL/GR/SP	5280-8299'
CNL/FDC/GR/CAL	5280-8301'
BHCS/GR	5280-8299'
HDT-DIPMETER	5280-8303'
CST SIDEWALL	Top Shot 5332'; Btm Shot 8157', Shot 30, Rec. 6

Additional Logs to Run

Zones of Interest

Depth	Gross Thickness	Net Feet of Porosity	Lith	Porosity	Probable Fluid Content
6180-6210'	30	12	Ss	2%	None
6320-6356'	36	31	Ss	1-6%	Pos Wtr
6940-6970'	30	22	Ss	5%	Prob Wtr
6970-6990'	20	20	Ss	8%	Prob Wtr

Discussion:

Above Ø values from FDC. These sands appear silty and tight. Hole badly washed out. 1923' of the 3000' of open hole are 20" or greater.

Log Tops & Correlations:

FORTRESS MTN. 7886'

Additional Evaluation Plans:

D. YOUNG

A. KANE Wellsite Geologist

Log Analyst

12/77

HUSKY OIL NPR OPERATIONS, INC.
U.S. GEOLOGICAL SURVEY/ONPRA

LOGGING REPORT

WELL NAME AWUNA TEST WELL NO. 1

Date March 23, 24, 1981 Driller Depth 10,127'

Elevation 1127' KB Logger Depth 10,122'

Logs Ran and Intervals

SP/GR/DIL/BHC 8311-10,116'

Additional Logs to Run

NONE

Zones of Interest

Depth	Gross Thickness	Net Feet of Porosity	Lith	Porosity	Probable Fluid Content
NO ZONES OF INTEREST					

Discussion:

Logs do not appear to be too adversely affected by the cement in the hole.

Log Tops & Correlations:

None - Apparently still in Torok

Additional Evaluation Plans:

None

D. YOUNG
Wellsite Geologist

A. Kane
Log Analyst

12/77

HUSKY OIL NPR OPERATIONS, INC.
U.S. GEOLOGICAL SURVEY/ONPRA

LOGGING REPORT

WELL NAME AWUNA TEST WELL #1

Date April 16-18, 1981 Driller Depth 11,200'

Elevation 1127' KB Logger Depth 11,194'

Logs Ran and Intervals

HRT - Temperature (2)	100-11,185'	Birdwell Velocity - Top 6180' - Bottom 11,170'
GR/BHC	10,119-11,187'	CST Sidewall Cores - Top 10,139' - Bottom 11,150'
GR/SP/DIL/SFL	10,119-11,186'	
GR/CAL/CNL/FDC	10,119-11,193'	
HRD - Dipmeter	10,119-11,150'	

Additional Logs to Run

NONE

Zones of Interest

Depth	Gross Thickness	Net Feet of Porosity	Lith	Porosity	Probable Fluid Content
ABSOLUTELY NO ZONES OF INTEREST.					

Discussion:

Entire open hole is very low porosity and tight. Bulk density averages 2.65 g/cc with some densities 2.7 g/cc. In the 7-5/8" casing, the CNL appears useable qualitatively but in the 9-5/8" with the enlarged borehole, the CNL is of little value.

Log Tops & Correlations:

Still in Torok/Fortress Mt.

Additional Evaluation Plans:

NONE

D. YOUNG
Wellsite Geologist

A. KANE
Log Analyst

12/77

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

USGS/HUSKY OIL, OPR.
AWUNA #1
AWUNA
NORTH SLOPE, ALASKA

DATE : 17-APR-80
FORMATION :
DRLG. FLUID: WBM
LOCATION : SEC 30-T3S/R25W

FILE NO : BP-3-583
ANALYSTS : WSP,TLS
LABORATORY: ANCHORAGE

CORE ANALYSIS RESULTS

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY (MD) MAXIMUM	90 DEG	VERTICAL	POR %	GRAIN DEN.	FLUID SATS. OIL	WTR	API OIL	DESCRIPTION
1	3664.0	0.03			10.2	2.71			--	ss;vf-fgr,cly
2	3665.0	<0.01			8.5	2.71			--	same
3	3666.0	0.05			7.9	2.70			--	same;sc carb

These analyses, opinions or interpretations are based on observations and materials supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions excepted); but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representations, as to the productivity, proper operations, or profitableness of any oil, gas or other mineral well or sand in connection with which such report is used or relied upon.

HUSKY OIL NPR OPERATIONS, INC.
U.S. GEOLOGICAL SURVEY/ONPRA

DRILL STEM TEST REPORT FORM

WELL NAME Awuna Test Well No. 1 DST. NO. 1 DATE 2/6/81

Formation Tested Fortress Mountain
Hole Size 8-3/4"

Test Interval 8225-8412' (9-5/8" casing @ 8297')
Drill Collar Length -- I.D. --

Total Depth 8412'
Drill Pipe Length 8195' I.D. 4/2

Choke Size: Surface -- Bottom Hole 3/4"
Packer Depth(s) 8225' Ft.

Depth Tester Valve Ft.

Cushion Type None Amount

TEST DATA

Tool open at 1444 hrs.
Initial flow period 188 min.
Initial shut-in period 376 min.
Final flow period -- min.
Final shut-in period -- min.
Unseated packer at 0:08 hrs.

RESISTIVITY/CHLORIDE DATA

	Resistivity			Chloride Content
Recovery Water	--	@	°F.	6800 ppm
Recovery Mud	--	@	°F.	300 ppm
Recovery Mud Filtrate	--	@	°F.	-- ppm
Mud Pit Sample	--	@	°F.	300 ppm
Mud Pit Sample Filtrate	--	@	°F.	-- ppm

Mud Weight 16.8 vis 47 cp

Description of initial flow period moderate blow after 3 min. (glycol in lines); increased to strong blow in 15 min.; increased to very strong blow with increasing pressure, M.T.S. in 56 minutes; muddy water to surface in 65 minutes.

Description of final flow period

PRESSURE DATA

TEMPERATURE	Gauge No. 13866 Depth: 8214 ft.		Gauge No. 10051 Depth: 8243 ft.		Gauge No. Depth: ft.		TIME	
	48 Hour Clock		48 Hour Clock		Hour Clock		Tool	A.M.
Est. °F.	Blanked Off		Blanked Off		Blanked Off		Opened 1444	P.M.
Actual 155 °F.	Pressures		Pressures		Pressures		Opened Bypass	A.M. P.M.
	Field	Office	Field	Office	Field	Office	Reported Minutes	Computed Minutes
Initial Hydrostatic	7156		7184					
First Period FLOW Initial	2948		3115				—	—
First Period FLOW Final	3848		3883					
First Period Closed In	7132		7136					
Second Period FLOW Initial	--		--				—	—
Second Period FLOW Final	--		--					
Second Period Closed In	--		--					
Third Period FLOW Initial	--		--				—	—
Third Period FLOW Final	--		--					
Third Period Closed In	--		--				—	—
Final Hydrostatic	7322		7327					

RECOVERY DATA

Cushion	--	Type	Amount	--	Depth Back Pres. Valve	Surface Choke None	Bottom Choke 3/4"
Recovered	estimated 175		Feet/bbl of	muddy salt water (6800 ppm Cl⁻)			
Recovered			Feet/bbl of				
Recovered			Feet/bbl of				
Recovered			Feet/bbl of				

Remarks Well flowed salty water at rate of one gallon/second = 2057 B.W.P.D. (6800 ppm Cl⁻)

Gordon W. Legg
Prepared by

11 78

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276
Anchorage, Alaska 99509

TELEPHONE (907)-279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

WATER ANALYSIS REPORT

OPERATOR Husky Oil Company
WELL NO. Ewuna No. 1
FIELD NPRA
COUNTY
STATE Alaska

DATE March 3, 1981 LAB NO. 6637-2
LOCATION
FORMATION
INTERVAL DST No. 1 (8297-8412)
SAMPLE FROM End of Flow Period

REMARKS & CONCLUSIONS:

Cations	mg/l	meq/l	Anions	mg/l	meq/l
Sodium	7590	330.17	Sulfate	170	3.54
Potassium	40	1.02	Chloride	5800	163.56
Calcium	280	13.97	Carbonate	1040	34.63
Magnesium	0.5	0.04	Bicarbonate	0	—
Iron	—	—	Hydroxide	2440	143.47
Total Cations		345.20	Total Anions		345.20

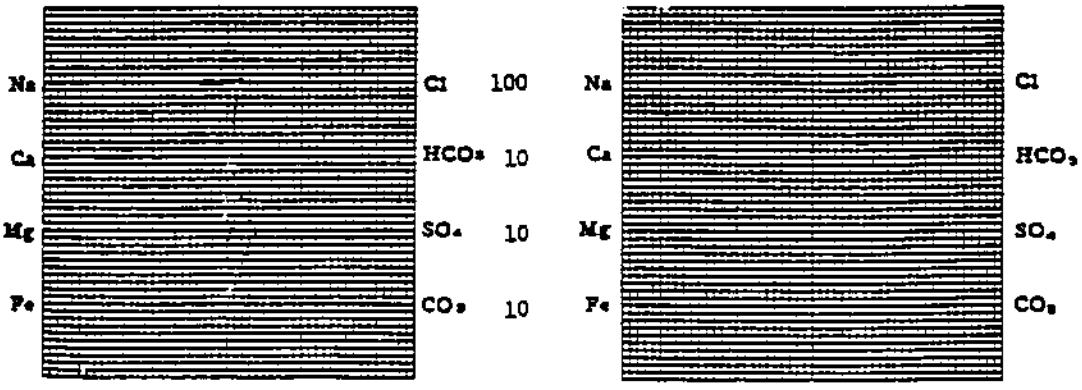
Total dissolved solids, mg/l 17360
NaCl equivalent, mg/l 17532
Observed pH 11.6

Specific resistance @ 44°F.:
Observed 0.37 ohm-meters
Calculated 0.38 ohm-meters

WATER ANALYSIS PATTERN

Sample above described

Scale
MEQ per Unit



(No value in above graph includes Na, K, and Li)
NOTE: Mg/l = Milligrams per liter Meq/l = Milligram equivalents per liter
Sodium chloride equivalents by Dunlap & Hawthorne calculation from components

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276
Anchorage, Alaska 99509

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274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

WATER ANALYSIS REPORT

OPERATOR Husky Oil Company
WELL NO. Awuna No. 1
FIELD NPRA
COUNTY
STATE Alaska

DATE March 3, 1981 LAB NO. 6637-3
LOCATION
FORMATION
INTERVAL
SAMPLE FROM Test Tool

REMARKS & CONCLUSIONS:

Cations	mg/l	meq/l	Anions	mg/l	meq/l
Sodium	6195	269.50	Sulfate	280	5.82
Potassium	27	0.69	Chloride	5800	163.56
Calcium	4	0.20	Carbonate	880	29.30
Magnesium	0.4	0.03	Bicarbonate	0	—
Iron			Hydroxide	1220	71.74
Total Cations		270.42	Total Anions		270.42

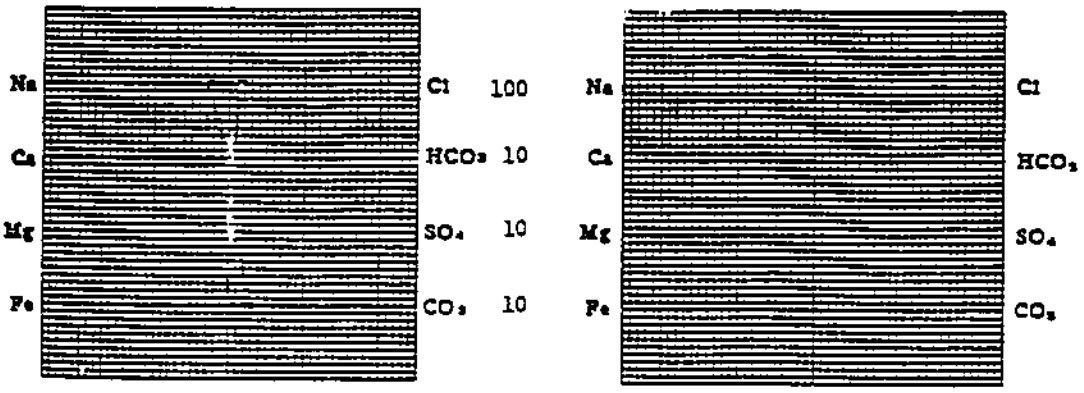
Total dissolved solids, mg/l 14407
NaCl equivalent, mg/l 14504
Observed pH 11.5

Specific resistance @ 40°F.:
Observed 0.45 ohm-meters
Calculated 0.46 ohm-meters

WATER ANALYSIS PATTERN

Sample above described

Scale
MEQ per Unit



(No value in above grams indicates No. 2 and 1.0)

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907)-279-4014
274-3384

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

GAS ANALYSIS REPORT

Company Husky Oil Company Date February 7, 1981 Lab No. 6637

Well No. Awuna No. 1 Location

Field NPRA Formation

County Depth DST #1 (8297-8412)

State Alaska Sampling Point Tool Chamber

Line pressure psig; Sample pressure 650 psig; Temperature 70 °F; Container number

Remarks Recovered 5250 cc gas, 1425 cc gas cut muddy water

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	2.96	
Carbon dioxide	TRACE	
Hydrogen sulfide	—	
Methane	96.94	
Ethane	0.08	
Propane	0.02	0.005
Iso-butane & Higher	TRACE	TRACE
Total	100.00	0.005

GPM of pentanes & higher fraction	0
Gross btu cu. ft. @ 60° F. & 14.7 psia (dry basis)	981
Specific gravity (calculated from analysis)	0.567
Specific gravity (measured)	0.565

Remarks:

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276
Anchorage, Alaska 99509

TELEPHONE (907)-279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

ANALYTICAL REPORT

From Husky Oil Company — Product Drilling Mud

Address Anchorage, Alaska — Date February 5, 1981

Other Pertinent Data

Analyzed by AG — Date March 3, 1981 — Lab No. 6637

REPORT OF ANALYSIS
DRILLING MUD SAMPLE
AWUNA NO. 1
NPRA, ALASKA

Sample received February 5,1981

SAMPLE	DEPTH	OIL & GREASE, Milligrams/liter
Top of Shaker	8377	91000

LISTING OF OTHER AVAILABLE GEOLOGICAL DATA

A. Final Biostratigraphic Report, Foraminifera by BioStratigraphics, dated April 30, 1981.

B. Final Biostratigraphic Report, Palynology by BioStratigraphics, dated April 30, 1981.

SOURCE OF OTHER GEOLOGICAL AND WELL DATA

Copies and some reproducibles of information referenced in this report which was generated as part of the USGS/NPRA exploration effort, can be obtained by contacting:

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