NATIONAL PETROLEUM RESERVE IN ALASKA

GEOLOGICAL REPORT

INIGOK TEST WELL NO. 1

HUSKY OIL NPR OPERATIONS, INC.
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Edited by: R. G. Brockway

For the

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

The Inigok Test Well No. 1 is located in the NE 1/4 of protracted Section 34, T8N, R5W, Umiat Meridian, approximately 124 miles southeast of Barrow, Alaska, and 50 miles north-northwest of Umiat (Figures 1 & 2). Drilling commenced on June 7, 1978. The well reached a total drilled depth of 20,102 feet in the Mississippian Kekiktuk Formation. The rig was released on May 22, 1979. No commercial quantities of hydrocarbon were noted in the well.

Pre-Drilling Prognosis

The primary objective of the Inigok well was to test a large structural closure in the basal Lisburne Group or underlying Devonian strata (see Figure 3). Principal secondary objectives of the well were the sands of the "Pebble Shale" interval, and the Sag River Sandstone. The Ivishak Formation of the Sadlerochit Group was not expected to contain reservoir quality rocks.

Dolomites within the Lisburne Group were also considered to potentially contain up to 300 feet of low porosity rocks at the location. Sediments underlying the Lisburne Group were interpreted to most probably be Devonian clastics and thermally overmature. Up to 3,500 feet of these Pre-Lisburne rocks were expected at the location. The top of the argillite "basement" was forecast at 19,750 feet. An additional objective of this test well was to obtain general stratigraphic data on deep sediments in this area.

Post-Drilling Summary

Formations penetrated in the well down to the Lisburne Group were generally within 200-300 feet of original forecast depths. The sedimentary rocks below the Lisburne Group were Mississippian clastics and consisted of equivalents of the Kayak and Kekiktuk Formations. The argillite "basement" was not penetrated in the well.

Potential reservoir intervals are apparent only in the relatively shallow sands of the Nanushuk Group, some of the tight sands of the Torok Formation, and an interval of about 35 feet in the Ivishak Formation. All of these sands were water wet. Minor shows of gas were noted in Cretaceous through Mississippian sediments along with rare, scattered occurrences of dead oil. The Lisburne Group carbonates did not contain any potentially significant reservoir intervals. Considerable H_2S gas was encountered at a depth of 17,570 feet which caused a major delay in the drilling operations. The H_2S gas apparently was from fractured carbonates in the lower portion of the Lisburne Group. Solidified sulphur was also noted in the cutting samples, likely forming in the well bore from decreasing pressure upward in the mud column from what was a heavy hydrogen sulfide gas (H_2S_9) at depth. Electric logs across the apparent

hydrogen sulphide bearing interval give no indication of the gas, sulphur, or of extensive fracturing.

The presence of the originally interpreted closure in the Lisburne could not be directly confirmed from the well data. Apparent dip did increase below the Lisburne Group.

None of the rocks penetrated contained any significant hydrocarbon shows or reservoir intervals and therefore were not tested.

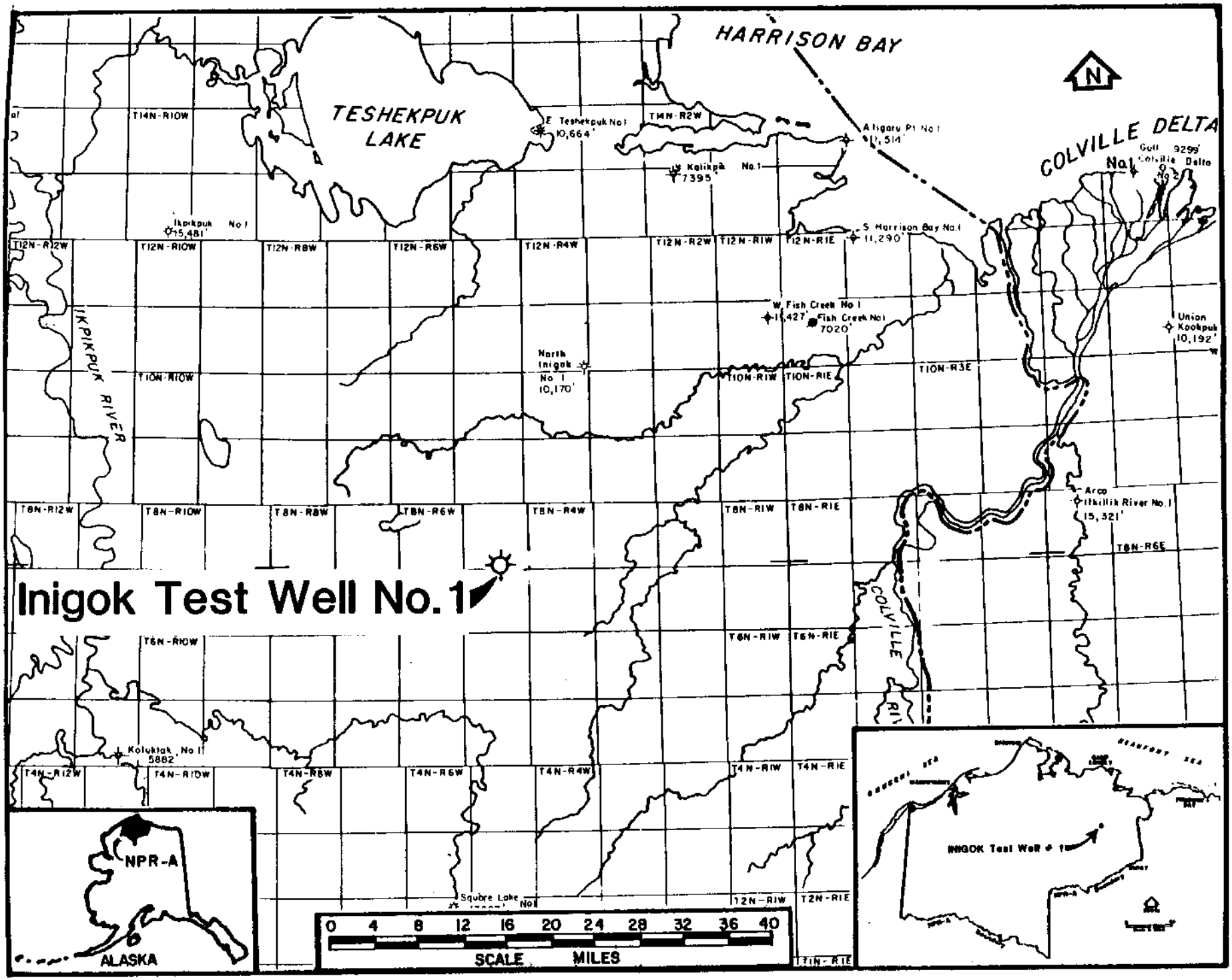
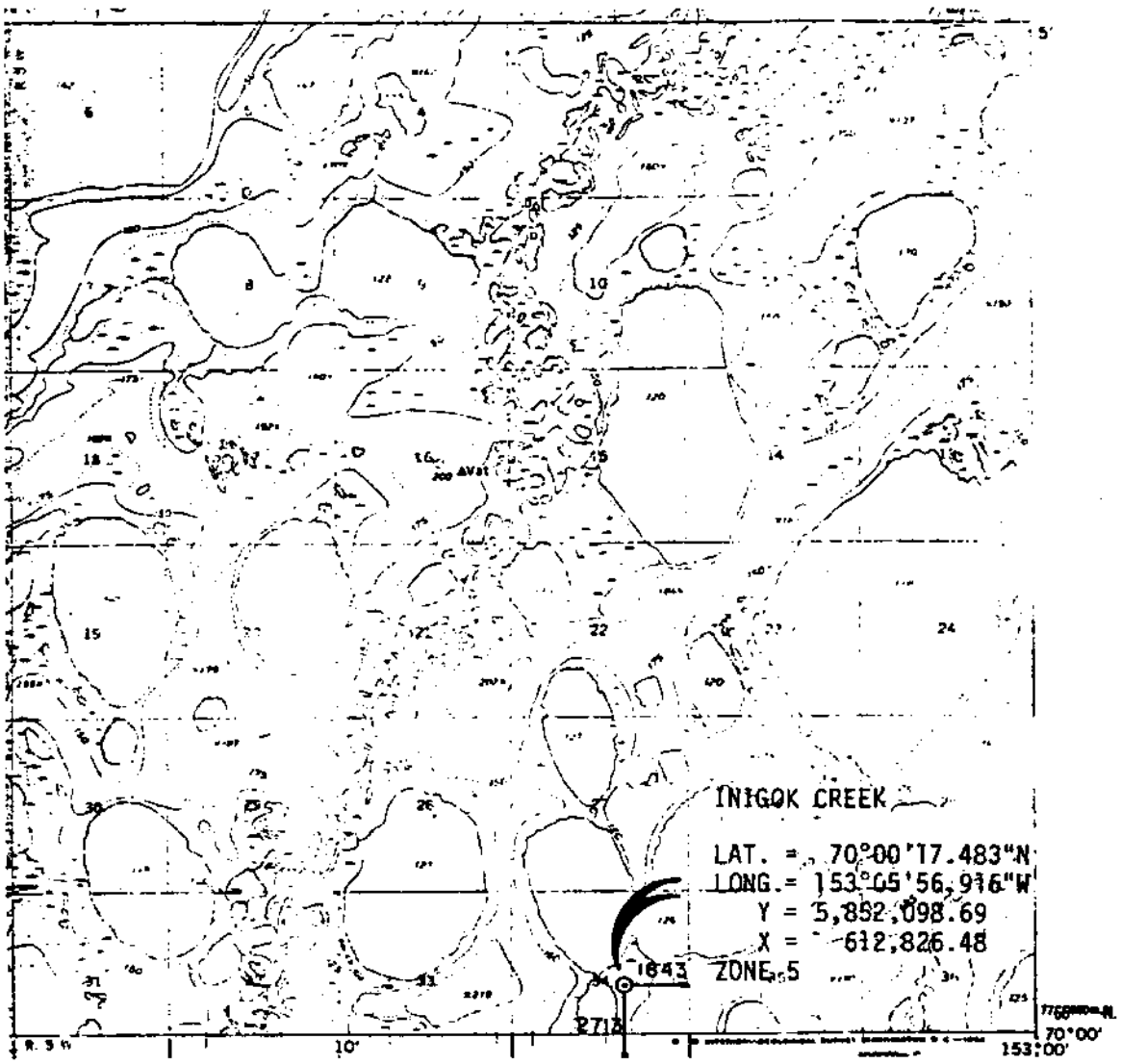


FIGURE 1 - LOCATION MAP - INIGOK TEST WELL NO. 1



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.

Feb. 2, 1978

STATE OF ALASKA
49TH
JOHN H. HERRING
No. 953-S
REGISTERED PROFESSIONAL LAND SURVEYOR

FIGURE 2
SURVEYOR'S CERTIFICATE

0 1/2 1 2
SCALE IN MILES

AS STAKED
INIGOK CREEK
LOCATED IN
NE 1/4 PROTRACTED SEC.34 T8 N,R5W UMIAT MERIDIAN, AK

Surveyed for
HUSKY OIL
N.P.R. OPERATIONS INC.

Surveyed by
Bell, Herring and Associates
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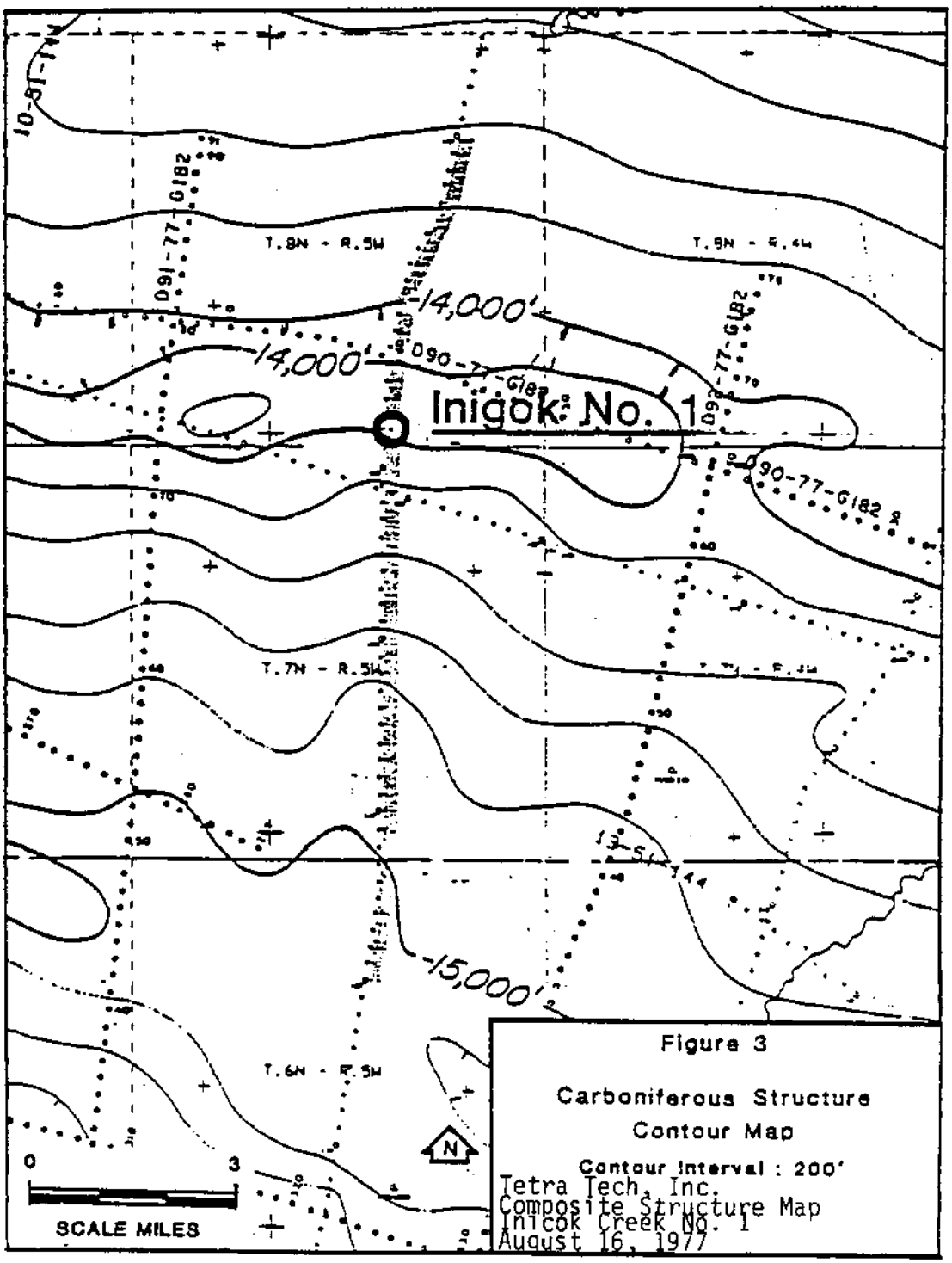

Figure 3

Carboniferous Structure Contour Map

Contour Interval : 200'

Tetra Tech, Inc.
Composite Structure Map
Inicok Creek No. 1
August 16, 1977

WELLSITE GEOLOGIST'S REPORT
by R. G. BROCKWAY

INTRODUCTION

Inigok Test Well No. 1, drilled to a depth of 20,102 feet, penetrated sediments of Cretaceous through Pennsylvanian ages and bottomed in Mississippian rocks. Zones of interest to be explored for hydrocarbon potential were in the Cretaceous Torok sands and "Pebble Shale" sandy section, Triassic Sag River, Triassic-Permian Sadlerochit Group, the Permian-Mississippian Lisburne Group and a possible Devonian closure.

Small gas shows were detected throughout the well, but none were considered significant enough to test. Oil shows were nil except in rare cases where traces of dead hydrocarbon residue were noted.

Effective porous zones were generally limited to the Cretaceous sands and no suitable reservoir rocks were found below these sands.

Interesting is the fact that two new intervals of sediments were drilled in Inigok No. 1 that had not been drilled in previous wells in NPRA. The first of these was a sequence of interbedded limestones, shales and siltstones at the top of the Lisburne limestones and appears to be a transition zone between the Permian Echooka Formation and the Pennsylvanian Lisburne Group. The second is the presence of massive quartzitic sandstones in the lower portion of the Mississippian drilled in this well.

From the 23 conventional cores taken, apparent horizontal bedding dips were recorded in six, Cores Nos. 4, 5, 6, 16, 17, and the upper part of 18. In Core No. 18, at a depth of 14,052', limestone appears to be in contact with shales at 15°.

Below 14,052' there seems to be a gradual increase in the bedding dips with Core No. 21 (17,053-17,083') exhibiting 10-15° dips, Core No. 22 (19,360-19,372') 15-20°, and Core No. 23 (20,091-20,102') 30-32°.

It appears that there are only two major unconformities in Inigok No. 1 instead of three as logged in previous wells. Possibly local unconformities exist. The two major ones are those between the "Pebble Shale" (Cretaceous) and Kingak (Jurassic) Formations and between the Kavik Member of the Ivishak (Triassic-Permian) and the Echooka Formation (Permian) of the Sadlerochit Group. A third one which is usually between the Permian Echooka and the Pennsylvanian Lisburne Group may not be present because of the transition zone logged in this well. Foraminifera from this zone has been dated middle Pennsylvanian to early Permian.

STRATIGRAPHY

WIRELINE TOPS

	DRILLED DEPTH (FEET BELOW KELLY BUSHING)	SUB-SEA (KB 163')
CRETACEOUS		
Colville Group (undifferentiated)	110'	53'
Nanushuk Group (undifferentiated)	1,988'	-1,825'
Torok Formation	3,355'	-3,192'
"Pebble Shale"	9,042'	-8,879'
JURASSIC		
Kingak Formation	10,260'	10,097'
Sag River Sandstone	12,170'	-12,007'
TRIASSIC		
Shublik Formation	12,220'	-12,057'
TRIASSIC-PERMIAN		
Sadlerochit Group	12,640'	-12,477'
Ivishak Formation	12,640'	-12,477'
Kavik Shale Member	13,314'	-13,151'
Echooka Formation	13,656'	-13,493'
PERMIAN-MISSISSIPPIAN		
Lisburne Group	13,980'	-13,817'
Transition Zone	13,980'	-13,817'
Massive Unit	14,474'	-14,311'
MISSISSIPPIAN		
Endicott Group	17,870'	-17,707'
Kayak Formation	17,870'	-17,707'
Kekiktuk Formation	18,184'	-18,021'
TOTAL DRILLER'S DEPTH	20,102'	-19,939'

CRETACEOUS

Colville Group (undifferentiated): 110' to 1988'

The Colville Group is composed of a variety of interbedded rocks ranging from claystones to gravels and thin coal beds. Sandstones generally vary from 1' to 30' in thickness with the exception of the interval 320' to 510'. This interval was predominantly sandstone with thin interbedded claystones and shales in the drilling samples. Most sandstones exhibit varying amounts of intergranular porosity with some sandstones in the interval 400-800' having gas shows up to 420 units. Gravels are present at 530-570' and 1050-1100'. The thin coal beds are scattered throughout the

upper 1100' of the group. Light and medium gray siltstones are present throughout the Colville Group with the thicker zones in the upper 320' and lower 638' (1350-1988').

The sandstones, nearly all light gray and partly "salt and pepper", range from very fine to very coarse with fine and medium grained predominant. They are subangular, poor to medium sorted, calcareous, silty, argillaceous and carbonaceous; some beds are slightly conglomeratic. Composition of the sandstones is clear and white quartz with some coal fragments, dark mineral and chert grains. The pebbles occurring in the sandstones and gravels are predominantly light and dark chert with scattered quartzite and quartz. Clay ironstone (siderite?) concretions and pyritized worm tubes are present in the upper 500'. The claystones and shales are light to dark gray.

Anderson, Warren & Associates, Inc. (AWA) have dated, by paleontology, the interval 110' to 2090' as Late Cretaceous [Senonian, F-5 (110-560'), Turonian to Coniacian, F-6 (560-1490'), and Cenomanian to Turonian, F-7 (1490-2090')].

Nanushuk Group (undifferentiated): 1988-3355'

Although the interval 1988' to 2090' has been included in Anderson, Warren & Associates, Inc.'s Colville Group, this writer prefers a pick of 1988', based on lithology and electric log correlations, as the top of the Nanushuk Group. Strata of the Nanushuk Group is composed of interbedded sandstones, siltstones, and shales with a few thin coals.

The sandstones, dominant above 2935', are very fine to medium grained and light to medium gray. Some brown colors were noted above 2130'. They are subangular, medium to poorly sorted, in part conglomeratic, silty, slightly argillaceous and calcareous. Coal grains and chips are moderately common. Some tuffaceous material was noted below 2665'.

The main sandstone section of the Nanushuk (2250-2500') contains units up to 80' thick. These sandstones had fair to good visible porosity but were devoid of any hydrocarbon shows. The only shows noted in the Nanushuk were small gas readings at 2800' and 2890'.

From 2935' to 3355', the rocks are predominantly interbedded medium to dark gray shales and medium gray siltstones. Scattered shell fragments and foraminifera were observed in this zone.

Two cores were taken at 2632-2662' and 3072-3082' and both were shale, slightly silty, with thin sandstone stringers. Biostratigraphic identification by Anderson, Warren & Associates, Inc. dates both these cores as middle to late Albian (AWA F-9) in age. They have dated the interval 2090-3520' as Late to Early Cretaceous, Cenomanian to middle Albian (AWA F-8 to F-9).

Torok Formation: 3355-9042'

The upper 4590' of this formation is composed predominantly of shales varying in color from medium gray at the top to very dark gray in the lower portion. An interval from 6000-6800' contains brown and gray-brown shale stringers. These shales are fissile, pyritic, micromicaceous, and commonly fossiliferous. Paleontology data has placed these shales into the AWA F-10 and F-11 zones (Albian to Aptian).

Thin siltstone and sandstone beds and laminations are present throughout and become increasingly numerous below 6800'.

Rocks in the lower 1097' (7945-9042') are interbedded sandstones, siltstones and shales. The sandstones are as much as 30' thick and are light gray to "salt and pepper", very fine grained, subangular, argillaceous, and calcareous, silty, slightly pyritic and carbonaceous. Preliminary paleontology reports place this interval as probable Aptian (AWA F-11).

Small amounts of gas and tarry hydrocarbon residue were detected in the interval 8700-9000' in which porous streaks in the sandstones were estimated to have 3-8% porosity.

Five cores were cut in the Torok Formation: 4206-4216', 5000-5010', 7054-7064', 8210-8240', 8842-8852'. All cores except No. 6 (8210-8240) were composed of shales and siltstones. Core No. 6 was a gray to light gray, subangular, very fine grained sandstone, calcareous, carbonaceous, slightly clayey, silty, rarely glauconitic, and tight with thin shale and siltstone stringers. No shows were detected in the cores.

The approximate lithologic composition of the Torok Formation consists of sandstone 10%, siltstone 15%, and shale 75%.

"Pebble Shale": 9042-10,260'

The "Pebble Shale" is composed of dark gray-brown, very dark gray and black shales, that are generally fissile and contain scattered floating rounded quartz grains and granules, pyrite and scattered fossils in the upper portion.

At 9265' there is a downward color change from dark gray-brown to very dark gray and black; there is also a slight increase in silty and sandy content and occasional sandstone stringers not over 4' thick. This zone, which extends to 9610', may be equivalent to the so-called sandy section present in wells drilled further to the north and west.

The color changes back to a dark gray-brown at 9610' and continues into the Jurassic Kingak Formation below 10,260'. These shales highly resemble those of the Kingak but an assemblage of foraminifera in an interval from 9060' to 10,260' has been assigned an early Cretaceous, Neocomian age (F-12 to F-14) by Anderson Warren & Associates, Inc. (see Appendix F).

The interval 9480-10,260', Neocomian (AWA F-13 to F-14) is possibly the equivalent of the Kuparuk River section logged in wells further to the east and north.

Two shale cores were cut at 9338-9348' and 9448-9458'.

JURASSIC

Kingak Formation: 10,260-12,170'

The Kingak is predominantly dark gray-brown shales that are fissile, micaceous, partly silty and slightly pyritic, and siltstones that are gray-brown, finely micaceous, argillaceous to shaly and contain rare glauconite grains. Very dark gray and black, fissile to papery shales are predominant in the lower 200' of the formation with a few thin beds containing glauconite. The shales commonly have a tendency to slough badly while drilling although they were drilled in the No. 1 Inigok with a minimum of difficulty.

A 145' glauconitic sandstone section with interbedded shale and siltstone is present in the upper portion of a thick siltstone unit of the Kingak Formation. The sandstones in the interval 10,325-10,470' appear to be correlative to sandstones informally known as the Simpson sandstone found in the following wells: South Meade No. 1 at 7858-7966'; Topagoruk No. 1 at 7750-7850'; South Simpson No. 1 at 6520-6700'; and Kugrua No. 1 at 8710-8875'.

The sandstones are relatively thin and do not exceed 10' except at 10,415-10,445' where they are approximately 30' thick. These sandstones are gray-brown to "salt and pepper", very fine grained, subrounded, silty, clayey, slightly calcareous and contain rare glauconite pellets. Some very slight porosity was observed and slight trace of gas recorded.

Scattered fossil fragments and foraminifera were noted throughout the formation.

Paleontology reports place the interval 10,260-11,006' in Late Jurassic (AWA F-15 and F-16) (Appendix F), and the interval 11,006-12,210' in Early to Middle Jurassic (AWA F-17 to F-18).

All three cores in the Kingak (10,295-10,305', 10,998-11,008', 11,704-11,714') contained dark gray-brown, fissile, platy and "poker chip" shales with scattered pelecypods and pyritic worm tubes.

Sag River Sandstone: 12,170-12,220'

Dark gray-brown siltstones and shales compose the 50' interval that is the equivalent of the Sag River Sandstone. The siltstones are shaly, hard, pyritic, micaceous, and have rare glauconite grains, and the shales are glauconitic, pyritic and have occasional siltstone laminations. This interval has been dated as Early to Middle Jurassic (AWA F-17 to F-18).

TRIASSIC

Shublik Formation: 12,220-12,640'

The Shublik Formation consists of siltstones and silty shales with several thin limestones from 12,275-12,315'.

The siltstones are dark gray-brown to dark gray, calcareous, fossiliferous, partly glauconitic and pyritic in the upper 210'. The lower siltstones become noncalcareous, slightly carbonaceous, and slightly siliceous. Shales are generally very dark gray to gray-black with some gray-brown, slightly silty, and partly fossiliferous. The thin limestones are gray-brown, argillaceous to shaly and contain Monotis sp. and Halobia sp. Some beds are almost a coquina.

Phosphate pellets were present in one zone (12,420-12,440'). A core (No. 13) taken from 12,273-12,283' contained a calcilutite composed of thin irregular bands of gray to brown, fine crystalline fossiliferous limestone and black to dark gray-brown, thinly laminated shaly limestone with Monotis sp. and Halobia sp. assemblages. Core No. 14 (12,500-12,530') was composed of a dark gray to black, silty, micaceous shale. Scattered pelecypods and pyritized worm borings were noted. Small-scale fractures are abundant with some bleeding gas.

The zone 12,210-12,480' is Triassic in age (AWA F-19). Below this zone the samples are barren of foraminifera.

TRIASSIC-PERMIAN

Sadlerochit Group: 12,640-13,980'

The Sadlerochit Group is composed of two formations: the Ivishak (12,640-13,656'), with a lower unit known as the Kavik Shale Member, and the Echooka (13,656-13,980').

Ivishak Formation: 12,640-13,656'

Sandstones comprise the major part of the upper section (12,640-13,314') of the Ivishak Formation. They are buff to very light gray, very fine to fine grained, subangular to subrounded, medium to well sorted, siliceous to quartzitic, and barren of fossils. In some cases, these sandstones are slightly "salt and pepper", partly silty and have rare occurrences of tripolitic chert grains. No porosity or shows were observed except in one zone (12,950-13,000'). Electric-log calculations indicate that this zone has an average of 20% porosity and is water wet. Visual examination indicated much less porosity. A trace of dead hydrocarbon was detected at the top of this porous zone.

A core taken in the Upper Ivishak (12,705-12,735') had very fine grained sandstones interbedded with thin shales up to 2" thick. These shale and sandstone beds showed numerous sedimentary structures, small-scale ripple cross-laminations, rip-up clasts, bioturbation and possible high-angle crossbeds. Some fracture planes were observed.

Medium to very dark gray hard shales and black to brown siliceous to quartzitic siltstones are interbedded with the sandstones in the upper 285' of the Ivishak Formation.

After correlation with the U. S. Navy South Harrison Bay No. 1, Section 6, T12N, R2E, U.M. and the Atlantic Richfield Itkillik River No. 1, Section 10, T8N, R5E, there appears to be a general thickening of the Ivishak Formation in a south and west direction from these two wells. Although the individual sandstone units of the No. 1 Inigok appear thicker and more massive than those of the No. 1 Itkillik, there is an overall reduction in the total amount of sandstone: Itkillik 570', Inigok 440'. The Inigok well has approximately 50' more sandstone than the South Harrison well. This may be due to non-deposition in relation to their locations on the Barrow Arch with the South Harrison well higher on the flank. The sandstones of the Inigok well become finer grained and tighter than those of the other two wells. There is also an increase in the amount and thickness of siltstones which indicates deposition may be approaching the distal edge of the Ivishak sandstones. The Ivishak Formation at the USGS Tunalik No. 1, Section 20, T10N, R35W, U.M. is at least twice as thick but is primarily shale and siltstone.

A decreasing amount of tripolitic chert grains also indicates a further distance from the source area, considered to be northeast of Prudhoe Bay. At the Prudhoe Bay field, 100-110 miles east-northeast of Inigok, tripolitic chert grains are an abundant constituent of the Ivishak; it is less common at the Itkillik and South Harrison Bay wells and rare at Inigok.

Kavik Shale Member: 13,314-13,656'

The Kavik Shale Member has medium to dark gray siltstones and very dark gray shales, with the siltstones deposited in the upper 150'. This then shows a gradational type deposition from the lower Kavik shales upward into the Ivishak sandstones. The siltstones of the Kavik are slightly siliceous, argillaceous to shaly, slightly carbonaceous and pyritic. The shales are micaceous, partly siliceous, and platy. Some break with conchoidal fractures. Occasional siltstone laminations and beds occur in the shale section with some thin sandstone beds present in the interval 13,590-13,625'.

A core (13,480-13,510') from the Kavik Shale Member consisted of very dark gray shale that is micaceous, moderately hard, partly siliceous and platy yet breaks with slight conchoidal fracture. Scattered pyrite pellets were noted.

Echooka Formation: 13,656-13,980'

Rocks of the Echooka Formation are composed of siltstones, shales and occasional sandstones.

The siltstones are very dark to medium gray, carbonaceous, slightly glauconitic, partly pyritic, shaly, and siliceous throughout most of the formation, but become slightly dolomitic to very calcareous at the base.

The shales are very dark gray to black, slightly carbonaceous, calcareous and siliceous. Scattered fossil fragments and casts, along with pyrite pellets and inclusions were observed. A core taken at 13,831-13,880' consisted of siltstone and shale, with the siltstone present from 13,833-13,851'. The rest was shale as described above. Alteration and replacement of the fossil fragments by calcite and occasionally by quartz and pyrite makes identification difficult, but some seem to be either brachiopods or pelecypods and possibly some algae.

Light to dark gray colors characterize the sandstones of this formation. They are fine to very fine grained, subangular, siliceous, slightly carbonaceous, and have rare glauconite grains. Individual sandstone thicknesses are moderately thin, but one bed at 13,675-13,690' has a thickness of 15'. This bed had slight porosity and gave a 1,600-unit gas reading. This reading may be erroneous as a drill-pipe connection was made at about this time and higher gas readings were common on connections in the general interval.

The Sadlerochit Group has approximately 35% sandstone, 42% siltstone and 23% shale. Of the 35% sandstone, 92% is in the Ivishak Formation.

Although biostratigraphic data was very sparce, the Sadlerochit Group has been placed in the Triassic-Permian, F-20 zone by Anderson, Warren & Associates, Inc.

PERMIAN-MISSISSIPPIAN

Lisburne Group: 13,980-17,870'

Transition Zone: 13,980-14,474'

A transition zone, not previously noted in other wells drilled in NPRA prior to the No. 1 Inigok, is present in this well and is characterized by interbedded shales, siltstones and limestones. AWA has dated the interval 13,890-14,150' as early Permian (AWA Zone F-21) but note that the base of Zone 21 may be as low as 14,450'. Lithology and the electric logs indicate that the base of the transition zone should be at 14,474', top of the massive limestones.

The limestones of this zone are light to dark gray and contain pellets, oolites and fossil debris. They are partially altered and vary from chalky to very fine crystalline, with the fossil debris and pellets being very fine to coarse size. The fossil debris is predominantly indistinct but some algae was observed. Limestone comprises approximately 60% of the transition zone and occurs in units 3' to 30' thick.

The siltstones are dark gray to tan, fossiliferous, slightly dolomitic to very calcareous, and partly siliceous. Siltstones comprise 24% of the transition zone. Shales of the zone are very dark gray, partly calcareous and siliceous and contain fossil fragments.

18

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A core taken from 14,020-14,066' was predominantly siltstone with interbedded limestones and thin shales. The siltstones and shales are as described above with brachiopods or pelecypods and crinoids present. The limestones are gray-brown and partly bioclastic with algae, foraminifera, brachiopods or pelecypods. Tight vertical fractures with calcite cement were present in the limestones.

An open 45° fracture which was highly slickensided was present at 14,051.7' and indicates a possible small fault. A 9-foot thick limestone bed below this fracture was highly fractured, with indications of slickensides. Some vertical hairline fractures with calcite cement were also present.

Massive Unit: 14,474-17,870'

The limestones of the main Lisburne section are light gray to gray-brown to very dark gray and black, and predominantly low-energy bioclastic deposits. Interbedded with these are thin beds of high-energy sediments composed of bioclastic material, pellets and oolites. One limestone unit, 115' thick, (14,605-14,720'), is assumed to be a high-energy deposit although it is highly altered and leached. The light gray and gray-brown colors are predominant down to 16,850'; at this point, the limestone becomes darker (partly dark to very dark gray) and increasingly argillaceous.

Scattered throughout the massive unit are thin very dark gray interbedded shales, gray dolomites, and occasional siltstones with an increase in shale below 16,850'.

Nearly all of the limestones, originally bioclastic, have been recrystallized to the point where identification of the fossil debris is difficult. Some crinoids, algae, bryozoa, and occasional foraminifera were recognized. Corals, brachiopods and bryozoa were observed in a core at 15,185-15,215'. This core contained 16' of calcareous and dolomitic shales in the upper part and bioclastic limestones in the lower 14'. According to Anderson, Warren & Associates, Inc., the interval 14,450-14,740' can not be older than Mamet's Zone 21 but may be as young as Zone 24 (middle to late Pennsylvanian). Foraminiferal reports have placed the intervals 14,740-15,215' in Mamet's Zone 21 and 15,215-15,740' in Zone 20 (early to middle Pennsylvanian).

A second core in the Lisburne Group Massive zone 16,185-16,198', is entirely limestone that is light to medium gray, dolomitic and recrystallized with crinoids, brachiopods, and bryozoa fossils. Calcite-filled fractures up to 1/4" were noted.

Although some dolomitization has taken place above 15,820', it becomes prominent below this point to a depth of 16,900'. Anderson, Warren & Associates, Inc. have designated the interval 16,220' to 16,490' as the Dolomite unit. This includes the main dolomite section of the Lisburne Group (16,265-16,460') which is composed of very light gray to black, very fine crystalline, cherty, fossiliferous dolomites with interbedded black, siliceous shales and light buff to dark gray dolomitic, cherty limestones. One zone (16,367-16,386') is fine to medium crystalline

dolomite. Porosity through the Dolomite unit was nil with the exception of a three-foot interval (16,403-16,406') where the neutron porosity log showed 3%. No visible shows were noted.

Below 16,850', where the limestones become darker and more argillaceous, there appears to be a decrease in bioclastic material and an increase in algal material. Chert, which is common throughout the Lisburne, also changes to darker colors below this point. Occasional pebbles of detrital chert were present in the limestones from 17,800-17,870'.

No significant hydrocarbon shows were observed in the Lisburne Group, although some dead-oil residue was noted from 14,500-14,550', and traces were found in fractures from 17,200-17,800'. While circulating for a logging run at 17,570', H_2S gas and sulfur were encountered (the first noted in NPRA). The gas was measured at 300 ppm at the shaker tanks. Efforts to control the H_2S resulted in many drilling problems, i.e., lost circulation, stuck pipe, fishing jobs, sulfur-plugged pipe and cement jobs. Crystalline sulfur and H_2S gas were noted during periods of circulation while fishing and conditioning the hole. Drilling was curtailed for a period of 78 days after encountering the H_2S (for detailed explanation see "History of Drilling Operations, Inigok Test Well No. 1, Husky Oil NPR Operations, Inc., September 1982", pages 5-8 and 65-79). Interpretation of the electrical logs does not indicate bedded sulfur so presumably the H_2S gases came from fractures. Sulfur, with a density of 2.02, was not indicated on the density logs. The sulfur found in the cuttings was probably a product of cooling and decreasing pressures of "heavy" hydrogen sulfide gas (H_2S_9) as it rose to surface conditions.

Fractures were common throughout the entire Lisburne section and were generally sealed with calcite. In some cases the calcite was very fine to medium crystalline thereby establishing some porosity.

Porosity in the Lisburne Group was generally of the earthy type although some fracture porosity was noted. In the highly altered beds 14,605-14,715', some intercrystalline and vugular porosity was observed.

Foraminifera identification indicate Mississippian ages for the following intervals:

15,740-16,220'	Mamet's Zones 18 to 19 (late Mississippian)
16,220-16,490'	Mamet's Zones 17 to 18 (AWA's Dolomite Zone (late Mississippian)
16,490-16,880'	Mamet's Zone 16 (late Mississippian)
16,880-17,720	Mamet's Zones 12 to 15 (probable late Mississippian)
17,720-18,110	Mamet's Zones 10 to 11 (possible late Mississippian)

Anderson, Warren & Associates, Inc. feel that the interval 16,880-18,110' is an interbedded Kayak Shale and Alapah or Wachsmuth Limestone section as quoted from their Foraminifera Report, dated July 9, 1979, page 12:

"The whole interval is felt to represent interbedded Kayak Shale and Alapah or Wachsmuth Limestone ranging in age from Zone 10 or Zone 11 near the base to possibly as young as Zone 16 at the top of the interval." Sample study and electric-log correlations indicate that the base of the Lisburne Group should be at 17,870'.

MISSISSIPPIAN

Endicott Group: 17,870-20,102' (Total Depth)

Kayak Formation: 17,870-18,184'

Interbedded limestones, shales and siltstones compose the Kayak Formation. The limestones are dark gray to dark gray-black, slightly dolomitic, partly pyritic, and have algal, crinoid and occasional ostracod fossil debris. The shales are very dark gray to black, siliceous, very hard, slightly silty and dolomitic, and micromicaceous in part. The siltstones are medium to dark gray and gray-black, pyritic, argillaceous to shaly and calcareous. Crinoids appear moderately common throughout. Calcite-filled fractures were observed.

These rocks have been designated Late Mississippian, possibly Mamet's Zones 10 to 11 or older to a depth of 18,110'. Below 18,110', biostratigraphic data is indeterminate.

Kekiktuk Formation: 18,184-20,102' (Total Depth)

In the interval 18,184-18,980', the sedimentary rocks are a succession of interbedded sandstones, shales, siltstones and coals with individual units not exceeding a thickness of 20'. Below 18,980' the sandstones become increasingly massive with occasional units reaching thicknesses of 80' to 100'. The coals are most prevalent above 18,980' and occur in beds not exceeding 3 feet. Below this depth, coal thicknesses up to 5 feet have been logged. These coals are anthracitic, black, very hard and brittle.

The sandstones are dark gray to white and clear, very fine to very coarse grained, partly conglomeratic, predominantly quartzose with some light and dark chert grains, siliceous to quartzitic, subangular to angular, and partly argillaceous with occasional coal grains and inclusions. They are tight to slightly porous and appear partially altered in the lower portion and may possibly be called metaquartzites. The finer grained and darker colored sandstones are generally confined to the interval above 19,200', although there are coarse grained and conglomeratic streaks present. Below this depth the sandstones are massive, medium to very coarse grained, and partly conglomeratic with occasional conglomerate beds. In the interval 19,550-19,690' the sandstones are very slightly calcareous to slightly dolomitic.

A core taken at 19,360-19,372' was mostly a medium to very coarse grained, partly quartzitic sandstone with a conglomerate bed from 19,363-19,365' and a shale from 19,366-19,367.2'. A sandstone from 19,367.2-19,370' was dark gray, had thin coaly partings and appeared highly shattered and slickensided.

The shales are very dark gray to black, siliceous, partly cherty and carbonaceous, and have scattered coal partings. The siltstones are dark to very dark gray, and siliceous to quartzitic. A few calcite-filled fractures were noted.

The last core taken in the well (20,091-20,102') only recovered 2 feet of which 1 foot was sandstone and 1 foot shale. The sandstone was medium to dark gray, medium to coarse grained, and subangular to angular. No hydrocarbon shows were evident. The shale was black to dark gray with thin anthracite partings and traces of graphite and talc. Bedding dips were approximately 32°.

Small shows of gas were common throughout the interval 18,184-19,000' but most appear to be associated with the coal beds. The gasses are almost entirely methane (C_1) and rarely contained propane (C_3). No other shows were observed.

Fractures were common in the upper portion of the Kekiktuk Formation and were filled with quartz, rarely with calcite. Some fracturing may have been present in the lower part but was not recognizable from the samples. An interval of 19,367-19,370' in Core No. 22 (19,360-19,372') appeared to be highly shattered and slickensided.

Age dating by paleontology below 18,110' was indeterminate. This interval is probably Mississippian in age as suggested by the very poorly preserved spores and spore fragments (AWA P-T21).

It appears that possibly some low-grade metamorphism has occurred below 19,500'. Some of the sandstones appear slightly altered and there is a minor amount of angular quartz which has the appearance of being formed from altered sandstone. The shales become slightly schistose, phyllitic or argillitic in part. The coals are harder, shinier and in part slightly greasy.

OIL AND GAS INDICATIONS

The samples were examined for hydrocarbons by use of ultraviolet lights, microscope, chloroethane and hydrogen flame chromatographs. No visual detections of hydrocarbons were observed in any of the samples except in a recrystallized limestone of the Lisburne Group between 14,500' and 14,550' and in scattered fractures in the Lisburne in the interval 17,200-17,800'. These shows were dead hydrocarbon residue that gave no cut or fluorescence.

Methane gas in very small amounts was logged in the Nanushuk Group. Sandstones in the lower part of the Torok Formation yielded larger amounts of gas. In the interval 8700-9125', gas readings varied from 350-2,000 units. Gas from the 2,000- unit reading contained 355,000 ppm C_1, 25,170 ppm C_2, 12,650 ppm C_3, 3,450 ppm C_4-nC_4, and 920 ppm C_5. While drilling the interval 8700-9125', the background gas rose sharply to a maximum of 1,500 units and averaged approximately 700 units.

The background gas gradually decreased downward to 250 units until the glauconitic sandstone in the Kingak Formation was reached where the background gas again increased to an average of 500 units. From the glauconitic sandstone the highest gas reading was 1,135 units.

Gas readings of 1,800 units and 1,700 units were recorded from siltstones in the Sag River and Shublik Formations at 12,183' and 12,223', respectively. Electric log, core and sample analysis of the Cretaceous Nanushuk Group through the Triassic Shublik Formation strata reveal that porosity and permeabilities are low; therefore, there are no potential zones of interest. Analysis of a Torok Formation core (No. 6, 8210-8240'), the only core analyzed, had porosities from 6.8% to 9.1% but permeabilities were 0.0-0.1 millidarcies (Appendix D).

Gas kicks in the Sadlerochit Group were very small. The maximum was 320 units at 12,983' in a zone of porosity (12,960-13,003') in the Ivishak Formation, which had a trace of dead hydrocarbon at the top. Electric log computations over the interval 12,964-12,999' gave an average porosity of 20% and a water saturation of 82% to 100%. All other sands of the Ivishak Formation were of low porosity (10% or less). The Echooka Formation had an insignificant amount of gas from a very slightly porous dirty sandstone at 13,675-13,690'.

A show of gas of 502 units was recorded from a recrystallized oolitic limestone in the transition zone of the Lisburne Group at 14,184-14,195'. No other shows were observed.

Numerous small gas shows (maximum of 330 units) were recorded in the upper part of the Kekiktuk Formation. It appears that most of these are associated with coal beds and consist almost entirely of methane gas.

Log analysis of the Lisburne and Endicott Groups reveal very low porosities and no potential zones of interest.

Because of low porosities, lack of visible hydrocarbon shows and high water saturation in the one good zone of porosity (12,960-13,003') in the Inigok Test Well No. 1, it was deemed unnecessary to test this well, consequently, it was plugged and abandoned.

CONCLUSIONS

1. After full evaluation of all available information, the Inigok Test Well No. 1 is a dry hole.

2. Southward and westward from the Prudhoe Bay area where the Ivishak Formation of the Sadlerochit Group is the main hydrocarbon reservoir, the potential reservoir zones of the Ivishak Formation become finer grained, tighter, and thinner. Porous zones in the Lisburne Group also appear thinner, less crystalline and tighter. Hydrocarbon shows diminish greatly.

Cretaceous sandstones may become the important hydrocarbon reservoirs of the NPRA. Nearly all of the wells drilled in NPRA have had at least some gas shows during the drilling of these sandstones.

3. Inigok Test Well No. 1 yielded much valuable stratigraphic information, especially the newly discovered transition zone at the top of the Lisburne Group, and the presence of thick sandstone intervals in the Mississippian strata.

PERTINENT DATA AND APPENDICES

PERTINENT DATA AND APPENDICES (Continued)

G. Listing and Source of Additional Pertinent Data (Continued)

2. Report to USGS...
"Possible Source of Elemental Sulfur
from Inigok Well No. 1", March 12, 1979

3. Drilling History for Inigok Test Well No. 1

Source of Other Geological and Well Data

SUMMARY OF PERTINENT DATA, OPERATIONS AND ANALYSIS

WELL NAME:	Inigok Test Well No. 1
API NO.:	50-279-20003
OPERATOR:	Husky Oil NPR Operations, Inc.
LOCATION:	2713' FSL; 1843' FEL NE 1/4, protracted Section 34, T8N, R5W, Umiat Meridian, Alaska
COORDINATES:	Latitude: 70°00'17.483"N Longitude: 153°05'56.916"W X = 612,826.48 Y = 5,852,098.69 Zone 5
ELEVATION:	163' Kelly Bushing; 135' Pad
CASING:	42" @ 110' 30" @ 508' 20" @ 2,594' 13-3/8" @ 8,286' 9-5/8" @ 12,283' 7-5/8" liner @ 11,818' to 17,432'
DATE SPUDDED:	June 7, 1978
DATE RIG RELEASED:	May 22, 1979
TOTAL DEPTH:	20,102' below Kelly Bushing (reached May 16, 1979)

LOGGING RECORD:

Open Hole	DIL/DLL/SP/GR/CAL	506-20,046'
	BHCS/GR/TTI	50-20,055'
	CNL/FDC/GR-porosity	2,594-20,060'
	FDC/GR/CAL-RR	2,594-20,060'
	HDT-Dipmeter	8,282-20,067'
	HRT Temperature Log	5,920- 9,535'
	Birdwell Velocity Survey	Surface-20,090'
	Mudlog	110-20,102'
	Mud Temperature	2,625-20,102'
	Dc Exponent	2,625-20,102'
CASED HOLE:	CBL/VDL/CCL/GR	11,800-17,308'

COMPUTED LOGS:

Dipmeter Cluster	8,320-20,055'
Geogram	Surface-20,090'

SIDEWALL CORES:

8,504-12,200', Shot 44, Recovered 44
12,339-14,375', Shot 60, Recovered 20

CONVENTIONAL CORES:

CORE NO.	INTERVAL	RECOVERY	FORMATION/GROUP
1	2,632- 2,662'	30'	Nanushuk
2	3,072- 3,082'	10'	Nanushuk
3	4,206- 4,216'	10'	Torok
4	5,000- 5,010'	10'	Torok
5	7,054- 7,064'	10'	Torok
6	8,210- 8,240'	30'	Torok
7	8,842- 8,852'	10'	Torok
8	9,338- 9,348'	10'	"Pebble Shale"
9	9,448- 9,458'	10'	"Pebble Shale"
10	10,295-10,305'	10'	Kingak
11	10,998-11,008'	10'	Kingak
12	11,704-11,714'	10'	Kingak
13	12,273-12,283'	9.5'	Shublik
14	12,500-12,530'	29'	Shublik
15	12,705-12,735'	30'	Ivishak
16	13,480-13,510'	30'	Kavik
17	13,831-13,880'	49'	Echooka
18	14,020-14,066'	45.5'	Lisburne
19	15,185-15,215'	30'	Lisburne
20	16,185-16,198'	12.8'	Lisburne
21	17,053-17,083'	30'	Lisburne
22	19,360-19,372'	10.5'	Endicott
23	20,091-20,102'	2'	Endicott

CORE ANALYSIS:

CORE NO.	INTERVAL	SAMPLE NO. (LAB)
6	8,211.0- 8,239.0'	1-26
22	19,361.6-19,368.2'	1-3

TESTS: None

FLUID & SPECIAL ANALYSIS:

Analytical Report - Ditch Sample @ 17,570'
Analytical Report - Mud Sample @ 17,570'
Water Analysis - Mud Filtrate @ 17,570'
Report: "Possible Source of Elemental Sulfur..." (see Appendix F)

WELL STATUS: Dry and abandoned

WELLSITE GEOLOGIST:	A. Ehm R. Brockway D. Fenex D. Young
LOG ANALYST:	A. Kane
DRILLING CONTRACTOR:	Nabors Alaska Drilling, Inc., Rig 25
MUD LOGGERS:	Exploration Logging Services
BIOSTRATIGRAPHIC ANALYSIS:	Anderson, Warren & Associates, Inc.

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

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

INIGOK NO. 1
DRILL CUTTINGS AND CORE DESCRIPTIONS
BY

A. EHM	-	110- 5,409'
		12,298-13,359'
		14,834-16,906'
		17,786-18,146'
		19,274-19,360'
R. BROCKWAY	-	5,409- 8,315'
		13,359-14,834'
		16,906-17,786'
		18,146-19,274'
		19,360-19,988'
D. FENEX	-	8,315-12,298'
D. YOUNG	-	19,988-20,102'

NOTE: Sample descriptions in this unit were written as the well was drilled and have not been corrected to electric-log control.

(See Footnote at end of descriptions.)

DRILLED DEPTH (FEET BELOW KELLY BUSHING)	
0-110	No recovery.
110-200	Siltstone: light gray, sandy, micaceous, slightly calcareous, with carbonaceous flakes and scattered black chert pebbles; Claystone: light gray, silty, very slightly calcareous.
200-230	Sandstone: very light gray, slightly "salt and pepper", fine to medium grained, subangular, trace clay, scattered granules, dark chert grains, friable, porous; Coal: lignite, black, pyrite inclusions, trace of amber.
230-320	Claystone: light to medium gray, olive-gray, partly silty and carbonaceous, trace dark brownish-gray, carbonaceous shale and very light gray bentonite, rare siderite nodules, scattered dark gray siltstone stringers, thin coals as above.
320-350	Sandstone: light gray, very fine to fine grained, subangular, bentonitic, silty, slightly carbonaceous, partly porous, with stringers of dark gray carbonaceous siltstone and lignite. Trace Claystone: medium to dark gray.

350-380	Sandstone: light to medium gray, fine to medium grained, partly very fine grained, subangular, medium sorted, calcareous and clayey, carbonaceous, white altered grains, slightly bentonitic, slightly iron stained; Claystone: medium to dark gray, silty.
380-410	Sandstone: light gray, "salt and pepper", medium grained, subangular, calcareous, carbonaceous, slightly bentonitic, trace siderite nodules, slightly porous; trace dark gray siltstone and dark brownish-gray, carbonaceous shale; Claystone: brown, hard, sideritic, trace siderite nodules.
410-440	Sandstone: as above with light brown sideritic hard claystone and lignite.
440-500	Sandstone, shale and coal interbedded; Sandstone: light gray, partly "salt and pepper", very fine to fine grained, subangular, calcareous, carbonaceous, light and dark chert grains, slightly porous, occasional black chert granule; Coal: lignite; Shale: very dark gray to dark brownish-gray, silty, carbonaceous.
500-530	Sandstone: light gray, "salt and pepper", trace tan and dark chert grains, coal grains, medium grained, subangular, chert pebbles, calcareous, slightly porous, with Shale: dark brownish-gray to gray-brown, coal stringer; no fluorescence or cut.
530-560	Gravel and sandstone; Gravel: predominantly dark gray rounded chert pebbles with silty sandstone matrix; Sandstone: light to medium gray, fine grained, subangular, poorly sorted, conglomeratic with rounded chert pebbles, slight porosity, silty, clayey; no fluorescence or cut; trace shale and coal as above.
560-590	Gravel and sandstone as above; trace Claystone: medium gray, micaceous.
590-680	Siltstone: samples predominantly loose gravel; Siltstone: light gray, micaceous, soft, chert pebbles, carbonaceous sandstone stringers, trace dark gray shale and coal, black; trace claystone, rare trace very light gray bentonite.
680-710	Sandstone: light gray, partly varicolored, fine grained, subangular, poorly sorted, conglomeratic, clayey; no fluorescence or cut; Shale: dark gray to dark gray-brown, carbonaceous, lignite stringers.
710-800	Siltstone: medium gray, carbonaceous, soft, chert pebbles interbedded with Sandstone: tan, light gray,

	fine grained, subangular, silty, partly conglomeratic, slightly calcareous; and Shale: medium gray, carbonaceous; trace Claystone: light to medium gray and lignite black.
800- 890	Siltstone: medium to light gray, clayey, soft, carbonaceous, sandstone laminae, shale stringers, chert pebbles common, trace Shale: light to dark gray, carbonaceous, coal stringers.
890- 910	Sandstone: light gray, "salt and pepper", fine to medium grained, subangular, poorly sorted, calcareous, clayey, conglomeratic, occasional tan grains, coal and dark chert grains, slight porosity; no show; trace Siltstone: as above.
910-1030	Interbedded sandstone, shale and siltstone; Sandstone: light gray, "salt and pepper", fine to medium grained, subangular, poorly sorted, conglomeratic, clayey, partly calcareous, shaly in part; no shows; Siltstone: light to dark gray, sandstone and shale laminations, carbonaceous, chert pebbles; Shale and Claystone: light to medium gray, partly silty, sandstone stringers.
1030-1060	Gravel: unconsolidated, light and dark rounded chert pebbles, trace "salt and pepper" sandstone, appears to be thin stringers, appears silty and clayey, some Siltstone: light gray, soft, and Shale: medium to dark gray, and Claystone: light gray, rare trace white bentonite.
1060-1120	Gravel: as above with Sandstone: light gray to "salt and pepper", fine to medium grained, conglomeratic, subangular, poorly sorted, calcareous, partly carbonaceous, slightly porous, trace very fine grained, silty, calcareous sandstone; no shows; trace Siltstone: gray, carbonaceous, clayey, and Coal: brownish-black.
1120-1210	Sandstone: light to medium gray, very fine to medium grained, appears thin bedded, partly conglomeratic, subangular, medium to poorly sorted, calcareous, clayey, occasional siltstone inclusions, slightly porous streaks; no show, thin interbedded Siltstone: medium gray, clayey, slightly micaceous, occasional shale partings.
1210-1330	Thin interbedded sandstones, siltstones, and shales; Sandstone: light to medium gray, very fine to medium grained, thin beds, partly conglomeratic, occasionally calcareous, clayey, tight; no shows; Siltstone: medium to light gray, trace dark gray, micaceous, shale partings, partly sandy; and Shale: medium to dark gray, carbonaceous, chert pebbles common.

1330-1360	Sandstone: light gray, "salt and pepper", medium grained, poorly sorted, conglomeratic, silty, clayey, very calcareous streaks, siltstone stringers, very slight porosity; no shows; trace gray micaceous siltstone and very fine grained sandstone.
1360-1480	Siltstone: medium to light gray, sandy, clayey, micaceous, shale partings, scattered chert pebbles and coal inclusions; thin light gray, very fine to fine grained conglomeratic sandstone stringers and beds; trace very light gray bentonite.
1480-1510	Sandstone: medium gray, fine grained, subangular, silty, clayey, calcareous streaks, bentonitic streaks, soft, interlaminated siltstone and shale, slightly porous streaks; no show; trace siltstone and Shale: as above.
1510-1560	Sandstone: as above.
1560-1620	Siltstone: medium to light gray, trace gray-brown, micaceous, carbonaceous flakes, sandy, sandstone, soft shale and claystone laminations, scattered dark chert pebbles, coal inclusions.
1620-1680	Shale: medium gray, partly gray-brown, silty, slightly micaceous, siltstone and sandstone laminations, scattered chert pebbles, rare limestone nodule, interbedded Siltstone: as above; trace light gray, very fine grained, calcareous sandstone, thin light gray bentonite stringers.
1680-1710	Sandstone: light gray, fine grained, subangular, calcareous, bentonitic, rare pebbles; with interbedded Siltstone: medium gray, sandy, micaceous shale laminations; and Shale: medium to dark gray, partly claystone, carbonaceous, siltstone laminations, trace very light gray bentonite.
1710-1800	Siltstone: medium gray, sandy, shale partings, partly micaceous, soft, chert pebbles common, thin interbedded Shale: medium gray, micaceous, partly flaky, trace medium gray, very fine grained silty sandstone.
1800-1830	Sandstone: medium gray, very fine grained, subangular, very silty, micaceous, carbonaceous flakes, chert pebbles common, tight, no show.
1830-1920	Siltstone: medium to light gray, partly sandy, micaceous, carbonaceous, shale stringers, trace bentonite, thin bentonite bed, very light gray in 1890-1920' sample; thin light gray, very fine grained, conglomeratic sandstone beds; trace medium gray shale.

1920-1980	Shale: dark brownish-gray to gray-brown, siltstone and sandstone laminations with interbedded Siltstone: gray-brown, carbonaceous; and Sandstone: fine to medium grained, subangular, partly conglomeratic, calcareous; trace gravel, varicolored chert pebbles with silt and clay matrix.
1980-2010	Sandstone: light gray to gray-brown, very fine to fine grained, subangular, poorly sorted, slightly conglomeratic, shale partings partly calcareous, interbedded Shale: medium gray, slight porosity; no shows.
2010-2040	Siltstone: medium gray, brown with interbedded Sandstone: light brown, very fine to fine grained, subangular, conglomeratic, slightly calcareous; thin gravel bed, chert pebbles with silt and clay matrix.
2040-2070	Sandstone: medium to light brown, fine to medium grained, conglomeratic, subangular, poorly sorted, chert pebbles, coal chips and siltstone inclusions, brown grains common, silty, calcareous, streaks very calcareous, streaks with fair porosity; no shows; trace medium gray siltstone.
2070-2130	Sandstone: light to medium gray, trace gray-brown, very fine to fine grained, subangular, poorly sorted, silty, calcareous, scattered pebbles, very slight porosity; no shows; with interbedded Siltstone: medium gray, micaceous, shale partings, chert pebbles; and Shale: medium gray, partly silty, carbonaceous, trace coal stringers.
2130-2250	Siltstone: medium gray, micaceous, sandy, scattered siderite nodules, interbedded with Shale: medium dark gray, partly carbonaceous and Sandstone: light gray, "salt and pepper", very fine to medium grained, partly conglomeratic, thin beds, rare coal stringer 2220-2250'.
2250-2310	Sandstone: "salt and pepper", light gray, fine to medium grained, subangular, poorly sorted, conglomeratic, chert and quartz pebbles, silty, slightly clayey, scattered coal grains and inclusions, rare siltstone stringers and siderite nodules, friable, fair to good porosity; no shows; trace light gray siltstone.
2310-2340	Sandstone: light gray, "salt and pepper", medium grained, subangular, poorly sorted, conglomeratic, chert pebbles and coal chips, siltstone inclusions, silty, slightly clayey, friable; no shows; Siltstone: light gray, soft, sandy, slightly micaceous.

2340-2370	Sandstone: as above, scattered coal stringers and siderite nodules; Shale: medium gray to light brown, micaceous.
2370-2400	Shale: medium gray, silty, carbonaceous, with interbedded Siltstone: medium gray, sandy, clayey, and Sandstone: light gray, "salt and pepper", fine grained, subangular, chert pebbles and inclusions, partly calcareous; no shows.

calcareous; no shows.

and disrupted beds. Some pelecypod, scaphopods present, common below 2645', no odor, stain, cut or fluorescence.

2662-2670 Shale: as in Core No. 1.

2670-2700 Sandstone: light gray, fine grained, subangular, poorly sorted, conglomeratic, silty, tuffaceous, coal chips, slightly porous; no shows; minor siltstone: medium gray, micaceous, shale laminations.

2700-2730 Sandstone: light to medium gray, fine grained, subangular, conglomeratic, silty, partly calcareous, partly hard and sideritic; no shows; with interbedded Shale: medium gray, micaceous, lignite stringer, black.

2730-2790 Shale: medium gray, partly claystone, micaceous, siltstone laminae and thin beds, medium gray, micaceous, interbedded Sandstone: light gray, very fine to fine grained, partly silty and carbonaceous, partly tuffaceous.

2790-2850 Sandstone: light gray, "salt and pepper", fine grained, subangular, poor to medium sorted, partly conglomeratic, micaceous, carbonaceous, tuffaceous, very slight porosity; no fluorescence or cut; slight gas kick.

2850-2880 Shale: medium gray, micaceous, siderite nodules, coal chips, thin, medium gray, micaceous, slightly sandy siltstone.

2880-2940 Sandstone: light gray, slightly "salt and pepper", fine grained, subangular, medium sorted, silty, clayey, carbonaceous, trace micaceous, siltstone and shale stringers; trace Shale: as above and Siltstone: medium gray, slightly micaceous, sandstone stringers.

2940-3072 Shale: medium gray, partly silty, carbonaceous, scattered chert pebbles, interbedded Siltstone: medium gray, clayey, shale laminations, trace pyrite, scattered coarse grains and granules.

3072-3082 Core No. 2, Cut 10', Recovered 10'.

3072.0-3082.0 (10.0') Clay Shale: dark gray to black, micaceous, highly carbonaceous, firm, some soft beds of 1/2" thick, parts easily along laminations, occasional well rounded granules of dark mineral grains to 1 cm in diameter, grades downward into silty

Shale: medium gray, moderately hard, cross-laminated, some tan clay rip-up clasts, occasional very fine sand grains, grades downward into Sandstone: medium gray, very fine grained, well sorted, subangular to subrounded, quartz and dark mineral grains, noncalcareous, well indurated, firm to moderately friable, very slightly glauconitic, core breaks along irregular fractures on bedding planes, scaphopods present, especially in lower portion, no odor, stain, cut or fluorescence.

3082-3130	Siltstone: medium gray, slightly calcareous, shale laminations, interbedded Sandstone: light gray, very fine and fine grained, subangular, silty, calcareous, tuffaceous; trace medium and dark gray, fissile shale.
3130-3190	Siltstone: medium to light gray, slightly micaceous and carbonaceous, shale and sandstone laminations, interbedded Shale: medium gray, slightly carbonaceous, micaceous, sandstone and siltstone laminations.
3190-3220	Shale: medium gray, micaceous, siltstone laminations, interbedded Sandstone: light gray, very fine to fine grained, subangular, very silty, partly tuffaceous, soft, slightly carbonaceous, fossil fragments.
3220-3310	Siltstone: medium to light gray, micaceous, tuffaceous, trace pyrite, sandstone and shale laminations, shell fragments and foraminifera, interbedded Shale: medium dark and dark gray, micromicaceous, scattered pyrite nodules.
3310-3340	Sandstone: light to medium gray, very fine to fine grained, subangular, very silty, micaceous, carbonaceous, clayey, porous, friable streaks; no shows; shale and Siltstone: as above.
3340-3370	Shale: medium dark gray, micromicaceous, very slightly carbonaceous; Sandstone: as above.
3370-3490	Shale: as above, with scattered pyrite nodules and chert pebbles; trace fossil fragments and foraminifera.
3490-3520	Siltstone: light to medium gray, micaceous, scattered chert and quartz granules and pebbles, trace sandstone and shale stringers.

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46.

3520-3640	Shale: dark gray, partly silty, micaceous, siltstone laminations, slightly carbonaceous, with rare chert and quartz pebbles and pyrite inclusions, thin interbedded Siltstone: medium to dark gray, micaceous, slightly carbonaceous, sandstone laminations.
3640-3880	Shale: medium gray, trace dark gray, partly silty, siltstone and sandstone laminations, scattered chert pebbles, very coarse sand grains and granules 3670-3700', rare fossils, crinoid.
3880-3910	Sandstone: light gray, very fine grained, subangular, silty, micaceous, calcareous, hard, slightly carbonaceous, interbedded Shale: as above and Siltstone: medium gray.
3910-4030	Siltstone: light to dark gray, partly sandy, trace pyritic, micaceous, rare shell fragments; interbedded Shale: medium to dark gray, micaceous, sandstone and siltstone laminations, pyrite inclusions, trace chert pebbles and loose sand grains.
4030-4206	Shale: dark gray, fissile, micromicaceous, slightly carbonaceous, rare pyrite and siderite nodules, siltstone laminations.
4206-4216	Core No. 3, Cut 10', Recovered 10'.
4206.0-4216.0 (10.0')	Clay Shale: medium dark gray to dark gray, firm, fissile, very thinly laminated, parts easily along lamination, micromicaceous, highly carbonaceous, occasional granules of well rounded dark rock fragments, marcasite replacement of worm borings and trails, borings to 1/2" in diameter to more than 4" in length, trace of very thin laminations of very fine sandstone to siltstone, pelecypod noted at 4208', no odor, stain, cut or fluorescence.
4216-4290	Shale: dark gray, slightly micaceous, partly silty, occasional siltstone and sandstone laminations, slightly carbonaceous, scattered pyrite inclusions, quartz and chert granules, trace fossil fragments and foraminifera.
4290-4380	Shale: as above, increasing sandstone, trace coal.
4380-4440	Shale: as above, with thin interbedded Sandstone: medium gray, fine grained, subangular, silty, micaceous, carbonaceous, thin coal stringers, black, lignite to subbituminous.

4440-4530 Shale: dark gray, micromicaceous, carbonaceous, scattered quartz and chert granules, siltstone and sandstone laminations; interbedded Sandstone: medium to light gray, fine grained, subangular, silty, carbonaceous, trace thin coal partings; no shows.

4530-4660 Siltstone: medium gray, micaceous, carbonaceous, occasionally with thin coal partings, shale laminations, interbedded Shale: as above; trace medium gray, fine grained carbonaceous sandstone.

4660-4720 Shale: dark gray, pyrite inclusions, trace coal partings, sandstone and siltstone laminations, crinoid and fossil fragments.

4720-4930 Siltstone: medium gray, micaceous, carbonaceous, rare pyrite, sandstone and shale laminations; interbedded Shale: as above; scattered very coarse and coarse sand grains and granules.

4930-5000 Shale: dark gray, trace slightly brown, micaceous, carbonaceous, partly silty, siltstone and sandstone laminations, trace pyrite, scattered rounded quartz and chert granules.

5000-5010 Core No. 4, Cut 10', Recovered 10'.

5000.0-5010.0 (10.0') Clay Shale: dark gray to grayish-black, firm to moderately hard, well indurated, predominantly fissile, some blocky, highly carbonaceous, some visible plant remains, micromicaceous, especially along bedding planes, very slightly calcareous, interlaminated with Siltstone: medium gray to dark gray, hard to very hard, very well indurated, highly carbonaceous, micromicaceous, slightly calcareous, and minor interlaminated Sandstone: light gray, very hard, very well indurated, very fine grained to silt size, angular to subangular quartz and carbonaceous fragments, very calcareous, well cemented, one 4" sandstone bed at 5007', no odor, stain, cut or fluorescence, horizontal bedding is predominant, abundant slump structures, disrupted bedding, bioturbation, some recumbent folds to 4" thick, some zones appear highly organic rich, numerous marcasite replacement of worm borings.

5010-5410	Clay Shale: medium gray to dark gray and grayish-black, firm to hard, well indurated, fissile, carbonaceous, micromicaceous, very slightly calcareous, interlaminated Siltstone: medium gray to dark gray, hard, well indurated carbonaceous, micromicaceous and minor interlaminated Sandstone: light gray, hard, well indurated, very fine grained to silt size, angular to subangular, calcareous, very well cemented, marcasite replacement of worm borings.
5410-5950	Shale: very dark to dark gray, micromicaceous, fissile to slightly blocky, slightly carbonaceous, partly silty with interlaminated Siltstone: light to dark gray, micacaceous, slightly carbonaceous, and Sandstone: light gray, very fine grained, subangular, partly tuffaceous, slightly carbonaceous, micaceous, occasional pyrite inclusion, trace Inoceramus and forams 5790-5810'.
5950-6350	Shale: very dark gray with dark gray and occasional brownish streaks, micromicaceous, fissile, very slightly carbonaceous, brown streaks are very slightly calcareous and chips disintegrate in hydrochloric acid. Siltstone laminations are common and average 15 to 30% of the samples. Occasional sandstone laminations are present. Inoceramus and pyrite inclusions are moderately common. Rare light and dark chert granules are present.
6350-6850	Shale: dark gray to gray-brown, fissile, micromicaceous, slightly carbonaceous, partly susceptible to liquid, increasing sandstone (5-15%) and siltstone (15-25%) laminations, Sandstone: light gray, gray, very fine grained with occasional fine grained streaks, silty, micaceous, clayey, very slightly calcareous, carbonaceous, rare glauconite, Siltstone: gray to gray-brown, micaceous, slightly carbonaceous, pyrite inclusions, Inoceramus prisms, occasional light and dark chert granules. Increasing sandstone and siltstone 6770-6850'.
6850-6880	Sandstone: light gray, gray, very fine to fine grained, subangular, micaceous, carbonaceous, silty, calcareous, occasional streaks very carbonaceous sandstone equals 35-40%; with interbedded Siltstone: gray, dark gray, micaceous, carbonaceous slightly calcareous, and Shale: very dark and dark gray, trace brownish-gray, micromicaceous, slightly carbonaceous, trace pyrite and Inoceramus prisms.
6880-6900	Sandstone: as above, with thin Siltstone and Shale: stringers, as above, slight porosity (05%), trace white calcite veins.

6900-7054	Shale: very dark gray, dark gray, micromicaceous, slightly carbonaceous, with interlaminated sandstone and siltstone, occasional pyrite inclusion and Inoceramus prisms, rare chert granules.
7054-7064	Core No. 5, Cut 10', Recovered 10'.
7054.0-7064.0 (10.0')	Shale: gray-brown, fissile, slightly micromicaceous, fine rounded pyrite pellets and pyrite replacing carbonaceous material with dark brownish-gray, slightly silty, micaceous, carbonaceous stringers in upper 6'. Occasional very thin siltstone partings and inclusions in lower 4', scattered fish fragments and echinoids (?)
7064-7125	Shale: dark gray-brown to gray-brown, micromicaceous, fissile, very slightly carbonaceous, partly silty with interlaminated and thin bedded sandstone and siltstone.
7125-7175	Sandstone: light gray, gray, very fine to fine grained, subangular to subrounded, calcareous, clayey, silty streaks, carbonaceous, slightly micaceous with thin interbedded siltstone and shale, estimated 08% porosity, 80 units of gas, no fluorescence or cut.
7175-7520	Shale: very dark gray, dark gray, micromicaceous, slightly carbonaceous, fissile with interlaminated and thin interbedded Sandstone: light gray, gray, subangular, clayey, very fine to fine grained, and Siltstone: gray, dark gray, micaceous, slightly carbonaceous, pyrite inclusions, Inoceramus prisms, occasional white calcite veins.
7520-7570	Shale: very dark to dark gray, micromicaceous, slightly carbonaceous, rare shell fragments and Inoceramus prisms, trace pyrite inclusions, interlaminated siltstone.
7570-7590	Siltstone: medium to dark gray, micaceous, slightly carbonaceous, with sandstone and shale laminae, scattered pyrite inclusions.
7590-7605	Shale: very dark gray, as above.
7605-7650	Siltstone: dark gray, gray, micaceous, carbonaceous, slightly calcareous, with interbedded sandstone and shale.
7650-7656	Sandstone: light gray, gray, very fine to fine grained, micaceous, carbonaceous, calcareous, 82 units gas, no fluorescence or cut.

7656-7676	Interbedded Siltstone and Shale: as above.
7676-7687	Sandstone: light gray, gray, very fine to fine grained, subangular to subrounded, carbonaceous, micaceous, calcareous, silty and clayey in part, no show, 62 units gas, rare fossil fragments, rare very coarse rounded chert grains.
7687-7707	Shale: very dark gray, micromicaceous, slightly carbonaceous, and Siltstone: gray, dark gray, micaceous, carbonaceous, interbedded.
7707-7712	Sandstone: light gray, gray, very fine to fine grained, subangular to subrounded, carbonaceous, micaceous, calcareous, silty and clayey in part, no show.
7712-7718	Shale: very dark gray, micromicaceous, carbonaceous, slightly calcareous.
7718-7727	Siltstone: gray, dark gray, micaceous, carbonaceous, slightly calcareous, sandstone laminae.
7727-7742	Shale: very dark gray, micromicaceous, Inoceramus prisms.
7742-7755	Siltstone: gray, dark gray, micaceous, with light gray sandstone stringer.
7755-7802	Shale: very dark gray, micromicaceous, carbonaceous, fissile, with sandstone and siltstone laminae, pyrite inclusions, Inoceramus prisms.
7802-7808	Sandstone: light gray, gray, very fine to fine grained, subangular, carbonaceous, slightly calcareous, micaceous.
7808-7852	Shale: very dark gray, fissile, carbonaceous, micromicaceous, with interbedded sandstone and siltstone, pyrite inclusions, trace Inoceramus prisms.
7852-7866	Siltstone: gray, light gray, micaceous, carbonaceous, calcareous, with shale and sandstone laminae.
7866-7892	Sandstone: light gray, gray, very fine to fine grained, subangular, carbonaceous, calcareous, slightly micaceous, slightly siliceous, silty with shale and siltstone laminae, 210 units gas, no fluorescence or cut.
7892-7946	Shale: very dark gray, dark gray, micromicaceous, slightly carbonaceous, slightly calcareous, with thin interbedded sandstone and siltstone, pyrite inclusions and banding, occasional coal parting.

7946-7970	Sandstone: light gray, gray, very fine to fine grained, subangular, clayey, partly silty, thin bedded, carbonaceous, calcareous, 0-8% porosity, 460 units gas, no fluorescence or cut.
7970-7985	Siltstone: dark and very dark gray, micaceous, carbonaceous, shale and sandstone laminae, streak blackish-gray shale, siliceous, Inoceramus prisms.
7985-8005	Sandstone: light gray, gray, very fine to fine grained, subangular, carbonaceous, calcareous, silty, with shale and siltstone laminae, 0-5% porosity, no show.
8005-8158	Thin interbedded sandstone, siltstone and shale, appears to be beds 1' to 8' in thickness. Sandstone: light gray, gray, very fine to fine grained, carbonaceous, calcareous, partly clayey, slightly micaceous, slightly conglomeratic with light gray to black rounded chert granules, rare calcite vein, Shale: dark and very dark gray, blackish-gray, hard, siliceous streaks, micromicaceous, slightly carbonaceous, Siltstone: gray and dark gray, trace brownish-gray, micaceous, carbonaceous, slightly calcareous.
8158-8188	Sandstone: light gray, gray, very fine to fine grained, slightly conglomeratic, silty, carbonaceous, slightly calcareous, limy streak, trace micaceous, siltstone and shale laminae, 100 units gas, no fluorescence or cut.
8188-8210	Shale: very dark gray, micromicaceous, slightly carbonaceous, with siltstone stringers.
8210-8240	Core No. 6, Cut 30', Recovered 30'.
8210.0-8240.0 (30.0')	Sandstone: gray, light gray, very fine grained with fine grained streaks, subangular, silty, carbonaceous, micaceous, calcareous, rare glauconite, partly clayey, no shows, thin dark gray shale beds at 8211-8212' and 8218-8219', thin siltstone beds at 8219-8220', 8222-8223' and 8239.5-8240'.
8240-8250	Siltstone: gray, dark gray, micaceous, carbonaceous, slightly calcareous.
8250-8275	Sandstone: light gray, thin bedded, as above, Siltstone: gray, as above, and Shale: very dark gray, carbonaceous, micromicaceous, partly silty.
8275-8292	Siltstone: gray, dark gray, carbonaceous, micaceous, partly calcareous, partly shaly, with thin shale and sandstone stringers.

8292-8310	Shale: very dark gray, carbonaceous, micromicaceous, partly silty with thin siltstone stringers.
8310-8350	Sandstone: light gray, "salt and pepper", fine and very fine grained, subangular, partly with white clay filling, silty, shale stringers; interbedded Shale: dark gray, silty, micaceous, siltstone laminations.
8350-8400	Siltstone: light gray, sandy, carbonaceous, calcareous, sandstone and shale laminations; interbedded Shale: dark gray, fissile, silty.
8400-8500	Shale: dark gray, fissile to platy, silty, partly pyritic, sandstone and siltstone laminae; trace Sandstone: light gray, very fine grained, subrounded, silty, calcareous.
8500-8510	Sandstone: light gray, "salt and pepper", very fine grained, subrounded, very silty, calcareous, glauconite grains, shale laminae.
8510-8580	Interbedded sandstone and shale; Sandstone: light gray, very fine grained, subrounded, silty, clayey, calcareous, moderately friable; no shows; Shale: dark gray, micaceous, trace pyrite.
8580-8710	Interbedded sandstone, siltstone and shale; Sandstone: light gray, "salt and pepper", very fine grained, trace medium grained, subangular, medium sorted, silty, calcareous, trace glauconite; Siltstone: light gray, "salt and pepper", micaceous, calcareous; Shale: dark to very dark gray, fissile, micaceous, slightly calcareous in part.
8710-8740	Interbedded shale and sandstone; Shale: dark gray, fissile, silty; Sandstone: light gray, "salt and pepper", medium to fine grained, subrounded to subangular, carbonaceous, calcareous, slightly porous, gas shows; no fluorescence or cut.
8740-8800	Interbedded sandstone and shale; Sandstone: light gray, "salt and pepper", fine grained, subrounded to subangular, carbonaceous, calcareous, friable, slight porosity, gas shows; Shale: dark gray, fissile, silty, micaceous.
8800-8842	Siltstone: light gray, "salt and pepper", sandy, carbonaceous, pyritic; sandstone and Shale: as above.
8842-8852	Core No. 7, Cut 10', Recovered 10'.
8842.0-8852.0 (10.0')	Siltstone: dark gray, sandy, argillaceous, carbonaceous, well indurated, with finely disseminated

mica and pyritized worm bores, with interbedded Shale: dark gray, fissile, firm with finely disseminated mica, pyritized worm tubes.

8852-8855 Siltstone: as above.

8855-8915 Sandstone: light gray, "salt and pepper", very fine grained, subrounded to subangular, medium sorted, silty, firm, calcareous, becomes unconsolidated in part, poor to apparently good porosity, loose tar globs, with fast streaming cut; no stain in matrix, 1,800 units gas at 8860'; trace coal, dark gray fissile shale interbed.

8915-8950 Shale: dark gray, fissile, silty, pyritic, siltstone stringer.

8950-9070 Sandstone: as above, 3,560 units gas at 8975'; 1,270 units at 9050'; interbedded Shale: dark gray, as above.

9070-9175 Sandstone: as above, with interbedded Shale: dark gray, fine disseminated mica, pyrite inclusions, 2,000 units gas at 9125'.

9175-9338 Shale: dark gray-brown, black, fissile to occasional splintery, finely disseminated mica, pyrite inclusions, trace coal, (9200-9210'), moderately indurated, with rare quartz pebbles, and coarse grains, frosted, rounded, rare fossil fragments.

9338-9348 Core No. 8, Cut 10', Recovered 10'.

9338.0-9348.0 (10.0') Shale: dark gray to black, silty, subfissile to fissile, well indurated, finely disseminated mica, pyrite inclusions with very thin laminations of Siltstone: light to medium gray-brown, argillaceous, very well indurated, brittle, with rare pelecypods.

9348-9448 Shale: silty, as above, with thin Sandstone, light gray, "salt and pepper", very fine grained, moderately well sorted, subrounded to subangular, moderately indurated, calcite cement, nil visible porosity, no show (total gas: 1,875 units from 9408-9416').

9448-9458 Core No. 9, Cut 10', Recovered 10'.

9448.0-9458.0 (10.0') Shale: dark gray to black, fissile, well indurated, silty, grades to siltstone in part, finely disseminated

mica, pyritized worm burrows, rare to moderately common scaphopods and pelecypods in top, decrease towards base.

9,458- 9,760 Shale: as above, silty, grades to siltstone in part, with rare quartz pebbles, amber to frosted to clear.

9,760-10,295 Shale: dark gray-brown, fissile to platy, smooth to silty, moderately well indurated, pyrite inclusions, rare quartz pebbles, as above, and rare chert pebbles, black, gray, green, amber, thin interbedded siltstone zones occur throughout this interval; trace glauconite in lower 40'.

10,295-10,305 Core No. 10, Cut 10', Recovered 10'.

10,295.0-10,305.0 (10.0') Shale: dark gray-brown to black, fissile to platy, finely disseminated mica, pyritized worm burrows and inclusions, rare carbonaceous fragments, rare pelecypod fragments, moderate to well indurated, trace of glauconite pellets, very hard, brittle, siliceous in part.

10,305-10,332 Shale: as above, becomes very silty towards base.

10,332-10,452 Sandstone: gray-brown, argillaceous, very fine grained to silty, grades to siltstone, "salt and pepper", fair to moderately well sorted, subrounded, slightly calcareous, rare glauconite pellets, firm, nil visible porosity (total gas: 1,000 units), with interbedded Shale: as above, sandstone contains finely disseminated mica and trace of chert pebbles.

10,452-10,890 Siltstone: gray-brown, sandy, argillaceous, "salt and pepper", finely disseminated mica, rare glauconite pellets, slightly calcareous, friable to moderately well indurated, grades to silty sandstone in part, with interbedded Shale: dark gray-brown to black, becomes smooth, blocky, very well indurated, brittle, siliceous, pyrite inclusions (fossil casts), finely disseminated mica, trace chert pebbles.

10,890-10,998 Shale: dark gray-brown, platy to blocky, fine disseminated mica, common pyrite, firm, silty in part; interbedded Siltstone: as above.

10,998-11,008 Core No. 11, Cut 10', Recovered 10'.

10,998.0-11,008.0 (10.0') Shale: dark gray- brown, fissile to platy, finely disseminated mica,

rare to common pyritized worm burrows, rare pelecypods, smooth to slightly silty, moderately indurated, rare organic fragments.

11,008-11,300 Shale: as above, with interbedded Siltstone: dark gray, pyrite inclusions, moderately indurated, trace of fossil prisms and common chert pebbles.

11,300-11,704 Shale: dark gray-brown, occasionally medium gray, platy to some splintery, finely disseminated mica, pyritized fossil casts, trace Inoceramus prisms, smooth to silty, moderately indurated, with rare chert pebbles, rare green glauconite pellets, trace of siderite concretions, overpressured.

11,704-11,714 Core No. 12, Cut 10', Recovered 10'.

11,704.0-11,714.0 (10.0') Shale: dark gray-brown, very finely laminated, "poker chip", very fine sparsely disseminated mica, fissile to platy, scattered organic material along laminations, moderate to poorly indurated, rare pelecypod, rare pyritized worm burrows.

11,714-11,820 Shale: as above, with thin streaks of Siltstone: dark gray-brown, very argillaceous, with green glauconite pellets.

11,820-11,860 Siltstone: dark gray-brown, very argillaceous, grades to shale, with green glauconite pellets, black, shiny calcite prisms with interbedded Shale: as above.

11,860-11,910 Shale: as above.

11,910-12,175 Shale: as above, very finely laminated, very fissile to splintery, with black shiny carbonaceous material along laminations, soft, smooth with finely disseminated mica, trace fossil prisms, becomes silty towards base with pyrite (overpressured).

12,175-12,197 Siltstone: dark gray-brown, argillaceous, sandy in part, abundant green glauconite pellets, finely disseminated mica, some shell fragments, calcareous, soft to moderate induration.

12,197-12,209 Shale: as above, silty.

12,209-12,230 Siltstone: as above.

12,230-12,273 Shale: very limy, gray-brown, silty, moderately soft, grades to Limestone: calcilutitic, gray-brown, argillaceous, silty, poor to moderately indurated, pelletal in part, becomes dense and blocky in part.

12,273-12,283 Core No. 13, Cut 10', Recovered 9.5'.

12,273.0-12,282.5 (9.5') Limestone: calcilutite composed of very thin irregular (varved effect) bands of Limestone: gray-brown, finely crystalline, very hard and dense with 50% pelecypod fragment (Monotis sp. and Halobia sp.), well preserved, and Limestone: black to dark gray-brown, very argillaceous (50% shale), very thinly laminated, breaks into thin slabs with each slab containing an almost coquinoid assemblage of well preserved Monotis sp. and Halobia sp.

12,282.5-12,283.0 (0.5') No recovery.

12,283-12,370 Limestone: dark gray-black, hard, brittle, very argillaceous, grading to very calcareous shale and siltstone, limestone decreases downward, abundant cement contamination.

12,370-12,415 Siltstone: dark gray and brownish-black, hard, well indurated, dark gray to black, very calcareous, and Limestone: dark gray, silty, very argillaceous, fossiliferous, Monotis sp. and Halobia sp. fragments, pyrite as crystalline aggregates and amorphous interlaminations, limestone decreases downward, shale and siltstone increase.

12,415-12,425 Sandstone: light gray to buff, very fine grained, subangular quartz, firm, micaceous, tight.

12,425-12,500 Siltstone, shale and limestone, as from 12,370-12,415', some small aggregates of phosphate pellets.

12,500-12,530 Core No. 14, Cut 30', Recovered 29'.

12,500.0-12,529.0 (29.0') Shale: dark gray to black, hard, very well indurated, silty, very slightly sandy in part, micro-micaceous, very slightly calcareous, few small-scale ripple cross-laminations, slightly carbonaceous in

part, rare pyritized worm borings 1/4" in diameter, rare carbonaceous material, abundant small-scale irregular fractures, small pelecypod at 12,523', core bleeding gas from some fractures.

12,529.0-12,530.0 (1.0') No recovery.

12,530-12,600 Shale: as above, becoming silty and calcareous.

12,600-12,683 Sandstone: light gray to medium brown, very fine grained, subangular to subrounded, noncalcareous to very calcareous, becoming siliceous and hard in lower part, with interbedded Siltstone: very dark gray-brown, black, hard, well indurated, and Shale: dark gray-black, hard, silty, partly calcareous, micromicaceous; minor brownish-black limestone.

12,683-12,700 Sandstone: tan to medium brown, very fine grained quartz, subangular to subrounded, well sorted, silica cemented, very hard, quartzitic, tight, noncalcareous, minor buff Sandstone: very fine grained, subangular to subrounded, moderately sorted, slightly calcareous, difficultly friable to friable, buff sandstone increases downward, no odor, stain, cut or fluorescence, 135 units of gas at 12,698'.

12,700-12,705 Sandstone: as above, and Shale: medium gray to dark gray, hard, very well indurated, noncalcareous.

12,705-12,735 Core No. 15, Cut 30', Recovered 30'.

12,705.0-12,735.0 (30.0') Sandstone and interlaminated to interbedded sandstone and shale, Sandstone: tan to medium gray, very fine grained, subangular to subrounded, silica cemented, quartzitic, tight, noncalcareous, beds 1-6' thick, possible high angle crossbeds (foreset beds?), some iron stained fracture planes, sandstone and shale sequence is in laminations and beds to 2" thick predominantly 1/4-1/2", Sandstone: as above, Shale: dark gray-black, very hard, very well indurated, blocky, noncalcareous, sandstone and shale sequence is bioturbated, has ripple cross-laminations, load casts, rip-up clasts, disrupted bedding and flame

structures, minor pyritized worm borings, by calculation, core is 70% sandstone, 30% shale, no odor, stain, cut or fluorescence.

12,735-12,820 Sandstone: as above, and minor shaly Siltstone: dark gray and brownish-gray, noncalcareous, hard, trace of varicolored well rounded chert pebbles and trace of red shale.

12,820-12,830 Sandstone: as above, with interbedded Siltstone: dark gray to black, sandy, dirty, noncalcareous, grading to silty sandstone; dark gray Shale: as above.

12,830-12,930 Shale: as above, with Sandstone: light to medium gray, very fine grained, subangular to subrounded, poorly sorted, clay filled, quartz and dark mineral fragments, hard to firm, trace of varicolored well rounded chert pebbles, trace of red shale, relative amounts of constituents variable.

12,930-13,200 Sandstone: light gray to tan, quartzitic, as above, Sandstone: dark gray, silty, as above, and minor Shale: medium gray, as above, and Sandstone: very light gray to white, lightly speckled, fine to medium grained, rounded to subrounded quartz and dark rock fragments, clay filled, firm to hard, well indurated, silica cemented, noncalcareous to very slightly calcareous, tight, becoming very slightly porous downward, becomes slightly friable downward, relative amounts of constituents variable.

13,200-13,350 Sandstone: as above, with increasing amounts of shale and brown to very dark gray, sandy to shaly siltstone, some pyrite and quartz pebbles.

13,350-13,355 Sandstone: as above.

13,355-13,480 Siltstone: gray to dark gray, trace brownish-gray, argillaceous to shaly, micaceous, partly siliceous, carbonaceous, with thin interbedded and interlaminated Sandstone: white to dark gray, very fine grained, subangular, shaly to quartzitic, partly silty and Shale: very dark gray, partly silty, micaceous, trace pyrite.

13,480-13,510 Core No. 16, Cut 30', Recovered 30'.

13,480.0-13,510.0 (30.0') Shale: very dark gray, micaceous, partly silty with occasional siltstone laminations and partings, sandstone in top 6" of core.

13,510-13,575	Thin interbedded and interlaminated Sandstone: white to gray, very fine to fine grained, subangular, siliceous, slightly carbonaceous, partly quartzitic, slightly "salt and pepper", slightly pyritic, with Siltstone: gray, dark gray, micaceous, partly silty, carbonaceous, and Shale: very dark and dark gray, micromicaceous, partly silty, hard, partly siliceous, pyrite inclusions.
13,575-13,590	Shale: dark and very dark gray, micromicaceous, partly fissile, slightly siliceous, occasional very carbonaceous streaks with sandstone and siltstone stringers.
13,590-13,670	Thin interbedded sandstone, siltstone and shale as those from 13,510-13,575'.
13,670-13,692	Siltstone: dark gray to very dark gray, shaly to siliceous with shale and sandstone laminations.
13,692-13,702	Sandstone: light to dark gray, fine to very fine grained, siliceous, partly carbonaceous, partly shaly, slightly porous streaks, gas show, no odor, cut or fluorescence.
13,702-13,709	Siltstone and Shale: dark and very dark gray.
13,709-13,714	Sandstone: as above.
13,714-13,753	Siltstone: gray and dark gray, carbonaceous, siliceous, interbedded with Shale: dark and very dark gray, siliceous, trace black with glauconite and Sandstone: light to dark gray, siliceous, partly carbonaceous, trace dark chert.
13,753-13,758	Sandstone: very light to dark gray, siliceous, fine to very fine grained, carbonaceous, rare glauconite, trace porosity, slight gas show, no cut or fluorescence.
13,758-13,768	Shale: very dark and dark gray, partly siliceous, glauconitic.
13,768-13,813	Siltstone: dark and very dark gray, siliceous, shaly, sandy, carbonaceous, trace dark argillaceous chert, micaceous, rare glauconite, quartzitic streaks with thin interbedded sandstones and shales.
13,813-13,817	Sandstone: very dark gray to light gray streaks, very fine to fine grained, subangular, siliceous.
13,817-13,831	Interbedded Siltstone, Shale and Sandstone: as above.

13,831-13,880 Core No. 17, Cut 49', Recovered 49'.

13,831.0-13,833.0 (2.0')	Shale: very dark gray, gray-black, micaceous, siliceous, silty, hard, occasional siltstone laminae, rare glauonite.
13,833.0-13,844.4 (11.4')	Siltstone: very dark gray, shaly, slightly sandy, very siliceous, hard, partly quartzitic, occasional irregular shale partings, shale stringer, 13,840.3-13,841', dark gray, very siliceous, small round elongate pyritized stems, 13,833-13,834', pyrite inclusions, 13-834-13,835', becoming dark brownish-gray, quartzitic, shaly stringers at 13,441.5'; fossil casts(?) partly coated with pyrite at 13,444'.
13,844.4-13,848.0 (3.6')	Shale: very dark gray, carbonaceous, siliceous, interbedded with Sandstone: very dark gray, very fine grained, silty, quartzitic, glauconitic and Siltstone: very dark gray, shaly, siliceous, partly quartzitic, scattered glauconite.
13,848.0-13,851.0 (3.0')	Siltstone: very dark gray, very siliceous, slightly calcareous, streaks with pyrite, slightly carbonaceous, rare fossil fragment.
13,851.0-13,880.0 (29.0')	Shale: very dark gray to black, carbonaceous, siliceous, silty, slightly calcareous, micromicaceous, trace small pyrite pellets and inclusions, scattered altered fossil fragments, and fossil casts, replaced by calcite and quartz and pyrite, some with appearance of pelecypods.

13,880-13,940 Shale: very dark gray, to black, carbonaceous, siliceous, silty, slightly calcareous, micromicaceous, fossiliferous, brachiopods and algae, siltstone and sandstone laminations.

13,940-13,992 Siltstone: very dark gray to medium gray, slightly carbonaceous, slightly dolomitic to very calcareous, pyrite inclusions, fossil fragments, thin interbedded shale.

13,992-13,995	Limestone: dark to medium gray, cryptocrystalline to very fine crystalline, fossil debris, silty, partly shaly, occasional fusulinid(?).
13,995-14,002	Siltstone: dark and medium gray, very calcareous, fossiliferous, micaceous, carbonaceous, sandstone and shale laminations.
14,002-14,005	Limestone: light gray and medium gray, bioclastic, silty, argillaceous, trace of light chert.

	and Siltstone: dark brown-gray to dark gray, calcareous, partly shaly, siliceous, micaceous, carbonaceous flakes, pyrite inclusions, brachiopod(?), fracture with slickensides at 14,051.7'.
14,052.7-14,062.0 (9.3')	Limestone: gray-brown, litho graphic to cryptocrystalline, fossil shadows, fine pyrite pellets, slightly siliceous, thin shale partings, highly fractured, breaks in tabular plates, possible slickensides, vertical fractures with calcite cement, lower part becomes bioclastic with algae, spicules and pelecypods(?).
14,062.0-14,066.0 (4.0')	Siltstone: light brown to brown-gray, limy, micaceous, shaly streaks, scattered carbonaceous grains, pelecypods(?).
14,066-14,070	Siltstone: as above.
14,070-14,080	Limestone: light brown to brown, cryptocrystalline to lithographic, slightly pyritic, recrystallized, indistinct fossil debris, trace argillaceous and carbonaceous flakes, very slightly siliceous, occasional pellet.
14,080-14,161	Siltstone: dark gray to light brown, micaceous, moderately to very calcareous, partly shaly, pyritic with thin interbedded Limestone: dark brown to buff, very silty, cryptocrystalline to very fine crystalline, fossil fragments, trace light gray chert, occasional pellets, shale laminae.
14,161-14,175	Limestone: light gray to dark brown, earthy to very fine crystalline to lithographic, argillaceous, silty, soft to hard, scattered pyrite crystals, occasional fossil fragment and pellets, possible weathered zone, questionable fracturing in lithographic zone, thin siltstone streaks, no cut or fluorescence, slight gas kick 40 units above background.
14,175-14,193	Siltstone: dark gray to tan, shaly to very limy, occasional fossil fragment, with interbedded Shale: dark gray to brown, silty, partly calcareous, thin Sandstone: very light gray, subangular, siliceous, occasional white grains, mica flakes and Limestone: light gray to buff, very fine crystalline to earthy, very silty.

14,193-14,216 Limestone: light gray to tan to dark gray, dark argillaceous pellets, oolites and fossil debris, fine to very coarse size, occasional streaks with 100% oolites with calcite cement, becoming earthy to very fine crystalline by recrystallization, becomes cryptocrystalline at base and argillaceous, trace of chert, scattered pyrite, rare foraminifera, trace algae material, trace white calcite, fracture fill(?), estimated 5-7% porosity due to recrystallization, no cut or fluorescence, 502 units gas, C_1 and C_2.

14,216-14,222 Siltstone and Shale: dark gray, trace tan, calcareous.

14,222-14,228 Limestone: as above, trace very light gray and clear chert.

14,228-14,233 Siltstone and Shale: as above.

14,233-14,242 Limestone: tan, light gray, dark gray-brown, chalky to lithographic, dark argillaceous pellets, occasional fossil shadow, slightly siliceous with fine elongated quartz crystals, trace light gray chert with pellets, scattered pyrite, calcite filled fractures, estimated 3% porosity, no stain.

14,242-14,250 Siltstone: dark gray to tan-gray, partly shaly, micaceous, partly siliceous and dolomitic, pyritic, fossil fragments, with Shale stringers: dark gray and Limestone: thin beds, dark gray and dark gray-brown, cryptocrystalline to lithographic, slightly siliceous, partly very hard and brittle, partly silty.

14,250-14,258 Limestone: light tan-gray to gray, recrystallized, very siliceous, silica crystals after calcite, occasional fossil shadow and pellets, trace gray brown chert, pyritic, argillaceous, trace fractures with calcite and quartz filling, rare trace dead oil.

14,258-14,279 Siltstone: as above, with Shale: dark gray, micaceous, slightly siliceous, trace pyrite, trace Sandstone: very light gray, very fine grained, siliceous.

14,279-14,293 Limestone: light gray-brown to gray-brown, siliceous, zone 14,282-14,286' nearly completely replaced by very fine silica crystals, thin light gray chert with pellets from 14,286-14,288', occasional fossil shadows and pellets.

14,293-14,303 Siltstone: dark gray to gray-brown, slightly calcareous, siliceous, micaceous, pyritic with Shale: very dark gray to gray-brown, silty, slightly calcareous.

14,303-14,315 Limestone: dark to light brown, lithographic, algal(?), grades to oolitic and fossiliferous Limestone: medium to coarse size, partly altered, thin bands with 100% oolites with calcite cement, trace light brown chert with pellet shadows, trace algae, rare foraminifera.

14,315-14,326 Siltstone: dark gray, shaly, micaceous, calcareous, rare fossil fragment, and Shale: very dark gray, partly silty, trace pyrite, altered fossil fragments, limestone stringers.

14,326-14,350 Limestone: light gray, buff to dark brown, chalky to cryptocrystalline, partly sucrosic, recrystallized, partly argillaceous, rare pellets, trace algae, fine scattered pyrite crystals, occasional stylolite, thin siltstone and shale stringers, estimated 3-5% porosity, no stain.

14,350-14,360 Limestone: buff to gray-brown, bioclastic, medium to very coarse size, algal debris, occasional pellet, partly recrystallized, stylolites, rare scattered pyrite, very light gray chert moderately common, thin shale parting.

14,360-14,385 Limestone: dark brown, lithographic, hard, brittle, slightly argillaceous, stylolites, indistinct shadows, probably algal, scattered pyrite, thin light gray, slightly earthy beds, fine calcite filled fractures.

14,385-14,424 Limestone: buff to gray, thin bioclastic, oolitic and algal beds; bioclastic limestone is fine to coarse grained, partly recrystallized, siliceous, slightly dolomitic, oolitic limestone is fine to medium grained, siliceous and slightly dolomitic, algal limestone is lithographic, thin dark brown to black argillaceous chert bed, occasional dolomite crystals and oolites at 14,391-14,392'. Limestone below chert bed is slightly cherty, stylolites throughout, occasional thin shale parting, very dark gray.

14,424-14,433 Siltstone: very dark and dark gray, siliceous, partly quartzitic, disseminated pyrite, slightly calcareous, partly shaly, trace fossil fragments, and Shale: very dark gray, micaceous, pyritic partly silty.

14,433-14,445 Limestone: tan-gray, gray and gray-brown, bioclastic, with oolites, pellets and fossil debris, medium to very coarse grained, slightly argillaceous and shaly, recrystallized, fossils predominantly indistinct, occasional algal and crinoid fragment, oolites and pellets partly dark gray and argillaceous, slightly siliceous and dolomitic, increasing silica and chert at base, estimate 3-5% porosity, interoolitic and interfossil, trace vugs with calcite and quartz fill, rare trace dead hydrocarbon, no cut or fluorescence.

14,445-14,448 Siltstone: dark gray, argillaceous, siliceous, calcareous, trace glauconite.

14,448-14,478 Limestone: brown and dark brown, homogeneous, lithographic to cryptocrystalline, hard, siliceous, trace brown algal chert in upper 5', becomes buff to gray, bioclastic, partly altered, algae, bryozoa(?) and pellets, fine to very coarse grain size, slightly siliceous, scattered glauconite, argillaceous, appears partly leached, 5-7% porosity, interoolitic and interfossil, scattered traces dead hydrocarbon, no cut or fluorescence, increasing silica and chert at 14,475'.

14,478-14,480 Shale: very dark gray, micaceous, and Siltstone: dark gray, calcareous.

14,480-14,605 Limestone: buff to tan-gray, trace brown, bioclastic, oolites, pellets and algal debris, fine to very coarse, partly leached, recrystallized, secondary calcite crystals, partly chalky, soft, argillaceous, siliceous, cherty 10-15%, 3-7% porosity, earthy interoolitic and interfossil, possible vugs, black residue, possible dead hydrocarbon, no cut or fluorescence, becoming partly gray with stylolites and shale partings 14,590-14,605', slight increase in chert.

14,605-14,620 Limestone: buff, light brown, oolitic, fine to medium grain size, calcite cement, partly altered and recrystallized, slightly cherty.

14,620-14,720 Limestone: buff to light gray, partly gray-brown, thin interbedded, oolitic and bioclastic limestones, fine to coarse grain size, altered and recrystallized, chalky to very fine crystalline, partly leached, trace vugs, fractures with calcite cement, occasional shale parting and stylolites, cherty, 10-15%, light gray to brown limestone, appears highly fractured, 14,670-14,680 aggregates of medium crystalline calcite, fracture filling, increasing bioclastic material at 14,685', very cherty 14,695-14,710' (15-20%).

14,720-14,732 Limestone: buff, bioclastic, altered and recrys chalky to very fine crystalline, occasional pelle crinoids and algae, predominantly indistinct, ch very light gray, milky.

14,732-14,735 Dolomite: gray, sucrosic, calcareous, argi occasional shadow, trace calcite-filled fracture dark gray shale stringer.

14,735-14,740 Limestone: brown-gray, algal, lithograph cryptocrystalline, homogeneous, rare hairline f with calcite cement, trace gray chert, occasional sty

14,740-14,760	Limestone: buff to light gray, altered and recrystallized, chalky to very fine crystalline, oolitic, partly replaced with silica, becomes dark gray and shaly at 14,755', trace fusulinid and foraminifera, 3% porosity, no stain.
14,760-14,800	Limestone: buff to brown-gray, altered and recrystallized, chalky to fine crystalline, partly microsucrosic, chips with oolites and bioclastic material, appears to be clasts in chalky, soft matrix, fractures with calcite filling, possible vugs, 5% earthy, vugular porosity, rare trace dead hydrocarbon, no cut or fluorescence, at 14,780-14,790', slightly dolomitic.
14,800-14,810	Limestone: gray-brown to buff, fossil hash fine grained, recrystallized, indistinct, occasional pellets, trace chert.
14,810-14,890	Limestone: gray-brown to buff, very fine grained, chalky, bioclastic, pelletoid, oolitic, trace chert, trace pisolites, occasional Siltstone: light to medium gray, micromicaceous.
14,890-14,940	Limestone: as above, becoming dark gray, microcrystalline, recrystallized, bioclastic, pelletoid, minor light gray to buff limestone, minor chert, dolomitic in part.
14,940-14,990	Limestone: very light gray to buff, very fine grained, moderately firm, recrystallized in part, trace of pinpoint porosity, Limestone: medium gray to brown, finely crystalline to microcrystalline, recrystallized in part, pelletoid, bioclastic, Limestone: dark gray, microcrystalline, hard, recrystallized in part, Limestone: medium brown, cryptocrystalline, Chert: dark and light gray, some transluscent relict clasts and fossils, trace of oolitic limestone, trace of very light gray, very fine grained sandstone, very hard, siliceous.
14,990-15,000	Limestone and Chert: as above, Limestone: becoming very dark brownish-gray to black cryptocrystalline, very hard, splintery, platy, and dolomitic.
15,000-15,185	Predominantly Limestone: white to buff, very fine grained, recrystallized in part, generally medium crystalline, oolitic, bioclastic pelletal in part, some dark gray to brown oolitic bioclastic limestone, minor gray-black, very thinly laminated limestone, and thinly interbedded dolomitic Limestone: medium gray to dark brownish-gray, very hard, crystalline, argillaceous, occasional chert, trace of pyrite.

15,185-15,215 Core No. 19, Cut 30', Recovered 30'.

15,185.0-15,190.0 (5.0')	Shale: medium dark gray to brownish-gray, calcareous, bioclastic, very hard, massive, very slightly dolomitic, corals, brachiopods and others, some shells replaced by coarse crystalline calcite and minor silica; trace brown and gray chert as alteration of calcium carbonate.
15,190.0-15,201.0 (11.0')	Shale: medium to dark gray, dolomitic, very hard, massive, fossiliferous, corals, brachiopods, and others, some shell fragments altered to coarse crystalline calcite, some with silica, chert grains with calcite, many with disseminated pyrite centers, some very finely crystalline pyrite replacement of fecal materials(?).
15,201.0-15,210.0 (9.0')	Limestone: medium dark gray, bioclastic, dolomitic, fine to very fine crystalline, recrystallized, cherty, argillaceous, brachiopods, bryozoa and others, shell material altered to coarse crystalline calcite, very thin black chert and dark gray limestone beds with corals at 15,204' and 15,206'.
15,210.0-15,215.0 (5.0')	Limestone: medium to dark gray, bioclastic, very hard, massive to laminated, argillaceous in part, medium crystalline, recrystallized, fossils replaced with coarse crystalline calcite, some light gray translucent chert.

15,215-15,265 Limestone: predominantly light gray to buff, bioclastic, fine to medium crystalline, recrystallized, moderately firm, minor medium gray to brownish-gray limestone, bioclastic, medium crystalline, recrystallized, very hard, minor medium gray-brown and translucent chert.

15,265-15,275 Shale: medium gray to dark gray, calcareous, dolomitic, moderately firm to hard, fossiliferous, cherty.

15,275-15,325 Limestone: medium to dark gray, bioclastic, cherty, and argillaceous, minor white to light gray limestone,

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moderately firm to hard bioclastic, fine to very finely crystalline, recrystalline, Chert: light to medium gray and translucent, limestone becomes dolomitic in part, minor medium to dark gray silty shale.

15,325-15,335 Shale: as above, calcareous, dolomitic.

15,335-15,365 Limestone and dolomitic Limestone: as above, some white and gray opaque chert.

15,365-15,375 Shale: as above, calcareous, dolomitic.

15,375-15,560 Limestone and dolomitic Limestone: as above.

15,560-15,600 Limestone and dolomitic Limestone: as above, with up to 40% limy Dolomite: light gray to very light gray, very slightly calcareous, very hard, dense, microcrystalline to cryptocrystalline, fossiliferous, cherty.

15,600-15,655 Limestone: as above, slightly dolomitic, some black chert, some black limestone, thinly laminated, platy.

15,655-15,670 Limestone: white to light gray, fine to coarse crystalline, firm to hard, recrystallized, commonly altered to coarse calcite crystals, fossiliferous, trace of pinpoint porosity, Limestone: medium to dark gray, very fine to medium crystalline, some coarse crystalline, very hard, recrystallized, slightly fossiliferous, some buff to brown limestone, lithographic to microcrystalline, recrystallized in part, dense, very hard, Chert: as above, marked increase in silty Shale: medium to dark gray, very hard, micromicaceous.

15,670-15,695 Limestone: predominantly medium to dark gray, medium crystalline, recrystallized in part, pelletal, very hard, fossiliferous, Limestone: white to light gray, medium crystalline in part, pelletal, moderately firm to hard, fossiliferous, matrix commonly recrystallized to coarse calcite crystals, pellets generally unaltered or partly recrystallized, minor dense brown Limestone: as above, Chert: as above, silty Shale: as above, trace of crystalline pyrite.

15,695-15,715 Limestone: as above, becoming very dolomitic, in part Dolomite: light gray, very finely crystalline, sucrosic, very hard, dense, nonporous, Chert: as above, increasing minor silty Shale: as above.

15,715-15,735 Limestone: as above, becoming less dolomitic, increase in pellets.

15,735-15,985 Limestone: predominantly white to light gray, fine to medium crystalline, chalky, in part, recrystallized, matrix commonly altered to coarse calcite crystals, pellets commonly unaltered, occasional pinpoint porosity, fossiliferous, occasionally pelletal, in part, Limestone: medium gray, very fine to microcrystalline, dense, abundant translucent and tan chert, some gray chert, becomes very dolomitic in part, occasionally becomes limy dolomite, occasionally bioclastic, minor silty Shale: as above, trace of disseminated and crystalline pyrite.

15,985-16,005 Limestone: as above, increase in silty Shale: medium to dark gray, micromicaceous, very hard.

16,005-16,025 Limestone: as above, predominantly white to light gray, pellets common, dolomitic, minor silty Shale: as above.

16,025-16,035 Limestone: as above, silty Shale: as above.

16,035-16,135 Limestone: white to light gray, fine to medium crystalline, recrystallized, firm to moderately hard, chalky, matrix altered to coarse calcite crystals, bioclastic, pelletoid, occasionally slightly cherty, minor medium to dark gray Limestone: fine to medium crystalline, very hard, minor silty shale in uppermost part.

16,135-16,185 Limestone: as above, becoming dolomitic in part and grading to limy Dolomite: light gray to white, fine to medium crystalline, some crystalline dolomite rhombs, trace of pinpoint vugular porosity.

16,185-16,198 Core No. 20, Cut 13', Recovered 12.8'.

16,185.0-16,197.8 (12.8') Limestone: white to light gray, medium to coarsely crystalline, some very coarsely crystalline, recrystallized, bioclastic with crinoids, bryozoa, brachiopods, and others, some fractures to 1/4" filled with coarse calcite crystals, no porosity, no odor, stain, cut or fluorescence, grading to dolomitic Limestone: medium dark gray, very hard, very finely crystalline, dense, bioclastic, as above, no porosity, no odor, stain, cut or fluorescence.

16,197.8-16,198.0 (0.2') No recovery.

16,198-16,270 Limestone: as above, grading to limy Dolomite: as above, minor brown Limestone: microcrystalline, dense, very hard, Chert: light to medium gray, tan and brown, trace of medium to dark gray silty Shale: hard, micromicaceous.

16,270-16,325 Limestone: as above, with increase in dolomite, becoming argillaceous downward, Chert: as above, silty Shale: as above, becoming calcareous and dolomitic.

16,325-16,410 Shale: medium gray to dark gray, silty, very hard, very slightly calcareous to calcareous, predominantly very dolomitic, micromicaceous, slightly cherty to cherty; stringers of Limestone: white to light gray, bioclastic, pelletal, firm to hard, stringers of sandstone comprised of fine to medium sized dolomite crystals, light to medium gray, Chert: brownish-gray, very dark gray to black, translucent and opaque white.

16,410-16,610 Limestone: white to light gray, as above, Limestone: medium gray to dark gray, as above, dolomitic in part, minor Limestone: medium gray, microcrystalline to cryptocrystalline, Limestone: medium gray to dark gray and black, argillaceous, very finely crystalline grading to very calcareous Shale: medium gray to dark gray, dolomitic in part, minor dolomite, medium gray, microcrystalline, very hard, occasionally sucrosic, Chert: translucent, tan, gray, opaque white and black, trace of crystalline pyrite.

16,610-16,645 Limestone: white to light gray, bioclastic as above, becoming dark gray to black, nonbioclastic, nonpelletal, platy, very finely crystalline to microcrystalline, argillaceous, cherty, Shale: medium gray to dark gray, some light gray, occasionally silty, occasionally very dolomitic, cherty, noncalcareous to slightly calcareous, trace of disseminated pyrite, trace of well rounded gray and black chert granules.

16,645-16,695 Limestone: medium gray, fine to medium crystalline, recrystallized, slightly bioclastic, hard, cherty, Limestone: medium gray, very finely crystalline to microcrystalline, nonbioclastic, minor Limestone: white to light gray, fine to medium crystalline, recrystallized, bioclastic, pelletal, firm to hard, Chert: dark gray, brown and black, unit becomes predominantly white to light gray limestone downward.

16,695-16,735 Limestone: as above, predominantly medium to dark gray, very finely crystalline to microcrystalline, very hard, platy, occasionally recrystallized fossil fragments,

argillaceous, slightly dolomitic grading to dolomite, medium to dark gray, fine to medium crystalline, nonfossiliferous, nonpelletal, very hard, argillaceous, some recrystallized dolomite rhombs, commonly sucrosic, trace of disseminated pyrite.

16,735-16,845 Limestone: white to light gray and medium gray, predominantly fine to medium crystalline, some coarsely crystalline, recrystallized, bioclastic, pelletal, occasionally oolitic, firm to hard, Limestone: medium gray to brownish-gray, very finely crystalline to microcrystalline, very hard, cherty, occasionally argillaceous, occasionally very slightly dolomitic, occasionally very minor Dolomite: light gray, very finely crystalline to microcrystalline, sucrosic, very hard, Chert: transluscent gray, brown and black, rare well rounded gray chert granules.

16,845-16,875 Limestone: as above, limy Dolomite: medium gray to dark gray, very finely crystalline to microcrystalline, very hard, argillaceous, dolomitic Shale: dark gray to black, well indurated, splintery to subfissile, very hard, silty, occasionally recrystallized dolomite rhombs, minor Chert: as above.

16,875-16,885 Limestone: light gray to medium gray, finely crystalline to very finely crystalline, very pelletal, occasionally bioclastic, slightly argillaceous, cherty, slightly dolomitic.

16,885-16,905 Limestone: as above, Shale: medium to dark gray, very hard, splintery to subfissile, noncalcareous to very slightly calcareous, some fossil fragments, slightly dolomitic, silty in part, Shale: dark gray to black, very hard, micromicaceous, splintery to subfissile, slightly dolomitic to very dolomitic, Dolomite: medium gray, very finely crystalline to microcrystalline, hard, sucrosic, trace of Chert: brown, black and dark gray.

16,905-16,940 Limestone: light gray to medium gray, recrystallized in part, finely to medium crystalline and fine to medium grained, very pelletal, occasionally bioclastic, occasionally argillaceous, cherty.

16,940-16,970 Limestone: light to dark gray, occasionally very dark streak, recrystallized, very fine to fine size, pellets and fossil hash, partly algal or bryozoan, occasional crinoid, argillaceous, becomes shaly, partly cherty, trace medium and coarse crystalline calcite, fracture fill(?), trace dark chert pebble, caving(?).

16,970-16,975 Shale: very dark gray, black, dolomitic, and Dolomite: dark gray to black, shaly, very fine crystalline.

16,975-16,990 Limestone: light to dark gray, recrystallized, pellets and fossil hash, indistinct, possibly algae, rare crinoid, shaly streaks, slightly dolomitic at 16,980-16,985'.

16,990-17,030 Limestone: light gray to dark brownish-gray, recrystallized, chalky to cryptocrystalline, pellets and algal material, rare crinoids, partly siliceous, slightly dolomitic, bioclastic streaks, coarse algal clasts in softer matrix, thin dolomite stringers, 16,990-17,005', becomes argillaceous and shaly 17,020-17,030', thin shale partings.

17,030-17,045 Limestone: light to dark gray, trace light brown, pelletoid, pellets partly after fossil debris and partly argillaceous, recrystallized, interpellet cement now very fine silica crystals, pellets fine to medium size, trace chert, slight porosity, partly leached, no stain, calcite-filled fractures.

17,045-17,053 Limestone: as above, and Dolomite: dark and very dark gray, argillaceous, very fine crystalline to microsucrosic, occasional pellet and fossil shadows.

17,053-17,083 Core No. 21, Cut 30', Recovered 30'.

17,053.0-17,055.0 (2.0')	Limestone: very dark gray, very argillaceous, very siliceous, pellets and indistinct fossil debris, coarse fossils replaced by coarse calcite crystals, original argillaceous calcareous cement now replaced by very fine silica crystals, random calcite-filled fractures, trace crinoids.
17,055.0-17,060.0 (5.0')	Shale: very dark gray, very siliceous, partly pyritic, occasional thin bands with fossil hash, slightly carbonaceous, carbonaceous plant remains, 17,056-17,056.5', slightly cherty, vertical fractures, calcite-filled, 17,057-17,058'.
17,060.0-17,062.0 (2.0')	Chert: gray-black, lithographic, very argillaceous, limy, very hard, highly shattered, conchoidal fracture, random calcite-filled fractures.
17,062.0-17,063.0 (1.0')	Shale: black, smooth, siliceous dolomitic, hard.

17,063.0-17,068.0 (5.0')	Limestone: dark gray to dark brownish-gray, recrystallized, argillaceous, hard, very siliceous, indistinct fossil hash, very fine to fine grained size, becoming cryptocrystalline, occasional crinoid and brachiopod, thin dark shale partings, vertical fractures, hairline to 7 mm, filled with fine to coarse crystalline calcite, scattered dead hydrocarbon residue, no cut or fluorescence.
17,068.0-17,071.0 (3.0')	Shale: very dark gray, calcareous, fossiliferous, streak of recrystallized limestone, 17068-17069', crinoids and brachiopods, vertical fractures as above.
17,071.0-17,072.0 (1.0')	Limestone: dark gray, siliceous, argillaceous, cryptocrystalline, vertical fractures, with calcite filling, black hydrocarbon residue, no fluorescence, very slight yellow cut.
17,072.0-17,073.0 (1.0')	Shale: very dark gray, limy, siliceous, hard, crinoid and brachiopods, algae(?), vertical fractures as above.
17,073.0-17,076.0 (3.0')	Limestone: very dark gray, dolomitic, argillaceous, cryptocrystalline, siliceous, fossiliferous, trace crinoid, vertical fractures, as above.
17,076.0-17,078.0 (2.0')	Shale: very dark gray, very siliceous, almost chert, rare fossils, scattered pyrite, vertical fractures with calcite fill.
17,078.0-17,080.0 (2.0')	Chert: very dark gray, argillaceous, dolomitic, random fractures with calcite fill.
17,080.0-17,083.0 (3.0')	Shale: very dark gray, very siliceous, partly carbonaceous, slickensides with calcite coating, 17,080-17,081', bryozoan inclusions 17,081-17,081.5', becomes highly shattered and brecciated at 17,081.5', cemented with calcite.

17,083-17,090 Shale: very dark gray, black, hard, fossiliferous, calcareous, cherty, limestone stringers, gray, dark gray, argillaceous, trace crinoids, calcite-filled fractures.

17,090-17,130 Limestone: light to dark gray, recrystallized, slightly earthy, microsucrosic to cryptocrystalline, occasional pellets, and fossil debris, pellets medium size, fossil debris fine to coarse size, thin shale stringers, light to dark gray, pyritic, trace chert, crinoids common at 17,120', occasional calcite-filled fracture.

17,130-17,173 Limestone: medium to very dark gray, argillaceous, dolomitic, siliceous, earthy to very fine crystalline, occasional streak with fine pellets, indistinct fossil debris, trace crinoids, and interbedded Dolomite: very dark gray, black, hard, argillaceous to shaly, occasional fossil shadow, thin very dark gray shale beds, calcite-filled fractures.

17,173-17,176 Shale: very dark gray, black, carbonaceous, very pyritic, occasional fossil fragment.

17,176-17,245 Limestone: gray to black, streaks with pellets, indistinct fossils, siliceous, argillaceous, recrystallized, microcrystalline to very fine crystalline, cryptocrystalline streaks, shale partings, occasionally slightly cherty, trace fusulinids and bryozoa, 17,210-17,220', fractures with calcite, fine crystalline, trace porosity, trace dead hydrocarbon in fractures, no cut or fluorescence.

17,245-17,293 Limestone: light to very dark gray, recrystallized, earthy to cryptocrystalline, microsucrosic streaks, indistinct fossil debris, argillaceous, dolomitic, occasional thin dolomite stringers, very dark gray, microsucrosic.

17,293-17,297 Shale: very dark gray, trace gray, dolomitic, pyritic, carbonaceous.

17,297-17,355 Limestone: gray to very dark gray, recrystallized, earthy to very fine crystalline, argillaceous, indistinct fossil debris, trace pellets, pyritic, partly shaly, trace calcite-filled fractures, occasional thin dolomites, trace chert.

17,355-17,400 Limestone: gray to very dark gray, earthy to cryptocrystalline, argillaceous to shaly, slightly dolomitic in part, dolomite stringers, 17,345' and 17,365', dark gray to black, occasional gray streak, calcareous, carbonaceous, occasional streaks with chert, becoming pyritic at 17,370', brachiopod casts at 17,370-17,375', ostracods, 17,380-17,400', occasional calcite-filled fractures.

17,400-17,414 Limestone: gray to very dark gray, earthy to cryptocrystalline, argillaceous to shaly, streak lithographic and very fine crystalline, slightly dolomitic in part, slightly carbonaceous with interbedded Shale: very dark gray to black, occasional gray streak, calcareous, carbonaceous, trace chert, becoming pyritic at 17,370', brachiopod 17,370-17,375', ostracods 17,380-17,414'.

17,414-17,418 Shale: dark gray to black, limy, streaks with glauconite, partly hard and cherty, pyritic.

17,418-17,495 Limestone: gray to black, earthy to cryptocrystalline, streaks lithographic and very fine crystalline, streaks with medium to coarse pellets, argillaceous to shaly, partly pyritic, partly recrystallized, indistinct fossils, occasional siliceous and cherty streaks, thin interbedded Shale: very dark gray, black, pyritic, partly carbonaceous, ostracods, 17,450-17,470', fractures with fine to medium crystalline, calcite, trace dead hydrocarbon in fractures 17,420-17,430', 17,465-17,475', no cut or fluorescence.

17,495-17,565 Limestone: very dark gray to black, earthy to cryptocrystalline, lithographic streaks, occasionally very fine crystalline, partly pyritic, occasional thin hard siliceous stringer, slightly cherty, streaks with pellets and oolites, partly pyritic, thin interbedded and interlaminated Shale: very dark gray, black, calcareous, carbonaceous, occasional light to dark chert granules and pebbles, calcite filled fractures, trace dead hydrocarbon 17,510-17,515', no cut or fluorescence.

17,565-17,570 Limestone: as above, only trace in samples; Sulphur: light yellow to white when wet, soft, yellow when dry, burns with light blue flame, very pungent odor. Hit H_2S gas while circulating. Drilling curtailed for 78 days (see History of Drilling Operations, Inigok Test Well No. 1, Husky Oil NPR Operations, Inc., September 1982, pages 5-8 and 65-79).

17,570-17,575 Limestone: very dark gray to dark gray-brown, cryptocrystalline to lithographic, partly dolomitic, partly very siliceous to cherty, argillaceous to shaly, thin pelletoid and fossil debris streaks, fractures with calcite filling, trace hard black shiny dead hydrocarbon residue, no cut.

17,575-17,595 Limestone: very dark gray to brownish-gray, cryptocrystalline to earthy, increasing fossil debris, recrystallized to very fine crystalline calcite, decreasing silica, trace very light colored chert, possible coral or

algae, becomes partly earthy 17,790-17,795', with trace gray limy clay and gray fissile shale, fractures with medium to very coarse crystalline calcite, trace dead black hydrocarbon residue, no cut.

17,595-17,634 Limestone: very dark gray to gray-brown, lithographic to cryptocrystalline, predominantly algal mud, partly pelletoid algae and coarse algal debris, argillaceous, dolomitic, streak black very limy shale with pellets and algal debris and light gray and gray very calcareous claystone, 17,620-17,625', streaks black shiny, slightly pyritic oolites with recrystallized secondary calcite matrix, fine to medium size, 17,625-17,634', calcite-filled fractures.

17,634-17,637 Claystone: brown and gray, siliceous, occasional siliceous pellets, appears to be weathered zone.

17,637-17,674 Limestone: very dark gray to gray-brown, lithographic to earthy, siliceous, occasional pellets and recrystallized fossils, occasional streaks with very coarse oolites with light gray clay matrix, with thin interbedded Claystone and Shale: gray to dark gray, limy, dark pellets common, occasional light and dark chert granules.

17,674-17,676 Shale: very dark gray, slightly calcareous, trace pyrite.

17,676-17,694 Limestone: very dark gray, dark gray-brown, cryptocrystalline, siliceous, hard, trace pyritic oolites, grading to medium to coarse black oolitic limestone with light gray and gray earthy, argillaceous, slightly dolomitic matrix, occasional altered fossils, calcite-filled fractures.

17,694-17,697 Dolomite: brownish-gray, sucrosic, pyritic, argillaceous, occasional pellet, trace brown siltstone. Samples very poor 17,680-17,760', 80-95% sulphur.

17,697-17,703 Limestone: black to gray-brown, lithographic to earthy, siliceous, partly dolomitic, argillaceous, partly with pellets.

17,703-17,705 Sandstone: brown, very fine grained, subangular, silty, clayey, hard, with trace brown claystone.

17,705-17,724 Limestone: gray-brown, earthy, clayey, fossiliferous, becoming very dark gray and black, hard, with occasional pellets, becoming siliceous and cherty 17,720-17,724'.

17,724-17,726 Shale: black, calcareous, siliceous, pyritic with trace dark gray siltstone.

17,726-17,734	Limestone: very dark gray, hard, siliceous, partly cherty.
17,734-17,736	Dolomite: brownish-gray, earthy to microsucrosic, argillaceous, limy.
17,736-17,744	Limestone: very dark gray, hard, siliceous, trace oolite and fossil shadows, thin shale stringer 17,740-17,741'.
17,744-17,748	Limestone: gray-brown, earthy, argillaceous, fossiliferous.
17,748-17,754	Limestone: very dark gray, black, lithographic, hard, siliceous, slightly cherty, occasional pellet and fossil shadow, calcite-filled fractures.
17,754-17,758	Dolomite: dark gray, gray-brown, shaly, microsucrosic to cryptocrystalline, partly very hard.
17,758-17,760	Shale: very dark gray, black, very dolomitic, partly very hard, trace fossil fragments, rare dark chert pebble.
17,760-17,786	Limestone: black and dark gray, argillaceous, moderately soft to hard, partly silty, Dolomite: black, cryptocrystalline, very argillaceous, siliceous, Sandstone: light brown, very fine grained, subangular to angular, siliceous, argillaceous, hard, partly silty, trace of light brown claystone, trace of subwaxy shale, limestone is occasionally earthy, pelletal, fossiliferous and has a trace of dead oil stain.
17,786-17,880	Limestone: dark gray to black, becoming white to light gray in part, very finely crystalline to cryptocrystalline, recrystallized, generally slightly dolomitic, very slightly cherty, fossiliferous with algae, gastropods(?), occasional pellets, calcite vein filling common, minor Shale: gray black, calcareous, very hard.
17,880-18,000	Limestone: as above, with increase in noncarbonates, predominantly shaly Siltstone: medium gray to dark gray, hard, slightly micromicaceous, slightly calcareous, trace of chert fragments and chert pebbles, trace of pyrite.
18,000-18,050	Shale: very dark gray, very hard, silty, siliceous, slightly calcareous, minor Limestone: as above, minor dolomite, silty shale grades into shaly siltstone.
18,050-18,075	Siltstone: as above, shaly, with increasing amounts of Limestone: as above, limestone increases to 70% at 18,060', then diminishes.

18,075-18,105	Siltstone: as above, predominantly siltstone with minor limestone.
18,105-18,140	Siltstone: as above, becoming predominantly limestone.
18,140-18,152	Claystone and Shale: dark to very dark gray, very calcareous, altered fossil fragments, pyrite inclusions and disseminated crystals, occasional bands, occasional light and dark chert pebbles, trace quartz pebble, thin Limestone stringers: light to dark gray, fossiliferous, trace with pellets, trace very dark gray dolomite, calcite-filled fractures.
18,152-18,163	Siltstone: very dark gray, calcareous, dolomitic, argillaceous to shaly, pyrite inclusions and disseminated crystals, fossil fragments, crinoids and ostracods(?), partly altered and pyritic Shale stringer: very dark gray, silty, calcareous, fossiliferous, scattered chert pebbles, trace Limestone: very dark gray.
18,163-18,183	Claystone and Shale: as above, crinoids, streak brown claystone, slightly calcareous, slightly silty, 18,175-18,180'.
18,183-18,193	Sand: loose, fine to medium grained, subangular, predominantly quartz with brown and black chert grains, rare chips with silica, calcite and argillaceous cement.
18,193-18,198	Shale: black, dark gray, calcareous, pyritic.
18,198-18,218	Sand: loose, as above, increasing shale 18,210-18,215', trace clear angular quartz.
18,218-18,224	Shale: very dark gray, black, slightly pyritic, slightly calcareous, partly claystone.
18,224-18,226	Chert: light gray, gray-brown.
18,226-18,228	Limestone: dark brown, to very light gray, hard, conchoidal fracture, siliceous.
18,228-18,238	Shale: black, gray-black, hard, dolomitic, siliceous, partly silty with coal stringer, black, hard, brittle, anthracite.
18,238-18,250	Sand: loose, fine grained, subangular, trace very light gray, and dark gray sandstone, very fine grained, siliceous, partly silty, shaly, shale stringers.
18,250-18,262	Shale: black, gray-black, hard, siliceous, partly platy, trace siltstone and limestone.

18,262-18,286	Sand: loose, "salt and pepper", fine grained, subangular, occasional orange and brown grain, trace brown and gray chert grains, trace clear angular quartz, fracture fill or vein, probably silica cement, shale stringers.
18,286-18,298	Shale: black, very dark gray, slightly carbonaceous, hard, disseminated pyrite, some Chert: light to medium gray and gray-brown, anthracite coal stringers, quartz-filled fractures.
18,298-18,305	Sandstone: medium to dark gray, fine grained, occasional medium grained streak, subangular to subrounded, quartzitic, coaly inclusions, argillaceous to shaly, no show, Shale stringer: black, hard, siliceous, partly sandy, quartz inclusions, quartz-filled fractures, coal stringer, becomes very fine grained and silty at base.
18,305-18,315	Siltstone: dark gray, siliceous to shaly, carbonaceous, partly sandy, micaceous.
18,315-18,318	Sandstone: light to dark gray, fine grained with medium grained streaks, shaly, quartzitic, trace quartzite, trace light gray chert grains, no show.
18,318-18,325	Shale: black, very dark gray, moderately to very siliceous, scattered pyrite with Siltstone: gray, dark gray, partly sandy, siliceous.
18,325-18,346	Sandstone: light to dark gray, very fine to fine grained, subangular, partly silty, partly quartzitic, shaly, siliceous, occasional gray chert grain interbedded with Shale: very dark gray, black, pyritic, siliceous, and Siltstone: gray to dark gray, partly sandy, siliceous, shaly, scattered fine pyrite inclusions, quartz-filled fractures.
18,346-18,352	Shale: black, very dark gray, siliceous, streak with white altered grains, moderately soft, trace coal, rounded chert pebbles.
18,352-18,363	Sandstone: gray to very dark gray, very fine grained with fine grained streaks, subangular, partly quartzitic at top, shaly, siliceous, part with white altered grains, pyritic streaks.
18,363-18,372	Siltstone: very dark gray, gray-black, slightly siliceous, micromicaceous, pyritic, becoming dolomitic, trace coal, quartz-filled fractures.
18,372-18,387	Shale: very dark gray to black, siliceous, slightly carbonaceous, occasional cherty streaks, dolomite and quartz-filled fractures.

18,387-18,401	Sandstone: light to dark gray, very fine to fine grained, subangular, argillaceous, siliceous, partly shaly interbedded with Siltstone: very dark gray, micromicaceous, dolomitic, partly shaly, and Shale: black, very dark gray, as above, becoming light gray, soft, fissile, slightly micaceous, black pellets common, partly pyritic.
18,401-18,410	Shale: very dark gray, trace black, hard, siliceous, trace chert, occasional chert granule.
18,410-18,420	Sandstone: light to medium gray, very fine grained, to coarse grained, subangular, poorly sorted, silty and shaly streaks, partly quartzitic, occasional light and dark chert grain, partly rounded, becoming fine to medium grained and quartzitic at base.
18,420-18,427	Shale: very dark gray, hard, siliceous, partly fissile, trace quartz-filled fractures, abundant chert granules.
18,427-18,435	Siltstone: light to dark gray, siliceous, argillaceous, carbonaceous, coaly partings, sandy interbedded with Sandstone: light to dark gray, very fine grained, subangular, medium sorted, siliceous, silty, partly shaly, carbonaceous, coal inclusions.
18,435-18,450	Shale: very dark gray, gray-black, firm, blocky to slightly fissile, micromicaceous, carbonaceous, very fine crystalline pyrite inclusions, thin Coal beds: black, very hard, brittle, pyrite inclusions and banding.
18,450-18,457	Sandstone: gray, fine grained, subangular to angular, quartzitic, predominantly quartz with light and medium gray chert grains, partly argillaceous, tight, becoming very fine grained, silty and clayey.
18,457-18,480	Shale: very dark gray, partly fissile, micromicaceous, scattered pyrite, partly gray claystone, thin Coal beds: black, hard, brittle, thin siltstone interbeds.
18,480-18,517	Shale: black, hard, siliceous, partly cherty, carbonaceous, micromicaceous, occasional siltstone and sandstone, coal beds 1-2', black, hard, brittle.
18,517-18,537	Sandstone: gray to dark gray, fine to medium grained, occasional coarse grained, subangular, siliceous, partly quartzitic, argillaceous dolomitic, partly shaly, coal partings, no show, thin interbedded siltstone and shale.
18,537-18,566	Shale: black, gray-black, micromicaceous, carbonaceous, pyrite inclusions, blocky and hard to moderately soft and fissile, partly siliceous, thin coal beds.

18,566-18,570	Coal: black, hard, brittle, trace pyrite.
18,570-18,577	Shale: very dark gray, black, carbonaceous, siliceous.
18,577-18,586	Sandstone: gray to dark gray, fine to medium grained, occasional coarse grain, occasional quartz inclusion, subangular to subrounded, siliceous, partly quartzitic, slightly dolomitic, argillaceous, occasional coaly inclusion, tight, no show, fractures with medium and coarse crystalline quartz filling.
18,586-18,591	Coal: black, hard, brittle, shiny.
18,591-18,610	Shale: black, gray-black, slightly fissile, micromicaceous, occasional hard siliceous streak, carbonaceous, partly claystone, occasional pyrite inclusion, trace limestone inclusion and parting, trace fossil (bryozoa?), dolomite and quartz-filled fractures.
18,610-18,617	Coal: black, hard, brittle, conchoidal fracture, anthracite(?).
18,617-18,625	Shale: very dark gray, black, siliceous streaks, partly cherty, carbonaceous, occasional pyrite inclusion, occasional limestone inclusion and parting.
18,625-18,627	Coal.
18,627-18,644	Sandstone: dark gray and gray, very fine grained subangular, silty siliceous, partly shaly, carbonaceous, tight, no show, grades downward to Siltstone: dark to very dark gray, trace black, argillaceous, carbonaceous, slightly siliceous and sandy, micaceous and down to Shale: black, gray-black, slightly micaceous, partly fissile, carbonaceous to coaly, siliceous, pyrite inclusions; trace of Limestone: gray-brown, shaly, with foraminifera and gastropod(?) (cavings?).
18,644-18,652	Coal and Shale: very dark gray.
18,652-18,667	Sandstone: light to dark gray, very fine grained, subangular, partly silty, argillaceous to shaly, siliceous, carbonaceous, tight, no show.
18,667-18,680	Sandstone: light to dark gray, fine grained, occasional medium grained, subangular, quartzitic, partly shaly, tight, no show, trace fractures with crystalline quartz filling.
18,680-18,721	Shale: very dark gray to black, carbonaceous, coaly, micromicaceous with thin coal beds, 4' at 18,698-18,702', and thin sandstone beds, 3' at 18,685-18,688' and 18,702-18,705', occasional siltstone bed.

18,721-18,731	Sandstone: light to dark gray, fine to medium grained, subangular, quartzitic to siliceous and shaly, hard, tight, becomes medium to coarse grained at base, very quartzitic.
18,731-18,740	Shale: very dark gray, silty, hard, very siliceous with very fine silica crystals, becomes partly very carbonaceous with thin coal beds.
18,740-18,745	Sandstone: very dark and dark gray, very fine to fine grained, subangular, very silty, shaly, carbonaceous, slightly siliceous, no show.
18,745-18,753	Siltstone and Shale: very dark gray, interbedded.
18,753-18,764	Sandstone: light and medium gray, medium to coarse grained, subangular to angular, very siliceous, partly quartzitic, partly with shale matrix, grades downward to coarse and very coarse grained, no porosity, no show.
18,764-18,768	Shale and Siltstone: dark gray, mica.
18,768-18,793	Sandstone: gray to very dark gray, very fine to fine grained, occasional medium and coarse grains, argillaceous to shaly, partly siliceous, carbonaceous, partly silty, becomes dirtier at 18,775', increasing carbonaceous material, shale partings, trace coal, partly quartzitic, occasional quartz inclusion.
18,793-18,800	Shale: very dark gray, black, micromicaceous, carbonaceous, with thin hard coal beds.
18,800-18,807	Sandstone: light to dark gray, fine to coarse grained, subangular to angular, poorly sorted, siliceous, partly quartzitic, partly shaly, grades downward to very fine grained, partly silty.
18,807-18,814	Siltstone: very dark gray, micaceous, shaly, trace pyrite with interbedded Shale: very dark gray, black, carbonaceous.
18,814-18,819	Sandstone: dark gray to black, very fine grained, subangular, very siliceous to shaly, coaly streaks, hard, tight, no show.
18,819-18,822	Coal.
18,822-18,833	Shale: black, blocky, very siliceous, hard, very slightly cherty.
18,833-18,838	Sandstone: gray to dark gray, medium to coarse grained, subangular, quartzitic, partly quartzite, argillaceous, tight, no show.

18,838-18,843 Shale: black and very dark gray, very siliceous, slightly cherty, siltstone laminations.

18,843-18,852 Sandstone: light gray to medium gray, medium to very coarse grained, subangular, quartzitic, partly shaly, becomes slightly conglomeratic at 18,845' with light gray chert grains and granules, tight, no show.

18,852-18,858 Siltstone: gray to dark gray, very siliceous, argillaceous to shaly, with Sandstone: very dark gray, partly silty.

18,858-18,860 Conglomerate: quartzitic, quartz grains and pebbles with light and dark gray rounded chert pebbles, trace quartz and calcite-filled fractures.

18,860-18,872 Shale: black, siliceous, micaceous, carbonaceous, siltstone laminations, sandstone partings, coal bed at 18,863-18,865', 53 units gas at 18,862'.

18,872-18,895 Sandstone: dark to light gray, fine to medium grained, subangular to angular, siliceous, partly quartzitic, shaly, occasional coal inclusions and partings, becoming partly conglomeratic with gray chert pebbles, trace pyrite, trace fibrous green fracture fill, chlorite(?), 120 units gas at 18,886'.

18,895-18,915 Sandstone: gray to dark gray, fine grained, occasional medium grained, subangular, siliceous, argillaceous, tight, slightly carbonaceous, grades downward to very fine grained sandstone, then to Siltstone: gray and dark gray at 18,902'; and Shale: black carbonaceous at 18,906', coal bed at 18,912-18,915', quartz and minor calcite-filled fractures, 330 units gas at 18,912'.

18,915-18,930 Sandstone: gray, dark gray, very fine grained, grading to siltstone at 18,918, and shale at 18,921', becomes coaly at 18,927' with thin coal beds, 63 units gas at 18,916'.

18,930-18,950 Sandstone: light to medium gray, fine to very coarse grained, subangular to angular, poor sorted, silica and shale cement, slightly conglomeratic, clear quartz pebbles and inclusions, light to dark gray rounded chert granules, trace pyrite, coal inclusions and partings, black shale stringer, becomes fine grained and silty at 18,940', grades to siltstone at 18,943' and to shale and coal at 18,945'.

18,950-18,958 Sandstone: light gray, gray, fine grained with occasional medium and coarse grains, subangular to angular, very siliceous to quartzitic, argillaceous streaks, hard, tight, trace calcite-filled fractures, grades downward to siltstone at 18,955' then to shale.

18,958-18,962	Coal: black, hard, brittle, anthracite, 76 units gas at 18,960', 160 units at 18,964'.
18,962-18,966	Shale: black, partly fissile, moderately soft to hard, very carbonaceous, micromicaceous, with very thin limestone partings with pellets and foraminifera(?).
18,966-18,972	Coal: black, anthracite.
18,972-18,984	Shale: black, fissile, micromicaceous, thin coal partings, occasional limy streak.
18,984-19,025	Sandstone: light to dark gray, fine to very fine grained, subangular to angular, siliceous to quartzitic, hard, tight, partly argillaceous, carbonaceous with black shale bed, 18,989-18,992', sandstone becomes fine to medium grained at 19,010' and medium to coarse grained at 19,015', slightly conglomeratic with clear and white quartz granules, partly quartzite, occasional coal inclusion, becomes conglomeratic at 19,020' with clear and white quartz granules, angular to subangular, partly quartzitic, slight porosity (3-5%), 73 units of gas.
19,025-19,028	Sandstone: conglomeratic, as that from 19,020-19,025'.
19,028-19,048	Siltstone: very dark gray to light gray, siliceous, micaceous, shaly and sandy, thinly interbedded and interlaminated with Sandstone: light to very dark gray, very fine to fine grained, subangular, siliceous, partly quartzitic, partly shaly and silty, hard and tight, scattered shale partings and thin beds; trace of coal.
19,048-19,094	Sandstone: light to dark gray, very fine to fine grained, subangular to angular, siliceous to quartzitic, partly argillaceous and shaly, hard, tight with thin interbedded Siltstone: gray to dark gray; and Shale: black to very dark gray, occasional coal stringer, becomes slightly conglomeratic at base.
19,094-19,100	Sandstone: conglomeratic, clear to gray, very siliceous to quartzitic, angular to rounded, argillaceous to shaly, scattered pyrite crystals, clear quartz and light to very dark gray chert granules, appears tight, possible slight porosity, no show.
19,100-19,191	Sandstone: fine to medium grained, clear to dark gray, subangular to angular, siliceous to quartzitic, micaceous, slightly conglomeratic streaks, thin interbedded Siltstone: black to gray, micromicaceous, and Shale: black to very dark gray, fissile, micromicaceous, carbonaceous with coal stringers.
19,191-19,194	Coal: black, hard, brittle, anthracite.

19,194-19,215 Siltstone: black and very dark gray, argillaceous to shaly, partly very quartzitic, micaceous, shale laminations, occasional sandstone bed and coaly bed.

19,215-19,230 Sandstone: gray to dark gray, very fine to fine grained, subangular, argillaceous to shaly, partly silty, siliceous, partly quartzitic, thin siltstone and shale beds and partings, no show.

19,230-19,274 Sandstone: light gray, gray, medium to coarse grained, occasional pebbles, subangular, siliceous to quartzitic, slightly carbonaceous, rare light chert grain, grades to very fine to fine grained, with thin siltstones and shales.

19,274-19,358 Sandstone: conglomeratic, light to very light gray, medium to coarse grained, moderate to poorly sorted, predominantly glassy quartz and opaque white and gray chert, very hard to hard, some intergranular silty shale filling, rare anthracite coal, white to light gray opaque chert pebbles common, some intergranular porosity, 5%(?), minor dark gray to black shale.

19,358-19,360 Shale: black, micromicaceous, carbonaceous.

19,360-19,372 Core No. 22, Cut 12', Recovered 10.5'.

19,360.0-19,363.0 (3.0') Sandstone: light to medium gray, coarse to very coarse grained, subangular, becoming conglomeratic at 19,362', siliceous, no show.

19,363.0-19,365.0 (2.0') Conglomerate: light to medium gray, subangular, clay and silica cement, granules and pebbles of clear and milky quartz, light and medium gray chert, and dark gray argillite, occasional granule partly altered, slight porosity, predominantly tight, no shows.

19,365.0-19,366.0 (1.0') Sandstone: medium to very coarse grained, slightly conglomeratic, light to medium gray, clay and silica cement, partly quartzitic, occasional irregular shale partings with slickensides, no shows.

19,366.0-19,367.2 (1.2') Shale: very dark gray, black, carbonaceous, hard, siliceous, coaly inclusions, with Sandstone: fine to medium grained, dark gray to light

	brown, shaly, siliceous, light brown mineral common, appears stained, no fluorescence or cut, irregular bedding.
19,367.2-19,370.5 (3.3')	Sandstone: very dark gray, medium to coarse grained, subangular, shaly, very siliceous, partly quartzitic, thin coal partings, appear highly shattered with slickensides, irregular bedding, conglomeratic streak at 19,370', apparent dip 15-20°.
19,370.5-19,372.0 (1.5')	Missing.
19,372-19,408	Sandstone: clear to gray, quartzose, medium to very coarse grained, conglomeratic streaks, subangular to angular, shale and silica cement, partly quartzitic, quartz, argillite, and chert granules and pebbles, chert partly altered to clay, occasional coal grain, slight porosity, 3-5%, no show.
19,408-19,450	Sandstone: clear to gray, coarse to very coarse grained, subangular, siliceous and shaly matrix, estimated 5-10% porosity, with stringers of medium to coarse grained sandstone, occasional pebble, siliceous, hard, 0-3% porosity, occasional coal grain, thin very dark gray and black shale partings, trace with coal laminations, occasional aggregate of fine to coarse elongated quartz crystals at 19,430-19,435', possible fracture or vug filling, possible trace dead hydrocarbon, no fluorescence or cut, sandstone becomes slightly calcareous 19,445-19,450'.
19,450-19,455	Shale: black, very dark gray, micromicaceous, schistose appearance, siliceous, cherty, trace hairline fractures with quartz filling.
19,455-19,458	Coal: black, hard, shiny, brittle, anthracite.
19,458-19,485	Sandstone: light to medium gray, medium to coarse grained, subangular, silica and shale cement, coal grains and partings, scattered light gray chert grains, occasional granule, estimated 0-5% porosity, no show, porosity due to recrystallization of silica cement.
19,485-19,495	Sandstone: as above, becoming fine to medium grained, increasing silica, partly quartzitic, tight, no shows, coal and shale partings.

19,495-19,517 Sandstone: clear to gray, medium to coarse grained, subangular to subrounded, scattered very coarse grains, occasional light gray chert grain, partly altered, occasional coal clast, increasing grain size downward, becomes very coarse grained and conglomeratic at 19,510-19,517', 3-5% porosity, slight gas kick on connection at 19,497', no fluorescence or cut.

19,517-19,521 Sandstone: clear to gray, as above, tight, with coal and shale stringers.

19,521-19,545 Sandstone: clear to gray, coarse to very coarse grained, subangular to subrounded, quartzose, siliceous, slightly argillaceous, occasional coal grain, 3-7% porosity, trace gas on connection at 19,522', no fluorescence or cut.

19,545-19,578 Sandstone: light buff, very light gray, predominantly coarse to very coarse grained, occasional fine to medium grained streaks, scattered granules, subangular to angular, siliceous, slightly calcareous to dolomitic, occasional light gray chert grain, partly altered, rare coal grain, sandstone matrix appears slightly altered, hard, tight, no shows.

19,578-19,592 Shale: black, very dark gray, hard, partly fissile, partly cherty, very micaceous streaks, slightly schistose, with interbedded Siltstone: dark to very light gray, siliceous, shaly, partly banded, coal partings.

19,592-19,635 Sandstone: buff, very light gray, medium to very coarse grained, slightly conglomeratic streaks, subrounded to subangular, predominantly quartzose, scattered light gray chert grains, partly altered, trace coal grains, siliceous, dolomitic, matrix appears slightly altered, streaks with slight porosity, 3%, no show, occasional thin black shale partings.

19,635-19,650 Sandstone: very light to medium gray, fine to medium grained, occasional coarse grained, subrounded to subangular, siliceous, dolomitic, partly shaly, hard, tight, no show, thin dark gray and black shale stringers, thin coal bed at 19,635'.

19,650-19,677 Sandstone: light to dark gray, fine to medium grained, partly conglomeratic, subangular to rounded, siliceous, shaly, slightly dolomitic, light and dark gray chert granules and pebbles, quartz pebbles, occasional porous streak, 3%, thin black and dark gray shale beds, partly carbonaceous, very micaceous streaks.

19,677-19,684 Conglomerate: very light gray, buff, subrounded to subangular, light and dark gray chert and quartz

pebbles, very fine crystalline silica and dolomite cement, slight porosity, 3-5%, no show, rock appears slightly altered.

19,684-19,686 Shale: black, hard, siliceous, slightly brecciated, trace very fine quartz veins or fracture fill, partly argillite, coal partings.

19,686-19,692 Sandstone: very light to dark gray, fine to very coarse grained, slightly conglomeratic, argillaceous to shaly, siliceous, partly quartzitic.

19,692-19,723 Sandstone: light buff to dark gray, fine to very coarse grained, slightly conglomeratic, subrounded to subangular, siliceous, dolomitic, partly with carbonaceous shaly matrix, becomes slightly porous at 19,705', thin coal bed at 19,715'.

19,723-19,728 Coal: anthracite, hard, shiny, brittle.

19,728-19,735 Shale: black, very dark gray, micaceous, carbonaceous, partly argillite, trace very fine quartz veins, with dark gray sandstone, very fine grained and siltstone, very dark gray, shaly, carbonaceous in upper 3'.

19,735-19,783 Sandstone: light to dark gray, very fine to fine grained, subangular, occasional rounded granule, siliceous, argillaceous to shaly, carbonaceous, scattered coal grains, partly silty, with thin interbedded and interlaminated Siltstone: medium to very dark gray, shaly, carbonaceous, siliceous, and Shale: black to dark gray, slightly micromicaceous, partly siliceous and cherty, occasional very fine parting with light gray, moderately soft mineral, quartz(?), thin anthracite coal stringers.

19,783-19,794 Sandstone: very light to dark gray, very fine to fine grained, grading to medium grained, trace coarse grained, subangular to subrounded, partly silty and shaly, very light gray and white altered chert grains, scattered black argillite and chert grains, rare coal grains, very slight porosity, no show.

19,794-19,797 Coal: anthracite.

19,797-19,806 Interbedded Sandstone: as above, Siltstone: black and dark gray, and Shale: black, carbonaceous with thin coal bed at base.

19,806-19,848 Sandstone: medium gray to clear, fine grained, grading downward to very coarse grained and slightly

conglomeratic, subrounded to angular, predominantly quartzose, scattered very light gray and white altered chert grains, occasional light and dark chert granule, occasional black shale parting, rock appears slightly altered and recrystallized, occasional porous streaks, 0-7%, trace gas at 19,842', no fluorescence or cut.

19,848-19,851 Shale: black, hard, fissile, carbonaceous, and coal, anthracite, very shiny, appears slightly greasy.

19,851-19,916 Sandstone: clear to very light gray, very coarse to coarse grained, occasional granules, siliceous, partly quartzitic, scattered very light gray and white altered chert grains, streaks with slight porosity, occasional coal grains and inclusions, occasional thin shale stringers, conglomeratic streaks, possible fractures at 19,870-19,880' with clear and milky quartz fill.

19,916-19,957 Sandstone: very light gray, clear, coarse to very coarse grained, occasional granule and pebble, angular to subangular, light altered chert grains, partly altered to clay, becomes slightly conglomeratic, 3-7% porosity, rock appears slightly altered.

19,957-19,960 Shale: black, fissile, carbonaceous, mica, with anthracite coal bed.

19,960-19,985 Sandstone: as above, occasional light green-gray chert pebbles 19,975-19,980', 3-5% porosity.

19,985-19,988 Shale: black, mica, rare pyrite, slightly phyllitic, coal partings.

19,988-19,995 Shale: dark gray to black, firm, occasionally slightly phyllitic with coal partings.

19,995-20,010 Siltstone: medium gray, mottled, firm, interbedded with Shale: as above, and coal.

20,010-20,030 Sandstone: fine to medium grained in part medium to coarse grained, subangular quartz, tight, quartz overgrowth white to light gray, few large chert fragments.

20,030-20,035 Sandstone: as above, interbedded with Shale: dark gray, firm, and Siltstone: medium gray, firm, and coal.

20,035-20,050 Sandstone: white to clear, medium to coarse grained, hard, quartzose, subangular, tight, no shows, no porosity.

20,050-20,080	Sandstone: white to light gray, fine to medium grained, clear, white quartz, lightly compacted, siliceous to quartzitic, tight, hard, with occasional patch of soft white clay mineral alteration.
20,080-20,091	Sandstone: light gray to white, medium to coarse grained, clear, white, milky quartz, light gray chert and dark gray argillite grains with disseminated pyrite and quartz veinlets, hard, tight, no porosity, no shows.
20,091-20,102	Core No. 23, Cut 11', Recovered 2'.

20,091.0-20,091.5 (0.5')	Sandstone: medium to dark gray, medium to coarse grained, hard, tight, argillaceous, subangular to angular, white, clear, milky quartz, and chert, predominantly dark gray argillite grains.
20,091.5-20,091.55 (0.05')	Coal parting, anthracite, slickensides.
20,091.55-20,092.58 (1.03')	Shale: black to dark gray, hard, silty, with finely disseminated pyrite and mica, thin coal partings with traces of graphite and talc, bedding dips of 32°.
20,092.58-20,093.0 (0.42')	Sandstone: medium gray, fine to medium to coarse grained, poorly sorted, graded bedding coarse at bottom and becoming fine towards top, subangular to angular, hard, tight, coal pods, dips of approximately 30°, no shows, no porosity.
20,093.0-20,102.0 (9.0')	No recovery.

TOTAL DEPTH: 20,102 feet.

FOOTNOTE: Because of incomplete sample descriptions on some portions of the well, the samples were rerun at a later date by R. G. Brockway, American Stratigraphic Co. (see Amstrat log No. A-352).

LOGGING REPORTS AND ANALYSIS

NOTE: Formation tops listed in this section are preliminary tops picked at the wellsite and may or may not agree with final correlations.

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

LOGGING REPORT

WELL NAME INIGOK TEST WELL NO. 1

Date June 15, 1978 Driller Depth 2625

Elevation 163' KB Logger Depth 2616

Logs Run and Intervals

DIL - 506' - 2616'

BHC - GR 50' - 2590'

Additional Logs to Run

None

Zones of Interest None

Depth	Gross Thickness	Net Feet of Porosity	Lith	Porosity	Probable Fluid Content

Discussion:

Log Tops & Correlations:

Additional Evaluation Plans:

ARLEN EHM
Wellsite Geologist

Log Analyst

HUSKY

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

LOGGING REPORT

WELL NAME INIGOK TEST WELL #1

Date August 4 and 5, 1978 Driller Depth 8315'

Elevation 163' K.B. Logger Depth 8310'

Logs Run and Intervals

Dual Laterolog - MSFL	2593-8310'
Neutron-Density	2594-8310'
Compensated Sonic	2594-8310'

Additional Logs to Run

Zones of Interest

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

Discussion:

Borehole exrremely washed out causing erratic log responses and cancellation of dipmeter and sidewall cores.

Log Tops & Correlations:

	Inigok	Fish Creek
Torok top not readily apparent on poor quality logs - possibly	3360' ?	3710'
Fortress Mt	7180'	4800'
Spot correlation (GR)	7125'	(SP) 4620'
Spot correlation (GR)	7950'	(SP) 5520

Additional Evaluation Plans:

R. BROCKWAY
Wellsite Geologist

A. KANE
Log Analyst

C-3

12/77

97.

Log Analysis

ARMOUR KANE

Formation Evaluation

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

August 9, 1978

Mr. S. L. Hewitt
Husky Oil/NPR Operations, Inc.
2525 C Street, Suite 400
Anchorage, Alaska 99503

Dear Mr. Hewitt:

Schlumberger began logging operations on Inigok Test Well No. 1 at 0330 hours on August 4, 1978, and completed Dual Laterolog, Neutron-Density and Compensated Sonic at 0700 hours August 5, 1978. Dipmeter and sidewall cores were cancelled due to the extremely washed out borehole. Because of some anomalous log responses on the DLL-MSFL it was re-run with different down-hole tools and panels, and while the repeat was not a true layover with the first run the essential trends were about the same. With tool orientation different between the two runs, the MSFL calipers revealed that the borehole is elliptical with the long diameter being in excess of 24" and the short diameter ranging from 18"-19". The large hole was confirmed by the FDC caliper although its reach was a maximum of 21". Due to the very low porosities recorded by the FDC, an 800 foot section of the bottom of the hole was re-run with different tools and panels, and while again the repeat was not perfect, the first run was confirmed. It appears that the shale density is very high, in the order of 2.65 g/cc.

Quantitative analysis reveals the presence of no hydrocarbons in the sands from casing to 2920 or in the sandstones from 7125-7180 and 8120 to total depth. Porosities in these zones are low, from 3% to 9% , precluding the possibility of production.

Correlations were not readily apparent but the top of the Torok has been tentatively put at 3360 and Fortress Mountain at 7180 vs. 4800 at Fish Creek. Two possible spot correlations are Inigok 7125, Fish Creek 4620, and Inigok 7950 , Fish Creek 5520 but these are not precise.

In the interest of better logging conditions I would suggest that in future when a 17½" is required it be drilled at 12¼", logged and then reamed to 17½" to avoid the problems encountered on Inigok.

Very truly yours,

Armour Kane

Armour Kane

HUSKY

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

LOGGING REPORT

WELL NAME INIGOK TEST WELL #1

Date Sept. 14, 15, 16, 1978 Driller Depth 12,311'

Elevation 163' KB Logger Depth 12,255'

Logs Run and Intervals

Dual Laterolog-MSFL	Casing - 12,255'
Neutron-Density	Casing - 12,252'
Compensated Sonic	Casing - 12,285'
Dipmeter	Casing - 12,285'

Additional Logs to Run

Zones of Interest

Depth	Gross Thickness	Net Feet of Porosity	Lith	Porosity	Probable Fluid Content
Very little sand - No zones of interest.					

Discussion:

Very unsatisfactory logging job. Kingak upper correlations based on the usual sudden resistivity decrease. Deeper Kingak correlation at No. Kalikpik is from Paleo. Deeper Kingak correlation at Inigok correlates with Kalikpik paleo point. Pebble shale pick is at top of gamma ray anomaly.

Log Tops & Correlations:

	Inigok	North Kalikpik	Fish Creek
Pebble Shale	9040	6896	7090 poss.
Kingak	9150 from log anomaly	7052 from log anomaly	
	9262 correl. w/Kalikpik	7148 from paleo	
Sag River	12,166		9217
Shublik	12,220		9322

Additional Evaluation Plans:

A. EHM
C-5 Wellsite Geologist
A. KANE
Log Analyst

12/77

Log Analysis

ARMOUR KANE
Well Log Analyst
18360-8 Cantara St
Reseda, Ca. 91335
(213) 993-0586

Formation Evaluation

September 21, 1978

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

Dear Mr. Hewitt:

Schlumberger began logging operations on Inigok Test well No. 1 at 0100 hours September 14, 1978 and finally completed Dual Laterolog-MSFL, Neutron-Density, Sonic, Dipmeter, Velocity Survey and Sidewall Cores on the afternoon of September 16, 1978. Much lost rig time was encountered due to equipment of the DLL and CNL-FDC failing and some engineer ineptitude. No trouble was experienced with the Sonic and Dipmeter but a satisfactory DLL was never obtained.

Formation tops encountered were: Pebble Shale at 9040 correlating with 6896 at North Kalikpik, the top being picked at the top of the GR anomaly; Kingak at 9150 compared to 7052 at North Kalikpik. This correlation is based on the characteristic decrease in resistivity on the log. A deeper correlation at Kalikpik is from paleo analysis at 7148 and the corresponding point at Inigok is 9262. The Sag River top is 12,166 as compared to 9217 at Fish Creek and the Shublik was topped at 12,220 compared to 9322 at Fish Creek.

Very little sand was encountered from casing to total depth and none was of any interest from a production standpoint. The Sag River indicated a very silty, tight formation of low porosity and no indication of hydrocarbon accumulation. Correlations with the Fish Creek and North Kalikpik wells were very good. 43 of 44 sidewall cores selected were recovered.

Very truly yours,

Armour Kane

Armour Kane

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

LOGGING REPORT

WELL NAME INIGOK #1

Date February 14 - 18, 1979 Driller Depth 17,571'

Elevation 163' KB Logger Depth Tool not taken to TD; fish in hole

Logs Ran and Intervals

SP/GR/DIL (2 runs)	12,268 - 17,277'
SP/GR/DLL (2 runs)	12,266 - 15,998'
GR/BHC	12,270 - 17,350'
GR/CAL/CNL/FDC (3 runs)	12,266 - 16,000'
HRD - Dipmeter (2 runs)	12,260 - 16,000'

Additional Logs to Run

CST-Sidewall Samples	12,464 - 14,375'
Birdwell Velocity Survey	12,162 - 14,375'

Zones of Interest

Depth	Gross Thickness	Net Feet of Porosity	Lith	Av Porosity	Probable Fluid Content
12,964-99'	35	35	Sandstone	20%	Water

Discussion:

All other Sadlerochit Sands are of low porosity: 10% or less

Log Tops & Correlations:

	Inigok	Itkillik River
Sadlerochit	12,640'	10,272'
Kavik	13,314'	11,070'
Echooka	13,657'	11,370'
Base Echooka	13,848'	
Lisburne Transition	13,980'	
Main Lisburne	14,464'	11,514'

Additional Evaluation Plans:

Ron Brockway

C-7 Armour Kane Wellsite Geologist

Log Analyst

12/77

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Log Analysis

ARMOUR KANE

Well Log Analyst
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Reseda, Ca 91335
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Formation Evaluation

February 21, 1979

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

Dear Mr. Hewitt:

Logging operations were begun by Schlumberger on Inigok Test well No. 1 at midnight February 13, 1979, and by 0800 hours, February 17, 1979, two DIL, two DLL, 1 BHC, three CNL/FDC and two HRD surveys were completed after many tool failures and mis-runs. Log quality as finally obtained was acceptable but just barely. This is no reflection upon the engineers but is a sad commentary upon the condition of the surface and down-hole equipment. It is true hole conditions were not conducive to the best logging operations with high temperatures (342°), wash-outs and bridges.

Formation tops were: Sadlerochit 12,640, Kavik 13,314, Echooka 13,848, a Lisburne transition zone at 13,980 and the main Lisburne at 14,464. Correlations with the Itkillik River well were good both from electric logs and lithology logs. The thickening of the Echooka and the Lisburne transition did not appear in the Itkillik River well.

The Sadlerochit sands were mostly low porosity, 10% or less, except for an interval from 12,964 to 12,999 where the average porosity was 20% and water saturation from 82% to 100% based on Rwa calculations. The Echooka interval indicated porosities of 6.5% to 8.5% with some water saturations of less than 60% from Rwa calculations, but these determinations are not precise and are open to question.

Very truly yours,

Armour Kane

Armour Kane

Log Analysis

COMPANY: HUSKY OIL/NPR OPERATIONS, INC. | WELL: INIGOK #1

FIELD: NPRA | COUNTY: NORTH SLOPE | STATE: ALASKA

DEPTH	R_T	ϕ_D	ϕ_N	X-PLOT q_c	R_{mf}	S_w	REMARKS
SADLEROCHIT							
12965-72	2.5	24	15.5	20	.12	91	
12972-82	3.0	22.5	18	20.5	.15	82	
12982-92	2.6	22	18	20	.13	88	
12992-94	2.3	21.5	13	18	.10	100	
ECHOOKA							
13680-90	90	11	5.5	8.5	.65	56	
13690-13700	80	12	4.5	8.5	.60	58	
13744-50	65	10.5	3.5	7.0	.30	82	
13810-20	50	9.5	3.0	6.5	.20	100	

Log Analysis

ARMOUR KANE
Well Log Analyst
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(213) 993-0586

Formation Evaluation

February 28, 1979

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

Dear Mr. Hewitt:

The following is a chronological report of the logging operations on Inigok Test Well No. 1:

2/14/79 - 0000 - Began DIL - Finished at 0630. No marks on cable. Log invalid, ILm too low and erratic, IL_D too high and questionable.
2/14/79 - 0630 - Began BHC - Finished at 1500. Log skipping badly as well as "spiking". Had some sticking at 17,000±. Maximum Temperature at 17,200 was 342°F.
2/14/79 - 1500 - Changed DIL tools and began 2nd attempt. Finished at 2000. Same problem as before and logs failed to repeat. ILm was somewhat higher, LL_8 runs repeated. Actually, due to high formation Rt and very saline mud, the DIL should not have been attempted. We called for and received DLL tools from Dead Horse.
2/14/79 - 2000 - Began DLL, finished 0330, 2/15/79. Tool stuck in hole at 16,980 but worked free after about 1½ hours. Log invalid, LL_d completely wild and useless and in places saturated at less than 200 ohms. LL_s was good overlay of IL_d from DIL. Recorded 20' off depth.
2/15/79 - 0330 - Began CNL/FDC - finished 1300. Used the high temp. tools but log invalid. ϕ_N showed negative ϕ of 3 - 6%, FDC ϕ very high and erratic. Caliper apparently jammed in spots and operating erratically. Film jammed on one roll due to defective recorder.
2/15/79 - 1300 - Changed CNL/FDC to conventional set. Found and repaired a short in a panel connector cable, could not repair recorder so called Dead Horse to fly in replacement. Still on the surface at 1900. Lost time to this point: 43 hours.
2/15/79 - 1900 - Decided to re-run DLL while awaiting new recorder. Finished 0130, 2/16/79. Log acceptable but recorder cut off depth numbers on 2" film.
2/16/79 - 0200 - Began 2nd CNL/FDC with conventional tool - finisned 0830. FDC, Caliper and GR OK but CNL went completely dead.
2/16/79 - 0900 - Began 3rd CNL/FDC after changing CNL tool, finished 1230, Log OK.
2/16/79 - 1400 - Began BHC, finished 1730. Engineer Rather dissatisfied with log and requested re-run. Had galvo trouble on first run, found leaks in head before second run - repaired. On 2nd run pads opened while still in casing and wouldn't close - tool low on oil - finished log 0800, 2/17/79. Still bothered with the galvo problem so that #1 dip curve did not print on the film but was recorded on the tape. Apparently, according to Rather, the galvo was being affected by some stray DC current which he could not find.

IRQ

Total of lost time and down time is approximately 60 hours.

2/17/79 - Round trip to circulate and condition mud. Ran velocity survey 12,162 to 14,375.

2/18/79 - Began CST Run #1, interval 13,045 - 14,375. Shot 30 cores, recovered 13, 1 misfire.

2/19/79 - Began CST Run #2, interval 12,339 - 14,306. Attempted 30 shots, recovered 6, 8 bullets shot off. The #3 wire on core gun was not operative and Gamma Ray stopped operating. Result: many misfires. Completed logging operations at 0600, on 2/19/79.

Armour Kane

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

LOGGING REPORT

WELL NAME INIGOK #1

Date APRIL 26 - 27, 1979 Driller Depth 19,273

Elevation 163' KB Logger Depth 19,250'

Logs Ran and Intervals

GR/DLL	17,394-19,225' (Depths are 16' shallow)
GR/CAL/CNL/FDC	15,500' (CNL), 17,410' (CNL/FDC)-19,250'
GR/BHC	17,410' (GR 16,500')-19,243'
HRD-Dipmeter	17,406-19,243'
Velocity Survey	16,320-TD

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:

All sandstones are of very low porosity and extremely high density reaching from 2.8 to 2.95 g/cc. Some sonic travel time as low as 45 μ sec/ft. Many zones of high gamma radiation ranging up to 160 API units. Maximum recorded temperature was with BHC at 350°

Log Tops & Correlations:

	INIGOK	ITKILLIK RIVER
Kekiktuk	18,174' (+16')	14,590'
Correlation Marker	18,230' (+16')	14,660'
Correlation Marker	18,520' (+16')	14,930'

Additional Evaluation Plans:

ARLEN EHM
C-12 Wellsite Geologist
ARMOUR KANE
Log Analyst

12/77

Log Analysis

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

Formation Evaluation

May 1, 1979

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

Dear Mr. Hewitt:

Logging operations were begun by Schlumberger on Inigok Test Well No. 1 at 0230 hours on April 26, 1979, and by 1200 hours of the same day the DLL and CNL/FDC had been completed. Both logs were of very good quality, although the DLL was recorded 16' shallow. Maximum recorded temperature on both runs was 348°. A clean-out run to condition and cool the mud was then made and completed at 0430 hours April 27, a total of 16 hours. At 0500 the first HRD attempt was begun, but, due to temperature the tool failed after recording 200 feet from bottom. Maximum temperature 340°. The second set of HRD was run in the hole and managed to log from bottom to 18,400 before it too failed due to temperature. Maximum recorded temperature 340°. A third set of HRD equipment was ordered from Dead Horse and in the interim the BHC was run resulting in a very good log. Maximum recorded temperature 350°. The third set of HRD resulted in an acceptable log. Birdwell Velocity Survey was completed at 2000 hours on April 27. Maximum recorded temperature 358°.

Top of the Kekiktuk was found at 18,174 and correlated well with the Itkillik River well at 14,590. Some good marker correlations were found at 18,230 in Inigok vs 14,660 in Itkillik, and 18,520 vs. 14,930. Sixteen feet should be added to the above Inigok figures since the DLL was recorded 16' shallow.

All sandstone and limestone intervals were of very low porosity, 0 to 1.5%, and some intervals indicated extremely high bulk densities from 2.8 to 2.95 g/cc, while some extraordinarily high sonic velocities were recorded, in the order of 45 to 47 microseconds per foot. In my experience this is quite rare.

Engineers Rathert and Bond are to be commended for a very efficient and trouble-free job under trying conditions of great depth and high temperatures.

Very truly yours,

Armour Kane

Armour Kane

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

LOGGING REPORT

WELL NAME INIGOK #1

Date MAY 12, 13, 14, 1979 Driller Depth 20,091'

Elevation 163' KB Logger Depth 20,061'

Logs Run and Intervals

		MAX TEMP.
GR/DLL	17,410-20,046'	362°F.
GR/CAL/CNL/FDC	19,000-20,060	365°F.
HRD-Dipmeter	19,100-20,067'	362°F.
GR/BHC	19,000-20,055'	369°F.
Birdwell Velocity Survey	15,900-20,063'	372°F.

Additional Logs to Run

Zones of Interest

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

Discussion:

All sandstone beds are of low porosity: less than 1% to 3%

Log Tops & Correlations:

No recognizable tops or correlations.

Additional Evaluation Plans:

DAVE YOUNG
Wellsite Geologist

C-14

ARMOUR KANE
Log Analyst

Log Analysis

ARMOUR KANE

Formation Evaluation

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

May 21, 1979

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

Dear Mr. Hewitt:

At 1800 hours on May 12, 1979, Schlumberger began final logging operations on Inigok Test Well No. 1 and completed DLL and CNL/FDC at 0030 hours May 13. The DLL was re-run from bottom up to the casing shoe to correct the depth discrepancy of the previous run. Both logs were of good quality and no lost rig time was incurred. An 18-hour clean-out run was then made to cool and condition the mud and Schlumberger then ran HRD, BHC and Birdwell Velocity Survey, finishing at 0600 hours May 14, 1979. Some lost rig time was incurred with the BHC due to a gamma ray tool failure but total elapsed time was 36 hours, 18 hours of which were due to the clean-out run. Maximum temperatures went from 362° on the DLL to 372° on the velocity survey. The clean-out run accomplished a reduction of only 3° between the CNL/FDC and the HRD. All logs run by engineers Rathert and Chaffy were of good quality. No recognizable log tops or correlations with other wells were found.

Two strange anomalies at 19,432-38 and 19,690-98 appeared on the logs exhibiting a very low resistivity of 0.5 ohm-meters and very high porosity, in the order of 50-55% from density, 30%+ from neutron and 45% from the sonic. If the Rwa technique is employed using $\emptyset_s$ of 45% and Rt of 0.5, Rw_a is found to be 0.14. The apparently clean sandstones in the bottom few hundred feet are of very low porosity, 0-1%, but one interval from 20,004-18 indicates a CNL/FDC cross-plot $\emptyset$ of 3%, a formation factor of roughly 1000 and an average Rt of 130 ohm-meters. This results in Rw of 0.13, a fair check of the results in the two anomalous zones. Nothing unusual was recorded on the lithology log in these two zones and I am at a loss to explain the log responses. However, no possible productive zones are seen in the logs.

Very truly yours,

Armour Kane

Armour Kane

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

Company USGS/HUSKY OIL COMPANY, OPR Formation _____ Page 1 of 2
Well INIGOK #1 Cores DIAMOND File BP-3-529
Field WILDCAT Drilling Fluid WBM Date Report JUNE 6,1979
County NORTH SLOPE State ALASKA Elevation _____ Analysts WSP
Location _____ Remarks PERM & BOYLES LAW POROSITY

CORE ANALYSIS RESULTS

(Figures in parentheses refer to footnote remarks)

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS			POROSITY PERCENT	GRAIN DENSITY	RESIDUAL SATURATION		REMARKS
		Horizontal Maximum	Horizontal 90°	Vertical			Oil % Pore	Total Water % Pore	
1	8211	0.0			7.1	2.72			ss,vfg,v slty ,calc
2	8212	0.0			7.9	2.72			same
3	8213	0.0			8.4	2.71			same
4	8214	0.0			8.5	2.72			same
5	8215	0.1			8.1	2.72			same
6	8216	0.1			6.8	2.72			same
7	8217	0.0			8.4	2.73			same
8	8220	0.1			8.2	2.71			same
9	8221	0.1			7.6	2.69			same
10	8223	0.0			8.9	2.71			same
11	8224	0.0			8.8	2.72			same
12	8225	0.1			8.6	2.71			same
13	8226	0.0			8.7	2.71			same
14	8227	0.0			8.9	2.71			same
15	8228	0.0			8.4	2.72			same
16	8229	0.1			9.1	2.72			same
17	8230	0.1			9.1	2.72			same
18	8231	0.0			9.0	2.71			same
19	8232	0.1			8.7	2.71			same
20	8233	0.1			8.3	2.71			same
21	8234	0.0			8.5	2.71			same
22	8235	0.0			8.5	2.71			same
23	8236	0.0			9.1	2.72			same
24	8237	0.0			8.1	2.71			same
25	8238	0.0			8.3	2.72			same
26	8239	0.1			8.3	2.72			same

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

Company USGS/HUSKY OIL COMPANY, OPR. Formation _____ Page 2 of 2
Well INIGOK NO. 1 Cores DIAMOND File BP-3-524
Field WILDCAT Drilling Fluid WBM Date Report 5/2/79
County NORTH SLOPE State ALASKA Elevation _____ Analysts WSP, KR
Location _____ Remarks BOYLES LAW POROSITY

CORE ANALYSIS RESULTS

(Figures in parentheses refer to footnote remarks)

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS			POROSITY PERCENT	GRAIN DENSITY	RESIDUAL SATURATION		REMARKS
		Horizontal Maximum	Horizontal 90°	Vertical			Oil % Pore	Total Water % Pore	
1	19361.6	0.0			3.2	2.64			ss,vf-cg, sil
2	19364	0.1			3.0	2.64			ss,vcg,cong,sil
3	19368.2	0.0			1.3	2.63			ss,vfg,sil

105

IRD

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.
TELEPHONE (907) 279-4014 P.O.BOX 4-1276 4649 BUSINESS PARK BLVD
ANCHORAGE, ALASKA 99509

ANALYTICAL REPORT

Company Husky Oil Company Type of sample Sulfur Compound
Address Anchorage, Alaska Date January 2, 1979 Lab. No. 9434
Other Pertinent Data Ditch Sample 17570' Inigok #1

Analytical method ICAP Analytical classification

CONFIDENTIAL

	ELEMENT	ppm		ELEMENT	ppm
1	Silver	<10		Tungsten	<10
2	Aluminum	100		Titanium	4
3	Arsenic	<10		Zirconium	<10
4	Gold	<10		Cesium	<50
5	Boron	<10		Tellurium	<50
6	Barium	1260		Rubidium	<50
7	Bismuth	<1		Beryllium	<10
8	Calcium	32200		Lithium	<10
9	Cadmium	<1		Sulfur	(94%)
10	Cobalt	<1			
11	Chromium	25			
12	Copper	257			
13	Iron	630			
14	Mercury				
15	Potassium	<100			
16	Magnesium	376			
17	Manganese	17			
18	Molybdenum	<1			
19	Sodium	93			
20	Nickel	2			
21	Phosphorous	18			
22	Lead	15			
23	Platinum	<10			
24	Antimony	<1			
25	Selenium	<10			
26	Silica				
27	Tin	<10			
28	Strontium	45			
29	Vanadium	<1			
30	Zinc	52			
	Threshold				

ND - Not detected

Remarks CONFIDENTIAL

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.
P.O. BOX 4-1276
5633 "B" STREET
ANCHORAGE, ALASKA 99509
TELEPHONE
279-4014

ANALYTICAL REPORT

From Husky Oil Company
Product Mud
Address Anchorage, Alaska
Date January 18, 1979
Other Pertinent Data

Analyzed by SK
Date January 26, 1979 Lab No. 9561

REPORT OF ANALYSIS
DRILL CUTTING & MUD SAMPLES
NO. 1 INIGOK
NRA, ALASKA

Samples received January 18, 1979

SAMPLE	% by Dry Weight ELEMENTAL SULFUR	% by Dry Weight SULFIDE SULFUR
1	21	0.21
2	16	0.22
3	34	0.26
4	36	0.49
5	55	0.34
6	67	0.21
7	39	0.38

QUANTITATIVE ANALYSIS OF SAMPLE NO. 1	PERCENT BY WEIGHT
Elemental Sulfur	21
Sulfide Sulfur	0.21
Ignition loss @ 700°C, less sulfur (organic material believed to be lost circulation material)	70
Iron	2.6
Calcium	1.0
Silicon	0.8
Zinc	0.7
Sodium	0.68
Barium	0.38
Magnesium	0.10
Aluminum	0.08
Chromium	0.05

QUANTITATIVE ANALYSIS OF SAMPLE NO. 4	PERCENT BY WEIGHT
Elemental Sulfur	36
Sulfide Sulfur	0.49
Ignition loss @ 700°C, less sulfur	6.4
Iron as iron oxide Fe_3O_4	17.6
Silicon as Silica	15
Calcium as calcium carbonate	14
Barium as barite	6.7
Zinc	2.0
Aluminum	0.7
Magnesium	0.28
Manganese	0.15
Lead	0.14
Copper	0.054
Chromium	0.043
Nickel	0.021

MICROSCOPIC EXAMINATION

SAMPLE	RESULTS
Sulfur Crystals	1-5% of visual field, white plastic beads, 1-2 mm diameter.

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

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

TELEPHONE (907)-279-4014
274-3384

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

WATER ANALYSIS REPORT

OPERATOR Husky Oil Company
WELL NO. Inigok Creek
FIELD North Slope
COUNTY
STATE Alaska

DATE February 15, 1979 LAB NO. 9754
LOCATION
FORMATION
INTERVAL
SAMPLE FROM Mud Filtrate

REMARKS & CONCLUSIONS: Quebracho Filtrate

Cations	mg/l	meq/l	Anions	mg/l	meq/l
Sodium	26609	1157.49	Sulfate	1160	24.13
Potassium	280	7.17	Chloride	23000	648.60
Calcium	37	1.86	Carbonate	7200	239.76
Magnesium	Trace	-	Bicarbonate	0	-
Iron	-	-	Hydroxide	4320	254.02
Total Cations		1166.51	Total Anions		1166.51

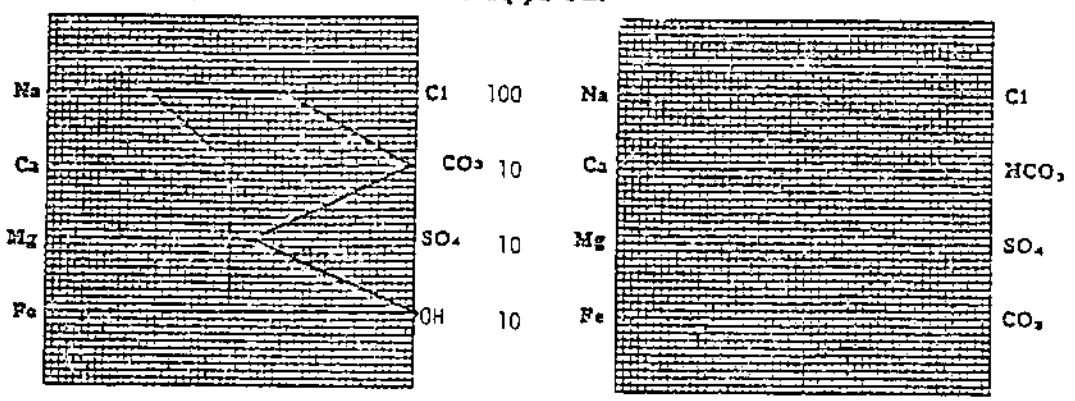
Total dissolved solids, mg/l 62506
NaCl equivalent, mg/l 94136
Observed pH 12.4

Specific resistance @ 68°F.:
Observed 0.05 ohm-meters
Calculated 0.08 ohm-meters

WATER ANALYSIS PATTERN

Sample above described

Scale
MEQ per Unit



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

UNITED STATES GOVERNMENT

memorandum

DATE: February 4, 1981

REPLY TO ATTN OF: Roger J. Witmer, ONPRA

SUBJECT: Micropaleo stage/zonule revisions

TO: NPRA consociates

Revisions for 7 A.W.A. foraminiferal and 8 palynological reports were distributed on August 18, 1980 to everyone involved in NPRA projects. Recent conversations and phone calls have led me to believe that some of you may have misplaced these reports. Since then there have also been further revisions on the foraminiferal stage/zonules for Ikpikpuk #1 and [redacted] in regard to the Jurassic-Cretaceous boundary. As a result, I am forwarding an updated set so that you can make any necessary adjustments. If you have any questions, please give me a call.

Revisions for Anderson, Warren, and Associates FORAMINIFERA REPORTS of the following NPRA Test Wells: Cape Halkett 1, J. W. Dalton 1, Ikpikpuk 1, Inigok 1, Kugrua 1, S. Meade 1, and Peard 1.

RE: USN - NPRA
Cape Halkett #1
Sec. 5, 16N/2W, U.B.M.
North Slope, Alaska

FORAMINIFERA REPORT - REVISION

3340-4430' : Early Cretaceous (Middle to Late Albian) F-9.
4430-5600' : Early Cretaceous (Albian) F-10.
5600-6000' : Early Cretaceous (Late Aptian to Early Albian) F-10 to F-11.
6000-7320' : Early Cretaceous (Aptian) F-11.
7320-7510' : Early Cretaceous (Hauterivian to Barremian) F-12 to F-13.
7510-7630' : Indeterminate age. Sandstone.
7630-7960' : Late Triassic to Early Jurassic (F-18 to F-19). Sag River Ss.? at 7950 feet.
7960-8160' : Triassic (F-19).
8160-8320' : Permo-Triassic (F-20). Sohocta Fm. lithology at 8190 feet.
8320-9020' : Middle Pennsylvanian (Manet's Zone 21).
9020-9160' : Early Pennsylvanian (Manet's Zone 20).
9160-9320' : Late Mississippian (Manet's Zone 18 to Zone 19).
9320-9770' : Possible Late Mississippian. Endicott Group?
9770-9900' : Indeterminate age. Argillite.

RE: Husky/USGS - NPRA
J. W. Dalton #1
Sec. 14, 12N/3W, U.B.M.
North Slope, Alaska

FORAMINIFERA REPORT - REVISION

8317-8960' : Probable Middle Pennsylvanian (Zone 21+).
8960-8980' : This interval remains Middle Pennsylvanian (Zone 21).

RE: Husky/USGS - NPRA
Ikpikpuk #1
Sec. 28, 13N/10W, U.B.M.
North Slope, Alaska

FORAMINIFERA REPORT - REVISION

7480-8100' : Change age to read: Early Cretaceous, Neocomian (Berriasian to Valanginian) F-13 to F-14.

8100-9100' : Change age to read: Late Jurassic (Kimmeridgian to Tithonian) F-18 to F-16.

RE: Husky/USGS - NPRA
Inigok #1
Sec. 34, 8N/6W, U.B.M.
North Slope, Alaska

FORAMINIFERA REPORT - REVISION

9060-9480' : Change age to read: Early Cretaceous, Neocomian (Hauterivian to Barremian) F-12 to F-13.

9480-10260' : Change age to read: Early Cretaceous, Neocomian (Berriasian to Valanginian) F-13 to F-14.

10260-11000' : Change age to read: Late Jurassic (Kimmeridgian to Tithonian) F-18 to F-16.

RE: Husky/USGS - NPRA
Kugrua #1
Sec. 8, 14N/26W, U.B.M.
North Slope, Alaska

FORAMINIFERA REPORT - REVISION

7220-7450' : Change age to read: Early Cretaceous (Hauterivian to Barremian) F-12 to F-13. This now means that strata from 6890 feet to 7450 feet are Early Cretaceous (Hauterivian to Barremian) F-12 to F-13.

7450-8020' : Change age to Early Cretaceous (Berriasian to Valanginian) F-13 to F-14. This means we are now suggesting that the Early Cretaceous is sitting directly on the Oxfordian (F-16) age strata in this well.

RE: Husky/USGS - NPRA
S. Meade #1
Sec. 31, 15N/15W, U.B.M.
North Slope, Alaska

FORAMINIFERA REPORT - REVISION

6760-6970' : Change age to read: Early Cretaceous (Berriasian to Valanginian) F-13 to F-14. This means we feel that the Early Cretaceous is sitting directly on Oxfordian (F-16) age strata in this well.

RE: Husky/USGS - NPRA
Peard Bay #1
Sec. 25, 16N/28W, U.B.M.
North Slope, Alaska

FORAMINIFERA REPORT - REVISION

6720-7243'SW : Change age to Early Cretaceous (Berriasian to Valanginian) F-13 to F-14. This means that, like the Kugrua #1 and S. Meade #1 wells, we now feel that we are dealing with Early Cretaceous strata sitting directly on Oxfordian (F-16) age strata.

Interpreted by:

M. B. Nickly

ANDERSON, WARREN & ASSOCIATES, INC.

Richard E. Anderson

F-2

LISTING AND SOURCE OF ADDITIONAL PERTINENT DATA

1. a. Foraminifera Report by Anderson, Warren & Associates, Inc.

   b. Palynology Report by Anderson, Warren & Associates, Inc.

   c. Revisional to Foraminifera and Palynology Reports for Inigok et al, dated February 4, 1981

2. Report to USGS...
   "Possible Source of Elemental Sulfur from Inigok Well No. 1" from Global Chemistry Corp., March 12, 1979

3. Drilling History for Inigok Test Well No. 1
   prepared by Husky Oil NPR Operations, Inc.

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