NATIONAL PETROLEUM RESERVE IN ALASKA

GEOLOGICAL REPORT

SOUTH MEADE TEST WELL NO. 1

HUSKY OIL NPR OPERATIONS, INC.
Prepared by: Geology Department

For the

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

The South Meade Test Well No. 1 is located in the NW 1/4, protracted Section 31, T15N, R19W, Umiat Meridian, approximately 47 miles south of Barrow, Alaska (see Figure 1). Drilling of the well commenced on February 7, 1978. Sloughing shale problems within the lower Torok shale, the resulting delay in sidetracking the well, and the lack of an all weather airstrip required that the well be suspended for the summer on May 17, 1978, at a depth of 8,519 feet. Drilling recommenced on December 1, 1978. The well reached final total depth of 9,945 feet (KB) on January 14, 1979. Indications of hydrocarbons (principally gas) were essentially confined to thin sandstone intervals above approximately 7,000 feet. Analysis of all available data indicated, however, that none of these intervals has any commercial potential and did not warrant testing or further evaluation.

Pre-Drilling Prognosis

The well was drilled to test potential stratigraphic traps on the crest of the Meade Arch. The primary stratigraphic objective of the well was to test the sediments near the seismically interpreted updip pinchout of the Lisburne and/or Endicott Group rocks at a structurally high position on the Meade Arch. Figure 2 illustrates the structural interpretation of the area at the "Basement" or "Argillite" horizon which directly underlies the Lisburne/Endicott interval. Figure 3 is a direct tracing from the north-south seismic section interpretation at all horizons and illustrates possible dip reversal at the deeper horizons. The actual northern limit of the Lisburne/Endicott rocks was interpreted to occur approximately 5 miles north of the South Meade location.

Potential reservoir sands were also anticipated in rock of Cretaceous, Jurassic, and Triassic-Permian age.

Post-Drilling Summary

The well was drilled to a total depth of 9,945 feet into probable Devonian(?) age metasedimentary rocks. Formation tops were generally penetrated approximately 50 to 300 feet lower than forecasted by seismic data. No economically significant shows of oil or gas were encountered in the well. The primary objectives in the Lisburne/Endicott groups were apparently absent in the well, although the clastic sediments penetrated below approximately 9,530 feet may represent at least in part thermally altered equivalents of the Endicott group. Of the sediments within this group and the overlying Permian-Triassic sediments, none exhibited any favorable reservoir properties or indications of hydrocarbon content.

The Cretaceous through Jurassic age sediments were secondary objectives of the well, but only the shallower sands of the Cretaceous age Nanushuk Group and the thin basal sands of the Torok Formation exhibited any

detectable hydrocarbons. All of the shows within this Cretaceous interval were limited to gas shows in relatively thin zones of low porosity and permeability.

Very minor shows of dead oil were noted in the Ivishak sandstones of the Sadlerochit Group between 9,300 feet and 9,400 feet.

The Jurassic age South Simpson/Kugrua sandstone at approximately 7,865 feet and the Jurassic Sag River sandstone at about 8,800 feet did exhibit some significant potential reservoir characteristics and porosity development, however, both of these sandstones were essentially 100% water saturated.

Additional details of the log and core analysis are available in the appendices to this report.

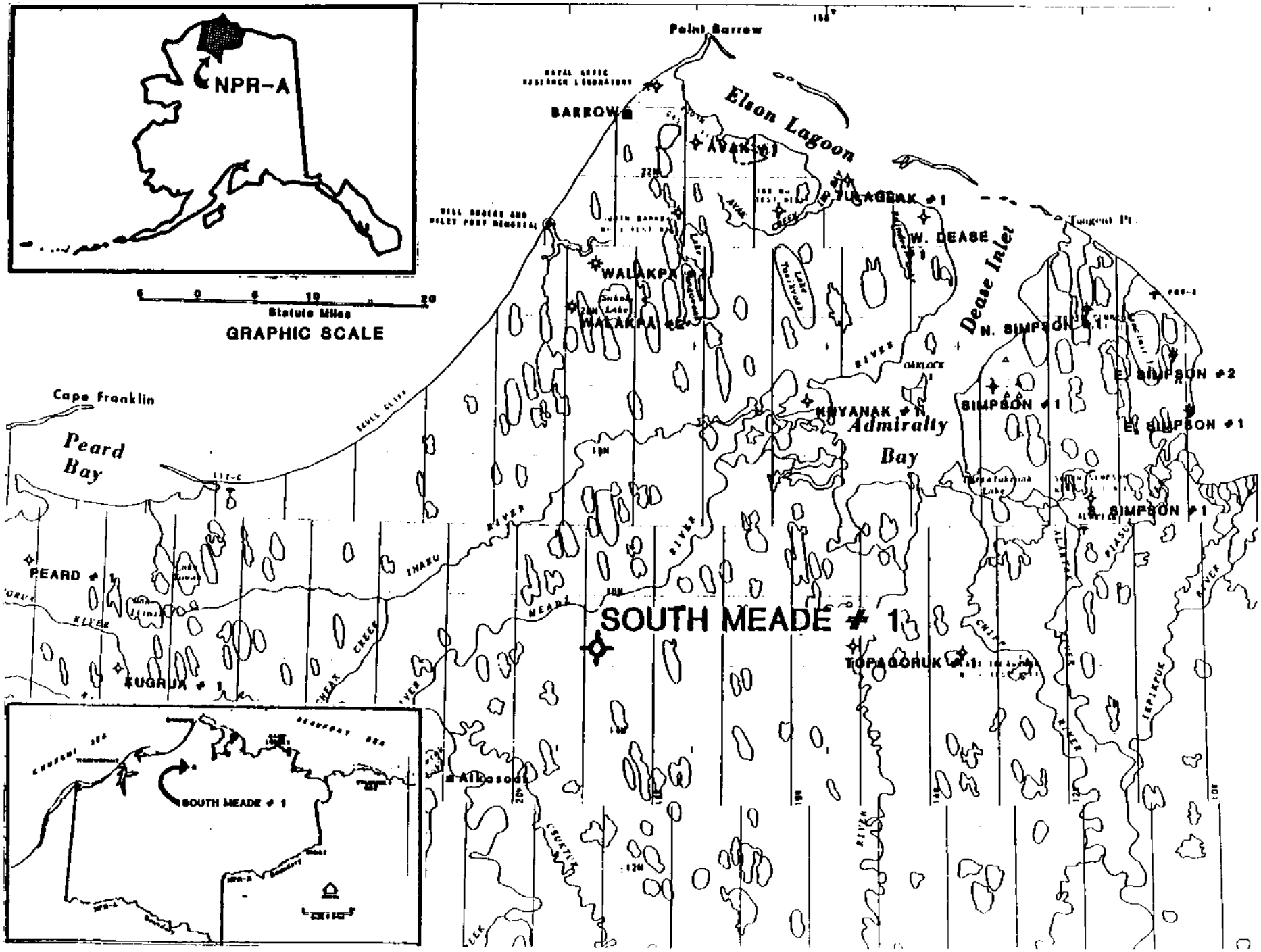
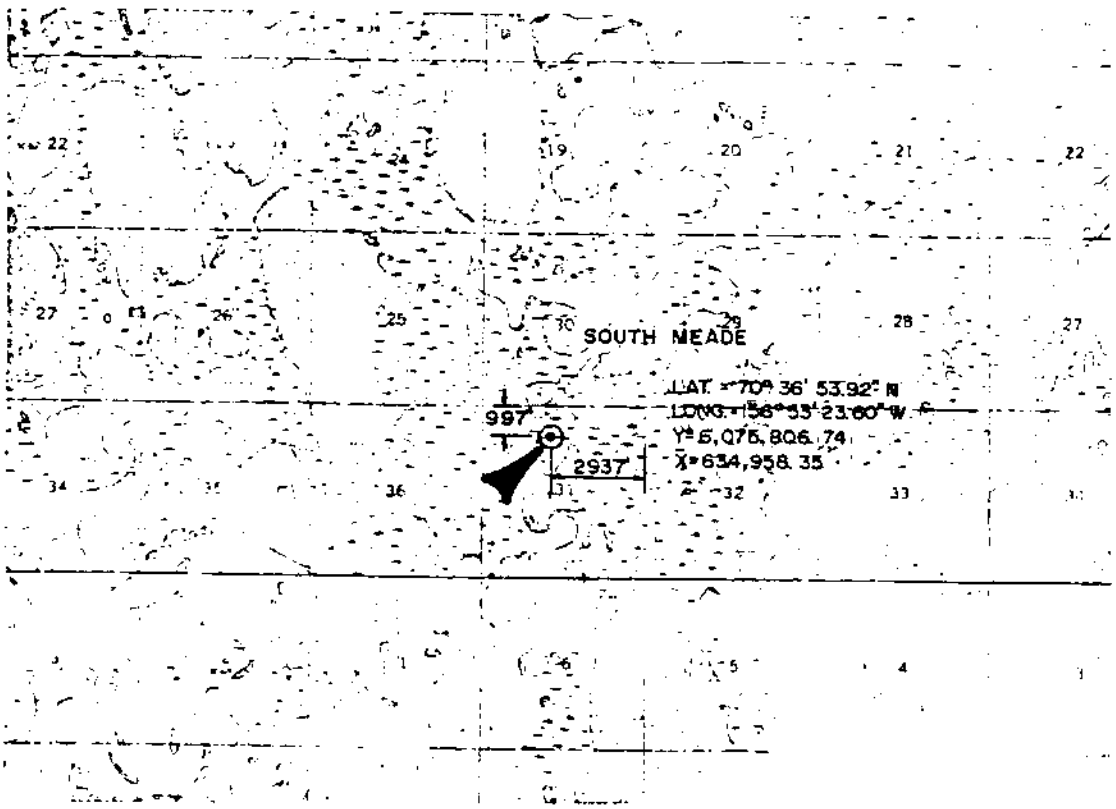


FIGURE 1 - LOCATION MAP - SOUTH MEADE NO. 1



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.

October 7, 1977

FIGURE 2
SURVEYOR'S CERTIFICATE

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

0 1/2 1 2
SCALE IN MILES

AS STAKED
SOUTH MEADE
LOCATED IN
NW1/4 PROTRACTED SEC. 31 T 15 N, R 19W, UMIAT MERIDIAN, AK

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

Surveyed by
Bell, Herring and Associates
ENGINEERS AND LAND SURVEYORS
801 West Fireweed, Suite 102
ANCHORAGE, ALASKA 99503

4

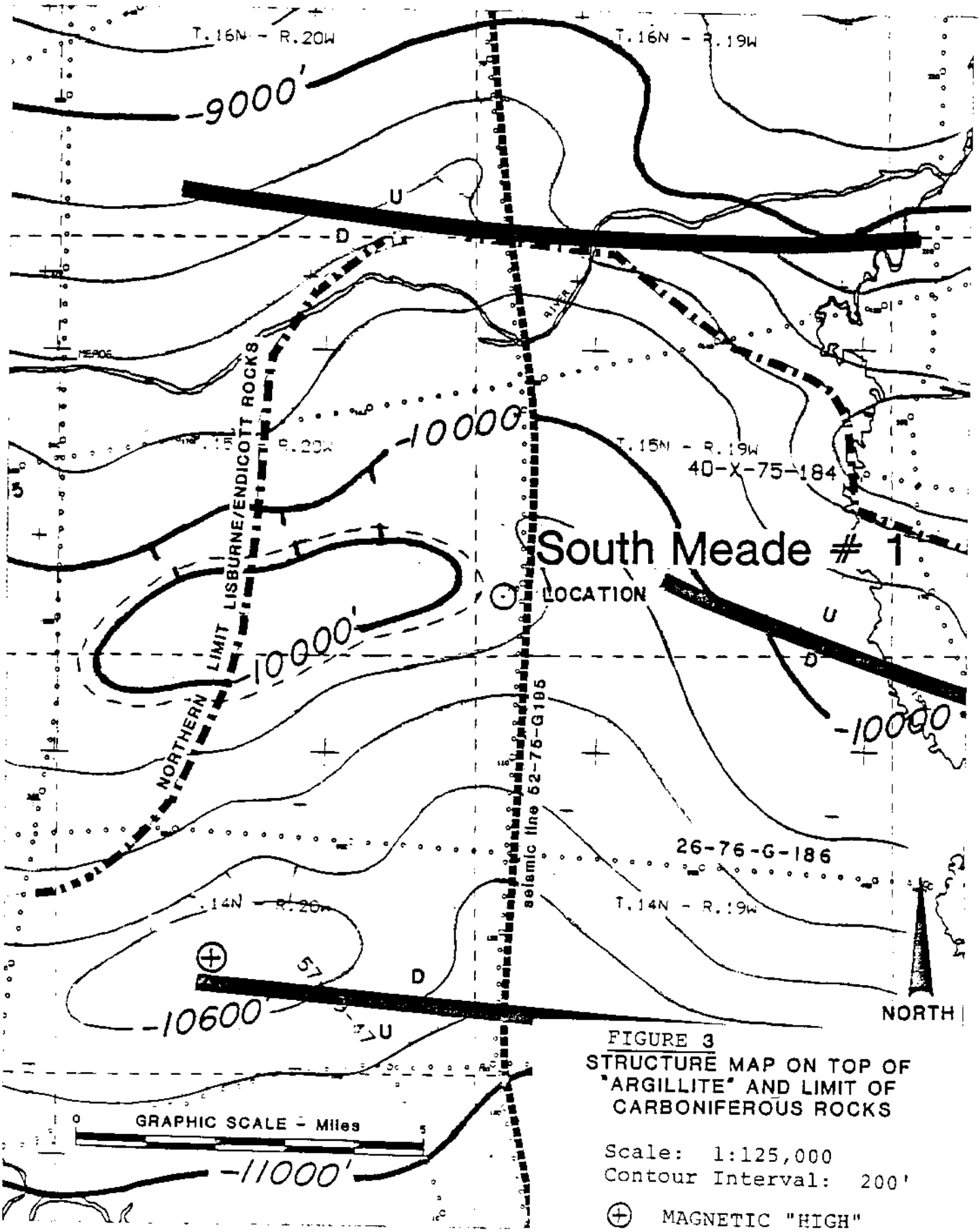


FIGURE 3
STRUCTURE MAP ON TOP OF "ARGILLITE" AND LIMIT OF CARBONIFEROUS ROCKS

Scale: 1:125,000
Contour Interval: 200'

⊕ MAGNETIC "HIGH"

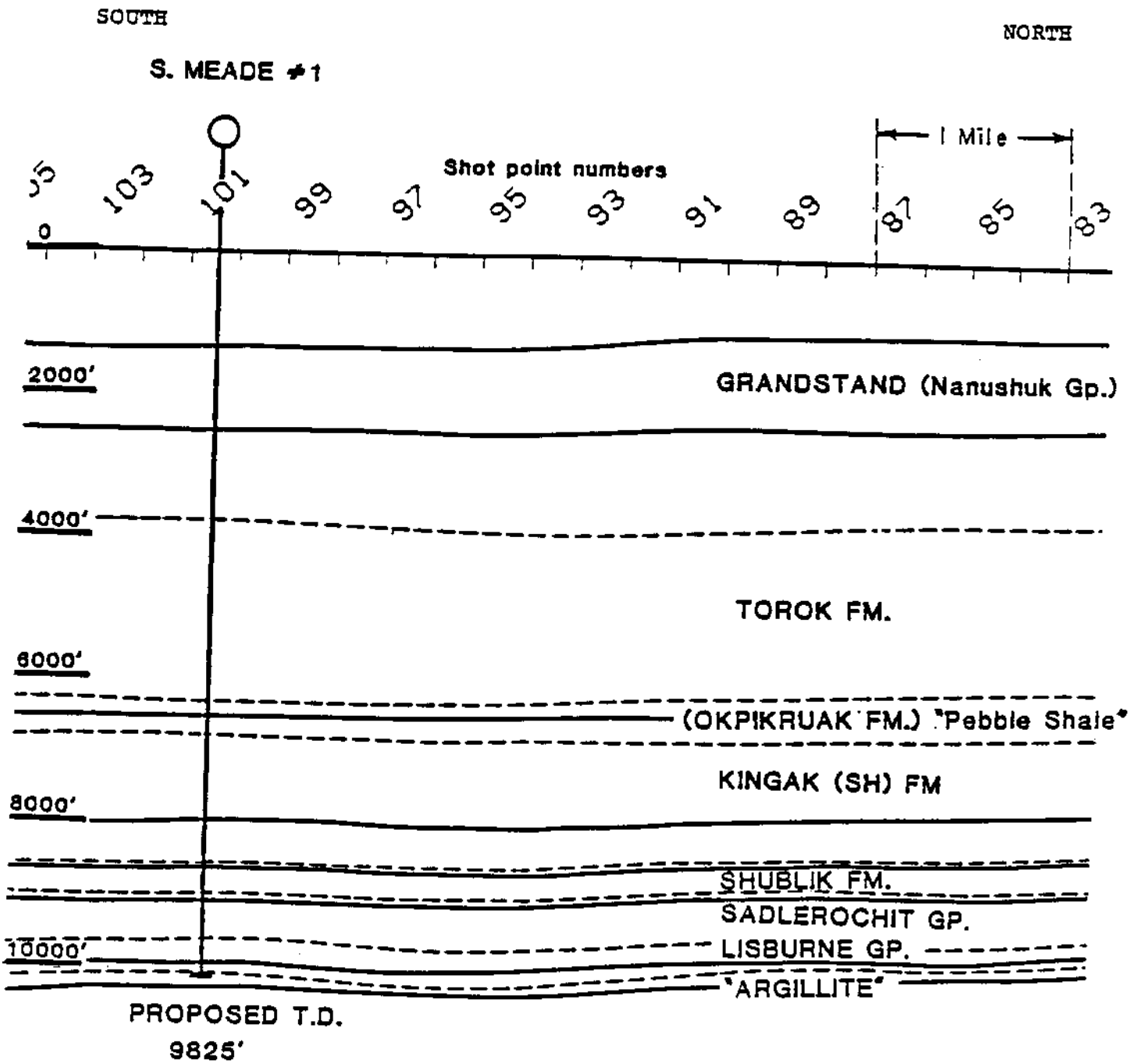


FIGURE 4
Depth Section
Interpretation
Seismic Line
52-75-G195

WELLSITE GEOLOGIST'S REPORT
by R. G. Brockway
D. O. Bossort
Edited by G. Legg

SUMMARY

The South Meade Test Well No. 1 is located 997' FNL, 2937' FEL, Sec. 31, T15N, R19W, Umiat Meridian, Alaska (Figure 2). The wellsite is located on the flat, barren North Slope some 47 miles south of Barrow and 70 miles east of Wainwright, Alaska. The location is situated in an area of small shallow lakes and marshes approximately four miles south of the Meade River (Figure 1).

This test, located on the Meade Arch, was drilled to test the hydrocarbon potential of the Cretaceous, Jurassic, Triassic-Permian and Mississippian age sediments.

Minor gas shows were observed in sandstones of both the Nanushuk Group and Torok Formation, but none of the sandstones warranted testing or further evaluation.

Paleontological and Palynology analysis for the well were performed exclusively by Anderson, Warren and Associates, Inc. Minor discrepancies may exist between paleo tops and log tops due to the 30' composite sampling interval of paleo samples.

Log tops of the stratigraphic units penetrated in the well are listed below:

WIRELINE LOG TOPS

	DRILLED DEPTH (FEET BELOW KELLY BUSHING)	SUB-SEA
LOWER CRETACEOUS		
Nanushuk Group	95'	-35'
Torok Formation	3060'	-3000'
"Pebble Shale"	6474'	-6414'
"Kuparuk River" equivalent	6716'	-6656'
JURASSIC		
Kingak Formation	6730'	-6670'
"Kugrua/South Simpson" (Mid-Jurassic) Sandstone	7858'	-7798'
TRIASSIC		
Sag River Sandstone	8772'	-8712'
Shublik Formation	8897'	-8837'
Lower phosphate zone	9078'	-9018'

PERMO-TRIASSIC		
Sadlerochit Group		
Ivishak Formation	9184'	-9124'
DEVONIAN(?)	9531'	-9471'
TOTAL DEPTH	9945'	-9885'

Correlation wells used in conjunction with the drilling of this well were the U.S. Navy Topagoruk No. 1 (drilled in 1950-51), Sec. 25, T15N, R16W, U.M., approximately 23 miles east of South Meade No. 1, the U.S. Navy South Simpson No. 1, Sec. 22, T17N, R12W, UM, approximately 50 miles northeast, and the USGS/NPRA Kugrua No. 1, Sec. 8, T14N, R26W, UM, 42 miles west.

STRATIGRAPHY

LOWER CRETACEOUS

Nanushuk Group: 95-3060'

The South Meade No. 1 drilled out from under casing at 95' in the Nanushuk Group sediments, these sediments being sandstone, siltstone and shale.

The sandstones are light gray to salt and pepper with occasional medium gray and tan stringers, predominantly fine grained with a few medium and very fine grained beds, subangular, medium sorted, slightly calcareous or dolomitic and occasionally siliceous or sideritic, carbonaceous, slightly micaceous, and in part clayey with scattered pyrite and rare glauconite grains. Rare shell fragments and occasional Inoceramus prisms were found in the sands.

Sandstone beds varied in thickness from a few inches to 50' with the thicker beds generally confined to the upper 1400' of the Group.

Occasional shows of gas were present, but only one at 1840-1853' was of any significance (see log analysis in Appendix).

The siltstones are light gray to medium gray and become partly dark gray in the lower 200' of the Group. It appears that the siltstones become progressively darker with depth in the Nanushuk Group with the light grays predominant in the upper 1000'. These siltstones are also micaceous, carbonaceous, clayey to shaly and generally have thin shale and sandstone laminations. They also have rare pyrite inclusions and crystals and rare fossils. One zone (1600-1700') had unidentifiable fossil fragments, ostracods and crinoid fragments.

The shales of the Nanushuk Group are dark gray with occasional very dark gray and medium-gray beds, fissile to moderately firm, micromicaceous and carbonaceous with occasional pyrite inclusions and disseminated grains. Siltstone and sandstone laminations are common.

Claystone, dolostone, coal and siderite comprise approximately 6% of the formation and are mostly confined to the upper 600' although occasional coal beds are present down to 1750'.

The claystones are light gray to tan, dolomitic and sideritic. The dolostones are tan and brown, moderately hard, contain carbonaceous flakes and are pyritic. These dolostones resemble siderites but appear to be more effervescent in hydrochloric acid than siderite. Thin brown and tan siderites make up about 2% of the sediments. The coals are black to brownish black, lignitic with occasional subbituminous streaks, shaly, moderately hard to flaky.

Core No. 1 (3010-3020.5', recovered 9.6') was cut in the lower Nanushuk Group and consisted of dark brownish-gray shale with carbonaceous plant remains and siltstone laminations.

The age of the Nanushuk Group in this well is Early Cretaceous, Albian, F-9 and F-10 zonules. These rocks were deposited in a shallow-marine environment and possibly a transitional environment in the upper portion (see Appendix reference to Anderson & Warren Report).

Sandstones comprise approximately 25% of the Nanushuk Group while siltstones occupy 34% and shales 35%. The remaining 6% is occupied by claystones, dolostones, coal and siderite as mentioned above.

Torok Formation: 3060-6474'

The Cretaceous Torok Formation consists of shales and sandstones with minor siltstones. The upper portion (3060-4250') is shale, dark gray to very dark gray, slightly carbonaceous, fissile to firm, micromicaceous, partly pyritic, partly silty with rare scattered chert and quartz pebbles and scattered white calcite veins. Rare fossils were observed in the Torok. Occasional thin siltstone and sandstone beds and laminations are present.

The lower zone (4250-6474') is a sandstone-shale sequence with some siltstone beds. The sandstones are light gray to medium gray, occasionally gray-brown, and partly salt and pepper. They are predominantly fine grained and contain quartz with rare glauconite, dark chert, argillaceous, and carbonaceous grains; occasional beds are very fine and medium-grained. They are medium sorted, subangular, with clay and silt matrix, predominantly noncalcareous, although a few beds are partly calcareous or siliceous. These sands occur in beds from a few inches to 30' in thickness except for a basal sand which is 145' thick. Porosities range from 0% to 15% with an average of 6% to 7%. The cleanest sands were deposited in 5' to 20' beds; thicker beds tend to be silty, clayey and have thin interbedded shales and siltstones, and low porosities.

Gas in varying amounts (15-3000 units) was present in nearly all of the sands with the better zones in the intervals: 5665-5685', 6008-6013' and 6030-6040'. These will be discussed further in the Oil and Gas Shows.

The siltstones are dark brownish gray, dark gray, carbonaceous, micaceous with sandstone and shale laminations while the shales of this section are similar to those described in the upper zone.

A total of three cores were taken in the Torok Formation and are summarized as follows: Core No. 2 (4010-4020', recovered 1'): Shale: very dark gray, partly fissile, banded, very slightly calcareous, horizontal bedding, siltstone laminations, vertical fractures; Core No. 3 (4950-4961', recovered 10.0'): Shale: dark brownish gray, slightly carbonaceous, partly rare glauconite, occasional thin sandstone stringers and laminations, horizontal bedding in top 5' increasing to 50° at base; Core No. 4 (5992-6002.5, recovered 10.5'): Siltstone: dark brownish gray, carbonaceous, coaly plant remains, occasional sandstone inclusions and sandy partings, micaceous.

Age of the Torok Formation is Early Cretaceous, Aptian and Early Albian, F-10 and F-11 zonules. The unit was deposited in a quiet marine environment. The formation is composed of approximately 15% sandstone, 9% siltstone and 76% shale.

"Pebble Shale": 6474-6730'

A 256 foot thick Pebble Shale unit is present in the South Meade No. 1 well and is characterized by very dark gray to black shales which are moderately soft and carbonaceous. The presence of floating rounded quartz grains, occasionally slightly frosted and pitted and varying from very fine to very coarse grained and rarely granular in size are a good identifier of this formation. Scattered dark chert grains and granules are also present along with pyrite inclusions and partings. In the South Meade No. 1, the "Pebble Shale" has occasional thin light-gray, tan and brown sub-waxy shale partings. A 14 foot basal sand (6716-6730') is present in this well and is light gray to gray in color, very fine to fine grained, siliceous, partly sideritic and has a trace of glauconite grains. The top of the unit also is identifiable on the Gamma Ray log by the sharp increase in radioactivity. The base of the unit was selected for convenience at the base of the sandstone.

Paleontology reports place the "Pebble Shale" as late Neocomian in age (F-12 to F-13) zonules. It was deposited in a moderately turbid middle to outer neritic environment.

JURASSIC

Kingak Formation: 6730-8772'

The top of the Jurassic Kingak Formation was penetrated at 6730'. The unit has a total thickness of 2042'. Revised paleontology reports lower Neocomian fauna from 6760' to 6970' directly overlying Oxfordian (F-16). The shales of the Kingak in the upper zone 6730' to 7858' highly resemble those of the Cretaceous "Pebble Shale" in that they are very dark gray to black and have the floating rounded quartz grains and scattered chert granules, although they seem to be less carbonaceous and have more

streaks of brownish-gray color. Siderite inclusions and thin streaks along with pyrite inclusions are common within this upper interval. Rare traces of glauconite were observed. The lower 308' (7550-7858') of the upper interval tends to become more sandy and silty than that above, with thin bedded gray-brown and dark-gray, very-fine-grained, slightly carbonaceous sandstones and dark-gray and dark gray-brown siltstone interbedded with the shales.

An unnamed highly glauconitic, Jurassic age sandstone occurs at 7858-7966' which separates the upper Kingak shale unit from the lower. This sand unit is divided into two zones. The upper zone (7858-7905') is composed of quartz grains and glauconite pellets. It varies in color from dark gray in the upper 6' to light greenish-gray to very light-gray at the base. A light-gray clayey and brown siderite matrix occurs in this zone. Possibly the light-gray clayey matrix is an alteration product of the glauconite pellets, many of which appear to be altered to a light and dark gray color. This light gray matrix has a slight greenish tinge when wet. Grain size is predominantly fine grained, subangular, for the quartz; the pellets are rounded and occasionally reach 1/4 mm in size. Estimated porosity ranges from 0 to 15%. A slight gas show of 90 units was recorded in this interval. Log analysis indicated the interval is water wet.

The lower interval (7905-7966') has an interbedded sandstone shale and siltstone sequence with occasional thin glauconite pellet beds. The sandstones are very light to dark gray, also partly gray-green, very fine to fine grained, very glauconitic (up to 40%) to slightly glauconitic, subangular predominantly with a siderite matrix, occasionally with clay or silica cement. Siltstones are black to dark gray, partly gray-green and brownish-gray with glauconite pellets. The shales are black to very dark gray and glauconitic. The thin glauconite pellet beds are generally medium grained size but rarely are up to 1/2 mm in diameter in a dark clay and siderite matrix.

Some constituent (possibly the glauconite) of this sand profoundly affects the electrical logs in this zone. The S.P. reads abnormally high, and the Compensated Neutron Formation Density Porosity Log reads a negative porosity on the density curve and high porosity on the neutron curve.

Correlation of this unnamed sandstone zone indicates that it is the same sandstone zone that occurs at 7750-7850' in the U.S. Navy Topagoruk No. 1 (Sec. 25, T15N, R16W, U.M.) and possibly the same as a highly glauconitic zone (6520-6700') in the U.S. Navy South Simpson No. 1 (Sec. 22, T17N, R12W, U.M.). It appears that a correlative sandstone zone is at 8710-8875' in the USGS/NPRA Kugrua No. 1 (Sec. 8, T14N, R26W, U.M.).

The lower shale unit of the Kingak Formation (7966-8772') is very dark to dark-gray, occasionally slightly brown, micromicaceous, partly pyritic, slightly glauconitic and has siltstone laminations.

A good fossil assemblage consisting of foraminifera, ostracods and occasional fish fragments was observed in the washed samples at wellsite, throughout the interval 6780-7680'.

Cores No. 5 and No. 6 were cut in the Kingak. Core No. 5 (7500-7504', recovered 3') consisted of a gray-black shale, hard, blocky, micromicaceous with fine pyrite inclusions and streaks and scattered foraminifera and pyritic pelecypods. Core No. 6 (8489-8519', recovered 30') had very dark gray, silty shale with scattered carbonaceous inclusions and thin siltstone beds in the upper 9' and a siltstone gray to dark gray, fine grained with very dark gray shale stringers in the lower 21'. The entire core had a weak vertical fracture system.

The Kingak Formation below Core No. 6 (8489-8519') to the top of the Sag River Formation at 8772' is a very dark gray, fissile to splintery, micaceous shale with interbeds of siltstone and very fine sandstone.

The interval from the top of the South Simpson sandstone to base of Kingak is 796' in the Kugrua No. 1 well; 919' in the South Meade No. 1 well; and 976' in the Topagoruk No. 1 well, indicating regional thickening in an easterly direction, in lower and middle Kingak interval.

Biostratigraphic analysis gives a Triassic to Early Jurassic (F-18 to F-19) age from foraminifera for sample interval 8520-8930' with a probable top of Sag River at 8760'. The palynology for the interval was indeterminate.

The interval Pre-Cretaceous unconformity to South Simpson sandstone is 1416' in the Kugrua No. 1; 1123' in the South Meade No. 1; and 1018' in the Topagoruk No. 1, indicating an increase in the beveling of Pre-Cretaceous beds in an easterly direction.

The Kingak sediments probably were deposited in a quiet marine environment.

TRIASSIC

Sag River Formation: 8772-8897'

In the South Meade No. 1 well the top of the Sag River Formation occurs at 8772'. The uppermost 16' is a very dark gray siltstone. The main Sag River sandstone encountered at 8788' is a very fine grained sandstone to siltstone; it is composed of quartz grains very well cemented in a siliceous matrix with abundant secondary quartz overgrowths on the grains. Inclusions, blebs, and thin partings of argillaceous material are common. Abundant glauconite is a typical component of the Sag River sandstone; however, in the South Meade No. 1 well cuttings, only one rare occurrence of glauconite was noted in the first sample of the interval. The Sag River sand is tight and had no shows of hydrocarbons.

Core No. 7 was cut at 8807-8808' with no recovery. Core No. 8 was cut at 8819-8873' (recovered 53.3'). At cored depth 8858' (log depth 8857') the very fine sandstones and siltstones grade to very dark-gray, noncalcareous, argillaceous shaly siltstone.

Biostratigraphic analysis indicates a possible Triassic age from foraminifera for the cored interval. From palynology, a Late Triassic age is indicated for the cored interval. A Triassic to Early Jurassic age (F-18 and F-19) from foraminifera is indicated from ditch samples for interval 8520-8930'.

In well cuttings the change from the very dark gray, noncalcareous argillaceous and shaly siltstones to dark brownish-gray calcareous and fossiliferous shale, typical of Shublik lithology, occurs below 8900'. The change may coincide with the increase in radioactivity recorded by the Gamma Ray log curve at 8897-8904'.

In the writers' opinion, the above-cited lithologic change and gamma ray inflection at approximately 8900' is the contact between the Sag River Formation and the underlying Shublik Formation. The interval 8857-8897' is a silty and shaly facies of the lower Sag River Formation, resulting in a drilled thickness of 125' for the formation.

In the Kugrua No. 1 and Topagoruk No. 1 wells the Sag River Formation is 118' and 108' in thickness, respectively. As compared with the lithology of the Kugrua No. 1 well, the Sag River Formation in the South Meade No. 1 well is finer grained, develops shaly and silty facies in the upper and lowermost zones and lacks the typical glauconite constituents.

Shublik Formation: 8897-9184'

Rocks of the Shublik Formation occur in the interval 8897-9184' (287') in the South Meade No. 1 well.

The upper 85' of the Shublik Formation is a very dark-gray to dark brownish-gray, very calcareous, silty, fissile, highly fossiliferous shale. In the uppermost 20' the shales contain glauconite and white specks and in part grade to a dark brownish-gray argillaceous limestone.

The middle 100' of the Shublik Formation is a very dark-gray calcareous shale, with rare fossil debris becoming abundant and siltstone stringers common in the lowermost 20'.

The lower 102' of the Shublik Formation is made up of interbedded very dark gray, calcareous, silty, fossiliferous shales and very fine grained, dark gray, calcareous sandstones and siltstones. The uppermost 20' of this lower unit is a dark gray limestone made up of fine to coarse fossil fragments, fish remains and black phosphate pellets.

Core No. 9 was cut at 9040-9059' recovering 16.5'. Biostratigraphic analysis gives a Triassic (F-19) age from the cored interval. From well cuttings, a Triassic (F-19) age from Foraminifera is indicated for the interval 8930-9170'. The palynology indicates Triassic 8873' to 9510'.

The Kugrua No. 1 well penetrated 350' of Shublik sediments; the South Meade No. 1 well drilled 287' of Shublik and the Topagoruk No. 1 well encountered 397' of Shublik. In the thinner interval found in South Meade

No. 1 well, the phosphate pellets and fish remains in the lower Shublik interval do not appear to be as common as in the Kugrua and Topagoruk wells.

The relatively thin Shublik sediments in the South Meade No. 1 well is an expression of the well's position on a paleo topographic high.

PERMO-TRIASSIC

Sadlerochit Group-Ivishak Formation: 9184-9531'

Sediments of the Ivishak Formation occur in the interval 9184-9531' (347') in the South Meade No. 1 well. The normally underlying units of the Sadlerochit Group (Kavik and Echooka) were completely absent at the location.

The upper 248' of the Ivishak Formation is predominantly a sequence of interbedded very fine-grained quartz sandstones and siltstones, with occasional thin conglomeratic beds. The sandstones and siltstones are composed of very fine sand to silt size quartz grains with occasional carbonaceous grains and abundant white tripolite grains; all very well cemented in a siliceous matrix. Occasional interbeds of coarse conglomeratic sandstones and chert pebble conglomerates occur in the sequence. There is no indication of porosity and no live hydrocarbon shows. Mechanical logs and sidewall cores indicate the presence of thin interbeds of medium to very dark gray, fissile, micaceous, silty shales that were not distinguished from cavings from the overlying Shublik and Kingak Formations in onsite examination of the cuttings.

The lowermost 99' of the Ivishak Formation consist of a massive conglomeratic sandstone and chert conglomerate. The predominance of fragments of milky white chert with sharp irregular edges and conchoidal fracture in the samples from the interval 9460-9500' suggests the presence of a high percentage of secondary chert and perhaps bedded chert in this interval. The conglomeratic sandstones and pebble conglomerates consist of subrounded chert and quartz grains and chert pebbles, very well cemented in a siliceous matrix. There is no evidence of porosity or hydrocarbon shows.

Core No. 10 was cut in the Ivishak interval 9305-9337' with 218' recovered. Biostratigraphic analysis gives a Permo-Triassic (F-20) age determination from foraminifera at 9308'. Palynology indicated a Permo-Triassic age for the cored interval 9305-9317'. From well cuttings, Biostratigraphic analysis reports a Permo-Triassic (F-20) age determination from foraminifera, interval 9170-9530'. Palynology determinations 8873-9510'; reports a Permo-Triassic age.

The Ivishak sediments in the South Meade No. 1 well are 347' thick; quite thin as compared to 497' in the Topagoruk No. 1 well and 1024' in the Kugrua No. 1 well. The thin Ivishak sediments of the South Meade No. 1 well rest unconformably upon a sub-metamorphic sequence of Pre-Lisburne rocks.

In the Kugrua No. 1 well, 166' of Kavik "red beds", 174' of Echooka sands, and 1425' of Lisburne limestone, were present beneath the Ivishak Formation. In the Topagoruk No. 1 well, 185' of Kavik "red beds" were encountered beneath the Ivishak Formation that in turn lie unconformably upon Pre-Lisburne rocks.

A correlation of the three wells mentioned above indicates the South Meade No. 1 well is located on a topographic high on the Pre-Lisburne erosion surface, a high against which the Lisburne Group, Echooka and Kavik Formations progressively onlap over the high.

DEVONIAN?

Pre-Lisburne Rocks: 9531-9945'

The South Meade No. 1 well encountered a sub-metamorphic sequence of rocks lying unconformably below a thin Ivishak Formation at a drilling depth of 9531' and drilled in this sequence to a total depth of 9945'. The Pre-Lisburne strata penetrated is an interbedded sequence of shale, highly altered coal and shaly coal, sandstone, siltstone and conglomerate.

The shales are predominantly dark-gray to black, silty, micaceous, fissile and well indurated, but in part these dark-colored shales become very well indurated and break with a sharp irregular fracture and occasionally display a metallic luster on carbonaceous bedding planes. Pyrite is common.

Dark-gray, very fine-grained sandstones and siltstones are interbedded and gradational with the dark colored shales.

Thin interbeds of poorly indurated shales occur throughout the sequence. These softer shales vary in color from light to medium gray, medium greenish gray and black. The softer shales show considerable alteration, often developing thin "papery", "waxy" bedding planes. In sidewall cores from 9630' and 9584' black carbonaceous shale with nearly vertical cleavage or fracture planes was discovered. Specific descriptions and recoveries for the interval are shown on the composite log tail.

Highly altered and "schistose" coals, shaly coals and highly carbonaceous shales occur in sample intervals 9590-9670' and 9890-9920'. These altered coals and carbonaceous shales are brittle, display a black shiny metallic luster, and occasionally contain floating quartz grains.

A junk-sub recovery from the depth of 9884' contained a black very fine "grained" argillite with minute veinlets of a light greenish-gray, "talc-like" material.

A conglomerate occurring in the interval 9790-9827' is composed of fragments of light gray to black chert and black argillite, medium to coarse grains and light to dark gray pebbles. The conglomerate is very well compacted with a minor siliceous matrix. Occasionally the black argillite grains are "warped" around the edge of an adjacent chert grain.

A sandstone occurring in the samples from 9920' to total depth is quartzitic, breaking across the grains with a sharp irregular fracture.

The Pre-Lisburne strata in the South Meade No. 1 well were somewhat difficult to conclusively identify in well cuttings, as only the coals, shaly coal and highly carbonaceous beds show readily recognizable alteration or metamorphic characteristics. The less well indurated shales show some degree of alteration, but recovery from these softer beds in cuttings is poor. The more competent and well indurated shales, siltstones and sandstones do not display readily recognizable metamorphic characteristics in well cuttings under binocular microscope. The use of the rock term "argillite" for the complex and variable Pre-Lisburne strata is a misnomer and confusing.

The Pre-Lisburne strata in the South Meade No. 1 well are quite similar to, and appear correlative with, the Pre-Lisburne strata in the Topagoruk No. 1 well below a depth of 10,063'. A description of well cuttings and cores of the Topagoruk No. 1 well cites an identification of fragmental plant remains from cored interval 10,441' as "probably Middle Devonian, not younger" and "possibly could be somewhat older".

Anderson, Warren & Associates report no diagnostic microfossils below 9530'. Their report contains the following comments on lithology from the South Meade No. 1 well, and on core examinations from the Topagoruk No. 1 well:

> "Lithologies in ditch samples below 9530 feet in South Meade #1 similar to lithologies in cores examined from 10,228 to 10,503 feet in Topagoruk #1 based on thin section examination. Major difference observed is that there are more coaly micro-stringers compared to disseminated particulate carbonaceous matter in the S. Meade #1 well. This may be a matter of sampling though, since coal seams are shown at about 10,190 feet in the USGS P.P. 305-D report on the Topagoruk #1 well. Another possibility is that the degree of thermal alteration is greater in the S. Meade #1 well.
>
> "Examination of Topagoruk #1 T.W. cores for comparison of S. Meade.
>
> "10,489 to 10,492' Frequent, simple morphology spores, suggesting possible Devonian Age".

Temperatures to a maximum of 273°F were recorded at total depth in the South Meade No. 1 well. The highest temperature recorded on maximum recording thermometers during logging of the Topagoruk No. 1 well is 188°F at a depth of 9877', thus measured above the Pre-Lisburne rocks. Nonetheless, the markedly higher temperature in South Meade No. 1 is abnormal.

STRUCTURAL INTERPRETATION

Cores No. 1 (3010-3020.5') and No. 2 (4010-4020') exhibited horizontal bedding. Core No. 3 (4950-4961') had horizontal bedding in the upper 5'

and dips varying from 35° to 50° in the lower 5'. Possibly these dips are the result of slump or compaction. Cores No. 2 and No. 6 (8489-8519') displayed some vertical fracturing. Core No. 7 (8807-8808') had no recovery. Core No. 8 (8819-8873') had essentially horizontal bedding and exhibited some vertical fracturing. Cores No. 9 (9040-9059') and Core No. 10 (9305-9328') had essentially horizontal bedding with no fracturing.

The only dipmeter results available are below 9-5/8" casing (8023') because the dipmeter was not run in the upper hole due to poor hole conditions at the time.

The arrow plots of dips revealed clusters of dips in the range of 0-5° with values more predominant toward the low end (1-2°) down to 9500'. The dip directions were principally some component of west to west southwest down to 8700' and appeared to shift slightly to west and west northwest from 8700' to 9500'. Below 9500' no dip clusters are apparent and data are erratic and of a low order of reliability; there is a general trend of stronger dip rates in the range of 20°-40° with rare values below 20° and a few values above 40°. The dip directions are also erratic, with directions of west, northwest and southwest. No definite trend is apparent, but generally from 9500' to 9750' directions are principally south and southwest. From 9750' to 9943', dips are principally northwest.

HYDROCARBON SHOWS

There were no live oil shows in the South Meade No. 1, but several relatively thin sandstones contained gas shows.

The most significant gas shows occurred in two sandstones located at 1840-1852' and 1873-1886' with net thicknesses of 12' and 13' and log porosities of 32% and 33% respectively. Gas readings were up to 1,040 units on the chromatograph with components of C_1, C_2 and C_3. Since these sandstones were at a very shallow depth and were drilled in a 17-1/2" hole, no attempt was made to test them. Actually, the only feasible way to test these sands would be to drill a separate well designed to test them. The thin possible pay zones and probable low reservoir pressures due to the shallow depth, as well as possible completion problems due to their proximity to the permafrost zone, would make any attempt to test or complete these zones a difficult task.

Several other thin sandstones from 4398' down through 6400' produced gas shows on the gas detector; however, all of these sandstones were thin (ranging from 10' to 25'), exhibited extremely low porosity (averaging less than 9% with a maximum of 12%) and, in fact, were obviously due to geo-pressured conditions as evidenced by the high gas readings, high pore pressures and very low porosities. None of these sandstones warranted testing.

The only other gas show was a rather minor show of 90 units in the "South Simpson Sandstone" at 7858-7966'. This sandstone was highly glauconitic and had an apparent bulk density of greater than 3 gm/cc

coupled with an apparent high porosity and hydrogen index. This is probably due to a mineral such a daphnite or limonite, both of which are hydrous with high bulk densities. No testing of this sandstone was warranted.

No other significant shows were encountered in the well.

PERTINENT DATA AND APPENDICES

SUMMARY PERTINENT DATA*

WELL NAME:	South Meade Test Well No. 1
API NO. :	50-163-20001
OPERATOR:	Husky Oil NPR Operations, Inc.
LOCATION:	997' FNL; 2937' FEL NW 1/4, Protracted Section 31, T15N, R19W, Umiat Meridian, Alaska
COORDINATES:	Latitude 70°36'53.92"N Longitude 156°53'23.60"W X = 634,958.35; Y = 6,075,806.74 Zone 6
ELEVATION:	60' K.B.; 35' Ground
CASING:	20" @ 505' K.B. 13-3/8" @ 2616' K.B. 9-5/8" @ 8023' K.B.
DATE SPUDDED:	February 7, 1978
DATE SUSPENDED:	May 17, 1978
DEPTH AT RE-ENTRY:	8519'
DATE RE-ENTERED:	December 5, 1978
TOTAL DEPTH:	9945' Driller; 9940' Schlumberger
DATE REACHED TOTAL DEPTH:	January 14, 1979

LOGGING RECORD:

GR/SP/DIL	502-9934'
GR/BHC/TTI	502-9940'
GR/CAL/FDC/CNL	2507-9939'
HDT Dipmeter	8022-9936'
Temperature Log, Run No. 1	90-9940'
Temperature Log, Run No. 2	Surface-9940'
Saraband	2622-8016'
Velocity Survey	250-9210'
Mudlog (Petro-Tec)	100-9945'
"d" Exponent & Temp. Log	8520-9945'
Geogram	Surface-9880'

SIDEWALL CORES:* 5448-8014', 60 shot, 54 recovered;
8275-9909', 45 shot, recovered 33 shots.

CONVENTIONAL CORES:

No.	Interval	Recovery
1	3010-3020.5'	9.6'
2	4010-4020'	1.0'
3	4950-4961'	10.0'
4	5992-6002.5'	10.5'
5	7500-7504'	3.0'
6	8489-8519'	30.0'
7	8807-8808'	0.0'
8	8819-8873'	53.3'
9	9040-9059'	16.5'
10	9305-9328'	21.8'

TESTS: None

STATUS: Dry and abandoned.

WELLSITE GEOLOGIST: R. G. Brockway
D. O. Bossort

DRILLING CONTRACTOR: Nabors Alaska Drilling, Inc. - Rig No. 1

MUDLOGGERS: Petro Tec Geological Wellsite Service

BIOSTRATIGRAPHIC ANALYSIS: Anderson, Warren & Associates, Inc.**

* Sidewall cores were utilized for various analysis including: lithology, paleo, and geochemical.

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

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

Telephone: (303) 497-6376

SOUTH MEADE TEST WELL NO. 1
DRILL CUTTINGS AND CORE DESCRIPTIONS
BY

R. BROCKWAY	-	95-8519'
D. BOSSORT	-	8520-9943'

DRILLED DEPTH (FEET BELOW KELLY BUSHING)	
0- 95	No samples recovered.
95- 150	Thin interbedded Siltstone: light gray to gray, carbonaceous; Sandstone: light gray, fine grained, subangular, carbonaceous, silty, slightly calcareous, micaceous; and Coal: black, lignitic; occasional claystone and shale; thin Dolomite at 120-125': brown, tan, fractured, hard; porosity poor in sandstone, no shows.
150- 170	Sandstone: light gray, fine to very fine grained, subangular, partly conglomeratic, partly hematitic and limonitic stain, carbonaceous, slightly calcareous, friable, poor porosity, no shows.
170- 270	Sandstone: light gray, fine to very fine grained, subangular, poor porosity; interbedded with Siltstone: light gray, partly sideritic, slightly carbonaceous; interbeds Coal: black, lignitic; and Claystone: light gray, tan; "dolostone" stringer 265-267'.
270- 285	Sandstone: light gray, very fine to fine grained, subangular, fair sorting, carbonaceous, micaceous, silty, fine coal partings, very poor porosity, no shows.
285- 315	Claystone: tan to light gray, dolomitic, partly silty, slightly carbonaceous; with interbedded "Dolostone": tan, buff, hard, occasional carbon flake, slightly silty and siliceous.
315- 330	Sandstone: light gray, fine grained, subangular, carbonaceous, micaceous, moderately friable, "dolostone" stringers.
330- 370	Sandstone: light gray, medium grained, with fine and very fine grained stringers, subangular to angular, occasional pebbles, chert grains, very slightly calcareous, occasional glauconite grains.

370- 505	Interbedded sandstone, siltstone, claystone, and coal; Sandstone: light gray, fine to very fine grained, trace medium grain, subangular, fair sorting, slight to poor porosity; Siltstone: light gray, tan, slightly carbonaceous, calcitic to sideritic; Claystone: tan, buff, slightly carbonaceous, silty in part, trace dark shale; Coal: black, lignitic, partly sub-bituminous; interbeds siderite throughout interval.
505- 510	"Dolostone": tan, brown, pyritic, partly marlstone/calcite vein material.
510- 595	Sandstone: light gray, fine grained, silty, subangular, fair sorting, sideritic, carbonaceous, very poor porosity.
595- 610	Claystone and Shale: gray to light gray, tan, silty, partly sideritic.
610- 640	Sandstone: light gray to light tan, fine grained, with medium grained stringers, poorly sorted, subangular, occasional chert pebbles, dolomitic and sideritic nodules, carbonaceous, pyritic, partly calcitic, partly clayey, poor porosity, no shows.
640- 745	Interbedded Claystone: tan, light gray, slightly carbonaceous; Siltstone: light gray, micaceous, slightly carbonaceous; and Sandstone: gray to light brown, fine grained, occasional very fine and medium grained stringers, subangular, fair sorting, coaly parting, Inoceramus at 655-665'.
745- 865	Sandstone: light gray, light tan, salt and pepper, very fine to fine grained, occasional medium grained stringer, carbonaceous, calcareous, coal parting, argillite and occasional chert grains, subangular, fair sorting, thin interbedded siltstone, claystone and coal, rare fossil fragment, nil to poor porosity, mineral fluorescence.
865- 910	Interbedded siltstone and sandstone; Siltstone: light gray, carbonaceous, micaceous, partly sandy; Sandstone: light gray, silty, very fine to fine grained; slightly calcareous, fair sorting, carbonaceous, micaceous.
910-1095	Sandstone: light gray, tan to gray, salt and pepper, occasional very fine grained stringer, subangular, fair sorting, carbonaceous, calcareous, coal inclusions, occasional coal bed, interbedded siltstone and claystone, porosity varies from very poor to fair.

1095-1115	Claystone and Shale: light gray, gray, slightly carbonaceous, slightly calcareous, thin sandstone bed, trace coal.
1115-1155	Sandstone: salt and pepper, medium grained, subangular, fair sorting, dolomitic; dark chert, argillite and coal grains, shale stringers, coal and siltstone stringer in lower part, becoming fine grained, good porosity, no shows.
1155-1170	Shale: very dark gray, carbonaceous, micaceous, fissile, coal parting.
1170-1186	Sandstone: light gray, salt and pepper, fine to very fine grained, slightly calcareous, white clay material, fair porosity; interbedded Siltstone: gray, carbonaceous, micaceous.
1186-1198	Shale: very dark gray, carbonaceous, micaceous, fissile to blocky.
1198-1210	Siltstone: gray, carbonaceous, partly sandy; interbedded Shale: dark gray; and interbedded Siderite: brown.
1210-1243	Sandstone: salt and pepper, fine grained, trace very fine and medium grained, subangular, calcareous, carbonaceous, pyritic, dark chert and argillaceous grains, very poor to fair porosity, no shows.
1243-1255	Shale: dark gray, carbonaceous; and Siltstone: gray, carbonaceous.
1255-1270	Sandstone: light gray to gray, fine to very fine grained, subangular, fair sorting, carbonaceous, micaceous, pyritic, silty, clay matrix, very poor porosity.
1270-1308	Claystone: tan, sideritic; and Sandstone: light gray, as at 1255'.
1308-1326	Shale: very dark to dark gray, carbonaceous, pyritic, micaceous, coal stringers.
1326-1500	Sandstone: light gray, salt and pepper, fine grained, subangular, moderate to well sorted, carbonaceous, slightly calcareous, occasional brown grains of siderite(?), coal and siderite inclusions, thin interbedded siltstone and shale, poor porosity, no shows, trace fractured calcite rhombs 1360-1380', Inoceramus 1380-1500'.

1500-1700	Interbedded and interlaminated sandstone, siltstone and shale; Sandstone: light gray, salt and pepper, fine to very fine grained, subangular, fair sorting, calcareous, silty, carbonaceous, pyrite inclusions, rare glauconite and chlorite grains, partly tuffaceous, siderite nodules, micaceous, nil to poor porosity, rare coal partings; Siltstone: gray, light gray, carbonaceous, micaceous; Shale: dark gray, micaceous, slightly carbonaceous, partly silty; bentonite stringers at 1525'; occasional fossil fragments at 1600-1700'.
1700-1740	Siltstone: gray, light gray, micaceous, carbonaceous; with interbedded Sandstone: light gray, very fine to fine grained, subangular, micaceous, silty, slightly carbonaceous, pyrite inclusions; and Shale: gray, micaceous, slightly carbonaceous.
1740-1760	Siltstone: as at 1700'; with interbeds Sandstone: becoming very calcareous, fine to medium grained.
1760-1823	Interbedded and interlaminated sandstone, siltstone and shale; Sandstone: light gray to gray, very fine to fine grained, subangular, fair sorting, micaceous, silty, carbonaceous; Siltstone: light gray, micaceous, slightly carbonaceous; Shale: gray, micaceous, carbonaceous.
1823-1835	Sandstone: salt and pepper, fine to medium grained, subangular to angular, fair sorting, dark chert and argillaceous grains, carbonaceous, calcareous stringers, good porosity, slight gas show, no odor, stain, cut or fluorescence.
1835-1850	Interbedded Shale and Siltstone: gray, light gray, micaceous, carbonaceous.
1850-1875	Sandstone: salt and pepper, fine to medium grained, subangular to angular, fair sorting, dark chert and argillaceous grains, calcite, carbonaceous, fair porosity, gas show; no odor, stain, cut or fluorescence.
1875-1882	Siltstone and Shale: as at 1835'.
1882-1893	Sandstone: as at 1850'; fair gas show, no odor, stain, cut or fluorescence.
1893-1980	Thin interbedded sandstone, siltstone and shale; Sandstone: light gray to gray, partly salt and pepper, fair sorting, slightly calcareous, carbonaceous, micaceous, occasional light brown grains; Siltstone: gray, micaceous, slightly carbonaceous; Shale: gray to dark gray, carbonaceous, micaceous, pyrite inclusions.

1980-2088	Shale: dark gray, gray; interbedded with Sandstone: light gray to gray, fine to very fine grained, subangular, fair sorting, carbonaceous; and Siltstone: gray, micaceous, carbonaceous; beds to 10' thick.
2088-2113	Sandstone: gray, light gray, very fine to fine grained, subangular, fair sorting, carbonaceous, silty; interlaminated siltstone and shale.
2113-2160	Interbedded Sandstone, Siltstone and Shale: as at 1882'.
2160-2213	Shale: dark gray, micromicaceous; with siltstone laminations, pyrite inclusions.
2213-2232	Thin interbedded Sandstone: light gray, salt and pepper, very fine to fine grained, subangular, fair sorting; with Siltstone: gray, micaceous; and Shale: dark gray, pyrite inclusions.
2232-2242	Shale: gray, dark gray, micaceous; interlaminated siltstone.
2242-2260	Thin interbedded Sandstone, Siltstone and Shale: as at 2213'.
2260-2270	Shale: dark gray, micaceous; interlaminated siltstone, pyrite inclusions.
2270-2298	Interbedded Sandstone: light gray, salt and pepper, very fine to fine grained, fair sorting; with Siltstone: gray, micaceous; and Shale: dark gray.
2298-2317	Sandstone: light gray, fine grained, very fine and medium grained stringers; partly salt and pepper, subangular, slightly carbonaceous, rare glauconite; siltstone laminations, poor porosity, no shows.
2317-2365	Interbedded Shale: dark gray, micromicaceous; Sandstone: light gray, fine grained, subangular, fair sorting; and Siltstone: gray, micaceous.
2365-2386	Interlaminated sandstone and siltstone; Sandstone: light gray, fine grained, subangular; and Siltstone: gray, micaceous.
2386-2480	Interbedded Shale: gray, dark gray, micaceous, silty, slightly carbonaceous; with Sandstone: light gray, fine to very fine grained, subangular, fair sorting; and Siltstone: light gray, gray, slightly carbonaceous.

2480-2492	Sandstone: light gray, subangular, fair sorting, carbonaceous, calcareous, slightly siliceous, with thin siltstone and shale laminae, very poor porosity, no shows.
2492-2500	Interbedded shale, siltstone and sandstone as at 2386'.
2500-2535	Sandstone: light gray, salt and pepper, fine to very fine grained, subangular, fair sorting, white clay and calcareous cement, partly silty, slightly carbonaceous, trace glauconite, interlaminated siltstone and shale, poor porosity, no shows.
2535-2560	Sandstone: as at 2500'; with occasional Siltstone and Shale interbeds.
2560-2575	Sandstone: light gray, gray, salt and pepper, fine grained, micaceous, subangular, carbonaceous, partly calcareous; shale interbeds.
2575-2610	Siltstone: gray, micaceous; with interbedded Sandstone: light gray, gray, fine to very fine grained, fair sorting, carbonaceous; and Shale: dark gray, micaceous, slightly carbonaceous.
2610-2690	Shale: dark gray, micromicaceous, slightly carbonaceous, thin interlaminated sandstone and siltstone.
2690-2728	Siltstone: gray, micaceous, slightly carbonaceous, partly very shaly; interlaminated sandstone and shale.
2728-2742	Sandstone: light gray to gray, fine to very fine grained, subangular, fair sorting, carbonaceous, micaceous, rare glauconite, slightly calcareous; with siltstone and shale laminae, nil porosity, no shows.
2742-2752	Siltstone: gray to dark gray, micaceous, slightly carbonaceous; interlaminated sandstone and shale.
2752-2805	Thin interbedded and interlaminated Sandstone: light gray, as at 2728'; Siltstone: gray to dark gray, as at 2742'; and Shale: dark gray, micromicaceous.
2805-2900	Shale: dark gray, micromicaceous, carbonaceous; interlaminated sandstone and siltstone.
2900-3000	Siltstone: gray, dark gray, micaceous, carbonaceous, partly shaly; interbedded and interlaminated Shale: dark gray, gray, trace pyrite, occasional sandstone laminae, rare Inoceramus prisms.

3000-3010	Shale: dark gray to brown, slightly micaceous, slightly carbonaceous; sandstone and siltstone laminae.
3010-3020.5	Core No. 1, Cut 10.5', Recovered 9.6'.
3010.0-3019.6' (9.6')	Shale: dark brown to gray, micaceous, slightly carbonaceous; thin rare siltstone and sandstone laminae, disseminated pyrite stringers, carbonaceous plant remains, horizontal beds, trace siltstone crossbeds at 3011-3012', siltstone and sandstone laminae from few microns to 1/2" thick.
3019.6-3020.5' (0.9')	No recovery.
3020.5-3035	Shale: as at 3010'.
3035-3048	Sandstone: light gray, fine to very fine grained, subangular, moderate sorting; siltstone and shale laminae, poor porosity; no odor, stain, cut or fluorescence.
3048-3060	Sandstone: light gray, fine grained, subangular, moderate sorting, slightly siliceous, clayey, carbonaceous, micaceous, rare pyrite, argillaceous grains, rare glauconite, poor porosity, no shows.
3060-3085	Shale: dark gray to dark brown to gray, micromicaceous, slightly carbonaceous; siltstone and sandstone laminae.
3085-3095	Siltstone: dark gray to gray, carbonaceous, slightly micaceous; shale laminae.
3095-3390	Shale: dark gray, micromicaceous, slightly carbonaceous; interlaminated Siltstone: gray, dark gray, slightly micaceous, slightly carbonaceous, trace pyrite, trace bentonite at 3220', light chert pebbles at 3360'.
3390-3400	Siltstone: gray, dark gray, micaceous, carbonaceous, apparent slight stain, no cut, no fluorescence.
3400-3410	Shale: as at 3095'.
3410-3420	Siltstone: as at 3390'.
3420-4010	Shale: dark gray to very dark gray; interlaminated Siltstone: gray to dark gray, shaly, slightly carbonaceous, micaceous, trace white calcite; occasional fossil fragments, limestone nodules at 3570'.

4010-4020	Core No. 2, Cut 10', Recovered 1.0'.
	4010.0-4011.0' (1.0') Shale: dark gray; siltstone laminations.
	4011.0-4020.0' (9.0') No recovery.
4020-4180	Shale: very dark to dark gray, micromicaceous, slightly carbonaceous, fissile; interlaminated Siltstone: dark gray, gray, micaceous, slightly carbonaceous, trace pyrite.
4180-4381	Interbedded and interlaminated Shale: very dark gray, micaceous, slightly carbonaceous, fissile; Siltstone: dark gray, micaceous, slightly carbonaceous; and Sandstone: gray, becoming slightly brown at 4270', very fine grained, with fine grained stringers, moderate sorting, carbonaceous, micaceous, silty, slight staining, no fluorescence, very slight dull yellow cut.
4381-4412	Sandstone: brown to gray, very fine, with fine grained stringers, subangular, moderate sorting, silty, carbonaceous, micaceous, clayey, slightly siliceous, very slightly calcareous, rare glauconite, coaly parting, nil to very poor porosity, slight staining, no fluorescence, very faint dull yellow cut, fair gas show.
4412-4660	Shale: very dark gray, micromicaceous, slightly carbonaceous; interbedded and interlaminated with Siltstone: dark gray, micaceous, slightly carbonaceous; and Sandstone: gray to brown, very fine to fine grained, subangular, silty, slightly carbonaceous, micaceous, pyritic, calcareous veins.
4660-4734	Interbedded Shale: very dark and dark gray, carbonaceous, micromicaceous, silty in part; Siltstone: dark gray, micaceous, slightly carbonaceous; and Sandstone: gray to light gray, very fine to fine grained, subangular, carbonaceous, micaceous, silty, clayey, rare glauconite.
4734-4742	Sandstone: gray to light gray, very fine to fine grained, subangular, moderate sorting, micaceous, carbonaceous, clayey, slightly siliceous, no shows.
4742-4774	Interbedded Sandstone: as at 4734'; Siltstone: gray, micaceous, carbonaceous; and Shale: dark gray.
4774-4782	Sandstone: gray, fine grained, occasional medium grained, subangular, moderate sorting, occasional very fine grained stringers, carbonaceous, siliceous, clayey, micaceous, argillaceous and chert grains, very poor porosity, no odor, stain, cut or fluorescence, trace gas.

4782-4800	Interbedded Shale: dark gray; Sandstone and Siltstone: as at 4742'.
4800-4810	Sandstone: gray, fine grained; very fine grained stringers, occasionally medium grained, carbonaceous, subangular, micaceous, silty, siliceous, rare glauconite, no odor, stain, cut, fluorescence, trace gas.
4810-4950	Interbedded Siltstone: gray to dark gray, micaceous, carbonaceous; Shale: dark gray to very dark gray, micromicaceous, carbonaceous; and Sandstone: gray to light gray, very fine to fine grained, subangular, carbonaceous, dark chert and argillaceous grains, no shows.
4950-4961	Core No. 3, Cut 11', Recovered 10'
	4950.0-4957.0' (7.0') Shale: dark brown to gray, silty, micaceous, carbonaceous.
	4957.0-4960.0' (3.0') Shale: as above; sandstone parting and laminated 1/3" to 1" thick, horizontal bedding from 4950' to 4955'; 30° to 50° bedding from 4955' to 4960'.
	4960.0-4961.0' (1.0') No recovery.
4961-5010	Shale: dark brown to gray, micaceous, slightly carbonaceous; interlaminated and thinly interbedded siltstone and sandstone.
5010-5055	Siltstone: gray to dark gray, micaceous, carbonaceous, partly shaly; shale laminations, trace sandstone.
5055-5065	Shale: dark and very dark gray, micromicaceous, carbonaceous flakes.
5065-5088	Siltstone: gray to dark gray, micaceous, carbonaceous.
5088-5105	Sandstone: gray, very fine grained, trace fine grained, subangular, moderate sorting, rare glauconite, siltstone stringers, mica, nil to very poor porosity; no odor, stain, cut, or fluorescence, gas show.
5105-5132	Siltstone: gray, micaceous, carbonaceous, rare glauconite; sandstone and shale laminations.
5132-5139	Sandstone: gray to brown, fine grained, occasionally medium grained, subangular, moderate sorting, carbonaceous, silty, dolomite, rare glauconite, poor to fair porosity, no fluorescence, faint yellow cut, faint light yellow fluorescent residue, fair show gas.

5139-5143	Siltstone: gray, carbonaceous, micaceous.
5143-5152	Sandstone: gray to brown, fine grained, very fine grained and siltstone stringers, slightly dolomitic, subangular, carbonaceous, silty, no fluorescence, very faint yellow cut, slight residue as above, fair gas show.
5152-5208	Interbedded Siltstone: gray to brown, micaceous, carbonaceous; Shale: dark and very dark gray; and Sandstone: gray to brown, fine to very fine grained, subangular, medium sorting, trace white calcite.
5208-5426	Shale: dark gray to very dark gray, micromicaceous, partly carbonaceous; interbedded siltstone; occasional sandstone stringer.
5426-5433	Sandstone: light gray, very fine to fine grained, subangular, moderate sorting, carbonaceous, calcareous, siliceous, white clay matrix; no odor, stain, cut, fluorescence, poor show gas.
5433-5445	Shale: dark and very dark gray, micromicaceous; siltstone interbeds.
5445-5462	Sandstone: light gray, fine grained, subangular, moderate sorting, carbonaceous, micaceous, slightly calcareous, siliceous, clay, chert and argillaceous grains, poor porosity, no odor, stain, cut, fluorescence, fair show gas.
5462-5477	Shale: dark gray to very dark gray; siltstone stringers.
5477-5482	Sandstone: light gray, salt and pepper, fine grained, subangular, medium sorting, micaceous, 100 units gas; no odor, stain, cut, fluorescence.
5482-5520	Shale: dark and very dark gray, micromicaceous; siltstone laminations.
5520-5524	Sandstone: light gray, as at 5477', slight show gas.
5524-5568	Shale: very dark gray to dark gray, micromicaceous; siltstone laminations.
5568-5573	Sandstone: light gray to gray, partly salt and pepper, subangular, moderate sorting, clayey, silty, micaceous stringers; slightly porous, no odor, stain, cut, fluorescence, trace gas.
5573-5633	Shale: dark and very dark gray, moderately blocky to fissile, micromicaceous, slightly carbonaceous; interbedded siltstone and shale.

5633-5638	Sandstone: light gray to gray, partly brown, fine to very fine grained, subangular, moderate sorting, carbonaceous, clayey, silty, siliceous, no fluorescence, slight dull yellow crushed cut, trace gas.
5638-5662	Shale: dark and very dark gray, micromicaceous; interbedded siltstone and sandstone.
5662-5682	Sandstone: light gray, salt and pepper, fine grained, subangular, moderate sorting, carbonaceous, slightly dolomitic, micaceous, slightly silty, slightly siliceous, argillaceous grains, rare glauconite, trace clay, poor porosity, no fluorescence, very slight dull yellow crushed cut, fair show gas.
5682-5758	Interbedded Siltstone: dark gray to brown; Shale: very dark and dark gray; and Sandstone: as at 5662'.
5758-5766	Sandstone: light gray to gray, partly salt and pepper, fine to very fine grained, subangular, moderate sorting, carbonaceous, micaceous, slightly siliceous, clay cement, partly silty, no odor, stain, cut, fluorescence, trace gas.
5766-5774	Shale: very dark gray to dark gray; siltstone laminae.
5774-5797	Sandstone: light gray to gray, partly salt and pepper, fine to very fine grained, subangular, moderate sorting, carbonaceous, micaceous, slightly siliceous, clayey, partly silty, thin shale and siltstone beds, poor porosity, no fluorescence, slight medium yellow crushed cut, fair gas show.
5797-5835	Thinly interbedded Sandstone: as at 5774', Siltstone: dark brown to gray, micaceous, slightly carbonaceous; and Shale: very dark gray, micromicaceous, slightly carbonaceous, partly silty.
5835-5840	Sandstone: light gray to gray, fine grained, subangular, moderate sorting, slight gas show.
5840-5853	Interbedded Siltstone: dark brown to gray; Sandstone: as at 5385'; and Shale: very dark gray.
5853-5868	Sandstone: light gray to gray, fine to very fine grained, occasionally medium grained, carbonaceous, slightly calcareous, micaceous, rare glauconite, siltstone and shale stringers, poor porosity, no fluorescence, slight medium yellow cut when crushed, fair show gas.
5868-5934	Shale: dark and very dark gray, micromicaceous, carbonaceous; interbedded siltstone and sandstone, trace pyritic fossils (pelecypods?).

5934-5945	Sandstone: light gray to brown to gray, fine to very fine grained, subangular, micaceous, carbonaceous, coaly partings, slightly calcareous, no fluorescence, very slight cut when crushed, poor gas show.
5945-5952	Interbedded shale and siltstone.
5952-5956	Sandstone: as at 5934', trace gas.
5956-5973	Sandstone: as at 5934'; shale stringers.
5973-5980	Shale: very dark gray to black, micromicaceous, partly hard and brittle, siliceous, partly silty, trace round frosted coarse quartz grains; trace Limestone: light gray to brown, siliceous, argillaceous.
5980-5992	No samples recovered.
5992-6002.5	Core No. 4, Cut 10.5', Recovered 10.5'
5992.0-6002.5' (10.5')	Siltstone: dark gray to brown, sandy, micaceous, carbonaceous, large coaly plant remains, rare glauconite, shale bed 5996-5997'.
6002.5-6010	Shale: dark gray to brown, micromicaceous, silty, slightly carbonaceous; siltstone stringers.
6010-6016	Sandstone: light gray, fine grained, subangular to subrounded, moderate sorting, carbonaceous, micaceous, clayey, siliceous.
6016-6028	Shale: dark brown to gray, micromicaceous, slightly carbonaceous; siltstone laminae.
6028-6040	Sandstone: light gray to gray, salt and pepper, fine to very fine grained, subangular to subrounded, moderate sorting, slightly siliceous, carbonaceous, clayey, micaceous, no fluorescence, slight dull yellow crushed cut, good show gas.
6040-6070	Interbedded Shale and Siltstone: dark brown to gray, micaceous, carbonaceous.
6070-6074	Sandstone: light gray to gray, partly salt and pepper, moderate sorting, subangular, rare glauconite, carbonaceous, micaceous.
6074-6140	Shale: dark gray to brown; interlaminated and interbedded siltstone and sandstone, becoming slightly siliceous.

6140-6145	Sandstone: light gray, fine to very fine grained, subangular, carbonaceous, silty, clayey, siliceous.
6145-6160	Shale: dark brown to gray to very dark gray, slightly siliceous, moderately hard, micromicaceous, slightly carbonaceous; siltstone interbeds.
6160-6170	Sandstone: light gray, slightly salt and pepper, fine to very fine grained, subangular, moderate sorting, carbonaceous grains, clayey, siliceous, slightly porous, poor show gas.
6170-6180	Shale: as at 6145', sandstone stringers.
6180-6190	Interbedded siltstone and sandstone.
6190-6205	Sandstone: light gray, slightly salt and pepper, fine to very fine grained, subangular, moderate sorting, carbonaceous, micaceous, clayey, siliceous, slight porosity, minor gas.
6205-6218	Shale: very dark gray to dark gray, trace black to gray, micromicaceous; siltstone laminae and sandstone stringers.
6218-6230	Sandstone: light gray to gray, slightly salt and pepper, fine to very fine grained, occasionally medium grained, subangular, moderate sorting, carbonaceous, micaceous, clayey, partly silty, siliceous, rare glauconite, no odor, stain, cut, or fluorescence, trace gas.
6230-6345	Shale: very dark gray, partly dark brown to gray, micromicaceous, slightly carbonaceous; thinly interbedded and interlaminated Sandstone: light to dark gray, subangular, very fine to fine grained, moderate sorting; and Siltstone: dark gray to dark brown to gray, slightly carbonaceous, coaly parting, pyrite inclusions.
6345-6405	Sandstone: light to dark gray, fine to very fine grained, occasionally medium grained, subangular, moderate sorting, very slightly calcareous, carbonaceous, coaly parting, micaceous, silty to shaly, thinly interbedded shale and siltstone, nil to poor porosity, no odor, stain, cut, or fluorescence, show gas.
6405-6460	Shale: very dark gray to dark gray, micromicaceous, carbonaceous; interbedded Sandstone: as at 6345'; and Siltstone: dark gray to gray.

6460-6600	Shale: very dark gray to black, trace gray claystone, micromicaceous, floating round quartz grains, pyrite inclusions, occasional dark and light chert granules, thin siltstone and sandstone laminae.
6600-6700	Shale: very dark gray, black, floating round quartz grains, pyrite, occasional dark chert pebbles, thin, cherty siliceous claystone and siderite at 6670-6700'.
6700-7100	Shale: very dark gray, trace black and dark gray, micromicaceous, carbonaceous; thin sandstone and siltstone laminae; pyrite, floating round quartz grains, siderite stringer 6700-6730', foraminifera 6820-7100', rare chert granules.
7100-7223	Shale: very dark gray, partly dark gray to brown, partly micromicaceous, slightly carbonaceous, occasional sandstone and siltstone laminae, pyrite, occasional floating round sand grains, trace siderite.
7223-7226	Siderite: brown, pyritic.
7226-7310	Shale: very dark gray, occasional dark gray and brown stringers, pyrite, occasional floating sand grains, foraminifera.
7310-7330	No samples recovered.
7330-7500	Shale: very dark gray to brown, trace black, partly subwaxy, fissile, occasional siderite stringers, floating round quartz grains, pyrite; occasional sandstone and siltstone stringers, foraminifera.
7500-7504	Core No. 5, Cut 4', Recovered 3'
7500.0-7503.0' (3.0')	Shale: gray to black, hard, blocky, micromicaceous, pyrite inclusions and stringers, scattered foraminifera, occasional pelecypods.
7503.0-7504.0' (1.0')	No recovery.
7504-7615	Shale: gray to black, occasional dark gray, gray to brown stringers, micromicaceous, occasional sandstone and siltstone stringers, occasional floating round quartz grains, pyrite, trace siderite nodules; foraminifera, pelecypods, ostracods at 7560-7570'.
7615-7635	Interbedded Shale: as at 7504'; Sandstone: gray to brown, very fine grained, subangular, slightly

	carbonaceous, slightly micaceous, shaly; and Siltstone: dark brown to dark gray, slightly micaceous, slightly carbonaceous, minor gas at 7625'.
7635-7875	Shale: gray to black to brown, fissile to blocky, partly hard, slightly siliceous, pyrite, occasional floating round quartz grains, occasional siderite stringers; siltstone and sandstone laminae, foraminifera.
7875-7890	Sandstone: dark gray to very light gray, very fine to fine grained, subangular, medium sorting, light gray clay matrix, soft, possibly slightly glauconitic, slightly porous, no odor, stain, cut, or fluorescence, slight show gas.
7890-7910	Very poor samples; lost circulation at 7913'; Sandstone: light gray to dark gray, very fine to fine grained, moderate sorting, light gray clay to dark brown siderite matrix, soft to hard, possible glauconite and iron stained pellets, slightly calcareous; occasional very dark gray to black shaly sandstone; carbonaceous, occasional round sandstone pellets and granules, trace dark brown siderite; interbedded Shale: very dark gray to gray-brown stringers, glauconite, trace quartz and calcareous filled fractures; and Siltstone: dark to light gray to brown, partly sideritic.
7910-7957	Interbedded Sandstone: dark gray to green, very fine to fine grained, subangular, moderate sorting, glauconite, partly sideritic, trace iron stain; Siltstone: black, green to gray, glauconite; and Shale: black to dark gray to brown, occasional glauconite pellet stringers, siderite.
7957-7982	Sandstone: very light gray to gray, very fine grained, subangular, silty, clayey to siliceous, rare glauconite, siltstone laminae, very poor porosity, no show.
7982-8120	Shale: very dark gray to gray-brown, slightly pyritic, partly brittle becoming fissile to platy; interbedded Sandstone: light gray to gray-brown, silty, partly siliceous, partly calcareous, occasional stringers glauconite.
8120-8130	Siltstone: very dark gray, trace brown, micaceous, shaly, carbonaceous.
8130-8142	Shale: dark gray, micromicaceous, partly silty, slightly carbonaceous.

8142-8155	Siltstone: very dark gray to gray to slightly brown, micaceous, shaly, slightly siliceous, slightly carbonaceous; interbedded Shale: very dark gray.
8155-8230	Shale: very dark gray, slightly brown, silty in part, slightly carbonaceous, slightly siliceous, pyrite inclusions, rare trace coal, occasional stringers glauconite pellets; thinly interbedded Siltstone: dark gray.
8230-8280	Shale: very dark, slightly brownish-gray, fissile, "papery", in part highly micromicaceous.
8280-8489	Shale: very dark, slightly brownish-gray, fissile, "papery", in part highly micromicaceous; trace Siltstone: dark gray to very dark gray, shaly.
8489-8519	Core No. 6, Cut 30', Recovered 30'
8489.0-8494.0' (5.0')	Shale: very dark gray, silty, well indurated, sharp irregular fracture, micromicaceous, scattered carbonaceous inclusions.
8494.0-8498.0' (4.0')	Shale: as at 8494'; interbedded with thin beds Siltstone: dark gray, inclusions of "gilsonite" with septarian type veination at base.
8498.0-8519.0' (21.0')	Siltstone: gray to very dark gray, fine grained quartz, well indurated, sharp irregular fracture, thinly interbedded and irregularly laminated with very dark gray carbonaceous and micromicaceous shale; very weak vertical fractures throughout core.
8519-8570	Shale: very dark gray to black, fissile, micaceous, moderately indurated; interbedded minor amounts Siltstone: medium to dark gray, quartz grains, well indurated, slightly calcareous and slightly dolomitic in part.
8570-8630	Siltstone: medium dark gray, argillaceous to shaly, slightly dolomitic in upper part, moderately well indurated, grades to silty shale in part; and interbedded Shale: as at 8519'.
8630-8670	Sandstone: medium to dark gray, very fine quartz grains, very slightly calcareous, moderately well indurated, grades to siltstone in part, nil porosity, no cut, no fluorescence.

8670-8680	Siltstone: medium dark to dark gray, very slightly calcareous, moderately well indurated; grades in part to Sandstone: as at 8630', nil porosity, no cut, no fluorescence.
8680-8730	Shale: very dark gray, fissile, micaceous, carbonaceous, silty in part, very slightly calcareous in part, well indurated, trace glauconite 8690-8700', occasional finely disseminated pyrite and small inclusions of pyrite.
8730-8750	Shale: very dark gray to black, fissile to "papery", micaceous, moderately well indurated.
8750-8782	Shale: very dark gray to black, fissile, micaceous, moderately well indurated.
8782-8790	Shale: as at 8730'; with interbedded Siltstone: as at 8670'.
8790-8807	Sandstone: light gray, very fine quartz grains, very silty, occasionally carbonaceous grains, rare glauconite grains, rare biotite, slightly calcareous, slightly dolomitic, abundant secondary quartz, very well indurated, nil porosity, no cut, no fluorescence.
8807-8808	Core No. 7, Cut 1', Recovered 0'
	8807.0-8808.0' (1.0') No recovery.
8808-8819	Sandstone: as at 8790'.
8819-8873	Core No. 8, Cut 54', Recovered 53.7'
	8819.0-8819.3' (0.3') Not recovered.
	8819.3-8819.65' (0.35') Shale: very dark gray, fissile, micaceous, slightly silty, well indurated.
	8819.65-8858.0' (38.35') Sandstone: medium gray, very fine to silt quartz grains, siliceous matrix, abundant secondary quartz inclusions, blebs of very dark gray argillaceous material, (worm borings?), occasional thin irregular very dark gray argillaceous partings, occasional bleb light gray very fine sandstone, very well indurated, occasional vertical fracture, nil porosity, no cut, no fluorescence.

	8858.0-8873.0' (15.0')	Sandstone: as at 8819.65'; grades to very dark gray argillaceous Siltstone: siliceous, very well indurated, occasional vertical fracture.
8873-8900		Siltstone: very dark gray, quartz grains, slightly calcareous, very slightly dolomitic, argillaceous, very well indurated.
8900-8910		Shale: very dark gray, calcareous, silty, fissile, glauconitic, white specks common, well indurated.
8910-8920		Shale: dark brownish-gray, very calcareous, grades to argillaceous limestone in part, abundant fossil fragments, moderately indurated.
8920-8940		Shale: very calcareous; interbedded with Shale: calcareous and silty.
8940-8950		Shale: very dark gray to dark brownish-gray, silty, calcareous, fissile, moderately well indurated, fossil fragments common.
8950-8980		Shale: very dark gray, calcareous, fissile, moderately well indurated, fossil imprints and fragments common, occasional white calcite, silty in part.
8980-9040		Shale: as at 8950', fossil debris becoming rare.
9040-9059		Core No. 9, Cut 19', Recovered 16.5'
	9040.0-9056.5' (16.5')	Shale: very dark gray, fissile, micaceous, calcareous, fossils abundant, silty in part, rare pyrite, well indurated.
	9056.5-9059.0' (2.5')	No recovery.
9059-9070		Shale: very dark gray, fissile, micaceous, calcareous, fossils abundant, silty in part, rare pyrite, well indurated.
9070-9090		Siltstone: medium gray, very coarse silt to very fine sand size quartz grains, very calcareous, well cemented, nil porosity, no cut, no fluorescence; interbedded Shale: as at 9059'.
9090-9110		Limestone: medium to dark gray, fine to coarse shell fragments of fish remains, black phosphate pellets, moderately well cemented in lime mud matrix, pyrite common.

9110-9120	Shale: medium to very dark gray, very calcareous, fissile, silty in part, fossil fragments and imprints abundant, white specks common, well indurated; grading to shaly limestone in part.
9120-9130	Shale: dark gray, calcareous, fissile, micaceous, silty in part, fossil imprints common, well indurated.
9130-9140	Shale: very dark gray, calcareous, fissile, micaceous, very silty to sandy, very well indurated.
9140-9150	Sandstone: dark gray, very fine subangular quartz, calcareous, argillaceous, very well indurated.
9150-9160	Shale: very dark gray, calcareous, fissile, micaceous, silty, well indurated, rare fossil imprints, pyrite.
9160-9190	Siltstone: medium dark gray, very coarse silt to very fine sand size quartz grains, very calcareous, very well cemented; interbedded with Shale: as at 9150', occasional fossil imprint, trace pyrite.
9190-9200	Siltstone: medium gray, quartz grains, carbonaceous grains common, well cemented in siliceous matrix, slightly dolomitic, no cut, no fluorescence.
9200-9220	Siltstone to very fine Sandstone: light gray, quartz grains well cemented in siliceous matrix, carbonaceous grains rare, slightly dolomitic, slightly calcareous in part, nil porosity, no cut, no fluorescence.
9220-9265	Sandstone: medium gray, very fine quartz grains, very well cemented in siliceous matrix ("quartzitic"), slightly dolomitic, nil porosity, no cut, no fluorescence; interbedded with Sandstone: light gray, very fine subrounded quartz grains, carbonaceous grains common, well cemented in siliceous cement, calcareous, nil porosity, no cut, no fluorescence.
9265-9280	Sandstone: light to medium gray, very fine quartz and occasional carbonaceous grains well cemented in siliceous matrix, very slightly calcareous in part, nil porosity, no cut, no fluorescence.
9280-9305	Sandstone: light to medium light gray, very fine quartz and occasional carbonaceous grains well cemented in siliceous matrix, slightly calcareous in part, very slightly dolomitic, occasional fragment of chert pebble, no porosity, no cut, no fluorescence.

9305-9328 — Core No. 10, Cut 23', Recovered 21.8'

9305.0-9319.7' (14.7')	Siltstone to very fine Sandstone: medium dark to dark gray, quartz and occasional carbonaceous grains, very well cemented in siliceous matrix; interbedded in part with thin beds and thin laminations of Shale: very dark gray, micaceous, very well indurated, trace finely disseminated pyrite.
9319.7-9320.2' (0.5')	Sandstone: medium dark gray, coarse subrounded chert grains in very fine quartz sandstone to siltstone matrix, very well cemented in siliceous cement, slightly argillaceous, abundant finely disseminated pyrite, abundant inclusions of what appears to be coarse noncalcareous and soft shell fragments and "shards", nil porosity, no shows.
9320.2-9326.8' (6.6')	Siltstone to very fine Sandstone, interbedded with Shale: as at 9305', pyrite abundant in shale.
9326.8-9328.0' (1.2')	No recovery.

9328-9340 — Sandstone: medium light gray, very fine to silt size, quartz grains, rare carbonaceous grains, occasional "tripolite", very well cemented in siliceous matrix, nil porosity, no cut, no fluorescence.

9340-9360 — Sandstone: light gray, very fine to fine grained, subrounded quartz grains, occasional carbonaceous grains and inclusions, white "tripolite" common, rare coarse chert grains, very well cemented in siliceous matrix, slightly calcareous, pyrite common, nil porosity, no cut, no fluorescence.

9360-9370 — Sandstone: light to medium gray, very fine to silt size as at 9340'; with occasional interbedded Sandstone: very fine to coarse, conglomeratic, poorly sorted subrounded quartz and chert grains, occasional rounded chert pebble, very well cemented in siliceous matrix, nil porosity, no cut, no fluorescence.

9370-9380 — Sandstone: light gray, fine subrounded quartz grains, abundant white tripolite, occasional carbonaceous grains and inclusions; occasionally interbedded Sandstone: fine to coarse, conglomeratic, poorly sorted subrounded quartz and chert grains, occasional chert pebble, pyrite common, all very well cemented in siliceous matrix, nil porosity, no cut, no fluorescence.

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9380-9410	Sandstone: medium light gray, fine to medium subrounded quartz grains, abundant white "tripolite", occasional carbonaceous grains and inclusions; interbedded with Sandstone: fine to coarse, conglomeratic, poorly sorted subrounded quartz and chert grains and pebbles, carbonaceous inclusions common, pyrite abundant; all very well cemented in siliceous matrix, nil porosity, no cut, no fluorescence.
9410-9440	Sandstone: light gray to milky white, very fine to fine subrounded quartz grains, abundant white "tripolite" grains, very well cemented siliceous matrix; interbedded with Sandstone: fine to coarse, "conglomeratic", poorly sorted, subrounded quartz and chert grains and chert pebbles, carbonaceous inclusions common, very well cemented in siliceous matrix, milky white chert abundant, nil porosity, no cut, no fluorescence.
9440-9460	Chert: milky white to dark gray; with Sandstone: very fine to fine; and Sandstone: conglomeratic, as at 9410', traces red to reddish-brown staining.
9460-9550	Chert: milky white to dark gray; with Sandstone: conglomeratic, as at 9410'.
9550-9520	Conglomerate: dark gray to gray, fine to coarse quartz grains and chert pebbles, very well cemented siliceous matrix, pyrite common; with Chert: as at 9460', traces soft white "tripolite", nil porosity, no cut, no fluorescence.
9520-9540	Sandstone: light to medium gray, fine to coarse quartz, chert and tripolite grains, argillaceous in part, chert pebbles, conglomeratic in part, very well cemented siliceous matrix, pyrite common; with Chert: as at 9460'; nil porosity, no cut, no fluorescence.
9540-9560	Shale: medium to dark gray, very finely silty, blocky irregular fracture, moderately indurated, pyrite common.
9560-9570	Shale: as at 9540'; traces Shale: medium gray to buff, fissile, micaceous, poorly indurated.
9570-9580	Shale: dark gray, very finely silty, blocky irregular fracture, well indurated, pyrite common; trace Shale: medium greenish-gray, poorly indurated, fissile, micaceous.
9580-9590	Shale: as at 9570'; with Shale: glossy black, highly carbonaceous, highly sheared, soft, "coaly", silty; and traces Shale: brown, very silty, petroliferous(?), poorly indurated, micaceous.

9590-9640	"Bituminous" Schist: highly altered low grade shaly to silty Coal: glossy black, metallic luster, highly sheared and slickensided, occasional sand grains, poorly indurated; interbedded with Shale: very dark gray to black, carbonaceous, very finely silty, micaceous, fissile, moderately well to well indurated; and Shale: medium gray, fissile, micaceous, poorly indurated.
9640-9670	"Bituminous" Schist: as at 9590'; interbedded with Shale: very dark gray to black, very finely silty, micaceous, fissile, moderately well to well indurated; grades in part to Shale: black, bituminous, poorly to moderately indurated.
9670-9700	Shale: dark gray, very fine silty, micaceous, fissile, well indurated; interbedded with Shale: light to medium light gray, faint brownish tints, fissile to very thinly "papery", soft, slightly "wavy" cleavage parallel to bedding, pyrite abundant.
9700-9720	Shale: as at 9670'; light gray, with prominent brown tints and stains.
9720-9730	Shale: dark gray to very dark gray, very fine silty, fissile to sharp irregular fracture, very well indurated.
9730-9770	Shale: as at 9720'; interbedded with and in part grading to Sandstone: dark gray, very fine silty quartz grains, black carbonaceous grains and inclusions, argillaceous, well indurated, nil porosity, no cut, no fluorescence.
9770-9780	Shale: very dark gray, silty to sandy, grading in part to and interbedded with Sandstone: very dark gray, very fine, as at 9730'.
9780-9788	Conglomerate: medium to coarse grained, light gray to black chert and black argillite, angular to subangular, and light to dark gray chert pebbles, subangular to subrounded, very well compacted, very minor siliceous and fine grained matrix ("quartzitic"), argillaceous grains occasionally wrapped or warped around edges of adjacent chert grains; traces minute quartz veinlets, nil porosity.
9788-9800	Shale: dark to very dark gray, very finely silty, micaceous, fissile, pyrite common; interbedded minor Shale: light gray, fissile to very thin "papery", slight "wavy" cleavage parallel to bedding, soft.
9800-9810	Conglomerate: as at 9780'.

9810-9830	Conglomerate: as at 9780', becoming coarser (samples 80% sharp fractured chert), increase in very dark gray to black siliceous matrix.
9830-9860	Siltstone: medium dark to dark gray, quartz and shiny black carbonaceous grains, shaly, argillaceous, occasionally sandy, moderately well indurated, in part grades to Sandstone: very dark gray, very fine grained, shaly, traces black metallic luster.
9860-9884	Sandstone: medium dark gray to very dark gray, very fine to medium grained, poorly sorted, subangular to subrounded quartz, chert and black argillaceous grains in argillaceous matrix, well to very well indurated; interbedded with Sandstone: gray, fine to coarse grained, subangular quartz, chert and argillite grains, siliceous matrix, very well indurated (breaks across grains), with minor Clay: medium gray, mottled light gray specks, soft.
9884-9890	Argillite: very dark gray to black, silty, carbonaceous, thinly and irregularly interbedded, very argillaceous, carbonaceous, fine grained sandstone, black metallic luster on cleavage fractures (junk sub-recovery).
9890-9910	Shale/Argillite: very dark gray to black, in part silty to sandy; with black schistose highly carbonaceous shale, shiny black metallic luster, brittle.
9910-9920	As at 9890'; interbedded very fine to fine, dark gray quartzitic sandstone.
9920-9943	Sandstone: (quartzitic) dark gray, fine to medium chert, quartz and minor argillite grains, subangular to subrounded, very well indurated and cemented in argillaceous and siliceous matrix (breaks across grains), sharp irregular fracture.
9943	Total Depth Samples.
9945	Total Depth Driller.

Log Analysis

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Formation Evaluation

May 12, 1978

Mr. Gordon W. Legg
Husky Oil/NPR Operations, Inc.
2525 C Street, Suite 400
Anchorage, Alaska, 99503

Dear Mr. Legg:

Schlumberger began logging operations on South Meade #1 at 1045 hours April 28, 1978, and made two attempts with the Dual Induction Laterolog but failed to get deeper than 3800+ feet. A clean-out run was made with the pipe and Schlumberger re-entered the hole at 0630 April 30 and successfully ran the DIL. The Neutron-Density failed to get to bottom and another clean-out run was made. At about midnight May 1, Schlumberger got to bottom twice with the Neutron-Density but had equipment failures, once with the surface equipment and once with the down-hole tools. The third attempt was successful and was completed about noon on May 1 and the sonic log was then run although difficulty was encountered getting to bottom. The sonic log and sidewall cores were completed at 2030 hours on May 1. Due to the very badly washed out hole the dipmeter and velocity surveys were cancelled. Only about 1100 feet of the open hole were less than 15" in diameter and the calipers indicated a very rugose bore-hole wall.

Identifiable formation tops were Pebble Shale at 6474, Kuparuk River Sand at 6718 and possible Kingak at 6915. Correlations with East Teshepuk and South Simpson Wells were fairly good. Sand stringers from 5450 to 6200 which exhibited some gas shows were of very low porosity (3% - 12%) and hence of no interest. A zone from 7840 to 7930 displayed a Neutron-Density anomaly similar to the ones in the South Simpson and Iko Bay Wells, i.e., a bulk density of greater than 3 g/cc and a high neutron porosity. Schlumberger Research has suggested this anomaly could be attributed to the presence of Daphnite (a chlorite) or limonite, both of which have a high density and a hydrogen index of 45% to 55%.

Very truly yours,

A. Kane

Note:
This is a copy of the original report mailed May 12, 1978.

Log Analysis

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Well Log Analyst
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Formation Evaluation

January 22, 1979

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

Dear Mr. Hewitt:

Schlumberger began logging operations on South Meade No. 1 at 0300 hours January 14, 1979, and completed two temperature surveys, DIL, CNL/FDC, BHC, Dipmeter and recovered 33 of 45 selected sidewall cores at about 0900 hours January 15, 1979, and experienced no tool failures or lost rig time. This is a tribute to Engineer Larry Nelson and his crew. Log quality on all logs was very good except for the usual erratic SP curve on the DIL.

Recognizable formation tops were: Sag River at 8772, Shublik at 8860 and Sadlerochit at 9184. These points correlate well with the Kugrua and South Simpson wells. A "Pre-Lisburne" formation was selected by Geologists D. Bossart and I. Tailleur at 9531.

In the Sag River the 10 foot interval from 8790 to 8800 indicated a porosity of about 6% from the Density and about 7% from the Sonic, and using an Rw value of 0.1 which compares favorably with computed values from other wells would result in 100% water saturation.The interval 8800 to 8840 indicates an average porosity of 10% and a water saturation of 90%+. The sandstone stringers in the Sadlerochit are all of low porosity from 5%-10% and thus of no interest. The two conglomeratic intervals from 9436-9530 and 9795-9827 have an average porosity of about 2%. It appears that a matrix velocity of 19,500 ft/sec and a grain density of 2.68 g/cc should be used in these intervals.

Thank you for the opportunity of serving you.

Very truly yours,

Armour Kane

Armour Kane

Log Analysis

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

Formation Evaluation

February 3, 1979

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

Dear Mr. Hewitt:

In the two sands in the South Meade No. 1 well at 1842-56 and 1873-88 Rw calculated from the SP equals 0.44. Using this figure with a sonic derived porosity of 32% and Rt of 28 in the upper sand, Sw is 35% and in the lower sand a sonic porosity of 33% and Rt of 18 results in Sw of 42%. The sonic response in the upper sand is not indicative of gas but in lower sand the sonic is skipping which would indicate gas or a very large hole wash-out. The two sonic passes over the same interval do not repeat but if the first pass is used, Sw in the upper sand would be about 40%.

Very truly yours,

Armour Kane

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

LOGGING REPORT

WELL NAME SOUTH MEADE #1

Date January 14 - 15, 1979 Driller Depth 9945'

Elevation 40' K.B. Logger Depth 9940'

Logs Run and Intervals

Temp Survey Run #1	90-9940'	Run #2 Surface - 9940'
GR/SP/DIL	8016-9934'	
GR/BHC/TTI	8016-9940'	
GR/CAL/FDC/CNL	8016-9939'	
HDT Dipmeter	8020-9936'	
CST Sidewall Sampler	8275-9909'	

Additional Logs to Run

None

Zones of Interest

Depth	Gross Thickness	Net Feet of Porosity	Lith	Porosity	Probable Fluid Content
8790-8800'	10'	10'	Sandstone	6%	Water
8800-8840'	40'	36'	Sandstone	10%	Sw approx. 90%

Discussion:

Conglomeratic Interval 9436-9530' indicates average porosity = 2%
Conglomerate/Cherty interval 9795-9827': average porosity = 2%
All other sandstone intervals are of low porosity

Log Tops & Correlations:

Sag River	8992'	9516'	7486'
Shublik	8860'	9630'	7675'
Sadlerochit	9184'	9965'	8220'
Pre-Lisburne	9531'		

Additional Evaluation Plans:

DALLAS BOSSORT
Wellsite Geologist

ARMOUT KANE
Log Analyst

12/77

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CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907) 279-4014 P.O. BOX 4-1276 ANCHORAGE, ALASKA 99509 4049 BUSINESS PARK BLVD.

GAS ANALYSIS REPORT

Company Husky Oil Company Date March 22, 1978 Lab. No. 7547
Well No. South Mead No. 1 Location Sec. 31, T-15-N, R-19-W.um
Field NPR No. 4 Formation
County Depth
State Alaska Sampling point
Line pressure psig; Sample pressure 300 psig; Temperature ° F; Container number
Remarks Sample taken @ gas sample valve between 13 5/8 & 20" Casing
March 17, 1978 by Mr. Ron Brockway. (± 500' to ± 2600')

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	Trace	
Carbon dioxide	Trace	
Hydrogen sulfide	--	
Methane	95.33	
Ethane	3.44	
Propane	0.68	0.187
Iso-butane	0.36	0.117
N-butane	0.04	0.013
Iso-pentane	0.06	0.022
N-pentane	0.01	0.004
Hexanes	0.04	0.016
Heptanes & higher	0.04	0.018
Total	100.00	0.377

GPM of pentanes & higher fraction 0.060

Gross btu cu. ft. @60° F & 14.7 psia (dry basis) 1061
Specific gravity (calculated from analysis) 0.587
Specific gravity (measured) 0.588

Remarks:

LISTING OF OTHER AVAILABLE GEOLOGICAL DATA

FINAL MICROPALEONTOLOGY REPORTS
(by Anderson, Warren and Associates, Inc.)

1. "FINAL MICROPALEONTOLOGY REPORT"
   Dated: July 26, 1978 (includes interpretation to 8519 feet).

2. "FINAL MICROPALEONTOLOGY REPORT"
   Dated: February 2, 1979 (includes interval 8520-9943'). Also includes interpretation of USN Topagoruk No. 1 Test Well.

3. Revisions to above reports for interval 6760-6970', dated: August 18, 1980, and February 4, 1981.

PALYNOLOGY REPORTS
(by Anderson, Warren and Associates, Inc.)

1. "PALYNOLOGY REPORT"
   Dated: July 27, 1978 (includes interpretation to 8519').

2. "PALYNOLOGY REPORT"
   Dated: February 1, 1979 (includes interpretation interval 8520-9943').

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

Telephone: (303) 497-6376