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BIOSTRATIGRAPHIC CORRELATIONS OF SELECTED TEST WELLS OF NATIONAL PETROLEUM RESERVE IN ALASKA

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SUMMARY

Biostratigraphic correlations are released for 18 test wells in the National Petroleum Reserve in Alaska (N.P.R.A.) and one industry well to the east of the Reserve along three lines of section. The correlations are based on two microfossil groups, Foraminifera and palynomorphs (dinoflagellates, acritarchs, pollen, and spores), analyzed by the N.P.R.A. subcontractor Anderson, Warren, and Associates, Inc., San Diego, California. Micropaleontology reports, which record the microfossil assemblages recovered for the specified intervals delineating the zones in the correlated wells, are also included for reference.

INTRODUCTION

An area of approximately 37,000 square miles in northern Alaska was established as the Naval Petroleum Reserve No. 4 (N.P.R.-4) in 1923. From 1944 to 1953, thirty-six test wells and 45 core tests were drilled in and adjacent to N.P.R.-4 (Gryc, 1970). In 1964, drilling again resumed in the Reserve and continued until 1977 during which time 17 additional test wells were completed. On June 1, 1977, the jurisdiction of N.P.R.-4 was transferred from the Department of the Navy to the Department of the Interior (U.S. Geological Survey), and the Reserve has subsequently been known as the National Petroleum Reserve in Alaska (N.P.R.A.). As drilling contractor for N.P.R.A. since mid 1975, Husky Oil N.P.R. Operations, Inc. has completed a total of 27 test wells and eight field wells, six test wells and two field wells under the N.P.R.-4 program, and 21 test wells and six field wells during the current N.P.R.A. program. No additional wells are planned at the present time.

This report releases biostratigraphic correlations of 19 wells along three lines of section across N.P.R.A. based on both Foraminifera and palynomorphs (dinoflagellates, acritarchs, pollen, and spores). The biostratigraphic zonation schemes were established at the laboratory of the subcontractor Anderson, Warren, and Associates, Inc., of San Diego, California. Forty-one foraminiferal zonules (includes 20 Paleozoic Mamet zones) and 30 palynological zonules constitute the zonation.

All of the wells that have been biostratigrapically correlated in this report were drilled in the Arctic coastal plain and northern Arctic foothills provinces and have penetrated varying parts of the three generally recognized stratigraphic sequences of the North Slope. Based on sediment source areas, these sequences and their age ranges (in the coastal plain) include the Franklinian (pre-Mississippian), the Ellesmerian (Mississippian-Early Cretaceous), and the Brookian (Early Cretaceous-Quaternary).

The Foraminifera and palynology reports prepared by Anderson, Warren, and Associates, Inc., upon which these biostratigraphic correlations are based, are also included as part of this open-file release (see p. 17-86).

GENERAL GEOLOGIC FRAMEWORK

Much of the stratigraphic information in this section has been briefly summarized from Carter et al. (1977) and Bird (1981a), to which the reader is referred for a more detailed explanation. Other publications pertinent to N.P.R.A. stratigraphy include Brosge' and Tailleur (1971), Bird (1978), and numerous Nanushuk Group and related studies in Ahlbrandt (1979) and Molenaar (1981), as well as those listed in bibliographies compiled by Mather and Trollman (1970), Carter et al. (1975), and Blean (1976).

The subsurface lithologic units of N.P.R.A. (see Figure 2, p. 8) can be grouped into three major stratigraphic sequences on the basis of provenance of sediments (Lerand, 1973; Grantz et al., 1975) as follows:

(1) Franklinian sequence: Considered economic basement, this pre-Mississippian age interval of rocks consists of steeply-dipping metamorphosed clastics and carbonates. Source for the clastics was an orogenic uplift in the approximate position of present-day northernmost Alaska. Most of the wells that penetrated this sequence in the Reserve have encountered a dark gray, wavy banded argillite at total depth.

(2) Ellesmerian sequence: This succession of rocks, which unconformably overlies the Franklinian sequence, consists of shallow marine and non-marine clastics, as well as platform carbonates. Sedimentologic and stratigraphic evidence suggests the Ellesmerian shorelines approximated the present Arctic coast with open seas southward. In the northern foothills and coastal plain provinces, the sequence ranges in age from Mississippian to Early Cretaceous (Neocomian). Major lithologic units include (in ascending order) the Endicott Group (Mississippian), Lisburne Group (Late Mississippian-Early Permian), Sadlerochit Group (Early Permian-Early Triassic), Shublik Formation (Middle-Late Triassic), Sag River Sandstone (Late Triassic-Early Jurassic), Kingak Formation (Jurassic), and the informal pebble shale unit (Early Cretaceous: Neocomian).

(3) Brookian sequence: The uplift of the Brooks Range provided a southern source for this final sequence of sediments. This orogeny produced large scale subsidence to the north in the form of the Colville Basin. The Barrow Arch, a basement high which essentially parallels the present-day Alaskan Beaufort Sea shoreline, resulted from subsidence of the northern land area by both northward downwarping and normal faulting. After deposition of the predominantly Ellesmerian-derived pebble shale unit, thick clastic wedges began periodically building out into the Colville Basin in the Early Cretaceous (Aptian?) time and lasted through the Tertiary. The Torok Formation/Nanushuk Group (Cretaceous: Aptian-Cenomanian) reflects a prograding depositional system consisting of topset beds of the Nanushuk and upper Torok (alluvial-deltaic-shelf deposits), and foreset beds (slope deposits) and bottomset beds (basin floor deposits) of the middle and lower Torok (see Bird and Andrews (1979) and Molenaar (1981)). Subsequent clastic wedges include the Colville Group (Late Cretaceous: Cenomanian-Maestrichtian) and the Sagavanirktok Formation (Tertiary). The Quaternary sediments of the coastal plain include the Gubik Formation and Recent surficial deposits.

The North Slope Rock Unit Report (Bird, 1981b) lists the depths to the tops of the lithologic units (as shown in Figure 2, p. 8, of the present report) encountered in the wells of N.P.R.A., as well as many off the Reserve. Many of the lithologic references in this release, other than those taken directly from the A.W.A. Foraminifera reports, were based on Bird (1981b).

CORRELATED WELLS

Foraminiferal and palynological zones have been correlated for 18 wells within N.P.R.A. and one industry well (ARCO Itkillik River No. 1) just outside the eastern boundary of the Reserve. Three lines of section, B-A, A-C, and A-D (see Figure 1), constitute the biostratigraphic correlations.

Line of section B-A, a total distance of about 150 miles, trends generally northeasterly from near Icy Cape to Pt. Barrow and includes the following wells:

Tunalik No. 1
Peard No. 1
Kugrua No. 1
S. Meade No. 1
S. Barrow No. 17

At a total depth of 20,335 ft., Tunalik No. 1 is the deepest of the N.P.R.A. wells.

Line of section A-C runs southeasterly from Pt. Barrow toward the Umiat area for an approximate distance of 130 miles and includes the following wells:

S. Barrow No. 17
E. Simpson No. 1
S. Simpson No. 1
Ikpikpuk No. 1
Inigok No. 1

The Inigok well is the second deepest test hole in the Reserve with a total penetration of 20,102 ft.

Line of section A-D also trends generally southeasterly following the Barrow Arch for much of the distance and finally off the Reserve to ARCO Itkillik River No. 1. The traverse runs for a total distance of about 220 miles and includes the following wells:

S. Barrow No. 17
E. Simpson No. 1
Drew Point No. 1
J. W. Dalton No. 1
W. T. Foran No. 1
Cape Halkett No. 1
E. Teshekpuk No. 1
N. Kalikpik No. 1
Atigaru Point No. 1
S. Harrison Bay No. 1
W. Fish Creek No. 1
Itkillik River No. 1 (ARCO)

The 19 wells correlated in this report with their completion dates, total depths, and deepest units (ages) penetrated are listed in Table 1.

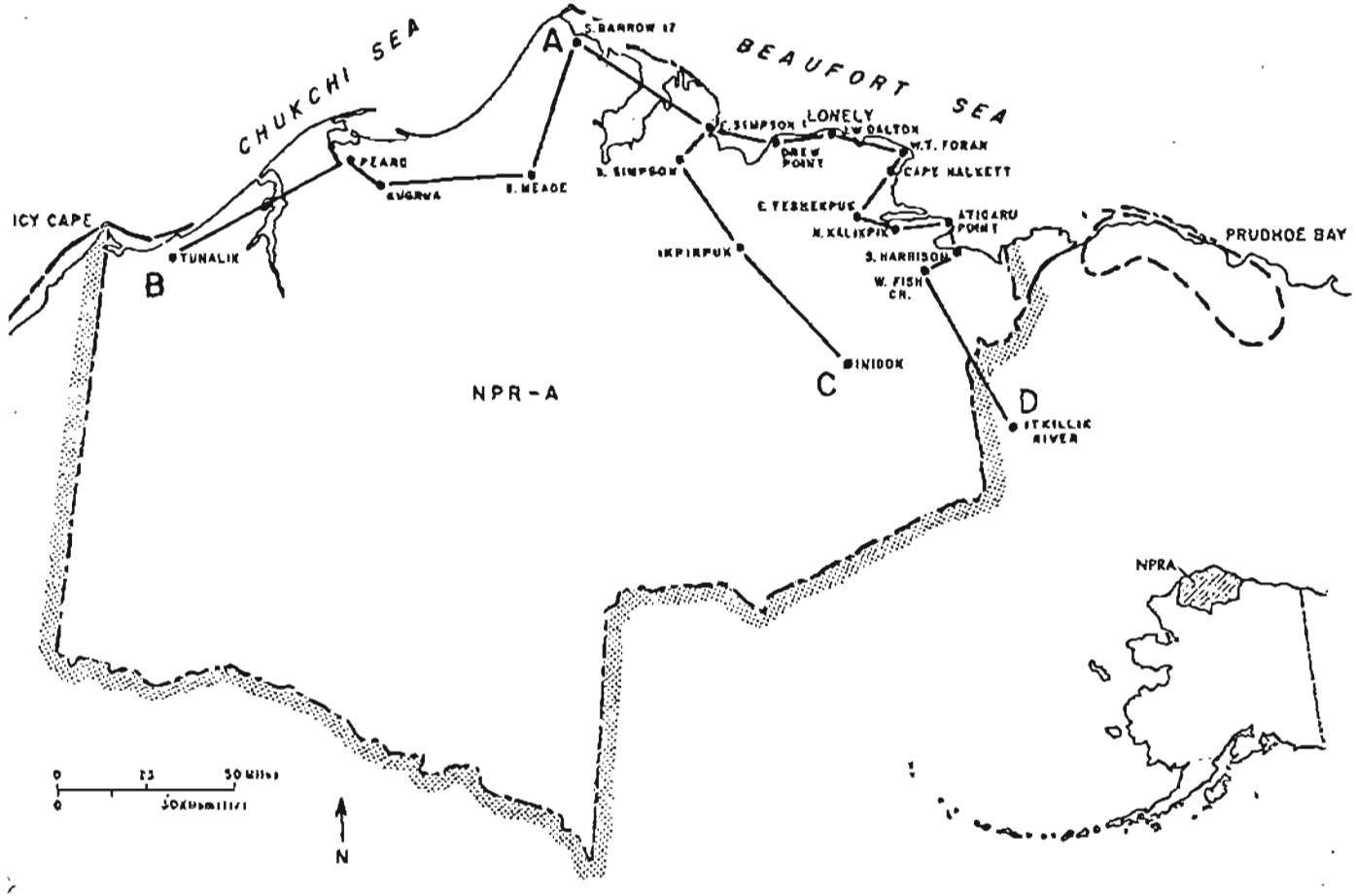

Figure 1. Map of N.P.R.A. showing biostratigraphic correlation lines of section B-A, A-C, and A-D.

Table 1. Alphabetical listing of 19 correlated wells with completion dates, total depths, and deepest units (ages) penetrated.

Well	Completion Date	Total Depth	Deepest Unit Penetrated (Age)
Atigaru Test Well No. 1	3/77 [2]	11,535 ft.	Argillite Basement (Indeterminate) [3]
E. Barrow Field Well No. 17	4/78	2,362 ft.	Argillite Basement (Indeterminate) [3]
Cape Halkett Test Well No. 1	6/75 [2]	9,800 ft.	Argillite Basement (Indeterminate) [3]
J. W. Dalton Test Well No. 1	8/79	9,367 ft.	Argillite Basement (Indeterminate) [3]
Drew Point Test Well No. 1	3/78	7,948 ft.	Argillite Basement (Indeterminate) [3]
W. Fish Creek Test Well No. 1	4/77 [2]	11,427 ft.	Kayak Shale (Probable Mississippian)
W. T. Foran Test Well No. 1	4/77 [2]	8,884 ft.	Argillite Basement (Indeterminate) [3]
S. Harrison Bay Test Well No. 1	2/77 [2]	11,290 ft.	Lisburne Group (Middle Pennsylvanian or younger)
Ikpikpuk Test Well No. 1	2/80	15,461 ft.	Kekiktuk Fm.? (Probable Mississippian)
Inigok Test Well No. 1	5/79	20,102 ft.	Kekiktuk Fm.? (Mississippian)
Itkillik River Test Well No. 1 [1]	7/72	15,321 ft.	Argillite Basement (Indeterminate) [3]
N. Kalikpik Test Well No. 1	4/78	7,393 ft.	Kingak Sh. (Jurassic)
Kugrua Test Well No. 1	5/78	12,585 ft.	Lisburne Group (Middle Pennsylvanian)
S. Meade Test Well No. 1	1/79	9,945 ft.	Clay shales/siltstones of indeterminate unit (Indeterminate) [4]
Peard Test Well No. 1	4/79	10,225 ft.	Argillite Basement (Indeterminate) [3]
E. Simpson Test Well No. 1	4/78	7,739 ft.	Argillite Basement (Indeterminate) [3]
N. Simpson Test Well No. 1	4/77 [2]	8,795 ft.	Argillite Basement (Indeterminate) [3]
E. Teshekpuk Test Well No. 1	5/78 [2]	10,664 ft.	Granite Basement OR Kekiktuk Fm.? (Mississippian) [5]
Tunalik Test Well No. 1	1/80	20,335 ft.	Lisburne Group (Mississippian)

Footnotes:

1 - Well was drilled by ARCO (Atlantic Richfield Co.) to the east of N.P.R.A.

2 - Well was drilled during Naval Petroleum Reserve No. 4 (N.P.R.-4) program.

3 - Argillite in these wells is barren of palynomorphs and foraminifera, hence, the Indeterminate age designation. The following reports shed some light on its possible age range: Ordovician - Silurian aged graptolites and chitinozoans recovered from argillite at Point Barrow and Prudhoe Bay wells (Carter and Laufield, 1975); Early Cambrian radiometric ages from mica in argillite of Prudhoe Bay well (Drummond, 1974); Early? - Middle Devonian aged carbonized plant fragments in steeply-dipping carbonaceous clay shale, likely part of argillite basement sequence, near bottom of Topagoruk well (Collins, 1958; Bergquist, 1966). The age of economic basement in N.P.R.A. is typically considered as Middle Devonian or older.

4 - The clay shales/siltstones near the bottom of this well are steeply-dipping and very similar in character to those in the basal part of the Topagoruk well dated as Early? - Middle Devonian on the basis of plant fragments. These strata are barren of foraminifers in both wells. The interval in S. Meade is essentially barren of palynomorphs; in Topagoruk these basal strata are suggestive of a pre-Carboniferous age.

5 - Bird et al. (1977) concluded that this well bottomed in a granitic intrusive (Lisburne/granite contact given as 10,617 ft.). Radiometric dates based on two different minerals yielded discordant ages: 332 ± 10 m.y. (Mississippian age) for K feldspar and 243 ± 7 m.y. (Late Permian age) for biotite. Alternatively, an A.W.A., Inc., report for this well suggests the following:

Foraminifera
10,390 - 10,650 ft.: Endicott Group, Kekiktuk Fm.? (Mississippian)
10,650 - 10,664 ft. TD: Quartzite? (Indeterminate age)

Palynology
9,870 - 10,664 ft. TD; Carboniferous

GENERAL CONCEPT OF ZONATION

The basic unit in biostratigraphy is the biostratigraphic zone, defined as a body of strata typically characterized by particular fossil taxa. Although the zone often takes its name from one or more of the characteristic taxa, the zones of this report are alphanumeric designations. The Code of Stratigraphic Nomenclature states that "... biostratigraphic evidence is the most useful means for determining time-stratigraphic boundaries, but criteria for defining biostratigraphic and time-stratigraphic units differ fundamentally." Biostratigraphic zones should never simply be assumed to have time-stratigraphic significance.

Many of the zones that make up the N.P.R.A. biostratigraphic column may in fact be time-transgressive in character. All of the Foraminifera recovered in the N.P.R.A. subsurface are benthonic, and as a result were controlled in large part by the sedimentary facies which migrated both geographically and temporally. The dinoflagellate assemblages, although planktonic, may have been influenced as well to varying degrees by particular facies, likely as an indirect consequence of water depth, distance from shore, nutrient parameters, etc. This facies influence on microfossil assemblages leads to a time-transgressive oriented zonation. A good case in point is reflected in the foraminiferal zonal boundaries F-9/F-10/F-11 and the palynological zonal boundary PM-17/PM-18 (see Figure 2). These boundaries have been dashed and slanted to represent the time-transgressive nature of the prograding complex of Torok Formation/Nanushuk Group strata. One must realize that many of the other zonal boundaries shown as level lines (implying isochronous surfaces) in Figure 2 might in fact be diachronous interfaces.

Additional problems are encountered in biostratigraphic zonation when one or both of the boundaries of zones are represented by disconformities. It is difficult to know how much strata (and reflected time) are missing as a result of subaerial/submarine erosion or non-deposition.

The reader is referred to the Code of Stratigraphic Nomenclature prepared by the American Commission on Stratigraphic Nomenclature (1970) for a detailed discussion of biostratigraphic zones. Applications and attendant problems of biostratigraphic zonation techniques are addressed in Kaufmann and Hazel (1977), Berggren (1978), and Johnson (1979).

FORAMINIFERAL BIOSTRATIGRAPHY

Introduction

The foraminiferal zonation scheme for N.P.R.A. (see Figure 2), established by Michael B. Mickey while at Anderson, Warren, and Associates (A.W.A.), consists essentially of 21 A.W.A. zones (designated "F"), in addition to 20 Paleozoic zones (designated "Z") of Mamet (refer to Mamet and Ross (1971), and Armstrong and Mamet (1977)). Zones F-21 through F-1 range in age from Early Permian to Quaternary, whereas zones Z-5 through Z-22 (or younger) are predominantly Mississippian through Pennsylvanian in age.

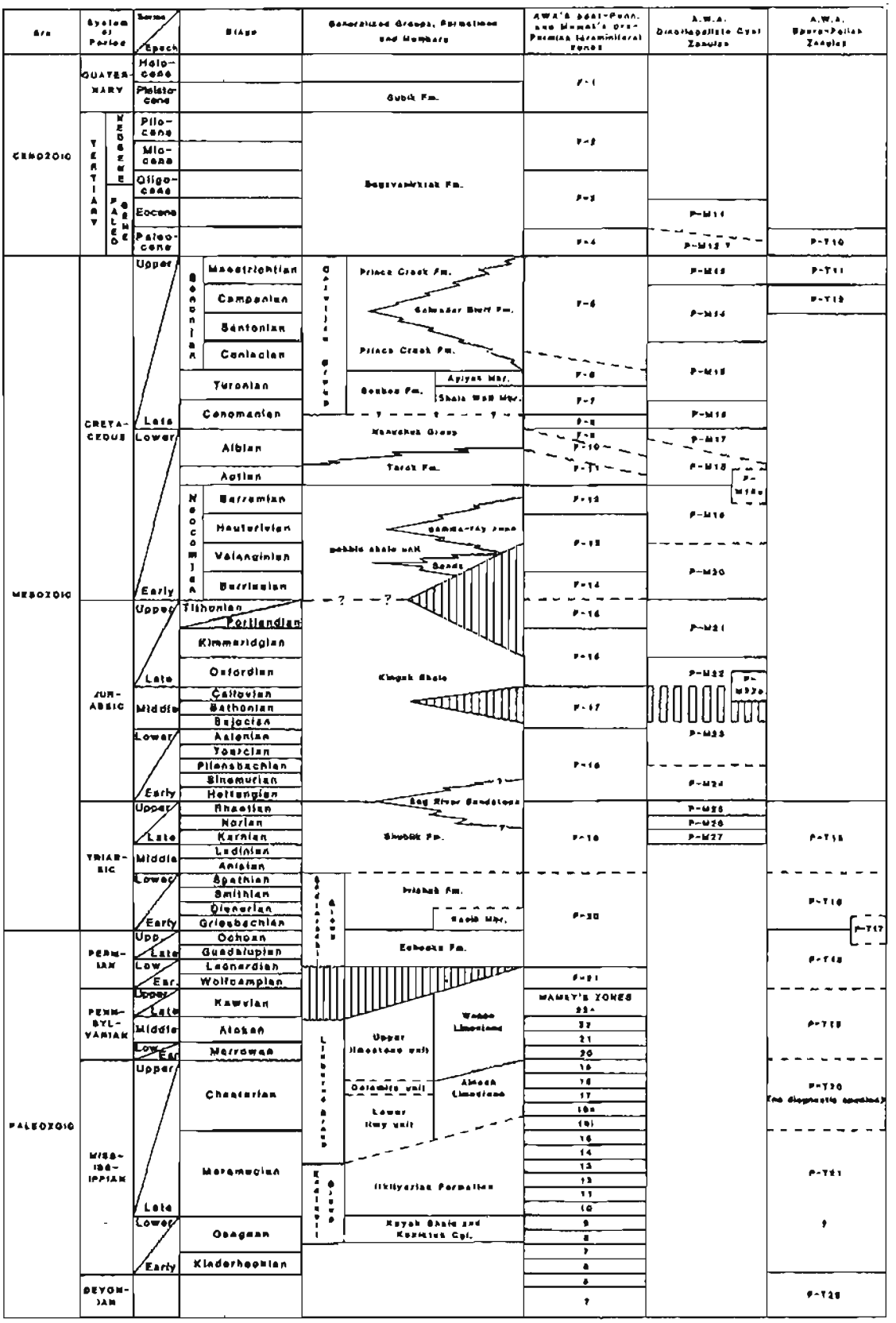

Figure 2. N.P.R.A. subsurface time-stratigraphic/stratigraphic/biostratigraphic units. (Modified from 1980 chart of Anderson, Warren, and Associates, Inc.)

General remarks are included under the following three subheadings of the report for the foraminiferal zones correlated in the 19 wells along lines of section B-A, A-C, and A-D. A number of comments, most of which apply to all three sections, are offered below:

(1) The designation Lithocampe sp. N, or L. sp. N, shown on many of the wells (e.g., at a depth of 6,210 ft. in Peard No. 1) marks the top occurrence of a particular radiolarian which typically occurs just above the top of the Neocomian age strata in N.P.R.A.

(2) Generally, in the Torok Formation/Nanushuk Group complex, the F-11 zone defines the bottomset and foreset slope deposits, the F-10 zone in the foreset and topset outer shelf to upper slope deposits, and the F-9 zone the topset inner to middle shelf (some non-marine) deposits. The F-8 zone coincides with predominantly very shallow inner shelf deposits. In the Colville Group, the F-7 zone generally delineates the distal facies of the Shale Wall Member, the F-6 zone the slope deposits of the Seabee Formation, and the F-5 zone the non-marine to shelf deposits of the Schrader Bluff Formation.

(3) Poor to non-existent recovery of Foraminifera in many of the sandstones shown on the charts precludes assignment of a specific zone or age. As a result, these units can only be considered as bracketed by subjacent and superjacent designations.

(4) The stratigraphic correlation of the sandy unit in S. Barrow No. 17 (2,080-2,170 ft.) with a sandstone in S. Meade No. 1 (8,760-8,930 ft.; see Chart 1-A) and with a sandstone in E. Simpson No. 1 (6,740-6,900 ft.; see Charts 2-A and 3-A) has been queried and warrants further comment. The sands in S. Meade No. 1 and E. Simpson No. 1 are recognized by most geologists as definite Sag River Sandstone. The sandy interval listed above for S. Barrow No. 17, however, has been called Barrow Sands by Bird (1981b) and Carter (verbal communication, 1981), with the Sag River Sandstone indicated in the interval 2,275-2,345 ft. directly atop argillite basement. An alternative explanation offered in this report suggests that the Sag River Sandstone of S. Meade No. 1 and E. Simpson No. 1 correlates stratigraphically with the sands in S. Barrow No. 17 at approximately 2,080-2,170 ft. The interbedded sands/biocalcarenites described in the Husky Oil Geologic Report of S. Barrow No. 17 from 2,277-2,344 ft. may in fact be the more arenaceous updip facies of the Shublik Formation. Foraminifera recovered from the entire interval 2,170-2,320 ft. are generally more suggestive of a Shublik F-19 zone assemblage than one that might be derived from the Sag River Sandstone. Further detailed well log and seismic correlations, combined with paleontological/paleonenvironmental evidence, will help elucidate this stratigraphic problem.

(5) The top of a pebble sandstone which often occurs in the basal Shublik Formation, as described by Tappan (1951), has been marked as Pbl. Ss. in the wells it has been observed (e.g., at a depth of 8,640 ft. in Peard No. 1); see the basal F-19 zone on the correlations.

(6) Some of the zones (e.g., F-20 (Echooka); Z-17 to Z-18 (Dolomite Unit)) are not strictly biostratigraphic zones; these units are defined by characteristic taxa and/or recognition of the particular lithologies of the Echooka Formation of the Sadlerochit Group and dolomite of the Lisburne Group, respectively. Lithologies such as the Kayak-Itkilyariak and Kekiktuk Formations of the Endicott Group have also been correlated in certain wells (e.g., Ikpikpuk No. 1 and Inigok No. 1).

(7) A broken unconformity line indicates that the evidence for an unconformable horizon is not quite as strong as for those shown with solid lines.

(8) A discussion on the possible age of the argillite basement complex is presented in Footnote 3 of Table 1.

(9) For details of the zonation of the correlated wells, see the A.W.A. Foraminifera reports included with this release. In the case of differences in zone assignments or depths between the reports and the correlation sections, the latter prevails.

Line of Section B-A

The foraminiferal biostratigraphic correlation of the five wells of traverse B-A is depicted in Chart 1-A. An expanded section in Tunalik No. 1 thins considerably in S. Barrow No. 17 on the Barrow Arch. Strata in the Tunalik well range from a thick F-9 zone of the Nanushuk Group to the Z-21 zone of the Lisburne Group at total depth. Of particular interest is the relatively thick section of zones F-12/13 to F-13/14, making much of what has been called Kingak Shale (Bird, 1981b) Neocomian age. In S. Barrow No. 17, a section of F-10 Torok Formation through F-19 Sag River Sandstone/Shublik(?) sediments rests unconformably atop the argillite; the disconformity between F-13/14 and F-18 reflects the absence of zones F-15, F-16, and F-17. Whereas the total range and succession of zones represented in Kugrua No. 1 are nearly identical (though condensed) to that of Tunalik No. 1, the F-21 through Z-21 Lisburne Group zones are absent in Peard No. 1 and S. Meade No. 1. In the Peard well, the F-20 (Echooka) zone rests on argillite, while in the S. Meade well the steeply-dipping, barren strata at total depth are of indeterminate age (see Footnote 4 of Table 1 for details).

Line of Section A-C

Chart 2-A represents the correlation of the foraminiferal zones of the five wells along line of section A-C. Much of the expanded sections of strata encountered in the Ikpikpuk and Inigok wells are thinned considerably or truncated before reaching S. Simpson No. 1. Kingak Shale through Sadlerochit Group strata representing zone F-17/18 through F-20 maintain a rather consistent thickness in these wells. In Inigok No. 1, the strata penetrated include the F-5 zone of the Colville Group through the pre--Z-10 zone section of questionable Kekiktuk sediments (of indeterminate age) at total depth. The Lisburne carbonates assigned a Z-10 or 11 zone

are the oldest known immediately overlying the Endicott Group in N.P.R.A. Similar questionable Kekiktuk rocks are reported for the bottom of Ikpikpuk No. 1; the top sample in this well (at 100 ft.) belongs to the F-8 zone of the Nanushuk Group. The F-9 Nanushuk Group through pre--Z-20 undifferentiated Carboniferous-Permian section in S. Simpson No. 1, as well as the F-7 Colville Group through F-20 Sadlerochit Group section in E. Simpson No. 1, rests unconformably atop argillite basement. Aside from the considerable truncation of strata by the basement unconformity, other subsequent disconformities have eliminated at least the F-14/F-15/F-16 interval of sediments in South Simpson No. 1 and E. Simpson No. 1.

Line of Section A-D

Foraminiferal zones are correlated for 12 wells along line of section A-D (see Chart 3-A). All of the wells, except E. Teshekpuk No. 1, S. Harrison Bay No. 1, and W. Fish Creek No. 1, bottomed in argillite basement. The rocks at total depth in the E. Teshekpuk well are believed by Bird et al. (1977) to be part of a granitic intrusive, while the A.W.A. Foraminifera report for the well suggests that they are a quartzite (of the Kekiktuk? Formation). S. Harrison Bay No. 1 encountered zone Z-20 (revised from A.W.A. Foraminifera report listing zone Z-21) of the Lisburne Group at total depth, and W. Fish Creek No. 1 bottomed in the Endicott Group (Kayak Shale?).

Strata below the basal Cretaceous unconformity (at base of zone F-13/14 or base of sand below zone F-12/13) and above the argillite generally range from zones F-16 or F-15/16 of the Kingak Formation to Endicott Group lithology along the traverse from E. Teshekpuk No. 1 to ARCO Itkillik River No. 1. The basal Cretaceous unconformity has cut out zones F-15 and F-16 of the Kingak Formation in the Atigaru Point well. Directly below the unconformity are either zone F-18 Kingak Formation or F-19 Shublik Formation strata from Cape Halkett No. 1 to S. Barrow No. 17. In this series of wells, Endicott Group strata rest atop basement in Cape Halkett No. 1, W. T. Foran No. 1, and J. W. Dalton No. 1. Zone F-20 Sadlerochit Group rocks lie on the argillite in Drew Point No. 1 and E. Simpson No. 1. At a total depth of 7,395 feet, the N. Kalikpik well, the second most shallow well on the traverse (after S. Barrow No. 17), bottomed in zone F-16 Kingak strata.

Strata above the basal Cretaceous unconformity range generally from the F-5 zone of the Colville Group to the F-12/13 or F-13/14 zones of the pebble shale unit/Kingak strata in ARCO Itkillik River No. 1, W. Fish Creek No. 1, S. Harrison Bay No. 1, Atigaru Pt. No. 1, N. Kalikpik No. 1, E. Teshekpuk No. 1, and Cape Halkett No. 1. Younger zone strata were encountered near the top of other wells as follows: S. Barrow No. 17 (F-10 zone Torok Formation), E. Simpson No. 1 (F-7 zone Colville Group), W. T. Foran No. 1 (F-4 zone Sagavanirktok Formation), and Drew Point No. 1 and J. W. Dalton No. 1 (F-1 zone Gubik Formation, with subjacent F-5 and F-4? zone strata, respectively).

PALYNOLOGICAL BIOSTRATIGRAPHY

Introduction

Hideyo Haga, while employed by Anderson, Warren, and Associates (A.W.A.), erected the palynological zonation scheme used in N.P.R.A. (see Figure 2). The zonation contains 19 A.W.A. dinoflagellate cyst zones (designated "PM") and 11 A.W.A. spore-pollen zones (designated "PT"). Dinoflagellate zones PM-27 through PM-11 range from the Late Triassic to the Eocene. Spore-pollen zonation ranges from the PT-22 zone in the Devonian to the PT-10 zone in the Paleocene.

The three subheadings which follow include general comments pertaining to the 19 wells correlated in the lines of section B-A, A-C, and A-D on the basis of dinoflagellates, as well as pollen and spores. A few comments, which apply to all three sections, are stated below:

(1) Zone PM-18a (possible Neocomian age) is a relatively newly designated unit which has a general Early Cretaceous aspect, and occurs below zone PM-18 and above the definite Neocomian age PM-19 zone. Based on palynological evidence alone, zone PM-18a could be of Aptian age; the associated formaniferal assemblages, however, indicate a Neocomian age. Hence, zone PM-18a is positioned to stradle the Aptian-Neocomian (Barremian) boundary (see Figure 2) and is tentatively designated as possible Neocomian age. In some of the A.W.A. palynology reports, it is recorded as zone PM-18a in the Summary of Revisions section, but in others the equivalent intervals were reported as zone PM-19 and/or PM-20.

(2) Poor palynomorph recovery and lack of diagnostic forms precluded a detailed zonation in particularly the Jurassic, Triassic, and Carboniferous age intervals of many of the wells.

(3) The reader is referred to the A.W.A. palynology reports included with this release for details of the zonation of individual wells. The correlation sections supercede the reports in the event of discrepancies in zone assignments or depths.

Line of Section B-A

Chart 1-B represents the palynological biostratigraphic correlation of the five wells which constitute traverse B-A. The expanded section encountered in Tunalik No. 1 ranges from PM-17/18 zone Nanushuk Group strata to an interval at the bottom of the hole of indeterminate age subjacent to zone PT-19 of the Lisburne Group. Much of this section is either markedly thinned or not represented on the Barrow arch in S. Barrow No. 17, where penetration ranged from zone PM-18 of the Torok Formation to undifferentiated Triassic sediments. The section in S. Barrow No. 17, as well as the zone PM-17/18 Nanushuk Group through Triassic? age strata in Peard No. 1, unconformably overlie the argillite basement. The section penetrated in Kugrua No. 1 ranges from zone PM-17/18 Nanushuk Group through probable Pennsylvanian age (PT-19?) Lisburne Group strata at total depth. In S. Meade No. 1, the total section drilled extends from zone PM-17/18 Nanushuk Group strata to an interval at the bottom of the hole of indeterminate age

(see Footnote 4 of Table a for details) with a superjacent zone PT-17? (based on sidewall core at 9,370 ft.). Only a very general tenuous zonation is possible in the Jurassic-Triassic interval of the Peard, Kugrua, and S. Meade wells. The possible Neocomian PM-18a zone was recognized from S. Barrow No. 17 to Peard No. 1, but was not observed in the "very poor recovery" interval of the Tunalik well. Note the thick Neocomian age PM-19 zone which spans pebble shale unit/Kingak Shale strata in Tunalik No. 1.

Line of Section A-C

Palynological zones were correlated for five wells along line of section A-C in Chart 2-B. Strata drilled in Inigok No. 1 extend from the PM-14 zone of the Colville Group to the PT-21 zone of the Endicott Group at total depth. The strata penetrated in the Ikpikpuk well represent a section of PM-16 zone Nanushuk Group through undifferentiated Carboniferous age Endicott Group. The sections of PM-17 zone Nanushuk Group through undifferentiated Carboniferous (Mississippian?) age strata in S. Simpson No. 1 and PM-16 Colville Group through undifferentiated Permo-Triassic age Sadlerochit Group strata in E. Simpson No. 1 both unconformably overlie argillite basement. The possible Neocomian PM-18a zone is recorded along the traverse from S. Barrow No. 17 to Ikpikpuk No. 1, but does not extend to the Inigok well. Strata representing zones PM-19 through PM-22 have pinched out (or have possibly been truncated) between the Ikpikpuk and S. Simpson wells. Palynomorph recovery permitted only undifferentiated system assignments for much of the Permo-Triassic through Jurassic age part of the section. The thick Carboniferous age section of zones PT-19, 20, and 21 in Inigok No. 1 and the undifferentiated Carboniferous age section in Ikpikpuk No. 1 thins considerably to a 38 ft. thick interval recognized atop the argillite in S. Simpson No. 1. No Carboniferous age sediments were recorded in the E. Simpson No. 1 well.

Line of Section A-D

Palynological zones are correlated for 12 wells along traverse A-D (see Chart 3-B). Definite argillite basement rocks are recorded along this line of section at total depth for S. Barrow No. 17, E. Simpson No. 1, Drew Point No. 1, J. W. Dalton No. 1, W. T. Foran No. 1, Cape Halkett No. 1, and Atigaru Point No. 1. In the E. Teshekpuk well, the entire basal interval from 9,870-10,664 ft. (total depth) is reported as Carboniferous age (see Footnote 5 of Table 1 for additional information). The relatively more shallow N. Kalikpik well at a total depth of 7,395 ft. bottomed in zone PM-22 Kingak strata. The basal sections in both S. Harrison Bay No. 1 and W. Fish Creek No. 1 are listed as indeterminate age; Bird (1981b), as well as A.W.A. Foraminifera reports for these wells, indicate that bottom hole strata in the former well is the upper limestone unit of the Lisburne Group and in the latter well Kayak Shale of the Endicott Group. The lowermost unit encountered in the ARCO Itkillik River No. 1 well

(14,950-15,321 ft., total depth) is recorded as basement complex in Bird (1981b) and as argillite in the A.W.A. Foraminifera report. Mississippian age spores recovered in a core sample in the interval 15,311-15,321 ft. pose a problem; a resampling of this basal core is presently planned in order to rule out a possible previous sampling error.

Strata below the basal Cretaceous unconformity (at the base of PM-18a, 19, or 20) and above the argillite generally range as follows along this traverse: Jurassic? age Kingak Formation through Permo-Triassic age or PT-16 zone Sadlerochit Group strata from E. Simpson No. 1 to Drew Point No. 1; Late Triassic-Early Jurassic age or zone PM-22 or PM-23 Kingak or Shublik Formation through Carboniferous age Lisburne Group or Endicott Group strata from J. W. Dalton No. 1 to Atigaru Pt. No. 1 (the relatively shallow N. Kalikpik No. 1 well bottomed in PM-22 zone Kingak sediments); PM-22 or PM-21 zone Kingak Formation through Lisburne Group and Endicott Group strata (Bird, 1981b) of indeterminate age based on palynology in the S. Harrison Bay and W. Fish Creek wells, respectively. In the Itkillik River No. 1 well, a basal Cretaceous unconformity has been placed at a depth of 8,700 ft. based on Foraminifera. On the basis of palynology, however, there was no obvious evidence for an unconformity of any significance throughout the entire interval spanning the Lower Cretaceous and Upper Jurassic (boundary at 8,790 ft.), which includes Neocomian zone PM-19 through Oxfordian zone PM-22 (base of pebble shale unit reported by Bird (1981b) at 7,893 ft.). Pre-Cretaceous age units in this well range from PM-21 zone Kingak Formation through PT-21 zone Endicott Group strata.

For much of the traverse, strata immediately above the basal Cretaceous unconformity belong to the pebble shale unit. The zones represented directly superjacent to the unconformity can be summarized as follows: PM-19/20 in Atigaru Point No. 1; PM-19 in N. Kalikpik No. 1, E. Teshekpuk No. 1, Cape Halkett No. 1, W. T. Foran No. 1, and S. Barrow No. 17; PM-18a in W. Fish Creek No. 1, J. W. Dalton No. 1, Drew Pt. No. 1, and E. Simpson No. 1. In Itkillik River No. 1, though no definite basal Cretaceous unconformity was recognized on the basis of palynomorphs, the lowermost Cretaceous age strata recorded was the PM-19 zone pebble shale unit, which in turn overlies PM-19 and 20 zone Kingak Shale. In the S. Harrison Bay well, PM-18 zone Torok strata lie atop the basal Cretaceous unconformity (pebble shale unit is absent in this well). It should be noted that the PM-18a zone (possible Neocomian age) was recognized in all wells along the traverse except Cape Halkett No. 1, Atigaru Pt. No. 1, S. Harrison Bay No. 1, and Itkillik River No. 1.

Drew Pt. No. 1, E. Teshekpuk No. 1, N. Kalikpik No. 1, and W. Fish Creek No. 1 recorded PM-14 zone Colville Group strata in the uppermost paleontological samples near the top of the wells. One pocket of Tertiary (and Quaternary?) age sediments was recognized on the traverse in the following wells: J. W. Dalton No. 1 (Quaternary?), W. T. Foran No. 1 (Eocene zone PM-11), and Cape Halkett No. 1 (Paleocene zone PT-10). In Atigaru Pt. No. 1 and Itkillik River No. 1, mixed Tertiary and Late Cretaceous

palynomorph assemblages were recovered near the top of the wells; in the latter well a possible Plio-Pleistocene age was assigned to the palynology sample at 250 ft. Uppermost units in the remaining wells on the line of section include PM-18 zone Torok strata in S. Barrow No. 17, PM-16 zone Colville Group strata in E. Simpson No. 1, and PT-11 zone Colville Group strata in S. Harrison Bay No. 1.

FORAMINIFERA AND PALYNOLOGY MICROSCOPE SLIDES

The U.S. Geological Survey has now made available for examination all foraminiferal and palynological microscope slides upon which the micropaleontology reports of these 19 correlated wells, in addition to numerous others, have been based. Open-File Reports No. 80-193 (Witmer, 1979), No. 81-13 (Witmer, 1980), and No. 1081 (Witmer, 1981) inventory all the available slides and explain loan and on-site examination policy. Standard strewn palynological slides have been prepared by the subcontractor from well cuttings, sidewall core, and conventional core samples.

FORAMINIFERA AND PALYNOLOGY REPORTS

The Foraminifera and palynology reports prepared by Anderson, Warren, and Associates, Inc., for the 19 wells correlated in this release are included in this section for reference. Please note that in addition to the original reports, many of the wells contain addenda and revisions which should not be overlooked. Microfossil assemblages, including relative abundances (Fl: Flood; A: Abundant; F: Frequent; C: Common; R: Rare) and inferred paleoenvironments are reported for specified depth intervals marking the particular zones in the wells. Foraminifera reports for the following wells do not include specific zone designations, but zones have been subsequently assigned for purposes of constructing the biostratigraphic correlation sections: Atigaru Pt. No. 1, W. Fish Creek No. 1, W. T. Foran No. 1, S. Harrison Bay No. 1, ARCO Itkillik River No. 1 (also palynology report), S. Simpson No. 1, and E. Teshekpuk No. 1. Depths listed on the correlation charts take precedence over the reports in any disparities one may encounter.

For information relating to purchase of the entire package of micropaleontology reports and fossil distribution charts (in paper copy and microfilm) of all the N.P.R.A. wells analyzed by both Anderson, Warren, and Associates, Inc., and BioStratigraphics (micropaleontology subcontractor for final six wells drilled in N.P.R.A. program), please write or call the following agency:

National Geophysical and Solar-Terrestrial Data Center
(D-621)
NOAA/EDIS/NGSDC
Boulder, CO 80303
Telephone: (303)-499-1000 (ext. 6338)

The A.W.A. palynology and Foraminifera reports for each of the 19 correlated wells of this release are presented in alphabetical order as follows:

Atigaru Point No. 1
S. Barrow No. 17
Cape Halkett No. 1
J. W. Dalton No. 1
Drew Point No. 1
W. Fish Creek No. 1
W. T. Foran No. 1
S. Harrison Bay No. 1
Ikpikpuk No. 1
Inigok No. 1
Itkillik River No. 1 (ARCO)
N. Kalikpik No. 1
Kugrua No. 1
S. Meade No. 1
Peard No. 1
E. Simpson No. 1
S. Simpson No. 1
E. Teshekpuk No. 1
Tunalik No. 1

Atigaru #1 (Palynology)

PALYNOLOGY REPORT

A total of 122 ditch and 21 sidewall core samples were processed and examined for palynological age determinations. The ditch samples were 30 foot composites covering the interval from 530 feet to the total depth of 11,520 feet. The sidewall cores examined were taken between 4200 feet and 8100 feet.

530-890'

Laevigatosporites (C-A), Betulaceae (C), Ulmus (R-F), Gleichheniidites senonicus (R), Aquilapollenites colvillensis (R), A. quadrilobus (R), A. magnus (R), A. scabridus (R).

AGE: Mixed Late Cretaceous (Campanian to Maastrichtian) and Tertiary
ENVIRONMENT: Nonmarine

890-1160'

Aquilapollenites magnus (F), A. senonicus (R), A. cf. quadricretae (R), Wodehouseia spinata (R), W. edmontiacola (single).

Deflandrea cf. speciosa (R-F), Ovoidinium verrucosum (R, reworked).

AGE: Maastrichtian
ENVIRONMENT: Very Marginal Marine

1160-1520'

Aquilapollenites magnus (R), A. trialatus (R-F), A. spp. (R).

Deflandrea microarma (F), Diconodinium arcticum (R), Odontochitina operculata (single), Palaeoperidinium basilium (single).

AGE: Campanian
ENVIRONMENT: Very Marginal Marine

1520-2330'

Chlamydophorella nyei (R-F), Australiella cooksoni (F), A. granulifera (F), A. sverdrupiana (F-C), A. spectabilis (F-A), Deflandrea dictyoma (F), Odontochitina operculata (C), Exochosphaeridium bifidum (R-F), Hexagonifera chlamydata (F-C), Hystrichosphaeridium difficile (F-C), H. stellatum (R), Spongodinium delirianum (R-F).

AGE: Santonian-Campanian
ENVIRONMENT: Marine

2330-2780'

This interval contained a much sparser assemblage than above, however, many of the same species occurred herein. The forms present do not permit any precise age assignment.

AGE: ?Turonian-?Coniacian
ENVIRONMENT: Marginal Marine

2780-3950'

Vitreisporites pallidus (R), Gleichheniidites senonicus (R).

Chlamydophorella nyei (R-F), Cyclonephelium distinctum (R-F), Odontochitina operculata (F-C), Oligosphaeridium complex (R-F), Cribroperidinium edwardsi (R-F), Astrocysta cretacea (R-C), Kroomia jaegeri (R), Pseudoceratium cf. dettmanae (R), P. cf. expolitum (R).

AGE: Cenomanian
ENVIRONMENT: Marine

3950-5976'

This interval carried essentially the same assemblage as above with the addition of the following species: Gardodinium eisenacki (R, scattered), Luxadinium propaculum (R-F), Spinidinium venustum (R-F), and Muderongia sp. (R, scattered).

AGE: Albian
ENVIRONMENT: Marine

5976-7280'

Gleichheniidites senonicus (R).

Odontochitina operculata (R-F), Oligosphaeridium complex (R-F), Cribroperidinium edwardsi (R), Kroomia jaegeri (R), Astrocysta cretacea (R-C), Gardodinium eisenacki (R, scattered), Muderongia sp. (R).

AGE: Aptian-Early Albian
ENVIRONMENT: Marine

This interval is separated principally on the base of the Luxadinium and Spinidinium occurrences. Usually this interval is also characterized by the consistent occurrence of Gardodinium eisenacki, however, this species was not well developed here.

7282' SWC-7350'

Vitreisporites pallidus (R).

Oligosphaeridium complex (A), Astrocysta cretacea (R), Gardodinium eisenacki (A), Psaligonyaulax apatela (R), Paracodinia ceratophora (R).

AGE: Neocomian
ENVIRONMENT: Marine

The sidewall core at 7282' produced a prolific Neocomian assemblage, however, the ditch samples through this depth revealed no Neocomian. The base of this interval is placed at the depth where the first Jurassic species appeared.

7350-8012'

Vitreisporites pallidus (R), Classopollis classoides (R-C), striated bisaccates (R, reworked).

Nannoceratopsis gracilis (R-C), N. sp. 1 (R-F), undescribed microplankton JRD-1, JRD-2 and JRD-5 (R); Fromea elongata (R-F), Tasmanaceae (R-F).

AGE: Early-Middle Jurassic (Late Pliensbachian-Callovian)
ENVIRONMENT: Marine

8012-8540'

Vitreisporites pallidus (R), Classopollis classoides (R), striated bisaccates (R, scattered, reworked?).

Tasmanaceae (R), Micrhystridium spp. (R).

AGE: Probable Triassic-Early Jurassic
ENVIRONMENT: Very Marginal Marine

8540-8900'

Undifferentiated striate bisaccates (F-C), Taeniasporites sp. (F-C), Striseites richcari (R), Duthuntysporites minuta (R), Classopollis classoides (sporadic, C).

Micrhystridium spp. (R-F).

AGE: Triassic
ENVIRONMENT: Very Marginal Marine

8900-9170'

Undifferentiated striate bisaccates (R-F).

Micrhystridium spp. (R-F), Sverdrupeilla unicata (R), S. manicata (R), S. cf. sabinensis (R).

AGE: Late Triassic (Carnian-Norian)
ENVIRONMENT: Marine

9170-9530'

Taeniasporites sp. (R-F), Striseites richcari (F), Krasuselisporites spinulosa (R), Klausipollenites staplini (R-F), ?Lundbladispora sp. (R-C), Luecksporites sp. (R), undifferentiated verrucate spores (F-C), ?Vittatina sp. (single).

AGE: Permian-Triassic
ENVIRONMENT: Nonmarine

A single, questionable specimen of Vittatina was recovered in the sample 9440-9530 feet. It is possible the base of this interval, below 9440 feet, is of Permian age.

9530-10,250'

Most of the palynomorpha seen in the above continue through this interval in somewhat less consistent occurrences. These forms are present here due to down-hole contamination.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10,250-11,970'

Potonieisporites sp. (R-F), ?Triquitrites sp. (single), ?Hystrichosporites sp. (R).

AGE: Pennsylvanian
ENVIRONMENT: No evidence Marine

11,970-11,970' T.D.

Densosporites spp. (F-A), ?Hystrichosporites sp. (R), Reticulatisporites polygonalis (single).

AGE: Probable Mississippian
ENVIRONMENT: No evidence Marine

The abundance of densospores through this interval suggests that it is probably of Mississippian age.

Atigaru #1

4064' SWC

Undifferentiated bisaccates (C), Lycopodiumsporites sp. (R), Classopollis classoides (R).

Aptea polymorpha (R), Cyclonephelium distinctum (R), Odontochitina operculata (R), Oligosphaeridium complex (R), Palaeoperidinium cretaceum (R).

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

4098' SWC

Undifferentiated bisaccates (F).

Oligosphaeridium complex (R), Palaeoperidinium cretaceum (R), Spiridinium vestitum (R).

AGE: Middle-Late Albian (P-M17)
ENVIRONMENT: Marine

5920' SWC

Undifferentiated bisaccates (A), Lycopodiumsporites sp. (R), Trilobosporites perverulentus (R).

Batioladinium jaegeri (R), Chlamydophorella nyei (R), Cyclonephelium distinctum (F), Gardodinium trabeculosum (R), Lunadinium propatulum (F), Odontochitina operculata (R), Oligosphaeridium complex (F), Palaeoperidinium cretaceum (C), Pseudoceratium retusum (R).

AGE: Middle-Late Albian (P-M17)
ENVIRONMENT: Marine

6087' SWC

Undifferentiated bisaccates (A), Vitreisporites pallidus (R), Classopollis classoides (R).

Batioladinium jaegeri (R), Cyclonephelium distinctum (R), Muderongia asymmetrica (R), Odontochitina operculata (R), Oligosphaeridium complex (F), Nannoceratopsis gracilis (single, reworked).

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

6482' SWC

Undifferentiated bisaccates (A), Vitreisporites pallidus (R).

Aptea polymorpha (R), Batioladinium jaegeri (F), Cyclonephelium distinctum (R), Odontochitina operculata (R), Oligosphaeridium complex (R), Palaeoperidinium cretaceum (C), Pseudoceratium retusum (R).

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

6618' SWC

Undifferentiated bisaccates (A).

Batioladinium jaegeri (R), Hystrichosphaeridium stellatum (R), Odontochitina operculata (R),

6618' SWC (con't.)

Oligosphaeridium complex (R), Palaeoperidinium cretaceum (R), Micrhystridium sp. (R).

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

6880' SWC

Undifferentiated bisaccates (A).

Batioladinium jaegeri (R), Gardodinium trabeculosum (R), Muderongia asymmetrica (R), M. tetracantha (R), Odontochitina operculata (R), Oligosphaeridium complex (F), Palaeoperidinium cretaceum (R), Pseudoceratium retusum (R), Wallodinium anglicum (R), Micrhystridium spp. (R), Nannoceratopsis gracilis (single, reworked).

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

6957' SWC

Undifferentiated bisaccates (A), Trilobosporites perverulentus (R), striate bisaccate (single, reworked).

Batioladinium jaegeri (F), Cyclonephelium distinctum (R), Muderongia tetracantha (R), Odontochitina operculata (R), Oligosphaeridium complex (R), Palaeoperidinium cretaceum (A), Pseudoceratium retusum (R), Micrhystridium spp. (R).

Genus "W" (single, contaminant?), Chatangiella granulifera (single, contaminant), Nannoceratopsis gracilis (R, reworked), N. pellucida (R, reworked).

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

If the single specimen of Genus "W" is indigenous then this sample belongs to the Middle-Late Albian, PM-17 Zone. Unfortunately, there is a single Senonian age contaminant in this sample, which makes the presence of the PM-17 species questionable.

7163' SWC

Undifferentiated bisaccates (A).

Batioladinium jaegeri (R), Cyclonephelium distinctum (R), Dimidiadinium uncinatum (single), Gardodinium trabeculosum (R), Odontochitina operculata (F), Oligosphaeridium complex (F), Palaeoperidinium cretaceum (R), Paracodinia dasyforma (single), Pseudoceratium sp. (R), Scandrupiella usitata (single, reworked).

AGE: Neocomian (P-M4)
ENVIRONMENT: Marine

8564' SWC

Undifferentiated bisaccates (C), Classopollis classoides (R), Striatites richteri (C), Taeniasporites spp. (F).

Micrhystridium spp. (R), Veryhachium spp. (R).

AGE: Triassic (P-T15)
ENVIRONMENT: Very marginal marine to nonmarine

8712' Core

Undifferentiated striate bisaccates (R), Taeniasporites spp. (R).

AGE: Triassic (P-T15)
ENVIRONMENT: Nonmarine

8742' Core

Undifferentiated bisaccates (A), Kraeuselisporites sp. (F), Lunatisporites sp. (R), Striatites richteri (R), Taeniasporites spp. (C), undifferentiated verrucate spores (C).

AGE: Triassic (P-T15)
ENVIRONMENT: Nonmarine

8739' Core

Undifferentiated bisaccates (C), Taeniasporites spp. (F), undifferentiated verrucate spores (F).

AGE: Triassic (P-T15)
ENVIRONMENT: Nonmarine

Atigaru #1 (con't.)

8876' Core

Essentially barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10,964' SWC

Barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

SUMMARY OF PALYNOLOGY REVISIONS

530-890'	:	Mixed Late Cretaceous and Tertiary.
890-1160'	:	Late Cretaceous, Maastrichtian (P-T11).
1160-1520'	:	Late Cretaceous, Campanian (P-T12).
1520-2330'	:	Late Cretaceous, Santonian-Campanian (P-M14).
2330-2780'	:	Late Cretaceous, ?Turonian-?Coniacian (P-M15).
2780-3950'	:	Late Cretaceous, Cenomanian (P-M16).
3950-7083'?	:	Early Cretaceous, Middle-Late Albian (P-M17).
7083-7163'	:	Early Cretaceous, Aptian-Early Albian (P-M18).
7163-7350'	:	Early Cretaceous, Neocomian (P-M19 to P-M20).
7350-8012'	:	Early-Middle Jurassic, Late Pliensbachian-Early Bajocian? (P-M21).
8012-8540'	:	Triassic-Early Jurassic (probable P-T15 to P-M14).
8540-9440'	:	Permian-Triassic (P-T17 to P-T16).
9900-9170'	:	Norian (P-M26). This is Shublik assemblage and appears to be derived from upholo.
9440-9530'	:	Possible in Permian (P-T187).
9530-10,250'	:	Age indeterminate.

Atigaru #1 (Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1" to 100' faunal distribution log, four faunal checklists, and a Paleozoic correlation section on the Atigaru #1 well. The conclusions presented in this report are based on the processing, picking and examination of 300 ditch samples, generally composited on 30 to 40 foot intervals, and 21 sidewall core samples. Seventy-six (76) thin sections were prepared on 10 foot ditch intervals below 9430 feet. A generalized age summary of the well is provided below, along with a sample-by-sample faunal listing of the sidewall cores in an appendix at the end of the report.

530-980'

Although generally barren of Foraminifera this interval does contain rare Cenosphaera spp., Haplophragmoides rota, and some small agglutinated forms that appear to be astrorhizids. This interval is probably Latest Cretaceous to Tertiary in age. These strata probably represent marginal marine and nonmarine deposition.

AGE: Probable Latest Cretaceous to Tertiary
ENVIRONMENT: Probable Nonmarine to Marginal Marine

980-2630'

Eoeponidella strombodes, Dorothia smokyensis, Nonionella taylorensis, Praebulimina venusta, Textularia gravenori, Caucasina vicrea, Verneuilinoides fischeri, Trochammina ribaconensis, T. albertensis, T. whittingtoni, Cenosphaera spp., Spongurus spp., Sethocyrtis sp., Archicorys sp., Theocorys sp., Dictyomitra spp., D. multicostata, Spongodiscus spp., S. cf. ganilleaformis, Rhopalodictyum sp., Spongostaurus sp., Stylospongia sp., and Xiphosphaera sp.

The above assemblage is characteristic of the Senonian Schrader Bluff Formation. Faunas obtained throughout this interval are indicative of oscillating middle neritic to upper bathyal (non-turbid) deposition.

AGE: Late Cretaceous (Senonian) Schrader Bluff Fm.
ENVIRONMENT: Middle Neritic to Upper Bathyal (non-turbid)

2630-3410'

Saccammina lathrami, Tritaxia spiritensis, Trochammina rutherfordi, T. gatesensis, Ionodiscus sp. A, Cenosphaera spp., Spongurus spp., and Spongodiscus spp. characterize this interval.

A top on the "Paper Shale" ("cuticized leaves") was found at 3080 feet. This point is probably at the top of or down in the Shale Wall Member of the Seabee Formation. This lower interval is generally dominated by starved basin deposition as indicated by the high organic content and the lack of preserved calcareous foraminifera associated with the few short pulses of open marine radiolarian bursts.

AGE: Late Cretaceous (Cenomanian to Turonian) Seabee Fm.
ENVIRONMENT: Open Marine (starved basin)

3410-3530'

This fauna contains: Gaudryina cf. irenensis, Trochammina rainwateri, T. mcmurrayensis, Haplophragmoides topagorukensis, and pyritized diatoms. This association appears to be a transitional fauna which could be either Albian or Cenomanian in age. These strata probably represent turbid inner to middle neritic deposition.

AGE: Early to Late Cretaceous (Albian to Cenomanian) Probable Nanushuk Group
ENVIRONMENT: Probable Inner to Middle Neritic (turbid)

3530-5320'

Haplophragmoides topagorukensis, H. cf. linki, H. gigas, H. cf. emsavata, Ammobaculites fragmentarius, A. wenonahae, Lenticulina macrodisca, L. bayrocki, Trochammina umiacensis, T. mcmurrayensis, Miliammina manitobensis, Psammosphaera bowmani, Saccammina lathrami, Cyclammina cf. pacifica, C. cf. cancellata, Saracenaria durroi, S. grandestandensis, Pseudobolivina rayi, Bathysiphon vitta, Verneuilinoides borealis and Ditrupa cornu occur in this interval. The above association is typical of the Verneuilinoides borealis Faunal Zone and is Albian age. The environments represented by these moderately diverse assemblages were probably of somewhat turbid middle to outer neritic depths with short periods of lesser turbidity.

AGE: Early Cretaceous (Albian) Nanushuk Group
ENVIRONMENT: Middle to Outer Neritic (fluctuating turbidity)

5320-5363'SWC

A pyritized radiolarian assemblage characterized these strata together with rare non-diagnostic agglutinated foraminifera. Some very rare calcareous forms occur which may or may not be caved from the overlying interval. According to Ramsey (1970) this zone of pyritized radiolaria separates the Verneuilinoides borealis zone from the Gaudryina cailleuxi zone, and is probably Aptian to early Albian in age. Due to the preservation of this fauna, all that can be said about the environment of

deposition is that it was marine and open to oceanic currents. These strata may represent deep marine (below compensation depth) basal slope deposits. This is certainly a possibility since calcareous foraminifera are very scarce in this interval and could represent caved specimens when they do occur.

AGE: Early Cretaceous (Aptian to Early Albian) Torok Fm. or Fortress Mountain Fm.

ENVIRONMENT: Open Marine

7282'SWC-7340'

This very thin interval contains a fauna that appears to be Neocomian in age, but contains some forms suggestive of the Late Jurassic. Since the fauna is not absolutely definitive, the age of this unit is spread in this report. This assemblage probably represents turbid neritic deposition.

AGE: Late Jurassic to Neocomian

ENVIRONMENT: Neritic (turbid)

7340-8310'

Ammobaculites barrowensis, A. glaskensis, A. vetusta, Bathysiphon anomalocoelia, Trochammincides spp., Involutina asperra, Gaudryina dymerita, Haplophragmoides casui, Trochammina contornata, arenaceous spp. (irg., ofa.) and common to abundant pyritized radiolaria of the genera Cytocapsa, Patulibrachium, Stichomitra, Rhopalastrum, Cenosphaera, Lithocampe, Spongodiscus and Dictyomitra occur in these strata. Also diagnostic of this unit is a burst of Tasmanites spp. which appears to be characteristic in this area. These strata are Early to Middle Jurassic in age. They probably represent deposition in middle neritic to upper bathyal depths characterized by fluctuating turbidity. A sandstone occurs at the base of this unit which may be an equivalent to the Sag River Sandstone.

AGE: Early to Middle Jurassic Kingak Fm.

ENVIRONMENT: Middle Neritic to Upper Bathyal (fluctuating turbidity)

8310-8580'

Frondicularia acmaea, Astacolus connudatus, Nodosaria laring, N. shublikensis, Lingulina alaskensis, L. borealis, Pseudoglandulina simpsonensis, P. lata and Nonotis fragments occur throughout these beds. The Triassic age of these strata is firmly established on the basis of the above fauna. The fauna appears to be common only in the upper portion of this interval. These faunas probably represent inner to middle neritic open marine conditions.

AGE: Triassic Shublik Fm.

ENVIRONMENT: Inner to Middle Neritic

8580-9490'

Tolypammina glareosa, Ammodiscus sp. P., Ammobaculites cf. barrowensis, A. sp. (sml., thin), and Trochammincides spp. together with rare radiolaria mark this interval. This assemblage would appear to represent nonmarine to turbid inner shelf deposition. Three samples at the bottom of this unit (9400-9490') contain a heavily glauconitic sandstone suggestive of the Echooka Member of the Sadlerochit Formation.

AGE: Permo-Triassic Sadlerochit Fm.

ENVIRONMENT: Nonmarine to Inner Neritic (turbid)

9490-9550'

This very thin interval is characterized by occurrences of microdolomite and pelmatozoan-bryozoan-foraminifera-algal packstone. The presence of Proto-nodosaria sp. and rare Paleomplysina sp. indicate that this unit is probably early Permian in age. These strata probably represent deposition in the subtidal portion of a carbonate platform suite.

AGE: Probable Early Permian

ENVIRONMENT: Inner Shelf (subtidal)

9550-10,350'

Generally throughout the North Slope of Alaska, the Lisburne Group can be divided into three lithologic units:

1. Upper Limestone Unit
2. Dolomite Unit
3. Lower Limy Unit

The Upper Limestone Unit is 910 feet thick in this well. Strata between 9550 feet and about 9910 feet contain rare Siseriella parva, rare Eoschubertella yukonensis, and rare to frequent Stylocodium sp. These rocks conspicuously lack occurrences of Asteroarchaediscus spp., Neoarchaediscus spp., and Archaediscus spp. These rocks are certainly no older than Zone 21 but could easily be as young as Zone 22 (see Mamet, 1971, pages 203 and 204)*. These strata probably correlate with strata between 9680 feet and 9930 feet in the East Teshekpuk Lake #1 well. Bursts of Eoschubertella yukonensis, Pseudostaffella sp., and Kamaenid algae together with occurrences of Neoarchaediscus spp., Asteroarchaediscus spp., Archaediscus spp., and frequent Stylocodium sp. indicate that the strata between about 9910 feet and 10,270 feet are definitely Zone 21 in age. A Zone 20 call is made at 10,270 feet based on a significant reduction in the occurrence of Kamaenid algae. The presence of Paleotextularia ss. at 10,550 feet indicates that we are in Zone 18-Zone 19 (Alapah Limestone) at this point, however, a questionable occurrence of Eosigmoilina rugosus at 10,460 feet suggests that the top of Zone 18-Zone 19 is probably near that point. The Upper Limestone Unit represents shoaling shelf and subtidal facies of a carbonate platform suite.

The Dolomite Unit is about 120 feet thick (10,640-10,760') and consists of gray microdolomite. This unit is poorly fossiliferous and somewhat masked by cavings in ditch samples. In other areas where dates have been obtained within or bracketing this unit it was found to be Zone 17 or Zone 18 in age.

The Lower Limy Unit is about 90 feet thick. This interval is questionably identified by rare occurrences of coral well debris indicating a tenuous Zone 16 or older age. This unit appears to consist of thin beds of pelmatozoan-bryozoan packstone and red-brown shale.

AGE: Late Mississippian to Middle Pennsylvanian or Younger Lisburne Group

ENVIRONMENT: Supratidal to Outer Shelf (Carbonate Platform Suite)

10,850-11,330'

This interval is characterized by a change to unfossiliferous dark gray and red-brown shale with common coal occurring below 11,120 feet suggestive of the Kekiktuk Fm.

AGE: Probable Mississippian (Endicott Group)

ENVIRONMENT: Probable Nonmarine to Inner Shelf

11,330-11,520' T.D.

This last unit is picked on the basis of a lithologic change to argillitic shale. There were no foraminifera recovered from this interval.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

*Mamet, B. L., and Ross, C. A., 1971, in Bamber & Waterhouse, "Carboniferous and Permian Stratigraphy and Paleontology, Northern Yukon Territory, Canada"; Bull. of Can. Petr. Geol., vol. 19, no. 1, pp. 196-203.

APPENDIX

(Faunal lists and washed lithology descriptions for 21 sidewall core samples)

4221' SWC

Ammobaculites wenonahae (R), Ammodiscus rocularius (F), Globobulimina exserta (R), Haplophragmoides cf. excavata (C), H. topagorukensis (R), Psammosphaera bowshari (R), Trochammina sp. (F), Verneuilinoides borealis (F), Cenosphaera sp. (F) glauconitic; megaspores (F), coal (A), pyrite (C).

AGE: Albian
WASHED LITH: Dark gray silty mudstone

4305' SWC

Ammobaculites fragmentarius (R), Haplophragmoides cf. excavata (R), H. topagorukensis (R), Trochammina wheatsheafensis (R), Verneuilinoides borealis (R), Cenosphaera sp. (R) glauconitic; coal (C), pyrite (FL).

AGE: Albian
WASHED LITH: Dark gray pyritic mudstone

4341' SWC

Arenaceous spp. (R), Praebulimina nanina (R); Cenosphaera sp. (R), megaspores (F), fishbone fragments (F), coal (A), pyrite (R).

AGE: Probable Albian
WASHED LITH: Black carbonaceous silty mudstone

4375' SWC

Arenaceous spp. (F), Haplophragmoides cf. excavata (R), H. sp. (R), Psammosphaera bowshari (R), Verneuilinoides borealis (C), Cenosphaera sp. (R) glauconitic; fishbone fragments (F), coal (F), pyrite (R).

AGE: Albian
WASHED LITH: Brownish-gray iron-stained siltstone

4392' SWC

Ammobaculites fragmentarius (R), Bathysiphon vitta (R), Haplophragmoides cf. excavata (F), H. topagorukensis (R), Trochammina ecmorrayensis (R), Verneuilinoides borealis (F), Cenosphaera sp. (C) glauconitic; fishbone fragments (R), coal (F), pyrite (R).

AGE: Albian
WASHED LITH: Brownish-gray siltstone

4686' SWC

Haplophragmoides topagorukensis (R), Cenosphaera sp. (R) glauconitic; megaspores (F), coal (F), pyrite (R).

AGE: Probable Albian
WASHED LITH: Brownish-gray siltstone

5110' SWC

Ammobaculites fragmentarius (R), Ammodiscus cf. rocularius (R), Haplophragmoides cf. excavata (R), Cenosphaera sp. (C) glauconitic.

AGE: Probable Albian
WASHED LITH: Brownish-gray mudstone

5461' SWC

Spongodiscus spp.? (C), paper shale (FL).

AGE: Aptian to Albian
WASHED LITH: Dark gray-black organic shale

5816' SWC

Cenosphaera sp. (F) glauconitic; megaspores (F), coal (A), pyrite (R).

AGE: Aptian to Albian
WASHED LITH: Brownish-gray siltstone

5943' SWC

Megaspores (F), paper shale (FL).

AGE: Indeterminate
WASHED LITH: Black organic shale

5976' SWC

Haplophragmoides topagorukensis (R), Cenosphaera sp. (R) glauconitic; megaspores (F), shell fragments (F), paper shale (FL).

AGE: Probable Aptian to Albian
WASHED LITH: Black organic shale

6240' SWC

Arenaceous spp. (R), Verneuilinoides borealis (R), Cenosphaera sp. (F) glauconitic; megaspores (R), pyrite (FL), pyritized plant debris (F).

AGE: Probable Aptian to Albian
WASHED LITH: Dark gray to black pyritized siltstone

6893' SWC

Cenosphaera sp. (F) glauconitic.

AGE: Probable Aptian to Albian
WASHED LITH: Brownish-gray iron-stained siltstone

7022' SWC

Arenaceous sp. (R), Cenosphaera sp. (R) glauconitic; coal (F), pyrite (R).

AGE: Probable Aptian to Albian
WASHED LITH: Brownish-gray siltstone

7059' SWC

Cenosphaera sp. (1) glauconitic.

AGE: Probable Aptian to Albian
WASHED LITH: Brownish-gray silty mudstone

7081' SWC

Cenosphaera sp. (1) glauconitic.

AGE: Probable Albian to Aptian
WASHED LITH: Dark gray very fine-grained sandstone or siltstone

7282' SWC

Arenaceous spp. (large, coarse)(C), Caudryina sp. (R), Glomospirella sp. 3 (R), G. gaultina (R), Haplophragmoides spp. (R), Lituotuba irregularis (R), Thurammoides sp. (R), Trochammina conicominuta (F), T. cf. sablei (R), T. sp. (plano-convex)(R), T. squamata (F), Cenosphaera sp. (R) glauconitic; round frosted quartz floaters (A), Inoceramus prisma (R), pyrite (R).

AGE: Late Jurassic to Neocomian
WASHED LITH: Dark brown muddy sandstone

7414' SWC

Cenosphaera sp. (F) glauconitic; C. spp. (C) pyritized; Lithocampe sp. (F) pyritized; Inoceramus prisma (F), megaspores (R), pelecypods (pyrite casts)(R), pyrite (C).

AGE: Probable Jurassic
WASHED LITH: Dark brown organic shale

7626' SWC

Barren of Foraminifera. Megaspores (R), fecal pellets (F).

AGE: Probable Jurassic
WASHED LITH: Dark brown organic shale

8017' SWC

Arenaceous sp. (R), Tasmanites (F), glauconite (F).

AGE: Early to Middle Jurassic
WASHED LITH: Dark brown silty paper shale

8069' SWC

Dictyomitra sp. (R) pyritized; Cenosphaera sp. (R) glauconitic; C. spp. (A) pyritized; Lithocampe sp. (R) pyritized; Tasmanites sp. (F).

AGE: Early to Middle Jurassic
WASHED LITH: Dark brown paper shale

Atigaru #1

4064' SWC

No Foraminifera found. Megaspores (R), Pyricized plant debris (PL), coal (C).

AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Brown pyritic carbonaceous mudstone

7015' SWC

No Foraminifera found.

AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Brownish-gray very fine-grained sandstone

7318' SWC

Cenosphaera spp. (F)(pyritized), Tasmanites sp. (R).

AGE: Probable Early to Middle Jurassic
ENVIRONMENT: Marine
WASHED LITH: Dark brown silty mudstone

Note: If not reworked, this would raise the top of the Early to Middle Jurassic to this point (7318').

8419' SWC

No Foraminifera found.

AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Dark brown to black shiny irridescent shale

8713' Core

No Foraminifera found.

AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Light gray to white fine-grained sandstone

8725' Core

Ammodiscus F (F), Glomospira sp. (R), Haplophragmoides sp. (very small)(R), Nodosaria cf. Lagena (R), pyrite (F).

AGE: Permo-Triassic (probable Sadlerochit Fm.)
ENVIRONMENT: Probable Inner to Middle Neritic
WASHED LITH: Light gray siltstone or silty mudstone

8739' Core

No Foraminifera found.

AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Buff tan siliceous mudstone

8742' Core

No Foraminifera found. Pyrite (F), siderite? spheres (F).

AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Gray sandy shale

9473' SWC

No Foraminifera found. Glauconite (A).

AGE: Probable Permian (based on Echooka lithology)
ENVIRONMENT: Indeterminate
WASHED LITH: Dark gray to black dolomitized sandstone

9525' SWC

No Foraminifera found. Glauconite (C).

AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Gray slightly calcareous fine-grained sandstone

10,805' SWC

No Foraminifera found. Pyrite (R), fecal pellets? (R).

AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Reddish-brown sandy shale

S. Barrow #17
(Palynology)

PALYNOLOGY REPORT

Introduction

A total of 42 samples were processed and examined for palynological age determinations. The samples consisted of 31 ditch and 11 sidewall cores. The entire well from 100 feet to the total depth of 2382 feet was analyzed.

Results

100-1450'

Undifferentiated bisaccates (F-A), reworked striated bisaccates (R, sporadic).

Cyclonephelium distinctum (R), Gardodinium trabeculosum (R), Odontochitina operculata (R), Oligosphaeridium complex (R), Nuderongia asymmetrica (R, sporadic); rare, scattered occurrences of reworked Triassic, Jurassic, and Neocomian dinocysts.

AGE: Early Cretaceous (Aptian-Albian) P-M17 to P-M18

ENVIRONMENT: Marine

The absence of any Middle to Late Albian marker species suggests that this interval may belong to the P-M18 zonule.

1450-1640'

Undifferentiated bisaccates (C-A), Cicatricosisporites australiensis (single), Trilobosporites apiverrucatus (single).

The dinocyst assemblage shows a marked increase in abundance for such species as: Cyclonephelium distinctum, Gardodinium trabeculosum, Odontochitina operculata, Oligosphaeridium complex, and Palaeoperidinium cretaceum, Batioladinium jaegeri (R-F), Cribroperidinium edwardsi (R), Nuderongia tetracantha (R).

AGE: Early Cretaceous (probable Neocomian) P-M19?

ENVIRONMENT: Marine

Although the usual marker species are lacking in this interval, the prolific assemblage is characteristic of the Neocomian. The absence of any more age restrictive forms permits only a tentative age assignment at this time.

1640-1800'

The assemblage in this interval is nearly identical to the above interval except for the addition of the Neocomian species Pseudocantium nudum and Batioladinium longicornutum.

AGE: Early Cretaceous (Neocomian) P-M19

ENVIRONMENT: Marine

1800-2180'

Undifferentiated bisaccates (A), Vitreisporites pallidus (R-F), Classopollis classoides (F-C), Cerebropollenites mesozoicus (R).

Micrhystridium spp. (F-A), Nannocratopsis senex (R-F); undescribed microplankton JRD-2 (F), and JRD-6 (R).

AGE: Early to Middle Jurassic (probable Pliensbachian to Bajocian?) P-M23

ENVIRONMENT: Marine

The reported range of N. senex is Pliensbachian to Early Bajocian. This species along with the undescribed microplankton forms are characteristic of the P-M23 zonule.

2180-2350'

Undifferentiated bisaccates (F-A), Vitreisporites pallidus (R-F), Nelioisporites altmarkensis (R-F), Tsugaesporites sp. (single), Kraeuselisporites sp. (R, sporadic), ?Lundbladispora sp. (R, sporadic).

Micrhystridium spp. (R).

2180-2350' (con't.)

AGE: Triassic (undifferentiated)

ENVIRONMENT: Marginal Marine

2350-2382' T.D.

Barren of palynomorphs.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

ADDENDUM TO PALYNOLOGY REPORT

A total of 86 additional samples from the subject well were processed and analyzed for palynological age determinations. The samples consisted of material from the conventional cores number 1, 2, 3 and 4. The depths covered were between 2096 feet and 2345 feet. Examination of these cores provided additional refinement to part of the Triassic section.

Core #3 (2295-2300') contained a Sevatia assemblage, and lacking other older dinocyst genera in association the age is placed as Rhaetian (P-M25).

The upper part of Core #4 (2312-2334') contained Sevatia and Sverdrupiella. The assemblage provides evidence for a Norian age and it can possibly get as old as Karnian. The remainder of Core #4 is undifferentiated Triassic.

S. Barrow #17
(Foraminifera)

FINAL MICROPALEONTOLOGICAL REPORT

The following final micropaleontological report is based on picking, examination and checklisting of 78 ditch samples and 9 sidewall core samples covering the interval 100 feet to 2382 feet (total depth). Enclosed you will also find a 1" to 100' faunal distribution log, a faunal checklist and a sketched correlation chart comparing this well with the So. Barrow #13 and So. Barrow #14 wells. Below is a generalized age summary of the So. Barrow #17 well.

100-1450'

Occurrences of Lenticulina macrodisca, Saccammina lathrami, Valvulineria loeterlei, Textularia topagorukensis, Eurycheilostoma grandstandensis, Gavelinella awunensis, G. stictata, Haplophragmoides cf. excavata, H. topagorukensis, Miliammina manitobensis, Psammiopeltz subcircularis, Vernauilinoides borealis, Bathysiphon vitta, Ammodiscus rotularius, Tritaxia manitobensis, Pseudobolivina ravi and Hippocrepina barkadalei indicate that the strata between 100 feet

100-1450' (con't.)

and about 1000 feet are Aptian to Albian (Zonule F-10) in age. The occurrence of frequent to common pyritized radiolaria of the genera Cenosphaera spp., Lithocampe spp., Dictyomitra sp. and Spongodiscus spp. suggests that the strata below 1000 feet are Aptian (Zonule F-11) in age. The faunas found in the uppermost portion of this interval (above 610') probably represent middle neritic deposition. Due to the low abundance and poor preservation of the faunas below 610 feet all that can be said about the environment of deposition is that it was probably marine, but there is not enough evidence to tell whether it represents very shallow or very deep marine deposition. It has been suggested that high latitude faunal diversity and abundance diminishes in both directions from the shelf edge.

Two possible local correlation points occur at 130 feet and 460 feet which appear to be recognizable in the So. Barrow #12, So. Barrow #13, Iko Bay #1 and So. Barrow #14 wells.

AGE: Aptian to Albian (F-10 to F-11)
ENVIRONMENT: Uppermost portion: Middle Neritic
Lowermost portion: Probable Marine

1450-1730'

This interval is characterized by occurrences of the following species: Ammobaculites reophacoides, Gaudryina tappanae, G. cf. cailleuri, Haplophragmoides duoflatis, H. inflatigrandis, Trochammina squamata, Arenaceous spp., and frequent to abundant rounded frosted quartz floaters. These species suggest a Neocomian age for these strata.

This interval correlates with the unit called Neocomian to Late Jurassic in reports on the So. Barrow #12 and Iko Bay #1 wells. After examining and comparing Foraminifera and palynomorphs from several wells to the east we now feel that this assemblage is best assigned a Neocomian age rather than a Late Jurassic age.

The dominantly agglutinated nature of this assemblage suggests that it was deposited in turbid waters. The relatively good abundance and diversity indicate a probable neritic depositional site.

AGE: Early Cretaceous (Neocomian)
ENVIRONMENT: Neritic (turbid)

1730-1820'

This assemblage contains forms suggestive of the Late Jurassic but it could conceivably still be Early Cretaceous, so we have had to spread the age to reflect this uncertainty. This interval is the same as the interval called Jurassic (undifferentiated) in earlier reports on the So. Barrow #12 and Iko Bay #1 wells.

The depositional environment of these strata could have been as shallow as middle neritic or as deep as middle bathyal.

AGE: Late Jurassic to Early Cretaceous (Neocomian)
ENVIRONMENT: Middle Neritic to Middle Bathyal (turbid)

1820-2170'

Occurrences of Astacolus pediscus, Involutina arpera, Textularia areoplecta, Lenticulina pomeranse, Gaudryina dyscrita, G. Melleri, Reophax metensis, R. dense, Trochammina zablai, T. canningensis, Haplophragmoides barrowensis, arenaceous spp. (large, coarse) together with frequent to common pyritized radiolaria characterize this assemblage. These forms suggest an early to middle Jurassic age.

This assemblage, like the previous one, could represent deposition as shallow as middle neritic or as deep as middle bathyal.

AGE: Early to Middle Jurassic (F-17 to F-18)
ENVIRONMENT: Middle Neritic to Middle Bathyal

2170-2320'

Astacolus connudatus, A. dubius, Nodosaria larina, N. cf. gnublikensis, Marginulina bergquisti, Lingulina cf. boreslis, Vaginulinopsis scrulus, Tolypammina glargoss and Ostracoda (medium-large, smooth) occur in these strata indicating a Triassic age.

2170-2320' (con't.)

These forms suggest an open marine, inner to middle neritic depositional site.

AGE: Triassic (F-19)
ENVIRONMENT: Inner to Middle Neritic (open marine)

2320-2362' T.D.

Unfossiliferous black argillite considered by most to be basement, and Cambrian to Ordovician in age.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

ADDENDUM
TO
FORAMINIFERA REPORT

The following addendum to the S. Barrow #17 report is based on the processing, picking and examination of 86 samples from conventional cores #1 through #4. A faunal checklist is enclosed for your convenience.

The only change necessary to make to the original interpretation concerns the top of the argillite. The argillite top was originally placed at the top of a ditch sample from 2320 to 2350 feet. Examination of Core #4 (2372 to 2345 feet) shows that the top of the argillite is at 2344 feet based on the one foot core intervals sampled.

Cape Halkett #1 (Palynology)

PALYNOLOGY REPORT

A total of 101 ditch and 67 sidewall core samples were processed and analyzed for palynological age determinations. The samples covered the interval from 510 feet to the total depth of 9900 feet.

510-650'

Barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

680-1100'

Scattered occurrences of Osmunda, Betula, Sphagnum, gymnosperm pollen, ? Astrocysta cretacea, and Oligosphaeridium complex.

The palynomorph recoveries were poor. The rare dinoflagellates recorded suggest this unit to be Cretaceous in age. However, these specimens may have been redeposited.

AGE: (?) Cretaceous
ENVIRONMENT: (?) Marine

1100-1320'

Single specimens of Triprojectus magnus, Gleichenidites senonicus, and Osmunda.

The palynomorph recoveries remain poor in this interval.

AGE: Probable Campanian-Maestrichtian
ENVIRONMENT: Nonmarine

1320-2040'

Australiella cooksoni (F), A. victoriensis (F), Deflandrea acuminata (R), Hystrichodinium pulchrum (F), Odontochitina operculata (C), Diconodinium arcticum (F), Hystrichosphaeridium difficile (F).

This interval contains an abundant and diverse microplankton assemblage.

AGE: Santonian-Campanian
ENVIRONMENT: Marine

2040-2500'

This interval shows a decrease in microplankton abundance and diversity. Many of the common forms from the above interval are present here in decreased numbers.

AGE: (?) Turonian- (?) Coniacian
ENVIRONMENT: Probably marginal marine

2500-3357'

Astrocysta cretacea (F), Odontochitina operculata (C), Deflandrea acuminata (F), Cribroperidinium edwardsi (F), Pseudoceratium dettmanae (R), Broomea jaegeri (R).

The return to an abundant microplankton assemblage is reflected in this interval.

AGE: Cenomanian
ENVIRONMENT: Marine

3357' SWC - 4554'

"Scriniodinium eurypylum" (F), Ascodinium verrucosum (R), Astrocysta cretacea (A), Oligosphaeridium complex (R), Broomea jaegeri (R), Odontochitina operculata (C).

AGE: Albian
ENVIRONMENT: Marine

4554' SWC - 7506'

Astrocysta cretacea (A), Oligosphaeridium complex (R), Odontochitina operculata (C), Cribroperidinium edwardsi (R), Broomea jaegeri (R), Gardodinium eisenacki (R).

The interval between 5800 feet and 6550 feet possibly represents nonmarine or very marginal marine deposition.

AGE: Aptian
ENVIRONMENT: Marine

7506' SWC - 7570'

Muderongia simplex (C), Psaligonyaulax apatela var. (R), Oligosphaeridium complex (C), Broomea jaegeri (F), Gardodinium eisenacki (R).

AGE: Neocomian
ENVIRONMENT: Marine

7570-7715'

Muderongia simplex (R), Astrocysta cretacea (R), Oligosphaeridium complex (F), Gardodinium eisenacki (R), Broomea jaegeri (R).

The large amount of down-hole contamination renders the selection of in situ elements difficult.

No sidewall cores within this short interval were processed for palynology. The age assignment must therefore remain questionable.

AGE: (?) Neocomian
ENVIRONMENT: (?) Marine

7715' SWC - 7810'

Single occurrences of Heliosporites altmarkensis, cf. striate bassacate, and indeterminate spore genus as seen at 6348 feet core sample in the Simpson #1.

AGE: Probably Triassic
ENVIRONMENT: Nonmarine

7810-8040'

Numerous undescribed Triassic dinoflagellates designated as: TRD-2, TRD-6, TRD-7.

AGE: Triassic (Carnian-Norian)
ENVIRONMENT: Marine

8040-8826'

Taeniaesporites sp. (R), Striatites richteri (R-F), Klausipollenites sp. (R), Dulhuntyisporites minuta (R), Kraeuselisporites sp. (R), Crustaesporites sp. (single).

The single specimen of Crustaesporites sp. in sample 8130-8220' D suggests an Early Triassic age at this depth.

The ditch samples contained common marine Triassic palynomorphs; however, the sidewall cores indicate that this interval is nonmarine.

AGE: Permian-Triassic
ENVIRONMENT: Nonmarine

8826' SWC - 9900' T.D.

The sidewall cores within this interval were all barren of palynomorphs. The organic residues in cores below 9200 feet exhibited high thermal alteration and were black in color.

Two (2) separate ditch samples below 9600 feet yielded single fragments of a spore (Hystrichosporites sp.) characteristic of Devonian strata. These spores were colored dark red-brown, showing less thermal alteration than evidenced in the organic recoveries of the sidewall samples from similar depths. The conclusion, based on these color differences, is that the Devonian spores were probably redeposited into the Permo-Triassic section above and their appearance here cannot be taken as age indicative.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

PALYNOLOGY REVISIONS

510-1100'?	:	Tertiary, Nonmarine.
1100-1320'	:	Late Cretaceous, Campanian-Maestrichtian (P-T12 to P-T11), Nonmarine.
1320-2040'?	:	Late Cretaceous, Santonian-Campanian (P-M14), Marine
2040-2500'	:	Late Cretaceous, ?Turonian-?Coniacian (P-M15), Marginal Marine
2500-3357'	:	Late Cretaceous, Cenomanian (P-M16), Marine.
3357-6820'?	:	Early Cretaceous, Mid-Late Albian (P-M17), Marine.
6820-7506'	:	Early Cretaceous, Aptian-Early Albian (P-M18), Marine.
7506-7660'?	:	Early Cretaceous, Neocomian (P-M19), Marine.
7660-7715'	:	Indeterminate age.
7715-7810'	:	Late Triassic (undiff.) (P-T152), Nonmarine.
7810-8040'	:	Late Triassic, Norian (P-M26), Marine.
8040-8620'	:	Triassic (P-T16 to P-T15), Nonmarine to Marginal Marine.
8620-8826'	:	Permian-Triassic (P-T17), Nonmarine to Marginal Marine?
8826-9320'	:	Indeterminate age.
9320-9779'	:	In Carboniferous (P-T213), Nonmarine?
9779-9900'TD	:	Indeterminate age. Argillite (lith-pick).

Cape Halkett #1
(Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1" to 200' faunal diversity log and three faunal checklists on the U.S.N. Cape Halkett #1 Well. The conclusions presented in this report are based on the processing, picking and examination of 316 ditch samples, generally composited on 30 to 40 foot intervals, and 123 sidewall core samples. Thin sections were prepared on 30 foot ditch intervals and all sidewall core samples below 8760 feet. A generalized age summary of the Cape Halkett #1 Well is provided below.

510-1120'

Generally barren of foraminifera. Coaly oberty sandstone with rare to frequent volcanic glass shards. This unit is probably equivalent lithologically to the Kogosukruk Tongue of the Prince Creek Fm.

AGE: Probable Senonian

1120-2440'

Koeponidella strombodes (R-F), Anomalinoides pinguis (R), Nonionella cf. taylorensis (R), Praebulimina venusae (R-F), Lacosteina gouskovi (R), Caucasina vitrea (R), Koeponidella linki (R), Nuvobulimina canadensis (R), Vaginulina schradergensis (R), Verneuilinoides fisheri (R), Trochammina ribstonensis (R), T. whittingtoni (R), Cenosphaera spp. (R-C), Sachocyrtis spp. (R-F), Archicorys sp. (R-C), Theocorys sp. (R-F), Dictyomitra multicostata (R-F), Spongodiscus spp. (R-C), Rhopalodictyum sp. (R).

The above assemblage is characteristic of the Senonian Schrader Bluff Formation. Faunas obtained throughout this interval are indicative of oscillating middle to outer shelf (non-turbid) depositional environment.

AGE: Senonian (Schrader Bluff Fm.)

2440-3340'

Saccammina lathrami (R), Trochammina ribstonensis (R-F), Zonodiscus sp. A (R-F), Cenosphaera spp. (R-C), Spongodiscus spp. (R-C), Coal (R-C), Pyrite (R-A).

This interval is generally poor in fauna, but it does contain Zonodiscus sp. A which is considered by Sarquist (1966, U.S.G.S. P.P. 302-D p. 182) to be a marker for the Seabee Formation. A top on the "Paper Shale" ("cuticlized leaves") was found at 2940 feet, this point is at the top of or down in the Shale Wall Member of the Seabee Formation. This interval is generally dominated by shallow starved basin deposition as indicated by the large amounts of pyrite and coal in these samples, and the lack of preserved calcareous foraminifera associated with the few short pulses of open marine radiolarian bursts.

AGE: Turonian-Cenomanian (Seabee Fm.)

3340-3640'

Haplophragmoides bonnazaensis (R-C), H. rota (R-F), H. topagorukensis (R), Bathysiphon brosgei (R), Verneuilinoides borealis (R), Ammobaculites fragmentarius (R), Ditrupa cornu (R).

While the above fauna seems indicative of the Albian, the frequency of occurrences of the Albian forms is rare enough to make one suspicious of reworking. A similar interval occurred in the Fish Creek #1 Well between 2750 feet and 3130 feet.

AGE: Albian (Probable)

3640-5740'

Haplophragmoides topagorukensis (R-A), H. rota (R-F), Ammobaculites fragmentarius (R), A. wanobae (R), Lenticulina macrodisca (R), Trochammina umiatensis (R-C), T. rainwateri (R-F), Miliammina manitobensis (R-F), M. awunensis (R), Bathysiphon brosgei (R), B. vitta (R), Verneuilinoides borealis (R-C), Psammonopelta bowsheri (R), P. subcircularis (R), Ditrupa cornu (R-F), Oolina apiculata (R-F), Gavelinella stictata (R), Eurycheilostoma grandstandensis (R), Valvulineria loetterlei (R).

The above fauna is typical of the Verneuilinoides borealis Faunal Zone of Albian Age. There is slight evidence in the ditch sample from 4430-4460' for the presence of the Textularia topagorukensis Faunal Subzone which may mark the top of the Torok Formation locally.

The environments represented by these assemblages were probably of middle to outer shelf depths characterized by generally clear waters with only occasional short periods of high turbidi

AGE: Albian-Aptian

5740-7320'

Interval characterized by occurrence of pyritized radiolaria (R-C), rare agglutinated forms, megaspores (R-F), Coal (R-C), and Pyrite (F-PL).

Deposition of these strata probably took place in depths varying from marginal marine to middle shelf, and uniformly characterized by reducing (oxygen deficient) bottom conditions. This especially holds true for the lower 600 feet of this interval where high organic concentration ("paper shale") suggests a paucity of available clastic detritus and probably highly reducing bottom conditions.

The lack of any fauna suggestive of the Gaudryina taillauri Zone provides some negative evidence that this interval is still Aptian to possibly Albian Age. In fact, this poorly fossiliferous pyritized facies could be older Cretaceous.

AGE: Aptian to Albian ?

7320-7510'

Rounded frosted quartz floaters (F-C), Lithocampe sp. "M" (R), Trochammina canningensis (R), Gaudryina cf. milleri (R), G. topagorukensis (R), G. taillauri (R-F), Conorboides "J" (R), Pseudobolivina sp. (R-F).

This fauna is indicative of a Latest Jurassic to Earliest Cretaceous (Barrissian) Age. The first evidence for "Pebble Shale" appears in the samples at 7320' (D) and 7326' (SWC).

This assemblage suggests a depositional environment of outer neritic to possibly as deep as upper bathyal turbid waters.

AGE: Latest Jurassic to Earliest Cretaceous (Barrissian)

7510-7630'

A basal sandstone unit occurs between 7530 feet and 7545 feet that is similar in appearance to the Sag River Ss., but whether the unconformity lies above or below this unit cannot be precisely established since the unit is faunally depauperate.

7630-8160'

Astacolus connudacus (R-F), Trochammoides cf. wertens (R), Frondicularia lustrata (R), Marginulina cf. prima (R), Nodosaria pachistika (R), N. phobytica (R), N. shublikensis (R), Tolypammina glareosa (R), Monotis sp. (R-F).

The above listed species are characteristic of Triassic Age. This faunula is probably representative of a relatively clear water middle neritic to upper bathyal environment. The lithologic top of the Shublik Fm. occurs at around 7850 feet suggesting that there may be some Triassic age Kingak Shale (lithologically) or else some different facies (lithologically different) Shublik Fm. or Sag River equivalents occurring between 7630 feet and 7850 feet.

8160-8820'

This interval is generally barren of foraminifera suggesting that it represents either nonmarine deposition or else the results of dilution of the faunas by an increased rate of sedimentation. Lithologically, this interval is similar to the Sadlerochit Formation of Permian Age to Triassic Age. Samples between 8160 feet and 8750 feet lithologically represent the Ivishak Member while samples between 8750 feet and 8820 feet suggest the presence of a thin interval of the Echooka Member.

AGE: Probable Permian-Triassic

8820-9160' (?)

This interval is characterized by occurrences of Globivalvulina bulloides, Biseriella parva, Monotaxinoides multivolutus, Ammovertella sp., Trepeilopsis sp., Earlandia elegans, Pseudoglomospira sp., Asteroarchaediscus sp., Neoarchaediscus incertus, Endothyra sp., Eostaffella radiata?, Priscella prisca, Planospirodiscus keimyricus?, Planoendothyra rotayi, Millerella carbonica, Zellerina sp.

The above species are indicative of the Early to Middle Pennsylvanian Wahoo Limestone in Alaska. These species represent Zones 20 and 21 in Mamet's zonal scheme for the Carboniferus. It appears that based on a decrease in frequency of Globivalvulina bulloides and an increase in the frequency of Biseriella parva and Priscella prisca a Zone 20-Zone 21 boundary may be placed at around 9020 feet.

The Mississippian-Pennsylvanian boundary is hard to place, even in core material, but the first indications for Mississippian Age occur at 9230 feet. The contact may be as high as 9160 feet where it appears on the accompanying faunal log.

AGE: Early to Middle Pennsylvanian

9160(?)-9779'

The placing of the upper boundary of this interval was discussed above. The co-occurrence of Cribrostomum bradyi and Biseriella parva in the same fragment at 9230 feet suggests that these strata are Zone 18 in age (Upper Mississippian). The co-occurrence of Earlandinella sp., Neoarchaediscus incertus and Asteroarchaediscus sp. indicate Zone 16s or Zone 17 age (Upper Mississippian) for the strata at 9390 feet. The above age calls were difficult to recognize due to an abundant amount of caved Zone 20 and Zone 21 limestone fragments in the ditch material. There were rare occurrences as high as 9370 feet of forms indicative of Zone 13, but again due to the large amount of cavings, and questionable taxonomic assignments of rare, poorly oriented specimens, the Zone 13 calls may not prove to be very reliable. The lithology changed at 9320 feet to a greenish gray and gray shale. This is probably the Kayak Shale.

AGE: Upper Mississippian

9779-9900' T.D.

Thin sections from sidewall cores at 9779 feet and 9858 feet exhibit good lineations and secondary growth of mica along planar surfaces indicating the weak metamorphism of a shale or mudstone to an argillite. The sidewall core from 9890 feet appears to be a black strongly lineated argillite or slate. The exact age of this unit is unknown; no foraminifera were recovered in this interval.

FORAMINIFERA REPORT - REVISION

3340-4430'	:	Early Cretaceous (Middle to Late Albian) F-9.
4430-5600'	:	Early Cretaceous (Albian) F-10.
5600-6800'	:	Early Cretaceous (Late Aptian to Early Albian) F-10 to F-11.
6800-7320'	:	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 7850 feet.
7960-8160'	:	Triassic (F-19).
8160-8820'	:	Permo-Triassic (F-20). Echooka Fm. lithology at 8790 feet.
8820-9020'	:	Middle Pennsylvanian (Mamet's Zone 21).
9020-9160'	:	Early Pennsylvanian (Mamet's Zone 20).
9160-9320'	:	Late Mississippian (Mamet's Zone 18 to Zone 19).
9320-9779'	:	Possible Late Mississippian. Endicott Group?
9779-9900'	:	Indeterminate age. Argillite.

J. W. Dalton #1
(Palynology)

PALYNOLOGY REPORT

A total of 278 samples were processed and analyzed from the subject well. The total consists of 103 ditch cuttings composited into 90 foot intervals, 5 sidewall cores, and 170 core samples. The total sequence examined ranges from 90-9365.8' T.D.

Included with this report are Figures 1, 2 and 3 which illustrate the distribution of the ditch samples, cores, and sidewall cores respectively. A summary of the findings is given below.

90-270'

Undifferentiated bisaccates (A), Araucariacites australis (R), Deltoidospora spp. (R), Laevigatosporites spp. (R), Lycopodiumsporites spp. (R), Osmundacidites spp. (R), Sphagnum (R), Taxodiaceae (F), Betula (R).

Cleistosphaeridium spp. (R), Spiniferites ramosus (R).

AGE: Indeterminate
ENVIRONMENT: Nonmarine to Marginal Marine

Palynomorphs recovered from this interval are of mixed ages. Numerous Cretaceous taxa are present along with those ranging from Tertiary to Recent.

270-900'

Undifferentiated bisaccates (F-A), Alnus (R), Betula (R-F), Carya (R), Cicatricosisporites dorogensis (R), Gleichenidites senonicus (R-F), Laevigatosporites spp. (R-F), Taxodiaceae (R-F).

Cladopyxidium septatum (R), Deflandrea phosphoritica (R), Dinopteryglum cladoides (R), Hemicystodinium sp. (R), Spiniferites ramosus (R), Wetzelielia articulata (R).

AGE: Paleogene (P-M11 to P-M12)
ENVIRONMENT: Marine to Marginal Marine

A Paleogene age is suggested by the presence of Cladopyxidium septatum, Deflandrea phosphoritica, Wetzelielia articulata, and Cicatricosisporites dorogensis.

900-2160'

Undifferentiated bisaccates (F-A), Aequitriradites spinulosus (R), Cicatricosisporites dorogensis (R), C. hallei (R-F), Costatoperforosporites foveolatus (R), Cyathidites australis (R), C. minor (R-C), Distaltriangulisporites spp. (R), Foraminisporis asymmetricus (R), P. wonthaggiensis (R), Gleichenidites senonicus (R-A), Lycopodiumsporites spp. (R-F), Osmundacidites (R-A), Sestrosporites pseudoalveolatus (R), Taxodiaceae (R-A), Trilobosporites crassus (R), Triporolites radiatus (R), Vitreisporites pallidus (R).

Alterbia acuminata (R-A), Chatangiella bispertura (R), C. coronata (R), C. decorosa (R-C), C. ditissima (R), C. granulifera (R), C. spectabilis (R), C. victoriensis (R-A), Chlamydophorella nyei (R-F), Cyclonephelium compactum (R-A), C. distinctum (R-C), Exochosphaeridium spp. (R-C), Gonyaulacysta tenuiceras (R-A), Hexagonifera chlamydata (R-F), Hystrichodinium pulchrum (R), Hystrichosphaeridium difficile (R-A), Kleithriasphaeridium spp. (R-F), Membranosphaera tabulata (R-C), Odontochitina costata (R), O. operculata (R-F), Oligosphaeridium complex (R), Operculodinium spp. (R-F), Palaeoperidinium basilium (R-F), Palambages sp. (R-F), Spinidinium echinoideum (R), Spiniferites dingulatus (R-F), S. ramosus (R-C).

AGE: Santonian to Campanian (P-M14)
ENVIRONMENT: Marine

The Santonian to Campanian age for this unit can be recognized by numerous and diverse taxa of Cretaceous age. Those of special importance are Chatangiella spp., Chlamydophorella nyei, Cyclonephelium spp., and Odontochitina spp.

2160-2320'

Undifferentiated bisaccates (A), Cicatricosisporites australiensis (R), Cyathidites minor (F-A), Gleichenidites senonicus (R-A), Osmundacidites (C-A), Taxodiaceae (A).

Alterbia acuminata (R-C), Cunningia minor (R), Chatangiella victoriensis (R-C), Cribroperidinium edwardsi (R), Cyclonephelium compactum (C-A), Gonyaulacysta tenuiceras (R-C), Isabelidinium belfastense (R-C), Oligosphaeridium complex (R-F), Spiniferites ramosus (R-C).

AGE: Turonian to Coniacian (P-M15)
ENVIRONMENT: Marine

This interval is recognized by the first rare occurrences of Cribroperidinium edwardsi.

2320-2970'

Undifferentiated bisaccates (F-A), Cyathidites minor (R), Gleichenidites senonicus (R-F), Taxodiaceae (R-A).

Alterbia acuminata (R-A), Cribroperidinium edwardsi (R-C), Cyclonephelium distinctum (R-F), Fromea amphora (R), Hystrichodinium pulchrum (R-F), Indeterminate yellow cysts (F-A), Isabelidinium cooksoniae (C), Odontochitina costata (R-C), Oligosphaeridium complex (R-C), Palaeocystodinium cretaceum (R-F), Palambages spp. (R-F), Spiniferites ramosus (R-F), Surculosphaeridium longifurcatum (R), Xiphophoridium alatum (R).

AGE: Cenomanian (P-M16)
ENVIRONMENT: Marine

This interval is characterized by common to abundant occurrences of Cribroperidinium edwardsi and the "Indeterminate yellow cysts". Other useful taxa that indicate the age given are Fromea amphora, Surculosphaeridium longifurcatum, and Xiphophoridium alatum.

2970-5490'

Undifferentiated bisaccates (F-A), Aequitriradites spinulosus (R), Araucariacites australis (R-F), Cingutriletes clavus (R), Classopollis classoides (R), Cyathidites minor (R-C), Eucommiidites minor (R), Gleichenidites senonicus (R-F), Osmundacidites spp. (R-C), Punctatosporites scabrosus (R), Rogalskaisporites cicatricosus (R), Schizosporis parvus (R), Taxodiaceae (R-A), Trilobosporites apiverrucatus (R), T. parverulentus (R).

Aptea polymorpha (R), Apteodinium grande (R-C), Cunningia colliveri (R), C. minor (R-F), Cribroperidinium edwardsi (R-C), Cyclonephelium distinctum (R-A), Genus "W" (R), Hystrichosphaeridium cooksoniae (R), Luxadinium propatulum (R-A), Muderongia asymmetrica (R), Odontochitina operculata (R-A), Oligosphaeridium complex (R-A), Palaeoperidinium cretaceum (R-A), Palambages sp. (R), Pseudoceratium expolitum (R-F), P. retusum (R-F), P. turneri (R-A), Spinidinium vestitum (R-C).

AGE: Middle to Late Albian (P-M17)
ENVIRONMENT: Marine

The top and base for this unit are defined by the total ranges of Genus "W", Luxadinium propatulum, and Spinidinium vestitum which do not occur either above or below the P-M17 zonule. Those occurrences of these taxa in the ditch samples that do occur lower in the well are probably the result of "uphole" contamination.

5490-7380'

Undifferentiated bisaccates (A), Callialasporites dampieri (R), Cyathidites minor (R-F), Gleichenidites senonicus (R-F), Taxodiaceae (R-F), Trilobosporites minor (R), T. trioreticulatus (R).

Cunningia colliveri (R), Cribroperidinium edwardsi (R), Gardodinium trabeculosum (R), Odontochitina operculata (R-F), Oligosphaeridium complex (R), Palaeoperidinium cretaceum (R-C), Pseudoceratium retusum (R), Spiniferites ramosus (R-F).

AGE: Aptian to Early Albian (P-M18)
ENVIRONMENT: Marine

As described for the interval above, the top of this unit is defined by the base of Genus "W", Luxadinium propatulum and Spinidinium vestitum. Callialasporites dampieri is also an important fossil which can be used to define the top of this interval.

7380-7650'

Undifferentiated bisaccates (A), Cyathidites australis (R), Gleichenaiidites senonicus (R), Taxodiaceae (R-F).

Canningia colliveri (R-F), Cleistosphaeridium spp. (R-C), Cyclonephelium distinctum (F-C), Gardodinium trabeculosum (R-C), Herendeenia piscifornis (R), Muderongia simplex (R), Odontochitina operculata (R-A), Oligosphaeridium complex (A), O. complex (thick-wall) (F), Palaeoperidinium cretaceum (F-C), Pterospermopsis sp. (C-A).

AGE: Probable Neocomian
ENVIRONMENT: Marine

The interval defined here is distinguished from the proceeding by the increased numbers and diversity of taxa present. No important new forms appear, and therefore the age is suggested as probable Neocomian.

7714-7967'

Undifferentiated bisaccates (R-A), Acanthotriletes varius (R), Calliialasporites dampieri (R), Densosporites fissus (R), Leptolepidites argenteaeformis (R), Limbosporites lundbladii (R).

Cymatiosphaera spp. (R-F), Tasmanaceae (R), Tyrrhodiscus foveolatus (R).

AGE: Late Triassic to Early Jurassic
ENVIRONMENT: Nonmarine to Marginal Marine

The age for this unit is based on taxa found in the sidewall core samples. Those of importance are: Acanthotriletes varius, Densosporites fissus, Leptolepidites argenteaeformis, Limbosporites lundbladii, and Cymatiosphaera spp. The ditch samples collected over this interval contain taxa similar to the "uphole" intervals.

7967-8370'

Undifferentiated bisaccates (R-A), Anapiansporites stipulatus (R), Apiculatisporis lanjouwii (R), Aratrisporites sp. (R), Convolutispora sp. (R), Granulatisporites sp. (R), Hystrichosporites sp. (R), Kraeuselisporites sp. (R), Lycospora sp. (R), Ovalipollis sp. (R), Punctatisporites spp. (R-F), Raistrickia sp. (R), Spinotriletes sp. (R), Striatites richteri (R), Taeniasporites sp. (R), undifferentiated verrucate spores (C), Vestispora sp. (R), Vitreisporites pallidus (R).

Nothyetridium sp. (R).

AGE: Permian to Triassic
ENVIRONMENT: Nonmarine to Marginal Marine

Occurrences of such taxa as Apiculatisporis lanjouwii, Aratrisporites sp., Ovalipollis sp., Striatites richteri, and Taeniasporites sp. all suggest a Permian to Triassic age for this interval.

Two core samples (i.e., 8081 and 8113) contain Cretaceous aged taxa. In both cases they are the top samples and alien to the remaining core samples. They are here considered to be either contaminated by mud invasion or collected from rubble in the top of the core barrel.

8370-9365.8' T.D.

Undifferentiated bisaccates (R-A), Punctatisporites spp. (R), Striatites richteri (R), Taeniasporites sp. (R), undifferentiated verrucate spores (R).

AGE: Indeterminate
ENVIRONMENT: Indeterminate

Taxa from this interval in the ditch samples are the same as those noted in higher units and are probably derived from "uphole" contamination. The core samples are all barren of palynomorphs.

J. W. Dalton #1 (Foraminifera)

FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checklisting of 282 washed ditch samples, 16 thin sectioned ditch samples, 4 washed sidewall cores, 2 thin sectioned sidewall cores, 112 washed conventional core samples, and 58 thin sectioned conventional core samples covering the interval 90 to 9365.8 feet. Thin sections were prepared on all samples below 8256 feet. Six sidewall core samples received after the checklists were completed appear in an appendix at the back of this report. Three checklists and a faunal distribution log are enclosed for your convenience.

Standard techniques were employed in processing the material. All samples were boiled in Quaternary-O and washed over 20 and 200 mesh screens.

Frequency symbols used in this report correspond to the following numerical values: R = rare (1-5); F = frequent (6-32); C = common (33-99); A = abundant (100-199); and FL = flood (200+).

90-110'

Occurrences of Cassidulina cf. norcrossi, Dentalina soluta, Elphidium clavatum, E. cf. acutum and Elphidium spp. suggest a Pliocene to Pleistocene age. The above forms indicate a shallow probable inner neritic depositional environment.

AGE: Tertiary to Quaternary
Pliocene to Pleistocene
ENVIRONMENT: Probable Inner Neritic

110-1050'

Most of this interval was barren of Foraminifera, but the rare specimens found would suggest a Tertiary age for these strata.

AGE: Tertiary
Undifferentiated
ENVIRONMENT: Nonmarine to Inner Neritic

1050-1160'

A faunal increase characterizes this unit. It contains such forms as: Haplophragmoides rota, H. bonanzensis, Saccammina lathrami, Trochammina ribatonensis, T. whittingtopi, T. albertensis, Vernuilinoides fleghei, Vaginulina schradersensis, and silicified radiolaria of the genera Sethocyrtis, Archicorys, Dictyomitra, Theocorys, Cenosphaera, Spongodiscus, and Spongurus. The above association indicates a Senonian (F-5) age.

AGE: Late Cretaceous
Senonian (F-5)
ENVIRONMENT: Probable Middle to Outer Neritic

1160-2550'

This interval is based on the occurrence of Arenobulimina cornuta at 2340 feet coupled with correlations to adjacent wells. Most of the Foraminifera found in these strata also occur in the overlying strata. Some of the fauna may indeed be caving from the overlying strata. This interval is believed to represent a Turonian to Coniacian (F-6) age.

AGE: Late Cretaceous
Turonian to Coniacian (F-6)
ENVIRONMENT: Marginal Marine to Inner Neritic

2550-2730'

A top on the "Paper Shale" ("cuticlized leaves") was found at 2550 feet. This interval is most likely an equivalent to the Shale Wall Member of the Seabee Fm. It probably represents a Cenomanian to Turonian age. Common occurrences of silicified radiolaria typify these strata suggesting open marine conditions.

AGE: Late Cretaceous
Cenomanian to Turonian (F-7)
ENVIRONMENT: Open Marine (starved basin)

2730-2820'

This thin interval contains a poor transitional assemblage. The rare occurrence of Haplophragmoides cf. topagorukensis may indicate an Albian age or may represent a reworked specimen.

AGE: Early to Late Cretaceous
Probable Albian to Cenomanian (F-8)

ENVIRONMENT: Probable Marginal Marine

2820-4740'

Haplophragmoides topagorukensis, H. collyra, H. gigas, H. cf. excavatus, Ammobaculites fragmentarius, A. wenonahug, Lenticulina macrodisca, L. erecta, Trochammina umiatensis, T. mcmurrayensis, Miliammina manitobensis, M. anumensis, Psammosphaera bowsheri, P. subcircularis, Saccammina lathrami, Tritaxia manitobensis, Hippocrepina barksdalei, Marginulinopsis cylindri, Bathysiphon vitta, Verneuilinoides borealis, and Oltrupa corny occur in this interval. The above association is typical of the Verneuilinoides borealis Faunal Zone and is Albian age. Unlike most of the other wells from the NPRA area this well did not contain any of the F-10 zonule markers. Since this may be a facies problem we will assume that some of the lower portion of this interval may be an F-10 equivalent. The environments represented by these moderately diverse assemblages were probably of somewhat turbid inner to outer neritic depths with short periods of lesser turbidity.

AGE: Early Cretaceous
Albian (F-9 to F-10)

ENVIRONMENT: Neritic (fluctuating turbidity)

4740-7380'

A mixed pyritized and silicified radiolarian assemblage characterizes these strata together with rare non-diagnostic agglutinated Foraminifera. Some rare calcareous forms occur such as: Hedbergella cf. aptiana, Fragmulimina panina, and Saracenaria italica. According to Ramsay (1970) this zone of pyritized radiolaria separates the Verneuilinoides borealis Zone from the Gaudryina taillauri Zone, and is probably Aptian to early Albian in age. Lithocampe cf. N tape near the base of this interval at 7350 feet. Due to the preservation of this fauna, all that can be said about the environment of deposition is that it was marine and open to oceanic currents. Some of these strata may represent deep marine (below compensation depth) basal slope deposits. This is certainly a possibility since calcareous Foraminifera are very scarce in this interval.

AGE: Early Cretaceous
Aptian to Early Albian (F-11)

ENVIRONMENT: Open Marine (Possible Bathyal)

7380-7730'

Rare occurrences of Haplophragmoides duoflacia, Thurammina septagonalis, Gaudryina taillauri, Ammobaculites erectus, Lituotuba galluci, and Trochammina sp. (small, plano-convex) together with common rounded frosted quartz floatsare indicate that these strata are Neocomian (F-12 to F-13) in age.

AGE: Early Cretaceous
Neocomian (F-12 to F-13)

ENVIRONMENT: Probable Middle to Outer Neritic (turbid)

7730-7880'

Based on the presence of Monotis/Halobia fragments and Liquina borealis at 7730 to 7760 feet in this well we suggest the existence of a hiatus in the section resulting in Neocomian (F-12 to F-13) strata sitting on Triassic (F-19) strata. The sidewall core at 7790 feet contained a good Triassic (F-19) assemblage with such forms as: Agathoglus connudatus, Marginulina grisea, Nodosaria larina, Pseudoglandulina simpsonensis, and Vaginulinopsis agrulus. A distinctive dark brown to black calcareous pebbly sandstone similar to that described by Tappan (1951, pp. 5-6) from the basal 25 to 50 feet of the Shublik Fm. in the Sadlerochit River Region occurs in samples from the interval 7820 to 7880 feet in this well.

AGE: Triassic
F-19

ENVIRONMENT: Inner to Middle Neritic

7880-8317' Core

The top of this interval is based on a lithology change to strata lithologically similar to the Ivishak Fm. A rare agglutinated assemblage similar to the F-20 zonule occurs together with caved specimens from the overlying F-19 zonule. No lithologic evidence for the Echooka Fm. was found, suggesting that it may not be present in this section. For the most part these strata would appear to represent nonmarine to marginal marine deposition, but there is some evidence to indicate that a few of the beds below 8000 feet could represent deposition as deep as middle neritic.

AGE: Permo-Triassic
F-20

ENVIRONMENT: Nonmarine to Middle Neritic

8317'Core 9160'

Generally throughout the North Slope of Alaska the Lisburne Group can be divided into three lithologic units:

1. Upper Limestone Unit
2. Dolomite Unit
3. Lower Limy Unit

The Upper Limestone Unit is 843 feet thick in this well. Occurrences of Eoschubertella yukonensis, Millerella carbonica, Pseudostaffella sp., Zellerina designata, Pseudoendothyra ornata, and Kamaenid algae together with occurrences of Neoarchaediscus spp., Asterparchaediscus spp., and Stylocodium sp. indicate that the strata between about

8317'Core-9160'

8317 feet and 8580 feet are Zone 21 in age. A Zone 20 call is made at 8980 feet based on a significant reduction in the occurrence of Kamaenid algae. The Upper Limestone Unit represents a shoaling shelf and subtidal to tidal carbonate platform suite.

The Upper Limestone Unit was the only unit of the Lisburne Group encountered in this well. There are two possible explanations for this:

1. An unconformity exists at 9160 feet between the Lisburne Group and underlying Endicott Group.
2. The clastic facies of the Endicott Group has climbed with respect to age in the section.

AGE: Early to Middle Pennsylvanian
Zone 20 to Zone 21

ENVIRONMENT: Nonmarine to Outer Shelf
(Carbonate Platform Suite)

9160-9250'

This interval is characterized by a change to predominantly red-brown shale and siltstone with frequent caving of limestone from the overlying carbonate section. The age of this unit is considered to be tenuous since it could represent strata as old as Early Mississippian or as young as Early Pennsylvanian.

AGE: Probable Early Mississippian to
Early Pennsylvanian

ENVIRONMENT: Probable Nonmarine to Inner Shelf

9250-9365.4'

This last unit is picked on the basis of a lithologic change to argillite. There were no indigenous Foraminifera recovered from this interval.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

FORAMINIFERA REPORT - REVISION

8317-8560' : Probable Middle Pennsylvanian (Zone 21+).

8560-8980' : This interval remains Middle Pennsylvanian (Zone 21).

APPENDIX A

7453'SWC

No Foraminifera found. Pyrite (R), pyrite sticks (R). Reddish-brown shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

7714'SWC

No Foraminifera found. Pyrite (C), coal (F), pyrite sticks (F). Dark gray pyritic silty shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

7789'SWC

No Foraminifera found. Coal (R). Brownish-gray very fine-grained sandstone or siltstone.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

7790'SWC

Agathocolus connudatus (F), *Marginulina prisca* (R), *Nodosaria larina* (R), *Pseudoglandulina simpsonensis* (R), *Vaginulinopsis acrulus* (R), pyrite (C), coal (F). Reddish-brown silty shale.

AGE: Triassic (F-19)
ENVIRONMENT: Probable Middle Neritic

8266'SWC

No Foraminifera found. Brownish-gray very fine-grained microdolomite.

AGE: Indeterminate
ENVIRONMENT: Possible Supratidal

8450'SWC

Bisseriella parva (F), *Calcisphaera pachysphaerica* (R), *Endothyra* spp. (F), *Priscella prisca* (R), *Pseudoglomospira* sp. (F), *Trepeilopsis* sp. (F), *Kamaena* sp. (R). Brown palmatozoan-bryozoan-foraminiferal packstone.

AGE: Probable Middle Pennsylvanian (Zone 21)
ENVIRONMENT: Shoaling Shelf

Drew Pt. #1 (Palynology)

PALYNOLOGY REPORT

Introduction

A total of 437 samples were processed and examined for palynological age determinations. This total consisted of 91 ditch, 35 sidewall and 310 conventional core samples. The entire well was examined from 80 feet to the total depth of 7946 feet except for a gap between 7103 feet and 7280 feet. This gap exists due to the lack of ditch samples or core samples through the interval.

This report does not include any analysis of sidewall core samples from the "second run" (below 6835 feet). These sidewall cores have not been received by the AWA, Inc. laboratory as of this time.

Summary of Results

80-620'

Undifferentiated bisaccates (A), Osmundacidites spp. (F), Gleichenidites senonicus (F).

Alterbia acuminata (F-C), Chatangiella dizisaima (R-F), C. cf. granulifera (F), Odontochitina operculata (-F), Trithyrodinium suspectum (R), Hystrichosphaeridium difficile (C-A).

AGE: Late Cretaceous (Santonian-Campanian) P-M14

ENVIRONMENT: Marine

620-980'

Many of the same species as in the above interval occur herein but in significantly reduced numbers. This is the usual characteristic for the interval that has been tentatively assigned a Turonian-Coniacian age in the north slope region.

AGE: Late Cretaceous (?Turonian-?Coniacian) P-M13

ENVIRONMENT: Probable Marginal Marine to Non-marine

980-1610'

Undifferentiated bisaccates (A), Taxodiaceae (F-A), Gleichenidites senonicus (R-F), Vitreisporites pallidus (R).

Odontochitina operculata (F-C), Oligosphaeridium complex (A-F), Chlamydophorella nyei (F-C).

Cyclonephelium distinctum (R-F), Cribroperidinium edwardsi (R-F).

AGE: Late Cretaceous (probable Cenomanian) probable P-M16

ENVIRONMENT: Marine

The usual forms marking the top of the P-M16 zonule are absent, however, based on the continuous occurrences of Cribroperidinium edwardsi, beginning at 980 feet, a tentative Cenomanian age for this interval is assigned.

1610-1790'

The important elements in this narrow interval are the spores Trilobosporites perverulentus (R) and Costatoperforosporites foveolatus (R). These Early Cretaceous species make their first appearance in the well at 1610 feet. Numerous dinocysts also occur, but none are restrictive Early Cretaceous species.

AGE: Early Cretaceous (Albian) probable P-M17

ENVIRONMENT: Marine

1790-2420'

Undifferentiated bisaccates (A), Vitreisporites pallidus (R), Gleichenidites senonicus (R-F), Appendicisporites spp. (R), Trilobosporites spp. (R, sporadic).

Odontochitina operculata (F), Oligosphaeridium complex (R), Chlamydophorella nyei (F), Palaeoperidinium cretaceum (R-C), Cribroperidinium edwardsi (F), Cyclonephelium distinctum (A-F), Batioladinium jaegeri (R), Luxadinium propatulum (R), Genus "H" (R).

AGE: Early Cretaceous (Middle-Late Albian) P-M17

ENVIRONMENT: Marine

2420-6749' SWC

Undifferentiated bisaccates (A), Lycopodiumsporites spp. (R), Trilobosporites perverulentus (R, above 3700'±), T. spiverrucatus (R, sporadic); rare reworked occurrences of deltoidospores and striated bisaccates throughout.

Odontochitina operculata (R-C), Oligosphaeridium complex (R-A), Palaeoperidinium cretaceum (R-A), Cyclonephelium distinctum (R-F), Genus "H" (R, scattered), Batioladinium jaegeri (R), Pseudoceratium retusum (R), Muderoogia asymmetrica (R-F), Gardodinium trabeculosum (R, scattered); numerous rare and sporadic reworked occurrences of Triassic, Jurassic and Neocomian dinocysts.

AGE: Early Cretaceous (probable Aptian-Early Albian) probably P-M18

ENVIRONMENT: Marine to very Marginal Marine

The upper part of the interval probably represents very marginal marine deposition. Below approximately 4000 feet the depositional environments are increasingly marine. Along with the increased dinocyst counts below 5000 feet, there is a corresponding change in the organic constituents from dominantly woody, land-derived material to amorphous or sapropelic material.

The absence of any Middle to Late Albian marker species suggests that this interval may be of Aptian to Early Albian age (P-M18).

6750-6905'C

Odontochitina operculata (F-A), O. sp.-1 (R), Oligosphaeridium complex (C-A), Palaeoperidinium cretaceum (F-A), Cyclonephelium distinctum (F-A), Batioladinium jaegeri (R-F), Gardodinium trabeculosum (F-A); single occurrences of Batioladinium pellifarum and Dimidiadinium uncinatum.

AGE: Early Cretaceous (probable Neocomian) P-M19

ENVIRONMENT: Marine

The restrictive Neocomian age species B. pellifarum and D. uncinatum are very rare in this interval. These forms are characteristic of Hauterivian to Barremian age strata but their scarcity here is the reason for only a tentative P-M19 age assignment.

6905-6957'C

Vitreisporites pallidus (F-A), Kraeuselisporites sp. (R-F), Taeniaesporites spp. (R-F), Pluudbladispora sp. (R-F), Striacites richtari (R, sporadic).

Microhystridium spp. (A-C); sporadic occurrences of Norian to Rhaetian dinocysts.

AGE: Late Triassic?

ENVIRONMENT: Marginal Marine

The only diagnostic palynomorphs observed were the numerous Triassic species. The scattered dinocysts appear to be represented by a mixture of Norian and Rhaetian species, and their presence may be a result of reworking. It is possible that all of the Triassic fossils have been reworked into an otherwise poorly fossiliferous basal Jurassic section.

6977-7009'C

The important species in this interval is the dinocyst Suessia swabiana which ranges no younger than Rhaetian in age. If the mixture of species as discussed in the preceding interval is accepted as reworked then a Rhaetian age for this interval makes sequential sense.

AGE: Late Triassic (Rhaetian) P-M23

ENVIRONMENT: Marine

7093-7380'C

Micrhystridium spp. (F-A), Moricysta fimbriata (R-C), M. varivallata (R-F), M. pannucea (R-F), Hebecysta brevicornuta (R), H. asymmetrica (R-F), Suessia sudbiana (R-A), ?Shublikodinium sp. (R, sporadic).

AGE: Late Triassic (Karnian?-Norian) (P-M26 to P-M27?)

ENVIRONMENT: Marine

7544-7602'C

Taeniasporites spp. (R-A), Striatites richteri (F-A), Duthuntysporis minuta (R-F).

Microhystridium spp. (F-A), Veryhachium spp. (R-C).

AGE: Probable Early to Middle Triassic (P-T16)

ENVIRONMENT: Marginal Marine

The marine palynomorphs are represented only by scritarchs through this interval. The dinocysts do not extend down into this zone.

The consistent and abundant S. richteri occurrences indicate that this section is probably equivalent to the strata represented by the P-T16 zonule.

7602-7630'C

The significant element in this interval is the appearance of Aratrisporites psenulatus.

AGE: Early to Middle Triassic (P-T16)

ENVIRONMENT: Marginal Marine

The presence of A. psenulatus in this interval is very distinctive. A similar occurrence was recorded in the Topagoruk Test Well #1 at the depth of 9433 feet to 9597 feet.

7704-7727'C

Barren of palynomorphs.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

Although barren of palynomorphs, the presence of Triassic forms in the core below indicates that this interval is Triassic in age.

7793'C

Kraeuselisporites sp. (R), ?Lundbladispora sp. (F), Taeniasporites spp. (C), Striatites richteri (F).

AGE: Probably continues in Early to Middle Triassic (P-T16)

ENVIRONMENT: Very Marginal Marine

The absence of Vittatina suggests that the well has not penetrated Permian strata by this depth.

7794-7946'S.C.

Barren of indigenous palynomorphs.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

ADDENDUM
TO
PALYNOLOGY REPORT

A total of 14 additional sidewall core samples were processed and examined for palynological age determinations from the subject well. The sidewall samples were taken between the depths 6960 feet and 7830 feet.

The details from this study are plotted on the attached distribution chart. No alteration of the original subdivisions resulted through this additional examination, but some further corroboration in the Late Triassic zonation was obtained.

Drew Pt. #1 (Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1" to 100' faunal distribution log and four faunal checklists on the Drew Point #1 well. The conclusions presented in this report are based on the processing, picking and examination of 220 ditch samples, generally composited on 30 to 40 foot intervals, 32 sidewall core samples and 110 conventional core samples. Twenty (20) thin sections were also prepared on Core 15. A generalized age summary of the well is provided below.

80-140'

Occurrences of Cassidulina californica, C. quadrata and Elphidium spp. suggest a Pleistocene to Recent age. The above forms indicate a shallow probable inner neritic depositional environment.

AGE: Quaternary Pleistocene to Recent (F-1)

ENVIRONMENT: Probable Inner Neritic

140-350'

This thin interval is considered to be Senonian (F-5) age based on the common to abundant occurrence of volcanic glass shards. These shards are known to typify Senonian deposits locally. The presence of Tertiary foraminifera in this interval is considered to represent caving from the overlying Pleistocene to Recent strata.

AGE: Late Cretaceous Senonian (F-5)

ENVIRONMENT: Possible Nonmarine

350-1040'

Based on occurrences of Pseudoglavulina hastata at 150 feet, Hedbergella loetterlei at 500 feet, and Zonodiscus A at 590 feet this unit is considered to be Turonian to Coniacian (F-6) in age. In correlating with adjacent wells it would appear that 620 feet in this well would probably equate to the top of the Cenomanian to Turonian interval in previous well reports. These strata probably represent inner to middle neritic deposition.

AGE: Late Cretaceous Turonian to Coniacian (F-6)

ENVIRONMENT: Inner to Middle Neritic

1040-1760'

A top on the "Paper Shale" ("cutinized leaves") was found at 1040 feet. This point is probably at the top of or down in the Shale Wall Member of the Seabee Formation. The F-8 transitional faunule was not developed in this well, but whether or not this is due to facies problems is not known at this time. This interval is generally dominated by starved basin deposition as indicated by the high organic content and the paucity of preserved calcareous foraminifera associated with pulses of open marine radiolarian bursts.

AGE: Late Cretaceous Cenomanian to Turonian (F-7 to F-8?)

ENVIRONMENT: Open Marine (Starved basin)

1760-2860'

Rare occurrences of Haplophragmoides topagorukensis, Gavelinella awunensis, Lenticulina macrodisca, L. arcta, Valvulineria loetterlei, Miliammina manitobensis, Hyperammina bartkadahl, Vernuilinoides borealis, Oolina apiculata, Ammobaculites wenonahee together with frequent to common Citrupa cornu indicate that these strata are Middle to Late Albian (F-9) age. These samples are dominated by radiolaria which are similar to, and may be caving from, the overlying strata. There is not enough sidewall core control to establish the true nature of these faunas. This, therefore, introduces an element of uncertainty into the environmental interpretation. If the radiolaria represent

1760-2860' (con't.)

caving then the depositional environment suggested by the rare mixed calcareous-agglutinated faunas would be inner to possibly middle neritic.

AGE: Early Cretaceous
Middle to Late Albian (F-9)

ENVIRONMENT: Inner to possibly Middle Neritic

2860-4740'

This interval is characterized by occurrences of the following: Gaudryina nanushukensis, Leptoulina topagorukensis, L. grecta, Marginulinopsis jonesi, Eurycheilostoma grandestandensis, Glomospirella gaultina, Trochammina rainwaterei, Ammobaculites fragmentarius, A. wenonahae, Psammosphaera subcircularis, P. bowsheri, Textularia topagorukensis, Ammodiscus rotalarius, Saracenaria projectura, Pallaimorphina ruckerae, Millammina manitobensis, Haplophragmoides topagorukensis, H. cf. excavata, and arenaceous spp. (large, coarse). The above fauna indicates a Late Aptian to Early Albian (F-10) age. The environments represented by these moderately diverse assemblages were probably somewhat turbid inner to middle neritic depths with short periods of lesser turbidity.

AGE: Early Cretaceous
Late Aptian to Early Albian (F-10)

ENVIRONMENT: Inner to Middle Neritic
(fluctuating turbidity)

4740-6740'

A pyritized radiolarian fauna characterizes these strata together with rare occurrences of agglutinated and calcareous foraminifera. Pyritized radiolaria of the following genera occur: Canosphaera spp., Spongodiscus sp., Lithocampe spp., Dictyomitra spp., Cyrtocapsa sp., and Stichomitra? sp. Lithocampe cf. N cope near the base of this unit at 6600 feet and becomes frequent at 6710 feet. According to Ramsey (1970) this zone of pyritized radiolaria separates the Verneuilinoides borealis zone from the Gaudryina caillieuri zone, and is probably Aptian to early Albian in age. We feel that it is probably Aptian in age, but our data is tentative at this time. Due to the preservation of this fauna, all that can be said about the environment of deposition is that it was marine and open to oceanic currents. These strata may represent deep marine (below compensation depth) basal slope deposits. This is a possibility since calcareous foraminifera are very scarce in this interval and would represent caved specimens when they do occur.

AGE: Early Cretaceous
Aptian (F-11)

ENVIRONMENT: Open Marine

6740-6900'

Occurrences of Gaudryina cf. caillieuri and common to abundant rounded frosted quartz floacers suggest a Neocomian age for these rocks. This fauna is totally agglutinated and indicates deposition in a relatively shallow (inner to middle neritic) turbid environment.

AGE: Early Cretaceous
Neocomian (F-12 to F-13)

ENVIRONMENT: Inner to Middle Neritic (turbid)

6900-6977'C

This unit is not easily recognized in ditch samples since it is relatively thin, and there is a gap in the ditch samples between 6940 feet and 7280 feet. It is, however, represented in conventional cores 4, 5 and 6. Species characterizing this interval include: Gaudryina dyscrita, G. adora, Textularia areopecta, Bathysiphon anomalocoelia, Involutina silicea, Lituotuba irregularis, Trochammina sablei, T. topagorukensis, T. cf. canningensis, Tolypammina gigantea, and Trochamminoides spp. While the above fauna does contain a couple of forms previously reported from the Triassic we feel that the overall assemblage indicates a probable Early Jurassic age. These agglutinated faunas probably represent turbid middle neritic to upper bathyal deposition.

AGE: Probable Early Jurassic
F-18

ENVIRONMENT: Probable Middle Neritic to Upper Bathyal (turbid)

6977C-7554'C

Astacolus connudatus, Nodosaria shublikensis, N. liracella, N. larina, Saccoplecta inornata, Bolivina lathetica, Lingulina borealis, L. alaskensis, Frondicularia acuaea, F. luaerea, Pseudoglandulina lata, P. simpsonensis, Vaginulinopsis acrulus, Marginulina prisca, Trochammina helicta, and Monotis fragments occur throughout these beds. These faunas appear to represent open marine middle neritic to upper bathyal conditions. A distinctive dark brown to black calcareous pebbly sandstone similar to that described by Tappan (1951, pp. 5-6) from the basal 15 to 50 feet of the Shublik Fm. in the Sadlerochit River Region occurs in samples from the interval 7460 feet to 7553 feet in this well.

AGE: Triassic
F-19

ENVIRONMENT: Middle Neritic to Upper Bathyal
(Open Marine)

7554C-7830'

A poor fauna consisting of Ammobaculites cf. barrowensis, A. sp. (very small), Haplophragmoides spp., Trochammina cf. sablei, T. cf. canningensis, Ammodiscus P. Bathysiphon anomalocoelia and pyritized radiolaria occurs in the upper portion of this interval above 7804 feet. This assemblage is indicative of Zonule F-20, and is probably still Triassic based on the lack of any Echooka Fm. lithology or any Permian foraminifera. The top of this unit is placed on the basis of the F-20 fauna, and the base of the aforementioned basal Shublik Fm. pebbly sandstone in core 10. We recognize that the strata associated with the uppermost 48 feet of this interval are not typical Sadlerochit Fm., and it is possible that the F-20 Faunule may climb into the Shublik Fm. So far we have only observed this boundary in ditch samples where it appears that the F-20 Faunule is restricted to the Sadlerochit Fm. These strata probably represent nonmarine to inner neritic deposition.

AGE: Triassic
F-20

ENVIRONMENT: Nonmarine to Inner Neritic

7830-7945' T.D.

This last unit is picked on the basis of a lithologic change to argillite. There were no indigenous foraminifera recovered from this interval.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

ADDENDUM
TO
FORAMINIFERA REPORT

The following addendum is based on the processing, picking and examination of 14 sidewall core samples from the Drew Pt. #1 well. A faunal checklist is enclosed for your convenience.

The only significant alteration of the original report based on this new data would be that the top of the argillite would have to lie below 7830 feet (i.e., 7831 to 7860 feet).

W. Fish Creek #1
(Palynology)

PALYNOLOGY REPORT

A total of 122 samples were processed and examined for palynological age determinations. The samples were ditch composites of 90-foot intervals except near the Jurassic/Cretaceous boundary where 30-foot samples were examined. The total interval studied was from 300 feet down to the total depth of 11,420 feet.

500-770'

Australiella spectabilis (C), A. severdrupiana (R-C), A. granulifera (R-F), Dinogodinium excisum (R), Odontochitina operculata (F-C), Hexagonifera chlamydata (R), Palaeoperidinium basilium (R), Oeflandrea ditissima (F).

AGE: Late Cretaceous (Santonian-Campanian)
ENVIRONMENT: Marine

770-1670'

Gleichenidites senonicus (R-F), Vitreisporites pallidus (R-F).

Australiella/Oeflandrea spp. (R), Palaeoperidinium basilium (R-F), Odontochitina operculata (R), Cyclonephelium distinctum (R), Cribroperidinium edwardsi (R).

AGE: Late Cretaceous (Turonian-Coniacian)
ENVIRONMENT: Nonmarine to Marginal Marine

1670-2840'

Gleichenidites senonicus (R-F), Vitreisporites pallidus (R).

Palaeoperidinium basilium (R-C), Odontochitina operculata (R-C), Oligosphaeridium complex (R), Cyclonephelium distinctum (R), Cribroperidinium edwardsi (R-F), Broomea jaegeri (R, scattered), Pseudocerastium cf. dettmannae (R, near top of interval).

AGE: Late Cretaceous (Cenomanian)
ENVIRONMENT: Marine to Marginal Marine below approximately 1400 feet

2840-4410'

Gleichenidites senonicus (R), Classopollis classoides (R), Trilobosporites apiverrucatus (R, scattered)) reworked Triassic grains (R, scattered).

Odontochitina operculata (R-F), Oligosphaeridium complex (R-F), Cyclonephelium distinctum (R), Cribroperidinium edwardsi (R), Broomea jaegeri (R), Astrocysta cretacea (F-C),

Luxadinium propatulum (R-F), Spinidinium vesicum (R), Herendeenia piciformis (reworked, R, scattered).

AGE: Early Cretaceous (Albian)
ENVIRONMENT: Marine

4410-7260'

Classopollis classoides (R), Densospores (R, reworked).

Odontochitina operculata (R-F), Oligosphaeridium complex (R), Cyclonephelium distinctum (R), C. compactum/membraniphorum (R), Broomea jaegeri (R-F), Astrocysta cretacea (R-F), Gardodinium eisenacki (R); scattered specimens of reworked Jurassic and Triassic dinocysts.

AGE: Early Cretaceous (Aptian-Early Albian)
ENVIRONMENT: Marine

This interval is characterized by the absence of Luxadinium and Spinidinium as well as the consistent occurrence of Gardodinium eisenacki. As observed in other wells of the region, this interval may range as young as Early Albian and as old as Aptian in age.

7260-7290'

Oligosphaeridium complex (C), Cyclonephelium distinctum (R), Astrocysta cretacea (R), Gardodinium eisenacki (A).

AGE: Early Cretaceous (Neocomian)
ENVIRONMENT: Marine

7290-7860'

Classopollis classoides (F), Corabropollenites mesozoicus (R).

Sirmiodinium grossi (R), Psaligonyaulax apatela (R), Gonyaulacysta jurassica (R), G. cladophora (R), Endoscrinium galericum (R-F).

AGE: Late Jurassic (Kimmeridgian)
ENVIRONMENT: Marine

The presence of Endoscrinium galericum below 7680 feet indicates that the lower one-third of this interval may be assigned an Early Kimmeridgian age.

7860-8940'

Classopollis classoides (R-F), striated bisaccates (R, reworked).

Paradinia ceratophora (R), P. cf. verrucosum (R-F), Sirmiodinium grossi (R-F), Gonyaulacysta cladophora (F-C), Endoscrinium galericum (R-F), Nannoceratopsis pellucida (F-C).

AGE: Late Jurassic (Oxfordian)
ENVIRONMENT: Marine

8940-9210'

Striated bisaccates (R, reworked).

Nannoceratopsis gracilis (R), N. pellucida (R-F); undescribed microplankton cysts JRD-1, JRD-1, JRD-1 (R).

AGE: Early-Middle Jurassic (Late Pliensbachian-Callovian)
ENVIRONMENT: Marine

9210-9480'

Essentially barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

9480-10,470'

Undifferentiated striate bisaccates (R-F), Taeniasporites sp. (R-F), Striatites richteri (R), Lueckisporites sp. (R), Klausipollenites staplinii (R), Krauselisporites spinosus (R), ?Lundbladispora sp. (R), verrucate spores (F).

AGE: Permian-Triassic
ENVIRONMENT: Nonmarine

10,470-11,420' T.D.

No indigenous palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

W. Fish Creek #1

4320' SWC

Undifferentiated bisaccates (A).

Batioladinium jaegeri (R), Odontochitina operculata (R), O. sp.-1 (R), Palaeoperidinium cretaceum (F), Pseudocerastium retusum (R).

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

4649' SWC

Undifferentiated bisaccates (A).

W. Fish Creek #1 (con't.)

4649' SWC (con't.)

Batioladinium jaegeri (R), Cyclonephelium distinctum (R), Odontochitina operculata (R), Oligosphaeridium complex (F), Palaeoperidinium cretaceum (R), Pseudoceratium retusum (R).

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

4824' SWC

Undifferentiated bisaccates (A).

Batioladinium jaegeri (F), Cyclonephelium distinctum (R), Odontochitina operculata (C), Oligosphaeridium anthophorum (R), O. complex (R), Palaeoperidinium cretaceum (C), Pseudoceratium retusum (R), Genus "H" (R), Nannoceratopsis pellucida (R, reworked).

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

5742' SWC

Undifferentiated bisaccates (F),

Batioladinium jaegeri (R), Cyclonephelium distinctum (R).

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

5984' SWC

Undifferentiated bisaccates (A).

Batioladinium jaegeri (R), Cribroperidinium edwardsi (R), Cyclonephelium distinctum (R), Hystrichosphaeridium stellatum (R), Odontochitina operculata (F), Oligosphaeridium complex (F), Palaeoperidinium cretaceum (R), Pseudoceratium retusum (R); reworked occurrences of Nannoceratopsis pellucida (F) and Gonyaulacysta cladophora (R).

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

6888' SWC

Undifferentiated bisaccates (C).

Oligosphaeridium complex (R), Nannoceratopsis pellucida (R, reworked).

AGE: Indeterminate
ENVIRONMENT: Marine

7011' SWC

Undifferentiated bisaccates (A), Vitreisporites pallidus (A).

Cyclonephelium distinctum (R), Gardodinium trabeculosum (R), Odontochitina operculata (R), O. sp.-1 (R), Oligosphaeridium complex (R), Palaeoperidinium cretaceum (R),

Pseudoceratium retusum (R); reworked rare occurrences of Nannoceratopsis pellucida, Sverdrupiella usitata.

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

7630' SWC

Adnatosphaeridium cf. caulleryi (R), Endoscrinium galeritum (R), Gonyaulacysta cladophora (F), G. jurassica (R), Nannoceratopsis pellucida (A), Paraodinia prolongata (F).

AGE: Late Jurassic (probable Oxfordian) (P-M22)
ENVIRONMENT: Marine

If the few specimens of N. pellucida are considered to be indigenous then the sample is in the Oxfordian PM-22 zone. This would raise the top of the Oxfordian interval, as interpreted in the ditch samples, by 210 feet.

8818' SWC

Undifferentiated bisaccates (A).

Gonyaulacysta cladophora (R), Nannoceratopsis pellucida (C), Paraodinia sp. (verrucose)(R), Sirmiodinium grossi (R).

AGE: Late Jurassic (Oxfordian)(P-M22)
ENVIRONMENT: Marine

SUMMARY OF PALYNOLOGY REVISIONS

500-770'	:	Late Cretaceous, Santonian-Campanian (P-M14).
770-1670'	:	Late Cretaceous, ?Turonian-?Coniacian (P-M15).
1670-2840'	:	Late Cretaceous, Cenomanian (P-M16).
2840-4620'?	:	Early Cretaceous, Middle-Late Albian (P-M17).
4620-7260'	:	Early Cretaceous, Aptian-Early Albian (P-M18).
7260-7290'	:	Early Cretaceous, possible Neocomian (P-M18a).
7290-7630'	:	Late Jurassic, Kimmeridgian-Tithonian (P-M21).
7630-8940'	:	Late Jurassic, Oxfordian (P-M22).
8940-9210'	:	Early-Middle Jurassic, Late Pliensbachian-Early Bajocian? (P-M23).
9210-9660'	:	Triassic-Early Jurassic (probable P-T15 to P-M24).
9660-10,470'	:	Permian-Triassic (P-T17 to P-T18). No definite evidence of P-T18.
10,470-11,420'	:	T.D. Age indeterminate.

W. Fish Creek #1 (Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1" to 100' faunal distribution log and four faunal checklists on the West Fish Creek #1 well. The conclusions presented in this report are based on the processing, picking and examination of 313 ditch samples, generally composited on 30 to 40 foot intervals. Thirty-four (34) thin sections were prepared on 30 foot ditch intervals below 10,410 feet. A generalized age summary of the well is provided below.

500-1550'

Textularia cf. gravenori, Verneuilinoides cf. fisheri, Trochammina ribstonensis, T. whittingtoni, Cenosphaera spp., Spongurus spp., Methoxyrtis sp., Archicoryne sp., Theocorys sp., Dictyomitra spp., D. multicostata, Spongodiscus spp., S. cf. reniliaeformis, Stylospongia sp., Rhopalodictyum sp., Spongostaurus sp., and Xiphosphaera sp.

The above assemblage is characteristic of the Senonian Schrader Bluff Formation. Faunas obtained throughout this

500-1550'

interval are indicative of oscillating middle neritic to upper bathyal (non-turbid) deposition.

AGE: Late Cretaceous (Senonian) Schrader Bluff Fm.
ENVIRONMENT: Middle Neritic to Upper Bathyal (non-turbid)

1550-2510'

Trochammina whittingtoni, Pseudoclavulina hastata, Vaginulina schradaranaia, Tonoginous sp. A, Cenosphaera spp., Spongurus spp., Spongodiscus spp., and S. cf. reniliaeformis characterize this interval. Two single specimen occurrences of Pseudoclavulina hastata above 1550 feet are considered reworked or facies occurrences in this report.

A stop on the "Paper Shale" ("cuticlised leaves") was found at 2090 feet. The Shale Wall Member is generally siltier than it is in surrounding wells. This interval is generally dominated by starved basin deposition as indicated by the high organic content and the lack of preserved calcareous foraminifera associated with the few pulses of open marine radiolarian bursts.

AGE: Late Cretaceous (Cenomanian to Turonian) Seabee Fm.
ENVIRONMENT: Open Marine (starved basin)

2510-2630'

This fauna contains Trochammina rainwateri, Verneuilinoides cf. borealis, and Haplophragmoides cf. topagorukensis. This association appears to be a transitional fauna which could be either Albian or Cenomanian in age. These strata probably represent turbid inner to middle neritic deposition.

AGE: Early to Late Cretaceous (Albian to Cenomanian)
Probable Nanushuk Group

ENVIRONMENT: Probable Inner to Middle Neritic (turbid)

2630-4800'

Hyperammina barksdalei, Ammodiscus rotalarius, Haplophragmoides topagorukensis, H. cf. linki, H. gigas, H. cf. excavata, Ammobaculites fragmentarius, A. wenonahensis, Lenticulina macrodisca, L. bayrocki, Trochammina umiatensis, T. mcmurrayensis, Miliammina manitobensis, Psammopelta bowsheri, Saccammina lathrami, Globorotalites alaskensis, Valvulineria loetterlei, Bathysiphon vitta, Verneuilinoides borealis and Ditrupa cornu occur in this interval. The above association is typical of the Verneuilinoides borealis faunal Zone and is Albian age. The environments represented by these moderately diverse assemblages were probably of relatively clear water middle to outer neritic depths with some short periods of turbidity.

2630-4800' (con't.)

AGE: Early Cretaceous (Albian)
Nanushuk Group

ENVIRONMENT: Middle to Outer Neritic (relatively clear water)

4800-7250'

A pyritized radiolarian assemblage characterizes these strata together with rare non-diagnostic agglutinated foraminifera. Lithocampe cf. sp. N occurs in the bottom of this interval, but preservation makes the identification uncertain. According to Ramsey (1970)*, this zone of pyritized radiolaria separates the Verneuilinoides borealis zone from the Gaudryina taillieuri zone, and is probably Aptian to early Albian in age. Due to the preservation of this fauna, all that can be said about the environment of deposition is that it was marine and open to oceanic currents. It was recently brought to our attention that these strata may represent deep marine (below compensation depth) basal slope deposits. This is certainly a possibility since calcareous foraminifera are very scarce in this interval and could represent caved specimens when they do occur. We also know that faunal diversity decreases in both directions from the shelf edge in northern latitudes.

*Ramsey, W. V., 1970, "Geological Age of Gaudryina taillieuri in Northern Alaska", Nature, vol. 227, p. 598.

AGE: Early Cretaceous (Aptian to Early Albian)
Torok Fm. or Fortress Mountain Fm.

ENVIRONMENT: Open Marine (possibly Lower Bathyal to Abyssal)

7250-7280'

This very thin interval contains Ammobaculites reophacoides, Ammodiscus mackenziensis, Gaudryina taillieuri, Gravellina sp., Glomospirella arctica, Haplophragmoides duoflatis, Thurammina septagonalis, Trochammina cf. sabini, and common rounded frosted quartz floaters (Pebble Shale), suggesting a Neocomian age for these strata. A turbid middle neritic to upper bathyal depositional environment is suggested by this association.

AGE: Probable Neocomian
Probable Okpikruak Fm.

ENVIRONMENT: Probable Middle Neritic to Upper Bathyal (turbid)

7280-7870'

Occurrences of Ammobaculites alaskensis, arenaceous spp. (large, coarse), Gaudryina millari, G. leffingwelli, G. topagorukensis, G. dyscrita, Glomospira pettoni, Glomospirella sp. B, Haplophragmoides canui, Marginulinopsis phragmites, Pseudobolivina sp., Trochammina cunningensis, T. topagorukensis, T. greyi, Lenticulina judax, L. prima, L. toarcense, Conorboides hofkeri, Thurammina sp., Involutina chersadospira, Recurvoides turbinatus and Textularia areoplecta indicate that these strata are Late Jurassic (Kimmeridgian to Tithonian) in age. These strata were probably deposited in clear water outer neritic to bathyal depths.

AGE: Late Jurassic (Kimmeridgian to Tithonian)
Kingak Fm.

ENVIRONMENT: Outer Neritic to Bathyal (clear water)

7870-8910'

In addition to continuing occurrences of some of the above species, the following species occur for the first time in this interval: Saracenaria topagorukensis, Astacolus pediacus, A. cf. dubius, A. gallionsis, A. daintreei, Citharina fallax, Frondicularia lustrata, Lenticulina quenstedti, Trochammina instowensis, and Vaginulina sharborni. This fauna would indicate an early Late Jurassic (Oxfordian) age. The abundant and diverse faunas of this interval probably represent an outer neritic to upper bathyal environment of deposition associated with fluctuating amounts of turbidity.

AGE: Late Jurassic (Oxfordian)
Kingak Fm.

ENVIRONMENT: Outer Neritic to Upper Bathyal

8910-9270'

Ammobaculites alaskensis, Bathysiphon anomalocoelia, Trochammina spp., T. cf. grossa, Lingulina nicida, and frequent to common pyritized radiolaria of the genera Cyrtocapsa, Stichomitra, Cenosphaera, Lithocampe, Spongodiscus and Dictyomitra occur in these strata. Also diagnostic of this unit is a burst of Tasmanites spp., which appears to be characteristic in this area. These strata are Early to Middle Jurassic in age. They probably represent deposition in middle neritic to upper bathyal depths characterized by fluctuating turbidity. A sandstone occurs at the base of this unit which may be an equivalent to the Sag River Sandstone.

AGE: Early to Middle Jurassic
Kingak Fm.

ENVIRONMENT: Middle Neritic to Upper Bathyal

9270-9660'

Marginulina prisca, Astacolus connudatus, Vaginulinopsis acrulus, Nodosaria larina, N. shublikensis, Pseudoglandulina simsonensis, and Monocis fragments among others, occur throughout these beds. The Triassic age of these strata is firmly established on the basis of the above fauna. These faunas represent fluctuating marginal marine to middle neritic deposition.

AGE: Triassic
Shublik Fm.

ENVIRONMENT: Marginal Marine to Middle Neritic

9660-10,470'

Occurrences of Ammodiscus sp. F. and Ammobaculites sp. (small, nodose) mark this interval. These strata would appear to represent nonmarine to marginal marine deposition. Two samples at the bottom of this unit (10,410-10,470') contain a heavily glauconitic sandstone suggestive of the Echooka Member of the Sadlerochit Formation.

AGE: Permo-Triassic
Sadlerochit Fm.

ENVIRONMENT: Nonmarine to Marginal Marine

10,470-10,500'

This very thin interval is characterized by occurrences of micritic coated palmatoporan-bryozoan-foraminiferal-algal grainstone. The presence of a single specimen of Protonodosaria sp. and rare Paleoaplysina sp. suggests that this unit is probably early Permian in age. These strata probably represent deposition in the shoaling shelf portion of a carbonate platform suite. Two fragments of grainstone found in the sample at 10,440-10,470 feet are here regarded as reworked but may mean that the top of this interval is slightly higher (less than 30 feet) than we have reported.

AGE: Probable Early Permian

ENVIRONMENT: Shoaling Shelf (carbonate platform suite)

10,500-11,310'

Generally throughout the North Slope of Alaska, the Lisburne Group can be divided into three lithologic units:

1. Upper Limestone Unit
2. Dolomite Unit
3. Lower Limy Unit

The Upper Limestone Unit is 560 feet thick in this well. Strata between 10,500 feet and about 10,620 feet contain rare Bigerella parva, rare Pseudoschaefferella sp., and frequent Stylocodium sp. These rocks conspicuously lack occurrences of Asteroarchaediscus spp., Neoarchaediscus spp., and Archaediscus spp. These rocks are certainly no older than Zone 21 but could easily be as young as Zone 22 (see Mamet, 1971, pages 203 and 204)*. These strata probably correlate in part with strata between 10,275 feet and 10,720 feet in the S. Harrison Bay #1 well. Bursts of Koninckopora yukonensis, Pseudoschaefferella sp., and Kamaenid algae together with occurrences of Neoarchaediscus spp., Asteroarchaediscus spp., and frequent Stylocodium sp. indicate that the strata between about 10,620 feet and 10,950 feet are definitely Zone 21 in age. A Zone 20 call is made at 10,950 feet based on a significant reduction in the occurrence of Kamaenid algae. Evidence for Zone 18-Zone 19 was lacking. Based on the possible occurrence of section equivalent to the Zone 17-Zone 18 Dolomite Unit below this interval, a scarcity of Globovalvulina bulloides, and a lower questionable occurrence of Rosiqmoilina rugosus? which may have caved from this interval, we suggest the possibility that section between 11,100 feet to 11,160 feet may be Zone 18 to Zone 19 in age. The Upper Limestone Unit represents shoaling shelf and subtidal facies of a carbonate platform suite.

The Dolomite Unit is questionably placed between 11,160 feet and 11,310 feet based on a lithologic change to microcrystalline dolomite and microcrystalline dolomitic limestone. This unit is poorly fossiliferous. The only newly occurring species in this interval is a questionable specimen of Rosiqmoilina rugosus? at 11,230-11,280 feet which occurs in a rare piece of packstone which as mentioned above is probably caved from somewhere around 11,100-11,160 feet. This unit probably represents a supratidal depositional environment.

AGE: Late Mississippian? to Middle Pennsylvanian or Younger Lisburne Group

ENVIRONMENT: Supratidal to Shoaling Shelf (carbonate platform suite)

11,310-11,430' T.D.

This interval is characterized by a change to unfossiliferous orange-brown shale and siltstone. These strata probably represent nonmarine deposition.

AGE: Probable Mississippian (Endicott Group)

ENVIRONMENT: Probable Nonmarine

W. Fish Creek #1

4220' SWC

No Foraminifers found. Megaspores (R).

AGE: Indeterminate

ENVIRONMENT: Indeterminate

WASHED LITH: Brown silty mudstone

4649' SWC

No Foraminifers found. Megaspores (F), coal (R).

AGE: Indeterminate

ENVIRONMENT: Indeterminate

WASHED LITH: Brown siltstone

4824' SWC

Ammobaculites sp. (very small, thin)(R), Trochammoides sp. (very small, thin)(F), megaspores (R), pyrite (R), coal (R).

AGE: Indeterminate

ENVIRONMENT: Probable Inner Neritic

WASHED LITH: Brown silty mudstone

9016' SWC

Trochammina sp. (very small, thin)(F), Tasmanites sp. (C).

AGE: Early to Middle Jurassic

ENVIRONMENT: Probable Inner Neritic

WASHED LITH: Dark brownish-black shiny irridescent shale

*Mamet, B. L., and Ross, C. A., 1971, in Sanber & Waterhouse, "Carboniferous and Permian Stratigraphy and Paleontology, Northern Yukon Territory, Canada"; Bull. of Can. Petr. Geol., vol. 19, no. 1, pp. 196-203.

* In examining the 30 foot ditch samples from the West Fish Creek #1 well, I felt that there might be some early Permian based on a single specimen of Protonodosaria sp. and a piece of Paleoaplysina sp. in the sample from 10,470-10,500 feet. I have just finished examining 10 foot ditch samples over this interval and found no additional specimens to better establish the presence of the early Permian in this well. It would now appear that although not conclusive, the rare specimens reported in the initial report may be no more than fortuitous orientations of other forms. If this is the case, then the underlying Zone 21+ probably continues up to 10,470 feet and there is no unconformity at 10,500 feet as suggested in the report.

W. T. Foran #1
(Palynology)

PALYNOLOGY REPORT

A total of 33 ditch and two (2) sidewall core samples were processed and analyzed for palynological age determinations. The ditch samples consisted of 90 foot composites taken from the interval 500 feet to the total depth of 8864 feet.

500-990'

Betulaceae (F), Alnus (F), Juglans (R), Carya (R), Onagraceae (R), Tilia (R), Nemipites (R).

Metzgiella articulata (single), Odontochitina operculata (single, reworked).

AGE: Probable Eocene
ENVIRONMENT: Marine

990-1490'

Betulaceae (F), Paralnipollenites confusus (R-F).

Rare, scattered, reworked Cretaceous dinocysts: Broomea lawseri, Australiella cooksoni, A. granulifera, and Oligosphaeridium complex.

AGE: Paleocene
ENVIRONMENT: Nonmarine

1490-1850'

Aquilapollenites magnus (R), A. quadricretus (R), Normapolis laqueanus (R), Cranwellia striata (R).

Deflandrea biaperculata (R-F).

AGE: Maastrichtian
ENVIRONMENT: Marginal Marine

1850-2120'

Taxodiaceae (A), Aquilapollenites trialatus (single specimen at top of interval).

Odontochitina operculata (C), Australiella cooksoni (R), A. granulifera (R-C), A. spectabilis (F-A), Deflandrea amphiata (R-F), D. diktyoma (R-C), Hystrichosphaeridium diffiglo (F-C), Hexagonifera chlamydata (R-C), Palaeoperidinium basilium (R-F).

AGE: Santonian-Campanian
ENVIRONMENT: Marine

2120-3020'

Osmundacidites sp. (R), Gleichenidites senonicus (R-F).

Odontochitina operculata (R-F), Cribroperidinium edwardsi (R-F), Odontochitina cf. tenuicerata (R),

Meiosniella acerna (F, at top of interval), Siliciphaera ferox (R). Australiella/Deflandrea spp. appear less consistent and less frequent than above.

AGE: Probable ?Turonian-?Coniacian
ENVIRONMENT: Marine to Marginal Marine

3020-4010'

Odontochitina operculata (F-C), Cyclonephelium membraniphorum/compactum (C), Cribroperidinium edwardsi (F-C), Pseudoceratium cf. dartmannae (C at 3110-3200'), P. cf. gerolicum (R, sporadic).

AGE: Cenomanian
ENVIRONMENT: Marine

4010-5800'

Osmundacidites sp. (R-F), Gleichenidites senonicus (R-F), Trilobosporites spiverrucatus (R, scattered).

Odontochitina operculata (R-C), Cyclonephelium distinctum (R-F), C. membraniphorum/compactum (R-C), Cribroperidinium edwardsi (R-C), Hystrichodinium pulchrum (R), Pseudoceratium spp. (R), Astrocysta cretacea (F), Luxadinium propexum (R), Spinidinium vesertum (R, sporadic), Oligosphaeridium complex (R-F).

AGE: Albian
ENVIRONMENT: Marine

5800-7330'

Osmundacidites sp. (R), Gleichenidites senonicus (R-F), Callialasporites trilobatus (R, sporadic).

Odontochitina operculata (R-F), Cribroperidinium edwardsi (R-F), Astrocysta cretacea (R-F), Oligosphaeridium complex (R-F).

AGE: Aptian-Early Albian
ENVIRONMENT: Marine to Marginal Marine

Based principally on the absence of Luxadinium propexum and Spinidinium vesertum, this interval is assigned an Aptian to Early Albian age.

The interval below approximately 6600 feet reflects relatively poor marine conditions.

7330-7551'

Odontochitina operculata (R-C), O. sp. 1 (R), Broomea lawseri (R), Oligosphaeridium complex (A), Gardodinium aissenacki (F), Astrocysta cretacea (F), Canninginia colliveri (R), Cyclonephelium distinctum (R), Nudaranella simplex (F), Paradinium cerastophora (R).

AGE: Neocomian
ENVIRONMENT: Marine

7551-7610'

The sidewall core at 7551 feet contained Vitreisporites pallidus (R), and Microhystridium spp. (F).

AGE: Indeterminate
ENVIRONMENT: Very Marginal Marine

7610-8240'

Taeniasporites sp. (R-F), Striatites richteri (F-C), Lugoisporites sp. (R, sporadic); rare occurrences near base of interval: Kraeselisporites spinosus, Klausipollenites staplini, ?Lundbladispora sp.

Microhystridium spp. (A).

AGE: Permian-Triassic
ENVIRONMENT: Very Marginal Marine to Nonmarine

8240-8510'

No indigenous palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

8510-8780'

A single specimen of Triparsites verrucus was recovered at the top of this interval. If this specimen is not reworked, it indicates the presence of Mississippian strata.

AGE: Probable Mississippian
ENVIRONMENT: No evidence of Marine

8780-8864' T.D.

No indigenous palynomorphs. Mainly black organic fragments. Poor recoveries.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

W. T. Foran #1

7539' Core

Veryhachium sp. (single).

AGE: Indeterminate
ENVIRONMENT: Very Marginal Marine?

7541' Core

Essentially barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

7551' Core

Veryhachium sp. (single).

AGE: Indeterminate
ENVIRONMENT: Very Marginal Marine?

8257' Core

Barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

8267' Core

Barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

7660' SWC

Undifferentiated bisaccates (R), Striatites richteri (R), Taeniaesporites spp. (R), Classopollis classoides (R), reworked dematospores (R).

Micrhystridium spp. (F).

AGE: Triassic (P-T15, T16)
ENVIRONMENT: Nonmarine to very Marginal Marine

8168' SWC

Striatites richteri (F), Taeniaesporites sp. (R).

Micrhystridium spp. (F).

AGE: Permo-Triassic (P-T16, T-17)
ENVIRONMENT: Nonmarine to very Marginal Marine

SUMMARY OF PALYNOLOGY REVISIONS

500-590'	Tertiary, probable Eocene (P-M11).
590-1490'	Tertiary, Paleocene (P-T10).
1490-1670'?	Late Cretaceous, Maastrichtian (P-T11).
1670-1850'	Late Cretaceous, Campanian (P-T12).
1850-2570'?	Late Cretaceous, Santonian-Campanian (P-M14).
2570-3020'	Late Cretaceous, ?Turonian-?Coniacian (P-M15).
3020-4010'	Late Cretaceous, Cenomanian (P-M16).
4010-5800'	Early Cretaceous, Middle-Late Albian (P-M17).
5800-7330'	Early Cretaceous, Aptian-Early Albian (P-M18).
7330-7510'	Early Cretaceous, possible Neocomian (P-M18a).
7510-7551'	Early Cretaceous, Neocomian (P-M19).
7551-7610'	Age indeterminate.
7610-8240'	Permian-Triassic (P-T17 to P-T16).
8240-8510'	Age indeterminate
8510-8780'	In Mississippian (probable P-T21).
8780-8864'	T.D. Age indeterminate.

W. T. Foran #1 (Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1" to 100' faunal distribution log and three faunal checklists on the W. T. Foran #1 well. The conclusions presented in this report are based on the processing, picking and examination of 249 ditch samples, generally composited on 30 to 40 foot intervals and two (2) sidewall core samples. Twenty-seven (27) thin sections were prepared on 10 foot ditch intervals below 8080 feet. A generalized age summary of the well is provided below, along with a sample-by-sample faunal listing of the sidewall cores in an appendix at the end of the report.

500-1010'

This interval contains several long ranging Tertiary forms. Some of these forms are recorded from Miocene or younger strata in northern Alaska, and may represent caved occurrences from the upper 500 feet of this well.

AGE: Tertiary (Undifferentiated) Probable Sagavanirktok Fm.
ENVIRONMENT: Probable Inner to Middle Neritic

1010-1580'

Although generally barren of Foraminifera, this interval does contain rare Cenosphaera spp. and Spongodiscus sp. This interval is probably Latest Cretaceous to Tertiary in age. These strata probably represent marginal marine and nonmarine deposition.

AGE: Probable Latest Cretaceous to Tertiary
ENVIRONMENT: Probable Nonmarine to Marginal Marine

1580-2450'

Haplophragmoides rota, H. bonanzaensis, Saccammina lachrami, Epeponidella strombodes, Praebulimina venusta, Textularia gravenori, Verneuilinoides fischeri, Trochammina ribstonensis, T. albertensis, T. whittingtoni, Cenosphaera spp., Spongurus spp., Sethocyrtis sp., Archicorys sp., Theocorys sp., Dictyomitra spp., D. multicostata, Spongodiscus spp., S. cf. reniliaeformis, Rhopalodictyum sp., Spongostaurus sp., Stylospongia sp., and Xiphosphaera sp.

The above assemblage is characteristic of the Senonian Schrader Bluff Formation. Faunas obtained throughout this interval are indicative of oscillating middle neritic to upper bathyal (non-turbid) deposition.

AGE: Late Cretaceous (Senonian) Schrader Bluff Fm.
ENVIRONMENT: Middle Neritic to Upper Bathyal (non-turbid)

2450-2840'

This interval is characterized by a significant reduction of fauna brought about by either a regression to poorer marine conditions or an increased sediment accumulation rate resulting in dilution of the above fauna. Due to the poor nature of the faunas in this interval, it is hard to establish its exact age. The Prince Creek Fm.-Seabee Fm. boundary probably lies within this interval. A single specimen of Hedbergella loetterlei, if not reworked, suggests that the Seabee Fm. top could be as high as 2570 feet.

AGE: Turonian to Coniacian Seabee Fm. or Prince Crk. Fm.
ENVIRONMENT: Probable sediment diluted shallow Marine

2840-2850'

Hedbergella loetterlei, Saccammina lachrami, Haplophragmoides rota, Trochammina ribstonensis, Ionodiscus sp. A, Cenosphaera spp., Archicorys sp., Spongurus spp., and Spongodiscus spp. characterize this interval.

A top on the "Paper Shale" ("cutinized leaves") was found at 3410 feet. This point is probably at the top of or down in the Shale Wall Member of the Seabee Formation. This lower interval is generally dominated by starved basin deposition as indicated by the high organic content and the lack of preserved calcareous foraminifera associated with the few short pulses of open marine radiolarian bursts.

AGE: Late Cretaceous (Cenomanian to Turonian)
Seabee Fm.

ENVIRONMENT: Open Marine (starved basin)

3650-3770'

This fauna contains rare, possibly reworked, occurrences of Gaudryina canadensis, Trochammina umiatensis, Verneuilinoides borealis, and Haplophragmoides topagorukensis, along with continued occurrences of Haplophragmoides rota and Trochammina ribstonensis. This association appears to be a transitional fauna which could be either Albian or Cenomanian in age. These strata probably represent turbid inner to middle neritic deposition.

AGE: Early to Late Cretaceous (Albian to Cenomanian)
Probable Nanushuk Group

ENVIRONMENT: Probable Inner to Middle Neritic (turbid)

3770-5950'

Haplophragmoides topagorukensis, H. cf. linki, H. gigas, H. cf. excavata, Ammobaculites fragmentarius, A. wenonshae, Marginulinopsis jonesi, Globulina prisca, Lenticulina macrodisca, L. topagorukensis, L. eracta, Trochammina umiatensis, T. mcmurrayensis, Miliammina manitobensis, Psammiopelta bowsheri, Saccammina lathrami, Praebulimina nanina, Vaginulina quilla, Globorotalites alaskensis, Valvulineria loetterlei, Saracenaria dutroi, Gentalina? dettermani, Pseudobolivina ravi, Bathysiphon vitta, Verneuilinoides borealis, astrorhizids and Citrupa gorbu occur in this interval. The above association is typical of the Verneuilinoides borealis Faunal Zone and is Albian age. The environments represented by these moderately diverse assemblages were probably of relatively clear water middle to outer neritic depths.

AGE: Early Cretaceous (Albian)
Nanushuk Grp.-Upper Torok Fm.

ENVIRONMENT: Middle to Outer Neritic

5950-7380'

A pyritized radiolarian assemblage characterizes these strata together with continued occurrences of the above fauna. Lithostampe cf. sp. M occurs in the bottom of this interval, but preservation makes the identification uncertain. According to Ramsey (1970) this zone of pyritized radiolaria separates the Verneuilinoides borealis zone from the Gaudryina caillouxi zone, and is probably Aptian to early Albian in age. Due to the apparent large amount of cavings in this interval, an environmental interpretation is difficult. All that can be said about the environment of deposition is that it was marine and open to oceanic currents.

AGE: Early Cretaceous (Aptian to Early Albian)
Torok Fm. or Fortress Mountain Fm.

ENVIRONMENT: Open Marine

7380-7530'

Occurrences of Haplophragmoides goodenoughensis, H. cf. corpis, Ammobaculites arctus, Gaudryina sillari, G. leffingwelli, G. tappenae, Trochammina conicominuta, T. squamata, Pseudobolivina sp., Glomospirella arctica, Lithostampe cf. sp. N, arenaceous spp. (large, coarse) and abundant rounded frosted quartz floaters (Pebble Shale) suggest a Neocomian age for these strata. The sidewall core sample from 7510 feet suggests an earliest Neocomian (Barremian) age for the strata at that point. A turbid middle to outer neritic depositional environment is suggested by this association.

AGE: Probable Neocomian
Probable Okpikruak Fm.

ENVIRONMENT: Probable Middle to Outer Neritic (turbid)

7530-7590'

The age of this interval is indeterminate. A lithologic change to a brown fine to medium-grained sandstone distinguishes this unit for the overlying sandy shale interval. Foraminifera are rare and probably represent caved specimens from the previous unit.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

7590-7650'

This very thin interval is distinguished on the basis of a couple of rare questionable occurrences of Monotis fragments. The lithology is somewhat obscured by well cement making its exact nature uncertain. Whether this interval belongs with the overlying indeterminate unit and contains some reworked Monotis fragments, or is a Triassic equivalent of the Shublik Fm., or else is Triassic and equivalent to the uppermost Sadlerochit Fm. occurring below it, is not certain. Since other occurrences of Monotis fragments in this area of NPR-4 have been within the Shublik Fm., we will suggest the possibility for a thin interval of Shublik Fm. in this well.

AGE: Possible Triassic
Possible Shublik Fm.

ENVIRONMENT: Indeterminate

7650-8200'

Faunal occurrences below 7650 feet are nearly nonexistent suggesting that these strata are predominantly nonmarine. Frequent glauconite and very rare agglutinated foraminifera in the bottom sample (8170-8200') indicate that the lowermost portion of this interval may be marginal marine. There was no lithologic evidence observed to substantiate the occurrence of any Echooka Member in this well.

AGE: Probable Permo-Triassic

ENVIRONMENT: Nonmarine to Marginal Marine

8200-8590'

Generally throughout the North Slope of Alaska the Lisburne Group can be divided into three lithologic units:

1. Upper Limestone Unit
2. Dolomite Unit
3. Lower Limy Unit

The Upper Limestone Unit is 390 feet thick in this well. Bursts of Eoschubertella yukonensis, Pseudostaffella sp., and Kamaenid algae together with occurrences of Neoarchaediscus spp., Asterparchaediscus spp., and frequent Stylocodium sp. indicate that the strata between about 8200 feet and 8300 feet are definitely Zone 21 in age. A Zone 20 call is made at 8300 feet based on a significant reduction in the occurrence of Kamaenid algae. The Upper Limestone Unit represents a shoaling shelf and subtidal to tidal carbonate platform suite.

The Upper Limestone Unit was the only unit of the Lisburne Group encountered in this well. There are two possible explanations for this:

1. an unconformity exists at 8590' between the Lisburne Group and underlying Endicott Group.
2. the clastic facies of the Endicott Group his climbed with respect to age in the section.

AGE: Early to Middle Pennsylvanian
Lisburne Group

ENVIRONMENT: Tidal to Outer Shelf (Carbonate Platform Suite)

8590-8770'

This interval is characterized by a chaotic to unfossiliferous brown and red-brown shale and siltstone with frequent caving of limestone from the overlying Lisburne Group. The age of this unit is here considered to be indeterminate since it could represent strata as old as early Mississippian or as young as early Pennsylvanian.

AGE: Indeterminate
(Probable Endicott Group)

ENVIRONMENT: Probable Nonmarine to Inner Shelf

8770-8864' T.D.

This last unit is picked on the basis of a lithologic change to argillite. There were no Foraminifera recovered from this interval.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

W. T. Foran #1

7551' Core

Arenaceous? spp. (R), fecal pellets? (F).

AGE: Indeterminate
ENVIRONMENT: Probable Inner Neritic
WASHED LITH: Dark brown to black silty shale

7609' SWC

No Foraminifera found. Megaspores (F).

AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Brownish-gray sandy mudstone

7645' SWC

Ammobaculites vetusta (R), Ammodiscus ? (F), Bathysiphon sp. (R), Dentalina? sp. (R), Trochammina sp. (very small) (F), Lithocampe sp. (R) (pyritized), Cenosphaera spp. (C) (pyritized), pyrite (A).

AGE: Probable Permo-Triassic
ENVIRONMENT: Probable Inner-Middle Neritic
WASHED LITH: Gray fine-grained pyritic sandstone

8206' SWC

No Foraminifera found.

AGE: Indeterminate
ENVIRONMENT: Supratidal
WASHED LITH: Buff brown fine-grained sandy dolomite

APPENDIX

(Faunal lists and washed lithology descriptions for 3 sidewall core samples)

7510' SWC

Arenaceous spp. (lrg., crs.) (A), Gaudryina Willeri (F), G. Laffinguelli (F), G. taillauri (C), G. tappanae (C), Gaudryinella irregularis (R), Glomospirella arctica (R), Thurammiaoides sp. (F), Trochammina squamata (F), T. conicominuta (R), T. cf. topagorukensis (R), Cenosphaera sp. (R), glauconitic; C. spp. (F), pyritized; round frosted quartz Floaters (A), pyrite (F).

AGE: Probable Neocomian (Berriasian)
WASHED LITH: Dark brown sandy mudstone

7551' SWC

Cenosphaera? sp. (R), glauconitic; Lithocampe sp. (R), pyritized; Inoceramus prisms? (R), glauconite (F), pyrite (C).

AGE: Indeterminate
WASHED LITH: Dark brown silty organic mudstone

S. Harrison Bay #1
(Palynology)

PALYNOLOGY REPORT

A total of 123 ditch and 23 sidewall core samples were processed and analyzed for palynological age determinations. The samples were taken from the interval 500 feet to the total depth of 11,290 feet.

500-770'

Aquilapollenites magnus (R-F), A. rectus (R), A. vegabrides (R), A. fusiformis (R), Wodehousela spinata (R).

Cyclonephelium distinctum (single, reworked?), Cleistosphaeridium spp. (R).

AGE: Late Cretaceous (Maastrichtian)
ENVIRONMENT: Essentially Nonmarine

770-950'

Aquilapollenites magnus (R), A. rectus (R), A. trialatus (R), Syncolpites sp. (single), Wodehousela jacutense (single).

AGE: Late Cretaceous (Campanian)
ENVIRONMENT: Nonmarine

950-2120'

Palaeoperidinium basilium (R-C), Hystrichosphaeridium difficile (R-C), Leptodinium biconiculum (R-C), Diconodinium arcticum (R), Exochosphaeridium bifidum (R), Deflandrea decorosa (R), D. dictissima (R-C), D. acuminata (R), Australiella spectabilis (R-C), A. sverdrupiana (F), A. granulifera (F), Odontochitina operculata (F-C), Hexagonifera chlamydata (R-F), Nallodinium luna (R).

AGE: Late Cretaceous (Santonian-Campanian)
ENVIRONMENT: Marine

2120-2210'

A significant decrease in the dinoflagellate assemblage occurs in this narrow interval, although many of the same forms present above continued herein. The abrupt decrease of Deflandroid forms by 2120 feet in the ditch samples suggests that the base of the Santonian is at least that high.

AGE: Late Cretaceous (possibly in ?Turonian-?Coniacian)
ENVIRONMENT: Marine

2210-3376'

Gleichenidites senonicus (R), Vitreisporites pallidus (R).

Cyclonephelium distinctum (R), Odontochitina operculata (F-C), Chlamydophorella nyei (R-C), Cribroperidinium edwardsi (R-F), Apteodinium grande (R), Pseudocerateum cf. expolitum (R).

AGE: Late Cretaceous (Cenomanian)
ENVIRONMENT: Marine

3376-6090'

Gleichenidites senonicus (R): rare, scattered occurrences of Vitreisporites pallidus, Classopollis classoides, and Trilobosporites apiverrucatus.

Cleistosphaeridium spp. (R-F), Odontochitina operculata (F-C), Oligosphaeridium complex (R), Chlamydophorella nyei (R-F), Cribroperidinium edwardsi (R-F), Broomea jaegeri (R), Astrocysta cretacea (R-F), Luxadinium propatulum (R), Spinidinium vestitum (R, scattered), Gardodinium eisenacki (few, rare occurrences near bottom of interval).

AGE: Early Cretaceous (Albian)
ENVIRONMENT: Marine

The base of the Albian is placed at the lowest occurrence of Spinidinium vestitum and Luxadinium propatulum. These forms occur just above a specimen of Nuderongia tetracantha, a species which ranges no younger than Aptian.

6090-7188'

Gleichenidites senonicus (R), Classopollis classoides (R).

Odontochitina operculata (R-F), Oligosphaeridium complex (R), Cribroperidinium edwardsi (R), Broomea jaegeri (R), Astrocysta cretacea (R-F), Cyclonephelium compactum/membraniphorum (R), Nuderongia tetracantha (single), Gardodinium eisenacki (R, sporadic); reworked, rare occurrences of Sirmiodinium grossi, Gonyaulacysta cladophora, Nannoceratopsis gracilis.

AGE: Early Cretaceous (possible Aptian)
ENVIRONMENT: Marine

There is only weak evidence for the possible Aptian age assignment. Although the Aptian/Albian boundary is tentatively placed at 6090 feet it is possible that this interval may be as young as Early Albian in age.

7188-8230'

Classopollis classoides (R), striated bisaccates (R)(reworked).

Pareodinia ceratophora (R), P. sp. (verrucose form)(R-F), Sirmiodinium grossi (R), Scriniodinium crystallinum (R), Gonyaulacysta cladophora (R-C), Nannoceratopsis pellucida (R-A).

AGE: Late Jurassic (Oxfordian)
ENVIRONMENT: Marine

8230-9300'

Classopollis classoides (F-C), Vitreisporites pallidus (R-F), striated bisaccates (R, reworked).

Micrhystridium spp. (F-C), Nannoceratopsis gracilis (C-A); undescribed dinocysts JRD-1 (F-C), JRD-2 (R), JRD-3 (R).

AGE: Early-Middle Jurassic (Late Pliensbachian-Callovian)
ENVIRONMENT: Marine

9300-9570'

This interval contains a similar assemblage to the above but in significantly reduced frequencies.

AGE: Indeterminate (probable Triassic-Early Jurassic)
ENVIRONMENT: Indeterminate

It appears that most or all of the palynomorphs are derived from up-hole.

9570-10,210'

Striated bisaccates (R), Taeniaesporites sp. (R), Striatites richteri (R-F), Klausipollenites schaulai (R-F), ?Lundbladispora sp. (R-F), unidentified verrucate spore (R-C).

AGE: Permian-Triassic
ENVIRONMENT: Nonmarine

10,210-11,290' T.D.

This interval recovered only Permo-Triassic and Jurassic palynomorphs derived from up-hole. No positive palynological evidence for any other age was found.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

The lithologic examination indicates that the Carboniferous units begin at 10,210 feet.

SUMMARY OF PALYNOLOGY REVISIONS

500-770'	:	Late Cretaceous, Maestrichtian (P-T11).
770-950'	:	Late Cretaceous, Campanian (P-T12).
950-1850'?	:	Late Cretaceous, Santonian-Campanian (P-M14).
1850-2210'	:	Late Cretaceous, ?Turonian-?Coniacian (P-M15).
2210-3376'	:	Late Cretaceous, Cenomanian (P-M16).
3376-6090'	:	Early Cretaceous, Middle-Late Albian (P-M17).
6090-7188'	:	Early Cretaceous, Aptian-Early Albian (P-M18).
7188-8230'	:	Late Jurassic, Oxfordian (P-M22).
8230-9300'	:	Early-Middle Jurassic, Late Pliensbachian-Early Bajocian? (P-M23).
9300-9570'	:	Triassic-Early Jurassic (probable P-T15 to P-M24).
9570-10,210'	:	Permian-Triassic (P-T17 to P-T16). No definite evidence of P-T18.
10,210-11,290'	:	T.D. Age indeterminate.

S. Harrison Bay #1 (Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1" to 100' faunal distribution log and four faunal checklists on the South Harrison Bay #1 well. The conclusions presented in this report are based on the processing, picking and examination of 351 ditch samples, generally composited on 30 to 40 foot intervals, 2 conventional cores, and 11 sidewall core samples. Thin sections were prepared on 30 foot ditch intervals below 10,150 feet. A generalized age summary of the well is provided below.

500-950'

Generally barren of foraminifera. Coaly cherty sandstone with frequent to abundant volcanic glass shards. This unit is probably equivalent lithologically to the Kogosukruk Tongue of the Prince Creek Fm.

AGE: Probable Late Cretaceous (Senonian) Probable Prince Creek Fm.

ENVIRONMENT: Nonmarine to Marginal Marine

950-2230'

Eponidella strombodes, Dorothia spokyensis, Nonionella taylorensis, Praebulimina venusse, Textularia gravenori, Verneuilinoides fischeri, Trochammina ribstonensis, T. whittingtoni, Cenosphaera spp., Spongurus spp., Sathoyrris spp., Archicorys spp., Theocorys spp., Dictyomitra spp., D. multicostata, Spongodiscus spp., S. cf. reniliaeformis, Rhopalodictyum sp., and Spongostagrus sp.

The above assemblage is characteristic of the Senonian Schrader Bluff formation. Faunas obtained throughout this interval are indicative of oscillating middle neritic to upper bathyal (non-turbid) deposition.

AGE: Late Cretaceous (Senonian) Schrader Bluff Fm.

ENVIRONMENT: Middle Neritic to Upper Bathyal (non-turbid)

2230-3210'

Gaudryina irenensis, Trochammina rutherfordi, T. ribstonensis, Zonodiscus sp. A, Cenosphaera spp., Spongurus spp., and Spongodiscus spp. characterize this interval.

A top on the "Paper Shale" ("cuticlized leaves") was found at 2880 feet. This point is probably at the top of or down in the Shale Wall Member of the Seabee Formation. This interval is generally dominated by starved basin deposition as indicated by the high organic content and the lack of preserved calcareous foraminifera associated with the few short pulses of open marine radiolarian bursts.

AGE: Late Cretaceous (Cenomanian to Turonian) Seabee Fm.

ENVIRONMENT: Open Marine (starved basin)

3210-3330'

This fauna contains: Gaudryina canadensis, Trochammina rainwateri, T. mcmurrayensis, T. gatesensis, Verneuilinoides cf. borealis, and Haplophragmoides bonanzensis. This association appears to be a transitional fauna which could be either Albian or Cenomanian in age. These strata probably represent turbid middle to outer neritic deposition.

AGE: Early to Late Cretaceous (Albian to Cenomanian) Probable Nanushuk Group

ENVIRONMENT: Probable Middle to Outer Neritic (turbid)

3330-5260'

Haplophragmoides topagorukensis, H. cf. linki, H. gigas, H. cf. excavata, Ammobaculites fragmentarius, A. wenonahee, Lenticulina macrodisca, L. erecta, Trochammina umiatensis, T. mcmurrayensis, Miliammina manitobensis, Praeminoposita subcircularis, Saccammina lathrami, Cyclammina cf. pacifica, Globorotalites alaskensis, Praebulimina nanina, Valvulineria lostterlei, Bathysiphon vitta, Verneuilinoides borealis and Dittrupa cornu occur in this interval. The above association

3330-5260' (con't.)

is typical of the Verneuilinoides borealis faunal zone and is Albian age. The environments represented by these moderately diverse assemblages were probably of somewhat turbid middle to outer neritic depths with short periods of lesser turbidity.

AGE: Early Cretaceous (Albian) Nanushuk Group

ENVIRONMENT: Middle to Outer Neritic (fluctuating turbidity)

5260-7270'

A pyritized radiolarian assemblage characterizes these strata together with rare non-diagnostic agglutinated foraminifera. Lithocampe cf. sp. N occurs in the bottom of this interval, but preservation makes the identification uncertain. According to Ramsey (1970) this zone of pyritized radiolaria separates the Verneuilinoides borealis zone from the Gaudryina taillauri zone, and is probably Aptian to early Albian in age. Due to the preservation of this fauna, all that can be said about the environment of deposition is that it was marine and open to oceanic currents. It was recently brought to our attention that these strata may represent deep marine (below compensation depth) basal slope deposits. This is certainly a possibility since calcareous foraminifera are very scarce in this interval and could represent caved specimens when they do occur.

AGE: Early Cretaceous (Aptian to Early Albian) Torok Fm. or Fortress Mountain Fm.

ENVIRONMENT: Open Marine (possibly Lower Bathyal to Abyssal

7270-7360'

Occurrences of Gaudryina taillauri, Haplophragmoides canui, Recurvoides turbinatus, Ammobaculites alaskensis, Lenticulina sudax, L. quenstedti, Textularia areogelecta, Trochammina inaccessis, and T. topagorukensis indicate that these strata are probably pre-Tithonian age. The lack of some of the Oxfordian forms found in the underlying interval suggest that this assemblage could be as young as Kimmeridgian in age. These strata were probably deposited in outer neritic to bathyal water depths.

AGE: Late Jurassic (Oxfordian to Kimmeridgian) Kingak Fm.

ENVIRONMENT: Outer Neritic to Bathyal

7360-8230'

Marginulina radiata, M. prima, Trochammina canningensis, T. inaccessis, T. sp. (sml., high spired), Involutina aspera, Lenticulina sudax, L. prima, Ammobaculites alaskensis, A. barrowensis, Marginulinopsis phragmites, Saracenaria topagorukensis, Haplophragmoides canui, H. barrowensis, Vaginulina sherborni, and Astacolus podiagus occur throughout these strata. Based on occurrences in nearby wells,

the above fauna would indicate an early Late Jurassic age. Also, the occurrence of Saracenaria topagorukensis would suggest the same age. The abundant and diverse faunas of this interval probably represent an outer neritic to upper bathyal environment of deposition associated with fluctuating amounts of turbidity.

AGE: Late Jurassic (Oxfordian)
Kingak Fm.

ENVIRONMENT: Outer Neritic to Upper Bathyal

8230-8970'

Ammobaculites vetusta, A. alaskensis, Bathysiphon anomalocoelia, Trochamminoides spp., T. cf. proteus, Gaudryina dyscrita, Astacolus dubius, Trochammina contorsta and common to abundant pyritized radiolaria of the genera Cyrtocapsa, Stichomitra, Cenosphaera, Lithocampe, Spongodiscus, and Dictyomitra occur in these strata. Also diagnostic of this unit is a burst of Tasmanites spp. which appears to be characteristic in this area. These strata are Early to Middle Jurassic in age. They probably represent deposition in middle neritic to upper bathyal depths characterized by fluctuating turbidity. A sandstone occurs at the base of this unit which may be an equivalent to the Sag River Sandstone.

AGE: Early to Middle Jurassic
Kingak Fm.

ENVIRONMENT: Middle Neritic to Upper Bathyal

8970-9360'

Ammobaculites sthenarus, Astacolus connudatus, Tolypammina glareosa, Nodosaria larina, N. shublikensis, Lingulina borealis, Pseudoglandulina simpsonensis, P. densa, and Monotis fragments among others, occur throughout these beds. The Triassic age of these strata is firmly established on the basis of the above fauna. The Triassic in this well, as in the East Teshekpuk #1 well, appears to be fairly continuously marine. These faunas represent fluctuating inner to outer neritic open marine conditions.

AGE: Triassic
Shublik Fm.

ENVIRONMENT: Inner to Outer Neritic

9360-10,210'

Trochammina sp. (sml., thin), Ammodiscus sp. P, Ammobaculites cf. vetusta, A. cf. barrowensis, A. sp. (sml., thin), and Trochamminoides spp., together with rare to common radiolaria, mark this interval. This assemblage would appear to represent turbid inner to middle shelf deposition. Two samples at the bottom of this unit (10,150-10,210') contain a heavily glauconitic sandstone suggestive of the Echooka Member of the Sadlerochit Formation.

AGE: Permo-Triassic
Sadlerochit Fm.

ENVIRONMENT: Inner to Middle Neritic (turbid)

10,210-11,290' T.D.

Generally throughout the area westward of the Prudhoe Bay State #1 well, the Lisburne Group can be divided into three lithologic units:

1. Upper Limestone Unit
2. Dolomite Unit
3. Lower Limy Unit

The Upper Limestone Unit is 1,080+ feet thick in this well, and it would appear to be unconformable at its upper boundary.

Strata between 10,210 feet and about 10,720 feet contain Paleotextularia sp. (?), rare Bisericella spp., rare Zoshubertella spp., and frequent Stylocodium sp. These rocks conspicuously lack occurrences of Asteroarchaediscus spp., Neoarchaediscus spp., and Archaediscus spp. These rocks are certainly no older than Zone 21, but could be as young as Zone 22 (see Mamet, 1971, pages 203 and 204)*. These strata probably correlate in part with strata between 9655 feet and 9930 feet in the East Teshekpuk #1 well.

10,210-11,290' T.D. (con't.)

Bursts of Zoshubertella yukonensis, Pseudostaffella sp., and Pseudoendothyra britishensis together with occurrences of Neoarchaediscus spp., Asteroarchaediscus spp., Archaediscus spp., and frequent Stylocodium sp. indicate that the strata between about 10,720 feet and 11,290 feet (total depth) are Zone 21 in age. The following are possible correlative horizons with the East Teshekpuk Lake #1 well:

S. Harrison Bay #1	E. Teshekpuk Lake #1
10,720'	9,930'
10,870'	10,020'
11,170'	10,140'

These strata for the most part represent a carbonate platform suite. Strata below 10,870 feet represent open shelf shales and cherty limestones, and platform edge oolitic and algal "bank" packstones and grainstones. Strata above 10,870 feet probably represent packstones, wackestones, and lime mudstones of the restricted shelf and lagoonal environments.

AGE: Middle Pennsylvanian or younger
Lisburne Group (Wahoo Lmst.)

ENVIRONMENT: Neritic (shelf)

*Mamet, B. L. & Ross, C. A., 1971, in Sanber & Waterhouse, "Carboniferous and Permian Stratigraphy and Paleontology, Northern Yukon Territory, Canada"; Bull. of Can. Petr. Geol., vol. 19, no. 1, pp. 196-203.

Ikpikpuk #1 (Palynology)

PALYNOLOGY REPORT

A total of 313 samples were processed and analyzed from the subject well. The total consists of 122 core samples, 33 sidewall cores, and 158 ditch samples composited for the most part into 90' intervals. The total section examined ranges from 100 feet to 14,210 feet total depth.

Included with this report are Figures 1 and 2 which illustrate the distribution of palynomorphs for ditch and sidewall cores, and conventional core samples, respectively. A summary of the findings is given below.

100-550'

Undifferentiated bisaccates (F-A), Camarozonosporites insignis (R), Cicatricosisporites annulatus (R), C. hallei (R), Cyathidites minor (R-A), Foraminisporis wonthaggiensis (R), Gleicheniidites senonicus (R-C), Lycopodiumsporites spp. (R), Neoraistrickia truncata (R), Ornamentifera echinata (R), Osmundacidites spp. (R-A), Stereisporites spp. (R), Taxodiaceae (R), Trilobosporites perverulentus (R), Triporoletes radiatus (R).

Callaiosphaeridium asymmetricum (R), Canningia colliveri (R), Chatangiella magna (R), Chlamydophorella nyei (R), Coronifera oceanica (R), Cyclonephelium vannophorum (R), Exochosphaeridium bifidum (R), Hystrichodinium pulchum (R), H. voigti (R), Hystrichosphaeridium cooksoniae (R), Isabelidinium cooksoniae (R), Kleithriasphaeridium echinodes (R), Odontochitina costata (R), O. operculata (R), Oligosphaeridium anthophorum (R), O. complex (R), O. pulcherrimum (R), Palaeohystrichophora infusorioides (R), Palaeoperidinium cretaceum (R), Spiniferite cingulatus (R), S. ramosus (R-F), Xenascus ceratioides (R), Xiphophoridium alatum (R).

AGE: Late Cretaceous, Cenomanian (P-M16)
ENVIRONMENT: Marine

The interval above contains several taxa restricted to the Late Cretaceous, e.g., Chatangiella magna, Isabelidinium cooksoniae, Odontochitina costata, and Palaeohystrichophora infusorioides. The base is defined by the first appearance of Luxadinium propatulum which is considered to be Late Albian in age.

550-3440'

Araucariacites australis (R), undifferentiated bisaccates (R-A), Cerebropollenites mesozoicus (R), Cicatricosisporites hallei (R), Concavissimisporites spp. (R), Cyathidites minor (R), Distaltriangulisporites spp. (R), Gleicheniidites senonicus (R), Osmundacidites spp. (R),

Punctatosporites scabratus (R), Trilobosporites apiverrucatus (R), T. crassus (R), Vitreisporites pallidus (R).

Aptea polymorpha (R), Apteodinium reticulatum (R), Canningia colliveri (R), Chlamydophorella nyei (R), Cleistosphaeridium polypes (R), Cribroperidinium edwardsi (R), Cyclonephelium distinctum (R-F), Endoscrinium campanula (R), Exochosphaeridium cf. E. scitulum (R), Gardodinium trabeculosum (R), Genus "W" (R), Gonyaulacysta cretaceum (R), G. tenuiceras (R), Kleithriasphaeridium simplicispinum (R), Luxadinium propatulum (R), Odontochitina operculata (R), Oligosphaeridium complex (R), O. complex (thick wall)(R), Palaeoperidinium cretaceum (R-F), Pareodinia ceratophora (R), Pseudoceratium regium (R), P. cf. P. turneri (R), Spinidinium vestitum (R), Spiniferites ramosus (R), Trichodinium spinosum (R).

AGE: Early Cretaceous, Middle to Late Albian (P-M17)
ENVIRONMENT: Marine

This unit is defined by the first occurrence of Luxadinium propatulum and the last occurrence of Genus "W", both of which are restricted to sediments of Middle to Late Albian age. It also contains ?Epelidosphaerida spinosa and Spinidinium vestitum which are commonly known from Middle Albian and younger sediments. Taxa from this interval that are known from Albian and older sediments are the following: Gardodinium trabeculosum, Gonyaulacysta cretacea, Pareodinia ceratophora, Trilobosporites apiverrucatus, T. crassus, and Vitreisporites pallidus.

3440-7360'

Araucariacites australis (R), undifferentiated bisaccates (R-A), Callialasporites dampieri (R), Camarozonosporites insignis (R), Cicatricosisporites australiensis (R), C. hallei (R), Cirratriradites teter (R), Classopollis classoides (R), Cyathidites minor (R), Densoisporites microrugulatus (R), Exesipollenites tumulus (R), Gleicheniidites senonicus (R), Lycopodiumsporites spp. (R), Osmundacidites spp. (R), Taxodiaceae (R).

Aptea polymorpha (R), Canningia colliveri (R), C. hirtella (R), Cribroperidinium edwardsi (R), Cyclonephelium compactum (R), C. distinctum (R), Endoceratium ludbrooki (R), Gardodinium trabeculosum (R), Muderongia tetracantha (R), Odontochitina operculata (R), Oligosphaeridium complex (R), O. complex (thick wall)(R), Palaeoperidinium cretaceum (R), Pareodinia ceratophora (R), Prionodinium alaskense (R, reworked?).

AGE: Early Cretaceous, Aptian to Early Albian (P-M18)
ENVIRONMENT: Marine to Marginal Marine

This unit is defined at the top by the base of Genus "W" as mentioned in the preceeding interval, and at the base by the first appearance of Neocomian fossils. Callialasporites dampieri which tops within this interval may be of significance since it is commonly believed to occur only in sediments of Middle Albian and older ages. Newly occurring dinoflagellates in this unit are rare and insignificant.

7360-7450'

Araucariacites australis (R), undifferentiated bisaccates (R-A), Callialasporites dampieri (R), Cyathidites minor (R), Foraminisporis dailyi (R), Schizosporis parvus (R).

Canningia asper (R), C. hirtella (R), Cleistosphaeridium ancoriferum (R), C. spp. (R-A), Gardodinium trabeculosum (R-A), Gonyaulacysta cretacea (R), G. hyalodermopsis (R), Hystrichosphaeridium recurvatum (R), Lithodinia spp. (R), Muderongia simplex (R), Odontochitina operculata (R-A), Oligosphaeridium complex (R-A), O. complex (thick wall)(R-A), O. totum (R), Pareodinia ceratophora (R), Palaeoperidinium cretaceum (R-A), Spiniferites spp. (R), Tanyosphaeridium boletum (R), T. variecalamum (R-C).

AGE: Early Cretaceous, Neocomian (P-M19)
ENVIRONMENT: Marine

This interval is best recognized in Core #5 (7360-7377') which contains a diverse assemblage of dinoflagellate cysts. Tanyosphaeridium boletum which occurs here is restricted to the Neocomian along with common to abundant occurrences of Oligosphaeridium complex, O. complex (thick wall), Gardodinium trabeculosum, Hystrichosphaeridium recurvatum, and Tanyosphaeridium variecalamum which are typical of the Neocomian.

Prionodinium alaskense which occurs in the sidewall core at 7142 feet may mark the top of the Neocomian section. However, no other data substantiates this until 7360 feet as reported above. This fossil was also found reworked in Core #2 (3784-3812.7'), but not in place in the Neocomian interval. It is, therefore, interpreted to be erratic in distribution for this well.

7480-7840'

Araucariacites australis (R), undifferentiated bisaccates (A), Callialasporites dampieri (R), Cerebropollenites mesozoicus (R), Cicatricosisporites angicanalis (R), C. australiensis (R), Concavissimisporites spp. (R), Coronatisporites valdensis (R), Cyathidites minor (R), Gleicheniidites senonicus (R), Leptolepidites tenuis (R), Pilosisporites trichopapillosus (R), Trilobosporites hannonicus (R), Vitreisporites pallidus (R), Canningia hirtella (R), Cleistosphaeridium spp. (R), Cyclonephelium distinctum (R), Dingodinium cerviculum (R), Endoscrinium campanula (R-F), Gonyaulacysta cretacea (R), G. jurassica (R), G. tenuiceras (R), Oligosphaeridium anthophorum (R), O. complex (R-A), O. complex (thick wall)(R-F), Pareodinia ceratophora (R), P. dasyforma (R-A), Scriniodinium crystallinum (R).

AGE: Early Cretaceous, Neocomian (P-M20)
ENVIRONMENT: Marine

Recognition of this interval is based on the presence of the Early Neocomian index fossil Pareodinia dasyforma, and the abundance of Oligosphaeridium complex which is confined to rocks of Cretaceous age. These taxa are present both in the

7480-7840' (con't.)

ditch samples and in Core #6 (7491-7501'). The spore taxa Cicatricosisporites endignalis, Leptolepidites tenuis, and Trilobosporites hannonicus are also typical for the early Neocomian.

7840-8290'

Undifferentiated bisaccates (A), Cerebropollenites mesozoicus (R), Cingulatisporites reticingulus (R), Classopollis classoides (R), Cyathidites minor (R), Deltoidospora juncta (R), Exesipollenites tumulus (R), Gleichenidites senonicus (R), Januasporites tumulosus (R), Plicatella abaca (R), Trilobosporites hannisartensis (R), T. canadensis (R).

Canningia hirtella (R), Cleistosphaeridium anporiferum (R), C. spp. (R), Cribroperidinium edwardsi (R), Ctenidodinium panneum (R), Cyclonephelium distinctum (R), Endoscrinium campanula (R), Gardodinium trabeculosum (R), Gonyaulacysta cretacea (R), Odontochitina operculata (R-F), Oligosphaeridium complex (F-A), O. complex (thick wall)(A-F), Paradinia borealis (R), P. ceratophora (R), P. dasyforma (R-F), Sirmiodinium grossi (R), Systematophora sp. 8 (R), Tanus rioultii (R), Tubotuberella apatela (R-F).

AGE: Late Jurassic, Kimmeridgian to Tithonian (P-M21)
ENVIRONMENT: Marine

The Late Jurassic is recognized here by Ctenidodinium panneum, Tanus rioultii, and Tubotuberella apatela.

Significant spore taxa occurring here are Januasporites tumulosus, Plicatella abaca, Trilobosporites hannisartensis and T. canadensis.

Occurrences of the following taxa are now considered to be "uphole" contamination: Cribroperidinium edwardsi, Gardodinium trabeculosum, Odontochitina operculata, Oligosphaeridium complex and O. complex (thick wall).

8290-9100'

Araucariacites australis (F), undifferentiated bisaccates (R-A), Kraeuselisporites sp. (R), Taxodiaceae (R), Tigrisporites reticulatus (R).

Cleistosphaeridium spp. (R-F), Ellipsoidictyum cinctum (R), Endoscrinium galeritum (R), E. lucidum (R), Gonyaulacysta cladophora (R-F), Leptodinium cf. L. eumorphum (R), L. subtile (R), Nannoceratopsis gracilis (R), N. pellucida (R-F), Paradinia ceratophora (R), P. dasyforma (R), P. gemingcontensis (R), Scriniocassis dictyota (R), Scrinodinium crystallinum (R), Tanus rioultii (R), Tuberuberella apatela (R), Wanea sp. (R).

AGE: Late Jurassic, Oxfordian (P-M22)
ENVIRONMENT: Marine

Important taxa for the Oxfordian interval are the following: Endoscrinium galeritum, E. lucidum, Gonyaulacysta cladophora, Nannoceratopsis gracilis, N. pellucida, Scriniocassis dictyota, and Wanea sp.

9100-9730'

Undifferentiated bisaccates (R-A).

Ctenidodinium ornatum (R), Endoscrinium galeritum (R), Gonyaulacysta cladophora (R), Nannoceratopsis gracilis (R-F), N. pellucida (R-C), N. senex (R), Paradinia dasyforma (R-F), Scrinodinium crystallinum (R).

AGE: Early to Middle Jurassic (P-M23)
ENVIRONMENT: Marine

Early to Middle Jurassic is here recognized by the reappearance of Nannoceratopsis spp., especially N. gracilis and N. senex.

9730-10,740'

Undifferentiated bisaccates (R-A).

AGE: Indeterminate
ENVIRONMENT: Indeterminate

Taxa from this interval are mostly rare and scattered in distribution. Many are apparently from "uphole" contamination.

10,740-11,830'

Aculeisporites sp. (R), Anaplanisporites stipulatus (R), Apiculatisporis lanjouwii (R), A. spp. (R-F), Aratrisporites sp. (R-F), undifferentiated bisaccates (R-C), Deltoidospora spp. (R), Densosporites spp. (R), Dictyotriletes sp. (R), Dulhuntyspora minuta (R), Endosporites sp. (R), Kraeuselisporites spp. (R-F), Lycospora spp. (R), Punctatisporites sp. (R-C), Riccisporites sp. (R), Striatites richteri (R-A), Taeniaesporites spp. (R-F), Tsugaepollenites jonkari (R), undifferentiated verrucate spores (R-A), Vitreisporites pallidus (R), Vittatina sp. (R).

AGE: Permian to Triassic, undifferentiated
ENVIRONMENT: Nonmarine to Marginal Marine

Occurrences of Kraeuselisporites spp., Aratrisporites sp., Anaplanisporites stipulatus, and Taeniaesporites spp. near the top of this unit and in Core #9 (10,815-10,842') suggest a Triassic age. The presence of Vittatina sp. at the base indicates Permian. No taxa between these two points suggest an age more specific than Permian to Triassic.

11,830-13,020'

Anaplanisporites stipulatus (R), Aratrisporites sp. (R), Apiculatisporis spp. (R), undifferentiated bisaccates (R-F), Densosporites spp. (R), Endosporites sp. (R), Klausipollenites schaulini (R), Kraeuselisporites spp. (R), Lundbladispora sp. (R), Lycospora spp. (R), Punctatisporites spp. (R), Striatites richteri (R), Taeniaesporites spp. (R), undifferentiated verrucate spores.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

The taxa found in this interval remain similar to those in the preceeding Permian to Triassic section, with the addition of no significant new forms. The age here is left indeterminate in order to accomodate the Foraminifera evidence which indicates Pennsylvanian at 11,830 feet.

13,020-13,380'

Apiculatisporis spp. (R), undifferentiated bisaccates (R), Calamospora (R), Cirratriradites (R), Densosporites spp. (R), Endosporites sp. (R), Florinites sp. (R), Lycospora spp. (F-C), Potoniesporites (R), Punctatisporites (R), Schopfipollenites sp. (R).

AGE: Pennsylvanian (P-T19)
ENVIRONMENT: Nonmarine to Marginal Marine

Based on the frequent to common occurrences of Lycospora sp. the persistent distribution of Punctatisporites spp., and the presence of Florinites sp., Potoniesporites sp., and Schopfipollenites sp., this interval can be dated as Pennsylvanian in age.

13,380-14,210'

Undifferentiated bisaccates (R), Endosporites sp. (R), Lycospora spp. (R-C), Punctatisporites (R-C), Punctulatisporites sp. (R), Raistrickia sp. (R), Reticulatisporites sp. (R), Spinozonotriletes sp. (R).

AGE: Carboniferous undifferentiated
ENVIRONMENT: Nonmarine to Marginal Marine

None of the taxa restricted to the Pennsylvanian remain persistent through this unit. More generalized species such as Endosporites sp., Lycospora spp., Punctatisporites spp., and Raistrickia sp. do remain however, and the interval is, therefore, dated as Carboniferous undifferentiated.

ADDENDUM TO PALYNOLOGY REPORT

Twenty-three (23) samples were processed and analyzed for palynological age determinations. The total consisted of 15 ditch and 8 core samples taken from the interval 14,210 feet to the total depth of 15,480 feet. This report is an addendum to the original report which covered the section above 14,210 feet, the depth where the well had been suspended at the end of the 1978-79 drilling season. The addendum covers the new section penetrated during the 1979-80 season.

A distribution chart displaying the occurrences of palynomorph taxa is included with this addendum.

Summary of Results

The palynomorphs recovered are not very distinctive forms and provide evidence for only an undifferentiated Carboniferous age assignment. Generally, the section of carbonates and red clastics above 15,200 feet yielded highly degraded organic matter and poorly preserved palynomorphs. Below 15,200 feet, where some gray-colored clastics appear, the spore abundance increases and their preservation is greatly improved.

The presence of scolecodonts between 14,390 feet and 14,820 feet is indicative of marginal marine conditions for that part of the section.

Ikpikpuk #1 (Foraminifera)

FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checklisting of 378 washed ditch samples, 99 thin sectioned ditch samples, 32 washed sidewall cores, 109 washed conventional core samples and 13 thin sectioned conventional core samples covering the interval 100 to 14,210 feet (suspended drilling depth). Thin sections were prepared on all samples below 11,290 feet. Five checklists and a faunal distribution log are enclosed for your convenience.

Standard techniques were employed in processing the material. All samples were boiled in Quaternary-O and washed over 30 and 200 mesh screens.

Frequency symbols used in this report correspond to the following numerical values: R = rare (1-5); F = frequent (6-32); C = common (33-99), A = abundant (100-199); and FL = flood (200+).

100-160'

This very thin interval is considered to be Late Cretaceous (Canomanian) based on occurrences of Trochammina cf. rishkensis, Lenticulina 8 and Aschiocorys sp.

AGE: Late Cretaceous Canomanian (F-8)

ENVIRONMENT: Probable Neritic

160-740'

Fauna from this interval is so scarce it is impossible to tell whether we are dealing with Albian or Canomanian strata.

AGE: Early to Late Cretaceous Albian to Canomanian (F-8 to F-9)

ENVIRONMENT: Nonmarine to Marginal Marine

740-3485'

Ammobaculites wenonahae, A. fragmentarius, Glomospirella gaultina, Eurycheilostoma grandestandensis, E. robinsonae, Haplophragmoides topagorukensis, H. cf. excavatus, H. gigas, Saccammina lathrami, Lenticulina pacrodiaca, Globulina exserta, Vermeuilinoides borealis, Gavelinella stictata, Marginulinopsis jonesi, Hippocrepina barkadalei, Haliammina manitobensis, H. sevumensis, Valvulinaria loertscheri, and Bathysiphon vitta among others, characterize these strata. The above association is typical of the Vermeuilinoides borealis faunal zone and is Middle to Late Albian age (F-9). The environments represented by these assemblages were probably marginal marine to inner neritic between 740 feet and 2300 feet, and inner to middle neritic below 2300 feet.

AGE: Early Cretaceous Middle to Late Albian (F-9)

ENVIRONMENT: Marginal Marine to Middle Neritic

3485-5180'

Based on co-occurrences of Gaudryina nanushukensis, Reophax troyeri, Gaudryina cf. taillouri, Saracenaria durgei, S. ergliopei, and frequent pyritized radiolaria, this interval is believed to represent Late Aptian to Early Albian (F-10) age. A middle to outer neritic depositional environment is suggested for these strata.

AGE: Early Cretaceous Late Aptian to Early Albian (F-10)

ENVIRONMENT: Middle to Outer Neritic

5180-7240'

A pyritized radiolarian fauna characterizes these strata together with rare to frequent occurrences of agglutinated and calcareous Foraminifera. Pyritized radiolaria of the following genera occur: Cenosphaera spp., Spongodiscus spp. and Lithocampe spp. This zonule is not as well developed in this well as it is in some of the other wells. Lithocampe M tops near the base of this unit at 7120 feet. According to Ramsey (1970) this zone of pyritized radiolaria separates the Vermeuilinoides borealis Zone from the Gaudryina taillouri Zone and is probably Aptian to Early Albian in age. We feel that it is probably Aptian in age, but our data is tentative at this time and the unit may indeed be time transgressive. Due to the preservation of this fauna, all that can be said about the environment of deposition is that it was marine and open to oceanic currents.

AGE: Early Cretaceous Aptian (F-11)

ENVIRONMENT: Open Marine

7240-7420'

Occurrences of Gaudryina taillouri, G. hilleri, Bathysiphon scintillata, arenaceous spp. (large, coarse), Trochammina squamata, Pseudogaudryina sp., Haplophragmoides duoflatis, H. inflatistrandis, and Conorboides cf. hofkeri indicate a Neocomian (F-12 to F-13) age for these strata. Frequent to abundant rounded frosted quartz floaters also dominate this interval. The moderate abundance and diversity of this assemblage suggests a relatively turbid middle to outer neritic depositional environment.

AGE: Early Cretaceous Neocomian (F-12 to F-13)

ENVIRONMENT: Middle to Outer Neritic (relatively turbid)

7420-7480'

A sandstone lithology characterizes this thin interval, therefore rare older foraminiferal occurrences are suspect of reworking and younger forms are suspected of caving from the overlying interval. There were no cores taken from this interval. In order to be objective this interval will be considered of indeterminate age at this time. It could be as young as the overlying interval or as old as the underlying interval.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

7480-7690'

Based on occurrences of Gaudryina millari, G. dyscrita, Trochammina instowensis, T. canningensis, T. sablei, Haplophragmoides canui, H. barrowensis, Bathysiphon anomalocoelia, Ammobaculites alaskensis, Epistomina liasica, Lenticulina sudax, Conorboides hofkeri, Marginulinopsis phragmites and Textularia kreopleta this interval could be as old as Tithonian or as young as Valanginian. Core 6 taken from this interval contains a similar assemblage. An outer neritic to bathyal paleodepth is suggested for these strata.

AGE: Late Jurassic to Early Cretaceous Tithonian to Valaginian (F-13 to F-15)
ENVIRONMENT: Outer Neritic to Bathyal

7690-8190'

Ammobaculites alaskensis, arenaceous spp. (large, coarse), Bathysiphon anomalocoelia, Haplophragmoides canui, H. barrowensis, Lenticulina sudax, Recurvoides turbinatus, Trochammina canningensis, T. instowensis, T. rostovzevi, T. kosyrevae, T. sp. (small, high-spired), T. sablei, T. topagorukensis, Gaudryina leffingwelli, G. topagorukensis, G. millari and Frondicularia lustrata, indicate that these strata are probably pre-Tithonian in age. A Tithonian age, however, cannot be entirely ruled out. An outer neritic to bathyal depositional environment similar to the overlying interval is suggested.

AGE: Late Jurassic Kimmeridgian to Tithonian (F-15 to F-16)
ENVIRONMENT: Outer Neritic to Bathyal

8190-9180'

Overlapping occurrences of Marginulinopsis phragmites, Trochammina sp. (small, high-spired), T. instowensis, T. sablei, T. kamensis, Glomospira patoni, Gaudryina millari, Saracenaria cf. oxfordiana, Lenticulina quenstedti, L. wisniowskii, Arenoturrispirillina intermedia, Opchalmidium saskatchewanensis, Astacolus cf. dubius, Ammobaculites vetusta, Ammodiscus charadospirus, Reophax liasica, R. metensis, and Epistomina metensis, among others, indicate an Oxfordian (F-16) age. The abundant and diverse assemblages associated with these strata suggest an outer neritic to bathyal depositional environment.

AGE: Late Jurassic Oxfordian (F-16)
ENVIRONMENT: Outer Neritic to Bathyal (clear water)

9180-9600'

These strata are considered Early to Middle Jurassic age based on occurrences of Ammobaculites vetusta, Triplasia sp., Astacolus dubius, Lenticulina cf. faveolata, Palmoglymorphina vagina, Nodosaria oltis, N. radiata, Neophax densa, and common to abundant pyritized radiolaria of the genera Canoptaera spp., Dictyomitra spp., Spongodiscus spp., Lithocampe spp., Cyrtocapsa? sp., Crucella sp., Shoshaugrum sp., and Patulibracchium sp. The abundance of radiolaria suggests open marine conditions. The depositional environment for these rocks was probably middle neritic to as deep as upper bathyal.

AGE: Early to Middle Jurassic (F-17 to F-18)
ENVIRONMENT: Probable Middle Neritic to Upper Bathyal (open marine)

9600-10,110'SW

It was necessary to spread the age of this interval since it contains a mixed assemblage. A fauna similar to the overlying interval occurs herein, along with possibly reworked Triassic (F-19) forms. Rare occurrences of Astacolus connudatus, Trochammina cf. helicca and Nodosaria cf. shublikensis suggest a Triassic (F-19) age, but the interval is lacking a complete F-19 assemblage. These strata probably represent inner to middle neritic deposition.

AGE: Triassic to Early Jurassic (F-18 to F-19)
ENVIRONMENT: Probable Inner to Middle Neritic

10,110SW-10,390'

Astacolus connudatus, Nodosaria shublikensis, N. lorina, Frondicularia acmana, Vaginulinopsis acrulus, Lingulina borealis, L. alaskensis, Pseudoglandulina simpsonensis, P. lata, Spirillina cf. gurgitata, Trochammina helicca, T. contornata, and Monotis/Halobia fragments occur throughout these beds. These faunas appear to represent open marine middle to outer neritic conditions. A distinctive dark brown to black calcareous pebbly sandstone similar to that described by Tappan (1951, pp. 5-6) from the basal 25 to 50 feet of the Shublik Fm. in the Sadlerochit River Region tops in a sidewall core at 10,273 feet in this well.

AGE: Triassic (F-19)
ENVIRONMENT: Middle to Outer Neritic (open marine)

10,390-10,570'

This interval contains a mixed assemblage of Triassic Shublik Fm. forms and possible Permo-Triassic Sadlerochit Fm. forms. Rare to frequent occurrences of Ammodiscus cf. P suggest a possible F-20 age, but the rest of the fauna and the lithology still appear similar to the Shublik Fm. The depositional environment of these strata could be as shallow as marginal marine or as deep as outer neritic depending on what is caved and what is not caved.

AGE: Triassic (F-19 to F-20)
ENVIRONMENT: Marginal Marine to Outer Neritic

10,570-11,380'

The upper portion of this unit is barren of Foraminifera and the top is picked on the basis of a lithologic change. A poor fauna consisting of Ammobaculites cf. vetusta, Gaudryina cf. dyscrita, and Ammodiscus P. occurs through most of the lower portion of this interval. This assemblage is indicative of Zonule F-20. A possible Kavik shale top is placed at 11,110 feet. A lithologic change to glauconitic quartzitic sandstone at 11,290 feet suggests that we are probably in the Permian Echooka Formation at that point. These strata probably represent nonmarine to marginal marine deposition.

AGE: Permo-Triassic (F-20)
ENVIRONMENT: Nonmarine to Marginal Marine

11,380-14,210'

Generally throughout the North Slope of Alaska, the Lisburne Group can be divided into three lithologic units:

1. Upper Limestone Unit
2. Dolomite Unit
3. Lower Limy Unit

The Upper Limestone Unit is 2100 feet thick in this well. A lithologic change to argillaceous limestone at 11,380 feet indicates that the strata between 11,380 feet and 11,620 feet may be a lithologic equivalent to what some people wish to call the Joe Creek Limestone. Early Permian (A.W.A. F-21) packstones and grainstones predominate below 11,620 feet. Since the argillaceous limestone lies below the Early Permian Echooka Fm. and is underlain by Early Permian (A.W.A. F-21) carbonates it is considered to be Early Permian in this report. Grainstones and packstones between 11,620 feet and 11,830 feet are characterized by nodosariids, cornuspirids, and frequent to common Protonodosaria sp. These forms indicate that these beds are Early Permian (A.W.A. F-21). The base of this interval, and the top of the underlying Pennsylvanian carbonates is very difficult to pick since it is based primarily on the lowest occurrence of Protonodosaria sp. and we are dealing with ditch samples. A core (C-11) from 11,718 feet to 11,733 feet substantiates the presence of Protonodosaria sp. in this section to at least 11,733 feet.

Strata between 11,830 feet and about 12,480 feet are certainly no older than Zone 21 but could easily be as young as Zone 24 (see Mamet, 1971, pp. 203 and 204)*. A burst of Koninckopora yukonensis, Pseudoparafusella sp., and Kamaenid algae together with occurrences of Neoarchaediscus spp., Asteroarchaediscus spp., and Stylococcum sp. indicate that the strata between about 12,480 feet and 12,930 feet are Zone 21 in age. A Zone 20 call is made at 12,930 feet based on a significant reduction in the occurrence of Kamaenid algae.

Based on the occurrence of section equivalent to the Zone 17-Zone 18 Dolomite Unit below this interval, a lack of Globivalvulina bulloides, and the occurrence of possible Paleotextularia sp. we suggest that section between 13,450 feet and 13,760 feet may be Zone 18 to Zone 19 in age. The Upper Limestone Unit represents the shoaling shelf facies of a carbonate platform suite.

The Dolomite Unit is placed between 13,760 feet and 14,000 feet based on lithologic change to gray microcrystalline dolomite. This unit is poorly fossiliferous. The Dolomite Unit probably represents a supratidal depositional environment.

This last unit (the Lower Limy Unit) is recognized on the basis of a lithologic change to packstone, coupled with frequent to common occurrences of coral wall debris. It probably represents a Zone 16 or older age.

AGE: Late Mississippian to Early Permian

ENVIRONMENT: Supratidal to Shoaling Shelf (Carbonate Platform Suite)

*Mamet, B. L., and Ross, C. A., 1971, in Bamber & Waterhouse, "Carboniferous and Permian Stratigraphy and Paleontology, Northern Yukon Territory, Canada"; Bull. of Can. Petr. Geol., vol. 19, no. 1, pp. 196-205.

ADDENDUM TO FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checklisting of 44 thin sectioned ditch samples, and 8 thin sectioned conventional core samples covering the interval 14,210 to 15,480 feet. Two checklists and a faunal distribution log are enclosed for your convenience.

Standard techniques were employed in processing the material. All samples were boiled in Quaternary-O and washed over 20 and 200 mesh screens.

Frequency symbols used in this report correspond to the following numerical values: R = rare (1-5); F = frequent (6-32); C = common (33-99); A = abundant (100-199); and FL = flood (200+).

14,210-14,850'

This interval is similar to the overlying basal unit of the earlier report and so the cap of the Lower Limy Unit lies at 14,000 feet. Occurrences of Neoarchaediscus iokartus, Archaediscus chernovsovensis, A. kreitovnikovi, Asphaltina sp., and frequent to common coral wall debris suggest that these packstones are probably Zone 14 to Zone 16 in age. These carbonates represent a low energy shoaling shelf environment.

AGE: Late Mississippian

ENVIRONMENT: Shoaling Shelf (Low Energy Conditions)

14,850-15,480' T.D.

This unit is picked primarily on the basis of a lithologic change to red shales and siltstones at 14,850 feet. Faunas occurring down to at least 15,020 feet, and possibly as low as 15,200 feet suggest that the strata are still of Late Mississippian (Zone 14 to Zone 16) age down to 15,200 feet. The abundance of quartzite and coal below 15,310 feet is suggestive of the Kekiktuk Fm. Argillitic shale found in samples below 15,400 feet appears to represent stringers within the Kekiktuk Fm. quartzites, but in some places the "Argillite" basement may be no more than an argillitic shale and this possibility should be considered.

AGE: Late Mississippian (14,850-15,300')
Probable Mississippian (15,300-15,480')

ENVIRONMENT: Normarine to Inner Neritic (14,850-15,200')
Indeterminate (15,200-15,480')

FORAMINIFERA REVISIONS:

The interval from 7480' to 8190' is modified as follows:

7480' - 8100': Early Cretaceous, Neocomian (F-13 to F-14)

8100' - 8190': Late Jurassic, Kimmeridgian to Tithonian (F-15 to F-16)

Inigok #1
(Palynology)

PALYNOLOGY REPORT

Introduction

A total of 387 samples were processed and examined from the subject well. The total consisted of 231 ditch, 139 core and 17 sidewall core samples. The samples covered the entire well from 110 feet to the total depth of 10,092 feet.

Included in the report are three (3) charts illustrating the distribution of palynomorph taxa. One (1) chart is a compilation of the ditch and sidewall core samples and two (2) charts make up the distribution from the conventional core samples.

Summary of Results

110-560'

Osmundacidites spp. (F-A), Gleichheniidites senonicus (F), Vitreisporites pallidus (R), Aequitriradites spinulosus (R).

Chatangiella ditissima (F-C), C. amphiata (C-A), Odontochitina operculata (F), Palaeoperidinium cretaceum (F-C), Cyclonephelium distinctum (F-C), Oligosphaeridium spp. (R).

AGE: Late Cretaceous, Santonian-Campanian (P-M14)

ENVIRONMENT: Marine

560-1460'

Spore-pollen assemblage is the same as the above interval, plus several occurrences of reworked Early Cretaceous and Triassic forms.

The dinocyst assemblage remains similar to the above interval; however, there is a subtle decrease in the species abundance and consistency of occurrences.

AGE: Late Cretaceous, probable ?Turonian-?Coniacian (P-M15)

ENVIRONMENT: Marine

1460-2360'

Spore-pollen assemblage is essentially unchanged, except for a decrease in abundances and the absence of reworked forms.

Palaeoperidinium cretaceum (F-C), Cribroperidinium edwardsi (R-F), Cyclonephelium membraniporum (R).

Pseudoceratium cf. P. dettmannae (single).

AGE: Late Cretaceous, Cenomanian (P-M16)

ENVIRONMENT: Marine

2360-7064'C

Gleichheniidites senonicus (R-F), Cicatricosisporites spp. (R); numerous occurrences of reworked striated bisaccates and densospores.

Odontochitina operculata (R-C), Palaeoperidinium cretaceum (F-A), Batioladinium jaegeri (R-F), Cardodinium trabeculosum (R), Muderongia asymmetrica (R-F), Luxadinium propatulum (R), Spinidinium vestitum (R), Pseudoceratium retusum (R-F), Genus "W" (R).

AGE: Early Cretaceous, Middle-Late Albian (P-M17)

ENVIRONMENT: Marine

The more diverse Middle-Late Albian assemblage which includes C. propaculum, S. vestitum, and the undescribed form Genus "W", is restricted to the interval above 4400 feet. The base of the Middle-Late Albian, however, is placed at 7064 feet which is the lowest occurrence of Genus "W" in the core samples. It is possible that Genus "W" has an older range than previously believed and should be extended into the P-M18 zonule.

7064-9210'

The palynomorph assemblage of this interval is similar to the above interval except for the absence of the restrictive Middle-Late Albian dinocysts.

There is an apparent decrease in dinocyst diversity below about 8500 feet.

AGE: Early Cretaceous, Aptian-Early Albian (P-M18)

ENVIRONMENT: Marine-Marginal Marine

9210-9448'C

Classopollis classoides (F).

Cyclonephelium distinctum (F), Odontochitina operculata (R-F), Oligosphaeridium complex (thick-wall var.)(A), Dimidiadinium uncinatum (R), Muderongia cf. M. simplex (R), ?Operculodinium spiniferum (R), Sirmiodinium grossii (R), Psaligonyaulax spatula (R).

AGE: Early Cretaceous, Neocomian (P-M19)

ENVIRONMENT: Marine

9448-9814'SWC

Cicatricosisporites australiensis (R), Classopollis classoides (F-C).

Oligosphaeridium complex (thick-wall var.)(R-A), Paradinia dasyforma (R-F), Psaligonyaulax spatula (R).

AGE: Early Cretaceous, Neocomian (P-M20)

ENVIRONMENT: Marine

This interval is marked by the occurrence of P. dasyforma, which is present in Core #5 at 9448 feet and as low as 9814 feet in a sidewall core.

9814-12,630'

Indeterminate, poorly preserved spores and spore fragments (R-A), Classopollis classoides (R).

AGE: Triassic-Jurassic

ENVIRONMENT: No evidence of marine

The palynomorph assemblage through this interval is very poor and lacks any restrictive elements upon which to base a definitive age.

12,630-14,020'±C

Undifferentiated striate bisaccates (R), Striatites richteri (R), Taeniaesporites spp. (R), Cretaceaspollenites sp. (R-F)

Micrhystridium sp. (single), scolecodont (R).

AGE: Permian-Triassic (P-T17 to P-T14)

ENVIRONMENT: Nonmarine to Marginal Marine

This interval contains relatively few palynomorphs. The best recoveries are in Core #16 (13,480-13,510') which yielded an assemblage most typical of Early Triassic age.

14,020-14,250'?

Undifferentiated striated bisaccates (R, sporadic), Vittatina sp. (R, sporadic).

AGE: Permian (P-T18)

ENVIRONMENT: Nonmarine

Although this entire interval is designated to be of Permian age, the highest occurrence of Vittatina is at 14,047 feet in Core #18 (14,020-14,065'). The base of this interval is placed at the depth just above the appearance of Potonieisporites.

14,250-15,301'

Potonieisporites sp. (R), ?Triquitrites spp. (R), ?Reticulatisporites polygonalis (single).

AGE: Carboniferous, Pennsylvanian (Westphalian?) (P-T19)

ENVIRONMENT: No evidence of marine

15,203-18,300'

Indeterminate spores and spore fragments, poorly preserved (R-C), Endosporites sp. (R, sporadic).

Scolecodont (R, sporadic).

AGE: Undifferentiated Carboniferous (P-T20)

ENVIRONMENT: Nonmarine?-Marginal Marine

18,300-20,092'T.D.

Densospora (R-C), Lycospora spp. (R-C), Endosporites spp. (R), Convolutispora sp. (R, sporadic), Murospora sp. (R, sporadic), Reinschospora cf. R. speciosa (single), Diatomotonotriletes cervicornutus (single), ?Tripartites sp. (single, Core #23).

AGE: Carboniferous; Mississippian (P-T21)

ENVIRONMENT: Nonmarine

The presence of Reinschospora and D. cervicornutus in the lower part of this interval indicates that the strata below 19,800 feet are Visean in age. The questionable (poorly preserved) Tripartites in the bottom Core #23 suggests that the well penetrated sediments no older than Mississippian age.

Inigok #1 (Foraminifera)

FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checklisting of 467 washed ditch samples, 212 thin sectioned ditch samples, 7 washed sidewall cores, 2 thin sectioned sidewall cores, 300 washed conventional core samples and 45 thin sectioned conventional core samples covering the interval 110 to 20,092 feet. Thin sections were prepared on all samples below 13,690 feet. Nine checklists and two faunal distribution logs are enclosed for your convenience. Five sidewall cores received after the faunal distribution logs had been completed appear in an appendix at the back of this report.

Standard techniques were employed in processing the material. All samples were boiled in Quaternary-O and washed over 20 and 200 mesh screens.

Frequency symbols used in this report correspond to the following numerical values: R = rare (1-5); F = frequent (6-32); C = common (33-99); A = abundant (100-199); and FL = flood (200+).

110-560'

Based on associated occurrences of Trochammina albertensis, T. albertensis, T. whittingtoni, Arenobulimina corula, Verneuilinoides fischeri, Neobulimina canadensis, and Dorothia smokyensis these strata are Senonian (F-5) in age. An inner to middle neritic paleodepth is suggested for these rocks.

AGE: Late Cretaceous Senonian (F-5)

ENVIRONMENT: Inner to Middle Neritic

560-1490'

A diminished fauna similar to the overlying interval occurs in these rocks. It is impossible to tell whether we are dealing with poor marine Seabee Fm. or Schrader Bluff Fm. The age of these strata is probably Turonian to Coniacian (F-6).

AGE: Late Cretaceous Turonian to Coniacian (F-6)

ENVIRONMENT: Marginal Marine to Inner Neritic

1490-2090'

The top of this unit is picked on the highest continuous occurrence of paper shale. The fauna in the upper half (above 1790') of this interval is similar to the overlying interval, while the fauna below 1790 feet contains radiolaria and Foraminifera suggestive of a Cenomanian to Turonian (F-7) age.

AGE: Late Cretaceous Cenomanian to Turonian (F-7)

ENVIRONMENT: Inner to Middle Neritic (starved basin)

2090-2360'

This thin interval is practically barren of Foraminifera, and it is impossible to tell whether it is Albian or Cenomanian in age.

AGE: Early to Late Cretaceous Albian to Cenomanian (F-8)

ENVIRONMENT: Probable Nonmarine to Marginal Marine

2360-3520'

Ammobaculites wenonahae, A. fragmentarius, Glomospirella gaultina, Euryoehelostoma grandscandensis, Trochammina umiatensis, Haplophragmoides topagorukensis, H. cf. ewavetus, H. linki, Saccammina lathami, Lenticulina macrodisca, Ammodiscus rotalarius, Verneuilinoides borealis, Gavelinella stictata, Quadrimorphina tuckerae, Marginulinopsis jonesi, Oolina apiculata, Miliammina manitobensis, Saracenaria trollopei, Psammosphaera bowsheri, and Globorotalites alaskensis, among others, characterize these strata. The above association is typical of the Verneuilinoides borealis Zone and is Middle to Late Albian age (F-9). The environments represented by these assemblages were probably marginal marine to inner neritic between 2360 feet and 3000 feet, and inner to middle neritic below 3000 feet.

AGE: Early Cretaceous Middle to Late Albian (F-9)

ENVIRONMENT: Marginal Marine to Middle Neritic

3520-5130'

Based on co-occurrences of Gaudryina nanushukensis, Textularia topagorukensis, Pseudobolivina ravi, Gaudryina cf. tailleuri, Saracenaria cf. dutroi, and Valvulineria loetscheri this interval is believed to represent Late Aptian to Early Albian (F-10) age. A middle to outer neritic depositional environment is suggested for these strata.

AGE: Early Cretaceous Late Aptian to Early Albian (F-10)

ENVIRONMENT: Middle to Outer Neritic

5130-6310'

A pyritized radiolarian fauna characterizes these strata together with rare to frequent occurrences of agglutinated and calcareous Foraminifera. Pyritized radiolaria of the following genera occur: Cenosphaera spp., Spongodiscus spp., Dictyomitra spp., Stichomitra sp., Archaeodictyomitra sp., and Lithocampe spp. According to Ramsey (1970) this zone of pyritized radiolaria separates the Verneuilinoides borealis Zone from the Gaudryina tailleuri Zone and is probably Aptian to Early Albian in age. We feel that it is probably Aptian in age, but our data is tentative at this time and the unit may indeed be time transgressive.

8130-8310' (604'Ez)

Due to the preservation of this fauna, all that can be said about the environment of deposition is that it was marine and open to oceanic currents.

AGE: Early Cretaceous
Aptian (F-11)

ENVIRONMENT: Open Marine

8310-8960'

This unit is essentially barren of fauna. Since Lithocampe N tops near the base of it at 8970 feet, it is here considered to be Aptian (F-11) age since Lithocampe N has topped near the base of the F-11 zonule in most of the other wells from NPR-A.

AGE: Early Cretaceous
Probable Aptian (Probable F-11)

ENVIRONMENT: Indeterminate (8310-8970')
Probable Open Marine (8970-9060')

9060-9660'

Occurrences of Ammodiscus mackenzignsis, Quinqueloculina 2, Glomospirella arcuiga, G. subarctica, G. S, Ammobaculites recohacoides, Quadrimorphina 4, Praebulimina 1, P. 2, Gaudryina taillouri, Bathysiphon scintillata, arenaceous spp. (large, coarse), Trochammina cf. canningensis, T. sp. (small plano-convex), T. squamata, Pseudobolivina sp., Haplophragmoides deflatio, H. coronis, H. goodenoughensis, H. inflatigrandis, and Conorboides cf. umiatensis indicate a Neocomian (F-12 to F-13) age for these strata. Cores 8 and 9 contain a similar assemblage. Frequent to abundant rounded frosted quartz floaters also dominate this interval. The abundance and diversity of this assemblage suggest an outer neritic to middle bathyal depositional environment. A sandstone occurs at the base of this interval (9370-9660') which may be an equivalent to the sandstone at 7420 to 7480 feet in the Ikpikpuk #1 well.

AGE: Early Cretaceous
Neocomian (F-12 to F-13)

ENVIRONMENT: Outer Neritic to Middle Bathyal

9660-9810'

Based on occurrences of Gaudryina millerí, Marginulinopsis gracillissima, M. ?, Nodosaria nana, Saracenaria cf. oxfordiana, Trochammina cf. sahlei, and Glomospira corona this interval could be as old as Tithonian or as young as Berriasian. A middle to outer neritic paleodepth is suggested for these strata.

AGE: Late Jurassic to Early Cretaceous
Tithonian to Berriasian
(F-14 to F-15)

ENVIRONMENT: Middle to Outer Neritic

9810-11,006'Core

Nodosaria regularis, N. cf. orthostoecha, Marginulinopsis phragmites, M. carlevalensis, Saracenaria oxfordiana, Ammobaculites alaskensis, arenaceous spp. (large, coarse), Bathysiphon anomalocoalia, Haplophragmoides canui, H. barrowensis, Lenticulina sudan, L. quenstedti, Recurvoides turbinatus, Trochammina kumaensis, T. canningensis, T. idaho-ensis, T. rostovzevi, T. kosyrevae, T. sp. (small, high-spired), T. sahlei, T. topagorukensis, T. gryci, T. kondaensis, Gaudryina laffingwelli, G. dyscrita, G. topagorukensis, G. millerí, and Frondicularia lustrata, indicate that these strata are probably pre-Tithonian in age. A Tithonian age, however, cannot be entirely ruled out. An outer neritic to bathyal depositional environment is suggested.

AGE: Late Jurassic
Kimmeridgian to Tithonian
(F-15 to F-16)

ENVIRONMENT: Outer Neritic to Bathyal

11,006'Core-11,670'

This interval is considered Oxfordian based on the highest occurrence of Saracenaria topagorukensis. The moderately abundant and diverse assemblages associated with these strata suggest a middle neritic to upper bathyal depositional environment.

AGE: Late Jurassic
Oxfordian (F-16)

ENVIRONMENT: Middle Neritic to Upper Bathyal

11,670-12,210'

These strata are considered Early to Middle Jurassic age based on occurrences of Ammobaculites verugata, A. cf. atherarus, Gaudryina dyscrita, Astacolus dubius, Involutina silicea, Trochammina concornata, and rare to abundant pyritized radiolaria of the genera Cenosphaera spp., Discyomitra spp., Spongodiscus spp., Stichomitra sp., Lithocampe spp., and Cyrtocapsa? sp. The abundance of radiolaria suggests open marine conditions. The depositional environment for these rocks was probably middle neritic to as deep as upper bathyal. There was no evidence of any Sag River Sandstone equivalent in this well.

AGE: Early to Middle Jurassic
(F-17 to F-18)

ENVIRONMENT: Probable Middle Neritic to
Upper Bathyal (open marine)

12,210-12,480'

Astacolus connudatus, Nodosaria larina, Trochammina helicta, T. concornata, Lithocampe cf. T. (pyritized), and Monotis/Halobia fragments occur throughout these beds. These faunas appear to represent open marine middle neritic conditions. A distinctive dark brown to black calcareous pebbly sandstone similar to that described by Tappan (1951, pp. 5-6) from the basal 25 to 50 feet of the Shublik Fm. in the Sadlerochit River Region tops in a sidewall core at 12,390 feet in this well.

AGE: Triassic
(F-19)

ENVIRONMENT: Middle Neritic (open marine)

12,480-13,890'

A very poor fauna characterizes these strata. Based on the occurrence of Ammodiscus P at 12,504 feet in Core 14 and a lithologic change at 12,480 feet in the ditch samples, this interval is Permo-Triassic (F-20) age. A lithologic change to quartzitic siltstone and sandstone at 13,680 feet suggests that we are probably in the Permian Echooka Formation at that point. These strata probably represent nonmarine to marginal marine deposition.

AGE: Permo-Triassic
(F-20)

ENVIRONMENT: Nonmarine to Marginal Marine

13,890-16,880'

Generally throughout the North Slope of Alaska, the Lisburne Group can be divided into three lithologic units:

1. Upper Limestone Unit
2. Dolomite Unit
3. Lower Limy Unit

The Upper Limestone Unit is 1730 feet thick in this well (14,010-15,740'). A lithologic change to argillaceous limestone at 13,890 feet indicates that the strata between 13,890 feet and 14,010 feet may be a lithologic equivalent to what some people wish to call the Joe Creek Limestone. Early Permian (A.W.A. F-21) packstones and grainstones predominate below 14,010 feet. Since the argillaceous limestone lies below the Early Permian Echooka Fm. and is underlain by Early Permian (A.W.A. F-21) carbonates it is considered to be Early Permian in this report. Grainstones and packstones between 14,010 feet and about 14,150 feet are characterized by cornuspirids, porcellaneous spp., and rare Protonodosaria sp. These forms indicate that these beds are Early Permian (A.W.A. F-21). The base of this interval, and the top of the underlying Pennsylvanian carbonates is very difficult to pick since it is based primarily on the lowest occurrence of Protonodosaria sp. and we are dealing with ditch samples. The base of the F-21 zonule could be as high as 14,150 feet or as low as 14,450 feet.

Strata between 14,450+ feet and about 14,740 feet are certainly no older than Zone 21 but could easily be as young as Zone 24 (see Mamet, 1971, pp. 203 and 204)*. A burst of Eoschubertella yukonensis, Pseudoparaffella sp., and kamaspid algae together with occurrences of Neoarchaediscus spp., Asteroarchaediscus spp., and Stylocodium sp. indicate that the strata between about 14,740 feet and 15,215 feet

*Mamet, B. L., and Ross, C. A., 1971, In Sanders & Waterhouse, "Carboniferous and Permian Stratigraphy and Paleontology, Northern Yukon Territory, Canada"; Bull. of Can. Petr. Geol., vol. 19, no. 1, pp. 196-205.

13,890-16,980' (con't.)

are Zone 21 in age. A Zone 20 call is made at 15,215 feet based on a noticeable lack of kamaenid algae below this point.

Based on the occurrence of section equivalent to the Zone 17-Zone 18 Dolomite Unit below this interval, a lack of Globivalvulina bulloides, and the occurrence of Falgotaxculzrii sp. we suggest that section between 15,740 feet and 16,220 feet may be Zone 18 to Zone 19 in age. The Upper Limestone Unit represents the shoaling shelf facies of a carbonate platform suite.

The Dolomite Unit is placed between 16,220 feet and 16,490 feet based on a lithologic change to dark gray (oil stained?) microcrystalline dolomite. This unit is poorly fossiliferous. The Dolomite Unit probably represents a supratidal depositional environment.

This last unit (the Lower Limy Unit) is recognized on the basis of a lithologic change to packstone, coupled with frequent occurrences of coral wall debris. It probably represents a Zone 16 age.

AGE: Late Mississippian to Early Permian
ENVIRONMENT: Supratidal to Shoaling Shelf (Carbonate Platform Suite)

16,980-18,110'

This interval is characterized by interbedded limestone and dark gray shale. A Zone 14 to Zone 15 age is suggested by fauna found in Core 21 (17,065-17,074'). A possible Zone 12 to Zone 13 age is indicated in the ditch samples from 17,510 feet, and a possible Zone 10 to Zone 11 ("Earlandia Facies") is found at and below 17,720 feet. The whole interval is felt to represent interbedded Kayak Shale and Alapah or Mackenzie 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. These strata probably represent the marginal marine to middle neritic inner portion of a shoaling shelf.

AGE: Probable Late Mississippian
ENVIRONMENT: Inner Portion of Shoaling Shelf (Marginal Marine to Middle Neritic)

18,110-20,092'T.D.

This interval is predominately coaly quartzitic sandstone and siltstone. Foraminiferal recoveries are minimal and even then may represent down-hole contamination. The age of this unit is indeterminate due to the lack of any indigenous age indicative fauna.

These strata are lithologically similar to the Nakiktuk Fm. The depositional environments associated with these strata was probably nonmarine to marginal marine.

AGE: Indeterminate
ENVIRONMENT: Nonmarine to Marginal Marine

APPENDIX A

12,625'SWC

No Foraminifera found. Brown quartzitic siltstone.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

12,890'SWC

No Foraminifera found. Coal (C). Dark brown sandy shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

13,684'SWC

No Foraminifera found. Dark brownish-gray quartzitic siltstone.

AGE: Indeterminate (Echooka lithology)
ENVIRONMENT: Indeterminate

13,712'SWC

No Foraminifera found. Glauconite (R), pyrite (F), pyrite sticks (F). Dark gray tuffaceous quartzitic siltstone.

AGE: Indeterminate (Echooka lithology)
ENVIRONMENT: Possible Marine

13,718'SWC

Bathysiphon sp. (R), pyrite (F), pyrite sticks (F). Dark gray tuffaceous slightly calcareous silty shale.

AGE: Indeterminate (Echooka lithology)
ENVIRONMENT: Possible Marine

FORAMINIFERA REVISIONS:

The interval from 9060' to 11,008' is modified as follows:

9000' - 9480': Early Cretaceous, Neocomian (F-12 to F-13)

9480' - 10,260': Early Cretaceous, Neocomian (F-13 to F-14)

10,280' - 11,006': Late Jurassic, Kimmeridgian to Tithonian (F-15 to F-16)

Itkillik #1 (ARCO)
(Palynology)

PALYNOLOGY REPORT

A total of one hundred sixty nine (169) samples were processed and analyzed for palynological age determinations. Two (2) samples were from cores and the remainder were 30 foot ditch composites. The interval examined was from 80 feet to the total depth of 15,321 feet.

80-250'

Pinus (F), Picea (F), Sphagnum (C), Laevigatosporites (C), Lycopodium (F), Alnus (R), Baculs (C).

AGE: Tertiary
ENVIRONMENT: Nonmarine

250-340'

Taxodium (C), Juglans (R), Ulmus (R), Tilia (C), Cicatricoel-sporites sp. (R), Aquilapollenites senonicus (R), A. ednatus (R).

AGE: Mixed Tertiary-Late Cretaceous
ENVIRONMENT: Nonmarine

This interval is represented by a single sample that appears to encompass the Tertiary/Cretaceous boundary. The mixed assemblage may also be explained by attributing the Cretaceous forms to reworking.

340-790'

Aquilapollenites senonicus (R), A. magnus (F), Wodehousia spinata (F), Kurtzipites sp. (R).

AGE: Maastrichtian
ENVIRONMENT: Nonmarine

790-2140'

Aquilapollenites magnus (R), A. attenuatus (R), A. trialatus (R), A. scabridus (R), Loranthacites sp. (R).

AGE: Campanian
ENVIRONMENT: Nonmarine

2140-3130'

Lycopodium (F), Aquilapollenites spp. (from up-hole), Australiella cookeoni (F), A. granulifera (R), A. victoriensis (R), Odontochitina operculata (R), Oligosphaeridium pulcherrimum (R), Diconodinium arcticum (R), Chlamydophorella nyei (R).

AGE: Santonian-Campanian
ENVIRONMENT: Marine

3130-5220'

Australiella cookeoni (R), Odontochitina operculata (R), Hexagonifera chlamydata (R), Cyclonephelium paucimarginatum (R).

AGE: probable Turonian-Coniacian
ENVIRONMENT: Marine

This interval produced relatively poor palynomorph recoveries.

5220-6320'

Odontochitina operculata (R), Oxflandrea cf. pichaensis (R), Hexagonifera chlamydata (R), Broomea jaegeri (R), Astrocysta cretacea (R), Cribroperidinium edwardsi (R), Oligosphaeridium complex (R), Ovoidinium verrucosum (R).

AGE: Cenomanian
ENVIRONMENT: Marine

6320-7020'

Odontochitina operculata (R), Broomea jaegeri (R), Astrocysta cretacea (C-A), Cribroperidinium edwardsi (R), Oligosphaeridium complex (R), Ovoidinium verrucosum (R), "Scrinodinium eurypylum" (R-F).

AGE: Albian
ENVIRONMENT: Marine

7020-7830'

Odontochitina operculata (F), Cyclonephelium distinctum (R), Broomea jaegeri (R), Astrocysta cretacea (A), Cribroperidinium edwardsi (R), Oligosphaeridium complex (R-F), "Scrinodinium eurypylum" (R), Cardodinium eisenacki (R).

AGE: Aptian
ENVIRONMENT: Marine

7830-8190'

Oligosphaeridium complex (C-A), Paradinia ceratophora (R), Cardodinium eisenacki (A), Psaligonyaulax apatela (R), Conyaulacysta cf. eisenacki (R), Mudarongia simplex (R).

AGE: Neocomian
ENVIRONMENT: Marine

8190-8910'

Oligosphaeridium complex (F-C), Odontochitina operculata (R-F), Astrocysta cretacea (R), Paradinia ceratophora (R), Psaligonyaulax apatela (R), Imbatodinium villosum (R), Sirmiodinium grossi (R).

AGE: Late Kimmeridgian-Valanginian
ENVIRONMENT: Marine

8910-10,350'

Paradinia ceratophora (R), Psaligonyaulax apatela (R), Sirmiodinium grossi (R), Conyaulacysta jurassica (R), G. cladophora (R), Nannoceratopsis pellucida (F-A), Ctenidodinium ornatum (F).

AGE: Oxfordian
ENVIRONMENT: Marine

The lower part of the interval (below 9720 feet) produced sparse palynomorphs. Although it is herein assigned to the Oxfordian, this bottom section probably encompasses the Jurassic/Triassic boundary.

10,350-11,340'

Klausipollenites sp. (R), Lueckisporites sp. (R), undifferentiated striate bisaccates (R).

AGE: Triassic
ENVIRONMENT: Nonmarine

11,340-11,520'

Klausipollenites sp. (R), Lueckisporites sp. (R), Striatites fichteri (R), Vittatina striata (R).

AGE: Permian
ENVIRONMENT: Nonmarine

11,520-11,610'

Numerous Permo-Triassic and younger palynomorphs from up-hole. Paleozoic dasyporaceae, Convolutispora sp. (single), cf. Calamospora sp. (R), Microhystridium spp. (R), Scolecodonts occur below 13,700 feet.

AGE: Carboniferous
ENVIRONMENT: Shallow marine deposition evidence below 13,700 feet

14,610-15,321'T.D.

Diatomozonotriletes caryiormutus (R), Tripercites vetustus (single), T. incisotriletes (single), T. sp. (R), cf. Florinites sp. (R), Densospores (P).

AGE: Mississippian
ENVIRONMENT: Nonmarine

The first evidence for Mississippian was observed below 14,600 feet in the ditch samples.

The bottom core at 15,311-321 feet produced organic residues that were dark brown to black in color. No black opaque minerals generally observed in argillite residues were seen. A number of spores were recovered in this core sample that indicate a Mississippian age at T.D.

Itkillik #1 (ARCO)
(Foraminifera)

FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checklisting of one hundred twenty-five (125) processed and picked foraminiferal slides and one hundred twenty-five (125) prepared thin sections. A checklist, an event correlation chart, and a correlated graphic log for the paleozoic section are enclosed for your convenience. A summary of the micropaleontology of the Itkillik River #1 well is presented below.

30-790' — Probable Late Cretaceous to Tertiary
Prince Crk. Fm. or Sagavanirktok Fm.

This interval is predominantly barren with a few scattered occurrences of rare foraminifera and rare Cenosphaera spp. This interval probably represents marginal marine to nonmarine deposition, but it could represent a marked increase in sediment accumulation rate.

ENVIRONMENT: Probable Marginal Marine to Nonmarine

790-2950' — Senonian
Schrader Bluff Fm.

This interval is characterized by the occurrence of the following species: Gaspontidella strombodes, Cycasina vitrea, Trochammina albertensis, Anomalinoides ralaria, Nonionella taylorensis, Praebulimina cushmani plus rare radiolarian species. These strata were probably deposited in a non-turbid middle to outer Neritic depth environment. The above mentioned species are indicative of a Senonian Age.

ENVIRONMENT: Probable Middle to Outer Neritic

2950-4300' — Turonian to Coniacian
Seabee Fm. or Prince Crk. Fm.

This interval is characterized by a significant reduction of fauna brought about by either a regression to poorer marine conditions or an increased sediment accumulation rate resulting in dilution of the above fauna. Due to the poor nature of the faunas in this interval, it is hard to establish its exact age. The Prince Creek Fm.-Seabee Fm. boundary probably lies within this interval (possibly at 3440'-45').

ENVIRONMENT: Probable sediment diluted shallow marine to nonmarine

4300-5920' — Cenomanian to Turonian
Ninuluk Fm.-Seabee Fm.

This interval contains a rare occurrence of Trochammina rutherfordi along with significant occurrences of fishbone fragments and bentonitic "paper" shales. The paucity of foraminifera together with the abundance of organic material suggests that these strata were deposited in a basin that was sediment starved, resulting in reducing bottom conditions and probably a slow accumulation of organic rich sediments. This type of sedimentation is similar to that described for the Shale Wall Member of the Seabee Formation.

ENVIRONMENT: Restricted Marine (Starved Basin)

5920-7830' — Probable Early Cretaceous (Undiff.)
Torok Fm.?

This interval is poorly fossiliferous and contains mostly pyritized radiolaria and Inoceramus prisms. Lithocampe sp. N And "Pebble Shale" occur near the base of this unit immediately above a large regional faunal change to forms suggestive of the Berriasian stage. Palynological evidence indicates that this interval is no older than Aptian in age. These strata are predominantly brownish gray pyritic siltstones and "paper" shale; this coupled with the lack of benthonic foraminifera and the presence of pyritized radiolaria suggests that the depositional site was open to marine currents but the bottom was oxygen deficient (reducing) thus proving unsuitable for the existence of, or preservation of, foraminifera.

ENVIRONMENT: Marine (Starved Basin)

7830-10,080' — Jurassic to Earliest Cretaceous
Xinzak Fm. to Okpikruak Fm.

The upper portion of this interval (above 8190') contains such forms as Gaudryina tailleuri and Conorboides "C" indicating a probable Berriasian Age for these strata. The Jurassic fauna contains some forms that have been published as Early Jurassic Age but in this report the Jurassic is not subdivided since these earlier published ranges were based on minimal data and are probably facies related ranges. Thin sandstones occur at

7830-10,080' (cont'd.)

the top and at the bottom of this interval. The probable Berriasian Age of the Upper Sandstone unit indicates that it may be an age equivalent to the Kuparuk River Sandstone. The probable Jurassic Age of the basal sandstone unit together with its brown saccharoidal nature suggest that it could be a Sag River Sandstone equivalent. The diverse nature of these faunas coupled with the rare but relatively consistent occurrence of calcareous foraminifera suggest that these strata were deposited in Neritic to Upper Bathyal depths probably associated with only minor periods of high turbidity.

ENVIRONMENT: Fluctuating Middle Neritic to Upper Bathyal

10,080-10,350' — Triassic
Shublik Fm.

The Triassic Age of this unit is based on the top occurrence of Astacolus connudatus and subsequent occurrences of Lingulina porrecta, Pseudoglandulina simpsonensis and fragments of Monotis sp. This unit is lithologically composed of brown shelly silty mudstone with frequent occurrences of pyrite, glauconite and ostracods.

ENVIRONMENT: Probable Middle to Outer Neritic

10,350-11,520' — Permian-Triassic
Sadlerochit Fm.

The fauna rapidly drops out in this unit, but there are enough faunal occurrences to suggest some interbedded marine intervals in the Sadlerochit Fm. in this well. This unit is lithologically similar to the Ivishak Member of the Sadlerochit Fm. with the exception of the bottom two samples (11,340-11,520') which contain a heavily glauconitic sandstone suggestive of the Echooka Member of the Sadlerochit Fm.

ENVIRONMENT: Probable fluctuating Marginal Marine to Nonmarine

11,520-13,980' — Late Mississippian-Middle Pennsylvanian
Lisburne Group

Due to the inconsistent nature of ditch sample data and the limited availability of core data, we have in certain instances incorporated information on this section from the examination of other available material at no additional charge.

Generally throughout the coastal area westward of the Prudhoe Bay State #1 well, the Lisburne Group can be divided into three lithologic units:

1. Upper Limestone Unit
2. Dolomite
3. Lower Limy Unit

The upper limestone unit is about 1700 feet thick in this well. It consists of bryozoan-pelmatozoan foraminiferal grainstone and oolitic foraminiferal grainstone. Faunas indicative of the Middle Pennsylvanian (Zone 21) occur between 11,520 feet and 12,240 feet. Faunas indicative of the Early Pennsylvanian (Zone 20) occur between 12,240 feet and 12,840 feet. The Zone 20/Zone 21 boundary was placed on the basis of a decrease in abundance of Globivalvulina spp. and Eoschubertella rykonensis. The strata between 12,840 feet and 13,230 feet range in age from Zone 18 to Zone 20 (Latest Mississippian to Earliest Pennsylvanian). The upper limestone unit represents a shallow shoaling shelf carbonate facies.

The dolomite unit is about 330 feet thick (13,230-13,560'). This unit is poorly fossiliferous and masked by cavings in ditch samples. In other areas where dates have been obtained within or bracketing this unit, it was found to be Zone 17 or Zone 18 in age (Chesterian).

The lower limy unit is 420 feet thick (13,560-13,980'). The occurrence of coral wall debris as high as 13,650-80' in this interval suggests that the strata below this depth are probably Zone 16 or older in age (Late Meramecian-Earliest Chesterian). This unit consists primarily of bryozoan-pelmatozoan packstones and wackestones and represents a shallow platform cyclic sequence.

ENVIRONMENT: Probable Middle Neritic to Supratidal

13,930-14,950' Upper Mississippian
Endicott Group

This interval is characterized by a change to dominantly red-brown shale with frequent coal occurring below 14,670 feet, suggestive of the Kekiktuk Fm. Strata between 14,400 feet and 14,640 feet contain rare evidence for an Early to Middle Meramecian age (Zone 13 or older).

ENVIRONMENT: Possible Inner Shelf to Nonmarine

14,950-15,110' T.D. Indeterminate
Probable Naruokpuk Fm.

This last unit is picked on the basis of a lithologic change to argillite. The top of the argillite was at 15,000 feet but the top of the unit was moved up 50 feet to coincide with an electric log change at 14,950 feet. There were no foraminifera recovered from this interval.

ENVIRONMENT: Indeterminate

N. Kalikpik #1
(Palynology)

PALYNOLOGY REPORT

Introduction

A total of 427 samples were processed and analyzed for palynological age determinations. This total consisted of 80 ditch, 35 sidewall core and 312 conventional core samples. The samples were taken from the interval 80 feet to the total depth of 7395 feet.

Included in this report are two (2) distribution charts illustrating the palynomorph recoveries.

Summary of Results

80-1010'

Undifferentiated bisaccates (A).

Alterbia acuminata (C-A), Chatangiella spp. (A), Laciniadinium spp. (F-C), Exocrosphaeridium bifidum (R).

Odontochitina operculata (A), Trithyrodinium suspectum (R-C), Spongodinium delitianae (R).

AGE: Late Cretaceous (Santonian-Campanian) P-M14

ENVIRONMENT: Marine

1010-1280'

Undifferentiated bisaccates (A), Gleichenidites senonicus (F).

The dinocyst count drops significantly through this interval. Most of the species seen in the above interval occur herein with less frequency.

AGE: Late Cretaceous (possible Turonian-?Coniacian) P-M15

ENVIRONMENT: Marginal Marine

The decrease in dinocyst abundance is characteristic of the intervals assigned questionably to the Coniacian and Turonian ages in the area of the Alaska north slope.

1280-2390'

Vitreisporites pallidus (R), Gleichenidites senonicus (F-A), Aequitriradites spinulosus (R).

Odontochitina operculata (R-F), Palaeoperidinium cretaceum (R-C), Oligosphaeridium anchophorum (R).

Kenaeus gerstioides (R, sporadic). Cribroperidinium edwardsi (R-F).

AGE: Late Cretaceous (probable Cenomanian) P-M16?

ENVIRONMENT: Marine

The continuous occurrence of C. edwardsi is the main criterion for tentatively placing this interval in the Cenomanian. The principal marker, Pseudoceratium, used to distinguish the Cenomanian in this area was not encountered until below.

2390-2570'

The dinocyst assemblage is similar to the above interval with the addition of Pseudoceratium cf. dettmannae.

AGE: Late Cretaceous (Cenomanian) P-M16

ENVIRONMENT: Marine

2570-5876'?C

Undifferentiated bisaccates (C-A), Vitreisporites pallidus (R, sporadic), Gleichenidites senonicus (R, sporadic), Trilobosporites spp. (R, sporadic).

Odontochitina operculata (R-C), Oligosphaeridium complex (R-C), Palaeoperidinium cretaceum (R-C), Luxadinium proteum (R), Spinidinium vestitum (R), Genus "W" (R, sporadic).

2570-5876'?C (con't.)

Pseudoceratium retusum (R-F), Batioladinium jaeger1 (R-F).

AGE: Early Cretaceous (Middle-Late Albian) P-M17

ENVIRONMENT: Marine

The base of this interval remains unclear but was placed at the lowest occurrence of S. vestitum, a Middle to Late Albian species, in the core samples (see figure 2). However, S. vestitum was recovered from a sidewall core sample at 6207 feet and in ditch samples down to 6910 feet. Presumably these latter occurrences are due to derivation from uphole and mud contamination.

5876-6990'

Odontochitina operculata (R-C), Oligosphaeridium complex (R-A), Palaeoperidinium cretaceum (R-C), Cribroperidinium edwardsi (R, sporadic), Gardodinium trabeculosum (R, sporadic), Batioladinium jaeger1 (R), Pseudoceratium retusum (R).

AGE: Early Cretaceous (Aptian-Early Albian) P-M18

ENVIRONMENT: Marine

6990-7047'C

Oligosphaeridium complex (C-A), Odontochitina operculata (F-A), Palaeoperidinium cretaceum (F-A), Gardodinium trabeculosum (F-A), Batioladinium jaeger1 (R-F).

AGE: Early Cretaceous (possible Neocomian) P-M19?

ENVIRONMENT: Marine

The highly organic shale with a prolific dinocyst assemblage is characteristic of the Neocomian section. This assemblage, however, lacks the age restrictive markers and, therefore, is tentatively given a Neocomian age.

7047-7141'?C

Oligosphaeridium complex (thick-wall variety)(F-A), Gardodinium trabeculosum (F-A), Hystrichosphaeridium cooksonae (F-A), Pareodinia ceratophora (R), Herendeenia pisciformis (R-C), Batioladinium pelliferum (R-C), Conyaulacysta serrata (R-C), Nuderongia spp. (F-A), Prionodinium alaskensis (R-F), Dimidiadinium unguiculum (R-A).

AGE: Early Cretaceous (Neocomian) P-M19

ENVIRONMENT: Marine

The numerous Neocomian marker species in this interval places the age at Hauterivian-Barremian.

The base of this interval (the Jurassic/Cretaceous boundary) is questioned because it should possibly be located at 7137 feet. Sample 7136 in Core #9 represents the base of the continuous Cretaceous samples. Sample 7141 in Core #10 represents the top of the continuous Jurassic samples. The ages in this problem interval are given below.

Core #8 7136'	=	Cretaceous
Core #9 7136'	=	Cretaceous
" " 7137'	=	Jurassic
" " 7138'		
" " 7139'		
" " 7140'		
Core #10 7140'	=	Cretaceous
" " 7141'	=	Jurassic

It is probable that this confusion is due to a sampling error in the cores, but it could possibly be the real rock sequence in this interval. Whatever the reasons, this interval is only five (5) feet thick and remains rather insignificant.

7141-7395'C T.D.

Conyaulacysta cladophora (R-A), Nannoceratopsis pellucida (F-A), Pareodinia spp. (R-C), Sirmiodinium grossi (R-C), ?Conyaulacysta sp. (R), Wanaea cf. acollacta (R-F).

AGE: Late Jurassic (Oxfordian) P-M22

ENVIRONMENT: Marine

ADDENDUM

TO

PALYNOLOGY REPORT

A total of 15 core samples were processed and examined for palynological age determinations. These samples represent two (2) resamplings of the repeated Jurassic/Cretaceous boundary in the subject well. The results are shown on the enclosed species distribution chart.

This study produced essentially the same results as reported in the initial report. The more detailed sampling herein shows more mixture of Jurassic species occurring with Neocomian forms; however, this was also seen, to a lesser extent, in the initial examinations. The mixing is assumed to be due to reworking of Jurassic rocks into the Neocomian section. The reason for the repeated Neocomian strata still remains an unsettled question at this time.

SUMMARY OF PALYNOLOGY REVISIONS

80-1010'	:	Late Cretaceous, Santonian-Campanian (P-M14).
1010-1490'?	:	Late Cretaceous, ?Turonian-?Coniacian (P-M15).
1490-2390'	:	Late Cretaceous, possible Cenomanian (P-M15?).
2390-2570'	:	Late Cretaceous, Cenomanian (P-M16).
2570-5876'?	:	Early Cretaceous, Middle-Late Albian (P-M17).
5876-6990'	:	Early Cretaceous, Aptian-Early Albian (P-M18).
6990-7047'C	:	Early Cretaceous, possible Neocomian (P-M18a).
7047-7137'	:	Early Cretaceous, Neocomian (P-M19).
7137-7395'	:	T.D. Late Jurassic, Oxfordian (P-M22).

N. Kalikpik #1 (Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1" to 100' faunal distribution log and four faunal checklists on the Kalikpik #1 well. The conclusions presented in this report are based on the processing, picking and examination of all ditch samples, generally composited on 30 to 40 foot intervals, 26 sidewall core samples, and 312 conventional core samples. These samples represent the interval 80 feet to 7395 feet (total depth). A generalized age summary of the well is provided below.

80-1100'

Anomalinoides talaria, A. pinguis, Dorothia smokyensis, Haplophragmoides rota, Praebulimina venusta, Textularia gravesori, Verneuilinoides fischeri, V. cf. bearpawensis, Trochammina ribstonensis, T. albertensis, T. whittingtoni, Cenosphaera spp., Spongurus spp., Bathycyrtis sp., Archicorys sp., Thecorys sp., Dictyomitra spp., D. multicostata, Spongodiscus spp., Rhopalodictyum sp., Spongotaurus sp., Stylospongia sp., and Xiphosphaera sp.

The above assemblage is characteristic of the Santonian Schrader Bluff Formation. Faunas obtained throughout this interval are indicative of oscillating middle neritic to upper bathyal (non-turbid) deposition.

AGE: Late Cretaceous Senonian (F-5)

ENVIRONMENT: Middle Neritic to Upper Bathyal (non-turbid)

1100-1340'

This interval is characterized by a large reduction in fauna, and no new occurrences. It probably represents a non-marine or marginal marine intertongue (Tuluvak equivalent?). The age is spread in this report since the fauna is insufficient to allow for a precise age determination.

AGE: Late Cretaceous Turonian to Coniacian (F-5 to F-6)

ENVIRONMENT: Nonmarine to Marginal Marine

1340-2030'

Based on occurrences of Pseudoclavulina hastata and Arenobulimina torula at 1340 feet, and Ionodiscus ? at 1910 feet this unit is considered to be Turonian to Coniacian (F-6) in age. These strata probably represent inner to middle neritic deposition.

AGE: Late Cretaceous Turonian to Coniacian (F-6)

ENVIRONMENT: Inner to Middle Neritic

2030-2450'

The upper portion of this interval contains Ionodiscus A, I. B, and Gaudryina irenensis. The basal portion contains Trochammina rainwateri, T. rutherfordi, and Flabellammina chapmani. These occurrences suggest a Cenomanian to Turonian age for these strata. While these strata are bentonitic, organic rich and contain frequent fishbone fragments, they are sandier than typical "fishbone shale".

AGE: Late Cretaceous Cenomanian to Turonian (F-7?)

ENVIRONMENT: Probable Neritic (open marine)

2450-2570'

This fauna contains: Saccammina lathrami, Trochammina rainwateri, T. mcmurrayensis, T. rutherfordi, Hippocrepina parkadalei, Gaudryina cf. hedgori, and pyritized Cenosphaera spp. This association appears to be a transitional fauna which could be either Albian or Cenomanian in age. These strata probably represent turbid inner to middle neritic deposition.

AGE: Early to Late Cretaceous Albian to Cenomanian (F-8)

ENVIRONMENT: Probable Inner to Middle Neritic (turbid)

2570-4265'

Haplophragmoides copagorukensis, H. cf. excavata, H. cf. liuki, Trochammina rainwateri, T. mcmurrayensis, T. umiatensis, Verneuilinoides borealis, Ammobaculites fragmentarium, A. wenonahae, Gavelinella scitata,

Lenticulina topagorukensis, Valvulineria lostcamiei, Globorotalia alaskensis, Miliammina manitobensis, M. swumensis, Dentalina? dettermani, Vaginulina cf. kochii, Astacolus peristriatus, Palmimorphina ruckerae, Paaminopelta bowsheri, Saracenaria projectura and Bathysiphon vitta among others, characterize these strata. The above association is typical of the Verneuilinoides borealis faunal zone and is Middle to Late Albian age (F-9). The environments represented by these diverse assemblages were probably middle to outer neritic associated with relatively clear (non-turbid) waters.

AGE: Early Cretaceous Middle to Late Albian (F-9)

ENVIRONMENT: Middle to outer Neritic (clearwater)

4265-5160'

This interval is characterized by occurrences of the following: Bathysiphon vitta, Lenticulina topagorukensis, Verneuilinoides borealis, Dentalina? dettermani, Eurycheilostoma grandstandensis, Ammobaculites fragmentarius, A. wenonahae, Paaminopelta bowsheri, Globorotalites alaskensis, Textularia topagorukensis, Ammodiscus rocularius, Trochamminoides spp., Miliammina manitobensis, Haplophragmoides topagorukensis, H. cf. excavata, and Cenosphaera spp. (pyritized). The above fauna indicates a Late Aptian to Early Albian (P-10) age. The environments represented by these moderately diverse

4765-5180' (con't.)

assemblages were probably somewhat turbid inner to middle neritic depths with short periods of lesser turbidity.

AGE: Early Cretaceous
Late Aptian to Early Albian (F-10)

ENVIRONMENT: Inner to Middle Neritic
(fluctuating turbidity)

5180-6970'

A pyritized radiolarian fauna characterizes these strata together with rare occurrences of agglutinated and calcareous foraminifera. Pyritized radiolaria of the following genera occur: Cenosphaera spp., Spongodiscus sp., Lithocampe spp., Dictyomitra spp., Gethocyrtis? sp., and Stichomitra sp. Lithocampe N ceps near the base of this unit at 6862 feet. According to Ramsay (1970) this zone of pyritized radiolaria separates the Verneuilinoides borealis zone from the Gaudryina taillauri zone, and is probably Aptian to Early Albian in age. We feel that it is probably Aptian in age, but our data is tentative at this time. Due to the preservation of this fauna, all that can be said about the environment of deposition is that it was marine and ope to oceanic currents. These strata may represent deep marine (below compensation depth) basal slope deposits. This is a possibility since calcareous foraminifera are very scarce in this interval and could represent caved specimens when they do occur.

AGE: Early Cretaceous
Aptian (F-11)

ENVIRONMENT: Open Marine

6970-7137'(?)

Occurrences of Gaudryina taillauri, Glomospirella S. Ammobaculites erectus, A. reophacoides, Trochammina squamata, T. cf. sabini, T. cf. instowensis, T. cf. canningensis, Ammodiscus gackenbiensis, Thurammoides septagonalis, Haplophragmoides deoflatis, Conorboides cf. hofkeri, Quadrimorphina 4, Praebulimina 2, Frondicularia cushmani, Lituotuba gallupi, Vaginulina cf. procera, Citharina cf. harpa, C. cf. acuminata, Quinqueloculina 2, Gavelinella cf. barrabiana and Lenticulina ouachensis among others, indicate a Neocomian (F-12 to F-13) age for these strata. Several forms with a great deal of affinity for European Neocomian species occur in these strata for the first time. This is probably due to the saturation sampling provided by the one foot conventional core sample intervals. Common to abundant rounded frosted quartz floaters also dominate this interval, especially in the core samples. The abundance and diversity of these assemblages suggests a clearwater middle neritic to upper bathyal depositional environment. The base of this interval is not clear at this time. It probably lies in Core #9 at 7137 feet, but it could belong at 7141 feet in Core #10. This problem will be the subject of a future addendum at such time as Cores #9 and #10 have been re-examined.

AGE: Early Cretaceous
Neocomian (F-12 to F-13)

ENVIRONMENT: Middle Ne...ric to Upper Bathyal
(clearwater)

7137?-7395'

An Oxfordian (F-16) age is indicated for this interval based on the following assemblage: Ammobaculites alaskensis, Astacolus dubius, A. pediscus, Lenticulina audax, L. quenstedti, Marginulinopsis phragmites, Saracenaria coppatrukensis, Trochammina instowensis, T. canningensis, Epistomina metensis, Reophax metensis, Nodosaria lirulata, N. orthoscocha, Vaginulinopsis cf. thomasi, Citharina entypometus, C. fallax, Vaginulina sherborni, Conorboides cf. hofkeri, Textularia arenoplecta, Frondicularia lustrata, and Ophthalmidium saskatchewanensis. Once again the abundance and diversity of these assemblages suggests a clearwater middle neritic to upper bathyal depositional environment.

AGE: Late Jurassic
Oxfordian (F-16)

ENVIRONMENT: Middle Neritic to Upper Bathyal
(clearwater)

N. Kalikpik #1
Sec. 3, 13N/2W, U.B.M.
North Slope, Alaska

ADDENDUM
TO
FORAMINIFERA REPORT

Enclosed you will find two faunal checklists illustrating the results of two separate resamplings of Cores 9 and 10, and a single resampling of Core 8. It is our understanding that resampling #1 represents material from Cores 9 and 10 reposited in Anchorage, and resampling #2 represents material from Cores 8, 9 and 10 reposited at Menlo Park. A sample by sample age listing and summary of the results of the examination and interpretation of these 25 samples is presented below.

Resampling #1

Core 9

7136.0'	Oxfordian (mixed with Neocomian)
7136.5'	Oxfordian (mixed with Neocomian)
7136.7'	Oxfordian
7137.2'	Oxfordian
7137.7'	Indeterminate
7138.2'	Probable Oxfordian
7139.0'	Oxfordian
7139.5'	Oxfordian

Core 10

7140.2'	Possible Neocomian (with reworked Oxfordian)
7140.5'±	Oxfordian
7140.6'±	Oxfordian
7140.8'±	Oxfordian
7141.0'	Oxfordian

Resampling #2

Core 8

7134'	Neocomian
7135'	Neocomian

Core 9

7136'	Oxfordian
7137'	Oxfordian
7138'	Oxfordian
7139'	Oxfordian

Core 10

7140'	Oxfordian
7140'3"	Indeterminate
7140'9"	Possible Neocomian
7141'	Oxfordian
7142'	Oxfordian
7143'	Oxfordian

Kugrua #1
(Palynology)

PALYNOLOGY REPORT

Introduction

A total of 212 samples were processed and analyzed for palynological age determinations. The total consisted of 143 ditch, 34 sidewall and 35 conventional core samples. The well was examined from 100 feet to the total depth of 12,594 feet.

This report includes two (2) palynomorph distribution charts.

Summary of Results

100-6912'SWC

Undifferentiated bisaccates (A), Lycopodiumsporites spp. (R), Densoxporea (R, reworked); rare sporadic occurrences of reworked Triassic species.

Cyclonephelium distinctum (R), Odontochitina operculata (R-F), Oligosphaeridium complex (R-C), Paleoperidinium cretaceum (R-C), Pseudoceratium retusum (R), Rudergnia asymmetrica (R-F), Batioladinium jaegeri (R-F), Gardodinium trabeculosum (R); numerous rare occurrences of reworked Triassic, Jurassic, and Neocomian dinocysts.

AGE: Early Cretaceous (Aptian-Albian) P-K18 to P-K17

ENVIRONMENT: Marine

The absence of any restrictive Middle to Late Albian species indicates that possibly this interval is entirely Aptian to Early Albian (P-K18) in age.

6912-7202'C

Oligosphaeridium complex (F-A), Gardodinium trabeculosum (R-F), Batioladinium jaegeri (R), Gonyaulacysta serrata (R-F), Prionodinium alaskense (R-F).

AGE: Early Cretaceous (Neocomian) P-K19

ENVIRONMENT: Marine

The presence of P. alaskense in this section places the age in Hauterivian to Barremian.

7202-10,480'

Undifferentiated bisaccates (R-C). Gleichenidites senonicus (R-F), Cicatricosisporites australiensis (R), Classopollis classoides (R-C; includes many questionable identifications).

?Gonyaulacysta ambigua (R; at top of interval).

AGE: Triassic-Jurassic

ENVIRONMENT: Marine-Nonmarine

A few poorly preserved dinocysts of probable Jurassic affinities were seen in the top of this interval. These forms are about the only positive evidence to indicate a possible Jurassic age and also the only suggestion of marine depositional conditions.

The overall palynomorph recoveries and preservation of fossils are quite poor through this interval.

10,480-11,032'C

Taeniaesporites spp. (R), ?Lundbladispora sp. (R), Striatites richteri (R-F); indeterminate spores (F-A).

Microhystridium spp. (A, sporadic).

AGE: Early Triassic P-T18

ENVIRONMENT: Marginal Marine

11,032-11,130'

Vittatina sp. (R), Lueckisporites sp. (R).

Microhystridium spp. (R).

AGE: Permian P-T15

ENVIRONMENT: Nonmarine-possible Marginal Marine

11,130-12,330'

Many of the species seen above occur in this interval of limestone lithology, however these forms are presumed derived from up-hole.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

12,330-12,594' T.D.

Potonieisporites sp.

AGE: Probable in Pennsylvanian P-T19

ENVIRONMENT: Marginal Marine?

The only significant palynomorph seen in this interval were very sparse and poorly preserved specimens of Potonieisporites. These specimens provide the evidence for a probable Pennsylvanian age.

Kugrua #1
(Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1" to 100' faunal distribution log and 3 faunal checklists on the Kugrua #1 well. The conclusions presented in this report are based on the processing, picking and examination of 392 ditch samples, generally composited on 30 to 40 foot intervals, 35 conventional core, and 32 sidewall core samples. Sixty-one thin sections were prepared on 10 to 30 foot ditch intervals below 11,130 feet. A generalized age summary of the well is provided below.

100-2760'

Haplophragmoides topagorukensis, H. cf. excavata, Saccammina lachrami, Trochammina nomugrayensis, Verneuilinoides borealis, Gavelinella stictata, Glomospira corona, Hippocrepina barkedalei, Miliammina manitobensis, M. swunensis, and Bathysiphon vitta among others, characterize these strata. The above association is typical of the Verneuilinoides borealis faunal zone and is Middle to Late Albian age (F-9). The environments represented by these assemblages were probably inner to middle neritic associated with fluctuating turbidity.

AGE: Early Cretaceous
Middle to Late Albian (F-9)

ENVIRONMENT: Inner to Middle Neritic
(fluctuating turbidity)

2760-4110'

This interval is characterized by occurrences of the following: Bathysiphon vitta, Valvulineria loetterglai, Verneuilinoides borealis, Ammobaculites fragmentarius, A. wenonahee, Saracenaria dutroi, S. projectura, Marginulinopsis jonesi, Textularia topagorukensis, Ammodiscus rotalarius, Miliammina manitobensis, Haplophragmoides topagorukensis, H. cf. excavata, and Saccammina lachrami. The above fauna indicates a Late Aptian to Early Albian (F-10) age. The environments represented by these moderately diverse assemblages were probably somewhat turbid inner to middle neritic depths with short periods of lesser turbidity.

AGE: Early Cretaceous
Late Aptian to Early Albian (F-10)

ENVIRONMENT: Inner to Middle Neritic
(fluctuating turbidity)

4120-6890'

A pyritized radiolarian fauna characterizes these strata together with rare occurrences of agglutinated and calcareous foraminifera. Pyritized radiolaria of the following genera occur: Cenosphaera spp., Spongodiscus spp., Lithocampe spp., and Dictyomitra spp. Lithocampe N tops just below the base of this unit at 6890 feet. According to Ramsay (1978) this zone of pyritized radiolaria separates the Vermeuiliniodes borealis zone from the Gaudryina taillouri zone, and is probably Aptian to Early Albian in age. We feel that it is probably Aptian in age, but our data is tentative at this time. Due to the preservation of this fauna, all that can be said about the environment of deposition is that it was marine and open to oceanic currents.

AGE: Early Cretaceous
Aptian (F-11)

ENVIRONMENT: Open Marine

6890-7220'

Occurrences of Gaudryina taillouri, G. tappanae, Glomospirella E, G. arctica, Ammobaculites erectus, arenaceous spp. (large, coarse), Trochammina squamata, T. conicominuta, T. cf. instowensis, Gaudrynella irregularis, Glomospira subarctica, Pseudobolivina sp., Haplophragmoides duplicata, H. corongis, H. inflatigrandis, Conorboides cf. umiatensis, Praebulimina 2, Saracenaria grandstandensis, Lituotuba gallupi, Globulina exsetta, Quinqueloculina 2, and Lenticulina sp. (raised sutures) among others, indicate a Neocomian (F-12 to F-13) age for these strata. Common to abundant rounded frosted quartz floaters also dominate this interval. The top of the Neocomian interval is placed at 6890 to 6920 feet in ditch samples, but sidewall cores from 6900 feet to 6912 feet indicate that the contact may lie somewhere between these two samples. This would make sense inasmuch as Lithocampe N usually tops in the basal F-11 beds. The abundance and diversity of these assemblages suggests a clearwater middle to outer neritic depositional environment.

AGE: Early Cretaceous
Neocomian (F-12 to F-13)

ENVIRONMENT: Middle to Outer Neritic
(clearwater)

7220-7330'

Based on occurrences of Gaudryina millori, Trochammina instowensis, T. gryci, T. sp. (small, plano-convex), T. cf. canningensis, Haplophragmoides canui, Ammobaculites alaskensis, and Involutina orbis, it is difficult to tell whether this interval is Latest Jurassic (Tithonian) or Earliest Cretaceous (Berriasian) in age. The domination of this assemblage by agglutinated foraminifera suggests a turbid neritic depositional site.

AGE: Latest Jurassic to Earliest Cretaceous
(F-14 to F-15)

ENVIRONMENT: Neritic
(turbid)

7330-7450'

This very thin interval appears to be Tithonian (F-15) based on the presence of: Gaudryina millari, G. leffingwelli, Haplophragmoides canui, Trochammina canningensis, T. sablei, T. topagorukensis, Glomospirella B, Globulina topagorukensis, and Coprogloides cf. hofkeri. These strata were probably deposited in inner to middle neritic depths associated with varying amounts of turbidity.

AGE: Late Jurassic
Tithonian (F-15)

ENVIRONMENT: Inner to Middle Neritic
(fluctuating turbidity)

7450-8020'

Marginulina prima, M. cf. perguleti, Saracenaria oxfordiana, Frondicularia lustrata, Eoguttulina liassica, Vaginulina curva, Gaudryina taillouri, Haplophragmoides canui, Ammodiscus thomsi, Recurvoides turbinatus, Ammobaculites alaskensis, Lenticulina audax, Globulina topagorukensis, Textularia areoplecta, Trochammina canningensis, T. gryci, T. sablei, and T. topagorukensis indicate that these strata are probably pre-Tithonian age. The lack of some of the Oxfordian forms found in the underlying interval suggest that this assemblage could be as young as Kimmeridgian in age. These strata were probably deposited in middle neritic to upper bathyal water depths.

AGE: Late Jurassic
Oxfordian to Kimmeridgian (F-16)

ENVIRONMENT: Middle Neritic to Upper Bathyal

8020-8890'

Saracenaria topagorukensis, Marginulinopsis phragminea, Citharina fallax, C. cf. inaequistriata, Lingulina cf. hathra, Trochammina rostovzevi, T. sp. (small, high spired), Lenticulina quenstedti, Astacolus pediacus, A. calliopsis, Dentalina cf. setacia, D. tenuistriata, Vaginulina sharborni, Involutina chersdosoira, Eoguttulina metensis, and Nodosaria cf. sphingothelma, among others, indicate an Oxfordian (F-16) age. The abundant and diverse assemblages associated with these strata suggest an outer neritic to bathyal clearwater environment of deposition.

AGE: Late Jurassic
Oxfordian (F-16)

ENVIRONMENT: Outer Neritic to Bathyal
(clearwater)

8890-9330'

These strata are considered Early to Middle Jurassic age based on occurrences of Ammobaculites vetusta, Triplasia sp., Astacolus dubius, Lenticulina bicostata, L. cf. d'orbigny, Nodosaria setulosa, N. mitis, N. radiata, N. orthostoecha, Neophax densa, and frequent to abundant pyritized radiolaria of the genera Cenosphaera spp., Dictyomitra spp., Spongodiscus spp., Lithocampe spp., Cyrtocapsa sp., Rhopalastrum spp., and Paculibracchium B. The abundance of radiolaria suggest open marine conditions. The depositional environment for these rocks was probably middle neritic to as deep as upper bathyal.

AGE: Early to Middle Jurassic
(F-17 to F-18)

ENVIRONMENT: Probable Middle Neritic to
Upper Bathyal
(open marine)

9330-9700'

It was necessary to spread the age of this interval since it contains a mixed assemblage. A fauna similar to the overlying interval occurs herein, along with questionable reworked Triassic (F-19) forms. Occurrences of Astacolus cf. connudatus and Nodosaria cf. larina suggest a Triassic (F-19) age, but the interval is lacking a complete F-19 assemblage. These strata probably represent inner to middle neritic deposition.

AGE: Triassic to Early Jurassic
(F-18 to F-19)

ENVIRONMENT: Probable Inner to Middle Neritic

9700-9970'

Astacolus connudatus, Nodosaria shublikensis, N. larina, Lingulina borealis, Pseudoglandulina simpsonensis, Triphasmina helicta, and Monotis fragments occur throughout these beds. These faunas appear to represent open marine middle neritic conditions. A distinctive dark brown to black calcareous pebbly sandstone similar to that described by Tappan (1951, pp. 3-4) from the basal 25 to 50 feet of the Shublik Fm. in the Sadlerochit River Region tops at 9840 to 9910 feet in this well.

AGE: Triassic
(F-19)

ENVIRONMENT: Middle Neritic
(open marine)

9970-11,130'

A poor fauna consisting of Ammobaculites spp., A. sp. (small, bell-shaped chambers), Tolypammina glarosa, Pseudoglandulina densa, Nodosaria liratella, Ammodiscus B, and pyritized radiolaria occurs through most of this interval. This assemblage is indicative of Zonule F-20, and is probably still Triassic in age. A lithologic change to glauconitic quartzitic sandstone at 10,980 to 11,110 feet (11,031' Core) suggests that we are probably in the Permian Echooka Formation at that point. The top of this unit is placed on the basis of the F-20 fauna, and the base of the aforementioned basal Shublik Fm. pebbly sandstone. We recognize that the strata associated with the uppermost 400 feet of this interval are not typical Sadlerochit Fm., and it is possible that the F-20 Faunule may climb into the Shublik Fm. So far we have only observed this boundary in ditch samples where it appears that the F-20 Faunule is restricted to the Sadlerochit Group. These strata probably represent nonmarine to inner neritic deposition.

9970-11,130' (con't.)

AGE: Permo-Triassic (F-20)

ENVIRONMENT: Nonmarine to Inner Neritic

11,130-12,594' T.D.

Generally throughout the North Slope Area, the Kuparuk Group can be divided into three lithologic units:

1. Upper Limestone Unit
2. Dolomite Unit
3. Lower Limy Unit

The Upper Limestone Unit is 1444+ feet thick, and appears to be the only unit penetrated in this well.

Grainstones and packstones between 11,130 feet and 11,600 feet are characterized by nodosariids, cornuspirids, porcellaneous spp., Protonodosaria sp., and very rare Paleoaplysina sp. These species indicate that these beds are Early Permian (F-21). The base of this interval, and the top of the underlying Pennsylvanian carbonates is very difficult to pick since it is based primarily on the lowest occurrence of Protonodosaria sp. and we are dealing entirely with ditch samples.

Strata between 11,600 feet and 12,380 feet contain frequent to common Trepeilopsis sp., Earlandia spp., Pseudoglomospira sp., Stacheoides meandriformis, and Mitcheldeania sp., together with rare Bisericella parva, Koschubertella yukonensis, Pseudostaffella sp., Monotaxinoides multivolucis, Volvotextularia mississippiana, Globivalvulina bulloides, and Stylococcodium sp. Since there was no noticeable burst of Koschubertella sp. or Pseudostaffella sp., we feel that the strata between 11,600 feet and 11,380 feet are no older than Mamet's Zone 22 and could be as young as Mamet's Zone 24 (see Mamet, 1971, pp. 203 & 204)*. The rare, but continuous, occurrence of oolites below 12,380 feet may be an indication that the carbonates below that point are possibly as old as the uppermost portion of Mamet's Zone 21. These strata represent a shallow shelf carbonate platform suite.

AGE: Middle Pennsylvanian to Early Permian (Mamet's Zone 21 to A.M.A. F-21)

ENVIRONMENT: Neritic (shoaling shelf)

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.

7450-8070' : 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.

S. Meade #1
(Palynology)

PALYNOLOGY REPORT

Introduction

A total of 179 samples were processed and analyzed for palynological age determinations. The total consisted of 100 ditch, 11 sidewall, and 68 conventional core samples. The sample coverage extends from 95 feet to the total depth of 8519 feet and incorporates the redrilled portion of the well.

Included in this report are two (2) charts depicting the palynomorph distribution in all the South Meade #1 samples examined.

Summary of Results

95-6560'

Undifferentiated bisaccates (C-A); rare sporadic occurrences of Vitreisporites pallidus, Aequitriradites spinulosus; numerous, rare occurrences of Triassic grains.

Satiladinium jaegeri (R), Cyclonephelium distinctum (R-F), Odontochitina operculata (R-F), Oligosphaeridium complex (R-F), Muderongia spp. (R), Genus "H" (R, sporadic); numerous occurrences of reworked Triassic, Jurassic and Neocomian species.

AGE: Early Cretaceous (Aptian-Albian) P-M18 to P-M17

ENVIRONMENT: Marine

No restrictive Albian dinocyst species were observed in this interval. Possibly this section is entirely correlative to the Aptian-Early Albian, P-M18, zonula.

Below approximately 4900 feet there is a slight decrease in dinocyst abundance reflected in the ditch samples. A decrease in marine conditions is supported at least in part by the lack of dinocysts in Core #3 (4950-4960').

6560-6830' SWC

Undifferentiated bisaccates (C-A); scattered occurrences of Gleichenidites senonicus, Classopollis classoides, Cicatricosisporites australiensis.

Oligosphaeridium complex (F-A).

AGE: Early Cretaceous (probable Neocomian) P-M20 to P-M19

ENVIRONMENT: Marine

The main evidence for Cretaceous was the O. complex influx as seen in the sidewall cores 6654 feet and 6830 feet. Nothing else of importance was observed to be indigenous in the samples through this interval. The O. complex specimens were all dark in color, poorly preserved, and fragmented. Lacking any other significant forms only a tentative age assignment is possible.

6830-7600'

Undifferentiated bisaccates (C), Gleichenidites senonicus (R), Classopollis classoides (R), Cicatricosisporites australiensis (single).

No indigenous dinocysts.

AGE: Jurassic-Cretaceous undifferentiated

ENVIRONMENT: No evidence of marine

7600-7840'

Gleichenidites senonicus (R), Classopollis classoides (R), indeterminate spores (R-C).

?Dareodinia osmingtonense (single), Convaulacysta cf. jurassica (single).

AGE: Possible Late Jurassic undifferentiated

ENVIRONMENT: Marine

The two (2) dinocysts of questionable affinity observed in this interval appear to be indigenous and are suggestive of a Late Jurassic age. The tentative identifications based on poorly preserved specimens provides for only a tentative age assignment.

7840-8519'

Undifferentiated bisaccates (F-C), Vitreisporites pallidus (R, sporadic), Classopollis classoides (R-C), ?Lycopodiumsporites semimurus (single); single specimens of reworked (?) Cycadopites sp., Taeniaesporites sp.

Micrhystridium spp. (R-F).

AGE: Triassic-Jurassic undifferentiated

ENVIRONMENT: Marginal Marine

A single, poorly preserved spore that is questionably identified as L. semimurus indicates that by 8504 feet the section may be Early Jurassic in age.

8520-8819'

Indeterminate spores (F), undifferentiated bisaccates (R).

AGE: Indeterminate

ENVIRONMENT: Nonmarine?

8819-8873'

Monosulcites sp. (R), Vitreisporites pallidus (R).

Sverdrupiella usitata (R-C), S. sp. (R).

AGE: Late Triassic, Norian (P-M26)

ENVIRONMENT: Marine

8873-9510'

Undifferentiated striate bisaccates (R); scattered, rare occurrences of Cretaceaspollenites sp., Taeniaesporites sp., Aratrisporites sp., Crustaesporites sp.

Micrhystridium spp. (R), Veryhachium spp. (R-F).

AGE: Triassic (probable P-T16)

ENVIRONMENT: Very Marginal Marine

9510-9943' T.D.

Essentially barren of palynomorphs.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

This interval shows a change in the thermal alteration of the organic constituents. Below 9510 feet the residues are gray to black in color, whereas, above 9510 feet the color range is in the brown.

PALYNOLOGY REPORT - ADDENDUM

Introduction

A total of 34 sidewall core samples were processed and examined for palynological age determinations. The samples were taken between the depths 8275 feet and 9404 feet, which represents section penetrated in the Redrill No. 1 and Redrill No. 2 of the South Meade well.

This work was conducted under Contract 617779, Item 04.

Summary of Results

Examination of the additional samples has produced some modifications to the original palynological subdivisions. The changes are as follows:

1. The base of the Late Triassic, P-M26, is lowered to 9099 feet.
2. SWC 9370 feet is probably in the P-T17 zonule, which was not observed originally.
3. Samples at 9384 feet and 9630 feet produced some identifiable spores which range in age from Devonian to Triassic.

Listing of Recovered Flora

8275'SWC

Indeterminate spore fragments, very poorly preserved (F).

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

8281'SWC

Undifferentiated bisaccates (F).

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

8758'SWC

Undifferentiated bisaccates (R), indeterminate spore fragments, poorly preserved (F), Micrhystridium sp. (R).

AGE: Indeterminate
ENVIRONMENT: Marginal Marine

8782'SWC

Indeterminate spore fragments, poorly preserved (R).

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

8808'SWC

Undifferentiated bisaccates (R), Micrhystridium sp. (R).

AGE: Indeterminate
ENVIRONMENT: Marginal Marine

8948'SWC

Undifferentiated bisaccates (R), Lycopodiumsporites sp. (R),)Noricysca sp. (R), Micrhystridium sp. (R), Emphanisporites sp. (single, reworked), indeterminate spore fragments, poorly preserved (A).

AGE: Probable Late Triassic, Norian (P-M26)
ENVIRONMENT: Marine

8985'SWC

Indeterminate spore fragments, very poor preservation (F), Micrhystridium sp. (R).

AGE: Indeterminate
ENVIRONMENT: Marginal Marine

9099'SWC

Undifferentiated bisaccates (F), Monosulcites sp. (R), indeterminate spores and spore fragments (C),)Noricysca sp. (F), Scolecodont (R).

AGE: Probable Late Triassic, Norian (P-M26)
ENVIRONMENT: Marine

9160'SWC

Undifferentiated bisaccates (R).

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

9174'SWC

Undifferentiated bisaccates (F).

AGE: Indeterminate
ENVIRONMENT: Nonmarine

9187'SWC

Undifferentiated bisaccates (R), Striatites richteri (R), Taeniaesporites sp. (R), Micrhystridium sp. (R).

AGE: Triassic (P-T16)
ENVIRONMENT: Marginal Marine

9196'SWC

Undifferentiated bisaccates (R), Dulhuntyspora minuta (R), Striatites richteri (R), Taeniaesporites sp. (F).

AGE: Triassic (P-T16)
ENVIRONMENT: Nonmarine

9203'SWC

Undifferentiated bisaccates (R), Dulhuntyspora minuta (R), Lueckisporites sp. (R), Striatites richteri (R), Taeniaesporites sp. (C).

AGE: Triassic (P-T16)
ENVIRONMENT: Nonmarine

9218'SWC

Undifferentiated bisaccates (R), indeterminate spores (F), Taeniaesporites sp. (F).

AGE: Triassic (P-T16)
ENVIRONMENT: Nonmarine

9236'SWC

Monosulcites sp. (R), Dulhuntyspora minuta (R), Kraeuselisporites sp. (R), Taeniaesporites sp. (F), Scolecodont (R).

AGE: Triassic (P-T16)
ENVIRONMENT: Marginal Marine

9249'SWC

Undifferentiated bisaccates (R), indeterminate spores (F), Dulhuntyspora minuta (R), Taeniaesporites sp. (C).

AGE: Triassic (P-T16)
ENVIRONMENT: Nonmarine

9278'SWC

Undifferentiated bisaccates (R), indeterminate spores (R), Taeniaesporites sp. (R).

AGE: Triassic (P-T16)
ENVIRONMENT: Nonmarine

9370'SWC

Undifferentiated bisaccates (C), Monosulcites sp. (R), indeterminate spores (C), Striatites richteri (C), Taeniaesporites sp. (C).

AGE: Probable Permian-Triassic (P-T17)
ENVIRONMENT: Nonmarine

9403'SWC

Barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

9469'SWC

Barren of indigenous palynomorphs. Mud contamination.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

9580'SWC

Indeterminate spores (R); small recovery.

AGE: Indeterminate
ENVIRONMENT: Nonmarine

9584'SWC

Spinotriletes sp. (F), indeterminate spores, poorly preserved (A), Calamospora sp. (single).

AGE: Devonian-Triassic
ENVIRONMENT: Nonmarine

9593'SWC

Monosulcites sp. (R), indeterminate spores, poorly preserved (C).

AGE: Indeterminate
ENVIRONMENT: Nonmarine

9610'SWC

Undifferentiated bisaccate (R), indeterminate spores, poorly preserved (P).

AGE: Indeterminate
ENVIRONMENT: Nonmarine

9630'SWC

Calamospora sp. (C), indeterminate spores, poorly preserved (A).

AGE: Devonian-Triassic
ENVIRONMENT: Nonmarine

9666'SWC

Indeterminate spores (R).

AGE: Indeterminate
ENVIRONMENT: Nonmarine

9756'SWC

Barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

9786'SWC

Barren of organics.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

9788'SWC

Indeterminate spores? (R), very small recovery.

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

9850'SWC

Indeterminate spores? (R), very poor preservation.

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

9874'SWC

Indeterminate spores? (R), very poor preservation.

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

9881'SWC

Indeterminate spores? (F), very poor preservation.

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

9895'SWC

Indeterminate spores? (R), very poor preservation.

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

9903'SWC

Indeterminate spores? (F), very poor preservation.

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

Preparation and analysis of Topagoruk T.W. #1 core samples for comparison with the S. Meade RD #2.

10,228-229'; 10-390-403'; 10,411'

Barren of palynomorphs.
Organic color = red-brown.

10,489-490'; 10,490-492'

Frequent spores, rather simple morphology, indeterminate genera. Possibly Devonian age.
Organic color = red-brown.

10,491'; 10,503'

Indeterminate spore fragments.
Organic color = red-brown.

These core samples lack any distinctive spore genera to make a definite age assignment. Based on the absence of certain forms, however, this assemblage is suggestive of a pre-Carboniferous age.

The TAI for the Topagoruk T.W. #1 samples are significantly less (3.0 range) than they are for the section in the bottom part of the South Meade RD #2 (4.0 range).

S. Meade #1
(Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1" to 100' faunal distribution log and 3 faunal checklists on the S. Meade #1 well. The conclusions presented in this report are based on the processing, picking and examination of 282 ditch samples, generally composited on 20 to 30 foot intervals, 68 conventional core, and 11 sidewall core samples. A generalized age summary of the well is provided below.

95-1740'

Eurycheilostoma robinsonae, Gaudryinella irregularis, Textularia tonagorukensis, Ammobaculites fragmentarius, A. wenonahae, Psammingpelta subcircularis, Valvulineria loetterlei, Haplophragmoides topagorukensis, H. cf. excavata, Saccammina lathrami, Trochammina murrayensis, Pseudobolivina rayi, Verneuilinoides borealis, Gavelinella stictata, G. swunensis, Gaudryina canadensis, Hippocrepina barksdalei, Miliammina manitobensis, M. swunensis, M. ischnia, and Bathysiphon vitta, among others, characterize these strata.

Ditrupa cornu tops at 640 feet and becomes common at 1300 feet. The above association is typical of the Verneuilinoides borealis faunal zone and is Middle to Late Albian age (F-9). The frequent occurrence of Textularia topagorukensis at 1300 feet suggests that the top of zonule F-10 may be as high as 1300 feet, but we prefer to place it at the top of Gaudryina nanushukensis at 1740 feet since we feel that the latter is a more reliable marker. The environments represented by these assemblages were probably inner to middle neritic associated with fluctuating turbidity.

AGE:	Early Cretaceous Middle to Late Albian (F-9)
ENVIRONMENT:	Inner to Middle Neritic (fluctuating turbidity)

1740-3360'

This interval is characterized by occurrences of the following: Bathysiphon vitta, Gaudryina nanushukensis, Verneuilinoides borealis, Gavelinella stictata, Eurycheilostoma robinsonae, Psammingpelta bowsheri, Tritaxia manitobensis, Marginulinopsis cephalotes, Textularia topagorukensis, Miliammina swunensis, Haplophragmoides topagorukensis, H. cf. excavata, and Conorboides umiatensis. The above fauna indicates a Late Aptian to Early Albian (F-10) age. The environments represented by these moderately diverse assemblages were probably somewhat turbid inner to middle neritic depths with short periods of lesser turbidity.

AGE:	Early Cretaceous Late Aptian to Early Albian (F-10)
ENVIRONMENT:	Inner to Middle Neritic (fluctuating turbidity)

3360-6500'

A pyritized radiolarian fauna characterizes these strata together with rare occurrences of agglutinated foraminifera. Pyritized radiolaria of the following genera occur: Cenosphaera spp., Spongodiscus sp., Spongurus sp., and Lithocampe spp. Lithocampe H tops just above the base of this unit at 6470 feet. According to Ramsay (1970) this zone of pyritized radiolaria separates the Verneuilinoides borealis zone from the Gaudryina taillouri zone, and is probably Aptian to Early Albian in age. We feel that it is probably Aptian in age, but our data is tentative at this time. Due to the preservation of this fauna, all that can be said about the environment of deposition is that it was marine and open to oceanic currents.

AGE:	Early Cretaceous Aptian (F-11)
ENVIRONMENT:	Open Marine

6500-6760'

Occurrences of Gaudryina taillouri, G. tappanae, G. Rillari, Globospirella S, G. arctica, Ammobaculites fragmentarius, arenaceous spp. (large, coarse), Trochammina squamata, T. gonicomiouta, T. cf. instowensis, Gravellina 1, Globospira subarcelia, Haplophragmoides quoflatus, H. coronis, H. infiacigrandis, Praebulimina 2, and Globulina exserta, indicate a Neocomian (F-12 to F-13) age for these strata. Common to abundant rounded frosted quartz floaters also dominate this interval. The abundance and diversity of this predominantly agglutinated assemblage suggests a relatively turbid middle to outer neritic depositional environment.

AGE:	Early Cretaceous Neocomian (F-12 to F-13)
ENVIRONMENT:	Middle to Outer Neritic (moderate turbidity)

6760-6970'

Conorboides hofkeri, Citharina cf. aequistriata, Saracenaria oxfordiana, Frondicularia lustrata, Eoguttulina liassica, Vaginulina curva, Marginulinopsis phragmites, Haplophragmoides canui, Lituotuba irregularis, Recurvoides turbinatus, Ammobaculites alaskensis, Lenticulina audax, L. prima, Globulina topagorukensis, Trochammina cunningensis, T. instowensis, T. sabigi, and T. topagorukensis indicate that these strata are Late Jurassic age. They are probably Tithonian in age, but could conceivably be as old as Kimmeridgian. These strata were probably deposited in middle neritic to upper bathyal water depths.

6760-6970' (con't.)

AGE:	Late Jurassic Kimmeridgian to Tithonian (F-15 to F-16)
ENVIRONMENT:	Middle Neritic to Upper Bathyal

6970-7990'

Frondicularia lustrata, Globulina topagorukensis, Recurvoides turbinatus, Gaudryina Leffingwelli, G. dyscrita, Nodosaria baltzata, N. cf. sphingothalma, Textularia areopleota, Saracenaria topagorukensis, Citharina fallax, Marginulinopsis phragmites, Lingulina aff. charagmata, Spirillina amphelicta, Trochammina rostovzevi, T. sp. (small, high spired), T. gryci, Lenticulina audax, Frondicularia squamosa, Dentalina cf. actadia, D. cf. gracilistriata, Involutina cheradospira, I. aspera, Eoguttulina liassica, and Glomospira perplexa, among others, indicate an Oxfordian (F-18) age. The upper boundary of this unit represents a hiatus in time (unconformity? fault?) since the interval between 7450 feet and 6820 feet referred to as Kimmeridgian to Oxfordian (F-16) in the Kugrua #1 well appears to be missing in the S. Meade #1 well. It is our opinion that this hiatus is most likely an unconformity. The abundant and diverse assemblages associated with these strata suggest an outer neritic to bathyal clearwater environment of deposition.

AGE:	Late Jurassic Oxfordian (F-18)
ENVIRONMENT:	Outer Neritic to Bathyal (clearwater)

7990-8519'

These strata are considered Early to Middle Jurassic age based on occurrences of Ammobaculites vetusta, Marginulina bergquisti, Astacolus dubius, Lenticulina cf. favorlata, L. d'orbigny, Nodosaria mitis, N. radiata, N. cf. shubikensis, Frondicularia baugri, Gaudryina dyscrita, and frequent to abundant pyritized radiolaria of the genera Cenosphaera spp., Spongodiscus spp., Paralibracachium sp., and Lithocampe cf. T. The abundance of radiolaria suggest open marine conditions. The depositional environment for these rocks was probably middle neritic to as deep as upper bathyal.

AGE:	Early to Middle Jurassic (F-17 to F-18)
ENVIRONMENT:	Probable Middle Neritic to Upper Bathyal (open marine)

8520-8930'

It was necessary to spread the age of this interval since it contains a mixed assemblage. A fauna similar to the overlying interval occurs, along with questionably reworked Triassic (F-19) forms. Rare occurrences of Astacolus connudatus, Lingulina borealis, Pseudoglandulina densa and Nodosaria cf. shublikensis suggest a Triassic (F-19) age, but the interval is lacking a complete F-19 assemblage. The number of rare Triassic forms tend to increase slightly near the base of this interval, and it is possible that the top of the definite Triassic (F-19) could be a sample or two higher somewhere between 8870' and 8900' feet. These strata probably represent inner to middle neritic deposition.

8520-8930' (con't)

AGE: Triassic to Early Jurassic (F-18 to F-19)

ENVIRONMENT: Probable Inner to Middle Neritic

8930-9170'

Astacolus connudatus, Nodosaria shublikensis, N. larina, Frondicularia acmeea, Lingulina borealis, Pseudoglandulina simpsonensis, P. densa, Trochammina helicta, and Monotis/Halobia fragments occur throughout these beds. These faunas appear to represent open marine middle neritic conditions. A few black chert pebbles were found in the interval 9080-9140 feet which suggest a correlation between 9080 feet in this well and 9860 feet in the Kugrua #1 well, but the abundance of these pebbles was much less in this well.

AGE: Triassic (F-19)

ENVIRONMENT: Middle Neritic (Open Marine)

9170-9530'

A very poor fauna consisting of Ammobaculites spp., Trochamminoides spp. and Ammodiscus P. occurs in this interval. This sparse assemblage is suggestive of Zonule F-20, and is probably still Triassic in age although a late Permian age can not be absolutely ruled out. The base of this interval is placed primarily on a lithologic change to medium to dark gray coaly and carbonaceous shales, siltstones, sandstones, and pebble conglomerates. These strata probably represent nonmarine to marginal marine deposition.

9170-9530' (con't)

AGE: Permian to Triassic (F-20)

ENVIRONMENT: Nonmarine to Marginal Marine

9530-9943' T.D.

These strata are barren of indigenous Foraminifera and are therefore of indeterminate age. The only Foraminifera found in ditch samples from this interval are interpreted as caving from the overlying Triassic (F-19) interval. The following lithologic changes were noted in the washed ditch samples.

9530-9730':	Dark gray shale. Coaly below 9590'.
9730-9810':	Dark gray very fine-grain sandstone and siltstone.
9810-9840':	Gray chert pebble conglomerate
9840-9943':	Black coaly siltstone, very fine-grain sandstone and shale.

Ten (10) core samples from the interval considered "Lower (?) or Middle Devonian" (10,040-10,503') in the U.S.N. Topagoruk #1 Test Well were processed and examined for the purpose of lithologic comparison with these strata. The individual sample descriptions are presented in Appendix A at the back of this report. The conclusions were as follows. The Topagoruk #1 core samples were also of indeterminate age. Only one sample (10,411') contained any Foraminifera. That sample contained only a single broken fragment of an unidentifiable species. A comparison of lithologies from thin sections and washed residues indicated

9530-9943' T.D. (con't)

that the lithologies in ditch samples below 9530 feet in the S. Meade #1 RD#2 well were similar to lithologies in cores examined from 10,228-10,503 feet in the Topagoruk #1 well. The major difference observed seemed to be that there were more coaly microstringers compared to disseminated particulate carbonaceous matter in the S. Meade #1 RD#2 samples. This may be a matter of sampling though, since coal seams are shown at about 10,190 feet in the U.S.G.S. pp. 305-D report on the Topagoruk #1 well. Another possibility is that the degree of thermal alteration may have been greater in the S. Meade #1 RD#2 well and was responsible for the formation of a greater number of coal seams.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

FORAMINIFERA REPORT - ADDENDUM

The following addendum to the S. Meade #1 micropalaeontological report is based on the examination and checklisting of 32 sidewall core samples received October 24, 1979. There were no ages found in these sidewall cores that would alter the original report. A sample-by-sample listing of the fauna, lithology, age and environment is presented below.

Standard techniques were employed in processing the material. All samples were boiled in Quaternary-O and washed over 20 and 200 mesh screens.

Frequency symbols used in this report correspond to the following numerical values: R = rare (1-5); F = frequent (6-32); C = common (33-99); A = abundant (100-199); and PL = flood (200+).

8275'SWC

Trochaminoides sp. (R). Dark brown iron-stained silty shale.

AGE: Probable Early to Middle Jurassic (F-17 to F-18)

ENVIRONMENT: Marine

8281'SWC

No Foraminifera found. Dark brown iron-stained silty shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

8758'SWC

Arenaceous sp. (R), pyrite (C). Dark brown pyritic silty shale.

AGE: Indeterminate

ENVIRONMENT: Possible Marine

8787'SWC

No Foraminifera found. Dark gray to black siltstone.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

8808'SWC

No Foraminifera found. Light brown very fine-grained saccharoidal sandstone.

AGE: Indeterminate (Sag River Ss. lithology)

ENVIRONMENT: Indeterminate

8948'SWC

Ammobaculites cf. vetusta (R), Astacolus connudatus (F), Ammodiscus sp. (R), Lingulina borealis (R), Pseudoglandulina simpsonensis (R), Monotis/Halobia fragments (A), ostracods (medium-large, smooth)(F), pelecypods (pyrite casts)(R), echinoid spines (R), pyrite (A), pyrite sticks (C). Dark brown to black shelly siltstone.

AGE: Triassic (F-19)

ENVIRONMENT: Middle to Outer Neritic

8985'SWC

Ammobaculites cf. vetusta (R), Arenaceous sp. (R), Astacolus connudatus (F), Nodosaria shublikensis (R), Pseudoglandulina simpsonensis (R), Monotis/Halobia fragments (R), pyrite (R). Dark brown silty shale.

AGE: Triassic (F-19)

ENVIRONMENT: Middle to Outer Neritic

9009'SWC

Astacolus connudatus (R), Nodosaria shublikensis (R), Monotis/Halobia fragments (F), ostracods (small-medium, smooth)(R), pyrite (F). Dark brown silty shale.

AGE: Triassic (F-19)

ENVIRONMENT: Middle to Outer Neritic

9160'SWC

No Foraminifera found. Pyrite (F). Black siliceous silty shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9174'SWC

No Foraminifera found. Dark brown iron-stained siltstone or silty shale.

AGE: Indeterminate (Ivishak Fm. lithology)

ENVIRONMENT: Indeterminate

9187'SWC

No Foraminifera found. Dark brown iron-stained siltstone.

AGE: Indeterminate (Ivishak Fm. lithology)

ENVIRONMENT: Indeterminate

9196'SWC

No Foraminifera found. Pyrite (C). Dark gray iron-stained pyritic shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9203'SWC

No Foraminifera found. Dark gray shiny silty shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9219'SWC

No Foraminifera found. Pyrite (R). Reddish-brown iron-stained silty tuffaceous shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9238'SWC

No Foraminifera found. Reddish-brown iron-stained silty tuffaceous shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9249'SWC

No Foraminifera found. Dark brown shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9610'SWC

No Foraminifera found. Black shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9620'SWC

No Foraminifera found. Black shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9666'SWC

No Foraminifera found. Coal (anthracite?)(A). Black shaly coal seam.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9735'SWC

No Foraminifera found. Dark gray shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9788'SWC

No Foraminifera found. Medium-dark gray iron-stained mottled bentonitic? shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9850'SWC

No Foraminifera found. Medium-dark gray iron-stained mottled bentonitic? shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9874'SWC

No Foraminifera found. Dark gray to black shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9881'SWC

No Foraminifera found. Dark gray to black shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9278'SWC

No Foraminifera found. Gray iron-stained quartzitic siltstone.

AGE: Indeterminate (Ivishak Fm. lithology)

ENVIRONMENT: Indeterminate

9370'SWC

No Foraminifera found. Pyrite (F). Gray fine-grained quartzitic sandstone.

AGE: Indeterminate (Ivishak Fm. lithology)

ENVIRONMENT: Indeterminate

9401'SWC

Endothyra? sp. (1), pyrite (R). Buff tan iron-stained fine-grained muddy sandstone.

AGE: Possible Permian?

ENVIRONMENT: Possible Marine

9580'SWC

No Foraminifera found. Black shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9584'SWC

No Foraminifera found. Black shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9555'SWC

No Foraminifera found. Black iron-stained shale.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

9895'SWC

No Foraminifera found. Coal (anthracite)(PL). Black shaly coal seam.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

9995'SWC

No Foraminifera found. Vein quartz (F). Dark gray to black fractured quartz-veined shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

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.

APPENDIX A
U.S.N. TOPAGORUK #1 TEST WELL
CORE SAMPLE DESCRIPTIONS

WASHED SAMPLE DESCRIPTIONS

10,228-10,229'Core
No Foraminifera. Dark brownish-gray charty quartzitic sandstone.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10,411'Core
Arenaceous sp. (R). Dark gray shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10,491'Core
No Foraminifera. pyrite (F). Dark brown to black siliceous shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

APPENDIX A (con't)

THIN SECTION DESCRIPTIONS

10,228-10,229'Core
No Foraminifera, pyrite (R), coal (R). Dark gray quartzitic very fine-grain sandstone.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10,286-10,287'Core
No Foraminifera. Brownish-gray coarse-grain chert sandstone or chert pebble conglomerate.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10,387-10,388'Core
No Foraminifera. Coarse-grain sandstone or chert pebble conglomerate as above.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10,390-10,403'Core (b)
No Foraminifera. Brownish-gray quartzitic very fine-grain sandstone or siltstone.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

THIN SECTION DESCRIPTION (con't)

10,390-10,403' Core (a)
No Foraminifera. Dark gray carbonaceous siltstone.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10,411'Core
No Foraminifera. Dark gray carbonaceous shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10,489-10,490'Core
No Foraminifera. Dark gray carbonaceous shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10,490-10,492'Core
No Foraminifera. Dark gray carbonaceous shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10,491'Core
No Foraminifera. Dark gray carbonaceous shale with coal microstringers.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

THIN SECTION DESCRIPTION (con't)

10,593'Core
No Foraminifera. Gray coarse-gray sandstone or chert pebble conglomerate.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

Peard #1
(Palynology)

PALYNOLOGY REPORT

A total of 248 samples were processed and analyzed from the subject well. The coral consists of 112 ditch cuttings composited into 90' intervals, 44 sidewall cores, 86 cores, and six additional core samples received at a later date and reported in an addendum to this paper. The total section examined ranges from 90 to 10,225' T.D.

Included with this report are figures 1 and 2 which illustrate the distribution of the ditch and sidewall cores and the conventional core samples, respectively. A summary of the findings is given below along with an addendum which reports the information from additional samples of Core #7 (7837-7868.5') received after the drafting of the data.

90-6210'

Undifferentiated bisaccates (R-A), Araucariacites australis (R), Callialasporites dampieri (R), Cyathidites australis (R), C. minor (R-F), Exesipollenites tumulus (R), Gleichaniidites senonicus (R), Lycopodiumsporites spp. (R), Osmundacidites spp. (R), Schizosporis parvus (R), Taxodiaceae (R).

Apteae polymorpha (R), Batioladinium jaegeri (R), Canningia colliveri (R-F), Cleistosphaeridium spp. (R-F), Cyclonephelium distinctum (R), Gardodinium trabeculosum (R), Hystrichosphaeridium cooksonae (R), Odontochitina operculata (R), Oligosphaeridium complex (R-F), Palaeoperidinium cretaceum (R-F), Spiniferites ramosus (R), Tenua cf. T. hystrix (R).

AGE: Early Cretaceous, Aptian-Albian (P-M18 to P-M17)

ENVIRONMENT: Marine

Taxa from this interval are numerous and consist of both marine and terrestrial forms. Their order of appearance does not suggest any further subdivision for this part of the section.

6210-6690'

Terrestrial taxa remain essentially the same as for those listed above with the addition of Lycopodiumsporites semimurus and Callialasporites triangularis.

Canningia colliveri (R-F), Cleistosphaeridium spp. (R), Cyclonephelium distinctum (R-A), Gardodinium trabeculosum (R-A), Gonyaulacysta granuligera (R), G. helicoidea (R), Herendeenia pisciformis (R), Impletosphaeridium sp. (R), Muderongia staurota (R), Odontochitina operculata (R-F), Oligosphaeridium complex (R-C), O. complex (thick wall)(R-F), Polysphaeridium laminaspinosum (R), Senoniasphaera microreticulata (R), Tanyosphaeridium variecalamus (R), Tenua cf. T. hystrix (R-A).

AGE: Probable Neocomian

ENVIRONMENT: Marine

Taxa such as Clathrocanocystis glecana, Herendeenia pisciformis, Muderongia spp., and Prionodinium klaskense are either missing or only poorly represented. Therefore, this interval has been left as probable Neocomian. In all other aspects, it is similar to the Neocomian (P-M19) zone known elsewhere from the Alaska North Slope area.

6688-7243'

Terrestrial taxa again remain the same. New taxa for this interval are: Cicatricosisporites purbeckensis (R), Concavissimisporites punctatus (R), Coronatispora valdensis (R), Leptolepidites osacosus (R), Pilosisporites trichopapillosus (R), Trilobosporites hannonicus (R).

Dinoflagellate cysts as well are similar to those above except for the following additions: Cleistosphaeridium ancoriferum (R), C. ehrenbergii (R), Cribroperidinium muderongense (R), Nelchinopsis kostromiensis (R), Paragonyaulacysta dasyforma (R), Sirmiodinium grossi (R), Trichodinium ciliatum (R), Tubotuberella apatela (R).

AGE: Early Cretaceous, Neocomian (P-M20)

ENVIRONMENT: Marine

This interval is defined by the first occurrences of Paragonyaulacysta dasyforma and Tubotuberella apatela at the top, and the last occurrence of Oligosphaeridium complex in the sidewall core sample at 7243'. O. complex and several other Early Cretaceous microplankton taxa do continue lower in the well in the ditch samples, but they are not well represented in the core and sidewall core samples, and are interpreted to be the result of "up-hole" contamination. Two of the new spore taxa from this section, i.e. Cicatricosisporites purbeckensis and Trilobosporites hannonicus are also typical of Early Neocomian sections.

7390-8190'

Terrestrial taxa continue as above, but become less diverse. New species occurring are: Plicatella abaca (R), Aubingile sp. (R), and Trilobosporites hannonicus (R).

Dinoflagellate cysts as well become less diverse. Significant new forms are Cleistosphaeridium tribulifarum (R), Scriniodinium crystallinum (R), and Tenua ciouiti (R).

AGE: Probable Jurassic, undifferentiated

ENVIRONMENT: Marginal Marine

The marked reduction in taxa does not allow for a more precise age in the interval described above. Those taxa present (i.e. Cleistosphaeridium tribulifarum, Scriniodinium crystallinum, and Tenua ciouiti) only weakly suggest a Jurassic age.

Core #7 (7837-7868') from this interval is completely barren except for the two uppermost samples (7837' and 7840') which contain Cretaceous (Neocomian-Albian) palynomorphs. These two samples are totally alien to the remainder of the core and are here considered to be either contaminated by mud invasion or collected from rubble at the top of the core. Reprocessing of these two samples produced the same results for 7837', but changed 7840' to barren and in agreement with the remainder of the core.

8214-9900'

Anapiansporites stipulatus (R-C), Apiculatisporis lanjouwii (R), undifferentiated bisaccates (R-A), Classopollis classoides (R), Deltoidospora sp. (R), Densosporites spp. (R), Dulhuntyspora minuta (R), Polycingulatisporites sp. (R), Taeniasporites spp. (R), undifferentiated verrucate spores (R), Vitreisporites pallidus (R).

AGE: Probable Triassic, undifferentiated

ENVIRONMENT: Nonmarine to Marginal Marine

Rare occurrences of Apiculatisporis lanjouwii, Dulhuntyspora minuta, Taeniasporites spp., and rare to common occurrences of Anapiansporites stipulatus weakly suggest a Triassic age for this interval. Frequent to abundant occurrences of Cretaceous dinoflagellates were also noted, but they are interpreted as "up-hole" contamination.

9900-10,225' T.D.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

ADDENDUM

Samples received later from Core #7 provide little additional data, and do not alter the zonation of the well. Data from these samples are as follows:

7837-7842.7'

Deltoidospora sp. (R), Lycopodiumsporites semimurus (R), Lycopodiumsporites spp., Osmundacidites spp.

7842.8-7848.5'

Deltoidospora sp. (R).

7848.8-7854.2'

Barren of palynomorphs.

7854.2-7859.8'

Deltoidospora sp. (R).

7859.8-7862.8'

Barren of palynomorphs.

7865.9-7868.5'

Barren of palynomorphs.

SUMMARY OF PALYNOLOGY REVISIONS

90-6210'	:	Early Cretaceous, Aptian-Albian (P-M18 to P-M17).
6210-6660'	:	Early Cretaceous, possible Neocomian (P-M18a).
6660-6688'?	:	Early Cretaceous, Neocomian (probable in P-M19).
6688-7243'	:	Early Cretaceous, Neocomian (P-M20).
7243-8214'	:	Probable Jurassic, undifferentiated.
8214-9630'	:	Probable Triassic, undifferentiated.
9630-10,225'	:	T.D. Age indeterminate.

Peard #1 (Foraminifera)

FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checklisting of 336 washed ditch samples, 71 washed conventional core samples, 43 washed sidewall core samples, and 24 thin sectioned ditch and conventional core samples covering the interval 90 to 10,225 feet (total depth). Thin sections were prepared on all samples below 9630 feet. Four checklists and a faunal distribution log are enclosed for your convenience. Six additional samples from Core #7 were received after the core checklists had been prepared so these appear in an appendix at the back of this report.

Standard techniques were employed in processing the material. All samples were boiled in Quaternary-O and washed over 20 and 200 mesh screens.

Frequency symbols used in this report correspond to the following numerical values: R = rare (1-5); F = frequent (5-32); C = common (33-99); A = abundant (100-199); and FL = flood (200+).

90-2610'

Haplophragmoides topagorukensis, H. cf. excavatus, Lenticulina macrodisca, L. erecta, Ammobaculites wanonahae, A. fragmentarius, Textularia topagorukensis, Pseudobolivina ravi, Praeminoplata bowsheri, Saccammina lathrami, Trochammina murrayensis, Verneuilinoides borealis, Gavelinella stigata, Hippocrepina barksdalei, Miliammina manitobensis, M. awunensis, M. ischioa, and Bathysiphon vitta among others characterize these strata. The above association is typical of the Verneuilinoides borealis faunal zone and is Middle to Late Albian (F-9) age. Strata between 90 feet and 450 feet while devoid of Albian Foraminifera are included with the Albian (F-9) strata based on the palynological results. The environments represented by these assemblages were probably inner to middle neritic associated with fluctuating turbidity below 1290 feet. Depositional environments above 1290 feet were probably nonmarine to marginal marine.

AGE: Early Cretaceous
Middle to Late Albian (F-9)

ENVIRONMENT: Nonmarine to Middle Neritic
(fluctuating turbidity)

2610-4110'?

This interval is characterized by occurrences of the following: Bathysiphon vitta, Gaudryina nanushukensis, Verneuilinoides borealis, Ammobaculites fragmentarius, A. wanonahae, Saracenaria durfei, Hippocrepina barksdalei, Textularia topagorukensis, Ammodiscus rotalarius, Glomospirella gaultina, Haplophragmoides topagorukensis, H. cf. excavatus, and Saccammina lathrami. The above fauna indicates a Late Aptian to Early Albian (F-10) age. The environments represented by these moderately diverse agglutinated assemblages were probably somewhat turbid middle to outer neritic depths.

AGE: Early Cretaceous
Late Aptian to Early Albian (F-10)

ENVIRONMENT: Middle to Outer Neritic
(turbid)

4110?-6240'

A pyritized radiolarian fauna usually characterizes these strata together with rare occurrences of agglutinated and calcareous foraminifera. However, the pyritized radiolaria do not develop until around 5880 feet in this well and it is only through lithologic and gross faunal correlations with the adjacent Kugrua #1 well that we can suggest a possible F-11 top at 4110 feet. It is possible that the strata from 4110 feet to 5880 feet are still Late Aptian to Early Albian (F-10) in age and we are dealing with some rapid thickness changes associated with the F-10 and F-11 intervals between the Kugrua #1 and Peard #1 wells. Lithocampe N tops just above the base of this unit at 6210 feet. According to Ramsay (1970) a zone of pyritized radiolaria separates the Verneuilinoides borealis Zone from the Gaudryina taillauri Zone, and is probably Aptian to Early Albian in age. We feel that it is probably Aptian in age, but our data is tentative at this time. Due to the limited nature and preservation of this fauna, all that can be said about the environment of deposition is that it was marine and open to oceanic currents below 5880 feet.

AGE: Early Cretaceous
Possible Aptian* (F-11?)

ENVIRONMENT: Marine (Open Marine below 5880')

6240-6720'

Occurrences of Bathysiphon scintillara, Ammodiscus mackenziensis, Thurammina/ides sp., Gaudryina taillauri, G. tappanae, Glomospirella S. G. arctica, Ammobaculites erectus, A. reophacoides, Arenaceous spp. (large, coarse), Trochammina squamata, T. conicotrunca, Gaudrinella irregularis, Glomospira subarctica, Pseudobolivina ravi, Haplophragmoides duoflacis, H. goodenoughensis, H. coronis, H. inflaticrandis, Conorboides cf. umiatensis, Praebulimina 2, Saracenaria projectura, Lituotuba dellupa, Globulina prisca, Quinqueloculina 2, and Lenticulina sp. (raised sutures) among others, indicate a Neocomian (P-12 to P-11) age for these strata.

Common to abundant rounded frosted quartz floaters also dominate this interval. The abundance and diversity of these assemblages suggests relatively clearwater associated with fluctuating middle neritic to upper bathyal paleodepths.

AGE: Early Cretaceous Neocomian (F-12 to F-13)

ENVIRONMENT: Middle Neritic to Upper Bathyal (clearwater)

7720-7243'SW

This interval is somewhat of an enigma. It contains common occurrences of forms from the overlying interval and rare to frequent occurrences of forms such as: Haplophragmoides canui, Trochammina inflatawanka, Saracenaria cf. oxfordiana, S. cf. topagorukensis, Nodosaria cf. pachiatika, Lingulina cf. loryi, and Ammodiscus thomsi. These latter species suggest a Late Jurassic age. Since the palynology indicates a Neocomian (P-N20) age for these strata it could mean that the Late Jurassic Foraminifera are either reworked or else they range higher in the section than we previously believed. In comparing this faunal sequence with the adjacent Kugrua #1 well there does appear to be a similarity in the foraminiferal sequences, but there is no corroborating palynological data in the Kugrua #1 well. It is possible, therefore, based on foraminiferal faunal comparisons, that the section called Tithonian to Berriasian (7220-7450') in the Kugrua #1 well is totally or in part correlative with the interval 6720 feet to 7243 feet in the Beard Bay #1 well. These faunas appear to represent depositional environments similar to the overlying interval.

AGE: Late Jurassic to Early Cretaceous Kimmeridgian to Valanginian (F-13 to F-16)

ENVIRONMENT: Middle Neritic to Upper Bathyal (clearwater)

7243SW-7920'

Based on the overlapping occurrences of: Astacolus pediacus, Geudrina dyscrita, G. milleri, G. laffinewelli, G. topagorukensis, Lenticulina quenstedti, Glomospira gaultoni, Ammodiscus asperus, A. silicosus, A. cheradopirus, Nautculina metensis, E. liassica, Marginulinopsis cariavalensis, M. phragmites, Saracenaria topagorukensis, S. oxfordiana, Trochammina cenningensis, Conorboides cf. hofkeri, Nodosaria orthopsecha, N. cf. spinochalma, Citharina entypomatus, and Textularia areoplecta these strata are Oxfordian (F-16) in age. The top of this interval is usually picked on the basis of the top occurrence of Saracenaria topagorukensis, which is at 7290 feet in this well. The sidewall core sample at 7243 feet while lacking Saracenaria topagorukensis does contain a fauna more similar to this interval than to the overlying interval so the boundary has been raised to accommodate this sidewall core sample. A sandstone appears on the logs at the bottom of this interval (7835-7910'). This sandstone is included in the Oxfordian interval since no faunal change is observed until we are in the shale underlying the sandstone unit. Examination of Core #7 and a few sidewall cores from the sandstone interval suggest that this unit may be of indeterminate age (i.e. as old as Early to Middle Jurassic or as young as Oxfordian).

AGE: Late Jurassic Oxfordian (F-16)

ENVIRONMENT: Outer Neritic to Bathyal

7920-8280'

These strata are considered Early to Middle Jurassic age based on occurrences of Ammobaculites cf. vetusta, Trochammina gryci, Nodosaria radiata, Reophax suevica, and frequent to common pyritized radiolaria of the genera Cenosphaera spp., Spongodiscus spp., and Lithocampe spp. The presence of radiolaria suggest open marine conditions. The depositional environment for these rocks was probably middle neritic to as deep as upper bathyal.

AGE: Early to Middle Jurassic (F-17 to F-18)

ENVIRONMENT: Probable Middle Neritic to Upper Bathyal (open marine)

8280-8532'SW

It was necessary to spread the age of this interval since it contains a mixed assemblage. A fauna similar to the overlying interval occurs herein, along with questionably reworked Triassic (F-19) forms. Rare occurrences of Saccoplecta himatioides and Lithocampe T suggest a Triassic (F-19) age, but the interval is lacking a complete F-19 assemblage. These strata probably represent middle to outer neritic deposition.

AGE: Triassic to Early Jurassic (F-18 to F-19)

ENVIRONMENT: Probable Middle to Outer Neritic

8532SW-8730'

Astacolus connudatus, Nodosaria yhublikensis, N. larina, Vaginulinopsis agrulus, Lingulina alaskensis, Pseudoglandulina simpsonensis, Frondicularia ecbaea, and Monotis fragments occur throughout these beds. These faunas appear to represent open marine middle neritic conditions. A distinctive dark brown to black calcareous pebbly sandstone similar to that described by Tappan (1951, pp. 5-6) from the basal 25 to 50 feet of the Shublik Fm. in the Sadlerochit River Region tops at 8640 feet in this well.

AGE: Triassic (F-19)

ENVIRONMENT: Middle Neritic (open marine)

8730-9630'

A very poor fauna consisting of Ammobaculites sp. (small), aranaceous spp. (very small), and Trochammina sp. occurs rarely in this interval. This assemblage is possibly indicative of Zonula F-20, although the marker for that zonule is not present, and is probably still Triassic in age. A lithologic change to glauconitic quartzitic sandstone at 9450 feet suggests that we are probably in the Permian Echooka Formation at that point. The top of this unit is placed on the basis of a lithologic change. These strata probably represent nonmarine to marginal marine deposition.

AGE: Permo-Triassic (Possible F-20)

ENVIRONMENT: Nonmarine to Marginal Marine

9630-10,225'

This last unit is picked on the basis of a lithologic change to medium to dark gray wavy banded argillite. The few rare foraminifera found near the top of this interval are believed caved from overlying intervals.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

APPENDIX A

7837-7842.7' Core 7

No foraminifera found. Glauconite (A). Dark brown glauconitic succosic sandstone.

AGE: Indeterminate

ENVIRONMENT: Probable Marine

7842.8-7848.5' Core 7

No foraminifera found. Glauconite (A). Dark brown glauconitic very fine-grained sandstone.

AGE: Indeterminate

ENVIRONMENT: Probable Marine

7848.8-7854.2' Core 7

No foraminifera found. Glauconite (A). Dark brown very fine-grained glauconitic sandstone.

AGE: Indeterminate

ENVIRONMENT: Probable Marine

7854.2-7859.3' Core 7

No foraminifera found. Glauconite (A). Dark brown very fine-grained glauconitic sandstone.

AGE: Indeterminate

ENVIRONMENT: Probable Marine

7859.9-7862.8' Core 7

No Foraminifera found. Glauconite (F). Dark brown to black very fine-grained sandstone or siltstone.

AGE: Indeterminate

ENVIRONMENT: Probable Marine

7865.9-7868.5' Core 7

No Foraminifera found. Glauconite (R). Dark brown to black very fine-grained sandstone or siltstone.

AGE: Indeterminate

ENVIRONMENT: Probable Marine

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.

E. Simpson #1
(Palynology)

PALYNOLOGY REPORT

A total of 179 samples were processed and analyzed from the subject well. The total consists of 65 core samples, 18 sidewall cores, and 96 ditch cuttings composited for the most part into 90' intervals (for the section from 6590-7190', 30' intervals were used). The total section examined ranges from 100-7738 feet total depth.

Included with this report are Figures 1 and 2 which illustrate the palynomorph distribution of the ditch and sidewall cores and the conventional core samples, respectively. A summary of the findings is given below.

100-460'

Undifferentiated bisaccates (R-A), Osmundacidites spp. (R-F), Schizosporis parvus (R-F), Taxodiaceae (R-F).

Alterbia acuminata (R-F), Canningia minor (R), Cleistosphaeridium spp. (R), Cribroperidinium edwardsi (R), Cyclonephelium distinctum (R), Fromea amphora (R).

Hystrichodinium pulchrum (R-F), Hystrichosphaeridium stellatum (R-F), Isabelidinium belfastense (R), Odontochitina costata (R), O. operculata (R-F), Oligosphaeridium pulcherrimum (R), Palaeohystrichophora infusorioides (R), Palaeoperidinium basilium (R), P. cretaceum (R-F), Spiniferites ramosus (R-F).

AGE: Late Cretaceous, Cenomanian (P-M16)

ENVIRONMENT: Marine

Alterbia acuminata, Isabelidinium belfastense and Palaeohystrichophora infusorioides are known from Cenomanian and younger aged rocks. They occur along with Cribroperidinium edwardsi and Palaeoperidinium cretaceum which generally are known from Cenomanian and older rocks. Therefore, this interval has been dated as Cenomanian in age.

460-1360'

Undifferentiated bisaccates (A), Araucariacites australis (R), Cicatricosisporites australiensis (R), C. hallei (R), Cyathidites australis (A), C. minor (R-C), Gleichenidites senonicus (R-F), Laevigatosporites spp. (R-F), Osmundacidites spp. (R-C), Schizosporis parvus (R), Stereisporites spp. (R), Taxodiaceae (R-A), Trilobosporites parverulentus (R).

Canningia colliveri (R), Chlamydophorella nyei (R), Cleistosphaeridium spp. (R), Cribroperidinium edwardsi (R),

Cyclonephelium distinctum (R), Fromea amphora (R-F), Genus "H" (R), Genus "W" (R-C), Hystrichosphaeridium coronatum (R), Luxadinium propatulum (R), Nelsoniella sp. (R), Odontochitina operculata (R), Oligosphaeridium complex (R-F), Palaeoperidinium cretaceum (R-C), Spiniferites ramosus (R-F).

AGE: Early Cretaceous, Middle to Late Albian (P-M17)

ENVIRONMENT: Marine

This interval is best defined by the first appearance of Luxadinium propatulum and the last occurrence of Genus "W".

1360-6330'

Terrestrial taxa remain essentially the same as above for this interval, but with the additions of Callialasporites dampieri (R), Olecalkrisangulisporites spp. (R), Exesipollenites tumulus (R), Neoraistrickia truncata (R).

Aptea polymorpha (R), Baltisphaeridium jaegeri (R), Callaiosphaeridium asymetricum (R-F), Canningia colliveri (A), Chlamydophorella nyei (R-F), Cleistosphaeridium spp. (R-C), Cribroperidinium edwardsi (R-F), Cyclonephelium compactum (A-F), C. distinctum (R-A), Hystrichosphaeridium coronatum (R), Odontochitina operculata (R-C), Oligosphaeridium complex (R-A), O. complex (thick wall)(R), Palaeoperidinium cretaceum (R-A), Pseudoceratium expolitum (R-F), P. retusum (R-F), Spiniferites ramosus (R-F), Tenua cf. T. hystrix (R).

6330-6602'

Terrestrial taxa for this interval remain as above, but in decreasing diversity. Cleistosphaeridium polypes (R), Cyclonephelium distinctum (R-C), Endoscrinium campanula (R), Gardodinium trabeculosum (R-F), Gonyaulacysta granuligera (R), Hystrichosphaeridium recurvatum (R), Micrhystridium sp. (R-F), Muderongia staurota (R), Odontochitina operculata (R-A), Oligosphaeridium complex (F-A), O. complex (thick wall)(R), Operculodinium spinigerum (R).

Palaeoperidinium cretaceum (R-C), Sphoniesphaera microreticulata (R), Spiniferites ramosus (R), Tenua anaphrissa (R-F), T. cf. T. hystrix (R).

AGE: Probable Neocomian (P-M10 to P-M15)

ENVIRONMENT: Marine

Since additional diagnostic fossils (i.e., Horgodeania piscifornis, Prionodinium alaskense, Paragonia dasyforma, Tubotubella apatela) were not found, a more definitive age cannot be assigned to this interval.

6602-6897'

Araucariacites australis (R), undifferentiated bisaccates (R-A), Callialasporites dampieri (R), C. triangularis (R), Cerebropollenites mesozoicus (R) Deltoidospora sp. (R), Dicyophyllidites harrisii (R), Foraminisporis dailyi (R), Osmundacidites spp. (R), Punctatisporites spp. (R-C), Taxodiaceae (R), undifferentiated verrucate spore (R-F), Vitreisporites pallidus (R).

Microplankton taxa become less diverse with Ellipsoidictyum cinctum (R), Leptodinium subtile (R), and Paragonia corotophora (R), as the only significant new forms.

AGE: Probable Jurassic

ENVIRONMENT: Nonmarine to Marginal Marine

Ellipsoidictyum cinctum and Leptodinium subtile only weakly suggest a Jurassic age.

Numerous Cretaceous taxa also persist in this section and below. They do not, however, occur in the sidewall cores of in Core 15 (6810-6870') from this interval and are, therefore, considered to be "upholes" contamination.

6897-7739'

Anaplanisporites stipulatus (R), Apiculatisporis lanjouwii (R), Araucariacites australis (R), undifferentiated bisaccates (R-A), Deltoidospora sp. (R-C), Heliosporites altmarkensis (R), Klausipollenites schaulini (R), Krauselisporites sp. (R), Leptolepidites sp. (R), Lueckisporites sp. (F), Monosulcites spp. (R-F), Punctatisporites spp. (R-C), Striatites richteri (R-F), Taeniaesporites spp. (R-F), Taxodiaceae (R), undifferentiated verrucate spores (R-A), Vitreisporites pallidus (R).

AGE: Triassic (P-T16 to P-T15)

ENVIRONMENT: Nonmarine to Marginal Marine

Taxa of significance here are: Anaplanisporites stipulatus and Apiculatisporis lanjouwii which are present in Core 16 (6897-6922') near the top of the interval; and Lueckisporites sp., Striatites richteri, and Taeniaesporites spp. which are frequent in distribution lower in the section (especially

Core #9 (7565-7593'))). Several of the taxa listed for the interval do range into the Permian, however, none of those found are more typical or restricted to that period, and the age has been left as Triassic.

Core #6 (6897-6922') from this interval contains Cretaceous aged (Neocomian to Albian) dinoflagellate cysts in the uppermost sample (6897'). This sample is totally alien to the remainder of the core and is here considered to be either contamination by mud invasion or colloided from rubble at the top of the core.

7729-7738' (Core 4)) T.D.

Barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

SUMMARY OF PALYNOLOGY REVISIONS

6897-7070'? : Late Triassic? (P-M26 to P-M257). Weak evidence for marine Late Triassic.
7070-7680' : Permian-Triassic (P-T17 to P-T16).
7680-7720' : T.D. Age indeterminate

E. Simpson #1 (Foraminifera)

FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checklisting of 244 washed ditch samples, 15 washed sidewall cores and four thin sectioned ditch samples covering the interval 100 to 7718 feet (total depth). Thin sections were prepared on samples below 7620 feet. Three checklists and a faunal distribution log are enclosed for your convenience.

Standard techniques were employed in processing the material. All samples were boiled in Quaternary-O and washed over 20 and 200 mesh screens.

Frequency symbols used in this report correspond to the following numerical values: R = rare (1-5); F = frequent (6-32); C = common (33-99); A = abundant (100-199); and FL = flood (200+).

100-450'

Haplophragmoides rota, Trochammina whittingtoni, T. ribstonensis, Dictyomitra multicostata, Thoracosphaera sp.,

Archaeosphaera sp. and frequent to common pyrite oblates suggest that these strata are probably Cenomanian to Turonian (P-7) in age.

AGE: Late Cretaceous
Cenomanian to Turonian (P-7)
ENVIRONMENT: Probable Middle Neritic to Upper Bathyal

450-670'

Rare specimens of Verneuilinoides cf. borealis and Haplophragmoides topagorukensis indicate an Early Cretaceous age, but their paucity suggests reworking.

AGE: Early to Late Cretaceous
Late Albian to Early Cenomanian (P-8)
ENVIRONMENT: Probable Nonmarine to Marginal Marine

670-1960'

Rare to frequent occurrences of Haplophragmoides topagorukensis, H. cf. linki, Lenticulina macrodisca, Valvulineria loetterlei, Miliammina manitobensis, Hyperammoides barkadalai, Verneuilinoides borealis, together with frequent to common Ditrupa cornu indicate that these strata are Middle to Late Albian (P-9) age. Depositional environments associated with these strata were probably inner to middle neritic.

AGE: Early Cretaceous
Middle to Late Albian (P-9)
ENVIRONMENT: Inner to Middle Neritic

1960-3540'

This interval is characterized by occurrences of the following: Gaudryina nanushukensis, Lenticulina topagorukensis, L. erecta, Marginulinopsis jonesi, Eucyclammina robinsonae, E. grandstandensis, Glomospirella gaylina, Ammobaculites fragmentarius, A. wynnsnae, Reophax subcircularis, R. bowneri, Textularia topagorukensis, Ammodiscus rotularius, Pseudobolivina ravi, Quadrimorphina ruckerae, Miliammina manitobensis, M. avunensis, Haplophragmoides topagorukensis, H. cf. excavatus, and arenaceous spp. (large, coarse). The above fauna indicates a Late Aptian to Early Albian (P-10) age. The paleodepths represented by these moderately diverse assemblages were probably middle to outer neritic.

AGE: Early Cretaceous
Late Aptian to Early Albian (P-10)
ENVIRONMENT: Middle to Outer Neritic

3540-6420'

A pyritized radiolarian fauna characterizes these strata together with occurrences of agglutinated and calcareous Foraminifera. Pyritized radiolaria of the following genera occur: Cenosphaera spp., Spongodiscus spp., Lithocampe spp., Dictyomitra spp., and Stichomitra? sp. Lithocampe cf. N tops near the base of this unit at 6390 feet. According to Ramsay (1970) this zone of pyritized radiolaria separates the Verneuilinoides borealis Zone from the Gaudryina taylouri Zone, and is probably Aptian to early Albian in age. We feel that it is probably Aptian in age, but our data is tentative at this time. Due to the preservation of this fauna, all that can be said about the environment of deposition is that it was marine and open to oceanic currents. These strata may represent deep marine (below compensation depth) basal slope deposits. This is a possibility since calcareous Foraminifera are very scarce in this interval and could represent caved specimens when they do occur.

AGE: Early Cretaceous
Aptian (P-11)
ENVIRONMENT: Open Marine

6420-8620'

Occurrences of Gaudryina taylouri, Haplophragmoides coronis, Bathysiphon sclintillata, and common to abundant rounded frosted quartz floaters suggest a Neocomian age for these rocks. This fauna is totally agglutinated and indicates deposition in a relatively shallow (inner to middle neritic) turbid environment.

AGE: Early Cretaceous
Neocomian (P-12 to P-13)
ENVIRONMENT: Inner to Middle Neritic (turbid)

8620-6900' Core

A probable Early Jurassic (P-18) age is suggested by the associated occurrences of Ammobaculites alaskensis, A. barrowensis, Ammodiscus siliquus, Reophax decensis, R. lenna, Lenticulina audax, Citrotuba irregularis, and Haplophragmoides kingakenzis. A fine-grained saccharoidal sandstone tops at 6740 feet which may be a Sag River Sandstone equivalent. Core 6 (6897-6922') is somewhat anomalous. The top sample (6897') contains Early Jurassic (P-18) Foraminifera and Neocomian palynomorphs. The top of this core could contain rubble from up-hole making any age determination highly suspect.

AGE: Probable Early Jurassic
P-18
ENVIRONMENT: Probable Middle Neritic to Bathyal

6900 Core-7460'

Astacolus connudatus, Nodosaria shublikensis, N. larina, Ammobaculites schenarus, Jagoplecta contata, Spirillina gorgitata, Lingulina horealis, L. alaskensis, Frondicularia acuta, F. lucerata, Pseudoglandulina lata, P. wimpsonensis, Troehammina helicta, and Monotis/Halobia fragments occur throughout these beds. These faunas appear to represent open marine middle to outer neritic conditions. It should be noted that the good Triassic (F-19) foraminifera do not occur until 7020 feet. The top of the Triassic is placed at 6900 feet in Core 4 based on possible Monotis/Halobia fragments and palynology. A distinctive dark green to black calcareous pebbly sandstone similar to that described by Tappan (1951, pp. 5-6) from the basal 25 to 50 feet of the Shublik Fm. in the Sadlerochit River Region tops in these samples at 7370 feet.

AGE: Triassic F-19

ENVIRONMENT: Middle to Outer Neritic (Open Marine)

7460-7620'

No new foraminifera were found in ditch samples from this interval and the core from these strata (7565-7593') was barren of foraminifera. A probable Permo-Triassic age is assigned to these rocks based on a similarity with Ivishak Fm. lithology only.

AGE: Probable Permo-Triassic (lithology)

ENVIRONMENT: Possible Nonmarine

7620-7738' T.D.

This last unit is picked on the basis of a lithologic change to argillite. There were no indigenous foraminifera recovered from this interval.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

S. Simpson #1
(Palynology)

PALYNOLOGY REPORT

A total of 93 ditch samples were processed and analyzed for palynological age determinations. The samples were 90-foot composites covering the interval from 510 feet to the total depth of 8795 feet.

510-690'

Gleichaniiditas senonicus (R), Aequitriradites spinulosus (R).

Astrocysta cretacea (R-F), Broomea jaegari (R), Odontochitina operculata (R), Pseudocerateum expolitum (R).

AGE: Cenomanian
ENVIRONMENT: Marine

The age ranges of the species observed do not exclude the possibility that this interval may be as old as Albian. Lacking the presence of any Albian marker species, however, a tentative Cenomanian age assignment is made.

690-870'

Classopollis classoides (R), Aequitriradites spinulosus (R).

Astrocysta cretacea (P-C), Cyclonephelium distinctum (R-F), Odontochitina operculata (R), Luxadinium propatulum (R).

AGE: Albian
ENVIRONMENT: Marine

870-2040'

Classopollis classoides (R-F), Gleichaniidites senonicus (R, scattered); rare, sporadic occurrences of reworked Permo-Triassic and Carboniferous forms.

Astrocysta cretacea (R), Cribroperidinium edwardsii (R), Oligosphaeridium complex (R).

AGE: Aptian-Albian
ENVIRONMENT: Marginal Marine

The microplankton assemblage was relatively sparse through this interval.

2040-6340'

Classopollis classoides (R, scattered), Lycopodiumsporites sp. (R); rare, sporadic occurrences of reworked Permo-Triassic and Carboniferous forms.

Astrocysta cretacea (R-C), Odontochitina operculata (R-C), Oligosphaeridium complex (R-F), Cyclonephelium distinctum (R), Broomea jaegari (R), Gardodinium eisenacki (R), Muderongia sp. (R, scattered); scattered reworked occurrences of Neocomian to Triassic age species.

AGE: Aptian-Albian (probably equivalent to Aptian-Early Albian interval)
ENVIRONMENT: Marine

This interval appears to be correlative to the Aptian-Early Albian interval observed in the other wells of this region.

6340-6880'

Astrocysta cretacea (F), Cyclonephelium distinctum (R-F), Odontochitina operculata (F-C), O. sp. 1 (R), Oligosphaeridium complex (A), Gardodinium eisenacki (R-F), Caesingia cf. colliveri (R-F).

AGE: Probable Neocomian
ENVIRONMENT: Marine

No definite Neocomian aged species were observed in this interval. The overall assemblage, however, is very similar to the Neocomian interval seen in this area.

6880-7690'

Classopollis classoides (F-C); single specimens of probable reworked ?Lundbladispora sp. and Taeniaesporites sp.

Nannoceratopsis gracilis (R-F), N. sp. 1 (R), Micrhystridium spp. (R-F), Gonyaulacysta cladophora? (single, at top of interval).

AGE: Early to Middle Jurassic (Late Pliensbachian to ?Callovian)
ENVIRONMENT: Marine

A single dinocyst specimen, probably Gonyaulacysta cladophora, indicates that the top of this interval may be at least as young as Bajocian in age.

7690-8410'

Classopollis classoides (R-F), ?Lundbladispora sp. (single), Taeniaesporites sp. (single), undifferentiated striate bisaccate (single), densospores (R, reworked).

Rhaetogonyaulax rhaetica (R), Micrhystridium spp. (R).

AGE: Late Triassic (Norian-Rhaetian)
ENVIRONMENT: Marginal Marine

8410-8770'

Klaustipollenites staplinii (R), ?Lundbladispora sp. (single), Taeniaesporites sp. (R), Lueckisporites sp. (single), Striatites richtari (R), undifferentiated verrucate spores (R-F), densospores (R, reworked).

AGE: Permian-Triassic
ENVIRONMENT: Nonmarine

8770-8795' T.D.

Densospores (C).

AGE: Possibly Carboniferous (Mississippian?)
ENVIRONMENT: Nonmarine

The common densospores in this bottom sample suggests that possibly Mississippian strata are present. These densospores had been observed reworked throughout the well in much less frequencies. The fact that these spore may also be reworked at the bottom of the well cannot be ruled out.

So. Simpson #1

2877' SWC

Undifferentiated bisaccates (A), Classopollis classoides (R).

Muderongia tetragontha (R), Oligosphaeridium complex (F), Sverdrupiella usitata (single, reworked).

AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

2972' SWC

Undifferentiated bisaccates (A), Classopollis classoides (R).

Cyclonephelium distinctum (R), Odontochitina operculata (R), Oligosphaeridium complex (R).

AGE: Cretaceous
ENVIRONMENT: Marine

2978' SWC

Undifferentiated bisaccates (R).

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

2991' SWC

Undifferentiated bisaccates (C).

Oligosphaeridium complex (R).

AGE: Indeterminate
ENVIRONMENT: Marine

6704' SWC

Undifferentiated bisaccates (A), Lycopodiumsporites sp. (R).

Micrhystridium spp. (R), ?Nannoceratopsis gracilis (single).

AGE: Probable Early-Middle Jurassic (P-M23)
ENVIRONMENT: Marginal Marine

6704' SWC (con't.)

This sample raises the base of the Neocomian interval by approximately 180 feet.

8064' SWC

Undifferentiated bisaccates (P), undifferentiated spores (P). Poor preservation of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Probable Nonmarine

8718' SWC

Essentially barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

SUMMARY OF PALYNOLOGY REVISIONS

510-870'	:	Early Cretaceous, Middle to Late Albian (P-M17).
870-6340'	:	Early Cretaceous, Aptian to Early Albian (P-M18).
6340-6700'	:	Early Cretaceous, possible Neocomian (P-M18a).
6700-7690'	:	Early to Middle Jurassic, Late Pliensbachian to Early Bajocian? (P-M23).
7690-8230'	:	Late Triassic, probable Norian-Rhaetian (P-M26 to P-M25).
8230-8580'	:	Permian to Triassic (P-T17 to P-T16).
8580-8718'	:	Pa Carboniferous.
8718-8795'	:	T.D. Age indeterminate.

S. Simpson #1 (Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1" to 100' faunal distribution log and two faunal checklists on the S. Simpson #1 well. The conclusions presented in this report are based on the processing, picking and examination of 284 ditch samples, generally composited on 30 to 40 foot intervals. Seven (7) thin sections were prepared on 30 foot ditch intervals below 8590 feet. A generalized age summary of the well is provided below, along with a sample-by-sample faunal listing of the thin sections in an appendix at the end of the report.

510-3780'

Gaudryina nanushukensis, Vaginulinopsis grata, Palliamorphina rockersa, Glomospirella gaultina, Gavelinella stictata, G. swanensis, Marginulinopsis ignesi, Eurychilostroma repinsonae, E. grandacandensis, Ammodiscus rotularius, Globulina prisca, Valvulineria loeblichi, Textularia topagorukensis, Haplophragmoides topagorukensis, H. cf. linki, H. cf. excavata, Ammobaculites fragmentarius, A. wenonahae, Lenticulina nagrodisca, L. topagorukensis, L. atopta, Trochammina umiatensis, Miliammina anuitopensis, Psammosphaera bowsheri, Saccammina lathrami, Cyclammina cf. pacifica, Saracenaria durgi, S. trollopei, S. projectura, Pseudobolivina rayi, Bathysiphon vitta, Verneuilinoides borealis and Dicrupa cormy occur in this interval. The above association is typical of the Verneuilinoides borealis Faunal Zone and is Albian age. The environments represented by these diverse assemblages were probably of relatively clear water middle neritic to upper bathyal depths.

AGE: Early Cretaceous (Albian)
Nanushuk Group - Upper Torok Fm.
ENVIRONMENT: Middle Neritic to Upper Bathyal

3780-6340'

A diverse pyritized radiolarian assemblage characterizes these strata together with a dominantly agglutinated foraminiferal fauna. The frequent and continuous occurrence of Lithocampe cf. sp. H at 6310 feet is here taken as the top of that form. Rare scattered occurrences above 6310 feet are considered reworked in this report. Some calcareous forms occur which may or may not be caved from the overlying interval. According to Ramsey (1970)* this zone of pyritized radiolaria separates the Verneuilinoides borealis zone from the Gaudryina taillieuri zone, and is probably Aptian to early Albian in age. Due to the preservation of this fauna, all that can be said about the environment of deposition is that it was marine and open to oceanic currents. These strata may represent deep marine (below compensation depth) basal slope deposits. This is certainly a possibility since it is felt that faunal diversity is reduced in both directions from the shelf edge in higher latitudes.

*Ramsey, W. O., 1970. "Geological Age of Gaudryina taillieuri in Northern Alaska", Nature, vol. 227, p. 598.

AGE: Early Cretaceous (Aptian to Early Albian)
Torok Fm. or Fortress Mountain Fm.
ENVIRONMENT: Open Marine

6340-6520'

Occurrences of Haplophragmoides goodenoughensis, Ammodiscus mackenziensis, Gaudryina tappanae, Glomospirella arctica, Lithocampe cf. sp. H, and abundant rounded frosted quartz floaters (Pebble Shale) suggest a Neocomian age for these strata. A turbid probable neritic depositional environment is suggested by this association.

AGE: Probable Neocomian
Probable Okpikruak Fm.
ENVIRONMENT: Probable Neritic (turbid)

6520-7660'

Bathysiphon anomalocoelia, Lituotuba irregularis, Trochammina instowensis, Haplophragmoides canui, Gaudryina dyscrita, Ammobaculites barrowensis, A. cf. sthenarus, Involutina aspera and Reophax dentata occur throughout these strata. This association is similar to the association described by Bergquist (1966, p. 159)* from lower Jurassic rocks in the Simpson Test Well #1. These sediments probably represent deposition in middle to outer neritic depths characterized by fluctuating turbidity. A sandstone occurs at the bottom of this interval which may be an equivalent to the Sag River Sandstone.

AGE: Probable Early Jurassic
Kingak Fm.
ENVIRONMENT: Probable Middle to Outer Neritic (fluctuating turbidity)

7660-8200'

Sagoplegra himstoides, Vaginulinopsis acrulus, Eoguttulina bulgelia, Frondicularia sumana, Astacolus connudatus, Modosaris larina, M. shublikensis, Lingulina glaskensis, L. borealis, Marginulina prisca, Pseudoglandulina simpsonensis, P. lata and Mongtis fragments occur throughout these beds. The Triassic age of these strata is firmly established on the basis of the above fauna. Single specimen

*Bergquist, Harlan R., 1966, Micropaleontology of the Nanushuk rocks of northern Alaska, Geol. Surv. Prof. Paper 302-D; U. S. Govt. Printing Office, Washington, D. C.

7660-8200' (cont'd.)

occurrences of Sagoplecta intrusata and Eogutticulina bulgella at 7400 feet are considered to represent reworking in this report. These faunas probably represent clear water middle to outer neritic open marine conditions.

AGE: Triassic Shublik Fm.

ENVIRONMENT: Middle to Outer Neritic

8200-8590'

Fauna throughout the upper portion of this interval is generally sparse. Caved specimens of the overlying Triassic fauna are rare to frequent in addition to rare occurrences of Ammobaculites cf. vetusta, Gaudryina adoxa, and G. cf. dysorita in the lower portion of this section. The sharp reduction in fauna and poor faunal diversity suggest a regression to fluctuating nonmarine to turbid inner neritic deposition. There was no lithologic evidence observed to indicate the presence of the Echooka Member in this well.

AGE: Permo-Triassic Sadlerochit Fm. (Ivishak Mbr.)

ENVIRONMENT: Nonmarine to Inner Neritic (turbid)

8590-8740'

This interval is marked by a lithologic change to algal packstone, chert and orange-brown shale and siltstone. The washed foram samples in this interval contain caved specimens from the overlying strata. Thin sections prepared on these rocks contained Rectogyrina sp., Girvanella duoii, Baressella sp., unidentifiable algae, and rare to frequent shell fragments. The algae reported above would suggest that these strata are probable Carboniferous to Permian in age. The rocks probably represent deposition in nonmarine to shallow marine (subtidal) environments of a carbonate platform suite.

AGE: Carboniferous to Permian

ENVIRONMENT: Nonmarine to Subtidal (Carbonate Platform Suite)

8740-8795' T.D.

This last unit is picked on the basis of a lithologic change to argillite. There were no foraminifera recovered from this interval.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

APPENDIX

8590-8620'

Rectogyrina sp. (R), shell fragments (R).

LITHOLOGY: Mixed pelmatozoan-bryozoan-packstone, chert and orange-brown shale and siltstone

8620-8650'

Girvanella duoii (R), ostracods (R).

LITHOLOGY: Predominantly orange-brown shale and siltstone

8650-8680'

Rectogyrina sp. (F), Baressella sp. (R), shell fragments (F), unidentifiable algae (F).

LITHOLOGY: Dolomitic lime mudstone, algal packstone and orange-brown shale and siltstone

8680-8710'

Rectogyrina sp. (R).

LITHOLOGY: Lithology as above packstone, shale and siltstone

8710-8740'

No Foraminifera or Algae found.

LITHOLOGY: Argillaceous limestone and shale

8740-8770'

No Foraminifera or Algae found.

LITHOLOGY: Black argillite

8770-8795' T.D.

Stylocodium sp.? (R)(caved); porcellaneous foraminifer (R)(caved).

LITHOLOGY: Black argillite

So. Simpson #1

6526' SWC

No Foraminifera found. Oolites? (F), glauconite (F).

AGE: Indeterminate

ENVIRONMENT: Indeterminate

WASHED LITH: Dark brown limonitic glauconitic siltstone

6573' SWC

No Foraminifera found. Glauconite (A).

AGE: Indeterminate

ENVIRONMENT: Indeterminate

WASHED LITH: Red limonitic glauconitic shale

7666' SWC

No Foraminifera found. Pelecypods (pyrite casts)(R), glauconite (F), pyrite spheres (F).

AGE: Indeterminate

ENVIRONMENT: Possible Marine

WASHED LITH: Gray very fine-grained sandstone

8146' SWC

Ammobaculites sp. (very small)(R), Gaudryina cf. dysorita (R), Trochammoides sp. (very small, thin)(F), Lituocampa sp. (R)(pyritized), pyrite spheres (F), pyrite (C).

AGE: Permo-Triassic (probably still Shublik Fm. based on lithology)

ENVIRONMENT: Probable Inner to Middle Neritic

WASHED LITH: Dark gray to black silty shale

E. Teshekpuk #1 (Palynology)

PALYNOLOGY REPORT

A total of 117 ditch and 36 sidewall core samples were processed and analyzed for palynological age determinations. The ditch samples were generally composited into 60 or 90 foot samples and covered the interval from 533 feet to the total depth of 10,664 feet. The selected sidewall cores were limited to those cores that had adequate recoveries and provided sufficient amounts of clean material to permit the additional palynological analysis in conjunction with the foraminiferal analysis.

533-680'

Australiella cooksoni (R), A. victoriensis (R), Deflandrea pirnaensis (R), Diconodinium arcticum (R), Hystrichosphaeridium difficile (R), Hexagonifera chlamydata (R), Chlamydophorella nyei (R), Hystrichodinium sp. (R).

AGE: Late Cretaceous (Santonian - Campanian)

ENVIRONMENT: Marine

680-1340'

Undifferentiated bisaccate grains (F-C).

Australiella cooksoni (R), Hystrichosphaeridium difficile (R), Oligosphaeridium complex (R), Palaeoperidinium basilium (R).

AGE: Late Cretaceous (probable Turonian - Coniacian)

ENVIRONMENT: Probable very marginal marine to nonmarine

A significant decrease in microplankton diversity occurs in this interval.

1340-2260'

Undifferentiated bisaccate grains (F-C), Oleichenilidites sanonicus (R).

Cribroperidinium edwardsi (R-F), Cyclonephelium distinctum (R), C. membraniphorum (R), Chlamydophorella nyei (R), Hystrichodinium pulchrum (R), Hystrichosphaeridium stellatum (R), Odontochitina operculata (R-F), Staphodinium coronatum (R), Wallodinium luna (R), Apteodinium grande (R), Broomea jaegeri (R), Pseudoceratium expolitum (single).

AGE: Late Cretaceous (Cenomanian)

ENVIRONMENT: Marine

The increase in microplankton abundance and diversity indicates open marine conditions throughout the interval.

The dinoflagellate species which has been used as the principal Cenomanian age indicator in this area of the North Slope was not observed in the subject well. The assemblage recovered, however, is sufficient to permit a fairly confident Cenomanian age assignment for this interval.

2260-2840'

Podocarpus (R), Cicatricosisporites venustus (R), Trilobosporites apiverrucatus (R), single specimens of Polycingulatisporites reduncus, Camarozonosporites insignis, Cicatricosisporites hallei.

Cyclonephelium distinctum (R-F), C. compactum (R-C), Odontochitina operculata (R-C), Broomea jaegeri (R), Astrocysta cretacea (R-C), Luxadinium propatulum (R), Oligosphaeridium complex (R-F), Cribroperidinium edwardsi (R)) rare reworked Triassic and Early Cretaceous dinoflagellates.

AGE: Early Cretaceous (Albian)

ENVIRONMENT: Marine

2840-7020'

Undifferentiated bisaccates (F-C), Podocarpus (R); scattered rare occurrences of Trilobosporites apiverrucatus, Polycingulatisporites reduncus, Appendicisporites sp.

Cribroperidinium edwardsi (R), Cyclonephelium distinctum (R), Chlamydophorella nyei (R), Oligosphaeridium complex (R-C), Odontochitina operculata (R-C), Broomea jaegeri (R), Astrocysta cretacea (R-C), Gardodinium eisenacki (R), Nuderongia sp. (R); reworked Neocomian and Late Jurassic dinoflagellates.

AGE: Early Cretaceous (Aptian)

ENVIRONMENT: Marine

7020-7290'

Cyclonephelium distinctum (F), Canningia hirtella (F), Oligosphaeridium complex (C), Gardodinium eisenacki (R-F), Psaligonyaulax apatela (R), Pseudoceratium nudum (R), Odontochitina sp.-1 (R), Nuderongia staurota (R).

AGE: Early Cretaceous (Neocomian)

ENVIRONMENT: Marine

7290-7470'

Psaligonyaulax apatela (F), Sirmiodinium grossi (R), Nuderongia cf. simplex (R-F), Ctenidodinium ornatum (R), Gonyaulacysta cladophora (R), G. jurassica (R).

AGE: Late Jurassic (Oxfordian)

ENVIRONMENT: Marine

7470-8080' SWC

Undifferentiated bisaccate grains (F-A), Classopollis classoides (R).

Nuderongia cf. simplex (R-F), Gonyaulacysta cladophora (R-F), Nannocerstopsis gracilis (R-A), N. sp.-1 (R), Fromea elongata (R), undescribed microplankton species JRD-1 (R).

AGE: Middle Jurassic (Bajocian - Callovian)

ENVIRONMENT: Marine

8080-9052' SWC

Undifferentiated bisaccate grains (R-A); poorly preserved, indeterminate spores (R-C).

AGE: Indeterminate

ENVIRONMENT: No evidence of marine

The palynomorph recoveries in this interval are very poor. Although the ditch samples from the upper half of the interval contained numerous Middle Jurassic microplankton, the sidewall cores indicate that these microplankton are coming from strata above 8080 feet.

Other, not too distant, North Slope wells that penetrated a Middle Jurassic section usually had a short section with poor dinoflagellate recoveries at the base of the designated Middle Jurassic interval. It is possible that some upper portion of the interval beginning at 8080 feet in the East Teshekpuk Lake #1, where the recoveries drop off, may be correlative with the tops of similar intervals in the nearby wells (i.e., 7510 feet in the Union Kalubik Creek #1).

9052' SWC - 9690'

Stratites richteri (R-F), Taeniaesporites spp. (R), Lunuki-sporites sp. (R), Klaumipollenites sp. (R-F), Lycospora spp. (R).

AGE: Permo-Triassic

ENVIRONMENT: No evidence of marine

9690-10,664' T.D.

Densospores (R), single specimens of Waltzispora cf. polita, Convolutispora cf. varicosa.

AGE: Carboniferous

ENVIRONMENT: No evidence of marine

The ditch samples are dominated with palynomorphs derived from the Permo-Triassic interval above.

The sidewall cores from within this interval were essentially barren of palynomorphs.

PALYNOLOGY REPORT REVISIONS

533-680'	:	Late Cretaceous. Santonian-Campanian (P-M14), Marine.
680-1540'	:	Late Cretaceous. ?Turonian-?Coniacian (P-M15), Marginal Marine.
1540-2260'	:	Late Cretaceous, Cenomanian (P-M16), Marine.
2260-4650'	:	Early Cretaceous, Middle-Late Albian (P-M17), Marine.
4650-6930'	:	Early Cretaceous, Aptian-Early Albian (P-M18), Marine.
6930-7110'	:	Early Cretaceous, possible Neocomian (P-M18a), Marine.
7110-7290'	:	Early Cretaceous, Neocomian (P-M19), Marine.
7290-7470'	:	Late Jurassic, probable Oxfordian (P-M22), Marine.
7470-8080'	:	Early-Middle Jurassic (P-M23), Marine.
8080-8700'	:	Triassic-Early Jurassic (P-T157 to P-M24?), Nonmarine-Marginal Marine?
8700-9052'	:	Probable Late Triassic (P-T157). Nonmarine?
9052-9510'	:	Early Triassic (P-T16), Nonmarine.
9510-9690'	:	Permian-Triassic (P-T17), Nonmarine.
9690-9870'	:	Age indeterminate.
9870-10,664'TD	:	In Carboniferous, Nonmarine?

E. Teshekpuk #1 (Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1" to 100' faunal diversity log, an environmental log for the Lisburne, and four faunal checklists on the U. S. Navy East Teshekpuk Lake #1 well. The conclusions presented in this report are based on the processing, picking and examination of 276 ditch samples, generally composited on 30 to 40 foot intervals, and 38 sidewall core samples. Thin sections were prepared on 30 foot ditch intervals and all sidewall core samples below 9600 feet. A generalized age summary of the East Teshekpuk #1 well is provided below.

533-1540'

Saplophragmoides rota, Trochammina albertensis, Saccammina lathrami, Vaginulina schradersensis and Quinqueloculina sphaera occur rarely in these strata. The poor quality of the faunas does not allow for differentiation of the Colville Group in this well. These strata probably represent shallow fluctuating inner Neritic to Nonmarine deposition of Turonian or Senonian Age. A lithologic change noted at 1300 feet to a brownish-gray silty calcilutite may mark the top of the Seabee Fm. but there was no substantiating foraminiferal evidence found.

AGE: Turonian to Senonian (Colville Group undifferentiated)

ENVIRONMENT: Probable fluctuating Nonmarine to Inner Neritic

1540-1940'

Common to abundant radiolaria and rare agglutinated foraminifera characterize these strata. A top on the "Paper Shale" was found at 1540 feet: this point is probably at the top of or down in the Shale Wall Member of the Seabee Formation. This interval is generally dominated by shallow starved basin deposition but with open access to oceanic currents since radiolaria abound. Reducing bottom conditions associated with high organic content probably accounts for the lack of any preserved calcareous foraminifera and the large amounts of pyrite.

AGE: Cenomanian to Turonian (Seabee Fm. - Shale Wall Mbr.)

ENVIRONMENT: Open Marine (Starved Basin)

1940-3110' (SW)

Haplophragmoides topagorukensis, H. cf. rota, Ammobaculites fragmentarius, A. wenonahae, Lenticulina macrodisca, Trochammina rainwateri, Miliammina manitobensis, M. sevunensis, Bathysiphon vitta, Verneuilinoides borealis and Ditrupa cornu occur in this interval. The above fauna is typical of the Verneuilinoides borealis Faunal Zone, and is Albian Age. The environments represented by these moderately diverse assemblages were probably of somewhat turbid inner to middle Neritic depths with short periods of lesser turbidity.

AGE: Albian (Nanushuk Group)

ENVIRONMENT: Inner to Middle Neritic (moderately turbid)

3110' (SW)-6930'

Textularia topagorukensis, Gaudryina nanushukensis, Psammosphaera bowsheri, P. suboircularis, Gavelinella stictata, Eyrycheilostoma grandstandensis, E. robinsonae, Saracenaria projectura, Miliammina manitobensis, Valvulineria loetterlei, Globorotalites alaskensis and Conorboides umiatensis are among some of the species characterizing this interval. These strata are probably Aptian Age. The lower portion of this interval below about 5700 feet is characterized by common to abundant pyritized radiolaria (see Ramsay, 1970, Nature, p. 598).

The upper portion of this Aptian interval above about 5100 feet represents relatively clear water middle to outer shelf deposition while an interval between 5100 feet and 5700 feet probably represents a regression to marginal marine or even nonmarine conditions or else is the result of sediment dilution. Below 5700 feet deposition probably took place in depths varying from inner to middle neritic with dominantly reducing bottom conditions evidenced by the abundance of pyrite and pyritic faunal preservation.

AGE: Aptian (Torok Fm.)

ENVIRONMENT: 3110-5100' - Middle to Outer Neritic
5100-5700' - Nonmarine to Marginal Marine
5700-6930' - Inner to Middle Neritic

6930-7200'

Lithocampe sp. N. var., Gaudryina taillouri, Ammobaculites alaskensis, Gaudryina millori, Glomospirella arctica, Gaudryinella irregularis, Saracenaria trollopei, and rounded frosted quartz floaters (Pebble Shale) suggest that this unit is of Neocomian Age. A sandstone develops below 7110 feet in this interval that may be an age equivalent to the Kuparuk River Sandstone. An inner to middle Neritic environment is suggested by these faunas.

AGE: Neocomian (Okpikruak Shale-Kuparuk River Ss.)

ENVIRONMENT: Inner to Middle Neritic

7200-7530'

Gaudryina taillouri, Marginulina prima, Trochammina canningensis, Marginulina pinguicula, Vaginulina curva, Lenticulina variana, L. tegaensis, Ammobaculites alaskensis, A. barrowensis, Marginulinopsis phragmites, Saracenaria topagorukensis,

7200-7930' (con't.)

Astacolus pediscus, Eoguttulina liassica occur throughout these strata. Based on occurrences in nearby wells to the east the above fauna would indicate an early Late Jurassic Age. Also, the overlapping occurrences of Gaudryina tailleuri and Saracenaria topagorukensis would suggest the same age. The abundant and diverse faunas of this interval probably represent a Middle Neritic to Upper Bathyal environment of deposition associated with fluctuating amounts of turbidity.

AGE:	Probable Late Jurassic (Oxfordian) (Kingak Fm.)
ENVIRONMENT:	Middle Neritic to Upper Bathyal

7930-8370'

Ammobaculites vetusta, A. fontinensis, Lenticulina cf. bicostata, Geophax liasica, G. metensis, G. danza, Frondicularia squamosa, Textularia areoplecta, and common to abundant radiolaria of the Genera Patulibracchium, Crucella, Phopalastrum, Cenosphaera, Lithocampe, Spongodiscus, and Dictyomitra occur in these strata. This interval is characterized by an abundant and diversified fauna. These strata are Early to Middle Jurassic in age. They represent deposition in middle Neritic to Upper Bathyal depths characterized by fluctuating turbidity.

AGE:	Early to Middle Jurassic (Kingak Fm.)
ENVIRONMENT:	Middle Neritic to Upper Bathyal

8370-9000'

Trochammina contornata, Astacolus connudatus, Tolypammina glareosa, Nodosaria larina, Frondicularia sagaca, F. lustrata, Lingulina borealis, Nodosaria shublikensis, N. lirstella, Pseudoglandulina simpsonensis, Vaginulinopsis acrulus and Trochammina hylicta among others occur throughout these beds. The Triassic in this well appears to be more continuously marine than observed in other wells from the area. These faunas represent fluctuating inner to outer Neritic open marine conditions. The Triassic Age of these strata is firmly established on the basis of the above fauna below 8460 feet, but the uppermost part of this interval (8370-8460') may still be Early Jurassic since we have seen Trochammina contornata possibly that high in the section before. The lithologic top of the Shublik Fm. occurs at around 8670 feet suggesting that there may be some Triassic age Kingak Shale (lithologically) or else some different facies (lithologically different) Shublik Fm. or Sag River equivalents occurring between 8370 feet and 8670 feet.

AGE:	Triassic (Shublik Fm. - Kingak Fm. ?)
ENVIRONMENT:	Inner to Outer Neritic

9000-9655' (SW)

Trochammina contorhata, T. sp. (sml., thin), Ammodiscus sp. P. Ammobaculites vetusta, Bathysiphon anomalocoelia, and Trochammminoides spp. together with rare to common radiolaria and rare calcareous foraminifera mark this interval. This is the most continuously marine Sadlerochit Fm. we have seen in this area. It would appear to represent somewhat turbid inner to middle shelf deposition (possibly pro-delta). Three samples at the bottom of this unit (9600-9660') contain a heavily glauconitic sandstone suggestive of the Echooka Member of the Sadlerochit Formation.

AGE:	Permo-Triassic (Sadlerochit Fm.)
ENVIRONMENT:	Inner to Middle Neritic (turbid)

9655 (SW)-10,590'

Generally throughout the area westward of the Prudhoe Bay State #1 well, the Lisburne Group can be divided into three lithologic units:

1. Upper Limestone Unit
2. Dolomite Unit
3. Lower Limy Unit

The Upper Limestone Unit is 935 feet thick in this well, and it would appear that it could be unconformable at both its upper boundary and lower boundary. This 935 feet of Upper Limestone Unit comprises the Lisburne Group in this well, which appears to rest unconformably on rocks questionably of the Endicott Group.

Strata between 9655 feet and about 9930 feet contain Paleotextularia sp., Climacammina spp., rare Biseriella sp., rare Eoshubertella spp., and frequent Stylocodium sp. These rocks conspicuously lack occurrences of Astecarchaediscus spp., Neoarchaediscus spp. and Archaediscus spp. These rocks are certainly no older than Zone 21 but could easily be as young as Zone 22 (see Mamet, 1971, pages 203 and 204)*. These strata probably correlate in part with strata above 11,940 feet previously included in Zone 21 in the ARCO Itkillik #1 well.

Bursts of Eoshubertella yukonensis and Pseudostaffella sp. together with occurrences of Neoarchaediscus spp., Astecoarchaediscus spp., Archaediscus spp., and frequent to common Stylocodium sp. indicate that the strata between about 9930 feet and 10,290 feet are definitely Zone 21 in age.

A questionable Zone 20 call is made at 10,290 feet based on a significant reduction in the occurrence of Kamaenid algae. Age data below 10,440 feet is conflicting in the ditch samples, and therefore tenuous at this time. There is rare questionable evidence indicating an age as old as Zone 18 or Zone 19, but there are also rare continuous occurrences of Globivalvulina bulloides which if not caved would indicate an age no older than Zone 20. For present, this interval

*Mamet, B. L. & Ross, C. A., 1971, in Barber & Waterhouse, "Carboniferous and Permian Stratigraphy and Paleontology, Northern Yukon Territory, Canada"; Bull. of Can. Petr. Geol., vol. 19, no. 1, pp. 196-205.

9655 (SW)-10,590' (con't.)

(10,440-10,590') is spread from Zone 18 to Zone 20. These strata represent a shallow shelf cyclic carbonate sequence with interbedded nonmarine, backreef, reefoid, and forereef deposits. Lithologies vary between red shales, lime mudstones, oolitic and algal grainstones, packstones, and wackestones. An environmental interpretation of Lisburne strata is presented on an accompanying enclosure.

AGE:	Latest Mississippian ? to Middle Pennsylvanian (Lisburne Group)
ENVIRONMENT:	Probable Nonmarine to Middle Neritic (Forereef)

10,590-10,650'

This interval is characterized by a lithologic change to fine grained calcarenite or calcareous sandstone. The sidewall core at 10,624 feet contained in its matrix one poor questionable Brunsia pulchra suggesting that these rocks are possibly no younger than Zone 18 in age.

AGE:	Mississippian ? (Endicott Group ?)
ENVIRONMENT:	Possible Inner Shelf

10,650-10,664' T.D.

The last ditch sample of this well represents a lithologic change to what appears to be a quartzite. There were no foraminifera recovered from this material.

AGE:	Indeterminate
ENVIRONMENT:	Indeterminate

Tunalik #1
(Palynology)

PALYNOLOGY REPORT

A total of 395 samples were processed and examined from the subject well. The total consisted of 227 ditch, 19 sidewall cores and 149 core samples covering the well from 90 feet to 20,330 feet.

The results are summarized by intervals, and accompanying the report are two (2) distribution charts illustrating occurrences for the recognized palynomorph taxa.

Summary of Results

90-8230'

Undifferentiated bisaccates (C-A), Schizosporis parvus (R); rare scattered occurrences of Cerebropollenites mesozoicus, Concavissimisporites punctatus, Cicatricosisporites australiensis, Aequitriradites spinulosus; numerous occurrences of reworked spores.

Cyclonephelium distinctum (R), Gaxdodinium trabaculosum (R, sporadic), Odontochitina operculata (R), Oligosphaeridium complex (R-C), Palaeoperidinium cretaceum (R-F); rare scattered occurrences of Pseudoceratium retusum, Nodosaria asymmetrica; numerous occurrences of reworked Triassic- to Neocomian-aged dinocysts.

AGE: Early Cretaceous; Aptian-Albian (P-M18 to P-M17)

ENVIRONMENT: Marine to very Marginal Marine or Nonmarine

The top part of this interval (90-2100') had very meager dinocyst recoveries, and probably represents nonmarine to marginal marine strata. Below 2100 feet the dinocyst recoveries increase and reflect a better marine depositional environment that the section above that depth.

8230-10,692'C

Indeterminate spores and spore fragments, poorly preserved (R).

AGE: Indeterminate

ENVIRONMENT: Nonmarine?

This interval is essentially barren of palynomorphs. No significant occurrences of spore-pollen or dinocysts were recorded.

10,692-13,340'

Undifferentiated bisaccates (R-A), indeterminate spores and spore fragments (R-C), Classopollis classoides (R-F).

Oligosphaeridium complex (thick-wall)(R-F).

AGE: Early Cretaceous; Neocomian (probable P-M19)

ENVIRONMENT: Marine

The main constituent identifying this interval is O. complex (thick-wall), which is most common in the Neocomian section.

Overall, the best recovery of palynomorphs through this interval occurs below approximately 12,500 feet, as evidenced in the ditch and core samples.

13,340-13,520'?

Undifferentiated bisaccates (F), indeterminate spores and spore fragments (F).

Oligosphaeridium complex (thick-wall)(R), Convolucysta hyalodermopsis (R), Paradinia dasyforma (R).

AGE: Early Cretaceous; Neocomian (probable P-M20)

ENVIRONMENT: Marine

This narrow interval is marked by the appearance of P. dasyforma. The bottom of the interval is questionably placed at the apparent base for O. complex as observed in the ditch samples.

13,520-13,880'

Undifferentiated bisaccates (C-A), Classopollis classoides (F-C), indeterminate spores and spore fragments (A).

Paradinia osmingtonense (R), Endoscrinium galeriatum (R), Tubotuberella apatela (R), Nannoceratopsis pellucida (R).

AGE: Late Jurassic; Oxfordian (P-M22)

ENVIRONMENT: Marine

This interval is marked by the top occurrence of P. osmingtonense. A somewhat better, but still not very well developed, Oxfordian dinocyst assemblage appears below about 13,700 feet.

Preservation from this interval through the underlying Late Triassic is extremely poor. The dinocyst specimens are all highly corroded.

13,880-14,330'?

Undifferentiated bisaccates (F-A), Classopollis classoides (R-F), indeterminate spores and spore fragments (C-A), Triancorasporites sp. (single, reworked?).

Nannoceratopsis gracilis (R), N. senex (R), JRD-2 (R), Micrhystridium spp. (R), Sverdrupiella usitata (single, reworked?).

AGE: Early to Middle Jurassic (P-M24? to P-M21)

ENVIRONMENT: Marine

The base of this interval is questioned because the ditch sample at 14,150-14,240' contained two (2) specimens of Triassic palynomorphs. The problem is that Triassic species can be seen reworked throughout much of the drilled section above and the rare occurrences here may also be reworked. The more frequent Late Triassic evidence is not seen until 14,330 feet.

14,330-14,690'?

Undifferentiated bisaccates (C-A), Classopollis classoides (R), Gleicheniidites senonicus (R), Taeniaesporites sp. (R).

Sverdrupiella usitata (R-C), Micrhystridium spp. (R), Veryhachium spp. (R).

AGE: Late Triassic; Norian (P-M26)

ENVIRONMENT: Marine

The lowermost limit for S. usitata in the ditch samples is used to mark the base of this interval. The lower boundary might be better placed at 14,510 feet or 14,600 feet, where the land-derived Triassic assemblage begins to appear somewhat more consistently.

14,690-16,929'C

Undifferentiated bisaccates (R-C), indeterminate spores and spore fragments (C-A), Taeniaesporites spp. (F-C),

Duthuisyspora minuta (R), Lueckisporites spp. (R), Striatites richteri (R-F), Monosulcites spp. (R).

Micrhystridium spp. (C-A), Veryhachium spp. (R-F), Leiofusa jurassica (R).

AGE: Triassic (P-T16 to P-T15)

ENVIRONMENT: Marine to Marginal Marine

No evidence was seen to enable the differentiation of zonula P-T17.

The Permian/Triassic boundary is placed at the top of Core #15 (16,929-16,947') wherein the first Permian evidence was recovered.

16,929-17,858'C?

Taeniaesporites spp. (F), Striatites richteri (R), Acanthotriletes sp. (R, sporadic), Vesanulisporites sp. (R), Vittatina sp. (R).

Micrhystridium (F-C).

AGE: Permian (P-T18)

ENVIRONMENT: Marginal Marine

The base of the Permian is placed tentatively at what appears to be the lowermost indigenous occurrence of Vittatina sp.

17,850-19,620'

The palynomorph assemblage remains similar to the above interval, but with fewer and less consistent occurrences. The forms observed are judged to be derived from up-hole.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

19,620-19,890'

The significant form occurring in this interval is Potonisporites sp.

AGE: In Pennsylvanian (F-T19)
ENVIRONMENT: Marginal Marine?

19,890-20,330'

Only Permo-Triassic palynomorphs derived from up-hole were recovered through this interval.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

The total depth for the well is given as 20,335 feet, however, the deepest sample depth received was 20,330 feet.

Tunalik #1 (Foraminifera)

FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checklisting of 605 washed ditch samples, 116 thin sectioned ditch samples, 17 washed sidewall cores, 121 washed conventional core samples and 28 thin sectioned conventional core samples covering the interval 90 to 20,330 feet. Thin sections were prepared on all samples below about 16,930 feet. Five checklists and two faunal distribution logs are enclosed for your convenience. Four sidewall cores received after the faunal checklists had been completed appear in an appendix at the back of this report.

Standard techniques were employed in processing the material. All samples were boiled in Quaternary-O and washed over 20 and 200 mesh screens.

Frequency symbols used in this report correspond to the following numerical values: R = rare (1-3); F = frequenc (6-32); C = common (33-99); A = abundant (100-199); and FL = flood (200+).

90-3620'

This interval is practically barren of Foraminifera. Rare occurrences of Trochammina gemmrayensis, T. cf. rainwateri and Verneuilinoides borealis suggest that these strata probably belong in the Early Cretaceous (Middle to Late Albian) F-9 Zonule. Depositional environments for these strata probably ranged from nonmarine to marginal marine.

AGE: Probable Early Cretaceous
Probable Middle to Late Albian
(Probable F-9)
ENVIRONMENT: Nonmarine to Marginal Marine

3620-5950'

Faunal recoveries pick up in this interval. Occurrences of: Miliammina manitobensis, M. owenensis, M. ischmia, Hippocrepina barksdalei, Verneuilinoides borealis, Cavellinella striata, Haplophragmoides topagorukensis, Saccammina lachrymi, Pseudobolivina ravi, Ammobaculites fragmentarius, A. vanhanen, Conorboides umiatensis, Quadrimorphina tuckerae, Textularia topagorukensis, Eurychellostomella robinsonia, Psammosphaera bowsheri, and rare Ditrupa cornu are indicative of a Middle to Late Albian (F-9) age. The paleodepths represented by these assemblages were probably inner to middle neritic.

AGE: Early Cretaceous
Middle to Late Albian (F-9)
ENVIRONMENT: Inner to Middle Neritic

5950-7350'

Based on co-occurrences of Gaudryina nanushukensis, Haplophragmoides excavatus, Verneuilinoides borealis, Pseudobolivina ravi, Psammosphaera subcircularis, and Conorboides umiatensis, this interval is believed to represent a Late Aptian to Early Albian (F-10) age. A middle to outer neritic depositional environment is suggested for these strata.

AGE: Early Cretaceous
Late Aptian to Early Albian (F-10)
ENVIRONMENT: Middle to Outer Neritic

7350-10,620'

A weakly developed radiolarian fauna characterizes these strata together with rare occurrences of agglutinated and calcareous Foraminifera. Pyritized radiolaria of the following genera occur: Cenosphaera spp., Dictyomitra sp., and Lithocampe spp. According to Ramsey (1970) this zone of pyritized radiolaria separates the Verneuilinoides borealis Zone from the Gaudryina taillauri Zone and is probably Aptian to Early Albian in age. We feel that it is probably Aptian in age, but our data is tentative at this time and the unit may indeed be time transgressive. For this reason it cannot be directly correlated between wells since the F-11 strata in one well may be slightly younger or older than the corresponding F-11 strata in another well. Due to the poor quality and preservation of this fauna, all that can be said about the environment of deposition is that it was marine and open to oceanic currents.

AGE: Early Cretaceous
Possible Aptian (Possible F-11)
ENVIRONMENT: Open Marine

10,620-12,620'

Occurrences of Lituotuba gallupi, Ammobaculites erectus, A. reophacoides, Ammodiscus elongatus, A. orbis, A. mackenziensis, arenaceous spp. (large, coarse), Citharina cf. acuminata, Glomospirella arctica, Haplophragmoides coronis, H. inflaticrandis, H. duoflatis, H. goodenoughensis, Pseudobolivina spp., Bathysiphon sciotillata, Lenticulina sp. (raised sutures), L. audax, Trochammina squamata, Conorboides cf. umiatensis, Gaudryina taillauri, Glomospira subarctica, Praebulimina 2, and Quinqueloculina 2 indicate a Neocomian (F-12 to F-13) age for these strata. Cores 8 and 10 contain a similar assemblage. Frequent to abundant rounded frosted quartz floaters can also be found in this interval. Strata between 10,620 feet and about 10,900 feet represent relatively clear water upper to middle bathyal deposition. Faunas below 10,900 feet indicate a relatively turbid middle to outer neritic environment.

AGE: Early Cretaceous
Neocomian (F-12 to F-13)
ENVIRONMENT: 10,620-10,900' = Upper to Middle Bathyal (Clearwater)
10,900-12,620' = Middle to Outer Neritic (turbid)

12,620-13,380'

This interval is considered to be Neocomian (F-13 to F-14) in age based on the following faunal association: arenaceous sp. (large, coarse), Glomospirella arctica, G. S. Haplophragmoides coronis, H. inflaticrandis, H. duoflatis, H. goodenoughensis, Ammobaculites reophacoides, A. cf. alaskensis, Bathysiphon sciotillata, Gaudryina millari, G. taillauri, G. leffingwelli, G. topagorukensis, Trochammina squamata, T. cf. sablai, and Glomospira subarctica. The upper portion of this interval probably represents turbid middle to outer neritic paleodepths similar to the overlying interval. Faunas below about 12,920 feet suggest outer neritic to bathyal conditions.

AGE: Early Cretaceous
Neocomian (F-13 to F-14)
ENVIRONMENT: 12,620-12,920' = Middle to Outer Neritic (turbid)
12,920-13,380' = Outer Neritic to Bathyal

13,380-13,590'

Occurrences of Ammosaginulina cf. barytica, Trochammina cf. topagorukensis, T. instowensis, Ammobaculites cobbani, and Lenticulina cf. quenstedti suggest that these strata are Late Jurassic in age. They could represent any age from Oxfordian to Tithonian though, and so are here reported as Late Jurassic (undifferentiated). This interval probably represents bathyal paleodepths similar to the lower part of the overlying interval.

13,380-13,590' (con't.)

AGE: Late Jurassic Undifferentiated
ENVIRONMENT: Bathyal

13,590-14,040'

Overlapping occurrences of Gaudryina milleri, G. topagorukensis, G. jeffingwelli, G. ellisiana, Ammobaculites alaskensis, Ammodiscus cf. charadospirus, A. thomsi, Trochammina sablei, Bathysiphon anomalocoelia and Saracenaria topagorukensis indicate that these rocks are Oxfordian in age. A bathyal paleodepth is again suggested for these strata.

AGE: Late Jurassic
Oxfordian (F-16)

ENVIRONMENT: Bathyal

14,040-14,250'

This interval is characterized by a reduction in fauna with only a few newly occurring forms. The new occurrences are: Astacolus dubius, A. cf. connudatus, Vaginulina cf. sherborni, and Ammobaculites cf. vetusta. These forms probably represent an Early Jurassic age, but the faunal data is tenuous. A middle to outer neritic paleodepth is suggested for these rocks.

AGE: Probable Early Jurassic
(F-18)

ENVIRONMENT: Probable Middle to Outer Neritic

14,250-14,810'

Astacolus connudatus, Nodosaria larina, N. radiata, N. shublikensis, Pseudoglandulina simpsonensis, P. lata, Lingulina borealis, L. alaskensis, Vaginulinopsis acrulus, Frondicularia acmaea, Trochammina contorqata, Lithocampe T (pyritized), and Monotis/Halobia fragments occur throughout these beds. These faunas represent open marine middle neritic conditions. A sandstone at 14,730 feet composed of frequent rounded frosted quartz grains and common clear angular quartz grains may be a facies equivalent of the basal pebble sandstone found in other NPRA wells at the base of the F-19 zonule.

AGE: Triassic (F-19)
ENVIRONMENT: Middle Neritic (Open Marine)

14,810-17,135.5' Core

This interval is characterized by a relatively poor agglutinated fauna. A lithologic change at 14,810 feet followed by the occurrence of Ammodiscus P at 15,080 feet is the basis for placing the top of the Permo-Triassic (F-20). A lithologic change at 16,020 feet may represent the top of the Kavik Shale. Another lithologic change to glauconitic sandstone and siltstone at 16,900 feet suggests that we are probably in the Permian Echooka Fm. at that point. These strata probably represent nonmarine to inner neritic deposition.

AGE: Permo-Triassic (F-20)
ENVIRONMENT: Nonmarine to Inner Neritic

17,135.5 Core-19,050'

A very thick (1900'+) section of Early Permian strata appears to develop in this well based on occurrences of Protonodosaria sp., Paleoaplysina sp., nodosariids, cornuspirids and porcellaneous Foraminifera. A significant occurrence of amygdaloidal basalt is found in the interval 17,380 feet to 18,050 feet. The age of this basalt is indeterminate since no Foraminifera or algae were found in it. Whether this volcanic rock represents an intrusive (dike, sill) or extrusive (flow) cannot be determined from the paleontological examination of these samples. Depositional environments for this unit appear to be as follows:

17,135.5-18,340' : Nonmarine to Restricted Carbonate Shelf and Lagoonal
18,340-19,050' : Shallow shelf (Carbonate Platform Suite)

Packstones and grainstones predominate below 18,340 feet.

AGE: Early Permian
(A.W.A. F-23)

ENVIRONMENT: 17,135.5-18,340' : Nonmarine to Restricted Carbonate Shelf and Lagoonal
18,340-19,050' : Shallow Shelf (Carbonate Platform Suite)

19,050-20,330'

This interval is predominately packstones and grainstones. Strata between 19,050 feet and 19,350 feet are no older than Zone 21 but could be as young as Zone 24. Occurrences of Pseudogaudryina sp. and Kasaena sp. coupled with the presence of Stylocodium sp. at 20,290-20,320 feet, in what appears to be in-situ lithology, suggest that the entire interval 19,050 feet to 20,330 feet is Zone 21 in age. However, if the Stylocodium sp. at 20,290-20,320 feet is caved then the strata below 20,210 feet might be Zone 20 in age.

These strata represent the shoaling shelf facies of a Carbonate Platform Suite.

AGE: Middle to Late Pennsylvanian
ENVIRONMENT: Shoaling Shelf
(Carbonate Platform Suite)

APPENDIX A

10,646'SWC

Arenaceous spp. (R), Lituotuba gallupi (R), Cancsphaera spp. (F) pyritized, Dictyoritra sp. (R) pyritized, rounded frosted quartz floaters (C), pyrite (C), L.C.M. (F). Dark brownish-gray sandy shale.

AGE: Neocomian
(Probable F-12 to F-13)
ENVIRONMENT: Open Marine

10,888'SWC

No Foraminifera found. Pyrite (R), L.C.M. (C). Buff tan very fine-grained sandstone.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

11,196'SWC

No Foraminifera found. Dark brown silty shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

11,317'SWC

No Foraminifers found. Inoceramus prisma (R), L.C.M. (A). Dark brown shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

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