UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards (and stratigraphic nomenclature).
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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 biostratigraphically 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>
<thead>
<tr>
<th>Well</th>
<th>Completion Date</th>
<th>Total Depth</th>
<th>Deepest Unit Penetrated (Age)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlgaru Test Well No. 1</td>
<td>3/77</td>
<td>11,535 ft.</td>
<td>Argillite Basement (Indeterminate) 3</td>
</tr>
<tr>
<td>S. Barrow Field Well No. 17</td>
<td>4/78</td>
<td>3,382 ft.</td>
<td>Argillite Basement (Indeterminate) 3</td>
</tr>
<tr>
<td>Cape Halkett Test Well No. 1</td>
<td>6/75</td>
<td>9,900 ft.</td>
<td>Argillite Basement (Indeterminate) 3</td>
</tr>
<tr>
<td>J. W. Dalton Test Well No. 1</td>
<td>8/79</td>
<td>9,387 ft.</td>
<td>Argillite Basement (Indeterminate) 3</td>
</tr>
<tr>
<td>Drew Point Test Well No. 1</td>
<td>3/78</td>
<td>7,946 ft.</td>
<td>Argillite Basement (Indeterminate) 3</td>
</tr>
<tr>
<td>W. Fish Creek Test Well No. 1</td>
<td>4/77</td>
<td>11,427 ft.</td>
<td>Kayak Shale (Probable Mississippian)</td>
</tr>
<tr>
<td>W. T. Foras Test Well No. 1</td>
<td>4/77</td>
<td>8,864 ft.</td>
<td>Argillite Basement (Indeterminate) 3</td>
</tr>
<tr>
<td>S. Harrison Bay Test Well No. 1</td>
<td>2/77</td>
<td>11,290 ft.</td>
<td>Lisburne Group (Middle Pennsylvanian or younger)</td>
</tr>
<tr>
<td>Ikpikpuk Test Well No. 1</td>
<td>2/80</td>
<td>15,481 ft.</td>
<td>Keklktuk Tm. 7 (Probable Mississippian)</td>
</tr>
<tr>
<td>Iqaluk Test Well No. 1</td>
<td>5/79</td>
<td>20,103 ft.</td>
<td>Keklktuk Tm. 7 (Mississippian)</td>
</tr>
<tr>
<td>Itkillik River Test Well No. 1</td>
<td>7/72</td>
<td>15,321 ft.</td>
<td>Argillite Basement (Indeterminate) 3</td>
</tr>
<tr>
<td>H. Kalskipik Test Well No. 1</td>
<td>4/78</td>
<td>7,395 ft.</td>
<td>Kingak Sh. (Jurassic)</td>
</tr>
<tr>
<td>Kugrus Test Well No. 1</td>
<td>5/78</td>
<td>12,588 ft.</td>
<td>Lisburne Group (Middle Pennsylvanian)</td>
</tr>
<tr>
<td>S. Meade Test Well No. 1</td>
<td>1/78</td>
<td>8,945 ft.</td>
<td>Clay shales/siltstones of indeterminate unit (Indeterminate) 3</td>
</tr>
<tr>
<td>Peard Test Well No. 1</td>
<td>4/79</td>
<td>10,225 ft.</td>
<td>Argillite Basement (Indeterminate) 3</td>
</tr>
<tr>
<td>Z. Simpson Test Well No. 1</td>
<td>4/79</td>
<td>7,730 ft.</td>
<td>Argillite Basement (Indeterminate) 3</td>
</tr>
<tr>
<td>S. Simpson Test Well No. 1</td>
<td>4/77</td>
<td>8,785 ft.</td>
<td>Argillite Basement (Indeterminate) 3</td>
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<tr>
<td>Z. Teaspekik Test Well No. 1</td>
<td>5/76</td>
<td>10,664 ft.</td>
<td>Granite Basement OR Keklktuk Tm. 7 (Mississippian) 5</td>
</tr>
<tr>
<td>Tusalk Test Well No. 1</td>
<td>1/80</td>
<td>20,335 ft.</td>
<td>Lisburne Group (Mississippian)</td>
</tr>
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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 Laurfield, 1975); Early Carboniferous 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 foraminifera 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: 333 ± 10 m.y. (Mississippian age) for K-feldspar and 342 ± 7 m.y. (Late Pennsylvanian age) for biotite. Alternatively, an A.W.A., Inc. report for this well suggests the following:
   Foraminifera
   10,550 - 10,650 ft.: Rediott Group, Keklktuk Tm. 7 (Mississippian)
   10,550 - 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 bentonic, 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/biostatigraphic 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).
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 foraminiferal assemblages, however, indicate a Neocomian age. Hence, zone PM-18a is positioned to straddle 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 (F: 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 90-foot composites covering the interval from 530 feet to the total depth of 11,570 feet. The sidewall cores examined were taken between 4200 and 8100 feet.

530-890'  
Leawigasporites (C-A), Betulasaccus (C), Ulmus (R-F), Cleischeities sanousus (R), Aqui lapollenites colovillenites (R), A. quadrilobus (R), A. magus (R), A. scabridus (R).

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

890-1140'  
Aquaiapolliinites magna (P), A. sanousus (R), A. cf. quadrioiotes (R), Hyperhymenata sinata (R), H. emontiacola (single).

AGE: Neocomian
ENVIRONMENT: Very Marginal Marine

1140-1520'  
Deflandrea cf. speciosa (R-F), Ovovinum verrucosum (R, reworked).

AGE: Neocomian
ENVIRONMENT: Very Marginal Marine

1520-1730'  
Chlamyscheites yule (R-F), Australiasella oceana (F), A. granulata (F), A. splendida (F), A. spectabilis (F-A), Deflandrea dictyoloma (F), Ovovinum operculatum (C), Eucholeaopilum bicuspidatum (F-C), Escartinetta chalcosynum (F-C), Cristalaria verrucosa (F-C), C. delavayana (R-F), Protovinum delavayanum (R-F).

AGE: Santonian-Campanian
ENVIRONMENT: Marine

2130-2780'  
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: Neocomian-Campanian
ENVIRONMENT: Marine

2780-3950'  
Vitreisporites pallidus (R), Cleischeities sanousus (R).

AGE: Campanian
ENVIRONMENT: Marine

3950-5976'  
This interval carried essentially the same assemblage as above with the addition of the following species: Gardodon eisenackii (R, scattered), Luxadinum propinquum (R-F), Spiniferites vestibulum (R-F), and Muderongia sp. (R, scattered).

AGE: Albian
ENVIRONMENT: Marine

5976-7829'  
Gleiehennidites sanousus (R).

AGE: Aptian-early Albian
ENVIRONMENT: Marine

This interval is separated principally on the base of the Luxadinum and Spiniferites occurrences. Usually this interval is also characterized by the consistent occurrence of Gardodon eisenackii, however, this species was not well developed here.

7829-MC-1150'  
Vitreisforites pallidus (R).

AGE: Neocomian
ENVIRONMENT: Marine

The ditch core at 7829' 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.

7350-8212'  
Vitreisporites pallidus (R), Claspassisina claviceps (R-C), scattered bissates (R, reworked).

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

8212-8540'  
Vitreisporites pallidus (R), Claspassisina claviceps (R), scattered bissates (R, scattered, reworked).

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

8540-9000'  
Undifferentiated scattered bisaccates (F-C), Tanniasporites sp. (F-C), Striatites richteri (R), Pulvinitesporites minutus (R), Claspassisina claviceps (aporalid, C).

AGE: Triassic
ENVIRONMENT: Very Marginal Marine

9000-9075'  
Vitreisporites pallidus (R), Tanniasporites sp. (F-C), Tanniasporites sp. (F-C), scattered bissates (R, scattered, reworked).

AGE: Late Triassic (Carthon-Moranian)
ENVIRONMENT: Marine

9075-9512'  
Tanniasporites sp. (F-C), Striatites richteri (F), Equisettites spinulosus (R), Claspassisina claviceps (R-F), Tanniasporites sp. (R), Tanniasporites sp. (R), undifferentiated verrucous stocks (F-C), Vitatina sp. (single).

AGE: Permian-Triassic
ENVIRONMENT: Nonmarine

A single, questionable specimen of Vitatina 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 palynomorphs 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

-17-
10.250-11.070’
Potonieisporites sp. (R-F), Triquiritrites sp. (single),
Hystrichosporites sp. (R).
AGE: Pennsylvanian
ENVIRONMENT: No evidence Marine

11.070-11.520’ T.D.
Densosporites spp. (P-A), Hystrichosporites sp. (R),
Reticulatisporites polygalon (single).
AGE: Probable Mississippian
ENVIRONMENT: Marine

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

6618’ SHC
Undifferentiated bisaccatae (A), Lycopsidiumporites sp. (R),
Classopollis classoides (R).
AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

6418’ SHC
Undifferentiated bisaccatae (A), Vitreisporites pallidus (R),
Classopollis classoides (R).
AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine

6618’ SHC
Undifferentiated bisaccatae (A).
Basioladiniuia jaegeri (R), Hystrichosporidium tristitum (R),
Odontochitina operculata (R).
AGE: Aptian-Albian (P-M17, M18)
ENVIRONMENT: Marine
Essentially barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10,964′ SMC
Barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

SUMMARY OF PALYNOLOGY REVISIONS

530-890′
580-1160′
1160-1520′
1520-2330′
2370-2780′
2730-3590′
3950-7083′
7083-7163′
7163-7350′
7350-8012′
8012-8540′
8540-9440′
9440-9530′
9530-10,250′

MIXED Late Cretaceous and Tertiary.
Late Cretaceous, Maastrichtian (P-T11).
Late Cretaceous, Campanian (P-T13).
Late Cretaceous, Santonian-Campanian (P-M14).
Late Cretaceous, Turonian-Coniacian (P-M15).
Late Cretaceous, Campanian (P-M16).
Early Cretaceous, Middle-Late Albian (P-M17).
Early Cretaceous, Aptian-Early Albian (P-M18).
Early Cretaceous, Neocomian (P-M19 to P-M20).
Early-Middle Jurassic, Late Pliensbachian-Early Bajocian (P-M21).
Triassic-Early Jurassic (probable P-T15 to P-M21).
Permian-Triassic (P-T17 to P-T16).
Permian (P-M24). This is Shublik assemblage and appears to be derived from uphole.
Possible in Permian (P-T187).
Age indeterminate.

5520-7282′ SMCD

Probable Late Cretaceous to Tertiary age. These strata probably represent marginal marine and nonmarine deposition.
AGE: Probable Late Cretaceous to Tertiary
ENVIRONMENT: Probable Nonmarine to Marginal Marine
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 cored specimens when they do occur.

AGE: Early Cretaceous
ENVIRONMENT: Open Marine

9724'W-9740'

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)

9740-8310'

Ammodiscus barrowensis, A. alaskanus, A. venezuelensis, Bathysiphon anomocoeus, Trochamnoides spp., Involutina aspera, Saadrylia sympetala, Hoplograllidus canalis, Trochamnoides contortus, arenaceous spp. (Irg., crs.) and common to abundant pyritized radiolarians of the genera Cyrtocapsa, Patulibracchium, Stichemita, Pholoe, Cenosphaera, Lithocapsa, Byngodiagast. and Dictyomitra occur in these strata. Also diagnostic of this unit is a burst of Tamassites 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
ENVIRONMENT: Middle Neritic to Upper Bathyal (fluctuating turbidity)

9910-8540'

Pseudoglabulina acaea, Astacolus venezuelensis, Nodosaria lata, Haplophragmoides canalis, Bathysiphon anomocoeus, Trochamnoides spp., Involutina aspera, Saadrylia sympetala, Hoplograllidus canalis, Trochamnoides contortus, arenaceous spp. (Irg., crs.) and common to abundant pyritized radiolarians of the genera Cyrtocapsa, Patulibracchium, Stichemita, Pholoe, Cenosphaera, Lithocapsa, Byngodiagast. and Dictyomitra occur in these strata. Also diagnostic of this unit is a burst of Tamassites 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
ENVIRONMENT: Middle neritic to upper bathyal (fluctuating turbidity)

9940-9490'

Tolyypaaaina glareosa, Aaaaridiscus sp., P. Aaaaridiscus cf. barrowensis, A. sp. ( simil., thin), and Trochamnoides spp. together with rare radiolarias mark this interval. This assemblage would appear to represent limestone to turbid inner shelf deposition. Three samples at the bottom of this unit (9490-9490') contain a heavy glauconitic sandstone suggestive of the Schooks Member of the Siderarchit Formation.

AGE: Permian-Triassic
ENVIRONMENT: Hommoraine to Inner neritic (turbid)

9490-9550'

This very thin interval is characterized by occurrences of microclolites and palaeomon-bryozan foraminiferal-algal packstone. The presence of Proto-Nodosaria sp. and rare Pseudostaffella 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)
APPENDIX
(Faunal lists and washed lithology descriptions for 21 sidewall core samples)

4221' SWC
Ammobaculites venosus (R), Ammodiscus rotulatus (F), Globorotalia menardii (R), Haplophragmoides cf. excavata (C), H. topogorukensis (R), Paennipertus bowenii (R), Trochammina sp. (F), Verneuilinoids borealis (F), Cenosphera sp. (F) glauconitic; megaspores (F), coal (A), pyrite (C).

AGE: Albian
WASHED LITH: Dark gray silty mudstone

4341' SWC
Arenaceous spp. (K), Praebulimina nanina (*) (C), Cenosphera sp. (R) glauconitic; megaspores (F), fishbone fragments (F), coal (A), pyrite (R).

AGE: Probable Albian
WASHED LITH: Black carbonaceous silty mudstone

4375' SWC
Arenaceous spp. (R), Haplophragmoides cf. excavata (R), H. topogorukensis (R), Verneuilinoids borealis (R), Psansinepelta bowshari (R), Verneuilinoids boraalis (F), Cenosphera sp. (R) glauconitic; coal (A), pyrite (R).

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

4392' SWC
Arenaceous spp. (R), Haplophragmoides cf. excavata (R), H. topogorukensis (R), Verneuilinoids borealis (C), Cenosphera sp. (R) glauconitic; fishbone fragments (F), coal (F), pyrite (R).

AGE: Albian
WASHED LITH: Brownish-gray siltstone

5110' SWC
Ammobaculites fragmentarius (R), Ammodiscus rotulatus (R), Haplophragmoides cf. excavata (R), Cenosphera sp. (R) glauconitic.

AGE: Probable Albian
WASHED LITH: Brownish-gray siltstone

5345' SWC
Megasporas (F), paper shale (FL).

AGE: Indeterminate
WASHED LITH: Black organic shale

5374' SWC
Haplophragmoides topogorukensis (R), Cenosphera sp. (R) glauconitic; megaspores (F), shell fragments (P), paper shale (A).

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

6748' SWC
Arenaceous spp. (R), Verneuilinoids borealis (R), Cenosphera sp. (F) glauconitic; megaspores (R), pyrite (FL), pyritized plant debris (F).

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

7083' SWC
Cenosphera sp. (R) glauconitic.

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

7282' SWC
Arenaceous spp. (R), Cenosphera sp. (R) glauconitic; coal (F), pyrite (R).

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

7474' SWC
Cenosphera sp. (R) glauconitic; C. spp. (A) pyritized; Lithocampe sp. (F) pyritized; Incoceras primas (F), megaspores (R), pelagic pyrite (W), pyrite (C).

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

7626' SWC
Cenosphera sp. (R) glauconitic; C. spp. (A) pyritized; Lithocampe sp. (R) pyritized; Integratus primas (F), megaspores (R), pelagic pyrite (W); pyrite (C).

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

8012' SWC
Barren of Foraminifera. Megaspores (R), fecal pellets (F).

AGE: Probable Jurassic
WASHED LITH: Dark brown organic shale

8069' SWC
Dictyonema sp. (R) pyritized; Cenosphera sp. (R) glauconitic; C. spp. (A) pyritized; Lithocampe sp. (R) pyritized; Tammanites sp. (F).

AGE: Early to Middle Jurassic
WASHED LITH: Dark brown paper shale
4064' SWC
No Foraminifera found. Megaspores (R), pyritized 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

7018' SWC
Cenosphaera spp. (P)(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 iridescent shale

8713' Core
No Foraminifera found.
AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Light gray to white fine-grained sandstone

8725' Core
Ammodeinacu P (P), Gloecospira sp. (R), Haplophragmides sp. (very small) (R), Nodosaria of. larina (R), pyrite (P).
AGE: Permio-Triassic (probable Sadlerochit Fm.)
ENVIRONMENT: Probable Inner to Middle Neritic
WASHED LITH: Light gray siltstone or silty mudstone

9473' SWC
No Foraminifera found. Glauconite (A).
AGE: Probable Permian (based on Zchoofca lithology)
ENVIRONMENT: Indeterminate
WASHED LITH: Dark gray to black dolomitized sandstone

9529' SWC
No Foraminifera found. Glauconite (C).
AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Gray slightly calcareous fine-grained sandstone

10,055' 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

1800-1900'

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

Cyclonephelium distinctum (R), Cardiogonium trabeculatum (R), Odonotochitina operculata (R), Oligospheridium complex (R), Nuderosa symmetrica (R, sporadic); rare, scattered occurrences of reworked Triassic, Jurassic, and Neocomian dinocysts.

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

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

1900-2000'

Undifferentiated bisaccates (C-A), Cleistocasioropites australiensis (single), Trilobosporites sp. (single).

The dinocyst assemblage shows a marked increase in abundance for such species as: Cyclonephelium distinctum, Cardiogonium trabeculatum, Odonotochitina operculata, Oligospheridium complex, and Pseudoammonium crustaceum. Naticoladinae hermanni (R), Triporicrepidina adwerti (R), Nuderosa symmetrica (R).

AGE: Early Cretaceous (probable Neocomian)
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.

2000-2100'

The assemblage in this interval is nearly identical to the above interval except for the addition of the Neocomian species Naticoladinae hermanni and Naticoladinae priscus.

AGE: Early Cretaceous (Neocomian)
ENVIRONMENT: Marine

2100-2180'

Undifferentiated bisaccates (A), Vitreisporites pallidus (R), Classopollis classoides (F-C), Ceratopollenites meadensis (R).

Micrhystridium spp. (F-A), Nanocamatospora near (R-F); undescribed microplankton JRG-2 (F), and JRG-6 (R).

AGE: Early to Middle Jurassic (probable Pliensbachian to Bajocian)
ENVIRONMENT: Marine

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

2180-2190' (cont'd.)

AGE: Triassic (undifferentiated)
ENVIRONMENT: Marginal Marine

Barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

ADDENDUM TO PALYNOLOGY REPORT

A total of 46 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 2064 feet and 2345 feet. Examination of these cores provided additional refinement to part of the Triassic section.

Core #2 (2295-2300') contained a Seussia assemblage, and lacking other older dinocyst genera in association, the age is placed as Rhaetian (C-M13).

The upper part of Core #4 (2222-2324') contained Seussia and Sverdrupielia. The assemblage provides evidence for a Norian age and it can possibly get as old as Kimeridgian. 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 113 and So. Barrow 114 wells. Below is a generalized age summary of the So. Barrow #17 well.

1900-1950'

Occurrences of Lenticulina macrodisca, Saccammina lathrami, Textularia topegorukensis, Eurycheilostome grandstandensis, Haplophragmoides cf. excavata, H. grandwaigleri, Miliammina arenbienensis, Psamminopelta subcircularis, Vermeilinoides borealis, Bathypogonistas, Ammodiscus rotalis, Tritaxia arenbienensis, Pseudobolivina rayi, and Hippocrepina barkadalei indicate that the strata between 100 feet
and about 1000 feet are Aptian to Albian (zones F-10 to F-11) in age. The occurrence of frequent to common pyritized radiolaria of the genera *Cenosphaera* spp., *Lithoeampe* spp., *Oietyomitra* sp., and *Spongodiscus* spp. suggests that the strata below 1000 feet are Aptian (zone F-11) in age. The fauna 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 fauna 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 diminish 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. The fauna found in the uppermost portion of this interval (above 610') probably represents middle neritic deposition.

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 (zones F-10 to F-11)

**Environment:** Uppermost portion: Middle Neritic

Lowermost portion: Probable Marine

---

This interval is characterized by occurrences of the following species: *Ammobaculites* sp., *Gauvyrina* spp., *G. cf. taillauri*, *Haplophragmoides duplicata*, *P. inflata*, *Trochammina squamata*, *arenoecus* 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)

---

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)

---

Occurrences of *Astacolus* pediacus, *Involutina aspera*, *Texitularia arenacea*, *Lenticulina teardens*, *Gaudryina dyricia*, *G. bedleri*, *Memphicryphus petersicki*, *H. densa*, *Trochammina salbei*, *T. canosinensis*, *Haplophragmoides barrowensis*, *arenoecus* 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 (zones P-17 to P-18)

**Environment:** Middle Neritic to Middle Bathyal (turbid)

---

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

**Age:** Triassic (zone F-19)

**Environment:** Inner to Middle Neritic (open marine)

---

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

**Age:** Indeterminate

**Environment:** Indeterminate

---

The following addendum to the So. Barrow #17 report is based on the process ion, picking and examination of 86 samples from conventional cores #4 through #6. 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 (2322 to 2345 feet) shows that the top of the argillite is at 2344 feet based on the one foot core intervals sampled.

**Age:** Early Cretaceous (Neocomian)

**Environment:** Neritic (turbid)

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)

---

**Age:** Early to Middle Jurassic (zones P-17 to P-18)

**Environment:** Middle Neritic to Middle Bathyal (turbid)
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

660-1100'
Scattered occurrences of Osmond, Retula, Sphenopodylum, and Oligospheridium 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

1100-1230'
Single specimen of Triprojectus magnus, Gliicheniellitites arenicosus, and Osmond.

The palynomorph recoveries remain poor in this interval.

AGE: Probable Cretaceous-Neocomian
ENVIRONMENT: Nonmarine

2040-3500'
The 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 (R), Hysterechosphaeridium pulchrum (F), Odontochitina operculata (C), Reticulodinium cretaceum (F), Hysterechosphaeridium difficile (F).

This interval contains an abundant and diverse microplankton assemblage.

AGE: Santonian-Campanian
ENVIRONMENT: Marine

3357-4554'
'Scriciolodinium eurypylum' (F), Astartevertex varrocum (R), Astrocysta cretacea (A), Oligospheridium complex (R), Rhoempa jaegari (R), Odontochitina operculata (C).

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

AGE: Cenomanian
ENVIRONMENT: Marine

4554-7560'
Astrocysta cretacea (A), Oligospheridium complex (R), Odontochitina operculata (C), Cribroperidinium edwardsi (F), Pycnostomatium detramaci (R), Broomea jaegari (R).

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

AGE: Aptian
ENVIRONMENT: Marine

7560-7715'
Muderongia simplex (C), Psilicyanula apatela var. (R), Oligospheridium complex (C), Rhoempa jaegari (R), Gardiniiium eisenacki (R).

AGE: Neocomian
ENVIRONMENT: Marine

7715-7810'
Muderongia simplex (R), Astrocysta cretacea (R), Oligospheridium complex (F), Gardiniiium eisenacki (R), Broomea jaegari (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

7810-8040'
Single occurrences of Helicosporites altamira, cf. striate basacate, and indeterminate spore genus as seen at 6348 feet core sample in the Simpson #1.

AGE: Probably Triassic
ENVIRONMENT: Nonmarine

8040-8296'
Tenuisporites sp. (R), Serraticites richardii (R-P), Eutheichosporites sp. (R), Hysterechosphaeridium pulchrum (R), Cribroperidinium sp. (R), Gardiniiium eisenacki (R).

The single specimen of Cribroperidinium sp. in sample #26-6220' 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: Triassic (Carnian-Hauterivian)
ENVIRONMENT: Nonmarine

8296-9320'
Scarcities of Triassic 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 (Hysterechosphaeridium 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 Permian-Triassic section above and their appearance here cannot be taken as age indicative.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

9320-9900'
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 (Hysterechosphaeridium 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 Permian-Triassic section above and their appearance here cannot be taken as age indicative.

AGE: ? Marine
ENVIRONMENT: ? Nonmarine

PAlyNOLOGY REPORT

PALSymology REVIEWS

510-1100' : Tertiary, Nonmarine.
910-1320' : Late Cretaceous, Campanian-Maastrichtian (P-T12 to P-T13), Nonmarine.
1100-12040' : Late Cretaceous, Campanian-Campanian (P-M14), Marine.
2040-1500' : Late Cretaceous, ? Turonian-? Coniacian (P-M15), Marginal Marine.
2500-3357' : Late Cretaceous, ? Cenomanian (P-M16), Marine.
7560-7715' : Early Cretaceous, Neocomian (P-M19), Marine.
7715-7810' : Late Cretaceous (undiff.) (P-T15), Nonmarine.
7810-8040' : Late Cretaceous, ? Lutetian (P-M16), Marine.
8040-8296' : Triassic (P-T14 to P-T15), Nonmarine to Marginal Marine.
8296-9320' : Permian-Triassic (P-T12), Nonmarine.
Cape Halkett #1 (Foraminifera)

FInal micropaleontology report

Enclosed you will find a 1' to 260' faunal diversity log and three faunal checklists on the U.S.W. 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 112 sidewall core samples. This section was 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.

\[510-1120^c\]

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

AGE: Probable Senonian

\[1120-2440^c\]


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.)

\[2440-1140^c\]

*Socoma* *lathrocni* (R), *Troehammina* *ribstonensis* (R-F), *T. ibbidi* spp. A (R-F), *Canospaera* spp. (R-C), *Spondiscus* spp. (R-C), *Cooka* spp. (R), *Pyrrus* (R-A).

This interval is generally poor in fauna, but does contain *Socoma* spp. A which is characterized by Bercuet (1966, U.S.S. S.P., 380-D, p. 182) to be a marker for the Seabee Formation. A *top* on the "Paper Shale" (*cutout 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 this samples, and the lack of preserved calcareous foraminifera associated with the few short pulses of open marine radiolarian bursts.

AGE: Turonian-Cenomanian (Seabee Fm.)

\[1140-1440^c\]

*Haplophragmoides* *bresciennis* (R-C), *E. retro* (R-F), *H. toponovarkensis* (R), *Sathytophryng* (R), *Vernamelinoides* *borealis* (R), *Ammonobaculites* *fragmentarius* (R), *Giradina* *cornua* (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 Wall between 7750 feet and 7830 feet.

AGE: Albian (Probable)

\[1440-5740^c\]

*Haplophragmoides* *topovarkensis* (R-A), *H. retro* (R-F), *Ammobaculites* *fragmentarius* (R), *A. venosa* (R), *Lenticulina* *pachistika* (R), *Troehamminoides* *mehraka* (R-C), *Z. meyeni* (R-F), *Millimammina* *mehraka* (R-F), *M. venosa* (R), *Sathytophryng* (R), *E. vista* (R), *Vernamelinoides* *borealis* (R-C), *Pseudobolivina* *broadleyi* (R), *P. subcarinulata* (R-F), *Ditrupa* *cornua* (R-F), *Canospaera* *apiculata* (R-F), *Cavitulina* *stictica* (R), *Pycnochelostoma* *grandstandense* (R), *Valvulina* *lotteri* (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 *Tectrachampia* *hoppesquenensis* Faunal Subzone which may mark the top of the Torok Formation locally.

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

\[5740-7320^c\]

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

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 *Vernamelinoides* *borealis* 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 ?

\[7320-7510^c\]

Bounded frosted quartz floaters (R-F), Lithocyclus sp. "H" (R), *Troehamminoides* *canningensis* (R), *Gaudryina* *milleri* (R), *C. topovarkensis* (R), *G. tailliei* (R-F), *Conorboides* *j" (R), *Pseudobolivina* sp. (R-F).

This fauna is indicative of a Latest Jurassic to Earliest Cretaceous (Serriasilian) Age. The first evidence for "paper shale" appears in the samples at 7320' (D) and 7326' (SMC). This assemblage suggests a depositional environment of outer neritic to possibly as deep as upper bathyal turbid waters.

AGE: Latest Jurassic to Earliest Cretaceous (Serriasilian)

\[7510-7630^c\]

A basal sandstone unit occurs between 7510 feet and 7545 feet that is similar in appearance to the Sag River Ss., but the unconformity lies above or below this unit cannot be precisely established since the unit is faunally depauperate.

\[7530-8140^c\]

*Astoculus* *conclusus* (R-F), *Troehamminoides* cf. *vertens* (R), *Frodolacris* *lustrata* (R), *Margarolina* *lamarina* (R), *Holodendra* *pachistika* (R), *H. phobytica* (R), *N. amphibolica* (R), *Polypma* *glazare* (R), *Macrospira* (R-F).

The above listed species are characteristic of Triassic Age. This fauna 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 above the lower 100 feet of this interval. 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 112 sidewall core samples. This section was 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.

\[8140-8320^c\]

This interval is generally barren of foraminifera suggesting that it represents either nonmarine deposition or else the results of dilution of the fauna by an increased rate of sedimentation. Lithologically, this interval is similar to the Sederocht Formation of Permian Age to Triassic Age. Samples between 8160 feet and 8790 feet lithologically represent the Tsivahak Member while samples between 8790 feet and 8820 feet suggest the presence of a thin interval of the Schooka Member.

AGE: Probable Permian-Triassic
This interval is characterized by occurrences of *Globivalvulina bulloidee*, *Biserialia parva*, *Monotaxinoides multivolutus*, *Ammonovartelia* sp., *Pseudonodosites* sp., *Earslandia elegans*, *Pseudogoniopora* sp., *Asteromphalus* sp., *Monaxonella inermis*, *Nodosohyra* sp., *Pseudoaffalina radiata*, *Priscella prisca*, *Pleurospiridiscus taimyricus*, *Planoendothyra rotayi*, *Millerella carbonica*, *Sellarina* sp.

The above species are indicative of the Early to Middle Pennsylvanian Wahoo Limestone in Alaska. These species represent Zones 20 and 21 in Namet's zonal scheme for the Carboniferous. It appears that based on a decrease in frequency of *Globivalvulina bulloidee* and an increase in the frequency of *Biserialia 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 *Biserialia parva* in the same fragment at 9230 feet suggests that these strata are Zone 18 in age (Upper Mississippian). The co-occurrence of *Earslandiana* sp., *Monaxonella inermis* and *Asteromphalus* sp. indicate Zones 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 Zones 20 and Zone 21 limestone fragments in the ditch material. There were rare occurrences as high as 9570 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 9220 feet to a greenish grey and grey shale. This is probably the Kayak Shale.

**AGE:** Upper Mississippian

**9779'-9900 T.O.**

Thin sections from sidewall cores at 9779 feet and 9850 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 9850 feet appears to be a black strongly liniated argillite or slate. The exact age of this unit is unknown; no foraminifers were recovered in this interval.

**FORAMINIFERA REPORT - REVISION**

<table>
<thead>
<tr>
<th>Age Interval</th>
<th>Formation/Group</th>
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<tbody>
<tr>
<td>3340-4430'</td>
<td>Early Cretaceous (Middle to Late Albian) F-9.</td>
</tr>
<tr>
<td>4430-5600'</td>
<td>Early Cretaceous (Albian) F-10.</td>
</tr>
<tr>
<td>5600-6800'</td>
<td>Early Cretaceous (Late Aptian to Early Albian) F-10 to F-11.</td>
</tr>
<tr>
<td>6800-7320'</td>
<td>Early Cretaceous (Aptian) F-11.</td>
</tr>
<tr>
<td>7320-7510'</td>
<td>Early Cretaceous (Hauterivian to Barremian) F-12 to F-13.</td>
</tr>
<tr>
<td>7510-7630'</td>
<td>Indeterminate age. Sandstone.</td>
</tr>
<tr>
<td>7630-7960'</td>
<td>Late Triassic to Early Jurassic (F-18 to F-19) Say River Sa.7 at 7850 feet.</td>
</tr>
<tr>
<td>7940-8160'</td>
<td>Triassic (F-19).</td>
</tr>
<tr>
<td>8160-8820'</td>
<td>Permo-Triassic (F-20). Echooka Fm. Lithology at 8790 feet.</td>
</tr>
<tr>
<td>8820-9020'</td>
<td>Middle Pennsylvanian (Namet's Zone 21).</td>
</tr>
<tr>
<td>9020-9160'</td>
<td>Early Pennsylvanian (Namet's Zone 20).</td>
</tr>
<tr>
<td>9160-9320'</td>
<td>Late Mississippian (Namet's Zone 18 to Zone 19).</td>
</tr>
<tr>
<td>9320-9779'</td>
<td>Possible Late Mississippian. Endicott Group?</td>
</tr>
<tr>
<td>9779'-9900'</td>
<td>Indeterminate age. Argillite.</td>
</tr>
</tbody>
</table>
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 composed into 90 foot intervals, 5 sidewall cores, and 170 core samples. The total sequence examined ranges from 90-270'.

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.

90-170'

Undifferentiated bisaccates (A), Araucariacites australis (R), Dictyoderidae sp. (R), Osmundacites spp. (R-F), Palaeoperidinium pseudoalveolatum (R-F), Cleistosphaeridium spp. (R), Spiniferites ramosus (R), Cleistochitina senonicus (R-F), Spiniferites cingulatus (R-P), Hystichosphaeridium pulchrum (R-P), Indeterminate yellow cysts (R-F), Cribroperidinium edwardsi (R), Cribroperidinium veetitum which do not occur either above or below the range of Genus "W", Luxadinium propatulum, and Spiniferites pseudoalveolatum. Other useful taxa that indicate the age given are Fromea amphora, Hymenidium senonicum, and Spiniferites pulchrum.

170-290'

Undifferentiated bisaccates (F-A), Alnus (R), Betula (R-P), Carpes (R), Cleistochitina senonicus (R), Cleistochitidae senonicus (R-P), Larixdrepanoites (R-P), Taxaceae (R-P).

Cleopsephalidium septum (R), Deflandrae phosporites (R), Dictyoderidae cedoides (R), Neopodocarpites (R), Spiniferites ramosus (R), Westella articulata (R).

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

A Paleogene age is suggested by the presence of Cleopsephalidium septum, Deflandrae phosporites, Westella articulata, and Cleistochitidae senonicus.

300-2150'

Undifferentiated bisaccates (F-A), Alnus (R), Cleistochitidae senonicus (R), Cleistochitidae cedoides (R), Carpes (R), Neopodocarpites (R), Westella articulata (R), Taxaceae (R-A), Trilobosporites creasum (R), Triporolites radiatus (R), Vitrasporites palidum (R).

Albiona australis (R), Chatangiella bisacerta (R), C. corona (R), C. decora (R-C), C. discina (R), C. granulosa (R), C. speciosa (R-C), C. victoriana (R-A), Chlamyderidites les (R-P), Cyclophelium complex (R-A), Cleistochitidae obtusata (R-C), Cleistochitidae cedoides (R-C), Gonyaulacysta bicaudata (R), Hexagoniferidium veetitum (R-F), Bryochaiosphaeridium diffusum (R), Bryochaiosphaeridium triloculatum (R-C), Hexagoniferidium obtusum (R), Dictyohelminthes longifurcatum (R), Dunaliella reticulata (R-F), Punctatoeporites foveolatus (R), Triporolites radiatus (R), Vitrasporites palidum (R).

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., Chlamyderidites les, Cyclophelium complex, and Odontochitina spp.

2143-1320'

Undifferentiated bisaccates (A), Cricotrispora antiqua (R), C. ignata (R), Cleistochitidae senonicus (R-A), Gomphacidites (C-A), Taxaceae (A).

Albiona australis (R), Canningia minor (R), Chatangiella victoriae (R-C), Cribroperidinium edwardsi (R), Cylindrosphaeridium complex (R-A), Gonyaulacysta bicaudata (R-C), Isabelidincurvata bicaudata (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.

125-1700'

Undifferentiated bisaccates (F-A), Cystochites minor (R), Cleistochitidae senonicus (R-P), Taxaceae (R-A).

Albiona australis (R), Cribroperidinium edwardsi (R-C), Cylindrosphaeridium complex (R-A), Gomphacidites (C-A), Cysnotrichoecia bicaudata (R-C), Oligosphaeridium complex (R-C), Palaeoperidinium creasum (R-F), Palaeoperidinium ciliatum (R-F), P. retangulatum (R-F), P. turneri (R-A), Spiniferites pulchrum (R-C).

AGE: Maastrichtian (P-M16)
ENVIRONMENT: Marine

This interval is characterized by common to abundant occurrences of Cribroperidinium edwardsi and the "indeterminate yellow cyst". Other useful taxa that indicate the age given are Fromea amphora, Cylindrosphaeridium longiserratum, and Spiniferites pulchrum.

3570-3490'

Undifferentiated bisaccates (F-A), Cleistochitidae senonicus (R), Cleistochitidae cedoides (R), Cleistochitidae obtusata (R), Gonyaulacysta bicaudata (R), Alnus (R), Cribroperidinium edwardsi (R), C. distinctum (R-C), C. spinulosum (R-P), Palaeoperidinium creasum (R), Palaeoperidinium ciliatum (R-F), C. victoriae (R-C), Cribroperidinium veetitum (R-P), T. reticulatum (R-F), T. turneri (R-A), Spiniferites pulchrum (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 Spiniferites pulchrum which do not occur either above or below the P-M17 Zone. These 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 (F-A), Cleistochitidae senonicus (R), Cleistochitidae cedoides (R), Cribroperidinium edwardsi (R), Cylindrosphaeridium complex (R-F), Oligosphaeridium complex (R-F), Palaeoperidinium creasum (R-C), Palaeoperidinium ciliatum (R-C), P. retangulatum (R-F), Spiniferites pulchrum (R-C).

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 Spiniferites pulchrum. Cleistochitidae senonicus is also an important fossil which can be used to define the top of this interval.
J. W. Dalton #1 (Foraminifera)

FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checklisting of 182 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 936.8 feet. Thin sections were prepared on all samples below 9216 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: A = rare (1-3); F = frequent (6-12); C = common (33-99); A = abundant (100-199); and PL = flood (200+).

90-210

Occurrences of Cassidulinoidia, Pororosina, Pantotila soluta, Elphidium ovatum. E. cf. acutum and Elphidium spp. suggest a Plicoline to Pliocene age. The above forms indicate a shallow probable inner neritic depositional environment.

AGE: Tertiary to Quaternary
ENVIRONMENT: Pliocene to Pleistocene

210-1050

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

AGE: Tertiary
ENVIRONMENT: Undifferentiated

1050-2160

A faunal increase characterizes this unit. It contains such forms as Napliophromoides rosa, N. latvalaisiensis, 'Sacculina flottai', Trocholasma ribsoni, T. whittingtoni, T. albertensis, Terebrulinoides (fusus), Terebrulinoides schucherti, and amoebids radiolarians of the genera Actinocystis, Archicyrtis, Dictyocystis, Thalamocyrtis, Cappellophora, Spongocystis, and Spongocystis. The above association indicates a Sanomias (F-5) age.

AGE: Late Cretaceous
ENVIRONMENT: Sanomias (F-5)

2160-2380

A top (the "Paper Shale" ("cutinized leaves") was found at 2380 feet. This interval is believed to represent a Turonian to Coniacian (P-6) age.

AGE: Late Cretaceous
ENVIRONMENT: Probable Middle to Outer Neritic

2380-2770

A top on the "Paper Shale" ("cutinized leaves") was found at 2550 feet. This interval is believed to represent a Turonian to Coniacian (P-6) age.

AGE: Late Cretaceous
ENVIRONMENT: Marginal Marine to Inner Neritic
This thin interval contains a poor transitional assemblage. The rare occurrence of *Haplophragmoides duoflatis* may indicate an Albian age or may represent a reworked specimen.

**AGE:** Early to Late Cretaceous  
**ENVIRONMENT:** Probable Albian to Cenomanian (F-6)  
**2730-2750'**


**AGE:** Early Cretaceous  
**ENVIRONMENT:** Probable Albian to Late Cenomanian (F-6 to F-10)  
**7340-7730'**

A mixed pyritized and silicified radiolarian assemblage characterized these strata together with rare non-deep-sea agglutinated Foraminifera. Some rare calcareous forms occur such as *Hedbergella cf. actinias*, *Psamminoeelta nana*, and *Arcoscopoma naticus*. According to Ramsey (1970) this zone of pyritized radiolarians separates the *Verneuilinoides borealis* Zone from the *Hedbergella taillauri* Zone, and is probably Aptian to early Albian in age. *Lithoclops cf. H. topa* 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) basinal slope deposits. This is certainly a possibility since calcareous Foraminifera are very scarce in this interval.

**AGE:** Early Cretaceous  
**ENVIRONMENT:** Probable Albian (F-11)  
**7730-7770'**

Rare occurrences of *Haplophragmoides douleti*, *Thuramia monosquamosa*, *Gaudryina taillauri*, *Ammoculitites excavatus*, *Lithogyra callipyga*, and *Trocchamiana sp.* (small, planor-conical) together with common rounded frosted quartz floaters indicate that these strata are Neocomian (F-12 to F-13) in age.

**AGE:** Early Cretaceous  
**ENVIRONMENT:** Probable Middle to Outer Neritic (turbid)  
**7770-7880'**

Based on the presence of *Haplophragmoides* fragments and *Lithogyra 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 Trassic (F-19) strata. The sidewall core at 7790 feet contained a good Trassic (F-19) assemblage with such forms as: *Asparagopsis condata*, *Epispiriferina sp.?,* *Moderocyclina latina*, *Psamminoolanidae sizemorei*, and *Vaginulinae subulosa*. 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 Sadlerochitic River Region occurs in samples from the interval 7820 to 7860 feet in this well.

**AGE:** Trassic  
**ENVIRONMENT:** Inner to Middle Neritic  
**7820-7880'**
APPENDIX A

7651' SHC
No Foraminifera found. Pyrite (R), pyrite sticks (R). Reddish-brown shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

7714' SHC
No Foraminifera found. Pyrite (C), coal (F), pyrite sticks (F). Dark gray pyritic silty shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

7788' SHC
No Foraminifera found. Coal (R). Brownish-gray very fine-grained sandstone or siltstone.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

7790' SHC
Astacolus consolutus (F), Marginula priest (R),Moderaria larina (R), Pseudoliopleurina spinosaeustae (R), Vaginulinopsis aequicosta (R), pyrite (C), coal (F). Reddish-brown silty shale.
AGE: Triassic (P-19)
ENVIRONMENT: Probable Middle Mesitic

8286' SHC
No Foraminifera found. Brownish-gray very fine-grained microdolomite.
AGE: Indeterminate
ENVIRONMENT: Possible Supratidal

8450' SHC
Biseriella papyr (P), Calcisphaera pachysphaerica (R), Endothyra spp. (P), Priacella priest (R), Pseudolomospira spp. (P), Tetraplophis sp. (F), Kamaena sp. (R). Brown palmatozoan-bryozoan-foraminiferal packstone.
AGE: Probable Middle Pennsylvania (Zone 2)
ENVIRONMENT: Shoaling Shelf
Summary of Results

80-620: Undifferentiated bisaccates (A), Omundiacidites spp. (F), Cleishanidites semenicus (F).

Altechiia crinita (C-R), Chasteaellus distans (R-P), C. cf. granulifera (F), Odontochitina operculata (R-P), Trinodripodion susceptum (R), Neurichosphaeridium difficilis (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-M14
ENVIRONMENT: Probable Marginal Marine to Non-marine

980-1610: Undifferentiated bisaccates (A), Taenioeces (F-P), Cleishanidites semenicus (R-P), Vitrupserites pallidus (R).

Odontochitina operculata (F-C), Oligosphaeridium complex (R-P), Chlamypberoides nvei (P-C), Odontochitina operculata (R-P), Trinodripodion susceptum (R), Neurichosphaeridium difficilis (C-A).

AGE: Late Cretaceous (Turonian-Coniacian) P-M14
ENVIRONMENT: Marine

The usual forms marking the top of the P-M16 zone are absent, however, based on the continuous occurrences of Oligosphaeridium 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 species Trilobosporites parvaevolutus (R) and Cretacoperidinium pusilla (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), Vitrupserites pallidus (R), Cleishanidites semenicus (R-P), Appendixacides spp. (F), Trilobosporites spp. (R, sporadic).

AGE: Early Cretaceous (probably Aptian-early Albian) probable P-M16
ENVIRONMENT: 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-M16).

6977-7009: Undifferentiated bisaccates (A), Lycopodiumaporites spp. (R), Trilobosporites parravolutus (R, above 3700'f), T. sp. (R-P), Trilobosporites parravolutus (R, above 3700'), Batioladinium jaegeri (R), Palaeoperidinium cretaceum (R-A), Cyclonephelium distinctum (R-A), Neurichosphaeridium edwardsi (R-P), Cribroperidinium edwardsi (F) sporadic occurrences of demospores and striated bisaccates throughout.

AGE: Early Cretaceous (probable Aptian-early Albian) probably P-M16
ENVIRONMENT: Marine

The restrictive Neocomian age species B. pelliferum and D. uncinatum are very rare in this interval. Forms are characteristic of Hauterivian to Barremian age strata but their scarcity here is the reason for only a tentative P-M16 age assignment.

6905-6957: Vitrupserites pallidus (F-P), Kraussiasporites sp. (R-P), Trilobosporites spp. (F-P), Trilobosporites parravolutus (R-P), T. sp. (R-P), Striatites richteri (R, sporadic).

AGE: Late Cretaceous (probable Neocomian) P-M19
ENVIRONMENT: Marine

The restrictive Neocomian age species B. pelliferum and D. uncinatum are very rare in this interval. Forms are characteristic of Hauterivian to Barremian age strata but their scarcity here is the reason for only a tentative P-M16 age assignment.

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 Morian 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.

AGE: Late Triassic (Rhaetian) P-M2S
ENVIRONMENT: Marine

Odontochitina operculata (F), Cleishanidites semenicus (R), Oligosphaeridium complex (R-C), Chlamypberoides nvei (P-C), Palaeoperidinium cretaceum (F-A), Cyclonephelium distinctum (R-F), Batioladinium jaegeri (R), Palaeoperidinium cretaceum (R-A), Cyclonephelium distinctum (R-F), Batioladinium jaegeri (R), Psaudocaration rettulaum (R), Hudsonocypria symmetrica (R-P), Cribroperidinium edwardsi (R, scattered); numerous rare and sporadic reworked occurrences of Triassic, Jurassic and Neocomian dinocysts.

AGE: Early Cretaceous (probable Aptian-early Albian) probable P-M16
ENVIRONMENT: Marine
Triassic in age. Although barren of palynomorphs, the presence of Triassic Kraeuselisporites sp. (R), ?Lundbladipora sp. (F), Taeniaesporites spp. (C). The consistent and abundant S. riehteri occurrences indicate that this section is probably equivalent to the strata penetrated by this depth. The marine palynomorphs are represented only by acritarchs and Icosactis richteri (F). The presence of A. paenulatus in this interval is very distinctive. Striatites riehteri (F-A), 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.

7731'C

Barren of indigenous palynomorphs.

AGE: Indeterminate

ENVIRONMENT: Indeterminate

ADDENDUM TO PALEONTOLOGY 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 9423 feet and 9597 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 section was obtained.

Drew Pt. #1
(Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1" to 100" faunal distribution chart 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 320 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.

80-149'

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

AGE: Quaternary

ENVIRONMENT: Probable Inner Neritic

140-240'

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 a submarine facies of open marine environment.

AGE: Senonian

ENVIRONMENT: Possible Nonmarine

350-1040'

Based on occurrences of Pseudocolluvina hastata at 350 feet, Hedbergella loetterlei at 500 feet, and Conococeras 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 Coniacian to Turonian interval in previous well reports. These strata probably represent inner to middle neritic deposition.

AGE: Turonian

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 Seebee Formation. This interval is generally considered to be the inner neritic facies of open marine radiolarian bursts. The high organic content and the paucity of preserved calcareous foraminifera associated with pulses of open marine radiolarian bursts.

AGE: Late Cretaceous

ENVIRONMENT: Open Marine (starved basin)

1760-2860'

Rare occurrences of Eaplophacopoides topogruzensis, Gay−
limella spp., Paracoluvinae, Lenticulina macroidea, L. extensa, Valvolinaria loetterlei, Kiliamina manitobensis, Hypereum−
oides baradela, Verneuilinoides formiciformis, Oolina spicu−
lates, Amphistegina spp. together with frequent to common Globorotalia major indicate that these strata are middle to Late Albian (F-9) age. These samples are dominated by radiolarians 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 radiolarians represent
suggested by the depasitional environment. This fauna, all that can be said about the
assemblage indicates a marine to inner neritic deposition.

AGE: Early Cretaceous
ENVIRONMENT: Open Marine

6740-6930' Occurrences of Gaudryina aff. sailleuri 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
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 characteristic of this interval include: Gaudryina gracilis, G. adoxa, Textularia armplicata, Bathysiphon lundegaard, Involutina silicea, Lituomitra irregularis, Trochammina sallei, T. topographeana, T. cf. canningsi, Polyplectia glauca, and Truncorhynchoides 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
ENVIRONMENT: Probable Middle Neritic to Upper Bathyal (turbid)

6977'C-7554'C Astacolus comatus, Nodosaria shublikensis, H. liratella, H. larina, Sepiolites increases, Bolivina lenticula, Lingula borealis, E. shaalensis, Ptychodiscus annulatus, T. liratella, Pseudoliolaufina lata, T. issempennsis, Vaginolithopora arabica, Marginulina kryenae, Trochammina helicta, and Montaltia androgynoides 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 base 15 to 50 feet of the Shublik Fm. in the Saldaerochit River Region occurs in samples from the interval 7460 feet to 7535 feet in this well.

AGE: Triassic
ENVIRONMENT: Middle Neritic to Upper Bathyal (Open Marine)

7544'C-7830' A poor fauna consisting of Ambaculites cf. barrowensis, A. sp. (very small), Haplophragmoides spp., Trochammina cf. sabeli, T. cf. canningsi, Ammonites P, Bathyphopora lamellocollis and pyritized radiolarians occurs in the upper portion of this interval above 7404 feet. This assemblage is indicative of tonule F-10, and is probably still Triassic based on the lack of any Eocene fm. lithology or any Permian foraminifers. The top of this unit is placed on the basis of the P-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 Sadlarochit Fm., and it is possible that the P-20 Faunule may climb into the Shublik Fm. So far we have only observed this boundary in ditch samples where it appears that the P-20 Faunule is restricted to the Sadlarochit Fm. These strata probably represent non-marine to inner neritic deposition.

AGE: Triassic
ENVIRONMENT: Nannofossil Faunal Zone P-20

7830-7946' T.D. This last unit is picked on the basis of a lithologic change to argillites. There were no indigenous foraminifers recovered from this interval.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

ADDITION TO FORAMINIFERA REPORT

The following addendum is based on the processing, picking and examination of 14 sidewall core samples from the Crew Fm. at 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 argillites would have to lie below 7830 feet (i.e., 7831 to 7860 feet).
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 500 feet down to the total depth of 11,420 feet.

500-770'

Australiae spectabilis (C), A. australiensis (R-C), A. granulifera (R-P), Dicomium scrobus (R), Odontochitina operculata (F-C), Zeaeophylla chlorophylla (R), Paleoperidinium basilium (R), Deflandrea distans (F).

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

770-1670'

Gleicheniadiates venosus (R-F), Vitreisporites pallidus (R-F).

Australiae/Deflandrea spp. (R), Paleoperidinium basilium (R-C), Odontochitina operculata (R-C), Oligosphaeridium complex (R), Cycloplegium distinctum (R), Cribroperidinium edwardsi (R-P), Broomesi scyphia (R, scattered), Pseudoceratium cf. dettmannae (R, near top of interval).

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

1670-2840'

Gleicheniadiates venosus (R-F), Vitreisporites pallidus (R-F), Paleoperidinium basilium (R-C), Odontochitina operculata (R-C), Oligosphaeridium complex (R), Cycloplegium distinctum (R), Cribroperidinium edwardsi (R-P), Broomesi scyphia (R, scattered), Pseudoceratium cf. dettmannae (R, near top of interval).

AGE: Late Cretaceous (Turonian-Coniacian)
ENVIRONMENT: Marine to Marginal marine below approximately 2400 feet

2840-4120'

Gleicheniadiates venosus (R), Classopollia classoides (R), Triposporites sp. (R, scattered) reworked Triassic grains (R, scattered).

Odontochitina operculata (R-P), Oligosphaeridium complex (R), Cycloplegium distinctum (R), Cribroperidinium edwardsi (R-P), Broomesia scyphia (R, scattered), Pseudoceratium cf. dettmannae (R, scattered).

AGE: Late Cretaceous (Campanian)
ENVIRONMENT: Marine to Marginal marine below approximately 2400 feet

4120-7260'

Classopollia classoides (R), Densosporea (R, reworked).

Odontochitina operculata (R-P), Oligosphaeridium complex (R), Cycloplegium distinctum (R), O. compactum (Berenbiniophora) (R), Broomesia scyphia (R-P), Astrocysta eratacea (R-P), Gardosinum 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 Gardosinum 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 (R), Cycloplegium distinctum (R), Astrocysta eratacea (R), Gardosinum eisenacki (A).

AGE: Early Cretaceous (Neocomian)
ENVIRONMENT: Marine

7290-7860'

Classopollia classoides (R), Carabopollinates cancellatus (R), Simosiagopsis grossi (R), Psilagonyaulax spinata (R), Gymnosclerites diastoma (R), Gardosinum eisenacki (R), Endoscrinium galeatum (R-P).

AGE: Late Jurassic (Kimmeridgian)
ENVIRONMENT: Marine

The presence of Endoscrinium galeatum below 7480 feet indicates that the lower one-third of this interval may be assigned an Early Kimmeridgian age.

7860-9210'

Classopollia classoides (R-P), striated bisaccates (R, reworked).

Parendenia carpathica (R), P. cf. verrucosa (R-P), Simosiagopsis grossi (R-P), Gymnosclerites diastoma (P-C), Endoscrinium galeatum (R-P), Nanocarposporites pellucida (R-C).

AGE: Late Jurassic (Oxfordian)
ENVIRONMENT: Marine

8920-9210'

Essentially barren of palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

9210-10,470'

Oligosphaeridium complex (P), Cycloplegium distinctum (R), Cribroperidinium edwardsi (R-P), Broomesia jaegeri (R-P), Astrocysta eratacea (R-P), Gardosinum eisenacki (R), scattered specimens of reworked Jurassic and Triassic dinocysts.

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

This interval is characterized by the absence of Luxadinium and Spinidinium as well as the consistent occurrence of Gardosinum 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.

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

No indigenous palynomorphs.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

-35-
W. Fish Creek #1 (con't.)

SUMMARY OF PALYNOLOGY REVISIONS

500-770': Late Cretaceous, Santonian-Campanian (P-M14).
770-1670': Late Cretaceous, Turonian-Coniacian (P-M15).
1670-2460': Late Cretaceous, Campanian (P-M16).
2460-4620': Early Cretaceous, Middle-Late Albian (P-M17).
6260-7260': Early Cretaceous, Aptian-Early Albian (P-M18).
7260-7290': Early Cretaceous, possible Neocomian (P-M19).
7290-7630': Late Jurassic, Kimmeridgian-Tithonian (P-M21).
7650-8940': Late Jurassic, Oxfordian (P-M22).
8940-9210': Early-Middle Jurassic, Late Pliensbachian-Early Bathonian (P-M23).
9210-9660': Triassic-Early Jurassic (probable P-T15 to P-T24).
9660-10,470': Permian-Triassic (P-T16 to P-T17). 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 composed on 30 foot ditch intervals. Thirty-four (34) thin sections were prepared on 30 to 40 foot intervals. A generalised age summary of the well is provided below.

500-1550':
Schrader Bluff Formation. Faunae obtained throughout this interval are indicative of oscillating middle neritic to upper bathyal (non-turbid) deposition.

If the few specimens of N. pellucida are considered to be indigeneous then the sample is in the Oxfordian P-M22 zone. This would raise the top of the Oxfordian interval, as interpreted in the ditch samples, by 230 feet.

5984': Late Jurassic (Late Bajocian-P-M23).
5742': Late Jurassic (probable Oxfordian)-P-T24.
5698': Late Jurassic (probable Oxfordian)-P-T24.
500-1550': Late Cretaceous, Santonian-Campanian (P-M14).
10,470-11,420': T.D. Age indeterminate.

500-1550': Late Cretaceous, Santonian-Campanian (P-M14).
10,470-11,420': T.D. Age indeterminate.

SUMMARY OF PALYNOLOGY REVISIONS

500-770': Late Cretaceous, Santonian-Campanian (P-M14).
770-1670': Late Cretaceous, Turonian-Coniacian (P-M15).
1670-2460': Late Cretaceous, Campanian (P-M16).
2460-4620': Early Cretaceous, Middle-Late Albian (P-M17).
6260-7260': Early Cretaceous, Aptian-Early Albian (P-M18).
7260-7290': Early Cretaceous, possible Neocomian (P-M19).
7290-7630': Late Jurassic, Kimmeridgian-Tithonian (P-M21).
7650-8940': Late Jurassic, Oxfordian (P-M22).
8940-9210': Early-Middle Jurassic, Late Pliensbachian-Early Bathonian (P-M23).
9210-9660': Triassic-Early Jurassic (probable P-T15 to P-T24).
9660-10,470': Permian-Triassic (P-T16 to P-T17). No definite evidence of P-T18.
10,470-11,420': T.D. Age indeterminate.
This fauna contains Trochammina rainwateri, Verneuilinoides cf. borealis, and Haplophragmoides of. topographicus. 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)

**Environment:** Probable Hanushuk Group

### 7289-7299

This very thin interval contains Ammobaculites tappanensis, Ammobaculites (Haplophragmoides) rossensis, Ammodiscus sp., G. dytcrita, Glomospira gattoni, Glomospirina pseodojamaicensis, P. sp., Haplophragmoides canus, Haplophragmoides phragmites, Pseudobulbina sp., Trochammina cancellata, T. topographicus, T. virgi, Lenticulina auditor, L. pime, L. seacores, Conchophiliidae orthali, Thuroinoceratidae spp.

In summary, the 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)

**Environment:** Outer neritic to Bathyal (clear water)

### 8410-8470

This interval contains Ammobaculites alexandrigae, Bathysiphon anomalocerata, Thuroinoceratidae spp., P. pseudomollis, Lingula nodosa, and frequent to common pyritized radiolaria of the genera Cyrtoceras, Stichoceras, Conocephala, Lithocampe, Spongides, and Dicytomitra in occur in these strata. Also diagnostic of this unit is a burst of Tasaanites 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 Maury Shale Sandstone.

**Age:** Early to Middle Jurassic

**Environment:** Upper bathyal to Upper bathyal

### 9270-9540

Marginalia sp., Astropecten geniculata, Vaginulina sp., Podoceratidae sp., Podocerophoria, and sponges are common throughout these beds. The Triassic age of these strata is firmly established on the basis of the above fossils. These strata represent fluctuating marl, margin to middle neritic deposition.

**Age:** Triassic

**Environment:** Marginal Marine to Upper bathyal

### 9640-10,479

Occurrences of Ammodiscus sp. P, 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 (10,410-10,479') contain a heavy glaciomarine sandstone suggestive of the Echoca Member of the Sadlerochit Formation.

**Age:** Permian-Triassic

**Environment:** Nonmarine to Marginal Marine
10,470-10,500’
This very thin interval is characterized by occurrences of micritic coated pelmatozoan-bryozoan-foraminiferal-algal grainstone. The presence of a single specimen of Protonodosaria sp. and rare Palaeophyllinae 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 10 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 Limestone Unit
The Upper Limestone Unit is 660 feet thick in this well. Strata between 10,500 feet and about 10,620 feet contain rare Micrasteria spp., rare Pseudostaffella sp., and frequent Ptychodiscus sp. These rocks conspicuously lack occurrences of Neogoniolithus spp., Neogoniolithus spp., and Archeochonetes spp. These rocks are certainly no older than Zone 21 but could easily be as young as Zone 22 (see Haeft, 1971, pages 203 and 204). These strata probably correlate in part with strata between 10,775 feet and 10,720 feet in the S. Harras Bay 11 well. Bursts of Eosigualpina rubra, Eosigualpina rubra, and Kamaenid algae together with occurrences of Neogoniolithus spp., Neogoniolithus spp., and Ptychodiscus sp. indicate that the strata between about 10,420 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 18-19 was lacking. Based on the possible occurrence of sections equivalent to the Zones 17-18 Dolomite Unit below this interval, a scarcity of Glomowayxia bulbiloides, and a lower questionable occurrence of Kosymalinella sp., which may have caved from this interval, we suggest the possibility that section between 10,160 feet and 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 41,160-11,310 feet and 41,310 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 questionably early Permian based on a single specimen of Protonodosaria sp. and a piece of Palaeophyllinae 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-early Permian continues up to 10,470 feet and there is no unconformity at 10,500 feet as suggested in the report.

AGE: Probable Early Permian
ENVIRONMENT: Shoaling Shelf (carbonate platform suite)

11,310-11,420’ 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
ENVIRONMENT: Probable Nonmarine

W, Fish Creek II

4220’ SNC
No Foraminifera found. Megaspores (R).

AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Brown silty mudstone

444’ SNC
No Foraminifera found. Megaspores (R), coal (R).

AGE: Indeterminate
ENVIRONMENT: Indeterminate
WASHED LITH: Brown siltstone

4924’ SNC
Ammococulispp. (very small, thin) (R), Trochamminoides (very small, thin) (R), megaspores (R), pyrite (R), coal (R).

AGE: Indeterminate
ENVIRONMENT: Probable Inner Neritic
WASHED LITH: Brown siltstone

5016’ SNC
Trochammina sp. (very small, thin) (R), Tasmanites sp. (C).

AGE: Early to Middle Jurassic
ENVIRONMENT: Probable Inner Neritic
WASHED LITH: Dark brownish-black shiny iridescent shale

W. T. Foran #1
(Palynology)

PALYNOLOGY REPORT

A total of 93 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 8844 feet.

500-599’

Betulaceae (P), Alnus (P), Juniperus (R), Carex (R), Quaum-
queens (R), Tilia (R), Homioites (R).

Materialia articulate (single), Odonodchitonics operculata
(single, reworked).

AGE: Probable Eocene
ENVIRONMENT: Marine

599-1449’

Betulaceae (P). Peraclinopollenites confusus (R-P).

Rare, scattered, reworked Cretaceous dinocysts: Brocon-
s (sorted), Australiella cookae, A. granulifera, and Olio-
sphaeridium complex.

AGE: Permian-Carboniferous
ENVIRONMENT: Marginal Marine

1450-1850’

Aquilapollenites magus (R), A. quadricreat (R), Mode-
housei jacqueta (R), Granvillea variata (R).

Deflandrea variata (R-P).

AGE: Middle-Aptian
ENVIRONMENT: Marginal-Marine

1850-2110’

Taxodiaceae (A), Aquilapollenites triatus (single speci-
man at top of interval).

Odonodchitonics operculata (C), Australiella cookae (R),
A. granulifera (R-C), A. spectabilis (P-A), Deflandrea
architecte (P-F), D. australis (R-C), Ostrichsphairum
difficile (P-C), Microsporites chlamyda (R-C), Pareodi-
arium vestigium (R-P).

AGE: Santonian-Campanian
ENVIRONMENT: Marginal-Marine

2120-2190’

Omnedianites sp. (R), Gleicheniidites senonius (R-P).

Odonodchitonics operculata (R-F), Cribroperonites pavo;
(R-P), Conusularia cf. tanaceti (R),
Najania graeca (P, at top of interval), Silleiophora
fleur (R). Australiella/Deflandrea spp. appear less con-
sistent and less frequent than above.

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

2190-3910’

Odonodchitonics operculata (P-C), Coloboceras umbraci-
iforme/commutatum (C), Cribroperonites advenatus (P-C),
Pseudocribrarium cf. Austrocarpa (C at 3110-3200”), Z. cf.
ersite (R, sporadic).

AGE: Cenomanian
ENVIRONMENT: Marginal-Marine

3910-4510’

Odonodchitonics operculata (P-C), Coloboceras umbraci-
iforme/commutatum (C), Cribroperonites advenatus (P-C),
Pseudocribrarium cf. Austrocarpa (C at 3110-3200”), Z. cf.
ersite (R, sporadic).

AGE: Cenomanian
ENVIRONMENT: Marginal-Marine

4510-5000’

Omnedianites sp. (R-P), Gleicheniidites senonius (R-P),
Trilobopollenites coheni (R, scattered).

Odonodchitonics operculata (R-C), Coloboceras zitautum
(R-P), C. umbraciiforme/commutatum (R-C), Cribroperonites
advenatus (R-C), Protocricibrarium paucatum (R), Protocri-
barium spp. (R), Astracoceras pavo (P-C), Ioudeninum propet-
ali (R), Biopollinum vestigium (R, sporadic), Olsosphaeri-
dium complex (R-P).

AGE: Albanian
ENVIRONMENT: Marine

$500-7333’

Cribroperonites sp. (R), Gleicheniidites senonius (R-P),
Cellulipollinum praelatus (R, sporadic).

Odonodchitonics operculata (P-C), Cribroperonites pavo;
(R-P), Astracoceras pavo (P-C), Olsosphaeridium complex
(R-P).

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

Based principally on the absence of Bactridinium praelatus
and Olsosphaeridium complex, this interval is assigned an
Aptian to Early Albanian age.

The interval below approximately 6600 feet reflects rela-
tively poor marine conditions.

7330-7551’

Odonodchitonics operculata (R-C), G. sp. 1 (R), Brocom largae
(R), Olsosphaeridium complex (A), Zancolinidites zancolii
(R), Astracoceras pavo (P-C), Zancolinidites zancolii (R),
Cribroperonites advenatus (R-C), Zancolinidites similis (P),
Eucolofia ceratophora (R).

AGE: Neocomian
ENVIRONMENT: Marine

7551-7610’

The sidewall core at 7551 feet contained Vitreisporites
sehliig (R), and Microsporites spp. (P).

AGE: Indeterminable
ENVIRONMENT: Very Marginal-Marine

7610-8240’

Tastisporites spinatus sp. (R-P), Astrocystites richteri (P-C),
Protocricibrarium spp. (R, sporadic); rare occurrences near
base of interval: Frasennopora spinosa, Frasennopora
sp. sp. 1, Pseudocribrarium sp.

Microsporites spp. (A).

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

8240-8510’

No indigenous palynomorphs.

AGE: Indeterminable
ENVIRONMENT: Indeterminable

8510-8780’

A single specimen of Tripodites renatus was recovered at
the top of this interval. If this specimen is not re-
worked, 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 frag-
ments. Poor recoveries.

AGE: Indeterminable
ENVIRONMENT: Indeterminable
W. T. Foran #1
(Foraminifera)

FINAL MICROPALEONTOLOGY REPORT

Enclosed you will find a 1' to 10' 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 10 to 40 foot intervals and two (2) sidewall core samples. Twenty-seven (27) thin sections were prepared on 30 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)
ENVIRONMENT: Probable Inner to Middle Neritic

1010-1580'

Although generally barren of foraminifera, this interval does contain rare Canoaphaera spp. and Spongodiacus 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'


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

2450-3310'

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 fauna in this interval, it is hard to establish its age with any certainty. The Prince Creek Fa. to Seabee Fa. boundary probably lies within this interval. A single specimen of Hedbergella loettleri, if not reworked, suggests that the Seabee Fa. top could be as high as 2570 feet.

AGE: Turonian to Coniacian
ENVIRONMENT: Probable sediment diluted shallow Marine

3310-4090'

Hedbergella loettleri, Sacammina lathamii, Bipolarosporella rata, Prochoania ribatotamana, Conocephalus sp., Canoaphaera spp., Archimytilia spp., Spongodiacus spp. and Spongodiacus sp. characterize this interval.

SUMMARY OF PALYNOLGICAL REVISIONS

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Environment</th>
<th>Faunal Assemblage</th>
</tr>
</thead>
<tbody>
<tr>
<td>500-590'</td>
<td>Tertiary, probable Eocene</td>
<td>(P-M11)</td>
</tr>
<tr>
<td>590-1490'</td>
<td>Tertiary, Paleocene</td>
<td>(P-T10)</td>
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<tr>
<td>1490-1670'</td>
<td>Late Cretaceous, Maastrichtian</td>
<td>(P-T11)</td>
</tr>
<tr>
<td>1570-1850'</td>
<td>Late Cretaceous, Campanian</td>
<td>(P-T12)</td>
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<tr>
<td>1850-2370'</td>
<td>Late Cretaceous, Santonian-Campanian</td>
<td>(P-M14)</td>
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<tr>
<td>2370-3020'</td>
<td>Late Cretaceous, Ptoranion-Combian</td>
<td>(P-M15)</td>
</tr>
<tr>
<td>3020-4010'</td>
<td>Late Cretaceous, Campanian</td>
<td>(P-M16)</td>
</tr>
<tr>
<td>4100-5800'</td>
<td>Early Cretaceous, Middle-Late Albian</td>
<td>(P-M17)</td>
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<td>5800-7330'</td>
<td>Early Cretaceous, Aptian-Early Albian</td>
<td>(P-M18)</td>
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<td>7330-7510'</td>
<td>Early Cretaceous, possible Neocomian</td>
<td>(P-M18a)</td>
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<tr>
<td>7510-7550'</td>
<td>Early Cretaceous, Neocomian</td>
<td>(P-M19)</td>
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<td>7551-7610'</td>
<td>Age indeterminate</td>
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<tr>
<td>7610-8240'</td>
<td>Permian-Triassic</td>
<td>(P-T13 to P-T16)</td>
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<td>8240-8510'</td>
<td>Age indeterminate</td>
<td></td>
</tr>
<tr>
<td>8510-8730'</td>
<td>In Mississippian (probable P-T11)</td>
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</tr>
<tr>
<td>8780-8864'</td>
<td>T.D. Age indeterminate</td>
<td></td>
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</tbody>
</table>
A top on the "Paper Shale" ("cutinized leaves") was found at 7410 feet. This point is probably at the top of or down in the Shale 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 foraminifers associated with few short pulses of open marine radiolarian bursts.

**AGE:** Late Cenomanian (Cenomanian to Turonian)
**ENVIRONMENT:** Open Marine (starved basin)

### 7520-7550'

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 wall 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 north of WPS-4 have been within the Shublik Fm., we will suggest the possibility for a thin interval of Shublik Fm. in this well.

**AGE:** Probable Triassic
**ENVIRONMENT:** Probable Shublik Fm.

### 7550-7620'

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

**AGE:** Probable Permian-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 Lisburne Unit
2. Dolomite Unit
3. Lower Lisny unit

The Upper Lisburne Unit is 390 feet thick in this well. Bursts of *Pseudohorabductes rubens*, *Pseudoasterias sp.*, and *Kamaanid* algae together with occurrences of *Menichthys* sp., *Asteroarchaedes* spp. and frequent *Euplocodium* sp. indicate that the strata between about 8200 feet and 8500 feet are definitely Zone 21 in age. A Zone 21 call is made at 8500 feet based on a significant reduction in the occurrence of *Kamaanid* algae. The Upper Lisburne Unit represents a shoaling shelf and subtidal to tidal carbonate platform sequence.

The Upper Lisburne 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 has climbed with respect to age in the section.

**AGE:** Indeterminate
**ENVIRONMENT:** Probable Endicott Group
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 II
7551' Core
Arenaceous? spp. (R), fecal pellets? (F).

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

7609' SHC
No Foraminifera found. Megaspores (F).

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

7646' SHC
Ammobaculites vetusta (R), Ammodiscus P (F), Bathysiphon sp. (R), Dentalina? sp. (R), Trochammina sp. (very small) (F), Lithocampe sp. (R) (pyritized), Canospheara, spp. (C) (pyritized), pyrite (A).

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

8206' SHC
No Foraminifera found.

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

APPENDIX
(Palynal lists and washed lithology descriptions for 2 sidewell core samples)

7510' SHC
Arenaceous spp. (lrg., crs.) (A), Gaudryina milleri (F), G. leaffingwelli (F), G. taileurii (C), G. tapponnes (C), Gaudryinella irregularis (R), Glomospirella arctica (R), Thrasaminoides sp. (F), Trochammina equinata (F), T. coni-cominata (R), T. cf. topogypgranula (R), Canospheara sp. (R), glauconite; C. spp. (F), pyritized; round frosted quartz floaters (A), pyrite (F).

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

7551' SHC
Canospheara? sp. (R), glauconite; Lithocampe sp. (R), pyritized; Inoceramus prisms? (R), glauconite (F), pyrite (C).

AGE: Indeterminate
WASHED LITH: Dark brown silty organic mudstone
A total of 123 ditch and 22 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'
Agilapollinite majus (R-P), A. rectus (R), A. waifridus (R), A. fusiformis (R), Wodehousea spinata (R).

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

AGE: Late Cretaceous (Maestrichtian)
ENVIRONMENT: Essentially Nonmarine

770-950'
Agilapollinite majus (R), A. rectus (R), A. trialatus (R), Syncopites sp. (single), Wodehousea jacutense (single).

AGE: Late Cretaceous (Campanian)
ENVIRONMENT: Nonmarine

950-2120'
Paleoperidinium basilei (R-C), Hystrixoch seascriordium diffici (R-C), Lactinidium bicorniculum (R-C), Gono- dinium arcticum (R), Eoosclerochaeidium bicolatum (R), Deflandreopertis decorosa (R), D. densa (R-C), D. seminana (R), Australiella spectabilis (R-C), A. eudorpingulata (R), A. granifera (R), Odontochitina operculata (R-C), Euspati- nerea chlorophora (R-P), Valodianum longum (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 Oedlandroid 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'
Gleicheniidites senonius (R-C), Vitreisporites pallidus (R), Cyclonephelium distinctum (R), Odontochitina operculata (P-C), Chlamydrionia ovata (R-C), Cribroperidinium edwardii (R-P), Apteodinium grandis (R), Pseudoceratium cf. expolitum (R).

AGE: Late Cretaceous (Cenomanian)
ENVIRONMENT: Marine

3376-6090'
Gleicheniidites senonius (R); rare, scattered occurrences of Vitreisporites pallidus (R), Classopollis classoides (R), and Triboconospermite sp. (P). 

Cleistosphaeridium spp. (P-R), Odontochitina operculata (P-C), Oligosclerochaeidium complex (R), Chlamydrionia ovata (R-P), Cribroperidinium edwardii (R-P), Eoosclerochaeidium bicolatum (R), Lactinidium bicorniculum (R), Spindinium vestitum (R, scattered), Gardonidium eisenacki (few, rare occurrences near bottom of interval).

AGE: Early Cretaceous (Aptian)
ENVIRONMENT: Marine

6090-7188'
Gleicheniidites senonius (R), Classopollis classoides (R), Odontochitina operculata (R-P), Oligosclerochaeidium complex (R), Cribroperidinium edwardii (R), Eoosclerochaeidium bicolatum (R), Lactinidium bicorniculum (R), Spindinium vestitum (R, scattered), Gardonidium eisenacki (few, rare occurrences near bottom of interval).

AGE: Early Cretaceous (possible Aptian)
ENVIRONMENT: Marine

There is only weak evidence for the possible Aptian age assignment. Although the Aptian/Aptian 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), stripped bisaccates (R) [reworked].

Paradinia carthophora (R), P. sp. (verrucous form) (R-P), Simiodinium grossi (R), Seriocidinium crystallinum (R), Gonyaulacysta gladiator (R-C), Nanocarcharopitopsis pallidus (R-A).

AGE: Late Jurassic (Oxfordian)
ENVIRONMENT: Marine

8230-9300'
Classopollis classoides (P-C), Vitreisporites pallidus (R-P), stripped bisaccates (R, reworked).

Micrhystridium spp. (P-C), Nanocarcharopitopsis gracilis (C-A); undescribed dinocysts JRD-1 (P-C), JRD-2 (R), JRD-5 (R).

AGE: Early-Middle Jurassic
ENVIRONMENT: Marine

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.

9300-9570'
Stripped bisaccates (R), Tribolepites sp. (R), Striatites richardii (R-P), Klaistosporites biglumis (R-P), ?Jassubolit- spore sp. (R-P), unidentified verrucate spore (R-C).

AGE: Permian-Triassic
ENVIRONMENT: Nonmarine

9570-10,210'
Stripped bisaccates (R), Tribolepites sp. (R), Striatites richardii (R-P), Klaistosporites biglumis (R-P), ?Jassubolit- spore sp. (R-P), unidentified verrucate spore (R-C).

AGE: Permian-Triassic
ENVIRONMENT: Nonmarine

This interval recovered only Permian-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.

10,210-11,290 T.D.

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

AGE: Indeterminate
ENVIRONMENT: Indeterminate

The base of the Albian is placed at the lowest occurrence of Spindinium vestitum and Lactinidium bicorniculum. These forms occur just above a specimen of Gardonidium eisenacki, a species which ranges no younger than Aptian.
SUMMARY OF PALYNOLOGY REVISIONS

500-770: Late Cretaceous, Maastrichtian (P-T1i).
770-950: Late Cretaceous, Campanian (P-T2i).
950-1850: Late Cretaceous, Santonian-Campanian (P-M14).
1850-2110: Late Cretaceous, Turolian-Turonian (P-M15).
2110-3376: Late Cretaceous, Campanian (P-M16).
3376-6090: Early Cretaceous, Middle-Late Albian (P-M17).
7188-8230: Late Jurassic, Oxfordian (P-M22).
8230-950: Early-Middle Jurassic, Late Pliensbachian-Early Toarcian (P-M23).
950-1850: Late Cretaceous, Santonian-Campanian (P-M15).
1850-2210: Late Cretaceous, Cenomanian (P-M16).
2210-3376: Late Cretaceous, Campanian (P-M16).
3376-6090: Early Cretaceous, Middle-Late Albian (P-M17).
7188-8230: Late Jurassic, Oxfordian (P-M22).
8230-950: Early-Middle Jurassic, Late Pliensbachian-
Early Toarcian (P-M23).
950-10210: Triassic-Early Jurassic (probable P-T15 to P-M24).
10210-11290: T. A. Age indeterminable.

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 in
tervals, 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 Early Cretaceous (Senonian)
ENVIRONMENT: 'Nonmarine to Marginal Marine

950-1330
Demoslidae scrapodes, Orisma ambornia, Monomenella
valloniana, Pseudulinella ramosa, Turritella gravenza.
Verneuilinoides fisheri, Trochammina rhabdamena, T.
whittingtoni, Caprosphora spp., Spontourus spp., Sathoryctis
spp., Archichacra spp., Thecocorys spp., Dicyomitra spp.,
D. multicornis, Spinocodium spp., S. cf. renillaeforrais,
Haplophragmoides spp., and Spongurus spp.

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

1330-3330
Gaudryina rutherfordi, Trochammina crassidentata, T.
crasidentata, F. rhabdomorpha, Globorotalites alaskensis,
Lenticulina audax, L. prina, Apmobaculites alaskensis,
Globorotalites alaskensis, Praebulimina nanina, Valvulineria
aspera, Lenticulina audax, L. quenstedti, Textularia areoplecta, Trocham-
ina instoveneis, and T. topaqorukensis 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 fauna could be as young as Kimmeridgian in
age. These strata were probably deposited in outer neritic
to bathyal water depths.

AGE: Late Cretaceous (Campanian to
ENVIRONMENT: Open Marine (starved basin

SUMMARY OF PALYNOLOGY REVISIONS

3330-3330
This fauna contains: Gaudryina canadensis, Trochammina
rhabdomorpha, T. crassidentata, T. rhabdomorpha, Lenticulina
audax, L. prina, Astacolus manitobensis, and Haplophragmoides
mannanensis. This association appears to be 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
ENVIRONMENT: Probably Middle to Outer Neritic
3330-5260
This is typical of the Verneuilinoides borealis Faunal Zone and
is Albian age. The environments represented by these
moderately diverse assemblages were probably of somewhat
moderate turbid middle to outer neritic depths with short periods
of lesser turbidity.

AGE: Early Cretaceous (Albian)
ENVIRONMENT: Middle to Outer Neritic
5260-7270
A pyritized radiolarian assemblage characterizes these
strata together with rare non-diagnostic agglutinated
foraminifera. Lithocampe cf. sp. B occurs in the bottom
of this interval, but preservation makes the identifica-
tion uncertain. According to Ramsay (1970) this zone of
pyritized radiolaria separates the Verneuilinoides borealis
zone from the Gaudryina lataeurn Fm. and is probably
Aptian to early Albian in age. Due to the preservation of
this fauna, all that can be said about the environ-
ment 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) basin
slope deposits. This is certainly a possibility since cal-
careous foraminifera are very scarce in this interval and
could represent caved specimens when they do occur.

AGE: Early Cretaceous (Aptian to Early Albian)
ENVIRONMENT: Middle to Outer Neritic
(oxidizing basin)

7270-7160
Occurrences of Gaudryina lataeurn, Raphephyreoides camui,
Raphephyreoides buruensis, Lenticulina audax, L. prina,
Textularia areoplecta, Trochammina crustacea, and T.
crusidentata 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)
ENVIRONMENT: Open Marine (possibly Lower Bathyal
to Abyssal

7360-8230
Marginalina radiata, N. primus, Trochammina canadensis,
T. instowensis, T. sp. (sm., high spired), Involutina
septata, Lenticulina audax, L. primus, Lenticulina alaskensis,
A. barrowensis, Marginalinopsis phragmites, Barbatia
crusidentata, Haplophragmoides camui, H. crassidentata,
Vascollina shorningi, and Astacolus pediculus 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 topogrigiakensis 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)  
**ENVIRONMENT:** Outer Neritic to Upper Bathyal

- **8230-8970'**  
  Ammobaculites vetus, *A. alaskensis*, Bathysiphon anomalous, *Trochammina contornata* and *A. cf. proteus*, **A. dyscrita**, Astacolus dubius, *Trochammina contornata* and *A. cf. proteus*, Gaudryina *pp.*, *Troehammina eontornata* and common to abundant pyritized radiolaria of the genera *Cyrtocysta*, *Cenosphera*, *Lithocapsa*, *Spongocysta*, and *Photommina* occur in these strata. Also diagnostic of this unit is a burst of *Tasaanites 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  
**ENVIRONMENT:** Middle Neritic to Upper Bathyal

- **8970-9360'**  
  *A. sthenarus*, *A. eonnudatus*, *Tolypammaina glareosa*, *Nodosaria larina*, *N. shublikiensis*, *Lingulina borealis*, *Pseudoquilulina 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. These faunas represent fluctuating inner to outer neritic open marine conditions.

**AGE:** Triassic  
**ENVIRONMENT:** Inner to Outer Neritic

- **9360-10,210' T.D.**  
  *P. Eehooka Member of the Sadlerochit Formation.*
Ikpikpuk #1
(Palynology)

PALYNOLGY REPORT

A total of 313 samples were processed and analyzed from the subject well. The total consists of 122 core samples, 13 sidewall cores, and 158 ditch samples 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.

Undifferentiated bisaccates (P-A), Camarosporites insignis (R), Cribrosporites annulatus (R), C. halli (R), Cystidinum minor (R-A), Peraminispora wongchianais (R), Glaichaniidium minuscule (R-C), Lygodiumsporites spp. (R), Neostratictes truncatus (R), Ornamentospora echinata (R), Osmundacites spp. (R-A), Sphaerites spp. (R), Nyssosporites aff. (R), Trilobosporites parvulaevatus (R), Trigonolobosporites radatus (R).

Callopharys aspamerum (R), Cancinga colluviae (R), Chathanaella magna (R), Chlamydomoridae nysii (R), Camerodium ocellatum (R). Cyclonephelium boleanum (R), Didinium bifidum (R), Hystrochitina boltonia (R), H. vogti (R), Hystrochitina cookeana (R), Fabellingium cookeana (R), Filatropisphaeridium ocellata (R), Odontochitina ocellata (R), O. operculata (R), Oligosphaeridium corymbiferum (R), G. complex (R), O. palufericum (R), Paleohystrichosphaera infloroides (R), Paleoperidinium cretaceum (R), Spiniferites circulatus (R), S. templus (R-P), Xenaxus carodiae (R), Xiphophoridium alatum (R).

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

The interval above contains several taxa restricted to the Late Cretaceous, Cenomanian (P-M16) and includes: Chathanaella magna, Fabellingium cookeana, Odontochitina ocellata, and Paleohystrichosphaera infloroides. The base is defined by the first appearance of Lygodium propinquum which is considered to be late Albian in age.

550-1440

Aranciaulis australis (R), undifferentiated bisaccates (R-A), Camarosporites insignis (R), Cribrosporites annulatus (R), Camerodium ocellatum (R), Cystidinum minor (R), Distaltropisporites spp. (R), Glaichaniidium minuscule (R), Osmundacites spp. (R), Peraminispora acutata (R), Trilobosporites spinulosus (R), T. crassus, Oligosphaeridium pallidus (R).

Apta spinosa (R), Apta spinulosa (R), A. rhomboidea (R), A. spinosa (R), A. subulata (R), A. trilobata (R), A. spinulosa (R), Eutrochosporella spinosa (R), Neosphaeridium serratum (R). Cystidinum coccolithum (R), Didinium bifidum (R), Hystrochitina boltonia (R), H. vogti (R), Hystrochitina cookeana (R), Fabellingium cookeana (R), Filatropisphaeridium ocellata (R), Odontochitina ocellata (R), O. operculata (R), Oligosphaeridium corymbiferum (R), G. complex (R), O. palufericum (R), Paleohystrichosphaera infloroides (R), Paleoperidinium cretaceum (R), Spiniferites circulatus (R), S. templus (R-P), Xenaxus carodiae (R), Xiphophoridium alatum (R).

AGE: Early Cretaceous, Aptian to Early Albian (P-M16) ENVIRONMENT: Marine to Marginal Marine

This interval is best recognized in Core 5 (7360-7377) which contains a diverse assemblage of dinoflagellate cysts. Panopeasporites waltonensis which occurs here is restricted to the Cenomanian along with common to abundant occurrences of Oligosphaeridium complex, G. complex (thick wall), Gardosporites trilobatus, Hystrochitina boltonia, and Oligosphaeridium sericeum which are typical of the Cenomanian. Priapinidium saxatilense which occurs in this interval at 7360 feet may mark the top of the Cenomanian section. However, no other data substantiates this until 7360 feet as reported above. This fossil was also found reworked in Core 3 (7374-7381) feet, but not in the Cenomanian interval. This is questionable, but interpreted to be eroded in distribution for this well.

1440-1800

Aranciaulis australis (R), undifferentiated bisaccates (R-A), Camarosporites insignis (R), Cribrosporites annulatus (R), Camerodium ocellatum (R), Cystidinum minor (R), Distaltropisporites spp. (R), Glaichaniidium minuscule (R), Osmundacites spp. (R), Peraminispora acutata (R), Trilobosporites spinulosus (R), T. crassus, Oligosphaeridium pallidus (R).

Apta spinosa (R), Apta spinulosa (R), A. rhomboidea (R), A. spinosa (R), A. subulata (R), A. trilobata (R), A. spinulosa (R), Eutrochosporella spinosa (R), Neosphaeridium serratum (R). Cystidinum coccolithum (R), Didinium bifidum (R), Hystrochitina boltonia (R), H. vogti (R), Hystrochitina cookeana (R), Fabellingium cookeana (R), Filatropisphaeridium ocellata (R), Odontochitina ocellata (R), O. operculata (R), Oligosphaeridium corymbiferum (R), G. complex (R), O. palufericum (R), Paleohystrichosphaera infloroides (R), Paleoperidinium cretaceum (R), Spiniferites circulatus (R), S. templus (R-P), Xenaxus carodiae (R), Xiphophoridium alatum (R).

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

This interval is best reworked in Core 5 (7360-7377') which contains a diverse assemblage of dinoflagellate cysts. Panopeasporites waltonensis which occurs here is restricted to the Cenomanian along with common to abundant occurrences of Oligosphaeridium complex, G. complex (thick wall), Gardosporites trilobatus, Hystrochitina boltonia, and Oligosphaeridium sericeum which are typical of the Cenomanian. Priapinidium saxatilense which occurs in this interval at 7360 feet may mark the top of the Cenomanian section. However, no other data substantiates this until 7360 feet as reported above. This fossil was also found reworked in Core 3 (7374-7381) feet, but not in the Cenomanian interval. This is questionable, but interpreted to be eroded in distribution for this well.
7480-7840' (cont.)

dich samples and in Core #6 (7491-7501'). The spore taxa Cladopollisporites angulicola, Lepidocladites samia, and Triboelepidites hannicus are also typical for the early

7840-8230'

Undifferentiated bisaccates (A), Carabopolisporites maasoucic (R), Cingulatisporites rectangulus (R), Glassellipollis lappulata (R), Gyanmites minor (R), Deltidiospora junca (R), Eoheleopsites tumulatus (R), Glaucophacidites laneri (R), Janusporites tumulosus (R), Plicatella abaca (R), Triboelepidites hannicus (R), T. canadenesis (R).

Canningia hirtella (R), C. praecoxisporites anoriferus (R), C. sp. (R), Cribroperidiniu edwardsi (R), Ctenidodinium sp. (R), Ctenidodinium pellucida (R-F), Endoaporiae sp. (R-F), Oligosporites eringulatus pink (F-A), O. complex (thick wall) (R-F), Paraedicularia boa (R), P. dayforata (F-A), P. dayfora
ADDENDUM TO PALYNOLOGY REPORT

Twenty-three (23) samples were prepared 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 15,430 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 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 more abundance increases and their preservation is greatly improved.

The presence of molluscan data between 14,390 feet and 14,840 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 checking of 376 washed ditch samples, 99 thin sectioned ditch samples, 32 washed sidewall cores, 109 washed conventional core samples and 11 thin sectioned conventional core samples covering the interval 100 to 14,210 feet (suspended drilling depth). This 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 200 mesh screens.

Frequency symbols used in this report correspond to the following numerical values: R = rare (1-5); F = frequent (6-12); C = common (13-99); A = abundant (100-199); and FL = flood (200+).

140-145
This very thin interval is considered to be Late Cretaceous (Cenomanian) based on occurrences of Trochammina cf. spiramensis, Sonoecia B and Archiornia spp.

AGE: Late Cretaceous
ENVIRONMENT: Margin Marine

145-147
Fauna from this interval is so scarce it is impossible to tell whether we are dealing with Albian or Cenomanian strata.

AGE: Early to Late Cretaceous
ENVIRONMENT: Margin Marine to Marginal Marine

147-149
Ammobaculites vendenae, A. fragum, Glossopteris grahamensis, Erythrocheiloceras grandis, G. robinsoniae, Haplocyclina praecox, Lenticulina praecox, H. fragmenta, Saccammina lathrami, Bucinella arenacea, Glossopteris revoluta, Verneuilinoides borealis, Gavelinella stictata, M. monticola, N. manitobensis, M. awumensis, Vivalilamina loetzei, and Bathysiphon sp. among others, characterize these strata. The above association is typical of the Verneuilinoides borealis fauna and is Middle to Late Albian age (F-9). The environments represented by these assemblages were probably marine to inner neritic between 740 feet and 2300 feet, and inner to middle neritic below 2300 feet.

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

149-150
Based on co-occurrences of O. nanushukensis, Reophax truexi, Cenoconulina, B. inflatigrandis, B. reticulata, and frequent pyritized radiolarians, 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
ENVIRONMENT: Late Albian to Early Albian (F-13)

150-151
A pyritized radiolarian fauna characterizes these strata together with rare to frequent occurrences of agglutinated and calcareous Foraminifera. Pyritized radiolarians of the following genera occur: Cenosphaera spp., Sonoecia B, and Lithoconus spp. This zone is as well as it is in some of the other wells. Lithoconus B tops near the base of this unit at 7120 feet. According to Ramsey (1970) this zone of pyritized radiolarians separates the Verneuilinoides borealis zone from the Gaudryina tailliei 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
ENVIRONMENT: Open Marine

151-152
Occurrences of Gaudryina tailliei, G. marcali, Bathysiphon, C. rugosa, and Cenoconulina, and the following genera 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 curbed middle to outer neritic depositional environment.

AGE: Early Cretaceous
ENVIRONMENT: Middle to Outer Neritic
A sandstone lithology characterizes this thin interval, therefore rare 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, and it is considered Oxfordian in age. The depositional environment of these strata could be as shallow as Tithonian or as deep as Bathyal, with an age suggested to be probably middle neritic to as deep as outer neritic conditions. These faunas appear to represent open marine conditions. 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: Early Middle Jurassic
ENVIRONMENT: Outer Neritic to Bathyal

Based on occurrences of Gaudryina milleri, G. ovata, Trochammina instowensis, T. cancellata, T. radiata, Marginulinopsis phragmoides canui, M. barrowensis, Bathysiphon anomalocoelea, Ammobaculites laeviuscula, Podocyclina latissima, Lenticulina audax, Conorboides hofkeri, Marginulinopsis phragmoides canui, H. barrowensis, Bathysiphon anomalocoelea, Podocyclina latissima, Lenticulina audax, Conorboides hofkeri, Marginulinopsis phragmoides canui, H. barrowensis, Bathysiphon anomalocoelea, Podocyclina latissima, Lenticulina audax, Conorboides hofkeri, Marginulinopsis phragmoides canui, H. barrowensis, Bathysiphon anomalocoelea, Podocyclina latissima, Lenticulina audax, Conorboides hofkeri, Marginulinopsis phragmoides canui, H. barrowensis, Bathysiphon anomalocoelea, Podocyclina latissima, Lenticulina audax, Conorboides hofkeri, Marginulinopsis phragmoides canui, H. barrowensis. These strata are considered Early to Middle Jurassic age based on occurrences of Ammobaculites laeviuscula, Ammobaculites grayi, Ammocococacca canui, Gaudryina milleri, Marginulinopsis phragmoides canui, M. barrowensis, Bathysiphon anomalocoelea, Ammobaculites laeviuscula, Podocyclina latissima, Lenticulina audax, Conorboides hofkeri, Marginulinopsis phragmoides canui, H. barrowensis, Bathysiphon anomalocoelea, Podocyclina latissima, Lenticulina audax, Conorboides hofkeri, Marginulinopsis phragmoides canui, H. barrowensis. These strata are considered Early to Middle Jurassic age based on occurrences of Ammobaculites laeviuscula, Ammobaculites grayi, Ammocococacca canui, Gaudryina milleri, Marginulinopsis phragmoides canui, M. barrowensis, Bathysiphon anomalocoelea, Ammobaculites laeviuscula, Podocyclina latissima, Lenticulina audax, Conorboides hofkeri, Marginulinopsis phragmoides canui, H. barrowensis, Bathysiphon anomalocoelea, Podocyclina latissima, Lenticulina audax, Conorboides hofkeri, Marginulinopsis phragmoides canui, H. barrowensis. These strata are considered Early to Middle Jurassic age based on occurrences of Ammobaculites laeviuscula, Ammobaculites grayi, Ammocococacca canui, Gaudryina milleri, Marginulinopsis phragmoides canui, M. barrowensis, Bathysiphon anomalocoelea, Ammobaculites laeviuscula, Podocyclina latissima, Lenticulina audax, Conorboides hofkeri, Marginulinopsis phragmoides canui, H. barrowensis, Bathysiphon anomalocoelea, Podocyclina latissima, Lenticulina audax, Conorboides hofkeri, Marginulinopsis phragmoides canui, H. barrowensis.
Strata between 11,330 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 Eoschubertella yukonensis, Pseudostaffella sp., and kamaeid algae together with occurrences of Neoarchaediscus spp., Aateroarchaediscus spp., and Stylacodium 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 kamaeid algae.

Based on the occurrence of section equivalent to the Zone 17-18 Dolomite Unit below this interval, a lack of Globivalvulina bulloides, and the occurrence of possible Paleotextula sp., we suggest that section between 12,450 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 Liny 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)

Archaediscus chernoussovensis, A. krestovnikovi, Asphaltina sp., and frequent to common coral wall debris suggest that these carbonates 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)

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 15,110 feet is suggestive of the Kesiktuk Fm. The Argillitic shale found in samples below 15,400 feet appears to represent stringers within the Kesiktuk 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 (14,850-15,200'; Probable Mississippian (15,200-15,480')
ENVIRONMENT: Nonmarine to Inner Margin (14,850-15,200')
Indeterminate (15,200-15,480')

FORAMINIFERA REVISIONS:

The interval from 7480' to 8190' is modified as follows:
7480' - 8100': Early Jurassic, Neocomian (F-13 to F-14)
8100' - 8190': Late Jurassic, Kimmeridgian to Tithonian (F-15 to F-16)

ADDENDUM TO FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checklisting of 44 thin sectioned ditch samples, and 3 thin sectioned conventional core samples covering the interval 14,210 to 15,400 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-0 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+).

14,210-14,400'

This interval is similar to the overlying basal unit of the earlier report and so the top of the Lower Liny Unit lies at 14,000 feet. Occurrences of Neoarchaediscus incertus, Archaeococcomyenia chernoussovensis, and Asphaltina sp., and frequent to common coral wall debris suggest that these carbonates are probably Zone 14 to Zone 16 in age. These carbonates represent a low energy shoaling shelf environment.
**Inigok #1**

(Palynology)

**PALYNOLOGY REPORT**

**Introduction**

A total of 587 samples were processed and examined from the subject well. The total consisted of 231 ditch, 339 core and 17 sidewell core samples. The samples covered the entire well from 110 feet to the total depth of 20,092 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 sidewell core samples and two (2) charts make up the distribution from the conventional core samples.

**Summary of Results**

**9210-9448'B**

Clasopolis clavataes (F).

Cyclonephalium distinctum (F), Odontochitina operculata (B-P), Oligosphaeridium complex (thick-wall var.) (A), Undifferentiated bisaccates (R), U. spinigerum (R), Strombidium grosw (R), Psilopteris australis (R).

**Age:** Early Cretaceous, Aptian-Early Albian (P-M18).

**Environment:** Marine-Marginal Marine.

**9448-9120'BC**

Cicatricosisporites aurantiaceus (R). Clasopolis clavataes (F-C).

Oligosphaeridium complex (thick-wall var.) (A), Pteridinella dasyforma (B-P), Psilopteris australis (R).

**Age:** Early Cretaceous, Neocomian (P-M19).

**Environment:** Marine.

**9120-12,630'C**

Indeterminate, poorly preserved spores and spore fragments (B-A), Clasopolis clavataes (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.**

**12,630-14,047'C**

Undifferentiated bisaccate rays (B), Spinosites exsulory (F), Taeniasporites spp. (B), Oligosphaeridium complex sp. (B-P).

**Age:** Triassic-Jurassic.

**Environment:** No evidence of marine.

**This interval contains relatively few palynomorphs. The best recoveries are in Core 1 at 9448 feet and as low as 9114 feet in a sidewell core.**

**9114-9814'B**

Undifferentiated bisaccates (B), Clasopolis clavataes (B).

**Age:** Triassic-Jurassic.

**Environment:** No evidence of marine.

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

**There is an apparent decrease in dinocyst diversity below about 9500 feet.**

**Age:** Early Cretaceous, Aptian-Early Albian (P-M18).

**Environment:** Marine-Marginal Marine.

**9814-9468'B**

**AGE:** Late Cretaceous, Aptian (P-M14).

**Environment:** Marine.

**Summary of Results**

**110-1460'**

Osmundaexditea spp. (F-A), Gleicheniidites senenicus (R-F), Cyclonephalium distinctum (F-C), Oligosphaeridium spp. (R), Classopollis clavataes (F-C), Psaligonyaulax apatela (R).

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

**Environment:** Marine.

**560-1460'C**

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, probably Turonian-Coniacian (P-M15).

**Environment:** Marine.

**1460-2360'C**

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

**AGE:** Late Cretaceous, Campanian (P-M16).

**Environment:** Marine.

**2360-7064'C**

Osmundaexditea spp. (F-A), Cicatricosisporites spp. (B), Undifferentiated bisaccates (R), Anlaginae spp. (S), undifferentiated bisaccates and dinoepores.

**Odontochitina operculata (B-C), Paleosporidium cretaceum (B-P), Psaligonyaulax apatela (R), Cyclonephalium membraniform (B), Pseudosedimentum cf. P. setosum (single).**

**AGE:** Late Cretaceous, Campanian (P-M16).

**Environment:** Marine.

**3814-564'C**

Gleineiiidites senenicus (R-F), Cicatricosisporites spp. (F-R), Undifferentiated bisaccates and dinoepores.

**Odontochitina operculata (B-C), Paleosporidium cretaceum (B-P), Psaligonyaulax apatela (R), Cardiodinium trabeculatum (R), Muderongia asymmetric (R-P), Luxadiniua protatum (R), Spinulidium vistatum (R-P), Pseudosedimentum retatum (B-P), Genus "W" (R).**

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

**Environment:** Marine.

**The more diverse Middle-Late Albian assemblage which includes L. prepatua, 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 zone.**

**AGE:** 564-9120'C.

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

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

**Environment:** Marine-Marginal Marine.

**AGE:** Late Cretaceous, Aptian (P-M14).

**Environment:** Marine.

**This interval is marked by the occurrence of P. dasyforma, which is present in Core 1 at 9448 feet and as low as 9114 feet in a sidewell core.**

**AGE:** Late Cretaceous, Campanian (P-M16).

**Environment:** Marine.

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

**AGE:** Triassic-Jurassic.

**Environment:** No evidence of marine.
Indeterminate spores and spore fragments, poorly preserved (R-C), Endosporites sp. (R, sporadic).

**AGE**: Undifferentiated Carboniferous

**ENVIRONMENT**: Nonmarine-Marginal Marine

### 16,000-20,000' T-O

Denseospora (R-C), Lycospora spp. (R-C), Endosporites spp. (R), Convoluicospora sp. (R, sporadic), Murospora sp. (R, sporadic), Reinschospora cf. R. speciosa (single), Diatomastracites cervicornutus (single), Tripartites sp. (single, Core 23).

**AGE**: Carboniferous: Mississippian

**ENVIRONMENT**: Nonmarine

The presence of Reinschospora and D. cervicornutus in the lower part of this interval indicates that the strata below 19,600 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.

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Inigok #1

(Foraminifera)

### FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checking of 467 washed ditch samples, 213 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 13,486 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+).

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Based on associated occurrences of *Trochammina ribetoniensis*, *T. Albartensis*, *T. Whittingtoni*, *Arenonliqui* *torus*, *Verneullinoides fischeri*, *Mediulisina canadensis* and *Gaudryina ammonitensis* these strata are Senonian (F-5) in age. An inner to middle neritic paleodepth is suggested for these rocks.

**AGE**: Late Cretaceous

**ENVIRONMENT**: Inner to Middle Neritic

### 1490-1490'

A diminished fauna similar to the overlying interval occurs in these rocks. It is impossible to tell whether we are dealing with poor marine Seabees Fm. or Schrader Bluff Fm. The age of these strata is probably Turonian to Coniacian (F-6).

**AGE**: Late Cretaceous

**ENVIRONMENT**: Marginal Marine to Inner Neritic

### 1060-1360'

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

**ENVIRONMENT**: Probable Nonmarine to Marginal Marine

### 2160-2220'

Ammobaculites vononahae, A. fragmentarius, *Gonioplectus salinarius*, Eurychitina lauritzeni, *Verneullinoides grandadannesis*, *Trochammina umitensis*, *Halaplosphaera tosoporensis*, R. cf. *saccatum*, R. lintii, Sacrumina lathami, *Santculina macrodloia*, *Ammobaculites calyxius*, *Verneullinoides borealis*, *Savilchina simplex*, *Gauvrvina rugosa*, *Marantaliopsis sp.*, *Gobiesocidium sp.*, *Millimania manitobansis*, *Saggia lalchii*, *Terebratula terebrata*, *Psammospongia boweryi*, and *Dibootilites axialites*, among others, characterize these strata. The above association is typical of the *Verneullinoides* borealis Zone and is Middle to Late Albian age (F-9). The environments represented by the thin intervals were probably marginal marine to inner neritic between 2160 feet and 3000 feet, and inner to middle neritic below 3000 feet.

**AGE**: Early Cretaceous

**ENVIRONMENT**: Middle to Late Albian (F-9)

### 2510-2530'

Based on co-occurrences of *Gaudryina nanusnukensis*, *Paragaudryina tosoporensis*, *Pseudobollivina typi*, *Gaudryina cf. tailleurii*, *Paracolpinae of. everti*, and *Verneullinoides longicollis*, 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

**ENVIRONMENT**: Middle to Outer Neritic

### 510-5110'

A pyritized radiolarian fauna characterizes these strata together with rare to frequent occurrences of agglutinated and calcareous Foraminifera. Pyritized radiolarians of the following genera occur: *Cenosphaera* spp., *Boophyclis* spp., *Dictyomitra* spp., *Stichomitra* spp., *Archacodictyum* spp., and *Lithonema* spp. According to Ramsey (1976) this zone of pyritized radiolarians separates the *Verneullinoides* borealis Zone from the *Gaudryina tailleurii* 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.

**ENVIRONMENT: Open Marine**

**AGE:** Early Cretaceous

This unit is essentially barren of fauna. Since Lithocampe spp. tops near the base of it at 8970 feet, it is here considered to be Aptian (+F-11) age since Lithocampe spp. has topped near the base of the F-11 units in most of the other wells from NPR-A.

**ENVIRONMENT:** Probable Open Marine (970-9960')

**AGE:** Early Cretaceous

This interval is considered to be Aptian (+F-11) age since Lithocampe spp. has topped near the base of the F-11 units in most of the other wells from NPR-A.

**ENVIRONMENT:** Probable Aptian (Probable +F-11)

**AGE:** Early Cretaceous

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.

**ENVIRONMENT:** Open Marine

**AGE:** Early Cretaceous

**AGE:** Neocomian (F-12 to F-13)

**ENVIRONMENT:** Middle Neritic to Upper Bathyal

**AGE:** Late Jurassic to Early Cretaceous

Based on the occurrence of ammonoids, this interval is considered to be Oxfordian (F-14) to Aptian (F-15) age.

**ENVIRONMENT:** Middle to Outer Heteric

**AGE:** Late Jurassic to Early Cretaceous

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.

**ENVIRONMENT:** Open Marine

**AGE:** Early Cretaceous

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.

**ENVIRONMENT:** Open Marine

**AGE:** Early Cretaceous

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.

**ENVIRONMENT:** Open Marine

**AGE:** Early Cretaceous

These strata are considered Early to Middle Jurassic age based on occurrences of Ammobaculites vetustus. A. cf..getValue. The occurrence of Ammobaculites vetustus and A. cf. vetustus is typical of Late Jurassic to Early Cretaceous age. The moderately abundant and diverse assemblages associated with these strata suggest a middle neritic to upper bathyal depositional environment.

**ENVIRONMENT:** Middle neritic to Upper Bathyal

**AGE:** Late Jurassic to Early Cretaceous
13,890-16,880' (cont.)

are Zone 21 in age. A Zone 10 call is made at 15,215 feet based on a noticeable lack of kamaniid 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 Globorotalia bulloides, and the occurrence of Reticulofenestra, we suggest that section between 15,740 feet and 16,220 feet may be Zone 18 or 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?) micritic crystalline dolomite. This unit is poorly fossiliferous. The Dolomite Unit probably represents a supratidal depositional environment.

This last unit (the Lower Limestone 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)

16,480-18,110'

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 (17,845-17,074'). A possible Zone 12 to Zone 13 age is indicated in the ditch samples from 17,310 feet, and a possible Zone 10 to Zone 11 ('Eocadian Facies') is found at and below 17,720 feet. The whole interval is felt to represent interbedded Kayak Shale and Alapah or Washakie 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 predominantly coal 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 Reekituk Fm. The depositional environments associated with these strata was probably nonmarine to marginal marine.

AGE: Indeterminate
ENVIRONMENT: Nonmarine to Marginal Marine

APPENDIX A

12,675'SWC
No Foraminifera found. Brown quartzitic siltstone.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

12,890'SWC
No Foraminifera found. Coal (C1). Dark brown sandy shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

13,684'SWC
No Foraminifera found. Dark brownish-gray quartzitic siltstone.
AGE: Indeterminate
ENVIRONMENT: Eocene Lithology

13,712'SWC
No Foraminifera found. Glauconite (R), pyrite (F), pyrite sticks (F). Dark gray tuffaceous quartzitic siltstone.
AGE: Indeterminate
ENVIRONMENT: Possible Marine

13,718'SWC
Spathysiphon sp. (R), pyrite (F), pyrite sticks (F). Dark gray tuffaceous slightly calcareous silty shale.
AGE: Indeterminate
ENVIRONMENT: Possible Marine

FORAMINIFERA REVISIONS:
The interval from 9060' to 11,006' 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)
10,260' - 11,006': Late Jurassic, Kimmeridgian to Tithonian (F-15 to F-16)

-54-
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 90 foot ditch composites. The interval examined was from 80 feet to the total depth of 15,321 feet.

80-230'
*Pinus (F), Picea (?), Sphagnum (C), Jevigatosporites (C), Lycopodiun (F), Alnus (R), Betula (C).*

**AGE:**  
**ENVIRONMENT:** Tertiary  
Nonmarine

250-340'
*Taxodium (C), Juglans (R), Ulmus (R), Tilia (C), Cicatricosispores (R), Aquilapollenites sp. (R), Aquilapollenites s. novonicua (R), A. cenaeus (R).*

**AGE:**  
**ENVIRONMENT:** Mixed Tertiary-Late Cretaceous  
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 s. novonicua (R), A. magnus (R), Wodehouseia spinata (R), Kurtzicipites sp. (R), Aquilapollenites sp. (R).*  

**AGE:**  
**ENVIRONMENT:** Cretaceous  
Nonmarine

3140-3190'
*Oligosphaeridium complex (C-A), Parodiolina carotaphora (R), Gondwanapollis ailenacksi (A), Psaligonyaulax apatela (R), Conyaulacysta cf. ailenacksi (R), Mudangoria simplex (R).*  

**AGE:**  
**ENVIRONMENT:** Marine

7830-3190'
*Oligosphaeridium complex (C-A), Parodiolina carotaphora (R), Gondwanapollis ailenacksi (A), Psaligonyaulax apatela (R), Conyaulacysta cf. ailenacksi (R), Mudangoria simplex (R).*  

**AGE:**  
**ENVIRONMENT:** Cretaceous  
Nonmarine

The first evidence for Mississippian was observed below 14,400 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.O. -55-
Itkillik #1 (ARCO) (Foraminifera)

FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checking 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 paleontic section are enclosed for your convenience. A summary of the micropaleontology of the Itkillik River well is presented below.

290'-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 Cenozoic elements. This interval probably represents marginal marine to nonmarine deposition, but it could represent a marked increase in sedimentation rate.

ENVIRONMENT: Probable Marginal Marine to Nonmarine

790-2950' Senonian Schrader Bluff Fm.

This interval is characterized by the occurrence of the following species: Conoceramus strombodes, Gausia vitrea, Trochammina albertensis, Anomalinae salkarii, Minonella taylorensis, Pseudulinia buchanani plus rare radiolarian species. These strata were probably deposited in a moderately shallow marine to outer Neritic depth environment. The above mentioned species are indicative of a Senonian Age.

ENVIRONMENT: Probable Middle to Outer Neritic

2950-4100' Turonian to Coniacian Seabee Fm. or Prince Crk. Fm.

This interval is characterized by a significant reduction in 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 fauna 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' or 3515').

ENVIRONMENT: Probable sediment diluted shallow marine to nonmarine

4100-5920' Cenomanian to Turonian Ninulk Fm.-Seabee Fm.

This interval contains a rare occurrence of Trochammina ruberformis 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 radiolarians and Pycnographe prisms. Lithocampe sp. H 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 grey pyritic siltstones and "paper" shales coupled with the lack of bentonic foraminifera and the presence of pyritized radiolarians 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 Kings Fm. to Overwash Fm.

The upper portion of this interval (above 8190') contains such forms as Gaudryina taliardi and Conoceramus "Z" 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. These sandstones occur at 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 sandstone 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 subaerial erosion.

ENVIRONMENT: Fluctuating Middle Neritic to Upper Bathyal

10,080-10,350' Triassic Shablik Fm.

The Triassic Age of this unit is based on the top occurrence of Asterozous conchaticus and subsequent occurrences of Lingulina burwellia, Pseudocladocora simpsonensis and fragments of Monzia sp. This unit is lithologically composed of brown shelly silty mudstones with frequent occurrences of pyrite, glauconite and ostracods.

ENVIRONMENT: Probable Middle to Outer Neritic

10,350-11,520' Permian-Triassic Shadrocot Fm.

The fauna rapidly drops out in this unit, but there are enough faunal occurrences to suggest some interbedded marine intervals in the Shadrocot Fm. in this well. This unit is lithologically similar to the Tivikhan Member of the Shadrocot Fm. with the exception of the bottom two samples (11,460-11,520') which contain a heavily glauconitic sandstone suggestive of the Shadscohu Member of the Shadrocot Fm.

ENVIRONMENT: Probable Fluctuating Marginal Marine to Nonmarine

11,520-11,980' Late Mississippian-Middle Pennsylvanian Lisburne Group

Due to the inconsistent nature of disc 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 Limestone Unit The upper limestone unit is about 1700 feet thick in this well. It consists of bryozoa-pelma- tozoan foraminiferal grainstones and pelma- tozoan foraminiferal grainstone. Faunas indicative of the Middle Pennsylvanian (Zone 21) occur between 11,950 feet and 12,240 feet. Faunas indicative of the Early Pennsylvanian (Zone 20) occur between 11,240 feet and 12,440 feet. The Zone 20/Zone 21 boundary was placed on the basis of a decrease in abundance of Limoninae sp. and Trochocotilus yukonensis. The strata between 12,440 feet and 13,310 feet range in age from Zone 18 to Zone 20 (Latest Mississippian to Early Pennsylvanian). The upper limestone unit represents a shallow shoaling shelf carbonate facies. The Dolomite unit is about 330 feet thick (13,350-13,580'). This unit is poorly fossiliferous and masked by cavings in disc samples. In other areas where cavings have been obtained within or bracketing this unit, it was found to be Zone 17 or Zone 18 in age (Chesterian).

The Lower Limestone unit is 410 feet thick (13,360-13,980'). The occurrence of coral, well developed as high as 13,450'-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 bryozoa- pelma- tozoan pelecypods and pelecypods and represents a shallow platform cycloc sequence.

ENVIRONMENT: Probable Middle Neritic to Supratidal
13,930-14,950' Upper Mississippi
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 Kerlinsk Fm. Strata between 14,400 feet and
14,640 feet contain rare evidence for an Early to Middle
Naramacian age (Zone 13 or older).

ENVIRONMENT: Possible Inner Shelf to Neritmarine

14,950-15,310' T.D. Indeterminate
Probable Neruskup 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

Unidentifiable bisaccates (A).

Alvearia sonomica (C-A), Chatanella spp. (A), Lacina- 
idinium spp. (F-C), Exocochosphaeridium bifidum (R),

Odontochitina operculata (A), Trithyrodinium sp. (8-A), 

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

1010-1280'

Unidentifiable bisaccates (A), Glochidinidites vernoniou (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 Short-Cretaceous in the area of the Alaska north slope.

2390-2570'

Vitratosporites pallidus (R), Glochidinidites cornutus (8-A), Aequirritidites spiculosus (R).

Odontochitina operculata (R-F), Palaeoperidinium cretaceum (R-C), Oligosphaeridium complex (thick-wall variety) (F-A), Cardioporelminium echinatum (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 section. This assemblage, however, lacks the age restrictive markers and, therefore, is tentatively given a Cenomanian age.

6990-7047'

Oligosphaeridium complex (8-C), Odontochitina operculata (F-A), Palaepoenidinium cretaceum (F-A), Gardodinium trabeculatum (R-A), Batioladinium jaegeri (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.

1570-1876'C (cont.):

Pseudoceratium reticulatum (R-F), Batioladinium jaegeri (R-F).

AGE: Early Cretaceous (Middle-Late Albian) P-M11
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 6915 feet. Presumably these latter occurrences are due to derivation from upper and mud contamination.

6990-7047'C

Oligosphaeridium complex (F-C), Odontochitina operculata (R-A), Palaeoperidinium cretaceum (F-A), Gardodinium trabeculatum (R-A), Batioladinium jaegeri (R-F).

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

The numerous Neocomian marker species in this interval places the age at Hauterivian-Barremian. 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 6915 feet. Presumably these latter occurrences are due to derivation from upper and mud contamination.

7141-7147'C

Oligosphaeridium complex (thick-wall variety) (F-A), Gardodinium trabeculatum (R-A), Hystrichosphaeridium conostronges (F-A), Parodinia cristata (R), Verendania planiformis (R-C), Batioladinium pallidulum (R-C), Cosynuswyrata serrata (R-C), Hederocysta spp. (F-A), Prionodiniua alaskae (R-A), Dimorphidinium umbraculatum (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 is questioned because it should possibly be located at 7137 feet. Sample 7136 in Core 99 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 88 7136' = Cretaceous
Core 99 7136' = Cretaceous
7137' = Jurassic
7126' = Jurassic
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.

Jurassic

Cosynuswyrata cladospor (R-A), Vannoceratops palicola (F-A), Parodinia app. (R-C), Spermocysta spp. (R-C), Congenus swyrata sp. (R), Vannoceratops cf. acollaria (R-F).

AGE: Late Jurassic (Oxfordian) P-M2
ENVIRONMENT: Marine

-58-
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

90-1010' : Late Cretaceous, Santonian-Campanian (P-M14).
1010-1450' : Late Cretaceous, Turonian-Coniacian (P-M15).
1450-1930' : Late Cretaceous, possible Campanian (P-M16).
1930-2570' : Late Cretaceous, Neocomian (P-M16).
2570-5876' : Early Cretaceous, Middle-Late Albian (P-M17).
5876-6990' : Early Cretaceous, Aptian-Early Albian (P-M18).
6990-7047' : Early Cretaceous, possible Neocomian (P-M18a).
7047-7137' : Early Cretaceous, Neocomian (P-M18b).
7137-7395' : T. D. Late Jurassic, Oxfordian (P-M21).

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 41 ditch samples, generally composited on 10 to 40 foot intervals. These samples represent the interval 80 feet to 7395 feet (total depth). A generalized age summary of the well is provided below.

80-1100'

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

AGE: Late Cretaceous
ENVIRONMENT: Middle to Late Albian (P-M9).

1100-1140'
This interval is characterized by a large reduction in faunal and non new occurrences. It probably represents a non-marine or marginal marine intertongue (Lurin equivalent). The age is spread in this report since the fauna is insufficient to allow for a precise age determination.

AGE: Late Cretaceous
ENVIRONMENT: Non-marine to Marginal Marine

1340-2030'
Based on occurrences of Pseudocoeusia habata and Ango­
halinina torna at 1340 feet, and Indodiscus at 1910 feet this unit is considered to be Turonian to Coniacian (P-M6) in age. These strata probably represent inner to middle neritic deposition.

AGE: Late Cretaceous
ENVIRONMENT: Inner to Middle Neritic

2450-2570'
The upper portion of this interval contains Indodiscus A. B. and Caytonina irinensis. The basal portion contains Trochammina rainwateri, T. rutherfordi, and Flabellammina chapmanii. These occurrences suggest a Campanian to Turonian age. While these strata are neritic, organic rich and contain frequent fishbone fragments, they are sandier than typical "fishbone shale." 

AGE: Late Cretaceous
ENVIRONMENT: Probable Neritic (open marine)

3750-5250'
Hapalapryroideos topogrubakens, A. cf. excavata, V. cf. excavata, Trochammina rainwateri, T. rutherfordi, Haplophragmoides topagorukensis, A. wenonahae, Clev refereus, and pyritised Cenopus spp. This association appears to be a transi tional fauna which could be either Albian or Campanian in age. These strata probably represent turbid inner to middle neritic deposition.

AGE: Early to Late Cretaceous
ENVIRONMENT: Probable Inner to Middle Neritic (turbid)

4265-5180'
This interval is characterized by a large reduction in fauna, and no new occurrences. It probably represents a non-marine or marginal marine intertongue (Lurin equivalent). The age is spread in this report since the fauna is insufficient to allow for a precise age determination.

AGE: Late Cretaceous
ENVIRONMENT: Non-marine to Marginal Marine

5250-5976'
The above assemblage is characteristic of the Sahelian Schrader Bluff Formation. Faunas obtained throughout this interval are indicative of oscillating middle neritic to upper bathyal (non-turbid) deposition.

AGE: Late Cretaceous
ENVIRONMENT: Middle to Upper Bathyal (non-turbid)

5976-6990'
Lenticulina topagorukensis, Voumakioides roti, Globo­
toritula klugia, Miliammina manitobensis. Haplophragmoides topagorukensis, H. cf. excavata, and Cenosphaera spp. (pyritized). The above fauna is typical of the Voumakioides klugia fauna zone and is Middle to Late Albian age (P-M6). The environments represented by these diverse assemblages were probably middle to outer neritic associated with relatively clear (non-turbid) waters.

AGE: Early to Late Cretaceous
ENVIRONMENT: Middle to Upper Neritic (clearwater)

5976-6990'
Hapalapryroideos topogrubakens, A. cf. excavata, V. cf. excavata, Trochammina rainwateri, T. rutherfordi, Haplophragmoides topagorukensis, A. wenonahae, Clev refereus, and pyritised Cenopus spp. This association appears to be a transi tional fauna which could be either Albian or Campanian in age. These strata probably represent turbid inner to middle neritic deposition.

AGE: Early to Late Cretaceous
ENVIRONMENT: Probable Inner to Middle Neritic (turbid)

5976-6990'
Lenticulina topagorukensis, Voumakioides roti, Globo­
toritula klugia, Miliammina manitobensis. Haplophragmoides topagorukensis, H. cf. excavata, and Cenosphaera spp. (pyritized). The above fauna is typical of the Voumakioides klugia fauna zone and is Middle to Late Albian age (P-M6). The environments represented by these diverse assemblages were probably middle to outer neritic associated with relatively clear (non-turbid) waters.

AGE: Early to Late Cretaceous
ENVIRONMENT: Middle to Upper Neritic (clearwater)
Assemblages were probably somewhat turbid inner to middle neritic depths with short periods of lesser turbidity

**AGE:** Early Cretaceous

**ENVIRONMENT:** Inner to Middle Neritic (fluctuating turbidity)

6920-6970

A pyritized radiolarian fauna characterizes these strata together with rare occurrences of agglutinated and calcareous foraminifera. Pyritized radiolaria of the following genera occur: *Canospira* spp., *Spongiodiscus* spp., *Lithocampe* spp., *Dicyosphera* spp., *Idiosphaera* spp., and *Fusulina* spp. *Lithocampe* spp. *Haplophragmoides* planus and *Haplophragmidae* planus, *Quinqueloculina* spp., *Neohaplophragmoides* planus. The fauna is dominated by *Canospira* spp., *Spongiodiscus* spp., *Lithocampe* spp., and *Fusulina* spp. According to Ramsey (1970) this zone of pyritized radiolaria separates the *Vernaciolinoides* and the *Canospira* spp., *Ochithomitra* spp., *Sethocyrtis* sp., and *Stichoceras* spp., 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 water (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

**ENVIRONMENT:** Open Marine

6790-7137

Occurrences of *Gaudryina tailleuri*, *Gloeoepirella* sp., *Ammobaculites* cf. *rupestris*, *Epistegina* squamata, *T. cf. sablei*, *T. cf. instowensis*, *T. cf. cannigensis*, *A. reophacoides*, *Trochashina squamata*, *A. reophacoides*, *T. cf. sablei*, *T. cf. instowensis*, *T. cf. cannigensis*, *C. fallax*, *Vaginulina* sherborni, *Conorboides* cf. *hofferi*, *Vaginulina* squamata, *Gavelinella* cf. *barreti*, *Citharina* cf. *barreti*, *Vaginulina* squamata, *Gavelinella* cf. *barreti*, *Citharina* cf. *barreti*, *Vaginulina* squamata, *Gavelinella* cf. *barreti*, *Citharina* cf. *barreti*, *Vaginulina* squamata, *Gavelinella* cf. *barreti*, *Citharina* cf. *barreti*, *Vaginulina* squamata, *Gavelinella* cf. *barreti*, *Citharina* cf. *barreti*. One again the abundance and diversity of these assemblages suggests a clear-water middle neritic to upper bathyal deposition environment. The base of this unit at 6920-6970 feet. According to Ramsey (1970) this zone of pyritized radiolaria separates the *Verneuilinoides* and *Canospira* spp., *Ochithomitra* spp., *Sethocyrtis* sp., and *Stichoceras* spp., 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 water (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

**ENVIRONMENT:** Open Marine

7137-7139

An Oxfordian (F-16) age is indicated for this interval based on the following assemblages: *Ammobaculites* stevensi, *Ammobaculites* obsieri, *b. pedunculata*, *Lenticulina* echinoides, *L. quinqueloculata*, *Marciniolinops* guaymasensis, *Eponithia* sp., *Ophiomorphidae* planus, *Neohaplophragmoides* planus. The fauna is dominated by *Ammobaculites* stevensi, *Ammobaculites* obsieri, *b. pedunculata*, *Lenticulina* echinoides, *L. quinqueloculata*, *Marciniolinops* guaymasensis, *Eponithia* sp., *Ophiomorphidae* planus. This problem will be the subject of a future addendum. The abundance and diversity of these assemblages suggests a clear-water middle neritic to upper bathyal depositional environment. This is a possibility since calcareous foraminifera are very scarce in this interval and could represent caved specimens when they do occur. The fauna is dominated by *Ammobaculites* stevensi, *Ammobaculites* obsieri, *b. pedunculata*, *Lenticulina* echinoides, *L. quinqueloculata*, *Marciniolinops* guaymasensis, *Eponithia* sp., *Ophiomorphidae* planus. This problem will be the subject of a future addendum. The abundance and diversity of these assemblages suggests a clear-water middle neritic to upper bathyal depositional environment.

**AGE:** Oxfordian (F-16)

**ENVIRONMENT:** Middle Neritic to Upper Bathyal (clearwater)

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 Core 9 and 10 resampled in Anchorage, and resampling #2 represents material from Cores 8, 9 and 10 resampled 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

<table>
<thead>
<tr>
<th>Core 9</th>
<th>Core 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>7136.0'</td>
<td>Oxfordian (mixed with Neocomian)</td>
</tr>
<tr>
<td>7136.5'</td>
<td>Oxfordian (mixed with Neocomian)</td>
</tr>
<tr>
<td>7137.0'</td>
<td>Oxfordian</td>
</tr>
<tr>
<td>7137.5'</td>
<td>Oxfordian</td>
</tr>
<tr>
<td>7137.7'</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>7138.2'</td>
<td>Probable Oxfordian</td>
</tr>
<tr>
<td>7139.0'</td>
<td>Oxfordian</td>
</tr>
<tr>
<td>7139.5'</td>
<td>Oxfordian</td>
</tr>
</tbody>
</table>

Resampling #2

<table>
<thead>
<tr>
<th>Core 8</th>
<th>Core 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>7134'</td>
<td>Neocomian</td>
</tr>
<tr>
<td>7135'</td>
<td>Neocomian</td>
</tr>
<tr>
<td>7136'</td>
<td>Oxfordian</td>
</tr>
<tr>
<td>7137'</td>
<td>Oxfordian</td>
</tr>
<tr>
<td>7138'</td>
<td>Oxfordian</td>
</tr>
<tr>
<td>7139'</td>
<td>Oxfordian</td>
</tr>
</tbody>
</table>

Resampling #3

<table>
<thead>
<tr>
<th>Core 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>7140'</td>
</tr>
<tr>
<td>7140.5'</td>
</tr>
<tr>
<td>7140.8'</td>
</tr>
<tr>
<td>7141'</td>
</tr>
<tr>
<td>7142'</td>
</tr>
<tr>
<td>7143'</td>
</tr>
</tbody>
</table>

Resampling #4
Kugrua #1
(Palynology)

PALYNOLOGY REPORT

Introduction

A total of 312 samples were processed and analysed 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

61-931° FMC

Undifferentiated bisaccates (A), Lyopydidioporesites spp. (R), Lycopodiumspores (R), rare sporadic occurrences of reworked Triassic species.

Cyclonephalus distinctus (R-F), Odontolithina opaca (R-F), Oligosphaeridium complex (R-C), Paleoperidinium cretaense (R-C), Pseudoaulacista retama (R), Modernia asymmetrica (R-F), Batioladiniua Jaegeri (R-F), Goniadina trabeculosum (R); numerous rare occurrences of re-worked Triassic, Jurassic, and Neocomian dinocysts.

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

The absence of any restrictive Middle to Late Albian species indicates that possibly this interval is entirely Aptian to Early Albian (P-M18) in age.

6912-7202° C

Oligosphaeridium complex (R-F), Gardodiadinium trabeculosum (R-F), Batioladiniua Jaegeri (R), Convolvularia sertata (R-F), Prionodinium alaskense (R-F).

AGE: Early Cretaceous (Neocomian) P-M13
ENVIRONMENT: Marine

The presence of P. alaskense in this section places the age in Hauterivian to Barremian.

7202-10,480° FMC

Undifferentiated bisaccates (A-C), Gleicheniidites senoni (R-F), Ondifferentiated bisaccates (R-C), Gleicheniidites senoni (R-C), modernia asymmetrica (R-F), Batioladiniua Jaegeri (R-F), Goniadina trabeculosum (R); numerous rare occurrences of re-worked Triassic, Jurassic, and Neocomian dinocysts.

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

The only significant palynomorph seen in this interval were very sparse and poorly preserved specimens of Potonieiaporites. These specimens provide the evidence for a probable Pennsylvanian age.

10,480-11,030°

Oligosphaeridium complex (R-F), Gardodiadinium trabeculosum (R-F), Batioladiniua Jaegeri (R), Convolvularia sertata (R-F), Prionodinium alaskense (R-F).

AGE: Early Cretaceous (Neocomian) P-M13
ENVIRONMENT: Marine

The overall palynomorph recoveries and preservation of fossils are quite poor through this interval.

11,032-11,130°

Ophiactisporites spp. (R), Ophiactisporites spp. (R), Striatae sp. (R-F), indeterminate spores (R-F).

AGE: Early Triassic P-T16
ENVIRONMENT: Marginal Marine (fluctuating turbidity)

This interval is characterized by occurrences of the following: Bathysphincis vitis, Valvulinaria loxetera, Verneulinoidea borealis, Potonieiaporites, and Ophiactisporites. The above association is typical of the Verneulinoidea borealis fauna 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.

12,330-12,594° T.D.

Potonieiaporites (R), Ophiactisporites (R).

AGE: Early Cretaceous (Neocomian) P-M13
ENVIRONMENT: Marine

The only significant palynomorph seen in this interval were very sparse and poorly preserved specimens of Potonieiaporites. 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 5 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 composed on 30 to 40 foot intervals, 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.

100-476°

Haplophragmoides copagorukensis, H. cf. alpatica, Sarcoaerina lathraai, Trochammina naramurreyi, Verneulinoidea borealis, Potonieiaporites, and Ophiactisporites among others. The above association is typical of the Verneulinoidea borealis fauna 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 (Neocomian) P-M13
ENVIRONMENT: Inner to Middle Neritic (fluctuating turbidity)

1760-4110°

This interval is characterized by occurrences of the following: Bathysphincis vitis, Valvulinaria loxetera, Verneulinoidea borealis, Anomocystites fragmentarius, A. venosa, Paracancinoidea dule, P. projecta, Haplophragma neon, Haplophragma neon, Haplophragma neon, Haplophragma neon, Haplophragma neon, and Haplophragma neon. The above fauna indicates a Late Aptian to Early Albian (F-10) age. The environments represented by these moderately ... assemblages were probably somewhat curtail inner to middle neritic with short periods of lesser turbidity.

AGE: Early Cretaceous Late Aptian to Early Albian (F-10)
ENVIRONMENT: Inner to Middle Neritic (fluctuating turbidity)
A pyritized radiolarian fauna characterizes these strata together with rare occurrences of agglutinated and calcareous foraminifers. Pyritized radiolarians of the following genera occur: Cenosphera spp., Sympolosporites spp., Lithocampe spp., and Dictyonites spp. Lithocampe H tops just below the base of this unit at 6800 feet. According to Ramsey (1970) this zone of pyritized radiolarians separates the Verneuilinoides borealis zone from the Gaudryina tauri zona and is probably Aptian 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 
**ENVIRONMENT:** Open Marine 

**AGE:** Latest Jurassic to Early Cretaceous 
**ENVIRONMENT:** Middle to Outer Neritic (clearwater) 

**AGE:** Late Jurassic 
**ENVIRONMENT:** Triassic to Early Jurassic 

**AGE:** Proterozoic 
**ENVIRONMENT:** Upper Bathyal 

**AGE:** Proterozoic 
**ENVIRONMENT:** Middle Neritic (open marine) 

**AGE:** Late Provician 
**ENVIRONMENT:** Middle Neritic to Upper Bathyal (clearwater) 

**AGE:** Late Jurassic 
**ENVIRONMENT:** Upper Bathyal 

**AGE:** Oxfordian to Kinverian (P-16) 
**ENVIRONMENT:** Late Jurassic to Early Cretaceous 

**AGE:** latest Jurassic to Earliest Cretaceous 
**ENVIRONMENT:** Turbid (clearwater) 

**AGE:** Early Jurassic 
**ENVIRONMENT:** Middle to Upper Bathyal (clearwater)
9750-11,130' (cont.)

AGE:       Permo-Triassic
         (F-20)
ENVIRONMENT:  Nonmarine to Inner Neritic

11,130-12,594' T.D.

Generally throughout the North Slope area, the Lisburne
Group can be divided into three lithologic units:
1. Upper Limestone Unit
2. Dolomite Unit
3. Lower Limestone Unit

The Upper Limestone Unit is 1464+ 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 nodosarids, cornuaspirids, por-
cellaneous spp., Protodosaria sp., and very rare Palae-
ospyline 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 Protodosaria sp. and we are dealing entire-
ly with ditch samples.

Strata between 11,600 feet and 12,380 feet contain frequent
to common Trpeleopsis sp., Kerlandia spp., Pseudolimno-
spira sp., Stachides mendtiformis, and Mitchiedesia sp.,
together with rare Bissieria spp., Oepchubertella vorac-
ensis, Pseudosphaera sp., Monotaxinoides multivulatas,
volvocinarias mississippiensis, Globivalvulina bullidens,
and Stylodoium sp. Since there was no noticeable burst
of Oepchubertella sp. or Pseudosphaera sp., we feel that
the strata between 11,600 feet and 12,380 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.W.A. F-31)
ENVIRONMENT:  Neritic (shoaling shelf)

FORAMINIFERA REPORT - REVISION

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

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

-63-
PALYNOLogy REPORT

Introduction

A total of 179 samples were processed and analyzed for palynological age determinations. The total consisted of 100 ditch, 11 sideward, and 68 conventional core samples. The sample coverage extends from 95 feet to the total depth of 8590 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

95-4560'
Undifferentiated bisaccates (C-A); rare sporadic occurrences of Vitreisporites pallidus, Aquitanites sequinicus; numerous, rare occurrences of Triassic grains.

Basilicadinium jaeug (R), Cyclonephelium distinctum (R-P), Odonthochitina operculata (R-P), Oligosphaeridium complex (R-P), Muderonia spp. (R), Genus "B" (R, sporadic); numerous occurrences of reworked Triassic, Jurassic and Neocomian species.

AGE: Early Cretaceous (Aptian-Alian) 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, zone.

Below approximately 4500 feet there is a slight decrease in dinocyst abundances 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').

5660-'8830' YMC
Undifferentiated bisaccates (C-A); scattered occurrences of Gleichaniidites senonicus, Classopollis clasoides, Cicatrizeisporites australiensis.

Oligosphaeridium complex (P-A).

AGE: Early Cretaceous (probable Neocomian) P-M15 to P-M14
ENVIRONMENT: Marine

The main evidence for Cretaceous was the Q. complex influx as seen in the sideward cores 6664 feet and 6820 feet. Nothing else of importance was observed to be indigenous in the samples through this interval. The Q. complex specimens were all dark in color, poorly preserved, and fragmentated. Lacking any other significant forms only a tentative age assignment is possible.

8830-7600'
Undifferentiated bisaccates (Q), Gleichaniidites senonicus (R), Classopollis clasoides (R), Cicatrizeisporites australiensis (single).

No indigenous dinocysts.

AGE: Jurassic-Cretaceous undifferentiated
ENVIRONMENT: No evidence of marine

7600-7840'
Gleichaniidites senonicus (R), Classopollis clasoides (R), indeterminate spores (R-C).

"Pareolidia omanoophane" (single), Gonyaulacysta cf. jura­sica (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.

7840-8019'
Undifferentiated bisaccates (P-C), Vitreisporites pallidus (R, sporadic), Classopollis clasoides (R-C), ?Lycopsis seminutus (single); single specimens of reworked (?) Loochlispores sp., Teenisaspores sp.

Micrhystridium spp. (R-P).

AGE: Triassic-Jurassic undifferentiated
ENVIRONMENT: Marginal Marine

A single, poorly preserved spore that is questionably identified as L. seminutus indicates that by 8504 feet the section may be Early Jurassic in age.

8020-8019'
Indeterminate spores (F), undifferentiated bisaccates (R).

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

8019-8273'
Nonmosaicites sp. (R), Vitreisporites pallidus (R).

Sverdrupia usitata (R-C), S. sp. (R).

AGE: Late Triassic, Norian (P-M26)
ENVIRONMENT: Marine

8273-9510'
Undifferentiated strite bisaccates (R); scattered, rare occurrences of Gnetaceaeopollenites sp., Teenisaspores sp., Aratrisporites sp., Crustaceasporites sp.

Micrhystridium spp. (R), Veryhachiia spp. (R-P).

AGE: Triassic (probable P-M26)
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.

8273-8919'
Undifferentiated bisaccates (C-A); rare sporadic occurrences of Vitreisporites pallidus, Aquitanites sequinicus; numerous, rare occurrences of Triassic grains.

Basilicadinium jaeug (R), Cyclonephelium distinctum (R-P), Odonthochitina operculata (R-P), Oligosphaeridium complex (R-P), Muderonia spp. (R), Genus "B" (R, sporadic); numerous occurrences of reworked Triassic, Jurassic and Neocomian species.

AGE: Early Cretaceous (Aptian-Alian) 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, zone.

Below approximately 4500 feet there is a slight decrease in dinocyst abundances 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').

5660-'8830' YMC
Undifferentiated bisaccates (C-A); scattered occurrences of Gleichaniidites senonicus, Classopollis clasoides, Cicatrizeisporites australiensis.

Oligosphaeridium complex (P-A).

AGE: Early Cretaceous (probable Neocomian) P-M15 to P-M14
ENVIRONMENT: Marine

The main evidence for Cretaceous was the Q. complex influx as seen in the sideward cores 6664 feet and 6820 feet. Nothing else of importance was observed to be indigenous in the samples through this interval. The Q. complex specimens were all dark in color, poorly preserved, and fragmentated. Lacking any other significant forms only a tentative age assignment is possible.

8830-7600'
Undifferentiated bisaccates (Q), Gleichaniidites senonicus (R), Classopollis clasoides (R), Cicatrizeisporites australiensis (single).

No indigenous dinocysts.

AGE: Jurassic-Cretaceous undifferentiated
ENVIRONMENT: No evidence of marine

7600-7840'
Gleichaniidites senonicus (R), Classopollis clasoides (R), indeterminate spores (R-C).

"Pareolidia omanoophane" (single), Gonyaulacysta cf. jura­sica (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.

7840-8019'
Undifferentiated bisaccates (P-C), Vitreisporites pallidus (R, sporadic), Classopollis clasoides (R-C), ?Lycopsis seminutus (single); single specimens of reworked (?) Loochlispores sp., Teenisaspores sp.

Micrhystridium spp. (R-P).

AGE: Triassic-Jurassic undifferentiated
ENVIRONMENT: Marginal Marine

A single, poorly preserved spore that is questionably identified as L. seminutus indicates that by 8504 feet the section may be Early Jurassic in age.

8020-8019'
Indeterminate spores (F), undifferentiated bisaccates (R).

AGE: Indeterminate
ENVIRONMENT: Nonmarine?

8019-8273'
Nonmosaicites sp. (R), Vitreisporites pallidus (R).

Sverdrupia usitata (R-C), S. sp. (R).

AGE: Late Triassic, Norian (P-M26)
ENVIRONMENT: Marine

8273-9510'
Undifferentiated strite bisaccates (R); scattered, rare occurrences of Gnetaceaeopollenites sp., Teenisaspores sp., Aratrisporites sp., Crustaceasporites sp.

Micrhystridium spp. (R), Veryhachiia spp. (R-P).

AGE: Triassic (probable P-M26)
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.
PALYNOLQGY 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 9909 feet, which represents section penetrated in the Redrill No. 1 and Redrill No. 2 at the South Meade well.

This work was conducted under Contract 817779, 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 9584 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?

8284'SWC
Undifferentiated bisaccates (R), indeterminate spore fragments, poorly preserved (F), Microhystridiom sp. (R).
AGE: Indeterminate
ENVIRONMENT: Marginal Marine

8287'SWC
Indeterminate spore fragments, poorly preserved (R).
AGE: Indeterminate
ENVIRONMENT: Nonmarine?

8292'SWC
Undifferentiated bisaccates (R), indeterminate spores (R), Taeniasporites sp. (F), Microhystridiom sp. (R).
AGE: Triassic (P-T16)
ENVIRONMENT: Nonmarine

8305'SWC
Undifferentiated bisaccates (R), indeterminate spores (C), Microhystridiom sp. (R).
AGE: Indeterminate
ENVIRONMENT: Marginal Marine

9099'SWC
Undifferentiated bisaccates (F), Monosulcites sp. (R), indeterminate spores and spore fragments (C), Microhystridiom sp. (F), Scolecodont (R).
AGE: Probable Late Triassic, Norian (P-M26)
ENVIRONMENT: Marine

9163'SWC
Undifferentiated bisaccates (R).
AGE: Indeterminate
ENVIRONMENT: Nonmarine?

9174'SWC
Undifferentiated bisaccates (R), Striatites richteri (R), Taeniasporites sp. (R), Microhystridiom sp. (R).
AGE: Triassic (P-T16)
ENVIRONMENT: Marginal Marine

9176'SWC
Undifferentiated bisaccates (R), Dulhuntyspora minuta (R), Striatites richteri (R), Taeniasporites sp. (F).
AGE: Triassic (P-T16)
ENVIRONMENT: Nonmarine

9203'SWC
Undifferentiated bisaccates (R), Dulhuntyspora minuta (R), Lucrectisporites sp. (R), Striatites richteri (R), Taeniasporites sp. (F).
AGE: Triassic (P-T16)
ENVIRONMENT: Nonmarine

9213'SWC
Undifferentiated bisaccates (R), indeterminate spores (F), Taeniasporites sp. (F).
AGE: Triassic (P-T16)
ENVIRONMENT: Nonmarine

9236'SMC
Monosulcites sp. (R), Dulhuntyspora minuta (R), Praeestrachyphorites sp. (R), Taeniasporites sp. (F), Scolecodont (R).
AGE: Triassic (P-T16)
ENVIRONMENT: Nonmarine

9264'SMC
Undifferentiated bisaccates (R), indeterminate spores (F), Dulhuntyspora minuta (R), Taeniasporites sp. (C).
AGE: Triassic (P-T16)
ENVIRONMENT: Nonmarine

9274'SMC
Undifferentiated bisaccates (R), indeterminate spores (R), Taeniasporites sp. (R).
AGE: Triassic (P-T16)
ENVIRONMENT: Nonmarine

9317'SMC
Undifferentiated bisaccates (C), Monosulcites sp. (R), indeterminate spores (C, Striatites richteri (C), Taeniasporites sp. (C).
AGE: Probable Permian-Triassic (P-T17)
ENVIRONMENT: Nonmarine
9403'SHC
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

9544'SMC
Spinotriletes sp. (?), indeterminate spores, poorly preserved (A), Calamospora sp. (single).
AGE: Devonian-Triassic
ENVIRONMENT: Nonmarine

9524'SMC
Microscelites sp. (R), indeterminate spores, poorly preserved (C).
AGE: Indeterminate
ENVIRONMENT: Nonmarine

9510'SMC
Indifferentiated bisaccate (R), indeterminate spores, poorly preserved (F).
AGE: Indeterminate
ENVIRONMENT: Nonmarine

9668'SMC
Calamospora sp. (C), indeterminate spores, poorly preserved (A).
AGE: Devonian-Triassic
ENVIRONMENT: Nonmarine

9666'SMC
Indeterminate spores (R).
AGE: Indeterminate
ENVIRONMENT: Nonmarine

9756'SMC
Barren of palynomorphs.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

9766'SMC
Barren of organic.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

9788'SMC
Indeterminate spores? (R); very small recovery.
AGE: Indeterminate
ENVIRONMENT: Nonmarine?

9935'SMC
Indeterminate spores? (R), very poor preservation.
AGE: Indeterminate
ENVIRONMENT: Nonmarine?

9955'SMC
Indeterminate spores? (R), very poor preservation.
AGE: Indeterminate
ENVIRONMENT: Nonmarine?

9905'SMC
Indeterminate spores? (R), very poor preservation.
AGE: Indeterminate
ENVIRONMENT: Nonmarine?

Preparation and analysis of Topazoruk T.W. 41 core samples for comparison with the S. Meade RD 42.

10,228-229'; 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 Topazoruk T.W. 41 samples are significantly less (3.0 range) than they are for the section in the bottom part of the South Meade RD 42 (4.0 range).
ENVIRONMENT:

This interval is characterized by occurrences of the following:

- *Bathysiphon vitta*, *Gaudryina nanushukensis*, *Verneuilinoides borealis*, *Gaudryina leffingwelli*, *G. dyacrita*, *Boquttulina arenacaeaeus* (large, coarse), *T. gryci*, *Lenticulina audax*, *Frondicularia lustrata*, *Globulina topagoruXenais*, *Tcochamaina canningensis*, *Haplophragmoides duoflatis*, *H. eoronis*, and *T. ef. instowensis*. 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

**ENVIRONMENT:** Inner to Middle Neritic (fluctuating turbidity)

**3460-6500′**

A pyritized radiolarian fauna characterizes these strata together with rare occurrences of agglutinated foraminifera. Pyritized radiolaria of the following genera occur: *Cenosphera* spp., *Spongosia* spp., *Spongyrella* spp., and *Lithocampe* spp. *Lithocampe* spp. 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 nanushukensis* 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

**ENVIRONMENT:** Open Marine

**5500-6760′**

Occurrences of *Gaudryina tailleri*, *G. hagenii*, *G. milleri*, *Gloecamperella* sp., *G. arctica*, *Ammobaculites fragmentarius*, *A. arenaceous* spp. (large, coarse), *Trochammina squarata*, *T. squamata*, *T. cf. instowensis*, *Gravellina* i., *Gloecamperella* subarctica, *Haplophragmoides* douglasii, *H. orontia*, *H. in­flata*, and *Verneuilinoides borealis* 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

**ENVIRONMENT:** Middle to Outer Neritic (moderate turbidity)

**6760-6970′**

*Conorboides* holkeri, *Citharoida* cf. *agculus*, *Saxag­naria* oxfordiana, *Pronodularia* iustrata, *Eucalyptina* *liassica*, *Vaginulina curva*, *Margarinunopygus* *phragmites*, *Haplophragmoides* *canus*, *Lincuta* *irregularia*, *Recuroides* *turbidites*, *Ammobaculites* *alaskaensis*, *Gastrovina* *sudetica*, *Diphylloides* *topagorukensis*, *G. arctica*, *Gloecamperella* *to­pagorukensis*, *Trochammina* *canadensis*, *Haplophragmoides* *canui*, *Lituotuba* *irregularis*, *Recuroides* *exserta*, *Nodosaria* *balteata*, *N. cf. sphingothalma*, *Textularia* *areolata*, *Eoguttulia* *liassica*, *Involutina* *caeradospira*, *I. apera*, *Eoguttulina* *liassica*, *Gloecamperella* *subarctica*, *Eucalyptina* *liassica*, and *Gloecamperella* *perplaxa*, among others, dominate these strata. This interval is characterized by occurrences of the *Jool lowe* zone from the *Gaudryina tailleuri* zone, and is 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.

**AGE:** Latest Jurassic

**ENVIRONMENT:** Middle Neritic to Upper Bathyal

**6970-7992′**

*Pronodularia* iustrata, *Gloecamperella* *topagorukensis*, *Recuroides* *turbidites*, *Haplophragmoides* *canus*, *T. gryci*, *Lenticulina* *f. cf. faveolata*, *Trochammina* *squarata*, *T. gryci*, *Lenticulina* *audax*, *Frondicularia* *lustrata*, *Globulina* *topagoruXenais*, *Tcochamaina* *canningensis*, *H. ef. excavata*, *G. arctica*, *Gloecamperella* *fragmentarius*, *A. arenaceous* spp. (large, coarse), *T. ef. instowensis*, *Gravellina* *sp., Spongodiacus* *sp., *Sponqurus* *sp.*, and *Lithocampe* *cf. T. The abundance and diversity of this predominantly agglutinated assemblage suggests a relatively turbid middle to outer neritic depositional environment.

**AGE:** Latest Jurassic

**ENVIRONMENT:** Outer Neritic to Bathyal (clearwater)

**7990-8519′**

These strata are considered Early to Middle Jurassic age based on occurrences of *Ammobaculites vetus*, *Margarinunopygus* *bavariensis*, *Astacolus* *dubius*, *Lenticulina* *f. cf. faveolata*, *Conorboides* *holkeri*, *Gastrovina* *subarctica*, *Diphylloides* *topagorukensis*, and *G. arctica*. The abundance of *Pronodularia* 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

**ENVIRONMENT:** Probable Middle Neritic to Upper Bathyal (open marine)
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 connatus, 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 9000' feet. These strata probably represent inner to middle neritic deposition.

A few black chert pebbles were found in the interval 9080-9140 feet which suggest a correlation between 9080 feet in this well and 9880 feet in the Kugrua II well, but the abundance of these pebbles was much less in this well. No Foraminifers found. Dark gray to black siltstone.  


dd

FORAMINIFERA REPORT - ADDENDUM

The following addendum to the S. Madsen II micropaleontological 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 FL = flood (200+).

9530-9943' T.O. (cont')

The following addendum to the S. Madsen II micropaleontological 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.

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 9000' feet. These strata probably represent inner to middle neritic deposition.

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9530-9943' T.O. (cont')

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A few black chert pebbles were found in the interval 9080-9140 feet which suggest a correlation between 9080 feet in this well and 9880 feet in the Kugrua II well, but the abundance of these pebbles was much less in this well. No Foraminifers found. Dark gray to black siltstone.  


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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+).
No Foraminifera found. Light brown very fine-grained saccharoidal sandstone.
AGE: Indeterminate (Sag River Ss. lithology)
ENVIRONMENT: Indeterminate

Ammobaculites cf. vetuata (R), Astacolus connudatus (F), Ammodiscus sp. (R), Lingulina borealis (R), Pseudoglandulina simpsonensis (R), Monotis/Halobia fragments (A), ostracods (medium-large, smooth) (P), pelecypods (pyrite casts) (R), echinoid spines (R), pyrite sticks (C). Dark brown to black shelly siltsone.
AGE: Triassic (P-19)
ENVIRONMENT: Middle to Outer Neritic

Ammobaculites cf. vetuata (R), Arenaceous sp. (R), Astacolus connudatus (F), Nodosaria shublikensis (R), Pseudoglandulina simpsonensis (R), Monotis/Halobia fragments (R), pyrite (R). Dark brown silt shale.
AGE: Triassic (P-19)
ENVIRONMENT: Middle to Outer Neritic

No Foraminifera found. Pyrite (P). Black silty siltstone.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Dark brown iron-stained siltstone or silty shale.
AGE: Indeterminate (Ivishak Fm. lithology)
ENVIRONMENT: Indeterminate

No Foraminifera found. Dark brown iron-stained siltstone.
AGE: Indeterminate (Ivishak Fm. lithology)
ENVIRONMENT: Indeterminate

No Foraminifera found. Pyrite (C). Dark gray iron-stained pyritic shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Dark gray shiny silty shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Pyrite (R). Reddish-brown iron-stained silty turbidaceous shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Reddish-brown iron-stained silty turbidaceous shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Dark brown shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Black shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Black shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Coal (anthracite)? (A). Black shaly coal seam.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Medium-dark gray iron-stained mottled bentonitic? shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Medium-dark gray iron-stained mottled bentonitic? shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Gray iron-stained quartzitic siltstone.
AGE: Indeterminate (Ivishak Fm. lithology)
ENVIRONMENT: Indeterminate

Endothyra? sp. (1), pyrite (R). Buff tan iron-stained fine-grained muddy sandstone.
AGE: Possible Permian?
ENVIRONMENT: Possible Marine

No Foraminifera found. Black shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Black shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Black iron-stained shale.
AGE: Indeterminate
ENVIRONMENT: Indeterminate
No Foraminifera found. Coal (anthracite) (FL). Black shaly coal seam.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

No Foraminifera found. Vein quartz (F). Dark gray to black fractured quartz-replaced shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

FORAMINIFERA REPORT - REVISION

6760-6770': 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 (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

10.284-10.287'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

THIN SECTION DESCRIPTION (con't)

10.390-10.403'Core (b)
No Foraminifera. Brownish-gray quartzitic very fine-grain sandstone or siltstone.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10.411'Core
No Poraminifera. Dark gray carbonaceous siltstone.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10.411'Core
No Poraminifera. Dark gray carbonaceous shale with coal microstringers.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

APPENDIX A (con't)

U.S.N. TOPAGORUX II TEST WELL
CORE SAMPLE DESCRIPTIONS

MASTRED SAMPLE DESCRIPTIONS

10.228-10.229'Core
No Poraminifera. Dark brownish-gray cherty quartzitic sandstone.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10.411'Core
Arenaceous sp. (R). Dark gray shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10.491'Core
No Poraminifera, pyrite (F). Dark brown to black siliceous shale.

AGE: Indeterminate
ENVIRONMENT: Indeterminate

10.491'Core
No Poraminifera. Gray coarse-grain sandstone or chert pebble conglomerate.

AGE: Indeterminate
ENVIRONMENT: Indeterminate
PALYNOLGY REPORT

A total of 248 samples were processed and analyzed from the subject well. The total 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.

early Cretaceous, Aptian-Albian

Terrestrial taxa again remain the same. New taxa for this interval except for the following additions: 

Cleiatosphaeridium ancosum 

Dinoflagellate cysts as well become less diverse. Significant new forms are Cleistosphaeridium tribuliferum (R), Schiniodinium cristallinum (R), and Tenua rioulti (R).

AGE: Early Cretaceous, Neocomian
ENVIRONMENT: Marine

This interval is defined by the first occurrences of Pareodinia daeniforma and Tupotuberculata pastasi 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 hermanesii and Trilobosporites bernissartensis are also typical of Early Neocomian sections.

7837-7840'

Terrestrial taxa continue as above, but become less diverse. New species occurring are: 

Ficopollis abaca (R), Rubiella sp. (R), and Trilobosporites bernissartensis (R).

Dinoflagellate cysts as well become less diverse. Significant new forms are Cleistosphaeridium tribuliferum (R), Schiniodinium cristallinum (R), and Tenua rioulti (R).

AGE: Probable Jurassic, undifferentiated
ENVIRONMENT: 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 tribuliferum, Schiniodinium cristallinum, and Tenua rioulti only weakly suggest a Jurassic age.

Core #7 (7837-7868.5') from this interval is completely barren except for the two uppermost samples (7837' and 7840') which contain Cretaceous (Neocomian-Aptian) 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'

Anaplasiosporites stipulatus (R-C), Apiculatisporites lajouvensis (R), undifferentiated bisaccates (R-A), Cylindrospora garaonensis (R), Dolichosporites sp. (R), Didymosporites sp. (R), Distansiosporites sp. (R), Tanniasporites app. (R), undifferentiated verrucate spores (R), Vitrinariosporites calidus (R).

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

Rare occurrences of Anaplasiosporites lajouvensis, Distansiosporites minuta, Tanniasporites app., and rare to common occurrences of Anaplasiosporites 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:

7837-7842.77

Dolichosporites sp. (R), Lycopodiumsporites seminuncus (R), Osmundadendrites sp. (R), Osmundacidites sp. (R),

7842.8-7848.5

Dolichosporites sp. (R).
SUMMARY OF PALYNOLOGY REVISIONS

<table>
<thead>
<tr>
<th>Depth Interval</th>
<th>Age</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-6210'</td>
<td>Early Cretaceous, Aptian-Albian (P-M18 to P-M17)</td>
<td>Marine (Open Marine below 5880')</td>
</tr>
<tr>
<td>6210-6660'</td>
<td>Early Cretaceous, possible Neocomian (P-M18a)</td>
<td>Late Aptian to Early Albian (F-10)</td>
</tr>
<tr>
<td>6660-6880'</td>
<td>Early Cretaceous, Neocomian (probable in P-M19)</td>
<td>Late Aptian to Early Albian (F-10)</td>
</tr>
<tr>
<td>6880-7243'</td>
<td>Early Cretaceous, Neocomian (P-M20)</td>
<td>Late Aptian to Early Albian (F-10)</td>
</tr>
<tr>
<td>7243-9214'</td>
<td>Probable Jurassic, undifferentiated.</td>
<td>Monmarine to Middle Neritic (fluctuating turbidity)</td>
</tr>
<tr>
<td>8214-9630'</td>
<td>Probable Triassic, undifferentiated.</td>
<td>Early Cretaceous, Late Aptian to Early Albian (F-10)</td>
</tr>
<tr>
<td>9630-10,225'</td>
<td>T.D. Age indeterminate.</td>
<td>Middle to Outer Neritic (turbid)</td>
</tr>
</tbody>
</table>

Peard #1 (Foraminifera)

FORAMINIFERA REPORT

The following micropaleontological report is based on the examination and checking 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. Your 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-0 and washed over 20 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 PL = Flood (200+).
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 palaeodepths.

**AGE:** Early Cretaceous  
**ENVIRONMENT:** Middle Neritic to Upper Bathyal (clearwater)

6720-7243'FW

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: Haestropelagodiscus canai, Trochammina insensae, Saraceneria cf. oxfordiana, S. cf. tommasinianae, Nodosaria cf. pachiatika, Lingula cf. jassyi, and Hammites ovata. These latter species suggest a Late Jurassic 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 II well this interval does appear to be a similarity in the foraminiferal sequences, but there is no corroborating palynological data in the Kugrua II well. It is possible, therefore, based on foraminiferal faunal comparisons, that the section called Tichonian to Serravalian (7720-7740) in the Kugrua II well is totally or in part correlative with the interval 6720 feet to 7243 feet in the Perd Bay I well. These faunas appear to represent depositional environments similar to the overlying interval.

**AGE:** Late Jurassic to Early Cretaceous  
**ENVIRONMENT:** Middle Neritic to Upper Bathyal (clearwater)

7243'FW-7920'FW

Based on the overlapping occurrences of: Astacolus pediculatus, Gaudryina denticula, G. salicola, G. jeffersoni, G. tommasinianae, Tenticulina quinquesetata, Saururina tommasi, Astacolus pediculatus, A. setosus, and Pseudocorynophorina. Foraminiferal assemblages are Oxfordian (F-16) in age. The top of this interval is usually picked on the basis of the top occurrence of Saraceneria tommasinianae, which is at 7290 feet in this well. The sidewall core sample at 7243 feet while lacking Saraceneria tommasinianae does contain a fauna more similar to this interval than the overlying interval so the boundary has been raised to accommodate this interval core sample. A sandstone is included in the Oxfordian interval since no flint is present, and is probably still Triassic in age. A distinctive dark brown to black calcareous pebbly sandstone similar to that described by Tappan (1951, pp. 1-6) from the basal 25 to 50 feet of the Shublik Fm. in the Selenech- 

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

9430-9630'FW

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

7847-7854'FW  Core 7

No Foraminifera found. Glaucocystis (A). Dark brown glauco- 

**AGE:** Indeterminate  
**ENVIRONMENT:** Probable Marine

7848-7854'FW  Core 7

No Foraminifera found. Glaucocystis (A). Dark brown glauco- 

**AGE:** Indeterminate  
**ENVIRONMENT:** Probable Marine

7849-7855'FW  Core 7

No Foraminifera found. Glaucocystis (A). Dark brown very 

**AGE:** Indeterminate  
**ENVIRONMENT:** Probable Marine

7850-7857'FW  Core 7

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 Aegoplectas bicrenatus and Lithocodium 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  
**ENVIRONMENT:** Probable Middle to Outer Neritic

5533'BM-6720'BM

Astacolus connatus, Nodosaria shublikensis, N. klesa, Tenticulina quinquesetata, Lingula jeffersoni, Pseudocorynophorina. Foraminiferal assemblages are Oxfordian (F-16) in age. The top of this interval is usually picked on the basis of a lithologic change. This assemblage is possibly indicative of Sonula F-20, although the marker for that tonuie 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 Shanks Formation at this 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:** Permian-Triassic  
**ENVIRONMENT:** Nonmarine to Marginal Marine

9630-10,225'FW

This last unit is picked on the basis of a lithologic change to medium to dark gray very banded argillite. The few rare Foraminifera found near the top of this interval are believed caved from overlying intervals.

**AGE:** Indeterminate  
**ENVIRONMENT:** Indeterminate

**AGE:** Indeterminate  
**ENVIRONMENT:** Probable Marine

7847-7854'FW  Core 7

No Foraminifera found. Glaucocystis (A). Dark brown glauco- 

**AGE:** Indeterminate  
**ENVIRONMENT:** Probable Marine

7848-7854'FW  Core 7

No Foraminifera found. Glaucocystis (A). Dark brown glauco- 

**AGE:** Indeterminate  
**ENVIRONMENT:** Probable Marine

7849-7855'FW  Core 7

No Foraminifera found. Glaucocystis (A). Dark brown very 

**AGE:** Indeterminate  
**ENVIRONMENT:** Probable Marine

7850-7857'FW  Core 7

No Foraminifera found. Glaucocystis (A). Dark brown very 

**AGE:** Indeterminate  
**ENVIRONMENT:** Probable Marine

7850-7857'FW  Core 7

No Foraminifera found. Glaucocystis (A). Dark brown very 

**AGE:** Indeterminate  
**ENVIRONMENT:** Probable Marine
No foraminifera found. Glaucophite (F). Dark brown to black very fine-grained sandstone or siltstone.

AGE: Indeterminate
ENVIRONMENT: Probable Marine

No foraminifera found. Glaucophite (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 (Barremian to Valanginian) F-13 to F-14. This means that, like the Kupra II and S. Meade II wells, we now feel that we are dealing with Early Cretaceous strata sitting directly on Oxfordian (F-16) age strata.
E. Simpson #1
(Palynology)

PALEONTOLOGY 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 100-7733 feet total depth.

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

100-460' Unidentified bisaccates (R-A), Osmundacidites spp. (R-F), Schizosporites parvus (R-F), Tsoadiaceae (R-P).

Alterpus aramnata (R-P), Canninga minor (R), Cleistophy1lidites australiensis (R), Cleistosphaeridium polypedes (R), Oligosphaeridium polygonum (R-F), Oligosphaeridium punctatum (R), Pseudoceratium axpolitus (R-F), P. cayalixum (R-F), Helicosphaeridium parvum (R-F), Hystrichosphaeridium recurvatum (R), Micrhystridium operculatum (R), Monosulcate sp. (R-P), Punctatisporites spp. (R-C), Striatites richteri (R), undifferentiated verrucate spore (R-F), Vitreoglobus paludosus (R).

AGE: Late Cretaceous, Campanian (P-M15)
ENVIRONMENT: Marine

Alterpus aramnata, Isabellinae bisaccatae and Paleosphaeridium informes are known from Cenomanian and younger aged rocks. They occur along with Cribroperidinium edwardai and Palaeoperidinium cretaceum which generally are known from Cenomanian and older rocks. Therefore, this interval has been dated as Cenomanian in age.

460-1360' Unidentified bisaccates (A), Araucariacites australis (R), Cistenocerasporites australiensis (R), Cleistosphaeridium edwardsii (R), Cribroperidinium edwardai (R), Cyclicnephalum distinctum (R), Ctenophyllum triquetrum (R), Ctenosporites arnoldensis (R), C. minor (R), Cleistosphaeridium sphaeridium (R-F), Dictyophyllum harrisii (R), Foraminisporites dailyi (R), Gonyaulacysta granulosa (R), Halosphaeridium altaarkensis (R), Helicosphaeridium parvum (R-F), Monosulcate sp. (R-P), Oligosphaeridium complex (R-C), O. punctatum (R-F), Punctatisporites spp. (R-C), Tenua anaphrissa (R-P), Striatites richteri (R), undifferentiated serrate spores (R-F), Vitreoglobus paludosus (R).

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

The top for this interval has been defined as the base of Genus "M" at 1360 feet. It could as well be placed one sample lower at 1450 feet or as low as 2670 feet whichever depth is the true base of Lueckispontites pseudolatus. In other wells on the North Slope, the base of Genus "M" has been used more frequently to define this horizon. And for this reason it is used here.

This base for this interval is defined by the reappearance of frequent occurrences of Cardiodinium trabeculosum, Oligosphaeridium complex, and Tenua parvulae which indicate the top of the probable Neocomian horizon between 6330 feet and 6510 feet.

6330-6602' Terrestrial taxa for this interval remain as above, but in decreasing diversity. Cleistosphaeridium polypedes (R), Cyclonephalum distinctum (R-C), Endocerium campanulatum (R), Gonyaulacysta granulosa (R), Hystrichosphaeridium recurvatum (R), Micrhystridium operculatum (R), Monosulcate sp. (R), Nudulopsis australis (R), Oligosphaeridium complex (R-A), O. punctatum (thick wall) (R), Opereodinium pyrum (R), Palaeoperidinium cretaceum (R-C), Senoniasphaera microrotalitatsa (R), Spiniferae ramosus (R), Tenus anaphrissa (R-F), T. cf. T. hystrix (R).

AGE: Probable Neocomian (P-M20 to P-M15)
ENVIRONMENT: Marine

Since additional diagnostic fossils (i.e., Herendeenia pankiiformis, Priapuncus alaskense, Pseudodia ceratophora, Tubulocerus spatula) were not found, a more definitive age cannot be assigned to this interval.

6602-6897' Araucarioxylon austriaticum (R), undifferentiated bisaccates (R-A), Callialasporites damieri (R), C. trigonellae (R), Ctenosporites australiensis (R), Deltoidospora sp. (R), Dictyophyllum harrisii (R), Foraminisporites dailyi (R), Gonyaulacysta granulosa (R), Monosulcate sp. (R-F), Punctatisporites spp. (R-F), Tsoadiaceae (R), Undifferentiated verrucate spores (R-F), Vitreoglobus paludosus (R).

AGE: Probable Jurassic
ENVIRONMENT: Nonmarine to Marginal Marine

Elleiposporidium cinctum and Leptosporites subtile are the only significant new forms.

pageIndex #2

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

The top for this interval is defined by the base of Genus "M" at 1360 feet. It could as well be placed one sample lower at 1450 feet or as low as 2670 feet whichever depth is the true base of Lueckispontites pseudolatus. In other wells on the North Slope, the base of Genus "M" has been used more frequently to define this horizon. And for this reason it is used here.

This base for this interval is defined by the reappearance of frequent occurrences of Cardiodinium trabeculosum, Oligosphaeridium complex, and Tenua parvulae which indicate the top of the probable Neocomian horizon between 6330 feet and 6510 feet.

6330-6602' Terrestrial taxa for this interval remain as above, but in decreasing diversity. Cleistosphaeridium polypedes (R), Cyclonephalum distinctum (R-C), Endocerium campanulatum (R), Gonyaulacysta granulosa (R), Hystrichosphaeridium recurvatum (R), Micrhystridium operculatum (R), Monosulcate sp. (R), Nudulopsis australis (R), Oligosphaeridium complex (R-A), O. punctatum (thick wall) (R), Opereodinium pyrum (R), Palaeoperidinium cretaceum (R-C), Senoniasphaera microrotalitatsa (R), Spiniferae ramosus (R), Tenus anaphrissa (R-F), T. cf. T. hystrix (R).

AGE: Probable Neocomian (P-M20 to P-M15)
ENVIRONMENT: Marine

Since additional diagnostic fossils (i.e., Herendeenia pankiiformis, Priapuncus alaskense, Pseudodia ceratophora, Tubulocerus spatula) were not found, a more definitive age cannot be assigned to this interval.

6602-6897' Araucarioxylon austriaticum (R), undifferentiated bisaccates (R-A), Callialasporites damieri (R), C. trigonellae (R), Ctenosporites australiensis (R), Deltoidospora sp. (R), Dictyophyllum harrisii (R), Foraminisporites dailyi (R), Gonyaulacysta granulosa (R), Monosulcate sp. (R-F), Punctatisporites spp. (R-F), Tsoadiaceae (R), Undifferentiated verrucate spores (R-F), Vitreoglobus paludosus (R).

AGE: Probable Jurassic
ENVIRONMENT: Nonmarine to Marginal Marine

Elleiposporidium cinctum and Leptosporites subtile are the only significant new forms.

PAGE INDEX #2

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

The top for this interval is defined by the base of Genus "M" at 1360 feet. It could as well be placed one sample lower at 1450 feet or as low as 2670 feet whichever depth is the true base of Lueckispontites pseudolatus. In other wells on the North Slope, the base of Genus "M" has been used more frequently to define this horizon. And for this reason it is used here.

This base for this interval is defined by the reappearance of frequent occurrences of Cardiodinium trabeculosum, Oligosphaeridium complex, and Tenua parvulae which indicate the top of the probable Neocomian horizon between 6330 feet and 6510 feet.

6330-6602' Terrestrial taxa for this interval remain as above, but in decreasing diversi...
Core #9 (7565-7593') Core 9 contains Cretaceous-age 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 collected from rubble at the top of the core.

SUMMARY OF PALYNOLOGY REVIEWS

6897-7070': Early Triassic? (P-T17 to P-T16). Age indeterminate
7070-7680': Neocomian? (F-12 to F-13). Age indeterminate
7680-7738': Upper Bathyal

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 7738 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 the following numerical values: R = rare (1-5); F = frequent (6-32); C = common (33-99); A = abundant (100-199); and PL = flood (200+).

100-460' Raphephragmoides rose, Trochammina whittingtonia, T. ribizon- Ensia, Dictyomitra multicosata, Thracoptyla sp., Archiogyra sp. and frequent to common prysite oblates suggest that these strata are probably Callovian to Turonian (P-7) in age.

AGE: Late Cretaceous Callovian to Turonian (P-7)
ENVIRONMENT: Probable Middle Neritic to Upper Bathyal

460-470' Rare specimens of Verneuilinoides cf. borealis and Raphephragmoides rose indicate an Early Cretaceous age, but their paucity suggests reworking.

AGE: Early to Late Cretaceous Late Albian to Early Cenomanian (F-8)
ENVIRONMENT: Probable Nonmarine to Marginal Marine

470-1960' Rare to frequent occurrences of Raphephragmoides rose, cf. jenkinsi, Lenticulina macrodiscus, Valvulinella lochaster, Nilssonia multicostata, Raphephragmoides rosea, G. grandis, G. deminutum, Ammohelis fragmentaria, A. venenata, Nannomyxus sub- circularis, and the associated occurrences of Ammonium grangei, Textularia tooagorukensis, and were probably inner to middle neritic.

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

1960-4420' This interval is characterized by occurrences of the following: Gaudryina nanubakensi, Lenticulina macrodiscus, N. hybrid, Lenticulina incisa, Lenticulina macrodiscus, L. grandis, G. grandis, G. deminutum, Ammohelis fragmentaria, A. venenata, Nannomyxus sub- circularis, and the associated occurrences of Ammonium grangei, Textularia tooagorukensis, and were probably inner to middle neritic.

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

4420-4450' A pyritized radiolarian fauna characterized by occurrences of the following genera: Cacerops sp., Spondilus sp., Lithocampe sp. and Pseudophaviroidea sp. Lenticulina cf. G tops near the base of this unit at 6390 feet. According to Ramsey (1970) this zone of pyritized radiolarians separates the Verneuilinoides borealis Zone from the Gaudryina tailleuri Zone, and is probably Aptian to Early Albian age.

AGE: Early Cretaceous Aptian (F-11)
ENVIRONMENT: Open Marine

4450-4520' Occurrences of Gaudryina tailleuri, Raphephragmoides rosea, Lithocampe sp. and Pseudophaviroidea sp. Lenticulina cf. X tops near the base of this unit at 6390 feet. According to Ramsey (1970) this zone of pyritized radiolarians separates the Verneuilinoides borealis Zone from the Gaudryina tailleuri Zone, and is probably Aptian to Early Albian age.

AGE: Early Cretaceous Aptian (F-11)
ENVIRONMENT: Open Marine

4520-4550' Core 10 is a probable Early Jurassic (F-18) age, suggested by the occurrence of the following genera: Ammonoceras, Utahiceras, Ammonoceras hoekense, A. equinum, Lenticulina macrodiscus, Nannomyxus subcircularis, A. grangeri, and Raphephragmoides rosea. The top sample (6897') contains Early Jurassic (F-19) Foraminifera and Neocomian palyonorphs. The top of this core could contain rubble from up-hole making any age determination highly suspect.

AGE: Probable Early Jurassic F-18
ENVIRONMENT: Probable Middle Neritic to Bathyal
Astacolus connudatus, Nodosara shubikensis, E. larina, Nodosara rhododactylus, trochoidea connutata, Foraminifera gurritata, Lingulina borealis, L. alaskensis, Pseudoquadrula acus, R. lustrata, Pseudolittalina lata, F. simpsonensis, Trochamerina helicata, 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 (P-19) Foraminifera do not occur until 7020 feet. The top of the Triassic is placed at 6900 feet in Core 6 based on possible Monotis/Halobia fragments and palynology. 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 these samples at 7370 feet.

AGE: Middle Triassic
ENVIRONMENT: Middle to Outer Neritic (Open Marine)

7460-7620' T.D.

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: 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
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′
Gloeochilinus secundus (R), Aegiquadriradiates spinulosus (R).
Astrocytta cretacea (R-P), Goniocrinita operculata (R), Pseudosaracium expolitum (R).

AGE: Cenomanian
ENVIRONMENT: Marine

The age range 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.

690-840′
Classopollis clausoides (R), Aegiquadriradiates spinulosus (R).
Astrocytta cretacea (F-C), Cyclonaphelium distinctum (R-F), Goniocrinita operculata (R), Loxadinum propatulum (R).

AGE: Albian
ENVIRONMENT: Marine

670-870′
Clasopollis clausoides (R), Gloeochilinus secundus (R, scattered); rare, sporadic occurrences of reworked Permo-Triassic and Carboniferous forms.

AGE: Albian
ENVIRONMENT: Marine

The microplankton assemblage were relatively sparse through this interval.

2040-6340′
Classopollis clausoides (R, scattered), Lycopediumsporites sp. (R); rare, sporadic occurrences of reworked Permo-Triassic and Carboniferous forms.

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

8410-8770′
Klausipollenites staplinii (R), ?Lundbladiapora sp. (single).

AGE: Probable Naocomian

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.

6880-7490′
Classopollis clausoides (F-C); single specimens of probable reworked Lundbladiapora sp. and Teissleriasporites sp.
This sample raises the base of the Neocomian interval by approximately 180 feet. Undifferentiated basin faults (F), undifferentiated species (P). Poor preservation of palynomorphs.

Essentially barren of palynomorphs.

SUMMARY OF PALYNOLOGY REVISIONS

510-870': Early Cretaceous, Middle to Late Albian (P-M17).

870-6340': Early Cretaceous, Aptian to Early Albian (P-M18).

6340-6705': Early Cretaceous, possible Neocomian (P-M18a).

6700-7660': Early to Middle Jurassic, Late Pliensbachian to Early Bajocian? (P-M23).

7690-8230': Late Triassic, probable Norian-Rhaetian (P-M26 to P-M25).

8230-8680': Permian to Triassic (P-T17 to P-T16).

8680-8718': In Carboniferous.

870-6340': Early Cretaceous, Aptian to Early Albian (P-M18).

510-870': Early Cretaceous, Middle to Late Albian (P-M17).

870-6340': Early Cretaceous, Aptian to Early Albian (P-M18).

6340-6705': Early Cretaceous, possible Neocomian (P-M18a).

6700-7660': Early to Middle Jurassic, Late Pliensbachian to Early Bajocian? (P-M23).

7690-8230': Late Triassic, probable Norian-Rhaetian (P-M26 to P-M25).

8230-8680': Permian to Triassic (P-T17 to P-T16).

8680-8718': In Carboniferous.

8718-8795': T.D. Age indeterminate.

8790-8230': Late Triassic, probable Norian-Rhaetian (P-M26 to P-M25).

6704-7690': Early to Middle Jurassic, Late Pliensbachian (T-R).

7660-8200': Early Cretaceous, Aptian to Early Albian (P-M18).

510-3710': Early Cretaceous, Middle to Late Albian (P-M17).

Enclosed you will find a 1" to 100' faunal distribution log and two faunal checklists on the S. Simpson #1 well.

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 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


Enclosed you will find a 1" to 100' faunal distribution log and two faunal checklists on the S. Simpson #1 well.
occurrences of *Rhipocyclus paradoxus* and *Rhipocyclus bul- 
gellia* at 7600 feet are considered to represent reworking  
in this report. These faunas probably represent clear  
water middle to outer neritic open marine conditions.  

**AGE:** Triassic  
**ENVIRONMENT:** Middle to Outer Neritic

**8200-8590'**  
Fauna throughout the upper portion of this interval is  
generally sparse. Caved specimens of the overlying Tri- 
asic fauna are rare to frequent in addition to rare  
ocurrences of *Ammobaculites cf. varus*, *Gaudryina adoxa*,  
and *G. cf. dyscrita* 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 Echuca Member in  
this well.

**AGE:** Permo-Triassic  
**ENVIRONMENT:** Nonmarine to Inner Neritic (turbid)  

**APPENDIX**

**8590-8620'**  
Rectangulina sp. (R), shell fragments (R).  
**LITHOLOGY:** Mixed pelmatozoan-bryozoan-pack- 
stone, chart and orange-brown  
shale and siltstone

**8620-8650'**  
*Girvanella ducii* (R), ostracods (R).  
**LITHOLOGY:** Predominantly orange-brown shale  
and siltstone

**8650-8680'**  
Rectangulina sp. (F), *Beresella* sp. (R), shell fragments  
(F), unidentifiable algae (F).  
**LITHOLOGY:** Dolomitic lime mudstone, algal  
packstone and orange-brown shale  
and siltstone

**8680-8710'**  
Rectangulina 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.**  
*Strylocodium sp.?* (R) (caved); porcellaneous foraminifer  
(R) (caved).  
**LITHOLOGY:** Black argillite
A total of 117 ditch and 36 sidewall core samples were processed and analysed for palynological age determinations. The ditch samples were generally composited into 30 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'

E. Teshekpuk #1
(Palynology)

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

Australiella cooksoni (R), A. victoriensis (R), Deflandrea pinnamensis (R), Diatomium areticum (R), Hystrochonosphaeridium difficile (R), Nannagnostera chilamdata (R), Chlamydomraphella nyyi (R), Hystrochonosphaeridium sp. (R).

680-1540'

Undifferentiated bisaccate grains (F-C).

Australiella cooksoni (R), Hystrochonosphaeridium difficile (R), Oligosphaeridium complex (R), Pseudosphaeridium basilium (A).

AGE: Late Cretaceous (probable Turonian - Coniacian)
ENVIRONMENT: Probable very marginal marine to nonmarine

A significant decrease in microplankton diversity occurs in this interval.

1540-3260'

Undifferentiated bisaccate grains (F-C), Gleichenidites seminicus (R).

Cribroperidinium edwardsi (R-F), Cyclonematopsis distinctum (R), C. membraniphorum (R), Chlamydomashire nyyi (R), Hystrochonosphaeridium pulchrum (R), Hystrochonosphaeridium stellatum (R), Odontochitina operculata (R-F), Stephonolina coronata (R), Vallidinum lance (R), Agnostidinium grande (R), Brownes Jessoa (R), Pseudosphaeridium auritum (Singleton).

AGE: Late Cretaceous (Campanian)
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 Campanian 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 Campanian age assignment for this interval.

2280-2840'

Podocarpus (R), Cicatricosisporites venustus (R), Trilocosporeta sp. sp. I, single specimen of Polycyclatolitospores redunes, Camarosporites insignis, Cicatricosisporites haallet.

Cyclonematopsis distinctum (R-F), C. compactum (R-C), Odontochitina operculata (R-C), Broomea jepsoni (R), Astracocyatida cretacea (R-C), Luidinum propriatum (R), Oligosphaeridium complex (R-F), Cribroperidinium edwardsi (R-F); rare reworked Triassic and Early Cretaceous dinoflagellates.

AGE: Early Cretaceous (Albian)
ENVIRONMENT: Marine

2840-7020'

Undifferentiated bisaccate grains (F-C); Podocarpus (R); scattered rare occurrences of Trilocosporeta sp. sp. I, Polycyclatolitospores redunes, Appendisporites sp.

Cribroperidinium edwardsi (R), Cyclonematopsis distinctum (R), Chlamydomashire nyyi (R), Oligosphaeridium complex (R-C), Odontochitina operculata (R-C), Broomea jepsoni (R), Astracocyatida cretacea (R-C), Luidinum propriatum (R), Oligosphaeridium complex (R-F), Cribroperidinium edwardsi (R); reworked Neocomian and Late Jurassic dinoflagellates.

AGE: Early Cretaceous (Aptian)
ENVIRONMENT: Marine

7020-7790'

Cyclonematopsis distinctum (F), Camarosporites hirtella (F), Oligosphaeridium complex (C). Cardinonidae ariakensi (R-F), Psaligonyaulax apatela (R), Pseudoeeratium nudum (R), Odontochitina sp.-1 (R), Hystrochonosphaeridium exclamans (R).

AGE: Early Cretaceous (Neocomian)
ENVIRONMENT: Marine

7790-7470'

Psaligonyaulax apatela (F), Eimiaocardium sp., Nuderynagia cf. simplex (F-R), Zorzonea cf. ovata (F), Oligosphaeridium complex (C), Gardodinium eisenacki (F), Muderongia eretaea (R-C), Gonyaulacysta cladosporae (R), G. jurassica (R).

AGE: Late Jurassic (Oxfordian)
ENVIRONMENT: Marine

7470-8080' SWC

Undifferentiated bisaccate grains (F-A), Classosporites classoides (R).

Nuderynagia cf. simplex (F-R), Gonyaulacysta cladosporae (R), Nanoceratopsis gracilis (F-A), H. sp.-1 (R), Pseudoaspis alata (F), 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 barren of palynomorphs. The sidewall cores from within this interval were essentially barren of palynomorphs.

9052' SWC - 9690'

Stratites richteri (R-F), Tazinaspores sp. (R), Lueckiosporites sp. (R), Klausipollenites sp. (F-R), Lycopora sp. (R).

AGE: Permo-Triassic
ENVIRONMENT: No evidence of marine

9690-10,664' T.D.

Demosporites (R), single specimens of Waltripispora cf. polita, Convolutispora cf. varia scoring.

AGE: Carboniferous
ENVIRONMENT: No evidence of marine

The ditch samples are dominated with palynomorphs derived from the Permo-Triassic interval above.
E. Teshekpuk #1
(Foraminifera)

**PALEONTOLOGY REPORT REVISIONS**

<table>
<thead>
<tr>
<th>Age Range</th>
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<tr>
<td>533-680'</td>
<td>Late Cretaceous, Santonian-Campanian (P-Mk4), Marine.</td>
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<tr>
<td>680-1540'</td>
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<tr>
<td>2260-4650'</td>
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<td>Early Cretaceous, Aptian-Early Albian (P-Mk1), Marine.</td>
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<tr>
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<td>Early Cretaceous, Aptian-Early Albian (P-Mk1), Marine.</td>
<td>Early Cretaceous, Aptian-Early Albian (P-Mk1), Marine.</td>
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<tr>
<td>6930-7110'</td>
<td>Early Cretaceous, possible Neoconian (P-Mk6a), Marine.</td>
<td>Early Cretaceous, Neoconian (P-Mk6a), Marine.</td>
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<tr>
<td>7110-7290'</td>
<td>Early Cretaceous, Neoconian (P-Mk6a), Marine.</td>
<td>Late Jurassic, probable Oxfordian (P-Mz2), Marine.</td>
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<tr>
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<td>Late Jurassic, probable Oxfordian (P-Mz2), Marine.</td>
<td>Late Jurassic, probable Oxfordian (P-Mz2), Marine.</td>
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<tr>
<td>7470-8080'</td>
<td>Early-Middle Jurassic (P-Mz2), Marine.</td>
<td>Early-Middle Jurassic (P-Mz2), Marine.</td>
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<tr>
<td>8090-8700'</td>
<td>Triassic-Early Jurassic (P-T15 to P-Mz4), Nonmarine-Marginal Marine.</td>
<td>Triassic-Early Jurassic (P-T15 to P-Mz4), Nonmarine-Marginal Marine.</td>
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<tr>
<td>8700-9052'</td>
<td>Triassic-Early Jurassic (P-T15 to P-Mz4), Nonmarine-Marginal Marine.</td>
<td>Triassic-Early Jurassic (P-T15 to P-Mz4), Nonmarine-Marginal Marine.</td>
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<tr>
<td>9052-9510'</td>
<td>Triassic-Early Jurassic (P-T15 to P-Mz4), Nonmarine-Marginal Marine.</td>
<td>Triassic-Early Jurassic (P-T15 to P-Mz4), Nonmarine-Marginal Marine.</td>
</tr>
<tr>
<td>9510-9690'</td>
<td>Triassic-Early Jurassic (P-T15 to P-Mz4), Nonmarine-Marginal Marine.</td>
<td>Triassic-Early Jurassic (P-T15 to P-Mz4), Nonmarine-Marginal Marine.</td>
</tr>
<tr>
<td>9690-9870'</td>
<td>Age indeterminate.</td>
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</tr>
<tr>
<td>9870-10,664'TD</td>
<td>In Carboniferous, Nonmarine.</td>
<td>In Carboniferous, Nonmarine.</td>
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</table>

**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 Fl 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. This section was prepared on 30 foot ditch intervals and all sidewall core samples below 9600 feet. A generalized age summary of the East Teshekpuk Fl well is provided below.

**AGE: 3110'-6930'**

**ENVIRONMENT:** Inner to Middle Neritic (moderately turbid)

**AGE: 1540-1940'**

Common to abundant radiolaria and rare agglutinated foraminifers 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 agglutinated foraminifers and the large amounts of pyrite.

**AGE: 5700-6930'** (SW)

**ENVIRONMENT:** Open Marine (Starved Basin)

**AGE: 9600-1110'**

**ENVIRONMENT:** Inner to Middle Neritic (moderately turbid)

**AGE: 9052-9510'**

**ENVIRONMENT:** Open Marine (Starved Basin)

**AGE: 7200-7530'**

**ENVIRONMENT:** Inner to Middle Neritic (moderately turbid)

**AGE: 1540-1940'**

**ENVIRONMENT:** Inner to Middle Neritic

**AGE: 9690-9870'**

**ENVIRONMENT:** In Carboniferous, Nonmarine?

**AGE: 9510-9690'**

**ENVIRONMENT:** In Carboniferous, Nonmarine.

**AGE: 9052-9510'**

**ENVIRONMENT:** In Carboniferous, Nonmarine.

**AGE: 8700-9052'**

**ENVIRONMENT:** In Carboniferous, Nonmarine.

**AGE: 7470-8080'**

**ENVIRONMENT:** In Carboniferous, Nonmarine.

**AGE: 7110-7290'**

**ENVIRONMENT:** In Carboniferous, Nonmarine.

**AGE: 6930-7110'**

**ENVIRONMENT:** In Carboniferous, Nonmarine.

**AGE: 680-1540'**

**ENVIRONMENT:** In Carboniferous, Nonmarine.

**AGE: 533-680'**

**ENVIRONMENT:** In Carboniferous, Nonmarine.

**AGE: 4650-6930'**

**ENVIRONMENT:** In Carboniferous, Nonmarine.

**AGE: 3110'-6930'**

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**AGE: 9690-9870'**

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**ENVIRONMENT:** In Carboniferous, Nonmarine.

**AGE: 1540-1940'**

**ENVIRONMENT:** In Carboniferous, Nonmarine.
Astrocuculodes pedunculatus, Fontinalis liassica occur throughout these strata. Based on occurrences in nearby wells to the east above the Shublik would indicate an early Late Jurassic Age. Also, the overlapping occurrences of Condruca tai­laeuri and Stachnotheres toscanoppeius would suggest the same age. The abundant and diverse fauna 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)  
**ENVIRONMENT:** Middle Neritic to Upper Bathyal

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**ENVIRONMENT:** Inner to Middle Neritic  
**AGE:** Early to Middle Jurassic

---

Ammonculites vatsa, A. fontinalis, Lentinella cf. bico­stata, Neophyus liassica, P. densa, Podocorynia squamosa, Textularia aarctoppeius, and common to abundant radiolaria of the Genera Fauilubricatrum, Euphrasia, Monidiastrom, Cenomaena, Lisboaforma, Stipulina, 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  
**ENVIRONMENT:** Middle Neritic to Upper Bathyal

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**ENVIRONMENT:** Probable Inner to Middle Neritic (fore reef)

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**ENVIRONMENT:** Indeterminate

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**ENVIRONMENT:** Possible Inner Shelf

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10,624 feet included in Zone 18 in age. The stratigraphic change to what appears to be a quartzite. There were no foraminifera recovered from this sample.

---

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, reef, 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  
**ENVIRONMENT:** Probable Nonmarine to Middle Neritic (fore reef)
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**

90-9230’
Undifferentiated bisaccates (C-A), Schiakopsida varia (R); rare scattered occurrences of Calamopteris giganteus. Concavisphaeridium punctatum, Concavisphaeridium ausensiensis, Neuwiedia tenuis; numerous occurrences of reworked spores.

Cyclonеoboλium distinctum (R), Gajdsia minor (R), Undifferentiated bisaccates (R-A), indeterminate spores and spore fragments (F), very scattered occurrences of Pseudocarpitium retusum, Mudarongia.

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.

10.692-13.340’
This interval is essentially barren of palynomorphs. No significant occurrences of spore-pollen or dinocysts were recorded. The main constituent identifying this interval is O. complex as observed in the ditch samples.

The Permian/Triassic boundary is placed at the top of Core 16,929-16,947’ wherein the first Permian evidence was 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.

13,320-13,890’
Undifferentiated bisaccates (C-A), Classopolis classidens (F-C), indeterminate spores and spore fragments (A).

Pecopteris seminispina (R), Endopteris salicifolia (R), Tubulospirides sparsa (R), Nanopteris pellucida (R).

**AGE:** Late Jurassic; Oxfordian (P-M22)

**ENVIRONMENT:** Marine

This interval is marked by the top occurrences of P. seminispina. 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.

13,890-14,330’
Undifferentiated bisaccates (F-A), Classopolis classidens (F-P), indeterminate spores and spore fragments (C-A), Triasporinopitises sp. (single, reworked?), Nanopteris pellucida (R), Microbryidium sp. (R), Sverdrupiella usitata (R-C), Microbryidium spp. (R), Verybachium sp. (F).

**AGE:** Early to Middle Jurassic

**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 14,310 feet or 14,600 feet, where the land-derived Triassic assemblage begins to appear somewhat more consistently.

14,490-15,390’
Undifferentiated bisaccates (C-A), Classopolis classidens (R), Classifolitites seminispina (R), Triasporinopitises sp. (R).

**AGE:** Late Triassic; Norian (P-M16)

**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 14,310 feet or 14,600 feet, where the land-derived Triassic assemblage begins to appear somewhat more consistently.

14,490-16,290’
Undifferentiated bisaccates (C-A), indeterminate spores and spore fragments (C-A), Triasporinopitises sp. (F-C).

**AGE:** Triassic (P-T16 to P-T15)

**ENVIRONMENT:** Marine to Marginal Marine

No evidence was seen to enable the differentiation of sonic P-T17.

The Permian/Triassic boundary is placed at the top of Core 16,929-16,947’ wherein the first Permian evidence was recovered.

16,929-17,650’
Triasporinopitises sp. (F), Stratiformis richeri (R), Acastaspis sp. (R, sporadic), Tennysoniasporites sp. (R), Vittatina sp. (R).

**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.
17,816-19,620′
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

19,420-19,890′
The significant form occurring in this interval is Pottedonapores sp. I
AGE: In Pennsylvania (P-T19)
ENVIRONMENT: Marginal Marine

19,890-20,330′
Only Permian-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.

Tunaliik #1
(Foraminifera)

FORAMINIFERA REPORT

The following microfaunal report is based on the examination and checking of 605 washed ditch samples, 114 thin sectioned ditch samples, 17 washed sidewall cores, 111 washed conventional core samples, and 28 thin sectioned conventional core samples covering the interval 90 to 20,330 feet. Each sample was treated with Quaternary-0 and washed over 20 mesh screens.

Frequency symbols used in this report correspond to the following numerical values:
R = rare (1-5); F = frequent (6-12); C = common (13-99); A = abundant (100-199); PL = flood (200+).

50-7350′
This interval is practically barren of Foraminifera. Rare occurrences of Terebratulina subcarinata and Terebratulina sp. are found in the overlying interval. The age of these strata is Late Jurassic in age. They could represent any age from Late Jurassic to Early Cretaceous.
AGE: Early Cretaceous
ENVIRONMENT: Middle to Outer Bathyal

7350-10,620′
Occurrences of Lithocodium salpinx, Ammonitidae rufus, A. rufus, A. multilocularis, A. histrio, A. mackenziana, and Arenaceous spp. are found in this interval. The age of these strata is Early Cretaceous (Middle to Late Albian). The paleo-depths represented by these strata range from about 10,620 to 13,870 feet and appear relatively clear water to upper middle bathyal deposition. Faunas below 10,900 feet indicate a relative turbid middle to outer neritic environment.
AGE: Early Cretaceous
ENVIRONMENT: Open Marine

10,620-12,620′
Occurrences of Lithocodium salpinx, Ammonitidae rufus, A. rufus, A. multilocularis, A. histrio, A. mackenziana, and Arenaceous spp. are found in this interval. The age of these strata is Early Cretaceous (Middle to Late Albian). The paleo-depths represented by these strata range from about 10,620 to 13,870 feet and appear relatively clear water to upper middle bathyal deposition. Faunas below 10,900 feet indicate a relative turbid middle to outer neritic environment.
AGE: Early Cretaceous
ENVIRONMENT: Open Marine

12,620-13,380′
This interval is considered to be Middle to Late Albian (F-9) age. The paleo-depths represented by these strata range from about 12,920 to 13,590 feet and appear relatively clear water to upper middle bathyal deposition. Faunas below 12,920 feet suggest outer neritic to bathyal conditions.
AGE: Early Cretaceous
ENVIRONMENT: Open Marine

13,380-13,590′
This interval is considered to be Middle to Late Albian (F-9) age. The paleo-depths represented by these strata range from about 12,920 to 13,590 feet and appear relatively clear water to upper middle bathyal deposition. Faunas below 12,920 feet suggest outer neritic to bathyal conditions.
AGE: Early Cretaceous
ENVIRONMENT: Open Marine
AGE: Late Jurassic Undifferentiated
ENVIRONMENT: Bathyal

13,990-13,940'
Overlapping occurrences of *Gaudryina milleri*, *G. supercruzensis*, *G. leffingwelli*, *Ammoceras lakensais*, *Ammoceras cf. herdiana*, and *Ammoceras trossichianum* 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

13,940-13,900'
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*, *Vagnulina 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

13,900-13,590'
This interval is predominately packstones and grainstones. Strata between 13,950 feet and 13,550 feet are no older than Zone 21 but could be as young as Zone 24. Occurrences of *Pseudostaerylites* sp. and *Ramenska* sp. coupled with the presence of *Erythrophora* sp., at 20,290-20,320 feet, in what appears to be in-situ lithology, suggest that the entire interval 19,350 feet to 20,310 feet is Zone 21 in age. However, if the *Erythrophora* 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: Permian (F-20)
ENVIRONMENT: Nonmarine to Inner Neritic

13,590-13,550'

13,550-13,390'
A very thick (1900') section of Early Permian strata appears to develop in this well based on occurrences of *Protonodosaria* sp., *Paleospirina* sp., *nodosariidae*, *cornuspiridae* and porcellaneous Foraminifers. A significant occurrence of amygdaloidal basalt is found in the interval 17,580 feet to 18,050 feet. The age of this basalt is indeterminate since no Foraminifers 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:

AGE: Early Permian
ENVIRONMENT: Nonmarine to Inner Neritic

17,135.5-18,340'
Nonmarine to Restricted Carbonate Shelf and Lagoonal

18,340-19,050'
Shallow shelf (Carbonate Platform Suite)

PACKSTONES AND GRAINSTONES: 18,340'

AGE: Early Permian
ENVIRONMENT: Nonmarine to Restricted Carbonate Shelf and Lagoonal

19,050-20,310'
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 *Pseudostaerylites* sp. and *Ramenska* sp. coupled with the presence of *Erythrophora* sp., at 20,290-20,320 feet, in what appears to be in-situ lithology, suggest that the entire interval 19,350 feet to 20,310 feet is Zone 21 in age. However, if the *Erythrophora* 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.
REFERENCES


