



**MICROPALÉO**  
CONSULTANTS, INC.

**USGS/HUSKY - NPRA**  
**TULAGEAK NO. 1**

**API #50-023-20018**

**SEC. 7, T21N/R14W UM**

**NORTH SLOPE, ALASKA**

**Prepared by:**

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**BIOSTRATIGRAPHY REPORT**

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Figure P-1	Palynomorph Distribution Chart (105-4014'C)

## **INTEGRATED SUMMARY**

105-2490'

Early Cretaceous  
Aptian to Early Albian

2490-2525'

Early Cretaceous  
Barremian  
KE<sub>B</sub>

2525-2948'

Early Cretaceous  
Hauterivian  
KE<sub>H</sub>

2948-3005'

Possible Middle Jurassic  
Possible Aalenian  
JM<sub>A</sub>?

3005-3320'

Early Jurassic  
Toarcian  
JE<sub>T</sub>

3320-3890'

Early Jurassic  
Pliensbachian  
JE<sub>P</sub>

3890-3970'

Late Triassic  
Norian  
TL<sub>N</sub>

3970-4014'C (Bottom Sample)

Indeterminate Age

Discussion. Dark gray to black silty argillite.

# **FORAMINIFERA REPORT**

**Interpreted by**

**Michael B. Mickey**

## **FORAMINIFERA SUMMARY**

### 105-2490'

<u>Age.</u>	Early Cretaceous Aptian to Early Albian
<u>Zones.</u>	F-9 to F-11
<u>Environment.</u>	Middle Neritic to Bathyal (Middle Shelf to Slope & Base of Slope)

### 2490-2530'

<u>Age.</u>	Early Cretaceous Barremian
<u>Zone.</u>	F-12
<u>Environment.</u>	Outer Neritic (Outer Shelf)

### 2530-2947'C

<u>Age.</u>	Early Cretaceous Hauterivian
<u>Zone.</u>	F-13a
<u>Environment.</u>	Middle Neritic to Upper Bathyal (Middle Shelf to Upper Slope)

2949C-3000'

<u>Age.</u>	Possible Middle Jurassic Possible Aalenian
<u>Zone.</u>	F-17?
<u>Environment.</u>	Upper to Middle Bathyal (Upper to Middle Slope)

3000-3300'

<u>Age.</u>	Early Jurassic Toarcian
<u>Zone.</u>	F-18a
<u>Environment.</u>	Upper to Middle Bathyal (Upper to Middle Slope)

3300-3890'

<u>Age.</u>	Early Jurassic Pliensbachian
<u>Zone.</u>	F-18b
<u>Environment.</u>	3300-3770': Outer Neritic to Middle Bathyal (Outer Shelf to Middle Slope) 3770-3890': Middle Neritic (Middle Shelf)



3890-3950'

<u>Age.</u>	Late Triassic Norian
<u>Zone.</u>	F-19b
<u>Environment.</u>	Inner Neritic (Inner Shelf)

3950-4014'C (Bottom Sample)

<u>Age.</u>	Indeterminate
<u>Environment.</u>	Indeterminate
<u>Discussion.</u>	Dark gray to black silty argillite.

## **INTRODUCTION**

### **Scope**

Data from 158 Foraminifera samples from the USGS/Husky Tulageak No. 1 well were incorporated into this report. These samples consisted of 129 ditch and 29 conventional core samples covering the interval 105 to 4014C feet. This work was done as part of M.C.I. Job Number 21-106.

### **Procedures**

Standard techniques were used to process the material. All samples were boiled in Quaternary-O and washed over 20 and 200 mesh screens. Frequency symbols correspond to the following numerical values: very rare (1), rare (2 - 4), frequent (5 -25), common (26 - 100), abundant (101 - 999) and prolific (1000+). The picked foram slides and residues are repositied at the State of Alaska Geological Materials Center in Eagle River, Alaska.

Certain factors such as shelf widths, basin configuration and overall basin depths associated with Arctic Mesozoic basins are not completely understood at present. The paleoenvironments presented in this report reflect relative basinal position only and should not be tied to specific water depths. Generally, neritic corresponds to shelf or deltaic environments, while bathyal corresponds to slope or prodelta environments and bathyal (starved basin) corresponds to distal (far from the source) deposition. As an example, prodelta deposits could represent deposition as shallow as middle neritic or as deep as bathyal (slope) depending on the delta type and shelf width. With a narrow shelf, a river-dominated deltaic system could build across the shelf and the prodelta deposits would be in a bathyal (slope) depth. A tide-dominated deltaic system associated with a wide shelf could result in middle neritic prodelta deposition.

## **Format**

A listing of the age, environment, fauna and occasional lithology comments for each biostratigraphic interval follows. A generalized summary of the well is presented in the Conclusions section at the end of the Foraminifera Report. A Foraminifera Distribution Chart (Figure F-1) and a High Resolution Biostratigraphy Plot (Figure B-1) containing foram diversity/abundance plots, a cumulative faunal plot and paleoenvironmental plot(s) are in pockets at the back of this report.

## RESULTS

105-2490'

Age. Early Cretaceous  
Aptian to Early Albian

Zones. F-9 to F-11

Environment. Middle Neritic to Bathyal  
(Middle Shelf to Slope & Base of Slope)

Fauna. *Gavelinella stictata*, *G. awunensis*, *Globulina prisca*, *Eurycheilostoma grandstandensis*, *Verneuilioides borealis*, *Haplophragmoides excavatus*, *H. topagorukensis*, *H. gigas*, *Lenticulina macrodisca*, *L. erecta*, *Saracenaria projectura*, *S. navicula*, *Miliammina manitobensis*, *M. ischnia*, *Marginulinopsis jonesi*, *M. collinsi*, *Hippocrepina barksdalei*, *Ammodiscus rotalarius*, *Bathysiphon vitta*, *Valvulineria loetterlei*, *Vaginulina exilis*, *Tritaxia manitobensis*, *Ammobaculites wenonahae*, *A. fragmentarius*, *Psamminopelta subcircularis*, *P. bowsheri*, *Astacolus peristriatus*, *Quadriformina ruckerae*, *Glomospirella gaultina*, *Gaudryina nanushukensis*, *Gaudryinella irregularis*, *Pseudobolivina rayi*, *Textularia topagorukensis*, *Inoceramus prisms*, *Ditrupa cornu*, coal, pyrite, frequent pelmatozoan fragments above 690 feet, and frequent to abundant pyritized radiolaria below 1980 feet.

2490-2530'

<u>Age.</u>	Early Cretaceous Barremian
<u>Zone.</u>	F-12
<u>Environment.</u>	Outer Neritic (Outer Shelf)
<u>Fauna.</u>	<i>Ammobaculites reophacoides</i> , arenaceous spp. (large, coarse), <i>Gaudryina subcretacea</i> , <i>G. tailleuri</i> , <i>Glomospira subarctica</i> , <i>Glomospirella arctica</i> , <i>G. sp. S</i> , <i>Haplophragmoides coronis</i> , <i>H. duoflatis</i> and abundant rounded frosted quartz floating sand grains.

2530-2947'C

<u>Age.</u>	Early Cretaceous Hauterivian
<u>Zone.</u>	F-13a
<u>Environment.</u>	Middle Neritic to Upper Bathyal (Middle Shelf to Upper Slope)
<u>Fauna.</u>	<i>Ammodiscus mackenziensis</i> , <i>Trochammina squamata</i> , <i>Thuramminoides</i> spp., <i>Gaudryina tailleuri</i> , <i>Haplophragmoides duoflatis</i> , <i>H. inflatigrandis</i> , <i>H. coronis</i> , <i>Glomospirella arctica</i> , <i>G. sp. S</i> , <i>Ammobaculites reophacoides</i> , <i>Bathysiphon scintillata</i> , arenaceous spp. (large, coarse), <i>Trochamminoides</i> spp., <i>Inoceramus</i> prisms, pyrite and rare to abundant rounded frosted quartz floating sand grains.

2949C-3000'

<u>Age.</u>	Possible Middle Jurassic Possible Aalenian
<u>Zone.</u>	F-17?
<u>Environment.</u>	Upper to Middle Bathyal (Upper to Middle Slope)
<u>Fauna.</u>	<i>Ammodiscus siliceus</i> , <i>Haplophragmoides</i> spp., arenaceous spp., <i>Gaudryina dyscrita</i> , <i>Trochammina</i> <i>sablei</i> , <i>Trochamminoides</i> spp., <i>Stichomitra?</i> sp. (pyritized), megaspores, pyrite and pyrite sticks.

3000-3300'

<u>Age.</u>	Early Jurassic Toarcian
<u>Zone.</u>	F-18a
<u>Environment.</u>	Upper to Middle Bathyal (Upper to Middle Slope)
<u>Fauna.</u>	Arenaceous spp. (large, coarse), a. spp., <i>Trochamminoides</i> spp., <i>Ammodiscus orbis</i> , <i>A. asperus</i> , <i>Haplophragmoides</i> spp., <i>Gaudryina dyscrita</i> , <i>Lenticulina audax</i> , <i>L. toarcense</i> , <i>Dentalina</i> <i>pseudocommunis</i> , <i>Ammobaculites alaskensis</i> , <i>Textularia</i> <i>areoplecta</i> , <i>Trochammina topagorukensis</i> , <i>T.</i> <i>canningensis</i> , <i>Triplasia kingakensis</i> , <i>Astacolus pediacus</i> , <i>A. dubius</i> , <i>Marginulina utricula</i> , pelmatozoan fragments, pyrite and rare to common pyritized radiolaria.

3300-3890'

<u>Age.</u>	Early Jurassic Pliensbachian
<u>Zone.</u>	F-18b
<u>Environment.</u>	3300-3770': Outer Neritic to Middle Bathyal (Outer Shelf to Middle Slope) 3770-3890': Middle Neritic (Middle Shelf)
<u>Fauna.</u>	<i>Ammobaculites alaskensis</i> , <i>A. barrowensis</i> , <i>A. cf. sthenarus</i> , <i>A. cf. vetusta</i> , <i>Lenticulina toarcense</i> , <i>L. audax</i> , <i>Trochamminoides</i> spp., <i>Haplophragmoides</i> spp., <i>Trochammina canningensis</i> , arenaceous spp., <i>Astacolus dubius</i> , <i>Marginulinopsis bergquisti</i> , <i>Globulina topagorukensis</i> , <i>Ammodiscus orbis</i> , <i>Nodosaria mitis</i> , <i>N. radiata</i> , <i>N. detruncata</i> , <i>Triplasia kingakensis</i> , <i>Reophax metensis</i> , <i>Eoguttulina bulgella</i> , <i>Lingulina polita</i> , <i>Halobia?</i> fragments, pyrite, and rare to frequent glauconite below 3800 feet.

3890-3950'

<u>Age.</u>	Late Triassic Norian
<u>Zone.</u>	F-19b
<u>Environment.</u>	Inner Neritic (Inner Shelf)
<u>Fauna.</u>	<i>Ammobaculites alaskensis</i> , <i>A. vetusta</i> , <i>Haplophragmoides</i> spp., <i>Marginulina</i> cf. <i>prisca</i> , ostracods, echinoid spines, brachiopod shell fragments and rare to frequent glauconite.

3950-4014'C (Bottom Sample)

<u>Age.</u>	Indeterminate
<u>Environment.</u>	Indeterminate
<u>Fauna.</u>	Barren of indigenous Foraminifera or other fauna.
<u>Discussion.</u>	Dark gray to black silty argillite.



## **CONCLUSIONS**

The USGS/Husky Tulageak No. 1 well penetrated the following biostratigraphic sequence based on foraminiferal analysis:

- 2843+ feet (105-2948') of Hauterivian to Aptian or Early Albian age (Early Brookian & Beaufortian - Rift Sequence) middle to outer shelf topsets, slope foresets and base of slope bottomsets.
- 942 feet (2948-3890') of Pliensbachian to possible Aalenian age (Beaufortian - Incipient Rift Sequence) inner shelf to outer shelf and upper to middle slope sedimentation.
- 80 feet (3890-3970') of Late Triassic (Norian) age (Late Ellesmerian) inner shelf deposition.
- 44+ feet (3970-4014'C) of indeterminate age (Franklinian) dark gray to black silty argillite.

# **PALYNOLOGY REPORT**

**Interpreted by:**

**Hideyo Haga**

## PALYNOLOGY SUMMARY

105-2520'

<u>Age.</u>	Early Cretaceous Aptian - Early Albian
<u>Zone.</u>	P-M18
<u>Environment.</u>	Marine
<u>Remarks.</u>	This age assignment is based on negative evidence.

2520-2880'

<u>Age.</u>	Early Cretaceous Barremian - Aptian
<u>Zone.</u>	P-M18a
<u>Environment.</u>	Marine

2880-2949'C

<u>Age.</u>	Early Cretaceous Hauterivian
<u>Zone.</u>	P-M19
<u>Environment.</u>	Marine

2949C-3795'C

<u>Age.</u>	Early - Middle Jurassic Undifferentiated
<u>Zones.</u>	P-M24 and P-M23
<u>Environment.</u>	Marine
<u>Remarks.</u>	The P-M24 zonule appears to top in the ditch sample at 3690 feet.

3795C-3870'

<u>Age.</u>	Late Triassic Possible Rhaetian
<u>Zone.</u>	P-M25?
<u>Environment.</u>	Marine

3870-3960'

<u>Age.</u>	Late Triassic Norian
<u>Zone.</u>	P-M26
<u>Environment.</u>	Marine

3960-4014'C (Bottom Sample)

<u>Age.</u>	Indeterminate
<u>Environment.</u>	Indeterminate
<u>Remarks.</u>	In argillite basement lithology.

## **INTRODUCTION**

### **Purpose and Scope**

The USGS/Husky Tulageak No. 1 well completed drilling in March, 1981. During the drilling process, a palynological study of the well was conducted from selected sample material. In the course of this investigation, 73 palynology samples were examined. The total consisted of 44 ditch-cutting composites and 29 conventional core samples taken between 105 feet and 4014C feet.

The cores were originally sampled and examined at very close intervals. For this report, some of the core data are composited into larger intervals where the contained assemblages are similar and no biostratigraphic boundaries are straddled.

Additional data from examination of later palynological preparations have also been added for this restudy.

This report provides an updated format from the original data. Some of the taxon designations have been revised to reflect the newer taxonomic assignments that have evolved over the decades since the initial study.

### **Procedures**

For the original analysis, palynological samples were processed in San Diego, California, using techniques that were standard for the time. The chemical treatments involved the use of hydrochloric, hydrofluoric and nitric acids. The resulting kerogen residues were further concentrated by physical separation with heavy liquids and a sieving/panning technique. Permanent slide mounts were made of the residue concentrates. The coverslip mounting medium used was a synthetic resin sold under the brand name of "Coverbond".

The original palynomorph distribution chart data were entered into a desktop PC using proprietary software to compile new format charts. The charts are located in the pocket.

The Palynomorph Distribution Chart (Figure P-1) lists the occurrence and abundance of recorded taxa in each sample. Included on this chart are the diversity and abundance curves for the spore-pollen and the microplankton cysts.

High Resolution Biostratigraphy Plots - Foraminifera/Palynomorphs (Figure B-1) are also provided. This chart includes additional palynology parameters in the form of a cumulative plot that illustrates the relative abundance of the nonmarine, marine and miscellaneous palynomorph components.

## RESULTS

Based on the palynomorph assemblages observed, an age and generalized environment of deposition were interpreted for each palynostratigraphic subdivision. The environments, as interpreted from the palynological preparations, are simply categorized as nonmarine, marginal marine or marine. These categories are based on the absence or presence and diversity of microplankton.

The samples begin at 105 feet and the youngest units encountered at that depth are of Aptian - Albian age. The oldest datable unit is of Norian age. The well bottomed in argillitic basement rocks of indeterminate age.

### 105-2520'

<u>Age.</u>	Early Cretaceous Aptian to Early Albian
<u>Zone.</u>	P-M18
<u>Environment.</u>	Marine
<u>Palynomorphs.</u>	<p>This interval carries a generalized Aptian - Albian palynomorph assemblage.</p> <p>The spore-pollen assemblage includes the forms <i>Aequitriradites spinulosus</i>, <i>Cicatricosisporites hallei</i>, <i>C. venustus</i>, <i>Cerebropollenites mesozoicus</i> and <i>Rogalskaisporites cicatricosus</i>.</p> <p>The dinocyst species include <i>Cribroperidinium edwardsi</i>, <i>Cyclonephelium distinctum</i>, <i>Imbatodinium jaegeri</i> (long apical horn var.), <i>Muderongia</i> sp. 5, <i>Odontochitina operculata</i>, <i>Oligosphaeridium</i> complex, <i>Palaeoperidinium cretaceum</i>, <i>Pseudoceratium polymorphum</i> and <i>P. retusum</i>.</p>



Common to this interval are numerous scattered occurrences of reworked Carboniferous, Triassic, Jurassic and Neocomian palynomorphs.

Discussion.

Although the assemblage is similar to the Middle - Late Albian intervals seen in the region, an absence of Albian-restrictive species is significant. Based on this absence, an Aptian - Early Albian age is assigned.

2520-2880'

Age.

Early Cretaceous  
Barremian to Aptian

Zone.

P-M18a

Environment.

Marine

Palynomorphs.

The interval of Barremian - Aptian strata is marked by an increase in dinocyst abundance. The assemblage includes *Cyclonephelium distinctum*, *Gardodinium trabeculosum*, *Odontochitina operculata*, *Oligosphaeridium complex* and *Palaeoperidinium cretaceum*.

The spore-pollen assemblage is relatively sparse.

Discussion.

A depositional site with low detrital input is indicated by the paucity of land-derived palynomorphs. Therefore, the organics are amorphous-rich.

2880-2949'C

Age. Early Cretaceous  
Hauterivian

Zone. P-M19

Environment. Marine

Palynomorphs. The thin interval of Hauterivian strata is represented by one ditch sample; although, the thickness of this unit is further restricted by core sample control. The age assignment is based mainly on the presence of *Gardodinium trabeculosum*, *Herendeenia alaskaensis*, *Lunatadinium dissolutum*, *Oligosphaeridium complex* (thick-wall) and *Tubotuberella uncinata*.

2949C-3795'C

<u>Age.</u>	Early to Middle Jurassic Undifferentiated
<u>Zones.</u>	P-M24 to P-M23
<u>Environment.</u>	Marine
<u>Palynomorphs.</u>	<p>A distinct change in the palynomorph assemblage is seen in this interval.</p> <p>The spore-pollen assemblage includes abundant <i>Classopollis classoides</i>, and the appearance of <i>Contignisporites cooksonii</i> and <i>Lycopodiumsporites semimurus</i>.</p> <p>The dinocyst species include <i>Nannoceratopsis gracilis</i>, <i>N. cf. N. raunsgaardii</i>, <i>N. senex</i> and <i>Parvocysta nasuta</i>. Consistent occurrences of the acritarch form, <i>Michrhystridium</i>, are also noted.</p>
<u>Discussion.</u>	<p>The dinocyst assemblage suggests that the upper part of the interval is in Toarcian or possibly Early Aalenian.</p> <p>The decrease in dinocyst occurrences below 3690 feet places the Early Jurassic P-M24 zonule below that depth. This zonule generally correlates to the Pliensbachian stage.</p> <p>Fortuitously, Core #1 was cut across the Neocomian/Jurassic boundary and the large hiatus is documented in the dramatic change of assemblages in the core samples.</p>

3795C-3870'

<u>Age.</u>	Late Triassic Possible Rhaetian
<u>Zone.</u>	P-M25?
<u>Environment.</u>	Marine
<u>Palynomorphs.</u>	<p>The Late Triassic age is based on the appearances of the pollen <i>Ricciisporites tuberculatus</i> and the spore <i>Zebrasporites</i>.</p> <p>In the lower part, the dinocysts <i>Rhaetogonyaulax</i> and <i>Suessia swabiana</i> are seen.</p>
<u>Discussion.</u>	Although the upper part of this interval may have a questionable age assignment, the lower part appears to be of definite Rhaetian age based on the dinocysts recovered therein.

3870-3960'

<u>Age.</u>	Late Triassic Norian
<u>Zone.</u>	P-M26
<u>Environment.</u>	Marine
<u>Palynomorphs.</u>	The Norian age is represented in one ditch sample. The age assignment is based on the presence of <i>Suessia swabiana</i> and <i>Sverdrupiella septentrionalis</i> .

3960-4014'C (Bottom Sample)

<u>Age.</u>	Indeterminate
<u>Environment.</u>	Indeterminate
<u>Palynomorphs.</u>	This bottom interval is barren of indigenous palynomorphs.
<u>Discussion.</u>	The recoveries included significant amounts of black opaque minerals which are indicative of argillite basement lithology.

## **CONCLUSIONS**

Palynological analysis of the USGS/Husky Tulageak No. 1 well provides the following generalized palynostratigraphic succession:

- Marine Aptian - Early Albian strata occur from the top sample at 105 feet down to 2520 feet. This age assignment is based on negative evidence.
- Marine Barremian - Aptian strata are designated from 2520 feet to 2880 feet. This interval represents a time of low detrital input.
- Marine Hauterivian strata occur between 2880 feet and 2949C feet.
- Marine Early - Middle Jurassic strata are identified from 2949C feet to 3795C feet. This interval includes both P-M23 and P-M24 zonules.
- Marine Late Triassic strata of possible Rhaetian age are seen between 3795C feet and 3870 feet.
- Marine Norian age strata are identified in the single ditch sample of 3870 feet to 3960 feet.
- The bottom interval from 3960 feet to 4014C feet consists of argillite basement.