



**MICROPALÉO**  
CONSULTANTS, INC.

**UNOCAL**  
**KOOKPUK NO. 1**

**API #50-103-10003**

**SEC. 19, T11N/R7E UM**

**NORTH SLOPE, ALASKA**

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**BIOSTRATIGRAPHY REPORT**

**Job No. 21-106**

**March, 2002**

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## **INTEGRATED SUMMARY**

90-450'

Tertiary  
Undifferentiated

450-1890'

Late Cretaceous  
Maestrichtian

1890-2250'

Late Cretaceous  
Campanian

2250-3710'

Late Cretaceous  
Coniacian to Santonian

3710-4100'

Late Cretaceous  
Turonian to Coniacian

4100-5420'

Late Cretaceous  
Probable Cenomanian

5420-5760'

Early Cretaceous  
Middle to Late Albian

5760-5855'

Early Cretaceous  
Aptian to Early Albian

5855-6015'

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

6015-6075'

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

6075-6660'

Early Cretaceous  
Valanginian  
KE<sub>V</sub>

6660-6775'

Late Jurassic  
Possible Kimmeridgian  
JL<sub>K?</sub>

6775-7555'

Late Jurassic  
Oxfordian  
JL<sub>O</sub>

7555-7800'

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

7800-8020'

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

8020-8270'

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

8270-9180'

Early Triassic  
TE

Discussion. Ivishak Fm. tops at 8270 feet and Kavik  
Fm. tops at 8960 feet.

9180-9285'

Probable Late Permian  
PL

Discussion. Echooka Fm.

9285-9340'

Late Mississippian  
Chesterian  
Zone M-18 to Zone M-19

Discussion. Lisburne Group. Alapah Fm.; Upper  
Limestone Unit.

9340-9520'

Late Mississippian  
Chesterian  
Zone M-17

Discussion. Dolomite Unit

9520-9660'

Late Mississippian  
Meramecian to Chesterian  
Zone M-16 or Older

Discussion. Lower Limy Unit

9660-9940'

Probable Mississippian  
Probable Osagean to Meramecian

Discussion. Endicott Group. Kayak Fm. - Itkilyariak  
Fm.

9940-10,193'T.D.

Indeterminate Age

Discussion. Argillite



# **FORAMINIFERA REPORT**

**Interpreted by**

**Michael B. Mickey**

## **FORAMINIFERA SUMMARY**

### 90-1350'

Age. Latest Cretaceous to Tertiary  
Undifferentiated

Environment. Nonmarine  
(Alluvial Plain)

### 1350-2250'

Age. Late Cretaceous  
Campanian to Maestrichtian

Zone. F-5

Environment. Inner to Middle Neritic  
(Inner to Middle Shelf)

### 2250-3720'

Age. Late Cretaceous  
Coniacian to Santonian

Zones. F-5 to F-6

Environment. Outer Neritic to Bathyal  
(Outer Shelf to Slope)

3720-4020'

<u>Age.</u>	Late Cretaceous Turonian to Coniacian
<u>Zone.</u>	F-7
<u>Environment.</u>	Lower Bathyal - Distal (Base of Slope - Starved Basin)

4020-5320'

<u>Age.</u>	Late Cretaceous Probable Cenomanian
<u>Zones.</u>	Probable F-7 to F-8
<u>Environment.</u>	4020-4220': Lower Bathyal - Distal (Base of Slope - Starved Basin) 4220-5320': Bathyal (Slope)

5320-5720'

<u>Age.</u>	Early Cretaceous Middle to Late Albian
<u>Zones.</u>	F-10 to F-11
<u>Environment.</u>	Bathyal (Slope)

5720-5820'

<u>Age.</u>	Early Cretaceous Aptian to Early Albian
<u>Zone.</u>	F-11
<u>Environment.</u>	Probable Lower Bathyal - Distal (Probable Base of Slope - Starved Basin)

5820-6020'

<u>Age.</u>	Early Cretaceous Barremian
<u>Zone.</u>	F-12
<u>Environment.</u>	Distal (Starved Basin)

6020-6120'

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

6120-6520'

<u>Age.</u>	Early Cretaceous Valanginian
<u>Zone.</u>	F-13b
<u>Environment.</u>	Middle to Outer Neritic (Middle to Outer Shelf)

6520-6720'

<u>Age.</u>	Late Jurassic Possible Kimmeridgian
<u>Zone.</u>	F-16a?
<u>Environment.</u>	Upper Bathyal (Upper Slope)

6720-7540'

<u>Age.</u>	Late Jurassic Oxfordian
<u>Zone.</u>	F-16b
<u>Environment.</u>	Upper Bathyal (Upper Slope)

7540-7810'

<u>Age.</u>	Early Jurassic Toarcian
<u>Zone.</u>	F-18a
<u>Environment.</u>	Upper to Lower Bathyal - Some Distal (Upper to Lower Slope & Base of Slope - Some Starved Basin)

7810-7990'

<u>Age.</u>	Early Jurassic Pliensbachian
<u>Zone.</u>	F-18b
<u>Environment.</u>	Middle Bathyal - Distal (Middle Slope - Starved Basin)

7990-8260'

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

8260-9160'

<u>Age.</u>	Early Triassic
<u>Zone.</u>	F-20a
<u>Environment.</u>	Probable Nonmarine to Marginal Marine (Probable Alluvial Plain to Transitional)
<u>Discussion.</u>	Sloughed fauna common. Sadlerochit Group. Ivishak Fm. tops at 8260 feet and Kavik Fm. tops at 8980 feet.

9160-9250'

<u>Age.</u>	Probable Late Permian
<u>Zone.</u>	Probable F-20b
<u>Environment.</u>	Marginal Marine (Transitional)
<u>Discussion.</u>	Echooka Fm.

9250-9340'

<u>Age.</u>	Late Mississippian Chesterian
<u>Zones.</u>	M-18 to M-19
<u>Environment.</u>	Shoaling Shelf (Lagoonal to Inner Bank)
<u>Discussion.</u>	Lisburne Group. Alapah Fm.; Upper Limestone Unit.

9340-9520'

<u>Age.</u>	Late Mississippian Chesterian
<u>Zone.</u>	M-17
<u>Environment.</u>	Supratidal
<u>Discussion.</u>	Dolomite Unit

9520-9670'

<u>Age.</u>	Late Mississippian Meramecian to Chesterian
<u>Zone.</u>	M-16 or Older
<u>Environment.</u>	Shoaling Shelf (Lagoonal)
<u>Discussion.</u>	Lower Limy Unit

9670-9910'

<u>Age.</u>	Probable Mississippian Probable Osagean to Meramecian
<u>Environment.</u>	Nonmarine to Marginal Marine (Alluvial Plain to Inner Lagoonal)
<u>Discussion.</u>	Endicott Group. Kayak Fm. - Itkilyariak Fm.



9910-10,193'T.D.

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

## **INTRODUCTION**

### **Scope**

Micropaleo Consultants, Inc. processed, picked and analyzed for Foraminifera 97 ditch samples from the UNOCAL Kookpuk No. 1 well covering the interval 90 to 10,193 feet T.D. Thin sections were prepared and analyzed on 31 ditch samples from 9250 to 10,193 feet T.D. 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, prepared thin sections 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

### 90-1350'

<u>Age.</u>	Latest Cretaceous to Tertiary Undifferentiated
<u>Environment.</u>	Nonmarine (Alluvial Plain)
<u>Fauna.</u>	This interval is barren of Foraminifera. Frequent to common coal.

### 1350-2250'

<u>Age.</u>	Late Cretaceous Campanian to Maestrichtian
<u>Zone.</u>	F-5
<u>Environment.</u>	Inner to Middle Neritic (Inner to Middle Shelf)
<u>Fauna.</u>	<i>Eoeponidella strombodes</i> , <i>Trochammina albertensis</i> , <i>Praebulimina venusae</i> , <i>P. seabeensis</i> , <i>Anomalinoides</i> <i>pinguis</i> , <i>Caucasina vitrea</i> , <i>Lacosteina gouskovi</i> , <i>Verneuilinoides fischeri</i> and <i>Nonionella taylorensis</i> .

2250-3720'

<u>Age.</u>	Late Cretaceous Coniacian to Santonian
<u>Zones.</u>	F-5 to F-6
<u>Environment.</u>	Outer Neritic to Bathyal (Outer Shelf to Slope)
<u>Fauna.</u>	<i>Trochammina ribstonensis</i> , <i>Marginulinopsis</i> cf. <i>chandlerensis</i> , <i>Archicorys</i> spp., <i>Cenosphaera</i> spp., <i>Dictyomitra multicostata</i> , <i>D.</i> spp., <i>Rhopalastrum</i> sp., <i>Sethocyrtis</i> spp., <i>Spongodiscus</i> spp., <i>Spongurus</i> spp., <i>Stylospongia</i> sp. and <i>Theocorys</i> spp.

3720-4020'

<u>Age.</u>	Late Cretaceous Turonian to Coniacian
<u>Zone.</u>	F-7
<u>Environment.</u>	Lower Bathyal - Distal (Base of Slope - Starved Basin)
<u>Fauna.</u>	<i>Hedbergella loetterlei</i> , <i>Verneuilinoides fischeri</i> , frequent to common radiolaria, and common to abundant paper shale below 3820 feet.

4020-5320'

<u>Age.</u>	Late Cretaceous Probable Cenomanian
<u>Zones.</u>	Probable F-7 to F-8
<u>Environment.</u>	4020-4220': Lower Bathyal - Distal (Base of Slope - Starved Basin) 4220-5320': Bathyal (Slope)
<u>Fauna.</u>	<i>Saccamina lathrami</i> , <i>Trochammina</i> cf. <i>rutherfordi</i> , <i>T. ribstonensis</i> , <i>T. whittingtoni</i> , <i>Verneuulinoides fischeri</i> , <i>Haplophragmoides rota</i> , <i>Archicorys</i> spp., <i>Cenosphaera</i> spp., <i>Dictyomitra</i> spp., <i>D.</i> cf. <i>multicostata</i> , <i>Spongodiscus</i> spp., <i>Theocorys</i> spp., frequent to abundant <i>Inoceramus</i> prisms, and paper shale common above 4220 feet.

5320-5720'

<u>Age.</u>	Early Cretaceous Middle to Late Albian
<u>Zones.</u>	F-10 to F-11
<u>Environment.</u>	Bathyal (Slope)
<u>Fauna.</u>	Barren of indigenous Foraminifera. <i>Cenosphaera</i> spp., <i>Spongodiscus</i> spp., <i>Lithocampe</i> cf. N, frequent radiolaria, frequent to common <i>Inoceramus</i> prisms and common pyrite.

5720-5820'

<u>Age.</u>	Early Cretaceous Aptian to Early Albian
<u>Zone.</u>	F-11
<u>Environment.</u>	Probable Lower Bathyal - Distal (Probable Base of Slope - Starved Basin)
<u>Fauna.</u>	<i>Lithocampe</i> cf. N, <i>Saccamina lathrami</i> , <i>Textularia topagorukensis</i> , rare radiolaria and abundant paper shale.

5820-6020'

<u>Age.</u>	Early Cretaceous Barremian
<u>Zone.</u>	F-12
<u>Environment.</u>	Distal (Starved Basin)
<u>Fauna.</u>	Barren of Foraminifera. Rare radiolaria, frequent to abundant paper shale and frequent rounded frosted quartz floating sand grains.

6020-6120'

<u>Age.</u>	Early Cretaceous Hauterivian
<u>Zone.</u>	F-13a
<u>Environment.</u>	Middle to Outer Neritic (Middle to Outer Shelf)
<u>Fauna.</u>	<i>Ammobaculites fragmentarius</i> , arenaceous spp. (large, coarse), <i>Gaudryina tailleuri</i> , <i>Gravellina</i> spp., <i>Haplophragmoides coronis</i> , <i>H. duoflatis</i> , <i>H. inflatigrandis</i> , <i>Miliammina</i> cf. <i>ischnia</i> , <i>Praebulimina</i> 1 and common rounded frosted quartz floating sand grains.

6120-6520'

<u>Age.</u>	Early Cretaceous Valanginian
<u>Zone.</u>	F-13b
<u>Environment.</u>	Middle to Outer Neritic (Middle to Outer Shelf)
<u>Fauna.</u>	Arenaceous spp. (large, coarse), <i>Gaudryina leffingwelli</i> , <i>G. milleri</i> , <i>G. tailleuri</i> , <i>Glomospira subarctica</i> , <i>Haplophragmoides coronis</i> , <i>H. duoflatis</i> , <i>H. inflatigrandis</i> , <i>H. goodenoughensis</i> , <i>Lenticulina erecta</i> , <i>L.</i> sp. (raised sutures), <i>Marginulinopsis phragmites</i> , <i>Saracenaria projectura</i> , <i>Thuramminoides septagonalis</i> , <i>Conorboides</i> cf. <i>umiatensis</i> , <i>Ammodiscus asperus</i> , <i>Reophax troyeri</i> , <i>Trochammina squamata</i> and frequent to common rounded frosted quartz floating sand grains.



6520-6720'

<u>Age.</u>	Late Jurassic Possible Kimmeridgian
<u>Zone.</u>	F-16a?
<u>Environment.</u>	Upper Bathyal (Upper Slope)
<u>Fauna.</u>	<i>Saracenaria</i> cf. <i>navicula</i> , <i>Lenticulina audax</i> , <i>Haplophragmoides canui</i> , <i>Ammobaculites alaskensis</i> , <i>Glomospira perplexa</i> , <i>G. pattoni</i> , <i>Ammodiscus orbis</i> , <i>Inoceramus</i> prisms, pyrite, paper shale and frequent rounded frosted quartz floating sand grains.

6720-7540'

<u>Age.</u>	Late Jurassic Oxfordian
<u>Zone.</u>	F-16b
<u>Environment.</u>	Upper Bathyal (Upper Slope)
<u>Fauna.</u>	<i>Ammobaculites alaskensis</i> , arenaceous spp. (large, coarse), <i>Gaudryina leffingwelli</i> , <i>G. milleri</i> , <i>G. topagorukensis</i> , <i>Haplophragmoides canui</i> , <i>Lenticulina audax</i> , <i>L. excavata</i> , <i>Ammodiscus orbis</i> , <i>A. asperus</i> , <i>Glomospira pattoni</i> , <i>Nodosaria radiata</i> , <i>Pseudobolivina</i> spp., <i>Thuramminoides</i> spp., <i>Trochammina canningensis</i> , <i>T. topagorukensis</i> , <i>Bathysiphon anomalocoelia</i> , <i>Dentalina pseudocommunis</i> , <i>Lagena aphela</i> , <i>L. liassica</i> , <i>Textularia areoplecta</i> , <i>Trochamminoides</i> spp., <i>Marginulinopsis bergquisti</i> , <i>Vaginulina sherborni</i> , frequent rounded frosted quartz floating sand grains and common to abundant pyrite.

7540-7810'

<u>Age.</u>	Early Jurassic Toarcian
<u>Zone.</u>	F-18a
<u>Environment.</u>	Upper to Lower Bathyal - Some Distal (Upper to Lower Slope & Base of Slope - Some Starved Basin)
<u>Fauna.</u>	<i>Ammobaculites alaskensis</i> , <i>A. barrowensis</i> , <i>Ammodiscus siliceus</i> , <i>Bathysiphon anomalocoelia</i> , <i>Gaudryina topagorukensis</i> , <i>Haplophragmoides</i> spp., <i>Lituotuba irregularis</i> , <i>L.</i> sp., <i>Trochamminoides</i> spp., frequent to common radiolaria and common paper shale.

7810-7990'

<u>Age.</u>	Early Jurassic Pliensbachian
<u>Zone.</u>	F-18b
<u>Environment.</u>	Middle Bathyal - Distal (Middle Slope - Starved Basin)
<u>Fauna.</u>	<i>Ammobaculites alaskensis</i> , <i>Bathysiphon anomalocoelia</i> , <i>Eoguttulina metensis</i> , <i>Haplophragmoides</i> spp., <i>Lenticulina audax</i> , <i>Trochamminoides</i> spp. and abundant paper shale.

7990-8260'

<u>Age.</u>	Late Triassic Norian
<u>Zone.</u>	F-19b
<u>Environment.</u>	Marginal Marine to Inner Neritic (Transitional to Inner Shelf)
<u>Fauna.</u>	<i>Astacolus connudatus</i> , <i>Nodosaria larina</i> , <i>N. shublikensis</i> , <i>Pseudoglandulina lata</i> , <i>P. simpsonensis</i> , <i>Trochammina helicta</i> , frequent <i>Monotis/Halobia</i> fragments, rare ostracods (medium, smooth), black phosphate? sand sized pebbles are common below 8170 feet, and rare glauconite above 8080 feet.

8260-9160'

<u>Age.</u>	Early Triassic
<u>Zone.</u>	F-20a
<u>Environment.</u>	Probable Nonmarine to Marginal Marine (Probable Alluvial Plain to Transitional)
<u>Fauna.</u>	Most of the fauna is probably sloughed but some may be in place. <i>Ammobaculites alaskensis</i> , <i>Ammodiscus asperus</i> , <i>Bathysiphon anomalocoelia</i> , <i>Trochamminoides</i> spp., <i>Haplophragmoides</i> spp. and <i>Thuramminoides</i> spp.
<u>Discussion.</u>	Sloughed fauna common. Sadlerochit Group. Ivishak Fm. tops at 8260 feet and Kavik Fm. tops at 8980 feet.

9160-9250'

<u>Age.</u>	Probable Late Permian
<u>Zone.</u>	Probable F-20b
<u>Environment.</u>	Marginal Marine (Transitional)
<u>Fauna.</u>	Barren of indigenous Foraminifera. Frequent glauconite.
<u>Discussion.</u>	Echooka Fm.

9250-9340'

<u>Age.</u>	Late Mississippian Chesterian
<u>Zones.</u>	M-18 to M-19
<u>Environment.</u>	Shoaling Shelf (Lagoonal to Inner Bank)
<u>Fauna.</u>	<i>Endothyra</i> spp., <i>Paleotextularia</i> ss., <i>Pseudoglomospira</i> spp., Archæidiscids, <i>Asphaltina</i> sp. and <i>Girvanella ducii</i> .
<u>Discussion.</u>	Lisburne Group. Alapah Fm.; Upper Limestone Unit.

9340-9520'

<u>Age.</u>	Late Mississippian Chesterian
<u>Zone.</u>	M-17
<u>Environment.</u>	Supratidal
<u>Fauna.</u>	Barren of indigenous Foraminifera.
<u>Discussion.</u>	Dolomite Unit

9520-9670'

<u>Age.</u>	Late Mississippian Meramecian to Chesterian
<u>Zone.</u>	M-16 or Older
<u>Environment.</u>	Shoaling Shelf (Lagoonal)
<u>Fauna.</u>	<i>Pseudoglomospira</i> spp., <i>Trepeilopsis</i> spp., <i>Earlandia elegans</i> , <i>Archaediscus krestovnikovi</i> , <i>Asphaltina</i> sp., <i>Girvanella ducii</i> and frequent to common coral wall debris.
<u>Discussion.</u>	Lower Limy Unit

9670-9910'

<u>Age.</u>	Probable Mississippian Probable Osagean to Meramecian
<u>Environment.</u>	Nonmarine to Marginal Marine (Alluvial Plain to Inner Lagoonal)
<u>Fauna.</u>	Rare scattered <i>Pseudoglomospira</i> spp., <i>Trepeilopsis</i> spp., <i>Girvanella ducii</i> and coral wall debris.
<u>Discussion.</u>	Endicott Group. Kayak Fm. - Itkilyariak Fm.

9910-10,193'T.D.

<u>Age.</u>	Indeterminate
<u>Environment.</u>	Indeterminate
<u>Fauna.</u>	Barren of Foraminifera.
<u>Discussion.</u>	Dark gray to black argillite.

## **CONCLUSIONS**

The UNOCAL Kookpuk No. 1 well penetrated the following biostratigraphic sequence based on foraminiferal analysis:

- 1260+ feet (90-1350') of undifferentiated Tertiary to Quaternary age (Middle to Late Brookian) nonmarine (alluvial plain) clastic deposition.
- 2870 feet (1350-4220') of Cenomanian to Maestrichtian age (Early Brookian) shelf topsets, slope foresets and base of slope bottomsets.
- 1900 feet (4220-6120') of Hauterivian to probable Cenomanian age (Early Brookian & Beaufortian - Rift Sequence) middle to outer shelf topsets, slope foresets and base of slope bottomsets with a middle to outer shelf basal transgressive interval.
- 1870 feet (6120-7990') of Pliensbachian to Valanginian age (Beaufortian -Incipient Rift Sequence) middle to outer shelf topsets and slope to base of slope sedimentation.
- 1260 feet (7990-9250') of Late Permian to Late Triassic (Norian) age (Late Ellesmerian) nonmarine, marginal marine and inner shelf deposition.
- 660 feet (9250-9910') of Mississippian (Probable Osagean to Chesterian) age (Early Ellesmerian) shoaling shelf carbonates and nonmarine to marginal marine clastics.
- 283+ feet (9910-10,193'T.D.) of indeterminate age (Franklinian) dark gray to black argillite.



# **PALYNOLOGY REPORT**

**Interpreted by:**

**Hideyo Haga**

## PALYNOLOGY SUMMARY

90-450'?

Age. Tertiary  
Undifferentiated

Environment. Nonmarine?

450?-1890'

Age. Late Cretaceous  
Maestrichtian

Zone. P-T11 and marginal marine equivalent

Environment. Nonmarine to Marginal Marine

Remarks. The upper boundary is questionably placed at the first occurrence of *Vitreisporites*; however, the more age-restrictive Maestrichtian species do not occur consistently until 990 feet.

1890-2430'

Age. Late Cretaceous  
Campanian

Zone. P-T12 and marginal marine equivalent

Environment. Marginal Marine

2430-3320'

<u>Age.</u>	Late Cretaceous Santonian - Campanian
<u>Zone.</u>	P-M14
<u>Environment.</u>	Marine

3320-3620'

<u>Age.</u>	Late Cretaceous Undifferentiated
<u>Environment.</u>	Marine
<u>Remarks.</u>	This interval is poorly fossiliferous.

3620-3820'

<u>Age.</u>	Late Cretaceous Turonian - Coniacian
<u>Zone.</u>	P-M15
<u>Environment.</u>	Marine

3820-5720'

<u>Age.</u>	Early - Late Cretaceous Albian - Cenomanian
<u>Zones.</u>	P-M17 to P-M16
<u>Environment.</u>	Marine
<u>Remarks.</u>	This interval cannot be further subdivided on the basis of palynomorph species.

5720-5920'

<u>Age.</u>	Early Cretaceous Possible Barremian - Early Albian
<u>Zone.</u>	P-M18a?
<u>Environment.</u>	Marine

5920-6220'

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

6220-6720'

<u>Age.</u>	Early Cretaceous Probable Valanginian
<u>Zone.</u>	Probable P-M20
<u>Environment.</u>	Marine to Marginal Marine

6720-7540'

<u>Age.</u>	Late Jurassic Oxfordian
<u>Zone.</u>	P-M22
<u>Environment.</u>	Marine

7540-8260'

<u>Age.</u>	Early - Middle Jurassic Undifferentiated
<u>Zones.</u>	P-M24? to P-M23
<u>Environment.</u>	Marine
<u>Remarks.</u>	The section is probably in Toarcian by 7630 feet. The P-M24 zonule may top at about 8080 feet.

8260-8980'

<u>Age.</u>	Triassic Undifferentiated
<u>Zones.</u>	P-T16 to P-T15
<u>Environment.</u>	Nonmarine

8980-9250'

<u>Age.</u>	Probable Early Triassic
<u>Zone.</u>	Probable P-T17
<u>Environment.</u>	Nonmarine

9250-9340'

<u>Age.</u>	Permian Undifferentiated
<u>Zone.</u>	P-T18
<u>Environment.</u>	Nonmarine

9340-10,192'C

Age.

Indeterminate

Environment.

Indeterminate

Remarks.

The palynology preparations show evidence of argillite beginning at 9880 feet.

## **INTRODUCTION**

### **Purpose and Scope**

Micropaleo Consultants, Inc. examined for palynological study one (1) core and 108 ditch samples from the UNOCAL Kookpuk No. 1 well. The samples were taken between 90 feet and 10,192 feet.

### **Procedures**

The prepared slides were originally examined at the Conservation Commission Offices in Anchorage, Alaska. Currently, all of the slide material is on deposit at the State of Alaska, Department on Natural Resources, Geological Materials Center in Eagle Creek, Alaska.

As each sample was examined, an estimate of abundance for each taxon was recorded. These data were input to a microcomputer that derives the high resolution chart displays.

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

### **Report Format**

The following Results section gives the age, environment of deposition and significant palynomorphs for each palynostratigraphic subdivision. This is an expansion of the brief Palynology Summary.



Following the Results are some general remarks in the Conclusions section.

A Palynomorph Distribution Chart (Figure P-1) is located in a pocket. This chart records the occurrence and abundance of individual taxa in each sample. Included on this chart are the diversity and abundance curves for spore-pollen and microplankton cysts.

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

## RESULTS

90-450'?

Age.

Tertiary  
Undifferentiated

Environment.

Nonmarine?

Palynomorphs.

This interval yielded a pollen assemblage that included forms such as *Caryapollenites*, *Momipites*, *Tiliaepollenites* and *Ulmipollenites*. No microplankton were recorded.

Discussion.

If all the pollen are considered to be indigenous, at least some part of the section below 180 feet may include strata as old as Eocene.

No marine palynomorphs were recovered.

450?-1890'

<u>Age.</u>	Late Cretaceous Maestrichtian
<u>Zone.</u>	P-T11 and marginal marine equivalent
<u>Environment.</u>	Nonmarine to Marginal Marine
<u>Palynomorphs.</u>	This interval is marked by the presence of the pollen <i>Aquilapollenites</i> , <i>Expressipollis</i> and <i>Vitreisporites</i> . A few dinocysts, mainly <i>Isabelidinium</i> , occur below 1530 feet.
<u>Discussion.</u>	<p>The upper boundary is questionably placed at the first occurrence of <i>Vitreisporites pallidus</i>. Evidence for definite Maestrichtian does not appear until 990 feet.</p> <p>Consistent occurrences of marine forms begin below 1400 feet (Figures P-1 and B-1).</p>

1890-2430'

<u>Age.</u>	Late Cretaceous Campanian
<u>Zone.</u>	P-T12 and marginal marine equivalent
<u>Environment.</u>	Marginal Marine
<u>Palynomorphs.</u>	The top of this interval is defined by the appearance of <i>Aquilapollenites trialatus</i> . Rare, sporadic occurrences of dinocysts such as <i>Cyclonephelium distinctum</i> , <i>Laciniadinium biconiculum</i> and species of <i>Chatangiella</i> were recorded.

2430-3320'

<u>Age.</u>	Late Cretaceous Santonian - Campanian
<u>Zone.</u>	P-M14
<u>Environment.</u>	Marine
<u>Palynomorphs.</u>	The dinocysts become important in this section. The assemblage includes species such as <i>Chatangiella ditissima</i> , <i>C. granulifera</i> , <i>Cyclonephelium distinctum</i> , <i>Laciniadinium biconiculum</i> and <i>Hystrichosphaeridium difficile</i> .

3320-3620'

<u>Age.</u>	Late Cretaceous Undifferentiated
<u>Environment.</u>	Marine
<u>Palynomorphs.</u>	This section is poorly fossiliferous. Only sporadic occurrences of a few species seen in the above interval were recovered in this interval.
<u>Discussion.</u>	The absence of any definitive species leaves this Late Cretaceous interval undifferentiated. The few species recorded provide no basis for an assignment of this interval as a continuation of the Santonian - Campanian above or to the Turonian - Coniacian below.

3620-3820'

<u>Age.</u>	Late Cretaceous Turonian - Coniacian
<u>Zone.</u>	P-M15
<u>Environment.</u>	Marine
<u>Palynomorphs.</u>	This Turonian - Coniacian interval is marked by the dinocyst <i>Isabelidinium globosum</i> .

3820-5720'

<u>Age.</u>	Early - Late Cretaceous Albian - Cenomanian
<u>Zones.</u>	P-M17 to P-M16
<u>Environment.</u>	Marine
<u>Palynomorphs.</u>	The top of this interval is marked by the appearance of the dinocyst <i>Pseudoceratium</i> cf. <i>P. dettmannae</i> . None of the Middle - Late Albian marker species were recorded in the interval; however, some were recorded as sloughed specimens in the Neocomian section below.
<u>Discussion.</u>	Based on the absence of marker species occurrences within the interval, no further palynologic subdivisions are possible.

5720-5920'

<u>Age.</u>	Early Cretaceous Possible Barremian - Early Albian
<u>Zone.</u>	P-M18a?
<u>Environment.</u>	Marine
<u>Palynomorphs.</u>	This section is tentatively separated based on the increase in abundance of <i>Oligosphaeridium complex</i> and an increase in species diversity.
<u>Discussion.</u>	The added appearance of <i>Pseudoceratium nudum</i> is problematical. This species normally characterizes Hauterivian age strata. Due to some of the poor dinocyst sequences in this well, their presence is disregarded at this time. If the occurrences are truly indigenous, perhaps a Hauterivian age assignment for this interval would be proper.

5920-6220'

<u>Age.</u>	Early Cretaceous Hauterivian
<u>Zone.</u>	P-M19
<u>Environment.</u>	Marine
<u>Palynomorphs.</u>	This section yielded a diverse dinocyst assemblage consisting of species such as <i>Cyclonephelium distinctum</i> , <i>Imbatodinium pelliferum</i> , <i>Oligosphaeridium complex</i> , <i>O. complex</i> (thick-wall), <i>Dimidiadinium uncinatum</i> and <i>Pseudoceratium nudum</i> .

6220-6720'

<u>Age.</u>	Early Cretaceous Probable Valanginian
<u>Zone.</u>	Probable P-M20
<u>Environment.</u>	Marine to Marginal Marine
<u>Palynomorphs.</u>	The top of this interval is weakly marked by the dinocyst <i>Pareodinia ceratophora</i> . The zonal marker <i>Gochteodinia villosa</i> was only seen as caved specimens in the Oxfordian interval below.
<u>Discussion.</u>	Most of the dinocyst occurrences are due to the presence of sloughed specimens from up-hole.

6720-7540'

<u>Age.</u>	Late Jurassic Oxfordian
<u>Zone.</u>	P-M22
<u>Environment.</u>	Marine
<u>Palynomorphs.</u>	The age diagnostic dinocysts included the following species: <i>Endoscrinium galeritum</i> , <i>Gonyaulacysta cladophora</i> , <i>G. jurassica</i> and <i>Nannoceratopsis pellucida</i> .
<u>Discussion.</u>	The e-log correlations indicate that the top of the Late Jurassic should be at about 6510 feet. The "tops" of the Jurassic palynomorphs may be depressed similar to many of the Cretaceous forms. This well shows much evidence of caving.

7540-8260'

<u>Age.</u>	Early - Middle Jurassic Undifferentiated
<u>Zones.</u>	P-M24? to P-M23
<u>Environment.</u>	Marine
<u>Palynomorphs.</u>	The important dinocyst species include JRD-5, <i>Nannoceratopsis gracilis</i> and <i>Parvocysta cracens</i> .
<u>Discussion.</u>	The section is probably in Toarcian by 7630 feet. The decrease in dinocysts below about 8080 feet indicates that possibly the P-M24 zone is present below that depth.

8260-8980'

<u>Age.</u>	Triassic Undifferentiated
<u>Zones.</u>	P-T16 to P-T15
<u>Environment.</u>	Nonmarine
<u>Palynomorphs.</u>	This Triassic interval is characterized by a spore-pollen assemblage. The assemblage includes consistent occurrences of <i>Taeniaesporites</i> , and the presence of <i>Dulhuntyispora</i> , <i>Gnetaceaepollenites</i> and <i>Striatites</i> .
<u>Discussion.</u>	Probably all of the dinocyst species have been derived from up-hole.



8980-9250'

<u>Age.</u>	Probable Early Triassic
<u>Zone.</u>	Probable P-T17
<u>Environment.</u>	Nonmarine
<u>Palynomorphs.</u>	This interval is poorly identified. There is a slight diversity increase in the terrestrial assemblage. Most of the forms, however, occur through the above interval.
<u>Discussion.</u>	The terrestrial assemblage seen in this interval probably represents forms from the Kavik Fm.

9250-9340'

<u>Age.</u>	Permian Undifferentiated
<u>Zone.</u>	P-T18
<u>Environment.</u>	Nonmarine
<u>Palynomorphs.</u>	This section is marked by the pollen <i>Vittatina</i> .

9340-10,192'C

<u>Age.</u>	Indeterminate
<u>Environment.</u>	Indeterminate
<u>Palynomorphs.</u>	All forms are believed to be derived from up-hole.
<u>Discussion.</u>	The palynologic preparations have evidence for argillite beginning at 9880 feet.

## **CONCLUSIONS**

Palynological analysis of the UNOCAL Kookpuk No. 1 well provides the following generalized palynostratigraphic succession:

- Tertiary nonmarine? strata extends from the top sample at 90 feet down to 450? feet.
- Late Cretaceous strata occur from 450? feet to at least 3820 feet. The marine palynomorphs become significant and numerous below 2000 feet.
- Mid-Cretaceous strata of Albian - Cenomanian age are designated between 3820 feet and 5720 feet.
- Early Cretaceous strata are identified between 5720 feet and 6720 feet. These strata are subdivided into intervals that range from Valanginian to Early Albian ages. Some of the ages are qualified with a "probable" designation.
- Late Jurassic, Oxfordian age, strata are designated between 6720 feet and 7540 feet.
- Undifferentiated Early - Middle Jurassic age strata occur from 7540 feet to 8260 feet.
- Triassic age strata occur from 8260 feet to 9250 feet. The nonmarine components become dominant starting in the Triassic section.
- The last age-assignable interval consists of Permian strata occurring between 9250 feet and 9340 feet.

- The bottom interval, extending from 9340 feet to 10,192C feet, is of indeterminate age.