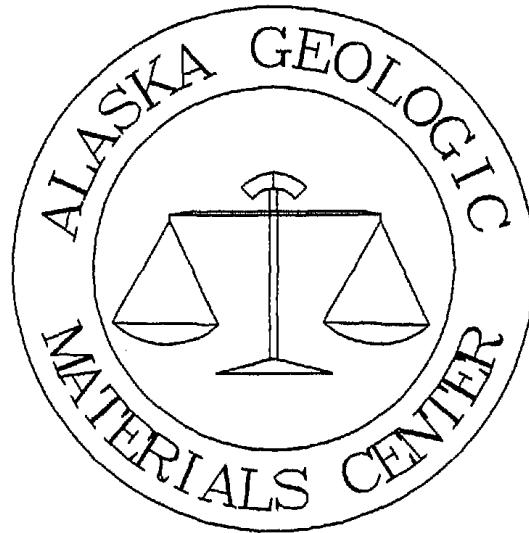


Palynological examination of samples from Arctic Alaska, consisting of:

Husky NPR Operations Inc. (U. S. Geological Survey) North Kalikpik Test Well No. 1 core samples (6,992.5' - 7,394.0'), and

International Conference on Arctic Margins 29 August - 1 September 1992 field trip about geology of the Brooks Range along the Dalton Highway samples.



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**PALYNOLOGICAL EXAMINATION
OF SAMPLES FROM ALASKA**

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Date: **Jan. 1993**

WELL KALIKPIK # 1

Eight samples from the Kalikpik #1 borehole were examined palynologically. Samples cover the interval 6992.5 to 7394.0'. Rich palynological assemblages are present, but preservation is highly variable. Age diagnostic species were recorded from all the samples.

Distribution of recorded palynomorphs is shown in Enclosure 1. The results of semi-quantitative kerogen analysis is illustrated in Enclosure 2.

Printout from database is found in Appendix 1.

INTERVAL 6992.5 - 7012.0'

Age: ?Hauterivian - Barremian - Early Aptian

Samples: 4 CCOs

Criteria for dating:

- *Cribopteridinium orthoceras*
- *Paleopteridinium cretaceum*
- *Odontochitina operculata*
- *Gardodinium trabeculosum*
- *Heerendenia pisciformis*

Comments: General assemblage composition at 6992.5' is characteristic of an Early Aptian to Barremian age. The distinct maximum in *G. trabeculosum* and *O. complex* at 7062' suggests an Early Aptian age at this level. A Barremian age can, however, not be ruled out.

The sample at 7124' produced a relatively poor assemblage. The presence of *H. pisciformis* gives an age no older than the Hauterivian. Both accompanying assemblage and the absence of older markers support this interpretation.

INTERVAL 7137 - 7178'

Age: Late Bathonian - Early Callovian

Samples: 2 CCOs

Criteria for dating:

- *Chytroesphaeridia hyalina* (7137 - 7178' maximum)
- *Nannoceratopsis pellucida* (7137' maximum)
- *Ctenidodinium* cf. *gochtii* (7178' maximum)
- *Gonyaulacysta jurassica* var. *adecta* (7178' maximum)

Comments: The assemblage composition is diagnostic of sediments close to the Bathonian - Callovian boundary. The maximum in *C. hyalina* is used to date the Early Callovian. Maxima in *N. pellucida* and *C. cf. gochtii* are known to occur consistently immediately below the *C. hyalina* maximum. Influx of abundant *G. jurassica* var. *adecta* is regarded to mark the latest Bathonian.

These criteria are widely used in the North Sea and the Norwegian shelf. Onshore Svalbard they have been recorded from a stratigraphical position in the lowermost part of the Agardhfjellet Fm.

INTERVAL 7200 - 7394'

Age: Bathonian

Samples: 2 CCOs

Criteria for dating:

- *Dissiliodinium willei* (7206.5 - 7394')
- *Nannoceratopsis pellucida* (- 7394')

Comments: Palynological assemblages from the two lowermost samples examined from this well are relatively poor, dominated by terrestrial species.

Presence of *D. willei* is diagnostic of a Bathonian to Late Bajocian age. However, presence of *N. pellucida* down to 7394' restricts the age to no older than the Bathonian. Questionable specimens of *Quadraeculina anellaeformis* at 7206.5' defines an age no younger than the Bathonian if verified.

GENERAL REMARKS

The examination of samples from this well suggests a considerable unconformity between 7124' and 7137', separating between Hauterivan and Early Callovian sediments.

The younger part may be equivalent to Carolinefjellet Fm. in Svalbard, but no assemblage of comparable composition has been reported. The elements present are, however, well known from the area except for *Heerendenia pisciformis*.

Age equivalent sediments to the Bathonian - Early Callovian recorded here are known from the lowermost part of the Agardhfjellet Fm. in Svalbard. They are thought to signal a distinct transgressive development in the lowermost Callovian. This is also observed in the North Sea. The same general assemblage composition is observed in all these areas.

DALTON

Two samples from locality Dalton (Dalton 2A and Dalton 14) were examined palynologically.

Both samples produced poor assemblages with only rare spores and bisaccate pollen.

Fragments of dinoflagellates are present in the Dalton 14 sample. A single fragment may possibly be referred to *Aptea anaphrissa*. The presence of this species would give a Barremian - Early Aptian age.

Assemblages give no further evidence for the age of these samples.

Dalton 2A & Dalton 14
collected during excavation
Manley Terrain
? Wolvercree Flych ?
Slope Mountain
? Albian

PALYNOLOGICAL ANALYSIS OF SAMPLES FROM ALASKA

Sample 92-MU 6-2 Kemik sandstone. Ignek Creek. (Prep. 57751)

Assemblage poorly preserved probably due to pyrite growth. The assemblage is dominated by *Cyclonephelium distinctum*. Preservation and assemblage composition suggests a tentative correlation with the middle and upper Rurikfjellet Fm. in Svalbard.

Species recorded:

<i>Cyclonephelium distinctum</i>	<i>Cribroperidinium orthoceras</i>
? <i>Trichodinium</i> sp.	<i>Oligosphaeridium</i> sp.
<i>Canningia</i> sp.	<i>Oligosphaeridium</i> complex
<i>Cassiculosphaeridia</i> sp.	<i>Gardodinium trabeculosum</i>
? <i>Apteodinium</i> sp.	

Sample 91-MU 42-3 Kingak shale (upper). Shavlovik River. (Prep. 57752)

Rare, poorly preserved spores. Dominated by degraded wood material. +- Barren. Non-diagnostic.

Sample 90-MU 27 Kemik sandstone. Echooka River. (Prep. 57753)

Extremely poor assemblage. Rare bisaccate pollen and spores. Dominated by inertinite, wood, and mineral grains. Non-diagnostic.

Sample 92-MU 48 Kingak shale. Lupine River. (Prep. 57754)

Barren of palynomorphs. Residue consisting of greyish clusters, inertinite and mineral grains.

Sample 92-MU 51 Kingak shale. Lupine River. (Prep. 57755)

Common spores, pollen, and dinoflagellates. Extremely poor preservation (ghosts). *Oligosphaeridium* sp. recorded. Sample probably thermally altered.

Sample 92-MU 55 Kingak shale. Saviukviayak River. (Prep. 57756)

As 92-MU 51.

Sample 92-MU 61 Kingak shale. Echooka River. (Prep. 57757)

Poor assemblage consisting of darkened spores, inertinite and wood. Non-diagnostic. Generally similar to MU 42-3 and MU 27.

Sample 92-MU 66 Pebble shale. Katakturuk River. (Prep. 57758)

Dominated by brown, rounded, and degraded debris of possible wood origin. Rare palynomorphs, *Oligosphaeridium* sp. recorded. This sample may be tentatively compared with the Early Cretaceous Rurikfjellet Fm. in Svalbard.

JURASSIC				CRETACEOUS		SYSTEM																																																						
BATHONIAN	BATHONIAN	L. BATH-E. CALL.	THAUTERIVIAN	BARRE-APTIAN	STAGE																																																							
7400					7300					7200					7100					7000					6900					DEPTH																														
7400					7300					7200					7100					7000					6900						LITHOLOGY																													
															LITHOLOGY															SAMPLER															ENCLOSURE 1	KALIKPIK #1 (6992 - 7394m)	H. DYPVIK U10	ANALYSTS: TBJ	DATE: 0189	SIS										
															COLOUR SELECT: MARINITY															<ul style="list-style-type: none"> CRIBROPERIDINIUM ORTHOCERAS CANNINGIA SPP. TANYOSPHAERIDIUM PROLIXOSPINOSUM TASMANITES SPP. PALEOPERIDINIUM CRETACEUM CYCLONOPHORIUM PAUCISPIMUM ODONTOCHITINA OPERCULATA SCRIBIDIINIUM CAMPANULUM GARDODINIUM TRABECULOSUM DLIGOSPHAERIDIUM ASTERIGERUM DELTOIDOSPORA MINOR BISACCATE POLLEN PTERODINIUM ALIFERUM DLIGOSPHAERIDIUM COMPLEX BATULADINIUM MICRODUM CANNINGIA CF. RETICULATA TANYOSPHAERIDIUM CF. VARIECALAMUM MUREONIA SIMPLEX FLORENTINIA COOKSONIAE CANNINGIA COMPTA SUBTILISPHAERIA SPP. TUBOTUBERELLA APATELA CHLAMYDOPHORELLA NYEII SRETONIA SPP. FORAMINIFERAL L'ININGS HEERENDINIA PISCIFORMIS GONYALACYSTA MELICOIDEA CYCLONOPHORIUM DISTINCTUM BAOULATISPORITES SPP. PAREODINIA CERATOPHORA MEGASTRICKIA TRUNCATA DICTYORHYNCHIDITES HARRISII DICHAODOGONYALAX SPP. LUNATISPORITES CF. PELLUCIDA SENTUSIDIINIUM VERRUCOSUM LYCOPODIUMSPORITES SPP. BONYALACYSTA JURASSICA ADECTA CANTONIPOLLERITES PALLIDUS DELTOIDOSPORA AUSTRALIS CHYTOEISPHAERIDIA HYALINA MAROSPORA FLORIDA APICULATISPORITES PARVISPINOSUS NANNOCERATOPSIS PELLUCIDA CERESODOLLENTES MESOZOICUS CTENIDODINIUM CF. GOCHTII CTENIDODINIUM SELLWOODY TODISPORITES MAJOR HARKNERIA VARIEVASCULATA MICROHYSTRIDIUM STELLATUM LYCOPODIUMSPORITES SEMIMURIS SENTUSIDIINIUM DENSISPINUM LYMESPORITES ARGENTAEFORMIS KALYPTEA HALOSA LYCOPODIACIOTITES FRUGLATUS PAREODINIA EVITTII CASSICULOSPHAERIDIA DICTYDIA DENSOISPORITES VELATUS TRAVISIPORA LAEVIGATA DISSILIDODINIUM WILLET DUPLEXISPORITES PROBLEMATICUS CTENIDODINIUM SPP. STAUROSACITES MINUTUS QUADRACULINA ANELLAEFORMIS APTEA ANAPRISSA ANAPRISSA FOLLICULOSA ENDOSCRINIUM GALERITUM 																					REF: 7400 7300 7200 7100 7000 6900									

BATHONIAN		JURASSIC		CRETACEOUS		SYSTEM
BATHONIAN		L. BATH-E. CALL.	?HAUTERIVIAN	BARREM-APTIAN		STAGE
7400		7300	7200	7100	7000	6900
						DEPTH
						REF:
						LITHOLOGY
						SAMPLES
						RELATIVE ABUNDANCE
						INERTINITE
						WOOD
						MEMBRANEOUS
						TERRESTRIAL PALYNOFORMS
						MARINE PALYNOFORMS
						DEGRADED
						AGGREGATES
						CONTAMINATION
						CAVED MATERIAL
						OTHER TYPES

ENCLOSURE 2 KALIKPIK #1 (6992 - 7394M) H. DYPVIK U10 ANALYSTS: TBU DATE: 0183 (SIS)

S I S B J E R K E

 KALIKPIK # 1 (6992.50-7394.00m) SAMPLE CARDS: 8

SPECIES	TOP (m)	BASE (m)
TASMANITES SPP.	6992.50	6992.50m
CANNINGIA SPP.	6992.50	6992.50m
CRIBROPERIDINIUM ORTHOCERAS	6992.50	6992.50m
TANYOSPHAERIDIUM PROLIXISPINOSUM	6992.50	6992.50m
CYCLONEPHELIUM PAUCISPINUM	6992.50	7012.00m
PALEOPERIDINIUM CRETACEUM	6992.50	7012.00m
ODONTOCHITINA OPERCULATA	6992.50	7062.00m
SCRINIODINIUM CAMPANULUM	6992.50	7062.00m
GARDODINIUM TRABECULOSUM	6992.50	7124.00m
OLIGOSPHAERIDIUM ASTERIGERUM	6992.50	7124.00m
DELTOIDOSPORA MINOR	6992.50	7206.50m
BISACCATE POLLEN	6992.50	7394.00m
PTERODINIUM ALIFERUM	7012.00	7012.00m
OLIGOSPHAERIDIUM COMPLEX	7012.00	7124.00m
CANNINGIA CF. RETICULATA	7062.00	7062.00m
TANYOSPHAERIDIUM CF. VARIECALAMUM	7062.00	7062.00m
SUBTILISPHERA SPP.	7062.00	7062.00m
BATIOLADINIUM MICROPODUM	7062.00	7062.00m
CANNINGIA COMPTA	7062.00	7062.00m
FLORENTINIA COOKSONIAE	7062.00	7062.00m
MUDERONGIA SIMPLEX	7062.00	7062.00m
TUBOTUBERELLA APATELA	7062.00	7062.00m
SPEETONIA SPP.	7062.00	7124.00m
CHLAMYDOPHORELLA NYEII	7062.00	7124.00m
FORAMINIFERAL LINGINGS	7124.00	7124.00m
CYCLONEPHELIUM DISTINCTUM	7124.00	7124.00m
GONYAULACYSTA HELICOIDEA	7124.00	7124.00m
HEERENDENIA PISCIFORMIS	7124.00	7124.00m
BACULATISPORITES SPP.	7124.00	7178.00m
DICHADOGONYAULAX SPP.	7137.00	7137.00m
PAREODINIA CERATOPHORA	7137.00	7137.00m
SENTUSIDINIUM VERRUCOSUM	7137.00	7137.00m
LUNATOSPORITES CF. PELLUCIDA	7137.00	7137.00m
DICTYOPHYLLIDITES HARRISII	7137.00	7137.00m
NEORAISTRICKIA TRUNCATA	7137.00	7137.00m
GONYAULACYSTA JURASSICA ADECTA	7137.00	7178.00m
LYCOPIDIUMSPORITES SPP.	7137.00	7178.00m
CHYTROEISPHAERIDIA HYALINA	7137.00	7206.50m
CAYTONIPOLLENITES PALLIDUS	7137.00	7206.50m
APICULATISPORITES PARVISPINOSUS	7137.00	7206.50m
DELTOIDOSPORA AUSTRALIS	7137.00	7206.50m
MUROSPORA FLORIDA	7137.00	7206.50m
NANOCERATOPSIS PELLUCIDA	7137.00	7394.00m
CEREBROPOLLENITES MESOZOICUS	7137.00	7394.00m
CTENIDODINIUM CF. GOCHTII	7178.00	7178.00m
CTENIDODINIUM SELLWOODY	7178.00	7178.00m
TODISPORITES MAJOR	7178.00	7178.00m
MANUMIA VARIVERRUCATA	7178.00	7206.50m
MICRHYSTRIDIUM STELLATUM	7178.00	7394.00m
CASSICULOSPHAERIDIA DICTYDIA	7206.50	7206.50m
KALYPTTEA HALOSA	7206.50	7206.50m

PAREODINIA EVITTII	7206.50 - 7206.50m
SENTUSIDINIUM "DENSISPINUM"	7206.50 - 7206.50m
DENSOISPORITES VELATUS	7206.50 - 7206.50m
LYCOPODIACIDITES RUGULATUS	7206.50 - 7206.50m
LYCOPIDIUMSPORITES SEMIMURIS	7206.50 - 7206.50m
UVAESPORITES ARGENTEAIFORMIS	7206.50 - 7206.50m
DISSILIODINIUM WILLEI	7206.50 - 7394.00m
IRAQUISPORA LAEVIGATA	7206.50 - 7394.00m
CTENIDODINIUM SPP.	7394.00 - 7394.00m
DUPLEXISPORITES PROBLEMATICUS	7394.00 - 7394.00m
APTEA ANAPHRISSA	Rew/??/Absent
ENDOSCRINIUM GALERITUM	Rew/??/Absent
QUADRAECULINA ANELLAIFORMIS	Rew/??/Absent
STAUROSACCITES MINUTUS	Rew/??/Absent
ANNULISPORIA FOLLICULOSA	Rew/??/Absent

 311 KALIKPIK # 1 6992.50mCCO H. DYPVIK

ODONTOCHITINA OPERCULATA	02
BISACCATE POLLEN	02
TASMANITES SPP.	02
CANNINGIA SPP.	02
CYCLONEPHELIUM PAUCISPINUM	02
GARDODINIUM TRABECULOSUM	02
OLIGOSPHAERIDIUM ASTERIGERUM	02
CRIBROPERIDIUM ORTHOCERAS	2
TANYOSPHAERIDIUM PROLIXISPINOSUM	2
DELTOIDOSPORA MINOR	2
PALEOPERIDIUM CRETACEUM	2
SCRINIODINIUM CAMPANULUM	2

312 KALIKPIK # 1 7012.00mCCO H. DYPVIK

ODONTOCHITINA OPERCULATA	02
OLIGOSPHAERIDIUM ASTERIGERUM	02
PALEOPERIDINIUM CRETACEUM	02
BISACCATE POLLEN	02
CYCLONEPHELIUM PAUCISPINUM	02
OLIGOSPHAERIDIUM COMPLEX	02
PTERODINIUM ALIFERUM	02

 313 KALIKPIK # 1 7062.00mCCO H. DYPVIK

GARDODINIUM TRABECULOSUM	10
OLIGOSPHAERIDIUM COMPLEX	30
ODONTOCHITINA OPERCULATA	02
APTEA ANAPHRISSA	??
SCRINIODINIUM CAMPANULUM	02
BATIOLADINIUM MICROPODUM	02
CHLAMYDOPHORELLA NYEII	02
CANNINGIA CF. RETICULATA	02
TANYOSPHAERIDIUM CF. VARIECALAMUM	02
MUDERONGIA SIMPLEX	02
FLORENTINIA COOKSONIAE	02
CANNINGIA COMPTA	02
SUBTILISPAHERA SPP.	02
SPEETONIA SPP.	02
TUBOTUBERELLA APATELA	02

314 KALIKPIK # 1 7124.00mCCO H. DYPVIK

FORAMINIFERAL LINGINGS	02
BISACCATE POLLEN	02
SPEETONIA SPP.	02
OLIGOSPHAERIDIUM COMPLEX	02
HEERENDENIA PISCIFORMIS	02
CHLAMYDOPHORELLA NYEII	02
GARDODINIUM TRABECULOSUM	02
GONYAULACYSTA HELICOIDEA	02
DELTOIDOSPORA MINOR	02
CYCLONEPHELIUM DISTINCTUM	02
OLIGOSPHAERIDIUM ASTERIGERUM	02
BACULATISPORITES SPP.	02

315

KALIKPIK # 1

7137.00mCCO H. DYPVIK

BISACCATE POLLEN	10
ENDOSCRINIUM GALERITUM	??
DELTOIDOSPORA MINOR	02
CAYTONIPOLLENITES PALLIDUS	02
PAREODINIA CERATOPHORA	02
NANNOCERATOPSIS PELLUCIDA	30
BACULATISPORITES SPP.	02
NEORAISTRICKIA TRUNCATA	02
DELTOIDOSPORA AUSTRALIS	02
CHYTROEISPHAERIDIA HYALINA	10
DICTYOPHYLLIDITES HARRISII	02
CEREBROPOLLENITES MESOZOICUS	02
MUROSPORA FLORIDA	02
APICULATISPORITES PARVISPINOSUS	02
LYCOPODIUMSPORITES SPP.	02
DICHADOGONYAULAX SPP.	02
GONYAULACYSTA JURASSICA ADECTA	02
LUNATOSPORITES CF. PELLUCIDA	02r
SENTUSIDINIUM VERRUCOSUM	02

 316 KALIKPIK # 1 7178.00mCCO H. DYPVIK

GONYAULACYSTA JURASSICA ADECTA	30
DELTOIDOSPORA MINOR	02
CHYTROEISPHAERIDIA HYALINA	30
CTENIDODINIUM CF. GOCHTII	10
CEREBROPOLLENITES MESOZOICUS	02
BISACCATE POLLEN	02
MICRHYSTRIDIUM STELLATUM	02
MUROSPORA FLORIDA	02
NANNOCERATOPSIS PELLUCIDA	02
CTENIDODINIUM SELLWOODY	02
BACULATISPORITES SPP.	02
LYCOPODIUMSPORITES SPP.	02
TODISPORITES MAJOR	02
MANUMIA VARIVERRUCATA	02

 317 KALIKPIK # 1 7206.50mCCO H. DYPVIK

CAYTONIPOLLENITES PALLIDUS	02
NANOCERATOPSIS PELLUCIDA	02
CHYTROEISPHAERIDIA HYALINA	02
DELTOIDOSPORA MINOR	02
CASSICULOSPHAERIDIA DICTYDIA	02
BISACCATE POLLEN	02
KALYPTEA HALOSA	02
PAREODINIA EVITTII	02
SENTUSIDINIUM "DENSISPINUM"	02
MICRHYSTRIDIUM STELLATUM	02
CEREBROPOLLENITES MESOZOICUS	02
IRAQUISPOA LAEVIGATA	02
DISSILIODINIUM WILLEI	02
MUROSPORA FLORIDA	02
LYCOPIDIUMSPORITES SEMIMURIS	02
DELTOIDOSPORA AUSTRALIS	02
MANUMIA VARIVERRUCATA	02
APICULATISPORITES PARVISPINOSUS	02
DENSOISPORITES VELATUS	02
QUADRAECULINA ANELLAEFORMIS	??
ANNULISPOA FOLLICULOSA	RR
LYCOPODIACIDITES RUGULATUS	02
STAUROSACCITES MINUTUS	RR
UVAESPORITES ARGENTEAEFORMIS	02

318

KALIKPIK # 1

7394.00mCCO H. DYPVIK

BISACCATE POLLEN	02
DUPLEXISPORITES PROBLEMATICUS	02
CTENIDODINIUM SPP.	02
CEREBROPOLLENITES MESOZOICUS	02
DISSILIODINIUM WILLEI	02
NANNOCERATOPSIS PELLUCIDA	02
MICRHYSTRIDIUM STELLATUM	02
IRAQUISPORA LAEVIGATA	02