UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Twenty-two Measured Sections of Cretaceous-Lower Tertiary Rocks,
Eastern North Slope, Alaska

by

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Open-file Report 84-695

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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1984
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TWENTY-TWO MEASURED SECTIONS OF CRETACEOUS-LOWER TERTIARY ROCKS, EASTERN NORTH SLOPE, ALASKA

INTRODUCTION

Twenty-two stratigraphic sections of Cretaceous to lower Tertiary rocks in the eastern North Slope were measured and sampled during the 1980 and 1982 field seasons. The westernmost section is along the Toolik River and the easternmost section is near the Sadlerochit River in the Arctic National Wildlife Refuge (fig. 1 and table 1). The purpose of this report is to present these sections in graphic form showing paleontologic data and inferred environments of deposition. Most of the sections contain significant amounts of either shallow marine and nonmarine or deep marine sandstone, because sandstones constitute the better outcrops, and because depositional environments of sandstone units are easier to interpret.

METHODS AND EXPLANATION

With few exceptions, the sections were measured with a Jacob staff and Brunton compass. Exceptions are (1) the thick, covered parts of the Gilead syncline section (section 6) and the Kavik River-Canning River section (section 15), which were calculated by map-scaling methods with vertical control from either a topographic map or a helicopter altimeter, (2) the Shaviovik anticline section (section 11) and the steeply dipping to overturned Ignek Valley section (section 19), which were measured by taping, and (3) the western fork of Marsh Creek (section 21), which was visually estimated. Section 21 was included to show the important stratigraphic relationships at the mid-Neocomian unconformity.

Except for most of the sections of the Lower Cretaceous Kemik Sandstone Member of the Kongakut Formation, the sections are plotted at a vertical scale of one inch equals 200 ft. Although this scale may seem inadequate for many of the shorter sections, the vertical depositional sequences are still clearly distinguishable and the sections can be better correlated or compared with thicker sections. The short sections of the Kemik Sandstone Member are plotted at a scale of 1 inch equals 50 ft in order to show more details. These sections are of older rocks that belong to a different depositional sequence. The column width used for these sections is double that of the other sections and that of the explanation of symbols as shown in figure 2.

The foraminiferal and palynological determinations shown on the sections were made by the following companies: Biostratigraphics Consulting Micropaleontology—sections 1, 2, 3, 4, 5, 6, 7, 10, 11, 18, and 19; Anderson Worldwide Associates, Inc.—sections 8, 13, 15, 17, and 21; and Anderson, Warren and Associates, Inc.—sections 20 and 22. These three companies are in San Diego, California. The paleontologic data on sections 20 and 22 are from Palmer and other (1979) or Lyle and others (1980), both of which use the same data.

Megafossil determinations, unless otherwise indicated, are by John W. Miller of the U.S. Geological Survey.
Table 2 shows the subdivisions of the Cretaceous System and a list of the abbreviations used for the paleontologic data. Because of facies and age differences, the stratigraphic names of Cretaceous rocks of the central North Slope are not applicable to most of the rocks of the eastern North Slope (fig. 3). Therefore, only the formal or locally established rock unit names are shown on the measured sections.

The shallow marine water depth inferred for the depositional environments refers to water depths on the shelf—probably less 100 m or the depth of storm wave base (fig. 3). Deep water refers to depths greater than storm wave base—beyond the shelf break on the basin slope or basin bottom.

Most of the turbidite sandstone sections were probably deposited near the base of the basin slope.

The twenty-two measured sections are shown in figures 4-15, and plate 1-4.

DEPOSITIONAL SETTING

Two depositional sequences are represented by the measured sections. The Neocomian pebble shale unit and older rocks belong to the Ellesmerian sequence. These rocks had a northern provenance and are mineralogically more mature than that of the overlying Brookian or southern provenance rocks. In the northern outcrops, a mid-Neocomian unconformity occurs at the base of the Kemik Sandstone Member of the Kongakut Formation or at the base of the pebble shale unit where the Kemik is not present (figs. 10, 12, 13, and 15; and plate 4). To the south, the unconformity merges into a conformable sequence (fig. 8) (Molenaar, 1983).

Following late Neocomian deposition, during which the depositional axis of the Colville trough was to the south little deposition occurred on the north flank of the basin until the deeper axial part of the basin to the south was filled by southerly and southwesterly derived sediments from the ancestral Brooks Range (Molenaar and others, 1982; Molenaar, 1983). These rocks, which belong to the Brookian sequence, are rich in lithic grains and consist of a prograding sequence of, in ascending order, basinal shale and turbiditic sandstone, slope shale, shallow marine prodelta shale and delta-front sandstone, and nonmarine deltaic deposits. Both the basinal and the shallow marine-nonmarine sequences become younger from west to east or southwest to northeast indicating progradation toward the east-northeast. Figure 3 shows the regional relationships of the Cretaceous-lower Tertiary rocks between the central and eastern North Slope.

Both the deep-water basinal facies and the shallow marine-nonmarine Brookian facies are represented in the measured sections, but none of the sections contain both facies because of the intervening thick slope shale sequences, which generally are not well exposed. In addition, structural complications preclude measuring these stratigraphic intervals. Well control indicates the shale section, including the basinal sequence, is as thick as 8,500 ft (2,600 m) as annotated on figure 3. Part of this thick section may be repeated by faulting, however.
REFERENCES CITED


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<th>No.</th>
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Table 1--List of measured sections of Cretaceous-lower Tertiary rocks, eastern North Slope, Alaska.
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<td></td>
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<td></td>
<td></td>
<td>Valanginian</td>
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<td>Barremian</td>
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<td>L.</td>
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<td>Maes.</td>
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<td>Val. Valanginian</td>
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Figure 1. Index map of northeastern Alaska showing locations of measured sections. Well spots A and B are wells referred to in figure 3.
Sandstone. On sections where column excursion is to left, column width indicates visual estimate of median grain size. Single row of dots extending outside of column represents a thin layer (1 ft) of coarser grains, the size of which is indicated. In essence, the left side of the column is a grain size profile.

Sandstone. On sections where column excursion is to right, no specific grain size is implied.

Siltstone

Shale or claystone

Silty shale or mudstone

Coal

Interbedded sandstone and shale or siltstone in which sandstone beds are thin or too subdued to separate from sequence. Proportions of each are indicated.

Interbedded sandstone and shale or siltstone in which sandstone proportion is less than 20%.

Partially covered interval.

Covered interval; lithology inferred if filled in.

Limestone

Thin limestone beds in shale

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Figure 2. Explanation of symbols used for graphic sections.
Figure 3. Schematic diagram showing inferred depositional relations of Cretaceous-lower Tertiary shallow marine-nonmarine strata and basinal strata between the central and eastern North Slope. No scale intended (modified from Molenaar, 1983). Annotated thicknesses are from, left to right, the Umiat area 70 mi (113 km) west of section 1; (2) Mobil Echooks No. 1 well (well spot A), section 32, T. 1 N., R. 16 E.; and (3) Mobil Beli No. 1 well (well spot B), section 8, T. 4 N., R. 23 E.
Section 1
Toolik River
Late Cretaceous
NE/4 sec. 19, T. 2 S., R. 12 E.
Sagavanirktok (B-4) Quadrangle

Comments and Inferred Depositional Environments

Sandstone, ripple laminations, bivalves (lower shoreface)

Sandstone, parallel laminations at top, hummocky cross stratification at base, bivalves (lower shoreface)

Siltstone, medium-gray (shelf)

Sandstone, hummocky cross stratification, well sorted, subrounded, bivalves, (lower shoreface)

Sandstone, light- to medium-gray, parallel bedded, well sorted, subrounded, vertical burrows, bivalves and gastropods (regressive shoreface)

Natica, Arctica?; Asarte, Entolium; Panope?, prob. Late Cretaceous

Figure 4. Section 1, Toolik River.
Section 2
Sagavanirktok River
Early Cretaceous(?)
C, N/2 sec. 16, T. 5 S., R. 14 E.
Sagavanirktok (A-4) Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIRONMENTS

Flute casts
Sandstone, LF with scattered M-C, medium-gray, hard, poorly bedded, graded bedding, internal scours, carbonaceous debris, shale galls (Facies B(?), turbidites)

Sandstone, (90%), VF with M at base, beds 1-3 ft thick

Sandstone, as below
Sandstone, VF, medium-gray, hard, medium to thick beds that thicken upward, sharp bases, ripple laminations at top, groove casts (turbidite lobe(?)) sequence

Sandstone, (50%), VF, beds up to 10 inches thick, ripple laminated (turbidites)
Mudstone, (50%), minor bentonite

Sandstone, UVF-LF, thick-beded, common bottom marks in lower part (turbidite lobe(?)) sequence

Sandstone, VF, beds 4-10 inches thick, groove casts, Bouma b-c
Sandstone, VF-LF, medium-gray, poorly bedded, ripple laminated on top, carbonaceous debris, shale galls (turbidites)

Figure 5. Section 2, Sagavanirktok River.
Section 4
Lower Gilead Creek
Late Cretaceous
SW/4 sec. 10, T. 2 S., R. 17 E.
Sagavanirktok (B-2) Quadrangle

COMMENDS AND INFERRED DEPOSITIONAL ENVIRONMENTS

Sandstone and siltstone in coarsening and thickening upward cycles (lower shoreface-shelf)

Sandstone, hummocky cross stratification, coarsening upward (lower shoreface)

Hummocky cross stratification

Sandstone, even parallel and ripple laminations, interbedded with mudstone and siltstone (lower shoreface-shelf)

Sandstone, broad open low-angle trough crossbeds, hummocky(?), 4½-inch-thick bentonite

Siltstone, medium-gray, burrowed, interbeds of very fine grained sandstone (shelf)

*F=Nucula?

Figure 6. Section 4, lower Gilead Creek
Section 5--Upper Ivishak River
Late Cretaceous
C, S/2, S/2 sec. 5, T. 3 S., R. 17 E.
Sagavanirktok (A-2) Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIRONMENTS
Sandstone, VF, bottom marks and grooves (lower slope(?)) turbidites
Shale and mudstone with less than 10% thin-bedded very fine grained sandstone, ripple laminations at tops of beds, Bouma b-c (lower slope(?))
Sandstone and shale as below
Grooves
Sandstone, (80–90%) VF, hard, graded beds 1–8 in. thick, ripple laminated tops on some beds, common bottom marks and grooves (turbidites)

Section 7--Lower Echooka River
Late Cretaceous(?)
NE/4, SE/4 sec. 25, T. 1 N., R. 16 E.
Sagavanirktok (B-2) Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIRONMENTS
Sandstone, VF, scattered pebbles, mudstone clasts, woody fragments with mudstone interbeds (subaerial deltaic and paludal)
Sandstone, trough crossbeds, abundant carbonaceous ar wood fragments, scattered chert pebbles, 4–5 inch cobbles (distributary(?)) channel)
Sandstone, light gray-brown, internal scours, quartzite pebbles up to 2 inches, hummocky cross stratification in lower part (shoreface distributary-mouth bar capped by distributary channel)
(Mower shoreface)
Mudstone, dark-gray, bentonitic (offshore shelf)

Figure 7. Sections 5 and 7, upper Ivishak River and lower Echooka River.
Section 8
Upper Echooka River
Early Cretaceous
NE 4, SW/4 sec. 36, T. 1 S., R. 18 E.
Sagavanirktok (B-2) Quadrangle

**Kemik Sandstone Member**

- **Transgressive shale with rounded quartz "floaters"**

- Sandstone, lower very fine grained, gray, well sorted, parallel beds 1-3 ft thick, irregular bedding surface. (offshore shelf)

- Gradational contact

- Siltstone, medium-gray, poorly bedded, vertical burrows (shallow marine shelf)

- Scattered beds of ironstone concretions

- Fa=Acroteuthis (sp?); prob. Early Cretaceous (Haut.-Barr.)
- Fb=Poss. Simbirskites; prob. Early Cretaceous (Haut.)

Figure 8. Section 8, upper Echooka River.
Section 9--Lower Shaviovik River II
Tertiary(?)
SW/4 sec. 29, NW/4 sec. 32, T. 3 N., R. 18 E.
Sagavanirktok (C-2) Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIRONMENTS

Coal (lignite), 50+ ft thick (covered above) (paludal)
Interbedded claystone and sand, bentonitic (delta plain, overbank)
Coal (lignite), 29 ft thick
Interbedded sand and claystone, bentonitic
Coal (lignite), 42 ft thick, R_q (vitrinite reflectance) = 0.27
Sandstone, fine- to medium-grained, dark-yellowish-brown, abundant
carbonaceous debris, coal clasts. Several channel sequences separated
by coal beds (subaerial delta plain-paludal)

Section 10--Lower Shaviovik River I
Tertiary
NW/4 sec. 16, T. 2 N., R. 18 E.
Sagavanirktok (C-2) Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIRONMENTS

Sandstone, medium-angle trough crossbeds, pebbles and granules, internal
scours (channel sandstone)
Sandstone, fining upward, ripple laminated, abundant carbonaceous debris
(channel)
3ft ft-thick coal bed
Sandstone as above
Carbonaceous shale and thin coal beds (paludal)
6-inch-thick coal bed (paludal)
Sandstone as above
Silty shale and sandstone, ripple laminated, carbonaceous (bay fill(?))
Sandstone as above, minor pebbles
Sandstone as above
(above section is all nonmarine)

Figure 9. Sections 9 and 10, lower Shaviovik River II and I.
Section 12
Upper Shaviovik River
Early Cretaceous
SW/4, NW/4 sec. 24, T. 1 S., R. 20 E.
Sagavanirktok (B-l) Quadrangle

Kemik Sandstone Member*

Sandstone, VF, light-gray, quartzose with tripolitic chert and glauconite grains, low-angle crossbeds (shallow marine shelf, transgressive)

Granule bed, poorly sorted

Unconformity

Thin sandstone interbeds increase upwards

Very fine grained sandstone interbeds (shelf)

Shale, silty, dark-gray to black

Shale, silty, dark-gray to black, Buchia fragments (neritic and/or deeper(?))

* of Kongakut Formation

F=Poss. Buchia sublaevis; probably Early Cretaceous (Valanginian)

Figure 10. Section 12, upper Shaviovik River.
Section 13—Kemik Creek Syncline
Early Cretaceous
SW/4, SW/4 sec. 8, T. 1 S., R. 21 E.
Sagavanirktok (B-1) Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIRONMENTS

Shale, dark-gray (N-3), fissile, cannonball concretions, rare floating pebbles and quartz grains, one 4-inch-thick bentonite(?) bed (deep water(?)

Pyrite replaced pebbles(?)

Jarosite staining
(neeritic and deeper(?))

Section 14—Fin Creek
Early Cretaceous
C, W/2, SW/4 sec. 26, T. 1 N., R. 21 E.
Mt. Michelson (B-5) Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIRONMENTS

Sandstone, lower very fine grained, medium-gray, thin-medium bedded, quartzose, horizontal and vertical burrows (shallow marine shelf)

Figure 11. Sections 13 and 14, Kemik Creek syncline and Fin Creek.
Section 15
Section between Kavik and Canning Rivers
Late Jurassic-Early Cretaceous
E/2 sec. 34 and SW/4, NW/4 sec. 35,
T. 1 N., R. 23 E.
Mt. Michelson (B-5) Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIRONMENTS

Shale, dark-gray fissile; no pebbles noted, rare floating quartz grains (neritic and deeper)

Probable unconformity

Sandstone, very fine grained, well sorted, quartzose, common black chert and glauconite grains, 5 ft exposed (shallow marine shelf)

Shale, dark-gray, fissile, locally slightly silty, rusty-weathering especially in lower part, minor rare floating quartz grains, rare chert pebbles (<1 inch) (shelf to upper slope(?))

Fa=Buchia fischeriana(?); Cylindroteuthis sp. probably Late Jurassic (Tith.)

Fb=Buchia sp.; Late Jurassic or Early Cretaceous

Figure 12. Section 15, between Kavik and Canning Rivers.
Section 16--West Side Canning River Valley
Early Cretaceous
W/2 sec. 6, T. 1 N., R. 24 E.
Mt. Michelson (B-4) Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIRONMENTS

Sandstone, LVF, medium-gray (N-4), parallel-bedded with
minor ripple laminations; one one-foot bed with chert
pebbles (1/2 in.) (shallow marine shelf)

Unconformity

Shale, dark-gray, fissile, floating quartz grains, minor
ironstone concretions (shelf-upper slope(?))

* of Kongakut Formation

Kemik Sandstone Member

Kingak Shale

Section 17--West Bank Canning River
Late Jurassic-Early Cretaceous
SE/4, SE/4, SE/4 sec. 30, T. 2 N., R. 24 E.
Mt. Michelson Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIRONMENTS

Top of unit eroded

Sandstone, VF, medium- to light-gray, quartzose,
coarsening upward, parallel-bedded in 2-6 inch thick
beds, irregular bedding surfaces, minor ripple
laminations (shallow marine shelf)

Silty shale, dark-gray-black, rare floating quartz
grains, ironstone concretions, chert pebbles at base
(shelf)

Sandstone, poorly sorted, glauconite
Unconformity

Shale, clayey, black, rare floating quartz grains
(shelf-upper slope(?))

Figure 13. Sections 16 and 17, west side Canning River.
Section 18—Ignek Creek
Early Cretaceous
NE/4, SW/4 sec. 27, T. 3 N., R. 25 E.
Mt. Michelson (C-4) Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIROMENTS
Shale, dark-gray, fissile, non-calcareous, bentonitic, (deep-water basinal)

10 inch siltstone boulder

Cobbles up to 4 inches, quartzite and chert (neritic or deeper)

Shale, dark-gray, fissile, scattered rare pebbles, rounded frosted quartz grains, (neritic)

Sandstone, poorly bedded in thick to thin parallel beds, chert pebbles at the top (1/2 inches) limonite-stained upper surface (shelf)

Shale, dark-gray with limonite-stained fractures

Section 20—Katakturuk River
Paleocene(?)
NE/4, SW/4 sec. 11, T. 4 N., R. 27 E.
Mt. Michelson (C-3) Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIRONMENTS
Interbedded siltstone and sandstone in 6-15-ft thick, thinning-upward cycles that are lenticular. Sandstone VF, 1-6 inch-thick beds, as below (slope turbidites)

Mudstone, grayish-brown, non-fissile (slope)

Interbedded siltstone and sandstone in thinning-upward cycles. Sandstone, F-Vf, yellow-brown, 3-24 inches-thick graded-to nongraded beds, Bouma b-c-d, carbonaceous, sole marks (slope(turbidites)

Light oil staining in lower part

* from Lyle and others, 1980
* from Palmer and others, 1979

Figure 14. Sections 18 and 20, Ignek Creek and Katakturuk River.
Section 21--West Fork Marsh Creek
SW/4, SE/4 sec. 22, T. 4 N., R. 29 E.
Early Cretaceous
Mt. Michelson (C-2) Quadrangle

COMMENTS AND INFERRRED DEPOSITIONAL ENVIRONMENTS

Shale, dark-gray, fissile, ironstone concretions (neritic or deeper)

Interbedded siltstone and mudstone, ironstone concretions, common scattered chert and quartzite pebbles up to 2 inches (neritic)

Unconformity

Sandstone, very fine to fine-grained, light-gray, quartzose (shallow marine)

Section 22--East End Sadlerochit Mountains
Early Cretaceous
C, E/2, E/2 sec. 11, T. 3 N., R. 31 E.
Mt. Michelson (C-1) Quadrangle

COMMENTS AND INFERRED DEPOSITIONAL ENVIRONMENTS

Shale, silty, dark-gray, ironstone concretions (offshore shelf)

Sandstone, LVF-LF, silty, medium-gray, parallel beds with zones of trough crossbeds, scattered quartz and chert pebbles, common burrows, ophiomorpha at top (shallow marine)

Unconformity or possible bedding-plane fault contact

Dark-gray to black interbedded sooty shale and limestone (shelf?)

* from Palmer and others, 1979; Lyle and others, 1980

** of Kongakut Formation

Figure 15. Sections 21 and 22, west fork of Marsh Creek and east end of Sadlerochit Mountains.