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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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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CONTENTS

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.

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Keller, A. S., Morris, R. H., and Detterman, R. L., 1961, Geology of the Shaviovik and Sagavanirktok Rivers region, Alaska: U.S. Geological Survey Professional Paper 303-D, p. 169-222.

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Molenaar, C. M., 1983, Depositional relations of Cretaceous and lower Tertiary rocks, northeastern Alaska: American Association of Petroleum Geologists Bulletin, v. 67, no. 7, p. 1066-1080.

Palmer, I. F. Jr., Bolm, J. G., Maxey, L. R., and Lyle, W. M., 1979, Petroleum source rock and reservoir quality data from outcrop samples, onshore North Slope of Alaska east of Prudhoe Bay: U.S. Geological Survey Open-File Report 79-1634, 52 p.

Table 1--List of measured sections of Cretaceous-lower Tertiary rocks, eastern North Slope, Alaska.

No.	Section Name	Thickness (ft)	Location	Section	T.	R.	Fig./Pl.
1	Toolik River	835	NE/4	19	2S	12E	3
2	Sagavanirktok River	600	C,N/2	16	5S	14E	4
3	Lower Ivishak River	2,600	NE/4	2	2S	16E	1
			SW/4	35	1S	16E	5
4	Lower Gilead Creek	810	SW/4	10	2s	17e	6
5	Upper Ivishak River	436	C,S/2,S/2	5	3S	17E	7
6	Gilead Syncline	2,500		28	3S	18E	2
	Lower Echooka River	540	NE/4,SE/4	25	1N	16E	7
8	Upper Echooka River	330	NE/4,SW/4	36	1S	18E	8
9	Lower Shaviovik River II	420	SW/4 29-NW/4	32	3N	18E	9
10	Lower Shaviovik River I	595	NW/4	16	2N	18E	9
11	Shaviovik Anticline	2,415	C	5	2N	19E	3
12	Upper Shaviovik River	220	SW/4,NW/4	24	1S	20E	10
13	Kemik Creek Syncline	400	SW/4,SW/4	8	1S	21E	11
14	Fin Creek	115	C,W/2,SW/4	26	1N	21E	11
15	Between Kavik and Canning Rivers	1,000	E/2 34-NW/4	35	1N	23E	12
16	West Side Canning River Valley	150	W/2	6	1N	24E	13
17	West Bank Canning River	120	SE/4,SE/4	30	2N	24E	13
18	Ignek Creek	630	NE/4,SW/4	27	3N	25E	14
19	Ignek Valley	2,300	W/2, NE/4	6			4
			NW/4,NW/4	5	2N	26E	
20	Katakturuk River	320	NE/4,SW/4	11	4N	27E	14
21	West Fork Marsh Creek	125	SW/4,SE/4	22	4N	29E	15
22	East End Sadlerochit Mtns	90	C,E/2,E/2	11	3N	31E	15

Table 2--Subdivisions of the Cretaceous System and list of abbreviations used for paleontologic data.

SYSTEM	SERIES	STAGE	
CRETACEOUS	UPPER	Senonian	Maestrichtian
			Campanian
			Santonian
			Coniacian
		Turonian	
		Cenomanian	
	LOWER	Albian	
		Aptian	
		Neocomian	Barremian
			Hauterivian
			Valanginian
			Berriasian

Bar.	Barremian	Neoc.	Neocomian
Camp.	Campanian	NF	No Foraminifera found
Con.	Coniacian	Paleoc.	Paleocene
Cret.	Cretaceous	prob.	probably
Eoc.	Eocene	poss.	possibly
Haut.	Hauterivian	Sant.	Santonian
Ind.	indeterminate	Sen.	Senonian
Jur.	Jurassic	Tert.	Tertiary
L.	Late	Tur.	Turonian
Maes.	Maestrichtian	Val.	Valanginian

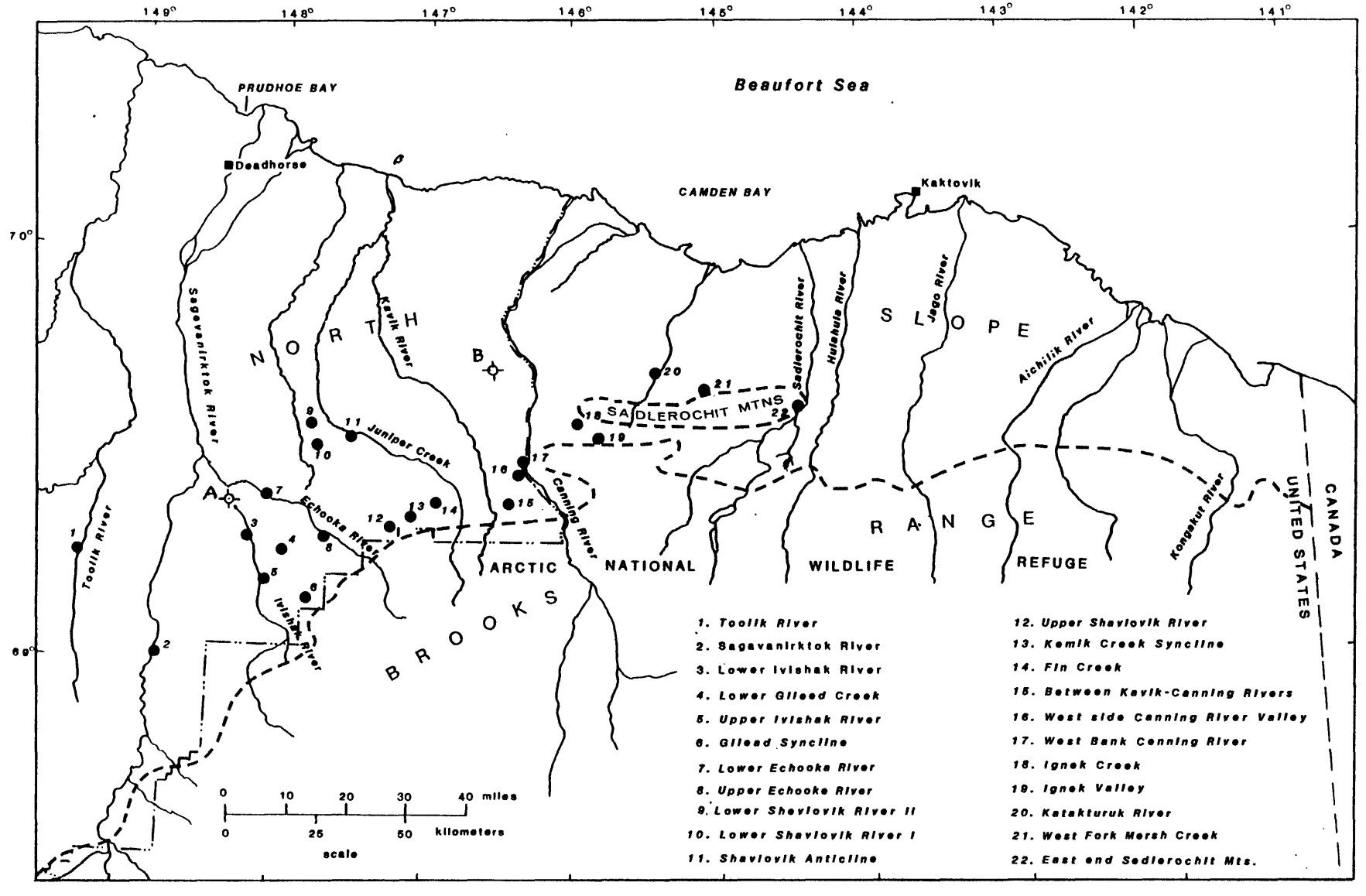


Figure 1. Index map of northeastern Alaska showing locations of measured sections. Well spots A and B are wells referred to in figure 3.

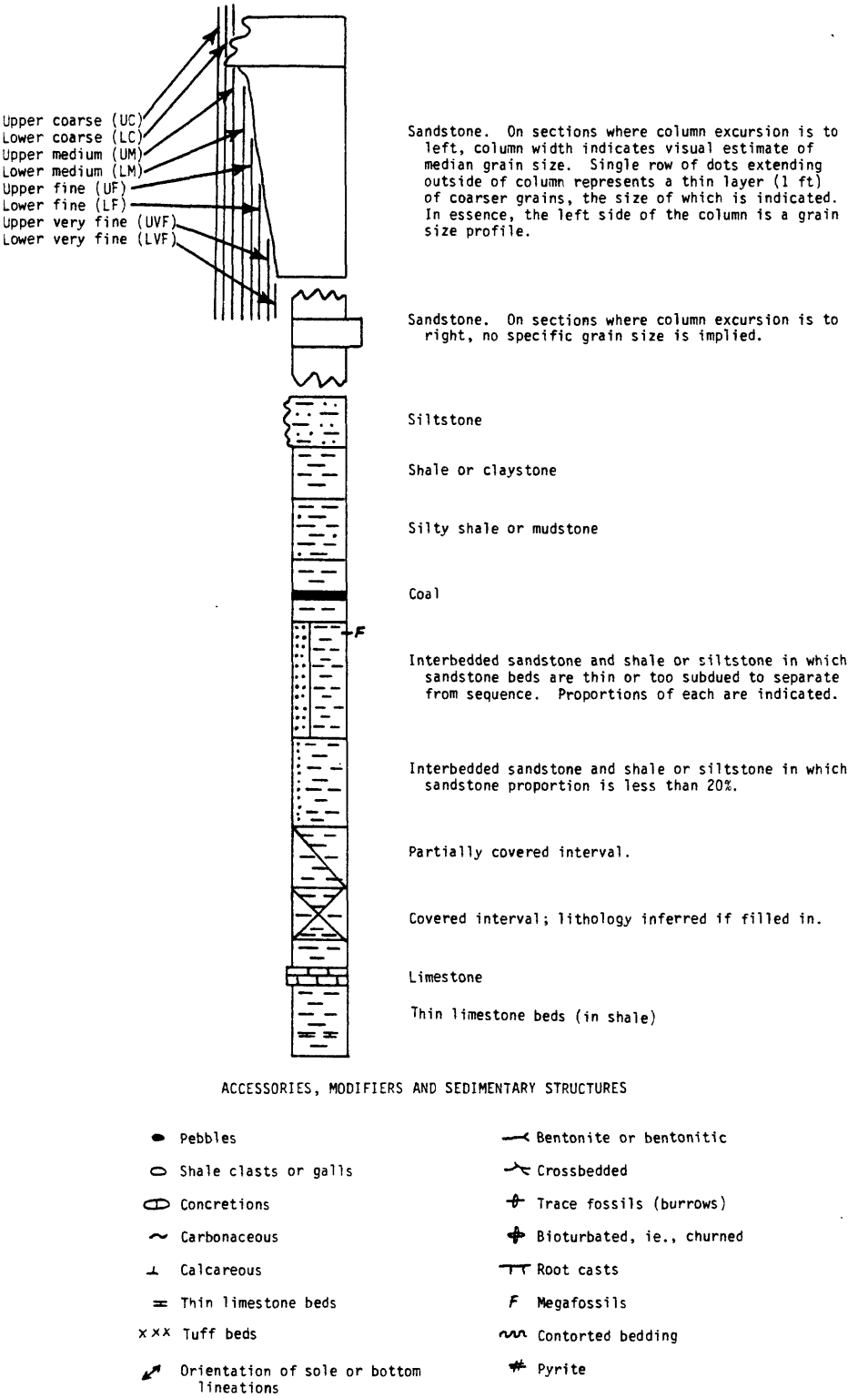


Figure 2. Explanation of symbols used for graphic sections.

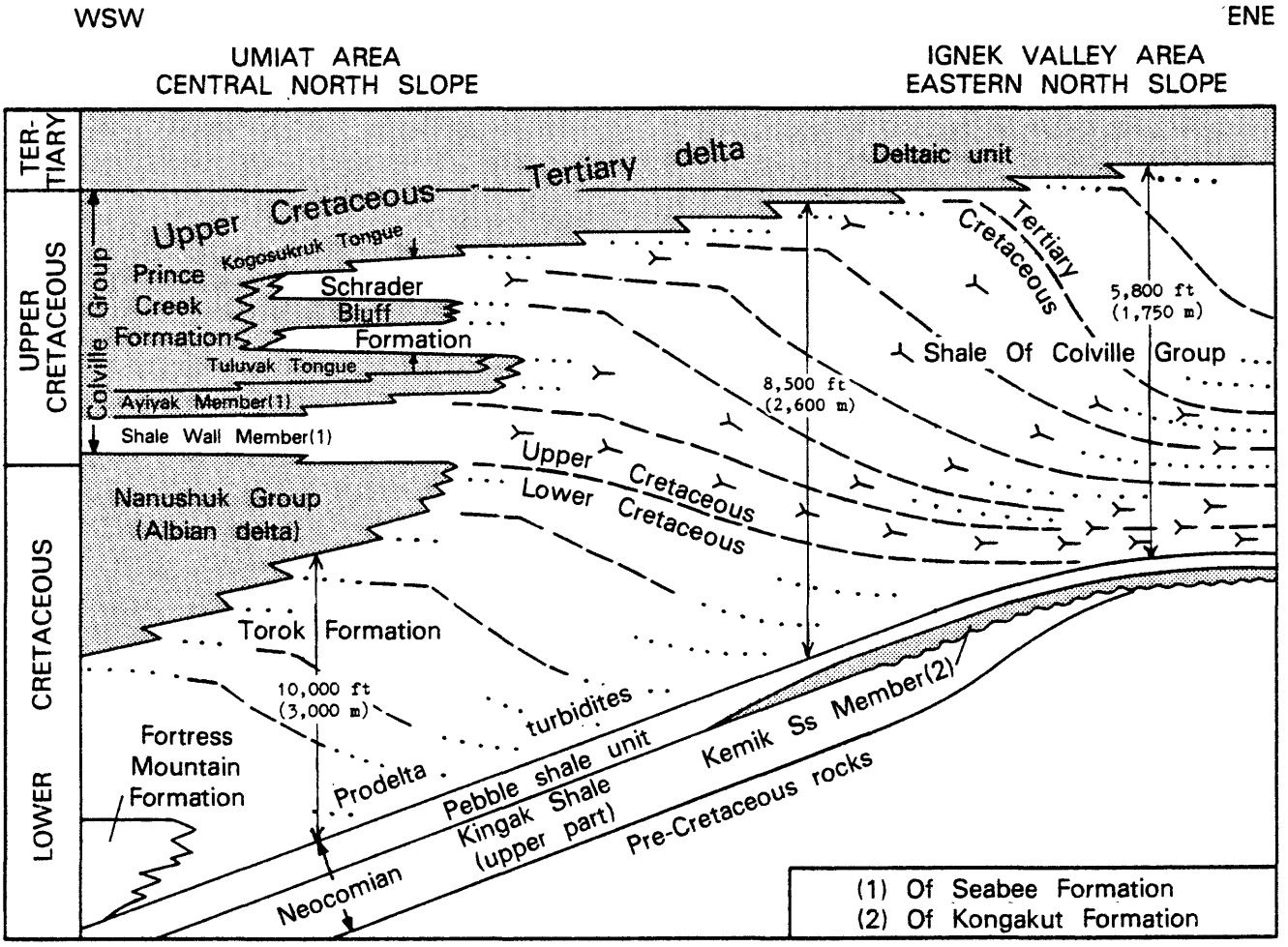
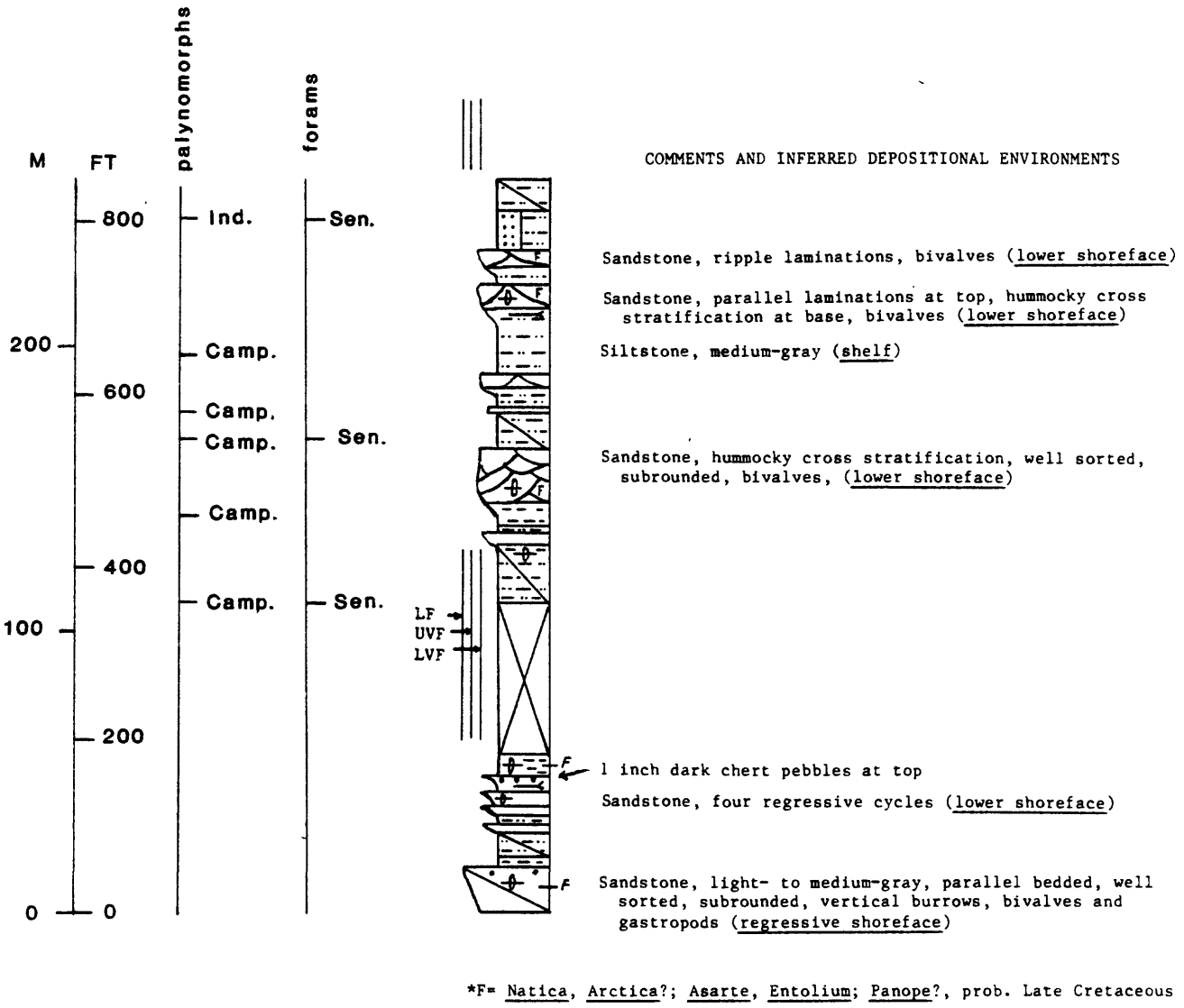


Figure 3. Schematic diagram showing inferred depositional relations of Cretaceous-lower Tertiary shallow marine-nonmarine strata and basinal strata between the central and eastern North Slope. No scale intended (modified from Molenaar, 1983). Annotated thicknesses are from , left to right, the Umiat area 70 mi (113 km) west of section 1; (2) Mobil Echooka 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



*F= 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

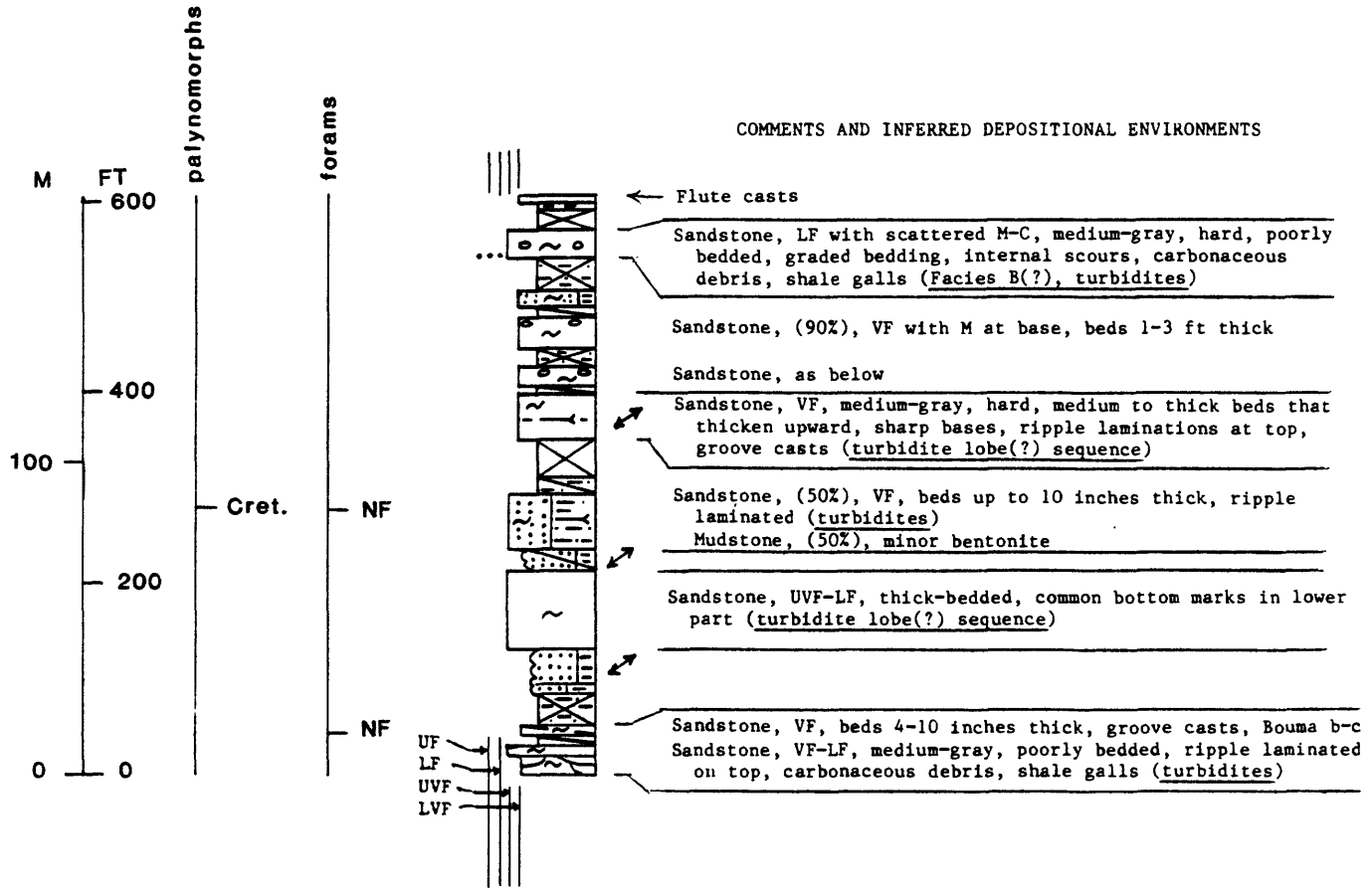


Figure 5. Section 2, Sagavanirktok River.

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

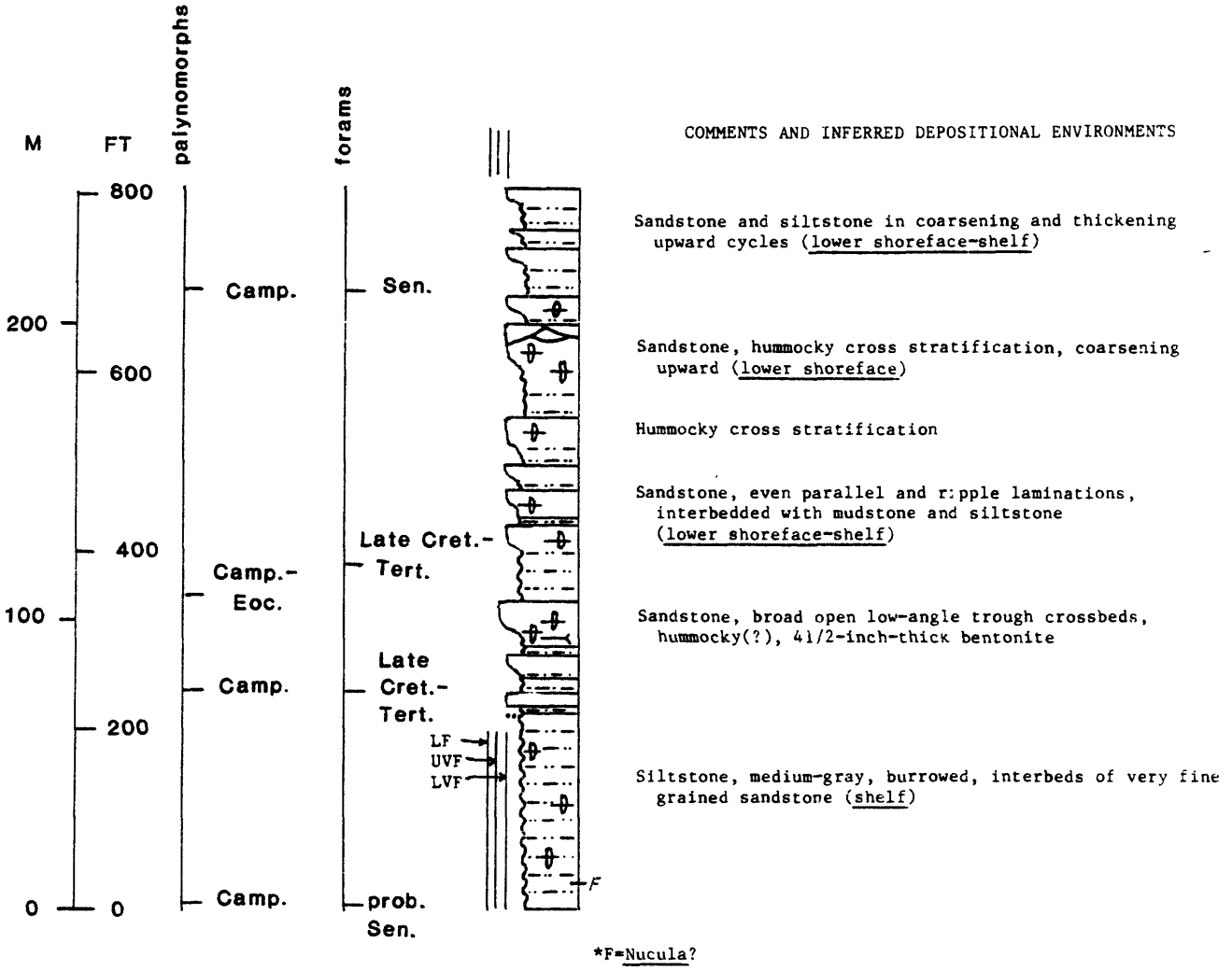
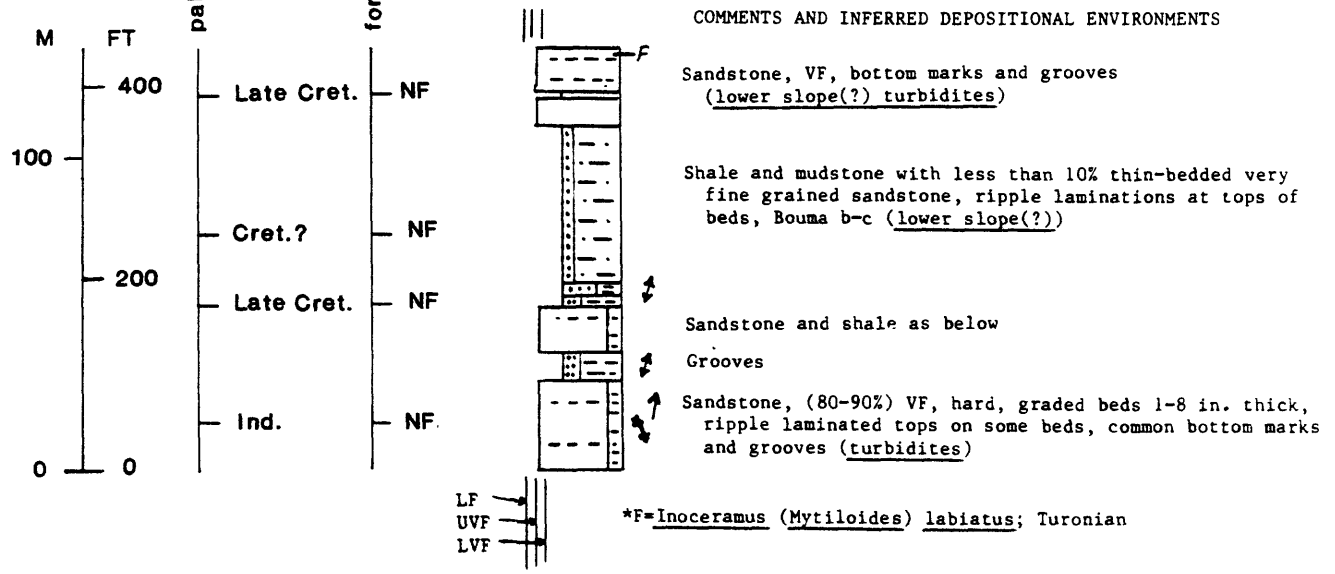


Figure 6. Section 4, lower Gilead Creek.

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



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

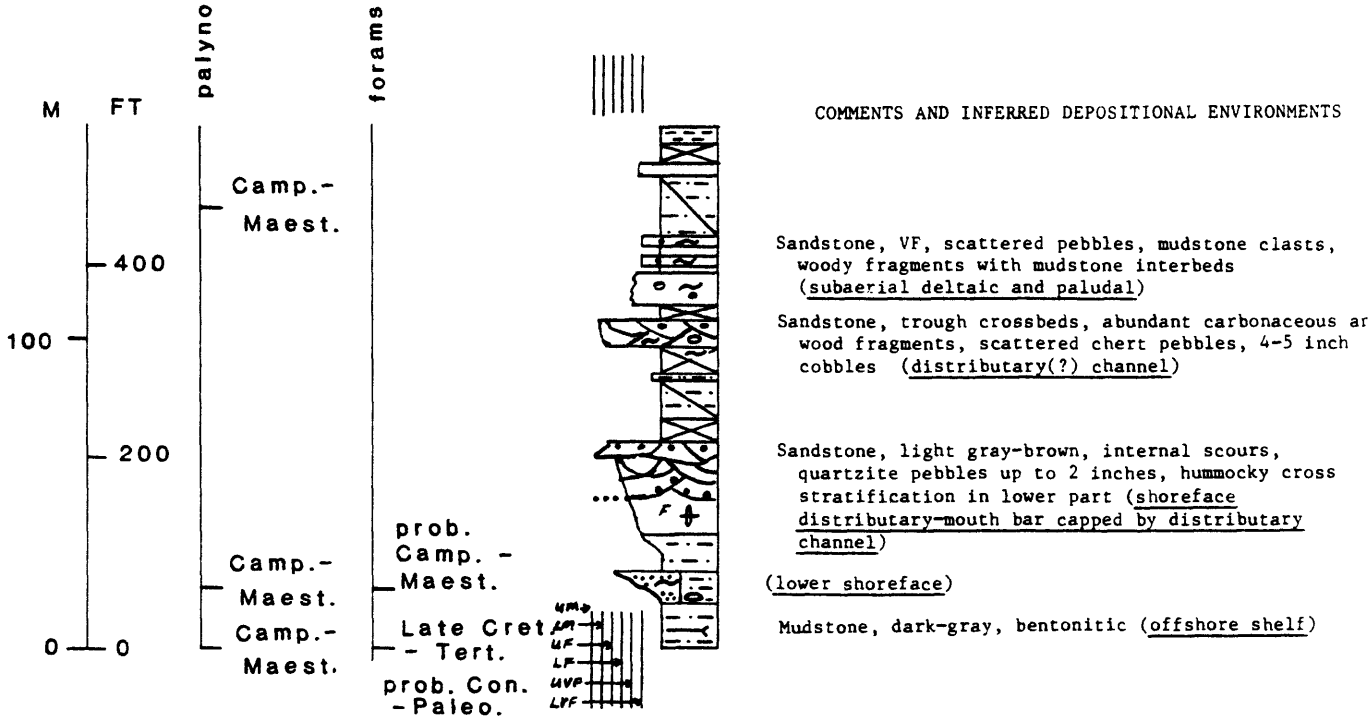


Figure 7. Sections 5 and 7, upper Ivishak River and lower Echooka River.

Section 8
Upper Echooka River
Early Cretaceous
NE 4, SW/4 sec. 36, T. 1 S., R. 18 E.
Sagavanirktok (B-2) Quadrangle

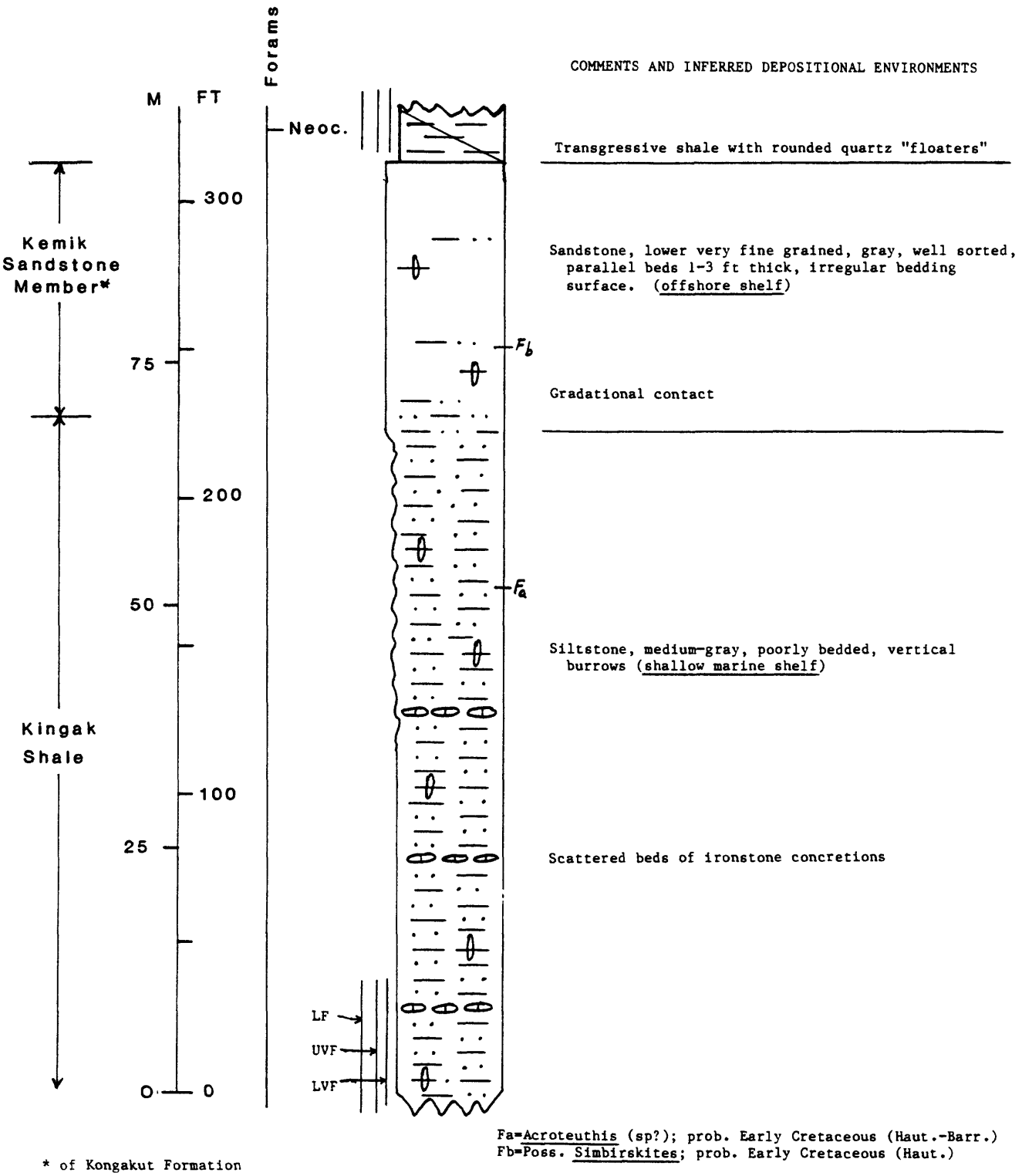
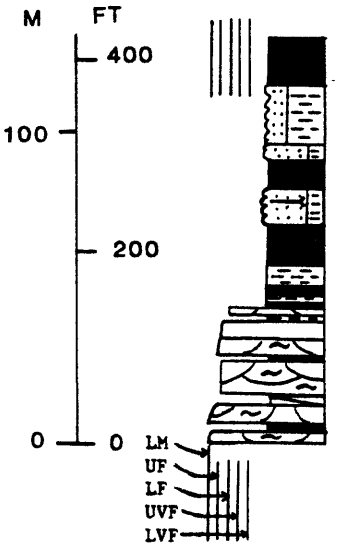


Figure 8. Section 8, upper Echooka River.

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)

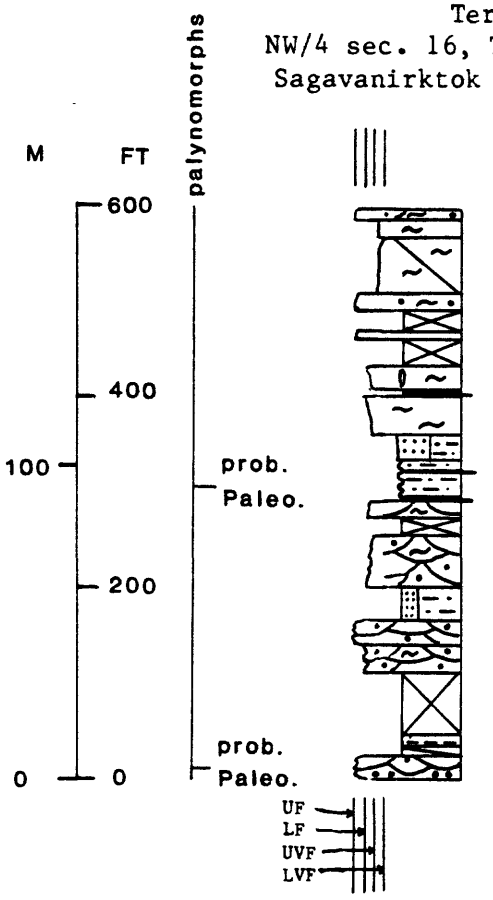
Coal (lignite), 29 ft thick

Interbedded sand and claystone, bentonitic

Coal, (lignite), 42 ft thick, R_o (vitrinite reflectance) = 0.27 (N. H. Bostick personal commun., 1984).

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)

3± 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-1) Quadrangle

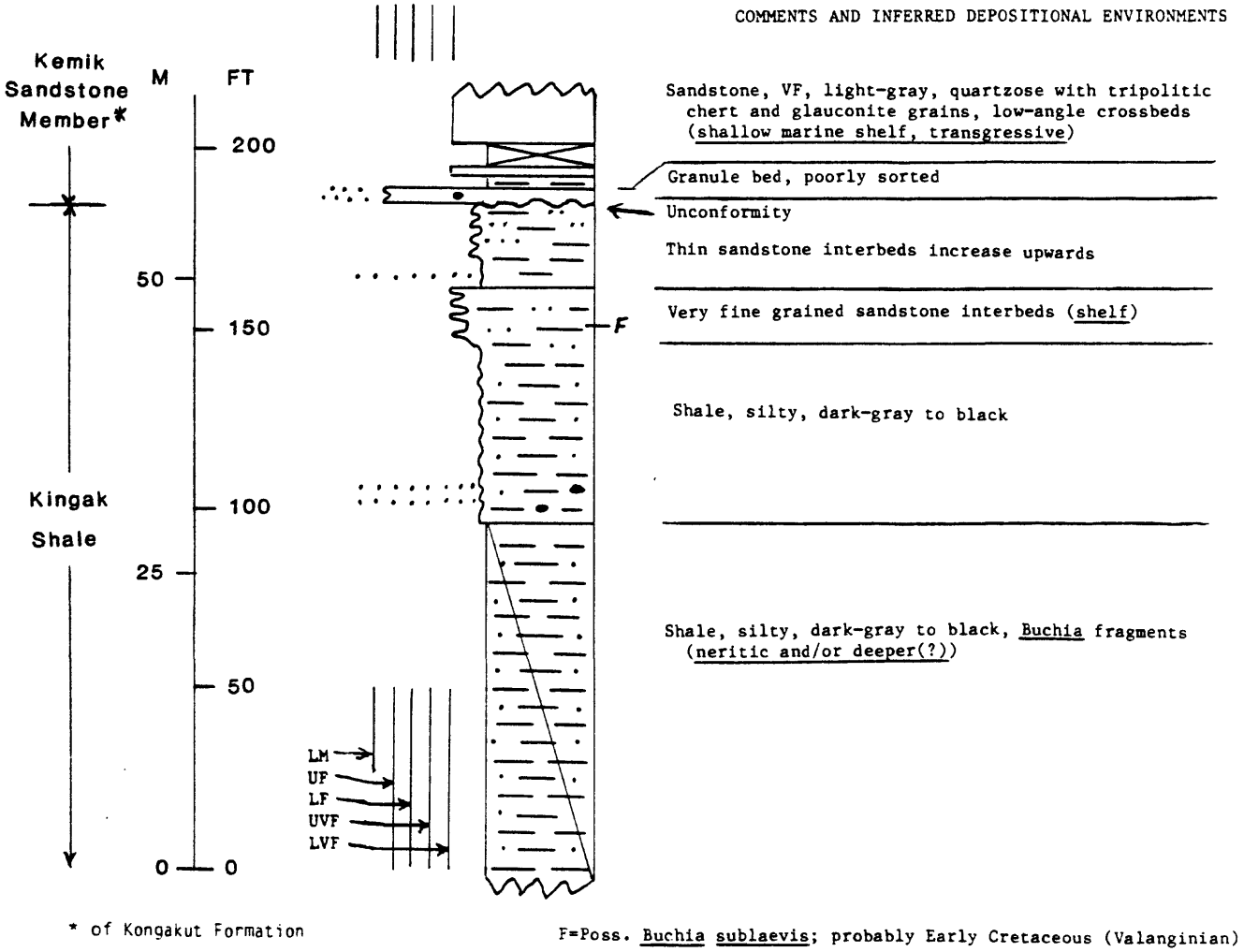
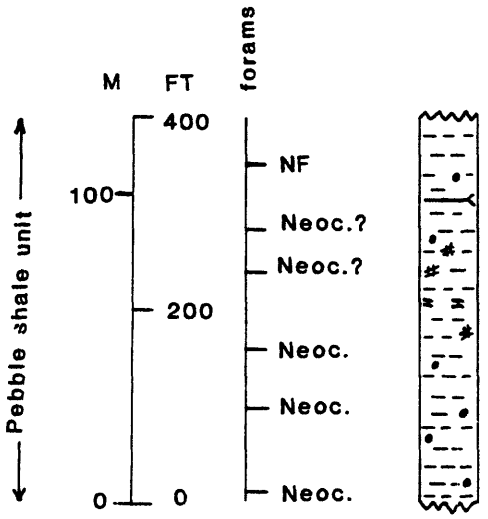


Figure 10. Section 12, upper Shaviovik River.

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

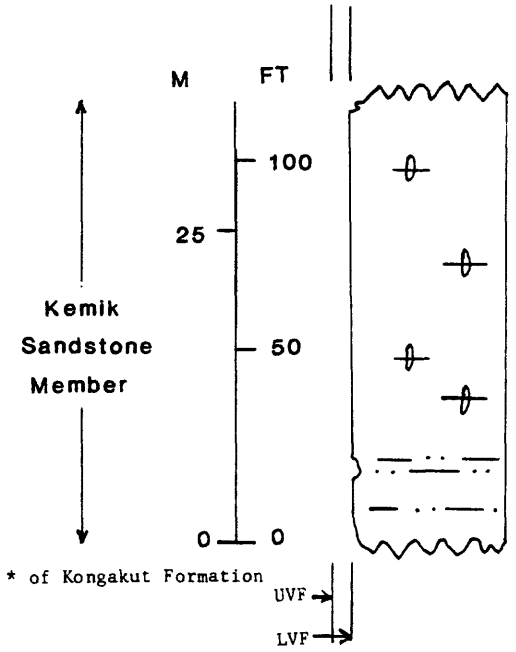
Shale, dark-gray (N-3), fissile, cannonball concretions, rare floating pebbles and quartz grains, one 4-inch-thick bentonite(?) bed (deep water(?))

Pyrite replaced pebbles(?)

Jarosite staining

(neritic 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

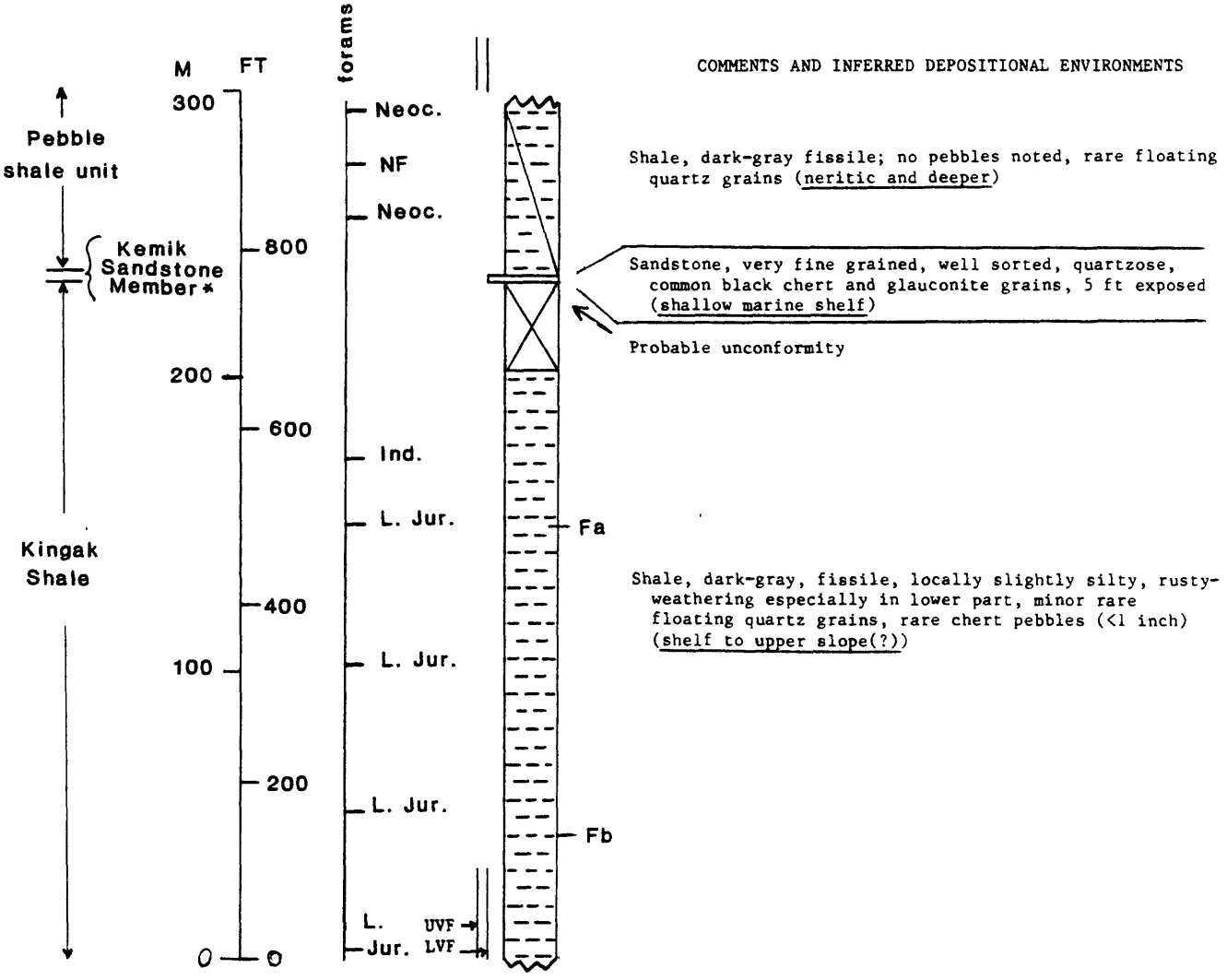
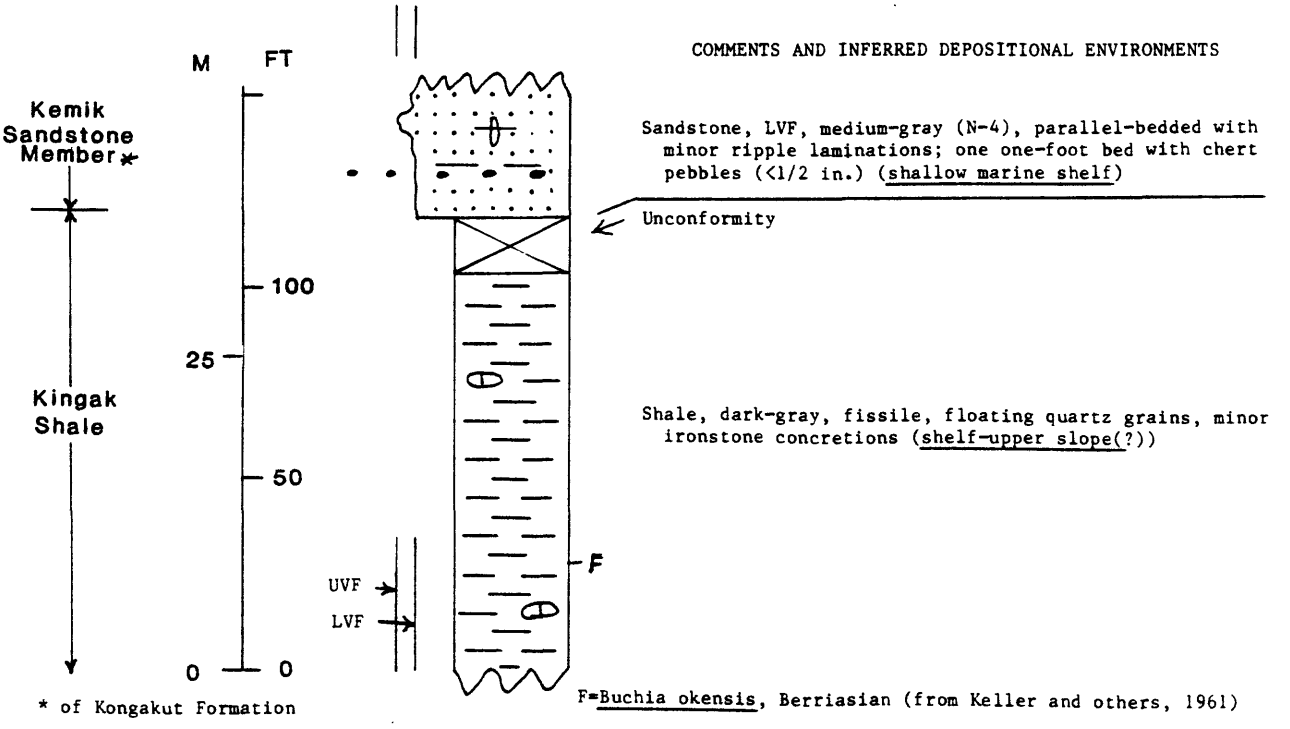


Figure 12. Section 15, between Kavik and Canning Rivers.

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



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

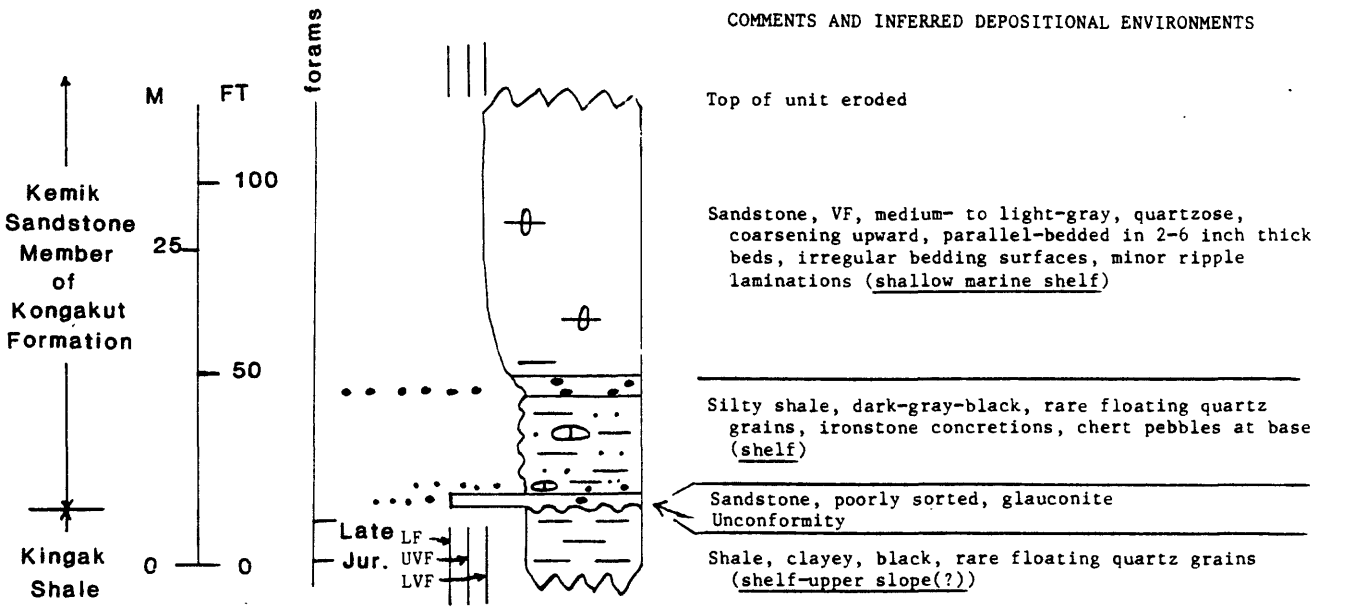
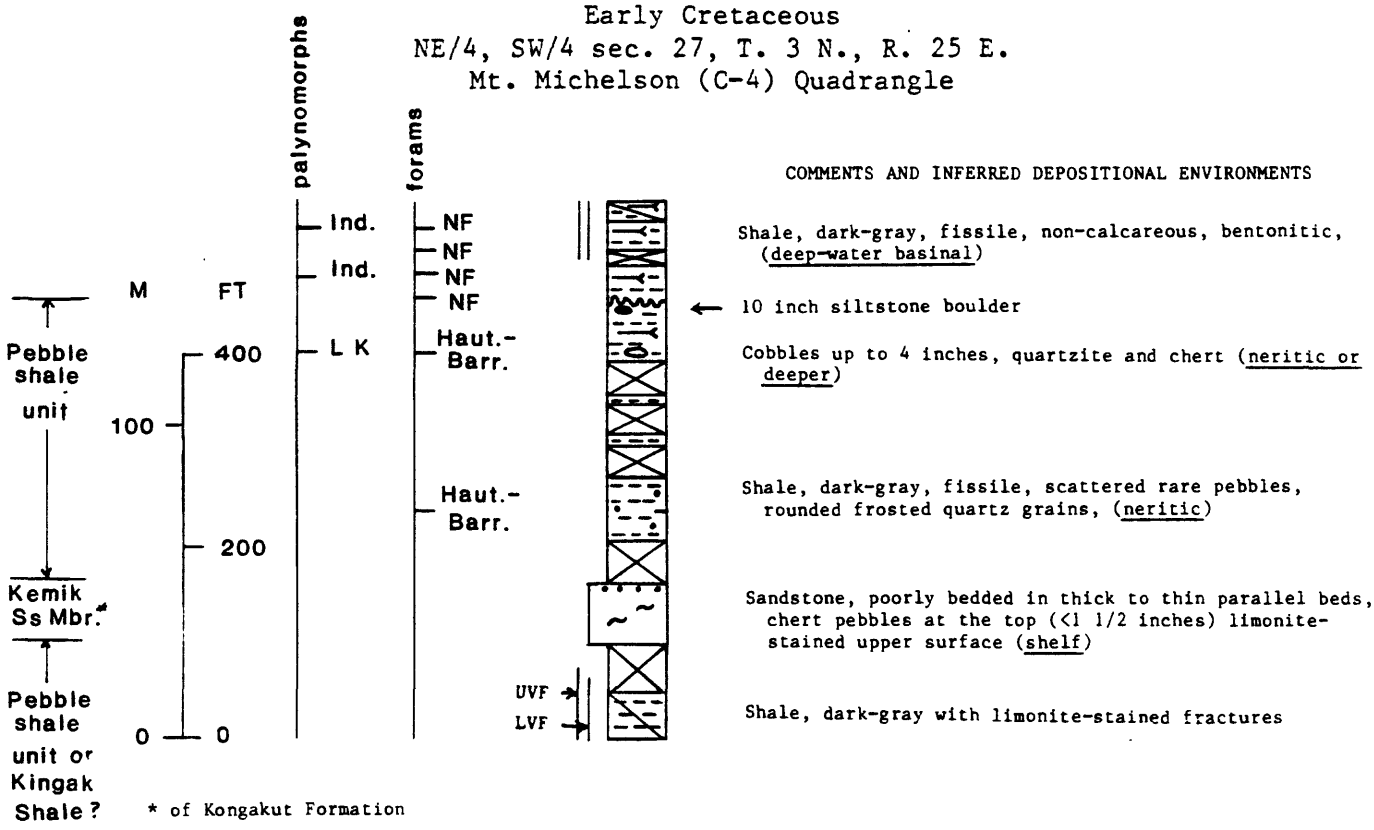


Figure 13. Sections 16 and 17, west side Canning River.



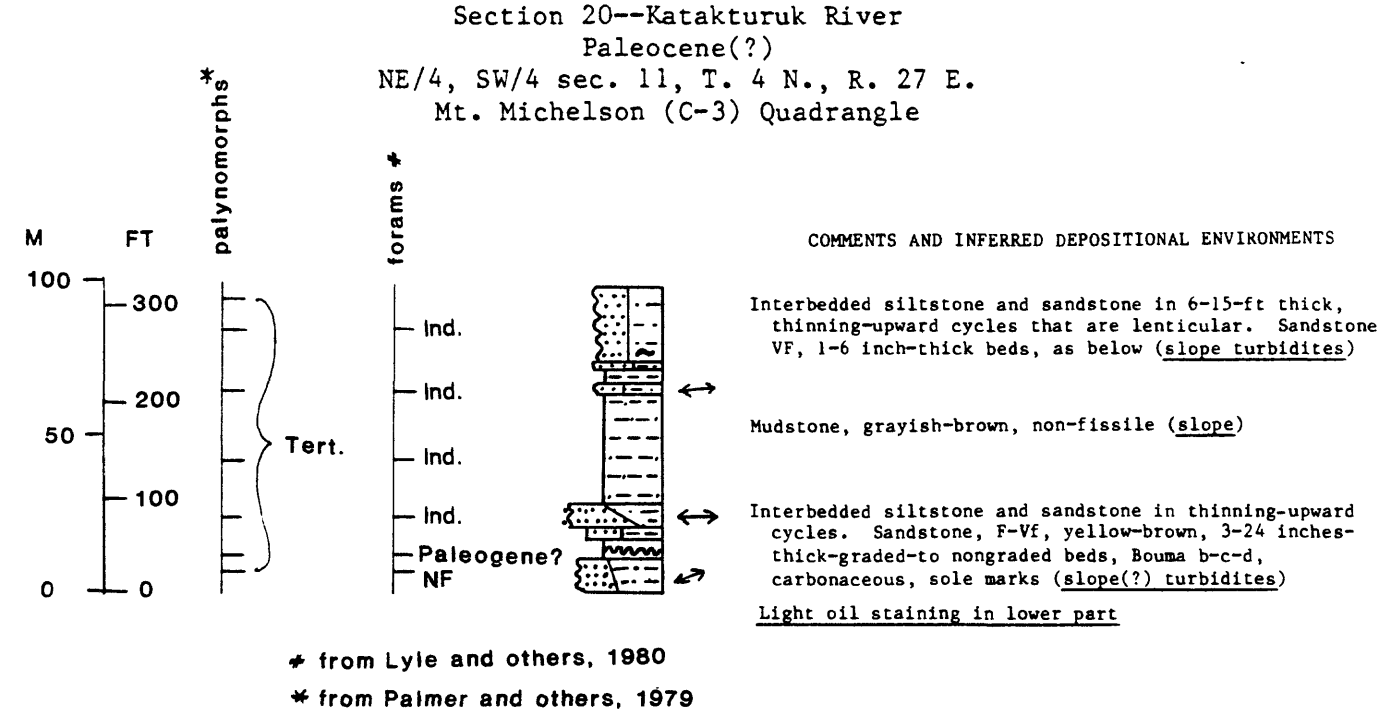
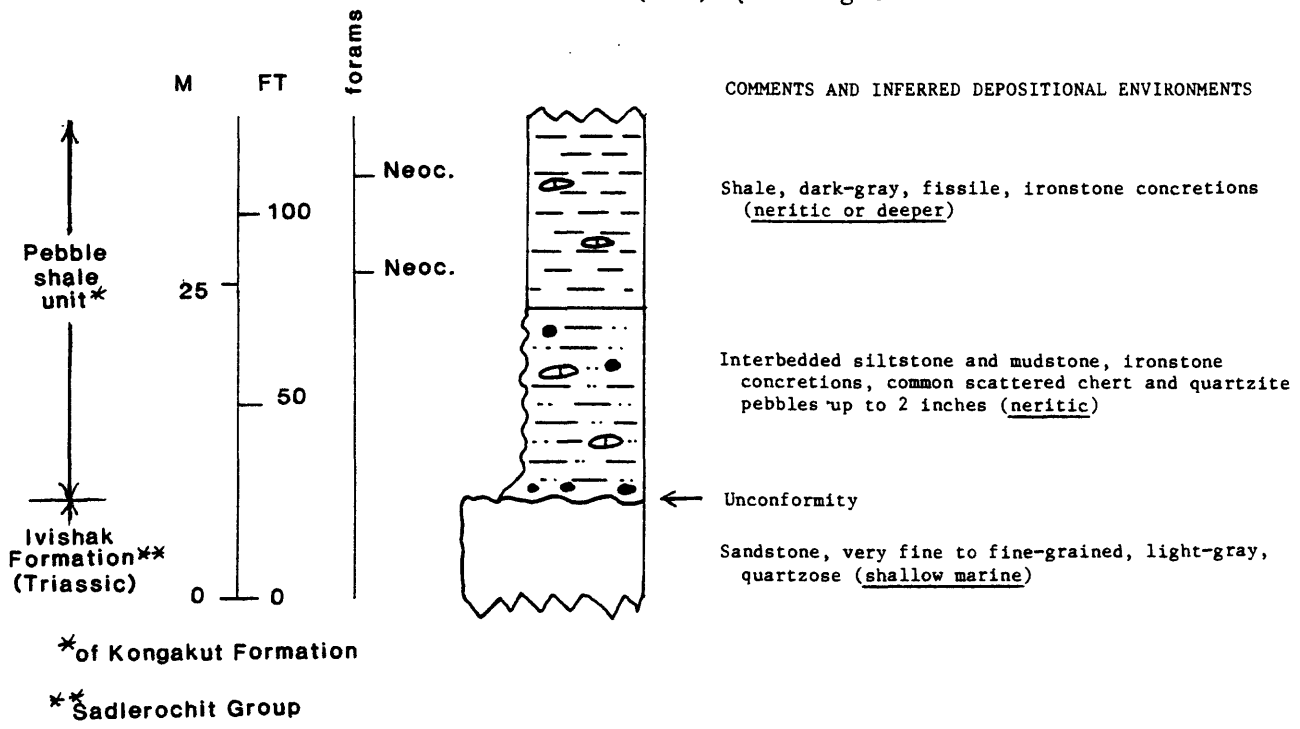
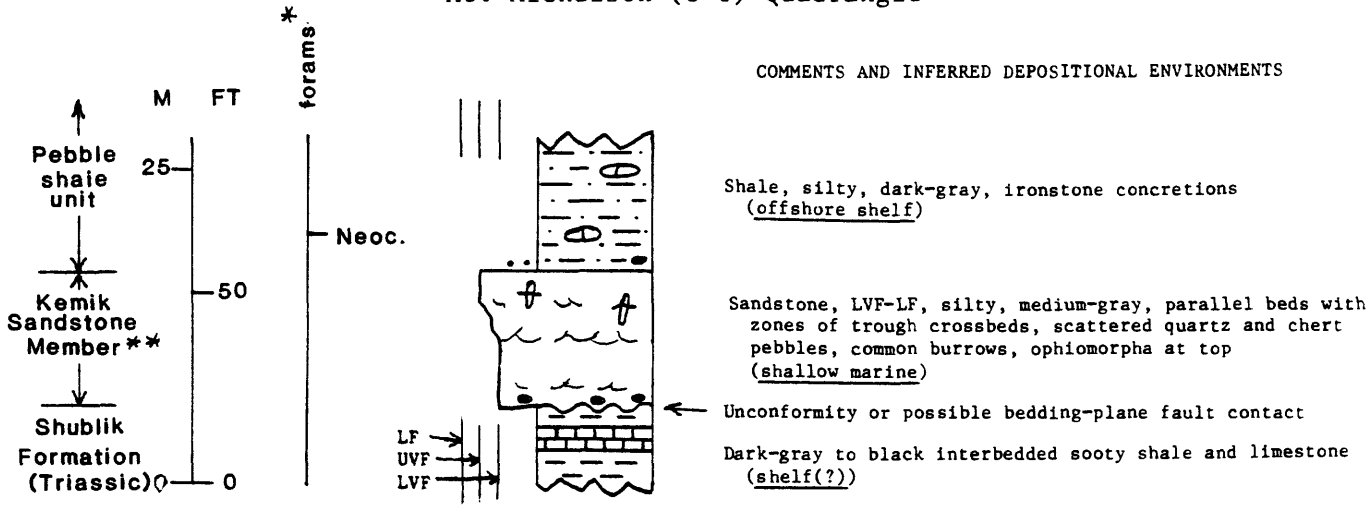


Figure 14. Sections 18 and 20, Ignek Creek and Katakturuk River.

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



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



* 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.