Public-data File 86-86a

# PRELIMINARY BEDROCK GEOLOGIC MAP OF THE NORTHERN CENTRAL SHUBLIK MOUNTAINS AND IGNEK VALLEY, NORTHEASTERN ALASKA

by

J.A. Rogers

Department of Natural Resources
Division of Mining and Geology

and

Brooks Range Research Program
University of Alaska Fairbanks

Alaska Division of
Geological and Geophysical Surveys

September 1986



3700 Airport Way
Fairbanks, Alaska 99709

This report contains preliminary information on the bedrock geology and structure of the northern central Shublik Mountains and Ignek Valley. All data were collected during the 1986 field season while participating in the Brooks Range Research Program, which is being conducted by the Department of Geology and Geophysics, University of Alaska, Fairbanks. Public-Data File 86-86a is a preliminary bedrock geologic map of the northern central Shublik Mountains and central Ignek Valley, northeastern Alaska. Special thanks is due to the Department of Natural Resources, Division of Mining and Geology for providing logistical support in the field, to Naresh Kumar, Atlantic Richfield Company, Alaska for providing transportation to and from Deadhorse, to Sohio Alaska for their contribution of funds and tour of Prudhoe Bay, to the Geophysical Institute, and the Department of Geology and Geophysics, University of Alaska, Fairbanks, Conoco, and Mobil Oil for their generous contribution of funds, John F. Rogers for his assistance in the field, and W.K., Wallace, Deptartment of Geology and Geophysics, University of Alaska, Fairbanks, for his help throughout this study.

# INTRODUCTION

Some of the northern-most exposures of rocks in the northeastern Brooks Range occur within the Shublik Mountains and Ignek Valley. These exposures are significant because they offer an important view of the structural geology of the Brooks Range. An understanding of the structural geology and evolution of the northeastern Brooks Range is necessary if an accurate evaluation for petroleum is to occur within the Arctic National Wildlife Refuge.

New contributions of this study include: 1) 1:25,000 scale mapping, 2) identification and mapping of subunits within the Katakturuk Dolomite and Nanook Limestone, 3) recognition of diagnostic clasts in the Kekiktuk Conglomerate, and 4) detailed documentation of structures in the area. Structural studies focused on lateral variations in range front structure, detachment in the Kayak Shale and folding in the overlying Lisburne Group, and documetation of a newly interpreted klippe in Ignek Valley.

The rocks in the Shublik Mountains and Ignek Valley can be subdivided into three different stratigraphic packages based on their structural characteristics. The first and oldest stratigraphic package, the Katakturuk Dolomite, Nanook Limestone, and Kekiktuk Conglomerate, is not internally deformed, it strikes nearly east-west (see map), and dips homoclinally to the south. This block was uplifted and tilted by displacement on a number of thrust faults along the range front.

The second stratigraphic package, the Kayak Shale, Lisburne Group, Sadlerochit Group, and Shublik Formation, is complexly folded above a detachment in the Kayak Shale which marks the structural boundary between the first and second stratigraphic packages. In the southern part of the area the Lisburne Group, Sadlerochit Group, and Shublik Formation have been tightly folded into asymmetric, north-vergent folds. In the eastern part of the area the entire package has been folded into a large, megascopic, upright, symmetric anticline. This anticline has been cut by a thrust fault which surfaces along the range front to the west and within the core of the range to the east. The amount of displacement along this fault is greatest to the west and decreases to zero to the east (see Map).

The third stratigraphic package contains the remainder of the units in the study area (see Lithic Descriptions). This package is structurally separated from the first two by thrust faulting to the west, but to the east, there are no breaks in stratigraphy. In Ignek Valley the third stratigraphic package has been gently to tightly folded into asymmetric, north-vergent folds and has several detachments within it. Displacement on one detachment, just below the Lower Cretaceous Kemik Sandstone has resulted in duplication of the Kemik Sandstone as many as six times in northern Ignek Valley (see Map). Displacement on another detachment, within the Upper Cretaceous Shale Wall, has duplicated the upper part of the Shale Wall and the Upper Cretaceous Turbidites.

## GEOLOGIC MAP SYMBOLS


Strike and dip of beds

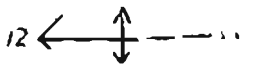

Strike and dip of beds where stratigraphic top is known from sedimentologic features


Strike and dip of overturned beds

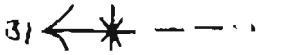

Strike and dip of overturned beds where stratigraphic top is known from sedimentologic features



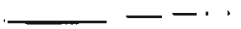
Vertical beds




Strike of the axial trace and plunge of the axis of a large anticline; long dashed where approximately located, dotted where inferred

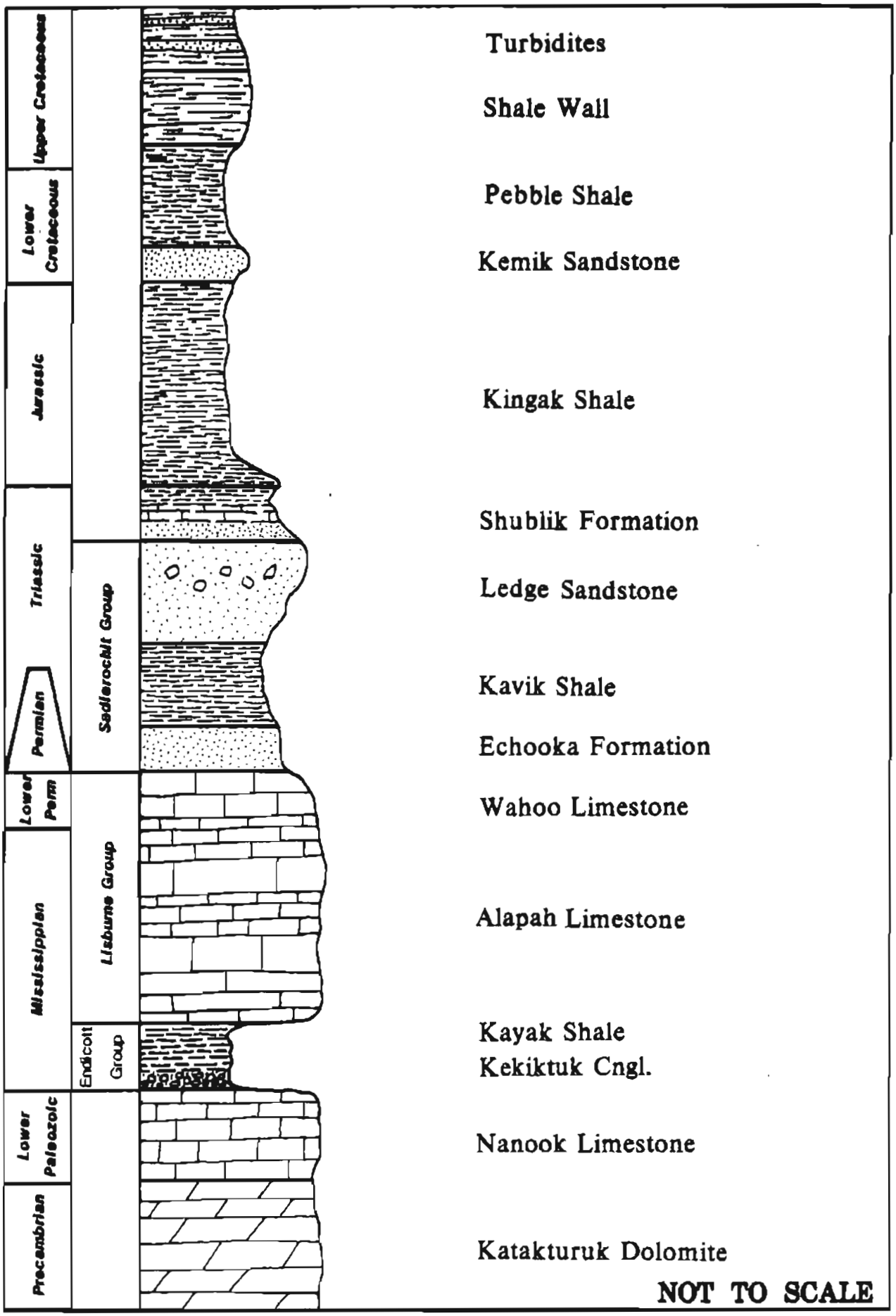



Strike of the axial trace and plunge of the axis of a large syncline; dashed where approximately located, dotted where inferred



Contact; solid where known, dashed where approximately located, dotted where inferred

Thrust fault, solid where known, dashed where approximately located, dotted where inferred, triangles on hanging wall




**Generalized stratigraphic column of the Shublik Mountains and Ignek Valley, ( adapted from Robinson and others, 1986 )**

## DESCRIPTION OF MAP UNITS

### uKt Upper Cretaceous Turbidites

Stratigraphic nomenclature and age determinations for the Upper Cretaceous Turbidites are based on Robinson and others, 1986.

- -Composed of interbedded lithic sandstones, siltstones, and shale.
- -Lithic sandstones are gray to brown, medium (5-15 cm) to thick (.5-1 m) bedded, medium (.3-.8 mm) grained, commonly graded, fluted and grooved, and non-calcareous.
- -Bouma sequences vary with more complete sequences occuring towards the top of the unit.
- -A non-resistant unit which outcrops only in stream banks or hill tops in Ignek Valley.
- -Lower contact of the Upper Cretaceous Turbidites is defined by the first upsection occurrence of sandstone turbidites above the Colville Group.

### uKs Upper Cretaceous Shale Wall Member of the Seabee Formation, Colville Group

Stratigraphic nomenclature and age determinations of the Shale Wall are based on Robinson and others, 1986.

- -Composed of interbedded thin (2.5-10 cm) layers of black fissile shale, gray, non-calcareous siltstone, buff colored, siliceous tuff, orange and yellow bentonite, and thick (.3-.5 m) layers of graded and cross-bedded limestones.
- -Forms Prominently colored hills in Ignek Valley which lack vegetation.
- -Lower contact of the Upper Cretaceous Shale Wall is defined by the first upsection occurrence of bentonite above the Kongakut Formation.

### Kongakut Formation

Stratigraphic nomenclature and age determinations for the Kongakut Formation are based on Detterman and others, 1975.

### Cretaceous Pebble Shale and Lower Cretaceous Kemik Sandstone

### Kp Cretaceous Pebble Shale

- -Dark gray to black, non-fossiliferous, fissile shale.
- -Contains blebs and layers of clay ironstone concretions.
- -Black chert and white quartz pebbles are abundant near the base but rare throughout the rest of the unit.
- -A non-resistant unit which forms saddles and recessive slopes in Ignek Valley.

-Occasionally outcrops where buttressed by the Kemik Sandstone.
-Lower contact of the Upper Cretaceous Pebble Shale is defined by the first upsection occurrence of shale above the Kemik Sandstone.

lKk Lower Cretaceous Kemik Sandstone

-Composed of interbedded layers of chert pebble conglomerate, well cross-bedded, bioturbated, and fossiliferous sandstone.
-Sandstones are light gray to rusty brown, medium (5-10 cm) to thick (.3-1 m) bedded, very fine (<.1 mm) grained, glauconitic (1-5 %), hematite stained, tripolitic chert bearing, non-calcareous to strongly calcareous, sub-lithic quartz arenite to litharenite.
-Conglomerates are black chert and white quartz pebble conglomerates which are commonly 1-3 cm. thick and as thick as 30-50 cm., continuous from outcrop to outcrop, and more abundant in the lower part of the unit.
-Lower part of the unit contains hummocky cross-stratified sandstones alternating with muddy bioturbated sandstones that fracture parallel to bedding.
-Upper part of the unit contains cleaner, conchoidally fracturing, massive sandstones with interbedded rusty red, thin (2.5-7.5 cm) beds of fossiliferous (pelecypods) sandstones.
-A very resistant unit which forms prominent ridges in Ignek Valley.
-Lower contact of the Lower Cretaceous Kemik Sandstone is defined by the first upsection occurrence of a basal clay above the Kingak Shale.

JKk Jurassic-Cretaceous Kingak Shale

Stratigraphic nomenclature and age determinations for the Kingak Shale are based on Leffingwell, 1919, and Detterman and others, 1975.

-Black, fossiliferous (ammonites, belemnites, and pelecypods), pyrite bearing fissile shale.
-Contains numerous beds of dark gray siltstone, and siltstone concretions.
-Abundant, thinly (2.5-5 cm) bedded pyrite is common.
-Nonresistant, forming saddles and recessive slopes, and outcrops rarely in stream banks in Ignek Valley.
-Lower contact of the Jurassic-Cretaceous Kingak Shale is defined by the first upsection occurrence of Jurassic index fossils above the Shublik Formation.

Trs Triassic Shublik Formation

Stratigraphic nomenclature and age determinations for the Shublik Formation are based on Detterman and others, 1975.

-Composed of three members; a siltstone member, limestone member, and claystone member.
-Upper claystone member is dark gray to black, thin (1.25-2.5 cm) bedded, very fine grained, fossiliferous (pelecypods), phosphatic, calcareous, and gives a fetid odor when broken.
-Middle limestone member is dark gray to black, thin (5-12.5 cm) bedded, very fine grained, fossiliferous (pelecypods), phosphatic, calcareous, and gives a fetid odor when broken.
-Lower siltstone member is light brown to black, thin (5-12.5 cm) bedded, micritic, fossiliferous (pelecypods), phosphatic, and gives a fetid odor when broken.
-Phosphate commonly occurs in all three members as black pebble sized nodules.
-Poor to moderate exposure occurs along stream banks on the northern flank of the Shublik Mountains.
-Lower contact of the Triassic Shublik Formation is defined by the first upsection occurrence of the lower black siltstone above the Sadlerochit Group.

Sadlerochit Group

Stratigraphic nomenclature and age determinations for the Sadlerochit Group are based on Keller and others, 1961, and Detterman and others, 1975.

Lower Triassic Ivishak Formation and Permian Echooka Formation

-Fire Creek Siltstone is not present in the area or is covered everywhere by vegetation.

lTri Lower Triassic Ivishak Formation (undifferentiated)

-Composed of two members, the Ledge Sandstone and the Kavik shale.
-Ledge Sandstone is medium gray to rusty brown, thick (.33-.67 m) bedded, medium to coarse (.3-.8 mm) grained, cross-bedded, tripolitic chert and pyrite bearing quartz arenite.
-Very resistant cliff former, upwards to 67 m. thick.
-Becomes finer grained (.1-.2 mm) and darker gray upsection.
-Kavik Shale is composed of tannish yellow, thin (.25-5 m) bedded, very fine (.1-.2 mm) grained, hematite stained, non-calcareous siltstone.
-Non-resistant saddle and recessive slope former.

-The lower contact of the Lower Triassic Ivishak Formation is defined by the first upsection occurrence of siltstone above the Echooka Formation.

Pe Permian Echooka Formation (undifferentiated)

-Composed of two members, the Ikiakpaurak member and the Joe Creek Member.
-Ikiakpaurak member is composed of brown, thin (2.5-5 cm) bedded, very fine (<.1 mm) grained, glauconitic, and calcareous litharenite and black, moderately (.2-.3 m) bedded, very fine (<.1 mm) grained, siltstone.
-Joe Creek member is composed of rusty orange, thin (7.5-20 cm) bedded, very coarse (2-3 cm) grained, graded, fossiliferous (bryozoans, crinoids, brachiopods, corals, and zoophycus trace fossils), hematite stained, glauconitic, calcareous, bioclastic conglomerate, black and green friable shale, a gray, thick (1-1.2 m) bed of medium to course (.5-1.2 mm) grained, siliceous quartz arenite, and a gray, thick (1.2-2.7 m) bedded black chert, white quartz pebble, and lithic cobble conglomerate.
-Resistant unit forming ridges and hogbacks.
-Members pinch out laterally.
-The lower contact of the Permian Echooka unconformably overlies the Wahoo Limestone.

## Lisburne Group

Stratigraphic nomenclature and age determinations for the Lisburne Group are based on Schrader, 1904, Leffingwell 1919, Bowsher and Dutro, 1957, Brosge and others, 1962, Armstrong and others, 1970, and Sable, 1977.

### Pennsylvanian Wahoo Limestone and Mississippian Alapah Limestone

Pw Pennsylvanian Wahoo Limestone

-Limestone is tannish gray to orange, thin (2.5-5 cm) to thick (3.3-10 m) bedded, contains irregular gray and black chert nodules, fossiliferous (bryozoans, corals, and brachiopods), pyrite bearing, bioclastic grainstone.
-Orange beds are dolomitic.
-Chert blebs are predominately parallel to bedding.
-Pyrite occurs as large crystals several tens of millimeters in size.
-Resistant unit forming massive cliffs in the Shublik Mountains.
-Upper contact of the Pennsylvanian Wahoo Limestone is a channelized unconformity on which the Echooka Formation lies.

-Lower contact of the Pennsylvanian Wahoo Limestone is defined by the first upsection occurrence of a massive bed of tannish orange weathering limestone above the Alapah Limestone.

Ma **Mississippian Alapah Limestone** (undifferentiated)

-Limestone is dark gray and black, thick (1-5 m) bedded, contains black irregular chert nodules, fossiliferous (crinoids, bryzoans, and corals), bioclastic, grain stone.
-Alternating black and dark gray layers gives the unit a banded appearance.
-Resistant unit forming cliffs and steep talus slopes in the Shublik Mountains.
-Lower contact of the Mississippian Alapah Limestone is defined by the first upsection occurrence of gray limestone above the Endicott Group.

## Endicott Group

Stratigraphic nomenclature and age determinations for the Endicott Group are based on Leffingwell, 1919, Bowsher and Dutro, 1957, Brosge and others, 1962, Dutro and others, 1972, and Armstrong and Mamet, 1975.

### Lower Mississippian Kayak Shale and Kekiktuk Conglomerate

lMks **Lower Mississippian Kayak Shale**

-Shale is black, thin (2.5-7.5 cm) bedded, non-calcareous shale.
-Grading defines bedding.
-The Kayak Shale is a melange, being pervasively sheared and mixed with boulder sized blocks of the Kekiktuk Conglomerate and undifferentiated mafic flows.
-Nonresistant unit forming recessive slopes in the Shublik Mountains.
-Lower contact of the Kayak Shale is defined by the first upsection occurance of shale above the Nanook Limestone.

lMkc **Lower Mississippian Kekiktuk Conglomerate**

-Conglomerate is a dark green to black, poorly sorted, angular, chert pebble and mafic clast bearing.
-Occurs only sporadically in the Shublik Mountains near the upper contact of the Nanook Limestone and as structural blocks within the Kayak Shale.

## Lower Paleozoic Nanook Limestone

Stratigraphic nomenclature and age determinations for the Nanook Limestone are based on Dutro, 1972 and Blodgett and others, 1986.

### lPzng Lower Paleozoic Nanook Grey Limestone

- -Limestone is bluish gray, massive, highly fractured locally, unfossiliferous grainstone.
- -Resistant unit forming cliffs and steep talus slopes in the Shublik Mountains.
- -Lower contact of the gray limestone is defined by the first upsection occurrence of a zone of red weathering limestone above the white dolomite.

### lPznw Lower Paleozoic Nanook White Dolomite

- -Dolomite is creamy white, thick (.67-1 m) bedded, algal laminated, microcrystalline dolomite.
- -Interbedded with white, thick (.67-1 m) beds of microcrystalline limestone.
- -Algal laminations are mostly 2.5-7.5 cm. thick and commonly ripped up.
- -Resistant unit forming cliffs and steep talus slopes in the Shublik Mountains.
- -Lower contact of the white dolomite is defined by the first upsection occurrence of white dolomite above the black limestone.

### lPznb Lower Paleozoic Nanook Black Limestone

- -Limestone is dark gray to black, thin (10-15 cm) bedded, microcrystalline limestone interbedded with black shales, red calcareous siltstone and limestone, and variegated shale.
- -Resistant where mostly limestone but forms recessive slopes where mostly shale.
- -Lower contact of the black limestone is defined by the first upsection occurrence of thin bedded shales above the Katakturuk Dolomite.

## Precambrian Katakturuk Dolomite

Stratigraphic nomenclature and age determinations for the Katakturuk Dolomite are based on Dutro, 1972, Robinson and others, 1986, and Blodgett and others, 1986.

### pCkp Precambrian Katakturuk Pink Dolomite

- -Dolomite is a pinkish gray weathering, massive, cross-bedded dolomite.
- -Fractures conchoidally.

-Unit becomes thicker to the east.
-Forms talus slopes of angular blocks in the Shublik Mountains.
-Lower contact of the pink dolomite is defined by the first upsection occurrence of dolomite with a pink coloration above the upper craggy dolomite.

pCkuc Precambrian Katakturuk Upper Craggy Dolomite

-Upper craggy is medium gray, thick (1-1.67 m) bedded, cross-bedded, dolomite.
-Resistant, forming cliffs and bare ridges in the Shublik Mountains.
-Lower contact of the upper craggy is defined by a thin (1.67-2.67 m) zone of algally laminated dolomite above the lower craggy dolowite.

pCklc Precambrian Katakturuk Lower Craggy Dolomite

-Lower craggy is medium gray, thick (1-1.33 m) bedded, cross-bedded, algally laminated, stromatolitic dolomite.
-Less resistant than the upper craggy, composed of a upper cliff former, upper recessive unit, lower cliff former and lower recessive unit.
-Lower contact of the lower craggy is defined by a tannish orange stromatolitic marker unit above the brown weathering dolomite.

pCkbn Precambrian Katakturuk Brown Weathering Dolomite

-Brown weathering dolomite is composed of an upper dark gray, zone, 3.33-5 m. thick, of dolomite sandstone and a white zone, 3.33-6 m. thick, of pisolitic dolomite.
-Moderately resistant unit forming talus slopes in the Shublik Mountains.
-Lower contact of the brown weathering dolomite is defined by the first upsection occurrence of the pisolitic dolomite above the chert and oolite unit.

pCkco Precambrian Katakturuk Chert and Oolite Unit

-Chert and oolite unit is a medium gray, thick (.67-1.67 m) bedded, cross-bedded, algally laminated, stromatolitic, silicified dolomite.
-Stromatolites occur in continuous beds and vary in height from a few inches to several feet.
-Dolomitic material weathers out, on talus blocks, forming highly abrasive surfaces.
-Very resistant unit forming massive cliffs in the Shublik Mountains.
-Lower contact of the chert and oolite unit in the Shublik Mountains is a fault contact with younger rock units.

## Undifferentiated Mafic rocks of uncertain age and composition

umf **Undifferentiated Mafic Flows**

- -Mafic flows are dark green to black, porphyritic, and vesicular.
- -Occurs as irregular, separate, structural blocks within the Kayak Shale.

umi **Undifferentiated Mafic Intrusive**

- -Mafic intrusive is a dark green to black, porphyritic, biotite bearing mafic dike.
- -Intrusive occurs within the Lower Paleozoic Nanook black limestone (lPznb).

## References Cited


Armstrong, A.K. and Mamet, B.L., 1975, Carboniferous biostratigraphy, northeastern Brooks Range, Arctic Alaska: U.S. Geol. Survey Prof. Paper 884, p. 29.

Armstrong, A.K., Mamet, B.L., and Dutro, J.T., 1970, Foraminiferal zonation and carbonate facies of Carboniferous (Mississippian and Pennsylvanian) Lisburne Group, central and eastern Brooks Range, Arctic Alaska: Am. Assoc. Petroleum Geologists Bull, v. 54, p. 687-698.

Blodgett, R.B., Clough, J.G., Dutro, J.T. Jr., Ormiston, A.R., Palmer, A.R., and Taylor, M.E., 1986: Age revisions of the Nanook Limestone and Katakturuk Dolomite, northeastern Brooks Range, Alaska: Abstracts with Programs, Geol. Society of Am., Cordilleran Section Meeting, v. 18, no 2, p. 87.

Bowsher, A.L., and Dutro, J.T., 1975, The Paleozoic section in the Shainin Lake area, central Brooks Range, northern Alaska: U.S. Geological survey Prof. Paper 303-A, 39p.

Brosge, W.P., Dutro, J.T. Jr., Mangus, M.D., and Reiser, H.N., 1962, Paleozoic sequence in eastern Brooks Range, Alaska: Am. Assoc. Petroleum Geologist Bull. v. 46, no. 12, p. 2174-2198.

Detterman, R.L., Reiser, H.N., Brosge, W.P., and Dutro, J.T. Jr., 1975, Post-Carboniferous stratigraphy of northeastern Alaska: U.S. Geol. Survey Prof. Paper 886, p. 46.

Dutro, J.T. Jr., Brosge, W.P., and Reiser, H.N., 1972, Significance of recently discovered Cambrian fossils and reinterpretation of Neruokpuk formation, northeastern Alaska: Am. Assoc, Petroleum Geologists Bulletin, v.56, no. 4, p. 808-815.

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

Leffingwell, E. de K., 1919, The Canning River region, northern Alaska: U.S. Geol. Survey Prof. Paper 109, 251 p.

Robinson, M.S., Decker, John, Pessel, G.H., Smith, T.E., Reifenstuhl, R.R., Clough, J.G., and Bakke Arne, 1986: Preliminary bedrock geologic map of part of the Mt. Michelson C-3 quadrangle, Sadlerochit Mountains, northeastern Alaska. Alaska Div. of Geol. and Geophysical Surveys, Public-Data File 86-1C, 18 p.

Sable, E.G. 1977, Geology of the western Romanzof Mountains, Brooks Range, Northeastern Alaska: U.S. Geol. Survey Prof. Paper 897, 84 p.

Schrader, F.C., 1904, A reconnaissance in northern Alaska across the Rocky Mountains, along Koyukuk, John, Anaktuvuk, and Coville Rivers and the Arctic coast to Cape Lisburne, in 1909, with notes, by W.J. Peters: U.S. Geol. Survey Prof. Paper 20, 139 p.