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GEOLOGIC MAP OF THE ARCTIC QUADRANGLE, ALASKA

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INTRODUCTION

GEOLOGIC SETTING AND LAND USE

The Arctic quadrangle is well located to shed light on the basic geologic relations of northern Alaska. The rocks represent all of the stratigraphic systems from Cambrian to Cretaceous and all but one of the tectono-stratigraphic subterranes of the Brooks Range, from the autochthonous subterrane in the north to the allochthonous subterranes farther south.

Among the distinctive geologic features displayed in the Arctic quadrangle are voluminous volcanic rocks of probable Devonian age, a wide array of Carboniferous carbonate facies in the Lisburne Group (which here extends up into the Middle Pennsylvanian), the southward transition of Upper Devonian (Famennian) clastic facies from fluvial conglomerate to marine sandstone, a full display of Upper Devonian (Frasnian) reef-related strata, and fossiliferous Ordovician rocks in both carbonate and chert terranes.

Most of the quadrangle is in the Arctic National Wildlife Refuge (ANWR) and Arctic Wildlife Refuge Wilderness. The quadrangle also includes Arctic Village, the only village in the region and a potential destination or transfer point for visitors to the wildlife refuge.

HISTORY OF GEOLOGIC MAPPING

This quadrangle geological map is the product of serendipitous mapping activities of the U.S. Geological Survey. Although never scheduled as an official project, data from the Arctic quadrangle have accumulated for more than 40 years. Geologists involved with the regional geology of the eastern and southern Brooks Range made occasional forays into the Arctic quadrangle, usually as adjuncts to projects with other emphases. Chief among these geologists were the authors, who were supported at various times by the people listed in the acknowledgments and on the map itself. The authors especially thank M.D. Mangus, T.H. Nilsen, T.E. Moore, W. Yeend, C.G. Mull, D.L. Jones, and M. Churkin, Jr. for help in the field and for ideas provided during the assembly of this map.

The paragraph at the lower right corner of the map gives a brief history of the geologic mapping in the quadrangle; a bit of elaboration is presented here. The first geologic reconnaissance of this region was by J.B. Mertie, Jr. who traversed parts of the quadrangle in 1926 and 1927 and published his results in 1930 (Mertie, 1930). This rapid reconnaissance, made mostly on foot under extremely difficult conditions, sketched out the rudimentary distribution of rock types, but little of the modern stratigraphy was discerned. The distribution of the Lisburne Limestone in the eastern part of the quadrangle was roughly shown; and the approximate distribution of the Devonian clastic rocks between the East Fork of the Chandalar and the Sheenjek valley was also shown although details of the history of these strata were not known. Most of the pre-Mississippian carbonate rocks were mapped by Mertie as Skajit Limestone, supposedly of Silurian ages. He mapped the chert and slate unit between Old Woman Creek and the East Fork of the Chandalar, and tentatively assigned it a Mississippian or Late Devonian age. This early reconnaissance provided the first geologic and topographic information about the area that is now known as the Arctic quadrangle.

The first modern work in the quadrangle was done by W.P. Brosgé, H.N. Reiser, M.D. Mangus, and J.T. Dutro, Jr. in 1952 as a part of a regional reconnaissance of the eastern Brooks Range made under the aegis of the program for exploration of Naval Petroleum Reserve No. 4 (see Reed, 1958, p. 156, 157). Work in this quadrangle was concentrated in the Porcupine Lake area, but a small amount of mapping was done by Mangus and Dutro in the Old Woman Creek area.

During the 1960's, Brosgé, Reiser, and Tailleur made trips of a few days to a month into the Arctic quadrangle while doing other regional work in northern Alaska. This resulted in a 1965 reconnaissance geologic map based, in large part, on photo interpretation. In 1969 and the early 1970's, a few outcrops were examined incidental to mapping in adjacent quadrangles. More detailed studies were undertaken in 1972 by Warren Yeend and most of the coauthors during the production of a geologic strip map of the corridor for a proposed gas pipeline from Prudhoe Bay to northwest Canada. In 1978 and 1979, work was done on the clastic rocks of the Mississippian-Devonian Endicott Group as a part of an overall regional restudy by T.H. Nilsen, T.E. Moore, Brosgé, Reiser, and Dutro. In 1979, R.L. Detterman joined the group for additional fieldwork on the upper Paleozoic sequence. The month's field work during August, 1979, was the most concentrated effort to collect geologic data in the Arctic quadrangle. Special purpose collecting, mostly for fossils, was done by several small groups of ge-

ologists during the 1980's, and their data have been incorporated in this compilation wherever relevant. In the late 1970's, the geologic map in almost its present form was compiled by Reiser. After a few weeks of additional fieldwork and the identification of conodont and radiolarian collections in 1982 to 1987, some new interpretations were possible and the final compilation was completed by Brosgé.

MINERAL RESOURCE AND GEOPHYSICAL SURVEYS

In 1965, a reconnaissance aeromagnetic survey of northeastern Alaska was flown at altitudes of 2,500 and 5,000 ft, and line spacings of 4 to 8 mi, with many gaps. It indicated parts of two linear east-west trending positive anomalies in the northern part of the Arctic quadrangle, but most of the northwestern part of the quadrangle was not surveyed (Brosgé and others, 1970).

In 1976, 1977, and 1978, geologists of the U.S. Bureau of Mines made a reconnaissance mineral assessment of most of the Arctic quadrangle. A geochemical sample survey of stream sediments in about three-fourths of the quadrangle was augmented by field investigations of mineral occurrences and geochemically anomalous areas. In addition, the geology and fluorite showings near Porcupine Lake were mapped in detail (Peace, 1979; Barker, 1981).

Little or no private mineral exploration has been done in the Arctic quadrangle, and little is now likely to be done within the Arctic National Wildlife Refuge. There are no known mineral deposits, however, the U.S. Bureau of Mines reported that several areas are favorable. The two areas cited for particular attention are a tract in the Devonian shale and sandstone and underlying lower Paleozoic carbonate rocks in the southwestern part of the quadrangle, and a tract in the Mississippian to Pennsylvanian carbonate rocks and Permian shale and sandstone near Porcupine Lake in the northwestern part of the quadrangle.

The tract in the Devonian and older rocks is the eastern extension of a more favorable tract in the adjacent Philip Smith Mountains quadrangle that contained five groups of claims. Two of these were for zinc and lead in quartz veins in the layer of replacement chert that locally caps the lower Paleozoic Skajit Limestone (Detra, 1977). Three were for copper in quartz and calcite veins in the top of the Skajit and in the clastic sediments of the overlying Devonian Beaucoup Formation. These suggest the possibility of both Mississippi Valley-type and shale-hosted deposits (Menzie and others, 1985).

Mineralization in the second tract is in veins of fluorite where some tetrahedrite and enargite were found for a strike length of about a mile just below the contact between Lisburne Group carbonate rocks and overlying Sadlerochit Group shale and sandstone about 2 mi north of Porcupine Lake. Fluorite partially replaces some of the limestone and occurs as large lumps of float 1.5 mi farther north where an unusual 50–ft layer of tuff lies between the Lisburne and Sadlerochit groups. The tract is outlined by anomalous concentrations of tin and silver in sediments from streams that drain a large area of the Lisburne Group immediately north of the fluorite veins.

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Most important to the map are all those who provided basic mapping information and assistance; these people are listed in the paragraph below the lower right corner of the map and in the list of contributors of paleontologic data in table 1. Special thanks go to Marv Mangus, Warren Yeend, Tor Nilsen, Tom Moore, Gil Mull, Norm Silberling, Mike Churkin, Dave Jones, Bonnie Murchey, Bill Oliver, Gus Armstrong, Mac Gordon, Bernard Mamet, Serge Mamay, Bruce Wardlaw and Ellis Yochelson, and to Karen Adams for help in drawing the map.

Over the years, several supervisors have given us the leeway to complete a wide range of studies in this quadrangle. Foremost among these is George Gryc who, during the 1970's and early 1980's, provided a research atmosphere that fostered optimum scientific results not only for evaluating petroleum reserves in northern Alaska but also for furthering the general knowledge of Arctic geology.

TERRANES, SUBTERRANES, AND STRATIGRAPHIC SEQUENCES

Cambrian to Cretaceous rocks crop out in six separate tectono-stratigraphic sequences in the Arctic quadrangle. Rocks of the same age differ in lithology and environment of deposition from sequence to sequence and may be missing in some sequences.

Similar stratigraphic sequences have been recognized throughout most of the Brooks Range. Almost every one of those sequences has been given a distinctive stratigraphic name (see list in Mayfield and others, 1988). In addition, the structural units in which they occur have been given several kinds of structural names. Recognized originally as allochthons, thrust panels, or belts by those who mapped them (Snelson and Tailleur, 1968; Martin, 1970; Mayfield and others, 1988; Patton and Box, 1989), they were also described as terranes or subterranes by Jones and others (1987). Terranes and subterranes are defined as "fault bounded packages of rock that display internal stratigraphic affinities, and geologic histories that differ", and thus form a system that

accommodates all the different structural units and the different stratigraphic sequences (Moore and others, 1994a).

Moore and others (1994a) adopted the terrane/subterrane nomenclature for all of northern Alaska with some modification of the names used by Jones and others (1987). We also use the subterrane nomenclature as a convenient way of ordering the rocks in the Arctic quadrangle. We use our own stratigraphic and geologic definitions for some of the subterrane boundaries, and use some of the local names originally used by Jones and others (1987). Karl and Mull (1993) suggested that the subterrane nomenclature does not contribute to geologic understanding, because the boundaries cannot be clearly drawn, and the term subterrane includes such a variety of structural units. However, this ambiguity is helpful in the Arctic quadrangle, where the different stratigraphic sequences occur in a variety of structural units, and some of the boundaries are poorly defined.

NAMES AND BOUNDARIES OF THE SUBTERRANES IN THE ARCTIC QUADRANGLE

All of the subterranes identified on the map are subdivisions of the Arctic Alaska Terrane as revised by Moore and others (1994). The Arctic Alaska Terrane extends from the south edge of the Brooks Range to the Arctic Ocean, and includes two subterranes that were originally described as separate terranes by Jones and others (1987) — the Venetie and Sheenjek Subterranes. Three of the subterranes (Endicott Mountains, De Long Mountains, and Sheenjek) also have been defined as allochthons, and the rocks of the Venetie Subterrane have been described as an obducted thrust panel. The North Slope Subterrane is the northern parautochthonous subterrane onto which the allochthonous and obducted subterranes have been thrust. Arranged in order from north to south, the stratigraphic sequences of the subterranes demonstrate that, in Devonian through Early Triassic times, dry land or generally shallow seas prevailed in the north, whereas there appears to have been progressively deeper water to the south.

The Hammond Subterrane, which extends along the Brooks Range south of the Endicott Mountains and De Long Mountains Subterranes, does not fit this pattern. It resembles the North Slope Subterrane because it includes an extensive basement of Lower Paleozoic and Proterozoic rocks that locally are overlain unconformably by Mississippian rocks. At depth, the Hammond Subterrane may be continuous with the parautochthonous rocks beneath the North Slope according to Mayfield and others (1988). However, it may be allochthonous rather than parautochthonous according to Oldow and others (1987) and Moore and others (1994a). The Hammond also differs from the North Slope Subterrane in that a large part of the Hammond Subterrane consists of Lower Paleozoic carbonate rocks, whereas the nearest outcrops of the North Slope Subterrane consist of Lower Paleozoic volcanic rocks and graptolitic shales. The Lower Paleozoic carbonate rocks of the Hammond Subterrane might also be closely related to the carbonate rocks of the Lower Paleozoic Porcupine Terrane to the southeast of the Arctic quadrangle (Dover, 1994).

Three areas in the Arctic quadrangle are underlain by structural assemblages of several subterranes. These are: the combined Endicott Mountains and De Long Mountains Subterranes near Porcupine Lake; the Endicott Mountains and Venetie Subterranes near Nichenthraw Mountain; and the Venetie and Sheenjek Subterranes south and east of the Junjik River. In addition, at the top of the assemblage of subterranes around Mount Annette, near Porcupine Lake, are small klippen of Triassic and Permian volcanic rocks and chert like the rocks of the Tozitna Terrane (Jones and others, 1987) that occur extensively just south of the Arctic quadrangle.

North Slope Subterrane

Jones and others (1987) defined the North Slope Subterrane as "Precambrian to lower Paleozoic basement rocks overlain by Kekiktuk Conglomerate (Mississippian)....Lisburne Group...Sadlerochit Group and younger Mesozoic strata". In the southern part of the subterrane east of the Arctic quadrangle, Anderson (1991b) mapped an additional unit of Middle Devonian to Mississippian(?) conglomerate, sandstone, and shale that locally rests unconformably on the basement rocks and lies unconformably beneath the Kekiktuk Conglomerate. The rocks of this southern unit may have been deposited in a rift basin on a south-facing passive continental margin (Anderson and Wallace, 1991). This southern unit crops out in a narrow belt along the Continental Divide, and probably extends westward into the northeast Arctic quadrangle (Anderson and others, 1993), where it is probably represented by the unnamed units of Devonian and Mississippian(?) shale, sandstone, and conglomerate.

Endicott Mountains Subterrane

The Endicott Mountains Subterrane of Jones and others (1987), later described in more detail by Silberling and others (1992), consists of Devonian terrigenous clastic rocks, Carboniferous shale and shelf carbonate deposits, and younger, mainly deep marine rocks. This stratigraphic assemblage is referred to as the Endicott Mountains allochthon by Mull (1985). This sequence of rocks is most readily identified by the presence of coarse-grained fluvial clastic rocks of the Upper Devonian and Lower Mississippian(?) Kanayut Conglomerate, which are unique to the subterrane, and which, together with the underlying Noatak Sandstone, Hunt Fork Shale, and Beaucoup Formation, form the lower part of the subterrane. At the top of the column, a stratigraphic assemblage of radiolarian chert and varicolored shale distinguishes the Permian and Triassic rocks of this subterrane from the coarse-grained Permian and Triassic rocks in the North Slope subterrane to the north. But similar chert-shale assemblages

occur in other subterranes to the south.

Our definition of the subterrane differs in one respect from that of Moore and others (1994a). They place the base of the Endicott Mountains Subterrane at the base of the Beaucoup Formation, but also suggest that the Beaucoup Formation may be in both the Endicott Mountains and the Hammond Subterranes, or that different parts of the Beaucoup may be in each subterrane. We place the older members of the Beaucoup in sedimentary sequence with the carbonate rocks of the Hammond Subterrane, and we place the younger wacke member in both subterranes.

We have mapped the Kanayut Conglomerate as extending farther north than other workers have; and consequently, we have mapped the north edge of the Endicott Mountains Subterrane farther north. Most maps (for example, Moore and others, 1994a, b; Imm and others, 1993) show the north edge of the subterrane at the north edge of the big outcrops of Kanayut Conglomerate that extend from the east quadrangle boundary east of the head of Old Woman Creek southwestward through Tetsyeh and Nichenthraw Mountains. However, we also identify the Kanayut Conglomerate in a long east-trending belt north of Cane and Sheep Creeks. Imm and others (1993) show those rocks as probably equivalent to the Kekiktuk Conglomerate, but we assign them to the Kanayut because the lower part of the Kanayut in that area is red shale and green wacke strikingly like that in the lower part of the unquestioned Kanayut east of Old Woman Creek. Similarly, where Imm and others (1993) show conglomerate probably equivalent to the Kekiktuk in a small anticline near Carter Pass, we have mapped Kanayut, because of Devonian(?) fossils and typical Kanayut lithologies there. (See Description of Map Units.)

Because we place the boundary so far north, the Endicott Mountains Subterrane covers a very large area. If the North Slope Subterrane lies beneath these rocks, it is possible that folding and imbrication subsequent to their emplacement has locally exposed North Slope Subterrane rocks among the Endicott Mountains Subterrane rocks. This might explain the presence, in the northeast part of the Endicott Mountains Subterrane, of a distinctive unit of Middle and Upper Devonian shale, limestone, and conglomerate that is probably equivalent to rocks in the North Slope southern unit of Anderson (1991b).

Hammond Subterrane

The Hammond Subterrane was defined as consisting of thick Lower Paleozoic carbonate rocks, Devonian granite, and a variety of slightly metamorphosed Devonian and older sedimentary rocks (Jones and others, 1987). As mapped in the Arctic quadrangle by Moore and others (1994a), it consists mostly of the Skajit Limestone. They mapped the overlying Beaucoup Formation as part of the Endicott Mountains Subterrane. On the other hand, Jones and others (1987) and Nokleberg and others (1994) apparently placed the entire Beaucoup Formation in the Hammond Subterrane, because they showed the overlying Hunt Fork Shale as the lowest unit of the Endicott Mountains Subterrane. We have mapped the north boundary of the Hammond Subterrane at a large fault, along which the Hunt Fork Shale and the wacke member of the Beaucoup Formation are thrust onto the Lisburne Group and the Kanayut Conglomerate of the Endicott Mountains Subterrane, and south of which the Kanayut is represented by partly marine quartzite rather than the typical fluvial conglomerate. Thus, the stratigraphic location of the subterrane boundary is unclear. The lower members of the Beaucoup must be part of the Hammond Subterrane because the basal beds are limestone pebble conglomerate where they rest on the Skajit Limestone. However, Moore and others (1994a) warned that these lower members of the Beaucoup might be stratigraphically or structurally separated from the type Beaucoup because at the type locality they are found adjacent to, but not in, the type section. So it is possible for different members to be present in different subterranes. On the other hand we show the wacke member, as well as the Hunt Fork Shale, to be present in both subterranes.

Sheenjek Subterrane

Jones and others (1987) described the Sheenjek Terrane as composed of thin Mississippian limestone which is overlain by Upper Paleozoic and Triassic chert and varicolored argillite and intruded by mafic sills. In the type area west of the Coleen River in the Coleen quadrangle, the terrane they outlined also includes a unit of black shale and chert and fine-grained sandstone (Brosgé and Reiser, 1969). The terrane Jones and others mapped is confined to a narrow belt that extends northwestward about 60 mi from the Coleen River in the Coleen quadrangle to an outlying klippe in the Arctic quadrangle. Moore and others (1994a) included these rocks in the much larger De Long Mountains Subterrane which is present discontinuously throughout the Brooks Range. This subterrane comprises four of the allochthons of Mayfield and others (1988). The second highest, the Ipnavik River Allochthon, is a sequence of rocks almost identical to that of the Sheenjek Subterrane, so application of the De Long Mountains Subterrane name is appropriate. However we retain the name Sheenjek, because it is a local name and in order to reserve the name De Long Mountains Subterrane for the klippen of the Picnic Creek Allochthon of the De Long Mountains Subterrane which also occurs in the Arctic quadrangle.

Venetie Subterrane

Jones and others (1987) gave the name Venetie Terrane to Devonian(?) graywacke and Upper Paleozoic and Triassic(?) chert that strike northeastward through the old Venetie Indian Reservation in a wide belt along the east side of the East Fork Chandalar River. Similar rocks of similar age crop out in a long narrow belt along the south edge of the Brooks

Range that was called the Slate Creek thrust panel of the Angayucham-Tozitna Terrane by Patton and Box (1989). Moore and others (1994a) have combined the rocks of both of these belts into the Slate Creek Subterrane of the Arctic Alaska Terrane. However, we retain the local name Venetie for the rocks in the Arctic quadrangle because they are separated by 50 mi from the Slate Creek rocks, and whereas the Slate Creek rocks rest consistently on the schists of the Coldfoot Subterrane, the Venetie rocks rest discordantly across the east ends of both the Ruby and the Hammond Subterranes.

Venetie and Sheenjek Subterranes, undivided
A structural assemblage of parts of two subterranes

A long synclinorium extends across the Arctic quadrangle from south of the Junjik River to Old Woman Creek. The entire synclinorium is probably a large complex klippe. The rocks grouped together within it include rocks that are definitely part of the Venetie Subterrane, rocks that are definitely part of the Sheenjek Subterrane, and rocks that may belong to either subterrane. At its center are large klippen of Devonian(?) wacke of the Venetie Subterrane. Beneath these klippen, on the limbs of the synclinorium, are Upper Paleozoic and Triassic(?) chert and varicolored argillites like the rocks that occur in both the Venetie and Sheenjek Subterranes. Black cherty shale with interbedded sandstone like that in the Sheenjek Subterrane occurs with these rocks on the south limb near Old Woman Creek, and a small klippe of Mississippian limestone and gabbro sills typical of the Sheenjek Subterrane lies above the Upper Paleozoic to Triassic(?) rocks on the north limb.

Endicott Mountains and Venetie Subterranes, undivided
A structural assemblage of parts of two subterranes

North of Nichenthraw Mountains an imbricated infold of Upper Paleozoic rocks lies above the Carboniferous Lisburne Group limestone of the Endicott Mountains Subterrane. The rocks of the infold include Carboniferous (and younger?) varicolored chert and slate like that of the Venetie Subterrane, and Mississippian limestone and Permian shale like those of the Endicott Mountains Subterrane. The north margin of this infold is marked by a large fault that juxtaposes two different Carboniferous facies where the Carboniferous chert and slate of the infold is thrust onto Permian shale and Carboniferous limestone of the Endicott Mountains Subterrane to the north. The geology of the infold is poorly mapped, and probably is more complicated than shown. An isolated outcrop of Mississippian Kuna Formation represents a facies of the Lisburne Group usually found in the Endicott Mountains Subterrane much farther west (Mull and others, 1982). Cretaceous(?) sandstone in the infold is like that in the Endicott and De Long Mountains Subterranes in the north part of the quadrangle near Mount Annette. The lateral extent of the infold is speculative.

De Long Mountains Subterrane

Two small areas outlined near the heads of Smoke Creek and Crow Nest Creek include a sequence of Mississippian black shale, Mississippian black chert, and Carboniferous to Permian varicolored chert typical of the upper part of the Picnic Creek Allochthon of the De Long Mountains Subterrane (Mull and others, 1987; Mayfield and others, 1988). These rocks are shown as klippen, although the nature of their contacts with the surrounding Devonian rocks is uncertain. Where these rocks rest locally on Kanayut Conglomerate, typical of the Endicott Mountains Subterrane, they probably are thrust on the Kanayut. At other places, they rest on the wacke member of the Beaucoup Formation, a unit that not only occurs in the Endicott Mountains Subterrane, but also is similar to the rocks in the base of the typical Picnic Creek Allochthon. The Mississippian shale and chert and Carboniferous to Permian varicolored chert crop out just east of, and on strike with, small outcrops of Mississippian limestone and Permian varicolored shale and argillite that rest on the Hunt Fork Shale of the Endicott Mountains Subterrane in the adjacent Philip Smith Mountains quadrangle (Brosgé and others, 1979). Those rocks might also be klippen. If so, the cherty rocks in the Arctic quadrangle may grade westward into the limestone and argillite within a short distance. Thus, although the presence of some rocks of the Picnic Creek Allochthon is certain, the boundaries of the allochthon are not.

Klippen of Endicott Mountains and De Long Mountains Subterranes and Tozitna(?) Terrane near Mount Annette

These rocks, not recognized by Jones and others (1987), are shown by Moore and others (1994a) as an outlier of the De Long Mountains Subterrane. The lowest allochthon of the De Long Mountains Subterrane in the western Brooks Range is the Picnic Creek Allochthon (Mull and others, 1987; and Moore and others, 1994a). Mississippian black chert and Pennsylvanian through Triassic gray and green chert characteristic of the Picnic Creek Allochthon form most of Mount Annette near Porcupine Lake. These rocks are imbricated and form a little pile of klippen which rests on a broader area of Permian and Triassic chert and shale typical of the Endicott Mountains Subterrane; these rocks in turn rest on the Permian and Triassic shale, limestone, and sandstone typical of the surrounding North Slope Subterrane. Thus the whole area of cherty rocks is a klippe consisting of two allochthons (Churkin and others, 1989).

Cretaceous rocks are also present. They rest on rock units of the subterranes and terrane within and outside the klippen, and may be unconformable on all of them. On Mount Annette, they also occur below the klippen of the Picnic Creek Allochthon and were therefore involved in the thrust faulting. Although we placed the Cretaceous rocks in the stratigraphic column of the Endicott Mountains Subterrane, it is

likely that all of their outcrops are klippen.

Two small klippen of Triassic and Permian volcanic rocks and chert rest on the Cretaceous rocks. The closest similar rocks are the Jurassic through Mississippian volcanic rocks and chert of the Tozitna Terrane south of the Arctic quadrangle.

DESCRIPTION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

Qu **Surficial deposits, undivided (Holocene and Pleistocene)**—Alluvial gravel, sand, and silt; glacial outwash of gravel and sand; and sandy bouldery gravel of glacial ground moraine and terminal moraines in larger valleys. Glacial deposits are from four glacial advances (Yeend and Brosgé, 1973a, b) that are described by Coulter and others (1962) as the Sagavanirktok River, Itkillik, Echooka River, and Alapah Mountain glaciations. These are probably equivalent to the Sagavanirktok (Middle? Pleistocene) through late Itkillik (Late Pleistocene) advances recognized in the adjacent Philip Smith Mountains quadrangle (Hamilton, 1978; Hamilton and Porter, 1975)

BEDROCK

North Slope Subterrane

Ki **Ipewik unit (Lower Cretaceous, Valanginian)**—Black clay and silt shale, manganiferous; contains botryoidal nodules and concretions of phosphatic chert. Float and poorly exposed thin layers or lenses of brown-weathering Valanginian pelecypod shell coquina (*Buchia* spp.) are found in the lower part of this 100-ft thick unit. Mapped near Mount Annette in northern part of quadrangle. Named informally by Crane and Wiggins (1976) in western Brooks Range, and recognized north of the central Brooks Range (Moore and others, 1994a)

Trs **Shublik Formation (Upper and Middle Triassic)**—Black, silty, partly calcareous, sooty shale, with local calcareous concretions and interbedded black silty and shaley limestone. Some gray to black, dense, fine-grained limestone that weathers brown to cream colored. Limestone beds contain phosphate nodules, late Middle and Late Triassic (Ladinian through Norian) pelecypods and ammonites, and late Middle through Late Triassic conodonts. Thickness more than 300 ft, probably about 500 ft

TrPs **Sadlerochit Group, undivided (Lower Triassic and Permian)**—Comprises Lower Triassic Ivishak Formation and Permian Echooka Formation. Ivishak Formation is black, silty shale, papery shale, and black, shaley to splintery siltstone that weather brown to rusty. Shale and siltstone are locally micaceous and contain rare thin beds and lenses of dark-gray, fine-grained sandstone. Nodules and concretions of pyrite, clay ironstone, and phosphatic chert are locally abundant. Calcareous concretions contain Lower Triassic (Scythian and Smithian) pelecypods and cephalopods. Thickness of Ivishak not known, probably about 1,000 ft. The Echooka Formation is easily recognized almost everywhere at the base of the Sadlerochit Group by the yellow-orange-weathering color of the pyritic calcareous siltstone in the lower part of the formation. The Echooka consists of gray to black siltstone with calcareous and ironstone concretions and rare layers of hematite oolite; yellow-weathering, pyritic, calcareous siltstone and sandstone; beds of fine-grained, yellow, silty limestone; and lenses of reddish-weathering, gray, fine-grained limestone. Unusual basal beds exposed 3 mi north of Porcupine Lake consist of 86 ft of fine-grained quartzite and pebble-granule conglomerate that contain chert and argillite clasts, overlain by gray, silvery-weathering silt shale (Peace, 1979; Barker, 1981). No fossils have been collected from the Echooka in this subterrane but the distinctive yellow calcareous rocks in the lower part of the formation are like those that contain Lower Permian brachiopods in the subterrane to the south (Detterman, 1988). Measured thickness southwest of Porcupine Lake is 260 ft (Detterman, 1988)

PPt **Unnamed tuff (Permian or Pennsylvanian)**—Light-green lapilli tuff in massive to laminated beds. Consists of angular clasts of pumice and cinders as large as 1.5 in. in diameter, altered to chlorite and palagonite; in carbonate and pyritic feldspathic matrix. Tuff and underlying limestone contain pyrite and chalcopyrite. Fluorite boulders in float (Peace, 1979; Barker, 1981). About 50 to 75 ft thick. Mapped at only one locality in northwest part of quadrangle. Overlain

directly by Sadlerochit Group slate. Rests on 10 ft of silicified Lisburne Group limestone underlain by cherty limestone with conodonts of latest Late Mississippian age. Probably either Pennsylvanian or earliest Permian

IPMl **Lisburne Group (Pennsylvanian and Mississippian)**—Cliff-forming, gray limestone with light-gray to black nodular chert; minor dolomite and silicified limestone. Top beds locally replaced by layer of rusty-weathering massive chert. Lisburne in this subterrane contains early Late Mississippian to Middle(?) Pennsylvanian corals and brachiopods. Thickness is about 2,300 to 3,200 ft based on incomplete measured sections. In the adjacent Mount Michelson and Sagavanirktok quadrangles, the Lisburne Group is divided formally into Wachsmuth(?) Limestone (early Late Mississippian), Alapah Limestone (Late Mississippian) (Mamet and Armstrong, 1972; and Armstrong and Mamet, 1977), and Wahoo Limestone (Latest Mississippian to Early and Middle(?) Pennsylvanian) (Watts, 1989). Judging from these measured sections and from incomplete sections near Porcupine Lake, and near Wahoo Lake 3 mi northwest of this quadrangle (Brosgé and others 1952, 1962), thicknesses of the formations in the northern part of the Arctic quadrangle are: Wachsmuth Limestone, from zero to 700 ft; Alapah Limestone, from 1,000 to 1,500 ft; and Wahoo Limestone, from 800 to 1,000 ft. In reconnaissance mapping of the Arctic quadrangle we did not map the three formal subdivisions of the Lisburne Group, instead we divided the Lisburne informally into a light-colored upper map unit (IPMlu) and a darker lower unit (Mll) that are recognized by their dominant weathering colors in the field and on aerial photographs and are similar to the units mapped in the adjacent Philip Smith Mountains quadrangle to the west (Brosgé and others, 1979). Where these units cannot be distinguished, we have mapped undivided Lisburne Group (IPMl)

IPMlu **Lisburne Group, upper unit (Middle? Pennsylvanian to Upper Mississippian)**—Medium gray, fine- to medium-grained limestone and calcilutite and white nodular chert. At some places near Porcupine Lake, the top beds are 25 to 50 ft of rusty-weathering, white massive chert with veins of quartz and fluorite; at one locality the top is green tuffaceous limestone with disseminated pyrite and fluorite replacing crinoids and bryozoans; a mineralized zone as much as 8 ft thick lies about 80 ft below the top (Peace, 1979; Barker, 1981). Base of unit is poorly defined; it has been examined only in the measured sections outside the quadrangle. Judging from these sections and from an incomplete section near Porcupine Lake, the unit is about 2,000 ft thick in this subterrane. Age of the base is probably late early Late to early late Late Mississippian (late Meramecian to early Chesterian). Top ranges in age from latest Late Mississippian to Middle(?) Pennsylvanian (Late Chesterian to Atokan?)

Mll **Lisburne Group, lower unit (Upper Mississippian)**—Mostly dark-gray, fine- to medium-grained limestone and minor amount of interbedded shaley limestone. Unit weathers dark to medium gray and red and yellow. Unit is about 50 percent dolomitized and contains black nodular chert. Base of unit contains corals of early Late Mississippian age (Meramecian). Top is probably early or late Late Mississippian in age (Meramecian or Chesterian). About 1,000 to 1,200 ft thick judging from measured sections north of Arctic quadrangle (Brosgé and others, 1962; and Armstrong and Mamet, 1977)

Mk **Kayak Shale (Upper? Mississippian)**—Black phyllitic shale with ironstone concretions; contains interbedded thin beds of orange- to brown-weathering crinoidal limestone. Lower part contains about 100 ft of interbedded shale and dark-gray, very fine grained sandstone. Thickness about 500 ft. Contains foraminifera of Late(?) Mississippian (Meremecian?) age. Identification is questioned in northeast corner of quadrangle where the unit consists of black rusty shale and brown to rusty, fine-grained, schistose, partly calcareous sandstone and quartzite with crinoid debris, gastropods, and pelecypods; some brachiopods, fish plates, and worm trails, all of indeterminate age

Mkk **Kayak Shale and Kekiktuk Conglomerate, undivided (Mississippian)**—Black shale, black fine- to coarse-grained quartzite and coal. Mapped at one locality in northeast corner of quadrangle

Mkt **Kekiktuk Conglomerate (Lower Mississippian)**—Quartzite, conglomerate, sandstone, and micaceous rusty shale; interbedded in fluvial cycles. Contains minor coal and ironstone. Conglomerate pebbles, 2 to 8 cm long, consist mostly of quartz (50 to 80 percent) and chert, with some pebbles of phyllite and limonitic sandstone. Quartzite is gray, fine to coarse grained, thin to massive bedded. Detrital grains are more than 80 percent quartz with minor chert; some secondary sericite, chlorite, and pyrophyllite. Ferruginous, fine-grained, carbonaceous sandstone is mostly chert grains. Thickness 125 to 300 ft on Canning River and East Fork Chandalar River; may be as much as 1,000 ft thick on upper Hulahula River. Contains plants of Early Mississippian age (Floral Zone 1, Read and Mamay, 1964). Identification questioned at one locality where conglomerate is quartz rich, but is sheared and brown weathering and interbedded with brown schistose sandstone like sheared conglomerate unit MDsc

MDbs **Unnamed brown sandstone (Mississippian or Devonian)**—Ferruginous, brown, partly schistose sandstone and quartzite interbedded with gray, fine- to coarse-grained quartzite; pebbly quartzite and conglomerate; black shale and ironstone. Conglomerate contains pebbles of quartz, chert, and slate chips as long as 9 cm; partly sheared, partly brown weathering. Makes brown rubble slopes. Thickness not known. Unfossiliferous, but apparently underlies Kayak Shale and Kekiktuk Conglomerate, so age is Mississippian or older. Mapped near head of East Fork Chandalar River

MDv **Unnamed volcanic rocks (Mississippian or Devonian)**—Green andesitic tuff and volcanic breccia weathers yellow and orange; sheared, schistose and altered to chlorite, epidote, clinopyroxene, and clay. Thickness probably a few hundred feet. Stratigraphic relations uncertain. May be interbedded with sheared conglomerate unit (MDsc) or with Kekiktuk Conglomerate (Mkt). Basaltic volcaniclastic rocks 4 mi to east in Table Mountain quadrangle are interbedded with Mississippian Kekiktuk Conglomerate, according to Anderson and others (1993), but a shale and conglomerate layer within those volcaniclastic rocks contains Devonian(?) plants according to Mamay (written commun., 5/5/81). Mapped only at head of East Fork Chandalar River

MDsc **Unnamed sheared conglomerate (Mississippian or Devonian)**—Sheared conglomerate composed of chert and argillite pebbles as long as 1 cm. Unit weathers brown and yellow and contains minor black shale and siltstone. Makes brown rubble slopes. Shale bed in similar conglomerate at head of Sheenjek River, 4 mi east of Arctic quadrangle contains plant fossils of probable Devonian age (Mamay, written commun., 5/5/81). May be equivalent to upper, plant-bearing part of the Ulungarat Formation (informal name) of Anderson (1991a, b) mapped 15 mi east of the Arctic quadrangle. If so, the thickness may be about 600 ft. Mapped in northeast corner of quadrangle

Dr **Unnamed rhyolite (Devonian?)**—Metamorphosed crystal and lithic tuff, volcanic breccia, and minor porphyry of rhyolitic compositions, now mostly recrystallized to fine crystalline quartz-sericite schist; gray, green, and purple; weathers yellow, rusty, and orange and white. Composed of quartz, sericite, albite, calcite, chlorite, and iron oxides; epidosite at one locality. Mostly a fine crystalline mosaic of quartz and mica with some relic phenocrysts and clasts. Porphyry contains plagioclase phenocrysts in felsic ground mass. Thickness of unit ranges from 25 ft to hundreds or perhaps thousands of ft. Underlies Mississippian Kekiktuk Conglomerate. Apparently interbedded with Devonian(?) unnamed shale and sandstone (Ds) and with Mississippian or Devonian unnamed brown sandstone unit (MDbs). Mapped near upper East Fork Chandalar River

Pzv **Unnamed volcanic rocks (Devonian? or older)**—Metamorphosed dacitic to andesitic layered crystal and lithic tuff, volcanic breccia, vesicular flows and minor intrusive rocks; green, purple, orange, and red; distinguished by dark-purple and green weathering colors. Fine-grained tuffs are now phyllite. Coarser grained rocks are lower greenschist facies assemblages of quartz, albite, sericite, chlorite, epidote, stilpnomelane, calcite, magnetite, and hematite. Includes some black shale and chert pebble conglomerate. Underlies Mississippian Kekiktuk Conglomerate; may underlie Devonian(?) rhyolite (Dr). Interlayered with Devonian(?) unnamed

shale and sandstone (Ds) at one locality, so probably Devonian, in part. Mapped in northeast part of quadrangle

Ds **Unnamed shale and sandstone (Devonian?)**—Mostly black shale, in part rusty weathering; interbeds of dark-gray, fine- to coarse-grained quartzite and dark-gray, brown-weathering, fine-grained sandstone. Contains pelecypods of Devonian(?) age and unidentifiable plant fragments. Probably less than 1,000 ft thick. Mapped locally west of upper East Fork Chandalar River

O€c **Unnamed chert and phyllite (Ordovician and Cambrian?)**—Structural assemblage of lenses of bedded chert in structurally complex matrix of pale-green, yellow-weathering slate and argillite and dark-gray, black, and red phyllite. Chert is black to gray, or white, rusty weathering; radiolarian; foliated and recrystallized. Also contains minor orange-weathering breccia or conglomerate of very fine grained dolomite (Moore and Churkin, 1984). Thickness probably greater than 1,000 ft (Anderson 1991a). Contains probable Middle Ordovician graptolites. Part of unit contains lenses of Cambrian volcanic rocks (€v). Same as Romanzof Chert of Anderson (1991a). Mapped at north edge of quadrangle

€v **Unnamed volcanic rocks (Cambrian)**—Mafic volcanic breccia, basalt, and vesicular amygdaloidal flows; green, weathers light red. Contains interbedded chert and green laminated argillite. North of Arctic quadrangle, includes fossiliferous limestone (Reiser and others, 1971) that contains Lower Cambrian trilobites. Thickness probably several hundred feet

Endicott Mountains Subterrane

Ŧo **Otuk Formation (Upper and Middle Triassic)**—Limestone and shale. Upper part is interbedded, gray, fine-grained, dense, platy limestone that weathers smooth and yellow, and gray and black, medium-grained, thin-bedded limestone that weathers yellow and black; with interbedded manganiferous silty shale that weathers gray and brown. Lower part is interbedded black shale, black, sooty phosphatic limestone, and gray, fine-grained limestone that weathers smooth and cream-colored. Upper part is dominantly limestone, is about 200 to 300 ft thick, and contains Upper Triassic (Norian) pelecypods (*Monotis*). Lower part is dominantly shaley, is about 450 to 600 ft thick, and contains Upper and Middle Triassic (Karnian and Ladinian) pelecypods (*Halobia* and *Daonella*)

Ŧs **Shublik Formation (Triassic)**—Limestone and shale. Limestone is black, silty, sooty; and gray to black, thin bedded, yellow weathering. Shale is black, silty, partly manganiferous, and weathers gray and brown. Few thin beds of hard black quartz siltstone at one locality. No fossils found; probably same age as Otuk Formation. More than 250 ft thick. Exposed at only two places in this subterrane, near Upper Sheep Creek and near Little Njoo Mountain north of Junjik River

ŦPss **Sadlerochit Group and Siksikpuk Formation?, undifferentiated (Lower Triassic and Permian)**—Upper part of the Sadlerochit Group (Ivishak Formation) is mostly black to dark olive-gray clay shale, silty shale, and siltstone. This part is pyritic, manganiferous, and weathers rusty and contains calcareous concretions, ironstone concretions and phosphatic chert nodules. It also contains minor black, fine-grained to very fine grained quartzite; a few 5- to 20-ft-thick beds of black chert; rare dolomite lenses. Lower part (Echooka Formation) consists of gray to black, pyritic, micaceous, partly rusty-weathering clay shale, silty shale and siltstone; some black, very fine grained sandstone, minor hematitic sandstone, and oolites of hematite. Calcareous and phosphatic concretions, ironstone and phosphatic chert nodules are abundant. At base of Echooka Formation is a characteristic yellow-weathering zone of calcareous and non-calcareous pyritic shale, siltstone, and very fine grained sandstone, with interbedded medium- to dark-gray limestone. Measured sections indicate that the Ivishak Formation is about 1,000 to 1,500 ft thick and the Echooka Formation is 400 to 1,450 ft thick (Detterman, 1988). No fossils found in Ivishak. Echooka Formation contains brachiopods of Early Permian (Wordian) age.

At many places in the south half of this subterrane, rocks of the Sadlerochit Group described above, are interbedded with additional intervals 500 to 1,300 ft thick

that were assigned to the Siksikpuk Formation(?) by Detterman (1988). Rocks in these intervals are mostly black shale and siltstone, but include 50 to 100 ft of black to gray-green, bedded, silty, radiolarian chert that is partly phosphatic. They contain radiolarians of Late Paleozoic age and rest on the yellow-weathering calcareous rocks of the Echooka Formation that contain Permian brachiopods. Where the Siksikpuk(?) Formation is present the total undifferentiated unit is 1,400 to more than 3,000 ft thick

Pe **Echooka Formation (Permian)**—Gray, brown, and black shale and slate, in part pyritic; brown and greenish-gray shale. Identified by yellow-weathering gray to gray-green, calcareous, pyritic shale and siltstone at base. Hematitic sandy oolite and a few beds of ferruginous crinoidal limestone are interbedded with the black shale. Nodules of pyrite, barite, and ironstone are present. About 200 to 600 ft thick. Contains Permian brachiopods

Ps **Siksikpuk Formation (Permian)**—North of the Junjik River consists of brown, olive, and black shale and silty shale that weathers orange, olive, and silvery; green argillite with minor pyrite and some black, bedded chert. Unit is identified as unquestioned Siksikpuk Formation because of the green argillite; red and green sediments are typical of the Siksikpuk Formation (Adams and Siok, 1989). Rests on Middle(?) Pennsylvanian limestone at top of Lisburne Group. South of Junjik River and near Spoonfish Lake includes much green and red pyritic shale and argillite and orange-weathering siliceous siltstone with barite nodules; rests on Lower Mississippian limestone of Lisburne Group. About 200 ft thick. No fossils found

IPMl **Lisburne Group (Middle Pennsylvanian to Lower Mississippian)**—Gray limestone, commonly silicified; very little dolomite; nodular black and gray chert is present throughout. Chert is most abundant east of East Fork Chandalar River where chert layers locally ramify across bedding in lower part of section. Beds at top of Lisburne commonly replaced by 25 ft or more of brecciated chert, which is black north of Junjik River (unit IPc, mapped locally) and is white to the south. Limestone partly recrystallized near faults. Lisburne in the northern part of this subterrane is about 2,500 ft thick, in the southern part about 1,500 ft thick, and about 500 ft thick in southernmost exposures (separately mapped as Ml). The youngest beds are Early and Middle Pennsylvanian in age (locally latest Mississippian) north of the Junjik River based on brachiopods and conodonts. The oldest beds are early Late Mississippian in the north based on foraminifera; whereas they are Early Mississippian in the south based on conodonts and brachiopods. In an incomplete measured section at the Sheenjek River 7 mi east of the Arctic quadrangle (Brosgé and others, 1962), the Lisburne is divided formally into about 700 ft of Wachsmuth Limestone (Early and early Late Mississippian) and about 1,300 ft of Alapah Limestone (Late Mississippian). These formations are present throughout the subterrane. The overlying Wahoo Limestone (Pennsylvanian and Late Mississippian) is present in most of the subterrane north of the Junjik River, but they could not be differentiated at the reconnaissance scale of mapping. In some areas, the Lisburne is divided into informal subdivisions that consist of an upper light-gray weathering limestone unit (IPMlu) and a lower darker-gray weathering unit (Mll) like those mapped in the Philip Smith Mountains quadrangle to the west (Brosgé and others, 1979). Where neither subdivision is recognizable the entire Lisburne is mapped as IPMl. In southernmost outcrops, where limestone is thin and entirely Mississippian in age, the unit is mapped as Ml

IPMlu **Lisburne Group, upper part (Pennsylvanian and Upper Mississippian)**—Medium-gray, fine- to medium-grained cherty limestone and silicified limestone; dolomite is rare. Capped locally by black chert layer described under unit IPc. Fluorite replaces small calcite vein in recrystallized packstone at one locality on Continental Divide at head of Junjik River. Forms medium- to light-gray slopes as seen from distance or on aerial photographs. Unit is probably about 1,000 to 1,200 ft thick near center of quadrangle; it probably pinches out to south near Junjik River. Top of unit contains late Late Mississippian foraminifera and Early to Middle(?) Pennsylvanian conodonts and brachiopods. Base of unit is poorly defined

but includes beds of early late Late Mississippian (early Chesterian) to late early Late Mississippian (late Meramecian) age

IPc **Unnamed chert (Pennsylvanian)**—Discontinuous black, massive to brecciated chert, locally with remnant lumps of partially replaced limestone; hematitic where underlying limestone is hematitic. Thickness is from 1 or 2 ft to more than 100 ft, but generally is 10 to 25 ft. Present north of Junjik River in many places where not mapped. Underlies fossiliferous Permian rocks of Sadlerochit Group. Disconformably overlies Lisburne Group in areas where Lisburne is as young as Pennsylvanian. Unit may have been formed by replacement and solution of Lisburne during the Late Pennsylvanian. Small chip of fluorite at locality 4 mi southeast of Carter Pass is probably related to fluorite mineralization at this horizon near Porcupine Lake

Ml **Lisburne Group, undivided (Mississippian)**—Gray, coarse-grained, crinoidal bioclastic limestone and medium-gray, fine-grained, silty limestone. Includes minor amount of medium-gray, medium-crystalline dolomite. In upper part of unit, limestone is replaced by bands of partly silicified limestone and white chert. Black and white nodular chert present throughout. About 200 ft thick near Spoonfish Lake, possibly as much as 500 ft thick farther west. Contains brachiopods and corals of Early Mississippian age near Spoonfish Lake and also near Smoke Creek about 4 mi west of Arctic quadrangle (Brosgé and others, 1979). No evidence of Pennsylvanian limestone in those areas. Mapped in small areas near Spoonfish Lake and upper Smoke Creek

Mll **Lisburne Group, lower part (Upper and Lower Mississippian)**—Dark-gray, fine- to medium-grained limestone and silicified limestone with abundant black chert nodules or layers. Lower part contains interbedded shaley limestone and some yellow-weathering coarse-grained limestone. Thickness about 1,000 to 1,500 ft, possibly decreasing to about 500 ft near Junjik River. Basal part contains early Late Mississippian (early Meramecian) foraminifera in the north, probable Early Mississippian (Osagian) conodonts in south. Top is poorly defined but youngest beds are probably late Late to early Late Mississippian (Chesterian to Meramecian)

Mk **Kayak Shale (Upper and Lower Mississippian)**—Black shale and slate with interbedded limestone and sandstone, commonly contains ironstone concretions and, locally, phosphatic concretions and phosphatic pebbles. Weathers black to rusty. Upper part of formation contains coarse-grained crinoidal limestone, generally in beds 5 to 10 ft thick, that weathers yellow or red and is locally hematitic. Lower part contains sandstone as much as 150 ft thick. Sandstone is gray, fine to very fine grained, thin bedded to nodular, locally micaceous, and contains plant fragments and worm trails. Sandstone is lacking in southernmost outcrops near Spoonfish Lake and upper Smoke Creek. Formation is about 500 to 1,000 ft thick. Commonly contains corals, brachiopods, conodonts, and foraminifera of Early Mississippian (Osagian and Kinderhookian? age), but contains corals and brachiopods of early Late Mississippian (Meramecian) age in the northeastern part of the quadrangle

Ms **Unnamed siltstone (Mississippian)**—Glassy to laminated black chert that grades into black, gray-weathering, sooty porous siltstone; interbedded calcareous siltstone, minor black thin-bedded limestone, and lenses of crinoidal limestone. Thickness uncertain. Similar rocks in quadrangles to the east contain brachiopods of early(?) Late Mississippian age (Brosgé and others, 1976) and bryozoans of Permian or Carboniferous age (Brosgé and Reiser, 1969). Occupies stratigraphic position of Kayak Shale. Mapped at one locality near head of Koness River

MDk **Kanayut Conglomerate (Lower Mississippian? and Upper Devonian)**—Interbedded fluvial conglomerate, sandstone and shale in fining-upward cycles that are generally 10 to 25 ft thick, and sandstone and conglomerate in couplets 10 to 30 ft thick. Conglomerate is composed mostly of chert pebbles; more than 80 percent of the clasts are chert at 15 of 18 localities where point counts were made (Nilsen and others, 1980a, 1981). The rest of the clasts are mostly vein quartz and quartzite. In thin sections, sandstone is composed mostly of quartz, generally less than 20 percent chert and minor lithic fragments, and mica, chlorite and pyrophyllite. Mean maximum pebble sizes at nine

localities range from 1 to 10 cm. Plant fragments are common but, in the areas mapped as Kanayut (MDk), they have been identified at only one locality, where they are probably Devonian.

The formation in this area is about 2,500 ft thick and consists of three parts, an upper part with about 20 percent shale, a middle part with less shale, and a lower part with 25 to 65 percent shale. These correspond to the Stuver member, middle conglomerate member, and lower shale member mapped in the adjacent Philip Smith Mountains quadrangle (Brosgé and others, 1979; described by Nilsen and others, 1980a, 1981). They correspond approximately to the Stuver, Shainin Lake, and Ear Peak members formally named in the type section farther west by Bowsher and Dutro (1957) and Nilsen and Moore (1984). However, they differ from the formal members in that the middle part, as mapped, is not restricted to the massive amalgamated conglomerate and sandstone beds defined as Shainin Lake Member, but includes a thicker interval composed mostly, but not entirely, of resistant beds. For this distinction, see Nilsen and Moore (1984, p. A15–A16). All three parts are mapped separately only near Nichenthraw Mountain. Elsewhere, if all the parts are present, either the whole formation is mapped as MDk, or, locally, the distinctively shaley lower part (Dkl) and the combined middle and upper parts (Dksm) are distinguished. In the southeast part of the quadrangle the Kanayut is partly marine and has no distinctive members, and is therefore mapped separately as undivided Kanayut (MDku). At the outcrop near Carter Pass, the identification of the Kanayut is uncertain. The section measured there was described originally as Kanayut Conglomerate (Nilsen and others, 1980a), then reassigned to the Kekiktuk Conglomerate (Nilsen and others, 1981), and subsequently mapped by Imm and others (1993) as an unnamed unit probably correlative with the Kekiktuk Conglomerate. We retain the original designation because the measured section contains rocks similar to the two upper members of the typical Kanayut, the conglomerate (like the typical Kanayut) is mostly of chert pebbles, and plants from near the base of the upper part are probably Devonian (table 1; no. 3).

The only other definitely identifiable fossils collected from the Kanayut in the Arctic quadrangle are Devonian plants from the lower part of the formation. The Mississippian(?) age of part of the formation is by correlation with part of the Stuver Member near the Anaktuvuk River, 110 mi west of the Arctic quadrangle where plants of probable Mississippian age were found (Nilsen and others, 1980a)

MDku **Kanayut Conglomerate, undivided (Mississippian? and Devonian)**—Mostly quartzite and sandstone with only minor amounts of conglomerate and shale, so that more resistant and less resistant members are not recognized. Mostly fluvial near Index Mountain; elsewhere fluvial and marine. Conglomerate is rare except near Index Mountain, where it occurs at the base of fining-upward and thinning-upward cycles that are about 25 ft thick. Pebbles of quartz and quartzite are more abundant than chert pebbles in most places, and are as much as 10 cm in diameter near Index Mountain, 5 cm near Titus Mountain, and 3 cm in the western part of the subterrane. Quartzite occurs in the fining-upward cycles, but is mostly in intervals of quartzite or sandstone hundreds of feet thick. Gray, fine- to coarse-grained, hard and blocky quartzite is composed of quartz and chert grains, some lithic fragments, feldspar, and secondary limonite and sericite. Gray quartzite near Titus Mountain contains interbeds of brown, fine-grained, thick-bedded manganiferous quartzite that contains brachiopods. Sandstone is gray to brown, thin bedded, fine to coarse grained, locally calcareous, and near Titus Mountain contains corals and brachiopods. Minor amounts of black and red shale or gray-green hematitic mudstone occur at the tops of cycles. The unit is probably at least 1,000 ft thick. It contains Late Devonian plants in black slate interbedded with the conglomerate at Index Mountain, Late Devonian (Famennian? and Frasnian?) brachiopods and corals in quartzite and sandstone near Titus Mountain, and Late Devonian (Famennian?) brachiopods in a thin bed of limestone interbedded in conglomerate near the west edge of the quadrangle

MDks **Kanayut Conglomerate, Stuver Member (Lower Mississippian? and Upper Devonian)**—Quartzite, sandstone, conglomerate and shale, organized into fining-upward and thinning-upward cycles 20 to 50 ft thick. Conglomerate is minor, mostly of black chert pebbles, but locally quartz rich. Pebbles as large as 5 cm diameter. Sandstone and quartzite are gray to maroon and rusty, tabular to cross bedded, partly micaceous, and contain ironstone nodules and black shale rip-up clasts. Silt shale is black, red and yellow; contains fossil leaf and wood fragments. Fossil logs as much as 3 ft long occur in quartzite at one locality near Nichenthraw Mountain. About 600 ft thick. This part of the Kanayut contains Devonian(?) plants in the outcrops near Carter Pass mapped as part of undivided Kanayut(?). Deposited by meandering streams (Nilsen and others, 1980a)

MDksm **Kanayut Conglomerate, Stuver Member and middle part, undivided (Lower Mississippian? and Upper Devonian)**—Consists of the more resistant upper parts of the Kanayut as distinguished from the shaley lower part (Dkl). Where mapped, contains unidentified plant fossils

Dkm **Kanayut Conglomerate, middle part (Upper Devonian)**—Cliff-forming unit of conglomerate and sandstone in massive, amalgamated beds 10 to 30 ft thick, and also in fining-upward cycles with shale at top. Clasts in conglomerate are mostly black, gray, and white chert and as much as 11 cm in diameter. Thickness is about 800 ft. No fossils found. Age is based on the Devonian(?) plants in the upper part and Devonian plants in the lower part of the Kanayut. Deposited by braided streams (Nilsen and others, 1980a)

Dkl **Kanayut Conglomerate, lower part (Upper Devonian)**—Shale, slate, quartz-rich sandstone, wacke, and conglomerate. In the area north of Old Woman Creek and Cane Creek, consists mostly of micaceous red slate, shale and argillite and green grit, hematitic sandstone, and lithic wacke. Wacke is pyritic, composed of angular grains of chert and quartz, rock fragments, and plagioclase in a matrix of calcite, sericite, chlorite, and glauconite. Few beds of gray fine- to medium-grained quartzite. Rare pebbles as long as 1 cm. Red shale at top of unit is interbedded with conglomerate at base of overlying middle part of Kanayut, which also contains green shale rip-up clasts. No fossils found. In the area southwest of Old Woman Creek, entirely red shale at Broshman Mountain; elsewhere consists of cycles 10 to 20 m thick that are about half red and black shale and half rusty, fine-grained quartzite and conglomerate. There the conglomerate pebbles are less than 5 cm in diameter, and more than 90 percent are chert, mainly gray and black. Shale contains Devonian plants. Deposited by meandering streams (Nilsen and others, 1980a). Thickness probably about 1000 ft

Dr **Unnamed rhyolite (Devonian?)**—Metarhyolite. Yellow-weathering, crystal and lithic tuff composed mostly of secondary quartz, sericite, and calcite; associated with schistose greenstone with malachite stain. About 50 ft thick. Only a few small outcrops, all of them in, or directly under, the Kanayut Conglomerate

Dn **Noatak Sandstone (Upper Devonian)**—Formerly described as the marine basal sandstone member of the Kanayut Conglomerate (Nilsen and others, 1981; Nilsen and Moore, 1984). Interbedded orange-weathering, dark-gray, fine-grained to very fine grained, thin-bedded, partly calcareous wacke and black siltstone and shale. Includes lenses of brown calcareous sandstone that contain phosphatic pebbles and lenses of sandy limestone coquina. Unidentified plant fossils are present in the shale. The coquina contains brachiopods and conodonts of Late Devonian (Famennian?) age. Thickness uncertain, probably about 500 ft. Mostly deposited as channel-mouth and offshore bars (Nilsen and others, 1981). Present only in southwestern part and near Tetsiyeh Mountain in eastern part of quadrangle

Dhf **Hunt Fork Shale, shale member (Upper Devonian)**—Black to gray clay shale that weathers brown to gray, brown-weathering micaceous silt shale, and gray-green, yellow-weathering slate that is partly pyritic or manganiferous. Sandstone forms about 10 to 25 percent of the unit and is mostly gray, fine to medium grained, thin bedded to shaley, ferruginous and locally hematitic, and partly calcareous. Some sandstone is gritty, coarse grained, medium bedded, and contains pebbles of quartz and shale. Green, fine-grained graywacke is rare. Brachiopods

and crinoids occur in the sandstone and in rare lumps of hematitic coquina and thin beds of orange-weathering limestone. Contains brachiopods, corals, and gastropods of early Late Devonian (Frasnian) age and conodonts of Middle to Late Devonian age. About 1,000 to 1,500 ft thick

Dbw **Beaucoup Formation, wacke member (Upper Devonian)**—Dark-gray, very fine grained to fine-grained limonitic wacke. Forms thin irregular beds interbedded with black to olive siltstone and shale. Shale is manganiferous and partly micaceous and locally contains phosphatic nodules. Also includes few beds of brown calcareous shale and brown-weathering calcareous siltstone that grades to limestone and to sandy limestone coquina; rare beds of black gritty quartzite with chert pebbles 1 to 3 cm in diameter. Sandstone is composed of detrital grains of quartz, chert, lithic fragments, and some plagioclase, cemented by chlorite and calcite. Foliated chloritic quartz siltstone grades to clear quartzite. Unidentified plant fragments are present in shale. Calcareous rocks contain atrypid, cyrtospiriferid, and productellid brachiopods, corals, and gastropods, all of early Late Devonian (Frasnian) age and conodonts of Late Devonian age. Thickness is uncertain, possibly about 1,000 ft

Dls **Unnamed limestone, shale, and conglomerate (Upper and Middle Devonian)**—Interbedded limestone, calcareous siltstone, shale, and quartzite in layers 25 to 100 ft thick. Limestone is black to dark gray, mostly fine grained and orange weathering. Crinoidal calcareous siltstone consists of micaceous, orange-weathering subgraywacke composed of detrital grains of quartz, calcite, plagioclase, chlorite, muscovite, and sphene. Shale is black, silty, partly micaceous. Quartzite is black, coarse, pebbly chert arenite that contains chert pebbles as much as 2 cm in diameter. Calcareous siltstone is hornfelsed at contacts with small diabase sills of unit Dm. Unit commonly weathers to yellow slopes. Thickness of unit is uncertain, probably 500 to 1,000 ft. Limestone contains brachiopods, bryozoans, tentaculitids, and a trilobite, all of Middle Devonian age and, at one locality near top of unit, corals of Late(?) Devonian age. Calcareous siltstone contains brachiopods and pelecypods of Middle(?) Devonian age. Although originally described as Early and (or) Middle Devonian (Brosgé and others, 1981), unit is now considered to be Middle and Late Devonian. Similar in age and lithology to Ulungarat Formation of Anderson (1991b) in Table Mountain and Demarcation Point quadrangles to the east and northeast

Dsc **Unnamed sheared conglomerate (Devonian?)**—Sheared conglomerate of chert and slate pebbles as much as 10 cm in diameter; partly calcareous, partly ferruginous; black micaceous shale and siltstone, and brown, fine- to medium-grained, orange-weathering, schistose wacke and quartzite. Makes brown and black rubble slopes. Thickness probably several hundred feet. Probably equivalent in age to, or slightly older than, the rhyolite (Dr). Contains more black shale than the unnamed sheared conglomerate unit (MDsc) of North Slope Subterrane; less shale than the unnamed shale and sandstone unit (Ds) of that subterrane

Dhl **Hunt Fork Shale, limestone member (Upper Devonian)**—Dark-gray, gray-weathering, fine-grained limestone and orange-weathering, argillaceous, shaley to nodular limestone. Contains atrypid brachiopods and corals of early Late Devonian (Frasnian) age. About 50 to 100 ft thick. Near the middle of the shale member of the Hunt Fork Shale

Dbl **Beaucoup Formation, limestone member (Upper or Middle Devonian)**—Light-gray, coarse-grained, crinoidal limestone and medium-gray, fine- to medium-grained, saccharoidal limestone; contains irregular bands and replacement patches of medium-gray to black chert. Present at only one locality on the East Fork Chandalar River. About 200 to 300 ft thick. Contains conodonts of Middle or early Late Devonian age. In other respects, resembles limestone of Lisburne Group

Dm **Unnamed mafic rocks (Devonian?)**—Two or more 25-ft-thick sills of light-green, rusty-weathering, fine- to medium-crystalline metadiabase. Diabasic texture is preserved although igneous minerals have been altered to chlorite and magnetite, albite, and clay with accessory sphene; patches of calcite may represent vesicle fillings. Fossiliferous (Middle? Devonian) calcareous siltstone of unit Dls has hornfels zones at contacts with sills

Hammond Subterrane

Dkq **Kanayut Conglomerate, quartzite member (Upper Devonian)**—Quartzite, sandstone, and shale that form fining- and thinning-upward cycles about 25 to 50 ft thick. Quartzite is gray, fine to coarse grained, and partly rusty weathering. It is massive at base of cycles and thin bedded and crossbedded above. Sandstone near tops of cycles is thin and shaley. Shale is black and brown. Plant fragments, and mixed plant, brachiopod, and crinoid fragments occur in the shale at the top of some cycles. About 500 to 1,000 ft thick. Contains brachiopods of Late Devonian (Famennian) age. Lack of conglomerate distinguishes this member from other members of the Kanayut

Dn **Noatak Sandstone (Upper Devonian)**—Sandstone and shale. East of Koness River unit is mostly yellow to gray-green, orange to gray weathering, thin bedded to shaley, bioturbated sandstone. Also includes brown- and gray-weathering, medium- to coarse-grained, thin-bedded calcareous sandstone and dark-red, fine-grained, bioturbated hematitic sandstone. Intervals of black, worm-burrowed siltstone and gray-green, mottled, irregularly bedded, worm-burrowed mudstone; minor amounts of black and brown, partly calcareous shale. West of Koness River some sandstone is black, yellow weathering, fine grained, shaley, and bioturbated; some is light gray, very fine grained, rusty, thin bedded, with load casts and ironstone concretions; and some is gray-green, fine- to medium-grained, limonitic, thin- to medium-bedded quartz wacke. The wacke is composed of quartz and chert grains in a matrix of clay, sericite, chlorite, and carbonate with minor sphene and pyrophyllite. Indeterminate plant fragments were found in the quartz wacke, and cyrtospiriferid brachiopods of Late Devonian (Famennian) age occur in the associated sandstone. Cyrtospiriferid brachiopods also are present in the sandstone east of the Koness River. Thickness is more than 300 ft, possibly as much as 1,000 ft. Identified only east of East Fork Chandalar River

Dvt **Unnamed volcanic rocks and tuff (Upper Devonian)**—Metamorphosed basaltic and andesitic flows and andesitic tuffs, crystal tuff, breccia, and volcanic conglomerate altered to greenstone, interbedded in black slate of the Hunt Fork Shale (Dhf). Some flows are vesicular, others are composed of pillows cemented by tuff and greenstone. Conglomerate between volcanic flows is composed of lumps of mafic rock and pebbles of limestone in a matrix of slate that may have been debris-flow mud. The volcanic rocks are now greenstone. Phenocrysts of hornblende are altered to chlorite; albite/andesine to sericite; plagioclase to feldspar and calcite; pyroxene to chlorite and magnetite. The volcanic matrix has been altered to epidote, chlorite, quartz, albite, and actinolite. Limestone clasts in the volcanic breccias and the conglomerate contain brachiopods and conodonts of Late Devonian (Frasnian) age. Thickness varies from about 500 ft to less than 100 ft. Unit is present locally between Old John Lake and Koness River

Dv **Unnamed volcanic rocks (Devonian)**—Metamorphosed sills and dikes of dacite, latite, or andesite and flows of rhyolite that intrude the conglomerate and shale member of Beaucoup Formation and intrude and overlie the Skajit Limestone. Intrusive rocks are fine to coarse crystalline, porphyritic, and composed of plagioclase and potassium feldspars altered to sericite and phenocrysts of volcanic quartz. Brown hornblende in part is altered to actinolite; biotite is rare. Matrix is composed of sericite, chlorite, and calcite. Skajit Limestone is green and silicified at the intrusive contacts. Flows that rest on the Skajit Limestone are porphyritic, composed of plagioclase, quartz, and sericite, with feldspar phenocrysts altered to chlorite, calcite, and epidote. Secondary pumpellyite and stilpnomelane are rare. Thickness of individual flows or sills varies; the thickest of each is about 1,000 ft. Also included in the unit are a few small dikes of metamorphosed basalt that intrude the Hunt Fork Shale and are associated with tuff unit Dvt. A Devonian age for the unit is based on the Devonian age of the fossils in the associated unit Dvt and on the apparent relation of the volcanic rocks with rocks of the Upper Devonian Beaucoup Formation, which contain clasts and intrusive bodies of volcanic rocks

Dhf **Hunt Fork Shale, shale member (Upper Devonian)**—Dark-gray to black shale and slate that weathers gray and brown; and dark-gray, brown-weathering, irregularly bedded

siltstone. Includes minor gray, fine- to medium-grained, cross-bedded quartzite, and gray, very fine grained, thin-bedded quartz sandstone composed of quartz, chert, and lithic fragments with minor sericite. Locally contains some thin beds of calcareous crinoidal sandstone and shaley bioturbated sandstone. Near top of unit in southeastern part of quadrangle, contains interbeds of tuff and fossiliferous volcanic conglomerate (Dvt) that contain Late Devonian (Frasnian) fossils. Thickness uncertain, possibly 1,000 to 1,500 ft

Dbw **Beaucoup Formation, wacke member (Upper Devonian)**—Interbedded schistose lithic wacke, quartz sandstone, siltstone, and shale. Each of these rock types also forms discrete units several hundred feet thick. Wacke is dark gray and gray-green, fine to medium grained, shaley to medium bedded, micaceous, ferruginous, manganiferous, partly calcareous, and weathers green and orange. It contains load casts and plant fragments. Wacke is composed of chert, quartz, mica, and slate chips. Sandstone is brown and dark gray, very fine grained to fine grained, thin bedded, micaceous, partly calcareous. Quartzite is brown and gray, white weathering, fine to medium grained, thin bedded, and contains ironstone nodules. A minor amount of green quartz grit and granule-pebble conglomerate is composed of quartz, chert, and slate chip clasts, and grades to wacke. Micaceous shaley siltstone and shale is dark gray, black, and gray-green, and contains clay pebbles, bottom marks, worm burrows, and brachiopods. Lenses of calcareous chert-pebble conglomerate in the wacke and lenses of coquina in calcareous sandstone both contain brachiopods, pelecypods, crinoids, and corals of Late Devonian (Frasnian) age. Thickness ranges from about 400 ft to probably more than 1,000 ft

Dbc **Beaucoup Formation, conglomerate and shale member (Upper Devonian)**—Conglomerate, sandstone, and shale with greenschist facies mineral assemblages interbedded in units 25 to 200 ft thick. Black, brown, and red-weathering sheared granule, pebble, and cobble conglomerate makes up from one third to two thirds of the member. Clasts are black, white, gray, green, and red chert, chips of black slate, and, in the upper part of the member, some chips of red and green argillite. Some clasts are quartz and quartzite, and rare pebbles ironstone. The conglomerate matrix is ferruginous grit to siltstone. Near Misty Mountain are beds of unusual maroon conglomerate that contains red chert and slate pebbles. Quartz wacke and arenite make up 20 to 40 percent of the member. They are schistose, micaceous, yellow and brown, fine to medium grained and consist mostly of quartz, chert and plagioclase grains, some lithic fragments, and some fragments of volcanic rock near the outcrops of volcanic rocks (Dv) in the southwestern part of the quadrangle. Matrix is sericite, chlorite, calcite, and iron oxides. Sericite lies both in the foliation and within the clasts.

Black and gray shale, slate, phyllite, and siliceous siltstone, and purple and green shale, slate, and chloritic siltstone make up 20 to 30 percent of the member. They produce the overall purplish weathering color that characterizes the member. Locally, the contact of this member with the overlying wacke member (Dbw) is gradational. Where the member rests on Skajit Limestone, the basal beds are limestone cobble conglomerate with clasts as much as 18 cm in diameter. Where it rests on the siltstone member of the Beaucoup Formation (Dbs) a basal limestone bed contains pebbles of slate. At one locality northeast of Crow Nest Creek, a thin bed of black, fine-grained limestone occurs within the conglomerate near the top of the member. Thin layers of calcareous sandstone within the sheared conglomerate and limestone lenses in calcareous grit contain crinoids and snails of Devonian(?) age. The only positively identified fossils are conodonts of Late Devonian (Famennian) age in an enigmatic collection (No. 192, table 1) assigned to this unit because its coordinate location is in the unit. Probably the conglomerate and shale member is Frasnian in age, like the rest of the Beaucoup. The member is about 1,500 to 2,000 ft thick

Dbl **Beaucoup Formation, limestone member (Upper Devonian)**—Consists mostly of medium-gray to black, fine-grained calcarenite, calcisiltite, and calcilutite, thin bedded to slatey, that weather yellowish gray to orange. Lesser amounts of light-gray to dark-gray, blocky, light-gray-weathering, very fine grained calcarenite and calcilutite and

brown-weathering, very fine grained, argillaceous limestone with a few interbeds of black shale. Minor coarse crinoidal limestone and dark-gray, fine-grained dolomite. Rare irregular nodules of replacement chert, silicified limestone, and silicified fossils. Abundant rugose and tabulate corals, atrypid, cyrtospiriferid, productellid, and strophomenid brachiopods, and conodonts; all of Late Devonian (Frasnian) age. About 200 to 400 ft thick

Pzc **Unnamed sheared conglomerate (Devonian?)**—Sheared conglomerate composed of pebbles of white chert, some black chert, quartz, quartzite, and black and purple slate. Largest pebbles are quartzite, 10 cm long. Chert pebbles are flattened, stretched, recrystallized, sugary-textured, sericitic, and locally foliated, and display chloritoid on the foliation surfaces. Conglomerate is deeply weathered to loose, brittle plates of flattened yellow, white, and rusty pebbles. Locally, no fresh rock is visible. Matrix of conglomerate is mostly very siliceous and partly calcareous; some is shaley. Quartzite interbedded with the conglomerate is purple and yellow; schistose sandstone is purple, yellow, and green like the overlying Noatak Sandstone (Dn). Top may be interbedded with the Noatak Sandstone. Stratigraphic position beneath the Noatak is uncertain because many of the contacts are faults. Base not exposed. The extreme shearing suggests that it may be a thrust fault. Thickness 1,000 ft or more. No fossils found

DSl **Unnamed fossiliferous limestone (Upper and Middle? Devonian and Upper? Silurian)**—Dark-gray, gray- and yellow-weathering, fine-grained limestone with abundant colonial corals and stromatoporoids underlain by gray calcilutite with sparry calcite patches, stromatoporoid layers, and a few coral fragments. Exposed in a continuous sequence about 200 ft thick. A fault separates these beds from 400 ft of similar beds, to the east, that may include some duplicate section. Top beds of 200-ft section contain brachiopods of Late Devonian (Frasnian?) age. Middle(?) Devonian corals occur throughout the underlying fine-grained limestone. Corals of Late(?) Silurian age collected by geologists of Standard Oil Co. of California (Oliver and others, 1975) at this locality may be from the structurally separated beds in the eastern part of the outcrop area

Dbs **Beaucoup Formation, siltstone member (Upper Devonian)**—Brown and tan, micaceous, slatey, calcareous siltstone and calcareous shale. Also includes greenish-gray to purple and black siltstone and slate interbedded with thin beds of sandstone, conglomerate, and limestone. Some brown-weathering, partly calcareous, sheared conglomerate composed of pebbles of slate, chert, and red-weathering limestone in a matrix of grit and siltstone is also present. Interbedded in the conglomerate is some dark-gray to black and sooty, thin-bedded to platey limestone that weathers yellow and orange and locally contains slate pebbles. Brachiopods and corals of Late Devonian (Frasnian) age occur in the calcareous shale. Thickness uncertain, but is more than 500 ft

DOs **Skajit Limestone (Devonian, Silurian, and Ordovician)**—Light- to medium-gray, very fine grained to fine-grained, massive limestone, recrystallized limestone, and coarse-crystalline marble. Unit weathers gray and yellowish gray. Includes minor black platey crinoidal limestone, and dark-gray, fetid, argillaceous limestone that weather gray and orange; and rare chert and orange dolomite. Unit is locally capped by layer of black chert 1 to 2 ft thick. Contains conodonts of Late Ordovician, probable Silurian, and possible Middle Devonian age and corals of Ordovician to Late Devonian age. Contains pentamerid brachiopods of Late(?) Silurian age 6 mi west of quadrangle (Brosgé and others, 1979). Probably about 2,000 ft thick; base not exposed

Sheenjek Subterrane
(Mapped in southeast part of quadrangle, near Old Woman Creek)

Jm **Unnamed mafic rocks (Jurassic?)**—Sills of metamorphosed, dark-green, very fine crystalline to medium-crystalline basalt. Composed of clinopyroxene altered to chlorite and actinolite, plagioclase to kaolin, sphene to leucoxene, with some celadonite and glass. Consists of many separate sills; total thickness more than 100 ft. Intruded between Lisburne Group limestone (Ml) and unnamed

chert and slate unit (PMp), and contains inclusions of limestone, chert and slate; therefore age is younger than Mississippian. Locally intrudes unnamed red and green argillite (TrPa), is therefore probably younger than Triassic

TrPa **Unnamed red and green argillite (Triassic through Permian)**—Red and green argillite. About 300 ft thick. No fossils found. Similar rocks in same sequence and subterrane (Silberling and others, 1992), about 45 mi southeast in Coleen quadrangle, contain one possible Permian or Triassic conodont (Brosgé and Reiser, 1969)

PMp **Unnamed chert and slate (Pennsylvanian? through Mississippian?)**—Interbedded gray siliceous argillite and gray chert. Thickness about 100 ft or more. No fossils found. Probably same age as same unit in adjacent Venetie Subterranes

Ml **Lisburne Group (Mississippian)**—Limestone, medium to dark gray, fine grained, sugary, laminated, partly to entirely silicified. About 50 to 100 ft thick. Underlain by 100 ft of rusty brown chert. Contains conodonts of Early Mississippian age and foraminifera of Early or early Late Mississippian age. Chert contains Mississippian radiolarians

Pzss **Unnamed slate and siltstone (Upper Paleozoic)**—Black to gray slate, silty phyllite and siltstone; minor gray, fine-grained, thin-bedded, partly calcareous quartz sandstone. Thickness not known. No fossils found

Venetie Subterrane
(Mapped in southeast part of quadrangle)

TrMs **Unnamed slate and chert (Triassic? through Mississippian)**—Black to light-gray, laminated radiolarian chert that weathers purple, orange, and rusty; gray-green glassy chert that grades to silicified argillite; and interbedded green, red, and yellow, manganiferous, partly silicified argillite. Probably hundreds of feet thick. Black and green chert contains radiolarians of Mississippian age and latest Mississippian to earliest Pennsylvanian age. The slate and chert unit extends southward into the Christian quadrangle where chert in red and green shale that crops out only about 3 mi to the south (Brosgé and Reiser, 1962) contains radiolarians of Mesozoic (or younger) age (D.L. Jones and B.L. Murchey, written commun., 3/31/81) and conodonts of Permian or Triassic age (Bruce Wardlaw, written commun., 3/12/79). Probable source of glassy black chert that has been worked for tools at several sites

Dkq **Kanayut Conglomerate, quartzite member (Devonian)**—Light-gray, fine-grained quartzite and dark-gray, fine-grained quartzite in beds about 6 in thick; contains slate chips. Thickness not known. No fossils found. Probably Devonian, according to apparent stratigraphic position and correlation with Kanayut in Hammond Subterrane

Dw **Unnamed wacke (Devonian?)**—Dark-gray and medium-gray to gray-green and yellow-brown, fine-grained, thin-bedded, micaceous wacke. Weathers orange and yellowish gray. Contains slate chips and plant fragments. Interbedded with about 50 percent black and gray-brown shale. Probably 1,000 to 2,000 ft thick. No fossils found, but same unit in outcrops 7.5 mi and 10 mi south in Christian quadrangle (Brosgé and Reiser, 1962) contains spores of probable Early Devonian age (J.M. Schopf, written commun., 2/7/73) and plant fossils of probable Upper Devonian age (Mamay, 1962)

Dhf **Hunt Fork Shale, shale member (Upper Devonian)**—Mostly black silty slate and shale that weather yellowish gray; dark-gray, very fine grained to fine-grained, brown-weathering, thin-bedded to laminated sandstone with slate chips; minor light-gray quartzite. About 800 ft to 1,000 ft thick. No fossils found; age inferred from stratigraphic position and correlation with Hunt Fork of Hammond subterrane

Venetie and Sheenjek Subterranes, undivided
(A structural assemblage of parts of two subterranes, mapped south of Junjik River and eastward to Old Woman Creek. See Plate 2 for location)

TrPa **Unnamed red and green argillite and chert (Triassic? to Permian?)**—Differentiated east of the East Fork Chandalar River and a few places farther west. Green to yellowish-gray, pyritic, manganiferous argillite and red, green, and purple, partly silicified, pyritic, manganiferous clay shale, and slate and silty slate. Argillite grades vertically into glassy, green, radiolarian, spicular(?), locally barite-bearing chert that makes up less than one fourth of the unit. Locally interbedded with

rusty weathering shale and siltstone at contacts with adjacent unit IPMp. No fossils identified. Probably about 300 ft thick

TrMs **Unnamed slate and chert (Triassic? through Mississippian)**—Black slate and chert, and red and green argillite and chert. Most of the red and green rocks are mapped as a separate unit (TrPa) east of the East Fork Chandalar River and locally to the west. Siliceous manganiferous black slate and black shaley siltstone in units 50 to 800 ft thick make up about one half of the undifferentiated unit. About one fourth is black and gray, glassy to silty, partly pyritic, radiolarian chert, some in thin beds interbedded in slate and grading into silicified slate; some in beds and lenses as much as 50 to 100 ft thick. Beds and lenses of red and green and gray-green manganiferous argillite and chert make up the rest of the unit. Some black slate contains ironstone nodules and minor black and gray, very fine grained, nodular to laminated sandstone. Black chert and the varicolored argillite contain veins and lenses of barite. About 1,000 to 1,500 ft thick. Contains Mississippian, Late Mississippian to Pennsylvanian, and Late Triassic radiolarians. The lower part of this unit is probably equivalent to unit (IPMp), but contains more chert

Pl **Unnamed limestone (Permian?)**—Interbedded light-brown, reddish-weathering, sandy limestone and irregular beds of gray-green, brown-weathering, fine-grained, very calcareous sandstone with minor black shale. About 500 ft thick. No fossils found. Resembles the lower Echooka Formation of North Slope Subterrane. Mapped only at one locality near Old Woman Creek

IPMp **Unnamed phyllite and chert (Pennsylvanian? and Mississippian)**—Mostly dark-gray to black phyllite, slate, and siltstone. Slate is locally silicified and grades to black fissile chert. Contains rare beds of white, gray, and black chert. Siltstone is shaley, micaceous, rusty weathering, and partly calcareous. Includes some interbedded gray-green, pyritic, manganiferous slate and argillite. Minor gray and black, fine-grained, calcareous wacke composed of quartz, chert, rock fragments, plagioclase, biotite, and some microperthite(?) grains. Probably 500 to 1,000 ft thick. Contains radiolarians of Mississippian age

Pzss **Unnamed slate and siltstone (Upper Paleozoic)**—Dark-gray and black shale, slate, and shaley siltstone that is partly manganiferous and rusty weathering and partly siliceous and white weathering. Includes minor gray-green manganiferous slate and argillite and some dark-gray and gray-green, very fine grained to fine-grained, thin-bedded, slightly calcareous, foliated quartz wacke and lithic wacke with rare biotite clasts. Probably 500 to 1,000 ft thick. No fossils found. Stratigraphic position uncertain

Dw **Unnamed wacke (Devonian)**—Mostly black shale and siltstone, and about one third lithic wacke, quartz wacke, and quartzite. Characterized by yellow-brown weathering and by abundant unidentifiable plant fragments. Fine-grained rocks consist of micaceous clay and silt shale, slate, and laminated siltstone and display flow marks, cone-in-cone structures, and nodules and thin beds of ironstone. Shale forms thin partings in the wacke, and also forms layers 10 to 100 ft thick. Most of the wacke is lithic wacke; it is medium to dark gray and greenish gray, very fine to medium grained, thin to medium bedded, micaceous, partly manganiferous, and locally foliated. It weathers yellow, orange, olive, and brown, and contains shale chips, load casts, a few quartz pebbles, and many plant fragments. The remaining quartz-rich wacke is medium gray to gray-green, fine grained, thin to thick bedded, partly siliceous, and partly limonitic. It weathers white, gray, and brown and contains shale and sandstone chips, flow marks, and wood fragments. The wacke forms layers 10 to 20 ft thick consisting of fining-upward cycles 6 to 12 in thick. Unit is probably about 1,500 to 2,000 ft thick. Contains spores of Late(?) Devonian age

Endicott Mountains and Venetie Subterranes, undivided
(A structural assemblage of parts of two subterranes, mapped north of the Junjik River and Nichenthraw Mountain. See Plate 2 for location)

Kk? **Kongakut Formation? (Lower Cretaceous?)**—Black manganiferous shale and phyllite, and black, very fine grained, medium-bedded, partly calcareous lithic wacke that weathers brown and orange. Wacke contains rare clasts of biotite and glaucophane. Probably about 600 to 1,000 ft thick. No fossils found.

Topography and weathering characters suggest correlation with fossiliferous Kongakut Formation assigned to the Endicott Mountains Subterrane near Mount Annette

TrPss **Sadlerochit Group and Siksikpuk Formation?, undifferentiated (Lower Triassic and Permian)**—Black and dark-gray micaceous manganiferous shale; olive and green-brown-weathering, non-calcareous, manganiferous shale; minor black, very fine grained, orange-weathering sandstone. Black massive radiolarian chert is locally interbedded with green shale in intervals 100 ft thick. Chert contains thin layers of dolomite and silicified limestone and radiolarians of Permian(?) age. Thickness not known

TrMs **Unnamed slate and chert (Triassic? to Mississippian)**—Red and green slate and chert and black chert and slate. About 50 percent of unit is red and green manganiferous slate, shale, and silicified argillite, green and brown siltstone, and orange-weathering green chert with layers of hematitic dolomite. About 40 percent is black radiolarian chert and some gray laminated chert; also includes one bed of barite. Black and gray slate and silty shale with rare calcareous shale and brown-weathering quartzitic siltstone compose rest of unit. About 500 ft thick. Contains Late Mississippian or Early Pennsylvanian radiolarians

Ps **Siksikpuk Formation (Permian)**—Olive-gray silicified siltstone, weathers white. Mapped at one locality

PMk **Kuna Formation (Pennsylvanian? and Mississippian)**—Black shale and black, fine-grained sooty limestone. Only about 100 ft to 200 ft exposed. Contains ammonite of Late Mississippian age. Recognized at one locality north of Nichenthraw Mountain

Pc **Unnamed chert (Pennsylvanian?)**—Thick-bedded black chert. Rests on Lisburne Group Limestone of early Late Mississippian age

Ml **Lisburne Group (Mississippian)**—Gray, partially silicified limestone with black nodular chert; light-gray calcilutite with light-gray chert. Contains foraminifera of early Late Mississippian age. Probably also includes beds of Early Mississippian age. Thickness not known; probably 1,000 to 1,500 ft

Mk **Kayak Shale (Mississippian)**—Black shale and yellow-weathering crinoidal limestone. Thickness not known. Contains brachiopods of Early(?) Mississippian (Osagian?) age

De Long Mountains Subterrane
(South of Junjik River)

PPi **Imnaitchiak Chert (Permian and Pennsylvanian)**—Chert, argillite, and silty shale. Chert is light green, weathers white and rusty; minor gray, black, and red chert. Argillite is maroon, red, and green and manganiferous; silty shale is gray, pyritic. More than 500 ft thick. Contains radiolarians of Mississippian or Pennsylvanian age and radiolarians of Pennsylvanian or Permian age

PMa **Akmalik Chert (Pennsylvanian and Mississippian)**—Black chert, some dull and silty, some glassy; mostly massive, some laminated. Unit locally includes a thin bed of dark-gray recrystallized limestone and rubble of ferruginous limestone and calcareous siltstone. About 250 ft thick. Chert contains radiolarians that are probably of Late Mississippian age. Brachiopods of Early Mississippian age were found in an adjacent small body of crinoidal limestone that might represent a small fault sliver of Kayak Shale

Ml **Lisburne Group (Mississippian)**—Light-gray, medium- to coarse-grained crinoidal limestone. Limestone is largely silicified or replaced by gray and white blocky chert in zones deposited along and normal to bedding. Probably only a few hundred feet thick; locally absent. Basal beds contain brachiopods of Early Mississippian age. May be entirely Early Mississippian if the overlying Akmalik Chert is entirely Late and younger Mississippian

Mk **Kayak Shale (Lower Mississippian)**—Black shale with ironstone concretions and yellow-weathering lenses of crinoidal limestone. Locally includes a basal quartzite that is as much as 100 ft thick. Contains brachiopods of Early Mississippian age. Probably about 500 ft thick

Dbw **Beaucoup Formation, wacke member (Upper Devonian)**—Gray, fine- to medium-grained, thin-bedded, ferruginous quartzite and quartz wacke that contain ironstone chips and some granules of quartz, chert, and slate. Wacke is black, very fine grained, orange and gray weathering, and forms thin, graded beds that are interbedded with black, manganiferous clay shale and silty shale. Lenses of orange-weathering, calcareous sandstone contain brachiopods and corals of Late Devonian (Frasnian) age. Probably about 1,000 ft thick

Klippen of Endicott Mountains and De Long Mountains Subterranes and Tozitna(?) Terrane near Mount Annette

[Nearly all faults mapped in the klippen are thrust faults, although level of detail on the map precludes addition of sawteeth]

Kk **Kongakut Formation (Lower Cretaceous)**—Black and gray-green, manganiferous, micaceous silt shale that weathers gray-green and brown and contains manganese nodules. Interbedded black and brown, very fine grained to fine-grained manganiferous lithic wacke that weathers green, brown, and orange. Rhythmically bedded in cycles 6 to 12 in thick. Minor hard, black, manganiferous, micaceous siltstone with manganese nodules. Contains minor black, soft clay shale with ironstone concretions that have 1- to 2-in-diameter cores of phosphatic chert. Thickness at least 500 ft. Contains spores of probable Cretaceous age and foraminifera of Early Cretaceous (Neocomian) age. Correlated with the black manganiferous shale and fine-grained graywacke of the Kongakut Formation in the northern part of the adjacent Philip Smith Mountains quadrangle (Brosgé and others, 1979) rather than with the coarser graywacke and conglomerate of the Neocomian Okpikruak Formation in the southern part of that quadrangle

TRPv **Unnamed volcanic rocks (Triassic and Permian)**—Basalt, andesite, and chert. Basalt is coarse crystalline, sheared, slickensided, and altered to chlorite, clay, and epidote. Andesite is mostly medium crystalline, rusty weathering; lower part of andesite is fine crystalline; contains amygdules of chlorite, calcite, prehnite, and pumpelleyite(?) and contains a 25-ft-thick zone of gray and brown silty chert. A few feet above the base of unit is a 5-ft-thick bed of dark-gray, fine-grained, brown-weathering, sandy limestone that contains crinoids and clasts of limestone, plagioclase, and probably sheared volcanic rock. This bed also contains corals and brachiopods of Late Permian age and foraminifera of Permian or younger age. Radiolarians of Late Triassic age are present in the chert. Thickness is more than 300 ft. Resembles rocks of the Tozitna Terrane south of the Arctic quadrangle

TRo **Otuk Formation (Triassic)**—Black clay and silt shale interbedded with limestone and with black, gray, and brown radiolarian chert that contains some beds of olive-gray calcilutite. Limestone in the shale is gray to black calcilutite, in beds as thick as 4 in, and weathers cream-colored to light brown. Monotid pelecypods of Late Triassic (Norian) age are abundant in all of the limestones. At one locality, a thick chert bed that is overlain by monotid-bearing limestone contains radiolarians of Late Triassic age and conodonts of Early Triassic (Smithian?) age. Thickness probably 300 ft or more

TRPe **Etivluk Group (Triassic through Permian?)**—Mostly radiolarian chert with lesser shale and siltstone and rare beds of limestone. Most chert is black to brown, thick bedded, and weathers brown to rusty orange; about one third is gray-green and weathers silver gray. Shale is black to dark gray, silty, hard, manganiferous, and rusty- to brown-weathering; silty shale is gray-green. Includes some silicified siltstone that grades into brown-weathering chert. Also contains rare gray, platy, creamy-weathering calcilutite in 5- to 10-ft-thick layers, and beds and lenses of black sooty limestone and fine-grained, silty, orange-weathering limestone in black shale. Mapped in most of area mainly by the light- and dark-brown rubble slopes. Traversed completely only on Mount Annette. Thickness is about 300 ft. Contains monotid pelecypods and radiolarians of Late Triassic age

TRMi **Imnaitchiak Chert (Triassic through Mississippian)**—Gray-green and olive, laminated siltstone, silty argillite, and silicified siltstone that grades to chert. Forms layers 50 to 100 ft thick. Interbedded gray and gray-green radiolarian chert that weathers white, olive, and gray-brown. Also includes a few 10-ft-thick beds and lenses of medium-gray, orange-weathering calcilutite, brown limestone, and calcareous siltstone. The limestones throughout the unit contain monotid pelecypods of Late Triassic (Norian) age. Olive and black chert at the base of the unit contains radiolarians of Mississippian or Pennsylvanian age. Chert higher in the unit contains radiolarians of Permian(?) age; and, near the top of the unit chert contains radiolarians of Late Triassic age. About 400 ft thick

PMa **Akmalik Chert (Pennsylvanian and Mississippian)**—Black, silty to glassy, pyritic chert, bedded and laminated. In lower part is a thin bed of black limestone and rubble of gray recrystallized limestone and recrystallized hematitic dolomite. About 75 ft thick. Limestone contains conodonts of Late Mississippian age

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Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*

[Fossils identified by: Armstrong, A.K.; Carter, Claire; Dutro, J.T., Jr.; Gordon, Mackenzie, Jr.; Grant, R.E.; Haga, Hideyo; Harris, A.G.; Hazel, J.E.; Holdsworth, B.K.; Hueber, F.M.; Jones, D.L.; Kummel, Bernhard; Mamay, S.H.; Mamet, B.L.; Mickey, M.B.; Miller, J.W.; Murchey, B.L.; Nichols, K.M.; Oliver, W.A., Jr.; Pojeta, John, Jr.; Silberling, N.J.; Taylor, D.W.; Tailleur, I.L.;Wardlaw, B.R.; and Yochelson, E.L. Identification of graptolites and some corals published in Moore and Churkin, 1984, and Oliver, 1975]

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
			Quaternary Deposits, undifferentiated (Qu)			
182	M-2989	66ABe291	68° 08' N 145° 32' W	pelecypods gastropods (freshwater)	Pleistocene or younger	Taylor 2/24/67
183	M-2988	66ABe289A	68° 10' N 145° 30' W	pelecypods gastropods ostracodes (freshwater)	Pleistocene or younger	Taylor 2/24/67 Hazel 4/6/67
			Cretaceous Rocks, Ipewik unit (Ki)			
23	M-7920	82ATr48A	68° 46' N 146° 36' W	pelecypods	Early Cretaceous (Valanginian)	Miller 2/27/84
24		82ATr40	68° 46' N 146° 30' W	pelecypod coquina	Cretaceous	Tailleur 1982 field ident.
			Cretaceous Rocks, Kongakut Formation (Kk)			
30		78ABe50A	68° 46' N 145° 56' W	spores	Cretaceous(?)	Haga 9/12/80
39		82ATr37	68° 44' N 146° 27' W	foraminifers	Early Cretaceous (Neocomian)	Mickey 10/82
			Triassic Rocks, Shublik Formation (Ŧs)			
15		68ATo11	68° 48' N 146° 32' W	pelecypods	Late Triassic (Karnian)	Silberling 10/28/68
16	Mes 32762	82ATr36	68° 48' N 146° 25' W	conodonts	Late Middle through Late Triassic	Wardlaw, Harris 12/15/82
16	Meso D12064	82ABe633	68° 48' N 146° 25' W	ammonites pelecypods	Late Triassic (Late Karnian)	Silberling 12/29/82
17		72ABe283A	68° 48' N 146° 09' W	ammonites	Indeterminate	Silberling, Nichols 3/13/73
17		72ABe283B	68° 48' N 146° 09' W	pelecypods	Late Triassic (Karnian or early Norian)	Silberling, Nichols 3/13/73
18		72ABe280	68° 48' N 145° 57' W	pelecypods	Late Triassic (Karnian or early Norian)	Silberling, Nichols 3/13/73
19	M-5065	68ATo12	68° 47' N 146° 28' W	pelecypods ammonites	Late Triassic (Late Karnian)	Silberling 10/28/68
22	Meso D12059	82ABe601A	68° 47' N 146° 37' W	ammonite	Middle Triassic or younger	Silberling 10/29/82
26		72ABe316A	68° 47' N 146° 23' W	pelecypods	Late Triassic (Karnian or early Norian)	Silberling, Nichols 3/13/73
			Triassic Rocks, Otuk Formation (Ŧo)			
21		72ABe284C	68° 47' N 146° 12' W	pelecypods	Late Triassic (Late Norian?)	Silberling, Nichols 3/13/73
27		68ATr13	68° 46' N 146° 28' W	pelecypods	Late Triassic (Late Norian)	Silberling 5/14/69

* Map numbers refer to locations shown on map sheet 2.

** All USGS Locality Numbers refer to the several catalogues maintained in the four USGS Paleontology and Stratigraphy Branch centers. Prefix abbreviations: M, general catalogue in Menlo Park, CA; Mes, Mesozoic catalogue in Reston, VA; Meso D, Mesozoic catalogue in Denver, CO; USGS MR, radiolarian catalogue in Menlo Park, CA. Suffix abbreviations: Mz, Mesozoic catalogue in Reston, VA; PC, Late Paleozoic catalogue in Washington, D.C. (partially computerized in Denver, CO); SD, Silurian-Devonian catalogue in Reston, VA.

Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*—Continued

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
Triassic Rocks, Otuk Formation (Ro)—*cont.*						
33	Meso D12062	82ABe605B1	68° 46' N 146° 30' W	pelecypods	Late Triassic (Late Norian)	Silberling 12/29/82
33	Meso D12063	82ABe605B2	68° 46' N 146° 30' W	pelecypods	Late Triassic (Late Norian)	Silberling 12/29/82
33		82ATr14C	68° 46' N 146° 30' W	radiolarians	Late Triassic	Murchey 6/15/83
33	Mes 32768	82ATr14-C	68° 46' N 146° 30' W	conodonts CAI 4.5-5	Early Triassic (Smithian?)	Harris, Wardlaw 12/28/82
116		72ABe297	68° 22' N 146° 02' W	pelecypods	Mixed Middle and Late Triassic (Ladinian and Karnian)	Silberling, Nichols 3/13/73
117		72ABe298C	68° 22' N 146° 02' W	pelecypods	Late Triassic (Late Norian?)	Silberling, Nichols 3/13/73
Triassic and Permian Rocks, Etivluk Group (RPe) (Otuk and Siksikpuk Formations, undivided)						
28		82ATr15A2	68° 46' N 146° 29' W	radiolarians	Triassic	Murchey 6/15/83
34		82ATr14B	68° 45' N 146° 30' W	radiolarians	Late Triassic	Murchey 6/15/83
38		72ABe314	68° 45' N 146° 29' W	pelecypods	Late Triassic (Norian)	Silberling, Nichols 3/13/73
Triassic and Permian Rocks, Sadlerochit Group (RPs) (Ivishak and Echooka Formations, undivided)						
14		52ADu48	68° 49' N 146° 25' W	cephalopods	Early Triassic (Scythian)	Kummel 4/12/54
20	24062 Mz	52ADu52	68° 47' N 146° 33' W	pelecypods	Middle Early Triassic	Silberling, Nichols 5/10/73
20	24063 Mz	52ABe32	68° 47' N 146° 33' W	pelecypods	Middle Early Triassic (Smithian)	Silberling, Nichols 5/10/73
22	24061 Mz	52ADu47	68° 47' N 146° 37' W	pelecypods	Middle Early Triassic	Silberling, Nichols 5/10/73
22	Meso D12060	82ABe601-B	68° 47' N 146° 37' W	pelecypods	Middle Early Triassic (Smithian)	Silberling 12/29/82
25	24064 Mz	52ABe43	68° 46' N 146° 31' W	pelecypods	Middle Early Triassic (Smithian)	Silberling, Nichols 5/10/73
26		72ABe316B	68° 47' N 146° 23' W	pelecypods	Indeterminate	Silberling, Nichols 3/13/73
31		82ATr14D	68° 45' N 146° 31' W	foraminifers	Probably Permian or Triassic	Mickey 10/82
32	Mes 32763	82ATr19B	68° 45' N 146° 31' W	conodonts	Middle Early Triassic (Middle Smithian)	Wardlaw, Harris 11/17/82
Triassic and Permian Rocks, Sadlerochit and Siksikpuk Formation, undivided (RPss)						
41	23571-PC	72ABe275C	68° 46' N 145° 26' W	brachiopods	Early(?) Permian	Dutro 2/13/73
42		72ABe274	68° 44' N 145° 20' W	goniatitacid ammonite	Late Paleozoic	Silberling, Nichols 3/13/73
43	23572-PC	72ARR253B	68° 48' N 145° 07' W	brachiopods	Early(?) Permian	Dutro 2/13/73
44		79ADt 204 unit 1	68° 49' N 144° 56' W	brachiopods ammonoid	Early Permian	Dutro 3/15/82
44		79ADt204 unit 2	68° 49' N 144° 56' W	brachiopods ammonoid	Early Permian	Dutro 3/15/82
47	23570-PC	72ABe272B	68° 42' N 145° 22' W	brachiopods	Early(?) Permian	Dutro 2/13/73
57		78ABe55B	68° 38' N 145° 46' W	cephalopods	Indeterminate	Dutro 6/88

Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*—Continued

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
Triassic and Permian Rocks, Sadlerochit and Siksikpuk Formation, undivided (ŦPss)—*cont.*						
58	USGS MR1101	79ADt200-2 (200-U2)	68° 35' N 145° 49' W	radiolarians	Late Paleozoic(?)	Jones, Murchey 3/31/81
59		79ABe216B	68° 35' N 145° 45' W	big gastropod	Early Permian	Dutro 6/90
62	23573-PC	72ARR258	68° 38' N 144° 30' W	brachiopods	Early(?)Permian	Dutro 2/13/73
83		78ARR27A	68° 30' N 145° 17' W	foraminifer (one)	Not reported	Murchey 3/30/79
90	USGS MR0524	78ARR19	68° 28' N 145° 27' W	radiolarians	Permian(?)	Jones, Murchey 3/30/79
104		79ABe154	68° 24' N 146° 54' W	brachiopods gastropods	Early Permian	Dutro 6/88
115		79ADt201 unit 1	68° 22' N 146° 05' W	brachiopods	Early Permian	Dutro 3/5/82
Triassic and Permian volcanic rocks (ŦPv)						
29	23583-PC	72ABe285	68° 46' N 146° 12' W	brachiopods	Late Paleozoic	Dutro 2/15/73
29	M-1059	72ABe285B	68° 46' N 146° 12' W	foraminifers	Permian or younger	Armstrong 12/6/72
29	M-1059	72ABe285B	68° 46' N 146° 12' W	corals (bryozoans) (crinoids)	Paleozoic	Armstrong 12/6/72
29	27430-PC	75ABe91	68° 46' N 146° 11' W	brachiopods	Late Permian	Dutro 3/2/79
29		82ATr17A	68° 46' N 146° 12' W	radiolarians	Late Triassic	Murchey 6/15/83
29		82ATr17B 17C	68° 46' N 146° 12' W	foraminifers	Latest Mississippian or considerably younger	Mamet 2/6/83
Triassic, Permian(?), and Carboniferous Rocks, Imnaitchiak Chert, (ŦMi)						
28		82ATr15A1	68° 46' N 146° 29' W	radiolarians	Latest Mississippian or earliest Pennsylvanian	Murchey 6/15/83
35	Meso D12061	82ABe604A	68° 45' N 146° 29' W	pelecypods	Late Triassic (Middle Norian)	Silberling 12/29/82
35		82ATr13F	68° 45' N 146° 29' W	conodont fragments	Permian or Triassic	Murchey 6/15/83
35		68ATr14A2	68° 45' N 146° 29' W	radiolarians (poor) coiled foraminifers	Permian(?)	Murchey 6/15/83
35		72ABe312B	68° 45' N 146° 29' W	pelecypods	Late Triassic (Middle or Late Norian)	Silberling, Nichols 3/13/73
36		82ATr13D	68° 45' N 146° 29' W	radiolarians	Late Triassic	Murchey 6/15/83
Triassic(?) to Mississippian Rocks, unnamed shale and chert (ŦMs)						
81	USGS MR1103	79ADt206-3	68° 31' N 145° 16' W	radiolarians	Late Mississippian to Early Pennsylvanian	Jones, Murchey 3/31/81
82	USGS MR1104	79ADt208	68° 30' N 145° 15' W	radiolarians	Late Mississippian to Early Pennsylvanian	Jones, Murchey 3/31/81
118		82ATr50G	68° 21' N 146° 06' W	radiolarians	Late Triassic	Murchey(?) 6/15/83
203		60ABe588	68° 03' N 145° 19' W	radiolarians	Mississippian (Latest?) to Earliest? Pennsylvanian	Holdsworth 3/5/79
204		60ABe589	68° 02' N 145° 18' W	radiolarians	Mississippian	Holdsworth 9/17/78, 3/5/79
206		60ABe591D	68° 01' N 145° 19' W	radiolarians	Mississippian probably Late Chesterian	Holdsworth 3/5/79, 9/17/78

Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*—Continued

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
			Permian Rocks, Echooka Formation (Pe)			
79		79ADt206 unit 1	68° 31' N 145° 15' W	brachiopods gastropod	Early Permian	Dutro 3/5/82
80		60ABe728	68° 31' N 145° 16' W	gastropods	Early(?) Permian	Dutro 1/25/62
122	23342-PC	66ABe298	68° 22' N 145° 49' W	brachiopods gastropods	Permian	Dutro 6/24/68
124	23574-PC	72ABe288C	68° 20' N 145° 50' W	crinoids brachiopods(?)	Paleozoic	Dutro 2/13/73
124		72ABe288D	68° 20' N 145° 50' W	brachiopod fragments	Indeterminate	Dutro 2/13/73
124		72ABe288E	68° 20' N 145° 50' W	brachiopod	Indeterminate	Silberling, Nichols 3/13/73
			Permian and Pennsylvanian Rocks, Imnaitchiak Chert (PIPi)			
109	USGS MR1093	79ARR1-A	68° 17' N 146° 45' W	radiolarians	Pennsylvanian to Early Permian	Jones, Murchey 3/31/81
109	USGS MR1092	79ARR1-B	68° 17' N 146° 45' W	radiolarians	Late Mississippian to Early Pennsylvanian	Jones, Murchey 3/31/81
			Pennsylvanian and Mississippian Rocks, Lisburne Group, Akmalik Chert (IPMa)			
37	28152-PC	82ATr13C	68° 45' N 146° 28' W	conodonts CAI 4	Late Mississippian (Late Meramec to Chester)	Harris 11/22/82
109	USGS MR1094	79ARR1-D	68° 17' N 146° 46' W	radiolarians	Late Mississippian to Permian (Late Miss.?)	Jones, Murchey 3/31/81
111	USGS MR1078	79ABe141-C	68° 17' N 146° 41' W	radiolarians	Late Mississippian to Early Permian (Late Miss.(?))	Jones, Murchey 3/31/81
112		60ABe761	68° 16' N 146° 41' W	brachiopods	Early Mississippian	Dutro 12/11/61
			Pennsylvanian and Mississippian Rocks, Lisburne Group, Kuna Formation (IPMk)			
91	21328-PC	63ABe153	68° 28' N 145° 18' W	ammonite	Late Mississippian	Gordon 9/4/63
			Pennsylvanian(?) and Mississippian Rocks, unnamed, phyllite, and chert (IPMp)			
85		78ARR29A	68° 30' N 144° 26' W	radiolarians	Mississippian	Jones, Murchey 3/30/79
86		78ARR33A,B	68° 29' N 144° 24' W	radiolarians	Mississippian(?) to Pennsylvanian(?)	Jones, Murchey 3/30/79
86	USGS MR0526	78ARR33D,E,F	68° 29' N 144° 24' W	radiolarians	Mississippian	Jones, Murchey 3/30/79
86	USGS MR0530	78ARR33 I-O	68° 29' N 144° 24' W	radiolarians	Late(?) Mississippian to Early(?) Pennsylvanian	Jones, Murchey 3/30/79
87	USGS MR0532	78ARR34S	68° 29' N 144° 25' W	radiolarians	Late Paleozoic Pennsylvanian(?)	Jones, Murchey 3/30/79
87	USGS MR0531	78ARR34R	68° 29' N 144° 25' W	radiolarians	Late Paleozoic (Permian?) (Pennsylvanian?)	Jones, Murchey 3/30/79
87	USGS MR0533	78ARR34Q	68° 29' N 144° 25' W	radiolarians	Late Paleozoic	Jones, Murchey 3/30/79
87	USGS MR0534	78ARR34H	68° 29' N 144° 25' W	radiolarians	Mississippian(?)	Jones, Murchey 3/30/79
87	USGS MR0528, 0529	78ARR34BCD,E FG	68° 29' N 144° 25' W	radiolarians	Late(?) Mississippian to Early(?) Pennsylvanian	Jones, Murchey 3/30/79
99	USGS MR1087	79ABe287	68° 24' N 144° 43' W	radiolarians	Late Mississippian to Early Pennsylvanian	Jones, Murchey 3/31/81
125		60ABe561A	68° 19' N 145° 13' W	radiolarians	Indeterminate	Holdsworth 9/17/78

Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*—Continued

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
Pennsylvanian(?) and Mississippian Rocks, unnamed, phyllite, and chert (PMp)—*cont.*						
127	USGS MR1090	79ABe290A	68° 20' N 145° 06'W	radiolarians	Late Mississippian to Early Pennsylvanian	Jones, Murchey 3/31/81
128	USGS MR1088	79ABe288	68° 22' N 144° 59'W	radiolarians	Late Mississippian to Early Pennsylvanian(?)	Jones, Murchey, 3/31/81
Pennsylvanian and Mississippian Rocks, Lisburne Group (PMl), and Mississippian Rocks, Lisburne Group (Ml) stratigraphic level of fossils in group uncertain						
40	28755-PC	82ATr38	68° 45' N 146° 22' W	conodonts CAI 3.5	Latest Mississippian (Late Chester)	Harris 11/22/82
74	30190-PC	87Tr23	68° 31' N 145° 57' W	conodonts CAI 5	late Early to early Late Mississippian (Middle Osagean - Meramecian)	Harris 6/20/88
92	20385-PC	60ABe724	68° 28' N 145° 16' W	coral	Mississippian(?) (or Devonian)	Oliver 1/30/62
95		60ABe722	68° 27' N 145° 23' W	corals	Silurian to Permian	Oliver 1/30/62
101		78ARR13	68° 24' N 144° 32' W	radiolarians	Mississippian	Jones, Murchey 3/30/79
102		78ARR12 E,F,G,H,I	68° 24' N 144° 32' W	foraminifers (shallow water)	Mississippian (Late Osage to Meramec)	Mamet 11/1/87
102		78ARR12J	68° 24' N 144° 32' W	radiolarians	Mississippian	Jones, Murchey 3/30/79
103		60ARR754	68° 26' N 144° 06' W	brachiopods	Early Mississippian	Dutro 1/25/62
132	28751-PC	82ATr62F	68° 20' N 144° 08' W	conodonts CAI 5.5	Early Mississippian (Late Kinderhook through Osagean)	Harris 11/22/82
133		60ARR611	68° 18' N 144° 52' W	brachiopods corals	Early Mississippian	Dutro 1/25/62
Pennsylvanian and Mississippian Rocks, upper part of Lisburne Group (PMlu), top beds						
12	28754-PC	82ATr35	68° 50' N 146° 25' W	conodonts CAI 5-5.5	Latest Mississippian (Latest Chester)	Harris 11/22/82
13		79ARR14F	68° 49' N 146° 26' W	brachiopods	Middle(?) Pennsylvanian	Dutro 6/18/90
56	30196-PC	87Tr19	68° 39' N 146° 05' W	conodonts CAI 3	Early Pennsylvanian (Morrowan)	Harris 6/20/88
73		78ABe53A	68° 31' N 145° 57' W	brachiopods	Middle(?) Pennsylvanian	Dutro 6/18/90
93		82ATr49A	68° 27' N 145° 56' W	conodonts CAI 5	Silurian to Permian	Harris 12/10/82
93		82ATr49A	68° 27' N 145° 56' W	foraminifers	Early Late Mississippian	Mamet 2/6/83
Pennsylvanian and Mississippian Rocks, top beds of undivided Lisburne Group (PMl)						
43	M-1071	72ARR253A	68° 48' N 145° 07' W	foraminifers	Late Mississippian (Chester)	Armstrong 3/73
45	30189-PC	87Tr21	68° 43' N 146° 07' W	conodonts CAI 3-3.5	Very Late Mississippian (Late Chester)	Harris 6/20/88
61	23582-PC	72ABe263D	68° 37' N 144° 34' W	brachiopods	Middle(?) Pennsylvanian (Des Moines)	Dutro 2/15/75
61	M-1065	72ABe263D	68° 37' N 144° 34' W	foraminifers	Late Mississisippian(?) (Chester?)	Armstrong 3/73
63		60ABe733	68° 37' N 144° 28' W	brachiopods bryozoans	Carboniferous	Dutro 6/18/90
76		78ARR18A,B,C, D,E,F	68° 29' N 145° 29' W	foraminifers	Latest Mississippian to Earliest Pennsylvanian (Namurian)	Mamet 11/1/87

Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*—Continued

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
Pennsylvanian and Mississippian Rocks, top beds of undivided Lisburne Group (PMl)—*cont.*						
77	22390-PC	66ABe316	68° 30' N 145° 27' W	brachiopods	Mississippian(?)	Grant 3/10/67
77	29239-PC	83S792	68° 30' N 145° 27' W	conodonts CAI 5-5.5	Middle Pennsylvanian (Atokan)	Harris 4/24/84
123		66ABe296A	68° 21' N 145° 47' W	foraminifers	Late Mississippian (Late Meramec to early Chester)	Armstrong 5/8/73 (oral)
123	M1003	66ABe296A,B	68° 21' N 145° 47' W	corals	Late Mississippian (Late Meramec to early Chester)	Armstrong 11/7/66, 5/8/73 (oral)
Mississippian Rocks, lower part of Lisburne Group (Mll), lowest beds						
5	M-1119	Armstrong 69R-4	68° 58' N 144° 52' W	corals	Late Mississippian (Meramec)	Armstrong 4/13/73
6	M-1118	Armstrong 69R-3	68° 58' N 144° 53' W	corals	Late Mississippian (Meramec)	Armstrong 4/13/73
11		79ABe251D	68° 51' N 144° 42' W	foraminifers	Early Late Mississippian (Early Meramec)	Mamet 11/1/87
Mississippian Rocks, Lowest beds of undivided Lisburne Group (PMl) and (Ml)						
50	M-1057	72ABe261D	68° 41' N 144° 29' W	foraminifers	Late Mississippian (Meramec)	Armstrong 12/1/72
107		60ABe748	68° 19' N 146° 41' W	brachiopods	Early Mississippian	Dutro 12/11/61
173	30191-PC	87Tr25A	68° 11' N 145° 38' W	conodonts CAI 5.5	Early Mississippian (Late Kinderhookian? through Osagean)	Harris 6/20/88
173	30192-PC	87Tr25B	68° 11' N 145° 38' W	conodonts CAI 5.5-6	Late Early Mississippian (Early 3/4 of Osagean)	Harris 6/20/88
Mississippian Rocks, Kayak Shale (Mk)						
4	M-1121	69ADu32	68° 59' N 144° 51' W	foraminifers	Late Mississippian(?) Meramec(?)	Armstrong 4/13/73
7		79ABe191	69° 00' N 144° 14' W	pelecypods gastropods crinoids (fragments)	Paleozoic	Dutro 6/88
11		79ABe251C	68° 51' N 144° 42' W	conodonts CAI 5	Early Mississippian (Kinderhook) to Permian	Harris 5/18/88
48		79ABe134	68° 43' N 144° 29' W	coral	Early Mississippian	Dutro 6/15/90
50	M-1057	72ABe261B	68° 41' N 144° 29' W	corals	Late Mississippian (Meramec)	Armstrong 12/1/72
51		79ABe283	68° 41' N 144° 28' W	brachiopods corals	Mississippian(?)	Dutro 6/17/91
51		79ABe283Y	68° 41' N 144° 28' W	foraminifers	Not Middle Devonian	Mamet 1/87
60		60ABe729	68° 36' N 145° 13' W	corals	Early Mississippian	Dutro 1/25/62
65	23577-PC	72ABe264	68° 36' N 144° 34' W	brachiopods	Late(?) Mississippian Meramec(?)	Dutro 2/14/73
65		72ABe264	68° 36' N 144° 34' W	plants	Indeterminate	Mamay 12/22/72
68		72ARR240	68° 33' N 144° 41' W	plants	Indeterminate	Mamay 12/22/72
72		60ARR712	68° 33' N 144° 04' W	brachiopods	Early Mississippian	Dutro 12/11/61

Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*—Continued

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
Mississippian Rocks, Kayak Shale (Mk)—*cont.*						
75		87Tr28B	68° 31' N 145° 50' W	conodonts CAI 5	Mississippian(?) (probably no younger than Middle Meramecian)	Harris 6/20/88
75	30195-PC	87Tr28C	68° 31' N 145° 50' W	conodonts CAI 5	Early Early Mississippian (upper Kinderhookian)	Harris 6/20/88
78	23580-PC	72ABe310B	68° 30' N 145° 22' W	brachiopods	Early(?) Mississippian (Osagean?)	Dutro 2/14/73
88		79ABe207	68° 28' N 144° 01' W	conodonts CAI 5	Silurian to Permian	Harris 5/18/88
89	M-1014	66ABe319A	68° 29' N 145° 26' W	brachiopods	Mississippian	Armstrong 11/7/66
89		66ABe319B	68° 29' N 145° 26' W	bryozoans	Indeterminate	Armstrong 11/7/66
89	23578-PC	72ABe308	68° 29' N 145° 26' W	brachiopods	Early(?) Mississippian (Osage?)	Dutro 2/14/73
89	23579-PC	72ABe308B	68° 29' N 145° 26' W	brachiopods	Early(?) Mississippian (Osage?)	Dutro 2/14/73
94	30193-PC	87Tr27C	68° 27' N 145° 55' W	conodonts CAI 5	Early Early Mississippian (Kinderhookian)	Harris 6/20/88
94		87Tr27D	68° 27' N 145° 55' W	conodonts CAI 5	Ordovician - Triassic	Harris 6/20/88
100		66ABe300C	68° 26' N 144° 38' W	brachiopods	Early Mississippian	Dutro 1/23/73
100		66ABe300E	68° 26' N 144° 38' W	bryozoans	Mississippian(?)	Dutro 1/23/73
110		79ABe143B	68° 17' N 146° 43' W	brachiopods bryozoans	Early Mississippian	Dutro 6/15/90
134		60ARR611A	68° 18' N 144° 52' W	brachiopods crinoids	Early Mississippian	Dutro 1/25/62
134	23581-PC	72ABe318A	68° 18' N 144° 52' W	brachiopods	Early(?) Mississippian (Osage?)	Dutro 2/14/73
135		60ARR613	68° 17' N 144° 53' W	brachiopods corals trilobites	Early Mississippian	Dutro 1/25/62
136	23576-PC	72ABe225	68° 18' N 144° 10' W	brachiopods	Early(?) Mississippian (Osage?)	Dutro 2/14/73
154	M-1013	66ABe314	68° 14' N 145° 43' W	brachiopods	Possibly Late Devonian or Early Mississippian; Early Mississippian(?)	Armstrong 11/7/66 Dutro 9/6/74
158		60ARR697	68° 15' N 144° 46' W	bryozoans coral	Early Mississippian(?)	Dutro 12/11/61
Mississippian Rocks, Kekiktuk Conglomerate (Mkt)						
3		78ABe47B	68° 58' N 145° 35' W	plants	Early Mississippian	Mamay 3/21/79
Mississippian(?) and Devonian Rocks, Kanayut Conglomerate (MDk) and Kanayut Conglomerate undivided (MDku)						
46		78ABe46A	68° 41' N 145° 53' W	plants	Probably Devonian, possibly Mississippian	Mamay 3/21/79
84		72ABe254	68° 30' N 144° 30' W	plants	Indeterminate	Mamay 12/22/72
105		60ABe688	68° 20' N 146° 54' W	brachiopods	Late Devonian (Famennian?)	Dutro 12/13/61
137		60ARR635	68° 16' N 144° 08' W	plants	Late Devonian	Mamay 11/4/60
156		60ABe620	68° 15' N 144° 52' W	brachiopods	Late Devonian (Famennian?)	Dutro 12/11/61

Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*—Continued

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
Mississippian(?) and Devonian Rocks, Kanayut Conglomerate (MDk) and Kanayut Conglomerate undivided (MDku)—*cont.*						
157	6417-SD	60ABe619	68° 15' N 144° 54' W	corals brachiopods	Late Devonian (Frasnian?)	Dutro, Oliver 12/12/61
Mississippian(?) and Devonian Rocks, Stuver Member and middle part of Kanayut Conglomerate (MDksm)						
8		72ABe210	68° 51' N 145° 26' W	plants	Indeterminate	Mamay 12/22/72
9		79ABe240A	68° 53' N 145° 09' W	plants	Unidentifiable	Mamay, Hueber 1/19/83
Upper Devonian Rocks, quartzite unit of Kanayut Conglomerate (Dkq)						
138		79ABe194B	68° 12' N 146° 54' W	brachiopods	Late Devonian (Famennian)	Dutro 6/88
159		79ABe274	68° 13' N 145° 04' W	brachiopods	Late Devonian?	Dutro 9/1/79
175		79ABe164A	68° 12' N 144° 53' W	brachiopods crinoids plant fragments fish fragments	Late Devonian (Famennian?)	Dutro 6/88
Upper Devonian Rocks, lower part of Kanayut Conglomerate (Dkl)						
96		78ABe33E	68° 26' N 145° 03' W	plants	Devonian	Mamay 3/21/79
96		78ABe33G	68° 26' N 145° 03' W	plants	Devonian	Mamay 3/21/79
Upper Devonian Rocks, Noatak Formation (Dn)						
97		79ABe213	68° 27' N 144° 52' W	conodonts CAI 4-5	Middle Devonian to Early Mississippian	Harris 5/18/88
97		79ABe213A	68° 27' N 144° 52' W	conodonts CAI 4-5	Late Devonian (Famennian?)	Harris 5/18/88
97		79ABe213	68° 27' N 144° 52' W	brachiopods pelecypods	Late Devonian (Famennian?)	Dutro 6/90
160		79ABe163	68° 13' N 144° 56' W	brachiopods	Late Devonian (Famennian)	Dutro 8/10/79
185		72ABe213A	68° 10' N 144° 21' W	plants	Indeterminate	Mamay 12/22/72
185		72ABe213B	68° 10' N 144° 21' W	plants	Indeterminate	Mamay 12/22/72
Upper Devonian Rocks, wacke member of Beaucoup Formation (Dbw)						
53		79ABe279B	68° 40' N 144° 02' W	brachiopods crinoids	Late Devonian (Frasnian)	Dutro 6/90
98		60ARR741	68° 25' N 144° 54' W	corals brachiopods	Middle or Late Devonian(?) (Frasnian?)	Oliver 2/27/61
106		76ABe423	68° 19' N 147° 00' W	brachiopods corals	Late Devonian (Frasnian)	Oliver 2/27/61, Dutro 6/90
108		78ABe23A 78ABe23	68° 17' N 146° 48' W	brachiopods	Late Devonian (Frasnian)	Dutro 6/90
108		78ABe23C	68° 17' N 146° 48' W	brachiopods corals	Late Devonian (Frasnian)	Dutro 6/90
113		79ABe139A	68° 15' N 146° 46' W	brachiopods corals gastropods	Late Devonian (Frasnian)	Dutro 6/18/90
148	11130-SD	84TAH22B	68° 15' N 146° 06' W	conodonts CAI 5-5.5	Late Devonian	Harris 4/18/85, 6/88
148	11129-SD	84TAH22	68° 15' N 146° 06' W	conodonts CAI 5	Late Devonian	Harris 4/18/85, 6/88

Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*—Continued

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
Upper Devonian Rocks, wacke member of Beaucoup Formation (Dbw)—*cont.*						
149		78ABe24	68° 14' N 145° 55' W	brachiopods corals	Late Devonian (Frasnian)	Dutro 6/90
162	9075-SD	72ABe228A	68° 10' N 146° 20' W	brachiopods	Middle to Late Devonian	Dutro 6/87
164		60ARR784	68° 10' N 146° 13' W	brachiopods	Late Devonian (Frasnian)	Dutro 12/11/61
169		60ABe546	68° 11' N 145° 54' W	brachiopods	Late Devonian (Frasnian?)	Dutro 12/12/61
170		60ABe547	68° 12' N 145° 53' W	brachiopods	Late Devonian (Frasnian?)	Dutro 12/11/61
171		60ABe548	68° 12' N 145° 53' W	brachiopods	Late Devonian (Frasnian?)	Dutro 12/12/61
172		60ABe549A	68° 12' N 145° 52' W	brachiopods	Late Devonian (Frasnian)	Dutro 12/11/61
174		60ARR618	68° 11' N 145° 13' W	brachiopods gastropods	Late Devonian (Frasnian?)	Dutro 12/11/61
179		60ABk201	68° 10' N 145° 53' W	brachiopods(?)	Indeterminate	Dutro 12/11/61
180	6427-SD	60ABk202	68° 09' N 145° 52' W	corals brachiopods	Late Devonian (Frasnian)	Dutro, Oliver 12/11/61
181		60ABe745	68° 09' N 145° 41' W	brachiopods	Devonian(?)	Dutro 12/13/61
184	11122-SD	84JFY66	68° 09' N 145° 00' W	conodonts CAI 5	Devonian	Harris 4/18/85, 6/88
198		60ARR649	68° 05' N 144° 37' W	brachiopods	Late Devonian (Frasnian)	Dutro 6/87
Upper Devonian Rocks, Hunt Fork Shale (Dhf)						
67	9064-SD 9065-SD	72ARR246 AX 246 AY	68° 36' N 144° 17' W	conodonts CAI 4-4.5	Middle to Late Devonian	Harris 5/18/88
67	9077-SD	72ARR246	68° 36' N 144° 17' W	brachiopods	Late Devonian (Frasnian)	Dutro 6/90
69		72ABe258F	68° 33' N 144° 17' W	plants	Indeterminate	Mamay 12/22/72
71		60ABe735 (reported as 734)	68° 33' N 144° 14' W	brachiopods	Late Devonian(?)	Dutro 12/13/61
96		78ABe33A	68° 25' N 145° 03' W	brachiopods gastropods	Late Devonian (Frasnian?)	Dutro 6/88
Upper Devonian Rocks, limestone member of Hunt Fork Shale (Dhl)						
66	9080-SD	72ARR248	68° 35' N 144° 22' W	brachiopods corals	Late Devonian (Frasnian)	Dutro 6/87
70	9073-SD	72ABe258B	68° 34' N 144° 16' W	brachiopods	Late Devonian (Frasnian?)	Dutro 6/10/91
70	9079-SD	72ABe258D	68° 34' N 144° 16' W	brachiopods	Late(?) Devonian (Frasnian?)	Dutro 6/10/91
176		79ABe165B	68 12'N 144 47'W	corals	Late(?) Devonian Frasnian(?)	Dutro 6/90
Upper Devonian Rocks, unnamed tuff (Dvt)						
196		60ARR642	68° 05' N 144° 47' W	brachiopods	Late Devonian(?)	Dutro 12/13/61
196		60ARR642Z	68° 05' N 144° 47' W	brachiopods	Late Devonian (Frasnian)(?)	Dutro 12/13/61

Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*—Continued

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
Upper Devonian Rocks, unnamed tuff (Dvt)—*cont.*						
197	11124-SD	84JFY73	68° 05' N 144° 43' W (loc?)	conodonts CAI 5-5.5	Late Devonian (Frasnian)	Harris 4/18/85, 6/88
205	11123-SD	84JFY68A	68° 01' N 145° 20' W (loc?)	conodonts CAI 5-5.5	Late Devonian	Harris 5/18/88
207	10864-SD	83S746B	68° 01' N 144° 43' W (loc?)	conodonts CAI 5	Late Devonian (Frasnian)	Harris 4/24/84
Upper Devonian(?) Rocks, unnamed wacke (Dw)						
114		60ABe672	68° 20' N 146° 19' W	plants	Unidentifiable	Mamay 11/4/60
119		72ABe302	68° 21' N 146° 08' W	plants	Indeterminate	Mamay 12/22/72
120		72ABe303	68° 20' N 146° 06' W	plants	Indeterminate	Mamay 12/22/72
121		78ARR3A	68° 20' N 146° 06' W	spore (one)	Devonian(?)	Haga 9/12/80
129		78ARR3B	68° 20' N 144° 48' W	plants	Unidentifiable	Mamay 3/21/79
129		78ARR3C	68° 20' N 144° 48' W	spores (non-marine)	Late(?) Devonian	Haga 3/6/80
130		78ARR4	68° 20' N 144° 47' W	spore (one) (non-marine)	Indeterminate	Haga 3/6/80
131		72ABe324	68° 21' N 144° 33' W	plants	Indeterminate	Mamay 12/22/72
155		79ABe162A	68° 13' N 145° 35' W	spores	Indeterminate	Haga 9/12/80
Upper Devonian Rocks, Beaucoup Formation, brown calcareous siltstone member (Db)						
141		79ARR11A	68° 13' N 146° 21' W	brachiopods corals	Late Devonian (Frasnian)	Dutro 6/15/90
Upper Devonian Rocks, Beaucoup Formation, conglomerate member (Dbc)						
143		60ARR786	68° 12' N 146° 14' W	gastropods	Devonian(?)	Dutro 12/11/61
163	9076-SD	72ABe230H	68° 09' N 146° 25' W	echinoderm debris and fish(?) remains	Indeterminate	Dutro 3/7/73
191	11117-SD	84JFY45	68° 06' N 146° 26' W	conodonts CAI 5-5.5 (in clast in conglomerate)	Silurian through Middle Devonian	Harris 4/18/85, 6/88
192	11119-SD	84JFY52	68° 05' N 146° 26' W	conodonts CAI 5	Late Devonian (Famennian)	Harris 4/18/85, 6/88
Upper Devonian Rocks, Beaucoup Formation, limestone member (Dbl)						
126	11861-SD	87Tr29	68° 21' N 145° 10' W	conodonts CAI 5	latest Middle to early Late Devonian	Harris 2/5/88
140		79ARR13	68° 13' N 146° 21' W	coral	Late(?) Devonian (Frasnian?)	Dutro 6/91
140	11115-SD	84JFY19	68° 13' N 146° 21' W	conodonts CAI 5	Late Devonian (Frasnian)	Harris 4/18/85, 6/88
142	6430-SD	60ARR785	68° 11' N 146° 15' W	corals	Middle or early Late Devonian	Oliver 2/16/61 Oliver 1975
144		78ABe25A	68° 11' N 146° 08' W	brachiopods corals	Late Devonian (Frasnian?)	Dutro 6/88

Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*—Continued

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
Upper Devonian Rocks, Beaucoup Formation, limestone member (Dbl)—*cont.*						
144		78ABe25A	68° 11' N 146° 08' W	conodonts CAI 5	Middle Devonian to Early Mississippian	Harris 3/27/79
145	11006-SD	84JFY32	68° 11' N 146° 07' W	conodonts CAI 5	Late Devonian	Harris 10/10/84
146		84TAH2	68° 11' N 146° 05' W	conodonts CAI 5	Ordovician to Triassic	Harris 5/18/88
147	8792-SD	66ABe312D	68° 12' N 145° 58' W	corals	Late Devonian (Frasnian)	Oliver 2/15/72 Oliver 1975
147	8791-SD	66ABe312B	68° 12' N 145° 58' W	corals brachiopods	Late Devonian (Frasnian)	Oliver 2/15/72 Oliver 1975
150	6408-SD	60ARR584	68° 14' N 145° 53' W	corals brachiopods	Late Devonian (Frasnian?)	Oliver 2/10/61 Oliver 1975
151		79ABe161A	68° 13' N 145° 50' W	corals	Late Devonian (Frasnian)	Dutro 6/15/90
152	6414-SD	60ABe555A	68° 13' N 145° 50' W	corals	Late Devonian (Frasnian)	Oliver 2/10/61 Oliver 1975
152	6415-SD	60ABe555B	68° 13' N 145° 50' W	corals	Late Devonian (Frasnian)	Oliver 2/10/61 Oliver 1975
152	6416-SD	60ABe555C	68° 13' N 145° 50' W	corals	Late Devonian (Frasnian)	Oliver 2/10/61 Oliver 1975
152	6407-SD	60ABe555D	68° 13' N 145° 50' W	corals brachiopods	Late Devonian (Frasnian)	Oliver 1975
152	8168-SD	66ABe313	68° 13' N 145° 50' W	brachiopods	Late(?) Devonian (Frasnian?)	Dutro 5/29/68
153	6426-SD	60ABe557	68° 13' N 145° 46' W	corals	Late Devonian (Frasnian)	Oliver 1975
161	11128-SD	84JFY95	68° 11' N 146° 25' W	conodonts CAI 5	Late Devonian	
166	6422-SD	60ARR787 cobbles in stream	68° 11' N 146° 08' W	corals pelecypods	Late Devonian (Frasnian)	Oliver 12/16/61 Oliver 1975
167	8911-SD	25576-11 (Standard Oil of CA)	68° 11' N 145° 58' W	corals	Late Devonian (Frasnian)	Oliver 1975
168	8910-SD	25576-7 (Standard Oil of CA)	68° 11' N 145° 57' W	corals	Late Devonian (Frasnian)	Oliver 1975
176	6413-SD	60ABe549F	68° 12' N 145° 52' W	corals gastropods	Late Devonian (Frasnian)	Oliver 1975
177	6425-SD	60ABk203	68° 09' N 145° 55' W	corals	Late Devonian (Frasnian)	Oliver 1975
178		72ABe233	68° 09' N 145° 53' W	corals	No report	
194	5727-SD	60ARR782	68° 05' N 146° 18' W	corals gastropods	Devonian	Dutro, Yochelson 12/11/61 Oliver 1975
195		60ARR769	68° 06' N 145° 46' W	brachiopods	Middle(?) or early Late(?) Devonian	Dutro 5/12/65
202	6440-SD	60ARR719	68° 01' N 146° 15' W	corals	Devonian	Oliver 1975
Middle Devonian(?) Rocks, unnamed shale (Ds)						
10		79ABe249A	68° 53' N 145° 09' W	big pelecypods	Devonian(?)	Pojeta 6/87

Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*—Continued

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
Middle Devonian Rocks, unnamed limestone, shale, and conglomerate (Dls)						
49		79ABe281B	68° 42' N 144° 10' W	brachiopods pelecypods	Middle(?) Devonian	Dutro 6/17/91
49		79ABe281C	68° 42' N 144° 10' W	brachiopods trilobite	Devonian	Dutro 6/88
52		79ABe132A	68° 41' N 144° 15' W	brachiopods trilobite sponge spicules	Middle Devonian	Dutro 6/15/90
52		79ABe132B	68° 41' N 144° 15' W	conodonts CAI 5	Middle or Late Devonian	Harris 5/18/88
52		79ABe132D	68° 41' N 144° 15' W	bryozoans tentaculitids	Middle Devonian	Dutro 6/15/90
54		79ABe284C	68° 39' N 144° 25' W	corals	Late(?) Devonian (Frasnian?)	Oliver 3/25/91
55		60ABe580	68 40' N 144 09' W	pelecypods	Indeterminate	Dutro 12/11/61
64		72ARR245	68° 37' N 144° 24' W	gastropods	Middle Devonian(?)	Yochelson 6/88
Middle Devonian and Silurian Rocks, unnamed limestone (DSl)						
186	8913-SD	256009-9 (Standard Oil of CA)	68° 09' N 144° 18' W	corals	Late(?) Silurian (Ludlovian?)	Oliver 1975
186	6434-SD	60ARR660	68° 09' N 144° 18' W	corals	Middle or Late Devonian (Late? Devonian)	Oliver 1/30/62 Oliver 1975
187	11125-SD	84JFY86	68° 09' N 144° 20' W	conodonts CAI 5	Middle Devonian	Harris 5/18/88
188	9081-SD	72ABe215A	68° 09' N 144° 19' W	brachiopods	Late Devonian (Frasnian?)	Dutro 6/88
188		72ABe215B	68° 09' N 144° 19' W	corals	Middle(?) Devonian	Dutro, Oliver 6/88
188		72ABe215C	68° 09' N 144° 19' W	corals	Middle(?) Devonian	Dutro, Oliver 6/88
188		72ABe215D	68° 09' N 144° 19' W	corals	Middle(?) Devonian	Dutro, Oliver 6/88
188		72ABe215E	68° 09' N 144° 19' W	corals	Middle(?) Devonian	Dutro, Oliver 6/88
188		72ABe215F	68° 09' N 144° 19' W	corals	Middle(?) Devonian	Dutro, Oliver 6/88
189		60ARR659	68° 09' N 144° 18' W	trilobites	Devonian(?)	Dutro 5/12/65
Devonian through Ordovician Rocks, Skajit Limestone (DOs)						
139		84JFY96A	68° 13' N 146° 28' W	conodonts CAI 5	Ordovician through Permian	Harris 6/88
165		84JFY31	68° 10' N 146° 10' W	conodonts CAI 5	Middle Silurian through Mississippian	Harris 6/88
190		84JFY46	68° 06' N 146° 25' W	conodonts CAI 5	Middle Ordovician through Middle Devonian	Harris 6/88
193		84JFY42	68° 05' N 146° 29' W	conodonts CAI 5	Early Ordovician through Devonian	Harris 6/88
199		84JFY5	68° 02' N 146° 14' W	conodonts CAI 5-5.5	late Late Ordovician	Harris 11/17/88
200	11114-SD	84JFY13	68° 01' N 146° 12' W	conodonts CAI 5	Silurian through Early Devonian (probably Silurian)	Harris 5/18/88
201	7011-SD	63ARR210	68° 01' N 146° 14' W	corals	Late Ordovician to early Late Devonian	Oliver 9/27/63

Table 1. *Fossil Collections from the Arctic Quadrangle, Alaska*—Continued

Map No.*	USGS Locality No.**	Field Sample No.	Latitude Longitude	Fossils	Age	Identified by
Ordovician and Cambrian(?) Rocks, unnamed chert and phyllite (O€c)						
1		83BR742 (MC) collected by geologists of ARCO Alaska	70° 00' N 145° 30' W	graptolites	Middle Ordovician(?)	Carter 6/18/84 Moore, Churkin, 1984
2		83BR744 (MC) collected by geologists of ARCO Alaska	69° 59' N 145° 30' W	graptolites	Middle Ordovician(?)	Carter 6/18/84 Moore, Churkin, 1984

Table 1A. *Index map numbers and symbols of the geologic map units at each fossil collection site.*

Map No.	Geologic Map Unit	Map No.	Geologic Map Unit	Map No.	Geologic Map Unit	Map No.	Geologic Map Unit
1	O€c	53	Dbw	105	MDku	157	MDku
2	O€c	54	Dls	106	Dbw	158	Mk
3	Mkt	55	Dls	107	Ml (base)	159	Dkq
4	Mk	56	PMlu (top)	108	Dbw	160	Dn
5	Mll (base)	57	TRPss	109	PPi; PMa	161	Dbl
6	Mll (base)	58	TRPss	110	Mk	162	Dbw
7	Mk	59	TRPss	111	PMa	163	Dbc
8	MDksm	60	Mk	112	PMa	164	Dbw
9	MDksm	61	PMl (top)	113	Dbw	165	DOs
10	Ds	62	TRPss	114	Dw	166	Dbl
11	Mll (base); Mk	63	PMl (top)	115	TRPss	167	Dbl
12	PMlu (top)	64	Dls	116	TRo	168	Dbl
13	PMlu (top)	65	Mk	117	TRo	169	Dbw
14	TRPs	66	Dhl	118	TRMs	170	Dbw
15	TRs	67	Dhf	119	Dw	171	Dbw
16	TRs	68	Mk	120	Dw	172	Dbw; Dbl
17	TRs	69	Dhf	121	Dw	173	PMl (base)
18	TRs	70	Dhl	122	Pe	174	Dbw
19	TRs	71	Dhf	123	PMl (top)	175	Dkq
20	TRPs	72	Mk	124	Pe	176	Dhl
21	TRo	73	PMlu (top)	125	PMp	177	Dbl
22	TRs; TRPs	74	PMl	126	Dbl	178	Dbl
23	Ki	75	Mk	127	PMp	179	Dbw
24	Ki	76	PMl (top)	128	TRMs	180	Dbw
25	TRPs	77	PMl (top)	129	Dw	181	Dbw
26	TRs; TRPs	78	Mk	130	Dw	182	Qu
27	TRo	79	Pe	131	Dw	183	Qu
28	TRPe; TRMi	80	Pe	132	Ml	184	Dbw
29	TRPv	81	TRMs	133	Ml	185	Dn
30	Kk	82	TRMs	134	Mk	186	DSl
31	TRPs	83	TRPss	135	Mk	187	DSl
32	TRPs	84	MDk	136	Mk	188	DSl
33	TRo	85	PMp	137	MDku	189	DSl
34	TRe	86	PMp	138	Dkq	190	DOs
35	TRMi	87	PMp	139	DOs	191	Dbc
36	TRMi	88	Mk	140	Dbl	192	Dbc
37	PMa	89	Mk	141	Db	193	DOs
38	TRPe	90	TRPss	142	Dbl	194	Dbl
39	Kk	91	PMk	143	Dbc	195	Dbl
40	PMl	92	PMl	144	Dbl	196	Dvt
41	TRPss	93	PMlu (top)	145	Dbl	197	Dvt
42	TRPss	94	Mk	146	Dbl	198	Dbw
43	TRPss; PPMl (top)	95	PMl	147	Dbl	199	DOs
44	TRPss	96	Dkl; Dhf	148	Dbw	200	DOs
45	PMl (top)	97	Dn	149	Dbw	201	DOs
46	MDk	98	Dbw	150	Dbl	202	Dbl
47	TRPss	99	PMp	151	Dbl	203	TRMs
48	Mk	100	Mk	152	Dbl	204	TRMs
49	Dls	101	PMl	153	Dbl	205	Dvt
50	PMl (base); Mk	102	PMl	154	Mk	206	TRMs
51	Mk	103	PMl	155	Dw	207	Dvt
52	Dls	104	TRPss	156	MDku		