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U.S. GEOLOGICAL SURVEY

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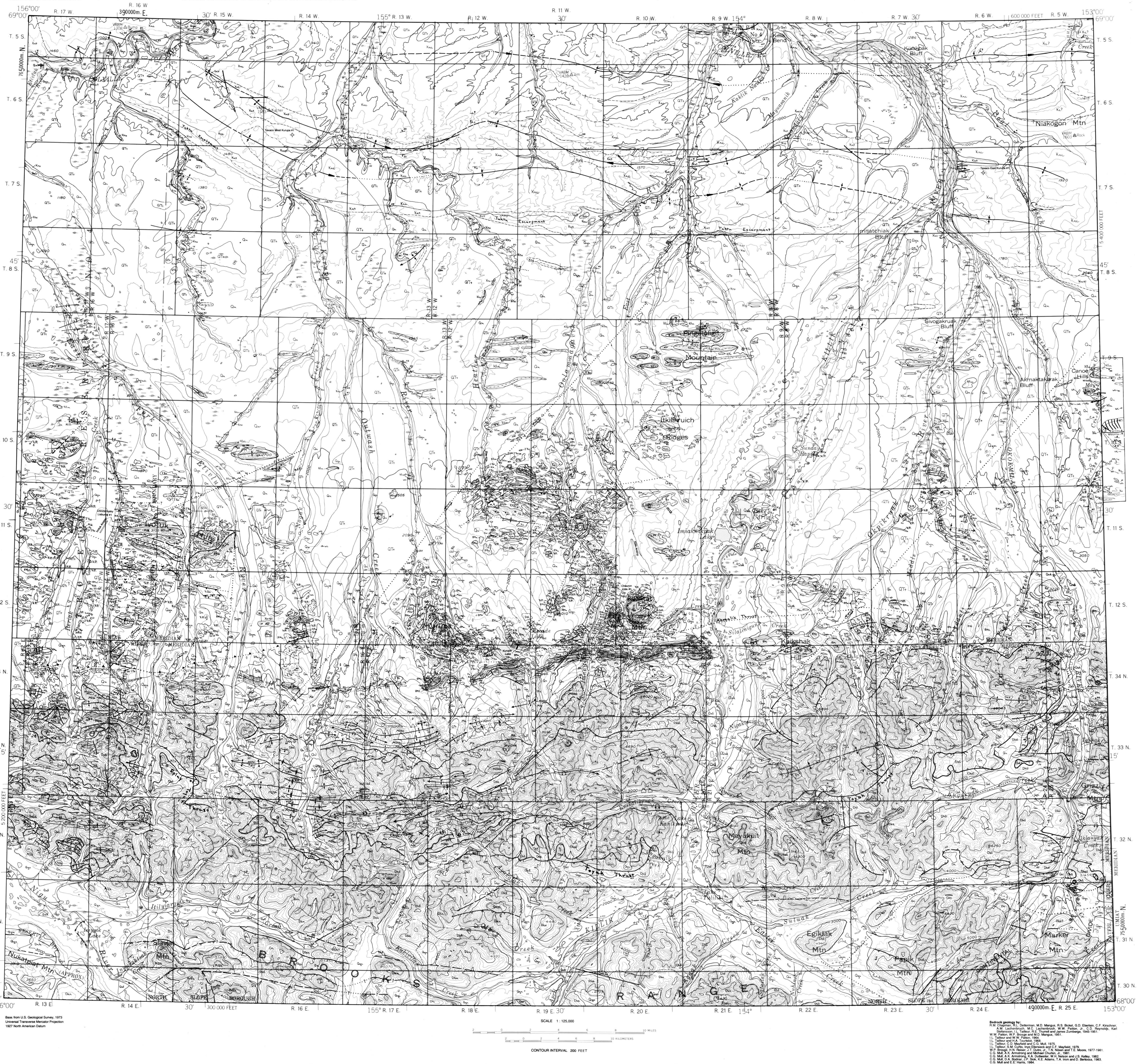
ALASKA DIVISION OF GEOLGICAL AND GEOPHYSICAL SURVEYS

OPEN-FILE REPORT 94-679
PLATE 1



Base from U.S. Geological Survey, 1973
Universal Transverse Mercator Projection
1927 North American Datum

SCALE 1 : 125,000

CONTOUR INTERVAL 200 FEET

GEOLOGIC MAP OF THE KILLIK RIVER QUADRANGLE, BROOKS RANGE, ALASKA

By

C.G. Mull, T.E. Moore, E.E. Harris and I.L. Tailleur

1994

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards or with the North American Stratigraphic Code. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Bedrock geology by:
R.M. Chapman, R.L. Detterman, M.D. Mangus, R.S. Bickel, G.D. Eberlein, C.F. Kirschner, A.M. Lachenbruch, M.C. Lachenbruch, W.W. Patton, Jr., C.D. Reynolds, Karl Stefansson, I.L. Tailleur, R.E. Thurrell and James Zumberge, 1945-1951.
W.W. Patton, W.P. Brosge and M.D. Mangus, 1951.
I.L. Tailleur and W.W. Patton, 1964.
I.L. Tailleur and H.A. Tourtelot, 1968.
I.L. Tailleur, C.D. Mayfield and C.G. Mull, 1975.
I.L. Tailleur, S.M. Curtis, Inyo Ellersieck and C.F. Mayfield, 1979.
W.P. Brosgé, H.N. Reiser, J.T. Dutro, Jr., T.N. Nilsen and T.E. Moore, 1977-1981.
C.G. Mull, A.K. Armstrong and Michael Churkin, Jr., 1981.
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C.G. Mull and E.E. Harris, 1984.
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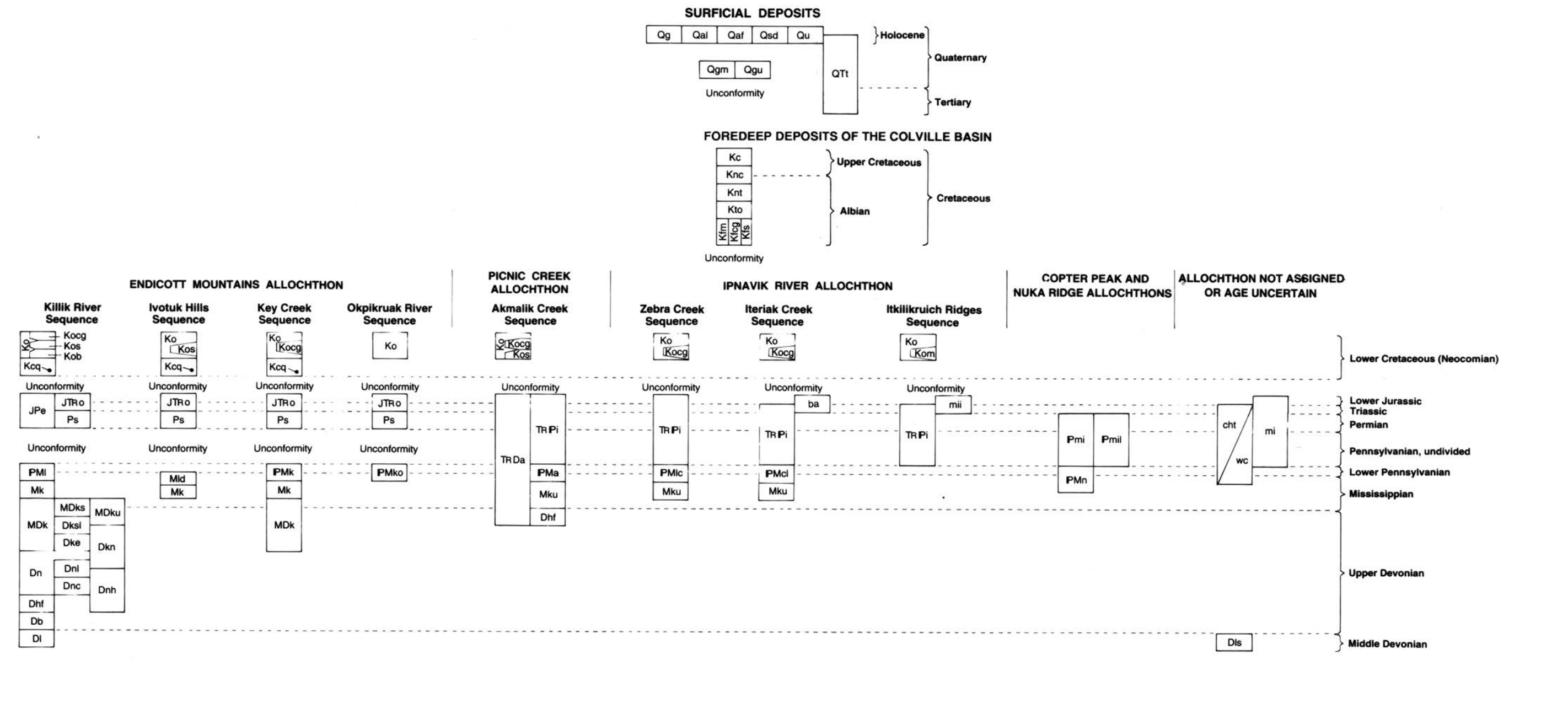
C.G. Mull, E.E. Harris T.E. Moore, I.L. Tailleur, and Inyo Ellersieck, 1986.
C.G. Mull, 1990.
C.G. Mull, G.H. Pessel, R.R. Reifenstuhl and T.E. Moore, 1991.
C.G. Mull, R.R. Reifenstuhl and T.E. Moore, 1992.
C.G. Mull, T.E. Moore, D.G. Howell, F. Cole, M. Underwood and C.S. Wang, 1993.
Surficial geology by:
T.D. Hamilton, 1965-1979.
Technical review by :
W.P. Brosgé and Inyo Ellersieck

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Modified from Hamilton, 1980

Qg	GLACIAL ICE (Quaternary)—Modern cirque glaciers.
Qal	ACTIVE ALLUVIAL DEPOSITS (Quaternary)—Silt, sand and gravel deposited by modern streams; includes flood-plain deposits which are lightly vegetated in some areas.
Qaf	ALLUVIAL-FAN DEPOSITS (Quaternary)—Poorly to moderately sorted fluvial silt, sand and gravel forming deltoid fans and aprons where tributaries join higher order streams.
Qsd	SAND AND DUNES (Quaternary)—Moderately sorted fine- to medium-grained sand, horizontally bedded to slightly cross-bedded. Initially deposited by slow-moving glacial streams reworking glacial outwash. Locally reworked into eolian deposits as sand sheets and dunes.
Qu	SURFICIAL DEPOSITS, UNDIVIDED (Quaternary)—Includes colluvium and older vegetated alluvial deposits above present stream levels, alluvial fans, upland silt deposits, lacustrine material in Killik, Okokmilaga, and Okpikruak River valleys, and other surficial material not otherwise differentiated.
Qgm	MORAINAL DEPOSITS (Quaternary)—Poorly sorted unstratified till ranging from clayey stony silt to sandy bouldery gravel, contains large erratic boulders in some places; deposits form subdued to distinct, lightly to heavily vegetated, lateral and terminal moraines that in some places form well defined nested concentric ridges. Includes deposits of Anaktuvuk River, Sagavanirktok River, and Itkillik glaciations.
Qgu	GLACIAL DEPOSITS, UNDIFFERENTIATED (Quaternary)—Stratified and unstratified drift of various glacial intervals. Includes till, outwash and ice-contact deposits.
QTt	TERRACE GRAVEL (Quaternary and Tertiary)—Gravel and sandy gravel, forms terraces ranging from 3-4 m above modern stream levels, to high-level terraces as much as 110 m above modern stream levels. Includes extensive low level terrace material near major stream valleys and extensive higher level surfaces near Killik River.

FOREDEEP DEPOSITS OF THE COLVILLE BASIN

Kc	COLVILLE GROUP, UNDIVIDED (Upper Cretaceous)—Poorly exposed interbedded marine sandstone and shale.
Knc	NANUSHUK GROUP, CHANDLER FORMATION (Lower Cretaceous, Albian to Upper Cretaceous, Cenomanian)—Dominantly nonmarine, gray to light-gray sandstone and quartz- and chert-pebble conglomerate interbedded with dark-gray shale and coal, forms rolling tundra-covered hills with occasional resistant sandstone or conglomerate ledges north of Tuktu Escarpment.
Knt	NANUSHUK GROUP, TUKTU FORMATION (Lower Cretaceous, Albian)—Dominantly gray to greenish-gray very-fine to fine-grained sandstone and conglomeratic sandstone.
Kto	TOROK SHALE (Lower Cretaceous, Albian)—Soft, dark-gray to black clay shale and thinly interbedded silty shale, generally exposed only in discontinuous stream cutbanks, most exposures tightly folded, lower portion interfingers with Fortress Mountain Formation.
Kfm	FORTRESS MOUNTAIN FORMATION, UNDIVIDED (Lower Cretaceous, Albian)—Dominantly greenish-gray graywacke interbedded with dark-gray mudstone and shale; forms Pingaluligit Mountain and lower resistant linear ridges between Okpikruak River and Kurupa River; interfingers with Torok Shale, in places contains differentiated units:
Kfcg-	—As above, contains thick massive beds of pebble- to boulder-conglomerate, clasts are well rounded and consist dominantly of gray, black, and green chert and a large variety of altered mafic igneous rocks.
Kfs	—As above, dominantly dark-gray shale and mudstone.

ALLOCHTHONOUS ROCKS

ENDICOTT MOUNTAINS ALLOCHTHON

Named for the Endicott Mountains (Mull, 1985), which are composed dominantly of rocks of this allochthon. Also known as the Brooks Range allochthon (Martin, 1970; Mayfield and others, 1988).

Killik River Sequence

Here named for the upper Killik River area, where the sequence is well exposed in the adjacent mountains, and along the northern mountain front west of the Killik River.

Ko	OKPIKRUAK FORMATION, UNDIVIDED (Lower Cretaceous, Valanginian(?))—Dominantly greenish-gray graywacke with interbedded mudstone and shale, in places divided into:
Kocg	—As above, contains massive cobble- to boulder-conglomerate, in many places is chaotic and unsorted to poorly sorted debris flow deposit; clasts consist dominantly of conspicuous white-weathering diorite and granodiorite, varicolored chert, and some light-gray sandstone and limestone.
Kos	—As above, dominantly dark-gray shale and mudstone.
Kob	—As above, consists of tectonic breccia or olistostrome, usually broken formation bearing exotic blocks of chert, silicified limestone or mudstone in sheared mudstone matrix.
Kcq	COQUINOID LIMESTONE (Lower Cretaceous, Valanginian)—Distinctive thin marker unit of gray to dark-gray limestone coquina composed of the pelecypod *Buchia sublaevis*, in beds up to 2 m thick, usually weathers reddish-brown, interbedded with reddish-brown to black clay shale; thickness less than 10 m. Unit is complexly deformed and commonly closely associated with Otuk Formation; in Killik River sequence, is observed only in small outcrops at mountain front east of Kurupa Lake, near the west fork of Kurupa River, west of Outwash Creek, and in float overlying Otuk Formation at "The Flap" near Killik River; also present in scattered outcrops in the foothills along Imnaitchiak Creek. Known occurrences shown by large dots on map.
JPe	ETIVLUK GROUP (Middle Jurassic to Permian)—Divided into:
JTRo	OTUK FORMATION (Middle Jurassic to Early Triassic)—Interbedded fossiliferous black chert, limestone, and shale in four lithogenetic units: a basal poorly exposed shale member—black organic shale (Early and Middle Triassic); the "chert" member—black silicified mudstone, chert and shale (Middle and Late Triassic); the limestone member—thinly interbedded shale and thin-bedded black- and light-gray banded limestone and silicified limestone commonly with abundant *Monotis* and *Halobia* sp. pelecypods, weathers yellowish-tan (Late Triassic); and at the top, the Blankenship Member—organic-rich black shale and thin bedded chert, represents condensed deposition (Early and Middle Jurassic). Formation generally not well exposed, commonly exposed only as yellow-gray weathering rubble of the limestone member or in structurally complicated partial sections in stream cuts. Thickness <100 m.
Ps	SIKSIKPUK FORMATION (Permian)—Dominantly siltstone and shale, minor "chert" or silicified mudstone, in four lithogenetic units: a thin basal member, unit A—greenish-gray siltstone that weathers to a conspicuous yellowish-orange color; grades up into unit B—maroon- to light-green-mottled siltstone with scattered barite seams and crystal aggregates; unit C—resistant green- to greenish-gray silicified mudstone or chert; and unit D—poorly exposed gray clay shale. Formation generally exposed only in stream cuts and recognized by the conspicuous yellowish-orange weathering beds overlying Lisburne Group carbonate rocks. Thickness <100 m.
PMl	LISBURNE GROUP (Lower Pennsylvanian, Atokan, to upper Mississippian, Meramecian)—Dominantly massive, light-gray weathering, cliff-forming crinoidal limestone and dolomite; in places contains abundant black chert nodules, lenses, and beds, contains distinctive sooty black phosphatic shale and limestone in upper part, locally contains leached pinpoint to vugular porosity filled with solid hydrocarbon in zones that are particularly abundant near pinchout west of Outwash Creek; in many areas includes poorly exposed Kayak Shale at base. Contains Meramecian to Morrowan conodonts at several localities along mountain front in eastern part of quadrangle (A.G. Harris, written commun(s)., 1985, 1992). Thickness up to 500 m, thins to the west along the mountain front, and west of Outwash Creek is replaced by Kuna Formation.
Mk	KAYAK SHALE (Lower Mississippian)—Dark-gray to black fissile clay shale with yellowish-brown-weathering thin fossiliferous limestone beds near top, commonly contains conspicuous reddish-brown-weathering nodules; lower part contains thin interbeds of gray sandstone, gradational downward into Kanayut Conglomerate. Forms broad bare shale slopes south of frontal Lisburne ridges in central part of quadrangle, is complexly deformed by isoclinal folding, and acts as a detachment zone for overlying Lisburne; thickness unknown, appears very thick, probably >500 m thick.
MDk	KANAYUT CONGLOMERATE (Lower Mississippian(?) to Upper Devonian)—Thick succession of gray- to brown-weathering quartzitic sandstone, quartz- and chert-pebble conglomerate, and shale, forms high mountains in the southern part of quadrangle, interpreted as dominantly fluvial deltaic deposits, thins and becomes finer grained westward in the quadrangle; divided into:
MDks	STUVER MEMBER (Lower Mississippian(?) to Upper Devonian)—Thin bedded brown fine-grained quartzose and quartzitic sandstone with minor quartz- and chert-pebble conglomerate interbedded with micaceous gray, greenish gray, reddish gray, and brown shale and silty shale, generally upward-fining succession; meandering stream deposit, up to 200 m thick, grades down into Shainin Lake Member.
Dksl	SHAININ LAKE MEMBER (Upper Devonian)—Pebble to cobble conglomerate, quartzitic sandstone, and minor shale; conglomerate clasts consist of chert, quartz, and minor quartzite; braided stream deposit, forms a massive dark gray to black weathering resistant marker unit up to 600 m thick; becomes thinner and less conspicuous in the western and southern part of the quadrangle; grades down into Ear Peak Member.
Dke	EAR PEAK MEMBER (Upper Devonian)—Shale, siltstone, sandstone, quartzite, and conglomerate. Shale is red to brown in northern part of area and black in southern part of area, quartzite, conglomeratic sandstone, and conglomerate generally in beds 1 to 3 m thick, conglomerate clasts of quartz and gray, black, green, and occasionally red to maroon chert, generally fining and upward thinning cycles, meandering stream deposit, unit is up to 300 m thick.
MDku	UPPER PART OF KANAYUT CONGLOMERATE, UNDIVIDED (Lower Mississippian(?) and Upper Devonian)—Includes part of Stuver and Shainin Lake Members north of the Toyuk thrust, mapped in area of upper drainages of East Fork of Etivluk River and Outwash Creek.
Dkn	KANAYUT CONGLOMERATE AND NOATAK SANDSTONE, UNDIVIDED (Upper Devonian)—Intertongued transitional facies south of Toyuk thrust in southwestern part of quadrangle, and north of Toyuk thrust between Ivotuk Creek and East Fork of Etivluk River.
Dn	NOATAK SANDSTONE (Upper Devonian, Famennian)—Light gray- to light-brown, fine- to coarse-grained thick bedded sandstone and quartzite in units up to 20 m thick; interbedded with dark-gray to brown shale with ironstone nodules; upper part generally forms steep tan-weathering rubble-covered mountain slopes, becomes thinner bedded downward in section. In southwestern part of quadrangle south of Toyuk thrust formation is locally differentiated into:
Dnl	NOATAK SANDSTONE, LOWER PART (Upper Devonian)—gray to greenish-gray, medium-bedded sandstone, generally fine-grained, calcareous, finely micaceous, contains abundant yellow-orange limonitic spots, commonly contains conspicuous cross beds and ripple marks; beds up to 2 m thick, interbedded with gray silty micaceous shale and local thin silty limestone beds; interval forms generally smooth, dark reddish-brown to brown weathering, rubble-covered mountain slopes, dominantly marine shelf sediments, probably >500 m thick. Contains Late Devonian (Famennian) brachiopods and conodonts (J. T. Dutro, Jr. and R.B. Blodgett, and A.G. Harris, written commun., 1992) in beds just above locally differentiated conglomerate and sandstone unit on west side of Ivotuk Creek.
Dnc	CONGLOMERATE AND SANDSTONE UNIT (Upper Devonian, Famennian)—Massive, thick-bedded, white to light-gray weathering pebble conglomerate and quartzitic sandstone; conglomerate contains matrix-supported white quartz and black and gray chert pebbles to 2 cm diameter; sandstone is dominantly fine- to medium-grained, quartzose, siliceous cement, locally calcareous, contains abundant yellowish-brown limonite spots in places. Unit is up to 25 m thick, forms conspicuous cliff-forming marker horizon between Ivotuk Creek and Iteriak Creek in southwestern part of quadrangle.
Dnh	NOATAK SANDSTONE AND HUNT FORK SHALE, UNDIVIDED (Upper Devonian)—Transitional facies south of Toyuk thrust in southwestern part of quadrangle; consists of gray to greenish-gray medium-bedded micaceous and calcareous sandstone as in overlying Noatak Sandstone, beds up to 1 m thick, interbedded with dolomitic siltstone and gray silty micaceous shale; interval forms generally smooth dark reddish-brown to brown weathering mountain slopes with local micaceous sheen. Thickness probably about 300 m.
Dhf	HUNT FORK SHALE (Upper Devonian)—Dark gray- and olive-green shale, with interbedded thin bedded quartz-chert wacke, quartzite, sandstone, and minor conglomerate in upper part north of Toyuk thrust, grades upward into Noatak Sandstone; dominantly micaceous phyllitic shale in lower part; contains scattered fossiliferous beds with brachiopods and corals; interpreted as a pro-delta deposit, more than 1000 m thick. South of Toyuk thrust, unit grades progressively down from thinly interbedded greenish-gray micaceous sandstone and phyllite into dominantly micaceous phyllite that forms smoothly weathered slopes with a conspicuous micaceous sheen.
Db	BEAUCOUP FORMATION (Upper Devonian)—Gray shale, weathers to smooth brown, orange, or gray weathering slopes, exposed locally north of Easter Creek.
Dl	UNNAMED LIMESTONE (Upper Devonian)—Possibly part of Beaucoup Formation, mapped locally south of Toyuk thrust near head of Kakivilak Creek in southcentral part of quadrangle.

Ivotuk Hills Sequence

Named for exposures in the area of the Ivotuk Hills in the westcentral part of the Killik River Quadrangle (Martin, 1970).

Ko	OKPIKRUAK FORMATION (Lower Cretaceous, Berriasian or Valanginian)—Greenish gray graywacke with interbedded mudstone and shale, forms rubble covered hills, generally poorly exposed. Along Otuk Creek north of Ivotuk Hills contains poorly sorted polymict cobble-to boulder- conglomerate and breccia, clasts consist of chert, mafic igneous rocks, gabbro, granitic rocks, limestone, and quartzitic sandstone, probably deposited as debris flows. Thickness unknown but probably <500 m, in places contains:
Kos	—As above, dominantly dark-gray shale and mudstone.
Kcq	COQUINOID LIMESTONE (Lower Cretaceous, Valanginian)—See description of coquinoid limestone in Killik River sequence. In the Ivotuk Hills sequence, unit is complexly deformed and commonly closely associated with Otuk Formation; is well exposed in a small outcrop on east bank of Otuk Creek 5.5 km north of Ivotuk Hills. Occurrences shown by large dots on map.
JTRo	OTUK FORMATION (Middle Jurassic to Early Triassic)—See description of Otuk Formation in Killik River sequence. In the Ivotuk Hills sequence, unit is generally not well exposed, commonly exposed only as yellow-gray weathering rubble of the limestone member or in a few well exposed but structurally complicated partial sections in stream cuts. Type locality of formation on east bank of Otuk Creek 6.3 km north of Ivotuk Hills. Exposed thickness <50 m at type locality shale member mostly covered.
Ps	SIKSIKPUK FORMATION (Permian)—See description of Siksikpuk Formation in Killik River sequence. In the Ivotuk Hills seqence, unit is exposed only on south side of Ivotuk Hills, contains barite nodules on tributary of Otuk Creek at west end of Ivotuk Hills. Thickness probably <75 m.
Mld	LISBURNE GROUP, UNDIVIDED (Mississippian, Meramecian to Chesterian)—Dolomite, light to medium gray, thin- to thick-bedded, massive, with white to bluish-gray weathering chert, some bioclastic beds, some beds of spiculitic mudstone and chert, dominantly thin-bedded chert and minor shale in lower part. In some zones, contains abundant pinpoint to vugular porosity filled with tarry oil and solid hydrocarbons. Forms high rubble covered ridges of Ivotuk Hills. Contains conodonts ranging from late Meramecian to latest Chesterian (Dumoulin and Harris, 1993). 225 m thick.
Mk	KAYAK SHALE (Lower Mississippian)—Dominantly black phyllitic shale and mudstone, and minor dolomite, contains scattered reddish brown weathering concretions; some beds contain abundant bioclastic debris, occasional thin layers contain abundant sponge spicules. Thickness unknown, unit is mostly covered beneath talus from overlying Lisburne, is well exposed only in a 50 m thick section along Otuk Creek below Lisburne at west end of Ivotuk Hills. Early Mississippian (Osagean) based on conodont fauna (Dumoulin and Harris, 1993).

Key Creek Sequence

Named for exposures along Key Creek, a tributary of the Kelly River in the De Long Mountains Quadrangle (Mayfield and others, 1982); in the Killik River Quadrangle exposed along the mountain front west of Outwash Creek.

Ko	OKPIKRUAK FORMATION (Lower Cretaceous, Berriasian or Valanginian)—Dominantly graywacke with interbedded poorly exposed mudstone, exposed only locally between Ivotuk River and East Fork of Etivluk River, in places contains differentiated unit:
Kocg	—As above. contains massive conglomerate and/or breccia.
Kcq	COQUINOID LIMESTONE (Lower Cretaceous, Valanginian)—See description of coquinoid limestone in Killik River sequence. In Key Creek sequence, unit is complexly deformed and commonly closely associated with Otuk Formation; found in float overlying Otuk Formation at two localities between Outwash Creek and the East Fork of the Etivluk River. Known exposures in Key Creek sequence shown by black dots on map.
JTRo	OTUK FORMATION (Middle Jurassic to Early Triassic)—See description of Otuk Formation in Killik River sequence. In Key Creek sequence, unit is generally poorly exposed, commonly as yellow-gray weathering rubble of the limestone member; Blankenship Member at top and shale member at base not exposed. Thickness probably <100 m.
Ps	SIKSIKPUK FORMATION (Permian)—See description of Siksikpuk Formation in Killik River sequence. In the Key Creek sequence, unit is present mostly in rubble along mountain front in western part of quadrangle. Thickness probably <100 m.
PMk	KUNA FORMATION, OF LISBURNE GROUP (Lower Pennsylvanian, Morrowan to Mississippian, Osagean)—Interbedded black siliceous mudstone, sooty limestone and dolomite, and shale; forms low resistant ridges north of mountain front. Reference section for formation is located on Otuk Creek 2.5 km north of mountain front. In Howard Pass Quadrangle, contains Osagean (Late Tournaisian) conodonts, (Dumoulin and Harris, 1993, 1994), but siliceous zones at top elsewhere contain Osagean to Morrowan (early Visean? to Bashkirian) (Late Mississippian to early Middle Pennsylvanian) radiolarians, (Murchey and others, 1988). Thickness <75 m.
Mk	KAYAK SHALE (Mississippian)—Dark gray to black fissile clay shale with abundant reddish brown weathering nodules, grades down into Kanayut Conglomerate.
MDk	KANAYUT CONGLOMERATE (Lower Mississippian to Upper Devonian)—See descriptions of Kaneyut units in Killik River sequence.

Okpikruak River Sequence

Here named for exposures along the Okpikruak River, 15-19 km north of Endicott Mountain front in the eastern Killik River Quadrangle. Mapped in scattered exposures between Killik River and Okokmilaga River.

Ko	OKPIKRUAK FORMATION (Lower Cretaceous, Berriasian to Valanginian)—Light greenish gray, thin-bedded graywacke sandstone and siltstone, with rhythmically interbedded silty mudstone, turbidite sequence, approximately 600 m thick. Type section well exposed on east side of Okpikruak River in northeastern part of quadrangle.
JTRo	OTUK FORMATION (Middle Jurassic to Early Triassic)—See description of Otuk Formation in Killik River sequence. In Okpikruak River sequence unit is exposed mostly as yellow-gray weathering rubble of the limestone member in Okpikruak River area. Blankenship Member at top and shale member at base not exposed. Thickness probably <75 m.
Ps	SIKSIKPUK FORMATION (Permian)—See description of Siksikpuk Formation in Killik River sequence. In Okpikruak River sequence, unit is mostly poorly exposed yellowish-orange weathering green siltstone and mottled maroon to light green siltstone; contains massive barite lenses on Okokmilaga River. Thickness probably <75 m.
PMko	KUNA FORMATION, OF LISBURNE GROUP (Lower Pennsylvanian, Morrowan to Mississippian, Osagean)—Dark-gray, fine grained micritic limestone, with black chert and sooty black shale, in tightly folded crumpled exposures that form low resistant ridges and rubble exposures along Okpikruak River, Okokmilaga River, and Killik River north of mountain front. Dated by analogy to dated Kuna in Key Creek sequence to the west. Exposed thickness < 50 m.

PICNIC CREEK ALLOCHTHON

Named for exposures in the Picnic Creek fenster in the eastern De Long Mountains of the western Brooks Range (Mayfield and others, 1982). New formations in this quadrangle named by Mull and others (1987).

Akmalik Creek Sequence

Here named for exposures on Akmalik Creek, a tributary of the Killik River near Kikiktat Mountain.

Ko	OKPIKRUAK FORMATION (Lower Cretaceous, Berriasian? and Valanginian)—Dominantly greenish gray graywacke turbidites with interbedded mudstone and shale, forms smooth greenish-gray weathering hillsides, in places divided into:
Kocg	—As above, contains cobble to boulder conglomerate. In Heather Creek and Imnaitchiak Creek area, unit is an olistostrome containing large rounded cobbles and boulders of white, gray, and blank chert, light-gray limestone, granodiorite, diorite, gabbro, basalt, fine-grained mafic igneous rock, and angular blocks of limestone up to 5 m long.
Kos	—As above, dominantly mudstone and shale.
TRDa	AKMALIK CREEK SEQUENCE, UNDIVIDED (Triassic to Upper Devonian(?))—Consists of, in descending order, Imnaitchiak Chert, Akmalik Chert, Kayak Shale, Kurupa Sandstone, and Hunt Fork Shale, mapped in poorly exposed rubble-covered hills between East Fork Etivluk River and Ivotuk Creek.
TRPi	IMNAITCHIAK CHERT, OF ETIVLUK GROUP (Triassic to Pennsylvanian) (Mull and others, 1987)—Yellowish-orange weathering gray to greenish gray thin-bedded chert or silicified mudstone, with interbedded siliceous shale, overlain by greenish-gray to maroon silty mudstone, base contains a distinctive dark gray evenly laminated glauconitic, phosphatic siltstone bed up to 1 m thick; locality at Akmalik Creek marked by an oncolitic conglomerate replaced by barite. Unit commonly structurally contorted, thickness <75 m thick.
PMa	AKMALIK CHERT, OF LISBURNE GROUP (Lower Pennsylvanian, Atokan to Mississippian, Osagean) (Mull and others, 1987)—Bedded black chert with finely disseminated pyrite, in beds to 10 cm thick with thin siliceous shale partings, contains two laterally persistent thin micritic limestone beds to 1 m thick near base, Locally includes underlying thin Kayak Shale, which is generally poorly exposed and not mappable at scale of map. Well exposed at type locality on Akmalik Creek 2 km north of mountain front, and in Kurupa Hills. Contains Osagean to Morrowan or younger conodonts (Mull and others, 1987); in Howard Pass Quadrangle, contains Osagean (late Tournaisian or early Visean) conodonts (Dumoulin and others, 1993, 1994). Thickness ~75 m.
Mku	KURUPA SANDSTONE (Lower Mississippian) (Mull and others, 1987)—Sandstone, light- to medium-gray, beds up to 1 m thick, abundant amalgamated graded beds, abundant flutes and grooves and well developed Bouma sequences. Sand 80-85% quartz, <10% chert, <10% feldspar. Weathers reddish brown, forms resistant ridges or spurs on valley walls. Well exposed at type locality in Kurupa Hills and in Akmalik Creek. Contains abundant plant fossils particularly near top formation, and scattered brachiopods near Otuk Creek. Dated as Kinderhookian to Meramecian. Thickness <40 m, grades downward into Hunt Fork Shale.
Dhf	HUNT FORK SHALE (Upper Devonian)—Greenish gray to gray silty mudstone and fissile shale, usually poorly exposed, but up to ~500 m thick in Kurupa Hills.

IPNAVIK RIVER ALLOCHTHON

Named for exposures in Ipnavik River area in the Howard Pass Quadrangle (Mayfield and others, 1982); best exposures in Killik River Quadrangle in the area of Akmalik Creek and between Ivotuk Creek and Otuk Creek in the western part of the quadrangle. Altered basalt and diabase sills intruded mostly within Carboniferous rocks and occasionally within Pennsylvanian to Triassic rocks are a conspicuous characteristic in the western part of the quadrangle, but become less numerous to the east.

Zebra Creek Sequence

Here named for excellent exposures on Zebra Creek, a short tributary of Akmalik Creek on the south side of the western peak of Kikiktat Mountain, where it underlies the Kikiktat Mountain klippe.

Ko	OKPIKRUAK FORMATION (Lower Cretaceous, Valanginian)—Graywacke, greenish-gray fine-grained to very coarse-grained, dominantly rubble exposures, in places contains:
Kocg	—As above, contains cobble to boulder conglomerate, clasts are well rounded pebbles to boulders of estimated 40% altered gabbro and fine-grained mafic igneous rock, 40% light gray micritic limestone, 19% dark-gray to black chert, and 1% light gray diorite or granodiorite; clasts mostly 2-16 cm diameter, but scattered diorite boulders range up to 75 cm diameter. Exposed mostly as rubble, thickness estimated less than 100 m.
TRPi	IMNAITCHIAK CHERT, OF ETIVLUK GROUP (Triassic to Pennsylvanian) (Mull and others, 1987)—Gray to greenish gray bedded chert or silicified mudstone, and greenish-gray to maroon silty mudstone, interbedded with gray to greenish-gray siliceous shale, beds 2-13 cm thick, exposed mostly as rubble. Contains Pennsylvanian to Late Triassic radiolarians (Mull and others, 1987). Thickness <100 m.
PMlc	UNNAMED LIMESTONE AND BLACK CHERT OF LISBURNE GROUP (Pennsylvanian to Mississippian)—Rhythmically thinly interbedded dark gray to black micritic limestone, black silicified limestone, and siliceous mudstone; upper third of section contains thick section of bedded black chert or silicified limestone and mudstone; has a distinctive black and gray banded appearance where well exposed. Deposited as a carbonate turbidite (A.K. Armstrong, oral commun., and Dumoulin and Harris, in press). Distinguished from Akmalik Chert by presence of abundant thin-bedded micritic limestone beds. On Zebra Creek, contains Osagean to Meramecian conodonts (A.G. Harris, written commun., 1991). In Howard Pass Quadrangle, contains Osagean (late Tournaisian to middle Visean) (early Mississippian) conodonts. (Dumoulin and Harris, 1993, 1994). >145 m thick on Zebra Creek, contains poorly exposed Kurupa Sandstone at base.
Mku	KURUPA SANDSTONE (Lower Mississippian) (Mull and others, 1987)—Gray quartzitic sandstone, weathers gray to reddish brown, mostly rubble exposures, exposed locally near Otuk Creek and present as rubble on Zebra Creek. Thickness estimated less than 20 m.

Iteriak Creek Sequence

Here named for exposures in the Iteriak and Otuk Creek area in the western part of the quadrangle, where it may consist of two separate thrust panels, one of which is distinguished by more abundant igneous rocks. Forms mostly rubble-covered ridges with few good outcrops.

Ko	OKPIKRUAK FORMATION (Lower Cretaceous, Berriasian(?) to Valanginian)—Greenish-gray, thin- to thick-bedded, fine-to very coarse-grained graywacke sandstone and siltstone, with rhythmically interbedded mudstone and shale, some beds contain sole markings and small scale ripple cross-lamination and convolute bedding; in other localities contains slightly calcareous and micaceous sandstones, coarse-grained beds contain conspicuous white leached chert grains and black shale flakes; intruded by white felsic dike at one locality on Otuk Creek. Locality on Iteriak Creek contains Valanginian *Buchia sublaevis* (W.P. Elder, written commun., 1992). Locally contains:
Kocg	—Cobble to boulder conglomerate. On tributary of Iteriak Creek forms 7 m-high pinnacle, composed dominantly of round boulders of felsite, granite, granodiorite, tonalite, fine-grained altered mafic and intermediate igneous rock, and tuff-breccia up to 70 cm diameter, and small black chert pebbles. On a tributary of Otuk Creek, a 25 m-thick chaotic disorganized conglomerate debris flow contains round cobbles and boulders to 45 cm diameter consisting of granodiorite, gabbro, fine-grained altered mafic igneous rock, limestone, tasmanite (organic-rich shale), and smaller pebbles of black, gray, blue-green, and white chert; interbedded graywacke contains blue amphibole grains (J.A. Dumoulin, oral commum.); interval forms conspicuous channel cut into graywacke and underlying cherts.
TRPi	IMNAITCHIAK CHERT (OF ETIVLUK GROUP) (Triassic to Pennsylvanian) (Mull and others, 1987)—Gray, greenish gray, and maroon bedded chert, silicified mudstone, and silty shale; commonly contains brilliant turquoise-blue-green chert where associated with basalt, commonly contains associated blocks and beds of tasmanite—a distinctive organic-rich shale. Forms mostly rubble exposures, commonly structurally contorted.
PMcl	UNNAMED GRAY LIMESTONE AND CHERT OF LISBURNE GROUP (Pennsylvanian(?) to Mississippian)—Thinly interbedded gray to dark gray micritic limestone and gray to black chert; limestone contains abundant sponge spicules in places; chert frequently weathers white; limestone weathers gray; forms smooth rubble covered hillsides with few bedrock exposures. Dated by analogy to rocks of Akmalik Creek sequence. Near Iteriak Creek contains conodonts no older than middle Osagean (Dumoulin and Harris, 1993, 1994).
Mku	KURUPA SANDSTONE (Lower Mississippian) (Mull and others, 1987)—Generally gray quartzitic sandstone, exposed as rubble, one exposure of light brown friable quartzose sandstone west of Iteriak Creek. Thickness probably less than 10 meters.
ba	BASALT DIKES AND SILLS—Dark green, fine- to coarse-grained basalt, weathers reddish brown, mostly in rubble exposures; commonly intruded into unnamed limestone and chert of Lisburne Group and in some places into Imnaitchiak Chert; age uncertain.

Itkilikruich Ridges Sequence

Here named for rocks exposed in the Itkilikruich Ridges area, central Killik River Quadrangle; also locally present west of Iteriak Creek at western edge of quadrangle and near Fortress Creek near eastern edge of quadrangle.

Ko	OKPIKRUAK FORMATION (Lower Cretaceous, Berriasian(?) to Valanginian)—Green to greenish gray graywacke, fine to coarse grained and poorly exposed gray silty mudstone; locally contains:
Kom	—As above, contains abundant mafic igneous clasts, some agglomerate, and breccia; generally poorly exposed, apparently derived from and difficult to differentiate from associated mafic igneous rocks (mii).
TRPi	IMNAITCHIAK CHERT, OF ETIVLUK GROUP (Triassic to Pennsylvanian) (Mull and others, 1987)—Gray, greenish gray, to black chert and silicified mudstone, mostly rubble exposures.
mii	MAFIC IGNEOUS ROCKS—Dark green, fine- to coarse-grained basalt, underlies Itkilikruich Ridge, light gray to greenish gray aphanitic rocks and volcanic breccia form isolated hills to south; on prominent cone-shaped mountain west of Ivotuk airstrip unit is conspicuously vesicular and amygdaloidal, age uncertain.

COPTER PEAK AND NUKA RIDGE ALLOCHTHONS, UNDIVIDED

Named for Copter Peak and Nuka Ridge in the De Long Mountains of the western Brooks Range (Mayfield and others, 1982).

Kikiktat Mountain Klippe

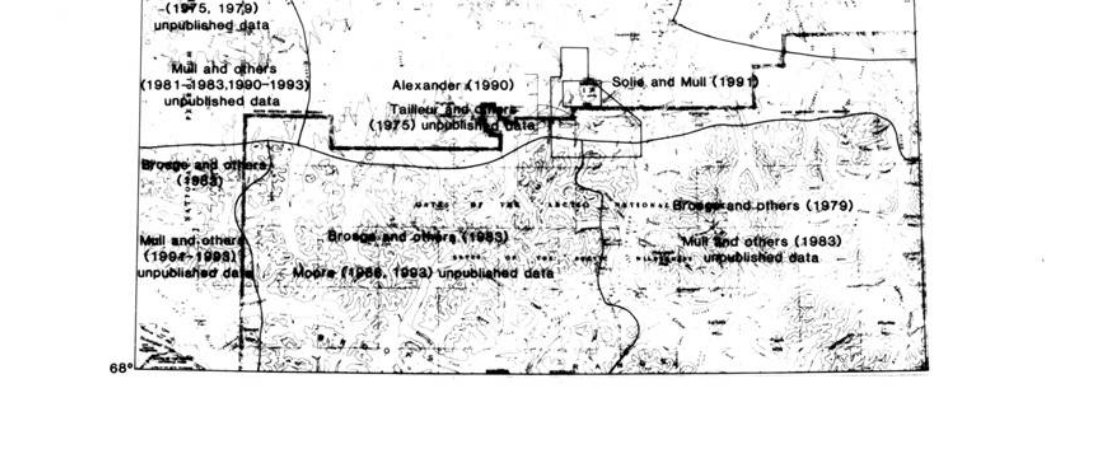
Forms Kikiktat Mountain, north of mountain front in central part of quadrangle. Upper part of klippe occupies structural position of Copter Peak allochthon. However, it differs from the Copter Peak allochthon because basalt that forms the top of the klippe overlies clastic sedimentary rocks of the Nuka Formation at a baked contact rather than at a thrust fault, suggesting that the basalt and Nuka at this location represent a single allochthon (Solie and Mull, 1991). Similar rocks closely associated with Nuka Formation also crop out in a small area west of Iteriak Creek. Basalt in the lower part of the klippe occupies the structural position and is similar to basalt in the Ipnavik River allochthon.

Pmi	UNNAMED MAFIC IGNEOUS COMPLEX (Pennsylvanian)—Basalt, dark green, fine grained, massive; contains discontinuous chert horizons up to 2 m-thick. Basalt is mostly homogeneous but contains scattered well developed pillow structures. Crudely stratified resistant layers up to 5 m thick are interpreted as individual flows or sills; unit contains a 15 m-thick columnar basalt interval on the west peak of Kikiktat Mountain. Pumpellyite vein fillings are present in some fractures. Milky bluish-green siliceous amygdules up to 2 mm diameter are present in some horizons; amygdules are most abundant near interlayered chert horizons. Intercalated chert contains Early Pennsylvanian to Late Mississippian radiolarians (K.M. Reed, B.L. Murchey, and T.E. Moore, in R.J. Alexander, 1990). Interval is 500 m thick on Kikiktat Mountain. Baked contact of basalt with underlying Nuka Formation is well exposed on southwest side of Kikiktat Mountain in lower end of "Duttweiler Canyon".
PMn	NUKA FORMATION (Pennsylvanian-Mississippian)—Arkosic limestone and sandstone, medium gray, weathers light gray, and interbedded black clay shale. Sandstone is fine to medium grained, calcareous, in thickening- and coarsening-upward beds, section has turbidite characteristics with graded beds up to 1 m thick with convolute bedding and large flute casts at base of some beds; base of section dominantly black clay shale. Arkosic limestone contains Late Mississippian to Early Pennsylvanian fossils in scattered localities (Solie and Mull, 1991). Section approximately 30 m thick, overlain by mafic igneous complex (Pmi) at a baked contact. Thrust fault contact with underlying mafic igneous rock (Pmil).
Pmil	MAFIC IGNEOUS COMPLEX, LOWER PART (Pennsylvanian(?))—Basalt with intervals of intercalated black chert, dolomitic(?) limestone, and shale. Basalt is fine grained and homogeneous although sheared in places, is composed of several 2 m-thick layers that may be either sills or flows; near top of unit one zone appears to contain pillows. A 3 m-thick interval of chert, limestone, and shale forms a prominent white to light-gray weathering band near middle of basalt interval; chert beds appear to be diagenetic and preserve parallel and cross bedded lamination in some places, are up to 9 cm thick, in some places have irregular bedding or occur as small isolated masses. Limestone contains bryozoans in at least two localities. Some basalt-sediment contacts are concordant, with no indication of fault movement; other contacts are thrust contacts. Age uncertain. Unit 30-50 m thick. Associated basalt and limestone, and structural position beneath Nuka Formation are characteristics of the Ipnavik River allochthon, but for convenience, unit is mapped as part of Kikiktat Mountain klippe. Base is a thrust fault.

ROCKS NOT ASSIGNED TO A SPECIFIC ALLOCHTHON

Dls	LIMESTONE AND MARBLE (Devonian)—Coarse-grained, light-gray limestone, commonly recrystallized, forms white-weathering pinnacles up to 10 m high surrounded by tundra near Nogak Creek and Otuk Creek. Distinguished from limestone of Lisburne Group by light-gray color and absence of chert; resembles Baird Group carbonates in southern Brooks Range. Probably emplaced as tectonic slivers at base of Ipnavik River allochthon. Unfossiliferous, but similar rocks 30 km west in Howard Pass Quadrangle contain Middle or Late Devonian fossils (Chapman and others, 1964).
wc	WHITE-WEATHERING CHERT OR SILICIFIED LIMESTONE—Forms isolated rubble exposures surrounded by tundra; weathering character similar to chert in Ipnavik River allochthon but in places difficult to distinguish from weathered rubble exposures of limestone member of Otuk Formation.
cht	GRAY, BLUISH-GRAY, GREENISH-GRAY, OR BLACK CHERT AND SILICIFIED MUDSTONE—Undivided siliceous sediments of Etivluk Group or Lisburne Group; mostly rubble patches not examined on the ground.
mi	FINE-GRAINED MAFIC-IGNEOUS ROCKS—Mostly small isolated masses of weathered basalt, probably part of either Ipnavik River or Copter Peak allochthon emplaced as tectonic slivers or olistoliths within Okpikruak Formation.

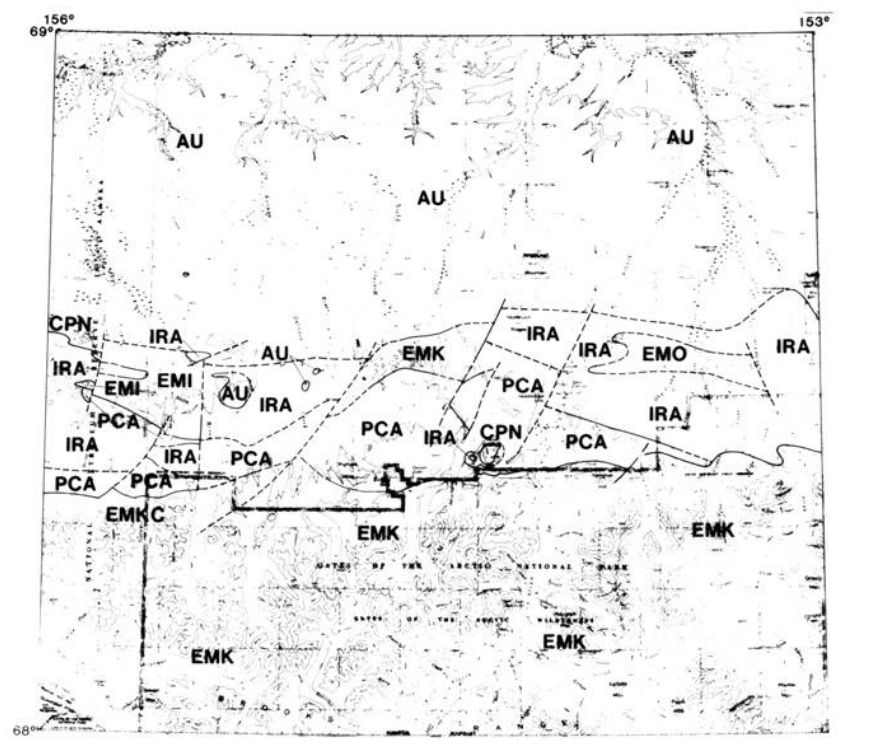
INDEX MAP SHOWING SOURCES OF BEDROCK GEOLOGY


156°
69°
153°
68°
Chapman and others (1964)
Tailleur and others (1975) unpublished data
Mull and others (1981-1986) unpublished data
Mull and others (1981, 1984, 1985) unpublished data
Patton and Tailleur (1964)
Tailleur and others (1975, 1979) unpublished data
Mull and others (1981-1983,1990-1993) unpublished data
Alexander (1990)
Tailleur and others (1975) unpublished data
Solie and Mull (1991)
Brosge and others (1983)
Mull and others (1984-1986) unpublished data
Moore (1986, 1993) unpublished data
Brosge and others (1979)
Mull and others (1983) unpublished data

LOCATION INDEX

156°
153°
69°
69°
68°
68°
Lookout Ridge
Ikpikpuk River
Umiat
Howard Pass
Killik River
Chandler Lake
Ambler River
Survey Pass
Wiseman
ALASKA

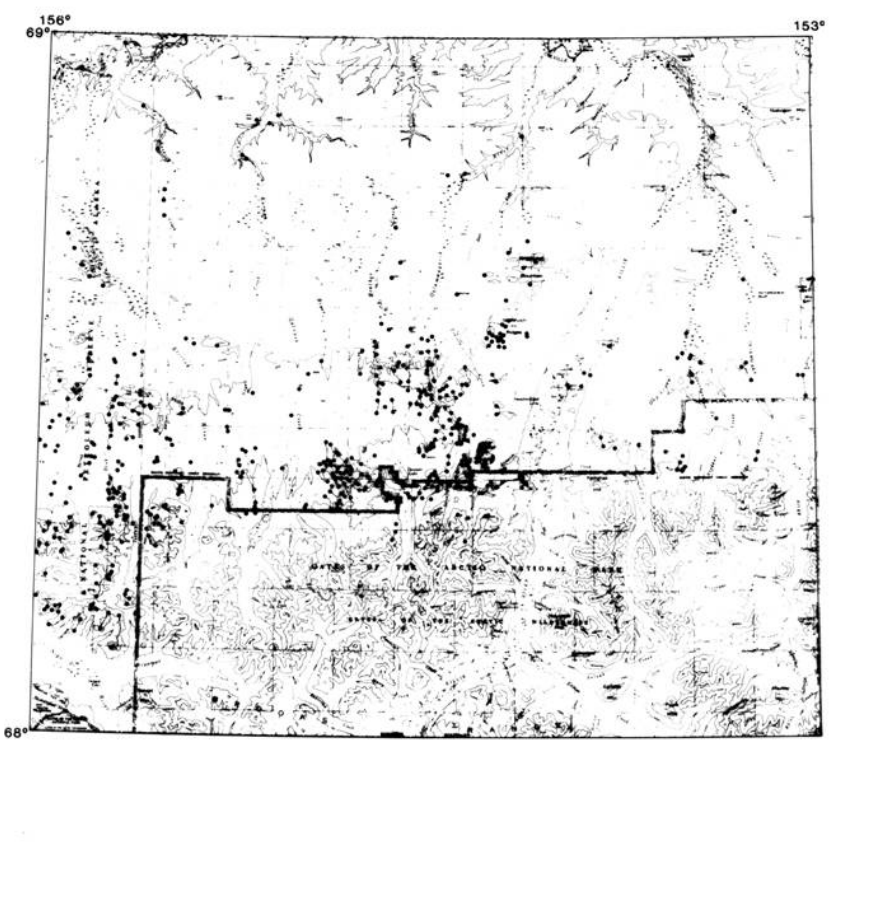
MAP SHOWING DISTRIBUTION OF ALLOCHTHONS



AU	Autochthonous	EMK	Killik River sequence
PCA	Picnic Creek allochthon	EMI	Ivotuk Hills sequence
IRA	Ipnavik River allochthon	EMKC	Key Creek sequence
CPN	Copter Peak & Nuka Ridge allochthons	EMO	Okpikruak River sequence

Endicott Mountains Allochthon

STATION AND TRAVERSE MAP



MAP SYMBOLS

Contact—Dashed where approximately located; dotted where concealed.

Fault—Dashed where approximately located; dotted where concealed; queried where uncertain.

U / D High angle fault—U, upthrown side; D, downthrown side.

Fault—Arrows show relative horizontal movement.

Thrust fault—Sawteeth on upper plate.

Major thrust fault bounding allocthons; sawteeth on upper allochthon.

Fold axis—Showing direction of plunge. Dashed where approximately located; dotted where concealed.

Anticline

Syncline

Overturned anticline

Overturned syncline

Strike and dip of beds

79 Inclined

Vertical

⊕ Horizontal

82 Overturned

87 Estimated

Traceable bedding

Well site

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