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SURFICIAL-GEOLOGIC MAP OF THE KIVALINA AREA, NORTHWEST ALASKA

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EXPLANATION

This map shows the distribution of unconsolidated deposits and bedrock exposed at the surface in portions of the southern Noatak D-6, southwestern Noatak D-5, and northwestern Noatak C-5 quadrangles near Kivalina, Alaska. We mapped units by interpreting: (1) aerial photographs taken in 1952, 1978, 1980, and 2003; (2) Worldview satellite data collected in 2008 and 2009; and (3) Spot5 satellite imagery collected in 2010 and 2020. We verified mapping from 2010 field investigations by Alaska Division of Geological & Geophysical Surveys (DGGS) staff. Map unit descriptions are modified from Mayfield and others (1987) and use data collected during DGGS fieldwork.

A map unit overlay pattern is used to indicate complex map units consisting of subcrops of the map unit shown covered by a thin (<0.09 m) veneer of surficial material derived in part from frost heaved, fractured, and weathered bedrock.

DESCRIPTION OF GEOLOGIC MAP UNITS

UNCONSOLIDATED DEPOSITS

Alluvial Deposits

Qa ALLUVIAL DEPOSITS, UNDIFFERENTIATED (HOLOCENE)—Poorly sorted to well-sorted, unconsolidated deposits of silt, sand, and gravel comprising active channel and overbank deposits, as well as alluvial deposits, adjacent to but no longer subject to inundation by streams. Generally found along smaller streams where alluvial deposits cannot be further differentiated at the map scale. Deposits include multiple-level surfaces, with abandoned channels and oxbow lakes common on elevated surfaces above the modern stream. Vegetation is sparse along active channels but generally more widespread and stable on higher surfaces adjacent to modern streams.

Qaa ACTIVE-FLOODPLAIN ALLUVIUM (HOLOCENE)—Poorly sorted to well-sorted, unconsolidated silt, sand, and gravel deposits comprising active stream channels, channel bars, and marginal areas. Deposits include point-bar deposits and low-lying areas frequently inundated by streams. Surfaces are unvegetated or have sparse open shrub vegetation.

Qab ABANDONED-FLOODPLAIN ALLUVIUM (HOLOCENE)—Poorly sorted to well-sorted, unconsolidated silt, sand, and gravel deposits comprising formerly active floodplain surfaces subject to inundation only during infrequent, rare, high-magnitude flood events. Surfaces may occur at multiple levels and are characterized by numerous abandoned channels that are often at least partially infilled with sediment. Numerous disconnected, arcuate oxbow lakes commonly occupy former stream channels. Lakes on older abandoned-floodplain surfaces tend to have more irregular morphology due to thermoerosional processes. These deposits are differentiated from alluvial terrace deposits (Qat) based on the more arcuate morphology and generally smaller size of the lakes and the presence of abandoned channel deposits easily identifiable in imagery.

Qaf ALLUVIAL-FAN DEPOSITS (HOLOCENE)—Fan-shaped deposits of unsorted to well-sorted gravel, sand, and silt where streams have deposited material due to decreased gradient.

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Qai INACTIVE-FLOODPLAIN ALLUVIUM (HOLOCENE)—Poorly sorted to well-sorted, unconsolidated silt, sand, and gravel deposits comprising low-lying surfaces above the active floodplain, but still subject to periodic flooding. Deposits may have surfaces at multiple levels and are characterized by numerous abandoned channels with small, scattered-to-sparse, linear to arcuate lakes. Deposits are unvegetated or have sparse open shrub vegetation. Inactive floodplain alluvium is differentiated from abandoned floodplain alluvium (Qab) by numerous abandoned channels that have not been infilled with sediment, fewer lakes, and a less dense vegetative cover.

Qat ALLUVIAL TERRACE DEPOSITS (HOLOCENE)—Poorly sorted to well-sorted, unconsolidated silt, sand, and gravel associated with high-level surfaces of formerly active floodplains no longer subject to alluvial inundation. These deposits are covered by stable vegetation, and terrace surfaces are characterized by numerous large thaw lakes with rounded to irregular shorelines.

Colluvial Deposits

Qc COLLUVIUM (QUATERNARY)—Unconsolidated clay, silt, sand, and gravel forming heterogeneous blankets, aprons, cones, fans, and lobate deposits created by complex, gravity-driven mass movements involving frost creep, sliding, flowing, and gelifluction. Lithologic clasts are often frost-shattered. Deposits may be complexly intermixed with alluvial and marine deposits and are often transitional with mixed colluvial and alluvial deposits (Qcfs). May include tundra, soil, lacustrine, paludal, and alluvial deposits.

Qcf MIXED COLLUVIUM AND ALLUVIUM (QUATERNARY)—Unconsolidated clay, silt, sand, and gravel that vary from elongate deposits with numerous gelifluction lobes occupying narrow valleys to broad areas on steep slopes and low relief surfaces with an abundance of gelifluction lobes. Formed by a combination of colluvial and alluvial processes where colluvial processes are dominant. Differentiated from colluvial deposits (Qc) by extensive areas of well-defined gelifluction lobes and evidence of very active colluvial processes. Deposits may develop in part due to the thawing of ice-rich permafrost.

Complex Deposits

Qafd ALLUVIAL-FAN DELTA DEPOSITS (QUATERNARY)—Fan-shaped deposits of unsorted to well-sorted gravel, sand, and silt deposited by streams as they decreased gradient near the coast. Map units are characterized by terrace-like surfaces with numerous large lakes with rounded to arcuate shorelines. These deposits are differentiated from alluvial terrace deposits (Qat) by the more abundant and larger lakes on the surface, more extensive development of permafrost features such as ice-wedge polygons, thermokarst lakes, and thermokarst lake basins, and by their fan-shaped morphology.

Qsi LOWLAND SILT (QUATERNARY)—Ice-rich silt, organic silt, and sand mantling low-lying areas where syngenetic permafrost is widespread. Ice content is variable. Deposits are extensively reworked by the formation, thawing, and redevelopment of ice-rich permafrost. Surfaces are characterized by thermokarst features, including ice-wedge polygons, beaded drainages, and large thaw lakes and thaw-lake basins. Deposits are complexly mixed with undifferentiated colluvium (Qc) and mixed colluvial and alluvial deposits (Qcfs). Thaw-lake basins may have paludal deposits. Surface morphology is generally smooth to hummocky and characterized by shallow interconnected channels and small lakes.

Marine Deposits

Qb BEACH DEPOSITS, UNDIFFERENTIATED (QUATERNARY)—Deposits of well-sorted, pebbly sand and gravel, generally parallel to present-day and former coastlines. Deposits include dunes, washover deposits, and sediments reworked by marine processes.

Qme ESTUARINE DEPOSITS (QUATERNARY)—Fine silt and clay intermixed with fine- to medium-grained sand of marine and fluvial origin. Includes tidal marshes segmented by complex beach strandlines. Surface morphology is generally smooth to hummocky and characterized by numerous shallow, interconnected channels and small lakes.

BEDROCK

Sedimentary Rocks

Ko OKPIKRUAK FORMATION (CRETACEOUS)—Interbedded, fine- to medium-grained, green lithic greywacke and gray mudstone. Lithic fragments include dolomitic clasts and black chert. Unit is only found in the northwestern map area, northwest of the Asikpak River. Fossils include the pelecypod *Buchia*. An unconformity occurs at the base in some places, and in other places the unit may be conformable on shale of the uppermost part of the Etivluk Group (JPe). Part of the Amphitheatre, Kelly, and Bogie sequences (Mayfield and others, 1987).

JPe ETIVLUK GROUP (JURASSIC TO PENNSYLVANIAN)—Radiolarian chert with variable amounts of interbedded red and green siliceous shale. Weathers to shades of brown, yellow, gray, green, and maroon. Weathering produces surfaces of blocky clasts ~5–10 cm in diameter. Epidote alteration and crystalline quartz are found locally. These rocks are only mapped north of the Asikpak River as northwest–southeast-trending units. Locally divided into the Otuk Formation (JTo) and the Siksikpuk Formation (Ps). Part of the Amaruk, Amphitheatre, Kelly, and Bogie sequences (Mayfield and others, 1987).

- JTo OTUK FORMATION (JURASSIC AND TRIASSIC)—Gray radiolarian chert that weathers brown to light-cream-colored. Fossils include the pelecypod *Monotis*. Mapped in two localities along the south bank of the Asikpak River between Umarachek Peak and Asikpak Mountain. Part of the Bogie Sequence (Mayfield and others, 1987).

- Ps SIKSIKPUK FORMATION (PERMIAN)—Maroon and gray radiolarian chert and siliceous shale. Mapped at one locality east of Tugak Lagoon. The base appears to be conformable on the Nuka Formation (PMn). Part of the Bogie Sequence (Mayfield and others, 1987).

PMk KUNA FORMATION (PENNSYLVANIAN TO MISSISSIPPIAN)—Black, carbonaceous, silver-blue-weathering shale with interbedded black chert and dark gray, fine-grained limestone. Fossils include conodonts, radiolarians, and brachiopods. Mapped in two locations northeast of the Kivalina Lagoon in the uplands north of Imnakuk Creek. Part of the Key Creek Sequence (Mayfield and others, 1987).

PMc BLACK CHERT (PENNSYLVANIAN? AND MISSISSIPPIAN)—Well-bedded black chert, locally interbedded with light-gray-weathering medium- to fine-grained limestone that is locally dolomitic. Includes shale partings and gray weathering chalcedony and quartz. Occurs as poorly exposed, low rubble-covered hills. Commonly bleached white and recrystallized by intrusions of mafic dikes and sills. Fossils include foraminifera and crinoids. Base is gradational into the Kogruk Formation (Mko) or conformable on the Kayak Shale (Mk). Part of the Amaruk and Ipnavik sequences (Mayfield, 1987).

Mko KOGRUK FORMATION (MISSISSIPPIAN)—Light gray to occasionally tan-weathering, medium-to fine-grained limestone and dolomite with up to 25 percent gray-to-black chert nodules and lenses. Often well-bedded and platy. Contains silicified zones of gray quartz and chalcedony. Surfaces may weather to tors with blocky, angular fragments >10 cm in diameter. Fossils include crinoids, gastropods, brachiopods, conodonts, foraminifera, and tabular and rugose corals. The base is gradational into the Utukok Formation (Mu) or the Micritic limestone (Mml). May be conformable on the Kayak Shale (Mk). Part of the Picnic Creek, Amphitheatre, Kelly, and Eli sequences (Mayfield and others, 1987).

IPMn NUKA FORMATION (PENNSYLVANIAN? AND MISSISSIPPIAN)—Light gray to maroon, medium- to coarse-grained arkose, calcareous arkose, and coarse-grained limestone. Locally contains red, green, or gray siliceous shale, glauconitic sandstone, and blocky chert. Fossils include crinoids, brachiopods, hexagonal corals, and foraminifera. Mapped as relatively small outcrops between Umarachek Creek and the Kivalina River. Part of the Bogie Sequence (Mayfield and others, 1987).

MDl LIMESTONE AND DOLOMITE (MISSISSIPPIAN OR DEVONIAN)—Light-gray-weathering limestone and carbonate rocks with chert nodules. Correlative with either part of the Mississippian Kogruk Formation (Mko) or the Devonian part of the Baird Group (Db and Dbl). Fossils include foraminifera, corals, and brachiopods. Mapped in the uplands along the Kivalina River in the eastern part of the map area. Part of the Eli Sequence (Mayfield and others, 1987).

Mk KAYAK SHALE (MISSISSIPPIAN)—Gray shale with subordinate interbedded rusty-weathering silty limestone, siliceous-to-sometimes-calcareous siltstone and fine-grained sandstone. Fossils include conodonts, foraminifera, crinoid impressions, and fossil hash. Mapped north of Kavrorak Hill in the northwest portion of the map area. Part of the Amaruk Sequence (Mayfield and others, 1987).

Mml MICRITIC LIMESTONE (MISSISSIPPIAN)—Gray to dark-gray, fine-grained limestone that weathers light gray to buff and breaks into platy to flaggy fragments on talus slopes. The uppermost part of the unit contains a few black chert nodules, and the lower part contains subordinate, interbedded, calcareous, dark-gray shale. Fossil hash is common throughout. Mapped north of Tugak Lagoon in the northwest corner of the map. Part of the Amphitheatre Sequence (Mayfield and others, 1987).

Mu UTUKOK FORMATION (MISSISSIPPIAN)—The upper part contains light gray-to-buff-weathering limestone and fine-grained calcareous quartzite. The unit often has blocky-weathered talus slopes. The lower part contains sandy limestone, calcareous siltstone, shale, and fine-grained sandstone. Less resistant to erosion than the Kogruk Formation (Mko) or the Baird Group (Db and Dbl), and thus commonly forms saddles or recessive zones. Fossils include conodonts, foraminifera, and brachiopods. Locally divided into the Buff limestone member (Mul) and Sandstone member (Mus). Part of the Kelly and Eli sequences (Mayfield and others, 1987).

Mul Buff limestone member (Mississippian)—Buff- to light-gray-weathering, medium-grained limestone, interbedded with minor amounts of sandy limestone and calcareous, shaly layers. Gradational with the overlying Kogruk Formation, although it may contain more fine clastic impurities. Gradational into the Sandstone member (Mus). Fossils include brachiopods, crinoids, and a few colonial corals. The unit is mapped in two areas: (1) between Asikpak Mountain and Kisaymaruktuk Mountain and (2) north of the Kivalina River near the eastern limits of the map area. Part of the Eli Sequence (Mayfield and others, 1987).

Mus Sandstone member (Mississippian)—Gray to light-brown, fine-grained quartzite with minor interbedded sandy limestone. Locally cross-bedded. Black lichens commonly cover sandier beds. Fossils include conodonts. Part of the Eli Sequence (Mayfield and others, 1987).

Db BAIRD GROUP, UPPER PART (DEVONIAN)—Light- to dark-gray-weathering, medium- to fine-grained limestone and dolomite with blocky weathering chert clasts ~5–10 cm in diameter; massive-to-thick bedded in most places. Fossils include foraminifera as well as rugose and hexagonal corals. Correlative with the Baird Group, upper part Limestone. Part of the Eli Sequence (Mayfield and others, 1987).

Dbl BAIRD GROUP, UPPER PART LIMESTONE (DEVONIAN)—Blocky weathering, fine- to coarse-grained, light- to dark-gray-weathering, massive- to thick-bedded limestone. Fossils include foraminifera. Mapped north of the Asikpak River near its mouth and in the northwest corner of the area. Correlative with the Baird Group, upper part. Part of the Ipnavik Sequence (Mayfield and others, 1987).

Igneous Rocks

JTrb BASALT (JURASSIC? AND TRIASSIC)—Green, red, gray, and brown-to-black weathering basalt and diabase. Texture may be vesicular and vuggy, with local pillow structures. Contains local malachite mineralization and epidote alteration. Generally found in the uplands of the Asikpak River drainage. Part of the Copter Igneous Sequence (Mayfield and others, 1987).

LINEAMENTS

Paleoshorelines

PELUKIAN PALEOSHORELINE (QUATERNARY)—Elevation and location suggest formation during the Pelukian Transgression (~125,000 yrs; Hopkins, 1973). Mapped by the presence of wave-cut scarps. Beach gravels are locally present.

KOTZEBUAN PALEOSHORELINE (QUATERNARY)—Elevation and location suggest formation during the Kotzebuan Transgression (~140,000–150,000 yrs; Hopkins, 1973). Mapped by the presence of wave-cut scarps. Beach gravels are locally present.

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REFERENCES

Hopkins, D.M., 1973, Sea level history in Beringia during the past 250,000 years: Quaternary Research, v. 3, p. 520–540.

Mayfield, C.F., Elliersieck, Inyo, and Taileur, I.L., 1987, Reconnaissance geologic map of the Noatak C5, D5, D6 and D7 quadrangles, Alaska: U.S. Geological Survey Miscellaneous Investigations Series Map 1814, 1 sheet, scale 1:63,360.