

- EXPLANATION**
- Tracts showing mineral resource potential:
    - A** Substantial or highly probable potential—Type of deposit(s) and geologic constraints are confidently known; contains known large deposits(s) or numerous small deposits
    - L** Probable potential—Type of deposit(s) known or can be confidently inferred; may or may not contain substantial number of known deposits. Definition of tract and its mineral resources may require some speculation or interpretation of subsurface geology
    - M** Weak or limited evidence of potential—Commonly contains few known deposits that may not be possible to classify type of deposits; boundaries usually highly subjective
  - Mineral deposits**—Described in detail in Grybeck and Nelson (1981b). Symbols on this map duplicate those on that map
    - $\square$  Cu, Zn Mineral deposit—Showing type, size, and significant elements or commodities
    - $\circ$  Sn, Mo Pervasiely mineralized area—Showing significant elements or commodities
    - Small<sup>1</sup> Large<sup>1</sup>
    - X Gold placer
    - $\triangle$  Stratiform volcanogenic Cu-Zn-Pb-Ag deposit
    - $\bullet$  Polymetallic contact-metamorphic deposit associated with felsic pluton
    - $\square$  Deposits other than those characterized above or of unknown type
- <sup>1</sup> Distinction between large and small deposits is subjective. Small deposits are those of limited size or apparently limited size. Large deposits are those having substantial mineral resources or reserves or those that have been extensively explored.

- DESCRIPTION OF MAP UNITS**
- UNCONSOLIDATED DEPOSITS**
- Qu Surficial deposits, undivided
- UNMETAMORPHOSED TO LOW-GRADE METAMORPHOSED SEDIMENTARY ROCKS**
- Ku Undivided conglomerate—Quartz-pebble and igneous-pebble conglomerate; some interbedded volcanic sandstone
- TPp Shublik and Sikilpak Formations (Triassic and Permian)—Pink-weathering limestone of Shublik Formation (Triassic) and black slate and chert of Sikilpak Formation (Permian)
- Endicott Group (Mississippian and Devonian)—In map area includes:
- Mkk Kayak Shale and Kekikuk Conglomerate (Lower Mississippian)—As mapped, unit includes related undifferentiated clastic rocks and a few outcrops of limestone in lower (?) part of Lisburne Group
- Dk Kanayut Conglomerate (Upper Devonian)—Non-marine nutty-weathering quartz sandstone, ferruginous mudstone, and black siltstone, and shale. Prominent resistant layers of black-lichen-covered light-gray quartzite. Rare conglomerate
- Dhf Hunt Fork Shale (Upper Devonian)—Dark-gray phyllite with minor quartz mudstone and sandstone. Upper part includes:
- Dhf1 Wacke sandstone member (Upper Devonian)—Thick monotonous unit of interbedded nutty-weathering, feldspathic sandstone and dark-gray mudstone and shale. Locally includes thin layers of reddish-gray fossiliferous limestone and calcareous sandstone
- Dp Gray phyllite—Mainly gray, calcareous phyllite and muscovite schist; contains limestone beds up to 20 m thick. Locally consists of lenses of quartz-pebble conglomerate interbedded with orange-weathering, fossiliferous limestone, black siliceous phyllite, or micaceous schist
- Ds1 Shajit Limestone (Devonian and Silurian)—Massive white to light-gray granoblastic marble and orange-weathering dolomitic marble. Some interlayered chlorite schist
- METAMORPHOSED IGNEOUS ROCKS**
- Dgr Gneissic granite—Medium- to coarse-grained biotite-muscovite orthogneiss ranging in composition from granite to alkali-feldspar granite. Commonly well-developed augen; locally cataclastically deformed
- Df Metafelsite—Mainly quartz-alkali-feldspar schist; locally porphyroblastic muscovite-biotite-quartz-alkali-feldspar rocks that retain igneous textures
- pCgr Granitic schist—Medium-grained porphyroblastic gray biotite-quartz-feldspar schist
- MAINLY METAMORPHIC MAFIC IGNEOUS ROCKS OF UNCERTAIN AGE**
- MzPz Mafic volcanic rocks, phyllite, sandstone, and chert—Consists mainly of interbeds and fault slivers of Devonian(?) to Jurassic pillow basal, gneiss, and diabase, gray phyllite, wacke sandstone, minor Triassic radiolarian chert, Mississippian radiolarian chert, and thin beds of Paleozoic limestone. Weakly metamorphosed to unmetamorphosed
- Pzm Mafic volcanic and intrusive rocks—Basalt, gneiss, and altered gabbro. Unmetamorphosed to slightly metamorphosed
- METAMORPHIC ROCKS OF UNCERTAIN AGE**
- MDcp Calcareous phyllite—Black calcareous phyllite with thin dark-gray limestone lenses
- Pz Low-grade schist—Chlorite-bearing quartz-muscovite schist, calcareous albite-muscovite schist, quartzite, and rare thin limestone beds. Schist locally contains glaucophane
- Pzq Chlorite quartzite—Chlorite quartzite and chloritic quartz schist
- Pzgn Low- to medium-grade schist and gneiss—Interlayered quartz-muscovite schists and orange-weathering marble. Medium-grade schist and gneiss with garnet, biotite, and amphibole near plutons
- N Contact—Dashed where approximately located; dotted where concealed
- Fault—Dashed where approximately located or inferred; dotted where concealed; queried where uncertain
- Thrust fault—Dashed where approximately located or inferred; dotted where concealed; queried where uncertain. Sawtooth on upper plate

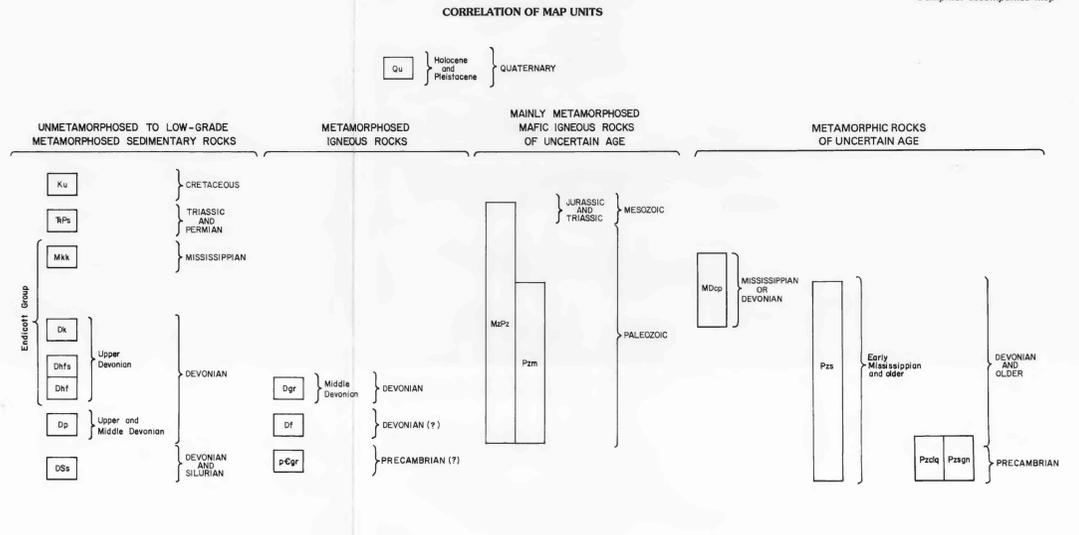


Table 1. Summary of tracts with mineral resource potential, Survey Pass Quadrangle, Brooks Range, Alaska

Tract	Type of deposit	Known deposit	Production/reserves	Exploration by industry	Criteria for definition of tract	Comments on location of additional deposits	Summary of mineral resource potential
A	Volcanogenic Cu-Zn-Pb massive sulfide	Several well-defined deposits known; one large class. A world-class deposit (Arctic) is just to west of quadrangle along extension of tract.	No production. About \$2.0 billion in high-grade reserves defined by drilling at San deposit.	Considerable drilling and detailed surface mapping since early 1970s.	Geology: Tract limited to Paleozoic schist unit (Pz), known deposits closely related to metamorphic (Df). Volcanogenic massive-sulfide deposits known widely in tract. Geochemistry: Numerous strong anomalies in a characteristic suite of elements. Alteration: Pattern more complex than can be explained by surface geology. Landsat: Not diagnostic.	Geology complex, deposits not always obvious at surface. Much of tract covered by surficial material, potential at depth largely untested.	Part of a major mineral belt of Alaska, the Amber district. Large high-grade massive-sulfide resources detected; additional deposits almost certain.
B	Volcanogenic Cu-Zn-Pb massive sulfide	Few small occurrences, probably massive-sulfide deposits.	None.	No drilling; cursory or no surface exploration.	Geology: Extension of tract along schist belt (unit Pz). Several probable massive-sulfide deposits are known. Geochemistry: Same suite of elements as in tract A but anomalies more widely dispersed and weaker. Alteration: Not diagnostic. Landsat: Not diagnostic.	Same as tract A but no major volcanogenic massive-sulfide deposits or metamorphites are known compared to tract A.	Eastward extension of tract A. Relatively untested area, but available evidence suggests less likelihood of substantial massive-sulfide deposits than in tract A.
C	Associated with felsic pluton	Numerous small and erratic quartz veins, skarn, and replacement deposits involving various combinations of Cu, Pb, Ag, Sn, Bi, As, Sb, and Mo.	None.	Cursory, mostly before 1971.	Geology: Tract controlled by periphery of granite pluton. Geochemistry: Strong, persistent anomalies in a felsic-plutonic suite of elements over most of tract. Alteration: Suggests that copper pluton south of the Noatak River persists at depths to north of tract. Landsat: Not diagnostic.	Most deposits in or adjacent to border of Devonian granite pluton. Favorable metamorphic rocks cap the pluton north of the Noatak River and are preserved as isolated erosional remnants south of the river.	Particularly favorable environment for felsic plutonic deposits as situated by widespread, strong geochemical anomalies and by numerous small known deposits.
D	Associated with felsic pluton	Several small deposits mostly quartz veins with combinations of Cu, Zn, Au, Ag, Sb, and Mo.	None.	Cursory, mostly before 1971.	Geology: Inference that pluton of tract C extends below this tract depth. Geochemistry: Widespread anomalies in suite of elements characteristic of felsic-plutonic deposits, anomalies somewhat less intense and more diffuse than in tract C. Alteration: Permissive that granite pluton extends under tract. Landsat: Not diagnostic.	Extension of tract C assumes that granite pluton extends under tract at depth.	Several mineral deposits and geochemical anomalies at surface suggest untested deposits at depth in or above the upper part of a buried granite body.
E	Associated with felsic pluton	Several small skarn, vein, or replacement deposits occur at or near granite-metasedimentary rock contact.	None.	Cursory, mostly before 1971.	Geology: Common occurrence of small, erratic mineral deposits near granite-metasedimentary rock contact, especially near vertical contact of granite that wraps around north end of Arigsteth Peaks and in shallowly dipping metasedimentary rocks that cap the western side of the Mount Igapak pluton. Landsat: Not diagnostic.	Additional deposits likely near granite-metasedimentary rock contact, especially near vertical contact of granite that wraps around north end of Arigsteth Peaks and in shallowly dipping metasedimentary rocks that cap the western side of the Mount Igapak pluton.	Several small deposits and widespread geochemical anomalies indicate that areas adjacent to granite are favorable for discovery of additional deposits.
F	Associated with felsic pluton	Several small quartz veins and skarns.	None.	None or cursory.	Geology: Surrounding geology and of known deposits. Geochemistry: Widespread, if not especially strong anomalies in a suite of elements characteristic of felsic-plutonic deposits. Alteration: Not diagnostic. Landsat: Not diagnostic.	Relies on the contact of a buried granite pluton with metasedimentary rocks. The undiscovered deposits will likely be at considerable depth.	Scattered mineral deposits and geochemical anomalies suggest the tract is underlain by a buried granite pluton similar to the exposed pluton to the north. Additional deposits likely in upper part of this buried granite pluton or in the metasedimentary rocks above it.
G and H	Associated with felsic pluton	Few small deposits of intermediate type involving combinations of Ag, Cu, Zn, As, and Sb.	None.	Probably none.	Geology: Surface geology not diagnostic. Geochemistry: Several anomalies in Ag. Alteration: Not diagnostic. Landsat: Not diagnostic.	Most favorable environment in upper part of a possible buried pluton and the metasedimentary rocks above it.	A few small mineral deposits, scattered geochemical anomalies, and circular patterns of arcuate features on satellite images suggest a buried granite pluton. Apex of pluton is probably centered below tract G.
I	Uncertain	Two small deposits, a massive-sulfide copper prospect and a Pb-Zn-Cu-Ag deposit in marble.	None.	Some drilling on Pb-Zn-Cu-Ag prospect at least part of tract examined in some detail in recent years.	Geology: Not diagnostic. Geochemistry: Several anomalies in Ag. Alteration: Not diagnostic. Landsat: Circular patterns of arcuate features analogous to those over known granite plutons in quadrangle.	Dependent on existence of a possible buried felsic pluton.	Several indications of mineral resources within the tract evidence not particularly strong or widespread.
J	Associated with felsic pluton	Small Ag-bearing galena prospect in skarn.	None.	No drilling. Probably examined repeatedly, but not in past two decades.	Geology: Exposures of granite and a known prospect. Geochemistry: Anomalies masked by more extensive anomalies of tract A. Alteration: Suggests that pluton exposed at surface extend to the west in the subsurface. Landsat: Not diagnostic.	Potential probably lies in sub-surface extension of two small granite bodies exposed at the surface.	Small galena prospect in skarn associated with one of two small granite bodies; subsurface extension of granite, perhaps at depth in the west, is favorable environment for additional deposits.
K	Associated with felsic pluton	Several small quartz veins, skarn, and brecciated zones with epidote, plagioclase, and chlorite.	None.	Probably none (deposits not previously known).	Geology: Not diagnostic. Geochemistry: Widespread anomalies in Pb, Zn, Cu, Ag, Sn, W, As, and Th. Alteration: Permissive suggestive of a buried granite pluton. Landsat: Well-developed circular pattern of arcuate features analogous to those over exposed granite plutons in the quadrangle.	Related to a possible buried granite pluton at considerable depth; pluton may be displaced by thrust faulting.	Geochemical anomalies and known deposits at surface strongly suggest a buried granite pluton with additional deposits at depth, particularly in upper part of the pluton or just above it.
L and M	Associated with felsic pluton	None.	None.	Probably none.	Geology: Not diagnostic. Geochemistry: Widespread anomalies in combinations of Pb, Zn, Cu, Mo, Bi, Ba, B, La, and Th, somewhat stronger and more persistent in tract L than in tract M. Alteration: Permissive of a buried granite pluton. Landsat: Circular pattern of arcuate features consistent on tract analogous to those over exposed granite plutons in quadrangle.	Related to a possible buried granite pluton at considerable depth; pluton may be displaced by thrust faulting.	Geochemical anomalies and known deposits at surface strongly suggest a buried granite pluton with additional deposits at depth, particularly in upper part of the pluton or just above it.
Pzq	Chlorite quartzite	Chlorite quartzite and chloritic quartz schist	None.	None.	Geology: Not diagnostic. Geochemistry: Scattered anomalies in Pb, Zn, Ba, or Ag. Alteration: Not diagnostic. Landsat: Not diagnostic.	Insufficient data to predict.	Some potential for discovery of substantial mineral deposits, but no strong or pervasive evidence.
O	Uncertain	None.	None.	Probably none.	Geology: Tract defined by exposures of Mississippian rocks. Geochemistry: Scattered anomalies in combinations of Pb, Zn, and Ba. Alteration: Not diagnostic. Landsat: Not diagnostic.	Insufficient data to predict.	Limited evidence suggests some potential for stratiform Pb-Zn-Ba deposits similar to Red Dog deposit, west-northwest of the quadrangle.

Base from U.S. Geological Survey, 1956 (revised 1982)  
Universal Transverse Mercator projection

SCALE 1:250,000

CONTOUR INTERVAL 200 FEET  
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology generalized from Nelson and Grybeck (1980)  
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ALASKA  
QUADRANGLE LOCATION

**MINERAL RESOURCE POTENTIAL MAP OF THE SURVEY PASS QUADRANGLE, BROOKS RANGE, ALASKA**

By  
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1996