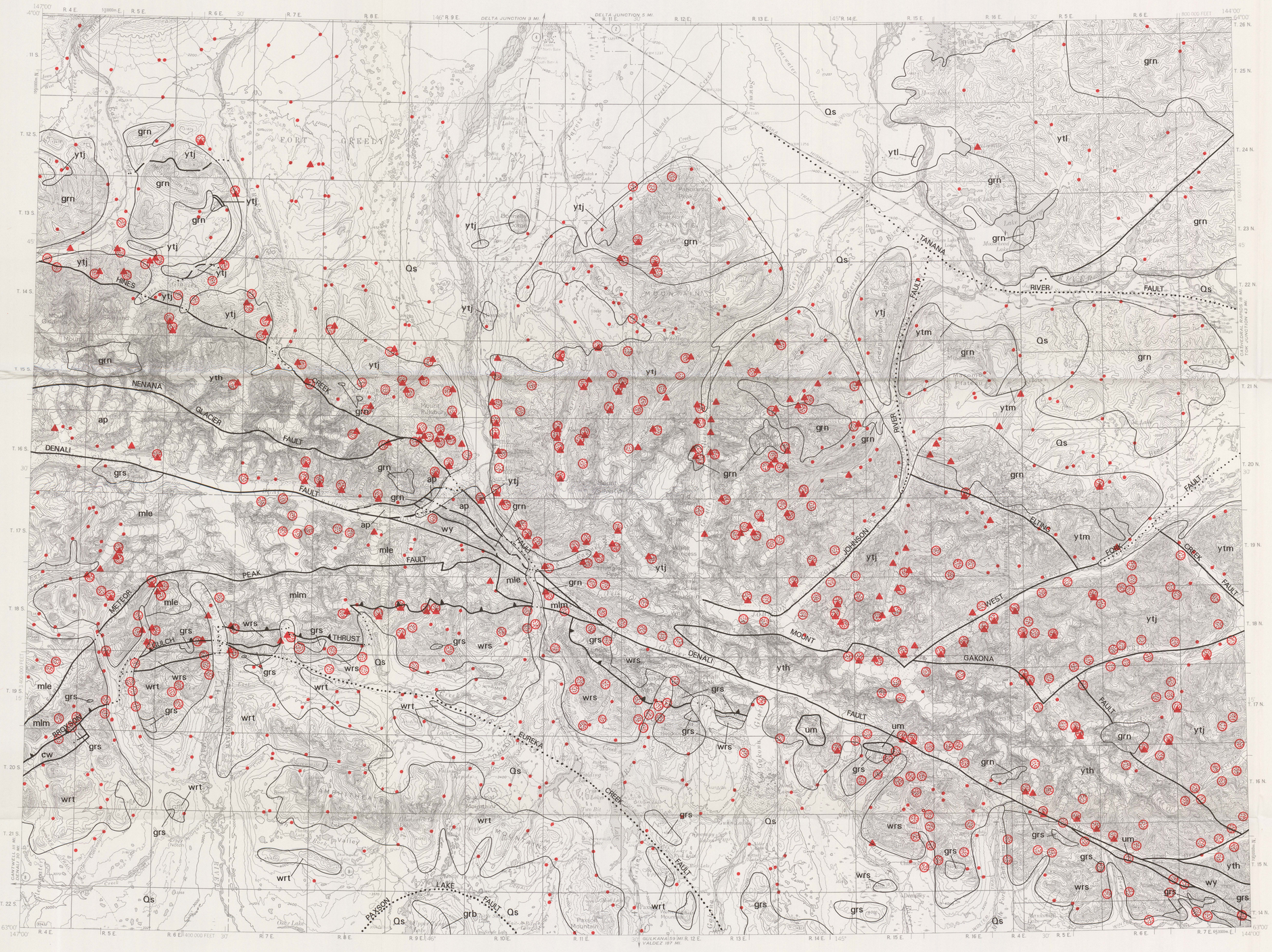
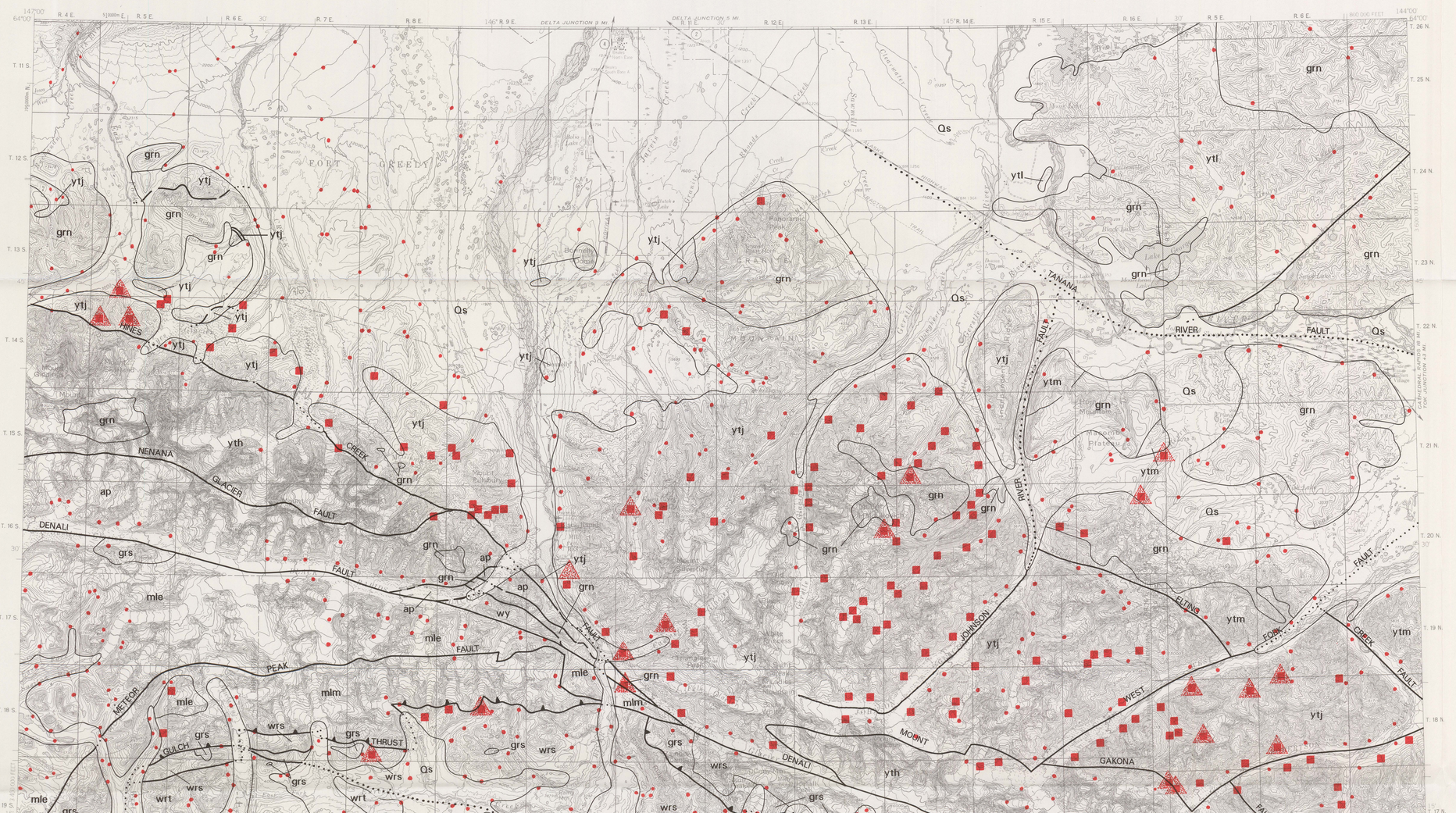
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1996-E (SHEET 1 OF 3)
FOLIO OF THE MOUNT HAYES QUADRANGLE
PAMPHLET ACCOMPANIES MAP



MAP A. DISTRIBUTION OF ARSENOPYRITE AND CHALCOPYRITE



MAP B. DISTRIBUTION OF GALENA AND SPHALERITE

Base from U.S. Geological Survey, 1955
Minor revisions 1975
Universal Transverse Mercator projection, 1927 North American Datum
100,000-foot grid based on Alaska Coordinate System, zone 3
10,000-meter Universal Transverse Mercator grid ticks, zone 6

Generalized terrane map compiled by Warren J. Nokleberg from mapping by Warren J. Nokleberg, Ian M. Lange, John N. Aleinikoff, Ronny T. Miyaoka, and Richard E. Zehner, 1977-85

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EXPLANATION OF MINERALOGICAL SYMBOLS FOR MAP A

[Amounts of minerals are less than 20 percent by volume of nonmagnetic fraction]

- Arsenopyrite
- Chalcopyrite
- Sample site where neither mineral was identified

DESCRIPTION OF MAP UNITS

Qs — **Surficial deposits (Quaternary)**—Alluvium; colluvial, glacial, fluviolacustrine, and rock-glacier deposits; snow and ice

grn — **Granitic plutonic rocks north of Denali fault (early Tertiary to Late Cretaceous)**—Chiefly medium- to coarse-grained biotite-hornblende granite and granodiorite and lesser quartz diorite and diorite. Predominant texture igneous rather than metamorphic. Locally intensely hydrothermally altered. Present as small dikes, stocks, and locally large plutons in southern Yukon-Tanana, Aurora Peak, and Windy terranes

grs — **Granitic plutonic rocks south of Denali fault (early Tertiary, Cretaceous, and Late Jurassic)**—Chiefly medium- to coarse-grained hornblende-biotite granodiorite and biotite granite and lesser diorite and quartz diorite. Predominant texture igneous rather than metamorphic. Locally weakly to extensively hydrothermally altered. Found in Maclaren, Clearwater, and Wrangellia terranes as small dikes, stocks, and moderate- to large-size plutons

YUKON-TANANA TERRANE

Lake George subterrane

ytl — **Augen gneiss and schist (Mississippian), gneissose granitic rocks (Devonian), and pelitic schist and quartzite (Devonian and older)**—Augen gneiss and schist are medium to coarse grained and composed of potassium feldspar, plagioclase, biotite, and quartz. Granitic rocks chiefly gneissose hornblende-biotite granodiorite. Pelitic schist and quartzite chiefly multiply deformed muscovite-quartz-biotite-garnet schist and quartzite. All rocks ductilely deformed and regionally metamorphosed at amphibolite facies into mylonitic gneiss and schist. Locally deformed and retrograded to lower greenschist facies

Macomb subterrane

ytm — **Granitic gneiss (Devonian) and metamorphosed pelitic, calcareous, and quartz-feldspar-bearing sedimentary rocks (Devonian or older)**—Granitic gneiss chiefly fine- to medium-grained gneissose granite and granodiorite. Found in plutons and dikes intruding pelitic, calc-quartz-feldspar schist. Metasedimentary rocks are medium-grained, multiply deformed biotite-muscovite-quartz-garnet-plagioclase schist. Both rocks ductilely deformed and regionally metamorphosed at epidote-amphibole facies into mylonitic gneiss and schist. Locally deformed and retrograded to lower greenschist facies

Jarvis Creek Glacier subterrane

ytj — **Gneissose granitic rocks (Devonian) and schistose metavolcanic and metasedimentary rocks (Devonian and older)**—Granitic rocks chiefly gneissose hornblende-biotite diorite and granodiorite and lesser augen gneiss. Found in small- to moderate-size homogeneous plutons. Metavolcanic rocks chiefly multiply deformed, fine-grained, schistose metaandesite and metamorphosed quartz keratophyre and lesser metadacite, metabasalt, pelitic schist, quartzite, calc-schist, and marble. Local disseminated and massive sulfide minerals. Metasedimentary rocks chiefly multiply deformed, fine-grained pelitic schist and quartzite and lesser calc-schist, quartz-feldspar schist, and marble. All rocks ductilely deformed and regionally metamorphosed at greenschist to amphibolite facies into mylonitic gneiss and schist. Rocks in northern part of quadrangle locally overlain by the Nenana Gravel (late Tertiary), fault-bounded prisms of sandstone (late and middle Tertiary), and sedimentary rocks of Jarvis Creek coal field (early Tertiary). Rocks in southern part of subterrane locally intruded by gabbro and metagabbro (Cretaceous)

Hayes Glacier subterrane

yth — **Schistose volcanic rocks and phyllite (Devonian) and schistose sedimentary rocks and volcanic rocks (Devonian and older)**—Schistose volcanic rocks and phyllite chiefly multiply deformed metaandesite and metakeratophyre, lesser metadacite and metabasalt, and locally abundant pelitic quartz-calc-phyllite. Local disseminated sulfide minerals. Schistose sedimentary rocks chiefly multiply deformed quartz–chlorite–white mica phyllite, graphitic-quartz phyllite, quartz-plagioclase phyllite, calc-phyllite, and marble in eastern part of quadrangle; in western part of quadrangle, chiefly multiply deformed pelitic schist and quartz-mica schist and lesser quartzite and calc-schist. All rocks ductilely deformed and regionally metamorphosed at lower and middle greenschist facies into phyllonite and blastomylonite. Rocks locally intruded by gabbro and metagabbro (Cretaceous)

AURORA PEAK TERRANE

ap — **Metamorphosed granitic rocks (Late to Middle Cretaceous) and metamorphosed sedimentary rocks (Triassic to Silurian)**—Granitic rocks chiefly gneissose granodiorite and granite and lesser quartz diorite, diorite, gabbro, and amphibolite. Found in east-striking plutons and dikes intruding calc-schist, marble, quartzite, and pelitic schist. Metasedimentary rocks chiefly multiply deformed, fine- to medium-grained calc-schist, marble, quartzite, and pelitic schist. Both rocks ductilely metamorphosed into blastomylonite and middle-greenschist facies

WINDY TERRANE

wy — **Melange (Cretaceous, Devonian, and Silurian)**—Structural melange consisting of two assemblages: (1) fault-bounded lenses of Cretaceous flysch and volcanic rocks (mainly argillite), quartz-pebble siltstone, sandstone, metagraywacke, and conglomerate and lesser andesite and dacite; and (2) fault-bounded lenses of limestone and marl of Silurian(?) and Devonian age. Weakly metamorphosed. Locally intensely deformed—phyllonite developed in shear zones. Incipient lower greenschist-facies metamorphism.

TERRANE OF ULTRAMAFIC AND ASSOCIATED ROCKS

um — **Ultramafic and associated rocks (Mesozoic?)**—Includes hornblende-plagioclase gneiss and minor serpentinite, marble, graphitic schist, tonalite, and granite. Earlier pervasive ductile deformation and metamorphism at amphibolite facies; local schistosity. Later, locally deformed and metamorphosed to lower greenschist facies

MACLAREN TERRANE

East Susitna batholith

mle — **Gneissose granitic rocks (early Tertiary and Late Cretaceous), schist and amphibolite (Late Cretaceous or older), migmatite (Cretaceous?), migmatitic schist (Cretaceous?), and schist, quartzite, and amphibolite (Triassic?)**—Gneissose granitic rocks chiefly multiply deformed quartz diorite and granodiorite. Schist and amphibolite contain hornblende, biotite, quartz, and plagioclase. Migmatite is highly contorted schist and amphibolite containing diffuse veins and sills of granodiorite and granite. Migmatitic schist chiefly schist and amphibolite containing sparse to moderately abundant granitic veins. Schist, quartzite, and amphibolite chiefly calc-schist, quartzite, and amphibolite

Maclaren Glacier metamorphic belt

mlm — **Schist, amphibolite, phyllite, argillite, and metagraywacke (Late Jurassic or older)**—Mainly faulted sequence. Lower greenschist facies to the south and middle amphibolite facies to the north. Ductilely deformed into mylonitic schist in schist and amphibolite part of unit, phyllonite in phyllite part of unit, and protomylonite and phyllonite in argillite and metagraywacke part of unit

CLEARWATER TERRANE

cw — **Metasedimentary and metavolcanic rocks (Late Triassic)**—Chlorite schist, muscovite schist, and marble. Lesser schistose metarhyolite and metarhyodacite flows, and greenstone. Intensely deformed at faults

WRANGELLIA TERRANE

Slana River subterrane

wrs — **Marine metasedimentary rocks (Early Cretaceous and Late Jurassic), limestone (Late Triassic), Nikolai Greenstone (Late Triassic), Eagle Creek Formation (Early Permian), intrusive stocks, dikes, sills, and small plutons (Early Permian), granitic plutons (Pennsylvanian), Slana Spur Formation (Early Permian to Middle Pennsylvanian), and Tetelna Volcanics (Pennsylvanian)**—Marine metasedimentary rocks chiefly interlayered gray argillite, siltstone, graywacke, pebble conglomerate, and andesite. Limestone chiefly fine-grained, gray limestone to medium-grained, gray or white marble; lenses and nodules of chert and patchworks of disseminated fine-grained quartz; locally forms skarn near granitic plutons. Nikolai Greenstone chiefly amygdaloidal basalt flows and thin beds of volcaniclastic rocks, chert, and argillite; generally regionally metamorphosed and locally schistose; abundant actinolite, epidote, chlorite, albite, and sericite; quartz veins and altered areas contain copper-sulfide minerals. Eagle Creek Formation chiefly argillite and limestone. Intrusive stocks, dikes, sills, and small plutons mainly dacite and lesser andesite, rhyodacite, and diabase; local disseminated sulfide minerals. Granitic plutons chiefly medium- to coarse-grained hornblende-biotite granodiorite and biotite granite; weakly deformed to nonschistose. Slana Spur Formation is sequence of marine calcareous volcaniclastic rocks (upper part) and noncalcareous volcaniclastic rocks (lower part) and lesser volcanic sandstone, conglomerate, tuff, volcanic breccia and flows, and limestone; pervasively metamorphosed to lower greenschist facies; local disseminated and massive sulfide minerals. Tetelna Volcanics chiefly andesite and dacite flows, sparse basalt flows, and local volcanic breccia, graywacke, conglomerate, and tuff; pervasively metamorphosed to lower greenschist facies; local disseminated sulfide minerals

Tangle subterrane

wrt — **Limestone (Late Triassic), Nikolai Greenstone (Late Triassic), and aquagene tuff, argillite, limestone and marble, chert, andesite tuff, and greenstone (late Paleozoic)**—Limestone chiefly fine-grained, gray limestone to medium-grained, gray or white marble; locally forms skarn near granitic plutons. Nikolai Greenstone chiefly amygdaloidal basalt flows, pillow basalt flows, and volcaniclastic rocks; generally regionally metamorphosed and locally schistose; local quartz veins and altered areas contain copper-sulfide minerals. Late Paleozoic rocks include interlayered basaltic aquagene tuff, siliceous argillite, limestone and marble, chert, andesite tuff, and greenstone; weakly schistose to massive; pervasively metamorphosed to lower greenschist facies

GULKANA RIVER TERRANE

grb — **Hornblende andesite (late Paleozoic?)**—Chiefly weakly metamorphosed hornblende andesite and lesser clinopyroxene basalt. Massive to weakly schistose

Contact

Fault—Dashed where approximately located; dotted where concealed

Thrust fault—Dotted where concealed

SCALE 1:250 000

5 0 5 10 15 MILES

5 0 5 10 15 KILOMETERS

CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EXPLANATION OF MINERALOGICAL SYMBOLS FOR MAP B

[Amounts of minerals are less than 10 percent by volume of nonmagnetic fraction]

- Galena
- Sphalerite
- Sample site where neither mineral was identified

MINERALOGICAL MAPS SHOWING DISTRIBUTION OF SELECTED ORE-RELATED MINERALS IN THE NONMAGNETIC, HEAVY-MINERAL-CONCENTRATE FRACTION OF STREAM SEDIMENT FROM THE MOUNT HAYES 1° x 3° QUADRANGLE, EASTERN ALASKA RANGE, ALASKA

By
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