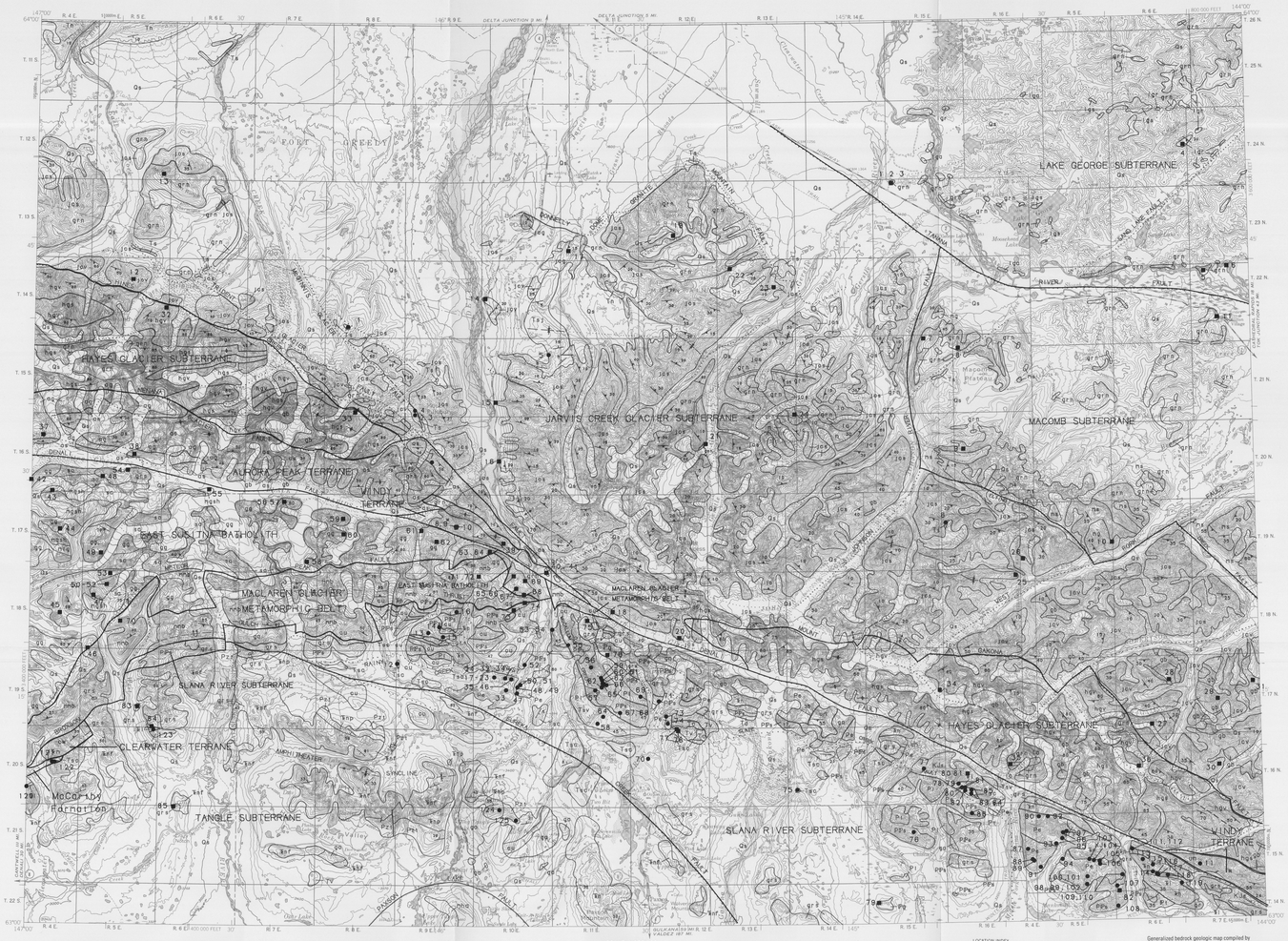
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

FOLIO OF THE MOUNT HAYES QUADRANGLE
MISCELLANEOUS FIELD STUDIES
MAP MF–1996–D
Explanatory pamphlet accompanies map



Base from U.S. Geological Survey, 1955
Universal Transverse Mercator projection

LOCATION INDEX

Generalized bedrock geologic 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

Edited by Dale Russell; prepared by Carol Quisenberry

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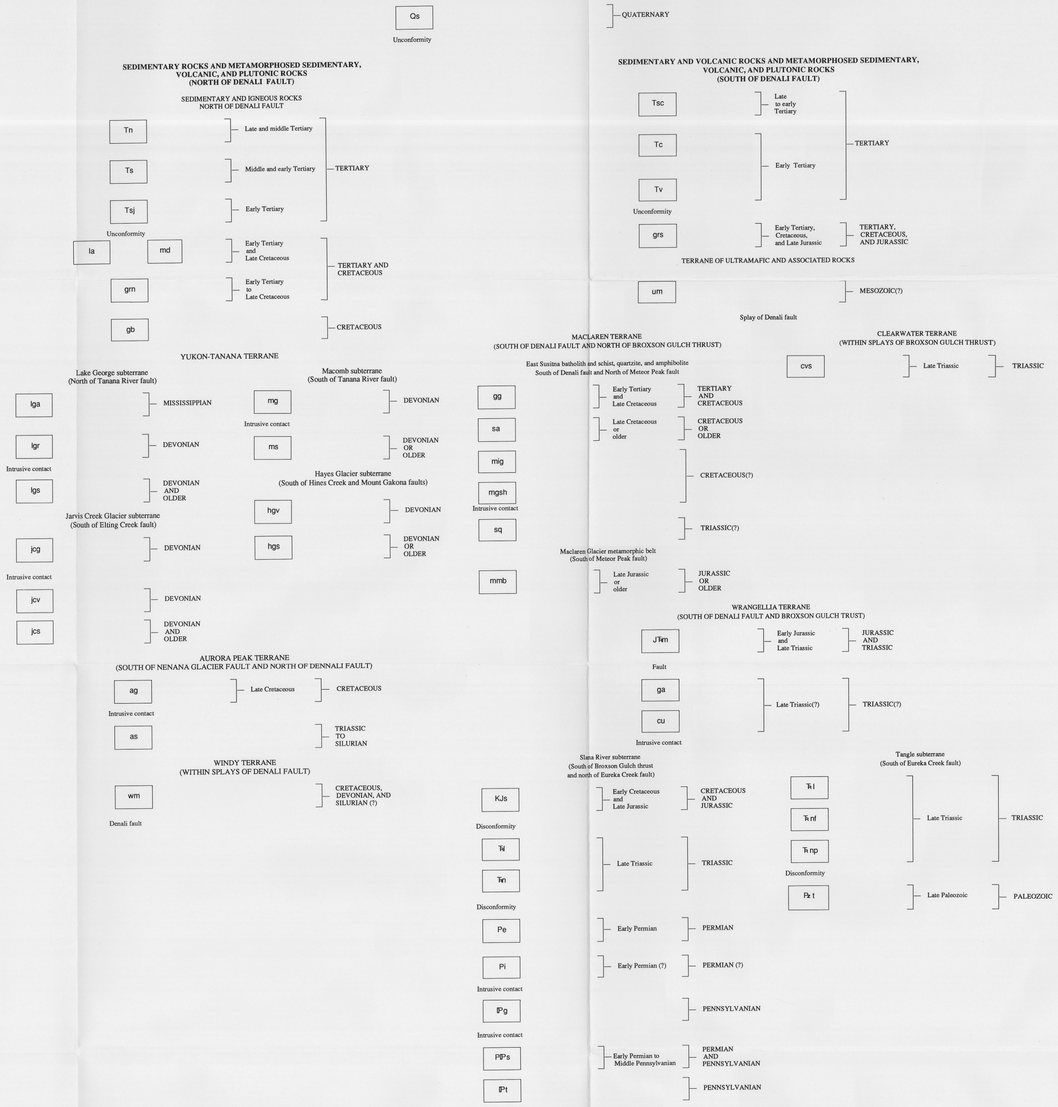
CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

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

SEDIMENTARY ROCKS AND METAMORPHOSED SEDIMENTARY, VOLCANIC, AND PLUTONIC ROCKS (NORTH OF DENALI FAULT)

SEDIMENTARY AND IGNEOUS ROCKS (NORTH OF DENALI FAULT)

Tn **Nenana Gravel (late Tertiary)**—Chiefly thick-bedded to massive, poorly sorted conglomerate with lesser sandstone and siltstone. Unconformably overlain by Pleistocene glacial deposits. Locally unconformably overlies sandstone unit (Ts) of Oligocene to Pliocene age, and locally overlies coal-bearing sedimentary rocks of Jarvis Creek coal field of early Tertiary age

Ts **Sandstone (late and middle Tertiary)**—Chiefly sandstone, graywacke, poorly consolidated siltstone, and mudstone. Found mainly in fault-bounded prisms along northern extent of Alaska Range. Locally overlain by Nenana Gravel and locally overlies sedimentary rocks of Jarvis Creek coal field (Tsj). Unit age is Oligocene, Miocene, and Pliocene

Tsj **Sedimentary rocks of Jarvis Creek coal field (early Tertiary)**—Chiefly conglomerate, sandstone, and coal beds. Locally overlain by sandstone unit (Ts) and Nenana Gravel (Tn)

la **Lamprophyre, alkalic gabbro, and alkalic diorite (early Tertiary and Late Cretaceous)**—Chiefly fine- to medium-grained, panidiomorphic-granular aggregates of olivine, orthopyroxene, clinopyroxene, hornblende, biotite, plagioclase, and potassium-feldspar with varying amounts of groundmass. Groundmass consists of fine-grained hornblende, biotite, plagioclase, and opaques and interstitial or replacement carbonate. Local embayed phenocrysts. Found in locally abundant dikes and sills, local small plutons, and in igneous complex of Mount Hajdukovich in north-central part of quadrangle

md **Monzonite and diorite (early Tertiary and Late Cretaceous)**—Chiefly fine- to medium-grained, hypautomorphic-granular aggregates of clinopyroxene, biotite, potassium feldspar, and plagioclase. Local white mica and carbonate alteration. Found in moderate-size plutons in igneous complex of Mount Hajdukovich in north-central part of quadrangle

grn **Granitic plutonic rocks north of Denali fault (early Tertiary to Late Cretaceous)**—Chiefly medium- to coarse-grained biotite-hornblende granite and hornblende-biotite granodiorite with lesser quartz diorite and diorite. Predominate igneous rather than metamorphic textures. Present as small dikes, stocks, and locally large plutons in southern Yukon-Tanana, Aurora Peak, and Windy terranes. Locally weakly to moderately deformed and metamorphosed at lower greenschist facies in Macomb Plutons area. Local intense hydrothermal alteration

gb **Gabbro and mafic plutonic rocks and dikes and sills (Cretaceous)**—Chiefly gabbro and metagabbro with lesser hornblende diorite and diabase. Intrudes Jarvis Creek Glacier and Hayes Glacier subterranes (of southern Yukon-Tanana terrane) and Windy terrane. Textures in gabbro, diorite, and diabase mainly hypautomorphic-granular or ophitic aggregates of hornblende, plagioclase and lesser biotite. Textures in metagabbro mainly subsolidus aggregates of actinolite, chlorite, biotite, epidote, and albite. Found in narrow dikes to small- to moderate-size plutons. Dikes and sills generally subconcordant to acutely crossing intense schistosity and parallel compositional layering in wall rocks. Crosscut and intruded by Cretaceous and early Tertiary granitic rocks

YUKON-TANANA TERRANE

Lake George subterrane (North of Tanana River fault)

lga **Augen gneiss and schist (Mississippian)**—Coarse- to medium-grained augen gneiss and schist composed of gneissose aggregates of potassium feldspar, plagioclase, biotite, and quartz. Ductilely deformed and regionally metamorphosed at amphibolite facies into mylonitic gneiss and schist. Found in moderate- to large-size, irregularly shaped, homogeneous plutons intruding gneissose granitic plutons and pelitic schist. Relict hypautomorphic-granular texture with relict potassium feldspar phenocrysts. Locally deformed and retrograded to lower greenschist facies

lgr **Medium-grained gneissose granitic rocks (Devonian)**—Chiefly gneissose hornblende-biotite granodiorite and lesser gneissose biotite granite. Relict hypautomorphic-granular texture. Found in moderate- to large-size, irregularly shaped, homogeneous plutons intruding pelitic schist. Ductilely deformed and regionally metamorphosed at amphibolite facies into mylonitic gneiss. Locally deformed and retrograded to lower greenschist facies

lgs **Pelitic schist and quartzite (Devonian and older)**—Chiefly polydeformed, medium- to coarse-grained pelitic muscovite-quartz-biotite-garnet schist and metaquartzite derived from quartz-rich to clay-rich shale. Ductilely deformed and regionally metamorphosed at amphibolite facies into mylonitic schist. Locally deformed and retrograded to lower greenschist facies

Macomb subterrane (South of Tanana River fault)

mg **Medium-grained granitic gneiss (Devonian)**—Chiefly fine- to medium-grained gneissose granite and granodiorite with lesser quartz diorite and diorite. Ductilely deformed and regionally metamorphosed into mylonitic gneiss at epidote-amphibolite facies. Form irregularly shaped plutons and dikes intruding pelitic schist, calc-schist, and quartz-feldspar schist. Locally deformed and retrograded to lower greenschist facies

ms **Metamorphosed pelitic, calcareous, and quartz-feldspar sedimentary rocks (Devonian or older)**—Medium-grained, polydeformed, biotite-muscovite-quartz pelitic schist, garnet-plagioclase schist, and quartz-plagioclase-biotite schist derived from shale, marl, and sandstone. Ductilely deformed and regionally metamorphosed at epidote-amphibolite facies into fine- to medium-grained mylonitic schist. Locally deformed and retrograded to lower greenschist facies

Jarvis Creek Glacier subterrane (South of Eliting Creek fault)

jcg **Fine- to medium-grained gneissose granitic rocks (Devonian)**—Chiefly gneissose hornblende-biotite diorite and granodiorite and lesser augen gneiss or gneissose granite. Found in small- to moderate-size, irregularly shaped, homogeneous plutons. Relict hypautomorphic-granular texture. Mainly in Donnelly Dome and benchmark Ober areas intruding pelitic schist and quartzite. Ductilely deformed and regionally metamorphosed at amphibolite facies into mylonitic gneiss and schist. Local retrogression to south to lower greenschist facies

jcv **Fine-grained schistose metavolcanic and metasedimentary rocks (Devonian)**—Chiefly polydeformed, fine-grained, schistose meta-andesite and metamorphosed quartz keratophyre with lesser metadacite, metabasalt, pelitic schist, quartzite, calc- schist, and marble. Ductilely deformed and regionally metamorphosed at greenschist facies into mylonitic schist or local phyllonite. Local intense iron staining, and disseminated and massive sulfide minerals

jcs **Fine-grained metasedimentary rocks (Devonian and older)**—Chiefly polydeformed, fine-grained pelitic schist and quartzite with lesser calc-schist, quartz feldspar schist and marble, and with very sparse schistose metavolcanic rocks. Metasedimentary rocks derived from shale, chert or quartz sandstone, marl, volcanic graywacke, and limestone. Ductilely deformed and regionally metamorphosed at greenschist facies into mylonitic schist or local phyllonite. Includes large areas of upper greenschist facies and lower amphibolite facies metamorphic rocks in area south of Granite Mountain and south of Donnelly Dome. Amphibolite facies minerals to north are progressively replaced by greenschist-facies minerals to south

Hayes Glacier subterrane (South of Hines Creek and Mount Gakona faults)

hgv **Fine-grained schistose volcanic rocks and phyllite (Devonian)**—Chiefly polydeformed, schistose to phyllitic meta-andesite and metamorphosed quartz keratophyre, and lesser metadacite and metabasalt with locally abundant pelitic-, quartz-, and calc-phyllite. Ductilely deformed and regionally metamorphosed at lower- and middle-greenschist facies into phyllonite and blastomylonite. Local areas of iron staining and disseminated sulfide minerals

hgs **Fine-grained schistose metavolcanic rocks and volcanic rocks (Devonian and older)**—Chiefly pelitic, quartz-, and calc-phyllite. In eastern part of quadrangle, chiefly polydeformed quartz-chlorite-white mica phyllite, graphite-quartz phyllite, quartz-plagioclase phyllite, calc-phyllite, and marble. Locally meta-andesite, metamorphosed quartz keratophyre, and metadacite. In western part of quadrangle, chiefly polydeformed pelitic schist, quartz-mica schist, and lesser quartzite, and calc-schist derived from shale, quartz-siltstone and sandstone, and marble. Derived from shale, chert or quartz siltstone, volcanic graywacke, marl, and limestone. Ductilely deformed and regionally metamorphosed at lower and middle greenschist facies into phyllonite and blastomylonite

AURORA PEAK TERRANE (SOUTH OF NENANA GLACIER FAULT AND NORTH OF DENNALI FAULT)

ag **Metamorphosed granitic rocks (Late to mid-Cretaceous)**—Chiefly gneissose granodiorite and granite with lesser quartz diorite, diorite, gabbro, and amphibolite derived from gabbro and diorite. Found in east-striking plutons and dikes intruding calc-schist, marble, quartzite, and pelitic schist. Relict hypautomorphic granular texture. Ductilely metamorphosed and penetratively deformed twice, once into mylonitic gneiss during earlier period of upper amphibolite facies metamorphism, and later into blastomylonite during period of lower greenschist facies metamorphism

as **Metamorphosed sedimentary rocks (Triassic to Silurian)**—Chiefly polydeformed, fine- to medium-grained calc-schist, marble, quartzite, and pelitic schist. Derived from marl, quartzite, and shale. Ductilely metamorphosed and deformed twice, once into mylonitic schist during older period of upper amphibolite facies metamorphism and later into blastomylonite at middle-greenschist facies

WINDY TERRANE (WITHIN SPLAYS OF DENALI FAULT)

wm **Melange (Cretaceous, Devonian, and Silurian?)**—Structural melange consisting of two assemblages: (1) small to large fault-bounded lenses of Cretaceous flysch and volcanic rocks, mainly argillite, quartz-pebble siltstone, quartz sandstone, metagraywacke, and conglomerate with lesser andesite and dacite; and (2) small to large fault-bounded lenses of limestone and marl of Silurian(?) and Devonian age. Weakly metamorphosed. Local weak schistosity. Locally intensely deformed locally, with development of phyllonite and pressure solution in narrow shear zones. Incipient lower greenschist-facies metamorphism. Found as in narrow, fault-bounded lenses along Denali fault

SEDIMENTARY AND VOLCANIC ROCKS AND METAMORPHOSED SEDIMENTARY, VOLCANIC, AND PLUTONIC ROCKS (SOUTH OF DENALI FAULT)

Tsc **Sandstone and conglomerate (late to early Tertiary)**—Chiefly continental clastic deposits of light-colored, fine-grained, poorly sorted, sandstone with locally interbedded siltstone, pebbly sandstone, pebble to cobble conglomerate, and sparse thin coal layers, and coarse white rhyodacite ash layers south of The Hoodoos. Found in scattered exposures. Overlies the conglomerate unit (Tc). Generally faulted against older bedrock. Commonly found as fault-bounded lenses in branches of Broxson Gulch thrust, Rainy Creek thrust, and Eureka Creek fault. Unit age is considered to be Eocene to Miocene

Tc **Conglomerate (early Tertiary)**—Chiefly continental clastic deposits of mainly poorly sorted, crudely bedded to massive, polymictic conglomerate and lesser sandstone. Conglomerate contains abundant clasts of rhyodacite to dacite tuff and flows, Nikolai Greenstone, argillite, volcanic sandstone, and andesite to dacite flows of Eagle Creek and Slana Spur Formations, quartz diorite, greenschist, gabbro, and ultramafic rocks. Local thin beds of coal in sandstone layers. Overlies volcanic rocks unit (Tv) and older bedrock of Slana Spur Formation. Locally faulted against older bedrock. Commonly found as fault-bounded lenses in branches of McCallum Creek-Slate Creek thrust. Unit age is considered to be Eocene

Tv **Volcanic rocks (early Tertiary)**—Chiefly ash-flow tuff, breccia, agglomerate, flows, dikes, and sills with lesser volcanic sandstone, conglomerate, and limestone, dikes, and sills; lgneous rocks chiefly rhyodacite, dacite, and andesite. Found at scattered outcrops. Overlain by, and locally in fault contact with conglomerate unit (Tc) and sandstone and conglomerate unit (Tsc). Locally faulted against older bedrock of Slana Spur Formation. Unit age is considered to be Eocene

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 with lesser diorite and quartz diorite. Predominant texture igneous rather than metamorphic. Found in Maclaren, Clearwater, and Wrangellia terranes in small dikes, stocks, and moderate-size to large plutons. Weakly deformed to nonschistose. Locally weakly to extensively hydrothermally altered

TERRANE OF ULTRAMAFIC AND ASSOCIATED ROCKS

um **Ultramafic and associated rocks (Mesozoic?)**—Partly serpentinized. Includes lesser hornblende-plagioclase gneiss, and minor serpentinite, marble, graphitic schist, tonalite, and granite. Earlier pervasive ductile deformation and metamorphism at amphibolite facies. Locally well defined schistosity. Later, locally,intensely deformed and metamorphosed to lower greenschist. Found as narrow, fault-bounded lens along Denali fault, and in klippen south of Denali fault

MACLAREN TERRANE (SOUTH OF DENALI FAULT AND NORTH OF BROXSON GULCH THRUST)

East Susitna batholith and schist, quartzite, and amphibolite
South of Denali fault and north of Meteor Peak fault

gg **Gneissose granitic rocks (early Tertiary and Late Cretaceous)**—Chiefly polydeformed quartz diorite and granodiorite, with lesser granite. Relict hypautomorphic-granular texture. Regionally metamorphosed and ductilely deformed at middle amphibolite facies into mylonitic gneiss. Grade into migmatite, migmatitic schist, and schist and amphibolite. Local retrograde, lower greenschist-facies metamorphism

sa **Schist and amphibolite (Late Cretaceous or older)**—Hornblende-biotite-quartz-plagioclase schist and hornblende-plagioclase-quartz amphibolite. Derived from gabbro, quartz gabbro, diorite, quartz diorite, and pelitic sedimentary rocks. Relict hypautomorphic-granular texture in metaigneous rocks. Ductilely deformed and regionally metamorphosed at middle amphibolite facies into mylonitic schist. Locally intensely deformed and metamorphosed at greenschist facies. Relatively older and more highly metamorphosed equivalent of gneissose granitic rocks (gg) of East Susitna batholith

mig **Migmatite (Cretaceous?)**—Highly contorted schist and amphibolite with abundant, diffuse, thin veins and sills of granodiorite and granite. Gradational unit between gneissose granitic rocks (gg), with fragments of nearly completely assimilated schist and amphibolite (sa), and migmatitic schist (mgsh) units. Contorted schistosity. Contains abundant, small to large granitic dikes

mgsh **Migmatitic schist (Cretaceous?)**—Chiefly schist and amphibolite with sparse to moderately abundant veins of granitic rocks. Attitude of schistosity generally constant over large areas. Gradational unit between schist and amphibolite (sa) and migmatite (mig) units. Contains fewer sills and veins of granitic rocks than migmatite (mig)

sq **Schist, quartzite, and amphibolite (Triassic?)**—Chiefly calc-silicate schist, para-amphibolite, and quartzite. Ductilely deformed and regionally metamorphosed at amphibolite facies into mylonitic schist. Intruded by gneissose granitic rocks (gg)

Maclaren Glacier metamorphic belt (South of Meteor Peak fault)

mmb **Schist and amphibolite, phyllite, and argillite and metagraywacke (Late Jurassic or older)**—Mainly faulted sequence. Metamorphic grade systematically increases from lower greenschist facies in south to middle amphibolite facies to north. Ductilely deformed into protomylonite and phyllonite in argillite and metagraywacke part of unit, phyllonite in phyllite part of unit, and mylonitic schist in schist and amphibolite part of unit. Found as fault-bounded unit south of Meteor Peak fault and north of Denali fault. Contact with conglomerate unit (Tc) and sandstone and conglomerate unit (Tsc). Locally faulted against older bedrock of Slana Spur Formation. Unit age is considered to be Eocene

CLEARWATER TERRANE (WITHIN SPLAYS OF BROXSON GULCH THRUST)

csv **Schistose metasedimentary and metavolcanic rocks (Late Triassic)**—Chlorite schist, muscovite schist, and marble. Lesser schistose metarhyolite and metarhyodacite flows, and greenstone derived from pillow basalt. Weakly deformed and metamorphosed at greenschist facies. Intensely deformed at faults between units in some areas

WRANGELLIA TERRANE (SOUTH OF DENALI FAULT AND BROXSON GULCH THRUST)

JTen **McCarthy Formation (Early Jurassic and Late Triassic)**—Thin- to medium-bedded calcareous argillite and impure limestone with abundant *Monotis*. Found in branches of Broxson Gulch thrust

ga **Gabbro, diabase, and metagabbro (Late Triassic?)**—Small, irregular bodies, dikes, and sills of medium- to coarse-grained gabbro and fine- to medium-grained diabase, and locally schistose metagabbro that are found throughout Wrangellia terrane. Gabbro and diabase range from hypautomorphic-granular or ophitic aggregates of clinopyroxene, plagioclase and lesser biotite, to regionally metamorphosed metagabbro composed of schistose aggregates of hornblende or actinolite, chlorite, biotite, epidote, and albite. In some areas, may be late Paleozoic in age and part of igneous suite in Slana Spur Formation and Tetelna Volcanics

cu **Cumulate mafic and ultramafic rocks (Late Triassic?)**—Moderate- to large-size sills of olivine, olivine-clinopyroxene, and clinopyroxene-plagioclase cumulate. Partly to mostly serpentinized. Locally intensely deformed into serpentinite, actinolite-chlorite schist, or talc schist. Found as large sills in Tangle subterrane, and as fault-bounded lenses in Slana River subterrane

Slana River subterrane (South of Denali fault and Broxson Gulch thrust and north of Eureka Creek fault)

KJs **Marine metasedimentary rocks (Early Cretaceous and Late Jurassic)**—Interlayered gray argillite, siltstone, graywacke, pebble conglomerate, and andesite. Abundant graded and rhythmic bedding, sole marks, and slump folds in some areas. Interpreted as deep-marine turbidite deposits. Locally isoclinally folded. Weakly metamorphosed to lower greenschist facies

Tkl **Limestone (Late Triassic)**—Fine-grained gray limestone in medium-grained gray or white marble. Thick bedded to massive. Weakly schistose. Pervasively recrystallized. Found in fault-bounded lenses adjacent to Nikolai Greenstone. Locally faulted and sheared. Locally metasomatized to skarn near granitic plutons

Tkn **Limestone (Late Triassic)**—Fine-grained gray limestone in medium-grained gray or white marble. Lenses and nodules of gray and black chert and irregular patchworks of disseminated fine-grained quartz. Thick bedded to massive. Weakly schistose. Pervasively recrystallized. Locally faulted and sheared. Locally faulted into subjacent Nikolai Greenstone. Locally metamorphosed to skarn near granitic plutons

Tkn **Nikolai Greenstone (Late Triassic)**—Dominantly massive basalt flows and minor basaltic breccia and tuff, and subordinate volcaniclastic rocks, chert, and argillite in some areas. Predominantly intermixed as and pahoehoe flows. Individual flows as much as few meters thick. Common ophitic texture or hypautomorphic-granular texture with clinopyroxene, plagioclase, and magnetite. Generally regionally metamorphosed and locally schistose with abundant metamorphic actinolite, epidote, chlorite, albite, and sericite. Lithologically similar to Nikolai Greenstone in Slana River subterrane. Local quartz veins and altered areas with Cu-sulfide minerals in some areas

Tknp **Pillow basalt flows member**—Massive pillow basalt flows, and minor basaltic breccia and tuff, and argillite. Basalt lithologically similar to subaerial basalt flows of Nikolai Greenstone. Weakly schistose to massive. Generally regionally metamorphosed with abundant metamorphic actinolite, epidote, chlorite, albite, and sericite. Local quartz veins and altered areas including Cu-sulfide minerals

Pzt **Aquagene tuff, argillite, limestone, chert, andesite tuff, and greenstone (late Paleozoic)**—Interlayered basaltic aquagene tuff, gray siliceous argillite, calcite limestone, and marble, red and black chert, and gray-green tuff and basalt. Medium to thick bedded. Weakly schistose to massive. Pervasively metamorphosed to lower greenschist facies

GULKANA RIVER TERRANE (SOUTH OF PAXSON LAKE FAULT)

mha **Metamorphosed hornblende andesite (late Paleozoic?)**—Chiefly unfossiliferous weakly metamorphosed hornblende andesite and lesser clinopyroxene basalt. Massive to weakly schistose. Correlative with Haley Creek metamorphic assemblage of Plafker and others (1989) in northern Valdez quadrangle to southeast that contains lithologically similar late Paleozoic metamorphosed andesite and basalt flows

IPg **Granitic plutons in Wrangellia terrane (Pennsylvanian)**—Chiefly medium- to coarse-grained hornblende-biotite granodiorite and biotite granite with lesser diorite and quartz diorite. Found in moderate-size and large plutons. Weakly deformed to nonschistose

IPPs **Slana Spur Formation (Early Permian to Middle Pennsylvanian)**—Thick sequence of marine calcareous (upper part) and noncalcareous (lower part) volcaniclastic rocks, and lesser volcanic sandstone, conglomerate, tuff, volcanic breccia and flows, and limestone. Fine to coarse grained. Volcanic rocks generally dacite and lesser andesite, rhyodacite, and basalt. Medium to thick bedded. Local abundant graded and crossbedded. Weakly schistose to massive. Pervasively metamorphosed to lower greenschist facies. Local abundant iron staining. Disseminated and massive sulfide minerals

IPt **Tetelna Volcanics (Pennsylvanian)**—Chiefly dark-gray-green andesite and dacite flows, with sparse basalt flows and local volcanic breccia, volcanic graywacke, conglomerate, and tuff. Fine to coarse grained. Thin to thick bedded. Weakly schistose to massive. Pervasively metamorphosed to lower greenschist facies. Local abundant iron staining. Disseminated and massive sulfide minerals

Tangle subterrane (South of Eureka Creek fault)

Tkl **Limestone (Late Triassic)**—Fine-grained gray limestone in medium-grained gray or white marble. Thick bedded to massive. Weakly schistose. Pervasively recrystallized. Found in fault-bounded lenses adjacent to Nikolai Greenstone. Locally faulted and sheared. Locally metasomatized to skarn near granitic plutons

Tknf **Nikolai Greenstone (Late Triassic)**—Divided into:

Tknf **Subaerial basalt flows member**—Subaerial, amygdaloidal basalt flows separated locally by thin beds of nonmarine volcaniclastic rocks and local thin beds of shale, chert, and siltstone. Predominantly intermixed as and pahoehoe flows. Individual flows as much as few meters thick. Common ophitic texture or hypautomorphic-granular texture with clinopyroxene, plagioclase, and magnetite. Generally regionally metamorphosed and locally schistose with abundant metamorphic actinolite, epidote, chlorite, albite, and sericite. Lithologically similar to Nikolai Greenstone in Slana River subterrane. Local quartz veins and altered areas with Cu-sulfide minerals

Tknp **Pillow basalt flows member**—Massive pillow basalt flows, and minor basaltic breccia and tuff, and argillite. Basalt lithologically similar to subaerial basalt flows of Nikolai Greenstone. Weakly schistose to massive. Generally regionally metamorphosed with abundant metamorphic actinolite, epidote, chlorite, albite, and sericite. Local quartz veins and altered areas including Cu-sulfide minerals

Pzt **Aquagene tuff, argillite, limestone, chert, andesite tuff, and greenstone (late Paleozoic)**—Interlayered basaltic aquagene tuff, gray siliceous argillite, calcite limestone, and marble, red and black chert, and gray-green tuff and basalt. Medium to thick bedded. Weakly schistose to massive. Pervasively metamorphosed to lower greenschist facies

GULKANA RIVER TERRANE (SOUTH OF PAXSON LAKE FAULT)

mha **Metamorphosed hornblende andesite (late Paleozoic?)**—Chiefly unfossiliferous weakly metamorphosed hornblende andesite and lesser clinopyroxene basalt. Massive to weakly schistose. Correlative with Haley Creek metamorphic assemblage of Plafker and others (1989) in northern Valdez quadrangle to southeast that contains lithologically similar late Paleozoic metamorphosed andesite and basalt flows

EXPLANATION

Contact—Dotted where concealed

Fault—Dashed where approximately located; dotted where concealed

Anticline or antiform—Dashed where approximately located; dotted where concealed; showing direction of plunge

Overturned antiform—Showing direction of dip of limbs; dotted where concealed

Syncline or synform—Showing direction of plunge; dashed where approximately located; dotted where concealed

Strike and dip of beds

30 Inclined

Vertical

Strike and dip of schistosity

30 Inclined

Vertical

2 Bedrock fossil locality—Refer to table 1 in pamphlet for field number, location, fossil(s), age, formation or host rock, identifier, and source reference(s). Refer to summary in pamphlet for listing of fossil localities by geologic unit. Localities are numbered by terrane from west to east and from north to south. A few local, narrow lenses of some geologic units are omitted for simplicity, resulting in some localities present in more prevalent, surrounding rock unit

9 Bedrock isotopic age sample locality—Refer to table 2 in pamphlet for field number, location, isotopic method and mineral, age, rock unit or type, and source reference(s). Refer to summary in pamphlet for listing of isotopic age sample localities by geologic unit. Localities are numbered by terrane from west to east and from north to south. A few local, narrow lenses of some geologic units are omitted for simplicity, resulting in some localities present in more prevalent, surrounding rock unit

MAP, TABLES, AND SUMMARY OF FOSSIL AND ISOTOPIC AGE DATA, MOUNT HAYES QUADRANGLE, EASTERN ALASKA RANGE, ALASKA

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