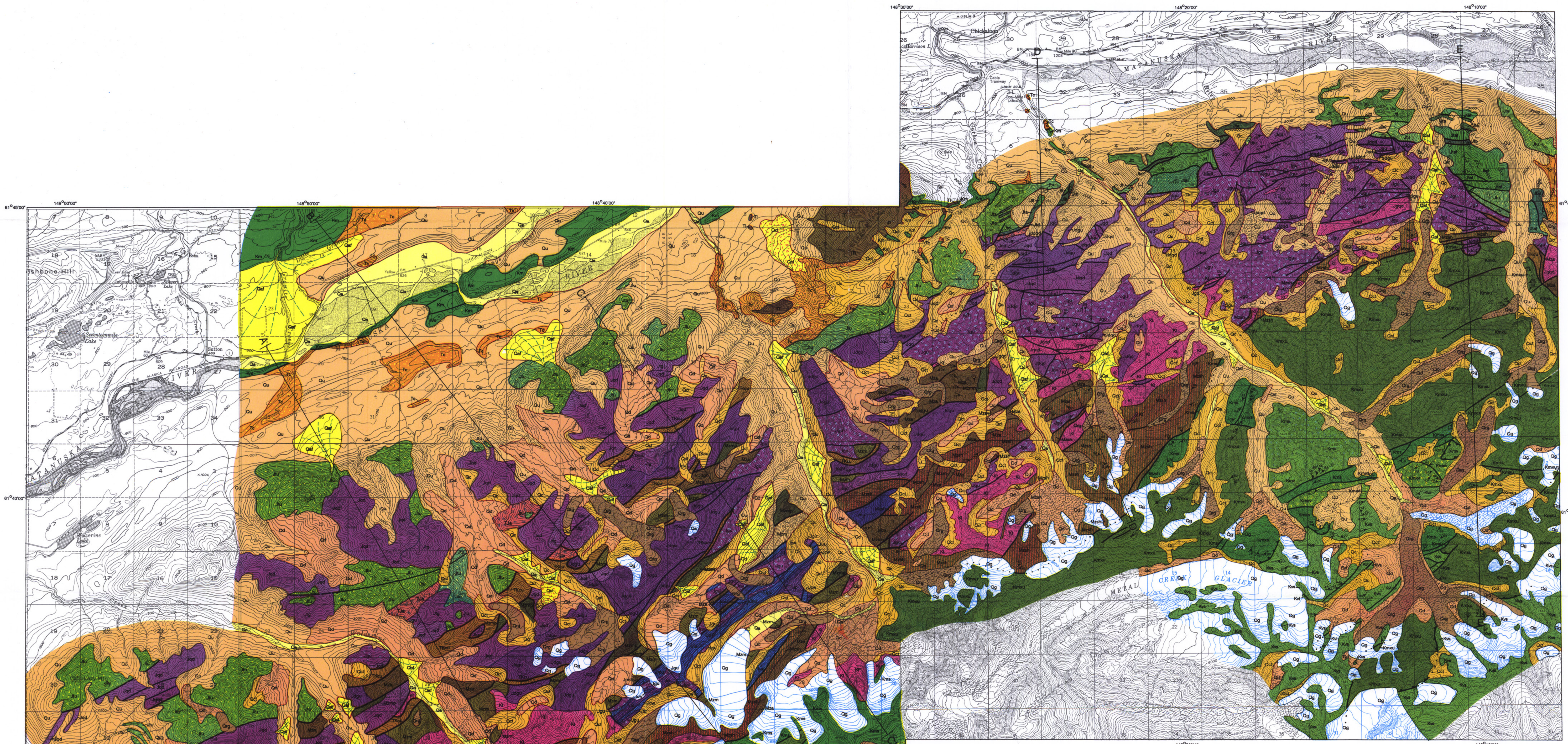
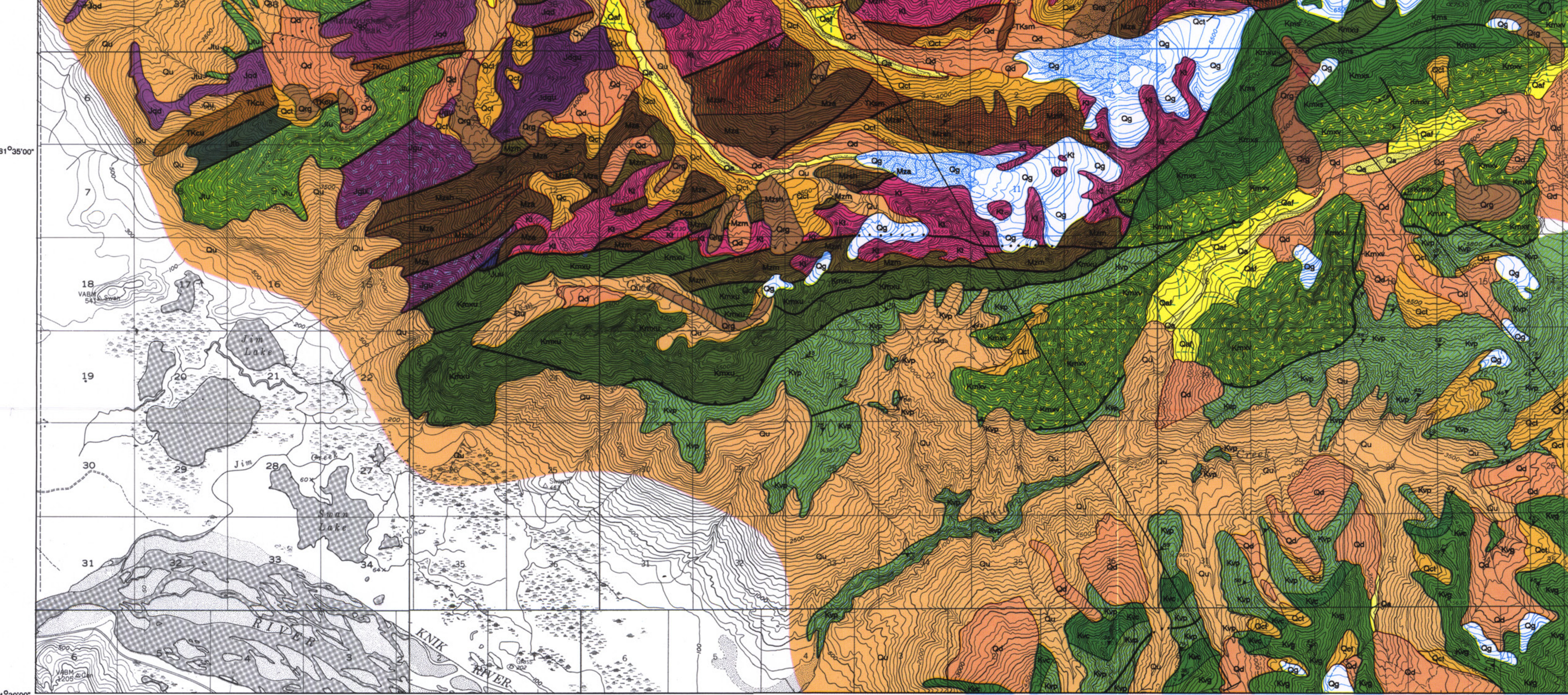
PR94-SH1

Base from U.S. Geological Survey Anchorage, C-4, C-5, and D-4, (1960) Quadrangles, Alaska. Universal Transverse Mercator Projection.

Geology by L.E. Burns, R.J. Newberry, T.A. Little, G.H. Pessel, and John Decker, 1982 Modified by T.A. Little, 1983, 1984, 1985. Anchorage D-1 Quadrangle mapping by G.H. Pessel, L.E. Burns, M.W. Henning, and T.L. Pavlis, 1979. Edited by A. Seward. Cartography by A.G. Sturmann.

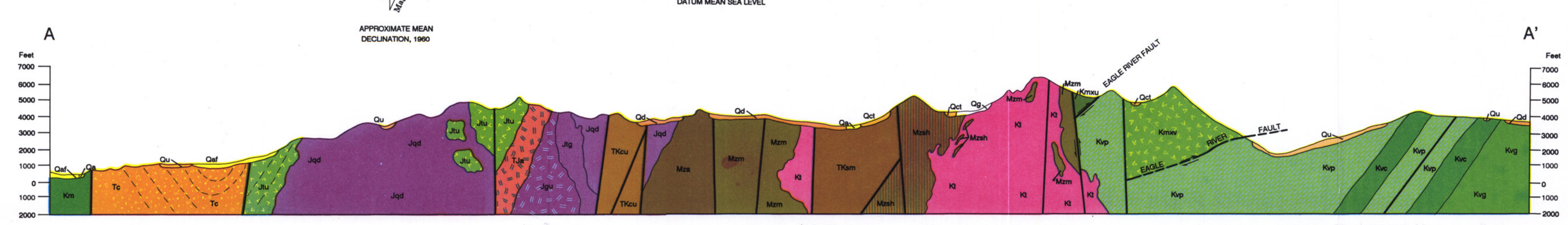
Scale 1:63,360

1 ½ 0 1 2 3 4 miles

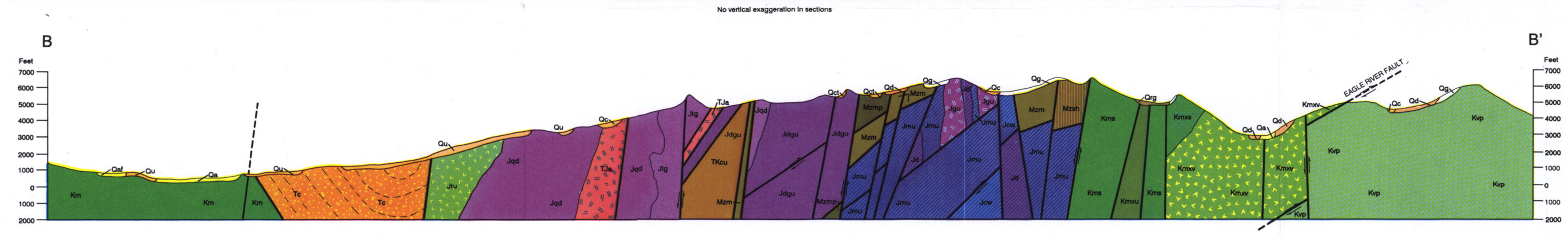
1 .5 0 1 2 3 4 5 kilometers

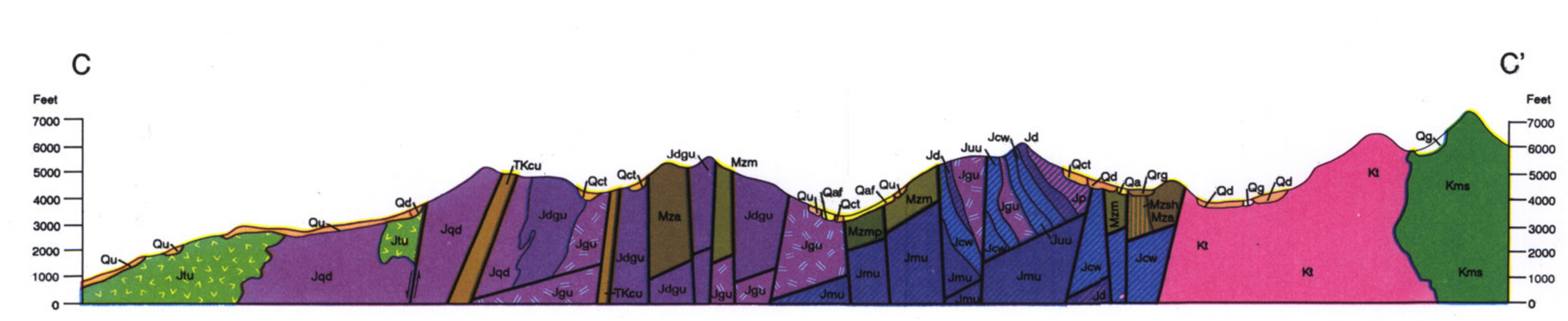
CONTOUR INTERVAL 100 FEET
DATUM MEAN SEA LEVEL

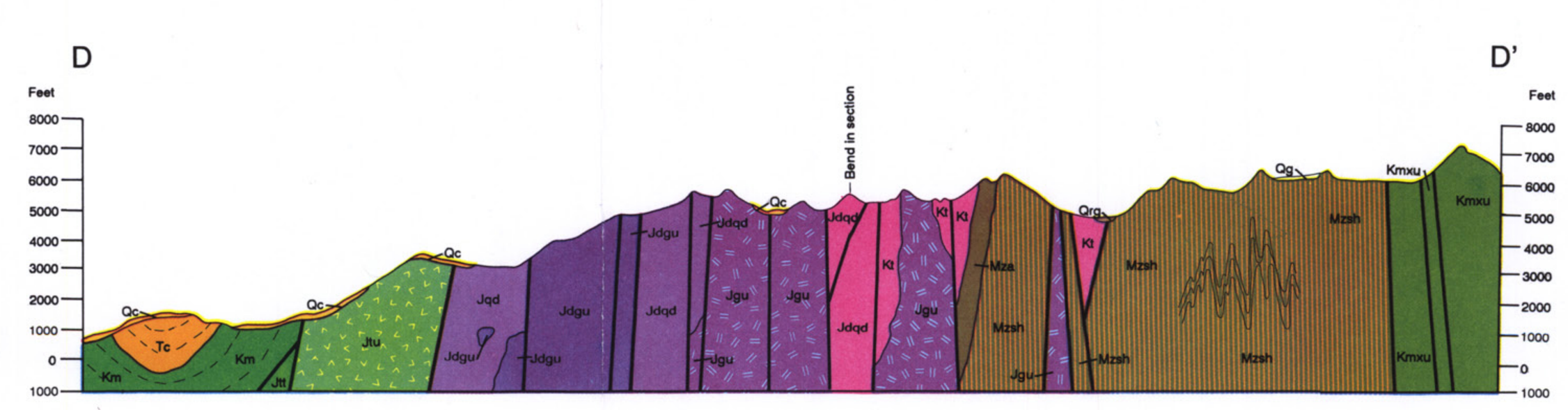
27° True North Magnetic North
APPROXIMATE MEAN DECLINATION, 1960

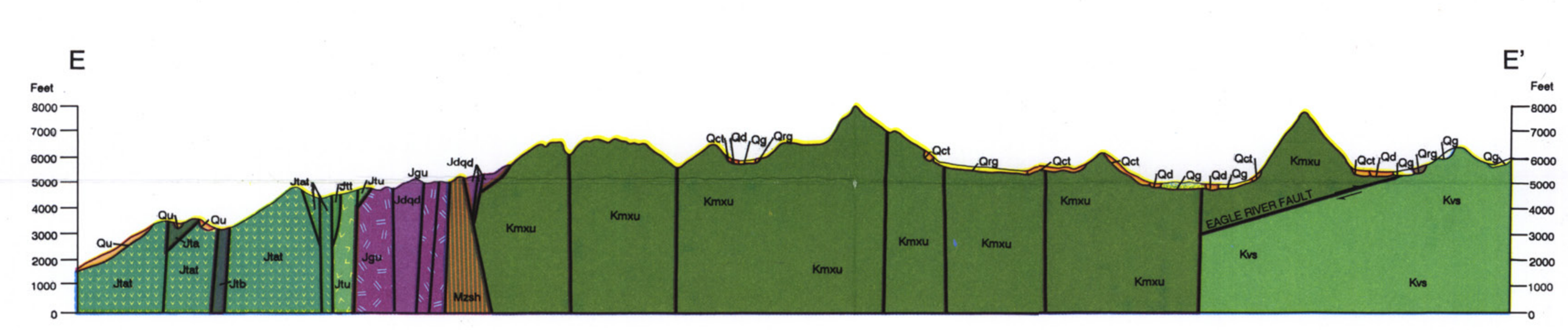


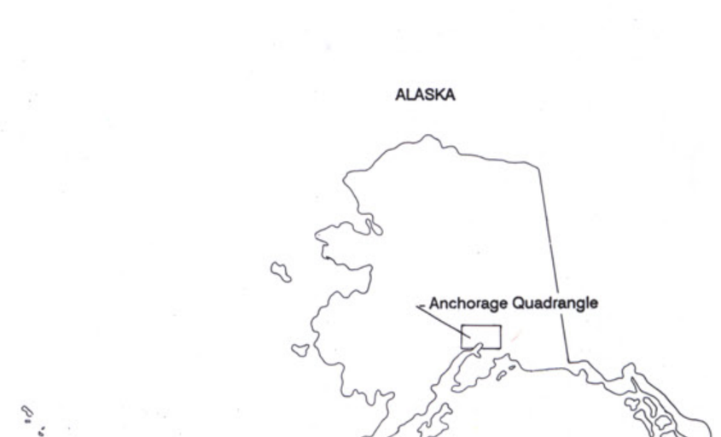
No vertical exaggeration in sections











GEOLOGIC MAP OF THE NORTHERN CHUGACH MTNS., SOUTHCENTRAL ALASKA

By

L.E. Burns, G.H. Pessel, T.A. Little, T.L. Pavlis, R.J. Newberry, G.R. Winkler, and John Decker

1991

DESCRIPTION OF MAP UNITS

[Colors of amphiboles, biotite, and chlorite are those observed during thin-section examination]

Qu SURFICIAL DEPOSITS, UNDIFFERENTIATED.

Qa STREAM DEPOSITS—Braided stream deposits; chiefly cobbly and pebbly gravel, coarse to fine sand, silt, and peat.

Qaf ALLUVIAL-FAN DEPOSITS—Thick-bedded and crudely sorted coarse gravel, sand, and silt. May include talus and colluvium.

Qc COLLUVIAL DEPOSITS—Gravity deposits, generally covered by alpine tundra and brush. Includes solifluction and soil creep deposits, talus, and till.

Qct TALUS—Generally unvegetated rubble aprons composed of angular clasts from grit to boulder size.

Qcl LANDSLIDE DEPOSITS—Coarse-grained mass-movement rubble deposited by sliding and slumping; typically exhibits hummocky topography and scarps at upper margins. Older landslides are heavily vegetated.

Qrg ROCK-GLACIER DEPOSITS—Lobate accumulations of blocky rubble with interstitial ice or ice cores where active. Most are active and located in north-facing cirques; unit includes ice-cored moraines.

Qd GLACIAL DEPOSITS, UNDIFFERENTIATED—Till of lateral, medial, ground, and end moraines. Includes some alluvium of outwash and kame terraces.

Qg GLACIAL ICE—Modern glaciers.

Sedimentary and volcanic rocks common to both terranes

Tc CHICKALOON FORMATION—Clastic sedimentary rocks of fluvial and lacustrine origin. Typical sequences consist of tabular beds as thick as several meters of dark brown to black (carbonaceous) mudstones rhythmically intercalated with scour-based beds of pebble conglomerate and sandstone. Clasts in Chickaloon Formation conglomerates were derived from both the Peninsular and the Chugach terranes. Sandstones and siltstones locally contain abundant carbonaceous plant fragments and leaf impressions. Thin (<1/4 m) coal beds are common in the formation in the lower reaches of Coal and Carbon Creeks (Anchorage C-4 Quadrangle) and are also present east of the Matanuska Glacier (Anchorage C-2 Quadrangle). The Chickaloon Formation is considered to be late Paleocene-early Eocene in age (Wolfe, as quoted in Little, 1988).

Intrusive rocks common to both terranes

[Terminology for plutonic rocks taken from Streckeisen (1976)]

Ti FELSITE—Porphyritic, hypabyssal dikes and small plugs of orange- to buff-weathering, light-gray to beige rock of andesitic to dacitic composition. Felsites commonly intrude high-angle faults in crosscutting and parallel relationships. Felsites intrude rocks as young as the late Paleocene-early Eocene age Chickaloon Formation and yield Eocene K-Ar ages (Winkler and others, 1981b). Commonly aphanitic in texture with approximately 5 percent small (1 to 2 mm) euhedral phenocrysts of plagioclase and lesser quartz, containing small amounts of hornblende and biotite; felsites with aphyric and microporphyritic textures are also present. Alteration consists of minor calcite, chlorite, and white mica in the groundmass. Plagioclase phenocrysts contain fine-grained secondary calcite, sericite, and minute granules of epidote and opaques. Hornblende and biotite are partially replaced by chlorite and calcite.

Kt TONALITE AND TRONDHJEMITE—Creamy-white or light-gray leucocratic tonalite and trondhjemite plutons (to 2 km^2) and dikes. Contains minor diorite and quartz diorite; consists of 50 to 65 percent zoned oligoclase (optical determination) anhedra, 25 to 35 percent quartz, and 10 to 15 percent bronze biotite. Mafic portions of the plutons contain up to 10 percent hornblende. Minor constituents include muscovite (to 5 percent), garnet, opaque oxides, apatite, and zircon. Quartz crystals are commonly strained and elongate, and their alignment produces foliation. Plagioclase is generally partly altered to sericite, epidote, clinozoisite, and sphene. Chlorite forms veins and individual crystals and also occurs as an alteration product of the mafic minerals; epidote veins are common. Some older (Jurassic ?) trondhjemites may be included in the unit.

TJa ANDESITE AND DACITE—Altered dikes and sills of massive light-gray-green porphyritic andesite and porphyritic dacite intruding Talkeetna Formation (Jtu) and quartz diorite-tonalite (Jqd). Porphyritic dacite contains about 7 percent euhedral to subhedral plagioclase phenocrysts (2 to 3 mm) and about 1 percent equant quartz phenocrysts (0.5 mm) in an aphanitic groundmass. Plagioclase phenocrysts are glomeroporphyritic, and groundmass is felty or xenomorphic. Mafic minerals have been completely altered to chlorite. Other alteration products are epidote, phengite, calcite, and pumpellyite.

TJu TALKEETNA FORMATION (Jtu), ANDESITE AND DACITE DIKES (TJa), AND QUARTZ DIORITE-TONALITE (Jqd), UNDIFFERENTIATED—Faulted complex that contains these units in inaccessible terrain east of Gravel Creek, near the northern Chugach Mountain front.

MAP SYMBOLS

Contact

Fault—Dashed where inferred; dotted where concealed; queried where doubtful

Thrust fault—Sawteeth on upper plate

Anticline, showing trace of axial surface

Syncline, showing trace of axial surface

Strike and dip of beds

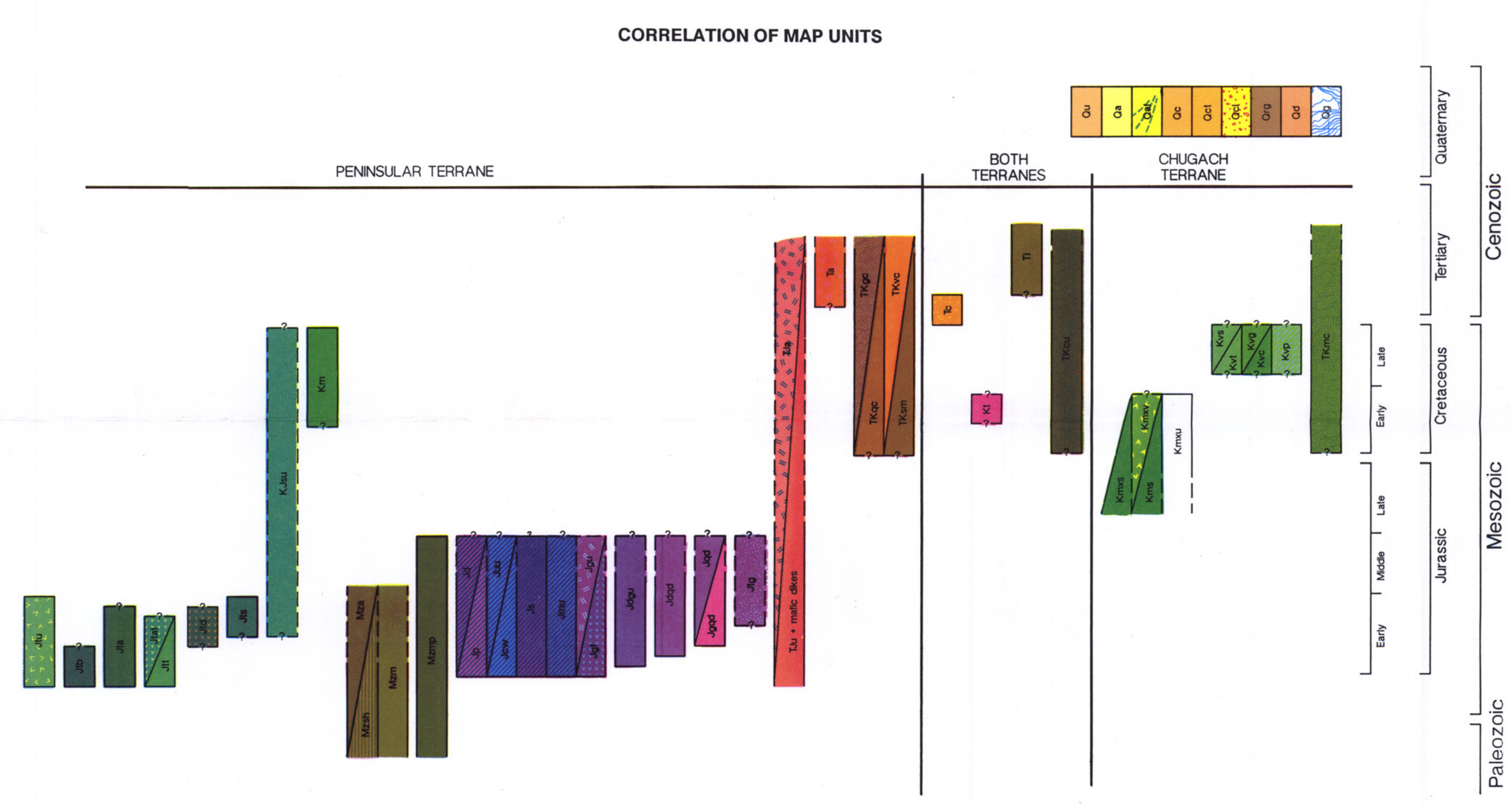
35 Inclined

Foliation

35 Strike and dip of foliation

Vertical

CORRELATION OF MAP UNITS



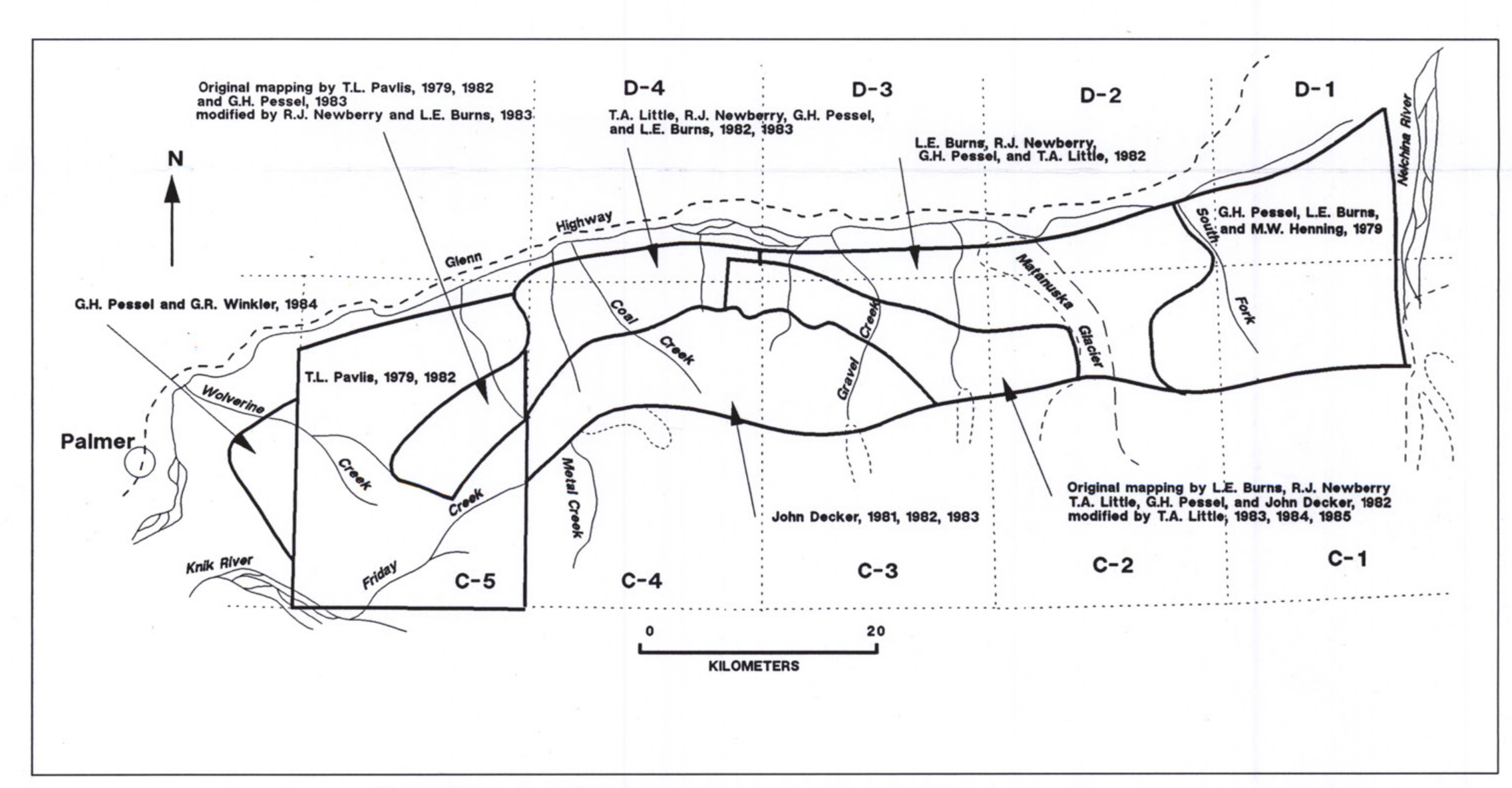
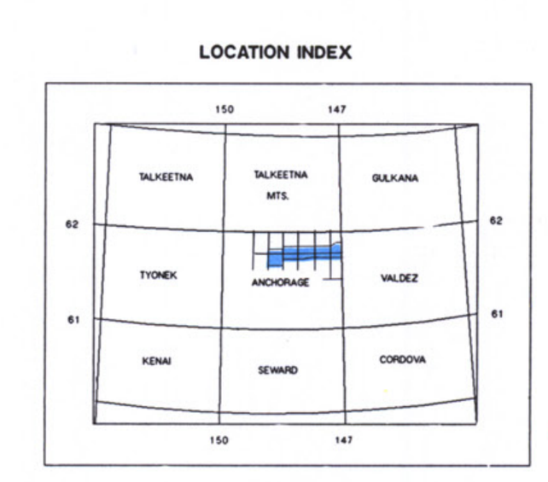


Figure 1. Diagram shows major geologic mapping personnel and the years the field mapping occurred.

LOCATION INDEX



Ta ANDESITE—Andesite porphyry similar to andesite and dacite unit (TJa). Assumed to be of Tertiary age because it intrudes younger units, including quartz diorite-tonalite (Jqd) and mafic cataclasite (TKqc), and because chloritic alteration of the mafic minerals is minimal compared to older andesitic rocks.

Sedimentary and volcanic rocks of the Peninsular terrane

Km MATANUSKA FORMATION, UNDIFFERENTIATED—Light- to dark-gray, finely laminated, fissile mudstone and claystone. Locally, mudstone is interbedded with thin beds of fine-grained silty sandstone and siltstone. Sole markings, flame structure, graded bedding, and other features indicative of turbidite deposition are abundant. Contains fossils of Albian, Cenomanian, and Maestrichtian age (Grantz, 1964). Much of the Matanuska Formation in the map area was probably deposited in a basin-plain environment.

KJsu MATANUSKA FORMATION (Km) and TALKEETNA FORMATION SEDIMENTARY ROCKS (Jts), UNDIFFERENTIATED—Unit present only in northern Anchorage C-1 Quadrangle, where the rocks were not mapped in detail.

Jtu TALKEETNA FORMATION, UNDIFFERENTIATED—Volcanic flows, hypabyssal intrusions, pyroclastic rocks, and volcaniclastic sedimentary rocks of intermediate composition: conglomerate, graywacke, fossiliferous siltstone, sandstone, and intercalated volcanic and sedimentary rocks. Pervasively altered to fine-grained epidote-chlorite ± calcite ± pumpellyite, ± white mica, and locally veined with zeolites. The age of the Talkeetna Formation is assumed to be Early Jurassic, on the basis of fossils in Cook Inlet and Talkeetna Mountain areas (Grantz and others, 1963).

Jts TALKEETNA FORMATION SEDIMENTARY ROCKS—Includes bedded, well-sorted sandstone and fossiliferous shale, typically intercalated on a medium scale (0.5 to 1 m) with volcaniclastic rocks.

Jtt TALKEETNA FORMATION TUFFS—Generally greenish weathering; includes crystal, crystal-lithic, lithic, ignimbritic, and vitric tuffs which contain devitrified pumiceous clasts of variable size in an aphanitic groundmass. Unit includes poorly sorted, poorly bedded tuff breccias, lapilli-ash tuff, and ash tuff. Variegated, fine-grained water-laid tuff is present but not common.

Massive light-green-weathering lithic tuff is dominantly lapilli-ash tuff containing unsorted, subrounded to angular lithic fragments (5 to 45 percent) in an altered, devitrified, microcrystalline, ashy groundmass. Thick beds of reworked tuffaceous conglomerate are also present with lithic tuff. The microcrystalline lithic lapilli are greenish to beige and include aphyric devitrified glass fragments (pumice ?) and microlithic (or trachytoid) andesitic flow rock with plagioclase microphenocrysts. These altered lithic fragments range in grain size from microscopic to about 2 cm. Broken euhedral plagioclase (andesine) phenocrysts, some with apatite, epidote, and (or) clear fibrous amphibole inclusions, are also a minor constituent. Locally, some of these tuffs have compaction textures, such as flattened clasts.

Crystal-lithic tuff is generally light-green-weathering lapilli-ash tuff containing 2 to 40 percent broken plagioclase phenocrysts (some glomeroporphyritic) and 1 to 30 percent angular to subrounded, aphyric or microporphyritic andesitic fragments (1 to 5 mm) in a devitrified microcrystalline groundmass. The lithic fragments are green and microcrystalline, and may include unsorted and poorly bedded to massive devitrified pumice.

Jtat TALKEETNA FORMATION ANDESITE AND TUFFS—Medium-bedded and massive tuffs, including lithic lapilli-ash and crystal-lithic lapilli-ash tuff, intercalated with andesite and lesser amounts of dacite. The presence of brecciated tuff both with and without amygdules suggests that volcanic flows, tuffs, and shallow andesitic sills are included in the unit. Andesite sills and dikes of probable Tertiary age are undoubtedly included in the unit, particularly near larger plugs of Tertiary andesite.

Jta TALKEETNA FORMATION ANDESITE—Dark- to medium-green-weathering andesite flows and hypabyssal intrusions; includes some dark-green nonamygdaloidal basalt and minor amounts of brown-weathering medium- to thin-bedded flows or hypabyssal intrusions of dacite. Andesite typically contains 10 to 20 percent oscillatory-zoned plagioclase crystals (1 to 2 mm) and 5 to 15 percent chloritized mafic minerals (largely pyroxene) in a felty microcrystalline groundmass. Major textural varieties are (1) medium-bedded amygdaloidal andesite porphyry, (2) glomeroporphyritic andesite with clasts of mafic and feldspar crystals in a nearly aphanitic groundmass, (3) massive porphyritic sub-equigranular andesite, (4) andesite mainly altered to chlorite and epidote, and (5) microporphyritic andesite. Some varieties of andesite closely resemble very fine grained diorite in texture and composition.

Jtb TALKEETNA FORMATION BASALT—Dark-purple-weathering, medium-bedded, slightly magnetic basalt and lesser mafic andesite. Basalt is variably amygdaloidal. Unit generally contains 5 to 20 percent plagioclase and 5 to 10 percent altered pyroxene (?) phenocrysts in a microcrystalline andesitic matrix. Some basalts are scoriaceous.

Jtd TALKEETNA FORMATION DACITE—Siciliceous, possibly silicified, brown-weathering medium- to thin-bedded flows or hypabyssal intrusions with 2 to 5 percent partly resorbed quartz phenocrysts, 5 to 15 percent tablet-shaped plagioclase crystals, and 2 to 5 percent chloritized mafic minerals. Locally eutaxitic structure. Typically contains 0.5 to 5 percent disseminated pyrite cubes (1 to 3 mm).

Intrusive rocks of the Peninsular terrane

Jtg TONALITE-GRANODIORITE—White-weathering medium-grained small stocks of hornblende-biotite tonalite and granodiorite. Similar to Jqd unit. Locally gneissic.

Jgqd GABBROIC ROCKS, DIORITE, AND QUARTZ DIORITE-TONALITE, UNDIFFERENTIATED—Mafic and intermediate composition plutonic rocks, including gabbronorite (Jgu), quartz diorite-tonalite (Jqd), and lesser amounts of hornblende gabbro and dioritic rocks, complexly intermixed from multiple intrusive episodes and faulting to form foliated plutonic dike complexes. Intrusions became more silicic with time. Dikes are typically concordant with surrounding igneous dikes; contact breccias occur locally. Xenoliths and schlieren of more mafic rocks are abundant in the silicic intrusions and are often oriented parallel to the walls of the dike. Textures and mineralogy of the xenoliths (hornblende, plagioclase, and iron oxides) suggest recrystallization in the hornblende hornfels facies. Plutonic rocks are intruded by dike swarms of andesite, dacite, diabase, and trondhjemite in some locations. The dike swarms tend to be more noticeable in the lighter colored, intermediate-composition plutonic rocks than in the gabbroic rock.

Jqd QUARTZ DIORITE-TONALITE—White-weathering, blocky-fracturing, medium-grained dikes and plutons; relatively homogeneous in composition and texture; unit commonly contains small xenoliths of dioritic and gabbroic rocks. Mafic dikes are common in this unit. The rocks are typically composed of 45 to 65 percent plagioclase, 10 to 35 percent strained quartz, and 15 to 25 percent hornblende. Apatite, iron-oxides, biotite, zircon, potassium feldspar, and sphene are present in trace amounts in some rocks. Alteration involves formation of clinozoisite, epidote, and sericite from plagioclase and chlorite from hornblende. Some rocks contain secondary actinolite. The unit contains minor amounts of massive pink-weathering granodiorite, consisting of 30 to 40 percent quartz, 30 to 40 percent plagioclase (heavily sericitized), 10 to 20 percent potassium feldspar, 2 to 5 percent chloritized biotite, and trace amounts of green hornblende, apatite and zircon. Secondary epidote forms granular masses and large radiating blades along fractures.

Jdqd DIORITE AND QUARTZ DIORITE-TONALITE, UNDIFFERENTIATED—Gray- to dark-weathering, blocky-fracturing, medium-grained hornblende diorite, hornblende gabbro, and lesser amounts of gray-weathering quartz diorite and tonalite. Most rocks are quartz-bearing. The quartz diorite-tonalite in this unit is identical to the quartz diorite-tonalite unit (Jqd). The diorites and hornblende gabbros in this unit contain 50 to 60 percent subhedral crystals of plagioclase, 30 to 40 percent hornblende, and 0 to 10 percent interstitial, strained quartz--generally secondary. Accessory minerals include opaque oxides, apatite, and zircon. Hornblende is 0.5 to 3 mm in diameter and is pleochroic in shades of green and yellow. In the most mafic rocks, plagioclase crystals have relatively unzoned calcic cores and commonly have extremely zoned, unaltered sodic rims. Hornblende contains inclusions of plagioclase, altered clinopyroxene, and opaque minerals.

Alteration of the rocks in this unit is extensive, especially in the strongly foliated diorites. The plagioclase alters to clinozoisite and minor amounts of epidote, which are both scattered evenly throughout the cores of crystals. Randomly oriented, blue-green acicular needles of a fibrous amphibole (actinolite ?) occur locally as a secondary mineral in plagioclase crystals; the fibrous amphibole formed after crystallization of clinozoisite and other typical alteration products. Hornblende is usually replaced by chlorite but can be partly or completely replaced by a ragged, fibrous, pale blue-green amphibole similar to that found in the altered plagioclase crystals. Feathery aggregates of chlorite, clinozoisite, and epidote represent altered clinopyroxene in the cores of hornblende crystals.

Jdgu HORNBLENDE GABBRO/DIORITE - GABBRONORITE—Gray- to dark-gray-weathering, medium-grained hornblende gabbro and diorite (?) and lesser amounts of pyroxene-hornblende gabbronorite and gabbronorite. Most rocks lack quartz. Locally, the hornblende gabbros and gabbronorites are intrusively and tectonically intermixed. Gabbronorites and hornblende-bearing gabbronorites are discussed below in the description for unit Jgu. The hornblende gabbro rocks are nearly identical to those in the diorite and quartz diorite-tonalite unit (Jdqd) but differ slightly on modal mineralogy. The hornblende gabbro contains 25 to 45 percent hornblende and 55 to 75 percent plagioclase. Opaque minerals form <2 percent of the rock but can compose as much as 5 percent. Apatite and zircon are present in trace amounts. Alteration is widespread and similar to that in the diorite and quartz diorite-tonalite unit (Jdqd) and the gabbroic rock unit (Jgu).

Jgu GABBROIC ROCKS, UNDIFFERENTIATED—Rusty-weathering, fine- to coarse-grained gabbronorite, with lesser amounts of dark-weathering pyroxene-hornblende gabbronorite and minor amounts of hornblende gabbro. Many of the gabbroic rocks are layered. Fine-grained rocks in this unit contain hornblende instead of pyroxenes; medium- to coarse-grained rocks are more likely to contain pyroxenes. Petrographic characteristics and mineralogy suggest a continuum between the hornblende gabbro and gabbronorite; the two extremes are discussed here.

Hornblende gabbro in this unit is similar to and probably correlative with the hornblende gabbro in the diorite and quartz diorite-tonalite unit (Jdqd). Hornblende generally has medium-green, dark-green, and light-brown pleochroism and is fine grained (0.5 to 1.0 mm) but can range to 1.5 mm. Small chlorite patches, which represent remnants of original pyroxene crystals, are common in hornblende grains, as is secondary magnetite. Some rocks are hornblende hornfels, presumably formed during recrystallization of a mafic plutonic rock. Alteration of hornblende is identical to that in the diorite and quartz diorite-tonalite unit (Jdqd). In hornblende gabbro, plagioclase crystals generally have cores of bytownite composition, but labradorite is also present. Plagioclase crystals and their alteration products are identical to those discussed in hornblende gabbro in the diorite and quartz diorite-tonalite unit (Jdqd).
Gabbronorite is commonly coarse-grained and variably altered. Primary minerals include orthopyroxene, clinopyroxene, plagioclase and minor magnetite and ilmenite. These minerals either are not zoned or are only slightly zoned. Minor amounts (<2 percent) of a relatively high-temperature pargasitic hornblende are present in some gabbronorites. In others, clinopyroxene (± orthopyroxene) is rimmed by dark-green hornblende ± magnetite. Secondary minerals in gabbronorite include cummingtonite/anthophyllite, clinozoisite, chlorite, and minor sphene. In the Anchorage C-4 and C-5 Quadrangles, the gabbronorite also contains large amounts of a secondary actinolitic(?) amphibole.

Jgf FINE-GRAINED GABBROIC ROCKS—Dominantly fine-grained gabbronorite and pyroxene-hornblende gabbronorite, with lesser amounts of medium- to coarse-grained gabbronorite and hornblende gabbro. Rocks are similar to, but finer grained than, those in the gabbroic rock unit (Jgu).

Js SERPENTINITE—Massive to schistose serpentinized and partially serpentinized ultramafic rocks. Protoliths were dominantly dunite, wehrlite, and olivine clinopyroxenite. Minor clinopyroxenites, websterites, troctolites, and possibly harzburgites, may also be present. Most serpentine is antigorite, but some chrysotile occurs in small masses within larger serpentinite bodies. Other common minerals are tremolite, magnetite, talc, and calcite.

Jcw CLINOPYROXENITE-WEHRLITE—Thinly layered (1 cm to 1 m) clinopyroxenite, wehrlite, and dunite; includes homogeneous masses of clinopyroxenite, olivine-clinopyroxenite, wehrlite, and minor dunite.

Jp PERIDOTITE—Medium-grained, commonly layered peridotite containing variable proportions of clinopyroxene and olivine, together with 0 to 20 percent orthopyroxene; unit includes websterite, harzburgite and lherzolite. Orthopyroxene is largely altered to anthophyllite/cummingtonite.

Jd DUNITE, CHROMITITE, AND LESSER WEHRLITE—Fine- to medium-grained olivine-rich rocks with variable amounts of chromite or blocks, layers, and lenticular bodies of clinopyroxenite; areas containing clinopyroxenite in dunite are generally too intermixed with dunite and chromitite to be mapped as distinct units at this scale. Where chromite is present, dunite contains less than 10 percent pyroxene; chromite is medium- to coarse-grained, subhedral, and forms layers, nodules, and sheared lenses. Locally, the rock contains up to 50 percent chromite.

Jmu MAFIC AND ULTRAMAFIC PLUTONIC ROCK, UNDIFFERENTIATED—A composite unit with individual units that are mappable by rock type but too small to show at map scale. Variable proportions of the following units are present: gabbroic rocks (Jgu), dunite (Jd), clinopyroxenite (Jcw), and lesser orthopyroxene-bearing peridotite (Jp). The units are mostly elongate and follow the northeast-southwest trend of adjacent ultramafic and mafic rock units. Units separated by gradational, intrusive, and fault contacts.

Juu ULTRAMAFIC PLUTONIC ROCK, UNDIFFERENTIATED—A composite unit with individual units that are mappable by rock type but too small to show at map scale. Variable proportions of the following units are present: dunite (Jd), clinopyroxenite (Jcw), and lesser orthopyroxene-bearing peridotite (Jp). The units are mostly elongate and follow the northeast-southwest trend of adjacent ultramafic and mafic rock units. Units are separated by gradational, intrusive, and fault contacts.

Cataclastic rocks of the Peninsular terrane

TKcu CATACLASITE, UNDIFFERENTIATED—Microbreccia and cataclasite. Dominantly plutonic-derived cataclastic rocks that contain strained porphyroclasts of plagioclase and relict plutonic fragments surrounded by an extremely fine grained, comminuted matrix. Commonly veined by carbonate + quartz ± laumontite ± chlorite.

TKqc QUARTZOSE CATACLASITE—Similar to TKcu but containing abundant quartz and inferred to have a protolith of quartz diorite-tonalite (Jqd). The original mafic minerals are mostly altered by low-grade (prehnite-pumpellyite) metamorphism and (or) bleached by zeolitization.

TKgc GABBROIC CATACLASITE—Similar to TKcu but containing little quartz and inferred to have a gabbroic (Jgu) protolith.

TKvc VOLCANIC CATACLASITE—Similar to TKcu but having a protolith of Talkeetna Formation volcanic rocks (Jtu).

TKsm CATACLASIZED METAMORPHIC ROCKS—Similar to TKcu but having a protolith of metamorphic rocks (Mzm).

Metamorphic rocks of the Peninsular terrane

Mzm METAMORPHIC ROCKS—Siliceous, pelitic, and semi-pelitic schists, epidote-amphibolite, and small amounts of garnet amphibolite and marble; about 70 percent are schists.

Mzsh SCHIST—Dominantly dark-red-brown, thinly interlayered siliceous schist, quartzite, pelitic schist, semi-pelitic schist, and minor amounts of metamorphosed marl, metadioritic rocks, and amphibolite; interpreted to be metamorphosed sequences of ribbon chert and siliceous argillite, with lesser amounts of metagraywacke and metatuff or both; metamorphic grade ranges from upper greenschist facies to epidote-amphibolite facies. Retrograde metamorphism of these metamorphic rocks is represented by a late generation of chlorite ± epidote and by veins of chlorite, carbonate, prehnite, and quartz. The unit is intruded by numerous trondhjemite dikes, small plutons, and veins.

Mza EPIDOTE-AMPHIBOLITE AND AMPHIBOLITE—Red-brown-weathering, fine- to medium-grained biotite-epidote amphibolite with lesser amounts of garnet amphibolite, marble, and calc-silicate; diorite and gabbroic rock locally intrude the amphibolite (see Mzmp).

The epidote-amphibolite contains 20 to 30 percent dark-blue-green to pale-yellow amphibole (actinolitic hornblende?), 30 to 50 percent granoblastic oligoclase, 1 to 30 percent clinozoisite-epidote, 10 to 20 percent red-brown biotite, 1 to 2 percent pale-green chlorite, and minor amounts of quartz, sphene, and magnetite ± white mica. Relict igneous plagioclase grains (blastophenocrysts) are andesine containing fine-grained clinozoisite-epidote and white mica.

Textures in the amphibolites range from granofels to finely laminated (foliated) schists. Amphibolite commonly shows thin (1 to 3 cm) compositional banding of lighter and darker layers. Trondhjemite in veins and concordant segregations parallel to the foliation of the schist may have formed by in-situ anatexis. Lenses to tens of meters thick of gray, siliceous marble and garnet-clinopyroxene-tremolite granofels are commonly present with the garnet-bearing amphibolite.

Mzmp METAMORPHIC AND PLUTONIC ROCKS—An intrusive complex consisting of gabbroic rocks (Jgu) or hornblende gabbro and gabbroic rocks (Jdqd) intruding amphibolite (Mza).

Bedrock of the Chugach terrane

TKmc MCHUGH COMPLEX CATACLASITE—Microbreccia and cataclasite similar to TKcu but inferred to have a protolith of McHugh Complex rocks.

Kvs / Kvt VALDEZ GROUP—Highly deformed gray and black phyllite, argillite, and thin- to thick-bedded graywacke; contains minor amounts of gray-green metatuff and stretched-pebble conglomerate. Metatuff and tuffaceous metaconglomerate (Kvt).

Kvp VALDEZ GROUP BLACK PHYLLITE—Highly deformed black phyllites interlayered with <30 percent very fine grained silty metagraywacke. Unit delineated only in Anchorage C-5 Quadrangle.

Kvg VALDEZ GROUP GRAYWACKE AND ARGILLITE—Interbedded sandstones and shales in which the sandstone to shale ratio is at least 1:1. Unit is delineated only in the Anchorage C-5 Quadrangle, where it forms the structurally lowest levels of the Chugach terrane in that area.

Kvc VALDEZ GROUP CONGLOMERATE GRAYWACKE—Massive units of foliated coarse-grained metagraywacke in which large dark argillite chips are interspersed. Unit is delineated only in the Anchorage C-5 Quadrangle.

Kmxu MCHUGH COMPLEX, UNDIFFERENTIATED—Dark-gray, very fine grained argillite, gray-green metatuff, and gray and green phyllite; also contains exotic blocks of graywacke, marble, and chert. The McHugh Complex in this area is highly deformed and composed of chaotically juxtaposed and intermixed lithologies; it is typically metamorphosed to the chlorite zone of the greenschist facies. Mineral assemblages consist of quartz + albite + chlorite + phengite + actinolite + epidote + magnetite + sphene ± carbonate. Late-stage veins are composed of quartz, calcite, and (or) prehnite.

Kmv MCHUGH COMPLEX METAVOLCANIC ROCKS—Medium-green or slightly bluish-green, predominantly massive low-grade greenstone with minor amounts of interlayered or chaotically intermixed dark-gray argillite. Locally, unit contains blocks of recrystallized marble and bedded chert as large as several meters.

Kmxv MCHUGH COMPLEX, PREDOMINANTLY METAVOLCANIC ROCKS—Mostly metavolcanic rock (50 to 80 percent) that is gradational between McHugh Complex metavolcanic rocks (Kmv) and metasedimentary rocks (Kms). Unit typically consists of light-green weakly to moderately foliated metatuff, interlayered and chaotically intermixed with dark-gray argillite. Metatuff contains abundant mud chip rip-ups.

Kms MCHUGH COMPLEX METASEDIMENTARY ROCKS—Dark-gray argillite and scaly argillite. Contains lenses of metatuff, bodies of graywacke, and bodies of chert.

Kmxs MCHUGH COMPLEX, PREDOMINANTLY METASEDIMENTARY ROCKS—Mostly metasedimentary rock (50 to 95 percent) that is gradational between the McHugh Complex metavolcanic rocks (Kmv) and metasedimentary rocks (Kms). Typically, the unit consists of dark-gray, scaly argillite and lenses and layers of green metatuff. Less commonly, consists of thinly interlaminated green and gray phyllite. Commonly contains blocks of marble, chert, and graywacke.