DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

GEOLOGIC QUADRANGLE MAP
MCCARTHY B-6 QUADRANGLE, ALASKA
GQ-1035

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS—The surficial deposits include alluvium, older alluvium, talus, rock glaciers, widespread glaciofluvial and glaciolacustrine deposits, and diverse moraines both on and off ice. The surficial deposits are mainly related to Quaternary glacial processes that shaped the physiography of the area. Precise ages of the surficial deposits were not determined. Several of the deposits are products of recurring deposition, and some overlap in age. In general, the older deposits are the glaciofluvial and glaciolacustrine deposits and some moraines, whereas the alluvium, talus, and rock glaciers, which include currently active ones, are the younger.

Qal, Qoa *ALLUVIUM AND OLDER ALLUVIUM*—Alluvial deposits characterize flood plains of the rivers, a few ancillary streams, and extensive outwash below the Kennicott Glacier. The deposits are well developed along low-gradient segments of sediment-laden glacial streams, mainly as ephemeral river bars and stream terraces. The alluvial deposits consist of well to poorly sorted unconsolidated detritus, mainly silt, sand, and gravel. Locally they are crudely stratified and, in places, show scour-and-fill structures and crossbedding. Older alluvium is generally confined to stepped stream terraces that support brush, grass, and small trees.

Qt *TALUS*—Talus forms local thin, narrow cones and aprons along steep hillsides in the mountainous part of the quadrangle. It consists entirely of freshly broken angular fragments and slabs of nearby rocks, chiefly felsic hypabyssal types, that range from a few inches to several feet in maximum dimension.

Qrg *ROCK GLACIERS*—Rock glaciers as much as 1½ miles long and ½ mile wide are well developed in the mountainous northern part of the quadrangle. Most are crudely lobate in outline, have steep fronts, and are 100 to 200 feet thick. Typically the rock glaciers occupy valleys headed by cirques, and are nurtured by rapid accumulation of locally derived rock debris falling from the steep cirque walls. The rock glaciers consist of disarrayed, angular, slabby, and blocky boulders that have a large size range. Most rock glaciers are currently active, but older parts of a few are stable and support scant vegetation.

Qm, Qmi *MORAINES AND MORAINES OVERLYING ICE*—Moraines both on and off ice are abundant in the northern part of the quadrangle. They include end, ablation, and lateral moraines, as well as scattered deposits that are probably remnants of ground moraine indicative of an older more widespread glaciation. The moraines on ice are exemplified by the ablation moraine that covers part of the Kennicott Glacier and by moraines that overlie a few alpine glaciers. End and lateral moraines are developed contiguous to the Kennicott Glacier and less extensively near some alpine glaciers. Moraines associated with the Kennicott Glacier are in places more than 100 feet thick. Other moraines are thinner.

The moraines consist of jumbled masses of angular and subangular boulders with a broad size range. Moraines associated with the Kennicott Glacier and those representative of older glaciation contain heterogeneous rock assemblages that include some rock foreign to the quadrangle. The other moraines are composed of nearby rocks.

Qg *GLACIOFLUVIAL AND GLACIOLACUSTRINE DEPOSITS*—Glaciofluvial and glaciolacustrine deposits mantle bedrock throughout most of the quadrangle. Their surfaces are marked by numerous subparallel ridges and troughs that trend about N. 65° W. Many of the ridges are eskers, and many of the troughs are occupied by elongate lakes. The deposits are as much as 500 feet thick, but they are much thinner over bedrock highs or near the mountainous upland. These deposits consist of near-horizontal sandstone, siltstone, and conglomerate that are poorly consolidated and readily eroded. They form buff to light-brown strata as much as 20 feet thick. Generally the deposits are well stratified; locally they are crossbedded. Their clasts are angular, subangular, or subrounded and range in size from silt fragments to boulders as much as 10 feet across. Those in the conglomerate and coarser sandstone are mainly composed of diverse rocks derived from the southern Wrangell Mountains. Clasts in the siltstone and finer sandstone are chiefly quartz and plagioclase.

The glaciofluvial and glaciolacustrine deposits are probably coextensive with similar deposits that cover large parts of the lower Chitina Valley and adjacent Copper River Basin. These deposits are interpreted to have formed mainly in a large proglacial lake whose size fluctuated periodically with glacial incursions and regressions. Radiocarbon dating of probably coeval glaciofluvial and glaciolacustrine deposits from the northeastern part of the Copper River Basin indicates a depositional span that extended from more than 38,000 years B.P. (before present) to 9,400 + 300 years B.P. (Ferrians, 1963, p. C121).

INTRUSIVE ROCKS —The intrusive rocks include intermediate granitic rocks and their andesitic border facies, felsic hypabyssal rocks, and andesitic and basaltic dikes. They are probably mainly shallow-seated intrusive affiliates of late Tertiary stages of Wrangell Lava volcanism, which ranges from Miocene to Holocene (MacKevett, 1970a, b).

QTa *ANDESITIC AND BASALTIC DIKES*—Andesitic and basaltic dikes are rare. They include steeply dipping andesitic dikes about 4 feet thick that cut intermediate granitic rocks and their associated andesitic border facies, felsic hypabyssal rocks, or Chititu Formation in the northern part of the quadrangle and a steeply dipping basaltic dike several hundred feet thick that cuts the Chititu Formation along the Nizina River. The dikes stand out from the rocks they cut. They are dark greenish gray with greenish-brown weathered surfaces. The dikes are strongly altered andesites and basalts that are generally porphyritic, with plagioclase and clinopyroxene phenocrysts in a very fine grained groundmass marked by abundant alteration products, chiefly chlorite, calcite, and epidote. The dikes are probably genetically affiliated with the Wrangell Lava and are inferred to be late Pliocene or Quaternary.

Tif *FELSIC HYPABYSSAL ROCKS*—Felsic hypabyssal rocks underlie large tracts in the mountainous northern part of the quadrangle and are exposed in widely scattered outcrops elsewhere. They are resistant chalky white, buff, or light-gray silica-rich rocks with local light-brown weathered surfaces. They form numerous small plutons, mainly sills, that cut the Chititu Formation or, rarely, the intermediate granitic pluton and its associated border-facies rocks. Locally the Chititu adjacent to some felsic plutons was mildly baked.

The dikes and sills are commonly 1 to 30 feet thick and exceptionally may be as much as several hundred feet thick. Some of them represent multiple intrusions, and several sills are marked by well-developed fractures parallel with and generally along contacts between successive intrusions. Where such fractures are closely spaced the sills have a pronounced platy texture.

The felsic hypabyssal rocks are conspicuously porphyritic, and most contain sufficient phenocrysts to be termed porphyries. They are altered dacites and minor rhyodacites that are characterized by abundant phenocrysts generally 1-2 mm long and rarely as much as 5 mm long in an extremely fine grained felty or intersertal groundmass. The phenocrysts are generally euhedral or subhedral and, in places, have been partly resorbed. They include plagioclase (mainly andesine), less abundant hornblende and quartz, and minor biotite. Some of the mafic phenocrysts have been replaced by chlorite pseudomorphs. The groundmasses are intensely altered. Their identifiable primary minerals are plagioclase, quartz, and less abundant to rare hornblende, biotite, apatite, magnetite, and sphene. K-feldspar is a fairly abundant groundmass constituent of the rhyodacite, and a few felsic rocks contain sparsely disseminated pyrite. Alteration products dominate most groundmasses and include chlorite, calcite, sericite, illite and other clay minerals, and subordinate hematite, clinozoisite, epidote, and a zeolite.

The felsic hypabyssal rocks and the intermediate granitic rocks are thought to represent shallow-seated intrusive phases of the Wrangell Lava. Although the felsic rocks postdate the intermediate granitic rocks, which are Pliocene, they apparently represent the same general episode of intrusive activity and are probably late Pliocene.

Ta *BORDER FACIES ANDESITIC ROCKS*—Andesitic rocks crop out in the eastern part of the stock in the northwest part of the quadrangle, where they form moderately rugged outcrops. They are gradational with the granitic rocks and have invaded and generally baked nearby Chititu rocks. They are cut by a few felsic hypabyssal and andesitic dikes. The andesitic rocks are interpreted to be a border facies of the granitic pluton. They consist of andesite and subordinate diabase, contain more mafic minerals and are finer grained than the granitic rocks, and they generally have porphyritic textures.

The typical andesitic rocks contain plagioclase and frayed clinopyroxene (probably augite) phenocrysts as much as 5 mm long in a very fine grained intersertal groundmass rich in plagioclase. Atypical variants have a fine-grained subophitic groundmass or are entirely subophitic. Hypersthene is fairly abundant in some of the andesitic rocks. The minor to rare minerals include partly secondary biotite, hornblende, magnetite, quartz, and sphene, and various alteration products—hematite, calcite, quartz, prehnite, chlorite, sericite, and clay minerals. Spatial and probable genetic relationships with the granitic rocks suggest that the andesitic rocks are of Pliocene age.

Ti *INTERMEDIATE GRANITIC ROCKS*—Granitic rocks of intermediate composition crop out boldly in a small stock that cuts the Chititu Formation in the northwestern part of the quadrangle. The Chititu near the stock has been baked. The granitic rocks grade eastward into an andesitic border facies. They are cut by felsic hypabyssal rocks and andesitic dikes and by quartz or calcite veins and veinlets.

The granitic rocks consist of medium-grained granodiorite and quartz diorite and local fine-grained diorite. They are mainly hypidiomorphic-granular rocks with diverse amounts of mafic minerals. Plagioclase is dominant and usually consists of normally or oscillatorily zoned calcic andesine or, locally, minor sodic labradorite. Other minerals in the granodiorite are fairly abundant quartz, K-feldspar, hornblende, and biotite, minor to rare magnetite, ilmenite, apatite, and sphene, and alteration products including chlorite, calcite, clay minerals, and clinozoisite. The quartz diorite contains less K-feldspar and biotite and more hornblende than the granodiorite. Most of the quartz diorites also contain some augite and traces of pyrite and hematite. The diorites lack quartz and contain only trace amounts of K-feldspar, but otherwise they are mineralogically similar to the quartz diorites. Some contain minor to abundant hypersthene.

The granitic rocks are probably coeval with similar granitic rocks that are widely distributed in the southern Wrangell Mountains. In the McCarthy C-5 and C-6 quadrangles similar granitic rocks cut the Miocene Frederika Formation or the lower (Miocene) parts of the Wrangell Lava (MacKevett, 1970b, 1972). Granitic rocks exposed near the west-central margin of the McCarthy B-3 quadrangle gave a concordant potassium-argon age of 8.4 ± 0.25 million years on hornblende and biotite (MacKevett, 1970c). The granitic rocks of the B-6 quadrangle are therefore considered to be Pliocene.

Kc, Kch **CHITITU FORMATION** —The Chititu Formation is well exposed in the upland terrain and along the Nizina and Chitina Rivers. Chititu rocks are inferred to be concealed beneath surficial deposits throughout most of the lowland. These rocks characteristically erode to smooth subdued surfaces with local protuberances of more resistant strata and lenses. Stratigraphic contacts are exposed only along the Nizina River and west of the Kennicott Glacier, where the Chititu apparently conformably overlies the Kennicott Formation. The incomplete Chititu stratigraphic section is probably at least 3,000 feet thick.

The Chititu Formation is predominantly mudstone, with less abundant sandstone, siltstone, shale, and impure limestone, minor porcellanite, and sparsely distributed limy concretions. The mudstones are massive and blocky, but the other rocks are thin bedded. Some sandstones and limestones are lenticular. The concretions are typically spherical and between 1 and 6 inches in diameter. A few are as much as 1½ feet in diameter. Some of the smaller concretions are discoidal. Most Chititu rocks are dark greenish gray with light- or greenish-brown weathered surfaces. Less abundant variants are medium gray, dark gray, or greenish black.

Chititu mudstones are extremely fine grained and contain abundant subangular clasts between 0.01 and 0.03 mm long in a microcrystalline matrix that generally constitutes 10 to 50 percent of the rock. The clasts include abundant quartz and Na-rich plagioclase and moderately abundant to rare cherty lithic fragments, biotite, K-feldspar, opaque minerals, chlorite, calcite, apatite, and zircon. The matrix consists of chalcedony, chlorite, illite, sericite, and carbonaceous material.

The sandstones, siltstones, and shales are mineralogically similar to the mudstones. The sandstones contain subangular clasts between 0.1 and 0.4 mm long and generally are calcite cemented. Cherty lithic fragments are more abundant than the mudstones. A few of the sandstones contain cannibalized fragments of Chititu mudstone or minor amounts of a zeolite, probably stilbite. The sandstones are mainly feldspathic arenites (terminology of Williams, Turner, and Gilbert, 1954, p. 293). Some sandstones have graded bedding and scour-and-fill structure. The siltstones and shales are finely laminated with quartz-rich silt- or clay-size particles scattered throughout a microcrystalline matrix.

The porcellanites contain dispersed very fine grained clasts, chiefly quartz and plagioclase, set in a chalcedony-rich microcrystalline matrix. The impure limestones contain minor amounts of very fine grained noncarbonate detritus, chiefly quartz and plagioclase, in a matrix of partly recrystallized lime mud that contains subordinate sericite and carbonaceous material. They qualify as impure lime mudstones in Dunham's (1962) classification.

Baked and welded rocks (Kch) in the Chititu Formation are exposed near some intrusive masses in the northern part of the quadrangle. These rocks are characterized by moderate-brown weathered surfaces, hackly and subconchoidal fracture, and greater induration than most Chititu rocks. They show the effects of incipient recrystallization but retain mineral assemblages similar to those of the Chititu mudstones.

Fossils from the Chititu Formation include *Inoceramus*, ammonite fragments, and microfossils, which are particularly abundant in some of the silica- or carbonate-rich pelites. Studies of Chititu megafossils by D. L. Jones indicate that most of the formation is Late Cretaceous, with an age span extending from at least Cenomanian to late Campanian. The age of the basal Chititu strata varies throughout the general region. The basal exposures along the Nizina River constitute the oldest known Chititu, and contain fossils indicative of the Lower Cretaceous Albian (probably early Albian) Stage (Jones and MacKevett, 1969, p. K17).

Kk **KENNICOTT FORMATION** —The Kennicott Formation is exposed locally in the northern part of the quadrangle and along the lower part of the Nizina River. The formation forms bold to subdued outcrops. It is almost 500 feet thick along the Nizina River where it unconformably overlies metamorphic rocks and is apparently conformably overlain by the Chititu Formation. A similar Kennicott-Chititu contact is exposed in a bedrock window near the western edge of the Kennicott Glacier. Elsewhere in the quadrangle neither the base nor the top of the Kennicott is exposed.

The formation consists mainly of thick-bedded to massive sandstone that grades downward into a thin basal conglomerate and upward into zones characterized by siltstone and minor shale. Calcareous concretions, generally 1 to 3 feet in diameter, are widely distributed. Lithologic descriptions of the Kennicott by Jones and MacKevett (1969, p. K9, K10) are generally applicable to the Kennicott Formation in the B-6 quadrangle. The rocks range from medium gray to dark greenish gray and weather diverse shades of brown. Kennicott sandstones in the B-6 quadrangle are feldspathic wacke and subordinately feldspathic arenite (terminology of Williams, Turner, and Gilbert, 1954, p. 290). These rocks are fine grained and characterized by subangular clasts, chiefly quartz, plagioclase (mainly andesine), and lithic fragments, set in a microcrystalline matrix that constitutes as much as 15 percent of the rock. The matrix generally contains chlorite, chalcedony, and clay minerals and minor calcite, carbonaceous material, and opaque dust. Other minerals found in moderate to trace amounts in some Kennicott sandstones include albite, actinolite, biotite, opaque minerals, sericite, clastic calcite and chlorite, glauconite, zircon, K-feldspar, epidote, clinozoisite, sphene, and garnet.

Only the lower unit of the regionally bipartite Kennicott Formation has been paleontologically documented in the quadrangle. This unit contains a faunal zone characterized by the ammonite *Moffitites robustus*, and the pelecypod *Aucellina* that is indicative of an early Albian (Early Cretaceous) age (Jones and MacKevett, 1969, p. K10, K11). Fossil wood is locally distributed in lower parts of the formation.

Ꞧng **NIKOLAI GREENSTONE**—The Nikolai Greenstone, a regionally widespread thick sequence of altered subaerial lavas, crops out over a small area near the northeast corner of the quadrangle. It is bounded laterally by Quaternary surficial deposits. The Nikolai Greenstone forms moderately rugged outcrops. Flows average about 10 feet in thickness, and the formation's exposed thickness in the quadrangle is about 400 feet. The Nikolai consists of altered basalts that are dark greenish gray or dark gray and weather greenish or reddish brown. Typical Nikolai basalts are fine grained, amygdaloidal, and porphyritic with intergranular groundmasses. They consist chiefly of labradorite and clinopyroxene and an array of alteration and amygdaloidal minerals dominated by chlorite. More detailed petrographic descriptions of the Nikolai Greenstone from nearby quadrangles are given in several publications, mainly MacKevett (1970a, c). On the basis of stratigraphic relations in the McCarthy C-4 quadrangle (MacKevett, 1970a) the Nikolai is late Middle and (or) early Late Triassic in age.

Pm **METAMORPHIC ROCKS** —Metamorphic rocks are exposed in canyon walls along the incised lower reaches of the Nizina River and near the western boundary of the quadrangle north of the Chitina River. They form bold to subdued outcrops. The metamorphic rocks are unconformably overlain by Quaternary surficial deposits or locally by the Kennicott Formation, but neither top nor base is exposed. The exposed metamorphic rocks probably represent a stratigraphic thickness of several thousand feet, but accurate thickness determinations are precluded by the lack of discrete marker horizons and by structural complexity.

The metamorphic rocks are greenish- and brownish-gray schists and phyllites with intervening, probably lenticular, zones of foliated, light-gray marble as much as 100 feet thick. Most of the rocks are fine grained. Many are intricately folded and sheared and show multiple deformation. Mineral assemblages are indicative of the greenschist-amphibolite transition facies (Turner, 1968, p. 303). The schists and phyllites consist dominantly of quartz and brown biotite that are generally associated with oligoclase, calcite, actinolite or tremolite, epidote or clinozoisite, and muscovite. Minor to rare minerals in some schists and phyllites include albite, chlorite, opaque minerals, chiefly magnetite, sphene, apatite, garnet (probably almandine rich), zircon, K-feldspar(?), and diopside.

The marble consists of crystalloblastic assemblages of calcite crystals between 1 and 2 mm long and subordinate phlogopite, tremolite, quartz, plagioclase, and sphene that together constitute about 25 percent of the rock.

No fossils were found in these rocks. They are probably metamorphosed counterparts of some Skolai Group rocks similar to those described in the McCarthy B-4 and C-4 quadrangles (Smith and MacKevett, 1970) and accordingly are probably Early Permian. Similar metamorphic rocks are widely distributed throughout parts of the Chitina Valley and along the flanks of its bordering mountains (Moffit, 1938, pl. 2).

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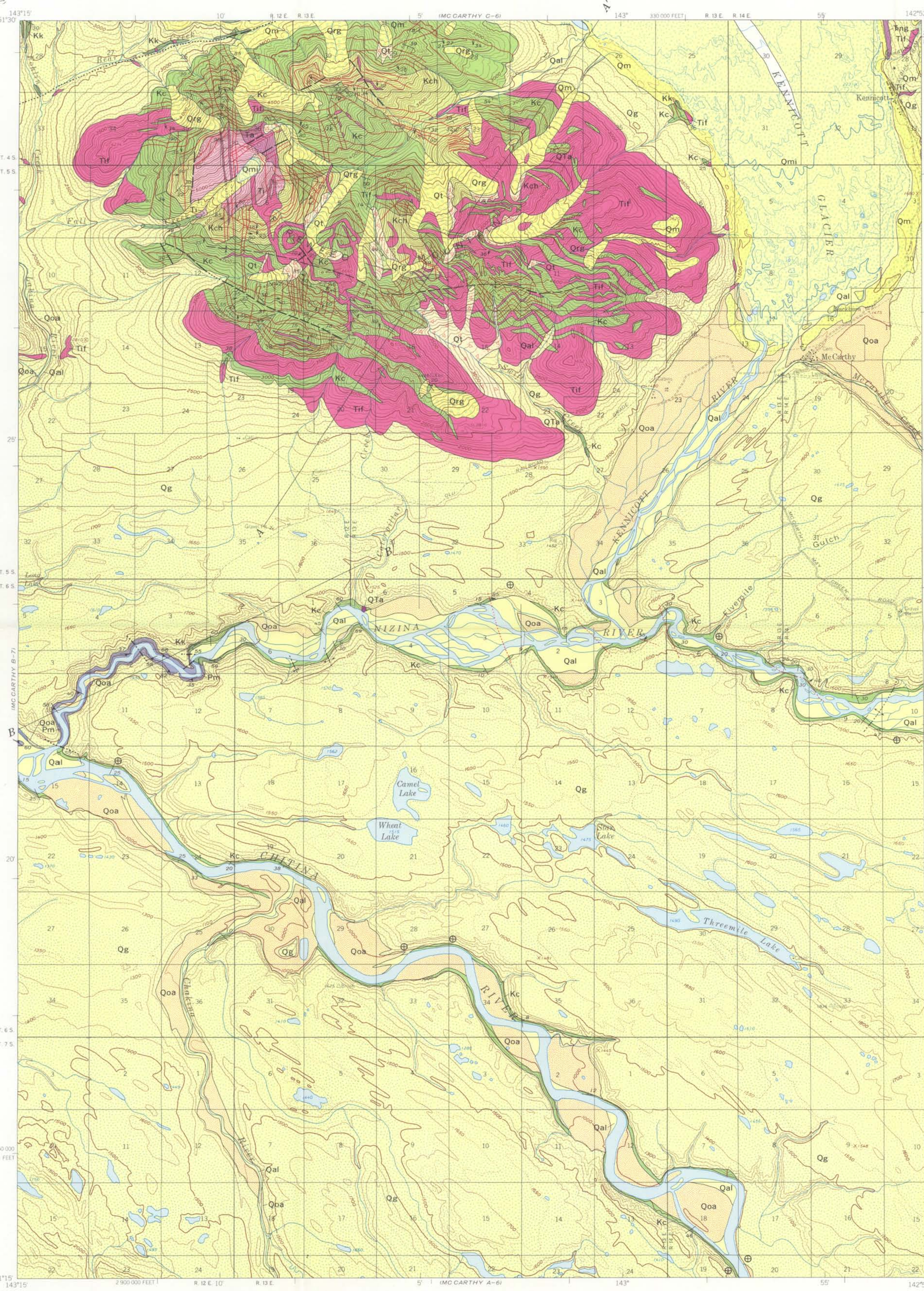


Base from U.S. Geological Survey, 1966
Universal Transverse Mercator projection.
1927 North American datum 10,000-foot grid based on Alaska coordinate system

APPROXIMATE MEAN DECLINATION, 1972

SCALE 1:63 360

CONTOUR INTERVAL 100 FEET
DOTTED LINES REPRESENT 50 FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

QUADRANGLE LOCATION

Geology mapped by E. M. MacKevett, Jr., J. G. Smith, and G. R. Winkler, 1967

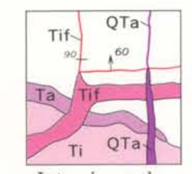
EXPLANATION

Qal	Qoa	Qt	Qrg	Qm	Qmi	Qg

Surficial deposits
Age equivalence not implied
Qal, *alluvium*
Qoa, *older alluvium*
Qt, *talus*
Qrg, *rock glaciers*
Qm, *moraines*
Qmi, *moraines overlying ice*
Qg, *glaciofluvial and glaciolacustrine deposits*

QUATERNARY

UNCONFORMITY



Intrusive rocks
QTa, *andesitic and basaltic dikes*
Tif, *felsic hypabyssal rocks; in places showing dips of dikes or sills; dotted where concealed*
Ta, *border facies andesitic rocks*
Ti, *intermediate granitic rocks*

Pliocene — TERTIARY

Kc / Kch

Chititu Formation
Top unexposed
Kc, *dominantly mudstone*
Kch, *baked and welded rocks*

Lower and Upper Cretaceous

Kk

Kennicott Formation
Dominantly sandstone

Lower Cretaceous — CRETACEOUS

UNCONFORMITY

Ꞧng

Nikolai Greenstone
Altered subaerial basalt.
Top and base unexposed

Middle and (or) Upper Triassic — TRIASSIC

Pm

Metamorphic rocks
Schist, phyllite, and marble.
Top and base unexposed

Lower Permian(?) — PERMIAN(?)

Contact, approximately located, showing dip
Dotted where concealed

Steep fault, approximately located
Dotted where concealed

Vertical fault, approximately located

Anticline — Syncline
Fold axes, approximately located, showing trace of axial surface
Dotted where concealed

Inclined — Vertical — Horizontal
Strike and dip of beds

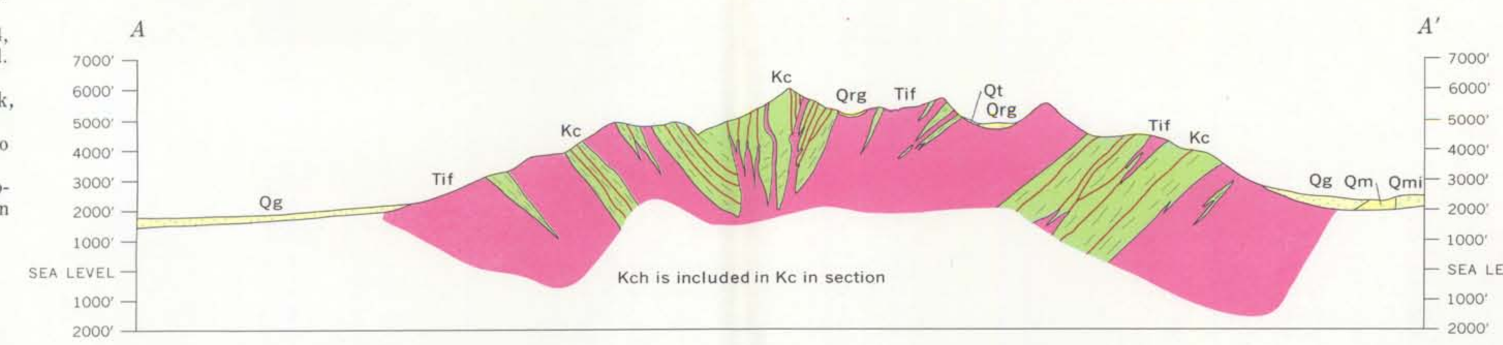
Strike and dip of foliation

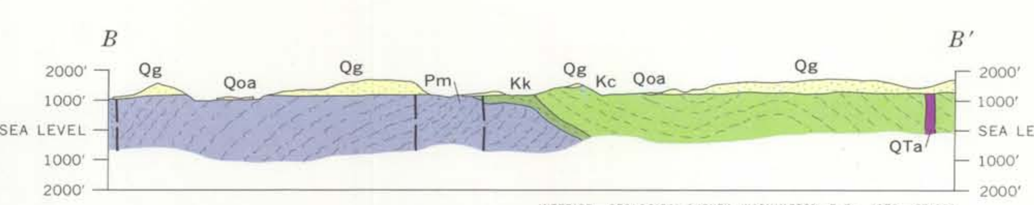
GEOLOGIC SUMMARY

The southern front of the Wrangell Mountains and the lower parts of the Kennicott Glacier extend into the northern part of the quadrangle. The southern part of the quadrangle is dominated by the lowlands of the Chitina Valley, which are largely mantled by glaciofluvial and glaciolacustrine deposits. Erosional and depositional features related to glaciation characterize the quadrangle's physiography. Bedrock exposures are confined to the mountainous upland and the incised lowland river valleys. The rocks range in age from probable Early Permian to Quaternary, an age span as long as any in nearby quadrangles. However, long periods of time are unrepresented by the geologic record in the B-6 quadrangle, and some characteristic Mesozoic formations of the southern Wrangell Mountains are absent. Most outcrops are either pelitic rocks of the Cretaceous Chititu Formation or upper Tertiary hypabyssal rocks.

Several broad folds and steep faults are exposed in the quadrangle. Generally these structures strike northwest, but only a few can be traced any appreciable distance because of glacial overburden. The largest exposed structure is a west-striking syncline on Fireweed Mountain.

There are no mines or prospects in the quadrangle. The glaciofluvial, glaciolacustrine, and alluvial deposits have supplied minor amounts of gravel for road metal and other local uses. Reconnaissance geochemical sampling (Winkler and others, 1971) detected anomalous concentrations of several metals, mainly from altered zones and quartz veins in the northern part of the quadrangle. Samples from the altered zones contained as much as 0.2 ppm (parts per million) gold, 2 ppm silver, 50 ppm molybdenum, and 2,000 ppm copper. The quartz veins are typically only a few inches thick. The richest sampled quartz vein contained 0.4 ppm gold, 7 ppm silver, 5,000 ppm arsenic, 150 ppm copper, 150 ppm lead, and 500 ppm zinc.





GEOLOGIC MAP OF THE MCCARTHY B-6 QUADRANGLE, ALASKA

By

E. M. MacKevett, Jr., and James G. Smith

1972

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1972

For sale by U.S. Geological Survey, price $1.00