Typically the pluton of Mt. Blackburn consists of biotite-hornblende granodiorite; locally it

grades into quartz monzondiorite. Texturally the pluton has two aspects; generally it is fine

grained and hypidiomorphic-granular, but large areas have a porphyritic intergranular tex-

ture. Undigested lapilli of porphyritic andesite and dacite are numerous, an indication of the

pluton's subvolcanic intrusive character. Plagioclase (andesine), hornblende, quartz, and

K-feldspar are essential minerals in the pluton, although the latter two are rather variable in

abundance. Biotite generally is present but varies greatly in amount; epidote and opaque

minerals are ubiquitous accessories; and clinopyroxene, sphene, and apatite usually occur in

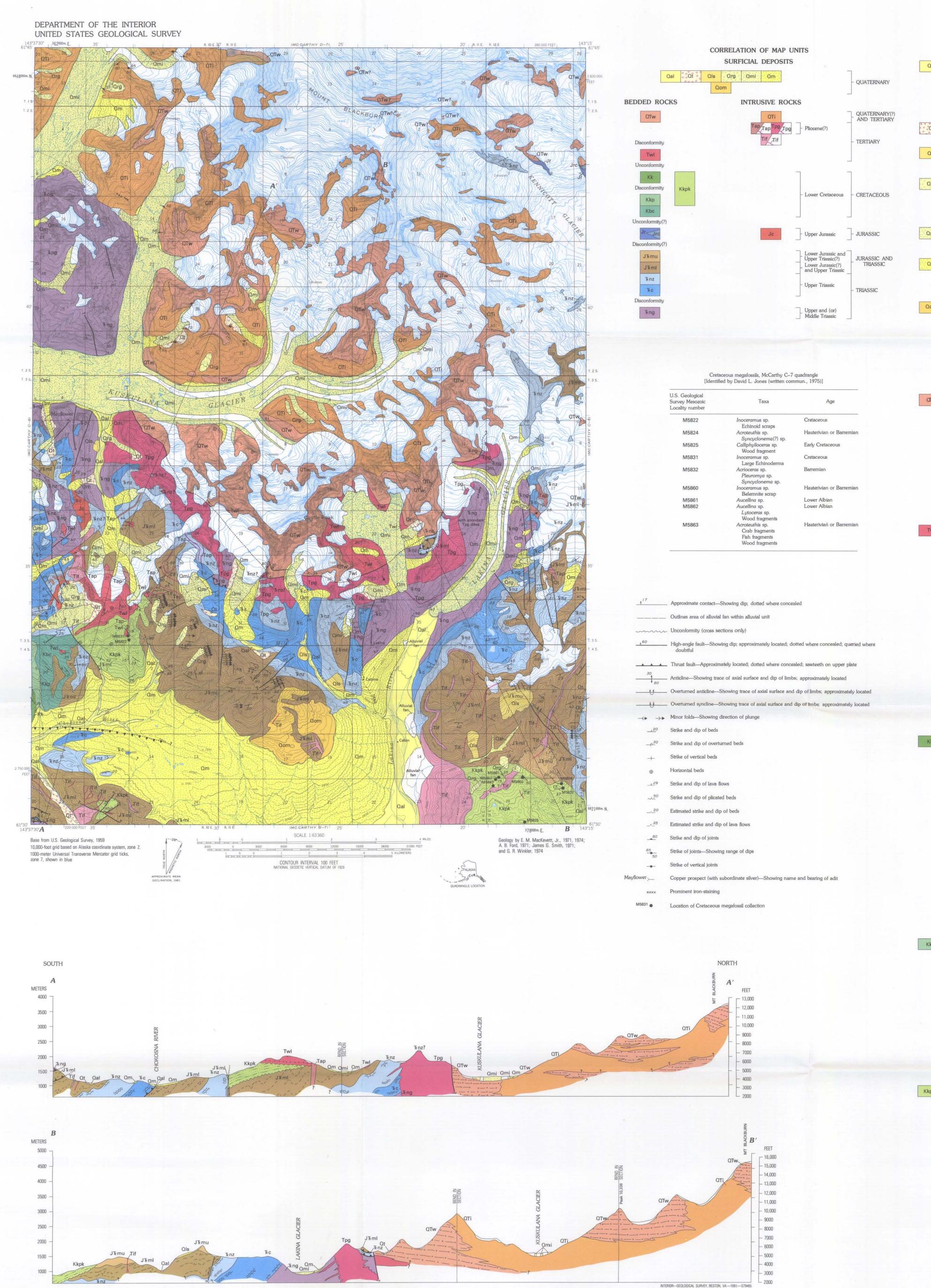
trace amounts. Inclusions of porphyritic hornblende andesite are common. Deuteric alteration

is extensive and consists of carbonate and chlorite replacements of hornblende and biotite,

The pluton forms most of the Mt. Blackburn massif: cirques on the south face expose best

the composite intrusive and volcanic character of the mountain. The imposing steepness of

and sericitization of plagioclase. Veins and patches of prehnite occur locally.



DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS ALLUVIUM-Glacial outwash and alluvium are widely distributed along bars, flood plain, and terraces of the Lakina River, where they fill present and former braided distributaries. Older alluvium and outwash above the present flood plain support a vegetative cover. Several short steep tributaries of the Lakina have formed alluvial fans at the abrupt change in gradient where they debouch into the main valley. A braided alluvial plain also occurs in the west-central part of the quadrangle along the lower reaches of an unnamed tributary to the Kuskulana Glacier. Elsewhere in the quadrangle, a thin veneer of alluvial is present along the middle reaches of a few streams and along the Chokosna River. The alluvium and outwash consist of unconsolidated detritus, chiefly poorly sorted gravel and sand. Maximum thicknesses of alluvium are not known but probably do not exceed 60 m.

TALUS-Thin aprons and lobes of talus are widespread in the quadrangle; only the more extensive deposits are shown. Generally the talus consists of coarse angular debris a few meters thick derived from adjacent bedrock. At many places the talus merges downslope into moraines or rock glaciers. LANDSLIDE DEPOSITS—Landslides occur along steep sidewalls of a few tributaries of the Lakina

River and Kuskulana Glacier. They consist of jumbled mixtures of rock and regolith and are characterized by hummocky surfaces and broad size range of their constituents. Some blocks are tens of meters in maximum dimension. Thicknesses of the landslides are not known but probably do not exceed 20 m. ROCK GLACIERS—Rock glaciers are well developed throughout the quadrangle and consist of lobate, spatulate, or sinuous trains of disarrayed angular slabs and blocks of local derivation.

They are partly cemented by ice and often display surface furrowing that is indicative of mass movement downslope. The rock glacier in T. 3 S., R. 10 E., sec. 10 is sufficiently active to have dammed a tributary of the Kuskulana Glacier. It is breached by a waterfall and separates alluvial plains whose elevations differ by 20 m. Rock glaciers characteristically merge upslope with talus, moraines, or alpine glaciers. Maximum thicknesses are not known but may exceed MORAINE ON ICE—Supraglacial moraines completely mantle the lower reaches of the Kuskulana

and Lakina Glaciers, some of their tributaries, and parts of alpine glaciers throughout the quadrangle. They are physically similar to moraines unit (Qm) described below but are underlain by ice. They consist dominantly of unweathered coarse rock debris, in a few places encased in gravelly mud. MORAINE—Lateral, end, and ground moraines of former more advanced stages of glaciation are

widespread. Many are proximal to modern glaciers. The broad moraine between the Lakina

and Chokosna River valleys, however, is a remnant of regional glaciation; it may include

minor glacial-lacustrine or glaciofluvial deposits. The moraines consist mainly of unsorted

boulders, cobbles, and gravel of diverse lithologies. The older moraines are weathered and support vegetation. Maximum thickness are unknown; exposed thicknesses on the order of 10 HIGH-LEVEL MORAINE—A discontinuous mantle of weathered glacial erratics lies above hummocku to smooth gravel-covered or bedrock upland with a well-developed soil profile in the south-central part of the quadrangle. It is probably the remnant of a once widespread deposit now largely modified by periglacial processes. Maximum thickness is 2-4 m.

BEDDED ROCKS The Wrangell Lava was named by Mendenhall (1905, p. 57-62) to designate the voluminous effusive rocks from the summit volcanoes of the Wrangell Mountains. The Wrangell Lava is part of a calc-alkaline volcanic province that extends through much of interior southern Alaska and nearby parts of the Yukon Territory in Canada. No direct evidence for the age of the Wrangell Lava has been gained in the McCarthy C-7 quadrangle, but regionally its age ranges from Miocene to Holocene.

The Wrangell Lava has been divided here informally into two parts: an upper member, by far the larger proportion of the formation, and a basal lower member that is exposed near Castle Peak and in isolated outcrops in the west-central part of the map. Upper member—Subaerial flows of the upper member of the Wrangell Lava are widespread in the central part of the quadrangle and are most conspicuous in the precipitous southern cliffs of Castle Peak, where they overlie the lower member with apparent disconformity. In addition, large areas near the summit and on the flanks of Mt. Blackburn consist of wellbedded volcanic rocks of the upper member. Outcrops generally are rugged and steep. Most flows are 1-5 m thick, but in many places well-developed vertical joint surfaces extend through more than one flow and mask bedding. The rocks are light to dark gray where fresh, and they weather various shades of brown to dark yellowish or greenish brown. The upper member is composed largely of differentiated andesite and dacite flows, but includes subordinate basaltic andesite and olivine basalt flows and dacitic puroclastic or laharic deposits. Typically the rocks are porphyritic, with phenocrysts of many sizes up to 2 mm in a very fine grained felted groundmass. Phenocrysts generally constitute about 10 percent of the rock. Vitrophyric or aphyric textures are common also, and a few flows are amygdaloidal or lapilli-rich. The andesite and basaltic andesite contain zoned plagioclase (andesinelaboradorite) and hornblende as their dominant phenocrysts and groundmass minerals, with lesser amounts of augite, ilmenite, apatite, epidote, sphene, chlorite, and carbonate or clay minerals in the groundmass. The dacite typically contains zoned plagioclase (andesine), homblende, strongly pleochroic biotite, embayed quartz, and partially resorbed augite phenocrysts. Groundmass minerals are the same as above, but frequently quartz and ortho

clase form a microcrystalline mosaic between phenocrysts The thickness of the upper member of the Wrangell Lava may exceed 3000 m. ower member—The lower member of the Wrangell Lava crops out in two places in the

(1) on the eastern and western sides of Castle Peak, where it is overlain along a very irregular contact by well-bedded, bold outcrops of the upper member and its base is not exposed;

(2) in the west-central part of the quadrangle where it overlies Upper Triassic and Lower Cretaceous rocks with slight to marked angular conformity and its top is not exposed. The substrate had considerable relief, as the small outcrop in T. 3 S., R. 10 E., secs. 22 and 23 demonstrates. The upper contact, where exposed, is disconformable, but it may represent only a brief hiatus between earlier, more explosive eruptions and subsequent more quiescent extrusions of regional extent. The lower member forms rugged or rounded slopes, and layering is irregular or absent. The rocks are light gray where they are fresh but weather rubbly or platy with distinctive rusty-tan to purplish coloration. The lower member consists predominantly of thin, terrestrial andesite and dacite flows, which are interbedded with thick volcanic breccias, lahar deposits, tuffs, and tuffaceous sedimentary rocks. In a few places, especially near the base of the western outcrops, minor conglomerate, marl, and carbonaceous shale are exposed. The flows generally are porphyritic, with small phenocrysts of strongly zoned plagioclase (andesine), homblende, biotite, and embayed quartz. Alteration has affected only scattered phenocrysts but has pervaded the groundmass, which consists of combinations of quartz, orthoclase, carbonate, chlorite, chalcedony, or epidote. The breccias, lahar deposits, and tuffs consist of angular to rounded, poorly sorted blocks, boulders, cobbles, and lapilli of felsitic, intersertal, microporphyritic, pilotaxitic, or amygdaloidal volcanic clasts. Matrices are completely altered to silica, chlorite, sericite, and carbonate or clay minerals. Tuffaceous sandstone consisting entirely of volcanic lithic clasts is common in places. Nonvolcanic sedimentary rocks are found only near the base of the lower member, thus this member may correlate in part with rocks in nearby areas that have been termed the Frederika Formation (for example, MacKevett, 1972). In its type area, however, the Frederika Formation (MacKevett, 1970) consists of diverse nonvolcanic continental sedimentary rocks that gradationally underlie or are intercalated with flows of the Wrangell Lava. Inasmuch as the lower member in the C-7 quadrangle lacks a significant nonvolcanic component, it has been mapped as part of the Wrangell Lava.

The lower member of the Wrangell Lava may exceed 500 m in thickness. It is cut by numerous dacitic, andesitic, and basaltic dikes, sills, and small plutons (map units Tif, Tap, and Tpg) that are presumed to be feeders to, or subvolcanic phases of, the upper member. KENNICOTT FORMATION—The Kennicott Formation crops out in a small area in the westcentral part of the quadrangle. These outcrops are continuous with more extensive exposures in the McCarthy C-8 quadrangle—part of the sequence of Lower Cretaceous formations described by MacKevett and others (1978). Descriptions of the Lower Cretaceous units herein are abstracted largely from that report. The Kennicott Formation overlies the Kuskulana Pass Formation along poorly exposed contacts that apparently are slightly unconformable. Probable Kennicott Formation also occurs about 3 km northeast of the outcrops mentioned above and in an area of poor exposure in the southeastern comer of the map; in both areas we have been unable to distinguish between the Kennicott and Kuskulana Pass Formations. The area in the southeast corner of the map is adjacent to the redefined type locality of the Kennicott Formation in the C-6 quadrangle (Jones and MacKevett, 1969, p. K4-K8). The Kennicott Formation is overlain unconformably by the lower member of the Wrangell Lava. The Kennicott Formation consists mainly of fine-grained sandstone and siltstone, but it includes much shale and some conglomerate, mainly near its base. Most of the rocks are thinly bedded. Some sandstone has crude graded bedding, crossbedding, and sole marks, and spherical limey concretions as much as half a meter in maximum dimension are distributed sparsely in parts of the formation. Most of the Kennicott is dark gray or dark greenish gray on fresh surfaces and weathers to shades of brown. The sandstone mainly is feldspathic or lithic wacke (terminology of Pettijohn and others, 1972, p. 158), and is characterized by poorly to moderately sorted subangular clasts embedded in a microcrystalline phyllosilicate, siliceous, or calcareous matrix. Framework grains are mainly quartz, plagioclase, biotite, detrital calcite, and various types of lithic clasts, chiefly altered volcanic grains probably derived from the Nikolai Greenstone. Glauconite and opaque minerals are minor constituents. Matrix constitutes at least 15 percent of Kennicott sandstone and largely is secondary chlorite, chalcedony, calcite, clay minerals, and hydrous oxide iron minerals. Conglomerate in the Kennicott

The Kennicott Formation is widely distributed in the southern part of the McCarthy 1:250,000 quadrangle (MacKevett, 1978). It presumably indicates rapid shallow marine deposition in a transgressive sea. Regionally the Kennicott is late Early Cretaceous (Albian) in age, and it correlates with the lower part of the revised Matanuska Formation in the Talkeetna Mountains to the west (Grantz, 1964, p. I10). In the McCarthy C-7 quadrangle, only a lower Albian faunal zone, documented by the pelecypod Aucellina, was recognized. KUSKULANA PASS FORMATION—The Kuskulana Pass Formation crops out in the west-central part of the quadrangle, where it is continuous with the type section in the eastern part of the McCarthy C-8 quadrangle (MacKevett and others, 1978). It underlies the Kennicott Formation with disconformity or slight angular unconformity and overlies the Berg Creek Formation gradationally. Probable Kuskulana Pass Formation also crops out about 3 km northeast of these outcrops and in an area of poor exposure near the southeastern corner of the map,

where we were unable to separate the Kuskulana Pass Formation from the Kennicott

Formation above.

contains clasts with a broad size range that are locally derived, and consist chiefly of Nikolai

At its type section the Kuskulana Pass Formation is about 300 m thick and underlies subdued to moderately steep slopes. It is uniformly thin-bedded and consists of very fine and fine-grained sandstone, siltstone, and subordinate shale. Limy lenses and spheroidal limy concretions up to 20 cm in size are sparsely distributed in parts of the formation. The rocks are medium gray to dark greenish gray on fresh surfaces and weather to shades of brown. The sandstone consists of moderately sorted subangular, very fine to fine-grained clasts embedded in a microcrystalline phyllosilicate or calcareous matrix that averages about 15 percent of the rock. Compositionally the sandstone ranges from arkosic to lithic wacke (Pettijohn and others, 1972): detrital components include quartz, plagioclase, and locally chert, minor lithic clasts, glauconite, carbonate minerals, opaque minerals, K-feldspar, biotite, epidote, and prehnite Matrices mostly are chlorite, with lesser white mica, hydrous iron oxides, and clay minerals; some samples have abundant sparry calcite cement. The Kuskulana Pass Formation accumulated fairly rapidly in a sihallow marine setting. Definitive ammonite and pelecypod collections from the McCarthy C-7 quadrangle, which

include Acrioceras and Syncyclonema, are indicative of the Barremian Stage of the Early

Cretaceous (D. L. Jones, oral commun., 1975). KENNICOTT AND KUSKULANA PASS FORMATIONS, UNDIVIDED-Two areas of poorly exposed Lower Cretaceous sedimentary rocks, each several square kilometers in extent, were mapped as undivided Kennicott and Kuskulana Pass Formations. A third isolated smaller area was mapped in T. 4 S., R. 10 E., sec. 22. In the west-central part of the quadrangle, rocks of this unit unconformably overlie the lower member of the McCarthy Formation with marked angularity and unconformably underlie the lower member of the Wrangell Lava with slight angularity. In the southeastern corner of the quadrangle, rocks of this unit unconformably overlie the Nizina Limestone and the lower and upper members of the McCarthy Formation with marked angularity. Here their top is not exposed. The unit is intruded by dikes and small plutons of Tertiary hypabyssal rocks. Outcrops form smooth undulating to steep gullied slopes. On fresh surfaces, outcrops are varied shades of dark greenish gray or medium gray, and weather to shades of brown and tan. The rocks are generally thin bedded and consist largely of calcareous siltstone, very fine grained sandstone, and shale. Spheroidal limestone concretions of widely varying size and sparse limy lenses occur in part of the unit, particularly within the shale. Siliceous siltstone and chert that may be secondary occur in several places; they contain scattered siliceous micro fossils. Fine- to medium-grained sandstone is conspicuous near the top of the unit in its western outcrops, and near the base of the unit in its eastern outcrops; in the eastern outcrops, much of the sandstone is a distinctive green on weathered surfaces. The sandstone varies from lithic to arkosic wacke. Subangular to subrounded grains of quartz, plagioclase, volcanic and sedimentary rock fragments, chert, and limestone always are present but in varying proportions. Glauconite generally is present and in a few places predominates. Most sandstone is calcareous and, in addition, frequently contains fragmented calcareous fossils: foraminifers, algae, sponge spicules, and mollusks. Diagenesis of rock fragments in many places has filled interstices with chlorite, clay minerals, and hydrous iron oxides. Most siltstone and shale is compositionally similar to the sandstone; mudstone and wackestone (terminology of Dunham, 1962, p. 117) also occur and are strongly bioturbated and contain calcareous pellets and microfossils.

Undivided rocks of the Kennicott and Kuskulana Pass Formations were deposited in a shallow marine environment. Influx of terrigenous detritus was episodic, and both an epifauna and an infauna developed. Megafossils ranging in age from lower Albian to Barremian were collected from the unit, chiefly from the southeastern exposures. Locations are shown on the map; identifications and ages are given in the accompanying table.

BERG CREEK FORMATION-A distinctive bioclastic sandy limestone unit, named the Berg Creek Formation named by MacKevett and others (1978) for exposures in the adjacent McCarthy C-8 quadrangle, extends 2-3 km into the west-central part of the C-7 quadrangle. The formation unconformably overlies the Nizina Limestone and grades upward into the Kuskulana Pass Formation. It forms subdued to bold outcrops and is thick to medium bedded and in places crossbedded. The Berg Creek Formation consists of impure bioclastic sandu limestone that texturally is grainstone (Dunham, 1962, p. 117). The limestone typically is light gray and weathers light tan or pale yellowish brown. It generally is well to moderately sorted and consists of subrounded grains that are cemented with calcite. In some samples, as much as 40 percent of the framework grains consists, in order of decreasing abundance, of sedimentary and volcanic rock fragments, plagioclase, chert, quartz, biotite, glauconite (some of it pelletoidal), and a host of trace minerals. Inoceramus fragments are abundant in the limestone and predominate in some samples. In places the limestone contains granule and pebble condomerate interbeds which weather in variegated shades of greenish gray, buff, and brown. Most conglomerate clasts are rounded or subrounded and were derived from the Triassic units

which crop out nearby. The Berg Creek Formation is approximately 250 m thick. Presumably it formed near the shoreline of a transgressive sea; parts of it probably were bars or shoals (MacKevett and others, 1978). No fossils were collected from the unit in the C-7 quadrangle; regionally, abundant pelecupod and belemnite collections indicate the Hauterivian or Hauterivian and Barremian Stages of the Early Cretaceous. The Berg Creek Formation correlates, in part, with the Nelchina Limestone (Grantz and others, 1966, p. C46) in the Talkeetna Mountains 200 km to

ROOT GLACIER FORMATION—The Root Glacier Formation (MacKevett, 1969, p. A45-A49) crops out in two nunataks near the head of the Kennicott Glacier in the northeastern part of the quadrangle and probably is coextensive with outcrops in the McCarthy C-6 quadrangle to the east (MacKevett, 1972). The Root Glacier consists of a marine fine-grained clastic sequence (Jr) and a subordinate conglomerate lentil (Jrc). These units have not been examined closely in the C-7 quadrangle. The lower contact of the Root Glacier is not exposed in the quadrangle, and the upper contact is an angular unconformity overlain by the upper member of the Wrangell Lava. The Root Glacier Formation probably was deposited in a moderately shallow sea. The

conglomerate lentil apparently represents rocks deposited in response to initial uplift and erosion related to regional Late Jurassic and Early Cretaceous orogeny. No fossils were found in the formation in the quadrangle; regionally, its age is Late Jurassic (late Oxfordian and Kimmeridgian). The Root Glacier Formation correlates with the Naknek Formation, a widely distributed unit of the Alaska Peninsula, the Cook Inlet region, and the Talkeetna Mountains. MUDSTONE, SILTSTONE, SANDSTONE, AND SHALE—The main part of the formation consists of diverse marine clastic rocks, chiefly mudstone and siltstone, less abundant impure sandstone and shale, and minor impure limestone lenses and scattered small limy concretions. Most rocks are dark greenish gray or dark gray where fresh and various shades of brown where weathered. The mudstone and shale is poorly bedded or massive; bedding in the siltstone and sandstone varies greatly in thickness but generally is inconspicuous.

CONGLOMERATE LENTIL—Sandy pebble and cobble conglomerate forms an intraformational lens near the top of the Root Glacier Formation (MacKevett, 1969, p. A46). The conglomerate is well indurated, thick bedded, and forms bold outcrops. The unit is medium or dark gray where fresh and weathers brown. Clasts in the conglomerate generally are well rounded and consist dominantly of limestone derived from the Chitistone and Nizina Limestones. Altered basalt derived from the Nikolai Greenstone, and minor chert, quartz, noncalcareous sedimentary, and granitic clasts also occur.

MC CARTHY FORMATION—The McCarthy Formation is widespread in the southern Wrangell Mountains. Subsequent to several revisions in nomenclature, MacKevett (1963, 1971) di vided the formation into an upper and lower member. Both members are present in the C-7

Upper member—The upper member of the McCarthy Formation crops out in two small areas near the southeastern corner of the map. It gradationally overlies the lower member, but its top is not exposed. Its exposed thickness probably does not exceed 200 m, whereas in the type locality in the McCarthy C-5 quadrangle, the upper member is more than 2,000 m thick (MacKevett, 1971, p. 14). The upper member forms subdued to rugged, ribbed outcrops of thinly bedded strata. Rock types include calcareous and carbonaceous chert, shaly limestone, and subordinate spiculite and shale. Shale generally forms the subdued outcrops. Where they are fresh, the rocks are dark gray or dark greenish gray; where weathered, they are dark yellowish brown or medium brown. The chert consists of abundant quartz or chalcedony and has disseminated siliceous microfossils, euhedral calcite, and flecks of carbonaceous material. Most of these rocks contain abundant chalcedonic or calcareous spicules, in some cases in such abundance that the rocks are better termed spiculites. These rocks grade into limestone that mainly can be classified as wackestone (Dunham, 1962). They contain grains of calcite, dolomite, quartz, plagioclase, pyrite, and microfossil tests and spicules suspended in a carbonaceous micritic matrix. Chlorite, clay minerals, and rare apatite also occur in the matrix. The shale is finely laminated and fissile, carbonaceous and calcareous, and contains abundant clay minerals and scattered apatite, pyrite, and microfossils.

The upper member probably formed mainly in a restricted sea where siliceous organisms flourished, but terrigenous detritus was not excluded completely. No diagnostic fossils were collected from the upper member in the C-7 quadrangle; regionally the member is largely or

Lower member—The lower member of the McCarthy Formation is widespread in the southern half of the quadrangle. It gradationally overlies the Nizina Limestone and is overlain gradationally by the upper member or overlain unconformably by Lower Cretaceous sedimentary rocks and the lower member of the Wrangell Lava. The lower member of the McCarthy Formation is the locus of abundant Tertiary hypabyssal dikes and small plutons. It is thinly bedded, structurally incompetent, forms subdued outcrops, and is characterized by abundant small- and large-scale folds that preclude valid determinations of thickness. Its estimated maximum thickness is about 300 m (MacKevett, 1971, p. 13). The member consists of calcareous carbonaceous shale, shaly limestone, and calcareous chert. Most of the rocks are dark gray, dark greenish gray, or nearly black where fresh. However, some of the limestone is paler shades of gray. The dark colors are attributable to carbonaceous material. The rocks weather various shades of yellowish brown, pale brown, or dark brown. The shale typically is fissile and finely laminated, and contains fairly abundant calcite bioclasts and microfossils. Most of the shale is calcareous and carbonaceous but some also is rich in quartz and chalcedony, and contains minor clay minerals, chlorite, and pyrite. The shaly limestone consists of wackestone and subordinate mudstone (Dunham, 1962), and includes minor siliceous limestone. Typically the shaly limestone is composed of abundant clastic grains, chiefly bioclasts, embedded in partly recrystallized lime mudstone, with subordinate silica, chlorite, clay minerals, hydrous iron oxides, and flecks of carbonaceous material. However, the shaly limestone has a wide variety of textural features and a wide range of proportions of its clastic and matrix components. The chert is dominantly microcrystalline silica, but much of it is impure and has fine wispy laminations of clastic and bioclastic material including fragments of adiolarians and sponge spicules.

The lower member probably formed in a fairly deep restricted sea, perhaps even a starved basin. Pelecypods of the genus Monotis are widespread and abundant in the lower part of the member in the C-7 quadrangle; they indicate the Norian (mainly late Norian) Stage of the Late Triassic (N. J. Silberling, written commun., 1972). However, no age-diagnostic fossils have been found in the upper part of the lower member in the southern Wrangell Mountains; conceivably the member may include Lower Jurassic strata. Rnz NIZINA LIMESTONE—The Nizina Limestone (Martin, 1916, p. 693) is distributed widely in the

southern half of the C-7 quadrangle and also crops out in several nunataks in the northeastern part of the quadrangle. The Nizina is bounded by gradational contacts with the Chitistone Limestone below and the lower member of the McCarthy Formation above, and is intruded by apophyses of the Chitina Valley batholith and Tertiary hypabyssal dikes and plutons. The Nizina ranges in thickness from about 200 to 450 m, and in contrast with the Chitistone Limestone it is mostly thin bedded. The Nizina consists of wackestone, lime mudstone, and minor grainstone (Dunham, 1962) and contains fairly abundant chert, mainly in thin lenses and nodules. The limestone is dark gray, dark greenish gray, or medium gray where fresh, and weathers to dull shades of brown, gray, and yellowish gray. The chert is greenish black or black. The Nizina characteristically is very fine grained and consists dominantly of calcite mud. The mud contains minor carbonaceous material, silica, and clay minerals. Subrounded calcareous pellets, fossil fragments, and minor quartz, plagioclase, pyrite, sponge spicules, and radiolarians are suspended in the mud. The noncarbonate component is most abundant in the upper part of the formation. Chert is characteristic of the Nizina Limestone. It forms nodules and irregular lenses as much as 10 m long and 15 cm thick. In some places adjacent to Tertiary hypabyssal intrusions, narrow zones of marble and calc-silicate skarns are present but these were not mapped separately. The marble consists of medium-grained granoblastic calcite; the skarn consists of calcite, diopside, epidote, and minor opaque minerals. More detailed descriptions and discussions of the Nizina Limestone are given in Armstrong

and others (1969) and MacKevett (1978). The Nizina is interpreted as having formed in a

sloping basinal apron fronting a drowned carbonate platform of the Chitistone Limestone: the upper contact with the McCarthy Formation probably represents a rapid deepening of the carbonate shelf to a depth where carbonate production nearly ceased (Armstrong and others, 1969, p. D57). Megafossils are sparse in the Nizina and no fossils were collected in the C-7 quadrangle. Regionally, the most diagnostic fossils are pelecypods of the genus Halobia, which indicate an age span from the late Karnian to middle Norian Stages of the Late Triassic. CHITISTONE LIMESTONE—The Chitistone Limestone (Rohn, 1900, p. 425) is distributed widely in the southern half of the quadrangle. It disconformably overlies the Nikolai Greenstone and grades upward and laterally into the Nizina Limestone. It is intruded by apophyses of the Chitina Valley batholith and by Tertiary hypabyssal rocks. The thickness of the Chitistone in the quadrangle varies between 400 and 500 m. It is thick or medium bedded and forms bold, steep outcrops, in contrast with the thinner bedded Nizina Limestone, which forms ragged but steep outcrops. On fresh surfaces, the Chitistone is dark greenish gray, medium gray, or even light gray and weathers to shades of rusty gray, yellowish gray, or tan. Typically the Chitistone emits a fetid odor when broken. It is very fine grained and partly recrustallized. In the vicinity of intrusions, it exhibits a fine- to medium-grained granoblastic texture. Texturally the Chitistone consists of lime mudstone and less abundant wackestone, with minor packstone and grainstone (terminology of Dunham, 1962, p. 117). Its composition dominantly is calcite, consisting of varying mixtures of mud, pellets, ooids, fossil fragments. and subhedral grains. Only minor amounts of carbonaceous detritus, quartz, chalcedony, secondary iron oxides, and clay minerals are present. Regionally, lower strata in the Chitistone contain limy dolomite and dolomitic limestone.

Armstrong and others (1969, p. D53-D57) suggest that the Chitistone indicates an early intertidal and supratidal sabhka depositional environment (dolomitic facies) and subsequent low-energy, restricted shallow marine deposition (mudstone-wackestone facies) alternating with high-energy deposition on shoals (packstone-grainstone facies). No diagnostic fossils were found in the C-7 quadrangle; regionally, Chitistone fossils are scanty and consist of a fauna characterized by the ammonite genus Tropites, which is indicative of the late Karnian Stage of the Late Triassic.

NIKOLAI GREENSTONE—The Nikolai Greenstone (Rohn, 1900, p. 425) is distributed widely in the quadrangle. Although nearly 3,000 m of Nikolai Greenstone is present, its base is not exposed in the quadrangle. The Nikolai Greenstone disconformably underlies the Chitistone Limestone and is intruded by Tertiary hypabyssal rocks (particularly map unit Tpg), by the Chitina Valley batholith, and by thin unmapped gabbro dikes and sills that are interpreted as feeders to the Nikolai Greenstone. Outcrops from rugged, steep, and craggy slopes. Most Nikolai Greenstone flows are between 1 and 10 m thick, but in many areas layering is not conspicuous. The Nikolai Greenstone is dominantly greenish and olive gray where fresh, and various shades of brown, gray, green, and maroon where weathered. The Nikolai Greenstone consists of altered undifferentiated tholeitic basalt flows that are

largely, if not entirely, subaerial. Except for flow interiors, the Nikolai Greenstone is characdimension. Some amygdules are filled with radiating clusters of secondary minerals which exhibit a "rosette" structure. Although alteration effects are widespread, in most places they have not destroyed the original texture of the tholeites. Most Nikolai Greenstone is fine grained and porphyritic, and contains plagioclase (labradorite) and clinopyroxene phenocrysts in an intergranular groundmass of plagioclase and dinopyroxene, subordinate iron and titanium oxides, rare apatite and olivine, and diverse secondary minerals. Less common textures include ophitic, subophitic, and intersertal. The abundant secondary minerals include dominant chlorite, epidote, calcite, and quartz, and subordinate, sericite, hematite, uralite, sphene, clinozoisite, and prehnite. The amygdules contain chlorite, calcite, quartz, epidote, and minor prehnite, zeolites, chalcedony, and native copper. Veinlets of quartz, epidote, calcite, and chlorite cut much of the greenstone.

Two copper prospects, which also assayed byproduct silver, are located within sheared Nikolai Greenstone in the quadrangle. At the Mayflower prospect (Moffit and Mertie, 1923, p. 135-136), vein deposits along faults contain minor bornite and chalcocite in a gangue of quartz and epidote. At the Lakina prospect (Moffit and Maddren, 1909, p. 75-77; MacKevett, 1976), chalcocite, bornite, covellite, and their oxidation products azurite and malachite are contained in narrow veins along shears. At the Lakina prospect native copper is disseminated

along one brecciated flow top in the Nikolai Greenstone. The Nikolai Greenstone is interpreted to be part of a voluminous flood basalt province that covers large areas of southern Alaska and adjacent parts of the Yukon Territory. Correlative rocks are believed to exist at least as far south as Vancouver Island. Together with overlying inner-platform carbonates (Chitistone and Nizina Limestones and correlatives) and the subjacent magmatic arc rocks (Skolai Group and correlatives), the Nikolai Greenstone is believed to outline fragments of a large allochthonous terrane in northwestern North America that now are separated by unrelated terranes (Jones and others, 1977). The Nikolai Greenstone was not dated in the C-7 quadrangle; regionally, the Nikolai is stratigraphically bracketed between fossiliferous Middle Triassic (Ladinian) and Upper Triassic (Karnian) strata (MacKevett, 1978). INTRUSIVE ROCKS

PLUTON OF MT. BLACKBURN—A widespread composite subvolcanic granodioritic pluton underlies the southern flanks and crown of Mt. Blackburn, and extends east and west into adjacent quadrangles. It intrudes rocks as old as the Nikolai Greenstone and as young as the upper member of the Wrangell Lava. Intrusive contacts with the upper member are well exposed but nearly inaccessible; in places contacts appear to be broadly concordant, whereas elsewhere they are strongly discordant.

Mt. Blackburn is in marked contrast to the smooth shield shape of nearby Mt. Wrangell, which is composed nearly entirely of Wrangell Lava. Tap PORPHYRITIC ANDESITE DIKES, SILLS, AND PLUGS—Small intrusions of porphyritic andesite, and subordinate basaltic andesite and lamprophyre, are widely scattered but cut most pedrock units of the quadrangle. The intrusions are particularly abundant in the Upper Triassic formations and the lower member of the Wrangell Lava (Twl). The intrusions are more

resistant than enclosing rocks and form bold outcrops. Most dikes and sills are between 1 and 5 m thick, but the pluglike bodies T.3 S., R.12 E., sec. 17 are much thicker. The intrusions are greenish gray where fresh and weather to shades of medium brown. The intrusions mostly are porphyritic with fine-grained intergranular or intersertal groundmasses. The andesite consists of plagioclase (andesine), which forms zoned phenocrysts as well as interstitial laths, and less abundant clinopyroxene, which forms partly resorbed or uralitic phenocrysts and small crystals scattered through the groundmass. Minor primary constituents in the andesite are quartz, biotite, K-feldspar, apatite, sphene, and opaque minerals. Alteration products are abundant locally: chlorite, calcite, and hematite are especially prominent. The lamprophyre is fine grained and coarsely porphyritic, with a groundmass that has been mostly obliterated by alteration. It contains phenocrysts of dinopyroxene and iron-rich biotite in a groundmass that is rich in calcite and chlorite. The dikes, sills, and plugs are mainly related to Wrangell Lava volcanism, as attested by their abundance in the lower member of the Wrangell Lava and nearby rocks. They are volumetrically unimportant but are widespread throughout much of the southern Wrangell Mountains.

intrusive rocks in the region. TP9 HYPABYSSAL GRANODIORITE AND QUARTZ MONZODIORITE—A semicircular belt of subvolcanic granodiorite and quartz monzodiorite (terminology of Streckeisen, 1973) 20 km long and up to 2 km wide forms a crude arc along the southern slopes of Castle Peak. This unit intrudes Upper Triassic bedded rocks and is in fault contact with the lower and upper members of the Wrangell Lava. It has a narrow thermal aureole, particularly where it intrudes the Chitistone and Nizina Limestones, which are converted to calc-silicate skarps and marble adjacent to the pluton. Locally, bodies of Nikolai Greenstone and Nizina Limestone forms blocks or screens in the pluton. The pluton forms rugged steep slopes and cliffs. It has a uniform light-gray to tan speckled appearance on both weathered and fresh surfaces. Homblende or homblende-biotite granodiorite is the predominant rock type of the pluton: subordinate parts grade into quartz monzodiorite. Texturally the pluton has two aspects, as does the pluton of Mt. Blackburn. Much of the pluton is fine-grained and hypidiomorphicgranular with abundant plagioclase (andesine) and hornblende; less abundant quartz, biotite, epidote, perthite, and K-feldspar; and traces of apatite, sphene, and opaque minerals.

They probably are linked genetically to the more voluminous felsic to intermediate hypabyssal

is extensive and consists chiefly of carbonate and chlorite replacement of hornblende and sericitization of plagioclase. The semicircular outcrop pattern of the unit is suggestive of a pluton intruded along a caldera rim fracture system, only the southern half of which still is exposed. If the lower and upper members of the Wrangell Lava were removed from inside the semicircle, a depression at least 1,500 m deep and 10 km across would remain. If the caldera interpretation is correct then exposures of the lower member of the Wrangell Lava (unit Twl) south of Castle Peak resulted from the first filling of the vent by flows, lahars, and pyroclastic deposits. Plutons that are believed to represent subvolcanic phases of the Wrangell Lava (MacKevett, 1978) are widely exposed along the southern flank of the Wrangell Mountains and nearby parts of the Yukon Territory. Their ages apparently span much of the late Tertiary (MacKevett, 1978). Porphyritic hornblende-biotite dacite (or hypabyssal granodiorite) float from Kus-

However, large areas of the pluton have corroded plagioclase and homblende crystals set in a

very fine grained intergranular matrix—a porphyritic texture that is nearly volcanic. Alteration

kulana Glacier moraine in the McCarthy C-8 quadrangle can be traced up the moraine to outcrops of this unit. Homblende from a float sample has been dated by K-Ar as 3.8±0.8 million years, or Pliocene (MacKevett and others, 1978). Tif FELSIC HYPABYSSAL ROCKS—Small stocks of felsic hypabyssal rocks are located in the west-central, southwestern, and southeastern parts of the quadrangle; felsic dikes and sills are widespread and cut most pre-Tertiary rocks. The felsic hypabyssal stocks are themselves intruded by porphyritic andesite dikes of unit Tap. The dikes and sills range from less than a meter to 20 m in thickness. Both stocks and the dikes and sills form bold outcrops or sharp ridges of conspicuous light-colored rocks. In places they are platy and weather to rubble of angular slabs or chips. The felsic plutons are pale gray or pinkish gray and weather tan, wish brown, or chalky white. They consist pr minor rhyodacite and andesite. They contain scattered to abundant phenocrysts, which in a few places make up as much as 30 percent of the volume of the rock. The groundmass generally is very fine grained and felty. In a few places the rocks are aphyric with intersertal or pilotaxitic textures. The phenocryst minerals are plagioclase (andesine) and less abundant quartz, biotite, K-feldspar, and relicts of clinopyroxene and amphibole. The groundmass is rich in plagioclase, quartz, and K-feldspar, and frequently contains disseminated pyrite.

hematite, and devitrified glass. Relative abundances of the essential and accessory minerals The felsic hypabyssal rocks have been interpreted as silica-rich subvolcanic differentiates related to Wrangell Lava volcanism (MacKevett, 1978). They are widespread in southern Alaska and adjacent parts of the Yukon Territory; they are best developed in a northwest trending belt along the southern flank of the Wrangell Mountains that is southwest of the main eruptive centers (MacKevett, 1978). The felsic plutons have not been dated in the McCarthy C-7 quadrangle, but a K-Ar date on sanidine of 6.5±0.2 million years has been obtained from a correlative pluton in the McCarthy C-5 quadrangle.

Alteration is general in the felsic plutons and has yielded day minerals, chlorite, calcite, silica,

CHITINA VALLEY BATHOLITH—Apophyses of the Chitina Valley batholith (MacKevett, 1978) crop out over small areas in the west-central part of the quadrangle; large stocks of the batholith occur 10-12 km to the west in the adjacent McCarthy C-8 quadrangle (MacKevett and others, 1978). The apophyses cut Upper Triassic greenstone and limestone and are themselves intruded by porphyritic andesite and dacite of units Tap and Tif. Rocks in the batholith are poorly foliated, fine- to medium-grained hypidiomorphic-granular granodiorite, with subordinate dioritic phases. They are composed of zoned plagioclase (andesine), quartz, K-feldspar, and lesser hornblende. Biotite is the main accessory mineral. Less abundant, local accessory minerals include epidote, sphene, apatite, and opaque minerals. Minor secondary minerals include chlorite, sericite, and calcite. In places the rocks contain disseminated pyrite and are cut by quartz and calcite veinlets.

The Chitina Valley batholith is widely distributed in the southern part of the McCarthy 1:250,000 quadrangle and extends west and east into adjacent quadrangles and the Yukon Territory. It is synchronous with early stages of a regional orogeny that affected much of southern Alaska. No dates were obtained from the C-7 quadrangle; samples from elsewhere in the McCarthy 1:250,000 quadrangle have yielded consistent Late Jurassic dates on hornblende that range from 138 to 146±4 million years (MacKevett, 1978).

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