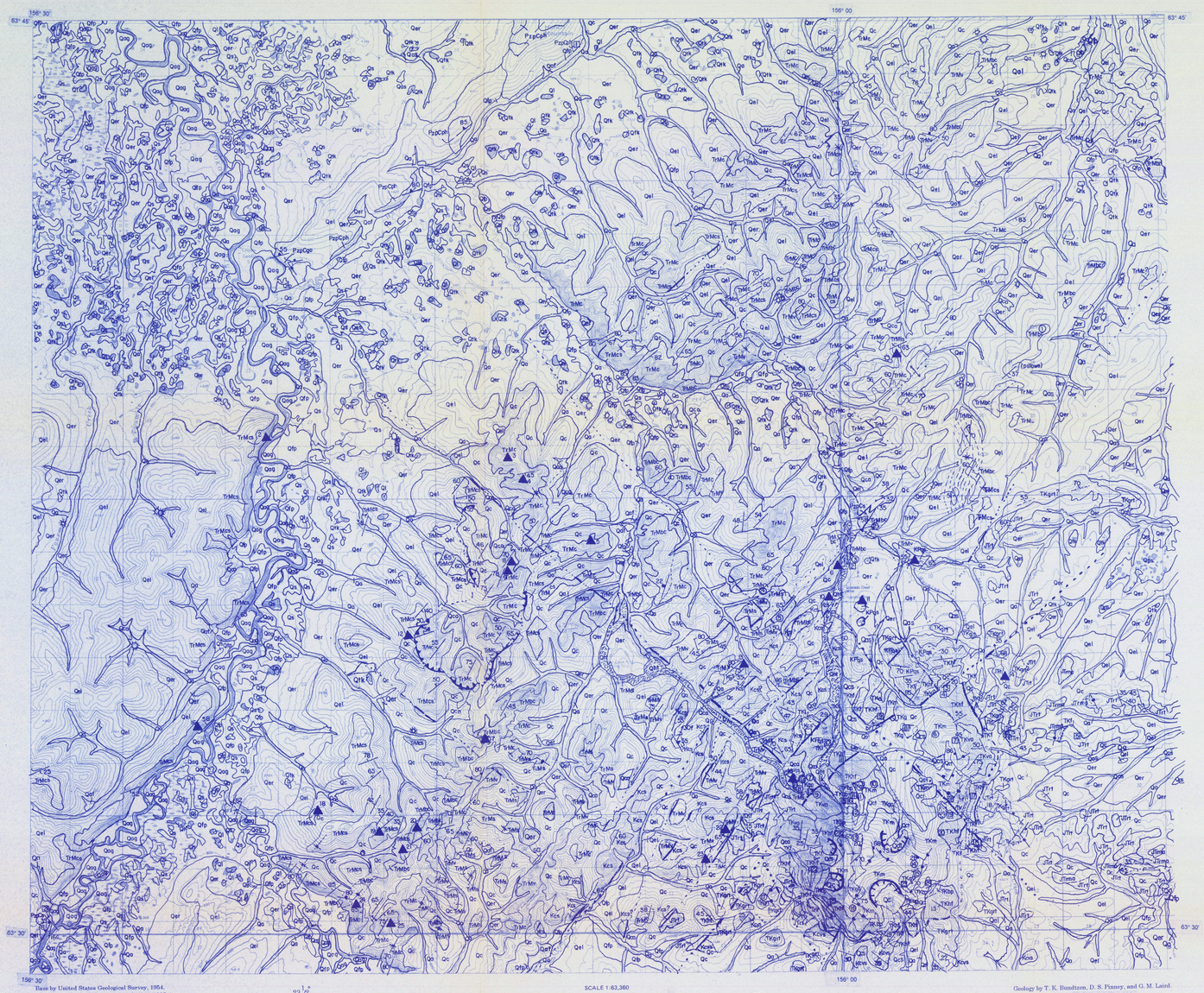
ALASKA DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS

PUBLIC-DATA FILE 97-46
BUNDTZEN AND OTHERS, 1997

EXPLANATORY TEXT ACCOMPANIES MAP



Basis by United States Geological Survey, 1954.
Universal Transverse Mercator projection, 1927.

APPROXIMATE MEAN DECLINATION, 1954

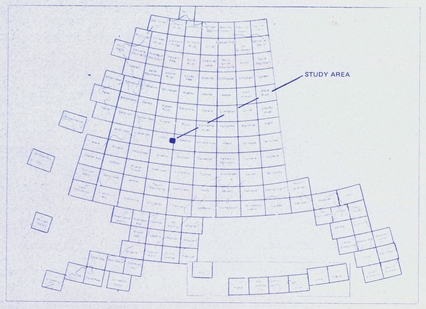
SCALE 1:63,360

CONTOUR INTERVAL 50 FEET (OPHIR C-1)
CONTOUR INTERVAL 100 FEET (MEDFRA C-6)
DATUM MEAN SEA LEVEL

ALASKA
QUADRANGLE LOCATION

Geology by T. K. Bundtzen, D. S. Pinney, and G. M. Laird.
Assisted by S. Fogle. May and June, 1996.

ALASKA

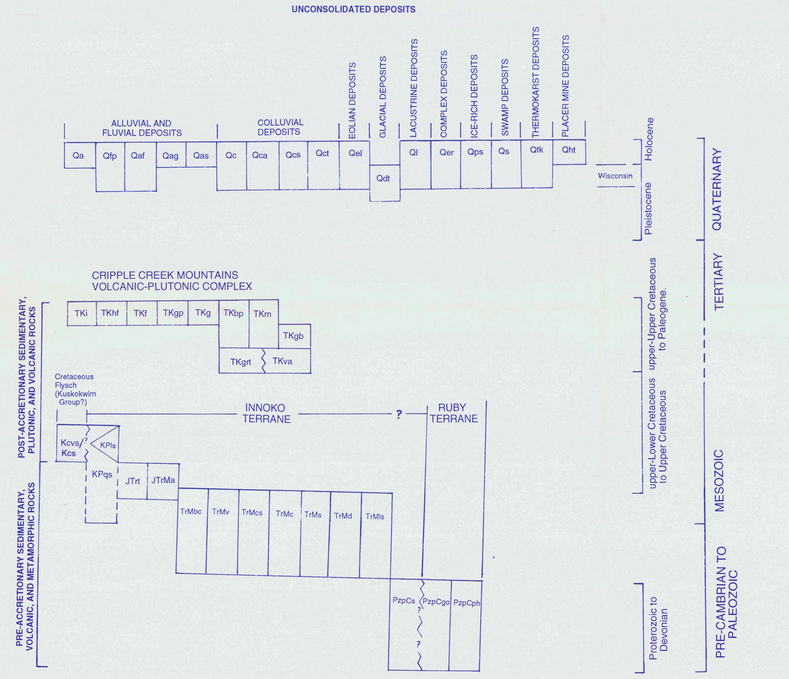


THIS REPORT HAS NOT BEEN REVIEWED FOR TECHNICAL CONTENT (EXCEPT AS NOTED IN TEXT) OR FOR CONFORMITY TO THE EDITORIAL STANDARDS OF DGGS

MAP SYMBOLS

- Contact; dashed where approximately located
- High-angle fault -- Dashed where approximately located, dotted where concealed.
- Thrust fault -- Teeth on upthrown block.
- Anticline, showing trace of axial plane
- Syncline, showing trace of axial plane
- Strike and dip of beds
- Strike and dip of joints
- Strike and dip of foliation with direction and dip of crenulations
- Pingo, Collapsed pingo
- Cirque
- Fossil locality (table 1)
- Major oxide locality (table 2)
- Trace element locality (table 3)
- p Pillows (TrMbc unit)

CORRELATION OF MAP UNITS



PRELIMINARY GEOLOGIC MAP AND DATA TABLES FROM THE OPHIR C-1 AND WESTERN MEDFRA C-6 QUADRANGLES, ALASKA

by

Thomas K. Bundtzen, DeAnne S. Pinney, and Gregory M. Laird

1997

DESCRIPTION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

ALLUVIAL AND FLUVIAL DEPOSITS

Qa UNDIFFERENTIATED STREAM ALLUVIUM--Elongate deposits of moderately to well sorted, well stratified, fluvial pebble-cobble gravel, silt, and sand deposited in active stream channels and associated low terraces. Deposit is medium to thick bedded, and locally crossbedded. Cobbles are generally rounded and reach a maximum of 3 ft (1 m) in diameter, and all are locally derived. Extensive willow alder thickets grow on Qa deposits in mature valley fills. Highly variable thickness (10-33 ft; 3-10 m); measurements made adjacent to placer mine and road cuts near Cripple Creek Mountains and along banks of Innoko River. Surface smooth.

Qfp FLOODPLAIN ALLUVIUM--Elongate deposits of moderately to well-sorted, well-stratified, fluvial gravel, silt, and sand with few to numerous boulders forming modern floodplains and associated low terraces. Generally finer gained than similar deposits in Qa unit, because of deposition during flood-stage events. Locally, it may include Wisconsin to Holocene terrace alluvium. Lower surfaces may be flooded during periods of maximum discharge. Thickness is highly variable and difficult to estimate due to poor exposure. Surface smooth except for local low scarps.

Qaf ALLUVIAL FAN DEPOSITS--Fan-shaped, heterogenous mixtures of poorly to moderately sorted, partially stratified, channelized gravel with some sand and silt and few to numerous subangular to subrounded boulders--especially in proximal areas. May include debris flow deposits. Generally located at intersection between 1st and 2nd order (tributary and trunk) streams. Age probably ranges from Early Wisconsin (?) to Holocene. Thickness varies from 10 feet (3 m) in distal settings to 66 feet (20 m) in proximal settings. Surface smooth except for numerous shallow, interconnected channels.

Qag GRAVEL BAR DEPOSITS--Arcuate deposits of moderately well-sorted, well-stratified gravel and coarse sand forming point bars along margins of modern streams and tracing abandoned stream channels. Older deposits may be locally capped by finer grained deposits of flood-stage events. Many surfaces are thickly vegetated by tall stands of deciduous trees.

Qas SILTY ALLUVIUM--Broad, elongate deposits of moderate- to well-stratified silt and minor fine sand deposited by streams traversing areas of thick silt cover. Upper seasonally active reaches are characterized by broad areas of alder and willow shrubs through which wind numerous silt-choked shallow rills and channels. Lower reaches may be deeply incised; here, the deposit is largely composed of reworked silt. Thickness unknown but estimated to be less than 10 feet (3 m). Surface smooth except for shallow, interconnected channels and local low scarps.

COLLUVIAL DEPOSITS

Qc UNDIFFERENTIATED COLLUVIUM--Irregular, heterogeneous blankets, aprons, and fans of angular to subrounded rock fragments, gravel, sand, and silt that are left on slopes, slope bases, or high level surfaces by residual weathering and complex mass-movement processes, including rolling, sliding, flowing, gelifluction, and frost creep. Locally washed by meltwater and slope runoff. Thickness highly variable. Surface generally reflects configuration of underlying bedrock surface.

Qca COLLUVIAL-ALLUVIAL VALLEY FILL, FAN, AND APRON DEPOSITS--Elongate, apron-shaped and fan-shaped, heterogeneous mixtures of poorly to moderately sorted, angular rock fragments with trace to some gravel, sand and silt of alluvial and colluvial origin deposited at the bases of steep slopes bordering modern stream valleys. Commonly forms alternating stratified and unstratified zones and lenses in gullies and steep tributary streams with intermittant or ephemeral streams. May include or be capped by a considerable amount of redeposited eolian silt. Locally washed by meltwater and slope runoff. Youthful alluvial-colluvial fan deposits are actively being formed or modified when seasonal snowpack is melting.

Qcs SOLIFLUCTION DEPOSITS--Irregular drapes of poorly sorted mixtures of angular rock fragments of local origin with trace to some sand and silt deposited on the upper slopes of the Cripple Creek Mountains primarily by soil creep (gelifluction/solifluction). Surface gently to moderately sloping with prominant scalloped ridges and lobes oriented approximately perpendicular to slope.

Qct CRYOTURBATED TALUS AND RUBBLE DEPOSITS--Irregular drapes and sheets of coarse blocks (3.3 feet (1 m) diameter and larger), angular rock fragments , and rubble with minor silt, sand and gravel deposited more-or-less in place on upper slopes of Cripple Creek Mountains by block weathering and frost riving. Deposits are widely subjected to reworking by cryoturbation processes including frost heave and frost jacking of rock fragments. Surface highly irregular, generally unvegetated, and characterized by openwork rubble mounds several meters thick.

EOLIAN DEPOSITS

Qel EOLIAN LOESS--Heterogeneous blankets of brown to dark gray, locally laminated silt of eolian (wind) deposition. Contains organic horizons 5 to 30 cm thick interpreted to be paleosols. Covers lower slopes and floodplains throughout study area, but is particularly thick west of Innoko River where Qel nearly completely covers bedrock lithologies. Probably perennially frozen. Surface smooth to locally gullied.

GLACIAL DEPOSITS

Qdt HIGHLY MODIFIED GLACIAL DRIFT--Heterogeneous blankets and mounds of non-stratified, unsorted to poorly sorted gravel, sand and silt and numerous subangular to subrounded boulders up to 70 cm in diameter deposited by glacial ice. Subsequently highly modified by mass-movement processes. Surface is mantled by frost-jacketed rubble and less than 10 cm of silt under a thick cover of lichen. Qdt in Cripple Creek Mountains confined to modified cirque basin at head of Colorado Creek, and may correlate with till of Bifurcation Lake age (early Wisconsin?) exposed in the Beaver Mountains about 70 km southwest of the study area (Bundtzen 1980; Kline and Bundtzen 1986).

LACUSTRINE DEPOSITS

Ql LACUSTRINE DEPOSITS--Arcuate or semicircular deposits of brown to dark gray silt, sand, and organic silt along margins of local small ponds and oxbow lakes adjacent to rivers and streams, and filling basins of drained lakes. Saturated, locally frozen, and locally ice-rich. Age range estimated to be Wisconsin to Late Holocene (Pewe 1975). Thickness highly variable; surface smooth.

COMPLEX DEPOSITS

Qer RETRANSPORTED LOESS AND SILT--Heterogeneous blankets of poorly to moderately stratified sandy-silt and organic silt of original eolian deposition, which were subsequently reworked by fluvial and colluvial processes. Perennially frozen and ice-rich; ice wedges are common. Thickness highly variable, but is up to 33 feet (10 m) adjacent to placer mine and road cuts near Cripple Creek Mountains and more than 26 feet (8 m) thick in natural exposures along banks of Butte Creek. Qer frequently overlies ancestral terrace alluvium in valley fills throughout map area, and may hold exploration potential for heavy mineral placer deposits in the Colorado and Cripple Creeek drainages. Pleistocene large mammal fauna collected by local placer miners include mammoth (*Mammuthus* sp.), horse (*Equus* sp.), steppe bison (*Bison priscus*), and caribou (*Rangifer tarandus*). Thorson and Guthrie also found wolf bones *(Canis lupus)* in these deposits (1982). Wood collected from near the base of the silt adjacent to the placer mine on lower Colorado Creek yields a minimum radiocarbon age for the deposit of 30,230 +5,740/-3,310 yr. BP (GX22464). This confirms another minimum limiting date of 28,410 ± 500 yr. BP (Beta 5578) on wood collected by J.T. Kline and T. K. Bundtzen in 1983, and reported by Thorson and Guthrie (1992). Surface smooth to locally pitted and gullied by melting of ice-rich permafrost. Slope failures and small-scale earthflows common along streamcuts and manmade exposures.

Qps ICE-RICH PITTED SILT--Heterogeneous blankets of poorly to moderately stratified silt and organic silt equivalent to Qer unit. Perennially frozen and extremely ice-rich. Ice wedges are common. Deeply and extensively pitted due to extreme melting of massive ground ice. Thickness unknown, but probably similar to Qer unit.

Qs SWAMP DEPOSITS--Elongate to blanket deposits of complexly bedded peat, organic silt, and organic sand accumulated as surface deposits in local basins, former stream channels, and downslope from springs and seeps. Saturated, locally frozen, and locally ice-rich. Thickness highly variable. Surface smooth.

Qtk THERMOKARST PIT DEPOSITS--Semicircular to irregularly shaped deposits of moderately stratified, heterogenous, brown to dark gray silt, sand and organic silt filling small, often interconnected basins resulting from the melting of ice-rich permafrost in silt. Saturated, locally refrozen, and locally ice-rich. Commonly associated with pingos; many pits may be the result of pingo meltout and collapse

Qht PLACER MINE TAILINGS Symmetrical to irregular, artificially stacked piles of washed, sorted gravels and in-situ bedrock-derived slab rock nearly exclusively mined from former stream channels in Colorado, Cripple, and Bear Creek floodplains. Cobbles are locally derived and dominated by intrusive lithologies of Cripple Creek Mountains volcanic-plutonic complex. Finer grained silts and clay partings removed during placer mine processing.

POST-ACCRETIONARY SEDIMENTARY, PLUTONIC, AND VOLCANIC ROCKS

TKi DIKES AND DIKE SWARMS -- UNDIFFERENTIATED--Wide variety of tan, weathered, fine-grained to aphanitic mafic, intermediate, and felsic dikes. Most are extensively altered and appear to have undergone extensive carbonate-silica replacement typical of alteration processes in mafic igneous rocks. No age control available.

CRIPPLE CREEK MOUNTAINS VOLCANIC-PLUTONIC COMPLEX

TKhf HORNFELS--Brown to gray, massive to locally porphyroblastic,chlorite-biotite-tourmaline hornfels. Dark gray massive varieties are difficult to distinguish from aphanitic volcanic rocks (TKva). TKhf includes thermally altered JTrt, Kcvs, and KPqs lithologies. It is generally resistant and forms the hogbacks and higher portions of eastern Cripple Creek Mountains.

TKf FELSIC RING DIKE COMPLEX--Light gray to bleached, aphanitic to fine-grained, ubiquitously altered muscovite aplite to granite. Individual dikes range from 3 to 100 feet (1-30 m) wide, and usually form in swarms of 5 to 10 in 1 to 1.5 mile (1.6 to 2.4 km) wide zones in hornfels (TKhf). These dikes are oriented in a crude ring around Cripple Creek Mountains pluton.

TKgp GRANITE AND QUARTZ PORPHYRY--Light gray, bleached, aphanitic to fine-grained, locally garnet-bearing, porphyro-aphanitic, biotite-muscovite granite and quartz porphyry. Mapped mainly as an elongate body that straddles the headward drainage basins of Colorado Creek -- a tributary of Eldorado Creek -- and Cripple Creek, both of which have collectively sustained approximately 265,000 ounces (8,240 kg) of placer gold production. Extensive tourmaline introduction near Nierod gold prospect (see location of sample 12, table 3 on map). All samples are corundum normative, peraluminous, and geochemically and mineralogically similar to plutons associated with peraluminous granite porphyry-hosted, gold-polymetallic deposits in the Kuskokwim Mineral Belt (Bundtzen and Miller 1997; table 2). It is notoresistant and forms flaggy scree to 1 ft (300 cm) in long dimension.

TKg HORNBLENDE GRANITE--Medium grained, phaneritic to hypidiomorphic-granular, biotite-hornblende granite. The hornblende grains are euhedral and exhibit distinctive olive green pleocroism; biotite occurs in small aggregated masses around larger hornblende grains. Locally graphic textures are developed in quartz-feldspar masses. Plagioclase grains (An_{27}) are rimmed by pink potassium feldspar. Stockwork quartz veining developed in selected TKg exposures.

TKbp BORDER PHASE QUARTZ MONZONITE--Light gray to brown, very fine-grained to fine-grained, phaneritic, biotite-rich quartz monzonite. Forms 330 to 660 ft (100-200 m) wide chill zone around western edge of Cripple Creek Mountains pluton. Plagioclase content averages An_{29} and unit is corundum normative (table 2). It is resistant and forms tors around the edge of the pluton.

TKm DIORITE, MONZONITE, AND QUARTZ SYENITE--Light to medium gray, bleached, fine- to coarse-grained, hypidiomorphic-granular, biotite-aegerine-olivine diorite, monzonite, and subordinate biotite quartz syenite. Olivine grains up to 5 mm in diameter exhibit successive kelyphitic rims of aegerine and biotite, which suggest strong differentiation processes during melt formation. Color index averages about 35. Amphibole is generally absent. Zircon occurs as inclusions in plagioclase, which ranges in composition from An_{23} to An_{42} and averages An_{38} (table 2). This unit forms the bulk of the Cripple Creek Mountains pluton. Unit TKm on northeast side of northwest trending Colorado Creek fault contains more felsic, quartz-saturated compositions than those southwest of the high angle structure. K-Ar age of 71.3 Ma obtained from mineral separate (Moll et al. 1980; Bundtzen and Miller 1997). Very resistant and forms highest upland in map area.

TKgb ALKALI GABBRO AND ANKARAMITE--Medium to dark gray, dark brow weathered, fine to coarse grained, hypidiomorphic granular, biotite olivine gabbro; locally ankaramite. Modally contains up to 33%olivine, 25% aegerine or diopside, and 10% biotite. No amphibole recognized. Color index ranges from 40 to 80 and averages about 54. Plagioclase composition ranges widely from An_{32} to An_{62} and averages An_{51} (table 2). TKgb is considered to be the oldest intrusive phase of the Cripple Creek Mountains pluton due to xenoliths of TKgb found in TKm and TKg phases.

TKgrt GRANITE PORPHYRY, TUFF, AND PYROCLASTIC ROCKS--Poorly exposed unit of both extrusive and subvolcanic rocks rimming Cripple Creek Mountains pluton. Subvolcanic intrusions are mainly garnet bearing, corundum normative, quartz porphyry as mainly exposed along the southwest flank of Cripple Creek Mountains. Significant amounts of rhyodacite crystal tuff with crystals of reddish-brown hornblende and plagioclase (An_{22}) occur mainly along eastern and southeastern edge of Cripple Creek Mountains (table 2). A poorly exposed ridge north of Cripple Creek is composed of fine grained air-fall lapilli tuffs (?), which we have tentatively included in TKgrt unit. All lithologies weather a tannish-gray to bleached, and are usually extensively altered both in hand specimen and in thin section. The felsic intrusive and extrusive lithologies in TKgrt have been lumped during this study due to their similar physical characteristics encountered during field investigation.

TKva BASALTIC ANDESITE, BASALT, AND LAPILLI TUFF--Medium greenish gray, aphanitic to fine-grained porphyritic, hornblende-rich basaltic andesite; uncommonly basalt and very fine-grained lapilli tuff (?). In basaltic andesite flows, euhedral hornblende grains, which comprise up to 15% of the rock by volume, are up to 5 mm long and exhibit a distinctive reddish-brown pleocroism. Zoned plagioclase averages An_{31} (table 2). Lapilli tuff, which is almost always sericitically altered, contains tiny biotite grains as clots throughout the groundmass. TKva unit was subjected to thermal alteration from Cripple Creek Mountains pluton and exhibit massive hornfels textures locally. No isotopic dating available, but TKva estimated to slightly predate the 71.3 Ma Cripple Creek Mountains Pluton (Moll et al. 1980; Bundtzen and Miller 1997).

CREATACEOUS (KUSKOKWIM GROUP?) FLYSCH

Kcvs / Kcs COARSE GRAINED VOLCANICLASTIC SANDSTONE AND CONGLOMERATE--Greenish gray, poorly sorted, fine- to coarse-grained lithic-volcaniclastic sandstone and pebble conglomerate. Thin section analysis (n=3) shows Kcvs composed of intermediate volcanics (35%), twinned plagioclase fragments (10%), chert (20%), quartz (20%), detrital white mica (6%), carbonate (5%), and opaque minerals (4%). Locally contains large *Inoceramus* prisms, which suggest a Cretaceous age (table 1, no. 10). Probably equivalent to Kvg unit of Patton et al. (1980) and Chapman et al. (1985), and is tentatively correlated with volcanogenic facies of the Kuskokwim Group (Miller and Bundtzen 1994). Generally nonresistant due to finer grained silt-rich partings in outcrop. No thickness estimate available. Kcs is included in Kcvs.

PRE-ACCRETIONARY SEDIMENTARY, PLUTONIC, AND VOLCANIC ROCKS

INNOKO TERRANE

KPqs/ KPls SUBLITHIC QUARTZ PEBBLE SANDSTONE--Light to medium gray, tan weathered, medium to coarse-grained, immature, calcareous, quartzose pebble-rich sandstone. Thin sections (n=4) show the following clast compositions : quartz (35%), chlortized intermediate volcanics (10%), phyllite and phyllitic sandstone (10%), chert (15%), sandstone (15%), trachytic volcanics (5%), and carbonate (8-10%). Unit lacks detrital white mica, which is found in Cretaceous flysch (Kcvs). Pelecypod shell fragments found in matrix are thought to represent Mesozoic forms (table 1, nos. 7 and 11); however, a thin limestone lense (KPls) interbedded with KPqs at head of Cripple Creek contains either *Atomodesma* sp. fragments of Permian age or *Inoceramus* sp. of Cretaceous age (table 1, no. 15). Two carbonate-rich samples submitted for conodont extraction failed to yield faunaj hence, KPqs as mapped in study area ranges from Permian to Cretaceous, but is most likely Mesozoic in age; if younger, then KPqs may be a shallow water facies associated with the Kcvs unit described above. KPqs is at least 1,300 feet (400 m) thick east of Colorado Creek. Generally nonresistant due to calcareous content.

JTrt SILICEOUS TUFF, CRYSTAL AND LITHIC TUFFS, AND METASILTSTONE--Light to medium gray, very fine-grained cherty tuff; fine- to coarse-grained, greenish gray crystal-lithic tuffs; and brownish, massive to conchoidally fractured metasiltstone. May include minor volcanic breccias as in JTrma. Unit JTrt locally intruded by small biotite-plagioclase diabase-to-diorite sills. It is also very nonresistant, and exposures are limited to scree and eroded outcrops on ridge tops mainly east of Cripple Creek Mountains. Thickness is unknown. A Jurassic-Triassic age was assigned to this unit on the basis of radiolaria and conodont collections reported from cherty beds in the Medfra quadrangle (Patton et al. 1980).

JTrma MAFIC VOLCANIC BRECCIA, TUFF, SILTSTONE, CHERT, AND AGGLOMERATE--Dark olive green, coarse-grained volcanic breccia, green siltstone, and basaltic agglomerate. Contains angular grains of augite-pigeonite (50%), plagioclase (10%), volcanic clasts (15%), and green chert (10%). Radiolaria identified in chert are Triassic and Lower Jurassic in age (Patton et al. 1980). Thickness is poorly constrained, but estimated to be at least 500 feet (152 m) in eastern part of map area. This unit is interbedded with JTrt unit.

TrMbc PILLOW BASALT, CHERT, AND MINOR AGGLOMERATE--Dark green-gray to olive green or maroon, aphanitic to porphyro-aphanitic basalt with large phenocrysts (up to 1 cm) of olivine and possibly diopside. Plagioclase averages An_{62}; clinopyroxene content averages 33.4%; olivine content averages about 7.0%. Chemically, TrMbc basalts average 47.28% SiO_2, and 1.17% TiO_2. Chemical signatures indicate that TrMbc basalts are part of a tholeiitic suite (table 2, nos. 1-3). Porphyro-aphanitic varieties contain the most olivine; finer grained phases contain less olivine and more clinopyroxene. Groundmass of flows are almost always altered. Well-developed pillows up to 7 ft (2 m) in diameter occur in several localities. Minor agglomerate beds contain clasts identical to those in the mafic flows and banded chert of TrMbc unit, which suggests local reworking of unit. Interbedded with basalt and agglomerate are thin, 1 to 7 ft (0.3 to 2 m) beds of gray to red cherts and clastic units which yielded *Fenestrellid* bryozoans of Late (?) Paleozoic--Mississippian age, and multicyrtid *Nassellarina* radiolaria of Triassic (?) age, hence the age range of Mississippian to Triassic (table 1; nos. 17 and 20). Mafic volcanics in the Innoko Terrane in other portions of western Medfra quadrangle yielded Mississippian radiolaria and Permian (?) bryozoans (Patton and others, 1980). Unit is somewhat resistant in fresh exposures; nonresistant where altered.

TrMv MAFIC TUFF, VOLCANICLASTIC SANDSTONE, AND MINOR MAFIC FLOWS--Medium to dark gray, coarse-grained augite-plagioclase-rich mafic tuff, volcaniclastic sandstone, and porphyritic basaltic andesite and basalt. Mafic flows and tuff are extensively altered. Mafic tuffs contain interbedded chert that yielded *Veghicyclia* spp., *Pauedohelidiscus* spp., and *Sarla* spp. from the Norian stage of the Upper Triassic (Table 1, no. 22). Sandstones exhibit coarse, immature textures, and contain about 50% igneous clasts composed of diorite and andesite, and 50% sedigenic clasts. Mafic flows superficially resemble those in TrMbc unit; however, limited major oxide chemistry indicates that TrMv flows are more siliceous (SiO_2=53.22%), and contain less titanium (TiO_2 =1.10 %) and magnesium (MgO = 3.44%) than TrMbc flows. High sodium content (Na_2O=4.51%) suggests that TrMv mafic flows are ocean floor spilites (Table 2, nos. 4 and 5). TrMv volcanics are transitional between tholeiitic and calc-alkaline compositions. Despite chemical variations between TrMv and TrMbc volcanics, we believe that both units are transitional and may be facies and age equivalents.

TrMcs CALCAREOUS, LITHIC, PEBBLE SANDSTONE--Light to medium green-gray, medium to coarse grained, commonly calcareous lithic pebble sandstone and minor medium gray siltstone that contains distinctive pebbles of green-gray chert, argillite, and tuff. Finer grained clasts consist of chert (35%), phyllite (25%), intermediate volcanics (15%), limestone (5-10%), and sandstone (15-20%) in a calcareous matrix. Prehnite alteration is locally present in volcanic-rich sands, and sandstones are conspicuously compacted and stretched near the Innoko River. Sandstone beds locally exhibit flute casts and graded beds up to 6.6 feet (2 m) thick with Bouma a-c intervals after Mutti and Ricci Luchi (1972). Field relationships suggest that unit TrMcs conformably overlies chert-rich unit (TrMc). Thin sections have yielded *Cryptostome* Bryozoan, brachiopod, and palmatozoan fragments of probable Late (?) Paleozoic age (table 1, nos. 2, 16, and 18); hence, the known age of TrMcs unit is imprecise in the study area, but may be equivalent to faunally-dated, Permian graywacke unit described by Chapman and Patton (1979) in Ruby quadrangle.

TrMc BANDED CHERT AND ARGILLITE--Medium to dark gray, green, and some red radiolarian chert, interbedded dark gray argillite, and very minor tuffaceous volcanic rocks. Unit is distinctively weathered yellow brown to reddish orange in outcrop, and locally exhibits a phyllitic texture in fine grained clastic interbeds. Fossil collections made near Lower Colorado Creek yielded *Albaillella* sp. of Middle and Late Mississippian age; *Latentibifistula* sp. of Pennsylvanian-Permian age, *Tormentum* sp. of Mississippian-Permian age, and *Capnodoce* sp. of Triassic (?) age (nos. 3-5, 9; table 1). Hence we assign the age range of Mississippian-Triassic for the TrMc unit. In addition Late Devonian radiolaria were reported in a similar chert-dominant unit in the Ruby quadrangle (Chapman and others, 1985). The unit is in thrust contact with the TrMcs unit east of Innoko River, but is apparantly conformable with TrMcs in other portions of the study area. Complex folding makes thickness estimates tenuous; however, TrMc is at least 10,000 ft (3,000 m) thick as estimated in Folger and Lower Colorado Creek stream cuts. Resistant and forms rugged cliffs along stream cuts and steepened slopes along higher ridgelines.

TrMs SANDSTONE AND SILTSTONE--Fine grained, brown-weathered sandstone and greenish, siliceous siltstone. Mainly exposed in a syncline near the head of Bear Creek. Overlies TrMc unit. Very nonresistant and rarely crops out.

TrMd DOLOMITIC LIMESTONE--Light gray, aphanitic to fine grained, massive dolomitic limestone exposed in roadcut of Cripple Creek pay channel. Relationship to other Innoko terrane lithologies unknown.

TrMls LIMESTONE--Light to medium gray, fine grained, limestone with subordinate sandy tuffaceous limestone, and siltstone. In contact with TrMc unit in northern part of map area. Although three of our samples from the study area failed to yield conodonts, limestone units probably equivalent to TrMls have yielded Mississippian conodonts and foraminifera from the western Medfra quadrangle (Patton and others, 1980).

PzpCs GREENSCHIST AND QUARTZ MICA SCHIST--Medium gray to medium green, medium to coarse grained, schistose, foliated, actinolite-chlorite-albite-epidote greenschist and biotite-chlorite-albite-quartz schist. Secondary crenulations and foliations suggest multiple periods of deformation, and mineral assemblages indicate recrystalization of metasedimentary and metavolcanic(?) protoliths to greenschist facies conditions. Confined to two, restricted, fault-bounded wedges encased in Innoko Terrane lithologies: (1) along Innoko River near southwestern map boundary; and (2) in Colorado Creek canyon about 1 mile (1.6 km) below limit of placer mine tailings (Qht). We conclude that PzpCs constitutes an unnamed metamorphic basement complex that underlies the Innoko terrane in the map area; PzpCs may also be fault slivers of the Ruby terrane, which is exposed in northwest corner of map area.

RUBY TERRANE

PzpCgo GRANITIC ORTHOGNEISS--Fresh, medium grained, medium gray, equigranular to well foliated, hornblende biotite quartz monzonite gneiss. Color index averages 25; quartz comprizes about 20 percent of the groundmass. Hornblende grains are equant and nearly black in color. Biotite is fine grained and usually occurs in cylindrical aggregates. Probably equivalent to granitic orthogneiss bodies described by Patton and others (1994) and Miller and Bundtzen (1994) in the Ruby terrane, which range in age from Proterozoic to Paleozoic--and yield mid-Cretaceous K-Ar mineral ages. Very resistant and forms large equant blocks up to 10 ft (3 m) in diameter at the toe of the slope near Cripple Landing; unit PzpCgo might constitute an excellent source for riprap.

PzpCph PHYLLITIC STRETCHED PEBBLE CONGLOMERATE, GREEN ARGILLITE, AND PHYLLITIC SCHIST--Medium to dark gray, coarsely crystalline, phyllitic to schistose, quartz-rich, stretched pebble conglomerate and graphitic slate-phyllite; and subordinate, distinctly green argillite and tan felsic phyllite. Presence of abundant chlorite, white mica, and albite suggests recrystallization of protoliths to lower greenschist facies metamorphic conditions. Semiresistant and poorly exposed along flanks of Hunch Mountain.

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