DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

DESCRIPTION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

Qg Reworked stream gravel (tailings).--Placer-mine tailings derived from buried stream gravels that were worked for gold by pick and shovel, mechanized surface, underground drifting, or dredging methods. Shown when map scale permits, and some small areas are included in unit Qa. Thickness commonly less than 30 feet.

Qs Swamp deposits.--Humus, peat, and silt in poorly-drained areas with abundant stagnant water. Generally frozen below a depth of several feet. Some small areas are included in units Qa, Qab, and Qsu. Thickness at least several feet, maximum unknown.

Qa Alluvium.--Silt, sand, and granule- to boulder-size gravel, with minor amounts of organic debris. Forms active stream bed, flood plain, and adjacent low terraces along most streams; is largely unfrozen. Commonly covered by vegetation and thin soil layer except in stream beds, and may be mantled by units Qsu or Qlc; includes minor glacial deposits near Cache Mountain. Thicknesses may range from one foot to about 50 feet.

Qd Dune sand.--Eolian sand, moderate yellowish-brown, consisting mainly of well-sorted, angular to round, yellowish-white, clear to opaque quartz grains (65 to 85 percent) and some dark gray to black rock fragments, chert, mica, traces of feldspar and light-colored rock fragments. Isolated dunes up to 30 feet high; mostly covered by eolian silt and stabilized by vegetation.

Qab Abandoned flood-plain alluvium.--Silt, sand, and granule- to pebble-size gravel, with minor amounts of organic material; commonly frozen. Thicknesses not known, but may be as much as 100 feet.

Qsu Silt undifferentiated and organic material (muck).--Silt, largely of eolian origin and, in part, locally retransported from original site of deposition to lower slopes and valley bottoms by alluvial and solifluctional processes. Locally rich in organic layers, masses, and disseminated debris. Commonly frozen and contains abundant ground ice as horizontal and vertical sheets, wedges, and irregular masses. Thicknesses may range from several feet to about 200 feet.

Qlc Loess and colluvium.--Loess is massive, homogeneous eolian silt, buff to tannish gray when dry and brown when wet; chiefly on upper slopes and hilltops. Mapped or interpreted where thickness is at least 3 feet; maximum thickness not known but locally is at least 40 to 50 feet. Colluvium is a mixture of silt and fragments of the local bedrock; generally several feet thick on upper slopes to several tens of feet in thickness lower on the slopes. Probably frozen if thicker than 10 to 15 feet, or on northerly-facing slopes.

Qfg Gravel, sand, and silt.--Alluvial gravel, sand, and silt that vary greatly in composition and size-grade distribution; locally developed and of limited extent. The Idaho Bar deposit near Hunter Creek includes some placer gold. Probably mostly frozen, and at much as 100 feet in thickness.

UNCONSOLIDATED SEDIMENTARY AND METAMORPHIC ROCKS

Ts Sandstone, siltstone, conglomerate, and coal.--Non-marine clastic rocks, dominantly arenaceous and rudaceous, light to medium greenish gray to gray, weather light and medium yellowish brown and brown, poorly to well consolidated, friable. Commonly have calcareous cement, some ironstone nodules, lenses, and thin layers, and plant fossils and fragments. Conglomerates are locally derived and the pebbles, cobbles, and less-common boulders range greatly in composition, angularity, and size. Siltstone and shale are less common. Lignitic shale, bituminous coal, and associated thin clay layers are present in minor amounts. Coal beds probably do not exceed 7 feet, and generally are 2 feet or less, in thickness. Plant fossils from the Drew mine locality are Eocene; some Paleocene and(or) Oligocene rocks may also be present here and elsewhere. Thickness is about 3,000 feet at Drew mine locality, and unknown elsewhere.

KJs Shale, graywacke, and quartzite.--Shale and siltstone are generally medium gray, silty and clayey, and slaty in part. Graywacke is commonly medium gray, fine to very coarse grained, thin to medium bedded, graded bedding and some flute-cast and rill-marked surfaces, calcareous cement in part; some feldspathic (volcanic) graywacke. Quartzite is light to dark gray, weathers to various shades of light yellow and tan, very fine to medium grained, rarely conglomeratic with small pebbles and angular shale fragments, generally massive but shaly bedded in minor part; some interbedded thin layers of shale and siltstone, some flute-cast and rill-marked surfaces; white quartz in veins, pods, and irregular masses is common. Rarely fossiliferous; poorly preserved invertebrate (mostly pelecypods, probably Buchia) and plant fossils in the Wolverine Mountain-Hunter Creek area are identified as Cretaceous, and Buchia is suggestive of Early Cretaceous. The thickness and sequence are not known, but the quartzite beds are probably in the lower part.

KJc Conglomerate, graywacke, and shale.--Polymictic conglomerate and conglomeratic graywacke, dark olive-gray to medium-dark gray, commonly iron stained on weathered surfaces, granules to cobbles and less-abundant boulders include - greenstone, quartzite, dark gray limestone, sandstone, chert, siltstone, phyllite, siliceous slate, medium dark gray slate (some with pencil cleavage), diorite, and other intrusive rocks; thick to massive beds, locally is greatly sheared and pebbles are flattened and stretched. Graywacke is medium to medium dark gray and greenish gray, iron stained on weathered surfaces, mostly very fine to medium grained, gradational to and interbedded with both conglomerate and siltstone; some rill or turbidity-current markings on graywacke-shale bedding planes. Shale is common, grades to siltstone, generally medium dark gray, micaceous, fissile to chunky; locally pencil fracture and poorly-developed slaty (slip) cleavage are prominent. The only fossil found (on the north side of the Dugan Hills) is a poorly preserved Inoceramus (?) probably of Cretaceous or possibly Jurassic age. The thickness of this unit is unknown.

PzU Undifferentiated chert, clastic rocks, limestone, and minor associated volcanic rocks.--Chert is vari-colored ranging from medium gray and black to several shades of green, red, yellow, and tan, mostly thin bedded, and banded in part. Clastic rocks include shale, slaty shale, siliceous slate, siltstone, argillite, sandy shale, graywacke sandstone, tuffs and tuffaceous rocks, volcanic breccia, and agglomerate; commonly these are medium to dark gray, but, in part, are green, yellow, red, and maroon; generally thin and irregularly bedded; siliceous, calcareous, or micaceous in parts. Limestone is rare, medium gray, generally thin and irregularly bedded to lenticular, gritty to conglomeratic in part, and may contain invertebrate fossils and fragments. Some interbedded or intruded mafic extrusive and intrusive rocks, unit MPv, which are too small to show separately, are included. Fossils from clastic rocks 6 miles north of Noodor Dome were originally identified as Mississippian, but recent reexaminations indicate a possible Early Permian age; bryozoans and pelecypod prisms from clastic limestone in this unit on the Yukon River 0.25 mile west of 150°00' W. long., in the Tanana quadrangle, have been identified as probably of Permian age. The thickness of this unit is unknown.

Pzc Conglomerate and shale.--Conglomerate is medium gray, in beds 6 to 10 inches thick, composed primarily of rounded to angular gray chert pebbles up to 1 inch in diameter, but also includes white quartz, slate, sandstone, and possible igneous rock fragments in a sandy, and in some places calcareous matrix. Clay shale makes up about 70 percent of the section, is medium gray to medium dark gray, relatively hard, and contains rare thin dirty sandstone and siltstone layers. Thin conglomerate and rare silty layers are highly iron-stained. Conglomerates contain fragmental bryozoans, brachiopods and corals that closely resemble the fossils of possible Early Permian age in unit PzU.

DCl Conglomerate, graywacke, and shale.--Conglomerate, light to medium-dark gray, has predominantly dark chert and white quartz granules and pebbles, locally polymictic, sandy graywacke matrix, locally sheared and pebbles are flattened or stretched. Graywacke is medium gray, weathers medium yellow brown to reddish brown, mostly fine to very fine grained, and partly calcareous. Siltstone is light to medium dark gray, sandy in part, grades in part to argillite. Silt shale and clay shale are medium to medium dark gray and olive gray, slaty and pencil fractured in part, and partly micaceous. Some quartzite, very light and medium gray, is in thin beds. Limestone and clastic limestone are very rare, light to medium-light gray and dark gray, commonly weather to light brown and dark yellowish orange, finely crystalline, locally very fossiliferous with corals, stromatoporoids that weather to white patches, massive bryozoans, and pelmatozoan debris. Pelecypods, including Actinopteria (McAlester, 1962), and some gastropods, brachiopods, corals, echinoderm debris, and plant fragments, are locally abundant near Livengood in shale-siltstone units, and in thin dark reddish-brown weathered coquina associated with a conglomerate-graywacke-shale unit. A late Middle to early Late Devonian age is indicated. Thickness is unknown.

DCl (South of Beaver Creek fault) Conglomerate, graywacke, and shale.--Conglomerate, light and medium gray, hard, granules and small pebbles are quartz, chert, and rarely other rock types, many angular pebbles, matrix is medium- to fine-grained. Graywacke is similar and is fine to very coarse grained. Conglomerate and graywacke are quartzitic in part. Siltstone and shale are medium gray and weather gray to olive. Thickness is unknown.

DSt Tolovana Limestone.--Limestone is light to medium gray, rarely dark gray, and weathers white, very light gray, and yellow to buff, predominantly finely crystalline, thick bedded and massive, less commonly thin bedded, blocky jointed, locally greatly fractured and recemented and veined by calcite and quartz; locally some dense dolomitic limestone. Fossils are rare, and include corals, crinoids, brachiopods, and Amphipora; some have been identified as Silurian and others as young as Middle Devonian. Rocks are the same north and south of Beaver Creek fault. Thickness is unknown, but may be several thousand feet.

DOd Dolomite, limestone, silicified carbonate rocks, and chert.--Dolomite and limestone are light to very light gray and nearly white and weather light to medium gray, light grayish yellow to light yellow, buff, and, in part, to a faint light pink or lavender, fine to very finely crystalline, silicified to various degrees, massive, medium bedded, and rarely thin to shaly bedded; brecciated in part and commonly veined with quartz and some calcite. Only fossils are from a site near Lost Creek, 9 miles west from Livengood, and are poorly preserved assemblage of invertebrates has been identified as most probably Silurian, or possibly Devonian. Limestone that is medium gray, weathers to medium dark gray or light gray, dense to very finely crystalline, generally thin bedded, and includes some chert lenses and nodules is less common. The interbedded chert is generally medium dark gray to black, greatly fractured and brecciated in parts; with associated slaty shale and siliceous argillite or siltstone that are dark gray with some medium red to brownish red, thin bedded, tuffaceous in part, and gradational to chert. Includes some mafic rocks, basaltic and diabasic, that are medium to dark greenish gray to grayish green and medium to medium-dark red and reddish brown, generally very fine grained; probably some are flows and others are sills and dikes, all too small to differentiate on this scale. Thickness is unknown.

DOc Chert.--Chert is generally light to medium gray with some medium-dark to dark gray, and weathers various light and very light shades of gray, green, yellow, reddish brown, and red with some iron and manganese stains and coatings, mainly massive to thick bedded with some thin- to shaly-bedded units, much fractured and brecciated in parts. Interbedded siliceous slaty shale, tuffaceous siltstone and argillite, and minor very fine-grained graywacke range from light gray and olive gray to medium-dark gray, with a minor amount of dark red and reddish-brown argillite and slaty shale, all generally in thin units. Some mafic intrusive bodies, too small to differentiate, are included. This unit may grade upward into unit DOd. Thickness is unknown.

Oq (South of Beaver Creek fault) Vitreous quartzite.--Quartzite is light to very light gray and weathers light or medium gray with yellow to brown iron stain and flecks, massive and rarely thin to shaly bedded, well fractured, very hard, generally very fine grained to, in part, dense giving a vitreous appearance; white quartz veining common; forms prominent ridges and ledges. Sandstone is light to medium gray, quartzitic, fine to very fine grained, rarely conglomeratic with small shale fragments. Some slaty shale and silty sandstone thin interbeds in the quartzite and sandstone are light to medium gray and weather to medium olive yellow; minor light gray chert, and medium to dark gray slate and phyllite. Non-fossiliferous in this quadrangle. Unit Oq has not been recognized north of Beaver Creek fault. Thickness is unknown but probably relatively thin.

OMCs (South of Beaver Creek fault) Chert, slate, and phyllite.--These rocks are predominantly medium to dark gray, banded in part, mostly thin bedded, and include some argillite, and rarely lenticular slaty limestone to calcareous argillite. The only fossils are a few trilobites and brachiopods from a small lime lens on Willow Creek about 9 miles above the mouth; they have been identified as Late Cambrian and as Early Ordovician, but the latter is favored. The thickness is unknown and probably thin. This unit has been recognized only in the White Mountains area.

Ꞓal Argillite, slate, quartzite, siltstone, and limestone.--Argillite and slate are medium to very dark red or maroon, and light to medium green and grayish green, and the colors alternate in interbedded units or in bands or irregular mottling within one unit, fissile to chunky; these rocks form a relatively thin but widespread and distinctive unit. Also slate and argillite that are medium-light to dark gray and greenish gray, and grade to a similar phyllite which ranges to light gray. Quartzite is light to medium gray and greenish gray, medium to thin bedded, generally fine grained and, in part, grit. Limestone that forms a unit near base of the section is very dark gray and weathers medium to dark gray, thin bedded and platy, dense to very finely crystalline. Another limestone unit is medium to dark gray and weathers medium gray or various shades of brown, yellow, and red, thin bedded and platy to shaly, dense, commonly arenaceous and argillaceous; in the upper part of the section and interbedded, or closely associated, with the red and green slate. Minor amounts of mafic rock, basaltic, probably intrusive, thin and too small to differentiate, are included. Entire unit is extensively folded, sheared, and fractured; quartz and calcite veins are common. Rocks are the same north and south of Beaver Creek fault. Thickness is unknown.

Ꞓgq Grit, quartzite, slate, argillite, and chert.--Grit and quartzite, gradational to hard sandstone and graywacke, are light to medium gray, greenish gray and olive and weather light gray with iron stain and flecks of oxidized pyrite, thin to medium bedded (2 inches to 2 feet), very hard, blocky fracture, generally very fine to medium grained, granules and rare small pebbles are largely clear quartz many of which have a pale blue color, feldspathic and pyritic in parts, white quartz veins, pods, and irregular masses are common; forms prominent ridges, hills, and ledges. Slate, grading to slaty argillite and phyllite, is light to medium gray, greenish gray, and olive, commonly thin bedded (3 to 8 inches) and interbedded with grit and quartzite, micaceous in part. Some gray and black chert near top of section; may grade upward into unit Ꞓal. Oldhamia fossils in greenish gray to olive slate and argillite, 8.5 miles northeast of Noodor Dome, tentatively indicate a Cambrian age, but previously were identified as Mississippian (Churkin and Brabb, 1965; Mertie, 1937). Thickness is unknown, but probably is relatively thick.

Ꞓgq (South of Beaver Creek fault) Grit, quartzite, slate, and argillite.--Unit is similar to that described above, but does not include chert or fossils. Thickness is unknown, but probably is relatively thick.

METAMORPHIC ROCKS

gf Greenschist facies.--Dominantly micaceous quartzites, garnet-mica schists, quartz-mica schists and phyllitic schists with subordinate greenschists and rare impure marbles are various shades of gray and weather reddish or yellowish brown. Degree of recrystallization decreases, across a northeasterly structural trend, toward the northwest. This transition is marked by the disappearance of garnet in the pelitic schists and by gradation from mica and quartz-mica schists to phyllites. Grades upward into unit Ꞓgq. Thickness is unknown.

eaf Epidote-amphibolite facies.--Unit includes lime silicate marbles, eclogitic rocks, garnet amphibolites, epidote amphibolites, garnet-schists, and graphitic and micaceous quartzites. These rocks are mostly various shades of gray and weather reddish or yellowish brown, except the amphibolites, eclogites, and some of the marbles which are grayish green to greenish black.

Geochronology.--Greenschist facies metamorphic rocks in the southeastern part of the quadrangle generally give Cretaceous K^{40}/Ar^{40} mica ages. Phyllitic schists in the Wickersham Dome area, which show decreasing recrystallization to the northwest, have given K^{40}/Ar^{40} whole rock ages as old as 256 ± 5 m.y. (Forbes and Engels, verbal commun., 1970).

Epidote-amphibolite facies rocks near the Chatanika River have provided amphibole K^{40}/Ar^{40} ages up to 470 ± 35 m.y. (Forbes and others, 1968) and a Rb^{87}/Sr^{87} muscovite age of 509 m.y. (Wasserburg and others, 1963). These rocks were apparently first recrystallized during an Ordovician metamorphic event, followed by partial recrystallization during a succeeding Mesozoic deformational episode. It is probable that the parent sedimentary rocks were, at least in part, of Precambrian age.

SEDIMENTARY AND VOLCANIC ROCKS

Tvs Volcanic and sedimentary rocks.--Volcanic rocks are basaltic, light to medium green, medium green, and grayish green, very finely crystalline to aphanitic, in part amygdaloidal, probably chiefly extrusive but some may be sills. The interbedded sedimentary rocks include siltstone, shale, graywacke sandstone, and polymictic granule-pebble sandy conglomerate, and all in part have graded bedding and cross bedding, and are non-calcareous, and in part tuffaceous. Carbonaceous plant fossils and fragments are abundant in a few silty shale layers, and are tentatively identified as Paleocene or Eocene. Thickness is approximately 1,500 feet near Isom Creek.

SOvs Volcanic and sedimentary rocks.--Volcanic rocks are chiefly mafic lava, tuff, breccia, and agglomerate, with a minor amount of mafic intrusive rock. Lava is basalt and diabase commonly altered to greenstone, medium to dark greenish gray, fine grained to aphanitic, amygdaloidal and vesicular in parts, layered and massive, and rarely with pillow structure; commonly fractured in irregular angular blocks and small fragments, crushed and slickensided zones common, foliation, slaty cleavage, and green schist locally developed. Fragmental rocks are dense tuffs similar in appearance to basalt, light olive gray to medium yellow green and grayish green and partly reddish brown, laminated to thin layered with some slaty cleavage. Coarser tuffaceous breccia with angular fragments, and agglomerate and/or volcanic conglomerate with rounded pebbles, cobbles, and boulders are less common than lava and tuff. Some gabbroic-diabasic greenstones, dark yellowish-green, green, and greenish-gray, medium- to fine-grained, which intrude the volcanic, volcaniclastic, and clastic rocks, are included. Contact with the overlying Tolovana Limestone is disconformable and the uppermost 30 to 200 feet of section, present in many, but not all, places includes: volcanic conglomerate, dark greenish-gray, with rounded pebbles, cobbles, and boulders composed chiefly of basaltic rocks with minor amounts of quartzite, slate, chert, and granitic rocks in a volcanic graywacke matrix; some limy tuff, light to medium grayish-green; and a tuffaceous sandy limestone or calcareous sandy tuff, light to medium reddish-brown, yellowish-brown, medium brown, and grayish-green, with bright orange-yellow weathered surface, abundantly fossiliferous in some places. Corals, brachiopods, stromatoporoids, and a few conodonts from this calcareous unit seem to include both Middle to Late Ordovician and Silurian types. The conglomerate, tuff, and limestone is interpreted as part of the disconformity zone, and, with reservations about its exact age relations to the overlying and underlying rocks, is included with the underlying volcanic section, similar to Mertie's (1937) Fossil Creek Volcanics. The section of predominantly sedimentary rocks includes dark gray shale or slate, tuff, argillite, dark gray chert, light to medium gray, sandy, thin-bedded to shaly or slaty limestone, and some olive-gray to greenish-gray, aphanitic meta-volcanic basaltic rocks. Minor amounts of units ꞒOcs and Ꞓal that are infolded or in fault slices may be included.

VOLCANIC ROCKS

Tb Basalt.--Olivine basalt, brownish-black, vesicular in part, shows some columnar jointing and possibly pillow structure. Thickness unknown, but probably relatively thin.

VOLCANIC AND PLUTONIC ROCKS

MPv Extrusive and intrusive mafic rocks with some undifferentiated sedimentary rocks.--Lava flows, tuffs, and breccias, basaltic and diabasic and possibly andesitic in part, are dark green and grayish green to almost black and weather light and medium and reddish brown, generally aphanitic to very fine grained; tuffaceous rocks are gradational into sedimentary tuffs and chert. The origins (volcanic or sedimentary, and intrusive or extrusive) of many of these rocks are difficult to determine; no pillow structure or other clearly extrusive features are obvious, and if such did exist they have probably been obliterated by structural deformation. Some undifferentiated sedimentary rocks of units PzU and Pzc, and possibly some unrecognized rocks of unit IVs may be included. Thickness is unknown. The intrusive rocks include diorite, diabase, and gabbro that are medium to dark green, grayish green, and greenish black and weather to various shades of yellow, brown, and reddish brown, fine to very coarse grained, hard, blocky jointed; commonly form prominent ridges, knobs, and bluffs. A hornblende K^{40}/Ar^{40} age date of 205 ± 5 m.y. was obtained from a gabbro on the north bank of the Yukon River about 4.2 miles west of 150°00' W long., in the Tanana quadrangle (Brosgé, Lanphere, Reiser, Chapman, 1969).

Pzm Mafic and ultramafic rocks.--Mafic and ultramafic rocks, intrusive and possibly some extrusive, commonly more or less altered, include diorite, metadiorite, diabase, gabbro, basalt, metabasalt, and greenstone. Altered mafic rocks that cannot be readily identified more precisely) that are generally medium to dark green, yellowish green, grayish green, and greenish gray and weather to darker shades of yellow, yellowish brown, reddish brown, olive gray, or greenish gray, fine to coarse grained and in part aphanitic, massive with blocky jointing and irregular fracturing, or in parts with poorly developed layering and rarely foliation.

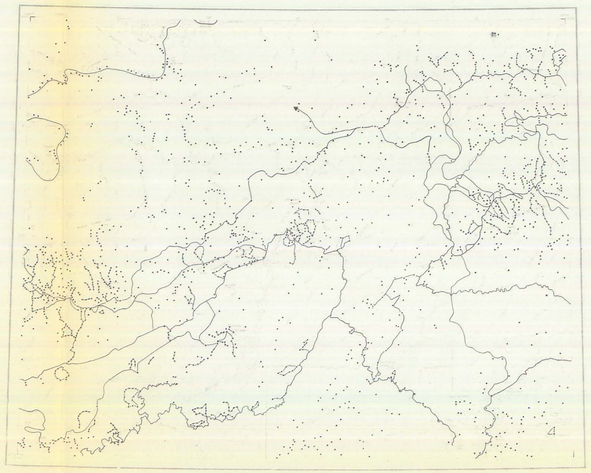
Pz sp Serpentinite with some rodingite and tectonic inclusions.--Serpentinite is light to dark yellowish green, grayish green, greenish black, and black and weathers to various shades of medium to dark brown, reddish brown, and grayish brown. It ranges from a sheared, foliated type (slickenlite) with shiny smooth, commonly curved, slickensided surfaces to an unsheared massive or blocky-jointed type (blockenlite); small segregations rich in chromium and nickel, and very thin veinlets of chrysotile asbestos are rare and sporadically developed. Minor lake equivalent limestone and rodingite and tectonic inclusions are tabular to irregular blocks, ranging from 2 to 50 feet in maximum dimension, and include olive-green, light green, dark gray, and very light gray rocks derived from intrusive and volcanic, sedimentary, and metamorphic rocks, and show various degrees of alteration. The unit commonly is overtaiga by barren to chinly-vegetated brownish and grayish soil and rubble patches on upper slopes and hilltops.

PLUTONIC ROCKS

TKg Granitic rocks.--Monzonite, quartz monzonite, quartz diorite-granodiorite, and granite are generally very light to medium gray and weather to various shades of yellow and reddish brown with abundant iron staining, commonly well jointed and irregularly fractured, largely medium to very coarse grained, both equigranular and porphyritic with feldspar phenocrysts as much as 5 to 7 centimeters in length, and some fine-grained phases; both angular blocky talus and grus are common weathering products. The plutons and stocks form prominent high peaks and knobs, and have surrounding hornfelsed zones of resistant rocks. Elephant Mountain is chiefly monzonite and quartz monzonite, which are generally porphyritic. Wolverine Mountain and the adjacent small stocks are mostly porphyritic quartz monzonite. Sawtooth Mountain is monzonite and quartz monzonite, partly porphyritic; the biotite K^{40}/Ar^{40} age date is 88.8 ± 3 m.y. The small muscovite granite stock on Troublesome Creek just below Union Creek has a muscovite K^{40}/Ar^{40} age date of 66.4 ± 2 m.y. Tolovana Hot Springs Dome is largely porphyritic quartz monzonite and monzonite, and has a biotite K^{40}/Ar^{40} age date of 63.3 ± 2.5 m.y. Similar small stocks in the Livengood-Cascaden Ridge area are mostly medium to fine grained and sparsely porphyritic. Cache Mountain is a quartz monzonite, medium- to coarse-grained, with some porphyritic and fine- to medium-grained phases. The Pedro Dome intrusive bodies are quartz diorite-granodiorite, and quartz monzonite that range from fine- to coarse-grained with some porphyritic phases; a mica K^{40}/Ar^{40} age date of 90.7 ± 3.1 m.y., has been obtained from the quartz diorite-granodiorite, and a hornblende K^{40}/Ar^{40} age date of 93 ± 5 m.y., was determined for the quartz monzonite (Britton, 1969; Forbes and others, 1968).

TKd Dikes, sills, and small intrusive bodies.--These are closely associated with unit TKg, and include a variety of granite, aplite, pegmatite, rhyolite, monzonite-latite, minette, and some mafic differentiates. They are generally very light to dark gray, have various grain sizes, and some are porphyritic.

TKs Syenite.--The only known syenite body, on Bear Creek near Cache Mountain, is medium-light gray, mostly weathered to yellow, orange, and brown, coarse to very coarse grained, porphyritic, deeply weathered. Age is uncertain, but probably is closely related to unit TKg rocks.



INDEX MAP OF LIVENGOOD QUADRANGLE SHOWING LOCATIONS OF FIELD OBSERVATION POINTS AND CONTINUOUS TRAVERSES

Identifiable field stations and traverse routes of geologists who worked between 1902 and 1932 are included. There are more field stations in the vicinities of Livengood and Pedro Dome than can be plotted on this scale. Many field stations along the continuous traverse routes are not shown individually.

Bedrock units, contacts, structures, and surficial deposits have been extended and interpreted between field stations with the aid of aerial reconnaissance and aerial photographs.

FOSSIL LOCALITIES NOT PREVIOUSLY REPORTED

Lat. N.	Long. W	Geographic description	Rock unit	Types of fauna or flora	Age
65°47'00"-65°47'15"	149°25'-149°26'30"	Three sites in roadcuts about 1 mile south of Isom Creek	Tvs	Plant leaves, needles, stems, and fragments	Paleocene or Eocene
65°03'15"	149°59'24"	South side of Niggerhead Creek	KJc	Poorly preserved pelecypod	Cretaceous or Jurassic
65°29'30"	148°27'40"	On ridge east side of Ester Creek at altitude of 1,200 + feet	Dcl	Mollusks, chiefly pelecypods	Late Middle to early Late Devonian -do-
65°30'40"	148°32'24"	On and near highway at Lillian Creek	Dcl	Corals, stromatoporoids, bryozoans, and pelmatozoan debris	
65°17'15"	148°09'	North side of highway at mile 38.4	DSt	Corals, stromatoporoids, Amphipora; very rare Amphipora	Middle Devonian
65°55'55"	147°10'-147°13'20"	Several sites 3.4-4.0 miles northnortheast of Mt. Schwatka	DSt		Probably Middle Devonian

AGE DETERMINATIONS FOR BIOTITE (B) AND MUSCOVITE (M)

[Argon analyses and age calculations by M. A. Lanphere and J. C. Von Essen; potassium analyses by L. B. Schlocker and H. C. Whitehead. Decay constants for K^{40} (total) = 0.585×10^{-10} year^{-1}; $\lambda_e = 4.72 \times 10^{-10}$ year^{-1}. Abundance ratio $K^{40}/K = 1.19 \times 10^{-4}$ atom percent.]

Location and field number	Coordinates	Geologic unit and mineral	K_2O (percent)	Ar^{40}_{rad} (moles/gm)	$Ar^{40}_{rad}/Ar^{40}_{total}$	Calculated age (millions of years)
Tolovana Hot Springs Dome 62Ach-65	65°15'45"N 148°55'W	TKi B	8.53 8.40 avg.8.46	8.05×10^{-10}	0.90	63.3 ± 2.5
Sawtooth Mountain 69Ach-96	65°21'40"N 149°35'W	TKi B	9.07	1.219×10^{-9}	0.78	88.8 ± 3
Troublesome Creek 69Ach-151	65°30'25"N 149°35'30W	TKi M	10.90 10.77 avg.10.835	1.082×10^{-9}	0.66	66.4 ± 2

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This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey standards and nomenclature.