

SURFICIAL DEPOSITS

Qa Qt QI Or Qu

Pleistocene

VOLCANIC ROCKS

Trw Trf

Tlw Tlf

Tv

Tc

MZU

Kn

RPc

MIXED METAMORPHIC

ROCKS

AND INTRUSIVE ROCKS

TITRUSIVE

ROCKS

Trp

Ti

Ti

To

Ti

To

MIXED METAMORPHIC

ROCKS

TITRUSIVE

ROCKS

TRANSIPHIC

ROCKS

TRANSIPHIC

ROCKS

TY

AND INTRUSIVE ROCKS

Yg

YSb

YSb

YSS

YSB

YXB

PROTEROZO

Description of map units

Qa ALLUVIUM (HOLOCENE) -- Sand and gravel along stream valleys. Includes
diatomaceous silt in lake deposit behind lateral moraine on
Sheep Creek (elev. 9,450 ft [3,100 m])

Qt TALUS (HOLOCENE) -- Loose deposit of blocks on steep slopes and at
base of cliffs; mostly in cifques and also on glacially

Qr ROCK GLACIER DEBRIS (HOLOCENE)

Qu COLLUVIUM (QUATERNARY)--Includes undifferentiated deposits of talus, solifluction debris, and till

oversteepened valley walls such as the Cache la Poudre River

Q1 LANDSLIDE DEBRIS (HOLOCENE)--Slumps of coherent to fragmental masses
of rhyolite along glacially oversteepened slopes in Neota-Flat
Top area

QZ TILL (PLEISTOCENE)--Bouldery deposits in lateral, terminal, and ground moraines

Trw RHYOLITIC ASH-FLOW TUFF (OLIGOCENE)--Light-brown, pale-gray, pinkish-gray, and cream-colored porphyritic rhyolite. Rock largely massive; locally a weak flow structure is evident and probable flattened pumice fragments are visible in hand specimen. Forms most of Lulu and Thunder Mountains and Mount Neota. Also present on Seven Utes Mountain. Phenocrysts

commonly 1-3 mm long of smoky quartz and colorless sanidine constitute 10-15 percent of rock. K-Ar date on sanidine,

RHYOLITE LAVA FLOWS (OLIGOCENE)—Brown to reddish-brown porphyritic rhyolite in tabular layers dipping gently northeastward from the northern part of Never Summer Mountains. Phenocrysts of quartz and sanidine are commonly 1-2 mm long and comprise a few percent of rock—usually less than 10 percent. Phenocryst content is generally less than in ash-flow tuffs. Groundmass is typically lithoidal. Thin vitrophyre layers are interlayered with lithoidal flows and/or ash-flow tuffs

Tv LAVA FLOWS, ASH-FLOW DEPOSITS, AND PYROCLASTIC ROCKS, UNDIVIDED (OLIGOCENE)--Principally rhyolitic

RHYOLITE PORPHYRY AND GRANITE (OLIGOCENE)—Pale-gray to tan massive but strongly jointed rock forming Mount Cumulus stock. Rhyolite contains white to pink alkali feldspar and white to smoky-gray quartz phenocrysts set in an aphanitic to fine-grained groundmass. Magnetite, partly altered to hematite and maghemite, and biotite, partly altered to chlorite, are sparse in rhyolite. Granite, which is equigranular to porphyritic, forms minor portion of stock. Biotite appears to be more abundant in granite than in rhyolite porphyry. The Mount Cumulus stock shows intrusive relations into the Mount Richthofen stock. Fission—track date on zircon, 28 m.y.

Tlw LATITIC ASH-FLOW TUFF (OLIGOCENE)—Massive; phenocrysts of plagioclase, pyroxene, and biotite. Very limited in extent

The LATITE LAVA FLOWS (OLIGOCENE)—Reddish-brown porphyritic latite.

Phenocrysts comprise 5-35 percent of rock. They are don's plagiocles and biotite and may include augite and of hornblende. The groundmass is totally crystalline and contains abundant plagioclase laths, sanidine, and quartz. Chemical analyses indicate the rock may contain 10-20 percent quartz.

Thr TRACHYANDESITE BRECCIAS (OLIGOCENE)--Flow breccias, which overlie trachyandesite lava flows (Ta) of Mount Richthofen, have a similar mineralogy to the flows

West of Thunder Pass interlayered mudflow breccias are composed

of clasts of quartz-bearing monzonite. K-Ar date on biotite,

Tbl MUDFLOW(?) BRECCIA (OLIGOCENE)—A small outcrop area immediately
east of the Michigan Lakes consists of poorly sorted breccia
composed predominantly of clasts of monzonite, quartz-bearing
monzonite, quartz monzonite, quartz-bearing trachyte porphyry,

and rhyolite porphyry that are as large as 3 m

Tgd GRANODIORITE (OLIGOCENE)--Equigranular to porphyritic, gray, mediumgrained, biotite-hornblende-pyroxene granodiorite, monzonite,
and quartz monzonite of Mount Richthofen stock. According to
Corbett (1964), the granodiorite forms a border zone of the
stock, monzonite forms the principal part of the interior, and
quartz monzonite forms irregular pods in monzonite. K-Ar date
on biotite, 28 m·y·

TRACHYANDESITE LAVA FLOWS (OLIGOENE)—Includes the trachyandesite of
Zimmerman Lake (Gorton, 1953; Corbett, 1966), and lava flows
east of Mount Richthofen. The flows south of Zimmerman Lake and
northwest of Long Draw Reservoir contain less than 10 percent of
various phenocrysts which include plagioclase, augite, olivine,
hornblende, or biotite, in a very fine-grained matrix of
plagioclase laths, sanidine, and biotite and/or pyroxene. The
flows east of Mount Richthofen contain 20-40 percent
phenocrysts, of which plagioclase is dominant, biotite is
abundant, and chlorite pseudomorphous after pyroxene(?) is
common, in a very fine-grained matrix that is partly glass and
partly irregular, non-oriented feldspar

Tw WHITE RIVER(?) FORMATION (OLIGOCENE)—Pale-yellow to white, poorly sorted tuffaceous sandstone and light-gray mudstone

Tap ANDESITE PORPHYRY (OLIGOCENE)—Large inclusions in the Mount Richthofen stock. Rock is massive and consists of zoned plagioclase phenocrysts and (in various combinations) biotite,

Mount Richthofen stock

To COALMONT FORMATION (EOCENE AND PALEOCENE)--Light- to dark-gray and green, hornfelsed mudstone and shale and lenses of fine- to medium-grained sandstone. Upper part of formation cut out by Never Summer thrust. Volcanic-pebble conglomerate typical of Middle Park Member of Coalmont crops out in Jack Creek valley just southwest of the map area

hornblende, hypersthene, and augite phenocrysts in aphanitic to glassy groundmass. May represent an early chilled phase of

Mzu MESOZOIC ROCKS, UNDIVIDED--Includes Pierre Shale, Niobrara
Formation, Benton Shale, Morrison Formation, and Sundance
Formation of Mesozoic age, and Chugwater Formation of Triassic
and Permian age in imbricate fault zone associated with Never

Summer thrust

Kp PIERRE SHALE (UPPER CRETACEOUS)--Interbedded medium- to dark-gray hornfelsed shale, siltstone, and sandstone

Kn NIOBRARA FORMATION (UPPER CRETACEOUS)---Small exposure of Fort Hays

Limestone Member near head of Michigan River

THE PC CHUGWATER FORMATION (TRIASSIC AND PERMIAN)--Reddish-brown to orange-

brown siltstone, shale, and fine-grained sandstone

Yg GABBRO OF THE IRON DIKE (PROTEROZOIC Y(?))--Fine- to medium-grained northerly trending dike about 20 m thick north of Long Draw

Reservoir

Ya ANDESITE AND BASALT DIKES (PROTEROZOIC Y(?))

Ysp SILVER PLUME QUARTZ MONZONITE (PROTEROZOIC Y)--Medium-graned,

trachytoidal, biotite-muscovite quartz monzoite. Mapped mainly

near Commanche Peak. Large area north and west of Comanche

Reservoir, where numerous small bodies of Silver Plume complexly
intrude older rocks, is shown by hachured line
Ysh SHERMAN GRANITE (PROTEROZOIC Y)--Coarsely porphyritic biotitic

granite at southeast corner of map area

YXss SILVER PLUME QUARTZ MONZONITE AND QUARTZO-FELDSPATHIC MICA SCHIST

AND GNEISS, UNDIVIDED (PROTEROZOIC Y AND X)

YXp PEGMATITE (PROTEROZOIC Y AND X)--Shown only at east edge of map but
present in small bodies throughout Precambrian rocks

Xgh METAGABBRO (PROTEROZOIC X(?))--Tough, massive to weakly foliated

dark-gray to black rock in north-trending body that crosses

Cache la Poudre River at north tip of area. Original pyroxene
phenocrysts partly altered to uralite and green biotite,
feldspars recrystallized

Xgg GRANITIC GNEISS (PROTEROZOIC X)--Variably foliated, medium- to fine-

grained biotite- or biotite-hornblende-bearing rocks that range
from alaskite, which is commonly gradational with and mixed with
pegmatite, through quartz monzonite, granodiorite, to quartz
diorite. The unit is very heterogeneous and contains many
inclusions of country rock gneisses that are variably
contaminated and recrystallized

Xhg GRANITIC GNEISS, HORNBLENDE GNEISS, AND QUARTZO-FELDSPATHIC SCHIST,

UNDIVIDED (PROTEROZOIC X)——Shown largely in areas of poor
exposure in central part of Comanche—Big South study area

XS QUARTZO—FELDSPATHIC MICA SCHIST AND GNEISS (PROTEROZOIC X)——Layered
metasediments that locally contain garnet and/or sillimanite.

Xbh QUARTZO-FELDSPATHIC MICA SCHIST AND GNEISS AND HORNBLENDE GNEISS,
UNDIVIDED (PROTEROZOIC X)

Xam HORNBLENDE GNEISS AND AMPHIBOLITE (PROTEROZOIC X)——Medium—grained,

poorly layered hornblende plagioclase rocks that contain small

but variable amounts of quartz and biotite

Migmatitic in part

FAULT ZONE

THRUST FAULT--Sawteeth on upper plate. Dotted where concealed

STRIKE AND DIP OF BEDS

STRIKE AND DIP OF FOLIATION

ANTICLINE--Showing direction of plunge

For Inclined

Vertical

FOLDED FOLIATION--Showing axes and symmetry of small folds

CONTORTED FOLIATION--Showing axes and asymmetry of small folds

BEARING AND PLUNGE OF LINEATION--May be combined with foliation symbol

VEIN SHAFT

→ OPEN ADIT
★ CAVED ADIT

NOSPECT PIT

BOUNDARY OF WILDERNESS STUDY AREA

LIMIT OF AREA IN WHICH ROCKS ARE COMPLEXLY INTRUDED BY SILVER PLUME