EXPLANATION

Surficial deposits
Qal, *alluvium*
Qa, *swamp deposits*
Qt, *talus deposits*
Qr, *rock glaciers*
Qc, *calcareous tufa*

Ql — Landslide deposits

Qor — Older rock glaciers

Qg — Glacial deposits
Black circles indicate isolated patches of glacial deposits

Qu — Quaternary deposits undifferentiated

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t — Granite of Treasure Mountain
Triangles indicate areas of intrusive breccia adjacent to granite plutons

g — Gabbro porphyry dikes

l — Lamprophyre and related rocks
Form small dikes and sills

f — Felsite porphyry
Forms dikes, sills, and a breccia pipe. Relative age uncertain
Triangles indicate areas of brecciated rock in and adjacent to breccia pipe
Crosses indicate hornfels aureole surrounding breccia pipe

r — Granodiorite

p — Granodiorite porphyry and quartz monzonite porphyry
Forms dikes, sills, and laccoliths

cd, bx, d — Rocks of Snowmass stock
cd, *clastic dikes*
bx, *brecciated rocks; associated with contacts and roof pendants of stock*
d, *granodiorite*

Kmu, Kmf, Kml — Mancos Shale
Kmu, *upper shale member*
Kmf, *Fort Hays Limestone Member*
Kml, *lower shale member*

Kd — Dakota Sandstone

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Jm — Morrison Formation

UNCONFORMITY

Je — Entrada Sandstone

UNCONFORMITY

PPm — Maroon Formation
Dashed line indicates thin nodular limestone bed
Stipple indicates areas of gray and brown strata containing marine fossils

PPg, PPge — Gothic Formation of Langenheim (1952)
Triangles indicate evaporite solution breccia
PPge, *gypsum and anhydrite; in part intrusive above normal stratigraphic position*

PPb — Belden Formation

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MPm — Molas Formation

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Ml — Leadville Limestone

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Dcd, Dcp — Chaffee Formation
Dcd, *Dyer Dolomite Member*
Dcp, *Parting Quartzite Member*

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Of — Fremont Limestone

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Ohm — Harding Sandstone and Manitou Formation undifferentiated

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Cp — Peerless Formation

Cs — Sawatch Quartzite

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pCd — Andesite dikes

pCa — Amphibolite

pCg — Quartz-biotite-plagioclase gneiss

Contact, showing dip
Dashed where approximately located

Fault, showing dip
Dashed where approximately located; dotted where concealed. U, upthrown side; D, downthrown side. Arrows indicate relative movement

Mineralized fault, showing dip
Dotted where concealed. U, upthrown side; D, downthrown side

Thrust or bedding plane fault, showing dip
Dashed where approximately located; dotted where concealed. Sawteeth on upper plate

Vein, showing dip

Lineament
Cause not determined, may represent fault

Antiline — Syncline

Overturned antiline — Overturned syncline

Folds
Showing trace of axial plane, direction of plunge, and direction of dip of limbs

Inclined — Overturned — Vertical — Top unknown

Strike and dip of beds

Inclined — Vertical

Strike and dip of foliation

Prospect — Portal of adit — Shaft

QUATERNARY: Holocene; Pleistocene and Holocene
TERTIARY: Miocene and Pliocene; Miocene(?) and Pliocene(?); Oligocene
CRETACEOUS: Upper Cretaceous; Lower(?) and Upper Cretaceous
JURASSIC: Upper Jurassic
CARBONIFEROUS: PENNSYLVANIAN AND PERMIAN; PENNSYLVANIAN; MISSISSIPPIAN AND PENNSYLVANIAN; MISSISSIPPIAN
DEVONIAN: Upper Devonian
ORDOVICIAN: Middle and Upper Ordovician; Lower and Middle Ordovician
CAMBRIAN: Upper Cambrian
PRECAMBRIAN

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS:

Alluvium—silt, sand, gravel, and cobble deposits in valley bottoms; poorly sorted silt- to boulder-sized material in alluvial fans.

Swamp deposits—organic debris, soil, silt, sand, and hydrous iron oxides in areas of poor drainage.

Talus deposits—angular rock fragments as much as several feet in diameter forming talus cones, aprons, and scree slopes; includes boulder fields produced by frost wedging.

Rock glaciers—glacier-shaped deposits of angular rock fragments, generally lacking fine-grained material on the upper surface. Some are actively advancing.

Calcareous tufa—calcium- and magnesium-carbonate deposits of extinct thermal springs.

LANDSLIDE DEPOSITS—poorly sorted material derived from bedrock and surficial deposits moved by block glide, rock slide, slump, and earthflow.

OLDER ROCK GLACIERS—glacier-shaped deposits of angular rock fragments with interstitial sand, silt, and soil; covered by vegetation.

GLACIAL DEPOSITS—predominantly poorly sorted morainal material of several ages, often forming hummocky topography; locally includes some glaciofluvial deposits.

QUATERNARY DEPOSITS UNDIFFERENTIATED—slope wash, inactive talus, soil, and undivided alluvial, colluvial, and glacial deposits.

GRANITE OF TREASURE MOUNTAIN—pale-red-purple to light-gray equigranular seriate porphyritic or porphyritic coarse- to very fine-grained granite composed of orthoclase, sodic plagioclase, and quartz with minor biotite. Occurs as a large laccolith-shaped pluton whose emplacement elevated the Treasure Mountain dome and as small dikes. Exposures west of Treasury Mountain are locally bordered by an intrusive breccia of rotated fragments of Precambrian rocks in a granite matrix. K-Ar dates of 12.4±0.6 m.y. (J. D. Obradovich, written commun., 1968).

GABBRO PORPHYRY DIKES—medium- to greenish- or brownish-gray fine-grained rock with scattered plagioclase phenocrysts 1–5 mm long and occasional quartz xenocrysts; commonly altered.

LAMPROPHYRE AND RELATED ROCKS—dark-gray, black, or greenish- to brownish-gray fine- to very fine-grained altered porphyritic rocks. Phenocrysts include hornblende, biotite, augite, plagioclase, and olivine. Original minerals largely replaced by chlorite, calcite, serpentine, hematite, and clay.

FELSITE PORPHYRY—white to yellowish-gray aphanitic rocks with scattered euhedral bipyramidal quartz and altered feldspar phenocrysts as much as 3 mm in length. Groundmass of quartz and altered alkali feldspar. Flow banding locally common. Breccia pipe grades into shattered wall rock intricately intruded by felsite porphyry, and is surrounded by a dense adularia-bearing albite-epidote hornfels. Felsite porphyry is probably of Oligocene age, essentially contemporaneous with granodiorite porphyry and quartz monzonite porphyry, but some rocks related to the granite of Treasure Mountain may be included.

GRANODIORITE—pinkish-, greenish-, or brownish-gray medium-grained biotite-augite-hornblende granodiorite. Margins of stock are porphyritic with coarse-grained potassium feldspar phenocrysts. Locally cut by aplite dikes and contains sparse inclusions of Precambrian basement rocks.

GRANODIORITE PORPHYRY AND QUARTZ MONZONITE PORPHYRY—light- to medium-gray or brownish- to greenish-gray porphyritic rocks of variable texture and grain size. Phenocrysts include potassium feldspar as much as 7 cm in length, commonly Carlsbad twinned; and plagioclase, quartz, hornblende, and biotite 1–7 mm in length. K-Ar date on biotite of 31.2±1.1 m.y. from Snowmass Creek sill in Capitol Peak quadrangle (J. D. Obradovich, written commun., 1968).

ROCKS OF SNOWMASS STOCK:

Clastic dikes—narrow dark-gray dikes composed of angular to rounded fragments, as large as a few centimeters in diameter, of sedimentary rocks and rare fragments of igneous rocks in a very fine grained matrix of pulverized rock. May represent injection of fluidized material from beneath stock.

Brecciated rocks—angular blocks (as much as tens of feet in length) and contorted masses of sedimentary rocks, and rare angular to rounded fragments (as much as a few feet in diameter) of igneous rock in a matrix of coarsely crystalline calcite and pulverized rock with local barite and pyrite.

Granodiorite—light- to medium- or greenish-gray medium-grained equigranular to seriate porphyritic rock composed of plagioclase, orthoclase, quartz, biotite, hornblende, and augite. Locally variably altered to calcite, sericite, and chlorite. Finer grained and richer in dark minerals adjacent to contacts. K-Ar data on biotite of 54.1±1.4 m. y. at west end of Snowmass Lake (J. D. Obradovich, written commun., 1968).

MANCOS SHALE (about 4,300 ft):

Upper shale member (about 4,000 ft; top not exposed)—medium- to dark-gray laminated fissile shale, locally indurated; thin to thick beds of siltstone and sandstone; sparse bentonite beds. Lower 300–600 feet generally calcareous.

Fort Hays Limestone Member (40–80 ft)—medium-bluish-gray to dark-gray thin- to thick-bedded limestone with partings and thin interbeds of calcareous shale. Upper contact gradational; base picked at bottom of first prominent limestone above *Scaphites whitfieldi* faunal zone.

Lower shale member (240–300 ft)—dark-gray to black thinly laminated to medium-bedded fissile calcareous and noncalcareous shales; in part bentonitic or carbonaceous. Some thin lenticular silty sandstone and limestone beds. Locally indurated

DAKOTA SANDSTONE (117–225 ft)—white to medium-gray thin- to thick-bedded orthoquartzite. A 10- to 35-foot-thick interval of shale and siltstone interbedded with quartzite occurs 50–110 feet above the base; a thin chert and quartz pebble conglomerate is usually present at the base.

MORRISON FORMATION (325–430 ft)—greenish- to dark-gray and variegated lenticular shale, siltstone, and marlstone, with subordinate sandstone. Several dolomitic limestone beds with a fresh-water fauna occur in a 15- to 50-foot-thick interval 20–70 feet above the base. Metamorphosed to dense hornfels, metaquartzite, and marble on Treasure Mountain dome.

ENTRADA SANDSTONE (20–40 ft)—white or light-gray to grayish-orange medium- to thick-bedded locally crossbedded quartz sandstone generally showing a distinct bimodal grain-size distribution. Basal 5–10 feet is coarse-grained sandstone or medium-grained pebble quartz conglomerate. Metamorphosed to quartzite on Treasure Mountain dome.

MAROON FORMATION (10,000 ft*)—interbedded lenticular thin- to thick-bedded, locally crossbedded, generally poorly sorted arkosic, micaceous, and calcareous siltstone to cobble conglomerate. Grain size decreases to the northeast. A 3- to 10-foot nodular limestone locally grading into gray and brown calcareous siltstone containing marine fossils occurs a few hundred feet above the base on the upper plate of the Elk Range thrust. Base mapped at color change from predominantly grayish-brown beds of Gothic Formation to predominantly moderate- to dusky-red beds of Maroon Formation, except on Treasure Mountain dome where thermal metamorphism has destroyed diagnostic colors and the contact was picked at top of highest thick marine limestone in the Pennsylvanian section.

GOTHIC FORMATION OF LANGENHEIM (1952) (1,630–1,900 ft*)—interbedded thin- to thick-bedded shale, siltstone, sandstone, conglomerate, limestone, and limestone conglomerate with complex intertonguing relationships. Clastic rocks are predominantly brownish gray to pale reddish brown except on Treasure Mountain dome where thermal metamorphism has altered them to light gray to dark gray or grayish green. Base mapped at bottom of a massive 60- to 100-foot orthoquartzite, which is first major sandstone in the Pennsylvanian section. Near Trail Rider Pass an evaporite solution breccia occurs near top of formation.

Gypsum and anhydrite—intrusive masses near Snowmass Lake; a lenticular bedded mass at Trail Rider Pass.

BELDEN FORMATION (about 840 ft*)—medium- to dark-gray and bluish-gray limestone, cherty limestone, and dolomite interbedded with dark carbonaceous shale. Carbonate rocks are sandier in upper part of formation. Metamorphosed to marble and calcium silicate hornfels on Treasure Mountain dome. Base mapped at bottom of first limestone bed above Molas. Of Early (Morrow) and Middle (Atoka) Pennsylvanian age.

MOLAS FORMATION (0–50 ft*)—brownish- or blackish-red to dusky- or grayish-green pebble to boulder sedimentary and residual breccia and conglomerate, argillite, sandy argillite, and argillaceous quartzite. Lower part massive, grading upward to thin to medium irregularly bedded rocks. Rests on irregular karst surface with a local relief of as much as 40 feet. Is in part of Mississippian age.

LEADVILLE LIMESTONE (210–275 ft*)—upper 90–175 feet is very finely to coarsely crystalline calcite marble with a few interbedded lenses of cherty and dolomitic marble; middle 70–90 feet consists of white to medium-bluish-gray thin-bedded to massive marble and dolomitic marble with scattered chert lentils; basal 20–80 feet consists of interbedded, locally cherty, sandy limestone and dolomite marble, calcareous sandstone, and a few thin hornfels beds.

CHAFFEE FORMATION:

Dyer Dolomite Member (60–95? ft*)—upper 51–75(?) feet is light-gray to grayish-orange-pink thin- to medium-bedded slabby locally cherty or mudcracked and sandy or micaceous dolomite and calcareous dolomite marble. Lower 10–20 feet is light-gray medium- to very thick-bedded calcite marble.

Parting Quartzite Member (55–65 ft*)—interbedded lenticular dolomitic marble, quartzite, and shale and siltstone hornfels. Top is a 5-foot-thick orthoquartzite bed; base is locally dolomite pebble conglomerate.

FREMONT LIMESTONE (50–65 ft*)—very light to medium dark gray thin-bedded to massive locally cherty limestone marble. Basal 5–12 feet slightly sandy with scattered salt crystal casts.

HARDING SANDSTONE AND MANITOU FORMATION UNDIFFERENTIATED:

Harding Sandstone (3–5 ft*)—light- to medium dark-gray fine-grained sandstone interbedded with greenish- to dark-gray silty hornfels and argillaceous dolomite. Of Middle Ordovician age. Unconformity at base.

Manitou Formation (80–150 ft*)—light- to medium-gray thin- to thick-bedded cherty dolomite and dolomitic marble with abundant metamorphic silicates. Of Early Ordovician age.

PEERLESS FORMATION (90 ft*)—interbedded white to purplish-gray locally calcareous or dolomitic orthoquartzite, light- to brownish-gray sandy limestone, dolomite, and edgewise limestone conglomerate, and greenish- to purplish-gray and dark-gray shale and siltstone hornfels. Commonly glauconitic. Top mapped at top of uppermost quartzite bed.

SAWATCH QUARTZITE (130–190 ft)—white to light-brownish-gray medium to very thick regularly bedded, locally ripple marked, crossbedded or glauconitic medium-grained quartzite, with some thin sandy or calcareous shale hornfels partings. Arkosic quartz pebble to small cobble conglomerate as much as 3 feet thick at base.

ANDESITE DIKES—rocks with diabasic texture composed of plagioclase, biotite, amphibole, and quartz forming dikes as much as 8 feet wide, with vestiges of chilled margins. Commonly intensely altered, sheared, and recrystallized. Locally cataclastic deformation has produced a foliation parallel to dike walls. May include some mylonites of other origins and some altered Tertiary lamprophyre dikes.

AMPHIBOLITE—dark-greenish-gray to greenish-black medium- to coarse-grained massive to well-foliated rock consisting of amphibole, calcic plagioclase, quartz, and biotite forming bands interlayered with quartz-plagioclase-biotite gneiss. Locally blastomylonitic.

QUARTZ-PLAGIOCLASE-BIOTITE GNEISS—medium- to dark- or brownish-gray well-foliated fine- to medium-grained equigranular to porphyroblastic blastomylonitic gneiss with migmatitic quartz-feldspar segregations. Cut by small medium-grained faintly foliated granite to diorite synkinematic plutons and late kinematic granite and syenite pegmatites too small to be shown at map scale.

*Asterisk indicates that formation was locally partly or completely removed by pre-Late Jurassic erosion. Figures show thickness of formation where not affected by pre-Late Jurassic erosion.

Langenheim, R. L., Jr., 1952, Pennsylvanian and Permian stratigraphy in Crested Butte quadrangle, Gunnison County, Colorado: Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 543–574.

Bass, N. W., and Northrop, S. A., 1963, Geology of Glenwood Springs quadrangle and vicinity, northwestern Colorado: U.S. Geol. Survey Bull. 1142–J, p. J1–J74.

Henbest, L. G., 1958, Significance of karst terrane and residuum in Upper Mississippian and Lower Pennsylvanian rocks, Rocky Mountain region *in* Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., Powder River Basin, Wyoming, 1958: p. 36–38.