COLORADO GEOLOGICAL SURVEY
DEPARTMENT OF NATURAL RESOURCES
DENVER, COLORADO

CONDENSED DESCRIPTION OF MAP UNITS

The complete description of map units and references is in the accompanying booklet.

SURFICIAL DEPOSITS

HUMAN-MADE DEPOSITS

af — **Artificial fill (latest Holocene)**

ALLUVIAL DEPOSITS

Qa — **Modern stream-channel, flood-plain, and low-terrace deposits (Holocene and late Pleistocene)**—Mostly poorly sorted, clast-supported gravel in a sandy or silty matrix. May locally include clayey deposits in some subsidence troughs. Includes terraces up to about 12 ft above modern river level

Qsw — **Sheetwash deposits (Holocene and late Pleistocene)**—Pebbly silty sand, sandy silt, and clayey silt deposited in ephem-eral and intermittent stream valleys, on gentle hillslopes, and in basins

Qty — **Younger terrace alluvium (late Pleistocene)**—Mostly poorly sorted, clast-supported, locally bouldery, pebble and cobble gravel in a sand and silt matrix. Deposited as glacial outwash. Underlies terraces 15 to 52 ft above modern stream level. May include fine-grained overbank deposits

Qtm — **Intermediate terrace alluvium (late Pleistocene)**—Deposits texturally and depositionally similar to younger terrace alluvium (Qty). Underlies terraces 55 to 100 ft above modern streams

Qtt — **Oldest terrace alluvium (middle and early? Pleistocene)**—Deposits texturally and depositionally similar to younger terrace alluvium (Qty). Clasts moderately to highly wea-thered. A single small terrace remnant in the southeast corner of the quadrangle that is about 380 to 400 ft above the Frying Pan River

QTg — **High-level gravel (early Pleistocene and/or late Tertiary)** —Chiefly clast-supported, sandy, silty, cobble and pebble gravel occurring on a subtle ridge line about 1 mi east of El Jebel and about 1,300 to 1,350 ft above the Roaring Fork River. Clasts are moderately to very highly weathered

QTm — **Sediments of Missouri Heights (early Quaternary and/or late Tertiary)**—Locally derived gravel, sand, silt, and clay deposited in the Missouri Heights area in alluvial and colluvial environments. May include pediment deposits derived from and deposited on the sediments of Missouri Heights in area between Spring Park Reservoir and Cattle Creek. Deposited in topographic depressions created by evaporite tectonism. Overlies Miocene basaltic rocks (Tb). Typically is less deformed than underlying rocks. Occurs about 1,000 to 1,650 ft above the Roaring Fork River

MASS-WASTING DEPOSITS

Qlsr — **Recent landslide deposits (latest Holocene)**—Includes a recently active landslide near the northeast corner of the map with very fresh morphological features. Hetero-geneous unit consisting of unsorted, unstratified rock debris, sand, and silt

Qc — **Colluvium (Holocene and late Pleistocene)**—Ranges from un-sorted, clast-supported, pebble to boulder gravel in a sandy silt matrix to matrix-supported gravelly, clayey, sandy silt. Usually coarser grained in upper reaches of colluvial slope and finer grained in distal areas

Qt — **Talus (Holocene and late Pleistocene)**—Angular, cobbly and bouldery rubble derived from outcrops of basalt, trachy-andesite, sandstone, or basalt-rich landslide deposits

Qbf — **Boulder-field deposits (Holocene and late Pleistocene)**—Angular boulders and cobbles of basalt with little or no matrix on moderate to steep slopes. Commonly has an undulatory surface suggestive of flowage as a rock glacier or related to periglacial processes

Qls — **Landslide deposits (Holocene and Pleistocene)**—Includes various types of landslide deposits. Consists of unsorted, unstratified gravel, sand, silt, clay, and rock debris

Qco — **Older colluvium (Pleistocene)**—Texturally similar to colluvium (Qc), but found on drainage divides, ridge lines, and dissected hillslopes

Qlso — **Older landslide deposits (Pleistocene)**—Landslide deposits dissected by erosion and lacking distinctive landslide geomorphology. Similar in texture to landslide deposits (Qls)

ALLUVIAL AND MASS-WASTING DEPOSITS

Qdfy — **Younger debris-flow deposits (Holocene and late Pleistocene)**—Poorly sorted to moderately well-sorted, matrix- and clast-supported deposits ranging from gravelly clayey silt to sandy, silty, cobbly, pebbly, and bouldery gravel. Fan heads tend to be bouldery, while distal fan areas are finer grained. Includes debris-flow, hyper-concentrated-flow, fluvial, and sheetwash deposits on active fans and in some drainage channels. Numeric subscripts indicate relative ages of younger debris-flow deposits in the southwest corner of the quadrangle. Deposits labeled $Qdfy_1$ are younger than and derived from deposits labeled $Qdfy_2$

Qac — **Alluvium and colluvium, undivided (Holocene)**— Moderately well-sorted to well-sorted, stratified, interbedded sand, silt, pebbly sand, and sandy gravel to poorly sorted, unstratified or poorly stratified, clayey, silty sand, bould-ery sand, sandy silt, and silty clay

Qcs — Colluvium and sheetwash deposits, undivided (Holocene and late Pleistocene)—Consists of colluvium (Qc) on steeper slopes and sheetwash deposits (Qsw) on flatter slopes. Mapped where contacts between the two types of deposits are very gradational and difficult to locate. May locally include lacustrine deposits in large subsidence troughs

Qaco — **Older alluvium and colluvium, undivided (Pleistocene)**—Deposits texturally and depositionally similar to alluvium and colluvium (Qac) that underlie terraces and hillslopes ranging from about 10 to 60 ft above the floor of tributary valleys

Qcso — **Older colluvium and sheetwash deposits, undivided (Pleistocene)**—Deposits texturally and depositionally similar to colluvium and sheetwash (Qcs) that underlie surfaces 20 to 160 ft above adjacent stream beds

Qdfo — **Older debris flow-deposits (Pleistocene)**—Remnant of an inactive debris fan on a ridge line about 80 to 120 ft above the adjacent stream bed near the southeast corner of the quadrangle. Similar in texture and genesis to younger debris-flow deposits (Qdfy)

SINTER DEPOSITS

Qtu — **Tufa (Holocene and late Pleistocene?)**—Low-density, porous, calcium carbonate deposits precipitated from a mineral spring along the Basalt Mountain Fault immediately north of Cattle Creek

UNDIFFERENTIATED SURFICIAL DEPOSITS

Q — **Surficial deposits, undivided (Quaternary)**—Shown only on cross section

COLLAPSE DEPOSITS

QTcd — **Collapse deposits (Quaternary and late Tertiary)**—Hetero-genous deposits of moderately to highly deformed bedrock and overlying undeformed to moderately deformed surficial deposits within the Carbondale Collapse Center. Locally includes large but displaced blocks of volcanic rocks. Formed in response to differential collapse resulting from dissolution and flow of underlying evaporite

BEDROCK

Tsp — **Trachyandesite of Spring Park (Pliocene)**—Medium-gray basaltic flows from an eruptive center about 0.5 mi east of the dam for Spring Park Reservoir. Petrographically the unit is xenocrystic olivine basalt, while geochemically it is a basaltic trachyandesite. Groundmass predominantly plagioclase and pyroxene. Contains sparse phenocrysts of mainly olivine and rare plagioclase. Locally contains abundant xenocrysts of quartz, sanidine, and plagioclase. Included in compositional group 6b′ of Budahn and others (2002). $^{40}Ar/^{39}Ar$ of 2.90 ± 0.02 Ma (Kunk and others, 2002)

Tspc — **Cinder deposits of Spring Park (Pliocene)**—Red and red-brown scoriaceous, unconsolidated cinder deposits associated with an eroded eruptive center about 0.5 mi east of the dam for Spring Park Reservoir. Petrographically the rock is olivine basalt with locally abundant xenocrysts of quartz, sanidine, and plagioclase. Geochemically these rocks are basaltic trachyandesite and are included in compositional group 6b′ of Budahn and others (2002). $^{40}Ar/^{39}Ar$ of 2.96 ± 0.02 Ma (Kunk and others, 2002)

Tcc — **Trachyandesitic flows of Cattle Creek (Pliocene)**—Medium- to dark-gray basaltic trachyandesite and trachybasalt flows along Cattle Creek between Shippes Draw and Sleepy Creek. Contains varying amounts of quartz and sanidine xenocrysts. Included in compositional group 6c of Budahn and others (2002). $^{40}Ar/^{39}Ar$ of 3.09 ± 0.02 Ma (Kunk and others, 2002)

Tccc — **Trachyandesite cinder deposits of Cattle Creek (Pliocene)**—Dark-gray to black, scoriaceous, cinder deposit exposed in cinder quarries along Cattle Creek between Shippes Draw and Sleepy Creek. Petrographically this deposit is a xenocrystic olivine basalt; geochemically it is basaltic trachyandesite. Included in compositional group 6c of Budahn and others (2002). $^{40}Ar/^{39}Ar$ of 3.01 ± 0.01 Ma (Kunk and others, 2002)

Tta — **Trachyandesitic flows, undifferentiated (Pliocene)**—Multiple flows of basaltic trachyandesite, trachyandesite, and trachybasalt. Contains varying amounts of quartz, sanidine, and plagioclase xenocrysts

Tsb — **Sediments of Basalt Mountain (Pliocene or Miocene)**—Chiefly medium-red-brown, weakly indurated, pebble and cobble gravel in a sandy or silty matrix. Locally bouldery. Deposited over basalt flows on northern edge of Basalt Mountain shield volcano by ancestral Cattle Creek

Tb — **Basaltic flows (Miocene)**—Multiple flows of basalt, basaltic andesite, and basaltic trachyandesite. Petrographically most flows are olivine basalt; many are porphyritic. Groundmass predominantly plagioclase and pyroxene. Phenocrysts chiefly olivine and occasionally plagioclase. May contain rare xenocrysts or xenoliths of quartz and quartzite. Locally includes slightly indurated sediments. Included in compositional groups 1b, 1c, 2b′, 4b, and 4b′ of Buhdan and others (2002). $^{40}Ar/^{39}Ar$ age dates range from 7.75 ± 0.03 Ma to 10.84 ± 0.06 Ma.

Ts — **Sedimentary deposits (Miocene)**—Mostly fluvial, clast-supported, silty, sandy pebble and cobble gravel but locally contains silty and sandy deposits of probable alluvial and/or colluvial origin. Locally slightly to moderately indurated

Km — **Mancos Shale (Upper Cretaceous)**—Light- to dark-gray, carbonaceous, silty to sandy shale and thin bentonite beds, gray limestone, and light- to medium-gray, grayish-yellow-weathering, clayey sandstone. Includes the Fort Hays Limestone Member, a thick-bedded, coarse-grained, gray limestone

Kd — **Dakota Sandstone (Lower Cretaceous)**—Light-gray to tan, medium- to very coarse-grained, quartzose sandstone and conglomeratic sandstone interbedded with carbonaceous siltstone, sandstone, and shale. May include Burro Canyon Formation in southern part of quadrangle

Jm — **Morrison Formation (Upper Jurassic)**—Pale-green, greenish-gray, and maroon variegated siltstone and claystone, buff to tan sandstone, and gray limestone. A thick-bedded, coarse-grained, oolitic, tan- and white-weathering, medium-dark-gray limestone at the base of the formation overlies the Entrada Sandstone

Je — **Entrada Sandstone (Upper Jurassic)**—Light-gray, tan, and white, medium- to very fine-grained, well-sorted sand-stone with large-scale crossbedding. Weakly to mod-erately indurated

TRc — **Chinle Formation (Upper Triassic)**—Thin, even-bedded, and structureless beds of dark-reddish-brown, orangish-red, and purplish-red, calcareous siltstone and mudstone and scattered thin lenses of light-purplish-red and gray lime-stone and limestone-pebble conglomerate. Locally in-cludes a thin, basal conglomeratic sandstone

TRPsb — **State Bridge Formation (Lower Triassic and Permian)**—Reddish-orange, grayish-red, and pale-reddish-pink silty sandstone, clayey siltstone, arkosic sandstone, and conglomeratic sandstone. Includes lenses of sandy dolo-mite and limestone of the South Canyon Creek Dolomite Member that are up to 18 inches thick and occur about 200 ft above the base of the formation. Sandstone beds are well sorted, equigranular, and have rounded to sub-rounded sand grains with a high degree of sphericity

TRPcs — **Chinle and State Bridge Formations, undivided (Triassic and Permian)**

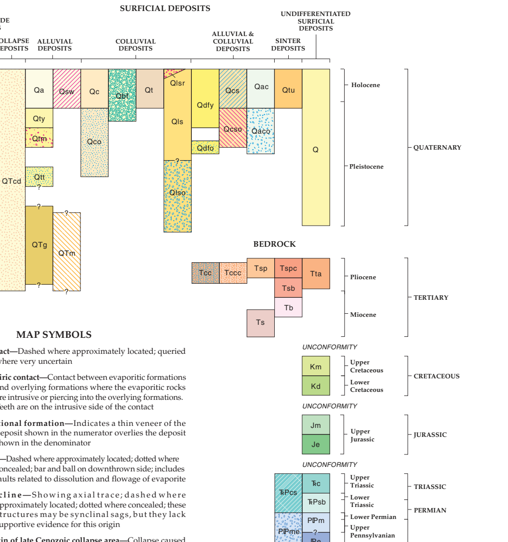
PIPm — **Maroon Formation (Lower Permian? and Upper Pennsylvanian)**—Red beds of sandstone, conglomerate, mudstone, silt-stone, and shale and minor, thin beds of gray limestone

IPe — **Eagle Valley Formation (Middle? Pennsylvanian)**—Reddish-brown, gray, reddish-gray, and tan siltstone, shale, sand-stone, gypsum, and carbonate rocks which are gradational between and intertonguing with the Maroon Formation and Eagle Valley Evaporite

PIPme — **Maroon and Eagle Valley Formations, undivided (Lower Permian and Upper and Middle? Pennsylvanian)**

IPee — **Eagle Valley Evaporite (Middle Pennsylvanian)**—Evaporitic sequence of gypsum, anhydrite, and halite interbedded with mudstone, fine-grained sandstone, thin carbonate beds, and black shale. Commonly intensely folded, faulted, and ductily deformed

CORRELATION OF MAP UNITS



MAP SYMBOLS

Contact—Dashed where approximately located; queried where very uncertain

Diapiric contact—Contact between evaporitic formations and overlying formations where the evaporitic rocks are intrusive or piercing into the overlying formations. Teeth are on the intrusive side of the contact

Qbf/Qls — **Fractional formation**—Indicates a thin veneer of the deposit shown in the numerator overlies the deposit shown in the denominator

Fault—Dashed where approximately located; dotted where concealed; bar and ball on downthrown side; includes faults related to dissolution and flowage of evaporite

Syncline—Showing axial trace; dashed where approximately located; dotted where concealed; these structures may be synclinal sags, but they lack supportive evidence for this origin

Margin of late Cenozoic collapse area—Collapse caused by evaporite tectonism; margin coincides with Basalt Mountain Fault; dashed where approximately located; dotted where concealed (see Kirkham, Streufert, and others, 2001; and Kirkham, Scott, and Judkins, 2002, for description of collapse)

Synclinal sag or subsidence trough—Showing axial trace of synclinal sag or subsidence trough related to evaporite dissolution and/or flowage; synclinal sags occur in bedrock, subsidence troughs are found on river terraces; dashed where approximately located; dotted where concealed; limbs of synclinal sags and subsidence troughs may be faulted; closed and nearly closed depressions in collapse debris (QTcd), which likely are at least in part sags or troughs, are not mapped

Sinkhole—Created by piping or collapse of surficial deposits, usually into dissolution caverns within underlying Eagle Valley Evaporite or by collapse or settlement of low-density surficial deposits; includes dissolution caverns in outcrops of Eagle Valley Evaporite; "x" denotes one or more small sinkholes; many small sinkholes other than those shown on the map are probably present in the quadrangle

55 — **Strike and dip of beds**—Angle of dip shown in degrees; most attitudes in basalt were measured on top of apparent surface

Inclined beds—Showing approximate attitude of surface on basalt flows as determined from stereoscopic models set on a Kelsh PG-2 plotter; dip between 0° and 30°

65 — **Strike and dip of foliation in extrusive flow rocks**—Includes measurements on flows within collapse debris (QTcd). Angle of dip shown in degrees

Linear ridge within landslide on west side of Basalt Mountain— Ridge is underlain by tilted slump blocks of basalt that range from nearly intact to very rubbly flows

Linear swale of uncertain origin along the Basalt Mountain Fault

Approximate boundary of a subsidence trough developed in surficial deposits—Resultant from collapse into voids created by dissolution or flowage of underlying evaporitic rocks. Queried where very approximate

Approximate boundary of a lava-filled crater at the crest of Basalt Mountain—Exposed part of crater has been filled with two thick, ponded lava flows. The lower flow averages about 200 to 250-ft thick and the upper flow averages about 40 to 50-ft thick

Adit

Gravel pit

Cinder quarry

L-23 — **Location and identification number of geochemical rock sample**—(Table l and Appendix A in booklet; Unruh and others, 2001; Budahn and others, 2002)

L-39 — **Location and identification number of rock sample with geochemical analysis (Unruh and others, 2001; Budahn and others, 2002) and $^{40}Ar/^{39}Ar$ age date (Kunk and Snee, 1998; Kunk and others, 2001). See Table 1 and Appendix A in booklet**

A ——— A′ — **Alignment of cross section**

ACKNOWLEDGEMENTS

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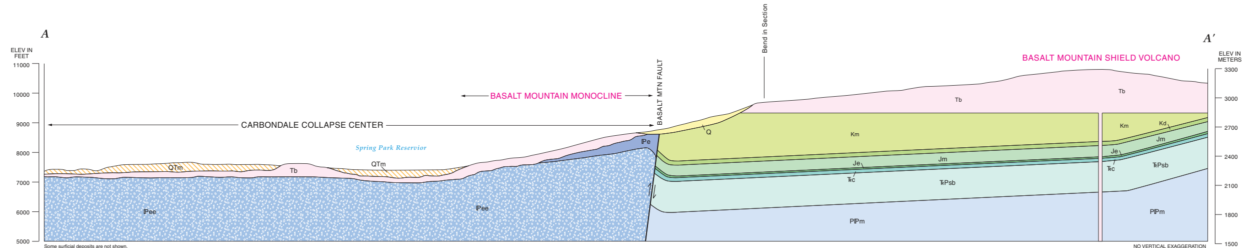

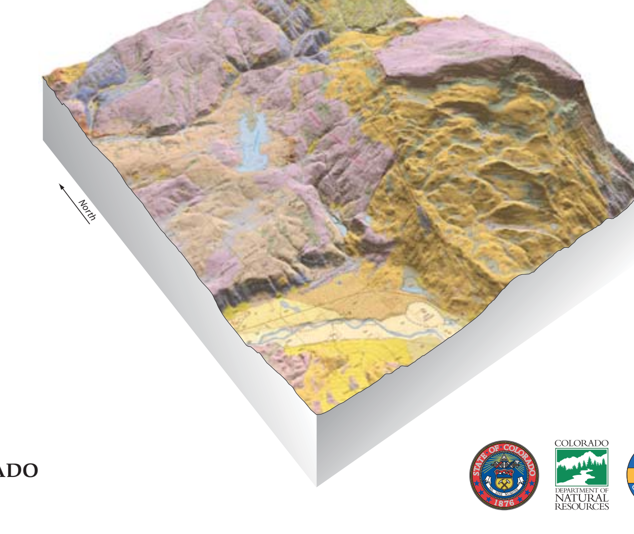

GEOLOGIC MAP OF THE LEON QUADRANGLE, EAGLE AND GARFIELD COUNTIES, COLORADO

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