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Geologic Map of the Dillon Quadrangle, Summit and Grand Counties, Colorado

By

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The data was compiled from unpublished mapping. One review, by Randall Streufert, was performed.

DESCRIPTION OF MAP UNITS

af **Artificial fill (Recent)**--Compacted and uncompacted rock fragments and finer material derived from excavation of Interstate 70. Composes roadbed and embankments along and adjacent to the interstate

Qal **Alluvium (Holocene)**--Unconsolidated silt- to boulder-size, moderately sorted to well-sorted sediment in modern floodplains, including overbank deposits; larger clasts are moderately rounded to well rounded. Includes swamp deposits in and adjacent to beaver ponds in North and South Willow Creek valleys. Maximum thickness unknown, but suspected to be greater than 10 m

Qf **Fan deposit (Holocene and upper Pleistocene)**--Moderately well sorted pebble- to boulder-size gravel in fan-shaped deposits from side streams of Blue River Valley, North Fork of the Williams Fork River, and Straight Creek. Include both stream alluvium and debris-flow deposits. Distal ends of deposits adjacent to Blue River are truncated, indicating that these deposits probably are Pinedale glacial-outwash deposits. Deposits west of Blue River mapped by West (1978) as Pinedale glacial outwash deposits. As much as about 15 m thick

Qt **Talus (Holocene and upper Pleistocene)**--Angular and subangular cobbles and boulders at base of steep valley walls or cliffs. Boulders generally are as large as 2 m, although in places are as large as 10 m. As much as 20 m thick

Qcl **Colluvium and loess, undivided (Holocene and upper Pleistocene)**--Unconsolidated to slightly indurated, mostly massive, dark-brown to light-gray-brown deposits that mantle gently to moderately sloping surfaces; sediment types are mixed by downslope movement. Colluvium contains cobbles and pebbles derived from weathering of bedrock; loess is very fine grained sand, silt, and minor clay. Commonly contains poorly to moderately developed soil profile in upper part. Includes alluvium in small channels and sheetwash on steeper hillsides. Commonly underlies areas covered by open meadows, sagebrush, and (or) sparse aspen. Unmapped in many areas, particularly where unit is thin and discontinuous. Maximum thickness probably less than 15 m

Qac **Alluvium and colluvium, undivided (Holocene and upper Pleistocene)**--Alluvium composed of unconsolidated silt- to boulder-size, moderately sorted to well-sorted sediment in narrow channels that are too small to map separately. Alluvium is flanked by colluvial deposits that are composed of mostly angular cobbles and smaller fragments derived from weathering of bedrock and transported by downslope movement. Colluvium may contain loess and have a moderate soil profile. Generally less than 10 m thick

Qls **Younger landslide deposit (Holocene and upper Pleistocene)**--Range from chaotically arranged debris to almost intact slump blocks of bedrock.

Surface of deposit commonly hummocky, and relatively steep breakaway zone identifiable. Larger landslide deposits greater than 50 m thick

Qrg **Rock glacier deposit (Holocene and upper Pleistocene)**--Hummocky, lobate deposits of angular boulders having a frontal slope near the angle of repose; locally active. In places, grade into and include some talus (unit Qt). Maximum thickness about 25 m

Qg **Terrace gravel (Holocene to middle Pleistocene)**--Moderately sorted, moderately rounded to well-rounded sand and gravel adjacent to modern floodplain of Blue River and Straight Creek. Clasts as large as one m composed of Proterozoic gneiss and, in Blue River Valley, subordinately of Dakota Sandstone, Pennsylvanian Maroon (?) Formation, and Tertiary intrusive rocks. Includes deposits in lower terrace levels in Blue River Valley that were part of active alluvial channel prior to completion of Dillon Dam, just south of quadrangle boundary, in 1962. Three terrace levels mapped by West (1978): a topographically lower Holocene terrace, an intermediate Pinedale terrace, and a high late Bull Lake terrace. Thickness as great as about 15 m

Qti **Pinedale or Bull Lake till, undivided (upper and middle Pleistocene)**--Unsorted and unstratified bouldery till on heavily forested north side of Tenderfoot Mountain, just north of Straight Creek, and in triangle-shaped area along west boundary of map. Not studied in detail

Qtp **Pinedale till (upper Pleistocene)**--Unsorted and unstratified bouldery till in moraines that have preserved original hummocky topography, commonly containing closed depressions and small ponds. Subrounded to subangular clasts composed entirely of Proterozoic gneiss and plutonic rocks. Soil profile is very thin to nonexistent and boulders are unweathered. Thickness as great as 135 m

Qtb **Bull Lake till (middle Pleistocene)**--Unsorted and unstratified bouldery till in moraines that have been dissected and rounded; hummocky topography rarely preserved. Subrounded to subangular clasts composed mostly of Precambrian gneiss and granitic rocks; west of Blue River, Bull Lake till contains as much as about 5 percent clasts of Dakota Sandstone. Boulders of Proterozoic gneiss and plutonic rock slightly to moderately weathered; soil profile is moderately to well developed, commonly with an uppermost black organic-rich zone several centimeters thick (A horizon) over a pale-colored elutriation zone in which clay and iron have been leached (E horizon); E horizon, in turn, overlies an orange-brown zone of clay and iron accumulation (B horizon). Thickness may exceed 100 m

Qtpb **Pre-Bull Lake till (middle Pleistocene)**--Unsorted and unstratified deposits containing clay- to boulder-size clasts. Moraine topography completely eroded; deposits beveled to smooth erosional surface on which only boulder tops are exposed. Deeply weathered; matrix of till orange-brown and clay rich and Proterozoic boulders have thick weathered surface. Contains about 10-20 percent clasts of Dakota Sandstone. Total thickness unknown, but greater than about 80 m

Qd **Diamicton (middle or lower Pleistocene)**—Unsorted, unstratified debris containing poorly to moderately rounded boulder-and-smaller-size clasts; poorly exposed at several localities in south part of quadrangle. Genesis uncertain; may be older landslide deposit, debris-flow deposit, or Bull Lake or older till

Qgo **Older outwash gravel (middle or lower Pleistocene)**--Light-yellowish-brown unconsolidated, moderately rounded to well-rounded, almost massive, matrix-supported pebble- and cobble-size gravel consisting mostly of Proterozoic gneiss and granite; sandy and silty matrix contains much decomposed granite debris (grus) and clay; locally iron stained and Proterozoic clasts partially weathered. Overlain by well-developed soil profile. Mapped as high as 100 m above present Blue River. Interpreted as "Older outwash and pediment gravels" of Pleistocene age (Tweto, 1973), although no pediment surface is apparent. Interpreted to be either Bull Lake or pre-Bull Lake in age. Underlies town of Dillon and surrounding areas. Greater than 30 m thick in places

Qbp **Gravel of Mesa Cortina ("Buffalo placers") (middle or lower Pleistocene)**—Poorly sorted, poorly stratified to massive, poorly consolidated light-tan to grayish-orange bouldery deposit underlying much of the terrace (Mesa Cortina) near the southwestern border of the quadrangle. Deposit is deeply weathered, matrix-supported, and contains clasts of Precambrian gneiss and granite, Dakota Sandstone, Maroon Formation, and rare Tertiary dacite porphyry. Boulders of Dakota and Maroon are as large as 5 m across, although most are less than 2 m across; Precambrian boulders are strongly weathered. Matrix is weathered (clay-rich) grussy sand. Deposit underlies sloping, dissected terrace as high as 330 m (1,000 ft) above Blue River. Deposit is poorly exposed on terrace surface, where it resembles an old till. Interpreted as debris-flow and hyperconcentrated-flow deposits of the ancestral Blue River, but at least partial source may be from Ten Mile Creek, about 5 km south of quadrangle. Enormous size of some clasts and their distance from source suggests that deposit may be glacial outwash (pre-Bull Lake?). The deposit, also known as the Buffalo Placers, was first mined for gold by hydraulic methods in the 1870s and 1880s; it was worked intermittently thereafter until 1934 (Parker, 1974). Mapped by Tweto (1973) as Dry Union Formation of Pliocene and Miocene age, but correlation with the well-stratified, well-indurated, mostly fluvial Dry Union Formation of the Arkansas River valley near Leadville seems unlikely. Probably correlates with very similar auriferous terrace gravels along valley margins and tributaries of Blue River near Breckenridge, approximately 7-10 km south of quadrangle (Ransome, 1911; K.S. Kellogg, unpublished mapping, 1997). Total thickness unknown, but may be more than 100 m

Qdf **Debris-flow deposit (middle to lower Pleistocene)**--Poorly sorted, poorly stratified deposit containing clasts as large as boulders. Deposits deeply dissected along Blue River indicating that they may either correlate with or be older than Bull Lake glacial deposits (Qtb). Derived from older landslide deposits (QTls). As much as 30 m thick

QTls **Older landslide deposit (middle Pleistocene to Pliocene)**--Mostly angular fragments of Proterozoic rock in grussy matrix that is partially altered to clay. Locally contains relatively unfractured gneiss blocks as long as 30 m. All topographic evidence of breakaway zone and original hummocky landslide morphology eroded; some valleys (such as Bushee Creek) incised as much as 175 m into and below deposits. Very extensive; underlies over half of west side of Williams Fork Mountains, obscuring most of the trace of the Williams Range thrust. Deposits are thickly forested by conifers and aspen. Landslide movement deformed Pierre Shale as deep as about 10 m below base of deposit in Bushee Creek. Probably as thick as several hundred meters

Kp **Pierre Shale, undivided (Upper Cretaceous)**--Dark-gray, grayish-brown, and black fissile marine shale and mudstone in approximately lower 300 m; calcareous in lowest 10-20 m. Grades upward into a sequence of dark-gray and black silty shale and mostly thin, brown, clayey, commonly ripple-marked fine- to very-fine-grained sandstone. Contains one ledgy brown, about 20-m-thick shaly sandstone (feldspathic graywacke) bed at top of lower shaly part. Undivided Pierre Shale mapped where exposures are too poor to determine stratigraphic position. Top of Pierre Shale not exposed in quadrangle

Kpm **Shale and sandstone member**--Black and gray fissile shale, claystone, and subordinate, thin, clayey, very fine grained brown sandstone. Top not exposed, but member is greater than about 500 m thick in quadrangle. Conformable above sandstone member

Kps **Sandstone member**--Very fine grained to medium grained, light-brown, well indurated, ledgy feldspathic graywacke that contains about 50 percent quartz, 30 percent feldspar, and about 15 percent green, black, and brown lithic grains. Beds are 5 to 25 cm thick and flaggy to blocky and locally contain dark grayish-brown interbedded shale. May correlate with 30-m-thick shaly sandstone bed encountered 225 m above base of formation in Harold D. Roberts Tunnel, one to two km south of quadrangle boundary (Wahlstrom and Hornback, 1962); may also correlate with Kremmling Sandstone Member (Izett, 1970) which is about 575 m above base of formation about 30 km north of quadrangle. About 20 m thick

Kpl **Lower shale member**--Dark-gray, brownish-gray, and black marine shale and mudstone. Lowest 10-20 m is calcareous and calcite veining encountered at contact. Bedding indistinct in fresh outcrops; breaks with conchoidal fracture. In weathered outcrops, bedding fissility is visible. Conformable lower contact with underlying Niobrara Formation; mapped above point where weathering to light-gray, platy, calcareous fragments, typical of upper Niobrara, no longer visible. Estimated about 300 m thick

Kn **Niobrara Formation (Upper Cretaceous)**--Consists of two parts: 1) an upper calcareous shale member (Smoky Hill Shale Member), consisting of gray, platy-weathering, calcareous shale and shaly limestone, becoming generally more shaly upward; weathers light gray; about one km south of quadrangle member is about 138 m thick (Robinson and others, 1974), and 2) a lower blocky, gray micritic limestone member (Fort Hays Limestone Member); beds 5-15 cm thick; commonly contains encrusted inoceramid bivalves; member about 6-10 m thick; weathers light gray; relatively resistant. Formation is conformable above Benton Shale

Kb **Benton Shale (Upper Cretaceous)**—Uppermost 1.5 m is a thin-bedded, black to dark-gray, fetid, resistant, crystalline limestone that shows pinch-and-swell structures and contains thin, dark-gray, siliceous siltstone interbeds; interpreted to be equivalent to Juana Lopez Member of the Carlile Shale (Berman and others, 1980). The uppermost limestone overlies about 5 m of dark-gray fetid limestone and dark-brown to gray calcareous, rusty siltstone and shale that, in turn, overlies about 3 m of resistant brownish-gray, fine-grained, rusty, arkosic sandstone, bioturbated at base, that locally contains chert pebbles (probably equivalent to Codell Sandstone Member of Carlile Shale; Berman and others, 1980). The Codell Sandstone (?) unconformably overlies mostly dark-brown to black, fissile, rusty shale. Calcareous beds characteristic of the Greenhorn Limestone near Denver (Scott, 1972) are not apparent in the area; sequence below Codell Sandstone (?) is more characteristic of lower Mancos Shale as described west of area (e.g., Merewether and Cobban, 1986). The lower approximate 25 m (equivalent to Mowry Shale of Wyoming) consist of wavy-bedded black shale containing fish scales and, in lowest 3 m, thin (less than 5 cm) fine-grained gray quartzite beds; sequence is conformable above Dakota Group. Total thickness of unit about 95-110 m

Kd **Dakota Group (Lower Cretaceous)**—Generally consists of three informal members: an upper quartzite member, a middle shale member, and a lower quartzite member. The upper quartzite member is 6-20 m thick and contains an upper sequence of light-gray, commonly cross-bedded, 10- to 30-cm-thick, quartzite beds, and thin, black, commonly carbonaceous shale interbeds. The base of the upper member is a massive 2-10 meter thick, resistant quartzite bed. Joint surfaces contain red, orange, and yellow limonite encrustations. The middle shale member consists of interbedded dark-gray to black, commonly carbonaceous shale and generally thin- to medium-bedded, medium-grained, equigranular, gray to light-gray quartzite; quartzite beds are as thick as about 2 m. The thickness of the middle shale member is highly variable: 6 to 28 m thick. The lower quartzite member consists of thick (as much as 12 m), massive, medium-grained, grayish-white equigranular quartzite with thin dark-gray shale interbeds; quartzite is very rusty on joint surfaces. No chert-pebble beds, characteristic of the lower Dakota elsewhere, observed in lower member, which is unconformable above Morrison Formation. Thickness of lower member is 20-26 m. The total thickness of the Dakota Group in the Breckenridge area, about 10 km south of quadrangle, is 52-69 m (Lovering, 1934). Total thickness of the Dakota Group in the Harold D. Roberts tunnel, about one kilometer south of the quadrangle, reported to be 66 m (Robinson and others, 1974)

Jm **Morrison Formation (Jurassic)**—Mostly light-gray and light-greenish-gray, locally calcareous claystone; upper 4 m contains some maroon claystone. The lower half of the formation contains several light-yellow to white medium-grained sandstone beds as thick as about 5 m that commonly contain Liesegang rings (rusty layers parallel to joint surfaces) and limonitic spots. One prominent 2-4-m-thick gray limestone bed about 5-10 m from base of formation (not exposed in quadrangle). Thickness of formation in the Blue River Valley about 55-79 m (Holt, 1961)

JPu **Jurassic to Pennsylvanian (?) rocks, undivided**—Do not crop out in quadrangle; shown only on cross section B-B'. Includes the Middle Jurassic Entrada Sandstone (0-55 m thick; Holt, 1961) and underlying dark-red to pale-pink conglomerate, sandstone, and siltstone that is greater than 33 m thick in drill holes near Dillon Dam near south border of quadrangle and correlated with rocks as old as the Lower Permian and Upper and Middle Pennsylvanian Maroon Formation (unpublished data from E.E. Wahlstrom; reported in Holt, 1961). Redbed sequence unconformably overlies Precambrian rocks

Proterozoic rocks

Pu **Proterozoic rocks, undivided**

Rocks of the Routt Plutonic Suite--Most rocks of the suite, defined by Tweto (1987), are granodiorite and quartz monzonite, but the suite also includes diorite, gabbro, and granite. Age of the suite is 1,667-1,750 Ma

Pp **Pegmatite**—Very coarse grained microcline-plagioclase-quartz-muscovite rock in pods and dikes as wide as about 25 m; mostly much smaller. Locally grades into quartz veins or aplitic granite

Pgr **Granodiorite and quartz monzonite**—Gray to light-gray, medium- to coarse-grained, hypidiomorphic to xenomorphic, massive to slightly foliated equigranular microcline-plagioclase-quartz-biotite intrusive rock that occurs in irregular-shaped stocks. Accessory minerals are zircon, opaque minerals, apatite, ± muscovite (locally as much as 5 percent), and ± epidote

Ppg **Pegmatite and granite complex**—Approximately equal volumes of pegmatite and granitic rocks; pegmatite bodies are irregular in shape and large (as much as 30 m wide)

Pdi **Diorite**—Dark gray, medium- to coarse-grained, inequigranular, hypidiomorphic to xenomorphic, massive to weakly foliated biotite-hornblende diorite and quartz diorite. Contains 40-50 percent plagioclase (approximately An_{40}), 5-30 percent hornblende, 5-40 percent biotite, 5-10 percent quartz, 0-10 percent potassium feldspar, 1-3 percent opaque minerals, trace apatite, and 0-2 percent secondary epidote. Forms relatively small, irregular intrusive masses

Pgrb **Granitic rocks, gneiss, and pegmatite, undivided**—Complex composed of approximately equal amounts of intrusive rocks and gneiss. Granite and pegmatite form irregular dikes and small intrusive bodies that contain rafts of gneiss as long as several tens of meters in which foliation is generally parallel from one block to the next

Pmg **Migmatite**—Consists of gray, well-foliated gneiss alternating with approximately equal amounts of very light-gray to white granitic component in layers ranging from a fraction of a centimeter to about 10 centimeters thick. Layers show much pinch and swell and in most places are strongly folded. Igneous component interpreted to be injected rather than the product of local diffusion, and derived from granitic bodies. In most places, the gneiss component is biotite gneiss or biotite-muscovite gneiss

Pbg **Biotite gneiss**—Gray, medium-grained, hypidiomorphic to xenomorphic, well-foliated gneiss containing approximately 25-50 percent quartz, 20-30 percent plagioclase (approximately An_{30}), 0-30 percent microcline, 10-15 percent biotite, 0-15 percent muscovite, 0-5 percent sillimanite, 0-5 percent hornblende, 1-2 percent opaque minerals, and a trace zircon. Rarely contains a few percent hornblende. Generally lacks conspicuous sillimanite and muscovite in hand sample, although these minerals are locally present. Typically contains 5-20 percent migmatitic layers.

Pkbg **Microcline-biotite gneiss**—Gray and pinkish-gray medium-grained, well-foliated gneiss containing approximately 10-20 percent biotite and conspicuous pink microcline-rich layers as thick as 5 cm. Migmatitic; locally contains as much as 40 percent granitic migmatite layers. Mapped at one location along crest of Williams Fork Mountains

Pbmg **Biotite-muscovite gneiss and schist**—Gray, medium-grained, xenomorphic, well foliated rock containing 30-60 percent quartz, 20-30 percent plagioclase, 0-10 percent microcline, 10-25 percent biotite, 10-40 percent muscovite, 0-5 percent sillimanite, 1-2 percent opaque minerals, and a trace zircon. Characterized by conspicuous muscovite on foliation planes. Locally contains as much as 40 percent migmatite layers

Psg **Biotite-muscovite-sillimanite gneiss and schist**—Gray to light-gray, medium-grained, well-foliated, hypidiomorphic gneiss and schist that contains 25-50 percent quartz, about 20 percent plagioclase, 15-25 percent biotite, 5-10 percent muscovite, about 10 percent sillimanite (commonly in fibrous, elongate aggregates, producing light-colored "spots" as wide as about 1 cm), 1-2 percent opaque minerals, and a trace zircon. Locally migmatitic

Pam **Amphibolite**—Dark-gray to black, medium-grained, hypidiomorphic, well-foliated rock containing 50-70 percent green hornblende (in thin section), 0-5 percent brown biotite, 25-35 percent plagioclase, 0-10 percent quartz, 1-2 percent opaque minerals, and a trace apatite. Locally migmatitic and commonly contains numerous diffuse, white, plagioclase-rich, felsic segregations

Pqz **Quartzite**—Gray, medium- to coarse-grained, inequigranular, foliated rocks that contain about 70-90 percent quartz, 10 percent plagioclase, and as much as 5 percent epidote (after plagioclase?). Observed as layers as wide as several tens of meters at several localities

Contact—Dashed where approximately located; dotted where concealed

Normal fault—Showing dip. Dashed where approximately located; dotted where concealed. Bar and ball on downthrown side

Thrust fault-- Dashed where approximately located; dotted where concealed. Teeth on upper plate

Anticline or antiform—Trace of axial plane

Syncline or synform—Trace of axial plane

Strike and dip of beds

Inclined

Vertical

Horizontal

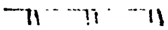
Strike and dip of foliation

Inclined

Vertical

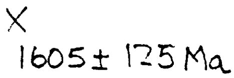
Strike and dip of foliation and bearing and plunge of lineation—

Lineation defined by aligned mineral grains, mullion structures, and small fold axes. In most cases, lineation interpreted to be stretching direction during ductile deformation



Fracture—Linear scarp- or trench-like feature interpreted to be fracture associated with downslope creep. May represent incipient landslide scarp

Quarries or prospects of Hammer fluorspar deposits (Tweto and others, 1970)



Uranium-lead ages from zircons—(A) Granite sample D96-180, (B) Pegmatite sample D95-2A (D. Unruh, unpublished data, 1997)

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