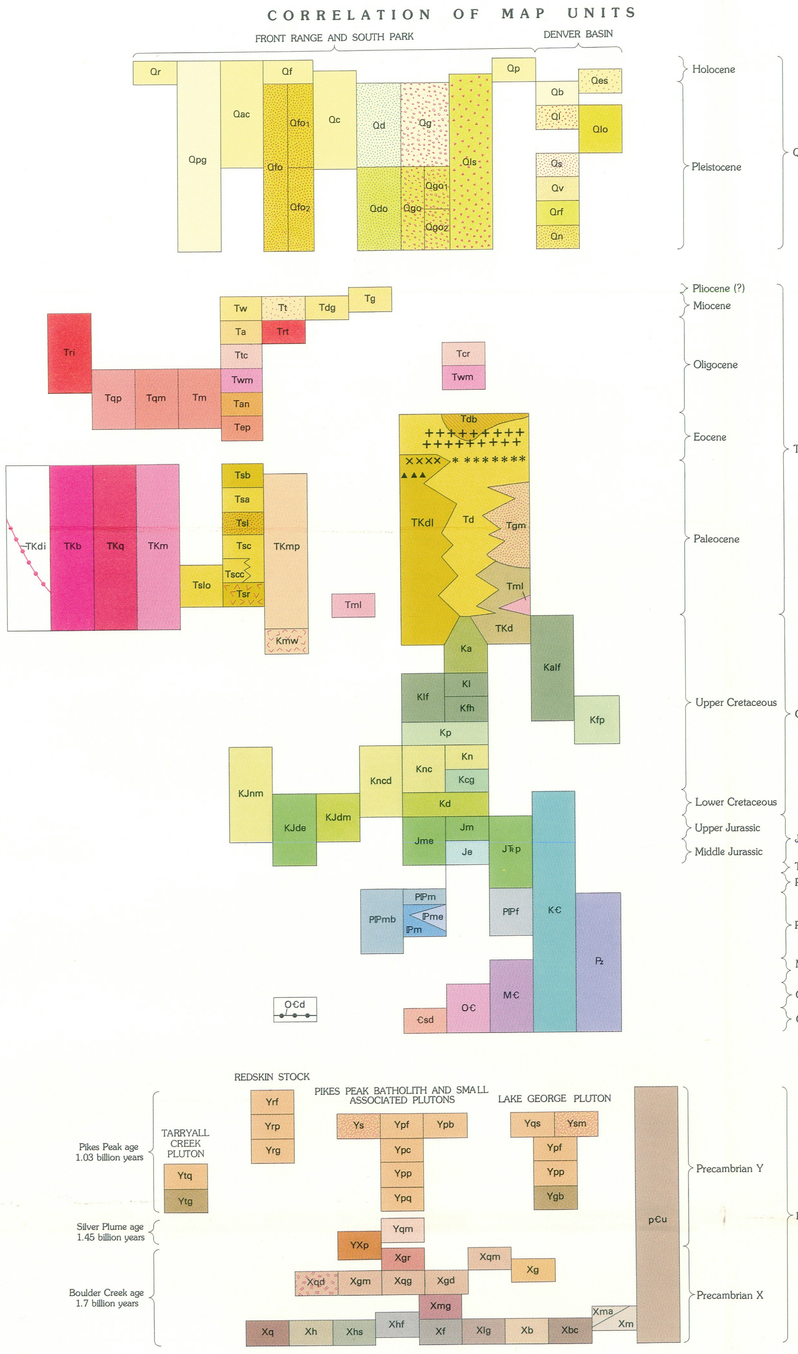
CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

(All isotopic ages recalculated using decay constants accepted by the U.S. Geological Survey in 1978)

Qf FAN ALLUVIUM (HOLOCENE)—Gravel, sand, and silt; abundant boulders in some beds

Qp ALLUVIUM (HOLOCENE)—Post-Piney Creek alluvium, Piney Creek Alluvium, and pre-Piney Creek alluvium; may also include some Broadway and Louviers Alluviums where those deposits are too small to map

Post-Piney Creek alluvium—Light-yellowish-gray to grayish-brown unconsolidated silt, sand, and coarse pebbly to cobbly gravel containing interbedded dark-brown clayey and silty lenses. Locally magnetite rich. Poorly to well stratified, commonly crossbedded. Locally humic, commonly contains plant debris. Generally lacks soil development. Forms flood plain and the lowest terrace above most streams. Thickness as much as 9 m; generally less than 3 m thick

Piney Creek Alluvium—Dark-gray to dark-brownish-gray, humic clay, silt, and sand. Generally gravelly in lower part. Usually well stratified. Locally contains charcoal. Generally has a poorly developed soil at top. Forms terrace 2–3 m above stream level in most stream valleys. Thickness as much as 9 m

Pre-Piney Creek alluvium—Light-brown, moderate-brown, moderate-yellowish-brown, and reddish-brown stratified silt and sand containing thin lenses of pebbles. Soil generally weakly developed. Forms terrace deposits only in small stream valleys. Thickness as much as 12 m, generally less than 3 m

Alluvium generally contains larger proportion of gravel in the western part of the quadrangle; may include glacial outwash (Qg) at some localities

Qr ROCK GLACIERS (HOLOCENE AND UPPERMOST PLEISTOCENE)—Angular boulders and cobbles at the surface, embedded in a matrix of sand and silt below the surface, form a deposit with a convex cross profile

Qes EOLIAN SAND (HOLOCENE AND PLEISTOCENE)—Pale-yellowish-brown to light-brown, locally silty, very fine to coarse sand containing sparse pebbles. Predominantly quartz with minor feldspar. Deposited by westerly to northwesterly winds. Well-developed thick to thin Brown soil generally present in upper part. Thickness generally less than 3 m but may be more than 9 m

Qpg PEDIMENT GRAVEL (HOLOCENE AND PLEISTOCENE)—Poorly sorted boulder to pebble gravel containing sand and silt matrix. Mantles areas in South Park north and east of Hartsel (T. 10–12 S., R. 74–76 W.)

Qac ALLUVIUM AND COLLUVIUM (HOLOCENE AND PLEISTOCENE)—Boulders, cobbles, pebbles, sand, silt, and peat; occurs near valley heads of some streams in nonglaciated areas, especially in the Kenosha and Tarryall Mountains

Qfo OLDER FAN ALLUVIUM (PLEISTOCENE)—Gravel, sand, silt, and locally, boulders in fan-shaped deposits above present drainage
Qfo1—Younger fan deposits in Manitou Park area (T. 11 S., R. 69 W.)
Qfo2—Older fan deposits in Manitou Park area (T. 11 S., R. 69 W.)

Qc COLLUVIUM (HOLOCENE AND PLEISTOCENE)—Poorly sorted material ranging in size from silt to blocks as much as 2 m long. Areas of colluvium with abundant blocks common in the higher mountains east of the Continental Divide

Qd YOUNG GLACIAL DRIFT (PLEISTOCENE)—Poorly sorted bouldery till and associated soil and gravel deposits. As mapped, may include some landslide, alluvium talus, and rock glacier deposits. Probably of Bull Lake(?) and younger age

Qg YOUNG OUTWASH GRAVELS (PLEISTOCENE)—Outwash gravels of Bull Lake(?) and younger age

Qls LANDSLIDE DEPOSITS (HOLOCENE AND PLEISTOCENE)—Poorly sorted; particle sizes range from clay to blocks more than 100 m long; includes mudflow, debris avalanche, block glide, and slump deposits

Qb BROADWAY ALLUVIUM (PLEISTOCENE)—Grayish-brown, moderate-yellowish-brown, light-brown, and reddish-brown fine- to coarse-grained, well-sorted, crudely stratified sand and finer grained well-stratified silty humic sand. Locally well-developed soil at top as thick as 1 m. Forms terrace 1.6–12 m above streams. Thickness 0–9 m. Late Wisconsin in age; probably equivalent to Pinedale age glacial deposits

Qlo LOESS (PLEISTOCENE)—Includes loess deposits of two and possibly three ages
Younger loess—Moderate-yellowish-brown to olive-gray, light-yellowish-gray, and grayish-red silty sand or sandy silt that is commonly clayey. May be structureless or may have moderately developed prismatic or columnar structure. Contains calcium carbonate mottling, nodules, and coatings on prism faces in eastern part of map area. Well-developed mid-Wisconsin Brown soil commonly at top. Thickness generally about 1.6 m near mountains but may be as much as 8 m thick in eastern part of map area
Older loess—Brown or moderate-brown to yellowish-gray, massive to columnar, slightly clayey, sandy silt or silty sand. May be calcareous or noncalcareous. Generally contains some small pebbles indicating it may be in part colluvial. Thickness 0.6–1.3 m near mountains but may be more than 5 m thick in eastern part of map area

Ql Oldest(?) loess deposits—Grayish-yellow sandy silt and silty fine sand containing minor coarse granules; possibly of Kansan age (Soister, 1972) in Peoria quadrangle in the eastern part of the map area

LOUVIERS ALLUVIUM (PLEISTOCENE)—Brown, grayish-brown, yellowish-brown, and reddish-brown clayey silt and sand and coarse-cobbly clayey sand and gravel. Generally exhibits graded bedding with contorted clay and silt layers, and contains iron- and manganese-oxide staining. Well-developed soil commonly present at top. Generally deposited on well-developed terrace 9–24 m above modern streams. Thickness 0–36 m. Early Wisconsin in age

Qs SLOCUM ALLUVIUM (PLEISTOCENE)—Dark reddish brown near mountains changing to yellowish brown and grayish brown basinward. Generally well-stratified, clayey sand containing lenses of silt, pebbles, and cobbles in pediment deposits and in terrace deposits. Clasts coarser and more angular near mountains and in pediment deposits. May be stained with iron and manganese oxides. Generally has a well-developed soil of probable Sangamon age at top. Forms terrace deposits 8–60 m above modern streams and occurs on pediment surfaces about 50 m below Verdos (Qv) pediment surfaces near mountains. Thickness 0–30 m

Qv VERDOS ALLUVIUM (PLEISTOCENE)—Reddish-brown, moderate-brown, yellowish-brown and yellowish-gray, well-to poorly stratified, clayey, silty sand and boulder gravel. Contains a variable amount of calcareous cement. Interbed of volcanic ash is considered to be a correlative of the 600,000 year old Pearlette type 0 ash in the Denver area (Scott, 1963a, p. 17). Well-developed Yarmouth soil at top. Alluvium occurs on pediment surfaces 51–75 m above streams near mountains and 24–30 m above streams in eastern part of map area. Thickness 0–21 m

Qrf ROCKY FLATS ALLUVIUM (PLEISTOCENE)—Reddish brown near mountains changing to pale orange and yellowish gray in eastern part of map area. Bouldery, cobbly, poorly sorted sand and gravel; locally contains some silt and clay in upper part. Boulders as much as 6 m in length near mountains in Ralston Buttes quadrangle (Van Horn, 1967), and at Air Force Academy (Varnes and Scott, 1967), and as much as 0.3 m in length in Peoria quadrangle in eastern part of map area (Soister, 1972). Commonly very calcareous; calcite forms layers, veins, and caliche coatings on boulders. Well-developed pre-Bull Lake (Aftonian?) Brown soil preserved in upper part at some localities. Alluvium occurs on pediment surfaces about 105 m above modern streams near mountains and about 60 m above streams in eastern part of map area. Thickness 0–15 m

Qn NUSSBAUM ALLUVIUM (PLEISTOCENE)—Moderate-reddish-brown to yellowish-brown and yellowish-gray coarse bouldery gravel in a clayey and silty sand matrix. Darker colored and coarser grained near mountains. Coarse components predominantly sandstone, conglomerate, and granitic and metamorphic rocks. Fragments of Wall Mountain Tuff (Twm) are conspicuous in the Nussbaum in the southeastern part of the map area and in T. 5 S., R. 62 W. Alluvium occurs on pediment surfaces 60–135 m above modern streams and about 15 m above Rocky Flats pediment near mountains. Thickness as much as 9 m near mountains, and more than 30 m in southeastern part of map area

Qgo OLD GRAVEL (PLEISTOCENE)—Outwash gravels on higher terraces. Sequence of terrace deposits mapped locally in Fraser Basin (T. 1 S., R. 75 W.) and South Park (T. 8–11 S., R. 76–77 W.); probably pre-Bull Lake(?) in age
Qgo1—Lower terrace deposit
Qgo2—Higher terrace deposit

Qdo OLD GLACIAL DRIFT (PLEISTOCENE)—Unsorted bouldery till, morainal form subdued or lacking. In Fraser Basin (T. 1 S., R. 75 W.) may include some deposits of pre-Quaternary diamicton. Probably pre-Bull Lake(?) in age

Tg GRAVEL (PLIOCENE? OR MIOCENE)—Boulder gravels capping ridges above major streams in the mountains east of the Continental Divide in the drainages of the North Fork of the South Platte, Bear Creek, Clear Creek, and Boulder Creek

Tw WAGONTONGUE FORMATION (MIOCENE)—Pebble and cobble gravel, sandstone, and siltstone. About 150 m thick preserved in syncline northeast of Antero Reservoir in South Park (T. 12 S., R. 76 W.)

Tt TROUBLESOME FORMATION (MIOCENE)—Tuffaceous siltstone rich in swelling clays; local beds of water-laid tuff. Lenses of arkosic sandstone and conglomerate near basin margin. Thickness of about 250 m preserved in Fraser Basin (T. 1 S., R. 75, 76 W.)

Tdg GRAVEL AT DIVIDE (MIOCENE)—Bouldery gravel on crest of Rampart Range along south edge of quadrangle (T. 12 S., R. 68 W.)
East and southeast of Palmer Lake (T. 11 S., R. 67 W.), yellowish-gray to greenish-gray pebble to boulder gravel containing lenses of greenish-gray, very micaceous, commonly clayey sand. Pebbles and boulders are mostly granitic rock but Wall Mountain Tuff (Twm) is a conspicuous component as well as andesitic rocks that may be from the Thirtynine Mile volcanic field to the southwest. Deposit mapped on a surface more than 160 m above Monument Creek, which is too high to be correlated with either the Rocky Flats (Qrf) or Nussbaum (Qn) Alluvium. Thickness about 21 m

Tri RHYOLITE (MIOCENE AND OLIGOCENE)—In plugs at Red Mountain (T. 3 S., R. 76 W., 3 km southeast of Berthoud Falls) and south of Georgetown. Quartz, sanidine, and plagioclase phenocrysts in aphanitic groundmass; biotite phenocrysts in bodies south of Georgetown. K-Ar age of sanidine from plug at Red Mountain 28±3 m.y. (Taylor and others, 1968). Fission-track ages of zircons from a sequence of silicic intrusives at Red Mountain range from 24 to 29±2–3 m.y. (Naeser and others, 1973)

Tri Dike

Ta ANTERO FORMATION (OLIGOCENE)—Water-laid ash, air-fall tuff, siltstone, sandstone, and algal limestone, in South Park (T. 10–12, S., R. 76–77, W.)

Trt RHYOLITE (OLIGOCENE)—Rhyolitic crystal-lithic tuff; forms small bodies of ash-flow tuff below the Troublesome Formation along the south margin of the Fraser Basin (T. 1–2, S., R. 75 W.). K-Ar age of sanidine 30±3 m.y. (Taylor and others, 1968)

Ttc TALLAHASSEE CREEK CONGLOMERATE (OLIGOCENE)—Boulder conglomerate containing volcanic and Precambrian rocks and, in the Tarryall Creek valley (T. 11 S., R. 72 W.), beds of tuff. Also occurs in southwestern corner of quadrangle

Tcr CASTLE ROCK CONGLOMERATE (OLIGOCENE)—Grayish-orange, yellowish-gray, and brownish-gray, poorly to well-cemented, commonly crossbedded conglomerate and coarse-grained arkosic sandstone containing numerous greenish-gray to brown claystone layers. Coarse components consist mostly of granitic rocks. Paleozoic and Mesozoic sandstone and limestone, and light-colored porphyritic igneous rocks, including abundant to sparse fragments of Wall Mountain Tuff (Twm) are also present. Clasts are commonly 5–10 cm in length but may be as long as 1.3 m. Thickness as much as 91 m

Twm WALL MOUNTAIN TUFF (OLIGOCENE)—Rhyolite ash-flow tuff in South Park (T. 10–12 S., R 74–76 W.) and east of the Puma Hills, which lie east of South Park; contains phenocrysts of biotite, plagioclase, and sanidine. Maximum thickness 10 m. Gray, lavender, and pink vitric ash-flow tuff in areas south of Denver where thickness is as much as 6 m. Several radiometric ages indicate age of about 36 m.y. (Epis and Chapin, 1974)

Tan ANDESITE (OLIGOCENE)—Hornblende-biotite and biotite andesite and flow breccia. About 270 m thick on west limb of syncline northeast of Antero Reservoir; fills paleovalley southeast of Kenosha Pass (T. 7 S., R. 75 W.). Hornblende andesite in volcanic neck at Signal Butte

Tqp PORPHYRITIC QUARTZ MONZONITE (OLIGOCENE AND EOCENE)—Porphyritic hornblende-bearing biotite quartz monzonite containing phenocrysts of potassic feldspar as much as 2 cm long along west margin of map (T. 6 N., R. 77 W.)

Tqm QUARTZ MONZONITE (OLIGOCENE AND EOCENE)—Hornblende-biotite quartz monzonite. Includes Montezuma Quartz Monzonite, a small Oligocene stock

Tqm Dike or sill

Tm MONZONITE (OLIGOCENE AND EOCENE)—Pyroxene-hornblende-biotite monzonite, locally grades to quartz monzonite (Tqm). Includes, small latite intrusive northwest of South Park (T. 7 S., R. 75 W.)

Tm Dike or sill

Tep ECHO PARK ALLUVIUM (EOCENE)—Boulder conglomerate containing Precambrian rock fragments as large as 3 m in length. In southwestern part of quadrangle

Tsb SOUTH PARK FORMATION (PALEOCENE)
Boulder conglomerate—Conglomerate and sandstone containing boulders of Precambrian granitic rock as much as several meters in length

Tsa Upper conglomerate and arkose—Arkosic siltstone, sandstone, and conglomerate; contains some beds of boulder conglomerate. Maximum thickness 1,000 m

Tsl Link Spring Tuff Member—Crystal tuff and crystal lithic tuff, laminated waterlaid tuff, andesite flows, and volcanic breccia; K/Ar age of biotite from crystal tuff 59.7±2.0 m.y. (Bryant and others, 1975); maximum thickness 200 m

Tsc Lower conglomerate and arkose—Composed of a mixture of plutonic, sedimentary, and igneous rock fragments. Maximum thickness 1,800 m

Tscc Coarse-grained conglomerate—Rich in clasts of volcanic and hypabyssal porphyry; contains some quartzite and sandstone. Maximum thickness about 400 m

Tsr Reinecker Ridge Volcanic Member—Andesite flow, breccia, tuff, sandstone, and conglomerate; maximum thickness about 300 m

Tslo Reinecker Ridge Volcanic Member and lower conglomerate and arkose

Tdb DAWSON ARKOSE (EOCENE, PALEOCENE, AND UPPER CRETACEOUS)
Siliceous conglomerate and conglomeratic sandstone facies—Yellowish-gray to grayish-brown arkosic conglomerate and coarse-grained to conglomeratic arkosic sandstone. Matrix is commonly hard, siliceous, and may be opalized or tuffaceous. Locally contains tuffite lenses which are very hard and break with conchoidal fracture across sand grains. Thickness is as much as 30 m

\+ Tuffite lens near Rattlesnake Butte, south edge of quadrangle

Td Arkosic sandstone and claystone facies—Yellowish-gray to light-gray, commonly ironstained, coarse- to fine-grained, locally conglomeratic, massive to crossbedded argillaceous arkose and feldspathic sandstone containing numerous gray to greenish-gray clay lenses. Locally contains thin carbonaceous shale lenses. Generally loosely cemented but contains many hard ironstone lenses throughout and in the upper 120 m contains hard, gray to yellowish-gray tuffite beds that break with conchoidal fracture. A weathered crystal tuff occurs in the lower part of the facies in the central part of the map area southeast of Denver. Biotite from this tuff has been dated at 56.5±1.9 m.y. (R. F. Marvin, written commun., 1975); this, and a fission-track age determination of 54.8±5.6 m.y. on zircon by C. W. Naeser (unpub. data, 1977) from what is believed to be the same tuff, indicate that the tuff is of late Paleocene or early Eocene age. Thickness more than 305 m in surface exposures; estimated to be about 915 m in subsurface (Kittleman, 1956) but this figure includes about 210 m of carbonaceous shale and coal facies that is included in unit TKdl on this map. In cross-section Td includes Tdb

\+ Tuffite beds
* Crystal tuff

TKdl Fine-grained sandstone, carbonaceous shale and lignite facies—Light-gray, hard, limy, fine-grained, concretionary sandstone and soft, rusty, fine-grained sandstone beds containing limy "cannonball" concretions with brown rinds interbedded with gray to dark-brown and black carbonaceous shale and clay and numerous lignite beds. Small spherical ironstone concretions with coal nuclei are present locally, and large, irregularly-shaped ironstone crusts and lenses are common in soft rusty sandstone layers. A hard gray tuffite bed several cm to 30 cm thick is present at or near the top of the facies throughout much of the southeast part of the map area. A conspicuous clinker horizon occurs near the top of the facies in the southeast part of the map. The clinker bed is overlain by the tuffite in at least one locality. The top of the facies is also commonly marked by a residue of quartz and chert pebbles and occasionally by a red, yellow, and white variegated clay paleosol zone. The clay zone commonly contains abundant quartz and some feldspar grains and locally, T. 12 S., R. 61 W., grades laterally into the tuffite. Pollen identifications suggest an Eocene age for beds above the paleosol (Paul Soister, written commun., 1977). Fossil leaves from below the paleosol in T. 12 S., R. 61 W., from the clinker horizon mentioned above, and in T. 9 S., R. 61 W. are of Paleocene age (Brown, 1962). Thickness may be as much as 300 m

Paleosol zone (shown only on fence diagram, sheet 2)
Clinker horizon
Tuffite bed

Tgm GREEN MOUNTAIN CONGLOMERATE (PALEOCENE)—Yellowish-brown cobble and boulder conglomerate with interbedded andesitic sandstone, siltstone, and claystone. Clasts of conglomerate are composed of mafic volcanic rock related to monzonite intrusives (TKm), andesite, gneiss, pegmatite, quartzite, and sandstone. Contains pollen and plant fossils of Paleocene age in the lower 135 m (Scott, 1972). Thickness about 200 m

Tml MAFIC LATITE (PALEOCENE)—Dark-gray porphyritic lava flows in Denver Formation on North and South Table Mountains and the north side of Green Mountain west of Denver. Includes three flows. Aggregate thickness about 46 m. To north near Ralston Reservoir, includes plugs of similar material which have a K/Ar whole-rock age of 63.7±2.5 m.y. (Hoblitt and Larson, 1975). Parts of this unit have been mapped as Table Mountain Shoshonite by Scott (1972)

TKd DENVER FORMATION (PALEOCENE TO UPPER CRETACEOUS)—Yellowish-brown to grayish-olive fluvial tuffaceous claystone, siltstone, and sandstone interbedded with conglomerate and olive-gray mudflows. In the Morrison quadrangle, clasts in the conglomerate are about 95 percent andesitic volcanic rocks and 5 percent granitic, igneous, and metamorphic rocks (Scott, 1972). Contains numerous beds rich in carbonaceous plant remains. Thickness as much as 290 m

TKmp MIDDLE PARK FORMATION (PALEOCENE AND UPPER CRETACEOUS?)—Siltstone, mudstone, arkosic and micaceous sandstone, and conglomerate; conglomerate in lower part richer in clasts of volcanic and hypabyssal intrusive rock than in upper part. Maximum thickness preserved in northwest corner of quadrangle 610 m

Kmw Windy Gap Volcanic Member (Upper Cretaceous?)—Andesitic laharic breccia and conglomerate; volcanogenic sandstone. Maximum thickness 215 m in northwest corner of quadrangle

TKdi DIABASE (PALEOCENE AND UPPER CRETACEOUS)—Diabase dikes that contain phenocrysts of augite, labradorite, and olivine with interstitial augite, plagioclase, and opaque minerals. In T. 1–2 S., R. 72 W.

TKb BOSTONITE (PALEOCENE AND UPPER CRETACEOUS)—Leucocratic porphyry containing phenocrysts of alkali feldspar in an altered quartz-feldspar groundmass

TKb Dike

TKq GRANODIORITIC INTRUSIVES (PALEOCENE AND UPPER CRETACEOUS)—Hornblende granodiorite, biotite granodiorite, leucogranodiorite, and quartz monzonite; fine- to coarse-grained, equigranular to porphyritic

TKq Dike

TKm MONZONITIC INTRUSIVES (PALEOCENE AND UPPER CRETACEOUS)—Hornblende-pyroxene monzonite, nepheline monzonite, leucocratic monzonite, quartz monzonite, porphyritic monzonite, latite, and mafic monzonite. Includes mafic analcime monzonite dikes in South Park (T. 11 S., R. 75 W.)

TKm Dike or sill

Ka ARAPAHOE FORMATION (UPPER CRETACEOUS)—Yellowish-gray to yellowish-brown, coarse- to fine-grained quartz-mica-feldspar sandstone, siltstone, claystone, and pebble and cobble conglomerate. Clasts in conglomerate composed of rocks derived from Front Range during its initial uplift. A poorly exposed or discontinuous conglomerate marks the base in many places. South of Littleton (T. 5 S., R. 68 W.) these rocks have been shown as the Cretaceous part of the Dawson Formation on detailed maps (Scott, 1962, 1963b). Thickness as much as 153 m

Kl LARAMIE FORMATION (UPPER CRETACEOUS)—In eastern part of map area upper part is olive-gray and medium- to dark-gray shale, siltstone, and clay that contains ironstone concretions and lenses, and some coal beds. About 91 to 106 m thick. Lower part consists mainly of sandstone and is about 48 m thick (Soister, 1972). East of the mountain front in the central part of the map area formation consists of white to tan and yellowish-gray fine- to medium-grained friable sandstone and dark-gray, commonly carbonaceous or lignitic shale and ranges in thickness from 75 to 305 m. In northern South Park (T. 8–9 S., R 76 W.) contains two coal beds and is about 90 m thick; truncated to south by erosion that predated South Park Formation

Kfh FOX HILLS SANDSTONE (UPPER CRETACEOUS)—Yellowish-gray to greenish-gray, fine-grained marine sandstone that contains hard, brown-weathering, calcareous sandstone concretions interbedded with gray sandy marine shale. Thickness 18–91 m. In western part of South Park absent beneath pre-South Park Formation unconformity

Kalf ARAPAHOE FORMATION, LARAMIE FORMATION, AND FOX HILLS SANDSTONE—Shown only in cross section

Klf LARAMIE FORMATION AND FOX HILLS SANDSTONE

Kp PIERRE SHALE (UPPER CRETACEOUS)—Olive-gray to black, fossiliferous marine shale containing limestone, sandstone, and bentonite beds. Hygiene Sandstone Member about 213 m thick is present 366–488 m above base. Thickness as much as 2,073 m in Denver Basin; 1,800 m in South Park

Kfp FOX HILLS SANDSTONE AND PIERRE SHALE—Shown only in cross section

Kn NIOBRARA FORMATION (UPPER CRETACEOUS)—Pale- to yellowish-brown, soft, thinly bedded calcareous shale with interbedded layers of limestone. Contains marine fossils. Thickness 122–183 m

Kcg CARLILE SHALE, GREENHORN LIMESTONE, AND GRANEROS SHALE (UPPER CRETACEOUS)
Carlile Shale—Medium-dark-gray noncalcareous siltstone and minor beds of fine-grained sandstone. Thickness about 21 m
Greenhorn Limestone—Gray, dense limestone and hard calcareous shale that grades downward into gray, shaly calcarenite and thin grayish-brown beds of hard calcarenite with bentonite beds at the base. Thickness about 79 m
Graneros Shale—Dark-gray, hard clayey shale. Thickness about 55 m

Knc NIOBRARA FORMATION, CARLILE SHALE, GREENHORN LIMESTONE, AND GRANEROS SHALE

Kd DAKOTA SANDSTONE (LOWER CRETACEOUS)—Called Dakota Group east of the mountain front and includes South Platte and Lytle Formations
South Platte Formation—Three yellowish-gray sandstone layers separated by two dark-gray, indurated, silty shale layers interbedded with thin gray sandstone layers. Thickness about 67 m
Lytle Formation—Yellowish-gray or yellowish-brown, medium- to fine-grained ironstained sandstone and conglomerate. Thickness 24–30 m

Kncd NIOBRARA FORMATION, CARLILE SHALE, GREENHORN LIMESTONE, GRANEROS SHALE, AND DAKOTA SANDSTONE—Shown only in northwest corner of mapped area

Jm MORRISON FORMATION (UPPER JURASSIC)—Yellowish weathering sandstone and siltstone, gray limestone, and green, red, and gray claystone. Some quartz pebble conglomerate near base at south edge of quadrangle in South Park (T. 12 S., R. 75 W.). Thickness 76–91, in Denver Basin. Maximum thickness about 120 m in South Park

KJdm DAKOTA SANDSTONE AND MORRISON FORMATION—Shown along southwest and northwest edges of mapped area

Je ENTRADA SANDSTONE (MIDDLE JURASSIC)—Gray to brownish-red sandstone locally having a bimodal grain-size distribution. Local quartz- and chert-granule conglomerate at base. Maximum thickness about 100 m in South Park

Jme MORRISON FORMATION AND ENTRADA SANDSTONE

KJde DAKOTA SANDSTONE, MORRISON FORMATION, AND ENTRADA SANDSTONE—Unit includes about 45 m of Chinle Formation of Late Triassic age south of Boreas Pass (T. 7 S., R. 77 W.) (Poole and Stewart, 1964). Shown near west central margin of mapped area

KJnm NIOBRARA FORMATION, CARLILE SHALE, GREENHORN LIMESTONE, GRANEROS SHALE, DAKOTA SANDSTONE, AND MORRISON FORMATION—Shown only in cross section

J-Tkp MORRISON AND RALSTON CREEK FORMATIONS (UPPER JURASSIC), LYKINS FORMATION (LOWER TRIASSIC AND UPPER PERMIAN), AND LYONS SANDSTONE (PERMIAN)—Shown along east side of the Front Range
Ralston Creek Formation—Varicolored claystone interbedded with some limestone, siltstone, and sandstone. Contains thin beds and disseminated nodules of varicolored chalcedony. Thickness 18–46 m
Lykins Formation—Grayish-red shaly mudstone with thin beds of light-gray, very fine-grained sandstone and some "crinkled" limestone in lower part. Thickness 107–168 m
Lyons Sandstone—Light-gray to grayish-orange, crossbedded, fine- to medium-grained quartzose sandstone and some conglomerate, siltstone, and mudstone. Thickness 46–76 m

PPf FOUNTAIN FORMATION (PERMIAN AND PENNSYLVANIAN)—Grayish-red, reddish-brown, moderate-red, and gray coarse-grained, arkosic sandstone with lenses of siltstone and fine-grained sandstone, locally conglomeratic and crossbedded. Unit forms prominent hogbacks along east edge of Front Range and underlies Manitou Park (T. 10–12 S., R. 69 W.). Thickness 240–900 m; about 1,200 m in subsurface near south edge of quadrangle

PPm MAROON FORMATION (LOWER PERMIAN AND UPPER AND MIDDLE PENNSYLVANIAN)—Grayish-red to moderate-red and gray arkose, siltstone, and mudstone in western South Park. Bleached to green and gray colors in the Tarryall Creek (T. 8 S., R. 77 W.) area by contact metamorphism. About 1,700 m thick

IPm MINTURN FORMATION (MIDDLE PENNSYLVANIAN)—Grayish-red, moderate-red, reddish-brown, and gray arkosic siltstone and mudstone containing beds of gray limestone. At least 1,100 m thick

IPme Evaporite-bearing facies of Minturn Formation—Gray shale, limestone, siltstone, sandstone, white silty limestone, anhydrite, and gypsum in southwest corner of mapped area. Flowage makes original thickness uncertain

PPmb MAROON FORMATION, MINTURN FORMATION AND BELDEN (MIDDLE AND LOWER PENNSYLVANIAN) FORMATION—Shown only in cross section; may contain some older Paleozoic rocks at west part of B–B′.

M-C MISSISSIPPIAN, DEVONIAN, ORDOVICIAN, AND CAMBRIAN ROCKS
Leadville Limestone (Mississippian)—Gray, pink, and buff, fine- to coarse-grained limestone and dolomite. Present only in Manitou Park (T. 10–12 S., R. 69 W.) where maximum thickness is about 30 m
Williams Canyon Limestone (Devonian)—Lavender-mottled gray to buff, finely crystalline sandy dolomite or dolomitic limestone with thin interbeds of sandstone and shale. Present in Perry Park (T. 9–10 S., R. 68 W.) and Manitou Park (T. 10–12 S., R. 69 W.). Thickness about 14 m
Manitou Limestone (Lower Ordovician)—Tan to brown finely crystalline, well-bedded limestone; pink to red, fine- to medium-crystalline dolomite in upper part. Present west of Air Force Academy in T. 12 S., R. 67 W. and in Manitou Park (T. 10–12 S., R. 67 W.). Maximum thickness 21 m
Peerless Dolomite (Upper Cambrian)—Red glauconitic coarsely crystalline sandy dolomite. Thickness 2.5–5 m
Sawatch Sandstone (Upper Cambrian)—White, medium- to coarse-grained quartz sandstone, commonly feldspathic in lower part. Grades into brown or red fine- to medium-grained calcareous glauconitic sandstone upward. Thickness about 27 m

O-C ORDOVICIAN AND CAMBRIAN ROCKS—Manitou Limestone, Peerless Dolomite, and Sawatch Sandstone in T. 12 S., R. 67 W.

O-Cd DIABASE (ORDOVICIAN OR CAMBRIAN)—Potassic feldspar-bearing augite diabase. Forms dikes east of South Park (T. 9–10 S., R. 74 W.)

K-C DAKOTA SANDSTONE AND UNDERLYING MESOZOIC AND PALEOZOIC ROCKS—Shown only in cross section

Csd SANDSTONE DIKE (CAMBRIAN?)—Quartzitic sandstone in fractures in Precambrian rocks. Mapped only on west side of Manitou Park (T. 12 S., R. 69 W.)

Pz PALEOZOIC ROCKS OF THE FOUNTAIN, LEADVILLE, WILLIAMS CANYON, MANITOU, PEERLESS, AND SAWATCH FORMATIONS—Shown only in cross section

PIKES PEAK BATHOLITH AND ASSOCIATED PLUTONS (PRECAMBRIAN Y)

Ytq Tarryall Creek pluton (T. 11 S., R. 72 W.)
Quartz monzonite—White coarse-grained bornblende-biotite quartz monzonite grading inward to fine-grained porphyritic quartz monzonite containing phenocrysts of quartz, plagioclase, and potassic feldspar

Ytg Gabbro—Dark-green, medium- to coarse-grained olivine gabbro; forms outer zone of intrusive

Redskin stock—Mapped on southeast side of South Tarryall Peak, T. 10 S., R. 72 W.

Yrf Redskin Granite
Fine-grained granite—Pink to reddish, fine-grained equigranular muscovite-biotite granite; forms core of stock

Yrp Porphyritic granite—Pink, medium-grained seriate porphyritic muscovite-biotite granite containing phenocrysts of potassic feldspar, albite, and, locally, quartz

Yrg Medium-grained granite—White to pale-pink, medium-grained equigranular biotite granite

Ys Main body of Pikes Peak batholith and small associated plutons
Syenite—Light-tan to gray-green, fine- to coarse-grained syenite, quartz syenite and leucosyenite, locally containing ferrohastingsite, fayalite, and hedenbergite. Forms small plutons at Sugarloaf Peak (T. 9 S., R. 71 W.) east of Thunder Butte (T. 10 S., R. 71 W.), and in the central Rampart Range and forms dikes north of the Lone Rock pluton in T. 3 S., R. 71 W. and T. 4 S., R. 72 W.

Ys Dike

Ypf Fine-grained granite—Pink, fine-grained equigranular biotite granite. Locally grades into fine-grained porphyritic granite

Ypb Fine-grained porphyritic granite—Pink, fine- to medium-grained porphyritic biotite granite with phenocrysts of spherical gray quartz, and subhedral microcline and oligoclase. Resembles the Windy Point Granite of the Pikes Peak area, south of this map

Ypc Coarse-grained porphyritic granite—Seriate porphyritic biotite granite with tabular microcline phenocrysts as long as 5 cm. In T. 10 S., R. 72 W.

Ypp Pikes Peak Granite—Pink to reddish medium- to coarse-grained biotite or hornblende-biotite granite. Predominant rock type of the Pikes Peak batholith

Ypq Quartz monzonite to granodiorite—Medium- to coarse-grained porphyritic hornblende-biotite quartz monzonite to granodiorite; locally contains xenocrysts of sodic labradorite with albite rims

Yqs Lake George pluton—Shown on south border of mapped area in T. 12 S., R. 71 W. Quartz syenite and fayalite granite—Fine- to medium-grained fayalite quartz syenite and fayalite granite in discontinuous ring dikes

Ysm Syenomonzonite—Dark-green, coarse-grained, augite-ferrohastingsite syenomonzonite in center of stock and fine-grained ferrohastingsite syenite near margin of stock (Stewart, 1964)

Ypf Fine-grained granite—Pink to red, fine- to medium-grained granite, locally porphyritic with alkali feldspar phenocrysts and spherical clusters of biotite grains

Ygb Alkali diorite—Fine-grained alkali diorite containing andesine, augite, olivine, and abundant secondary biotite. Occurs as large elongate bodies in syenomonzonite

Yqm QUARTZ MONZONITE (PRECAMBRIAN Y)—White to grayish-orange, fine- to medium-grained, muscovite-biotite quartz monzonite; locally porphyritic with alined tabular microcline phenocrysts. Unit includes Silver Plume Quartz Monzonite in Silver Plume batholith

YXp PEGMATITE AND APLITE (PRECAMBRIAN Y AND X)—Irregular pods and dikes primarily composed of massive coarse-grained milky quartz, perthitic microcline, albite-oligoclase, muscovite, and biotite. Magnetite, garnet, tourmaline, and beryl are present locally

Xgr GRANITE (PRECAMBRIAN X)—Massive to poorly foliated coarse-grained to porphyritic biotite granite and quartz monzonite with small bodies intruding quartz monzonite and granodiorite in Mt. Evans area (T. 5–6 S., R. 73–74 W.)

Xqm TWIN SPRUCE QUARTZ MONZONITE (PRECAMBRIAN X)—Gray, fine- to medium-grained biotite-muscovite quartz monzonite, poorly foliated and lineated. Finer-grained variety locally intrudes the medium-grained variety but their contacts are usually gradational. Intrudes Boulder Creek Granodiorite (Xgd) in the Boulder Creek batholith

Xg GABBRO AND MAFIC ROCKS (PRECAMBRI