PART A

MINES AND MINERALIZED AREAS DATA

Wilson and Spanski delineated the 37 mineralized areas (PartB\Data\...\mnrlareas.*) utilizing data in mines.* (PartB\Data\mines.xls; PartB\Data\...\mines.*) plotted on the 1:250,000 digital geologic map (Day and others, 1999), geochemistry (Steven M. Smith, U.S. Geological Survey, unpub. data), and geophysics (Viki Bankey, U.S. Geological Survey, unpub. data). Each MA is defined by the presence of mines, prospects, and/or mineralized occurrences that belong to one deposit-type or a group of genetically related deposit-types in a geographic area. A MA may include an entire mining district or portions of several mining districts. Where practical, a MA is given the name of one of the more prominent mining districts or mining settlements that is within its bounds. Where this is not feasible, a new name is assigned that is geographically descriptive or the name of a productive or well known mine that is located in the area. We have not attempted to apply MA's to the placer mining districts as defined by Parker (1961) and have not included placer districts in the following discussion of MA's.

In the descriptions of the mineralized areas that follow, the following categories are described:

- Size: reported in square miles and square kilometers. May not be exactly equivalent due to rounding.
- Mining Districts: refers to historic mining districts or districts outlined by Plumlee and others, 1995
- County: The county (or counties) which host(s) the mineralized area. Because mines and claims are permitted by county, these entries are fairly reliable.
- Quadrangles: 1:24,000 quadrangles
- Major deposits: Lists some of the deposits included in the mineralized area. These are not ranked by size, production, or importance. Deposits in some areas may be prominent and important, deposits in other areas may be very small and of little consequence.
- Deposit types: Deposit types normally follow the classification of Cox and Singer (1986).
- Geology: As shown on the 1:250,000 maps compiled by Day and others (1999). When supplemented with other data, these references are cited.
- Boundary: (Basis of Delineation) Description of the considerations taken by Wilson and Spanski when outlining the mineralized areas.
- Mining Activity: Contains interesting information gleaned from the literature or observed in the course of studying the deposits or geology of the area.
- References: Lists many of the references that contain information about the mines and prospects in the area. This may or may not include references to the general geology of the area. U.S. Geological Survey (USGS) and U.S. Bureau of Mines (USBM) data files, Mineral Resources Data System (MRDS) and Minerals Availability System (MAS), are understood to be references for each area.

MINERALIZED AREAS

Ruby

Size: 46 mi^2, 119 km^2

Mining Districts: Irwin, Ruby, Mt. Emmons, Redwell Basin

County: Gunnison

Quadrangles: Oh-Be-Joyful, Mount Axtell, Marcellina Mountain

Major deposits: Mt. Emmons, Forest Queen, Keystone, Standard (Micawber), Daisey

Deposit types: Polymetallic veins, Climax Mo

Geology: Felsic sills, dikes, and stocks of Middle Tertiary (Oligocene; 26-38 Ma.) age (Tmi) intrude Cretaceous to Tertiary sandstones and shales including Upper Cretaceous Mesaverde Formation (Kmv) and Mancos Shale (Km) and Eocene and Paleocene Wasatch and Paleocene Ohio Creek Formations (Two) (Day and others, 1999). The granite stock that underlies the Mount Emmons deposit is 16-18 Ma (Thomas and Galey, 1982; White and others, 1981); some of the exposed felsic sills, dikes, and stocks may be contemporaneous. Especially in the southern part of the area, brilliant, red-orange-yellow pyritic alteration is adjacent to intrusions (Red Lady Basin, Redwell Basin).

Boundary: Includes mines and occurrences with polymetallic veins and Climax Mo porphyry mineralization clustered in the vicinity of exposed or inferred Middle Tertiary felsic intrusions.

Mining Activity:
According to Emmons and others (1894, p. 4, column 2), Ruby district is a synonym for Irwin district, yet the location of the Ruby district and the Ruby mine appear to be purposefully vague in Vanderwilt (1947, p. 106). Ellis (1983, p. 4) indicates that the Irwin silver district is a subdistrict of the Ruby. The Ruby #1 vein is accurately located (Gaskill and others, 1967, USGS GQ-578; Ellis, C.E., 1983, USBM MLA 81-83, table 1, p. 15, pl. 1) and is assumed to be the same as the Ruby mine referred to by Vanderwilt. Supposedly, the Ruby mine "produced rich ruby silver ore" from a vein in Cretaceous Mesaverde shale that was "cut off at a relatively shallow depth and lost on a flat fault (Vanderwilt, 1947, p. 106)." As of 1947, Vanderwilt (1947) reported that there had been no activity for many years. On the other hand, Ellis (1983) reports that mines in the Ruby part of the district "operated from 1883 to the 1910 and the Ruby mine operated from 1930-1966, producing a small amount of Ag, Au, Pb, and Zn.

"During the 1900's attempts were made to work the silver-rich base-metal veins of the region, but little was accomplished until 1950 when the Keystone, Micawber (Standard), [and] Daisy mines began operations [...] These base-metal veins were mined until 1969, after which

molybdenum exploration became the main activity." (Ellis, 1983, p. 5). This discrepancy in dates and activity suggests that different authors were referring to different mines. There are no records of production available.

Silver mining in the Irwin part of the district began in 1874 when it was "still part of the Ute Indian Reservation and effectively ended by 1890. The Ruby Chief and Bullion King mines, followed by the Forest Queen and Ruby King Mines were the district's early principal producers (Ellis, 1983, p. 4)." The first two mines were obliterated by snowslides in 1882 and 1884, respectively (Ellis, 1983, p. 4). Only the Forest Queen continued to operate intermittently, "reaching $1 million in production by 1915" (Socolow, 1955, p. 52-53).

Base metals and silver have been produced intermittently from fissure veins on the flanks of Mt. Emmons including from the Keystone, Daisy, and Standard (Micawber) mines, the largest in the area. Two major molybdenum deposits were discovered in the 1970's in the Mount Emmons-Redwell Basin areas (Thomas and Galey, 1982). Neither has been developed.

Information Sources:
Cunningham and others, 1994, USGS Bull.2109, 31p.
Ellis, C.E., 1983, USBM MLA-81-83
Emmons and others, 1894, USGS Folio 9
Gaskill and others, 1987, USGS GQ-1604
Gaskill and others, 1967, USGS GQ-578
Gaskill and others, 1977, USGS OFR-77-751
Harrer and Tesch, USBM IC-7918
Mutschler and others, 1981, in Epis and Callender, eds., NMGS 32nd Conf., p. 317-324.
Socolow, 1955, Columbia Univ. PhD dissertation, 113 p.
Thomas and Galey, 1982, Econ. Geol. v. 77, p. 1085-1104.
Vanderwilt, 1947, Min. Res. of Colo.
Voegeli and King, 1969, USGS WSP 1535-N
White and others, 1981, 75th Anniv. Econ. Geol. vol., p. 270-316.
Worcester, 1919, CGS Bull. 14

Mount Bellview

Size: .36 mi^2, .92 km^2

Mining Districts: part of Elk Mountains as outlined by Davis and Streufert (1980) and Plumlee and others (1995)

County: Gunnison

Quadrangle: Snowmass Mountain

Major Deposits: Silver Spruce mine

Deposit Types: Mo-Cu porphyry

Geology: A zoned granodiorite to quartz monzonite intrusive complex. Hydrothermally altered. 1200 m diameter hornfels aureole in Mancos shale host rock surrounds the intrusive complex and local quartz-molybdenite veinlets are also present (Lynch and others, 1985).

Boundary: Immediate area of Mt. Bellview intrusive complex, including the Silver Spruce mine on the southeast flank.

Mining Activity:

The only mine in the area, the Silver Spruce, consists of three adits on a vein along the intrusion-Mancos shale contact. The mine produced a small amount of silver and lead ore in 1933-34 and molybdenum is present in most samples (Weisner and Bieniewski, 1984). While probably not of sufficient grade and tonnage to rank as a "deposit", this area is shown as a mineralized area because of previous exploration interest and indications such as surface alteration and geochemistry that suggest a mineralizing event took place.

Information Sources:
Lynch and others, 1985, Geol. Soc. Am., Rocky Mtn. Sec. [abstr.], v. 17, no. 4.
Weisner and Bieniewski, 1984, USBM, MLA 23-84.

Elk Mountains

Size: 17 mi^2, 43.8 km^2

Mining Districts: Elk Mountains (includes 3 areas of Plumlee and others, 1995)

County: Gunnison

Quadrangles: Gothic

Major deposits: Sylvanite, Virginia

Deposit types: Polymetallic vein and replacement, skarn

Geology: Pennsylvanian to Upper Cretaceous sedimentary rocks [including Upper Cretaceous Mancos Shale (Km); Dakota , Morrison, and Entrada Formations (KJdm, KJde); Maroon Frm (Permian And Pennsylvanian) (PPm)] intruded by middle Tertiary (Oligocene, 26-38 Ma.) intrusive rocks(Tmi) of the White Rock Pluton.

Boundary: Includes mines and occurrences with polymetallic veins, polymetallic replacements, or skarn mineralization in and on the southwest flank of the White Rock pluton. Bounded on the southwest by the Copper Creek Sill (Gaskill and others, 1991).

Summary:
Elk Mountains mineralized area, about 20 mi north of Crested Butte, includes the historic Elk Mountain district and the ghost town of Gothic. Mineralized veins in the area contain sphalerite, galena, and chalcopyrite. Gold and silver, in unknown forms, were also present. "Mineralization is widespread but the veins are small and irregular. The country rock is Mancos shale with dikes, sills, and laccolithic masses of quartz monzonite" (Vanderwilt, 1947, p. 101). From 1932 through 1945, the Elk Mountain district had as many as 4 lode mines and 3 placer mines operating annually. These few mines produced 148 oz lode gold and 25 oz placer gold; 11,864 oz lode silver and 11 oz placer silver; 19,060 lbs. copper; 36,700 lbs. lead; and 9,400 lbs. zinc (Vanderwilt, 1947, p. 102).

Information Sources:
Emmons and others, 1894, USGS Folio 9
Gaskill, 1991, USGS GQ-1689
Gaskill, 1956, UNM M.S. Thesis
Vanderwilt, 1947, Min. Res. of Colo.

Dorchester

Size: 7.2 mi^2, 18.7 km^2

Mining Districts: Taylor River, Dorchester; maybe some Taylor Park

County: Gunnison

Quadrangles: Pearl Pass, Italian Creek

Major deposits: Hope, Bull Domingo, Clara, Star, Ender

Deposit types: Polymetallic vein and replacement

Geology: Paleozoic sedimentary rocks [including undifferentiated Mississippian Devonian Ordovician and Cambrian rocks (Mer) and Minturn and Belden Formations (hmb)] overlying Precambrian (1,700 Ma) granitic rocks(Xg) and intruded by middle Tertiary (Oligocene, 26-38 Ma) intrusive rocks (Tmi). The intrusive rock is 33.9 Ma tonalite of the Italian Mountain complex (Fridrich and others, 1998)

Boundary: Includes mines and occurrences with polymetallic vein or polymetallic replacement mineralization in Paleozoic rocks on the northeast flank of a mid-Tertiary felsic intrusion. Bounded on the northeast by Precambrian granitic rocks.

Mining Activity:
The Dorchester mineralized area includes the most of the historic Dorchester (synonym: Taylor River) mining district, about which extremely little is known geologically. According to

Vanderwilt (1947, p. 101), “lead-zinc mineralization occurs in faulted and folded limestone and dolomite” equivalent to that at the Aspen mining district 10 mi to the north.

The Star mine operated intermittently from 1878 (Garrett, 1950, p. 30; Slebir, 1957, p. 61) until at least 1950 (Garrett, 1950, p. 29). The only recorded production is from the Star mine in 1927-1928 when it produced $8,224 in silver-lead ore (Garrett, 1950, p. 32). This translates roughly to about 116 tons of ore, of which about $2467 was silver and $5756 was lead, or 4328 oz silver and 8788 lbs lead (A. Wilson, USGS, unpub. calculations, 12/1/99).

Information Sources:
Fridrich and others, 1998, USGS I-2565
Garrett, 1950, CSM M.S. Thesis
Harder, 1908, USGS Bull.380E
Harrer and Tesch, 1959, USBM IC-7918
Prather, 1961, CU M.S. Thesis
Slebir, 1957, CSM M.S. Thesis
Vanderwilt, 1947, Min. Res. of Colo.

Forest Hill

Size: 1.2 mi^2, 3.1 km^2

Mining Districts: Part of Taylor Park

County: Gunnison

Quadrangles: Italian Creek

Major deposits: Forest Hill, Paymaster

Deposit types: Polymetallic replacement and polymetallic veins

Geology: At 1:250,000 this area appears to be Oligocene inter-ash flow andesitic lavas and breccias (Taf) adjacent to 1,700 Ma granitic rocks (Xg). More detailed mapping at 1:50,000 (Fridrich and others, 1998) shows the Paymaster at the fault contact of the middle rhyolite subunit of the Oligocene Grizzly Peak Tuff with Early Proterozoic Granite of Henry Mountain and metasedimentary gneiss. The Granite of Henry Mountain and the rhyolite are both iron-stained and cut by quartz-pyrite veinlets. A small Eocene felsic dike is present in the granite between the two mines (Fridrich and others, 1998).

Boundary: Includes immediate area of the Forest Hill and Paymaster mines near the contact of the volcanic rocks with Proterozoic rocks south of the Grizzly Peak caldera.

Mining Activity:
Forest Hill mine is in a tiny part of the historic, but ill defined, Taylor Park district (Vanderwilt, 1947, p. 107). From 1932 to 1945 as many as 3 lode mines were operating in the Taylor Park district. It is assumed that the Forest Hill and Paymaster were two of these, and were the principle mines contributing to the 101 oz of gold, 21,890 oz silver, 5500 lbs. copper, 607,600 lbs lead, 139,400 lbs zinc produced from the district (Vanderwilt, 1947, p. 108). However, production from 1938 to 1941 for the Tincup district was combined with that of Taylor Park and could account for as much as 82 oz of gold, 7,164 oz silver, 3000 lbs. copper, 152,700 lbs lead, 115,000 lbs zinc included in the former figures, thus significantly reducing the importance of mineralization in the Forest Hill MA. (Only 19 oz Au, 14,726 oz Ag, 2500 lbs Cu, 454,900 lbs lead, and 24,400 lbs zinc is directly attributable to Taylor Park during this time frame).

Information Sources:
Fridrich and others, 1998, USGS I-2565
Vanderwilt, 1947, Min. Res. of Colo.

Spring Creek

Size: 5 mi^2, 13 km^2

Mining Districts: Spring Creek

County: Gunnison

Quadrangles: Matchless Mountain

Major deposits: Doctor, Barium Maggie

Deposit types: Polymetallic replacement, Replacement Mn

Geology: Paleozoic sedimentary rocks [including Mississippian Devonian Ordovician and Cambrian rocks, undifferentiated (Mer) and Minturn and Belden Frms (hmb)] to the north form a narrow south-trending "peninsula" in the mineralized area adjacent to 1,700 Ma granitic rocks (Xg) on the east and west. North-trending faults are mapped in the narrows. Oligocene intrusive rocks are exposed to the northeast and may also be buried in the vicinity of the mine workings.

Boundary: Includes mines and occurrences of polymetallic replacement deposits in Paleozoic rocks bounded by Proterozoic rocks near exposed Oligocene (26-38 Ma) intrusive rocks (Tmi) or a buried intrusion.

Mining Activity:
The only significant mine in the district is the Doctor mine. Zinc carbonate was mined "several hundred feet" from narrow replacement bodies in altered Leadville dolomite. "Development [...]

reached a depth of about 200 feet and insufficient work has been done to determine whether the oxidized ore represents the roots of an eroded ore body or whether the lead and zinc carbonate are the oxidized parts of a sulfide ore body as yet undiscovered at depth" (Vanderwilt, 1947, p. 106-107). There are no sulfides.

The Doctor mine produced and unknown amount of "silver-bearing lead carbonate in 1880 and 1890 and at least 17,000 tons zinc carbonate in 1917 and 1918" (Vanderwilt, 1947, p. 106). "The last recorded production was 641 tons of sorted zinc carbonate from the dump in 1937 and 1938 that yielded 203,000 pounds of zinc and 25,900 pounds of lead" (Vanderwilt, 1947, p. 107).

Meissner (1954, p. 109) notes that there is zinc, lead, and copper mineralization in the area. No silver, gold, or manganese, all reported by Vanderwilt, were noted in the mines and prospects that he investigated and there is no evidence of mineralization in either the Beason or Boston mines (Meissner, 1954, p. 110-111).

Information Sources:
Meissner, 1954, CSM M.S. Thesis
Vanderwilt, 1947, Min. Res. of Colo.

Tincup-Cumberland Pass

Size: 24.75 mi^2, 64.1 km^2

Mining Districts: Tincup, Quartz Creek

County: Gunnison

Quadrangles: Tincup, Cumberland Pass, Fairview Peak

Major deposits: Copper King, Gold Cup Republic, Hubnerite, Ida May, Bon Ton, Red Jacket, Fairview, Cleopatra, Swiss Bell, Silent Friend, Terrible, Silver Basin shaft

Deposit types: Polymetallic vein and replacement, Iron skarn, Climax Mo(?)

Geology: 1,700 Ma granitic rocks (Xg) are overlain by Paleozoic sedimentary rocks [Mississippian Devonian Ordovician and Cambrian rocks (Mer); Minturn and Belden Formations (hmb)]. Oligocene (26-38 Ma) intrusive rocks(Tmi) are exposed throughout the area which is on the west margin of the Mount Aetna volcanic area at the southern end of the Mount Princeton batholith (Toulmin and Hammarstrom, 1990). Locally there are Quaternary sediments (Ql, Qd, Qg). Geologically, this area is similar to the Dorchester area.

Boundary: Includes mines in Paleozoic rocks on the northeast flank of a Tertiary intrusion and some mines in the adjacent Proterozoic rocks. Bounded on the northeast by Precambrian granitic rocks.

Mining Activity:
Tincup mineralized area includes most of the historic Tincup and Quartz Creek mining districts on the north and south flanks of Cumberland Pass. Much of the area contains polymetallic replacement deposits in the Paleozoic carbonates. The southern part of the mineralized area, including the area around Cumberland Pass, contains most of the historic Quartz Creek mining district. Tungsten-molybdenum veins in the Cumberland Pass area were explored in the 1970's (MRDS). The southwestern-most part of the area is similar to the Gold Brick area: there are base- and precious-metals in quartz veins in Precambrian rocks. Unusual graphite deposits occur at the southeastern edge of the area. "It seems to be the opinion of most of the prospectors at Pitkin that ore will always be found at the contact of the dolomite and the "Fairview" shale (Hill, 1909, p. 36).

Total production credited to the historic Tincup mining district from 1901 to 1935 was 298 oz gold, 26,446 oz silver, 177 lbs. copper, and 153,820 lbs of lead (Vanderwilt, 1947, p. 109). Half of the tonnage came from one mine, and the remainder from seven mines. In 1932 and 1933 the district produced a "small amount" of ore. Production from 1938 to 1941, and possibly 1934-1937, was combined with Taylor Park and could account for as much as 82 oz of gold, 7,164 oz silver, 3000 lbs. copper, 152,700 lbs lead, 115,000 lbs zinc (Vanderwilt, 1947, p. 108) included in the figures credited to Taylor Park. From 1934-1943, as many as 3 lode mines in the historic Quartz Creek district produced 186 oz gold, 3,781 oz silver, 150 pounds copper, and 13,560 lbs. lead (Vanderwilt, 1947, p. 104).

Information Sources:
Belser, 1956, USBM IC-7748
Colo. Metal Mining Fund Board, 1960, Tungsten Mines of Colo.
Dings and Robinson, 1957, USGS PP 289
Emmons and others, 1894, USGS Folio 9
Goddard, 1936, Colo. Sci. Soc. Proc. v. 13, no. 10
Harder, 1909, USGS Bull.380E
Harrer and Tesch, 1959, USBM IC-7918
Hill, 1909, in Hayes and others, USGS Bull. 380A
King, 1970, USGS MR-55
Koksoy, 1961, CSM M..S. Thesis
Lemmon, D.M., and Tweto, O.L., 1962, Tungsten in the U.S., USGS MR-25
Parker, 1961, CSM PhD dissertation
Rosenlund, 1984, CSU M.S. Thesis
Toulmin and Hammarstrom, 1990, USGS Bull. 1864
Trammell, 1961, CU M.S. Thesis
Tweto, 1943, USGS Strategic Min. Invest. Open File Report
Vanderwilt, 1947, Min. Res. of Colo.
Voegeli and King, 1969, USGS WSP-1535-N
Worcester, 1919, CGS Bull. 14

Gold Brick

Size: 5.3 mi^2, 13.7 km^2

Mining Districts: northernmost of 3 areas labeled "Gold Brick" (of Plumlee and others, 1995)

County: Gunnison

Quadrangles: Fairview Peak, Pitkin

Major deposits: Carter, Raymond, Sandy Hook, Chronicle, Gold Links, Grand Prize

Deposit types: Polymetallic vein

Geology: Almost entirely 1,700 Ma granitic rocks (Xg) and interlayered felsic and hornblende gneiss (Xfh).

Boundary: Almost entirely within Precambrian host rocks, minor exposure of Paleozoic sedimentary rocks (Mer) along the northeastern boundary. Includes all mines in the Precambrian rocks in the immediate vicinity. (Not likely to host replacement deposits. Assignment of replacement to this district was probably a remnant of old mining district boundaries.)

Mining Activity:
Principal ore is gold-silver-lead in veins in Precambrian granite and gneiss. In the 4 mi X 1mi productive zone, numerous mines have produced chiefly gold with some silver, lead, and copper. The ore is low tonnage, but high grade and, except for the Carter which goes to about 1,500 ft, within a few hundred feet of the surface. "Nearby sedimentary formations [..] have not been productive." (Vanderwilt, 1947, p. 103)

From 1932-1942, between 3 and 13 lode mines produced 69,566 tons ore which yielded 16,395 oz gold, 45,657 oz silver, 2350 lbs copper, and 218,990 lbs lead. (Vanderwilt, 1947, p. 103).

Information Sources:
Crawford and Worcester, 1916, Colo. Geol. Sur. Bull. 10
Hill, 1909, in Hayes and others, USGS Bull.380A
Parker, 1961, Colo. Sch. Mines PhD. Thesis
Rugg, 1956, Colo. Sch. Mines M.S. Thesis
Trammell, 1961, CU M.S. Thesis
Vanderwilt, 1947, Min. Res. of Colo.,

Quartz Creek Pegmatite–(formerly SOUTH Gold Brick)

Size: 7.6 mi^2, 19.7 km^2

Mining Districts: southernmost of the "Gold Brick" areas (of Plumlee and others, 1995)

County: Gunnison

Quadrangles: Parlin, Pitkin

Major deposits: Brown Derby, Bucky, White Spar, Beryl, Black Wonder, Buckhorn

Deposit types: Pegmatite

Geology: Interlayered Precambrian felsic and hornblendic gneiss (Xfh).

Boundary: Drawn to include all pegmatite deposits in this area. Technically, this is not a metallic mineralized area. It is included here because of the density of known mines and prospects and to distinguish these from metallic deposits in close proximity.

Mining Activity:
Lithium pegmatites are numerous in the Quartz Creek district. These pegmatites commonly contain lepidolite, spodumene, amblygonite, zinwaldite, cleavelandite, quartz, topaz, lithia tourmaline, beryl, and microlite. In 1942-44, the district produced at least 250 tons of lepidolite.

Information Sources:
Crawford and Worcester, 1916, Colo. Geol. Sur. Bull. 10
Hanley, 1947, in Vanderwilt, Colo. Bur. Mines Ann. Report 1956, P. 466-470.
Hill, 1909, in Hayes and others, USGS Bull.380A
Parker, 1961, Colo. Sch. Mines M.S. Thesis
Rugg, 1956, Colo. Sch. Mines M.S. Thesis
Trammell, 1961, CU M.S. Thesis

Box Canyon

Size: 2.2 mi^2, 5.8 km^2

Mining Districts: Box Canyon

County: Gunnison

Quadrangles: Pitkin, Whitepine

Major deposits: Independence, Campbird

Deposit types: Low-sulfide gold

Geology: Granitic rocks (Precambrian X- 1 700 Ma. Age Group) (Xg); biotitic gneisses and migmatite (Precambrian X) (Xb); minor Mississippian Devonian Ordovician and Cambrian rocks (Mer); Upper Cretaceous Mancos Shale (Km) unconformably overlies the older units.

Boundary: Almost entirely within Precambrian host rocks, with only minor exposures of Paleozoic and Mesozoic rocks. Appears to be fault controlled along NE-trend. Drawn to include mines and prospects in the Precambrian rocks in the immediate vicinity.

Mining Activity:
Independence and Camp Bird (not to be confused with the one in the San Juan Mountains!) are the principal mines. As of 1909, the Independence had been abandoned for several years as the deposit was entirely exhausted. (Hill, 1909, p. 38). "The ore body was a lens of mica schist seamed and veined with quartz containing free gold (Hill, 1909, p. 38)." "Production has been from free-milling small quartz lenses in schist. The Roosevelt tunnel, driven as a 2 1/2 mi crosscut, never intersected ore veins. "Considerable production is claimed for the early years." In 1932, 1938, and 1939, 573 tons of ore yielded 69 oz of gold, and 10 oz silver (Vanderwilt, 1947, p. 98)

Information Sources:
Hill, 1909, in Hayes and others, USGS Bull. 380A
Vanderwilt, 1947, Min. Res. of Colo.

Whitepine

Size: 11.5 mi^2, 29.8 km^2

Mining Districts: Tomichi

County: Gunnison

Quadrangles: Whitepine, Garfield

Major deposits: Akron, Spar Copper, Parole, Morning Star, Erie, Eureka-Nest Egg, Maid of Erin-Silver Pick, Mazeppa, May, North Star, Tenderfoot, Victor, West Point, Congress,

Deposit types: Polymetallic vein and replacement, Iron skarn

Geology: In the Whitepine area, Paleozoic sedimentary strata (Mer and hmb) overlie 1,700 Ma granitic rocks (Xg). Both units are intruded by a 26-38 Ma intrusive stock. Tertiary extrusive rocks (Taf, Tpl) are present along the northeast margin of both the intrusion and the mineralized area. Locally, there is minor glacial drift of Pinedale and Bull Lake age (Qd).

Boundary: Includes all mines in or adjacent to the pluton. None of the mines is in the Precambrian rocks.

Mining Activity:
Initially oxidized silver and lead ore were the primary commodities. Later, primary lead and zinc were the valuable ores. Some gold, silver and copper were recovered, as was a small amount of iron ore from a magnetite deposit. Most of the ore is classified as: 1), replacement ores in limestone and dolomite; 2, contact deposits (skarn) and 3, fissure veins. Of the mines in the area, the Akron was the most productive. Between 1901 and 1950 it produced almost 100,000 tons or ore containing 724 oz gold, 474,160 oz silver, 232,783 pounds copper, 20,751,676 pounds lead, and 25,629,942 pounds of zinc (Dings and Robinson, 1957).

Information Sources:
Bush, 1951, Colo. Sci. Soc. Proc. v. 15, no. 8
Crawford and Worcester, 1916, Colo. Geol. Sur. Bull. 10
Dings and Robinson, 1957, USGS PP 289
Hill, 1909, in Hayes and others, USGS Bull. 380A
Harder, 1908, USGS Bull.380E
Harrer and Tesch, 1959, USBM IC-7918
Leith, 1906, USGS Bull. 285
Robinson, 1955, CU PhD Thesis
Vanderwilt, 1947, Min. Res. of Colo.
Voegeli and King, 1969, USGS WSP-1535-N

Marshall Pass

Size: 15.4 mi^2, 39.8 km^2

Mining Districts: Marshall Pass

County: Gunnison, Saguache

Quadrangles: Pahlone Peak

Major deposits: Little Indian No. 36, Pitch, Lookout No. 22

Deposit types: Stratabound and vein uranium

Geology: Mississippian Devonian Ordovician and Cambrian rocks (Mer); Minturn and Belden Formations (hmb); and Precambrian interlayered felsic and hornblendic gneiss (Xfh). Major north-northwest trending regional Precambrian faults reactivated in the late Paleozoic and in the late Cretaceous to early Tertiary.

Boundary: Includes the stratabound and vein uranium mines and occurrences in Harding Quartzite and veins in any rock occurring in the vicinity of the Chester fault zone. Bounded in the south by Tertiary volcanic cover.

Mining Activity:
The major mines in the area produced nearly 1.3 million lbs. of uranium oxide from approximately 113,000 short tons of ore between 1956 and 1963 (Nelson-Moore and others, 1978; Nash, 1988). Numerous small mines were superseded by a large open pit at the Pitch mine in the 1980's where a reserve of 2.1 millions tons of ore containing 7.14 million lbs. of 0.17% uranium oxide was reported (Nash, 1979, 1988; Ward, 1978).

Information Sources:
Nash, 1979, USGS OFR 79-1566
Nash, 1988, USGS Bull. 1797
Nelson-Moore and others, 1978, CGS Bull. 40
Olson, 1977, USGS OFR 77-325
Olson, 1988, USGS PP 1457
Ranspot, 1958, CU M.S. Thesis
Ward, 1978, AIME abstr.
Wright and Everhart, 1960, in Del Rio

Cochetopa North (probably includes northern part of old Cochetopa Creek district)

Size: 17.25 mi^2, 44.7 km^2

Mining Districts: northern of two Cochetopas and part of NE-most Gunnison Gold Belt (contains Cochetopa [synonyms Green Mountain, Gold Basin] of Vanderwilt, 1947, p. 100-101)

County: Gunnison, (Saguache)

Quadrangles: Iris

Major deposits: Lucky Strike, Maple Leaf, Lubricator, Lula, Mineral Hill, Hathaway, Black Cat

Deposit types: low sulfide gold

Geology: Xfh, Tial, Jmj. Also Taf, Xb, Xg.

Boundary: Includes low sulfide gold deposits.

Mining Activity:
The rocks are entirely red and gray granite and gneiss. Ferromagnesian minerals are in segregations that appear dike-like. The granite is coarse textured to pegmatitic.

The Lucky Strike (at the west end) is about 200 ft. deep and 600 ft long. The ore vein is about 2 - 4 ft wide in massive iron-stained to white quartz containing tourmaline. Reportedly, the ore contains 1 to 2 oz per ton (Hill, 1909), but of what metal isn't stated. A small amount of copper and possibly tellurium is in the waste pulp.

The Maple Leaf mine (at the east end) is a free-milling massive quartz containing both gold and silver in E-W striking veins in coarse diorite (Hill, 1909). It closed in 1908.

"The veins [in Cochetopa Creek district] relatively small and contain primarily gold. A small production is reported (Vanderwilt, 1947, p. 193)."

Information Sources:
Hill, 1909, in Hayes and others, USGS Bull. 380A, p. 37-38
Vanderwilt, 1947, Min. Res. of Colo., p. 100-101, 193 [Saguache Co])

Green Mountain (probably includes southern part of old Cochetopa Creek district)

Size: 2.4 mi^2, 6.3 km^2

Mining Districts: connects NE-most Gunnison Gold Belt and southern Cochetopa

County: Saguache

Quadrangles: Iris, Houston Gulch

Major deposits: Alaska, Yukon, Denver City

Deposit types: Kuroko Massive Sulfide

Geology: Jmj, Tial, Xfh, Xb

Boundary: Drawn to include a thin band of greenschist that host VMS deposits overlapping a broader region hosting low-sulfide gold.

Mining Activity:
"The veins [in Cochetopa Creek district] relatively small and contain primarily gold. A small production is reported (Vanderwilt, 1947, p. 193)."

This mineralized area is outlined to include two mines, Denver City on the west end, and Alaska and Yukon on the east end that are Kuroko massive sulfide deposits, surrounded by low sulfide gold deposits in the Cochetopa north and central areas.

Information Sources:
Afifi, 1981, *in* Epis and Callender, NMGS 32nd Ann. Field Conf., Guidebook 32, p. 287-292.
Olson, 1976, USGS GQ-1287
Vanderwilt, 1947, Min. Res. of Colo., p. 193

Cochetopa Central (all mines classified in MRDS as Cochetopa Creek district–see Cochetopa South, below)

Size: 8.2 mi^2, 21.3 km^2

Mining Districts: Southern Cochetopa

County: Saguache

Quadrangles: Iris, Houston Gulch, Sawtooth Mountain, Razor Creek Dome

Major deposits: Los Ochos (Thornburgh)

Deposit types: Vein uranium and minor stratabound uranium.

Geology: Deeply eroded Proterozoic basement complex of low grade metamorphosed granites (Xg), biotite gneisses (Xb), and migmatites (Xm), and mafic intrusive rock; unconformably overlain by generally flat-lying sequence of Jurassic and Cretaceous sedimentary rocks (KJdj, Km), which is unconformably overlain by Oligocene volcanic rocks. Major faulting trends east-west and is steeply dipping, showing major movement during Laramide time.

Boundary: Drawn to include mines and occurrences with vein or stratabound uranium mineralization occurring in Precambrian or Mesozoic rocks in the vicinity of the Los Ochos Fault and related faults.

Mining Activity:
District formerly mined for gold (see Cochetopa South). Mined for uranium from 1955-1962 (USGS, 1999a,b). Veins of pyrite-marcasite-pitchblende occur along Los Ochos fault zone; however, most ore was produced from stratabound deposits in sandstones in the Jurassic Morrison Formation and some in Cretaceous Dakota Formation. Virtually all of the 1.35 million lbs. of uranium oxide produced form 1956 to 1963 came from the Los Ochos mine complex (Nelson-Moore and others, 1978).

Information Sources:
Malan and Ranspot, 1959, Econ. Geol. v. 54, no. 1, p. 1-19.
McCulla, 1980, Univ. Nevada M.S. Thesis, 128 p.
Nelson-Moore and others, 1978, Colo. Geol. Survey Bull. 40, p. 391-392
Olson and Steven, 1976, USGS MF-748
Olson, 1988, USGS PP 1457, p. 9

Cochetopa Tantalite

Size: .4 mi^2, 1.1 km^2

Mining Districts: none

County: Saguache

Quadrangles: Sawtooth Mountain

Major deposits: Cochetopa Prospect, Tantalite Prospect (NO production)

Deposit types: Pegmatite

Geology: Xg

Boundary: Drawn to include pegmatite deposits in Precambrian granite.

Mining Activity:
Insignificant area. Prospected for pegmatite but never developed. No mine. No production.

Information Sources:
Lemmon and Tweto, 1962, USGS MR-25, P. 10
Olson and Steven, 1976, USGS MF-733.

Cochetopa South (all mines classified in MRDS as Cochetopa Creek district–see Cochetopa Central, above)

Size: 1.4 mi^2, 3.5 km^2

Mining Districts: none

County: Saguache

Quadrangles: Sawtooth Mountain

Major deposits: Dependable, Elisha, LaRue, Mercury, M and W

Deposit types: Vein Uranium
Geology: Xg, KJdj

Boundary: Drawn to include uranium deposits in Precambrian granite overlain by younger sedimentary rocks. (Similar to Cochetopa South)

Mining Activity:
District previously mined for gold and base metals from small gold-bearing veins in Precambrian rocks. Of the known mines, only the LaRue has recorded production. From 1954--60, it produced 7 tons ore yielding 28 lb U3O8 and 16 lb V2O5 (MRDS D009287).

Information Sources:
Malan and Ranspot, 1959, Econ. Geol. v. 54, no. 1, p. 1-19.
Nelson-Moore and others, 1978, Colo. Geol. Survey Bull. 40, p. 391-392
Olson and Steven, 1976, USGS MF-748
Olson, 1988, USGS PP 1457, p. 9
Vanderwilt, 1947, Min. Res. of Colo., p. 193

Wolf Creek (tiny "eye" within Powderhorn)

Size: .4 mi^2, 1 km^2

Mining Districts: Powderhorn

County: Gunnison

Quadrangles: Carpenter Ridge

Major deposits: Only 2 deposits: Keezer No. 2 prospect, Lilly Belle. An unnamed pegmatite, and an unnamed thorium prospect within the area are part of the Powderhorn area..

Deposit types: Low sulfide gold (Keezer, Lilly Belle?). Alkali intrusion related ? (Lilly Belle?)

Geology: Yam

Boundary: Drawn to tightly include low sulfide gold deposits in 1.4 Ga alkalic and mafic rocks (Yam) within a broader area with Thorium-REE veins.

Mining Activity:
Unproductive properties outlined because of possible Low sulfide gold within area of Th veins and carbonatite of Powderhorn district.

Information Sources:
Argall, 1943, Mines Mag. v. 33, no. 6, p. 313-314
Belser, 1956, USBM IC-7748
Hedlund and Olson, 1973, USGS GQ-1070
Olson and others, 1977, USGS Jour. Research, v. 5, no. 6, p. 673-687.
Sharps, 1965, Colo. Sch. Mines Min. Ind. Bull. v. 8, no. 5,, p. 7

Beaver Creek (an eastern extension of the Vulcan district)

Size: 1 mi^2, 2.5 km^2

Mining Districts: central of 3 Gunnison Gold Belts

County: Saguache

Quadrangles: Spring Hill Creek

Major deposits: Midland, Continental

Deposit types: Kuroko Massive Sulfide

Geology: Xfh, Taf

Boundary: Geologically, could be shown as an extension of the Vulcan district, below, but separated due to lack of evidence of mineralization between.

Mining Activity:
Formerly included in Vulcan district. Separated here, based on intervening host lithologies.
Entry in MRDS puts only these two mines in the Beaver Creek District.
Only reported production was gold-silver ore from Continental mine in 1932. 46 tons ore assaying 1.28 oz/t gold, 0.05 oz/ton silver. Or less than 60 oz gold, 2.3 oz silver.

Information Sources:
Olson and others, 1975, USGS MF-713

Goose Creek

Size: 1.7 mi^2, 4.4 km^2

Mining Districts: Within Powderhorn area (Madera district is synonym)

County: Gunnison

Quadrangles: Gateview

Major deposits: Adair, White Iron, (Dubois is a Th-REE vein)

Deposit types: Low sulfide gold

Geology: Xfh, Taf

Boundary: Drawn to include low-sulfide gold deposits within broader area of Th-REE veins. Geologically similar to Vulcan area in the same rock units to the east but that area hosts massive sulfide deposits.

Mining Activity:
Occasional small shipments of led-silver and gold-silver-copper ore are recorded from this area of Precambrian granite an schist overlain by some of the Potosi Volcanic series. Only production since 1931 (in 1939 and 1940) 30 tons of ore yielded 1 oz gold, 178 oz silver, 400 lbs copper, and 1,400 lbs. lead (Vanderwilt, 1947, p. 104).

Information Sources:
Boyles, 1947, Colo. Mining Assoc. 1947 Mining Yearbook, p. 119.
Hedlund and Olson, 1961, USGS PP 424-B. p. B283-B286.
Nelson-Moore and others, 1978, CGS Bull. 40, p. 176-177.
Olson and Hedlund, 1973, USGS GQ-1071
Olson and Hedlund, 1981, USGS PP 1049-C
Olson and Wallace, 1956, USGS Bull. 1027-O
Sheridan and others, 1981, in Epis and Callender, eds, NM Geol. 32nd Field Conf. Guidebook, p. 273-277.
Vanderwilt, 1947, Min. Res. of Colo., p. 104

Vulcan (extends toward Beaver Creek)

Size: 5 mi^2, 12.9 km^2

Mining Districts: part of W-most of Gunnison Gold Belt (Cebolla, synonyms Vulcan, Domingo, White Earth)

County: Gunnison

Quadrangles: Powderhorn

Major deposits: Vulcan, Anaconda, Champion, Copper King, Gunnison, Headlight, Iron Cap, Mammoth-Good Hope

Deposit types: Kuroko massive sulfide (Red Rock claim is Th-REE vein)

Geology: Greenstone belt included in Xfh, but locally differentiated on larger scale maps.

Boundary: Tightly drawn to follow the greenstone belt that hosts massive sulfide deposits.

Mining Activity:
Gold produced from a pyrite zone referred to as the vein along the schistosity. Much pyrite has little or no gold content. The gold may be later in age than the pyrite. Small shipments of lead, gold-silver, and copper-gold-silver ores are reported from other veins. Veins are in Precambrian schist and possibly also in Cretaceous sediments. Iron and manganese deposits have been described but there has been no recorded production. 75 tons ore mined in 1932, 1933, 1934, and 1941 yielded 55 oz gold, 208 oz silver, 100 lbs copper, and 100 lbs lead. (Vanderwilt, 1947, p. 100)

Lenses of pyrite rich rock in Precambrian meta-volcanic rocks. E-W alighnent of mines and prospects part of submarine volcanic stratigraphy. High Se and Te. Gossans identified in 1884, produced gold and silver from 1889-1904, some S and Se in 1917-1918 (J.T. Nash, USGS, unpub. data).

Information Sources:
Hartley, 1976, Vulcan, Stanford M.S.Thesis
Hartley, P.D., 1983, DREGS Field Trip Guidebook, p. 19-27.
Hedlund and Olson, 1975, Powderhorn Quad., USGS GQ-1178
Nelson and Riesmeyer, 1983, Anaconda-Gunnison mine area, in DREGS, p. 8-18.
Sheridan and others, 1981, Precambrian sulfides, in NMGS 32nd field conf., p. 273-277
Vanderwilt, 1947, Min. Res. of Colo., p. 98, 100.

Vulcan South (the “mole”)

Size: .1 mi^2, .26 km^2

Mining Districts: none

County: Gunnison

Quadrangles: Powderhorn

Major deposits: Old Lot

Deposit types: Kuroko Massive Sulfide

Geology: Almost entirely Xfh. Greenstone belt. Minor Tial, Yam.

Boundary: Tightly drawn to include only the outlying massive sulfide deposit in Xfh similar to Vulcan area–entirely within Powderhorn area. Intervening Precambrian granite precluded connecting the two areas.

Mining Activity:
Only recorded production in 1931 and 1934 was very negligible.
Related to greenstone belt mines.

Information Sources:
Hedlund and Olson, 1975, USGS GQ-1178
Hunter, 1925, USGS Bull. 777, 94 p. (p. 70-71)?

Powderhorn (the “head and face”)

Size: 88 mi^2, 228 km^2

Mining Districts: Powderhorn and part of Gunnison Gold Belt (Cebolla [synonyms Vulcan, Domingo, Powderhorn, White Earth, per Vanderwilt, 1947, p. 98, 100]).

County: Gunnison

Quadrangles: Powderhorn, Rudolf Hill, Gateview, Carpenter Ridge, Big Mesa(?)

Major deposits:
Th veins: Jeanie, Little Johnny, Lucretia, Mrs. Roberts, Red Rock, Whitney,
Carbonatite: Dupont tunnel, Iron Hill, Titan,

Deposit types: Th veins; Carbonatite

Geology: Yg, Xg, Cam, Taf, Xm, Jm, Ql, Xfh, Tpl, Yam, Km, Qa, Xb,Tbb

Boundary: Drawn broadly to include known Th-REE veins and carbonatite deposits in the region.

Mining Activity:

Information Sources:
Hedlund and Olson, 1961, USGS PP 424-B, p. B283-286
Olson and Hedlund, 1981, USGS PP 1049-C
Olson and Wallace, 1956, USGS Bull.1027-O
Vanderwilt, 1947, Min. Res. of Colo., p. 98, 100.

Bondholder

Size: 4.8 mi^2, 12.4 km^2

Mining Districts: Bondholder

County: Saguache

Quadrangles: Stewart Peak, San Luis Peak

Major deposits: Woodmansee, Allara, Cascade, Manganese, Jackass

Deposit types: Polymetallic vein

Geology: In the center of the San Luis caldera in Oligocene volcanic rocks including inter-ash flow quartz latitic and andesitic lavas and breccias (Tiql, Taf), Rat Creek Tuff (Tr), and quartz latite of Baldy Cinco (Tbd; probably equivalent to Tiql). There are several small heterogeneous hypabyssal intrusive rocks consisting of equigranular to coarsely porphyritic gabbro diorite granodiorite emplaced during the period of ash-flow eruptions (Tiy). Minor Quaternary glacial drift is locally exposed. Prior to Steven and Bieniewski (1977), no reports about the Bondholder area were available. Most of the previous work in the region has focused on the Creede district, on the same trend and several miles to the south.

Boundary: Includes all known polymetallic vein deposits in Tertiary volcanic rocks several miles north of Creede.

Mining Activity:
Earliest records of prospecting date to 1887 with the staking of three mining claims in the vicinity of the Cascade mine (Steven and Bieniewski, 1977). At the Cascade mine, three short tunnels follow irregular, curving, and branching mineralized fractures with only local concentrations or ore-grade material. There are numerous workings in the vicinity of the Woodmansee mine that have lead, zinc and silver values approaching ore-grade. In the 1960's the Allara tunnel was cut to intercept them at depth. None were of economically significant. Bieniewski (1977) attributes at most $100,000 from the entire Bondholder area in comparison with the approximately $81 million from Creede.

Information Sources:
Bieniewski, 1977, in Steven and Bieniewski, USGS Bull. 1420
Steven and Bieniewski, 1977, USGS Bull. 1420
Thompson, T.B., 1992, SEG newsletter

Carson

Size: 3.9 mi^2, 10.2 km^2

Mining Districts: Carson Camp

County: Hinsdale

Quadrangles: Lake San Cristobal, Finger Mesa

Major deposits: St. Jacobs, George III, Maid of Carson, Mayflower, Bonanza King

Deposit types: Polymetallic vein, (Bog Iron)

Geology: The Carson volcanic center is a 29 Ma monzonite to quartz monzonite plug (Bove, USGS, unpub. data, this assessment dataset) intruding intermediate lavas and breccias (Ten) and andesites and rhyolites of the Henson and Burns Formations (Theb). Locally there is Quaternary glacial drift, especially in Wager Gulch, and landslide material.

Boundary: Tightly drawn to include only the area immediately surrounding the deposits. Also known bog iron deposits in Wager Gulch. The area's more productive mines, the St. Jacob and George III are outside the GMUG Forests.

Mining Activity:
Mineralization extends south across the divide at the head of Wager Creek into the head of Lost Trail Creek (Vanderwilt, 1947, p. 114). The general geology and nature of the veins may be comparable to other mining districts in Hinsdale County (Vanderwilt, 1947, p. 114).

Discontinuous and irregular "gashes and fractures" in the Carson volcanic center contain ore minerals in altered porphyry. Ore containing silver and lead with copper and some gold in

barite gangue varies in these zones from a few inches to 18 inches wide. (Ore minerals were primarily enargite, chalcopyrite, and galena (Larsen, 1911, p. 36-37)). The ore was valued at as much as "$50 to $500 per ton" and early production claims about $200,000 (in then-day dollars, not adjusted) (Vanderwilt, 1947, p. 115).

The St. Jacob group of mines, was worked after 1889 and produced ore worth about $150,000. The ore contained enargite, pyrite, chalcopyrite, galena, sphalerite, and marcasite (Larsen, 1911, p. 36). George III produced about $50,000 in ore similar to the St. Jacob group. The ore zones are described as soft and full of gouge material (Larsen, 1911, p. 36). Irving and Bancroft (1911, p. 17) attribute only $5,439 to this mine and an additional $3,590 from the Mayflower, $3,290 from the Bonanza King, and $27,397 from the Maid of Carson.

Information Sources:
Burbank and Luedke, 1968, in Ridge, ed., Graton-Sales volume, p. 714-733.
Harrer and Tesch, 1959, USBM IC-7918, p. 44.
Hon and Lipman, 1989, in Chapin and Zidek, eds., NM Bureau of Mines and Mineral Resources Memoir 46, p. 350-380.
Irving and Bancroft, 1911, USGS Bull.478, p. 17.
Larsen, 1911, in Hayes and Lindgren, USGS Bull.470, p. 30-38.
Vanderwilt, 1947, Min. Res. of Colo., p. 114-115.

General Refs:
Hon and Mehnert, 1983, USGS OFR 83-668
Larsen and Cross, 1956, USGS PP 258
Lipman and others, 1973, USGS Jour. Research v. 1, no. 6, p. 627-642
Lipman, 1976, USGS I-962
Lipman and others, 1976, Econ. Geology, v. 71, no 3, p. 571-588
Steven and Lipman, 1976, USGS PP 958

Red Mountain (east)

Size: 1.4 mi^2, 3.5 km^2

Mining Districts: Red Mountain

County: Hinsdale

Quadrangles: Lake San Cristobal

Major deposits: Red Mountain Alunite exploration prospect.

Deposit types: Mo-Cu porphyry

Geology: A 22.9 Ma (Miocene) volcanic neck of altered dacite porphyry (shown as quartz latite, Tsi, on Day and others, 1999) associated with the Lake City caldera..

Boundary: Includes the entire altered dome complex at Red Mountain, immediately southwest of Lake City (not to be confused with the other Red Mountain near Red Mountain Pass, north of Silverton, south of Ouray).

Mining Activity:

In the 1970's to 1980's, the area around Red Mountain was explored for alunite. No development has taken place.

Information Sources:

Bove and others, 1999, USGS OFR 99-347.
Bove and others, 1990, USGS OFR-90-235, 30 p.
Bove and Hon, 1992, USGS I-2286
Engineering and Mining Journal, Intern. dir. 1983, v. 9, no. 10, p. 3
Hall, 1978, USGS PP 1076-A
Hall, 1970, in Schowchow, S.D., ed., CGS Resource Series 8, p. 77-88
Hon and Lipman, 1989, in Chapin and Zidek, eds., NM Bureau of Mines and Mineral Resources Memoir 46, p. 350-380.
Larsen, 1913, USGS Bull. 530D
Lipman, 1976, USGS I-962
Lipman and others, 1976, Econ. Geol. v. 71, p. 571-588
Mehnert, 1979, USGS OFR 79-1642
Sanford and others, 1987, USGS Bull. 1715B, 35 p.
Slack, 1980, Econ. Geol. v. 75, no. 7, p. 963-991
Steven and others, 1974, USGS I-764

Lake City

Size: 9.8 mi^2, 25.3 km^2

Mining Districts: Lake Fork (synonym: Lake San Cristobal)

County: Hinsdale

Quadrangles: Lake City, Lake San Cristobal

Major deposits: Golden Fleece, Fanny Fern, Monte Queen, Pelican, Black Crook, Contention, Gladiator, Missouri Favorite, Gold Quartz, Belle of the East, Belle of the West

Deposit types: Polymetallic vein deposits (23 Ma barite/precious metal in veins).

Geology: Almost entirely within caldera fill of the Uncompahgre caldera on the northeast margin of the Lake City caldera. Exposed rock units include Oligocene inter-ash flow quartz latitic and andesitic lavas and breccias(Tiql, Taf, Tial) and local flows (Tq), Bachelor Mountain and Carpenter Ridge tuffs (Tbc), 27.8 Ma Fish Canyon tuff and Outlet Tunnel member of La

Garita tuff (Tfg), Henson and Burns Formations (Theb), and Sapinero Mesa, Eureka, and Dillion Mesa tuffs (Tsd). 22.5 Ma (Miocene) silicic lavas associated with the Lake City caldera (Tsl) and Miocene and Pliocene bimodal rhyolitic rocks (Tbr) are also exposed.

Boundary: Includes the 23 Ma barite/precious metal veins on the east margin of the Lake City caldera.

Mining Activity: After the initial flurry of activity in the late 1800's, most of these mines have been abandoned or worked only intermittently.

Golden Fleece mine (originally the Hotchkiss), discovered in 1874, produced high grade gold telluride ore. As of 1926 it was credited with total production of $1.4 million (Henderson, 1926, p. 51; Irving and Bancroft, 1911, p. 14).

Pelican mine produced silver ore intermittently from 1891 to 1960, including 1907-1910, 1912-1913, 1916-1917, and 1919-1922. In its first two years, the mine produced just over $2000 in silver (Irving and Bancroft, 1911, p. 97). In 1959, 1,100 tons ore yielded 6067 oz Ag, 23 oz Au; in 1960, 1,500 tons yielded 6867 oz Ag, 25 oz Au (USGS, 1999a, MRDS). The ore minerals apparently were freibergite (argentiferous tetrahedrite), pyrargyrite, and galena (Irving and Bancroft, 1911, p. 97).

Fanny Fern produced silver primarily from tetrahedrite (Brown, 1926, p. 14). In 1920-1923 and 1931, the mine produced at least 1,250 tons of ore yielding about 74,000 oz of silver and 65 oz of gold (computed by A. Wilson from USGS, 1999a, MRDS).

No production records exist for the period before 1917 for the Monte Queen. It produced an unrecorded amount in 1917, and 6150 tons of ore in 1966-1968 and 1974. In 1966 the 1000 tons yielded 23 oz silver, .03 oz Au, and 261 lbs copper.

Black Crook mine operated intermittently for 12 years until 1903. In 1884 it produced 1,277 tons of ore valued at $124,447 (Irving and Bancroft, 1911, p. 116). Production was also reported for 1913, 1919-1921, 1927, 1949, 1950, and 1953. Of these, the only known quantities are one ton of ore in 1953 and 25 tons in 1927 that contained 7 oz Au, 268 oz silver, 10,200 lbs Pb, and 12,425 lbs Zn (USGS, 1999a, MRDS).

From 1889 to 1892, the Contention mine yielded 8,701 oz silver and 112 oz gold. No other records are available.

Much smaller mines:

Between 1945-1948, the Gold Quartz mine produced 28 tons of ore containing 930 ounces of silver, about 6 oz of gold, 9000 pounds copper, and 164 lbs lead (computed from USGS, 1999a, MRDS).

Prior to 1911 the Missouri Favorite produced 18 tons of hand picked ore (Irving and Bancroft, 1911, p. 98).

Known production for the Belle of the East and Belle of the West amounts to 182 tons yielding about 19,400 oz silver.

In 1938 the Gladiator mine produced 588 oz silver, 2 oz gold, 650 lbs copper, and 4000 pounds lead from 100 tons of ore. Additional ore was produced in 1916 (788 tons), 1919, 1921, and 1937, but no other records are available. Bove (1987) cites a letter from 1901 by mine superintendent Thomas A. Dall that the “mine was patented in 1881 and was active, probably as

an exploratory venture, between 1897 and 1901." Between 1980 and 1982 the Colorado Gold and Silver Company worked the property, but no production was recorded (Bove, 1987).

Information Sources:
Bove, 1987, USGS OFR 87-480
Bove and others, 1999, USGS OFR 99-347
Brown, 1926, Colo. School of Mines Magazine, v. 15, no. 11, p. 5-15.
Burbank and Luedke, 1968, in Ridge, ed., Graton-Sales volume, p. 714-733.
Henderson, 1926, USGS PP 138, p. 50-51.
Hon and Lipman, 1989, in Chapin and Zidek, eds., NM Bureau of Mines and Mineral Resources Memoir 46, p. 350-380.
Hon and others , 1985, Econ. Geology, v. 80, p. 410-417
Irving and Bancroft, 1911, USGS Bull. 478
Kirk and others, 1983, USGS OFR 83-704.
Larsen, 1913, USGS Bull. 530D
Lipman, 1976, USGS I-962
Lipman and others, 1976, Econ. Geol. v. 71, p. 571-588
Sanford and others, 1987, USGS Bull. 1715B, 35 p.
Sanford and others, 1991, USGS MF 2152
Slack, 1976, Stanford PhD dissertation, 327 p.
Slack, 1980, Econ. Geol. v. 75, no. 7, p. 963-991
Steven and Lipman, 1976, USGS PP 958, 35 p.
Steven and others, 1977, USGS Bull.1391-E, p. 82
Vanderwilt, 1947, Min. Res. of Colo., p. 118, 439-443.

Golden Wonder

Size: .03 mi^2, .09 km^2

Mining Districts: within Lake City (or Lake Fork)

County: Hinsdale

Quadrangles: Lake City

Major deposits: Golden Wonder

Deposit types: Hot spring

Geology: Unlike any deposit in the area in an intrusive volcanic breccia pipe (Slack, 1980). Geology mapped (Day and others, 1999) as Oligocene inter-ash flow quartz latitic lavas and breccias (Tiql).

Boundary: Includes only the immediate vicinity of the Golden Wonder mine.

Mining Activity:
The Golden Wonder mine was recognized as unique by Irving and Bancroft (1911, p. 101), but classified by them as a "true replacement deposit." Billings (1983) and Billings and Kalliokoski (1982) classify the deposit as a hot springs-type gold-telluride deposit. The ore occurs within a rhyolite flow-dome complex that was emplaced along the ring fracture of the Uncompahgre caldera (Billings, 1983). Productive portions of the vein were emplaced in a zone of closely spaced en echelon fractures. There are two ore assemblages: gold-bearing chert (chert-type) and pyrite-marcasite-sulfosalt (sulfide-type). The chert-type occurs in pods bounded by the fracture surfaces in areas where hydrothermal waters could pond. The sulfide-type is found along the vein structure between the high grade chert-type pods where the vein structure was more constricted (Billings, 1983). Two types of hydrothermal breccias are also present: the silicified dikes with fragments of sulfide and chert veins locally contain gold, the argillically altered dikes do not (Billings, 1983).

Recorded production includes 2 carloads in 1906, unrecorded amounts in 1913 and 1935-1937, 63 tons in 1939 (63 oz silver, 46 oz gold), 700 tons in 1961 (205 oz silver, 81 oz gold), and 45 tons in 1981.

Information Sources:
Billings, 1983, USGS OFR 83-907
Billings and Kalliokoski, 1982, GSA Abs w/ programs, v. 14, no. 7, p. 524.
Irving and Bancroft, 1911, USGS Bull. 478, p. 101-102
Kalliokoski and Rehn, 1987, USGS OFR 87-344, 46 p.
Lipman, 1976, USGS I-962
Lipman and others, 1976, Econ. Geol. v. 71, p. 571-588
Slack, 1980, Econ. Geol. v. 75, no. 7. p. 963-991.

Henson Creek

Size: 14.4 mi^2, 37.25 km^2

Mining Districts: eastern Galena

County: Hinsdale

Quadrangles: Lake City, Uncompahgre Peak, Redcloud Peak

Major deposits: Ute, Ulay also: Hidden Treasure, Ocean Wave (Vermont), Yellow Medicine, Czar, Capitol City, Big Casino, Pride of America.

Deposit types: Polymetallic vein

Geology: Henson Creek is north of, and parallel to, the north margin of the Lake City Caldera. Almost the entire Henson Creek area is underlain by Tertiary volcanic rocks of the

Uncompahgre caldera complex. At the western end, near Capitol City, 26 Ma quartz monzonite to monzonite stocks, plugs, plutons are exposed.

Boundary: Includes the known mineralized area along Henson Creek on the north margin of the Lake City caldera.

Mining Activity:

Ores in this area tend to have be the result of secondary enrichment and oxidation. Originally the ores were concentrated in the upper parts of the mines, but by 1903 the rich deposits were depleted and the region began its decline.

Ore ranges from mediocre to extremely rich and is primarily composed of argentiferous galena, argentiferous tetrahedrite (freibergite), native silver, chalcopyrite, and sphalerite.

Silver-lead ore was discovered in the Ute and Ulay veins in 1871 (Vanderwilt, 1947, p. 439) and production began in 1874. Together, the veins of the Ute-Ulay mine are among the largest producers of silver and lead in Colorado with about $12 million (gross) as of 1911 (Irving and Bancroft, 1911, p. 14, 89). Production continued intermittently from 1918 to 1967 and some cleanup work was done in 1980 (USGS, 1999a, MRDS). The adjacent Hidden Treasure has produced ore worth at least another $700,000 (Irving and Bancroft, 1911, p. 89).

The Ocean Wave group was discovered in 1876 and is known to have shipped ore in 1884, 1887-88, and 1892-96 claiming a total production of more than $115,000 (Irving and Bancroft, 1911, p. 86). The mine ceased production in 1916 (USGS, 1999a, MRDS).

Yellow Medicine mine produced $40,000 worth of ore (about 7/8 value from silver, 1/8 from copper) prior to 1896. It is credited with 500 tons of ore in 1898 and 174 tons of silver ore in 1948 and 1949 and unspecified amounts in 1906, 1907, 1910, and 1950-1952. No grades or other values are available.

The Czar shipped ore for several years beginning in 1899 (Irving and Bancroft, 1911, p. 14). It apparently shipped 3 carloads prior to 1904 and another in 1904 that contained 42% lead. The cost to separate the lead and zinc made these shipments unprofitable (Irving and Bancroft, 1911, p. 76). The property was revived briefly in the 1950's and produced 22 tons of ore containing 212 oz silver, 9300 lbs lead, and 4000 lbs zinc (USGS, 1999a, MRDS).

Capitol City was discovered in 1882 and last produced ore in 1954.

The Big Casino mine was discovered in 1876. Although its owners claimed assays ran as high as 200-412 oz silver per ton of ore (Irving and Bancroft, 1911, p. 81), the values for 1927, 1928, and 1968 indicate that 100 tons of ore contained 3167 oz silver, less than 2 oz gold, 56,534 lbs lead, and 51,351 lbs zinc (USGS, 1999a, MRDS). No other production records are available. No production is recorded prior to 1967 for the Pride of America adjacent to the Big Casino. In 1967-68 and 1976-77, more than 1000 tons of ore (containing more than 13,000 oz silver, 182,000 lbs lead, and 247,000 lbs zinc) were produced. The ore in both mines was galena and freibergite.

Information Sources:
Bove and others, 1999, USGS OFR 99-347
Burbank and Luedke, 1968, in Ridge, ed., Graton-Sales volume, p. 714-733.
Cross and Larsen, 1935, USGS Bull. 843
Hon and Lipman, 1989, in Chapin and Zidek, eds., NM Bureau of Mines and Mineral Resources Memoir 46, p. 350-380.
Irving and Bancroft, 1911, USGS Bull. 478, p. 72-99.
Korzeb, 1986, USBM MLA 68-86, 105 p.
Lipman, 1976, USGS I-962
Lipman and others, 1976, Econ. Geol. v. 71, p. 571-588
Sanford and others, 1986, USGS OFR 86-629
Sanford and others, 1987, USGS Bull. 1715B, 35 p.
Sanford and others, 1991, USGS MF 2152
Slack, 1976, Stanford Univ., PhD dissertation, 327 p.
Slack, 1980, Econ. Geology, v. 75, no. 7, p. 963-991
Steven and Lipman, 1976, USGS PP 958, 35 p.
Vanderwilt, 1947, Min. Res. of Colo., p. 115, 439-443.

Uncompahgre Peak

Size: 2.8 mi^2, 7.2 km^2

Mining Districts: none

County: Hinsdale

Quadrangles: Wetterhorn Peak, Uncompahgre Peak

Major deposits: Beth, Eagle and Mary Alice

Deposit types: Vein U

Geology: Taf, Tial

Boundary: Tightly drawn on trend with regional structure to include two similar vein U occurrences in Oligocene volcanic rocks. 18-19 Ma bimodal rhyolite domes with associated minor alteration and uranium mineralization are exposed at either end of the mineralized area. The Iron Beds intrusion (Bove and others, 1999), a 26 Ma quartz monzonite to monzonite stock, is exposed near the center of the area, but is not associated with any mineralization.

Mining Activity:

The Beth group of unpatented claims, at the east end of the area, produced 18 tons of ore containing 68 lbs of U_3O_8 ore in 1958-1961 (USGS, 1999a, MRDS). The Eagle and Mary Alice claims, at the west end of the area, are inactive prospects that never produced. To the best of our

knowledge, there has been no mining activity or serious mineral exploration interest in the area for nearly 40 years.

Information Sources:
Bove and others, 1999, USGS OFR-99-347.
Fischer and others, 1968, USGS Bull.1261-C, p. 37
Lipman, 1976, USGS I-962
Lipman and others, 1976, Econ. Geol. v. 71, p. 571-588
Nelson-Moore and others, 1978, CGS Bull.40, p. 179
Steven and others, 1977, USGS Bull. 1391-E, p. 110-111
Slack, 1980, Econ. Geol. v. 75, no. 7, p. 963-991
Zielinski and others, 1977, American Mineralogist, v. 62, p. 426-437.

Cimmaron

Size: 5.5 mi^2, 14.3 km^2

Mining Districts: unnamed

County: Hinsdale

Quadrangles: Wetterhorn Peak, Uncompahgre Peak

Major deposits: Silver Jack, Dix and Cimarron Chief

Deposit types: Polymetallic vein, (Mo)

Geology: Adjacent to Tmi in Tpl.

Boundary: Drawn to include 3 geologically similar deposits adjacent to Oligocene granodiorite and quartz monzonite (mapped as Tmi by Day and others, 1999) in pre-ash flow andesitic lavas and breccias (Tpl on Day and others, 1999). A west-northwest trending zone of small intrusions in the northern part of the area are exposures of a 30 to 35 Ma quartz monzonite to monzonite volcanic center (Lipman, 1976). The Matterhorn Peak stock, at the southern part of the area is 26 Ma quartz monzonite to monzonite (Lipman, 1976; Bove and others, 1999).

Mining Activity:

The Silver Jack is the area's only productive mine. It was last worked in 1931 (USGS, 1999a, MRDS). Supposedly it produced a small amount of silver and lead ore (probably galena) but there are no records of production (USGS, 1999a, MRDS). The Dix and Cimarron Chief consist of 240 unpatented claims (USGS, 1999a, MRDS). Together they comprise an inactive, only slightly developed, molybdenum prospect consisting of several prospect trenches and pits, and one shallow shaft. The Silver Jack mine, at the northeastern part of the tract and an unknown mine in the northwestern part, are associated with a 30 to 35 Ma quartz monzonite to

monzonite volcanic center (Lipman, 1976). The Dix and Cimmaron Chief mine is associated with the 26 Ma quartz monzonite to monzonite Matterhorn Peak stock (Lipman, 1976; Bove and others, 1999).

Information Sources:
Bove and others, 1999, USGS OFR-99-347
Fischer and others, 1968, USGS Bull.1261-C,
Lipman and others, 1973, USGS Jour. Research, v. 1, no. 6, p. 627-642
Lipman, 1976, USGS I-962
Lipman and others, 1976, Econ. Geol. v. 71, no. 3, p. 571-588
Luedke, 1972, USGS GQ-1011
Steven and others, 1977, USGS Bull. 1391-E, p. 36-37, 85-86, 112-113

Ouray

Size: 11.8 mi^2, 30.6 km^2

Mining Districts: Ouray (Uncompahgre, Upper Uncompahgre, Ouray)

County: Ouray

Quadrangles: Ouray

Major deposits: American Nettie, Bachelor (including Wedge and Neodesha), Mineral Farm, Pony Express

Deposit types: Polymetallic vein and replacement

Geology: Mostly volcanic rocks of the San Juan volcanic field overlying Paleozoic and Mesozoic sedimentary rocks adjacent to Laramide intrusive rocks.

Boundary: Includes mineral deposits north of the San Juan volcanic field that are hosted in Paleozoic and Mesozoic sedimentary rocks adjacent to Laramide intrusive rocks.

Mining Activity:

Bachelor mine (including the Wedge and Neodesha mines) was a large, intermittent producer (USGS, 1999a, MRDS): as of 1905 it was credited with $3.5 million in production (Irving and Cross, 1905, p. 17). Between 1942 - 1946 it produced an additional 201,000 pounds(!) silver, 2,080,000 lbs lead, 1,300,000 pounds zinc, and 71,000 lbs copper (USGS, 1999a, MRDS). Ore minerals included galena, sphalerite, chalcopyrite, argentiferous tetrahedrite, and pearceite (Bastin, 1923, p. 70). Locally there may also be chalcocite, chrysocolla, argentite, and native silver (Bastin, 1923, p. 72).

Although the American Nettie is listed as a small intermittent producer (USGS, 1999a, MRDS), between 1889 and January, 1905, it produced 23,641,316 pounds of ore valued at $1,464,923.35 (Irving, 1905, p. 70). This ore averaged $123.12 per ton, or 6 oz gold per ton of sorted rock (Irving, 1905, p. 70). It is not known when the mine was last worked.

As of 1905, ore values in the Mineral Farm and Pony Express mines were described as "extremely irregular and [...] uniformly low" (Irving, 1905, p. 73). Ore from the Pony Express averaged $30 per ton: The average value of the Mineral Farm ore was so low it didn't pay to mine it (Irving, 1905, p. 73).

Production for this area is included with all production from Ouray county for the period 1946-1958. It is not possible, from published reports, to determine the production from the Ouray mineralized area. As of 1988 the American Nettie (Au, Ag, Pb, Zn) was in an exploration and development stage with 1 employee (Streufert and Ohl, 1989), Black Girl (Ag, Au, Pb, Zn) was on "standby", and the Bachelor (Ag, Au) was being explored and rehabilitated. As of 1995-96 the only active or permitted mine in Ouray County was a gravel pit.

Information Sources:

Bastin, 1923, USGS Bull. 735D, p. 65-129
Burbank, 1930, Colo. Sci. Soc. Proc. vol. 12, no. 6
Burbank, 1940, USGS Bull. 906E, p. 189-265
Burbank, 1947, in Vanderwilt, p. 409-414.
Burbank and Luedke, 1968, in Ridge, ed., Graton-Sales volume, p. 714-733.
Cross, Howe, and Irving, 1907, USGS Folio 153
Hemborg, H.T., 1996, CGS Information Series 41 (Active Permitted Mine Operations in Colorado, 1995-1996)
Henderson, 1926, USGS PP 138, p. 183
Irving, 1905, USGS Bull.260, p. 50-77.
Kelley, V., 1957, in N.M. Geological Society, 8th conf. Guidebook, p. 219
King and Allsman, 1950, USBM IC -7554, p. 50-51
Koschmann, A.H., and Bergendahl, M.H., 1968, USGS PP 610, 283 P.
Lipman and others, 1976, Econ. Geol. v. 71, p. 571-588
Luedke and Burbank, 1981, USGS I-1247
Streufert, R.K., and Ohl, J.P., 1989, Colorado Metal Mining Activity Map with Directory: Colorado Geological Survey Map Series 25, scale 1:500,000.
White, D. E., 1962, Antimony in U.S.: USGS MR - 20
Vanderwilt, 1947, Min. Res. of Colo., p. 161

San Juan

Size: 170 mi^2, 441 km^2

Mining Districts: Burrows Park, western Galena (Henson Creek), Eureka, S. Ouray, Sneffels (Imogene Basin), Telluride, Ophir; Red Mountain, Lower San Miguel (syn. Placerville, "Sawpit, Newmire)

County: Hinsdale, Ouray, San Juan, San Miguel,

Quadrangles: Mt Wilson, Ophir, Telluride, Ironton, Ouray, Handies Peak, Redcloud Peak

Major deposits: Palmetto, Black Hawk, Graham, Portland, Galena Queen, Cora Belle, Red Mountain, Genessee, Vanderbilt, Guston, Idarado, Camp Bird, Paymaster, National Belle

Deposit types: Polymetallic vein and replacement

Geology: Mostly in volcanic rocks of the San Juan volcanic field.

Boundary: Because there is so little difference in the genesis and setting of ore deposits in this region, and historic mining districts were located based on access, most of the historic districts in the region were combined for the purposes of this assessment into one large mineralized area. The area could easily have been expanded to the south into the Silverton area, however, that area is outside the study area and an arbitrary southern boundary was drawn.

Mining Activity: Extensive. For details, see the information sources below.

Information Sources:

Bove and others, 1999, USGS OFR 99-347
Brown, 1926, Mines Mag. v. 15, p. 5-15
Hazen, S.W., Jr., 1949, USBM RI-4508, 110 p.
Hon, 1987, USGS MF-1949.
Hon and Lipman, 1989, in Chapin and Zidek, eds., NM Bureau of Mines and Mineral Resources Memoir 46, p. 350-380.
Krasowski, 1976, (Burrows Park): CSU M.S.Thesis, 111 p.
Lipman, 1976, USGS I-962
Lipman and others, 1976, Econ. Geol. v. 71, p. 571-588
Sanford and others, 1987, USGS Bull. 1715B, 35 p.
Steven and Lipman, 1976, USGS PP 958, 35 p.
Vanderwilt, 1947, Min. Res. of Colo., p. 118 (Park[Sherman]); p. 112, 114 (Burrows Park [Whitecross]); p. 158 (Red Mountain); p. 202, 204 (Lower San Miguel [Placerville, Sawpit, Newmire]); p. 158 (Red Mountain); p. 161 (Sneffles [Imogene Basin]); p. 205, 209, 425-427 (Ophir [Irong springs, Ames]); p. 209, 421-425 (Upper San Miguel [Telluride]); p. 196, 431-433 (Animas); p. 199, 435-437 (Eureka [Cement Creek,

Mineral Creek, Animas Forks]); p. 202 (Ice Lake Basin–mostly in San Juan NF, not in GMUG)

Wilson Peaks

Size: 3.0 mi^2, 7.7 km^2

Mining Districts: Mt. Wilson

County: San Miguel

Quadrangles: Dolores Peak, Mt. Wilson

Major deposits: Silver Pick, Morning Star, Rock of Ages, Silver Eagle, Synopsis, Special Session, Wheel of Fortune

Deposit types: Polymetallic vein

Geology: Tertiary intrusive rocks (Ti). Heterogeneous intermediate to silicic hypabyssal intrusive rocks with a wide range in textures and compositions (Ti), mapped only in Durango quadrangle. Granodiorite and quartz monzonite; generally porphyritic but equigranular in some large bodies; in stocks dikes sills and irregular bodies (Tgg) and granodiorite and quartz monzonite; generally porphyritic but equigranular in some large bodies; in stocks dikes sills and irregular bodies (Tgd); mapped only on Cortez quadrangle.

Boundary: Includes only the mines and prospects in the Mt. Wilson area., almost all of which are veins in Tertiary intrusive rocks (or in adjacent sedimentary rocks). .

Mining Activity:

The main vein systems strike west and southwest, and are offset by thin barren veins striking north. the more productive veins are quartz-filled fissures containing pyrite, chalcopyrite and arsenopyrite with lesser amounts of galena, sphalerite, tetrahedrite, stibnite, and calcite. The narrow pay streaks within the veins, carry high values in gold. Veins in the fine-grained facies of the diorite, chalcopyrite and galena commonly indicate high values of gold, and those in coarser-grained parts of the intrusion the gold is thought to be associated with arsenopyrite. In the eastern part of the area near Bilk Creek the veins contain considerable galena and sphalerite. Silver Pick mine produced at least $750,000 (not adjusted) in ore. The Tam O'Shanter (one of the claims of the Silver Pick mine) and Special Session mines are on prominent veins nearby.

The Morning Star produced 36 tons of ore in 1913 and 45 tons in 1914. The mine presumably produced some ore between 1878-1903, 667 tons of ore from 1904-1914, and a small amount in 1952 (USGS, 1999a, MRDS). No figures are available prior to 1904 and no production is reported for 1906, 1910-11, 1915-1951, and after 1952 (USGS, 1999a, MRDS).

The Silver Pick was first mined in 1882. Between 1882 and 1898 it produced 6,030 tons of ore containing about 94,000 oz silver and 32,000 oz gold (USGS, 1999a, MRDS). Other figures are unknown.

Information Sources:
Bromfield, 1967, USGS Bull. 1227
Bromfield and others, 1972, USGS Bull. 1353-A
Cross and Purington, 1899, USGS Folio 57
Vanderwilt, 1947, Min. Res. of Colo., p. 205, 428

Western Uranium

Size: 886 mi^2, 2294 km^2

Mining Districts: Gateway, Uravan, Bull Canyon, Gypsum Valley, Slick Rock, Paradox, Uravan Mineral Belt

County: Mesa, Montrose, San Miguel

Quadrangles: Gateway, Juanita Arch, Roc Creek, Paradox, Anderson Mesa, Horse Range Mesa, Egnar, Pine Mountain, Calamity Mesa, Red Canyon, Davis Mesa, Bull Canyon, Hamm Canyon, Joe Davis Hill, Uncompahgre; Butte, Atkinson Creek, Uravan, Naturita NW, Gypsum Gap, Dawson Draw, Nucla, Naturita, Basin, McKenna Peak

Major deposits: More than 1,200 mines and mineralized sites identified (Nelson-Moore and others, 1978; Finch, 1967).

Deposit types: Sandstone-hosted uranium-vanadium

Geology: Permian to Late Cretaceous sedimentary rock sequence of predominantly terrestrial origin. Structures present include a series of parallel northwest-trending salt-cored anticlines with associated, steeply dipping faults with small displacement on the fold flanks parallel to the fold axes..

Boundary: Includes mines and occurrences of uranium and vanadium hosted in continental sandstones (Salt Wash and Brushy Basin Members of the Morrison Formation, Burro Canyon Formation, Dakota Sandstone).

Mining Activity:
Deposits first mined for radium beginning in 1898 and terminating in 1923. Emphasis shifted to vanadium production in the mid 1930's and continued through the end of WWII. Interest in recovery of uranium started in 1942 and grew under a program of government price supports, ending in 1970. Demand from the nuclear energy industry sustained production until 1990 when the last mill shut down. The MA is included in the Uravan Mineral Belt (Fisher and Hilpert,

1952) from which 85 million lbs. of uranium oxide and 427 million lbs. of vanadium oxide were produced between 1947 and 1982. Vanadium production prior to 1947 amounted to less than a tenth of that produced after 1947.

Information Sources:
Butler and Fischer, 1978, USGS PP 988B, 22 p.
Chenoweth, 1997, Nonrenewable Resources, v. 6, no. 1, p. 33-41.
Finch, 1967, USGS PP 538
Fischer and Hilpert, 1952, USGS Bull. 988A, 13 p.
Motica, 1968, in Ridge, ed., The Graton-Sales volume, p. 805-813
Nelson-Moore and others, 1978
Vanderwilt, 1947, Min. Res. of Colo., p. 141
Wood and Lekas, 1958, in Intermtn. Assoc. Petrol. Geols. 9th AAm. Annual Field Conf., p. 208-215.

Sinbad

Size: 21.6 mi^2, 55.9 km^2

Mining Districts: Sinbad

County: Mesa, Montrose

Quadrangles: Juanita Arch, Roc Creek, Dolores Point South

Major deposits: Sinbad Valley (includes Copper Rivet and Pyramid)

Deposit types: Redbed copper

Geology: In Permian to Jurassic sedimentary rock units, especially in Cutler and Dolores Formations. Structurally controlled. Veins and disseminated deposits along cross-faults, flank of salt anticline.

Boundary: Includes all sedimentary-hosted copper deposits in the immediate area; surrounded by uranium deposits.

Mining Activity: As of 1921, there had been “considerable prospecting” at the Pyramid and Copper Rivet properties (Coffin, 1921). In 1940 and 1942 the area shipped 30 tons of ore containing 9% copper and 4 oz silver per ton (Vanderwilt, 1947, p. 142). The small tonnage of low-grade copper ore was deemed unsuitable for acid leaching and not adaptable to open-cut mining operations (Traver, 1947, p. 491).

Information Sources:
Coffin, 1921, CGS Bull.16, p. 220
Fischer, R.P., 1936, Econ. Geol., v. 31, no. 6, p. 571-599.
Shoemaker, E.M., 1955, USGS GQ-81
Shoemaker, E.M., 1956, USGS GQ-83
Traver, W.M., Jr., 1947, in Vanderwilt, p. 491.
Vanderwilt, 1947, Min. Res. of Colo., p. 141-142 (see Sinbad district in Mesa Co, north of La Sal Ck).

Sunrise/Morning Glory

Size: 1.3 mi^2, 3.4 km^2

Mining Districts: none

County: Montrose

Quadrangles: Roc Creek

Major deposits: Sunrise

Deposit types: Redbed Copper, (Polymetallic ?)

Geology: Triassic Chinle, Kayenta, Wingate Formations on flank of salt anticline. Structurally controlled veins and disseminated deposits. Supposedly the northern extension of the Cashin fault (Coffin, 1920, p. 220).

Boundary: tightly drawn to include only the two known copper-bearing deposits. Separated from Cashin area (La Sal Creek) on other side of basin (salt anticline?).

Mining Activity: Very little ore has been shipped from any of the properties in the West Paradox Valley. The Sunrise mine, on a N 22 E-trending fault, "produced 12 cars of ore assaying better than 30% copper and containing from 6 to 10 ounces of silver per ton" (Coffin, 1921, p. 220). The Fairview claim [...] "encountered a little ore" and the Morning Glory was a prospect (Coffin, 1921, p. 220).

Information Sources:
Coffin, R.C., 1921, CGS Bull. 16, P. 220.
Fischer, R.P., 1936, Econ. Geol., v. 31, no. 6, p. 571-599.
Shoemaker, E.M., 1956, USGS GQ-83

Cashin (La Sal Creek)

Size: 1.2 mi^2, 3.1 km^2

Mining Districts: La Sal Creek

County: Montrose

Quadrangles: Paradox

Major deposits: Cashin, Cliffdweller

Deposit types: Redbed copper

Geology: In Permian to Jurassic sedimentary rock units (JTrgc, Jse, Jms) along northeast-trending faults on flank of Paradox salt anticline. Structurally controlled veins and disseminated deposits.

Boundary: Includes all copper-bearing deposits in the immediate vicinity of a northeast-trending structure.

Mining Activity:
The ore is concentrated along two intersecting fault fissures in the Dolores Formation (Vanderwilt, 1947, p. 151). Adjacent to the fissures, chalcocite impregnates sandstone. Native copper with some native silver is found in breccia zones. Copper sulfides usually occur higher in the fissures than the metallic copper. The fissures have been developed by several hundred feet of tunnels and winzes (Vanderwilt, 1947, p. 151). Before 1920 an unspecified amount of ore was shipped that contained 35-50 % copper with 8-10 oz silver per ton (Vanderwilt, 1947, p. 154). From 1937-1935 between 1 and 3 lode mines, presumably including the Cashin and Cliffdweller, produced 97 oz gold, 59,537 oz. silver, and 1,462,200 lbs. copper (Vanderwilt, 1947, p. 153). Exploration drilling has revealed a reserve of 10.9 million tons of 0.55% Cu at the Cashin Mine (Northern Miner, 1995).

Information Sources:
Coffin, 1921, CGS Bull.16, p. 220
Emmons, W. H., 1906, USGS Bull. 285, p. 125-128.
Fischer, R. P., 1936, Econ. Geol., v. 31, no. 6, p. 571-599.
Northern Miner, 1995, v. 81, no. 28.
Vanderwilt, 1947, Min. Res. of Colo., p. 151, 154 (see La Sal Creek district in Montrose Co, south of Sinbad)
Withington, C.F., 1955, USGS GQ-72

REFERENCES (not included in mines_refs.wpd or mnrlarea.xls)

Cox, D.P., and Singer, D.A., eds., 1986, Mineral deposit models: U.S. Geological Survey Bulletin 1693, 379 p.

Davis, M.W., and Streufert, R.K., 1980, Gold occurrences of Colorado: Colorado Geological Survey Resource Series 28, 101 p.

Day, W.C., Green, G.N., Knepper, D.H., Jr., and Phillips, R.C., 1999, Spatial geologic data model for the Gunnison, Grand Mesa, Uncompahgre National Forest mineral resource assessment area, southwestern Colorado and digital data for the Leadville, Montrose, Durango, and the Colorado parts of the Grand Junction, Moab, and Cortez 1^{o} x 2^{o} geologic maps, U.S. Geological Survey Open-File Report 99-427.

Parker, B.H., Jr., 1961, The goelogy of the gold placers of Colorado: Golden, Colorado, Colorado School of Mines, PhD dissertation, 578 p.

Plumlee, G.S. and others, 1995, Map showing potential metal-mine drainage hazards in Colorado, based on mineral-deposit geology: U.S. Geological Survey Open-File Report 95-26, scale 1:750,000.

U.S. Geological Survey, 1999a, Mineral Resource Data System [MRDS: active computer file; data available from U.S. Geological Survey, Mineral Resources Program, Building 20, Denver Federal Center, Denver CO 90225].

U.S. Geological Survey, 1999b, Minerals Availability System [MAS: active computer file; data available from U.S. Geological Survey, Mineral Information Team (formerly U.S. Bureau of Mines), Building 20, Denver Federal Center, Denver CO 90225].