Colorado Mineral Belt Revisited—An Analysis of New Data

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U.S. DEPARTMENT OF THE INTERIOR
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The three accompanying plates were presented as a poster session at the Geological Society of America's National meeting, October 29, 2002, in Denver, Colorado. The maps are based on digital data sets of geology, mining districts, and mineral deposits (extensively revised, edited, and corrected, unpublished data compiled by Wilson, 2002) overlain on the Proterozoic basement map of Colorado interpreted from aeromagnetic data by Sims and others (2001). All the maps were created in MapInfo, a GIS software program, and images of the maps were exported to Adobe Illustrator v.10. Adobe Acrobat Reader (downloadable free from www.adobe.com) is the only requirement for viewing the plates. Open GSA_poster_all.pdf and select the plates using the bookmarks, thumbnails, or page selection. To plot the maps at full-scale (3 ft X 4 ft) requires a large format plotter, but the plates may be resized to print on smaller paper.

Although much discussed in the literature, maps showing the detailed outline of the Colorado Mineral Belt are lacking. Lovering and Goddard (1950) show the geology and mines associated with the "Front Range mineral belt", and Sims and Tweto (1963) published the outline of the Colorado mineral belt as page-size illustrations. Based on detailed information on the location of the Tertiary intrusions and mineral deposits, and on the control provided by the Proterozoic structures, all superimposed using GIS data, a new outline of the Colorado Mineral Belt is proposed herein.

Plate 1 includes an index map showing the location of the Colorado Mineral Belt, the abstract text, and the map showing the Colorado Mineral Belt, Cretaceous-Tertiary intrusions and inferred batholiths, mineral districts, and metallic deposits that may be related to the Cretaceous-Tertiary intrusions.
Plate 2 includes a simplifed geologic map, explanation for the map shown on plate 1, conclusions, and references.
Plate 3 shows two maps, each with the Proterozoic rock units stripped away to better display the relationships of the Proterozoic structures to the Cretaceous-Tertiary intrusions and mineralization.

Acknowledgements:
We are grateful to the following people, among many others, for their assistance in numerous ways. Eric Anderson for converting the Proterozoic basement map from an unregistered image to a GIS-compatible file. Bill Ferguson for retrieving a useable digital dataset from the mines and prospects databases. Luke Kinch for checking and rechecking references, metadata, converting MapInfo files to ArcView and vice versa, cleaning up the bibliography in the MRDS data, and for suggesting that the poster might fit vertical panels, instead of horizontal ones, and still stay within the 36 in maximum paper width. Terry Klein and Doug Stoeser each reviewed the final digital files.

REFERENCES and Selected Data Sources

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The Colorado Mineral Belt Revisited--An Analysis of New Data

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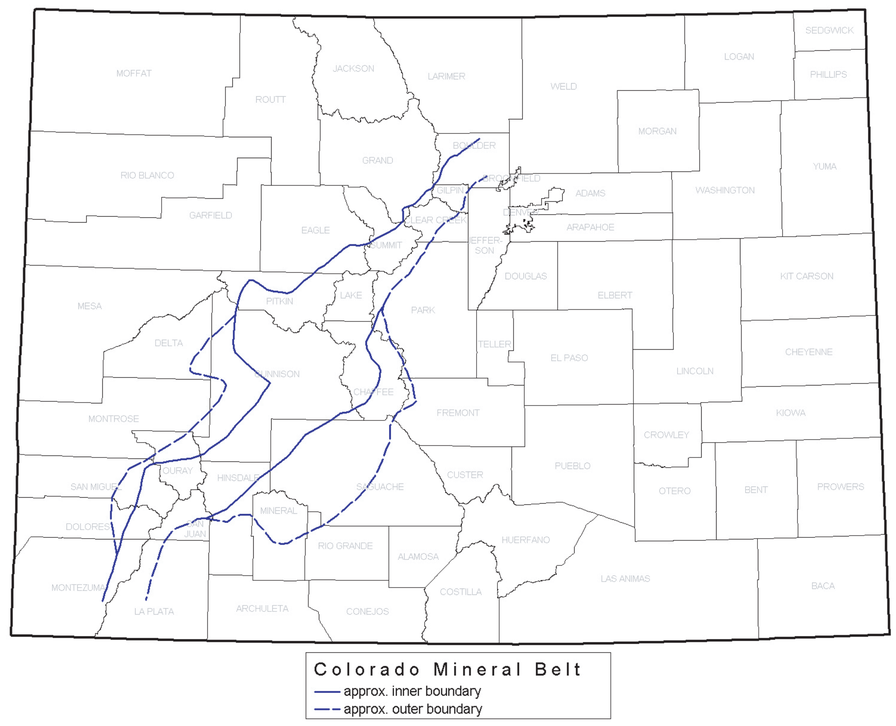
ABSTRACT

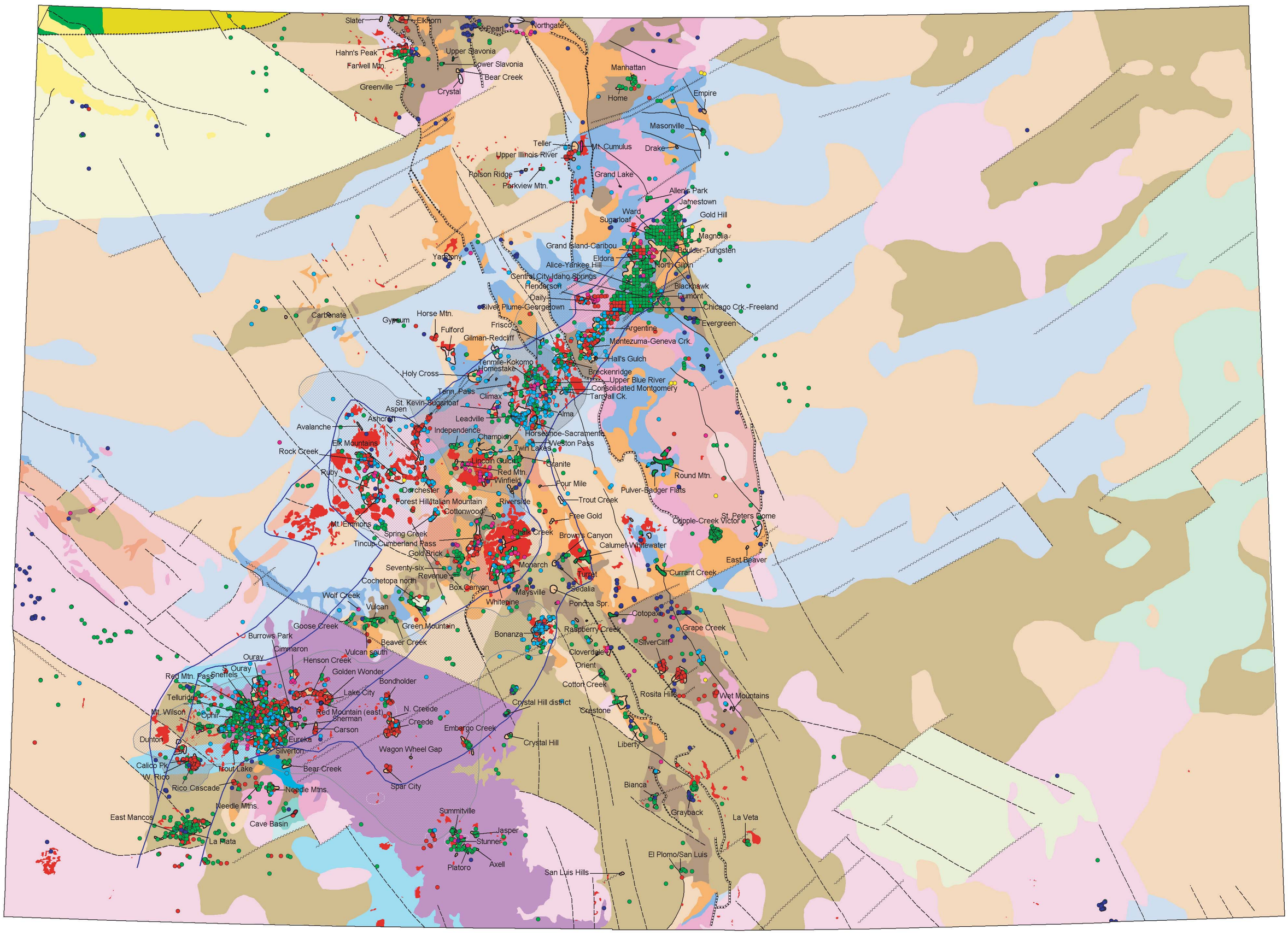
New geologic and geophysical data extend our knowledge of the complementary role of inherited zones of weakness in Precambrian basement and Late Cretaceous-Tertiary magmatism in development of the Colorado Mineral Belt (COMB). The new data indicate that the northeast-trending ductile shear zones that localized ore-related igneous activity in COMB are more abundant than known previously, extend outward laterally to the northwest and southeast, and can account for localizing valuable ore deposits in outlying regions such as Cripple Creek, Rosita Hills-Silver Cliff, and Summitville. The shear zones formed in the Mesoproterozoic (ca. 1.4 Ga) as a result of transpressional tectonics. Locally, they followed pre-existing Paleoproterozoic structures. A second set of Mesoproterozoic shears of northwest orientation, which has been poorly understood, had a secondary control on emplacement of intrusions in the central part of COMB. This control is most evident in central Colorado where the mineral belt abruptly widens from a width of about 15 to 60 km to about 140 km.

Recent geochronologic data indicate that a minor late Tertiary ore-forming event was locally superposed on the two major periods of mineralization: Late Cretaceous-early Tertiary and mid-Tertiary. Accordingly, episodic magmatism in the region spanned an interval of about 70 m.y. Gravity data indicate that COMB overlies two distinct gravity lows (-300 mg) interpreted as long-lived magma chambers that spawned both Late Cretaceous-early Tertiary and mid-Tertiary magmas. The gravity lows are en-echelon and separated by a prominent northwest-trending basement shear zone, exposed in the Gunnison River area.

Location of the Colorado Mineral Belt



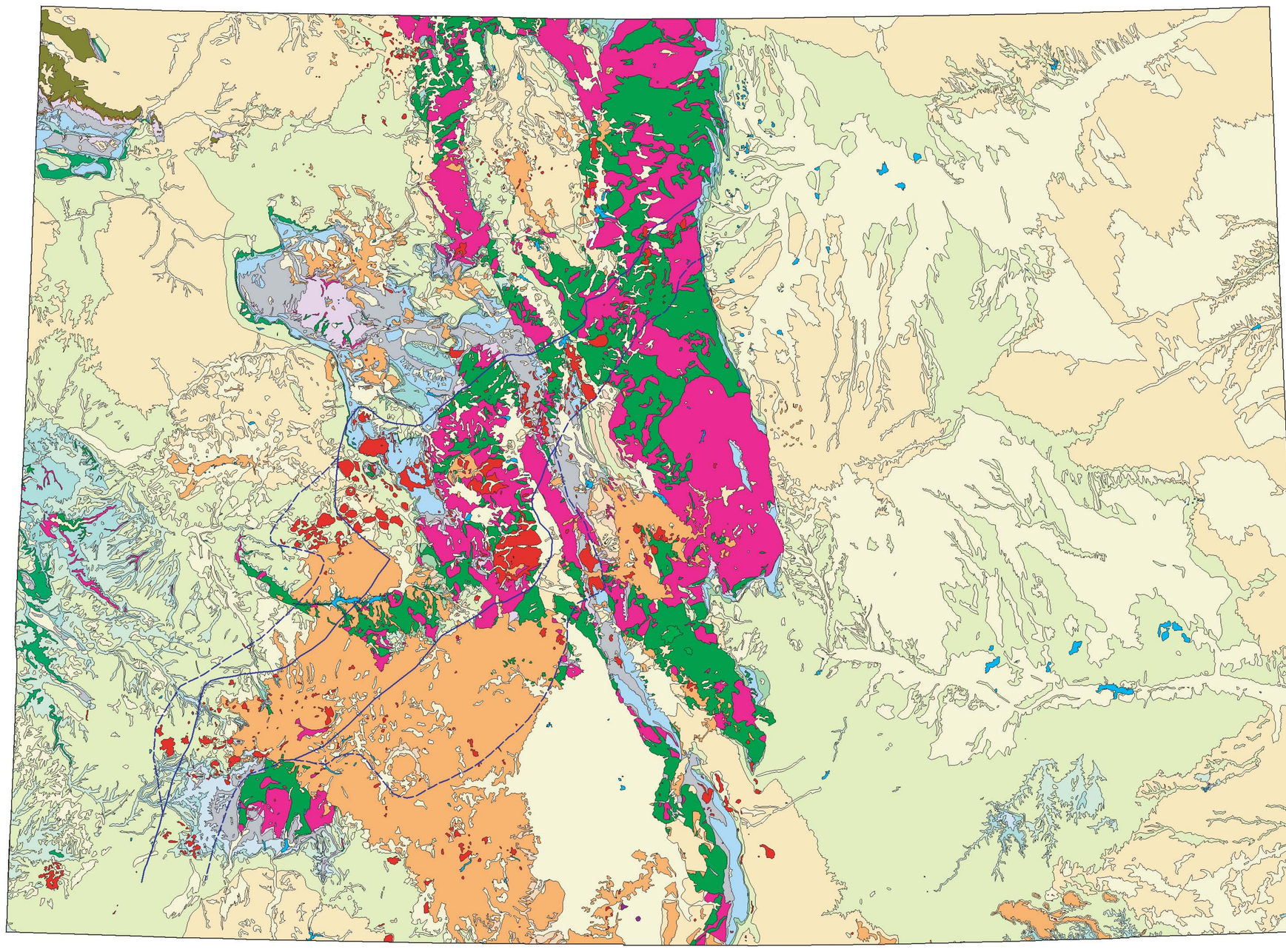
Colorado Basement Geology (from Sims and others, 2001), Cretaceous-Tertiary Batholiths and Intrusions, Mines, Metallic Mineral Districts and Mineralized Areas, and the Colorado Mineral Belt



U.S. Department of the Interior

U.S. Geological Survey

Simplified Geologic Map of Colorado showing the Colorado Mineral Belt



EXPLANATION

- Quaternary, unconsolidated
- Quaternary, basalt
- Tertiary, unconsolidated
- Cretaceous-Tertiary, plutonic rocks
- Tertiary, volcanic rocks
- Tertiary, volcaniclastic rocks
- Tertiary, sedimentary rocks
- Cretaceous, sedimentary rocks
- Cretaceous-Jurassic, sedimentary rocks
- Jurassic, sedimentary rocks
- Jurassic-Triassic, sedimentary rocks
- Triassic, sedimentary rocks
- Triassic-Permian, sedimentary rocks
- Triassic-Pennsylvanian, sedimentary rocks
- Permian, sedimentary rocks
- Mesozoic, sedimentary rocks, undifferentiated
- Permian-Pennsylvanian, sedimentary rocks
- Pennsylvanian, sedimentary rocks
- Mississippian-Cambrian, sedimentary rocks
- Cambrian, sedimentary rocks
- Cambrian, intrusive rocks
- Proterozoic Y, sedimentary rocks
- Proterozoic Y-Proterozoic X, intrusive rocks
- Proterozoic Y-Proterozoic X, metamorphic rocks
- Archean, metamorphic rocks

Colorado Mineral Belt

- approx. inner boundary
- approx. outer boundary

scale 1:1,000,000

Geology simplifed from
Tweto, 1979 and Green, 1992

MAP EXPLANATION

Metallic Mineral Districts
by deposit type

- Au-Te veins
- Climax-type porphyry molybdenum
- Cu-Mo porphyry
- F-rich veins
- hot springs-type gold
- low-sulfide gold
- massive sulfide
- polymetallic replacement
- polymetallic veins
- polymetallic veins and replacements
- pyrite-poor replacement in carbonate sedimentary rocks
- quartz-alunite epithermal
- unknown

Primary Commodity (MRDS)

- AG
- AU
- CU
- MO
- NI
- PB
- PT
- ZN

Primary Commodity (MAS/MILS)

- AG
- AU
- CU
- MO
- NI
- PB
- PT
- ZN

Batholiths
unexposed, postulated from gravity lows

- Composite Late Cretaceous to middleTertiary
- middle Tertiary

Proterozoic Structures

- normal fault, exposed
- normal fault, inferred
- Shear zone, exposed
- Shear zone, inferred
- thrust, exposed
- thrust, inferred

Basement Geology
(_ex, exposed; _un, unexposed or inferred)

- Agn_un
- Ag_un
- Tv_ex, Tertiary volcanic rocks
- Xb_ex
- Xb_un
- Xfh_ex
- Xfh_un
- Xg_ex
- Xg_un
- Xm_ex
- Xm_un
- Xqs_ex
- Xqs_un
- Ygf_ex
- Ygf_un
- Ygp_ex
- Ygp_un
- Yg_ex
- Yg_un
- Yl_un
- Yun_ex
- Yun_un
- Yu_ex
- Yu_un
- Yv_ex
- Yv_un

Late Cretaceous-Tertiary intrusive rocks (exposed)
(from Tweto, 1979; Green, 1992)

- Late Cretaceous-Tertiary intrusive rocks (exposed)

mineralized area, unmined
(white dashed outline)

SCALE 1:750,000

GENERAL OBSERVATIONS AND CONCLUSIONS:

- All mineral belts from New Mexico to Idaho and Montana trend northeast
- Colorado Mineral Belt (COMB) follows inherited zones of weakness in Precambrian rocks
- Intrusions and ore deposits tend to be at intersections of the NE-trending belt with NW-structures
- Mesoproterozoic (1.4 Ga) shear zones followed pre-existing Paleoproterozoic structures and localized ore-related hydrothermal activity and emplacement of intrusions:
  - along NE-trending ductile shear zones
  - control on NW shear zones evident where COMB widens.
- Refined outline of COMB based on intrusions, mining districts, basement structures
- Three periods of mineralization:
  - Late-Cretaceous-early Tertiary (major)
  - Mid-Tertiary (major)
  - Late-Tertiary superimposed (minor)
- Batholiths
  - interpreted from gravity lows (-300 mg), were source of Late Cretaceous-early Tertiary and mid-Tertiary magmas.
  - underlie different basement blocks separated by a NW-trending shear zone
- Possible left-lateral offset of the COMB along NW structures

BASEMENT MAP

MESOPROTEROZOIC (1,600 – 900 Ma)

Ygp	rocks of Pikes Peak batholith (~1,010 Ma)
Yl	Las Animas Formation
Yu	Unita Mountain Group
Yun	Uncompahgre Formation
Yv	Vallecito Conglomerate
Yg	Granitic rocks (~1,400 Ma age group)
Ygf	Foliated granodiorite (~1,400 Ma age group)

PALEOPROTEROZOIC (2,500 – 1,600 Ma)

Xg	Granitic rocks (~1,700 Ma age group)
Xm	Mafic rocks (~1,700 Ma age group)

PALEOPROTEROZOIC GNEISS COMPLEX

Xb	Biotite gneiss and migmatite
Xqs	Quartzite and mica schist facies of Xb unit
Xfh	Felsic and hornblendic gneisses

ARCHEAN (2,500 Ma and older)

Ag	Late Archean rocks
Agn	Late Archean gneiss

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Colorado mineral belt, Proterozoic structures, inferred batholiths, and metallic mineral districts

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Colorado mineral belt, Proterozoic structures, inferred batholiths, Cretaceous-Middle Tertiary intrusive rocks, and metallic mineral districts

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Late Cretaceous-middle Tertiary Intrusive Rocks
(from Tweto, 1979; Green, 1992)

- Late Cretaceous-middle Tertiary intrusive rocks

scale 1:1,000,000