Databases and Simplified Geology for Mineralized Areas, Claims, Mines and Prospects in Colorado

Part A: Data Files and Formats
Part B: Figures and Maps
Part C: Metadata

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U.S. GEOLOGICAL SURVEY

[1] U.S. Geological Survey, Denver, Colorado

CONTENTS

FILES ON CD-ROM

Root Directory:

Part A:

Data Files and Formats

*File names in the ArcView directory include _region, _polyline, or _point, indicating the type of data contained, after the name given above.

Part B. Illustrations (.pdf)

Adobe Acrobat Reader (installation file) . . . . . AcroReader51_ENU_full.exe

PDF (Figures 1-8, all in .pdf format)

Figure 1. Colorado index map . . . . . CO_index
Figure 2. Mineralized areas . . . . . CO_mnarea
Figure 3. Distribution of metallic minerals . . . . . CO_metdep
Figure 4. Land ownership . . . . . CO_lndown
Figure 5. Simplified geologic map . . . . . CO_geol
Figure 6. Claim activity map . . . . . CO_minclm
Figure 7. Distribution of mineral deposits . . . . . CO_allmin
Figure 8. Placer claims and deposits . . . . . CO_placer

Part C: Metadata (all are ASCII text files, .txt)

Geology . . . . . ofr_92_0507_metadata
Mineralized areas . . . . . CO_dists
MRDS data . . . . . CO_MRDS
MAS/MILS data . . . . . CO_MAS
County boundaries . . . . . CO_cnty
250,000-, 1:100,00-, and 1:24,000-scale Quadrangles . . . . . CO_quads
Claims . . . . . CO_claim
State outline . . . . . CO_state
Public Lands Survey System . . . . . CO_PLSS
Land Ownership . . . . . CO_publd
Colorado mineral belt . . . . . CO_mb
Major rivers . . . . . CO_river
Major water bodies . . . . . CO_water
Major highways . . . . . CO_hwys
Lakes . . . . . CO_lake
Creeks . . . . . CO_creek
Cities . . . . . CO_city
Railroads . . . . . CO_railr
County roads . . . . . CO_RdCou
Forest Service roads . . . . . CO_RdFS
Local roads . . . . . CO_RdLoc

Colorado Department of Transportation (CDOT directory) . . . . . .

airports
railroads
streams
lakes
County roads
Local roads
Forest Service roads
Highways
Counties
Land status data
Major roads
Municipal boundaries

Files on CD

DATA FILES	SIMPLIFIED GEOLOGY	GEOLOGIC MAP*
CO_MRDS	CO_geol	CO_attributed_geology
CO_MAS	H2O	CO_thin_units_dikes_as_lines
CO_250k	Q_uncons	CO_faults_and_contacts
CO_100k	Q_basalt	CO_faults_all_types
CO_024k	T_uncons	CO_asterisk_volcanicneck
CO_state	T_sed	CO_structure_axes
CO_cnty	T_vclast	CO_fault_bars
CO_dists	T_volc	CO_fault_balls
CO_city	T_pluton	CO_thrustfault_triangles
CO_hwys	K_sed	
CO_claim	KJ_sed	
CO_PLSS	J_sed	
CO_publd	JTr_sed	
CO_airpt	Tr_sed	
CO_creek	TrP_sed	
CO_lake	Perm_sed	
CO_river	Tr_Penn_sed	
CO_water	P_Perm_sed	
CO_railr	Penn_sed	
CO_RdCou	Mz_sed	
CO_Rdfs	MDOC_sed	
CO_RdLoc	Camb_sed	
CO_indus	Camb_intr	
CO_perm	Y_sed	
CO_mb	YX_intr	
	YX_met	
	W_met	
	pCplut	

*(Geologic map layers from Green's 1992 geologic map formatted for MapInfo and ArcView, and attributed by Wilson in 2002. CO_thin_units_dikes_as_lines created by selecting the original "line_line.e00" file of Green. CO_faults_and_contacts from the "contact_line.e00" file. All other datasets created by selecting individual codes from Green's data files.)

INTRODUCTION

This data release contains mineral resource data for metallic and nonmetallic mineral sites in the State of Colorado. Along with the resource data, there is additional data, such as mineralized areas and mining districts; mine, prospect and commodity information; claim density by section; county boundaries; quadrangles; and simplified geology. All the geographic data are provided in formats for two commonly used Geographic Information Systems (GIS) software packages (MapInfo and ESRI's ArcView). Not only does GIS software allow the data to be shown as layers in "map" views that can be displayed with various geographic and geologic data, but the data can be queried and analyzed relative to data in any of the layers. Free shareware, ArcExplorer, is provided with this report so users may display the data in "map" views and query the various datasets (Appendix A) without requiring a GIS program such as Arc/Info[1], ArcView[1], or MapInfo[1]. Additional data, such as original and unedited mine and prospect files, bibliography and references, and text are provided in appropriate formats such as in spreadsheets (Microsoft Excel), or documents (text, WordPerfect, or Microsoft Word).

Explanatory material is in the Introduction (and root directory on the CD release and online). Part A includes all the data files with subdirectories for ArcView and MapInfo. Part B contains illustrations as .pdf maps (an installation file for Adobe Acrobat Reader for viewing the .pdf files is on the CD). Part C contains metadata, explanatory details on the structure and content of each data file.

To use ArcExplorer, run ae2setup. Once the program is installed you may work with either of the ArcExplorer project files (CO_geol.aep or CO_data.aep) or create your own. Run ArcExplorer and then open the .aep file from within the program.

MINE AND PROSPECT DATA

Mineral resource data for metallic and nonmetallic mineral sites in the State of Colorado were initially extracted from the U.S. Geological Survey's large worldwide databases: Mineral Resources Data System (MRDS) and Minerals Availabilty System/Mineral Industry Location

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[1] Registered trademark of ESRI
[2] Registered trademark of MapInfo Corporation

System (MAS/MILS) (McFaul and others, 2000; U.S. Geological Survey, 2001). For this report, many of the existing records for Colorado in both databases were corrected or revised. The changes have not yet been incorporated into the USGS's active databases. This report uses the modified and revised records.

The MRDS and MAS/MILS (McFaul and others, 2000; U.S. Geological Survey, 2001) databases were originally compiled for different purposes and contain different information, although some information is common to both. MRDS was constructed by the USGS and MAS/MILS was built by the U.S. Bureau of Mines (USBM). After the Bureau of Mines was abolished in 1996, custody of MAS/MILS was transferred to the USGS. MAS/MILS includes records for geothermal, coal, ash, nitrogen, oil, and sand and gravel, none of which are normally included in the MRDS database. The MRDS database is primarily descriptive and contains historical data about mineral deposit sites, including mines, prospects, and occurrences, deposit description, geologic characteristics, production, reserves, potential resources, and references. Most of the additions and corrections to the MRDS database in this report are limited to location information, commodities, geologic data, and deposit types. MAS/MILS contains less geologic information but more information regarding extraction and processing operations.

In each database, records are identified by a unique alphanumeric code and describe a site. A "site" may be a single mine, block of claims, group of mines or workings, mining district, or even a region. Each record contains the location (usually by latitude and longitude), name of the deposit, information about the mineral deposit, and commodities present. Locations for many, but by no means all, of the metallic mineral deposits in the MRDS database were verified by plotting locations given in the original references on 1:24,000 scale USGS digital raster graphics images (DRGs) of topographic maps, and digitizing them on screen. All the data from both databases were imported into GIS (MapInfo) and the locations of dozens of mislocated deposits were adjusted so that they would plot in Colorado. In addition, the locations of a large number of deposits were adjusted to plot within the correct county, quadrangle, or township and range. Each of these adjustments was made for different reasons, with different levels of confidence, none of which are recorded in the database. There will certainly be erroneous locations–but in nearly every case, they will be better located than previously.

Minor attempts were made to coordinate or reconcile the difference between the locations in the MRDS and MAS/MILS databases. In general, the MRDS location records the approximate center of the deposit, whereas the MAS/MILS location is often the main access to the deposit. In some cases the two locations can be many miles apart. In the CO_MRDS database, the second data column contains the corresponding MAS/MILS record number, if it could be determined. Many fewer MAS/MILS sites contain a corresponding MRDS record (column labeled "GEOLSURV"). For many records, where MRDS and MAS/MILS records clearly correlate, the locations were adjusted to plot at the same point. It must be emphasized that these locations are estimates based on descriptions provided in the literature, various databases, topographic, or geologic maps–they have not been measured by a geographic positioning system (GPS) in the field.

MRDS data structure

The original MRDS database contains at least 226 variable-length fields. Many records exceed the approximately 254 characters per field and 4000 character limitation per record of most GIS programs. Due to this constraint, we have restructured the data to be compatible with MapInfo and ESRI's ArcView. Certain fields from the original database were extracted, based on the percentage of data population for each field and its importance related to mineral resource assessment. Some of these 5,470 records have been newly created, most others were revised in some way in the course of preparing data for this publication. The selected fields and their formats in CO_MRDS are listed in the corresponding metadata file in the Part C, the metadata subdirectory.

MAS/MILS data structure

16,151 deposits are included in the MAS/MILS database. This database contains many deposit types and mining-related sites that are not included in the MRDS database such as mills, tunnel sites, and non-metallic resources such as coal, sand and gravel, and geothermal energy. Several fields with minimal information or deemed non-essential for this study were deleted.

The field “quad024k” contains the name of the 24,000 scale topographic map on which the deposit is located. The 71 fields and their formats in CO_MAS are listed in the metadata.

MINERALIZED AREAS AND MINING DISTRICTS

Mining district boundaries were modified from an unpublished ArcInfo cover developed by the USBM from data presented on the Metallic and Industrial Mineral Map of Colorado (Harris and others, 1985). Based on deposit types, commodities present, and mineral locations in CO_MRDS and CO_MAS, overlain on geology, the map has been adapted to show mineralized areas. A mineralized area encloses a geographic area that 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 distinct geologic setting. A mineralized area may include an entire district or portions of several mining districts. Mineralized areas differ from mining districts because they are based on geology, and on similarity of deposits and related commodities. Districts are defined in geographical terms and may contain completely unrelated deposit types.

Thirty mineralized areas include metallic deposits exclusive of sedimentary uranium deposits. Sixteen areas primarily contain sedimentary uranium deposits and an additional three areas primarily contain bentonite. Not all mineralized areas contain mines that are included in the MRDS or MAS/MILS databases.

CLAIM DENSITY

Claim density data for Colorado (Hyndman and Campbell, 1999) are combined with the Colorado Public Land Survey grid (CO_PLSS) as a single file, CO_claims. Total counts of open and closed claims in each section between 1976 and 1996 are given in whole numbers for Lode, Placer, Mill site, and Tunnel site. Sections with no recorded claims in the same time period are not included. Complete description of these data can be found in Hyndman and Campbell’s 1999 USGS Open-File Report 99-542. These claims often border the historic districts where

many of the known deposits are on patented ground. Unfortunately, the claim information does not date back to the 1800s. If they did, the distribution may look quite different.

SIMPLIFIED GEOLOGY

Simplified geology was constructed from Green's (1992) digital rendering of Tweto's (1979) geologic map of Colorado. For this report, the ArcInfo coverages were imported and converted to MapInfo where map units were combined to create a simplified map with only 25 combined rock units and another unit for water bodies. The 25 combined units include:

Q_uncons	Quaternary unconsolidated sediments
Q_basalt	Quaternary igneous rocks
T_uncons	Tertiary unconsolidated rocks
T_sed	Tertiary sedimentary rocks
T_vclast	Tertiary volcaniclastic rocks
T_volc	Tertiary volcanic rocks
T_plut	Tertiary plutonic rocks
K_sed	Cretaceous sedimentary rocks
KJ_sed	Cretaceous and Jurassic sedimentary rocks
J_sed	Jurassic sedimentary rocks
JTr_sed	Jurassic and Triassic sedimentary rocks
TrP_sed	Triassic and Permian sedimentary rocks
Perm_sed	Permian sedimentary rocks
Tr_Penn_sed	Triassic, Permian, and Pennsylvanian sedimentary rocks
P_Perm_sed	Pennsylvanian and Permian sedimentary rocks
Penn_sed	Pennsylvanian sedimentary rocks
Mz_sed	Mesozoic sedimentary rocks, undifferentiated
MDOC_sed	Mississippian to Cambrian sedimentary rocks
Camb_sed	Cambrian sedimentary rocks
Camb_intr	Cambrian intrusive rocks
Y_sed	Middle Proterozoic sedimentary rocks
YX_intr	Early and Middle Proterozoic sedimentary rocks
YX_met	Early and Middle Proterozoic metamorphic rocks
W_met	Archean metamorphic rocks
H20	Major water bodies, lakes, reservoirs, rivers

For more geologic detail, an "attributed" version of Green's digital map is included (CO_attributed_geology). Attributing is subject to interpretation. However, it allows the user to query the map based on dominant lithology (the rock type most prevalent in the unit, general lithology (an overall estimate of the rock type), or age, as interpreted by the attributer. Also included are files containing the very thin units (CO_thin_units_dikes_as_lines) and volcanic

necks (CO_asterisk_volcanicnecks) that are not represented as polygons, geologic faults and contacts (CO_faults_and_contacts), structural axes (CO_structure_axes), and faults (CO_faults_all_types). The geologic symbols that decorate the faults, such as bar and balls, and triangles on the overriding plate of thrust faults are in separate files (CO_fault_balls, CO_fault_bars, CO_thrustfault_triangles). For details on specific line codes see the metadata by Green (1992).

Viewing mineral deposits by commodity or mineral deposit type relative to the host geology is valuable for determining the characteristics and distribution of the deposits. For additional detail, the user should retrieve the original maps (Green, 1992; or Tweto, 1979). Be aware, that due to the uncertainties in the location of the deposits in MRDS and MAS/MILS and the scale of the geologic map (1:500,000), mines may not plot within the host rock listed in the databases for the deposits.

ADDITIONAL DATA

Other datasets are included for general interest and ease of use. These include a general outline of Colorado, the county boundaries, maps identifying the 1:24,000, 1:100,000, and 1:250,000 topographic maps, public land ownership (showing such distinctions as state lands, National Forests, BLM lands, reservations, etc.), major and minor roads, towns, rivers and major water bodies, streams, location of industrial mineral deposits and permitted mines (Keller and others, 2002), and railroads. A complete list is found in the Table of Contents, Appendix A, or in the CD directory. Each of the topo grids was created especially for this report based on other published datasets, none of which were imported correctly or accurately enough for this report. Most other datasets were modified from data available publicly on the internet from BLM, Colorado Department of Transportation, and other sources. Metadata for each dataset clearly explains its origin and how it was modified for this report.

Many MRDS records contain a list of references used by the original compilers to create the original data record. This field, may in fact, be the single most important field in the database. However, the citations were not in any standard format. For this data release, all the references have been standardized in a shortened format in the “refs” field: first author (“and

others", if appropriate), date, condensed and abbreviated mode of publication, page number (if given). All of the published and verifiable references were extracted from the database and the complete citation listed alphabetically by author is in CO_MRDS_published_refs.pdf. References that are unpublished, could not be verified, located, deciphered, or were clearly wrong, are in CO_MRDS_unpublished_refs.pdf. The bibliography very well might be the most useful feature of this report.

REFERENCES CITED

Green, G.N., 1992, The digital geologic map of Colorado in ARC/INFO format: U.S. Geological Survey Open-File Report 92-507.

Harris, R.E., Hausel, W.D., Meyer, J.E., compilers, 1985, Metallic and industrial minerals map of Colorado: Geological Survey of Colorado, Map Series 14, scale 1:500,000.

Hyndman, P.C., and Campbell, H.W., 1999, Digital mining claim density map for Federal lands in Colorado--1996: U.S. Geological Survey Open-File Report 99-542.

Keller, J.W., Phillips, R.C., and Morgan, K., 2002, Digital inventory of industrial mineral mines and mine permit locations in Colorado (includes shapefiles and ESRI Arc Explorer software): Colorado Geological Survey Information Series 62.

McFaul, E.J., Mason, G.T., Jr., Ferguson, W.B., and Lipin, B.R., 2000, U.S. Geological Survey mineral databases--MRDS and MAS/MILS: U.S. Geological Survey Digital Data Series DDS-52.

Tweto, Ogden, 1979, Geologic map of Colorado: U.S. Geological Survey Special Geologic Map, scale 1:500,000.

U.S. Bureau of Mines, 1996, Minerals Availability System (MAS) database–Deposit information manual and data dictionary, U.S. Bureau of Mines.

U.S. Geological Survey, 2001, Mineral Resource Data System [MRDS: active computer file; data available from U.S. Geological Survey, Mineral Resources Program, Mail Stop 913, National Center, Reston, VA 21092].

U.S. Geological Survey, 2001, Minerals Availability System [MAS: active computer file; data available from U.S. Geological Survey, Minerals Information Team (formerly U.S. Bureau of Mines), Building 20, Denver Federal Center, Denver CO 80225].

Appendix A. Data files showing file names, formats, and projections.

[Three character file extensions throughout this report are as follows: .shp, ArcView shape file; .tab, MapInfo table file; .xls, Microsoft Excel spreadsheet; .met, metadata in text format; .aep, ArcExplorer Project file; pdf, Adobe Acrobat Reader portable document file; *, refers to any extension. All spatial data is recorded in latitude and longitude coordinates and is unprojected.]

DATA TYPE	FILE	.shp	.tab	.xls	.met	projection
MRDS	CO_MRDS	X	X	X	X	latlong
MAS/MILS	CO_MAS	X	X	X	X	latlong
250k quadrangles	CO_250k	X	X		X	latlong
100k quadrangles	CO_100k	X	X		X	latlong
24k quadrangles	CO_024k	X	X		X	latlong
claim density	CO_claim	X	X		X	latlong
county boundaries	CO_cnty	X	X		X	latlong
public land survey system	CO_PLSS	X	X		X	latlong
public land ownership	CO_publd	X	X		X	latlong
mineralized areas/districts	CO_dists	X	X		X	latlong
towns/cities	CO_city	X	X		X	latlong
highways	CO_hwys	X	X		X	latlong
local roads	CO_RdLoc	X	X		X	latlong
county roads	CO_RdCou	X	X		X	latlong
forest roads	CO_Rdfs	X	X		X	latlong
railroad lines	CO_railr	X	X		X	latlong
airports	CO_airpt	X	X		X	latlong
rivers	CO_river	X	X		X	latlong
major water bodies	CO_water	X	X		X	latlong
creeks and streams	CO_creek	X	X		X	latlong
lakes	CO_lake	X	X		X	latlong
state outline	CO_state	X	X		X	latlong
industrial mineral mines	CO_indus	X	X		X	latlong
industrial permits	CO_perm	X	X		X	latlong
Colorado mineral belt	CO_mb	X	X		X	latlong
Geology	CO_geol	X	X		X	latlong
	H2O, Q_uncons, Q_basalt, T_uncons, T_sed, T_vclast, T_volc, T_pluton, K_sed, KJ_sed, J_sed, JTr_sed, Tr_sed, TrP_sed, Perm_sed, Tr_Penn_sed, P_Perm_sed, Penn_sed, Mz_sed, MDOC_sed, Camb_sed, Camb_int, Y_sed, YX_intr, YX_met, W_met	X	X			latlong
Detailed Geology	CO_asterisk_volcanicneck, CO_attributed_geology, CO_fault_balls, CO_fault_bars, CO_faults_all_types, CO_faults_and_contacts, CO_structure_axes, CO_thin_units_dikes_as_lines, CO_thrustfault_triangles	X	X			latlong

Appendix B. ArcView shape (.shp) files used to construct ArcExplorer project (aep) and ArcView Project (.apr) files and MapInfo (.tab) files used to construct MapInfo workspace (.wor) files.

PROJECT/WORKSPACE	FILE
(.AEP, .APR, .WOR)	(.shp, .tab)
CO_DATA	CO_MRDS
	CO_MAS
	CO_250k
	CO_100k
	CO_024k
	CO_cnty
	CO_state
	CO_claim
	CO_publd
	CO_PLSS
	CO_hwys
	CO_town
	CO_dists
CO_GEOL	H2O
	Q_uncons
	Q_basalt
	T_uncons
	T_sed
	T_vclast
	T_volc
	T_pluton
	K_sed
	KJ_sed
	J_sed
	JTr_sed
	Tr_sed
	TrP_sed
	Perm_sed
	Tr_Penn_sed
	P_Perm_sed
	Penn_sed
	Mz_sed
	MDOC_sed
	Camb_sed
	Camb_int
	Y_sed
	YX_intr
	YX_met
	W_met

Appendix C. List of files included in Figures 1-8 (PartB\PDF\...).

FIGURE	CONTENT (.pdf filename)	FILES USED
1	Index map	CO_state
	(CO_index.pdf)	CO_city
		CO_cnty
		CO_hwys
2	Mineralized areas	CO_state
	(CO_mnarea.pdf)	CO_dists
		CO_cnty
3	Metallic mineral deposits	CO_MRDS (thematic)
	(CO_metdep.pdf)	CO_MAS (thematic)
		CO_cnty
4	Land Ownership	CO_publd (thematic)
	(CO_lndown.pdf)	
5	Simplified geologic map (CO_simpgeol.pdf) and explanation (CO_geolexpl.pdf)	H2O, Q_uncons, Q_basalt, T_uncons, T_sed, T_vclast, T_volc, T_pluton, K_sed, KJ_sed, J_sed, JTr_sed, Tr_sed, TrP_sed, Perm_sed, Tr_Penn_sed, P_Perm_sed, Penn_sed, Mz_sed, MDOC_sed, Camb_sed, Camb_int, Y_sed, YX_intr, YX_met, W_met
6	Claim Activity	CO_claim (thematic)
	(CO_minclm.pdf)	CO_state
		CO_dists
		CO_cnty
7	Mineral Deposits	CO_MRDS
	(CO_allmin.pdf)	CO_MAS
		CO_dists
		CO_cnty
		CO_state
8	Placers	CO_MRDS
	(CO_placer)	CO_MAS
		CO_dists
		CO_claim (thematic)
		Q_uncons

FIGURES (.pdf)

1. Index map of Colorado, showing location of mineralized areas, counties, major towns and highway. (CO_index.pdf)
2. Map showing mineralized areas in Colorado. (CO_mnarea.pdf)
3. Map showing distribution of selected metallic minerals in Colorado. MRDS shown as squares, MAS/MILS locations as circles. Any deposit containing, as the primary commodity, chromium, cobalt, or nickel shown in blue; tin or tungsten in lavender; molybdenum in pink; gold, silver, or platinum group elements in red; copper, lead, or zinc in green; and iron or titanium in brown. (CO_metdep.pdf).
4. Thematic map showing simplified land ownership in Colorado. (CO_lndown.pdf)
5. Simplified geologic map of Colorado (CO_geol.pdf) and explanation (CO_geolmap_expl.pdf).
6. Map showing intensity of claim activity in Colorado from 1976 to 1996. Intensity of open claim activity shown in shades of red superimposed on closed claims in shades of blue. (CO_minclm.pdf)
7. Map showing distribution of mineral deposits in Colorado (CO_allmin.pdf). CO_MRDS shown as squares, CO_MAS locations as circles, industrial materials may use different symbols (see map explanation for details, CO_allmin_expl.pdf).
8. Map showing location of placer claims and deposits in Colorado. (CO_placer.pdf)