The following was presented at DMT'13
(June 2-5, 2013, Golden, CO).

The contents are provisional and will be
superseded by a paper in the
DMT'13 Proceedings.

See also earlier Proceedings (1997-2012)
http://ngmdb.usgs.gov/info/dmt/

Building the U.S. Mineral Resource Database - One Mine Feature at a Time

17th Annual Workshop on Digital Mapping Techniques
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Introduction

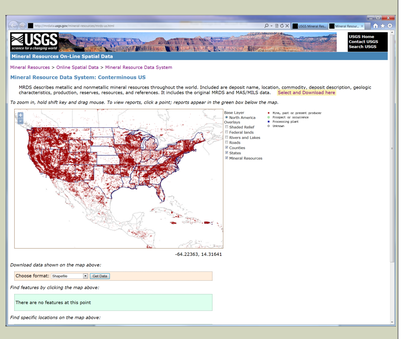
A core mission of the USGS Mineral Resource Program (MRP) is the collection and dissemination of information on mineral resources. This information is used by the USGS, other government entities including State and Federal agencies, private industry, and the general public. An accurate, up-to-date mineral deposit database facilitates the conduct of ongoing USGS projects, the management of mineral resources in the United States, and the formulation of a national minerals strategy.

The USGS is currently upgrading its national mineral deposit database to provide accurate and up-to-date geospatial information on mineral deposits and occurrences. Core tasks include: data acquisition, compilation of relevant geologic and production information, database design, mineralogic characterization of mine features from satellite remote sensing data, and data delivery. This poster summarizes activities related to the first core area, data acquisition.

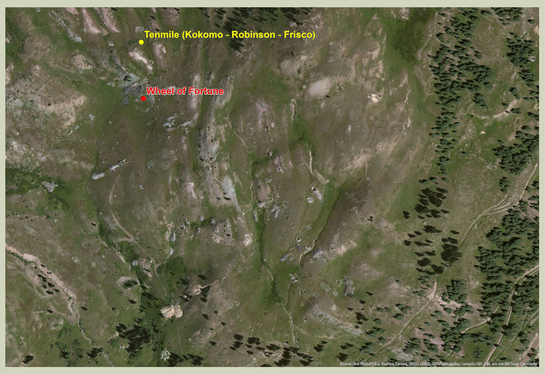
Data acquisition is divided into three tasks: 1) acquiring features related to mining activity and mineral deposits from USGS topographic maps, 2) collecting information from other sources such as geologic maps and reports, and 3) compiling available mineral production, resource, and reserve data.

Background

The USGS and the US Bureau of Mines (USBM) developed national-scale mine and mineral deposit databases in the 1960's. The USGS, which maintained the Mineral Resource Data System (MRDS), acquired custody of the USBM Minerals Availability System (MAS) and Minerals Industry Location System (MILS) databases after closure of the USBM in 1996. In 2000, these databases were merged into a single ORACLE database consisting of approximately 300,000 records and over 200 data fields. Public access to this information continues to be provided at the MRDATA website http://mrdata.usgs.gov

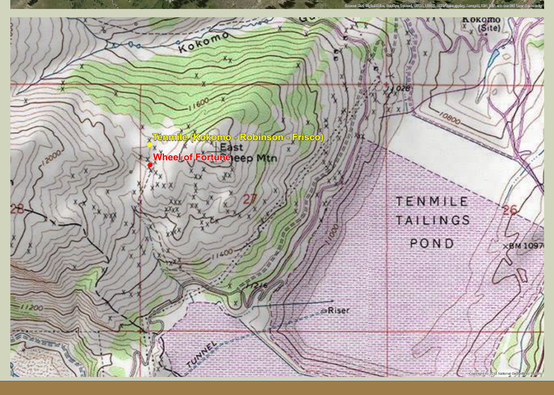


A large volume of information maintained in the MRDS was compiled prior to the development and widespread use of modern geospatial technologies. In addition, the managing agencies had similar yet different scopes; these subtleties were reflected in the complex MRDS database structure. Consequently, issues related to accuracy of mine feature locations and the consistency/completeness of attribute information persisted. The USGS Mineral Deposit Database Project (USMIN), started in 2012, is a new initiative to modernize the mineral resources database for the U.S.



Climax Mine Area Leadville, CO

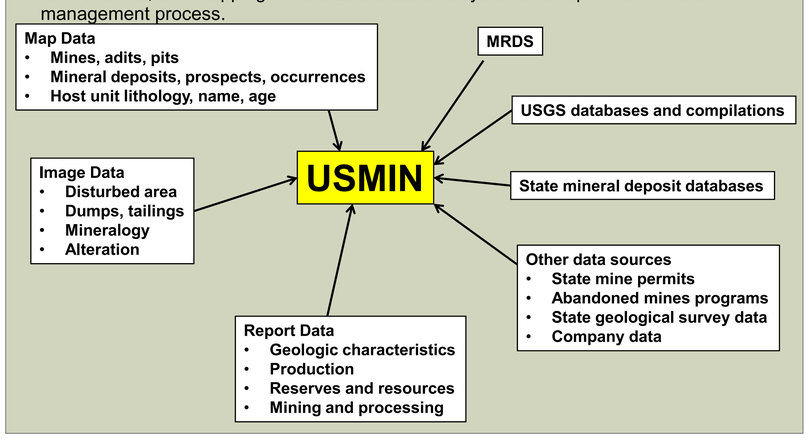
The red and yellow points are from the USGS MRDS database. Note the pitted topography resulting from extensive exploration in the area. This database does not reflect this activity.



The USGS 1:24,000-scale topography map more accurately depicts the extensive prospecting in the area. Mining features are now being captured in the USMIN database.

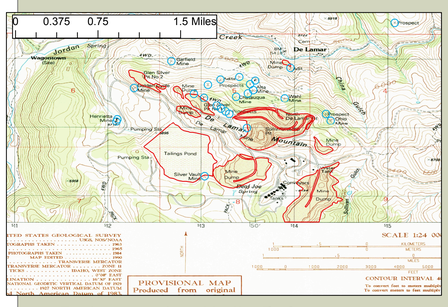
Objectives

The objective of the USMIN project is to develop and publish a comprehensive geospatial database of mineral deposits which will include information on geology, production, resources, history, and development status. The database will form a geographic information system (GIS) which will meet the needs of a wide community of users that extends beyond the geoscience and mineral exploration communities. Potential uses of USMIN include land use planning, assessing abandoned mine lands and mine-related environmental impacts, assessing the value of mineral resources from federal lands, and mapping mineralized areas and systems for input into the land management process.



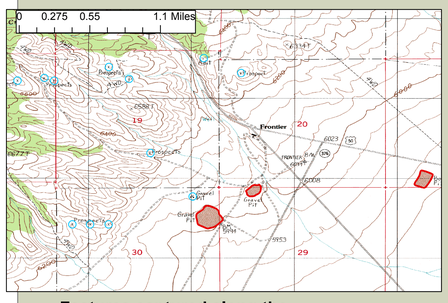
Work Flow

Much of the work to date involves the development of procedures and work flows to capture the location and/or area of mineral deposits and related mine features to the database. The work flow includes a number of quality control steps and development of feature-level metadata at each stage. Using the new USGS Historical Topographic Maps Collection, all mine feature symbols on georeferenced, 7.5-minute (1:24,000-scale) topographic quadrangles are being digitized on a state-by-state basis. This process renders not only a more complete picture of mining activity in an area, but an approximate time line of when these activities occurred is also captured at the feature level metadata stage.



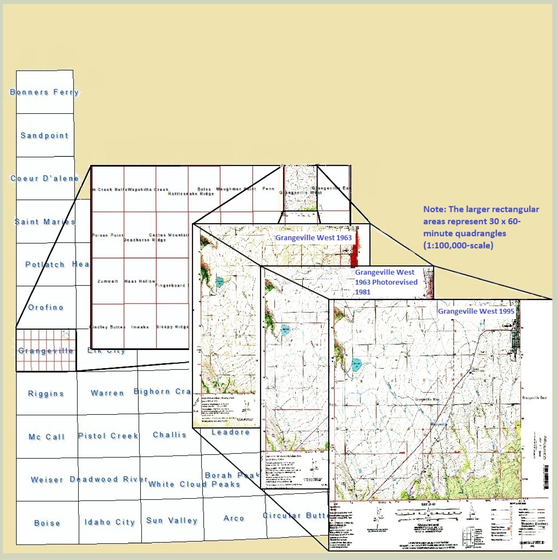
Features captured in the De Lamar, Idaho area. Topographic feature capture is the first phase of the project.

Current aerial imagery of the area, De Lamar, Idaho. Capturing features from aerial imagery will be the next phase of the project.



Features captured along the Carlin Trend in Nevada. Topographic feature capture is the first phase of the project.

Current aerial imagery of the Carlin Trend, Nevada area. Capturing features from aerial imagery will be the next phase of the project.



USGS Historical Topographic Map Collection makes all versions of quadrangle maps available. USGS 7.5-minute quadrangle topographic maps comprise primary source data. http://nationalmap.gov/historical/

Quality Control(QC)

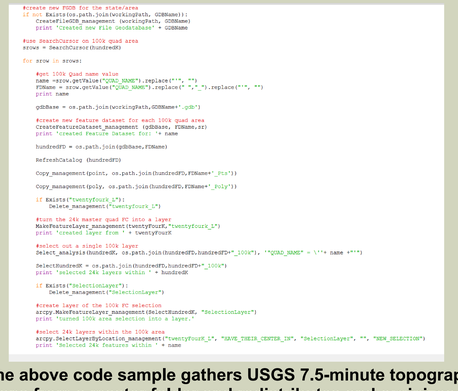
Procedures used to verify data accuracy include:

- Checking tabular data and spatial accuracy at the feature level (point, polygon)
- Verifying topology for polygonal features and correcting errors such as inadvertent slivers, gaps, and overlaps.
- Reviewing tabular for typographical errors and to ensure completeness and consistency of records.
- Spot checking a random 20% of the quadrangle areas (by state) for:
  - Locational accuracy of features
  - Completeness of features captured within each 7.5-minute quadrangle
  - Accuracy of attribute value fields (for example dates and names of quadrangles)

Work Flow Automation

Scripts have been developed to automate routine workflow, including the identification, downloading, and reformatting of scanned, georeferenced topographic quadrangles. Specifically, these scripts automate:

- Obtaining digital 7.5 minute quadrangles and converting to ArcGIS format
- Staging of required datasets
- Quality Control – selects a random 20% sample of 7.5-minute quadrangles to be reviewed

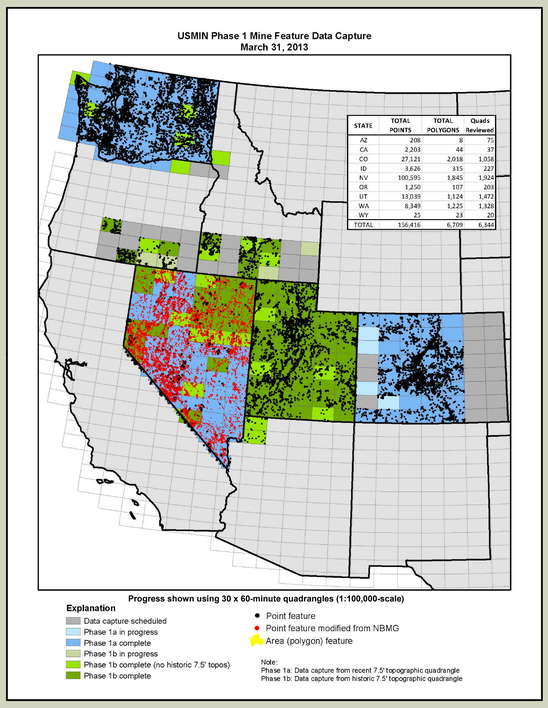


```
#create new FGDB for the state/area
if not Exists(os.path.join(WorkingPath, GDBName)):
    CreateFileGDB_management (workingPath, GDBName)
    print 'Created new file geodatabase' + GDBName

#use SearchCursor on 100k quad area
srows = SearchCursor(HundredFD)

for srow in srows:

    #get 100k Quad name value
    name =srow.getValue("QUAD_NAME").replace(r" ", "")
    FDName = srow.getValue("QUAD_NAME").replace(" ", "").replace("/", "")
    print name

    gdbBase = os.path.join(workingPath,GDBName+'.gdb')

    #create new feature dataset for each 100k quad area
    CreateFeatureDataset_management (gdbBase, FDName,sr)
    print 'created Feature Dataset for: ' + name

    hundredFD = os.path.join(gdbBase,FDName)

    RefreshCatalog (hundredFD)

    Copy_management(point, os.path.join(hundredFD,FDName+'_Pts'))

    Copy_management(poly, os.path.join(hundredFD,FDName+'_Poly'))

    if Exists("twentyfourk_1"):
        Delete_management("twentyfourk_1")

    #turn the 24k master quad FC into a layer
    MakeFeatureLayer_management(twentyFourK,"twentyfourk_1")
    print 'created layer from ' + twentyFourK

    #select out a single 100k layer
    Select_analysis(hundredFD, os.path.join(hundredFD,hundredFD+"_100k"), "QUAD_NAME" = \''+ name +"'")

    SelectHundredK = os.path.join(hundredFD,hundredFD+"_100k")
    print 'selected 24k layers within ' + hundredK

    if Exists("SelectionLayer"):
        Delete_management("SelectionLayer")

    #create layer of the 100k FC selection
    arcpy.MakeFeatureLayer_management(SelectHundredK, "SelectionLayer")
    print 'turned 100k area selection into a layer.'

    #select 24k layers within the 100k area
    arcpy.SelectLayerByLocation_management("twentyFourK_1", "HAVE_THEIR_CENTER_IN", "SelectionLayer", "", "NEW_SELECTION")
    print 'Selected 24k features within ' + name
```

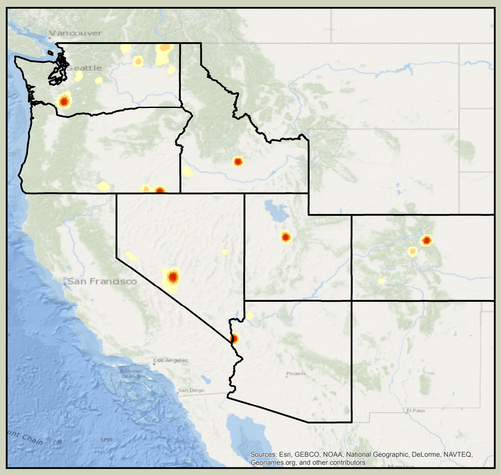
The above code sample gathers USGS 7.5-minute topographic maps from a master folder and redistributes and orginizes them according to 30 x 60-minute (1:100,000 scale) working areas.

Status

Since September 2012, preliminary mine feature capture for Washington, Utah, Colorado, and the northern portion of the Great Basin has been completed. A Nevada Bureau of Mines and Geology mine feature data set served as the starting point for that state. These data were reviewed and modified to conform to the USMIN database structure. Datas for the other states are now in review.



STATE	TOTAL POINTS	TOTAL POLYGONS	Quads Reviewed
AZ	208	8	75
CA	2,203	44	37
CO	27,121	2,018	1,058
ID	3,626	315	227
NV	100,595	1,845	1,924
OR	1,250	107	203
UT	13,039	1,124	1,472
WA	8,349	1,225	1,328
WY	25	23	20
TOTAL	156,416	6,709	6,344

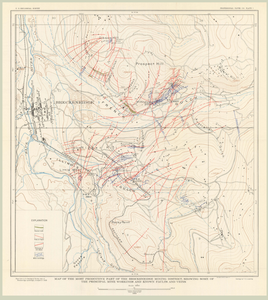


Density distribution of highly active mining areas

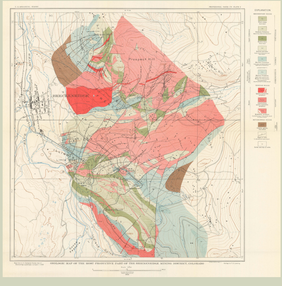
Phase 1 Feature Capture: As of March 31, 2013 a total of 156,416 point and 6,709 polygonal features have been captured from USGS topographic maps. Progress within the Great Basin and Colorado continues while Nevada and Utah have entered the final QC phase. Feature capture occurs on multiple versions of topographic maps (spanning several years and including photrevised renditions) where available.

Other Tasks

The compilation of mineral resource information from sources other than topographic maps is also occurring. An extensive literature and web search is being conducted to obtain historic, non-digital information, as well as to update existing digital information. This review has yielded an extensive collection of geologic maps, reports, and ancillary databases. Historic commodity maps are currently being converted to digital geospatial information - perhaps for the first time. Ultimately this information will serve as important sources of new geological, production, and resource data, as well as historical and development information, to the USMIN database.



Breckenridge: 1934 USGS Mining District Faults, Veins and Workings



Breckenridge Mining District: 1934 USGS Geologic Map

Carlin North: Newmont Factbook 2010

The USMIN Team thanks you!

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Rajesh Rajchal - GIS
Evan Roberts - GIS
Caitlin Zeiler - Metadata/GIS

Head frame, Red Mountain Pass, CO
Photo: Z. King 2010