CRITICAL MINERALS AND ABANDONED MINES (AML) IN NEW MEXICO

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ACKNOWLEDGEMENTS

- AML Funding
  - Energy Minerals and Natural Resources Department (Abandoned Mine Lands Bureau), U.S. Department of the Interior, Office of Surface Mining and Reclamation (OSMRE)
  - New Mexico EPSCoR, National Science Foundation, NSF, award #IIA-1301346)
  - New Mexico Geological Society
  - NMBGMR and NMIMT Mineral Engineering Department
- Mineral-resource potential funding
  - SLO and BLM

PREVIEW

- Definitions
- Define the problem
- Purpose of NMBGMR AML mines program
- Sources of information on mine feature locations
- Inventory
- Critical minerals in NM

DEFINITIONS

CRITICAL MINERALS

1. identified to be a nonfuel mineral or mineral material essential to the economic and national security of the United States
2. from a supply chain that is vulnerable to disruption
3. that serves an essential function in the manufacturing of a product, the absence of which would have substantial consequences for the U.S. economy or national security

Disruptions in supply chains may arise for any number of reasons, including natural disasters, labor strife, trade disputes, resource nationalism, conflict, and so on.

DEFINITION OF AML (ABANDONED MINE LANDS)

- Lands that were excavated and left unreclaimed where no individual or company has reclamation responsibility and there is no closure plan in effect
- Excavations, either caved in or sealed, that have been deserted and where further mining is not intended in the near future, generally >10 yr old
- Includes mines and mine features left unreclaimed on Federal, State, private and Native American lands because the current owner was not legally responsible for reclamation at the time the mine was created
- Also called inactive, legacy, and orphaned mines

DEFINE THE PROBLEM

View east showing the Longtail and Rose repository areas, Rosedale district. November 29, 2007.

DEFINE THE PROBLEM

- Identify areas in NM with AML and tailings that have potential high physical risk and risk to the environment
- Identify AML and legacy sites that have potential critical and other minerals
- Identify areas in NM with critical minerals

- At some point in the future we will be re-processing these mine wastes because they do have concentrations of minerals, including critical minerals, that will be economic in the future


Hillsboro


Pinos Altos


Hillsboro


Jicarilla

PURPOSE OF NMBGMR AML PROGRAM

Rosedale mill launder, now buried under cover of the Longtail tailings (from Sherman and Sherman, 1975:179)

Looking NE across reclaimed Rosedale tailings, 2012.

PURPOSE OF NMBGMR AML PROGRAM

Provide data on districts, mines, and mills in New Mexico

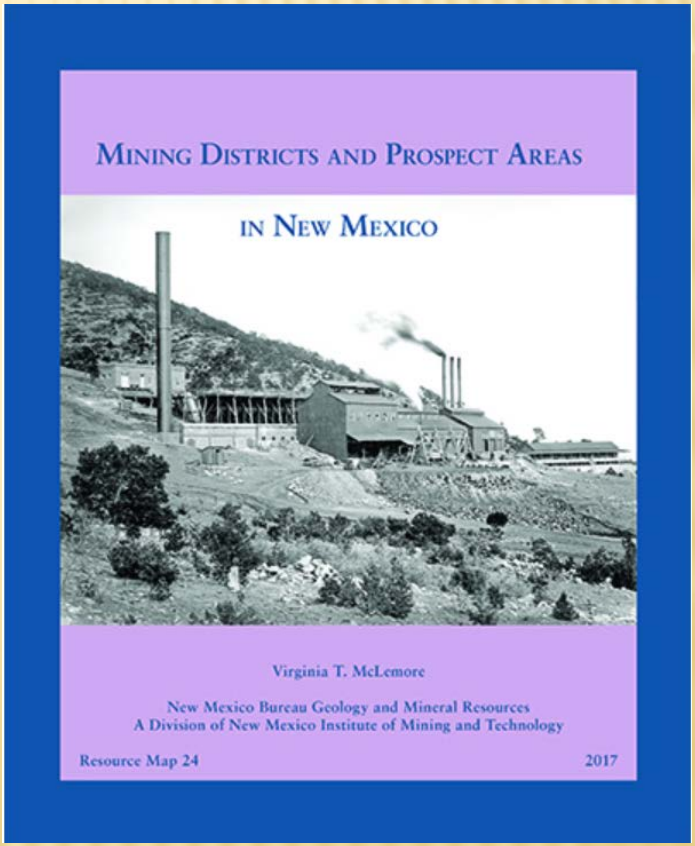
- Help plan and assess reclamation procedures
- Determine background concentrations
- Understand geologic processes
- Compare trace-element concentrations in mined versus undisturbed areas
- Provide background data that can assist with the planning of future mining operations

Summit mine, Steeple Rock district, Grant County (operated 2009-2014, now on stand by)

SOURCES OF INFORMATION ON MINE FEATURE LOCATIONS

GIS DATA

- Coal fields and Mining districts
- Coal mines and reserve data
- **Mines and mills**
- Geochemistry
- **Photographs**
  - (both recent and historic)
- Bibliography
- **Mine maps**
- **Mine production**
- Mine reserves
- **Drill data** (Petroleum records)
- Well logs (Coal library and Petroleum records)



Mines Records by Location and Name (~20,000 records)

M604

T. 5, R. 5W., Sec. 6/7, N. M. P. M.
District Rosedale County Socorro
Property or claim name: Great London Lode + mill Site

Number of claims ?
Lode ✓ Placer ..... Other M.S.
Survey No. 1076-A + B
Year Patented ✓ Rejected .....
Owner's Name: Address: Date:

The W. H. Martin Co.

Operator: .....
Production: Total .....
From ..... To .....
Present Rate ..... per ..... Date .....

R5W. Sec 6+7 (See other side for general information)
R6W. " 1 + 12) 24.479 acres
MS. on Sec 6

Location if Twp. and Range not given:

Classification:
Chief Mineral .....
Accessory Minerals .....

Status Date

County Clerk's Record:
Book ..... Page .....
Source of Information:
* Locke, Augustus, Short Rept. on the Rosedale mine. Jan. 1. 1921
* T. Lindsley papers, Letter on the Rosedale mine. Aug. 1913 U. Wyoming
* Bush J. E. July 11th, 1910, Letter Rept. on Rosedale, Swary Papers. Amer. zinc file #423 UNLMO / Rolla

USGS MRDS, Mineral Commodity, topo mines data

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Mineral Resources On-Line Spatial Data

Mineral Resources / Online Spatial D

Mineral Resources Data

MRDS is a collection of reports describin
geologic characteristics, production, rese
service provides a subset of the databas
available as well. Current status: As of 2(

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Mineral Resources On-Line Spatial Data

Mineral Resources Online Spatial Data

Interactive maps and downloadable data for regional and global Geology, Geochemistry, Geophysics, and Mineral Resources

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ScienceBase Catalog → USGS Data Release Products → Prospect- and Mine-Related...

Prospect- and Mine-Related Features from U.S. Geological Survey 7.5- and 15-Minute Topographic Quadrangle Maps of the United States

View

Dates

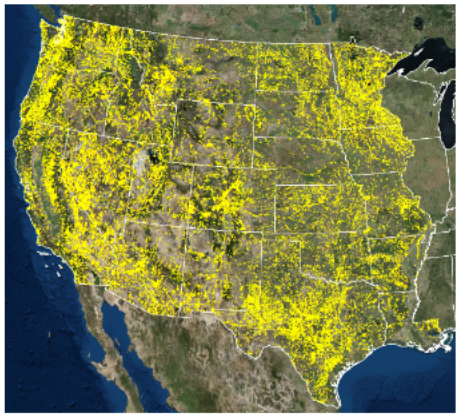
Publication Date : 2017-12-01
Start Date : 1888
End Date : 2006

Citation

Horton, J.D., and San Juan, C.A., 2017, Prospect- and Mine-Related Features from U.S. Geological Survey 7.5- and 15-Minute Topographic Quadrangle Maps of the United States: U.S. Geological Survey data release, https://doi.org/10.5066/F78W3CHG.

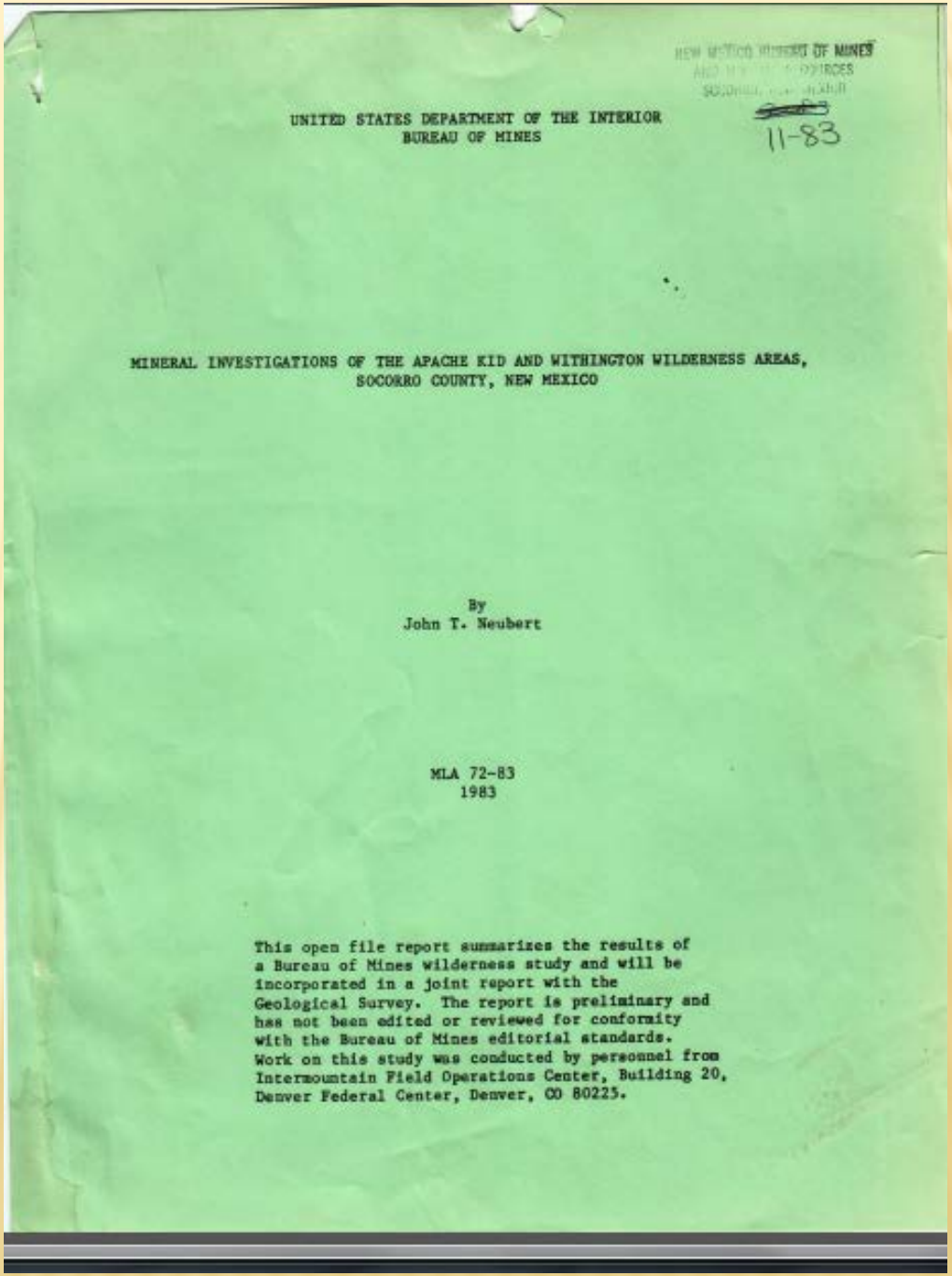
Summary

These data are part of a larger USGS project to develop an updated geospatial database of mines, mineral deposits and mineral regions in the United States. Mine and prospect-related symbols, such as those used to represent



https://mrdata.usgs.gov/,
https://www.sciencebase.gov/catalog/item/5a1492c3e4b09fc93dcfd574

USBM and USGS mineral resource assessments



UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

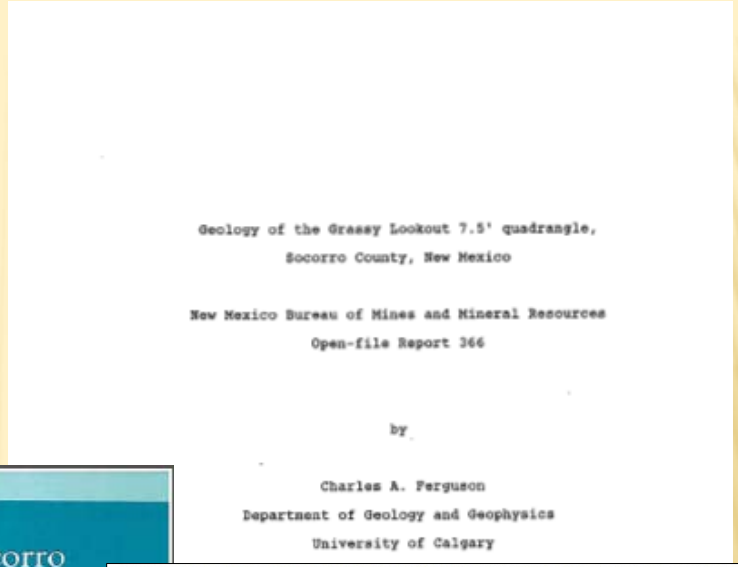
MINERAL INVESTIGATIONS OF THE APACHE KID AND WITHINGTON WILDERNESS AREAS, SOCORRO COUNTY, NEW MEXICO

By
John T. Neubert

MLA 72-83
1983

This open file report summarizes the results of a Bureau of Mines wilderness study and will be incorporated in a joint report with the Geological Survey. The report is preliminary and has not been edited or reviewed for conformity with the Bureau of Mines editorial standards. Work on this study was conducted by personnel from Intermountain Field Operations Center, Building 20, Denver Federal Center, Denver, CO 80225.

NMBGMR mapping projects, bulletins, and open file reports

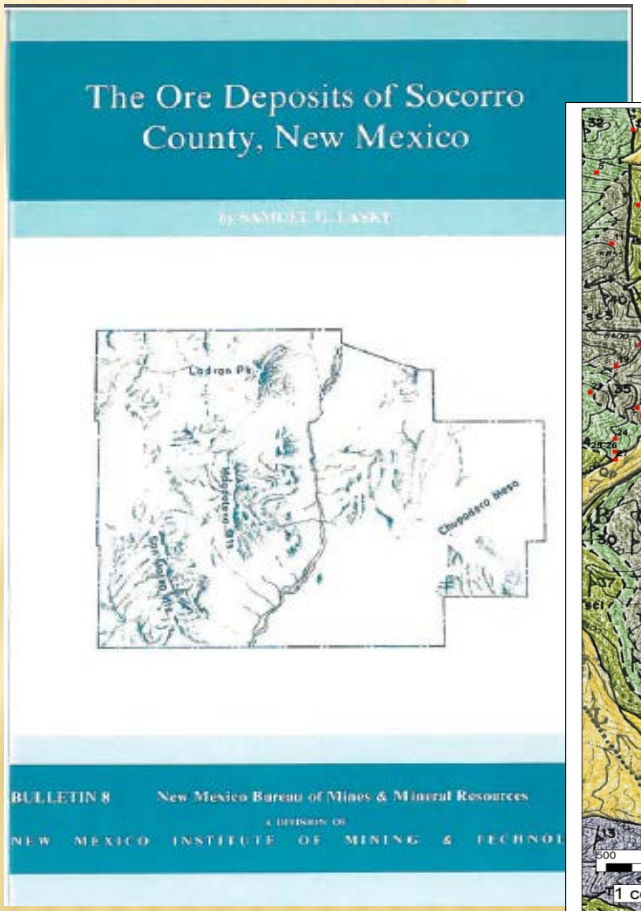


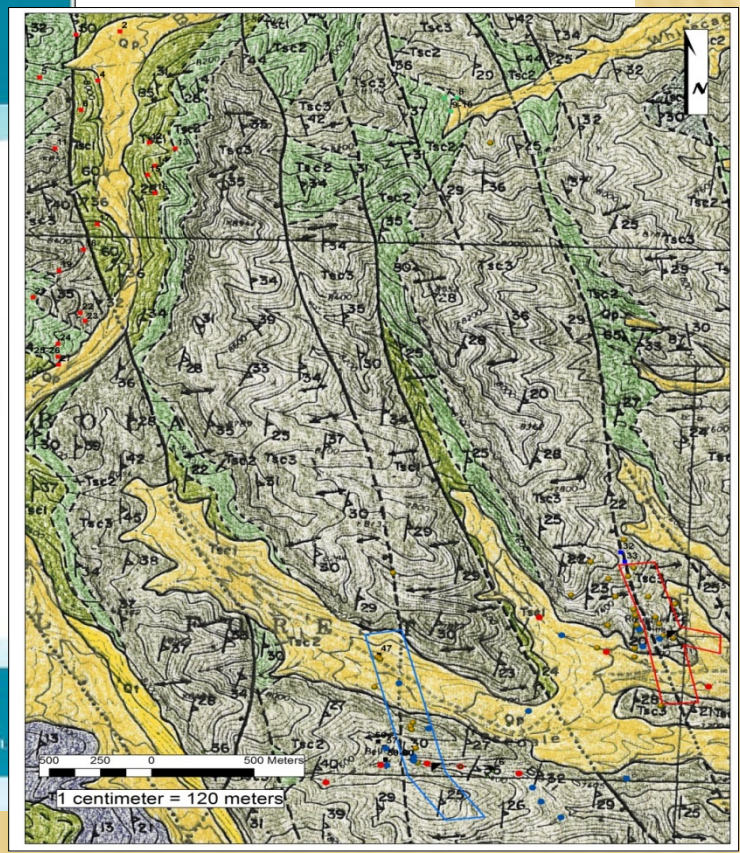
Geology of the Grassy Lookout 7.5' quadrangle,
Socorro County, New Mexico

New Mexico Bureau of Mines and Mineral Resources
Open-file Report 366

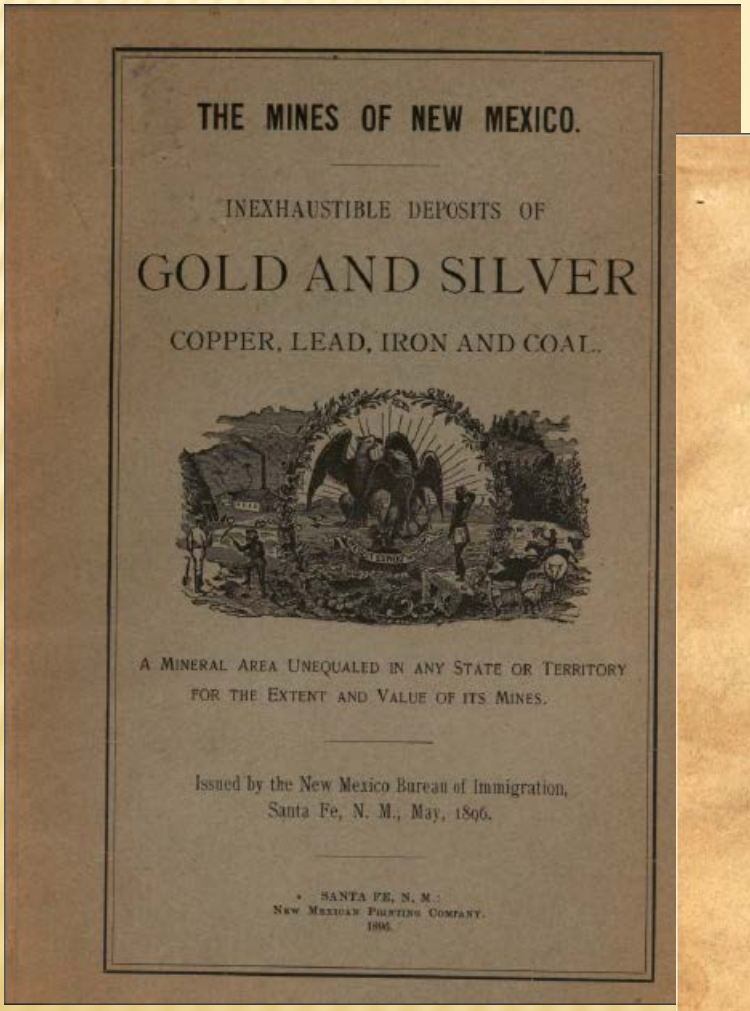
by

Charles A. Ferguson
Department of Geology and Geophysics
University of Calgary





Other reports, company reports, published and unpublished



THE MINES OF NEW MEXICO.

INEXHAUSTIBLE DEPOSITS OF

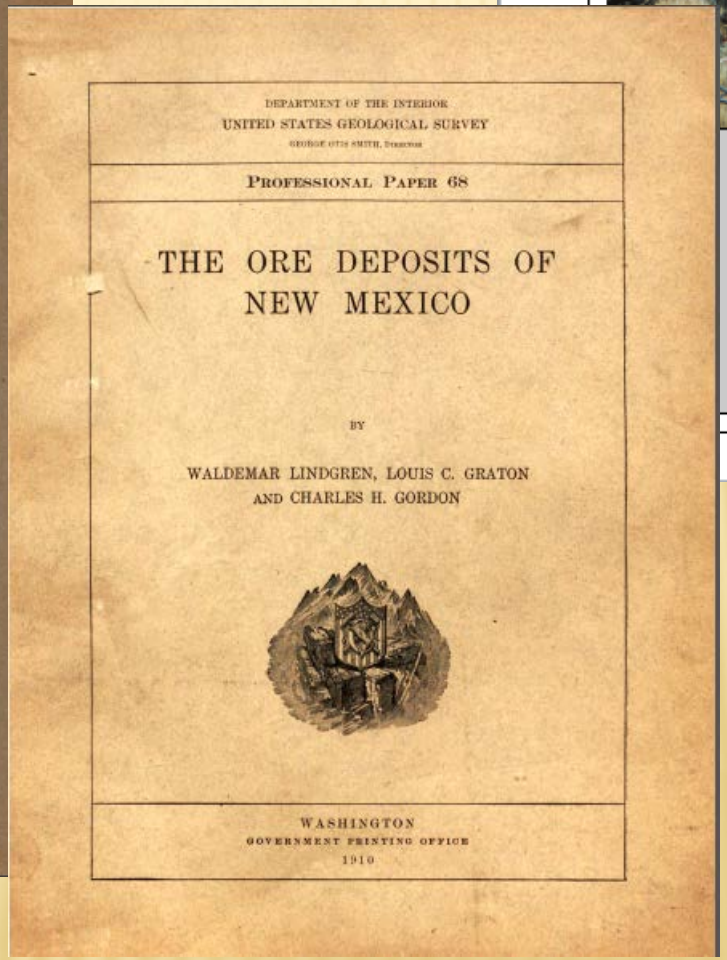
GOLD AND SILVER

COPPER, LEAD, IRON AND COAL.

A MINERAL AREA UNEQUALED IN ANY STATE OR TERRITORY FOR THE EXTENT AND VALUE OF ITS MINES.

Issued by the New Mexico Bureau of Immigration, Santa Fe, N. M., May, 1896.

SANTA FE, N. M.: NEW MEXICAN PRINTING COMPANY. 1896.



DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

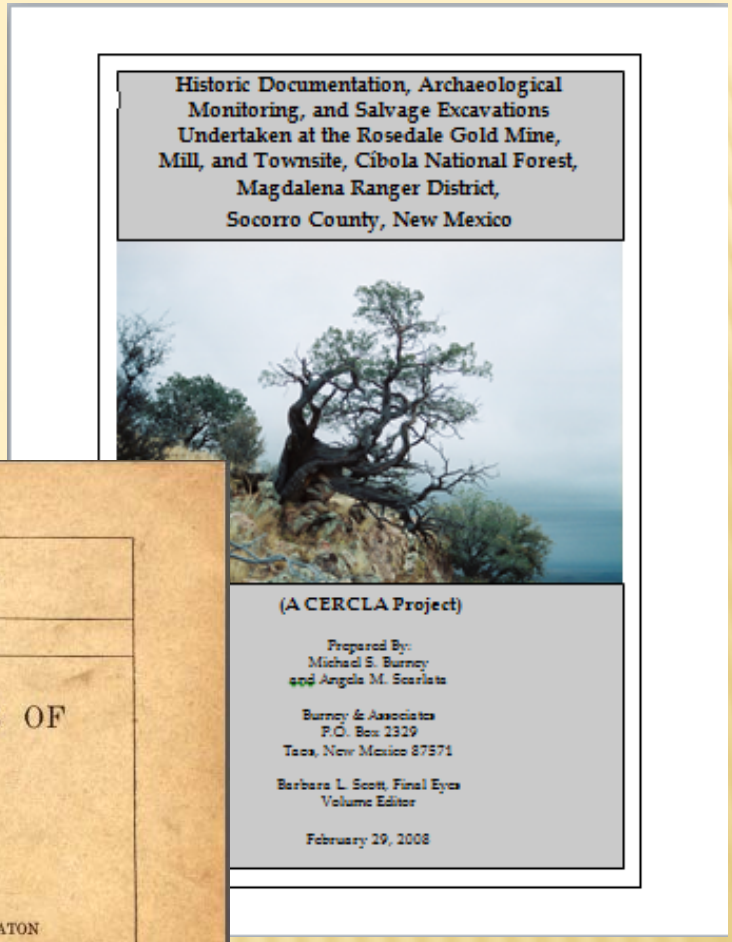
PROFESSIONAL PAPER 68

THE ORE DEPOSITS OF NEW MEXICO

BY

WALDEMAR LINDGREN, LOUIS C. GRATON AND CHARLES H. GORDON

WASHINGTON
GOVERNMENT PRINTING OFFICE
1910



Historic Documentation, Archaeological Monitoring, and Salvage Excavations Undertaken at the Rosedale Gold Mine, Mill, and Townsite, Cíbola National Forest, Magdalena Ranger District, Socorro County, New Mexico

(A CERCLA Project)

Prepared By:
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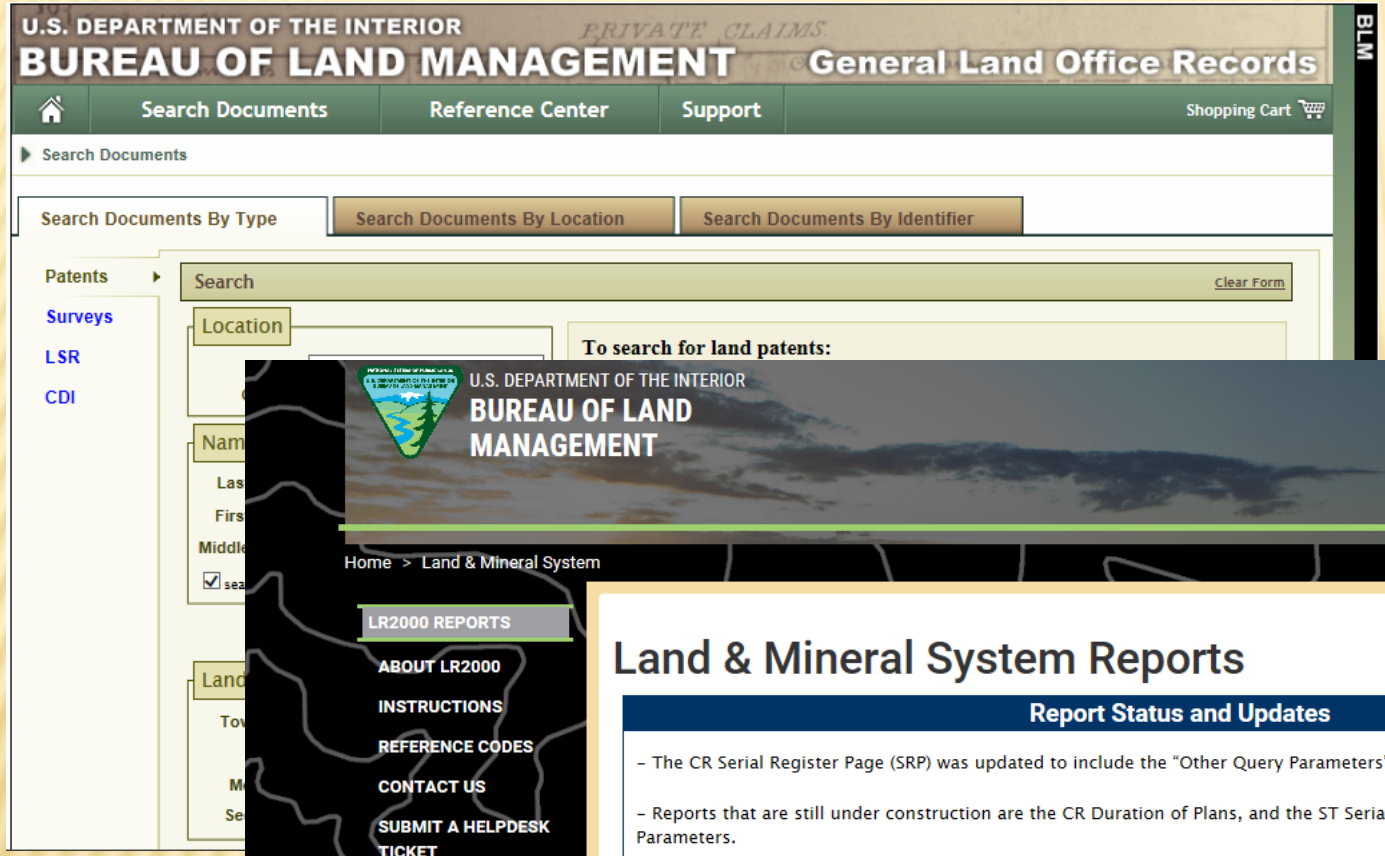
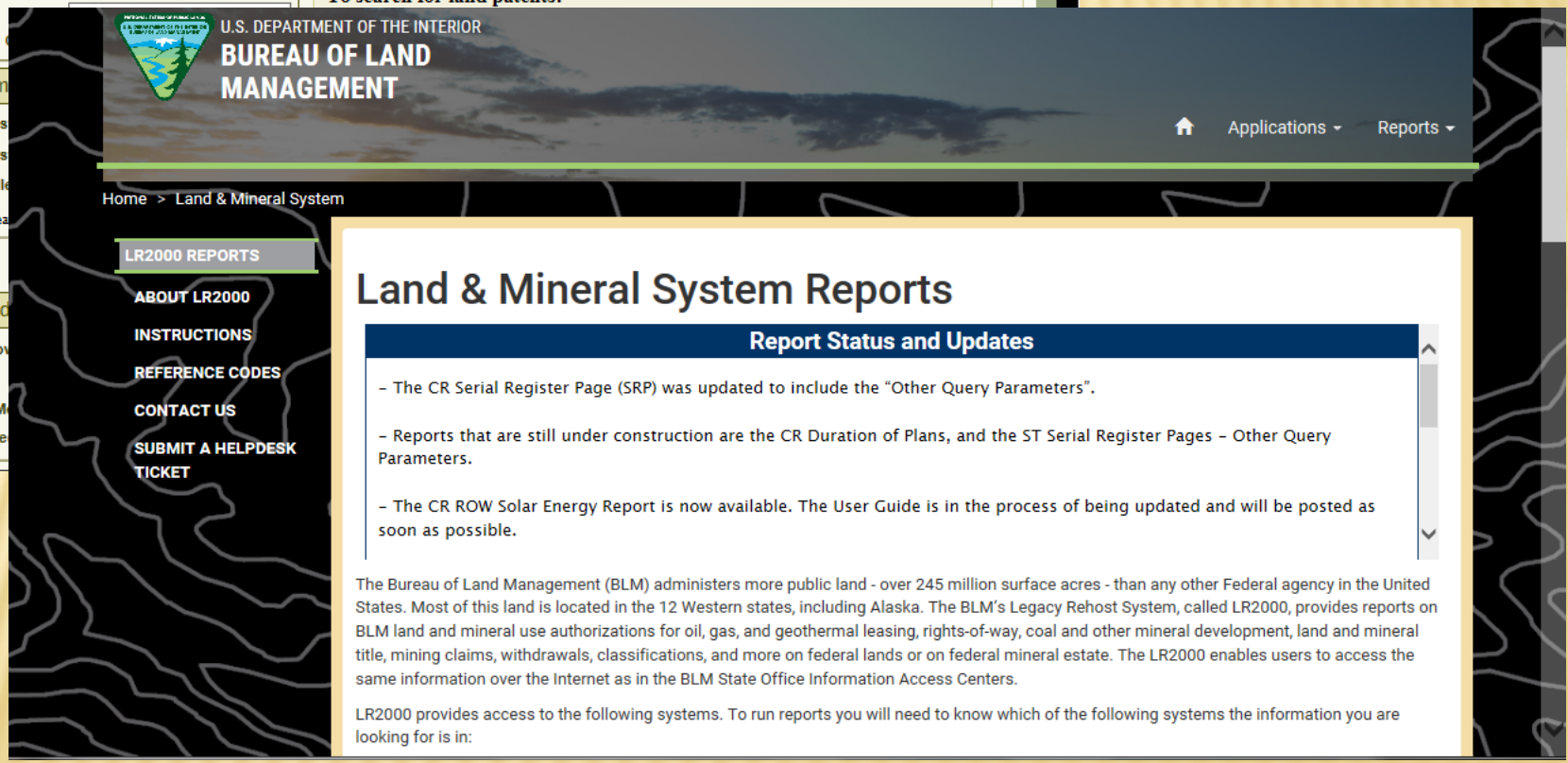
Barbara L. Scott, Final Eyes
Volume Editor

February 29, 2008

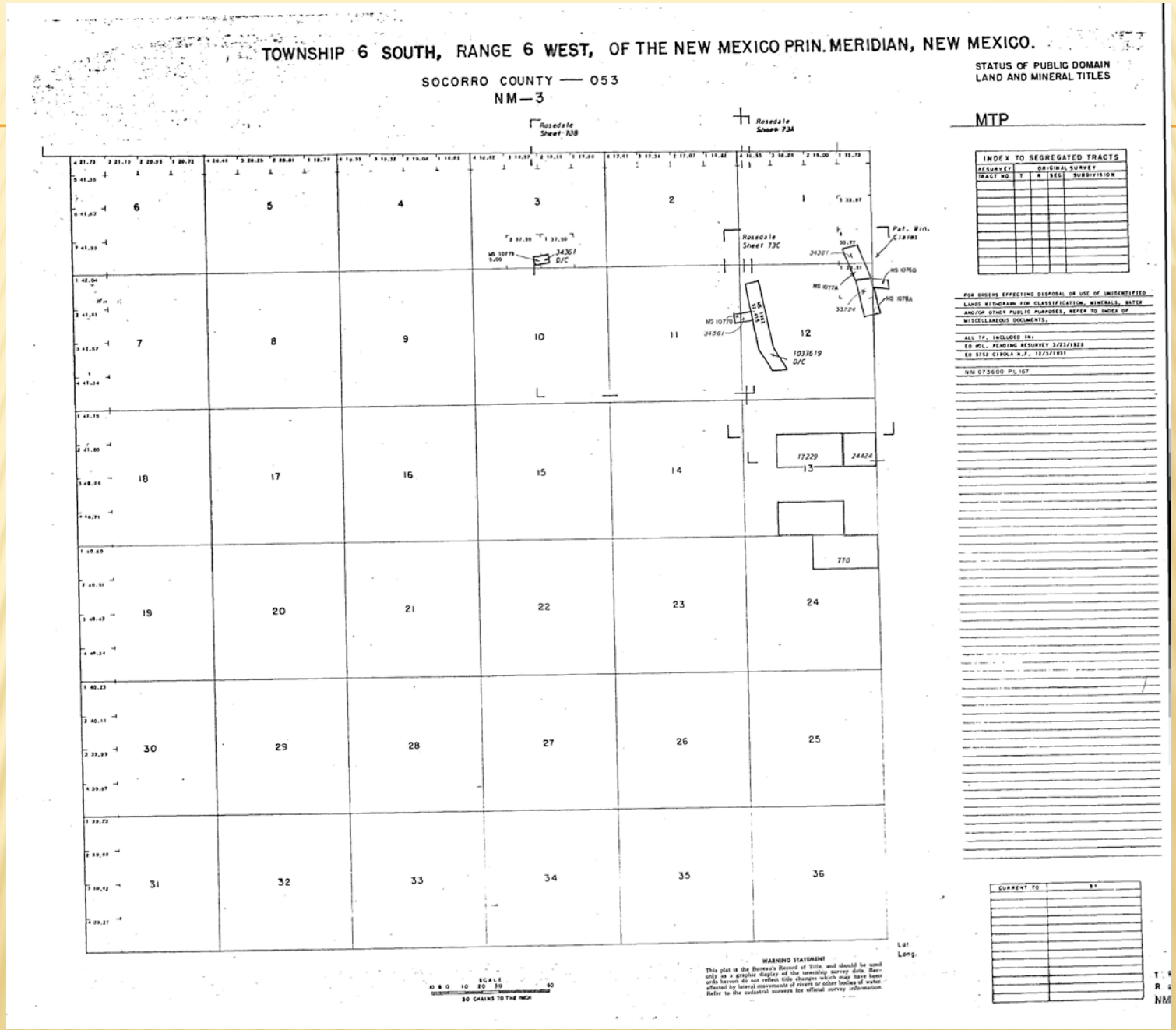
BLM mineral patents and mining claims records





https://glorecords.blm.gov/search/default.aspx;
https://reports.blm.gov/reports.cfm?application=LR2000

BLM master title plat



NMMMD active mines and permits

Contact MMD FAQs RFPs/ITBs Publications

Home Programs Commissions MMD Online GIS & Maps Information

MARP - Pending Permit Activities (Applications, Revisions, Modifications and Closeout Plans)

Follow the links below to review Mining Act Reclamation Program pending permit applications, modifications and revisions for exploration projects, minimal impact mines and regular mines, and approved and denied exploration applications. Permits are listed in each section by descending permit number.

NOTE: Approved, Denied, Withdrawn and Released sites older than approximately 6 months are removed from this website.

Application and Annual Reporting Forms
Pending Permit Activities
Announcements, Public Notices, RFP/ITB
Guidance and Guidelines
FAQ - MARP
Annual Report to the Mining Commission
Rules and Regulations

Pending Exploration Applications

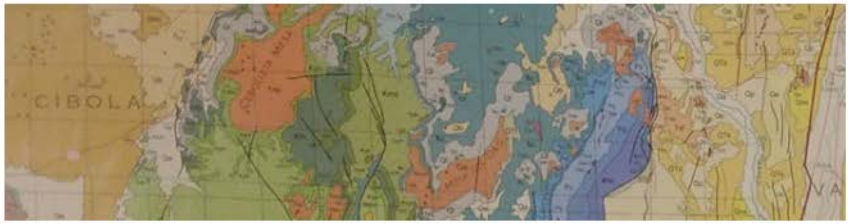
Minimal Impac
Regular Explo

Pending Mi

Minimal Impac
Minimal Impac
Regular - New
Regular - Exis

Contact MMD FAQs RFPs/ITBs Publications

Home Programs Commissions MMD Online GIS & Maps Information



GIS, MAPS AND MINE DATA

MMD uses a Geographic Information System (GIS) to locate and track its mining activities in the state. This is a computer system that can capture, store, analyze and display geographically referenced (location) information. The power of this system is its ability to draw conclusions about relationships between data that have a spatial component. GIS provides a method of displaying accurate mapping and database information to the staff and public.

http://www.emnrd.state.nm.us/MMD/MARP/MARPPermitsRevModClose.html;
http://www.emnrd.state.nm.us/MMD/gismapminedata.html

New Mexico Mines Database

Relational database in ACCESS that will ultimately be put on line with GIS capabilities

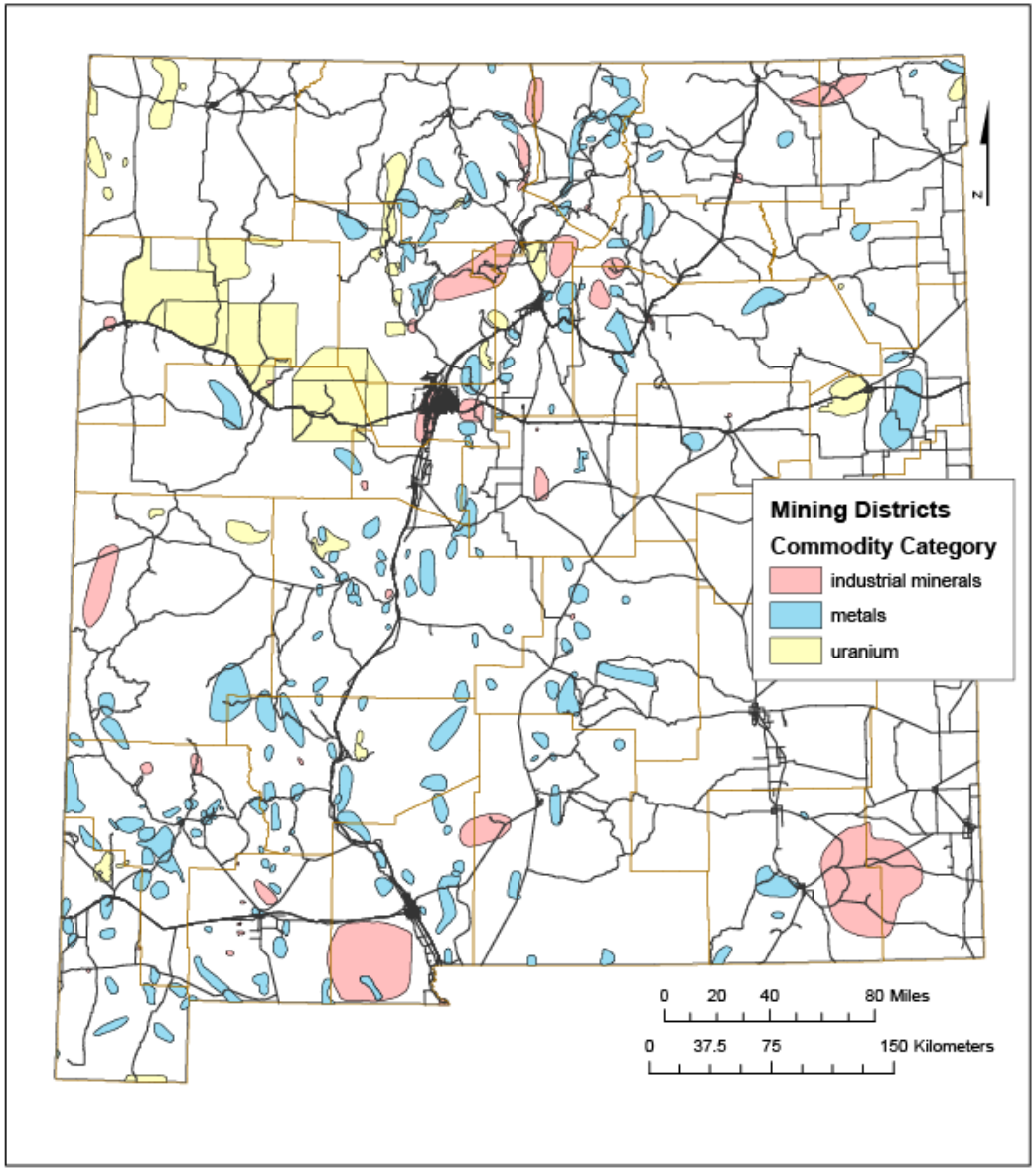
- ACCESS is commercial software and this design is compatible with other formats
- Metadata (supporting definitions of specific fields) can be inserted into the database
- ACCESS is flexible and data can be easily added to the design
- Easily imported into ArcGIS

MINING DISTRICTS AND COAL FIELDS

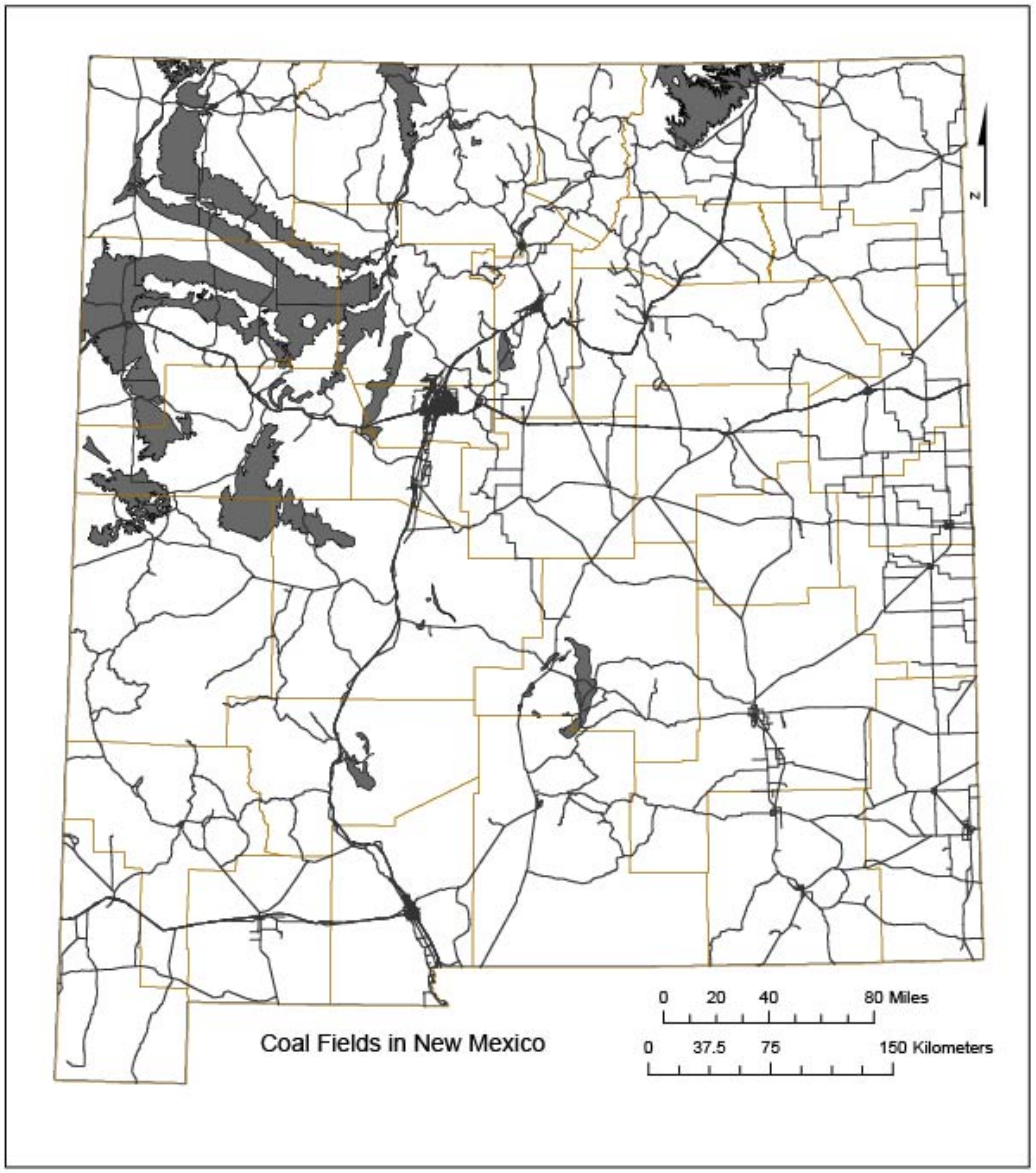
- 274 coal fields and mining districts in NM
  - ~30 districts have had zero production
- Each district is classified by predominant commodity
- Each district can have more than 1 commodity type
- 28 coal fields
- 40 industrial minerals districts
- 173 metals districts
- 32 uranium districts


Chino copper mine


San Juan coal mine



MINING DISTRICTS IN NEW MEXICO



COAL FIELDS IN NEW MEXICO

MINES

- Each mine is classified by predominant commodity
- Each mine can have more than 1 commodity type
- 9000 mines in the database that include active, inactive, abandoned, and exploration sites
- Not all mines have workings
- Some mines have multiple workings

Questa mine, Taos County

MINE INVENTORY

STEPS

- Inventory the mines and mine features
  - History of the site (production, commodities, mine methods, processing facilities)
- Preliminary characterization
  - Paste pH, mineralogy, chemistry
- Prioritize mine features
- Detailed characterization
  - Detailed mineralogy and chemistry
  - ABA/NAG tests
  - Particle size analyses
  - Shear tests

Available Data

- Location (= GIS, point and polygon data, QA/QC)
- Production, reserves, resource potential significant deposits, drillhole data
- Geologic
- Geochemical (rock, water, etc.)
- Environmental
- Water well data
- Historical and recent photographs
- Mining methods, maps
- Ownership
- Other data

Environmental Data

- Commodities produced and present
- Potential hazardous materials
- Evidence of potential acid drainage
- Hydrology
- Receiving stream
- Reclamation
- Mitigation status
- Sensitive environments
- Chemical data (both solids and water)

INVENTORY SHEETS

Mine Entry

NM Bureau of Geology and Mineral Resources

Mine ID _____ **Mine Name** _____

District id _____ **District** _____

☐ **Active Location:** _____ ☐ **Too Dangerous to Approach**

☐ **Historic/legacy location:** _____ ☐ **Aggregate mine**

Latest year of infomation _____

LOCATION

County _____ USGS Quadrangle _____

Location Assurance _____ Location Reference _____

Latitude _____ Longitude _____ Coordinate system _____

Township _____ Range _____ Section _____ Subsection _____

UTM Northing _____ UTM Easting _____ UTM zone _____

Elevation _____ Elev. Source _____

Location Notes

GENERAL MINE HISTORY

Commodity Catergory _____ Production Category _____

Year of Initial Production _____ Year of Last Production _____ Year of Discovery _____

Commodities Produced Commodities Present Not Produced

FEATURE DESCRIPTION _____

Development _____

Access _____ Visibility _____ Known Multiple Entrances _____

Depth _____ Length/height _____ Width: _____

Disturbed acres _____ Reclaimed acres _____ Mining Methods _____

Condition Mine Feature _____ General Slope _____

Aspect (trending direction)/ slope of feature _____

Surface Land Status _____ Minerals Land Status _____ Ownership _____

CULTURAL SIGNIFICANCE **Note UTM for sites in field notes! They get entered into another database.**

Cultural resources _____ Description of features _____

Archeology site no.: _____

GEOLOGY

Host Formation: _____

Geology: _____

Stability: _____ Rock type: _____

Mineralogy: _____

Nonore mineralogy: _____

Type of deposit: Size of deposit: _____

Alteration: _____ Soils: _____

TERRAIN

Type of terrain: _____ Land use: _____

Mine: District: 5/28/2017

Mine Entry

NM Bureau of Geology and Mineral Resources

☐ Is water present? ☐ Is waste rock present? ☐ Subsidence? ☐ Maintenance Required?

Recent Human Use: _____

Sensitive environments: _____

Erosion: _____

HYDROLOGY

Hydrology: _____ Receiving Stream: _____

Water drainage: _____ Floodplain: _____ Aquatic Life: _____ Color of Water: _____

Evidence of potential acid drainage: _____

Ecosystem

Vegetation: Vegetation density: _____ Vegetation type: _____

Animals: _____ Animal rating: _____ ☐ Are bats present? ☐ Are owls present?

ENVIRONMENTAL DATA AND POTENTIAL HAZARDS

Radiation readings: _____

Air quality/condition: _____ Mitigation Status: _____

Reclamation: _____ ☐ Trash In Mine?

Circle the number or value that is correct!

BLM Danger Level	0	remediated	remediated
	1	None	no danger level
	2	Low	sites located more than a quarter mile
	3	Medium	sites near historic mining towns, historic schools, recreation areas, parks, camps, or trails
	4	High	sites near homes or school, within a quarter mile of one or more AML sites
	5	Extreme	extreme danger level
	6	Unknown	unknown danger level, not visited
	7	active mining	active mining, reclamamtion planned or underway

NOAMI	A	highest class, deep unprotected openings to surface, Hazardous openings on surface, crown pillars, waste rock piles with ARD and radioactive
	B	deep unprotected openings to surface such as shafts, raises and open stopes. Hazardous openings on surface, crown pillars, waste rock piles wit
	C	hazardous openings to surface, waste rock piles and possible dilapidated structures associated with the mine openings, no tailings or tailings are
	D	minor surface features only such as trenches, test pits and stripping, no tailings
	O	no information

Are lead or sulfide minerals present? Note here also.

Potential hazardous materials: _____

Comments:

Recommendations:

☐ Remediated? **Data Reliability** Data reliability: Inspected by: Date inspected:

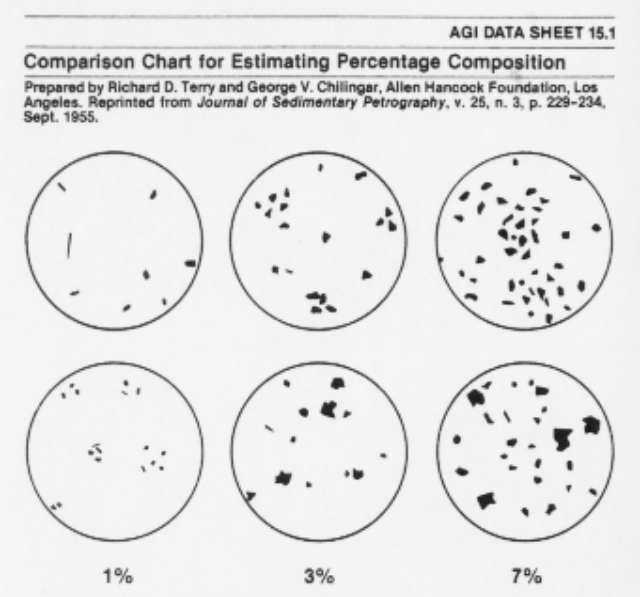
Verified by: Date last modified:

Mine: District: 5/28/2017

MINERALOGY AND CHEMISTRY

- Petrography
- Whole rock geochemistry
  - Critical minerals
- Paste pH
- Mineralogy
  - XRD
  - Electron microprobe
  - Chemical analyses of minerals, esp. pyrite

SOIL PETROGRAPHY–FIRST STEP IN DETERMINING MINERALOGY

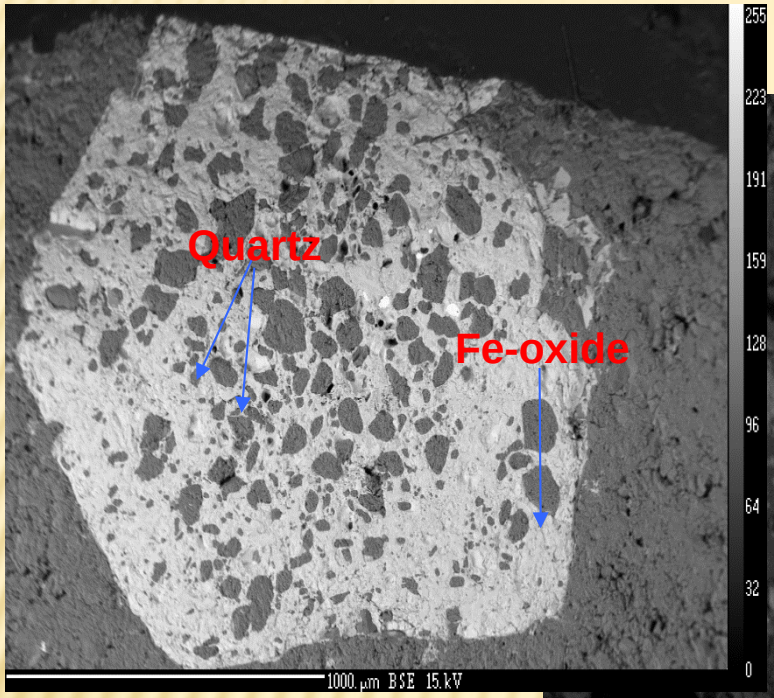


2 mm

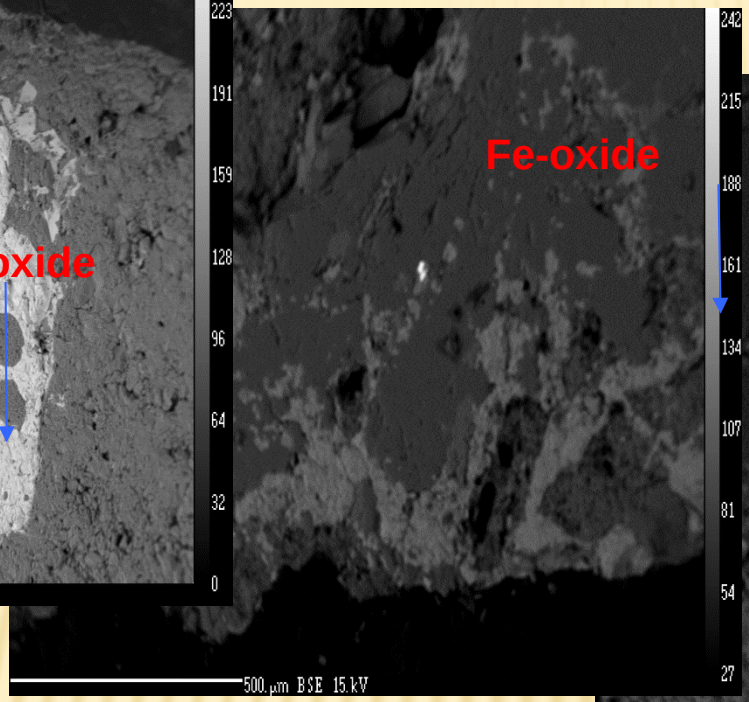
Pyrite characterization

Evaluate the distribution, form, size, amount, surface area of pyrite in the rock piles

MICROPROBE ANALYSIS (BSE) IMAGES



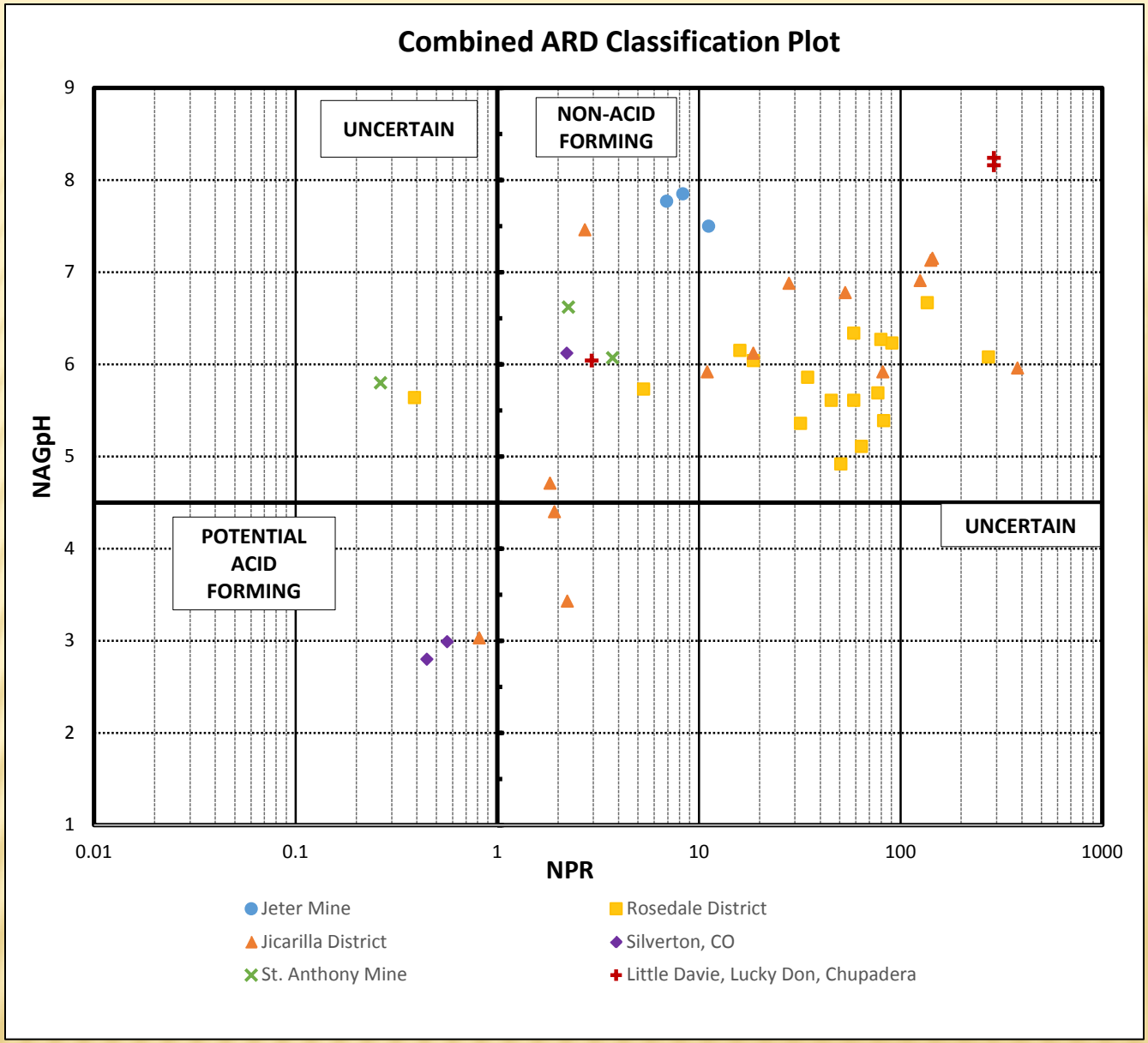
a)



b)

c)

a) Backscattered electron images of quartz grain replacing Fe-oxide in sample Jic410. This is likely supergene replacement.
b) Backscattered electron images of Fe grain in sample Jic412. Note how altered and pitted the grain is.
c) Backscattered electron images of pyrite grain in sample Jic412 c. Note how pristine the pyrite grain is.



Acid Rock Drainage (ARD) plot of waste rock pile at mines examined during the NMBGMR AML project.

HAZZARD RANKING

National Orphaned/Abandoned Mines, Canada, http://www.noami.org/intro_e.php?language=English

NOAMI Class	Description
A	A site with potential to cause environmental, public health and public safety concerns
B	A site with limited potential to cause environmental concerns but with potential for public health and safety concerns
C	A site with public safety concerns but little or no public health or environmental concerns
D	A site with no expected environmental, public health or public safety concerns
O	Information is not available
R	Remediated

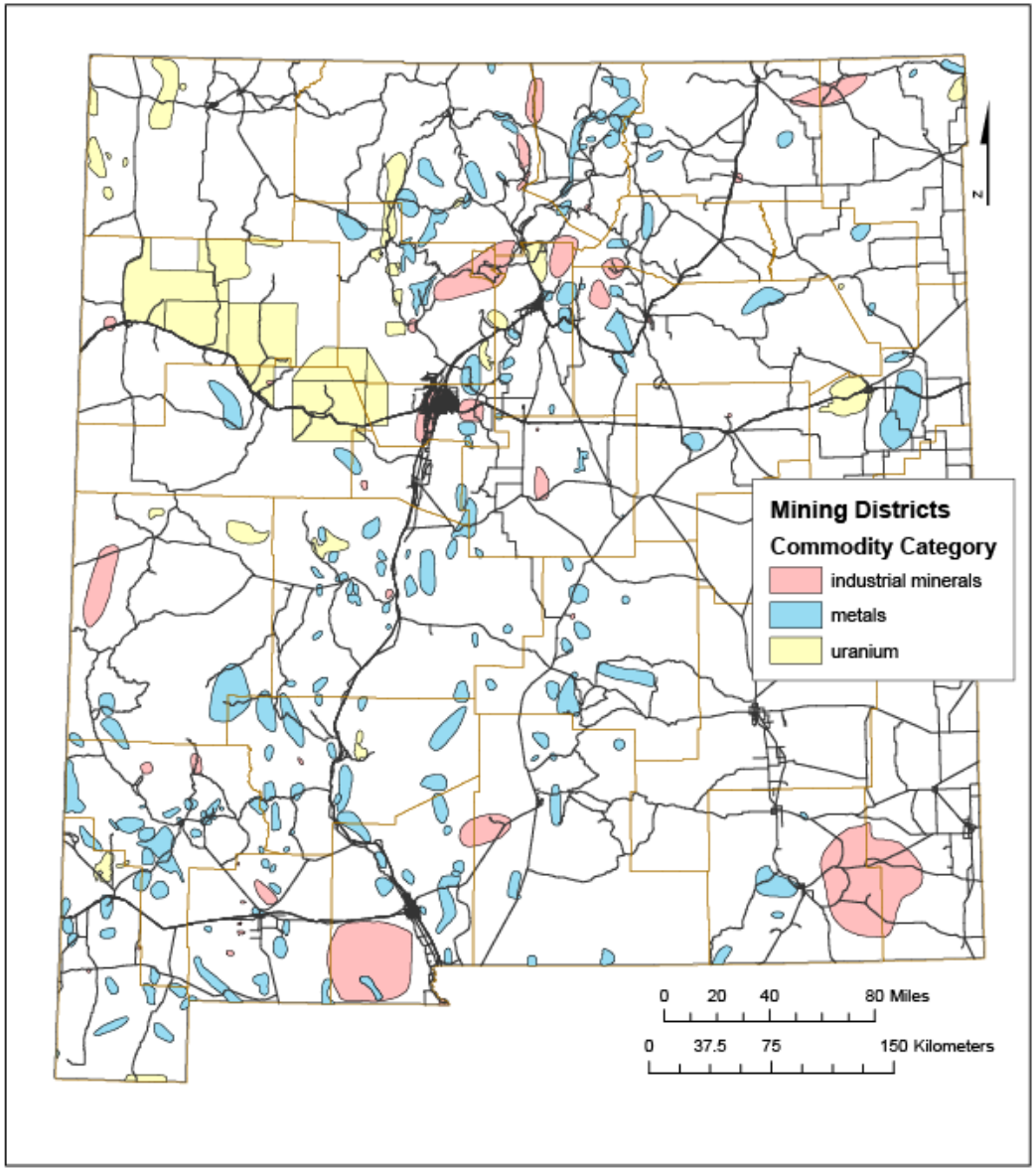
GENERAL COMMENTS

- Many of the critical minerals do not require the tonnages we are used to mine for metals like Fe, Cu, Pb, Zn—i.e. smaller deposits
- Some of these minerals are found in only 1-3 deposits in the world
- Some of these minerals are found in areas of the world that may not be economically unstable or particularly friendly to the U.S.
  - Minerals that provide major revenue to armed fractions for violence, such as that occurring in the Democratic Republic of Congo (GSA, Nov. 2010)
- Some of these minerals come only from the refining of metal deposits and are dependent upon that production
  - Many Cu and Au deposits utilize heap leach technology, which leaves other potential minerals unrecovered in the heap leach

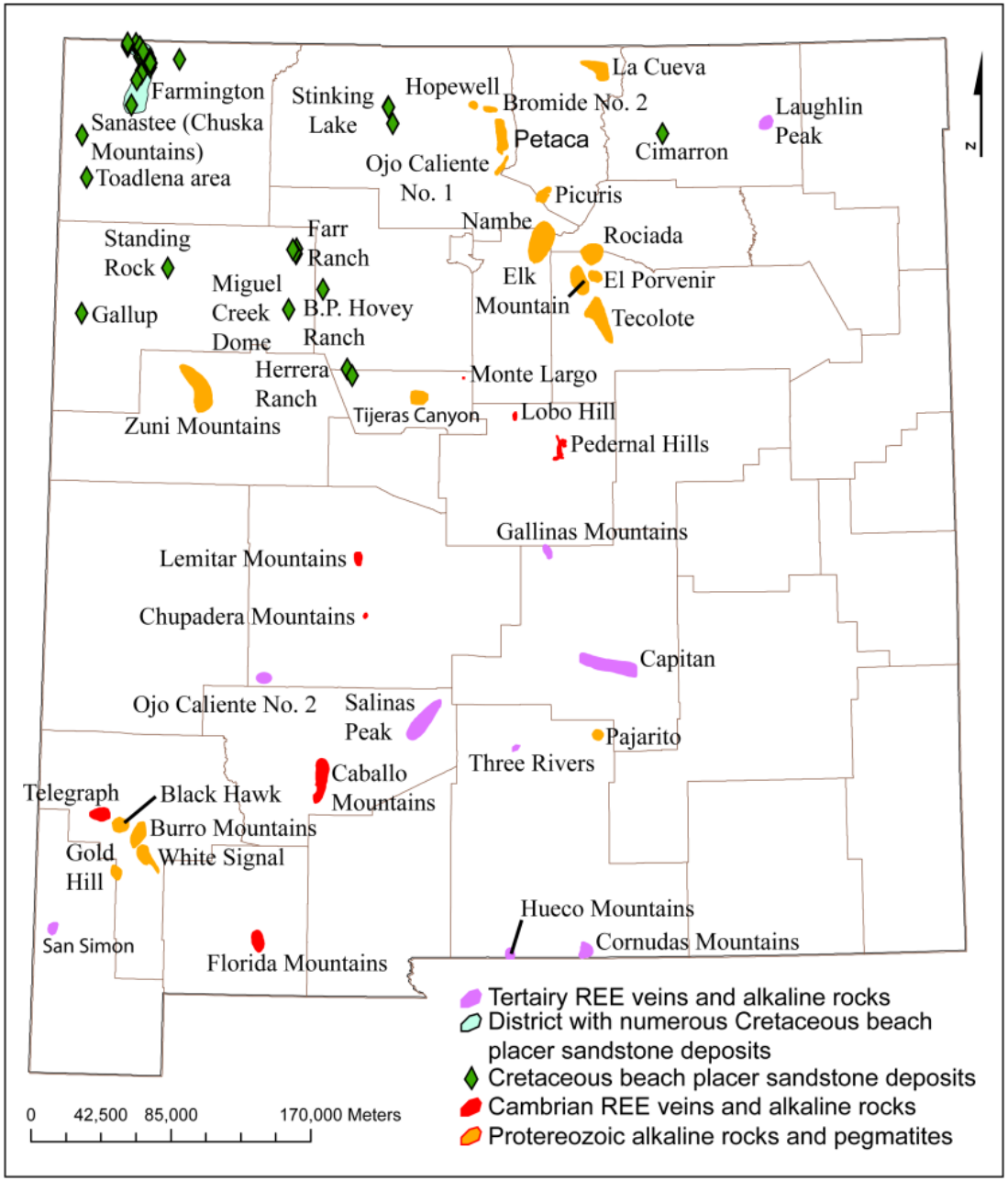
WHERE ARE CRITICAL MINERALS FOUND IN NEW MEXICO?

WHERE ARE CRITICAL MINERALS FOUND?

- Minerals are found in specific mineral deposits containing predominantly one or more of the mineral—Cu, Pb, Zn, Ni, PGM, Fe, Mo, REE, Be, etc.
- Minerals are found as a by-product or trace element in another type of mineral deposit and would be recovered only if metallurgical technologies are available and economically feasible—Cd, Se, Mo, Te, Au, Ag, etc.
- Minerals are extracted from the material remaining after refining of metals (anode slimes)—Ga, Ge, In, etc.



MINING DISTRICTS IN NEW MEXICO

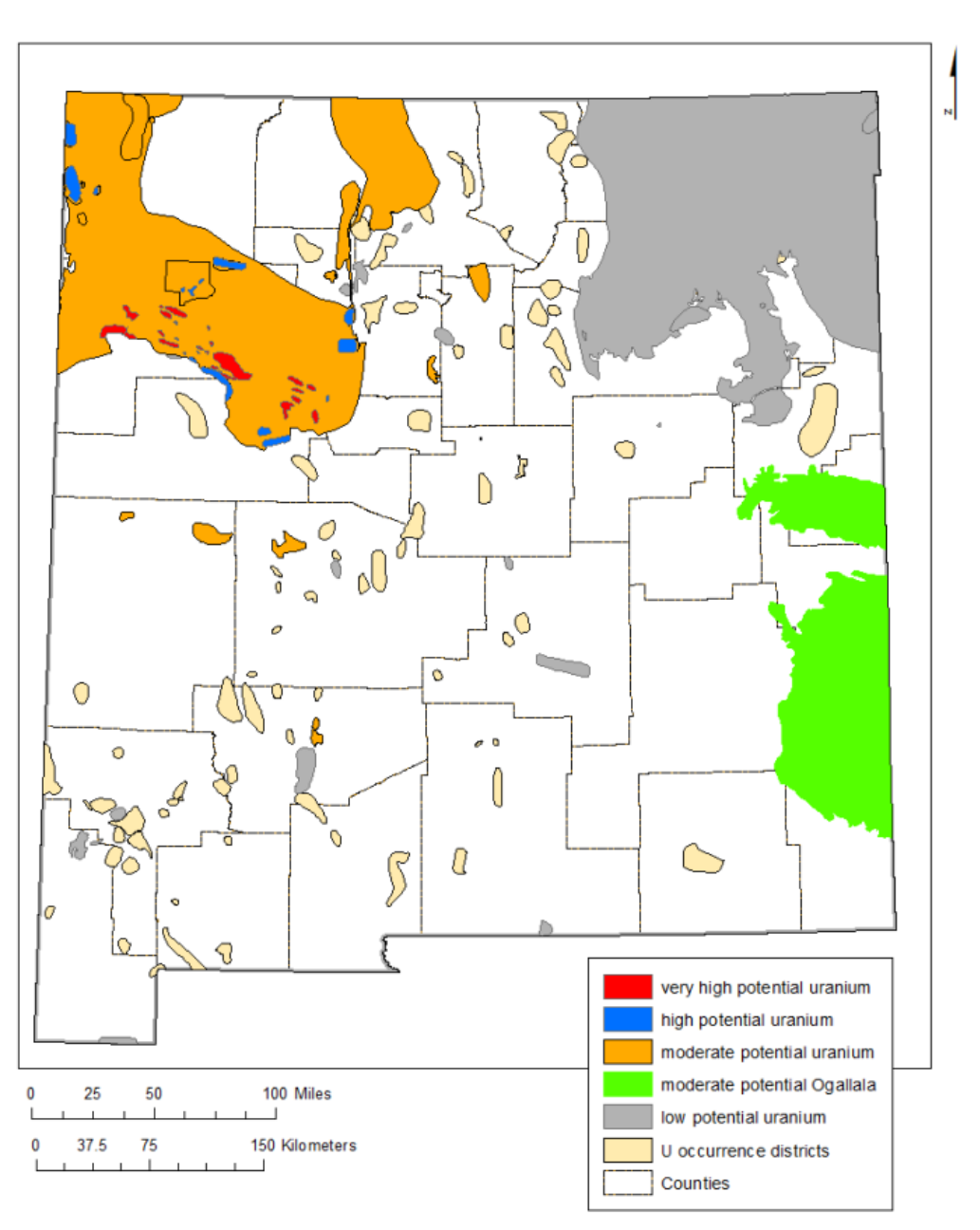


Rare earth elements (REE) in NM

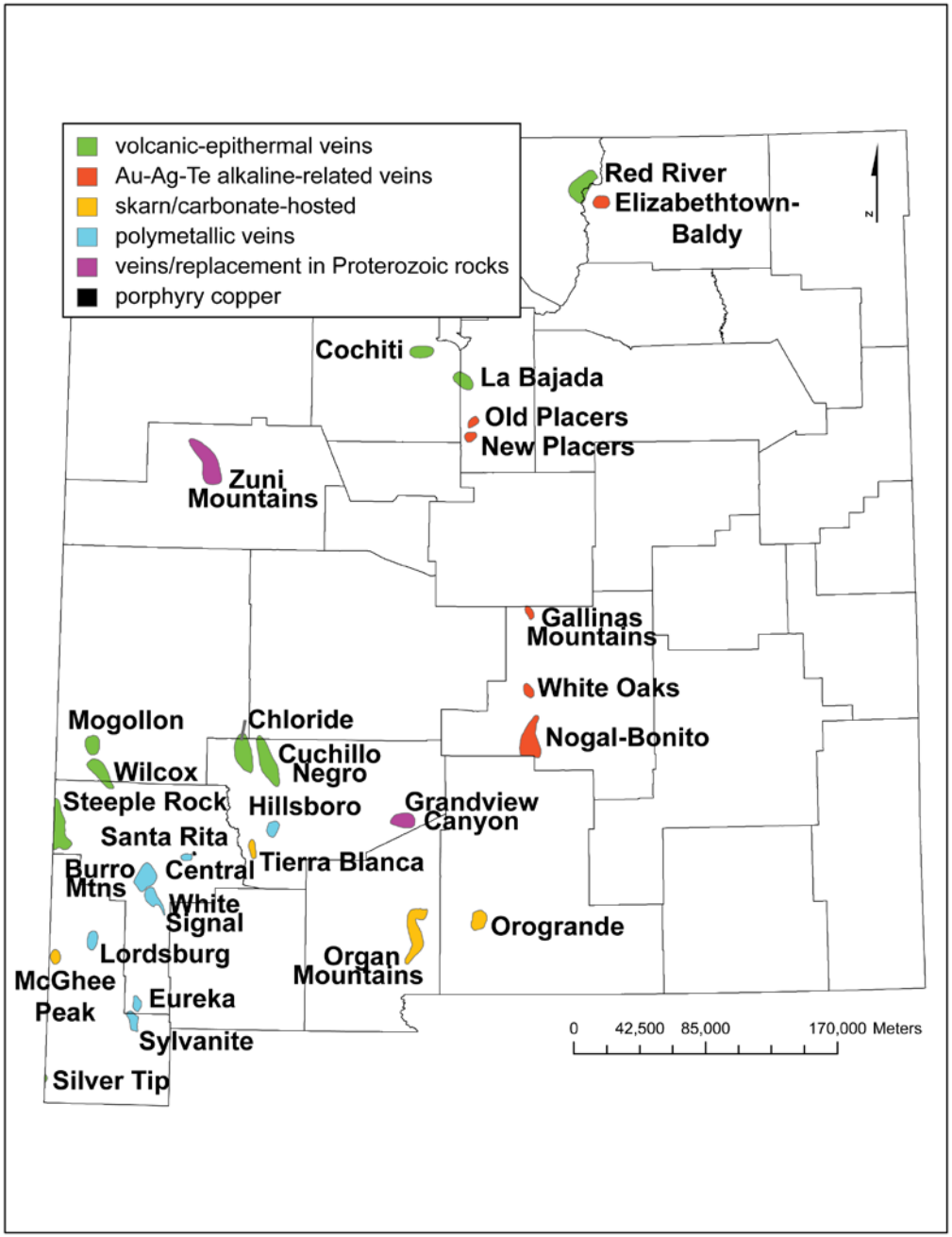
Exploration is or has occurred in the Lemitar, Gallinas, and Cornudas Mountains

Drilling at Pajarito Mountain, Spring 2014

Mining claims staked in the Caballo Mountains

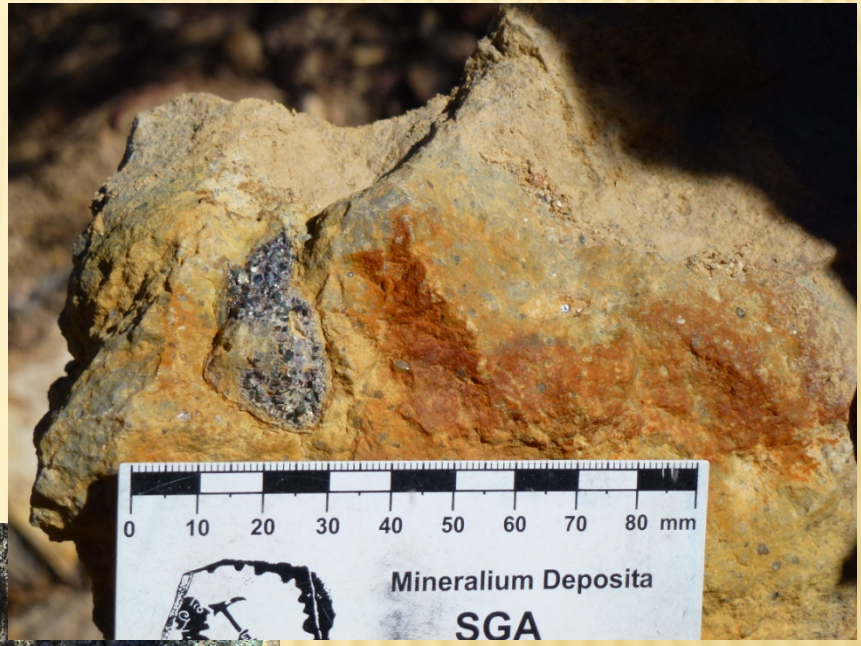


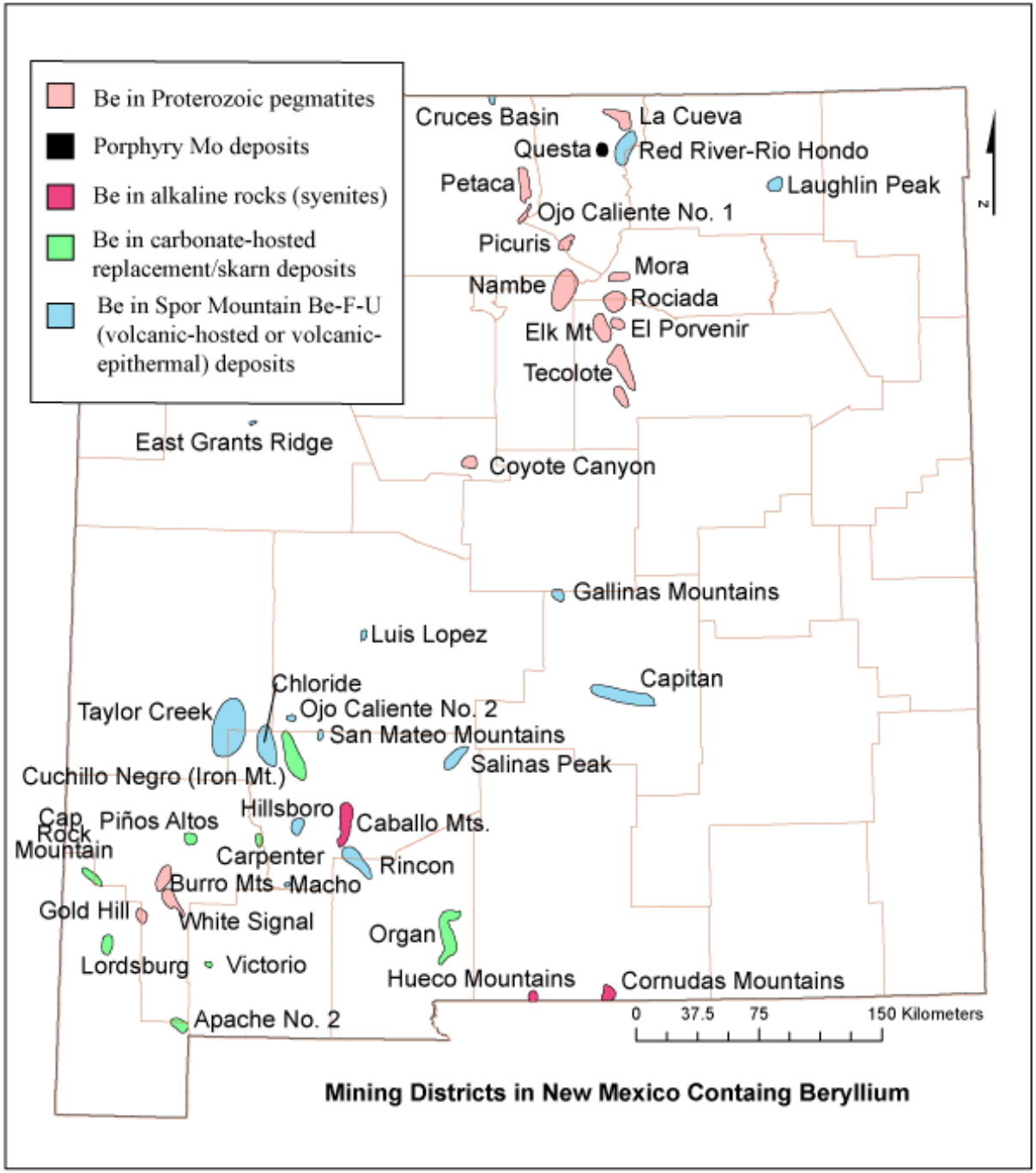
Uranium in New Mexico



Mining districts in New Mexico with tellurium minerals or chemical assays >20 ppm Te

Lone Pine, Wilcox district, Catron County—volcanic epithermal vein

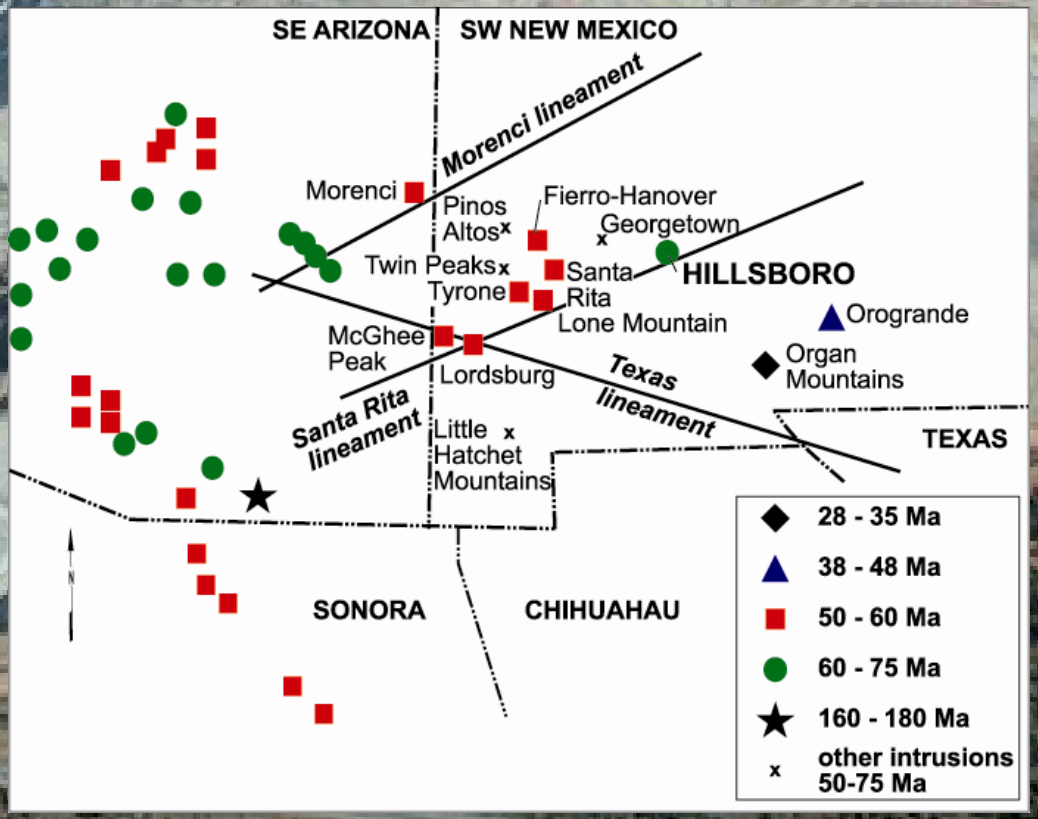




Mining districts in New Mexico that contain beryllium (Be). More details are in McLemore (2010)

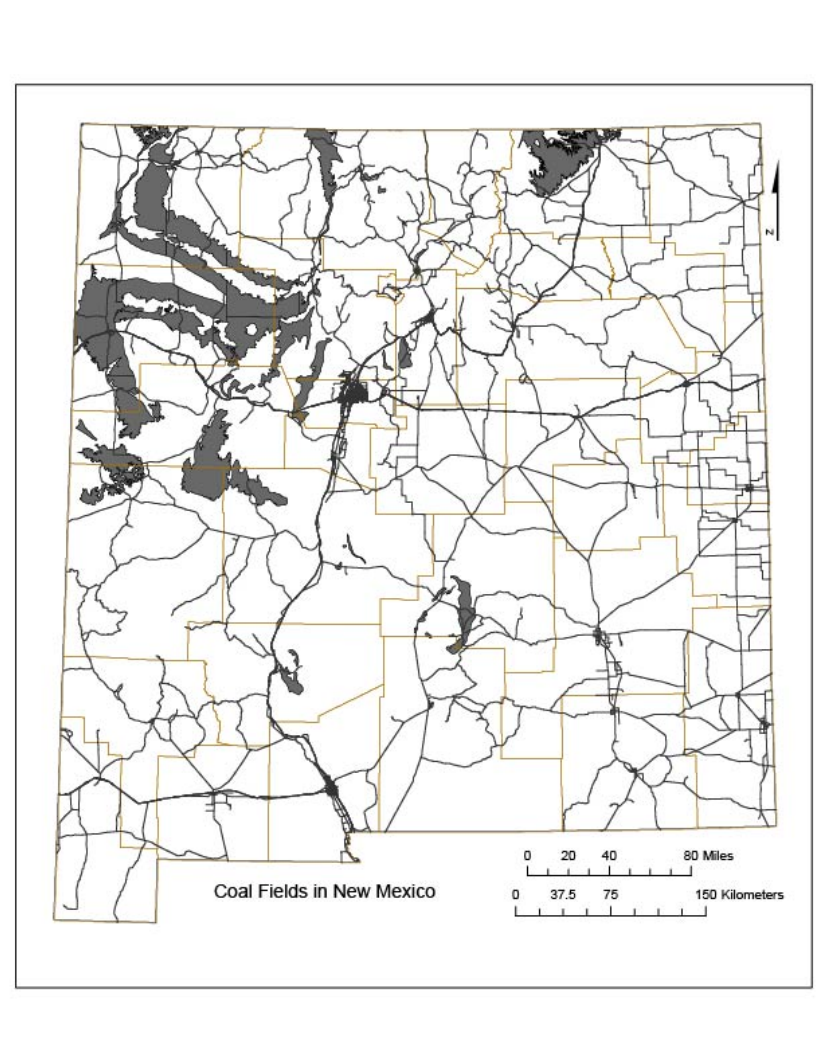
Porphyry copper deposits

- Current
  - Gold
  - Silver
  - Molybdenum
- Possible
  - Tellurium
  - Gallium
  - Germanium
  - Indium
  - Others



POTENTIAL CRITICAL MINERALS IN COAL

- REE
- Be
- Se
- Humate
- Other critical minerals??



SOME OF THE CHALLENGES IN PRODUCING THESE TECHNOLOGIES

- How much of these minerals do we need?
- Are there enough materials in the pipeline to meet the demand for these technologies and other uses?
- Can any of these be recycled?
- Are these minerals/elements environmental friendly—what are the reclamation challenges?
  - REE are nearly always associated with U and Th and the wastes from mining REE will have to accommodate radioactivity

FOR MORE INFORMATION

- http://geoinfo.nmt.edu/geoscience/hazards/mines/aml/home.html
- http://geoinfo.nmt.edu/staff/mclemore/projects/environment/home.html

QUESTIONS?