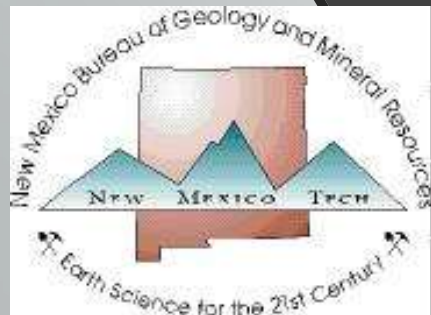


NEW MEXICO AML PROJECT: INVENTORY AND CHARACTERIZATION OF INACTIVE/ABANDONED MINE FEATURES

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- B.S. degrees in Geology and Geophysics (1977) and M.S. degree in Geology (1980) from New Mexico Tech and Ph.D. in Geoscience from University of Texas at El Paso (1993)
- Background in mapping, characterizing mineral resources in NM, mineral-resource evaluation, and environmental effects on mining wastes
- Research topics include New Mexico Mines Database, geology of critical minerals (including rare earth elements), economic geology of New Mexico, and weathering of mine wastes

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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



Purpose—continued

To make informed decisions about

- Economic impacts
- Resource development and management (mineral resource potential)
- Impacts on water supplies
- Impacts on land use
- Environmental impacts (including potential sources of AD [acid drainage] or other MIW [mine influenced waters])
- Physical hazard assessment and remediation



Adit, Jicarilla Mountains, Lincoln County



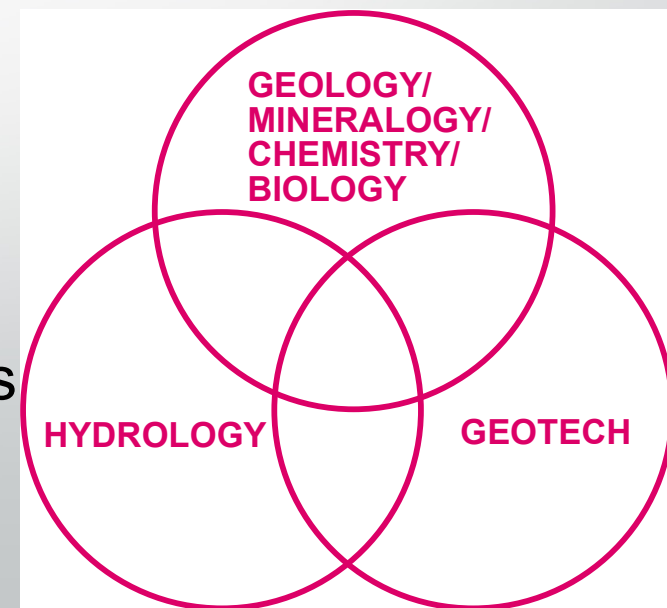
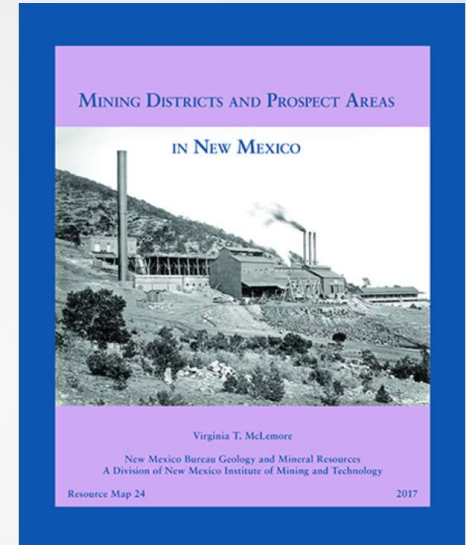
M.I.C.A. mica mine (closed)

Available Data

The New Mexico Bureau of Geology and Mineral Resources (NMBGMR) has been collecting data on mining districts since it was created in 1927

The task is to convert these data into electronic form and import into ArcGIS

And identify the data gaps for future studies



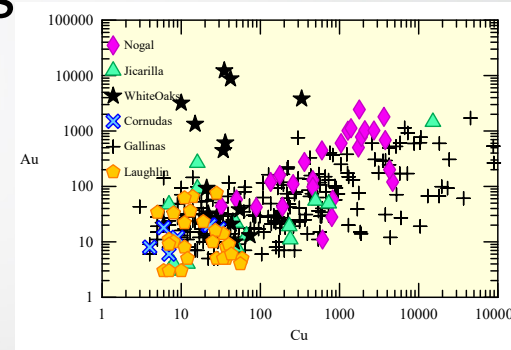
New Mexico Mines Database

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

- Includes information on mining districts and coal fields and individual mines
- 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

Selected Past and Ongoing Projects

- Questa weathering study—examine the effects of weathering on the stability of the Questa mine waste rock piles
- Geochemistry of legacy mines
 - Mines in Sierra and Otero Counties
 - Uranium mines, Socorro and McKinley Counties
 - Mines in Gallinas Mountains district, Lincoln County



Gold vs copper, alkaline-related deposits

- Pecos River project—examine stream sediments and water samples above and below a volcanic massive sulfide mine and mill
- Uranium study group—examine the mobility of uranium in the Grants district
- Inventory of AML in New Mexico (New Mexico Mines Database)

Preliminary conclusions

- Mineralogy and chemistry are important characteristics to understand
 - Whole-rock geochemical analyses are needed to determine the potential for critical and other minerals that could be recovered (re-mining)
- Poor understanding of effects of weathering on the degradation of materials
 - Predominant weathering reactions in the Questa GHN rock pile are oxidation of pyrite, dissolution of carbonate, and formation of sulfate minerals (gypsum, jarosite, and soluble, efflorescent salts)
 - Clays are predominantly from the pre-mining hydrothermal alteration, not the result of chemical precipitation in the Questa rock piles under low pH during weathering over the last 25-40 years
- Poor foundation conditions
 - Weak materials like clay, altered, fractured rock

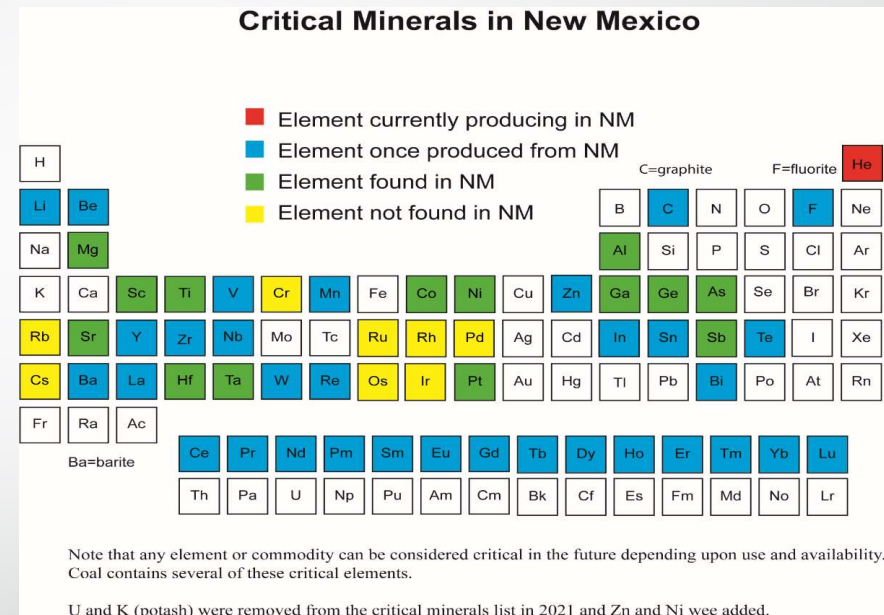
Every site is different and must be specifically characterized

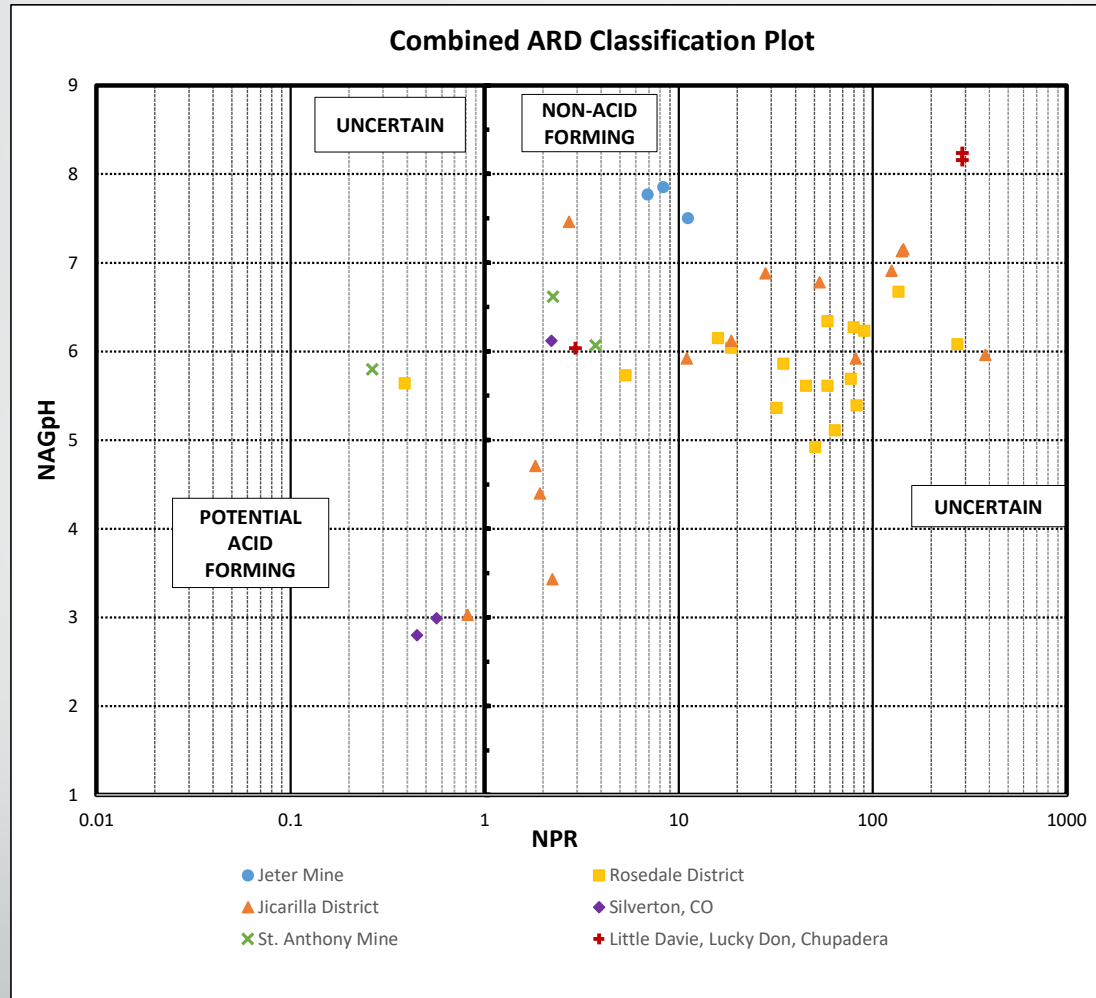
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 - U.S. Army Corps of Engineers
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 - Chevron Mining Inc. (formerly Molycorp, Inc.)—Questa project
 - New Mexico Geological Society student grants
 - NMIMT Brightstar Scholarship Program
 - NMBGMR and NMIMT Mineral Engineering Department
- Numerous M.S. theses
- Professional staff and many students who worked on these projects

Definitions

- AML—Abandoned mine lands (AML) are areas that were mined and left unreclaimed where no individual or company has reclamation responsibility (also called inactive, legacy and orphaned mines)
- Critical mineral—*is a mineral (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, and (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*





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