GEOCHEMISTRY OF CRITICAL MINERALS IN MINE WASTES IN NEW MEXICO

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AML Project (nmt.edu)
Purpose Of NMBGMR Mine Wastes Program

- Test USGS procedures
- Provide data on districts, mines, and mills in New Mexico
  - Help plan and assess reclamation procedures
  - Determine background concentrations
  - Understand geologic processes
  - Identify and quantify critical mineral potential
  - Compare trace-element concentrations in mined versus undisturbed areas
  - Provide background data that can assist with the planning of future mining operations
Critical Minerals in New Mexico in 2024

- Element currently producing in NM
- Element once produced from NM
- Element found in NM
- Element not found in NM (except in trace amounts)

- Formerly a critical mineral (He, K are being produced in NM, U was once produced from NM)

C=graphite F=fluorite

Graphite, fluorite, and barite are listed as critical minerals instead of the element because of their specific industrial uses.

Copper (Cu) was added as a critical mineral in 2023 by the Department of Energy (DOE)

Note that any element or commodity can be considered critical in the future depending upon use and availability. Coal can contain several of these critical elements.

U, Re, He, Sr, and K (potash) were removed from the critical minerals list in 2022 and Zn and Ni were added. In 2023, the Department of Energy added Cu to the critical materials list.
Map of mining districts in New Mexico that have critical minerals

- Coal fields are on next slide
- Other areas in New Mexico, such as high-magnesium dolomites, lithium-bearing playas, and coal fields, are not found in specific mining districts and also have potential for critical minerals (CM)
Coal fields in San Juan Basin, New Mexico
Location of areas sampled in the New Mexico mine waste study
Field Procedures

• Inventory
  • Feature descriptions at each site

• Mapping
  • GPS/sketches/LiDAR
  • Radiometric surveys at Black Hawk
    • Divide rock pile into zones based upon radioactivity

• Water Sampling

Joseph working hard at Jicarilla district!
Field Procedures-continued

• Waste Rock Sampling
  • Soil samples, rock chip samples
    • composite of cells within each feature
    • select of certain areas
    • Profiles where feature eroded
  • Sample microbes
  • Select samples
  • Ore samples
  • Slag samples
• Mineralogy, chemistry

Eroded oxidation profile in a rock pile at Copper Flat
Results

REE Chondrite Norm (Taylor and McLennan, 1987)

Colour
Deposit type
- 5-element vein
- Au vein
- Cu vein
- REE vein
- U vein
- carbonate-hosted
- coal
- porphyry copper
- sandstone hosted Cu
- sandstone uranium
Results-continued
Acid Rock Drainage (ARD) plot of waste rock pile at mines examined during the NMBGMR mine wastes project.

\[
AP(\text{kg CaCO}_3/\text{tonnes}) = 31.25 \times S(\%) \\
NP(\text{total C}) = 83.3 \times C(\%) \\
NNP = NP - AP \\
NPR = NP / AP
\]
Endowment at Copper Flat Tailings, Hillsboro district

Assumes a bulk density of 1430 kg/m³
Important note

• Production of critical minerals from mine wastes will likely depend on if the mine wastes can be reprocessed for the major commodity (Au, Ag, base metals)
  – Economic production of solely critical minerals is probably not possible in most cases

• There will likely still be a remaining waste
Preliminary conclusions

• A sampling protocol has been developed that can estimate the chemical composition of mine wastes
• Larger mine features are divided into subareas for sampling
• Composite samples are collected from cells within the sample areas and homogenized into a single sample
• Elevated critical minerals are found in some of the mine features in New Mexico and these features should be evaluated for potential re-mining or reprocessing
• The available critical minerals are dependent upon types of deposits
• Possible re-mining of mine wastes could clean up these sites and pay for reclamation
Questions?