Critical Minerals in the Silver City area, New Mexico

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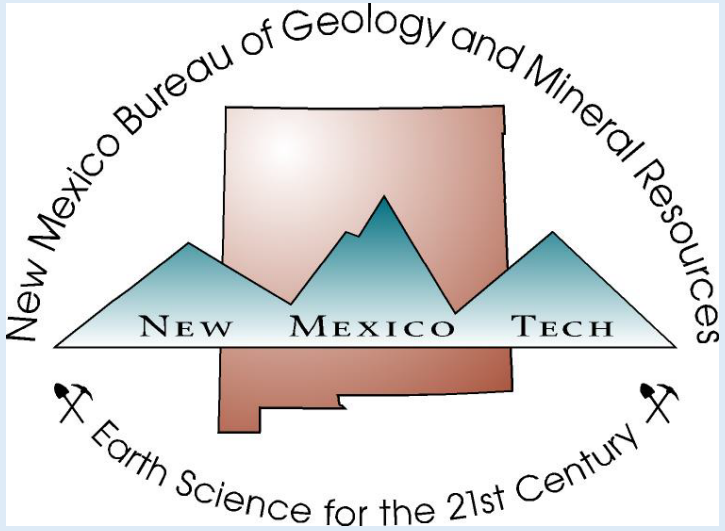


What do these two areas have in common?

Santa Rita mine, NM

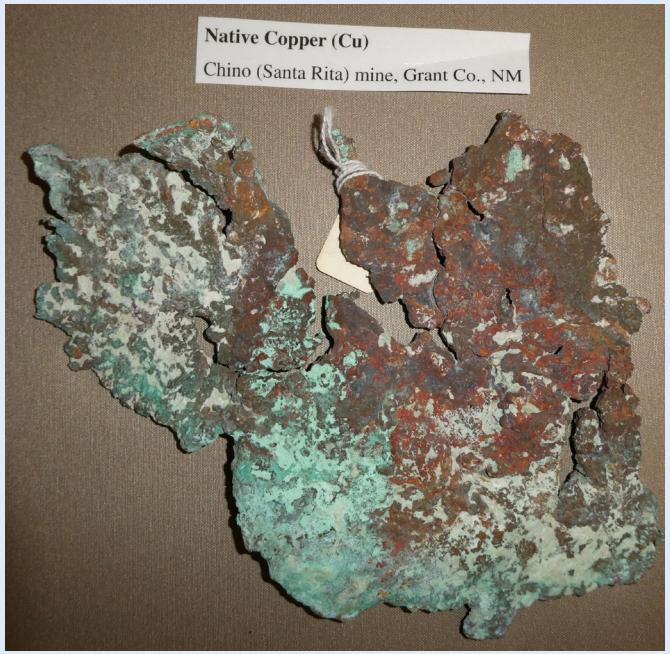
Nutt, NM

Both areas have critical minerals!

What are critical minerals?

Definition of minerals

In industry, *minerals* refer to any rock, mineral, or other naturally occurring material of economic value, including metals, industrial minerals, energy minerals, gemstones, aggregates, and synthetic materials sold as commodities



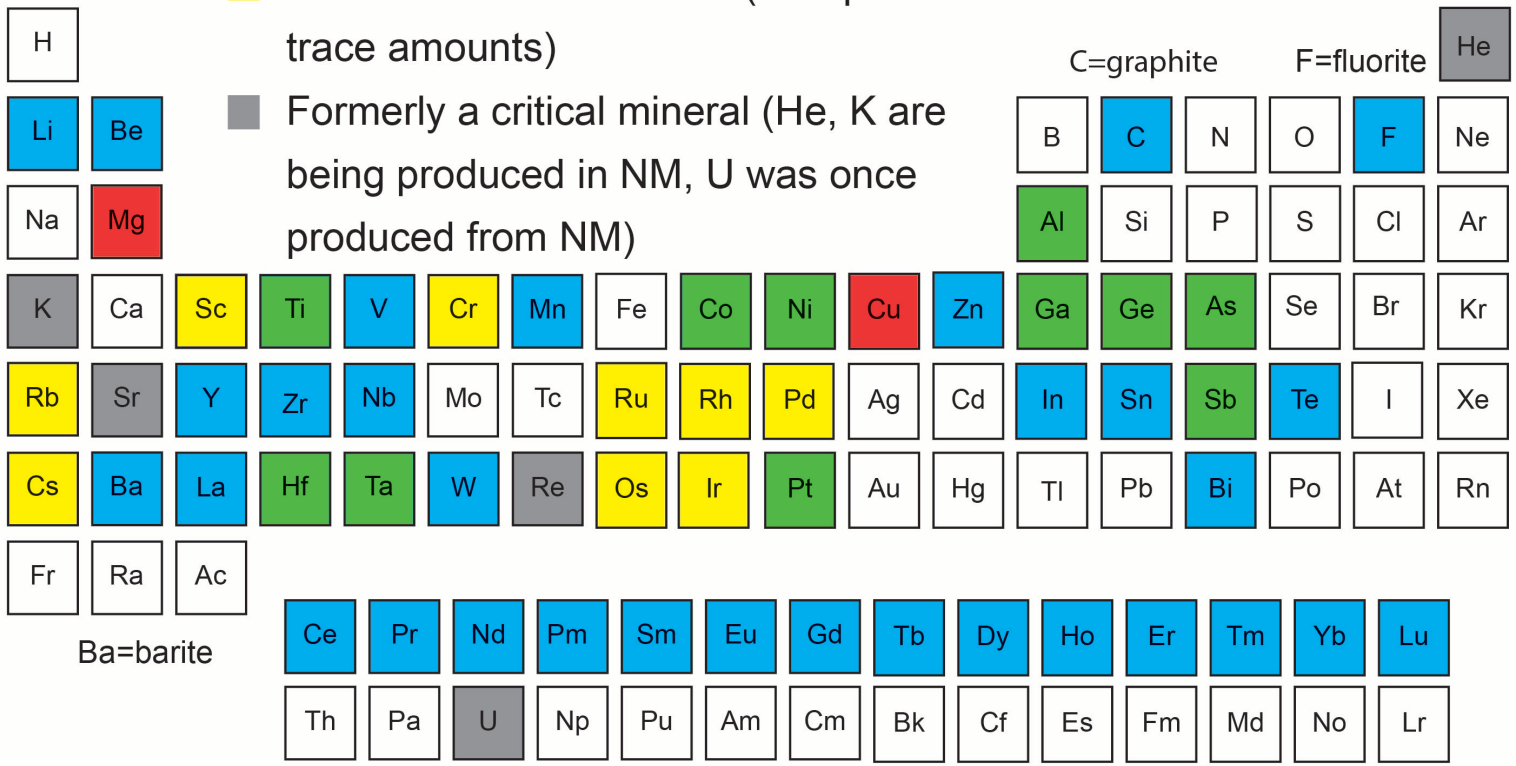
Definition of critical minerals

- A nonfuel mineral or mineral material essential to the economic and national security of the United States
- From a supply chain that is vulnerable to disruption
- Is essential in the manufacturing of a product needed for the U.S. economy or national security

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)

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



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.

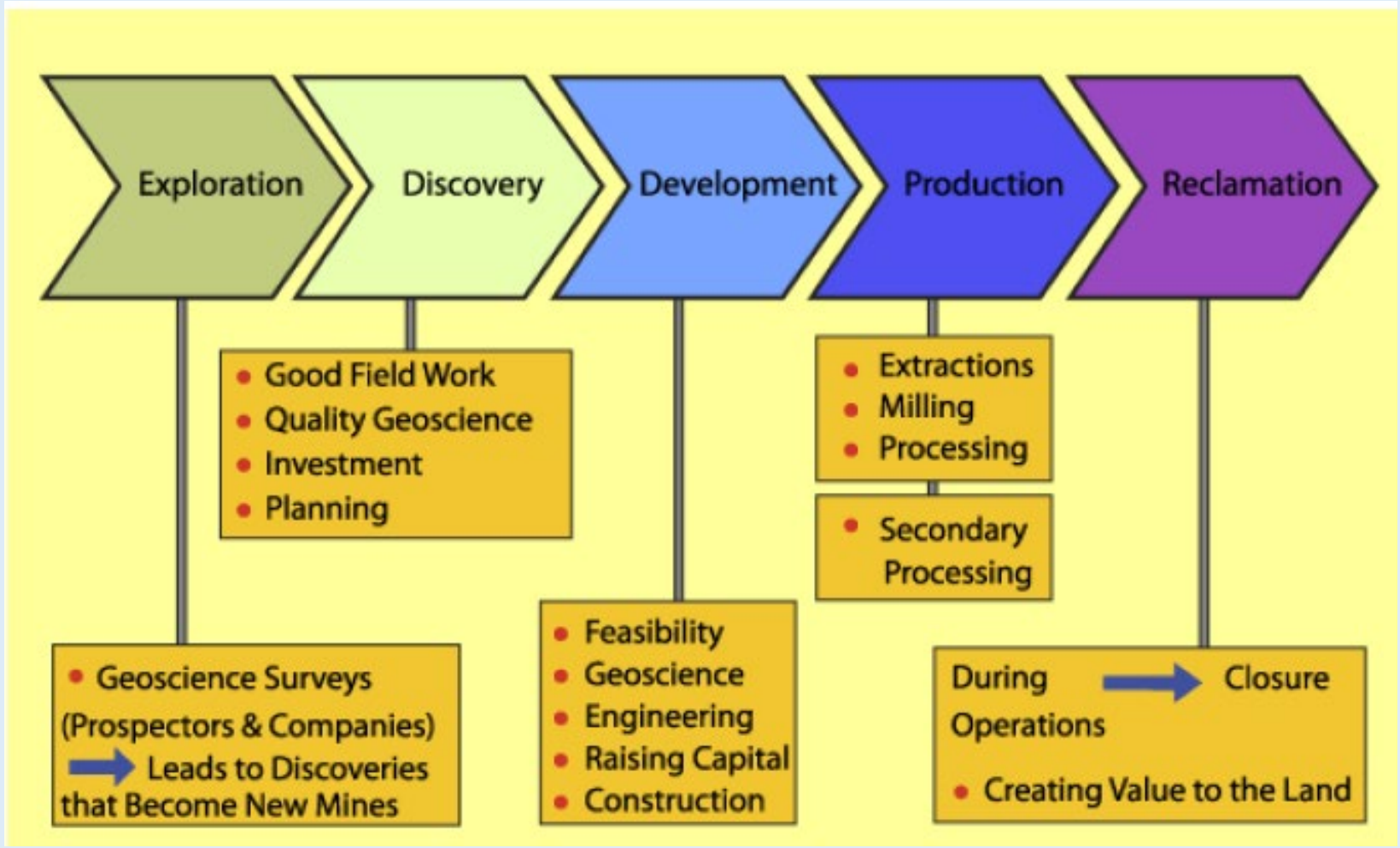
U, Re, He, Sr, and K (potash) were removed from the critical minerals list in 2022 and Zn and Ni were added. In 2023, the Department of Energy added Cu to the critical materials list.

How do we provide critical minerals to society?

The mine life cycle

Water is needed at all stages

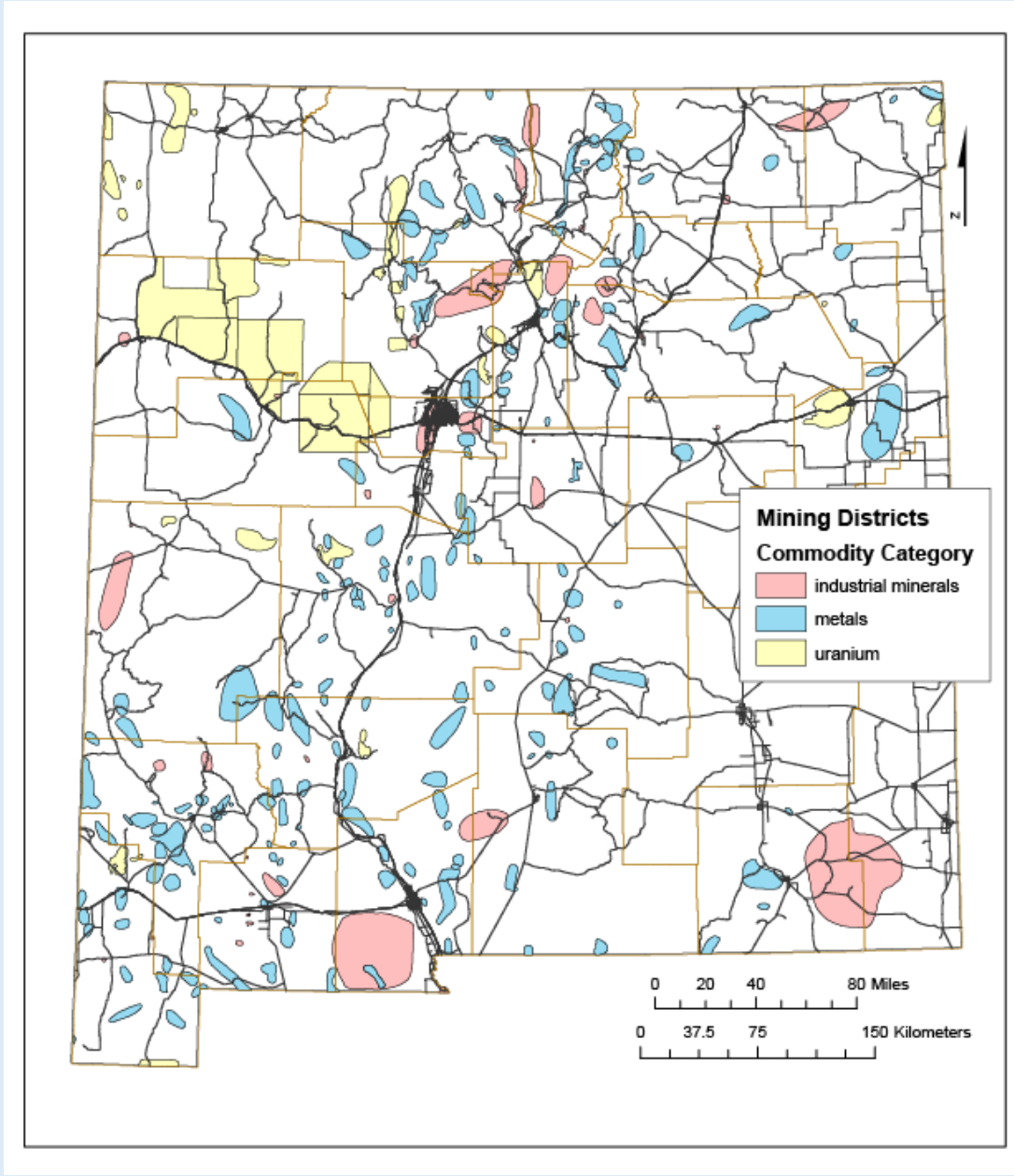
Permitting at all stages—can take as long as 15-20 yrs

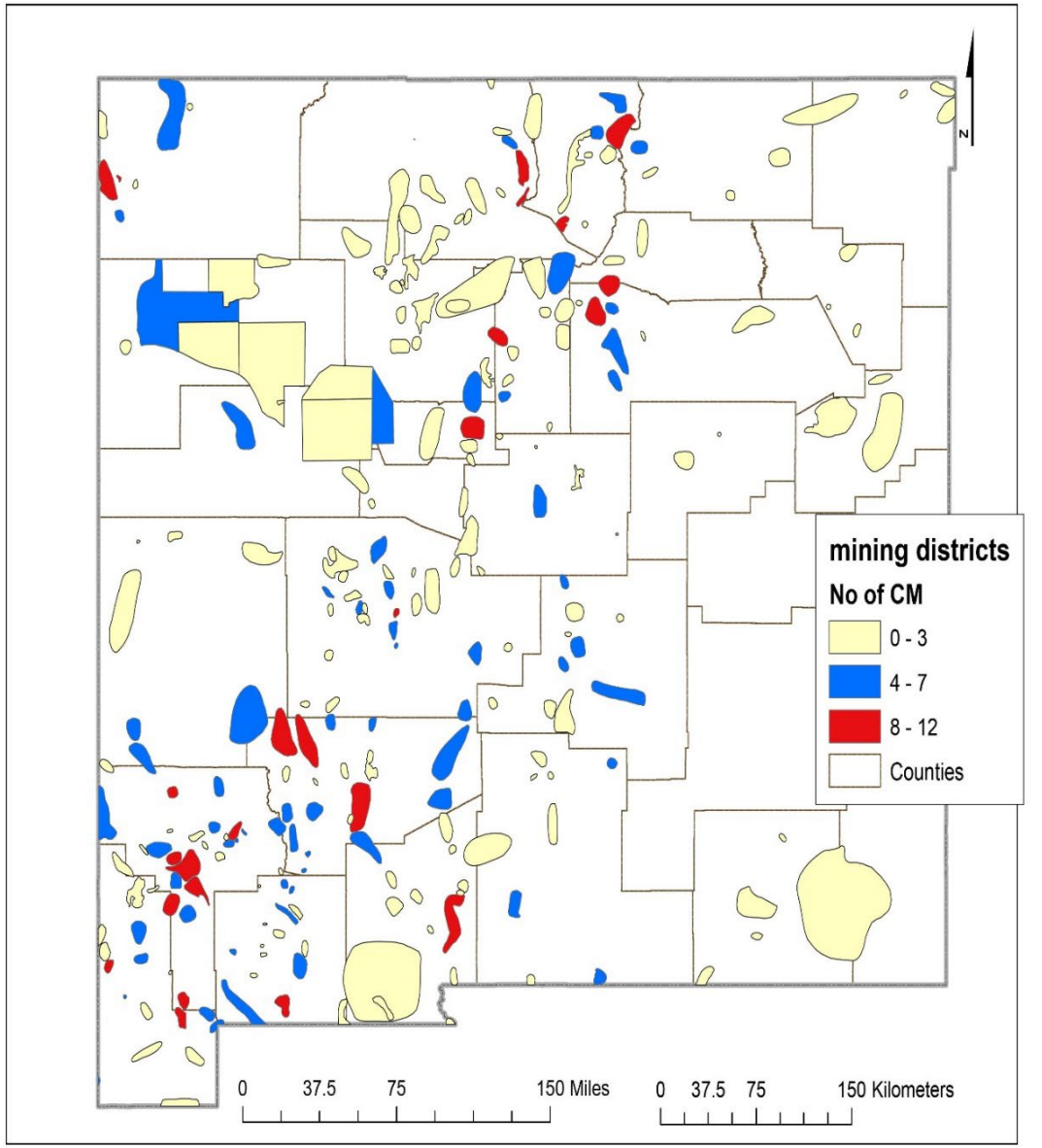


Exploration drilling for critical minerals on the Jicarilla Apache Tribal Lands

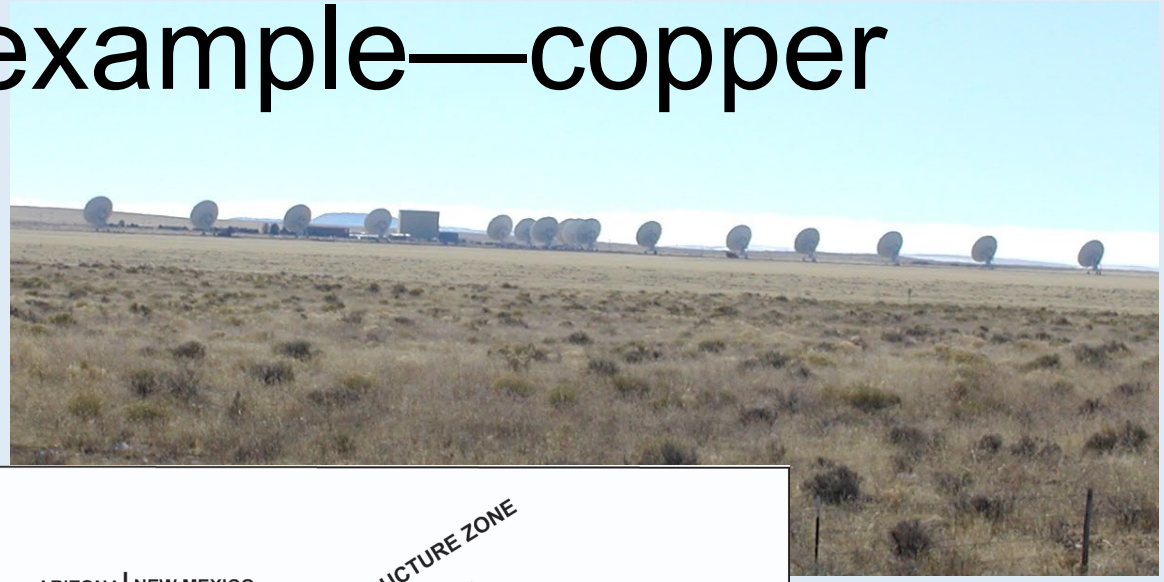
Where are critical minerals found in New Mexico?

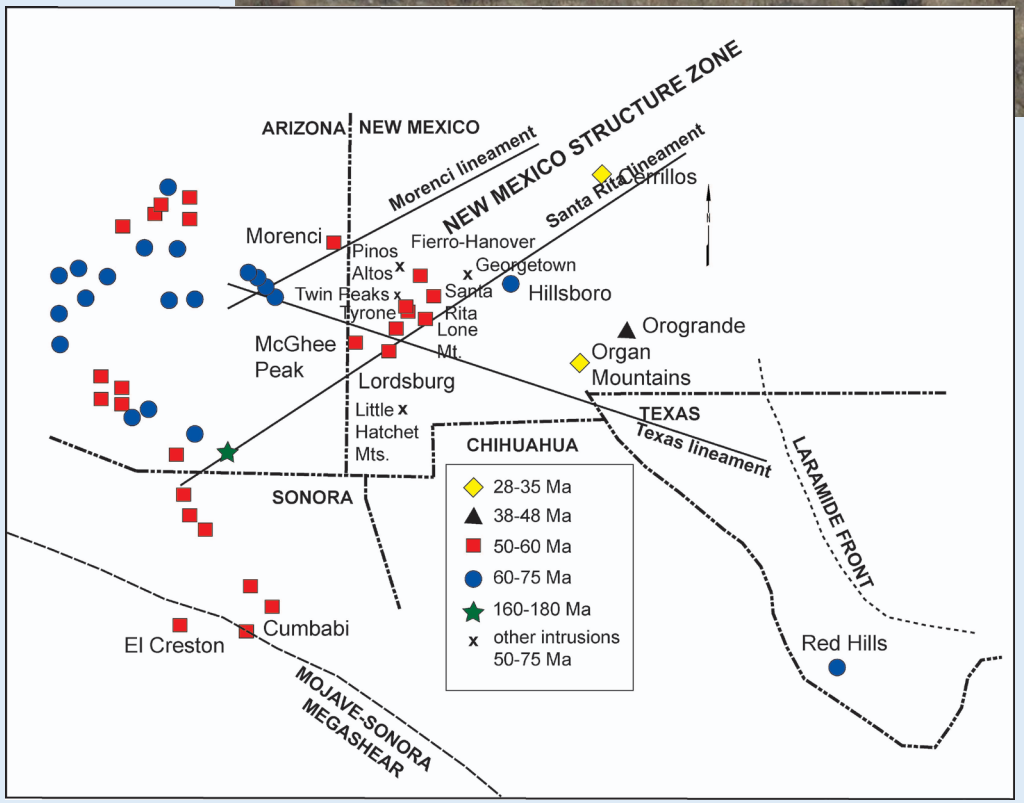
A mining district is a group of mineral deposits in a geographically defined area that are defined by geologic criteria and has had some minerals production or future minerals potential

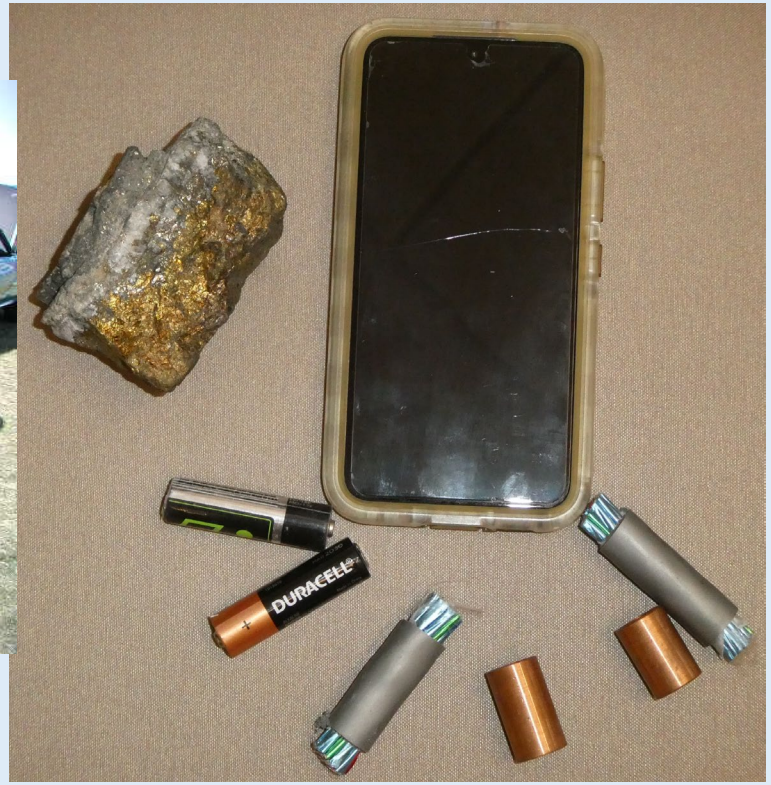




An example—copper







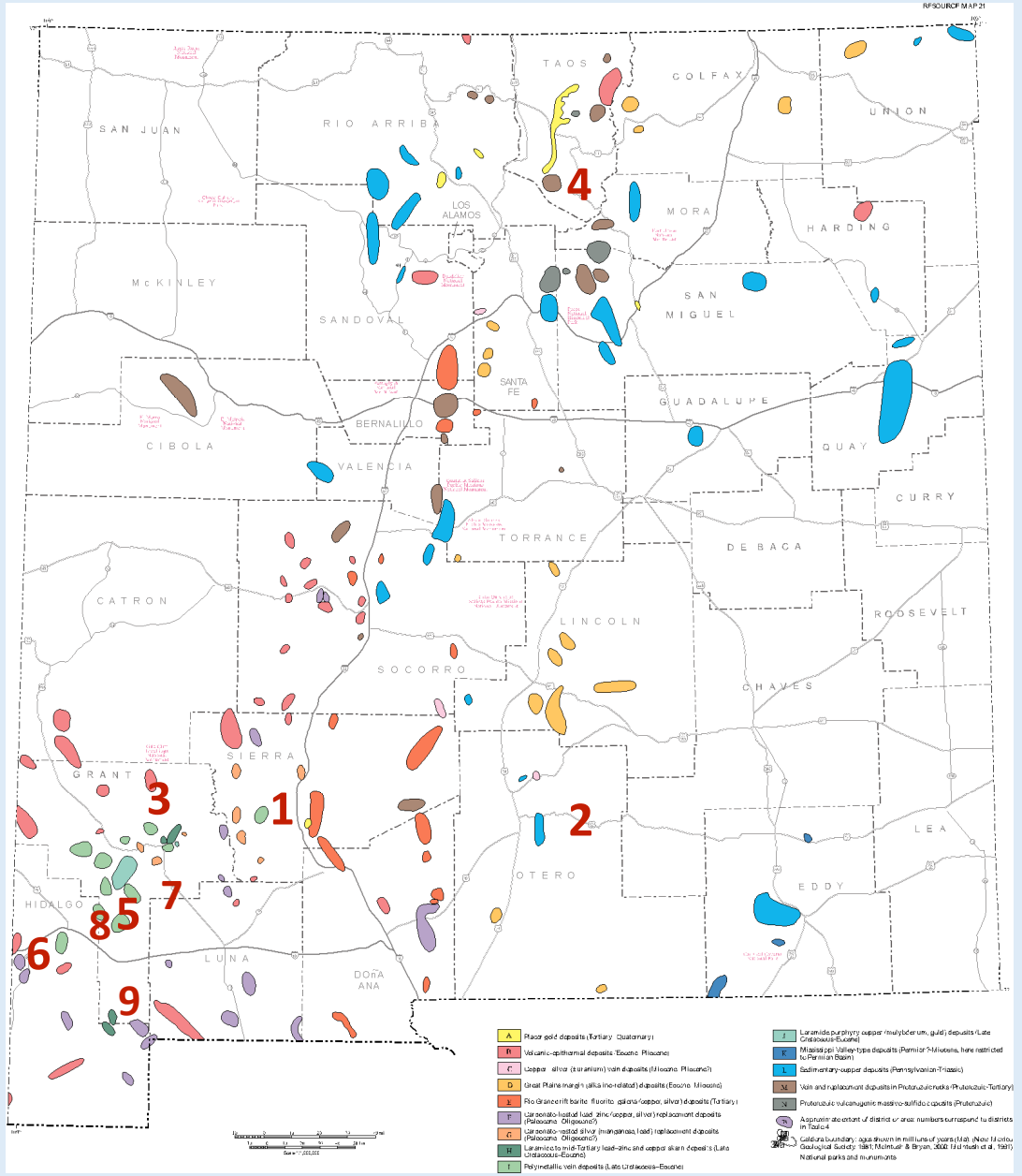
Uses of Copper

- Uses
  - Building construction—46%
  - Electrical and electronic products—21%
  - Transportation equipment—16%
  - Consumer and general products—10%
  - Industrial machinery and equipment—7%

- Approximately 4.7 tons of copper are needed in a 3 MW wind turbine (for cable, wiring, turbines, and transformers)
- Approximately 5.5 tons of copper are needed in solar panels (for heat exchangers, wiring, and cables)
- Hybrid car uses 88 lbs of copper and a fully electric car uses 183 lbs of copper, compared to 48 lbs of copper needed in a regular car run by an internal combustion engine
- **Copper demand is expected to increase in the future**

Potential Copper Deposits in New Mexico

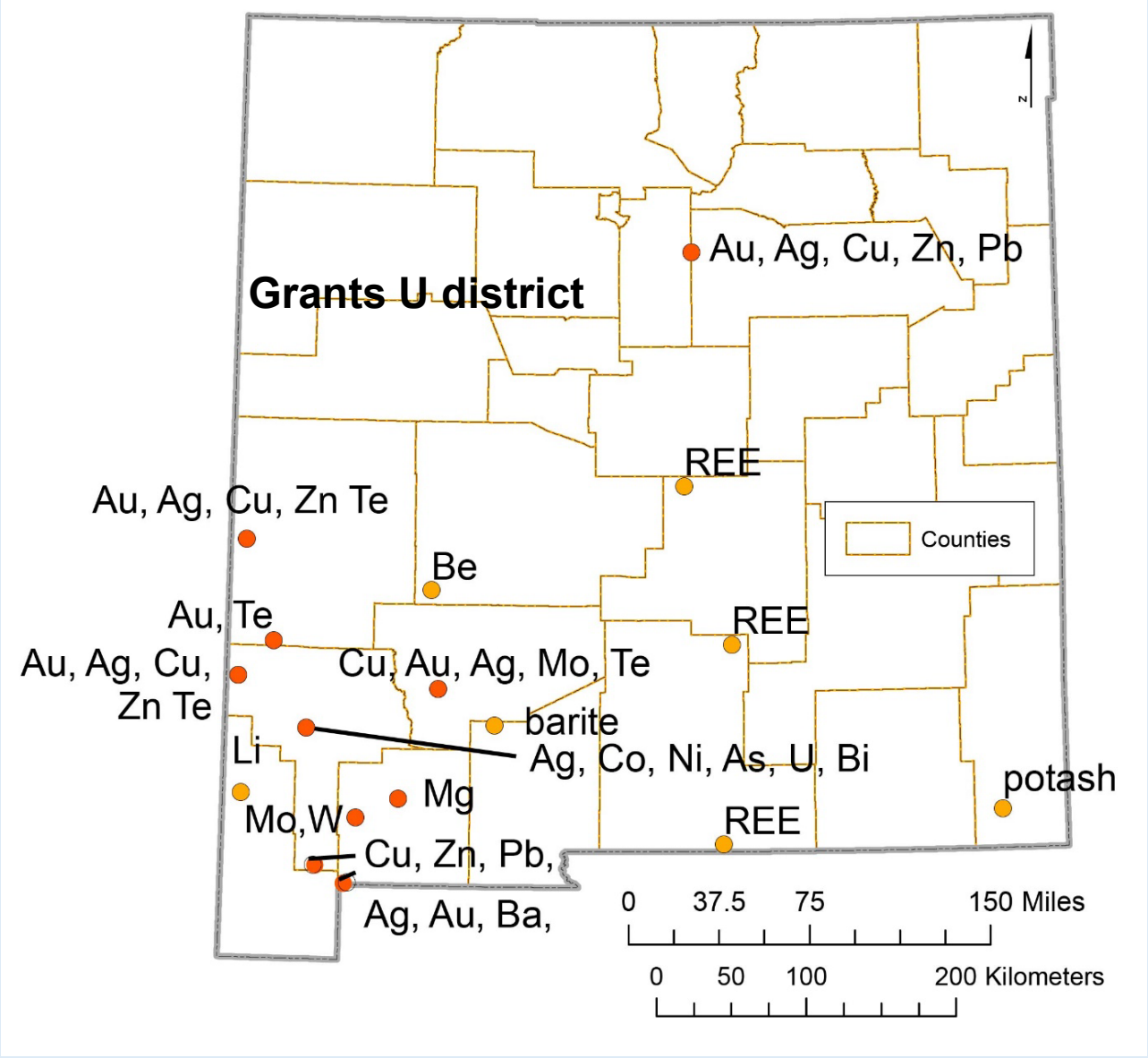
1. Copper Flat (98.1 million short tons at 0.31% Cu, 0.009% Mo, 0.003 oz/short ton Au, and 0.07 oz/ short ton Ag)
2. Orogrande, Otero Co.
3. Hanover Mountain (80 mill st reserves at 0.38% Cu), Grant
4. Copper Hill, Picuris district (46.5 mill st of ore at 0.42% Cu)
5. Lone Mountain (7.5 mill st at 2-3% Cu, 1.2% Pb, 4-5% Zn, 203 opt Ag, .01-.02 opt Au)
6. McGhee Peak, Pelloncillo Mts
7. Mimbres, Grant Co
8. Oak Grove, Grant Co
9. Eureka, Grant Co



Potential critical minerals include Te, V, REE, Re, Ga, In, Ge, Zn, W, Cu

Other Critical Minerals in New Mexico

- Cu deposits in Grant County contain Re, In, Ga, Ge, and Zn
- U deposits in the Grants district contain V, Se, REE, Mo, Re?
- Exploration for other critical minerals include REE, Te, Li, Be, Co
- Other critical minerals were once produced from New Mexico (Sn, V, Mn, fluorspar, barite, graphite, Zn)

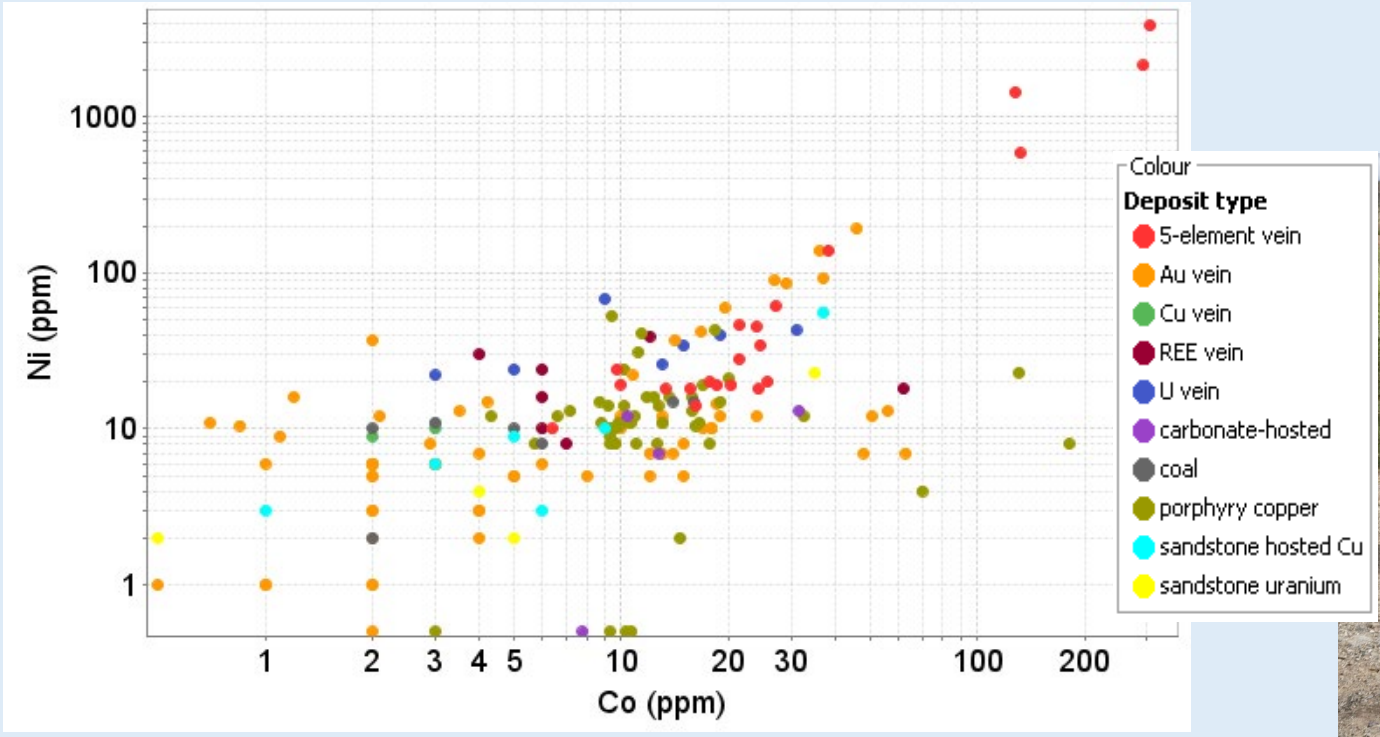


Selected exploration sites of critical minerals in New Mexico

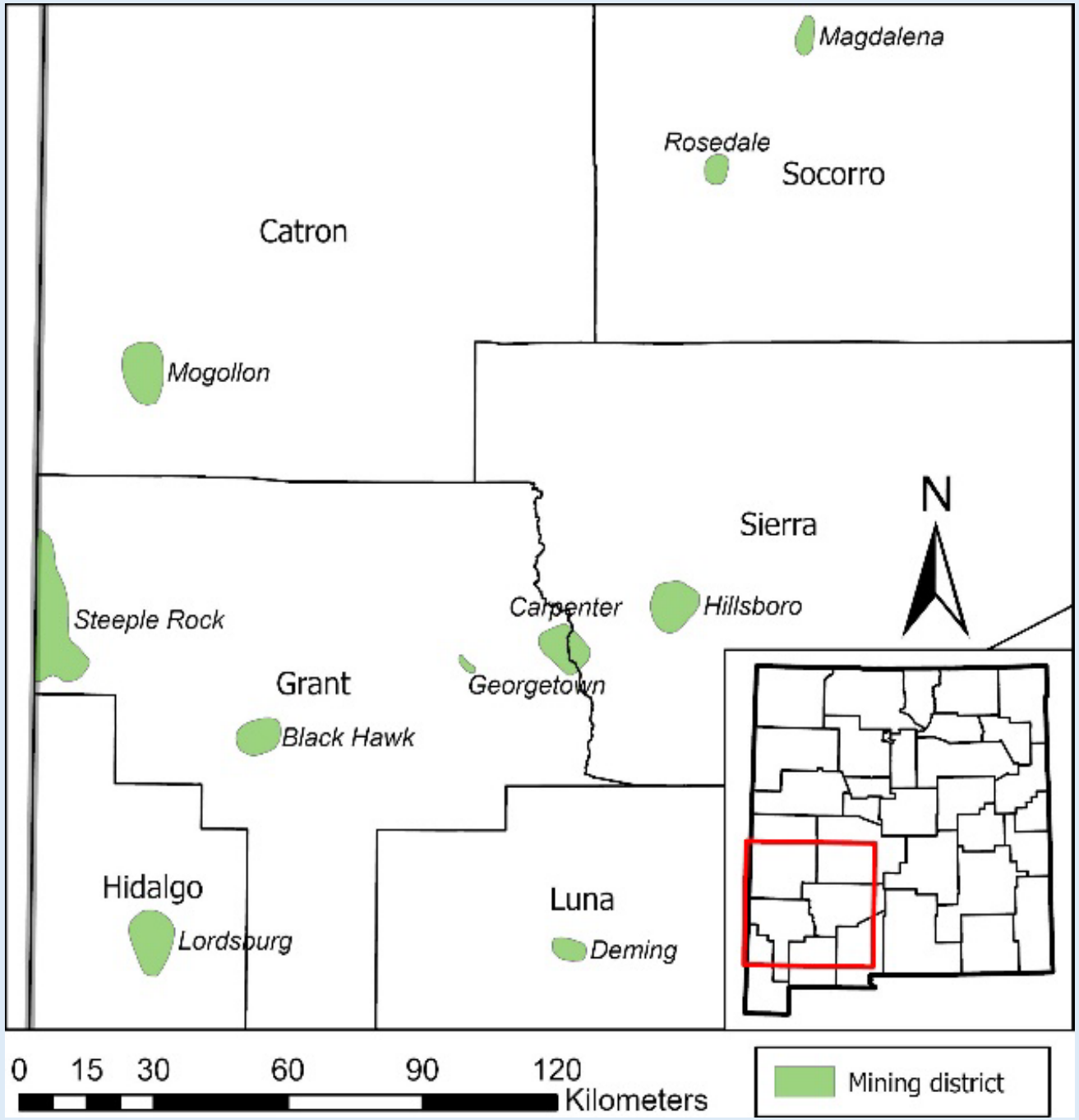
Are critical minerals found in mine wastes?

Mine waste inventory and characterization

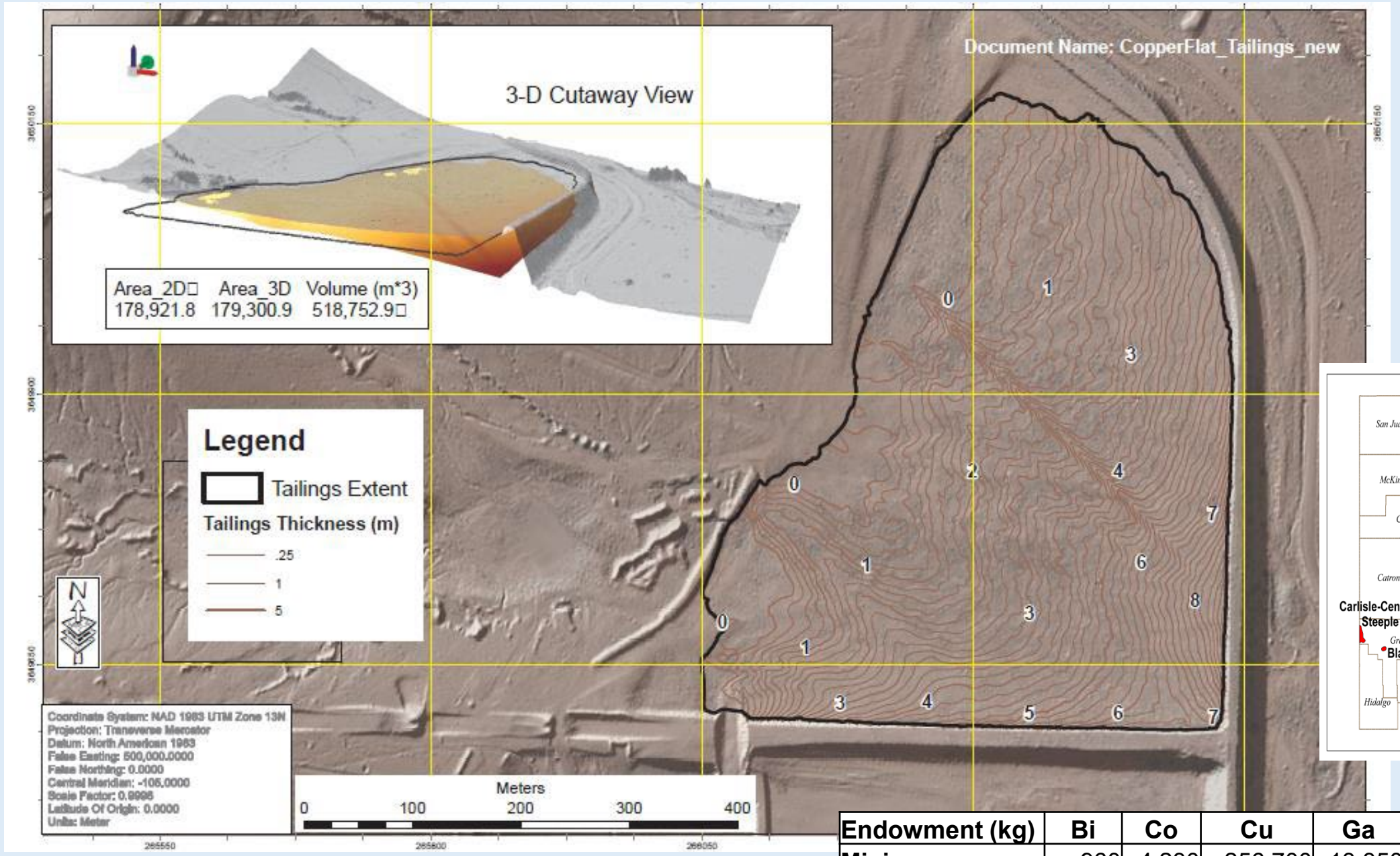
- Inventory mine wastes in New Mexico for USGS Earth MRI
- Use this inventory to prioritize mine wastes for the USGS Earth MRI characterization project

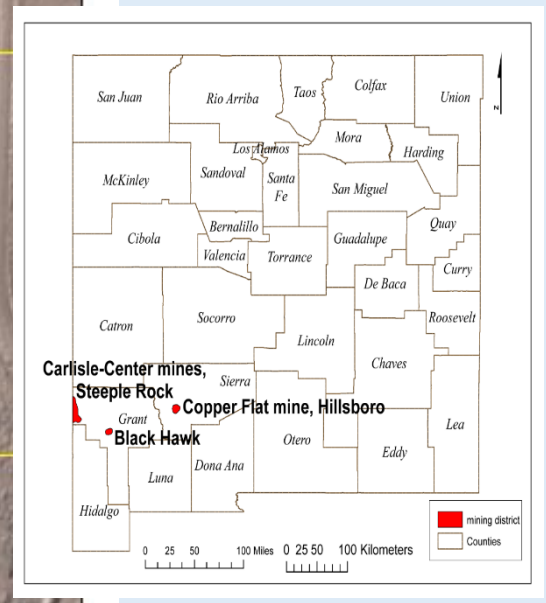


Location of mining districts where we have or plan to map, sample, and characterize mine wastes in southwestern New Mexico



Copper Flat tailings, Hillsboro district





Volume 518,753 m^3

Assumes a bulk density of 1430 kg/m^3

Endowment (kg)	Bi	Co	Cu	Ga	Te	Zn	Zr
Minimum	960	4,230	256,700	13,350	180	29,900	174,000
Maximum	1,700	7,900	574,200	15,600	360	53,400	210,600
Mean	1,280	6,880	402,900	14,240	300	44,000	194,400

What do these two areas have in common?

Santa Rita mine, NM

Nutt, NM

Must mine and process minerals, especially critical minerals

Santa Rita mine, NM

Nutt, NM

In order to have the products we need for our way of life

The challenge is to provide society with its needs, while protecting future resources, water resources, limit alteration of the landscape, and affect local communities as little as possible (leave the world better than before mining)

What needs to be accomplished?

- Produce more, waste less, use less
  - Increase recycling and reprocessing of mine wastes
  - Many critical minerals are difficult to recycle
  - Expand capacity at larger mines—recover more critical minerals from ore as well as mine wastes
- Improve our understanding of where critical minerals resources are found
  - Understand geologic processes that form mineral deposits—models
  - Develop more efficient models
- Improve access to potential mineral deposits (access to land for exploration and mining, financing, permitting)
- Facilitate the development of domestic ore refining capabilities
- Understand and manage water resources for all uses

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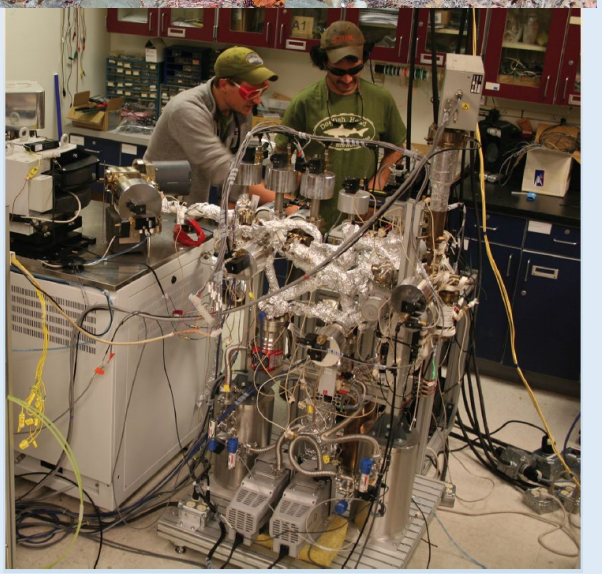
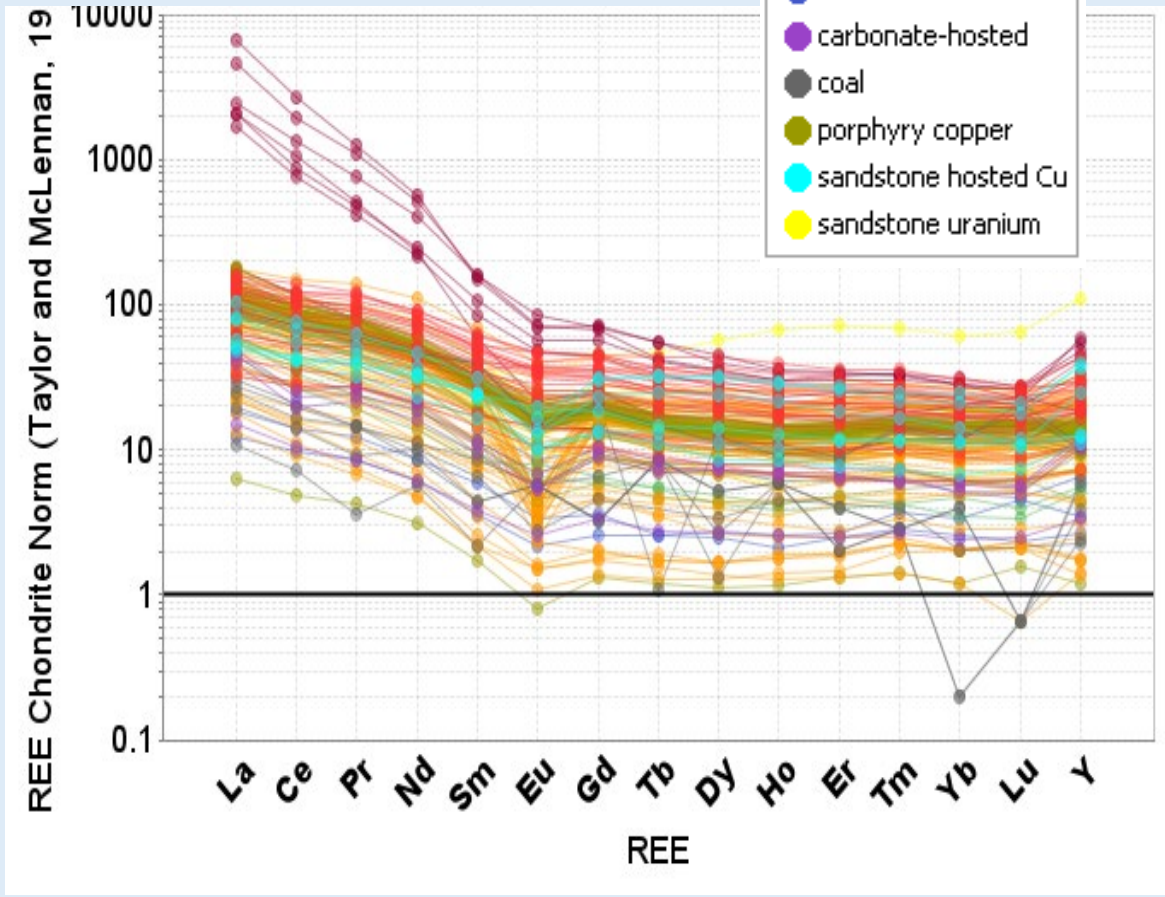


Critical Minerals are defined by

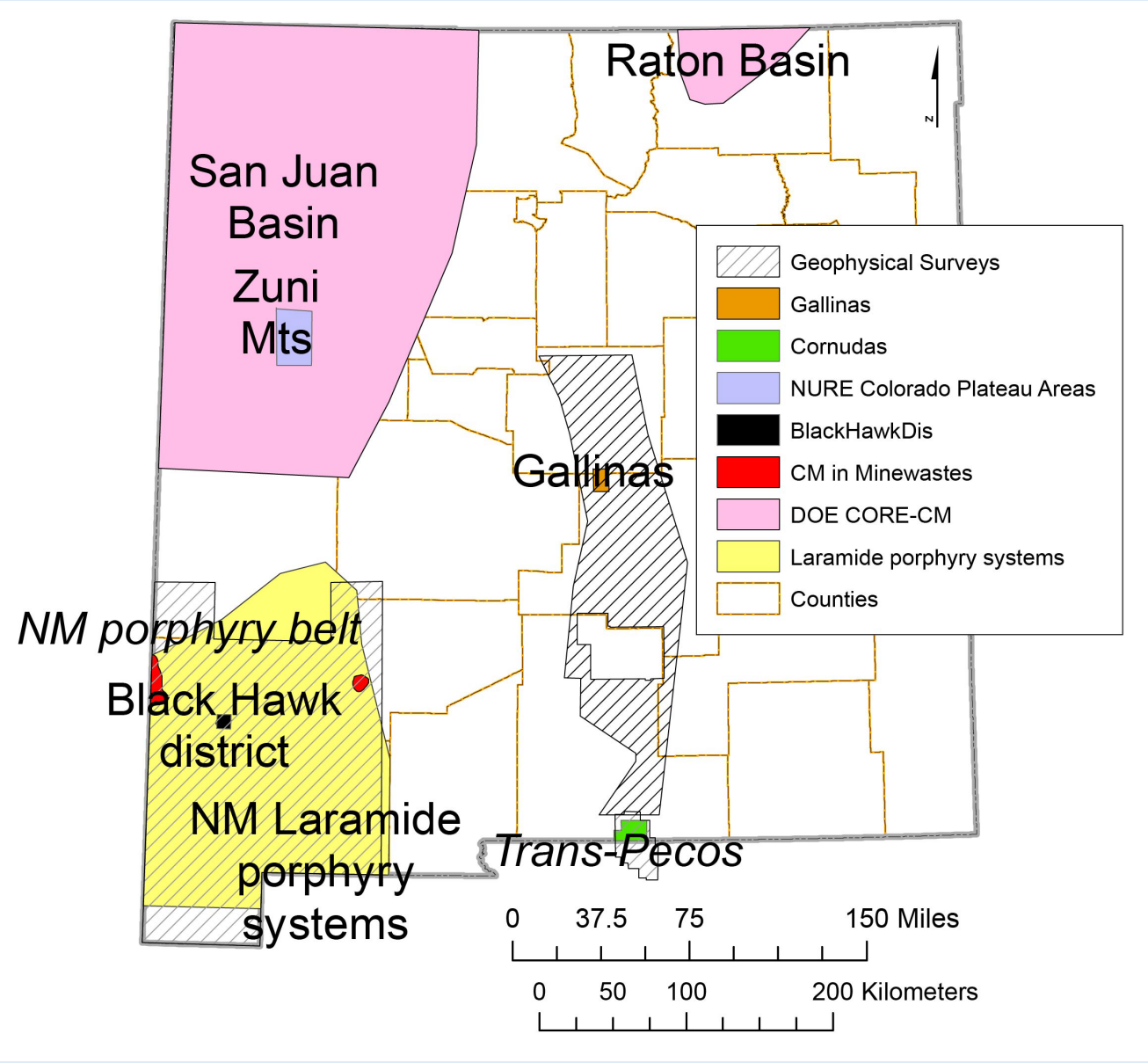
- Economic vulnerability
  - Essential to economic, strategic or national defense
  - Especially needed for the transition to non-CO_2 producing technologies
- High risk of supply disruption
  - Difficulty of permitting new mines
  - Labor disputes
  - Mine closures
- Trade exposure
  - Dependency on foreign supplies (including refining)
  - Net import reliance of >50%

Database of chemical analyses of Critical Minerals in New Mexico

- Compilation of chemical analyses from literature
- Convert paper data into excel where it can be used (generally by students by hand)
- Provides preliminary chemistry of mineralized samples from mining districts in NM to aid in selecting areas for additional study
- Includes new chemical analyses from Earth MRI projects and DOE CORE-CM (3000 samples)

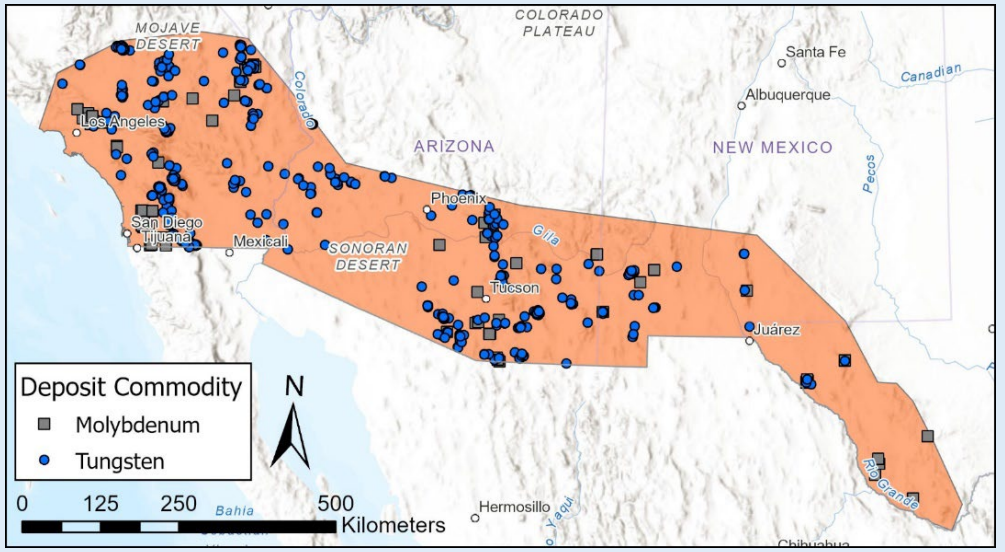


Rare earth elements in various deposits in New Mexico (chondrite normalized)



USGS Earth MRI and DOE CORE-CM projects in New Mexico

Geochemical reconnaissance of Southwest U.S. Mo-W deposits in southwest Texas, New Mexico, Arizona, and California (August 2024-July 2027) *(in cooperation with Arizona, California, and Texas Geological Surveys)*



More than 24 students employed and trained on these projects. Many of these students have internships and final jobs with mining companies! A few students actually are employed in New Mexico!

Collaboration with mining companies, other state surveys, Sandia and Los Alamos National Labs!!!

IMPORTANCE OF MINING REE AND CRITICAL MINERALS IN NEW MEXICO

- Future mining of REE and Critical Minerals will directly benefit the economy of New Mexico and the U.S.
- Mineral resources must be identified before land use decisions are made by government officials
- Crucial to re-establish a domestic source of REE and Critical Minerals minerals in the U.S. to help secure the nation's clean energy future, reducing the vulnerability of the U.S. to material shortages related to national defense, and to maintain our global technical and economic competitiveness
- Training of the future workforce because students at New Mexico Tech and San Juan College will be hired to work on this project and outreach activities train high and middle school students as well as their teachers