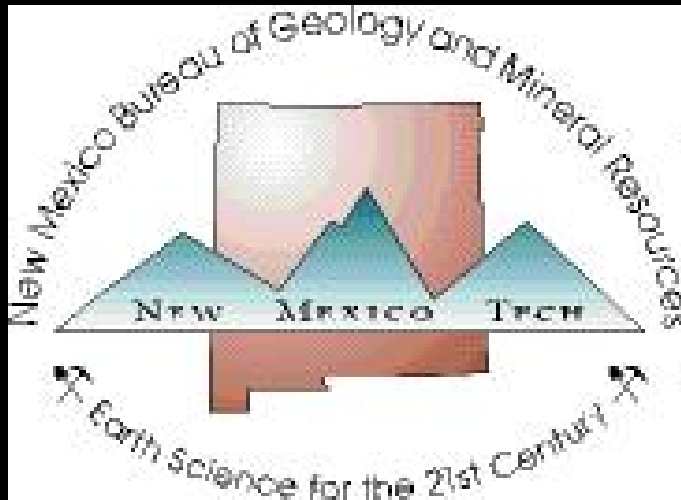


# MINING ISSUES FACING NEW MEXICO- 2020



***Virginia T. McLemore***  
***New Mexico Bureau of  
Geology and Mineral  
Resources, New Mexico Tech,  
Socorro, NM***



# ACKNOWLEDGEMENTS

- New Mexico Energy, Minerals and Natural Resource Department
- Company annual reports
- Personal visits to mines
- Historical production statistics from U.S. Bureau of Mines, U.S. Geological Survey, N.M. Energy, Minerals and Natural Resource Department (NM MMD), company annual reports
- Students at NM Tech
- New Mexico Mining Association

# DEFINITIONS

# Minerals

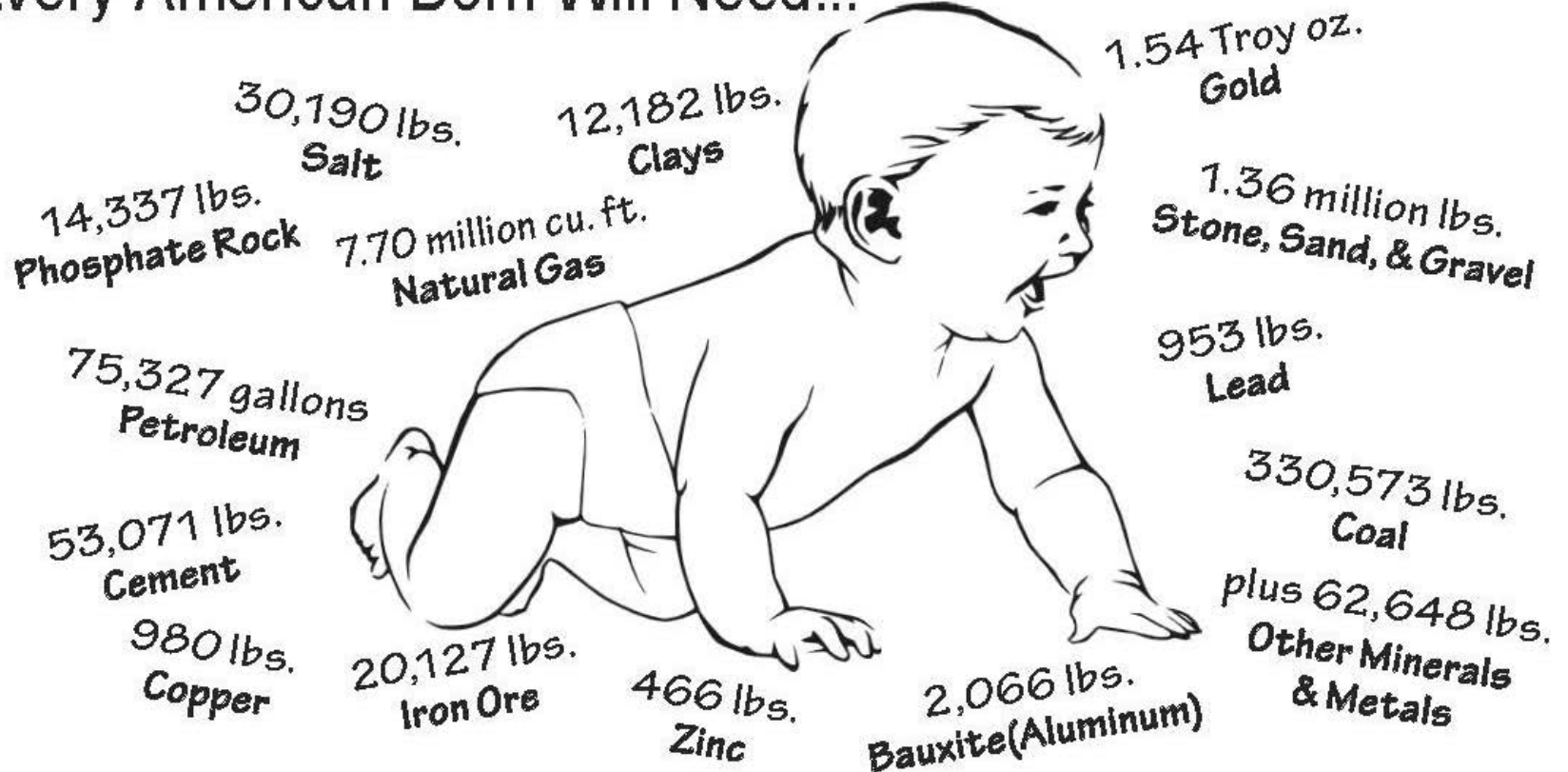
In the mining industry, *minerals* refer to any rock, mineral, or other naturally occurring material of economic value, including metals, industrial minerals, energy minerals, gemstones, aggregates, and synthetic materials sold as commodities.



# Industrial minerals

- Any rock, mineral, or other naturally occurring material of economic value, excluding metals, energy minerals, and gemstones
  - One of the nonmetallics
  - Includes aggregates
-

# Every American Born Will Need...



3.19 million pounds of minerals, metals, and fuels in their lifetime

©2019 Minerals Education Coalition

Learn more at [www.MineralsEducationCoalition.org](http://www.MineralsEducationCoalition.org)

## Minerals are essential to our way of life

<https://mineralseducationcoalition.org/wp-content/uploads/2019-Mineral-Baby.pdf>

# OUTLINE

- What, where, and how much minerals are produced in New Mexico?
  - What are the Mining Issues Facing New Mexico?
  - How are we responding?
    - Research
-

**WHAT, WHERE, AND HOW  
MUCH MINERALS ARE  
PRODUCED IN NEW  
MEXICO?**

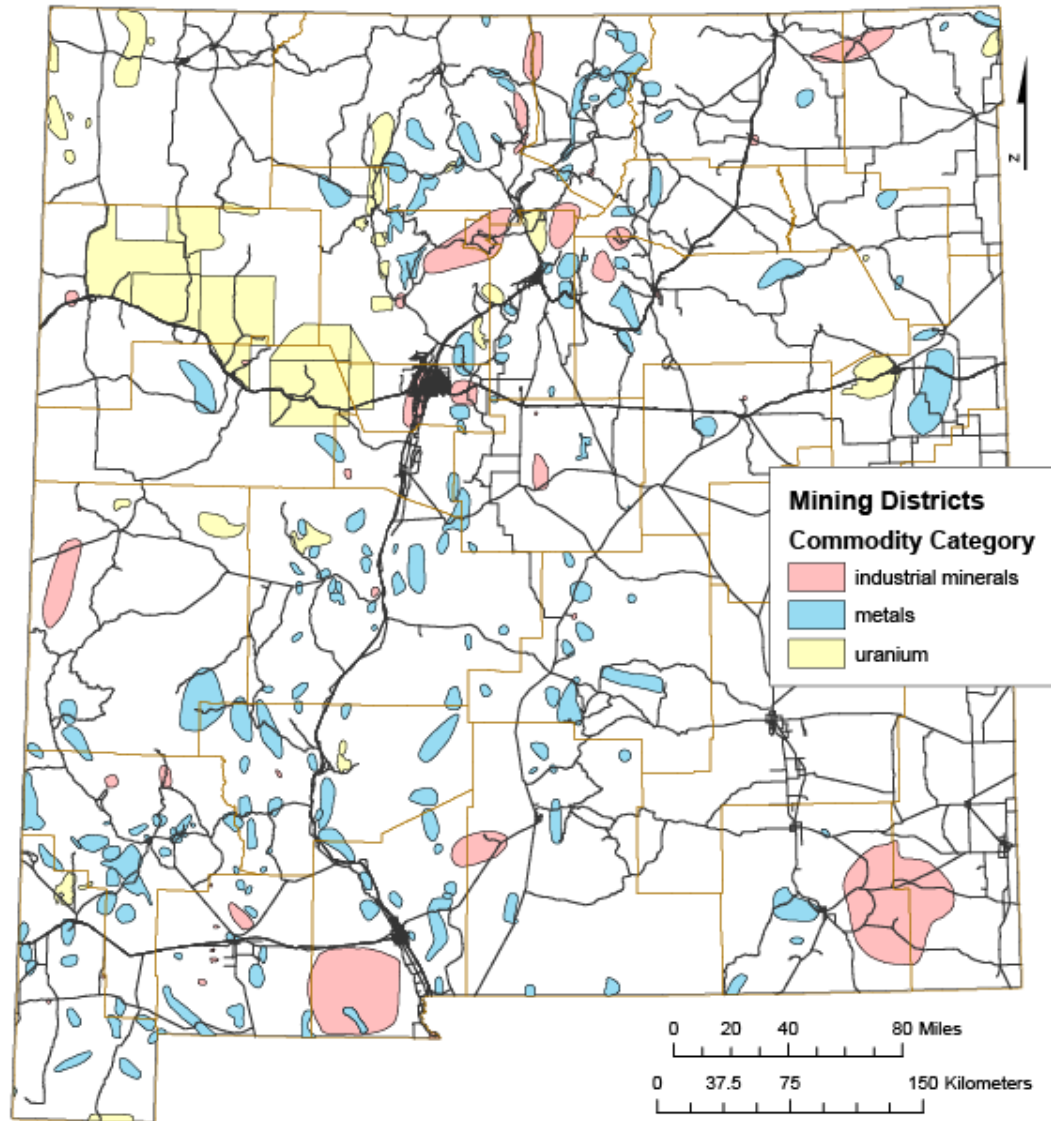
# INTRODUCTION

- ✖ NM has some of the oldest mining areas in the United States
- ✖ Native Americans mined turquoise from Cerrillos Hills district more than 500 yrs before the Spanish settled in the 1600s
- ✖ One of the earliest gold rushes in the West was in the Ortiz Mountains (Old Placers district) in 1828, 21 yrs before the California Gold Rush in 1849



One of the turquoise mines in the Cerrillos Hills district

# MINING DISTRICTS IN NEW MEXICO



## MINING DISTRICTS AND PROSPECT AREAS

### IN NEW MEXICO



Virginia T. McLemore

New Mexico Bureau Geology and Mineral Resources  
A Division of New Mexico Institute of Mining and Technology

Resource Map 24

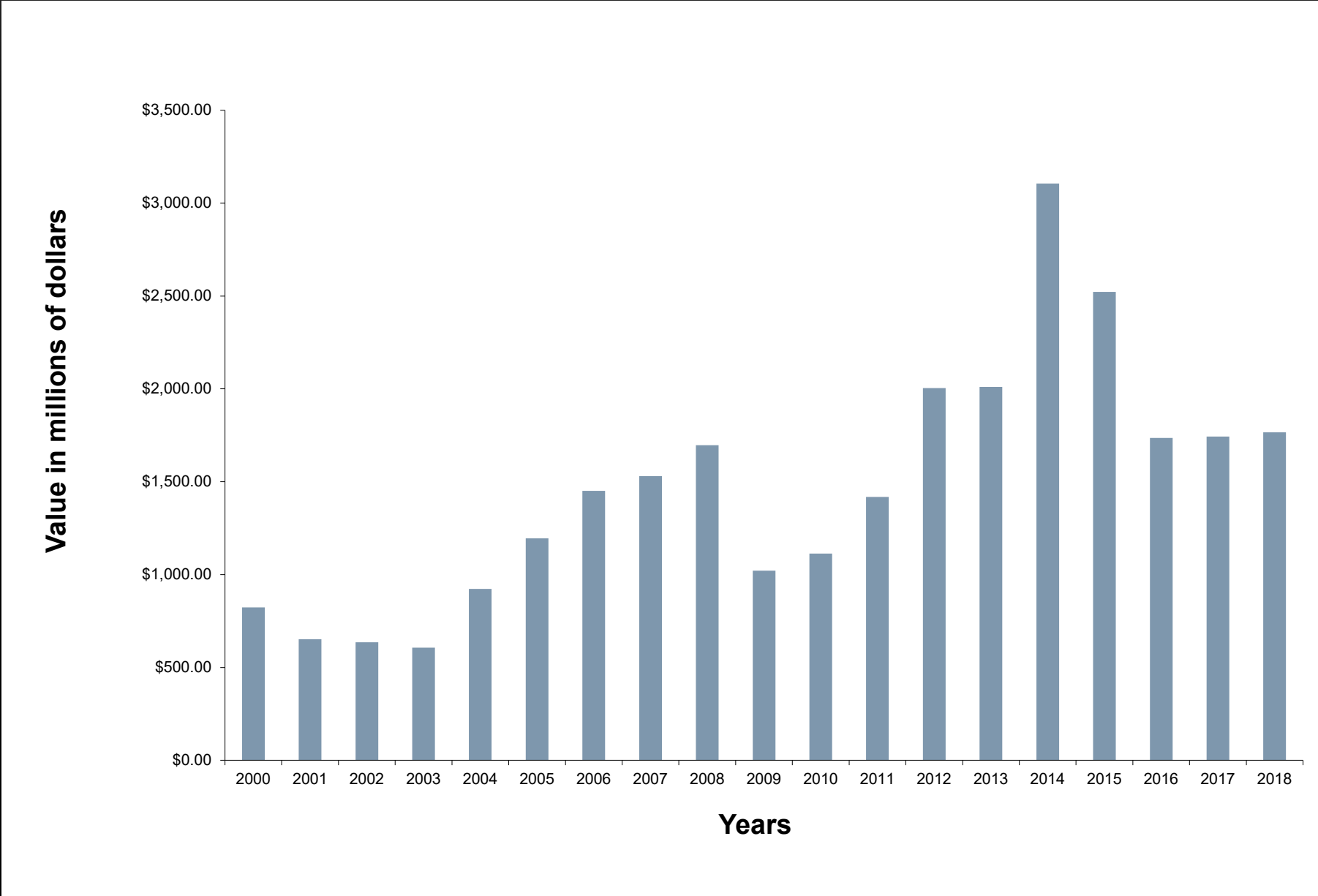
2017

# PRODUCTION SUMMARY—2020

- Value of mineral production in 2018 was <\$1.7 billion (does not include oil and gas)—ranked 28<sup>th</sup> in the US
- Employment in the mining industry is 5,000
- Exploration for garnet, gypsum, limestone, nepheline syenite, agate, specimen fluorite, gold, silver, iron, beryllium, uranium, copper, potash, rare earth elements, humate, clays
- ***MINERALS PRODUCTION IS DECREASING, ESPECIALLY COAL***



# MINERALS PRODUCTION IN NEW MEXICO 2000-2018

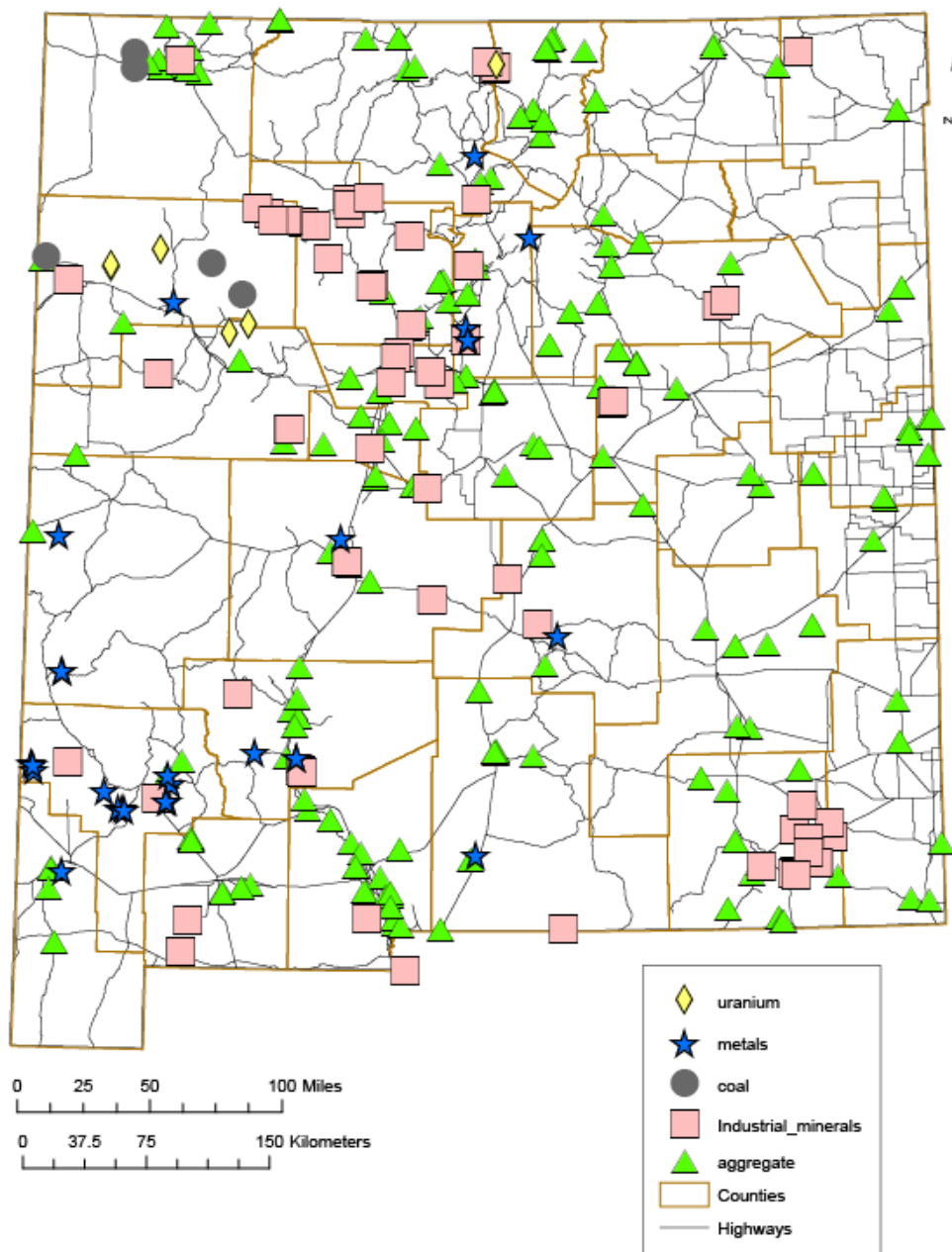




# ACTIVE MINES 2020

- ~282 active registered mines (NMMMD)
- 4 coal
- 3 potash, 4 potash plants
- 2 copper open pits, 1 concentrator (mill), 2 solvent/electro-winning (SX-EW) plants
  - 2 additional mines in permitting stage
  - Several exploration
- 1 gold mine and 1 mill (on standby)
- 2 iron mines
- 32 industrial minerals mines, 18 mills
- ~236 aggregate/stone

# ACTIVE MINES AND EXPLORATION SITES IN NEW MEXICO 2000-2020



# COAL

- Fuels electrical generating plants
- 3 surface mines and 1 underground mine in San Juan Basin
- Resources at Raton, Carrizozo
- 14<sup>th</sup> in production in U.S. in 2018
- 11<sup>th</sup> in estimated recoverable coal reserves—7 billion tons of recoverable reserves (2005 figures)
- ***Coal production is expected to decrease in the near future***



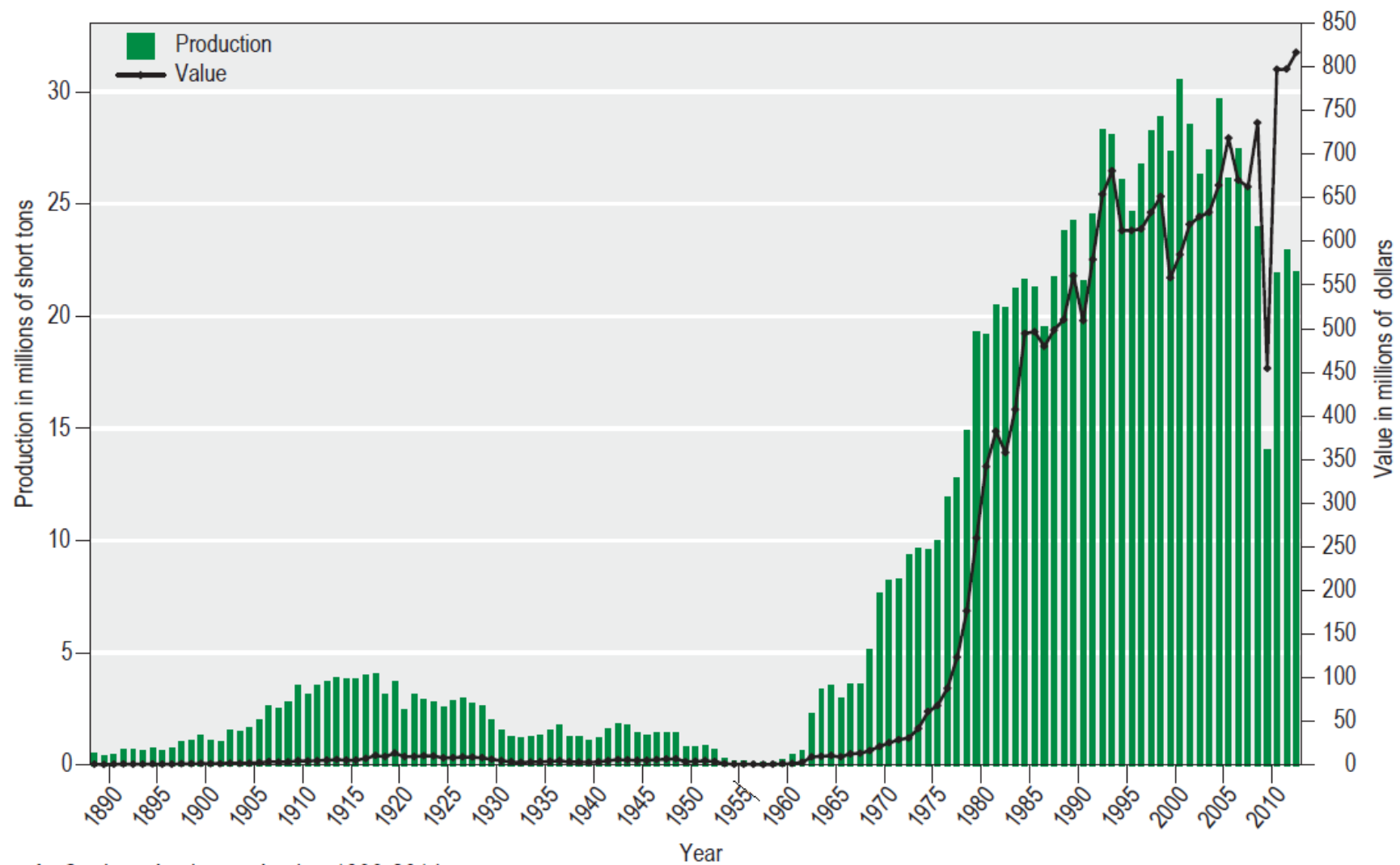
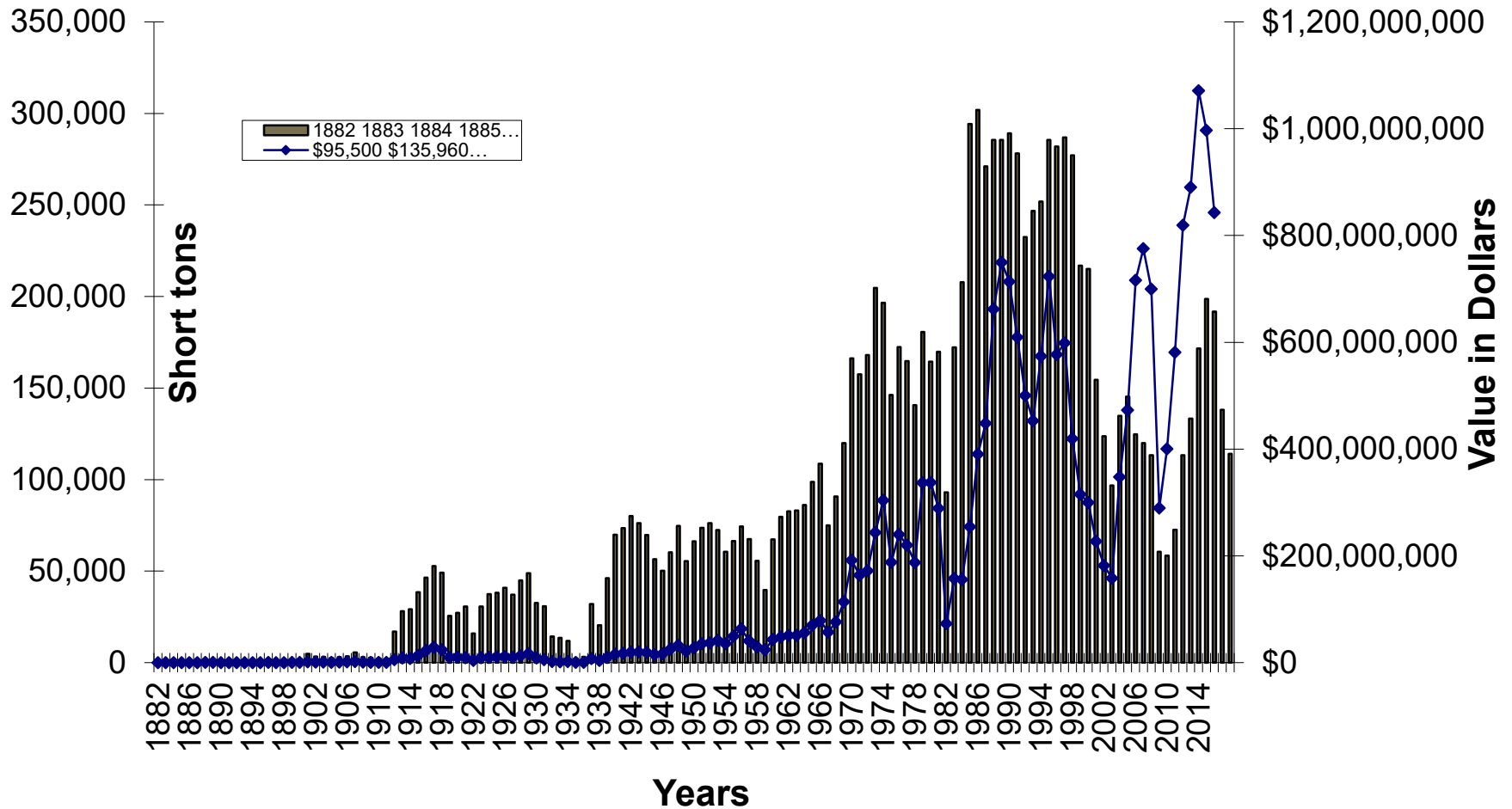


Figure 4. Coal production and value 1899-2014.

# METALS—3RD IN COPPER PRODUCTION IN 2019 (CHINO, TYRONE)



# Copper Production 1882-2018



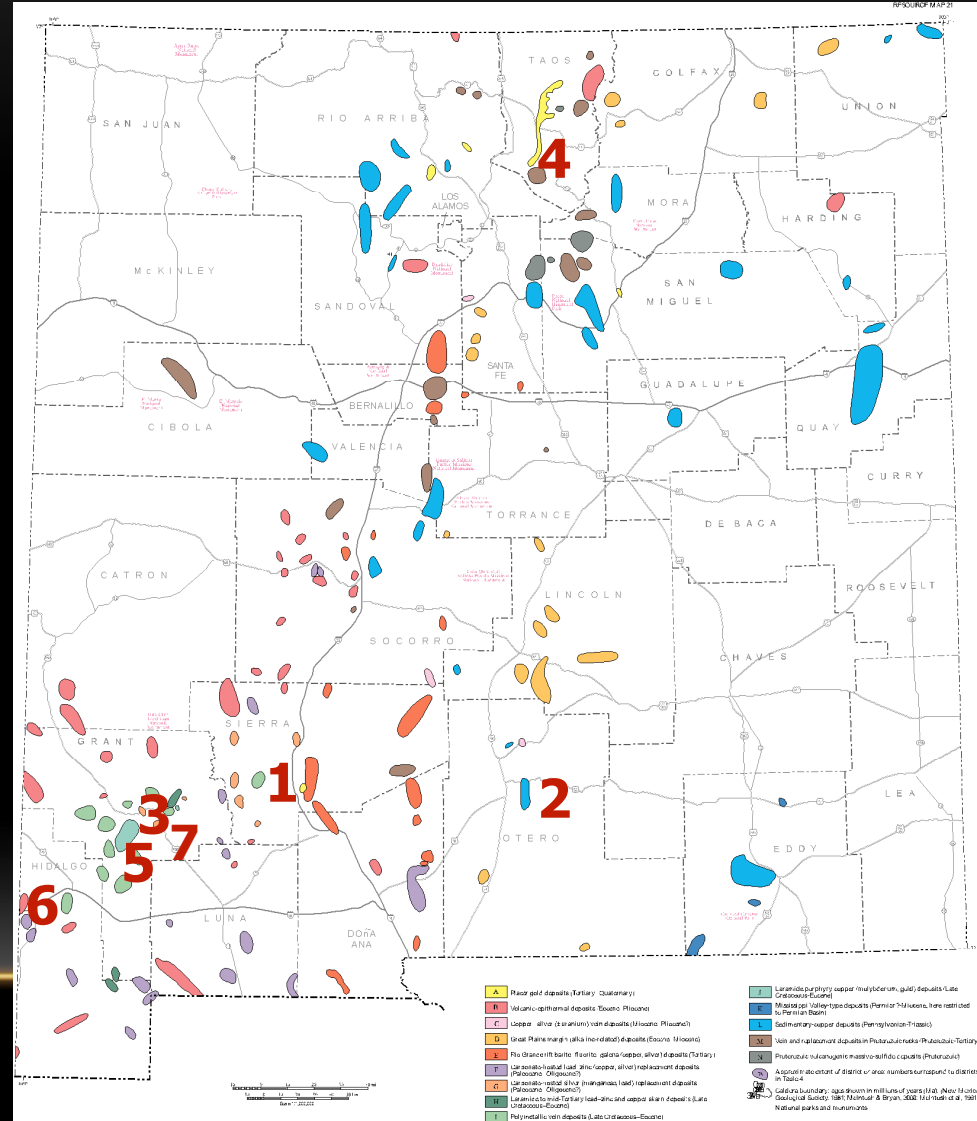
# COPPER RESERVES—2019

- Chino (including Cobre)
  - milling reserves are 224 million metric tons of 0.51% copper, 0.05 g/t gold, 0.91 g/t silver and 0.01% molybdenum
  - leaching reserves are 100 million tons of 0.32% Cu
- Tyrone (incl. Little Rock)
  - leaching reserves are estimated as 49 million metric tons of ore grading 0.25% Cu
  - Expected to close 2020s
- Cobre
  - Included with Chino mine



# POTENTIAL COPPER DEPOSITS

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
3. Hanover Mountain (80 mill st reserves at 0.38% Cu )
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 Mountains
7. Mimbres





# Copper Flat, Themax Resources

## Planned production per year for ~15 yrs

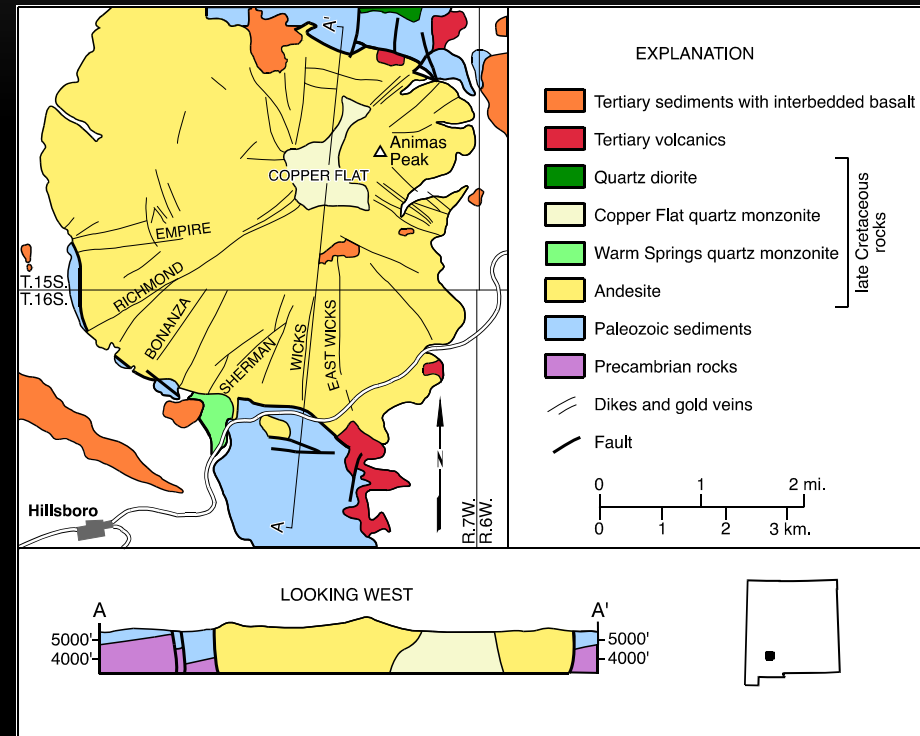
50.76 mill lbs Cu

1.01 mill lbs Mo

12,750 oz Au

455,390 oz Ag

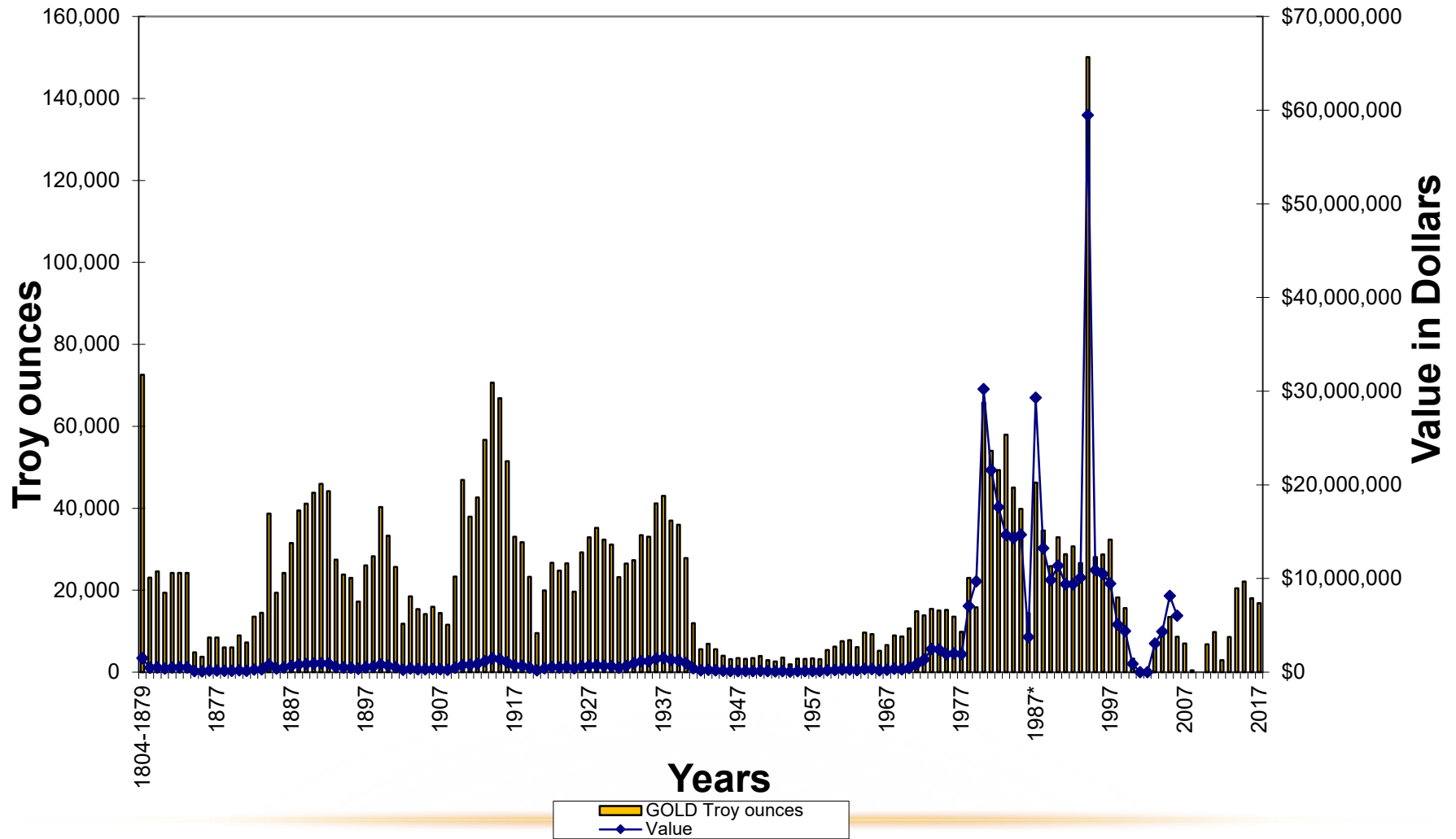
Start in 2020s?



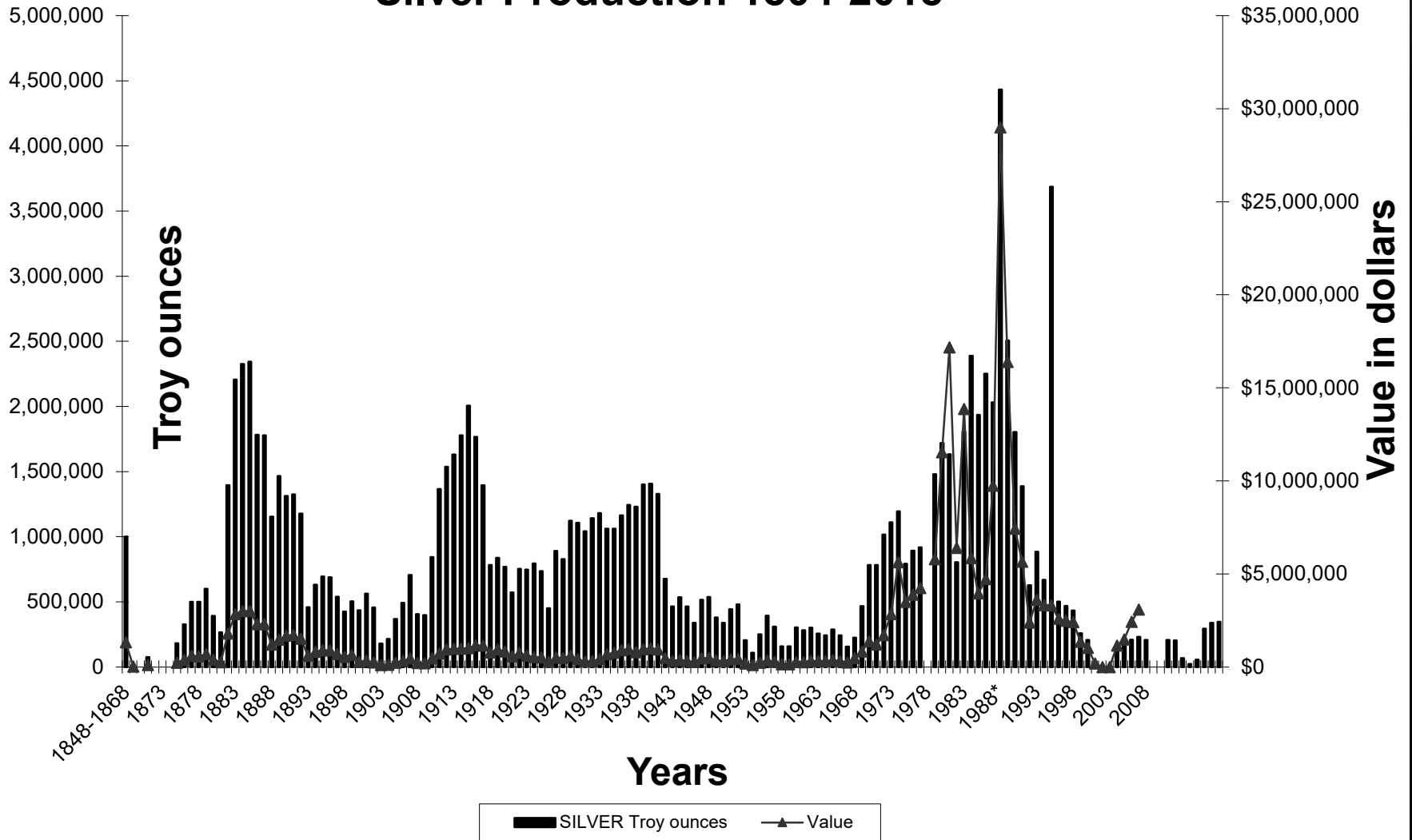
# GOLD AND SILVER PRODUCTION

- In 2004-2018 as a byproduct of copper production from the Ivanhoe concentrator (Freeport-McMoRan)
  - 2009 Summit mine opened (currently on standby)
  - 9<sup>th</sup> in gold production
  - 10<sup>th</sup> in silver production
-

# Gold Production 1804-2018



# Silver Production 1804-2018





# SUMMIT GOLD MINE

An aerial photograph of the Summit Gold Mine processing area. The scene is set in a dry, hilly landscape with sparse vegetation. In the center, there is a large, light-colored pile of material, likely tailings or waste rock. To the left, a large yellow excavator is visible near a pile of dark material. To the right, there are several large, light-colored storage bins or silos, with several pickup trucks parked nearby. In the foreground, there are more piles of material and some dry, scrubby vegetation. The background shows a steep, rocky hillside.

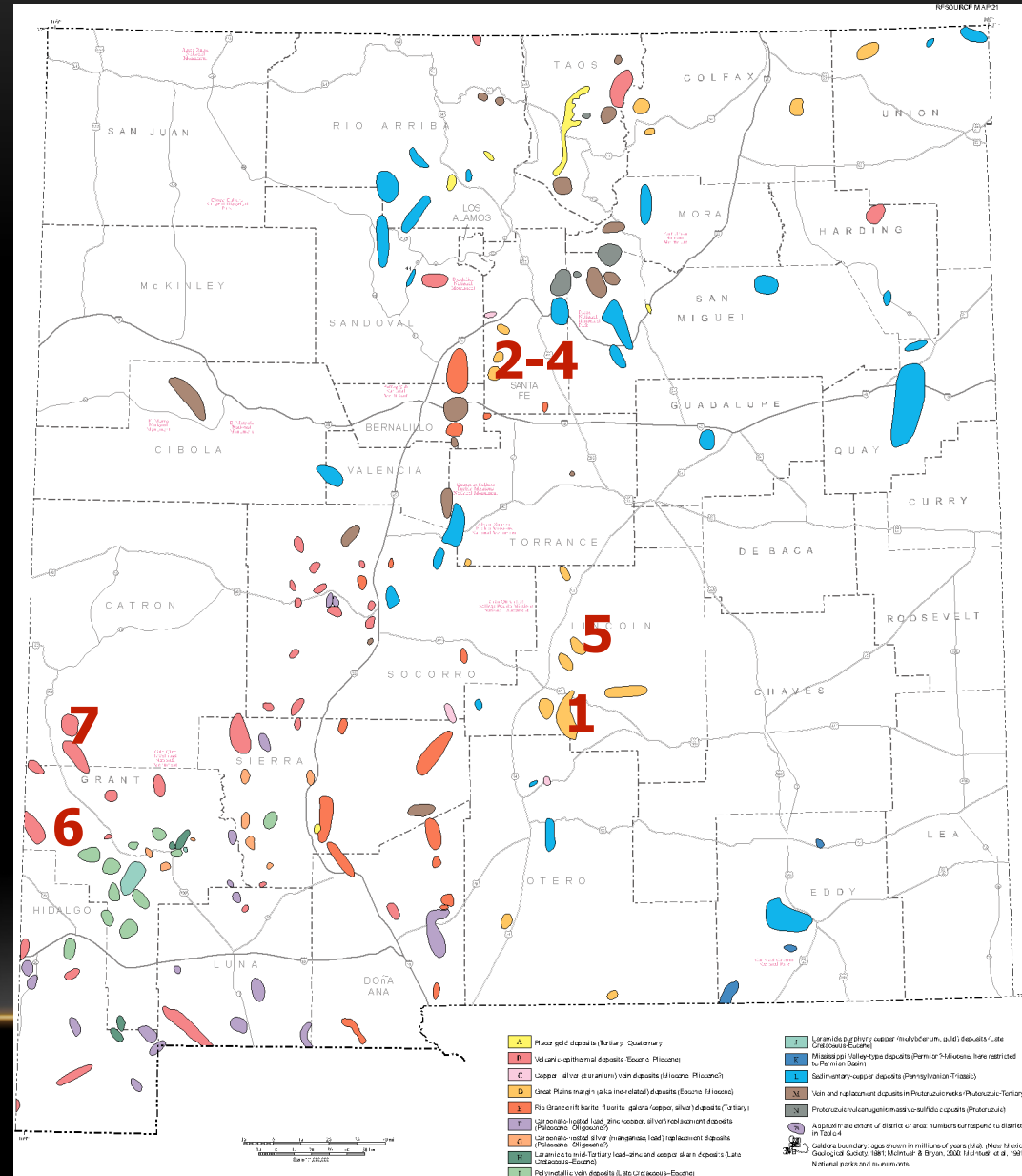
In 2009, Santa Fe Gold opened the Summit mine in the Steeple Rock district

The ore was milled at Lordsburg and sold as silica flux



# GOLD AND SILVER

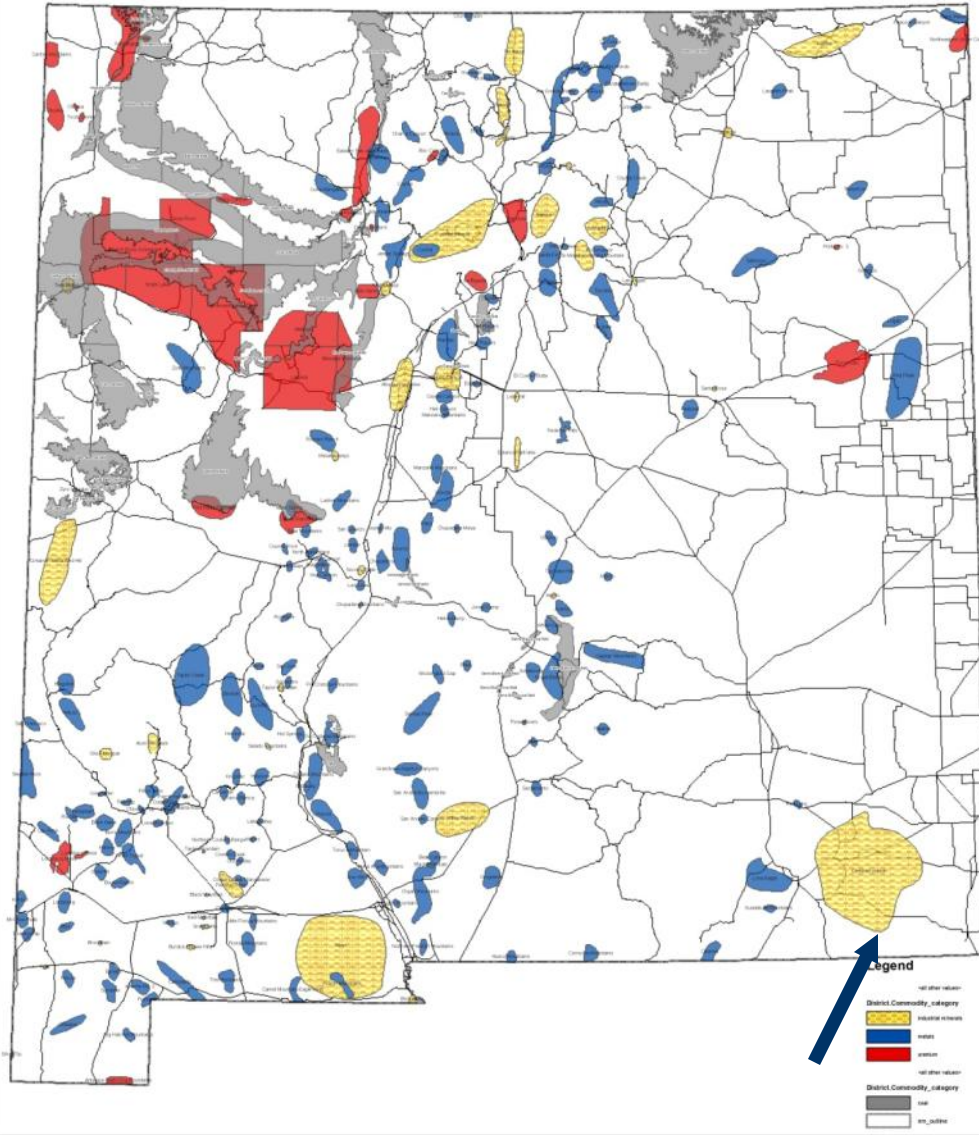
1. Vera Cruz, Lincoln Co
2. Carache Canyon, Santa Fe Co
3. Lukas Canyon, Santa Fe Co
4. San Lazarus, Santa Fe Co
5. Jicarilla Au placers
6. Steeple Rock district
7. Mogollon



# INDUSTRIAL MINERALS

Any rock, mineral, or other naturally occurring material of economic value, excluding metals, energy minerals, and gemstones, generally nonmetallics

## NM Mining Districts



# POTASH PRODUCTION

1951-2018 115 million tons  
worth >\$16 billion

## Reserves in Carlsbad District

Potash (>553 million tons)

*Potash is used in fertilizers  
among other uses*

*Intrepid closed one mine*

**Competition from  
Canadian deposits**



## Potash production 1951–2014



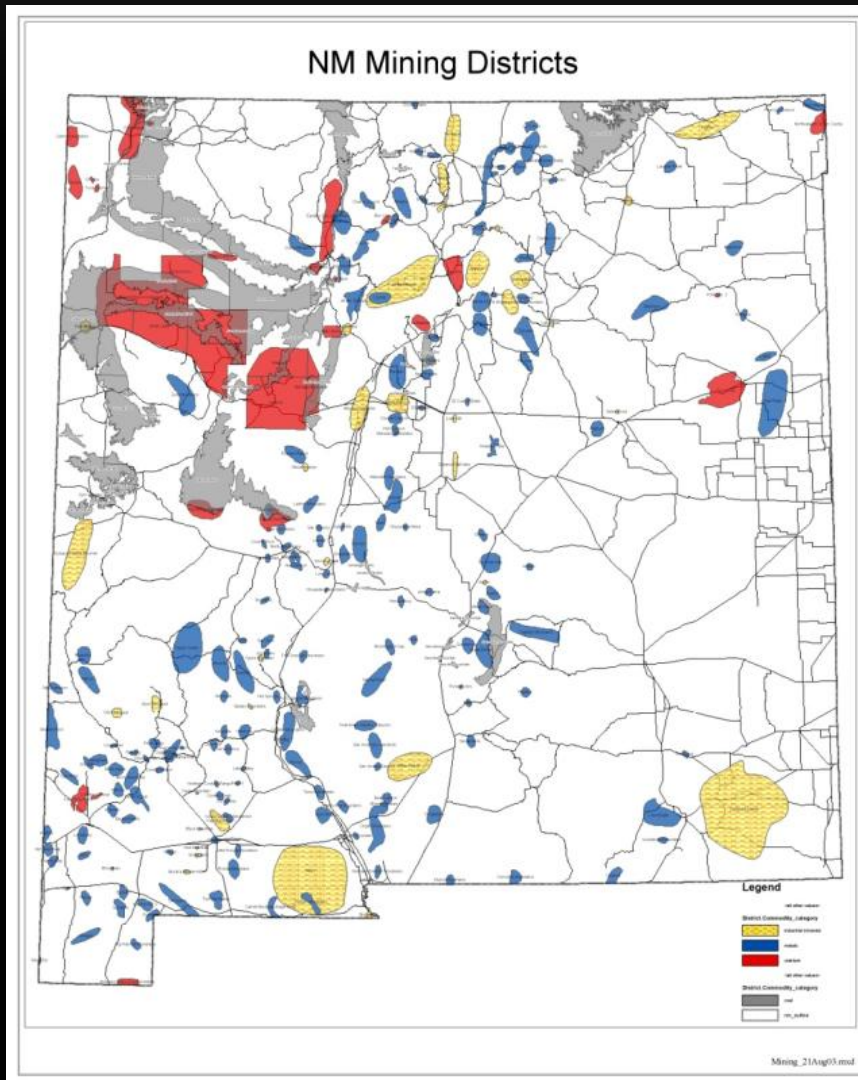


1<sup>ST</sup> IN POTASH IN 2018 (MOSAIC,  
INTREPID MINING)

# RECENT DEVELOPMENTS IN POTASH

- Intercontinental Potash Corp. (IPC) plans to mine polyhalite at the Ochoa deposit SE of the district
  - Intrepid Mining NM LLC is using solution mining techniques at the HB Solar Solution mine (old potash workings)
-

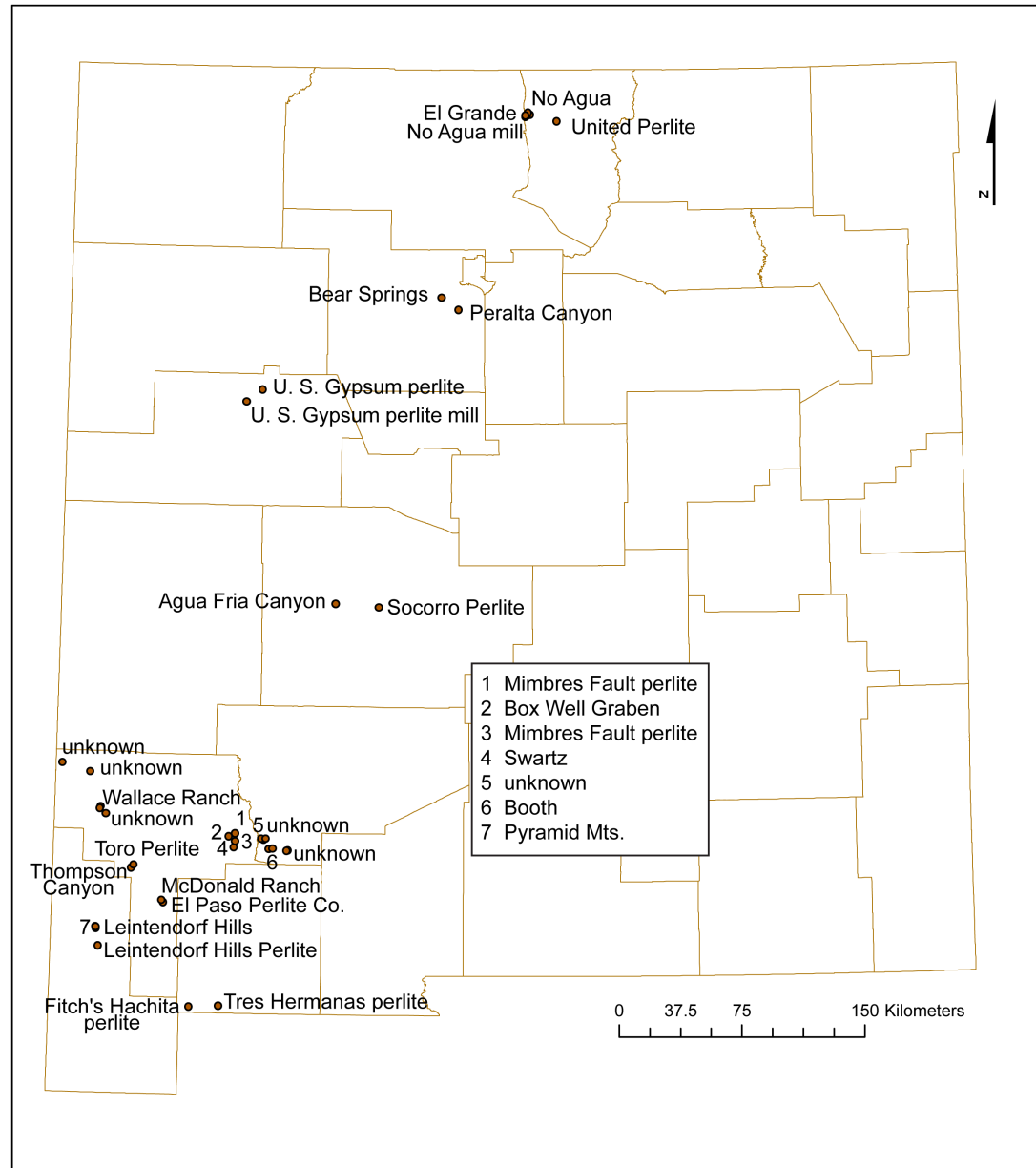
# ADDITIONAL INDUSTRIAL MINERALS IN NEW MEXICO



- 1<sup>st</sup> in zeolite (St. Cloud, Sierra County)
- 5<sup>th</sup> in pumice (6 operations)
- 1<sup>st</sup> in perlite (4 operations)
- 11<sup>th</sup> in salt (4 operations, Carlsbad)

# PERLITE IN NEW MEXICO

*Competition  
from Greece*



# OTHER INDUSTRIAL MINERALS DEPOSITS

- Aggregates
- Gypsum for wallboard
- Brick and clay in El Paso, Albuquerque areas
- Cement in Tijeras Canyon
- Humate in the San Juan Basin
- Sulfur, helium, carbon dioxide
- Travertine (dimension stone), Meso del Oro, west of Belen
  - 477.6 million tons of travertine

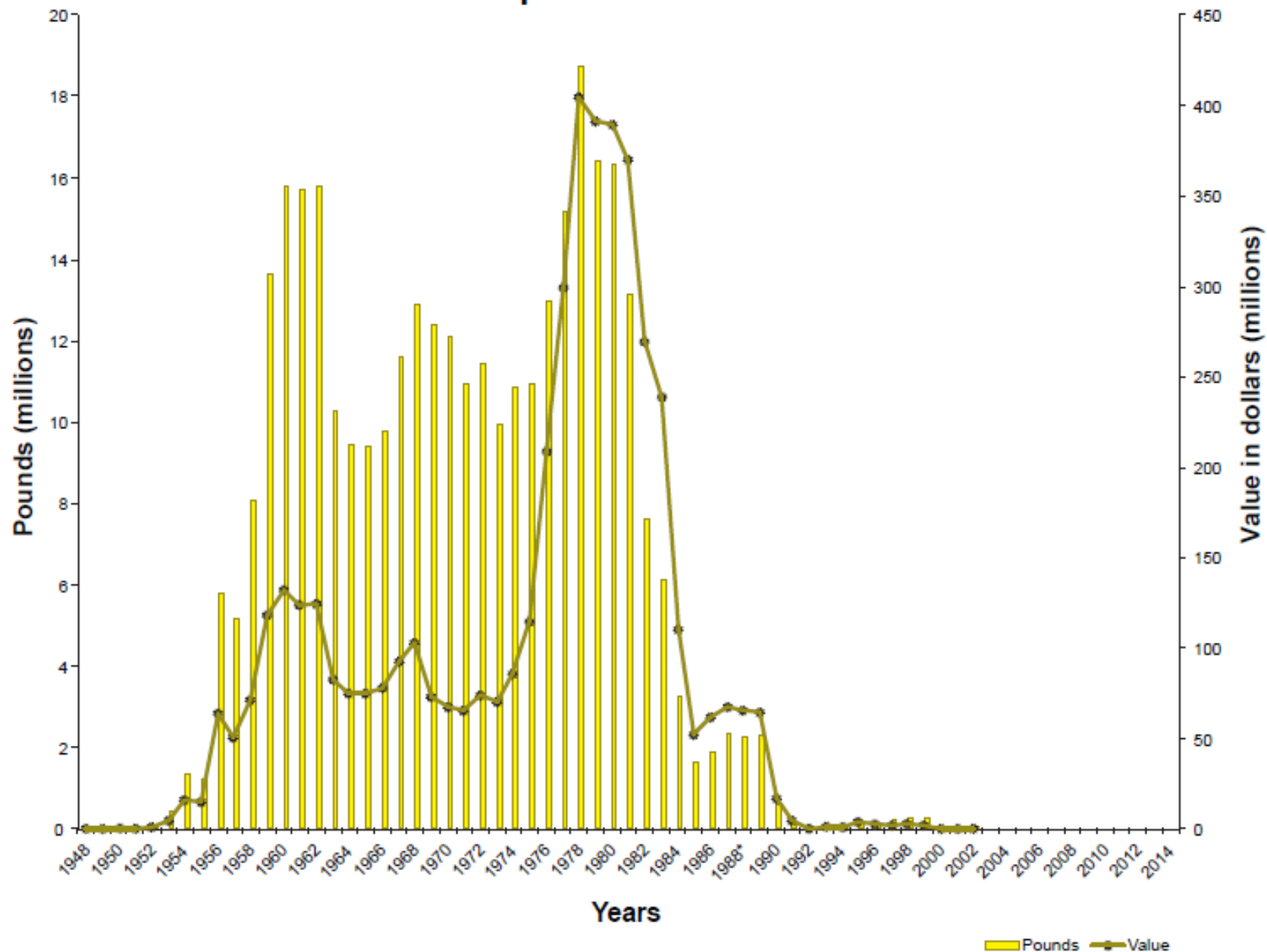
Panel Rey is building a wallboard plant in Ciudad Juarez, Chihuahua, Mexico which could impact the New Mexico gypsum industry

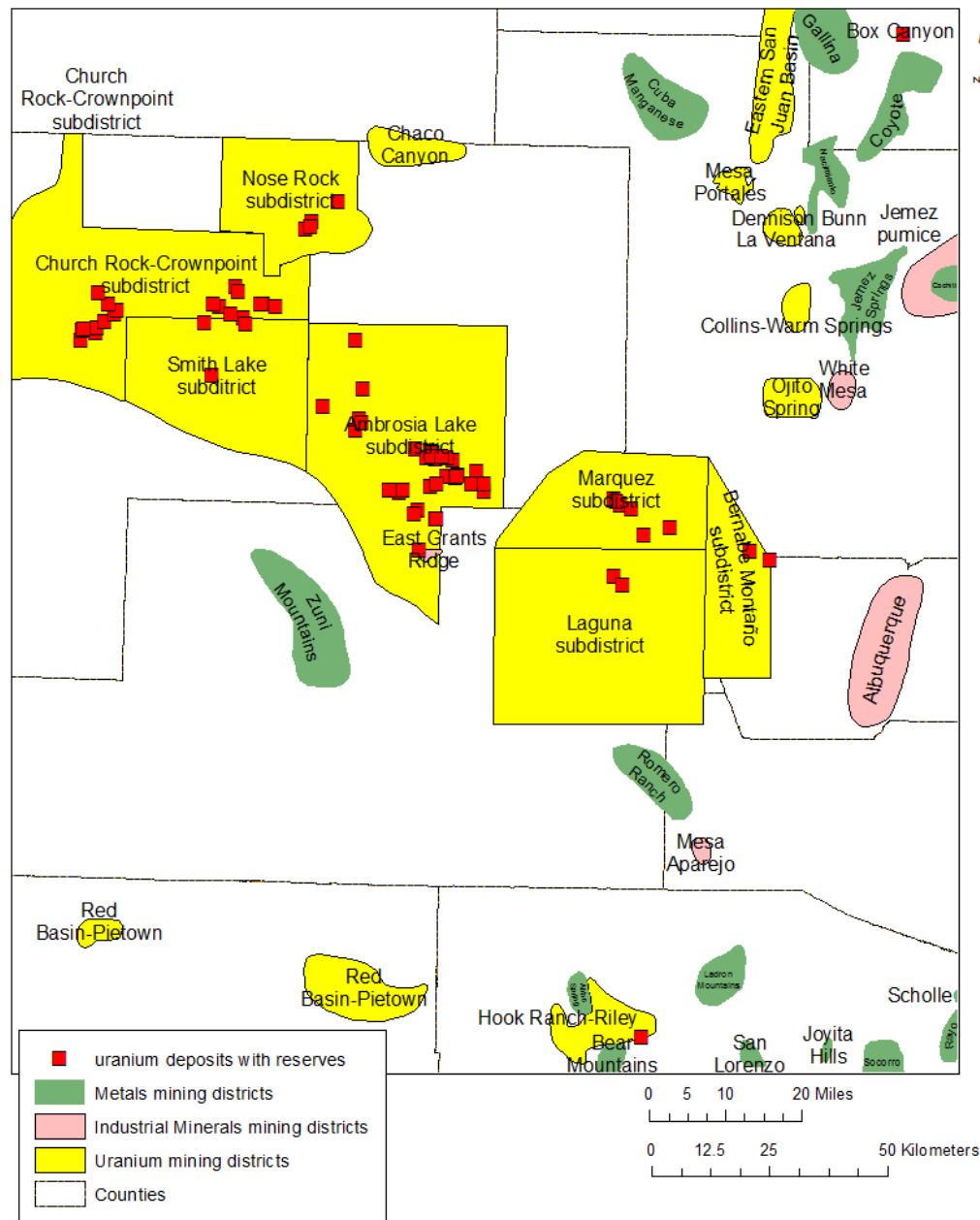
# URANIUM IN NEW MEXICO 2020

- 2<sup>nd</sup> in uranium resources 15 million tons ore at 0.277%  $\text{U}_3\text{O}_8$  (84 million lbs  $\text{U}_3\text{O}_8$ ) at \$30/lb (DOE estimates in 2002)
- Numerous companies have acquired properties (Energy Minerals, Laramide Resources, among others)
- Energy Fuels acquired Strathmore in 2013 and is now permitting the Roca Honda mine
- HRI, Inc. awaiting permits for in situ leach in Church Rock, Ambrosia Lake areas
- Several exploration permits approved or in progress



## Uranium production 1948–2014





Deposits with uranium resources in New Mexico (McLemore and Chenoweth, 2017). Only major mines and deposits are included here.



**MOUNT TAYLOR HEAD FRAME, 2006**







# WHAT ARE THE MINING ISSUES FACING NEW MEXICO?



Gold King adit



Animas River after Gold King spill

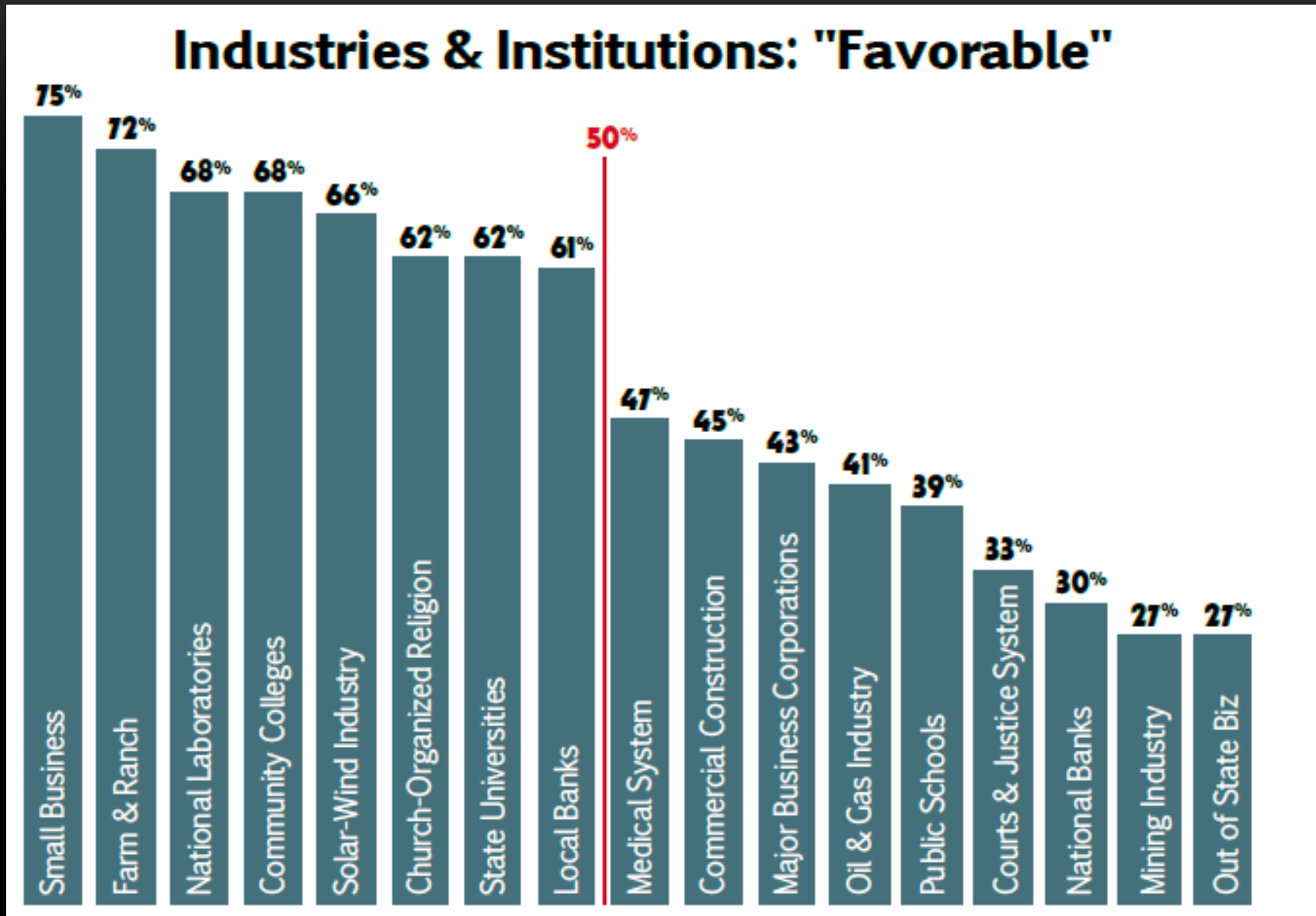
# MINING ISSUES FACING NEW MEXICO

- Some current mines are reaching the end of their life and will close over the next decade
  - There are not many new mines to replace them
  - Results in unemployment and decrease in revenues
    - Affects rural economies
    - Affects state revenues
-

# MINING ISSUES FACING NEW MEXICO

- Mining requires water and their environmental effects can not impact water supplies
  - Legacy issues of past mining activities form negative public perceptions of mining
    - Abandoned or legacy mines, especially Grants uranium district and Questa mine (superfund sites)
    - Gold King spill
-

Mining is viewed as favorable by only 27% of New Mexicans





# MINING ISSUES FACING NEW MEXICO

- Many inactive mines still have the potential to contaminate the environment or present a hazard to health and safety
  - Gold King spill
  - AML sites (Abandoned mine lands)
  - Grants uranium district
- Global competition is closing some of our mines
- Lower prices=closed mines, little exploration

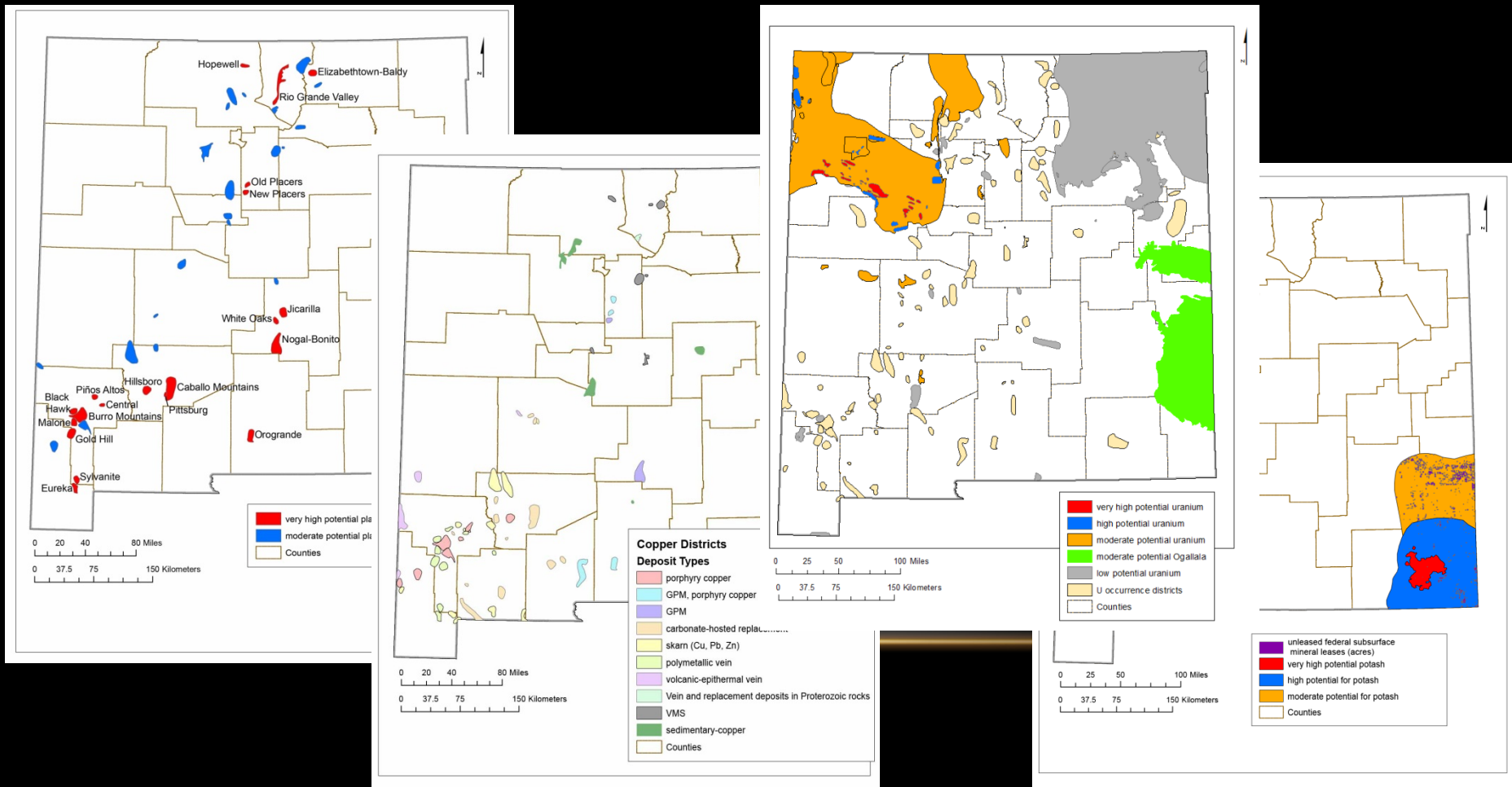
# MINING ISSUES FACING NEW MEXICO

- In some areas conflicts arise between mining and other activities
  - Grants uranium district
  - Otero Mesa
  - **Water**
- **Shortage of young geologists and engineers to explore for, develop, mine, permit these commodities and evaluate their effect on the environment—math, science skills critical**

**HOW IS THE STATE RESPONDING?**

# HOW IS THE STATE RESPONDING?

- NMBGMR is evaluating the mineral-resource potential of commodities in NM



# HOW IS THE STATE RESPONDING?

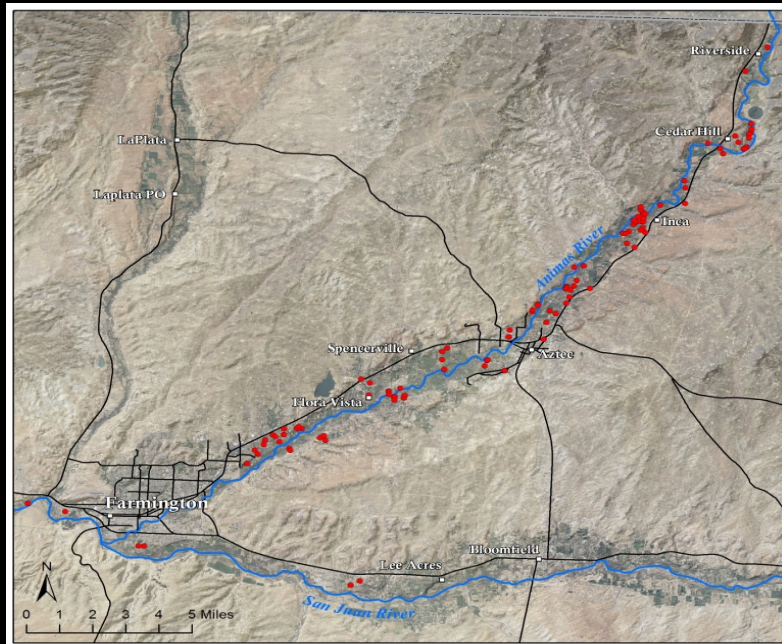
## Modifications to the 1993 NM Mining Act

NMMMD and the NM Mining Commission increased the minimum acreage for a minimal impact mine from 10 acres to 40 acres for five industrial minerals (humate, garnet, perlite, dolomite, zeolites), except in Bernalillo, Dona Ana, and Santa Fe Counties

---

# HOW IS NMBG/NMT RESPONDING?

NMED, NMBGMR with other universities and state agencies are cooperating and monitoring the Animas River watershed and the potential effects to New Mexico





# HOW IS NMBGMR/NMT RESPONDING?

NMBGMR and NM Tech is working with the state and federal AML (abandoned mine land) programs to evaluate other areas in New Mexico for potential environmental concerns

AML project

<http://geoinfo.nmt.edu/geoscience/hazards/mines/aml/home.html>





# HOW IS NMBG/NMT RESPONDING?

- NMBGMR, NMT, UNM, and other universities are examining environmental issues with uranium mines in NM
- New Mexico's Experimental Program to Stimulate Competitive Research (NM EPSCoR)



# HOW IS NMBG/NMT RESPONDING?

- NMBGMR, NMT, UNM, and other universities conducted a workshop on Making AML wastes profitable

<https://geoinfo.nmt.edu/publications/openfile/details.cfm?Volume=597>

MAKING ABANDONED MINE LANDS (AML) PROFITABLE—  
WORKSHOP  
PROCEEDINGS AND ABSTRACTS

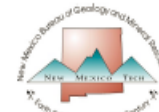
Virginia T. McLemore and Bonnie Frey, editors

New Mexico Bureau of Geology and Mineral Resources

OPEN-FILE REPORT 597

April 2018

A NM EPSCoR Sustainability Innovative Working Group Workshop



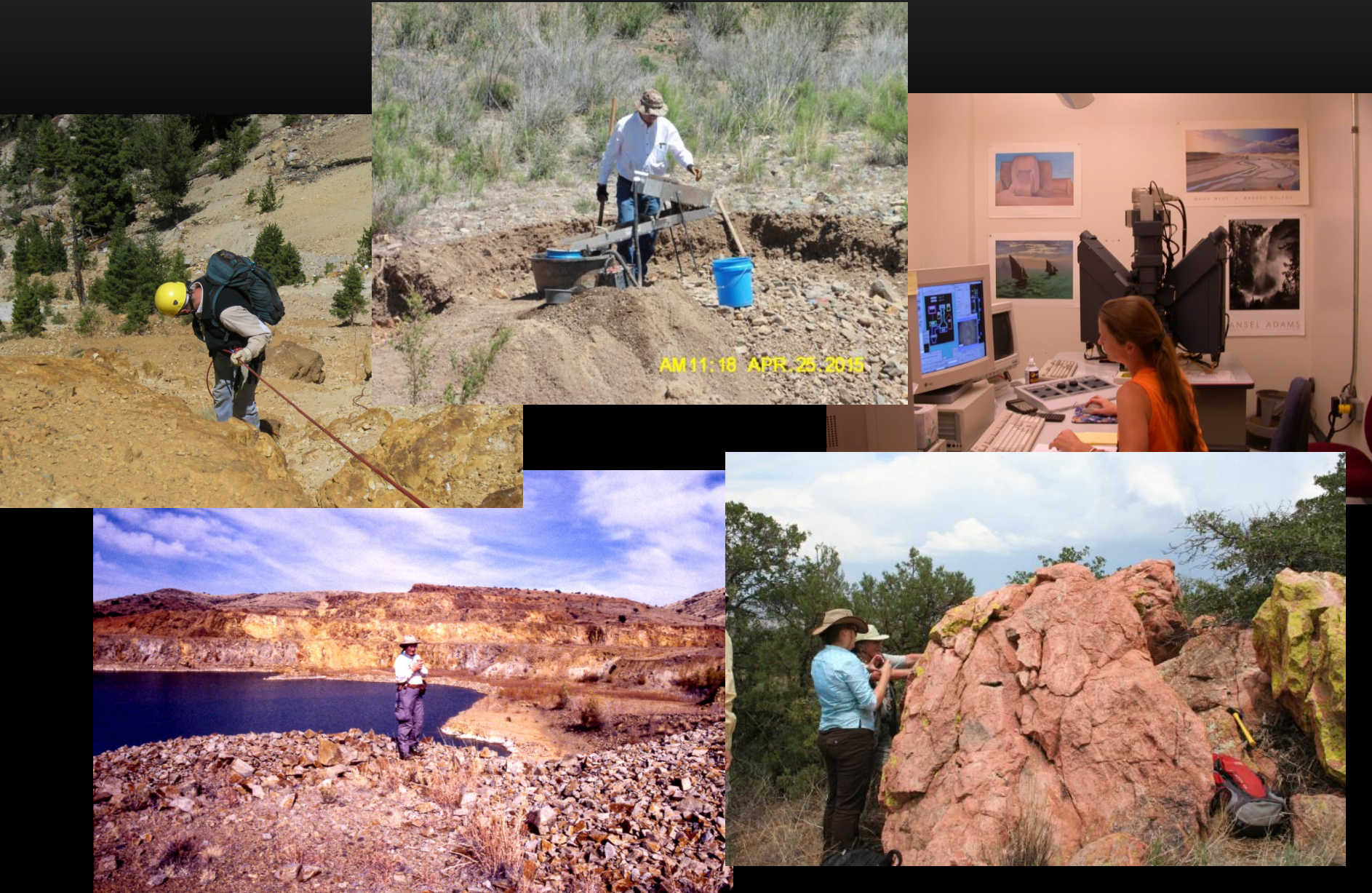
New Mexico Bureau of Geology and Mineral Resources

A division of New Mexico Institute of Mining and Technology

Socorro, New Mexico 87801



# ADDITIONAL RESEARCH



# CRITICAL MINERALS IN NEW MEXICO

# CRITICAL MINERALS

- *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*
- President Trump signed an executive order (Presidential Executive Order (EO) No. 13817) that requires the Departments of Interior and Defense to develop a list of critical minerals



# CRITICAL MINERALS

- 35 critical minerals were identified
- New Mexico has many of these critical minerals
  - Potash is currently being produced in Carlsbad
  - Copper deposits in Grant County contain rhenium, indium, and germanium
  - Uranium deposits in the Grants district
  - Exploration for other critical minerals include REE, tellurium, lithium, beryllium, cobalt
  - Other critical minerals were once produced from New Mexico (tin, vanadium, manganese, fluorspar, barite, graphite)

# Critical Minerals in New Mexico

■ Element currently producing in NM

■ Element once produced from NM

■ Element found in NM

■ Element not found in NM

H																	C=graphite						F=fluorite		He
Li	Be																	B	C	N	O	F	Ne		
Na	Mg																	Al	Si	P	S	Cl	Ar		
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr								
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe								
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn								
Fr	Ra	Ac																							
Ba=barite			Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu									
			Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr									

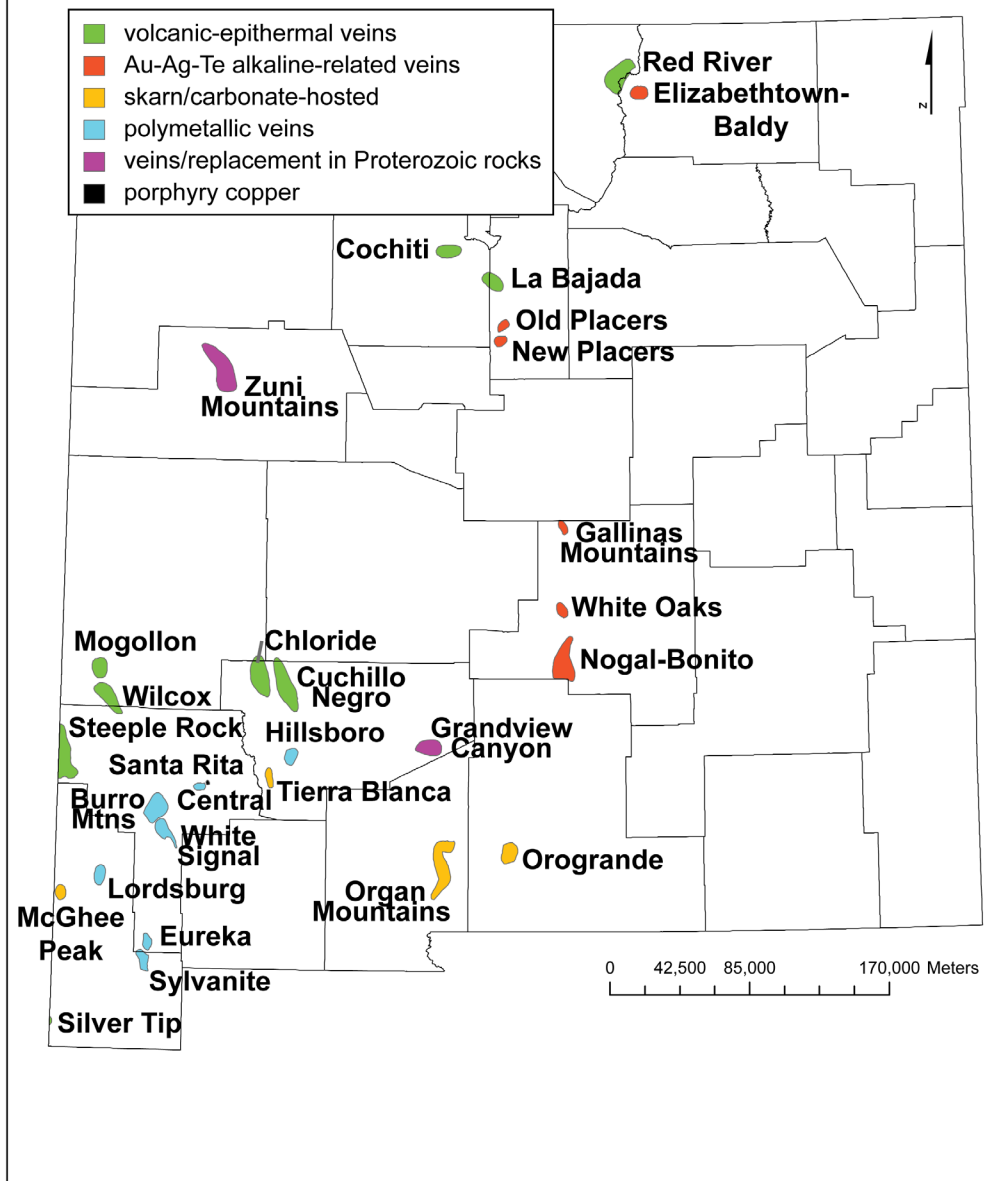
Note that any element or commodity can be considered critical in the future depending upon use and availability.  
Coal contains several of these critical elements.



# TELLURIUM IN MAGMATIC SYSTEMS NEW MEXICO

# Uses of Te

- Alloying additive in steel to improve machining characteristics
- Processing of rubber
- As a component of catalysts for synthetic fiber production
- As pigments to produce various colors in glass and ceramics
- **Thermal imaging devices**
- Thermoelectric cooling devices, such as summertime beverage coolers
- Thermoelectronics
- **Solar panels/cells**

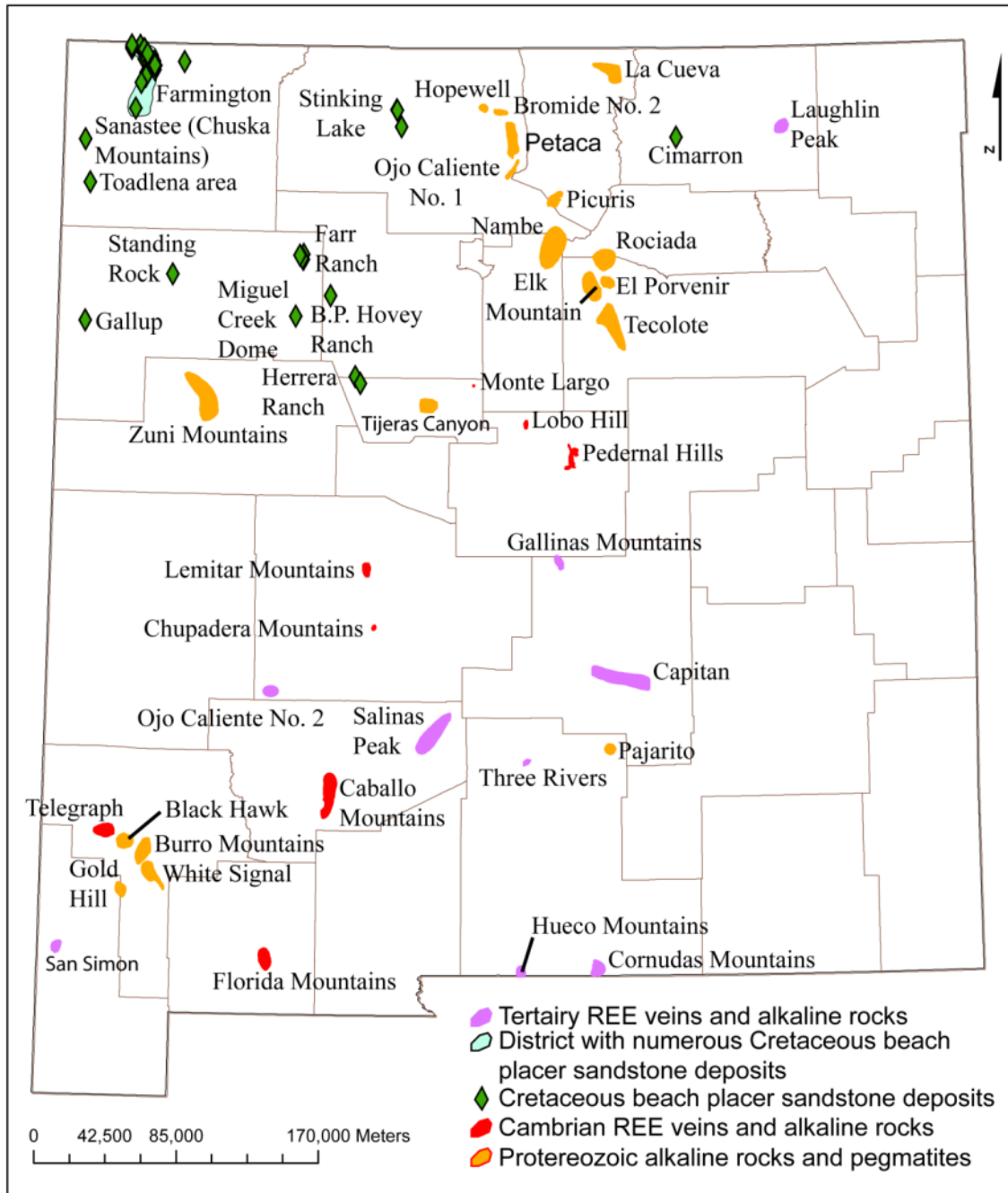


Mining districts  
in New Mexico  
with tellurium  
minerals or  
chemical  
assays >20  
ppm Te

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

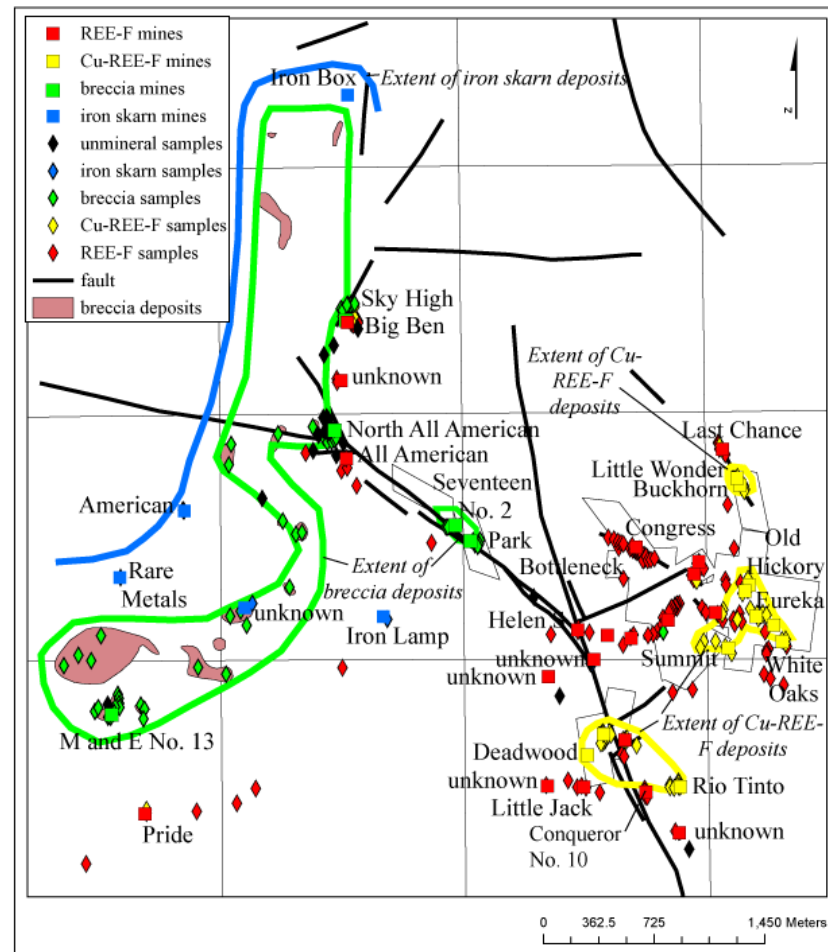
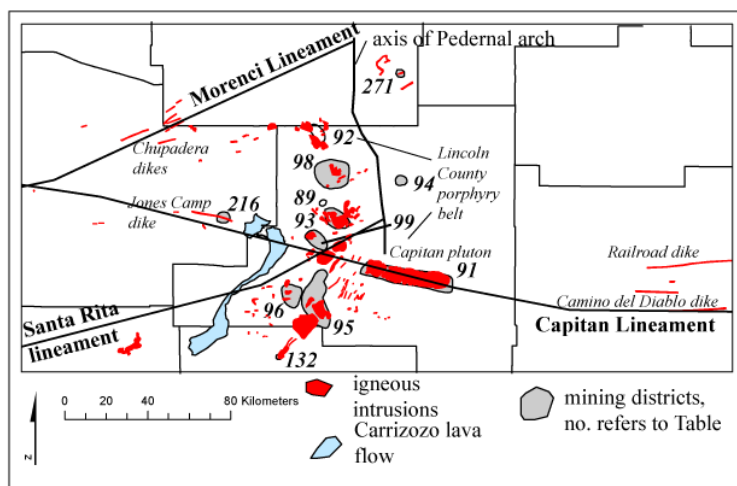
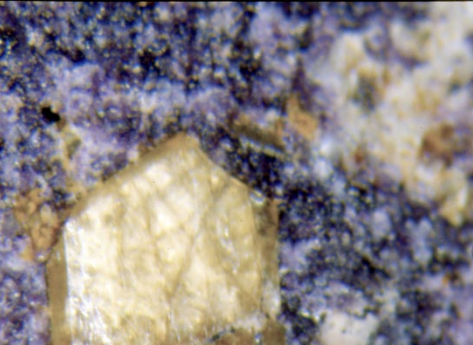


# OCCURRENCES OF RARE EARTH ELEMENTS (REE) IN NEW MEXICO





# REE in Gallinas Mountains, Lincoln County



# SUMMARY

- New Mexico has a wealth of mineral resources
    - Geologic processes control the location of mineral deposits and many of these same processes form the scenic views we treasure
  - Minerals are critical in providing our way of life—everything we use has to be grown or mined
  - Mining creates jobs and revenues in the community
-



# SUMMARY

- New Mexico has a wealth of mineral resources
    - Geologic processes control the location of mineral deposits and many of these same processes form the scenic views we treasure
  - Minerals are critical in providing our way of life—everything we use has to be grown or mined
  - Mining creates jobs and revenues in the community
-

## MORE INFORMATION

- NM Mines and Minerals Division  
<http://www.emnrd.state.nm.us/MMD/>

Virginia McLemore web page

<http://geoinfo.nmt.edu/staff/mclemore/home.html>

- New Mexico Bureau of Geology and Mineral Resources  
<http://geoinfo.nmt.edu/>



# MEMOIR 50—ENERGY AND MINERAL RESOURCES OF NEW MEXICO

# SILVER AND GOLD IN NEW MEXICO



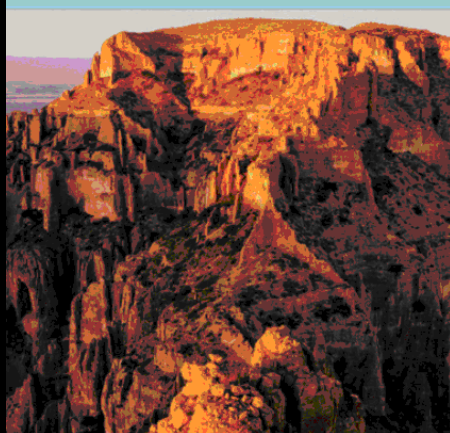
Virginia T. McLemore

New Mexico Bureau of Geology and Mineral Resources

Reston, Virginia 2019

## New Mexico GEOLOGY

August 2019  
Volume 52, Number 3



New Mexico Bureau of Geology and Mineral Resources / A Division of New Mexico Tech

NEW MEXICO BUREAU OF GEOLOGY AND MINERAL RESOURCES

### MINING IN NEW MEXICO

The Environment, Water,  
Economics, and Sustainable  
Development

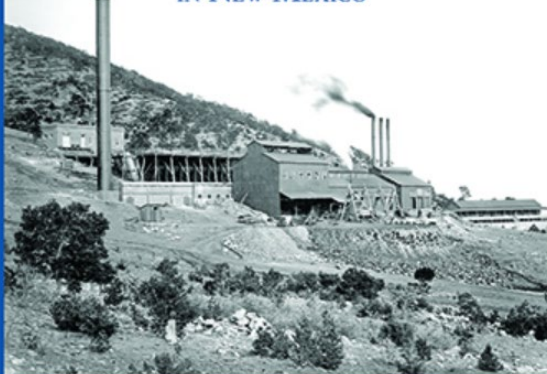
A Special Report, Douglas H. Wood, Virginia T. McLemore,  
and Daniel M. Barlow, Editors

HISTORICAL MINING  
FROM 1800 TO 1900  
TODAY



## MINING DISTRICTS AND PROSPECT AREAS

### IN NEW MEXICO



Virginia T. McLemore

New Mexico Bureau of Geology and Mineral Resources  
A Division of New Mexico Institute of Mining and Technology

Resource Map 24

2017

## New Mexico EARTH MATTERS

Volume 2018



### New Mexico Potash—Past, Present, and Future

Potash is the granddaddy of minerals and has been mined in New Mexico since the 1800s. It is a vital mineral for the production of many products, including fertilizers, glass, and chemicals. The New Mexico Potash Project is a major initiative to develop new potash resources in the state.



White potash crystals from the New Mexico Potash Project.

The New Mexico Potash Project is a major initiative to develop new potash resources in the state. It involves the construction of a new potash mine and the development of new potash processing facilities. The project is expected to create thousands of jobs and generate significant revenue for the state.

Production of potash in New Mexico has increased significantly in recent years, and is expected to continue to grow in the future.

The New Mexico Potash Project is a major initiative to develop new potash resources in the state.

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Published by the New Mexico Bureau of Geology and Mineral Resources, a Division of New Mexico Tech

## Lite Geology

### Geothermal Energy

FALL 2019 ISSUE 26



Flowers growing in a geothermal greenhouse at Mexican Springs Farm, New Mexico.

### IN THIS ISSUE ...

Geothermal Energy • How Do Geysers Work?

Classroom Activity: Infrared Yellowstone Lesson Plans • Geothermal Crossword Puzzle

Geothermal Applications in New Mexico

Geothermal Greenhouse Heating at Radium Springs, New Mexico

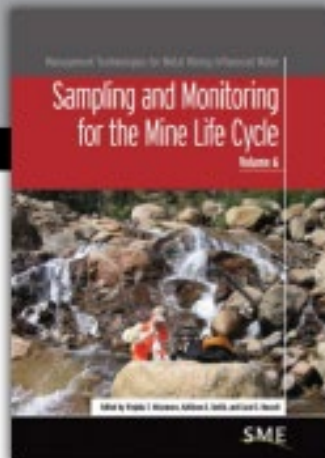
Heating New Mexico Tech's Campus with Geothermal Energy

Most Wanted Mineral: Opal • Through the Hand Lens

New Mexico's Enchanting Geology • Short Hikes of Interest

NEW MEXICO BUREAU OF GEOLOGY & MINERAL RESOURCES, A DIVISION OF NEW MEXICO TECH





## Sampling and Monitoring for the Mine Life Cycle

Edited by Virginia T. McLemore, Kathleen S. Smith, and Carol C. Russell

**Sampling and Monitoring for the Mine Life Cycle** provides an overview of sampling for environmental purposes and monitoring of environmentally relevant variables at mining sites. It focuses on environmental sampling and monitoring of surface water, and also considers groundwater, process water streams, rock, soil, and other media including air and biological organisms. The handbook includes an appendix of technical summaries written by subject-matter experts that describe field measurements, collection methods, and analytical techniques and procedures relevant to environmental sampling and monitoring.

The sixth of a series of handbooks on technologies for management of metal mine and metallurgical process drainage, this handbook supplements and enhances current literature and provides an awareness of the critical components and complexities involved in environmental sampling and monitoring at the mine site. It differs from most information sources by providing an approach to address all types of mining influenced water and other sampling media throughout the mine life cycle.

**Sampling and Monitoring for the Mine Life Cycle** is organized into a main text and six appendices that are an integral part of the handbook. Sidebars and illustrations are included to provide additional detail about important concepts, to present examples and brief case studies, and to suggest resources for further information. Extensive references are included.

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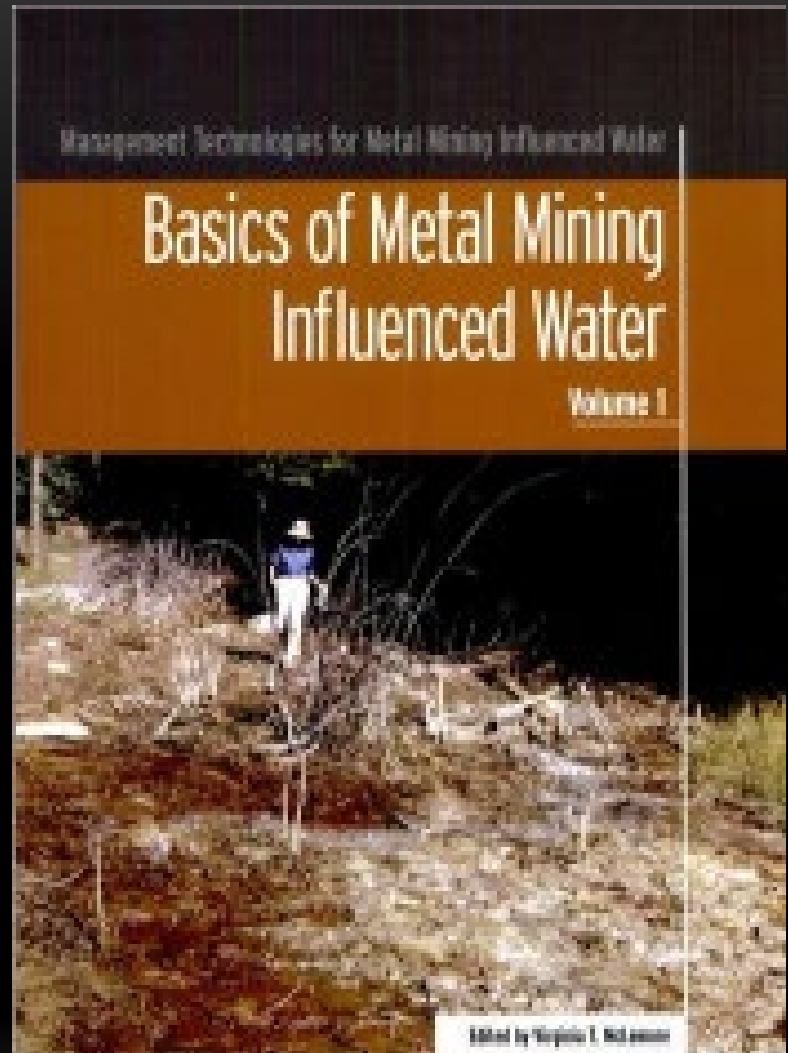
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Management Technologies for Metal Mining Influenced Water

## Basics of Metal Mining Influenced Water

Volume 1

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# QUESTIONS?

