

STATUS OF THE MINING INDUSTRY IN NEW MEXICO—2019



Virginia T. McLemore

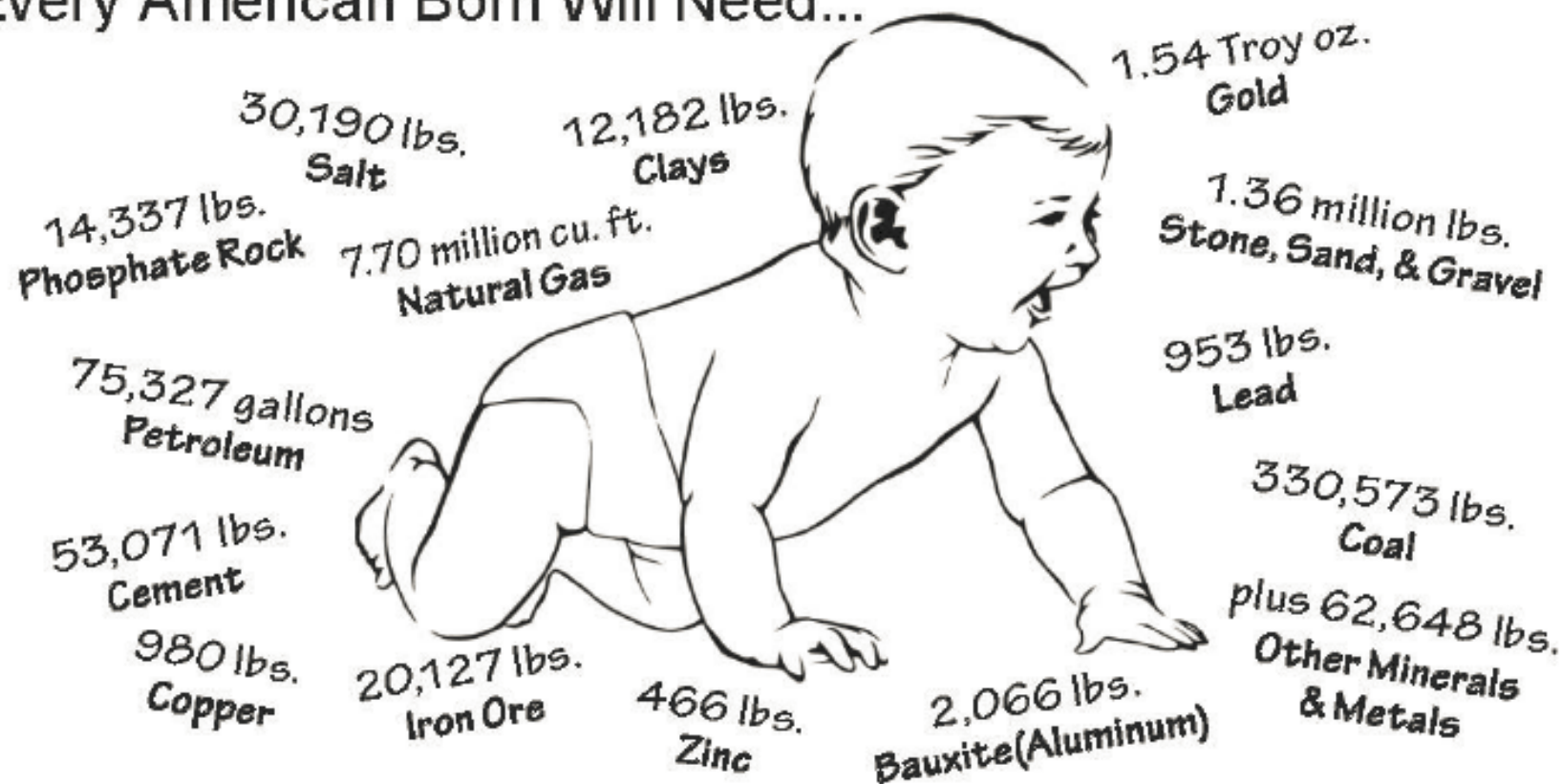
*New Mexico Bureau of
Geology and Mineral
Resources, New Mexico Tech,
Socorro, NM*



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

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

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OUTLINE

- What, where, and how much minerals are produced in New Mexico?
 - Where are potential future resources?
 - Are there critical minerals in New Mexico?
 - What are the Mining Issues Facing New Mexico?
-

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

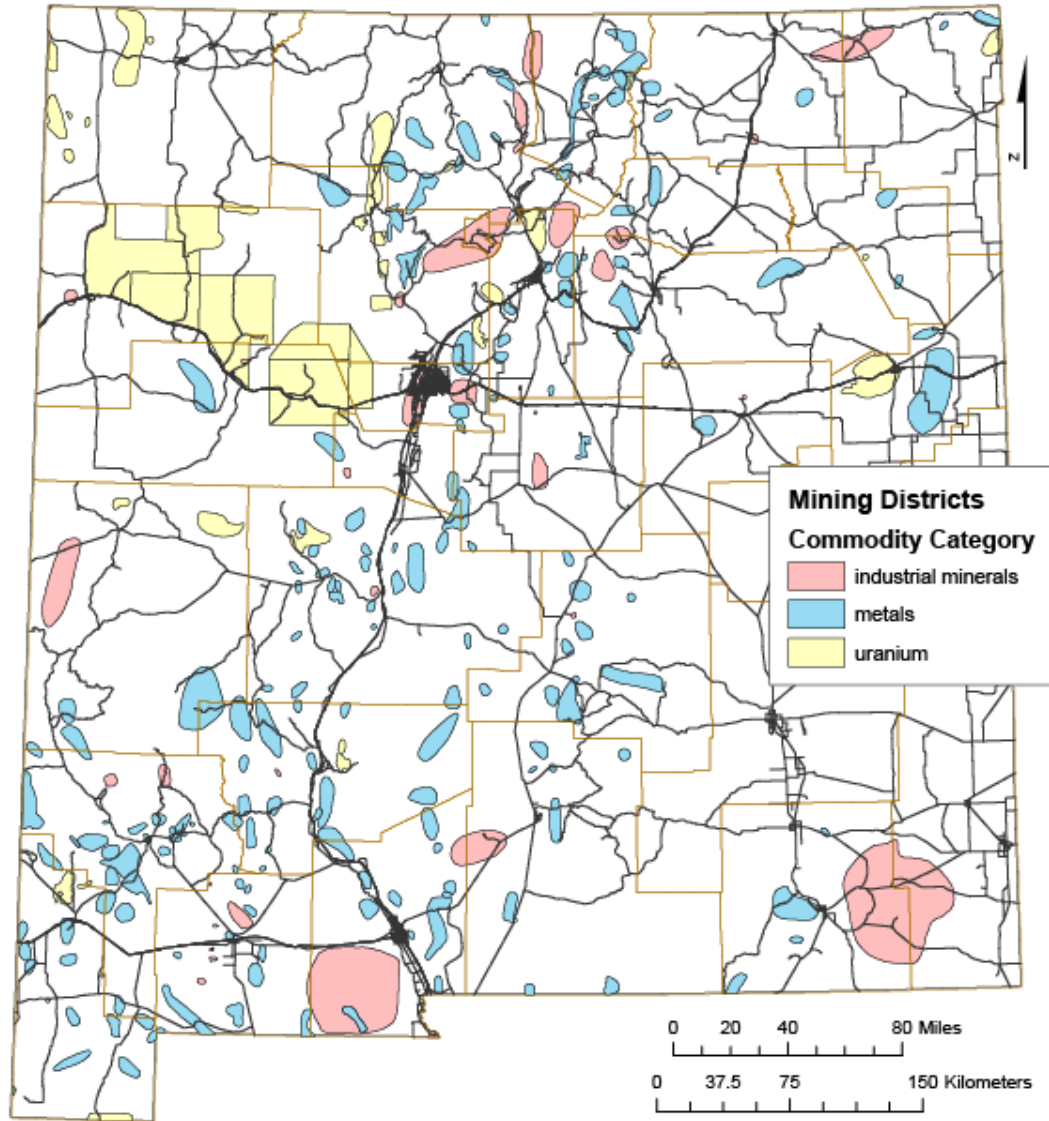
INTRODUCTION

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

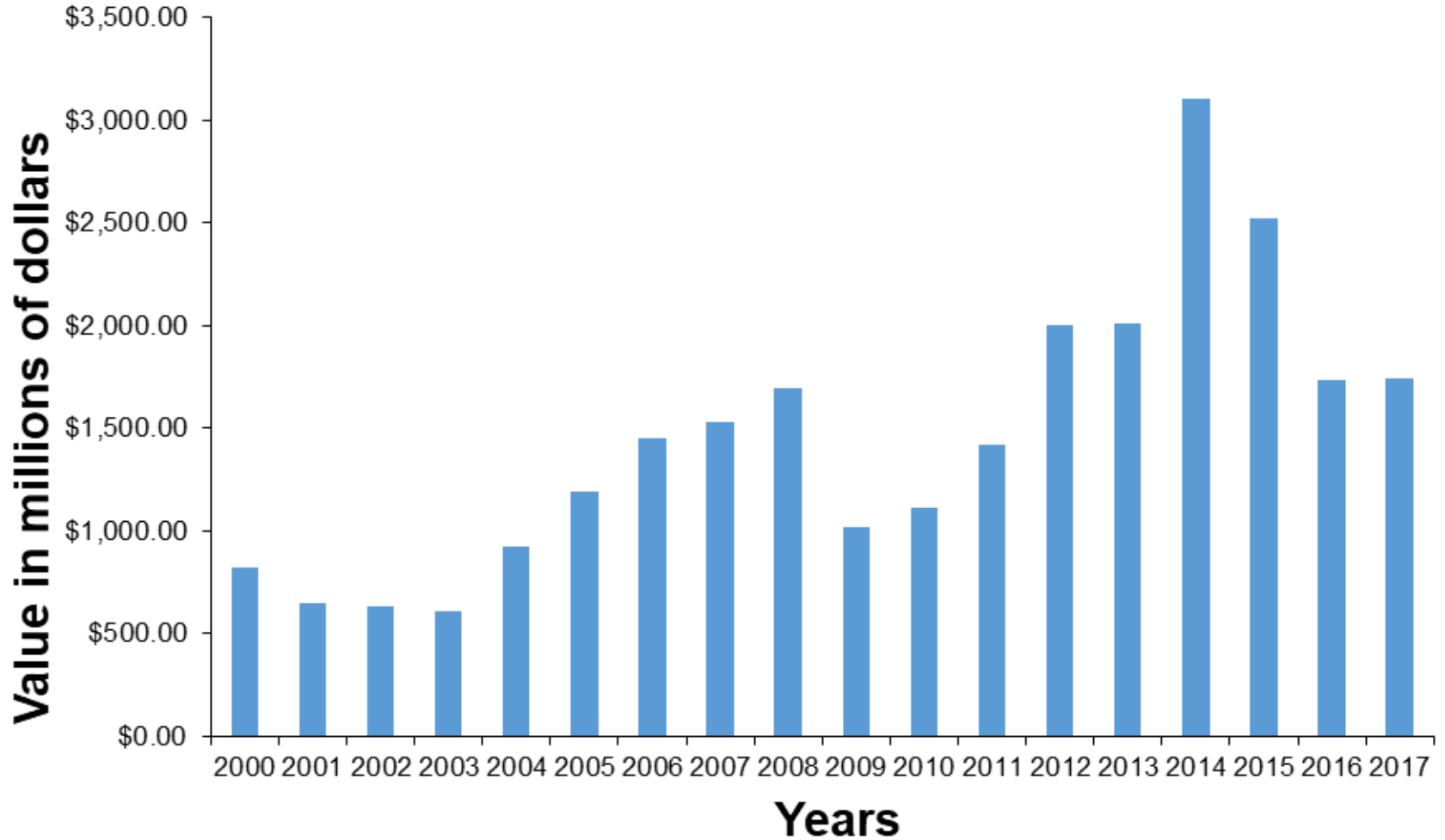
Resource Map 24

2017

PRODUCTION SUMMARY—2017

- Value of mineral production in 2017 was \$1.7 billion (does not include oil and gas)—ranked 18th in the US
- Employment in the mining industry is 4,685
- 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***

VALUE OF MINERAL PRODUCTION IN NEW MEXICO 2000-2017 (MMD)



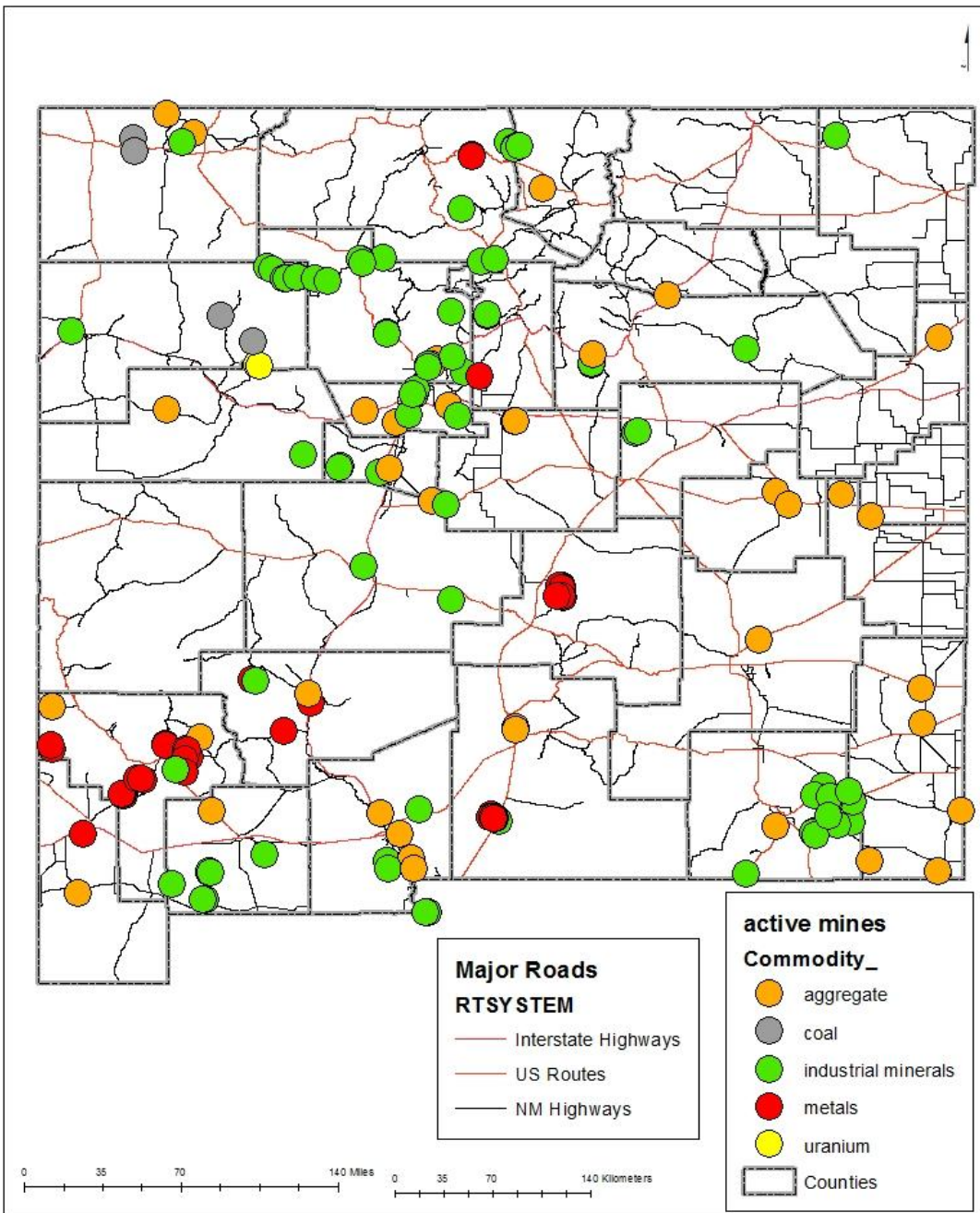
ACTIVE MINES 2019

- ~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

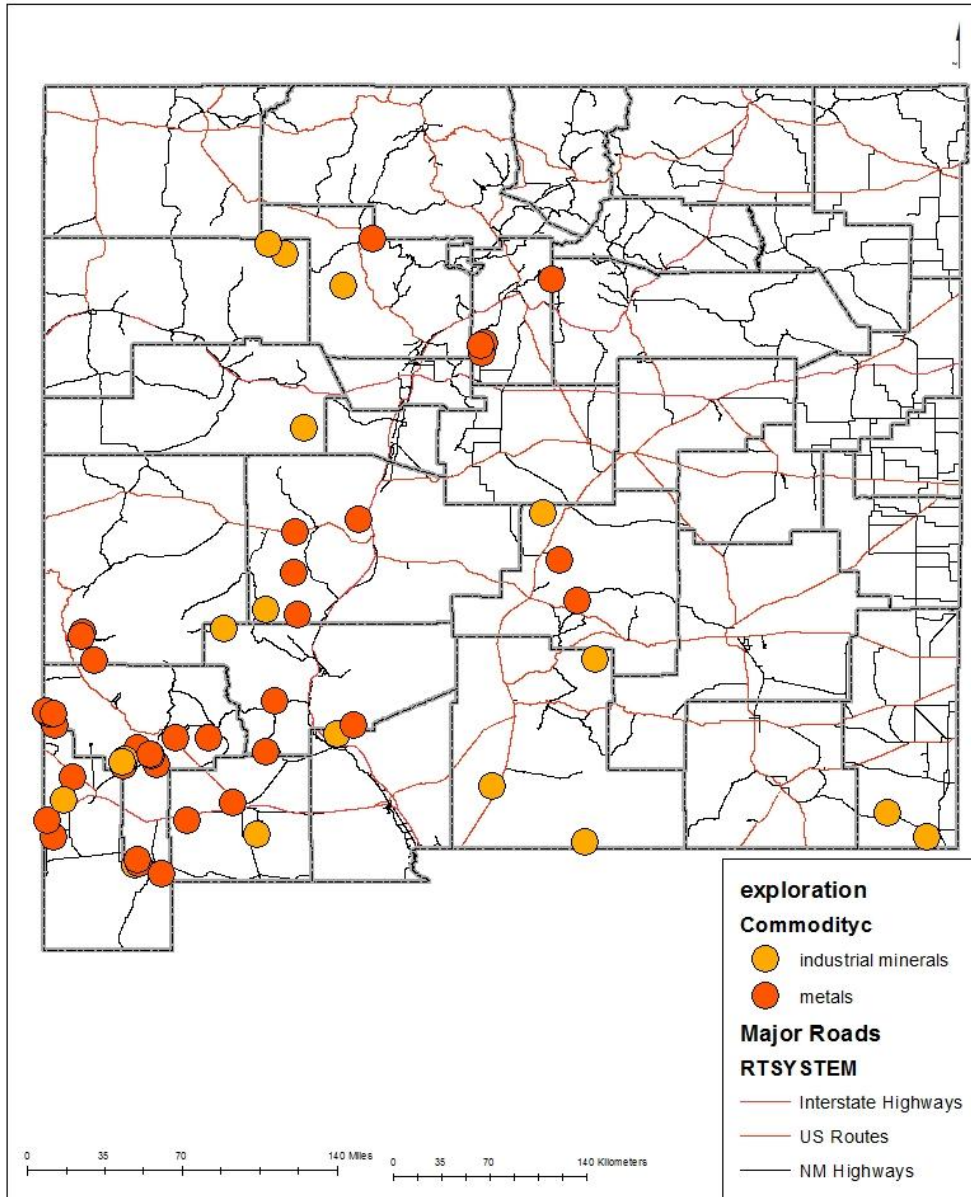
ACTIVE MINES IN NEW MEXICO 2016-2019

Not all
aggregate mines
are shown

From NM Mining
and Minerals
Div. database



SELECTED ACTIVE EXPLORATION SITES IN NEW MEXICO 2016- 2019 (EXCLUDING U)



From NM Mining
and Minerals Div. and
NMBGMR databases,
company web sites

Most of these exploration sites
have been known for >20 yrs

Industrial minerals deposits
sometimes can be permitted
within a few yrs but not metal
mines

COAL

- Fuels 3 electrical generating plants
- 3 surface mines and 1 underground mine in San Juan Basin
- Resources at Raton, Carrizozo
- 11th in production in U.S. in 2017
- 11th in estimated recoverable coal reserves—7 billion tons of recoverable reserves (2005 figures)
- San Juan generating station in the Farmington is scheduled to close in the near future
- ***Coal production is expected to decrease in the near future***



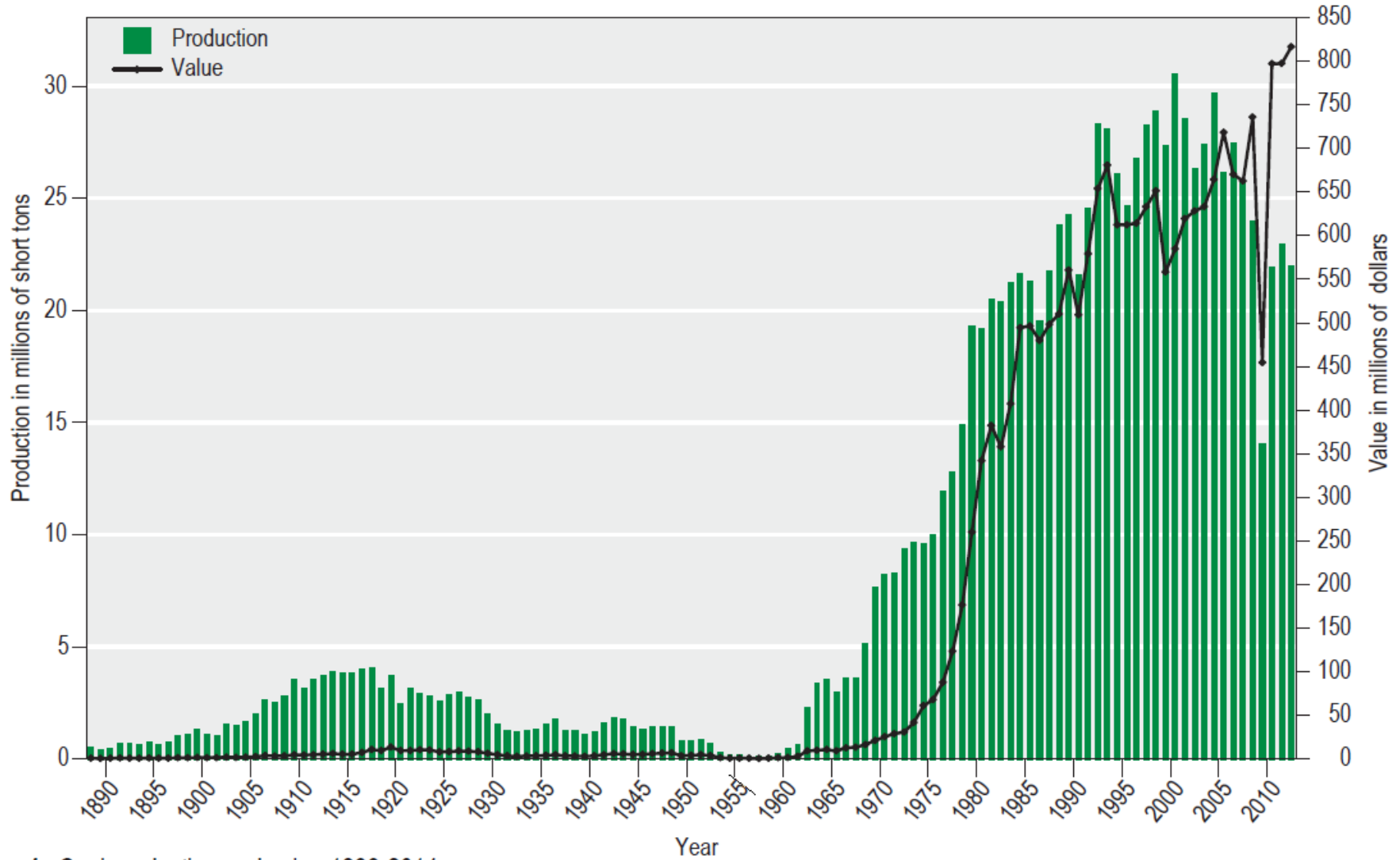
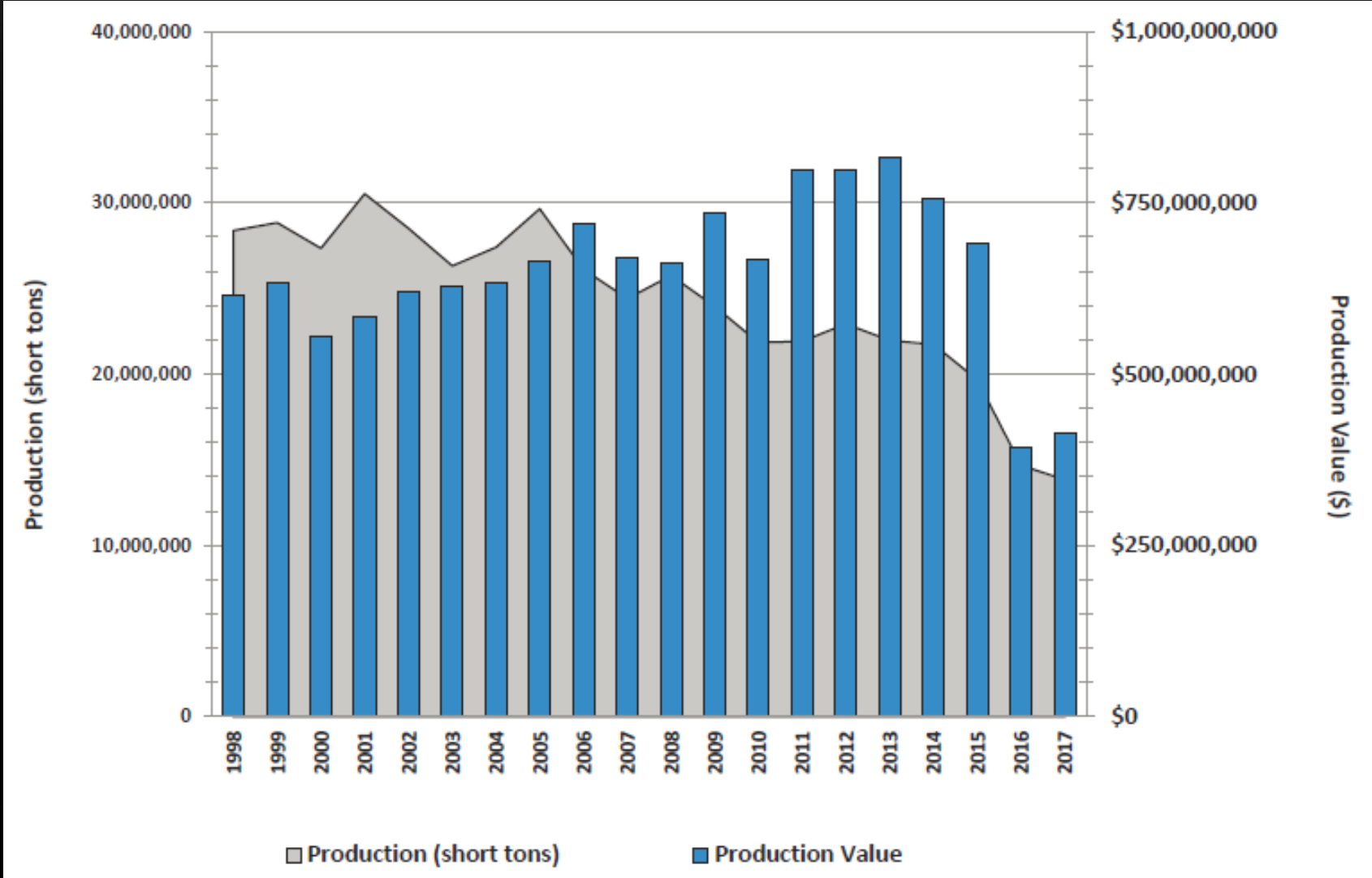


Figure 4. Coal production and value 1899-2014.

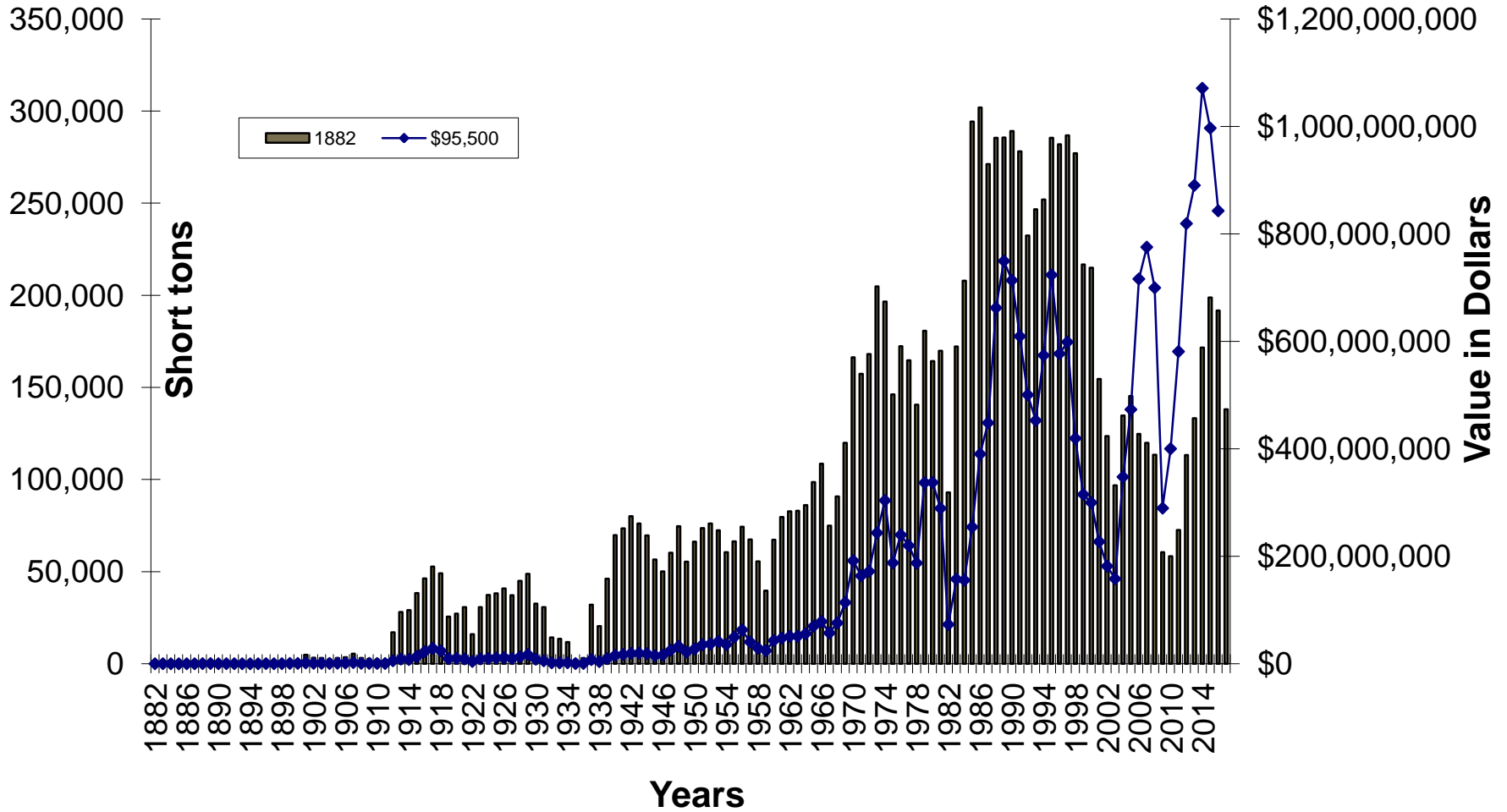
COAL PRODUCTION IN NEW MEXICO 1998-2017



METALS—3RD IN COPPER PRODUCTION IN 2017 (CHINO, TYRONE)



Copper Production 1882-2017



COPPER RESERVES—2018

- Grades are decreasing
- Chino (incl. Hanover, Cobre)
 - milling reserves are 274 million metric tons of 0.54% copper, 0.04 g/t gold, 0.93 g/t silver and 0.01% molybdenum
 - leaching reserves are 121 million tons of 0.29% Cu
- Tyrone (incl. Little Rock)
 - leaching reserves are estimated as 55 million metric tons of ore grading 0.25% Cu
 - Expected to close 2020s

Copper Flat, Themax Resources

Planned production per year for ~15 yrs

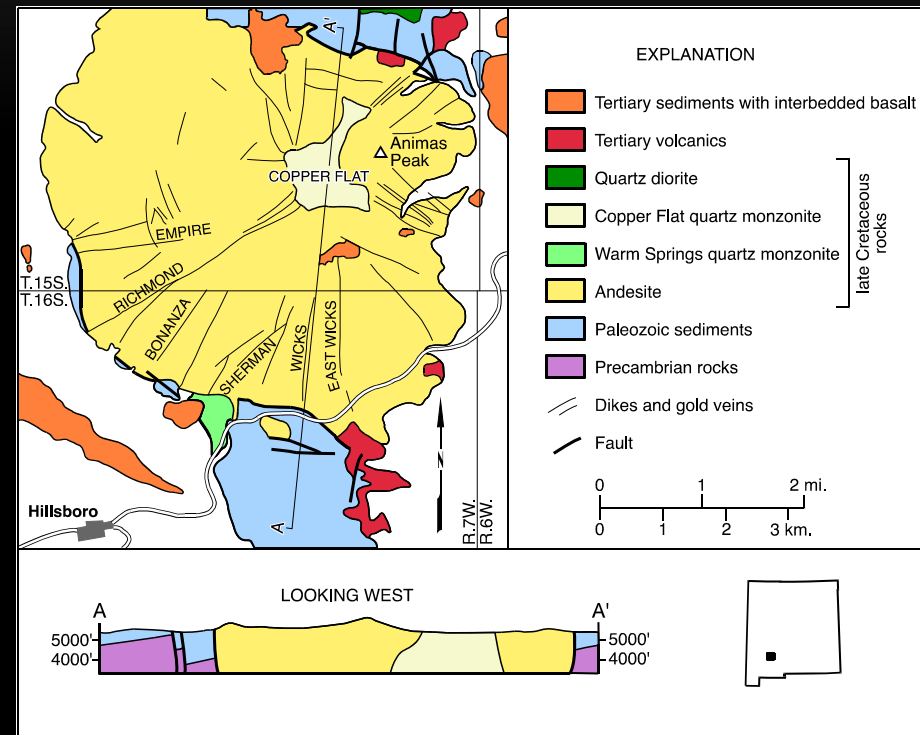
50.76 mill lbs Cu

1.01 mill lbs Mo

12,750 oz Au

455,390 oz Ag

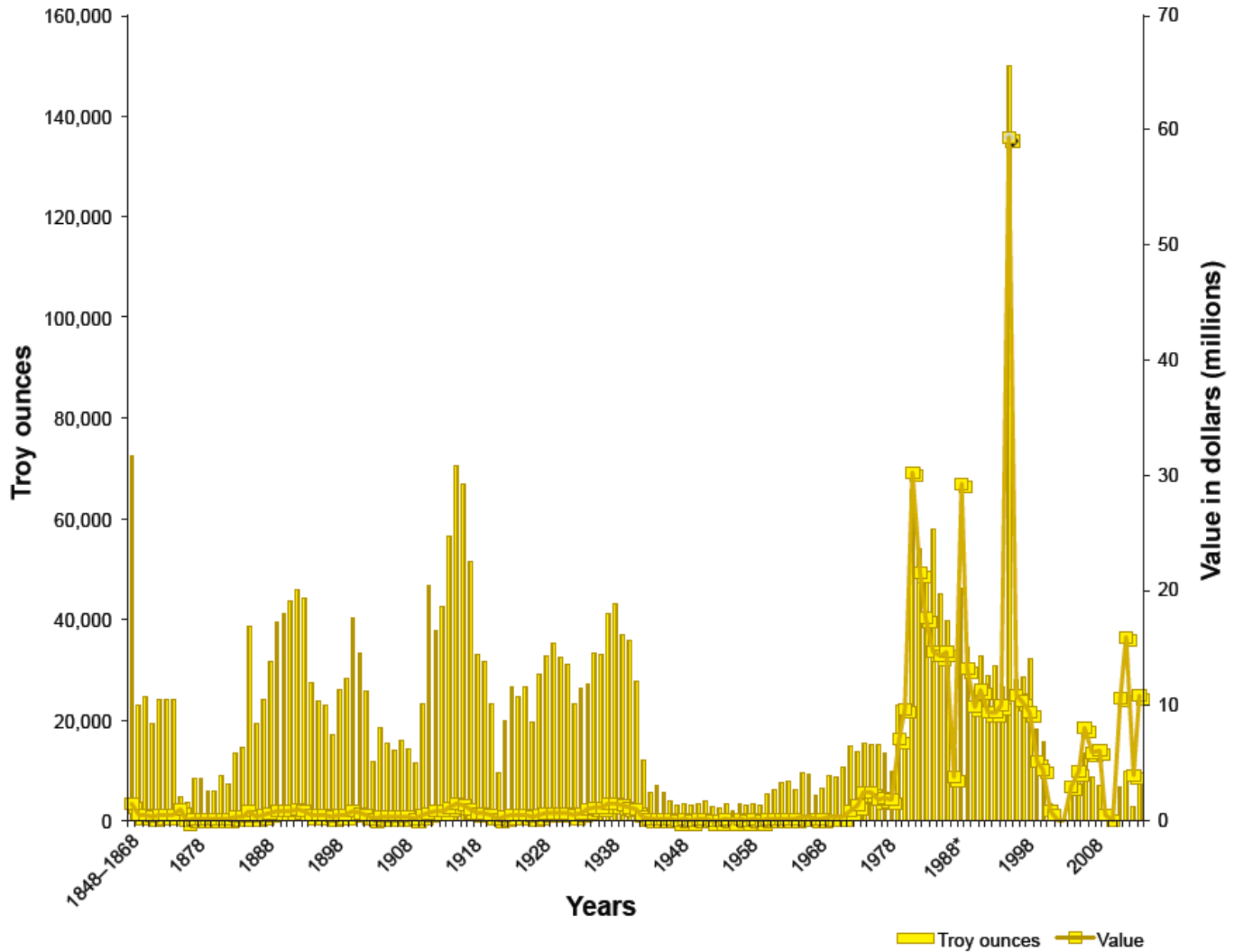
Start in 2020s?



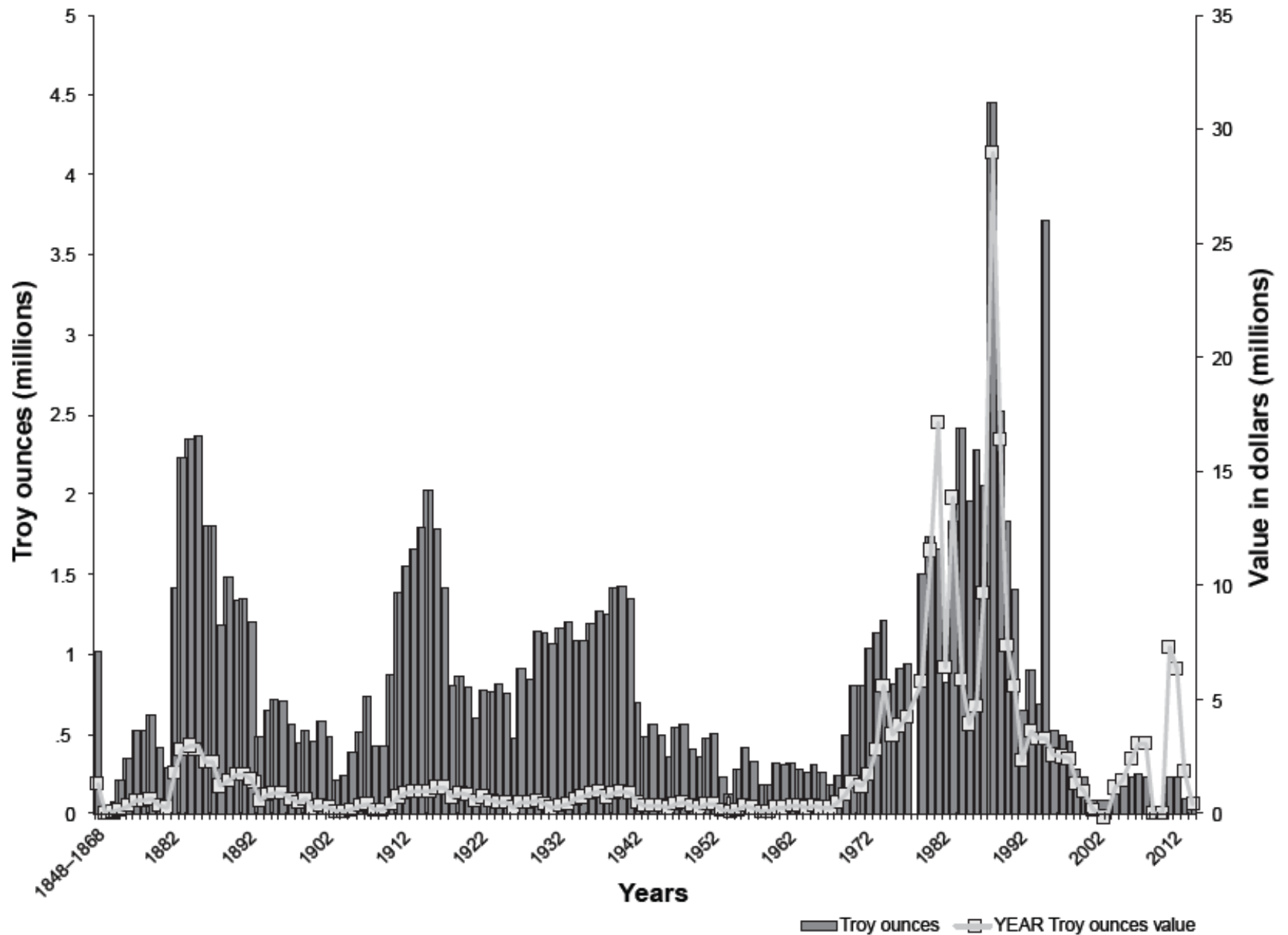
GOLD AND SILVER PRODUCTION

- In 2004-2017 as a byproduct of copper production from the Ivanhoe concentrator (Freeport-McMoRan)
 - 2009 Summit mine opened (currently on standby)
 - 9th in gold production
 - 10th in silver production
-

Gold production 1848–2014



Silver production 1848–2014



SUMMIT GOLD MINE



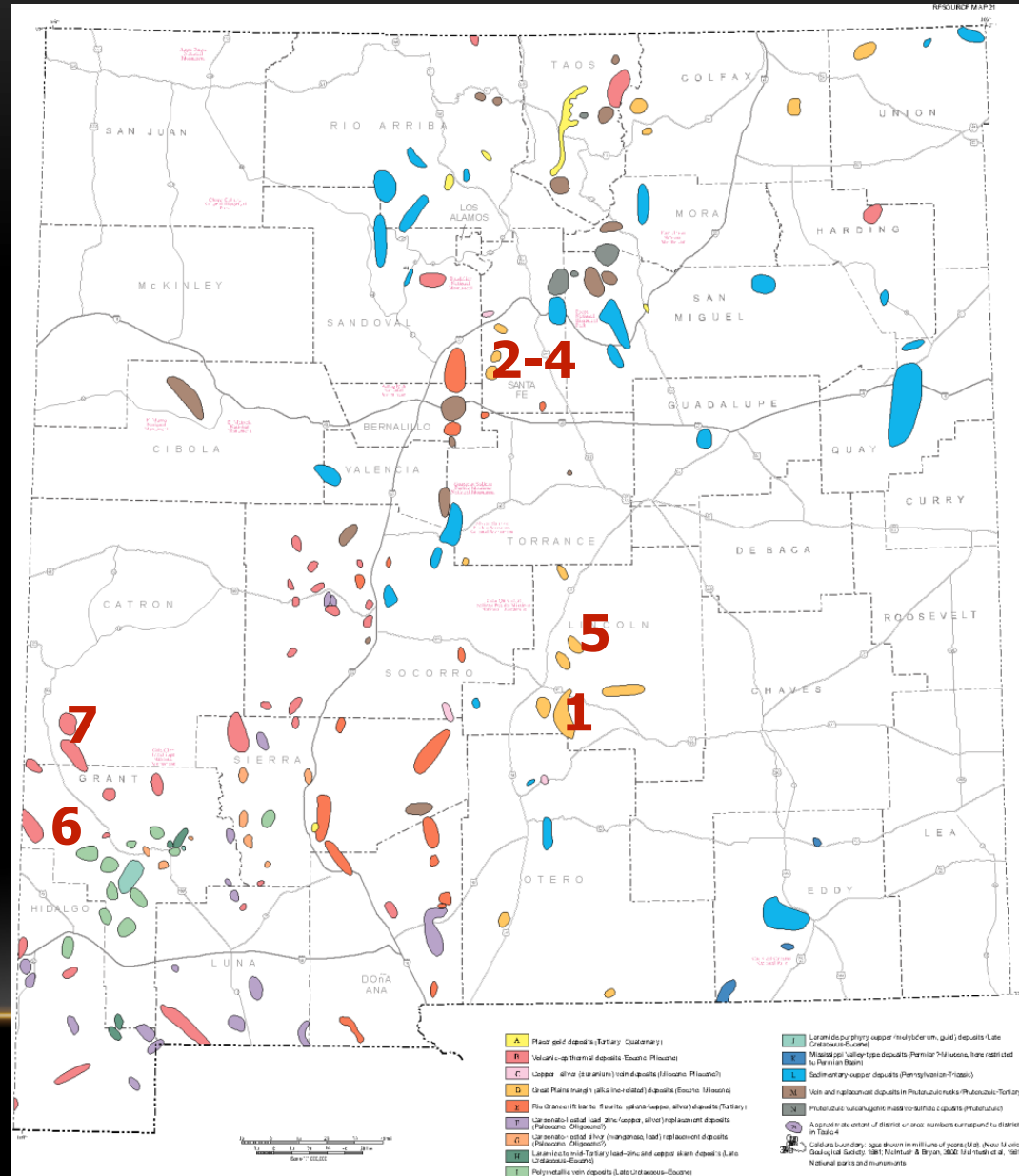
In 2009, Santa Fe Gold opened the Summit mine in the Steeple Rock district

The ore was milled at Lordsburg and sold as silica flux

New owners have not announced future plans

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

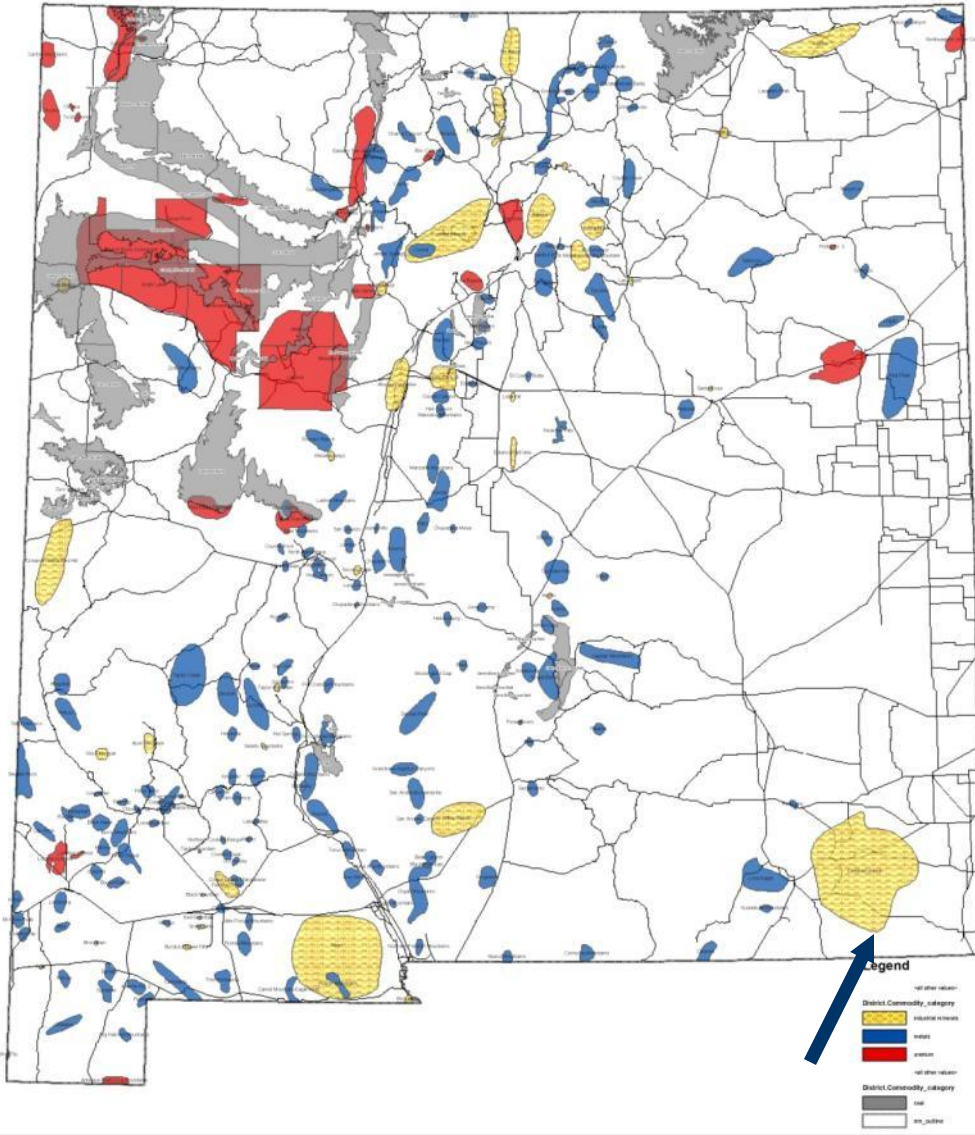


INDUSTRIAL MINERALS

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

Many critical minerals are considered industrial minerals

NM Mining Districts



POTASH PRODUCTION

1951-2017 109 million tons worth >\$15 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



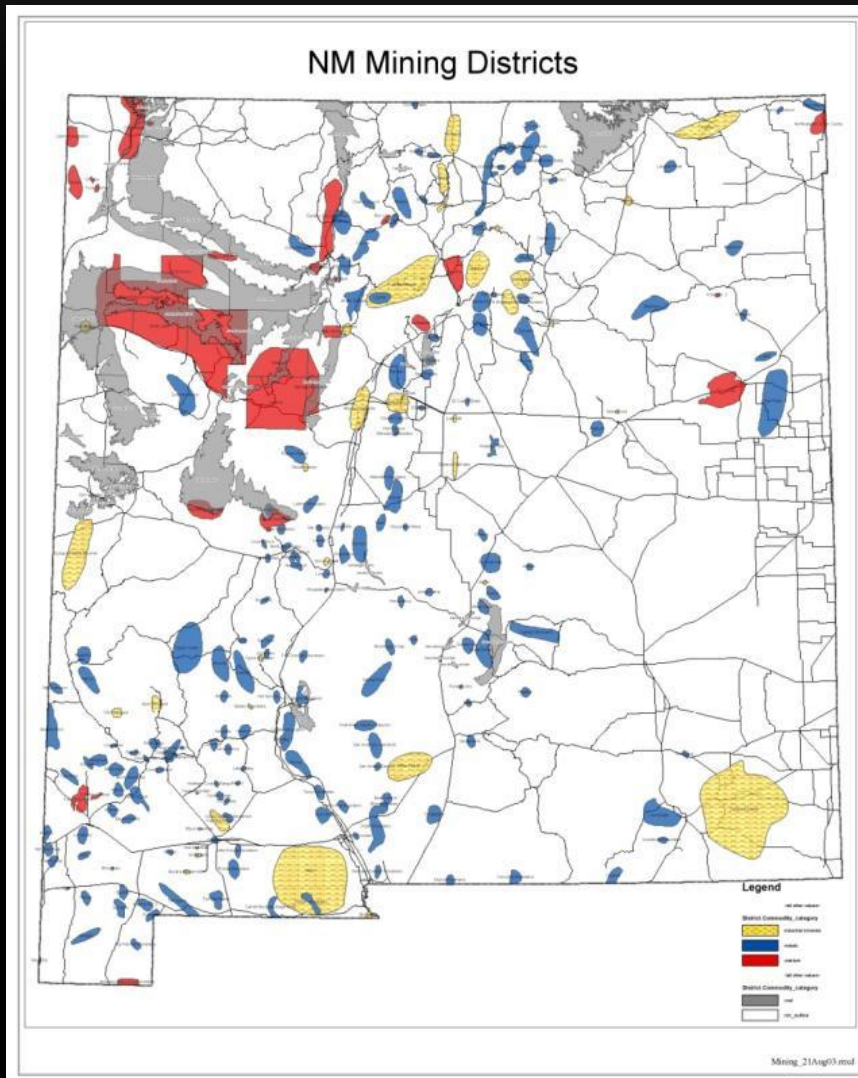


1ST IN POTASH IN 2017 (MOSAIC,
INTREPID MINING)

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)
-

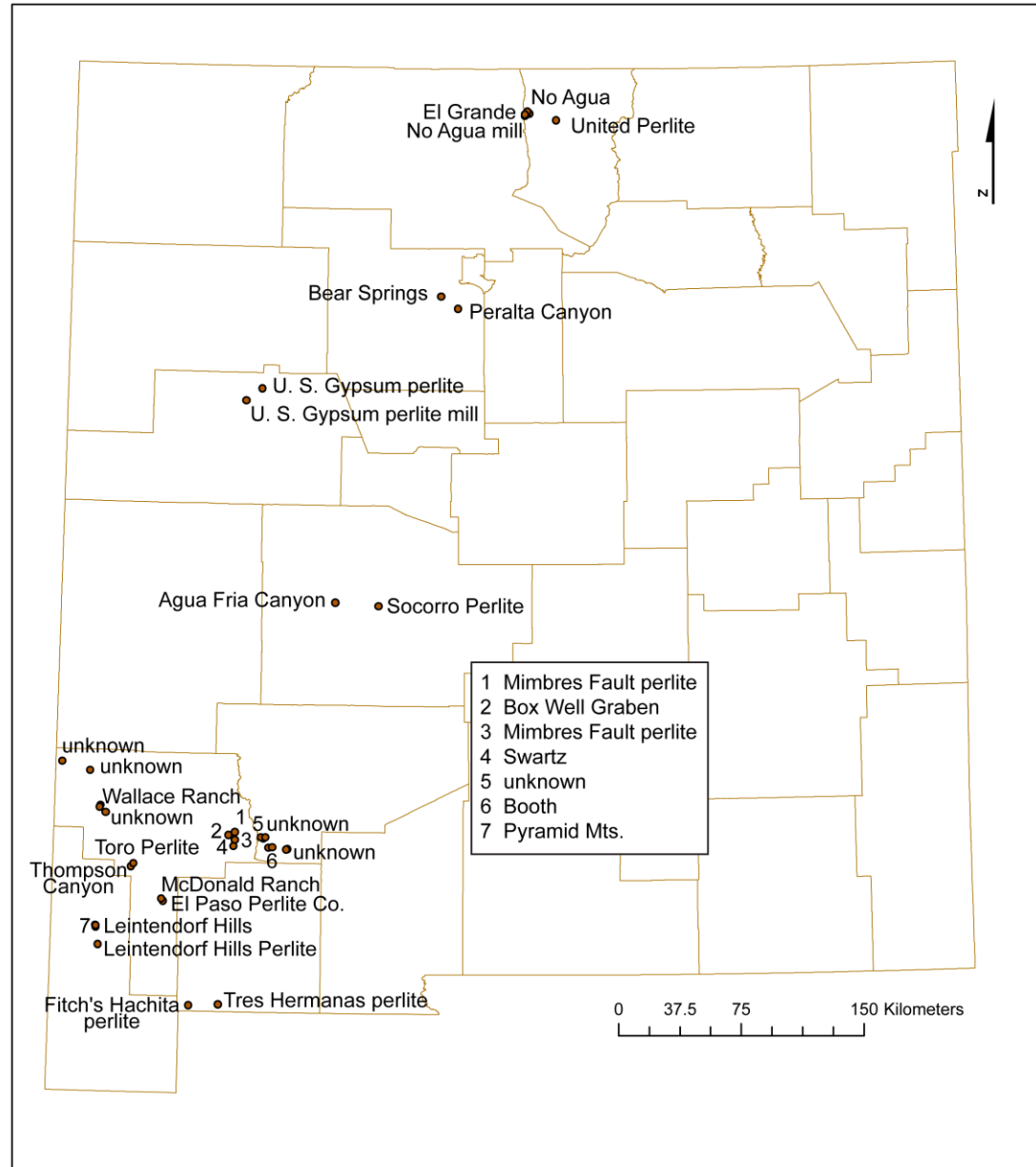
ADDITIONAL INDUSTRIAL MINERALS IN NEW MEXICO



- 1st in zeolite (St. Cloud, Sierra County)
- 5th in pumice (6 operations)
- 1st in perlite (4 operations)
- 11th in salt (4 operations, Carlsbad)
- Humate is important

PERLITE IN NEW MEXICO

Competition from Greece



OTHER INDUSTRIAL MINERALS DEPOSITS

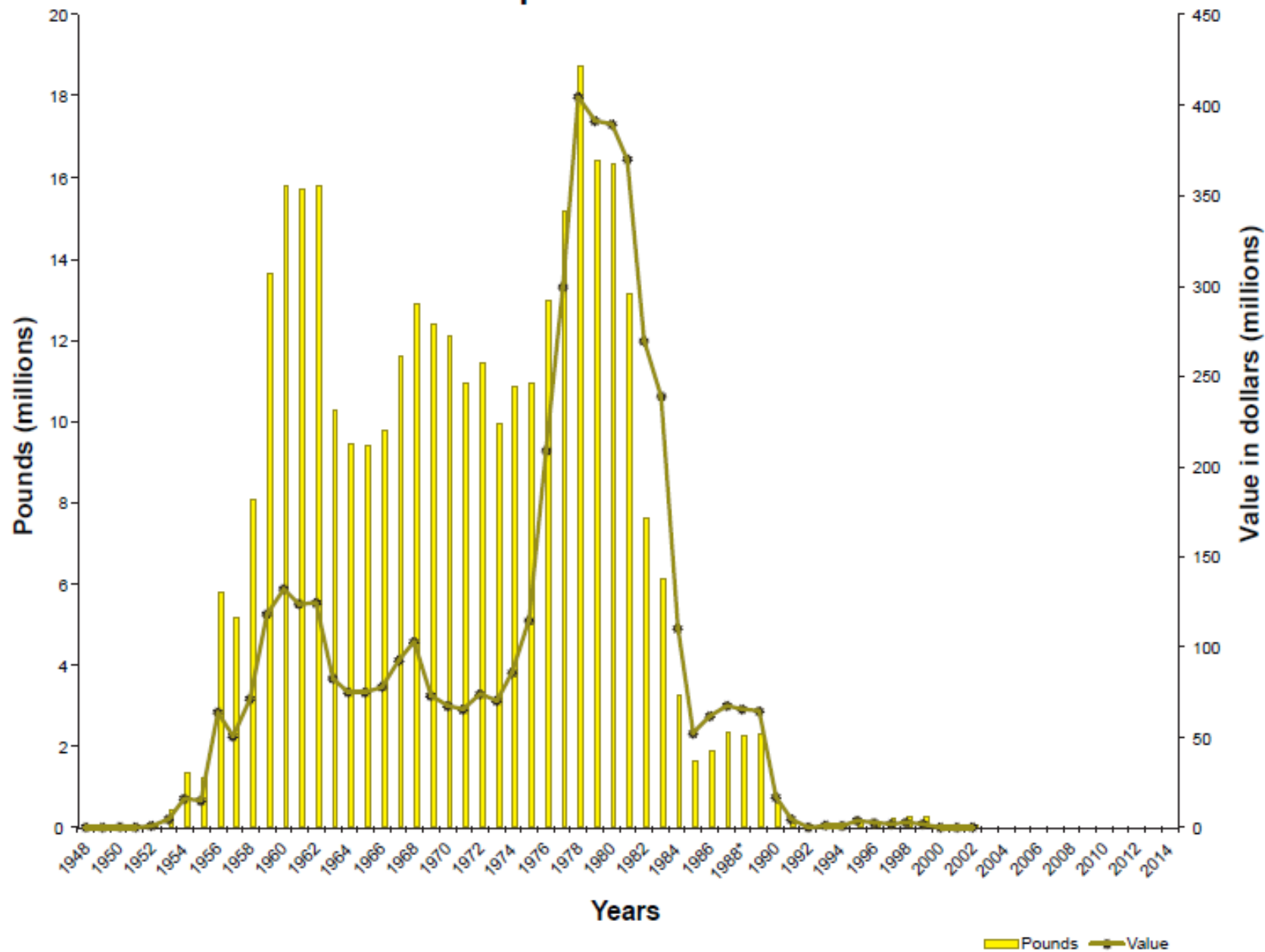
- Aggregates
- Gypsum for wallboard
- Brick and clay in El Paso, Albuquerque areas
- Cement in Tijeras Canyon
- Humate in the San Juan Basin
- Sulfur, helium, carbon dioxide
- Travertine (dimension stone), Meso del Oro, west of Belen
 - 477.6 million tons of travertine

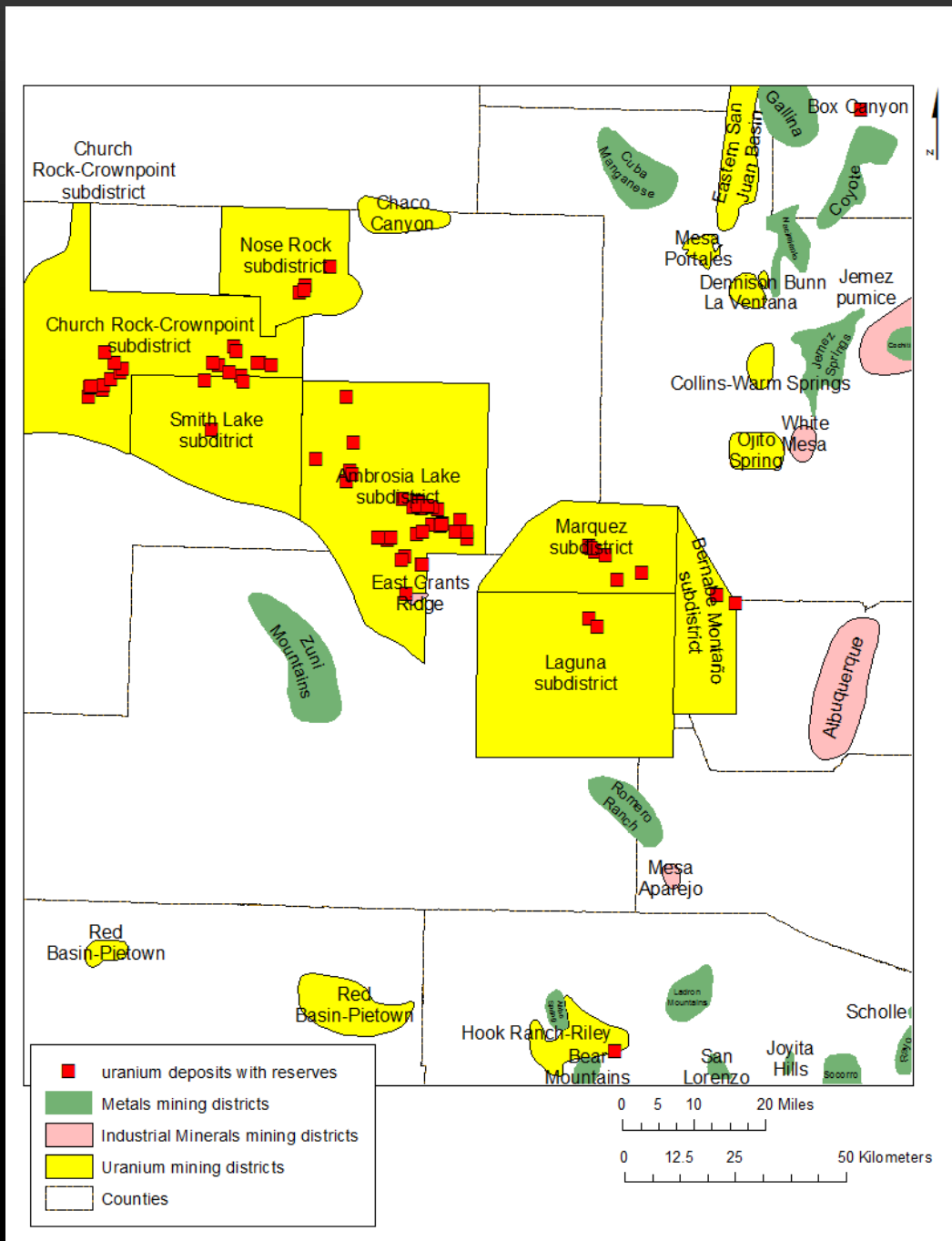
Panel Rey is building a wallboard plant in Ciudad Juarez, Chihuahua, Mexico which could impact the New Mexico gypsum industry

URANIUM IN NEW MEXICO 2016

- 2nd in uranium resources 15 million tons ore at 0.277% U₃O₈ (84 million lbs U₃O₈) at \$30/lb (DOE estimates in 2002)
- Numerous companies have acquired properties (Strathmore, 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



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)

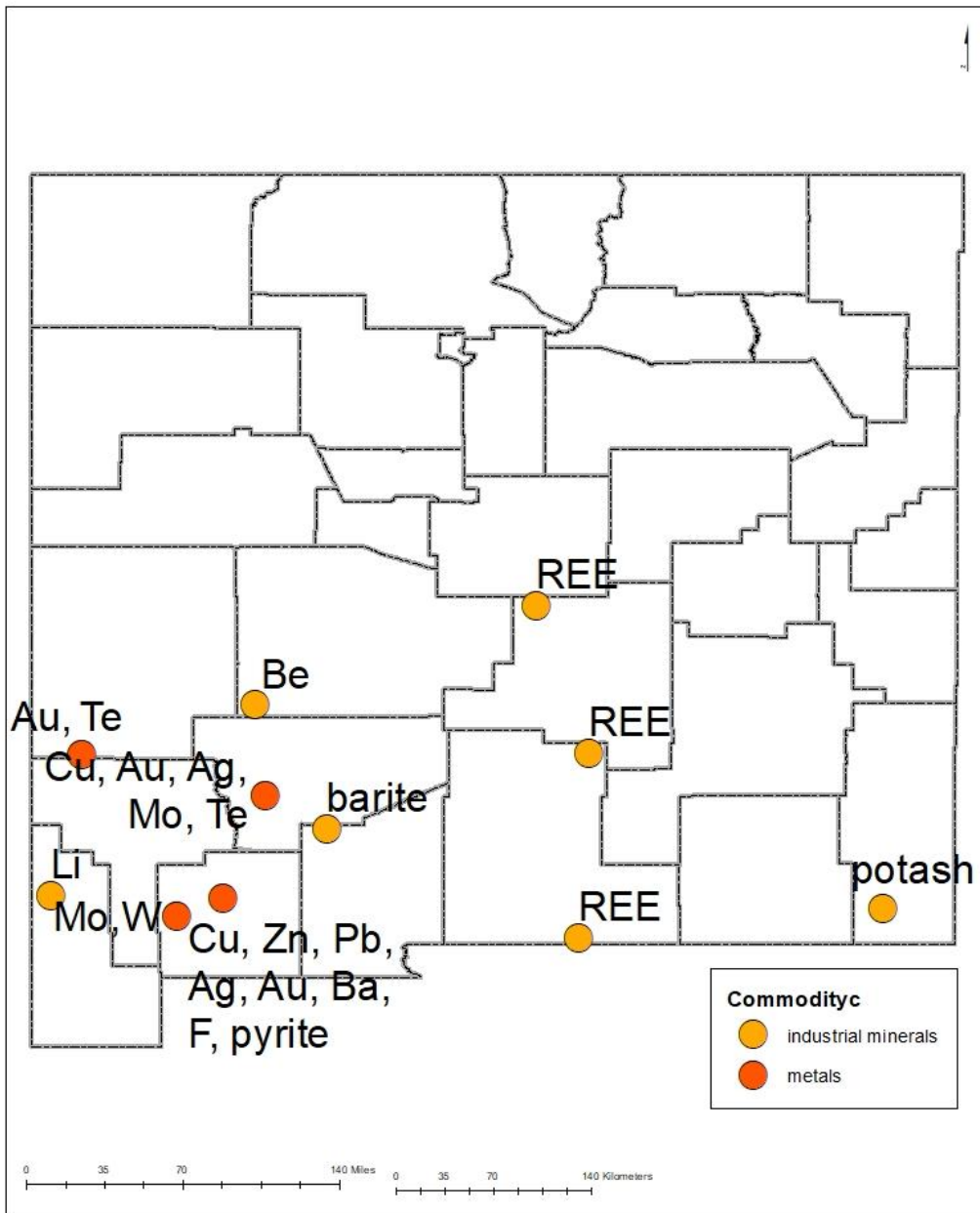
Critical Minerals in New Mexico

- 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.

SELECTED EXPLORATION SITES OF CRITICAL MINERALS IN NEW MEXICO 2016-2019



From NM Mining
and Minerals Div. and
NMBGMR databases,
company web sites

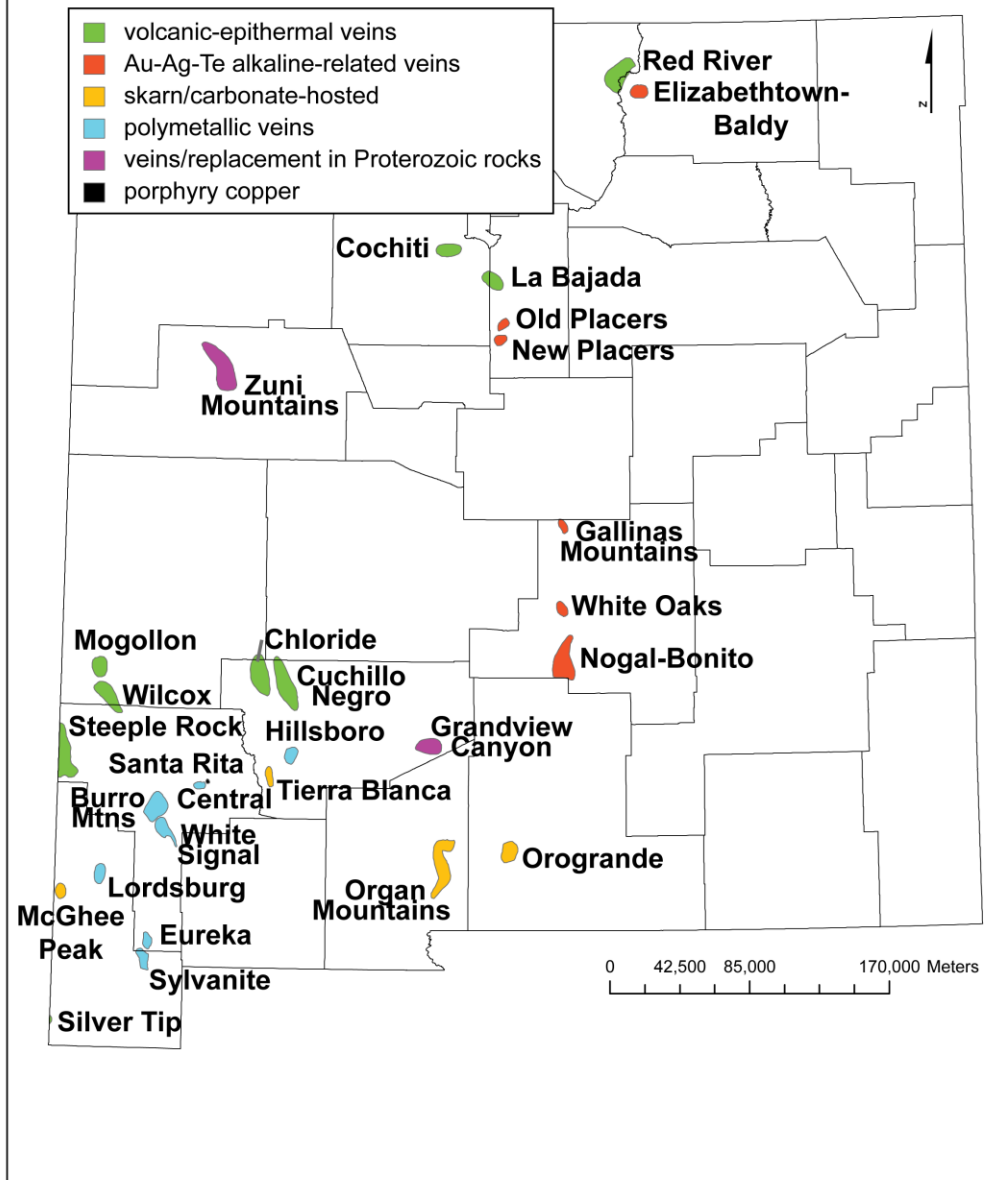
CRITICAL MINERALS ASSOCIATED WITH URANIUM DEPOSITS

- Vanadium and molybdenum were produced with uranium in the past and could resume by-product production in the future
- Uranium deposits contain anomalously high rare earth elements (REE) in ore—companies should examine their deposits and determine if a Ce circuit is feasible and economic

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**

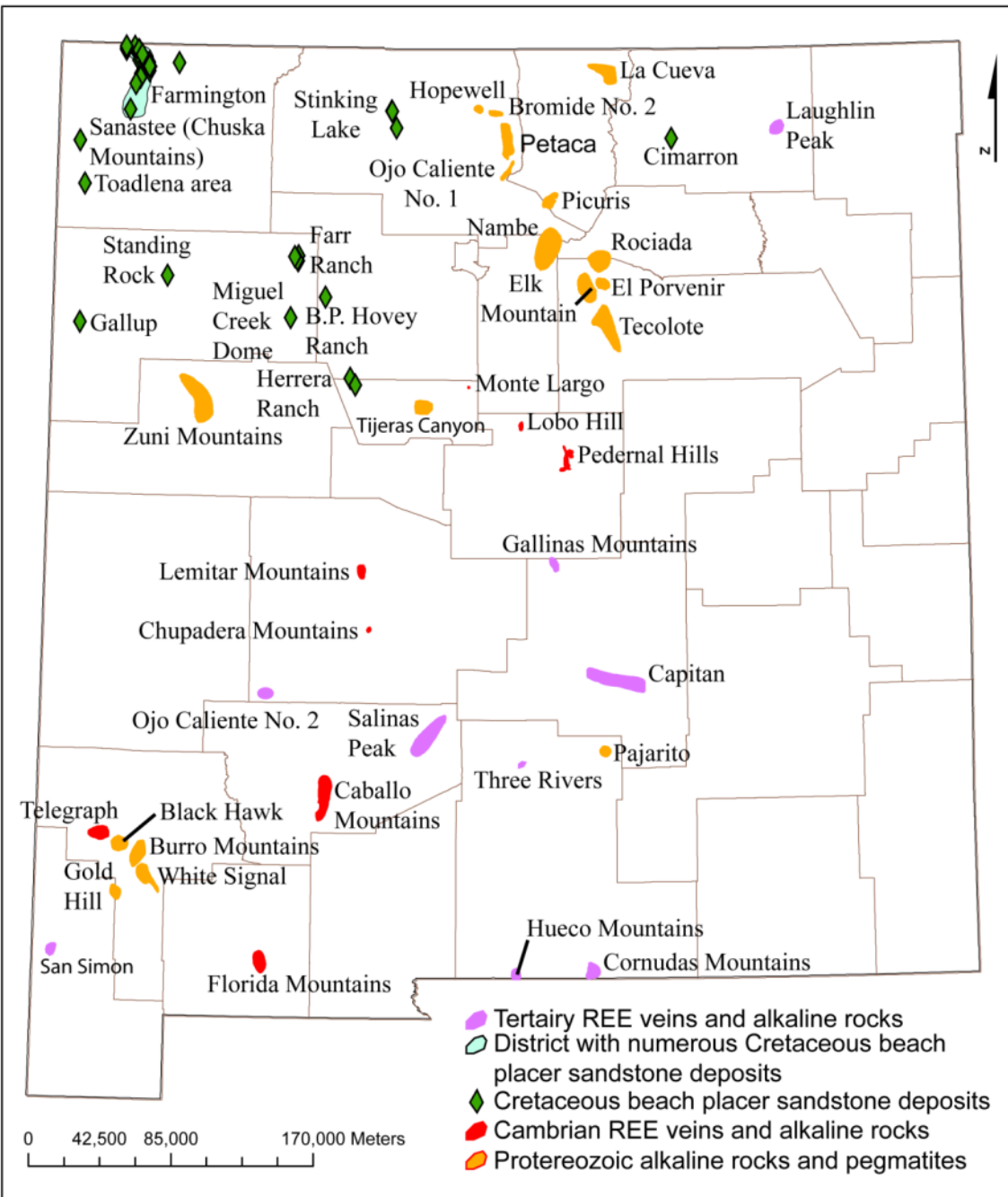


Mining districts
in New Mexico
with tellurium
minerals or
chemical
assays >20
ppm Te

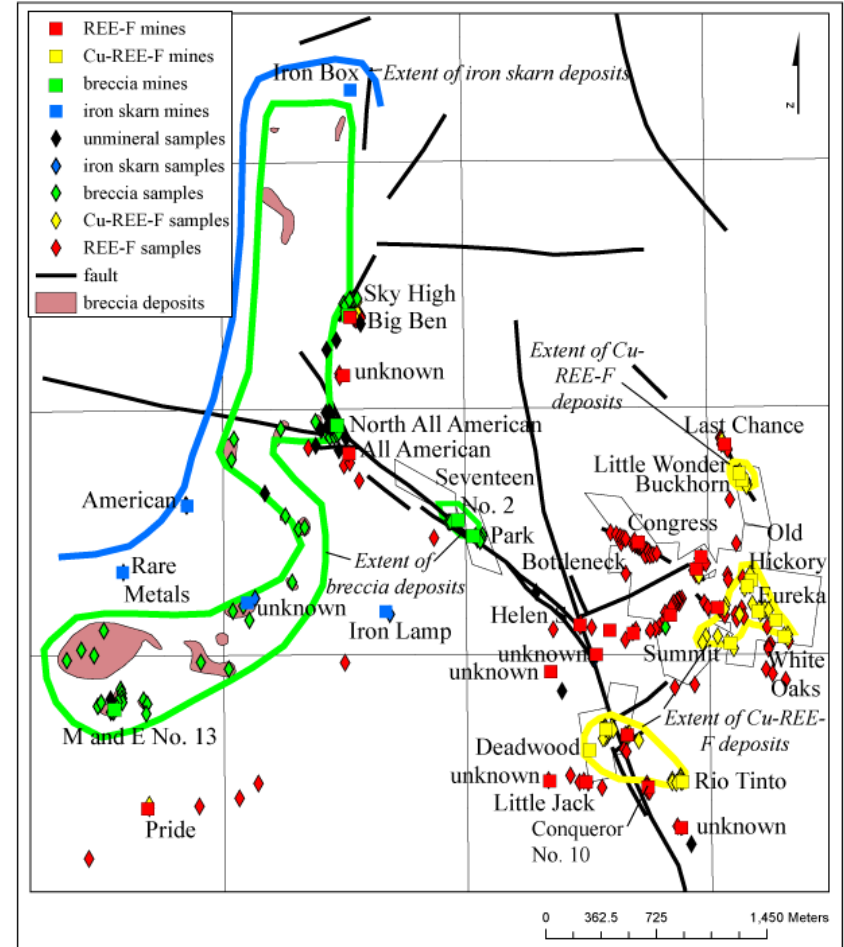
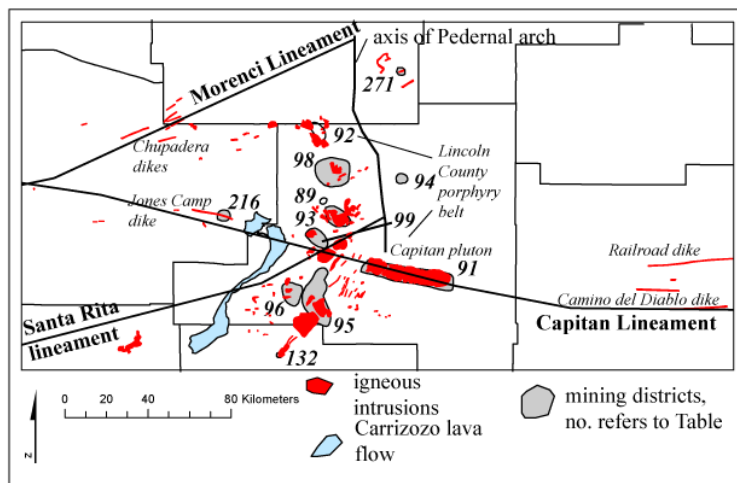
Lone Pine, Wilcox district, Catron County— volcanic epithermal vein



OCCURRENCES OF RARE EARTH ELEMENTS (REE) IN NEW MEXICO



REE in Gallinas Mountains, Lincoln County



WHAT ARE THE MINING ISSUES FACING NEW MEXICO?



Gold King adit



Animas River after Gold King spill

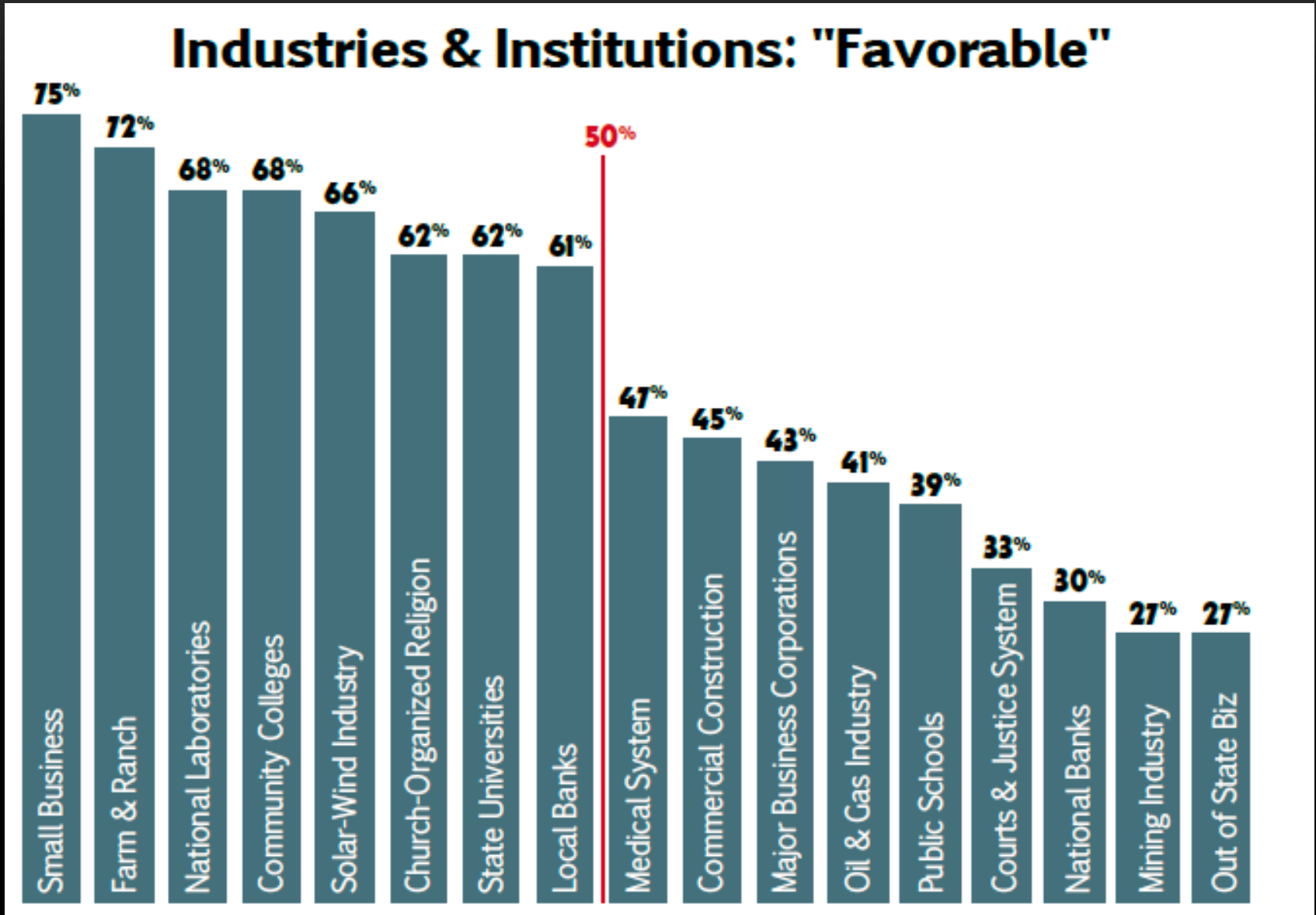
MINING ISSUES FACING NEW MEXICO

- **Some current mines are reaching the end of their life and will close over the next decade=decreasing minerals production**
- **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 must 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
 - Gold King spill
 - Not in my backyard!!!!!!

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
-

MINING ISSUES FACING NEW MEXICO

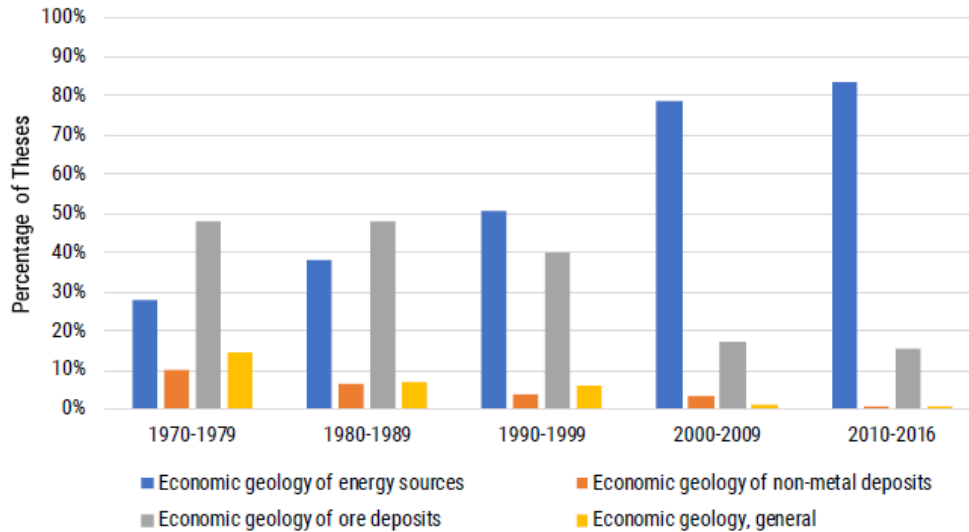
- Global competition is closing some of our mines
- Exploration for new deposits often results in drill targets based upon regulatory minimal impact regulations rather than optimum geological criteria
- Permitting for exploration can take longer than exploration funds are available
- Lower prices=closed mines, little exploration

MINING ISSUES FACING NEW MEXICO

- In some areas conflicts arise between mining and other activities
 - Grants uranium district
 - Otero Mesa
 - Pecos/Tererro mine
 - **Water, don't want a mine in their backyard**
- **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**

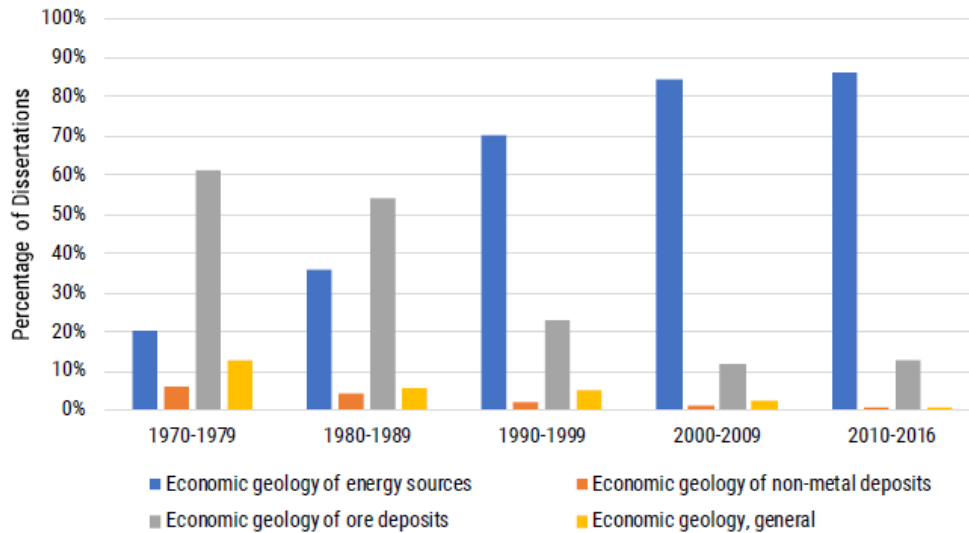
Number of theses and dissertations on non-energy economic geology has decreased

Economic Geology Thesis Topics



Source: AGI GeoRef

Economic Geology Dissertation Topics



Source: AGI GeoRef

http://www.multibriefs.com/briefs/aipg/DataBrief_2019_008_EconomicGeologyThesesDissertations.pdf

SUMMARY

- New Mexico has a wealth of mineral resources
- Exploration and permitting takes many years before a deposit can be mined, >10 yrs
- Legacy issues are being addressed
- Negative public perceptions are major issue as is funding
- Global competition is a major threat
- NMBG/NMT research is addressing some of these issues, as well as training future geologists and engineers

ADDITIONAL RESEARCH



MORE INFORMATION

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

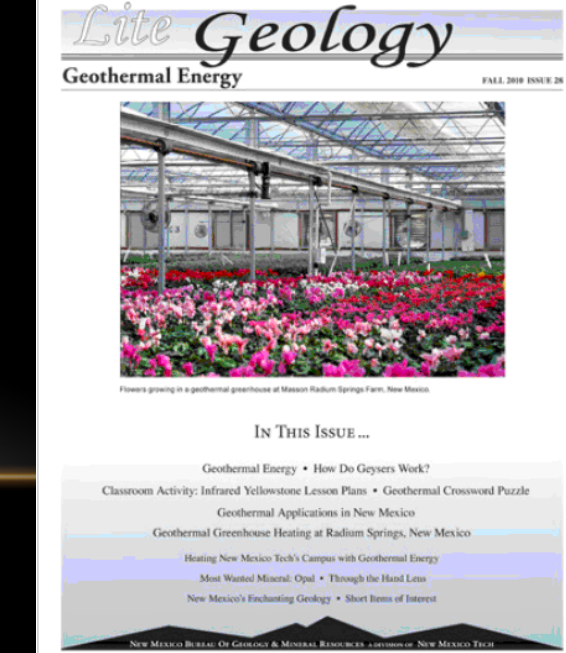
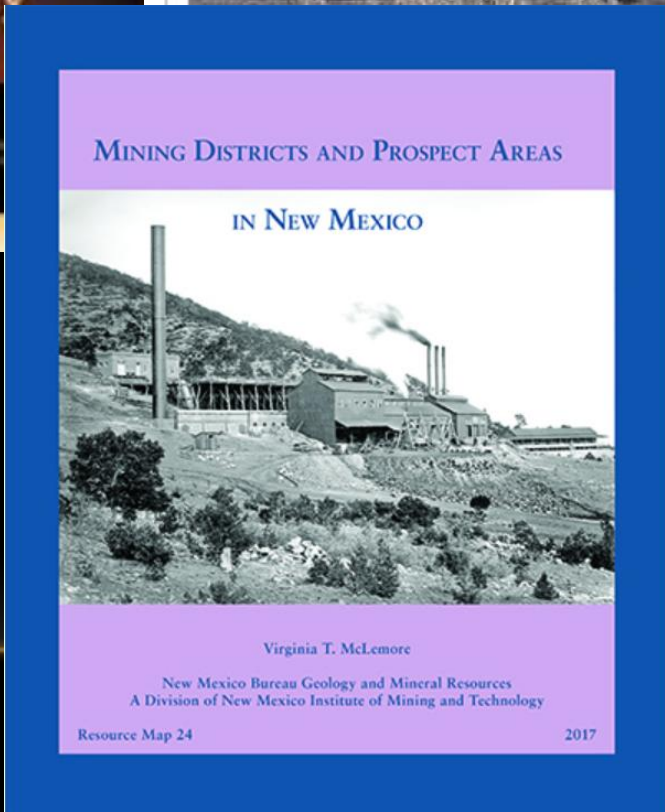
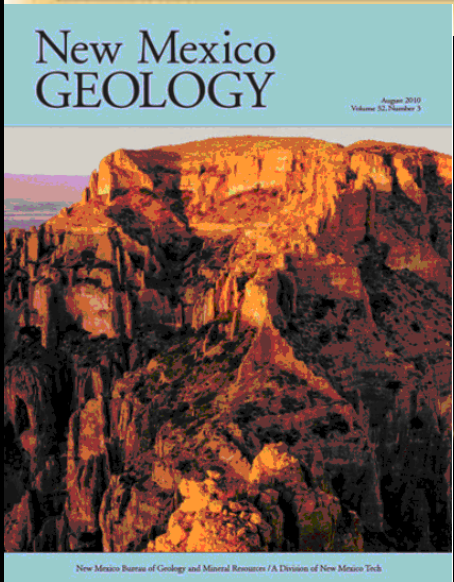
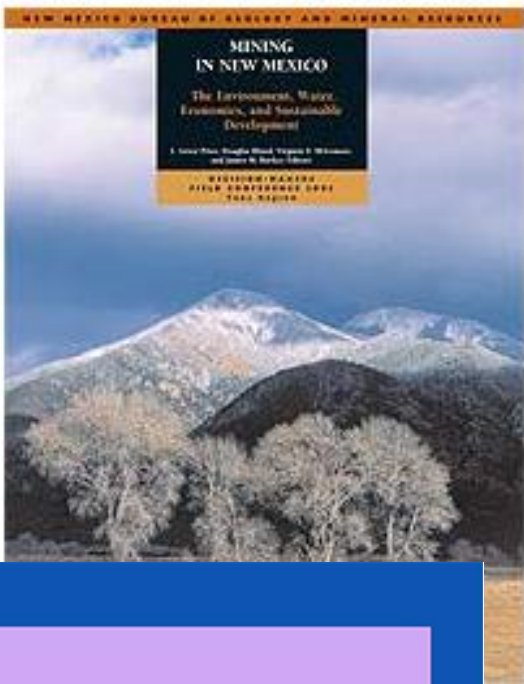
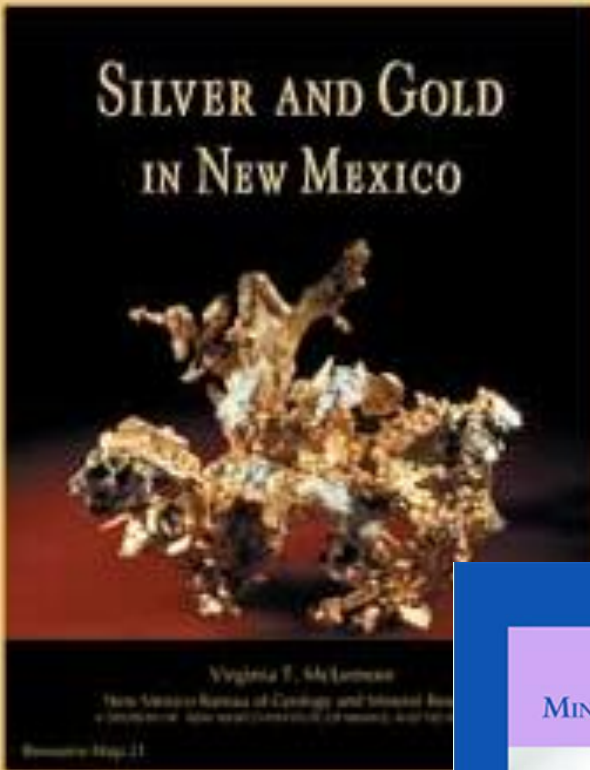
Virginia McLemore web page

<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



New Mexico Potash—Past, Present, and Future

Thanks to the great work by several authors, the geology of potash in New Mexico is well documented. Potash is well known as a naturally occurring mineral resource in several states, including New Mexico. The state's potash resources are located in the "C" block, "D" block, and "E" block. The state's potash resources are located in the "C" block, "D" block, and "E" block. The state's potash resources are located in the "C" block, "D" block, and "E" block.

History of Potash Production in New Mexico

Potash was originally used as a fertilizer and in the production of glass. The state's potash resources are located in the "C" block, "D" block, and "E" block. The state's potash resources are located in the "C" block, "D" block, and "E" block.

Future of Potash Production in New Mexico

The state's potash resources are located in the "C" block, "D" block, and "E" block. The state's potash resources are located in the "C" block, "D" block, and "E" block.

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QUESTIONS?

