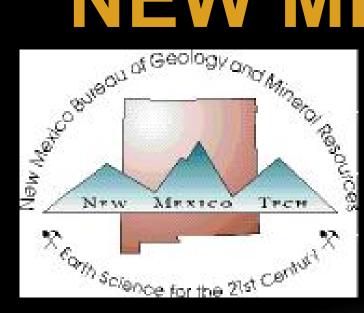
STATUS OF THE MINING INDUSTRY IN NEW MEXICO-2019





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



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

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?

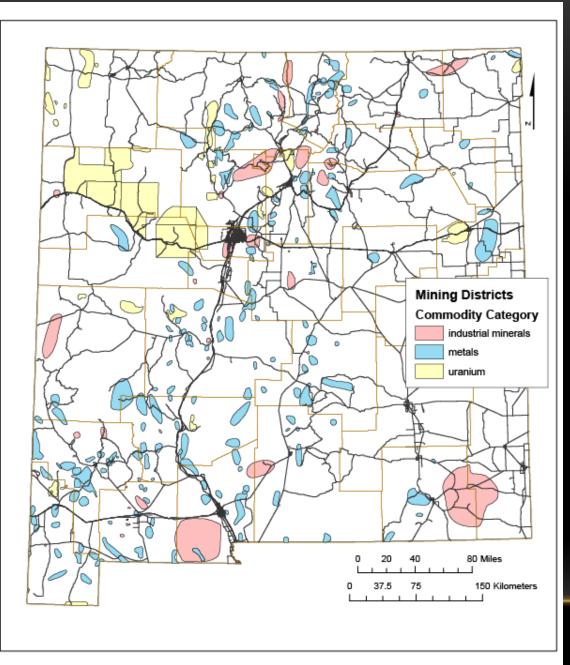
WHAT, WHERE, AND HOW MUCH MINERALS ARE PRODUCED IN NEW MEXICO?

INTRODUCTION

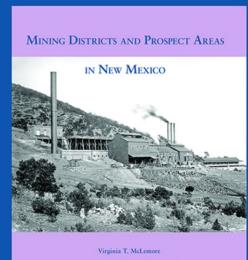
- NM has some of the oldest mining areas in the United States
- Native Americans mined turquoise from Cerrillos Hills district more than 500 yrs before the Spanish settled in the 1600s
- One of the earliest gold rushes in the West was in the Ortiz Mountains (Old Placers district) in 1828, 21 yrs before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



One of the turquoise mines in the Cerrillos Hills district



MINING DISTRICTS IN NEW MEXICO



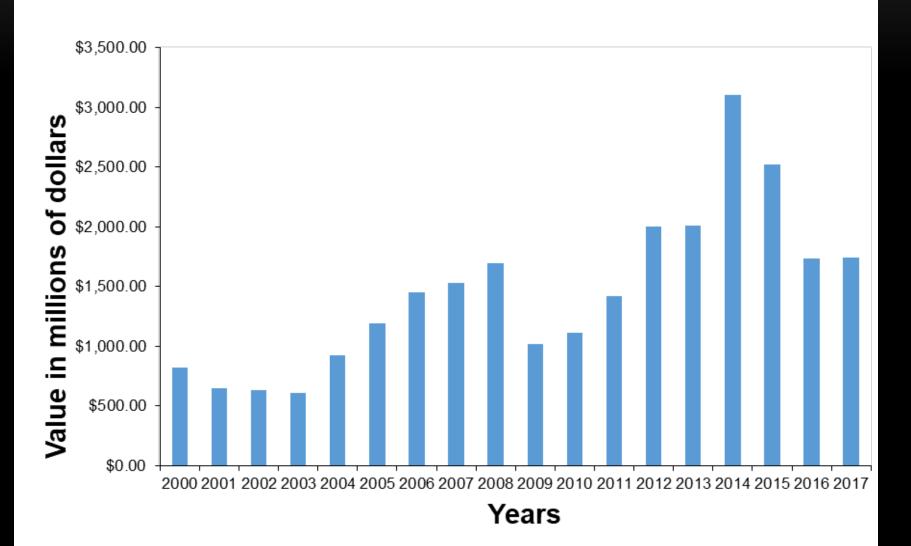
New Mexico Bureau Geology and Mineral Resources A Division of New Mexico Institute of Mining and Technology

Resource Map 24

PRODUCTION SUMMARY—2017

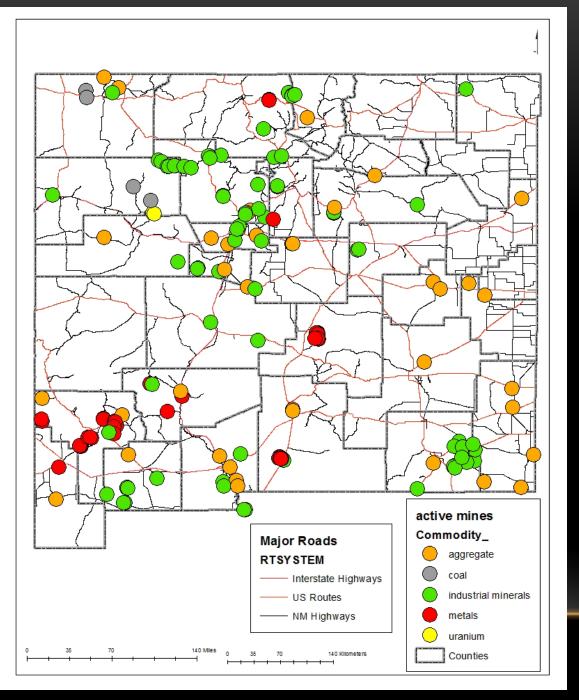
- Value of mineral production in 2017 was \$1.7 billion (does not include oil and gas)—ranked 18th in the US
- Employment in the mining industry is 4,685
- Exploration for garnet, gypsum, limestone, nepheline syenite, agate, specimen fluorite, gold, silver, iron, beryllium, uranium, copper, potash, rare earth elements, humate, clays
- MINERALS PRODUCTION IS DECREASING, ESPECIALLY COAL

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



ACTIVE MINES 2019

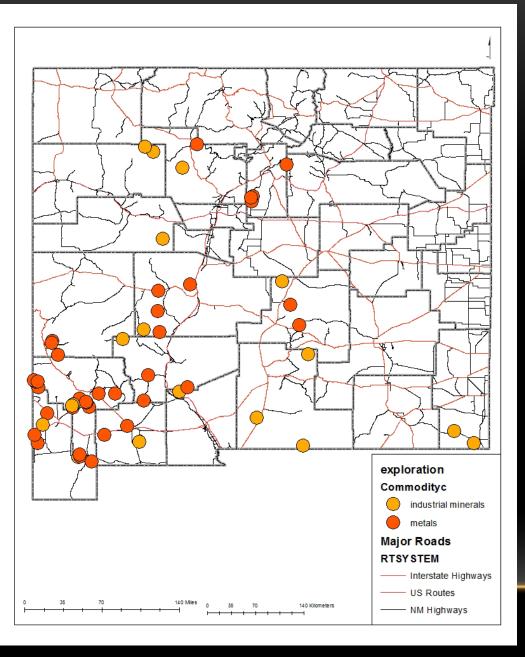
- ~282 active registered mines (NMMMD)
- 4 coal
- 3 potash, 4 potash plants
- 2 copper open pits, 1 concentrator (mill), 2 solvent/electro-winning (SX-EW) plants
 - 2 additional mines in permitting stage
 - Several exploration
- 1 gold mine and 1 mill (on standby)
- 2 iron mines
- 32 industrial minerals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



ACTIVE **MINES IN** NEW **MEXICO** 2016-2019 Not all aggregate mines

aggregate m are shown

From NM Mining and Minerals Div. database



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

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

NEW MEXICO BUREAU OF GEOLOGY AND MINERAL RESOURCES | NEW MEXICO GEOLOGICAL SOCI Memoir 50B | Special Publication 13B

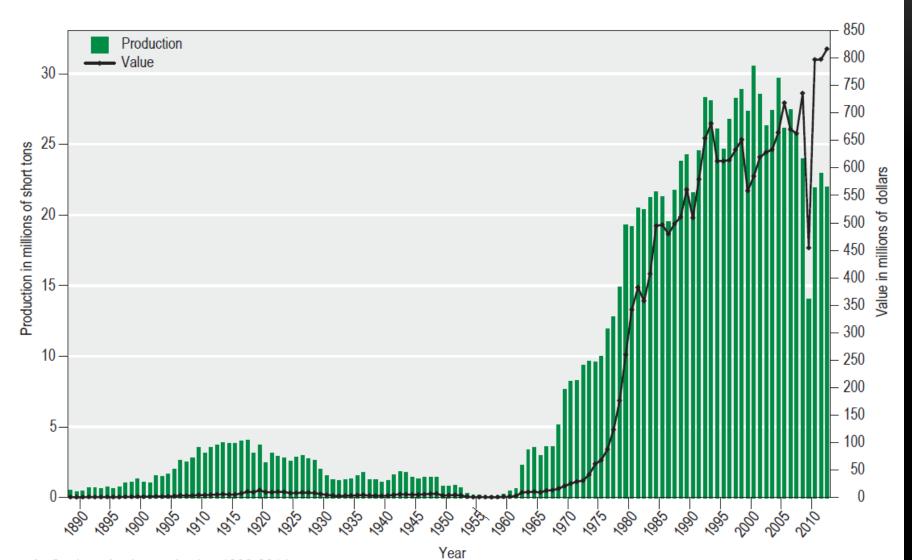
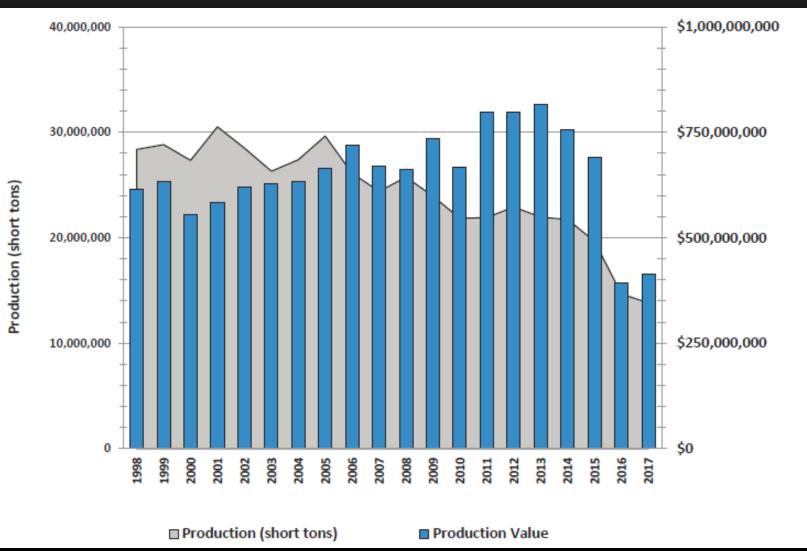


Figure 4. Coal production and value 1899-2014.

COAL PRODUCTION IN NEW MEXICO 1998-2017



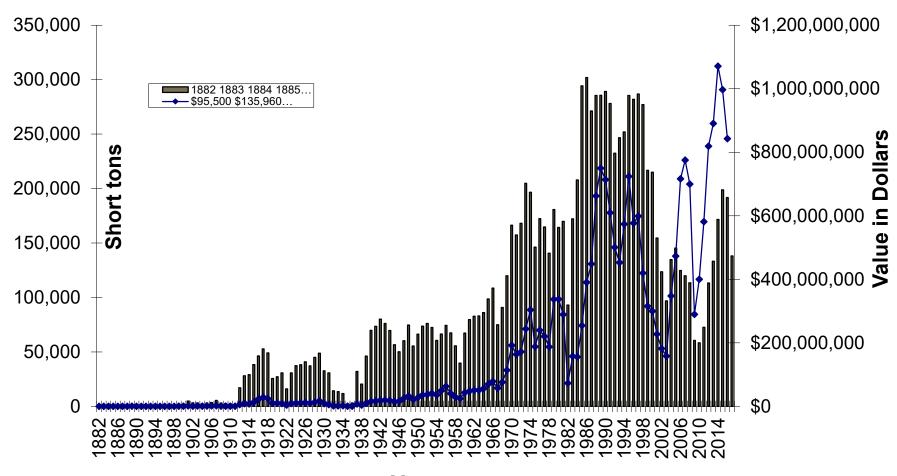
http://www.emnrd.state.nm.us/ADMIN/documents/bw2018AR30Feb.pdf

Production Value (\$)

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



Copper Production 1882-2017



Years

COPPER RESERVES—2018

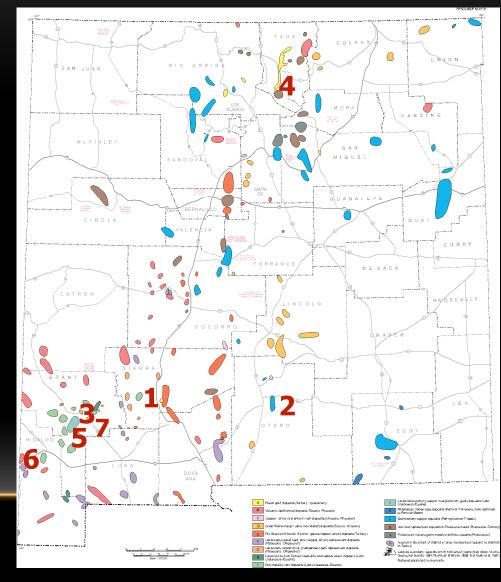
- Grades are decreasing
- Chino (incl. Hanover, Cobre)
 - milling reserves are 274 million metric tons of 0.54% copper, 0.04 g/t gold, 0.93 g/t silver and 0.01% molybdenum
 - leaching reserves are 121 million tons of 0.29% Cu
- Tyrone (incl. Little Rock)
 - leaching reserves are estimated as 55 million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

 Copper Flat (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

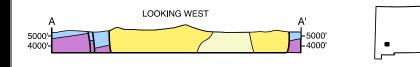
- 3. Hanover Mountain (80 mill st reserves at 0.38% Cu)
- 4. Copper Hill, Picuris district (46.5 mill st of ore at 0.42% Cu)
- 5. Lone Mountain (7.5 mill st at 2-3% Cu, 1.2% Pb, 4-5% Zn, 203 opt Ag, .01-.02 opt Au)
- 6. McGhee Peak, Pelloncillo Mountains
- 7. Mimbres

POTENTIAL COPPER DEPOSITS



Copper Flat, Themax Resources Planned production per year for ~15 yrs 50.76 mill lbs Cu **EXPLANATION** 1.01 mill lbs Mo Tertiary sediments with interbedded basalt Tertiary volcanics COPPER FLA Quartz diorite 12,750 oz Au Cretaceo rocks Copper Flat guartz monzonite Warm Springs guartz monzonite ate Andesite 455,390 oz Ag Paleozoic sediments Precambrian rocks Dikes and gold veins Start in 2020s? Fault 2 mi. 3 7W Hillsboro

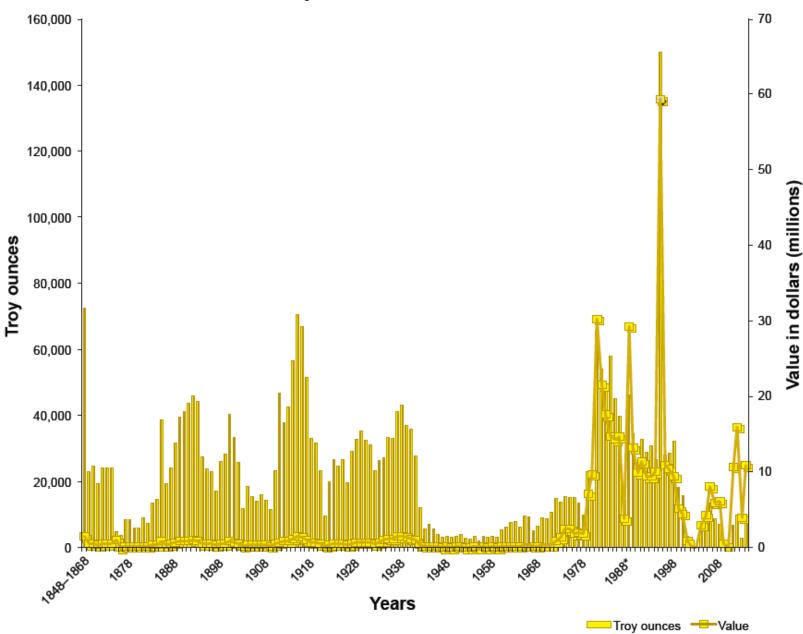




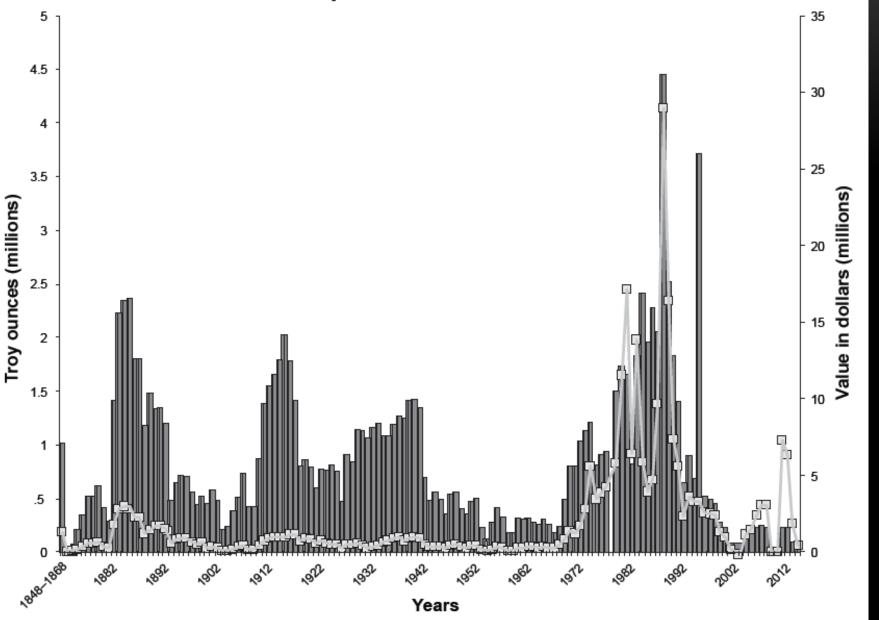
GOLD AND SILVER PRODUCTION

- 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



Troy ounces - YEAR Troy ounces value

SUMMIT GOLD MINE

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

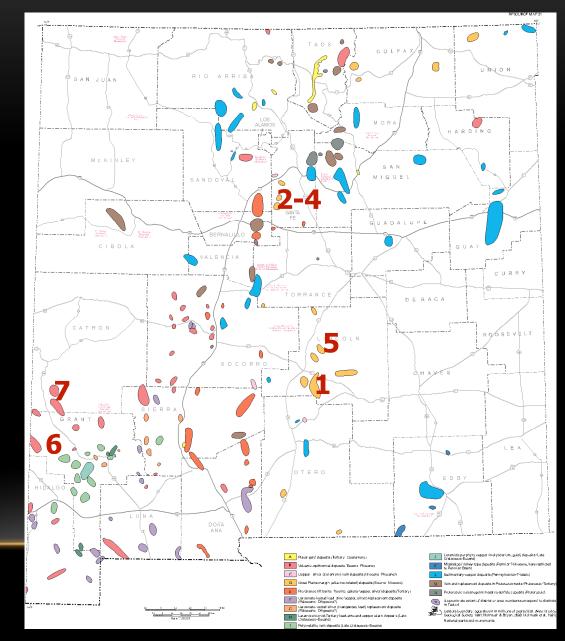
The ore was milled at Lordsburg and sold as silica flux

New owners have not announced

future plans

GOLD AND SILVER

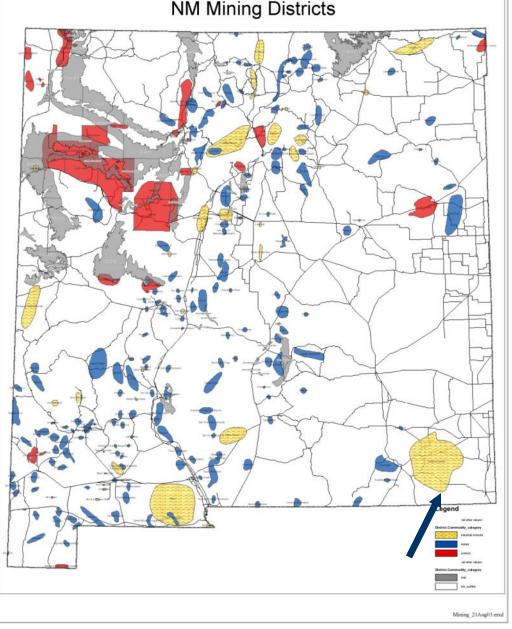
- 1. Vera Cruz, Lincoln Co
- 2. Carache Canyon, Santa Fe Co
- 3. Lukas Canyon, Santa Fe Co
- 4. San Lazarus, Santa Fe Co
- 5. Jicarilla Au placers
- 6. Steeple Rock district
- 7. Mogollon



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



POTASH PRODUCTION

1951-2017 109 million tons worth >\$15 billion

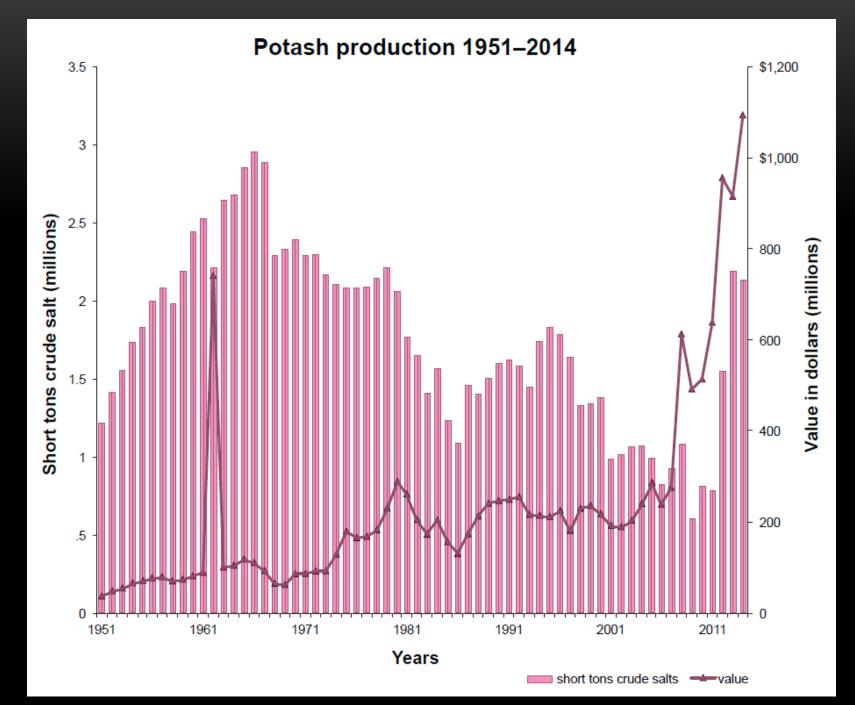
Reserves in Carlsbad District

Potash (>553 million tons)

Potash is used in fertilizers among other uses

Intrepid closed one mine

Competition from Canadian deposits



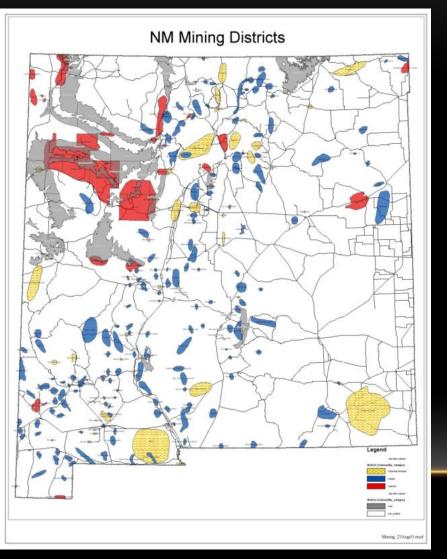


1ST IN POTASH IN 2017 (MOSAIC, INTREPID MINING)

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)

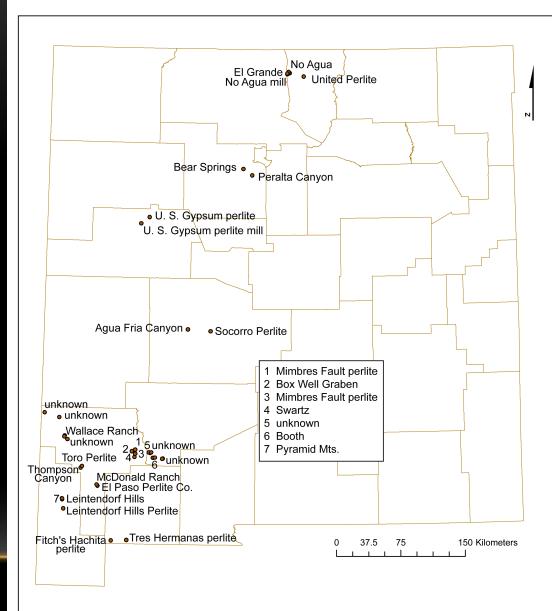
ADDITIONAL INDUSTRIAL MINERALS IN NEW MEXICO



- 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

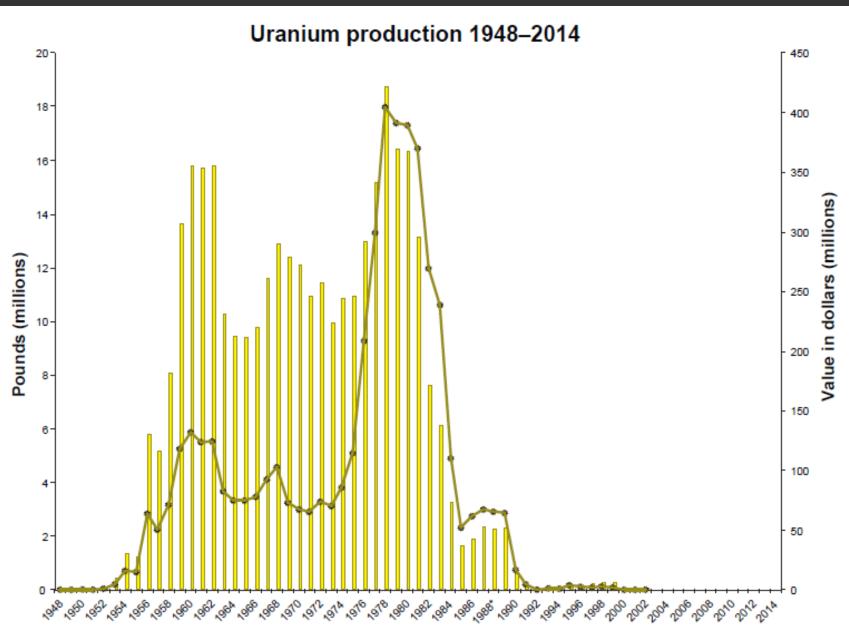
- Aggregates
- Gypsum for wallboard
- Brick and clay in El Paso, Albuquerque areas
- Cement in Tijeras Canyon
- Humate in the San Juan Basin
- Sulfur, helium, carbon dioxide
- Travertine (dimension stone), Meso del Oro, west of Belen
 - 477.6 million tons of travertine

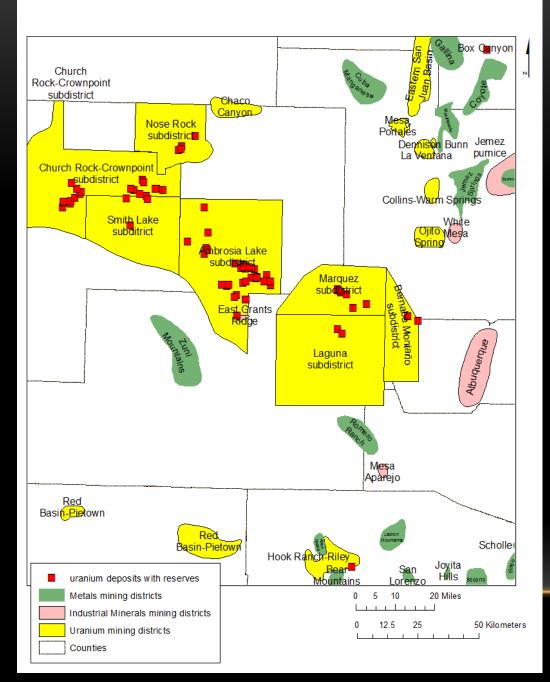
Panel Rey is building a wallboard plant in Ciudad Juarez, Chihuahua, Mexico which could impact the New Mexico gypsum industry

http://panelrey.com/en/news-pr/entering-its-third-decade-panel-rey-will-be-opening-new-production-plant

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





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





CRITICAL MINERALS IN NEW MEXICO

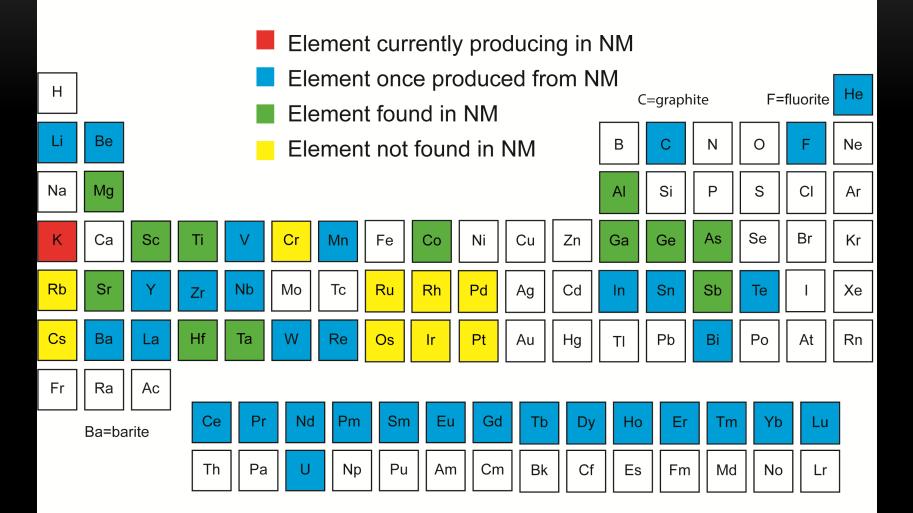
CRITICAL MINERALS

- 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

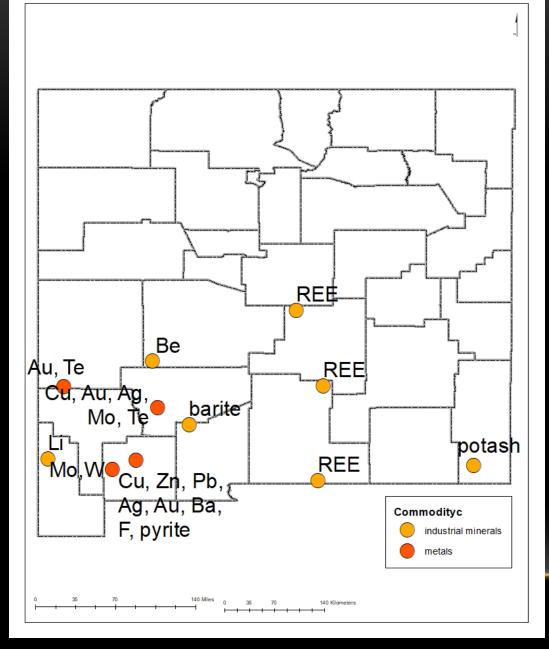
CRITICAL MINERALS

- 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



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

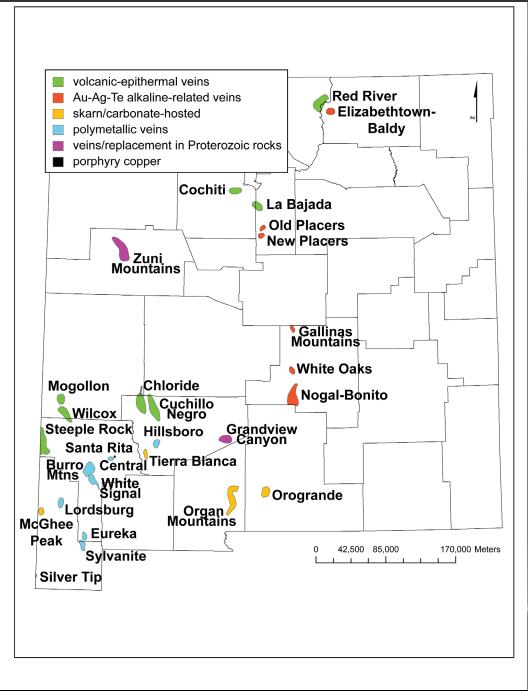
CRITICAL MINERALS ASSOCIATED WITH URANIUM DEPOSITS

- Vanadium and molybdenum were produced with uranium in the past and could resume byproduct 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

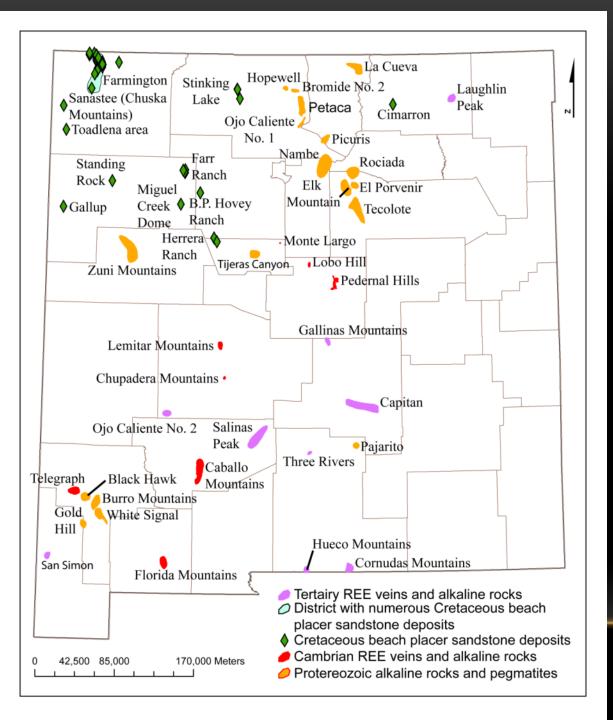
- Alloying additive in steel to improve machining characteristics
- Processing of rubber
- As a component of catalysts for synthetic fiber production
- As pigments to produce various colors in glass and ceramics
- Thermal imaging devices
- Thermoelectric cooling devices, such as summertime beverage coolers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



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

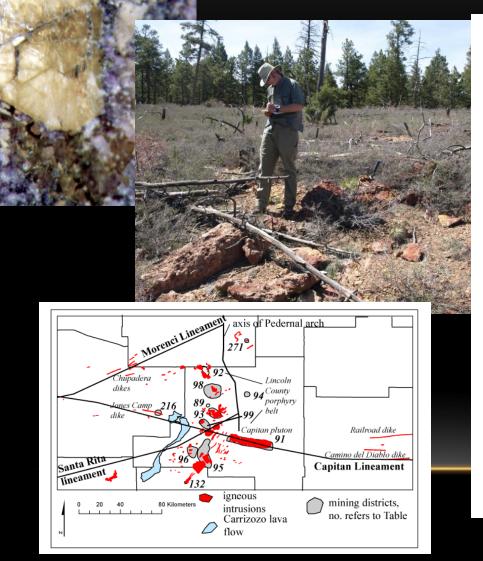
Lone Pine, Wilcox district, Catron Countyvolcanic epithermal vein

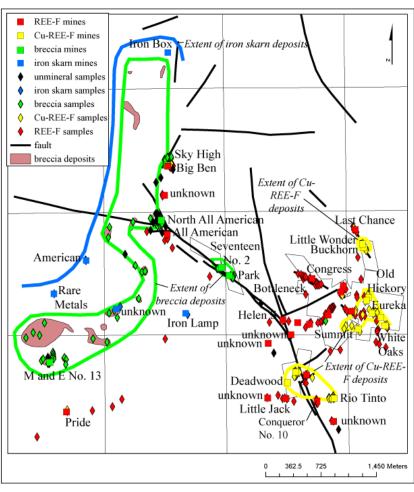




OCCURRENCES OF RARE EARTH ELEMENTS (REE) IN NEW MEXICO

REE in Gallinas Mountains, Lincoln County





WHAT ARE THE MINING ISSUES FACING NEW MEXICO?



Gold King adit

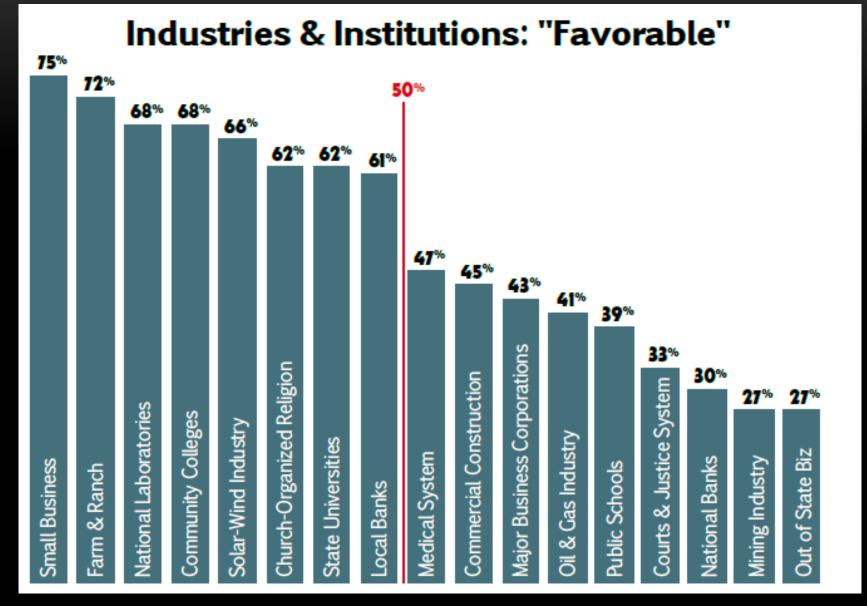


Animas River after Gold King spill

- 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 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



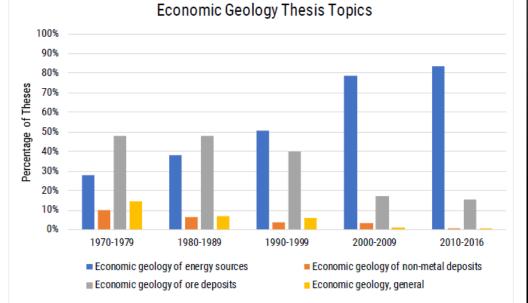
http://garritypr.com/sites/default/files/uploads/documents/2017_Garrity_Perception_Survey.pdf

- 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

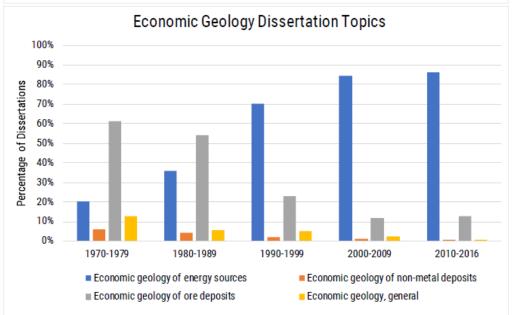
- Global competition is closing some of our mines
- Exploration for new deposits often results in drill targets based upon regulatory minimal impact regulations rather than optimum geological criteria
- Permitting for exploration can take longer than exploration funds are available
- Lower prices=closed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

- 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



Source: AGI GeoRef



Number of theses and dissertations on nonenergy economic geology has decreased

http://www.multibriefs.com/briefs/ aipg/DataBrief_2019_008_Econo micGeologyThesesDissertations.

pdf

Source: AGI GeoRef

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



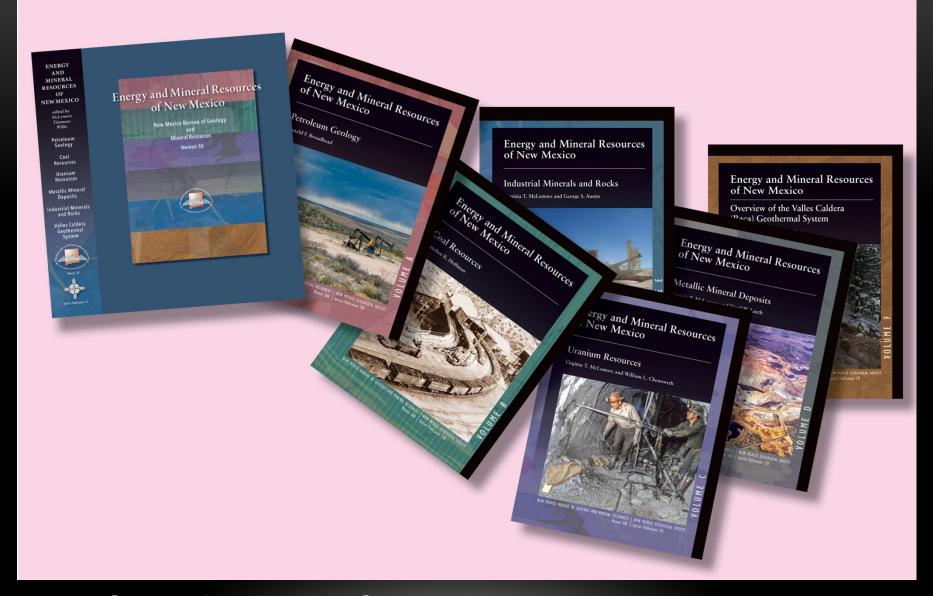
MORE INFORMATION

• 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

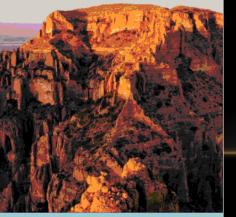
SILVER AND GOLD IN NEW MEXICO

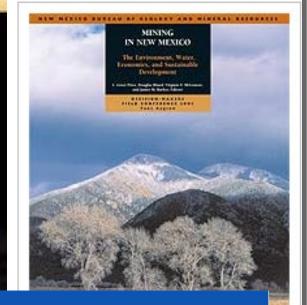


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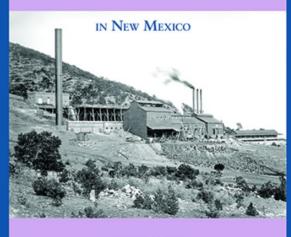
August 2010 Volume 32, Number 3

New Mexico GEOLOGY





MINING DISTRICTS AND PROSPECT AREAS



Virginia T. McLemore

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

Resource Map 24

2017



New Mexico Potash-Past, Present, and Future

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Geothermal Energy

FALL 2010 ISSUE 2



NEW MEXICO BUREAU OF GEOLOGY & MENERAL RESOURCES A DIVISION

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 Items of Interest

rest / & Division of New Mr. and Mineral Res

QUESTIONS?