MINING ISSUES FACING NEW MEXICO-2015

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ACKNOWLEDGEMENTS

- New Mexico Energy, Minerals and Natural Resource Department
- Company annual reports
- Personal visits to mines
- Historical production statistics from US Bureau of Mines, US Geological Survey, NM Energy, Minerals and Natural Resource Department (NM MMD), company annual reports
- New Mexico Mining Association

OUTLINE

- What are minerals?
- Why are they important?
- How are minerals formed?
- What, where, and how much minerals are produced in New Mexico?
- What are the Mining Issues Facing New Mexico?
- More Information

WHAT ARE MINERALS?

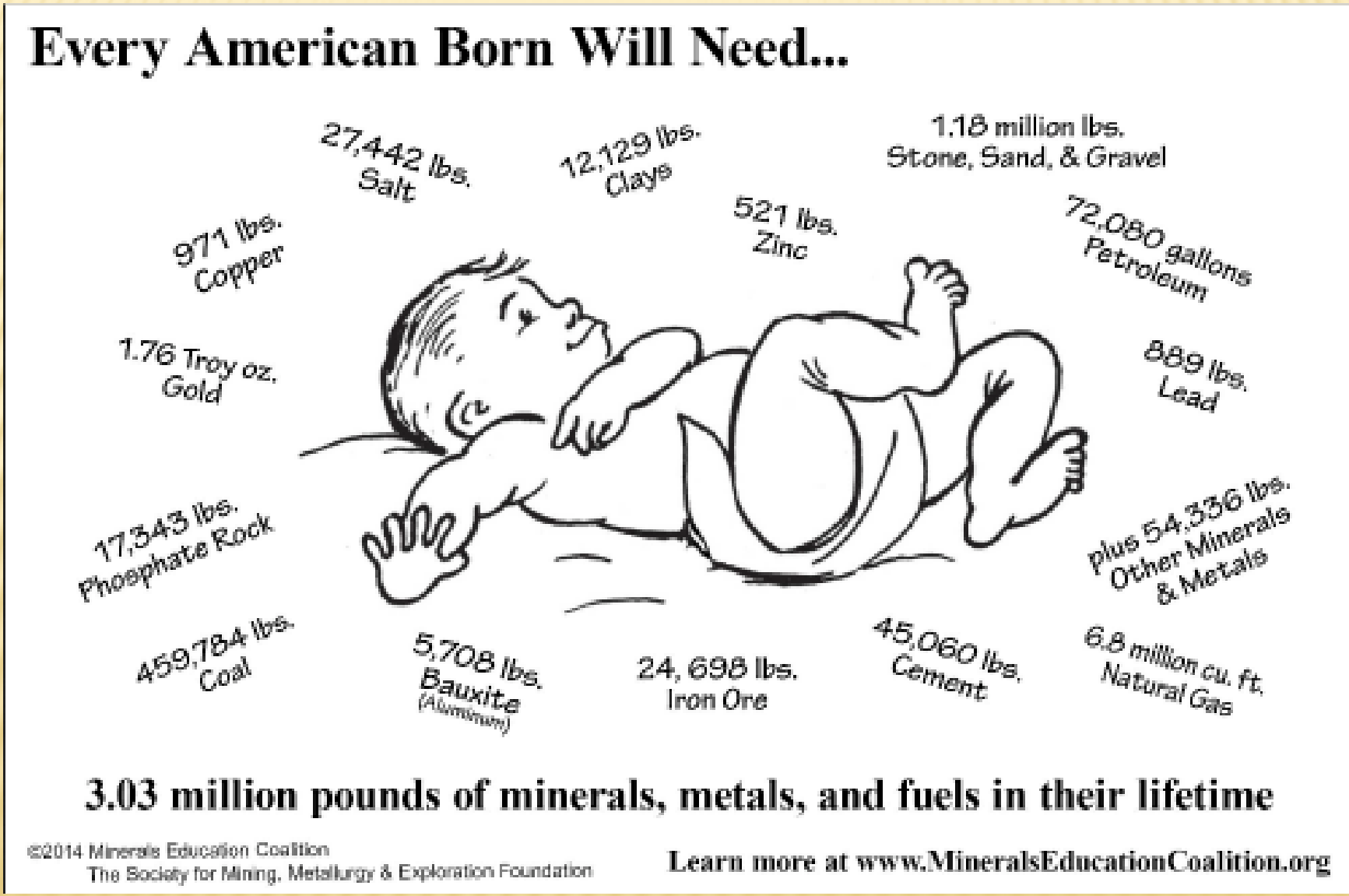
WHAT ARE MINERALS?

Minerals refer to any rock, mineral, or other naturally occurring material of economic value, including metals, industrial minerals, energy minerals, gemstones, and aggregates

WEALTH CREATOR

WHY ARE MINERALS IMPORTANT?

YOUR WORLD IS MADE FROM MINERALS



http://www.mii.org/

Every Year— 38,212 pounds of new minerals must be provided for every person in the United States to make the things we use every day

9,002 lbs. **Stone** used to make roads, buildings, bridges, landscaping, and for numerous chemical and construction uses

6,251 lbs. **Sand & Gravel** used to make concrete, asphalt, roads, blocks and bricks

556 lbs. **Cement** used to make roads, sidewalks, bridges, buildings, schools and houses

348 lbs. **Iron Ore** used to make steel— buildings; cars, trucks, planes, trains; other construction; containers

349 lbs. **Salt** used in various chemicals; highway deicing; food & agriculture

207 lbs. **Phosphate Rock** used to make fertilizers to grow food; and as animal feed supplements

152 lbs. **Clays** used to make floor & wall tile; dinnerware; kitty litter; bricks and cement; paper

78 lbs. **Aluminum (Bauxite)** used to make buildings, beverage containers, autos, and airplanes

12 lbs. **Copper** used in buildings; electrical and electronic parts; plumbing; transportation

11 lbs. **Lead** 87% used for batteries for transportation; also used in electrical, communications and TV screens

7 lbs. **Zinc** used to make metals rust resistant, various metals and alloys, paint, rubber, skin creams, health care and nutrition

35 lbs. **Soda Ash** used to make all kinds of glass; in powdered detergents; medicines; as a food additive; photography; water treatment

6 lbs. **Manganese** used to make almost all steels for construction, machinery and transportation

488 lbs. **Other Nonmetals** have numerous uses: glass, chemicals, soaps, paper, computers, cell phones

24 lbs. **Other Metals** have the same uses as nonmetals but also electronics, TV and video equipment, recreation equipment, and more

Including These Energy Fuels

• 906 gallons of **Petroleum** • 5,666 lbs. of **Coal** • 84,348 cu. ft. of **Natural Gas** • 1/4 lb. of **Uranium**

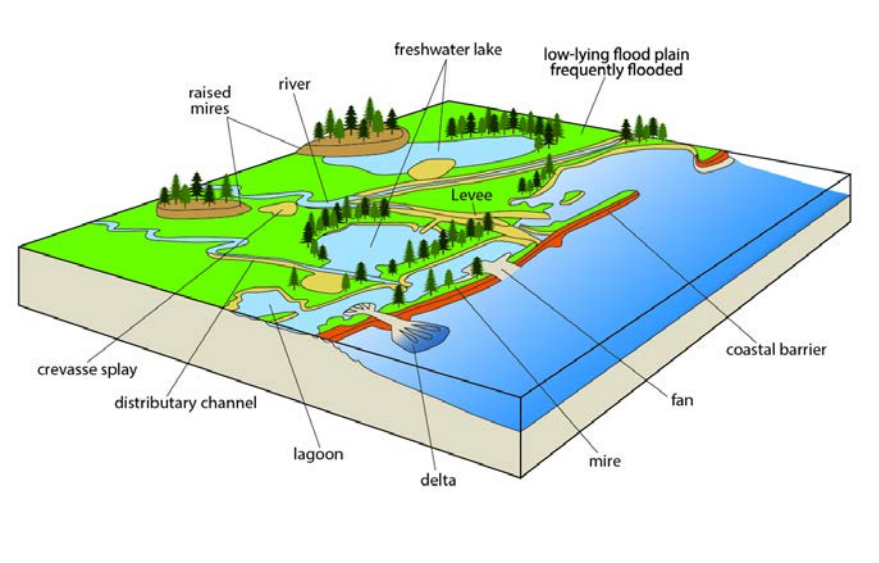
To generate the energy each person uses in one year—

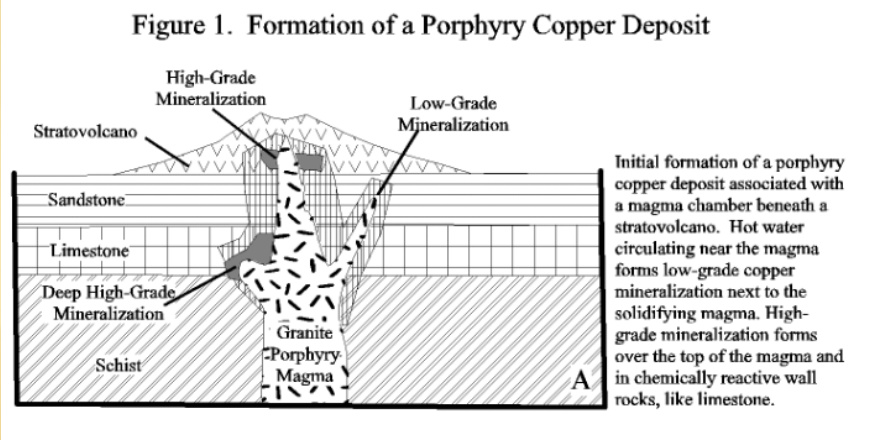
www.MineralsEducationCoalition.org

Society for Mining, Metallurgy and Exploration Foundation

HOW ARE MINERAL DEPOSITS FORMED?

- By natural geologic processes in specific places in the world
- Mineral deposits are not always found in the most convenient places in the world





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

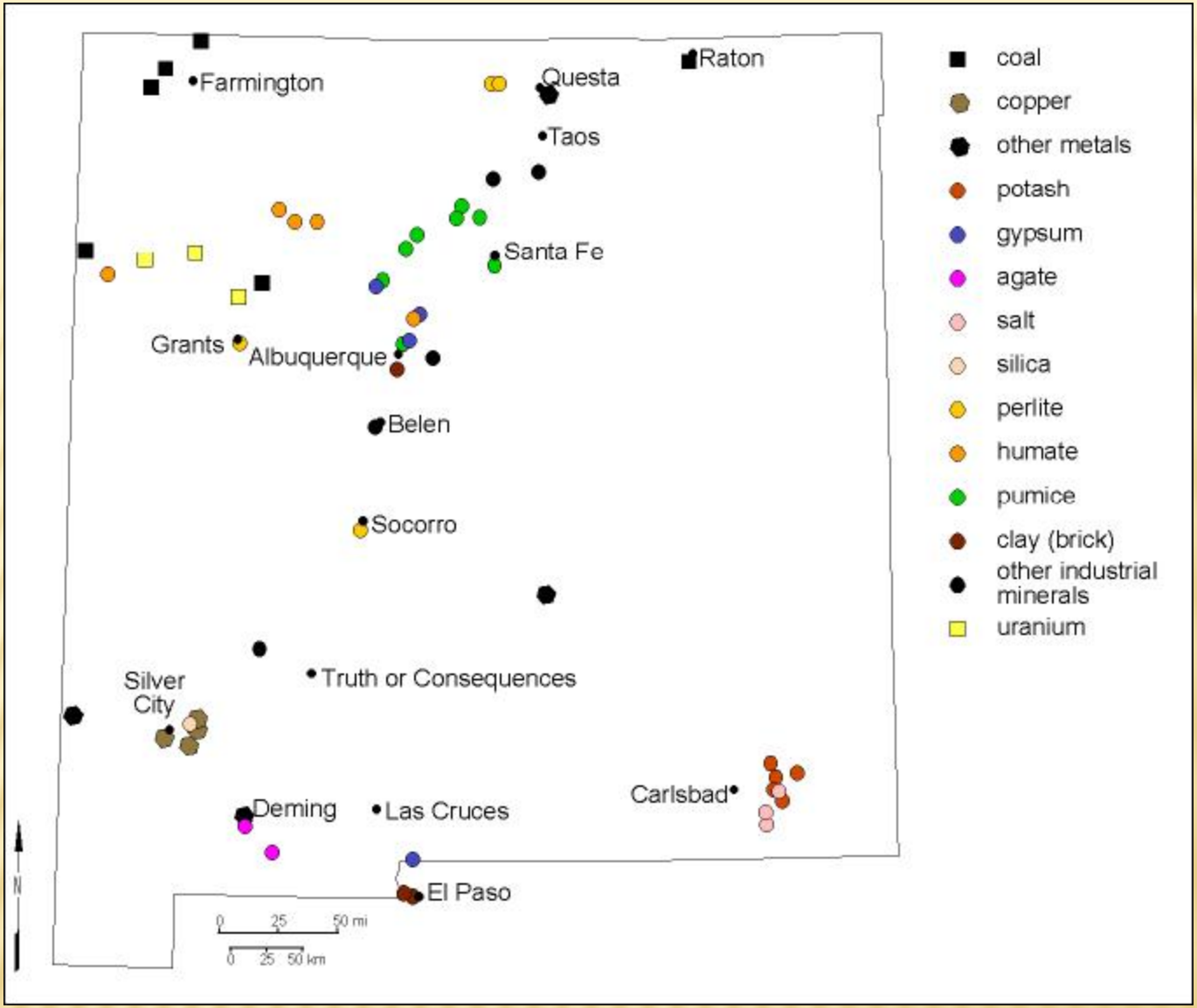
SUMMARY

- Value of mineral production in 2013 was $2.8 billion (does not include oil and gas)—ranked 12th in the US
- Employment in the mining industry is 7,112
- Exploration for garnet, gypsum, limestone, nepheline syenite, agate, specimen fluorite, gold, silver, iron, beryllium, uranium, copper, potash, rare earth elements, humate, clays

TABLE 1 New Mexico Summary of Commodity Production, Production Value, Employment, Payroll, Revenue and Ranking: 2013

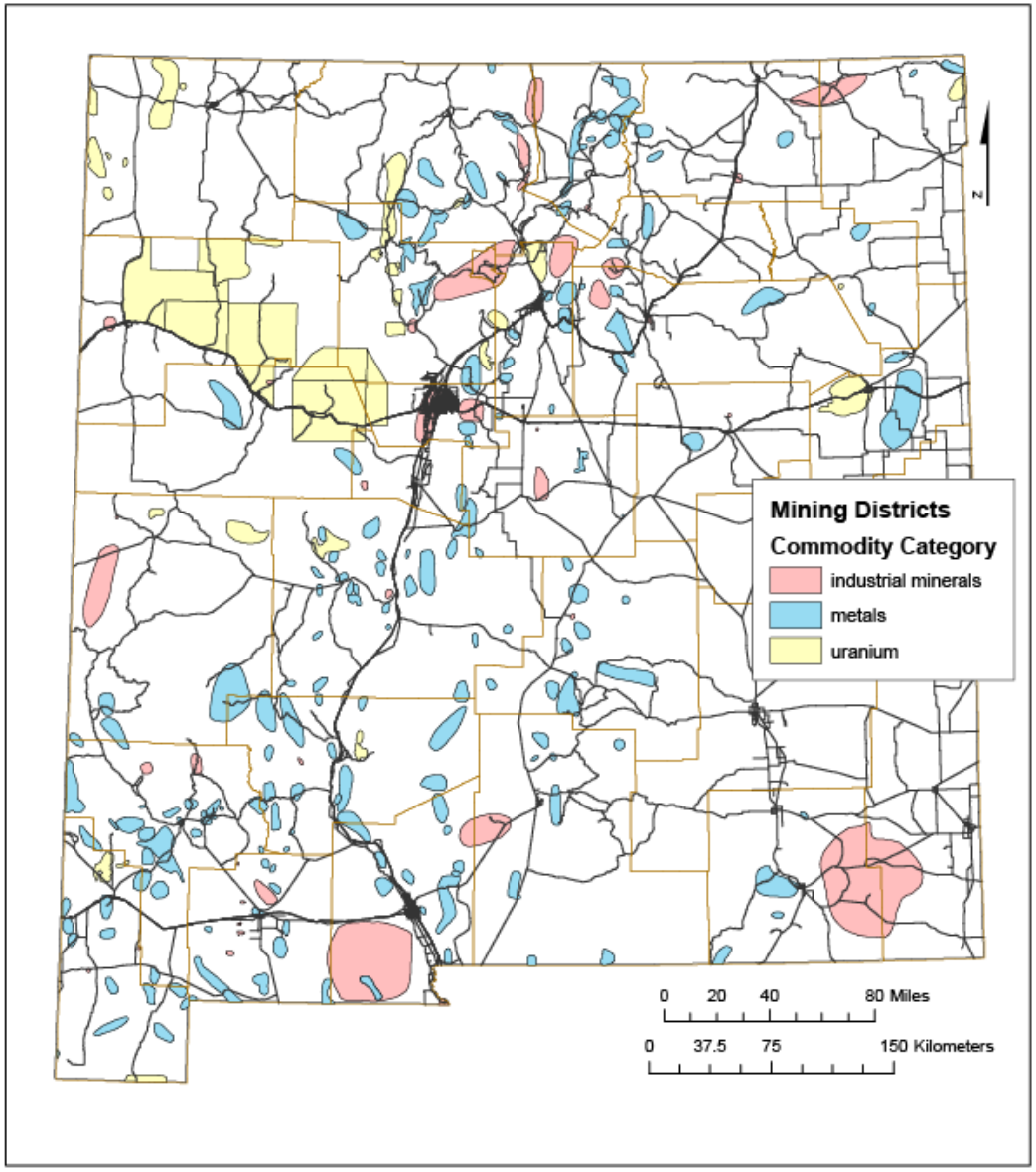
Mineral	Production [1]	Production Rank [2]	Production Value $	Employment [3]	Reclamation Employment	Payroll $ [4]	Revenue Generated $ [5]	
							State	Federal
Coal	21,968,639	12	$ 816,628,814	1,623	183	$ 85,145,465	$ 22,700,382	$ 8,068,407
Copper	266,483,184	3	$ 890,357,625	1,885	88	$ 106,936,573	$ 7,259,514	$ -
Gold	2,943	-	$ 3,994,109	59	-	$ 2,392,294	$ 58,068	$ -
Industrial Minerals [6]	1,248,312	-	$ 91,113,849	471	11	$ 17,860,998	$ 1,028,914	$ 212,690
Aggregates [7]	9,393,107	-	$ 81,505,531	937	101	$ 14,264,197	$ 2,498,063	$ -
Other Metals	512,323	-	$ 2,539,625	65	-	$ 1,877,897	$ 651,719	$ -
Molybdenum	2,384,109	-	$ 24,730,281	461	-	$ 19,028,960	$ -	$ -
Potash [8]	2,188,874	1	$ 914,659,051	1,600	15	$ 95,988,330	$ 5,254,275	$ 11,369,170
Silver [9]	68,523	-	$ 1,867,207	-	-	$ -	$ 33,886	$ -
Uranium [10]	-	-	$ -	11	18	$ 1,164,144	$ -	$ -
TOTAL			$ 2,827,405,091	7,112	416	$ 344,658,858	$ 39,484,821	$19,650,267

Source: Mining and Minerals Division, unless otherwise noted.



ACTIVE MINES AND EXPLORATION IN NEW MEXICO 2000-2015 (EXCLUDING AGGREGATES)

HISTORICAL PRODUCTION



MINING DISTRICTS IN NEW MEXICO

ESTIMATED TOTAL PRODUCTION OF MAJOR COMMODITIES IN NEW MEXICO

- More than $68 billion worth of minerals have been produced from New Mexico since 1804

ESTIMATED TOTAL PRODUCTION OF MAJOR COMMODITIES IN NEW MEXICO

Commodity	Years of production	Estimated quantity of production	Estimated cumulative value ($)	Quantity of production in 2013* (natural gas and oil are in 2014)	Value in 2013 ($)*	Ranking in U.S. in 2013
Coal	1882-2013	>1.06 billion short tons	>$20.75 billion	21,968,639 short tons	$816,628,814	12
Copper	1804-2013	>11.2 million tons	>$19.6 billion	266,483,184 pounds	$890,357,625	3
Potash	1951-2013	109,923,866 Short tons	>$13 billion	2,188,874 short tons	$914,659,051	1
Uranium	1948-2002	>347 million pounds	>$4.7 billion	none		
Industrial minerals	1997-2013	39,076,946	>$2.5 billion	1,248,312	$91,113,849	
Aggregates	1951-2013	>654 short tons	>$2.4 billion	9,393,307	$81,505,531	
Molybdenum	1931-2013	>176 million pounds	>$852 million	2,384,509 pounds	$24,739,281	6
Gold	1848-2013	>3.2 million troy ounces	>$452 million	2,943 ounces	$3,994,109	9
Silver	1848-2013	>118.7 million troy ounces	>$279 million	68,523 ounces	$1,867,207	7

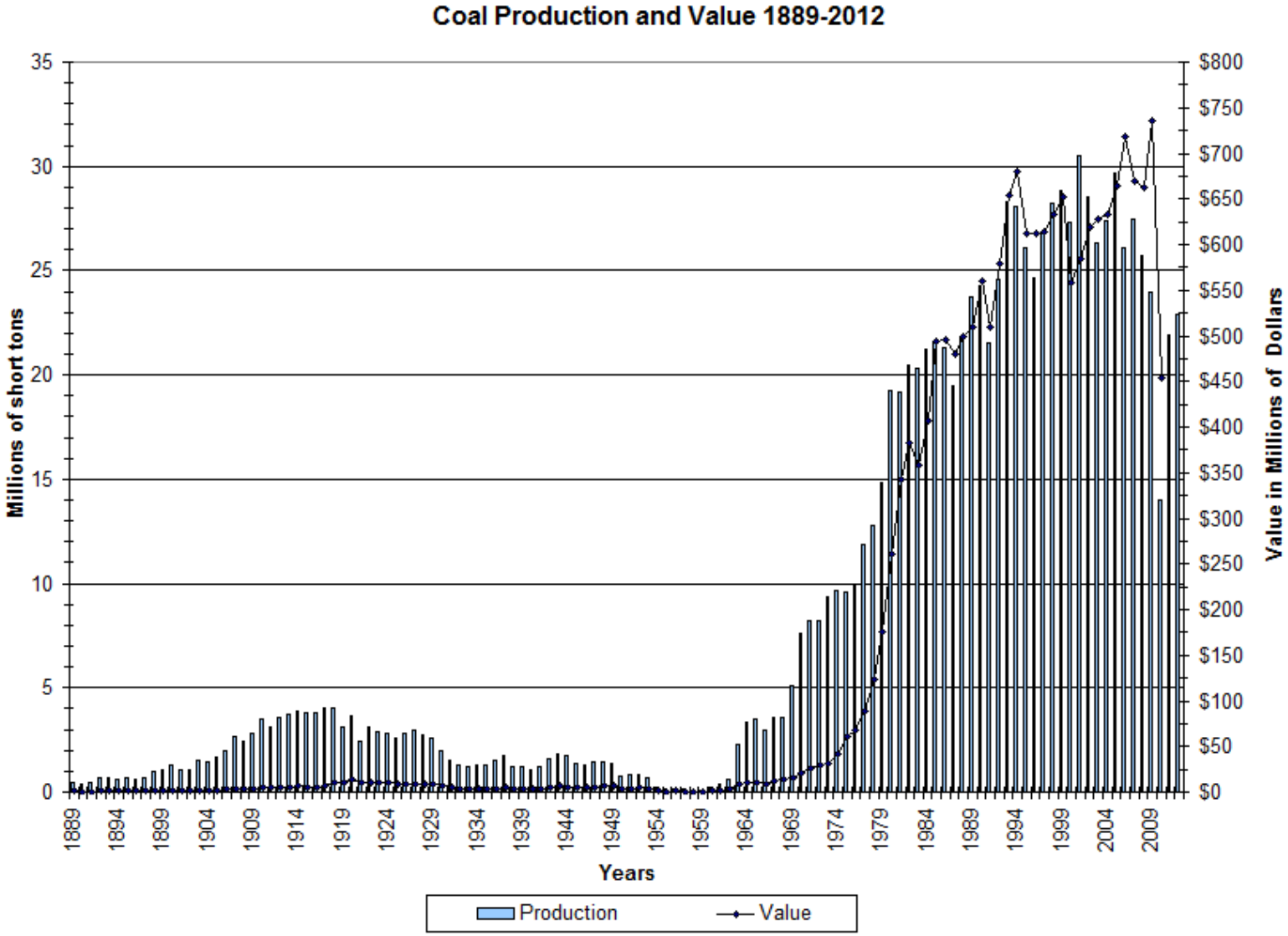
ACTIVE MINES 2015

- ~240 active registered mines (NMMMD)
- 5 coal
- 3 potash, 5 potash plants
- 1 gold mine and mill (on standby)
- 2 copper open pits, 1 concentrator (mill), 2 solvent/electro-winning (SX-EW) plants
  - 2 additional mines in permitting stage
  - Several exploration
- 20 industrial minerals mines, 18 mills
- ~200 aggregate/stone

COAL

COAL

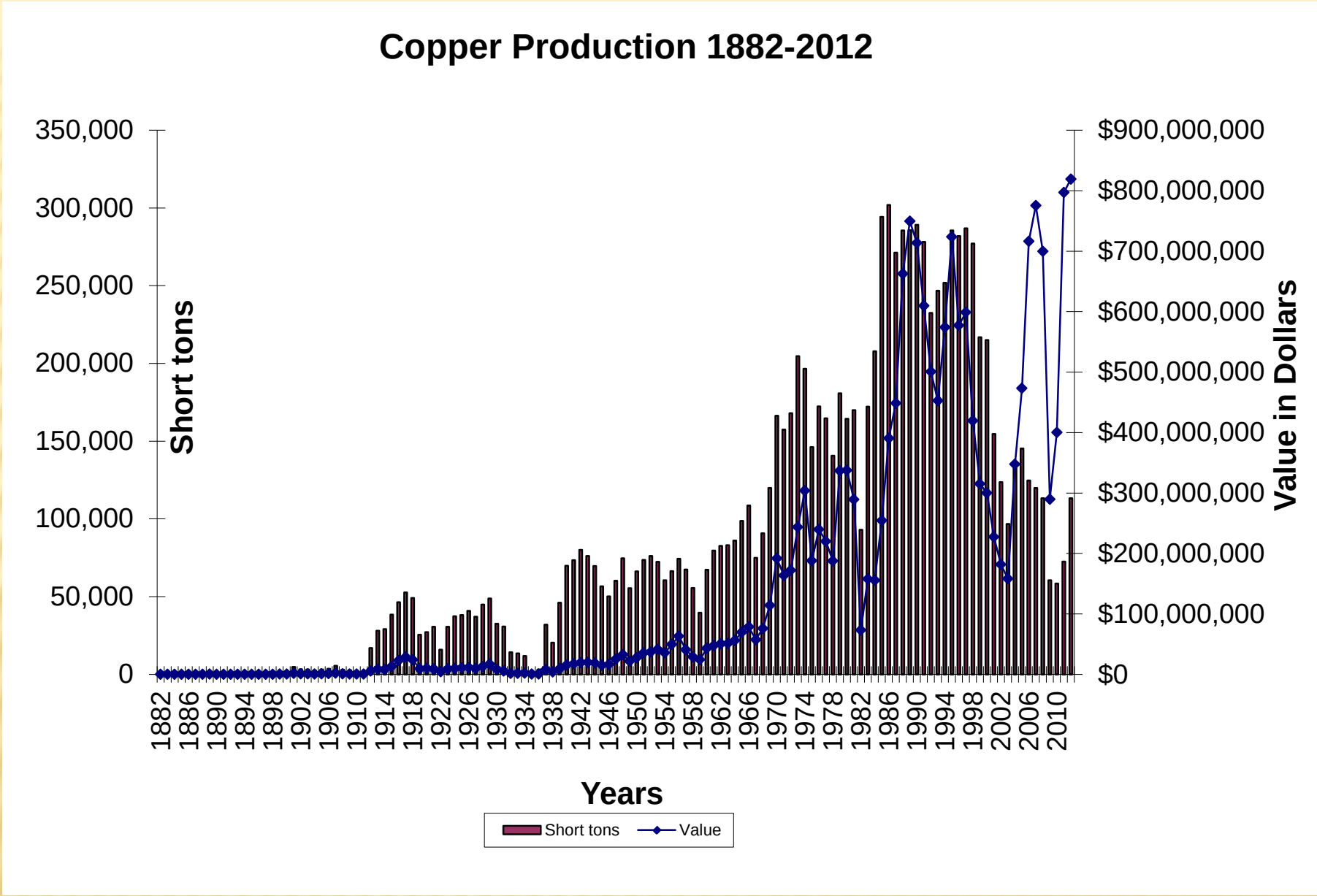
- Fuels electrical generating plants
- 4 surface mines and 1 underground mine in San Juan Basin
- Resources at Raton, Carrizozo
- 12th in production in U.S. in 2013
- 11th in estimated recoverable coal reserves—7 billion tons of recoverable reserves (2005 figures)
- **Coal production is expected to decrease in the near future**



1882-2013 >1.06 BILLION SHORT TONS COAL WORTH >$20.75 BILLION

METALS

3RD IN COPPER IN 2013 (CHINO, TYRONE)



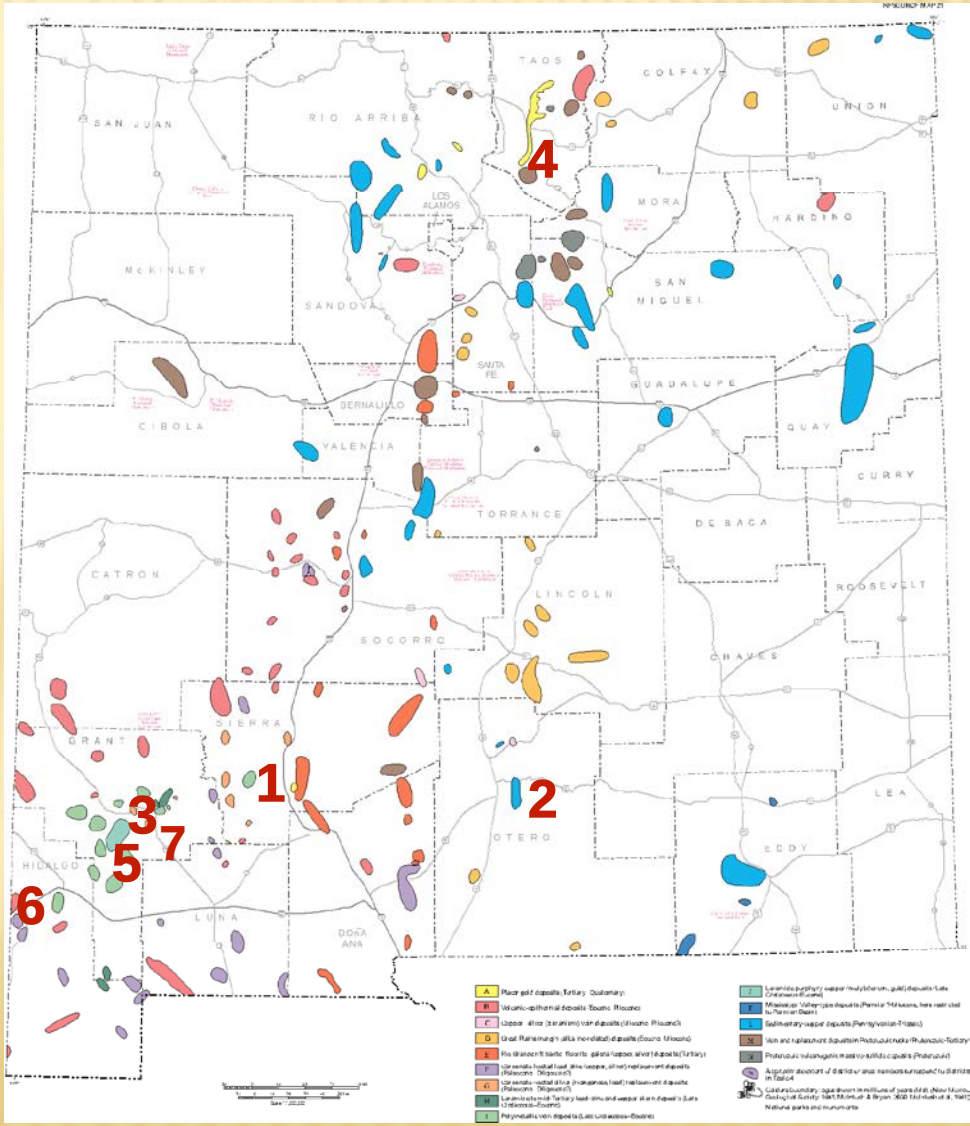
1804-2013 >11.2 MILLION SHORT TONS CU WORTH >$19.6 BILLION

COPPER RESERVES—2009

- Chino
  - milling reserves are 54 million tons of 0.66% copper, 0.03 g/t gold and 0.013% molybdenum
  - leaching reserves are 69 million tons of 0.41% Cu
- Tyrone
  - leaching reserves are estimated as 139 million tons of ore grading 0.32% Cu
- Cobre
  - leaching reserves are 71 million tons of 0.40% Cu
- Niagara deposit
  - contains 500 million tons of ore grading 0.29% Cu (leaching)

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, 102% 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 11 yrs

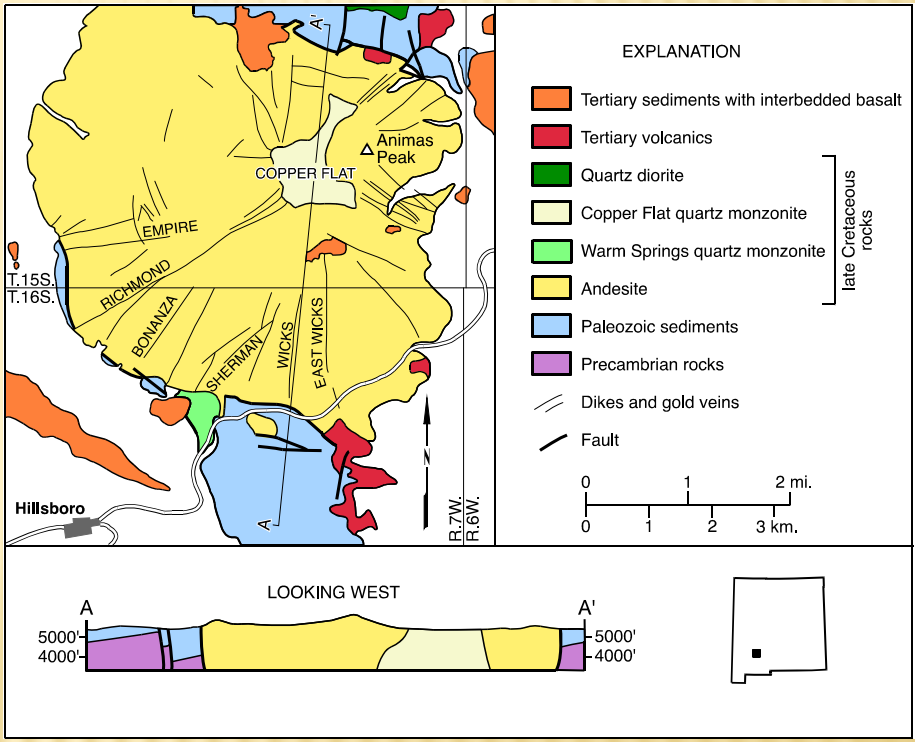
50.76 mill lbs Cu

1.01 mill lbs Mo

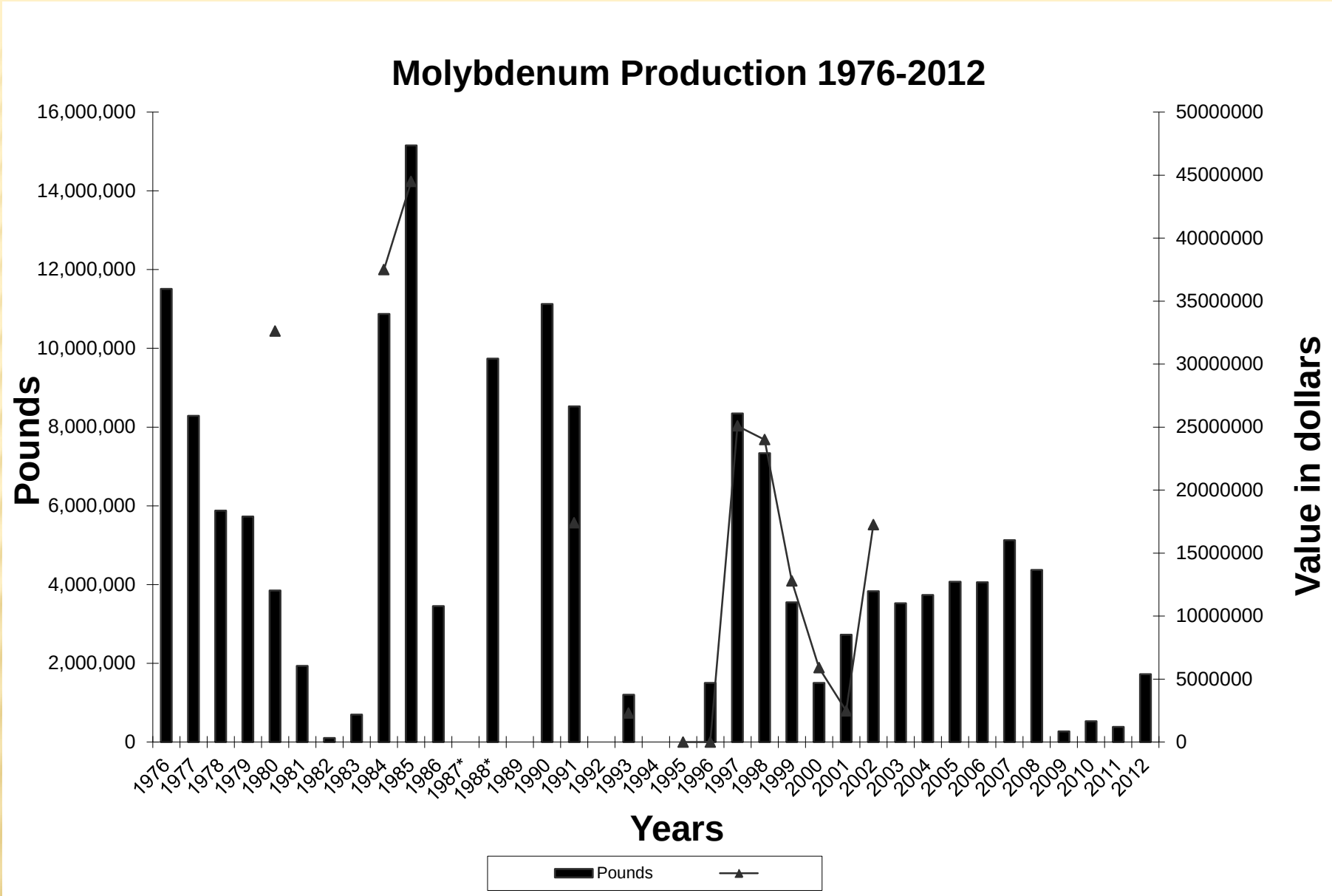
12,750 oz Au

455,390 oz Ag

Start in 2018?



ONCE PRODUCED MOLYBDENUM (QUESTA)—CLOSED IN JUNE 2014



1931-2013 >176 MILLION POUNDS MO WORTH >$852 MILLION

MOLY RESERVES AT QUESTA CHEVRON MINING INC.

- Proven reserves
  - 16,344,898 tons of 0.343% MoS_2 at a cutoff grade 0.25% MoS_2
- Probable
  - 47,198,409 tons of 0.315% MoS_2
- Possible
  - 3,223,000 tons of 0.369% MoS_2

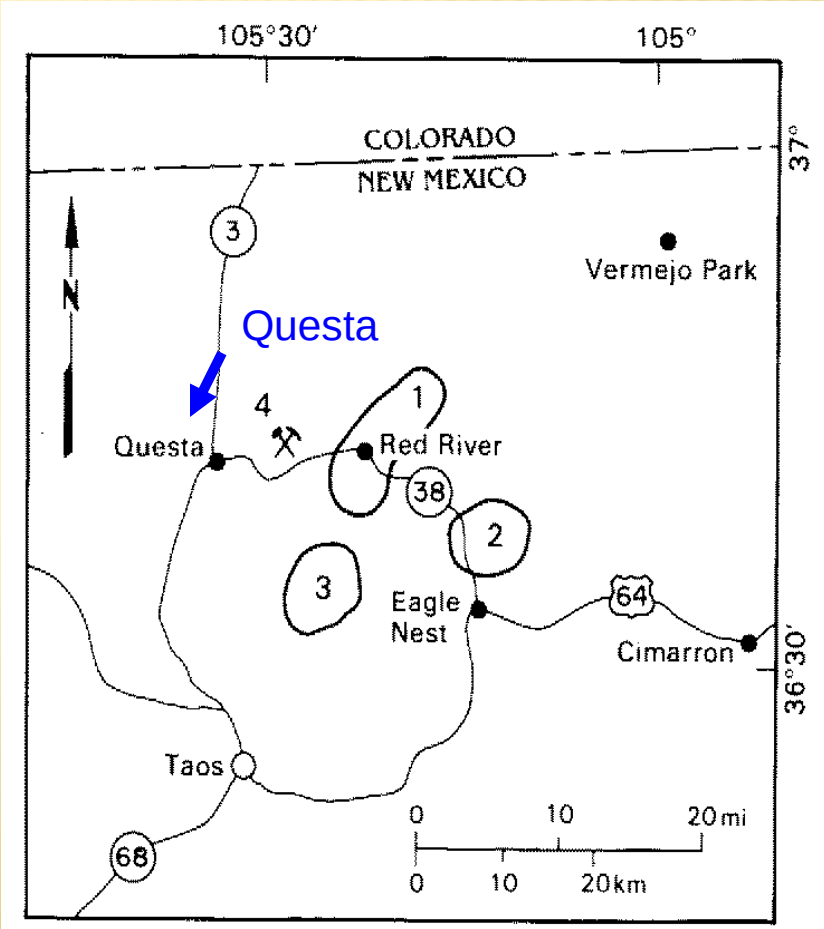
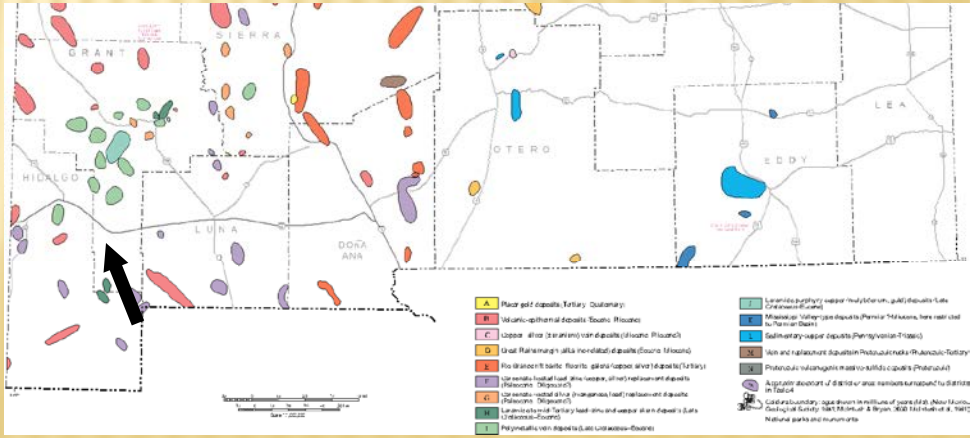


FIGURE 1. Location map of the Red River mining district. 1 = Red River district; 2 = Elizabethtown-Baldy district; 3 = Twining district; 4 = Molycorp Questa mine.

VICTORIO MOUNTAINS, LUNA COUNTY

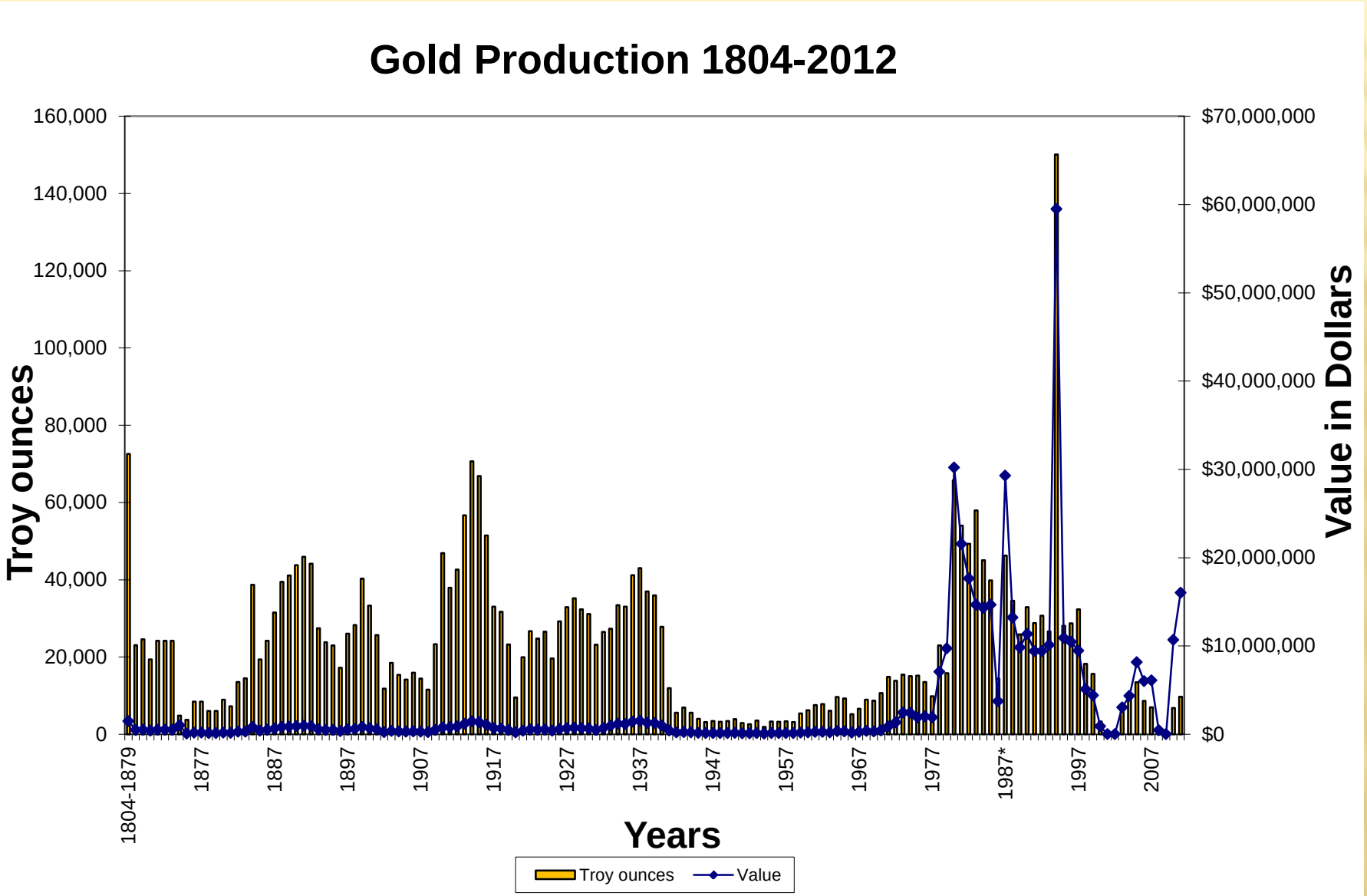
- 21.5 million tons indicated ore at a grade of 0.15% Mo, 0.13% W
- Drilling this year increased the resource estimate
- Be also found in district



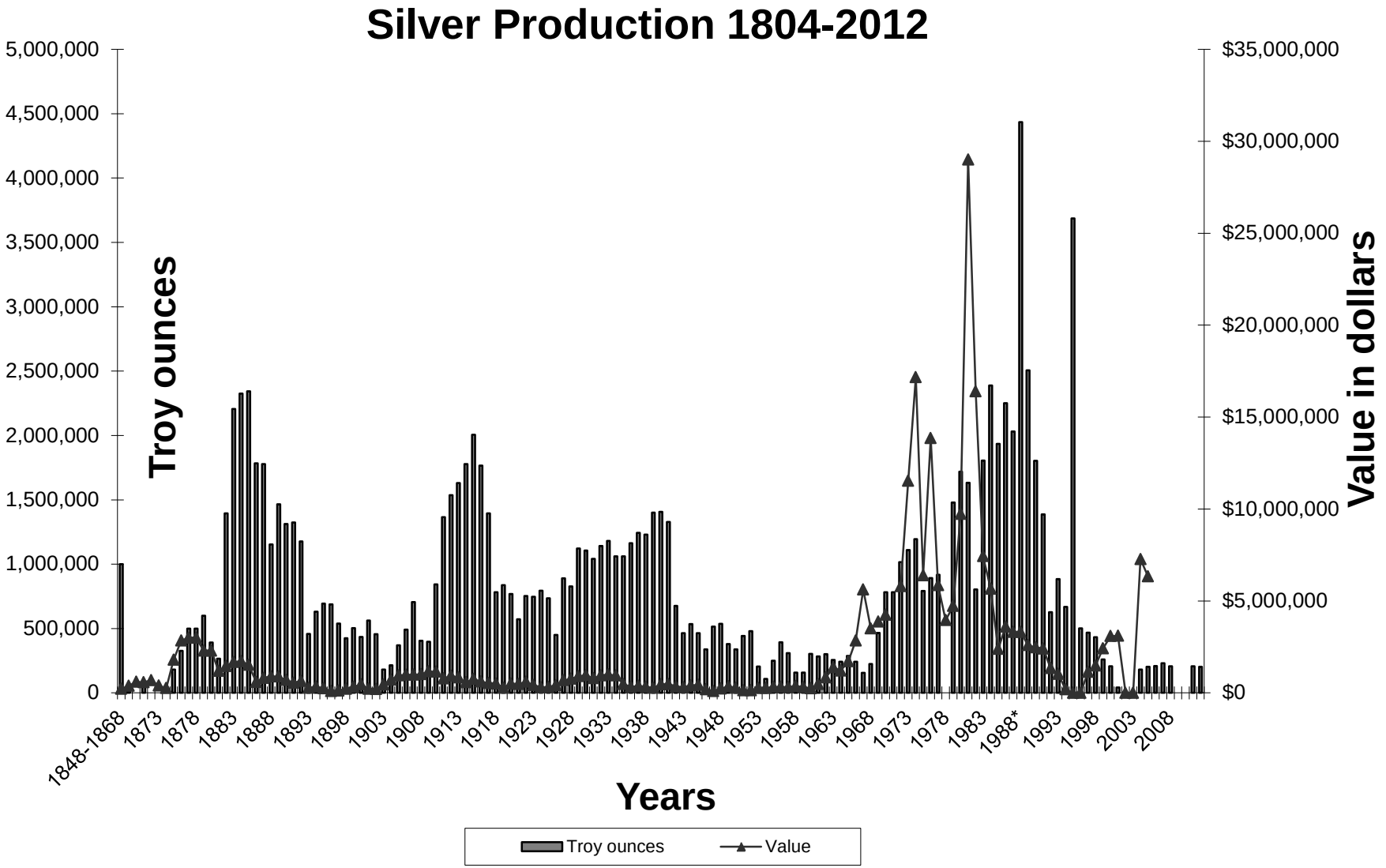
GOLD AND SILVER PRODUCTION IN 2004-2015 AS A BYPRODUCT OF COPPER PRODUCTION FROM THE IVANHOE CONCENTRATOR (FREEPORT-MCMORAN)

2009 SUMMIT MINE OPENED (CURRENTLY ON STANDBY)

9TH IN GOLD PRODUCTION
10TH IN SILVER PRODUCTION



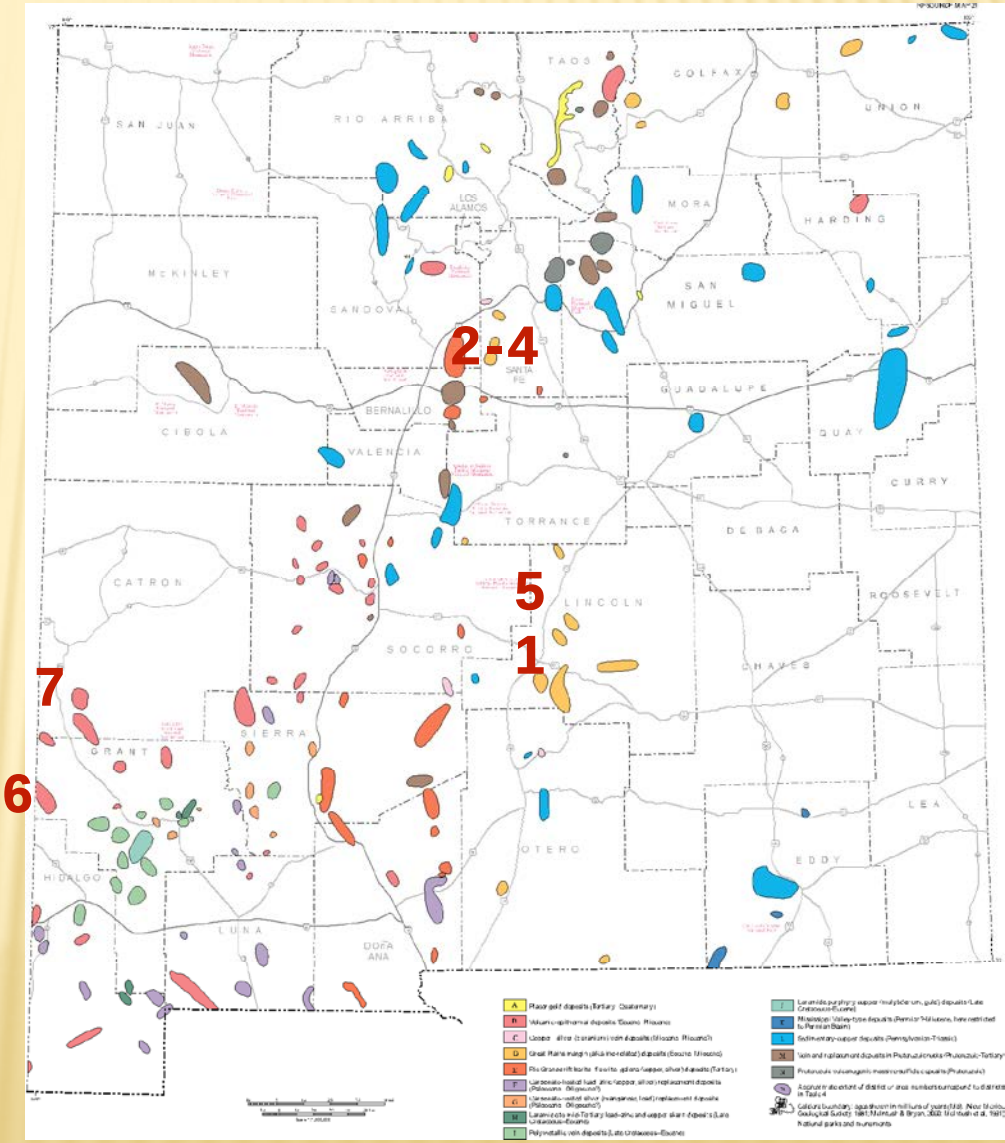
1804-2013 >3.2 MILLION TROY OUNCES AU WORTH >$452 MILLION



1848-2013 >118.7 MILLION TROY OUNCES AG WORTH >$279 MILLION

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

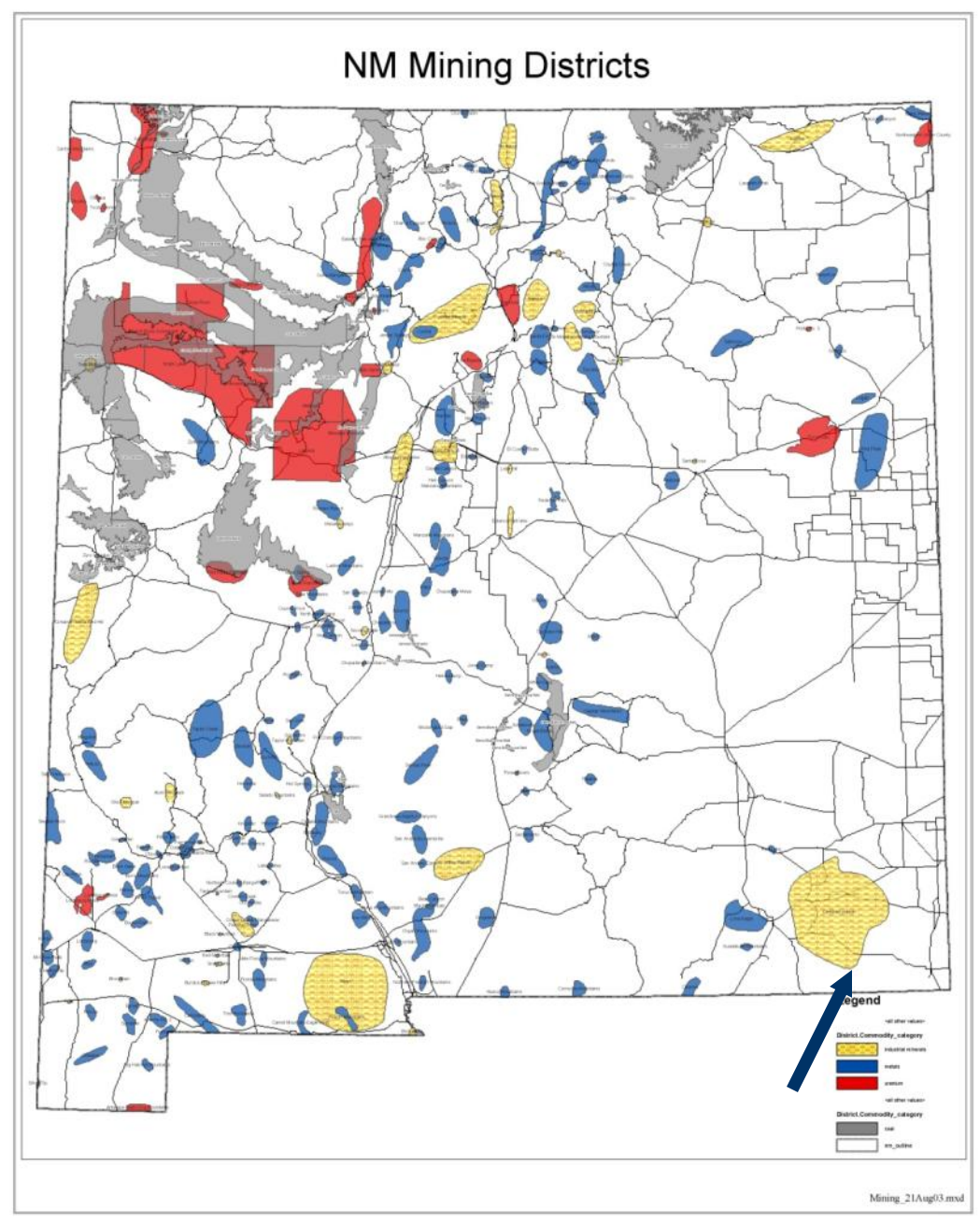


SUMMIT GOLD MINE

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

The ore is milled at Lordsburg

INDUSTRIAL MINERALS



PRODUCTION

1951-2013 109 million tons worth >$13 billion

RESERVES IN CARLSBAD DISTRICT

Potash (>553 million tons)

Potash is used in fertilizers among other uses

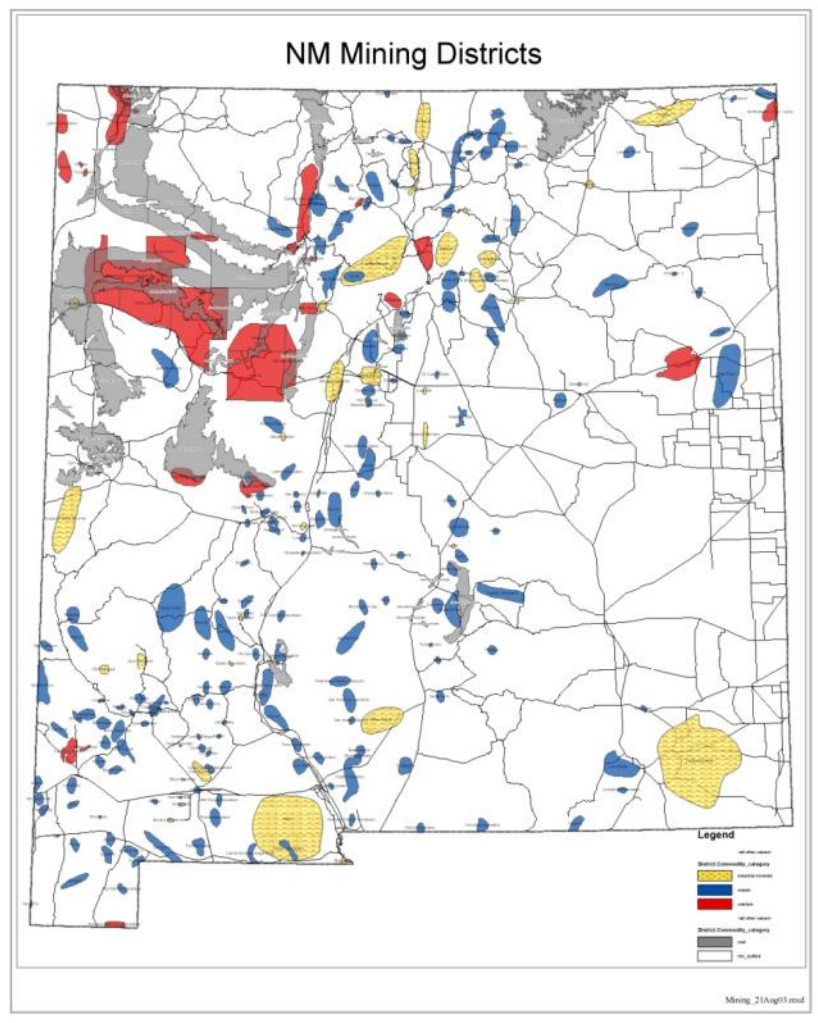
1ST IN POTASH IN 2013 (MOSAIC, INTREPID MINING)

UNDERGROUND OPERATIONS AT MOSAIC POTASH MINE, CARLSBAD.

NEW 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)

INDUSTRIAL MINERALS ARE INCREASING IN IMPORTANCE IN NEW MEXICO



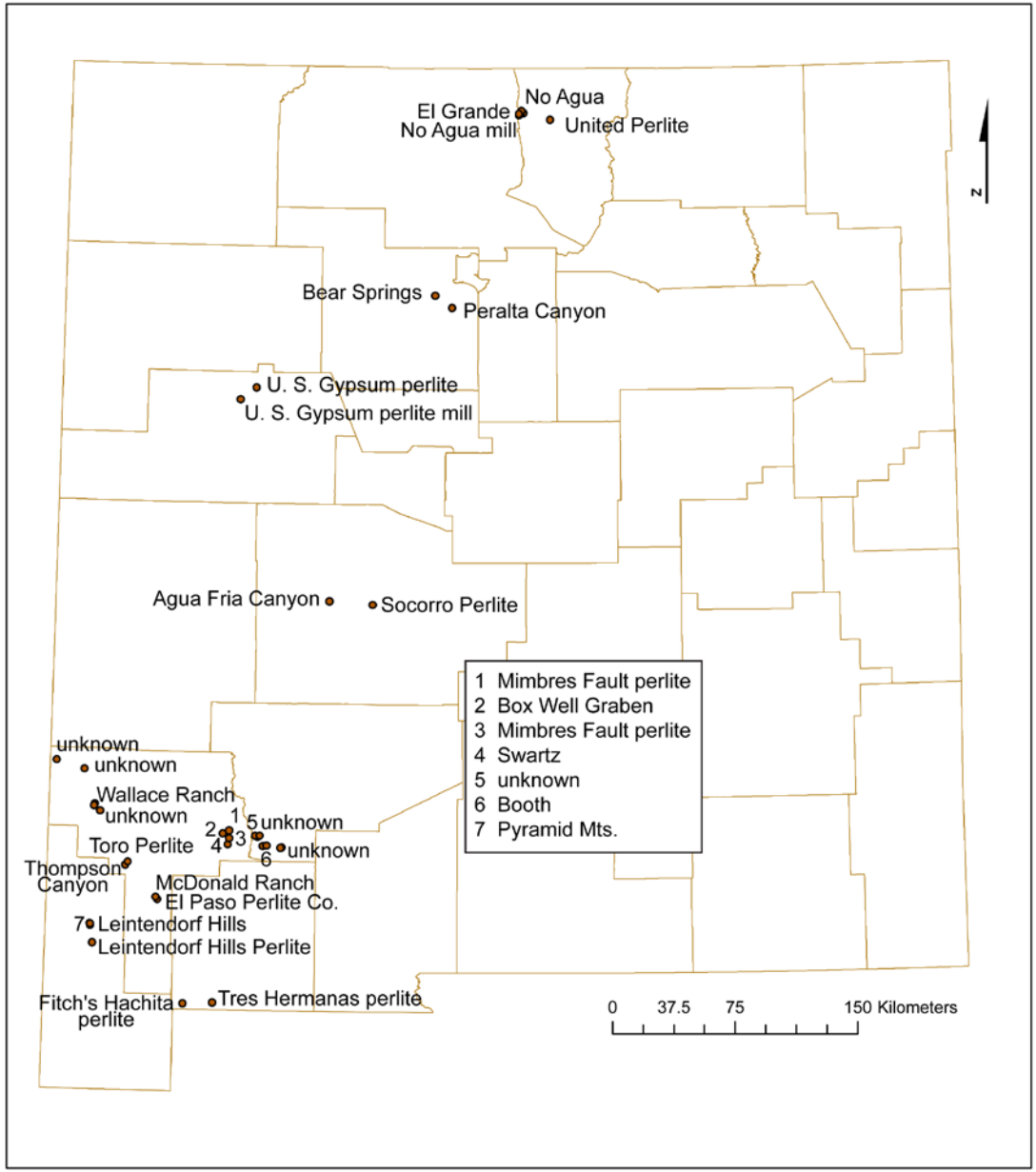
- 1st in zeolite (St. Cloud, Sierra County)
- 5th in pumice (6 operations)
- 1st in perlite (4 operations)
- 11th in salt (4 operations, Carlsbad)

STONE HOUSE ZEOLITE MINE, SIERRA COUNTY (18.3 MILLION TONS OF RESERVES).

LAS CONCHAS PUMICE QUARRY, SANDOVAL COUNTY

SOCORRO PERLITE QUARRY

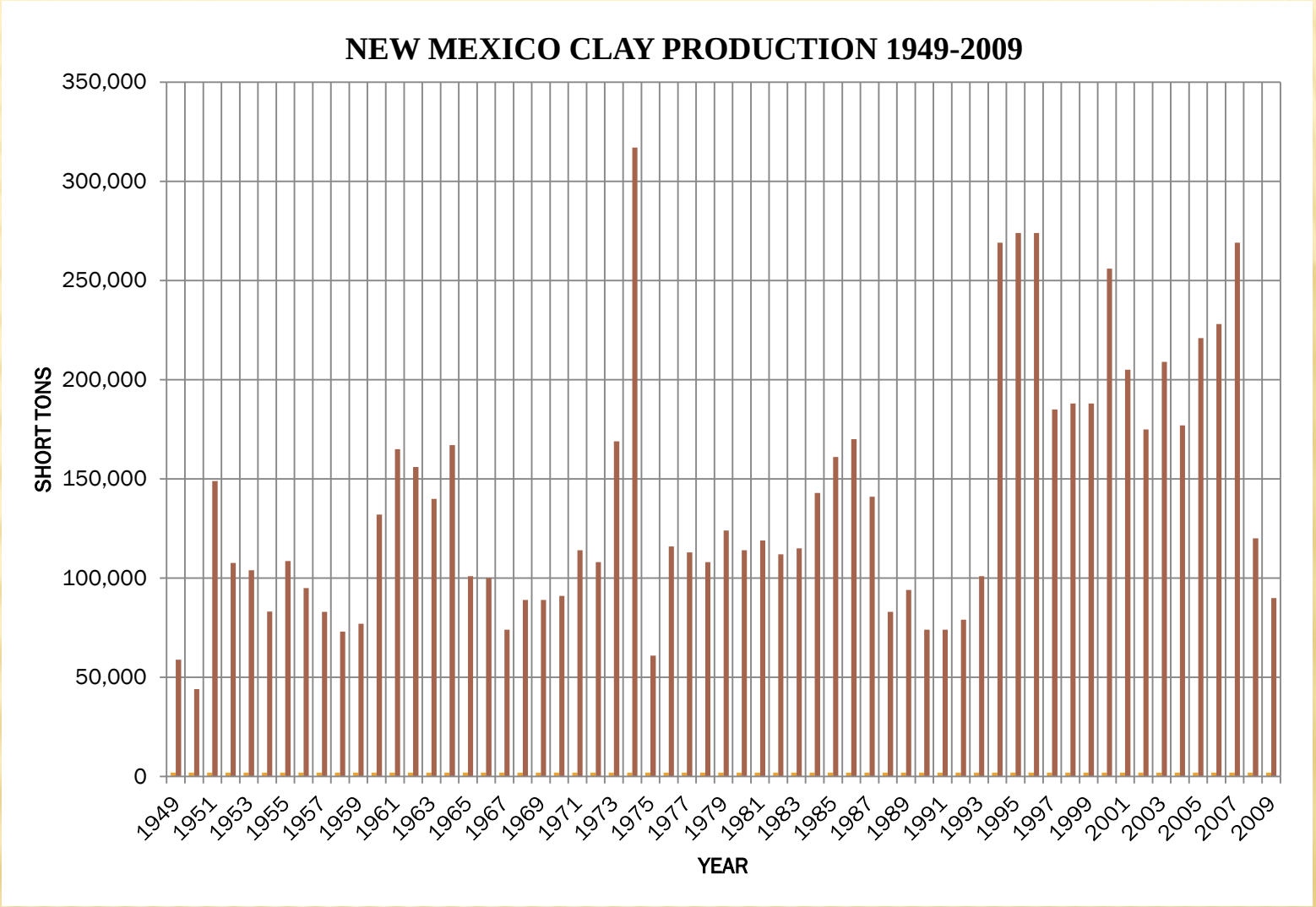
PERLITE IN NEW MEXICO



GYPSUM IS MINED AT WHITE MESA, SANDOVAL COUNTY (EAGLE MATERIALS, FORMERLY CENTEX AMERICAN GYPSUM) AND USED TO MANUFACTURE WALLBOARD.

OTHER INDUSTRIAL MINERALS DEPOSITS

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



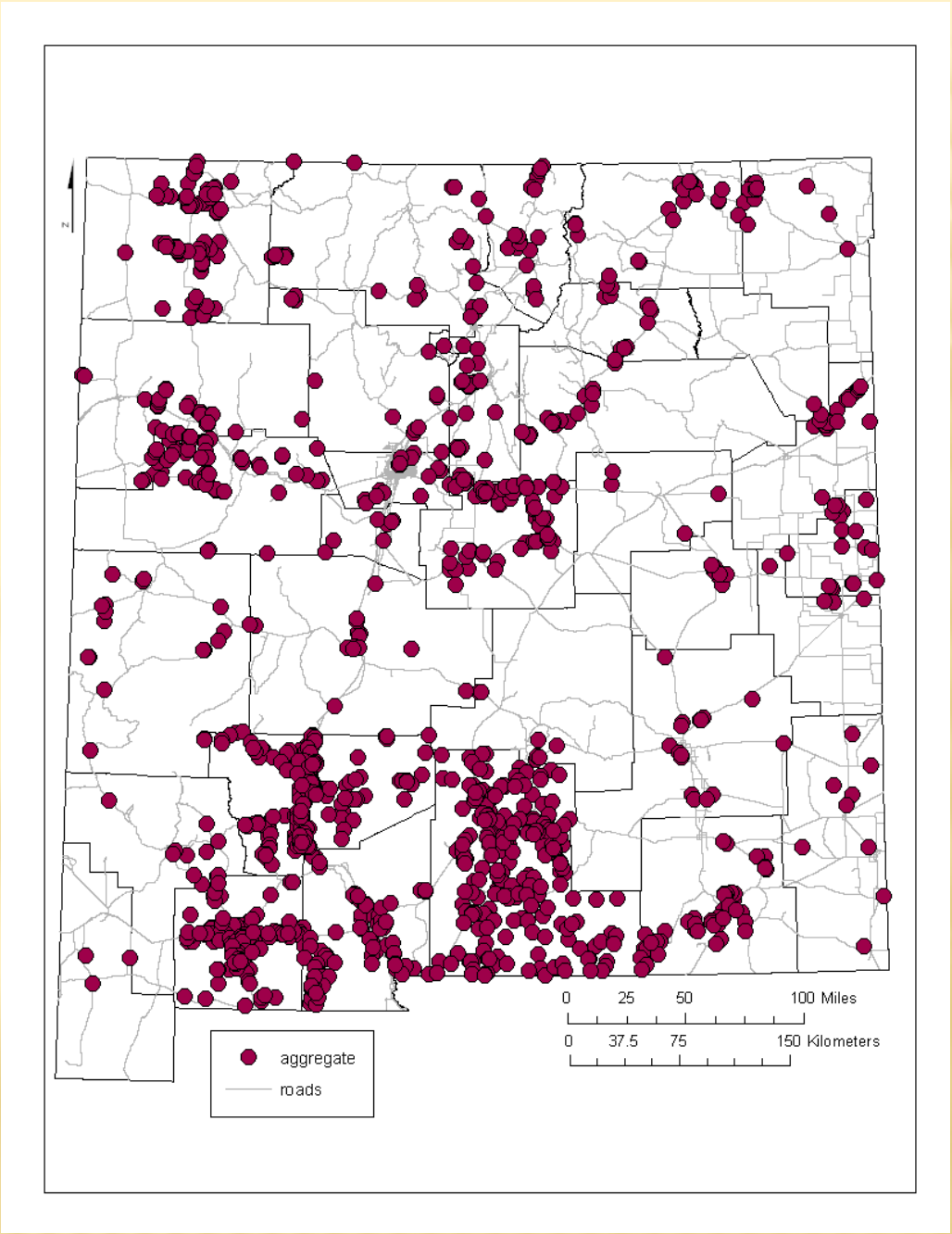
CLAY PRODUCTION

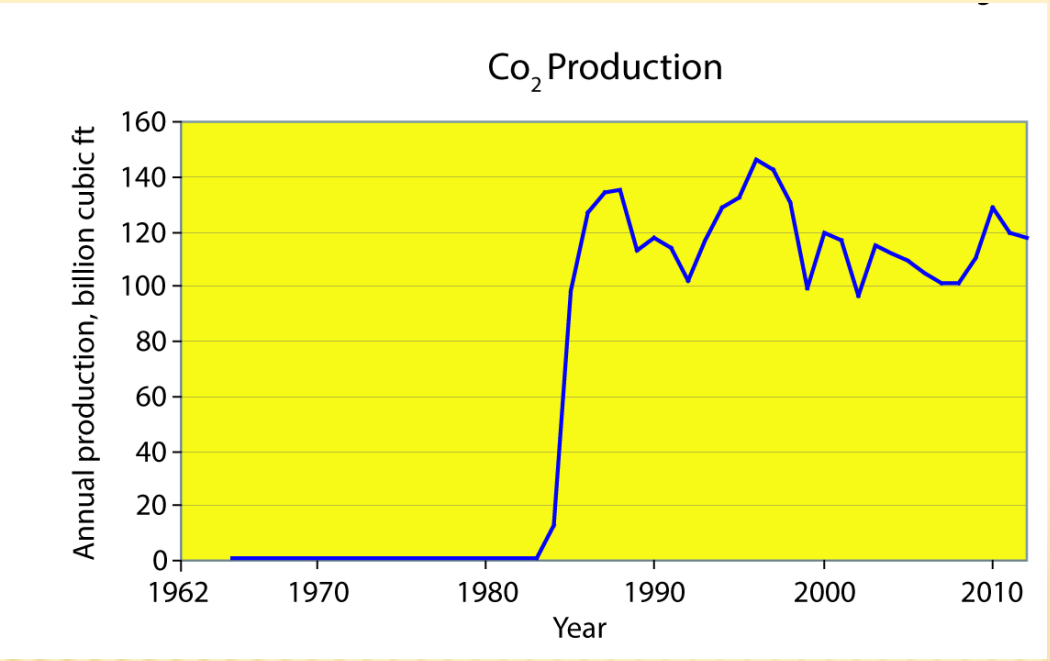
>3 MILLION TONS WORTH >$8 MILLION 1949-2013

AGGREGATES

- ~200 active and standby aggregate mines in 2015
- highways, railroad, and home construction
- More aggregate operations are in rural areas
- A shortage of aggregate in urban areas is expected

AGGREGATE MINES IN NEW MEXICO

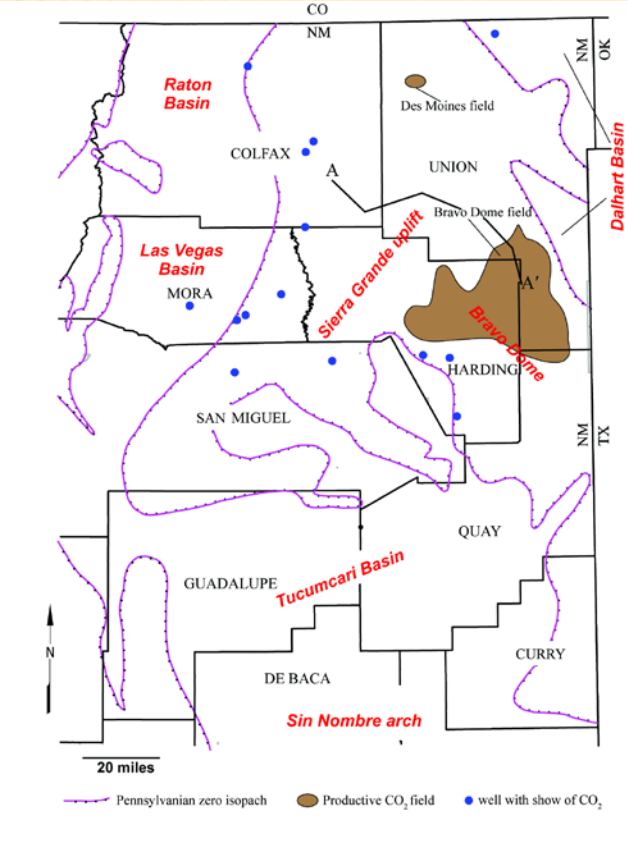




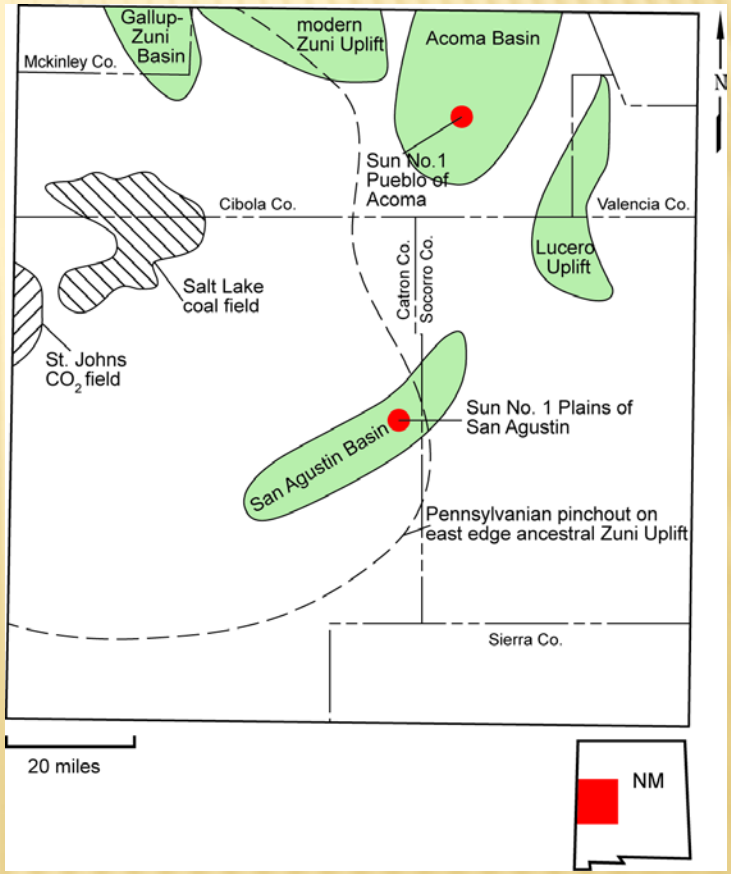
CARBON DIOXIDE

Annual volume of CO_2 gas produced from natural geological accumulations in New Mexico in billion ft^3 (BCF). Production data not available prior to 1965. Compiled by Ron Broadhead from data obtained from New Mexico Oil Conservation Division

CARBON DIOXIDE FROM BRAVO DOME FIELD OF UNION AND HARDING COUNTIES, AND THE NOW ABANDONED DES MOINES FIELD OF UNION COUNTY AND THE TWO ESTANCIA FIELDS OF TORRANCE COUNTY



BRAVO DOME AND SIERRA GRAND UPLIFT INDICATING LOCATIONS OF THE BRAVO DOME AND DES MOINES CO_2 GAS FIELDS, WELLS THAT ENCOUNTERED CO_2 GAS SHOWS



WEST-CENTRAL NEW MEXICO SHOWING MAJOR TECTONIC ELEMENTS, THE ST. JOHNS CO_2 FIELD

HELIUM

- Helium-rich gases have been produced from small Devonian, Mississippian and Pennsylvanian reservoirs in western San Juan County since World War II

SULFUR

- New Mexico has produced sulfur, mostly as a by-product of natural gas plants, although there are geological occurrences of sulfur in New Mexico
- Sulfuric acid from copper mills

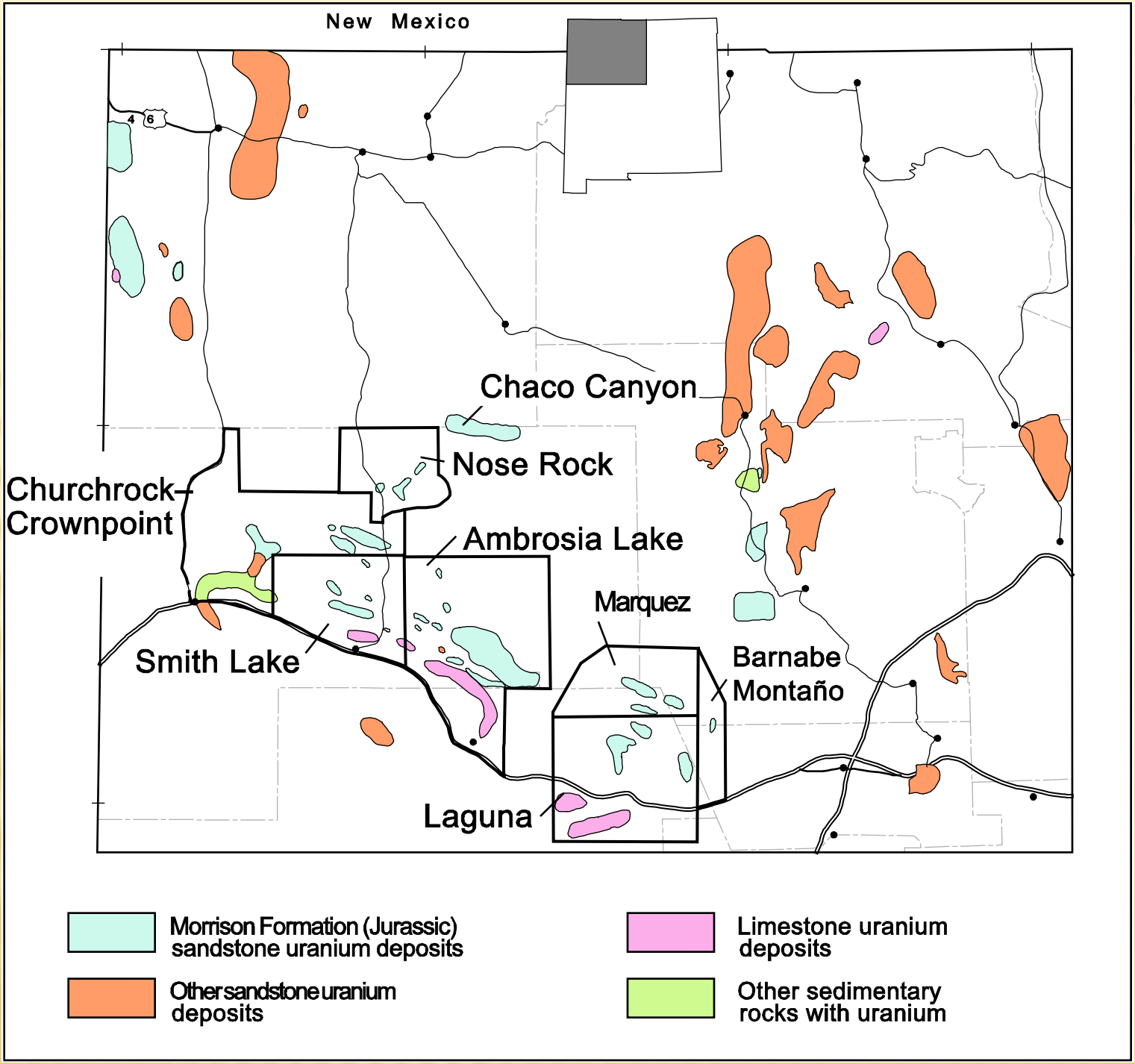
URANIUM

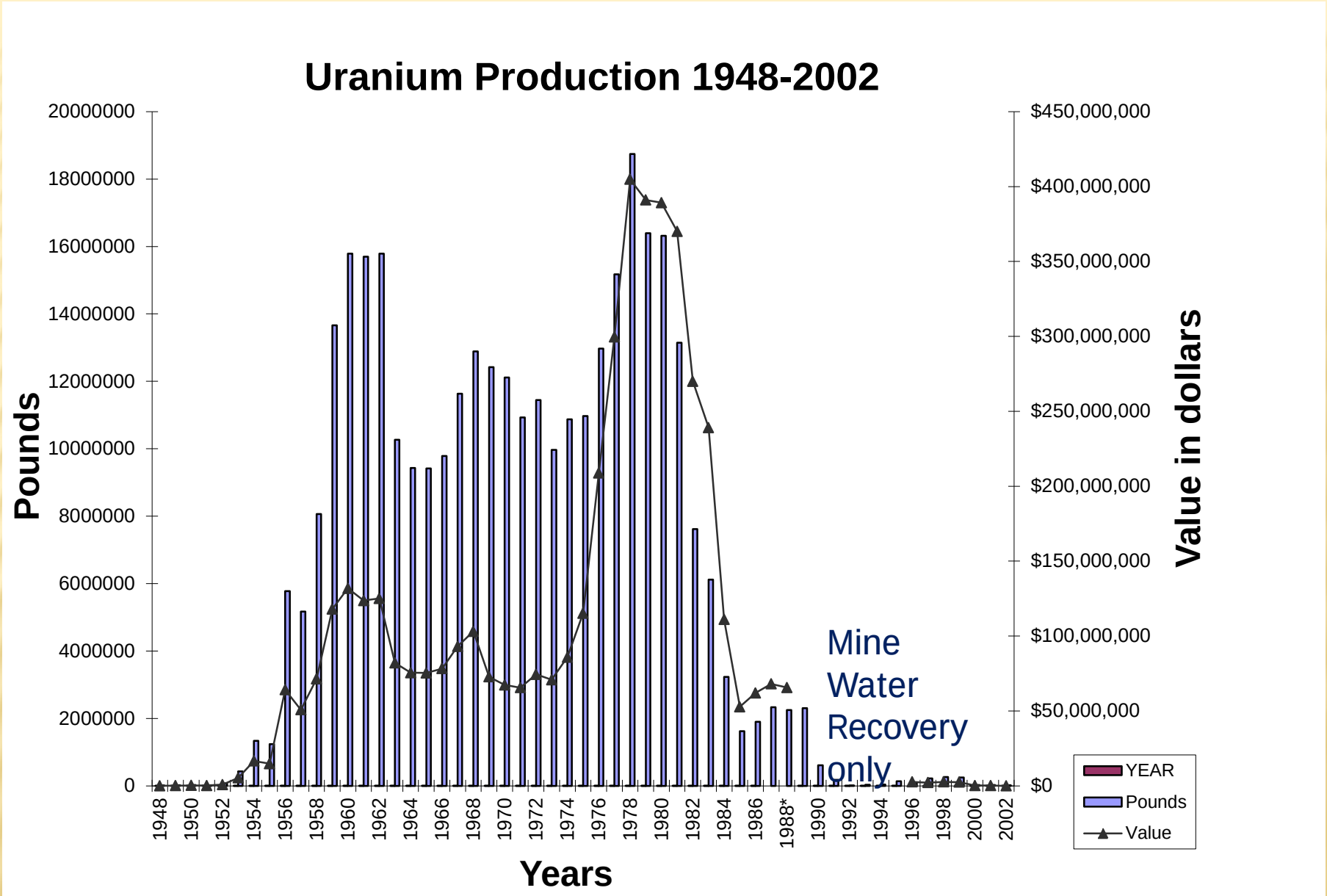
URANIUM IN NEW MEXICO 2015

- 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 IN GRANTS DISTRICT

- World-class deposits
- 340 million lbs of U_3O_8 from 1948-2002 produced
- 4th largest district in total uranium production in the world
- More than 30% of the total uranium production in the United States
- ~380 million pounds of resources identified by the companies in 1980s (McLemore, 2007, 2013)
- Probably another 300 million lbs of U_3O_8 remaining to be discovered
- District total of 600-900 million lbs of U_3O_8


New Mexico
Chaco Canyon
Nose Rock
Churchrock
Crownpoint
Ambrosia Lake
Marquez
Smith Lake
Barnabe
Montaño
Laguna
Morrison Formation (Jurassic) sandstone uranium deposits
Other sandstone uranium deposits
Limestone uranium deposits
Other sedimentary rocks with uranium



1948-2002 >347 MILLION POUNDS U WORTH >$4.7 BILLION

MOUNT TAYLOR HEAD FRAME, 2006


6
3

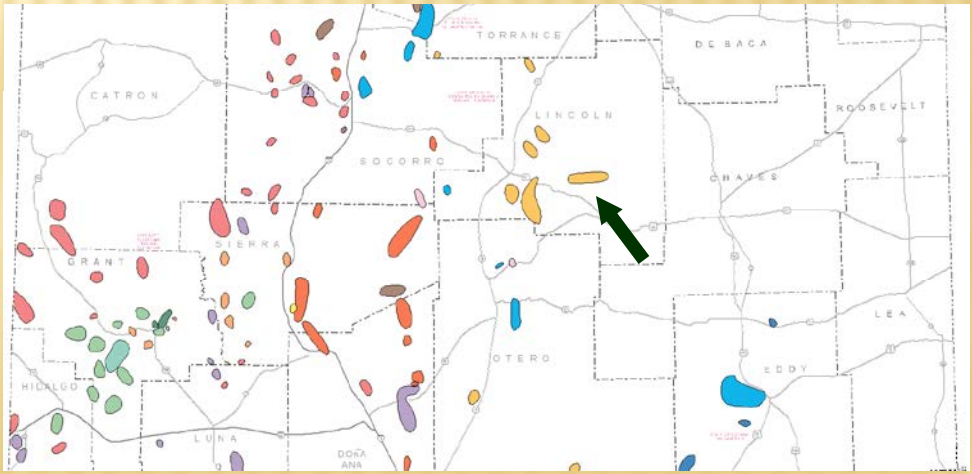
Importance of sandstone uranium deposits in the Grants district

- Major mining companies abandoned the districts after the last cycle leaving advanced uranium projects.
- Inexpensive property acquisition costs includes $$ millions of exploration and development expenditures.
- Availability of data and technical expertise.
- Recent advances in in situ leaching makes sandstone uranium deposits attractive economically.

OTHER POTENTIAL COMMODITIES

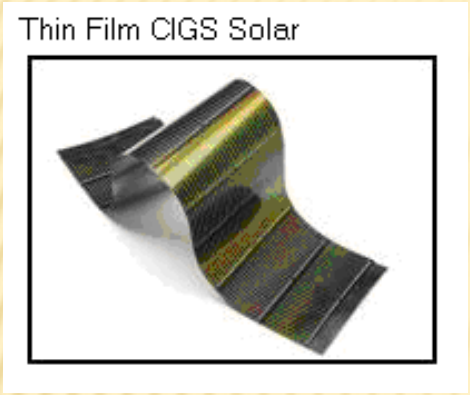
IRON ORE FROM THE CAPITAN MTS

- Produced 250,000 mill tons Fe ore 1963-1988
- El Capitan Precious Metals Corp. claims a resource of 141,000 tons ore of 0.041 opt Au
- Drilling permit approved by MMD 11/26/07, but rejected by the USFS requesting additional work

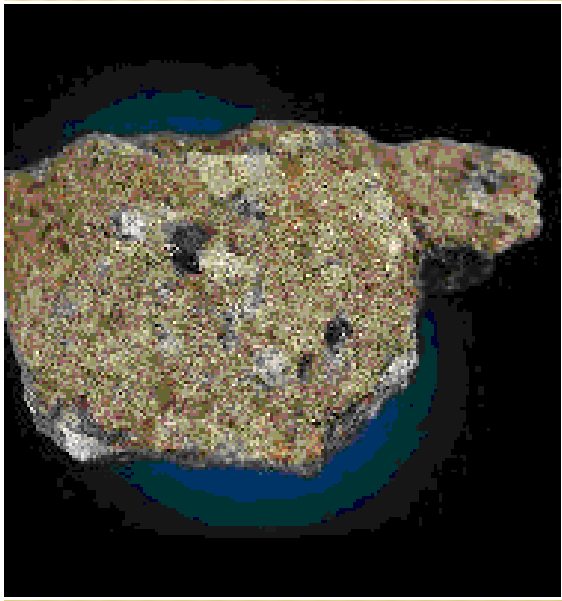


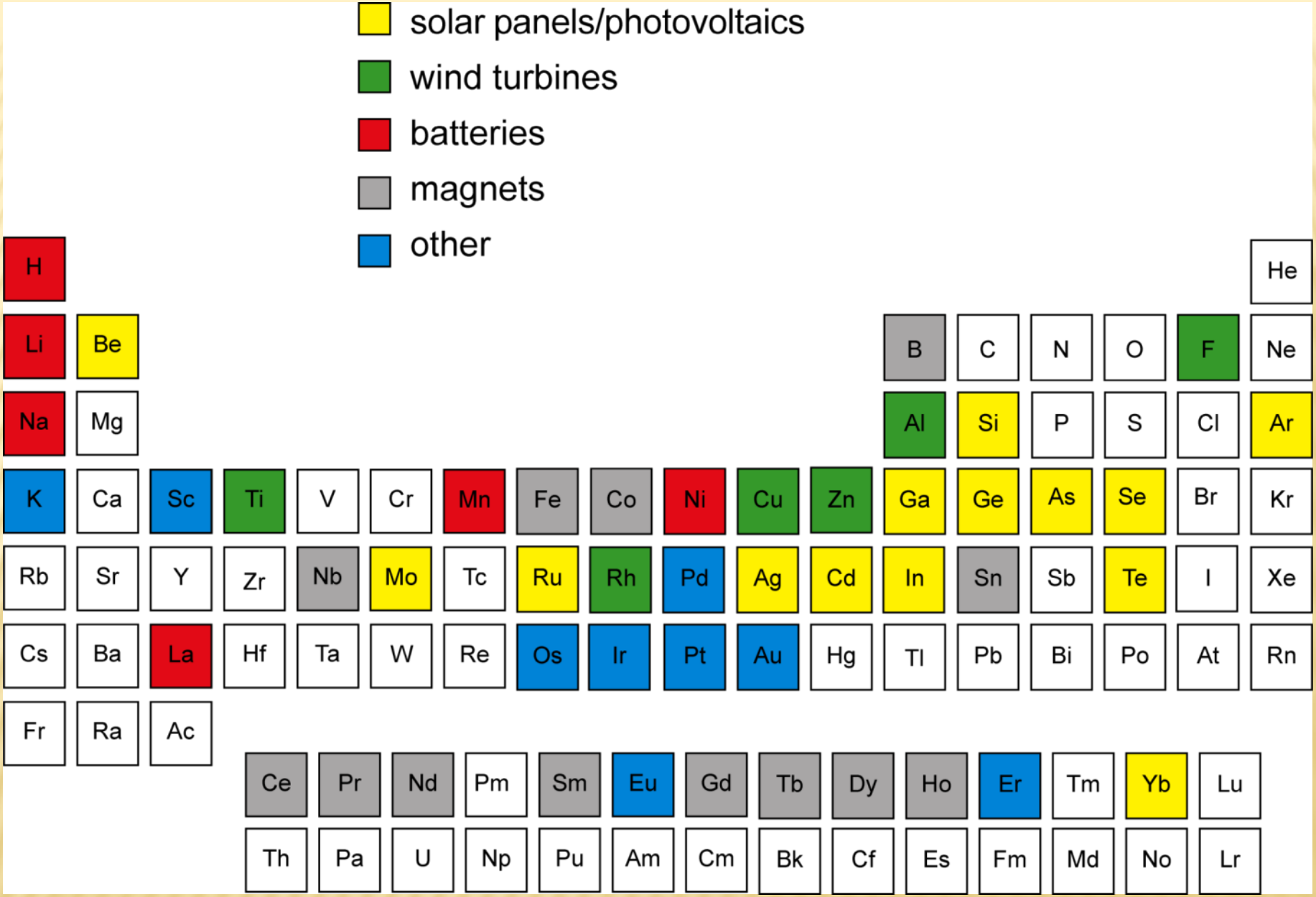
KLINE MOUNTAIN KAOLIN DEPOSIT

MINERALS NEEDED FOR EMERGING GREEN TECHNOLOGIES



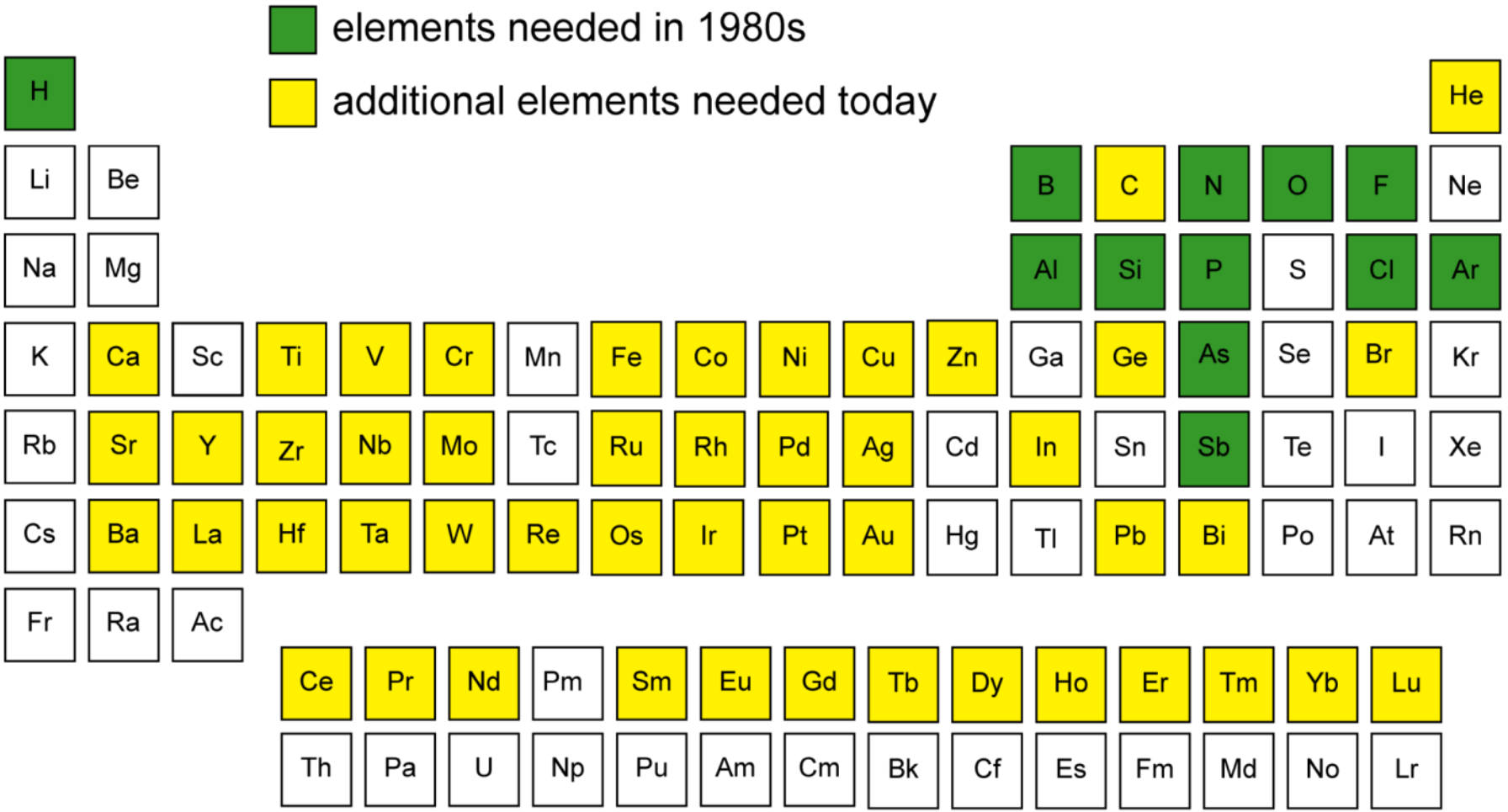
beryllium tuff (USGS OF 98-524)

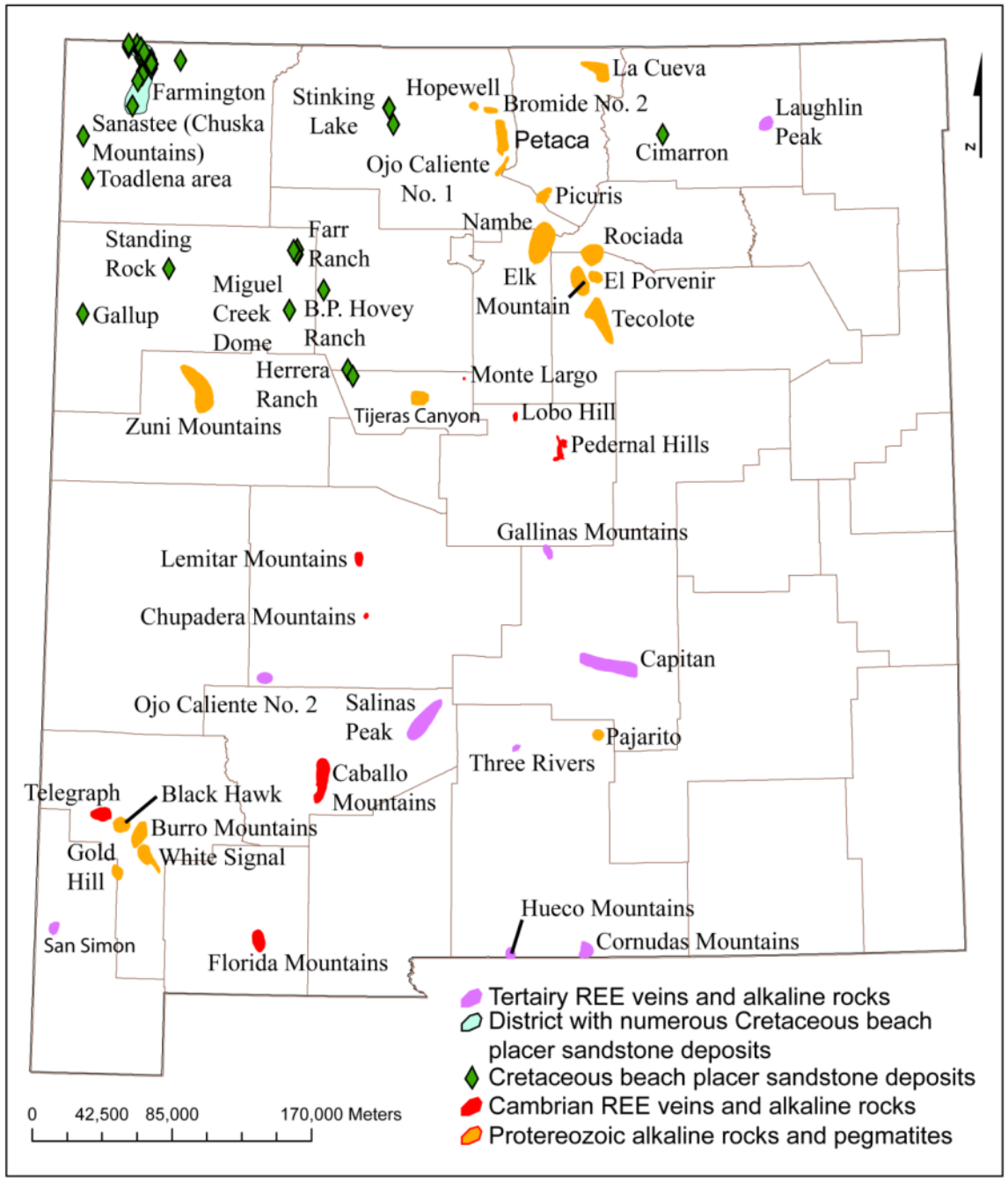




SOME OF THE MINERALS REQUIRED FOR THESE GREEN TECHNOLOGIES ARE FOUND IN NEW MEXICO

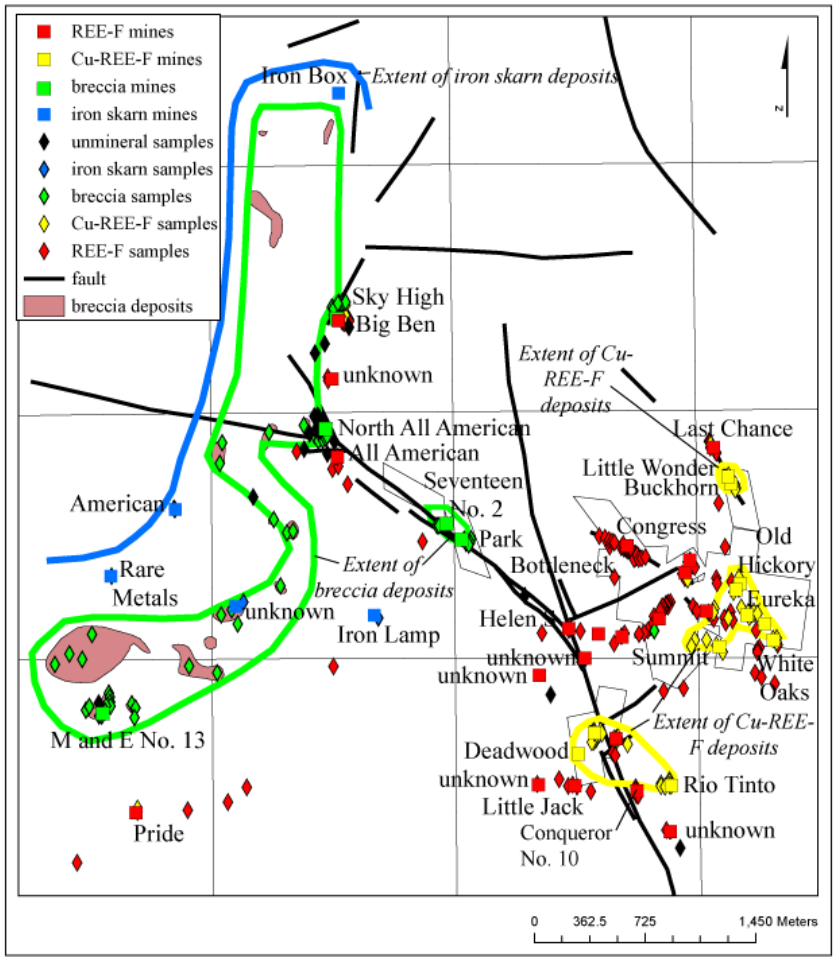
Elements in Computer Chips (National Research Council, 2007)

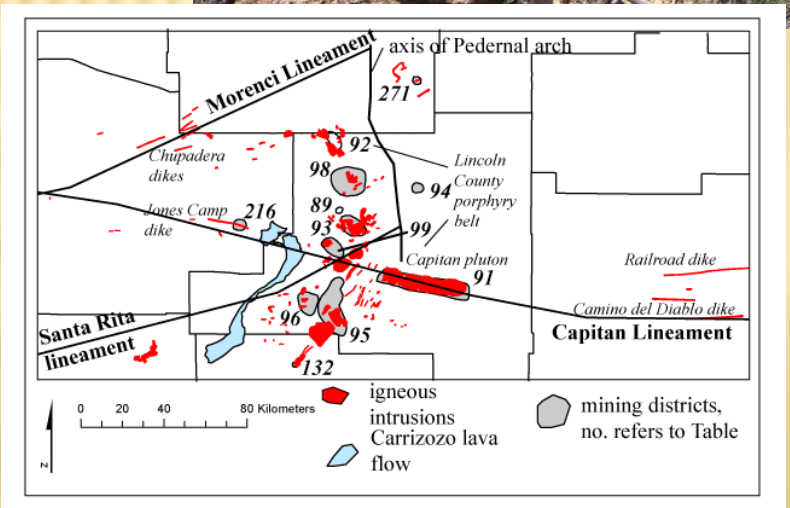




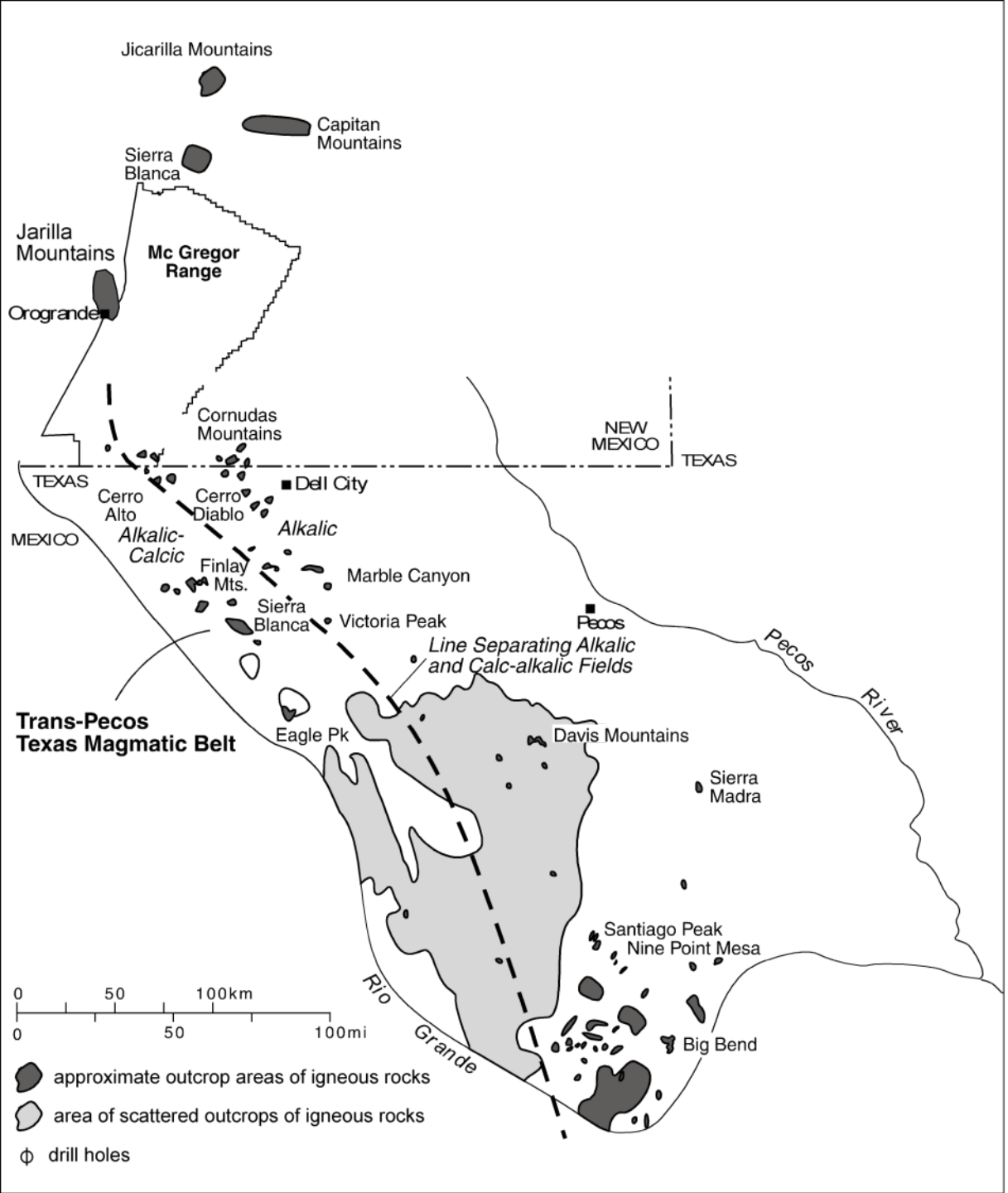
OCCURRENCES OF RARE EARTH ELEMENTS (REE) IN NEW MEXICO

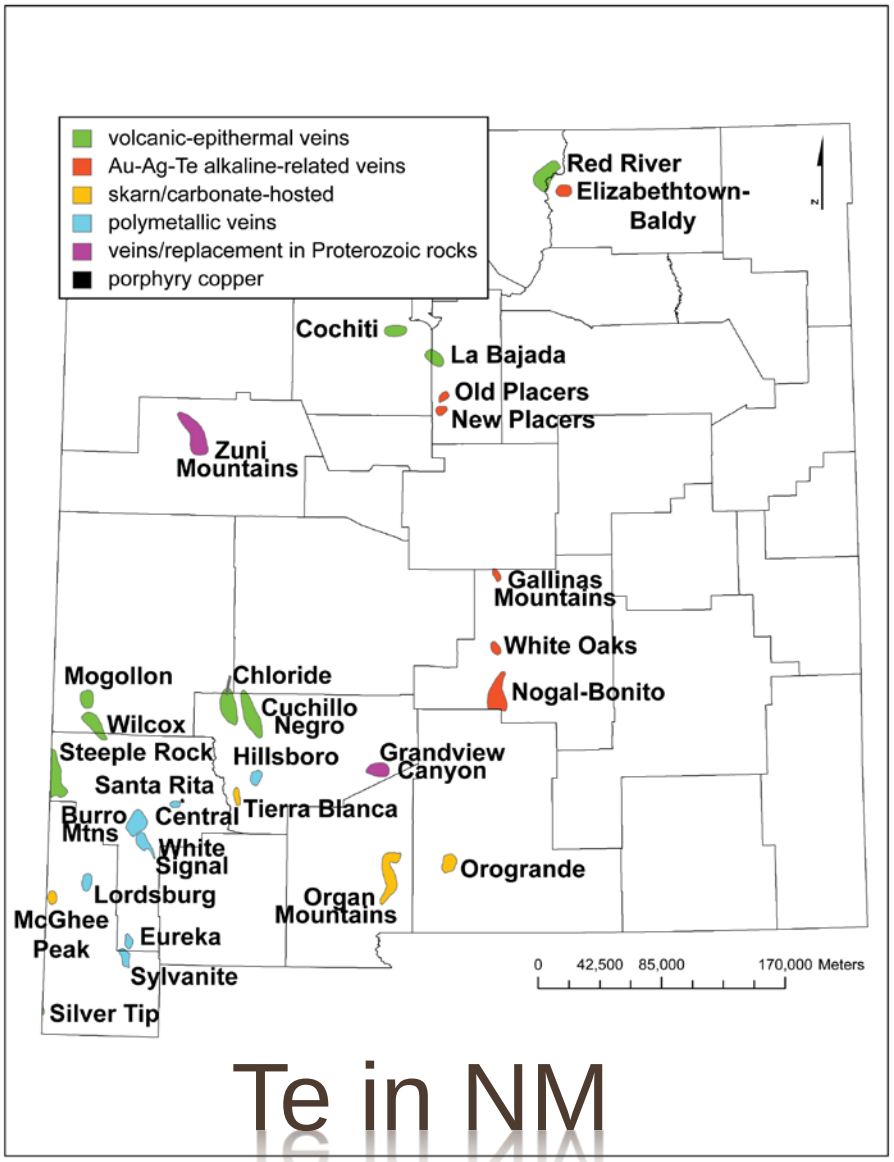
REE in Gallinas Mountains, Lincoln County



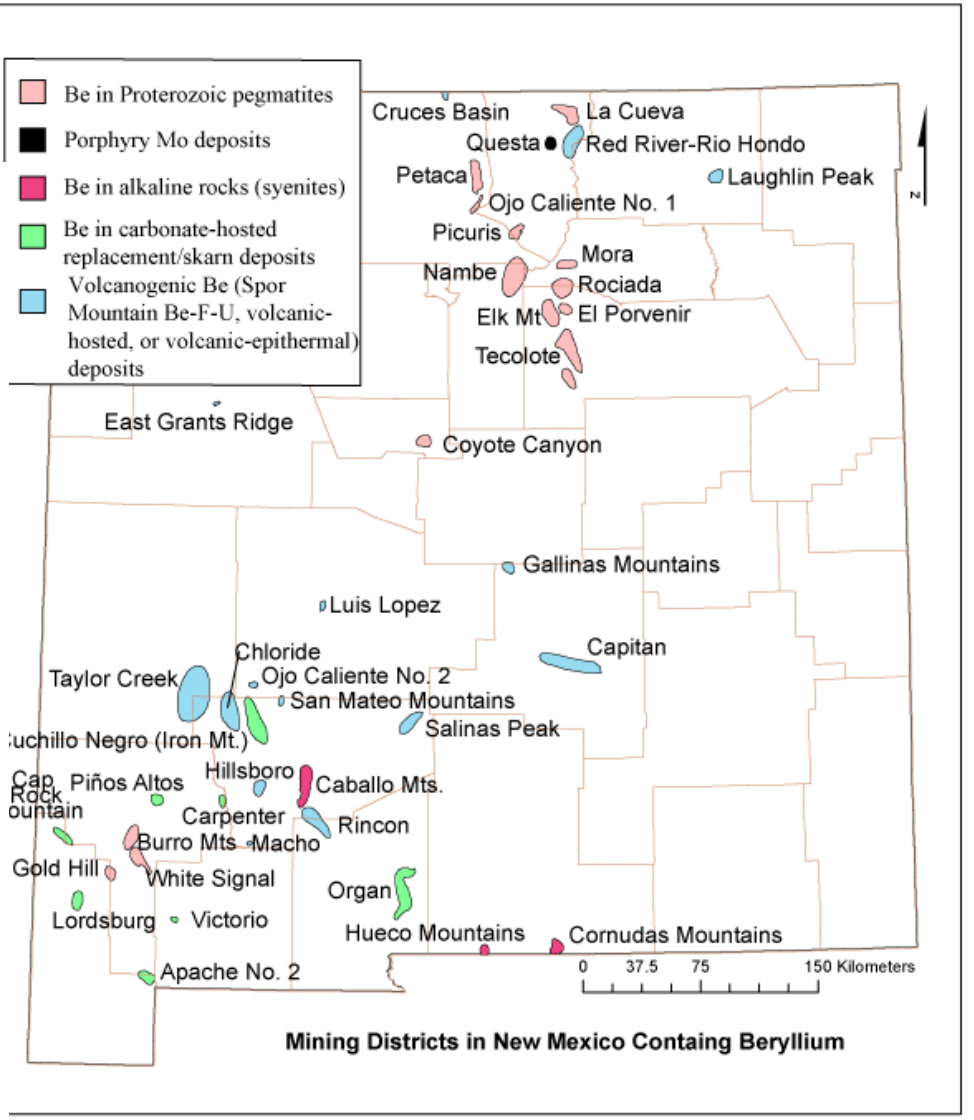


REE IN CORNUDAS MOUNTAINS, OTERO MESA





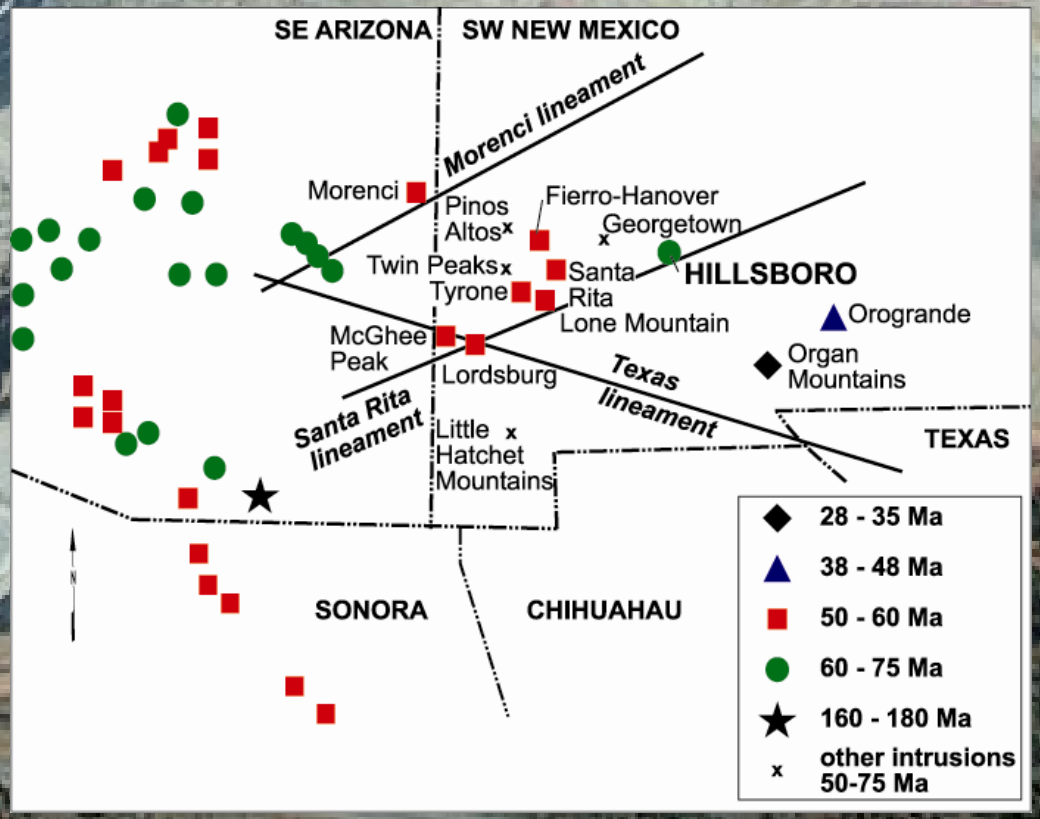
Te in NM



Be in NM

Porphyry copper deposits

- Current
  - Gold
  - Silver
  - Molybdenum
- Possible
  - Tellurium
  - Gallium
  - Germanium
  - Indium
  - Others



OTHER POTENTIAL COMMODITIES

- Nepheline syenite from Wind Mt, Cornudas Mts (200,000,000 tons)
- Garnet from Grant County, San Pedro, Orogrande
- Iron ore from Orogrande
- Titanium (Fe, REE, Th, Y, Zr) from Cretaceous black sandstone deposits in San Juan Basin
- Kaolin, tin in Taylor Creek
- Au, Ag Steeple Rock, Malone, Burro Mountains

WHAT ARE THE MINING ISSUES FACING NEW MEXICO?

Gold King adit

Animas River after Gold king spill

WHAT ARE THE MINING ISSUES FACING NEW MEXICO?

- Legacy issues of past mining activities form negative public perceptions of mining
- Many inactive mines that have the potential to contaminate the environment or present a hazard to health and safety
  - Gold King spill
- Mining today is not performed in the same manner as 20 years ago

WHAT ARE THE MINING ISSUES FACING NEW MEXICO?

- NMBGMR with other universities and state agencies are cooperating and forming a monitoring program of the Animas River watershed and the potential effects to New Mexico
- 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

WHAT ARE THE 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

SUMMARY

SUMMARY

- Commodities are needed to maintain our standard of living, even for green technologies, like solar, wind
- Mineral deposits are controlled by geology
- New Mexico has a wealth of mineral resources

SUMMARY

- Exploration and permitting takes many years before a deposit can be mined
- Mining is important to rural New Mexico (create wealth)
- Mining disturbs the ground—there can be risks
- Legacy issues are being addressed
- Boom or bust—cyclic industry

WE HAVE MOVED INTO OUR NEW BUILDING ON CAMPUS! COME AND VISIT!


MINERAL
MUSEUM
AM8:20 SEP.9.2015

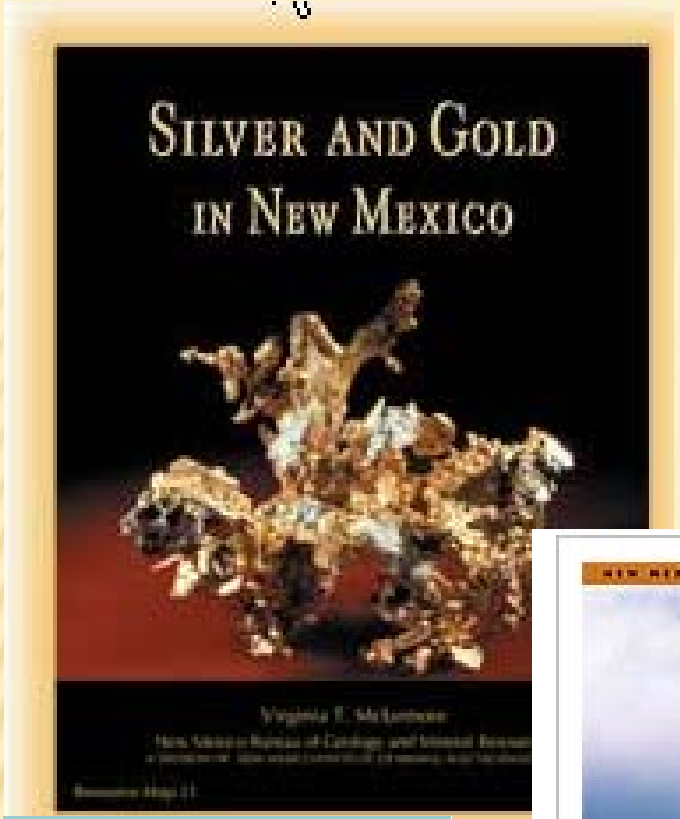
MORE INFORMATION

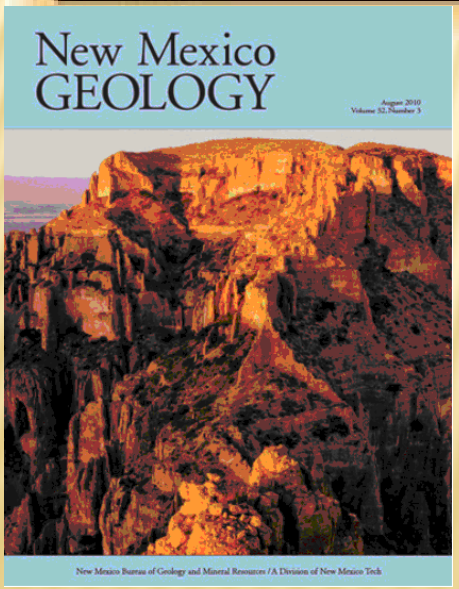
- Mines and Minerals Division

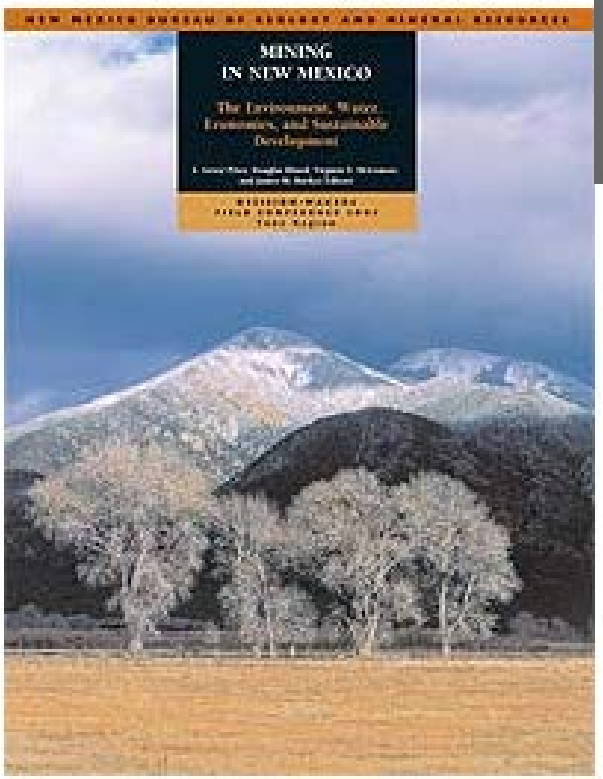
  http://www.emnrd.state.nm.us/MMD/index.htm
- Virginia McLemore web page

  http://geoinfo.nmt.edu/staff/mclemore/home.html
- New Mexico Bureau of Geology and Mineral Resources

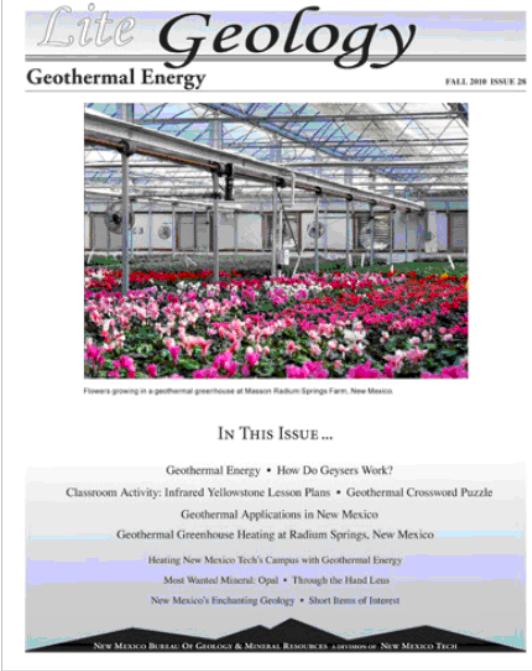
  http://geoinfo.nmt.edu/

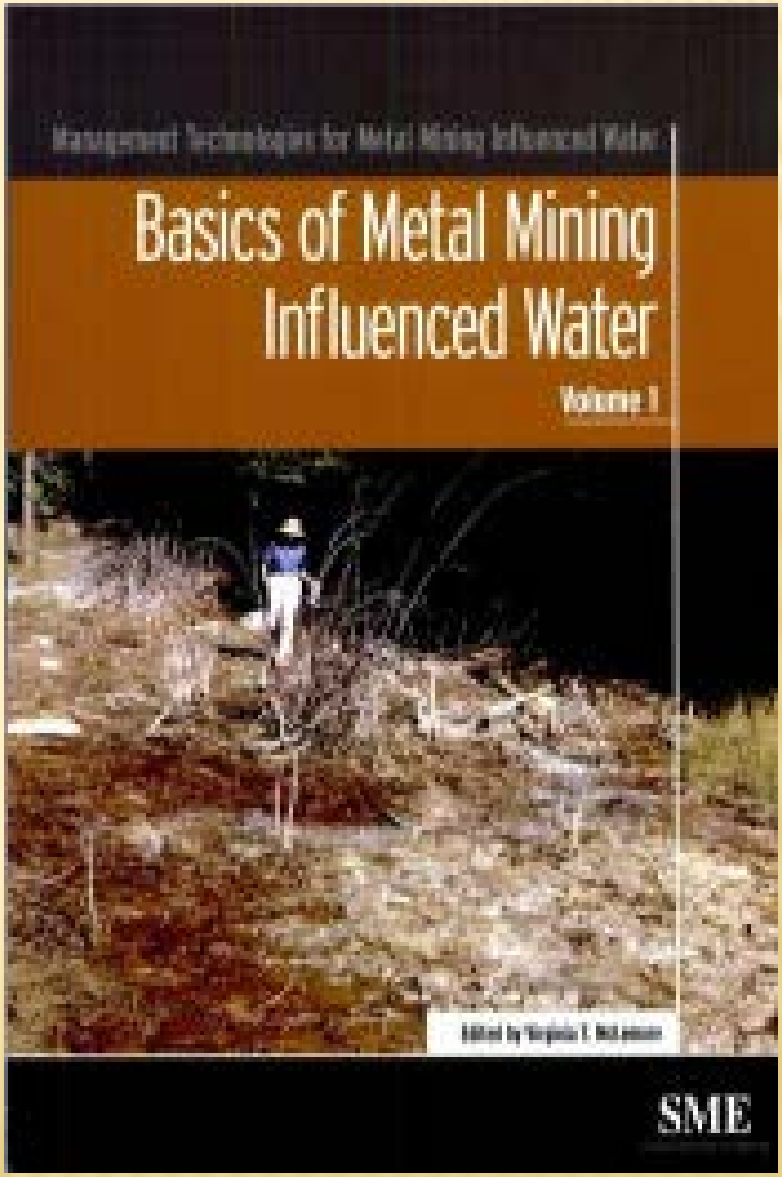






2005 guidebook cover





http://www.smenet.org/publications/