IS THERE FUTURE MINING POTENTIAL IN NEW MEXICO–2015?

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New Mexico Tech

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

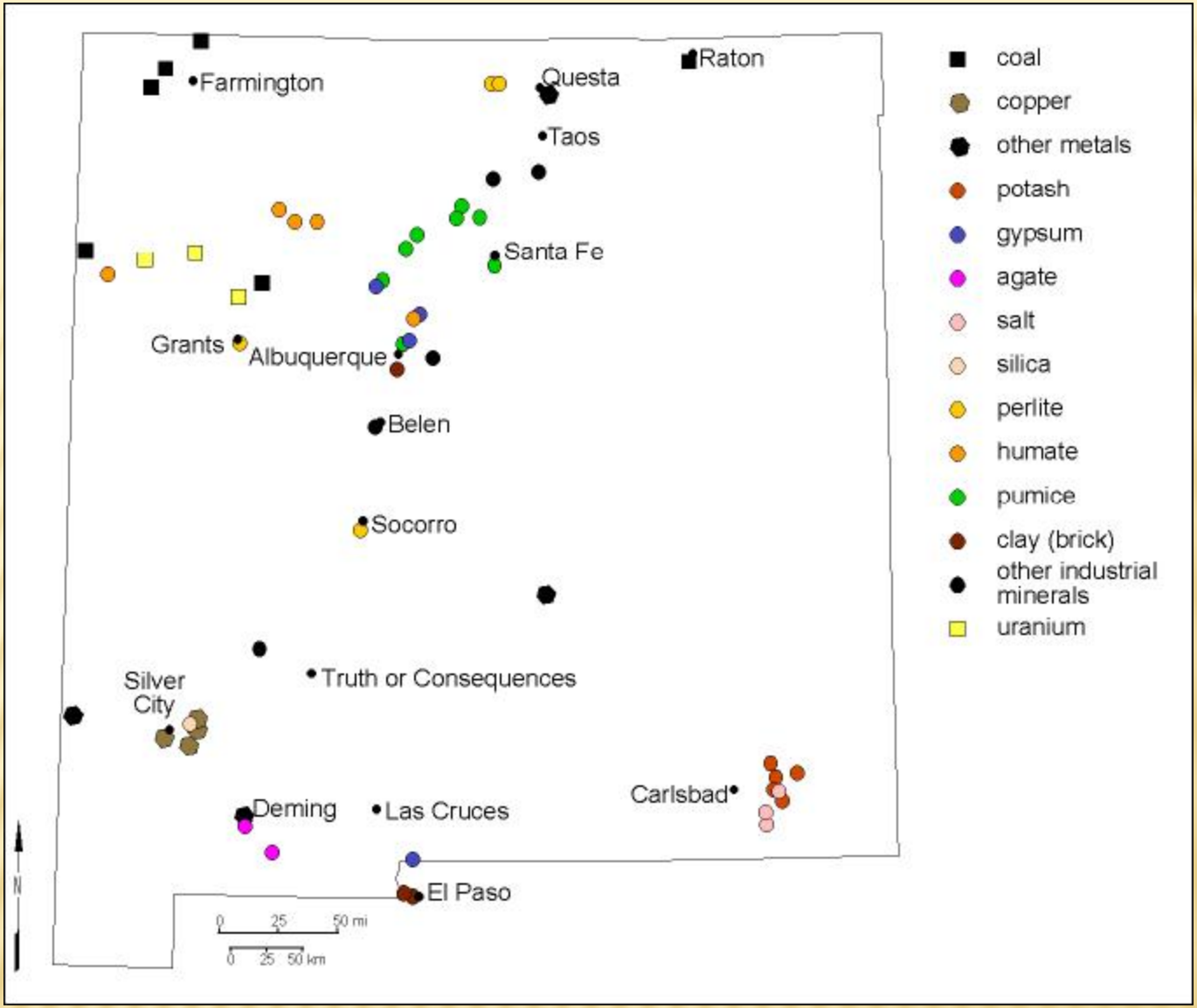
OUTLINE

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

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

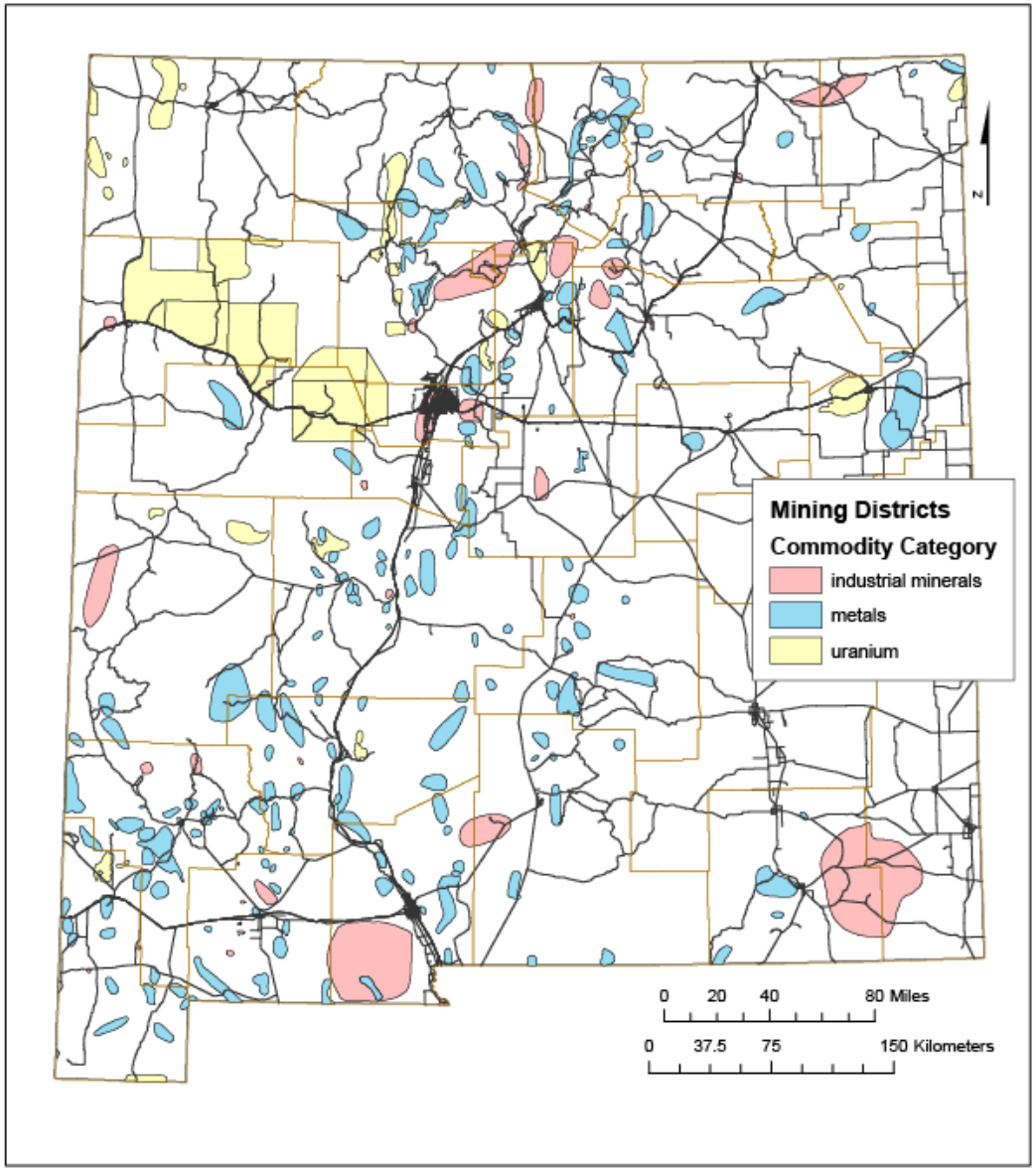


ACTIVE MINES AND EXPLORATION IN NEW MEXICO 2000-2015 (EXCLUDING AGGREGATES)

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

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

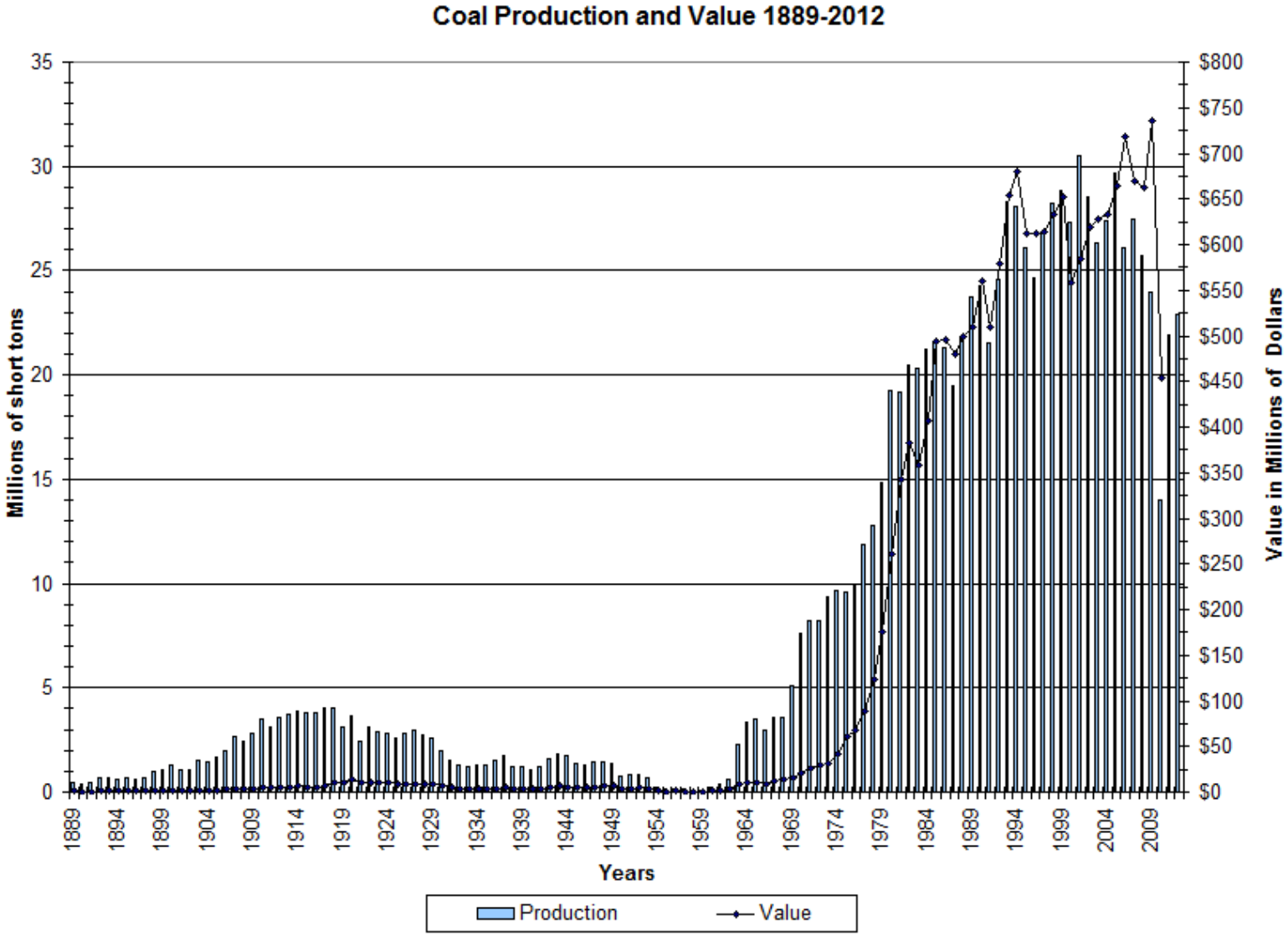
ESTIMATED TOTAL PRODUCTION OF MAJOR COMMODITIES IN NEW MEXICO

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

COAL

COAL

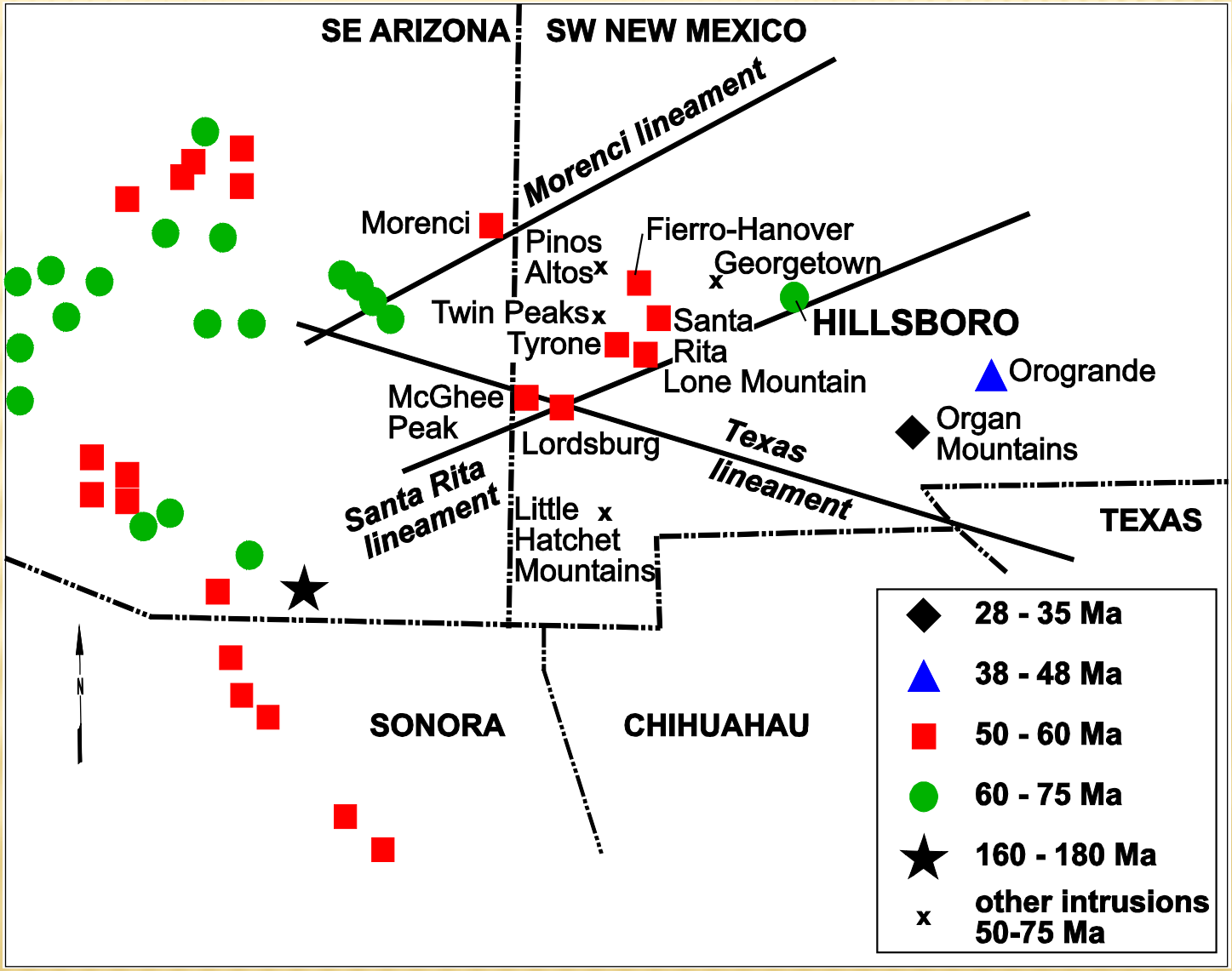
- Fuels electrical generating plants
- 4 surface mines and 1 underground mine in San Juan Basin
- Resources at Raton, Carrizozo
- 12th in production in U.S. in 2013
- 11th in estimated recoverable coal reserves—7 billion tons of recoverable reserves (2005 figures)
- **Coal production is expected to decrease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



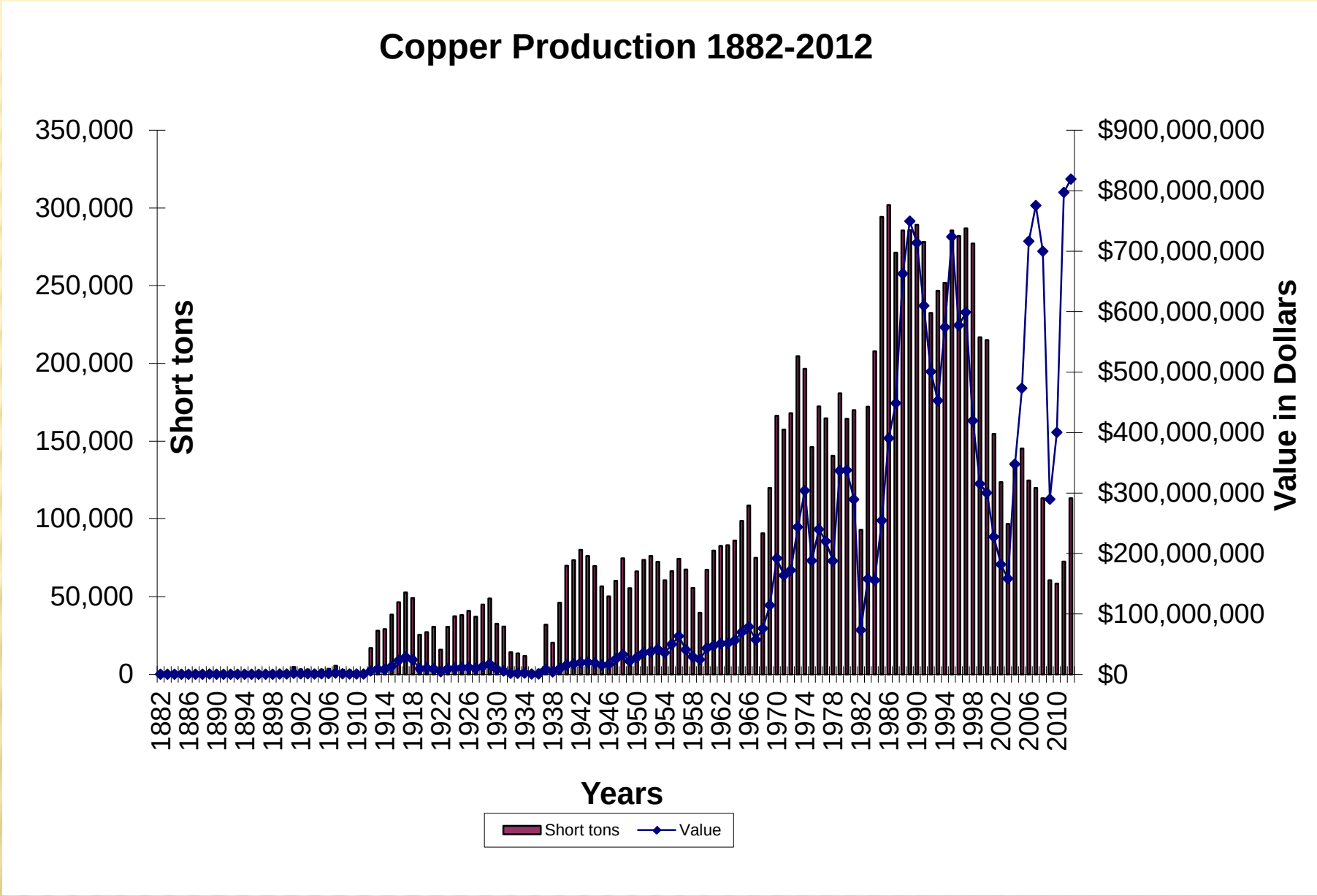
1882-2013 >1.06 BILLION SHORT TONS COAL WORTH >$20.75 BILLION

METALS

COPPER


SE ARIZONA
SW NEW MEXICO
Morenci lineament
Morenci
Pinos Altos
Fierro-Hanover
Georgetown
Twin Peaks
Tyrone
Santa Rita
HILLSBORO
Lone Mountain
Orogrande
McGhee Peak
Lordsburg
Organ Mountains
Texas lineament
Santa Rita lineament
Little Hatchet Mountains
TEXAS
N
SONORA
CHIHUAHAU
28 - 35 Ma
38 - 48 Ma
50 - 60 Ma
60 - 75 Ma
160 - 180 Ma
other intrusions 50-75 Ma

3RD IN COPPER IN 2013 (CHINO, TYRONE)



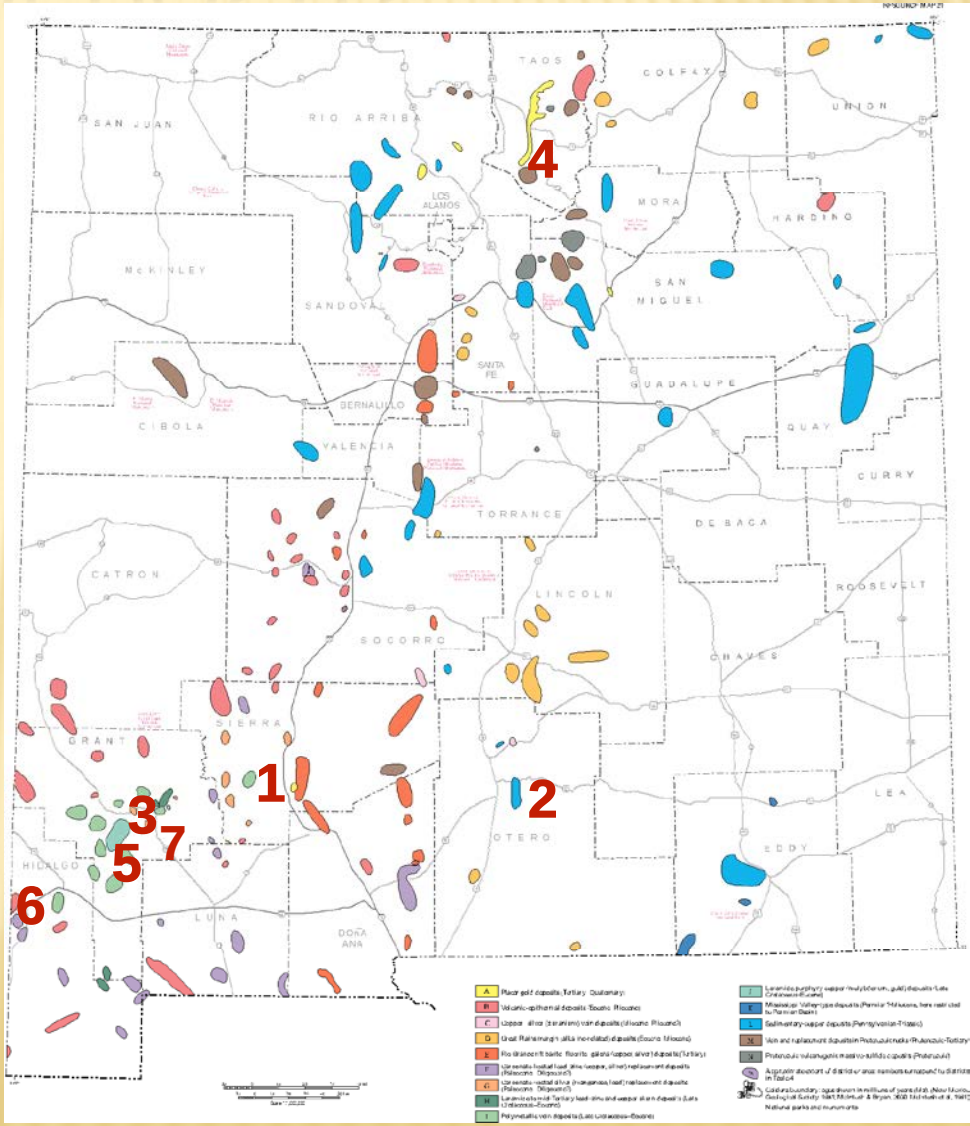
1804-2013 >11.2 MILLION SHORT TONS CU WORTH >$19.6 BILLION

COPPER RESERVES—2013

- Chino
  - milling reserves are 231 million tonnes of 0.3% copper, 0.03 g/t gold and 0.013% molybdenum
  - leaching reserves are 145 million tonnes of 0.61% Cu
- Tyrone
  - leaching reserves are estimated as 69 million tonnes of ore grading 0.34% Cu
- Cobre
  - leaching reserves are 73 million tons of 0.39% Cu

POTENTIAL COPPER DEPOSITS

1. Copper Flat (43-101 reserves 113 million short tons at 0.3% Cu, 0.009% Mo, 0.096 g/t Au, and 1.93 g/ t Ag)
2. Orogrande
3. Hanover Mountain (historic resources 80 mill st at 0.38% Cu)
4. Copper Hill, Picuris district (historic resources 46.5 mill st of ore at 0.42% Cu)
5. Lone Mountain (historic resources 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

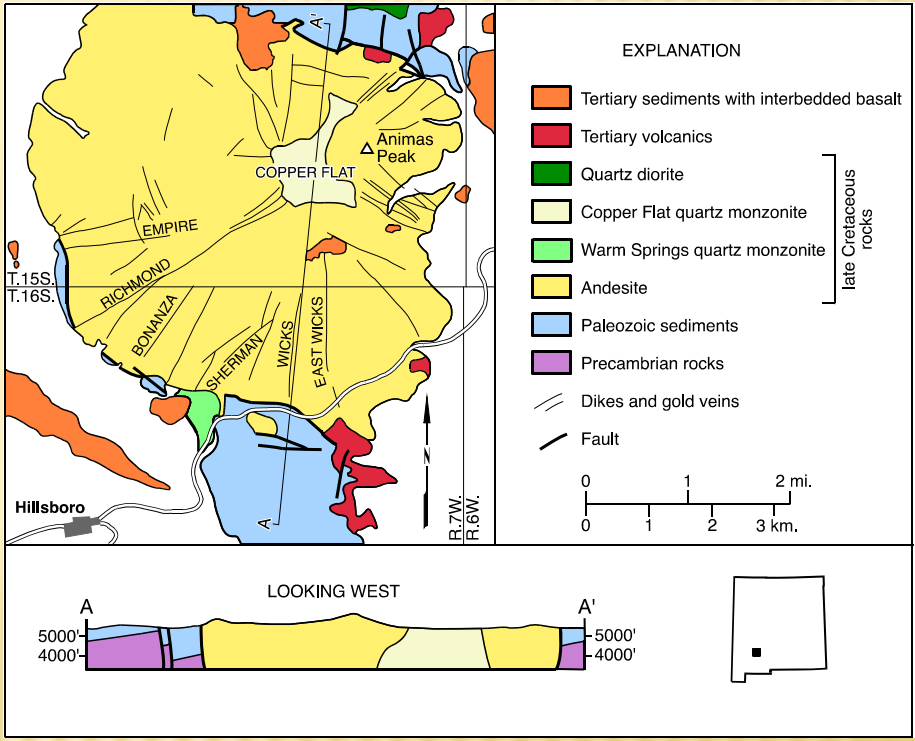
628 mill lbs Cu

15 mill lbs Mo

227,000 oz Au

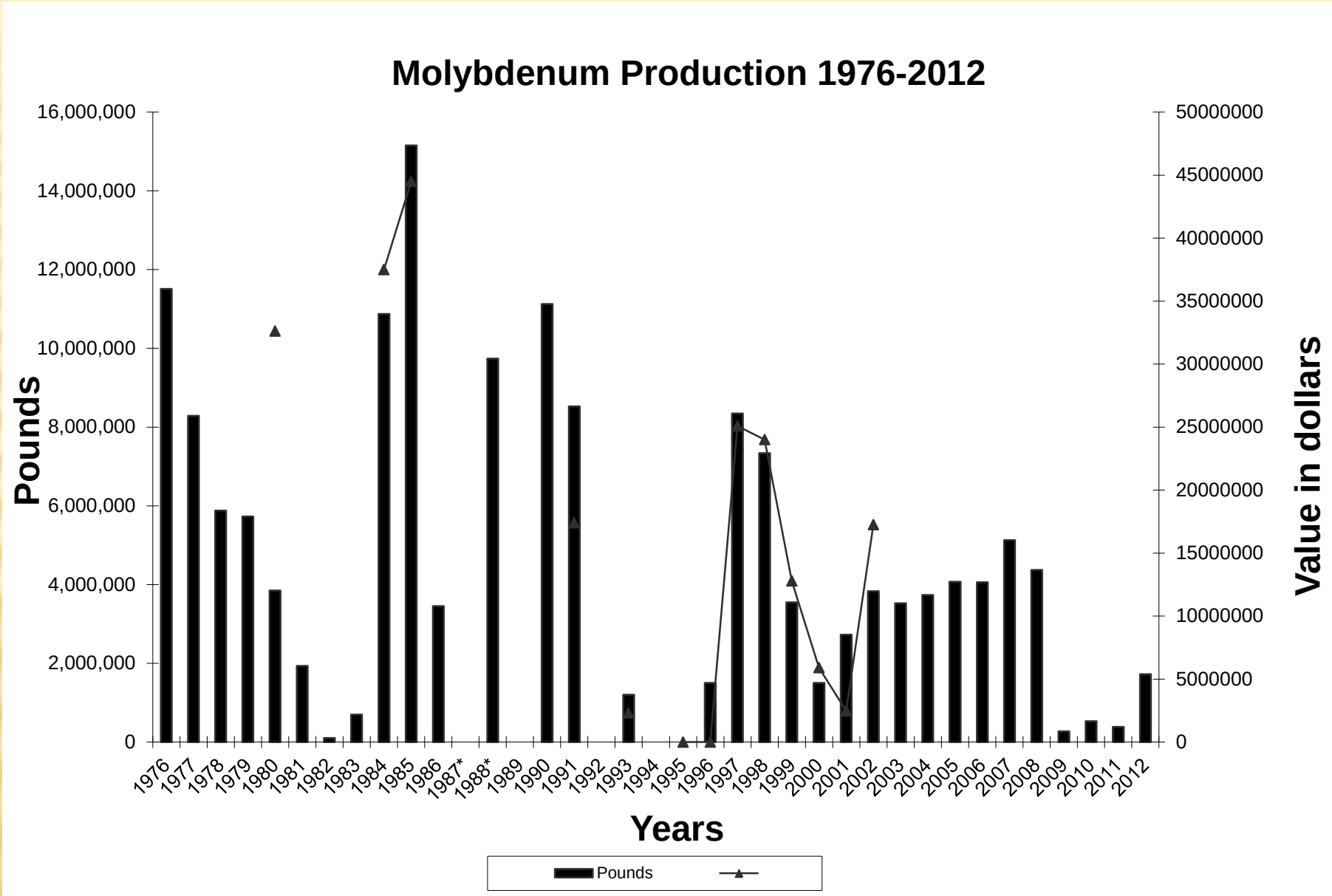
5,950,000 oz Ag

Start in 2018?



MOLYBDENUM

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

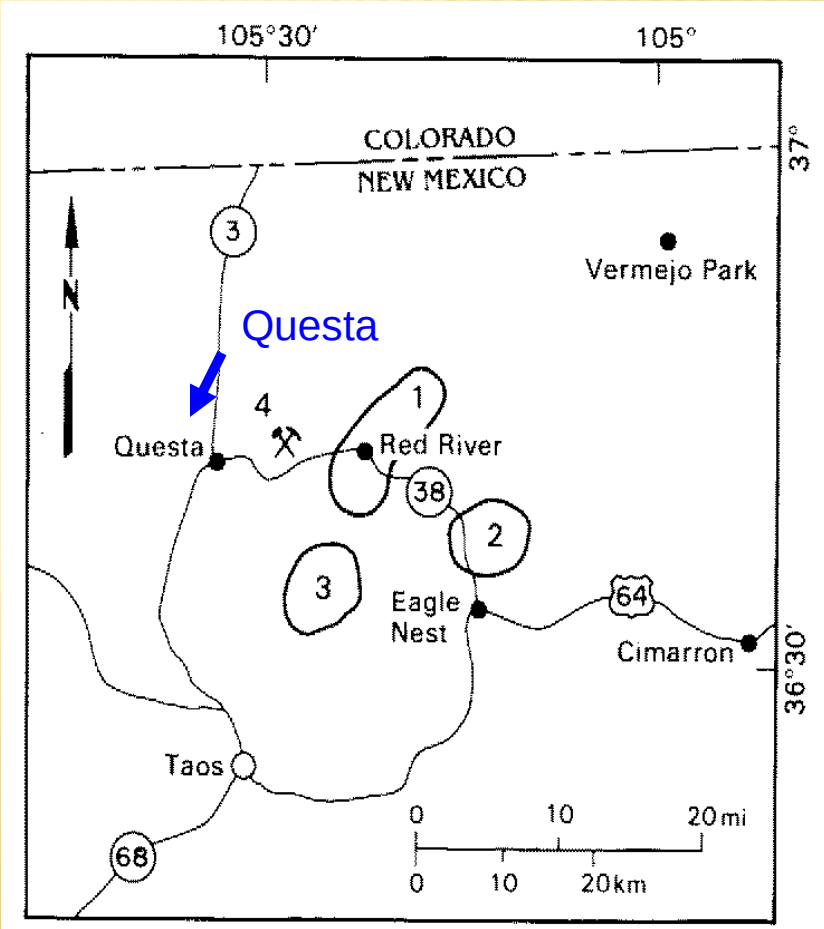
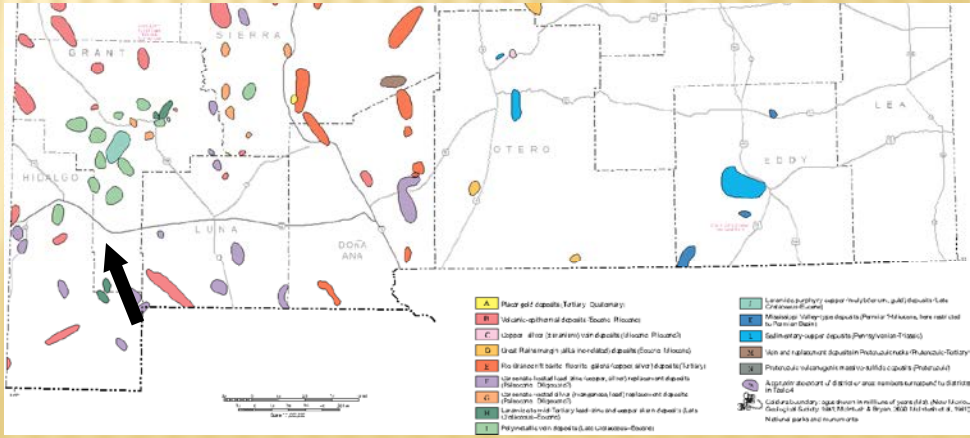


FIGURE 1. Location map of the Red River mining district. 1 = Red River district; 2 = Elizabethtown-Baldy district; 3 = Twining district; 4 = Molycorp Questa mine.

VICTORIO MOUNTAINS, LUNA COUNTY

- 21.5 million tons historic indicated ore at a grade of 0.15% Mo, 0.13% W
- Be also found in district

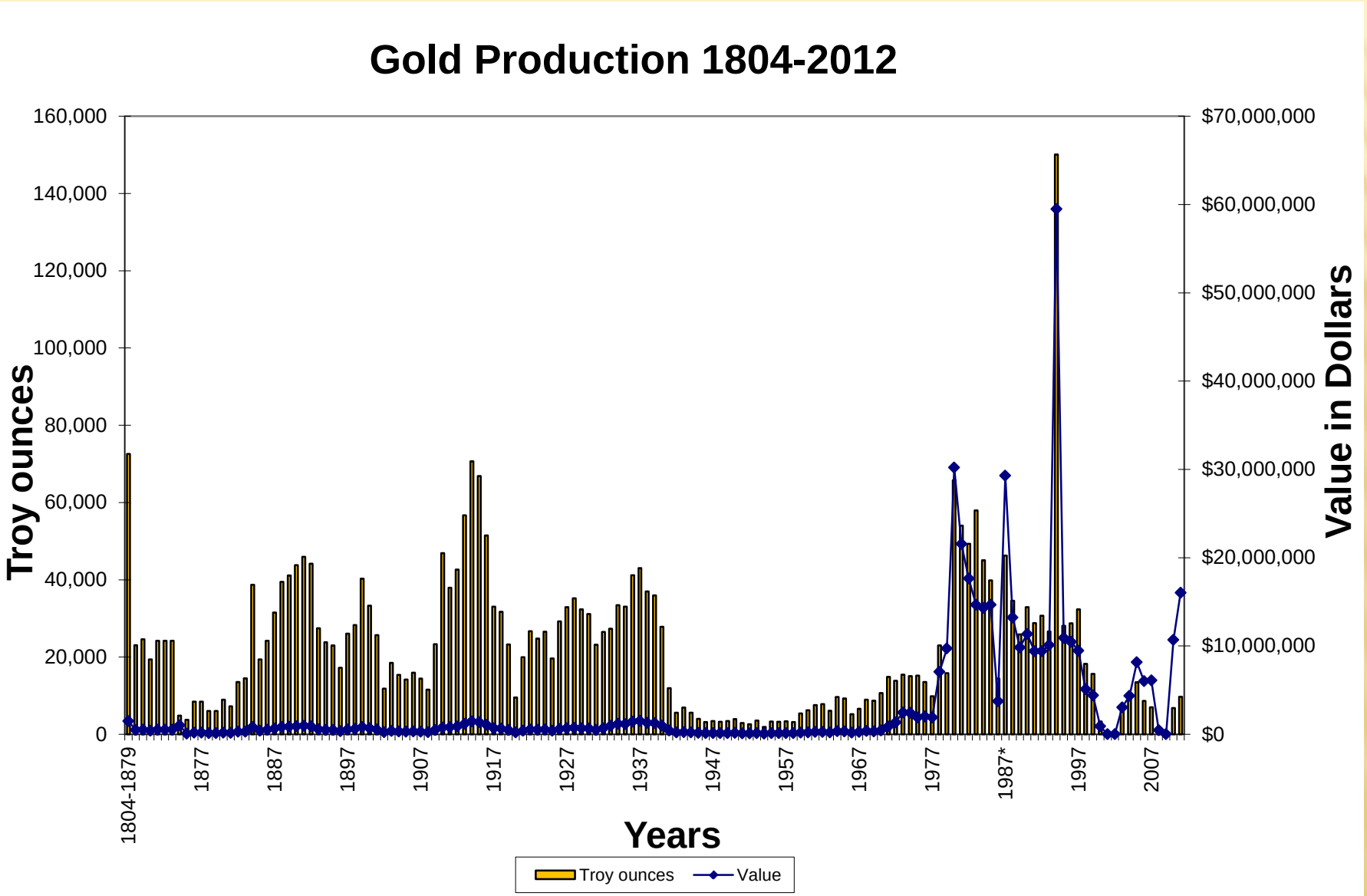


GOLD AND SILVER

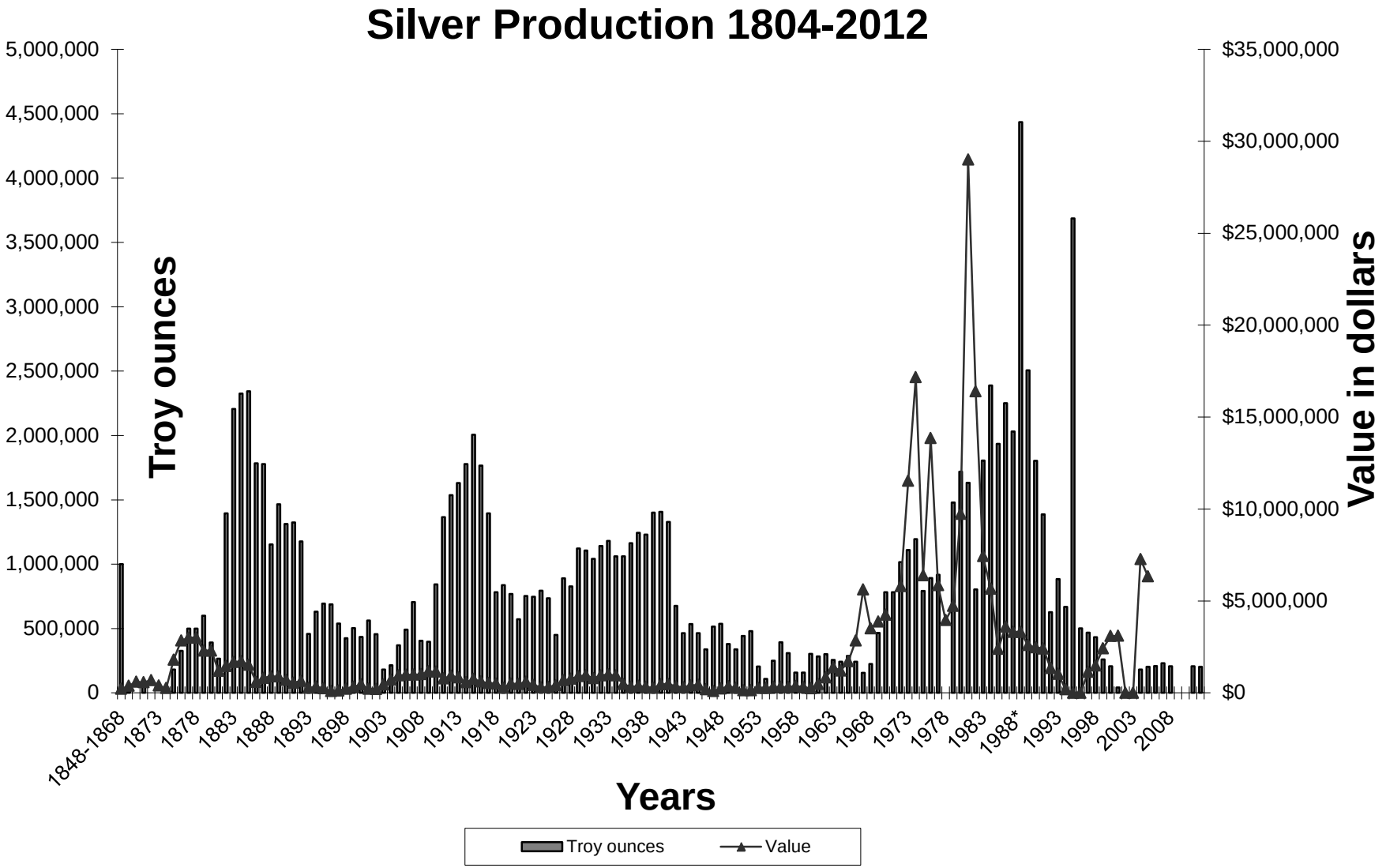
GOLD AND SILVER PRODUCTION IN 2004-2015 AS A BYPRODUCT OF COPPER PRODUCTION FROM THE IVANHOE CONCENTRATOR (FREEPORT-MCMORAN)

2009 SUMMIT MINE OPENED (CURRENTLY ON STANDBY)

9TH IN GOLD PRODUCTION
10TH IN SILVER PRODUCTION



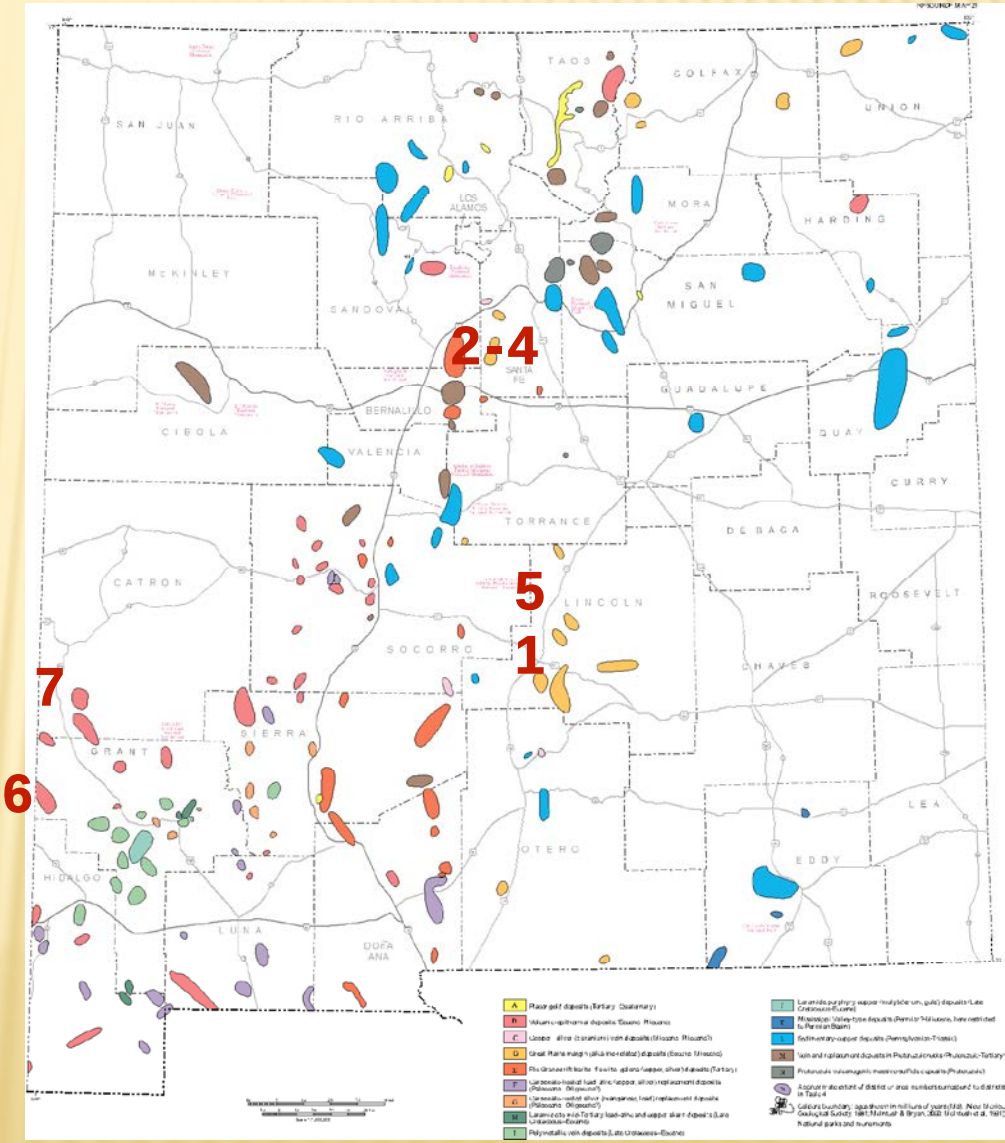
1804-2013 >3.2 MILLION TROY OUNCES AU WORTH >$452 MILLION



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



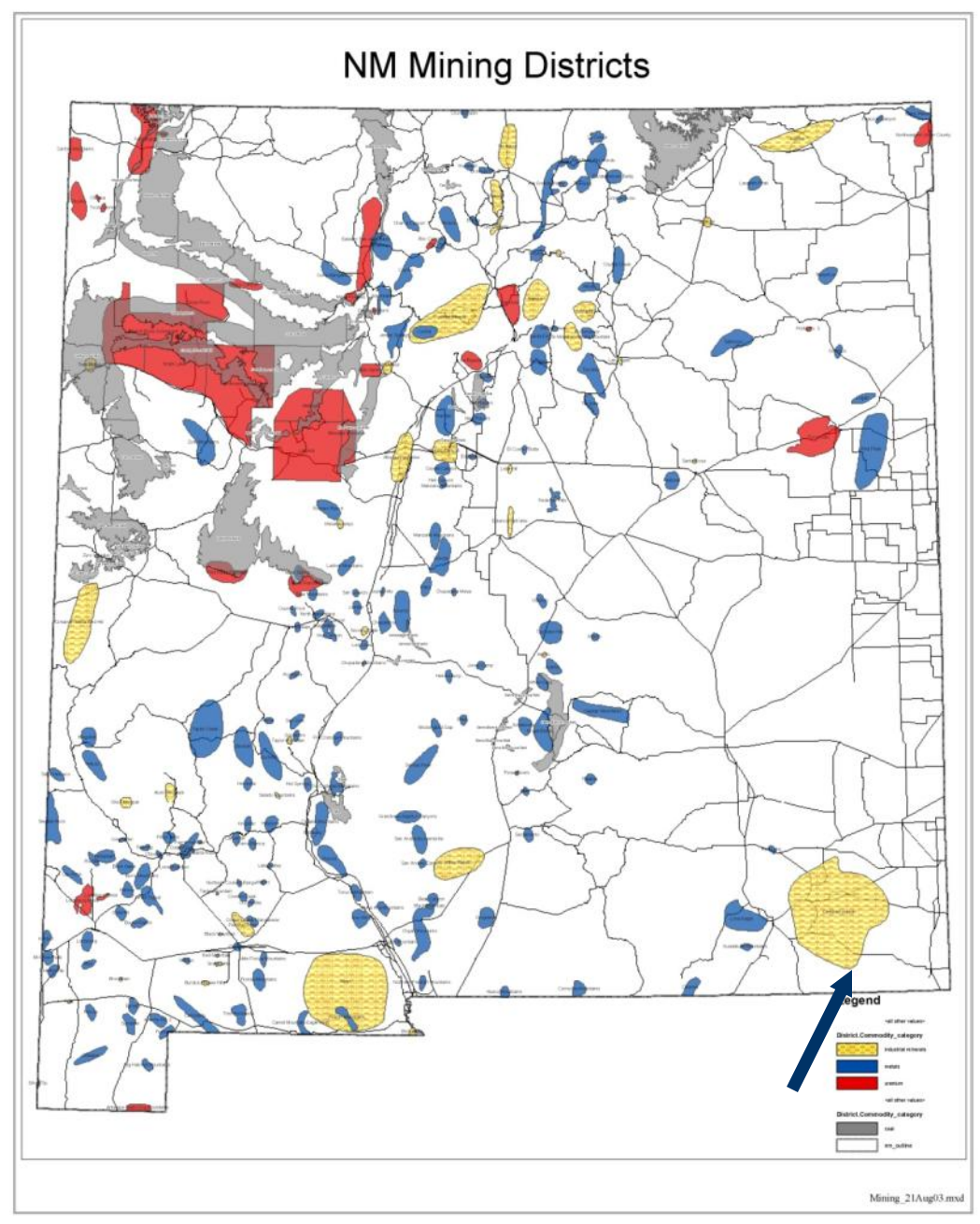
SUMMIT GOLD MINE

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

The ore is milled at Lordsburg

INDUSTRIAL MINERALS

POTASH



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

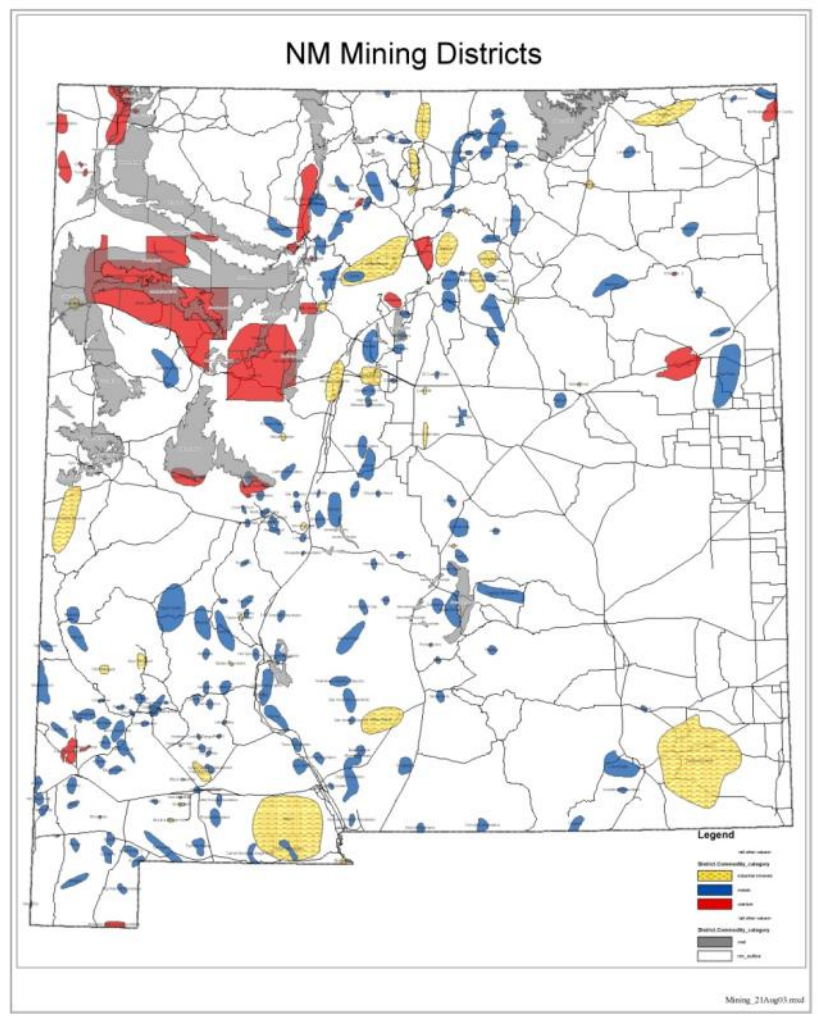
1ST IN POTASH IN 2013 (MOSAIC, INTREPID MINING)

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

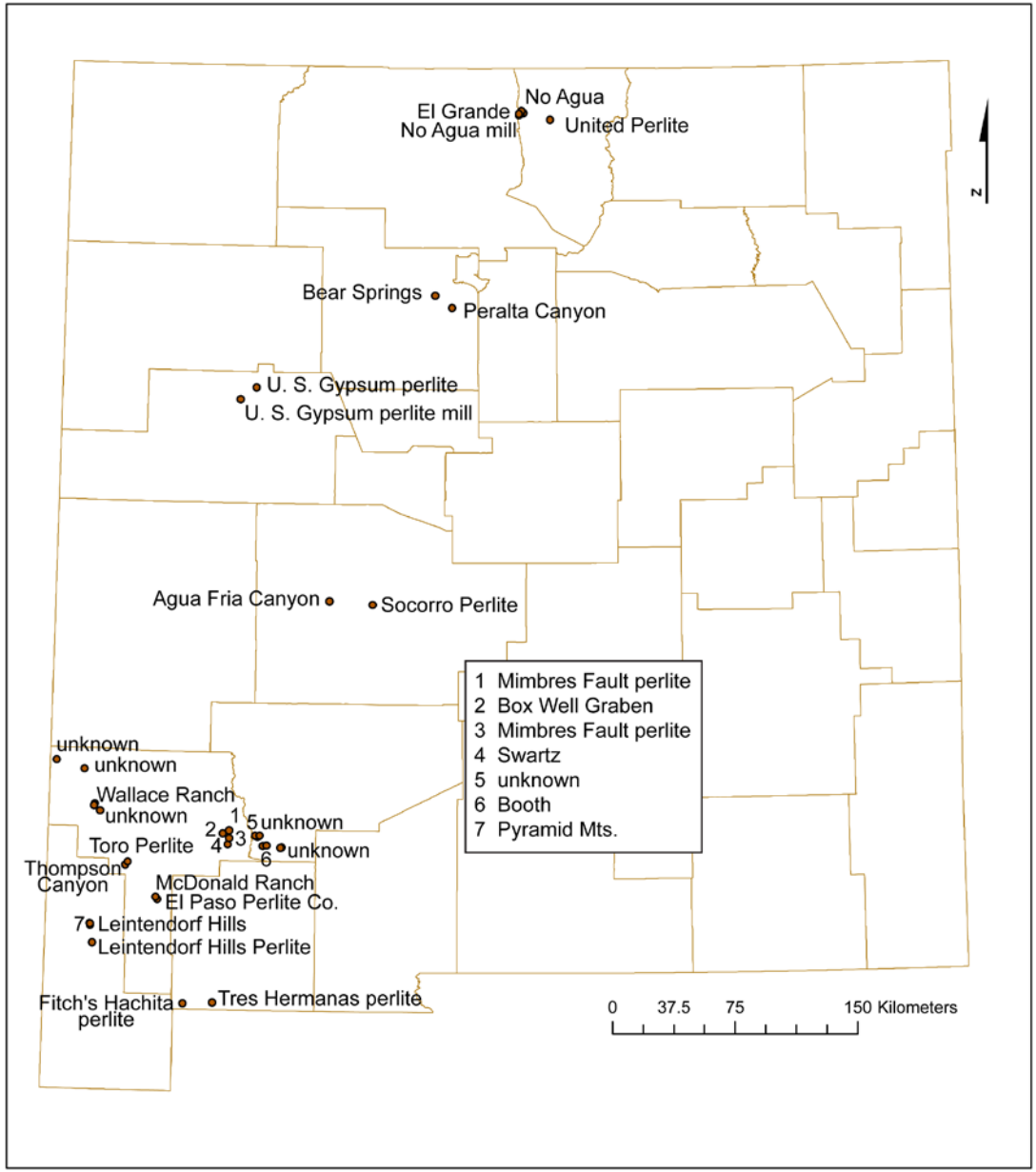


- 1st in zeolite (St. Cloud, Sierra County)
- 5th in pumice (6 operations)
- 1st in perlite (4 operations)
- 11th in salt (4 operations, Carlsbad)

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

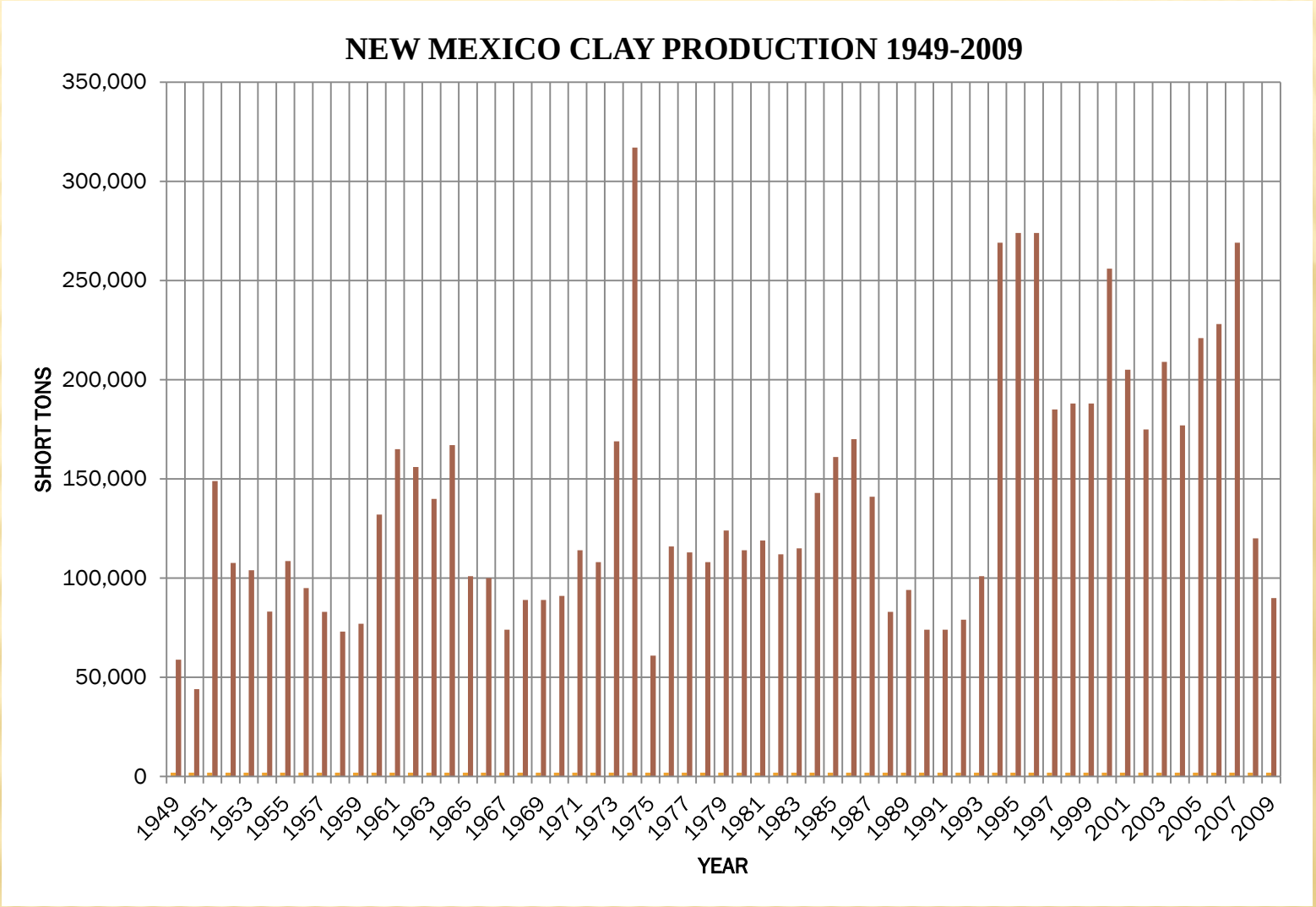
SOCORRO PERLITE QUARRY

PERLITE IN NEW MEXICO



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



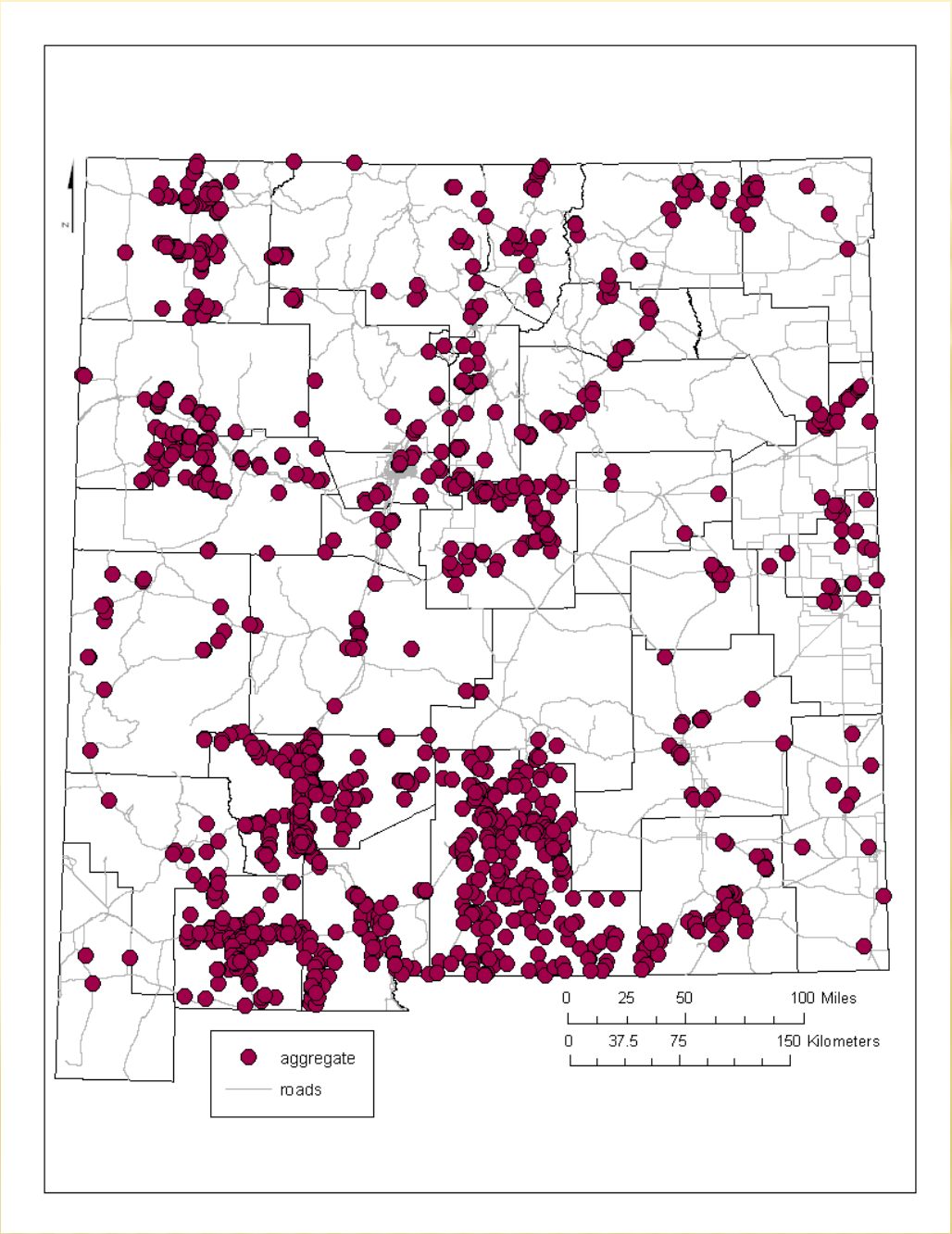
CLAY PRODUCTION

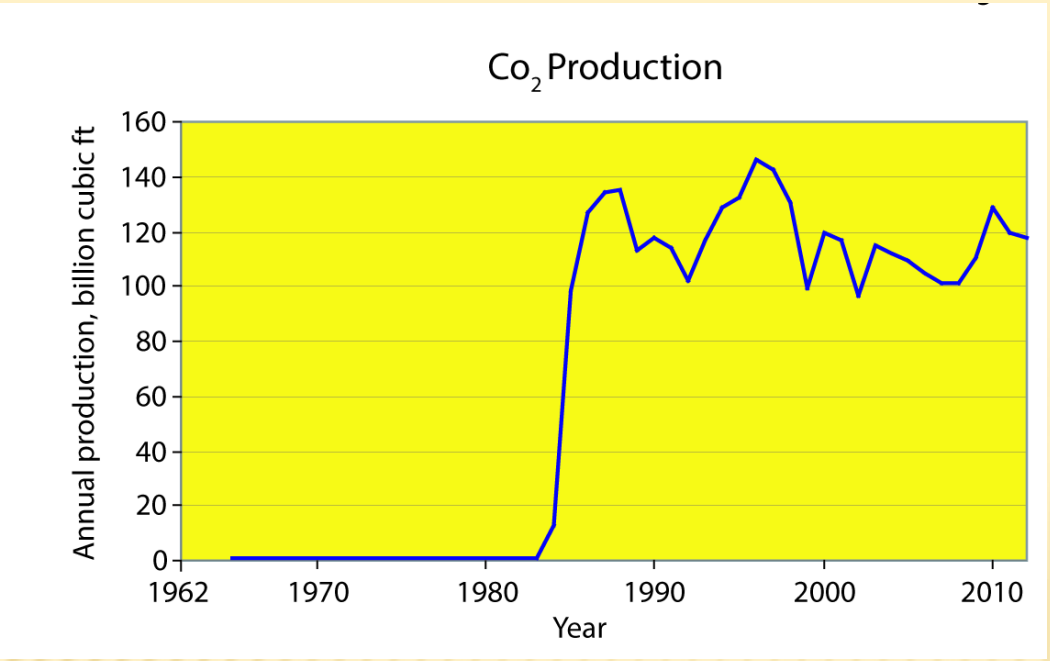
>3 MILLION TONS WORTH >$8 MILLION 1949-2013

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

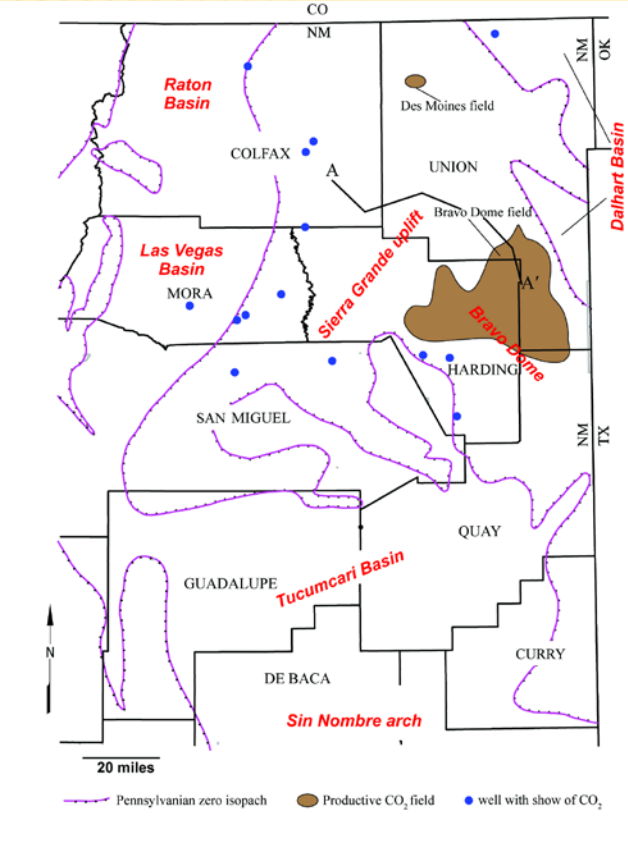




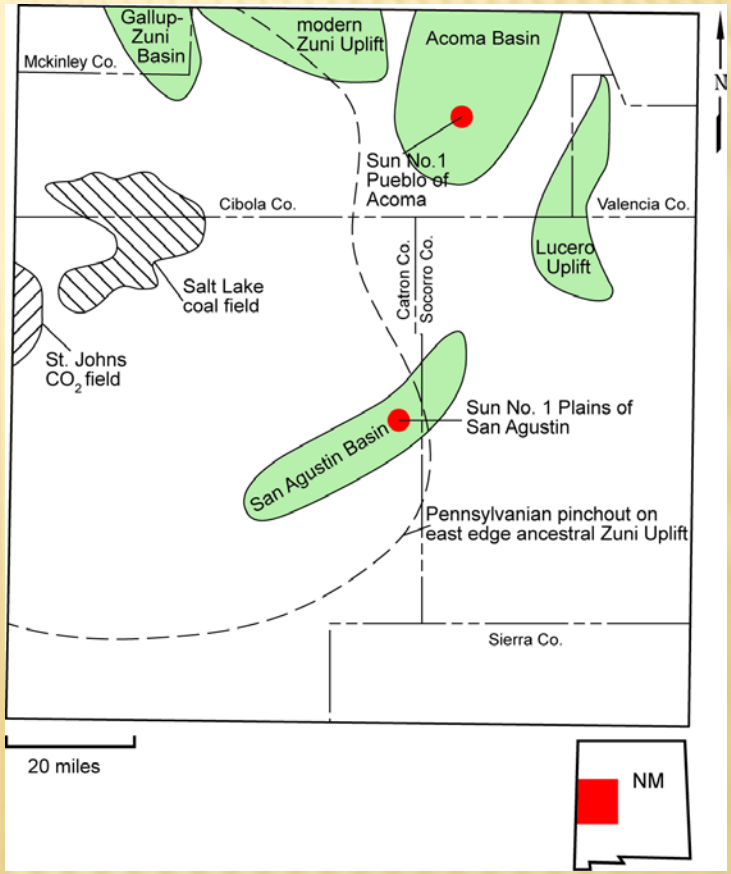
CARBON DIOXIDE

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

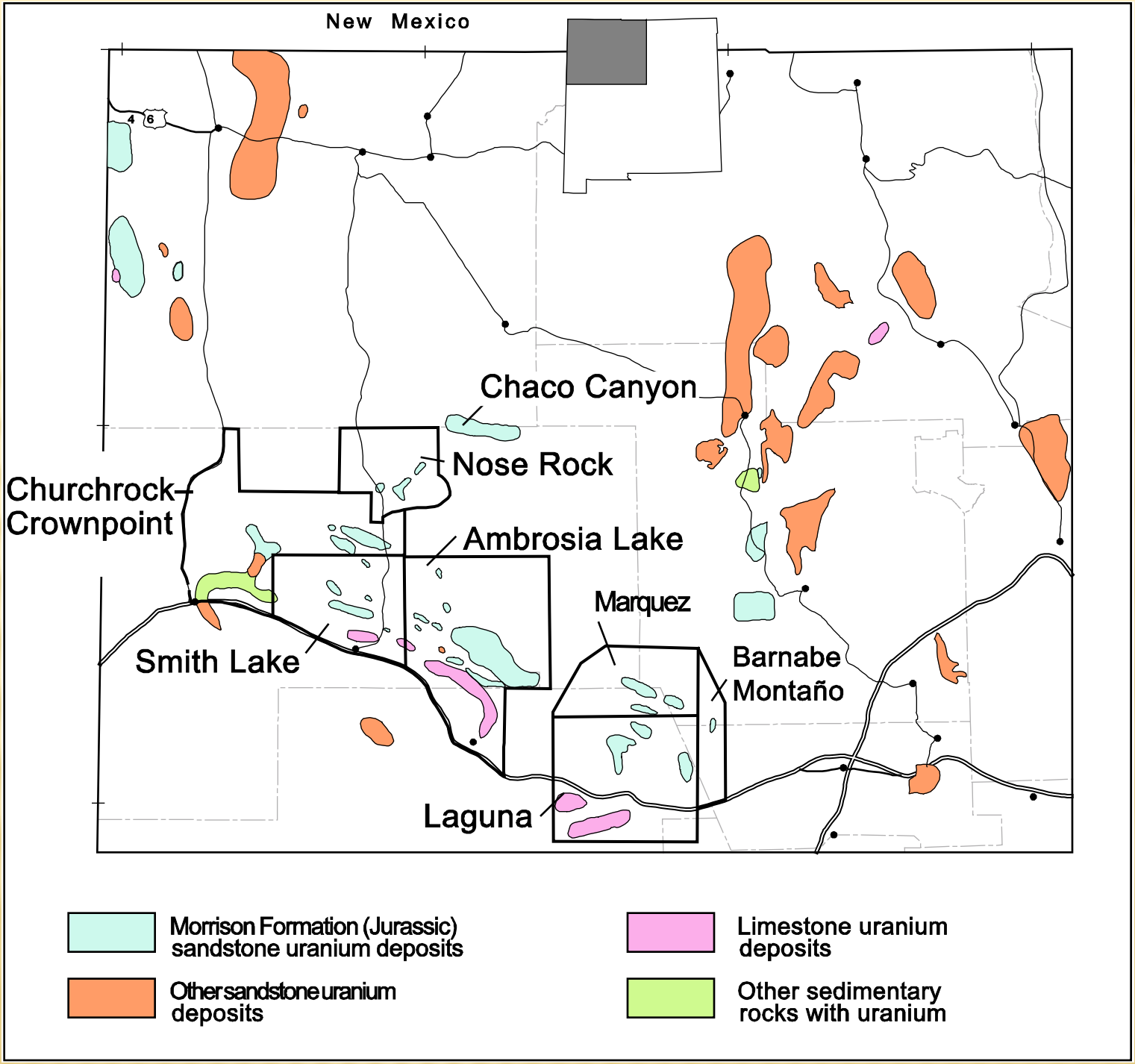
URANIUM

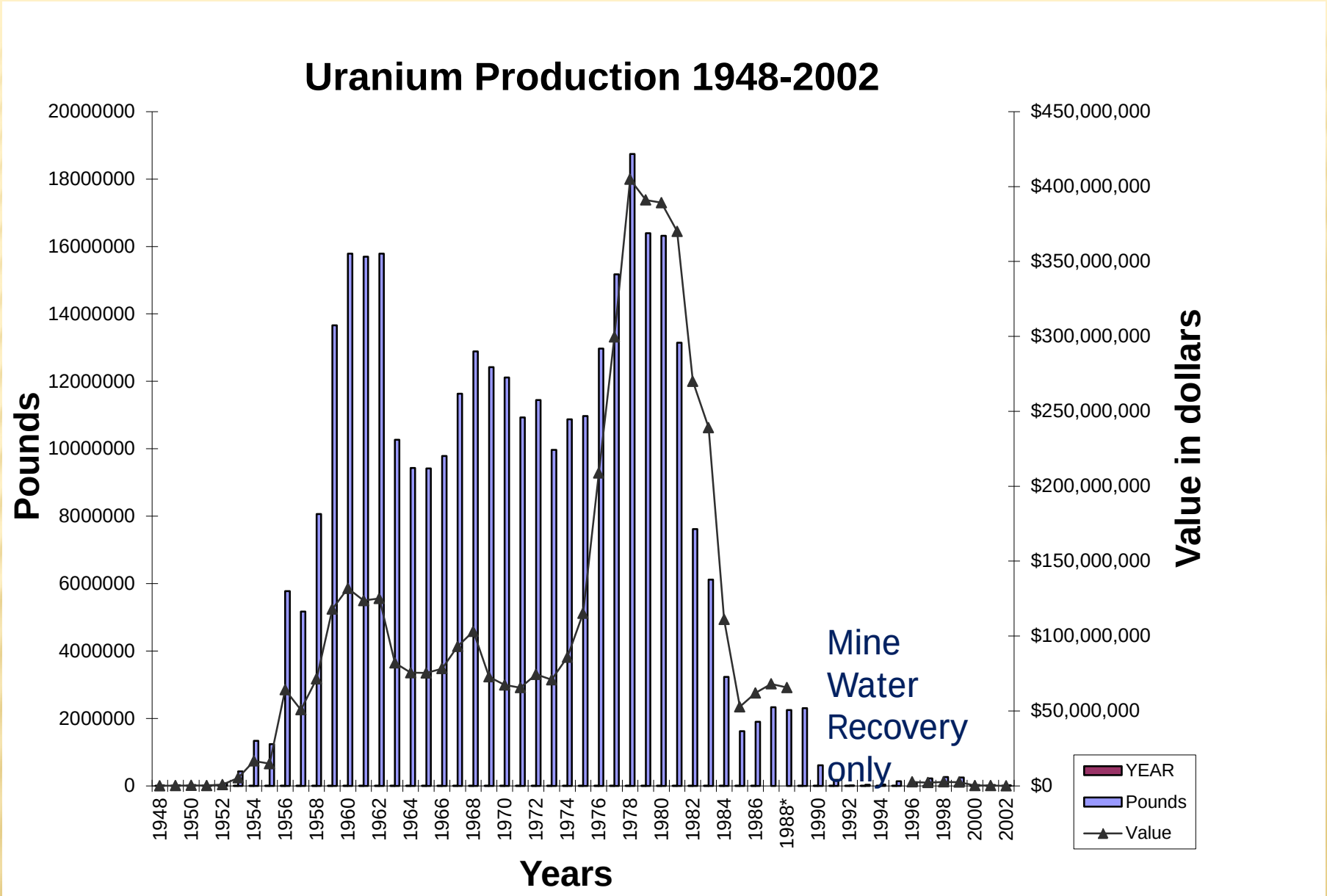
URANIUM IN NEW MEXICO 2015

- 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
- 7th 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

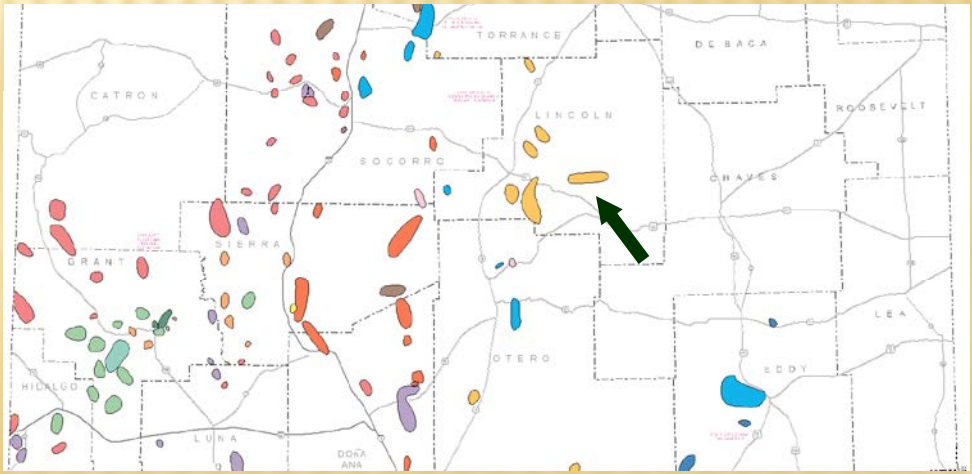
Importance of sandstone uranium deposits in the Grants district

- 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

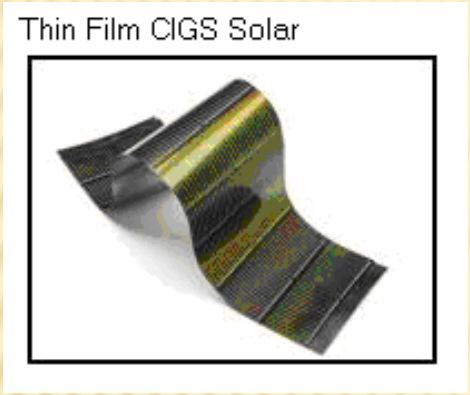
IRON ORE FROM THE CAPITAN MTS

- 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

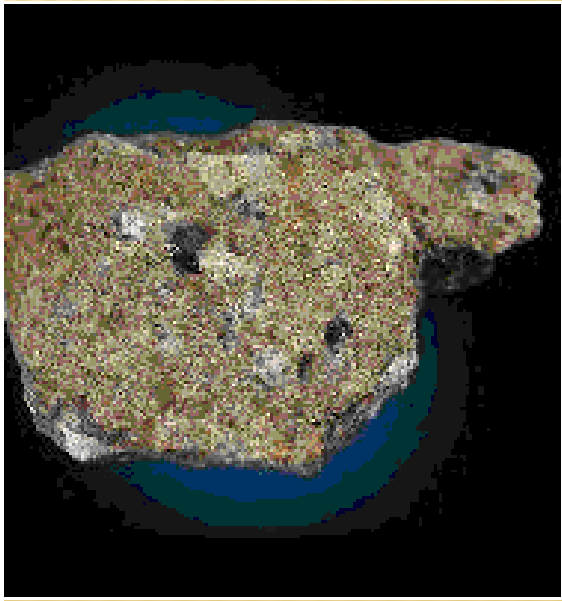


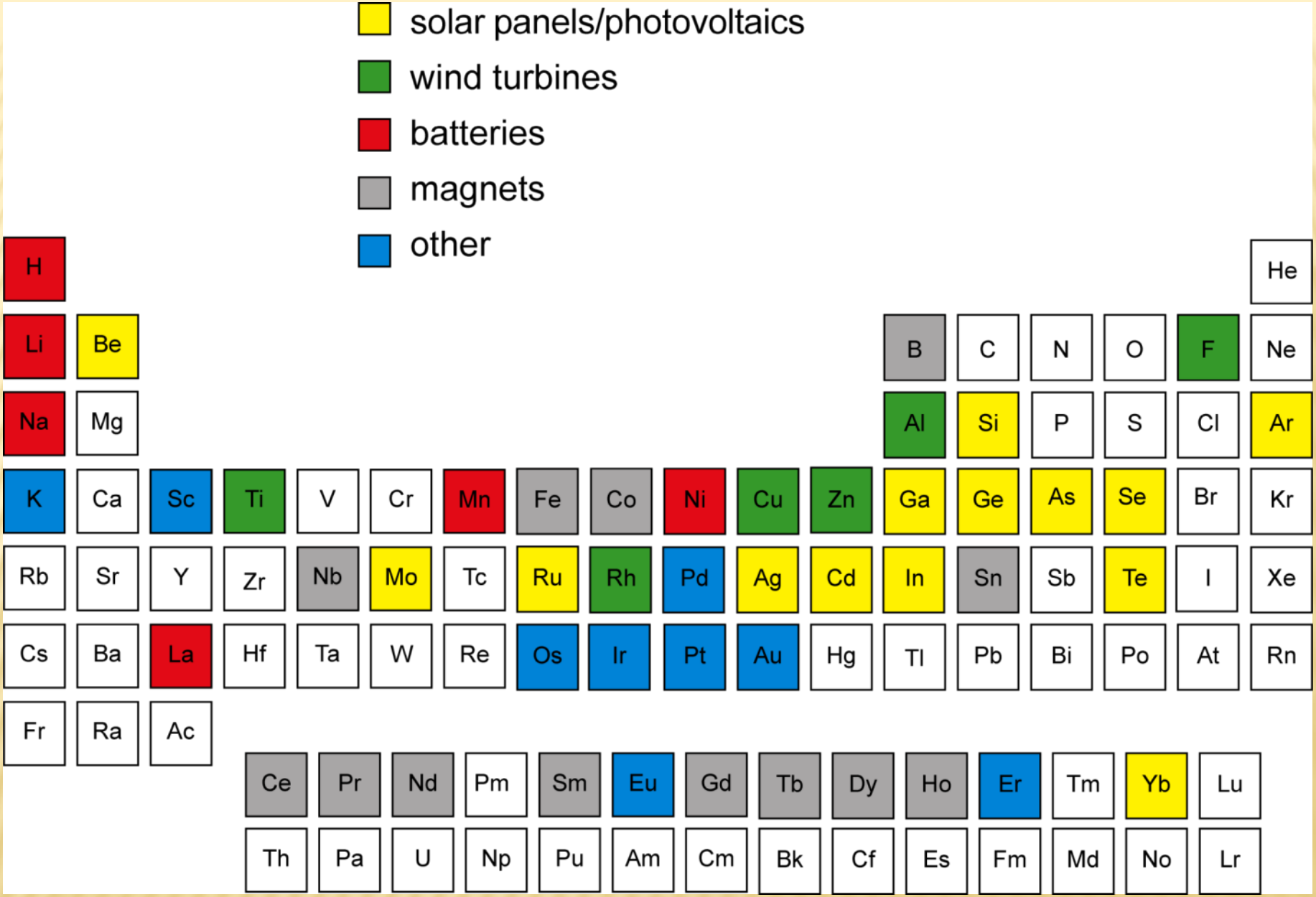
KLINE MOUNTAIN KAOLIN DEPOSIT

MINERALS NEEDED FOR EMERGING GREEN TECHNOLOGIES



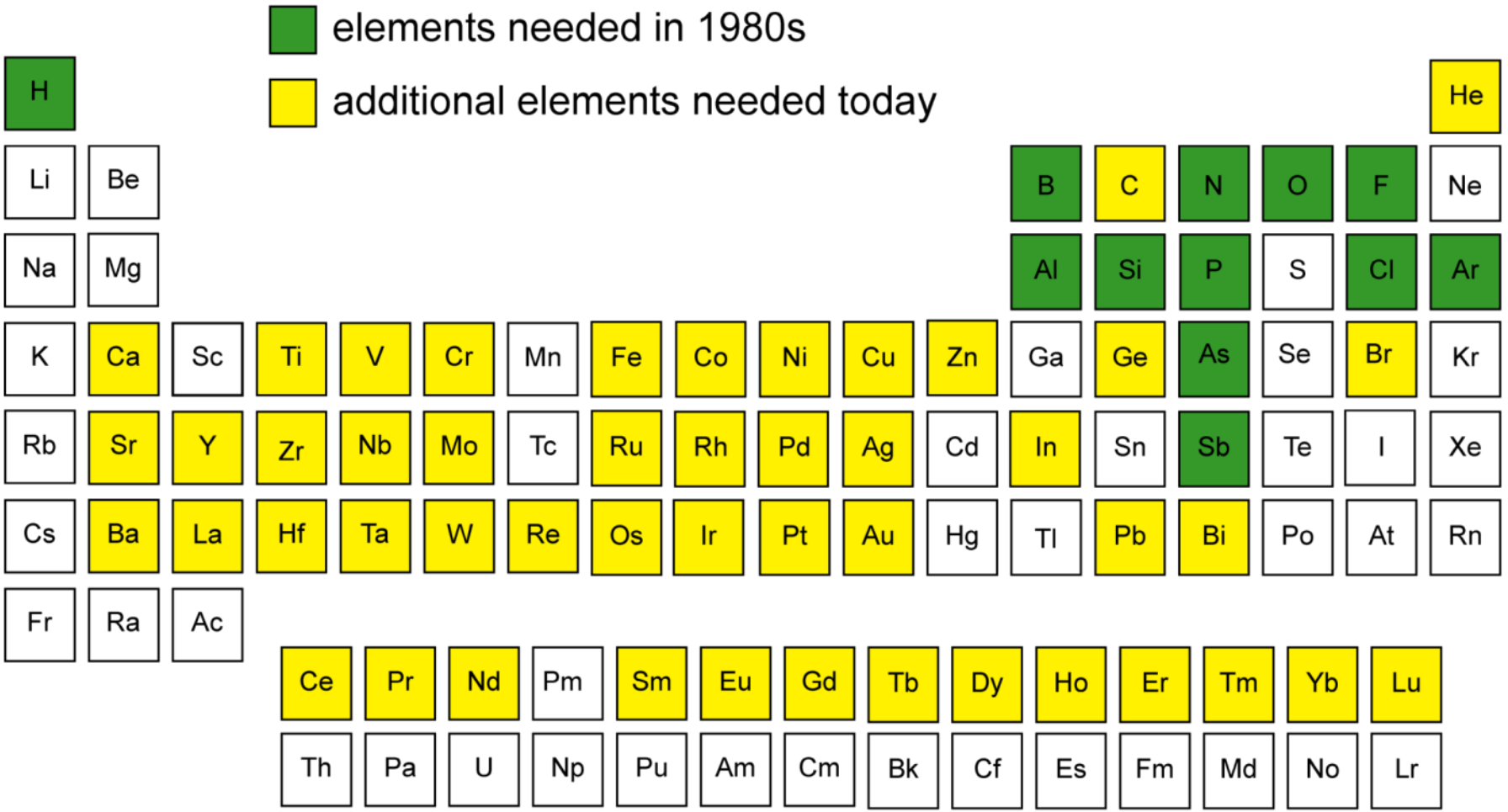
beryllium tuff (USGS OF 98-524)

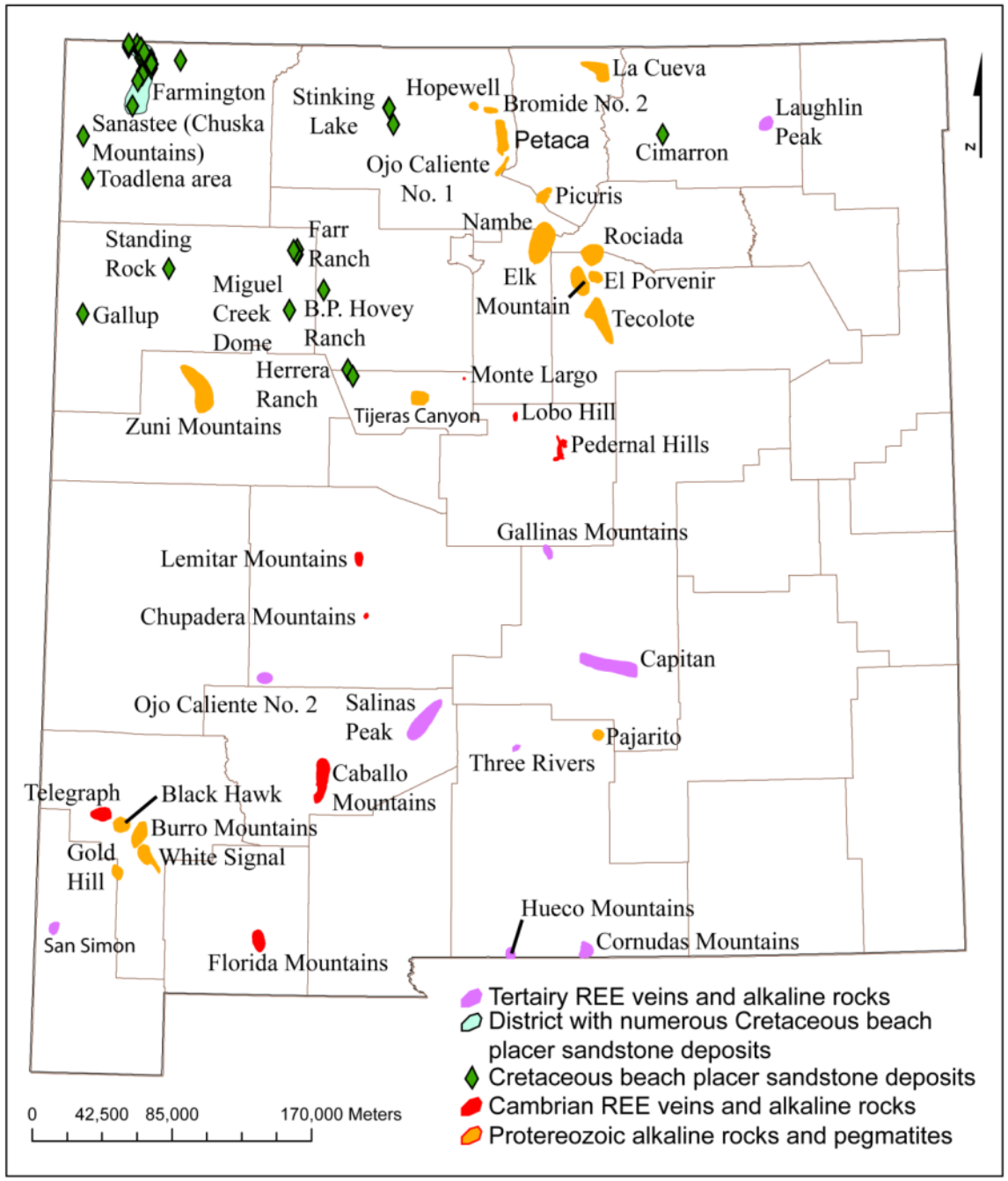




SOME OF THE MINERALS REQUIRED FOR THESE GREEN TECHNOLOGIES ARE FOUND IN NEW MEXICO

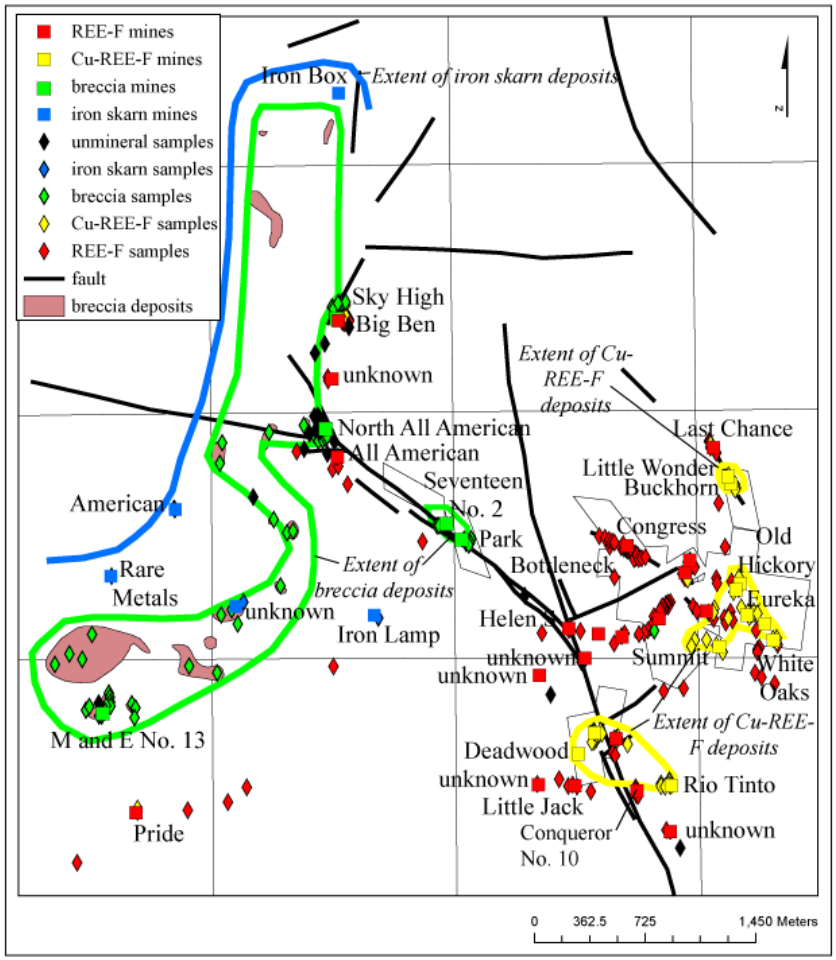
Elements in Computer Chips (National Research Council, 2007)

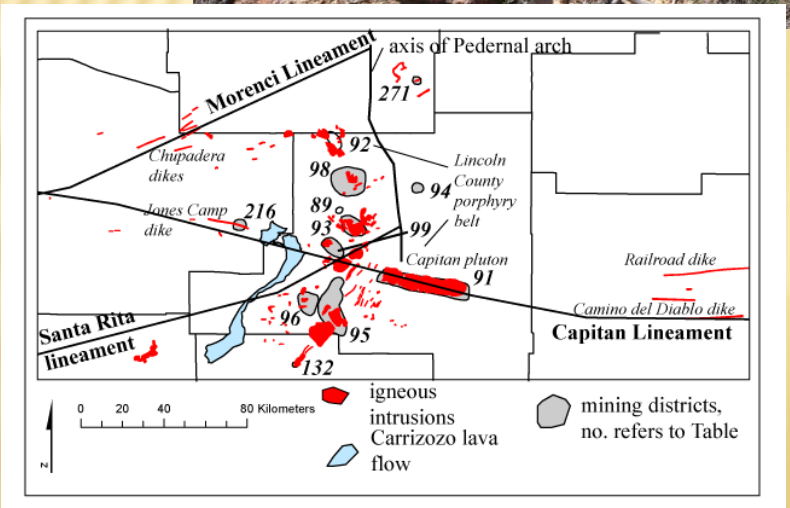


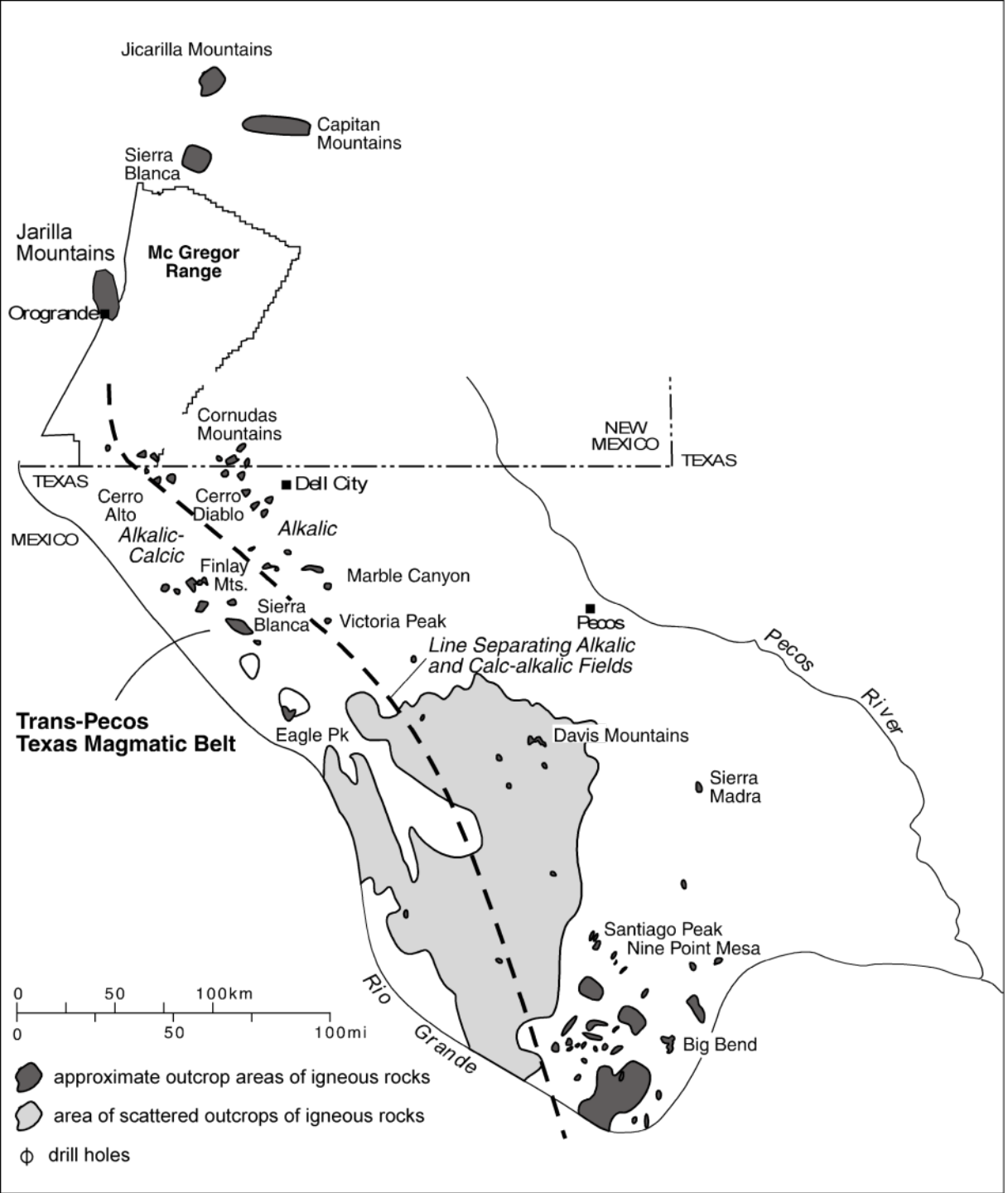


OCCURRENCES OF RARE EARTH ELEMENTS (REE) IN NEW MEXICO

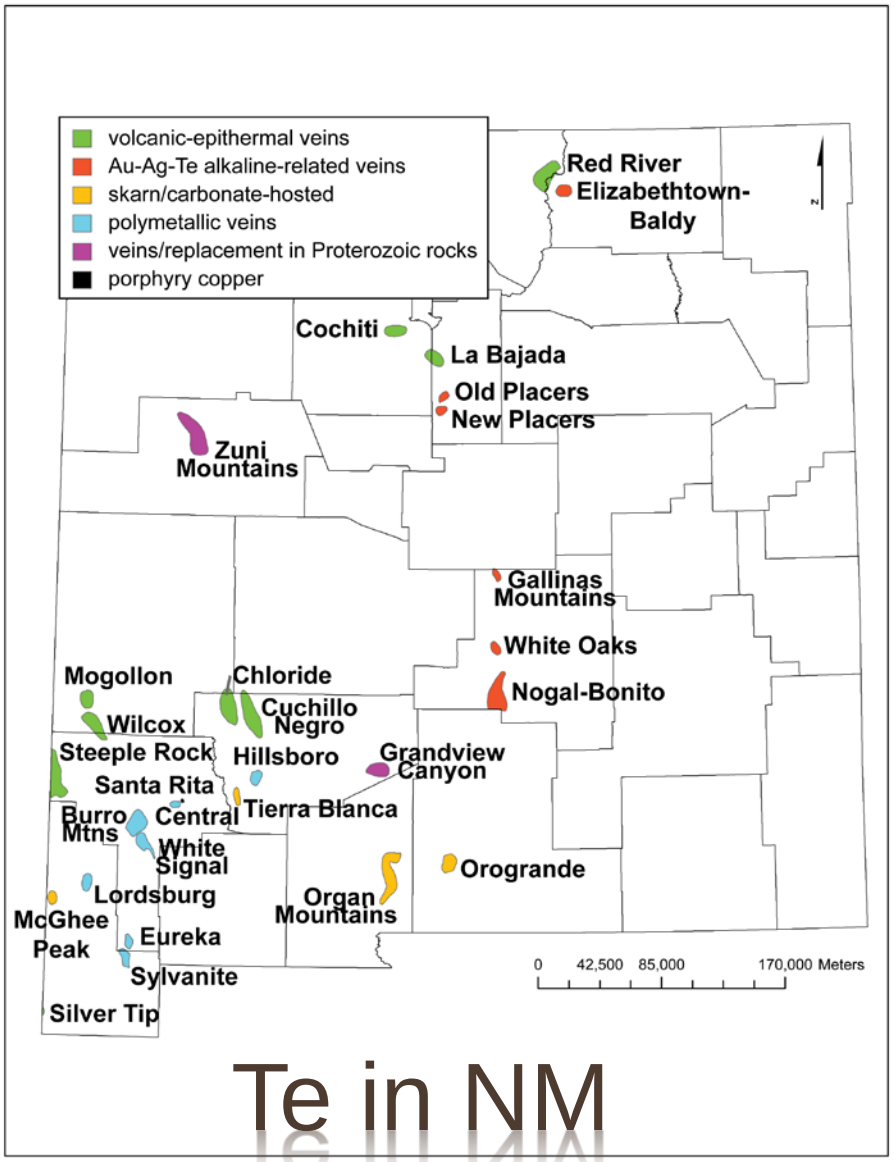
REE in Gallinas Mountains, Lincoln County







REE IN CORNUDAS MOUNTAINS, OTERO MESA



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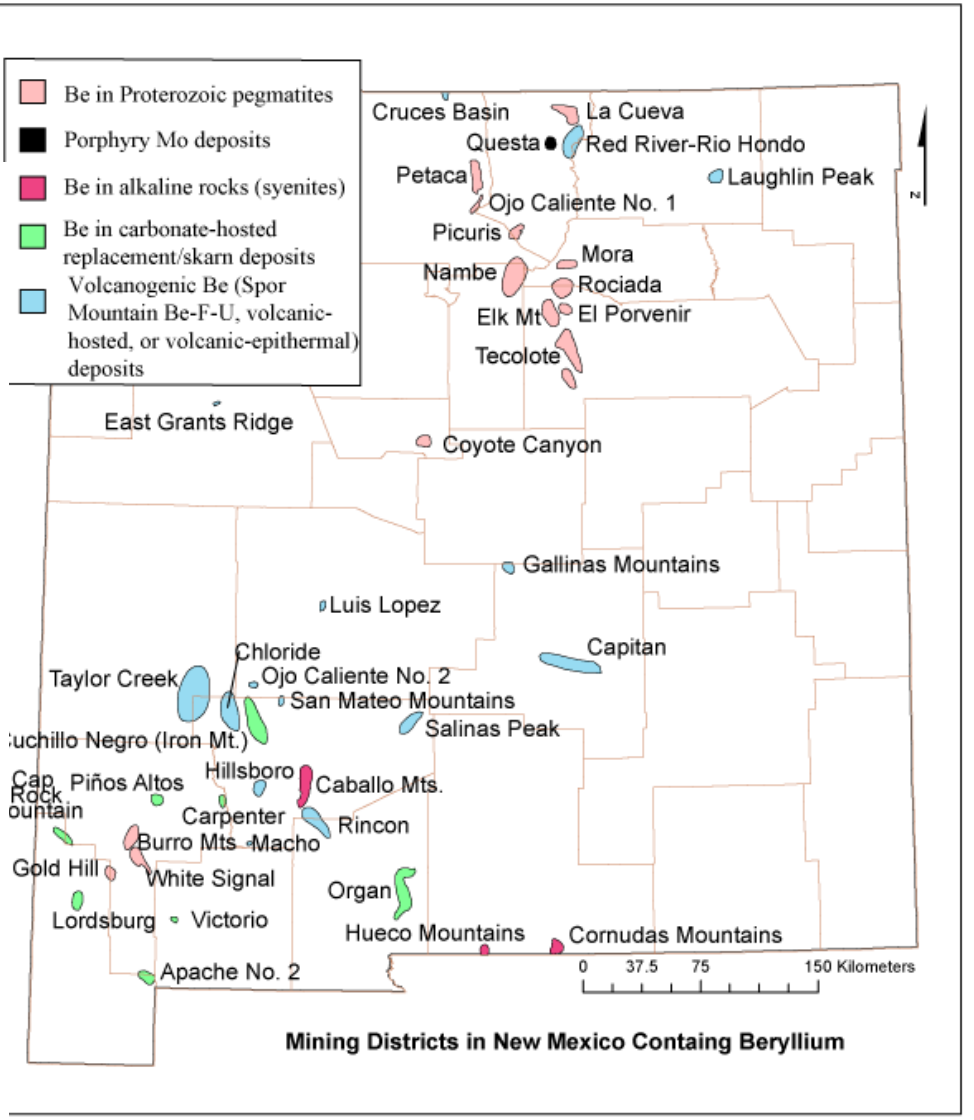
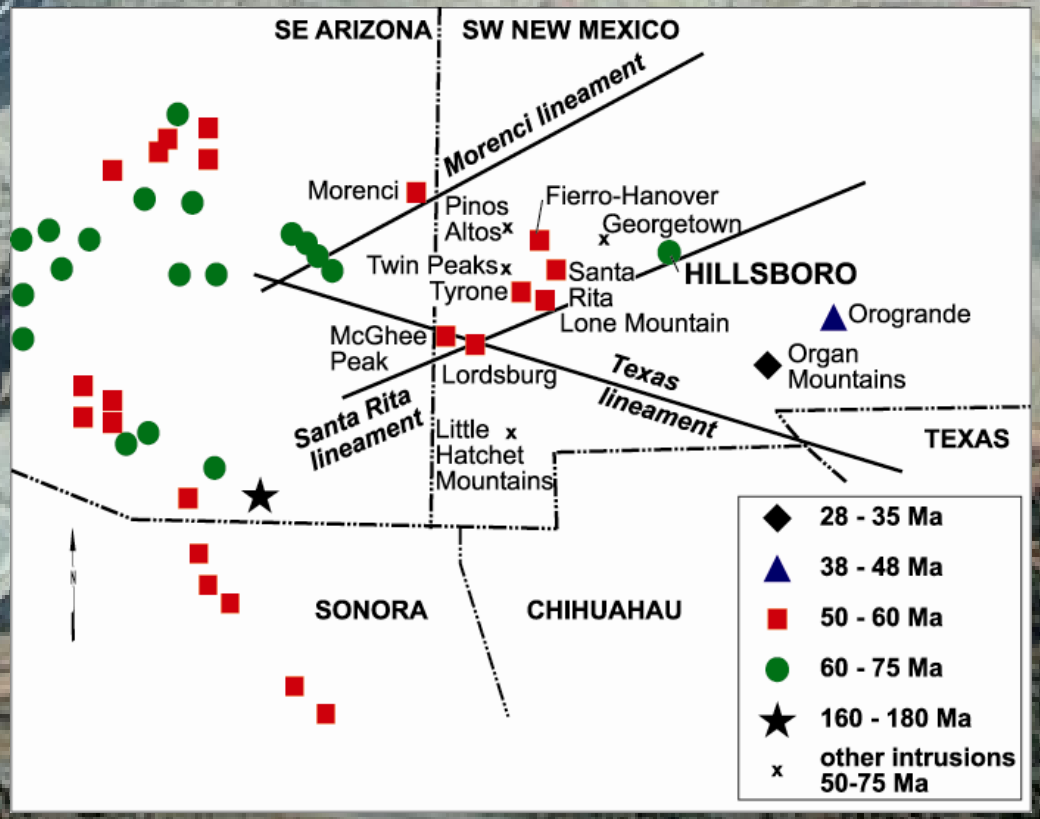


Be in NM

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
- 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)
- Legacy issues are being addressed
- Boom or bust—cyclic industry, but now is the time to acquire new deposits

CONCLUSIONS

- Yes there is a wealth of mineral potential in NM
- Many significant deposits, many different commodities
- Although, advanced exploration targets are rare in NM, there are many targets to be examined and some might be economic
- Exploration and mining in NM will now occur quickly, bring patience and perseverance—plan for years

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/