Gold in New Mexico—2022

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ACKNOWLEDGEMENTS

- New Mexico Energy, Minerals and Natural Resource Department
- Company annual reports
- Personal visits to mines
- Students at NM Tech
- New Mexico Mining Association
- Virgil Lueth for photos of museum gold specimens
OUTLINE

• Introduction
• Production
• Types of deposits
• Placer gold deposits
• Volcanic-epithermal deposits
• Great Plain Margin deposits
• Potential for gold in NM
• Publications
New Mexico Bureau of Geology and Mineral Resources

- A non-regulatory governmental agency (the state’s geological survey) that conducts scientific investigations leading to responsible economic development of the state’s mineral, water, and energy resources.
- We are a research division of New Mexico Tech.
- Founded in 1927 through state legislation.
- Currently 66 full and part time staff with a range of expertise. We have a number of active emeritus staff and mentor and employ a total of around 60 graduate and undergraduate students.
Uses of Gold

• Currency (Coinage, Bullion, Backing)
• Jewelry
• Electronic products like computers, telephones, and home appliances, industries, medical field, etc.
• Glassmaking (red or purple colors in glass, thin film of gold in windows in tall buildings, airplanes, space craft, reflects much of the very intense solar radiation, mirrors)
• Dentistry
• Drug to treat a small number of medical conditions
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
INTRODUCTION

- Spanish settled New Mexico in hopes of finding riches, in particular gold.
- But New Mexico doesn't have the gold deposits that other western states have.

11313B - Gold, San Pedro

11439A - Gold, Magdalena
Hydraulic mining at the Lynch Placer in Colfax County, New Mexico, about 1880 (NMBGMR #p-00565)
Arrastre in action with John and Jake Long at Piños Altos New Mexico, 1892
MINING DISTRICTS IN NEW MEXICO

274 mining districts and prospect areas

173 metals, 40 industrial minerals, 33 uranium districts, 28 coal fields
MINERAL PRODUCTION

16136 - Gold - Nogal Canyon
Production Summary—2020

• Value of mineral production NM in 2020 was $1.56 billion (down from 2019) (does not include oil and gas)—ranked 23rd in the US (18th in 2017)

• Employment in the mining industry is 4,500

• Exploration for garnet, gypsum, limestone, nepheline syenite, agate, specimen fluorite, gold, silver, iron, beryllium, uranium, copper, potash, rare earth elements, humate, clays, lithium

• COVID closed at least one mine (reopened), but most of the industrial minerals and aggregate operations increased production

• MINERALS PRODUCTION IS DECREASING, ESPECIALLY COAL
Value of mineral production in New Mexico 2000-2020

[Bar chart showing the value of mineral production in millions of dollars from 2000 to 2020.]
Active mines 2022

- ~355 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
  - 1 addition mines in permitting stage
  - Several exploration
- 2 gold mines and 1 mill (active but not producing)
- 1 iron mine
- 1 uranium mine (active but not producing)
- 31 industrial minerals mines, 18 mills
- ~302 aggregate/stone

Not all aggregate mines are shown

From NM Mining and Minerals Div. database
Selected active exploration sites in New Mexico 2019-2022 (excluding U)

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

From NM Mining and Minerals Div. and NMBGMR databases, company web sites
1804-2020 >3.4 million troy ounces Au worth >$582 million
Gold and silver production in 1994-2008, 2011-2022 as a byproduct of copper production from the Ivanhoe concentrator (Freeport-McMoRan)

2009-2016 Summit mine

9th in gold production
10th in silver production
Chino mine

• In operation since 1910
• 36,000 metric ton-per-day concentrator and 150 million pound-per-year SX/EW plant
• Closed in April 2020 in response to COVID
• Reopened in January 2021
• Production was 92 million pounds in 2020, 175 million pounds in 2019
• Mine life is 2039
• Updating of permits for planned expansion underway
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, Catron Co
8. Magdalena, Socorro Co
9. Rosedale, Socorro Co
10. Terrero, Santa Fe
Summit gold mine

In 2009, Santa Fe Gold opened the Summit mine in the Steeple Rock district, closed 2016.

The ore was milled at Lordsburg and sold as silica flux.
<table>
<thead>
<tr>
<th>District</th>
<th>County</th>
<th>Estimated gold production (oz)</th>
<th>Type of deposits</th>
</tr>
</thead>
<tbody>
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<td>Grant</td>
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<td>471,400</td>
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<td>*Old Placers</td>
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<td>+ Mogollon</td>
<td>Catron</td>
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<td>*Hillsboro</td>
<td>Sierra</td>
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<td>Laramide vein, placer</td>
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<tr>
<td>Lordsburg</td>
<td>Hidalgo</td>
<td>266,600</td>
<td>Laramide vein, minor placer</td>
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<tr>
<td>Willow Creek</td>
<td>San Miguel</td>
<td>179,000</td>
<td>Proterozoic massive sulfide, minor placer</td>
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<tr>
<td>White Oaks</td>
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<td>Great Plains Margin, placer</td>
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<td>*Pinos Altos</td>
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<td>150,000</td>
<td>Laramide vein, carbonate-hosted, placer</td>
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</table>

*Major placer production (>50,000 oz), + no known placer deposits.
TYPES OF GOLD DEPOSITS IN NEW MEXICO

11443A - Gold, North Baldy, Magdalena

11314A - Gold and Pyrite, San Pedro
Types of Gold Deposits in New Mexico

- Placer gold
- Volcanic-epithermal
- Copper-silver (±uranium) vein
- Great Plains Margin
- Rio Grande Rift
- Carbonate-hosted lead-zinc (copper-silver) replacement
- Carbonate-hosted silver (manganese, lead) replacement
- Laramide copper and lead/zinc skarn
- Laramide vein
- Laramide porphyry-copper (molybdenum, gold)
- Sedimentary-copper
- Vein and replacement deposits in Proterozoic rocks
- Proterozoic massive-sulfide deposits
PLACER GOLD DEPOSITS IN NEW MEXICO

15811 - Gold, San Lazurus Gulch, San Pedro
Placer Gold Deposits in New Mexico

• Important source of gold in NM prior to 1902
• Placer production in NM after 1902 has been minor
• Most placer gold deposits discovered in NM by 1900
• ~662,000 oz of gold produced 1828 to 1991
• No recorded placer production since 1991
• Placer is from Spanish meaning alluvial sand
• Any natural accumulation or concentration of a material in unconsolidated sediments of a stream, beach, or residual deposit
• Four conditions must occur
  • Source terrain must crop out
  • Source must be weathered
  • Gold is eroded, transported and concentrated
  • Deposit must be preserved from erosion
Types of placer deposits

- Alluvial, including terrace placers
  - the sands and gravels of streams, rivers, beaches and deltas
- Aeolian
  - windblown sand deposits and are relatively minor
- Eluvial (hill-slope) or residual
  - weathered detritus directly over or near the outcrops of the lode deposits
Alluvial deposits

- Hill-side placers on valley slopes that are partly sorted by running water but not in distinct channels
- Gulch or creek placers that are shallow placers in or adjacent to the beds of small streams
- Bench or terrace placers, consisting of old stream gravels partly removed by later streams that have cut into the original bedrock
Alluvial deposits—cont

- River-bar placers that occur in river bars and in gravel flats adjacent to larger streams of small gradient
- Gravel-plain placers formed in flood plains, deltas and alluvial fans
- Buried placers that have been buried by a later accumulation of sediments or by surface flows of igneous rock
- Beach placer deposits
Major placer gold deposits in NM

- >100,000 oz gold
  - Elizabethtown/Baldy
  - Hillsboro
  - Old Placers
  - New Placers

- Generally occur in alluvial fan deposits, bench or terrace gravel deposits, river-bars, and stream deposits or as residual placers formed directly on top of lode deposits
<table>
<thead>
<tr>
<th>Map no.</th>
<th>District</th>
<th>County</th>
<th>Year of discovery</th>
<th>Estimated prior to 1902 (oz)</th>
<th>Recorded 1902–1991 (oz)</th>
<th>Total estimated placer production (oz)</th>
<th>Total estimated lode production (oz)</th>
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<td>Elizabethtown-Baldy</td>
<td>T27N R16-18E Moreno River valley, flanks of Baldy Mountain, Ute and Ponil Creeks</td>
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<td>T17-18S R12-13W drainages near Bayard</td>
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<td>Red River</td>
<td>T28-29N R14-15E, T26-27N R13E Bitter Creek, Comanche Creek, Placer Creek, Red River, Gold Hill, Lucero Creek, Arroyo Hondo</td>
<td>Precambrian, mid-Tertiary</td>
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Placer mining with rockers and longtoms in mouth of Baxter Gulch near Baxter Mountain near White Oaks, New Mexico, ca 1900 (NMBGMR #p-01658)
The Oro Dredge on the Moreno Placers, New Mexico, July 8, 1905 (NMBGMR #sh-00905)
Using Trace Element Analysis of Placer Gold to Determine Source and type of original deposit
METHODOLOGY

- Physical collection and organization
  - Sphericity & Roundness
  - Morphological studies
- Microprobe analysis
  - Backscattered electron (BSE) imaging
- Quantitative Analysis

<table>
<thead>
<tr>
<th>Sample Name</th>
<th>Length (mm)</th>
<th>Size of Particles (d)</th>
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<th>Roundness</th>
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Backscattered Electron Imaging

- Analysis begins with backscattered electron (BSE) imaging using an electron microprobe to determine if chemical or weathering zonation was present in gold particles
Source of placer gold deposits

backscattered electron (BSE) imaging to determine chemical zonation in gold particles

Hillsboro grain

PA grain

JICS/Sally vein grain
Quantitative Analysis

• Determine composition of different areas of a selected grain.

• Element selection
  – Ag, Au, Cu, As, Pb, Fe, S

• Analyses on:
  – Rims
  – Cores
  – Inclusions

<table>
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<tr>
<th>Point</th>
<th>Sample</th>
<th>Ag</th>
<th>Au</th>
<th>Cu</th>
<th>As</th>
<th>Pb</th>
<th>Fe</th>
<th>S</th>
<th>Total</th>
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<td>01</td>
<td>DeadwoodGulch-01</td>
<td>24.55</td>
<td>72.77</td>
<td>0.02</td>
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<td>0</td>
<td>0.01</td>
<td>0.02</td>
<td>97.38</td>
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<td>DeadwoodGulch-02</td>
<td>0.87</td>
<td>96.34</td>
<td>0.06</td>
<td>0</td>
<td>0</td>
<td>0.01</td>
<td>0.03</td>
<td>97.31</td>
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<td>04</td>
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<td>0.01</td>
<td>0</td>
<td>0</td>
<td>0.03</td>
<td>96.88</td>
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</tbody>
</table>
Piños Altos

2 sources
- Au-rich Cu porphyry
- Pb-Zn and Cu skarns and polymetallic veins
New Mexico placer gold districts

- New Mexico’s placer gold didn’t travel far from source
- Chemical compositions of placer gold samples can be correlated with specific
Best places to pan for gold in New Mexico
VOLCANIC-EPITHERMAL VEIN DEPOSITS
Summit gold mine, Steeple Rock district

In 2009, Santa Fe Gold opened the Summit mine in the Steeple Rock district, closed in 2016.

The ore was milled at Lordsburg.
Breccia ore
GREAT PLAINS MARGIN (ALKALIC-RELATED) GOLD DEPOSITS
or NORTH AMERICAN ALKALINE GOLD BELT

16136 - Gold - Nogal Canyon

16295 - Gold, Helen Rae mine, Nogal Canyon

16136 - Gold - Nogal Canyon
Great Plains Margin (Alkaline-related) Gold Deposits

• Part of a regional belt of similar deposits that extends northward into Canada and southward into Mexico

• Gold vein, skarn, breccia pipe, porphyry, placer that are associated with alkaline rocks

• Associated with Fe, Mo, F, W, U, Th, REE (rare earth elements), Nb
General characteristics of GPM mineral deposits

- Gold/silver ratios in GPM deposits are generally higher than other deposits in New Mexico.
- Low silver, lead, and zinc concentrations.
- REE deposits in Laughlin Peak and Gallinas, Capitan, and Cornudas Mountains, but are typically not found with significant gold deposits, although trace amounts of gold are locally present.
Age and geochemistry

- Eocene to Oligocene
- Igneous rocks are typically subalkaline to alkaline, predominantly metaluminous to peraluminous intrusions
- Many intrusions are porphyritic and texturally and compositionally zoned

Ages of igneous rocks associated with GPM districts in New Mexico, arranged from north to south.
<table>
<thead>
<tr>
<th>District</th>
<th>County</th>
<th>Estimated gold production (oz)</th>
<th>Type of deposits</th>
</tr>
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<tbody>
<tr>
<td>+ Santa Rita</td>
<td>Grant</td>
<td>&gt;475,000</td>
<td>porphyry copper</td>
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<tr>
<td>*Elizabethtown-Baldy</td>
<td>Colfax</td>
<td>471,400</td>
<td>Great Plains Margin, placer</td>
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<tr>
<td>*Old Placers</td>
<td>Santa Fe</td>
<td>450,000</td>
<td>Great Plains Margin, placer</td>
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<tr>
<td>+ Mogollon</td>
<td>Catron</td>
<td>365,000</td>
<td>volcanic-epithermal</td>
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<td>*Hillsboro</td>
<td>Sierra</td>
<td>270,000</td>
<td>Laramide vein, placer</td>
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<td>Lordsburg</td>
<td>Hidalgo</td>
<td>266,600</td>
<td>Laramide vein, minor placer</td>
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<td>Willow Creek</td>
<td>San Miguel</td>
<td>179,000</td>
<td>Proterozoic massive sulfide, minor placer</td>
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<td>White Oaks</td>
<td>Lincoln</td>
<td>163,500</td>
<td>Great Plains Margin, placer</td>
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<td>+ Steeple Rock</td>
<td>Grant</td>
<td>151,000</td>
<td>volcanic-epithermal</td>
</tr>
<tr>
<td>*Pinos Altos</td>
<td>Grant</td>
<td>150,000</td>
<td>Laramide vein, carbonate-hosted, placer</td>
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</tbody>
</table>
New Mexico GPM Deposits

- Elizabethtown-Baldy district
  - 471,400 oz Au produced
- Old Placers district
  - 450,000 oz produced
- New Placers district
- Jicarilla district
- White Oaks district
- Nogal-Bonito district
- Orogrande district
  - 305,000 metric tons of ore grading 1.7 ppm Au

- Great Western deposit
  - 3.275 million metric tons of ore containing less than 2 ppm Au
- Vera Cruz deposit
  - 188,590 metric tons of ore grading 4.8 ppm Au
- Carache Canyon breccia deposit
  - 4.5 million metric tons of ore grading 3.2 ppm Au
- Lukas Canyon
  - 5.4 million metric tons of ore grading 1 ppm Au
Types of GPM deposits

- Polymetallic epithermal to mesothermal veins
- Gold-bearing breccia deposits and quartz veins
- Copper-gold and/or gold porphyries
- Iron skarns and replacements
- Copper, lead-zinc, and gold skarns or carbonate-hosted replacements,
- Gold placers
- Th-u-ree-fluorite epithermal veins and breccias
Jicarilla district

Ray and Alpers (1993)
Oldest igneous rocks (Old Placers, Jicarilla Mountains, Orogrande, Organ, Conrudas Mountains)

• Older than 36 Ma
• Magnesian, alkali-calcic to alkalic
• Gold districts
Production, Jicarilla district

- 800 oz placer Au
- 800 oz lode Au
- 38,000 oz Ag
- 8000 tons Fe ore
- Possible Spanish production

Types of Deposits

- Placer
- Au-bearing quartz veins
- Fe skarn/replacement and vein deposits
- Low sulfur, little silver, copper, lead, zinc
Au in veins and mineralized rocks

As=ppm
Au=ppb
White Oaks district
POTENTIAL FOR GOLD IN NEW MEXICO

17 - Gold, Boot Heel Claim
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
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
• Mining requires water and their environmental effects must not impact water supplies
• Results in unemployment and decrease in revenues
  • Affects rural economies
  • Affects state revenues
• 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 Issues Facing New Mexico—continued

• 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
SUMMARY

• New Mexico has a wealth of mineral resources
• The New Mexico Bureau of Geology and Mineral Resources has a long history in minerals research
  • We have a number of ongoing research projects in the broad field of minerals, especially critical minerals, with strong field and laboratory components
• Exploration and permitting takes many years before a deposit can be mined in NM, >10 yrs
• Legacy issues are being addressed
• Negative public perceptions are major issue as is funding
• Global competition is a major challenge
• NMBG/NMT research is addressing some of these issues, as well as actively training future geologists and engineers
Placer gold deposits in New Mexico

by Virginia T. McLemore, New Mexico Bureau of Mines and Mineral Resources, Socorro, New Mexico 87801

Abstract

Thirty-six mining districts in New Mexico contain placer gold deposits. Production from these deposits began as early as 1828, resulting in the first gold rush in the western United States, however, minor production by Pueblo Indians and Spaniards probably occurred 200 or more years earlier. Most placer deposits were discovered by 1900, and almost all placer production occurred before 1902. It is estimated that 662,000 oz of gold were produced from New Mexico placer deposits between 1828 and 1991. The deposits typically are found in late Tertiary to Recent alluvial or eluvial deposits; alluvial fan deposits, bench or terrace deposits, river bars, stream concentrations, and residual placers that formed directly on top of lode deposits are known. New Mexico placer gold deposits are derived from Oligocene-Miocene Great Plains Margin deposits, Laramide vein deposits, and Proterozoic vein and replacement deposits in highly weathered and eroded terrains. The future potential will depend on discovery of large-volume, low-grade deposits. Also, new technologies minimizing water may stimulate activity because lack of deposits in New Mexico were discovered by 1900. Early production from placer deposits is poorly documented, and total production can only be estimated. It is estimated that 662,000 oz of gold have been produced from placer deposits throughout New Mexico from 1828 to 1991 (updated from Johnson, 1972). This production is insignificant compared to larger placers found in Alaska, California, New Zealand, and South America that contain millions of ounces gold. Only four districts here have yielded more than 100,000 oz of placer gold production: Elizabethtown-Baldy, Hillsboro, Old Placers, and New Placers. Currently only one district is yielding some minor production (White Oaks) although small exploration activities and recreational gold panning are occurring in most areas of the state.

Also in this issue

Oso Ridge Member (new).
Abo Formation.
Zuni Mountains.

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Decision Makers Field Guides

The New Mexico Bureau of Geology and Mineral Resources is joining with several state and local governmental agencies and organizations in conducting a series of field conferences for influential New Mexico decision makers. The purpose of these conferences is to present decision makers with the opportunity to learn first-hand about geological problems, opportunities, and potential solutions from some of the state's top experts, and to hear impartial (or at least balanced) opinions regarding current scientific knowledge about these matters.

Mining in New Mexico—The Environment, Water, Economics, and Sustainable Development

Decision-Makers Field Guide 2005

Edited by L. Greer Price, Douglas Bland, Virginia T. McLemore, and James M. Barker

Mining has played a significant role in the history and development of New Mexico and continues to play an important role in the state's economic prosperity. The future of this industry will depend upon achieving a balance between our needs and desires, the changing economy, and our growing concern over environmental and social issues. This anthology of 30 articles is a timely look at some of those science and policy issues. 176 pages with tables, diagrams, maps, and color photographs throughout.
Memoir 50—Energy and Mineral Resources of New Mexico
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/
QUESTIONS?