

MINERAL RESOURCES IN TAOS COUNTY, NEW MEXICO

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ABSTRACT.—There are ten types of deposits in the nine mining districts of Taos County, New Mexico. Four of these are world-class mineral deposits: molybdenum at Questa (Questa district), perlite at No Agua (No Agua district), mica at the U. S. Hill mine in the Picuris Mountains (M.I.C.A. district), and the Harding pegmatite (Picuris district). All of these deposits are currently producing with the exception of the Harding pegmatite, which is owned by the University of New Mexico for use as a field classroom and amateur mineral collecting site. Ten aggregate (sand and gravel) mines also are currently operating. Future mineral production in Taos County is certain, especially at three of the previously mentioned world-class deposits (Questa, No Agua, U. S. Hill mine), and of sand and gravel in the aggregate mines in the vicinity of Taos and along the Rio Grande.

INTRODUCTION

There are ten types of deposits in nine mining districts in Taos County, New Mexico (Fig. 1, Tables 1 and 2), including several world-class deposits. This paper summarizes the geology, geochemistry, and mineral production of the mineral deposits in Taos County. Detailed geology and stratigraphy of the districts are described elsewhere in this guidebook and in cited references. A brief description of each mineral deposit type is in Table 2; more detailed descriptions are by Cox and Singer (1986), North and McLemore (1986, 1988), Du Bray (1995), McLemore and Lueth (1996), McLemore et al. (1998), and McLemore (2001). This work is part of ongoing studies of mineral deposits in New Mexico that include updates and revisions of prior work by Schilling (1960), McLemore (1983, 2001), and North and McLemore (1986, 1988).

Published and unpublished data were inventoried and compiled, including existing mines and mills within Taos County, a literature search, and compilation of unpublished file data. Mineralized areas were examined and sampled in 1981 through 2003. Information on the mining districts and individual mines are included in the New Mexico Mines Database (McLemore et al., 2003), which will be available in CD-ROM and on the NMBGMR web site sometime in the future.

Mineral production since the late 1800s is listed by district in Tables 3, 4, and 5. Active mines are listed in Table 6. Mining and production records are generally poor, particularly for the earliest times and many early records are conflicting. These production figures are the best data available and were obtained from published and unpublished sources (New Mexico Bureau of Geology and Mineral Resources, NMBGMR file data). However, production figures are subject to change as new data are obtained.

DESCRIPTION OF MINING DISTRICTS

La Cueva District

La Cueva district is in the vicinity of Costilla Creek, south of Amalia in northern Taos County (Fig. 1). Uranium minerals were first reported in pegmatites in La Cueva district in the early 1950s (Collins, 1954, 1956), and during Phillips Petroleum Company and Duval Corporations' exploration for uranium deposits in the

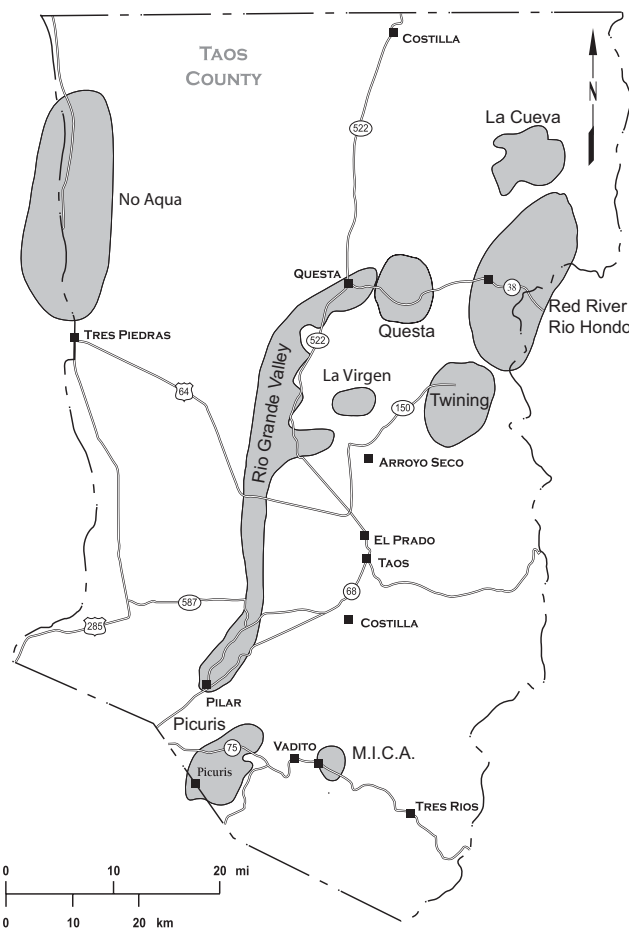


FIGURE 1. Mining districts in Taos County.

area in the 1970s and 1980s (Reid et al., 1980; Zelenka, 1984; McDonnell, 1992; McLemore, 1990). No production has been reported from the district.

Two types of deposits are found in La Cueva district: vein and replacement deposits in Precambrian rocks and pegmatites. Mineralized zones containing high concentrations of uranium, thorium, and rare-earth elements are found in fracture zones within the Proterozoic Costilla granite and pegmatites. Chemical analyses as high as 3780 ppm U_3O_8 are found along fracture zones in the granite (Goodknight and Dexter, 1983), and as high as 1850 ppm U are found from some pegmatites (Zelenka, 1984). Uranium

TABLE 1. Mining districts in Taos County, New Mexico. Names of districts are after File and Northrop (1966) wherever practical, but many districts have been combined and added. Commodity symbols are defined in Appendix 1. District identification number is from the New Mexico Mines Database (McLemore et al., 2003). Estimated value of production is in original cumulative dollars and includes all commodities in the district, except aggregate (sand and gravel) and dimension stone (see text). Production data modified from Lindgren et al. (1910), Anderson (1957), U. S. Geological Survey and U. S. Bureau of Mines Mineral Yearbooks (1900-1993), New Mexico State Inspector of Mines (1912-1982), and Energy, Minerals and Natural Resources Department (1986-2003). Type of deposit after North and McLemore (1986) and McLemore (2001). * district contains world-class mineral deposit. Locations of mining districts are in Figure 1.

District identification number	District (Aliases)	Year of Discovery	Years of Production	Commodities Produced (Present)	Estimated Cumulative Value of Production (In Original Dollars)	Type of Deposit
DIS232	La Cueva (Costilla Creek)	1970s	none	(Au, Cu, U, beryl, mica, Th, REE)	—	Precambrian vein and replacement, pegmatite
DIS233	La Virgen	1826	none	(Cu, Ag, Pb, Zn)	—	Volcanic massive-sulfide
DIS234	*M.I.C.A. (Peñasco)	1959	1900s-present	mica	9,000,000 (?)	Proterozoic mica
DIS235	*No Aqua (San Antonio Mountain)	1948	1950-present	scoria, perlite	>10,000,000	scoria, perlite
DIS236	*Picuris (Copper Hill)	1900	1902-1955	Au, Ag, Cu, W, turquoise, Be, Li (U, Sb, Cr, V, Ba, mica, Nb, Sn)	3,000	Precambrian vein and replacement, placer gold, pegmatite
DIS238	*Questa	1866	1918-present	Mo	>100,000,000	Porphyry Mo ($\pm$ W)
DIS238	Red River-Rio Hondo (Midnight, La Belle, Keystone, Anchor, Black Copper Canyon) Rio Grande	1826 (possible Spanish mining prior to 1680)	1902-1956	Au, Ag, Cu, Pb, Zn, U (Mo, F)	<100,000	volcanic-epithermal, placer gold, porphyry Mo ($\pm$ W), Precambrian vein and replacement, alunite, argillic alteration
DIS239	Valley (Rio Colorado)	1600	1902-1935	Au	<20,000	placer gold
DIS240	Twining (Gold Hill, Rio Hondo)	1890		Au, Ag, Cu (Mo, Pb, Zn)	<5,000	Precambrian vein and replacement, volcanic massive-sulfide

concentrations in stream waters in the area contained as much as 145.1 ppb U, whereas stream sediments contained as much as 202.2 ppm U (Morgan and Broxton, 1978). Radioactive minerals found in La Cueva district include uraninite, thorite, uranotorite, magnetite, zircon, allanite, apatite, sphene, thorogummite, uranophane, uraniferous hematite, and an unknown uranyl silicate (Zelenka, 1984). Pegmatites also contain abundant sheet mica 3 inches across, and minor beryl and chrysoberyl. Graphite also is found in the Pinabete Peak area (NMTA0555 in the New Mexico Mines Database; Schilling, 1960). A quartz vein containing malachite, chrysocolla, and chalcopyrite in Proterozoic gneiss assayed 374 ppb Au (NMTA0560; McDonnell, 1992, no. 204).

Structural relationships, mineralogy, high U/Th ratios, and variable degree of foliation suggest a late-stage magmatic-hydrothermal origin for the uranium vein and replacement deposits in Precambrian rocks (Zelenka, 1984; McLemore, 1990). Leaching, remobilization, and concentration of uranium from the quartz

monzonite locally has produced some localized supergene deposits (Goodknight and Dexter, 1983; McLemore, 1990). Future potential for uranium, thorium, beryl, graphite, rare-earth elements, mica, gold, and copper in La Cueva district in the near future is minimal because of low demand, low prices, low grade, and small size.

La Virgen District

Mining in the La Virgen district began around 1826. Very little is known about La Virgen volcanogenic massive-sulfide deposit in central Taos County (Fig. 1; Robertson et al., 1986; McLemore, 2001; NMTA0557 in New Mexico Mines Database). These deposit types are typically associated with Proterozoic greenstones (metamorphosed lavas), and are formed by hot saline brines that occur with submarine volcanism (Robertson et al., 1986). The deposit is accessed by a shaft; chalcopyrite, pyrite,

TABLE 2. Descriptions of types of mineral deposits found in Taos County, New Mexico, in order of perceived age.

Type of Deposit	Description	Mineralogy	Perceived Age (Ma)
Volcanogenic massive-sulfide (VMS)		Chalcopyrite, sphalerite, galena, silver, gold, pyrite	1650–1600 Ma
Pegmatite		Quartz, feldspar, mica and various accessory minerals	Probably 1450–1400 Ma, 1100–1200? Ma
Mica	Scrap and flake mica hosted by Precambrian mica schist.	Muscovite, quartz	Proterozoic
Vein and replacement deposits in Precambrian rocks	Vein and replacement deposits are found along faults, fractures, shear zones, and contact zones within Proterozoic granitic and metamorphic rocks.	Malachite, chalcopyrite, chalcocite, azurite, gold, silver minerals, iron oxides, quartz common to most deposits.	Proterozoic or younger
Porphyry Mo ($\pm$ W)		Molybdenite, quartz, pyrite	Probably 35–25 Ma
Volcanic-epithermal vein		Quartz, pyrite, gold, silver, chalcopyrite	35–16 Ma or younger
Argillic alteration, alunite		Quartz, pyrite, alunite, jarosite, iron oxides and sulfates	35–16 Ma or younger
Perlite	Weathered natural glass that is formed by the rapid cooling of viscous, high-silica rhyolite lava and lava domes	perlite	3.3–7.8 Ma
Scoria	Volcanic cinder deposits	scoria	late Miocene to Pliocene
Placer gold		Gold, native silver, magnetite, zircon	Pliocene–Recent

and other sulfides have been reported. Proterozoic schist hosts the mineral deposit, which is cut by Tertiary rhyolite dikes. There is no history of production from the district.

M.I.C.A. District

Only one mine currently produces mica in New Mexico, the U. S. Hill mine (formerly M.I.C.A. mine; NMTA0008) in the Picuris Range of the Sangre de Cristo Mountains, southeastern Taos County (Fig. 1;). Pueblo Indians have used micaceous clay for pottery from the area since Prehistoric times. The modern U. S. Hill mine was first operated in 1959 by the Mica Industrial Commodities of America or M.I.C.A. Franklin Limestone Company, a subsidiary of Franklin Industries purchased the operation in 1990. In 1992 the company name was changed to Franklin Industrial Minerals (Nelson, 1996). Oglebay-Norton Inc., the largest producer of muscovite mica in the United States, acquired the mine in December 1999 from Franklin Industries and currently operates the mine and processing plant.

Mica is used as functional filler in building materials because of its unique physical characteristics, including color, flexibility, durability, thermal properties, and weight. Mica from the U. S. Hill mine is used in joint compound, plastics, rubber and sound deadening materials.

At the U. S. Hill mine, mica is produced from a muscovite quartz schist of Proterozoic age (Austin et al., 1990; Nelson, 1996). The deposit is economical because of its high mica content and absence of other minerals. Reserves are estimated as exceeding 4 million short tons (Nelson, 1996) or 49 years (Oglebay-Norton,

Inc., 2002). The deposit is one of the largest known surface deposits of pure, high-quality muscovite in the world. The current mine is the fourth largest scrap-mica mine in the U. S. Total disturbed acreage is approximately 50 acres, the pit covers 13 acres and the stockpiles covers 20 acres. An expansion plan calls for an increase to 90 acres within 20 years. The nearby Picuris Pueblo opposes any expansion of the mine because of conflict with their needs for pottery glazes and protection of sacred sites. After the mica is mined using a dozer, the ore is crushed, screened on site, and then shipped to the Velarde Plant for additional processing by a flotation circuit and dry grinding. The final product is then packaged and shipped. The Velarde Plant has been operating since the early 1980s [<http://www.oglebaynorton.com/performance.html#links>], accessed on December 26, 2003).

No Agua District

The No Agua district in northwestern Taos County (Fig. 1) is a world-class perlite deposit containing one of the largest known perlite deposits in the world (Barker, 1990; Barker et al., 1996). Two perlite mines are currently in operation: No Agua (NMTA0515) and El Grande (NMTA0010). Both perlite and scoria have been produced from the No Agua district since the early 1950s (Schilling, 1960). Great Lakes Carbon began operations at El Grande mine in 1958 (Schilling, 1960), and General Refractories Co. (renamed Grefco) operates the mine today. The No Agua mine consists of several areas: North Peak, Areas A and B on South Peak, and West Peak. The mine was first operated by F. E. Schundler in 1951. In 1959 Johns Manville operated the

TABLE 3. Reported and estimated base and precious metals production by district in New Mexico. Production from U. S. Geological Survey and U. S. Bureau of Mines Mineral Yearbooks (1900-1993) and Johnson (1972). — no reported production. W withheld or not available. * includes placer gold production. () estimated data.

District	Years	Ore (Short Tons)	Copper (Lbs)	Gold (Oz)	Silver (Oz)	Estimated Value (\$)
Picuris	1902-1955	187	3400	65*	1103	2098
Red River-Rio Hondo	1902-1956	—	17,000	365	8051	100,000
Rio Grande Valley	1902-1935	—	—	(<1000)*	—	<20,000
Twining		—	W	(80)	(1000)	<1000

No Agua mine, followed by Celite. Harborlite currently operates the mine. The United Perlite mine, ten miles east of the mines at No Agua Peaks, began production in 1959 (Schilling, 1960), but is no longer in operation. Scoria is found north of the No Agua mines, and at San Antonio Mountain and was mined during the 1950s.

Perlite is weathered (hydrated), natural glass that is formed by the rapid cooling of viscous, high-silica rhyolite lava. In New Mexico, perlite is found in high-silica rhyolite lava flows and lava domes that are typically 3.3-7.8 Ma (Chamberlin and Barker, 1996; Barker et al., 1996). The feature that distinguishes perlite from other volcanic glasses is that when heated above 1600° F, it expands or 'pops' to four to twenty times its original volume, forming a lightweight, glass foam. This expansion is due to the presence of 2-6% combined water in the mined perlite. This expansion also results in a white color. While the mined perlite may range from waxy to pearly, light gray to black or even brown, blue, or red, the color of expanded perlite ranges from snowy white to grayish white. Perlite is used in building construction products, as a horticultural aggregate, filter aid, fillers, and other uses.

Scoria is a pyroclastic deposit formed as volcanic fragments are ejected during explosive volcanic eruptions (Osburn, 1979, 1982). Scoria, also known as volcanic cinder, is red to black to gray, vesicular, basaltic (50-60% SiO₂) volcanic fragments. Most scoria deposits occur as loose, poorly consolidated, poor- to well-sorted cones or mounds of stratified fragments. The ejected material ranges in size from minor quantities of volcanic ash or cinder (< 2 mm in diameter), scoria (2-100 mm in diameter), and volcanic bombs (smooth-sided) and blocks (angular fragments), which are greater than 100 mm in diameter. Scoria is not to be confused with pumice. Scoria is denser and more coarsely cellular or vesicular than most pumice. Pumice is light in color ranging from white to gray to pale yellow, pink, or brown. It is dacitic to rhyolitic in composition (60-70% SiO₂). The vesicular nature

of scoria results in lower density and higher porosity than most rock types. These properties result in commercial use as lightweight aggregates, insulators, absorbents, and abrasives. Scoria typically has a higher crushing strength than pumice and is more desirable for certain aggregate uses. Most scoria in New Mexico is used currently to manufacture cinder block and concrete, and in landscaping. In the 1950s, scoria was used in railroad ballast and road aggregate. Scoria is quarried from open pits by digging and ripping with tractors, is stockpiled, crushed, then screened. Other uses include roofing granules and erosion control. Scoria from No Agua deposits is mostly black (Osburn, 1979). San Antonio Mountain (NMTA0537) is one of several volcanic cinder cones in Taos County that have yielded scoria in the past. Scoria currently is mined in Dona Ana, Luna, Union, and Catron Counties.

No Agua Peaks is one of a group of rhyolite and andesite volcanic centers in northwestern Taos County. No Agua Peaks, approximately 3.9 Ma, consists of two erosional remnants of rhyolite domes and associated volcanic rocks that cover approximately 6.5 km² (Whitson, 1982; Barker, 1990; Barker et al., 1996; Chamberlin et al., 1996). Differential cooling of the rhyolite domes formed textural and compositional zones ranging from an inner dense felsite to an outer perlitic glass.

The United Perlite mine (Uniperl) in the Brushy Mountains, 19 km east of No Agua, consists of 10-15 m thick vitrophyric perlite breccia that is older than the perlite at No Agua (Weber and Austin, 1982). Minor production occurred in 1959 and in the early 1980s (Schilling, 1960; Weber and Austin, 1982), but the deposit is currently inactive.

Picuris District

The Picuris district, in the Picuris Range of the Sangre de Cristo Mountains (Fig. 1) is best known for the Harding pegmatite, a Proterozoic complex-zoned pegmatite, which has produced substantial amounts of beryl, lepidolite, spodumene, and tantalum-nio-

TABLE 4. Estimated molybdenum production from Molycorp's Questa mine (Schilling, 1960; http://www.molycorp.com/home_frameset.html).

Years produced	Short tons MoS ₂ produced	Mining method	Comments
1919-1956	18,095,000	Underground	Grade 4% MoS ₂ , some stopes as high as 35%
1965-1983	81,000,000	Open pit	Grade 0.17%
1989-1992		Block caving	
1996-2001	6,200,000	Block caving	
2002	867,266	Block caving	Grade 0.407% MoS ₂
Estimated total			

TABLE 5. Tungsten production from Taos County, New Mexico (from Dale and McKinney, 1959; Hobbs, 1965).

District	Period of Production	Production (Pounds)	%WO ₃	Estimated Value (\$)
Picuris	1918-1920	3000	60	<100
Picuris	1955	12,000	—	<500
TOTAL NM	1907-1956	1,100,000	60	250,000

bium (microlite) minerals. The pegmatite was discovered about 1910 and mining for lepidolite began in 1919. This was the first of three mining periods (the Lepidolite period, 1919-1930; Jahns and Ewing, 1977). Lepidolite, a lithium-bearing mica, is used to manufacture glass. From 1920 to 1930, approximately 12,000 tons of lepidolite-spodumene ore, averaging 3.5% LiO₂ was produced (Schilling, 1960). Additional production occurred in 1942-1947 (41 tons of spodumene, 558 tons of lepidolite) and again in 1950-1953 (806 tons of lepidolite, 249 tons of spodumene).

The second period of mining, the Microlite period (1942-1947), began in 1942 when Arthur Montgomery began mining microlite, a tantalum-niobium mineral. The Harding pegmatite is one of the few mines in the world to produce microlite. From 1942 to 1947, more than 22,000 pounds of tantalum concentrates, averaging 68% Ta₂O₅ and 7% Nb₂O₅, were produced (Jahns and Ewing, 1977). In addition, 464 pounds of placer tantalite and columbite (43% Ta₂O₅, 36% Nb₂O₅) were produced.

The third mining period, the Beryl period, occurred between 1950 and 1958. From 1950 to 1959, 848.3 tons of beryl averaging 10% BeO were produced from the Harding pegmatite, and from 1950 to 1955 the pegmatite accounted for nearly 20% of the beryl production in the United States (Schilling, 1960). After mining ceased in 1959, the Harding mine was leased to several companies for exploration of additional resources. Since the early 1970s, the mine has been leased and subsequently donated to the University of New Mexico for preservation.

The Champion Mine consists of large quartz-copper veins on the western slope of Copper Hill north of the Harding mine. It

is hosted by a muscovite-rich quartzite, which contains kyanite, staurolite, and muscovite (Williams and Bauer, 1995). Based on the stability field and presence of kyanite in the vein, an estimate of the temperature is between 400 and 500° C (Williams and Bauer, 1995). The quartz veins contain chalcocite, malachite, chrysocolla, cuprite, covellite, and argentite. Resources are estimated at 46,500,000 short tons of 0.42% Cu (McLemore, 2001).

In addition to the Harding mine, other commodities have been produced from veins and replacements in Proterozoic rocks and metamorphic deposits. Approximately 850 pounds of optical-grade calcite was mined from the Iceland Spar mine (NMTA0505), adjacent to the Harding mine in 1939. The deposit is a lenticular, pipelike body in amphibolite schist and quartzite near the Harding mine. Tungsten was produced during World War I and in 1955 from the quartz veins at the Wichita mine (Table 5). A small quantity of bismuth was produced from quartz veins at the Bismuth mine in 1950. Sillmanite and kyanite are found in quartzite of the Ortega Formation in the northern part of the Picuris district. Staurolite twins, locally called “fairy crosses”, have been collected from Proterozoic schists in the Picuris district and made into jewelry since as early as 1891.

Questa District

Molybdenum was discovered in the Questa district along the Red River in northern Taos County (Fig. 1) about 1914 (Schilling, 1960, 1990). The soft black to steel blue mineral was first misidentified as graphite, and the bright-yellow molybdenum

TABLE 6. Active mines in Taos County (from Pfeil et al. 2001). Mine identification number is the Mine_id from the New Mexico Mines Database (McLemore et al., 2003). * Exact location not known. Sand and gravel mines typically do not fall with a mining district.

District	Mine ID No.	Name	Latitude, longitude (decimal degrees)	Commodity	Operating company
M.I.C.A.	NMTA0008	U. S. Hill	36.205782, 105.616828	Mica	Oglebay-Norton, Inc.
Questa	NMTA0017	Questa	36.6997421, 105.5030855	Mo	Molycorp, Inc.
No Agua	NMTA0513	No Agua	36.74265, 105.956203	Perlite	Harborlite Corp.
No Agua	NMTA0010	El Grande	36.742174, 105.968359	Perlite	Dicaperl Corp.
—	NMTA0098	Peñasco	36.2085, 106.7844	Sand, gravel	Fernandez Gravel
—	NMTA0099	Gonzales	36.4866, 105.7388	Sand, gravel	Gonzales Sand and Gravel Company
—	NMTA0100	Costilla	36.4736, 105.7917*	Sand, gravel	Medina Robert and Sons Concrete
—	NMTA0101	Sunshine	36.8514, 105.6125	Sand, gravel	Medina Robert and Sons Concrete
—	NMTA0102	Taos Pit IL	36.4583, 105.6292	Sand, gravel	Medina Robert and Sons Concrete
—	NMTA0104	Sanistaven	36.5167, 105.7028	Sand, gravel	Perovich Properties
—	NMTA0105	Silva's 1	36.3708, 105.6542	Sand, gravel	Silva's Excavation
—	NMTA0106	Silva's 2	36.8361, 105.5944	Sand, gravel	Silva's Excavation
—	NMTA0562	Taos	36.4736, 105.7917*	Sand, gravel	Medina Robert and Sons Concrete
—	NMTA0563	Torres	*	Sand, gravel	Perovich Properties

veins and jarosite altered outcrops were misidentified as sulfur (hence the geographic name Sulphur Gulch). By 1918, the R and S Molybdenum Mining Company correctly identified the ore as molybdenite and began underground mining of high-grade veins. The ore was hauled several miles by horse and mule drawn wagons to the June Bug mill, which was the relocated gold mill from Elizabethtown. In 1919 R and S Molybdenum Mining Company was reorganized as the Molybdenum Corporation of America, which eventually became Molycorp, Inc. In 1923, Molycorp built a processing mill, which was one of the first flotation mills in North America. The mill has since been rebuilt several times.

Underground mining of high-grade vein ore was from 1919 to 1956 (Table 4; Schilling, 1960, 1990). Exploration continued from 1956 to 1964, when open-pit mining commenced. The company mined some 81 million tons of ore from their open pit at a grade of 0.191% Mo between 1965 until 1982. Underground block caving of ore commenced in 1983. Molycorp continued mining through 1986, when soft market conditions caused the temporary shutdown of the mine until 1989. Mining operations again were placed on standby in 1992 and resumed in 1995 and continue to this day.

Current ore grade ranges between 0.3 and 0.5% Mo. Reserves and resources (Bruce Walker, Molycorp, personal communication, 1999) at Questa are as follows:

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

When proven and probable reserves are considered the mine life is 25-35 years, and when resources are included the mine life is 50-80 years.

The Log Cabin deposit, also a porphyry molybdenum deposit, is southeast of the Questa deposit and potentially contains some 51,000,000 short tons of 0.17% Mo (Bruce Walker, Molycorp, personal communication, 2001). Quartz-molybdenite veins are found in the Bear Canyon, Sulphur Gulch, Blind Gulch, and near Columbine Canyon (Schilling, 1960) that suggest additional porphyry molybdenum deposits likely are concealed in the Questa district.

Red River – Rio Hondo District

Six deposit types are found within the Red River-Rio Hondo district in northern Taos County (Fig. 1): placer gold, volcanic epithermal veins, alunite-argillic alteration, porphyry molybdenum, and Precambrian vein and replacement deposits. The production from the district mostly has come from the volcanic epithermal veins and placer gold deposits.

Although the Spanish probably prospected the area and may have found some placer gold, it wasn't until 1826 that gold was discovered in the district. Major exploration and development didn't occur until 1867, when the Waterbury Watch Company of Connecticut began development at the Anaconda claims. By

1897, Red River had a population of 2000, but the mines never yielded large amounts of gold or other metals (Table 3; Roberts et al., 1990). Exploration and development, with little mining, continued into the 1980s. There are several reasons why mining was not profitable, including poor milling practices, bad management, lack of sufficient capital, high operating costs, isolation of the district and low grades.

Metals deposits in the Red River-Rio Hondo district are found as fault-controlled quartz cemented breccia zones and banded, massive or vuggy quartz veins that are characteristic of volcanic epithermal vein deposits. Gold, pyrite, molybdenite, sphalerite, galena, bornite, chalcocite, malachite, azurite, fluorite, chalcopyrite, pyrrargyrite, and argentite are found in the breccia zones and veins.

Other deposits are found in the district. Placer gold deposits are found in Red River and local drainages of Red River. Quartz-molybdenite veins associated with Tertiary porphyritic granitic intrusions in the Bobcat, Mallette, and Bitter Creeks area indicate the possibility of a concealed porphyry molybdenum deposit (Schilling, 1960). Local areas of pyrite-bearing hydrothermal and acid weathering, locally known as alteration scars, are associated with both the Red River-Rio Hondo and Questa districts in Red River valley, where alunite is found. Alunite is a potential source of aluminum. Quartz veins of unknown age are found in Precambrian rocks that contain small amounts of gold, silver, copper, and other metals.

Rio Grande Valley District

Placer gold deposits are found in the Rio Grande gorge and at the mouths of Red River, Lama Canyon, Alamo Canyon, Garrapata Canyon, San Cristobal Creek, and the Rio Hondo, all forming the Rio Grande Valley district in central Taos County (Fig. 1; Johnson, 1972; McLemore, 1994). The Spanish probably prospected and panned for gold along the Rio Grande in the 1600s, but reported production didn't occur until 1902. The Oro Grande Company built a floating dredge near Glenwoody in 1902. In the early 1930s, Charles Curtis built a dredge near the Taos Junction Bridge, but massive basalt boulders made dredging difficult and the operation only lasted a few weeks. The deposits were found in bench, river bed, and deeper river deposits along the river. The gold is coarse and flaky with very little fine gold. The sources of the gold are veins in the Proterozoic rocks.

Twining District

Mining in the Twining district (Fig. 1) began around 1869 (Park and McKinlay, 1948). Shear zones in the metamorphic Precambrian rocks (metavolcanics and metasediments), as well as quartz veins, act as hosts for the ore minerals. Common minerals present within the quartz vein zones are tourmaline, epidote, pyrite, galena, chalcopyrite, and malachite. Gold, galena, bornite, chalcocite, chalcopyrite, pyrite, hematite, magnetite, malachite, azurite, and fluorite are some of the other minerals found in the district. The predominate mine in the Twining district was the

Frazer. It was a copper mine that was worked before the turn of the century by local prospectors. The amount of copper extracted from the Fraser mine is not known (Park and McKinlay, 1948).

OTHER COMMODITIES

Adobe bricks are manufactured in the Taos area for local homes. Commercial operations vary in activity according to local demand.

Sand and gravel deposits are found throughout the valleys and along the Rio Grande in Taos County. Ten aggregate pits are currently active in the county, mostly in the vicinity of Taos (Table 6).

Limestone is abundant in Tres Ritos Hills, where a small quarry was operated prior to 1960 for local building stone and aggregate use (NMTA0551 in New Mexico Mines Database; Schilling, 1960). It is unlikely that limestone for cement will be mined in the near future in Taos County because of long distance to potential markets. However, limestone will likely be mined as an aggregate, especially as construction in Taos and other areas expands.

Coal is found along the Rio Fernando de Taos in the Pennsylvanian Sandia Group (NMTA0564 in New Mexico Mines Database). The coal is too thin and impure to be economic (Schilling, 1960).

RECLAMATION

All currently active mines in Taos County have ongoing reclamation and close-out plans. Various agencies, including the New Mexico Abandoned Mine Lands Bureau and the U. S. Forest Service have reclaimed some of the older, inactive mines in the county, based on their priority ratings.

OUTLOOK

Minerals production in New Mexico has continued to decline since maximum annual minerals production was achieved in 1989 (McLemore et al, 2002). This decline is a result of numerous complex and interrelated factors. Some of the more important factors include declining commodity prices and quality of ore. Other factors have hampered new mines from opening in the state, including water rights issues, public perceptions, and the complexity and length of time for the entire regulatory process to occur in the U. S. at local, state, and federal levels. All of these factors add to the cost of mining, not only in New Mexico, but also throughout the world. A healthy mineral industry is vital to the economy of New Mexico and to maintenance of public education and services. The occurrence of world-class deposits in Taos County should encourage the continuation of mining in the county.

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APPENDIX 1

As—arsenic	Fe—iron	Sb—antimony
Au—gold	Ga—gallium	Sn—tin
Ba—barium	Ge—germanium	Te—tellurium
Be—beryllium	Mn—manganese	Th—thorium
Bi—bismuth	Mo—molybdenum	U—uranium
Co—cobalt	Ni—nickel	V—vanadium
Cu—copper	Pb—lead	W—tungsten
F—fluorine	REE—rare-earth elements	Zn—zinc