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TELLURIUM RESOURCES IN NEW MEXICO

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ABSTRACT

Tellurium (Te) is one of the least abundant elements in the crust and tends to form minerals associated with copper, lead, zinc and iron sulfide deposits. Today, most tellurium production comes from the anode slimes and other wastes generated in metal refining. Most of the current tellurium produced in the world is used as an alloying agent in iron and steel, as catalysts, and in the chemical industry. However, future demand and production could increase because tellurium is increasingly used in solar panels and some electronic devices. Tellurium minerals are found in Au-Ag districts in New Mexico, but were not considered important exploration targets in the past. In New Mexico, tellurium is found associated with porphyry copper deposits in southwestern New Mexico and with Au-Ag veins in the Eureka, Sylvanite, Organ, Lordsburg, Steeple Rock, Wilcox, Mogollon, Chloride, Cuchillo, Hillsboro, Zuni Mountains, White Oaks, and Nogal-Bonito districts. The only tellurium production from New Mexico has been from the Lone Pine deposit (Wilcox district), where approximately 5 tons of tellurium ore was produced. Gold-tellurides are found with gold, silver, pyrite, and fluorite in fracture-filling veins in rhyolite at Lone Pine, with reported assays as much as 5,000 ppm Te. Other districts in New Mexico have potential for tellurium, but require field evaluation.

INTRODUCTION

Tellurium (Te) is one of the least abundant elements in the crust and tends to form minerals associated with gold, silver, bismuth, copper, lead, zinc and iron sulfide deposits. Tellurium has an atomic number of 52 and atomic weight of 127.6. Tellurium is a rare element; the average concentration of tellurium in the crust is 0.005 ppm (Ayres et al., 2003). Tellurium is a chacophile element and is found in sulfide, skarn and hydrothermal mineral deposits.

Production statistics are in Table 1; other countries producing tellurium include Australia, Belgium, Chile, China, Colombia, Germany, Mexico, the Philippines, Poland, Kazakhstan, and Russia. The world production of tellurium is estimated as 450-1,000 tonnes per year (Naumov, 2010; http://seekingalpha.com/instablog/65370-jack-lifton/12427-the-tellurium-supply-conjecture-and-the-future-of-first-solar, accessed on 11/8.12). Total world tellurium reserves are estimated as 24,000 metric tonnes (U.S. Geological Survey, 2012). Approximately 50% of the current production of tellurium is used as an alloying agent in iron and steel to improve machinability. Approximately 25% of tellurium production is used in catalysts and other chemical use and 10% of tellurium production is used in alloying with non-ferrous metals like copper and lead (U.S. Geological Survey, 2010, 2012). Approximately 8% of tellurium production is used in electronic applications and the remaining 7% is used in other applications. Additional uses of tellurium include ingredient in blasting caps, pigment to produce various colors in glass and ceramics, fiber optics, refrigeration technologies, air conditioning, and heat-resistant rubber. However, future demand and production could increase because tellurium is used in cadmium telluride (CdTe) thin-film photovoltaics (TFPVs) in solar panels (Committee on Critical Mineral Impacts of the U.S. Economy, 2008) and some electronic devices, such as digital storage devices. TFPVs in solar panels convert sunlight directly to electricity using thin films of semiconductors. The thin films are 3-300 microns and approximately 8 grams of tellurium is used per solar panel, or approximately 696.8 kg of tellurium for 10 MW of power production (http://greenecon.net/solar-energy-limits-possible-constraints-in-tellurium-production/solar-stocks.html, accessed on May 3, 2010). In 2008, CdTe TFPVs accounted for approximately 8% of the 7 gigawatt global TFPV market (U.S. Department of Energy, 2010). It is not known how much tellurium production is needed to sustain manufacture of solar panels.

Tellurium deposits have been reported from New Mexico, but were not considered important exploration targets in the past because the demand in past years has been met by other deposits in the world. The purpose of this report is to summarize the known occurrences of tellurium in New Mexico.

METHODS OF STUDY

Data used in this report have been compiled from a literature review, field examination, and unpublished data by the author. Limited field investigation occurred in some areas. A summary of the mining districts in New Mexico containing tellurium deposits is in Appendix 1. Tellurium mining districts, mines, and other spatial data were plotted using GIS ArcMap and are shown in Figure 1. For the purposes of this report the districts in Appendix 1 and Figure 1 are reported to have tellurium minerals or have samples that assayed >20 ppm Te.

Table 1. World refinery production, reserves, and prices of tellurium (George, 2009, 2012; U.S. Geological Survey, 2010, 2012). Naumov (2010) estimates the U.S. production as 50 tonnes/yr.

Year/Country	2004 (kg)	2006 (kg)	2008 (kg)	2009 (kg)	2010 (kg)	2011 (kg)	Reserves (tonnes)
Canada	55,000	10,000	19,000	16,000	8,000	6,000	800
Japan	33,000	35,000	46,500	49,200	47,000	40,000	W
Peru	22,000	33,000	28,000	7,000	—	—	3,600
Russia	—	—	34,000	34,000	34,000	34,000	W
United States	W	W	W	W	W	W	3,500
Price ($/kg, 99.95% min.)	22.50	89	175	130	221.25	349.35	

W=withdrawn
— no data

GEOLOGY OF TELLURIUM DEPOSITS IN THE WORLD

Although tellurium minerals have been described from many deposits, there have not been specific geologic models developed on how tellurium deposits form or how to explore for them. The predominant source of tellurium today is from anode slimes or sludges produced during the refining of copper and lead ores. It takes approximately 500 tons of copper ore to produce 1 pound of tellurium. Tellurium concentrations in porphyry copper deposits vary widely and can be as high as 6,000 ppm Te (Table 2), but are typically less than 1 ppm Te (Cox et al., 1995). The slimes remaining from copper refining can contain as much as 2% Te (George, 2012). The ASARCO LLC copper refinery in Amarillo, Texas was the only U.S. producer of refined tellurium in 2011 (George, 2012). Tellurium is recovered only from conventional milling and refining of porphyry copper deposits, and is not recovered from porphyry copper deposits that are processed by heap leaching.

Tellurium can be found as a native metal, but it is more commonly found in more than 40 minerals, many of which are telluride minerals. Tellurium is one of the few elements that can form a variety of minerals with gold as principal component (e.g. calaverite $AuTe_2$, krennerite $(AuAg)Te_2$, petzite Ag_3AuTe_2 and sylvanite $AgAuTe_4$). These minerals have been known for a long time and are found in many deposits such as Cripple Creek (Colorado), Emperor (Fiji), and Săcărîmb (Romania).

Other known telluride minerals are hessite (Ag_2Te), tellurobismuthite ($BiTe_3$), tetradymite (Bi_2Te_2S), and altaite ($PbTe$).

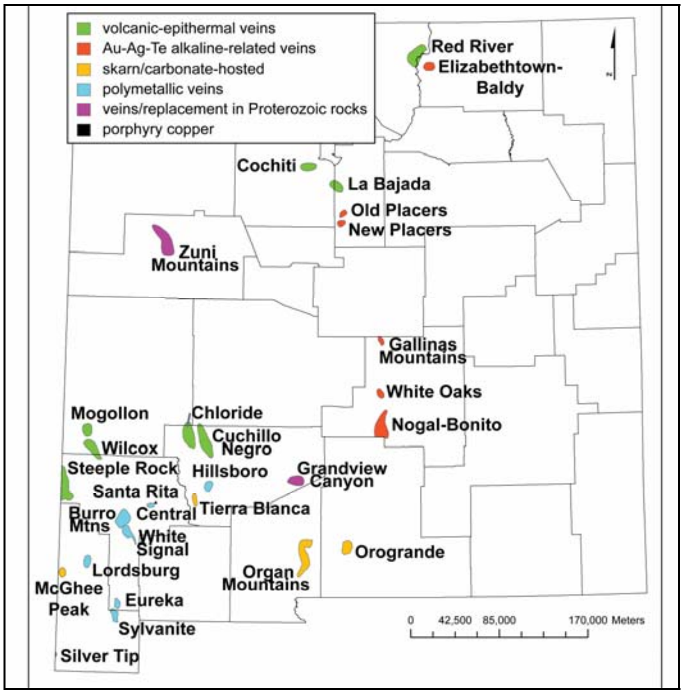

Figure 1. Mining districts in New Mexico with tellurium minerals or chemical assays >20 ppm Te.

Tellurium is found in many Au-Ag vein deposits (Table 2), but the amount of tellurium is generally so low that the deposit generally must be economic for gold and silver with tellurium as a by-product. The Kankberg gold mine in northern Sweden and operated by Boliden contains 4.1 g/tonne Au and 186g/tonne Te (http://www.boliden.com/Documents/Press/Presentations/Kankberg.pdf , accessed on 11/8/12). Kankberg should be in production this year.

Table 2. Ranges in concentration of tellurium in selected deposits (Everett, 1964; Boyle, 1979; Cox et al., 1995).

Type of deposit	Te (ppm)
Gold-quartz veins	0.2-2,200
Gold skarn deposits	0.2-0.5
Polymetallic gold deposits	0.2-10
Gold quartz-pebble conglomerate deposits	<0.2-0.7
Carlin-type deposits	<0.2-0.6
Porphyry copper deposits	<0.1-6,000
Lead-zinc ores	0.5-1.0

Apollo Solar Energy, Inc. is developing two tellurium mines in Chengdu, Sichuan Province in China. The Dashuigou mine contains an estimated 30,200 tonnes of ore (indicated and inferred) grading 1.09% Te and the Majiagou mine contains an estimated 13,400 tonnes of ore (indicated and inferred) grading 3.26% Te (http://www.prnewswire.com/news-releases/apollo-solar-announces-results-of-independent-technical-review-of-dashuigou-and-majiagou-tellurium-projects-61824367.html, accessed on 11/6/12). Tellurium is found in the second of three stages of vein mineralization and grades range from 0.2 to 5% (Jingwen et al., 1995).

Deer Horn Metals has estimated indicated mineral resources at the Deer Horn gold-silver-tellurium deposit in British Columbia as 414,000 tonnes of 5.12 g/t Au, 157.5 g/t Ag and 160 ppm Te (Lane and Giroux, 2012). This deposit is still in the feasibility stage.

Another exploration target is the Bambolla mine in Moctezuma, Sonora, Mexico, where as much as 0.37 oz/ton Au and 0.15% Te are found in quartz veins that are 1-2 m wide (Everett, 1964).

Tellurium also is found in placer gold deposits, because tellurium can be resistant to weathering and will remain with the gold during formation of placer gold deposits (Boyle, 1979).

TYPES OF TELLURIUM DEPOSITS IN NEW MEXICO

Au-Ag-Te alkaline-related veins

Au-Ag-Te alkaline-related veins are found associated with alkaline to subalkaline igneous rocks, and contain predominantly gold with local concentrations of silver, copper, lead, and zinc and are spatially associated with iron, molybdenum, fluorite, tungsten, uranium, thorium, rare-earth elements, tellurium, and niobium deposits. The veins have high gold/base metal ratios and typically low silver/gold ratios (Kelley et al., 1995; McLemore, 1996a). Native gold and a variety of silver minerals are found in veins in most districts along with chalcopyrite, galena, and sphalerite. Pyrite, calcite, quartz, iron and manganese oxides and clay minerals are common gangue minerals. Veins occur in both Tertiary intrusives and surrounding sedimentary rocks. Veins are typically thin, less than a 1 m wide, have steep dips, and occur along faults. Wall-rock alteration is typically weak propylitic to argillic (Douglass and Campbell, 1995; McLemore, 1996a, 2001). Tellurides are common to most Au-Ag-Te alkaline-related veins.

Volcanic-epithermal veins

Volcanic-epithermal vein deposits in New Mexico, like elsewhere in the world, are found in structurally complex tectonic settings that provide an excellent plumbing system for circulation of hydrothermal fluids. Lindgren (1933) defined the term "epithermal" to include a broad range of deposits that formed by ascending waters at shallow to moderate depths (<1500 m), low to moderate temperatures (50°-200°C), and which are typically associated with intrusive and/or volcanic rocks. It is now generally accepted that epithermal deposits were formed at slightly higher temperatures (50°-300°C) and relatively low pressures (a few hundred bars) based on fluid inclusion and isotopic data. The volcanic-epithermal deposits of New Mexico are confined to faults and fissures in rhyolitic ash-flow tuffs and andesites of Oligocene-Miocene age, commonly within or adjacent to resurgent caldrons (Elston, 1978; 1994; Rytuba, 1981; McLemore, 1996b, 2001). Tellurium locally is found with gold and silver in some of these veins.

Skarns/carbonate-hosted deposits

Skarn deposits of copper and other metals can form near the contact between intrusions and adjacent limestone and other carbonate-bearing rocks. Skarn is a term for rocks that can have diverse origins, but with similar mineralogy, typically calcium-bearing varieties of garnet and pyroxene (Einaudi et al., 1981; Einaudi and Burt, 1982; McLemore and Lueth, 1996). Whereas these types of deposits can form in a number of geological environments, they are most common in the southwestern U.S. in contact metamorphic deposits aureoles where hot, igneous rocks have intruded calcareous host rocks (Einaudi, 1982). Hydrothermal fluids exsolved from the igneous rocks metasomatize the calcareous wall rocks, converting them to garnet and pyroxene. Magnetite and calcsilicate minerals commonly also are present, especially in magnesian (dolomitic) host rocks.

Carbonate-hosted Pb-Zn and Ag-Mn replacement deposits in southwestern New Mexico were formed about 40-20 Ma and include replacements in carbonate rocks with little or no calc-silicate minerals, small skarns, and veins in carbonate rocks (McLemore and Lueth, 1996). These replacement deposits are typically lead-zinc or manganese-silver dominant, with by-product copper, silver, and gold. Calc-silicate minerals typical of skarn deposits are rare to absent in most of these deposits, and, if present, they are not as abundant and do not display mineralogical zonation. Galena and sphalerite are the predominant ore minerals with lesser amounts of chalcopyrite and silver minerals. Many deposits in New Mexico contain cerussite, anglesite, smithsonite and manganese minerals, which were mined in the past. The host rocks are predominantly Paleozoic carbonate rocks, with a few smaller deposits in Cretaceous carbonate rocks. Tellurium is found in both types of deposits, generally associated with pyrite.

Polymetallic veins

Polymetallic veins generally consist of quartz, pyrite, clay, iron oxides, barite, free gold, copper sulfides, galena, and additional minor minerals (McLemore, 2001). Some veins are as much as 1,500 m long and 0.8-3 m wide. They are typically en echelon and pinch and swell. The veins locally grade along strike into an alteration zone of sericite and pyrite with little or no metals concentrations. The polymetallic vein deposits are locally found associated with porphyry copper and/or skarn deposits near intrusions. The veins vary tremendously in chemical composition, but are typically enriched in Au, Ag, Cu, As, Bi, Pb, Zn, Sb, and Te.

Vein and replacement deposits in Proterozoic rocks

Vein and replacement deposits containing base and precious metals occur sporadically throughout most of the Proterozoic terranes in New Mexico. Many of these deposits are structurally controlled by schistosity or shear zones of Proterozoic age and are, therefore, syn- or post-metamorphic (Zuni Mountains, Grandview Canyon; McLemore, 2001). Anomalous tellurium is found in the Zuni Mountains and Grandview Canyon areas and could be present in other districts.

Porphyry copper (±molybdenum, gold) deposits

Porphyry copper (±molybdenum, gold) deposits are large, low-grade (<0.8% Cu) deposits that contain disseminated, breccias and stockwork veinlets of copper and molybdenum sulfides associated with porphyritic intrusions (Schmitt, 1966; Kesler, 1973; Lowell, 1974; Titley and Beane, 1981; Cox and Singer, 1986; Cox et al., 1995; McLemore, 2001; Seedorff et al., 2005). These copper deposits typically are found in and around relatively small porphyritic diorite, granodiorite, monzonite, and quartz monzonite plutons that were intruded at relatively high crustal levels, commonly within 1-6 km of the surface, and are surrounded by crudely concentric zones of hydrothermal alteration (Seedorff et al., 2005). Hydrothermal solutions are released through these fractures and react with the host rocks, altering them in a characteristic, concentric zonation. Tellurium is found in trace amounts in these systems and is recovered only from the refinery wastes.

DESCRIPTIONS OF SELECTED TELLURIUM DEPOSITS IN NEW MEXICO

Lone Pine, Wilcox district, Catron County

The Lone Pine deposit is in the Wilcox district in the Mogollon Mountains, where 5 tons of tellurium was produced from Au-Te epithermal veins. Some of the first tellurium minerals found in New Mexico were reported from this deposit, including native tellurium (Ballmer, 1932; Gillerman, 1964; Ratté et al., 1979; Lueth et al., 1996). Primary mineralization occurs as fracture fillings in veinlets in silicified flow banded rhyolite at most of the prospects in the region. Disseminated mineralization is also present. At the Lone Pine mine primary mineralization occurs in a large zone of silicified flow banded rhyolite and silicified andesite. Primary mineralization consists of pyrite, fluorite, native tellurium, molybdenite and gold-tellurides. A vertical zonation is apparent with pyrite stratigraphically lowest, grading into a pyrite-tellurium assemblage, followed by a fluorite-rich zone at the highest elevations. Tellurium mineralization is strongest at the pyrite-fluorite transition zone. Samples assayed as much as 3,500 ppm Te (Ratté et al., 1979) to 5,000 ppm Te (V.T. McLemore, unpublished files).

Organ Mountains, Doña Ana County

The Organ Mountains district is in the Organ Mountains, where metal production from the district amounts to $2.7 million worth of copper, lead, zinc, silver, and gold (McLemore et al., 1996). Six types of deposits are distributed in five mineral zones; a core of copper-molybdenum porphyry deposit is surrounded by zinc-lead, lead-zinc, gold-silver, and outer fluorite-barite zones (Lueth and McLemore, 1998; Lueth, 1998) and are associated with the Organ batholith. The Sugarloaf Peak quartz monzonite, one of three major phases of the Organ batholith, is 34.4±0.3 Ma (McLemore et al., 1995, 1996). Samples collected from selected mines in the district range from <0.1 to 160 ppm Te (McLemore et al., 1996, table 23). Tellurium minerals are found at several mines in the district. Most of the district is on the White Sands Missile Range and withdrawn from mineral entry.

Sylvanite District, Hidalgo County

The Sylvanite district is in the Little Hatchet Mountains where Laramide skarn, Laramide vein, and gold placer deposits are found; mineral production is estimated at approximately $315,000, including 2500 oz Au and 35,000 oz Ag (McLemore et al., 1996; McLemore and Elston, 2000). In 1908, placer gold and tetradymite were found at the Wake Up Charlie mine. Native gold and tetradymite also were found in veins at Gold Hill, Green, and Little Mildred mines (Short and Henderson, 1926; Lasky, 1947). Tellurobismuthite was found at the Buckhorn mine. Additional sampling is required to determine the potential for tellurium and gold in this district.

Tierra Blanca, Sierra County

The Tierra Blanca or Bromide No. 1 district lies south of the Kingston district in the Black Range of western Sierra County. Tierra Blanca is Spanish for white earth, named after the white capped hills and mountains formed by rhyolitic rocks. Gold, silver, and lead were produced from carbonate-hosted Ag-Mn replacement deposits. Volcanic epithermal vein and sedimentary-iron deposits also are found in the district. Tellurium minerals are found at the Lookout and other mines.

Grandview Canyon, Sierra County

Proterozoic vein and replacement deposits are found in the Grandview Canyon district in the San Andres Mountains. Total metals production from the district is unknown, but some copper, gold, silver, and lead have been produced. Approximately 20,000 lbs of tungsten was produced from Grandview Canyon in 1907–1920 (Dale and McKinney, 1959). In 1918, 1,500 lbs of ore containing 70.2% WO_3 and some gold and silver were shipped from the Pioneer claim (Lasky, 1932). In addition, George Stone produced mineral specimens of bismutite from the claims in the early 1900s. Minor replacements, thin mineralized veins and seams, and fracture coatings along faults and shear zones are found in Proterozoic granite and schist adjacent to amphibolite dikes. The mineralized bodies consist of malachite, bornite, chalcopyrite, chalcocite, scheelite, powellite, bismutite, bismuthinite, pyrite, and quartz (Lasky, 1932; Clemmer and Holstein, 1974; NMBMMR files; V.T. McLemore, unpublished field notes, February 18, 1994). Tellurium is associated with the tungsten and bismuth minerals. Quartz veins and mineralized seams are typically less than a few centimeters wide and cut across the schistosity; several veins and seams are found locally in a zone up to 1.5 m wide and several hundred meters long. Pods of mineralized veins and seams surrounded by unmineralized but altered host rocks are common within these zones. The zones are steeply dipping and strike predominantly N70°W. The veins appear to thin and pinch out with depth. Samples from the Pioneer mine <2-200 ppb Au, 0.15-1.5 ppm W, <10-11,000 ppm Bi, and <0.2-90 ppm Te (unpublished data). The district is on the White Sands Missile Range and withdrawn from mineral entry.

Porphyry copper deposits

There are eight Laramide porphyry copper deposits in New Mexico (Fig. 2; McLemore, 2008). Many other areas in the state have potential for porphyry copper deposits, but there are no reported reserves or production. Only the Chino and Tyrone mines are currently in production. The largest Laramide porphyry copper deposit in New Mexico is the Chino mine in the Santa Rita district, where copper sulfides occur in the upper part of a highly fractured granodiorite and adjacent sedimentary rocks. Although there is no chemical data for tellurium in these deposits, it is likely that tellurium could be recovered from the refinery slimes after processing.

POTENTIAL FOR NEW MEXICO TELLURIUM DEPOSITS

Like most areas in the world, the resource potential for tellurium deposits in New Mexico depends upon the economic potential for gold-silver veins or porphyry copper deposits. Tellurium likely is found in trace amounts in the porphyry copper deposits, but detailed mineral chemistry is required to determine what minerals tellurium is found.

Table 3. Laramide porphyry copper deposits in southwestern New Mexico (McLemore, 2008). ** skarn or carbonate-hosted replacement deposits also present. Mine identification number is from the New Mexico Mines Database (McLemore et al., 2005a, b).

Mine Identification Number	Porphyry Deposits	Latitude (decimal degrees)	Longitude (decimal degrees)
NMGR0029	Chino**	32.791667	108.06667
NMGR0084	Tyrone	32.643889	108.36722
NMSI0610	Copper Flat**	32.806667	108.12222
NMGR0478	Gold Lake	32.55270	108.32957
NMGR0208	Hanover Mountain	32.833	108.083
NMGR0409	Lone Mountain**	32.718056	108.17667
NMGR0160	Little Rock (Ohio)	32.646698	108.40675
NMHI0327	Steins	32.186111	109.020833

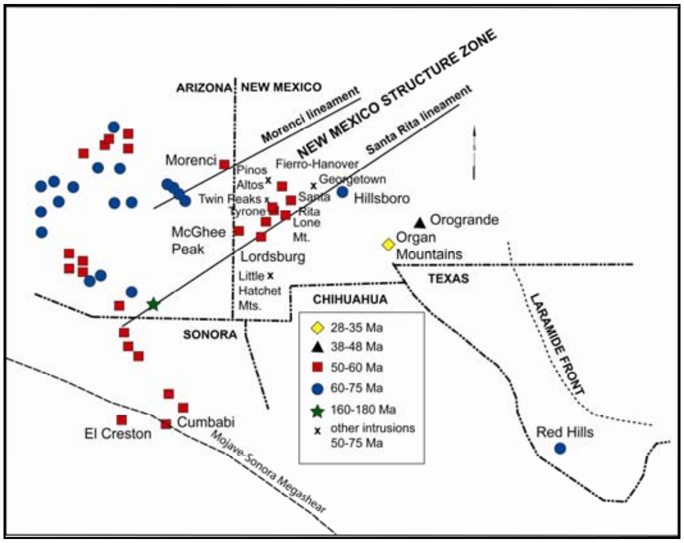

Figure 2. Laramide porphyry copper deposits in southwestern United States and northern Mexico.

RECOMMENDATIONS

There have not been specific geologic models developed on how tellurium deposits form or how to explore for them, and detailed studies are required to develop these models. Detailed mapping, mineralogical, and geochemical analyses are required in all of the New Mexico deposits, especially those in the Wilcox, Organ Mountains, and Sylvanite districts and porphyry copper deposits to fully understand the formation and future resource potential of tellurium. All porphyry copper and gold deposits in New Mexico, including placer gold deposits, should be analyzed for tellurium.

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APPENDIX 1—Mining districts in New Mexico with tellurium reportedly present (as tellurium minerals or >20 ppm Te). Names of districts are after File and Northrop (1966) wherever practical, but some districts have been combined and added. Estimated value of production is in original cumulative dollars and includes all commodities in the district. Districts may extend into adjacent counties or states or into Mexico. District Id is from the New Mexico Mines Database (McLemore et al., 2005a, b).

District Id	District (Aliases)	Year of Discovery	Years of Production	Commodities Produced (Present)	Age of Deposits	Type of Deposit	Comments
Catron County							
DIS010	Wilcox (Seventy-four, Savton Mesa, Tellurium)	1879	1941	Au, Ag, Cu, F, Te (Pb, Zn, Mo, Cd, Mn)	—	volcanic-epithermal veins	5 tons Te produced from Lone Pine mine (Lueth et al., 1996)
DIS007	Mogollon (Coney, Alma, Glenwood)	1875	1875-1969	Au, Ag, Cu, Pb, Zn, U (Mo, F, Ba, Mn, Fe, Te)	—	volcanic-epithermal veins	Tellurium reported by Northrop (1996)
Cibola County							
DIS017	Zuni Mountains (Copper Hill, Diener)	1800	1905-1965	Cu, Pb, Ag, Au, F (Fe, U, Ba, V, REE, Te)	—	vein and replacement deposits in Proterozoic rocks	Possible tellurium
Colfax County							
DIS019	Elizabethtown-Baldy (Ute Creek, Moreno, Ponil, Aztec, Cimarron, Wiloc Creek, Copper Park, Eagle Nest, Hematite, Iron Mtn)	1866	1866-1968	Au, Ag, Cu, Pb (W, Mo, Bi, Te)	29.1 Ma	Au-Ag-Te alkaline-related veins, placer gold	Tetradymite at the Aztec mine (Lee, 1916; Chase and Muir, 1922; Crawford, 1937)
Doña Ana County							
DIS030	Organ Mtns (Mineral Hill, Bishops Cap, Organ, Gold Camp, Modoc, South Canyon, Texas)	1830s (perhaps as early as 1797)	1849-1961	Cu, Au, Ag, Pb, Zn, U, F, Ba, Bi (Mo, Te, W, Sn, Mn, Fe)	34.5 Ma ($^{30}Ar/^{29}Ar$, McLemore et al., 1995)	carbonate-hosted/skarn, polymetallic veins, porphyry copper-molybdenum, vein and replacement deposits in Proterozoic rocks	Tellurium minerals found at Memphis, Black Quartz, Excelsior, Ben Nevis, Crested Butte, Rickardite mines (Lueth, 1998; Lueth and McLemore, 1998)
Grant County							
DIS043	Central (Bayard, Groundhog, San Jose)	1858	1902-1969	Cu, Pb, Au, Ag, Zn, V, Fe, limestone (W, Mo, Te, Ba)	—	polymetallic veins, placer gold	Tetradymite, possible Te (Everett, 1964)
DIS046	Burro Mtns (Tyrone)	1871 (earlier mining by Spanish and Indians)	1879-present	Au, Ag, Cu, Mo, Pb, Zn, F, W, Mn, Bi, U, turquoise (Te, Be)	Tyrone stock, 54.5 ($^{40}Ar/^{39}Ar$; McLemore, 2008)	placer gold, porphyry copper, polymetallic veins	Tetradymite, tellurium (Anderson, 1957; Davidson and Granger, 1965; Northrop, 1996), Possible Te in slimes from porphyry copper production
DIS065	Santa Rita (Chino)	1800	1801-present	Cu, Au, Ag, Mo (Zn, Pb, Fe, Sb, Be, U, Te)	Santa Rita stock, 58.3 ($^{40}Ar/^{39}Ar$; McLemore, 2008)	porphyry copper, skarn	Possible tellurium in slimes from porphyry copper production
DIS068	White Signal (Cow Spring)	1880	1880-1968	Cu, U, Au, Ag, Pb, Bi, F, Ra, garnet (Th, Zn, Nb, Ta, turquoise, Zn, Be, REE, Ba, Te)	—	polymetallic vein, placer gold	Possible tellurium
DIS053	Eureka (Hachita)	1871	1878-1957	Au, Ag, Cu, Pb, W, Zn, As, turquoise (Be, Te, Bi, Mo, Ba, F)	Hidalgo Formation 71.4 Ma, ($^{40}Ar/^{39}Ar$)	polymetallic veins, skarn, placer gold	Tellurium minerals at Ridgewood, Clemmie, Pearl mines
DIS066	Steeple Rock	1860	1880-present	Au, Ag, Cu, Pb, Zn, F, Mn (Ba, Mo, U, Be, Te)	—	Volcanic-epithermal vein	Possible tellurium
Hidalgo County							
DIS088	Sylvanite	1871	1902-1957	Cu, Pb, Au, Ag, W, As (Sb, Te, Zn, Ge, Be, Mo, Bi, Ba, F)	32.3 Ma ($^{40}Ar/^{39}Ar$), Hidalgo Formation, 71.4 Ma ($^{40}Ar/^{39}Ar$)	skarns, polymetallic veins, placer gold	Gold Hill, Creeper, Hand Car, Buckhorn, Wake Up Charlie, Little Mildred mines (Lasky, 1932; McLemore and Elston, 2000)
DIS083	McGhee Peak (Granite Gap, San Simon, Steins Pass, Kimball)	1894	1894-1956	Cu, Pb, Ag, Au, Zn (Te, Mo)	—	Skarn/ carbonate-hosted	257 ppm Te reported from Silver Star mine (Hoag, 1991)
DIS087	Silver Tip (Bunk Robinson, Whitmore, Cottonwood Basin)	1930	none	(Au, Ag, Cu, Pb, Zn, Mo, F, Ba, Bi, Te)	—	Volcanic- epithermal vein	Samples contained as much as 4,540 ppb Au and 1,400 ppm Te (Armstrong, 1993)
DIS082	Lordsburg (Pyramid, Shakespeare)	1854	1870-1999	Cu, Pb, Au, Ag, F, Zn (Ge, Ba, Mo, Be, Te)	Granodiorite, 58.5 Ma ($^{40}Ar/^{39}Ar$)	Polymetallic vein, porphyry-copper	Possible tellurium
Lincoln County							
DIS092	Gallinas Mountains	1881	1909-1956	F, Cu, Pb, Au, Ag (Mo, Te)	—	Au-Ag-Te alkaline-related veins, Fe skarn,.placer gold	Samples assay 5 – 78 ppm Te
DIS095	Nogal-Bonito (Cedar Creek)	1865	1865-1942	Cu, Au, Ag, Pb, Zn (Mo, Te)	—	Au-Ag-Te alkaline-related veins, placer gold	Tetradymite in the Bear Canyon area, as much as 3.2 ppm Te (Segerstrom et al., 1979; Fulp and Woodward, 1991)
DIS099	White Oaks (Lone Mtn)	1850	1850-1953	Au, Ag, Cu, Pb, W, Fe (W, Te)	—	Au-Ag-Te alkaline-related veins, iron skarn	Tellurium suggested in exploration samples

District Id	District (Aliases)	Year of Discovery	Years of Production	Commodities Produced (Present)	Age of Deposits	Type of Deposit	Comments
Otero County							
DIS129	Orogrande (Jarilla, Silver Hill)	1879	1879-1966	Cu, Au, Ag, Pb, Fe, W (U, Th, Zn, Te)	—	carbonate-hosted/skarn, polymetallic veins, porphyry copper-molybdenum	As much as 450 ppm Te (Korzeb and Kness, 1994)
Sandoval County							
DIS168	Cochiti (Bland)	1880	1894-1963	Ag, Au, Cu, Pb (U)	—	volcanic-epithermal veins	Tellurium in ores (Jenks, 1908)
Santa Fe County							
DIS184	La Bajada (La Cienega, Cerrito, Santa Fe)	1900s	1914-1966	scoria, U, V, Cu, Ag, Mn (Zn, Te, Cd, Ni)	—	copper-silver (U) veins	Possible tellurium (Everett, 1964)
DIS186	New Placers (San Pedro)	1839	1839-1968	Au, Ag, Cu ,Pb, Zn, Mn, garnet (W, Mo, Fe)	—	Au-Ag-Te alkaline-related veins	Tellurium reported by Statz (1909)
DIS187	Old Placers (Ortiz, Dolores)	1828	1828-1986	Cu, Au, Ag, Pb (W, Te, Fe)	—	Au-Ag-Te alkaline-related veins, placer gold, porphyry copper	Tellurium at Carache Canyon
Sierra County							
DIS191	Chloride (Black Range, Apache, Grafton, Phillipsburg)	1879	1879-present	Cu, Pb, Zn, Ag, Au, Sn (F, Ba, Sn, Be, Mo, Sb, Te, V, U)	—	volcanic-epithermal veins	Tellurium reported by Northrop (1996) (Korzeb et al., 1995)
DIS192	Cuchillo Negro (Cuchillo Negro, Chise, Iron Mtn, Limestone)	1879	1880-1970s	Cu, Pb, Zn, Ag, F, U, W, Fe (Mo, Au, Be, Sn, Te)	—	volcanic-epithermal veins, carbonate-hosted/skarn	Tellurium in jasperoids and veins; 70 ppm Te at Iron Mtn (Lovering and Heyl, 1989; Korzeb et al., 1995)
DIS197	Hillsboro (Las Animas, Copper Flat)	1877	1877-1968	Au, Ag, Pb, Zn, Cu, V, Mn (As, Te)	Copper Flat, 75 Ma ($^{40}Ar/^{39}Ar$)	porphyry-copper, polymetallic veins, placer gold, carbonate-hosted/skarn	Tetradymite from Copper Flat (Harley, 1934), Te in samples in northern part of district (Lovering and Heyl, 1989; Korzeb et al., 1995; Geedipally et al., 2012)
DIS205	Tierra Blanca (Percha, Bromide No. 1)	1900s	1919-1955, 1971-1972	Au, Ag, Cu, Pb, Zn (W, Te)	—	carbonate-hosted, volcanic- epithermal veins	As much as 2,800 ppm Te (Korzeb et al., 1995); hessite at Lookout and Gray Eagle mines (Northrop, 1996)
DIS195	Grandview Canyon (Sulfur Canyon)	1896	1907-1920	Au, Ag, Cu, Pb, W, Bi, Fe (Mo, Mn, Te)	—	Vein and replacement deposits in Proterozoic rocks	90 ppm Te in sample from Pioneer mine (unpublished data)
Taos County							
DIS238	Red River (Rio Hondo, Midnight, La Belle, Keystone, Anchor, Black Copper Canyon)	1826 (possible Spanish mining prior to 1680)	1902-1956	Au, Ag, Cu, Pb, Zn, U (Mo, F, Te)	—	volcanic-epithermal veins, placer gold, Au-Ag-Te alkaline-related veins (?)	Petzite reported in 1904 (Crawford, 1937; Anderson, 1954), Te reported at Sampson, Memphis, Independence mines (Northrop, 1996)