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Virginia T. McLemore

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MINERAL RESOURCES OF THE ROSEDALE MINING DISTRICT, SOCORRO COUNTY, NEW MEXICO

VIRGINIA T. MCLEMORE

New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology, 801 Leroy Place, Socorro, NM 87801; virginia.mclemore@nmt.edu

Abstract—The Rosedale mining district, discovered about 1882, is a small mining district in the eastern foothills of the northern San Mateo Mountains in southwestern Socorro County and is estimated to have yielded 28,000 oz Au and 10,000 oz Ag from volcanic-epithermal vein deposits. Exploration for potential gold and silver is underway at the Rosedale Mine. The veins and associated alteration in the district formed after eruption and deposition of the 27.7 Ma South Canyon Tuff. The predominant alteration is argillic, which is characterized by clays, silica, and local K-feldspar. Structurally controlled, volcanic-epithermal veins are found along faults in volcanic breccias, rhyolite lavas, and South Canyon Tuff. The veins carry free-milling gold and are usually associated with hematite and manganese oxides that occur as replacements of pyrite grains and stringers, and as coatings on fracture surfaces. The district has a high mineral-resource potential for volcanic-epithermal, low-sulfidation, quartz-dominant, low-base metal, gold-silver vein deposits along the Rosedale and Bell faults. There is an unknown mineral-resource potential for volcanic-epithermal base metal vein deposits at depth below the present precious-metal workings. The potential for critical minerals is low, except for zinc, which could occur at depth with base metals. Deep drilling would be required to determine if there are any base metals at depth.

INTRODUCTION

The price of gold and silver have dramatically increased in recent decades, resulting in reexamination of gold and silver mining districts throughout New Mexico for their mineral-resource potential. These districts also are being examined for potential critical minerals (McLemore, 2020; Nassar and Fortier, 2021). The Rosedale mining district (DIS225; McLemore, 2017) is a small mining district in the eastern foothills of the northern San Mateo Mountains in the Cibola National Forest in southwestern Socorro County (Fig. 1). The San Mateo Mountains' name is derived from St. Matthew ("Mateo" in Spanish). The Rosedale district is estimated to have yielded 28,000 oz Au and 10,000 oz Ag from volcanic-epithermal vein and placer gold deposits that were discovered about 1882 (Table 1; Lasky, 1932; McLemore et al., 2019). Volcanic-epithermal vein deposits are metallic vein deposits, predominantly enriched in gold, silver, copper, lead, and zinc, that are formed by ascending waters at shallow to moderate depths (<1370 m), low to moderate temperatures (50–300°C), and typically associated with intrusive and/or volcanic rocks (McLemore and Lueth, 2017; John et al., 2018). Some of New Mexico's largest gold and silver deposits are volcanic-epithermal vein deposits (McLemore, 1996, 2001, 2017; McLemore and Lueth, 2017). The purposes of this report are to: (1) summarize the district mining history, geology, geochemistry, and mineral resources, and (2) determine the mineral-resource potential of the Rosedale mining district. This paper is a partial summary of McLemore et al. (2019).

METHODS

Published and unpublished data on existing mines and mills within the Rosedale district were inventoried and compiled in the New Mexico Mines Database (McLemore et al., 2005a, b; McLemore, 2017). Locations of mines (Appendix 1) were obtained from published and unpublished reports, patented mining claims files, and field reconnaissance. Known mines and mineralized areas were examined and mapped in 1980, 2012, and 2016–2018. Mining in the district was by surface and/or underground methods (pits, shafts, and/or adits). Samples of altered and brecciated host rocks, veins, and composite mine dump samples were collected and submitted to ALS Laboratory Group in Reno, Nevada, for evaluation of major and trace elements (see McLemore et al., 2019 and Appendix 2 for more details). Chemical analyses are in Appendix 2 and include those obtained in this study and from past reports. Details for the analytical data, including analytical methods, analytical precision, and detection limits are in McLemore et al. (2019).

MINING HISTORY

Mineral production from the Rosedale district is in Table 1. Mining and production records are generally poor, particularly for the earliest years, and many early records are conflicting. Production figures in this report are the best data available and were obtained from published and unpublished sources (NMBGMR file data). However, production figures are subject to change as new data are obtained. The mining history of the district is summarized by Burney and Scarlata (2008) and in historical mining records (on file at the NMBGMR, at https://geoinfo.nmt.edu/geoscience/hazards/mines/aml/documents/AML_Rosedale_Portfolio.pdf, accessed 12/30/2021). In 1882, Jack W. Richardson found small placer gold deposits in the Rosedale district, which led to the discovery of gold veins (Marshall, 1910). The district was named after his wife, Rose (Julyan, 1996). A small gold rush soon developed and production continued sporadically through 1981. Three mill tailings were constructed at various times at the Rosedale Mine: Longtail (the easternmost consolidation), Elizabeth (westernmost), and the Rose (between the Longtail and Elizabeth) repository areas; the mill tailings have been reclaimed.

The community of Rosedale grew around the Rosedale Mine, and it was typical of many mining towns of the era, consisting of residences, a grocery store, a general merchandise store, a post office, saloon, blacksmith shop, assay office, and other sundry structures. Ranches also began in the area surrounding the community. The post office operated from 1899

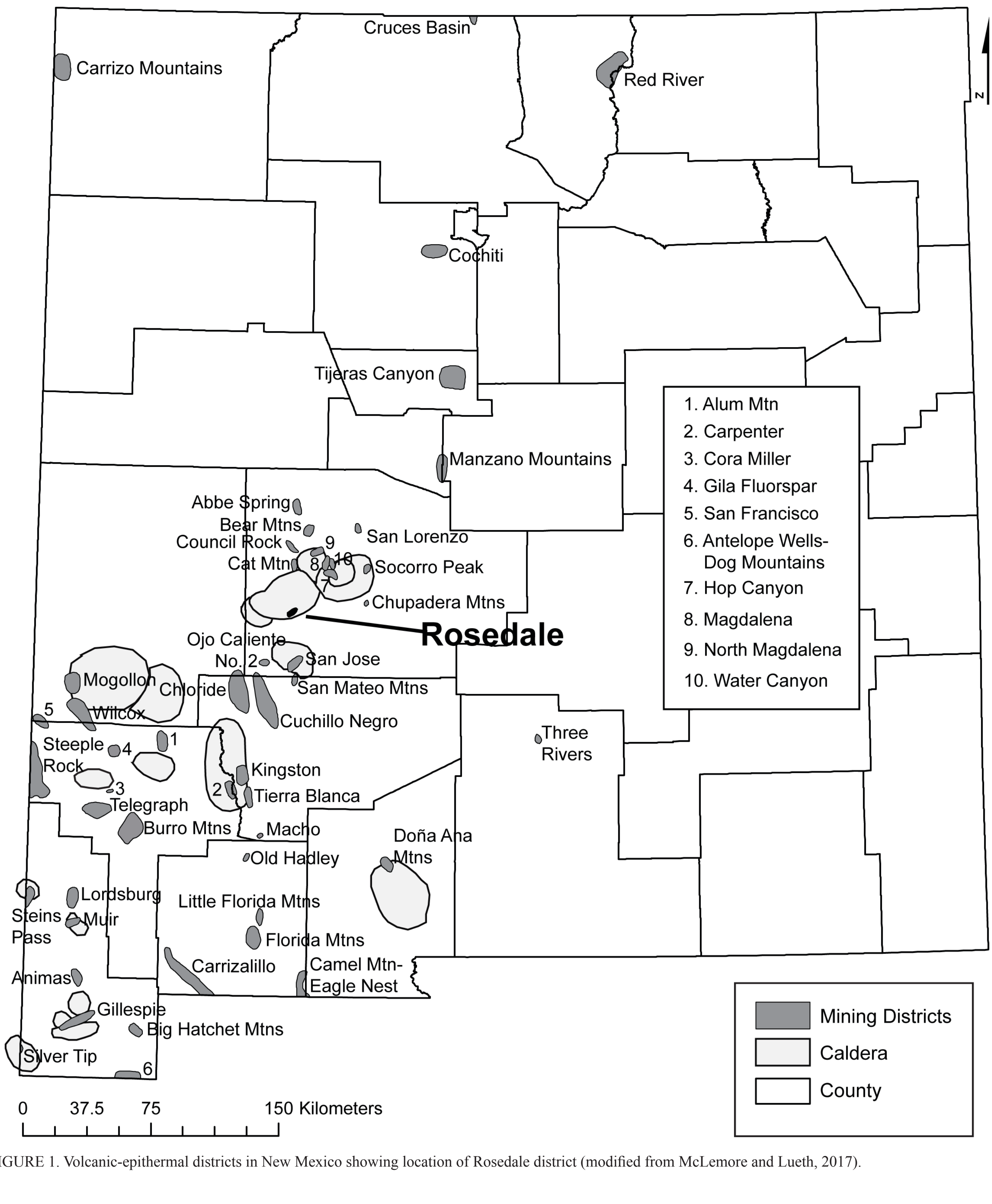

FIGURE 1. Volcanic-epithermal districts in New Mexico showing location of Rosedale district (modified from McLemore and Lueth, 2017).

TABLE 1. Metals production from the Rosedale mining district, Socorro County (from U.S. Geological Survey, 1902–1927, U.S. Bureau of Mines, 1927–1994; Wells and Wootton, 1940; North, 1983; McLemore, 2017; NMBGMR file data). Note that — is none and ? is unknown production. Value is in dollars at the time of production.

YEAR	ORE (short tons)	GOLD (ounces)	SILVER (ounces)	VALUE $	OWNER-OPERATOR
1896	?	47.2	—	976	Rosedale Mining Co.
1898	2,003	510.5	—	10,552	W.H. Martin Co.
1899	4,731	1,367.3	—	28,262	W.H. Martin Co.
1900	5,995	2,188.2	—	45,230	W.H. Martin Co.
1901	3,406	984.3	—	19,601	W.H. Martin Co.
1903	912	485.2	—	10,029	W.H. Martin Co.
1904	5,471	1,800.0	—	37,206	W.H. Martin Co.
1905	3,252	994.2	—	20,550	W.H. Martin Co.
1909	4,561	1,397.0	—	28,876	W.H. Martin Co.
1910	430	?	?	?	Rosedale Mining and Milling Co.
1911–1913	?	?	—	?	W.H. Martin Co.
1934	58	13.2	115	535	Rosedale Mining and Milling Co.
1935	2,972	158.1	147	5,641	Black Bear Mining Co.
1936	16,179	1,631.4	2,682	59,174	Rosedale Gold Mines, Ltd.
1937	30,513	1,665.4	2,291	60,062	Rosedale Gold Mines, Ltd.
1941	200	35	128	1,316	Rosedale Gold Mines, Ltd.
1981	?	?	?	?	
Total Reported	80,253	13,277	5,363	328,010	
Estimated Total 1882–1981	100,000	28,000	10,000	500,000	Totals reported by Wells and Wootton (1940), Koschmann and Bergendahl (1968), and McLemore (2017)

to 1928 (Julyan, 1996). By 1934, the community began to decline in population. Today, only foundations and a few structures remain. More details on the mining district history are in McLemore et al. (2019).

Exploration in the district has been ongoing since discovery. Harrison Schmitt, Sr. examined and sampled the Rosedale Mine (ca. 1937–1938) with favorable results, and he suggested that extension of the existing workings should be considered (NMBGMR files). Samples were collected and assayed around and within the Rosedale and Bell mines during the 1970s. In 1974, Perry, Knox and Kaufman, Inc. drilled four holes. Resources America, Inc. also drilled near the Rosedale Mine in 1979. The results of the drilling program indicated moderately strong gold-silver mineralization at the southern portion of the Bell Mine. Perry, Knox and Kaufman, Inc. estimated 1.5–2 million short tons of 0.3 oz/short tons Au remain (historic resource determined in 1974 and does not comply with today's Canadian NI43-101 or U.S. SEC reporting guidelines).

The U.S. Bureau of Mines examined the area in the early 1980s as part of evaluating the mineral-resource potential of the Withington Wilderness Study Area (Neubert, 1983). In 1991, Trigg Oil and Mining Corp. performed assessment work on mining claims adjacent to the Rosedale and Bell patents. A New Mexico Tech geochemistry class performed a stream-sediment and rock chip survey in the area in the 1990s (summarized in Table 2), partially paid for by exploration mining companies. Exploration by mining companies continued in the district through 2022.

GEOLOGY

The San Mateo Mountains lie in a tectonically active and structurally complex area of the southwestern U.S. and are part of the Mogollon-Datil volcanic field, which is a late Eocene-Oligocene volcanic province that extends from west-central New Mexico southward into Chihuahua, Mexico (Fig. 1; McIntosh, 1989; McIntosh et al., 1991, 1992a, b; Chapin et al., 2004). Very little is known about the pre-Oligocene geologic history of the San Mateo Mountains because thick, Oligocene ash-flow tuffs or ignimbrites cover most of the area. These tuffs erupted from local calderas (Deal, 1973; Deal and Rhodes, 1976; Ferguson, 1986, 1990; Ferguson et al. 2012).

The oldest rocks in the Rosedale district are Oligocene ash-flow tuffs (La Jencia Tuff, Vicks Peak Tuff) and rhyolitic breccias and lavas overlying the Vicks Peak Tuff (Ferguson, 1990). The breccias and lavas are discolored like the younger South Canyon Tuff and at some places contain cavities up to several inches across lined with irregularly oriented quartz crystals (Lasky, 1932).

The Lemitar Tuff locally overlies the rhyolitic breccias and rhyolite lavas and is a moderately crystal-rich (10–35% phenocrysts), quartz-feldspar-biotite bearing rhyolitic ash flow

TABLE 2. Characteristics distinguishing the low-sulfidation (adularia-sericite) and high-sulfidation (alunite-kaolinite) epithermal deposits (from Hayba et al., 1985; Cox and Singer, 1986; Heald et al., 1987; Berger and Henley, 1989; White and Hedenquist, 1990).

	High sulfidation (Alunite-kaolinite; acid-sulfate)	Low sulfidation (Adularia-sericite)	Rosedale district characteristics
Structural Setting	intrusive centers	structurally complex	Faults
Host rocks	rhyodacite common, acid to intermediate	various acid to intermediate fluids	rhyolites
Timing of ore and host	similar ages of the host and ore	variable ages	Ore younger than host rocks
Mineralogy	enargite, pyrite, gold, electrum, base-metal sulfides including covellite, chlorite rare, no selenides, Mn minerals rare, bismuthinite, Higher sulfide-mineral assemblage, chalcedony and adularia absent unless overprinting, abundant alunite and pyrophyllite	argentite, tetrahedrite, tennantite, silver, gold, base-metal sulfides, chlorite present, selenides, Mn minerals common, no bismuthinite, Lower sulfide-mineral assemblage, chalcedony common, adularia, minor alunite and pyrophyllite	Gold, argentite?, quartz, pyrite, electrom, chlorite present, Mn minerals common, low base metals
Production	Gold, silver, and copper	Gold, silver, variable base metals	Gold, silver, copper sulfides reported at depth
Alteration	Extensive propylitic with advanced argillic to argillic with hypogene alunite and kaolinite, but no adularia	Extensive propylitic with sericitic to argillic with supergene alunite and some kaolinite and abundant adularia	argillic
Localizing controls	any faults or fracture zones related to volcanic centers	major regional faults in subvolcanics	faults
General character of fluids	low to high salinity, meteoric with magmatic waters, pH acid from magmatic HCl and H2S, oxidized to reduced, total S typically high and as sulfate, base-metal content low to high	low salinity, meteoric waters, pH near neutral, reduced, total S low and as sulfide, base metal content low	low salinity, meteoric waters, pH near neutral, reduced, total S low and as sulfide, base metal content low

tuff (Ferguson, 1990). The Hardy Ridge caldera is interpreted to be the source for the Lemitar Tuff and extends from the eastern part of Mt. Withington eastwards to the west-central Magdalena Mountains (Ferguson et al., 2012).

The most prominent rock in the Rosedale district is the purple-brown, rhyolitic South Canyon Tuff. The South Canyon Tuff overlies the volcanic breccias, rhyolite lavas, and the Lemitar Tuff, and it was erupted from the Mt. Withington caldera about 27.7 Ma (27.3 Ma age of McIntosh, 1989, adjusted for an $^{40}Ar/^{39}Ar$ monitor of 28.201 Ma). The South Canyon Tuff is a moderately crystal-rich (10–30% phenocrysts), quartz-feldspar bearing, locally flow-banded ash-flow tuff. The intracauldron facies of the South Canyon Tuff is found in the Rosedale district (Ferguson, 1990).

Alteration

Much of the district's volcanic host rocks show moderate argillic alteration (defined by predominantly clay, silica, and local K-feldspar). Argillic alteration is most intense along some of the faults, veins, and most of the mine features located within these altered rocks (McLemore et al., 2019). Argillic alteration typically overprints and cross-cuts the older fault zones (many of which contain gold-silver veins). Alteration of the rhyolitic country rock consists of bleaching and increase in clays replacing feldspar phenocrysts. Alteration increases in intensity toward the veins and is usually accompanied by variable amounts of oxidized pyrite. Irregular zones of silicification locally marks the end of ore-bearing veins. These silicified zones, which are predominant in fault zones, consist of breccia fragments of the South Canyon Tuff and rhyolite lavas.

The youngest and most pervasive alteration style at Rosedale is oxidation, where the sulfide and mineral phases in the veins have been altered by near-surface oxidizing, low-temperature fluids to form iron oxide (such as hematite and goethite) and manganese oxide minerals that replace pyrite on fractured surfaces and veins, as shown by electron microscope studies (McLemore et al., 2019). Iron oxides are variably colored but are predominantly reddish brown and are nearly ubiquitous on fracture surfaces.

MINERAL DEPOSITS

Two types of mineral deposits are found in the Rosedale district: volcanic-epithermal vein and placer gold deposits. Volcanic-epithermal vein deposits are found in many districts in New Mexico (Fig. 1) and form in structurally complex tectonic settings that provide the structural plumbing system necessary for circulation of hydrothermal fluids. Similar volcanic-epithermal districts in southwestern New Mexico include Steeple Rock, Mogollon, Chloride, and others (Fig. 1; McLemore, 1996; McLemore and Lueth, 2017).

Lindgren (1933) defined the term *epithermal* to include a broad range of deposits that are formed by ascending waters at

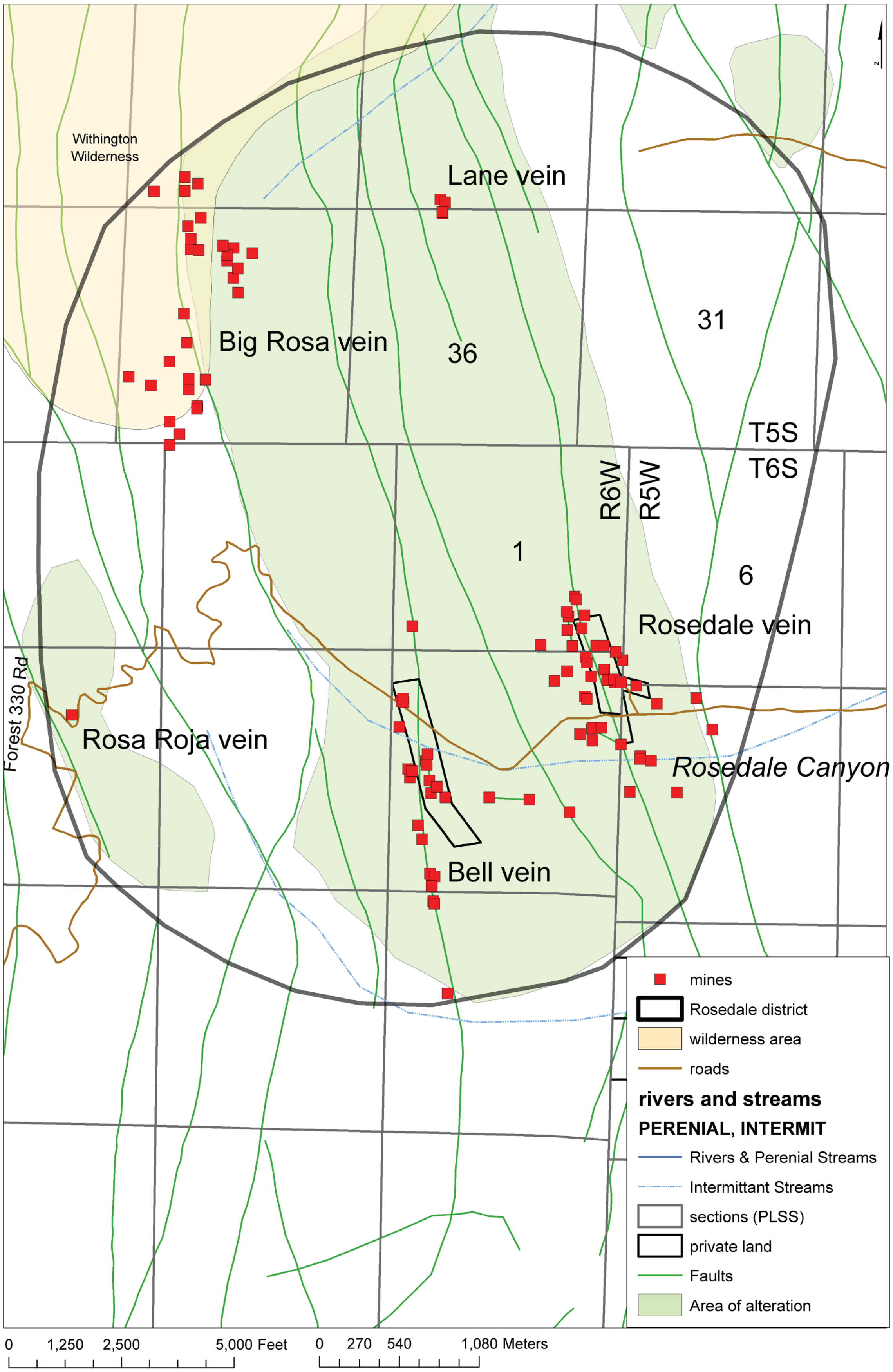

FIGURE 2. Mines and prospects in the Rosedale district, Socorro County, New Mexico. See Appendix 1 for a list of mines and prospects. More detailed maps showing faults, hydrothermal breccias and veins, mines, prospects, and sample locations are in McLemore et al. (2019).

shallow to moderate depths (<1370 m), low to moderate temperatures (50–200°C), and 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 (Simmons et al., 2005; John et al., 2018). White (1955, 1981) established the now-recognized association between epithermal mineral deposits and active geothermal or hot spring systems. However, there are many small hot spring systems with no known associated gold or base metals. An important advance in the knowledge of epithermal-mineral deposits occurred when Hayba et al. (1985) provided a two-fold classification based on mineralogy and associated alteration: adularia-sericite and acid-sulfate (Table 2). Hayba et al. (1985), Heald et al. (1987), Berger and Henley (1989), and White and Hedinquist (1990) provide convincing evidence that low-sulfidation (alkali-chloride; adularia-sericite) and high-sulfidation (acid-sulfate; alunite-kaolinite) deposits occur in separate and distinct geochemical environments that rarely overlap. John et al. (2018) summarized the epithermal deposit model. Only low-sulfidation deposits have been found in the Rosedale district (McLemore et al., 2019).

Most volcanic-epithermal vein deposits in New Mexico are restricted to veins associated with late Eocene to Miocene volcanic fields and the margins of calderas (Fig. 1; Rytuba, 1981; Elston, 1994; McLemore, 1996), although other structurally complex volcanic settings, such as silicic domes and andesitic stratovolcanoes, are not uncommon for these deposits worldwide. It is important to note that not all calderas are mineralized. Typical volcanic-epithermal deposits in the state occur as quartz vein fillings, breccia pipes, disseminations, and replacement deposits.

Five subparallel vein systems have been identified in the Rosedale district based upon geologic mapping and locations of mines, prospects, and mineralized areas (Fig. 2): Rosa Roja, Big Rosa, Lane, Rosedale, and Bell. The veins are hosted by the South Canyon Tuff and underlying volcanic breccias and rhyolite lavas. Most of the production has been from the Rosedale vein, although some production from the Bell vein is reported (McLemore et al., 2019). Drilling along the Bell vein indicated additional mineral bodies at depth (NMBGMR file data). The other veins have only been explored at the surface.

The Rosedale vein is a 1–15 m wide, brecciated, sheared, and silicified zone that strikes N20–10°W, dips 70–90°W, and is at least 2286 m long. The Rosedale vein appears to end just south of Rosedale Canyon (Fig. 2). The ore shoots were irregular and discontinuous (Metzger, 1938) and form zones of hydrothermal breccias that contain rock fragments of the host rocks and older clasts of quartz veins. Gold and silver were mined from two ore shoots 23–30 m below the surface and extending to a depth of 220 m, where they coalesced to form a single ore shoot (1 m thick) that continues below the mined stopes (Fig. 2; also see McLemore et al., 2021, fig. 8). Free gold is found in bluish-white quartz veins with an accessory gangue of iron and manganese oxides and rare fluorite, barite, and calcite (Koschmann and Bergendahl, 1968). Some of the highest-grade gold was associated with greenish quartz with a waxy luster (Metzger, 1938), an association noted in gold ores throughout the western U.S. and thought to be related to the presence of chlorite, sericite, or roscoelite (Kurtz and Hauff, 1988; Spry and Scherbarth, 2006). Silver is present in small amounts. Some ore averaged as much as 0.5 oz/short ton (17 ppm) Au (Lasky, 1932). Historical accounts indicated that the best ore was associated with copper staining. Uranium is locally found in the district (0.010–0.011% U_3O_8; Neubert, 1983; McLemore, 1983).

The Bell vein roughly parallels the Rosedale vein, trending N10°W, and consists of iron and manganese oxides and quartz. The Bell vein appears to end at Rosedale Canyon (Fig. 2). The brecciated and sheared zone at the Bell vein is as much as 1 m wide in the South Canyon Tuff.

Textures typical of volcanic-epithermal low-sulfidation vein deposits elsewhere in New Mexico are found in the Rosedale district, such as open-space and cavity fillings, drusy cavities, banding, sharp contacts with host rocks, multiple periods of brecciation, quartz-replacing calcite, late-stage vug-filling quartz, comb structures, crustifications, colloform banding, multi-stage hydrothermal brecciation, replacements, lattice textures (quartz pseudomorphs after bladed calcite), and irregular sheeting (McLemore et al., 2019). The veins are hosted by brecciated, fractured, and silicified rhyolitic tuff, lavas, and volcanic breccias and contain trace amounts of oxidized pyrite. The sanidine phenocrysts are altered to white or orange by iron oxides or chalky kaolinite.

The Rosedale placer gold deposits are small and generally occur in Holocene-age alluvial fan deposits, channel-bars, and other ephemeral stream deposits (field reconnaissance; Johnson, 1972; McLemore, 1994). The gold concentrates by gravity in alluvium. Although there has been no reported placer gold production from the Rosedale district, small, irregular placer gold deposits have been found in Rosedale Canyon near the Rosedale Mine (field reconnaissance). Stream-sediment geochemical analyses also indicate gold is present downstream of the Rosedale and Bell veins (McLemore et al., 2019). The lack of flowing water in arroyos has hampered any production of potential placer deposits.

GEOCHEMISTRY

Five separate sampling programs were conducted in the Rosedale district and samples were analyzed for geochemistry (Appendix 2) in order to characterize the mineralization and identify potential areas of environmental concern, as described in McLemore et al. (2019). A statistical summary of the geochemical analyses is in Table 3. Samples of quartz vein material and/or intensely altered South Canyon Tuff were collected by Ferguson (1990) throughout the district, but only a few samples in the Lane area were high in gold and silver (Appendix 2). Additional samples collected by Neubert (1983) of mineralized areas also were low in precious and base metals (Appendix 2). In 1991, an exploration program consisting of stream sediment and rock chip sampling was conducted by students at New Mexico Tech (NMIMT) under the supervision of Dr. Dave Norman for Sunshine Mining Company, Idaho,

TABLE 3. General statistics of samples collected in the Rosedale district (in parts per million). See Appendix 2 for complete analyses and McLemore et al. (2019) for geochemical maps showing spatial analyses of samples. Critical minerals include As, Sb, Bi, Ga, Zn, and Te (Nassar and Fortier, 2021). NMIMT = New Mexico Institute of Mining and Technology.

Stream sediments (Table 3-1, NMIMT, 39 samples, see Appendix 2, Streamsediments sheet)

	Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	Zn	Bi	Cd	Ga	Se	Te
minimum	0.04	3.12	0.00	0.82	0.02	0.33	5.75	0.58	0.47	8.35	0.07	0.04	0.53	0.24	0.05
maximum	3648.00	49.98	336.00	20.60	0.45	31.40	59.10	38.40	2.34	105.00	2.61	0.65	6.79	1.00	0.50
average	143.51	8.38	20.12	5.78	0.08	4.71	15.72	3.72	0.60	35.32	0.31	0.21	1.66	0.40	0.15
standard deviation	604.80	8.02	64.30	4.47	0.08	7.93	11.53	6.44	0.33	21.28	0.41	0.15	1.27	0.29	0.17

Rock chips from Bell vein (Table 3-2, NMIMT, 204 samples, see Appendix 2, RockChips sheet)

	Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	Zn	Bi	Cd	Ga	Se
minimum	0.01	0.20	0.00	0.05	0.02	0.72	1.13	0.34	0.46	0.19	0.13	0.09	0.25	0.06
maximum	6.99	82.80	3.32	15.90	0.54	45.30	81.3	20.7	487	178.0	0.89	2.47	3.17	942
average	0.20	10.83	0.05	4.19	0.10	9.53	11.0	3.25	3.01	32.95	0.25	0.14	1.69	5.57
standard deviation	0.90	8.35	0.32	2.15	0.04	5.94	6.21	2.84	34.0	15.14	0.06	0.19	0.45	65.9

Composite and select waste rock piles and select rock chip (Table 3-3, McLemore et al., 2019, 26 samples, see Appendix 2, ThisStudy sheet)

	Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	Zn	Bi	Cd	Ga	Se	Te
minimum	0.50	2.90	0.00	1.0	0.01	1.00	8.0	0.55	0.03	17.0	0.02	0.50	13.1	0.20	0.01
maximum	72.70	34.60	3.61	47.0	0.77	55.00	119.0	126.0	0.65	121.0	4.17	0.50	25.1	0.60	0.81
average	14.85	12.70	0.49	12.0	0.17	8.88	37.6	17.4	0.21	58.3	0.44	0.50	17.9	0.29	0.08
standard deviation	20.87	7.56	0.93	12.3	0.18	12.03	28.7	27.2	0.14	25.0	0.86	-	2.74	0.14	0.20

in the vicinity of the Rosedale and Bell mines (Appendix 2). The rock chips were collected along a pre-determined grid along the southern Bell vein, whereas the stream samples were collected from arroyos near the Rosedale and Bell veins. The highest gold anomalies in stream sediments are downstream of the Rosedale Mine (McLemore et al., 2019, fig. 19). The most recent sampling program consisted of composite waste rock samples, selected waste rock samples, and selected rock chip samples, as described in McLemore et al. (2019). The highest gold anomalies from this recent sampling program are found along the Rosedale and near the Bell veins (McLemore et al., 2019, fig. 21).

In summary, the geochemical analyses from all samples collected from the Rosedale district indicate that the mineralization is low in sulfur, base metals, critical minerals, and other elements of environmental concern (Table 3; Appendix 2). The limited geochemical analyses suggest that there are no critical minerals in economic concentrations associated with the Rosedale district. There are some erratic, elevated analyses of tellurium in some samples (as much as 0.81 ppm, Appendix 2), but these are not economic. The best pathfinder element for exploration in this district is the concentration of gold, although gold does correlate with antimony (McLemore et al., 2019).

MINERAL-RESOURCE POTENTIAL

The *mineral-resource potential* of an area is the probability or likelihood that a mineral will occur in sufficient quantities so that it can be extracted economically under current or future conditions, including the occurrence of undiscovered concentrations of metals, nonmetals, industrial materials, and energy resources (Taylor and Steven, 1983; Goudarzi, 1984; McLemore, 1985). The mineral-resource potential is not a measure of the quantities of the mineral resources, but is a measure of the *potential* of occurrence. Classification of mineral-resource potential differs from the classification of mineral resources and reserves. Quantities of mineral resources are classified according to the availability of geologic data (assurance), economic feasibility (identified or undiscovered), and as economic or uneconomic. Mineral-resource potential is a qualitative judgement of the probability of the existence of a commodity and is classified as high, moderate, low, or no potential according to the availability of geologic data and relative probability of occurrence (Goudarzi, 1984).

The Rosedale district has a high mineral-resource potential for gold and silver in volcanic-epithermal veins (Appendix 2; Zutah, 2017; McLemore et al., 2019). Perry, Knox and Kaufman, Inc. estimated 1.5–2 million short tons (1.3–1.8 million metric tons) of 0.3 oz/short ton (10 ppm) Au remain (historic resource determined in 1974 and does not comply with today's Canadian NI43-101 or U.S. SEC reporting guidelines), and gold and silver concentrations are found along the veins (Appendix 2). Past production, volcanic-epithermal textures, and geochemical data indicate that the Rosedale and Bell veins in the Rosedale district have a high mineral-resource potential for gold and silver in low-sulfidation, quartz-dominant, low-base metal, volcanic-epithermal vein deposits. There is an unknown mineral-resource potential for base metals at depths below the present precious-metal workings. Chemical analyses (Appendix 2) indicate that the only critical mineral that has elevated concentrations and a possible economic potential is tellurium (McLemore, 2016). Future exploration should continue to sample potential zones for tellurium. The mineral-resource potential along the Lane, Big Rosa, and Rosa Roja veins (Fig. 2) is moderate because there are few assays indicating high concentrations of gold and silver; these areas require drilling to properly evaluate the mineral-resource potential. Deep drilling would be required to determine if there are any base metals at depth in the district. Altered areas elsewhere in the Rosedale mining district (Fig. 2) have a low mineral-resource potential because there are no assays indicating potential gold and silver; these areas require additional sampling and drilling to better evaluate the mineral-resource potential. Chemical analyses (Appendix 2) indicate that it is unlikely that any critical minerals (McLemore, 2020; Nassar and Fortier, 2021) in economic concentrations are associated with the Rosedale veins, except for zinc (which could occur at depth with base metals).

CONCLUSIONS

Volcanic-epithermal veins and associated alteration in the district developed after eruption and deposition of the 27.7 Ma South Canyon Tuff. Structurally controlled, hydrothermal, volcanic-epithermal veins are hosted in veins in rhyolitic breccias, rhyolite lavas, and the South Canyon Tuff. They are locally cemented by banded greenish-white quartz. The veins carry free-milling gold and are usually associated with hematite and manganese oxides that occur as replacements of pyrite grains and stringers and as coatings on fracture surfaces. The predominant alteration is argillic, which is characterized by clays, silica, and K-feldspar.

The Rosedale district has a high mineral-resource potential with a high level of certainty for gold and silver as volcanic-epithermal, low-sulfidation, quartz-dominant, low-base metal vein deposits along the Rosedale and Bell veins. There is an unknown mineral-resource potential with a low degree of certainty for base metals at depths below the present precious-metal workings. Deep drilling would be required to determine if there are any base metals at depth.

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Appendices can be found at
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Pond at New Mexico Tech golf course.