GEOLOGY, MINERAL-RESOURCE POTENTIAL, AND POTENTIAL ENVIRONMENTAL IMPACTS OF THE ROSEDALE MINING DISTRICT, SOCORRO COUNTY, NEW MEXICO

Virginia T. McLemore[1], William Zutah[2], Marcus Silva[2], John Asafo-Akowuah[2], Amy Trivitt-Kracke[3], Joseph Shackelford[2], Navid Mojtabai[2], Madeline Richards[4], Nicholas Harrison[4], John Durica[2], Bon Durica[2], and Ben Sears[5]

[1]Principal Senior Economic Geologist, Certified Professional Geologist #CPG-7438, New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology, Socorro, NM 87801
[2]Department of Mineral Engineering, New Mexico Institute of Mining and Technology, Socorro, NM 87801
[3]New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology, Socorro, NM 87801
[4]Department of Earth and Environmental Science, New Mexico Institute of Mining and Technology, Socorro, NM 87801
[5]Department of Mechanical Engineering, New Mexico Institute of Mining and Technology, Socorro, NM 87801

OPEN-FILE REPORT 603

JANUARY 2019

New Mexico Bureau of Geology and Mineral Resources

A division of New Mexico Institute of Mining and Technology

SUMMARY

This report summarizes the mining history, geology, geochemistry, mineral-resource potential and potential environmental impacts of mining in the Rosedale mining district. The Rosedale mining district (DIS225) is a small mining district in the eastern foothills of the northern San Mateo Mountains in southwestern Socorro County. The climate of the Rosedale district is semiarid and alpine, with warm summers and cold winters. The Rosedale district was discovered circa 1882 and is estimated to have yielded 28,000 oz Au and 10,000 oz Ag from volcanic-epithermal vein deposits. Foundations from the Rosedale townsite, Rothchild mill (NMSO0748), Bell mill (NMSO0590), and scattered collapsed cabins are found in the district. Currently, the Rosedale mine owner is conducting exploration for potential gold and silver.

Volcanic-epithermal veins and associated alteration in the district were probably developed shortly after eruption and deposition of the 27.4 Ma South Canyon Tuff. The predominant alteration is argillic, which is characterized by clays, sanidine, and quartz, and cross-cuts fault zones that juxtapose altered and unaltered rock. Structurally-controlled, volcanic-epithermal veins are hosted in well-developed breccia and sheared rhyolite porphyry and are locally cemented by banded greenish-white quartz. The shear-zone veins extend into a footwall of white rhyolite porphyry. 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. Replacement textures of iron oxides after pyrite can be seen in electron microprobe analysis. Replacement of magmatic or late magmatic biotite is common.

Most of the mine features in the Rosedale district are shallow prospect pits and short adits. Mining-related disturbance is minor and found only in the vicinity of the individual mine features. However, the Rosedale shaft complex (NMSO0064, NMSO0543, NMSO0586, NMSO0585, NMSO0591, NMSO0585), Bell adit (NMSO0061), Robb shaft (NMSO0545) and Lane shaft (NMSO0734) are dangerous and require proper safeguarding. A few short adits also have the potential for unsafe conditions. Many of the mine features are in remote areas with no road access. The main tailings facilities (NMSO0264, NMSO0265) have been previously reclaimed by the U.S. Forest Service. Only one sample from the Rosedale district plotted in the uncertain field on the acid rock drainage (ARD) diagram; the other samples plotted as non-acid forming. The Rosedale samples contain low concentrations of all metals. Water samples collected from the Robb prospect (NMSO0545) and springs and seeps in the area exhibit no

harmful water quality issues and are typical of surface water from the area. None of the other mine features had any water, except the main Rosedale shaft (NMSO0064), where water was encountered at 726 ft and was not sampled. The mean annual precipitation for the Rosedale mining district is low (15.7 in/yr) and calculated values for the 5 year peak flood are also low (119 cfs), which collectively indicates that environmental impacts of mining in the Rosedale district are low.

The Rosedale district has a high mineral-resource potential with a high level of certainty for gold>>silver as a low-sulfidation, quartz-dominant, low-base metal, volcanic-epithermal vein deposit along the Rosedale and Bell veins, with 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.

TABLE OF CONTENTS

INTRODUCTION

Description and purpose of project

The Rosedale mining district is in the San Mateo Mountains east of Magdalena, New Mexico (Fig. 1). The known mineral deposits consist of volcanic-epithermal vein and placer gold deposits that were discovered about 1882 (Lasky, 1932). Volcanic-epithermal vein deposits are metallic vein deposits, predominantly gold, silver, copper, lead, and zinc, that are formed by ascending waters at shallow to moderate depths (<4,500 ft), low to moderate temperatures (50–300 °C), and typically associated with intrusive and/or volcanic rocks. 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) compile the mining history and mineral production, 2) summarize the geology, geochemistry, and mineral resources, 3) describe the mine features, 4) characterize any potential physical and environmental impacts of mining, and 5) determine the mineral-resource potential of the Rosedale mining district. A glossary of mining and geological terms is in Appendix 1.

Location, access, and infrastructure of Rosedale mining district

The Rosedale mining district (DIS225, New Mexico Mines Database, McLemore et al., 2005a, b; 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 is estimated to have yielded 28,000 oz Au and 10,000 oz Ag from volcanic-epithermal vein deposits.

The district is accessed west of Magdalena via U.S. Highway 60, then approximately 30 miles southwest on State Highway 107. The district is situated approximately 6 miles west on Forest Road 330 from State Highway 107; both are gravel roads (Fig. 2). The area is rural and a only few ranches are located within several miles of the district. Cell phone coverage is spotty or absent.

Regional geography, topography, and terrain

The Rosedale district is on the Grassy Lookout topographic quadrangle map. Western Socorro County consists of moderately rugged, forested mesas and mountain ranges separated by broad bushy valleys. The Continental Divide is west of Rosedale in the San Mateo Mountains. The San Mateo Mountains consist of rough terrain with steep slopes, narrow canyons and broad, flat mesas. Elevations in the district range from 5,400 to 7,300 ft.

The San Mateo Mountains in southern Socorro and northern Sierra Counties are approximately 40 miles north-south, and part of the Mogollon volcanic field in the Basin and Range physiographic province. Seven high peaks in the range exceed 10,000 ft in elevation (Vicks Peak, 10,252 ft, San Mateo Mountain, 10,145 ft, San Mateo Peak, 10,139 ft, West Blue Mountain, 10,783 ft, Blue Mountain, 10,336 ft, Apache Kid Peak, 10,048 ft, and Mt. Withington, 10,115 ft). The Plains of San Augustine, an ancient lake bed, lies to the west of the district. Mulligan Gulch drains the valley east of Rosedale. The San Mateo Mountain range contains two wilderness areas; the Apache Kid Wilderness (44,650 acres) is in the southern portion of the range and the Withington Wilderness (18,869 acres) is in the north. The San Mateo Mountains are bound by the Monticello graben to the west and the Mulligen Gulch and San Marcial basin to the east (Fig. 2).

Climate

The climate of the Rosedale district is semiarid and alpine, with warm summers and cold winters. Monsoon rains in the summer and snow in the winter provide most of the precipitation. Summer rains can cause mudslides and flash floods. The nearest weather station is in Magdalena (Table 1).

TABLE 1. Summary of climate data for Magdalena, New Mexico at an elevation of 6,752 ft (from http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nmmagd, accessed 1/6/2019).

	January	April	August	November	Year
Average high temperature °F	47.4	67.5	84.1	58.6	68.1
Average low temperature °F	19.2	35.2	54.9	27	37.3
Average precipitation in inches	0.47	0.48	2.62	0.36	11.75
Average snowfall in inches	2	0.1	0	0.1	5.0

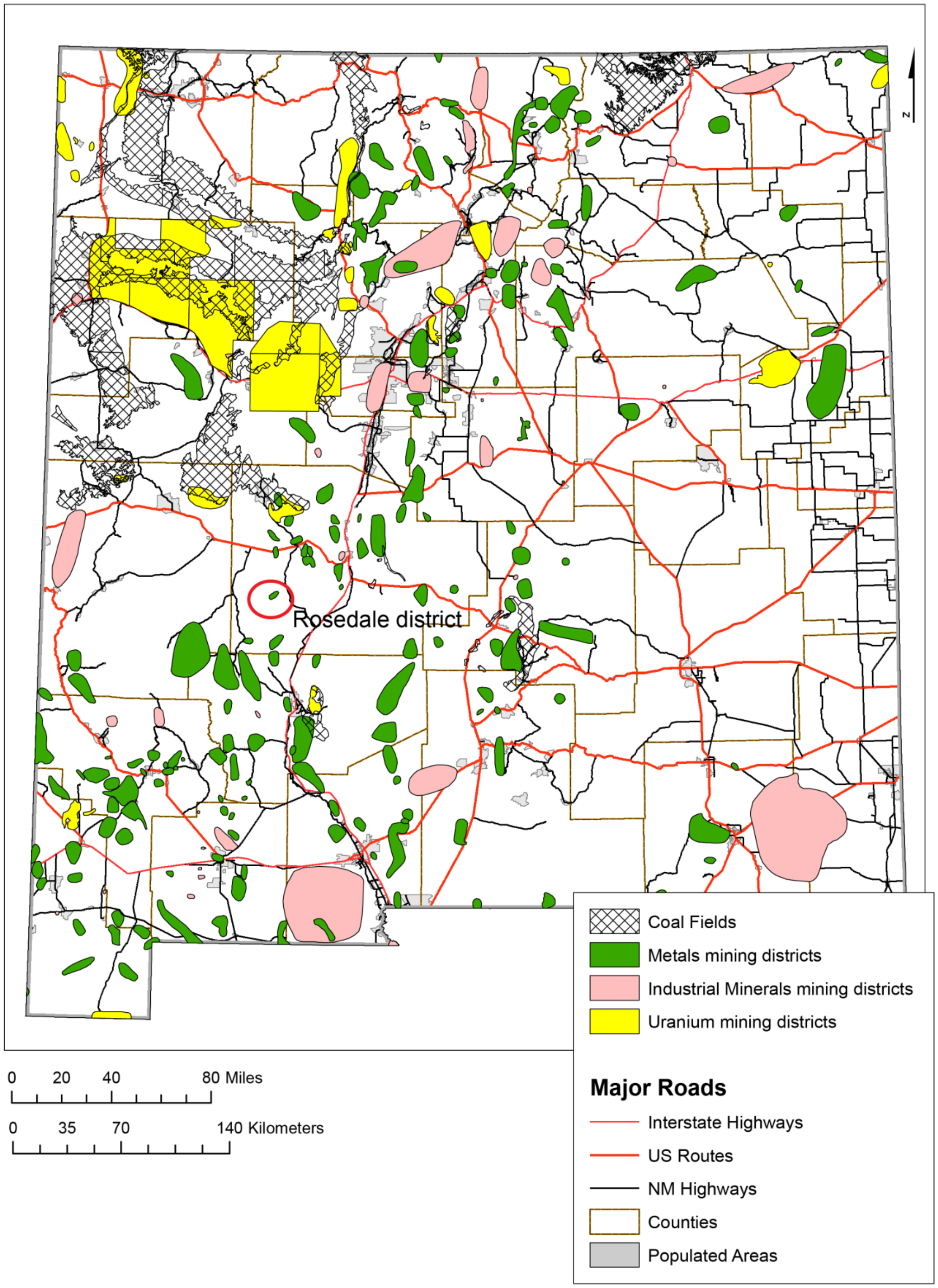


FIGURE 1. Mining districts of New Mexico, showing the location of the Rosedale mining district, Socorro County (McLemore, 2017).

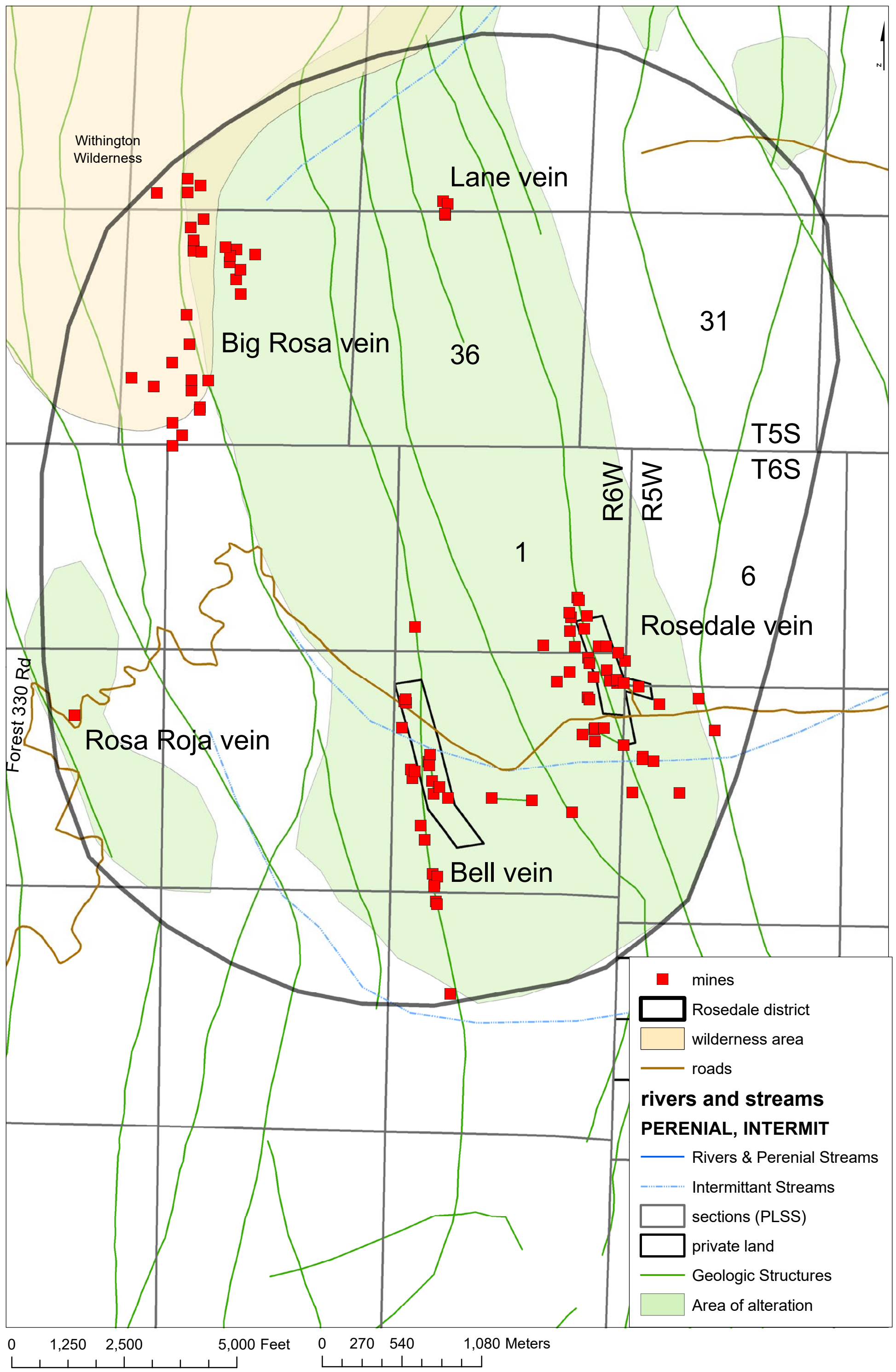


FIGURE 2. Mines and prospects in the Rosedale district, Socorro County, New Mexico. See Appendix 2 for a list of mines and prospects. The entire area shown in this figure is within the Cibola National Forest.

Current land uses

The Rosedale district lies within the Cibola National Forest and the current land uses of the area are predominantly for recreation, hunting, camping, hiking, and cattle grazing. The Rosedale and Bell mines are on private, patented mining claims (Fig. 2). Permission was obtained from the current claim owner to access the property.

Vegetation

Vegetation ranges from spruce-aspen cover at the highest elevations through large areas of piñon-juniper. A forest fire in 2016 burned portions of the forest within and near the district, but much of the forest is otherwise healthy. There are no known endangered species of flora or fauna within the district. The San Mateo Mountains are heavily forested with vegetation covering much of the rock units, except along steep cliffs. The Rosedale district lies mostly in the transition zone between Upper Sonoran and Piñon-Juniper Belt, and is dominated by woody shrubs, oak, piñon, alligator juniper, ponderosa pine, yucca, and cactus.

METHODS

Field Inventory of mines and mills

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 2) were obtained from published and unpublished reports, and patented mining claims files. Additional sources include:

- Official government publications (including NMBGMR, U.S. Geological Survey (USGS), U.S. Bureau of Mines, Bureau of Land Management, U.S. Forest Service published reports)
- Scientific journals
- N.M. Bureau of Geology and Mineral Resources mining archives
- University theses and other project works
- USGS MRDS database (https://mrdata.usgs.gov/mrds/, accessed 1/6/2019)
- USGS prospect- and mine-related features on USGS topographic maps database (https://mrdata.usgs.gov/usmin/, accessed 1/6/2019)
- USGS major mineral deposits database (https://mrdata.usgs.gov/major-deposits/, accessed 1/6/2019)
- Bureau of Land Management official land records (https://glorecords.blm.gov, accessed 1/6/2019)
- Bureau of Land Management LR2000 mining claims database (https://reports.blm.gov/reports.cfm?application=LR2000, accessed 1/6/2019)
- NM Mining and Minerals Division mine registration database (http://www.emnrd.state.nm.us/MMD/mmdonline.html, accessed 1/6/2019)
- New Mexico State Mine Inspector annual reports
- Mine Safety and Health Administration mines data set (https://arlweb.msha.gov/drs/asp/extendedsearch/minesbystatecommodity.asp, accessed 1/6/2019)
- Office of Surface Mining Reclamation and Enforcement Abandoned Mine Land Inventory System (AMLIS; https://www.osmre.gov/programs/**AMLIS**.shtm, accessed 1/6/2019)
- Office of Surface Mining Reclamation and Enforcement National Mine Map

Repository (https://mmr.osmre.gov/MultiPub.aspx, accessed 1/6/2019)

- County courthouse records and other public information.

The U.S. Forest Service includes some of these mines and water wells as constructed feature points in their public GIS data (Cibola https://www.fs.usda.gov/detail/r3/landmanagement/gis/?cid=stelprdb5212078, accessed 1/6/2019).

A geologic map was compiled in ArcMap by modifying Ferguson (1986). Names of types of mineral deposits (i.e. volcanic-epithermal veins) are from Cox and Singer (1986), North and McLemore (1986, 1988), McLemore (1996, 2001, 2017) and McLemore and Lueth (2017). Topographic maps and Google earth images also were examined for mine features.

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) and waste rock piles are located around or near the openings of most of these features. A summary of the mines is in Appendix 2. Some mines were located and described in the literature or mines records, but could not be found during the field investigation; these features were included in the database and identified as not found. A chronological synopsis of the mining history is in Appendix 3.

Sample collection

In order to evaluate the mineral resources and environmental impacts of the Rosedale district, a variety of field sampling methods were utilized. Sampling and laboratory analyses are important to:

- Determine the mineralogy and geochemistry of the ore deposit and waste rock, especially sulfide minerals, in order to determine if the rock is potentially acid generating, possibly contains potential hazardous metals, or contains commodities of potential economic interest.
- Understand the weathering processes at the surface and within the waste rock and tailings piles to determine physical stability of the rock piles, tailings, and other mine features.
- Identify water quality problems caused by drainage and related activities from legacy mines.
- Determine how reactive pyrite and carbonate minerals are in order to evaluate acid

drainage potential and other water quality issues.

- Determine the suitability of existing waste rock piles for backfill material and location of additional suitable backfill material.
- Determine the geochemical characteristics of the bedrock and foundation underlying the mine features and their influence on waste rock pile stability.

A sample is a representative portion, subset, or fraction of a body of material representing a defined population (Koch and Link, 1971; Wellmer, 1989; Davis, 1998; Neuendorf et al., 2005; Downing, 2008; McLemore et al., 2014). A sample is that portion of the population that is actually studied and used to characterize the population. Collecting a representative sample of waste rock-pile material can be difficult because of the compositional, spatial, and size heterogeneity of the material. It is necessary to define the particle-size fraction of the sample required and analyzed, because of the immense size heterogeneity in many waste rock piles (Smith et al., 2000).

Composite samples of waste rock piles were collected, using procedures developed by Munroe (1999) and the U.S. Geological Survey (Smith et al., 2000; Smith, 2007; McLemore et al., 2014) and summarized in the GARD Guide (http://www.gardguide.com/index.php?title=Main_Page, accessed on 1/6/2019). Evenly spaced metal flagging pegs were positioned across an entire rock pile at each site marking a subsample location. Subsamples are collected with a small stainless steel hand trowel or shovel and sieved using ½ inch mesh into a 5-gallon bucket. This type of sampling is developed by the USGS and poses no stability or erosion risks of the waste rock piles. Approximately two shovels of material were collected from each marked location on the waste pile. Subsamples are then mixed thoroughly and stored in buckets or large plastic bags. Sampling equipment is cleaned after sampling each waste pile. A subsample of the homogenized, composite sample was split for petrographic, mineralogical, geochemical and geotechnical analyses. Figure 3 is a flow chart describing the steps in collecting samples and the laboratory analyses performed on selected samples.

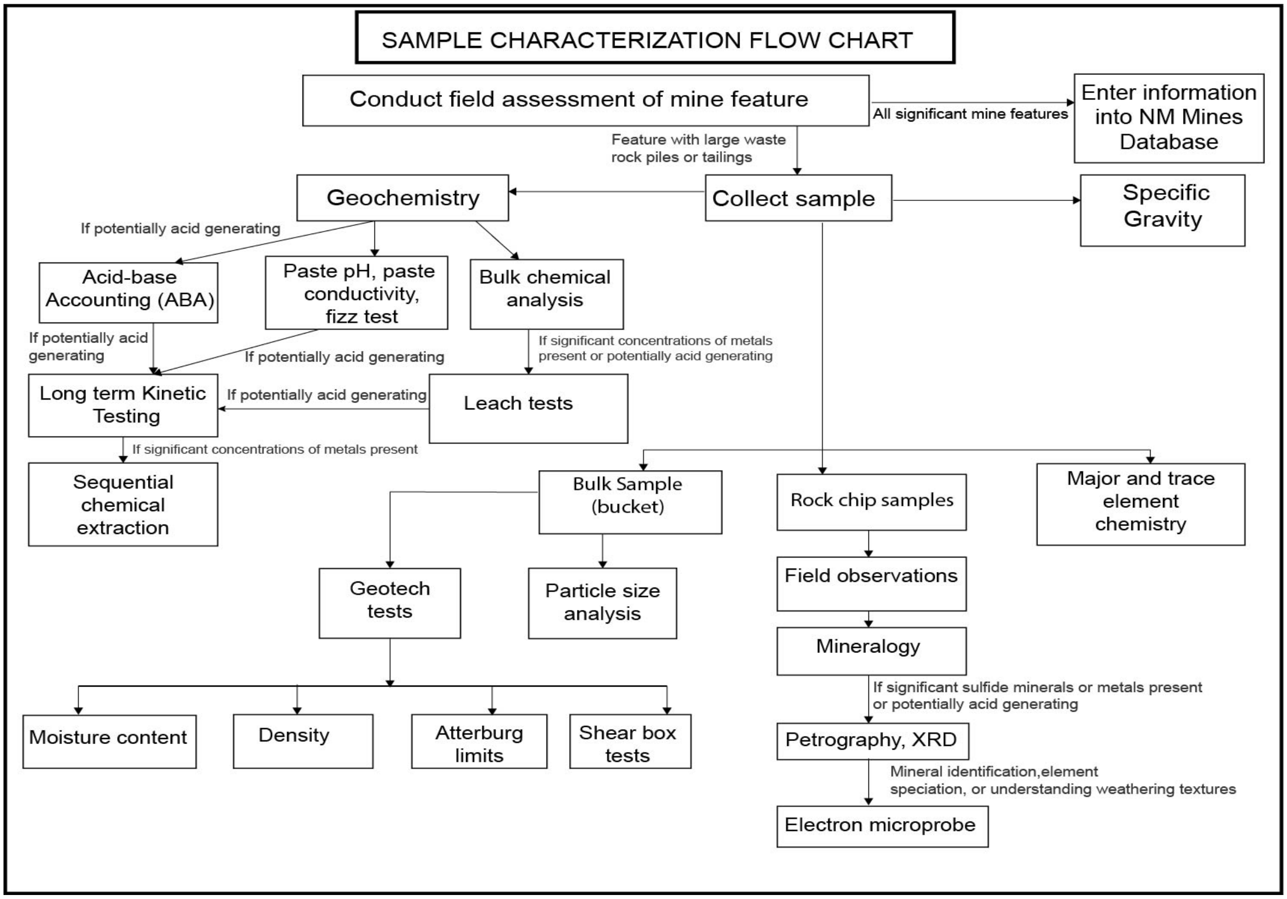


FIGURE 3. Sample characterization flow chart.

Laboratory Analyses

Sample preparation

Laboratory analyses were performed on selected samples based upon a combination of criteria including the size of the waste rock pile (i.e. larger piles in the district) and mineral composition (i.e. presence of pyrite and/or jarosite and other minerals). Selected rock chips and fragments from the waste rock piles or from mineralized outcrops were collected in order to determine the mineralogical and chemical composition. Sample preparation for different laboratory analyses is summarized in Table 2.

TABLE 2. Summary of sample preparation for different laboratory analyses. XRF–X-ray fluorescence analyses. XRD–X-ray diffraction analysis. ICP–Induced-coupled plasma spectrographic analysis.

Laboratory analysis	Type of sample	Sample Preparation	Method of obtaining accuracy and precision
Petrographic analyses (Appendix 4)	Collected in the field, used split from chemistry sample	Uncrushed, typically smaller than gravel size material used, thin sections made of selected rock fragments	Not applicable
Paste pH and paste conductivity (Appendix 5)	Collected in the field, used split from chemistry sample	Uncrushed, typically smaller than gravel size material used	Use duplicates, compare to mineralogical analysis
Whole-rock chemical analysis (XRF, ICP, S/SO_4) (Appendix 5)	Collected in the field in separate bag, analysis performed on powdered sample	Crushed and pulverized	Use reference standards and duplicates
Chemical analyses of water samples (Appendix 6)	Collected in the field in bottles	Refrigerated until analyzed	Use reference standards and duplicates
Particle size analysis (Appendix 7)	Bulk sample collected in the field	Sample sieved for each size fraction weighed	Not applicable
X-ray diffraction (XRD) analyses (Appendix 8)	Used select split from chemistry sample	Crushed	Compared to detailed analysis by electron microprobe
Electron microprobe analyses (Appendix 9)	Collected in the field or split from chemistry sample	Uncrushed, generally rock fragments or soil matrix	Use reference standards

Petrographic descriptions and mineralogy

Petrographic analyses were performed using standard petrographic techniques (hand lens and binocular microscope). These analyses were supplemented by thin section petrography, electron microprobe analyses, X-ray diffraction (XRD) analyses, and whole-rock chemical analyses. Modal mineralogy was estimated using standard comparison abundance charts. Mineral concentrations and phase percentages, grain size, roundness, and sorting were estimated using standard charts (Carpenter and Keane, 2016). Data are summarized in Appendix 4.

Bulk mineral identification can be used to identify minerals present in quantities greater than approximately 3%. Estimates of both primary and secondary minerals were determined, cementation and alteration described, and mineralogy and lithology described (Folk, 1974; Carpenter and Keane, 2016). Any special features were noted. Altered, unaltered, and mineralized samples, including select samples of cement, are powdered and analyzed by XRD. Weathered waste rock piles typically contain some amount of amorphous material that cannot be identified by XRD (Smith et al., 2000), but by integrating electron microprobe and geochemical data this material can be characterized. This amorphous material typically contains metals that can be released into the water and can contain clay minerals, and in some cases, acts as a cement.

Paste pH and conductivity

Paste pH and paste conductivity were determined to predict geochemical behavior of waste rock materials subjected to weathering under field conditions and to estimate or predict the pH and conductivity of the pore water resulting from dissolution of secondary mineral phases on the surface of oxidized rock particles (Weber et al., 2006). The paste conductivity values were converted to total dissolve solids (TDS) using standard procedures. Data for selected samples are in Appendix 5.

Geochemistry of solid samples

Samples underwent multiple analyses such as X-Ray Fluorescence (XRF), inductively coupled plasma atomic emission spectroscopy (ICP-AES), and inductively coupled plasma mass spectrometry (ICP-MS) at the ALS Laboratory Group in Reno, Nevada for evaluation of major and trace elements (CCP-PKG03 and Au-ICP21; https://www.alsglobal.com/myals/downloads?keywords=Geochemistry+Fee+Schedule&category=b5b5208b58bc4609bd2fa20f32d820f8, accessed 1/6/2019). Samples were dried, crushed, split and pulverized according to standard ALS Laboratory Group preparation methods PREP-31; https://www.alsglobal.com/myals/downloads?keywords=Geochemistry+Fee+Schedule&category=b5b5208b58bc4609bd2fa20f32d820f8, accessed 1/6/2019). This package combines the whole rock package ME-ICP06 plus carbon and sulfur by combustion furnace (ME-IR08) to quantify the major elements in a sample. Trace elements, including the full rare earth elements (REE) suites, are performed after three acid digestions with either ICP-AES or ICP-MS finish: 1) a lithium borate fusion for the resistive elements (ME-MS81), 2) a four-acid digestion for the base metals (ME-4ACD81) and 3) an aqua regia digestion (ME-MS42). Gold was analyzed separately (Au-ICP21). Chemical analyses are in Appendix 5.

On-going control samples were submitted with each batch of samples submitted. Certified standards are commercial standards with certified values as determined by round robin analyses at numerous certified laboratories. Certified standards are expensive, so on-going control samples were analyzed instead. The on-going control samples are standards collected by NMBGMR personnel and analyzed by different methods over several years of analyses by different laboratories. Duplicate samples were also submitted. A summary of the quality assurance and quality control (QA/QC) is in Appendix 9 and McLemore and Frey (2009). More details are found at the ALS website (https://www.alsglobal.com/myals/downloads?keywords=Geochemistry+Fee+Schedule&category=b5b5208b58bc4609bd2fa20f32d820f8, accessed 1/6/2019).

Geochemistry of water samples

In central and southern New Mexico, relatively few mine features contain water. However, if water was encountered, a sample was collected for chemical analyses. Water was collected in a 250 mL plastic bottle and kept cool with no headspace and as little particulate matter as possible, until transported to the NMBGMR Chemical Laboratory. Data are in Appendix 6.

Particle size analyses

Particle size distributions were determined in order to understand the structural properties and the amount of fine material present in the sample. The analyses were performed using ASTM D422-63. The composite waste rock pile samples when collected were screened and only the screened, material was used. Particle size distributions are in Appendix 7.

X-ray Diffraction (XRD)

X-ray diffraction (XRD) analysis was conducted on selected portions of composite waste rock samples to determine the mineralogy. Samples were ground into a well-homogenized material with a mortar and pestle, forming a fine powder (~75µ/0029 mesh). This was poured into an aluminum sample holder and mounted with the silicon standard in the XRD instrument. A five-minute absolute scan analysis was run. Sample analyses were performed using an appropriate software program. More details are found at NMBGMR website (https://geoinfo.nmt.edu/labs/x-ray/home.html, accessed 1/6/2019). Data are in Appendix 8.

Electron Microprobe Mineralogical Analyses

Selected samples were examined using a Cameca SX100 electron microprobe with three wavelength-dispersive spectrometers at New Mexico Institute of Mining and Technology (NMIMT) to characterize compositional, chemical and textural characteristics. Samples chosen for microprobe analysis were selected based on presence of pyrite or other sulfide minerals. Samples cut to an appropriate size were placed in 1-inch round sample mounting cups, set in epoxy, and cured overnight at around 80° C. Once cured, samples were first polished using coarse diamond grinding wheels and finely polished with diamond powder suspended in distilled water. Polished sample surfaces were then cleaned using petroleum ether and carbon coated to 200 angstrom thickness.

Different types of analyses are performed. The initial observations of the samples are made using backscattered electron imaging (BSE), which allowed observation of sample textures, and location of high mean atomic number (Z) phases. BSE observations are coupled with acquisition of rapid X-ray maps and/or qualitative geochemical scans, which allow for qualitative assessment of the elements present in a given mineral phase. Peaks that appeared on the scans were identified using Cameca software. The elements shown by the peaks and their relative abundance, based on peak height, were used to identify the mineral phases. Qualitative scans were carried out using an accelerating voltage of 15 kV and a probe current of 20 nA.

For more information on the electron microprobe laboratory see http://geoinfo.nmt.edu/labs/microprobe/home.html (accessed 1/6/2019). Data of the microprobe analyses are in Appendix 9.

Quality Control Procedures and Sample Security

Samples were collected, prepared, and analyzed according to standard methods for each specific laboratory analysis. Samples were collected in the field and kept under direct control of the authors to avoid contamination. Samples are archived at the NMBGMR. Samples collected are complete, comparable, and representative of the defined population at the defined scale as documented in Appendix 10. Precision and accuracy are measured differently for each field and laboratory analysis (parameter), and are explained in the methods section of this report as well as Appendix 9 and McLemore and Frey (2009). Most geochemical laboratory analyses depend upon certified or on-going reference standards and duplicate analyses (Appendix 10). The sampling and analysis plans for each segment of the field and drilling program as well as the control of accuracy and precision as defined here, provides a large high-quality set of observations and measurements that are adequate to support the interpretations and conclusions of this report. Field and laboratory audits by the senior author were performed to ensure that standard operating procedures were followed.

Hydrologic characteristics

Basin-wide hydrologic characteristics were determined by averaging data from the nearest weather station (Table 1; from http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nmmagd, accessed 1/6/2019) and by utilizing software available from the USGS (https://streamstats.usgs.gov/ss/; http://prism.oregonstate.edu/normals/, accessed on 1/6/2019). The results are in Appendix 11.

Classification of mineral-resource potential

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 (Fig. 4).

High mineral-resource potential is assigned to areas where there are known mines or deposits where the geologic, geochemical, or geophysical data indicate an excellent probability that mineral deposits occur. All active and producing properties fall into this category, and also includes active exploration projects that are in the permitting process. All identified deposits in known mining districts with significant past production or in areas of known mineralization fall into this category, unless mined out. Speculative deposits, such as reasonable extensions of known producing mining districts and identified deposits or partially defined deposits with past exploration within geologic trends are classified as high mineral-resource potential when sufficient data indicate a high probability of occurrence. This assignment, like other classifications, can be revised when new information, new genetic models, or changes in economic conditions develop.

DEFINITIONS OF LEVEL OF RESOURCE POTENTIAL

N **No mineral-resource potential** is a category reserved for a specific type of resource in a well-defined area with no evidence of mineral resources.

L **Low mineral-resource potential** is assigned to areas where geologic, geochemical, and geophysical characteristics indicate geologic environment where the existence of economic mineral resources is unlikely and is assigned to areas of no or dispersed mineralized rocks.

M **Moderate mineral-resource potential** is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for mineral-resource occurrence.

H **High mineral-resource potential** is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence and development. Assignment of high mineral-resource potential to an area requires some positive knowledge that mineral-forming processes have been active in at least part of the area.

DEFINITIONS OF LEVEL OF CERTAINTY

A Available information is not adequate for the determination of the level of mineral-resource potential.

B Low, available information suggests the level of mineral-resource potential.

C Moderate, available information gives a good indication of the level of mineral-resource potential.

D High, available information clearly defines the level of mineral-resource potential.

<table>
<tr><td rowspan="5">↑
INCREASING LEVEL OF RESOURCE POTENTIAL</td><td rowspan="5">U/A
Unknown Potential</td><td>H/B
High Potential</td><td>H/C
High Potential</td><td>H/D
High Potential</td></tr>
<tr><td>M/B
Moderate Potential</td><td>M/C
Moderate Potential</td><td>M/D
Moderate Potential</td></tr>
<tr><td>L/B
Low Potential</td><td>L/C
Low Potential</td><td>L/D
Low Potential</td></tr>
<tr><td rowspan="2">L/B
Low Potential</td><td rowspan="2">L/C
Low Potential</td><td>N/D
No Potential</td></tr>
<tr><td>N/D
No Potential</td></tr>
<tr><td colspan="5">***INCREASING LEVEL OF CERTAINTY*** →</td></tr>
</table>

FIGURE 4. Classification of mineral-resource potential and certainty of assurance (from Goudarzi, 1984).

Moderate mineral-resource potential is assigned to areas where geologic, geochemical, or geophysical data suggest a reasonable probability that undiscovered mineral deposits occur in formations or geologic settings known to contain economic deposits elsewhere. Areas with multiple active or closed mining claims and areas of past exploration efforts would be included as having a moderate mineral-resource potential. Speculative deposits in known mining districts or mineralized areas are assigned a moderate potential if evidence for a high potential of economic deposits is inconclusive. This assignment, like other classifications, can be revised when new information, new genetic models, or changes in economic conditions develop.

Low mineral-resource potential is assigned to areas where limited available data imply the occurrence of mineralization, but the data are insufficient to indicate a high or moderate probability for the occurrence of an economic deposit. This includes speculative deposits in geologic settings not known to contain economic deposits, but which are similar to geologic settings of known economic deposits. Areas with scattered active or closed mining claims and areas with above-background chemical values are classified as having a low mineral-resource potential. Additional data are generally needed to better classify such areas.

No mineral-resource potential is assigned to areas where sufficient information indicates that an area is unfavorable for economic mineral deposits. This evaluation may include areas with dispersed, but uneconomic mineral occurrences as well as areas that have been depleted of their mineral resources. Areas with unfavorable geologic environments for specific mineral resources are assigned a no mineral-resource potential. Use of this classification implies a high level of geologic assurance to support such an evaluation, and it is assigned for potential deposits that are too deep to be extracted economically, even though there may not be a high level of geologic assurance. These economic depths vary according to the commodity, and current and future economic conditions.

Unknown mineral-resource potential is assigned to areas where necessary geologic, geochemical, and geophysical data are inadequate to classify an area otherwise. This assessment is assigned to areas where the degree of geologic assurance is low and any other classification would be misleading.

Methods of mineral-resource assessment

This report assesses the potential of mineral resources on the surface and within the subsurface within the Rosedale mining district, excluding oil, gas, helium, and carbon dioxide potential. The evaluation of mineral-resource potential involves a complex process based on geologic analogy and probability of promising or favorable geologic environments with geologic settings (geologic models) that contain known economic deposits, as described in Goudarzi (1984) and McLemore (1985, 2018). Such subjective assessments or judgments depend upon available information concerning the area, as well as current knowledge and understanding of known deposits. The mineral resources were assessed by compilation and integration of all available published and unpublished geologic, geochemical, geophysical, and production data.

Most commodities were evaluated at the mining district or prospect area scale (as defined by McLemore, 2017), although some industrial minerals have potential outside of known mining districts, which are identified by polygons indicating the mineral-resource potential. The mineral-resource potential described in this report is adequate to the district scale (approximately at a scale of 1:12,000). In general, the process of determining mineral-resource potential for each commodity is to identify favorable geologic settings, known mines, deposits, unmined deposits, mining claims and favorable areas, and then to identify areas of high, moderate, and low for a given resource.

MINING HISTORY AND PREVIOUS WORK IN THE ROSEDALE DISTRICT

Mineral production from the Rosedale district is in Table 3. 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 (NMBGMR file data). However, production figures are subject to change as new data are obtained. A report by Burney and Scarlata (2008) further describes the mining history of the Rosedale district. Other mining records are on file at the NMBGMR and found at https://geoinfo.nmt.edu/geoscience/hazards/mines/aml/documents/AML_Rosedale_Portfolio.pdf (accessed 1/6/2019). A chronological synopsis is summarized in Appendix 3.

TABLE 3. 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). — = none. ?=unknown 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.
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)

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 developed but mining was delayed for four years because of raids by indigenous Apache Indians. Once the Apaches were placed on reservations, prospectors once again rushed into the area. In 1886, the Rosedale Mining Co. was formed and operated the Rosedale mine (Great London and Rothchild claims) until 1898, when E.H. Martin Co. acquired the property. The Great London Lode and Mill site, including the Rosedale mine, were patented in 1901 by W.K. Martin Company (Table 4). Only ruins of foundations remain today (Fig. 5).

TABLE 4. Patented mining claims in the Rosedale district, Socorro County, New Mexico.

Mine Id	Patent Name	Mineral Survey No.	Patent No.	Date of patent	Comments
NMSO0064	Great London Lode	1076A	33724 (218186)	4/6/1901	20.11 acres, W. K. Martin Company
NMSO0064	Great London Mill site	1076B	33724 (218186)	4/6/1901	4.37 acres, W. K. Martin Company
NMSO0748	Rothchild mill	1077A, B	34301	08/15/1901	19.55 acres
NMSO0061	Bell	1962	1037619	5/24/1930	Three Brothers, Red Oak, New Golden Bell, 53.4 acres

The Rosedale shaft was developed to 50 ft in 1888 and the first assays were reported as 6 oz/short ton Au. The Rothchild mill was built in 1894. Ore was first processed in a wood-fired, steam-operated 10-stamp mill using mercury amalgamation and cyanide treatment (Fig. 6). A 50-short ton capacity cyanide plant was built in 1899 and was among the first cyanide operations to operate in the western U.S. Approximately two-thirds of the gold was processed by mercury amalgamation and the rest by cyanidation. Every day, the mill and cyanide plant required four to five cords of wood, 13 pounds of cyanide, three pounds of zinc, oil, and other incidentals (Batchelder, 1910). Three miles of pipe delivered water from a distant spring, owned by the company as part of the mineral patent, to the milling operations. A separate sawmill supplied lumber to the mine. The assay office burned down in 1901 and the mill records were lost. The Rosedale mine was developed to 732 ft with 13 levels by 1901 in order to access a rich part of the vein.

After detailed sampling the Rosedale mine was sold in 1907. By 1908 approximately 30,000 short tons of ore were milled and 200,000 short tons were in reserves. W.H. Martin Co. sold the mine and water rights to the newly formed Rosedale Mining and Milling Co. in 1909. The mine closed in 1910 due to fire in August that damaged or destroyed the 20-stamp mill and cyanide plant. The exploratory drift on the 6^{th} level collapsed in late 1910.

Under new ownership the mine reopened in 1913 and operated until another fire destroyed the mill in 1916. Several fires hampered production at Rosedale mine over the next few years (Burney and Scarlata, 2008).

FIGURE 5. Foundations of the Rosedale townsite near the Rosedale mine, looking northwest.

In 1930, the Rosedale mine again changed ownership. From about 1934–1935, the Rosedale Gold Mines Limited (headquarters in Vancouver, Canada), acquired the property and the Black Bear Mining Co. operated the mine from 1934 to 1935 (Fig. 6, 7; Anderson, 1957). A new 135 short ton/day mill and a new 65 short ton/day cyanide plant were built (Anderson, 1957). A flow sheet of the Rosedale mill appeared in Metzger (1938). But early in 1935, the Black Bear Mining Company sold the Rosedale property to the Rosedale Mining Company (1935–1937). The mine changed ownership once more in 1941 and fires destroyed the mills and buildings in 1941–1942. All ore concentrates were shipped to El Paso for smelting. An auction in 1942 sold the remaining equipment (New Mexico Mining News 1942, no. 3, 6). A longitudinal section of the Rosedale mine is in Figure 8. Mines associated with the Rosedale mine are shown in Figure 9.

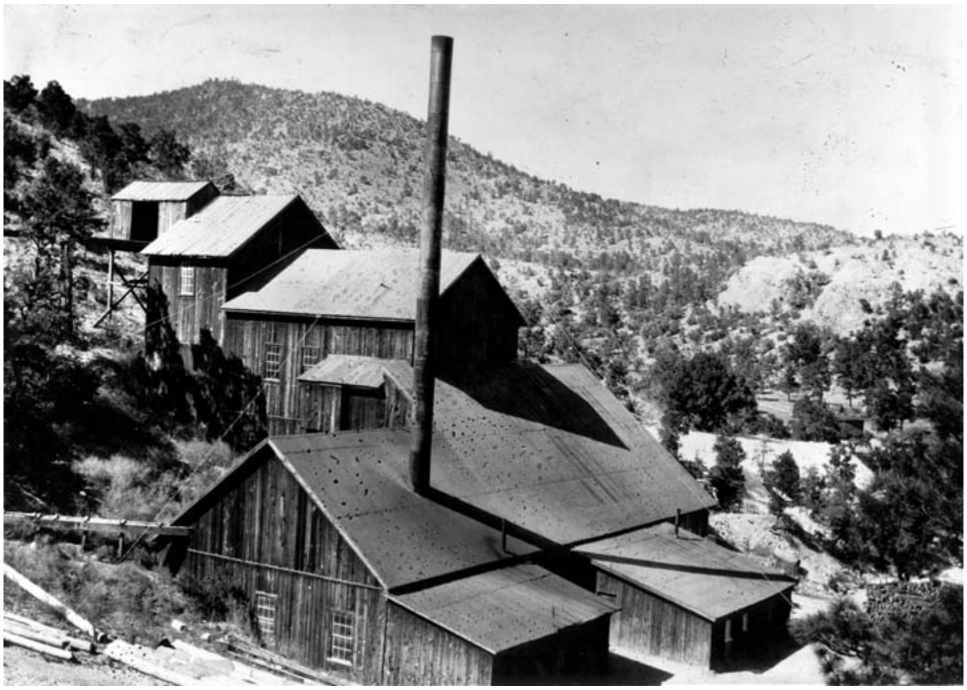


FIGURE 6. Mill and cyanide plant at the Rosedale mine, looking north, about 1905 (NMBGMR historical photos #p-00970).

FIGURE 7. Rosedale adit, shaft and buildings, looking north, about 1950 (NMBGMR historical photo #p-01819).

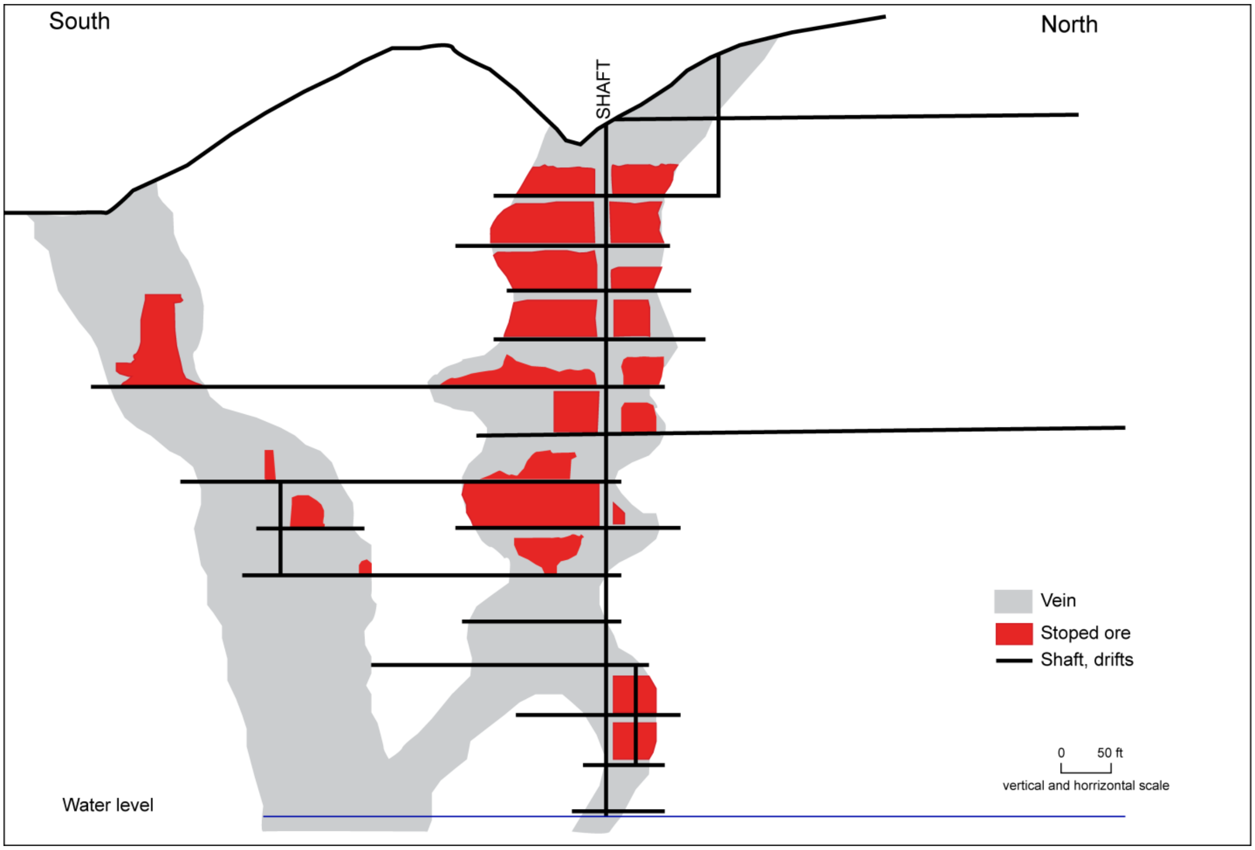


FIGURE 8. Longitudinal section of the Rosedale mine, Rosedale mining district, Socorro, County, New Mexico, circa 1912 (modified from NMBGMR files). The mine is 732 ft deep.

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 Longtail and Rose were reclaimed by the U.S. Forest Service in 2007-2008 (Fig. 10). The Elizabeth was not reclaimed due to funding constraints and small size (Burney and Scarlata, 2008). Early tailings were transported from the mill to the tailings by mill launder or flume (Sherman and Sherman (1975). Burney and Scarlata (2008) included a photograph of the remaining vertical posts that were subsequently buried during the reclamation.

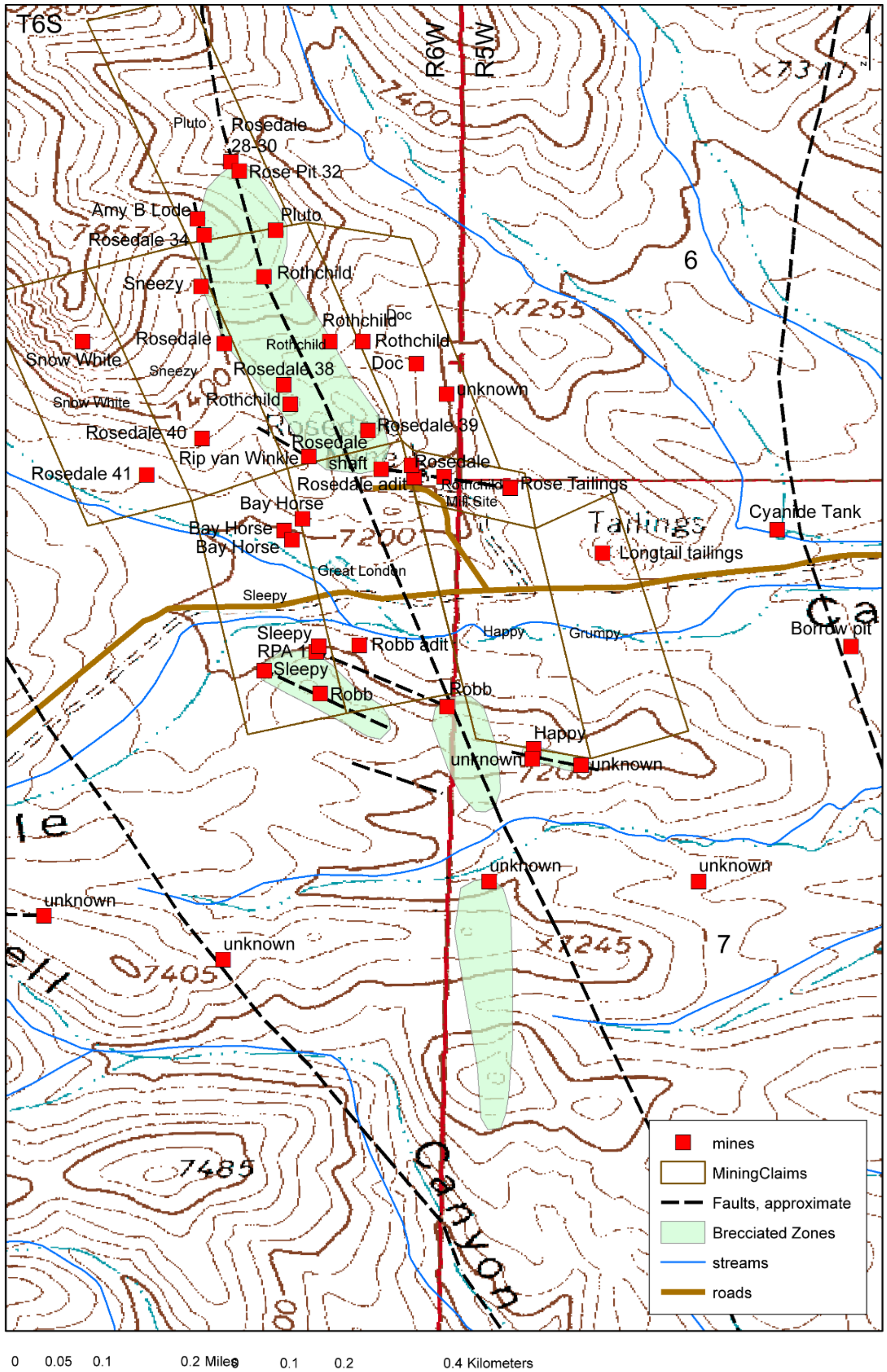


FIGURE 9. Mines along the Rosedale vein, Rosedale district, Socorro County, New Mexico. Northwest-trending faults are from Ferguson (1986), east-trending faults and brecciated zones are from this report. See Figure 2 for location in the district.

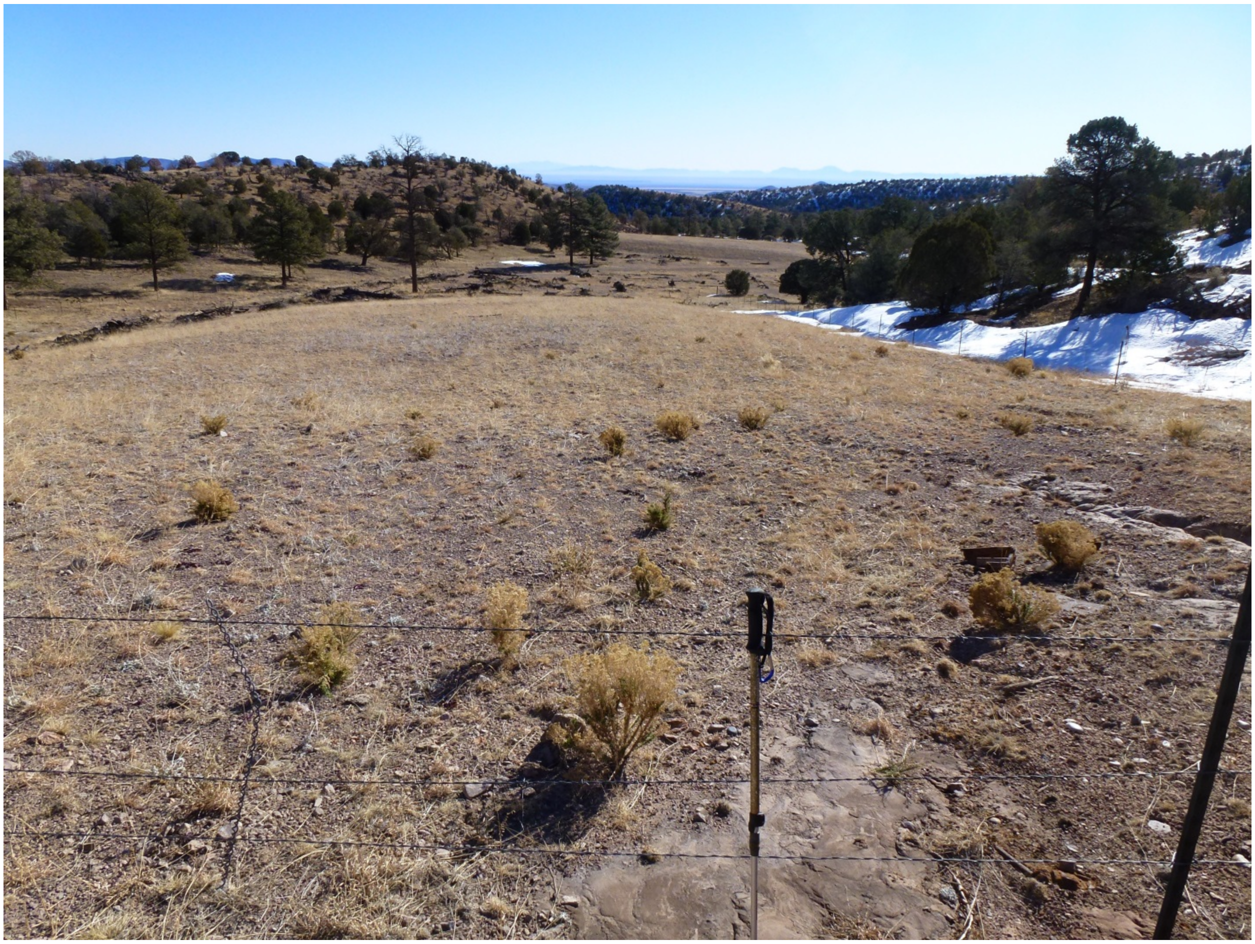


FIGURE 10. View across reclaimed Longtail tailings, looking east.

Other mining claims were staked in the district during the early 1900s (Fig. 11, 12), but only the Bell (Golden Bell) was patented in 1930 (Table 4; Fig. 13). The Bell mine produced some ore in 1902–1904, as did a few of the other mines. A prospect south of Rosedale mine, Robb (Fig. 9), along the same vein as the Rosedale, found good ore in a 10-ft section. The Continental Lode is adjacent to the Rosedale to the south. The Gospel Lode and Bay Horse (produced in 1902) are west of the Rosedale mine. The Lane (Whitecap) mine started production in October 1901 (Fig. 13) and mines in the Big Rosa area were showing promising assays (Fig. 12). Other claims include May Dew, Ninety Nine, Alabama, Amy B., Baking Powder, Bay Horse, Big Rosa, Gold Cap, Golden Gate, Gospel, Graham, Greenwood Group, Guiding Star, Justice, Lone Star, May Dew, New Year (Ninety-Nine), Noonday, Red Wave, Republican, Rockefeller, Seal Package, Sun Rise, and Toledo, but not all could be located during field examinations (Appendix 2; Ackerly, 1997; Burney and Scarlata, 2008; NMBGMR files).

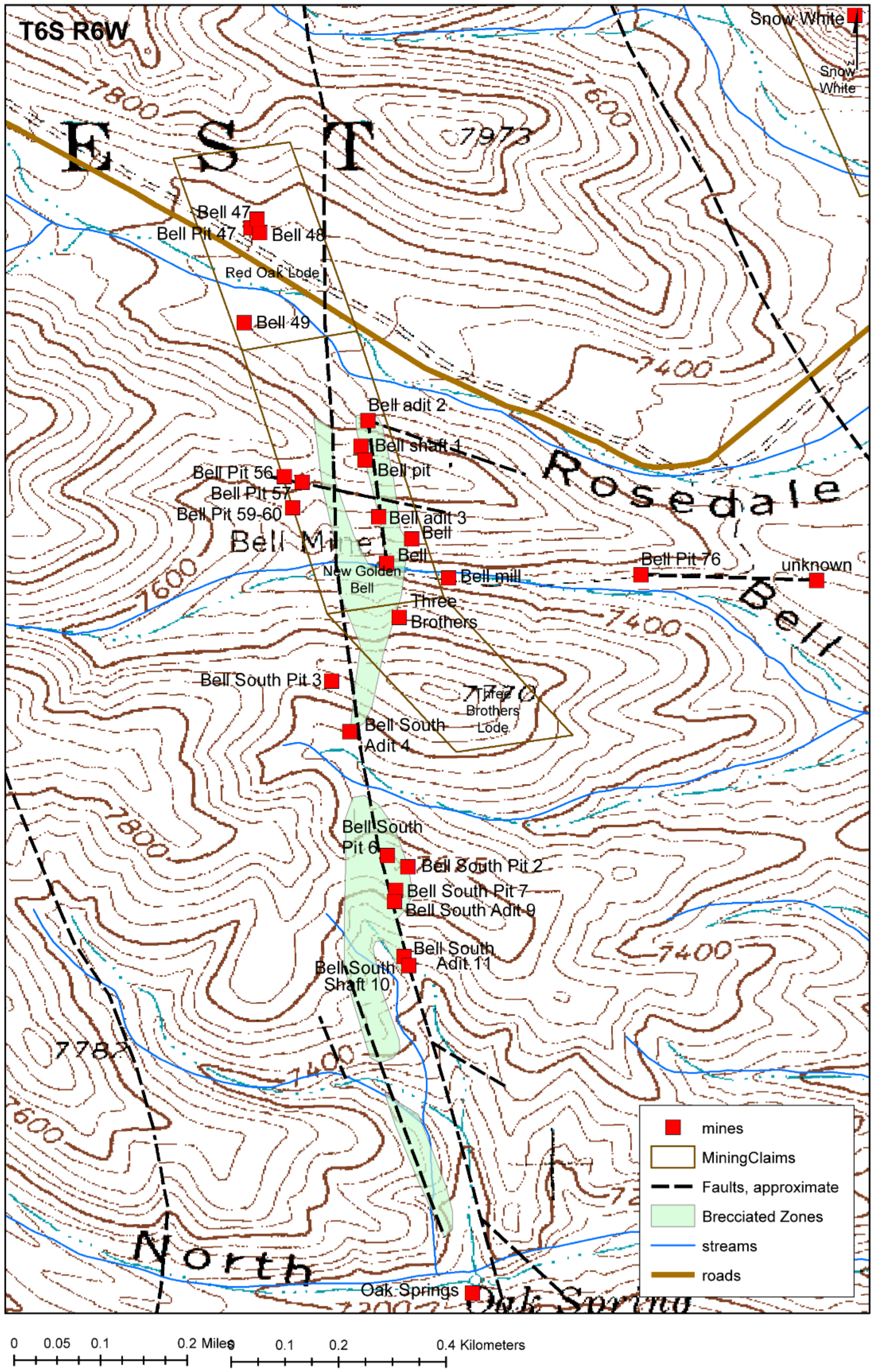


FIGURE 11. Mines along the Bell vein, Rosedale district, Socorro County, New Mexico. Northwest-trending faults are from Ferguson (1986), east-trending faults and brecciated zones are from this report. See Figure 2 for location in the district.

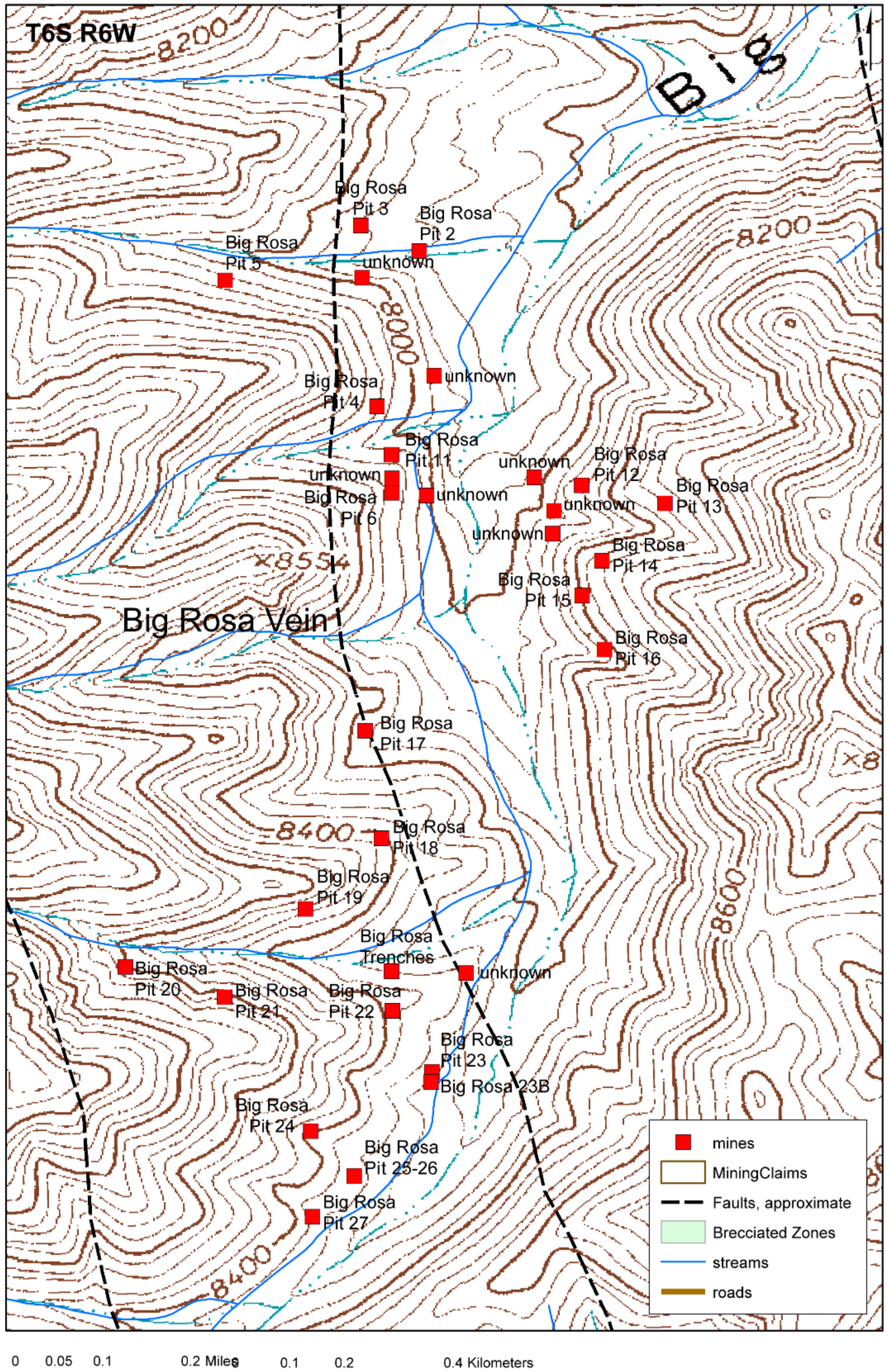


FIGURE 12. Mines along the Big Rosa Canyon vein, Rosedale district, Socorro County, New Mexico. Northwest-trending faults are from Ferguson (1986). See Figure 2 for location in the district.

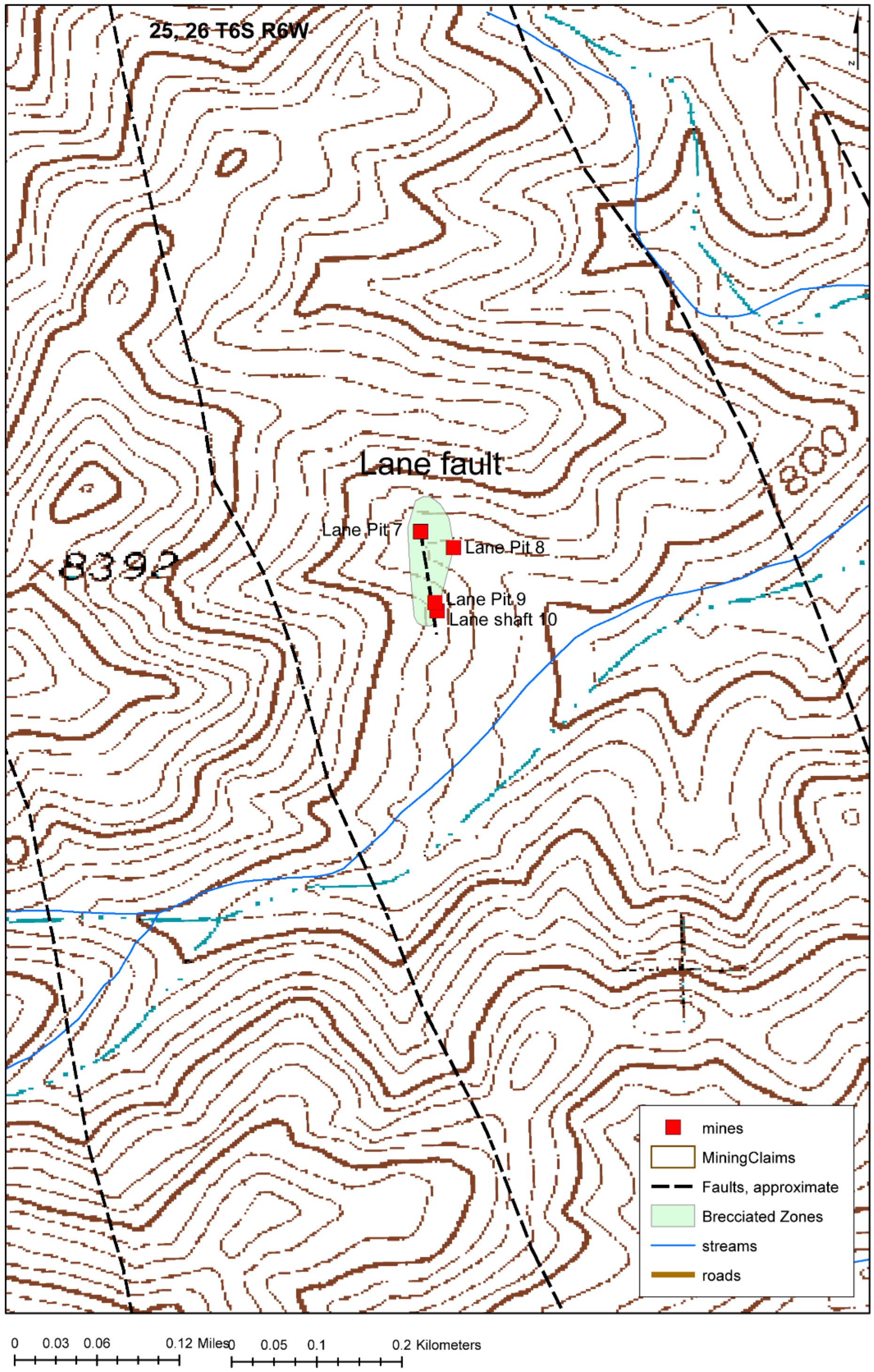


FIGURE 13. Mines along the Lane vein, Rosedale district, Socorro County, New Mexico. Northwest-trending faults are from Ferguson (1986), Lane fault and brecciated zone are from this report. See Figure 2 for location in the district.

The community of Rosedale, next to the Rosedale mine, was typical of many mining towns of the era and consisted of residences, grocery store, general merchandise store, a post office, saloon, blacksmith shop, assay office, and other sundry structures. Ranches also began in the area surrounding the community. Population of the community fluctuated, but likely did not exceed 200 residents (Burney and Scarlata, 2008). The post office operated from 1899 to 1928 (Pearce, 1965). By 1934, the community began to decline in population. Burney and Scarlata (2008) documents many artifacts from the former community. The cemetery is east of the mine, where the first known burial was a soldier from Fort Craig in 1882. A hunting lodge was built west of the Rosedale mine in the 1900s and subsequently burned down in 1943. A native-rock chimney is all that remains (Fig. 14). This area is now a popular camping site.

Rosedale is not only a historic site, but a potential future mining site since additional mineral resources could be present. In 1937–1938, Harrison Schmitt, Sr. examined and sampled the Rosedale mine, with favorable results and suggesting that extension of the existing workings should be considered. Since 1950, reported exploration in the district included a drilling project carried out by Perry, Knox, and Kaufman in the 1970's (NMBGMR archive report no. 5602_mf). 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 and in 1979, Resources America, Inc. drilled six holes near the Rosedale mine. In 1976, during the drilling project, eight holes were drilled with a total depth of 1472 ft. The results of the drilling program showed moderately-strong gold-silver mineralization at the southern portion of the Bell mine. From these results, Perry, Knox and Kaufman, Inc. estimated 1.5–2 million short tons of 0.3 oz/short ton Au remain (historic resource, not NI43-101 compliant). In 1976, eight holes were drilled with a total depth of 1,472 ft near the Bell mine. The results of the drilling showed to have strong gold-silver mineralization in the area south of the Bell mine.

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 located mining claims adjacent to the Rosedale and Bell patents. A NMIMT geochemistry class performed a stream-sediment and rock chip survey in the area in the 1990s, partially paid for by exploration mining companies. Exploration by mining companies continued in the district through the late 1990s.

The price of gold and silver have dramatically increased in recent decades, resulting in re-examination of gold and silver mining districts throughout New Mexico for their mineral resource potential. In 2017, Fred Holly received a minimal-impact exploration permit to drill near the Rosedale mine. Results of these exploration efforts are unknown. Zutah (2017) examined the mineral-resource potential of the district.

This report is part of ongoing studies of mineral deposits in New Mexico and includes updates and revisions of prior work by Lindgren et al. (1910), Lasky (1932), Anderson (1957), Neubert (1983), North and McLemore (1986, 1988), Laughlin et al. (1986), Ackerly (1997) and McLemore (1996, 2001). Historical records from the NMBGMR mine archives are on the NMBGMR web site (https://geoinfo.nmt.edu/geoscience/hazards/mines/aml/documents/AML_Rosedale_Portfolio.pdf, accessed 1/6/2019). The earliest geologic studies in the San Mateo Mountains were by Lasky (1932), Willard (1957), and Weber (1963). Deal (1973) defined the Mt. Withington caldera in the northern San Mateo Mountains. Regional mapping included Osburn (1984), who compiled a geologic map of Socorro County. The geology of the northern San Mateo Mountains has been described by Ferguson (1986, 1990). These early reports are important because they describe the mineral deposits when they were mined. Most of the mineralized material was mined and milled and is no longer available for observation. The hydrology of Socorro County was by Roybal (1989).

FIGURE 14. A native-rock chimney is all that remains of a hunting lodge that was built west of the Rosedale mine in the 1900s and burned down in 1943.

REGIONAL GEOLOGY

Even though detailed geologic mapping in the San Mateo Mountains is not completed, the available mapping indicates that the overall geologic history of the range is similar to that found throughout southwestern New Mexico. 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. 15; McIntosh et al., 1991, 1992a, b; Chapin et al., 2004a, b). In the southwestern U.S, Tertiary volcanic activity began about 40–36 Ma with the eruption of andesitic volcanism, followed by episodic bimodal silicic and basaltic andesite volcanism during ~36 to 24 Ma (Cather et al., 1987; McIntosh et al., 1992a, b). Approximately 25 high- and low-silica rhyolite ignimbrites (ash-flow tuffs) were erupted and emplaced throughout the Datil- Mogollon volcanic field during the second event; source calderas have been identified for many of the ignimbrites (Fig. 15; McIntosh et al., 1992a, b; Chapin et al., 2004a, b). Subsequent faulting, hydrothermal alteration, and volcanism have offset, altered, and covered portions of the ignimbrites, which creates difficulties for regional correlations. Many volcanic-epithermal deposits formed along the ring fracture zones of some calderas (Fig. 15). The Rosedale mining district is found along the Mt. Withington caldera.

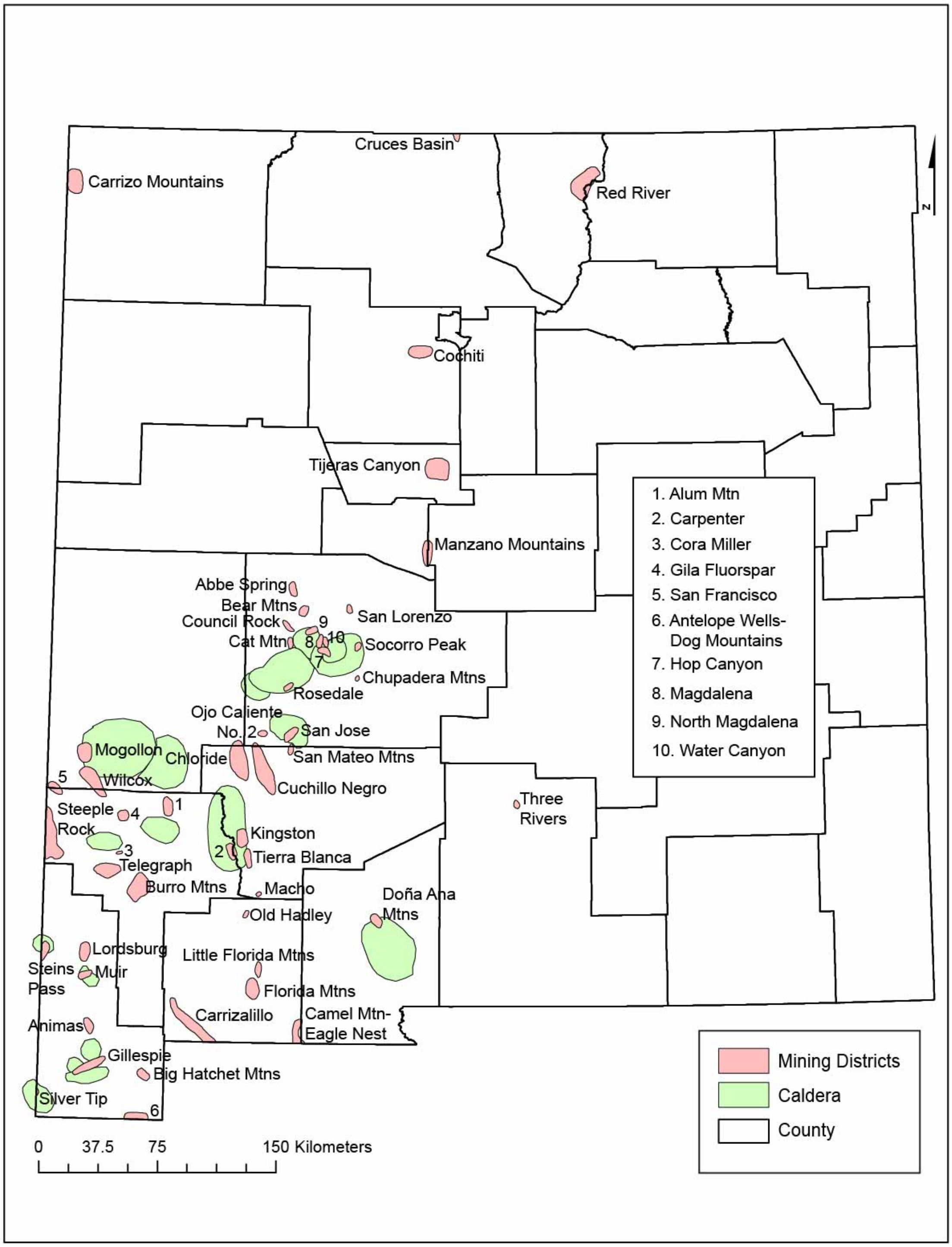


FIGURE 15. Calderas and volcanic-epithermal mining districts in the Datil-Mogollon volcanic field, southwestern New Mexico (calderas from Chapin et al., 2004a, b; mining districts from McLemore, 2017 and McLemore and Lueth, 2017).

DISTRICT GEOLOGY

Geology and stratigraphy

Very little is known about the pre-Oligocene geologic history of the San Mateo Mountains because thick ash-flow tuffs or ignimbrites (South Canyon Tuff, 27.3 Ma; McIntosh, 1989) cover the entire area (Fig. 16). These tuffs erupted from the Mt. Withington caldera 27.3 Ma (Deal, 1973; Deal and Rhodes, 1976; Ferguson, 1990). The South Canyon Tuff is the second youngest major regional ash flow tuff in central New Mexico. Before eruption of Mt. Withington caldera, rhyolite lavas erupted and underlie the South Canyon Tuff locally. The South Canyon Tuff is a moderately crystal-rich (10–30% phenocrysts) quartz-feldspar bearing, locally flow-banded ash flow tuff. The intracauldron facies is found in the Rosedale district. The Lemitar Tuff also is present in the Rosedale district and is a crystal-rich (10-35% phenocrysts) quartz-feldspar-biotite bearing rhyolite ash flow tuff. The source caldera is unknown but thought to be in the central San Mateo Mountains.

The most prominent rock in the Rosedale district is purple-brown rhyolite porphyry. Rhyolite lavas are present throughout the Rosedale district below the Lemitar Tuff. Volcanic breccia and tuff are generally exposed and overlie the rhyolite porphyry, and these rocks are in turn generally overlain by a coarse porphyritic rhyolite which caps the rounded hills of the district. In some areas a layer of flow rhyolite lies between the tuff and the porphyritic rhyolite. The breccia and tuff are discolored like the underlying rhyolite porphyry and at some places contain cavities up to several inches across lined with irregularly oriented quartz prisms (Lasky, 1932). The porphyritic rhyolite that caps the breccia and tuff ranges in color from gray to grayish-blue and lavender and is rather soft as compared to the brittle, hard flow-banded rhyolite porphyry. It contains approximately 20% medium and coarse-grained feldspar phenocrysts in a sugary quartz-feldspar groundmass. Phenocrysts and groundmass are nearly identical in color. Black grains of magnetite are common. This rock also is bleached and discolored in places, particularly in the vicinity of faults (Lasky, 1932). Mineralized breccias and quartz veins are found along north to northwest trending faults in the Rosedale district.

The most pervasive alteration style at Rosedale is oxidation. The sulfide and mineral phases in waste rock piles have been oxidized. Oxidation has resulted in the formation of iron oxide minerals, such as hematite, as replacement mineral for pyrite on fractured surfaces and veins. Iron oxides are variably colored but are predominantly reddish brown and ubiquitous on nearly all fracture surfaces.

Much of the district is underlain by large areas of argillic (clay and silicified rock) altered areas found along some of the faults in the area and most of the mine features are found in these altered areas (Fig. 17). Argillic alteration, associated with the mineralization, occurs parallel and adjacent to faults throughout the area. The most intense alteration occurs along the Lemitar-South Canyon contact on the head of North Canyon and along north-northwest trending faults between North Canyon and Big Rosa Canyon (Ferguson, 1988, 1990). Areas affected by varying degree of argillic alteration are shown on Figure 16. Along the contacts, most advanced alterations are located in the thin poorly welded tuff just below the vitrophyre of the South Canyon Tuff. Argillic alteration typically overprints cross-cuts fault zones and is attributed to the late Oligocene phase of extension, but younger basin and range style high-angle fault juxtapose altered and unaltered rock (Ferguson, 1990). Alteration of the rhyolitic country rock consists of bleaching, which increase in intensity and usually accompanied by variable amount of oxidized pyrite closer to the veins. Most of the rock units in the study area exhibits hematite coatings with stringers of manganese oxide on the South Canyon Tuff because of hydrothermal oxidation.

Along the contact between fault zones, irregular zones of silicification usually marks the end of ore-bearing zones locally. These silicified zones, which are predominant in fault zones, consist of breccias of the rhyolitic porphyry. The siliceous rocks at the Rosedale mine contain numerous cavities lined with quartz crystals. Silicification extends downward along the sides of shear zones into a footwall and the hanging wall of the rhyolite porphyry (Lindgren et al, 1910).

Hydrology

There are no running streams in the district. Most of the precipitation is from monsoon rains in the summer and snow in the winter (Roybal, 1989). Annual precipitation from the Magdalena weather station is in Table 1. The mean annual precipitation for the Rosedale mining district is 15.7 in/yr (Appendix 11). Calculated values for the five-year peak flood are 119 cfs (USGS software described above with results in Appendix 11). Available published data are not sufficient to easily or accurately characterize the flow rates of low to moderate-discharge events or associated erosion rates. Additional detailed studies by qualified hydrologist and geomorphologists are required to provide these estimates.

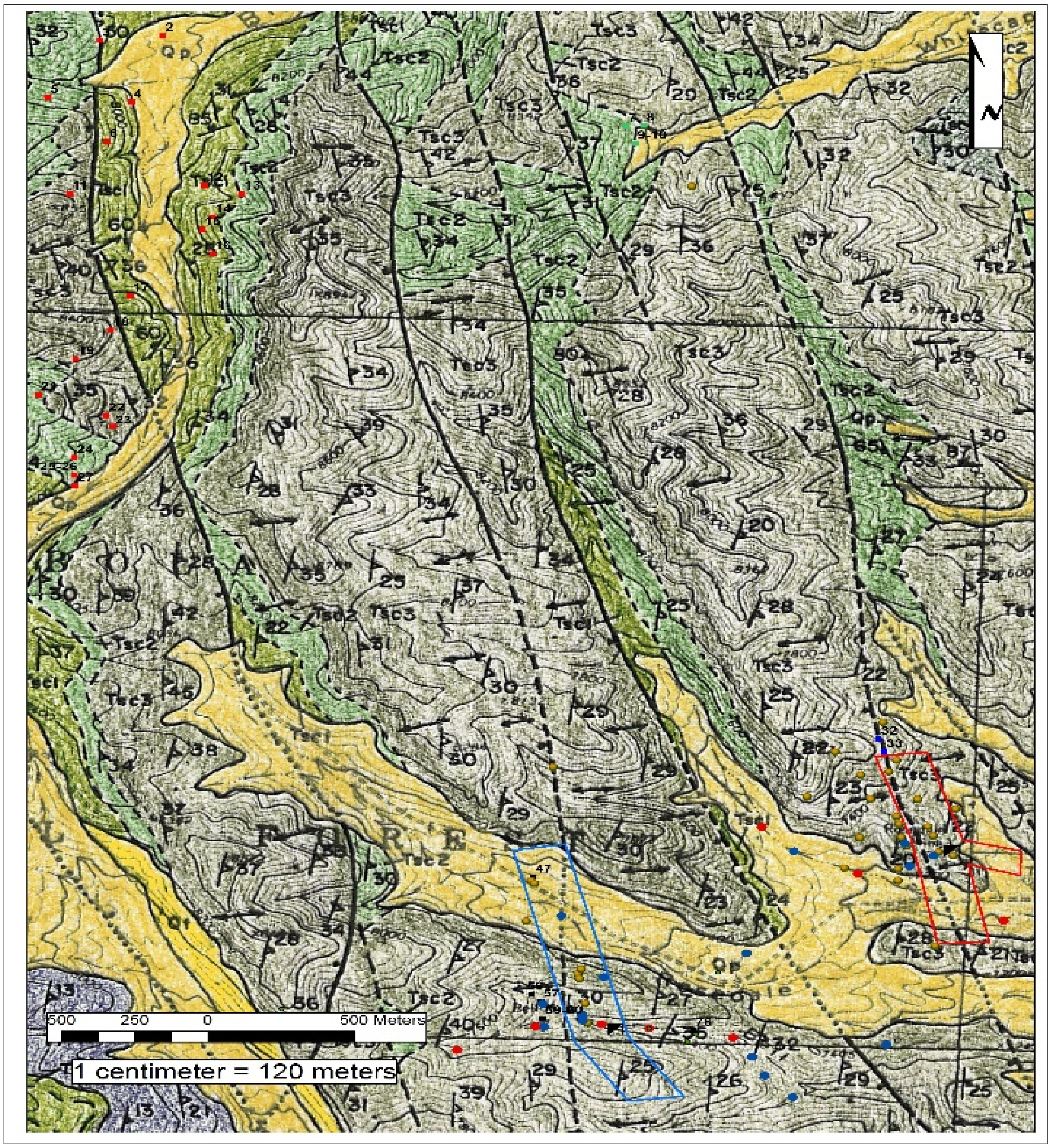


FIGURE 16. Geologic map of the Rosedale district, Socorro County (from Ferguson, 1986). Red box is Rosedale patented claims and blue box is Bell patented claims.

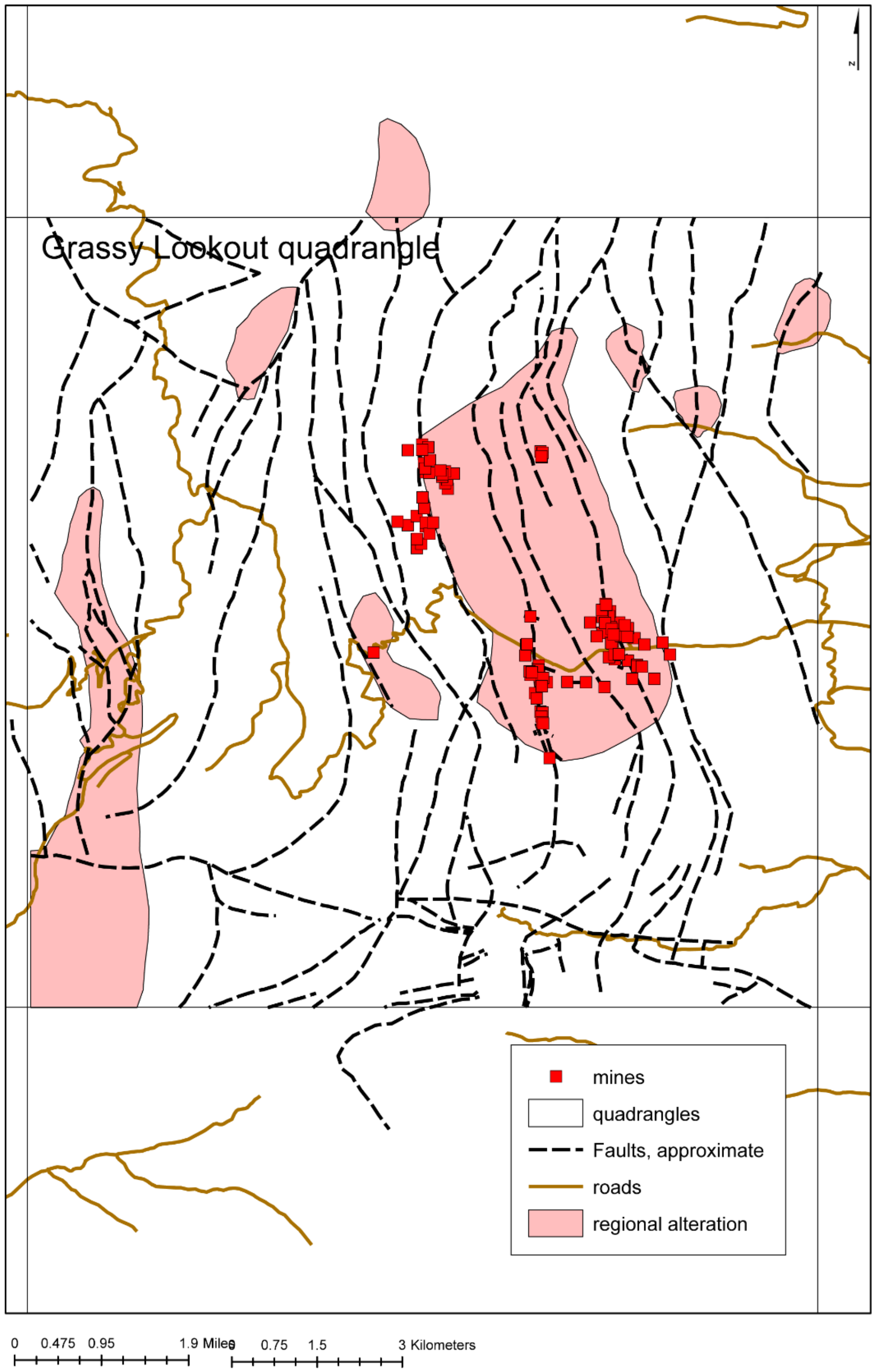


FIGURE 17. Structure and alteration (stippled pattern) map of the Grassy Lookout quadrangle (modified from Ferguson, 1990). The Rosedale district is in the center of the largest alteration area.

Water is not abundant in the northern San Mateo Mountains and groundwater is found mostly in scattered fractured zones of the volcanic rocks (Roybal, 1989). There are springs in the vicinity of the mining district, but they are mostly dry throughout the year. Even the water wells tend to stop flowing during the summer and during dry years. Water is currently piped (3-inch spiral riveted pipe) from a spring approximately 3 miles west of the mine, which is part of the Rosedale mine patent. Water was encountered in the Rosedale mine at 726 ft (Lindgren et al., 1910; Wells and Wootton, 1940), indicating that the depth to groundwater is at least 726 ft and even greater in most areas in the district (Roybal, 1989). The Rosedale mine yielded 2,000 gallons of water per day, which was used in the mill (Batchelder, 1910).

Description of 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. 15) in structurally complex tectonic settings that provide an excellent plumbing system necessary for circulation of hydrothermal fluids and include districts such as Steeple Rock, Mogollon, Chloride, and others (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 shallow to moderate depths (<4,500 ft), 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 (Simmons et al., 2005). White (1955, 1981) established the now-recognized association between epithermal mineral deposits and active geothermal or hot springs systems. However, there are many small hot spring systems with no known associated gold or base metals. The difficulty remains in identifying paleo-geothermal systems that contain economic concentrations of gold and/or base metals.

Most volcanic-epithermal vein deposits in New Mexico are restricted to veins associated with Oligocene to Miocene volcanic fields and calderas (Fig. 15; Cox and Singer, 1986; McLemore, 1996). Many volcanic-epithermal deposits in New Mexico occur along the margins of calderas (Fig. 15; 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. It is important to note that not all calderas are mineralized. Typical volcanic-epithermal deposits in the state occur as siliceous vein fillings, breccia pipes, disseminations, and replacement deposits. Common ore textures include: open-space and cavity fillings, drusy cavities, comb structures, crustifications, colloform banding, typically multi-stage brecciation, replacements, lattice textures (quartz pseudomorphs after bladed calcite), and irregular sheeting.

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. Most of the production has been from the Rosedale vein, although some production from the Bell vein has occurred. Drilling along the Bell vein indicated additional mineral bodies at depth. The other veins have only been explored at the surface.

The Rosedale vein is a 3–50 ft wide brecciated, sheared and silicifed zone that strikes N20–10°W and dips 70–90°W and is at least 7500 ft long (Fig. 9). The Rosedale vein appears to end just south of Rosedale Canyon (Fig. 9). The ore shoots were irregular and discontinuous (Metzger, 1938). Gold and silver were mined 75-100 ft below the surface to a depth of 725 ft from two ore shoots that coalesced at approximately 200 ft, forming a single ore shoot that continued below the mined stopes (Fig. 8). Oxidized, free gold is found in bluish-white quartz veins with 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). Silver is present in small amounts. Some ore averaged as much as 0.5 oz/short ton Au (Lasky, 1932). Historical accounts indicated that the best ore was associated with copper staining. Sulfides were found below 725 ft. Uranium is locally found in some areas in the district (0.010–0.011% U_3O_8, Neubert, 1983; McLemore, 1983).

Textures typical of volcanic-epithermal vein deposits elsewhere in New Mexico are found in the Rosedale district, such as banding, sharp contacts with host rocks, multiple periods of brecciation, quartz replacing calcite, and late-stage vug-filling quartz (Fig. 18). The veins are in brecciated, fractured, and silicified rhyolite with trace amounts of oxidized pyrite. The argillic alteration is restricted to fault zones where sanidine phenocrysts and groundmass are altered to white or orange by Fe oxides, or chalky kaolinite.

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. 11). The brecciated and sheared zone is as much as 4 ft wide in the South Canyon Tuff.

Placer gold deposits were an important source of gold in New Mexico prior to 1902, but placer production after 1902 has been minor (Johnson, 1972). The Rosedale placer gold deposits are small and limited and generally occur in Holocene age alluvial fan deposits, bench or terrace gravel deposits, river-bars, and stream deposits. During fluvial events, large volumes of sediment containing free gold are transported and deposited in relatively poorly-sorted alluvial and stream deposits. The gold concentrates by gravity in incised stream valleys and alluvial fans in deeply weathered highlands. 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. Stream-sediment geochemical analyses indicate gold is present downstream of the Rosedale and Bell veins (Fig. 19). The lack of flowing water in arroyos has hampered any production of potential placer deposits.

FIGURE 18. Quartz vein typical of the Rosedale district.

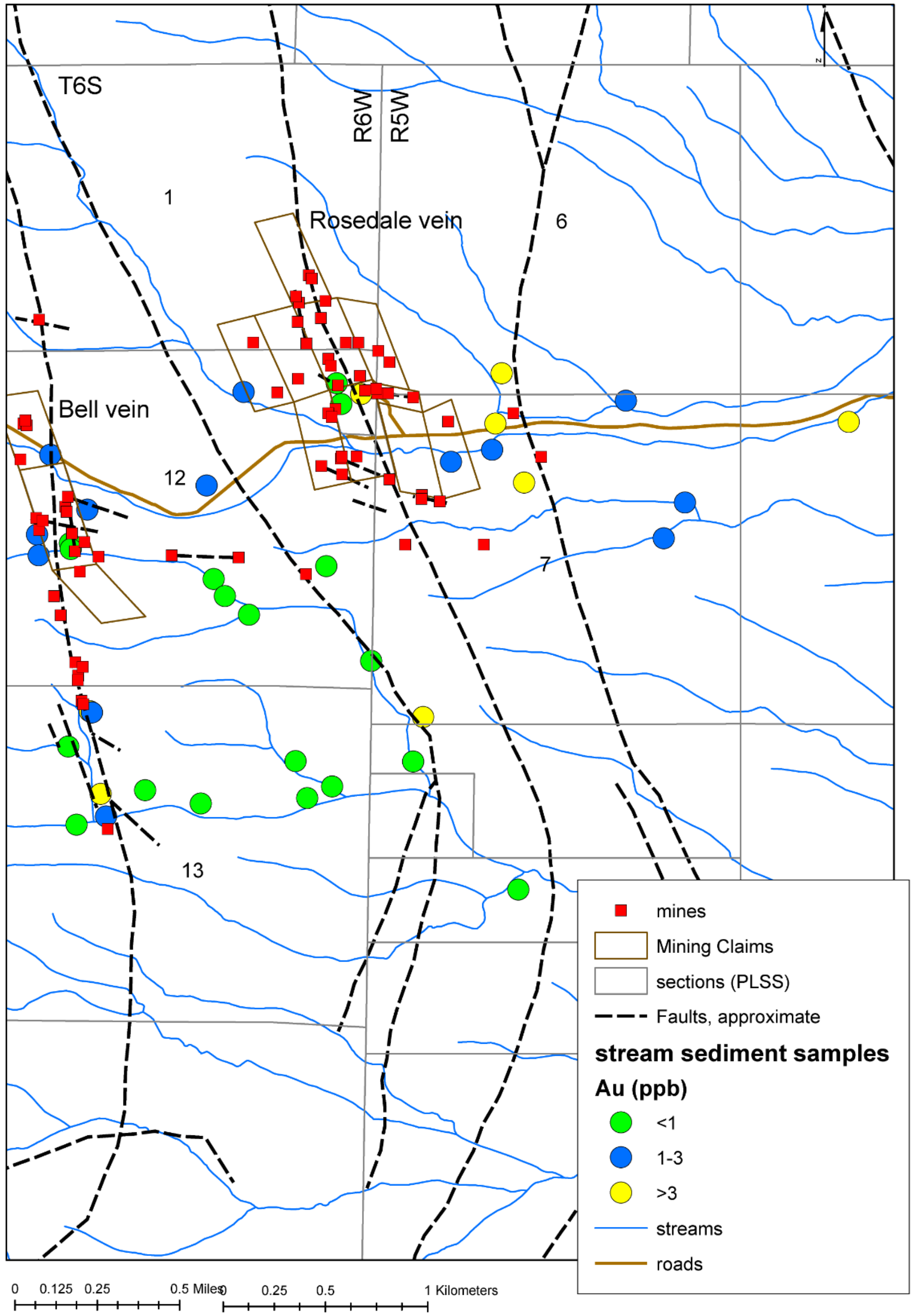


FIGURE 19. Geochemical map showing gold (ppb) in stream-sediment samples in the Rosedale mining district. Geochemical analyses are in Appendix 5-3.

MINERALOGY AND GEOCHEMISTRY

Petrography and mineralogy

Most rock samples from waste rock piles in the Rosedale district exhibit iron-oxide alteration, mostly as pyrite replacements by hematite. A description of selected samples is in Appendix 4. Most pyrite grains were oxidized to hematite, within quartz veinlets, and contain detectable gold as determined from electron microprobe analyses. The hematite after pyrite grains are the only evidence that indicate sulfide minerals existed in these rocks prior to oxidation. Sphalerite and an unidentified copper mineral are the only base metal sulfides observed by electron microprobe analyses in one sample from the Rosedale mine. Generally, little or no indication of detectable silver was present in any of the samples analyzed and this is typical of volcanic-epithermal vein deposits within the Rosedale mining district (Lasky 1932; McLemore, 1996); however most volcanic-epithermal vein deposits in New Mexico are silver rich (McLemore, 1996).

Gangue minerals associated with the Rosedale samples include quartz, K-feldspar, biotite and kaolinite, with rare calcite, fluorite, and barite. Quartz and K-feldspar are major constituents of the groundmass, where quartz forms the matrix of the sample. The destruction and replacement of biotite by hematite and quartz locally were observed along fractures. Replacement of magmatic or late magmatic biotite is common. In oxidized rock samples from waste rock piles, iron-oxide alteration after pyrite overgrowths is observed. Most pyrite grains were oxidized to hematite and contain detectable gold based on results from the quantitative scan on electron microprobe analyses (Appendix 9). In the rhyolitic breccias in fault and shear zones, iron oxide after pyrite with overgrowths are generally within quartz veinlets.

Geochemistry of solid samples

Five separate sampling programs were conducted in the Rosedale district and samples were analyzed for geochemistry in order to characterize the mineralization and identify potential areas of environmental concern (Appendix 5). Samples of quartz vein material and/or intensely altered hematite coated 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 5-1). Additional samples collected by Neubert (1984) of mineralized areas also were low in precious and base metals (Appendix 5-2). In 1991, an exploration program consisting of stream sediment

(Fig. 19) and rock chip sampling (Fig. 20) was conducted by students at New Mexico Tech (NMIMT) under the supervision of Dave Norman for Sunshine Mining Company, Idaho, in the vicinity of the Rosedale and Bell mines (Appendix 5-3, 5-4). 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 most recent sampling program, consisted of composite waste rock samples, selected waste rock samples, and selected rock chip samples collected for this report (Fig. 21), as described above in the methods section (Appendix 5-5). Statistical analyses of the samples collected by NMT (Appendix 5-3, 5-4, 5-5) are summarized in Tables 5 and 6. Samples collected by Ferguson (1990) and Neubert (1984) are not suited for statistical analyses because of the low concentrations and too small a sample population.

TABLE 5. General statistics of samples collected in the Rosedale district (in parts per million).

Stream sediments (Table 5-3, NMIMIT, 39 samples)

	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 chip (Table 5-4, NMIMT, 204 samples)

	Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	Zn	Bi	Cd	Ga	Se	Te
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	0.05
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	476
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	2.84
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	33.4

Composite and select waste rock piles and select rock chip (Table 5-5, this report, 26 samples)

	Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	Zn	Bi	Cd	Ga	Se	Te
minimum	0.50	2.90	0.00	1.00	0.01	1.00	8.00	0.55	0.03	17.00	0.02	0.50	13.1	0.20	0.01
maximum	72.70	34.60	3.61	47.00	0.77	55.00	119	126	0.65	121.0	4.17	0.50	25.1	0.60	0.81
average	14.85	12.73	0.49	12.00	0.17	8.88	37.6	17.4	0.21	58.31	0.44	0.50	17.9	0.29	0.08
standard deviation	20.87	7.56	0.93	12.28	0.18	12.03	28.7	27.2	0.14	25.00	0.86	-	2.74	0.14	0.20

TABLE 6. Selected Pearson correlation coefficients for samples collected in the Rosedale district. Pearson correlation coefficients above 0.7 or below -0.7 are considered significant and suggest a geochemical correlation.

	Stream sediments (Table 5-3, NMIMIT, 39 samples)	Rock chip (Table 5-4, NMIMT, 204 samples)	Composite and select waste rock piles and select rock chip (Table 5-5, this report, 26 samples)
Au:As	0.07	-0.04	0.55
Au:Ag	0.93	0.79	0.87
Au:Cu	0.51	-0.10	0.77
Au:Pb	0.26	-0.07	0.12
Au:Hg	0.84	0.45	0.48
Au:Mo	0.05	-0.02	-0.02
Au:Zn	0.50	-0.16	0.60
Au:Sb	0.91	-0.03	0.90
Au:Bi	-0.08	-0.18	-0.14
Au:Te	-0.11	-0.01	-0.10
Au:SiO2			0.33
Au:TiO2			-0.46
Au:Al2O3			-0.45
Au:CaO			0.32
Au:Fe2O3T			-0.14
Au:MgO			-0.12
Au:MnO			0.89
Au:Na2O			-0.39
Au:K2O			-0.11
Au:P2O5			-0.42
Au:S			-0.19
Au:C			-0.20
Au:Sr			0.72
Au:Th			-0.46
Au:U			0.26
Au:Y			-0.43
Au:La			-0.47
Au:Ce			-0.50

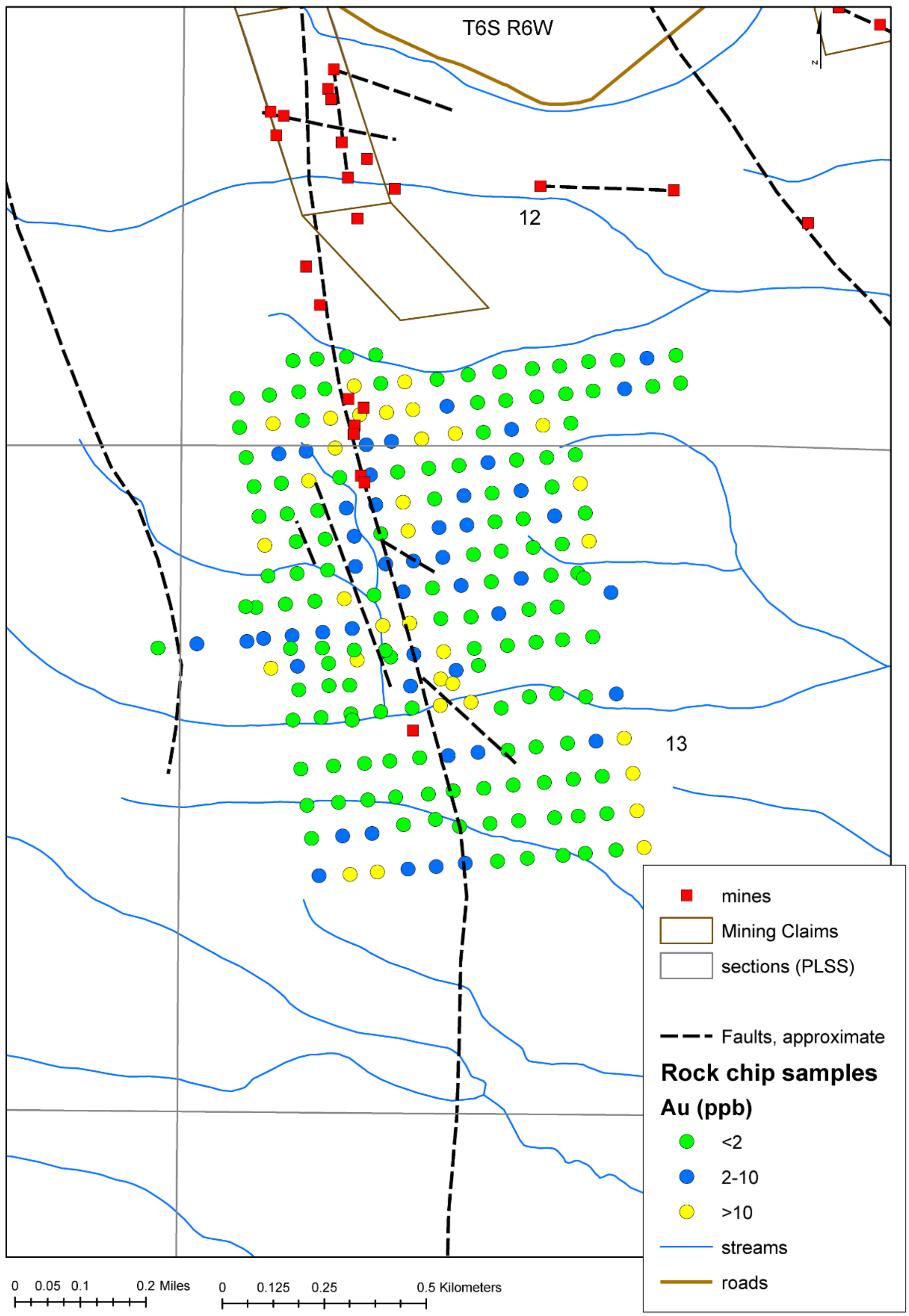


FIGURE 20. Geochemical map showing gold (ppm) in rock chip samples south of the Bell mine in the Rosedale mining district. Geochemical analyses are in Appendix 5-4. NMIMT data.

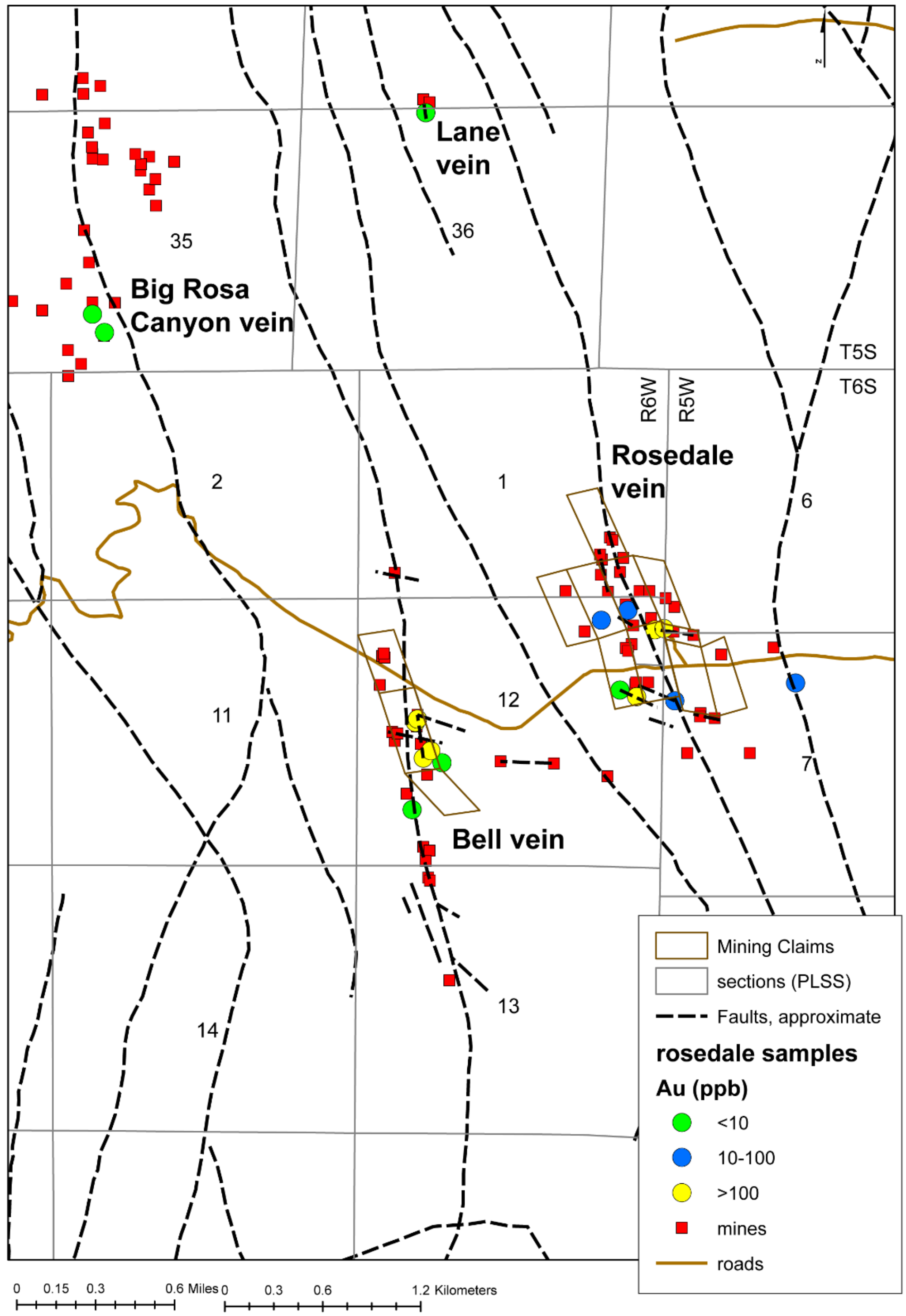


FIGURE 21. Geochemical map showing gold (ppm) in waste rock piles and select rock chip samples collected for this report in the Rosedale mining district. Geochemical analyses are in Appendix 5-5.

Stream sediment samples

Results of the stream sediment samples collected by NMIMT students indicated high gold (0.0008–336 ppm; Table 5; Fig. 22), but low in base and other metals concentrations in the drainages sampled.

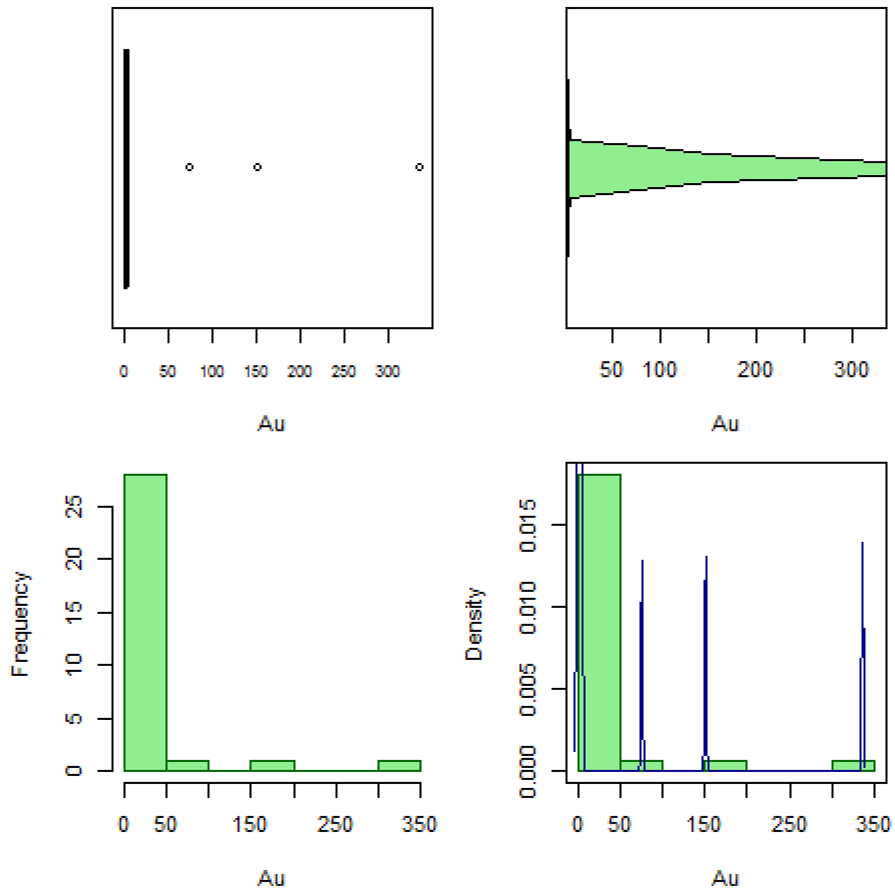


FIGURE 22. Summary range, box plot, cumulative frequency, histogram (from left to right, top to bottom) for gold concentrations in stream sediment samples. Chemical analyses are in Appendix 5-3. Number of samples is 39.

Rock chip samples

Rock chip sampling occurred south of the Bell mine by NMIMT students, based on the presence of abundant quartz and Fe- and Mn-oxides veins. Outcrops were sampled in a northeast grid, approximately 200 ft by 250 ft (Table 5; Fig. 23). High geochemical values of gold (0.0005–3.32 ppm; Fig. 24) were located at areas near known adits and drainages with quartz breccias.

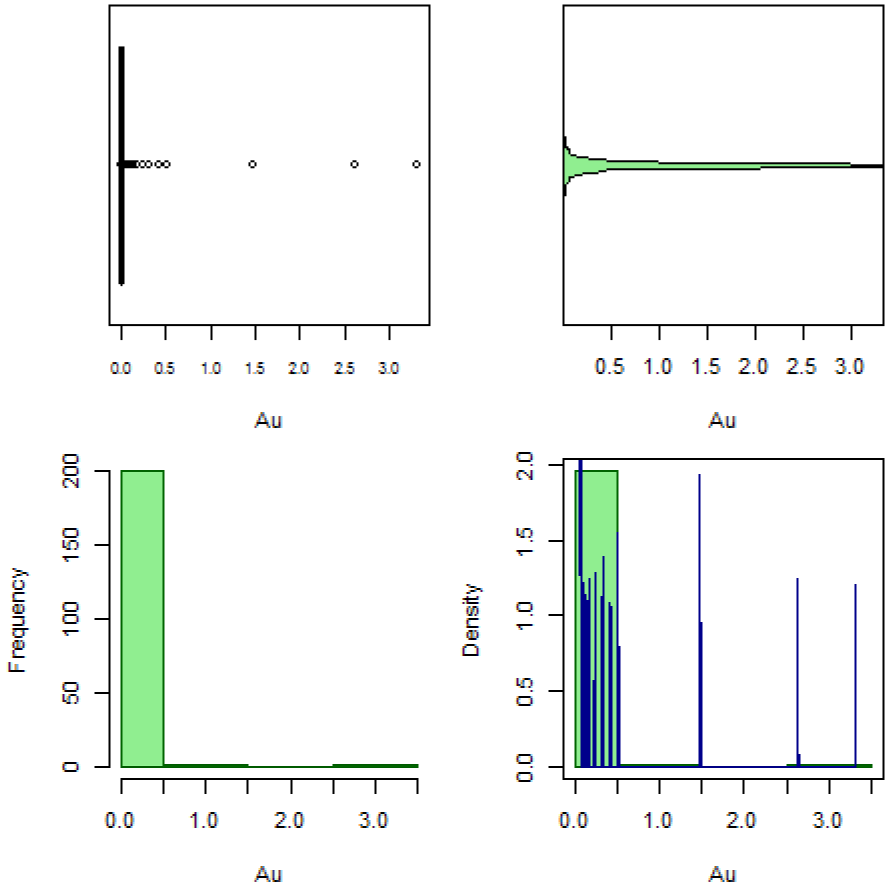


FIGURE 23. Summary range, box plot, cumulative frequency, histogram (from left to right, top to bottom) for gold concentrations in rock chip samples south of the Bell mine. Chemical analyses are in Appendix 5-4. Number of samples is 204.

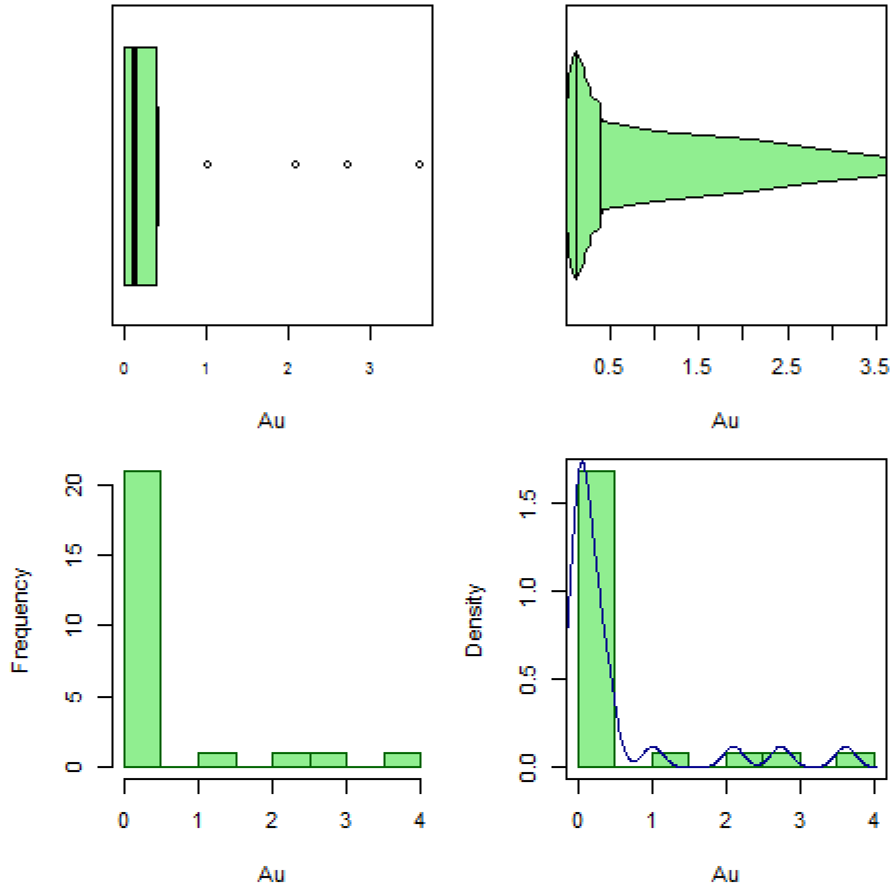


FIGURE 24. Summary range, box plot, cumulative frequency, histogram (from left to right, top to bottom) for gold concentrations in rock chip samples south of the Bell mine. Chemical analyses are in Appendix 5-4. Number of samples is 26.

Waste rock samples

Moderate geochemical values of gold (<0.001–0.42 ppm) were found in composite waste rock samples, selected waste rock samples, and selected rock chip samples sampled for this report (Table 5; Appendix 5-5). Average pH values of the mine features ranges between 4.9 and 6.6 (Appendix 5-5). The pH results indicate moderately alkaline to acidic waste rock piles. Total dissolved solids (TDS) values calculated were between 5.9 and 40 mg/L and these results provide an indication of the level of dissolved solids that could be derived from weathering of the waste rock piles. TDS values of 1 to 500 mg/L are typical of lakes and streams.

Potential for acid rock drainage

Acid rock drainage is formed when sulfide minerals are exposed to oxidizing conditions such as weathering. Field characteristics of potential ARD in mine waste rock piles include identification of pyrite and/or jarosite and low pH. The rate of sulfide oxidation depends on reactive surface area of sulfide, oxygen concentration and solution pH. ARD can be determined by Acid Base Accounting (ABA) and Net Acid Generation (NAG) Tests.

The ABA procedure consists of two separate tests; the acid potential (AP) test and the neutralization potential (NP) test. ABA was calculated and plotted on the ARD classification plot for waste rock pile samples from the various mines (Sobeck et al., 1978). The assumption is that all C in the samples are as $CaCO_3$ (no organic carbon) and also the NAG pH is equals the measured paste pH of the sample. Below are the formulae used:

AP (kg $CaCO_3$/metric ton) = 31.25 x S (%)

NP (total C) = 83.3 x C (%),

NNP = NP – AP,

NPR = NP/AP

Results of ABA tests are presented in Table 7 and Figure 25.

TABLE 7. Net Neutralization Potential (NNP) for selected samples from the Rosedale district Socorro County. See Figure 25 for ABA classification.

Sample	S (%)	C (%)	AP (Kg CaCO3)	NP (total C)	NNP	NPR	NAGpH	ABA classification
ROSE1	0.01	0.34	0.31	28.32	28.01	90.63	6.23	Non-acid forming
ROSE2	0.48	0.07	15.00	5.83	-9.17	0.39	5.64	Uncertain
ROSE3	0.01	0.07	0.31	5.83	5.52	18.66	6.04	Non-acid forming
ROSE4	0.01	0.06	0.31	5.00	4.69	15.99	6.15	Non-acid forming
ROSE5	0.01	0.02	0.31	1.67	1.35	5.33	5.73	Non-acid forming
ROSE007	0.01	0.22	0.31	18.33	18.01	58.64	6.34	Non-acid forming
ROSE008	0.01	0.19	0.31	15.83	15.51	50.65	4.92	Non-acid forming
BEL002	0.01	0.13	0.31	10.83	10.52	34.65	5.86	Non-acid forming
BEL003	0.01	0.31	0.31	25.82	25.51	82.63	5.39	Non-acid forming
BEL005	0.02	2.05	0.63	170.77	170.14	273.22	6.08	Non-acid forming
BEL008	0.01	0.12	0.31	10.00	9.68	31.99	5.36	Non-acid forming
BEL009	0.01	0.17	0.31	14.16	13.85	45.32	5.61	Non-acid forming
BEL012	0.01	0.24	0.31	19.99	19.68	63.97	5.11	Non-acid forming
ROBB2	0.01	0.29	0.31	24.16	23.84	77.30	5.69	Non-acid forming
BIG002	0.01	0.22	0.31	18.33	18.01	58.64	5.61	Non-acid forming

Sample	S (%)	C (%)	AP (Kg CaCO3)	NP (total C)	NNP	NPR	NAGpH	ABA classification
BIG003	0.01	0.3	0.31	24.99	24.68	79.97	6.27	Non-acid forming
LP10	0.01	0.51	0.31	42.48	42.17	135.95	6.67	Non-acid forming

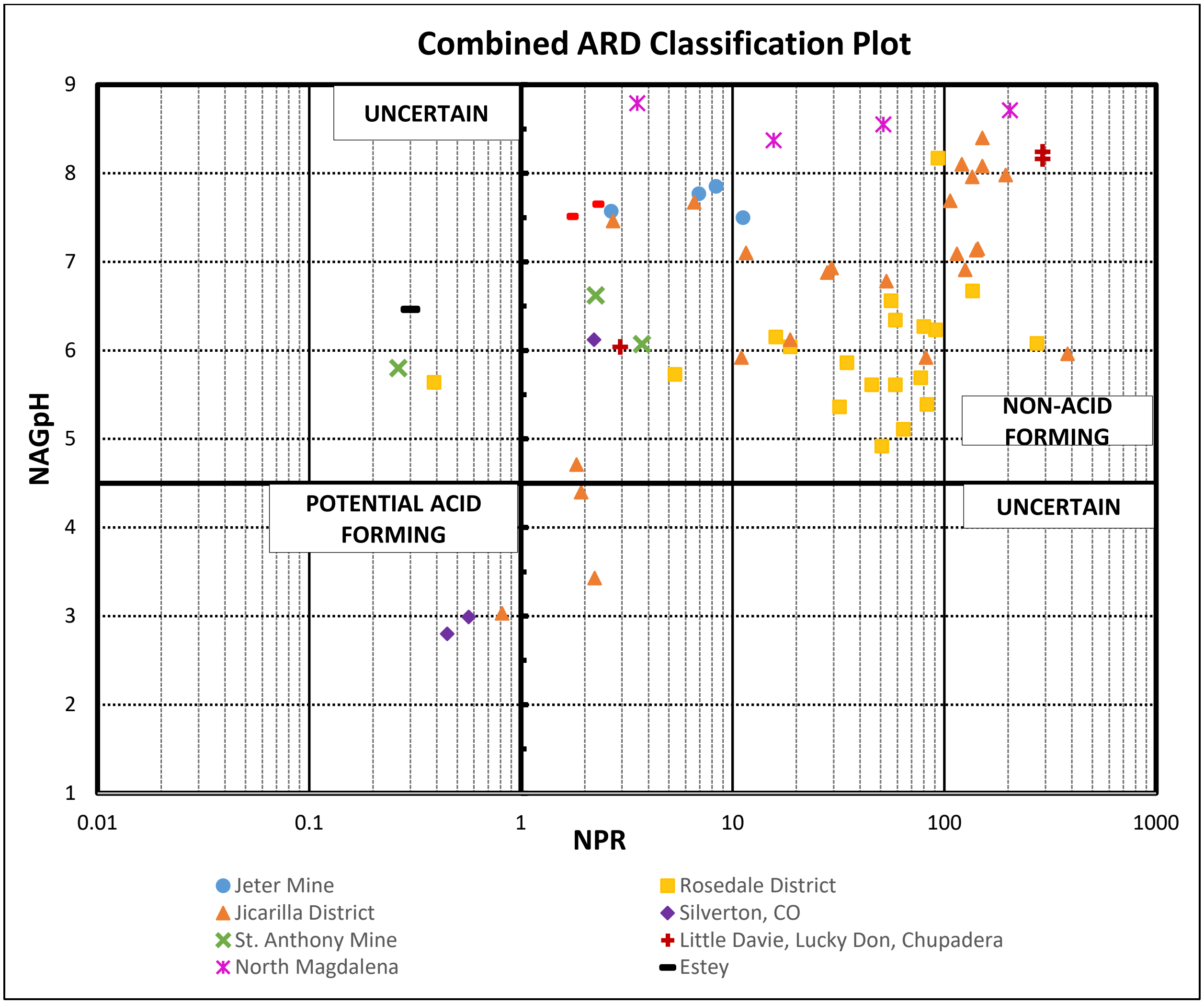


FIGURE 25. Acid Rock Drainage (ARD) plot of waste rock piles at mines examined during the NMBGMR AML project. The results for the waste rock piles from the Little Davie, Lucky Don, Chupadera, and Jeter uranium mines (Socorro, Chupadero, and Ladron Mountains districts, Socorro County), St. Anthony uranium mine (Laguna subdistrict, Cibola County), Rosedale and Jicarilla gold mines (Rosedale and Jicarilla districts, Socorro, and Lincoln Counties), North Magdalena copper and vanadium mines (North Magdalena district, Socorro County), Estey district (Lincoln County), and Silverton gold-silver mines (Colorado) are shown for comparison (unpublished work in progress). Results of these mines will be published in future reports; samples for the Rosedale district are in Appendix 5. Samples that plot in the uncertain and potential acid forming fields are not suitable for backfill material and need to be handled with care during reclamation. NPR is a parameter of ABA shown in Table 7.

Summary of geochemical analyses

In summary, the geochemical analyses from all samples collected from the Rosedale district indicate that the mineralization is low in sulfur, base metals, and other elements of environmental concern. The best element for exploration in this district is the concentration of gold, although gold does correlate with antimony (Table 6). Only one sample plotted in the uncertain field on the ARD diagram (Fig. 25). Therefore, the waste rock piles are suitable for backfill material if any of these mine features are to be remediated.

Geochemistry of water samples

Water samples collected from the Robb prospect, springs and seeps in the area exhibit no potentially hazardous metal levels. The waters are low SO_4 and alkali-chloride and are typical of water from the area (Fig. 26; Appendix 6). None of the other mine features had any water, except the main Rosedale shaft (NMSO0064), which encountered water at 732 ft and was not sampled.

Geochemistry of iron minerals

Pyrite was not found in most samples collected, however pyrite likely found in the covered tailings. Iron-oxide samples generally contain low sulfur and metals (Table 8), indicating that the waste rock piles will not form any acid generation. Gold is found in iron oxides and likely pyrite (Table 8).

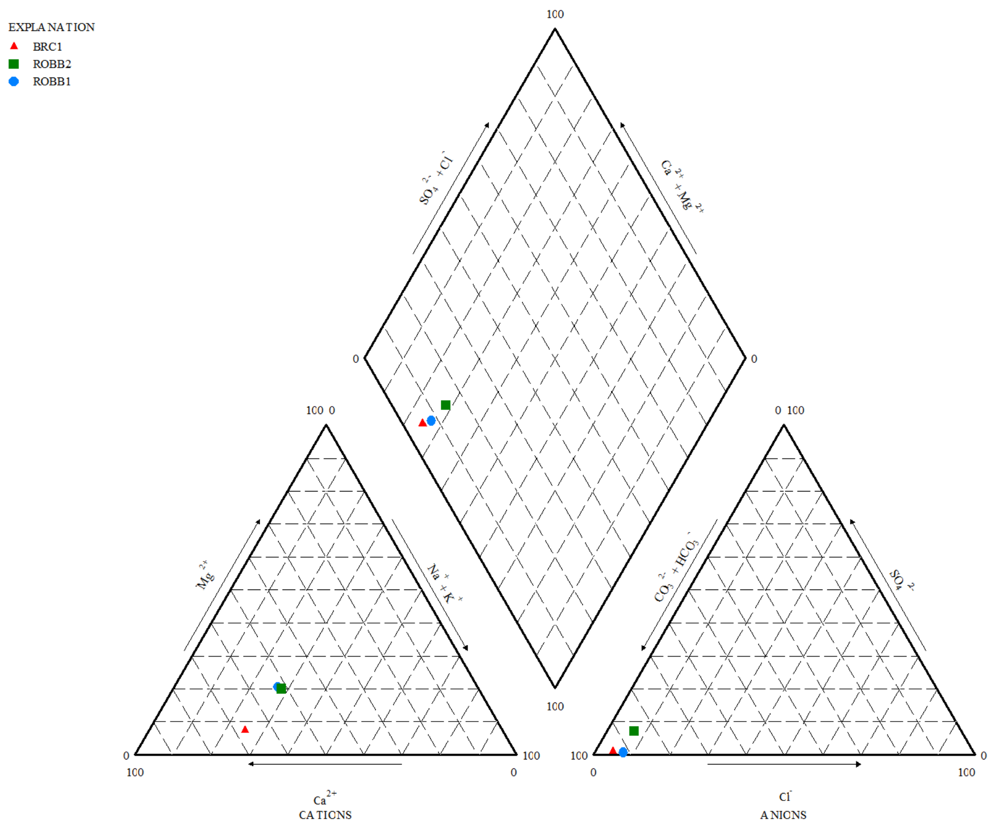


FIGURE 26. Piper diagram of samples from Rosedale district, San Mateo Mountains, Socorro County, New Mexico. Chemical analyses are in Appendix 6.

TABLE 8. Average composition (quantitative) of iron oxides (FeOx) phases (ROSE-001:10 analyses, ROSE-004: 6 analyses, ROSE-005: 11 analyses from Rosedale mine and BEL-001: 14 analyses, bel-002: 10 analyses, bel-003: 10 analyses, bel-012: 9 analyses from Bell mine). Sample element with asterisk (*) showed pyrite, but the analysis was conducted on oxide phase.

Element Concentration (Weight Percent)											
Al	**As**	**Au**	**Ca**	**Cu**	**Fe**	**Mg**	**Mn**	**Si**	**S**	**Ti**	**Total**
ROSE-001(FeO_x)											
0.97	0.11	0.61	0.12	0.03	77.65	0.03	0.16	4.33	0.06	0.08	84.15
ROSE-004 (FeO_x)											
1.03	0.36	0.63	0.19	0.03	72.50	0.14	0.63	3.69	9.79*	1.08	90.06
ROSE-005 (FeO_x)											
2.11	0.31	0.69	0.22	0.07	76.30	0.02	0.18	4.10	0.07	0.06	84.14
BEL-001 (FeO_x)											
2.58	0.24	0.67	0.22	0.02	64.80	0.17	0.59	7.56	0.06	0.76	77.66
BEL-002 (FeO_x)											
2.19	0.34	0.72	0.25	0.04	66.80	0.08	0.32	4.83	0.09	0.21	75.87
BEL-003 (FeO_x)											
30.29	0.16	0.56	0.22	0.38	51.49	0.07	0.55	3.60	0.02	0.05	87.38
BEL-012 (FeO_x)											
0.88	0.16	0.72	0.20	0.02	67.36	0.02	0.11	5.35	0.18	0.10	75.09

Particle size analyses

Plots of particle size distribution for waste rock piles are presented in Appendix 7. Particle size distribution curves obtained were generally well-graded soils. Waste rock piles were sieved with ½ inch mesh in the field during sampling to eliminate gravel to cobble size particles from samples, which are not indicated in Appendix 7. Samples plot mainly in the sand zone (Fig. 27). Total fines were less than 20% of the sieved sample. From visual inspection in the field, waste rock piles are generally stable.

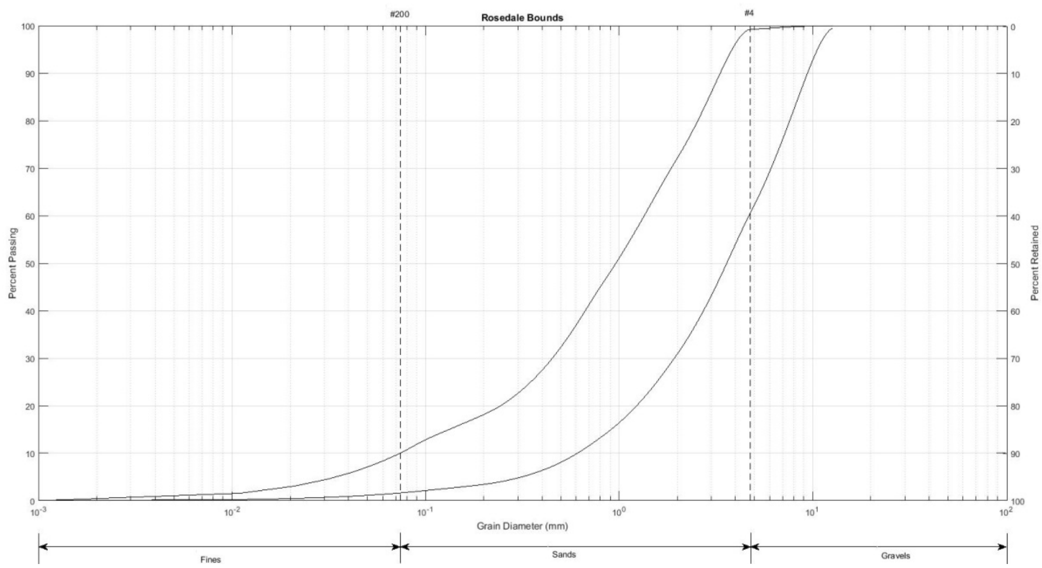


FIGURE 27. Upper and lower bounds of particle size analysis of Rosedale samples

DISCUSSION OF MINE FEATURES, ACID DRAINAGE, HAZARD RANKING AND POTENTIAL OFFSITE IMPACTS

None of the mines in the Rosedale district have water draining from them. Only two mines (Rosedale mine, NMSO0064, and Robb, NMSO0545) have water in the shafts; the rest of the mines are dry. The water in the Robb mine is most likely from surface runoff. All of the waste rock piles are suitable for backfill material. The borrow pit (NMSO0754) is an additional source of backfill material and was used as cover for the tailings piles.

Two separate hazard rankings were used in this report: USBLM (Table 9; Bureau of Land Management, 2014) and NOAMI (Table 10; National Orphaned/Abandoned Mines, Canada, http://www.noami.org/intro_e.php?language=English, accessed 1/6/2019). Appendix 2 indicates the hazard rankings for each mine feature in the Rosedale district. Most of the mine features in the Rosedale district are shallow prospect pits and short adits. Thirteen mine features were reported in the literature in the Rosedale district but could not be found. There are 22 mine features with a C rating, 55 with a D rating, and 14 that are remediated (most by natural collapse) (Table 10). Mining-related disturbance is minor and found only in the vicinity of the individual mine features. However, the Rosedale shaft complex (NMSO0064, NMSO0543, NMSO0586, NMSO0585, NMSO0591, NMSO0585, NMSO0880), Bell adit (NMSO0061), Robb shaft (NMSO0545) and Lane shaft (NMSO0734) are dangerous and require proper safeguarding. A few short adits also have the potential for unsafe conditions. Many of the mine features are in remote areas with no road access. The main tailings facilities (NMSO0264, NMSO0265) have been previously reclaimed by the U.S. Forest Service, but require monitoring for potential erosion. Table 11 summarizes the total number of mine features by type and area. The Rosedale mine is the largest mine in the district and consists of several shafts, adits, and drifts. The deepest level is at 732 ft (Fig. 5). Eighty-two mine features have waste rock piles surrounding them, as indicated in Appendix 2. The Rosedale samples contain low concentrations of all metals and sulfur (Table 8; Appendix 5; Zutah, 2017).

Water flow in adjacent streams occurs only during major storms. The monsoon rains of 2006 damaged many of the adobe structures, and the Longtail and Rose tailings were deeply eroded and channeled before remediation (Burney and Scarlata, 2008). Minor erosion of portions of the Longtail tailings has occurred since remediation. Therefore, it is likely that any remediation of the remaining mine features will not be adversely affected by local climate or erosion, unless a severe storm event occurs. There are no water quality issues in the Rosedale district and the ARD predictions indicate that no water quality issues are expected from runoff or erosion of the waste rock piles.

TABLE 9. BLM hazard ranking (Bureau of Land Management, 2014).

Number for danger level	Danger level	Definition
0	Remediated	Remediated
1	None	No danger level
2	Low	Sites located more than a quarter mile away from a populated place
3	Medium	Sites near historic mining towns, historic schools, recreation areas, parks, camps, or trails within a quarter mile of one or more AML sites
4	High	Sites near homes or school, within a quarter mile of one or more AML sites
5	Extreme	Extreme danger level
6	Unknown	Unknown danger level, not visited
7	Active mining	Active mining, reclamamtion planned or underway

TABLE 10. NOAMI definition of hazard rankings (National Orphaned/Abandoned Mines, Canada, http://www.noami.org/intro_e.php?language=English, accessed 1/6/2019).

NOAMI Class	Description	NOAMI definition
A	A site with potential to cause environmental, public health and public safety concerns	Highest class, deep unprotected openings to surface, Hazardous openings on surface, crown pillars, waste rock piles with ARD and/or radioactive concerns, large tailings ponds, Chemicals can include PCBs, asbestos, fuels, explosives and concentrates
B	A site with limited potential to cause environmental concerns but with potential for public health and safety concerns	Deep unprotected openings to surface such as shafts, raises and open stopes. Hazardous openings at surface, crown pillars, waste rock piles with ARD and/or radioactive concerns
C	A site with public safety concerns but little or no public health or environmental concerns	Hazardous openings to surface, waste rock piles and possible dilapidated structures associated with the mine openings, no tailings or tailings are remediated
D	A site with no expected environmental, public health or public safety concerns	Minor surface features only such as trenches, test pits and stripping, no tailings
O	Information is not available	No information
R	Remediated	Remediated

TABLE 11. Summary of mine features in the Rosedale mining district, Socorro County, New Mexico.

Mine area	Number of mine features	Mine features	Depth of workings (ft)
Rosedale	28	Shafts (14 levels), pits, adit, tailings, mill foundations, trenches	2- ≥732
Bell	16	Tailings, shafts, adit, mill foundations, pits	2 - >50
Bell South	7	Adit, shafts, pits	3 - >10
Big Rosa Canyon	34	Shafts, adit, pits, trenches	2 - >30
Robb Prospect	10	Adit, shaft	3 – 20
Lane Prospect	5	Shafts, pits, trenches	2 - >30
Oak Spring	1	Drillholes	
Other	2	Borrow pit	
Total number of features	103	See Appendix 2	

FUTURE MINERAL-RESOURCE POTENTIAL

The Rosedale district has future mineral-resource potential for gold and silver in volcanic-epithermal veins, as described by Zutah (2017) and this report. Perry, Knox and Kaufman, Inc. estimated 1.5–2 million short tons of 0.3 oz/short ton Au remain (historic resource). It is concluded that the Rosedale and Bell veins in the Rosedale district has a high mineral-resource potential with a high level of certainty for gold>>silver as a low-sulfidation, quartz-dominant, low-base metal, volcanic-epithermal vein deposit, with an unknown mineral-resource potential with a low degree of certainty for base metals at depths below the present precious-metal workings. The mineral-resource potential along the Lane, Big Rosa, and Rosa Roja veins (Fig. 2) is moderate because there are few assays indicating potential 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. 17), have a low mineral-resource potential with a moderate degree of certainty, because there are no assays indicating potential gold and silver; these areas require additional sampling and drilling to properly evaluate the mineral-resource potential. Chemical analyses indicate that it is unlikely that any critical minerals (i.e. REE, Te, Se, V, etc.) are associated with the Rosedale veins (Appendix 5).

CONCLUSIONS

Volcanic-epithermal veins and associated alteration in the district was probably developed shortly after eruption and deposition of the 27.4 Ma South Canyon Tuff. The predominant alteration is argillic, which is characterized by clays, sanidine, and quartz, and cross-cuts fault zones that juxtapose altered and unaltered rock. Structurally-controlled, volcanic-epithermal veins are hosted in well-developed breccia and sheared rhyolite porphyry and are locally cemented by banded greenish-white quartz. The shear-zone veins extend into a footwall of white rhyolite porphyry. The veins carry free-milling gold and are usually associated with hematite and manganese oxides (Table 8) that occur as replacements of pyrite grains and stringers, and as coatings on fracture surfaces. Oxidized sulfide, pyrite now replaced by hematite and goethite, is shown by electron microprobe analyses. Replacement of magmatic or late magmatic biotite is common.

Most of the mine features in the Rosedale district are shallow prospect pits and short adits. There are 22 mine features with a C rating, 55 with a D rating, and 14 that are remediated (most by natural collapse), according to the classification system presented by NOAMI (http://www.noami.org/intro_e.php?language=English, accessed 1/6/2019). Mining-related disturbance is minor and found only in the vicinity of the individual mine features. However, the Rosedale shaft complex (NMSO0064, NMSO0543, NMSO0586, NMSO0585, NMSO0591, NMSO0585), Bell adit (NMSO0061), Robb shaft (NMSO0545) and Lane shaft (NMSO0734) are dangerous and require proper safeguarding. A few short adits also have the potential for unsafe conditions. Many of the mine features are in remote areas with no road access (Fig. 2). The main tailings facilities (NMSO0264, NMSO0265) have been previously reclaimed by the U.S. Forest Service, but require monitoring for potential erosion.

Most of the waste rock piles surrounding the mine features are suitable for backfill material. In addition, one borrow pit (NMSO0754) was used as cover for the Longtail and Rose tailings, which is suitable for backfill material. Only one sample from the Rosedale district plotted in the uncertain field on the ARD diagram (Fig. 25); the other samples plotted as non-acid forming. The Rosedale samples contain low concentrations of all metals (Table 8; Appendix 5; McLemore et al., 2018).

Water samples collected from the Robb prospect, springs and seeps in the area exhibit no potentially hazardous metal levels and are typical of water from the area. None of the other mine features had any water, except the main Rosedale shaft (NMSO0064), which encountered water at 732 ft and was not sampled. The mean annual precipitation for the Rosedale mining district is low (15.7 in/yr; Appendix 11) and calculated values for the 5 year peak flood are also low (119 cfs; Appendix 11), which collectively indicates that environmental impacts of mining in the Rosedale district are low.

The Rosedale district has a high mineral-resource potential with a high level of certainty for gold>>silver as a low-sulfidation, quartz-dominant, low-base metal, volcanic-epithermal vein deposit along the Rosedale and Bell veins, with 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.

ACKNOWLEDGEMENTS

This report is part of on-going studies of mineral resources in New Mexico, supported by the New Mexico Bureau of Geology and Mineral Resources (NMBGMR), Dr. Nelia Dunbar, Director and State Geologist. Dr. Alex Rinehart provided some of the hydrogeology data. Bonnie Frey assisted with the paste pH analyses. Kelsey McNamara assisted with the XRD analyses and Lynn Heizler assisted with the electron microprobe analyses. Mark Mansell, Adam Read, and Phil Miller provided GIS support.

This project was funded in part by the Energy Minerals and Natural Resources Department (Abandoned Mine Lands Program) and the U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement (OSMRE). Most of the salary was funded by the NMBGMR and Mineral Engineering Department, New Mexico Tech. Additional funding of student research (including laboratory analyses) was by the New Mexico Bureau of Geology and Mineral Resources (NMBGMR), Mineral Engineering Department of NMIMT, Society for Mining, Metallurgy and Exploration (SME), New Mexico Geological Society (NMGS), and New Mexico EPSCoR (funded by the National Science Foundation, NSF, award #IIA-1301346). The Cameca SX-100 electron microprobe at NMIMT was partially funded by NSF Grant STI-9413900.

REFERENCES

Ackerly, N.W., 1997, An overview of the historic characteristics of New Mexico's mines: Dos Ríos Consultants, Inc., Silver City, New Mexico, Prepared for the Historic Preservation Division, Santa Fe, New Mexico.

Anderson, E.G., 1957, The metal resources of New Mexico and their economic features through 1954: New Mexico Bureau of Mines and Mineral Resources, Bulletin 39, 183 p.

Batchelder, J.H., Jr., 1910, Report on the Rosedale mine: unpublished company report on file at the New Mexico Bureau of Geology and Mineral Resources archive report no. 5560.mf, 16 p.

Bureau of Land Management, 2014, Abandoned Mine Land inventory study for BLM-managed lands in California, Nevada, and Utah: Site and feature analysis: Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO., 24 p., https://www.blm.gov/sites/blm.gov/files/uploads/AML_PUB_Inventory.pdf (accessed 1/6/2019).

Burney, M.S. and Scarlata, A.M., 2008, Historic documentation, archaeological monitoring, and salvage excavations undertaken at the Rosedale gold mine, mill, and townsite, Cíbola National Forest, Magdalena Ranger District, Socorro County, New Mexico: Cibola National Forest Report.

Carpenter, M.B. and Keane, C.M., 2016, The geoscience handbook 2016: Alexandria, Virginia, American Geosciences Institute (AGI) Data Sheets, 5th edition, 480 p.

Cather, S.M., McIntosh, W.C., and Chapin, C.E., 1987, Stratigraphy, age, and rates of deposition of the Datil Group (upper Eocene-lower Oligocene), west-central New Mexico: New Mexico Geology, v. 9, no. 3, p. 50-54.

Chapin, C.E., Wilks, M., and McIntosh, W.C., 2004a, Space-time patterns of Late Cretaceous to present magmatism in New Mexico; comparison with Andean volcanism and potential for future volcanism; in Tectonics, geochronology and volcanism in the southern Rocky Mountains and Rio Grande rift: New Mexico Bureau of Geology and Minerals Resources, Bulletin 160, p. 13-40.

Chapin, C.E., Wilks, M., and McIntosh, W.C., 2004b, Space-time patterns of Late Cretaceous to present magmatism in New Mexico; comparison with Andean volcanism and potential for future volcanism; in Tectonics, geochronology and volcanism in the southern Rocky Mountains and Rio Grande rift: New Mexico Bureau of Geology and Minerals Resources, Bulletin 160, p. 13-40.

Cox, D.P., and Singer, D.A., eds., 1986, Mineral deposit models: U.S. Geological Survey, Bulletin 1693, 379 p.

Davis, B., 1998, What is a sample? What does it represent? Australian Institute of Geoscientists Bulletin, v. 22, p. 39-34.

Deal, E.G., 1973, Geology of the northern part of the San Mateo Mountains, Socorro County, New Mexico: Ph.D. dissertation, University of New Mexico, Albuquerque, 268 p.

Deal, E.G. and Rhodes, R.C., 1976, Volcano-tectonic structures in the San Mateo Mountains, Socorro County, New Mexico: New Mexico Geological Society, Special Publication No. 5, p. 51-56.

Downing, B., 2008, ARD sampling and sample preparation: http://technology.infomine.com/enviromine/ard/sampling/intro.html, accessed 8/7/2008.

Elston, W.E., 1994, Siliceous volcanic centers as guides to mineral exploration: Review and summary: Economic Geology, v. 89, pp. 1662-1686.

Ferguson, C.A., 1986, Geology of the central San Mateo Mountains, Socorro County, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Open-file Report 252, 135 p., https://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=252, accessed 1/6/2019.

Ferguson, C.A., 1990, Geology of the Grassy Lookout 7.5' quadrangle, Socorro County, New Mexico: Mexico: New Mexico Bureau of Mines and Mineral Resources, Open-file Report 366, 46 p.. https://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=366, accessed 1/6/2019

File, L., and Northrop, S.A., 1966, County, township, and range locations of New Mexico's Mining Districts: New Mexico Bureau of Mines and Mineral Resources Circular 84, 66 p.

Folk, R.L., 1974, Petrology of Sedimentary rocks: Austin, Texas, Hemphill Pub. Co., 182 p.

Johnson, M.G., 1972, Placer gold deposits of New Mexico: U.S. Geological Survey, Bulletin 1348, 46 p.

Julyan, R., 1996, The place names of New Mexico: Albuquerque, New Mexico, University of New Mexico Press.

Koch, G.S., Jr and Link, R.F., 1971, Statistical analysis of geological data: Dover Publications, Inc., New York, ISBN 0-486-64040-X, 438 p

Koschmann, A.H., and Bergendahl, M.H., 1968, Principal gold-producing districts of the United States: U. S. Geological Survey, Professional Paper 610, 283 p.

Lasky, S.G., 1932, The ore deposits of Socorro County, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bulletin, 8, 139 p.

Laughlin, A.W., Cole, G.L., Freeman, S.H., Aldrich, M.J., and Maassen, L.W., 1985, A computer assisted mineral resource assessment of Socorro and Catron Counties, New Mexico: Geology and Geochemistry Group, Earth and Space Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico, unclassified report LA-UR-85-375.

Lindgren, W., 1933, Mineral deposits, 4th edition: New York, McGraw-Hill, 930 p.

Lindgren, W., Graton, L.C., and Gordon, C.H., 1910, The ore deposits of New Mexico: U.S. Geological Survey, Professional Paper 68, 361 p.

Marshall, W.S., 1910, Report on the Rosedale mine: unpublished company report on file at the New Mexico Bureau of Geology and Mineral Resources.

McIntosh, W.C., 1989, Ages and distribution of ignimbrites in the Mogollon-Datil volcanic field, southwest New Mexico: A stratigraphic framework using $^{40}Ar/^{39}Ar$ dating and paleomagnetism: Ph. D. dissertation, New Mexico Institute of Mining and Technology, Socorro, NM, 314 p.

McIntosh, W.C., Kedzie, L.L. and Sutter, J.F., 1991, Paleomagnetic and $^{40}Ar/^{39}Ar$ dating database for Mogollon-Datil ignimbrites, southwestern New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bulletin 135, 79 p.

McIntosh, W.C., Chapin, C.E., Ratté, J.C. and Sutter, J.F., 1992a, Time-stratigraphic framework for the Eocene-Oligocene Mogollon-Datil volcanic field southwestern New Mexico: Geological Society of America Bulletin, v. 104, p. 851-871.

McIntosh, W.C., Geissman, J.W., Chapin, C.E., Kunk, M.J. and Henry, C.D., 1992b, Calibration of the latest Eocene-Oligocene geomagnetic polarity time sale using $^{40}Ar/^{39}Ar$ dated ignimbrites: Geology, v. 20, p. 459-463.

McLemore, V.T., 1983, Uranium and thorium occurrences in New Mexico: distribution, geology, production, and resources; with selected bibliography: New Mexico Bureau of Mines and Mineral Resources, Open-file Report OF-183, 950 p., also; U.S. Department of Energy Report GJBX-11 (83), https://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=183, accessed 1/6/2019.
McLemore, V.T., 1994, Placer gold deposits in New Mexico: New Mexico Geology, v. 16, p. 21-25.
McLemore, V.T., 1996, Volcanic-epithermal precious-metal deposits in New Mexico; *in* Cyner, A.R. and Fahey, P.L., eds., Geology and ore deposits of the American Cordillera: Geological Society of Nevada Symposium Proceedings, Reno/Sparks, Nevada, April 1995, p. 951-969.
McLemore, V.T., 2001, Silver and gold resources in New Mexico: New Mexico Bureau of Mines and Mineral Resources, Resource Map 21, 60 p.
McLemore, V.T., ed. 2008. Management Technologies for Metal Mining Influenced Water, Volume 1: Basics of Metal Mining Influenced Water: Society for Mining, Metallurgy, and Exploration, Inc., Littleton, CO, 102 p.
McLemore, V.T., 2017, Mining districts and prospect areas of New Mexico: New Mexico Bureau of Geology and Mineral Resources, Resource Map 24, 65 p., scale 1:1,000,000.
McLemore, V.T., 2018, Mineral-resource Potential of proposed U.S. Bureau of Land Management exchange of lands with New Mexico State Land Office: New Mexico Bureau of Geology and Mineral Resources, Open-file Report OF-598, 152 p., https://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=598, accessed 1/6/2019.
McLemore, V.T., Donahue, K., Krueger, C.B., Rowe, A., Ulbricht, L., Jackson, M.J., Breese, M.R., Jones, G., and Wilks, M., 2002, Database of the uranium mines, prospects, occurrences, and mills in New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open file Report, v. 461, CD-ROM, http://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=461, accessed 1/6/2019.
McLemore, V.T. and Frey, B.A., 2009, Appendix 8. Quality control and quality assurance report (Task B1); *in* McLemore, V.T., Dickens, A., Boakye, K., Campbell, A., Donahue, K., Dunbar, N., Gutierrez, L., Heizler, L., Lynn, R., Lueth, V., Osantowski, E., Phillips, E., Shannon, H., Smith, M., Tachie-Menson, S., van Dam, R., Viterbo, V.C., Walsh, P., and Wilson, G.W., Characterization of Goathill North Rock Pile: New Mexico Bureau of Geology and Mineral Resources, Open-file report 523, http://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=523, accessed 1/6/2019).
McLemore, V. T., Hoffman, G., Smith, M, Mansell, M., and Wilks, M., 2005a, Mining districts of New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-file Report 494, CD-ROM, https://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=494, accessed 1/6/2019.
McLemore, V. T., Krueger, C. B., Johnson, P., Raugust, J. S., Jones, G. E., Hoffman, G. K. and Wilks, M., 2005b, New Mexico Mines Database: Society of Mining, Exploration, and Metallurgy, Mining Engineering, February, p. 42–47.

McLemore, V.T. and Lueth, V., 2017, Metallic Mineral Deposits; *in* McLemore, V.T., Timmons, S., and Wilks, M., eds., Energy and Mineral deposits in New Mexico: New Mexico Bureau of Geology and Mineral Resources Memoir 50 and New Mexico Geological Society Special Publication 13, 79 p.

McLemore, V.T., Smith, K.S., Russell, C.C., editors, 2014, Management Technologies for Metal Mining Influenced Water, volume 6: Sampling and monitoring for the mine life cycle: Society for Mining, Metallurgy, and Exploration, Inc., Littleton, CO.

Metzger, O.H., 1938, Gold Mining in New Mexico: U.S. Bureau of Mines, Information Circular 6987.

Munroe, E. A., 1999, Geology and geochemistry of waste rock piles in the Hillsboro mining district, Sierra County, New Mexico: M.S. thesis, New Mexico Institute of Mining and Technology, Socorro, 144 p.

Neubert, J.T. 1983, Mineral investigation of the Apache Kid and Withington Wilderness Areas, Socorro County, New Mexico: U.S Bureau of Mines, MLA 2-83, 34 p.

Neuendorf, K.K.E., Mehl, J.P., Jr., and Jackson, J.A., 2005, Glossary of Geology: American Geological Institute, 5th ed., Alexandria, Virginia, 779 p.

North, R.M., 1983, History and geology of the precious metal occurrences in Socorro County, New Mexico: New Mexico Geological Society, Guidebook 34, p. 261-268.

North, R.M., and McLemore, V.T., 1986, Silver and gold occurrences in New Mexico: New Mexico Bureau of Mines and Mineral Resources, Resource Map 15, 32 pp., scale 1:1,000,000.

North, R.M., and McLemore, V.T., 1988, A classification of the precious metal deposits of New Mexico; *in* Bulk mineable precious metal deposits of the western United States Symposium Volume: Geological Society of Nevada, Reno, Symposium held April 6-8, 1987, pp. 625-660.

Osburn, G.R., compiler, 1984, Socorro County geologic map: New Mexico Bureau of Mines and Mineral Resources Open-File Report 238, 14 p., 1 sheet, https://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=238, accessed 1/6/2019.

Roybal, F.E., 1989, Ground-water resources of Socorro County, New Mexico: U.S. Geological Survey, Water-resources Investigations Report 89-4083, 108 p.

Rytuba, J.J., 1981, Relation of calderas to ore deposits in the western United States; *in* Relations of tectonics to ore deposits in the southern Cordillera: Arizona Geological Society Digest, v. 14, p. 22.

Schmiermund, R.L., and Drozd, M.A. 1997. Acid mine drainage and other mining influenced waters (MIW), Ch. 13., *in* ed. J.J. Marcus, Mining Environmental Handbook: London, Imperial College Press. p. 599–617.

Sherman, J.E. and Sherman, B.H., 1975, Ghost Towns and Mining Camps of New Mexico: Norman, OK, University of Oklahoma Press.

Simmons, S.F., White, N.C., and John, D.A., 2005, Geological characteristics of epithermal precious and base metal deposits; in 100th Anniversary volume: Economic Geology, p. 485-522.

Smith, K.S. 2007. Strategies to predict metal mobility in surficial mining environments, J.V. DeGraff, editor, Understanding and Responding to Hazardous Substances at Mine Sites in the Western United States: Ch. 3. Reviews in Engineering Geology, Vol. 17, Boulder, CO, Geological Society of America. p. 25–45.

Smith, K.S., Huyck, H.L.O. 1999. An overview of the abundance, relative mobility, bioavailability, and human toxicity of metals, *in* The Environmental Geochemistry of Mineral Deposits. Part A, Vol. 6A, Chapter 2, Plumlee, G., Logsdon, M., eds., Reviews in Economic Geology: Society of Economic Geologists, Inc., Chelsea, MI. p. 29-70.

Smith, K.S., Ramsey, C.A., and Hageman, P.L., 2000, Statistically-based sampling strategy for sampling the surface material of mine-waste dumps for use in screening and prioritizing historical dumps on abandoned mines lands; *in* ICARD 2000; Proceedings from the 5th international conference on acid rock drainage: Society for Mining, Metallurgy, and Exploration, Inc., Littleton, Colo., p. 1453-1461. http://crustal.usgs.gov/minewaste/minewaste.pubs.html

Sobek, A. A., Schuller, W. A., Freeman, J. R. and Smith, R.M., 1978, Field and laboratory methods applicable to overburdens and minesoils: U.S. EPA 600/2-78-054, Washington, D.C., 203 p.

U.S. Bureau of Mines, 1927-1990, Mineral yearbook: Washington, D.C., U.S. Government Printing Office, variously paginated.

U.S. Geological Survey, 1902-1927, Mineral resources of the United States (1901-1923): Washington, D.C., U.S. Government Printing Office, variously paginated.

Weber, P.A., Hughes. J.., Conner, L.B., Lindsay, P., and Smart R.St.C., 2006, Short-term acid rock drainage characteristics determined by paste pH and kinetic NAG testing: Cypress prospect, New Zealand: 7th Internationa Conference on Acid Rock Drainage (ICARD), proceedings, p. 2289-2310, http://www.mwen.info/docs/imwa_2006/2289-Weber-NZ.pdf, accessed 1/6/2019.

Wellmer, F.W., 1989, Statistical evaluations in exploration for mineral deposits: Springer-Verlag, New York, ISBN 3-540-61242-4, 379 p.

Wells, E.H., and Wootton, T.P., 1940, Gold mining and gold deposits in New Mexico: New Mexico Bureau of Mines and Mineral Resources, Circular 5, 25 p.

White, D.E., 1955, Thermal springs and epithermal deposits: Economic Geology, 50th anniversary volume, p. 99-154.

White, D.E., 1981, Active geothermal systems and hydrothermal ore deposits: Economic Geology, 75th anniversary volume, p. 392-423.

Willard, M.E., 1957, Reconnaissance geologic map of Luera Spring 30-minute quadrangle, New Mexico Bureau Mines Mineral Resources, Geologic Map 2, p.

Weber, R.H., 1963, Cenozoic volcanic rocks of Socorro County, New Mexico, *in* Kuellmer, F. J., ed., Socorro Region: New Mexico Geological Society, Guidebook 14th Field Conference, p. 132-143.

Zutah, W.T., 2017, Origin and mineral resource potential of Rosedale district, Socorro County, New Mexico: New Mexico Institute of Mining and Mineral Resources, Independent Study, 71 p.

APPENDIX 1. ACRONYMS AND GLOSSARY OF TERMS

ACRONYMS

Ag	silver
A-S	acid-sulfate
Au	gold
Be	beryllium
BLM	U.S. Bureau of Land Management
CO_2	Carbon dioxide
Cu	copper
I/S	illite/smectite clays
ka	thousand years ago
km	kilometers
lbs	pounds
Li	lithium
m	meters
Ma	million years ago
Myr	Million years old
mi	miles
Ma	million years
NMBMMR	New Mexico Bureau of Mines and Mineral Resources
NMBGMR	New Mexico Bureau of Geology and Mineral Resources
NMMMD	New Mexico Mining and Mineral Division
NMIMT	New Mexico Institute of Mining and Technology
NURE	National Uranium Resource and Evaluation
OSHA	Occupational Safety and Health Administration
oz	ounces
oz/short ton	ounces per short ton
Pb	lead
ppb	parts per billion
ppm	parts per million
REE	rare earth elements
SMCRA	Surface Mine Control and Reclamation Act
Th	thorium
U	uranium
µm	micrometers
USGS	U.S. Geological Survey
USBM	U.S. Bureau of Mines
Wt%	weight per cent
Y	yttrium
Zn	zinc
Zr	zirconium
°C	degrees centigrade

CONVERSIONS

1 ounce (troy) = 31.1034768 grams.

1 troy ounce per short ton	= 34.2857 ppm	= 34.2857 grams per metric tonne	
1 gram per metric tonne	= 0.0292 troy ounce per short ton		
1 kilogram (kg)	= 32.151 ounces (troy)		2.205 pounds
1 ounce (avdp)	= 28.3495 grams		
1 inch (in)	= 2.54 centimeters		
1 foot (ft)	= 0.3048 meters		
1 cubic foot (cu ft)	= 0.028 cubic meters		
1 yard (yd)	= 91.44 centimeters	=0,9144 meters	
1 meter (m)	= 39.370 inches	=3.28083 feet	=1.094 yards
1 mile (mi)	= 1.6093 kilometers	=1609.3 meters	
1 kilometer (km)	= 0.621371 miles	=3280 feet	=1000 meters
1 acre (ac)	= 0.4047 hectares		
1 hectare (ha) = 2.471 acres	=10,000 square meters	=0.00386 square miles	
1 square kilometer (sq km)	= 247.1 acres	=100 hectares =0.3861 square miles	
1 square mile (sq mi)	= 640 acres	=258.99 hectares	=2.59 square kilometers
1 liter (l)	= 0.220 gallons	=0.880 quarts	
1 liter (l)	= 1000 cubic centimeters	=61.025 cubic inches	
1 kilogram (kg)	= 2.2045855 pounds		
1 metric ton (1000 kg)	= 0.9842 tons (long)	=1.102311 tons (short)	=2204.622 pounds
1 long ton (l t)	= 1.01605 tonne	=2240 pounds (lb)	
1 short ton (s t)	= 0.90718474 tonne	=2000 pounds (lb)	
1 pound (lb)	= 0.45359237 kilograms		
Degrees Fahrenheit (°F) - 32x5/9 = Degrees Celsius (°C)			

Glossary

Figure A1.1 shows mine features.

Abandoned: Deserted feature, such as a mine or mill site, where no apparent activity has taken place for some length of time. Usually implies that no living owner (person or company who worked or lived at the location) can be identified. An assumption of “abandoned” may be incorrect if an owner still exists even if they have not performed any activity at the location for a long period, in which case the feature may simply be “inactive”.

Abandoned mine: 1. Excavations, structures, or equipment left from a former mining operation that, for practical purposes, has been deserted and upon which property there is no evident intent of further mining. 2. abandoned workings - excavations, either caved or sealed, that are deserted and in which further mining is not intended and opening workings which are not ventilated and inspected regularly.

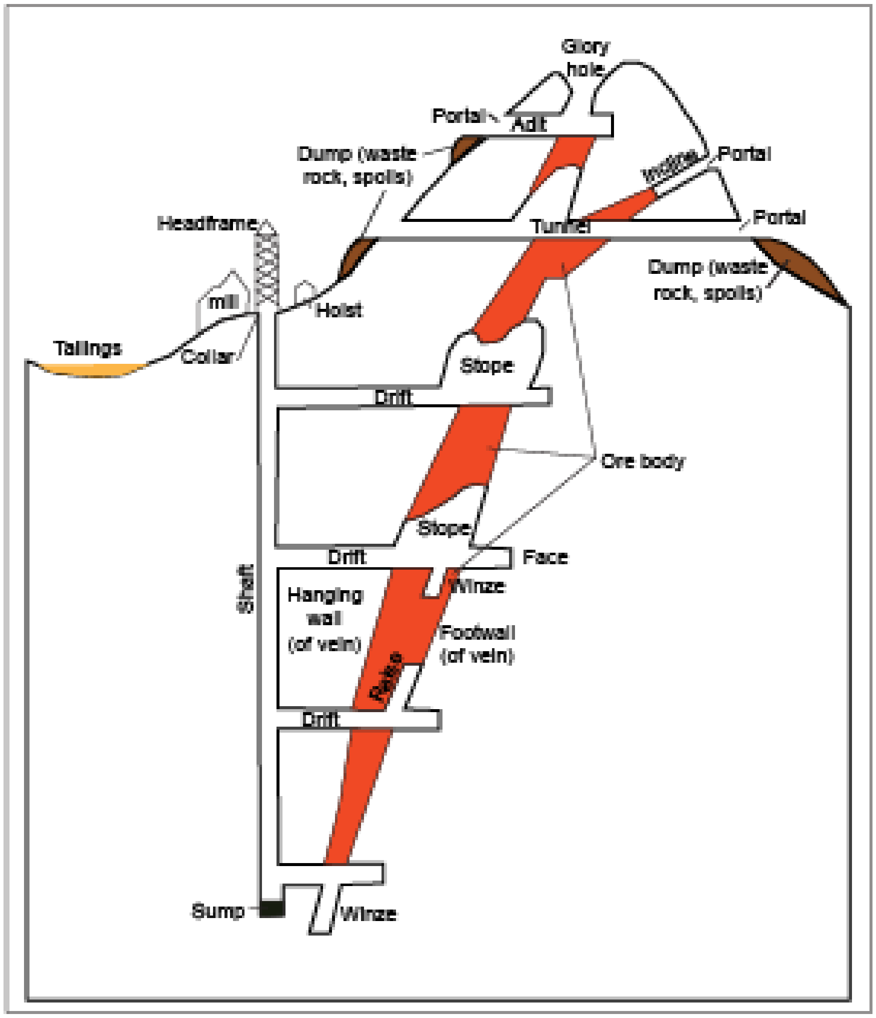


FIGURE A1.1. Mine features.

Abandoned Mine Lands (AML): Lands that were mined and left un-reclaimed where no individual or company has reclamation responsibility. These may consist of excavations, either caved in or sealed, that have been deserted and where further mining is not intended.

Active mine: The area in which active mining takes place relative to extraction of metal ores, industrial minerals, and other nonrenewable natural resources of economic value.

Adit: A horizontal or nearly horizontal passage driven from the surface for the development or dewatering of a mine. If an adit is driven through the hill or mountain to the surface on the opposite side, with two openings to the surface, it is called a “tunnel”. Generally, these are easy to walk in and out of.

Acid mine drainage (AMD): Acidic drainage generated by weathering of sulfide minerals in mines and mine wastes. Acid mine drainage results from oxidation of some sulfide minerals exposed because of mining, which produces sulfuric acid. Such drainage typically contains high sulfate and dissolved iron from the weathering of iron sulfides. Typically, the sulfuric acid dissolves minerals in the rocks, which tend to release metals to the water. This definition implies that acid drainage is caused by the mining process and does not include natural drainage (see ARD). Acidic drainage is possible from bituminous coal mines containing a high concentration of acidic sulfates, especially ferrous sulfate.

Acid rock drainage (ARD): A low pH, metal-laden, sulfate-rich drainage, which occurs during land disturbance where metal sulfides are disturbed. It forms under natural conditions from the oxidation of pyrite or other sulfide minerals and in which the acidity exceeds the alkalinity. There are non-mining exposures, such as along highway roadcuts, where sulfide materials are exposed. These may produce similar drainage, but technically they are not mined areas. This is distinct from AMD.

Alluvium: Soil or sediments transported and deposited by flowing water.

Alteration: Any change in the mineralogical composition of a rock brought about by physical or chemical means; can occur by weathering.

Anion: An ion with a negative charge. An anion [such as chloride (Cl^-), nitrate (NO_3^-), bicarbonate (HCO_3^-), or sulfate (SO_4^{2-})] may result from the dissociation of a salt, acid, or alkali. Anthropogenic formed through or related to the activities of humans.

Aquifer: A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to springs and wells.

Backfill: Geologic materials returned to the pit or placed back into the mine, after desirable minerals have been removed, to bring a surface mine back to original contour or to improve stability of underground workings.

Background: Natural concentrations of an element in natural materials that exclude human influence. A “background measurement” represents an idealized situation and is typically more difficult to measure than a “baseline”.

Barren: Land that has little or no plant cover.

Baseline: A “baseline measurement” represents concentrations measured at some point in time and may or may not represent the true background. Baseline concentrations are typically expressed as a range, not a single value.

Benched slope: A slope that has been constructed by making stair-like cuts into the side of a slope.

Beneficiation: The processing of coal or ores for the purpose of regulating the size of a desired product, removing unwanted constituents, and improving the quality, purity, or assay grade of a desired product. Concentration or other preparation of coal or ores can be for smelting by drying, flotation, or magnetic separation. Improvement of the grade of coal or ores can be by milling, flotation, sintering, gravity concentration, or other chemical and mechanical processes.

Berm: A narrow bank of earth.

Carbonates: A family of rocks containing Ca and/or Mg carbonate, such as limestone and dolomite, and which excludes siderite ($FeCO_3$).

Cation: A positively charged ion in an electrolyte solution, attracted to the cathode under the influence of a difference in electrical potential. Sodium ion (Na^+) and hydronium (H^+) are cations.

Contaminant: Any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, or soil.

Concentrating: The mechanical process, often involving flotation, by which the valuable part of an ore (the "concentrate") is separated from the "gangue", or non-economical rock minerals to be disposed of as "tailings."

Concentrator: Part of the mining plant used to separate valuable minerals from the ore. In mineral sand mining, the concentrator is often referred to as the “wet” mill because it uses a water slurry for separation, and it is often floated on pontoons in a dredge pond.

Cross beds: layers of sediment inclined at an angle.

Drainage: Any water draining from a natural or man-made feature. Includes natural surface water runoff, mine drainage, and groundwater that has come to the surface.

Drainage basin: The surface between topographic divides that receives precipitation. This water is conveyed down slope as surface runoff or groundwater. Also known as a catchment or watershed.

Environmental impact: A process required under the National Environmental Protection Act for projects assessment involving federal or state money, in which potential physical and social impacts and mitigation measures are discussed and analyzed. A provision for notifying citizens and considering their comments is integral to the process.

Ephemeral stream: A stream that flows only during and after a storm or snowmelt.

Erosion: The entrainment and transportation of soil through the action of wind, water, or ice.

Extraction: The process of mining and removal of coal or ore from a mine. This term often is used in relation to all processes of obtaining metals from ores, which involve breaking down ore both mechanically (crushing) and chemically (decomposition), and separating the metal from the associated gangue.

Fault: A discreet surface separating two rock masses across which one mass has slid past the other.

Fine tailings: Fine-grained clastic materials (silts and clays) and/or residual bitumen that consolidate very slowly.

Flotation: The method of mineral separation in which a froth, created in water by a variety of reagents, some finely crushed minerals floats, while other minerals sink.

Formation: A body of rock identified by lithic characteristics and stratigraphic position.

Fracture: General term for any surface within a material across which there is no cohesion, i.e. a crack.

Fracture flow: Flow of fluid, usually water or including water, through fractures in geological media (rock units or indurated sediments). Fractures may represent the predominant flow paths through media that otherwise are relatively impermeable, such as for igneous rocks and high-clay content units.

Framboidal pyrite: Spherically shaped agglomerations of minute (approximately 0.25 μm) crystals of pyrite (FeS_2). It is the most reactive of all pyrite morphologies.

Gangue: The valueless minerals in an ore; that part of an ore that is not economically desirable, but cannot be avoided when mining the deposit. It is separated from the ore during beneficiation.

Geoavailability: That portion of a chemical element's or compound's total content in an earth material that can be liberated to the surficial or near-surface environment (or biosphere) through mechanical, chemical, or biological processes. The geoavailability of a chemical element or compound is related to the susceptibility and availability of its resident mineral phase(s) to alteration and weathering reactions (Smith and Huyck, 1999).

Geographic information: A computer program or system that allows storage, retrieval, and analysis of spatially system (GIS) related information in both graphical and database formats.

Geostatistics: Mathematical assessment of variability in a biological, chemical, or physical parameter across a distance or area.

Geographic Information System (GIS): A computer program or system that allows storage, retrieval, and analysis of spatially related information in both graphical and database formats

Grain size and shape (see Fig. A1.2)

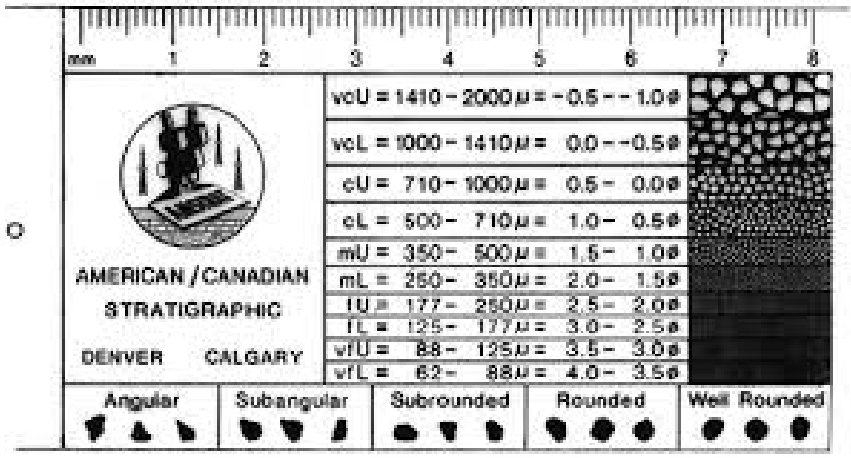


FIGURE A1.2. Grain size and shape of sedimentary rocks.

Heavy mineral sands: Detrital minerals such as rutile, ilmenite, leucoxene, zircon, and monazite typically occurring as a sand-sized fraction, with a high specific gravity relative to that of the host sand.

Impoundment: A closed basin that is dammed or excavated for retention of water, sediment, and/or waste.

Inactive mine: The area in which no active mining is currently taking place relative to extraction of metal ores, industrial minerals, and other minerals of economic value.

Incline: Sloped entrance to underground mine, mined from the surface usually along the dip of a vein or stratigraphic horizon. Sometimes called "decline," or "declined shaft." Steep enough that rail-mounted skip hoist system was necessary to extract ore. Clambering is required to get out.

Infiltration: The downward entry of water into a soil or other geologic materials.

Infrastructure: Elements that support development, including transportation, utility, and communication systems.

Ion: An atom or group of atoms having an electrical charge.

Jarosite: A pale yellow to gray-green potassium iron sulfate mineral [$KFe_3(OH)_6(SO_4)_2$] that forms under active acid sulfate conditions. Can be a pathfinder mineral for areas of oxidation of iron sulfides and associated acid generation.

K-mica: An aluminosilicate mineral in which two silica tetrahedral sheets alternate with one octahedral sheet, with entrapped potassium atoms fitting between the sheets

Kriging: A numerical analysis procedure used to estimate a biological, chemical, or physical value at locations where no samples were collected.

Land use: The primary use of a specific land area.

Leaching: Removal of dissolved, adsorbed, or absorbed substances from a matrix by passing liquids through the material.

Limestone: A sedimentary rock consisting largely of calcite ($CaCO_3$).

Lithology: The character of a rock described in terms of its structure, color, mineral composition, grain size, and arrangement of its component parts; all those visible features that in the aggregate impart individuality to the rock.

Milling: The grinding or crushing of ore. The term may include the operation of removing valueless or harmful constituents from the ore and preparation for additional processing or sale to market.

Mine: An opening or excavation in the ground for extracting minerals, even if there was no production.

Mineralogy: The study of minerals and their formation, occurrence, use, properties, composition, and classification. Also refers to the specific mineral or assemblage of minerals at a location or in a rock unit.

Mineral soil: A soil consisting predominantly of, and having its properties determined predominantly by, inorganic materials. Such soil can, however, contain up to 20% organic matter.

Mine soils: Soils constructed and developed after the surface removal of coal or other mined minerals from the earth.

Mining: The process of extracting useful minerals from the Earth's crust.

Mining district: A section of country usually designated by name, having described or understood boundaries within which mineral deposits are found and mined under rules and regulations prescribed by the miners therein or by a government body. There is no limit to its territorial extent, and its boundaries may be changed if vested mineral or property rights are not thereby interfered with. Can be either an informal name for a mineral area or a legally defined area encompassing all or part of a collection of mineral deposits and/or mines.

Mineral deposit: An occurrence of any valuable commodity or mineral that is of a sufficient size and grade (concentration) that might under favorable conditions have potential for economic development.

Mining influenced water (MIW): Similar to AMD, but does not imply any degree of acidity. Water sources that have (MIW) been affected by mining and/or mineral processing activities, including ARD/AMD, process solutions containing metal lixiviants (e.g., cyanide, acids, bases) and the degradation products of process solutions such as those with elevated ammonia, nitrate, and thiocyanate (SCN).

Mitigation: Correction of damage at the surface caused by mine subsidence, wetland impacts, AMD, etc.

Monitoring: The periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.

Morphological: Dealing with the form and structure of hillside, stream channels, soil pedon, or organism, with special emphasis on external features.

Multiple land use: Using a specific land area for more than one use at any specific time.

Non-point source: Diffuse pollution sources (i.e., without a single point of origin or not introduced into a receiving stream from a specific outlet). The pollutants are generally carried off the land by storm water or through groundwater flow and seepage. Common non-point sources are agricultural storm water, return flows from irrigated agriculture, forestry, urban, mining, construction, dams, channels, land disposal of wastes, saltwater intrusion, and city streets.

Open stope: Linear opening mined from underground to the surface along the course of a vein or mineralized zone.

Ore: The naturally occurring material from which a mineral or minerals of economic value can be extracted profitably or to satisfy social or political objectives. The term is generally, but not always, used to refer to metalliferous material, and is often modified by the names of the valuable constituents.

Ore deposit (ore body): Mineral deposit that has been tested and found to be of sufficient size, grade, and accessibility to be extracted at a profit at a specific time.

Organic matter: The accumulation of disintegrated and decomposed biological residues, and other organic compounds synthesized by microorganisms, found in soil.

Orphan mined land: Un-reclaimed land that was mined before state or federal laws required reclamation. Same as abandoned mine land (AML).

Overburden: Designates material of any nature, consolidated or unconsolidated, that overlies a deposit of useful and mineable materials, ores, or coal, especially those deposits that are mined from the surface by open cuts.

Oxidation: A chemical process involving reaction(s) that produce an increase in the oxidation state of elements such as iron and sulfur.

Oxidize: The chemical reaction involving the removal of electrons from an element (e.g., $Fe^{2+} \rightarrow Fe^{3+}$).

Oxidized zone: That part of the soil-geologic column from which sulfide minerals have been completely oxidized away, compared with the reduced zone. May be equivalent to the "zone of weathering".

Paleoenvironment: The ancient geologic setting (climate, geography, etc.) under which strata were deposited.

Pathway: The physical course a chemical or pollutant takes from its source to an exposed organism.

Performance standards: Standards which describe measurable conditions which a project must meet (e.g., the pH of water leaving the site must be between X and Y) without dictating the method of attaining the condition.

pH: A measure of the acidity (less than 7) or alkalinity (greater than 7) of a solution; a pH of 7 is considered neutral. A measure of the hydrogen ion concentration (more specifically, the negative log of the hydrogen ion activity) of a soil suspension or water.

Placer deposits: Mineral deposit formed by mechanical concentration of heavy mineral particles, such as gold from weathered debris.

Point source: A source of pollution that is discharged from a single point. 2. Defined by the Federal Water Pollution Control Act [Sec. 502(14)] as any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.

Pollutant: Any substance introduced into the environment that adversely impacts the usefulness of a resource.

Porosity: Measure of void spaces in a material.

Porewater: Water occupying the voids in soil or sediment.

Precision: The degree of agreement among repeated measurements of the same characteristic and monitored by multiple analyses of many sample duplicates and internal standards. It may be determined by calculating the standard deviation, or relative percent difference, among samples taken from the same place at the same time.

Processing: The methods employed to clean, process, and prepare coal and metallic ores for the final marketable product.

Production: The total amount of mass produced by a plant, mine, aquifer, etc.

Protore: An exploration and mining industry term for mineralization, particularly uranium, that is barely sub-economic and which could become "ore" if the commodity price increases enough, or if processing methods become more efficient, to make extraction and/or processing of the protore economically beneficial to the mining company. Protore mined as part of ore development and extraction typically is stockpiled separately from ore and waste piles. The term most commonly is used by the uranium industry.

Pyrite: An iron sulfide (FeS_2) which forms acid mine drainage upon exposure to oxidizing conditions and in the absence of $CaCO_3$. Sometimes called "fool's gold".

Quality assurance/quality control (QA/QC): A system of procedures, checks, audits, and corrective actions to ensure that all research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality

Quartz: A very hard, inert mineral of SiO_2, commonly found in sand and sedimentary, igneous, and metamorphic rocks.

Reclaim: Restoring mined or disturbed land to the conditions that are acceptable under regulatory requirements and which return the site to a safe and useful condition (e.g., grazing, recreation, agriculture, wildlife habitat, etc.).

Reclamation: Rehabilitation or return of disturbed land to productive uses; includes all activities of spoil movement, grading, seeding, etc. For coal mined lands, it includes the return of productivity equal to or exceeding that prior to its being disturbed.

Recontouring: Shaping mined areas after backfilling.

Refining: The purification of a crude metal product; normally the stage following smelting. For bitumen it is the fractionation into various components such as gasoline.

Regolith: Soil or unconsolidated materials.

Regrade: Shaping mined areas after re-contouring.

Relational database: An electronic database comprising multiple files of related information, usually stored in tables of rows (records) and columns (fields), and allowing a link to be established between separate files that have a matching field, as a column of invoice numbers, so that the two files can be queried simultaneously by the user.

Remediation: Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a site. The process of correcting, counteracting, or removing an environmental problem, often referring to the removal of potentially toxic materials from soil or water by use of bacteria (bioremediation) or plants (phytoremediation).

Re-mining: Returning to abandoned underground or surface mines or previously mined areas for further coal removal by surface mining and reclaiming to current reclamation standards. Also refers to the process of mining and processing of non-coal mine and mill wastes (processed or unprocessed) to extract additional metals or other commodities due to a change in extraction technology or economics that make such re-mining profitable.

Representative sample: A portion of material that is as nearly identical in content and consistency as possible to that in the larger body of material being sampled.

Restoration: Restoring disturbed land to the conditions that existed at the site before any disturbance occurred.

Riparian: Plants living or located on the bank of a natural or modified perennial water way. Also may refer to the land bordering a stream channel.

Risk: A measure of the probability that damage to life, health, property, and/or the environment will occur because of a given hazard.

Risk assessment: Qualitative and quantitative evaluation of the risk posed to human health and/or the environment by the actual or potential presence and/or use of specific pollutants.

Risk characterization: The last phase of the risk assessment process that estimates the potential for adverse health or ecological effects to occur from exposure to a stressor and evaluates the uncertainty involved.

Risk factor: Characteristics (e.g., race, sex, age, obesity) or variables (e.g., smoking, occupational exposure level) associated with increased probability of a toxic effect.

Risk management: The process of evaluating and selecting alternative regulatory and non-regulatory responses to risk. The selection process necessarily requires the consideration of legal, economic, and behavioral factors. Risk assessments provide a qualitative or quantitative evaluation of the risk posed to human health and the environment by the actual or potential presence of pollutants. Risk assessments are conducted for a number of reasons, including: to establish whether an ecological risk exists or not, to identify the need for additional data collection, to focus on the dangers of a specific pollutant or the risks posed to a specific site, and to help develop contingency plans and other responses to pollutant releases. Risk assessments are an important part of the Agency's Superfund program and play a key role in the development and implementation of new environmental regulations

Rock fragment: Unattached piece of rock >2 mm in diameter that is strongly cemented or relatively more resistant to rupture.

Room and pillar: Also sometimes called “board and pillar” in Europe. A form of underground mining in which typically more than half of the ore is left in the mine as pillars to support the roof. Room and pillar mines generally are not expected to subside, except where retreat mining is practiced. Also a mining method used for thick and/or flat-lying industrial, metal, and non-metal mineral deposits, such as limestone, trona, salt, etc.

Sample: A representative portion of a population.

Sands: Tailings particles of a size (generally >0.05 mm) and weight that readily settle in water.

Shaft: Vertical (or near-vertical) entrance to underground mine. “Cage” hoisting system (mine elevator) was necessary to transport people and equipment and to extract ore. Climbing is required to get out.

Shale: A thinly bedded or fissile sedimentary rock formed from clay or silt particles.

Shovel: Machine used to excavate for coal or other minerals and the loading of these minerals for transport. Its bucket is loaded from the top and has a bottom that is opened for emptying the contents.

Silicate ore: An ore in which the valuable metal is combined with silica rather than sulfur.

Slope: The degree to which the ground angle deviates from horizontal, expressed as a percent rise over run or as a degree angle.

Slurry: Any mixture of solids and fluids that behave as a fluid and can be transported hydraulically (e.g., by pipeline (see *Tailings)).* Also fine coal (<1 mm) refuse material, typically disposed of in an impoundment or behind embankments of coarse coal refuse.

Slurry Pond: Impoundment or basin designed and constructed for the dewatering and disposal of coal slurry or other mineral processing wastes.

Smelter: An industrial plant or process that extracts a metal from an ore at high temperature by chemical and physical processes that occur in the molten state.

Smelting: The chemical reduction of a metal from its ore by a process usually involving fusion, so that earthy and other impurities separate as lighter and more fusible slags and can readily be removed from the reduced metal. The process commonly involves addition of reagents (fluxes) that facilitate chemical reactions and the separation of metals from impurities.

Sorting: Refers to how similar grain sizes in a rock are (see Fig. A1.3).

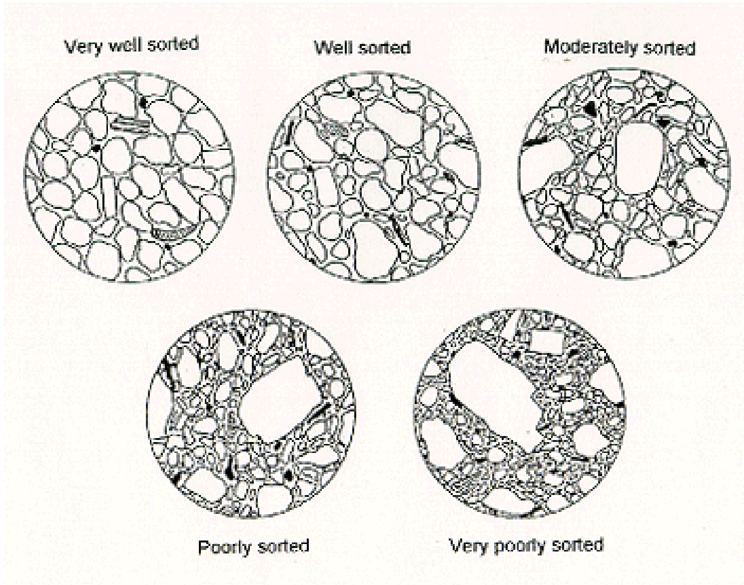


FIGURE A1.3. Sorting of sedimentary rocks

Spoil material: Geologic material between the soil and the desired minerals that has been disturbed and not used in the reclamation process.

Spoil: All overburden material removed above mineral resources in the process of mining.

Stack: A short form for "smokestack".

Stream channel: A trough in the landscape that conveys water and sediment. Channel formed is the product of the flow. Includes ephemeral, intermittent, and perennial stream channels. Also known as gullies, washes, runs, creeks, brooks, and rivers, with the term used often depending on size of the channel or waterway.

Stripping ratio: The relative amount of spoil or waste rock that must be removed in a surface mine to gain access to an amount of ore or mineral.

Subsidence: The caving in of the land surface due to the collapse of voids below the surface, often seen with near-surface or high-extraction underground mining. Collapse or settlement of soil materials or when materials high in organic matter settle from decomposition or other processes in a landfill. Also can be caused by groundwater removal from deep geologic units, and subsequent compaction of those units, such as in basin-fill areas of the Western United States.

Sulfidic materials: Soil taxonomy; diagnostic term to refer to soil materials that have the potential to become extremely acid when exposed to aerobic conditions.

Surface-mine (strip mine): A procedure of mining which entails the complete removal of overburden material. May generally refer to either an area and/or contour mine.

Surface Mining Control and Reclamation Act (SMCRA): Law passed by U.S. Congress in 1977. It provides national standards for pre-mine planning and permitting of underground and surface mines, gives requirements for mining and reclamation practices, and establishes the Office of Surface Mining and authorizes it to enforce rules. The Law also provides for the generation of funds to reclaim abandoned mine lands.

Surface water: Water at or near the land surface, such as lakes and streams as opposed to groundwater.

Swamp: A forested wetland with little peat development.

Subore: Similar to "protore"; refers to the economic status of mineralization, where the material may need to be mined for technical reasons, but is not of sufficient quality to process for a commodity. An increase in the commodity price can convert subore into ore.

Surface water: Water at or near the land surface, such as lakes and streams, as opposed to groundwater.

Tailings: The solid waste product (gangue and other refuse material) resulting from the milling and mineral concentration process (washing, concentration, and/or treatment) applied to crushed ore. Term usually used for sand to clay-sized refuse that is considered too low in mineral values to be treated further, as opposed to the concentrates.

Tailings basin: A tailings impoundment generally constructed by damming a broad, shallow valley or basin. Tailings basins are generally constructed to elevations controlled by local topography, but may be, and often are, constructed to higher elevations than surrounding topography.

Tailings dike: Any wall or berm constructed of tailings for the purpose of retaining tailings slurries. May refer to perimeter walls on the outside crest of tailings impoundments or internal walls for the establishment of smaller cells or ponds within the larger tailings impoundment.

Tailings embankment: A tailings impoundment, part or all of which is constructed above the elevation of the surrounding topography. May be a free-standing structure. Often referred to as a tailings stack. May also refer to any outside face of a tailings impoundment.

Tailings impoundment: Any structure designed and constructed for the purpose of capturing and retaining liquid-solid slurries of mill tailings in which the solids settle. The liquid may or may not be discharged or captured for recycling after the solids have settled out of suspension. "Tailings pond" and "tailings dam" are often used interchangeably with "tailings impoundment".

Tailings sand: The coarse fraction of the tailings stream consisting primarily of sand particles. In the case of oil sands, these tailings may contain a small amount of unrecovered bitumen.

Texture (massive): Refers to sedimentary rock that is free from laminations and forms a single, large bed.

Texture (planar): Refers to sedimentary rock that has parallel laminations within its beds

Topographic map: A map showing 2-dimensional representation of 3-dimensional changes in relief by means of contour lines.

Topsoil: The surface layer or horizon (A) of soil, generally darkened by organic matter and subject to plowing or which would normally be tilled in agriculture, or its equivalent in uncultivated soils.

Total maximum daily: An estimate of the pollutant concentrations resulting from the pollutant loadings from load (TMDL) all sources to a water body. The TMDL is used to determine the allowable loads and provides the basis for establishing or modifying controls on pollutant sources.

Toxicity: A property of a substance that indicates its ability to cause physical and/or physiological harm to an organism (plant, animal, or human), usually under specific conditions and above a certain concentration limit below which no toxicity effects have been observed.

Toxic material: A sample that has been tested and deemed to generate AMD when associated with metal or coal mining. Other materials may contain toxic levels of various elements to either or both plants and animals.

Trace minerals: Minerals containing trace elements, which are elements that make up less than 1% of a mineral.

Unoxidized zone: See “reduced zone”.

Ventilation drift or shaft: A horizontal adit or tunnel or vertical shaft in a mine having the prime purpose of exchanging gases with the outside atmosphere.

Volcanic ash: A usually fine-grained rock, formed by volcanic action at the earth's surface.

Waste rock: Barren or mineralized rock that has been mined, but is not of sufficient value to warrant treatment and, therefore, is removed ahead of the milling processes and disposed of on site. Term usually used for wastes that are larger than sand-sized material and can be up to large boulders in size. Waste rock pile also called dump, spoil pile, or spoils.

Water body: Any natural or artificial stream, river, or drainage with perceptible flow at the time of crossing during pipeline construction, and other permanent to ephemeral water body such as ponds and lakes.

Water balance: An accounting of the inflow to, outflow from, and storage changes of water in a hydrologic unit over a fixed period.

Water cycle: The process by which water travels in a sequence from the air (condensation) to the Earth (precipitation) and returns to the atmosphere (evaporation).

Water quality standards: State-adopted and EPA-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

Watershed: The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point.

Weathering: Process whereby earthy or rocky materials are changed in color, texture, composition, or form (with little or no transportation) by exposure to atmospheric agents.

Wetlands: Land areas containing ponded water or the surface soil saturated for some portion of the growing season. Those which have standing water for long periods may be mined only under special conditions and the company usually must reconstruct more acres of wetlands than originally disturbed.

Workings: The entire system of openings (underground as well as at the surface) in a mine.

APPENDIX 2. SUMMARY OF MINES AND PROSPECTS FOUND IN THE ROSEDALE MINING DISTRICT, SOCORRO COUNTY

See attached excel spreadsheet.

APPENDIX 3. CHRONOLOGICAL SYNOPSIS OF THE ROSEDALE MINING DISTRICT

This is a chronological synopsis of the history of the Rosedale mining district and is modified from Robert W. Eveleth (written communication, 1993), Karl Tonander (in Burney and Scarlata, 2008), and published and unpublished reports, including newspapers. A portfolio of the mining files at the NMBGMR can be found at http://geoinfo.nmt.edu/geoscience/hazards/mines/aml/documents/AML_Rosedale_Portfolio.pdf (accessed 1/6/2019). Note that in the synopsis below, the above portfolio is the primary source, unless otherwise stated.

Date	Event
December 15, 1882	Jack W. Richardson discovers Rosedale property (Lindgren et al., 1910; Lasky, 1932).
1885	White Cap mine developed.
1886	Rosedale Mining Company formed (Lasky, 1932). First ore shipments from Rosedale mine.
February 28, 1887	Great London and Rothchild mine claims are located.
May 14, 1887	Great London Mill claim located.
February 18, 1888	Shaft sunk 25 ft by J.W. Richardson, Fred Keith is President of Rosedale Mining Company.
April 7, 1888	Shaft sunk to approximately 40 ft. Assays up to 6 oz/short ton reported
June 22, 1888	Crosscut at 50 ft shows 12 ft of ore; $30 Au and 3 oz Ag/ short ton.
July, 1891	10-stamp mill completed, first run in August.
September 14, 1894	Rothchild mill claim located and mill constructed.
November 1, 1895	Whitecap mine is bonded to C.W. Barr and Company for development.
August 8, 1896	W.H. Martin and Company is incorporated.
1898	W.H. Martin and Company acquires property (Lasky, 1932) and operates the mine continuously until 1911. 10 stamp mill built.
February 1, 1899	Cyanide plant is completed. Ore processed by amalgamation and cyanidation in a 10-stamp mill (Lasky, 1932).
1901	Claims approved for patent (Table 4).
February 23, 1901	C.H. Featherstone (part-owner) reports good progress.
March 2, 1901	Rosedale increasing output and machinery.
March, 1901	Assay office burns, mine and mill records lost.
May 4, 1901	Rosedale reports bonanza on 600-ft level.
1901	Bell Mine reported sold.
May 25, 1901	Harry Richards is Night Foreman at the Rosedale (Martin) mine.
June 1, 1901	J.H. Tweed moving freight to Rosedale.
1901	L.M. Lasley (Chicago) named as possible investor.
June 8, 1901	Approximately 1,000 lbs of rich ore sent to Chamberlain Sampling Works, Denver.
June 15, 1901	Ore crusher down, expected repair in one month.
July 1, 1901	Mill closed to develop ore reserves.
July 6, 1901	Mill reported closed for about one week.
July 27, 1901	Town of 200 people. $105,746 in returns. 13 levels completed to 732 ft. Estimated ore body worth is $400k - $500k. 12th level ore is approximatelyt $2/lb. Mine superintendent is Edwin Martin. Charles A. Featherstone local stockholder (and one of original locators). Bell, White Cap, San Marcial and Ninety-Nine mines are operating.
August 3, 1901	Rosedale stage line sold.
August 15, 1901	Rothchild claims patented (Table 4).
October 10, 1901	Rosedale mine idle for one day to fix accident with hoisting engine. 99 [Ninety-Nine Mine] reports low grade ore (owners: Harry, Rosebrook). Golden Bell producing well; recently increased crew and equipment. White Cap is beginning production. Big Rosa reports favorable; gold-bearing quartz and plenty of water.

Date	Event
November 2, 1901	Martin Company temporarily ceased operations. Golden Bell completing plans for a stamp mill.
March 8, 1902	Golden Bell Mining Company in 'title fight' with Donaldson Walker. Minor production through 1904.
August 30, 1902	Big Rosa reported to have ore similar to Cripple Creek by J. McKinney. A.L. Heister recently struck a rich vein.
September, 1903	Mill reopened.
October 24, 1903	Rosedale reported reopened, 30 men employed, water encountered at 740 ft.
December 24, 1903	Rosedale has new machinery and full crew. Baking Powder mine in full operation; Walter Edwards, manager.
April and May, 1904	Entire mine sampled.
1905	Rosedale has a saloon, store and population of 100.
ca. February, 1907	Rosedale closed pending sale, ore worth about $9/short ton.
1907	Mine closed pending sale, 50 foot levels, 10-stamp mill at 18 short ton per day capacity, second ore shoot found.
November 30, 1907	Baking Powder Mining Company faces foreclosure.
1908	30,000 short tons of ore milled to date, with 200,000 short tons in reserve. 10-stamp mill. Main shaft is 732 ft deep. A 6,000 ft capacity saw mill is at the Rosedale mine. Mine produced for 6 months.
1909	Mine and mill worked by the Rosedale Mining and Milling Company.
ca. 1910	Continental Lode (145-ft shaft), Gospel and Bay Horse Lodes, Golden Bell and White Cap. Big Rosa under development.
1910	Mine provides 2000 gallons of water a day. Mill is closed from January 1 to May 6, 1910.
1910	20-stamp mill, L.R. Babcock, manager.
August 12, 1910 pm	20-stamp mill and cyanide plant burns, estimated $50k-$75k in damages.
August 12, 1910 pm	T.B. Everheart seriously 'but not dangerously' burnt.
pre-Nov. 27, 1910	Exploratory drift on the 6th level collapsed.
ca. 1911	Cyanide plant has burnt.
1911	Dissention among Eastern backers resulting in closure of the Rosedale mine.
ca. 1913	100,000 short tons of reserves, existing saw mill, blacksmith shop, assay office and hoist house.
August 4, 1913	Harden W. Hayward fails in attempt to sell the property.
1913	Property sold again.
1913	Property reopens.
1915	Stockholders have property for sale.
1915	Mine is caved badly; last company stoped all visible ore, 35,000 short tons of ore in reserve.
1916	Fire destroys mill and surface plant.
1920	Claims for sale for $100,000.
ca. 1920	40,000 short tons of ore removed; fire has destroyed mill, shaft house and upper shaft timbers.
1921	35,000 short tons of ore removed, 240,000 short tons of visible reserves, 5300 ft of workings.
1930	Rosedale mine sold (Lasky, 1939).
May 9, 1933	Previous owner presumed dead and property left to a charity institution in eastern U.S.
1934	Black Bear Mining Company became the new owners.
1934 (?)	Black Bear preparing mine for re-entry and planned to sink shaft an additional 500 ft.
1934	58 short tons of ore shipped to El Paso smelter.
1934	65 short tons per day mill was built. 13 oz of Au and 115 oz of Ag produced for $535.
May 3, 1935	Rosedale Gold Mines, Ltd. purchases property.
July, 1935	Mine begins extraction of ore.
November, 1935	A new 65-short ton per day cyanide mill was built and operated until 1936 (Metzger, 1938).
1935	2,972 short tons of ore milled.

Date	Event
1935	158 oz Au and 147 oz Ag produced for $5,641. Black Bear Mining Co. sold to Rosedale Mining Co.
1936	Work primarily above 500 ft. Reserves of 62,000 short tons reported on May 31, 1936.
1936	16,200 short tons of ore milled.
1936	Mill expanding to 135 short tons per day.
November, 1936	Mill closed to enlarge capacity.
March 15, 1937	Mill reopened after enlargement of the power plant and was treating 135 short tons of ore per day (Metzger, 1938).
1937	1,665 oz Au and 2,291 oz of Ag produced for $60,062.
December 2, 1937	Mill closed after 30,500 short tons of ore milled.
1937-1938	Sampling and evaluation by H. Schmidt, who reported the shaft was in bad shape.
1941	Cyanide tanks cleaned.
1941	Ownership changed. Fires destroyed equipment.
June and Sept., 1942	Attempted sales of remaining mine equipment.
1972-1973	Claims owned by Donald W. McCaig.
1974-1975	New claims staked. Sampling and drilling (four holes with a total depth of 1472 ft) by Perry, Knox, and Kaufman, Inc. for Superior Oil Co. and General Crude Oil Co.
1976	Two holes drilled near the Bell mine (Neubert, 1983).
1979	Resources America, Inc. drilled six holes (Neubert, 1983).
1980	Uranium occurrences examined (McLemore, 1983).
1981-1982	Mineral resources evaluated for Wilderness Study Area assessment (Neubert, 1983).
1986-1990	Detailed geologic mapping by Ferguson (1986, 1990).
1991	Sampling by New Mexico Tech geochemistry class.
2007-2008	Evaluation of the tailings for reclamation (Burney and Scarlata, 2008).
2007-2008	Longtail and Rose were reclaimed by the U.S. Forest Service.
Oct. 7, 2016	Exploration drilling permit submitted by Fred Holly approved by New Mexico Mining and Minerals Division.
Summer 2012, 2016-October 2018	This project.

APPENDIX 4. PETROGRAPHIC DESCRIPTIONS OF SAMPLES

Location of samples in Appendix 2. None of the samples had any effervescence upon exposure to calcite. HT=hydrothermal alteration. Mod=moderate. Plag=plagioclase

Sample	Rock frag-ments %	Clast shape	Rank of HT alteration	Intensity of HT alteration	Weather -ing	Mineralogy	Description of quartz	Descrip-tion of feldspar	Descrip-tion of oxides	Comments
ROSE1	40% of total sample, mostly rhyolite	Angular	Silicic	low	oxidized spots	quartz, feldspar, oxides	glassy prismatic, milky massive	plag in clasts	Single black grains and in clasts	
ROSE2	50% of tot., mostly rhyolite	Angular	Silicic	low	oxidized spots	quartz, feldspar, oxides	glassy prismatic, milky massive	plag in clasts	clasts show spots of oxidation	
ROSE3	50% of tot., mostly rhyolite	Angular	Silicic	low	oxidized spots	quartz, feldspar, oxides	glassy prismatic, milky massive	Some free plag	clasts show spots of oxidation	
ROSE4	50% of tot., mostly rhyolite, some solid gray clasts (andesite?)	Angular	Silicic	low	oxidized spots	quartz, feldspar, oxides	glassy prismatic, milky massive	Some free plag	clasts show spots of oxidation	Weakly-cemented clumps dissolved during washing
ROSE5	50% of total, mostly rhyolite, some clasts have black crust, rest is qtz+feld. Sand	Angular	Silicic	low	oxidized spots	quartz, feldspar, oxides	glassy prismatic, milky massive	Plag in sand	Present as black crusts on some clasts	Weakly-cemented clumps dissolved during washing
ROSE6	20% of tot. rest is sand	Angular	Silicic	low	oxidized spots	quartz, feldspar, oxides	glassy prismatic, milky massive	Plag in sand	Soft, subround black lumps of unk. Oxide	black lumps easily crush to powder between fingers
ROSE7	60% of tot, Mostly rhyolitic tuff	Angular	Argillic	mod	oxidized mod	quartz, feldsper, FeOx,MnO_2	glassy quartz, prismatic	Plag	Moderate Fe stains, MnO_2	Rhyolitic tuff fragment show moderate FeOx stains and MnO2 spots
ROSE8	30% of Tot, oxidized rhyolite with some tuff	Angular	Sicilic	low	Oxidized	Quartz, feldspar, FeOx, MnO_2	Milky to glassy.Moderate oxidation	plag	Moderate Fe stains, MnO2	Mostly quartz fragment with Tuff and Rhyolite, Moderate MnO_2 stringers

Sample	Rock frag-ments %	Clast shape	Rank of HT alteration	Intensity of HT alteration	Weather-ing	Mineralogy	Description of quartz	Descrip-tion of feldspar	Descrip-tion of oxides	Comments
BEL003	10% of tot., mostly rhyolite (broken-down), some andesite	Angular	Silicic	low	oxidation on clasts	quartz, feldspar, oxides	glassy prismatic, milky massive	present in clasts	Single black grains and in clasts	
BEL002	50% of tot, Rhyolite	Angular	Silicic	mod	Mod	quartz, feldspar, FeOx	Milky to glassy quartz	present in clasts	Moderate Fe stains, MnO_2	Mostly rhyolite fragments with quartz
BEL008	10% of tot, rhyolite fragment	Angular	Silicic	mod	Mod	quartz,MnO_2, FeOx	Milky to glassy quartz	Plag	Low Fe stains, MnO_2 spots	Mostly silicified quartz fragments with minor rhyolite
BEL009	70% of tot, Rhyolitic breccia	angular-subangular	Silicic	mod	Mod	quartz,MnO_2, FeOx	prismatic, Milky quartz	plag	Pervasive Fe stains, MnO2 stringers	Leached minerals forming vesicles in rhyolite, crystal quartz grains in rhyolite with low silicification
BEL012	20% of tot. rhyolite	Angular	Silicic	mod	Mod	quartz, FeOx	Milky to glassy quartz	Plag	Moderate Fe stains	Silicified rhyolite with moderate amount of iron stains. Spots of oxidized minerals
BEL015	70% of tot, Rhyolitic Tuff	angular-subangular	Argillic	mod	Mod	quartz, feldspar, FeOx, MnO_2	glassy prismatic, milky massive	plag	Low Fe stains, MnO2 spots	Moderate amount of argilic alteration on rhyolitic tuff. MnO2 spots
ROBB2	60% in total, Rhyolite fragment with quartz	Angular	Silicic,Argillic	mod	Oxidized spots	quartz, feldspar, iron oxide	glassy to milky quartz	Plag in porphyry rhyolite	Moderate Fe stains	Silicified rhyolite porphry with some argillic alteration. Moderate amount of iron stains

APPENDIX 5. CHEMICAL ANALYSES OF SOLID SAMPLES

TABLE A5-1. Chemical analyses of samples collected by Ferguson (1970). These analyses were determined by fire assay methods at the NMBMMR fire assay laboratory. UTM in zone 13, NAD27.

Sample ID	UTM Easting	UTM Northing	Au (oz/t)	Au (ppm)	Ag(oz/t)	Ag (ppm)
NM-89-1	275981	3742641	0.00	0	0.44	13.8
NM-89-10	278445	3747518	0.00	0	0.20	6.25
NM-89-10b	278439	3747526	0.00	0	0.00	0
NM-89-13	274544	3745310	0.00	0	0.00	0
NM-89-16	276228	3746360	0.00	0	0.04	1.25
NM-89-16a	276231	3746351	0.00	0	0.12	3.75
NM-89-16b	276235	3746366	0.00	0	0.00	0
NM-89-16d	276234	3746357	0.00	0	0.00	0
NM-89-17	275955	3746998	0.00	0	0.00	0
NM-89-18	275885	3746931	0.00	0	0.00	0
NM-89-19a	276069	3746629	0.00	0	0.64	20
NM-89-19b	276064	3746635	0.00	0	0.12	3.75
NM-89-19c	276072	3746638	0.00	0	0.90	28.1
NM-89-2	275974	3742636	0.00	0	0.00	0
NM-89-20	276138	3746611	0.04	1.25	0.04	1.25
NM-89-23a	277458	3748348	0.00	0	0.78	24.4
NM-89-23b	277467	3748346	0.00	0	0.34	10.6
NM-89-23h	277466	3748339	0.00	0	0.12	3.75
NM-89-24	277460	3748341	0.00	0	0.08	25
NM-89-29	272258	3748982	0.00	0	0.00	0
NM-89-33	273329	3746922	0.00	0	0.04	1.25
NM-89-34	276342	3748162	0.00	0	0.22	6.88
NM-89-35	271436	3745377	0.00	0	0.00	0
NM-89-36	269657	3745034	0.00	0	0.00	0
NM-89-9	275179	3746083	0.00	0	0.04	1.25
NM90.14	272490	3737073	0.00	0	0.02	6.25
NM90.22	269384	3739742	0.00	0	0.00	0
NM90.45	271624	3738736	0.00	0	0.00	0
T-89-11	274448	3745401	0.00	0	0.00	0
T-89-42a	274360	3746243	0.00	0	0.26	8.13
T-89-43	274360	3746243	0.00	0	0.10	3.13
T-89-XXX	279603	3749234	0.00	0	0.00	0

TABLE A5-2. Chemical analyses of samples collected by Neubert (1983). Latitude and longitude are in decimal degrees in NAD27. Qtz=quartz, rhy=rhyolite, nd=not detected, --- =not analyzed, *=atomic absorption analysis, **=fluorimetric analysis

Sample No.	Description	Latitude	Longitude	Au (oz/short ton)	Ag (oz/short ton)	Cu%	Pb%	Zn%	U_3O_8%
1	Dump, brown rhy	33.82676	-107.43763	ND	ND	0.001	ND	ND	ND
2	Dump, fractured, gray rhy.	33.838659	-107.43718	ND	ND	---	---	---	---
3	2 ft chip; red rhy.; Fe, Mn stains	33.83908	-107.43814	ND	ND	ND	ND	ND	ND
4	Fractured rhy	33.83609	-107.43787	ND	ND	0.001	ND	ND	0.004
5	Dump; gray rhy., qtz stringers	33.8381734003	-107.440380	ND	ND	---	---	---	---
6	40 inch chip; rhy.; Fe stained gouge	33.83466	-107.437628	ND	ND	0.006	0.01	ND	ND
7	Dump, red rhy.	33.837936	-107.419419	ND	ND	---	---	---	---
8	Dump; red rhy.; Fe, MN Stains	33.837771	-107.419069	ND	ND	---	---	---	---
9	Dump; Red rhy; 4 ft qtz vein strikes N 34º W, Dip vertical	33.8371	-107.419244	ND	ND	ND	ND	ND	0.01
10	8 inch chip; red rhy; 4 ft qtz vein stikes N 34º W, Dip vertical	33.83719	-107.419268	ND	ND	ND	ND	ND	ND
11	Dump; red rhy; Fe, MN stains	33.8349	-107.437624	ND	ND	---	---	---	---
12	Dump; red rhy; Fe Stains	33.8347830222	-107.434496	ND	ND	ND	ND	ND	ND
13	Dump; red rhy. And alluvium	33.8344882346	-107.433115	ND	ND	---	---	---	---
14	Dump; red rhy; Fe, MN stains	33.833537225	-107.434160	ND	ND	---	---	---	---
15	do.	33.832968	-107.43449	ND	ND	ND	ND	ND	ND
16	do.	33.8320709203	-107.434118	ND	ND	---	---	---	---
17	Dump; alluvium; brecciated rhy.	33.830734	-107.438068	ND	ND	---	---	---	---
18	Dump, red rhy.	33.8289564839	-107.437803	ND	ND	--	---	---	---
19	do.	33.8277866182	-107.439056	ND	ND	ND	ND	ND	ND
20	1.5 ft chip; white rhy.	33.8268331342	-107.442030	ND	ND	0.0003*	0.0011*	0.003*	0.001*
21	Dump; white, red rhy	33.826328937	-107.440387	ND	ND	---	---	---	---

Sample No.	Description	Latitude	Longitude	Au (oz/short ton)	Ag (oz/short ton)	Cu%	Pb%	Zn%	U_3O_8%
22	dump; red rhy; Mn stains	33.82611	-107.43762	ND	ND	---	---	---	---
23	Dump; red rhy	33.8251	-107.43697	ND	ND	ND	ND	ND	ND
24	Dump; red rhy; qtz	33.82412	-107.43897	ND	ND	---	---	---	---
25	Dump; red rhy; qtz vugs and Mn Stains	33.82338	-107.43825	ND	ND	ND	ND	ND	ND
26	Dump; high grade; selected qtz from pit	33.82338	-107.43825	ND	ND	0.0056*	0.0021*	0.0033*	ND
27	Dump; red, qtz rich rhy	33.822709	-107.43894	ND	ND	ND	ND	ND	ND
28	White rhy, Mn	33.813829	-107.409137	ND	ND	ND	0.01	ND	ND
29	8 inch vein, gouge, gray rhy	33.813829	-107.409137	ND	ND	ND	0.01	ND	0.003
30	Gray rhy	33.813829	-107.409137	ND	ND				
31	Dump; brecciated gray, 97hite, red rhy	33.8108671	-107.407509	ND	ND	ND	ND	ND	ND
32	4 ft chip; brecciated gray, 97hite rhy; Fe stains	33.813678	-107.409004	ND	0.3 (9.38 ppm)	---	---	---	---
34	1.5 ft chip; gray qtz rich rhy; Fe, Mn Stains	33.812621	-107.409579	ND	ND	---	---	---	---
35	2 ft chip; brecciated purple rhy; Mn stains	33.811935	-107.408594	ND	ND	0.001	ND	ND	0.01
36	Dump; pink, gray rhy; Fe, Mn Stains	33.8117773	-107.409632	ND	ND	ND	ND	ND	ND
38	2 ft chip; pink, gray rhy; Fe, Mn stains	33.810155	-107.408270	ND	ND	---	---	---	---
39	30 inch chip; pink, gray rhy; Fe, Mn stains	33.8094006	-107.406885	ND	ND	---	---	---	---
40	3 ft chip; pink, gray rhy; Fe, Mn stains	33.809275	-107.409615	ND	ND	0.001	ND	ND	ND
41	2 ft chip; pink, gray rhy; Fe, Mn stains	33.808671	-107.410526	ND	ND	---	---	---	---
42	2 ft chip; spongy gouge	33.807751	-107.408265	ND	ND	ND	ND	ND	ND
43	28 inch chip; vuggy, qtz rich, pink, gray rhy; Fe, Mn Stains	33.8076	-107.408131	ND	ND	ND	ND	ND	ND
44	17 inch chip; pink, gray rhy; gouge; Fe, Mn stains	33.808827	-107.406165	ND	ND	0.001	ND	ND	ND

Sample No.	Description	Latitude	Longitude	Au (oz/short ton)	Ag (oz/short ton)	Cu%	Pb%	Zn%	U_3O_8%
45	2 ft chip; pink barren rhy	33.808976	-107.407856	ND	ND	---	---	---	---
46	4 ft chip; fractured gray rhy; Fe stains on fractures	33.8118753	-107.420993	ND	ND	0.001	ND	ND	0.008
47	Dump; alluvium	33.8074539985	-107.421590	ND	ND	---	---	---	---
48	Dump; pink rhy	33.807229	-107.421546	ND	ND	---	---	---	---
49	3.5 ft chip; rhy	33.8057217	-107.421807	ND	ND	0.001	ND	ND	0.001
50	5 ft chip; rhy	33.8057217	-107.421807	ND	ND	0.001	ND	ND	0.004
51	Dump, high grade; yellow, 98hite, black, red chert	33.80408031	-107.41973	ND	1.8 (56.3 ppm)	0.0009*	0.0004*	0.0023*	ND
52	Dump; rhy and chert	33.80408031	-107.41973	ND	ND	0.0006*	0.0018*	0.0036*	ND
53	4 ft chip; red, qtz rich rhy	33.80408031	-107.41973	ND	ND	---	---	---	---
54	Dump; rhy; 98hite, 98hite chert	33.80365	-107.41985	ND	ND	ND	ND	ND	ND
55	2.5 ft chip; red rhy; qtz veinlets	33.80342184	-107.41978	ND	ND	---	---	---	---
56	4 ft chip; fractured gray, qtz rich rhy	33.803144	-107.421128	ND	ND	ND	ND	ND	ND
57	3 ft chip; fractured, qtz rich rhy	33.80305	-107.420834	ND	ND	---	---	---	---
61	Rhy, qtz, 3 inch Fe gouge	33.801694	-107.419417	ND	ND	0.004*	0.0022*	0.0006	
63	Rhy gouge, Fe, Mn stains	33.801694	-107.419417	ND	ND	ND	0.02	ND	ND
66	Rhy gouge, Fe, Mn stains	33.801694	-107.419417	ND	ND	0.0008*	0.001*	0.004*	ND
68	Rhy gouge, Fe, Mn stains	33.801694	-107.419417	ND	ND	0.0006*	0.0023*	0.0041*	ND
71	Rhy gouge, Fe, Mn stains	33.801694	-107.419417	ND	ND	0.0013*	0.0037*	0.0082*	ND
74	Rhy gouge, Fe stains	33.801694	-107.419417	ND	ND	ND	ND	ND	0.002
76	2.5 ft chip; buff rhy	33.801503	-107.415164	ND	ND	---	---	---	---

TABLE A5-3. Geochemistry of stream-sediment samples in the Rosedale and Bell mine areas, Rosedale district, Socorro County. Samples were collected by students of NMIMT. Analyses were by ICP at a commercial laboratory. Trace elements are in parts per million (ppm). UTM are in zone 13, NAD27.

Sample ID	Sample Type	UTM E	UTM N	Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	Zn	Bi	Cd	Ga	Se	Te
404	Stream Sed	277790.6717	3740913.91	5.18	5.64	0.197	1.45	0.117	1.67	20.5	2.2	0.494	43.7	0.78	0.128	2.01	0.247	0.056
406	Stream Sed	277423.0324	3741763.885	7.66	5.77	3	2.39	0.031	0.491	17.1	1.41	0.934	21.7	0.832	0.141	1.07	0.244	0.049
311	Stream Sed	276078.1872	3742808.101	41.5	3.93	2.87	9.42	0.027	0.982	12.9	0.575	0.494	37	0.237	0.161	2.93	0.247	0.049
464R	Stream Sed	277124.9963	3743298.851	0.223	8.03	0.038	16.5	0.1	4.44	47.8	1.58	0.499	56.3	0.25	0.649	1.66	0.998	0.499
2251	Stream Sed	275998.2554	3741272.108	14.9	5.87	0.197	4.59	0.075	1.39	14.9	1.88	0.494	31.4	0.485	0.244	1.74	0.247	0.049
2252R	Stream Sed	276120.4931	3741309.414	15.4	5.53	2.36	8.47	0.094	28.3	8.74	9.53	0.469	14.8	0.235	0.137	1.16	0.938	0.469
2253	Stream Sed	276099.8556	3741419.745	34.4	8.82	5.05	9.16	0.073	1.45	18.9	2.46	0.489	40.7	0.271	0.335	2.65	0.244	0.049
2254	Stream Sed	275974.0459	3741653.241	7.69	6.02	0.195	2.19	0.052	0.64	10.3	2.73	0.488	33.4	0.198	0.206	1.55	0.244	0.059
2255	Stream Sed	276066.6503	3741825.22	32.7	10.2	5.67	5.75	0.098	2.43	18.2	4.27	0.564	35.4	0.318	0.308	2.87	0.463	0.058
2256R	Stream Sed	276074.5878	3741817.283	13.1	10.8	1.47	12.3	0.097	28.6	36.8	7	0.486	24.6	0.243	0.421	0.754	0.973	0.486
2257	Stream Sed	276281.6247	3741434.033	11.3	24.3	0.918	3.33	0.06	8.27	12.9	3.12	0.492	20	0.22	0.23	1.13	0.246	0.049
2258	Stream Sed	276507.0431	3741364.496	11.8	11.3	0.198	4.07	0.054	0.326	15.3	3.42	0.495	36.2	0.201	0.337	1.26	0.247	0.049
2259R	Stream Sed	277045.1184	3742509.663	1.26	3.62	0.133	9.55	0.092	12.2	13	5.53	0.809	18.1	0.229	0.189	1.8	0.917	0.459
301	Stream Sed	278423.0712	3742613.777	2.91	5.36	1.29	1.52	0.019	0.601	7.12	1.24	0.485	16.8	0.155	0.073	0.768	0.243	0.065
302	Stream Sed	278513.5589	3742786.021	4.11	4.5	1.62	1.31	0.019	0.617	7.36	1.27	0.486	14.3	0.134	0.083	0.69	0.243	0.049
303	Stream Sed	277860.0367	3742898.602	72.5	3.32	75.9	1.6	0.02	1.37	6.81	1.64	0.496	22.7	0.104	0.058	1.17	0.248	0.051
304	Stream Sed	278284.2705	3743287.064	19.9	3.88	2.56	4.28	0.02	0.497	9.8	0.787	0.492	25.1	0.123	0.203	0.885	0.246	0.054
305	Stream Sed	277781.8522	3743432.532	24.9	3.6	3.17	4.78	0.051	0.548	10.4	0.627	0.495	24.3	0.121	0.198	1.19	0.247	0.049
306	Stream Sed	277749.8376	3743188.321	399	4.24	151	3.37	0.1	3.15	9.28	8.63	0.488	51.7	0.068	0.062	1.02	0.244	0.063
307	Stream Sed	277565.0257	3743005.097	6.67	6.16	1.95	3.46	0.105	0.502	11.2	1.23	0.495	25.2	0.183	0.139	1.43	0.248	0.06
308	Stream Sed	277734.3594	3743059.998	2.96	3.12	1.55	0.902	0.02	0.525	5.75	0.613	0.493	13.4	0.098	0.05	0.534	0.247	0.049
309	Stream Sed	276728.0411	3743365.473	2.97	5.99	1.29	6.69	0.02	2.19	6.14	1.19	0.494	14.7	0.124	0.083	0.612	0.247	0.049
310R	Stream Sed	279188.7504	3743162.273	1106	6.63	177	13	0.295	6.61	20.7	15.9	0.487	68.2	0.237	0.151	6.79	0.243	0.049
401	Stream Sed	276940.2991	3741380.371	12.9	8.88	0.198	4.4	0.056	0.325	12.4	1.14	0.495	38.7	0.157	0.131	1.15	0.248	0.05
402	Stream Sed	277044.016	3741433.817	8.57	49.98	0.2	2.07	0.059	0.344	9.71	1.44	0.499	29.3	0.185	0.162	1.19	0.25	0.05
403	Stream Sed	276897.4366	3741562.405	11.9	9.21	0.195	2.78	0.091	0.45	10.9	2.45	0.485	39.8	0.22	0.214	1.73	0.243	0.049
405	Stream Sed	277376.7302	3741548.249	5.52	3.79	0.197	3.47	0.047	0.331	19	0.781	0.494	23.9	2.61	0.136	1.24	0.247	0.073
407	Stream Sed	277218.0461	3742042.717	12.3	7.95	0.199	3.95	0.054	0.387	15.5	1.41	0.496	32	0.261	0.186	1.41	0.248	0.05
451	Stream Sed	275935.0771	3743079.476	9.61	4.19	1.75	9.42	0.061	1.04	16.8	0.728	0.494	27.9	0.393	0.348	1.04	0.247	0.084
452	Stream Sed	276566.9519	3742913.432	2.92	3.54	1.98	0.82	0.019	0.842	5.87	0.652	0.4986	12.4	0.113	0.039	0.543	0.243	0.071

Sample ID	Sample Type	UTM E	UTM N	Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	Zn	Bi	Cd	Ga	Se	Te
453	Stream Sed	275870.5054	3742690.762	11.7	11.3	1.99	3.06	0.095	1.93	12.1	3.31	0.497	54.5	0.197	0.214	2.32	0.249	0.084
454	Stream Sed	275875.1357	3742589.559	2.96	7.62	1.58	4.29	0.043	0.881	6.64	1.52	0.493	53	0.093	0.115	1.85	0.247	0.099
455R	Stream Sed	276003.8487	3742644.601	0.436	8.49	0.078	7.51	0.097	8.14	15.4	3.27	2.34	72.4	0.244	0.587	1.21	0.975	0.487
456R	Stream Sed	276006.6268	3742615.629	6.06	3.13	0.173	8.6	0.099	31.4	13	4.29	0.72	8.35	0.249	0.101	0.664	0.994	0.497
457	Stream Sed	276724.7294	3742278.461	18.8	10.4	0.199	5.9	0.101	1.87	15	2.11	0.498	33.2	0.307	0.286	1.66	0.249	0.078
459	Stream Sed	276585.8229	3742456.394	6.04	7.32	0.198	1.98	0.042	0.658	7.08	1.29	0.494	21.7	0.177	0.118	0.992	0.366	0.054
463R	Stream Sed	277108.4598	3743400.716	0.092	13.4	0.002	11.2	0.094	11.6	59.1	1.41	1.4	105	0.235	0.594	2.13	0.938	0.469
465	Stream Sed	277207.1496	3743344.888	3648	16.7	336	20.6	0.452	7.93	40.5	38.4	0.698	91.6	0.277	0.245	5.98	0.294	0.127
480	Stream Sed	276628.8178	3742372.388	0.035	4.46	0.0008	5.46	0.099	7.86	12.1	1.94	0.724	44	0.38	0.147	1.9	0.99	0.495

TABLE A5-4. Geochemistry of rock chip samples in the Bell mine area, Rosedale district, Socorro County. Samples were collected by students of NMIMT. Analyses were by ICP at a commercial laboratory. Trace elements are in parts per million (ppm). UTM are in in zone 13, NAD27.

Sample ID	UTM E	UTM N	Sample Type	ICP (ppm)														
				Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	Zn	Bi	Cd	Ga	Se	Te
287	275838	3741408	Rock Chip	0.112	14	0.012	4.71	0.1	9.88	7.62	4.17	0.499	28.3	0.25	0.125	1.02	0.998	0.499
289	275892	3741411	Rock Chip	0.045	1.85	0.002	5.75	0.098	9.97	11.6	2.99	0.488	34.9	0.244	0.153	1.85	0.977	0.488
299	275956	3741417	Rock Chip	0.05	5.35	0.0005	3.89	0.1	9.65	9.02	1.35	0.499	37.6	0.25	0.117	1.33	0.998	0.499
324	276015	3741424	Rock Chip	0.03	29.5	0.018	5.12	0.093	11.5	11.1	9.07	0.466	36.4	0.223	0.131	2.45	0.931	0.466
336	276083	3741429	Rock Chip	0.016	7.8	0.0005	2.65	0.095	7.7	10.6	5.82	0.475	29.3	0.238	0.115	1.96	0.951	0.475
340	275825	3741481	Rock Chip	0.014	16.8	0.004	2.04	0.096	7.71	8.43	2.06	0.479	14.5	0.239	0.096	0.861	1	0.479
420	275883	3741487	Rock Chip	0.022	7.83	0.006	3	0.099	7.63	6.75	0.86	0.497	43.2	0.249	0.101	1.72	0.994	0.497
427	276069	3741507	Rock Chip	6.18	9.03	0.51	7.03	0.096	32.9	5.42	8.43	0.481	16.2	0.314	0.096	1.32	0.962	0.481
456	276556	3741219	Rock Chip	6.06	3.13	0.173	8.6	0.099	31.4	13	4.29	0.72	8.35	0.249	0.101	0.664	0.994	0.497
458	276572	3741133	Rock Chip	6.99	0.197	3.32	0.049	0.543	8.3	1.13	0.493	19.4	0.19	0.162	0.968	0.247	0.059	
460	276578	3741042	Rock Chip	2.97	4.74	1.48	1.65	0.02	1.71	6.65	0.938	0.495	13.5	0.134	0.109	0.56	0.247	0.066
461	276590	3740951	Rock Chip	5.59	10.6	2.63	2.83	0.042	0.72	14.6	2.95	0.488	20.9	0.158	0.181	1.32	0.244	0.049
051	276034	3742024	Rock Chip	0.099	10	0.047	3.12	0.096	8.74	10.9	4.36	0.481	30.6	0.24	0.141	1.59	0.962	0.481
052	275916	3742014	Rock Chip	0.029	4.02	0.0005	4.2	0.093	10.1	12.9	1.06	0.466	36.3	0.233	0.39	1.97	0.931	0.466
053	275787	3742000	Rock Chip	0.03	3.94	0.0005	4.21	0.097	5.4	12.3	4.27	487	17.3	0.248	0.145	1.93	0.975	0.487
054	276024	3742095	Rock Chip	0.184	18	0.073	4.56	0.097	11.3	10.6	3.41	0.486	16.3	0.257	0.098	2.24	0.973	0.486

Sample ID	UTM E	UTM N	Sample Type	ICP (ppm)														
				Ag	**As**	**Au**	**Cu**	**Hg**	**Mo**	**Pb**	**Sb**	**Tl**	**Zn**	**Bi**	**Cd**	**Ga**	**Se**	**Te**
055	275911	3742083	Rock Chip	0.036	2.71	0.0005	3.18	0.099	7.1	9.98	0.705	0.496	26	0.248	0.111	1.96	0.992	0.96
056	275785	3742071	Rock Chip	0.036	3.85	0.0005	3.6	0.097	13.3	15.6	1.67	0.486	32.7	0.286	0.148	1.42	0.973	0.486
057	276128	3742103	Rock Chip	0.063	10.4	0.066	4.27	0.098	7.67	8.33	4.48	0.491	22.3	0.246	0.098	2.27	0.982	0.491
058	276258	3742117	Rock Chip	0.096	6.66	0.0009	8.75	0.099	11.4	24.9	1.75	0.494	84.5	0.247	0.117	1.85	0.988	0.494
059	276389	3742129	Rock Chip	0.056	4.97	0.0008	5.97	0.092	13.6	8.2	1.22	0.462	45.2	0.231	0.128	1.19	0.924	0.462
060	276505	3742144	Rock Chip	0.07	8.81	0.0005	4.28	0.1	8.75	13.8	2.09	0.481	34.9	0.24	0.096	1.71	0.962	0.481
061	276625	3742149	Rock Chip	0.05	7.9	0.002	6.13	0.097	12.5	9.58	2.88	0.487	41.1	0.244	0.097	1.82	0.975	0.487
062	276010	3742168	Rock Chip	0.057	4.11	0.0006	5.93	0.099	8.14	16.4	0.419	0.493	51.7	0.247	0.11	1.23	0.986	0.493
063	275901	3742160	Rock Chip	0.041	4.33	0.0005	5.16	0.098	10.9	12	0.851	0.49	46.7	0.245	0.127	1.61	0.98	0.49
170	276143	3742035	Rock Chip	0.475	20.3	0.025	5.62	0.096	16.6	11.6	3.04	0.479	32.3	0.239	0.113	1.8	0.958	0.479
171	276213	3742041	Rock Chip	0.045	14.2	0.003	4.94	0.094	11.6	18.9	1.22	0.471	27.4	0.235	0.182	1.94	942	0.471
172	276275	3742048	Rock Chip	0.045	7.59	0.0006	4.69	0.099	8.31	10.7	1.32	0.493	30.9	0.247	0.099	1.94	0.986	0.493
173	276333	3742053	Rock Chip	0.036	16.3	0.0005	4.85	0.097	15.9	6.22	2.24	0.484	38.9	0.242	0.097	1.17	0.969	0.484
174	276397	3742060	Rock Chip	0.044	9.41	0.0006	5.02	0.092	9.08	10.1	2.07	0.461	43.1	0.231	0.092	1.78	0.923	0.461
175	276456	3742066	Rock Chip	0.04	9.08	0.0007	5.91	0.092	16.9	8.85	2.52	0.461	48.9	0.231	0.096	1.99	0.923	0.461
176	276513	3742071	Rock Chip	0.052	13.7	0.0005	5.42	0.099	9.68	26.8	4.39	0.494	47.5	0.247	0.128	2.52	0.988	0.494
177	276577	3742075	Rock Chip	0.025	12.9	0.002	5.65	0.094	11.1	10.2	2.43	0.589	41.7	0.234	0.094	2.11	0.936	0.468
178	276635	3742080	Rock Chip	0.047	13	0.001	5.74	0.097	11.3	9.14	2.45	0.544	59.5	0.243	0.097	1.44	0.971	0.485
179	276692	3742087	Rock Chip	0.029	9.65	0.0005	6.48	0.096	18.2	8.68	1.74	0.48	43.8	0.24	0.096	1.88	0.96	0.48
180	275799	3741926	Rock Chip	0.036	11.3	0.001	4.36	0.093	9.48	12.1	8.56	0.466	34.3	0.233	0.152	2.97	0.931	0.466
181	275867	3741933	Rock Chip	0.03	5.01	0.002	4.44	0.1	12	12.6	3.48	0.537	26.5	0.25	0.159	1.72	1	0.5
182	275922	3741938	Rock Chip	0.043	5.43	0.002	7.05	0.1	9.34	11.5	3.86	0.499	28.6	0.276	0.155	1.99	0.998	0.499
183	275982	3741945	Rock Chip	2.35	23.2	0.423	8.77	0.097	39.5	6.27	9.96	0.942	28.8	0.243	0.114	1.2	0.971	0.485
184	276046	3741950	Rock Chip	0.064	10.5	0.004	6.54	0.092	11.2	12.2	4.13	0.46	62.5	0.23	0.122	2	0.921	0.46
185	276097	3741957	Rock Chip	0.061	9.49	0.003	5.56	0.099	17.1	18.1	5.59	0.494	63.3	0.247	0.134	1.55	0.988	0.494
186	276159	3741963	Rock Chip	0.056	12.5	0.01	6.1	0.099	11.7	9.77	3.17	0.493	21.1	0.247	0.108	1.27	0.986	0.493
187	276228	3741974	Rock Chip	0.044	18.8	0.038	6.33	0.094	14.2	11.8	7.29	0.472	26.9	0.236	0.167	1.43	0.943	0.472
188	276286	3741976	Rock Chip	0.033	8.81	0.0005	5.18	0.098	8.02	6.57	0.976	0.489	25.1	0.245	0.135	1.32	0.978	0.489
189	276343	3741981	Rock Chip	0.026	12.4	0.002	5.33	0.092	8.95	8.51	2.97	0.46	41.5	0.23	0.102	1.7	0.921	0.46
190	276408	3741990	Rock Chip	0.184	36.4	0.076	8.22	0.478	7.93	81.3	5.5	0.49	69.1	0.245	0.266	1.15	0.98	0.49
191	276465	3741993	Rock Chip	0.055	6.76	0.001	8.48	0.099	6.49	7.93	2.5	0.497	42.7	0.249	0.101	1.07	0.994	0.497

Sample ID	UTM E	UTM N	Sample Type	ICP (ppm)														
				Ag	**As**	**Au**	**Cu**	**Hg**	**Mo**	**Pb**	**Sb**	**Tl**	**Zn**	**Bi**	**Cd**	**Ga**	**Se**	**Te**
194	276189	3741744	Rock Chip	0.059	10.7	0.005	5.19	0.093	9.46	8.67	5.72	0.467	45.5	0.234	0.177	1.49	0.935	0.467
195	276246	3741750	Rock Chip	0.037	16.9	0.002	3.43	0.097	9.63	11.6	6.08	0.486	28.1	,.243	0.145	1.6	0.973	0.486
196	276305	3741756	Rock Chip	0.095	13.3	0.0006	6.03	0.097	10.6	13.1	6.31	0.484	42.9	0.242	0.208	1.58	0.967	0.484
197	276362	3741761	Rock Chip	0.043	11.8	0.001	5.13	0.094	11	15.6	2.87	0.468	52.8	0.253	0.137	1.9	0.936	0.468
198	276426	3741767	Rock Chip	0.031	12	0.002	5.76	0.092	7.85	8.27	2.84	0.458	43.9	0.229	0.1	1.26	0.916	0.458
199	276489	3741773	Rock Chip	0.035	16.2	0.0009	5.28	0.094	8.38	10.2	3.64	0.47	50	0.235	0.097	1.68	0.94	0.47
2152	275879	3741455	Rock Chip	0.014	5.98	0.0008	3.3	0.093	9.01	17.2	1.65	0.466	38.4	0.233	0.101	2.05	0.931	0.466
2153	275944	3741455	Rock Chip	0.017	8.56	0.001	3.29	0.093	5.75	18.1	6.79	0.466	28.4	0.233	0.143	2.05	0.931	0.466
2154	276009	3741448	Rock Chip	0.014	6.09	0.0005	3.28	0.093	7.54	13.8	2.58	0.471	34.3	0.235	0.113	1.72	0.942	0.471
2155	276072	3741446	Rock Chip	0.016	32.8	0.0005	3.64	0.096	10.6	10.8	20.7	0.482	41.7	0.241	0.131	2.56	0.963	0.482
2156	276131	3741435	Rock Chip	0.022	12	0.008	3.39	0.1	9.81	8.53	3.91	0.498	20.7	0.249	0.187	1.76	0.996	0.498
2157	276192	3741440	Rock Chip	0.238	82.8	0.02	5.66	0.098	31.3	24.5	2.85	2.96	32.6	0.265	1.19	2.18	0.98	0.49
2158	276255	3741447	Rock Chip	0.016	27.9	0.0008	3.2	0.092	45.3	10.8	2.54	0.46	30.1	0.412	0.195	2.14	0.921	0.46
2159	276322	3741453	Rock Chip	0.015	20.8	0.0005	2.88	0.098	6.9	12.3	2.59	0.49	29.3	0.245	0.155	2.05	0.98	0.49
2160	276381	3741459	Rock Chip	0.014	12.7	0.0005	2.23	0.096	8.53	10.4	0.445	0.478	13.3	0.239	0.22	1.51	0.956	0.478
2161	276436	3741463	Rock Chip	0.024	27.1	0.0005	3.38	0.099	5.52	11.9	1.99	0.493	25.9	0.247	0.246	1.57	0.986	0.493
2162	276497	3741469	Rock Chip	0.015	8.32	0.0005	2.88	0.097	6.33	7.99	0.714	0.484	34.8	0.242	0.112	1.43	0.969	0.484
2164	275833	3741709	Rock Chip	0.123	34.5	0.242	9.13	0.106	20.9	26.8	2.04	7.62	178	0.244	2.47	1.76	0.977	0.488
2165	275897	3741717	Rock Chip	0.015	10.6	0.0005	4.01	0.098	10.6	11.7	12.7	0.49	27.1	0.245	0.17	3.17	0.98	0.49
2166	275956	3741722	Rock Chip	0.014	5.92	0.0005	3.06	0.098	5.35	9.05	4.03	0.48	14.9	0.24	0.096	1.49	0.96	4.8
2167	276016	3741728	Rock Chip	0.018	6.48	0.002	4.03	0.097	9.81	10.6	7.65	0.486	31.3	0.253	0.104	1.78	0.973	0.486
2168	276070	3741732	Rock Chip	0.028	3.75	0.001	2.68	0.093	11.1	26.2	0.895	0.464	17.9	0.269	0.134	1.7	0.928	0.464
2169	276126	3741738	Rock Chip	0.233	10.8	0.03	4.37	0.17	14.5	12.9	4.4	0.476	36.8	0.306	0.18	1.91	0.952	0.476
259	275857	3742007	Rock Chip	0.084	6.16	0.026	3.41	0.099	7.67	13.8	5.76	0.494	33.4	0.247	0.11	2.12	0.988	0.494
260	276113	3741589	Rock Chip	0.039	8.38	0.004	3.4	0.099	7.95	15.1	4.05	0.493	36.6	0.247	0.174	1.69	1.28	0.493
261	276053	3741582	Rock Chip	0.203	7.97	0.0005	2.68	0.099	8.19	9.83	2.8	0.493	34.8	0.247	0.099	1.6	0.986	0.493
262	275992	3741575	Rock Chip	0.018	3.14	0.027	2.73	0.094	6.18	11	1.69	0.47	34.3	0.235	0.151	1.75	0.94	0.47
263	275932	3741570	Rock Chip	0.022	3.52	0.0005	3.8	0.099	8.28	12	0.452	0.497	34.9	0.249	0.099	1.63	1.38	0.497
264	275872	3741564	Rock Chip	0.015	9.6	0.0005	2.35	0.093	4.48	16.6	1.35	0.466	42.2	0.233	0.093	2.89	0.933	0.466
265	275811	3741558	Rock Chip	0.014	7.35	0.0005	3.12	0.095	7.26	20.8	6.19	0.476	34.1	0.238	0.16	2.21	0.952	476
266	275790	3741560	Rock Chip	0.016	5.64	0.0005	5.74	0.097	11.2	10.6	0.549	0.484	34.3	0.242	0.122	1.96	0.969	0.484

Sample ID	UTM E	UTM N	Sample Type	ICP (ppm)														
				Ag	**As**	**Au**	**Cu**	**Hg**	**Mo**	**Pb**	**Sb**	**Tl**	**Zn**	**Bi**	**Cd**	**Ga**	**Se**	**Te**
267	276173	3741597	Rock Chip	0.077	9.32	0.001	2.7	0.099	6	7.94	1.51	0.495	14.4	0.248	0.099	1.24	0.99	0.495
268	276232	3741602	Rock Chip	0.039	8.33	0.009	2.03	0.138	5.31	6.85	1.28	0.465	10.1	0.232	0.093	1.16	0.929	0.465
269	276293	3741609	Rock Chip	0.033	16.5	0.0005	1.82	0.099	11.3	11.7	1.83	0.46	14.1	0.23	0.142	1.78	0.919	0.46
270	276355	3741616	Rock Chip	0.029	22.4	0.002	2.86	0.098	8.58	6.28	3.71	0.491	35.8	0.246	0.202	1.49	0.982	0.491
271	276415	3741622	Rock Chip	0.021	9.05	0.0005	2.21	0.1	4.95	6.75	0.868	0.498	26.2	0.249	0.1	1.06	1.02	0.498
272	276470	3741627	Rock Chip	0.021	17.1	0.0005	6.12	0.095	7.59	8.15	2.05	0.473	28.7	0.236	0.108	1.09	0.945	0.473
273	276482	3741614	Rock Chip	0.029	29.2	0.0005	2.6	0.093	9.05	8.55	2	0.466	31.4	0.233	0.111	1.34	0.931	0.466
274	276118	3741808	Rock Chip	0.065	14.2	0.01	3.23	0.096	7.08	9.01	4.17	0.479	32.5	0.239	0.207	1.55	0.958	0.479
275	276182	3741815	Rock Chip	0.027	5.62	0.0005	2.08	0.095	4.82	9.22	0.504	0.475	14.6	0.238	0.095	1.12	0.951	0.475
276	276242	3741821	Rock Chip	0.023	11.9	0.003	2.89	0.093	8.55	8.89	1.5	0.467	24.2	0.234	0.145	1.92	0.935	0.467
277	276300	3741826	Rock Chip	0.016	9.65	0.0005	2.51	0.094	6.61	10.3	1.44	0.471	37.9	0.235	0.117	1.19	0.942	0.471
278	276360	3741831	Rock Chip	0.026	9.32	0.007	2.72	0.094	6.89	8.93	1.02	0.47	33.3	0.235	0.105	1.72	1.05	0.47
279	276423	3741839	Rock Chip	0.034	10.8	0.0005	2.26	0.095	6.73	9	1.96	0.473	44.9	0.236	0.106	1.33	0.95	0.473
280	276481	3741845	Rock Chip	0.02	10.6	0.028	2.7	0.093	7.05	8.31	2.86	0.465	39.9	0.232	0.095	1.52	0.929	0.465
281	276061	3741804	Rock Chip	0.223	8.1	0.003	2.97	0.098	9.63	8.67	3.29	0.492	22.7	0.246	0.098	1.21	0.984	0.492
282	276001	3741797	Rock Chip	0.03	2.82	0.004	2.85	0.094	7.17	9.9	6.02	0.472	16.6	0.236	0.094	1.4	0.943	0.472
283	275943	3741791	Rock Chip	0.026	1.79	0.0005	2.36	0.092	7.2	8.09	3.59	0.461	29.8	0.231	0.092	1.43	0.923	0.461
284	275880	3741786	Rock Chip	0.015	4.39	0.0005	2.36	0.1	6.54	12.8	14.4	0.498	19.8	0.249	0.1	2.05	0.996	0.498
288	275975	3742017	Rock Chip	0.394	15.4	0.079	7.84	0.094	12.4	8.99	3.46	0.47	40.3	0.235	0.094	2.32	0.94	0.47
290	276089	3742029	Rock Chip	0.15	6.26	0.01	6.41	0.097	22.4	3.26	2	0.483	15.6	0.241	0.097	1.9	0.965	0.483
291	276079	3742100	Rock Chip	0.028	13.9	0.0005	4.83	0.092	9.23	8.88	2	0.459	26.5	0.229	0.096	1.25	0.917	0.459
292	275964	3742089	Rock Chip	0.034	4.51	0.0005	3.98	0.098	8.16	8.71	2.2	0.488	22.4	0.244	0.098	1.66	0.977	0.488
293	275851	3742077	Rock Chip	0.036	3.56	0.0005	5.48	0.092	9.94	14.1	1.01	0.836	49.1	0.231	0.303	1.69	0.924	0.462
294	276194	3742107	Rock Chip	0.053	5.8	0.0005	5.17	0.095	8.44	8.93	1.08	0.473	36.3	0.236	0.121	1.36	0.945	0.473
295	276323	3742122	Rock Chip	0.037	4.26	0.0005	4.65	0.098	8.85	6.95	1.05	0.488	27.6	0.244	0.098	1.33	0.977	0.488
296	276445	3742134	Rock Chip	0.049	9.23	0.0005	4.38	0.091	9.55	7.62	2.91	0.457	36.9	0.229	0.109	1.18	0.914	0.457
297	276564	3742145	Rock Chip	0.028	5.45	0.0005	3.21	0.1	7.4	5.59	1.75	0.498	31.1	0.249	0.1	0.881	0.996	0.498
298	276684	3742155	Rock Chip	0.061	4.21	0.0005	4.7	0.099	13.5	10.2	1.3	0.494	24.8	0.247	0.099	1.01	0.988	0.494
300	275950	3742163	Rock Chip	0.032	3.34	0.0005	2.79	0.099	8.19	9.36	1.52	0.494	33.8	0.247	0.102	1.19	0.988	0.494
312	276224	3740921	Rock Chip	0.059	15.6	0.006	10.8	0.097	9.36	12.4	3.04	0.486	36	0.489	0.157	1.68	0.973	0.486
313	276165	3740914	Rock Chip	0.038	7.09	0.006	8.11	0.097	10.6	5.52	2.22	0.486	35.1	0.29	0.097	1.8	0.973	0.486

Sample ID	UTM E	UTM N	Sample Type	ICP (ppm)														
				Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	Zn	Bi	Cd	Ga	Se	Te
314	276107	3740910	Rock Chip	0.037	10.3	0.005	7.66	0.093	11.3	9.07	3.27	0.466	30.9	0.326	0.21	1.85	0.933	0.466
315	276044	3740904	Rock Chip	0.048	3.77	0.054	8.13	0.097	6.98	20.3	1.54	0.483	26.9	0.328	0.127	1.74	0.965	0.483
316	275988	3740900	Rock Chip	0.08	8.48	0.102	15.7	0.095	6.67	13.5	2.98	0.476	31.9	0.885	0.171	2.11	0.952	0.476
317	275924	3740898	Rock Chip	0.027	8.47	0.006	5.14	0.097	8.92	10.1	1.37	0.486	34.3	0.243	0.131	2.3	0.973	0.486
318	275911	3740989	Rock Chip	0.035	8.12	0.0006	13.9	0.097	5.97	10.9	2.62	0.486	33	0.289	0.122	2.28	0.973	0.486
319	275975	3740994	Rock Chip	0.047	5.99	0.004	15.9	0.099	8.93	13.6	2.07	0.494	32.9	0.294	0.139	2.24	0.988	0.494
320	276035	3740999	Rock Chip	0.059	13.5	0.005	6.03	0.093	10.5	10.3	19.5	0.467	28.1	0.297	0.157	2.33	0.935	0.467
321	276100	3741019	Rock Chip	0.032	9.32	0.0008	4.26	0.097	12.7	6.74	2.39	0.484	23	0.242	0.097	1.58	0.969	0.484
322	276166	3741030	Rock Chip	0.043	15.3	0.0008	5.09	0.094	8.01	10.9	4.44	0.469	43.2	0.407	0.102	2.2	0.938	0.469
323	276214	3741012	Rock Chip	0.066	3.58	0.0005	4.26	0.1	10.6	8	1.01	0.5	23.4	0.38	0.1	1.63	1	0.5
325	276182	3741309	Rock Chip	0.158	17.4	0.019	5.74	0.091	18	11.4	7.15	0.456	37.8	0.228	0.168	1.9	0.912	0.456
326	276245	3741315	Rock Chip	0.077	30.1	0.036	5.21	0.092	11.2	9.54	11.4	0.461	45	0.231	0.188	1.3	0.923	0.461
327	276306	3741300	Rock Chip	0.024	15.8	0.0005	2.49	0.097	16.4	7.15	3.83	0.483	22.5	0.241	0.104	1.17	0.965	0.483
328	276364	3741326	Rock Chip	0.035	4.59	0.0005	2.42	0.094	6.26	6.44	2.35	0.471	11.2	0.235	0.094	1.15	0.942	0.471
329	276420	3741332	Rock Chip	0.028	25.1	0.0005	3.58	0.096	12.4	8.7	5.29	0.481	33.4	0.24	0.112	1.36	0.962	0.481
330	276480	3741323	Rock Chip	0.028	19.4	0.0005	3.68	0.1	8.88	9.52	1.84	0.499	39	0.25	0.16	1.35	0.998	0.499
331	276542	3741328	Rock Chip	0.025	13.7	0.005	4.91	0.095	11.9	9.31	1.35	0.473	43.2	0.236	0.095	1.4	0.945	0.473
332	276262	3741405	Rock Chip	0.014	5.23	0.0005	2.14	0.095	5.65	4.64	1.53	0.474	20.5	0.237	0.095	0.544	0.949	0.474
333	276216	3741395	Rock Chip	0.048	12.9	0.008	2.3	0.094	14.7	6.34	2.02	0.471	9.44	0.235	0.098	1.14	0.942	0.471
334	276184	3741373	Rock Chip	0.343	37.6	0.137	3.84	0.093	10.6	8.06	11.3	0.463	31.5	0.231	0.139	1.29	0.926	0.463
335	276209	3741362	Rock Chip	0.165	22.8	0.328	3.02	0.096	9.97	8.58	6.06	0.48	14	0.24	0.096	1.21	0.96	0.48
337	275998	3741362	Rock Chip	0.017	6.04	0.0005	3.78	0.097	6.27	11.8	6.22	0.484	27.4	0.242	0.097	1.89	0.969	0.484
338	275956	3741362	Rock Chip	0.018	4.84	0.0005	3.27	0.091	5.25	13.9	2.79	0.457	36.6	0.229	0.091	1.53	0.914	0.457
339	275894	3741354	Rock Chip	0.014	5.17	0.0005	2.88	0.096	7.48	10.7	3.9	0.479	26.6	0.239	0.144	1.16	0.958	0.479
341	276122	3741358	Rock Chip	0.707	18.4	0.006	3.01	0.099	8.49	7.88	7.66	0.495	25.1	0.248	0.132	1.2	0.99	0.495
408	276135	3741664	Rock Chip	0.054	7.82	0.003	7.38	0.092	9.6	10.9	4.74	0.458	20.4	0.229	0.095	1.84	0.916	0.458
409	276079	3741657	Rock Chip	0.053	9.3	0.002	2.94	0.097	4.93	8.31	3.16	0.484	32.9	0.242	0.097	1.8	0.969	0.484
410	276017	3741653	Rock Chip	0.043	17.5	0.002	3.15	0.099	12.6	16.8	5.77	0.497	63.9	0.302	0.152	2.06	0.994	0.497
411	275960	3741645	Rock Chip	0.015	4.56	0.0005	2.86	0.099	7.44	17	7.33	0.497	15.2	0.325	0.099	2.14	0.994	0.497
412	275897	3741639	Rock Chip	0.016	6.14	0.0005	1.73	0.097	5.97	9.18	4.84	0.484	33.4	0.242	0.097	2.2	0.969	0.484
413	275838	3741634	Rock Chip	0.021	4.24	0.0005	2.73	0.099	7.04	10.6	1.17	0.497	24.8	0.249	0.102	1.91	0.994	0.497

Sample ID	UTM E	UTM N	Sample Type	ICP (ppm)														
				Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	Zn	Bi	Cd	Ga	Se	Te
414	276196	3741671	Rock Chip	0.083	9.09	0.002	2.43	0.097	4.46	14.5	1.4	0.484	16.7	0.242	0.097	2.46	0.969	0.484
415	276258	3741677	Rock Chip	0.027	22	0.0005	2.84	0.095	42.3	7.98	3.49	0.473	24.9	0.376	0.154	1.98	0.947	0.473
416	276315	3741684	Rock Chip	0.016	8.37	0.0005	2.73	0.094	3.43	7.51	1.83	0.47	43.4	0.235	0.128	1.99	0.94	0.47
417	276380	3741691	Rock Chip	0.024	11.2	0.0005	2.85	0.098	7.69	8.63	2.01	0.491	36.8	0.246	0.135	1.84	0.982	0.491
418	276440	3741698	Rock Chip	0.016	20.9	0.0005	2.82	0.096	4.59	6.71	2	0.48	39.8	0.24	0.123	1.55	1.19	0.48
419	276496	3741704	Rock Chip	0.033	11.5	0.015	3.71	0.098	7.84	11.7	4.17	0.488	24.9	0.244	0.098	2.67	1.17	0.488
421	276108	3741883	Rock Chip	0.023	3.07	0.0005	3.21	0.093	14.1	8.8	0.337	0.465	21.8	0.232	0.124	2.13	0.929	0.465
422	276053	3741877	Rock Chip	0.027	11.7	0.007	3.92	0.098	5.88	12.1	4.45	0.489	36.5	0.245	0.109	2.48	0.978	0.489
423	275990	3741872	Rock Chip	0.027	2.7	0.0005	3.2	0.097	9.07	9.29	1.73	0.487	12.2	0.244	0.097	2.04	0.975	0.487
424	275926	3741865	Rock Chip	0.024	4.34	0.017	2.81	0.096	3.71	8.98	1.95	0.482	36.8	0.241	0.096	1.97	0.963	0.482
425	275870	3741861	Rock Chip	0.019	2.68	0.0005	3.23	0.094	5.92	8.83	2.31	0.469	25.4	0.235	0.094	1.33	0.938	0.469
426	275814	3741854	Rock Chip	0.028	2.49	0.0006	2.49	0.097	5.21	10.9	3.8	0.483	22	0.241	0.098	1.79	0.965	0.483
428	276172	3741890	Rock Chip	0.021	3.15	0.0005	3.13	0.099	8.95	7.06	0.594	0.493	11.9	0.247	0.099	1.38	0.986	0.493
429	276234	3741895	Rock Chip	0.043	10.6	0.001	2.33	0.092	7.5	8.16	2.1	0.459	13.7	0.229	0.093	1.48	0.917	0.459
430	276293	3741901	Rock Chip	0.025	7.77	0.007	2.76	0.099	9.03	6.83	0.707	0.496	27.6	0.248	0.124	1.84	0.992	0.496
431	276352	3741906	Rock Chip	0.041	5.39	0.0005	2.34	0.095	7.98	7.72	1.08	0.473	34.3	0.237	0.095	1.5	0.947	0.473
432	276414	3741911	Rock Chip	0.017	11.7	0.0005	2.71	0.095	5.63	7.64	2.9	0.476	35.1	0.238	0.11	1.46	0.952	0.476
433	276472	3741917	Rock Chip	0.027	9.9	0.0005	4.08	0.097	7.51	8.36	2.96	0.484	40.3	0.242	0.102	1.79	0.967	0.484
434	276290	3740925	Rock Chip	0.017	10.7	0.0005	2.99	0.097	5.5	9.32	1.13	0.483	39.3	0.241	0.097	1.5	0.98	0.483
435	276351	3740931	Rock Chip	0.014	9.57	0.0005	3.74	0.092	8.73	9.16	1.84	0.458	39.3	0.229	0.092	1.71	0.916	0.458
436	276424	3740936	Rock Chip	0.017	10.3	0.0005	3.36	0.093	7.57	10.2	1.46	0.465	37.8	0.268	0.093	1.47	0.929	0.465
437	276470	3740940	Rock Chip	0.043	14.6	0.0007	2.4	0.093	5.98	11.4	4.81	0.466	37.5	0.233	0.093	0.96	0.933	0.466
438	276532	3740947	Rock Chip	0.027	11.5	0.0005	3.05	0.099	4.87	13.6	2.72	0.493	33.7	0.247	0.099	1.54	0.986	0.493
439	276516	3741037	Rock Chip	0.016	12.5	0.0005	3.1	0.097	9	12.1	0.954	0.483	30.2	0.241	0.097	1.34	0.965	0.483
440	276458	3741032	Rock Chip	0.02	9.08	0.0005	2.77	0.095	8.31	11.1	3.51	0.475	39.8	0.239	0.095	1.45	0.951	0.475
441	276409	3741028	Rock Chip	0.016	15.7	0.0005	3.09	0.098	6.43	12.2	5.76	0.488	41.7	0.367	0.098	2.22	0.977	0.488
442	276335	3741023	Rock Chip	0.059	7.58	0.0005	2.47	0.1	5.02	10.9	1.89	0.498	25.5	0.251	0.1	1.43	0.996	0.498
443	276277	3741018	Rock Chip	0.02	7.92	0.0005	2.4	0.091	8.38	11.4	2.48	0.456	28.7	0.302	0.091	1.33	0.912	0.456
444	276203	3741100	Rock Chip	0.019	15.2	0.0005	3.09	0.095	6.37	11	4.83	0.473	40.2	0.236	0.095	1.74	0.945	0.473
445	276266	3741104	Rock Chip	0.014	10.8	0.0005	2.5	0.092	5.01	7.78	3.96	0.461	41	0.231	0.092	1.58	0.923	0.461
446	276327	3741110	Rock Chip	0.023	15.7	0.0005	2.37	0.093	4.98	10.8	4.8	0.463	36	0.284	0.093	0.858	0.926	0.463

Sample ID	UTM E	UTM N	Sample Type	ICP (ppm)														
				Ag	**As**	**Au**	**Cu**	**Hg**	**Mo**	**Pb**	**Sb**	**Tl**	**Zn**	**Bi**	**Cd**	**Ga**	**Se**	**Te**
447	276390	3741115	Rock Chip	0.015	10	0.0005	2.06	0.098	7.49	7.91	1.08	0.491	28.6	0.246	0.098	0.995	0.982	0.491
448	276449	3741122	Rock Chip	0.014	4.33	0.0005	5.69	0.095	6.67	10.3	0.838	0.473	39.3	0.236	0.095	1.53	0.945	0.473
449	276509	3741128	Rock Chip	0.015	8.15	0.0005	3.25	0.099	6.33	9.49	0.699	0.496	38.7	0.248	0.099	1.61	0.992	0.496
466	276124	3741512	Rock Chip	0.095	13.5	0.021	3.53	0.097	10.5	6.75	2.21	0.486	29.5	0.243	0.102	1.79	0.973	0.486
467	276007	3741501	Rock Chip	0.035	4.05	0.002	6.94	0.1	5.7	14.7	2.03	0.498	32.8	0.314	0.232	2.38	0.996	0.498
468	275946	3741494	Rock Chip	0.028	3.28	0.002	3.84	0.092	6.13	9.21	1.49	0.462	34.4	0.231	0.146	1.93	0.924	0.462
469	275790	3741475	Rock Chip	0.03	2.24	0.003	3.51	0.095	4.67	9.94	1.36	0.473	30.9	0.237	0.116	1.76	0.947	0.473
470	275688	3741471	Rock Chip	0.028	3.24	0.003	3.5	0.092	4.94	10.2	2.39	0.459	36.7	0.229	0.104	1.99	0.917	0.459
471	275609	3741464	Rock Chip	0.044	4.36	0.0006	3.45	0.099	6.13	11.6	2.14	0.497	42	0.249	0.1	2.28	0.994	0.497
474	276307	3741531	Rock Chip	0.033	6.88	0.003	4.8	0.095	5.31	9.67	1.51	0.473	26.1	0.237	0.174	2.11	0.947	0.473
475	276369	3741539	Rock Chip	0.03	12.8	0.001	3.54	0.095	6.04	8.99	1.67	0.475	34	0.238	0.119	1.91	0.951	0.475
476	276426	3741544	Rock Chip	0.025	11.3	0.0007	3.73	0.099	4.9	8.4	1.53	0.494	33.2	0.247	0.126	1.86	0.988	0.494
477	276537	3741577	Rock Chip	0.027	15.9	0.003	2.76	0.094	5.53	7.02	1.97	0.485	34.7	0.235	0.094	1.55	0.938	0.469
481	275999	3741293	Rock Chip	0.015	7.1	0.0005	3.49	0.094	5.84	10.3	1.35	0.471	31.2	0.316	0.094	1.76	0.942	0.471
482	276001	3741278	Rock Chip	0.015	7.78	0.0005	3.62	0.097	8.87	11.6	4.23	0.487	34.7	0.244	0.132	2.1	0.975	0.487
483	275938	3741285	Rock Chip	0.016	6.66	0.0005	3.41	0.098	6.19	10.9	1.79	0.492	38.1	0.246	0.098	1.74	0.984	0.492
484	275880	3741280	Rock Chip	0.014	13.3	0.0005	2.88	0.097	5.8	13.7	4.35	0.483	40.6	0.241	0.097	1.76	0.972	0.483
485	275894	3741160	Rock Chip	0.022	10.1	0.0005	3.03	0.094	6.59	11.9	2.46	0.472	30.4	0.342	0.094	1.54	0.943	0.472
486	275960	3741166	Rock Chip	0.017	9.54	0.0008	2.96	0.092	9.41	11.2	3.5	0.46	30.2	0.276	0.092	1.47	0.919	0.46
487	276024	3741170	Rock Chip	0.014	8.14	0.0006	3.13	0.096	8.5	11.6	2.31	0.482	35.7	0.241	0.096	1.86	1.21	0.482
488	276076	3741175	Rock Chip	0.014	9.89	0.0005	3.11	0.093	8.19	11.6	2.43	0.464	34.7	0.339	0.093	2.17	0.928	0.464
489	276137	3741182	Rock Chip	0.015	8.13	0.0005	3.34	0.099	5.66	11	1.76	0.495	28.4	0.248	0.099	2.06	0.99	0.495
490	276195	3741185	Rock Chip	0.057	15	0.009	5.18	0.095	24.8	10.1	7.27	0.473	24.9	0.27	0.097	1.45	0.947	0.473
491	276257	3741192	Rock Chip	0.039	6.51	0.002	3.37	0.095	7.91	11.8	2.77	0.474	32.8	0.237	0.095	2.01	0.949	0.474
492	276317	3741197	Rock Chip	0.014	7.48	0.0005	3.76	0.092	9.18	11.1	1.71	0.46	29.4	0.23	0.092	1.81	0.921	0.46
493	276375	3741203	Rock Chip	0.015	12.5	0.0005	2.59	0.099	4.94	8.41	2.21	0.496	25.7	0.248	0.099	1.3	0.992	0.496
494	276440	3741210	Rock Chip	0.014	10.2	0.0005	3.61	0.091	10.1	7.74	1.28	0.456	38	0.228	0.091	1.4	0.912	0.456
495	276498	3741214	Rock Chip	0.118	9.42	0.008	3.77	0.099	8.69	8.98	3.73	0.494	26.2	0.247	0.099	1.74	0.988	0.494
496	276153	3741093	Rock Chip	0.018	9.96	0.0005	3.29	0.096	7.56	11.2	2.54	0.482	36.2	0.318	0.096	1.82	0.963	0.482
497	276085	3741086	Rock Chip	0.015	12.7	0.0005	3.59	0.099	6.59	13.6	3.29	0.493	39.1	0.263	0.099	2.54	0.986	0.493
498	276029	3741081	Rock Chip	0.015	8.1	0.0005	3.22	0.098	5.59	10.8	2.53	0.488	29.6	0.27	0.098	1.89	0.977	0.488

Sample ID	UTM E	UTM N	Sample Type	ICP (ppm)														
				Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	Zn	Bi	Cd	Ga	Se	Te
499	275968	3741076	Rock Chip	0.015	7.18	0.0005	3.65	0.098	9.56	12.4	3.68	0.491	32.6	0.246	0.098	2.66	0.982	0.491
500	275904	3741071	Rock Chip	0.014	8.54	0.0005	3.79	0.091	7.3	14	0.839	0.456	37.8	0.228	0.107	2.91	0.912	0.456

TABLE A5-5. Chemical analyses of samples collected from the Rosedale district for this report. Major element oxides, LOI, S, and C are in %, remaining trace elements are in parts per million (ppm). Fe_2O_3T=total iron calculated as Fe_2O_3. LOI is loss on ignition (water content). Latitude and longitude are in decimal degrees in NAD27.

Sample	Latitude	Longitude	type of sample	Mine ID	paste pH	paste conductivity	TDS (mg/l)	SiO_2	TiO_2	Al_2O_3	CaO	Fe_2O_3T	MgO	MnO
ROSE1	33.8087648	-107.4066624	composite	NMSO0585	6.23	116.4		83.63	0.1	7.15	0.24	1.16	0.09	0.22
ROSE2	33.8087648	-107.4066624	grab sample	NMSO0585	5.64	64.79	15.44	74.7	0.2	11.78	0.12	3.1	0.46	0.05
ROSE3	33.8087648	-107.4066624	select composite, top	NMSO0585	6.04	300		78.18	0.16	10.66	0.12	1.39	0.11	0.21
ROSE4	33.8087648	-107.4066624	select composite, middle	NMSO0585	6.15	87.5		81.62	0.1	7.6	0.3	1.78	0.1	1.21
ROSE5	33.8087648	-107.4066624	select composite, base	NMSO0585	5.73	73.41		83.64	0.09	6.8	0.97	1.08	0.1	1.3
ROSE6	33.8088270	-107.4061650	select green chert, pyrite	NMSO0586				94.42	0.02	1.84	0.52	0.76	0.04	0.57
ROSE 007	33.8098356	-107.4081613	composite	NMSO0593	6.34	63.59	15.77	75.3	0.24	12.98	0.44	2.3	0.49	0.17
ROSE 008	33.8092750	-107.4096150	composite	NMSO0553	4.92	135	7.409	82.03	0.14	8.9	0.11	1.6	0.21	0.03
BEL001	33.8016940	-107.4194170	select dump, breccia	NMSO0061				74.8	0.19	12.06	0.64	1.24	0.2	0.03
BEL002	33.8016940	-107.4194170	composite	NMSO0061	5.86	25.67	38.99	82.82	0.14	8.76	0.11	1.3	0.08	0.05
BEL003	33.8016940	-107.4194170	composite	NMSO0061	5.39	93.89	10.75	81.48	0.13	8.59	0.41	1.18	0.15	0.09
BEL004	33.8016940	-107.4194170	select dump, rhyolite, quartz	NMSO0061				86.54	0.1	6.99	0.08	0.89	0.03	0.04
BEL005	33.8014490	-107.4183800	composite of tailings	NMSO0590	6.08	100		73.21	0.3	11.61	0.53	1.75	0.24	0.12
BEL006	33.8018147	-107.4194813	rock chip, floor	none				91.6	0.05	3.63	0.12	0.9	0.04	0.04
BEL007	33.8018149	-107.4194706	rock chip	none				75.76	0.21	12.84	0.3	1.36	0.15	0.06
BEL008	33.8021000	-107.4190000	composite	NMSO0757	5.64	96.92	10.36	88.35	0.08	5.52	0.12	0.95	0.09	0.11
BEL009	33.8036500	-107.4198500	composite	NMSO0601	5.61	51.33	19.62	80.84	0.11	8.51	0.09	1.47	0.09	0.09

Sample	Latitude	Longitude	type of sample	Mine ID	paste pH	paste conductivity	TDS (mg/l)	SiO_2	TiO_2	Al_2O_3	CaO	Fe_2O_3T	MgO	MnO
BEL012	33.8038400	-107.4197300	composite	NMSO0602	5.11	169.2	5.936	79.74	0.17	9.7	0.13	2	0.2	0.07
ROBB2	33.8048550	-107.4055810	composite	NMSO0545	5.69	196.8		79.5	0.16	9.66	0.13	1.57	0.19	0.1
ROBB3	33.8054450	-107.4085890	composite	NMSO0756	6.61	34.85		76.08	0.24	11.6	0.45	1.8	0.31	0.08
Robb4	33.8050660	-107.4076710	composite	NMSO0750	5.92	113.7		79.73	0.15	10.03	0.24	1.23	0.19	0.03
BIG002	33.8251000	-107.4369700	composite	NMSO0623	5.61	30.5		77.75	0.16	12.48	0.23	1.31	0.33	0.05
BIG003	33.8261100	-107.4376200	composite	NMSO0624	6.27	28.96		76.87	0.21	12.54	0.22	1.3	0.24	0.04
LP10	33.8371900	-107.4192680	Lane, composite	NMSO0734	6.67	44.53		81.42	0.17	10.26	0.18	1.32	0.18	0.09
RBP001	33.8058410	-107.3989230	composite	NMSO0754	8.17	222		75.36	0.31	12.06	0.54	1.81	0.42	0.1
BEL015	33.7988740	-107.4200360	composite	NMSO0783	6.56	36.62		77.36	0.19	11.88	0.36	1.24	0.31	0.23

SAMPLE	Na_2O	K_2O	P_2O_5	LOI	S	C	Total oxides	As	Au	Ag	Ba	Bi	Cd	Co	Cr	Cs	Cu	Ga	Ge	Hf
ROSE1	0.29	5.03	0.01	1.1	0.01	0.34	99.37	13.7	2.1	20.2	191.5	0.1	<0.5	2	30	11.9	17	13.1	<5	3.3
ROSE2	0.94	4.66	0.05	2.31	0.48	0.07	98.92	5.6	0.011	0.8	369	2.12	<0.5	2	110	3.12	39	25.1	<5	9.6
ROSE3	0.49	7.11	0.02	0.97	0.01	0.07	99.5	19.3	0.125	6.2	148	0.12	<0.5	1	30	10.1	14	18.1	<5	5.3
ROSE4	0.22	4.91	0.01	1.13	0.01	0.06	99.05	34.6	3.61	57.7	677	0.12	<0.5	2	40	11.25	47	17.3	<5	2.9
ROSE5	0.12	4.64	0.01	1.19	0.01	0.02	99.97	19.6	2.74	72.7	1255	0.08	<0.5	3	30	10.25	44	16.2	<5	2.6
ROSE6	0.04	0.9	<0.01	0.69	0.02	0.02	99.84	7.4	1.015	43.1	598	0.02	<0.5	<1	60	5.55	15	13.7	<5	0.4
ROSE 007	0.85	4.32	0.04	2.61	<0.01	0.22	99.96	29.5	0.021	<0.5	122.5	0.35	<0.5	4	20	18.75	11	23.5	<5	6
ROSE 008	0.23	4.66	0.02	1.72	<0.01	0.19	99.84	18.2	0.085	1.4	79	0.18	<0.5	2	30	14.7	7	18.9	<5	3.5
BEL001	1.32	7.3	0.03	1.34	0.02	0.18	99.35	11.2	0.024	0.9	155	0.14	<0.5	3	40	4.97	4	20.8	<5	6.1
BEL002	0.31	5.69	0.01	0.81	0.01	0.13	100.22	12.8	0.403	7.5	88.1	0.12	<0.5	2	40	10.25	8	16.4	<5	4.3
BEL003	0.38	5.45	0.01	1.37	0.01	0.31	99.56	13.6	0.168	6.9	114	0.12	<0.5	2	30	13	8	17.8	<5	4.3
BEL004	0.13	4.75	0.01	0.59	0.01	0.03	100.19	7.8	0.201	12.4	55.1	0.1	<0.5	1	100	9.52	6	15.9	<5	3.5
BEL005	2.23	4.67	0.03	4.61	0.02	2.05	101.37	6.2	0.006	<0.5	191	0.15	<0.5	3	20	7.09	7	16.8	<5	8.8
BEL006	0.07	1.93	<0.01	0.69	0.02	0.05	99.14	8.3	0.283	25.2	26.1	0.06	<0.5	1	70	8.48	9	17.7	<5	1.8
BEL007	3.3	5.34	0.01	0.65	0.01	0.02	100.01	6.6	<0.001	<0.5	57.1	0.07	<0.5	1	20	8.95	1	20.4	<5	8
BEL008	0.23	3.71	0.01	0.71	0.01	0.12	100.01	16.2	0.397	10.2	89	0.71	<0.5	2	30	10.8	8	17.1	<5	2.7

SAMPLE	Na_2O	K_2O	P_2O_5	LOI	S	C	Total oxides	As	Au	Ag	Ba	Bi	Cd	Co	Cr	Cs	Cu	Ga	Ge	Hf
BEL009	0.46	5.84	0.01	0.71	0.01	0.17	98.4	17.1	0.281	9.7	102.5	4.17	0.5	2	20	12.85	8	15.8	<5	4.5
BEL012	0.37	6.11	0.02	1.26	0.01	0.24	100.02	17.2	0.418	3.1	155	0.46	<0.5	2	20	9.08	7	15.8	<5	4.5
ROBB2	0.94	5.93	0.01	1.14	<0.01	0.29	99.62	14.5	0.045	1	155	0.47	<0.5	2	20	20.3	7	14.4	<5	4.5
ROBB3	1.51	5.88	0.04	1.29	<0.01	0.28	99.56	9.2	0.01	<0.5	149.5	0.15	<0.5	3	20	23.9	13	18.4	<5	6.1
Robb4	1.27	6.08	0.02	0.59	<0.01	0.08	99.64	8.8	0.211	1.9	126.5	0.14	<0.5	2	30	12.5	13	15.9	<5	5.3
BIG002	0.71	4.36	0.02	2.35	<0.01	0.22	99.97	2.9	0.003	<0.5	60.1	0.42	<0.5	1	10	15.85	2	20.3	<5	5.9
BIG003	0.97	4.57	0.02	2.86	<0.01	0.3	100.14	4.2	0.003	<0.5	76.9	0.33	<0.5	<1	10	3.33	2	18.9	<5	7
LP10	0.32	3.59	0.02	2.48	0.01	0.51	100.55	10.8	0.013	0.5	69.6	0.37	<0.5	2	20	11.9	5	19.7	<5	5.1
RBP001	2.46	4.44	0.03	1.73	<0.01	0.35	99.61	3.5	0.034	0.7	216	0.19	<0.5	3	30	5.53	7	17.9	<5	7.9
BEL015	0.66	4.89	0.02	2.23	<0.01	0.21	99.58	12.3	0.001	<0.5	109	0.12	<0.5	2	10	12.6	3	19.3	<5	6.5

SAMPLE	Hg	Li	Mo	Ni	Nb	Rb	Pb	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Tl	U	V	W	Y	Zr
ROSE1	0.183	80	6	5	16.8	244	26	38.3	0.8	<0.2	2	49	1.2	0.04	13.15	0.19	5.76	9	17	32.3	82
ROSE2	0.018	10	24	37	34.8	156.5	78	0.55	0.5	0.6	4	73.2	2.1	0.81	13.6	0.24	5.27	21	5	49.3	311
ROSE3	0.224	40	3	6	27.6	345	28	42.3	1	0.2	3	68.7	1.8	<0.01	21.3	0.11	6.94	11	12	45.2	131
ROSE4	0.602	100	8	6	16.8	239	67	126	1.1	0.3	2	124	1	0.06	13.05	0.65	8.15	13	71	36.7	77
ROSE5	0.381	110	9	6	13.8	230	43	61.9	0.9	0.3	2	165.5	0.9	0.05	10.85	0.47	6.84	12	100	30.8	70
ROSE6	0.112	100	4	2	2.1	55.1	15	33.5	0.4	<0.2	1	59.2	0.1	<0.01	1.74	0.34	2.86	5	30	7.9	12
ROSE 007	0.285	60	8	7	32.7	236	118	1.58	0.9	<0.2	4	51.2	2.2	<0.01	24.5	0.34	7.33	19	8	52.8	154
ROSE 008	0.199	80	3	6	19.4	261	23	21.9	1.2	0.2	2	54.9	1.3	0.01	16.25	0.11	4.69	19	11	35.6	96
BEL001	0.049	20	1	5	33.6	353	20	3.66	0.7	<0.2	4	55.3	2.3	<0.01	26.7	0.23	10.85	19	6	51.4	153
BEL002	0.141	70	14	5	23.1	304	24	11.5	0.4	<0.2	3	43.2	1.6	0.02	17.35	0.13	5.84	12	5	40	107
BEL003	0.15	70	19	6	23.4	292	30	10.95	0.5	<0.2	3	46	1.6	0.01	17.35	0.29	7.38	16	7	44	105
BEL004	0.05	90	24	4	22.4	255	16	3.89	0.3	<0.2	2	34.2	1.3	0.01	14	0.28	4.03	11	3	34.5	83
BEL005	0.036	30	1	6	27.5	194.5	24	1.08	1	<0.2	4	62.3	1.8	0.01	14.8	0.08	4.23	18	2	46.5	286
BEL006	0.047	100	55	4	9.5	124	8	5.01	0.2	<0.2	2	21.2	0.6	<0.01	6.57	0.31	2.51	23	2	18.5	47
BEL007	0.011	30	1	2	31.6	208	23	1.02	1.2	<0.2	3	17.6	2.2	<0.01	21.5	0.03	5.11	7	3	62.1	236

SAMPLE	Hg	Li	Mo	Ni	Nb	Rb	Pb	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Tl	U	V	W	Y	Zr
BEL008	0.143	100	6	1	12.3	214	65	9.3	0.7	0.3	2	32	0.7	0.02	12.45	0.29	3.7	9	5	36.2	68
BEL009	0.161	60	4	1	21.1	326	119	10.5	0.7	0.2	2	38.5	1.5	0.16	16.6	0.26	5.16	9	5	49.6	119
BEL012	0.077	50	3	3	22.6	319	39	11	1.1	<0.2	3	54.9	1.5	<0.01	17.1	0.16	5.19	16	7	44.4	119
ROBB2	0.071	70	<1	2	23.5	306	33	16	0.9	<0.2	3	33.3	1.7	0.02	17.95	0.09	4.17	7	12	43.9	124
ROBB3	0.765	60	<1	6	29.3	300	27	8.86	1.2	<0.2	3	51.3	2.1	0.01	21.2	0.07	5.11	15	20	50.7	161
Robb4	0.341	60	2	3	26.5	341	27	29.6	2	<0.2	3	40.1	1.9	0.01	20.5	0.07	4.95	9	7	51.4	124
BIG002	0.069	30	2	1	33.5	219	25	0.57	0.8	<0.2	4	37.4	2.4	<0.01	26	0.07	4.55	7	6	43.7	135
BIG003	0.028	40	1	1	31.2	185.5	26	0.63	1.2	0.2	4	50.6	2.3	<0.01	22.6	0.12	4.6	8	3	60.4	188
LP10	0.099	50	11	6	29.4	217	28	1.21	0.6	<0.2	3	65.8	2.1	<0.01	21.1	0.24	5.49	12	6	42.1	127
RBP001	0.029	30	1	6	28.9	207	22	0.95	3	<0.2	3	65.8	2	<0.01	18.6	0.09	4.59	23	3	47.7	223
BEL015	0.163	50	3	<1	30.3	217	25	2.04	0.8	<0.2	3	56.4	2.3	0.01	22.3	0.18	6.1	11	8	56	177

SAMPLE	Zn	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	TREE
ROSE1	64	19.6	42.7	4.62	15.7	3.79	0.27	3.85	0.77	5.04	1.07	3.14	0.48	3.21	0.48	104.72
ROSE2	53	49.1	96.9	10.95	39.7	8.43	0.41	7.2	1.27	8.34	1.79	5.44	0.84	5.22	0.8	236.39
ROSE3	87	30.4	65.3	7.41	25.4	6.04	0.36	5.44	1.05	6.92	1.54	4.74	0.72	4.69	0.72	160.73
ROSE4	121	20.8	45.5	5.16	18	4.28	0.36	4.41	0.87	5.71	1.17	3.48	0.52	3.44	0.52	114.22
ROSE5	110	16.8	35.9	4.12	14.4	3.56	0.2	3.78	0.68	4.53	1.02	2.94	0.45	2.88	0.45	91.71
ROSE6	46	2.6	5.8	0.75	3.1	1.05	0.09	1.02	0.19	1.23	0.24	0.6	0.11	0.68	0.09	17.55
ROSE 007	92	36.2	84.9	8.25	27.9	6.25	0.42	6.4	1.18	7.92	1.74	5.81	0.81	5.78	0.9	194.46
ROSE 008	100	24.6	51.7	6.02	20.8	4.79	0.27	4.79	0.87	5.74	1.24	3.78	0.54	3.6	0.56	129.3
BEL001	49	46.8	96.2	11.15	36.9	8.4	0.49	6.95	1.33	7.88	1.77	5.5	0.88	5.67	0.84	230.76
BEL002	36	25.2	56.3	6.16	20.6	5.23	0.3	4.81	0.87	6.07	1.29	4.11	0.65	4.09	0.63	136.31
BEL003	51	26	57.4	6.4	22.3	5.57	0.32	5.29	0.99	6.55	1.48	4.33	0.71	4.6	0.7	142.64
BEL004	25	20.5	47	5.31	18.5	4.43	0.29	4.27	0.78	5.35	1.13	3.52	0.58	3.52	0.5	115.68
BEL005	53	31.6	70.6	8.34	30.3	7.35	0.64	6.65	1.24	7.94	1.69	4.85	0.7	4.64	0.7	177.24
BEL006	17	11	23.2	2.72	9.3	2.62	0.15	2.44	0.44	3.01	0.62	1.86	0.32	1.94	0.26	59.88
BEL007	68	50.2	113	13.35	47.6	11.55	0.61	9.97	1.68	10.75	2.26	6.5	0.98	6.05	0.89	275.39

SAMPLE	Zn	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	TREE
BEL008	42	16.8	52.1	4.69	18.6	4.34	0.25	5.25	0.91	5.91	1.15	3.91	0.5	3.21	0.45	118.07
BEL009	50	26.5	64.3	6.95	25.6	6.63	0.34	7.26	1.28	8.21	1.68	5.28	0.74	4.66	0.67	160.1
BEL012	57	28.3	71.9	7.02	25.4	5.55	0.36	6.1	1.08	7.29	1.53	4.65	0.74	4.66	0.63	165.21
ROBB2	54	29.3	66	7.17	24.9	5.87	0.45	5.69	1.04	6.9	1.49	4.64	0.71	4.49	0.67	159.32
ROBB3	64	34.3	73.7	8.26	28	6.22	0.42	6.45	1.18	7.97	1.64	5.79	0.86	5.1	0.78	180.67
Robb4	47	31.2	68	7.89	27.5	6.8	0.37	6.3	1.22	7.61	1.6	5.36	0.85	5.52	0.81	171.03
BIG002	39	36.3	73.8	7.65	25	5.09	0.3	5.26	0.96	6.38	1.39	4.5	0.69	4.99	0.74	173.05
BIG003	36	40.6	86	10.4	37.3	8.15	0.44	8.4	1.54	9.87	2.17	6.46	1.02	6.58	0.99	219.92
LP10	48	26.4	60	5.71	19.9	4.49	0.38	4.53	0.86	6.03	1.35	4.29	0.7	4.74	0.73	140.11
RBP001	54	33.8	73.3	8.49	30.6	7.59	0.61	6.72	1.22	7.58	1.61	5.21	0.79	5.03	0.71	183.26
BEL015	53	36.4	76.2	9.15	34.2	7.3	0.41	7.67	1.42	9.77	2.07	5.8	0.9	5.69	0.83	197.81

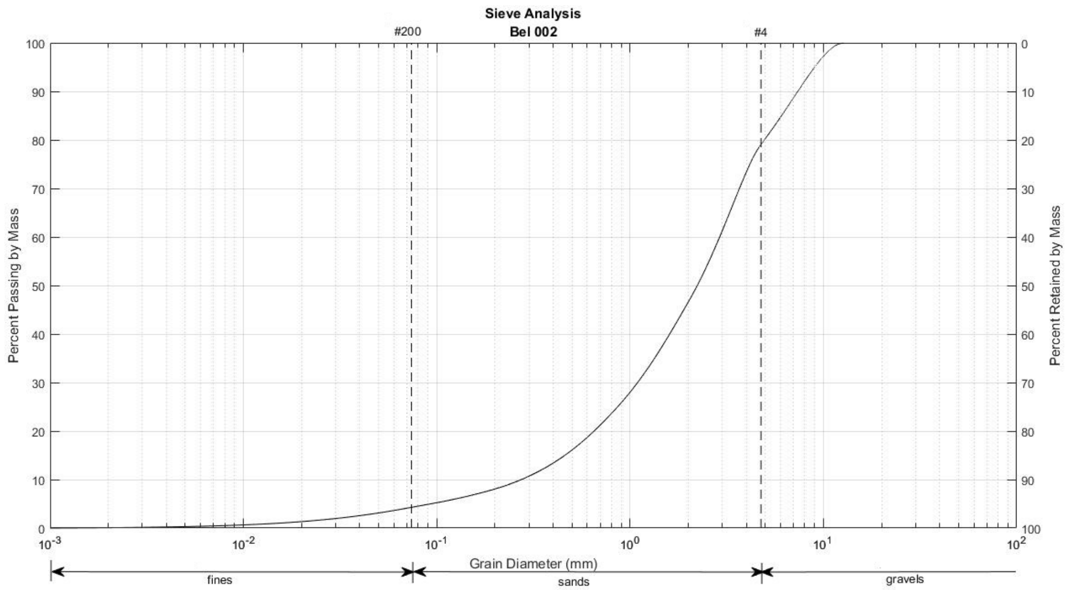
APPENDIX 6. CHEMICAL ANALYSES OF WATER SAMPLES

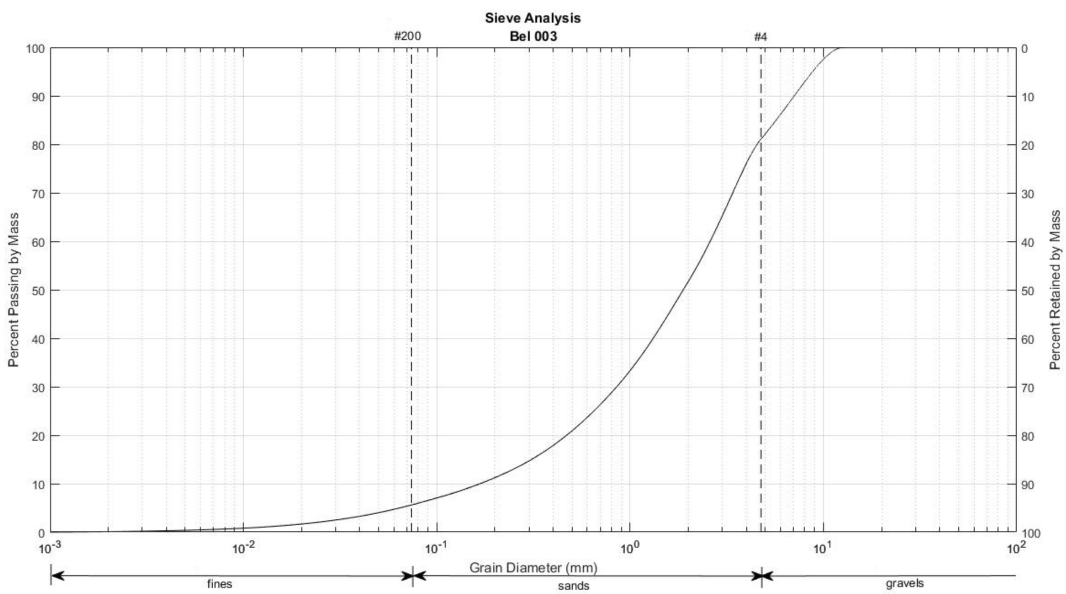
Chemical analyses of water samples from the Rosedale district.

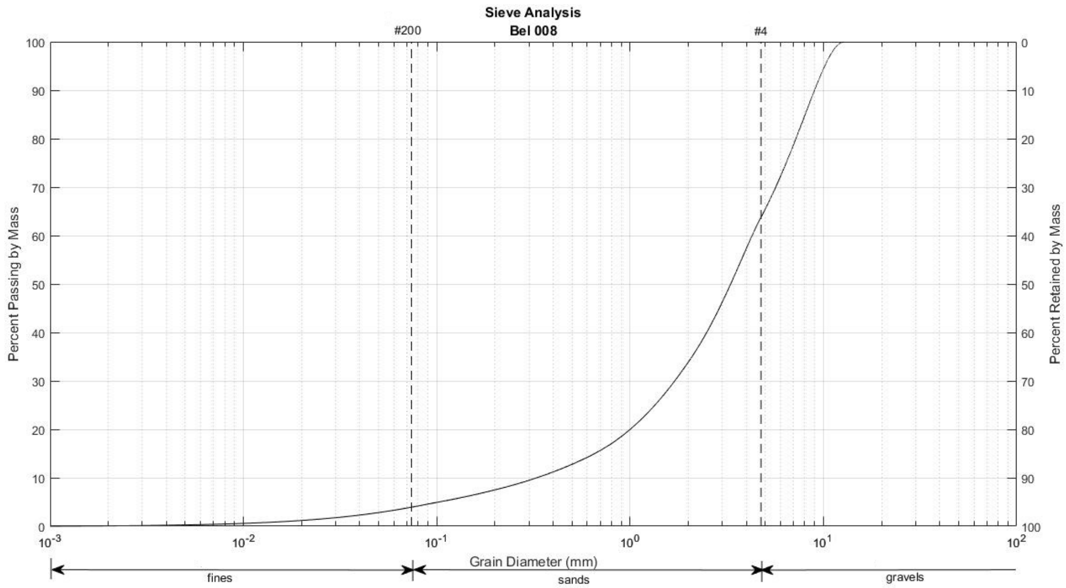
Sample Description	ROBB1	ROBB2	BRC1
Lab Sample	170601-01	170701-01	170708-01
Specific Conductance uS/cm	425	382	266
ph	7.8	7.8	7.7
Ca mg/L	32	31.4	40.3
Fe mg/L	0.378	0.496	0.268
Mg mg/L	7.61	7.30	2.64
K mg/L	11.4	11.6	3.82
Na mg/L	12.3	13.1	15.0
Sr mg/L	0.25	0.252	0.167
Al mg/L	ND	0.0027	0.0737
Sb mg/L	0.0009	0.0012	0.0005
As mg/L	0.0029	0.0038	0.0045
Ba mg/L	0.178	0.193	0.104
Be mg/L	ND	ND	ND
B mg/L	0.011	0.032	0.048
Cd mg/L	ND	ND	ND
Cr mg/L	0.0007	0.0009	0.0009
Co mg/L	0.0009	0.0009	0.0007
Cu mg/L	0.0035	0.0010	0.0028
Pb mg/L	ND	ND	ND
Li mg/L	0.001	0.001	0.007
Mn mg/L	2.48	1.34	1.46
Mo mg/L	ND	ND	0.001
Ni mg/L	0.0011	0.0011	0.0014
Se mg/L	0.001	0.001	0.001
Si mg/L	9.29	6.78	24.5
Ag mg/L	ND	ND	ND
St mg/L	0.262	0.265	0.171
Tl mg/L	ND	ND	ND
Th mg/L	ND	ND	ND
Sn mg/L	ND	ND	ND
Ti mg/L	ND	0.001	0.006
U mg/L	ND	ND	0.0006
V mg/L	ND	ND	0.0015
Zn mg/L	0.0015	0.0613	0.0334
Br- mg/L	ND	0.12	ND
Cl- mg/L	11.3	10.9	4.38
Fl- mg/L	0.29	0.30	0.45
NO-3 mg/L	0.32	0.93	ND
NO-2 mg/L	ND	ND	ND
PO4-3 mg/L	ND	ND	ND
SO2-4 mg/L	1.42	ND	1.24
CaCO3 mg/L	190	172	132

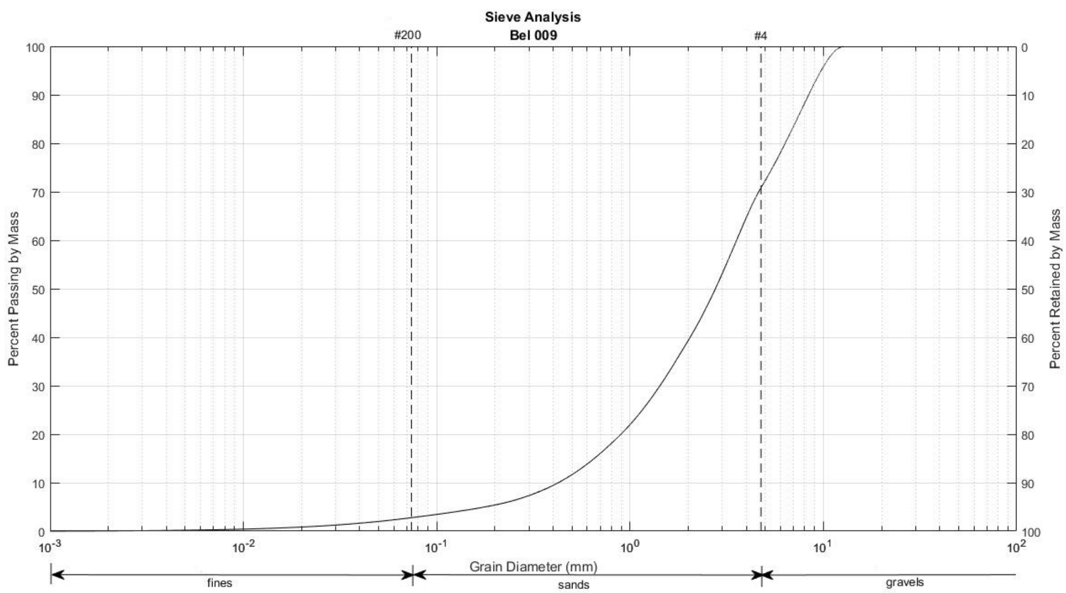
Sample Description	ROBB1	ROBB2	BRC1
HCO3 mg/L	232	209	162
CO3 mg/L	ND	ND	ND
Anions Total meq/L	4.17	3.78	2.82
Cations Total meq/L	3.05	3.04	2.98
% Difference	-15.61	-10.91	2.67
SiO2 mg/L	19.9	14.5	52.5
TDS Calc mg/L	216	198	203
Hardness mg CaCO3/L	111	109	112

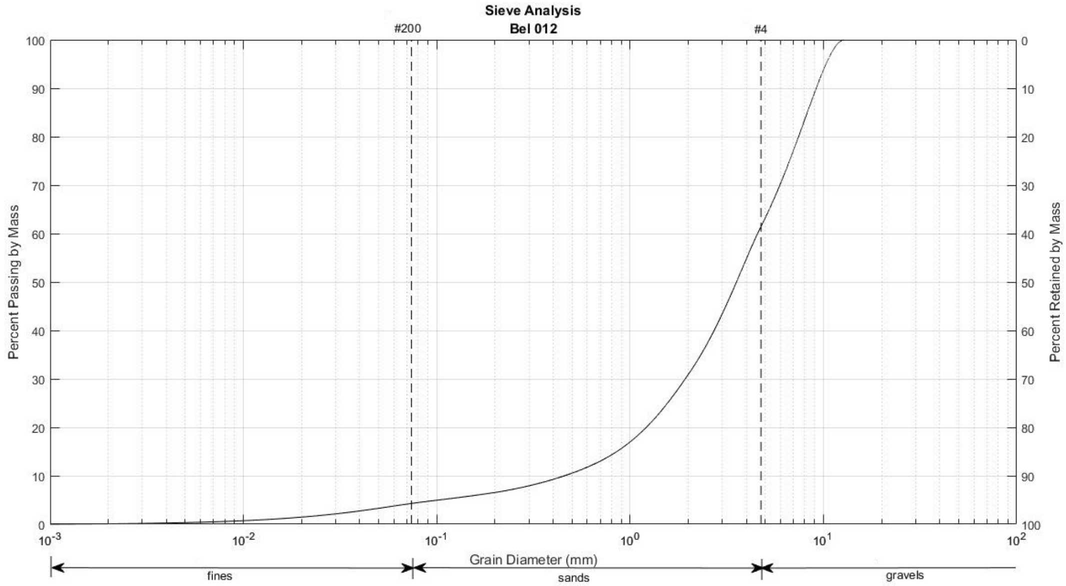
APPENDIX 7. PARTICLE SIZE ANALYSES

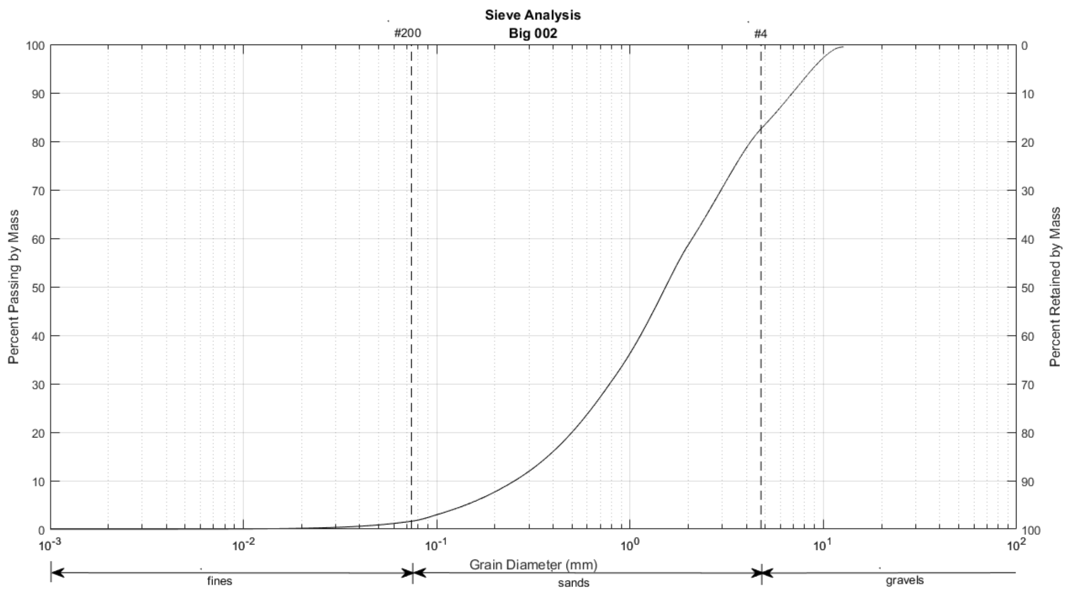


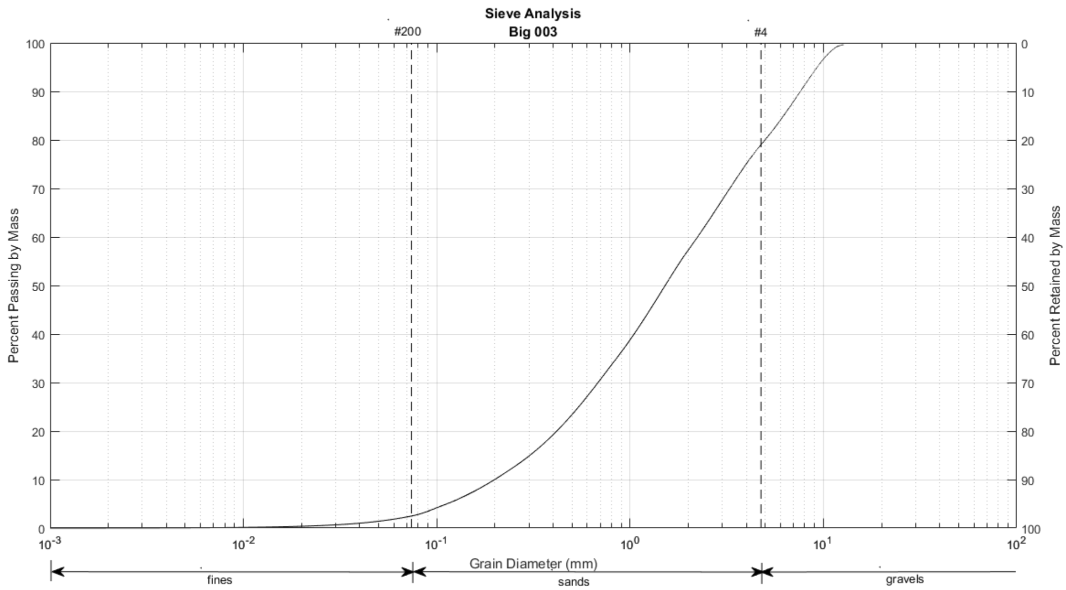



Sieve Analysis
Bel 008
#200
#4
Percent Passing by Mass
Percent Retained by Mass
Grain Diameter (mm)
fines
sands
gravels

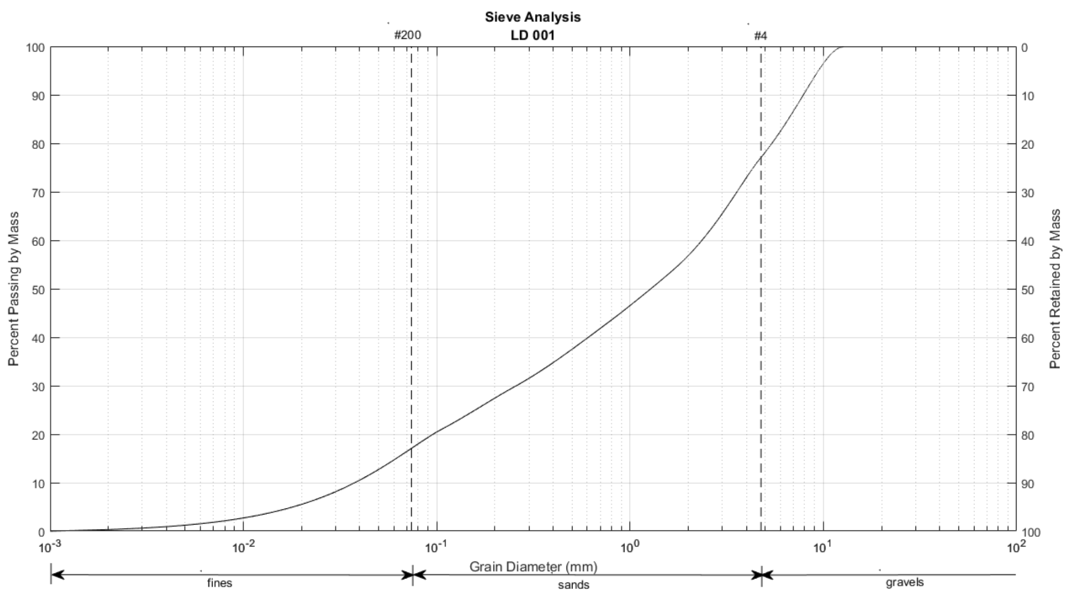

Sieve Analysis
Bel 009
#200
#4
Percent Passing by Mass
Percent Retained by Mass
Grain Diameter (mm)
fines
sands
gravels


Sieve Analysis
Bel 012
#200
#4
Percent Passing by Mass
Percent Retained by Mass
Grain Diameter (mm)
fines
sands
gravels

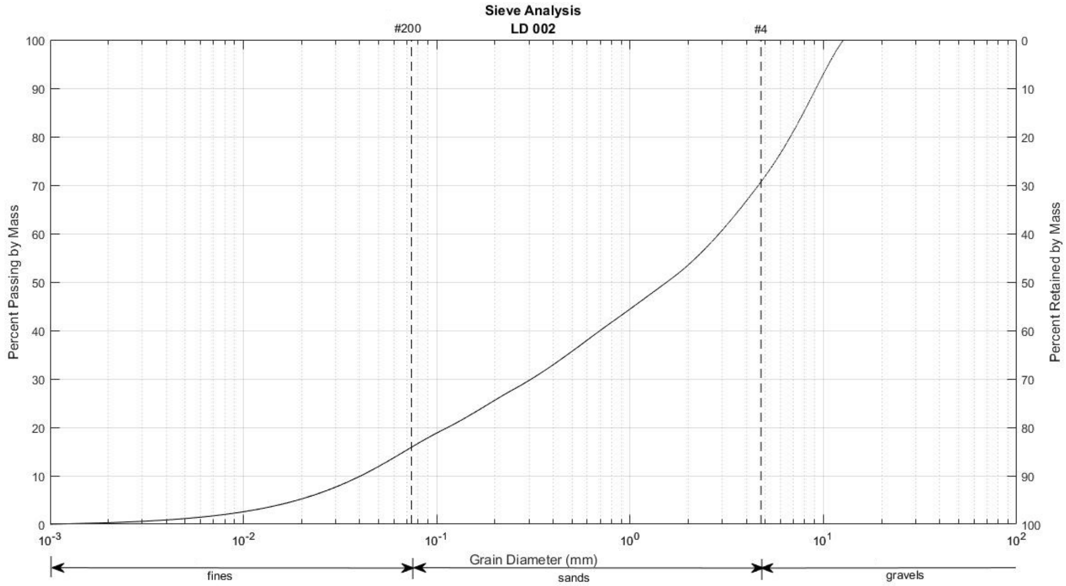

Sieve Analysis
Big 002
#200
#4
Percent Passing by Mass
Percent Retained by Mass
Grain Diameter (mm)
fines
sands
gravels



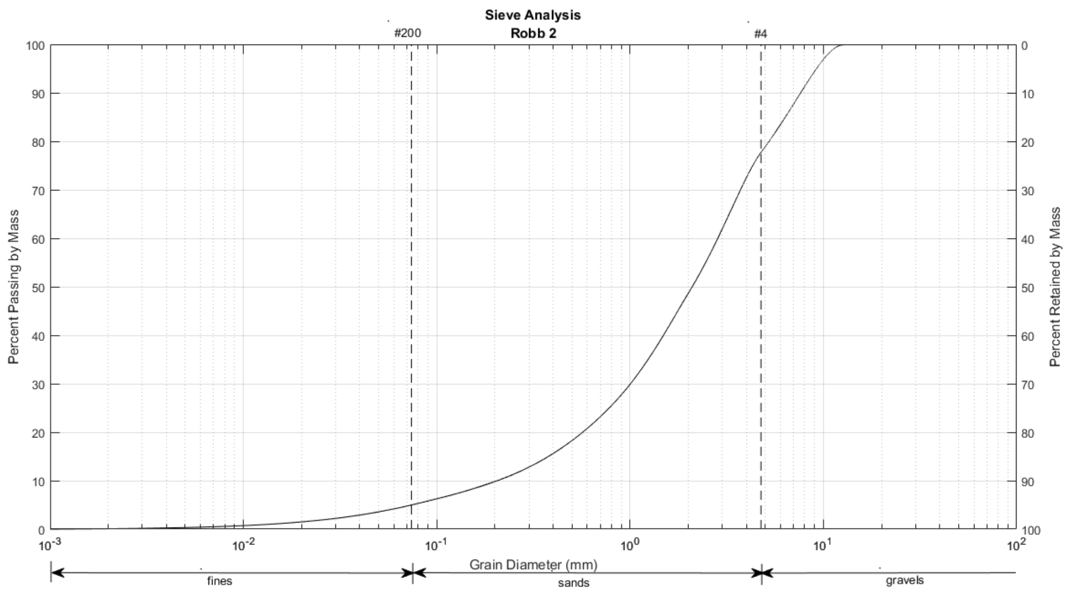
Sieve Analysis
Big 003
#200
#4
Percent Passing by Mass
Percent Retained by Mass
Grain Diameter (mm)
fines
sands
gravels



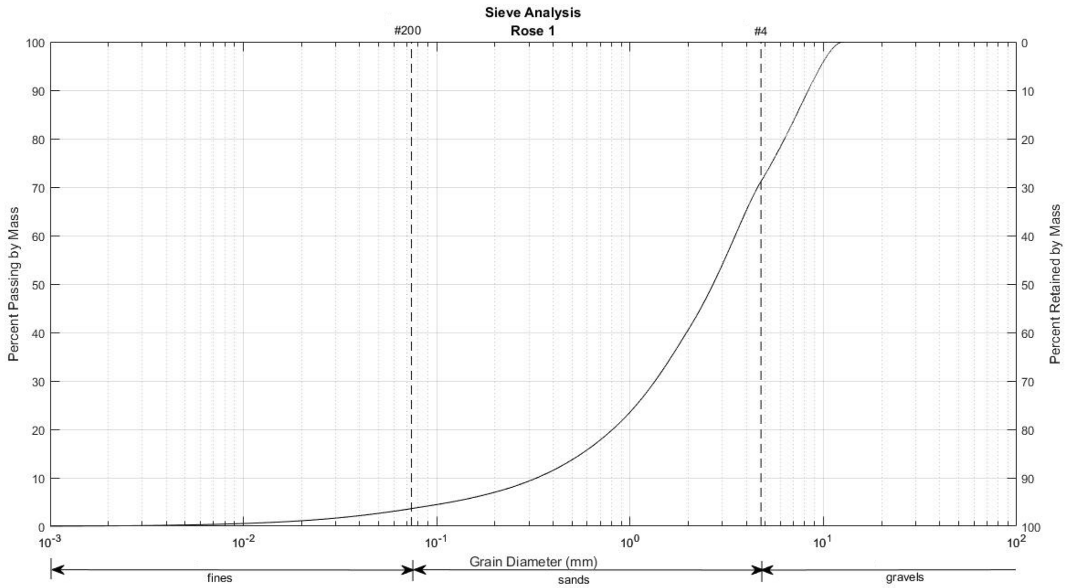
Sieve Analysis
LD 001
#200
#4
Percent Passing by Mass
Percent Retained by Mass
Grain Diameter (mm)
fines
sands
gravels

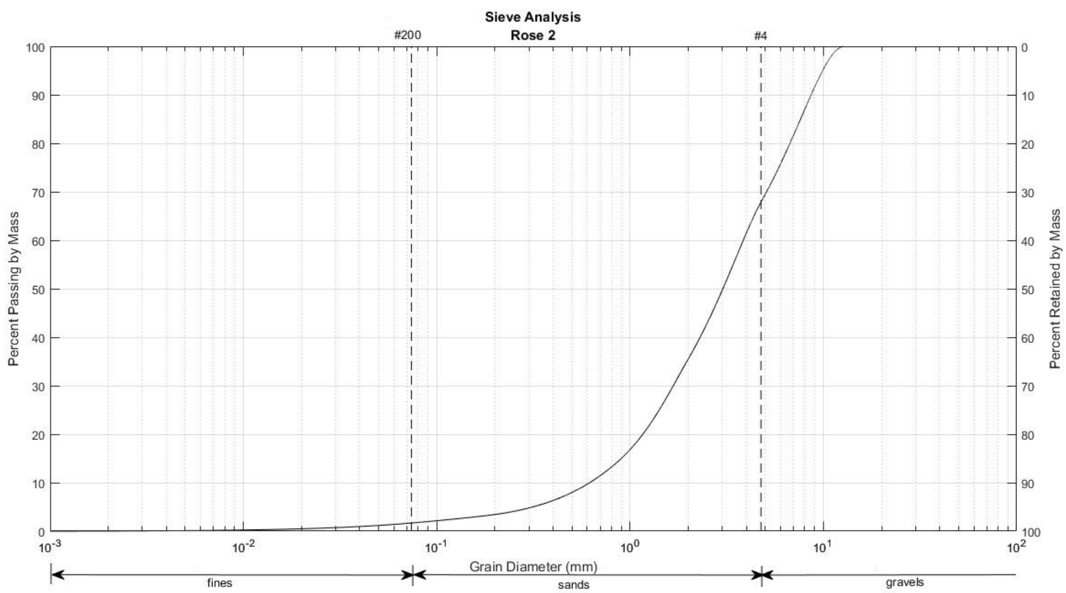


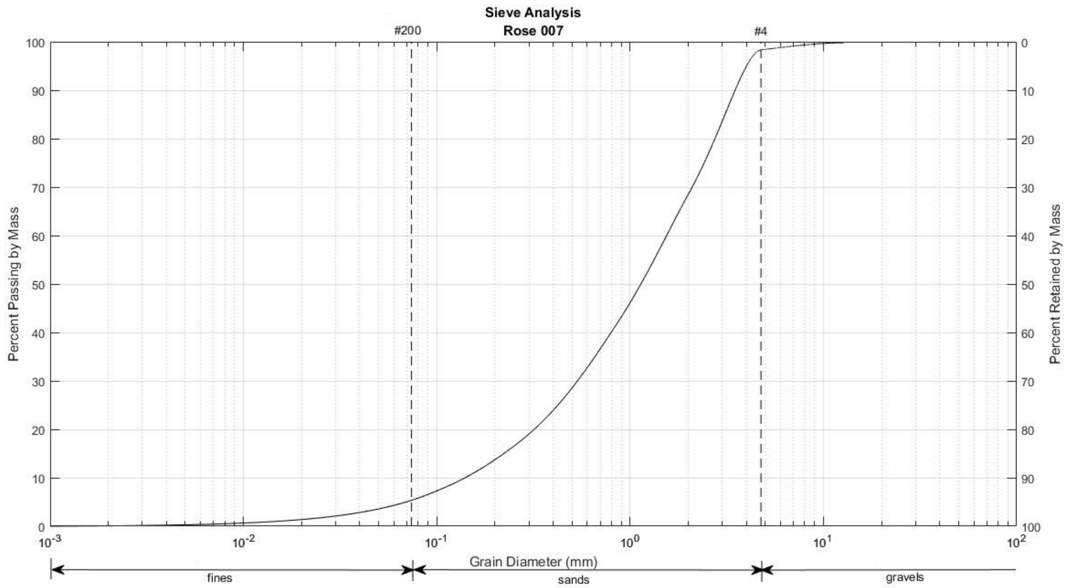
Sieve Analysis
LD 002
#200
#4
Percent Passing by Mass
Percent Retained by Mass
Grain Diameter (mm)
fines
sands
gravels

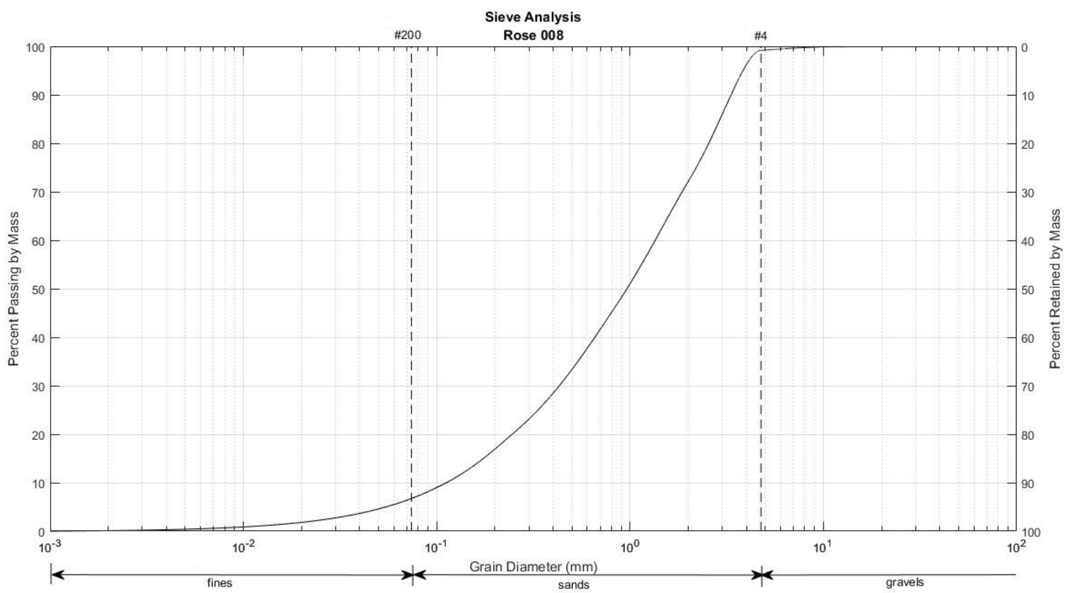


Sieve Analysis
Robb 2
#200
#4
Percent Passing by Mass
Percent Retained by Mass
Grain Diameter (mm)
fines
sands
gravels


Sieve Analysis
Rose 1
#200
#4
Percent Passing by Mass
Percent Retained by Mass
Grain Diameter (mm)
fines
sands
gravels

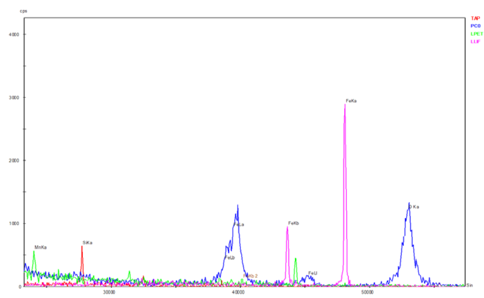

Sieve Analysis
Rose 2
#200
#4
Percent Passing by Mass
Percent Retained by Mass
Grain Diameter (mm)
fines
sands
gravels


Sieve Analysis
Rose 007
#200
#4
Percent Passing by Mass
Percent Retained by Mass
Grain Diameter (mm)
fines
sands
gravels

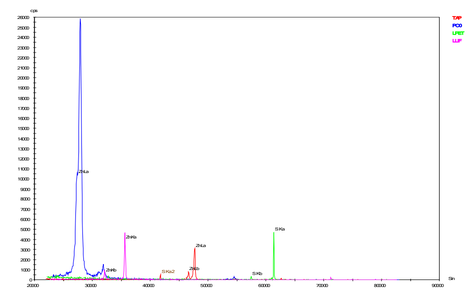

Sieve Analysis
Rose 008
#200
#4
Percent Passing by Mass
Percent Retained by Mass
Grain Diameter (mm)
fines
sands
gravels

APPENDIX 8. X-RAY DIFFRACTION (XRD) DATA

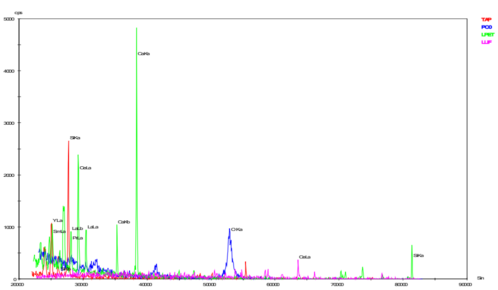
Qualitative analysis plot for metal phases in Bell mine



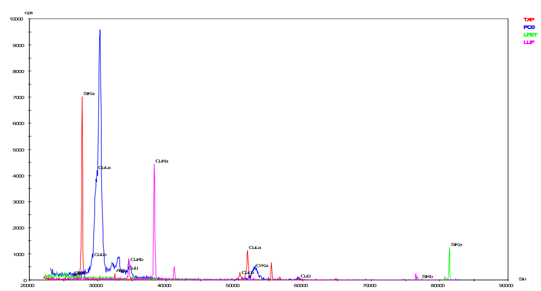
Hematite Phase



Sphalerite (ZnS) Phase

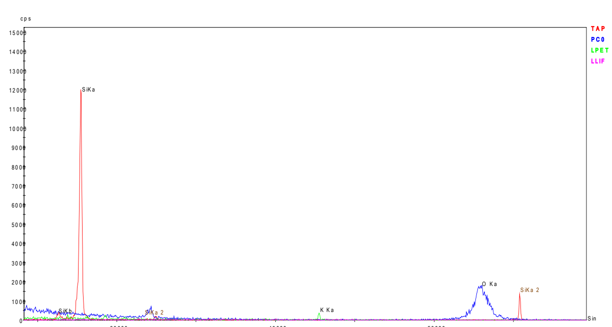


Calcium Silicate (Ca_2SiO_4) with REE's Phase

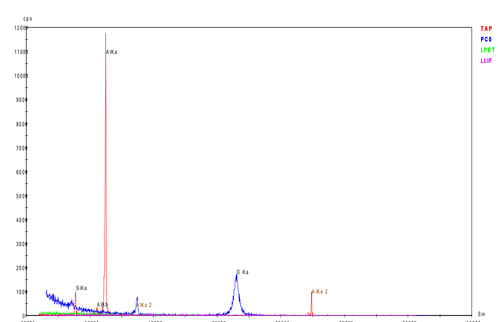


Copper (Cu) Phase

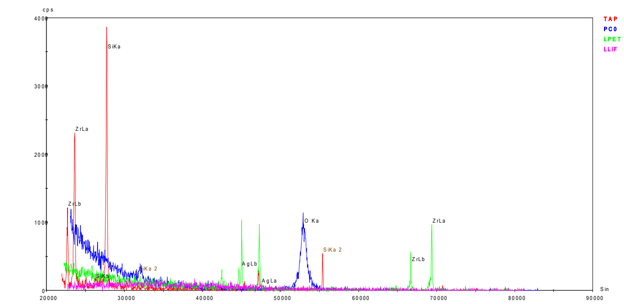
Qualitative analysis plot for metal phases in Bell mine



Quartz Phase

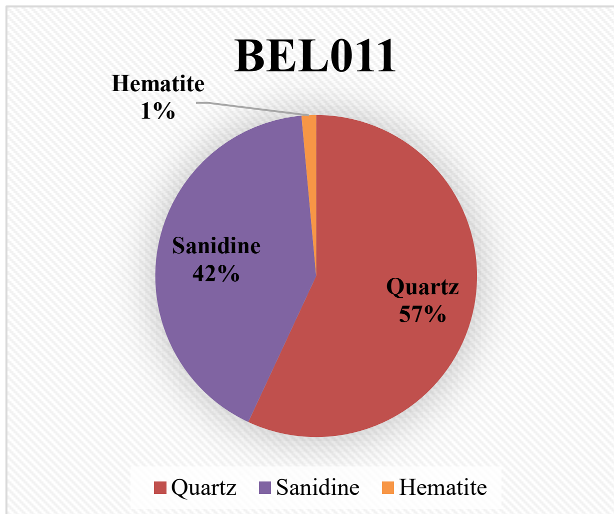


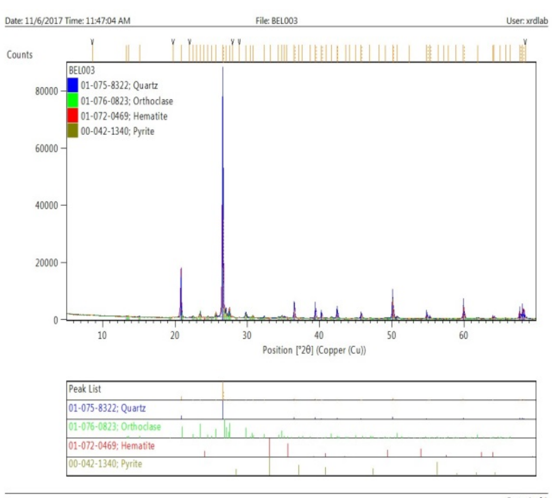
Aluminium Oxide Phase

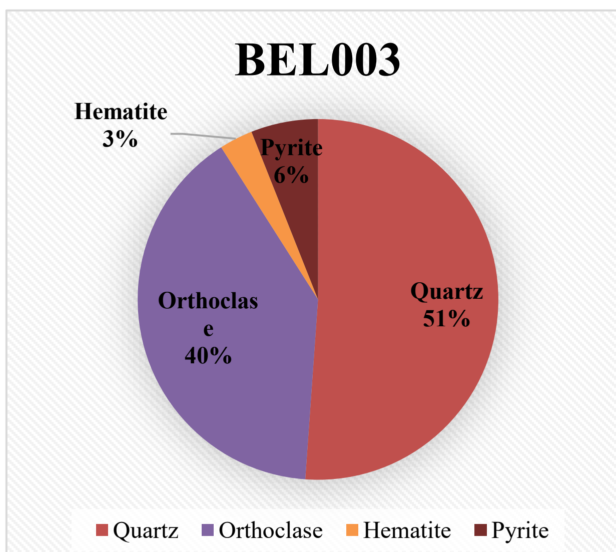


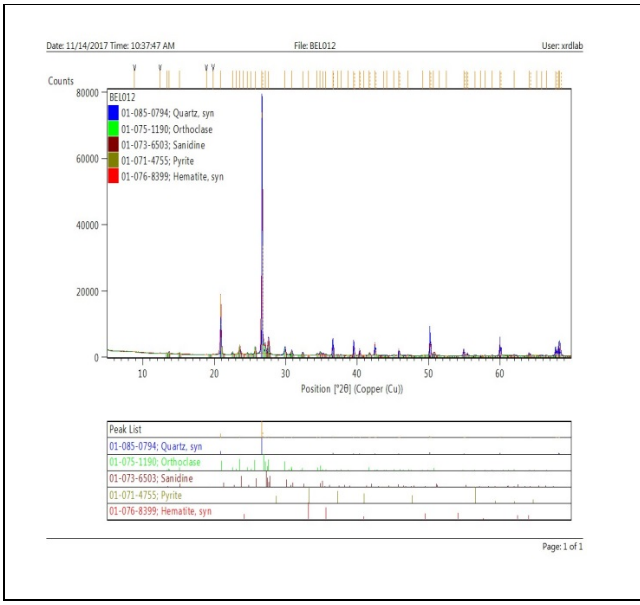
Zircon (Silver-bearing) Phase

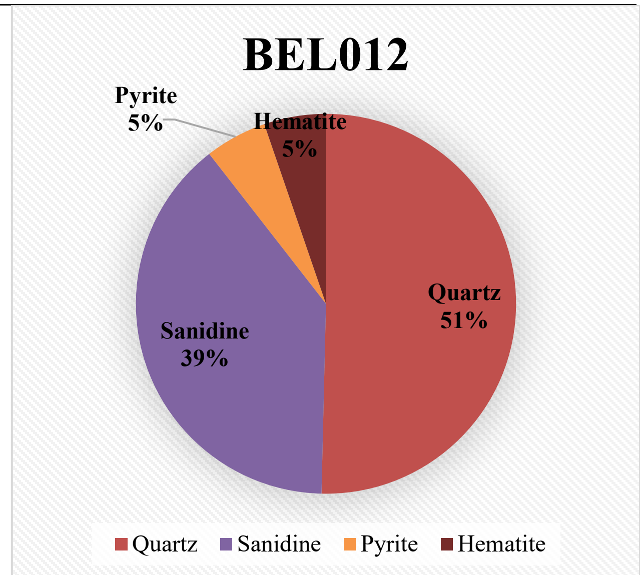
XRD Analysis data for Rosedale district

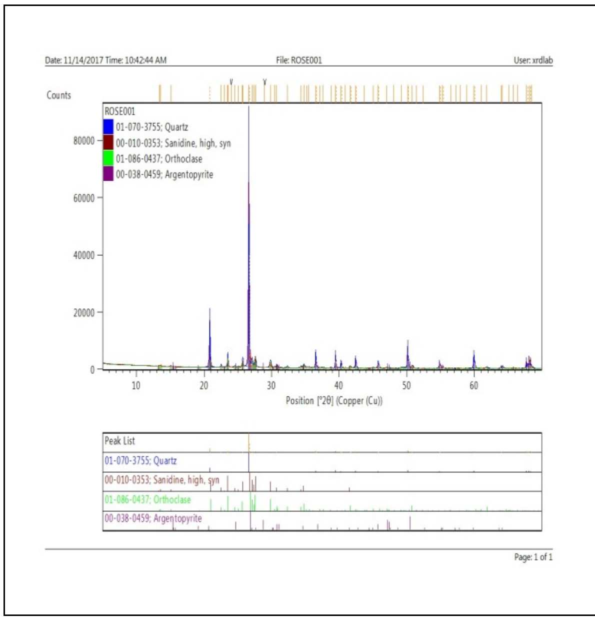


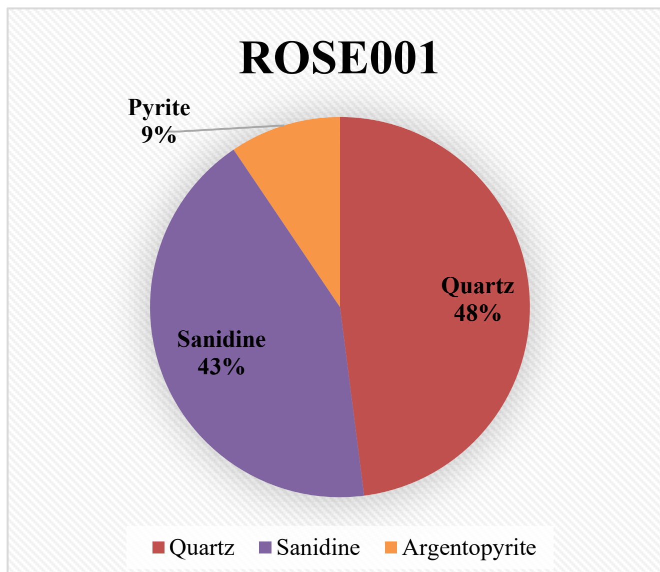


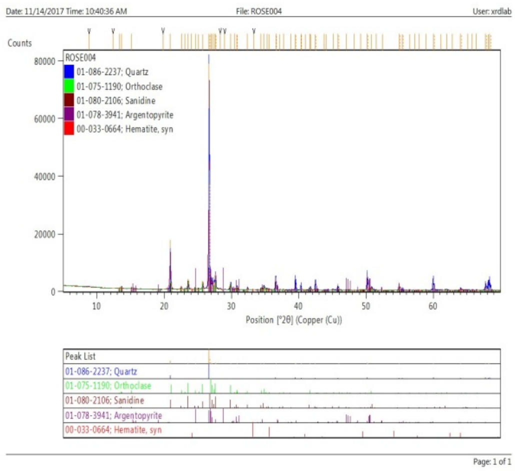



Date: 11/14/2017 Time: 10:37:47 AM
File: BEL012
User: xrdlab
Counts
BEL012
01-085-0794; Quartz, syn
01-075-1190; Orthoclase
01-073-6503; Sanidine
01-071-4755; Pyrite
01-076-8399; Hematite, syn
Position [°2θ] (Copper (Cu))
Peak List
Page: 1 of 1

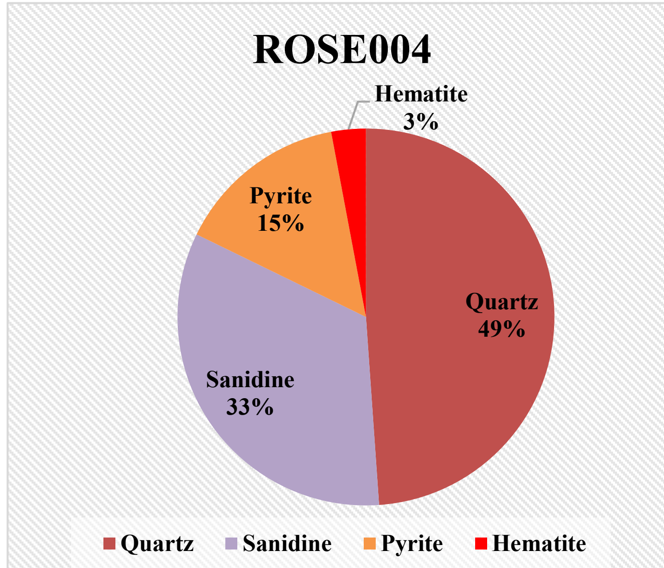

BEL012
Pyrite 5%
Hematite 5%
Quartz 51%
Sanidine 39%
Quartz
Sanidine
Pyrite
Hematite


Date: 11/14/2017 Time: 10:42:44 AM
File: ROSE001
User: xrdlab
Counts
ROSE001
01-070-3755; Quartz
00-010-0353; Sanidine, high, syn
01-086-0437; Orthoclase
00-038-0459; Argentopyrite
Position [°2θ] (Copper (Cu))
Peak List
Page: 1 of 1

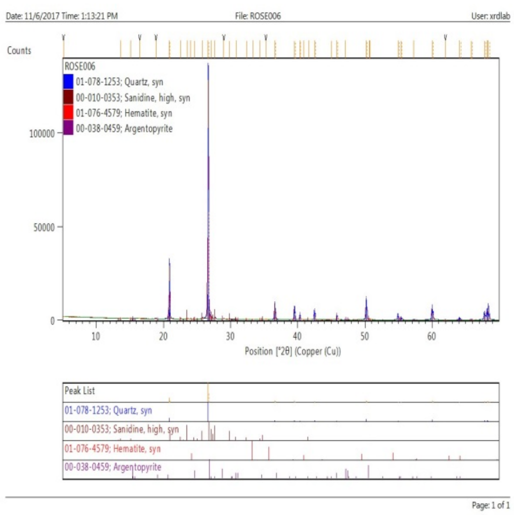

ROSE001
Pyrite 9%
Quartz 48%
Sanidine 43%
Quartz
Sanidine
Argentopyrite



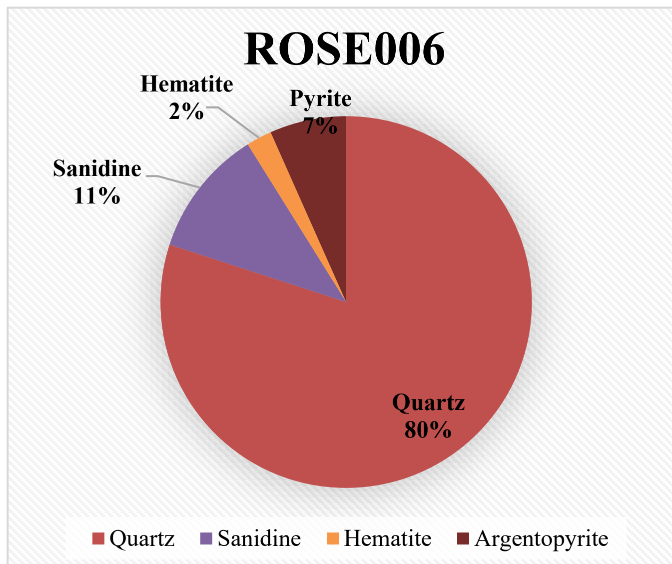
Date: 11/14/2017 Time: 10:40:36 AM
File: ROSE004
User: xrdlab
Counts
ROSE004
01-086-2237; Quartz
01-075-1190; Orthoclase
01-080-2106; Sanidine
01-078-3941; Argentopyrite
00-033-0664; Hematite, syn
Position [°2θ] (Copper (Cu))
Peak List
Page: 1 of 1



ROSE004
Hematite 3%
Pyrite 15%
Quartz 49%
Sanidine 33%
Quartz
Sanidine
Pyrite
Hematite



Date: 11/6/2017 Time: 1:13:21 PM
File: ROSE006
User: xrdlab
Counts
ROSE006
01-078-1253; Quartz, syn
00-010-0353; Sanidine, high, syn
01-076-4579; Hematite, syn
00-038-0459; Argentopyrite
Position [°2θ] (Copper (Cu))
Peak List
Page: 1 of 1



ROSE006
Hematite 2%
Pyrite 7%
Sanidine 11%
Quartz 80%
Quartz
Sanidine
Hematite
Argentopyrite

APPENDIX 9. ELECTRON MICROPROBE DATA

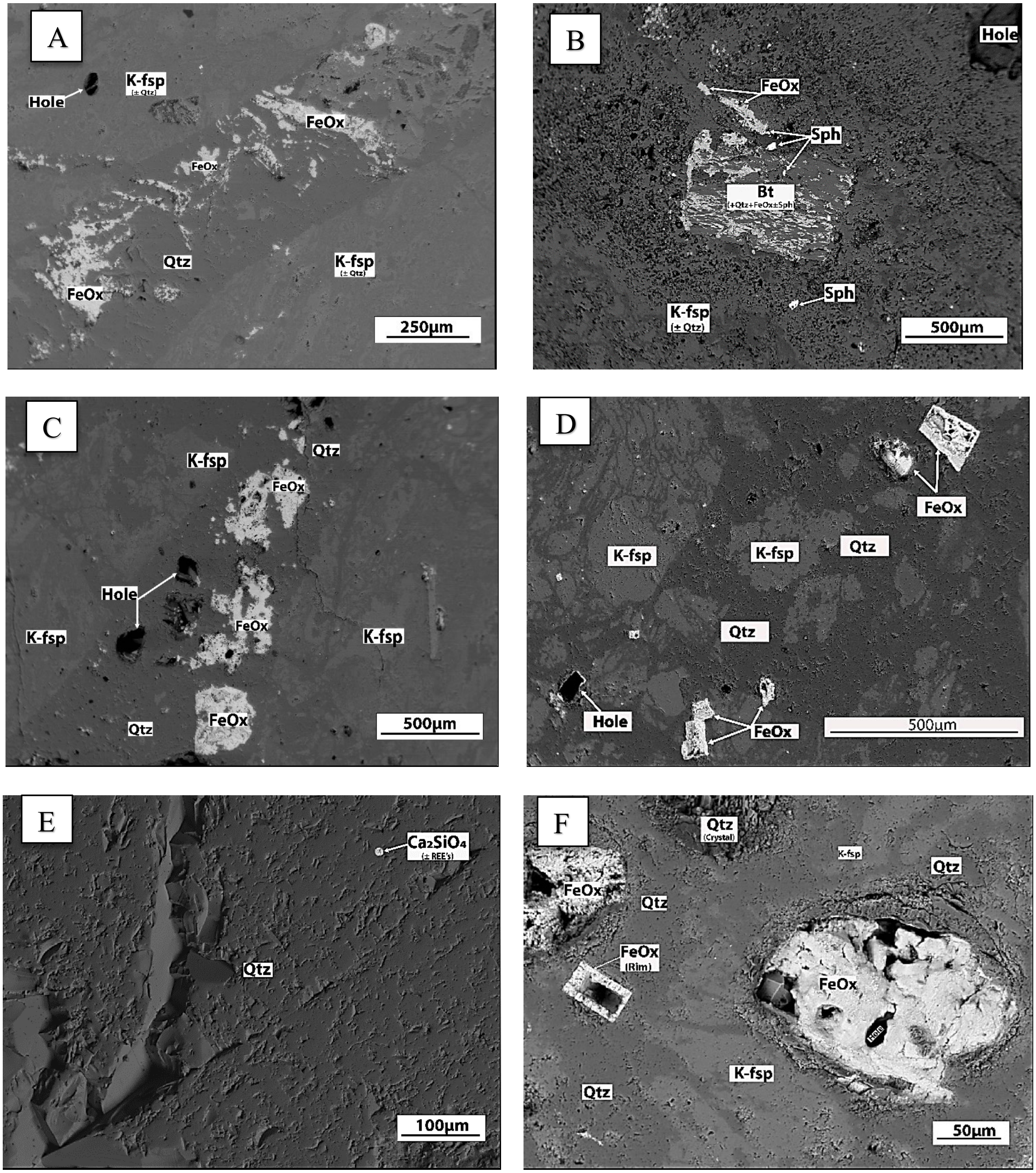


FIGURE 8-1. (A-F) BSE images of samples with gold concentrations from electron microprobe (Table 5). (A) Hematite associated with quartz vein (ROSE005). (B) Destruction and replacement of biotite by hematite and quartz. Pyrite intergrown with hematite and minor sphalerite replaced by hematite and quartz (ROSE004). (C) Hematite within quartz vein associated with silicification (ROSE005) (D) Completely altered pyrite by hematite (ROSE001). E) Observed calcium silicate with REE phase (ROSE004). F) Destruction and replacement of pyrite by hematite (ROSE-001).

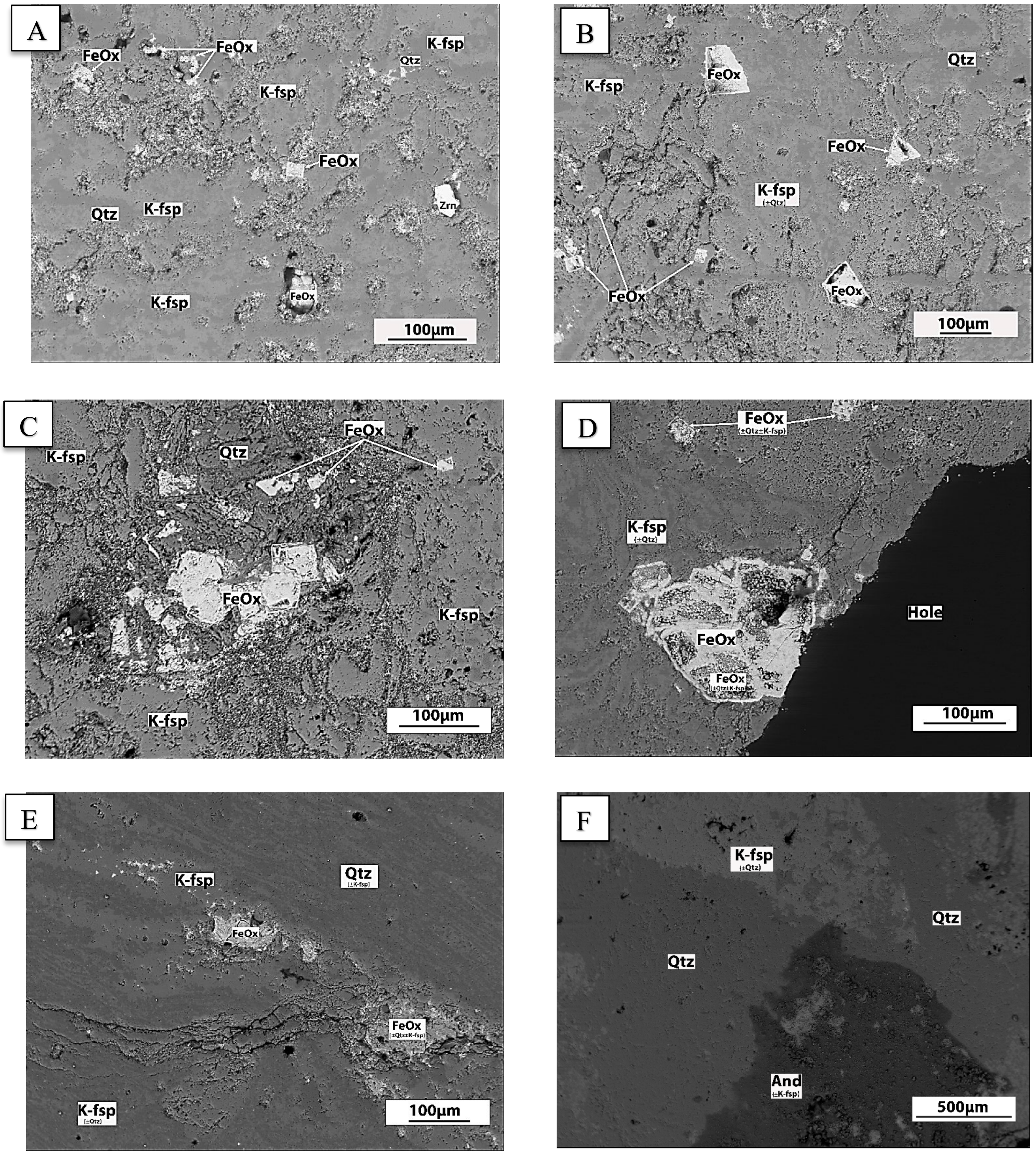


FIGURE 8-2. A-F) BSE images of samples with gold concentrations from electron microprobe (Table 5). A-E) Completely bifurcated and pyrite replaced by hematite (BEL001, BEL002) F) Pervasive potassium aluminum silicate in samples from Bell mine (BEL003).

APPENDIX 10. QUALITY CONTROL AND QUALITY ASSURANCE (QA/QC) REPORT

Introduction

The samples and field data (including field observations and measurements) are the basic component of the data collection and interpretation, which ultimately leads to the project conclusions. Therefore, it is important to understand the spatial and geological context and to describe the types of samples collected, sample preparation, and sample analyses. The purpose of this appendix is to present data to support the accuracy and precision for the geochemical, mineralogical, and geotechnical analyses obtained by NMBGMR. The data were obtained from the various laboratories and at least 10% of the data were validated or checked by an additional staff member to assure the data were entered into the database properly. If during validation, data were found to be entered incorrectly, the error was immediately corrected. This report only describes the sample collection and preparation of samples collected during the project (including analyses from ALS Chemex). The QA/QC procedures for the electron microprobe laboratory at NMIMT are explained at http://geoinfo.nmt.edu/labs/microprobe/home.html (accessed 1/6/2019).

Technical approach

A *sample* is a representative portion, subset, or fraction of a body of material representing a defined population (Koch and Link, 1971; Wellmer, 1989; Rollinson, 1993; Davis, 1998; Schreuder et al., 2004; Neuendorf et al., 2005; Downing, 2008). A sample is that portion of the population that is actually studied and used to characterize the population. Collecting a representative sample of sedimentary material can be difficult because of the compositional, spatial, and size heterogeneity of the material. The sampling process is defined in the project report and summarized below:

- Define the sample population
- Define the parameters to be measured
- Define the number of samples to be collected and where
- Define the sample collection method
- Define the quantity of sample collected
- Collect the sample according to standard procedures
- Record field observations and sample description
- Review the sampling process and modify if needed.

The determination of total error of a measurement depends upon several parameters, including the sample error and analytical error (Rollinson, 1993; Schreuder et al., 2004). The sample error is the error that results from studying the collected sample instead of the entire population and depends upon completeness, comparability, and representativeness, as defined below:

- *Completeness*—the comparison between the amount of valid, or usable, data originally planned to collect, versus how much was collected
- *Comparability*—the extent to which data can be compared between sample locations or periods of time within a project, or between projects
- *Representativeness*—the extent to which samples actually depict the true condition or population being evaluated.

Sample error is the error caused by observing a sample instead of the whole population and typically is dependent upon the sample-to-sample variation and is controlled by collecting a sample of suitable size relative to the heterogeneity of the sampled material, as well as a sufficient number of samples to characterize the population (Wellmer, 1989). Basically, all analytical measurements are incorrect at some level and are measured against an agreed upon standard of analysis. It is just a question of how large the errors are compared to an agreed upon standard of accuracy and if those errors are acceptable; these are typically defined in the original sampling plan. Analytical error is the error that results from laboratory analysis, is typically reported by the laboratory, and is defined by precision and accuracy, as defined below:

- *Precision* is the degree of agreement among repeated measurements of the same characteristic and is monitored by multiple analyses of many sample duplicates and internal standards. It can be determined by calculating the standard deviation, or relative percent difference, among samples taken from the same place at the same time (i.e. duplicates and triplicates, Fig. A10-1).
- *Accuracy* measures how close the results are to a *true* or accepted value and can be determined by analyzing certified reference standards as unknown samples and comparing with known certified values (Fig. A10-1).

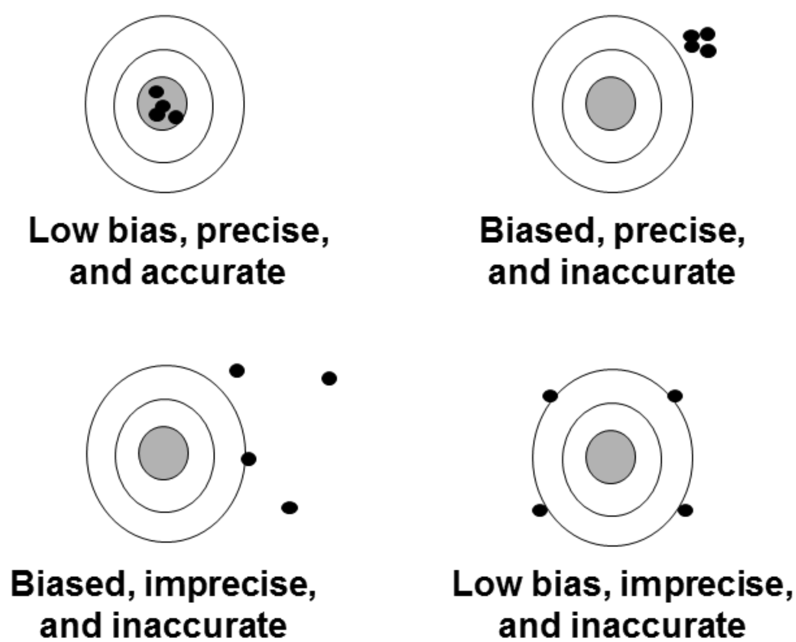


FIGURE A10-1. Diagram illustrating the difference between precision, bias, and accuracy.

Field Procedures

Typically, a 5-gallon bucket of waste rock material was collected at each location for chemical analysis, petrographic analyses, and archive. Other types of samples were collected locally as described. Each sample was stored in a separate bucket, assigned a unique number, logged on a field sample form, and entered into the project database. Selected sample sites were marked in the field and a digital photograph was taken at most localities. Photographs provide visual record of the sample site. Location information obtained by global positioning system (GPS), type of sample, and field petrographic descriptions were collected. Geologic observations were recorded on the field description form and each site was located on a map. Hand specimen description provided a record of what was collected, which aided in petrographic descriptions and provided information on the sample for the laboratory analysis (for example, high pyrite samples may be treated differently than low pyrite samples). Samples were collected in the field and kept under direct control of the authors to avoid contamination. Samples are archive at the NMBGMR.

Laboratory procedures

Samples were shipped by U.S. Postal Service to ALS Laboratory Group. Not all analyses were performed on each sample because only the specific analyses to address the task were performed. Not all samples collected were analyzed. Samples were collected at the surface. Summary of procedures is in Table 3 of the main report.

Accuracy and precision of rock chemistry data

The accuracy of the data is how close the measured value is to the true value. Analyzing standards to unknown samples and comparing with known values monitors accuracy. Each laboratory is responsible for the accuracy and that data is available upon request from the laboratory manager. On-going control samples were submitted with each batch of samples submitted. Certified standards are commercial standards with certified values as determined by round robin analyses at numerous certified laboratories. Certified standards are expensive, so on-going control samples were analyzed instead. The on-going control samples are standards collected by NMBGMR personnel and analyzed by different methods over several years of analyses by different laboratories. Duplicate samples were also submitted.

The precision of an analysis is the repeatability of a measurement. Precision is the degree of agreement among repeated measurements of the same characteristic and monitored by multiple analyses of many sample duplicates and internal standards. It can be determined by calculating the standard deviation, or relative percent difference, among samples taken from the same place at the same time (i.e. duplicates and triplicates).

In general, analyses obtained from the laboratories are in agreement with certified values of certified standards and precision is excellent between multiple analyses. However, differences between certified standards and duplicate pairs do exist. Generally no corrective procedures could be applied to solid samples. Variation in preparation of the bead used in the analysis is a major cause of these differences. Nugget effects can account for variations in gold (Au), copper (Cu), iron (Fe), lead (Pb), sulfur (S), zinc (Zn), and zirconium (Zr), observed in some pairs of samples. A nugget effect is where a small grain of native gold or other minerals occurs in one split and not the other split and produces a higher concentration. Another variation between certified values and the results provided by the laboratories is a result of different analytical techniques. ICP requires acid digestion and analyses of a liquid-base solution. In some cases, not all of the solid rock will be completely digested and can result in a lower value than that obtained by certified values typically done by XRF or instrumental neutron activation analysis (INNA).

The sum of major oxides should total between 99 and 101% (Appendix 5). Samples of NMBGMR on-going standards were analyzed for most batches and the difference between analyses is acceptable, within 10% (Table A10-1). The precision of analyses is acceptable (within 10%) for samples where multiple analyses of the same sample were obtained (Table A10-1). For every 10 samples submitted, a duplicate sample was analyzed; these analyses compared within 10%.

There are numerous reasons why duplicate samples and/standards do not always agree. Some samples, such as rhyolite and basalt, grind into powder more easily than other samples, such as sandstone samples and nepheline syenites. Fusion techniques required for XRF analyses can differ between different personnel that could result in variations between sample pairs. Analytical error is higher for analyses with concentrations close to the detection limit. Most variations between duplicate samples are probably a result of sample inhomogeneities and analytical errors related to low concentrations. Another problem encountered with sandstone samples, is the variability of sample collection.

TABLE A10-1. Summary statistics for multiple analyses of internal standard CAP-MLJ-0001 2008-2015 (rock pile sample from Capulin rock pile, Questa mine). Major oxides, S, C, LOI, Sum are in percent, trace elements are in parts per million (ppm). Sum is the total major oxides. FeOT and Fe_2O_3T are total iron calculated as FeO or Fe_2O_3. LOI is loss on ignition.

	Date	SiO_2	TiO_2	Al_2O_3	FeOT	Fe_2O_3T	MnO	MgO	CaO
CAP-MLJ-0001	5/28/2008	75.06	0.209	11.84	2.64		0.041	0.44	0.10
CAP-MLJ-0001	9/24/2006	75.04	0.208	11.80	2.50		0.041	0.44	0.20
CAP-MLJ-0001	2/11/2007	75.12	0.208	11.91	2.61		0.040	0.42	0.10
CAP-MLJ-0001	10/17/2006	75.70	0.212	11.95	2.52		0.041	0.45	0.19
CAP-MLJ-0001	5/17/2008	75.13	0.208	11.87	2.53		0.041	0.43	0.10
CAP-MLJ-0001	9/9/2015	75.92	0.22	12.03		2.87	0.04	0.45	0.12
CAP-MLJ-0001	7/7/2015	75.31	0.21	12.03		2.84	0.04	0.46	0.11
CAP-MLJ-0001	9/29/2015	75.95	0.21	11.99		2.84	0.05	0.43	0.12
CAP-MLJ-0001	9/12/2015	75.31	0.21	12.03		2.84	0.04	0.46	0.11
CAP-MLJ-0001	7/15/2015	75.31	0.21	12.03		2.84	0.04	0.46	0.11
CAP-MLJ-0001	10/18/2015	75.62	0.22	11.98		2.84	0.04	0.44	0.12
CAP-MLJ-0001	10/18/2015	75.37	0.21	11.99		2.86	0.04	0.43	0.12
CAP-MLJ-0001	12/14/2015	75.24	0.21	11.98		2.83	0.04	0.48	0.11
CAP-MLJ-0001	12/14/2015	75.22	0.2	11.94		2.88	0.04	0.47	0.11
Average		75.38	0.21	11.95	2.56	2.85	0.04	0.45	0.12
Standard deviation		0.29	0.00	0.07	0.05	0.02	0.00	0.02	0.03
maximum		75.95	0.22	12.03	2.64	2.88	0.05	0.48	0.20
minimum		75.04	0.20	11.80	2.50	2.83	0.04	0.42	0.10

	Na_2O	K_2O	P_2O_5	S	C	LOI	Sum	Ba	Ce
CAP-MLJ-0001	0.96	4.83	0.051			2.71	98.89	347	90
CAP-MLJ-0001	0.92	4.84	0.053			2.66	98.71	339	96
CAP-MLJ-0001	0.93	4.82	0.049				96.19	341	95
CAP-MLJ-0001	0.96	4.88	0.052				96.93	343	92
CAP-MLJ-0001	0.95	4.84	0.054			2.71	98.87	344	97
CAP-MLJ-0001	1	4.82	0.05	0.47	0.06	2.35	100.40	341	93.4
CAP-MLJ-0001	0.98	4.85	0.05	0.42	0.06	2.63	99.99	337	90.2
CAP-MLJ-0001	0.98	4.82	0.05	0.47	0.07	2.44	100.42	330	89
CAP-MLJ-0001	0.98	4.85	0.05	0.42	0.06	2.63	99.99	337	90.2
CAP-MLJ-0001	0.98	4.85	0.05	0.42	0.06	2.63	99.99	337	90.2
CAP-MLJ-0001	0.99	4.84	0.05	0.52	0.05	2.31	100.02	347	92.4
CAP-MLJ-0001	1	4.78	0.05	0.51	0.06	2.27	99.69	360	94.8
CAP-MLJ-0001	0.99	4.81	0.05	0.43	0.05	2.31	99.53	334	88.8
CAP-MLJ-0001	0.98	4.8	0.05	0.37	0.05	2.31	99.42	338	85
Average	0.97	4.83	0.05	0.45	0.06	2.50	99.22	341.08	91.71
Standard deviation	0.02	0.02	0.00	0.05	0.01	0.17	1.21	6.94	3.11
maximum	1.00	4.88	0.05	0.52	0.07	2.71	100.42	360.00	96.70
minimum	0.92	4.78	0.05	0.37	0.05	2.27	96.19	330.00	85.00

	Cr	Cs	Cu	Dy	Er	Eu	Ga	Gd	Hf
CAP-MLJ-0001	97	4	36				22		
CAP-MLJ-0001	97		42				25		
CAP-MLJ-0001	95		40				22		
CAP-MLJ-0001	100		41				22		
CAP-MLJ-0001	101	3	37				21		
CAP-MLJ-0001	90	2.82	54	7.71	5.05	0.37	20.4	7.53	8.6
CAP-MLJ-0001	100	2.8	33	8.44	4.91	0.39	23.8	7.03	9.3
CAP-MLJ-0001	100	2.78	37	8.59	5	0.38	23.6	7.17	9.1
CAP-MLJ-0001	100	2.8	33	8.44	4.91	0.39	23.8	7.03	9.3
CAP-MLJ-0001	100	2.8	33	8.44	4.91	0.39	23.8	7.03	9.3
CAP-MLJ-0001	100	2.86	35	8.19	5.31	0.42	23	6.98	8.5
CAP-MLJ-0001	100	2.92	34	8.34	5.36	0.4	22.9	7.24	8.8
CAP-MLJ-0001	90	2.66	38	7.87	5.29	0.39	23.1	7.67	8.9
CAP-MLJ-0001	90	2.72	39	7.94	5.37	0.39	22.9	7.32	9.3
Average	97.09	2.86	37.92	8.22	5.12	0.39	22.80	7.22	9.01
Standard deviation	4.03	0.32	5.26	0.29	0.19	0.01	1.10	0.23	0.30
maximum	100.50	3.80	54.00	8.59	5.37	0.42	24.50	7.67	9.30
minimum	90.00	2.50	33.00	7.71	4.91	0.37	20.40	6.98	8.50

	Ho	La	Lu	Nb	Nd	Pr	Rb	Sm	Sn
CAP-MLJ-0001		42		31.9	39		155		
CAP-MLJ-0001		46		30.9	40		159		
CAP-MLJ-0001		51		32.0	40		160		
CAP-MLJ-0001		44		30.4	38		158		
CAP-MLJ-0001		49		31.7	40		154		
CAP-MLJ-0001	1.71	47.1	0.82	31.1	39.8	10.65	145.5	8.17	3
CAP-MLJ-0001	1.87	46.2	0.84	34	38.5	10.05	144	8.17	3
CAP-MLJ-0001	1.79	45.3	0.77	33.9	36.9	9.89	147.5	8.19	4
CAP-MLJ-0001	1.87	46.2	0.84	34	38.5	10.05	144	8.17	3
CAP-MLJ-0001	1.87	46.2	0.84	34	38.5	10.05	144	8.17	3
CAP-MLJ-0001	1.71	46.5	0.78	34.2	37.5	10.3	150.5	8.73	3
CAP-MLJ-0001	1.74	46.8	0.81	34.1	38.4	10.4	151	8.32	3
CAP-MLJ-0001	1.81	48.4	0.76	32.9	38.5	10.65	149.5	8.5	3
CAP-MLJ-0001	1.77	46.8	0.78	33.9	36.7	10.05	149	8.04	3
Average	1.79	46.47	0.80	32.79	38.52	10.23	150.84	8.27	3.11
Standard deviation	0.06	2.04	0.03	1.34	0.97	0.26	5.49	0.20	0.31
maximum	1.87	50.70	0.84	34.20	39.80	10.65	159.60	8.73	4.00
minimum	1.71	42.00	0.76	30.40	36.70	9.89	144.00	8.04	3.00

	Sr	Ta	Tb	Th	Tm	U	V	W	Y
CAP-MLJ-0001	70			13		6	21		52
CAP-MLJ-0001	74			13		5	19		46
CAP-MLJ-0001	71			14		5	19		52
CAP-MLJ-0001	73			13		5	20		52
CAP-MLJ-0001	71			13		5	19		52
CAP-MLJ-0001	67.8	2	1.27	12.65	0.77	4.96	17	4	46.2
CAP-MLJ-0001	68.7	2.1	1.25	13.55	0.81	5.05	18	5	46.5
CAP-MLJ-0001	69.4	1.9	1.27	12.9	0.76	4.92	18	5	47.3
CAP-MLJ-0001	68.7	2.1	1.25	13.55	0.81	5.05	18	5	46.5
CAP-MLJ-0001	68.7	2.1	1.25	13.55	0.81	5.05	18	5	46.5
CAP-MLJ-0001	69.9	1.9	1.24	13.5	0.8	5.25	16	5	46.7
CAP-MLJ-0001	71.1	1.9	1.28	13.65	0.78	5.14	40	5	47.9
CAP-MLJ-0001	64.8	1.9	1.3	12.35	0.76	4.74	16	5	47.5
CAP-MLJ-0001	65	1.9	1.28	12.5	0.77	4.75	15	4	46.9
Average	69.44	1.98	1.27	13.13	0.79	4.98	19.46	4.78	48.24
Standard deviation	2.42	0.09	0.02	0.53	0.02	0.23	5.87	0.42	2.32
maximum	74.00	2.10	1.30	14.20	0.81	5.50	40.00	5.00	52.10
minimum	64.80	1.90	1.24	12.35	0.76	4.60	15.00	4.00	46.00

	Yb	Zr	Ag	Cd	Co	Li	Mo	Ni	Pb
CAP-MLJ-0001		272						31	75
CAP-MLJ-0001		275						36	80
CAP-MLJ-0001		275						32	80
CAP-MLJ-0001		279						35	80
CAP-MLJ-0001		274						32	103
CAP-MLJ-0001	5.44	263	0.7	<0.5	2	10	23	34	85
CAP-MLJ-0001	5.36	271	0.5	<0.5	1	10	23	33	74
CAP-MLJ-0001	5.53	282	0.7	<0.5	1	10	24	37	78
CAP-MLJ-0001	5.36	271	0.5	<0.5	1	10	23	33	74
CAP-MLJ-0001	5.36	271	0.5	<0.5	1	10	23	33	74
CAP-MLJ-0001	5.14	272	0.7	<0.5	1	20	25	33	80
CAP-MLJ-0001	5.34	262	0.5	<0.5	1	10	23	33	81
CAP-MLJ-0001	5.29	279	0.8	<0.5	1	10	27	38	86
CAP-MLJ-0001	5.29	305	0.7	<0.5	1	10	25	37	89
Average	5.35	275.11	0.62		1.11	11.11	24.00	34.05	81.33
Standard deviation	0.10	9.84	0.11		0.31	3.14	1.33	2.12	7.44
maximum	5.53	305.00	0.80		2.00	20.00	27.00	38.00	102.80
minimum	5.14	262.00	0.50		1.00	10.00	23.00	31.30	74.00

	Sc	Zn	As	Bi	Hg	Sb	Sc	Se	Te
CAP-MLJ-0001		51							
CAP-MLJ-0001		50							
CAP-MLJ-0001		54							
CAP-MLJ-0001		53							
CAP-MLJ-0001		51							
CAP-MLJ-0001	0.3	56	5.6	2.28	0.009	0.15		0.5	0.86
CAP-MLJ-0001	0.3	50	5.1		0.009	0.17		0.5	0.87
CAP-MLJ-0001	2	68	4.8	2.2	0.009	0.11	0.3	0.5	0.8
CAP-MLJ-0001	2	50	5.1	2.21	0.009	0.17	0.3	0.5	0.87
CAP-MLJ-0001	2	50	5.1	2.21	0.009	0.17	0.3	0.5	0.87
CAP-MLJ-0001	2	47	5.4	2.37	0.007	0.15	0.3	0.6	0.78
CAP-MLJ-0001	2	54	5.3	2.41	0.008	0.19	0.3	0.7	0.76
CAP-MLJ-0001	2	54	5.5	2.49	0.013	0.16	0.3	0.6	0.84
CAP-MLJ-0001	2	55	5.6	2.43	0.021	0.16	0.3	0.7	0.84
Average	1.62	53.08	5.28	2.33	0.01	0.16	0.30	0.57	0.83
Standard deviation	0.71	4.79	0.26	0.11	0.00	0.02	0.00	0.08	0.04
maximum	2.00	68.00	5.60	2.49	0.02	0.19	0.30	0.70	0.87
minimum	0.30	47.00	4.80	2.20	0.01	0.11	0.30	0.50	0.76

	Tl	Au
CAP-MLJ-0001		
CAP-MLJ-0001		
CAP-MLJ-0001		
CAP-MLJ-0001		
CAP-MLJ-0001		
CAP-MLJ-0001	0.16	0.004
CAP-MLJ-0001	0.15	0.003
CAP-MLJ-0001	0.15	0.003
CAP-MLJ-0001	0.15	0.003
CAP-MLJ-0001	0.15	0.003
CAP-MLJ-0001	0.16	0.002
CAP-MLJ-0001	0.16	0.002
CAP-MLJ-0001	0.17	0.003
CAP-MLJ-0001	0.16	0.003
Average	0.16	0.003
Standard deviation	0.01	0.001
maximum	0.17	0.004
minimum	0.15	0.002

Summary

Samples were collected, prepared, and analyzed according to standard methods for each specific laboratory analysis. Samples were collected in the field and kept under direct control of the authors to avoid contamination. Samples are archived at the NMBGMR. Samples collected are complete, comparable, and representative of the defined population at the defined scale as documented in this appendix. Precision and accuracy are measured differently for each field and laboratory analysis (parameter), and are explained in the methods section of this report and McLemore and Frey (2009). Most geochemical laboratory analyses depend upon certified or on-going reference standards and duplicate analyses as defined above. The sampling and analysis plans for each segment of the field program and the control of accuracy and precision as defined here, provides a large high-quality set of observations and measurements that are adequate to support the interpretations and conclusions of this report. Field and laboratory audits by the senior author were performed to ensure that procedures were followed.

References (Appendix 10)

Davis, B., 1998, What is a sample? What does it represent? Australian Institute of Geoscientists Bulletin, v. 22, p. 39-34.

Downing, B., 2008, ARD sampling and sample preparation: http://technology.infomine.com/enviromine/ard/sampling/intro.html, accessed 8/7/2008.

Koch, G.S., Jr. and Link, R.F., 1971, Statistical analysis of geological data: Dover Publications, Inc., New York, ISBN 0-486-64040-X, 438 p.

McLemore, V.T. and Frey, B.A., 2009, Appendix 8. Quality control and quality assurance report (Task B1); *in* McLemore, V.T., Dickens, A., Boakye, K., Campbell, A., Donahue, K., Dunbar, N., Gutierrez, L., Heizler, L., Lynn, R., Lueth, V., Osantowski, E., Phillips, E., Shannon, H., Smith, M., Tachie-Menson, S., van Dam, R., Viterbo, V.C., Walsh, P., and Wilson, G.W., Characterization of Goathill North Rock Pile: New Mexico Bureau of Geology and Mineral Resources, Open-file report 523, https://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=523, accessed 1/6/2019.

Rollinson, H.R., 1993, Using geochemical data: evaluation, presentation, interpretation: Longman Scientific and Technical, John Wiley and Sons, New York, 352 p.

Neuendorf, K.K.E., Mehl, J.P., Jr., and Jackson, J.A., 2005, Glossary of Geology: American Geological Institute, 5th ed., Alexandria, Virginia, 779 p.

Schreuder, H.T., Ernst, R., and Ramirez-Maldonado, H., 2004, Statistical techniques for sampling and monitoring natural resources: U.S. Department of Agriculture, Rocky Mountain Research Station, Fort Collins, CO, General Technical Report-GTR-126, 111 p.

Wellmer, F.W., 1989, Statistical evaluations in exploration for mineral deposits: Springer-Verlag, New York, ISBN 3-540-61242-4, 379 p.

APPENDIX 11. HYDROLOGIC CHARACTERISTICS

Results utilizing software available from the USGS (https://streamstats.usgs.gov/ss/, accessed 1/6/2019).

StreamStats Output Report			Rosedale		
State/Region ID	NM				
Workspace ID	NM20180604211123243000				
Latitude	33.81766				
Longitude	-107.43316				
Time	6/4/2018	3:11:41 PM			
Basin Characteristics					
Parameter Code	Parameter Description	Value	Unit		
DRNAREA	Area that drains to a point on a stream	0.0834	square miles		
HIGHREG	HIGHREG	1097	dimensionless test		
ELEV	Mean Basin Elevation	8480	feet		
I24H100YA2	Maximum 24-hour precipitation that occurs on average once in 100 years from NOAA Atlas 2	3.82	inches		
BSLDEM30ff	Mean basin slope computed from 30 m DEM in feet per foot	0.49	percent		
PRECIP	Mean Annual Precipitation	15.7	inches		
Peak-Flow Statistics Parameters	100 Percent Peak 2008 5119 Central MtnValley Flood Region 6				
Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0834	square miles	0.18	7220
HIGHREG	HIGHREG	1097	Dimensionless test		
*** Peak-Flow Statistics Disclaimers ***					

Warnings	One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors				
Peak-Flow Statistics Flow Report	100 Percent Peak 2008 5119 Central MtnValley Flood Region 6				
Statistic	Value	Unit			
2 Year Peak Flood	46.8	ft^3/s			
5 Year Peak Flood	119	ft^3/s			
10 Year Peak Flood	189	ft^3/s			
25 Year Peak Flood	310	ft^3/s			
50 Year Peak Flood	424	ft^3/s			
100 Year Peak Flood	563	ft^3/s			
500 Year Peak Flood	992	ft^3/s			
Application Version: 4.2.1					

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

USGS Software Disclaimer: This software has been approved for release by the U.S. Geological Survey (USGS). Although the software has been subjected to rigorous review, the USGS reserves the right to update the software as needed pursuant to further analysis and review. No warranty, expressed or implied, is made by the USGS or the U.S. Government as to the functionality of the software and related material nor shall the fact of release constitute any such warranty. Furthermore, the software is released on condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from its authorized or unauthorized use.

USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.