The Characterization of the Rosedale Mining District, Socorro County, New Mexico

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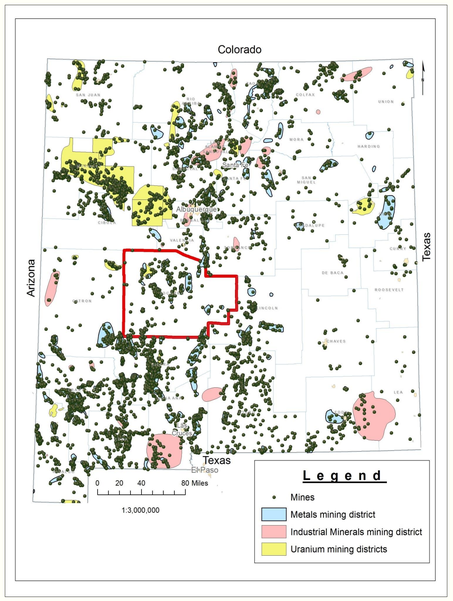


There are more than 10,000 legacy mines located in New Mexico (Source: NMBGMR)

Rosedale mine

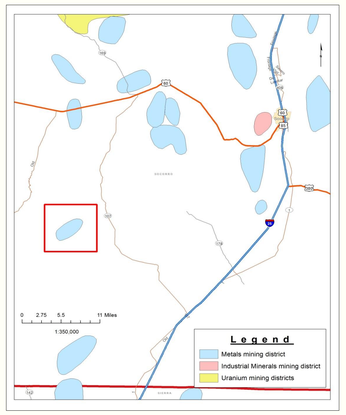
Introduction

Rosedale district is located in Socorro County, New Mexico and lies on the northeastern slope of the San Mateo Mountains south of Magdalena. Rosedale deposits are in hydrothermal quartz-rich breccia veins along faults cutting the South Canyon Tuff. The district is one of the important gold-producing districts in Socorro County, but Rosedale and Bell mines are the only two major properties. Rosedale was discovered in 1882, mining started in 1886 and ceased in 1911. A 10-stamp mill in 1891 and a cyanide plant in 1900 were built. The district remained inactive until the mid 1930's, when the Black Bear Mining Company and Rosedale Gold Mines Ltd produced for a short while. The mine finally closed in 1941. The Bell mine is located about 1.5 km southwest of the Rosedale mine and has a history roughly paralleling that of Rosedale. The Bell mine produced a small amount in the early 1900's. The foundation of a small crushing plant still stands just east of the Bell adit, but the history of operation is unknown. An estimated total value of metals (Au and Ag) produced from Rosedale district between 1882 to 1981 amounted to about $500,000.

Porphyritic rhyolite – Bell mine

Rhyolitic tuff – Rosedale mine

Glassy Quartz veins – Rosedale mine



Location of Rosedale District, Socorro County, New Mexico

Geologic Setting

Rosedale district lies in a tectonically active and structurally complex area and is 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. Timing of the mineralization and alteration in the Rosedale district was probably shortly after emplacement of the late-Oligocene South Canyon Tuff. Argillic alteration typically overprints and cross-cuts fault zones that juxtapose altered and unaltered rock. The mineralization occurs in a well-developed vein that is brecciated and sheared in rhyolite porphyry. The shear zone extends into a footwall of white rhyolite porphyry. The hanging wall is pale reddish-brown rhyolite porphyry, and breccia fragments of this rock are abundant in the vein. The brecciated and sheared rhyolite has been partly cemented by banded bluish-white quartz. This has also been fractured, and the entire mass has been recemented with glassy vein quartz. The walls have been silicified, and the outcrop stands out clearly. There is a small quantity of limonite throughout, and manganese dioxide occurs near the portal of the adit in stringers and as films on the fracture surfaces. Sulfides appear above the water level, which is at a depth of 726 ft. Some of the quartz in the oxidized zone above the water level contains cavities formerly occupied by other minerals.

Abstract

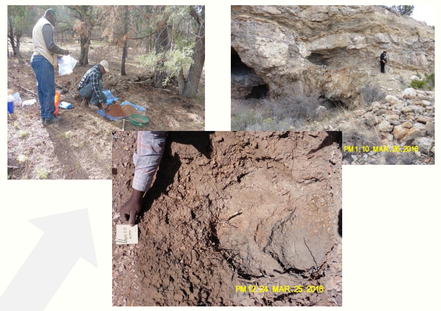
Mining has played an important role in the economic development of western United States, but has resulted in thousands of abandoned or legacy mines, some of which pose physical and even chemical hazards to the public and the environment. Despite the closure of many mine features as a way to mitigate physical safety hazards, state and federal agencies are concerned that some of these features could still pose an environmental risk after closure. The objective of this research is to develop cost-efficient methods of inventorying and characterizing these abandoned mine lands, using the Rosedale and Bell mines in the Rosedale mining district, Socorro County, New Mexico as a case study. By utilizing standard inventory techniques in the field and standard testing of waste rock materials, potential physical and chemical hazards posed by these abandoned mine sites will be evaluated. Concentrations of metals will be measured in samples from waste rock piles and tailings materials identified, in order to evaluate sites and environmental effect of these materials to soils and humans.

Goals of the Project

- Inventory, characterize, and prioritize hazards at legacy mines within Rosedale district and evaluate potential risks
- Determine if the waste rock piles are suitable for backfill material for closing these features
- Assess the stabilities of these mine features (waste rock piles and tailings materials)

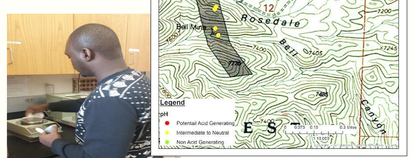
Data collecting at mine features

Waste rock pile Sampling

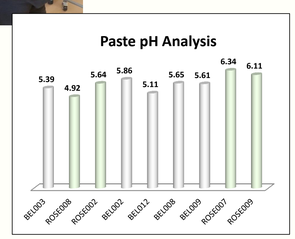


Methods of Investigations

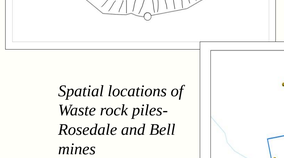
Field Inventory
Field inventory in the study area was using a detailed procedure modified by NMBGMR using the Bureau of Land Management (BLM), U.S. Forest Service, and Utah AML Bureau methods.
Waste Rock pile sampling
Representative samples from larger waste rock piles were collected for paste pH, geochemical and mineralogic, and general stability analyses.
Mapping of Waste rock Piles
Mapping and estimating volumes of waste piles was conducted
Laboratory Analysis of Waste Pile Samples
- Geochemical analysis-13 samples from Rosedale and Bell mines analyzed
  - XRD/XRF analyses
  - Electrons Microprobe Analysis
- pH and Conductivity measurements–9 samples from Rosedale and Bell mines analyzed
- Particle Size Analysis

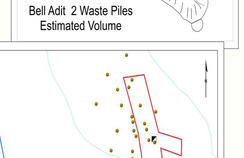


Spatial locations of pH values



Laboratory analysis of waste rock pile samples





Spatial locations of Waste rock piles- Rosedale and Bell mines

Mapping of waste rock piles

Paste pH

Paste pH measurements provide a quick indication of readily available acidity or alkalinity in fine-grained mine waste materials. Paste pH is useful for identifying areas for further sampling and determines geochemical behavior of waste materials subjected to weathering under field conditions. Paste pH procedure for the analysis used 25 g of sieved (<60 mesh) samples dissolved in 25 mL distilled or deionized water and allowed to stand for 10 minutes before measurement is taken. The pH meter was calibrated with pH 4.00 and pH 7.00 buffer solutions and measurements are taken for the pH within 5 minutes with a calibrated pH meter equipped with an appropriate electrode for immersion in soil pastes.

Conductivity measurements are taken by immersing the probe into sample paste.

Results

pH Analysis

Mine	Minimum pH	Maximum pH	Comment
Rosedale mine	4.92	6.11	Possible acid generating potential for pH values <5. Further testing required for these samples.
Bell mine	5.11	5.86	Not potentially acid generating unless significant evidence of acid rock drainage are observed in the field.

Geochemical Analysis

Mine	Element	Average	Min	Max
Rosedale mine	Au(ppm)	1.60	0.011	3.61
	Fe2O3(%)	1.55	0.76	3.10
	SiO2(%)	82.70	74.7	94.42
	Th (ppm)	12.28	1.74	21.30
	U(ppm)	5.97	2.86	8.15
	Ag(ppm)	33.45	0.8	72.70
	As(ppm)	16.70	5.6	34.6
	Te(ppm)	0.24	0.04	0.81
Bell mine	Au(ppm)	0.18	0.006	0.403
	Fe2O3(%)	1.23	0.89	1.75
	SiO2(%)	80.89	73.21	91.6
	Th(ppm)	16.90	0.9	26.70
	U(ppm)	5.71	2.51	10.85
	Ag(ppm)	10.58	0.9	25.20
	As(ppm)	9.50	6.2	13.6
	Te(ppm)	0.01	0.01	0.02

Field Observation

Mine	Mine Features	Depth of workings(ft)	Comment
Rosedale mine	Shafts, Pits, Adit, Tailings, 7 levels, Mill Foundations, Trenches	2 – 726	Physical hazards present
Bell mine	Tailings, Shafts, Adit, Mill foundations, Pits	2 - >50	Physical hazards present

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Generally, there was no evidence of acid drainage from field observations. Laboratory analysis of paste pH of Rosedale and Bell mine samples indicated little or no potential for acid generation, however there is at least one sample at the Rosedale mine (ROSE008) that had pH value of <5, suggesting the material potential for acid generation. Geochemical analysis values of waste rock samples from both areas also showed indications of elevated metals, specifically for Au, Ag, Te, Fe_2O_3 and other elements compared to USGS and EPA estimated minimum abundance of these elements for waste rock piles. Most waste rock piles are at the natural angle of repose or less (<38 degrees) and appears to be stable with no indications of failure' except for minor erosion.

Petrography, electron microprobe analyses, XRF, XRD will be performed on the samples for texture, geochemistry and mineralogy. Particle size analysis will also be performed. Assessment of all these will assist in the final hazard ranking of these areas that will be applicable for the area. Determination of hydrologic conditions will be made (estimate annual precipitation rates from published reports, depth of groundwater from New Mexico State Engineer and NMBGMR data, estimate of runoff, and erosion rates).

ACKNOWLEDGEMENTS

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