THE CHARACTERIZATION OF ABANDONED URANIUM MINES IN NEW MEXICO

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ABSTRACT

Not only has mining played a significant role in the United States, but for hundreds of years mining has aided in the economic and social development of New Mexico as early as the 1500s. One of the earliest gold rushes in the West was in the Ortiz Mountains (Old Placers district) in 1828, 21 years before the California Gold Rush in 1849. At the time the U.S. General Mining Law of 1872 was written, there was no recognition of the environmental consequences of direct discharge of mine and mill wastes into the nation's rivers and streams or the impact of this activity on the availability of drinking water supplies, and riparian and aquatic habitats. Miners operating on federal lands had little to no requirement for environmental protection until the 1960s and 1970s, although the dumping of mine wastes and mill tailings directly into the nation's rivers was halted by an Executive Order in 1935. It is important to recognize that these early miners were not breaking any laws, because there were no laws to break.

In New Mexico, there are tens of thousands of inactive or abandoned mine features in 274 mining districts and prospect areas (including coal, uranium, metals, and industrial minerals districts and prospect areas; McLemore et al., 2005a, b). The New Mexico Abandoned Mine Lands Bureau (NMAMLB) of the New Mexico Energy, Minerals and Natural Resources Department estimates that there are more than 15,000 abandoned mine features in the state (http://www.emnrd.state.nm.us/MMD/AML/amlmain.html). NMAMLB has safeguarded more than 2,300 mine openings in about 250 separate construction projects. The U.S. Bureau of Land Management recently estimated that more than 10,000 mine features are on BLM land in New Mexico and only 705 sites have been reclaimed (http://www.blm.gov/wo/st/en/prog/more/Abandoned_Mine_Lands/abandoned_mine_site.html).

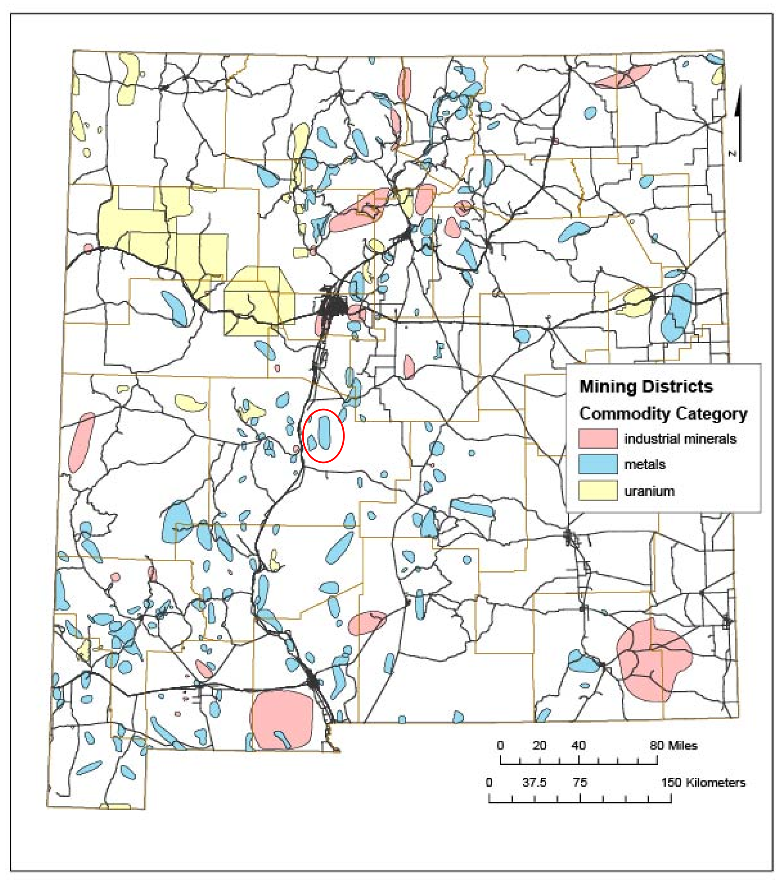
The New Mexico Bureau of Geology and Mineral Resources has collected published and unpublished data on the districts, mines, deposits, occurrences, and mills since it was created in 1927 and is slowly converting historical data into a relational database, the New Mexico Mines Database (McLemore et al., 2005a,b). More than 8,000 mines are recorded in the New Mexico Mines Database and more than 7,000 are inactive or abandoned. These mines often include two or more actual mine features.

Many of these mine features do not pose any physical or environmental hazard and many more, pose only a physical hazard, which is easily but costly to remediate. However, a complete inventory and prioritization for reclamation has not been accomplished in New Mexico. Some of these inactive or abandoned mine features can pose serious health, safety and/or environmental hazards, such as open shafts and adits (some concealed by deterioration or vegetative growth), tunnels that contain deadly gases, highwalls, encounters with wild animals, radon and metal-laden waters. Some sites have the potential to contaminate surface water, groundwater and air quality. Heavy metals in mine waste or tailings and acid mine drainage can potentially impact water quality and human health.

A recent example is the Gold King mine 'blowout' incident in Colorado where approximately 3 million gallons of acid mine water eroded soil and rock debris from the mine portal, pyritic rock and soil from adjoining waste rock dump, and were deposited in Cement Creek, and ultimately, flowing downstream to contaminate the Animas and San Juan Rivers (Gobla et al., 2015). Environmental accidents also have occurred at some New Mexico mine sites, mostly before the 1980s. In July 1979, 370,000 cubic meters of radioactive water containing 1,000 tons of contaminated sediment from a failure of the United Nuclear uranium tailings dam traveled 110 km downstream in the Rio Puerco in western New Mexico. Evidence of slope instability at the Goathill North waste rock pile at Questa molybdenum mine was observed as early as 1974, but was not stabilized until 2004.

Many state and federal agencies have mitigated the physical safety hazards by closing these mine features, but very few of these reclamation efforts have examined the long-term chemical effects from these mine sites. There is still potential for environmental effects long after remediation of the physical hazards, as found in several areas in New Mexico (for example Terrero and Questa mines; McLemore et al., 2001, 2009, 2010). Some of these observations only come from detailed electron microprobe studies that are not part of a government remediation effort (McLemore et al., 2009, 2010).

The objective of our research is to develop a better procedure to inventory and characterize inactive or abandoned mine features in New Mexico, using the Lucky Don and Little Davie uranium mines in the Chupadero mining district, Socorro County, New Mexico as an example. Hazard ranking of mine openings and features, using BLM ranking methodology will be utilized for most sites (Bureau of Land Management, 2014). Also we want to suggest remedial activities that would manage or mitigate dangers to the environment and public health, while taking into al resource potential.



Mining districts in New Mexico. Chupadero district is circled.

INTRODUCTION

The Lucky Don mine is located east of Socorro in the Bustos Well 71/2 quadrangle sheet and NE$^1/_4$ NE1/4 section 35 on the west side of a ridge in the in Chupadero mining district. The Lucky Don mine in February 1955, was first staked by E.R. Caprio. By 1955, Lucky Don was owned by Holly Uranium Corporation, who started a small open pit. Operations soon ended the following year due to failure of the rotary drilling methods which were unable to break through hard quartzitic sandstones. Lucky Don remained inactive. In 1959, exploration at Lucky Don continued until 1960 by the Lucky Don Uranium Co. and McKedy Mining and Exploration Co. upon the request of Miss McKedy. New claims were re-staked in 1961 under the name of R.L. Lummus, Paz Muriel, and Lorenzo Muriel. During this time, Lucky Don was referred to as Bonanza mine up until 1966 when Lummus leased the Bonanza claims to the Hallwood Corporation, represented by Karl Meyers in Dallas, TX. Hallwood Corporation completed a line of wagon drill holes ($630 total), along with extensive engineering work. In 1968, Bonanza mine was represented by geologist Philip M. Robertson, who filed proofs of labor on the mines claims. Final proof of labor, filed in mid-1969 by Robertson ensured the mine had produced $4,759.01 of core drilled. Included in this price are sampling and geological analyses (Mathewson, 1970). Total production from 1955 through 1963 amounted to 1,002 short tons of ore containing 4,490 pounds of U_3O_8 and 6,020 pounds of V_2O_5. Average grade of ore shipments ranged from 0.16% to 0.30% U_3O_8.

GEOLOGY

Lucky Don is accessible by the dirt road that leaves Highway 380 about 10 miles east of San Antonio. The Lucky Don mine lies in a complex faulted zone at the margin of the east side of the Rio Grande graben. The rock formations mostly consist of the Permian Yeso Formation, Glorieta Sandstone, and San Andres Formation. These formations are considered to be interbedded continental and marine in orogin and represent transgressions and regressions of the Permian seas. Lucky Don mine is hosted by the Yeso Formation which consist primarily of beds of sandstone, shale, siltstone, limestone and gypsum. Local rock types at the mine include orange to red, buff and yellow sandstones, gypsiferous siltstone, gypsum, siltstone and limestone.

PURPOSE

The objective of our research is to develop a better procedure to inventory and characterize inactive or abandoned mine features in New Mexico, using the Lucky Don and Little Davie uranium mines in the Chupadero mining district as an example. Hazard ranking of mine openings and features, using BLM ranking methodology will be utilized for most sites (Bureau of Land Management, 2014). Also we want to suggest remedial activities that would manage or mitigate dangers to the environment and public health, while taking into consideration historical, cultural and wildlife issues and mineral resource potential.

METHODOLOGY

The following methods were used during the visit to the Lucky Don Site. Readings collected from the scintillometer mapping and the paste pH will be used to determine future work in the Lucky Don area.

Geologic and Scintillometer Mapping

A scintillometer is an instrument which measures naturally occurring radioactivity and displays that data as counts per second (cps). Using standard survey and mapping techniques and instruments, including the RS-111 HANDY SCINT, a to-scale map of the Lucky Dom Mine was created for this report (Fig.1). The map shows the outline of the perimeter of the mine, and the locations of the stub adits and waste piles. The 16 points that can be seen on the map mark the locations used in mapping the mine, and most importantly are accompanied by scintillometer readings for that exact location. The importance of the various scintillometer readings recorded provide information on the variations/fluctuations in the level of radioactivity within the stub adits, and around the entire vicinity of the mine. The values from the scintillometer can be seen at each point after the dash. GPS data was recorded at the initial survey point, as well as at the base and berm of the waste rock pile.

Paste pH

Paste pH measurements of representative samples collected from the berms along the waste pile were determined following the guidelines of SOP No.11: Paste pH and Paste Conductivity. The importance of collecting paste pH is a preliminary indication of whether a material is likely to produce acidic drainage. These tests do not, however, provide any data regarding when acidification may occur or the rates at which acid generation and neutralization reactions will ensue.

The paste pH measurements taken from the representative samples collected averaged pH~8.1. See Table 1 for paste pH readings taken in the Economic Geology Lab at the New Mexico Bureau of Geology and Mineral Resources.

SUMMARY

The Lucky Don mine cuts across a NE trending normal fault that displaces the San Andres Formation against the Yeso Formation. The rock bed has been cut on the upper side of the San Andres Formation and filled on the lower side on the Yeso Formation. The mine features include three stub adits, one exploration adit, one pile, two (washed out) mine roads, and one structure. Please see images. Three stub adits were found at the Lucky Don mine. The deeper stub adit had dimensions of 4 ft high and 6 ft wide. The other two adits had dimensions approximately 6 ft high and 6 ft wide. One exploration stub adit, and one waste pile were mapped via GPS surveying (Figure 1). The area west of the stub adits was the top of the waste pile. One main waste pile was found at the Lucky Don mine. The waste pile is located west (below) of the four stub adits. The waste pile was measured to be declining at roughly 37° west-southwest. An old wooden ore shoot still stands along the west-southwestern slope of the Lucky Don waste pile. Most of the wood appeared to be rotting, being deemed unsafe. Other mining related buildings were not observed. The only other mining feature present is a washed out road that was used during when the mine was active. The road runs east to west, just north of Lucky Don. There is evidence of several drilling holes, indicating the Lucky Don mine was tested. No obvious reclamation activities were observed. The stub adits are partially filled with sediment and rocks. The waste pile has not been reclaimed.

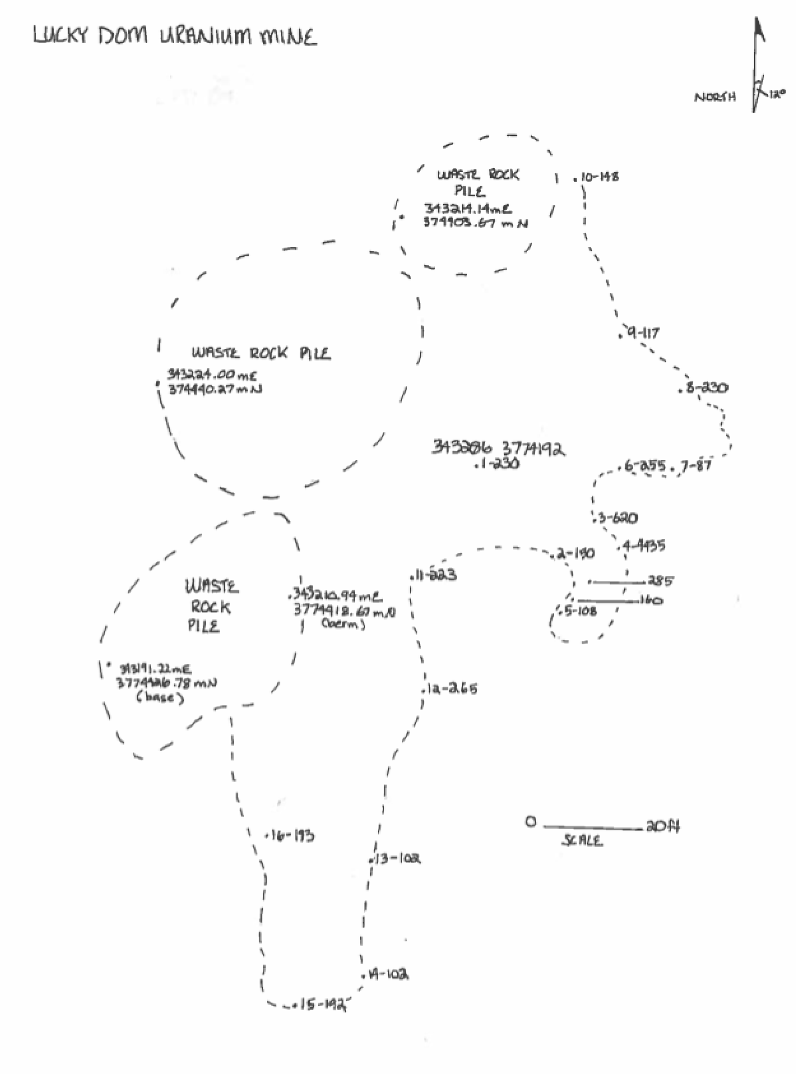
RECOMMENDATIONS

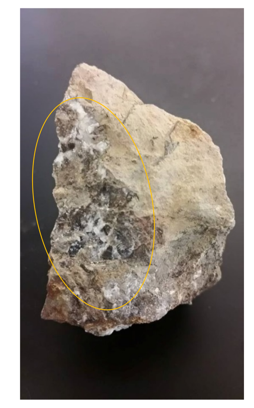
Additional testing includes whole rock analyses and petrology of the waste rock material and estimate of volumes and tonnages of waste and rock piles. Final Hazard ranking will be determined. Determination of hydrologic conditions will be made (estimate annual precipitation rates from published reports, depth of groundwater from State Engineers and NMBGMR data, estimate runoff, erosion rates).

Location and Field Relationships

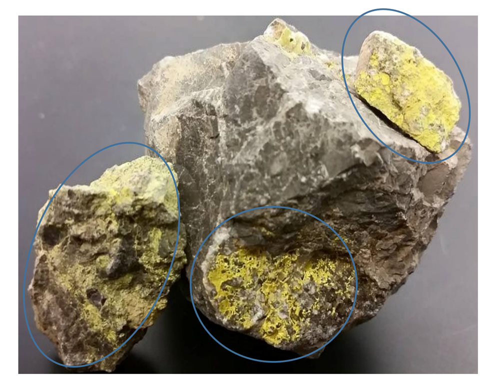
Main stub adits (above, left). General scintollometer mapping of the stub adits (below).

Base of waste pile looking northeast.





A sample of host rock containing uraninite from Lucky Don mine.



Samples of waste pile rocks with disseminated Carnotite from Lucky Don mine.

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