THE CHARACTERIZATION OF ABANDONED URANIUM MINES (AUM) IN NEW MEXICO

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OUTLINE

- Background
- Problem Identification
- Objectives
- Study Area
- Methodology
- Observations
- Conclusions
1948 – 2002, >347 million pounds of U was produced in NM cumulatively amounting >$ 4.7 billion

Aftereffects of Mining and Exploration in NM has resulted in >300 legacy Abandoned Uranium Mines (AUM)

>1000 uranium prospects and occurrences in NM (>100 ppm U)

These mines/prospects typically include two or more actual mine features
Many of these AUM pose little or no environmental or stability threat to the public and environment, but field examination is required to be certain.

New Mexico Mining and Minerals Division (NMMMD) has assessed approximately 57 AUM.

Most larger uranium mines have been or are being reclaimed by the former operating companies.
Reclamation efforts have not examined the long-term chemical effects from these mines.

There is still potential for environmental effects long after remediation of the physical hazards, as found in several areas in NM including Jackpile mine, Laguna subdistrict.

Some of these observations only come from detailed electron microprobe studies.

Many more legacy mines in NM, which either have not been safely remediated or closed or their status is unknown.
OBJECTIVES

➢ To develop a relatively quick and inexpensive procedure to inventory and characterize legacy uranium mines

► Determination of criteria for use of existing rock piles for backfill material

► Location of additional sources of backfill material if available

► Estimates of how local weather would affect the remediation

► Determine if there is potential for leaching U, V from waste materials
STUDY AREA

- Lucky Don and Little Davie uranium mines
  - Rio Grande Rift Cu-Ag (U) vein deposit type along faults in the Permian San Andres Formation
  - Lucky Don produced 1955–1963 U, V from limestone by surface and underground methods
  - Little Davie: U, V mined from limestone by surface and underground methods in 1955
  - Estimated value of U produced by Lucky Don and Little Davie $70,000
Mining districts within Socorro County

Lucky Don & Little Davie AUM
Examples of Legacy mine features

Loading bin, Lucky Don

Waste pile

Mine face
STUDY AREA

Jeter mine

✓ Rio Grande Rift Cu-Ag (U) vein deposit type along a fault between Proterozoic Capirote granite and the Miocene(?) sediments

✓ 1954–1958 U, V were mined from the clay zone in fault gouge along the Jeter fault by surface and underground mining methods

✓ Total U produced from Jeter mine amounts to 58,562 pounds worth $500,000
MAP OF STUDY AREA

Mining districts within Socorro County

Jeter AUM
OUR APPROACH

SAMPLE CHARACTERIZATION FLOW CHART

- Conduct Legacy Mine assessment of mine feature
  - Enter Information into NM Mines Database
  - Specific Gravity

- Paste pH and paste conductivity, Fizz test
  - No further Lab work
    - Is pH >5
      - Leach tests, Kinetic test
        - Stability issues
          - Moisture content
          - Density
          - Atterburg limits
          - Shear box tests

- Collect SAMPLE
  - Rock Samples
    - Petrography (binocular, thin section), microprobe
    - Chemistry/mineralogy sample (bags)
      - Air dried and split
        - Crushed
          - XRF, XRD

For Reclamation

Key:
- N = Feature not large enough for Reclamation
- Y = Feature large enough for Reclamation
METHODOLOGY

- GPS/scintillometer map
- Waste rock pile sampling
## OBSERVATIONS

*(scintillometer mapping)*

<table>
<thead>
<tr>
<th>Abandoned Uranium Mine</th>
<th>Background Radiation (cps)</th>
<th>Min Radiation (cps)</th>
<th>Max Radiation (cps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucky Don</td>
<td>20-50</td>
<td>100</td>
<td>4,435</td>
</tr>
<tr>
<td>Little Davie</td>
<td>20-50</td>
<td>120</td>
<td>771</td>
</tr>
<tr>
<td>Jeter</td>
<td>10-30</td>
<td>80</td>
<td>1,640</td>
</tr>
<tr>
<td>Abandoned Uranium Mine</td>
<td>Mine Feature</td>
<td>Depth of Workings (ft)</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------</td>
<td>------------------------</td>
<td></td>
</tr>
<tr>
<td>Lucky Don</td>
<td>6 stub adits, loading bin, waste/ rock pile</td>
<td>0–40</td>
<td></td>
</tr>
<tr>
<td>Little Davie</td>
<td>Pit, short adit, waste/ rock pile</td>
<td>5–10</td>
<td></td>
</tr>
<tr>
<td>Jeter</td>
<td>Concrete platform, 3 waste pile</td>
<td>300</td>
<td></td>
</tr>
</tbody>
</table>
# OBSERVATIONS (ore minerals & paste pH)

<table>
<thead>
<tr>
<th>Abandoned Uranium Mine</th>
<th>Ore Minerals</th>
<th>Paste pH</th>
<th>Field evidence of potential acid drainage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucky Don</td>
<td>tyuyamunite, carnotite, uraninite, Cu minerals, uranophane</td>
<td>~8.16</td>
<td>No</td>
</tr>
<tr>
<td>Little Davie</td>
<td>tyuyamunite, carnotite, uraninite, Cu minerals, uranophane</td>
<td>~8.24</td>
<td>No</td>
</tr>
<tr>
<td>Jeter</td>
<td>carnotite, tyuyamunite alunite, pitchblende, malachite, Fe-Mn oxides, clay, azurite, barite, calcite</td>
<td>~7.70</td>
<td>No</td>
</tr>
</tbody>
</table>
OBSERVATIONS (Mineralized samples)

- Carnotite
- U, V (uraninite?)

Samples of waste pile rocks with disseminated carnotite from Lucky Don

A mineralized sample of host rock from Lucky Don mine (4,435 cps)

A mineralized sample of host rock from Little Davie mine (771 cps)
OBSERVATIONS (Electron microprobe)
OBSERVATIONS (Electron microprobe)

CaCO$_3$

Fe-oxide
OBSERVATIONS (Electron microprobe)
Elevated U and V values (>100ppm)

<table>
<thead>
<tr>
<th>Waste Rock Pile</th>
<th>Uranium (ppm)</th>
<th>Vanadium (ppm)</th>
<th>Thorium (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jeter 1</td>
<td>23.7</td>
<td>93</td>
<td>14.1</td>
</tr>
<tr>
<td>Jeter 29</td>
<td>75.1</td>
<td>101</td>
<td>12.4</td>
</tr>
<tr>
<td>Jeter 31</td>
<td>138</td>
<td>74</td>
<td>13.8</td>
</tr>
<tr>
<td>Little Davie</td>
<td>160.5</td>
<td>457</td>
<td>1.32</td>
</tr>
<tr>
<td>Lucky Don</td>
<td>126.5</td>
<td>563</td>
<td>1.96</td>
</tr>
</tbody>
</table>
No evidence of potential acid drainage from field observations
No pyrite observed in XRD and electron microprobe analysis
No acid drainage potential from paste pH measurements (pH>5)
Elevated radioactivity (scintillometer mapping) and U and V values (>100 ppm) from chemical analyses in some waste rock piles
Waste piles should be covered
FUTURE WORK

- Proper evaluations for reclamation will be performed after all laboratory analyses data have been completed.
- Further field studies needed to determine the mineral potential of area.
THANK YOU!

QUESTIONS