SOIL DEVELOPMENT IN RESPONSE TO GEOMORPHIC RECLAMATION IN THE SEMI-ARID WEST

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Mining in Wyoming

- Magnitude of disturbance varies by method and intensity
  - Drastic topographic modifications
  - Exposure of geologic materials
  - Contamination, pollution
  - Erosional susceptibility
  - Loss of vegetative & habitat

- Wyoming top U-ore producer

Reclamation

- Restoration required by law (Surface Mining Control and Reclamation Act- SMCRA)

- Challenges of restoration in a high altitude, semi-arid environment
  - Low precipitation
  - Extreme temperatures
  - High intense winds
  - Little available and "healthy" topsoil

Landscape Reconstruction

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<th>Traditional Methods</th>
<th>Geomorphic Methods</th>
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<td>Landform design</td>
<td>Simple, uniform slopes and terraces</td>
<td>Complex landforms</td>
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<td>Geomorphic stability</td>
<td>Features to redirect water runoff</td>
<td>Long term stability?</td>
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<td>Hydrologic connectivity</td>
<td>Not integrated</td>
<td>Incorporated drainages, connected</td>
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<td>Resilience</td>
<td>Maintenance, erosion</td>
<td>Increased?</td>
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<td>Aesthetics</td>
<td>Not often seen in nature</td>
<td>Mimic natural environment</td>
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Gas Hills, Wyoming

- Abandoned pit mine (1975-1982)
- Reclaimed in 2006/2007 using both TRADITIONAL and GEOMORPHIC techniques on adjacent sites
  - Local topsoil stockpiled
  - 10 years later…
- Surrounding soils classified as Aridisols & Inceptisols. This site classified as “mine/dump”
  
  MAT: 5°C (42°F)
  Rainfall: 25 cm (10 in)
  Elevation: 2,133 m (~7,000 ft)

Site History

Salvaged topsoil
Age (?)
Subsurface overburden
Age (?)
Depth (?)
Location (?)

Buried native soil

Can reclamation technique influence the shorter-term time scale of soil genesis, in terms of A-horizon development?

Methods

- Treatments: Geomorphic, traditional and undisturbed reference site
- Pits dug to 1m (total 38 pits), described and sampled by horizon
- Analyzed for pH, EC, C/N, bulk density and morphological characteristics
Criteria for A-horizon

Requirements
- Mineral soil;
- ≥3 cm in thickness;
- Accumulation of OM (↑ total C% coupled with ↓ pH) when compared to horizon below;
- Decrease in bulk density when compared to horizon below.
- Root occurrence
- Presence of soil aggregation/structure

Typic Torriorthent

Typic Haplargid

A-horizon, Total C% difference in A-horizons and non A-surface horizons

A-horizon, pH

Total C% difference in A-horizons and non A-surface horizons

Treatment: Geomorphic, Traditional, Undisturbed
A pedologic approach

- There is evidence for A-horizon formation across both traditional and geomorphic methods of reclamation.
- A total of 13 pits out of 15 classified with A in Geomorphic treatment.
- A total of 10 pits out of 13 classified with A in Traditional treatment.

Future Work

- Relationships between landscape complexity and spatial distribution of development?
- Erosion modeling, vegetation establishment, overall assessment of use in Wyoming between reclamation techniques.

Implications

- Measure of A-horizon development as a marker for reclamation success?
- Refined definition/criteria for A-horizons in arid & semi-arid ecosystems.

Thank you