DNR Drill Core Library

- Located at DNR’s Hibbing Office
- 3 million feet of drill core from >9,000 locations
- State law keeps the core coming
Mineral Exploration in Minnesota

What exploration geologists want.

What exploration geologists too often get.
Bedrock Drilling

Depth to Bedrock
(MGS OFR 10-2)

- 0 - 15 feet
- 16 - 99 feet
- 100 - 249 feet
- 250 - 499 feet
- 500 - 1049 feet
Bedrock Drilling

**Depth to Bedrock**
(MGS OFR 10-2)

- 0 - 15 feet
- 16 - 99 feet
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Drill core analysis
Drill core analysis

• Assays and geochemistry
• Thin sections
• Geotechnical tests
(Destructive) drill core analysis

- Assays and geochemistry
- Thin sections
- Geotechnical tests
- Bulk analytical results
- Limited datasets
- Limits future analysis
(Non-destructive) drill core analysis

- Microanalytical
- Continuous and complete
- Preserves asset for future tests
(Non-destructive) drill core analysis
DNR Corescan Pilot Study

- Corescan mobile laboratory deployed to DNR Drill Core Library in Hibbing, December 2018
- 5000 meters of scanned core over 30 day residency
- Project funding from DNR Lands and Minerals (75%) and IRRR (25%)
The Corescan System
The Corescan System

- Coreshed
- CORE LIBRARY
- ELECTRONIC CORE LIBRARY
- Data Management
- Fast Access
- Online Data Access
- Electronic Core Library
The Corescan System

- Non-destructive analysis
- Asset preservation
- Remote public access
Corescan Mobile Laboratory
Hyperspectral Core Imager Mark III (HCI-3)

**VNIR-SWIR SPECTROMETERS**
- 450nm-2500nm
- 3.5nm spectral resolution
- 500um spatial resolution*
- 100,000 spectra per meter of scanned core

**RGB camera/ 3D laser profiler**
- 50 micron pixel size
- 20 micron surface profile resolution
- 3-6 Gb of data per meter
Reflectance Spectroscopy
Corescan results

Photography (50um)

Mineral Classification Map

White Mica Abundance

White Mica Chemistry

Phlogopite Abundance

Chlorite Abundance

Copper Assay (ppm)

Relative mineral abundance

White Mica chemistry ~2200nm position

2185nm

2196nm

2212nm

2225nm

Increase in Na (Paragonite)

Increase in K/Al (Muscovite)

Fe substitution (Phengite)

Low abundance

High abundance
Corescan Pilot Study Goals

• Evaluate effectiveness of the tool and the value it adds to the Drill Core Library and Minnesota’s mineral estate

• Promote mineral exploration and development in the IRRR Service Area and state-managed mineral rights

• Support the State’s policy on minerals diversification

• Generate some great science

• Provide the potential basis for funding a longer-term residency in the near future.
Biwabik Iron Formation Project

- Six transects of the Biwabik Iron Formation
- IRRR Service Area
- Great science
- Potential tool for active producers
- Showcases long-term benefits of investment in mining and mineral exploration research projects
International Falls Greenstone Project

- 11 drill holes in greenstone terrane
- Supports potential gold and/or VMS exploration and development on state-managed mineral rights
- Highlights coreshot’s capabilities
  - Alteration mineralogy
  - Distinguishing between fine-grained tourmaline and amphibole
Emily District Manganese Project

- 6 drill cores from manganese-rich iron formation in Cuyuna Range
- Primary vs. secondary mineralization
- Near CMR project location
- IRRR service area with state-managed mineral rights.

Base map geology: MGS M-99 (1999)
### Project Breakdowns (subject to change)

<table>
<thead>
<tr>
<th>Project</th>
<th>Total DDH</th>
<th>Total meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biwabik Iron Formation</td>
<td>6</td>
<td>1678</td>
</tr>
<tr>
<td>Rainy River Greenstone</td>
<td>11</td>
<td>1563</td>
</tr>
<tr>
<td>Emily District Manganese</td>
<td>6</td>
<td>781</td>
</tr>
<tr>
<td>Sudbury Impact Layer</td>
<td>2 (12)</td>
<td>48</td>
</tr>
<tr>
<td>Cuyuna North Range Sedex</td>
<td>12</td>
<td>530</td>
</tr>
<tr>
<td><strong>total</strong></td>
<td><strong>46</strong></td>
<td><strong>4600</strong></td>
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</tbody>
</table>
• Mobile lab arrives in Hibbing early December.
• Two week break over the holidays.
• Visitors welcomed.
Update on Non-Ferrous Exploration Activity

Heather Arends, Division of Lands and Minerals
October, 2018
Update on Nonferrous Exploration

• Leasing
• Exploration Activity
  • Exploration Plans
• Exploratory Drilling Inspections

https://www.dnr.state.mn.us/lands_minerals/metallic_nf/index.html
## Overview of Active Leases in the State

<table>
<thead>
<tr>
<th>Lease Type</th>
<th>Number of Leases</th>
<th>Number of Acres</th>
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<tbody>
<tr>
<td>Iron Ore/Taconite</td>
<td>112</td>
<td>9,633</td>
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<td><strong>Total</strong></td>
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### NUMBER OF STATE MINERAL LEASES BY COUNTY

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<th>Carlton</th>
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AngloGold is the largest lease holder that spans 3 counties (271)

Drilled 68 holes (Jan-Oct 2018)

Rotosonic Drilling
Drilled 1 exploration boring and 3 wedges from an existing boring

Diamond core
Soil sampling and geologic mapping at the Virginia horn site.
Nonferrous Exploration Update

https://www.dnr.state.mn.us/lands_minerals/metallic_nf/index.html

- Exploration Plans (state leases)
  - DNR notices a map on the DNR website (since 2013)
  - Inform of plans via GovDelivery email system
  - Undergoes DNR internal review
## Average number of drill holes in 40 years (1966-2016)

<table>
<thead>
<tr>
<th>Number of Parcels (approximately 40 acres)</th>
<th>Number of Drill Holes per Parcel</th>
<th>Total number of Drill Holes</th>
<th>Percentage of Leased Parcels and Exploration Drilling</th>
</tr>
</thead>
<tbody>
<tr>
<td>23,746</td>
<td>0</td>
<td>0</td>
<td>97.8% of the leased parcels had no exploration drilling</td>
</tr>
<tr>
<td>343</td>
<td>1</td>
<td>343</td>
<td>1.4% of the leased parcels had 1 exploration drill hole</td>
</tr>
<tr>
<td>123</td>
<td>2-5</td>
<td>343</td>
<td>0.5% of the leased parcels had between 2 and 5 exploration drill holes</td>
</tr>
<tr>
<td>18</td>
<td>6-10</td>
<td>132</td>
<td>0.1% of the leased parcels had between 6 and 10 exploration drill holes</td>
</tr>
<tr>
<td>39</td>
<td>11+</td>
<td>1,093</td>
<td>0.2% of the leased parcels had greater than 11 exploration drill holes</td>
</tr>
<tr>
<td>24,269 total leased parcels</td>
<td>1,911 total drill holes</td>
<td></td>
<td>2.2% of leased parcels had 1 or more drill holes. 97.8% of leased parcels had no exploration drilling.</td>
</tr>
</tbody>
</table>
Exploratory drill hole inspections occur on state and private lands. A number of companies are permanently sealing (cement) a number of holes.
Thank you