Michigan Natural Resources: A survey of Production Statistics

Presented by Dr. Peter Voice
Where did this data come from?

• Sifted through:
  • Older Michigan Geological Survey Annual Statistical Summaries (and predecessor series) – pre-1980 data
  • U.S. Bureau of Mines Annual Reports – pre-1930 data
  • U.S. Geological Survey Mineral Yearbooks – individual commodity reports and Mi domestic area reports (all post-1980 data, and 1940’s data)

• Because of the vintage of many of the sources – had to be very careful with units
  • Salt – sold by the barrel (~250 lbs), then in short tons, then in metric tons!
Types of Resources

• Mineral Resources
  • Metallic Minerals
  • Nonmetallic Minerals
• Aggregate Resources
• Energy Resources
• Groundwater
Metallic Minerals

- **Upper Peninsula resources (mainly Western UP)**
  - Gold – associated with peridotite (olivine-rich rock) – very minor resource
  - Copper (± Silver; Nickel, Zinc, Platinum Group Elements)
    - Keweenaw area and west
    - New Eagle Mine (Cu-Ni, PGE)
    - Back Forty Project (at permitting stage – also has some Zn)
- **Iron Ore (± Manganese)**
  - Three major trends – Marquette Range (last mine closing this year); Crystal Falls-Menominee Range; Gogebic Range
Mostly Native Cu ± Cu-oxides, Cu-carbonates
Cu production continued through the late 1990’s – but only a single mine (White Pine) produced, so much of that data is Withheld.
Annual Silver Production (troy oz.) - Composite Production Values

Native Cu Mines
Ag production

Ropes Gold Mine
Ag production

White Pine
Electroplate Ag production (data withheld 1980-1997)
Annual Gold Production (troy oz.) - Composite data

Ropes Gold Mine production (primarily)

Reprocessed Ropes Gold Mine Tailings
Associated with the Ropes Gold Mine area are serpentinized dolomitic marbles, called *Verde Antique*. This was quarried for an attractive dimension stone off and on from the 1880’s to 1920’s.

http://dayoopers.com/
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<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Northern Minnesota</td>
<td>Western Ontario</td>
<td>Wis.-Mi.</td>
<td>Badwater Greenstone</td>
<td>Jacobsville Sandstone</td>
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<td>Michigamme Fm.</td>
<td>Baraga Group</td>
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<td>Virginia Fm.</td>
<td>Rove Fm.</td>
<td>Tyler Fm.</td>
<td>Hemlock/Felch</td>
<td>Goodrich Quartzite</td>
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<td>Biwabik BIF</td>
<td>Gunflint BIF</td>
<td>Ironwood BIF</td>
<td>Vulcan BIF</td>
<td>Negaunee BIF</td>
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<td>Pokegama Quartzite</td>
<td>Basal Conglomerate</td>
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<td>Menominee Group</td>
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<td>Siamo Slate</td>
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<td>Ajibik Quartzite</td>
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<td>Bad River Dolomite</td>
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<td>Randville Dolomite</td>
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<td>Sturgeon Quartzite</td>
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<td>Fern Creek Fm.</td>
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<td>Archean Metaigneous Rocks (2.5 Ga+ in age)</td>
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<td>Chocolay Group</td>
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<td>Wewe Slate</td>
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<td>Kona Fm.</td>
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<td>Mesnard Quartzite</td>
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<td>Enchantment Lake Fm.</td>
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<td>Compeau Creek Gneiss</td>
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<td>Mona Schist</td>
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<td>Southern Complex Gneisses</td>
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Iron Ore Production

Dotted line – crude ore
Solid line – processed ore

Structural Steel – first skyscrapers!

Automobiles
Estimated Total Production: Metallic Resources

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Production</th>
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<tr>
<td>Processed Iron Ore</td>
<td>1,500,000,000 metric tons</td>
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<tr>
<td>Copper</td>
<td>5,887,000 metric tons</td>
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<tr>
<td>Silver</td>
<td>20,530,000 troy oz.</td>
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<tr>
<td>Ferruginous manganese ore</td>
<td>820,000 metric tons</td>
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<tr>
<td>Manganiferous iron ore</td>
<td>516,000 metric tons</td>
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<tr>
<td>Gold</td>
<td>33,600 troy oz.</td>
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Nonmetallic Mineral Resources

• Mostly LP production – though historic gypsum production in several rock units in the UP
• Rock Gypsum
• Rock Salt
  • Halite – NaCl salt
  • Sylvite – KCl salt (no active production today; historic production ~160,000 tons per year)
• Brines (Mg, I, Br, Ca, Cl) – data generally withheld – as few operators extract these
Willmet Gray #1-31
Osceola Co., MI 31-17N-18W
P#: 35800
Core Interval: 2337.4-2337.6 m (7668.5-7669.5 ft)
Sample of the C Shale (Salina Group) with secondary red halite cements filling a fracture
Samples of the F Salt (Salina Group) – the unit commercially mined in Detriot
Annual Michigan Salt Production

- Detroit Salt Mine begins operations
- Salt extracted from saline aquifers - brines
- Temporary closure of salt mine
Satin Spar Gypsum – secondary precipitant in the Cabot Head Shale, UP
Anhydrite in the Lucas Formation, Detroit River Group
Anhydrite in the Michigan Formation – the Michigan Formation was commercially mined in Grand Rapids and is still mined at Alabaster.
2000 drop-off in production – doesn’t correspond to any recession. So what happened?
Estimated Total Production: Nonmetallic Minerals

<table>
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<th>Commodity</th>
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<tbody>
<tr>
<td>Rock Salt</td>
<td>308,000,000 metric tons</td>
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<tr>
<td>Rock Gypsum</td>
<td>110,000,000 metric tons</td>
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</tbody>
</table>
Aggregate Resources

• Mined statewide – though different qualities, and types of materials quarried at different parts of the state
• Sand and Gravel (fill, glass sands, injection mold sands, brick filler, etc.)
• Clay and Shale (bricks and tiles, ceramics)
• Cement
• Lime
• Crushed Stone
• Dimension Stone
Sylvania Sandstone, Sylvania Minerals Quarry, Monroe Co.

Glass Sands

Note upper darker layer – glacial till
Sand Mining Operation, Southwestern MI
Traverse Group Limestones – Quarried at Charlevoix
Annual Portland Cement Production (metric tons)

Calendar Year

Portland Cement Production (metric tons)
Sawheidle Quarry, near Manistique, MI

Crushed Rock – Dolomite from the Burnt Bluff Group
Stromatoporoid sponge, Engadine Dolomite Drummond Island Quarry – crushed stone
Annual Total Stone Production (metric tons)

Crushed Stone + Dimension Stone

DS up to 10,000 metric tons/year
Ruins of Lincoln Brick Factory, Lincoln Brick Park, Grand Ledge, MI

http://is0.gaslightmedia.com/michigantrailmaps/
Annual Common Clay Production (metric tons)

Lots of pre-1940 production – but reported in # of bricks made and # of roofing tiles made.
## Estimated Total Aggregate Production

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Production</th>
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<tbody>
<tr>
<td>Masonry Cement</td>
<td>10,500,000 metric tons</td>
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<tr>
<td>Portland Cement</td>
<td>296,000,000 metric tons</td>
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<tr>
<td>Clay</td>
<td>91,000,000 metric tons</td>
</tr>
<tr>
<td>Lime</td>
<td>42,000,000 metric tons</td>
</tr>
<tr>
<td>Sand and Gravel</td>
<td>3,258,000,000 metric tons</td>
</tr>
<tr>
<td>Stone (Crushed + Dimension)</td>
<td>2,166,000,000 metric tons</td>
</tr>
</tbody>
</table>
Energy Resources

• Lower Peninsula Resources – some exploration in the UP – but nothing productive
• Oil
• Natural Gas
• Coal (historic production – none today)
Note Oil and Gas data – from Bill Harrison’s records

Antrim Shale – One of the first Unconventional Shale Plays
Note Oil and Gas data – from Bill Harrison’s records.

- **Dundee and Traverse Group**
- **Niagaran Reefs**
- **Renewed Trenton-Black River**
- **Trenton-Black River (Albion-Scipio)**
Coal Seam – Saginaw Fm., Grand Ledge, MI
Coal Production (metric tons)

Saginaw Valley and Thumb Region
– lots of mines
## Estimated Energy Resources Production

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Production</th>
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<tbody>
<tr>
<td>Oil</td>
<td>1,336,000,000 barrels</td>
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<tr>
<td>Natural Gas</td>
<td>8,086,000,000 cubic feet</td>
</tr>
<tr>
<td>Coal</td>
<td>42,000,000 metric tons</td>
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<tr>
<td>Peat</td>
<td>10,000,000 metric tons</td>
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Final Thought

• If we had to go back and mine these resources again – at 2013 prices, they would be worth approximately $500,000,000,000