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)

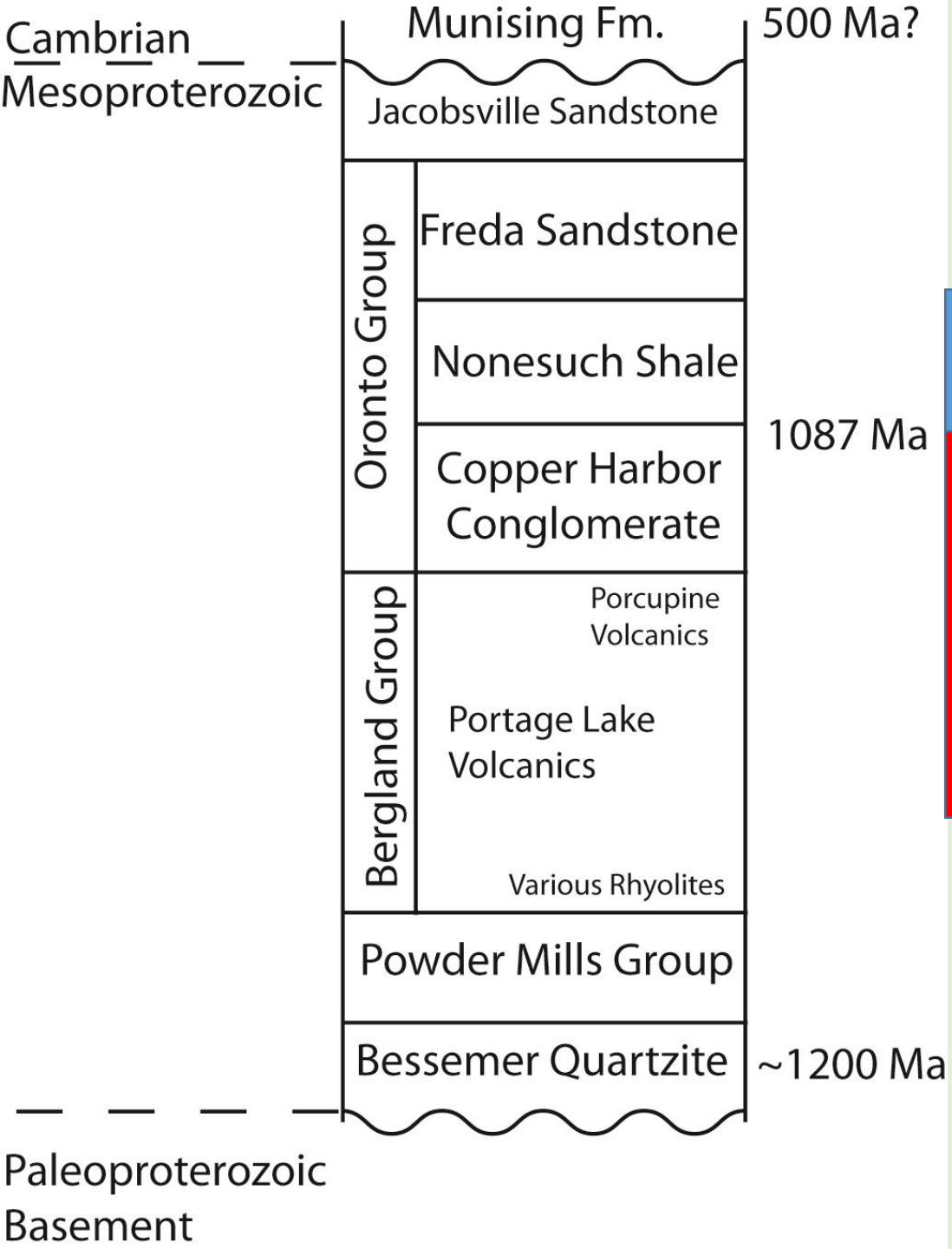
  - Because of the vintage of many of the sources – had to be very careful with units
    - Salt – sold by the barrel (~250 lbs), then in short tons, then in metric tons!

Types of Resources

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

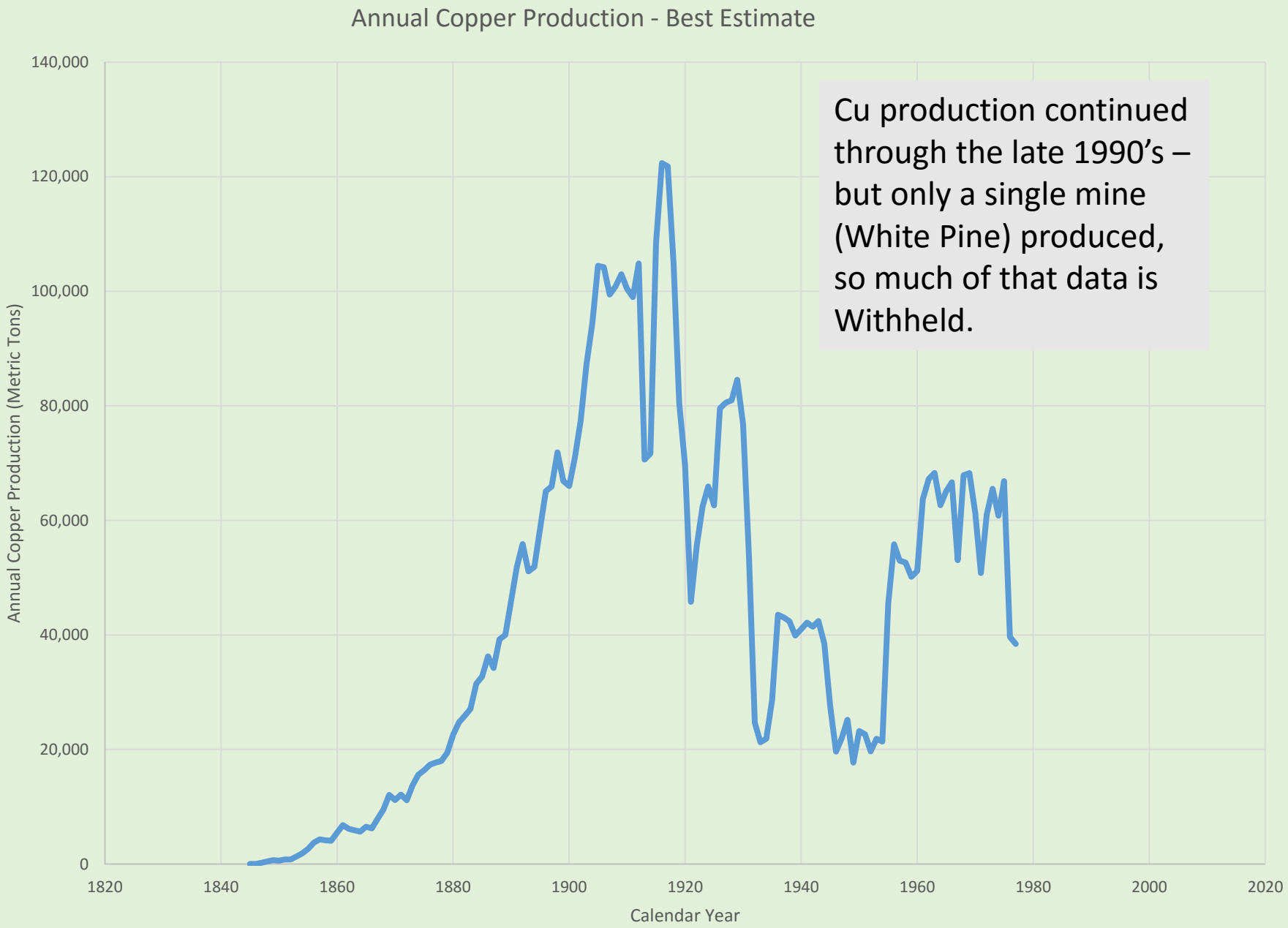
Metallic Minerals

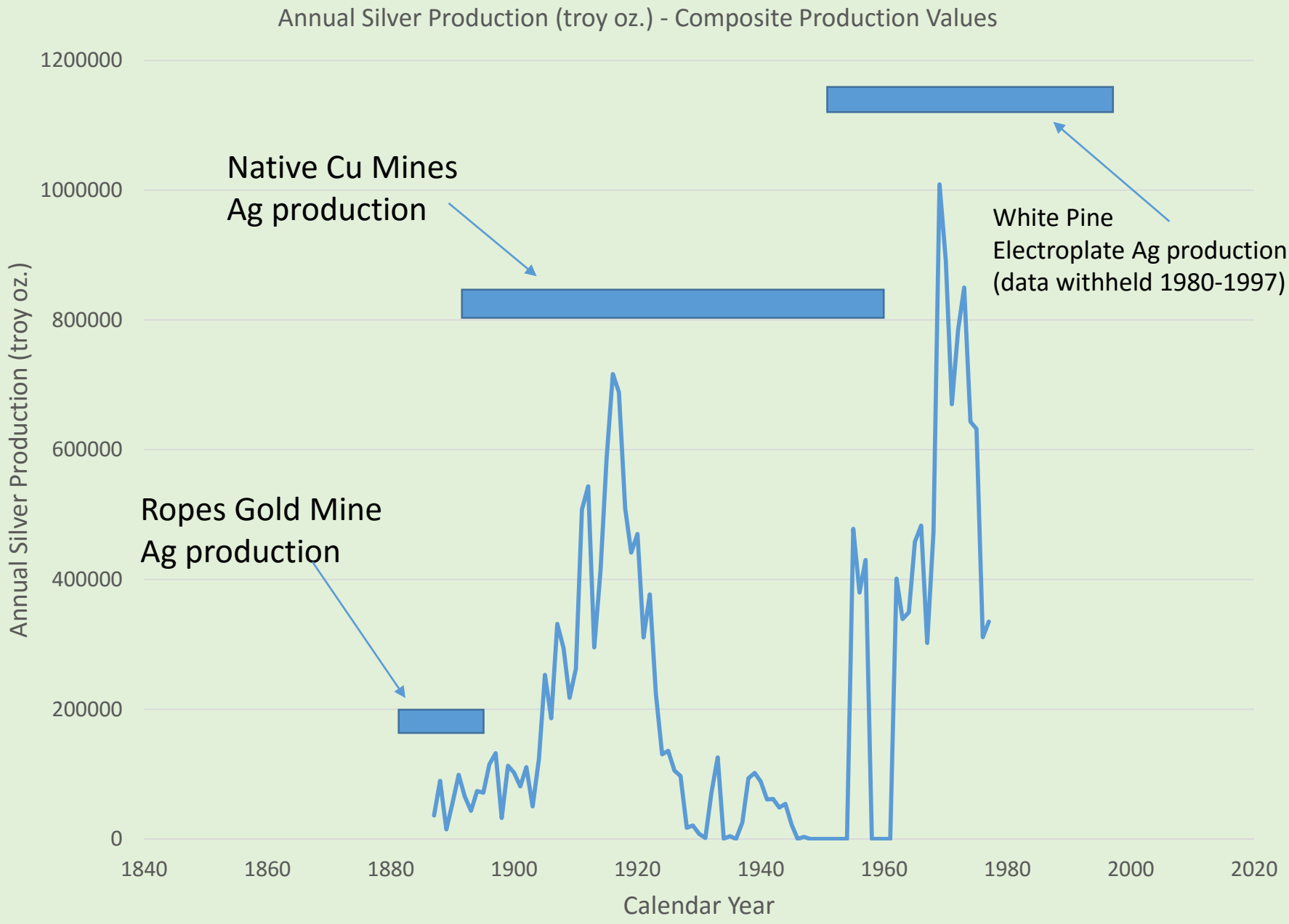
- Upper Peninsula resources (mainly Western UP)
  - Gold – associated with peridotite (olivine-rich rock) – very minor resource
  - Copper (± Silver; Nickel, Zinc, Platinum Group Elements)
    - Keweenaw area and west
    - New Eagle Mine (Cu-Ni, PGE)
    - Back Forty Project (at permitting stage – also has some Zn)
  - Iron Ore (± Manganese)
    - Three major trends – Marquette Range (last mine closing this year); Crystal Falls-Menominee Range; Gogebic Range

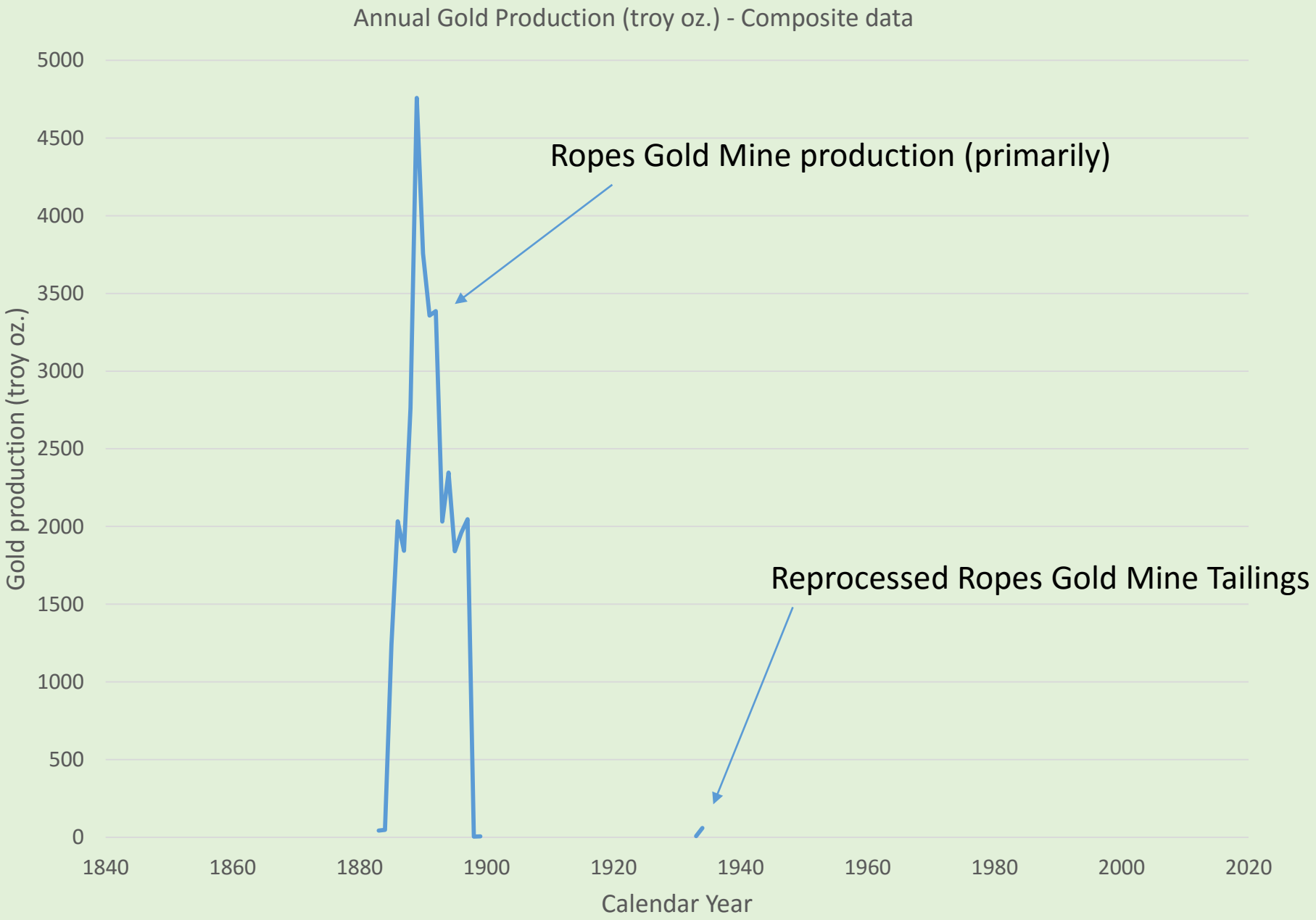


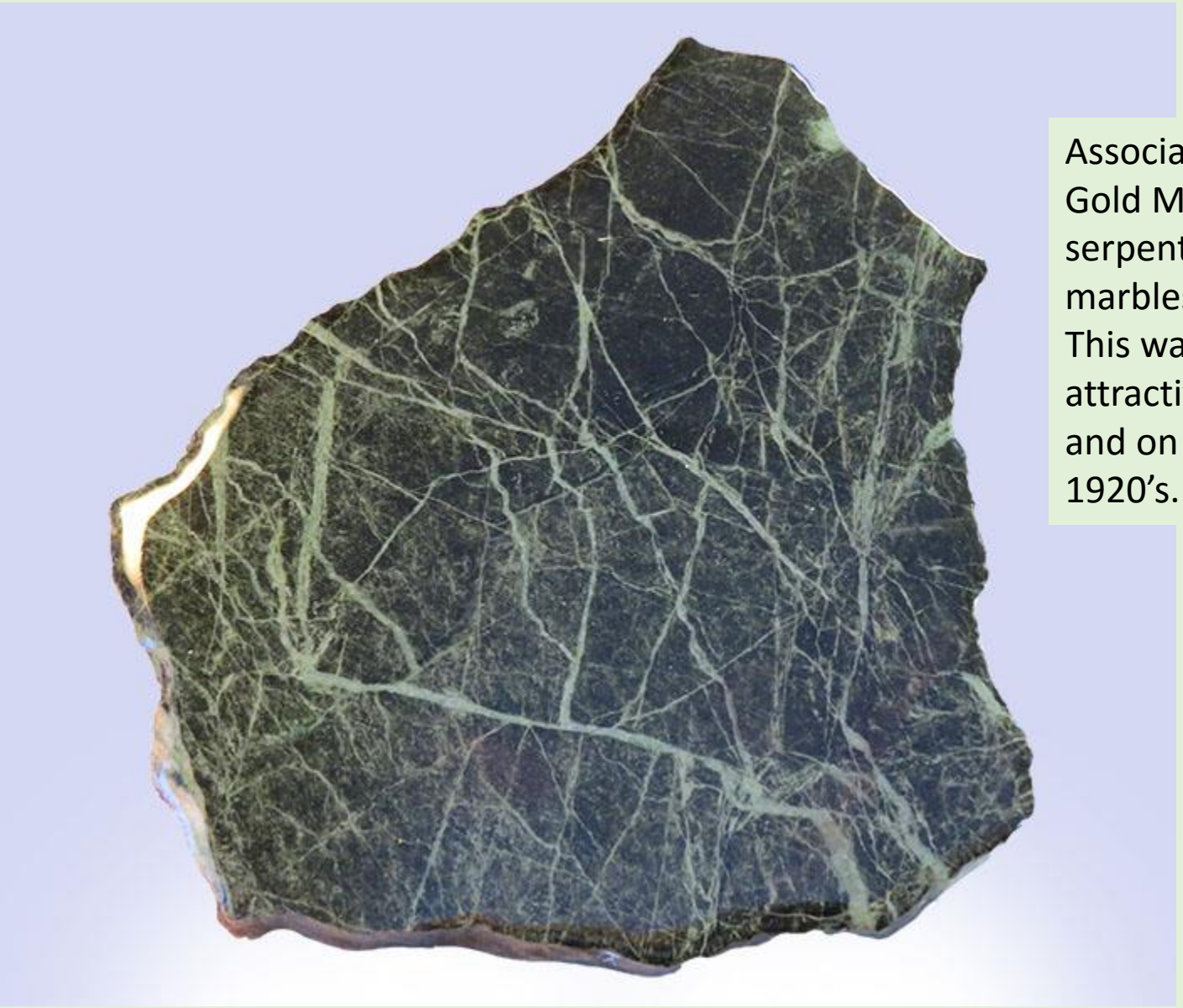
Cu-sulfides

Mostly Native Cu ± Cu-oxides, Cu-carbonates


Annual Copper Production - Best Estimate
Annual Copper Production (Metric Tons)
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1820
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
Calendar Year
Cu production continued through the late 1990's – but only a single mine (White Pine) produced, so much of that data is Withheld.

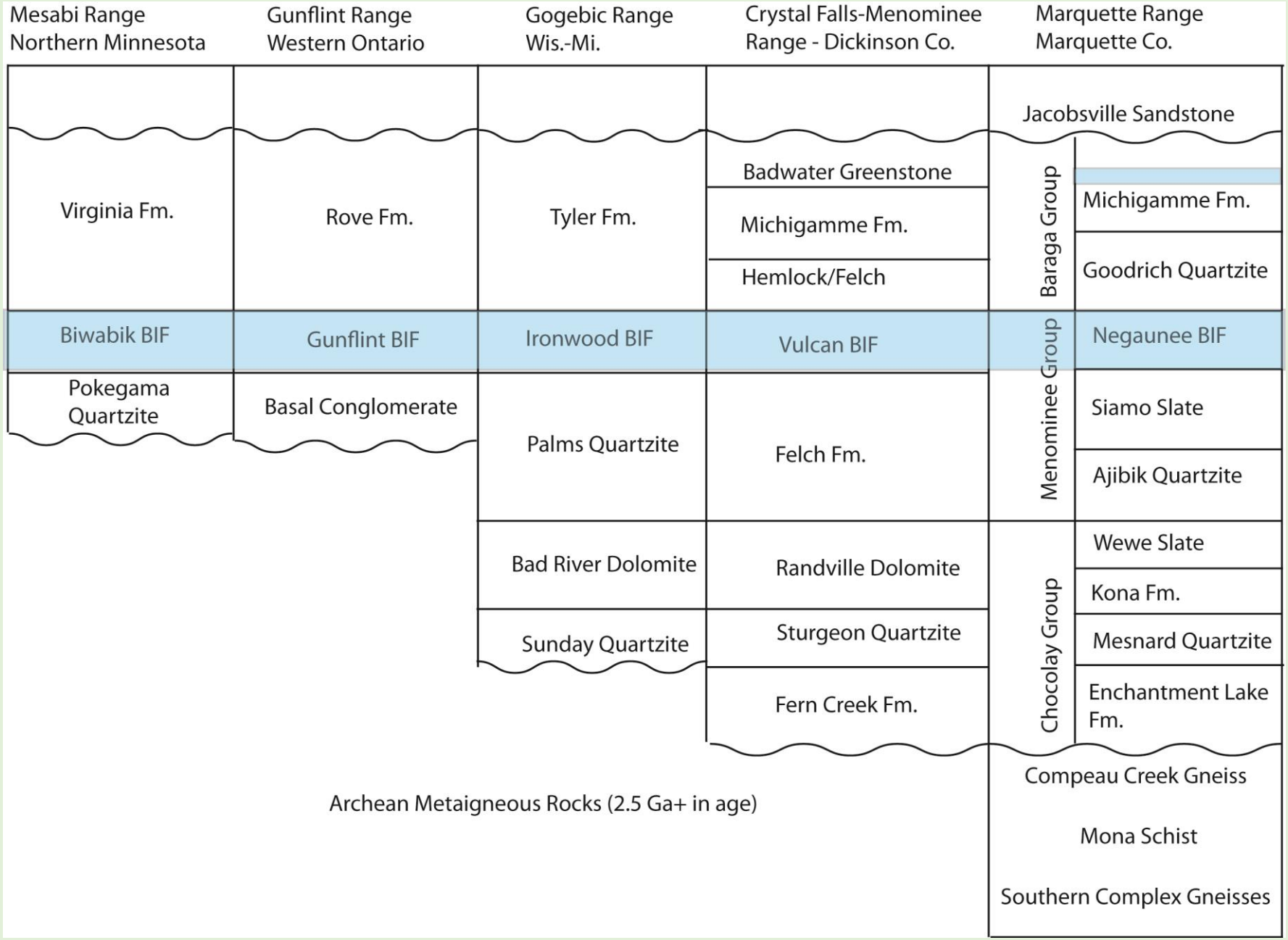

Annual Silver Production (troy oz.) - Composite Production Values
Native Cu Mines
Ag production
White Pine
Electroplate Ag production
(data withheld 1980-1997)
Ropes Gold Mine
Ag production
Annual Silver Production (troy oz.)
1200000
1000000
800000
600000
400000
200000
0
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
Calendar Year

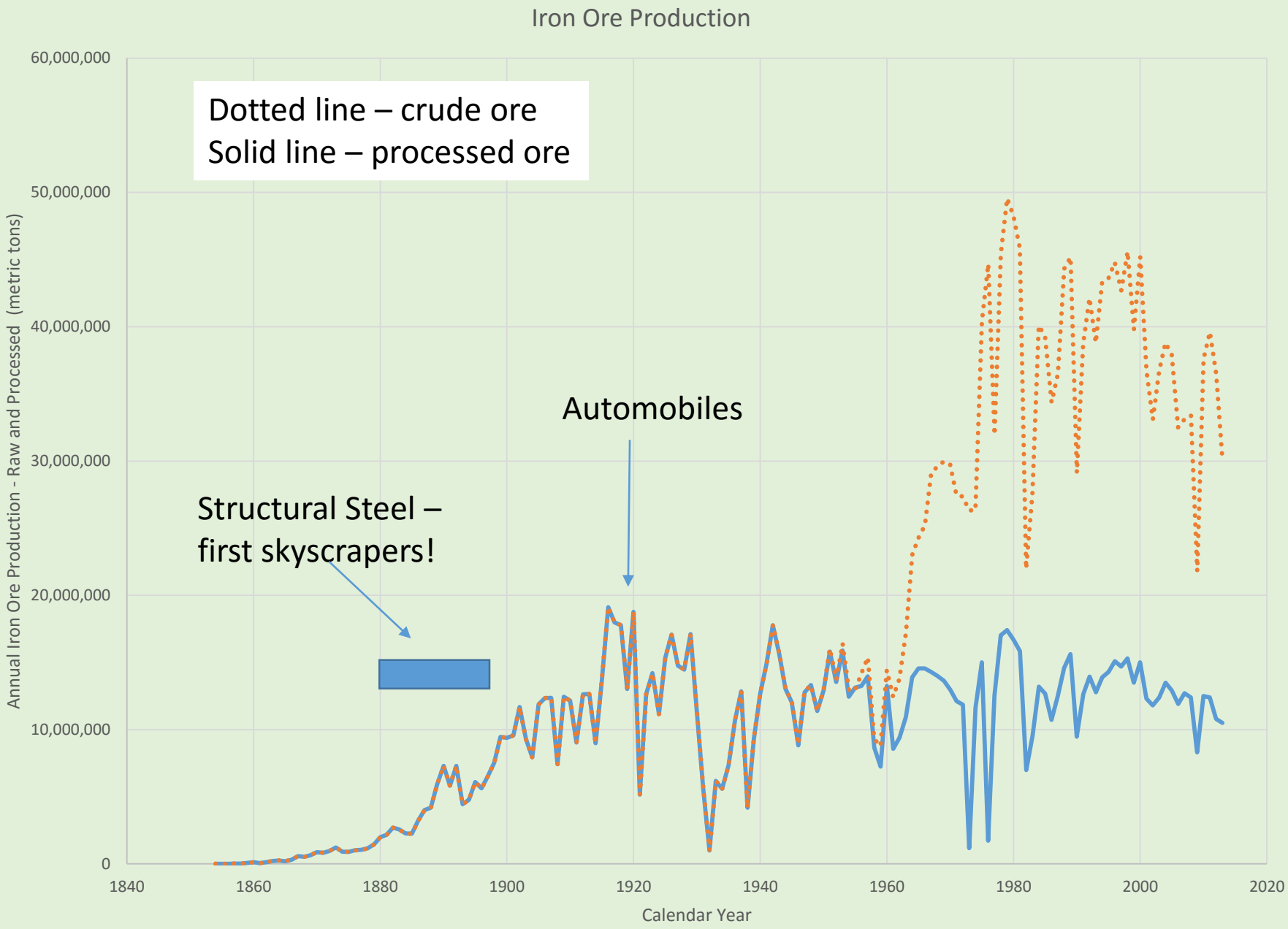

Annual Gold Production (troy oz.) - Composite data
Gold production (troy oz.)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
Calendar Year
Ropes Gold Mine production (primarily)
Reprocessed Ropes Gold Mine Tailings



http://dayoopers.com/

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.


Mesabi Range
Northern Minnesota
Gunflint Range
Western Ontario
Gogebic Range
Wis.-Mi.
Crystal Falls-Menominee
Range - Dickinson Co.
Marquette Range
Marquette Co.
Jacobsville Sandstone
Virginia Fm.
Rove Fm.
Tyler Fm.
Badwater Greenstone
Michigamme Fm.
Hemlock/Felch
Baraga Group
Michigamme Fm.
Goodrich Quartzite
Biwabik BIF
Gunflint BIF
Ironwood BIF
Vulcan BIF
Negaunee BIF
Menominee Group
Pokegama
Quartzite
Basal Conglomerate
Palms Quartzite
Felch Fm.
Siamo Slate
Ajibik Quartzite
Bad River Dolomite
Randville Dolomite
Wewe Slate
Kona Fm.
Sunday Quartzite
Sturgeon Quartzite
Mesnard Quartzite
Fern Creek Fm.
Chocolay Group
Enchantment Lake
Fm.
Compeau Creek Gneiss
Archean Metaigneous Rocks (2.5 Ga+ in age)
Mona Schist
Southern Complex Gneisses

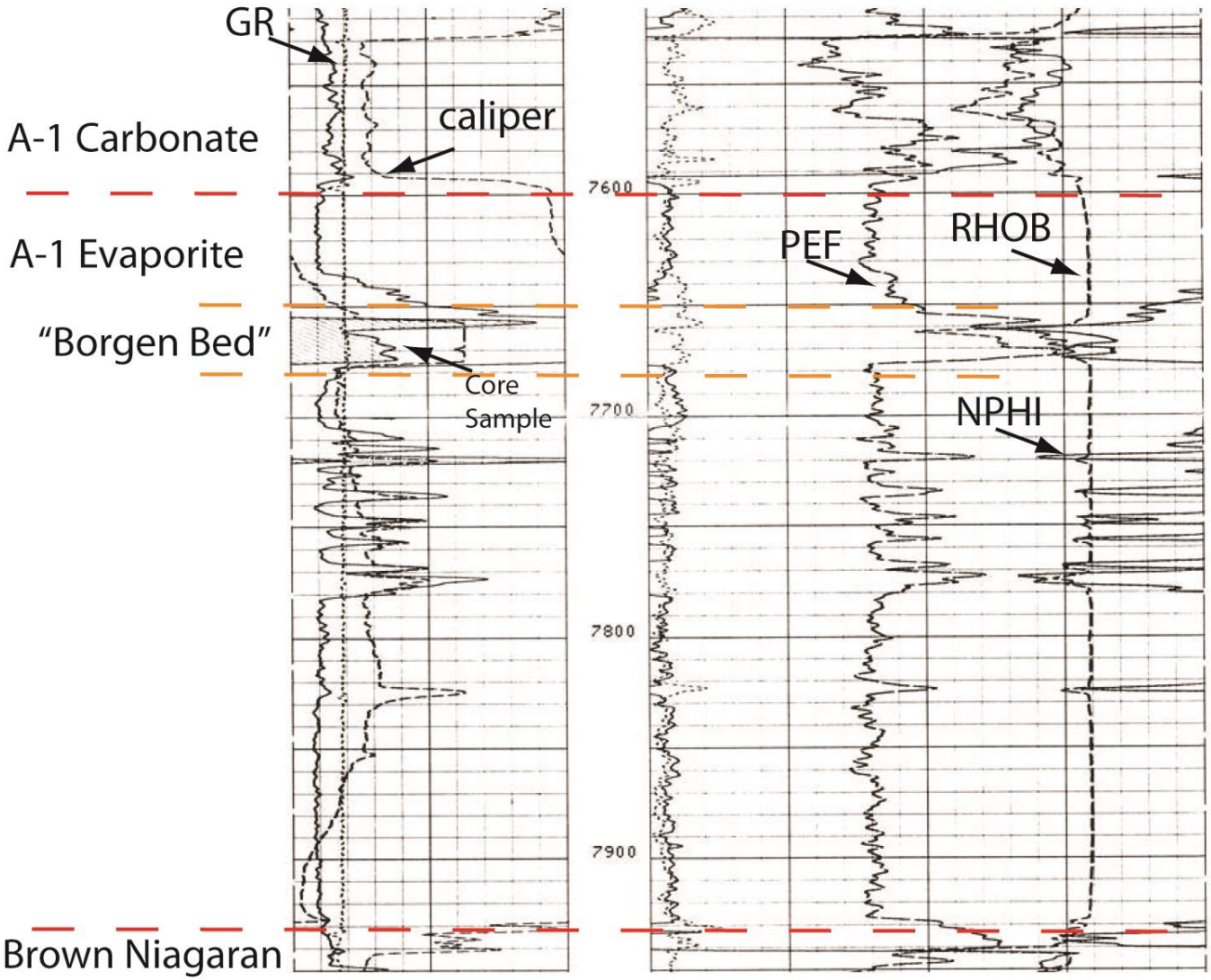

Iron Ore Production
Dotted line – crude ore
Solid line – processed ore
Automobiles
Structural Steel –
first skyscrapers!
Annual Iron Ore Production - Raw and Processed (metric tons)
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
Calendar Year

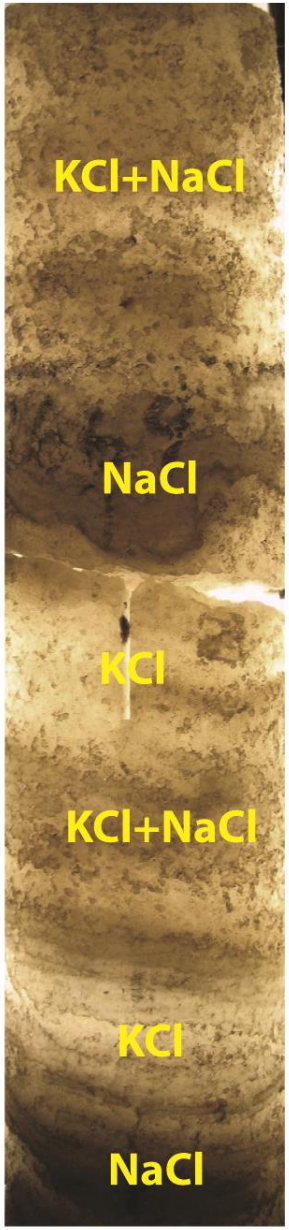
Estimated Total Production: Metallic Resources

Commodity	Production
Processed Iron Ore	1,500,000,000 metric tons
Copper	5,887,000 metric tons
Silver	20,530,000 troy oz.
Ferruginous manganese ore	820,000 metric tons
Manganiferous iron ore	516,000 metric tons
Gold	33,600 troy oz.

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

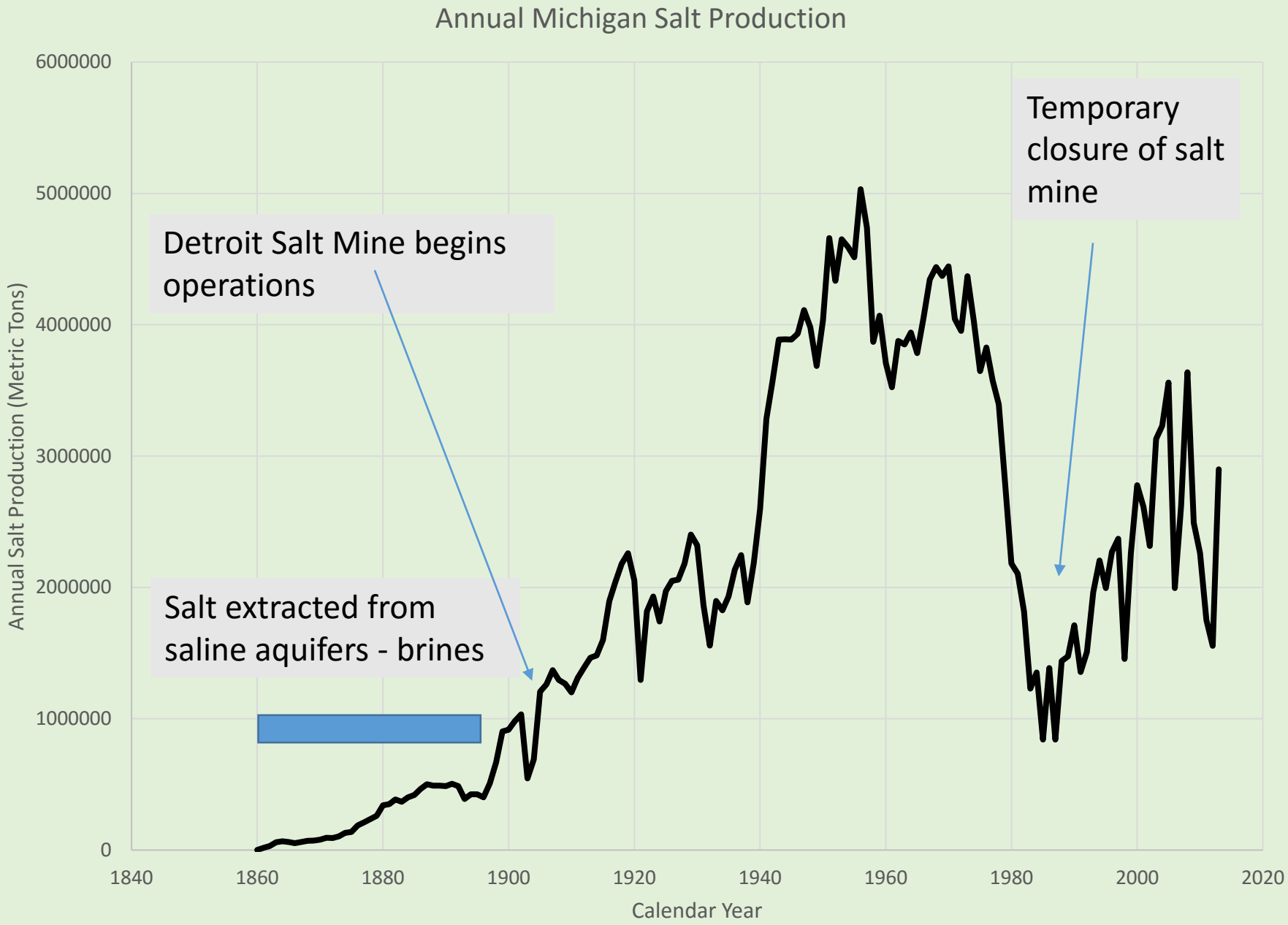




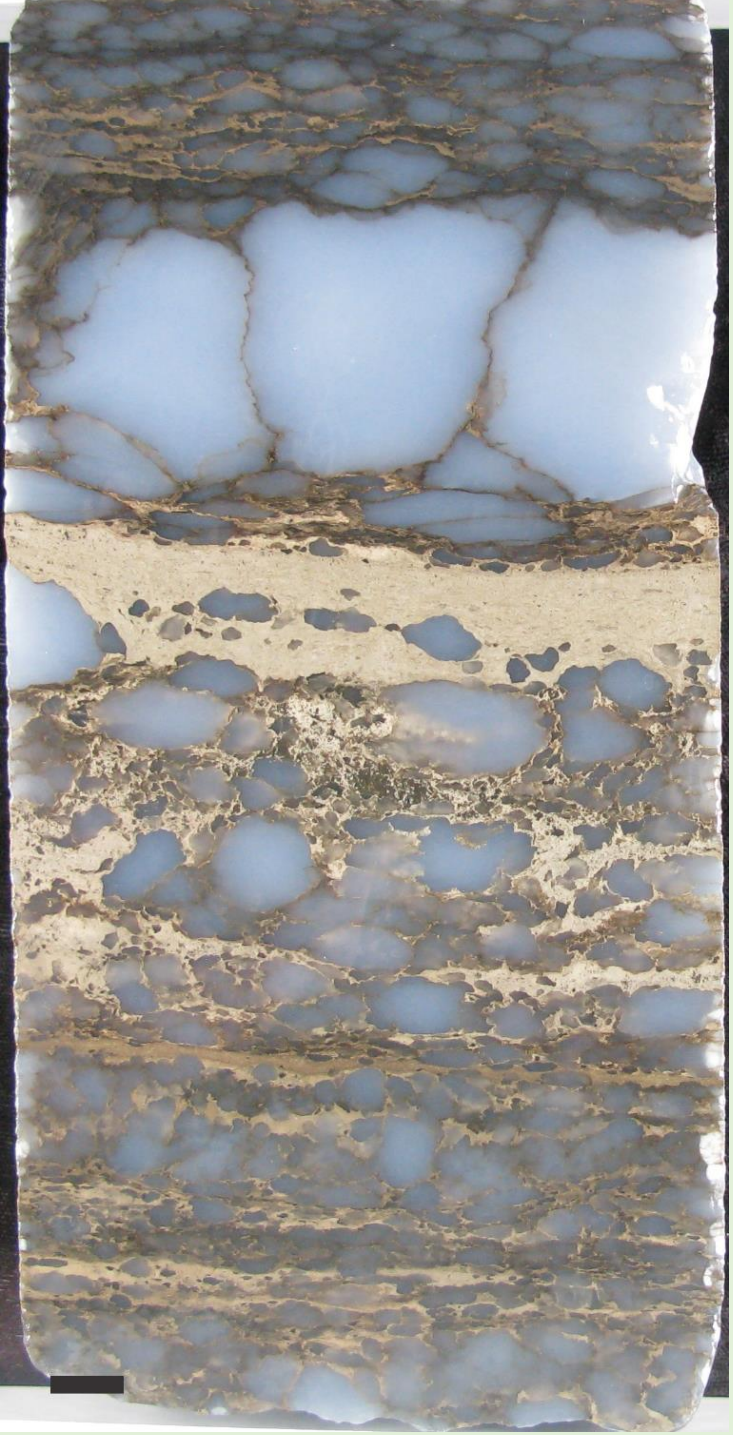
Willmet Gray #1-31
Osceola Co., MI 31-17N-18W
P#: 35800
Core Interval: 2337.4-2337.6 m (7668.5-7669.5 ft)

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

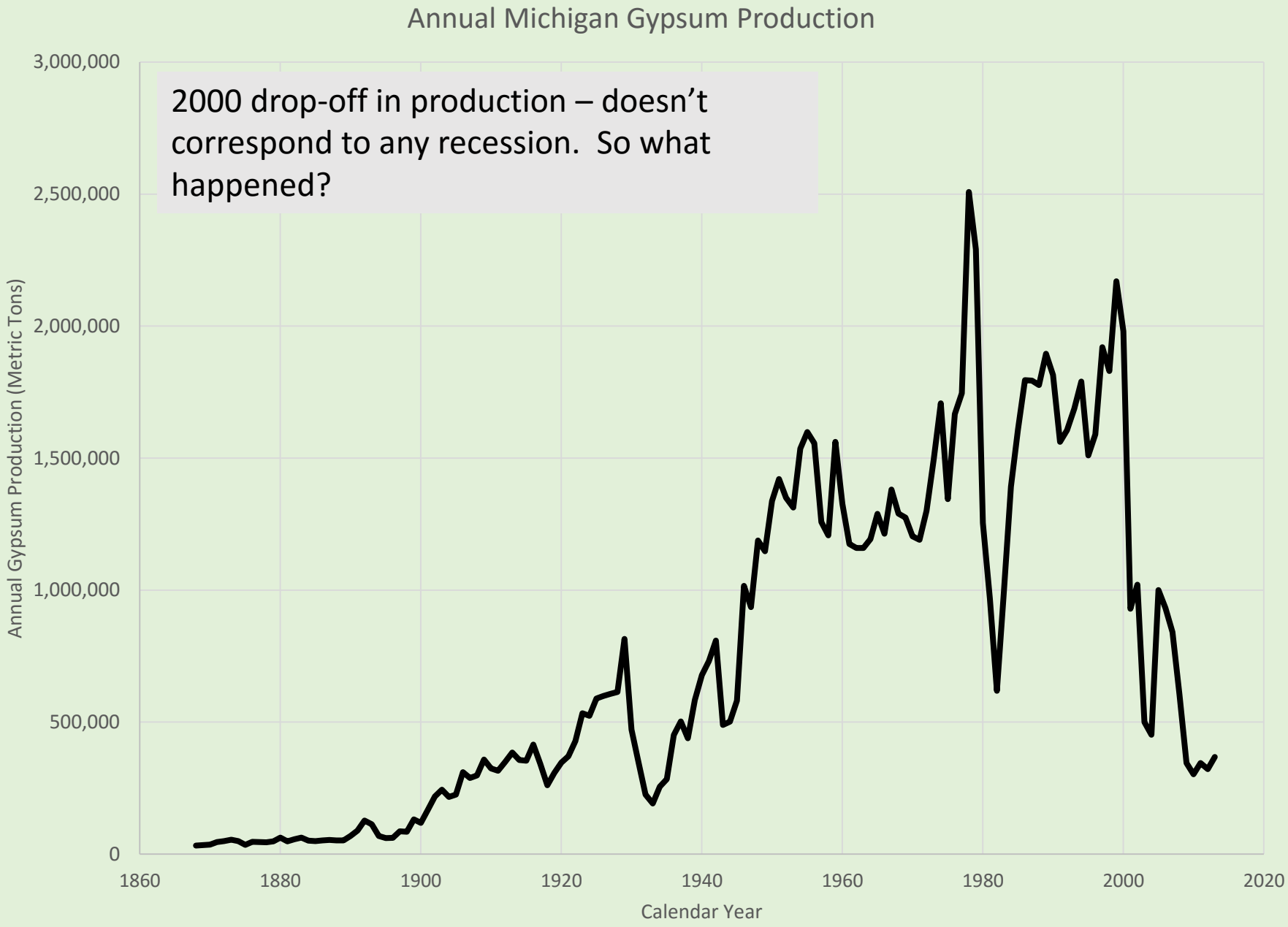

Annual Michigan Salt Production
6000000
5000000
4000000
3000000
2000000
1000000
0
Annual Salt Production (Metric Tons)
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
Calendar Year
Detroit Salt Mine begins operations
Temporary closure of salt mine
Salt extracted from saline aquifers - brines

Satin Spar Gypsum – secondary precipitant in the Cabot Head Shale, UP



Anhydrite in the Lucas Formation, Detroit River Group

Anhdyrite in the Michigan Formation – the Michigan Formation was commercially mined in Grand Rapids and is stilled mine at Alabaster.


Annual Michigan Gypsum Production
2000 drop-off in production – doesn't correspond to any recession. So what happened?
Annual Gypsum Production (Metric Tons)
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
1860
1880
1900
1920
1940
1960
1980
2000
2020
Calendar Year

Estimated Total Production: Nonmetallic Minerals

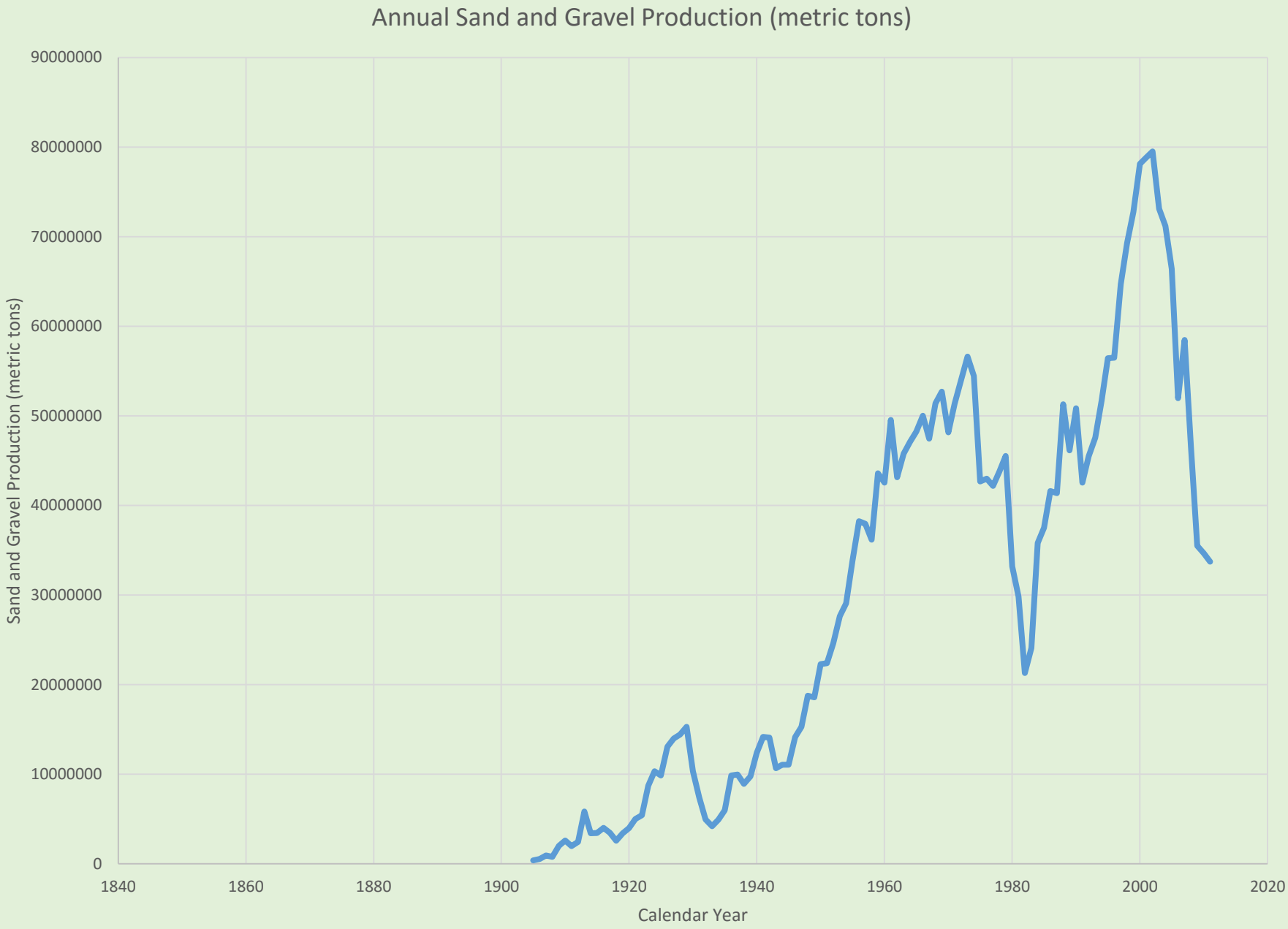
Commodity	Production
Rock Salt	308,000,000 metric tons
Rock Gypsum	110,000,000 metric tons

Aggregate Resources

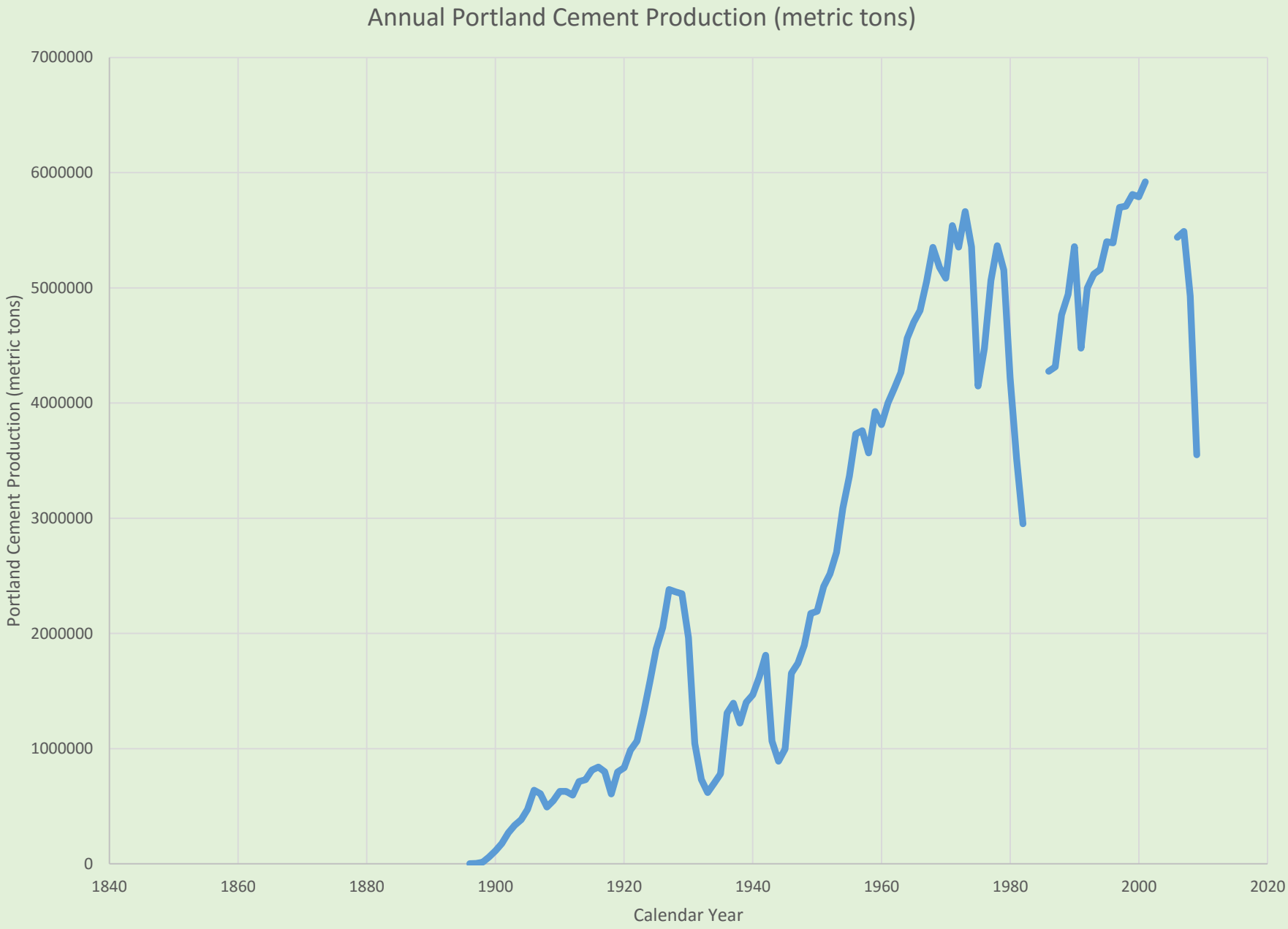
- Mined statewide – though different qualities, and types of materials quarried at different parts of the state
- Sand and Gravel (fill, glass sands, injection mold sands, brick filler, etc.)
- Clay and Shale (bricks and tiles, ceramics)
- Cement
- Lime
- Crushed Stone
- Dimension Stone


Sylvania Sandstone,
Sylvania Minerals Quarry, Monroe Co.
Glass Sands
Note upper darker layer – glacial till


Sand Mining Operation, Southwestern MI


Annual Sand and Gravel Production (metric tons)
Sand and Gravel Production (metric tons)
90000000
80000000
70000000
60000000
50000000
40000000
30000000
20000000
10000000
0
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
Calendar Year

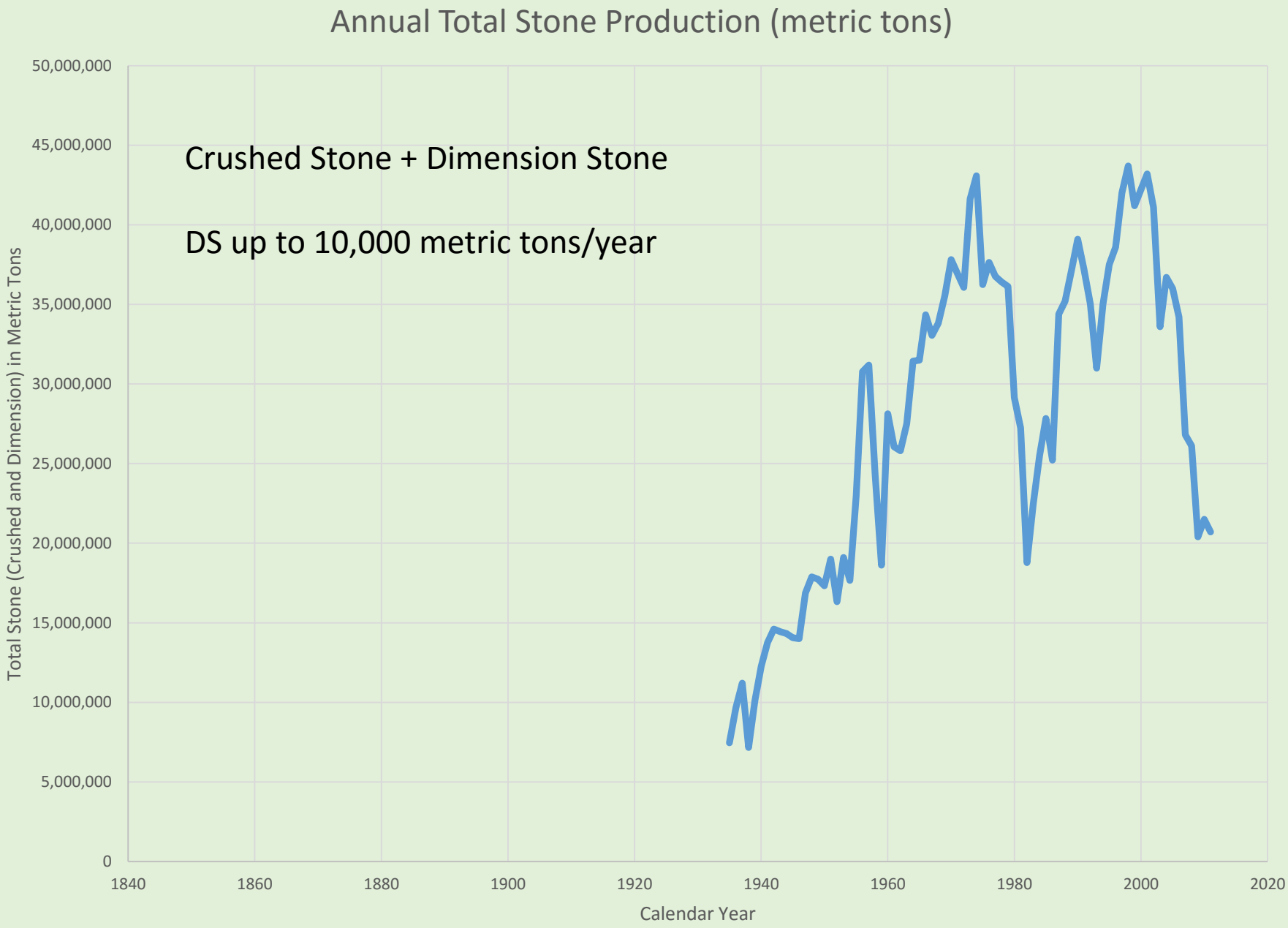

Traverse Group Limestones – Quarried at Charlevoix


Annual Portland Cement Production (metric tons)
Portland Cement Production (metric tons)
7000000
6000000
5000000
4000000
3000000
2000000
1000000
0
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
Calendar Year

Sawheidle Quarry, near Manistique, MI

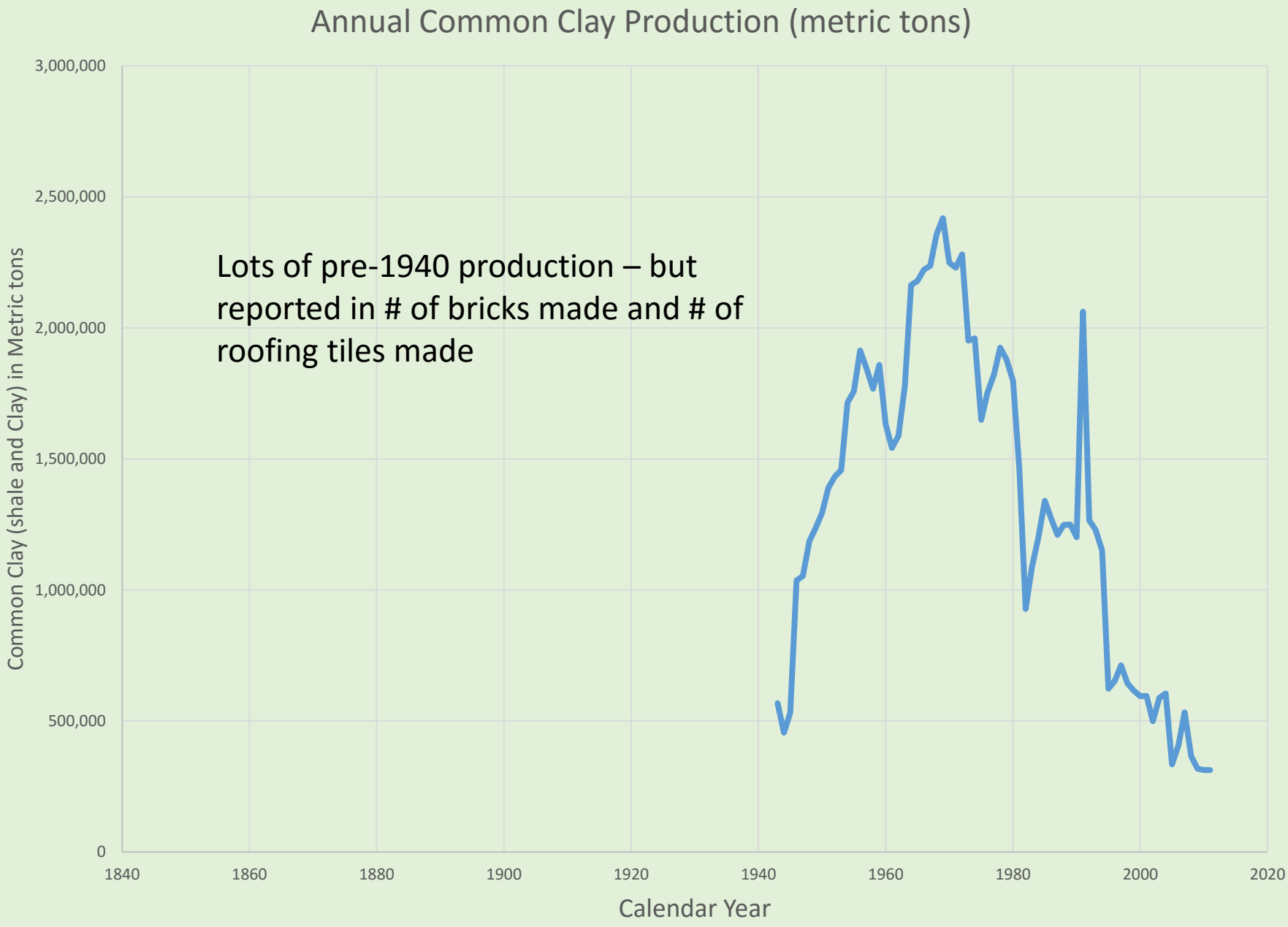
Crushed Rock – Dolomite from the Burnt Bluff Group


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
Total Stone (Crushed and Dimension) in Metric Tons
50,000,000
45,000,000
40,000,000
35,000,000
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
Calendar Year

http://is0.gaslightmedia.com/michigantrailmaps/

Ruins of Lincoln Brick Factory,
Lincoln Brick Park
Grand Ledge, MI

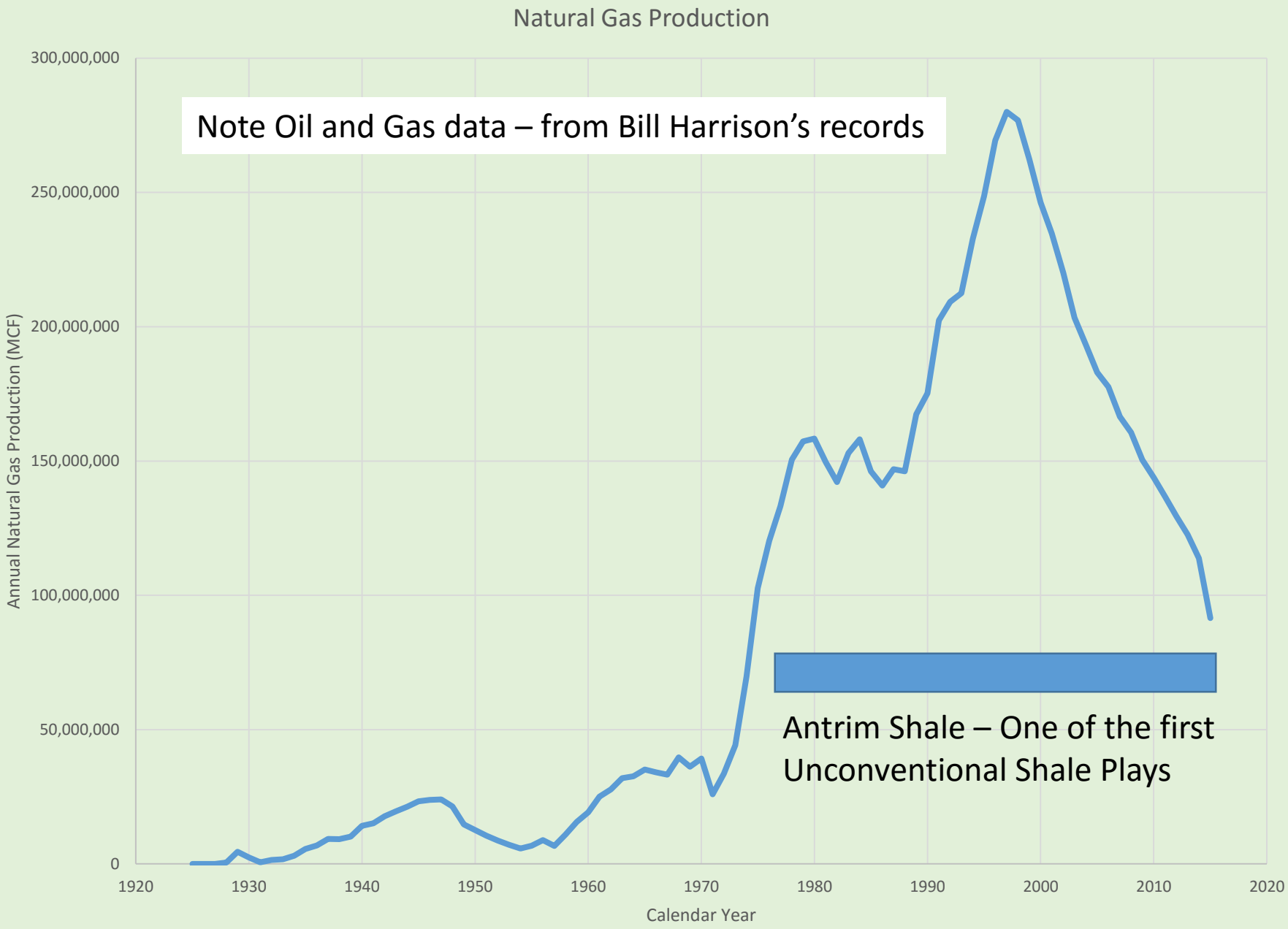

Annual Common Clay Production (metric tons)
Lots of pre-1940 production – but reported in # of bricks made and # of roofing tiles made
Common Clay (shale and Clay) in Metric tons
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
Calendar Year

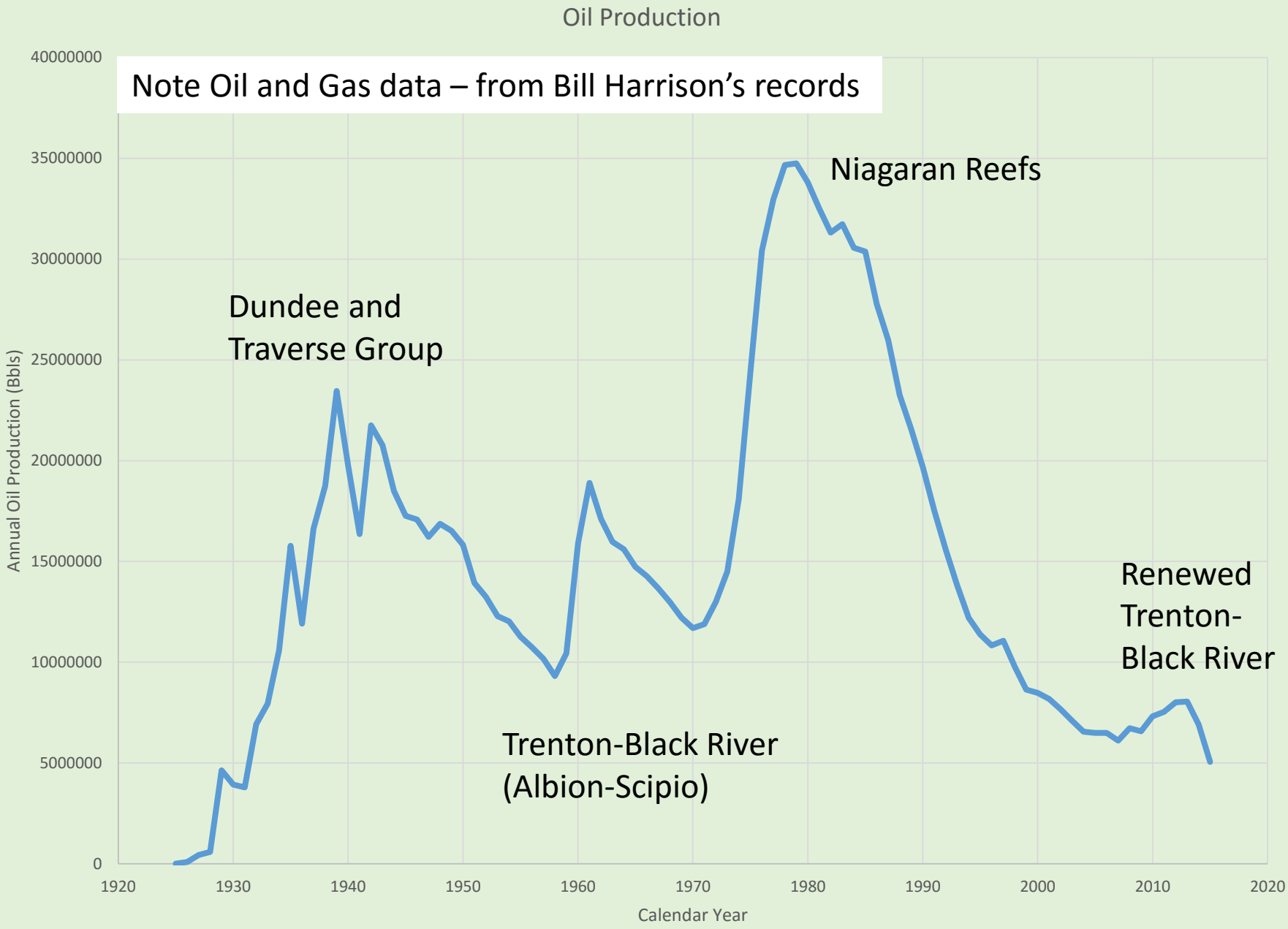
Estimated Total Aggregate Production

Commodity	Production
Masonry Cement	10,500,000 metric tons
Portland Cement	296,000,000 metric tons
Clay	91,000,000 metric tons
Lime	42,000,000 metric tons
Sand and Gravel	3,258,000,000 metric tons
Stone (Crushed + Dimension)	2,166,000,000 metric tons

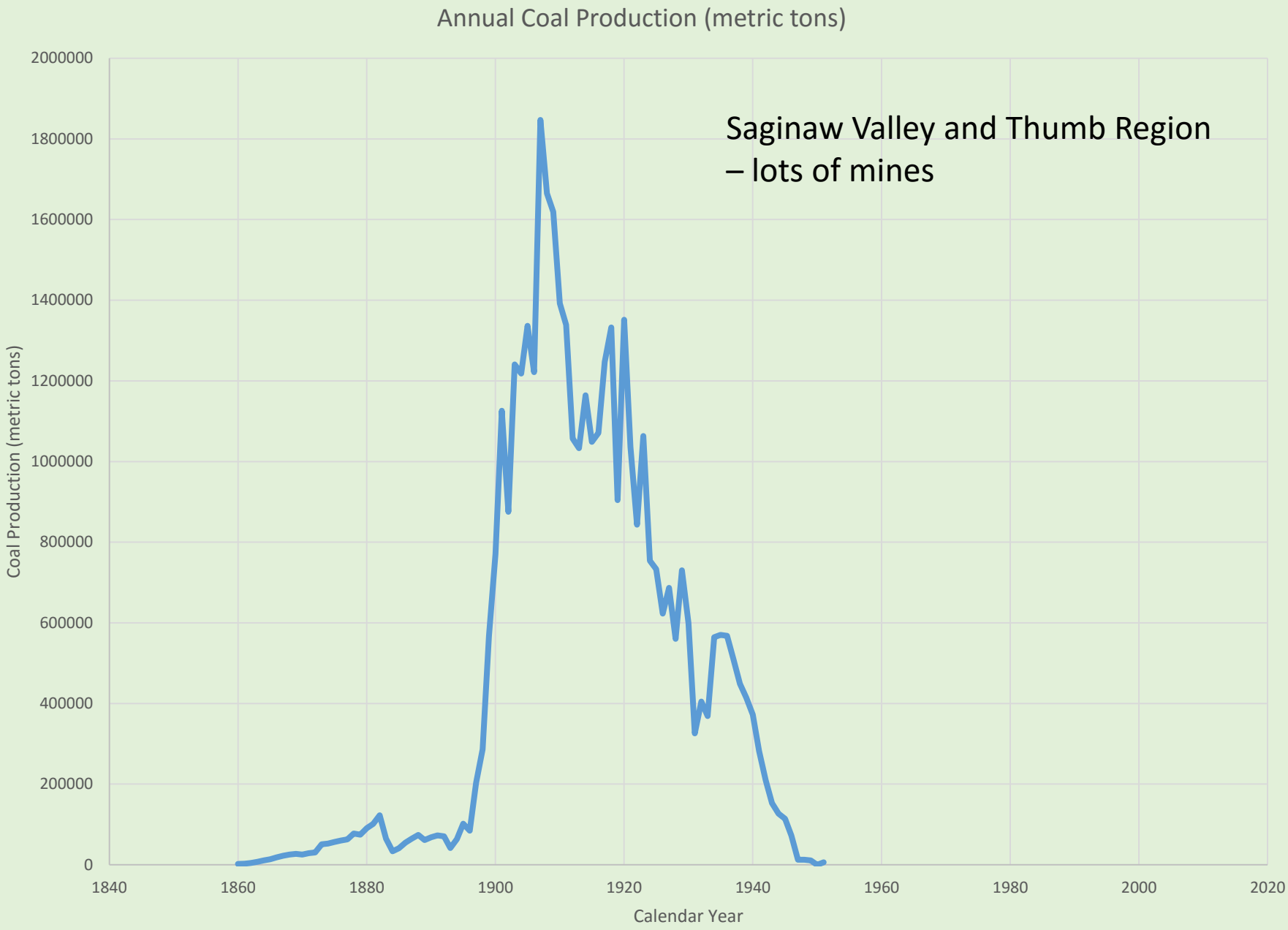
Energy Resources

- Lower Peninsula Resources – some exploration in the UP – but nothing productive
- Oil
- Natural Gas
- Coal (historic production – none today)


Natural Gas Production
Note Oil and Gas data – from Bill Harrison's records
Antrim Shale – One of the first Unconventional Shale Plays
Annual Natural Gas Production (MCF)
300,000,000
250,000,000
200,000,000
150,000,000
100,000,000
50,000,000
0
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Calendar Year


Oil Production
Note Oil and Gas data – from Bill Harrison's records
Annual Oil Production (Bbls)
40000000
35000000
30000000
25000000
20000000
15000000
10000000
5000000
0
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Calendar Year
Dundee and Traverse Group
Niagaran Reefs
Trenton-Black River (Albion-Scipio)
Renewed Trenton-Black River


Coal Seam – Saginaw Fm., Grand Ledge, MI


Annual Coal Production (metric tons)
Saginaw Valley and Thumb Region – lots of mines
Coal Production (metric tons)
2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
Calendar Year

Estimated Energy Resources Production

Commodity	Production
Oil	1,336,000,000 barrels
Natural Gas	8,086,000,000 cubic feet
Coal	42,000,000 metric tons
Peat	10,000,000 metric tons

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