White Pine Mineralogy and Origin through Structural/ Sedimentary Analysis

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NDSU Petrology 2018

Introduction

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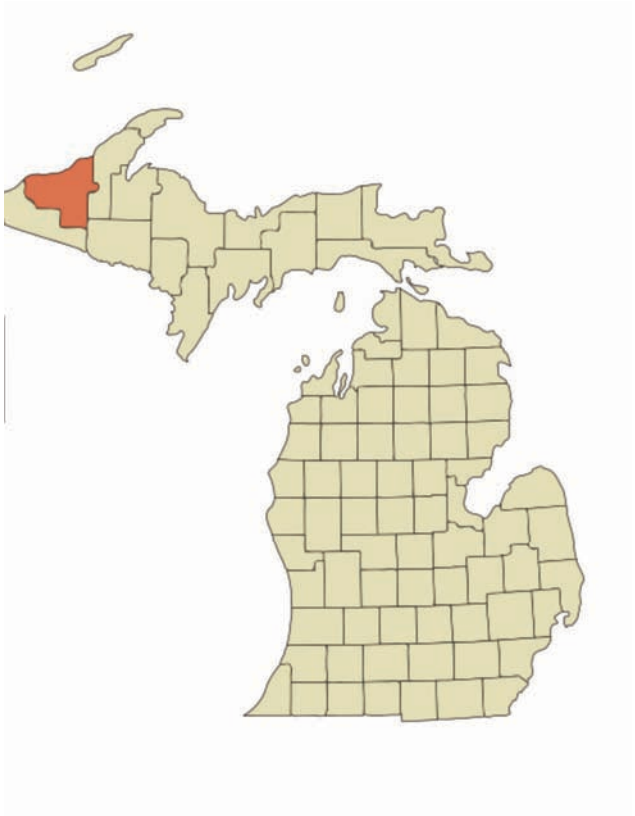

Introduction

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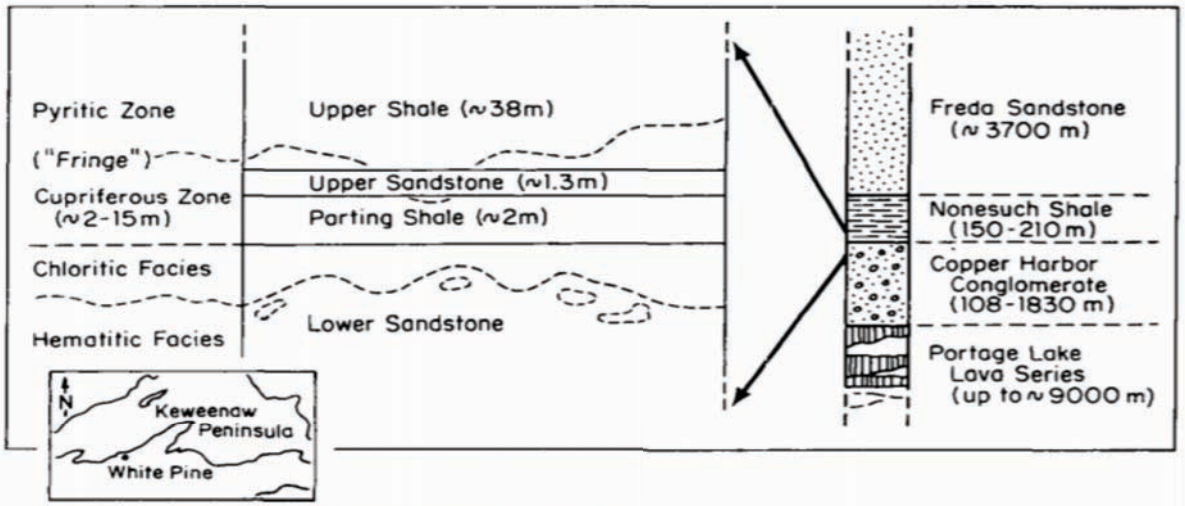

Figure 1. Location, stratigraphy, and mineralization facies of White Pine copper deposit.

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Samples

- Acquired by Dr. Eidukat on field trip

Interest

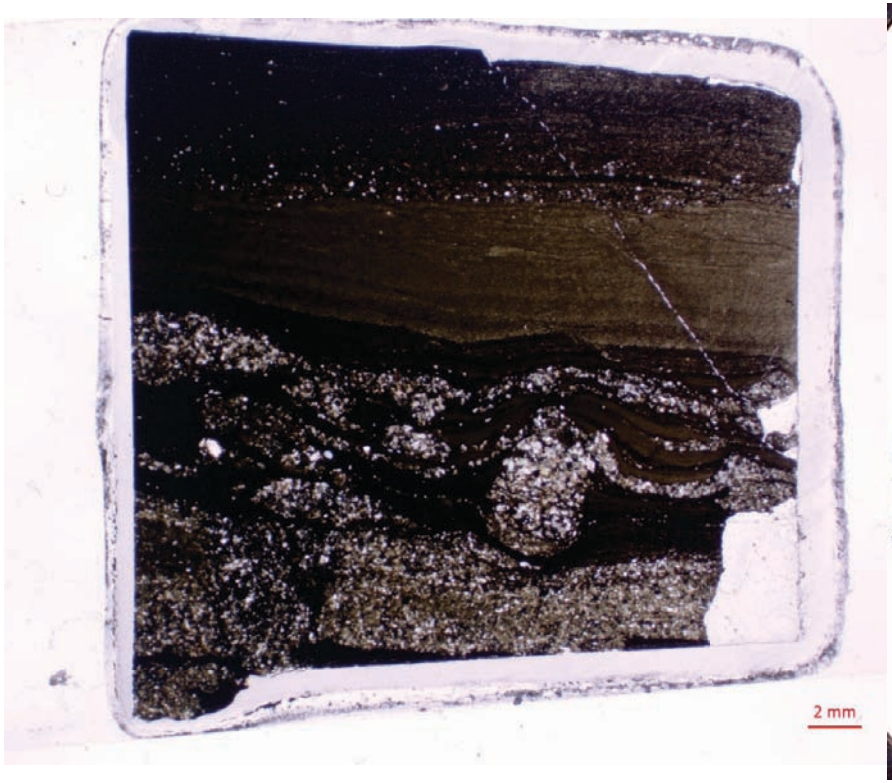
- Interesting contrast between copper and shale
- Structures within the samples
  - Microfold interactions with the copper and shale
- Origin interest

Guiding Questions

- What is the mineralogical makeup of the samples acquired?
- What could be a working hypothesis for the formation of the copper in the mine?

Methods

- Thin Sections
  - Choose sample rock to cut
  - Include significant structures
  - Cut two billets that fit at least inside a glass section
  - A piece was cut to also use as a round section
  - Using the soil sciences Buehler PetroThin saw grounded down to .25 mm
  - Then used 400 grit all the way up to 1000 using hands to polish the thin sections down
  - Sonic cleaned
  - Finally used the polishing disk to grind to .25 micrometers for both


2 mm

SEM Preparation

- Find points of interest in slide
- Map out points on paper using landmarks
- Carbon coat

SEM

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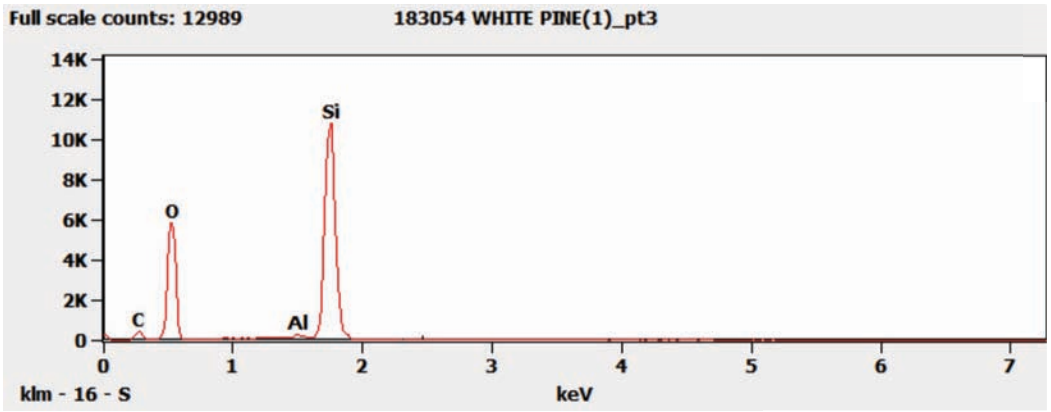

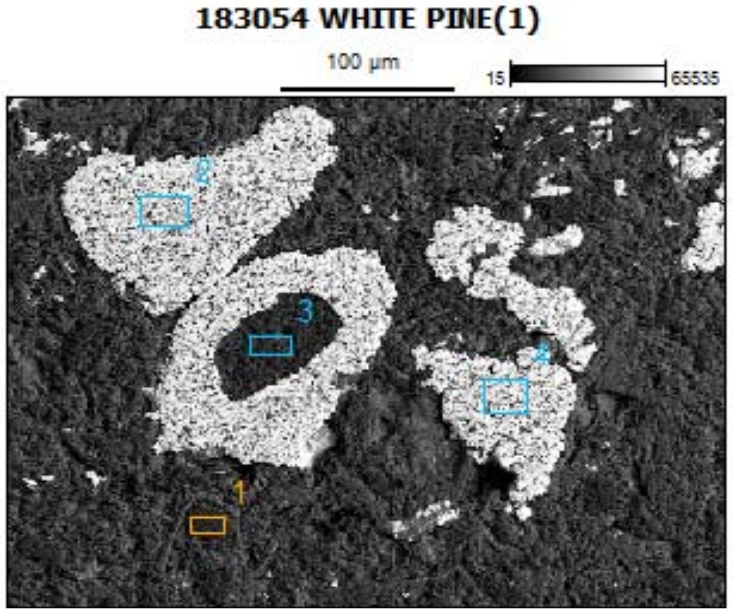

SEM

Weight %

	O-K	Al-K	Si-K	Fe-K	Cu-L
183054 WHITE PINE(1)_pt1	51.87		48.13		
183054 WHITE PINE(1)_pt2	3.74	0.51	11.04		84.72
183054 WHITE PINE(1)_pt3	51.20	0.41	48.39		0.00
183054 WHITE PINE(1)_pt4	4.36	0.43	10.16	0.69	84.36

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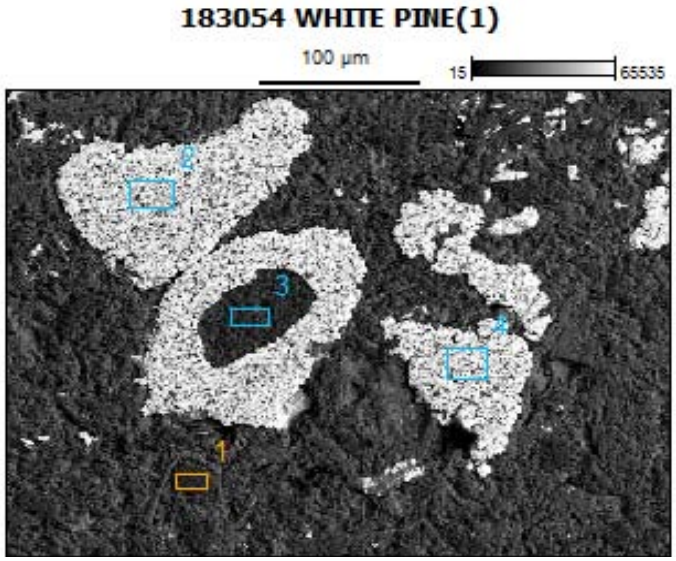

SEM

Atom %

	O-K	Al-K	Si-K	Fe-K	Cu-L
183054 WHITE PINE(1)_pt1	65.42		34.58		
183054 WHITE PINE(1)_pt2	11.80	0.95	19.86		67.39
183054 WHITE PINE(1)_pt3	64.81	0.30	34.89		0.00
183054 WHITE PINE(1)_pt4	13.69	0.80	18.18	0.63	66.70

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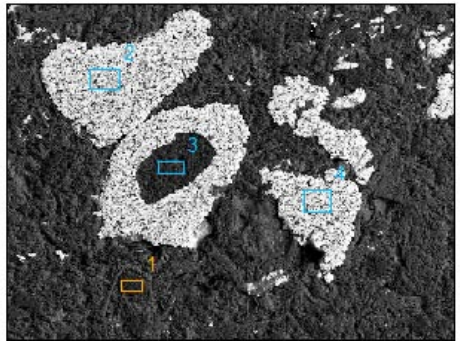
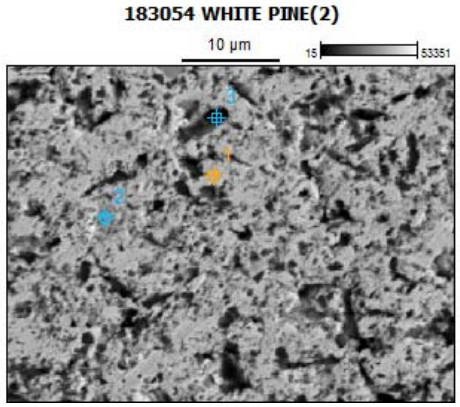


SEM

Weight %

	O-K	Mg-K	Al-K	Si-K	K-K	Fe-K	Cu-L
183054 WHITE PINE(2)_pt1	0.65						99.35
183054 WHITE PINE(2)_pt2	3.08	0.05	0.55	2.86	0.27	0.59	92.61
183054 WHITE PINE(2)_pt3	2.41		0.70	7.03			89.87



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SEM

Atom %

	O-K	Mg-K	Al-K	Si-K	K-K	Fe-K	Cu-L
183054 WHITE PINE(2)_pt1	2.54						97.46
183054 WHITE PINE(2)_pt2	10.74	0.11	1.14	5.68	0.38	0.59	81.36
183054 WHITE PINE(2)_pt3	8.17		1.40	13.59			76.84

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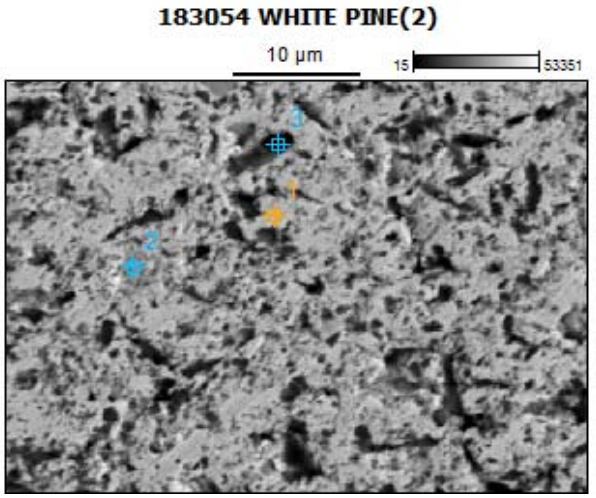

SEM

Weight %

	O-K	Si-K	S-K	Fe-K	Cu-L
183054 WHITE PINE(3)_pt1		0.14	16.80	0.83	82.23
183054 WHITE PINE(3)_pt2		0.54	16.80		82.66
183054 WHITE PINE(3)_pt3	0.90	0.24			98.86
183054 WHITE PINE(3)_pt4	0.56				99.44

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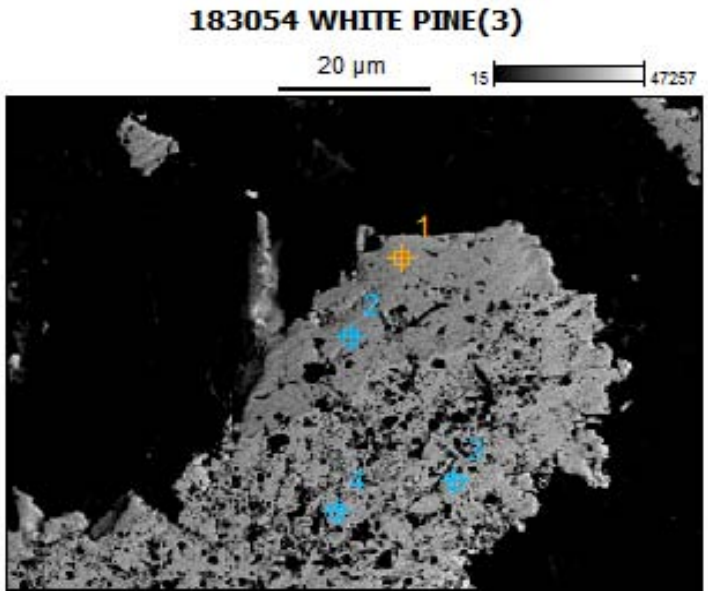

Sample Analysis

- Copper, Chalcocite
- High ratios of native copper to Chalcocite
- Mineable zone?

Discussion

- Escape features clearly visible
- Interfingering beds
- Hydrocarbons and petroleum coexisting copper
- Minimal age at 1045 Mya
- Hydrothermal processes, from surrounding rock/conglomerates

Discussion(continued)

- Likely several stages of copper mineralization
- Porosity and latent heat

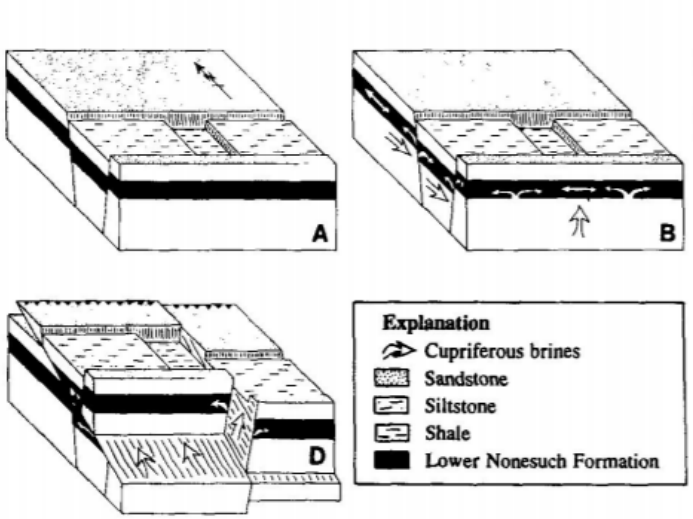

Figure 4. Schematic block diagrams illustrating geologic history of White Pine part of Midcontinent rift. A: Sedimentation and syndepositional faulting. B: Main-stage sediment-hosted stratiform copper mineralization. C: High-angle faulting. D: Thrusting accompanied by second-stage mineralization.

Photo courtesy of J.L. Mauk, et, al.

Further Work

- Samples from overlying and underlying formations
- An analysis of the underyling Porcupine volcanics
- Modeling

Acknowledgements

- Thanks to Dr. Hopkins for the use of the Buehler PetroThin machine.
- Thank you to Dr. Saini-Eidukat for his time, guidance, lab, and equipment.
- Thank you NDSU Electron Microscopy Center core facility