



**70th Annual Meeting
Institute on Lake Superior Geology**

**Houghton, Michigan
May 15-18, 2024**

Sponsored by:

A. E. Seaman Mineral Museum
Great Lakes Research Center

Department of Geological and Mining Engineering and Sciences
Michigan Technological University

Meeting Co-Chairs

Theodore J. Bornhorst, Erika C. Vye, Patrice Cobin, and James DeGraff

PROGRAM

Wednesday May 15, 2024

All field trips begin and end at the Michigan Tech Memorial Union Building

Parking tickets are given between 7 am to 4 pm weekdays.

Between ticketing hours all vehicles need a parking pass; these will be available from trip leaders.

Pre-meeting Field Trips May 15, 2024

8:00 am - 5:00 pm **PRE-MEETING FIELD TRIPS**

Trip 1: *Mesoproterozoic Midcontinent Rift-filling Strata and Native Copper Deposits of the Keweenaw Peninsula, Michigan*
Ted Bornhorst (Michigan Tech University)

Trip 2: *Mining History and Geology of the Quincy Mine, Keweenaw Peninsula Native Copper District, Michigan*
Tom Wright (Quincy Mine Hoist Association),
Jim DeGraff, Katherine Langfield, and Ted Bornhorst (Michigan Tech)

Trip 3: *Geoheritage of Buffalo Reef: Industrial Impact on Land, Culture, and Fish Sovereignty*
Erika Vye and Charlie Kerfoot (Michigan Tech)
Stephanie Swart (Michigan Department of Environmental Quality)
Dione Price and Evelyn Ravindran (Keweenaw Bay Indian Community)

Wednesday evening May 15, 2024

4:00 pm - 8:00 pm **Registration** (2nd floor, Michigan Tech Memorial Union)

6:30 pm - 8:30 pm **Poster Setup and Viewing** (2nd floor, Michigan Tech Memorial Union)

6:30 pm - 8:30 pm **Welcoming Reception** (2nd floor, Michigan Tech Memorial Union)

* Denotes a student eligible for Best Student Paper Award. To be eligible students must have graduated no more than one month before the ILSG meeting, be first author, and present the paper at the meeting
+ Denotes author that will present the paper if different than the first author.

Thursday - May 16, 2024

All vehicles need a parking pass between 7am to 4pm weekdays; these will be available from registration

7:15 am - noon **Registration** (2nd floor, Michigan Tech Memorial Union)

8:15 am **OPENING REMARKS** (2nd floor, Michigan Tech Memorial Union)
Ted Bornhorst, Erika Vye, Patty Cobin, and Jim DeGraff
Co-Chairs, 2024 ILSG

TECHNICAL SESSION I – ORAL PRESENTATIONS

Session Chair: Mark Smyk

8:20 **Jim MILLER**

Roland Duer Irving - Pioneer of Lake Superior geology

8:35 **Graham WILSON, Charles BUTT, Robert GARRETT and Heather ROBINSON**

R.W. Boyle's History of Geochemistry and Cosmochemistry

8:55 **James DeGRAFF, Nolan GAMET, Katherine LANGFIELD, Daniel LIZZADRO-McPHERSON, Sophie MUELLER, and Colin TYRRELL**

Transpressional Nature of the Keweenaw Fault System, Lake Superior Region, and Its Relationship to Grenville Orogenesis

9:15 **Alex BROWN**

Re-interpretation of hydrothermal alteration, mineralization and host-rock oxidation to form the Keweenaw native copper lodes, northern Michigan

9:35 **Esther STEWART, Michael TAPPA, Ann BAUER, Anthony PRAVE, and Latisha BRENGMAN**

Geochemical fingerprints from the late Mesoproterozoic epeiric seaway of the Nonesuch Formation, Wisconsin and Michigan, USA

9:55 **END OF TECHNICAL SESSION I**

9:55-10:10 **COFFEE BREAK**

TECHNICAL SESSION II – ORAL PRESENTATIONS

Session Chair: Ashley Quigley

- 10:10 **Sarah GORDEE, Madison RIAN, Stacy SAARI, and Matthew CARTER**
Description and application of the Consolidated Minerals Database to support geological investigations: an example from the Cuyuna Range, central Minnesota
- 10:30 **Stacy SAARI, Sarah GORDEE, Madison RIAN, and Matt CARTER**
Compiled historical drillhole and geochemical data from the Cuyuna Range, Minnesota, provides powerful new insights for geological and mineral potential investigations.
- 10:50 **Bob MAHIN, Ashley QUIGLEY, John YELLICH, John ESCH, and Nolan GAMET**
Critical Mineral Systems in the Upper Peninsula of Michigan, A Cooperative Effort Between the USGS and the Michigan Geological Survey
- 11:10 **Paul BEDROSIAN, Dana PETERSON, and Bennett HOOGENBOOM**
Geophysical imaging of the Paleoproterozoic Animikie basin in Minnesota
- 11:30 **Dan HOLLIS**
Use of Ambient Noise Tomography for Mineral Exploration in the Lake Superior Region
- 11:50 **END OF TECHNICAL SESSION II**
- 11:50-1:10 **LUNCH BREAK and ILSG BOARD OF DIRECTORS MEETING**
- lunches not provided to conference attendees-

TECHNICAL SESSION III- ORAL PRESENTATIONS

Session Chair: Mary Louise Hill

- 1:10 ***Demily THIBODEAU-BELLO, Mary Louise HILL, Andrew CONLY,**
An evaluation of structural and mineralogical controls on gold mineralization on the GoldRich property in the Abbie Lake area, Wawa, Ontario
- 1:30 **Dean PETERSON and Alex STEINER**
The geology and ore deposit model of the high-grade Emily Manganese Deposit, Cuyuna Range, Minnesota: Results from the 2023 drilling program
- 1:50 ***Gabriel AHRENDT and Aleksey SMIRNOV**
Rock magnetic investigation of the Vulcan Iron Formation: Unveiling Paleoproterozoic Paleoenvironments
- 2:10 ***Zsuzsanna ALLERTON, George HUDAK, Christian TEYSSIER, Annia FAYON, Martin DANIŠIK, Liam COURTNEY-DAVIES, and Phillip LARSON**
Geochronology and geochemistry of hematite ore in northeastern Minnesota

2:30 **Joyashish THAKURTA and Beau HAAG**
Sulfur-isotope ratios in Paleoproterozoic Michigamme Formation at the Lake Superior Region: Implications on basin evolution and ambient seawater composition in the Greater Animikie Basin

2:50 ***Jordan PETERZON, Noah PHILLIPS, Pete HOLLINGS, and Lionnel DJON**
Deformation conditions, micromechanics, and fault zone development in mafic protoliths at the Lac des Iles mine, northwestern Ontario

3:10 **END OF TECHNICAL SESSION III**

3:10-3:30 COFFEE BREAK

TECHNICAL SESSION IV – POSTER PRESENTATIONS

Session Chair: Allan Blaske and Patty Cobin

3:30-5:00 **AUTHORS PRESENT AT THEIR POSTERS**

5:00 **END OF TECHNICAL SESSION IV**

Thursday evening May 15, 2024

6:00 pm **RECEPTION AND CASH BAR** (2nd floor, Michigan Tech Memorial Union)

7:00 pm **ANNUAL BANQUET** (2nd floor, Michigan Tech Memorial Union)

2024 Goldich Medal Recipient:

Banquet Speaker: Robert M. Hazen, Carnegie Institution for Science

“Mineral Informatics: A New Frontier in Understanding Earth”

Mineral Informatics: A New Frontier in Understanding Earth

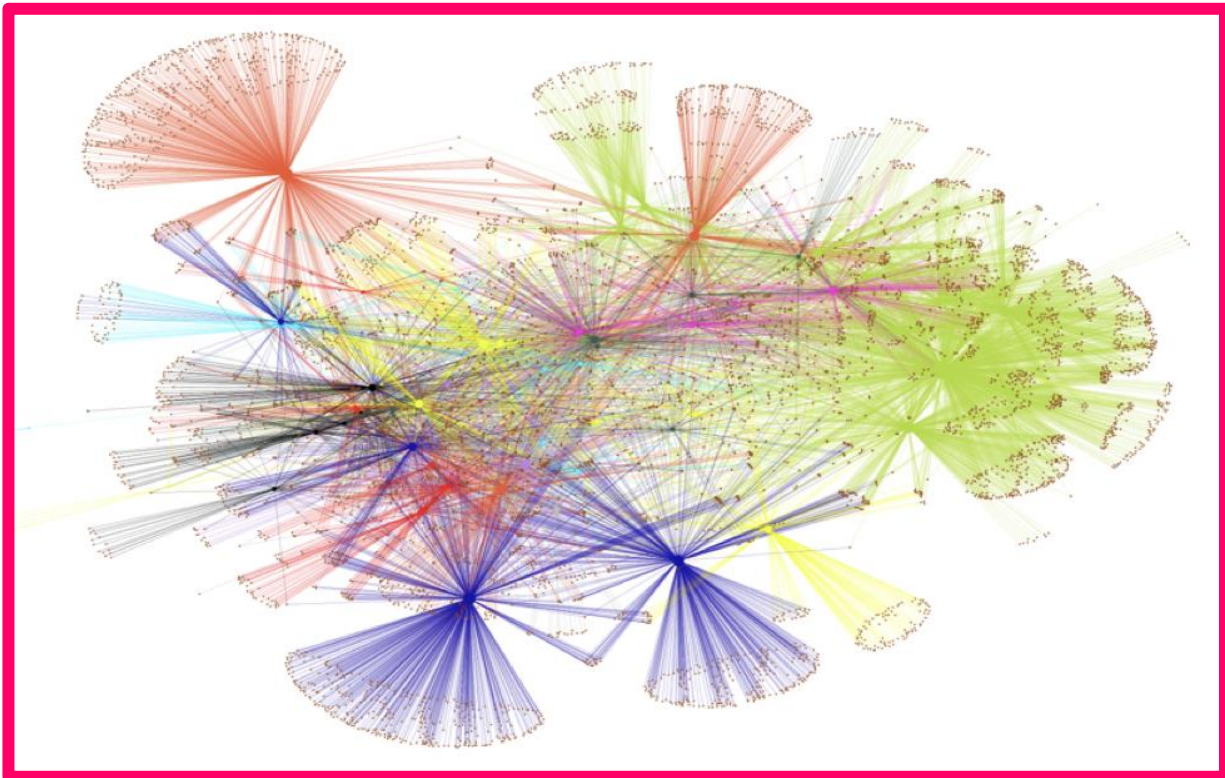
Robert M. Hazen

Banquet Speaker

Senior Staff Scientist, Earth and Planets Laboratory
Carnegie Institution for Science, Washington, DC 20015

Email: rhazen@carnegiescience.edu

The story of Earth is a 4.5-billion-year saga of dramatic transformations, driven by physical, chemical, and biological processes. The co-evolution of life and rocks unfolded in an irreversible sequence of evolutionary stages. Each stage re-sculpted our planet's surface, while introducing new planetary processes and phenomena. This grand and intertwined tale of Earth's living and non-living spheres is coming into ever-sharper focus, thanks to advances in "mineral informatics" - a field that employs large and growing mineral data resources to tell the deep-time stories of our evolving planet. Minerals are remarkably information rich, holding dozens of trace and minor elements, scores of stable isotopes, solid and fluid inclusions, chemical zoning, twinning, exsolution, countless defects, and a host of optical, magnetic, electrical, and other properties. Every mineral specimen is a time capsule waiting to be opened—waiting to tell its story. This lecture will explore some of the advanced data analytical and visualization methods that are shining new light on the old field of mineralogy, while revealing in ever greater clarity the co-evolution of the geosphere and biosphere.



A network diagram of all known minerals colored by the way the minerals form. For example, red indicates high-temperature igneous minerals, while green indicates minerals formed by life.

Friday - May 17, 2024

All vehicles need a parking pass available from co-chairs

- 8:15 **INTRODUCTORY REMARKS AND UPDATES** (2nd floor, Michigan Tech Memorial Union)
Ted Bornhorst, Erika Vye, Patty Cobin, and Jim DeGraff
Co-Chairs, 2024 ILSG

TECHNICAL SESSION V – ORAL PRESENTATIONS

Session Chair: Bernie Saini-Eidukat

- 8:20 ***Farhan BHUIYAN, Latisha BRENGMAN, and Esther STEWART**
Assessing depositional and post-depositional mineral associations in the <1.71 Ga Freedom Formation, Baraboo, WI, USA.
- 8:40 **Jack MALONE, Ryan CLARK, Amira HARRIS-BOMMARITO, and David MALONE**
Baraboo Interval Quartzites in Iowa: Reassessing the Origin and Provenance of the Washington County Quartzite, SE Iowa
- 9:00 **Gordon MEDARIS, Chloe BONAMICI, Phil BROWN, Laurel GOODWIN, Brian JICHA, Brad SINGER, Michael SPICUZZA and John VALLEY,**
Metamorphism and Fluid-Rock Interactions at 1.47 Ga in Baraboo Interval Sedimentary Rocks Deposited at 1.63 Ga in the Southern Lake Superior Region
- 9:20 **Amy Radakovich BLOCK, George HUDAK, and Kate SOUDERS**
Insights into the southwestern Superior Province: New igneous geochronology and geochemistry in northwestern Minnesota, USA
- 9:40 **Ryan CLARK, David PEATE, Allison KUSICK, Kenny HORKLEY, and Chris MACFARLANE**
Baddeleyite age reveals timing of the Northeast Iowa Intrusive Complex (NEIIC)
- 10:00 **END OF TECHNICAL SESSION V**

10:00-10:20 COFFEE BREAK

TECHNICAL SESSION VI – POSTER PRESENTATIONS

Session Chair: Allan Blaske and Patty Cobin

- 10:20-11:40 **AUTHORS PRESENT AT THEIR POSTERS**
- 11:40 **END OF TECHNICAL SESSION VI**
- 11:40-1:00 LUNCH BREAK**

TECHNICAL SESSION VII – ORAL PRESENTATIONS

Session Chair: Allan MacTavish

- 1:00 **Jim MILLER and John GREEN**
Two decades of teaching the geologic heritage of Minnesota's North Shore at the North House Folk School, Grand Marais
- 1:20 **Erika VYE, Daniel LIZZADRO-MCPHERSON, and James JUIP**
The Keweenaw Geoheritage Summer Internship Experience
- 1:40 **Eric NOWARIAK, S, Allison SEVERSON, and Amy Radakovich BLOCK**
Lithostratigraphy and Geochronology of the Lower Northeast Sequence of the North Shore Volcanic Group, Cook County, MN, USA
- 2:00 **Pete HOLLINGS and Mark SMYK**
New Insights into the Geology and Geochemistry of the Osler Group and Related Rocks, Midcontinent Rift System, Northern Lake Superior, Ontario
- 2:20 **David GOOD**
MCR Synthesis 1. Characterizing the MCR mantle plume
- 2:40 **END OF TECHNICAL SESSION VII**
- 2:40-3:00 COFFEE BREAK and TAKE DOWN POSTERS**

TECHNICAL SESSION VIII – ORAL PRESENTATIONS

Session Chair: Amy Radakovich Block

- 3:00 **Bill ROSE and James DeGRAFF**
Lidar Topography: Bright opportunity for reading Keweenaw Landscapes
- 3:20 **Wouter BLEEKER, Natasha WODICKA, Sandra KAMO, Michael HAMILTON, Quinn EMON, and Jennifer SMITH**
The Lake Superior area "event layer": Testing the connection with the Sudbury impact
- 3:40 **Tien GRAUCH, S. HELLER, Laurel WOODRUFF, and Esther STEWART**
Revisiting geophysical interpretations of the Midcontinent Rift below Lake Superior—Insights from GLIMPCE seismic-reflection line C
- 4:00 **Aaron HIRSCH**
Recent developments on the use of the Horizontal-to-Vertical Spectral Ratio (HVSr) passive seismic method to determine depth to bedrock in Minnesota
- 4:20 **END OF TECHNICAL SESSION VIII**

4:20 **Presentation of Student Awards**

Best Student Paper Awards – Stacy Saari

Student Travel/Participation Awards – Ted Bornhorst

4:40 **Concluding Remarks and Field Trips**

Ted Bornhorst, Erika Vye, Patty Cobin, and Jim DeGraff

Co-Chairs, 2024 ILSG

END OF TECHNICAL SESSIONS OF THE 70th ANNUAL MEETING

Friday Evening May 17, 2024

7 pm ATDC Building across the parking lot from the A.E. Seaman Mineral Museum

2024 Edith D. and E. Wm. Heinrich Lecture

**“Mineral Evolution: A Case Study of a New Natural Law”
by Robert M. Hazen**

Sponsored by the Edith D. and E. Wm. Heinrich Mineralogical Research Foundation
and the A. E. Seaman Mineral Museum

Saturday May 18, 2024

Field trips begin and end at the Michigan Tech Memorial Union

Parking pass not needed on weekend.

8:00 am – 5:00 pm **POST-MEETING FIELD TRIPS**

Trip 4: *Keweenaw Fault Geometry and Kinematics: Clues to Its Nature and Origin*
Jim DeGraff, Katherine Langfield, and Dan Lizzadro-McPherson (Michigan Tech)

Trip 5: *Adventure Mine, Ontonagon County, Michigan: Geology and History of a Native Copper Mine*
Matt Portfleet (Adventure Mining Company), *Ted Bornhorst* (Michigan Tech)

Trip 6: *Southern Complex Granitoids, Gneisses and Migmatites: New Data, Discoveries, and Perspectives*
Chad Deering (Michigan Tech)

Trip 7: *Landslides in the Glacial Lake Ontonagon Sediments*
Stan Vitton (Michigan Tech)

POSTER PRESENTATIONS

* Denotes a student eligible for Best Student Paper Award. To be eligible students must have graduated no more than one month before the ILSG meeting, be first author, and present the paper at the meeting

+ Denotes author that will present the paper if different than the first author.

Numbered Posters and Abstracts are in sequential order

Poster

Number

- 1. Sheree HINZ**
GeologyOntario: a powerful search tool for Ontario explorationists
- 2. Therese PETTIGREW, Robert CUNDARI, Rebecca PRICE, and Manuel DUGUET**
Identification of Fertile Parent Granitoid Units in the Superior Province of Ontario
- 3. Mia MORSON and + Shannon ZUREVINSKI**
Quartz trace element chemistry: Exploring the link between a fertile parental granite and a mineralized pegmatite
- 4. *Kevin MEXIA, Pete HOLLINGS**
Geochemistry of Midcontinent Rift-related intrusive rocks of the Sunday Lake intrusion
- 5. Justin JONSSON, Paul MALEGUS, Sophie CHURCHLEY, and Rebecca PRICE**
Characterizing the geochemistry and nickel-copper-platinum group elements potential of mafic and ultramafic intrusions in northwestern Ontario
- 6. *Andrea Paola CORREDOR BRAVO, Pete HOLLINGS, Matthew BRZOZOWSKI, and Geoff HEGGIE**
Magmatic and hydrothermal evolution of the Mesoproterozoic Current ultramafic PGE-Cu-Ni deposit within the Thunder Bay North Intrusive Complex: insights from trace elements, Nd, Sr, O, and H isotopes
- 7. Max LAXER and + David GOOD**
Building a 3D model for Cu/Pd inflection points throughout the Marathon PGE-Cu Deposit
- 8. *Vlad SHESHNEV, Pete HOLLINGS, Noah PHILLIPS, Ryan WESTON, Matt DELLER, and Dana CAMPBELL**
Geochemistry and Petrology of the Eagle's Nest Intrusion, McFaulds Lake Greenstone Belt, Northern Ontario

9. ***Yiruo XU and Robert HOLDER**
Cooling of an Archean metamorphic terrane: garnet diffusion study of the Quetico Subprovince, Canada
10. ***Clare BEAUDRY, Madelyn HESS, Cristian PEREIRA, and Bernhardt SAINI-EIDUKAT**
Petrology and geochemistry of Precambrian basement rocks in Walsh County, North Dakota
11. ***Cristian PEREIRA, Timothy NESHEIM, Jeffrey D. VERVOORT, and Bernhardt SAINI-EIDUKAT**
Major element geochemistry and first zircon U-Pb age dates of Precambrian basement rocks in eastern North Dakota
12. **Jamey JONES, Bill CANNON, Ben DRENTH, and Paul O'SULLIVAN**
Geologic and tectonic implications of detrital zircon U-Pb ages from the Dickinson Group in the western Upper Peninsula of Michigan, USA
13. **Bill CANNON, A. SOUDERS, Ben DRENTH, and Robert AYUSO**
The Sacred Heart Orogeny in Michigan: Latest Archean Granites and the Great Lakes Tectonic Zone
14. **A. SOUDERS, W. CANNON, B. DRENTH, R. SALERNO, J. THOMPSON, and P. SYLVESTER**
New LA-ICP-MS U-Pb geochronology of Archean rocks, central Upper Peninsula, Michigan, USA: a step toward refining the final assembly of the Superior craton
15. ***Zsuzsanna ALLERTON, Annia FAYON, George HUDAK, Christian TEYSSIER, Liam COURTNEY-DAVIES, and Martin DANIŠIK**
Geochronology campaign in northeastern Minnesota
16. **Ross SALERNO, Bill CANNON, Amanda SOUDERS, Jay THOMPSON**
Understanding the evolution of the upper Midwest Archean gneiss dome corridor using apatite, titanite, and monazite LA-ICP-MS U-Pb geochronology and microstructural analyses
17. ***Trent EDIGER and Marcia BJØRNERUD**
Glimpses of a Paleoproterozoic landscape: Analysis of exhumed topography on Archean basement rocks northwest of Marquette, Michigan
18. **Rebecca STOKES, Bill CANNON, and Ross SALERNO**
Characteristics of graphitization across a metamorphic gradient in the Michigamme Formation of the Marquette Trough and Baraga Basin, MI
19. **Tom BUCHHOLZ, Alexander FALSTER, and Wm. SIMMONS**
Preliminary mineralogy of a pegmatite in the pyroxene syenites of the Stettin Complex, Wausau Complex, Marathon County, Wisconsin

20. ***Katherine LANGFIELD, Nolan GAMET, James DeGRAFF**
Cross-sectional Geometry of the Keweenaw Fault System between Hancock and Mohawk, Upper Peninsula of Michigan
21. ***Braxton MURPHY, Katherine LANGFIELD, and James DeGRAFF**
Geometry, Slip Kinematics, and Deformation along the Hancock Fault in the Quincy Mine Workings, Upper Peninsula of Michigan
22. ***Kenz CARLTON, Basil TIKOFF, and Esther STEWART**
*The Honey Creek Structure, Sauk County, Wisconsin:
Asymmetric Faulting Associated with Seismic-Induced Fluid Escape*
23. ***Alex LAWRENCE, Adam VANDERKIN, and Robert LODGE**
Volcanic and Hydrothermal Reconstruction of the Paleoproterozoic Butler Zn-Cu occurrence, Clark County, Wisconsin
24. ***Lyndsie VICKERS, and Robert LODGE**
Petrology and Geochemistry of Felsic Magmatism in the Paleoproterozoic Eau Claire Volcanic Complex, Northcentral Wisconsin
25. ***Dan SHAKKED, Lucas ROBARGE, and Robert LODGE**
Analysis of deformation-related structures in the Eau Claire Volcanic Complex, Wisconsin
26. ***Gwendolyn MARTIN and Marcia BJØRNERUD**
Investigating the origin of pervasive breccias in the Paleoproterozoic Saunders Formation in northern Wisconsin
27. **Aaron HIRSCH, Emma SCHNEIDER**
Lithostratigraphic discrimination of Quaternary core in Minnesota using magnetic susceptibility
28. **Bill ROSE and Erika VYE**
Michigan Coastal Path: A Social Commitment to Geoeducation
29. **Bill ROSE and Erika VYE**
Jacobsville geoheritage is globally celebrated and locally loved
30. ***Alice MARTIN, Zsuzsanna ALLERTON, Emma JOHNSON, Annia FAYON, Jim ESSIG, Sarah GUY-LEVAR, George HUDAK**
The Soudan Geology Trail Project: Let's talk about rocks in northeastern Minnesota

**A tribute to Jean Peterman Kemp Zimmer and Jeanne Seaman Farnum
by the A.E. Seaman Mineral Museum: Trailblazers for Women in Geology**