



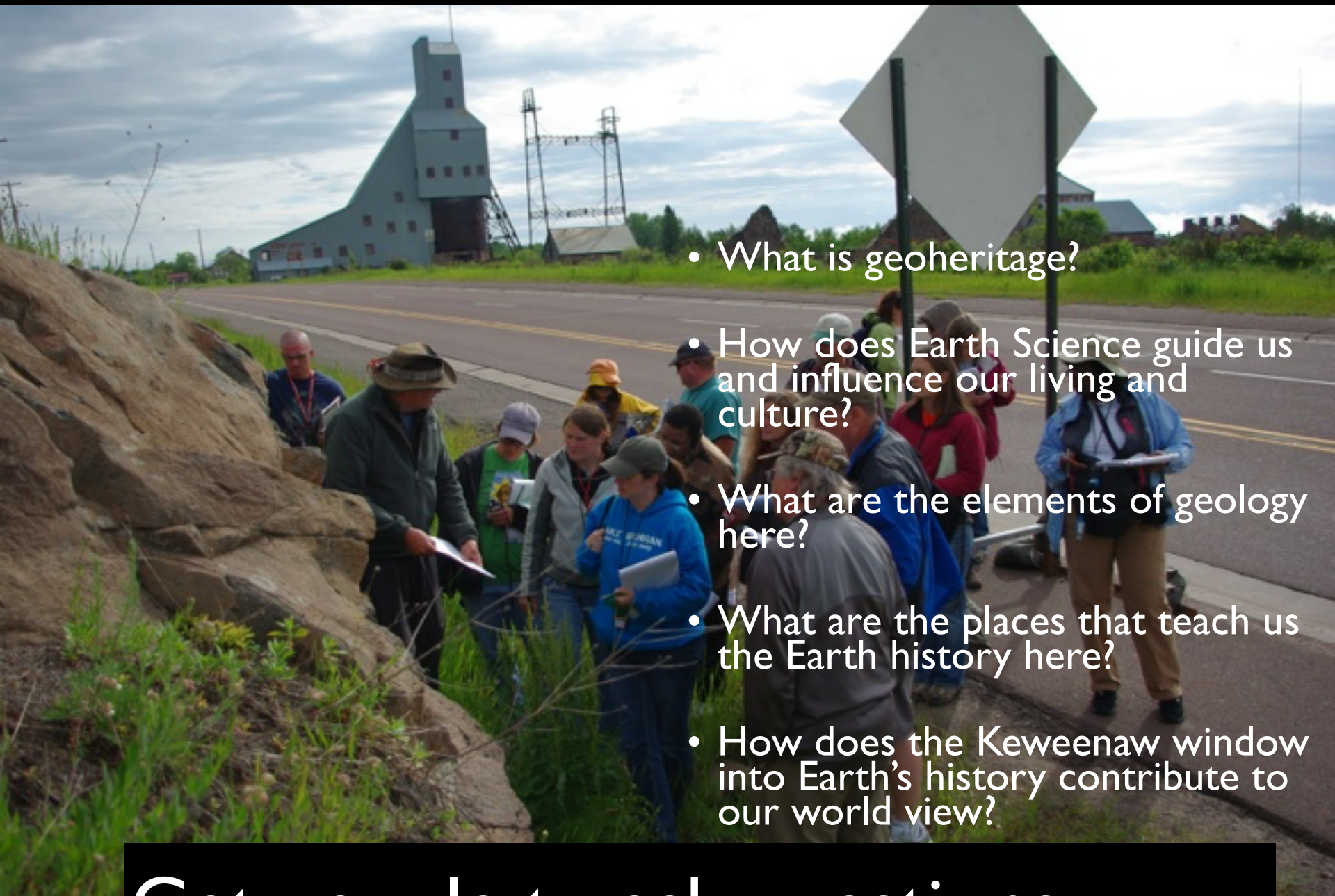
# **BUILDING LOCAL UNDERSTANDING OF STRONG *GEOHERITAGE*, MICHIGAN'S KEWEENAW AND ISLE ROYALE**

**William ROSE**

Geological Engineering & Sciences  
Michigan Technological University

[raman@mtu.edu](mailto:raman@mtu.edu)

GSA North-Central Meeting, May  
19-20th

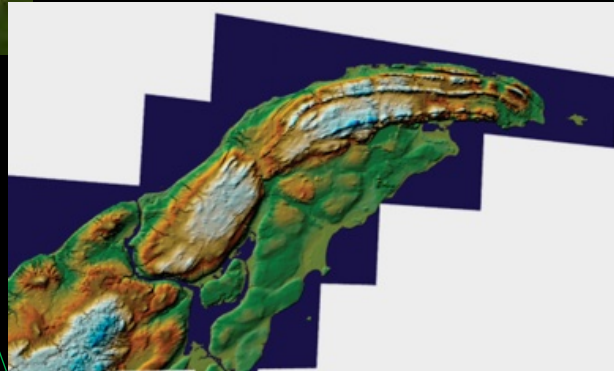


- What is geoheritage?
- How does Earth Science guide us and influence our living and culture?
- What are the elements of geology here?
- What are the places that teach us the Earth history here?
- How does the Keweenaw window into Earth's history contribute to our world view?

# Get people to ask questions



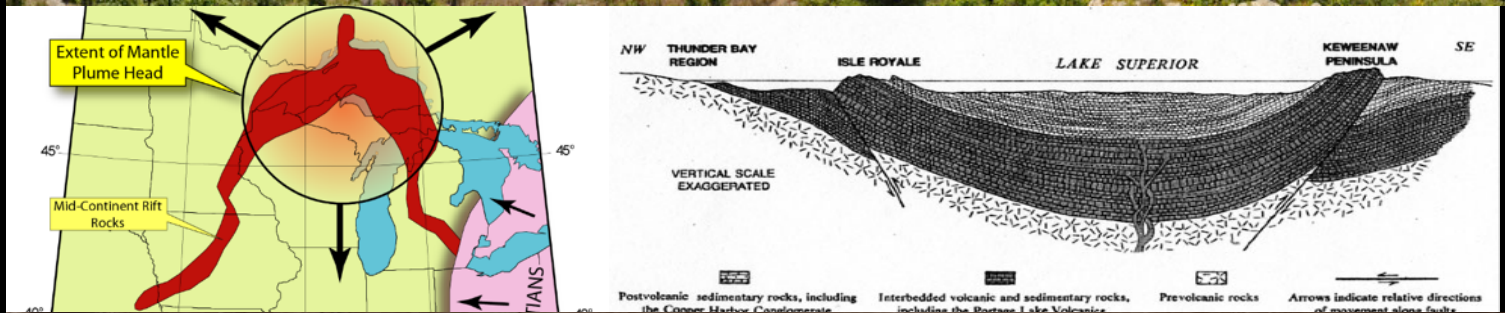
# Keweenaw Geology





## Isle Royale

National Park  
Michigan



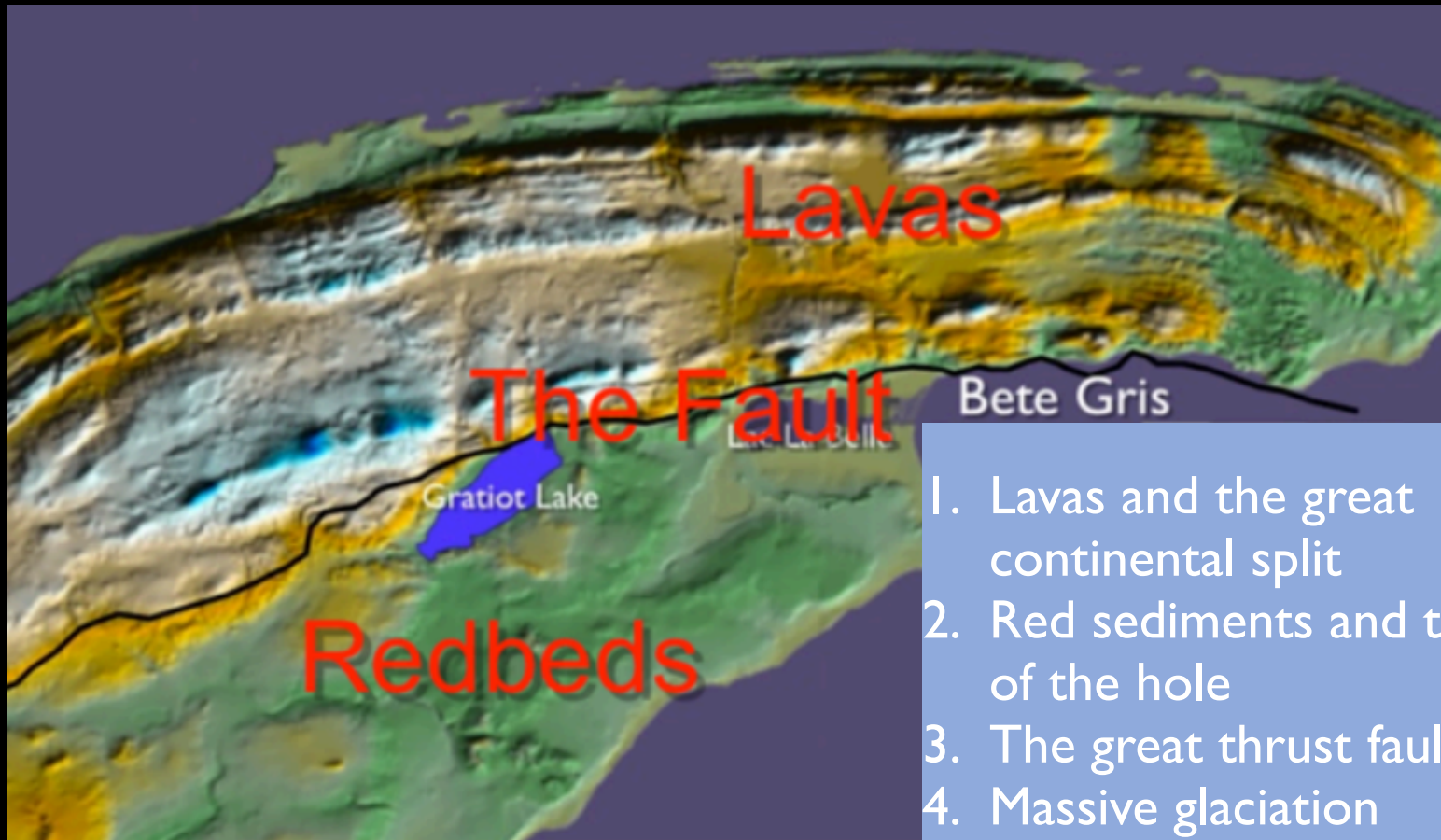
## Keweenaw

National Historical Park  
Michigan



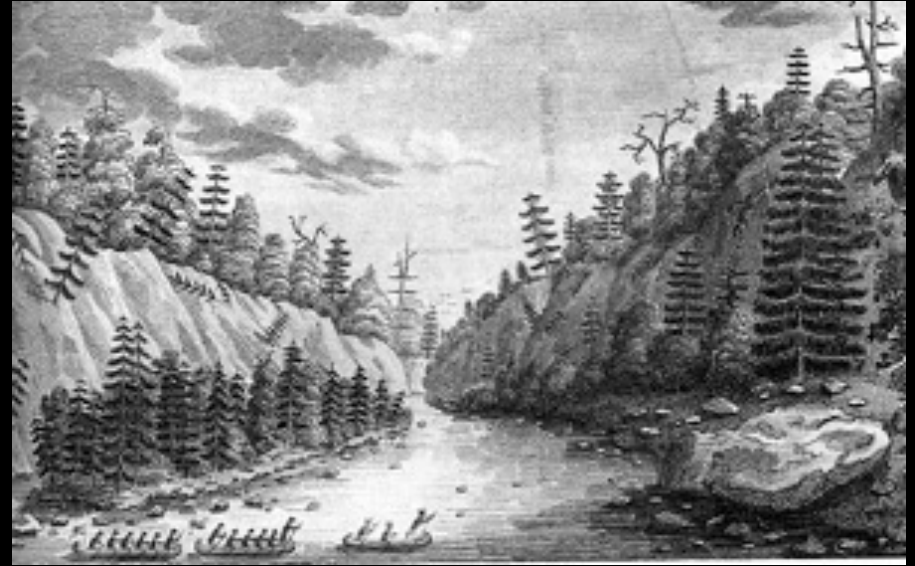


# Five Key Geo-elements of the Keweenaw



1. Lavas and the great continental split
2. Red sediments and the filling of the hole
3. The great thrust fault
4. Massive glaciation
5. The feel and look of the lake

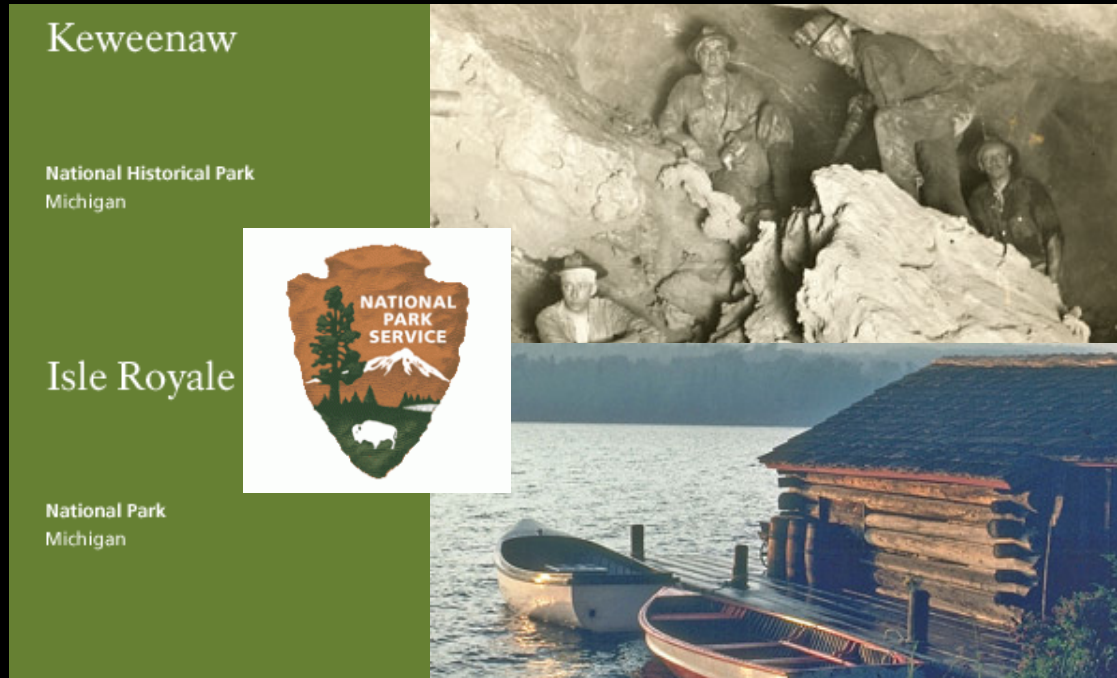
# Cultural Importance



- Native American mining history
- Diaspora of European cultures to the Keweenaw
- Corner stone of American economy



# Geoheritage Partners



Two NPS core partners

**MichiganTech**

FINLANDIA

Two University Partners



- Keweenaw Water Trail
- Keweenaw Trails
- Epic Bike Trails
- Cliff Mine
- Caledonia Mine
- Painesdale Mine and Shaft
- Delaware Mine
- Quincy Mine
- Old Victoria
- Adventure Mining Co
- Chassell Heritage Center
- Fort Wilkins State Park
- Le Roche Verte
- Copper Harbor
- Calumet
- Houghton
- Hancock
- Copper Country Trail Scenic Byway
- Copper Range Historical Museum
- Coppertown Mining Museum
- Finnish American Heritage Center
- Hanka Homestead
- Houghton County Historical Museum
- A.E. Seaman Mineral Museum
- St Annes Church, Calumet
- Keweenaw County Historical Society
- Ontonagon Historical Society
- Old Victoria
- Baraga County Historical Museum
- UP Fire Fighters Museum, Calumet
- Jacobsville Quarries

# Michigan Teaching Excellence Program







# Official EarthCache

The EarthCache program is coordinated by the Geological Society of America, in conjunction with Groundspeak.



GC34PC3 Copper Harbor Conglomerate at Horseshoe Harbor (Earthcache) in Michigan, United States - Windows Internet Explorer

http://www.geocaching.com/earthcache/details.aspx?guid=a1072623-0450-4f70-8a8e-1a95532eb96f

File Edit View Favorites Tools Help X Convert Select

Favorites Suggested Sites

GC34PC3 Copper Harbor Conglomerate at Horseshoe ...

X Find: src Previous Next Options

composed of rounded to subangular rock fragments larger than 2 mm in diameter (sand, silt, and clay; pebbles, cobbles, boulders) set in a fine-grained matrix of sand or silt, and commonly cemented by calcium carbonate, iron oxide, silica, or hardened clay; the consolidated equivalent of gravel.

individual sediment by the physical action of a larger

finer-grained

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a

rock

## Erosion and Transportation- Sediments on the Move

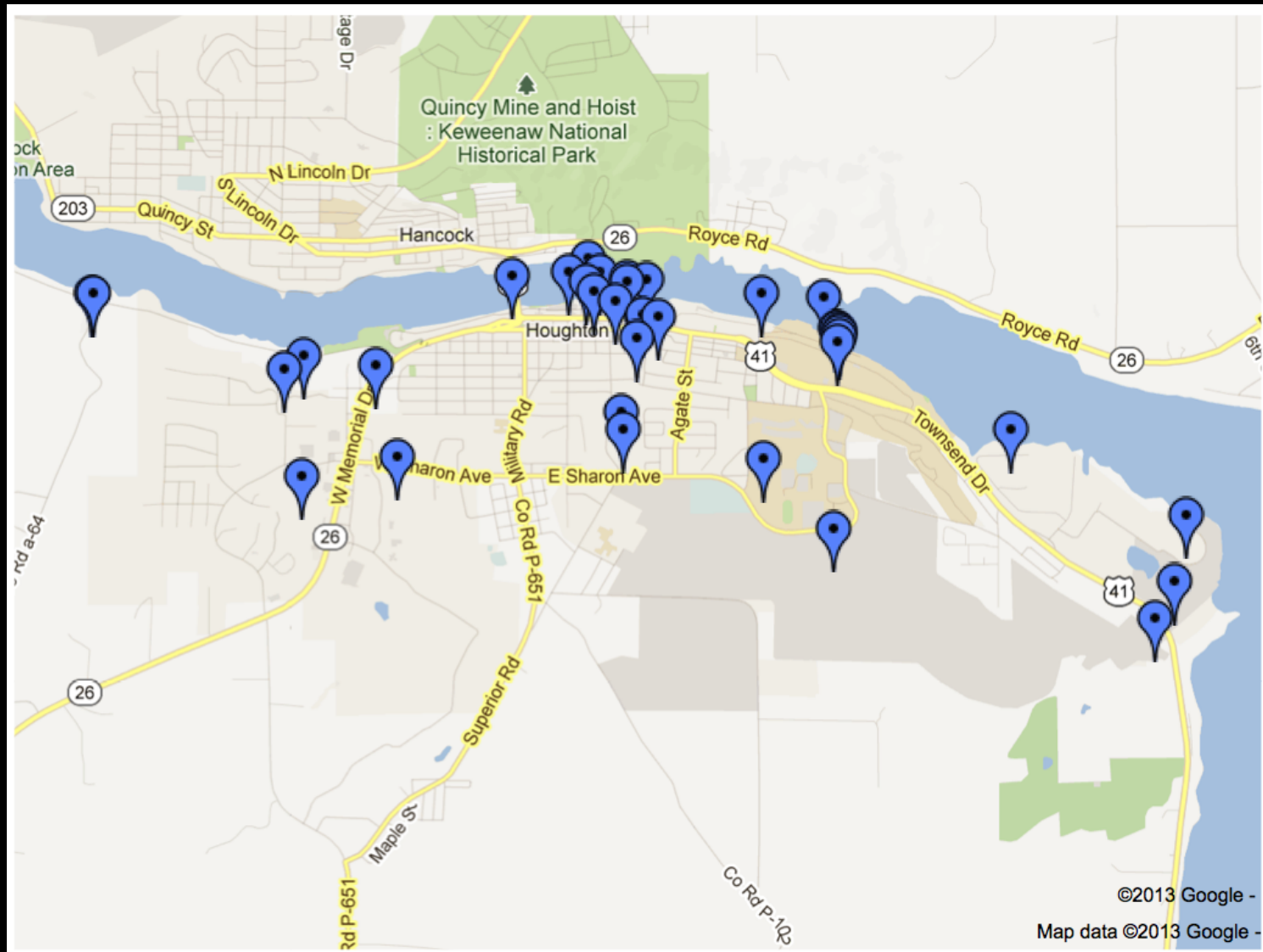
The energy of wind and water can transport sediments to a new location. The dip created by the midcontinent rift left a downward slope on either side of the Superior basin. As rain fell on the land, these slopes allowed water to collect into streams and run downhill towards the center of the basin. These rushing waters provided the energy to erode or move the broken sediments from their parent rocks toward the center of the basin. Today we can see evidence of this slope in the tilted rocks all around us.

*Logging Q2: Using a compass measure the direction of the dipping layers (give the degrees in numbers). What would you guess the direction of this dip would be for someone standing across the lake on the north shore of Lake Superior?*

**Stop 2: N 47°**  
28.398'  
W87°48.257'

**Deposition – Sediments**

# City of Houghton- Geowalk/bike tours



<http://www.geo.mtu.edu/~raman/SilverI/HoughtonEC>



# Houghton Geo Walk/Bike Sites

## Bent trees, slope stability testers



Trees growing on an unstable slope will show indications of slope movements because of geotropism--the growth of plants in a direction opposed to gravity. The degree of bending is indicative of the rate or amount of movement. In the example we have found in Houghton, we note that not all trees are bent. Why would this be? Could these observations be made into a slope stability map?

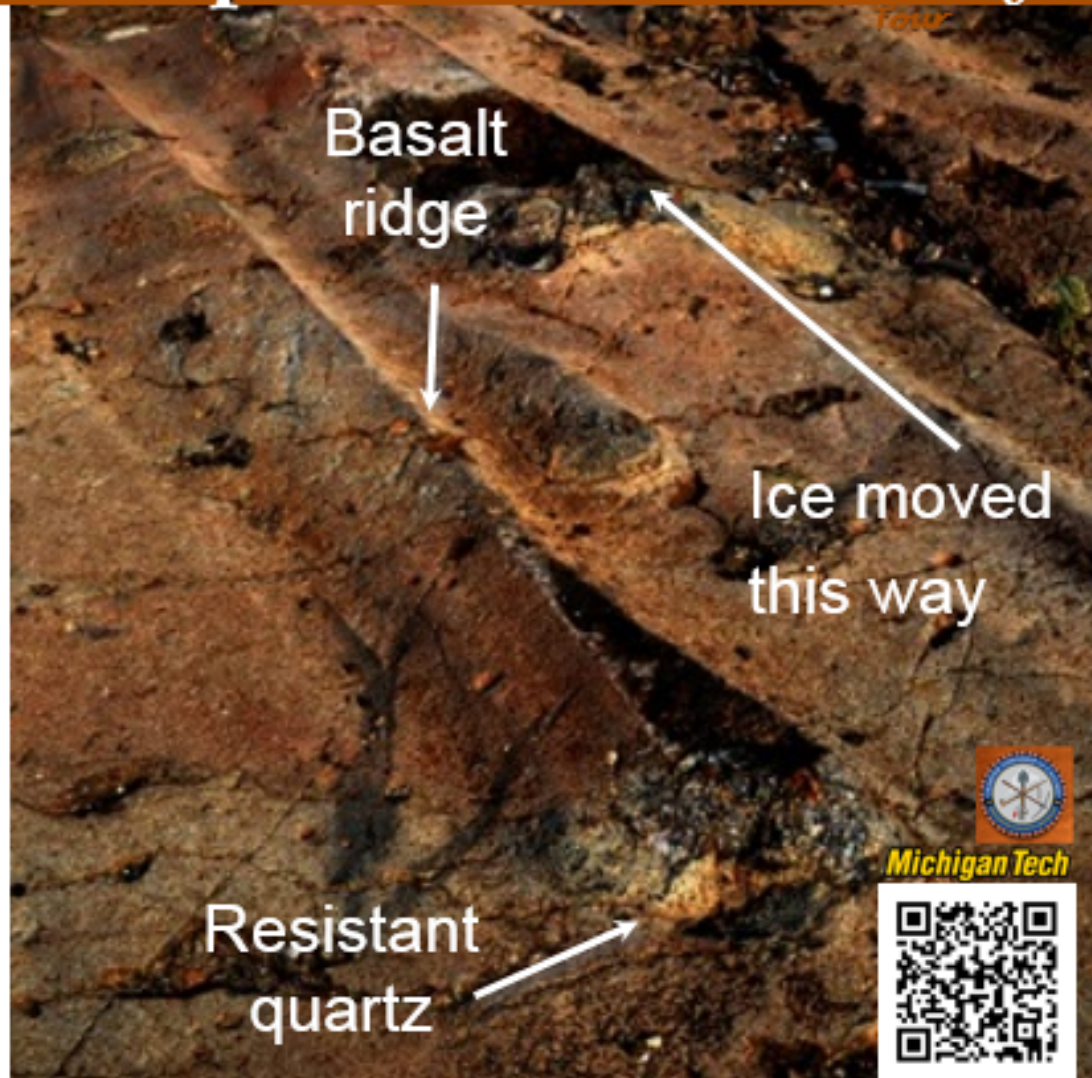
Questions:  
Why are some trees bent a lot and others not at all?  
Are they all bent in the same direction?

[http://www.geo.mtu.edu/~raman/Silverl/HoughtonEC/Bent\\_trees.html](http://www.geo.mtu.edu/~raman/Silverl/HoughtonEC/Bent_trees.html)

# Glacial roadmaps

Calumet  
Geoheritage  
Tour

Glaciers leave tracks in the rock surface that they move over. In the Keweenaw, grooves are found on many rock surfaces and help us understand directions of glacier movement. Here we use hard minerals as evidence that ice moved from NE to SW. The black rock you see is a basalt lava flow. It contains bubbles, or vesicle cylinders, which were filled with quartz - a very hard mineral. When the glacier slid across this outcrop, the quartz resisted much more than the rest of the lava flow. The vesicle cylinders now protrude with ridges of basalt that are tucked behind these bumps. Run your hand along the rock to feel these differences!



Michigan Tech

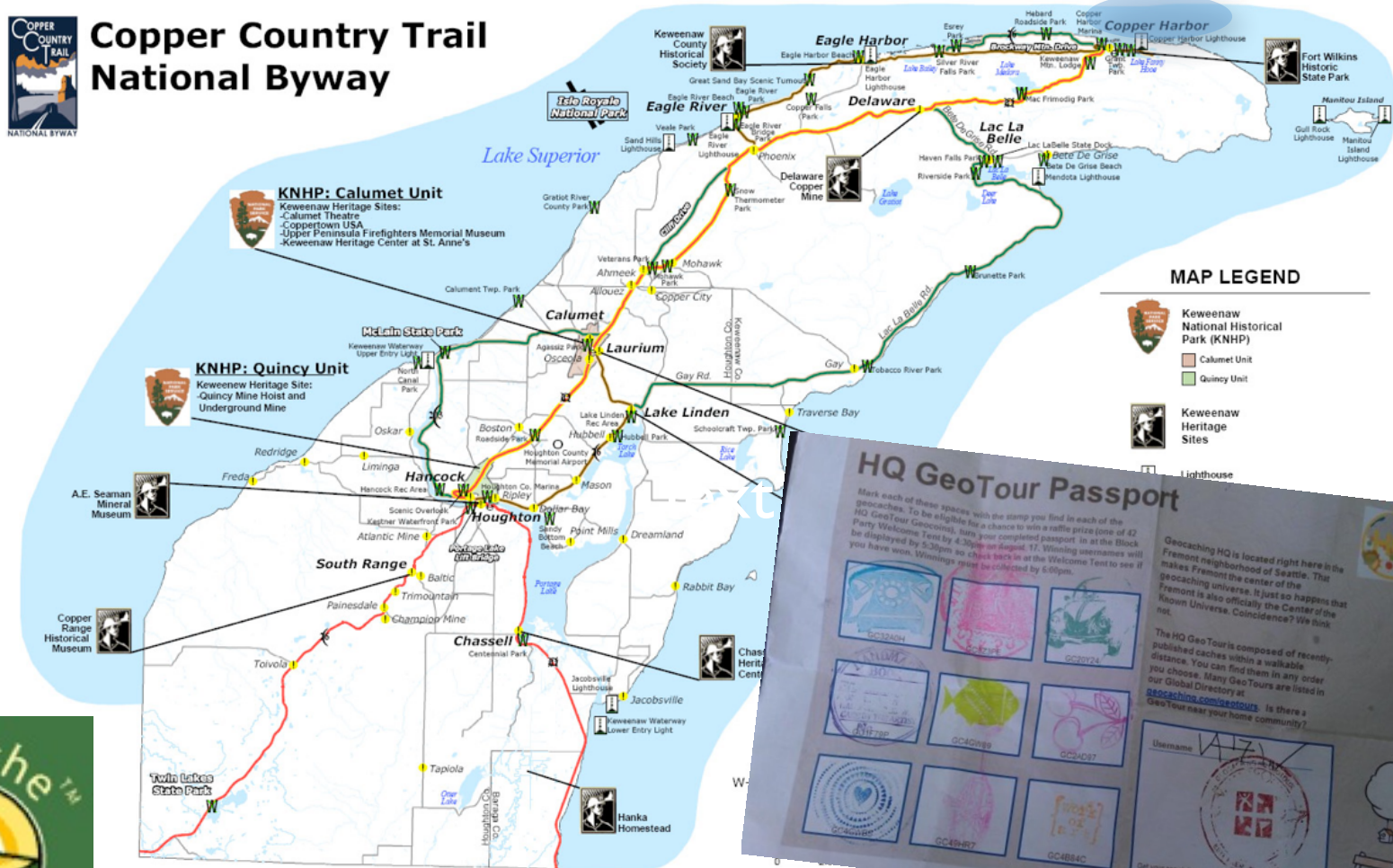




# Copper Country Trail National Byway - Geocaching Passport



## Copper Country Trail National Byway



### MAP LEGEND



Keweenaw National Historical Park (KNHP)

Calumet Unit

Quincy Unit



Keweenaw Heritage Sites



Lighthouse

### HQ GeoTour Passport

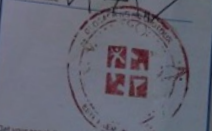
Mark each of these spaces with the stamp you find in each of the HQ GeoTours. To be eligible for a chance to win a raffle prize (one of 42 Party Welcome Tents by 4:30pm on August 17), winning usernames will be displayed by 5:30pm so check back in at the Welcome Tent to see if you have won. Winnings must be collected by 6:00pm.



Geocaching HQ is located right here in the Fremont neighborhood of Seattle. This makes Fremont the center of the Geocaching universe. It just so happens that Fremont is also officially the Center of the Known Universe. Coincidence? We think not.

The HQ GeoTour is composed of recently published caches within a walkable distance. You can find them in any order you choose. Many GeoTours are listed in our Global Directory at [geocaching.com/geotours](http://geocaching.com/geotours). Is there a GeoTour near your home community?

Username: LAZAR



# Isle Royale Field Trip Guide

[Lighthouse](#) [Ojibway](#) [LIDAR](#) [Keweenaw Peninsula](#) [Take Home](#) [Lake Levels](#)  
[RV Agassiz](#) [Biblio](#) [Acknowledgements](#) [Trippers](#)

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## Isle Royale: Keweenaw Rift Geology

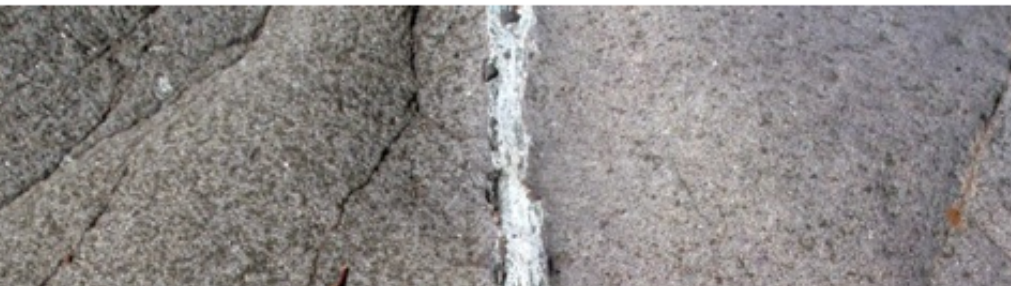
### Physical Volcanology of Large Lava Flows

Middle Proterozoic Continental Tholeiitic Flood Basalts of the 1.1 Ba Keweenaw Rift (Rodinia).

Log of field trip from [Institute of Lake Superior Geology](#), May 25-30, 2013

[Bill Rose](#), [Justin Olson](#) [Michigan Technological University](#)

**AWARD:** [Best Field Trip Guide of 2013!](#)



Native copper in a vein on Washington Island, Isle Royale (photo by Justin Olson). This occurrence of copper was found all over the Keweenaw and Isle Royale, but humans dug

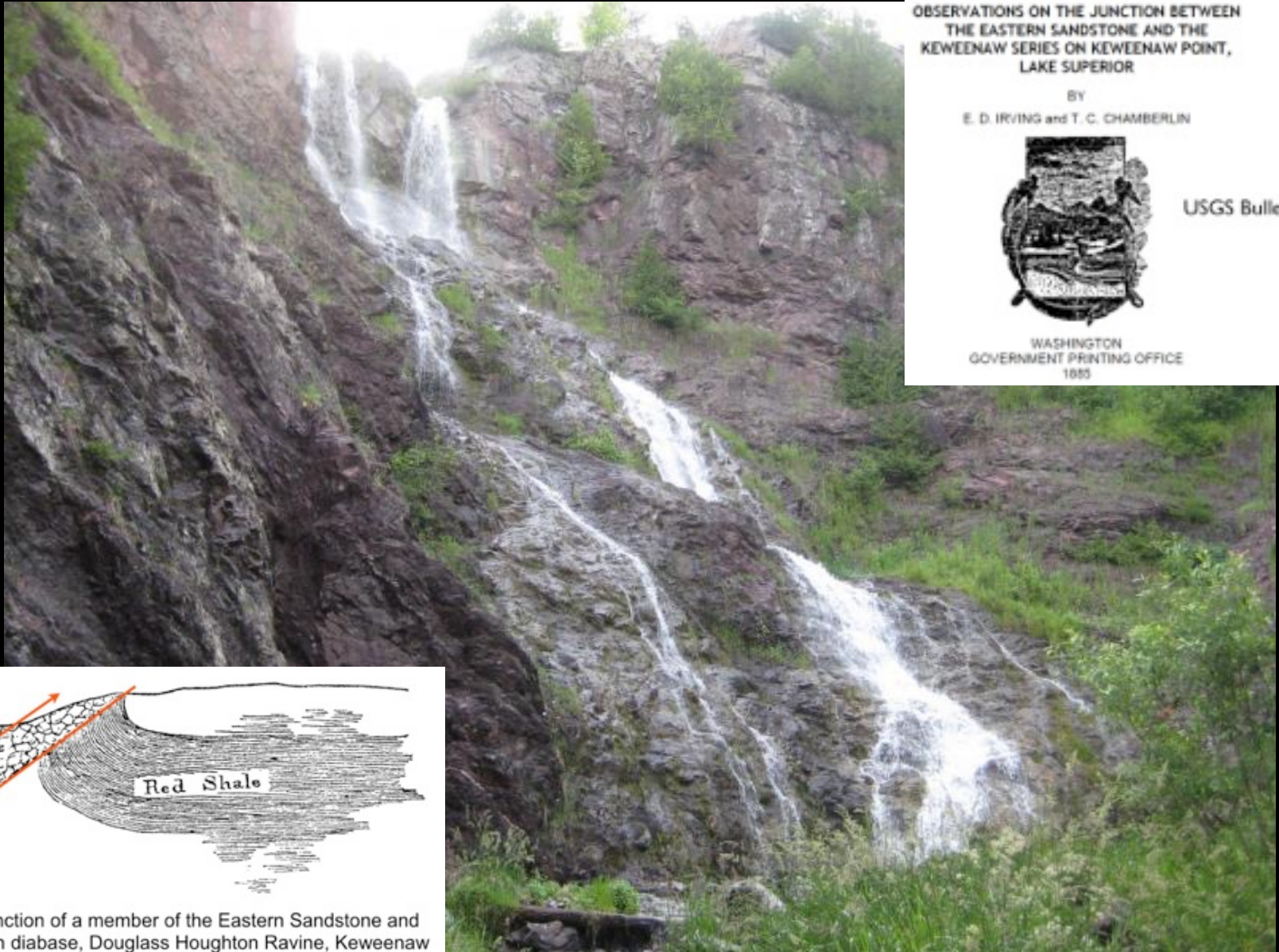


# Keweenaw Land Trust - Hungarian Falls





# Douglas Houghton Falls



OBSERVATIONS ON THE JUNCTION BETWEEN  
THE EASTERN SANDSTONE AND THE  
KEWEENAW SERIES ON KEWEENAW POINT,  
LAKE SUPERIOR

BY  
E. D. IRVING and T. C. CHAMBERLIN



USGS Bulletin No. 23

WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1885

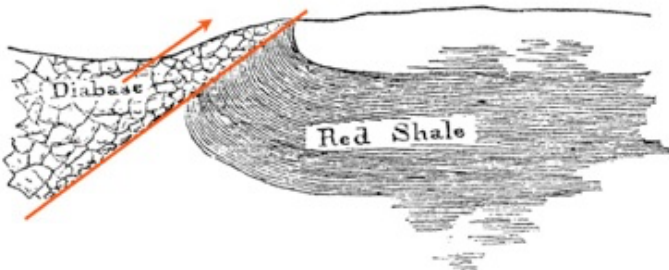


FIG. 4.—Junction of a member of the Eastern Sandstone and Keweenaw diabase, Douglass Houghton Ravine, Keweenaw Point, Michigan.



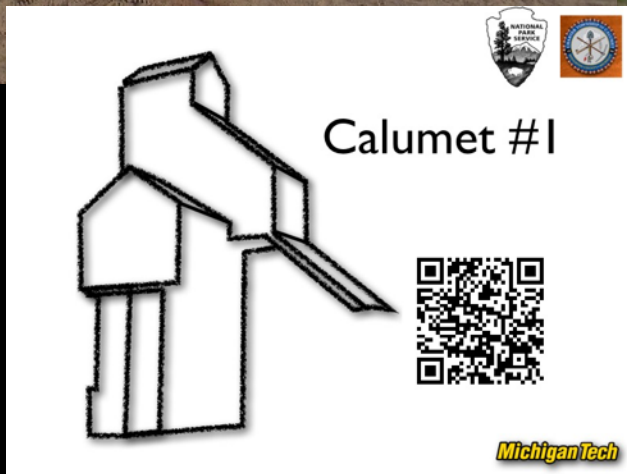
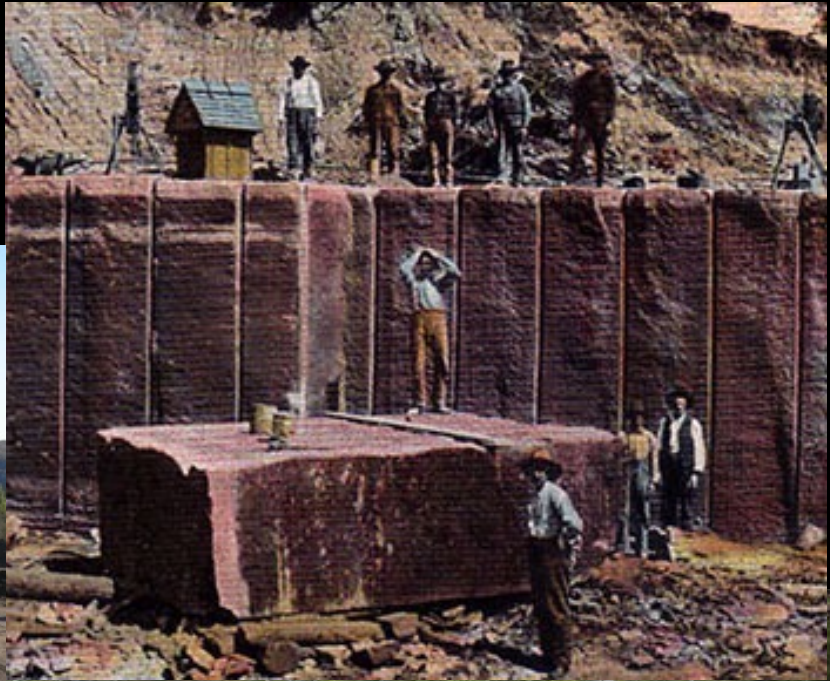
## Industry and university partners

**Eagle Mine**  
a subsidiary of **lundin mining**





# Quarry visits





# Carnegie museum Trolley tours



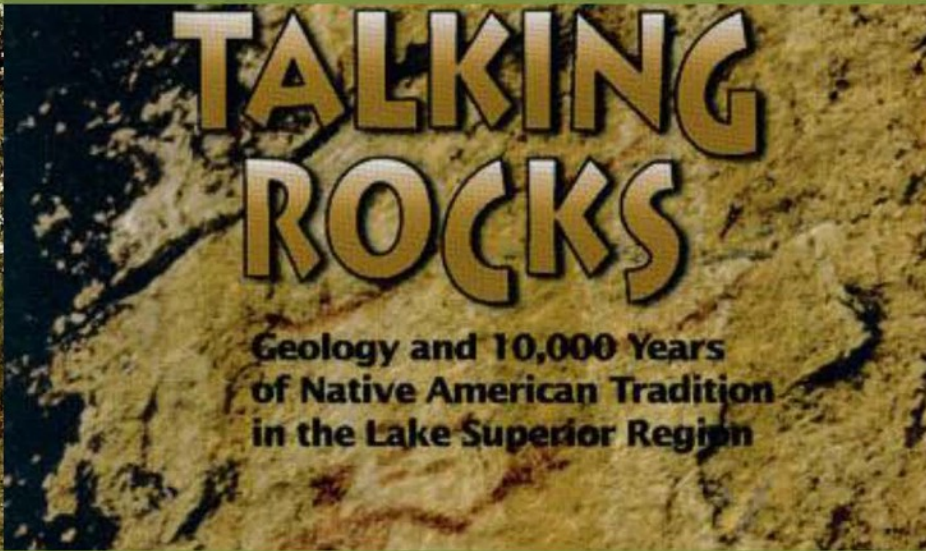


Carnegie Museum Seminar Series for 2014 – 2015



# Keweenaw Natural History Heritage

Monthly lecture series about the Keweenaw's Natural History. Held in the Carnegie Museum's Community Room.  
6:00 – 7:00 Refreshments and Introductions; 7:00 – 8:00 Lecture and Discussion. Open to the public. Free Admission.



## **Talking Rocks:**

**Common Ground – geology in the Lake Superior region and Native Americans.**

**Tuesday, April 14**

**6:00 – 8:00**

**Ron Morton**, Professor Emeritus,  
University of Minnesota-Duluth

**Carl Gawboy**, Artist and retired  
Professor, College of St. Scholastica

Join the conversation as an earth scientist and a Native American elder—wise men from two cultures—explore the natural history of the Lake Superior region, examining both the science and the spirit of the land. As the geologist carefully presents a modern scientific perspective, the storyteller eloquently recounts a traditional Native American understanding, passed on through tales, myths, and symbols that illustrate how intimately his people have known and honored the earth and its history for over a hundred centuries. Talking Rocks is not only a story of geological history told from two perspectives, it is also a chronicle of two people from very different cultural and scientific heritages learning to understand and appreciate each other's distinct yet complementary ways of viewing the land we share.



# Geothermal potential?



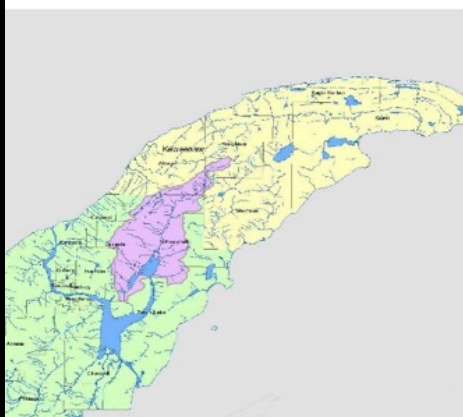
# Torch Lake Watershed Discussion

## Torch Lake Watershed

### PUBLIC MEETING

To address the formation of a comprehensive  
Torch Lake Watershed Management Plan.

All interested individuals are invited to attend.  
Speakers will share their knowledge of the Geology,  
History, Impairments, Research and Remediation Efforts  
in the Torch Lake Watershed.



## Tuesday, May 26th 2015

### 2:00 - 5:00 p.m.

Great Lakes Research Center  
100 Phoenix Drive, Michigan Tech



**Everyone welcome!**



RSVP is appreciated but not required.

Questions? [906.482.0214](tel:906.482.0214) [maericks@mtu.edu](mailto:maericks@mtu.edu)

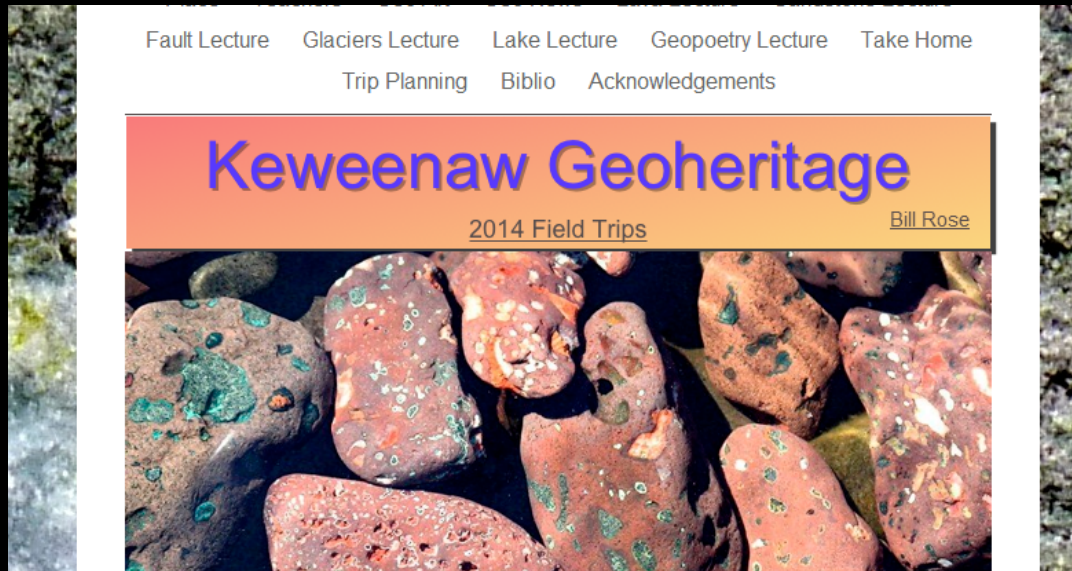
Hosted by the Houghton Keweenaw Conservation District



# Mining Waste



# Websites



[WELCOME](#) [GEOPARKS](#) [KEWEENAW GEOPARK](#) [GEOLOGIC HISTORY](#) [FAQ](#) [Pilgrim/Kew Fault](#) [Pilgrim Delta](#) [Waterway](#) [Bent trees](#) [Houghton Water](#)  
[PROPOSAL](#) [Sewage Treatment](#) [Iron Formation](#) [Impactite](#)

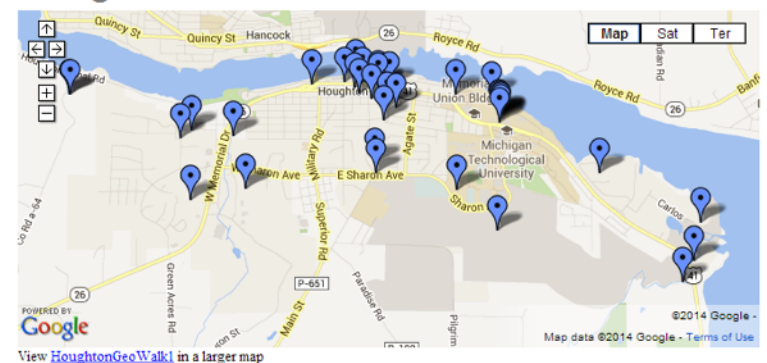


## Le Roche Vert

The Green Rock (Le Roche Vert) is the vein of chrysocolla shown by the red lines on the geologic map at right.



## Houghton Geo Walk/Bike Sites 2012



This site is to present a group of places of geological interest in and around Houghton, Michigan. It is

