Field Trip Guidebook For

Michigan Chapter of the American Institute of Professional Geologists

Part 1: Traverse of the Penokee/Gogebic Range of Wisconsin

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Introduction

The bedrock of the Penokee/Gogebic Range of Northern Wisconsin is a 25-kilometer layered sequence of rocks that span Archean to Mesoproterozoic age that reveal a remarkable geologic story of change spanning 1.6 billion years of earth history. The layers have been tipped to the north at 70 degrees so a traverse of the range from north to south goes across the edges of that sequence and exposes a wide variety of rock types representing many different geologic environments of the past.

![Map of the Penokee/Gogebic Range](image)

Figure 1. Road map of the field trip from the Porcupine Mountains to field trip stops near Mellen.

Next page: Figure 2. Schematic stratigraphic column of the Penokee range of Wisconsin. Compiled from many sources.
This field trip guide goes approximately from oldest to youngest rocks, first with a traverse near Mellen, then goes along strike to the east to exposures and vistas near Upson, Wisconsin. The guidebook is primarily about bedrock geology, although excellent surficial geologic features are also present in the area.

Figure 2. Map of field trip stops near Mellen, WI.
**Field Trip Stops**

All GPS locations are given in NAD 1983 datum. The UTM zone is 15T.

Figure 4. Geologic map of the Mellen area showing field trip stops. Stop 1 is just south off the map area but is within the pink unit, which is Puritan Formation. From Cannon et al., 1996.

**Stop 1: Puritan gneiss near Morse, Wisconsin.**
This is an outcrop on the east side of HWY 13, directly across from Schoch Road.
UTM: 0682308 mE  5120087mN
Lat., Long.: N 46.20993  W 90.63660

This is gneiss of the Puritan Formation. The Puritan is the felsic part of an Archean granite-greenstone belt. This is basement! Granitic rocks of the Puritan have been dated at 2735 Ma (Ma=million years). This outcrop contains bands of amphibolitic gneiss and quartzo-feldspathic gneiss. It is cross cut by coarse-grained pink granite in places. The contact between the pink granite
and the gneiss is in some places sharp, some places gradational. This is a complex rock that is hard to interpret. My interpretation is that it was in a volcanic sequence, perhaps part of an island arc, based on the intermediate composition of the gneiss (andesite or diorite proto:ith?). It was definitely highly metamorphosed and deformed. I think that while it was at high temperature it underwent partial melting to produce the granite, thus parts of it are migmatite.

**Stop 2: Puritan granite outcrop, on west side of HWY 13 south of Mellen, WI.**
UTM: 0678441 5128542
Lat., Long.: N 46.28698 W 90.68349

This is the pink granite phase of the Neoarchean-age Puritan Formation. This is 2735 Ma old. On top of the hill near the radio tower the rock is pink medium-grained granite composed of quartz and pink potassium feldspar, with very little else. It does not have much of a foliation on top of the hill, whereas the outcrop along the highway does have a foliation. There are excellent examples of glacial polish and striations of all sizes on the top of the outcrop.

**Stop 3A: Palms Formation**
This is an outcrop on east side of HWY 13, south of Mellen, WI. It is just north of the intersection of South Foley Road and HWY 13.
UTM: 0678253 5129323
Lat., Long.: N 46.29406 W 90.68564

This outcrop is thinly interbedded quartzite and slate of the Paleoproterozoic-age Palms Formation. It was originally sand and mud layers that have been metamorphosed into low-grade metamorphic rocks. The bedding and cleavage are parallel and are striking nearly E-W and dip north about 65 degrees. The Palms is near the base of the Paleoproterozoic package of rocks. This package of rocks was deposited in a shallow marine basin we call the Animikee Basin.

**Stop 3B: Ironwood Formation**
This outcrop is on east side of HWY 13, south of Mellen. This outcrop is walking distance from the Palms outcrop of stop 3A.
0678333 5129586
N 46.29640 W 90.68449

This outcrop is a grey and black banded iron formation composed of quartz-rich beds alternating with magnetite-rich beds. This rock is also sometimes called “taconite”, which is iron ore. The Ironwood Formation has been of interest as an iron resource since it was discovered back in the 1850s. Iron formations represent a fascinating time of changing ocean and atmosphere chemistry on Earth at the time they were deposited about 1880 Ma.
Stop 4: Mellen Gabbro
This outcrop is on the east side of HWY 13 about 0.5 miles north of the town of Mellen.
0680228 mE  5134092 mN
N 46.33642  W 90.65818

This is a spectacular outcrop of black coarse-grained gabbro, part of the Mellen Intrusive Complex. It formed as a large magma chamber within the mid-continent rift (MCR) 1102 Ma. It was a magma chamber under the volcanoes of the MCR. The dominant mineral is black plagioclase feldspar, but there are minor amounts of augite and magnetite present as well. The feldspar crystals are aligned in an igneous foliation that formed as crystals settled to the bottom of the magma chamber. There is also a small basalt dike at the south end of the outcrop. The foliation was horizontal and the dike was vertical before all of these rocks were tipped to the north. The tipping occurred after the rift was done and covered over by sedimentary rocks, probably at about 1060 Ma.

Stop 5: Archean Greenstone, Palms Formation, and Ironwood Formation
This sequence of outcrops is on the west side of Lake Road. Lake Road goes south off of HWY 77 about five miles east of Mellen. The outcrops are about one mile south of HWY 77 on Lake Road.

The west side of Lake Road has a sequence of outcrops strung along about 0.2 miles that goes from oldest in the south to youngest in the north. There is a very small outcrop of chlorite schist greenstone at the south end of the outcrop band. This is Ramsey Formation, the greenstone of the granite/greenstone belt in this area. It is ancient. It was intruded by the Puritan batholith, which has been dated at 2735 Ma. It was a basalt lava flow on the ocean floor a very long time ago when the crust of the Earth was first forming. It must be among the oldest rocks in Wisconsin.

The next exposures to the north are of Palms Formation. Thin bedded quartzite is well exposed and shows very nice bedding features. Graded beds are rare, but there are a few, and they indicate tops to the north, which makes sense based on the stratigraphy. Most of the Palms Formation is exposed here.

Near the north end of the outcrop belt is a contact between the Palms Formation and the overlying Ironwood Iron Formation. The contact is easy to find with a magnet because the Ironwood has so much magnetite in it. Not much of the Ironwood is exposed here, but there is about 750 feet of banded iron formation above this, which contains a lot of iron!

At the top of the iron formation is a crazy layer of breccia that is interpreted to have been generated by a massive meteorite impact 1850 Ma ago. The layer is not exposed in this area, but it’s a great geologic story.
Figure 5. Map of field trip stops near Upson, WI.

Figure 6. Geologic map of the area of field trip stops near Upson, WI. From Cannon, et al., 1996.
**Stop 6: Tyler Formation**
This outcrop is a road cut on the north side of HWY 77 just east of the Ashland/Iron County line in Iron County.
0692175 mE 5135922 mN
N 46.34959  W 90.50234

The Tyler Formation is 9500 feet of slate and quartzite above the Ironwood Formation in the Paleoproterozoic package of rocks. It is relatively soft in the lower section so is not exposed, but the upper part has more quartzite so it is harder and better exposed. This outcrop is about in the middle of the formation. Thin beds of black slate are the dominant rock type here. Some of the beds have pyrite and show the effects of acid being generated by weathering of the pyrite.

**Stop 7: Basal lava flow of the Sieman’s Creek Volcanics at Corrigan’s Bluff**
This outcrop is located at the end of a dirt two-track road that goes west from HWY 122, at the crest of the hill north of Upson.

This stop is at Corrigan’s Bluff, which has a beautiful vista looking west along the Penokee range. The rock is significant in that it is at the base of the Mid-continent rift! There are several miles of lava flows stacked on top of this. There are pillows present in the basalt. Pillows are not common in the MCR, but they are present at the base of the pile in Minnesota too, so evidently the first lava flows came out into a water body.

**Bibliography**


http://www.lakesuperiorgeology.org/Volumes.html#2010

https://gsa.confex.com/gsa/2016AM/webprogram/Paper283354.html

