Geology in Michigan –

Geological Excursions Around the Manistique Area, Schoolcraft and Delta Counties, Michigan

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This field trip guide visits three easily accessible locations in the area surrounding Manistique, Michigan. It showcases the largest freshwater spring in Michigan, a cross-section of the Burnt Bluff formation, and a location for the collection of gypsum at a somewhat obscure quarry within the Hiawatha National Forest. The directions for all three locations begin at Manistique, located along U.S. Highway 2 (US-2), approximately 86 miles west of St. Ignace, and approximately 54 miles east of Escanaba. The Manistique area is home to a thin layer of glacial overburden and shallow bedrock, providing for the commercial extraction of limestone and dolomite from many quarries; most of these are currently inactive and inaccessible. Manistique is nicknamed "The Emerald City," a name which is believed to be derived from the emerald-green waters of the nearby Kitch-iti-kipi spring. The Manistique Area Schools athletic teams are referred to as the "Emeralds."

Stop 1: Kitch-iti-kipi

Latitude: 46°00'14.69"N; Longitude: 86°22'56.18"W (spring)

Latitude: 46°00'17.03"N; Longitude: 86°23'06.19"W (Palms Book State Park entrance)

Section 25, T42N, R17W, Schoolcraft County

Directions

Editors Note: From Marquette, follow US-41 south for approximately 50 miles to the junction with US-2 at Rapid River. Turn left (east) and follow US-2 for about 39 miles to the US-2/M-94 intersection. However, the distance to Highway 194 is only about 33 miles...

From the intersection of US-2 and M-94 in Manistique, follow M-94 north through Manistique for approximately 1.75 miles. Continue straight onto County Road 442 (M-94 will turn north). Continue along 442 for 4.25 miles, where 442 ends and becomes County Road 149. Continue straight (west) on 149 for 3.4 miles, then turn north onto 149. Follow 149 another 4.5 miles to Palms Book State Park. Follow the signs! They are abundant and provide good direction to the park. Figure 1 illustrates the location of the park. Once at the state park (an entrance fee applies), the spring is a short walk from the parking area. A self-operated observation raft allows you to float across the spring overlooking the underwater features.

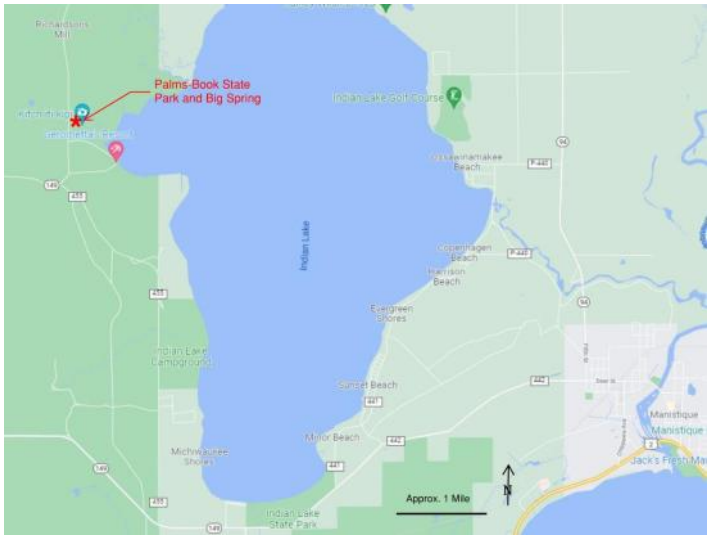

Figure 1: Location of Palm Book State Park and Big Spring. Adapted from Google Maps.

Description

Kitch-iti-kipi is Michigan's largest natural freshwater spring. The name means "big cold spring" or the "Mirror of Heaven" in the language of the Ojibwe. It is most commonly known as the "Big Spring" (possibly because Kitch-iti-kipi is difficult to pronounce!).

The Big Spring is an oval pool approximately 300 feet by 175 feet and is about 40 feet deep. Water emanates from the spring from fissures in underlying limestone and flows at approximately 10,000 gallons per minute throughout the year. The water is a constant temperature of 45 °F. Sand boils can be seen on the bottom of the spring. The water is an emerald-green color, and ancient

tree trunks with mineral and algae encrusted branches can be seen, as well as fish (most commonly lake trout, brown trout and brook trout) which can often be seen swimming about in the spring. Figures 2 and 3 illustrate the spring. Water from the spring discharges through an outlet channel on the east side of the spring (approximately 50 to 60 feet wide), and is connected to Indian Lake, located approximately 0.5 miles downstream of the spring. A review of USGS topographic maps reveals that several other springs are present in the area around Indian Lake, although none as large as the Big Spring.

Figure 2: Big Spring as seen from the walkway from the parking area. The spring water discharges through the river on the far side of the photograph to Indian Lake.

The spring is a result of a connection to an artesian aquifer system, where the hydrostatic pressure within the aquifer is sufficient to reach the surface. Water wells at the park and in the surrounding area indicate that there is a thin layer of unconsolidated glacial soil (clay and sand), underlain by broken limestone. The glacial deposits range between approximately 35 and 50 feet thick. Sinclair (1959) maps the bedrock beneath the spring as the Burnt Bluff Group (middle Silurian) and the underlying Cabot Head Shale of the Cataract Group (Early Silurian). GeoWebFace (accessed September 2021) indicates that the underlying bedrock is the Cabot Head Shale, but the presence of limestone in well logs in the area of the state park indicate that at least a thin layer of the Burnt Bluff group is present above the Cabot Head Shale below the spring. The Lime Island formation is the lowest member of the Burnt Bluff Group and consists of limestone and dolomite.

Figure 3: Big Spring, looking down from the raft. Note the “sand boils” on the bottom of the spring where spring water continuously enters the spring from below. Also note the fish suspended in the water column.

The Burnt Bluff Group is the most important aquifer in Schoolcraft County. Wells drilled into these rocks obtain water from openings formed by solution and weathering when the rocks are exposed at the surface, and from permeable zones developed within the limestone by solutional activity (Sinclair, 1959). Water in the formation is generally confined and under artesian pressure. The Burnt Bluff Group is therefore a likely source for at least a portion of the water to the Big Spring.

Beneath the Burnt Bluff Group is the Cabot Head Shale of the Cataract Group. This formation is permeable as a result of solution openings which have been developed through the dissolution of gypsum beds (Sinclair 1959). While the upper portions of the Cataract Group are predominantly shale and dolomite, groundwater is present, but usually saline and of poor quality, so it is not a source of fresh water in the county.

Sinclair (1959) and Poindexter (1936) indicate that water from the Big Spring is high in calcium, sulfate, and total dissolved solids. This indicates that a significant quantity of the water which emanates from the spring is sourced from the Cabot Head Shale within the Cataract Group, where the dissolution of gypsum is the source of the high calcium and sulfate content of the spring water. Interpretive signage at Palms Book State Park indicates the source of the water to be the Cataract Group rocks (Figure 4).

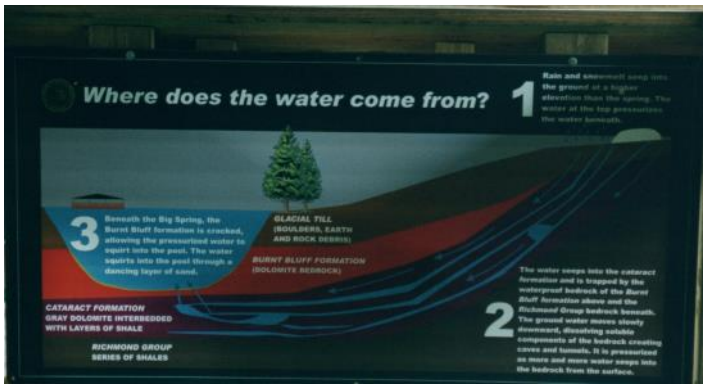

Figure 4: Interpretive sign on the raft, illustrating the hydrogeology of the Big Spring.

Stop 2: Stoney Cut Quarry Road Cut

Latitude: 46°01’45.82”N; Longitude: 86°16’19.06”W

Section 14, T42N, R16W, Schoolcraft County

Directions

This exposure is located on the east side of Michigan Highway 94 (M-94), north of Manistique, in Schoolcraft County, in the NE ¼ of the SW ¼ of Section 14, T42N, R16W. From the intersection of US-2 and M-94 in Manistique, follow M-94 north through Manistique and travel approximately 6.4 miles. The outcrop will be on the right

(east) side of M-94. Figure 5 illustrates the location of this road cut. Adjacent to the outcrop of the roadcut, small quarries are located on either side of M-94. These quarries are private property and should not be entered without permission of the owners.

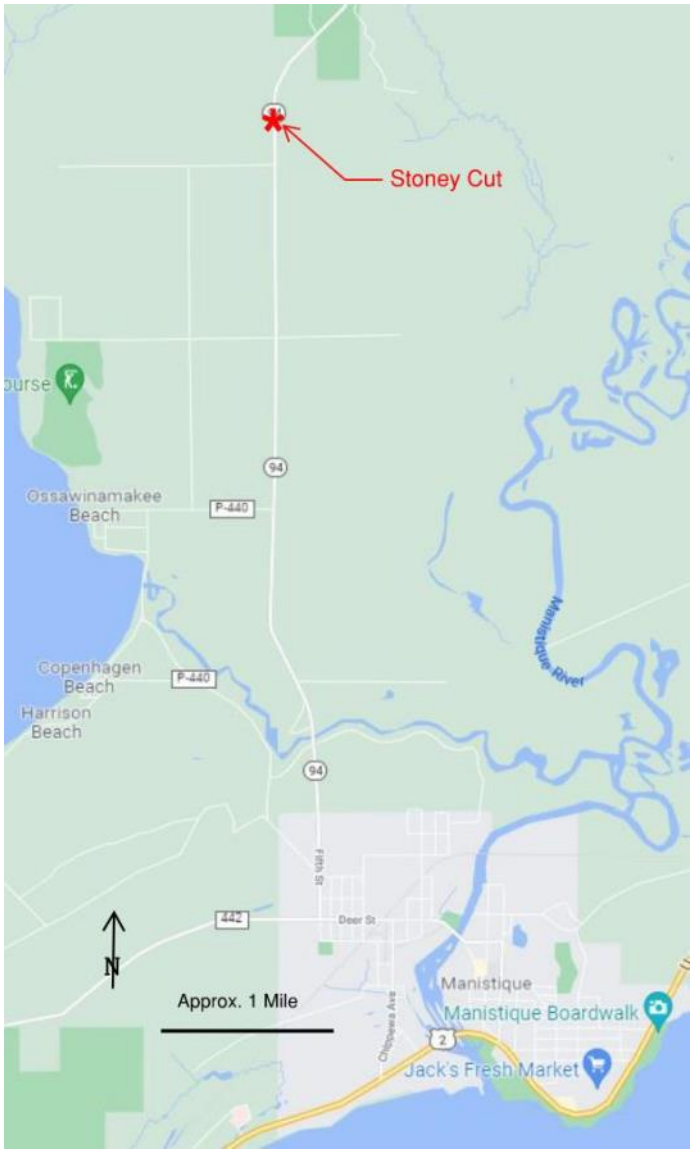

Figure 5: Location of Stoney Cut outcrop. Adapted from Google Maps.

Description

The highway at this outcrop goes downhill to the north, providing a road cut through the nearly flat-lying strata with increasing thickness toward the north. The outcrop is approximately 250 feet long. Because of the slope of the roadway, the upper parts of the strata are easily observed on the south end, with increasingly deeper sections of the strata exposed to the north. The outcrop and quarries are developed into the north-facing Niagara escarpment outcrop of the rock units. In addition to the Stoney Cut Quarry and road cut, this exposure has been called the "Big Hill Bluff" by some (Poindexter, 1936). The adjacent quarry is also known as the Sawheidle Quarry (Voice, et. al., 2017).

The rocks exposed at this location are the upper portions of the Burnt Bluff group of middle-Silurian age. Several formations within the Burnt Bluff are quarried at several locations in the southern Upper Peninsula, but the majority of these quarries are off-limits. This exposure provides an opportunity to observe the portions of the Hendricks and Byron formations of the Burnt Bluff Group.

Figure 6: Cross-sectional view of Stoney Cut outcrop. Wavy-bedded dolomite overlying thick-bedded dolomite.

Figure 7: Bryozoan and coral fossils on bedding surface of thick-bedded dolomite at the Stoney Cut outcrop.

The exposure is approximately 25 feet thick at the north end of the road cut. As you travel north (downhill),

successively deeper parts can be examined. The upper parts consist of wavy-laminated light buff colored dolomite, which easily splits into thin layers. Because of the weathering of the outcrop surface, this wavy lamination is obvious at the southern end of the outcrop. This unit comprises the upper 8 to 10 feet of the outcrop. Below the upper wavy-laminated dolomite, a brown to buff dolomite is present to the base of the outcrop (Figure 6). This dolomite is thick-bedded (up to 1-foot thick) and contains bryozoan, coral, stromatoporoids, crinoid columns, and brachiopod fossils (Dorr and Eschman, 1970), although none were found to be particularly well preserved by the author (Figure 7). Deeper portions of the Burnt Bluff group are exposed in the adjacent quarries. Brown-gray nodules of chert (some banded) are present in the strata underlying the road cut level, within the adjacent quarries. Voice, et. al. (2017) provides a very detailed discussion and description of the depositional environments of these units.

Stop 3: Forest Service Quarry

Latitude: 45°56'41.40"N; Longitude: 86°39'45.18"W

Section 15, T41N, R19W, Delta County

Directions

This exposure is located in the Hiawatha National Forest, in the SE ¼ of Section 15, T41N, R19W, in Delta County, Michigan. From the intersection of US-2 and M-94 in Manistique, travel approximately 24 miles west on US-2 to Nahma Junction. Turn north (right) onto Forest Service Highway 13 (NF-13) and continue approximately 3.3 miles. Turn east onto 28 Road (often labeled USFS 2231 on some maps). Continue along this well-maintained gravel road for approximately 2.6 miles. The quarry is located on the north side of 28 Road, at the northeast corner of the intersection of 28 Road and USFS 2740 Road. Figure 8 illustrates the location of the quarry. Be aware that these forest service roads are heavily used by ATVs, and there are many hills and turns on 28 Road. Travel carefully.

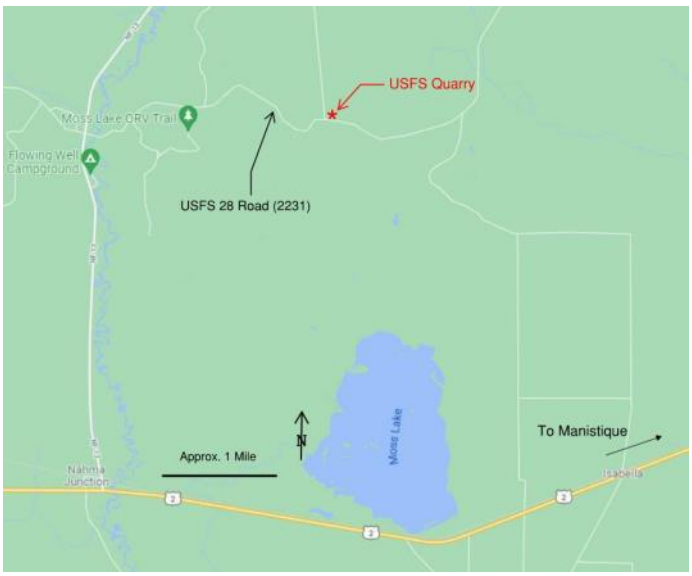

Figure 8: Location of small quarry on U.S. Forest Service Land, north and northeast of Nahma Junction. Adapted from Google Maps.

Description

The quarry is a small clearing in the forest and is basically a small (approximately ½ acre) excavation into the underlying bedrock. This location is not much of a quarry, as there has been very little excavation. Bedrock is exposed on the ground surface, with minimal vegetation growth. Interestingly, this location is listed in Kesling (1975) where he mentions that the quarry was "the same size as when I last saw it in 1957". Kesling also states "Nevertheless, it was remarkably free of weeds and young shrubs and still displayed the evaporite minerals in fine preservation". The quarry is in similar condition in 2021, as illustrated in the photograph of Figure 9. So after more than 60 years, little has changed at this location!

Figure 9: View of bedrock exposure at U.S. Forest Service quarry, looking north from USFS 28 Road.

The rocks exposed at this quarry are dolomitic facies of the early Silurian-aged Cabot Head Shale of the Cataract Group. The rocks here include gray, thin-bedded dolomite and gray to tan argillaceous shale and dolomite. The shale contains gypsum. This gypsum consists of thin layers along bedding planes and fractures throughout the shale, as well as small nodules. The thin layers of gypsum are of the "satin spar" variety and range from ¼" thick to over 2 inches in thickness. White to cream colored nodules and lumps of fine-grained gypsum are also present. Crude crystals of clear selenite can be found, usually included with brown mud. These can be seen along cleavage surfaces of the crystals as the shale is broken apart.

The "satin spar" gypsum is the main reason to travel to this location, unless you happen to be very interested in observing one of the only outcrops of the Cabot Head Shale in the state of Michigan! The satin spar gypsum is found in layers up to 2 or more inches in thickness (Figure 10). It consists of thin gypsum crystals in parallel growth habit, oriented perpendicular to the seam or vein, and has a silky and fibrous appearance. The thicker layers of satin spar gypsum are often formed into small domes on the quarry floor, where the gypsum layer is domed up several inches (and hollow beneath) in an area a foot or more in diameter. These dome structures were also noted by Kesling (1975). Gypsum is soluble in water. Therefore, the occurrence of gypsum at the surface of this quarry in veins and layers within the shale for more

than 60+ years suggests that the gypsum may be recrystallizing near the ground surface. The domal structures also suggest the recrystallization of gypsum, as the gypsum crystallizes into thicker layers of satin spar, forcing the overlying shale and dolomite into domes by the force of crystallization.

Figure 10: Gypsum (variety "satin spar") on floor of U.S. Forest Service quarry. Note domed structure of gypsum bed, which is hollow beneath. Gypsum bed is approximately 2 inches thick.

The total amount of gypsum at this location is not great. If you choose to collect gypsum from this location, please limit your collecting to a few pieces, and leave some for other individuals which will follow.

References

Dorr, J. A., and Eschman, D. F., 1970, Geology of Michigan, the University of Michigan Press, Ann Arbor, Michigan.

Kesling, R., V., 1975, Revision of the Upper Ordovician and Silurian Rocks of the Northern Peninsula of Michigan; University of Michigan Museum of Paleontology, Papers of Paleontology, No. 9.

Poindexter, O. F., 1936(?), Geology of Schoolcraft County, Michigan Geological Survey unpublished manuscript, 70 pages.

Sinclair, W. C., 1959, Progress Report Number 22, Reconnaissance of the Ground-Water Resources of Schoolcraft County, Michigan; State of Michigan, Department of Conservation, Geologic Survey Division, prepared in Cooperation with the U. S. Geological Survey.

Voice, P. J., Harrison, W. B., III, and Grammer, G. M., 2017, A reevaluation of the Burnt Bluff Group (Llandovery, Silurian, Michigan Basin) from subsurface and outcrop data: Development of a time-transgressive depositional model, in Grammer, G. M., Harrison, W. B., III, and Barnes, D.A., eds., Paleozoic Stratigraphy and Resources of the Michigan Basin: Geological Society of America Special Paper 531, p. 55-79, doi: 10.1130/2017.2531(04).

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The deadline for submitting articles for TPG is two months before the start of the quarter for which the TPG edition is published. Thus, February 1 is the deadline for the Apr/May/Jun edition.

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I'd like to encourage our members to consider submitting an article related to Michigan geology in advance of the Annual Meeting that will be held in Marquette in 2022.