

On the Rocks



A Newsletter of the Michigan Basin Geological Society

2005-2006 Number 5

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January 2006

EVENTS

January, 2006: This month's meeting will be presented by Dave Baxter. His multidisciplinary talk will cover the length and breadth of Michigan and is titled, "Precambrian Tectonics, Lower Peninsula Gold, and Michigan's Glacial Caves." Abstract and biography are below.

May 8-12, 2006: Institute of Lake Superior Geology meeting and field trips. See info below and at following link. <http://www.lakesuperiorgeology.org/Sault2006/index.html>

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Historical CD #1: Nine out-of-print publications from 1949 through 1965 and 1998, Devonian to Silurian Rock Fieldtrips to MI, WI, IL and Ontario, 2000, \$15

Historical CD #2: Four out-of-print publications from 1947, 1959, 1983 and 1991, Northern Devonian and UP Fieldtrips in MI, 2001, \$15

Historical CD #3: Six out-of-print publications from 1947, 1959, 1983 and 1991, Northern Devonian and UP Fieldtrips in MI, 2001, \$15

Historical CD #4: Six out-of-print publications from 1957, 1958, 1961, 1967, 1968 and 1970, Northern LP and UP Fieldtrips in MI, 2004, \$15

Special Price - Historical CDs #1, #2 #3 & #4 = \$40

NE Lower Peninsula Geological Field Conference, 2004, T. Black, M. Wollensak, 133 pp., illus., maps.
On CD \$10

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The Executive Committee meeting minutes are available on the website.

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University Talks and Seminars Websites

Western Michigan University:
www.wmich.edu/geology/SeminarGeos.html

Michigan State University:
www.glg.msu.edu/news/lectures.html

University of Michigan, Turner Lecture Series:
www.geo.lsa.umich.edu/announce/turner02b.html

Michigan AIPG Section website: www.aipg-mi.org.

MEETING CANCELLATION POLICY

Monthly meetings will be automatically cancelled whenever the National Weather Service issues a "Storm Warning" for the Lansing area. If driving conditions are poor but a "Warning" has not been issued please contact any member of the Executive Committee for the status of the meeting.

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Special Price - Historical CDs #1, #2, #3, & #4 \$40

NE Lower Peninsula Geological Field Conf, 2004, T. Black & M. Wollensak, 133 pp, illus, maps, on **CD \$10**.

Stratigraphic Lexicon for Michigan, 2001, prepared by MBGS and published by DEQ, 56 pp., chart, \$2.65 picked up or \$4 mailed, Can be ordered from MBGS or Geological Survey Div. of the DEQ

Prices Include postage, handling and any applicable sales tax. **MBGS members receive a 10% discount** on MBGS publications. Orders for publications should be prepaid in U.S. Funds and addressed to:
MBGS - Publications
P.O. Box 18074
Lansing, MI 48901-8074

MBGS Mug and Jacket Sale

The Michigan Basin Geological Society is offering mugs and jackets with the society logo for sale. The mugs are \$5.00 each. The jackets are \$60.00 each plus postage. Please contact Dan McGuire at: Phone (517) 772-5219, Fax (517) 772-7021, or danmcguire@sensible-net.com. Remember to include the correct size of the jacket and the quantity of each item. Checks should be made out to the MBGS.

MBGS MEETING

January 11, 2006 (WEDNESDAY)

**Coyote Creek
6951 Lansing Rd, Dimondale, MI.**

Schedule: 5:00 to 6:00 PM Social Hour
6:00 PM Dinner
Presentation after dinner

Cost \$25.00/member \$15.00 Student (includes dinner)

***Topic: "Precambrian Tectonics, Lower Peninsula Gold, and Michigan's
Glacial Caves."***

by
Dave Baxter

MBGS Dinner Meeting Reservation

Name _____

Number attending _____

Enclosed Registration Fee _____ Will Pay at Door _____

Please make checks payable to **MBGS** and return to Leonard Espinosa by **January 10, 2006**
Members are welcome to attend the presentation after dinner for no charge. Please contact
Leonard Espinosa to ensure adequate seating. Send reservations to:

Leonard Espinosa
P.O. Box 18074
Lansing, MI 48901-8074
Ph: Bus Ph: 517-335-3248, Fax 517-373-2443
E-mail: espinosl@michigan.gov

Precambrian Tectonics, Lower Peninsula Gold, and Michigan's Glacial Caves

David A. Baxter
PetroData Resources
January 2006

This story of Michigan's Lower Peninsula geological history started more than 1,500 million years ago as the Canadian Shield was continuing to accrete juvenile continental crust along a series of sub-parallel tectonic suture zones. Over time the lineation patterns of these Precambrian tectonic events would influence development of the Pleistocene glaciers, which ultimately created placer deposits of Canadian gold in Michigan and helped form two small but distinctive caves.

Consider the region of Saginaw Bay and the Saginaw River Valley, where the last glacier left deposits from an advancing finger of ice known as the Saginaw Lobe. As I presented in "How Michigan Got Its Thumb" (MBGS May 2004 Field Conference CD), the tectonic fabric of the Precambrian basement north of Saginaw Bay is dominated by a NE-SW series of lineations from the Mazatzal Orogeny, ending ~1,630 million years ago (Ma), and best exposed in the Mazatzal Mountains of central Arizona.

Following additional tectonic events further south, an extensive continental rift thinned the lithosphere as Keweenawan volcanism began. As tectonic features typically do, the Keweenawan Rift exploited weak zones in the pre-existing crust to form the Saginaw Bay 1st Order Accommodation Structure, involving the older Mazatzal structures. This feature is best displayed in gravity anomaly maps, where the prominent bend in central Michigan alters the strike direction of the Keweenawan rift graben.

The tectonic event that helped abort the Keweenawan Rift was collision of another slice of exotic crust along the Laurentian continental margin in the Grenville Orogeny. The earliest Grenville events in Michigan began about 1,110-Ma, then continued for an undocumented period of time, perhaps as long as 150 million years. At the culmination of this lengthy tectonism, Lower Michigan probably resembled the modern Himalayas. Differential segments of the upper crust were moved laterally as much as 60 miles and were uplifted as much as 30 miles, as shown by the extremely high grades of metamorphism in Grenville bedrock outcrops southeast of Sudbury, Ontario.

As earlier, the Grenville Front reactivated older tectonic structures along the >2,000-mile extent, while it met the southeast-end of the still-active Keweenawan Rift Zone in the southern Lower Peninsula. Large segments of dense crust, rich in rift-basalt and gabbro, were dramatically uplifted in places where the deepest portions of the Michigan Basin sedimentary rocks are now found. No serious tectonic action would impact Michigan after this, which allowed Grenville foliation to dominate weathering patterns, as minor reactivation from distant tectonics subtly jostled these faults. During the Paleozoic a series of major tectonic actions in the Appalachian region of the eastern US, with episodes of compression and extension, repeatedly altered the tectonic stress regime of the North American Plate under Michigan.

When Pleistocene glaciers advanced into Michigan from Canada, the negative topographic feature along the apex of Grenville metamorphic strain led to a finger-like

protrusion of ice known as the Saginaw Lobe. Best displayed by locations of the Port Huron Moraine girdling Saginaw Bay, this tongue of advancing ice rode along the Grenville structure like an inverse monorail. And luckily for those of us in Michigan, this lobe of glacial ice also scoured material from an extensive region of bedrock gold deposits in the Abitibi Greenstone Belt, near the Ontario-Quebec border.

As the last remnants of the Saginaw Lobe melted back, a large pro-glacial lake developed in the modern Saginaw River Valley—Glacial Lake Saginaw. The major outlet for this lake was near the modern town of Maple Rapids and the channel of the Maple River. In the 1850s to 1870s many reports of placer gold came from the Grand River in Ionia County. Following tactics learned in the California Gold Fields of the 1850s, Ionia settlers moved upstream in the Grand River searching for a bedrock source of gold. Each pursuit reportedly lost the trail of placer gold when they moved upstream of Muir and Lyons. But nobody seems to have checked the *tributary* entering the Grand River here; the Maple River.

Now that we have a better understanding of the history of glacial lakes and drainage channels, we might not have ignored the tributary Maple River Valley, where we see a channel five times wider than the flood channel of the Grand River above Lyons and below Jackson. And with the Michigan Chapter of the Gold Prospectors Association of America (a nationwide group of recreational gold panners) holding summer gatherings just east of Muir on Stony Creek, there remains no question where the Ionia County placer gold had really come from in the 1800s.

As Glacial Lake Saginaw was draining through Ionia and Grand Rapids and depositing placer gold in the Maple-Grand Channel, it entered Glacial Lake Chicago in the Lake Michigan basin, where water levels were much higher than the present day. During the Calumet and Glenwood levels of Glacial Lake Chicago (named for prominent glacial beaches near Chicago), upstream flooding in the glacial channel south and west of Grand Rapids reached an altitude of about 660-feet above mean sea level. This placed a long-term water body directly above a natural gypsum cave near Butterworth Road, accidentally discovered by underground gypsum mining in the middle 1970s.

Named Pellerito Cave for the man who first entered it, this cave appears to have formed by downward percolation of enormous volumes of water. In the furthest reaches of the cave tunnels (which follow fracture zones in the bedrock), glacial sand was reported by NSS cave researchers in 1977. This appears to indicate a former connection to the surface, which is blanketed by thick deposits of outwash sand. Although the ultimate destination of waters that dissolved gypsum to form the cave is unknown, it is thought water tables associated with Glacial Lake Chicago could have recharged the Marshall Formation bedrock aquifer through fractures in the overlying Michigan Formation shale and gypsum.

While gypsum bedrock was dissolving into a cavern near Grand Rapids, another cave was continuing to grow and evolve near the town of Buchanan in Berrien County, Michigan. Glacial Lake Chicago water levels also appear to have been involved in forming Bear Cave, where Late Pleistocene and Holocene tufa precipitation lithified terrace deposits along the west side of the St. Joseph River. It is thought the passages now allowing visitors to walk upright were formed by logs and forest debris, which later decayed in the 5,000 years of very low water levels of Glacial Lakes Chippewa, Stanley, and Hough.

The source of the dissolved carbonate necessary for the Bear Cave tufa to form remains enigmatic. But the sediments encrusted by the tufa have been mapped as a riverine terrace deposit, graded to an early water-level of Glacial Lake Chicago, so the earliest stage of cavern formation began less than 15,000 years ago. Bear Cave is thought to have attained much of its modern appearance by the end of Glacial Lake Nipissing time about 5,600 years ago, but further modification has certainly occurred as travertine formation continues where Bear Cave Creek flows overtop and through the cave.

So two Precambrian continental collisions, separated in time by Keweenawan rifting, helped form a tongue on Pleistocene ice sheets where Saginaw Bay is situated today. Then billions of gallons of meltwater left by retreating ice spread placer gold across much of the central Lower Peninsula, gypsum was dissolved in Michigan Formation bedrock at Pellerito Cave, and tufa lithified glacial sand, silt, and gravel at Bear Cave. Another example of how understanding the past can be the key to unraveling more recent geological events.

Biography for Dave Baxter:

A native of East Lansing, Mr. Baxter received both Bachelor of Science and Master of Science degrees in geology at Michigan Technological University; where in 1985 he was also the photo editor for the *Winter Carnival Pictorial* magazine and editor-in-chief of the *Keweenawan* yearbook. Now working as a geological consultant and photographer, he has published photographic bookmarks and note cards, on sale in many gift shops around the state. His photos have also appeared in *Michigan Forward*, *The Towne Courier*, Michigan Travel Bureau publications, and educational textbooks.

Mr. Baxter's geological career has included work for the Michigan Geological Survey in the Upper Peninsula, where he helped author publications on precious metals in the Archean bedrock of Marquette County and the potential for platinum deposits across the western UP. He also spent several years working in the mineral exploration and mining industry of the Pacific Northwest and more recently, has completed large environmental consulting projects for clients including Meijer, General Motors, Michigan National Bank, and Home Depot, at sites throughout the Lower Peninsula of Michigan.

He is now completing *Roadside Geology of Michigan*, one of the state-by-state earth science travel guides from Mountain Press Publishing of Montana, which is planned for a 2007 publication date.