Great Lake's sinkholes host exotic ecosystems

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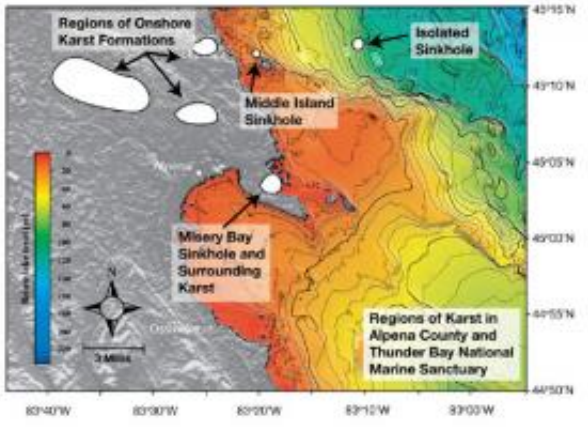
(Figure 1) Map of the North American Laurentian Great Lakes Basin showing regions of karst limestone formations and regions of above ground limestone formations in Alpena County, MI and submerged sinkholes (including the study sites - Misery Bay containing the El Cajon Bay Blue Hole, Middle Island Sinkhole and Isolated Sinkhole) in the Thunder Bay National Marine Sanctuary (TBNMS), Lake Huron. Image courtesy of Thunder Bay Sinkholes 2008, NOAA, OceanExplorer.noaa.gov

Researchers are exploring extreme conditions for life in a place not known for extremes.

As little as 20 meters (66 feet) below the surface of Lake Huron, the third largest of North America's Great Lakes, peculiar geological formations—sinkholes made by water dissolving parts of an ancient underlying seabed—harbor bizarre ecosystems where the fish typical of

the huge freshwater lake are rarely to be seen. Instead, brilliant purple mats of cyanobacteria—cousins of microbes found at the bottoms of permanently ice-covered lakes in Antarctica—and pallid, floating pony-tails of other microbial life thrive in the dense, salty water that's hostile to most familiar, larger forms of life because it lacks oxygen.



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Groundwater from beneath Lake Huron is dissolving minerals from the defunct seabed and carrying them into the lake to form these exotic, extreme environments, says Bopaiah A. Biddanda of Grand Valley State University, in Muskegon, Mich., one of the leaders of a scientific team studying the sinkhole ecosystems. Those ecosystems are in a class not only with Antarctic lakes, but also with deep-sea, hydrothermal vents and cold seeps.

"You have this pristine fresh water lake that has what amounts to materials from 400 million years ago … being pushed out into the lake," says team co-leader Steven A. Ruberg of the Great Lakes Environmental Research Laboratory of the National Oceanic and Atmospheric Administration (NOAA).

The researchers describe this little-known underwater habitat and their ongoing investigations of it in the current issue of *Eos*, the newspaper of the Earth and Space Sciences, published weekly by the American Geophysical Union (AGU). AGU is the world's largest organization of Earth and space scientists.

The scientists report that some deep sinkholes act as catch basins for dead and decaying plant and animal matter and collect a soft black sludge of sediment topped by a bacterial film. In the oxygen-depleted water, cyanobacteria carry out photosynthesis using sulfur compounds rather than water and give off hydrogen sulfide, the gas associated with rotting eggs. Where the sinkholes are deeper still and light fails, microorganisms use chemical means rather than photosynthesis to metabolize the sulfurous nutrients.

Biddanda, Ruberg, and their team are probing the origins of ancient minerals flowing in from beneath this fresh inland sea, striving to understand how long ago the minerals were deposited that are now entering the lake and how fast the salty brew containing them is arriving. The scientists also plan to chart transitions from light, oxygen-rich, fresh water near the lake's surface to dark, anoxic, salty soup down inside the sinkholes.

The sinkhole research—funded by the National Science Foundation and NOAA's Office of Ocean Exploration and Research—may shed light on how similar microbial communities can arise in environments as disparate as Antarctic lakes, deep-sea vents, and freshwater-lake

sinkholes, the scientists say. Biddanda adds, "it might also lead to the discovery of novel organisms and previously unknown biochemical processes, furthering our exploration of life on Earth."

More information: "Great Lakes Sinkholes: A Microbiogeochemical Frontier", Bopaiah A. Biddanda: Annis Water Resources Institute, Grand Valley State University, Muskegon, Michigan, U.S.A. *Eos*,

Source: American Geophysical Union