

# **FLOAT COPPER IN MICHIGAN**

by

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## **What is "float" copper?**

The term "float" copper locally refers to glacial-fluvial (river) transported native copper in the western Upper Peninsula of Michigan. In 1885 Whittlesey used the name float copper to refer to locally river water transported copper in vicinity of Eagle River, Michigan (1). Lane's studies in 1909 documented the role of glacial transport of native copper, he termed float copper, although long distance transport was unknown (2). The name "float" copper was used in a 1924 publication in the American Mineralogist by University of Michigan renowned mineralogist Edward H. Kraus (3). Mechanical rounding of rocks and minerals occur in glaciers as the clasts impact each other, the physical contact abrades the clasts and thus smooths and rounds them. Native copper occurs in Mesoproterozoic bedrock of the Midcontinent rift exposed around Lake Superior (Figure 1). The advancing glacial ice plucked the native copper from lodes or veins and entrained it in the glacial ice. As the ice moved generally southward the masses of native copper moved in the direction of ice movement (Figure 1). The masses of native copper were abraded by other rocks and minerals carried by the glacial ice which resulted in smoothing the malleable native copper and removing attached rocks or minerals from the surface. Glacial striations are visible on some float copper specimens from scraping of the surface by rocks carried by the glacial ice. On occasion, edges of the copper masses were bent over by collision with larger rocks carried by the glacier. When the glacier retreated these masses of native copper that were "floating" in the glacial ice were deposited along with smoothed and rounded clasts of the other rocks carried by the glacier.

## **Geologic History**

During the Pleistocene, from about 2.6 million to 10,000 years ago, the Upper Peninsula of Michigan was subjected to repeated continental glaciations. These repeated glaciations removed overlying rocks down to the level of the native copper ores hence, masses of native copper and surrounding rocks and minerals were at the surface where they could be removed and entrained in the moving glacial ice. Although the glacial ice moves 100s of miles, most rocks entrained in and carried by the glacier move only a relatively short distance of less than about 10 miles (16 km) from their source in the bedrock (4). However, some rocks are carried 100s of miles by the moving ice. The dispersion float copper is consistent with the direction of ice movement during the latest glacial episode, the Wisconsinan episode with maximum advance about 20,000 years ago and retreat about 10,000 years ago (5). Most masses of native copper entrained in the glaciers were deposited within the western Upper Peninsula of Michigan. Others of them moved considerable distance southward where they have been reported from southern Illinois, Central Indiana and southern Michigan, Ohio, and New York (Figure 1). The float copper scattered by the glaciers are usually small, ranging from a few to 50 cm across. The larger float copper masses are more often found nearby to the bedrock deposits in the western Upper Peninsula of Michigan, although a 1,700 lb piece was found in Bayfield County in northern Wisconsin (6).

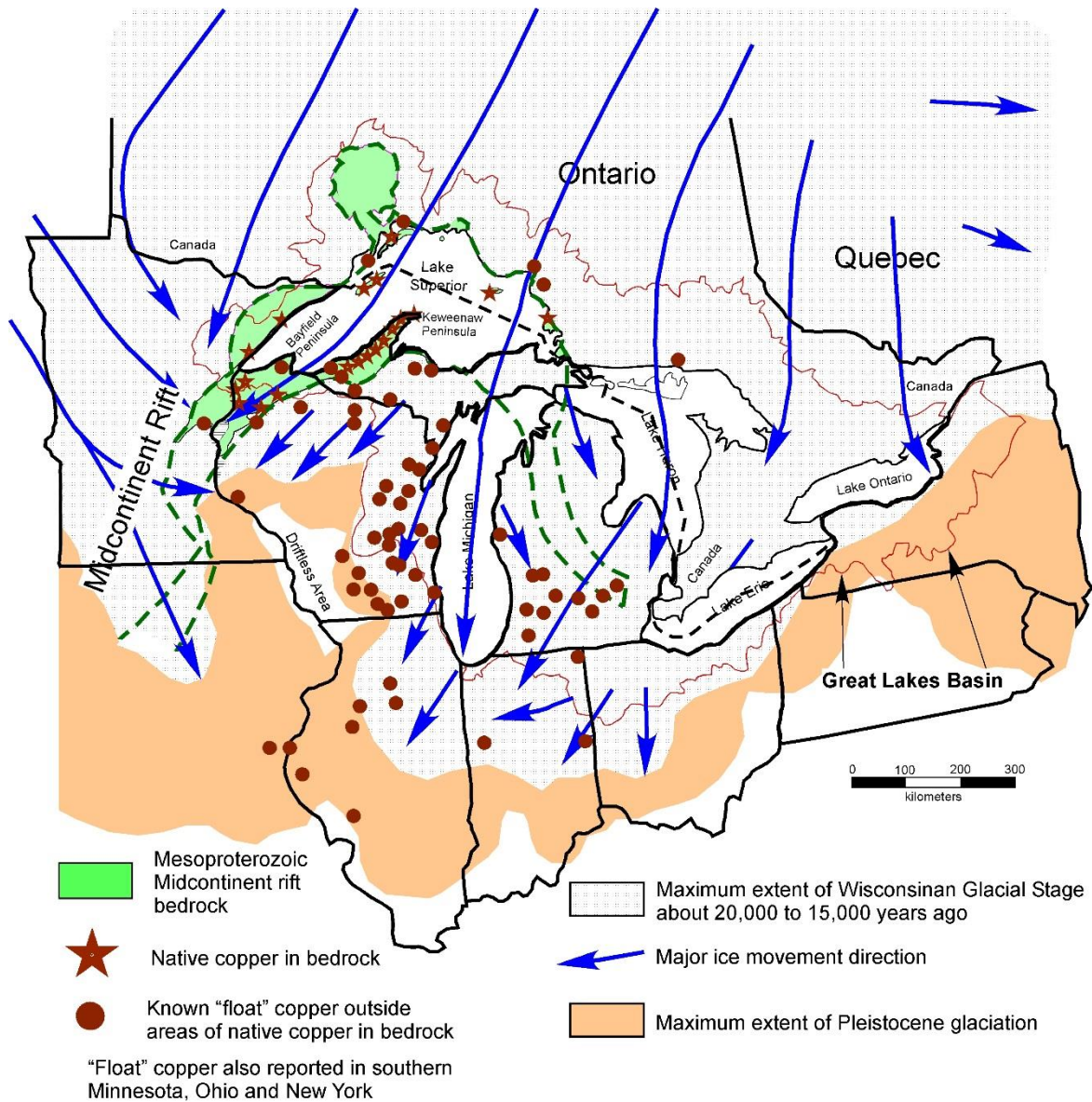


Figure 1: Map showing location of the native copper deposits of the Keweenaw Peninsula and the extent of float copper transported south by movement of glacial ice. Location of float copper from (6, 7 cited in 8, and 8)

The most famous of the float copper masses is the Ontonagon Boulder (Figure 2). To the south of the major native copper deposits along the Ontonagon River early European explorers were introduced to the famous Ontonagon boulder by Native Americans. It is a 3,708 pound float copper mass. After Michigan became a territory, Henry Rowe Schoolcraft led an expedition in 1820 with a special goal of seeing the Ontonagon boulder. In 1831, Douglass Houghton accompanied Schoolcraft and visited the boulder too. A piece off the boulder, attributed to Houghton, is part of the University of Michigan mineral collection held by the A. E. Seaman Mineral Museum under the Michigan Mineral Alliance. The Ontonagon boulder was removed to the nation's capital in 1843 and is now part of the National Gem and Mineral Collection at the Smithsonian Institution in Washington, DC.



Figure 2: Ontonagon boulder. A glacially transported mass of float copper, about 3.5 ft across visited, by early European explorers. The boulder is part of the National Gem and Mineral Collection at the Smithsonian Institution in Washington, DC. Photo courtesy of the Smithsonian Institution.

The largest known float copper was discovered in the early 2000s and weighed about 35 tons (70,000 lbs) near the Houghton County airport not far from its source; it was cut into smaller masses and was smelted and refined for commercial use. The existing world's largest float copper weighs 26.6 tons (53,100 lbs) and is owned by Collector's Edge of Golden, Colorado. It was discovered in 1997 on the Quincy Mine claims near Boston Location.

Float copper is considerably denser than most other rocks and minerals carried by the glacier. After it was deposited among other less dense unconsolidated gravel and sand, action of water preferentially removes the lighter gravel and sand thereby concentrating the float copper. This process results in a greater abundance of float copper masses at the surface today where they are also incorporated in surface soil.

The abrasion during transport in the glacier left the surface of the float copper pieces as "shiny" copper. Since the glaciers retreated about 10,000 years ago, these surfaces have been in contact with oxygen in the atmosphere and with oxygenated water (rain and groundwater connected with the atmosphere). The "shiny" native copper on the surface underwent chemical reactions during this time that altered the copper on the surface of the float copper mass from pure native copper to other forms of copper including cuprite (copper oxide), tenorite (copper oxide), malachite (hydrated copper carbonate) and rarely azurite (hydrated copper carbonate). These copper oxide and carbonate minerals are stable at surface conditions. During the past 10,000 years the typical thickness of surface alteration is only a few mm because the coating of the surface of the native copper mass by stable copper minerals generally protects the interior of the float copper mass from further alteration. Highly porous and fractured float copper pieces can be more altered as they allow continuing access of water to alter the native copper.

Humans returned to the Keweenaw Peninsula and Isle Royale about 7,000 years ago after glaciers retreated from Lake Superior and the initial large glacial lakes decreased in size. They likely first exploited native copper from discovery of float copper (9). When they saw unusual colored "stones" in stream gravels or on the surface, they gathered them up and experimented on them. The loose copper pieces were formed into shapes by cold hammering but hammering would have made the copper brittle. They discovered using fire to anneal them which facilitated them making native copper objects that they traded across eastern North America. As the easily found float copper diminished the first humans turned to digging pits where native copper occurred in the bedrock. Today buried float copper is located in shallow surface soil and sediments using metal detectors or by chance it is exposed during excavations.

The float copper on display in the Copper Pavilion has an attractive coating of malachite on its outer surface.

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