Copper-bearing quartzite near Watersmeet, Michigan

by

W. F. Cannon

U.S. Geological Survey Open-File Report 80-390

This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature.

Prepared in cooperation with Geological Survey Division
Michigan Department of Natural Resources
1980

Copper-bearing quartzite near Watersmeet, Michigan

Introduction

During field investigations in the summer of 1979, a small exposure of copper-bearing quartzite was found about 13 km northwest of Watersmeet, Mich. (fig. 1). The mineralization consists primarily of chalcopyrite, but secondary malachite is also abundant. The mineralized beds are vitreous white orthoquartzite interlayered with tremolitic marble. Two quartzite beds 0.25-0.5 m thick are present in the exposure. Both are mineralized.

No other exposures of this stratigraphic unit are known in the area, but outcrops are very scarce and the unit could be widespread. The mineralization is clearly stratabound, so it could also extend appreciable distances away from the outcrop. The mineralization found in this outcrop suggests that equivalent stratigraphic levels in the region, all of which are poorly exposed, should be considered potential zones for sedimentary copper deposits.

Description of outcrop

The outcrop containing the copper-bearing beds is a low roadside exposure on the south side of Gogebic County road 206 in the NE 1/4, sec. 5, T. 45 N., R. 40 W. It is about 230 m west of the crossing of County road 206 and Twomile Creek.

The exposure is about 6 m long parallel to the road and is 1-2 m wide. Bedding strikes N. 65° W. and dips 60° N. The most abundant rock type is a coarse-grained tremolitic marble consisting of sheaves of radiating light gray-green tremolite as much as 2 cm long, interspersed with dolomitic marble. Pods of coarse-grained quartz, generally a few centimeters long, are also common. The quartzite is in massive beds that have sharp contacts with the tremolitic marble. It is generally white and vitreous and contains only a few scattered patches of carbonate and tremolite. The principal copper mineral is chalcopyrite which is disseminated throughout the quartzite as grains having diameters from less than 1 mm to about 5 mm.

The rock is sufficiently weathered so that bright green malachite is common along fractures a few centimeters below the natural surface of the outcrop, but the natural surface itself has no malachite staining.

Because one of the quartzite beds is exposed only on a flat pavement surface on the top of the exposure, it could not be adequately sampled. The second bed was more accessible. A chip composite sample approximately representative of the bed was determined to contain 0.17% Cu by atomic absorption analysis[1]/. A second chip composite from broken material

---

1/ Analyzed by Jean Kane, U.S. Geological Survey, Reston, Va.

---

near the base of the outcrop contained 0.27% Cu, and a single grab sample of material that appeared to be the most mineralized contained 1.04% Cu.

The second chip composite and the grab sample also contained small amounts of silver, about 1 part per million, determined by a semiquantitative spectrographic technique.[2]/

2/ Analyzed by L. Mei, U.S. Geological Survey, Reston, Va.

No other base metals were detected.

Stratigraphic position of the quartzite

The quartzite and marble are tentatively correlated with the Chocolay Group of the Marquette Range Supergroup on the basis of two criteria: 1) the outcrop must be near the base of the Proterozoic section, and 2) the assemblage of vitreous quartzite and carbonate rocks elsewhere in northern Michigan is known only in the Chocolay Group.

Although outcrops are scarce in the region, the outcrop of copper-bearing quartzite must be very near the basal contact of the Marquette Range Supergroup with Archean gneiss (fig. 2). Before discovery of this outcrop, I thought that the Michigamme Formation, a younger part of the Marquette Range Supergroup, lay directly on Archean basement (Cannon, 1978), but now I think that the Chocolay Group is also present and, at least locally, separates the Michigamme from the Archean.

The rocks here may correlate with the Sunday Quartzite and Bad River Dolomite which constitute the Chocolay Group in the Gogebic iron range about 40 km to the west.

Figure 2 shows an interpretation of the local geology based on data from Fritts (1969) and my new data from 1979. The Proterozoic-Archean unconformity probably is a short but undetermined distance south of the copper-bearing outcrop. No exposures exist south of the outcrop, so geologic data cannot limit the position of the contact. A magnetic survey of the area likewise failed to find any magnetic expression of the contact.

Several hundred meters to the east, on the east side of Twomile Creek, Archean gneiss is exposed along County road 206 and for about 300 m north of the road. The northernmost exposures are along a rather prominent north-facing scarp that may be the topographic expression of the Archean-Proterozoic contact.

Several boulders of white quartzite along the base of the scarp may be local bedrock, indicating that the quartzite extends at least that far east.

The strike projection from the copper-bearing outcrop passes well south of the scarp, into the area of Archean gneiss exposures, indicating that the copper-bearing horizon is either folded or faulted between the two localities. A fault inferred to exist along Twomile Creek (fig. 2) may have a left lateral offset of about 300 m.

Regional implications

Rocks of the Chocolay Group have been of interest for copper exploration since the early 1960's, when substantial stratabound copper deposits were found in shale and quartzitic units of the Kona Dolomite, a part of the Chocolay Group, in the Marquette iron range. Although deposits there apparently are not presently economic, extensive drilling has outlined about 1 billion short tons of rock having an average grade of 0.3% Cu (Wilband, 1978).

The presence of substantially mineralized quartzite, which is probably of the Chocolay Group, in the Watersmeet region indicates that the outcrop belt of the basal units of the Marquette Range Supergroup could be a prime belt for copper exploration. The outcrop described here is on the north flank of a dome that has a core of Archean gneiss (see fig. 1). On the north and east sides of the dome, the Proterozoic-Archean contact can be defined within the limits of outcrop data, and with the aid of geophysical data, the contact was found to be in a belt about 1 to 3 km wide. On the west and south sides of the dome, the contact can be more precisely defined. A magnetic iron-formation, presumably near the base of the Proterozoic section, was accurately located by magnetic surveys. Fritts (1969) reported that drill holes at Watersmeet penetrated the magnetic iron-formation but were not drilled deep enough to reach Archean basement and hence did not sample the lowest part of the Proterozoic section where copper-bearing rocks might exist.

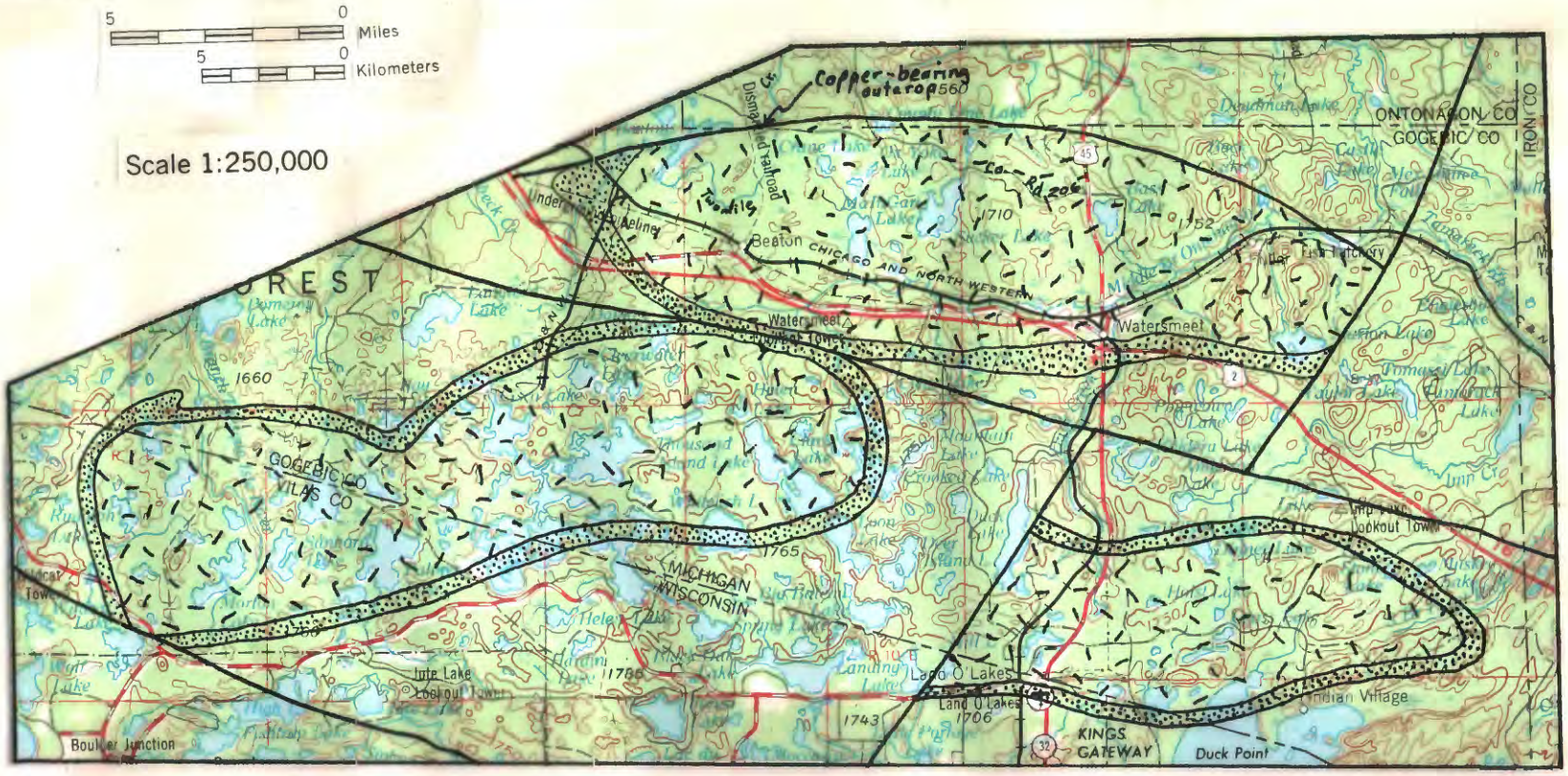
The entire basal zone of the Marquette Range Supergroup surrounding the Archean gneiss core of the dome near Watersmeet should be considered to have potential to contain copper-bearing sedimentary units as should basal zones around other geophysically inferred domes in the region (see fig. 1).

References cited

Cannon, W. F., 1978, Geologic map of the Iron River 1° x 2° quadrangle, Michigan and Wisconsin: U.S. Geological Survey Open-File Report 78-342, 1 pl., scale 1:250,000.

Fritts, C. E., 1969, Bedrock geologic map of the Marenisco-Watersmeet area, Gogebic and Ontonagon Counties, Michigan: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-576, 5 p., 1 pl. scale 1:48,000.

Wilband, John T., 1978, The copper resources of northern Michigan: East Lansing, Mich., Michigan State University, 66 p.



Michigamme Formation, metagraywacke and slate.

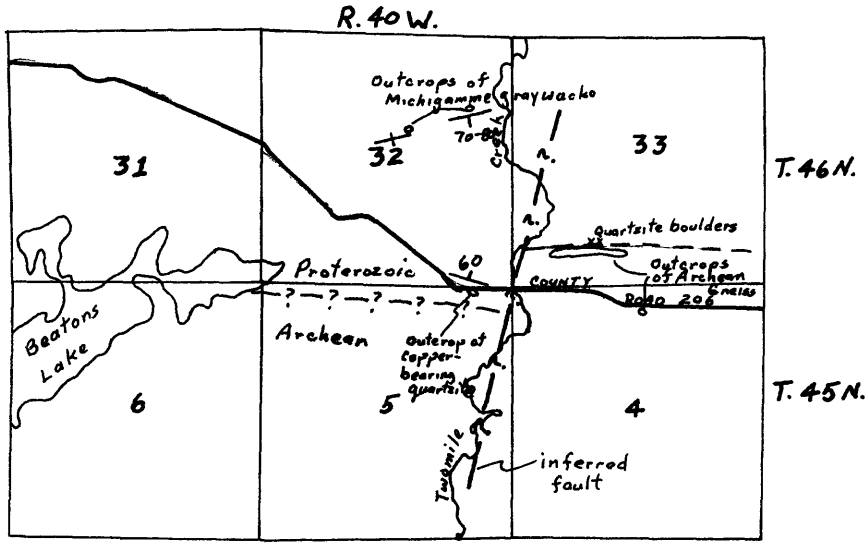
Magnetic unit near base of Proterozoic section.

Archean gneiss.

Contact

Fault

Figure 1. Regional geological map modified from Cannon (1978) showing the location of the copper-bearing outcrop with respect to regional structures. The area near the contact of Archean gneiss with the magnetic unit is considered a zone of potential for copper mineralization. Geology mostly inferred from aeromagnetic maps.



Scale 1:48000

Figure 2. Map of the area surrounding the outcrop of copper-bearing quartzite showing the known outcrops and inferred geology. Modified from Fritts(1969).