CHALCOCITE

Cu_2S

Widespread, but historically not significant as an ore mineral in Michigan, except at the White Pine deposit; in fissure veins cutting various rocks of the native copper lodes and locally disseminated in the lodes themselves; also present in a variety of metalliferous veins. Twelve chalcocite deposits have been located on the Keweenaw Peninsula, the most notable being the Mount Bohemia and Gratiot Lake deposits (Robertson, 1975; Maki, 1999). Maki (1999) estimates the Gratiot Lake deposit may contain as much as 4.5 million metric tons of ore with an average grade of 2.3% copper. Northern Peninsula.

Figure 54: Chalcocite crystals from the White Pine mine, White Pine, Ontonagon County. 3 x 5.5 cm. Shawn M. Carlson collection, Jeffrey Scovil photograph.

Baraga County: N ½ section 10, T52N, R30W: A vein in Jacobsville Sandstone carries chalcocite, calcite, and malachite (L. L. Babcock, personal communication).

Gogebic County: The Nonesuch Shale also is mineralized west of White Pine, in the Porcupine Mountains. The Presque Isle deposit (not to be confused with Presque Isle at Marquette) is estimated to contain 87 million metric tons of ore averaging 1.27% Cu for a total of about 1.2 billion kilograms of copper (Wilband, 1978). Other areas west of White Pine, in both Gogebic and Ontonagon Counties, are estimated to contain similar, if not even larger reserves (Cannon, 1983a).

Houghton County: 1. Baltic mine: In fissure veins with "ankerite"; locally in the lode itself. Veinlets of solid chalcocite several centimeters wide were found (Butler and Burbank, 1929). **2.** Isle Royale mine: In fissures with "ankerite" and "specularite." Lane (1911) reports veins of chalcocite, bornite, chalcopyrite, "whitneyite," pyrrhotite(?), natrolite, analcime, and "adularia." **3.** Centennial mine: Disseminated in the Calumet and Hecla Conglomerate. **4.** Champion mine: In veinlets with silver. Some as very fine-grained pulverulent material consisting of hexagonal platelets less than 0.5 mm across (Koenig, 1902). **5.** Portage mine: In fissure veins with quartz and orange calcite. **6.** Wolverine mine. **7.** Osceola mine: As complex microcrystals and crusts on prehnite from the No. 10 shaft (Falster, 1978). **8.** East slope Six Mile Hill, southwest of Houghton: Networks of veins with copper, calcite, epidote, prehnite, datolite, and a considerable amount of chalcocite (Rominger, 1895). **9.** Laurium mine: (Morris, 1983).

Iron County: Sherwood and Buck iron mines: With other sulfides and uraninite (Vickers, 1956b; James et al., 1968).

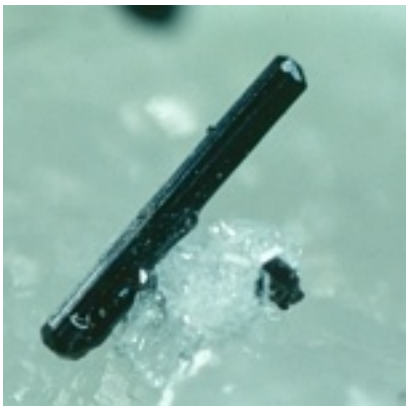

Figure 55: A 1.5 mm long chalcocite crystal on prehnite from the Clark mine, near Copper Harbor, Keweenaw County. Tom Rosemeyer specimen, Dan Behnke photograph.

Keweenaw County: 1. Allouez mine: In finely disseminated form in small calcite veins in the Allouez Conglomerate (Butler and Burbank, 1929), also as small crystals on native copper. **2.** Cliff mine property, near center of NW ¼ section 36, T58N, R32W: Amygdules in a basalt flow are mineralized for at least 300 meters along the strike. The 1 to 5 mm vesicles are lined with chlorite, and the rest of the cavity is filled with prehnite, calcite, analcime, chalcocite, and specular

hematite. The chalcocite-hematite mineralization was considered by Cornwall (1951a) to be confined mainly to the bottom 1.5 meters of the 4.5- to 6-meter Greenstone flow amygdaloid. However, trenching and drilling by the Calumet and Hecla Mining Company showed that the chalcocite mineralization occurs within the basal, cellular part of the next overlying flow (Roberston, 1972, citing R. J. Weege, personal communication). Microscopic grains of digenite, covellite, and chalcopyrite also are present, with the chalcocite extensively altered to malachite (Cornwall, 1951a). The minute chalcocite crystals show prismatic elongation with a, and have many forms. Some crystals appear pseudohexagonal, due to twinning (Moore and Beger, 1963). Williams (1966) has described crystals up to 4 mm long on prehnite and replacing copper. Commonly the chalcocite crystals are epitactically oriented on copper with [001] of the sulfide normal to {111} of the copper, and either [100] or [010] of chalcocite parallel with [\s\up6(–01] of the copper. Complex arborescent or dendritic copper forms are faithfully duplicated pseudomorphously by aggregates of minute chalcocite crystals. Three measured crystals all showed the forms {100}, {010}, {100}, {130}, {012}, {021}, {113}, {323}, and {211}. **3.** Mendota mine at Mount Bohemia: Veinlets of copper sulfides cutting "oligoclase" diorite. Associated minerals are chalcopyrite and bornite (Bhatt, 1952; Juilland, 1965; Robertson, 1972, 1975). **4.** Gratiot Lake Road. **5.** Suffolk mine. **6.** Kingston mine: In conglomerate. **7.** Clark mine, Copper Harbor (Morris, 1983; Bee and Dagenhart, 1984). As sharp, lustrous, black microcrystals (generally < 1 mm) in vugs in prehnite veins. **8.** In stromatolites (calcite) in the Copper Harbor Conglomerate near Copper Harbor with copper (q.v.), cuprite, bornite, and domeykite (Nishioka et al., 1984). Microscopic. **9.** *Copper Falls mine*: Elongate, skeletal crystals to 2 cm. (e.g., specimen JTR 506, A. E. Seaman Mineral Museum). **10.** Gratiot Lake chalcocite deposit, sections 6 and 7, T57N, R30W and sections 1 and 12, T57N, R31W: In brecciated amygdaloid flow tops in the Portage Lake Volcanics, associated with pyrite, and lesser amounts of bornite, chalcopyrite, and rare covellite (Maki, 1999).

Marquette County: **1.** Mount Mesnard near Marquette. **2.** NE ¼ NW ¼ section 1, T47N, R25W, west of Harvey: Veins and irregular replacements containing chalcocite (colloform type is common), pyrite, quartz, muscovite ("sericite"), chlorite, and dolomite in tan siliceous shale of the Kona Dolomite Formation (Reed, 1967a, b). **3.** Near Enchantment Lake, SW ¼ NE ¼ section 32, T48N, R25W. Siliceous dolomite cut by quartz veins and mineralized by chalcocite, bornite, specular hematite, and pyrite (Reed, 1967a, b). **4.** Kona Dolomite, general: In eastern Marquette County the Kona Dolomite, which reaches a maximum thickness of 731 meters, consists of interlayered marbles, argillites, and quartzites. Copper sulfides (chalcocite, chalcopyrite, bornite) and pyrite are disseminated in three beds with a total thickness of 17 meters, about 60 meters above the base of the formation. Mineralization is greatest along the argillite-quartzite contacts. (Taylor, 1972; Clark, 1974). The occurrences have been vigorously explored but are low grade, and the rock has poor grindability. Wilband (1978) has estimated that the Kona contains about 1 million tons of rock with an average grade of 0.3% Cu. **5.** Captain Daniels' mine, section 30, T50N, R26W: Massive stringers and microcrystals in quartz (DeMark, 2000).

Ontonagon County: **1.** *White Pine mine*: Michigan's only copper producer that mined chiefly chalcocite ore, which occurred mostly as microscopic grains and thin veinlets in the Nonesuch Shale. In the cupriferous zone chalcocite formed irregular, disseminated grains replacing chlorite and carbonate, and as nodules up to 20 mm with hematite inclusions and rims on some chalcocite grains. In the Cu-Fe transition zone, chalcocite occurred intergrown with digenite, less commonly covellite, and some bornite. Some was pseudomorphous after pyrite (White and Wright, 1954; Carpenter, 1963; Brown, 1966, 1968). In addition, disseminated grains and veinlets were found in the chlorite facies of the Copper Harbor Conglomerate (Hamilton, 1967). Though uncommon, sharp, well-formed crystals up to 4 cm in aggregates several times that size have been found in calcite-lined fractures in breccia zones (Wilson, 1983a; Rosemeyer, 1999). **2.** Cunningham Creek area: In barite vein.

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UPDATE

Ontonagon County: Cuyahoga mine, N ½ SE ¼ section 13, T51N, R43W, west of Silver City: As charcoal gray-to-black crystal aggregates in calcite veins cutting andesite and basalt flows of the Oronto Group. The morphology of some crystals suggests they may be pseudomorphs after chalcopyrite.

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