CHALCOPYRITE

$CuFeS_2$

A widespread and common copper ore mineral occurring in veins, disseminations, or as replacement deposits. Northern Peninsula.

Alpena County: 1. Lafarge Corporation, Great Lakes Region (formerly National Gypsum Company) quarry, Alpena: Rare, with calcite, dolomite, barite, sphalerite, marcasite, pyrite, and strontianite (Morris, 1983). **2.** Paxton quarry, Paxton: With calcite, dolomite, quartz, sphalerite, pyrite, and marcasite (Morris, 1983).

Baraga County: Ohio mines (Webster and Imperial mines), Imperial Heights near Michigamme: Associates are apatite, goethite, grunerite, graphite, palygorskite, carbonates, and other sulfides (Morris, 1983; DeMark, 2000). Crystals on calcite rhombohedra.

Dickinson County: 1. Metronite quarry, 4 km east-northeast of Felch: In tremolite marble (Randville Dolomite) along contact of aplite-pegmatite dike and in marginal parts of the dike itself (Heinrich, 1962b). **2.** Rian's quarry southeast of Felch: Similar occurrence (Pratt, 1954). **3.** In iron formation of the Menominee iron range and also just north of Felch: Rare, usually associated with secondary pyrite (Pratt, 1954; Brower, 1968). **4.** *Loretto (Loretto mine?):* Disphenoidal crystals up to 3 mm, some iridescent, with calcite on hematite in iron formation. **5.** Curry mine at Vulcan. **6.** Emmet mine: In hematite. **7.** Chapin mine: In hematite. **8.** In a railroad cut of the Chicago, Milwaukee and St. Paul Railroad south of Iron Mountain in highly fractured greenstone with other copper sulfides. **9.** Norway: In the footwall of the Randville Dolomite in several iron mines (8, 9, B. J. Westman, written communication, 1983). **10.** NW ¼ section 24, T39N, R28W: In siliceous dolomitic marble (Randville Dolomite?) as concretionary masses, partly altered to malachite and azurite (Rominger, 1881). **11.** *West Vulcan mine*: In Vulcan Iron Formation in vuggy veins with calcite crystals and pyrite (Bayley, 1904). **12.** Rock and gravel quarry near Norway, approximately 1 km east of Fumee Lake, SE ¼ section 25, T40N, R30W: As microcrystals to 2 mm with malachite in quartz-lined cavities. Uncommon (S. M. Carlson, personal communication, 2000). The quarry is privately owned and permission must be obtained before visiting. **13.** Groveland mine, near Felch. Common as attractive microcrystals (DeMark, 2000).

Figure 56: A 1.3 mm chalcopyrite crystal on dolomite from the Groveland mine, Dickinson County. Ramon DeMark specimen, Dan Behnke photograph.

Gogebic County: 1. Eureka mine near Ramsay, sections 12 and 13, T47N, R46W: With pyrite and gold in quartz veins at contact between granite and the Palms slate (Dickey and Young, 1938). **2.** Copp's mine 10 km north of Marenisco: With galena, sphalerite, pyrite, and dolomite (Dana, 1892). **3.** Roadside exposure on south side of County Road 206 and Two Mile Creek, about 13 km northwest of Watersmeet: Disseminated 15 mm grains in white, vitreous quartzite interlayered with tremolitic (q.v.) and dolomitic marbles (Sunday Quartzite and Bad River Dolomite of the Chocolay Group?) (Cannon, 1980). Malachite is common along subsurface fractures.

Gratiot County: Near Ithaca, T10N, R2W in Michigan Basin Deep Drill Hole: As an accessory constituent with pyrite in altered lower unit basalt in albite-epidote-actinolite-chlorite-augite (relict) rock. Analyses are given by McCallister et al. (1978).

Houghton County: 1. Baltic mine: Sparingly in the copper sulfide veins (chalcocite). **2.** Isle Royale mine: Similar occurrence (Lane, 1911; Butler and Burbank, 1929; Broderick, 1931) (chalcocite). **3.** Also occurs as disseminated microcrystals in some pegmatoid lenses of thicker basalt flows and as minute crystals in unaltered normal trap rock.

Iron County: **1.** Hiawatha iron mine: Euhedral crystals of tetrahedral aspect as large as 1 mm projecting into vugs and associated with quartz, pyrite, and specularite. Also occurs in iron formation as a post-ore mineral. **2.** Buck mine: Similar occurrence (James et al., 1968).

Keweenaw County: **1.** Ahmeek mine: Disseminated in Wolverine Sandstone (Butler and Burbank, 1929). **2.** On Cliff mine property: Disseminated grains in amygdaloid flow (chalcocite) (Cornwall, 1951a). **3.** Mount Bohemia: As veins in diorite also containing chalcocite and bornite (Butler and Burbank, 1929; Juilland, 1965; Robertson, 1972, 1975). **4.** 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 chalcocite, pyrite, and lesser amounts of bornite and covellite (Maki, 1999).

Marquette County: **1.** Dead River: Quartz-carbonate veins with copper sulfides (Puffet, 1966). Dead River Basin: east-central part section 3, T48N, R26W: Quartz-chalcopyrite veins and disseminated chalcopyrite in the Reany Creek Formation (Puffet, 1969). **2.** Holyoke mine, north of the Dead River: Quartz veins with chalcopyrite, galena, and sphalerite. **3.** Eastern Marquette range near Enchantment Lake, SW ¼ NE ½ section 32, T48N, R25W: Associated with bornite, chalcocite, covellite, specular hematite, and pyrite in siliceous dolomitic marble and quartz veins (Reed, 1967a, b). **4.** Copper Lake in eastern Marquette range, NW ¼ SE ¼ section 2, T47N, R25W: Veins, pods, and coarse clastic bands in tan and gray slates containing chalcopyrite, quartz, dolomite, chlorite, and muscovite ("sericite") with minor bornite replacing the chalcopyrite (Reed, 1967a, b). **5.** Presque Isle. Veinlets in serpentinite with galena, pyrite, pyrrhotite, violarite, and millerite (Brooks, 1873; Snelgrove et al., 1944). **6.** Sedgewick mine: Similar occurrence. **7.** Prospects near Morgan furnace: Similar occurrence (Brooks, 1873; Rominger, 1881). **8.** Ropes gold mine, NW ¼ section 29, T48N, R27W: A minor constituent of the gold-bearing quartz veins with accessory pyrite, silver, tetrahedrite, and scheelite (Snelgrove et al., 1944; Broderick, 1945). **9.** Michigan gold mine and other gold mines in the Greenwood area: In gold-quartz veins as an accessory mineral (Broderick, 1945). **10.** Magnetic iron mine northwest of Republic: With pyrite in late veinlets cutting iron formation (Lamey, 1934). **11.** Cliffs Shaft mine, Ishpeming: Massive with bornite and pyrite (Morris, 1983). At 221 meters in the Cliffs Shaft iron mine, section 10, T47N, R27W: Veinlets cutting upper part of the Negaunee Iron Formation (Reed, 1967a, b). **12.** Beacon iron mine (Dorr and Eschman, 1970). **13.** 32nd sublevel of Champion iron mine about 200 meters east of Number 7 shaft: In iron formation with almandine, pyrrhotite, and minor pyrite and quartz (Babcock, 1966a, b). **14.** Wheat mine (Dana, 1892). **15.** Sauk Head, section 21, T50N, R26W: In granite (K. Spiroff, personal communication). **16.** Puffet (1974) lists numerous pyrite-chalcopyrite sulfides in vein occurrences in the Negaunee quadrangle: a. section 25, T48N, R26W, three localities; b. section 28, T48N, R20W, with tetrahedrite; c. section 30, T48N, R26W; d. section 36, T48N, R26W; e. section 22, T48N, R26W, with galena; f. section 14, T48N, R26W, ± tetrahedrite, two localities; g. section 4, T48N, R26W, with sphalerite, galena; h. section 33, T49N, R26W; i. section 10, T48N, R26W; j. section 3, T48N, R26W, two localities. These veins occur in fractures in the Dead River pluton and in conglomerate of the Reany Creek Formation. **17.** Silver Creek-Rocking Chair Lakes area with pyrrhotite, arsenopyrite, and local galena and sphalerite in gold-bearing (q.v.) quartz veins (Johnson et al., 1986). **18.** Middle Island of Picnic Islands 0.8 km north of Marquette Lighthouse Point: As nodules of copper pyrites in a large mafic dike (hornblende-orthoclase-plagioclase-biotite-pyrite-epidote-calcite) (Rominger, 1881). **19.** Section 10, T48N, R25W: In veinlets in "diorite" with red K-feldspar, greenish white plagioclase, epidote, quartz, calcite, hematite, pyrite, chlorite, and chalcedony (Rominger, 1881). Probably now built over by City of Marquette. **20.** NE ¼ section 30, T50N, R26W: Newett (1899, page 289) reported a copper-silver occurrence near Sauk Head Lake as a mineralized gash vein in granite, one sample from which reportedly assayed 23.8% Cu and 1.75 oz/ton Ag. Presumably the mineralization was in the form of sulfides. The occurrence has been reinvestigated in detail by Snider (1977a), but no mineralization was found that duplicated the reportedly rich early find. **21.** Sections 11 and 12, T50N, R29W: Yellow Dog peridotite body, a partly serpentinized plagioclase lherzolite, has an accessory sulfide assemblage that

also includes chalcopyrite, pyrrhotite, pentlandite (major); pyrite, cubanite (minor); mackinawite, marcasite, bornite, and covellite (trace). The sulfides are in grain composites up to 3 mm across, with most less than 0.1 mm in diameter. They occur as fractured, irregularly shaped grains, interstitial to silicates, and preferentially associated with magnetite. Some sulfides form spheroids or globules within pyroxene crystals. Cubanite and pentlandite generally occur with chalcopyrite or pyrrhotite. Intergrowths are present: 1) laths of magnetite in chalcopyrite, 2) fine lamellae of chalcopyrite in cubanite, and 3) intergrowths of magnetite-chalcopyrite (Klasner et al., 1979). See olivine, augite, enstatite, and pyrrhotite. **22.** Clark Creek Region: Northern part of county in Ishpeming Greenstone belt. In veinlets of quartz-carbonate-sulfides and as disseminated grains in altered meta-basalt. The sulfides include pyrite, chalcopyrite, arsenopyrite (q.v.), and pyrrhotite, with local galena and sphalerite (Baxter et al., 1987). **23.** Hill's Lakes area: Associated with pyrite, and locally sphalerite-galena-arsenopyrite-pyrrhotite (q.v.) together with quartz veins in altered basalt (Johnson et al., 1987). **24.** Silver Lead mine, SE ¼ SE ¼ section 30, T46N, R24W, on the bank of Silver Lead Creek approximately 20 meters from its crossing with Marquette Co. Rd. 460: With galena and pyrite in quartz veins. **25.** Republic iron mine at Republic: A rare accessory mineral with dolomite and calcite in cavities in brecciated specular hematite ore. **26.** Volunteer mine, near Palmer: As disphenoidal crystals to 2 mm with quartz, lining fracture surfaces in iron formation.

Figure 57: Botryoidal chalcopyrite from the White Pine mine, White Pine, Ontonagon County. Field of view approximately 2.5 x 4 cm. A. E. Seaman Mineral Museum specimen No. DM 22786, Jeffrey Scovil photograph.

Ontonagon County: 1. *White Pine mine*, White Pine: Disseminated grains and in pyritic veinlets in the barren zone of the Nonesuch Shale. Also found in the Cu-Fe transition zone associated with bornite and digenite, in part pseudomorphous after pyrite (Carpenter, 1963; Brown, 1966, 1968; Brown and Trammell, 1966). A very minor microscopic constituent (in two polished sections) in veinlets in the chloritic facies of the Copper Harbor Conglomerate (Hamilton, 1967). Also as small bright crystals with calcite, galena, or sphalerite, and as botryoidal encrustations on barite (Rosemeyer, 1999). **2.** T49 and 50N, R42 and 43W: In veinlets in quartz porphyry in Onondaga drill cores (Butler and Burbank, 1929). **3.** Porcupine Mountains: In veins with quartz crystals, purple fluorite, and sphalerite (University of Michigan Collection).

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UPDATE

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(see Part IV, Menominee County)

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