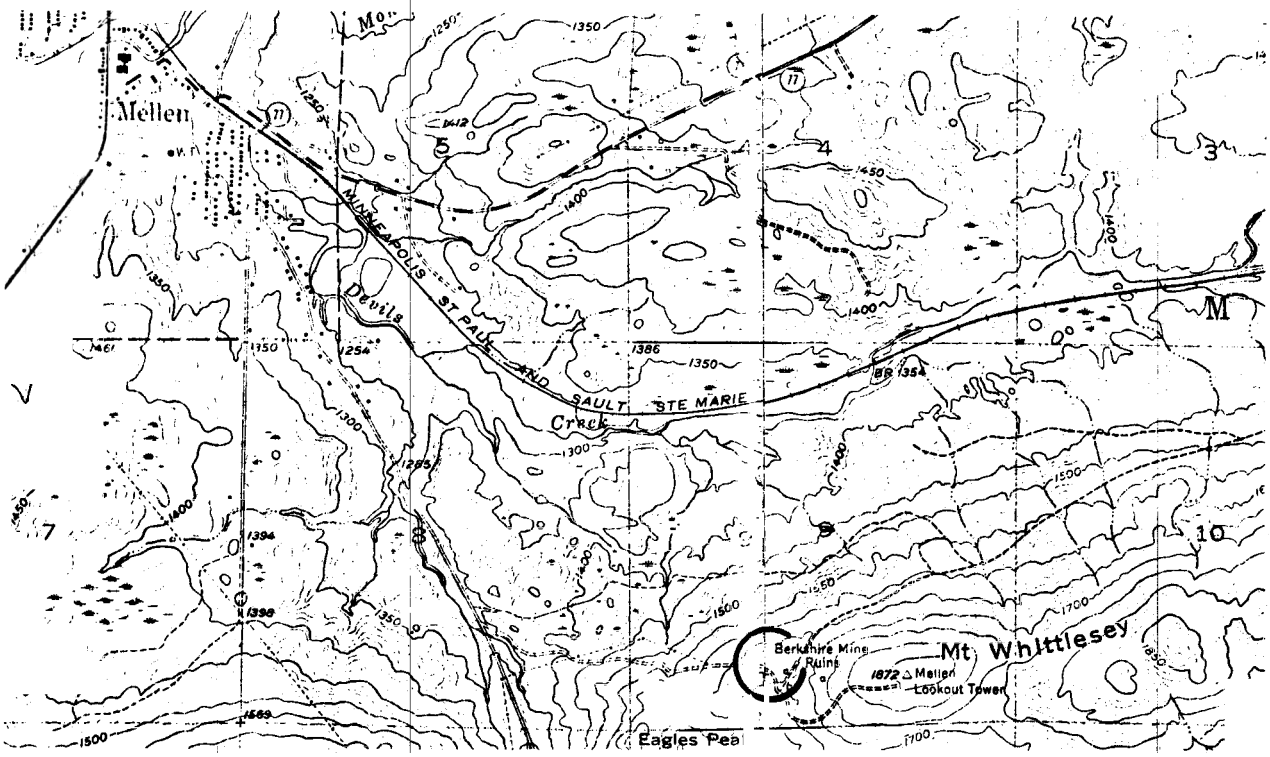
Title: Ironwood Iron-formation

Location: Mt. Whittelsey (Berkshire Mine Ruins), SE¼, SW¼, Sec. 9, T.44N., R.2W. (Mt. Whittelsey 7½ Min. Quad.) Ashland County (Get key from Ranger at Copper Falls State Park)



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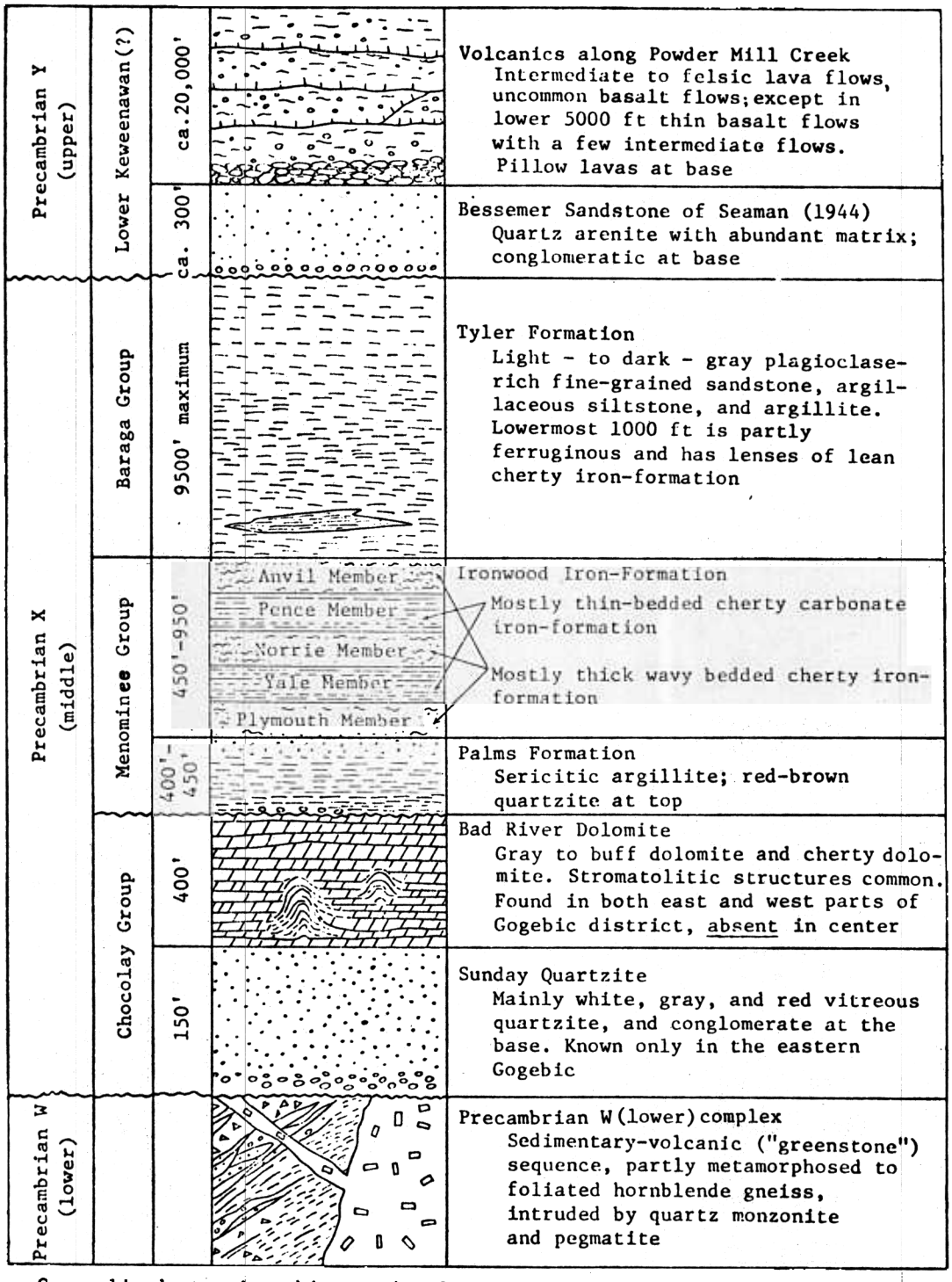
Description: This outcrop is man-made. The area was cleared off in connection with proposed mining operations on the hill. This is one of the best exposures of Middle Precambrian iron-formation in the entire Lake Superior region, and is a representative example of the rock type.

The iron-formation is composed of roughly equal portions of chert (SiO_2) and iron minerals with distinct segregation of the components into layers. Chert-rich layers range in thickness from less than 1 cm to several cm, and iron-rich layers are approximately the same thickness Note the highly irregular contacts between iron-rich and chert-rich layers at some levels and much smoother contacts in others.

Texturally, the iron formation is quite variable, and has features very comparable to post-Precambrian limestones. Some layers are composed of sand-size "granules" of chert and/or iron minerals set in a chert matrix. The "granules" are actually fragments of iron-formation and thus are called intra-clasts. Other layers are finely laminated and composed of silt size grains of chert and/or iron minerals.

Mineralogically, iron-formations consist of chert and one or more iron minerals: siderite ($FeCO_3$); iron silicates (minnesotaite, stilpnomelane, greenalite or grunerite); magnetite, hematite, and goethite.



Generalized stratigraphic section in central and western Gogebic district

From Schmidt & Hubbard, 1972.

Significance: The Ironwood Formation is typical of the Middle Precambrian iron formations in the Lake Superior region. It is similar to, and is believed to have been continuous with the iron formations on the Mesabi and Gunflint ranges on the north shore of Lake Superior. Thus, it represents a blanket-like deposit up to 800 feet thick that covered perhaps 20,000 square miles. It is underlain and overlain by typical detrital sediments (the Palms and Tyler Formations respectively) (Aldrich, 1929; Schmidt and Hubbard, 1972) and appears to interfinger with a thick volcanic pile (the Emperor Volcanics) (Hendrix, 1960) east of Wakefield, Michigan, yet the iron formation itself is almost completely devoid of detrital materials. How does this occur? Is iron-formation deposited so rapidly that clastic influx is insignificant? Or is it deposited during a period of extreme quiescence when no clastics are added to the basin.

Iron-formations are common throughout the world in rocks older than about 1800 m.y., but are virtually unknown in younger sequences. This may reflect a major change in the evolution of the earth's atmosphere and hydrosphere about 1800 m.y. ago.

Iron-formations are chemical (biochemical) precipitates, yet the mechanism of precipitation and nature and composition of the original material has been debated for more than a hundred years. The reason for this is that iron minerals respond to changes in Eh and pH of their environment. For example, hematite and goethite are most stable in an oxidizing environment while siderite and pyrite are most stable in a reducing environment. If the environment changes the iron minerals will also change. Therefore, the iron minerals present in these rocks today reflect the oxidation potential of the depositional environment, the diagenetic environment, the metamorphic environment and the weathering environment, and deciding when a particular mineral formed is at best difficult.

Many geologists now believe that iron-formations are largely biochemical precipitates with the iron being precipitated as a by-product of oxygen-producing photosynthetic organisms. The silica may also be largely organically precipitated.

References:

Aldrich, H. R., 1929, The Geology of the Gogebic Iron Range of Wisconsin: Wis. Geol. Nat. Hist. Survey Bull. 71, 279 p.

Hendrix, T. E., 1960, "Structural History of the East Gogebic," Unpublished Ph.D. Thesis, Univ. of Wis.

Schmidt, R. G., and Hubbard, H. A., 1972, Penokean Orogeny in the Central and Western Gogebic Region, Michigan and Wisconsin: Field Trip A, 18th Annual Institute on Lake Superior Geology, Houghton, Mich.