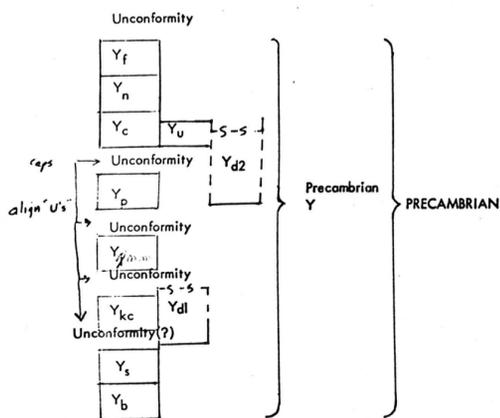


*author - make corrections indicated*

CORRELATION OF MAP UNITS



**Yc** COPPER HARBOR CONGLOMERATE (PRECAMBRIAN Y)—Grayish-red sandy lithic conglomerate containing lenses and interbeds of lithic sandstone and very subordinate siltstone; sandstone more abundant upward. Most cobbles less than 6 in. maximum diameter; boulders a foot across common, rare boulders 3 ft across at base of formation; maximum cobble size decreases upward and largest cobbles at top about 8 in. diameter. Matrix moderately well sorted, medium- to coarse-grained lithic sand. Sandstone beds moderately well sorted, very fine to fine-grained sand and silt, commonly in beds less than 6 in. thick. Sandstone generally crossbedded and massive, but fine sandstone and siltstone evenly laminated or massive and break into platy chips 1/4 to 1/2 in. thick. Along Black River, sandstone lenses generally less than 3 ft thick comprise less than 5 percent of the lower 2,500 ft; sandstone up section from Gorge Falls increases from 20 percent near Gorge Falls to about 60 percent at Sandstone Falls; upper 500 ft platy red sandstone, red facies of White and Wright (1966, p. 26); persistent conglomerate layer about 20 ft thick near top of red facies. Along Montreal River, ~~little~~ sandstone occurs.

DESCRIPTION OF MAP UNITS

[Figure 1 shows classification of volcanic rocks used in this report; figure 2 shows classification of sedimentary rocks]

Unconsolidated silt, clay, and gravel deposited from glaciers and periglacial streams and in periglacial lakes form the surficial material of the area. These deposits are not shown on the geologic map.

**Yf** FREDA FORMATION (PRECAMBRIAN Y)—Grayish-red, moderately well sorted, crossbedded sandstone interbedded with massive to poorly laminated siltstone. Lower 3,000 ft about 90 percent medium- to coarse-grained sandstone, proportion of siltstone gradually increases upward from 5 percent to 25 percent; middle 6,000 ft siltstone and very fine to fine-grained sandstone; upper 2,500 ft, predominantly fine- to very fine grained sandstone. Sandstone layers 2 in. to 5 ft thick, siltstone layers a fraction of an inch to about 5 in. thick. Sandstone and siltstone layers lenticular, persist only feet to tens of feet laterally. Major bedding planes of sandstone generally scalloped or undulatory with as much as 1 ft of relief in 10 ft laterally. Rare unscoured upper surfaces of sandstone with crescentic or cusp-shaped ripple marks. Mantled by siltstone. Angular fragments of siltstone occur as isolated chips and as concentrations in sandstone very common, do not form persistent layers. Slump structures in some of the finer sandstones, rare raindrop imprints on siltstone, and very rare mud cracks on fine siltstone.

Reddish-gray lithic sandstone and siltstone composed of angular to subangular grains; coefficient of sorting ranges from 1.29-2.45 (from 16 thin sections), and for half the samples coefficient is less than 1.66. Quartz 35 percent, feldspar 12 percent, and other grains, mostly rock fragments, 53 percent; most quartz grains have undulatory extinction, and many have polycrystalline extinction patterns. Most grains have secondary overgrowths and hematite coatings. Microcline 1-23 percent of the rock, and oligoclase and andesine (An<sub>20-10</sub>) from 3-10 percent, muscovite less than 1 percent of the rock but prominent on bedding planes. Epidote forms about 1 percent; rock fragments are mostly felsic volcanic rocks and rare iron-formation. Layer of sandy conglomerate to conglomeratic sandstone about 500 ft above base. About 150 ft thick on Montreal River, about 50 ft thick in sec. 16, T. 49 N., R. 47 W. Two counts show quartzite 33 percent, chert 16 percent, intermediate volcanic rocks about 10 percent, felsic volcanic rocks 7 percent, and iron-formation less than 3 percent of pebbles. Ground water from formation commonly salty. Conformable with Honesuch. About 12,000 maximum thickness.

Detritus predominantly felsic to intermediate volcanic rocks similar to Powdermill Group. In most places, most abundant lithology, reddish-brown aphanitic felsite with feldspar phenocrysts; other pebbles are aphanitic to very fine grained bluish-gray, dark-purple, and brownish-purple intermediate volcanic rocks; no volcanic rocks with ophitic texture observed. Locally 25 percent of detritus is nonvolcanic. The proportions of the different kinds of rock differ from place to place.

Differences in proportion of pebble types suggest crude inversion of stratigraphy of source terrain, the detritus from older rocks becoming more abundant upward

Lava flows occur along the Black River about 500 ft above base. Total thickness about 260 ft with 18 flows that vary from 12 to 70 ft. Microscopic study indicates that the rocks are andesites and basalts; the only rock whose mode was determined is trachyandesite. Rocks fine grained, most contain sparse plagioclase phenocrysts. Rocks blackish, very dusky red, greenish black, or brownish gray; flow tops commonly grayish red purple. Flow tops contain irregularly shaped vesicles, generally less than 1/4 in. across, and form less than 10 percent of rock. Vesicles generally in lenticular volumes less than 2 in. thick and a foot across separated by similar volumes of more massive rock. Vesicle fillings: laumontite, calcite, chlorite, quartz, and prehnite. In thin section, rocks have intergranular, intersertal, felted, subtrachytic, and ophitic textures. Subhedral to anhedral plagioclase, An<sub>20-25</sub>, 55-65 percent, pyroxene generally 10-18 percent, but ranges from 1-28 percent; pseudomorphs of olivine less than 1 percent; opaque minerals 5-30 percent. Groundmass feldspar very predominant, 1-0.2 mm, phenocrysts 0.4-0.7 mm, rare phenocrysts 10 mm. No epidote. Conformable on unnamed formation in east, may be unconformable on Portage Lake Volcanics in west; at only one exposure of contact (in Copper Harbor State park, about 25 mi west of area) Copper Harbor siltstone and sandstone overlie eroded and weathered Portage Lake felsite; contact at this exposure called Bad River Thrust by Aldrich (1929, pl. 1) but no evidence of movement. Thickness about 1,600 ft on Montreal River and increases eastward to almost 6,000 ft on Black River

**Yc** COPPER HARBOR CONGLOMERATE—footnote  
430-432  
Gordon (1904) called the flows Lake Shore Traps, but they are not correlative with the Lake Shore Traps of the type area (White and Wright, 1960, fig. 3.). Consequently, the subdivisions of the Copper Harbor of the type cannot be applied, and the terms Outer Conglomerate, Lake Shore Traps, and Great Conglomerate are abandoned for the Ironwood area.

**Ym** HONESUCH FORMATION (PRECAMBRIAN Y)—Thinly laminated lithic siltstone and thin-bedded very fine to fine-grained lithic sandstone. Siltstone laminations very thin, in places more than 40 per inch; nearly all sandstone beds less than 1/2 in. thick. Many layers graded, becoming finer upward. Crossbedding in some layers. Along Montreal River much of basal part massive; massive rock breaks into small parallel-sided chips or breaks with conchoidal fracture. Lithic sandstone and siltstone composed predominantly fragments, mostly of pre-Keweenaw rocks. More than half the grains of each thin section schists and other fine-grained rocks; 10-30 percent quartz; 5-10 percent intermediate to felsic volcanic rocks; and 5-10 percent feldspar; opaque grains abundant. Matrix about 1/3 of rock. Secondary cement includes silica overgrowths on quartz grains, calcite (especially in better sorted rocks), chlorite, and rare laumontite(?). No sample arkosic or composed predominantly of fragments of volcanic rocks. Conformable with Copper Harbor Conglomerate; predominantly reddish-brown siltstone of uppermost Copper Harbor Conglomerate grades upward into predominantly dark-gray siltstone over a stratigraphic distance of about 20 ft. Contact is arbitrary. About 550 ft thick at Black River and 450 ft on Montreal River

**Yp** UNNAMED FORMATION (PRECAMBRIAN Y)—... andesite and basalt lava flows interbedded with volcanoclastic sedimentary rocks. Flows 7-150 ft thick; ophitic flows average about 60 ft, nonophitic flows about 15 ft. Most flow tops pahoehoe type, but a few tops scoriae or fragmental. Most tops contain less than 5 percent vesicular pore space. Vesicles contain chlorite, epidote, zoisite, clinozoisite, quartz, calcite, calcite, laumontite, pumpellyite, and prehnite. Most rocks moderate to dark gray, but some grayish red, grayish purple, dusky blue, light-brownish gray, and pale red. A few flows contain brown oxidation bands about 1-2 in. thick, generally parallel with top. The rocks include basalts and olivine basalts, andesites, and felsites; four samples locally determined are basalt, quartz basalt, and rhyobasalt.

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

