La Rue Quarry

Location. Quarry in quartzite of the Precambrian Baraboo Formation is located southwest of North Freedom in the NW1/4, sec. 22, T11N, R5E, Sauk County (Rock Springs, Wisconsin, Quadrangle, 7.5-minute series, topographic, U.S. Geological Survey, 1975) (fig. 1). This is private property; you *must* gain permission to enter the quarry from Edward Kraemer & Sons, Inc., Plain, Wisconsin.

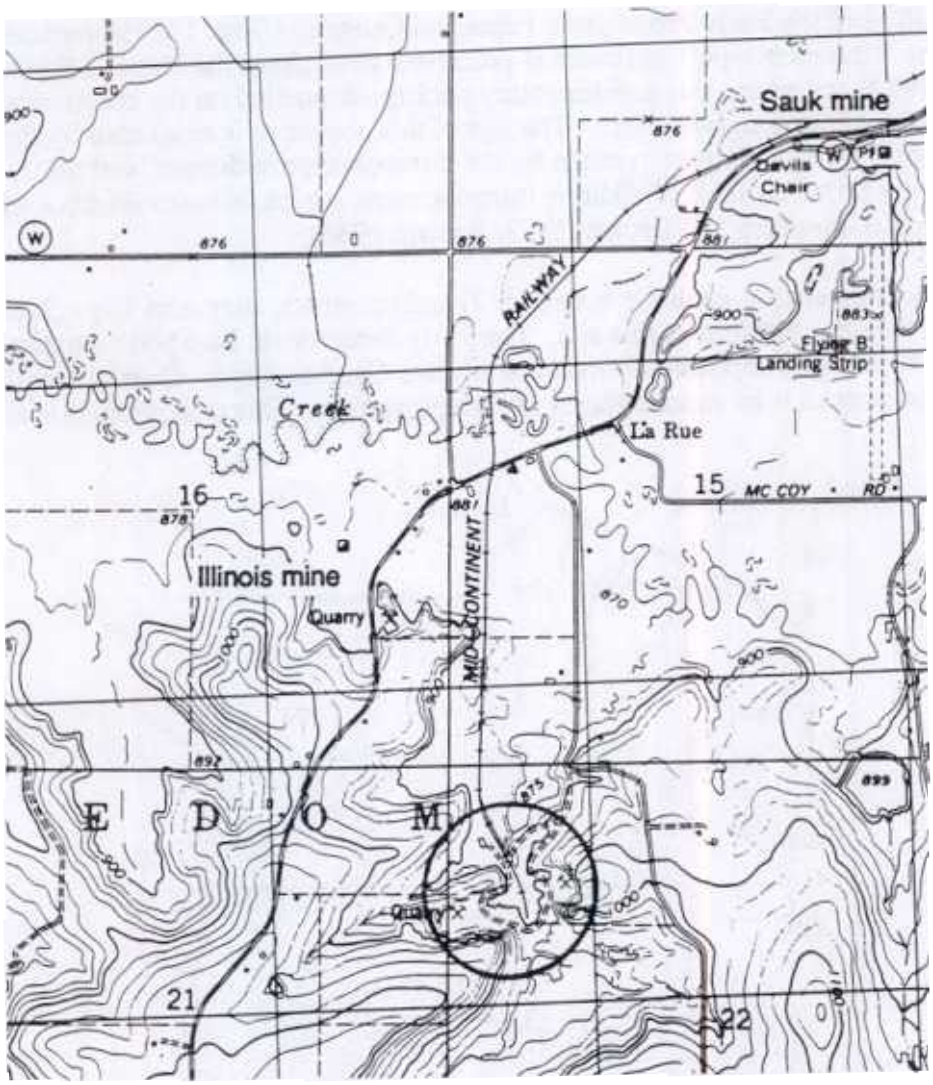

Figure 1. *Location of La Rue Quarry*

Authors B.A. Brown and M.E. Ostrom, 1989 (modified from Ostrom, 1966)

Introduction. The La Rue Quarry is located in the south limb of the Baraboo Syncline and provides an excellent exposure of the upper part of the Baraboo Formation. The Baraboo Formation consists of several hundred metres of metamorphosed quartz sandstone, pebble conglomerate, and minor argillite, interpreted by Dott (1983) to be of predominantly fluvial origin. The quartzite is generally a fining upward sequence, which grades upward from pebbly sandstone into a marine

argillite, the Seeley Formation. The upper part of the Baraboo Formation, exposed in this quarry and to the east along Highway 12, contains phyllite beds and marine sedimentary structures such as oscillation ripples. The increasing abundance of phyllitic beds and the appearance of marine sedimentary structures mark the transition from the fluvial environment of the Baraboo Formation into the overlying marine units. North of the quarry, the quartzite is overlain by slate of the Seeley Formation, which is in turn overlain by ferruginous slate and carbonate of the Freedom Formation. The Seeley and Freedom Formations are not exposed, but have been sampled by iron exploration drilling in the area of La Rue and North Freedom and by early mining operations at the Illinois and Sauk Mines (Weidman, 1904).

The Baraboo range is the best exposure in southern Wisconsin of a once-extensive sedimentary sequence representing the "Baraboo interval," a period of anorogenic sedimentary and igneous activity that followed the Early Proterozoic Penokean Orogeny (Dott, 1983; Greenberg and Brown, 1984). The "Baraboo-type" sediment is preserved throughout the Upper Midwest (Greenberg and Brown, 1984) and represents a sedimentary package deposited on the continental crust formed during the Penokean orogenic event. The age of this sequence is bracketed by the age of the 1,760 Ma rhyolite, which is in part overlain by the Baraboo-type sediment, and the 1,500 Ma age of the Wolf River batholith suite of alkaline intrusive rock, which intrudes Baraboo-equivalent quartzite at Waterloo (Greenberg and Brown, 1983; Brown, 1986).

Description. The accompanying geologic map (fig. 2) and schematic diagrams (figs. 3 and 4) clearly illustrate geologic conditions at this site. The Early Proterozoic Baraboo quartzite is unconformably overlain by younger deposits of sandstone of Late Cambrian age. Quartzite within several metres of the contact is in various stages of disaggregation. This disaggregation is caused

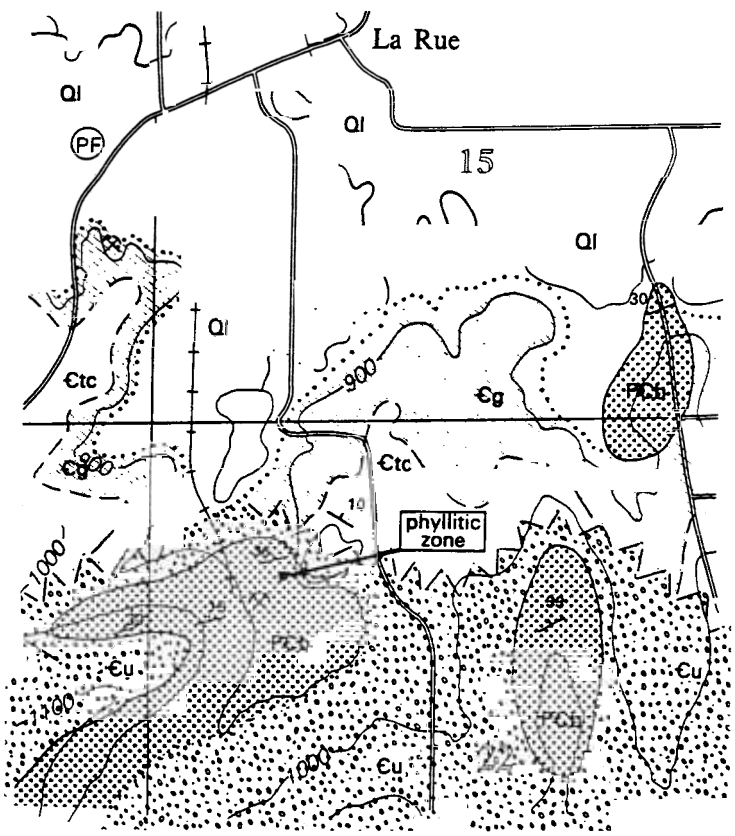

Figure 2. Geologic map of the La Rue Quarry area showing three quartzite hills surrounded by Cambrian strata. Ql = Quaternary sediment; €tc = Tunnel City Formation; €g = Galesville Member; €p = Parfreys Glen Formation; P€b = Baraboo Formation (modified from Usbug, 1968; Dalziel and Dott, fig. 31, 1970).

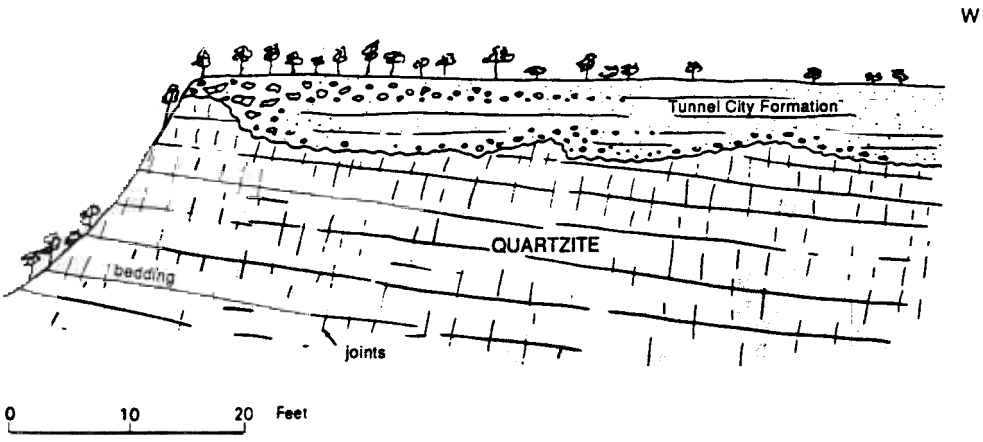

Figure 3. High southwest face of old La Rue Quarry showing conglomerate and sandstone of the Parfreys Glen Formation resting upon quartzite of the Baraboo Formation. Note large, angular quartzite clasts near buried knob at left and conglomerate tongue extending to west (right). Smaller quartzite clasts are all well rounded and clearly were transported (Dalziel and Dott, 1970, fig. 32).

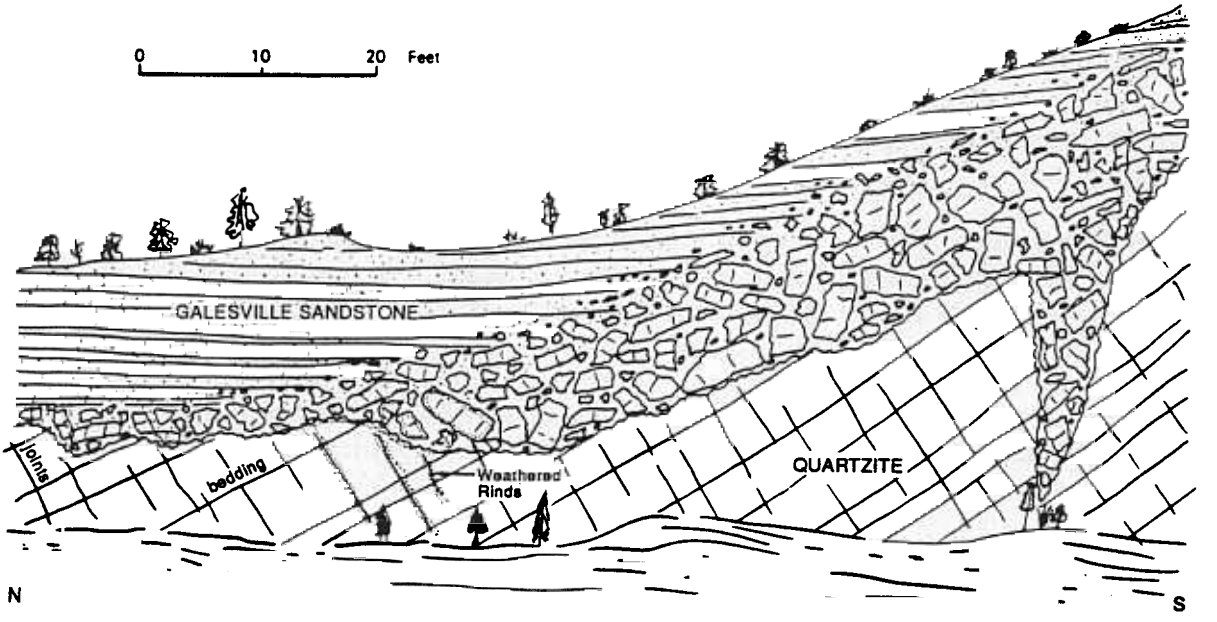

Figure 4. East face of La Rue Quarry showing nonconglomeratic Cambrian sandstone onlapped over angular quartzite blocks that rest upon the unconformity (note deep fissure filled with quartzite blocks at right). Note bleached, weathered rinds on quartzite bedrock and blocks (Dalziel and Dott, 1970, fig. 32).

by a breakdown of the silica cement, which releases rounded to subrounded quartz sand grains. At this location, these sand grains are an important constituent of the overlying Cambrian and Ordovician sandstone. Could disaggregation produce the amount of sand contained in the Cambrian and Ordovician sandstone?

We do not at this time understand how disaggregation occurs; for instance, we do not know why the thoroughly recrystallized quartz cement weathers preferentially, but it is obvious from this

exposure that this does occur. A detailed investigation of the quartzite weathering will be necessary before we have a satisfactory answer.

Whether disaggregation of the Baraboo-type sediment could have provided a sufficient volume of sand to form a major part of the Cambrian and Ordovician sandstone will probably never be determined conclusively. Rock of the Baraboo interval, including quartzite or its unmetamorphosed equivalent, formerly extended over much of the Upper Mississippi Valley and western Great Lakes area (Greenberg and Brown, 1984; Dott, 1983; Andersen and Ludvigsen, 1986; Morey, 1984; Southwick and Mossler, 1984). If, on a regional scale, this rock was originally as thick as the preserved Baraboo quartzite (1,200 m or more), it represents a large volume of potential sediment.

It is important to consider how much of the Baraboo interval sedimentary sequence was actually quartzite as seen in the Baraboo area and other preserved remnants. Greenberg (1986) observed that all the Baraboo interval quartzite exposed in Wisconsin, with the exception of the Barron and Flambeau in northwestern Wisconsin, is associated with 1,760 Ma or 1,500 Ma igneous intrusions. It is possible that the quartzite represents sandstone silicified by hydrothermal metamorphic processes. On the other hand, the Barron and the Sioux quartzite of Minnesota and South Dakota show little evidence of deformation and they are not associated with granitic intrusions. Field relationships suggest that they are part of the Baraboo interval sedimentary package. The Baraboo interval lasted nearly 260 million years. A period of nearly 1 billion years passed until deposition of the Cambrian sandstone. This represents an adequate time to deposit and erode several sedimentary sequences.

At La Rue Quarry, pebbles, cobbles, and boulders of quartzite occur with rounded sand grains in a Cambrian basal sandstone, which rests on the quartzite. Quartzite pebbles occur in sandstone at least 12 km east of outcropping quartzite and can be found in the upper part of the Jordan sandstone just north of Spring Green. There seems little reason to doubt that the source of the pebbles and some of the sand was the quartzite. Other evidence, such as heavy mineral suites, suggests that erosion of Baraboo-type quartzite was certainly not the only source of sediment for the Cambrian-Ordovician sandstone of the Upper Mississippi Valley, but it may locally have been an important source of sand grains.

Significance. Quarrying at La Rue has exposed an excellent example of the Precambrian-Paleozoic angular unconformity. The northward dipping Baraboo quartzite is significantly altered in its upper part and is overlain by flat-lying Cambrian sandstone containing altered quartzite boulders and quartz grains derived from the breakdown of the quartzite. This suggests that weathering and disaggregation of the Proterozoic quartzite was a source of sand for younger clastics. The regional extent of Baraboo interval sedimentary rock suggests that quartzite and unmetamorphosed sandstone of this once-extensive sedimentary package may have been a significant source of sand grains that now reside in the Cambrian-Ordovician clastic rocks of the Upper Midwest.

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