Proterozoic quartzite at Hamilton Mound, central Wisconsin

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LOCATION

The quarry at Hamilton Mound is in the NE¼,Sec.36,T.-20N.,R.6E., Coloma NW 7½-minute Quadrangle. It can be reached by turning east from Wisconsin 13 on Archer Drive, just north of Dorro Couche Lake, and proceeding about 4 mi (6 km) to a turnoff leading south into the quarry in the middle of Hamilton Mound. The turnoff from Wisconsin 13 is about 15 mi (24 km) south of Wisconsin Rapids (Fig. 1).

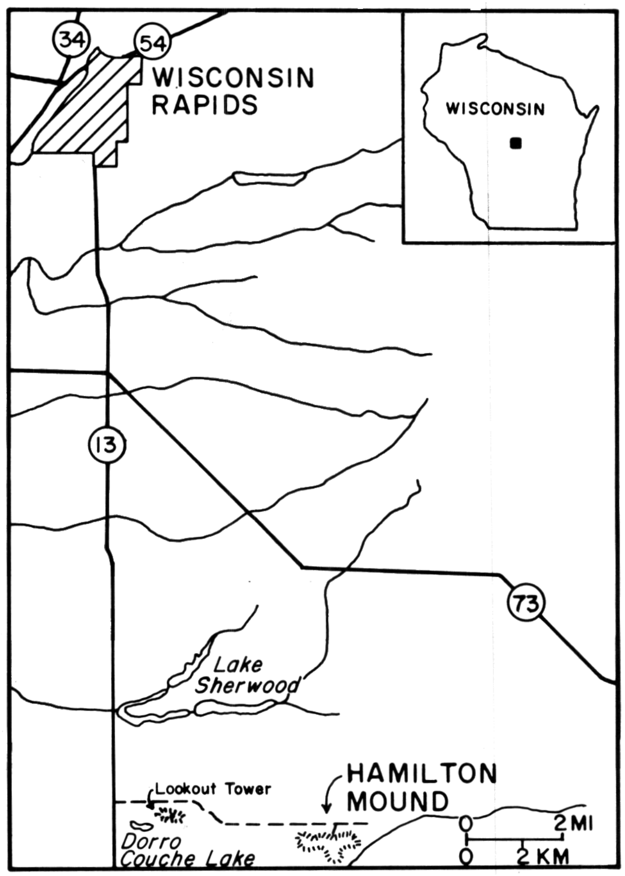

Figure 1. Location map.

SIGNIFICANCE

Hamilton Mound is an inlier of folded Proterozoic quartzite similar to the Baraboo Syncline and the Waterloo area exposures (Brown, 1986). The quartzite is exposed on a series of low hills; Upper Cambrian sandstone of the Elk Mound Group overlaps the quartzite and is exposed on the slopes. Hamilton Mound is a prominent feature on the flat sand plains of central Wisconsin. Sand dunes are scattered over the plain, which was a Quaternary lake bed. A quarry developed in the quartzite exposes a granite intrusive into the quartzite, and an unusual zone of contact metasomatism and alteration within the quartzite.

DESCRIPTION

The quartzite was originally a fine- to medium-grained quartz sand. Sericite and clays constitute from 1 or 2 percent to 25 percent of the rock, suggesting that the sandstone varied in content of clay (or feldspar?), which is now represented by mica or has been realtered to kaolin. Typical samples contain 5 to 10 percent sericite, 90 percent recrystallized quartz grains, and traces of hematite, chlorite, zircon, and other detrital minerals. Small feldspar grains (less than 1 mm) are common near the granite contact, and chlorite, zircon, sericite, and clay minerals are concentrated near the intrusion.

Primary sedimentary structures include bedding, cross-bedding, and, less commonly, ripple marks. Fine laminated units commonly are slumped and faulted, possibly due to tectonic as well as sedimentary deformation.

STRUCTURAL FEATURES

The macroscopic structure of the Hamilton Mound exposures was mapped by Ostrander (1931) who identified four major folds trending N75°W (Fig. 2). The roughly east-west axial trend is similar to that of the Baraboo Syncline and the Waterloo area. Other structures, including distortion of bedding, several sets of fracture cleavage, foliation, shear zones, and zones of breccia-tion are well developed in the area of the granitic intrusion (Fig. 3) and increase in intensity as the intrusive contact is approached. The intensity of deformation is evident in thin section (Fig. 4) where quartz grains become highly strained.

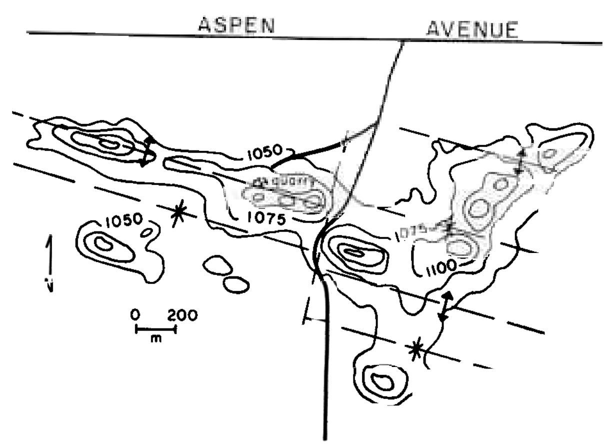

Figure 2. Major structures at Hamilton Mound (after Ostrander, 1931).

Figure 3. Excavation face at Hamilton Mound quarry showing steeply dipping beds in quartzite cut by nearly horizontal fracture cleavage.

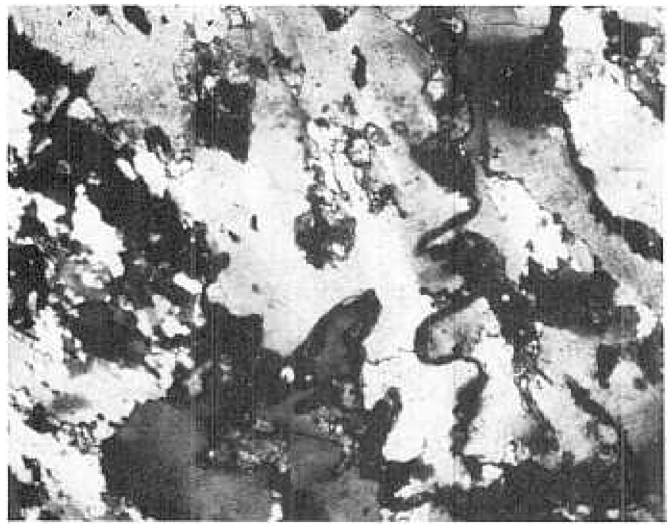

Figure 4. Micrograph of intensely deformed quartzite from near the intrusive contact. Note microstylolite developed between quartz grains. Long dimension is about 6 mm.

Important structural features are zones of quartzite breccia cemented by white vein quartz that extend upward from near the intrusive contact in the quarry. Similar brecciated zones are common in other areas where Baraboo interval quartzites are intruded by granitic rocks (Greenberg, 1986). Taylor and Montgomery (1986) observed porphyritic granitic fragments in the breccia zones, suggesting that they are late hydrothermal phenomena.

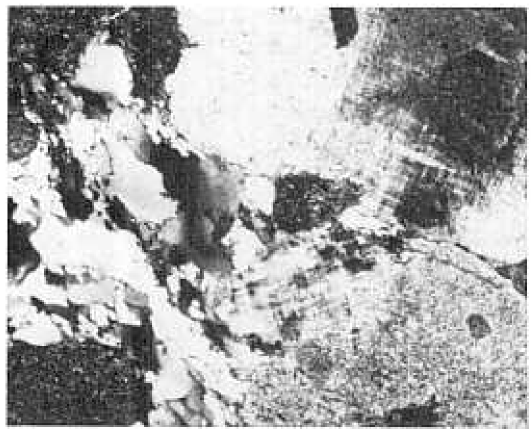

Figure 5. Micrograph of contaminated porphyritic granite. Note strained quartz and chlorite surrounding feldspar phenocrysts. Long dimension is about 8 mm.

THE INTRUSIVE ROCKS

From the present extent of exposure, there is no certain way of knowing the original igneous character of the granitic intrusion at Hamilton Mound. Contaminated igneous material is of two types. The more original-appearing rock is exposed near the pit entrance, and contains bright red-orange phenocrysts (to 0.8 in; 2 cm in length) of potassium feldspar and plagioclase, colored by hematite inclusions. Some larger quartz grains also occur as clasts in a matrix of highly strained quartz (to 50 percent of total), chlorite, opaque minerals, and sericite (Fig. 5). Much of the sericite may have been derived from altered feldspars. Zircon is common. Larger inclusions in the granitic rock are composed of quartz, biotite, chlorite, and sericite. These inclusions are unlike the overlying quartzite and may be remnants of digested basement rocks. Chemical analyses of samples of the porphyritic granite are consistent with a granitic intrusion contaminated by mafic and aluminous material (Taylor and Montgomery, 1986). Initial U-Pb zircon data from the porphyritic granitic rock suggest 1760 Ma (W. R. Van Schmus, unpublished data) as a possible age. This age would further establish a link between Baraboo-interval sedimentation and 1760 Ma magmatism. Rb-Sr analyses (Taylor and Montgomery, 1986) indicate that whatever the original age, the granite at Hamilton Mound was isotopically reset at 1585 ± 30 Ma, an age overlapping the uncertainties of both the 1630 Ma regional disturbance and the 1500 Ma (Wolf River) episode of anorogenic magmatism.

At the west end of the quarry, quartzite and intrusive rocks appear to be very complexly mixed. The gray foliated rock exposed here ranges from a highly deformed micaceous quartzite into a very quartz-rich banded rock containing large amounts of fresh fine-grained feldspar (microcline and plagioclase), biotite, and less common hornblende near the granite. In this zone of transition or mixing, fine banding with the appearance of sedimentary laminations, becomes contorted and indistinguishable from tectonic foliation (Fig. 6). Enigmatic round inclusions (xe-

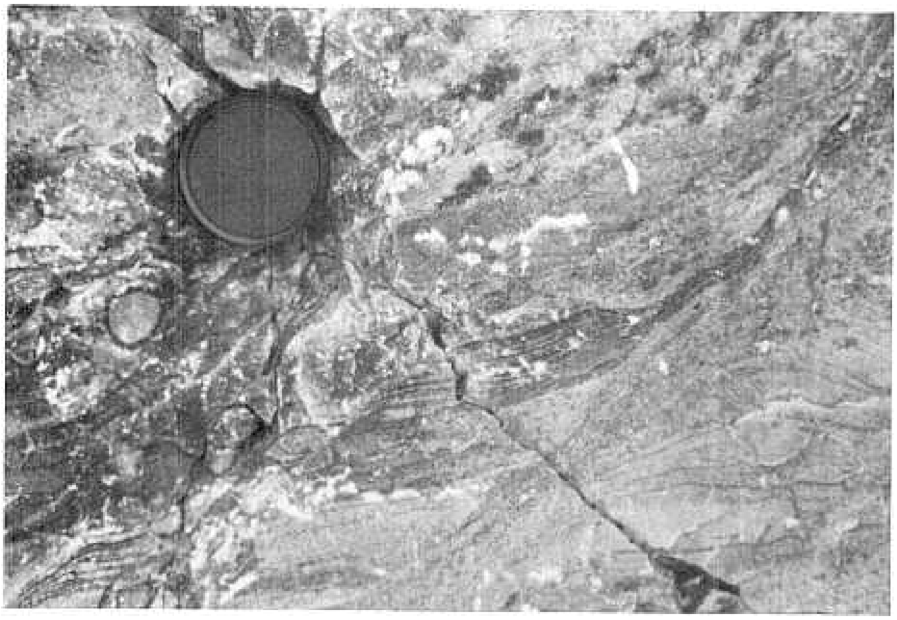

Figure 6. Distorted laminations and inclusions with reaction rims, from the quartzite-intrusion mixing zone at Hamilton Mound. Lens cap is 2 in (5 cm) in diameter.

Figure 7. Excavation face at Hamilton Mound quarry showing quartzite blocks in Cambrian sandstone overlying quartzite. Sandstone beds become more regular and flaggy to the right of the photo. Quartzite bluff is to left. Horizontal dimension is about 33 ft (10 m).

noliths?) of mafic material with reaction rims occur in the mixed zone. U-Pb analyses by W. R. Van Schmus (unpublished data) determined an age for the zircon crystals from this mixed zone as 2500 Ma. One interpretation is that these zircons and inclusions in the magma represent basement assimilated and brought up from below. Another possibility is that the Hamilton Mound quartzite contains detrital zircons derived from eroded Archean basement.

All thin sections of quartzite and intrusive rock collected from within or near the mixed zone have the high-strain deformational fabric associated with the quartzite-intrusion contact. Unusually strain-free grains, feldspar and biotite in particular, appear to be late magmatic (metasomatic?) phases that grew during or after deformation. Rare dikelets of granitic rock containing tourmaline are also known to postdate deformation (Taylor and Montgomery, 1986; Greenberg, 1986). These observations, along with the extensive brecciation, suggest both a forceful intrusion and a substantial chemical interaction between magma and overlying quartzite.

A definite influence of granitic intrusion on the quartzite is color alteration. Although Hamilton Mound quartzite away from the intrusion is characteristically pink-red (as seen on the ridge southeast of the quarry ridge), quartzite in proximity to the granitic rock is distinctly greenish. The color change is probably explained by the reduction of iron in hematite during heating. Similar color variations can be seen at Necedah and in the contact zone of the Baxter Hollow Granite at Baraboo (Greenberg, 1986).

SANDSTONE

A thin cap of sandstone sits atop poorly exposed quartzite along one wall of the quarry. This sandstone, like most other exposures in the area, is correlated with the Upper Cambrian Elk Mound Group. The sands are interpreted as having been deposited on a topographic high of the eroded Precambrian rocks.

Just above the quartzite, the sandstone is very poorly sorted with alternating beds of rubbly conglomerate and finer sand beds (Fig. 7). The rubbly conglomerate contains large angular blocks (to 3 ft; 1 m across) of quartzite. Away from the unconformity, the beds become thinner, with better sorting and flaggy parting.

The Cambrian sediments at Hamilton Mound may have been storm deposits like those which have been described in the Baraboo area by Dalziel and Dott (1970). The Hamilton Mound inlier probably stood above sea level as small islands or stacks during deposition of the flanking sandstone.

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