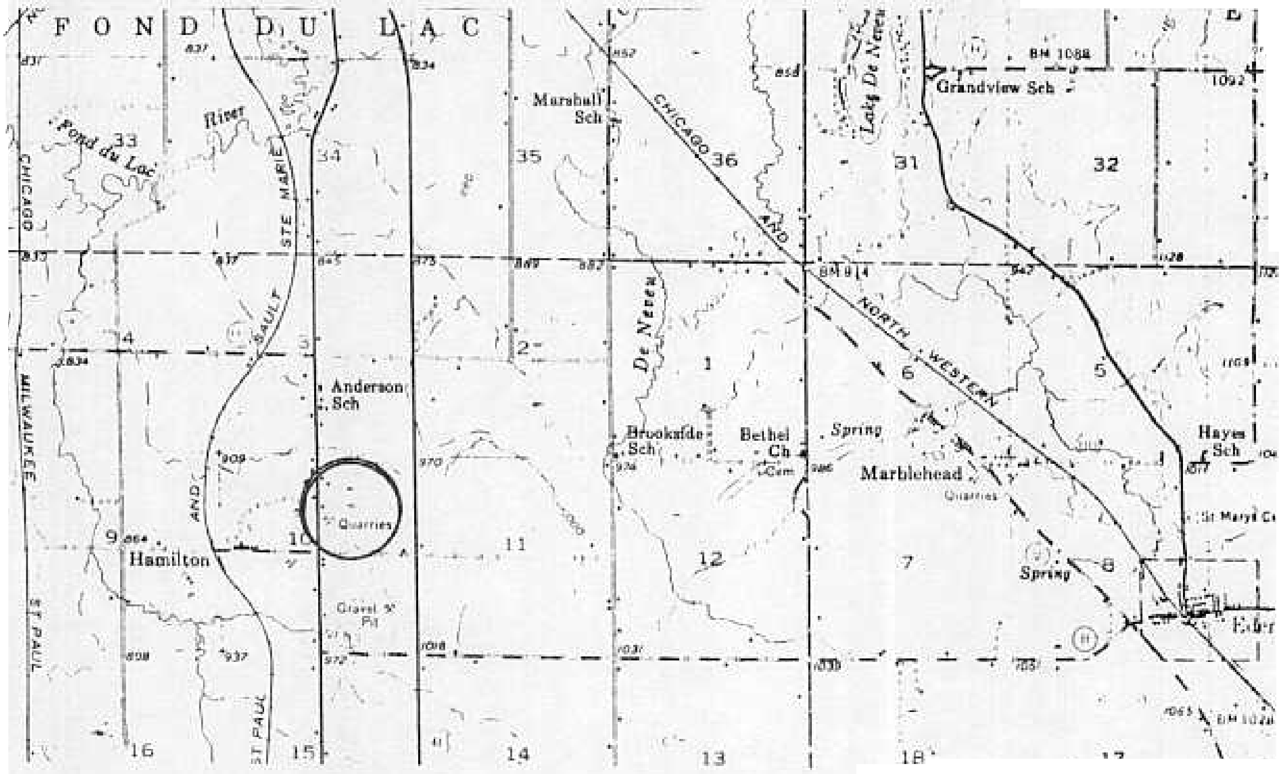
Title: Silurian dolomites of eastern Wisconsin

Location: Panetti Stone Quarry, NE¼, Sec. 10, T.14N., R.17E.
Get permission from John Panetti, Fond du Lac Stone Co
Fond du Lac, WI, (Phone: 414-922-4790).



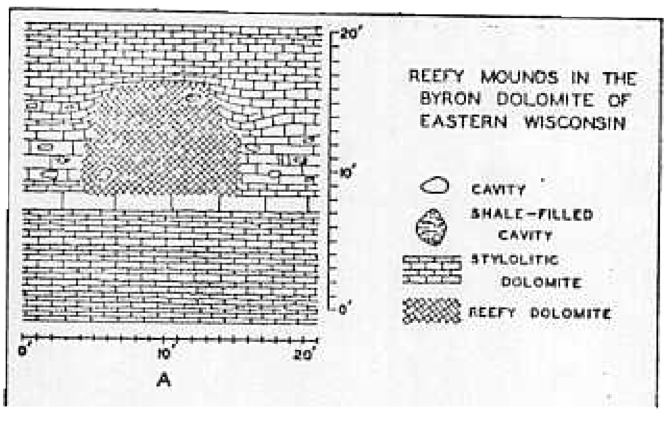
Author: Gene L. LaBerge (modified from Froemke, 1976)

Description: This quarry is in the lower part of the Middle Silurian dolomite. The Silurian in eastern Wisconsin consists almost entirely of dolomite which has been divided into six formations -- the Mayville, Byron, Hendricks, Manistique, Racine, and Waubakee Dolomites in ascending order (Ostrom, 1967). The formations exposed at this quarry are the Mayville Dolomite of late Alexandrian age and Byron Dolomite of Niagaran age. The Mayville is a thick bedded, cherty, fossiliferous, pink dolomite containing numerous domal structures generally believed to be "reef mounds" (bioherms). The bedding draped over the mounds produces the irregularities in the quarry floor. The Byron is a thinly bedded, semi-lithographic, buff to gray dolomite with scattered small bioherms (Shrock, 1939).

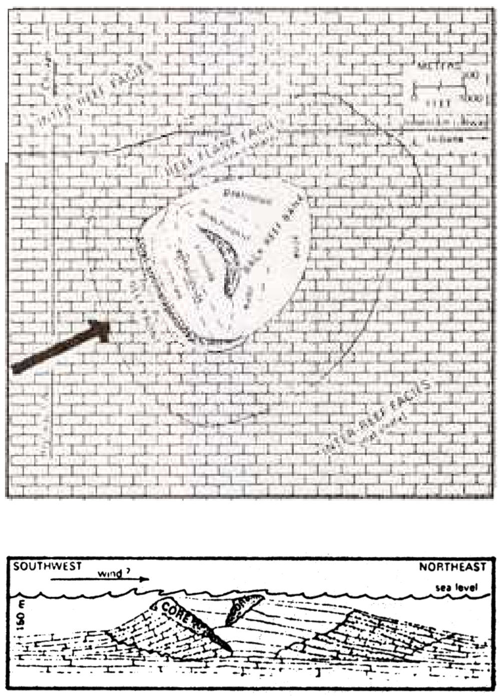
Blatt, Middleton and Murray (1972, pp. 410-411) define a bioherm as a mound of carbonate mud with larger skeletal fragments "floating" in the carbonate mud. Shrock (1939) described the Silurian bioherms in eastern Wisconsin as cuboidal, domal, or ridge-like masses of porous and cavernous crudely bedded, barren to highly fossiliferous dolomites that grade laterally and vertically into well-bedded dense to saccaroidal, relatively unfossiliferous dolomite. The bioherms range in size from mounds 10 feet high and 30 feet in diameter to ridge-like masses a quarter of a mile long. Those visible in this quarry are mainly small mounds of massive, clay-rich, unfossiliferous dolomite. One is visible on the south wall of the quarry; another on the west quarry wall. The bioherms are best developed in the upper part of the Mayville and lower Byron formations. Shrock (1939) concludes that they began forming in late Mayville time and continued growing into early Byron time.

The bioherms are different from typical Silurian reefs in that they lack the various reef facies. They may also form differently, or in a different environment than true reefs. In typical reefs (such as exposed in the Thorton quarry SE of Chicago (Ingels, 1963) and Quarry Park at Racine (Paull & Paull, 1977, pp. 170-171)), the various reef facies are revealed clearly by both lithology and fossil communities. Stromatoporoids and corals built the main wave-resistant core, while crinoids, mollusks and brachiopods dominated the back-reef and flanking deposits. During maximum development, the reefs assumed an atoll-like pattern (Ingels, 1963) restricting circulation in the Michigan Basin which resulted in accumulation of layers of salt as much as 100 feet thick. The Silurian contains the first coral reefs in the geologic record. In contrast, the diminutive bioherms exhibit little evidence of wave resistance, and also lack the facies characteristic of reefs. Furthermore, conclusive evidence of a rigid framework does not exist in most of the Silurian bioherms. Soderman and Carozzi (1963) suggested that the bioherms developed as a product of a constructing algae living in a relatively quiet, non-subsiding environment.

The diagrams illustrate the differences.



Diagrammatic cross-section of typical bioherm. (From Shrock, 1939.)



Diagrammatic map and cross-section of a typical Niagaran reef. Note difference between reef and bioherm. (From Ingels, 1963)

Question: If the bioherms are not reefs, what causes the massive mound-like structure?

At the Marblehead Quarry about 3 miles east of here, a highly fossiliferous horizon (a biostrome) approximately 20 feet thick extends laterally for hundreds of yards at the top of the Mayville. The most abundant fossils are internal molds of the pentameroid brachiopod *Virgiana decussata* (Whiteaves), along with algal stromatolites, simple corals and *Favosites* (Froemke, 1976). The biostrome is one of many at this horizon throughout the Great Lakes region (Ehlers & Kesling, 1947). They appear to have been shoals of brachiopod shells in relatively shallow parts of the basin variably bonded together by algal and coral growth. The genetic relationship between the biostromes and bioherms and coral reefs is not clear.

Along the west wall of the quarry are two structures in the Mayville Dolomite. The northernmost of these is triangular in the section exposed with the beds dipping inward to form a small syncline. The lowermost beds are brecciated and the fold narrows upward, terminating abruptly at the apex with flat-lying beds overlying the structure. The bedding within the structure is more apparent and appears to be thinner than in the adjacent dolomite. This feature is an excellent example of the "pitch and flat" structure we will examine in connection with the lead-zinc deposits in southwestern Wisconsin. Sketch the structure and compare it with one we will see near Platteville.

Several hundred feet south of the synclinal "pitch and flat" structure is a small tight fold in the thin-bedded dolomite. The fold plunges westward, and a small fault occurs near the axis of the anticlinal portion of the fold. Like the syncline described above, the fold dies out upward. What is the origin of these structures? Are they penecontemporaneous slump of carbonate mud off topographic ridges (bioherms?)? Are the later features produced by collapse of a cave in the underlying dolomite? The fact that the thin beds within the structures seem to be pulled apart vertically suggests that collapse of an underlying cave may be a more plausible explanation.

The dolomite in the quarries here has a variety of uses. The thin-bedded dolomite is broken along the bedding planes and then cut into blocks for building stone. The massive dolomite is not suitable for building stone, but is crushed and used for road or concrete aggregate. Some is also crushed to a fine powder and heated to convert it into lime and used for agricultural purposes. Lime is used as a soil conditioner to reduce soil acidity and to improve the texture of the soil.

Significance: The Silurian dolomites form a resistant unit up to six hundred feet thick that extends throughout eastern Wisconsin and continues eastward around the northern end of Lakes Michigan and Huron to Niagara Falls between Lakes Erie & Ontario. The dolomite overlies several hundred feet of Maquoketa Shale which is easily eroded. The western edge of the east-dipping dolomite forms an excellent example of a cuesta, with the ridge of dolomite bounded on the west by a broad lowland.

The Silurian dolomites here rest unconformably on the Maquoketa Shale, or Neda Formation of Late Ordovician age. The Mayville Dolomite is late Early Silurian (Alexandrian) age. Thus, most of the Early Silurian is missing in eastern Wisconsin (unless the Neda Formation is Early Silurian). The deposition of rather pure dolomite directly on shales on a regional erosion surface poses a problem. Why were no clastic sediments deposited in the Silurian seas in this area? Was the erosion of the underlying sediments done on a land surface? If so, why was the soft Maquoketa Shale still preserved? And why was dolomite deposited instead of clastic sediments when the sea again advanced over the area in Middle Silurian time? Was the erosion at the top of the Maquoketa accomplished in a submarine environment by an off-shore buckle roughly analogous to the Bahama Banks? If this was the case, a deepening of the sea to allow the accumulation of lime mud may account for the Mayville Dolomite resting unconformably on the Maquoketa.

Another interesting problem related to the Silurian (and other) carbonate rocks of Wisconsin is the origin of dolomites. Since dolomite does not precipitate in any appreciable quantity from sea water, the rocks must have been converted to dolomite from limestones. When were these rocks dolomitized? During, or shortly after, deposition? During diagenesis? During weathering? Silurian carbonates are not uniformly dolomitized, so age alone does not produce dolomite. Were these rocks initially limestones with an abnormally high magnesium content, making them more easily dolomitized?

Answers to these questions are not readily forthcoming, yet they are important to consider in explaining the nature and origin of these rocks.

References:

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