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GEOLOGY OF THE BARABOO GANISTER DEPOSITS

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The Baraboo district for many years has supplied large quantities of high grade ganister rock for the manufacture of silica brick. For a long period it has made Wisconsin the second state in rank in the production of this material. Pennsylvania has been first with two-thirds to three-fourths of the total used in the country, while Wisconsin has furnished approximately one-fifth. Quartzite is being produced for ganister purposes by the General Refractories Company and the Wisconsin Granite Company, whose quarries are located at Ableman, and by the American Refractories Company, whose quarry is at Devils Lake, and the Harbison-Walker Refractories Company, whose quarry is south of North Freedom. The following table of production gives the tonnage and value of ganister produced by Pennsylvania, by Wisconsin, and the U.S. total for the years 1918-1921 inclusive:

		Pennsylvania	Wisconsin	U.S. Total	
1918	Short tons	858,374	276,424	1,297,874	
	Value	$1,142,202	$303,760	$1,688,334	([illegible])
1919	Short tons	575,244	102,817	783,504	
	Value	$ 718,317	$116,996	$ 974,326	([illegible])
1920	Short tons	761,750	182,680	1,095,390	
	Value	$1,125,195	$216,609	$1,582,255	([illegible])
1921	Short tons	277,110	76,620	404,650	
	Value	$ 359,936	$ 90,254	$ 522,185	([illegible])

The distribution of this quartzite in the Baraboo region is indicated on the accompanying map. The quartzite forms high ridges surrounding a beautiful valley about 24 miles long and varying from 2 to 6 miles in width. The outcrops of this quartzite in this region are abundant and large so that the stripping problem in quarry operations is very minor.

Geology. The geology of the Baraboo quartzite has been best described in S. Weidman's Bulletin XIII of the Wisconsin Geological and Natural History Survey, published in 1904, and much of the descriptive matter has been taken from that report. Like practically all quartzite, this formation was deposited originally as sand on a shallow sea bottom. These original sand beds accumulated to a thickness of approximately a mile. Most of the beds were composed of very pure quartz sand with some few beds of less pure character which contained small amounts of clay. Toward the top of the formation, and in a few places throughout its thickness, conglomerates are found which are composed to a very large extent of clear quartz pebbles. This original sand

deposition was followed by a deposition of shale. This shale was a very fine-grained clayey material and accumulated to a thickness that is estimated at 500 to 1000 feet. At the present time none of this shale formation outcrops. It lies underneath the central portion of the valley together with the iron formation, and the formation which was deposited upon the shale. This upper portion of the Huronian series is now obscured by the Cambrian sandstones which form the surface rocks in the central portion of the valley. After the deposition of this material there followed the cementation of the sand grains by the filling of the interstices with pure quartz. Most of this quartz cement was ~~deposited~~ crystal in continuity with the sand grains so as to completely fill the pore spaces. The thin section under the microscope ~~sand of the lake~~ at the present time shows an irregular mosaic of quartz grains. Some of them, by reason of the fact that the original sand grains had a thin cover of iron oxide, still show the outline of the original grains, but most of the grains are so lacking in iron oxide covering that it is impossible to tell exactly what is the original sand grain and what is the added silica cement.

After the cementing of the sands to quartzite the beds which now compose the Baraboo ranges were up-heaved and folded into their present attitude. If you take a tablet ½" thick and fold one edge of it up vertically you will note that the upper sheets glide over the lower ones and readjust themselves to the new position. In this great mass of quartzite a mile

thick this readjustment between the beds had to take place. The beds containing the greatest amount of clay were naturally the weakest and consequently were the ones which yielded during the folding. ~~so that,~~ We have in the picture of the Van Hise rock the pure bed of quartzite to the right (originally the top bed of the two) and the somewhat more clayey quartzite to the left. In this latter bed is evident well developed schistosity, even though the original clay content was probably less than 5 per cent.

The folding to which this quartzite formation has been subjected is illustrated by the cross-section herewith, which was taken from Mr. Weidman's report. From this it will be noted that the beds on the South Range, which are those quarried at Devils Lake and to the south of North Freedom, have a rather gentle northward dip varying from 15 to 35 or 40 degrees, while in the North Range the beds are approximately vertical. This vertical dip is also shown in the photograph taken from Bulletin V of the Wisconsin Geological and Natural History Survey. This photograph was taken ~~from~~ below the east face in the gorge at Ableman. Similar ~~conglomerates~~ cliffs occur on the west side of this gorge, and also at Narrows Creek Narrows about 2 miles west of Ableman, and in the Lower Narrows of the Baraboo River about 6 miles somewhat north of east of Baraboo.

The original sand grains, of which the quartzite is composed, are well rounded and sub-angular in outline and are of

medium size. Probably the whole of these grains, if they could be separated, would go through a 30 or 40 mesh screen. The microscope shows in between these grains a complete filling of the interstices by crystalline quartz. There is a very small amount of iron oxide, chlorite and sericite in with the quartz grains. The color of the rock varies from a deep brick red to white, although there is very little of the white quartz present and it only occurs in verythin beds. In spite of the dark color, there is only a very small quantity of colored material. The predominant color is a rather grayish brown.

The great mass of this quartzite is strikingly pure in silica. At the base there are conglomerates and shale beds which make the quartzite impure for a thickness of a very few feet and the transition beds of Seeley slate which overly it are a mixture of quartz and slate, but these are a relatively few feet in thickness. Another notable peculiarity of this formation is the complete absence of alkalies. This lack of alkali also persists into the Seeley slate overlying, of which the following is a very careful analysis made by Dr. Victor Lenher of the University of Wisconsin and published in Weidman's bulletin:

Silica, SiO_2	62.03
Alumina, Al_2O_3	29.34
Ferric oxide, Fe_2O_3	trace
Ferrous oxide, FeO	5.09
Manganese oxide, MnO	none
Magnesia, MgO	0.29
Lime, CaO	0.16
Sodium oxide, Na_2O	trace
Potassium oxide, K_2O	trace
Water, at 110°, H_2O	0.01
Water, at red heat, H_2O	2.24
Titanium oxide, TiO_2	none
Phosphoric oxide P_2O_5	0.08
Chromium oxide, Cr_2O_3	none
Carbon dioxide, CO_2	none
Carbonaceous matter, C	none
Sulphur, S	0.10
	99.40

From this it appears that this slate is almost wholly made up of silica, alumina and ferrous oxide.

The following analyses of the Baraboo quartzite were also made by the same analyst in 1911. ~~and were published in Weidman's bulletin.~~ In all these analyses tests were made for alkalies and none found. In the note on these analyses the general stratigraphic position of the samples from which the analyses were made is given. These indicate that practically the whole of this formation is sufficiently pure in silica to be available for ganister. The samples that were collected for analysis were carefully taken to give very representative analyses of the localities selected. For this purpose a very considerable number of chips were taken from different parts of the outcrop or of the quarry and in the table of analyses appended the number of chips is indicated.

From this information it is evidence that there is a limitless supply of this material in the Baraboo ranges. As a matter of fact, the total amount of quartzite in this formation is measured by hundreds of cubic miles, and ever though much of it would be unavailable because of depth, the quantities that can be quarried easily are so vast as to be limitless no matter what calls may be made upon them.

	Loss on ignition	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO
1	0.28%	97.99	0.70 Fe=0.49	0.99	0.01	0.03
2	0.54	97.95	0.70 Fe=0.49	0.79	0.01	0.01
3	0.40	98.84	0.33 Fe=0.23	0.41	0.00 Less than 0.01	0.02
4	0.59	97.98	0.90 Fe=0.63	0.50	0.01	0.02
5	0.70	98.12	0.36 Fe=0.25	0.79	0.02	0.01
6	0.45	98.11	0.41 Fe=0.29	1.00	0.02	0.01
7	0.56	96.62	0.79 Fe=0.55	2.00	0.00 Less than 0.01	0.03
8	0.46	98.22	0.23 Fe=0.16	1.08	0.00 Less than 0.01	0.01
9	0.62	98.93	0.17 Fe=0.12	1.27	0.00 Less than 0.01	0.01
10	0.60	98.59	0.23 Fe=0.16	0.53	0.03	0.02
11	0.44	98.81 (Includes CaO, MgO)	0.08 Fe=0.06	0.67		
12	0.33	99.04	0.28 Fe=0.20	0.35		
13	0.51	97.17	0.97 Fe=0.68	1.35		
14	0.52	98.51	0.16 Fe=0.11	0.81		

1. American Refractories Co., Devils Lake. Taken from 4 cars, about 45 chips from each car. 180 chips. 1911, Quarry 500'-1000' from top of formation.

2. From ledge near center of quarry about 60-150 feet from railroad track at American Refractories Co. Devils Lake, Wis. 1911. 20 chips.

3. Specimens from Vilas Property, Devils Lake, 1911, 110 chips.

4. Samples from Claude Property, N. W. Corner Devils Lake. 1911, 73 chips. Within 500' of top of formation.

5. Mr. Kirk's Property, Devils Lake. 1911, about 50 chips. About the middle of the formation.

6. Specimens from Dyke Ringling's Property, Devils Lake. 1911, 45 chips. About the middle of the formation.

7. Sample from Hopkin's Quarry, Devils Lake, Wis. 1911. 65 chips. About the middle of the formation.

8. LeRue's Quarry at Ablemans, Wis. Rock ready for shipment. Harbison-Walker Co. From 1 car and pile. 1911. 90 chips. About 1500-2000' from top of the formation.

9. Sample American Refractories Co. Hultz Site, 1 mile south of Ablemans, Wis. 1911. 55 chips. Probably in upper part of formation.

10. Rattlesnake Den Site, Erswell Quarry Site, 1 mile south of LeRue, Wis. 1911. 65 chips. Near top of formation.

11. Sample from Riok Property, 1-1/2 miles southeast of Ablemans, Wis. 1911. 63 chips. Probably near top of formation.

12. Fleming Property, 1 mile south of Ablemans, Wis. 1911. 43 chips. From upper part of formation.

13. Sample from Quarry of Wisconsin Granite Co., Ablemans, Wis. Best hard rock. 1911. 58 chips. Near middle of formation.

14. Sample from the Narrows Creek, Narrows, 2 miles west of Ablemans, Wis. 1911. 109 chips.