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**SHARON CONGLOMERATE,
A SOURCE OF HIGH SILICA RAW MATERIAL**

by

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SHARON CONGLOMERATE, A SOURCE OF HIGH SILICA RAW MATERIAL

By J. OSBORN FULLER
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One of the most important rock formations in Ohio from the industrial standpoint is the Sharon conglomerate. It contributes essential products to the great steel industry in this and adjacent states in the form of molding sands and of pebbles for ferrosilicon and silica brick. Sand and gravel are divided into constructional and industrial material depending upon whether they are relatively impure or pure. The Sharon conglomerate, because of its high purity and ready workability is a premium material for industrial uses. Its production rose to a record high during the war although constructional sand and gravel production decreased after the flush of government-sponsored construction leveled off. Since the war, operators have been faced with uncertain markets but the long term outlook is extremely favorable. Some operators are looking for other properties to supplement their present supply

and several new operators are studying the field with the idea of opening new pits.

Figure 1 taken from the most recent

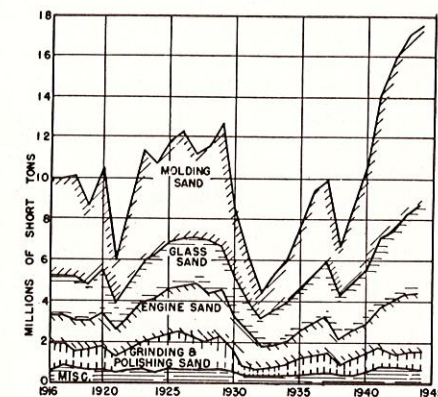


FIG. 1.—Production of industrial sands in the United States, 1916-1944.

*Minerals Yearbook*¹ indicates that the greatest expansion in production of industrial sands in the United States has been in glass sand and molding sand. Sand from the Sharon conglomerate has contributed materially to the expansion in molding sand but the use of Sharon for glass sand has continued to be limited because of the presence of limonite.

Location of Deposits

The Sharon conglomerate is the basal member of the Pennsylvanian System in Ohio except in the central part of the

state where the Sharon is absent and younger formations lie at the contact with the underlying Mississippian rocks. Sharon conglomerate is not exploited along the whole of its outcrop but is quarried in quantity only in northeastern and southern Ohio, near the two extremes of the contact as shown in Fig. 2. Some concept of the magnitude of exploitation can be obtained from Table I in which the figures are taken from the *Annual Quarry Report* for 1945.² The table is neither complete nor wholly accurate. Several companies did not report their tonnage and other companies recovering the pebble

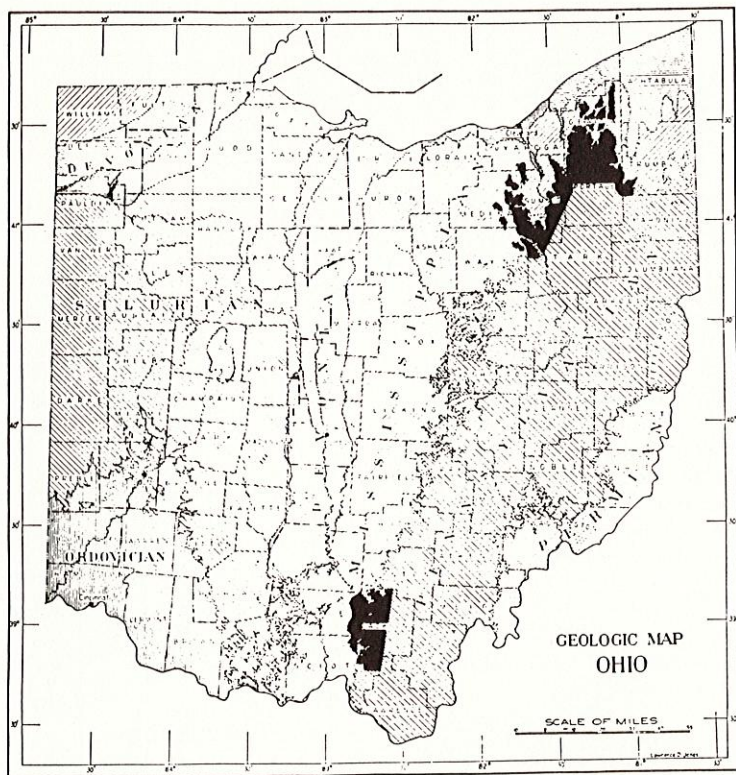


FIG. 2.—Black areas indicate outcrops in regions where Sharon conglomerate is worked extensively.

¹ C. E. Needham, *Minerals Yearbook*, U. S. Bureau of Mines, 1944, p. 1292, Fig. 4.

² *Annual Coal Report* with Directory of Coal

Operators and *Annual Quarry Report* with Directory of Reporting Firms, Department of Industrial Relations, Division of Labor Statistics, Columbus, 1946.

have not been disposed to report their coarse product as sand. It seems certain, however, that the total production of Sharon conglomerate for industrial uses is well over 700,000 tons per year. Table I

TABLE I
PRODUCTION OF SHARON CONGLOMERATE FOR SAND IN PRINCIPAL PRODUCING COUNTIES, 1945

	Silica Sand	Molding Sand	Misc.
<i>Northeastern Ohio</i>			
Geauga Co.	33,844	12,979	20,976
Portage Co.	361,880	.....	.....
Summit Co.	74,250	.....	70,885
<i>Southern Ohio</i>			
Jackson Co.	58,299	.....	.....
Pike Co.	59,978	.....	.....
Scioto Co.	2,065	.....	16,298
Grand Total	590,316	12,979	108,159

also erroneously suggests a uniformity of character and use each of which is in reality quite variable, as will be shown in the discussion to follow.

Pebble Rock

The formation called Sharon conglomerate is composed dominantly of sandstone with numerous scattered pebbles and some limited conglomerate zones. To avoid confusion in this paper the name Sharon conglomerate will be used when talking about the formation as a whole and sandstone and conglomerate or pebble rock will be used in talking about the two parts.

Pebble rock is confined to scattered beds which are most abundant near the base of the formation and to fairly thick, linear belts of conglomerate spaced miles apart which are in stream-like troughs or depressions of the erosion surface formed on the Mississippian beds. The scattered beds extend for considerable distances beyond the main pebble zone out into the sandstone areas. These relations are shown in Fig. 3.

The conglomerate is almost pure quartz, made of rounded quartz pebbles averaging from 1/8 to 3 in. in size. Larger pebbles may be found, the largest ever seen by the

writer being found near the base of the formation in the Miami Sand and Gravel No. 1 pit in Pike County. This was a quartzite boulder 8 in. wide and 15 in. long, weighing 47 lbs. The pebbles are generally white, although pink, rose, gray, and black are often found. Less abundant but more significant are pebbles of quartzite, sandstone, fine textured conglomerate, highly weathered limestone or dolomite,

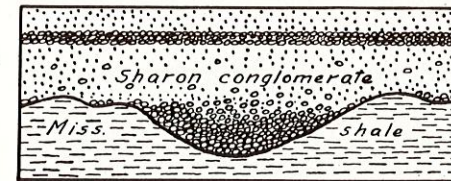


FIG. 3.—Diagram of relation of pebble phase and sandstone phase of the Sharon conglomerate to the Mississippian rocks.

and honeycomb coral. These indicate that a sedimentary series was at least part of the source for the clastic material of the Sharon conglomerate.

Sandstone

Sandstone covers the greater areas of Sharon conglomerate outcrop and makes up the bulk of the formation. Usually the sandstone contains a few scattered pebbles and a few conglomerate beds varying in thickness from 2 ft. to one pebble. On the whole the sandstone is medium to coarse grained but a few beds are fine grained, especially near the top of the formation. Because of its purity the sandstone is white to light gray on a fresh surface in the lower part of the formation but there is enough iron present or derived from overlying beds to give the upper part of the formation and the weathered rock a limonite-stained color varying from yellow to brown.

Cross-bedding

One feature of both sandstone and conglomerate is the presence of cross-bedding in most beds. A striking feature of a weathered surface is the sweep of the

cross-beds reaching a maximum of 5 or 6 ft. across a 2-ft. bed. The bulk of the formation has cross-bedding 18 in. or less in thickness as shown by Fig. 4.

The direction of the significant dip of the cross-bedding is to the northwest in southern Ohio and to the south in northeastern Ohio. These directions are parallel with the trend of the conglomerate belts and the two indicate the direction in which the source beds of the Sharon conglomerate are located.

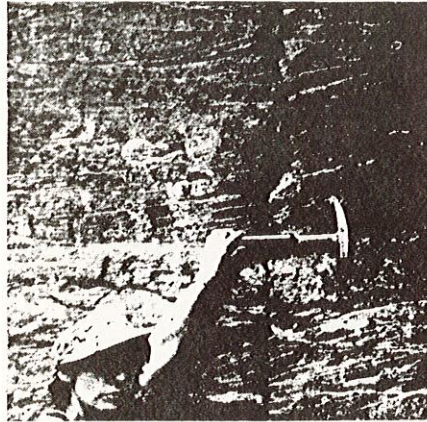


FIG. 4.—Typical cross-bedding in the Sharon conglomerate near Boone Cave, Jackson, Ohio.

The concept that the Sharon material is derived in part at least from erosion of a sedimentary series and that the northeastern Ohio Sharon material came from the north and the southern Ohio Sharon material came from the southeast are new in the literature.

Thickness

The maximum thickness of Sharon is comparable in the two areas. In northeastern Ohio a thickness of 175 ft. has been measured near Parkman and in southern Ohio 200-ft. sections are easily obtained. Not all of this material is quarried and at no place are there quarry faces of this height. In southern Ohio the pebble is more in demand and, therefore, the lower part of the formation is usually

the desirable part. Most quarry faces are 20 to 60 ft. high. In northern Ohio less relief along the outcrop has resulted in quarry faces averaging 15 to 40 ft.

Composition

The conglomerate and sandstone with 95 to 99 per cent silica are extremely pure for clastic beds. From the standpoint of quantity and effect on use of the formation the two most important impurities are alumina and iron oxide. In the field, the alumina appears as clay minerals in two forms. Some of the cementing material is clay matter but more important are the clay masses found in both conglomerate and sandstone phases. The argillaceous masses consist of a blue-gray to brown clay which grades into a poorly consolidated and slightly laminated shale of similar character. The only apparent difference between these two is



FIG. 5.—Clay masses in the Sharon conglomerate. The large mass 2 feet above the hammer is shale while most of the other are rounded clay masses like the one at the point of the hammer.

the presence of fine sand laminations in the shale. Because clay is the predominant material, both types hereafter will be referred to as clay masses. In size they range from pieces a fraction of an inch in diameter to lenticular masses 4 to 6 ft. long and a foot thick as shown by Fig. 5. Within the longer masses the bedding is

usually parallel with the length of the mass but some larger, more rounded masses show evidence of contorted bedding as though squeezed during movement. Orientation with respect to the bedding in the Sharon is notably lacking and the masses lie at any angle to the main bedding.

The clay masses apparently represent quiet water deposits formed and swept up en masse in time of storm before complete consolidation and then deposited as though they were pebbles along with the quartz pebbles.

In quarrying operations the larger clay masses are removed before hauling to the

plant. If roughly handled they break up and add to the smaller pieces already present with the result that considerable clay is sent to the plant. This, in part at least, accounts for the variation in alumina between the samples shown in Table II. Washing will remove part of the clay as is illustrated by the drop in alumina between Specimens 9 and 10 of Table II which represent unwashed and washed samples respectively from the same location.

The next most important impurity is ferric oxide which appears as limonite. It is a minor impurity in clean samples taken

TABLE II
ANALYSES OF SHARON CONGLOMERATE SPECIMENS*

Weight Content (in per cent)	Southern Ohio			Northeastern Ohio									
	Unwashed Sample Nos.											Washed	
	1	2	3	4	5	6	7	8	9	10	11		
Silica SiO ₂ . . .	99.06	98.60	96.19	97.91	98.54	97.41	98.29	95.99	98.31	99.33	98.14		
Alumina Al ₂ O ₃ . . .	0.49	0.45	2.22	0.51	0.28	0.58	0.69	1.97	0.39	0.10	0.16		
Ferric oxide Fe ₂ O ₃	0.14	0.37	0.20	0.44	0.24	0.31	0.18	0.35	0.31	0.009	0.35		
Calcium oxide CaO	0.01	0.10	0.00	0.05	0.01	0.11	0.00	0.09	0.09	0.07	0.38		
Magnesium oxide MgO	0.01	0.00	0.03	0.06	0.01	0.00	0.00	0.00	0.04	0.05	0.05		
Titanium oxide TiO ₂	0.05	0.05	0.18	0.05	0.07	0.09	0.04	0.27	0.08	0.09	0.08		
Alkalies	0.08	...	...	...	...	...	...	...	...	...	...
Sodium oxide Na ₂ O . . . . .	...	...	...	...	...	0.04	...	...	...	...	...
Potassium oxide K ₂ O . . . . .	...	...	...	...	...	0.08	...	...	...	...	...
Loss on ignition	0.26	0.30	0.65	0.32	0.29	0.44	0.28	0.62	0.26	0.15	0.31		

1. From mine at Limerick Pit, Davis Fire Brick Co., Oak Hill, Ohio (Courtesy of Davis Fire Brick Co.)
2. Jackson County—Chips from quarry face, Buzzard Rocks Cliff.
3. Jackson County—From samples of uncrushed rock, Jackson Sand Mining Co., 2 miles north of Coalton.
4. Summit County—Chips from 50-foot face, Boston ledges.
5. Summit County—Chips from quarry face, Bramley Quarry, Copley.
6. Summit County—Chips from 45-foot ledge, Summit Silica Co., near southern border of Barberton.
7. Summit County—Chips from lower part of quarry, Bedford Silica Products Co., N.E. quarter Northfield township.
8. Trumbull County—From samples of unwashed sand, The Trumbull Stone & Sand Co., 5½ miles west of Warren (B. & O. R. R.)
9. Mahoning County—Samples of unwashed glass sand from National Sand & Stone Co., 2 miles south of Mineral Ridge.
10. Mahoning County—Samples of washed glass sand, same location as No. 9.
11. Portage County—Samples of steel molding sand, Portage Silica Co., on Erie R. R. in eastern part of county, about midway between Garrettsville and Phalanx.

* Analyses (except Sample No. 1) selected from J. A. Bownocker, "Glass Sands and Molding Sands," *Ohio J. Sci.*, 21, 23, 26.

well below the surface as shown by the mined sample, number 1 of Table II, but surface samples contain a greater percentage of the mineral. Much of the limonite seems to be added to the rock by underground water which percolates through overlying mantle and rocks, removing iron in solution and depositing it as a surface coating of the Sharon grains or partially filling the pore space. Some zones become so well cemented that they are quartzitic rocks. Blocks high in limonite are discarded in quarrying and high limonite-bearing areas are avoided. The rapid variation in iron oxide content from one part of the quarry to the next and from quarry to quarry, as shown by Table II, has discouraged much use of the Sharon conglomerate for glass. Many former producers who used Sharon for poor grades of glass abandoned their Sharon quarries.

TABLE III
RECENT COMPLETE ANALYSES OF SHARON
CONGLOMERATE
(Analyst: Downs Schaaf)

Weight Content (in per cent)	Samples from Geauga County		
	1	2	3
Silica, SiO ₂	97.17	99.07	97.32
Alumina, Al ₂ O ₃	0.75	0.14	0.80
Ferric oxide, Fe ₂ O ₃	0.27	0.15	0.16
Ferrous oxide, FeO	0.35	0.09	0.22
Pyrite, FeS ₂	0.01	0.00	0.01
Magnesium oxide, MgO	0.20	0.03	0.21
Calcium oxide, CaO	0.38	0.22	0.40
Sodium oxide, Na ₂ O	0.09	0.01	0.10
Potassium oxide, K ₂ O	0.16	0.02	0.18
Water, hygroscopic, H ₂ O —	0.12	0.04	0.12
Water, combined, H ₂ O + Carbon dioxide, CO ₂	0.19	0.04	0.20
Titanic oxide, TiO ₂	0.15	0.16	0.14
Zirconium oxide, ZrO ₂	0.05	0.03	0.05
Phosphorus pentoxide, P ₂ O ₅	0.01	.....	0.01
Sulfur trioxide, SO ₃	0.08	0.01	0.06
Manganous oxide, MnO	0.01	0.00	0.01
Carbon, organic, C	0.015	0.01	0.01
	0.01	0.09	0.01

1. Leggett's Pit, ¼ m. south and east of Montville.
2. Pit of Leon D. Fredebaugh, ¾ m. south of Thompson.
3. Sidley's Pit, 2 m. south of Thompson on east side N-S road.

That simple washing sometimes reduces the iron oxide content to well within the maximum allowable percentage for better grades of glass is suggested by comparing unwashed sample 9 with washed sample 10 from the same quarry. Other beneficiation techniques should be explored because the high silica content indicates a potentially good glass sand.

The writer believes that careful quarrying and a beneficiation program would readily remove the free clay and relatively free limonite, thus reducing the alumina and iron oxide content to such an extent that the Sharon would be a high-grade glass sand.

Table III presents some recent and more comprehensive analyses of the Sharon conglomerate on file in the Geological Survey of Ohio.

Quarrying and Mining Methods

The bulk of Sharon is quarried from open pits. Both conglomerate and sandstone are so porous and friable that hammer blows will usually free the pebble or grains from each other and quickly reduce them from solid rock to their unconsolidated equivalents. A load of pebble or sand can easily be obtained with a sledge and shovel. In the larger quarrying operations the procedure for breaking the rock into usable sizes is fairly standard. A description of one operation will illustrate the general procedure. With a light, standard rig, 6-in. holes are drilled 10 to 20 ft. back from the face and from 15 to 20 ft. apart. When the drilling is completed along a whole face the holes are loaded with 5-in. dynamite and shot. After the explosion, most of the material is small enough to be loaded with a power shovel into cars or trucks for movement to the plant. A few larger blocks must be drilled and shot before loading. In some quarries, where cementing by limonite due to later groundwater circulation has been great, some large blocks are very hard and are discarded rather than shot. Further crushing before processing is usually done in a gyratory crusher at the plant and

from then on the process used depends on the ultimate use of the product.

In southern Ohio several operators have drifted into the side of a hill to extract pebble. This type of operation has been used where the overburden on a good pebble deposit has been too thick for economical removal. When the overburden is heavy, ground water has not brought in limonite and the product is very pure making the above type of operation advantageous. In Table II analysis No. 1 represents a mine sample.

Early Uses

Undoubtedly the first use the early settlers made of Sharon conglomerate was as an aquifer. Springs at or just above its contact are characteristic because the open textured Sharon lies on relatively impervious Mississippian shale or fine grained sandstone. These springs are still very important to numerous farms because, although they are seldom very large, they flow continuously throughout the summer. At present water from abandoned Sharon coal mines is being used for city and industrial supply in the Youngstown region.³

As log buildings were replaced by more permanent buildings, the sandstone phase became important as a foundation stone and building stone. Many small, long abandoned quarries for this type of product dot the landscape of Sharon outcrop.

The pebble phase of the Sharon conglomerate has had continuous use for driveways and roads. One famous user was John D. Rockefeller who, about 1912, had loose Sharon gravel shipped to his Cleveland home from the town of Scotland, 17 miles to the west.⁴ The clean, easily quarried conglomerate is used extensively by numerous counties for road metal. When mixed with a little clay or shale which acts as a binder, it makes a

³ J. O. Fuller, "Alleviation of Mahoning Valley Water Shortage," NEWS, June, 1942, p. 38.

⁴ C. S. Prosser, "The Devonian and Mississippian Formations of Northeastern Ohio," Geological Survey of Ohio, 4th series, Bul. 15, 193 (1912).

fine, cheap road material. Numerous medium-sized quarries of Sharon conglomerate, worked intermittently for this purpose, are found in both northeastern and southern Ohio. Bridges and bridge foundations of Sharon conglomerate are still abundant in the regions of the outcrop.

During the first 10 years of this century Sharon conglomerate was quarried in many locations in the state to produce window, light bulb, bottle and fruit jar glass. Sharon is now used in the production of roofing granules, and glass sand for light bulbs is a by-product of the process.

Present Uses

As the country developed industrially, demand for high silica sand and gravel increased and new uses developed. A shift from many small quarries toward larger quarries on the more favorable of the known locations took place. The companies concentrated their operation toward producing one type of product. In the process other grades of material resulted and were marketed as by-products. The by-product business supplied the established demand for Sharon for driveway gravel, engine sand, sodium silicate and glass sand and new minor uses were developed such as filter bed sand, abrasives, and gravel for gravel finished stucco.

The larger quarries are, however, mainly interested in recovering either molding sand or pebble for making ferrosilicon, silica brick, or roofing granules. The largest operation in northeastern Ohio is the plant of the Industrial Silica Co. at Phalanx, Ohio. Thousands of tons of molding sand are shipped out daily after being washed and classified. Before the depression, the company mined the pebble phase of the Sharon conglomerate and then crushed and sold it for sand blast. The quarry developed northward to follow the pebble phase. When the call for sand blast decreased and the demand for molding sand increased (especially during the war), the company shifted from sand blast to molding sand and has been quarry-

ing westward where the formation has less pebble. Another quarry in the pebble-free sandstone also has been opened.

In southern Ohio the greatest quantity of Sharon quarried is used in making ferrosilicon. The pebble phase must be quarried for this purpose, and washed and screened to give a product over $\frac{1}{2}$ in. Several operators are producing pebble for this purpose and over 20,000 tons leave southern Ohio monthly for steel plants.

The pebble phase is used by several companies both in southern and north-eastern Ohio for the production of silica brick. Since good pebble size and a very pure product are desirable, some companies in southern Ohio have found it profitable to drift mine along coarse pebble zones.

In northeastern Ohio the pebble phase is the raw material of a roofing granule plant of the Minnesota Mining and Manufacturing Co., 6 miles west of Akron near Copley, Ohio. The plant is operated on an outlier of Sharon conglomerate which is quarried, crushed, washed, and classified. The material between -10 and +28 screens is coated with iron oxide, chromic oxide, or titanium oxide to give, respectively, the red, green, and

white granules for roofing shingles. The granules are shipped to various supply houses which manufacture the shingles and Sharon coated granules cover many roofs in this region.

A new use for the Sharon has recently been developed by Walter Best of Chardon, Ohio who is quarrying a sandy pebble phase of the formation and is making concrete block. The material is washed and screened but practically the whole quarry product is used and the only addition is cement. The blocks are very light gray to white in color and have a better appearance and higher strength than most concrete block. Because of the character of the raw product and simplicity of the operation they are sold at the same price as other concrete block.

The scenic value of Sharon outcrops has long been recognized and numerous state and city parks are located along the outcrops. Recently there has been a big boom in scenic land around Akron and Cleveland where people are paying as much as \$500 an acre for the ledges, gorges, and waterfalls found in the country along Sharon outcrops. Many possible quarry locations have been removed from the market by this demand.