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A comparison of Missouri sandstones

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A COMPARISON OF MISSOURI SANDSTONES.

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THESIS

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OUTLINE FOR THESIS ON MISSOURI SANDS.

A COMPARISON OF MISSOURI SANDSTONES.

INTRODUCTION.

Because of the scarcity of fossils in sandstones, the ages of these stones are difficult to determine except by the fossil bearing rocks either above or below them. Consequently, sandstones, even of the same area, are often separated and correlated with difficulty. It is for this reason that an effort is made to determine a means by which each sandstone may be identified.

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METHODS.

Granulation of the Sand.

In most of the work undertaken in this paper, it was desirable that the rock be granulated without fracturing, so that the individual fragments might be studied. Those samples which were but slightly cemented could often be granulated without fracturing the grains by rubbing them lightly between wooden blocks, while many of those which were firmly cememted could be treated in this manner after they had been heated to a white heat in an assay muffle and allowed to cool.

In the following pages sandstones are considered in respect to the size and rounding of their grains and their cementation and impurities.

Sizing of Sand Grains.

The size of the quartz grains is a method by which two or more sands may be separated. Some sandstones are made up of large, fairly uniform grains, some of small grains, while again the size of grains in some sands will vary considerably. In places they will be very fine-grained, while in others the grains will be considerably coarser.

Sandstones which could be granulated successfully were screened, (30-40-60-80 and 100 mesh screens being used for the purpose), and the relative sizes of the grains determined in this way.

Rounding of Sand Grains.

The degree to which the quartz grains have been rounded is another possible means of identifying a sand. Some grains are fairly angular, and upon close inspection they can be recognized as almost perfect quartz crystals, while others show no crystal faces at all. The surface of the rounded forms is usually pitted and shows other evidences of abrasion.

No thin sections were made of these samples, so that it was impossible to say to what extent the crystal faces were due to secondary growth, but it is probable that they are largely secondary. Difference in degree of rounding then is more or less synonymous with the degree of cementation.

Degree of Cementation.

The degree of cementation determines to a large extent the hardness of the rock. If one sandstone was known to be of uniform hardness throughout, its degree of cementation would be readily determined, and this might serve as a definite characteristic of that rock. But the rocks of this region vary so much that this criteria is of very little value in differentiating them.

Presence of Foreign Material.

The presence of foreign material in sands can be determined by a chemical analysis or by means of specific gravity solution. In the latter method two solutions of mercuric iodide and potassium iodide were used, one of a specific gravity a little higher than that of quartz, about 2.67, so that the quartz and anything lighter would float, and the heavier substances sink; and the other just high enough, about 2.63, that the quartz would sink and the lighter substances float. This operation was performed in a Penfield tube, and the specific gravity of the solution determined by a Westphal balance.

ROUBIDOUX SANDSTONE.

The Roubidoux sandstone varies in color from a white to a brownish red. In general the color is a dirty white or a brownish red. Where exposed at the surface, it usually consists of sparkling quartz grains heavily stained with iron.

The rock varies in degree of cementation from a loose friable sandstone to a compact quartzite, the former being characteristic of the main mass, and the latter the result of case hardening at the surface. The loose material can be readily crumpled by the fingers, while the harder specimens can be disintegrated only by heating to a white heat.

When broken down the sand grains have a dirty white or colorless appearance, and as a rule are fairly fine grained, tending to be coarser near the upper part of the formation.

The result of several screen analyses is as follows:

	On 30	mesh	10%
Thru' 30	" 40	"	25
" 40	" 60	"	50
" 60	" 80	"	1
" 80	" 100	"	6
	Thru' 100		8

It can be seen from this that the grains are fairly uniform in size as fifty per cent will pass thru' 40 and remain on 60 mesh. A strange thing, however, is that only one per cent will remain on 80 mesh while fourteen per cent will pass thru' it.

The individual grains are almost colorless, but may be somewhat coated by iron oxide. They are almost perfect crystals, and show little evidence of abrasion, due probably to crystal growth.

The Roubidoux contains but little foreign matter except chert. The presence of this chert is one of the characteristics of the stone, and will be found in all parts of the Roubidoux.. The chert particles grade in size with those of the quartz except that they are slightly larger. The quantity and size increase in the upper horizons of the formation.

Three chemical analyses give the following results:

	#1	#2	#3
Moisture	.07	.03	.06
Ignition Loss	.22	.13	.18
SiO_2	98.78	99.3	99.19
Fe_2O_3	.13	.08	.09
Al_2O_3	.29	.10	.33
CaO	.01	.04	.01
MgO	.03	.02	.02
	99.53	99.70	99.88

ST. PETER SANDSTONE.

The St. Peter sandstone is in general a very friable sandstone made up of clear, colorless quartz grains, but in places may become grey, red, or brown and quite thoroughly cemented like a quartzite.

The grains are of a uniform size and well rounded, showing evidences of abrasion. A close examination often shows crystal faces, probably secondary. The grains are partially cemented by silica, which is commonly just strong enough to keep the grains together, but may be sufficient to form a hard, resistant rock.

Several screen analyses give the following:

		On	40	mesh	23%
Thru	40	on	60	"	61
"	60	"	80	"	0
"	80	"	100	"	7
"	100				9

It is here noted that 84 per cent will remain on the 40 and 60 mesh, showing that the greater portion of the grains are of uniform size.

As a rule there are but few foreign materials to be found in this sandstone, and then chiefly iron oxide. This is characteristic of surface exposures, and in places the resistance of erosion offered to the iron has caused it to appear as little nodules on the surface. No chert was found.

Chemical Analyses.

Moisture	.16	.07	.03
Ignition Loss	.45	.1[illegible]	.2
SiO_2	98.06	99.17	99.15
Fe_2O_3	.34	.14	.16
Al_2O_3	.76	.23	.42
CaO	.04	.02	.04
MgO	.04	.03	.03

CARBONIFEROUS SANDSTONE.

Local.

This sandstone is characteristically friable and colorless, but at points of exposure it becomes thoroughly cemented by the introduction of quartz and iron, the latter giving it a reddish color, and where its distribution is uneven, a rough, pitted surface.

The grains are not uniform in size, as in some samples they will almost all pass thru 100 mesh, while in others they have approximately the same ratio as the Roubidoux, 60 per cent remaining on 60 mesh.

The grains are often well worn, with pitted surfaces, but some still retain good crystal form.

Chemical Analyses.

Moisture	.06	.06
Ignition Loss	.19	.20
SiO_2	99.43	99.49
Fe_2O_3	.18	.13
Al_2O_3	.1	.11
CaO	.03	.05
MgO	.01	.01

Northern Missouri Sandstone.

This is a heavy argillaceous sandstone containing much clay, iron oxide and some mica. The color is a dark grey which turns toward a brown when the material is ground finely. The iron oxide it contains is free, not acting as a cement, but occurs as small modules which seem to be bunched together.

The cementing material is soluble in acids, and is either the clay or a little calcium carbonate, or both. It makes a fairly hard, resistant sandstone.

The quartz grains, when separated from the clay, are white and are very fine, all passing thru' 100 mesh. They have good crystal form and show little evidence of abrasion.

Two chemical analyses give the following results:

Moisture	.32	.27
Ignition Loss	2.13	2.13
SiO_2	79.59	81.08
Fe_2O_3	3.06	3.28
Al_2O_3	10.7	9.66

Chemical Analyses, Cont'd.

CaO	.43	.41
MgO	.43	.39
$CaCO_3$	(.2)	(.14)
$MgCO_3$	(.52)	(.5)

CONCLUSION.

Between the Roubidoux and the St. Peter sandstones practically the only similarity is the almost uniform size of the grains and the presence of iron. The colors of the two are somewhat different. Where the sands are white, the St. Peter is more of a milky white while the Roubidoux is glassy white. There also seems to be some difference in the makeup of the sandstones, as the St. Peter seems to be just a mass of quartz grains loosely cemented, while the grains of the Roubidoux seem to be more evenly arranged according to size.

The chief differences, however, between the two sands are the degree of rounding of the grains.

The Roubidoux shows no evidence of abrasion while the St. Peter is well rounded. The presence of chert in the Roubidoux is another difference between it and the St. Peter, where there is none.

The Carboniferous sands are distinctly different from either the Roubidoux or the St. Peter. The sand grains are not uniform, and may also show evidences of abrasion at one point while at another point such evidences may be lacking. In northern Missouri the sands carry large amounts of argillaceous material, the grains are very fine, and show no evidence of abrasion.

Taking sandstones as a whole, these are so few things that are characteristic of any one of them, and they are alike in so many respects, that it is almost impossible to distinguish them with certainty. Almost invariably the sands are made up of quartz grains, a little argillaceous matter, and varying amounts of iron. The size of the grains is something that is liable to vary anywhere, and because they are fairly uniform in one section, it is no sign that they would be uniform throughout an entire region. The iron and argillaceous content are likewise apt to vary, and other substances might come in on one region and be absent in another. The rounding of the grains would be the best method by far for distinguishing sandstones, but that might vary in different localities. So taking everything into consideration, the differences that arise and act as a means of identification in one region, would probably be of no use in another. Because of these facts, the few points brought forward in this thesis would probably not be of much use in regions outside of the immediate vicinity from which the samples came.