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INSOLUBLE RESIDUES OF THE MADISON SANDSTONE

by

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INSOLUBLE RESIDUES OF THE MADISON SANDSTONE

BY

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A STUDENT F. E. R. A. PROJECT

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1935

INTRODUCTION

Contents and purpose:

The following report is a summary of the insoluble residues found in the Madison sandstone. This research problem was made possible by the student Federal Emergency Relief Administration and was supervised by Mr. E.F. Bean, State Geologist, and by Dr. R.R. Shrock, Assistant Professor of Geology at the University of Wisconsin.

The problem is a continuation of the field work done by Mr. B.E. Karges in 1934 under the Civil Works Administration. Mr. Karges made a survey of the reserves of the Madison sandstone of suitable quality for building stone in the vicinity of Madison. He collected the samples which were used in the research done by the author. The numbers of the samples in this paper are the same as those used by Mr. Karges. His report should be used in conjunction with this one. A map at the end of this paper gives the field locations from which Mr. Karges collected the samples. The numbers refer to the location numbers of the report.

Method of procedure:

A macroscopic description of each sample was the first step in the laboratory work. Then about twenty-five grams of each specimen were weighed, crushed, and placed in a 250 cc. beaker. Hydrochloric acid of a one to one concentration was added until each beaker was about half full. This usually stood over night or until there was no further chemical reaction of the constituents. After all the insoluble substance had settled to the bottom of the beaker, the acid was decanted. The residue was washed several times to eliminate all the remaining acid.

The residue was divided into the silt-clay fraction and the sand fraction by straining through a 200 mesh screen. This is not an accurate method of division, as a 200 mesh screen has a 1/14 mm. size screen opening, while the largest silt dimension, by definition, is 1/16 mm. A very small amount of sand, therefore, may be considred to occur in the silt-clay fraction. The sand remained on top of the screen and was then transferred to watch glasses of known weight. The water was siphoned from the beakers which contained the silt and clay. These beakers and watch glasses were placed in an oven for the purpose of evaporating all the moisture. They were then weighed, and the actual weights of the two types of residues were figured. From these values the percentages of each of the silt-clay fractions and of the sand fractions were calculated.

A microscopic examination and description of the sand was made in reflected light under a binocular microscope.

For the purpose of distinguishing quartz from feldspar, a petrographic microscope was used. Quartz was the most dominant mineral. In many sections feldspars were found, but they were not very abundant in any one section. A few grains of the feldspar possess albite twinning, while others have the type of twinning that is characteristic of microcline. Most of the feldspar grains have euhedral shapes and are thus probably authigenic. A few other feldspar grains have a zoned structure. The latter usually contain a feldspar nuclei with a cryptocrystalline structure encircling them. The zoned feldspars appear to be anhedral and are probably detrital. No attempt was made to classify the various feldspars.

Dane County
February 5, 1935

Location No. 1

The N.W. ¼ of the N.W. ¼ of Sec. 19, T. 7 N., R. 9 E.

LOCATION NO. 1

1. Sample # H1

Macroscopic description of sample: Very hard, firmly cemented, gray, quartzitic sandstone.

Description of residue: 95% insoluble. No measurable amount of silt and clay. The sand is a pale grayish color. It is composed of quartz grains which have a medium and rounded texture. There are a few slightly rounded euhedral quartz crystals.

2. Sample # H2

Macroscopic description of sample: Medium to fine-grained, very firmly cemented sandstone. The coarser grains are embedded in a fine matrix giving an oolitic appearance. It has a medium yellow color.

Description of residue: 46.08% insoluble. Silt and clay: 1.08%, medium gray color. Sand: 45%, white, medium texture, rounded to subangular quartz grains, most of which are colorless. There are a few orange and deep red colored, rounded grains which are probably stained quartz.

3. Sample # H3

Macroscopic description of sample: Similar to H2.

Description of residue: 52.74% insoluble. Silt and clay: 0.84%, dark gray color. Sand: 51.9%, white and similar to H2.

4. Sample # H4

Macroscopic description of sample: Similar to H2.

Description of residue: 55.06% insoluble. Silt-clay fraction: 0.96%, dark gray color. Sand: 54.1%, white, similar to H2 plus a few small powdery grains of limonite.

5. Sample # H5

Macroscopic description of sample: Similar to H2.

Description of residue: 61.9% insoluble. Silt-clay

fraction: 1.2%, gray color. Sand: 60.7%, white, and similar to H2. A petrographic microscope analysis reveals nothing but quartz grains.

6. Sample # H6

Macroscopic description of sample: This sample is similar to H2, except that it is more porous and is not as well cemented.

Description of residue: 75.16% insoluble. Silt-clay fraction: 1.16%, reddish-brown. Sand: 74%, similar to H2.

7. Sample H7

Macroscopic description of sample: More porous and less firmly cemented than H2 but otherwise similar.

Description of residue: 74.6% insoluble. Silt-clay fraction: 1.2%, gray color. Sand: 73.4%, white. There are a number of fairly coarse, rounded, frosted grains of quartz. The larger portion is composed of medium to fine, rounded to subangular, colorless quartz grains. There are a few orange, red and yellow grains which are probably stained quartz. A mounted section under a petrographic microscope revealed only quartz.

8. Sample # H8

Macroscopic description of sample: A few black specks on the surface, otherwise similar to H2.

Description of residue: 73.06% insoluble. Silt-clay: 1.56%, tan color. Sand: 71.5%, white, similar to H7.

Dane County
February 5, 1935

Location No. 2

The S.W. ¼ of the N.E. ¼ of Sec. 17, T. 8 N., R. 9 E.

LOCATION NO.2
Undeveloped Quarry Site

1. Sample # BB1

Macroscopic description of sample: Medium to fine-grained, slightly porous, fairly well-cemented, faded yellow color. It contains a few filled worm holes.

Description of residue: 75.48% insoluble. Silt-clay fraction: 7.28%, creamy gray color. Sand: 68.2%, light tan color, fine to medium, angular to subangular grains of quartz, some of which are stained. There are a few coarse, rounded, frosted quartz grains. The residue contains many muscovite flakes.

2. Sample # BB2

Macroscopic description of sample: Similar to BB1.

Description of residue: 69.15% insoluble. Silt-clay fraction: 9.15%, cream color. Sand: 60%, light tan color. This sand is similar to BB1, except that it contains some limonite and some organic matter.

3. Sample # BB3

Macroscopic description of sample: Similar to BB1.

Description of residue: 52.14% insoluble. Silt-clay fraction: 1.84%, dull gray color. Sand: 50.3%, white. The sand is composed of medium to fine, angular to subangular grains which under the petrographic microscope were identified as quartz. There are quite a number of coarser, rounded, frosted, colorless, quartz grains. The residue also contained some greenish, irregularly shaped masses which resemble a copper mineral.

4. Sample # BB4

Macroscopic description of sample: Similar to BB1.

Description of residue: 60.7% insoluble. Silt-clay fraction: 2.2%, gray color. Sand: 58.5%, white, medium to fine, angular to subangular, colorless quartz grains with a few coarser, rounded and frosted grains of quartz.

Dane County
February 5, 1935

Location No. 3

S.W. ¼ of Sec. 11, T. 7 N., R. 8 E.

LOCATION NO. 3
Middleton Quarry

1. Sample # CC1

Macroscopic description of sample: Medium-grained, speckled yellowish color, firmly cemented sandstone. About 50% crystalline calcite.

Description of residue: 51.92% insoluble. Silt-clay fraction: 0.92%. Sand: 51%, fairly coarse, rounded, frosted, quartz grains, some of which are slightly stained. A few are subangular.

2. Sample # CC2

Macroscopic description of sample: Medium to fairly coarse grains, yellowish color, firmly cemented.

Description of residue: 62.05% insoluble. Silt-clay fraction: 0.85%. Sand: 61.2%, almost all coarse, rounded, colorless to slightly stained, quartz sand. There are a few finer grains.

3. Sample # CC3

Macroscopic description of sample: Coarse to medium-grained, speckled yellow color, well-cemented.

Description of residue: 59.6% insoluble. Silt-clay fraction: 2.2%. Sand: 57.4%, dominantly fairly coarse, rounded, frosted, colorless, quartz sand with a few green grains which are probably glauconite.

4. Sample # CC4

Macroscopic description of sample: Coarse, colorless grains embedded in a finer matrix, compact to slightly porous, pale yellow color, fair cementation.

Description of residue: 60.68% insoluble. Silt-clay fraction: 0.68%. Sand: 60%, fairly coarse, rounded to sub-angular, colorless, quartz grains which were checked with the petrographic microscope. The residue contains some organic matter--plant roots.

5. Sample # CC5

Macroscopic description of sample: Similar to CC4 but

probably not as well-cemented.

Description of residue: 72.27% insoluble. Silt-clay fraction: 1.28%. Sand: 71%, medium to fairly coarse, rounded, frosted, colorless to slightly stained, quartz sand.

Dane County
February 5, 1935

Location No. 4

The N.W. ¼ of the S.E. ¼ of Sec. 5, T. 8 N., R. 9 E.

LOCATION NO.4
McWhatey Madison Sandstone Quarry

1. Sample # N1

Macroscopic description of sample: Medium-grained, very firmly cemented, compact, conchoidal fracture, buff color.

Description of residue: 56.02% insoluble. Silt-clay fraction: 1.52%, medium gray. Sand: 54.5%, white. The size of the grains are variable--fairly coarse to fine. The coarser ones are rounded, colorless and frosted, while the others are colorless, angular to subangular. Under a petrographic microscope these grains were identified as quartz. The residue also contains a few angular chert grains, some organic matter and a few green grains--probably glauconite. There are also some orange grains. These are likely quartz grains which have been stained.

2. Sample # N2

Macroscopic description of sample: Medium to fine-grained, slightly porous, firmly cemented, yellowish color.

Description of residue: 86.34% insoluble. Silt-clay fraction: 0.64%, gray. Sand: 85.7%, white, similar to N1 plus a few flakes of muscovite.

3. Sample # N3

Macroscopic description of sample: Similar to N2, but lighter color than N2.

Description of residue: 80.24% insoluble. Silt-clay fraction : 0.24%,gray. Sand: 80%, white, similar to N1 but without the chert.

Dane County
February 5, 1935

Location No. 6

S.E. ¼ of the S.E. ¼ of Sec. 1, T. 8 N., R. 8 E

LOCATION NO. 6

1. Sample # K1

Macroscopic description of sample: Fine-grained, dusty coating, fairly well-cemented, slightly porous, light yellow color.

Description of residue: 78.69% insoluble. Silt-clay fraction: 3.24%, reddish-brown color. Sand: 75.45%, light tan color. The grains are dominantly fine, angular to sub-angular, rough, and colorless. Under a petrographic microscope both feldspar and quartz were found to be present. There are a few frosted, rounded, fairly coarse quartz grains. The residue also contains some muscovite, limonite, and some dark, opaque, amorphous grains--probably glauconite.

2. Sample # K2

Macroscopic description of sample: Medium to fine-grained, porous, poorly cemented, yellowish-white color.

Description of residue: 95.15% insoluble. Silt-clay fraction: 1%, brown color. Sand: 94.15%, light tan color. It is similar to K1 but has no mica. This residue possesses a pseudomorph of limonite probably after marcasite.

3. Sample # K3

Macroscopic description of sample: Medium to fine-grained, dusty surface, fairly well-cemented, light yellow color.

Description of residue: 79.88% insoluble. Silt-clay fraction: 11.2%, reddish-brown color. Sand: 68.68%, light tan, identical to K1.

4. Sample # K4

Macroscopic description of sample: Medium to fine-grained, slightly porous, fairly well-cemented, yellow color.

Description of residue: 80.65% insoluble. Silt-clay fraction: 12.5%, tan color. Sand: 68.15%, light tan, similar to K1. A mounted section of this sand reveals the presence of both feldspar and quartz.

5. Sample # K5

Macroscopic description of sample: Similar to K4.

Description of residue: 79.23% insoluble. Silt-clay fraction: 10.28%, brown color. Sand: 68.95%, light tan color, a small amount of organic material, otherwise similar to K1.

Dane County
February 6, 1935

Location No. 8

S.E. ¼ of the N.W. ¼ of Sec. 17, T. 8 N., R. 10 E.

LOCATION NO. 8
Undeveloped Quarry Site

(Note: There were two samples of P1, P2, and P3. The writer has numbered one of each pair as prime, such as P'1.)

1. Sample # P1

Macroscopic description of sample: Medium to fairly coarse-grained, fairly well-cemented, quite compact, buff color.

Description of residue: 27.56% insoluble. Silt-clay fraction: 0.08%, gray. Sand: 27.48%, dominantly well-rounded, frosted, fairly coarse, colorless, quartz grains. In addition the residue contains a few oolites, chert fragments, and some limonite and organic matter.

2. Sample #P'1

Macroscopic description of sample: Medium to fairly coarse-grained, rather porous, fairly well-cemented, yellowish-red color.

Description of residue: 97.76% insoluble. Silt-clay fraction: 0.76%, light brown color. Sand: 97%, dominantly medium, subangular and colorless. A few are stained grains of quartz. There is a fair percentage of fairly coarse, rounded, frosted, colorless, quartz grains.

3. Sample # P2

Macroscopic description of sample: Medium and rounded grains, poorly cemented, dirty white color.

Description of residue: 99.64% insoluble. Silt-clay fraction: 0.64%, cream color. Sand: 99%, medium to fine-grained, colorless, quartz sand. The coarser grains are well-rounded and frosted. The others are angular to rounded, most of which are frosted.

4. Sample # P'2

Macroscopic description of sample: Medium-grained, porous, poorly cemented, brick-red color.

Description of residue: 98.18% insoluble. Silt-clay fraction: 1.48%, light brown color. Sand: 96.7%, light brown,

dominantly medium, subangular, frosted and rough grains. There are a few fairly coarse, rounded, quartz grains. Cement clings to the grains. The color is probably due to iron oxide. One oolite is present.

5. Sample # P3

Macroscopic description of sample: Similar to P2.

Description of residue: 99.26% insoluble. Silt-clay fraction: 0.36%, gray color. Sand: 98.9%, similar to P2. A mounted section reveals only quartz.

6. Sample # P'3

Macroscopic description of sample: Medium-grained, porous, poorly cemented, yellow color.

Description of residue: 99.4% insoluble. Silt-clay fraction: 1.4%, light brown. Sand: 98%, white. The sand has a medium texture, subangular, and slightly frosted, quartz grains. A few coarser grains are frosted and fairly well-rounded. The residue also contains a few euhedral quartz grains which show a small amount of wear. There are a few light green, irregular masses which resemble a copper mineral. So far muscovite has not been found in the samples of this set.

7. Sample # P4

Macroscopic description of sample: Medium to fine-grained, compact, very firmly cemented, buff color.

Description of residue: 73.3% insoluble. Silt-clay fraction: 3.8%, grayish-white. Sand: 70.5%, white, dominantly medium to fine, subangular to angular, quartz grains. There are a few coarser, rounded and frosted grains. A slight amount of muscovite and limonite is also present. The mounted section showed only quartz grains.

8. Sample # P5

Macroscopic description of sample: Even, medium-grained, very firmly cemented, compact, buff color.

Description of residue: 80.34% insoluble. Silt-clay fraction: 2.34%, white. Sand: 78%, white, similar to P4.

9. Sample # P6

Macroscopic description of sample: Medium-grained, hard, compact, firmly cemented, yellowish-buff color.

Description of residue: 89.16% insoluble. Silt-clay

fraction: 3.16%, grayish-white. Sand: 86%, white, dominantly medium to fine, angular to subangular, quartz grains, some of which are frosted. There are a few fairly coarse, spherical, frosted, quartz grains. The residue also contains a small amount of limonite.

10. Sample # P7

Macroscopic description of sample: Medium, rounded grains, fairly well-cemented, porous, reddish-buff color.

Description of residue: 78.56% insoluble. Silt-clay fraction: 1.56%, dark cream color. Sand: 77%, white, medium, subangular to rounded, usually slightly frosted, colorless, quartz grains. There is one well-rounded green grain which is probably glauconite.

11. Sample # P8

Macroscopic description of sample: Medium texture, slightly porous, fairly well-cemented, yellow color.

Description of the residue: 88.04% insoluble. Silt-clay fraction: 1.64%, cream color. Sand: 86.4%, white. The sand is similar to P7, but it has no green grain.

Dane County
February 7, 1935

Location No. 9

N.W. ¼ of the S.E. ¼ of Sec. 27, T. 8 N., R. 9 E.

LOCATION NO. 9

1. Sample # AA1

Macroscopic description of sample: Coarse to medium-grained, porous, poorly cemented, yellowish-buff color.

Description of residue: 85.56% insoluble. Silt-clay fraction: 0.76%, dirty gray color. Sand: 84.5%, white, dominantly medium, angular to subangular, slightly frosted, quartz grains. There are a few coarse, rounded, frosted grains of quartz.

2. Sample # AA2

Macroscopic description of sample: Medium to coarse-grained, fairly compact, firmly cemented, yellow color.

Description of residue: 75.24% insoluble. Silt-clay fraction: 0.64%, grayish-white color. Sand: 74.6%, white, mainly medium to fine, subangular to angular, colorless grains of quartz. There is a large number of fairly coarse, rounded, frosted, quartz grains. The residue contains a small amount of muscovite and limonite, and some amporphous, green grains which are probably glauconite.

3. Sample # AA3

Macroscopic description of sample: Medium-grained, porous, poorly cemented, reddish color.

Description of residue: 99.68% insoluble. Silt-clay fraction: 1.28%, light brown color. Sand: 98.4%, pale tan color, medium, subangular to rounded, frosted, quartz grains, and a small amount of limonite.

4. Sample # AA4

Macroscopic description of sample: Medium-grained, slightly porous, fairly well-cemented, faint yellow color.

Description of residue: 87.44% insoluble. Silt-clay fraction: 0.64%, gray. Sand: 86.8%, white, dominantly medium to fine, subangular grains of quartz and feldspar with a few coarse, rounded, frosted, quartz grains. A few grains are orange throughout.

5. Sample # AA5

Macroscopic description of sample: Even texture, slightly porous, fairly well-cemented, yellowish-buff color.

Description of residue: 81.6% insoluble. Silt-clay fraction: 0.6%, gray. Sand: 81%, white medium to fine, subangular to rounded, colorless grains, a few of which are frosted. A mounted section reveals notly all quartz, and a few feldspar grains. The feldspars possess microcline type twinning and are zoned.

6. Sample # AA6

Macroscopic description of sample: Medium-grained, slightly porous, fairly well-cemented, light yellow color.

Description of residue: 81.6% insoluble. Silt-clay fraction: 0.44%, gray. Sand: 81.16%, white, dominantly medium to fine, subangular to angular grains--mainly quartz but also some feldspars. There are a few rather coarse, rounded, frosted, quartz grains.

7. Sample # AA7

Macroscopic description of sample: Similar to AA6.

Description of residue: 90.44% insoluble. Silt-clay fraction: 0.36%, gray. Sand: 90.08%, white. This sand is similar to AA6, except that it has a larger number of coarse, rounded, frosted grains.

INSOLUBLE RESIDUES CONTAINED IN SAMPLES

From

QUARRIES WEST OF MADISON

Dane County
February 6, 1935

Location No. 15

The N.W. ¼ of the S.E. ¼ of Sec. 17, T. 7 N., R. 9 E.

LOCATION NO. 15
Main Shorewood Hill Quarry
At point farthest north in Madison sandstone quarry.

1. Sample # 1

Macroscopic description of sample: Fine-grained with coarser grains embedded in this matrix, firmly cemented, compact, buff color.

Description of residue: 61.9% insoluble. Silt-clay fraction: 1.6%, grayish-white. Sand: 60.3%, grayish-white, coarse to fine, colorless grains. The coarse grains are rounded, frosted and are quartz. The finer grains are angular to subangular; some are quartz, while others are feldspars. There are a few green, red and yellow grains which are probably stained quartz.

2. Sample # 2

Macroscopic description of sample: Medium to fine-grained, fairly well-cemented, quite dense, yellowish color with brown specks.

Description of residue: 79.7% insoluble. Silt-clay fraction: 4%, brown color. Sand: 75.7%, light brown color, medium to fine, angular to subangular grains of both quartz and feldspar but mainly the former. Many of the grains are stained, and a few are orange or red throughout.

3. Sample # 3

Macroscopic description of sample: Medium to fine-grained, fairly well-cemented, quite dense, yellowish color with black specks.

Description of residue: 79.48% insoluble. Silt-clay fraction: 2.68%, light brown. Sand: 76.8%, light brown, dominantly medium to fine, angular to subangular, stained grains of both quartz and feldspars but mainly the former. There are a few rather coarse, rounded, frosted, quartz grains. Many muscovite flakes are present. The feldspars show both microcline and albite twinning in a mounted section.

4. Sample # 4

Macroscopic description of sample: Medium to fine-grained, well-cemented, white on fresh fracture.

Description of residue: 97.55% insoluble. Silt-clay fraction: 0.91%, gray. Sand: 96.64%, gray, dominantly medium to fine, angular to subangular, feldspar and quartz sand. There are many orange and yellow grains which are probably stained quartz.

5. Sample # 5

Macroscopic description of sample: Medium to fine-grained, fairly well-cemented, yellowish-buff color with black specks.

Description of residue: 87.8% insoluble. Silt-clay fraction:4.6%, light brown. Sand: 83.2%, light tan, similar to # 3.

6. Sample # 6

Macroscopic description of sample: Medium to fine-grained, compact, firmly cemented, buff color.

Description of residue: 85.56% insoluble. Silt-clay fraction: 7.2%, light tan. Sand:78.56%, light tan, dominantly fine to medium, angular to subangular, stained quartz grains, a few of which are yellow and orange throughout. Feldspars are also present. The residue contains many muscovite flakes and some organic matter.

Section at Spur on East End of Quarry

1. Sample # A1

Macroscopic description of sample: Medium to fine-grained, slightly porous, well-cemented, light yellow color.

Description of residue: 77.44% insoluble. Silt-clay fraction: 3.24%, tan. Sand: 74.2%, light tan, medium to fine, subangular to angular, stained grains which are dominantly quartz. There are also some feldspars which show albite and microcline twinning. The residue contains some muscovite and a few orange and black grains; the former are probably quartz.

2. Sample # A2

Macroscopic description of sample: Similar to the above.

Description of residue: 84.08% insoluble. Silt-clay fraction: 3.88%, greenish-gray. Sand: 80.2%, pinkish color, dominantly medium to fine, rounded to subangular, feldspar-quartz grains. The residue contains a few flakes of muscovite, some orange and red grains, which are likely stained quartz, and a few rather coarse, frosted quartz grains.

3. Sample # A3

Macroscopic description of sample: Medium to fine-grained, quite dense, firmly cemented, light color.

Description of residue: 96.36% insoluble. Silt-clay: 1.76%, brown color. Sand: 94.6%, white that has a yellow tint, similar to A2 but more angular and finer grains.

4. Sample # A4

Macroscopic description of sample: Medium to fine-grained, well-cemented, fairly dense, yellow color with a few black specks.

Description of residue: 82.9% insoluble. Silt-clay: 3.4%, greenish white. Sand: 79.5%, light yellow, similar to A2, plus a few dull green grains which are probably glauconite. A mounted section shows mostly quartz but also some feldspars. The latter possessed albite and microcline type twinning.

5. Sample # A5

Macroscopic description of residue: Medium to fine-grained, white with yellow zones which have dark specks. The white parts are more dense and more firmly cemented than the yellow zones.

Description of residue 88.04% insoluble. Silt-clay fraction: 5.64%, white with a greenish tint. Sand: 82.4%, light tan, medium to fine, angular to subangular, quartz grains with probably some feldspars. There is an abundance of muscovite.

6. Sample # A6

Macroscopic description of sample: Similar to A5.

Description of residue: 79.03% insoluble. Silt-clay fraction: 11.63%, white with a greenish tint. Sand: 67.4%, light tan, similar to A5 plus a few orange colored grains.

7. Sample # A7

Macroscopic description of residue: Similar to A5.

Description of residue: 92.92% insoluble. Silt-clay fraction: 4.52%, cream color. Sand: 88.4%, light tan. This sand is similar to A5 except that the grains appear to be finer.

Two samples were run on specimen # A7, and the insoluble content of the second was 1.82% less than that of the above.

Dane County Location No. 16
February 9, 1935

The N.E. ¼ of the N.E. ¼ of Sec. 20, T. 7 N., R. 9 E.
N.W. ¼ of the N.W. ¼ of Sec. 21, T. 7 N., R. 9 E.

LOCATION NO. 16
Stevens Quarry

1. Sample # B1

Macroscopic description of sample: Fine-grained, fairly dense, fairly well-cemented, worm holes present, light buff color.

Description of residue: 69.28% insoluble. Silt-clay fraction: 5.68%, creamy brown color. Sand: 63.6%, light tan color, fine to medium, angular to subangular grains (many stained, others colorless) of quartz and feldspar. There are also a few rather coarse, rounded, frosted, quartz grains. The residue contains a moderate amount of muscovite and also a small amount of limonite, some of which appear to be pseudomorphic.

2. Sample # B2

Macroscopic description of sample: Medium to fine-grained, firmly cemented, dense, worm holes present, light buff color.

Description of residue: 88.44% insoluble. Silt-clay fraction: 6.6%, creamy brown color. Sand: 81.84%, light tan. This sand is similar to B1, but it has finer grains and only a trace of limonite.

3. Sample # B3

Macroscopic description of sample: Medium to fine-grained, slightly porous, fairly well-cemented, light buff color. The sample has been near the weathered surface.

Description of residue: 72.74% insoluble. Silt-clay: 7.84%, creamy gray color. Sand: 64.9%, light tan. This sand is similar to B1, but it has no limonite and contains some organic matter. The mounted section revealed both quartz and feldspar; the latter possesses microcline-type twinning. The section also contained a green grain with a microcrystalline texture which may be glauconite.

4. Sample # B4

Macroscopic description of residue: Similar to B3.

Description of residue: 76.7% insoluble. Silt-clay

fraction: 13.3%, light brown. Sand: 65.6%, tan, similar to B1 with B4 modifications.

Dane County
February 9, 1935

Location No. 17

The S.E. ¼ of the N.E. ¼ of Sec. 20, T. 7 N., R. 9 E.

LOCATION NO. 17
Paunack Quarry

1. Sample # C1

Macroscopic description of residue: Fine-grained, well-cemented, faded yellow color.

Description of residue: 73.46% insoluble. Silt-clay fraction: 3.46%. Sand: 70%, fine to medium, angular to rounded, and frosted, stained to colorless grains. The sand is mainly quartz, but there are a few feldspar grains. A small amount of muscovite is present.

2. Sample # C2

Macroscopic description of sample: Medium to fine-grained, slightly porous, firmly cemented, light yellow color.

Description of residue: 79.72% insoluble. Silt-clay fraction: 2.92%. Sand: 76.8%, light yellow, dominantly fine to medium, angular to subangular, stained to colorless grains of quartz with some feldspars. A few of the coarser grains are rounded and frosted.

3. Sample # C3

Macroscopic description of sample: Fine-grained, fairly compact, well-cemented, light yellow color.

Description of residue: 62.18% insoluble. Silt-clay fraction: 4.48%. Sand: 57.7%, light yellow color. The sand has fine grains which are usually angular, stained, and some are in aggregates. There are a few coarser, quartz grains which are rounded and frosted. A mounted section revealed many grains with microcline-type twinning. The majority of the grains are quartz. The residue contains much muscovite.

Dane County
February 9, 1935

Location No. 18

The S.W. ¼ of the N.W. ¼ of Sec. 21, T. 7 N., R. 9 E.

LOCATION NO. 18
The Madison City Quarry

1. Sample # D1

Macroscopic description of sample: Fine to medium-grained, well-cemented, pinkish buff color with a few brown specks.

Description of residue: 62.44% insoluble. Silt-clay fraction: 3.24%. Sand: 59.2%, light yellow color, dominantly medium to fine, subangular to angular, colorless and stained, feldspar-quartz sand. Some of the larger grains are frosted.

2. Sample # D2

Macroscopic description of sample: Fine to fairly coarse-grained, dense, well-cemented, pale yellow color.

Description of residue: 62.67% insoluble. Silt-clay fraction: 2.67%. Sand: 60%, faded yellow color, dominantly fine-grained, quartz sand. There are some feldspars present. About 5% of this sand is fairly coarse-grained, being composed of rounded and frosted quartz.

3. Sample # D3

Macroscopic description of sample: Fine to medium-grained, well-cemented, compact, buff color with small dark specks.

Description of residue: 93.37% insoluble. Silt-clay fraction: 1.97%. Sand: 91.4%, faded yellow color, dominantly fine to medium, angular to subangular, colorless(a few stained) grains of quartz plus a few feldspar grains. There are some fairly coarse, rounded, frosted, quartz grains and a few flakes of muscovite. A small amount of limonite is also present.

4. Sample # D4

Macroscopic description of sample: This sample is similar to D3, but it is not as well-cemented and is not speckled.

Description of residue: 81.35% insoluble. Silt-clay fraction: 2.36%. Sand: 78.99%, light brown color, similar to D3.

5. Sample # D5

Macroscopic description of residue: Fine to medium-grained, fairly well-cemented, pale yellow color.

Description of residue: 88.8% insoluble. Silt-clay fraction: 3.4%. Sand: 85.4%, dominantly medium to fine, angular and stained grains. A mounted slide under a petrographic microscope revealed both feldspars and quartz. There are a number of muscovite flakes.

6. Sample # D6

Macroscopic description of sample: Fine to medium-grained, fairly well-cemented, buff color.

Description of residue: 73.86% insoluble. Silt-clay: 2.36%. Sand: 71.5%, light brown color. This sand is similar to D6, except that the grains appear to be finer.

7. Sample # D7

Macroscopic description of sample: Medium to fine-grained, fairly well-cemented, fairly compact.

Description of residue: 67.95% insoluble. Silt-clay fraction: 2.95%. Sand: 65%, dominantly fine, angular, stained grains of quartz and some feldspars. There are a few muscovite flakes and some fairly coarse, rounded, frosted, quartz grains.

8. Sample # D8

Macroscopic description of sample: Medium to fine-grained, fairly well-cemented, light yellow color with dark specks.

Description of residue: 66.2% insoluble. Silt-clay fraction: 11.6%, light tan color. Sand: 54.6%, light tan. This sand is similar to D7 and has a great amount of muscovite.

between pages 22 and 22a

Dane County
February 9, 1935

Location No. 19

The S.E. ¼ of the N.W. ¼ of Sec. 1, T. 7 N., R. 8 E.

LOCATION NO. 19

1. Sample # Il

Macroscopic description of sample: Medium to coarse-grained, porous, fairly well-cemented, tinted white color.

Description of residue: 99.6% insoluble. Silt-clay fraction: 2.3%, gray. Sand: 97.2%, light gray, coarse to fine, rounded to angular, usually colorless quartz grains, some of which are frosted. There are a few white chert fragments, and some organic matter. A small amount of limonite is also present.

INSOLUBLE RESIDUES CONTAINED IN SAMPLES

From

TOWN OF MADISON

Dane County
February 9, 1935

Location No. 20

The S.E. ¼ of the S.E. ¼ of Sec. 28, T. 7 N., R. 9 E.

LOCATION NO. 20

1. Sample # F1

Macroscopic description of sample: Medium to coarse, rounded grained, fairly compact, very firmly cemented, pinkish white color.

Description of residue: 99.04% insoluble. Silt-clay fraction: 0.84%. Sand: 98.2%, light brown color. About 5% of this sand is composed of very fine, angular, colorless grains. There is a slight amount of limonite. The remainder is composed of medium to coarse, rounded to subangular, frosted to non-frosted quartz grains.

2. Sample # F2

Macroscopic description of sample: Coarse to fine-grained, fairly well-cemented, quite porous, banded red color.

Description of residue: 98.9% insoluble. Silt-clay fraction: 1.6%, creamy gray color. Sand: 97.3%, light red color, dominantly medium to fine, subangular to angular, quartz grains, many of which are stained. There are quite a few coarse, rounded, frosted quartz grains, and a few small, white chert fragments.

3. Sample # F3

Macroscopic description of sample: Rather coarse-grained, very porous, poorly cemented, reddish color with a few bands.

Description of residue: 99.96% insoluble. Silt-clay fraction: 2.36%, creamy gray. Sand: 97.6%, light red color. This sand is similar to F2, except that it contains a larger percentage of fine grains.

4. Sample # F4

Macroscopic description of sample: Medium-grained, porous, poorly cemented, gray color.

Description of residue: 99.54% insoluble. Silt-clay fraction: 0.04%. Sand: 99.5%, dominantly medium to coarse, angular to rounded, non-frosted to frosted, colorless, quartz grains.

Dane County
February 9, 1935

Location No. 21

The S.E. ¼ of the N.W. ¼ of Sec. 28, T. 7 N., R. 9 E.

LOCATION NO. 21
Abandoned Quarry

1. Sample # E1

Macroscopic description of sample: Fine-grained, compact, well-cemented, faded yellow color.

Description of residue: 65.22% insoluble. Silt-clay fraction: 11.12%, creamy gray. Sand: 54.1%, light yellow color, dominantly fine, angular, rough, quartz grains with some feldspars. The residue contains many muscovite flakes, some black, slightly magnetic grains which are probably illmenite, and a few rather coarse, rounded, frosted, quartz grains. There are also a few orange and red colored grains.

2. Sample # E2

Macroscopic description of sample: Medium to fine-grained, slightly porous, well-cemented, buff color.

Description of residue: 91.73% insoluble. Silt-clay fraction: 4.84%, gray. Sand: 86.89%, light yellow color, similar to E1.

3. Sample # E3

Macroscopic description of sample: Similar to E2.

Description of residue: 61.84% insoluble. Silt-clay fraction: 9.72%, medium gray. Sand: 52.12%, very light yellow. This sand is similar to E1, but it contains an enormous amount of muscovite and a small amount of organic matter.

4. Sample # E4

Macroscopic description of sample: Similar to E2 but not quite as porous.

Description of residue: 41.04% insoluble. Silt-clay fraction: 8.16%, medium gray. Sand: 32.88%, very faint yellow, similar to E1.

5. Sample # E5

Macroscopic description of sample: Medium to coarse-grained, quite compact, well-cemented, faded yellow color.

Description of residue: 57.55% insoluble. Silt-clay fraction: 1.36%, bluish gray color. Sand: 56.19%, white. About 25% of the residue is coarse to medium-grained--the grains are rounded, frosted, colorless and are quartz. The residue is dominantly composed of fine, angular, rough colorless grains. A mounted section under a petrographic microscope reveals quartz and feldspar grains; the latter are zoned and possess the microcline-type twinning. Quartz predominates. There are a few colored grains.

6. Sample # E6

Macroscopic description of sample: Coarse-grained, slightly porous, poorly cemented, light yellow color.

Description of residue: 77.8% insoluble. Silt-clay fraction: 0.4%, medium gray. Sand: 77.4%, white. The sand is similar to E5, except there appears to be a larger percentage of coarse, rounded grains. There is also some organic matter present.

7. Sample # E7

Macroscopic description of sample: Coarse to medium-grained, porous, poorly cemented, white.

Description of residue: 99.73% insoluble. Silt-clay fraction: 0.08%, white. Sand: 99.65%, white, dominantly fine, angular, rough quartz grains. There are a few coarse, rounded, frosted, quartz grains, a few black, opaque grains which are probably illmenite or magnetite, several colored transparent grains, and two chert fragments.

THE INSOLUBLE RESIDUES CONTAINED IN SAMPLES

From

TOWN OF WESTPORT

Dane County
February 10, 1935

Location No. 22

The S.W. ¼ of the N.W. ¼ of Sec. 31, T. 8 N., R. 9 E.

LOCATION NO. 22

1. Sample # L1

Macroscopic description of sample: Medium to fine-grained, porous, fairly well-cemented, brown color.

Description of residue: 98.66% insoluble. Silt-clay fraction: 3.16%, brown color. Sand: 95.5%, brown. The sand is composed of angular to rounded, medium sized quartz grains which are usually rough and are coated with iron oxide and organic matter. There are a few chert fragments, and a few green grains which are probably glauconite.

2. Sample # L2

Macroscopic description of sample: Medium-grained, porous, moderately well-cemented, yellowish white color.

Description of residue: 99.94% insoluble. Silt-clay fraction: 1.04%, pinkish gray. Sand: 98.9%, grayish white. The sand contains fine to medium angular to rounded grains of quartz. Some of the larger grains are frosted. There are a few orange colored grains, a few chert fragments, and some green grains which are likely glauconite. A small amount of organic matter is also present.

3. Sample # L3

Macroscopic description of sample: Similar to L2.

Description of residue: 99.87% insoluble. Silt-clay fraction: 0.88%, pinkish gray. Sand: 98.99%, grayish white, similar to L2.

INSOLUBLE RESIDUES CONTAINED IN SAMPLES

From

TOWN OF BURKE

Dane County
February 10, 1935

Location No. 23

The N.E. ¼ of the S.W. ¼ of Sec. 17, T. 8 N., R. 10 E.

LOCATION NO. 23

1. Sample # R1

Macroscopic description of sample: Coarse to medium-grained, porous, fairly well-cemented, reddish-yellow to brown color.

Description of residue: 98.76% insoluble. Silt-clay fraction: 0.76%, medium brown. Sand: 98%, medium brown color. The sand contains rounded to subangular, medium to fine, frosted to non-frosted, quartz grains, most of which are stained with iron oxide. There are also a few orange colored grains.

2. Sample # R2

Macroscopic description of sample: Similar to R1.

Description of residue: 98.16% insoluble. Silt-clay fraction: 1.96%, medium brown color. Sand: 96.2%, medium brown. The sand is quite similar to R2, but it seems to be slightly coarser, contains more limonite and possesses a few green grains which are probably glauconite. There are also a few orange colored grains.

INSOLUBLE RESIDUES CONTAINED IN SAMPLES

From

TOWN OF WINDSOR

Dane County
February 10, 1935

Location No. 24

The S.W. ¼ of the S.E. ¼ of Sec. 31, T. 9 N., R. 10 E.

LOCATION NO. 24

1. Sample # T1

Macroscopic description of sample: Coarse to medium-grained, porous, fairly well-cemented, faintly banded, dirty-white color.

Description of residue: 99.28% insoluble. Silt-clay fraction: 2.88%, creamy-gray color. Sand: 96.4%, light gray. About 50% of the sand is composed of coarse to medium, rounded, frosted, quartz grains. The remainder is fine, angular, colorless, quartz grains. There is some organic matter and a few green grains which are probably glauconite.

2. Sample # T2

Macroscopic description of sample: Similar to T1 but no banding.

Description of residue: 99.78% insoluble. Silt-clay fraction: 2.88%, light gray. Sand: 96.9%, light gray. The residue is similar to T1, except that it contains a larger percentage of fine, angular grains which are usually rough.

3. Sample # T3

Macroscopic description of sample: Coarse to medium-grained, porous, poorly cemented, yellow color.

Description of residue: 99.9% insoluble. Silt-clay fraction: 2%, brown color. Sand: 97.9%, medium brown. About 50% of the sand is composed of medium to coarse, rounded, frosted, quartz grains. About 49% is fine to medium, angular to subangular, rough grained. A mounted section revealed mostly quartz and only one feldspar grain. Most of the grains are coated with iron oxide. There are a few chert fragments and some green grains which are probably glauconite.

4. Sample # T4

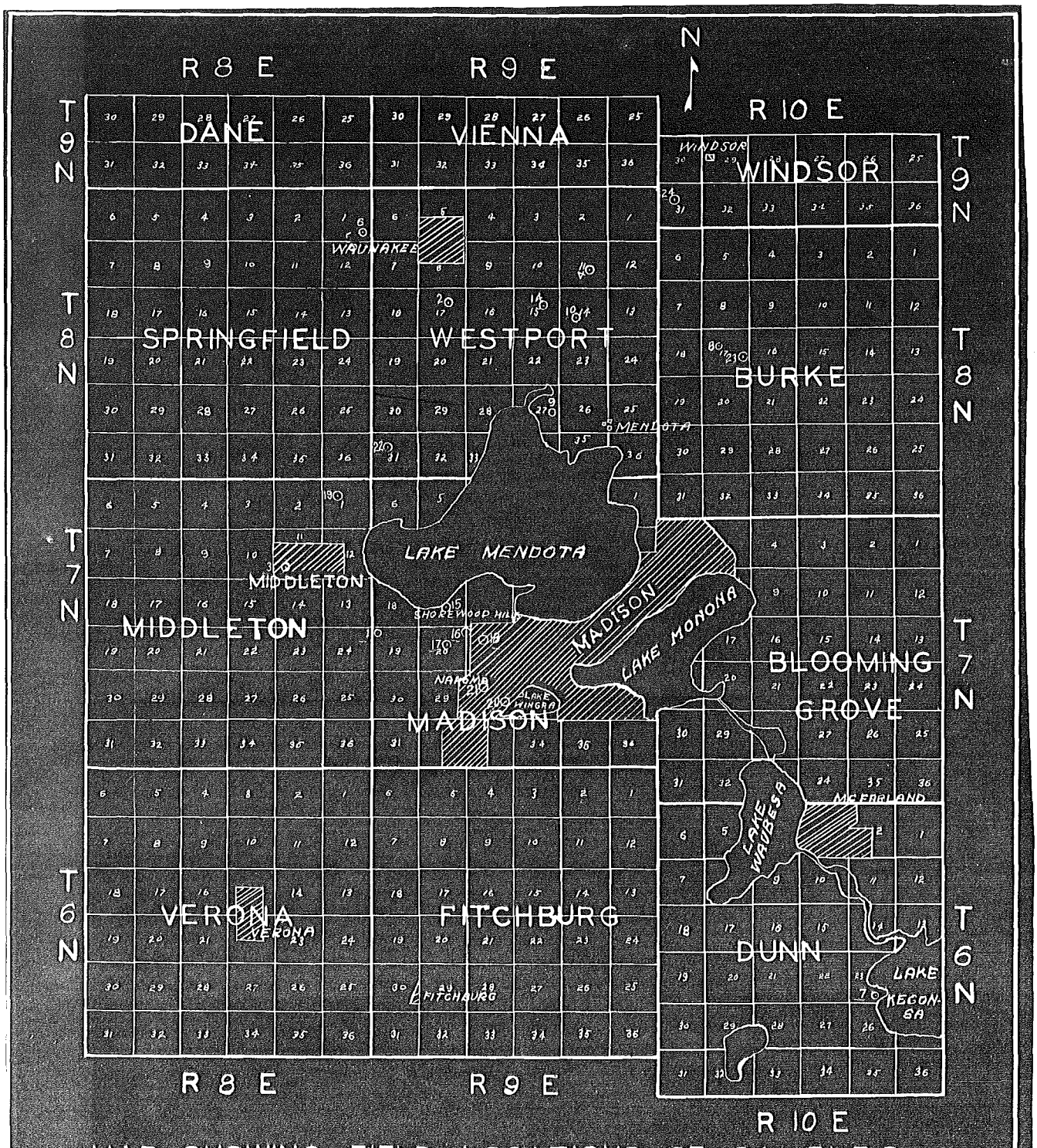
Macroscopic description of sample: Similar to T3 but better cemented and a darker yellow color.

Description of residue: 99.83% insoluble. Silt-clay fraction: 1.68%, creamy gray color. Sand: 98.15%, medium brown, similar to T3.

5. Sample # T5

Macroscopic description of sample: Similar to T4.

Description of residue: 99.2% insoluble. Silt-clay fraction: 2.6%, yellowish-gray. Sand: 96.6, medium brown color, similar to T3.



MAP SHOWING FIELD LOCATIONS OF SAMPLES

SCALE 1"=2 MILES

LEGEND: 10 ○ REFERS TO SAMPLE LOCATION NUMBERS OF MADISON SANDSTONE AS GIVEN IN REPORT

2/11/35

Ernest W. Fosshage

R 8 E

R 9 E

R 10 E

T 9 N

T 8 N

T 7 N

T 6 N

DANE

VIENNA

WINDSOR

WAUNAKEE

SPRINGFIELD

WESTPORT

BURKE

MENDOTA

LAKE MENDOTA

MIDDLETON

MIDDLETON

SHOREWOOD HILLS

MADISON

LAKE MONONA

NAKOMA

LAKE WINGRA

MADISON

BLOOMING GROVE

LAKE WAUBESA

MCFARLAND

VERONA

VERONA

FITCHBURG

FITCHBURG

DUNN

LAKE KEGONSA

R 8 E

R 9 E

R 10 E

MAP SHOWING FIELD LOCATIONS OF SAMPLES

SCALE 1"=2 MILES

LEGEND: 10 REFERS TO SAMPLE LOCATION NUMBERS OF MADISON SANDSTONE AS GIVEN IN REPORT

2/11/35

Ernest W. Fosshage