MISSISSIPPI
STATE GEOLOGICAL SURVEY

WILLIAM CLIFFORD MORSE, Ph.D.
Director

BULLETIN 62

ROCK WOOL

GEOLOGY
by
WILLIAM CLIFFORD MORSE, Ph.D.

TESTS
by
THOMAS EDWIN McCUTCHEON, B. S., Cer. Engr.

UNIVERSITY, MISSISSIPPI

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COMMISSION

STAFF

LETTER OF TRANSMITTAL

Office of the Mississippi Geological Survey
University, Mississippi
December 3, 1945

To His Excellency,
Governor Thomas L. Bailey, Chairman, and
Members of the Geological Commission

Gentlemen:

Herewith is Bulletin 62, Rock wool, Geology by William Clifford Morse, State Geologist, and Tests by Thomas Edwin McCutcheon, Ceramic Engineer.

It is presented to the citizens of Mississippi in the hope that the cheaper production of rock wool within the State will lead to wider usage and greater comfort.

Very sincerely yours,

William Clifford Morse,
Director and State Geologist

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GEOLOGY

WILLIAM CLIFFORD MORSE
STATE GEOLOGIST

USE

Rock wool is one of the most durable types of insulating materials on the market. Its use beneath the attic floor and in the walls of buildings adds enormously to the warmth comfort of homes in winter even at a fuel saving that soon pays for its installation. Its use adds enormously to the cool comfort of homes in summer without the cost of any other installation whatsoever. Rock wool is, therefore, a comfort producing material eventually without cost. Its use in the homes in Mississippi means more comfort to all that dwell therein, more to women and children for theirs are the longest hours indoors.

PRODUCTION POSSIBILITIES

Fortunately, rock wool of excellent quality can now be manufactured within the State, thus reducing even the transitory initial cost—a fact just demonstrated in the laboratories of the State Geological Survey.

OBJECTIVE

Rock wool wholly from one raw mineral or ingredient has long been the objective of the Mississippi State Geological Survey; and within the last few days that objective has been attained. In the experimental research laboratories of the Survey rock wool has been produced from some 15 feet of the Selma chalk that lies a few feet above the contact of the chalk with the underlying Coffee sand member of the Selma formation. In short, the rock wool can be produced from the Selma chalk, quarried as pit-run material.

POSSIBLE SOURCE BELTS

In fact three limestone belts may yield stone of the proper composition for rock wool—even though only one of these limestones has thus far been tested. The three belts are the hard Paleozoic rocks of northeastern Mississippi, the Cretaceous-Selma chalk of the northeast quarter, and the Vicksburg-Glendon belt of mid-Mississippi.

THE PALEOZOIC BELT

The Paleozoic rocks in Mississippi are confined to the valleys of the Tennessee River and its tributaries in Tishomingo County, the northeast county of the State. The lower of these beds, the Devonian-New Scotland, has been more or less submerged by the dammed waters of Pickwick Reservoir. The upper Paleozoic, the Mississippian-Carmack, Alsobrook, and Southward Pond, extends farther south up the headwater valleys of Bear Creek of the Tennessee River system and down the headwater valleys of Mackeys Creek of the Tombigbee River system.

Should laboratory experimental research reveal these limestones to be suitable material for rock wool, the stone is accessible to the Southern Railroad and to the Illinois Central System, as well as to the navigable waters of Pickwick Reservoir—and should the Bear Creek-Tombigbee waterways be completed, to this water system as well.

THE CRETACEOUS-SELMA BELT

The Selma formation is exposed at the surface in a broad belt 18 to 24 miles in width that extends across the northeast quarter of the State from Alcorn County along the Tennessee line to Noxubee County along the Alabama line. For the most part the Selma formation is a clayey or slightly sandy chalk. Northward from south central Lee County the northward extending tongues of chalk are intermembered with southward extending tongues of sand that make up a considerable part of the formation.

THE VICKSBURG-GLENDON BELT

The narrow Vicksburg-Glendon surface belt extends eastward all the way across mid-state from the Mississippi River Bluffs at Vicksburg to Clarke and Wayne County corners at the Alabama line. Throughout the extent of this belt, the Glendon limestones and interstratified marl beds are the conspicuous features along the bluffs at Vicksburg, in the agricultural limestone quarries at Thompson in Hinds County and at Brandon in Rankin County, as well as at other places. The Glendon limestones and marls will, no doubt, make rock wool as determined by the State Geological Survey chemical analyses, but blending of the limestones and marls will be necessary.

THE SOURCE

THE SELMA CHALK

IN GENERAL

The Selma chalk along with all the other formations in Lee County has been studied by both Harlan R. Bergquist and Franklin E. Vestal of the State Geological Survey in cooperation with a group of professional and business men of Tupelo, who voluntarily furnished private cooperative funds, rather than the WPA that was cooperative-

Figure 1.—Coffee sand member overlain by the projecting thin bed of shells of Exogyra ponderosa and Gryphaea convexa at the base of the Demopolis chalk member of the Selma formation at the western border of Saltillo (Sec. 17, T.8 S., R.6 E.). Photo by Harlan R. Bergquist.

ly functioning in Mississippi at the beginning of the survey. The results of these investigations are now in manuscript form and are being published as Bulletin 63, Lee County Mineral Resources, by the State Geological Survey.

The Selma formation has, as previously stated, a basal tongue of Coffee sand extending as far south as south-central Lee County (Figure 1). The chalk at the top contact of the Coffee sand consists of a semi-indurated thin shell bed (*Exogyra ponderosa-Gryphaea convexa*), overlain by some five feet of transitional sand and chalk, another thin shell bed, a few more feet of transitional sandy chalk,

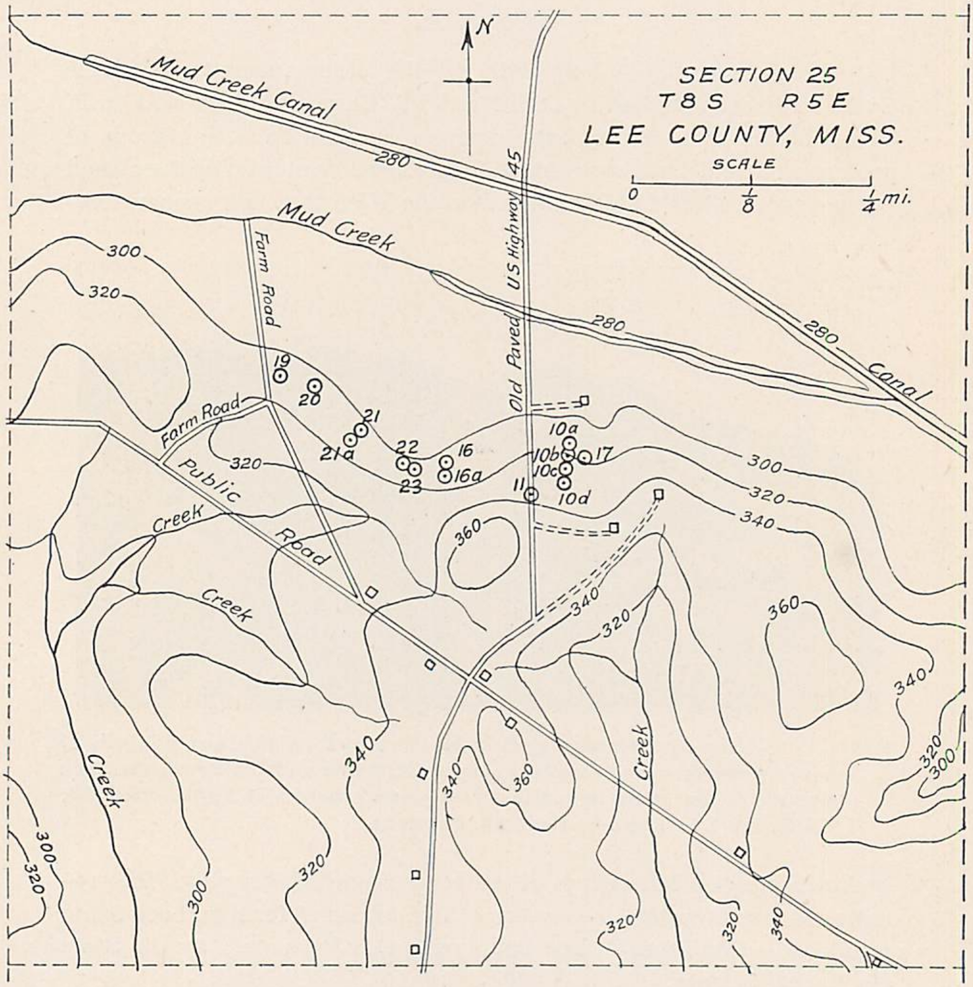

Figure 2.—Map of Mud Creek Bluff at the crossing of old paved U. S. Highway 45 (Sec. 25, T.8 S., R.5 E.) showing the locations from which the samples of chalk were taken.

and finally the clayey chalk. This lower Selma-Demopolis chalk, some five to ten feet above the Coffee sand, has, in the environs of Tupelo and Guntown, a composition almost ideal for the manufacture of rock wool.

ALONG MUD CREEK

This Selma chalk (basal Demopolis member phase), some 15 to 20 feet thick, extends for more than a mile along the south (west) bluff of Mud Creek on both sides of old paved U. S. Highway 45, some six miles north of Tupelo. Here in mid-Section 25 (T. 8 S., R. 5 E.) it lies just above the valley flat and beneath scarcely five feet of overburden. Here, fourteen samples from the places indicated on the map (Figure 2) were collected by Franklin E. Vestal; their analyses, as shown in the following tables, were determined by Herbert Safford Emigh.

At this place along the east wall of old paved U. S. Highway 45 cut, a 3-foot sample of the Selma chalk (basal Demopolis phase) was taken 25 to 28 feet above the top of the Coffee sand. This Sample 11 analyzed:

CHEMICAL ANALYSES

SAMPLE 11

Raw		As calcined	
Ignition loss	28.82		
Silica. SiO_2	25.13	SiO_2	35.30
Combined, R_2O_3	12.71	R_2O_3	17.86
Lime, CaO	32.04	CaO	45.01
Miscellaneous	1.30	Miscellaneous	1.83
Sulfur trioxide, SO_3	1.30		

A few yards east of the old paved highway, four samples from the Selma were taken at 5-foot intervals, beginning 10 feet above the Coffee sand. These Samples, 10a, 10b, 10c, and 10d in ascending order, analyzed:

CHEMICAL ANALYSES

SAMPLE 10a Raw		As calcined	SAMPLE 10b Raw		As calcined
Ign. loss	24.76	......	Ign. loss	27.51	......
Silica, SiO_2	32.69	43.45	Silica, SiO_2	24.73	34.11
Comb., R_2O_3	11.69	15.54	Comb., R_2O_3	14.68	20.25
Lime, CaO	30.77	40.89	Lime, CaO	32.29	44.55
Misc.	0.09	0.12	Misc.	0.79	1.09
Sul. Tri., SO_3	0.89		Sul. Tri., SO_3	1.23	

SAMPLE 10c

Raw		As calcined
Ign. loss	28.84	-------
Silica, SiO_2	24.70	34.71
Comb., R_2O_3	12.59	17.69
Lime, CaO	31.89	44.82
Misc.	1.98	2.78
Sul. Tri., SO_3	0.79	

SAMPLE 10d

Raw		As calcined
Ign. loss	29.28	-------
Silica, SiO_2	23.15	32.74
Comb., R_2O_3	11.57	16.36
Lime, CaO	33.11	46.82
Misc.	2.89	4.08
Sul. Tri., SO_3	none	

It was this 20 feet of Selma without the addition of any other material whatsoever that produced in the laboratory the excellent white rock wool at a temperature considerably in excess of the 2,200 degree Fahrenheit melt.

COMPLETE CHEMICAL ANALYSES
COMBINED SAMPLES 10a, 10b, 10c, 10d

Raw—110° Centigrade		As calcined	
Ignition loss	27.26		
Silica, SiO_2	27.02	SiO_2	37.15
Alumina, Al_2O_3	7.54	Al_2O_3	10.37
Iron oxide, Fe_2O_3	3.14	Fe_2O_3	4.32
Titania, TiO_2	0.50	TiO_2	0.69
Lime, CaO	31.50	CaO	43.31
Magnesia, MgO	0.63	MgO	0.87
Manganese, MnO_2	0.02	MnO_2	0.03
Alkalies, Na_2O, K_2O	1.12	Na_2O, K_2O	1.54
Sulfur, SO_3	0.84		
Carbon dioxide, CO_2	22.71		

About one hundred yards east of the old paved highway a 3-foot sample of the Selma chalk was taken 5 to 8 feet above the top of the Coffee sand. This Sample 17 analyzed:

CHEMICAL ANALYSES
SAMPLE 17

Raw		As calcined	
Ignition loss	27.98		
Silica, SiO_2	25.06	SiO_2	34.80
Combined, R_2O_3	12.86	R_2O_3	17.85
Lime, CaO	32.95	CaO	45.76
Miscellaneous	1.15	Miscellaneous	1.59
Sulfur trioxide, SO_3	0.81		

About 100 yards west of old paved U. S. Highway 45, a 5-foot sample of the Selma (basal Demopolis phase) was taken 5 to 10 feet above the Coffee sand, and another 5-foot sample, 10 to 15 feet above. These samples, respectively 16 and 16a, analyzed:

CHEMICAL ANALYSES

Sample 16 Raw		As calcined	Sample 16a Raw		As calcined
Ign. loss	25.56	....	Ign. loss	27.76	....
Silica, SiO_2	30.45	40.90	Silica, SiO_2	25.40	35.16
Comb., R_2O_3	12.35	16.59	Comb., R_2O_3	13.39	18.54
Lime, CaO	30.84	41.43	Lime, CaO	32.42	44.88
Misc.	0.80	1.08	Misc.	1.03	1.42
Sul. Tri., SO_3	0.94		Sul. Tri., SO_3	0.99	

About 225 yards west of the old paved highway, a 3-foot sample of Selma (basal Demopolis phase) was taken 12.5 to 15.5 feet above the Coffee sand. This Sample 23 analyzed:

CHEMICAL ANALYSES
SAMPLE 23

Raw		As calcined	
Ignition loss	26.62		
Silica, SiO_2	31.02	SiO_2	42.27
Combined. R_2O_3	12.17	R_2O_3	16.58
Lime, CaO	30.26	CaO	41.23
Miscellaneous	....	Miscellaneous	....
Sulfur trioxide, SO_3	none		

Some 250 yards west of the old paved highway, a 5-foot sample of the Selma (basal Demopolis phase) was taken 10.5 to 15.5 feet above the Coffee sand. This Sample 22 analyzed:

CHEMICAL ANALYSES
SAMPLE 22

Raw		As calcined	
Ignition loss	26.68		
Silica, SiO_2	29.82	SiO_2	40.67
Combined, R_2O_3	11.50	R_2O_3	15.68
Lime, CaO	31.16	CaO	42.50
Miscellaneous	0.84	Miscellaneous	1.15
Sulfur trioxide, SO_3	1.02		

Some 300 yards west of the old paved highway, 4-foot samples of the Selma (basal Demopolis phase) were taken 8 to 12 feet above the Coffee sand and 12 to 16 feet above. These respective Samples 21 and 21a analyzed:

CHEMICAL ANALYSES

Sample 21 Raw		As calcined	Sample 21a Raw		As calcined
Ign. loss	26.42	.....	Ign. loss	27.68	....
Silica, SiO_2	31.16	42.35	Silica, SiO_2	27.82	38.47
Comb., R_2O_3	11.50	15.63	Comb., R_2O_3	12.02	16.62
Lime, CaO	30.74	41.78	Lime, CaO	31.70	43.84
Misc.	0.18	0.24	Misc.	0.78	1.07
Sul. Tri., SO_3	none		Sul. Tri., SO_3	0.33	

Complete Chemical Analyses
Combined Samples 21, 21a

Raw—110° Centigrade		As calcined	
Ignition loss	26.35		
Silica, SiO_2	30.32	SiO_2	41.16
Alumina, Al_2O_3	6.86	Al_2O_3	9.31
Iron Oxide, Fe_2O_3	3.14	Fe_2O_3	4.26
Titania, TiO_2	0.40	TiO_2	0.54
Lime, CaO	31.18	CaO	42.34
Magnesia, MgO	0.69	MgO	0.94
Manganese, MnO_2	0.02	MnO_2	0.03
Alkalies, Na_2O, K_2O	1.35	Na_2O, K_2O	1.83
Sulfur, SO_3	0.47		
Carbon dioxide, CO_2	22.37		

About one-fourth mile west of the old paved highway, a 5-foot sample of the Selma (basal Demopolis phase) was taken 10 to 15 feet above the Coffee sand. This Sample 20 analyzed:

Chemical Analyses
Sample 20

Raw		As calcined	
Ignition loss	25.61		
Silica, SiO_2	33.21	SiO_2	44.64
Combined, R_2O_3	11.83	R_2O_3	15.90
Lime, CaO	29.27	CaO	39.35
Miscellaneous	0.08	Miscellaneous	0.11
Sulfur trioxide, SO_3	none		

About 200 feet still farther west, a 2-foot sample of the Selma (basal Demopolis phase) was taken 13 to 15 feet above the Coffee sand. This Sample 19 analyzed:

Chemical Analyses
Sample 19

Raw		As calcined	
Ignition loss	26.63		
Silica, SiO_2	30.50	SiO_2	41.57
Combined, R_2O_3	12.00	R_2O_3	16.36
Lime, CaO	31.15	CaO	42.46
Miscellaneous	------		
Sulfur trioxide, SO_3	none		

For more than a mile on both sides of old paved U. S. Highway 45, some 15 or 20 feet of Selma chalk (basal Demopolis member phase) is suited for the manufacture of rock wool. An adequate supply is, therefore, at hand—not to mention a supply of the same material at many other places. Not only so but the chalk pits would have natural drainage, an overburden perhaps not to exceed five feet, a site only six miles from Tupelo, a shorter distance from Saltillo.

NEAR GUNTOWN

The Selma chalk (basal Demopolis phase), likewise some 15 to 20 feet thick, constitutes an outlier, or rather a number of small outliers, a mile or so east of Guntown (Figure 3). Here are the basal semi-indurated thin shell bed, four or five feet of sandy chalk, another thin shell bed, some 15 to 18 feet of clayey chalk, and an overburden of scarcely five feet. Here the Selma chalk (basal Demopolis phase) adjoins a partly gravelled country road that leads to the Gulf, Mobile & Ohio Railroad tracks in Guntown, scarcely a mile and a half away.

From one of these outliers in the northeast quarter of Section 35 (T. 7 S., R. 6 E.), a 5-foot sample was taken 5 to 10 feet above the Coffee sand and another 10 to 15 feet above, respectively Sample 15 and Sample 15a, which gave the following analyses:

CHEMICAL ANALYSES

Sample 15 Raw		As calcined	Sample 15a Raw		As calcined
Ign. loss	24.48	......	Ign. loss	27.24	......
Silica, SiO_2	33.71	44.64	Silica, SiO_2	28.18	38.73
Comb., R_2O_3	12.58	16.66	Comb., R_2O_3	14.01	19.25
Lime, CaO	28.73	38.04	Lime, CaO	31.30	43.02
Misc.	0.50	0.66	Misc.	.....	......
Sul. Tri., SO_3	none		Sul. Tri., SO_3	none	

Along a partly gravelled roadway scarcely a mile and a half east of the Gulf, Mobile & Ohio Railroad in Guntown in the very top of flat hills with scarcely five feet of overburden, is the Selma chalk (basal Demopolis phase) 10 to 15 or 18 feet in thickness. In such thicknesses it extends for almost a mile, thus indicating sufficient tonnage for a rock wool plant.

COMPLETE CHEMICAL ANALYSES
COMBINED SAMPLES 15, 15a

Raw—110° Centigrade		As calcined	
Ignition loss	25.84		
Silica, SiO_2	30.90	SiO_2	41.66
Alumina, Al_2O_3	8.17	Al_2O_3	11.02
Iron Oxide, Fe_2O_3	2.98	Fe_2O_3	4.02
Titania, TiO_2	0.43	TiO_2	0.58
Lime, CaO	29.76	CaO	40.13
Magnesia, MgO	0.69	MgO	0.93
Manganese, MnO_2	0.02	MnO_2	0.03
Alkalies, Na_2O, K_2O	0.70	Na_2O, K_2O	0.94
Sulfur, SO_3	none		
Carbon dioxide, CO_2	22.35		

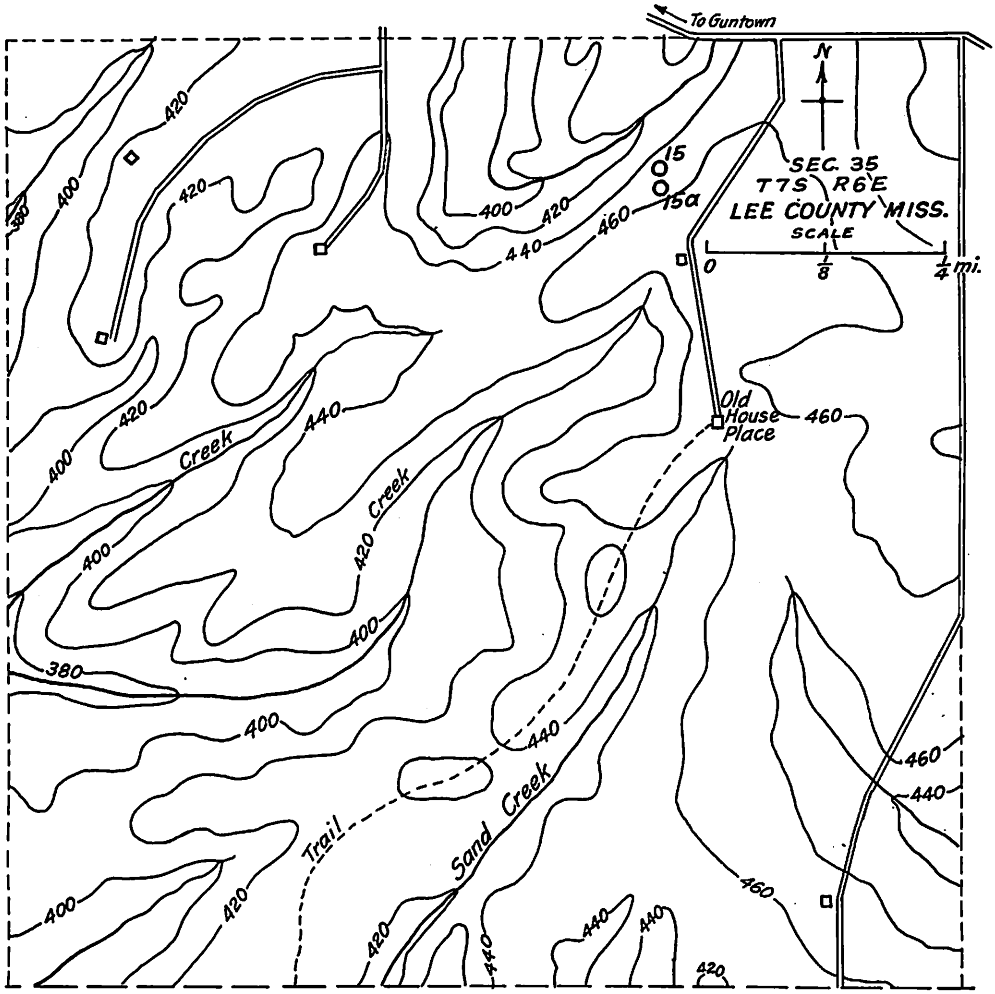

Figure 3.—Map of the area (Sec. 35, T. 7 S., R. 6 E.) southeast of Guntown showing the locations from which the samples of chalk were taken.

TESTS

THOMAS EDWIN McCUTCHEON
CERAMIC ENGINEER

CONCLUSIONS

ROCK WOOL POSSIBILITIES

Chemical analyses of 16 samples from the Selma chalk indicate that the material from a few feet above the base of the deposit (Demopolis member) to approximately 25 feet above it is suitable for making a good grade of rock wool. The chalk is high in silica in the lower portion and becomes richer in calcium in the upper part of the exposed sections. Some of the samples from approximately 5-foot intervals are too high in silica and some are too high in calcium. In most cases a composite of the lower and upper parts makes an ideal wool rock. A number of samples representing approximately 5-foot intervals are well suited for making rock wool.

Samples 10a, 10b, 10c, and 10d, each representing continuous 5-foot intervals, were combined in equal proportions, melted, and blown into a good quality of light-colored wool. The composite sample melts to a glass at 2200°F. but must be heated to a considerably higher temperature to produce a sufficiently liquid melt. The chemical analysis of the composite sample indicates a deficiency of silica which may be supplied by extending mining operations downward into the higher silica base. The sulfur content of the composite sample in terms of sulfur trioxide averages 0.727 percent which is not enough to be objectionable. The sulfur content of the unweathered chalk is not known.

Sample 11 represents a 3-foot interval of the chalk 25 to 28 feet above the base of the deposit. The chemical analysis of the sample is typical of the upper part of the chalk. Although the calcium content is higher and the silica content is lower than might be desired, the material is within the limits of wool rock. The sulfur content of this sample is higher than the average, but such variation may be expected from weathered material.

Samples 15 and 15a represent two continuous 5-foot intervals in the chalk from 5 feet to 15 feet above the local base. Both samples, either separate or composite, are suitable for rock wool. The samples contained no sulfur.

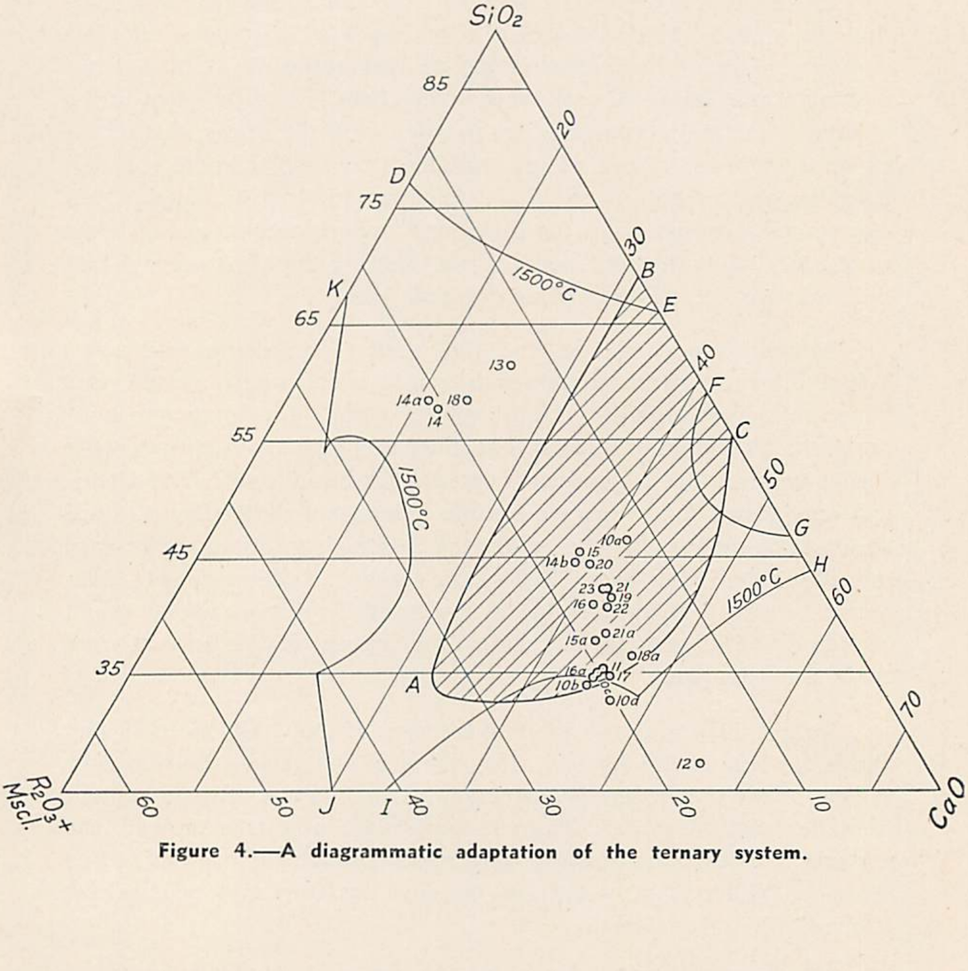

Figure 4.—A diagrammatic adaptation of the ternary system.

Samples 16 and 16a represent two 5-foot intervals of a discontinuous section of the Selma, 5 feet to 15 feet from the base of the local deposit. Sample 16 has an ideal wool rock composition. Sample 16a is also suitable for making rock wool singly or as a blend with sample 16. The sulfur content is nearly one percent for both samples but is not too high to be objectionable.

Sample 17 is an acceptable wool rock material but is rather high in calcium. Although the sample was taken 5 feet to 8 feet above the base of the local deposit, it is not typical of other samples from the lower section of the local chalk.

Samples 19, 20, 21, 21a, 22, and 23 represent 2-foot to 5-foot discontinuous intervals in the chalk 8 feet to 16 feet above the base of the local deposit. The samples are unusually uniform in composition and are ideal for making rock wool. The average sulfur content is very low.

The diagrammatic adaptation of the ternary system, consisting of SiO_2-Al_2O_3-CaO, from Bulletin 61, page 190, of the Illinois State Geological Survey, is useful for showing the composition of the Selma chalk suitable for making rock wool inasmuch as the quantity of minerals other than SiO_2-Al_2O_3-CaO in the typical chalk is insignificant. In this figure the Al_2O_3 co-ordinate is considered as R_2O_3 plus miscellaneous elements.

The shaded area enclosed by the lines A-B-C represents a range of compositions, consisting of SiO_2-Al_2O_3-CaO, which are known to be suitable for making rock wool having fiber diameters ranging from 3 to 10 microns when the melt is heated to 1500°C. The lines D-E, F-G, H-I, and J-K are the 1500°C. isotherm. The area enclosed by these lines represents compositions of SiO_2-Al_2O_3-CaO which will melt at or below 1500°C. Within the 1500°C. isotherm, only the SiO_2-Al_2O_3-CaO compositions in the shaded area (bounded by the lines A-B-C) melt to a liquid of sufficiently low viscosity to be blown into a good quality of rock wool.

The small circles on the diagram represent the composition of the Selma chalk collected for this study. It is to be noted that most of the Selma chalk samples have compositions suitable for making rockwool.