TEXTURAL GROUPS OF WISCONSIN TILL AND THEIR DISTRIBUTION IN ILLINOIS.

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ABSTRACT.

On the basis of field and laboratory studies the unleached glacial till of Wisconsin age has been divided into four textural groups. Mechanical analyses are given showing the range in composition of the four proposed groups. Depth of leaching is found to increase as the texture of the till becomes coarser. A map is presented which shows the distribution of the textural till groups as they occur in Illinois. No relationship is found to exist between these textural groups and the moraines or intermorainal areas.

INTRODUCTION.

In a previous paper[1] data were presented showing the wide textural variations found in Wisconsin till in northern Vermilion county, Illinois. On the basis of field observations and laboratory studies, it was proposed that for purposes of soil studies the till be divided into four groups defined as follows:

	Till group	Permeability	Color	Composition
1	Clarence	impermeable, plastic	usually gray	clay > 60-65% colloid > 34-31%
2	Plastic Elliott	slowly permeable, plastic	yellowish-gray	clay > 50-54% colloid > 28-26%
3	Elliott	slow to moderate permeability	grayish-yellow	clay > 36-38% colloid > 18-16%
4	Saybrook	permeable	yellow (or pink)	clay > 36-38% colloid < 16-18% sand > 15%

Krumbein[2] suggested a textural classification of Wisconsin till into three groups—Southern, Middle and Northern—as a result of a study of a suite of samples taken along a north-south transect near the Illinois-Indiana state line. His North-

[1] Winters, E., and Wascher, H.: Local variability in the physical composition of Wisconsin drift, Jour. Amer. Soc. Agron., Vol. 27, p. 617, 1935.
[2] Krumbein, W. C.: The textural and lithological variations in glacial till, Jour. Geol., Vol. 41, p. 382, 1933.

ern group covers nearly the same range in composition as our Elliott and Plastic Elliott till groups, whereas our Saybrook till group would include his Middle plus Southern groups. Nothing comparable to the Clarence till group was included in his study. Considering the dissimilar purposes and scopes of the two studies, the agreement in classification is as satisfactory as could be anticipated.

The recognition of textural till groups is important in helping to establish the identity of the soils developed upon them. Field study indicated that there is a close correlation between the character of the till and the permeability, erosiveness, and other features of the overlying soil. This was confirmed by Stauffer[3] who showed that soils developed on till of the Clarence group possess very different physical properties from those developed on till of the Saybrook group. This great significance of the texture of the unleached till in the classification of youthful soils prompted an extension of the Vermilion county study to include all that part of Illinois covered by Wisconsin till.

PROCEDURE.

The method of attack, which was the same as that employed in the work in northern Vermilion county, consisted of field observations and examination, supplemented by mechanical analyses of numerous samples. Some of these samples were taken from till exposures whose textural classification in the field was doubtful. Others were taken from exposures thought to be typical of a particular textural group. In this way type sections were established which proved invaluable as points of reference since the field work extended through several seasons.

All the till samples were collected with a spade, care being taken to secure undisturbed, unleached material from horizon 4 as defined by Leighton and MacClintock.[4] The procedure of Winters and Harland[5] for the mechanical analysis of calcareous samples was used. This is essentially the same as the method

[3] Stauffer, R. S.: Influence of parent material on soil character in a humid temperate climate, Jour. Amer. Soc. Agron., Vol. 27, p. 885, 1935.

[4] Leighton, M. M., and MacClintock, Paul.: Weathered zones of the drift sheets of Illinois, Jour. Geol., Vol. 38, p. 28, 1930.

[5] Winters, E., and Harland, M. B.: Preparation of soil samples for pipette analysis, Jour. Amer. Soc. Agron., Vol. 22, p. 771, 1930.

proposed by Krumbein.[6] The percentage of gravel was determined on the entire sample, which averaged about one kilogram. Other percentages are based on the weight of fine material remaining after removal of the gravel. The location of each sample collected is shown by placing the "location number" of Table I on the map, Fig. 1, at the point where the sample was obtained.

DATA.

The arrangement of the data in Table I in the approximate order of clay content helps to emphasize the more significant features of the composition of the till samples. The properties of the till, particularly with reference to permeability, exhibit as wide a variation as the range in clay (11 per cent to 90 per cent) would indicate. The lack of any discontinuities in the clay or colloid percentages throughout Table I agrees with the field observation that there are no distinct or easily recognizable separations between the textural till groups. The limits shown for Clarence, Elliott, and Saybrook in Table I are thus necessarily of an empirical nature and are those established in the previous study.[7]

The relationships of the coarser fractions are secondary in significance in contrast to the tremendous variation of the clay and colloids. The amount of gravel is small except in a few specimens of Saybrook. This group also has the highest percentage of sand, a feature that often proves helpful in field identification. There is some evidence to indicate the pedologic need for a "Sandy Saybrook" group to include tills which correspond in composition to sample No. 234. However, such a decision must await further study in the area southwest of Elgin where sandy till is abundant. Though Clarence averages lower in sand than Elliott, irregularities are numerous. The silt reaches a maximum in Elliott, falling to lower values in Saybrook and in Clarence because of increase respectively in sand and clay contents.

The till samples show differences in their content of free

[6] Krumbein, W. C.: Principles of mechanical analysis, J. Sed. Petr., Vol. 2, p. 89, 1932.
[7] Winters, E., and Wascher, H.: op. cit.

TABLE I.

Mechanical analyses and $CaCO_3$ equivalents of till samples.

Lab. No.	Location No.	% gravel >2.0 mm.	% $CaCO_3$ equivalent	% sand 2.0-.05 mm.	% silt .05-.005 mm.	% clay <.005 mm.	% colloid <.001 mm.
			Saybrook till group				
234	1	26.5	30.1	70.5	18.6	10.9	4.6
102	2	7.1	27.3	38.4	38.0	23.6	10.2
246	3	9.9	29.1	43.6	33.3	23.1	10.3
245	4	4.4	31.7	35.0	39.3	25.7	10.3
124	5	10.0	20.2	30.0	42.3	27.7	13.8
105	6	7.1	26.0	33.3	31.7	35.0	15.8
235	7	4.4	31.6	18.7	45.2	36.1	15.8
198	8	7.8	22.0	24.7	40.7	34.6	16.5
189	9	16.2	21.8	19.6	45.4	35.0	18.2
86	10	6.6	27.5	32.5	32.9	34.6	19.6
173	11	5.7	30.3	17.6	45.0	37.4	17.8
238	12	6.1	36.0	15.0	45.6	39.4	17.8
			Elliott till group				
200	13	2.7	34.4	13.0	44.8	42.2	18.4
87	14	14.0	38.4	19.0	43.1	37.9	20.6
257	15	2.5	25.9	16.0	45.0	39.0	20.6
247	16	6.8	29.0	10.6	46.1	43.3	20.4
231	17	.1	25.4	3.8	51.7	44.5	20.6
236	18	3.0	35.7	8.3	49.6	42.1	22.0
242	19	.3	39.3	10.9	46.1	43.0	22.4
301	20	2.1	26.2	11.8	43.2	45.0	22.8
118	21	4.4	25.0	12.4	39.7	47.9	21.6
300	22	2.7	26.2	11.8	42.4	45.8	23.2
151	23	2.7	19.0	15.7	37.3	47.0	24.1
121	24	2.5	24.8	10.9	40.8	48.3	24.6
89	25	4.2	...	10.8	42.6	46.6	24.8
233	26	1.5	32.6	11.8	37.4	50.8	25.2
17	27	3.2	23.4	11.0	38.9	50.1	25.5
303	28	...	19.8	11.2	39.3	49.5	26.5
88	29	6.0	...	12.0	38.1	49.9	26.6
171	30	.3	28.5	4.9	40.3	54.8	25.2
230	31	2.7	24.1	10.6	37.6	52.8	26.6
237	32	1.5	29.4	8.0	39.8	52.2	26.6
			Plastic Elliott till group				
127	33	4.0	22.9	9.3	37.7	53.0	27.9
128	34	2.0	22.1	11.3	35.7	53.0	30.4
250	35	1.1	24.4	8.5	35.1	56.4	30.4
152	36	1.3	23.6	7.8	32.8	59.4	30.6
232	37	.1	24.7	1.4	36.4	62.2	31.9
201	38	5.0	26.9	12.6	31.5	55.9	32.8
			Clarence till group				
153	39	2.3	21.2	7.6	29.2	63.2	32.8
134	40	.8	17.3	8.4	32.0	59.6	34.8
229	41	2.0	...	10.0	30.5	59.5	34.8
154	42	1.0	19.8	8.3	30.9	60.8	35.3
214	43	1.8	22.0	8.6	30.7	60.7	36.2
248	44	.1	22.8	1.2	27.0	71.8	35.6
216	45	1.0	26.4	7.3	28.9	64.8	37.4
252	46	.1	11.8	2.7	23.5	73.8	43.1
239	47	.1	25.2	1.8	20.2	78.0	46.6
190	48	.1	18.9	.4	8.5	91.1	58.0

carbonates that may have some import. The values in Table I averaged for the respective groups give:

Saybrook	27.8%	$CaCO_3$ equivalent
Elliott	28.2%	$CaCO_3$ equivalent
Plastic Elliott	24.1%	$CaCO_3$ equivalent
Clarence	20.6%	$CaCO_3$ equivalent

The distinctly lower percentage of carbonates in Clarence, which agrees with previous data,[8] would be expected in view of the high colloid content.

A study of the location of the samples that exceed 30 per cent in $CaCo_3$ equivalent shows that all but one lie north of Joliet. The lithologic study of Krumbein[9] indicated a marked predominance of limestone pebbles in the till in this same region. Thus, there seems to be a correlation of carbonate content by region as well as by textural group.

The depth of leaching was not determined at the time of sampling but a separate series of observations was made giving special attention to uniformity of topography. Effervescence with hydrochloric acid was the criterion used to determine the depth to carbonates. The mean depth to carbonates and the probable error, which were calculated on the results from 149 borings made on comparable topography, are as follows:

Till group	Number of observations	Mean depth to carbonates
Saybrook	42	36.1 ± 0.62 inches
Elliott	66	32.0 ± 0.48 inches
Plastic Elliott	17	28.8 ± 0.54 inches
Clarence	24	25.9 ± 0.52 inches

The difference between the averages for any two adjacent groups is about three times the probable error, indicating that the depth of leaching is only of moderate significance as a criterion of classification. However, the difference between the averages for Clarence and Saybrook is ten times the probable error and hence is very significant statistically.

TILL GROUP DISTRIBUTION.

The geographic distribution in Illinois of Clarence, Elliott, and Saybrook tills as above defined has been delineated on

[8] Winters, E., and Wascher, H.: op. cit.

[9] Krumbein, W. C.: The textural and lithological variations in glacial till, Jour. Geol., Vol. 41, p. 382, 1933.

Fig. 1. The scale employed in the construction of the map made certain generalizations desirable. Thus, Plastic Elliott

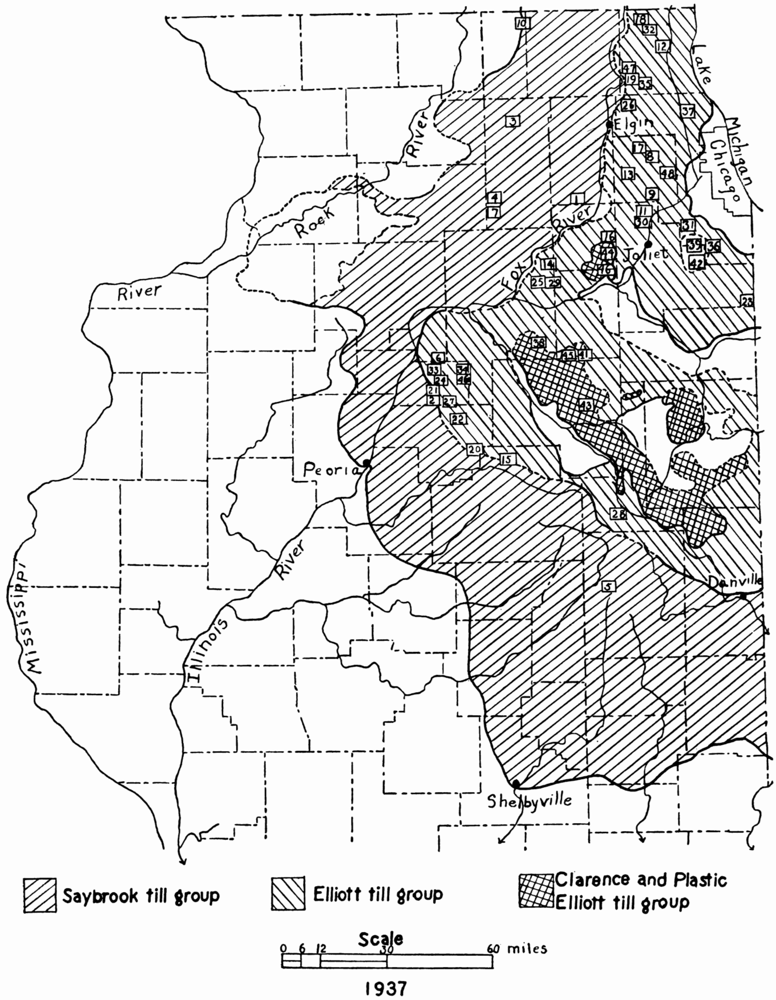

Fig. 1. The Distribution in Illinois of the Textural Groups of Wisconsin Till.

and Clarence are shown as one group, because the area of each is relatively small and they usually occur adjacent to one another. Small areas of outwash which are scattered throughout the region have been included with the surrounding till group. More extensive alluvial and lacustrine deposits such as occur in the Kankakee and Green River basins and Old Lake Chicago, are excluded from the classification. The Wisconsin till in the vicinity of the Illinois river has been classified without regard to the loessial covering[10] in this region.

The limit of the Wisconsin glaciation, which covers approximately one-third of the state, is essentially that given by Leverett[11] as revised by Leighton.[12] The dotted line in the Green River Lobe district indicates uncertainty as to the exact boundary of the Wisconsin glaciation in this locality. Similarly, broken lines separating the several till groups are tentative boundaries where field work was less intensive than elsewhere. Solid lines in all cases represent definitely established boundaries.

The relation of the till groups to the morainic systems is best seen by comparing Fig. 1 with the glacial map of Leverett[13] as revised by Leighton.[14] In several places a general correspondence is evident as suggested by Krumbein.[15] For example, the separation between the Elliott and Saybrook till groups coincides with the front of the Bloomington Moraine near Danville. However, the situation is usually more complex, and two or even three textural groups may be present on the same moraine. Thus, farther west the Saybrook-Elliott division cuts through the Bloomington Moraine in an irregular manner, while on portions of the Marseilles Moraine, areas of both Clarence and Elliott are present. That texture varies independently of any morainic system has already been pointed out for northern Vermilion county.[16]

The fact that in general morainic boundaries cannot be used as till group boundaries proved a complicating factor that necessitated a certain degree of generalization in preparing the map (Fig. 1). In this connection some mention should be made of the great local variability in till composition, particularly evident in the Elliott till group regions in which small

[10] Smith, R. S., et al.: Parent materials, subsoil permeability, and surface character of Illinois soils, Univ. Ill. Agr. Expt. Sta., 1935.

[11] Leverett, Frank: The Illinois glacial lobe. U. S. Geol. Survey Monograph, No. 38, 1899.

[12] Leighton, M. M.: The differentiation of the drift sheets of northwestern Illinois, Jour. Geol., Vol. 31, p. 265, 1923.

[13] Leverett, Frank: op. cit.

[14] Leighton, M. M.: op. cit.

[15] Krumbein, W. C.: The textural and lithological variations in glacial till, Jour. Geol., Vol. 41, p. 382, 1933.

[16] Winters, E., and Wascher, H.: op. cit.

areas of both Clarence and Saybrook, often but a fraction of a square mile in extent, are frequently encountered. The samples collected east of Elgin will illustrate this situation. The predominant texture is that of the Elliott till group, as the map indicates, and those samples of widely different composition shown here represent but small localized areas.

Frequently different tills overlie one another as has been known for some time from the records of deep-well drillings. Krumbein[17] has called attention to the superposition of dissimilar tills near Danville. A comparable situation is even more strikingly illustrated along the Saybrook-Elliott boundary northeast of Peoria. The Saybrook till group, which is slightly pink in this locality, can be traced for some distance underneath the grayish Elliott. Sample No. 102 (Table I) was taken two feet below No. 118 in the same road cut; the sharp contrast in composition needs no comment. Somewhat to the north, sample No. 105 illustrates the same situation, though in this case the overlying Elliott was not sampled.

No attempt has been made to correlate the occurrence of textural groups with the location of shale, limestone, and other rock formations lying in the path of glacial movement. It is suggested that some inferences might be made as to the regions of loading of the ice and the direction of its movement from a combined study of rock formations and data of the sort here presented.

[17] Krumbein, W. C.: The textural and lithological variations in glacial till, Jour. Geol., Vol. 41, p. 382, 1933.

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