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STUDIES ON THE ORIGIN OF THE SANDY LAND ALONG THE CIMARRON RIVER IN OKLAHOMA

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This investigation has been made in order to determine what part the wind has had in the developmentt of the sandy areas which exist along the northern side of many Oklahoma streams, particularly in the central and western part of the state. In a previous investigation conducted by the author and Charles A. Hollopeter, buried soils were used as a basis to determine how far the sand had been moved by the wind. Since no buried soils were found along the northern edges of the sandy land where it comes in contact in many places with a level prairie soil which is fine in texture and high in organic matter, it has been assumed that water rather than wind has been the most important geological factor in the deposition of this material; although wind action has modified the surface topography over extensive areas.

During the past year a further study of this problem has been made since two different areas were found which indicated that not all of the soil material which occurs in these so-called "sand hill areas" is composed of sand. In one area of high terrace soil, located ten miles south of Stillwater, a clay layer about 18 inches thick was found at a depth of about 8 feet below the surface of the ground. At first this material appeared to be a buried soil; although it could be a zone of concentration of clay and in a mature soil would be classified as a B horizon according to the Russian description of soil profiles. A third possibility was that this layer was merely an accumulation of clay which had been deposited in a depression in the flood plain of the stream during the development of this particular terrace.

Another observation of a soil profile occurring west of Ringwood also revealed a layer of soil material containing a high percentage of clay covered over with 5 or 6 feet of loose sand which indicated that this might be a buried soil. In order to determine whether or not the sandy land along the Cimarron River has been carried considerable distances by the wind, a careful study of these clay layers was necessary. If a large number of clay soils were found in these areas, the theory that water was responsible for the accumulation of these sediments would be more tenable than the theory that wind has played a major part in the deposition of the soil materials.

During the past year a large amount of grading has been done on U. S. Highway No. 60 between Ringwood and Cleo Springs, which are located in Major County, Oklahoma. A careful study of twelve different holes were made in this area in addition to several observations on the surface of the land which indicated that considerable amounts of clay were frequently found in the surface horizons. The location and description of the different holes which were studied are given in Table I.

TABLE I

Location, Description of Sediments and Depth of Cross Sections Examined in Connection with this Study

No.	Location	Description of Sample	Depth of Hole in Feet
1	S½ Sec. 7, Twp. 22N, R 10W	Deep friable sand	10*
2	SW SE Sec. 8, Twp. 22N, R 10W	Deep friable sand	13*
3	SE SE Sec. 9, Twp. 22N, R 10W	Deep friable sand	9*
4	SE SW Sec. 9, Twp 22N, R 10W	Clay layer at 5 ft.	16
5	SE SW Sec. 9, Twp. 22N, R 10W	Deep friable sand	8½
6	SE SW Sec. 10, Twp. 22N, R 10W	Deep friable sand	9
7	SE SE Sec. 8, Twp. 22N, R 11W	Clay layer at 2 ft.	12
8	SE SW Sec. 12, Twp. 22N, R 11W	Clay layer at 1 ft.	10
9	NE NE NE 14, Twp. 22N, R 11W	Clay layer at 6 in.	9
10	NW NW NE 14, Twp. 22N, R 11W	Clay layer at 1 ft.	9
11	NW NW NE 15, Twp. 22N, R 11W	Clay layer at 6 in.	3
12	NW NW NW 18, Twp. 22N, R 11W	$CaCO_3$ layer at 4 ft.	7

*Sandy clay frequently mottled with gray encountered at depths varying from 5 to 8 feet from the surface.

The examination of each soil profile was made by removing the soil material in one foot layers by means of soil tubes. In most cases the subsurface layers were composed of very loose sand which contained practically no fine material. It is interesting to note, however, that in practically every hole which was examined certain layers contained some clay.

It is possible for clay to accumulate in layers in a soil due to normal weathering processes and since the sandy land of Oklahoma readily absorbs the rainfall, conditions are favorable for a rapid weathering of the feldspars in the soil material which results in the formation of clay.

The development of mature soils containing zones of concentration of clay are usually associated with an acid surface soil. In most cases the sandy soils in this particular area are not acid, and the soil profiles are immature, which would eliminate weathering as the important agency which has been responsible for the development of these clay layers. In nearly all cases the examinations of the different soil sections were made at the lowest elevation which occurred in that particular area. Very frequently gray mottling and black iron concretions were found in the subsurface portion of the cross sections. This condition apparently is due to the fact that more water has accumulated in the depressions than at higher elevations where the soil was always red or yellow in color, indicating that conditions were more favorable for a complete oxidization of the iron in the soil material.

The mechanical composition of several different samples taken from typical areas of sandy land and from typical zones of clay which are found in this area is given in Table II.

TABLE II

Mechanical Analyses of Soil Material Secured Between Ringwood and Cleo Springs, Oklahoma

No.	Location	Distance Below Surface in Feet	Mechanical Analysis by Bouyoucos Method			Percent Clay by Sedimentation
			Percent Sand	Percent Silt	Percent Colloids	
1	SE SW 9, Twp. 22N, R 10W	5 - 6	36.4	20.0	43.6	37.8
2	SE SE 8, Twp. 22N, R 11W	2 - 3	35.0	15.0	53.0	47.7
3	SE SE 12, Twp. 22N, R 11W	1 - 2	25.0	24.0	51.0	41.6
4	NE NE NE 14, Twp. 22N, R 11W	0 - 1	51.4	15.5	33.1	28.9
5	NE NE NE 14, Ewp. 22N, R 11W	1 - 2	33.3	12.0	54.6	48.5
6	NE NE NE 14, Twp. 22N, R 11W	2 - 3	45.4	14.6	40.0	36.7
7	NE NE NE 14, Twp. 22N, R 11W	3 - 4	77.0	9.4	13.6	11.9
8	NE NE 14, Twp. 22N, R 11W	0 - 1	96.0	.5	3.5	2.7
9	NE NE 15, Twp. 22N, R 11W	0 - 1	93.7	1.3	5.0	3.8
10	NW NW NW 18, Twp. 22N, R 11W	4 - 5	57.0	10.0	33.0	31.7

The mechanical analyses of the samples were made according to the hydrometer method of Bouyoucos, and the clay content of the different, samples was checked by sedimentation. The agreement between the two methods is not exact but indicates that material high in clay exists in this sandy region. Samples 8 and 9 show the low content of the clay in the dune sand and in the sandy terrace soils. Samples 4, 5, 6 and 7 represent a profile sample taken from an old terrace soil located in the northeastern corner of Section 11, Twp. 22N, Range 11W, and show a high clay content in the first, second and third foot. The fourth foot contained less clay than the surface soil, and the deeper layers of soil, which in this particular case was examined to a depth of 9 feet, were composed of loose unconsolidated sand.

On the areas which contain a high percentage of clay in the surface soil, Buffalo grass and Grama grass are usually found. Conditions are not as favorable for the development of the Andropogons or the growth of "Blackjack" trees where the clay content of the surface soil is high. In no instance was there any indication of insect casts in the clay layers which were covered with several feet of sand. This would eliminate the

possibility that the clay layers may have been the remains of an old buried soil or that these layers have been derived from sedimentary material, since in every instance the clay layers were always underlaid by loose unconsolidated sand which was frequently light gray to tan in color similar to that which occurs in sand bars along streams. It is quite evident that the only explanation of the appearance of these accumulations of clay is that they have been deposited by water. It is rather difficult to determine the exact extent of many of these areas since they are frequently covered over with sand to a depth of several feet. In many instances rather large areas of relatively level land occur surrounded by small sand dunes.

During the present geological period the Cimarron River is depositing areas of clay and areas of sand on its flood plain and these areas in many instances have been cut off from the river by ridges or irregular areas of dune sand which at the present time vary from 10 to 30 feet high. Two very good photographs of this condition have been secured and the same condition can be observed in many places along the South Canadian River.

Another interesting observation which would indicate that the major portion of the sandy land has been deposited by water is the deposition of a layer of material in the northwest corner of the northwest quarter of Section 18, Twp. 22, Range 11W, containing a very large amount of calcium carbonate which apparently has been derived from the weathering of the cap rock of the high plains. In this particular profile a surface layer of fine sand extends downward to a depth of 30 inches. This surface layer is underlaid by 18 inches of sandy clay. A layer which is about 18 inches thick and contains a large amount of calcium carbonate occurs beneath the sandy clay horizon. Although this soil is located in the region of pedocals, the zone is not a typical zone of lime carbonate accumulation and is not a mature soil of this region. Loose sand is found below the calcium carbonate layer.

SUMMARY

A study was made in regard to the origin of the sandy land along the Cimarron River in western Oklahoma. The presence of clay soils in this region indicated that (1) either the sand had been drifted over the old weathered surface of sedimentary rocks, or (2) the clay layers might be zones of accumulation of clay which occur in mature soil profiles, or (3) the clay could have been deposited as alluvium during the development of this particular area.

The absence of mature soils having compact zones of concentration of clay and the absence of any indication that these clay layers had been worked over by insects which would suggest that they were buried soils and also due to the presence of unconsolidated sand beneath all of the clay layers examined, it seems that water has been the important geological factor in the origin of these sandy areas. Wind has modified the surface topography over extensive areas, but there is no evidence to substantiate the theory that the sand has been carried any appreciable distance from the point of deposition.

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