A Mineralogical Study of Thick-Surfaced Brunizemic Soils[1]

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In 1957, a report was published that included data on morphological, chemical, and physical properties of two Taloka soils and one Teller soil of eastern Oklahoma (Brengle et al., 1957).

Jarvis et al. (1959) reported from a chemical mineralogical study on Taloka, a Planosol, and other associated soils of southern Kansas.

It is the intention of this paper to supplement the information reported by Brengle, et al. (1957).

The two Taloka profiles were sampled to represent the thick-surfaced but highly leached Brunizemic soils, and the Teller, a medial Reddish Prairie, was sampled to compare weathering, leaching, and other processes of soil development.

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MINERALOGICAL METHODS

Slides were made of the light and heavy minerals from the 0.1 to 0.05 and 0.05 to 0.02 mm fractions of each horizon sampled. The mineral grains were mounted in Caedax. Grain counts were made with a Leitz polarizing microscope.

HEAVY MINERAL RESULTS AND INTERPRETATIONS

The different heavy mineral species in the 0.1 to 0.05 and 0.05 to 0.02 mm fractions were identified and percentages of the more common non-opaque minerals were calculated for all horizons sampled (Table I). The ratio of zircon/tourmaline in each size fraction was calculated for all horizons (Table II). The opaque minerals, represented chiefly by ilmenite, leucoxene, magnetite, and hematite, compose 60 to 70% of the heavy mineral suite in most horizons. Several other heavy minerals, notably sphene, rutile, and biotite, are present in small amounts. The heavy mineral suites for the different horizons sampled are similar qualitatively but show some variation quantitatively. In the very fine sand fraction of the Taloka-1 profile the zircon/tourmaline ratios show no consistent trend with depth. However, the zircon/tourmaline ratios of the coarse silt fraction are slightly lower in the lower three than in the upper three horizons. The difference between the ratios of the two fractions is not a discrepancy since it would not necessarily be expected that the mineral content of two size fractions would vary in the same way with depth. The zircon/tourmaline ratio in the very fine sand fraction of the Taloka-2 profile is appreciably lower in the lower three than in the upper three horizons. The ratio is slightly lower in the A22 than in the A1 and A21 horizons. In the coarse silt fraction the zircon/tourmaline ratios are slightly lower in the lower four than in the upper two horizons. In the Teller profile the zircon/tourmaline ratio in the very fine sand fraction of the B21 horizon is appreciably higher than are the ratios in the A1 and C horizons. In the coarse silt fraction the largest variation in the zircon/tourmaline ratio occurs in the C horizon where the ratio is considerably lower than are the ratios in the A1 and B21 horizons.

In both Taloka profiles the changes in the zircon/tourmaline ratios with depth indicate, but do not prove conclusively, stratification of soil parent materials. The evidence for stratification is stronger in the Taloka-2 than in the Taloka-1 profile. It appears that the discontinuity is between the A22 and B21 horizons and that there is considerable intermixing of the two. Stratification is also indicated in the Teller profile. In general, the total heavy mineral determinations and zircon/tourmaline ratio determinations point to similar conclusions. However, the zircon/tourmaline ratios of the very fine sand and coarse silt fractions of the Teller C horizon vary appreciably from the ratios of the corresponding fractions of the lower horizons of the Taloka profiles, whereas the total heavy mineral contents of the Teller C horizon and the lower Taloka-1 and Taloka-2 horizons are similar.

The heavy mineral data were used to calculate weathering ratios (Table II). The ratio used was that of zircon + tourmaline/hornblende. Since hornblende is much more susceptible to weathering than zircon and tourmaline, the ratio should widen as weathering intensity increases. A comparison of the A and B horizon ratios would not be valid since a lithologic change apparently occurs at the beginning of the B horizon; however, a comparison of the Taloka-1 and Taloka-2 ratios should indicate whether or not weathering intensity has been the same in both profiles. The weathering ratios show apparent differences in the degree of weathering in the two profiles, but the differences are not consistent and are difficult to explain with the present data. It is possible that the inconsistency is partially due to the generally low percent of hornblende.

TABLE I. HEAVY MINERAL DATA FOR THE VERY FINE SAND AND COARSE SILT FRACTIONS FOR THE TALOKA-1, TALOKA-2, AND TELLER PROFILES. Values are expressed as percentage by volume of the total heavy minerals except for the total heavy minerals which are expressed as percentage of the whole soil.

Depth Inches	Horizon	Total Heavy Minerals*	Very fine sand					Coarse silt				
			Zir-con	Tourma-line	Gar-net	Horn-blende	Epi-dote	Zir-con	Tourma-line	Gar-net	Horn-blende	Epi-dote
TALOKA-1												
0-20	A1	0.341	10	5		4	2	10	6	4	2	
20-26	A21	0.541	7	4	3	4	2	12	4	4	3	2
26-32	A22	0.509	11	4	2	3	1	10	6	2	3	2
32-42	B21	0.397	8	5	2	3	3	7	5	3	4	3
42-54	B22	0.298	8	4	2	4	5	7	6	4	2	3
54-60+	C	0.282	11	6	5	5	4	6	10	4	4	3
TALOKA-2												
0-11	A1	0.440	9	3		3		7	5	2	5	3
11-16	A21	0.365	12	5	2	4		9	7	4	3	4
16-24	A22	0.382	10	5	2	4	2	8	9	5	3	4
24-36	B21	0.277	9	7	3	5	1	9	9	6	2	5
36-60	B22	0.304	7	8	3	4	2	8	11	5	4	4
60-100+	C	0.301	5	7	3	2	2	9	10	7	6	5
TELLER												
0-11	A	0.540	10	6	3		2	10	6	3	2	
20-28	B	0.475	20	5	2	3	3	9	7	5	4	3
50-70	C	0.297	15	8	2	4	4	8	10	5	5	4

*Percent of heavy minerals in the whole soil of those in the 0.1-0.05 mm plus the 0.05-0.02 mm fractions.

TABLE II. RATIOS OF ZIRCON/TOURMALINE IN THE VERY FINE SAND AND COARSE SILT OF THE TALOKA-1, TALOKA-2, AND TELLER PROFILES AND ZIRCON + TOURMALINE/HORNBLENDE IN THE VERY FINE SAND AND COARSE SILT OF THE TALOKA-1 AND TALOKA-2 PROFILES.

Depth		Zircon/Tour. Ratio		Zircon + Tour./Horn. Ratio	
Inches	Horizon	Very Fine Sand	Coarse Silt	Very Fine Sand	Coarse Silt
		TALOKA-1			
0-20	A1	2.0	1.7	3.8	8.0
20-26	A21	1.8	3.0	2.8	5.3
26-32	A22	2.8	1.7	5.0	5.3
32-42	B21	1.6	1.4	4.3	3.0
42-54	B22	2.0	1.2	3.0	6.5
54-60+	C	1.8	0.6	3.4	4.0
		TALOKA-2			
0-11	A1	3.0	1.4	4.0	2.4
11-16	A21	2.4	1.3	4.3	5.3
16-24	A22	2.0	0.9	3.8	5.7
24-36	B21	1.3	1.0	3.2	9.0
36-60	B22	0.9	0.7	3.8	4.8
60-100+	C	0.7	0.9	6.0	3.2
		TELLER			
0-11	A	1.7	1.7		
20-28	B	4.0	1.3		
50-70	C	1.9	0.8		

Light mineral determination—The different light mineral species of the very fine sand and coarse silt size fractions were identified and were calculated as percent by volume of the total light minerals in each fraction. Feldspars and quartz compose more than 95% of the total light minerals in all horizons. Orthoclase is the dominant feldspar with microline and plagioclase composing a minor part of the feldspars.

CLASSIFICATION ACCORDING TO THE SEVENTH APPROXIMATION BY THE SOIL SURVEY STAFF, SCS, USDA, 1960.

Based on the results of this study and of the earlier study by Brengle, et. al. (1957) the Taloka and Teller soils were classified as follows:

Taloka — Clayey, mixed, nonacid, thermic, Typic Argialboll
Teller — Fine loamy, mixed, acid, thermic, Typic Argiudoll

It was necessary to make certain assumptions in the classification, and further study would possibly lead to revision of the classification.

LITERATURE CITED

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