

Short Notes

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LEACHED, CLAY-ENRICHED ZONES IN POST-SANGAMONIAN DRIFT IN SOUTHWESTERN OHIO AND SOUTHEASTERN INDIANA

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Zones of leaching and clay accumulation in outwash beneath calcareous till have been observed at many places in southwestern Ohio and southeastern Indiana. Most of these zones are a few inches to a foot or more thick, and in a few places tongues extend as much as several feet down into the sand and gravel. They resemble the *B* horizons of present-day gray-brown podzolic soils of the Fox series developed in glaciofluvial terrace materials.

Several workers have considered these leached zones that contain accumulated clay to be remnants of a Fox-like paleosol of regional extent and have used them as a key horizon for correlations in southwestern Ohio. These leached, clay-enriched zones in outwash have been supposed to be of the same age as a zone of leaching in till exposed in a railroad cut at Sidney, Ohio (Goldthwait, 1955; Flint and Rubin, 1955; Forsyth and La Rocque, 1956; La Rocque and Forsyth, 1957; Flint, 1957; and Forsyth, 1957). Flint and Rubin (1955) state that

"The soil, as well as the till and gravel in which it is developed, is believed to be post-Sangamon and pre-Wisconsin of existing terminology. The alternative possibility, that the soil is Sangamon and the drift beneath it Illinoian, is unlikely because weathering of the till is not comparable to that developed on drift of known Illinoian age."

During several years of study of the Pleistocene in the Whitewater valley of southeastern Indiana and surrounding areas, we found considerable evidence to suggest that the zones of leaching and clay accumulation in outwash beneath calcareous till in this area are not remnants of a paleosol but are extensions of the present surface soils through joints in the thin overlying till. This evidence and some of the implications are presented below.

In the area considered, a distinct soil discontinuity between the Miami and Russell silt

loams marks the boundary between two till sheets (tentatively "Champaign" and "Shelbyville" respectively). (See Gooding, 1957, p. 19-23, Figs. 4, 5, Pl. I.) The Miami soils to the north are developed in till that overlies the presumed paleosol; the Russell soils to the south are developed in till that, according to the published interpretations of the workers previously mentioned, must be of the same age as the stratified drift in which the suggested paleosol is developed. The greater depth of leaching of the Russell soils might seem to support the interpretation of a soil-forming interval between these two till sheets. However, the nature of the parent material, especially the thickness of loess mantles, is important in evaluating depths of leaching.

Gooding (1957) found that the depth of leaching on glaciofluvial terrace surfaces of the same level, and of the same age, varied directly with the thickness of the loess mantle. This relationship was found also on the till uplands in the area of Miami soils. The depth of leaching of the Russell soils averages about $1\frac{1}{2}$ times that of the Miami soils; this corresponds to differences in the thickness of the loess mantle on Russell and Miami soils. Miami-like soils occur at places in the area of Russell soils and, to a lesser extent, a few patches of Russell-like soils occur in the area of Miami soils, depending on the thickness of the loess mantle. Thus, we think that variations in the thickness of relatively fast-leaching loess is more responsible than is the time factor for the difference in depth of leaching between the areas of Miami and Russell silt loam soils.

Evidence from terrace studies in the Whitewater basin (Gooding, 1957) suggests that the time intervals between the post-Sangamonian glaciations in the basin were probably short and cool. Ice blocks up to three quarters of a mile across, believed to have been vestiges of the ice sheet that deposited the drift on which the

Russell soils are developed, were buried in the valley train associated with the advance of the ice that deposited the drift on which the Miami soils are developed. These ice blocks remained

at least three (the first may consist of two) post-Sangamonian tills regionally in the basin (Gamble, 1955, M. S. Thesis, Earlham College, 44 p.; Gooding, in preparation). The upper

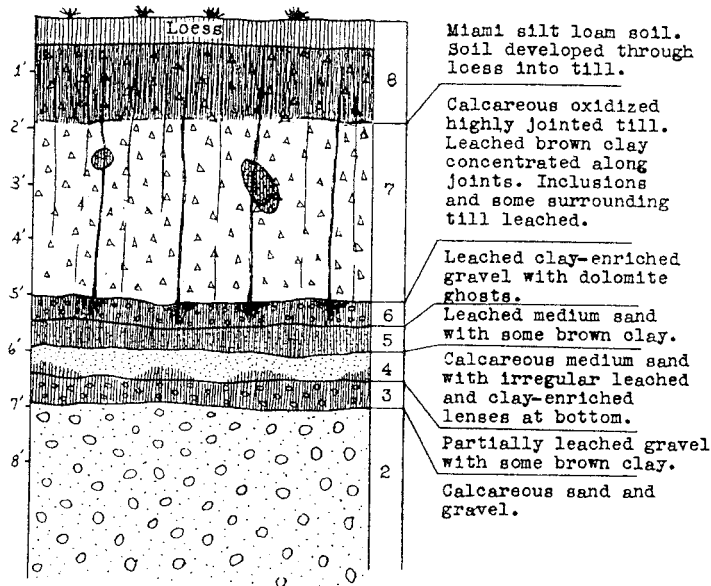


FIGURE 1.—SECTION SHOWING THE RELATIONSHIP OF LEACHED, CLAY-ENRICHED ZONE IN OUTWASH TO SURFACE SOIL AND JOINTS IN OVERLYING TILL

Section exposed along creek bank in NE $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 15, T.14 N., R.1 W., Wayne County, Indiana.

frozen while the ice melted back a short distance and then readvanced to Leverett and Taylor's (1915) "Bloomington" moraine position at the head of the basin. A scour surface formed by meltwater from the "Bloomington" ice partially exhumed some of the blocks of ice buried earlier. Their subsequent melting produced kettles, some of which lie on the escarpment between the valley-train terrace level, and the "Bloomington" scour terrace level. Thus, buried ice blocks apparently existed in valleys during the assumed interval of paleosol formation.

If the time interval between the glaciations that deposited the drift on which the Russell and Miami soils are formed was warm and long enough—estimated at 16,000 years by Flint and Rubin (1955, p. 4)—to permit the development of Fox soils similar to those found at the surface in the area today, then certain gravel-terrace soils beyond the Miami-Russell soil boundary should have very deeply leached profiles. No such deeply leached gravel-terrace soils of post-Sangamonian age exist in the Whitewater basin. Deep leaching on Whitewater terraces is confined to deep "backwater" silt deposits.

The detailed stratigraphic studies in the Whitewater basin so far indicate that there are

till does not extend south of the Miami-Russell soil discontinuity, but the other two extend well to the south of this line. Thin zones of leaching and clay accumulation, with a few more deeply penetrating leached tongues, have been observed at many places in outwash beneath post-Sangamonian till far south of the Miami-Russell soil discontinuity, as well as beneath the uppermost post-Sangamonian till in the area of Miami soils. In addition, similar leached, clay-enriched zones in outwash sand and gravel lie beneath thin till at Winchester, Indiana, on a terrace of the White River. This till is more clayey than the till south of Leverett and Taylor's (1915) "Bloomington" moraine in the Whitewater basin and surely is younger. Thus, the authors believe that these leached, clay-enriched zones in outwash beneath till are related to the existing landscape and surface soils and occur at various stratigraphic horizons.

In all places where the authors have observed the leached, clay-enriched zones in outwash, the overlying calcareous till is thin, thoroughly oxidized, and well jointed. This has also been noted by Dr. Guy D. Smith (Oral communication). Figures 1 and 2 illustrate two exposures that show some interesting features bearing on

the origin of the leached, clay-enriched zones in outwash beneath calcareous till.

At the locality shown by Figure 1, the following features are important:

Evidence leading to this same interpretation is seen at the location shown by Figure 2:

(1) The thin till (2) in this exposure is thoroughly oxidized and well jointed. Clay is

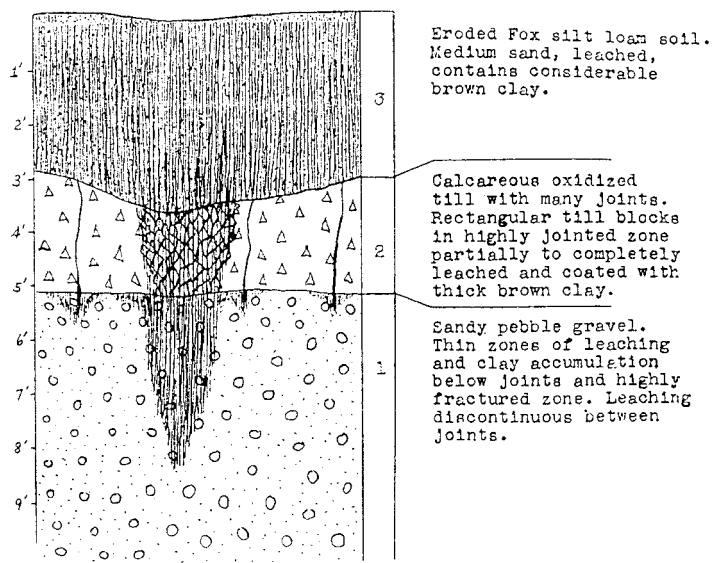


FIGURE 2.—SECTION SHOWING THE RELATIONSHIP OF LEACHED, CLAY-ENRICHED ZONE IN OUTWASH TO SURFACE SOIL AND JOINTS IN OVERLYING TILL

Section exposed in gravel pit north of Cambridge City, Indiana, in the SW corner, Sec. 23, T.16 N., R.12 E.

(1) Stratification is well preserved in the leached, clay-enriched zones, especially in the sand units. Also, the leaching and clay accumulation is variable from one unit to another. The sand unit (4) is only partially leached at the bottom; the overlying and underlying units (5 and 3) are more thoroughly leached and are richer in clay. These features are not normal characteristics of the *B* horizon of a Fox soil.

(2) The joints in the thin oxidized till (7) are lined with dark-brown, noncalcareous clay, and they extend visibly into the underlying leached gravel (6). Leaching is most nearly complete, and there is more clay, adjacent to the joints than away from the joints in unit 6.

(3) Two leached sand inclusions were found in the overlying till (7), but both were bisected by joints, and some of the till around one of the inclusions was leached.

The evidence at the location shown in Figure 1 seems to indicate clearly that leaching of the outwash (units 3 through 6) beneath, and the sand inclusions within, the till (7) occurred after the deposition of till (7), not before. Thus, the leaching and clay accumulation beneath till is an extension of the present surface soil and not a remnant of a buried paleosol.

rich along these joints in the till (2) and in the leached sand gravel (1) immediately beneath them. Leaching in the outwash is discontinuous laterally between joints.

(2) At one place the thin till is strongly jointed into rectangular blocks. These blocks of till are partially to completely leached and covered with heavy dark-brown clay coatings. A leached, clay-enriched tongue extends from the overlying leached sand (3), through the highly jointed area in the thin till (2), and 3 feet down into the underlying outwash (1).

At the locality shown in Figure 2, the leached, clay-enriched zone in outwash beneath calcareous till cannot be a remnant of a paleosol but is an extension of the *B* horizon of the present surface soil through joints in the thin till (2).

Another point believed to be significant is that, to our knowledge, a complete Fox-like soil profile has never been found beneath till in the area considered.

We believe it significant also that no buried zone of leaching and clay accumulation has been found in till considered to be of post-Sangamonian age anywhere in the area, except at the Sidney, Ohio, cut.

We have visited and studied the Sidney,

Ohio, cut on two occasions. We believe that the paleosol developed in till at this section (see La Rocque and Forsyth, 1957, Fig. 2) is only the lower part of a truncated soil whose total pre-

cut. Figure 3 is our modification of, and addition to, La Rocque and Forsyth's (1957, Fig. 2) descriptions of this section. We discovered a zone of leaching and clay accumulation 6 inches

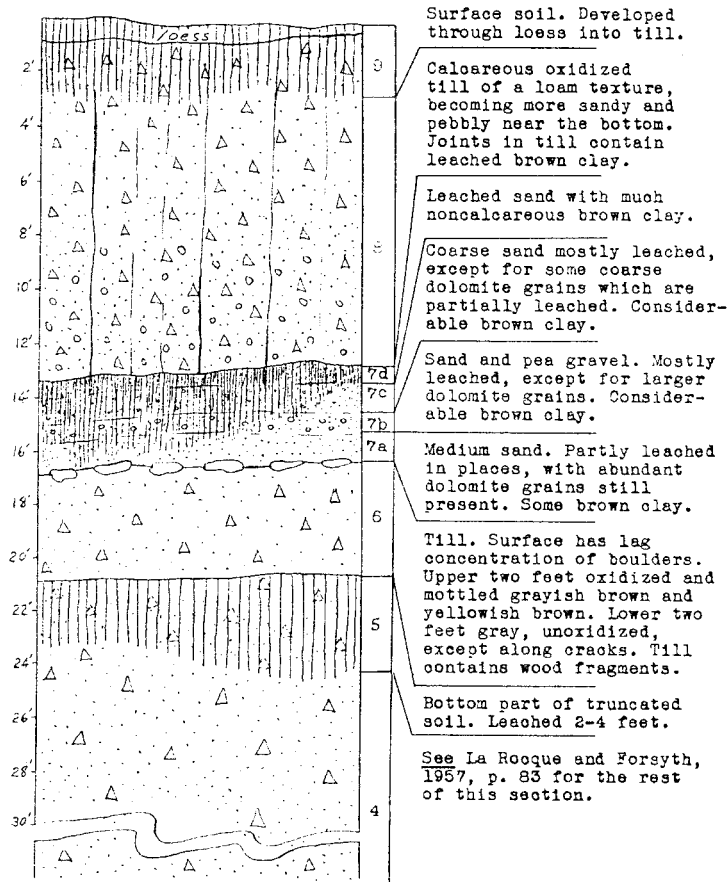


FIGURE 3.—THE AUTHOR'S MODIFICATION OF, AND ADDITION TO, LA ROCQUE AND FORSYTH'S (1957, FIG. 2) DESCRIPTION OF THE SIDNEY, OHIO, CUT

truncation depth of development may have been more than twice the thickness of the present zone of leaching, which is locally as much as 3-4 feet. We believe that the soil-forming interval was considerably longer than the 16,000 years suggested by Flint and Rubin (1955, p. 4). Therefore, if the widely occurring zones of leaching and clay accumulation in outwash beneath till are remnants of a Fox-like paleosol correlating stratigraphically with the zone of leaching in till at the Sidney, Ohio, cut (as suggested by Goldthwait, 1955; Flint and Rubin, 1955; Forsyth and La Rocque, 1956; La Rocque and Forsyth, 1957; Flint, 1957; Forsyth, 1957), they would be much more weathered and deeply developed than is the case.

There is a more serious basis for questioning the interpretations which the previously mentioned workers have given to the Sidney, Ohio,

to 2 feet thick at the top of the sand and gravel (7) beneath the oxidized and jointed "pebbly till" (8). This leached, clay-enriched zone in units 7a through 7d is identical with others found regionally in the area that are correlated by the previously mentioned workers with the truncated paleosol developed in till 5 but is here separated from till 5 by another till (6).

Conclusions

We believe that the post-Sangamonian leached, clay-enriched zones in outwash beneath calcareous till in southwestern Ohio and southeastern Indiana are related to the present landscape and are extensions of the present surface soils. The sands and gravels have been leached and illuviated by water that has passed through present surface soils and joints in the thin overlying calcareous till. They occur at

several stratigraphic horizons in this area and can be expected wherever the necessary conditions of good drainage through jointed surface till on outwash exist. The interpretation of these leached, clay-enriched zones in outwash beneath calcareous till as paleosols will inevitably lead to erroneous conclusions.

Acknowledgments

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