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**National
Soil Survey
Center**

Geomorphic Study in the Upper Gasconade River Basin, Laclede and Texas Counties, Missouri

Soil Survey Investigations Report No. 43

Abstract

This study was undertaken for the purpose of assisting the soil survey of the central Missouri Ozarks. The study began in Laclede County in the Drew 7.5 minute topographic quadrangle. This location was picked because it is typical of a large part of the Ozarks.

The Drew quadrangle is crossed from north to south by the divide between the Osage Fork River to the west and the Gasconade River to the east. The geomorphic map reveals a sequence of six surfaces—Drew, Falcon, Jacksonville, Lambeth, Lebanon, and Nebo. The Lebanon surface is an erosion surface that occupies the highest divide ridgetop or summit positions and is, therefore, the oldest. It is of small extent and exists as isolated remnants. The Falcon surface is a second summit surface, inset below the Lebanon and separated from it by a scarp. Drill hole and backhoe pit data show it to be, in part, of fluvial origin. It is a high, old, river terrace that now stands about 250 feet (76 m) above the present level of the Osage Fork River. It is not extensive.

Three valley slope erosion surfaces either truncate or occupy positions below the two summit surfaces. The Jacksonville surface is the oldest valley slope surface. It rises to and truncates the Lebanon and Falcon surfaces. It is of moderate extent and has relatively smooth rolling topography that has fairly long slopes. Topographic profiles show that it grades to a level well above the present stream system. The Drew surface is a younger erosion surface that has steeper slopes which truncate the Lebanon, Falcon, and Jacksonville surfaces. It is extensive. The Drew surface grades to the Lambeth terrace that stands from 40 to 50 feet (12 to 15 m) above the Osage Fork River. This terrace now exists as small remnants and cutoff meanders. The Nebo surface, that has even steeper slopes, truncates the Drew and grades to high floodplain steps and to the present floodplain.

The geomorphic mapping of Texas County, on the Houston and Raymondville 7.5 minute quadrangles, shows the same sequence of surfaces along the Big Piney River-Current River divide. One of the divide summit surfaces is the probable equivalent of the Lebanon surface. The other, the Success surface, is a higher and, therefore, older surface that exists as erosional remnants. Remnants of a high terrace standing about 220 feet (67 m) above the Big Piney River are identified and correlated with the Falcon surface in Laclede County. Three valley slope erosion surfaces were mapped. These surfaces have the same relationship to one another and to the summit and high terrace surfaces as the Jacksonville, Drew, and Nebo surfaces in Laclede County. One of the three surfaces grades to remnants of a terrace in the Big Piney Valley that stands from 40 to 60 feet (12 to 18 m) above the Big Piney River.

This relationship of erosion surface and terrace is similar to the Drew-Lambeth terrace relationship of the Osage Fork Valley in Laclede County. This eroded terrace and the related meander cutoffs can be traced down the Osage Fork to the Gasconade River, down the Gasconade to the Big Piney River and up the Big Piney to within 4 miles of its headwaters. Thus, the Lambeth terrace is of regional extent, and an erosion surface (Drew) that grades to it in the Osage Fork Valley can be correlated with the erosion surface that grades to it in the Big Piney Valley. The correlation of the Drew surface in Texas County makes it possible to correlate the other Texas County surfaces with those in Laclede County because of the similar relationship with the Drew surface in both cases.

Breshears Valley, a meander cutoff that stands from 40 to 50 feet (12 to 15 m) above the Pomme de Terre River level has been investigated by other workers and dated by their geochronologic and archaeological studies. The results follow: Alluviation of meander sediments began more than 160,000 years before present (BP); ended about 50,000 years BP; and the meander was abandoned 49-45,000 years BP. Topographic maps show Breshears Valley to be one of a series of cutoff meanders and terrace remnants similar to the Lambeth terrace in the Osage Fork Valley. Drew erosion, therefore, began more than 160,000 years BP and ended about 50,000 years BP. This includes the latter part of the Illinoian, the Sangamon Interglacial, early Wisconsin, and possibly some of middle Wisconsin. Geomorphic surface relations show that the Jacksonville, Falcon, Lebanon, and Success surfaces are all older than the latter part of the Illinoian. The Nebo surface and its associated complex of high floodplain steps and the present floodplain would range from middle Wisconsin to Holocene.

Acknowledgments

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Maurice J. Mausbach, SCS, research soil scientist, National Soil Survey Laboratory, provided major assistance with soil sampling, laboratory processing of samples, and data interpretation. He also assisted with the geomorphic mapping.

The Forest Service staff at Mark Twain National Forest provided the assistance of soil scientists, access to Forest Service land for soil sampling in Laclede County, and access to land in Texas County for the Big Piney River terrace study. The Division of Geology and Land Survey, Missouri Department of Natural Resources, provided power auger equipment and operating personnel for a part of this study in Laclede County. Geologist Ronald Ward provided information about the bedrock stratigraphy in Laclede County. Geologist John W. (Bill) Whitfield provided field assistance and geologic council.

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Geomorphic Study in the Upper Gasconade River Basin, Laclede and Texas Counties, Missouri

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Introduction

This study of the geomorphology of the central Missouri Ozarks was undertaken to aid the National Cooperative Soil Survey in the Ozarks. An understanding of the relationships among soils, landforms, and surficial stratigraphy (soil parent material) enhances the predictive capabilities of soil scientists. This results in faster and more accurate soil mapping. The study was begun in Laclede County in the Drew 7.5 minute topographic quadrangle. This location was picked because it is typical of a large part of the Ozarks and some soil mapping was complete. The study was designed to develop an understanding of the evolution of the landscape by determining the character and sequence of the geomorphic surfaces that exist in it.

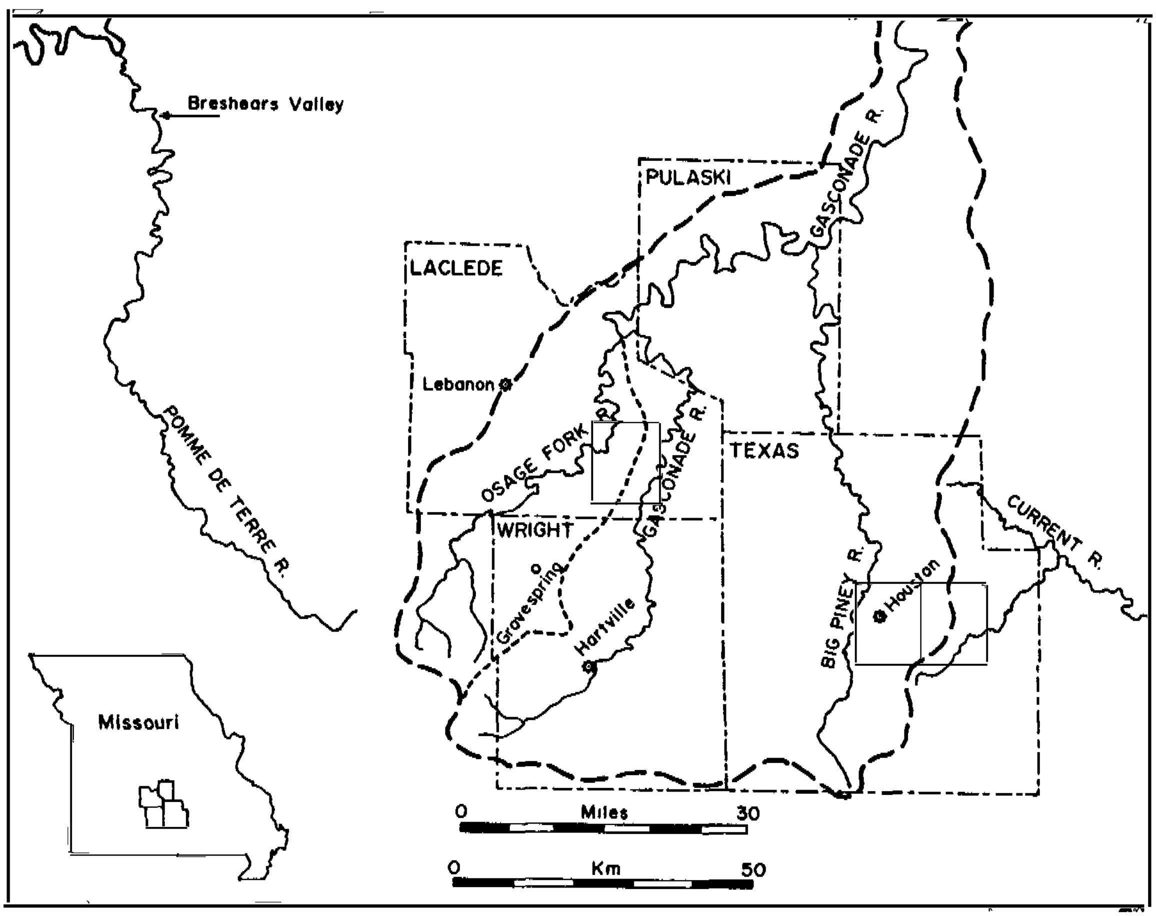

Figure 1. *Generalized map of the upper Gasconade drainage basin. The Drew Quadrangle is outlined in Laclede County and the Houston (west) and Raymondville (east) Quadrangles are outlined in Texas County. The heavier dashed line defines the Gasconade drainage divide. The lighter dashed line is the Osage Fork River - Gasconade River divide. The open stars show the county seats.*

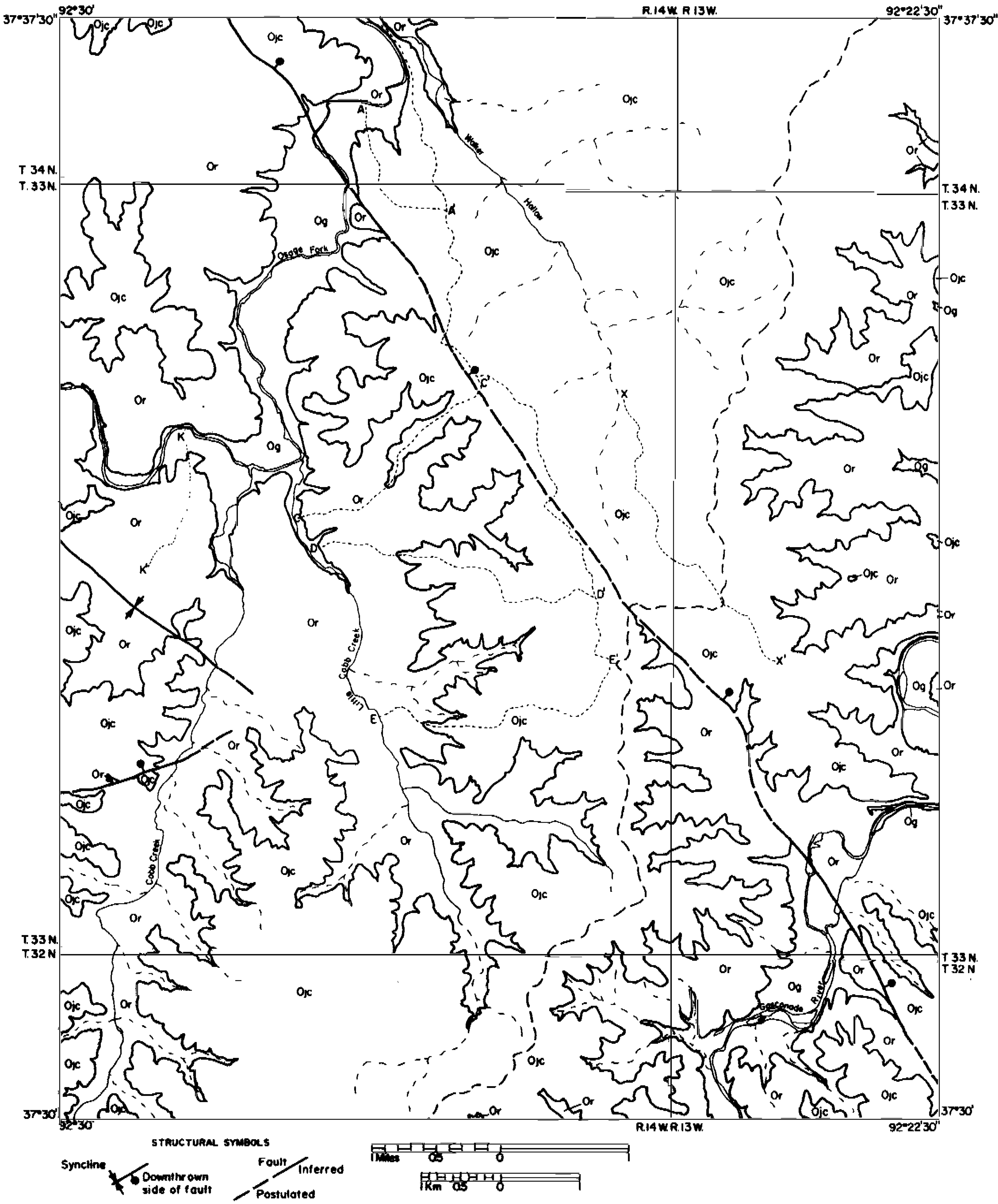

Figure 2. *Geologic map of the Drew 7.5 minute Quadrangle. The heavier northwest-southeast trending line is the "Jacksonville" fault. Lighter dashed line is the Osage Fork - Gasconade divide. Fine dashed lines show topographic profile locations and are labeled A — A', etc. Ojc = Jefferson City Fm.; Or = Roubidoux Fm; Og = Gasconade Fm. Taken from Missouri Department of Natural Resources, Division of Geology and Land Survey Open File Map - 84-190-GI.*

Several aspects are considered within such a study. One aspect is the establishment of the geomorphic or site history (*Daniels and others, 1971*, p. 85), that is, the development of an understanding of the evolution of the landscape. This involves determining the relative ages of the various parts of the landscape. These parts are geomorphic surfaces that can be mapped, and, in some instances, dated in actual years. Relations among geomorphic surfaces provide a chronologic framework for the study of soils. Along with this is the study of surficial stratigraphy, the determination of the origin, age, and character of the soil parent material related to the various geomorphic surfaces.

This geomorphic or site history forms a basis for understanding and then predicting the distribution of soils. It also provides for a better understanding of the genesis of the soils, leads to a firmer basis for their classification, and can be used to improve interpretations for use and management.

As originally proposed, this study was intended to assist a five-county survey area in the central Ozarks—Laclede, Morgan, Camden, Pulaski, and Miller Counties. Dave Wolf, party leader for this five county area, recommended that the study begin on representative terrain in Laclede County. The Drew 7.5 minute topographic quadrangle (fig. 1) was picked because some soil mapping was in progress, geomorphic surfaces were evident, and the major Osage Fork River - Gasconade River divide traversed the quadrangle from north to south. The Drew Quadrangle was a 10-foot (3 m) interval map; 10-foot (3 m) interval maps were available for a large adjacent area. Field work began in the Laclede County, Drew Quadrangle area, in August 1978.

Geomorphic surfaces were identified and mapped in detail in the Drew Quadrangle. work on geomorphic surfaces was extended north to the Osage Fork - Gasconade River confluence, southwest to the vicinity of Grovespring in Wright County, west to the vicinity of Lebanon, northeast to the Gasconade River, and east to the Laclede-Texas county line (fig. 1).

In 1984 the study was expanded into Texas County in support of a soil characterization study. Detailed geomorphic surface mapping was done in the Houston and Raymondville 7.5 minute quadrangles (fig. 1).

General bedrock geology

The bedrock of the Drew Quadrangle is composed of nearly horizontal Ordovician dolomites (fig. 2). The Jefferson City Dolomite is probably the major unit. It occurs along the Osage Fork - Gasconade divide and part way down the valley slopes. The Roubidoux Formation underlies the Jefferson City and is on the lower valley slopes. The Gasconade Dolomite is beneath the Roubidoux and is in the valley bottoms of the major streams, the Osage Fork River, and the Gasconade River.

These formations are high in siliceous material and can be described as cherty dolomites. The insoluble residue content (*Grohskopf and McCracken, 1949*) is high enough to produce a thick residuum when the carbonates are weathered out. In a drill hole transect, residuum thickness on the Jefferson City Formation varies from a few feet (1 m) to more than 47 feet (14 m). Mineralogical studies on the drill hole samples show that kaolinite and illite are the principal clay minerals in the Jefferson City residuum.

In the reconnaissance area around the Drew Quadrangle, the Jefferson City, Roubidoux, and Gasconade formations are in the same general sequence as in the Drew Quadrangle. Faults occur at various locations throughout the area.

The same Jefferson City, Roubidoux, and Gasconade sequence is present in Texas County. The Gasconade occurs in the bottom of the Big Piney River valley in the northern half of the county. Occasional faults are also present.

Concept of geomorphic surfaces

This study is approached from the point of view of identifying and mapping the sequence of geomorphic surfaces that compose the Ozarks landscape. The geomorphic work is done independently without reference to the soils. When it is finished, soil-surface relationships can be determined. Such relationships enhance the prediction of the occurrence of soils on the landscape. In addition, the geomorphology provides a time framework for study of the soils (*Ruhe, 1975*) because the relative ages of the surfaces are known and sometimes the actual age has been established.

A geomorphic surface is a part of the landscape that can be defined in space and time, and may include many landforms (*Ruhe, 1969*). It is a mappable feature, that is, it has defined limits or borders that can be identified. It has no thickness because it is a surface (*Daniels and others, 1971*). Its relation with other surfaces and association with rocks or sediments below or on it can be specified. It can be dated in a relative (older or younger than) or numerical (actual age in years) sense. A geomorphic surface can be given a geographic name when it is formally recognized (*Ruhe, 1969, 1975*).

A geomorphic surface may have related erosional and depositional elements (*Daniels and others, 1971*). It represents a specific period when processes of erosion and deposition were operating to produce a land surface of some extent, affected throughout by a particular sequence of events.

Recognition of a geomorphic surface is based on a number of clues derived from field observation, topographic map study, and air-photo interpretation. One important clue is a series of steps along the axis of a drainage divide where progressively lower levels, separated by scarps (steeper slopes), indicate a sequence of surfaces. Accordant summits in a dissected landscape may suggest a high surface of low relief that now exists as small ridgetop remnants. Intersecting sets of slopes may be evidence of a series of geomorphic surfaces. Steep slopes, that lie below and truncate or intersect less steep slopes or a flat area, can represent a younger erosion surface encroaching on a higher, older erosion surface or a depositional surface. The steep slopes may grade to the present drainage system. The higher less steep slopes may grade to a former drainage system that existed above the present valley floor. These and other clues are discussed in detail by Ruhe *(1975)* and Daniels and others *(1971)*.

Criteria for establishing relations between erosion surfaces and depositional surfaces
Landscapes do not develop through continuous slow erosion and alluviation but rather through periods of erosion and deposition followed by a period of stability. Each period of alluviation has to be accompanied by contemporaneous erosion of a source area. Valley slopes, shoulders, and narrow ridge crests are the sources of the alluvial fill on an adjacent valley floor. If a valley slope grades to or merges with an alluvial fill in a smooth concave profile, then the slope is an erosion surface the same age as the fill. The valley slope is the erosional equivalent of the depositional surface on the adjacent fill (*Daniels and Jordan, 1966*, pp. 35-38).

Not all valley slopes are necessarily eroded during a particular cycle. Slopes grading to an older alluvial fill have probably suffered little or none of the erosion that affected the slopes grading to a lower and younger fill. Such a landscape is not the same age in every part and actually consists of geomorphic surfaces of different ages. It may be a complex of surfaces difficult to separate into discrete units (*Daniels and Jordan 1966*, pp. 35-38).

Methods

Field
Geomorphic surfaces were mapped on 7.5 minute topographic quadrangles, in part by visual tracing of the identified surfaces in the field. Surfaces were also mapped, in part, by topographic map interpretation based on elevations and slope characteristics interpreted from contour line spacing. This mapping was verified in the field later at selected sites. Criteria for identifying and defining the various surfaces are presented in later sections where the specific geomorphic surface is discussed.

Surficial stratigraphy study was by power auger drilling with 4-inch (10 cm) flight auger and large 12 to 15 foot (3.6 to 4.6 m) deep backhoe pits. Soil sampling for characterization analysis was from these pits. Elevation control for the surficial stratigraphic sections was by transit survey.

Laboratory
Standard soil characterization analysis methods given in Soil Survey Investigations Report No. 1 (*Soil Survey Staff, 1984*) were used.

Other methods
Topographic profile sections and stream profiles were constructed in the office using standard methods as outlined by Lahee *(1952)*. The roundness terminology used in describing the shape of pebbles and cobbles in the various stratigraphic units follows the criteria of Powers *(1953)*.

Geomorphic Surfaces, Laclede County

The 7.5 minute Drew Quadrangle was selected as representative of the Laclede County soil survey area (fig. 1). This quadrangle and most of the adjoining ones had a 10-foot (3 m) contour interval. This interval is close enough that considerable detail about the shape of the land surface can be interpreted and elevations can be estimated fairly closely.

The Drew Quadrangle is crossed from north to south by the major drainage divide between the Osage Fork River to the west and the Gasconade River to the east (figs. 1 and 3A). This divide rises to the White River divide about 25 miles (40 km) to the southwest. The Osage Fork joins the Gasconade River about 9 miles (14.5 km) north of the Drew Quadrangle. The Gasconade eventually joins the Missouri River about 80 miles (129 km) northeast of this confluence.

The initial inspection of the Drew Quadrangle noted a relatively flat area on the divide and on a minor interfluve in the northern part of the quadrangle. In addition, on the main divide there was a step (scarp) up to a higher level toward the south (Location 1, fig. 3A). This was suggestive of two geomorphic surfaces on the main divide. The geomorphic surface mapping was begun at this point by drawing the toe of the scarp, delineating the higher area, and beginning to define the borders of the lower ridgetop area to the north.

Other surfaces were recognized, their place in the sequence determined, and concepts were generally refined as detailed mapping was expanded into the rest of the quadrangle. Reconnaissance geomorphic mapping was carried into parts of the adjoining Oakland, Russ, Grovespring, Drynob, Brownfield, and Winnipeg Quadrangles.

Divid summit surfaces

The divide summit surfaces are the surfaces that occupy the highest parts of the landscape along the Osage Fork - Gasconade divide.

Lebanon surface

The Lebanon (Lb) surface occupies the highest topographic positions on the Osage Fork - Gasconade divide in the Drew Quadrangle (fig. 3A). It is the higher level of the two initially identified in the north end of the quadrangle. By the principles of ascendancy and descendancy (*Ruhe, 1975*, p. 223), this surface is the oldest because it is the highest in this landscape. It is named the Lebanon surface after the town of Lebanon on the western divide of the Gasconade drainage.

The Lebanon surface exists on the Osage Fork - Gasconade divide as remnants, isolated from each other by other younger erosion surfaces (figs. 3A, 3B and 4). These remnants rise from north to south toward the White River divide as shown in figure 4. Their individual elevation ranges, estimated from the topographic map, from north to south are given in table 1.

Table 1. *Geomorphic surface site elevation ranges for the Lebanon and Falcon surfaces, from north to south along the Osage Fork - Gasconade divide, estimated from the Drew 7.5 min. quadrangle.*

Lebanon surface Site No.	Lebanon surface Elev. range feet	Falcon surface Site No.	Falcon surface Elev. range feet
1	1,230 - 1,245	North 6	1,200 - 1,230
2	1,250 - 1,271	7	1,210 - 1,225
3	1,260 - 1,283	8	1,220 - 1,230
4	1,260 - 1,300	9	1,220 - 1,235
5	1,295 - 1,314	10	1,220 - 1,235
		11	1,240 - 1,250
		12	1,245 - 1,255
		South 13	1,240 - 1,258

These remnants are part of a formerly more extensive erosion surface. This interpretation is based on the generally undulating or rounded, sloping form and because the remnants stand above, and are truncated by, the steeper slopes of the other surrounding erosion surfaces. In addition, deep pits dug in the remnants did not reveal any identifiable fluvial or terrace deposits. The surficial deposit sequence is usually a thin silty surface, probably loess, over a chert pebble lag concentration which in turn rests on weathered residuum of the Jefferson City formation (figs. 5 and 6). There is often a stone line at the contact between the cherty zone and the weathered residuum. The stone line indicates that the cherty

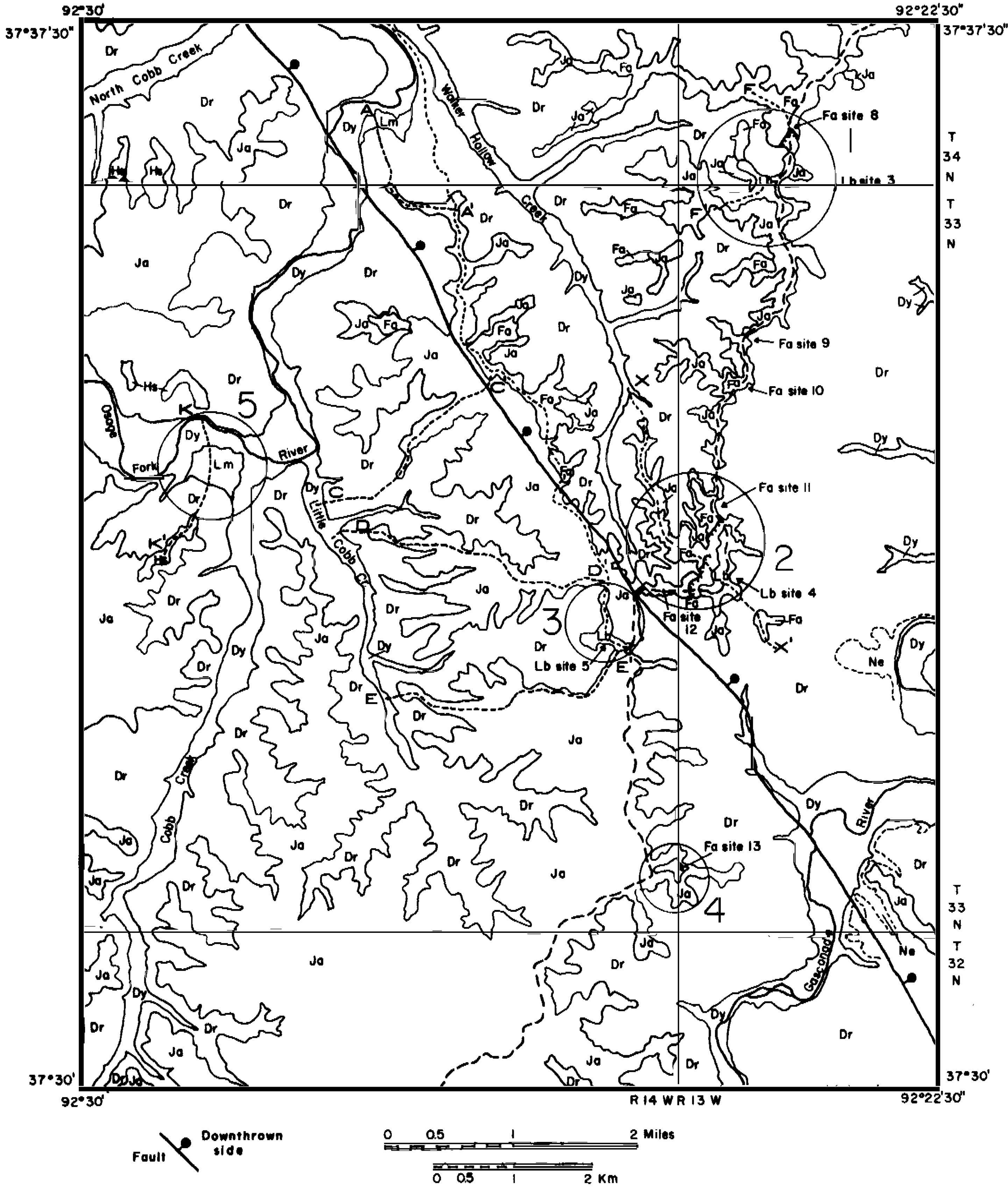

Figure 3A. *Geomorphic map of the Drew 7.5 minute quadrangle. The heavier line shows the trend of the "Jacksonville" fault, downthrown block on the northeast side. The coarse dashed line is the Osage Fork - Gasconade divide. Fine dashed lines show topographic profile locations and are labeled A ... A', etc.. The numbered circled areas indicate locations discussed in the text. Hachured lines (hachures upslope) show scarp toes. Ne = Nebo surface; Dy = Drynob complex, Dr = Drew surface, Lm = Lambeth terrace, Ja = Jacksonville surface, Hs = high strath terrace, Fa = Falcon surface, Lb = Lebanon surface.*

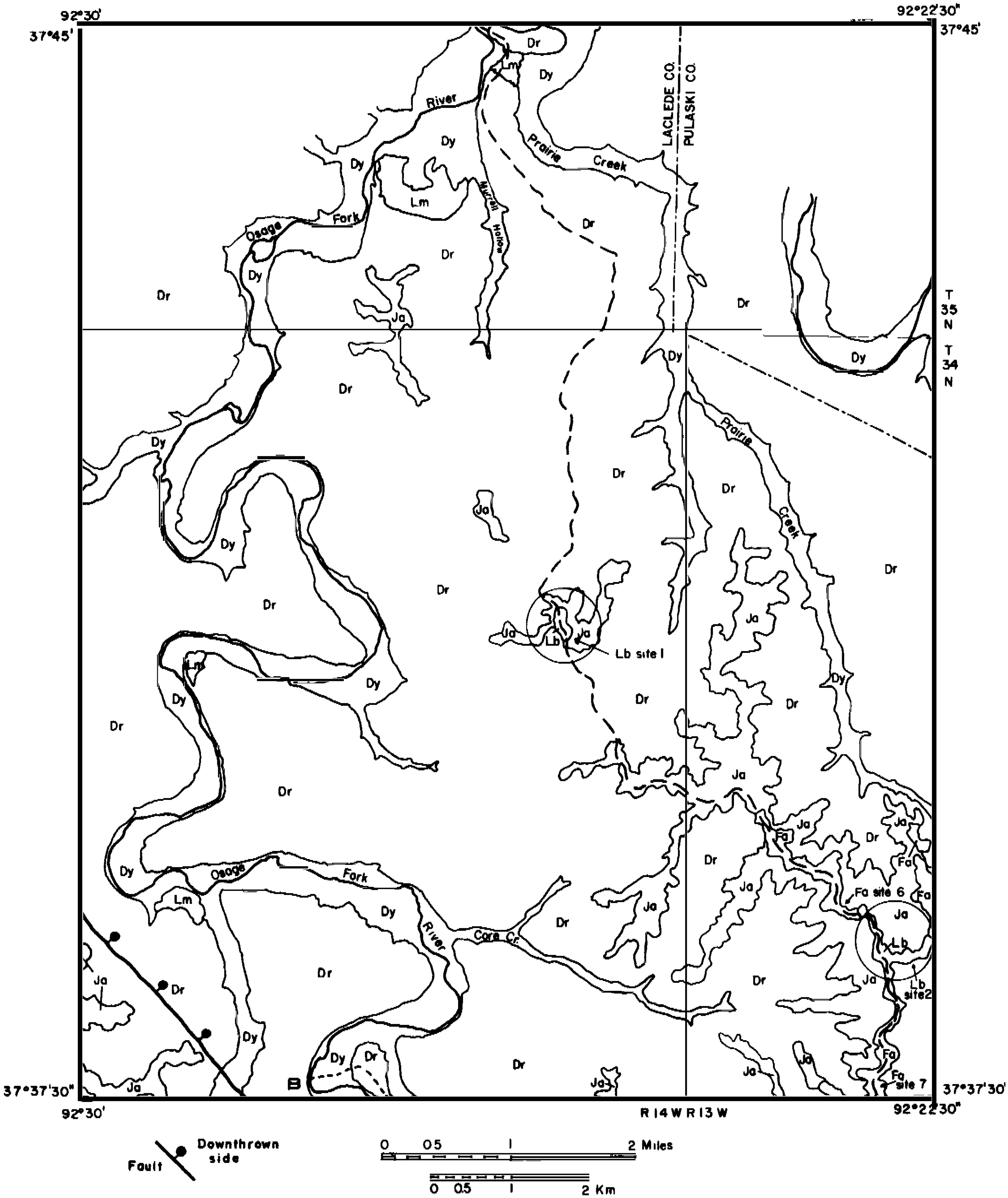

Figure 3B. *Geomorphic map of the Drynob 7.5 minute quadrangle. Joins figure 3A along the northern edge.*

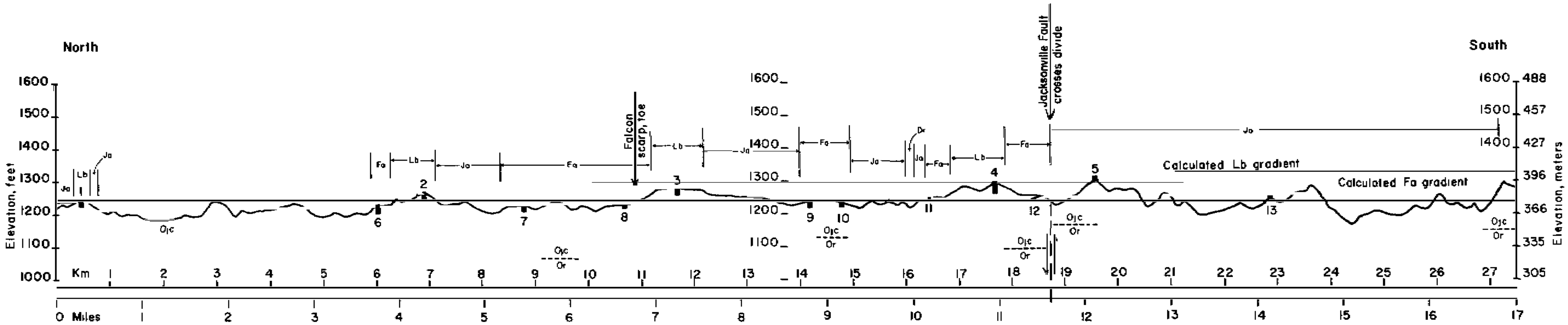

Figure 4. *Osage Fork River - Gasconade River divide topographic profile, north to south across part of the Drynob and Drew Quadrangles. Numbers 1 through 5 are Lebanon surface sites. Numbers 6 through 13 are Falcon surface sites. These sites are shown on figures 3A and 3B. The vertical length of the site symbol shows the elevation range of the site. Lb = Lebanon surface; Fa = Falcon surface; Ja = Jacksonville surface; Dr = Drew surface. The geologic contacts are taken from Missouri Department of Natural Resources geologic maps.*

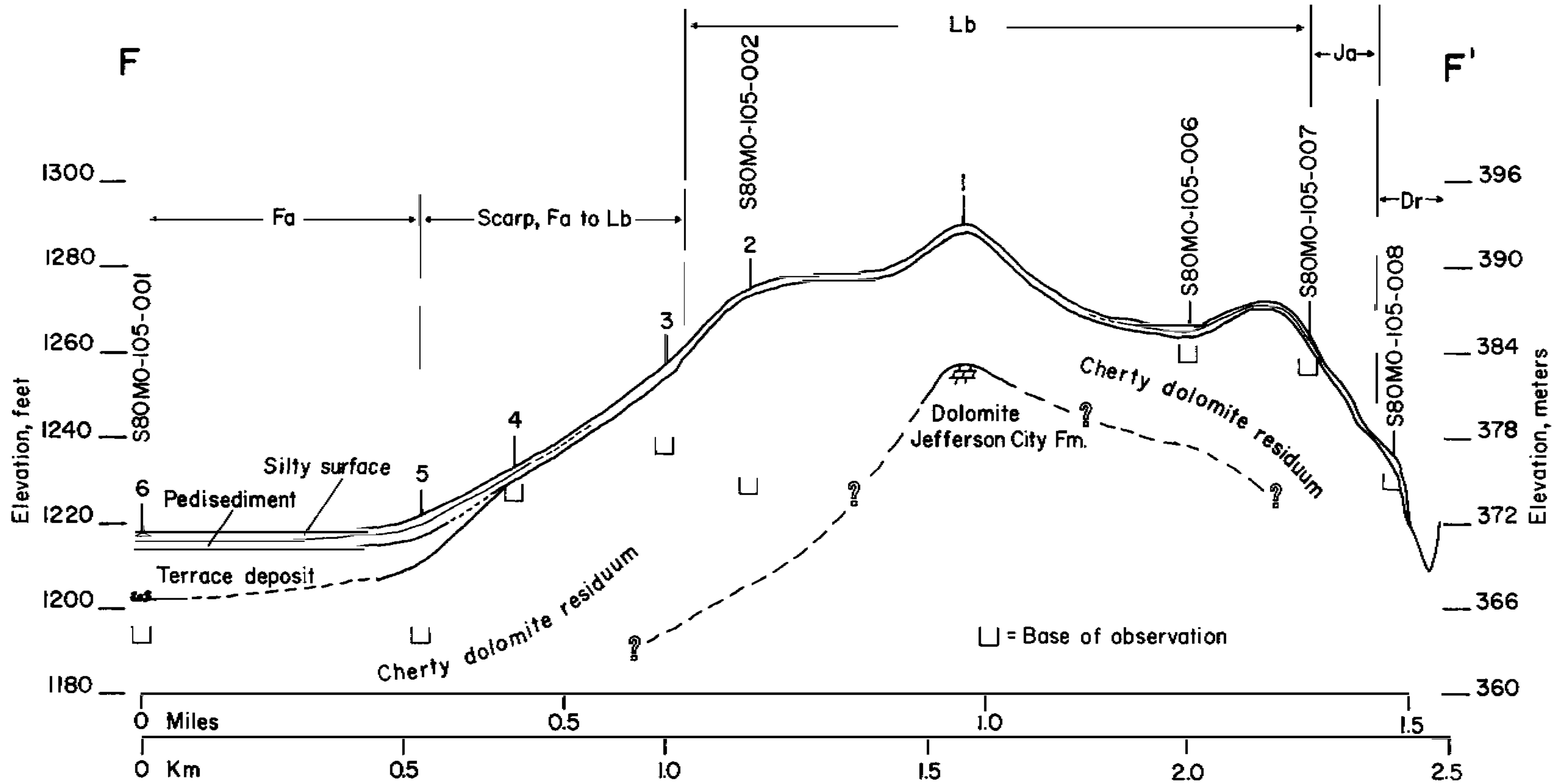

Figure 5. *Topography and surficial stratigraphy of profile FF', Lebanon - Falcon drill transect (location 1, fig. 3A). Surficial stratigraphy is from soil sampling pits (alpha-numeric codes) and power auger holes (numbers 1 through 6). Notes for power auger sites are in appendix A; pedon descriptions are in appendix E. Fa = Falcon, Lb = Lebanon, Ja = Jacksonville and Dr = Drew surface. Vertical exaggeration is 26X.*

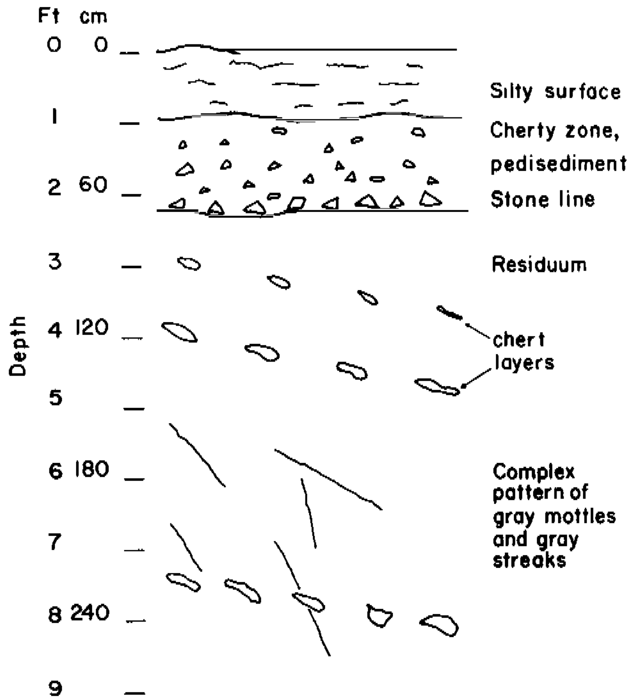

Figure 6. *Field sketch of surficial deposits on the Lebanon surface at sampling site S80MO-105-6 on profile FF', figure 5.*

zone is probably pedisediment (*Ruhe, 1975* p. 130), a type of surficial deposit characteristic of an erosion surface. The silty overlay, plus the cherty zone, is relatively thin across these remnants of the Lebanon surface as shown in figures 5 and 6.

Falcon surface

The Falcon surface was first noted, in the initial inspection of the Drew Quadrangle, as the relatively flat area on the main divide and on a minor interfluve in the northern part of the quadrangle (fig. 3A). This area is topographically below the Lebanon surface remnants and is separated from the Lebanon surface by the Falcon scarp with 40 to 50 feet (12 to 15 m) of relief. This is illustrated in figure 3A, location 1, and in figure 4. The name is taken from the small community of Falcon located about 1 mile to the east along State Route 32.

A fairly extensive area of the Falcon surface occupies the main divide ridgetop to the northeast of the scarp. This surface also occupies the summit of a minor interfluve to the west northwest of the scarp site (location 1, fig. 3A). The surface is flat enough, in the vicinity of the scarp toe and out away from the toe, for 3 to 5 tenths of a mile (0.3 to 0.5 km), so that it looks like a terrace. A series of power auger holes were drilled across the Lebanon surface, down the scarp and out onto the Falcon surface toward the northwest (See profile FF', location 1, fig. 3A).

The topographic profile and surficial stratigraphic section developed from these power auger holes and several soil sampling pits is shown in figure 5. The inset terrace deposits shown by drill holes 5 and 6 confirms the interpretation that a part, at least, of the Falcon surface is a terrace surface that now occupies the ridgetop position about 250 feet (76 m) above the present Osage Fork River level.

The fluvial character of the inset unit is demonstrated by the presence of subrounded to subangular chert gravel noted as occurring throughout the unit with some concentration at the base (see Drill Hole Notes appendix A). The pedisediment is probably local material derived from the present scarp and from other higher areas that no longer exist. The silty surface is the thin covering of loess, recognized as covering a large part of the Ozark landscape (*Scrivner, 1960*). The inset of the Falcon surface and the "terrace" materials below the Lebanon surface show that the surface and terrace materials are younger than the Lebanon surface.

The Falcon surface is mapped as remnants along the divide for a distance of about 10.5 miles (17 km) as shown on figures 3A, 3B, and 4. The elevations (table 1) of the remnants (fig. 4) rise toward the south so that the surface has a gradient of 3.4 feet (1.04 m) per mile. North of the Falcon scarp the surface occupies a ridgetop position on the main Osage Fork - Gasconade divide. To the south the surface occurs off the divide as well as on it. The surface exists as erosionally isolated remnants on some of the minor interfluves flanking Walker Hollow Creek. At location 2, figure 3A, the Falcon surface occupies a definite within valley position at the present head of Walker Hollow. Topographic profile XX' (fig. 7) shows the Falcon surface to be inset below the Lebanon surface similar to the inset at location 1. Note that the profile XX' traverses the middle one

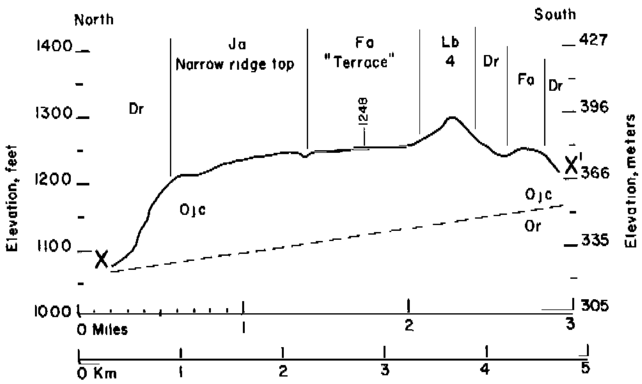

Figure 7. *Topographic profile XX' showing Falcon "terrace" inset topographically below the Lebanon surface at location 2 on figure 3A. Lb = Lebanon surface, Fa = Falcon, Ja = Jacksonville, Dr = Drew, Ojc = Jefferson City Fm., Or = Roubidoux Fm. Vertical exaggeration is 20X.*

of three adjacent remnants separated by minor drainages that have cut headward across this surface (fig. 3A). Two of these remnants are identified on figure 3A, location 2, and on figure 4 as Falcon sites 11 and 12. The elevation range for site 11 is 1,240 to 1,250 feet (378 to 381 m), for site 12, it is 1,245 to 1,255 feet (379.5 to 382.6 m). On figure 7, the elevation of 1,248 feet (380.5 m) in the center of the Fa "terrace" profile is a spot elevation shown at this location on the Drew Quadrangle.

The close agreement among these elevations indicates that these three sites are remnants of a once continuous surface inset below the Lebanon surface. When viewed in the field, one is struck by the terrace-like configuration. These three sites are interpreted as closely related remnants and are considered to be an up-valley equivalent of the Falcon terrace at the Falcon scarp in location 1. No power auger drilling was done on these sites so the presence of fluvial deposits under the terrace surface has not been verified. High-level fluvial deposits are fairly common in the Ozarks. Bretz (*1965*) comments on and illustrates their occurrence. He also notes high flattopped ridges adjacent to the major rivers and refers to them as straths or remnants of former wide-valley bottoms. The Falcon surface may well be such a strath. Based on the mapped extent of the surface (figs. 3A and 3B), the valley it represents might have been about 2 miles (3.2 km) wide in some places.

Valley slope erosion surfaces

Valley slope erosion surfaces truncate the divide summit surfaces and are, therefore, younger than the two summit surfaces. They form the present valley side slopes and are the major part of the landscape. Their sloping character is considered prima facie evidence that they are erosion surfaces. A sequence of three of these surfaces is recognized. Each surface can truncate (or cut) any one or all of the summit surfaces. A younger erosion surface can cut any one or all of the older erosion surfaces. These surfaces were separated and mapped on the basis of the relative steepness of the slope. They are seen on the topographic map as variation in the spacing of contour lines. Some mapping was by direct observation in the field.

Jacksonville surface

The Jacksonville surface (Ja) is named for the Jacksonville crossroads located near the center of the Drew Quadrangle. This surface rises to and truncates the Lebanon surface as shown by profile EE', figures 3A and 8. Figure 8 shows a sequence of topographic profiles along selected interfluves on the eastern side of the Little Cobb Creek Valley (fig. 3A). The Jacksonville surface also rises to and truncates the Falcon surface as shown by profile CC', figure 8. By the principle of ascendancy and descendancy (*Ruhe 1975* p. 222-223), the Jacksonville surface is younger than the Lebanon and the Falcon surfaces.

The Jacksonville surface is extensive in the Drew Quadrangle, particularly in the Cobb Creek and Little Cobb Creek drainage (fig. 3A). In the headwaters of Cobb and Little Cobb Creeks, there are relatively broad and continuous areas of this surface, and it forms the interfluve summit between these streams (fig. 3A). Inspection of the 7.5 minute Drew Quadrangle shows, especially in the headward half of the Little Cobb Creek drainage, that the Jacksonville surface is somewhat scoop-shaped with a well-integrated convergent drainage system. The surface rises to the surrounding headwater drainage divide in a generally concave-up form, and it is open toward the north with a downstream gradient (fig. 8). The surface projects into thin air in the down gradient direction toward the north and into the Little Cobb Creek Valley. This indicates that it was graded to

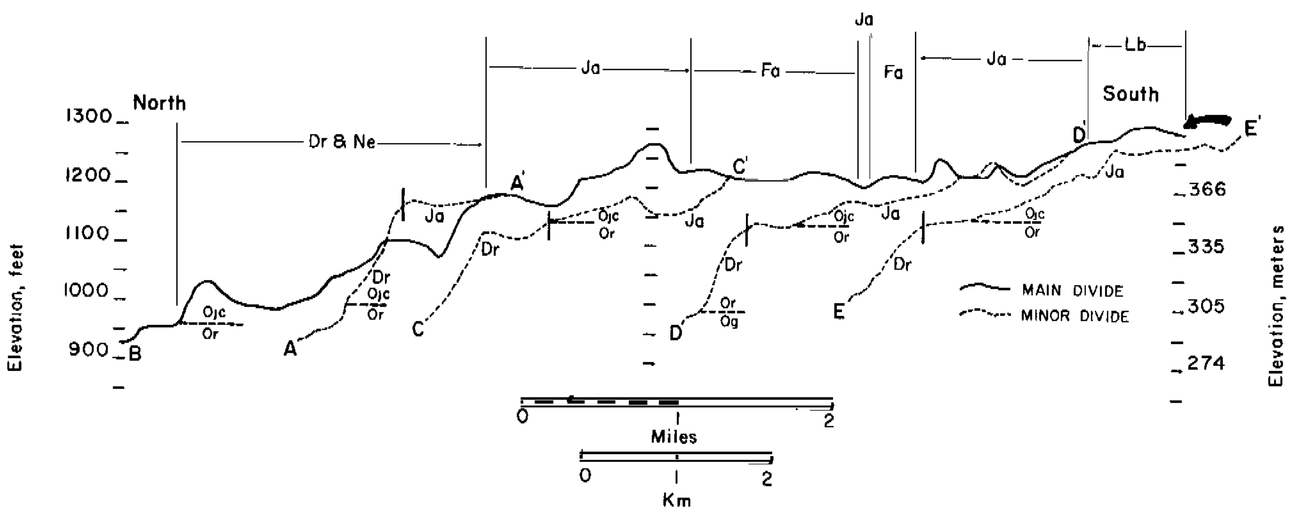

Figure 8. *Topographic profile (BE') along the divide between Walker Hollow Creek to the east and the Osage Fork River and Little Cobb Creek to the west (see Figs. 3A and 3B). The dotted lines are profiles along selected minor interfluves in the Osage Fork and Little Cobb Creek valleys on the west side of the divide. Geomorphic surfaces mapped along the divide are identified at the top. Surfaces mapped along the minor interfluves are marked by the vertical lines and identified by a symbol placed beneath each segment. Lb = Lebanon, Fa = Falcon, Ja = Jacksonville, Dr = Drew, Ne = Nebo, Ojc = Jefferson City Fm., Or = Roubidoux Fm. Geology from Missouri Department of Natural Resources Open File Map 84-190-GI. Vertical exaggeration is 20X.*

a higher base level than that of the present streams. The surface is characterized by a relatively smooth, rolling, topography, and fairly long slopes. The general slope range is 2 to 14 percent, based on estimates derived from the soil map. The surface becomes remnantal in the northern part of the Drew Quadrangle and especially so further north in the Drynob quadrangle (fig. 3B) closer to the confluence of the Osage Fork with the Gasconade River.

The concave-up configuration displayed by the Jacksonville surface in the Little Cobb Creek drainage is called a scoop-shaped pediment (*Ruhe, 1975* pp. 134-135) or a trough-shaped pediment (*Gilluly, 1937*). A pediment is defined by Ruhe (*1975*, p. 134) as "an erosion surface that lies at the foot of a receded slope, with underlying rocks or sediments that also underlie the upland, which is barren or mantled by alluvial sediment, and which normally has a concave upward longitudinal profile." The alluvial sediment is pedisediment as defined by Ruhe (*1975*, p. 130 and *1956*). It may be thought of as sediment on a pediment.

In summary, the Jacksonville surface is considered to be an erosion surface because it has a rolling, undulating, sloping topography, and there is no relatively flat depositional surface. The surficial stratigraphy is a thin mantle of loess overlying pedisediment over residuum. Erosion has developed a well integrated dendritic drainage system. The surface rises to and truncates the higher and older Lebanon and Falcon surfaces, and is, therefore, younger than these two surfaces. The surface projects to a level significantly higher than the present drainage system indicating that it was graded to former higher base level.

Drew surface

The Drew (Dr) erosion surface is the steeper valley slopes that truncate the Lebanon, Falcon, and Jacksonville surfaces and are, therefore, younger than those surfaces. Drew surface slopes, and their relation to the Jacksonville surface, are shown by the topographic profiles in figure 8. Location 1, figure 3A, illustrates the truncation of the three older surfaces by the Drew erosion surface. On the topographic map, this surface appears as a series of closely spaced lines, in contrast to the older surfaces. Slope measurements, made during the course of soil mapping, show that the slopes range from 9 to 35 percent. The surface was named for the Drew crossroads (SE corner, sec. 21, T33N, R14W) and for the Drew Quadrangle.

The Drew surface is extensive throughout the study area, especially in proximity to the major drainages (fig. 3A). It is not present in the extreme headward reaches of drainages in the southern part of the Drew Quadrangle. Although it is a valley slope surface, it occurs fairly frequently on narrow rounded ridgetops slightly below the Lebanon, Falcon, or Jacksonville surfaces. In these situations, Drew erosion has narrowed the ridge to the point where the older surface no longer exists and downwearing of the ridgetop has begun, even though the level may be close to that of the original older surface.

The Drew surface grades to the Lambeth terrace in the Osage Fork River valley (location 5, fig. 3A). This is illustrated in cross section in figure 9.

Nebo surface

The Nebo erosion surface is defined as the steepest slopes at the lower end of a valley slope. These slopes normally truncate the Drew surface and sometimes the Jacksonville. The Nebo surface is, thus, younger than these surfaces. An example of the Nebo surface can be seen next to the Gasconade River in the southeastern corner of the Drew Quadrangle (fig. 3A). The Nebo surface is not adjacent to the Lebanon and Falcon surfaces because these are the high ridgetop surfaces, and the Nebo does not occur on ridgetops.

The Nebo surface is shown on the topographic map by closely spaced contour lines. It is of limited extent, with narrow delineations that usually were included in the Drew surface mapping unit. Mapping and field observations indicate that the Nebo surface grades to some element of the Drynob complex (to be discussed later). It truncates the Lambeth terrace surface and deposits. The Nebo is, therefore, younger than the terrace surface and deposits. The name comes from the Nebo community along State Route 32 in eastern Laclede County.

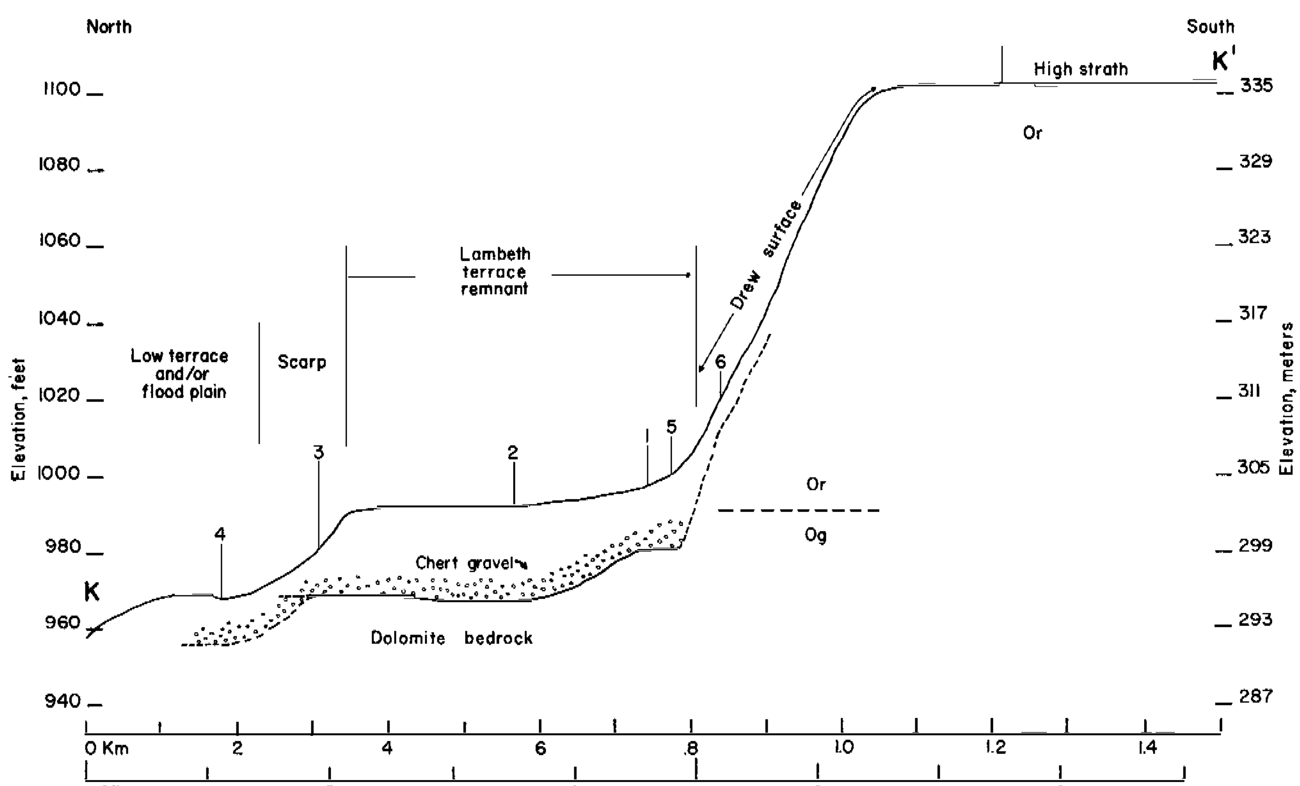

Figure 9. *Power auger drill traverse across the Lambeth terrace, profile KK', (fig. 3A location 5). Numbered sites are power auger hole locations. Auger hole descriptions are in appendix B. Bedrock formation contact is interpreted from Missouri Department of Natural Resources, 1984. Vertical exaggeration is 16.5X.*

Surfaces of the Valley Bottoms and former Valley Bottoms

Falcon surface

The Falcon surface has been discussed previously as a divide summit surface, but with emphasis on possible fluvial origin. More work is needed to confirm the presence of associated fluvial terrace deposits across the mapped extent of this surface. Fluvial deposits beneath the Falcon surface, which now occupy a ridgetop position about 250 feet (76 m) above the Osage Fork River, imply a topographic inversion from floodplain to ridgetop. This is not unusual because reference to water-worn gravel high in the Ozarks is common (*Bretz, 1965*). The Falcon surface may be a high strath terrace such as discussed by Bretz (*1965*, pp. 90, 106). Based on the mapped occurrence of this surface (figs. 3A and 3B), the course of the stream responsible was somewhat different from the present Osage Fork River or the Gasconade River.

High strath remnants

High strath remnants are relatively flat accordant ridgetops on minor interfluves adjacent the Osage Fork River and North Cobb Creek (fig. 3A). They appear to be separated from the higher Jacksonville surface part of the interfluve by a scarp, suggesting an inset terrace position. They are 130 to 150 feet (40 to 46 m) above the river (fig. 9). They are difficult to trace for any distance up or down valley. They often are narrow and rounded, enough that none of the original surface remains. For this reason, a number of these strath remnants were included with the steeper valley slope surfaces, such as the Drew. They were identified primarily by topographic map interpretation. The presence of fluvial deposits has not been determined.

Lambeth terrace in the Drew Quadrangle

The Drew erosion surface has already been noted as grading to the Lambeth terrace in the Osage Fork River valley (fig. 3A, profile KK', location 5; fig. 9). Location 5 is the site where the Lambeth terrace was first recognized (NW1/4, sec. 16, T. 33 N., R. 14 W.) on the south side of the Osage Fork, just west of the Lambeth bridge. The terrace was named for this bridge.

The surface of the Lambeth terrace stands 40 to 50 feet (12 to 15 m) above the Osage Fork River at this location. The terrace is in this quadrangle only as small eroded remnants. There is no continuous terrace surface present anywhere in the four river systems studied. The site at location 5 in figure 3A is one of the most nearly intact remnants of the original terrace surface that exists. Figure 9 shows that the terrace sediments are inset below the Roubidoux Formation and into the Gasconade Formation.

The Drew erosion surface grades to the uneroded remnant of the depositional Lambeth terrace surface (figs. 9, 3A, location 5). The Drew valley slope surface is the erosional element and the terrace surface is the depositional element (*Daniels and others, 1971*) of a geomorphic surface. An erosion surface is the same age as the depositional surface it grades to (*Ruhe, 1969, 1975; Daniels and others, 1971*). Application of this principle suggests that dating of the Lambeth terrace will lead to the dating of the Drew surface. This will be discussed in detail in a later section.

Drynob complex

The Drynob complex (Dy) is an erosional and depositional (cut and fill) complex of surfaces and deposits of the floodplain and the floodplain steps in the valley bottoms. It is similar to, and probably correlates with, the sequence of downcutting and aggradation events of the past 45,000 years as discussed by Brackenridge (*1981*) for the nearby Pomme de Terre River. The low terrace or floodplain, or both, shown on figure 9 is a part of the Drynob complex. Note that the associated deposits are inset into the bedrock below the base of the Lambeth terrace deposits. This is evidence that these deposits are younger than the Lambeth terrace. The Nebo erosion surface, of the lower valley slopes, is defined as grading to the floodplain or the high floodplain steps (*Ruhe, 1975; Howard, 1959*) of this complex. Although the Drynob Complex has been mapped, primarily by topographic map interpretation, it has not been studied in any detail. The name was taken from the Drynob Quadrangle.

Summary — geomorphic surfaces, Laclede County

The sequence of geomorphic surfaces in the Drew Quadrangle is shown diagrammatically in figure 10. The highest and oldest is the Lebanon surface which occupies the ridgetop. There are no fluvial deposits associated with it. It is an erosion surface.

The Falcon surface and the related underlying fluvial deposits are inset below the Lebanon surface and separated from it by a scarp. The presence of water-worn chert pebbles demonstrates the fluvial origin of these deposits. This surface is interpreted as a former stream terrace surface that has associated terrace deposits. Both it and the older Lebanon surface now exist as isolated remnants and occupy the ridgetop positions along the divide.

Three valley slope erosion surfaces exist: the Jacksonville, the Drew, and the Nebo. The moderately sloping Jacksonville surface rises to and truncates the older Lebanon and Falcon surfaces. Its erosional character is shown by its valley slope position and well-integrated drainage system.

The Drew surface is more steeply sloping, and it truncates the Jacksonville surface as well as the Lebanon and Falcon. The Drew surface grades to the Lambeth terrace in the Osage Fork River Valley. The youngest valley slope erosion surface is the Nebo, which truncates the Drew surface, the Lambeth terrace, and sometimes the Jacksonville surface.

Four surfaces are related to the valley bottoms or former valley bottoms. They are, from oldest to youngest, the Falcon, the high strath remnants, the Lambeth terrace, and the Drynob complex. The Falcon is now a divide summit surface but evidence suggests it is probably of fluvial origin and thus a former valley bottom. The high strath remnants are relatively flat accordant ridgetops 130 to 150 feet (40 to 46 m) above river level on minor interfluves next to the Osage Fork River and its major tributaries. These remnants are separated from the higher parts of the interfluve by a scarp, suggesting an inset terrace.

The Lambeth is a terrace surface that stands 40 to 50 feet (12 to 15 m) above the Osage Fork River. There are fluvial terrace deposits associated with this terrace surface. The surface and deposits exist as isolated erosional remnants. The Drew erosion surface grades to this surface.

The Drynob complex occupies the present valley bottoms. It is an erosional and depositional complex (cut and fill) of surfaces and deposits of the floodplain and floodplain steps. The Nebo erosion surface grades to the various parts of this complex.

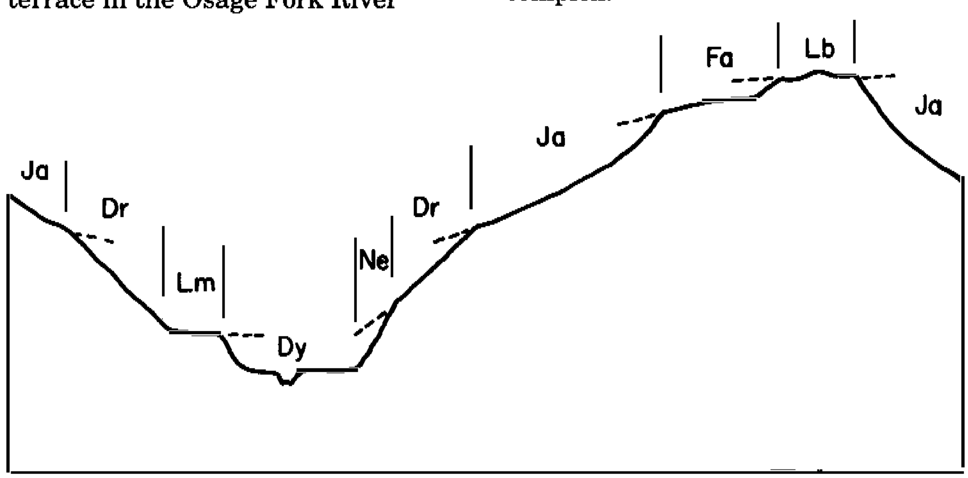

Figure 10. *Idealized cross section for the Drew Quadrangle area in Laclede County. Relations among the divide summit surfaces (Lebanon = Lb, Falcon = Fa), the valley slope erosion surfaces (Jacksonville = Ja, Drew = Dr, Nebo = Ne), and the valley bottom surfaces (Lambeth = Lm, Drynob = Dy) are shown.*

Bedrock geology and geomorphic surfaces

Geomorphic mapping in the Drew and adjoining quadrangles (figs. 3A and B) was done in 1978 and 1979. The surfaces were identified, defined, and mapped on a geomorphic basis, without reference to the bedrock geology. This was apparently before, and thus independent of, the most recent geologic mapping now available as Open File Map-84-190-GI (*Missouri Department of Natural Resources, 1984*). Figure 2 is derived from this map.

Cursory examination of the Cobb Creek and Little Cobb Creek drainage basins in the southwestern part of the Drew Quadrangle (fig. 3A) suggests that the geomorphic surfaces are related to bedrock outcrops (fig. 2). At first glance, one is struck by the steeper Drew (Dr) surface and the Roubidoux (Or) Formation that are nearly coincident. Furthermore, the less steep, smooth, rolling Jacksonville surface appears to be restricted to the Jefferson City (Ojc) Formation.

Detailed examination, with geology overlaying the geomorphic map, shows that the Jacksonville and Drew surfaces cut across the Jefferson City and Roubidoux Formations. This indicates that the geomorphic surfaces are independent of the distribution and outcrop of the various bedrock formations. Reference back and forth between figures 2 and 3A shows that the Drew surface cuts across the Jefferson City and Roubidoux Formations along the entire east side of the Drew Quadrangle to the east of the main divide. The Drew surface truncates these two formations both to the north and to the south of the Jacksonville fault. The surface also cuts across this fault. The steepness of the Drew slopes is not affected by the transition from one formation to the other.

In the Walker Hollow drainage in the north central part of the Drew Quadrangle, north of the Jacksonville fault and west of the main divide, all divide summit and valley slope surfaces (Lb, Fa, Ja, and Dr) occur on the Jefferson City Formation. The Jacksonville surface truncates both the Jefferson City and the Roubidoux Formations in the northwest corner of the Drew Quadrangle, north and west of the Osage Fork River. The Jacksonville surface mapped on the divide between Cobb Creek and Little Cobb Creek cuts across both the Jefferson City and Roubidoux. Ruhe (*1975*, p. 125) comments that "an erosion surface cuts across beds, materials of different erodibility, and rocks and geologic structures." The Jacksonville and Drew valley slope erosion surfaces, mapped in this study, fulfill these requirements for bonafide geomorphic surfaces. They are influenced by the bedrock stratigraphy only to a small degree.

Erosion surfaces do tend to exploit, to some extent, weaknesses or structural features that are present in an area. An example is the exploitation of the Jacksonville fault by the Drew surface erosion where it has cut headward from the Gasconade River along the strike of the fault. The head end of this can be seen at the Drew reentrant between locations 2 and 3 on figure 3A. A similar Drew reentrant, cutting into the Jacksonville surface, extends along the fault southeast from the Osage Fork River. This area is to the south of profile AA' on figure 3A.

Geomorphic Surfaces, Texas County

The geomorphic mapping in Texas County was done at a later date and independently of the work in Laclede County. A sequence of surfaces similar to that in Laclede County was established. Mapping was on the 7.5 minute Houston and Raymondville Quadrangles with a brief excursion into the Prescott and Licking Quadrangles just to the north.

Most of the Houston-Raymondville area is in the Big Piney River drainage, but the eastern third drains east to the Current River (fig. 1). The Big Piney River drains north to the Gasconade River that in turn continues north to the Missouri River. The Osage Fork River of Laclede County is a part of the Gasconade system. The Big Piney and the Osage Fork have a common base level via the Gasconade. Consequently, there should be a similar sequence of surfaces developed in the two related drainages.

The Current River drains southeast and south to the Black River, thence to the White River, and eventually to the lower Mississippi River in Arkansas. Thus, the Current River drainage may have had a somewhat different geomorphic evolution than the closely related Osage Fork - Gasconade - Big Piney drainages.

The geomorphic sequence in Texas County includes five surfaces, named from oldest to youngest, Success (Ss), Lebanon (Lb), Falcon (Fa), Jacksonville (Ja), and Drew (Dr). The last four are correlated with the surfaces of the same name in the Drew Quadrangle in Laclede County. A discontinuous terrace level, standing 40 to 60 feet (12 to 18 m) above the Big Piney River was correlated with the Lambeth terrace of the Osage Fork River. These surfaces and their general relations to one another are illustrated in figure 11.

A valley bottom complex is present in the Big Piney Valley and it was correlated with the Drynob (Dy) complex in Laclede County. It was not studied in the Texas County area.

The Surfaces

Success surface

The Success surface (Ss) exists as a few erosional remnants that stand above the Lebanon surface and are separated from the Lebanon by the Grovespring scarp. Remnants of the Success surface are along the Big Piney - Current divide south of Raymondville and the Grovespring scarp (fig. 12). The hill at the Boone Creek Church on the Licking Quadrangle (sec. 29 and 32, T. 32 N., R. 8 W.) is a remnant of this surface. The Licking Quadrangle lies to the north along the divide and is not a part of the geomorphic map, figure 12. This higher, older surface was named the Success surface after the village of Success on the Roubidoux Creek - Big Piney divide where a delineation of the surface was identified. Extensive mapping of the surface was not attempted.

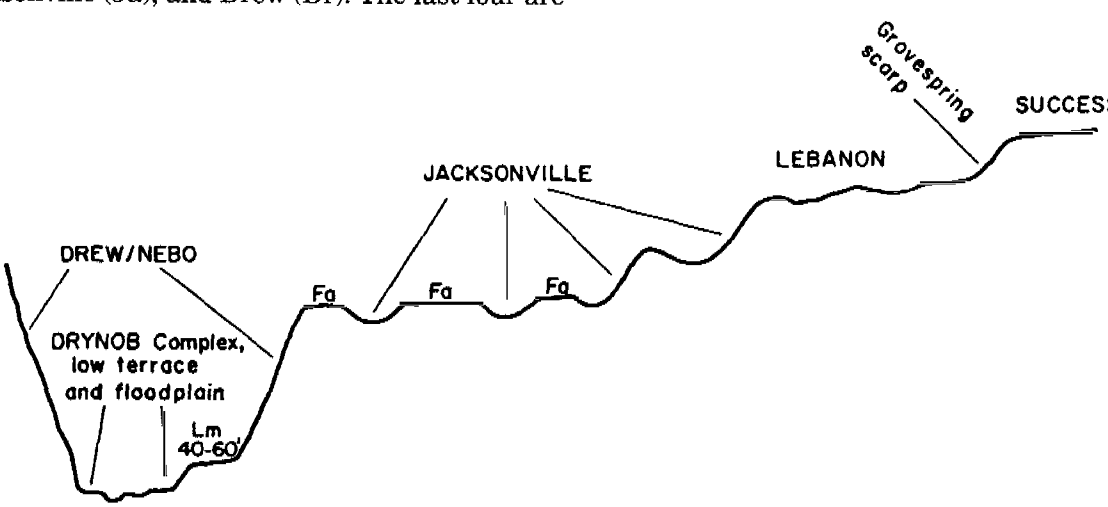

Figure 11. *Generalized diagram of geomorphic surfaces near Houston, Texas County, Missouri. Fa = Falcon surface, Lm = Lambeth terrace.*

Lebanon surface

The Lebanon (Lb) surface is a high, old erosion surface on the major divides. The relatively smooth, open, and flat to gently rolling topography is exemplified by the area in the vicinity of and to the north and east of Raymondville (fig. 12). This is the Big Piney - Current River divide. The Lebanon is thought to be an erosion surface because it is gently rolling and undulating with an established drainage system. The surface occupies parts of the minor divides such as those west of Raymondville that slope toward the Arthur Creek drainage. The presence of erosional remnants of the even higher and older Success surface that stand as outliers on the Lebanon surface are further evidence of the Lebanon's erosional origin.

The elevation of the Lebanon surface, as mapped on the Houston and Raymondville Quadrangles, ranges from about 1,300 feet (396 m) on the minor divides to about 1,400 feet (427 m). This higher elevation is where the Lebanon surface rises up the Grovespring scarp and truncates the higher and older Success surface (fig. 12). The toe elevation of the Grovespring scarp on the Big Piney-Current divide is between the 1,360- and 1,380-foot contours at the common corner for sections 4, 5, 8, and 9, T. 30 N., R. 8 W., Raymondville Quadrangle.

The Lebanon surface, in turn, is truncated by younger erosion surfaces and occurs as erosional remnants on some of the divides between tributaries of the Big Piney River. One such remnant is on the Indian Creek - Brushy Creek divide (topographic profile AA', figs. 12 and13). Three remnants were mapped on the Brushy Creek-Mineral Springs Hollow divide (topographic profile BB', fig. 12, fig. 14). Topographic map inspection indicates that the Lebanon surface extends up the Big Piney drainage toward the south as remnants on the divides between the major Big Piney tributaries. It no longer occupies the main Big Piney - Current divide as it does between Raymondville and Licking. Rather, the 1,400 foot (427 m) Success surface occupies the highest parts of the divide, and the Lebanon is a valley flanking pediment *(Ruhe, 1975*, p. 134; *Frye, 1954*). The Lebanon now exists only as remnants because it has been encroached on by lower and younger erosion surfaces. The Lebanon surface is traceable into the upper reaches of the Current River drainage. Small areas are mapped on minor divides to the east of the Big Piney - Current divide in the southeastern part of the geomorphic map (fig. 12).

The surficial stratigraphy of the Lebanon surface is, apparently, fairly complex. Preliminary studies by Missouri Geological Survey personnel (*J. W. Whitfield, 1989*, personal communication) and Soil Conservation Service soil scientists indicate a sequence of possibly two loess deposits, pedisediment units, and residuum in some of the slightly lower areas of this surface. In addition, there is evidence suggesting two paleosols within this sequence.

As the name suggests, this surface is correlated with the Lebanon surface mapped in the Laclede County study area. In both Texas and Laclede Counties, this surface occupies a high major divide position and is separated from an even higher surface by the Grovespring scarp. The Grovespring scarp will be discussed in detail in a later section.

Falcon surface

This surface (Fa) was first recognized on the Houston quadrangle to the west and northwest of Houston. It occurs as relatively narrow remnants on ridgetops and has an elevation range from 1,200 to 1,220 feet (366 to 372 m). It is separated from the adjacent upland by a scarp that has a toe elevation of 1,200 feet (366 m). This unnamed scarp is well-expressed on topographic profiles AA' and BB' (figs. 13 and 14). Falcon surface remnants are within a mile of the Big Piney River, and the topographic profiles show that the remnants grade toward the river from the scarp toe and occur on both sides of the river (fig. 14).

Rounded chert and sandstone pebbles and small cobbles were found in the southwest corner of sec. 30 and the northwest corner of sec. 31, T. 31 N., R. 9 W. (Houston Quadrangle). This site is in location 3 on the Falcon surface in the northwestern corner of the geomorphic map (fig. 12). These materials were observed as a gravel outcrop zone on the hillslope and in a backhoe pit. Figure 15 is the topographic and stratigraphic section developed from these observations. This gravel is the basal coarse deposit of a 15-foot (4.5 m) thick fluvial unit

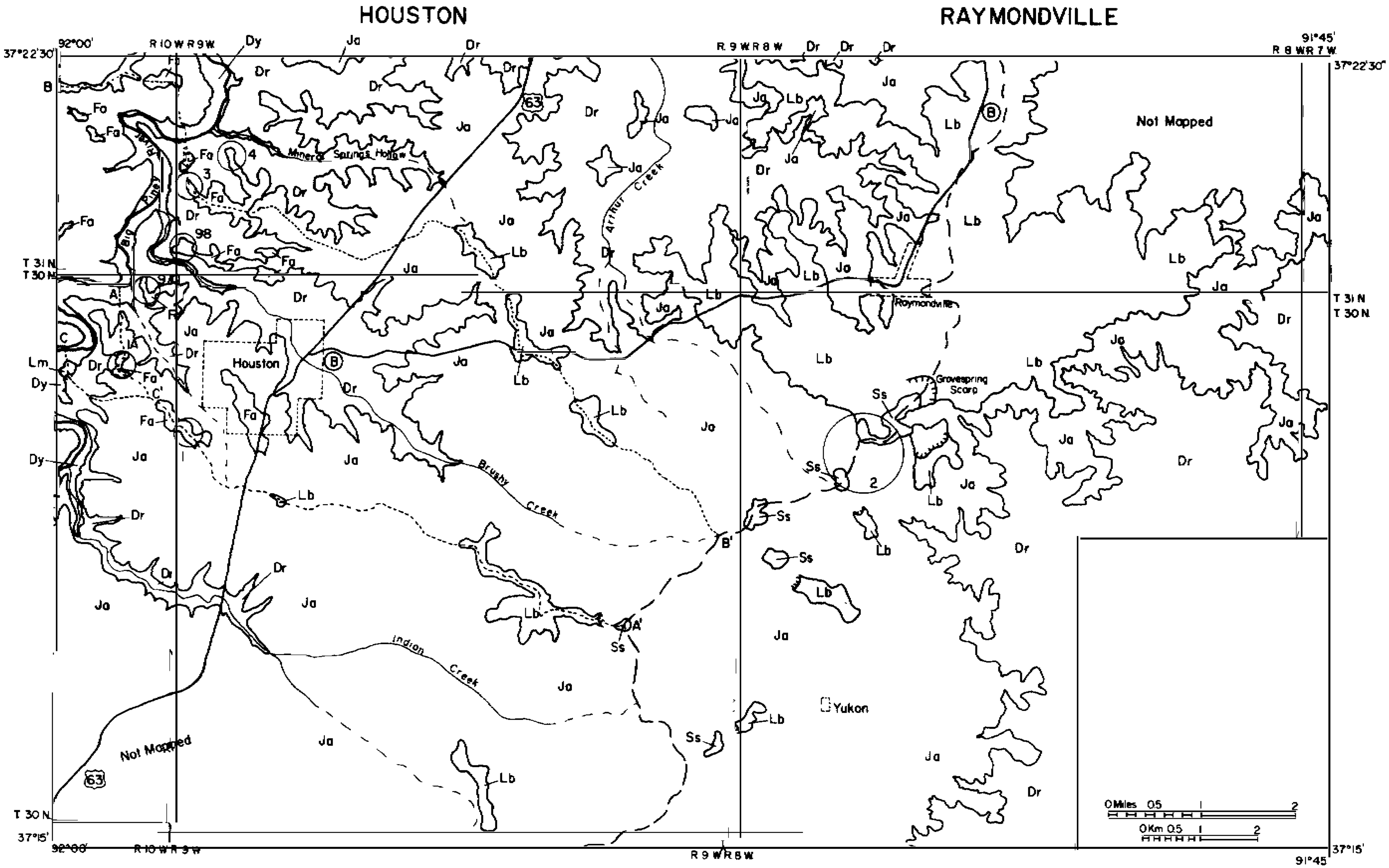

Figure 12. *Geomorphic map of the Houston (west) and Raymondville (east) 7.5 minute Quadrangles. The coarse dashed line is the Big Piney River - Current River divide. Topographic profiles are shown with short dashes. The numbered circled areas are locations discussed in the text. Hachured lines (hachures upslope) show scarp toes. Dy = Drynob complex, Dr = Drew surface, Lm = Lambeth terrace, Ja = Jacksonville surface, Fa = Falcon surface, Lb = Lebanon surface, Ss = Success surface.*

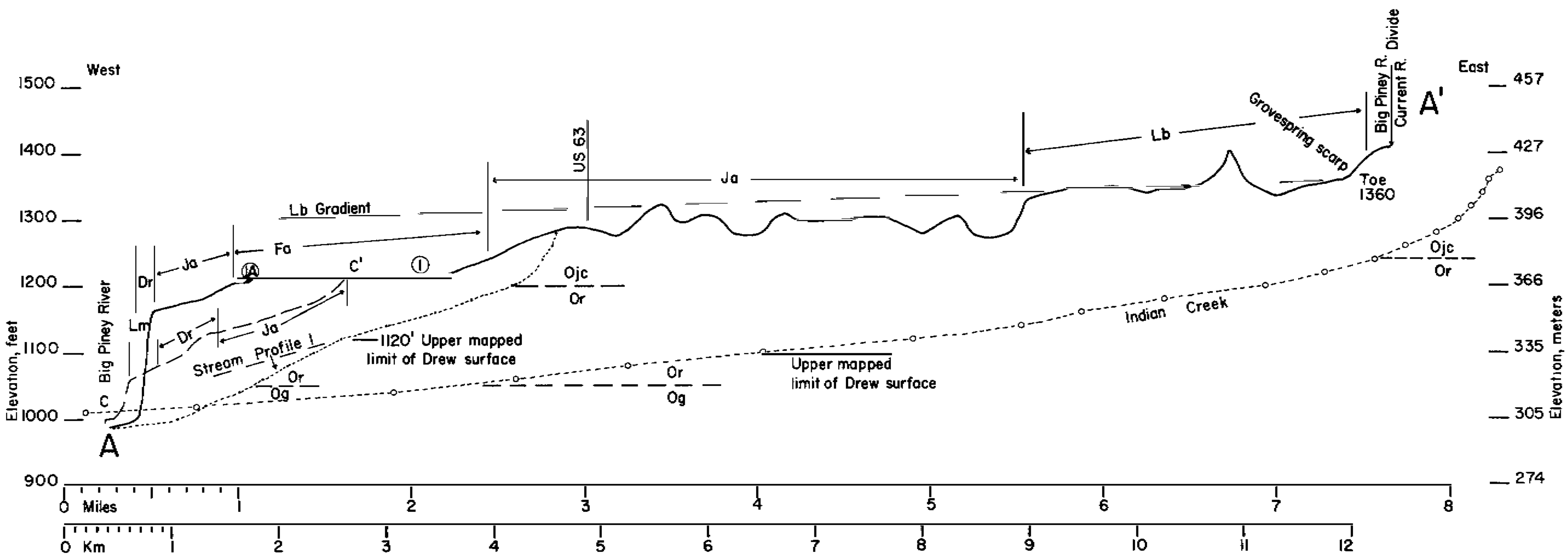

Figure 13. *Topographic profiles AA' and CC' along the Indian Creek - Brushy Creek divide. Elevations and distances are from the Houston 7.5 minute topographic map. Bedrock formation contacts are estimated from the Rolla 1° x 2° geologic map (Pratt and others, 1985). Stream profile 1 is from the small unnamed drainage west of Houston (fig. 12). Ojc = Jefferson City Fm, Or = Roubidoux Fm, Og = Gasconade Fm. See figure 12 for other abbreviations. Vertical exaggeration is 20X.*

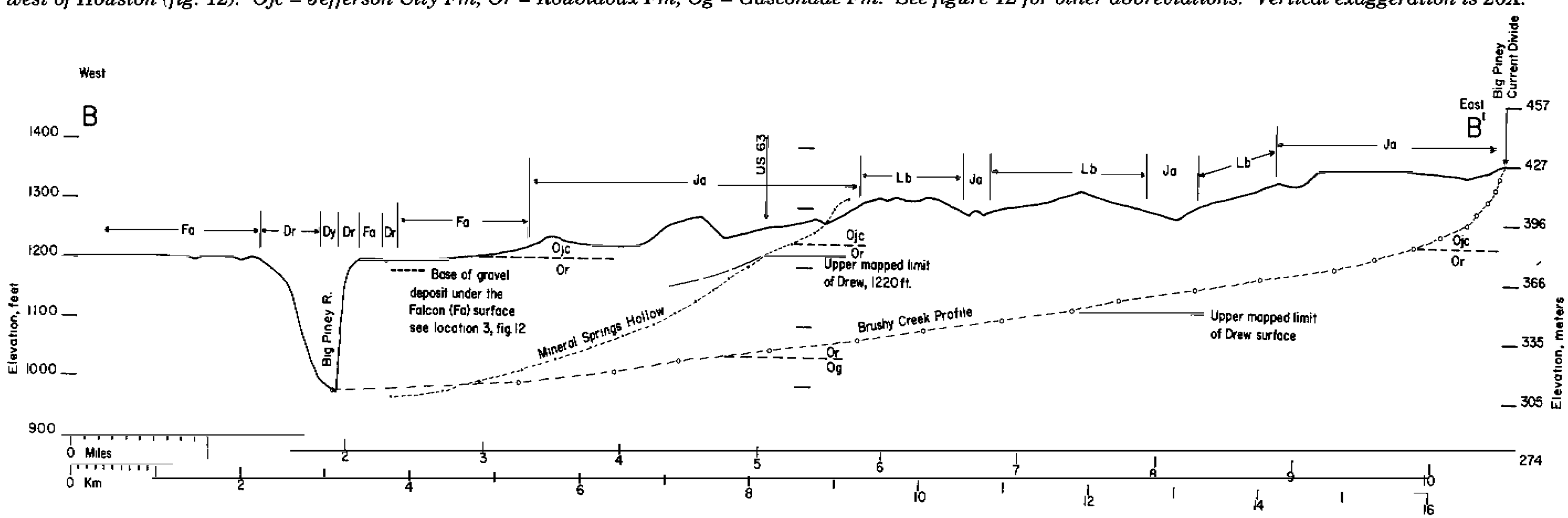

Figure 14. *Topographic profile BB' along the Brushy Creek - Mineral Springs Hollow divide. Elevation and distance are from the Houston and Raymondville 7.5 minute topographic maps. Bedrock formation contacts are estimated from the Rolla 1° x 2° geologic map (Pratt and others, 1985). Profile location is shown on figure 12. See figures 12 and 13 for abbreviations. Vertical exaggeration is 20X.*

with a base at an estimated 1,185 foot (361 m) elevation (fig. 14, mile 2.5, km 4.0). This fluvial unit underlies the Falcon surface. The field description of the backhoe pit face is given in appendix D.

The Falcon surface is interpreted as a fluvial terrace surface, inset into and below the higher upland ridgetop surfaces. As mapped, the surface is primarily remnantal with little intact undisturbed surface included. The underlying materials are fluvial in origin and are inset into and below the adjacent upland ridge materials. The scarp (toe 1,220 feet, 372 m) is the surficial evidence of the inset relation.

If the Falcon surface is a fluvial terrace surface, then it should have a gradient in some direction. A plot of elevation ranges of five remnants in the Houston vicinity east of the Big Piney River (fig. 12, location 1A, 97, 98, 3, and 4), constructed from south to north (fig. 16), does not show a detectable gradient. However, hand dug and backhoe pits at these five sites showed the presence of fluvial gravel, composed of rounded and subrounded quartzite and chert, at all sites. Recall that at location 3 the terrace deposit was at least 15 feet (4.5 m) thick (fig. 15). At the other four locations the gravel deposit was described as thin and the site was considered to be eroded. Erosional destruction of the original surface and deposit might account for the absence of gradient of these five sites.

Figure 17 shows the Big Piney River stream profile, the Lambeth terrace profile, and sites

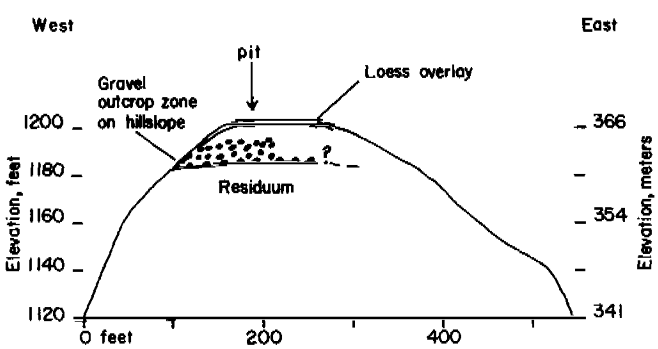

Figure 15. *Topographic and stratigraphic section (fig. 12 location 3, profile BB'); showing the fluvial gravel deposit underlying the Falcon surface. Topography is from the Houston 7.5 minute Quadrangle. Stratigraphy is from a backhoe pit and the hillslope gravel outcrop. Vertical exaggeration is 2.6X.*

thought to be the Falcon terrace, including those identified upstream and downstream from the Houston area. All Falcon terrace sites are identified by number. The location of the sites in Texas County upstream and downstream from the Houston area are given in table 2. Most of the Houston area sites (locations 1A, 97, 98, 3, and 4) appear to fall on or close to the general gradient established by the upstream and downstream sites. This is especially true of site 3 where a terrace deposit and surface is clearly demonstrated (fig. 15). It is concluded that the Texas County Falcon terrace surface remnants are the remains of a high, old, "strath" terrace now standing 210 to 225 feet (64 to 78 m) above the present river level. The terrace gradient from location 3 downstream is about 3.9 feet per mile (0.7 m/km). The terrace surface gradient, from Houston downstream, more or less parallels that of the present river (fig. 17), and the surface grades to some downstream point high above the present drainage system.

Table 2. *Locations of Falcon terrace sites on the Big Piney River in Texas County, upstream and downstream from the Houston area.*

Site No.	*Location*
	Upstream
81	1340'+ ridgetop in center of Sec. 27, T29N, R20W, Cabool NE Quadrangle
78	1320 to 1340'+ probable eroded remnant lying between the NW 1/4 and the SW 1/4, Sec. 10, T29N, R10W, Cabool NE Quadrangle
	Downstream
6	1160'+ ridgetop in NE 1/4 Sec. 24, T32N R10W and NW 1/4 Sec. 19, T32N, R9W, Prescott Quadrangle
15	1110 to 1120'+ interfluve summit in NW 1/4, NW 1/4 Sec. 36 and SW 1/4, SW 1/4, Sec. 25, T33N, R10W, Beulah Quadrangle
24	Ridgetop in NE 1/4 Sec. 16, T33N, R10W, Slabtown Spring Quadrangle
25	1100'+ ridgetop in SE 1/4, SE 1/4, Sec. 10, T33N, R10W, Slabtown Spring Quadrangle

This terrace surface in Texas County is correlated with the Falcon surface of the Laclede County area in the Osage Fork drainage. In both cases, the Falcon surface is apparently a fluvial strath terrace that now exists as remnants on interfluves high above the present river level. The general gradient is toward the north in both cases.

Jacksonville surface

An extensive erosion surface (Ja) was first recognized just to the west and northwest of the town of Houston (fig. 12; see also the SE1/4, sec. 1, T. 30 N., R. 10 W., Houston 7.5' Quadrangle). The unnamed Big Piney tributary located just west of the Houston town limits contains two distinct slope groups and an abrupt change in gradient in the stream profile (fig. 13, stream profile 1). The downstream part of this drainage crosses terrain characterized by steep slopes that range from 14 to 50 percent. The upstream part of this tributary crosses a less steep terrain with slopes ranging from about 3 to 10 percent. The sharp break in gradient of stream profile 1 (fig. 13) suggests a knickpoint related to these two slope groups.

Two geomorphic surfaces are indicated by these contrasting areas. The steeper slopes are a younger erosion surface that lies below and truncates the less steep slopes of a higher, older surface. This relationship is illustrated in the first mile of profile AA' (fig. 13) where the steep slopes of the Drew (Dr) surface rise from the Big Piney River and truncate the Jacksonville (Ja) surface. The knickpoint (or gradient change) in stream profile 1 coincides with the mapped boundary between the two surfaces. This point is in the Roubidoux Formation and 40 feet (12 m) below the contact with the Jefferson City Formation. The geomorphic surfaces were mapped before the stream profile was constructed and the formation contacts determined. The high, older, less steep surface is correlated with the Jacksonville surface in the Laclede County study area because it is in a similar position in the sequence of stepped surfaces, and its topographic character is similar.

Most of the area between Brushy Creek, to the north of Houston, and Indian Creek to the south (fig. 12), is characterized by the relatively smooth, moderately sloping topography of the Jacksonville surface. Slopes grade to a well integrated and clearly defined drainage system or are truncated by the steep slopes of the younger steeper surface. The Jacksonville surface rises to and truncates the Falcon fluvial terrace surface (fig. 13, profiles AA' and CC'). It is, therefore, younger than the Falcon surface. The Jacksonville surface also rises to and truncates the Lebanon surface (fig. 13, profile AA',

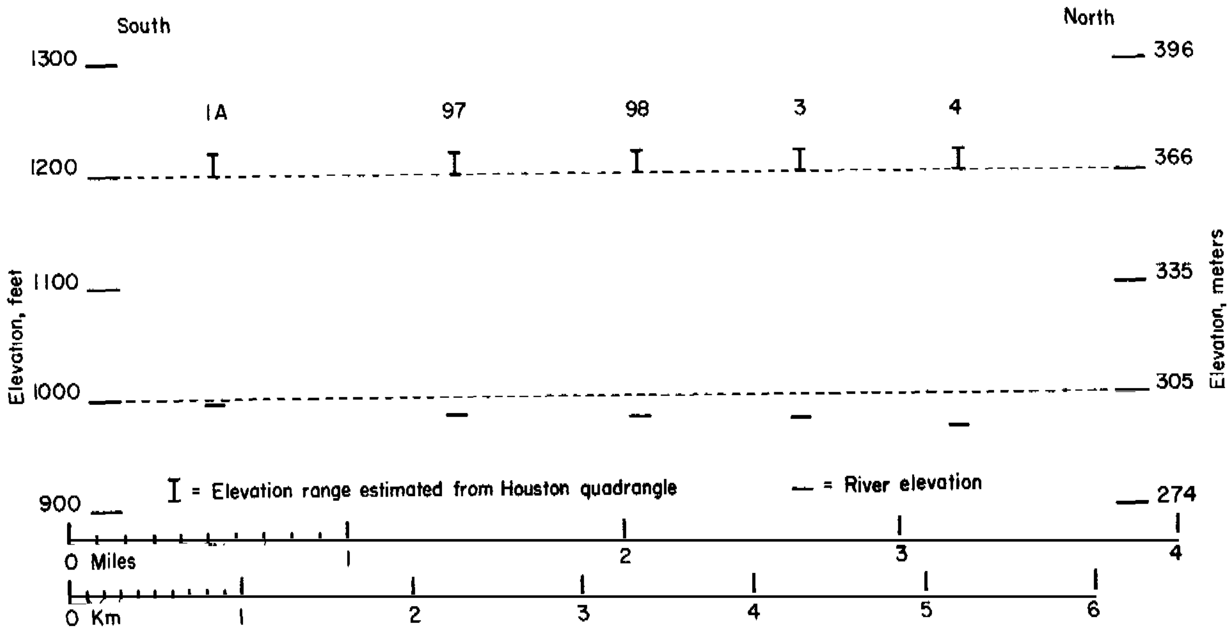

Figure 16. *Elevation ranges of five Falcon terrace remnants in the Houston area, versus distance south to north, and relative to river elevations. See numbered circled areas on figure 12 for the locations of these sites.*

mile 5.5; fig. 14, profile BB', mile 5.7), and is, thus, younger than the Lebanon. Furthermore, the Jacksonville surface truncates the Success surface (1,400 feet, 427 m) along the main Big Piney - Current divide as shown at the head of Arthur Creek in location 2, figure 12. The Jacksonville surface forms much of the main divide to the southwest of the Grovespring scarp.

The Jacksonville surface in Texas County is an erosion surface because all parts of it slope and some parts grade to an integrated drainage system. It is older than the steep slopes below it because it is truncated by them. It is younger than the Falcon terrace surface, the Lebanon surface, and the Success surface because it truncates all three. It is the most extensive surface in the study area.

Drew surface

This surface (Dr) was first recognized in the area to the north and west of Houston (fig. 12). It is composed of relatively steep slopes, some of which grade to a terrace and others grade to the present valley bottoms or floodplain, or both. These slopes range from about 14 to 50 percent. Some of this surface grades to a terrace within the Big Piney valley that stands 40 to 60 feet (12 to 18 m) above the present river. Based on the geomorphic maps, this surface truncates the Falcon terrace, Jacksonville surface, and the Lebanon surface (fig. 12). This surface in Texas County is, therefore, younger than any of these three surfaces. It is a complex erosion surface similar to the Drew/Nebo unit map of the Osage Fork and Gasconade valley in Laclede County. It is considered to be equivalent and is, therefore, named Drew.

Figure 18 is a topographic profile showing the Drew surface grading to a remnant of the terrace that generally stands about 40 to 60 feet (12 to 18 m) above the river. Thus, a part of this surface is contemporaneous with the deposition of this terrace. Profile CC', in figure 13, indicates that some of the slopes mapped with the Drew surface truncate this terrace surface and deposit. There is essentially none of the terrace tread remaining

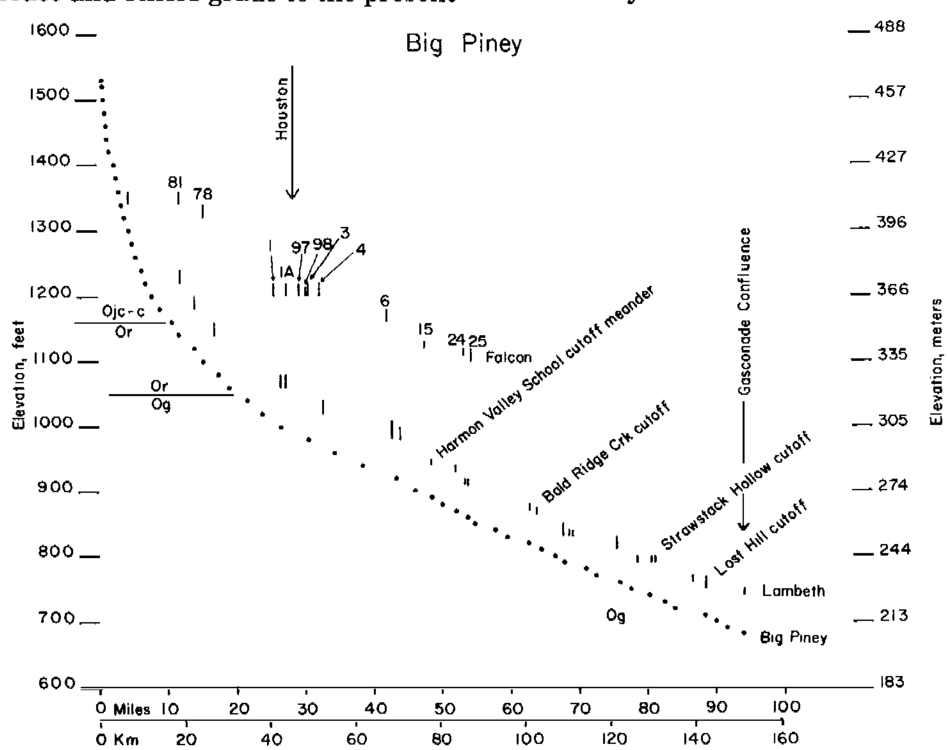

Figure 17. *Big Piney River stream profile with the Lambeth terrace sites and the Falcon terrace sites plotted. The elevation range of each site is shown by the vertical length of the line. Cutoff meander sites related to the Lambeth terrace are identified by name. Falcon terrace sites are numbered. Geology is interpreted from Missouri Department of Natural Resources, Division of Geology and Land Survey open file maps and from U.S. Geological Survey Rolla and Springfield 1° x 2° geology maps. Ojc - C = Jefferson City and Cotter Fms.; Or = Roubidoux Fm.; Og = Gasconade Fm.*

along this particular profile. Identification of an eroded remnant was based on the presence of rounded, subangular, and angular chert and quartzite pebbles and cobbles in a backhoe pit.

Two stream gradient profiles show gradient changes or knickpoints that are related to the Drew surface. Stream profile 1, in figure 13, represents the small unnamed drainage just west of Houston that has been discussed previously. There is a pronounced change in gradient at 1,120 feet (341 m) that corresponds to the upper limit of the more closely spaced contour lines that were mapped as the Drew surface (fig. 12). The gradient change is interpreted as marking the upper limit of Drew erosion in this small valley. The less steep gradient above this point corresponds to the more widely-spaced contour lines that define the Jacksonville (Ja) surface.

Some interpretations suggest that the steeper slopes in this unnamed drainage may be related to the outcrop of Roubidoux Formation sandstones and the less steep slopes (Jacksonville surface) above the gradient change are related to the Jefferson City Formation. The Roubidoux Formation is 30 to 40 percent sandstone in this area, and the sandstone beds are concentrated in the middle and lower parts. Well logs indicate a formation thickness of about 150 feet (*J. W. Whitfield, 1990,* personal communication). The bedrock stratigraphy for profile 1 (fig. 13) indicates

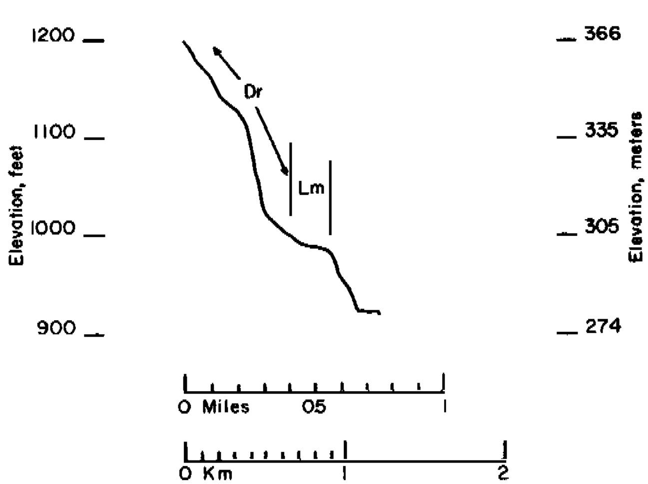

Figure 18. *Topographic profile showing the Drew (Dr) surface grading to a remnant of the Lambeth (Lm) Terrace. Vertical exaggeration is 20X.*

that the inflection point is in the middle of the Roubidoux Formation, well below the Jefferson City contact. On this basis, apparently the two surfaces are independent of the bedrock formations. However, a geomorphic surface should reflect, to some degree, the character of the bedrock it cuts across. The steeper, lower part of stream profile 1 may, in part, be related to the sandstone in the lower and middle part of the Roubidoux Formation.

A similar relation among gradient change, bedrock, and surface is shown by the Mineral Springs Hollow stream profile (fig. 14). Here the inflection point is at about 1,220 feet (372 m) and is interpreted to mark the upper limit of the Drew erosion cycle in this drainage. The less steep gradient from this point up to about 1,280 feet (390 m) is related to the Jacksonville surface. The inflection point, in this case, coincides closely with the estimated location of the Jefferson City-Roubidoux Formation contact.

The steeper part of the profile that is related to the Drew erosion cuts across the entire thickness of the Roubidoux with a smooth concave-up curve. There is no knickpoint or other evidence suggesting that the sandstone beds in the lower and middle part of the Roubidoux Formation influence the shape of this profile. The occurrence of the gradient change at a different point relative to the Roubidoux stratigraphy in these two profiles (stream profile 1, fig. 13 and Mineral Springs Hollow, fig. 14) suggests that bedrock control has only a minor effect on the Drew surface. Configuration of this surface, and the other surfaces, is to a large degree independent of bedrock control.

Indian Creek and Brushy Creek Stream profiles. The Indian Creek profile is shown on figure 13 and the Brushy Creek profile is on figure 14. Their locations are shown on the geomorphic map (fig. 12). Both profiles are concave-up curves, rising most steeply at the upstream end. In both a slight flexure is present in the gradient at 1,150 feet (351 m), well below the Roubidoux - Jefferson City contact at 1,240 feet (378 m) on Indian Creek and 1,260 feet (384 m) on Brushy Creek. On Indian Creek, the Drew surface was mapped to just below 1,100 feet (335 m) or a little more than 50 feet (15 m) below the flexure. The upper limit of this surface on Brushy Creek is about 1,140 feet (347 m), close to the flexure.

Both profiles cut across the Gasconade Formation up to about 1,050 feet (320 m) and across the Roubidoux Formation up to the Jefferson City contact at 1,240 to 1,260 feet (378 to 384 m). Neither the Brushy Creek nor the Indian Creek profile show any marked gradient changes or knickpoints that can be ascribed to crossing from one bedrock formation to another.

The most noticeable gradient change (knickpoint) is that noted at 1,150 feet (351 m) in the middle of the Roubidoux Formation. In the Brushy Creek Valley, this coincides with the upper limit (based on geomorphic criteria and field observation) of the Drew surface. In the Indian Creek Valley, the upper limit of the Drew surface was placed about 50 feet (15 m) below the 1,150-foot (351 m) flexure but still well within the Roubidoux Formation. Assuming that the flexure marks the headward limit of Drew erosion, as appears to be the case in Brushy Creek, the map of the Drew surface in Indian Creek is not entirely correct. The fact that crossing from one bedrock formation to another has such little effect on these stream profiles is further evidence of the minor influence of bedrock control on the configuration of the Drew and Jacksonville surfaces.

Summary of geomorphic surfaces, Texas County

The sequence of geomorphic surfaces in the Houston and Raymondville Quadrangles in Texas County is diagrammed in figure 11. The highest and oldest surface is the Success, which exists as a few erosional remnants along the divide between the Big Piney and Current Rivers. The Grovespring scarp rises to this surface and separates it from the Lebanon surface.

The Lebanon surface is an erosion surface lying one step below the Success surface. In the vicinity of Raymondville, on the Raymondville Quadrangle, there is a fairly large tract of this surface, characterized by a relatively smooth, open, and flat to gently rolling topography with an established drainage system. Toward the southwest, the Lebanon surface exists as remnants on the divides between the major tributaries of the Big Piney River. It has been encroached upon by lower and younger erosion surfaces.

The Falcon surface in Texas County, as in Laclede County, is a remnantal fluvial terrace surface inset below the higher upland ridgetop surfaces. It stands 210 to 225 feet (64 to 78 m) above the present Big Piney River level with a gradient toward the north that more or less parallels the present river. The terrace surfaces grades to some downstream point high above the present drainage system.

The Jacksonville surface is an extensive valley slope erosion surface with slopes of 3 to 10 percent, that truncates the Falcon, the Lebanon and the Success surfaces. Consequently, it is younger than any of these three surfaces. The Drew is a second valley slope erosion surface with complex steeper slopes (14 to 50 percent) that truncate the Falcon terrace, the Jacksonville surface, and the Lebanon surface. Part of the Drew surface grades to remnants of a terrace that stands 40 to 60 feet (12 to 18 m) above the Big Piney River. Other parts grade to the low terraces and/or floodplain steps of the present valley bottoms.

Bedrock geology and geomorphic surfaces

At first glance in Texas County, surfaces and mapped bedrock geology appear to coincide. This is similar to initial appearances in the Laclede County study area where critical examination showed surfaces to be independent of the bedrock geology. Detailed examination of the geomorphic map (fig. 12) and of the geologic maps (*Pratt and others, 1985; Missouri Dept. of Natural Resources, 1979*) for the Texas County area shows that surfaces cut across bedrock contacts and two or more surfaces may occur on one bedrock formation. Some examples follow.

In the vicinity of Yukon (fig. 12 Raymondville Quadrangle) both the Lebanon and the Jacksonville surfaces occur on the Jefferson City Formation. A short distance north of Yukon the Jacksonville surface cuts across the Jefferson City and the Roubidoux Formations. Along the southern part of the main divide, the Success, the Lebanon and the Jacksonville surfaces are all mapped on the Jefferson City Formation. On the Brushy Creek - Indian Creek divide, the Jacksonville surface is mapped across both the Jefferson City and Roubidoux Formations.

As stated earlier, an erosion surface by definition can cut across several stratigraphic units and materials of different erodibility (*Ruhe, 1975*). The surfaces in the Texas County area do this, as noted in the preceding paragraph. To some extent characteristics of these surfaces may reflect properties of the bedrock unit that the surface cuts across. For example, in the northwestern part of the Houston Quadrangle, steep slopes of the Drew surface, such as those in Mineral Spring Hollow (fig. 12), may partly be caused by the more resistant sandstone beds that are in the middle and lower part of the Roubidoux Formation. The Roubidoux is shown as outcropping on these valley slopes by Pratt and others (*1985*).

The Lambeth Terrace

This terrace is 40 to 60 feet (12 to 18 m) above river level in the Osage Fork and Big Piney River valleys. These river systems are major tributaries of the Gasconade River, which acts as a link between them (fig. 1). This terrace exists only as remnants isolated by erosion. There is no continuous terrace surface. It was first recognized, during the geomorphic mapping of the Drew Quadrangle, in the NW1/4, sec. 16, T. 33 N., R. 14 W. (fig. 3A, location 5). It was named Lambeth terrace after the nearby Lambeth bridge over the Osage Fork River.

Rationale for the terrace study

Geomorphic maps of Laclede County - Drew Quadrangle study showed that the Drew erosion surface graded to a remnant of a terrace in the Osage Fork River Valley (fig. 3A, location 5; fig. 9). Preliminary study identified several other remnants of this terrace downstream as far as the Gasconade River. Several meander cutoffs were noted also. Geomorphic maps of the Texas County study area (fig. 12) identifies a similar erosion surface grading to similar terrace remnants standing about the same elevation above the Big Piney River (fig. 18).

The occurrence of terrace remnants, with similar elevation above the river, in both the Osage Fork and the Big Piney suggested a study to find if they were equivalent in both valleys because the two were tied together via the Gasconade. If the Osage Fork - Gasconade - Big Piney regionality of the terrace could be established, then the regional extent and correlation of the related erosion surface would be established. Because the relative position of this surface in the geomorphic sequence of stepped surfaces in the two study areas was known, the regional extent and correlation of the other identified surfaces would also be established.

In any study of geomorphic surfaces, in addition to establishing relative ages of parts of the landscape, determination of actual age in years is always of interest. Breshears Valley is a meander cutoff in the Pomme de Terre River (fig. 1) that stands at the same elevation above the Pomme de Terre as the Lambeth terrace stands above the Osage Fork. This meander cutoff has been studied and dated (*Haynes, 1985; Brackenridge, 1981*). This elevation similarity suggested the possibility of extrapolating the Breshears Valley dating into the Osage Fork if a relationship could be established.

The Lambeth terrace study traced this remnantal level up and down the Osage Fork, along the Gasconade between the Osage Fork and the Big Piney and up the Big Piney.

Terrace study methods

River gradient

A valley centerline was drawn through the central axis of the valley on the 7.5 minute topographic maps. This line does not follow the actual river channel. It is probably shorter than the channel because it cuts off some of the channel curves. A short line, normal to the centerline, was drawn at each point where a contour line crossed the river channel. Distances between these contour crossing lines were measured along the centerline. Distances were cumulated in terms of miles from the confluence and miles from the source for each contour elevation point. These distances and elevations were plotted on cross section paper, and the river gradient was drawn through these plotted points.

Terrace gradient

Terrace remnants were identified by topographic map interpretation. The location was marked on the map by a numbered circle that was connected to the valley centerline by a perpendicular to the centerline. The distance along the centerline from the perpendicular to the nearest contour line crossing was measured and used to plot the location of the site. The elevation of a terrace site was plotted as a range determined by topographic map interpretation. The upper elevation limit was estimated from the contour line that defined the toe of the slope (or scarp) rising to a higher level. The lower limit was the contour line marking the beginning of the slope break (shoulder) to some lower level. Cutoff meander sites were identified, located, and plotted similarly to the terrace sites.

Verification

A number of the terrace remnant sites and cutoff meander sites in the Osage Fork and Big Piney valleys were examined in the field. The presence of fluvial sediments was verified by auger holes and pits. The presence of rounded, subrounded, and subangular chert, or sandstone pebbles, or small cobbles was the primary criterion used for establishing the fluvial origin of materials. The general terrace form of the site, albeit usually eroded, and a visual check of elevation above the river level were other criteria used.

Lambeth terrace in the Osage Fork Valley

The relationship of the Lambeth terrace to the Drew erosion surface has been discussed in detail in a preceding section entitled, "Surfaces of the Valley Bottoms and Former Valley Bottoms - The Lambeth Terrace in the Drew Quadrangle." Figure 9 shows the Drew erosion surface grading to a remnant of the terrace. The six drill hole descriptions are in appendix B. A basal chert gravel concentration varying from 3 1/2 to 6 feet (1 to 2 m) thick, composed of angular to well-rounded pebbles, is found in the lower part of the terrace deposit. This gravel deposit rests directly on dolomite bedrock. This remnant is one of the largest and most intact bits of terrace surface found during this study, excluding the several cutoff meander sites.

Figure 19 shows the profile of the Osage Fork River and the profile of the identified Lambeth terrace remnants. These remnants stand well above the 100-year flood stage, based on U.S. Geological Survey gaging station records. Note that there are three meander cutoffs in the Osage

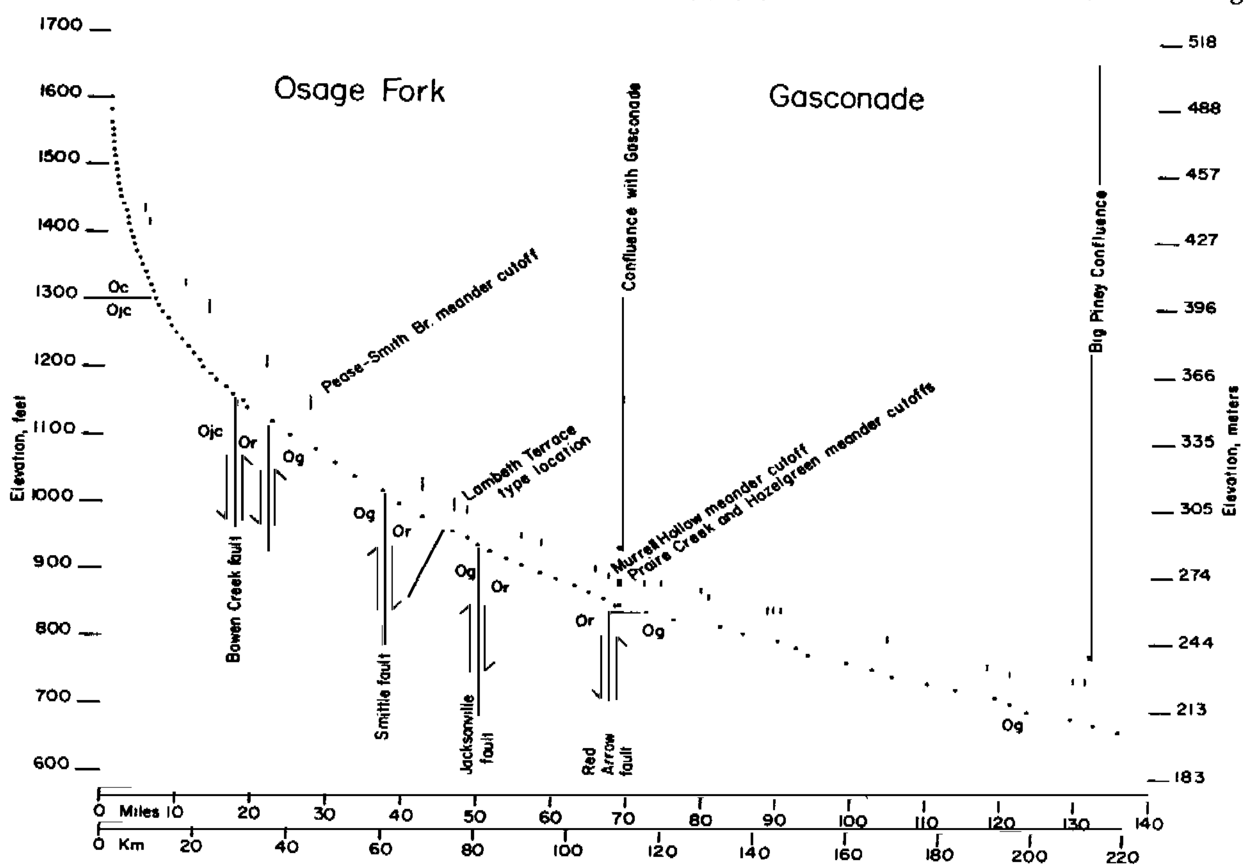

Figure 19. *Stream profile for the Osage Fork River and the Gasconade River between the Osage Fork and the Big Piney rivers. The vertical dashes show the location and elevation ranges of Lambeth terrace remnants. Cutoff meander sites are identified by a name. Geology is interpreted from Missouri Department of Natural Resources, Division of Geology and Land Survey open file maps. Oc = Cotter Fm.; Ojc = Jefferson City Fm.; Or = Roubidoux Fm.; Og = Gasconade Fm.*

Fork that fit on the terrace profile, Pease-Smith Br., Murrell Hollow, and Prairie Creek. The locations of the various meander cutoffs identified in this study are given in appendix C.
Figure 1 shows that the Osage Fork River is a major tributary of the Gasconade River. Figure 19 shows the Osage Fork profile joining the Gasconade profile. Note the flattening of the gradient in the Gasconade segment. The Gasconade River is the base level for the Osage Fork. Note, the continuation of the Lambeth terrace remnant profile on down the Gasconade.

Lamb th terrace in the Big Piney Valley

The Big Piney River is a major tributary to the Gasconade River (fig. 1), and it is the major drainage traversing Texas County from south to north. The Gasconade is the base level for the Big Piney. The stream profile for the Big Piney is shown in figure 17. The profile of a remnantal terrace that stands about the same elevation above the Big Piney as the Lambeth terrace of the Osage Fork is shown by short vertical lines. These remnants stand well above the 100-year flood level, based on U.S. Geological Survey gaging station records. In addition, four cutoff meander sites are plotted. Note that they all fall on the terrace profile, indicating a close relation with the terrace. The Lost Hill site shown on Figure 17 is the same as the lost hill site 167 described by Beveridge (*1978*) in his list of meander cutoffs. The meander cutoffs are fairly common features of Ozark rivers. With the exception of 167, none of the cutoffs noted in this Lambeth terrace study are listed by Beveridge.

This terrace profile in the Big Piney ties directly to the Lambeth terrace profile (fig. 19) traced down the Osage Fork and the Gasconade to the Gasconade - Big Piney confluence. The Lambeth terrace profiles are shown meeting at the confluence in figure 20. In this figure the Gasconade part is from figure19 and the Big Piney part is a mirror image from figure 17. This remnantal terrace is, thus, equivalent to the Lambeth terrace of the Osage Fork and the Gasconade. The Lambeth terrace is regional in extent throughout the Osage Fork - Gasconade - Big Piney drainage (fig. 1). Any erosion surface grading to this terrace surface in the Big Piney drainage is equivalent to the Drew surface as mapped in the Drew Quadrangle in Laclede County. Figure 18 shows the Drew surface in

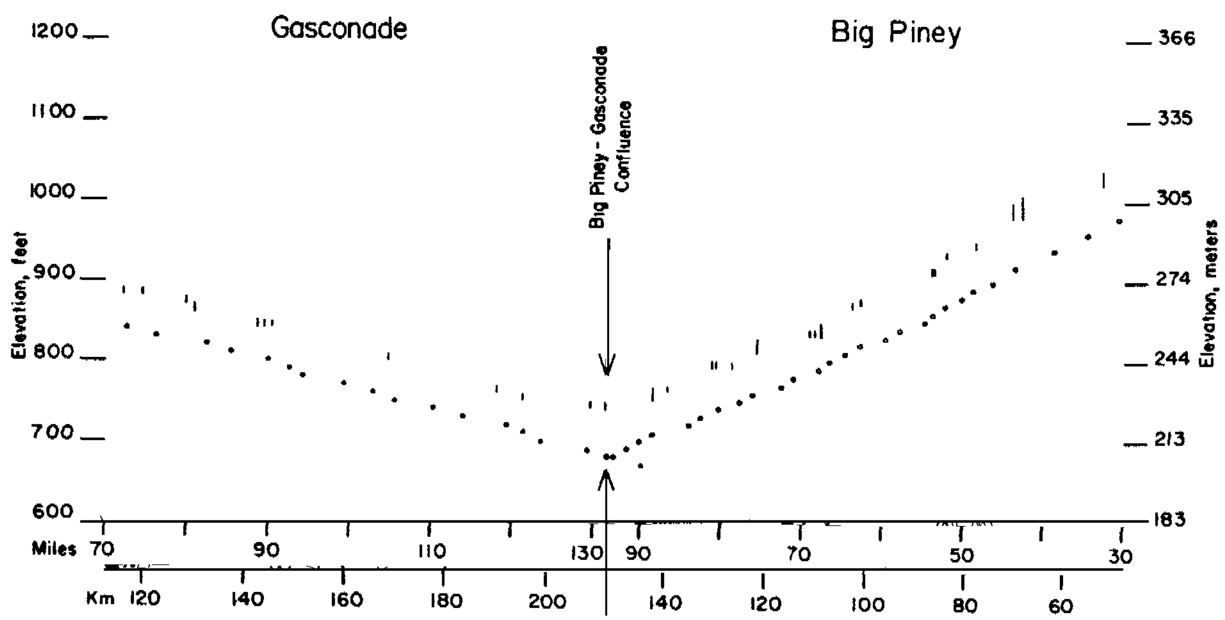

Figure 20. *Downstream portion of the stream profile and the Lambeth terrace profile for the Big Piney and the Gasconade Rivers, taken from figures 17 and 19.*

Texas County grading to this terrace surface. This establishes the regional extent of the Drew surface and indicates that other geomorphic surfaces in the sequence, of which Drew is a part, are also regional and correlative.

The study was later extended to the reaches of the Gasconade River above the Osage Fork confluence and below the Big Piney confluence. These reaches were checked by topographic map interpretation (without field verification) for Lambeth terrace remnants. The results showed that the terrace existed throughout the system. Clearly identifiable remnants are relatively rare between the Big Piney and the Missouri Rivers. One remnant, however, is notable. The large meander cutoff at Rich Fountain in Osage County (SW corner, Linn 7.5 minute quadrangle) plots exactly on the established Lambeth terrace gradient. This suggests that this cutoff occurred at the same time as all the others throughout the Gasconade system. Lambeth terrace remnants are present in the upper reach above the Osage Fork confluence. They are not as clearly defined as those in the Osage Fork and the Big Piney Rivers, and in the Gasconade between these two tributaries.

Dating of geomorphic surfaces

Relative dating is the determination of the older than or younger than relationships of a sequence of surfaces in a landscape. It is done by established geomorphic and stratigraphic principles, as discussed previously in reference to the various geomorphic surfaces described in this study. These principles are summarized by Ruhe (*1975*, pp. 222-224), Daniels and others (*1971*). Numerical dating is the determination of the age of a surface or deposit in terms of actual years. The Lambeth terrace has been mentioned as a means of dating the Drew erosion surface. This surface grades to the Lambeth terrace. Dating the terrace would give the age of the related erosion surface.

Breshears Valley, Pomme de Terre River

Breshears Valley is a cutoff meander in the Pomme de Terre River valley (fig. 1) just north of the Benton-Hickory county line in Benton County. It stands about the same elevation above the river level as the Lambeth terrace and related cutoff meanders in the Osage Fork valley. Archaeological and geochronologic studies in the lower Pomme de Terre included the Breshears Valley. The chronology developed for this site offers the possibility of dating the Lambeth terrace by extrapolation. The headwaters of the Pomme de Terre and the Osage Fork are only about 3 miles (4.8 km) apart in the vicinity of Marshfield, Missouri. This suggests the probability of similar climate, bedrock, and other factors in these drainages, therefore, extrapolation from one system to the other seems reasonable.

The alluvial chronology of the Breshears Valley has been reported in detail by Brackenridge (*1981*) and Haynes (*1985*). These authors refer to the meander cutoff floor as the T2 Terrace level and the terrace sediments as the Trolinger Formation (*Brackenridge, 1981*) or the Trolinger Spring Formation (*Haynes, 1985*). Haynes puts the surface of this unit at 46 feet (14 m) above river level. There is a basal gravel, considered to be channel gravel. This is overlain by clays and sandy clays that Haynes calls vertical accretion deposits.

Deposition of the T2 sediments apparently began more than 160,000 years before present (BP) date (*Haynes, 1985;* see also *McKinney, 1979*). Two carbon dates reported by Haynes (*1985*) suggest an end of sediment deposition at 48-51,000 BP date. This range essentially agrees with the 50-55,000 BP date given by Brackenridge (*1981*). According to Haynes (*1985*) deposition of the T2 terrace sediments occurred over the interval from the latter part of the Illinoian glacial, through the Sangamon Interglacial and into the early Wisconsinan. Based on the time scale used by Hallberg (*1986*), deposition continued into middle Wisconsinan if the 48-51,000 date for the end of deposition is valid.

The Breshears Valley meander was abandoned 49-45,000 BP according to Brackenridge (*1981*). Following abandonment, the Pomme de Terre cut a bedrock channel nearly to the present level and about 6 feet (2 m) below the bedrock base of the T2 meander sediments before aggradation began again. A complex cut and fill sequence followed through the remainder of the Wisconsin and into the Holocene. Both Haynes (*1985*) and Brackenridge (*1981*) ascribe this sequence of cut and fill to climatic causes.

A topographic map study of the Pomme de Terre River shows that terrace remnants and three other cutoff meanders are located both upstream and downstream from Breshears Valley (see appendix C for locations). These sites stand at about the same elevation above the Pomme de Terre River as Breshears Valley and they plot on the same gradient as Breshears Valley (fig. 21). They are presumed to represent the T2 terrace level of Brackenridge (*1981*) and Haynes (*1985*).

The occurrence of both the meander cutoffs and the terrace remnants on the same gradient suggests that meander abandonment and incision of the terrace were contemporaneous throughout the Pomme de Terre. If the cutoffs were not related to the terrace, and meander abandonment occurred at widely differing times, the cutoffs would have different elevations above the river and would not be on the same gradient.

Extrapolation into the Osage Fork Valley

In the Osage Fork River valley, the Lambeth terrace exists as small remnants standing about 48 feet (14.6 m) above river level in the lower 50 miles (80 km). At the type location (figs. 3A and 9) of the Lambeth terrace, the elevation range above the river estimated from the Drew topographic map is 30 to 50 feet (9 to 15 m). The elevation of the possible uneroded terrace surface above river level is 46 feet (14 m), measured from a large detailed river and terrace profile.

The Lambeth terrace profile in the Osage Fork has three meander cutoffs (fig. 19), Pease - Smith Br., Murrell Hollow, and Prairie Creek that fit on the terrace gradient. This is just like the T2 terrace, Breshears Valley, and the other cutoffs found in the Pomme de Terre.

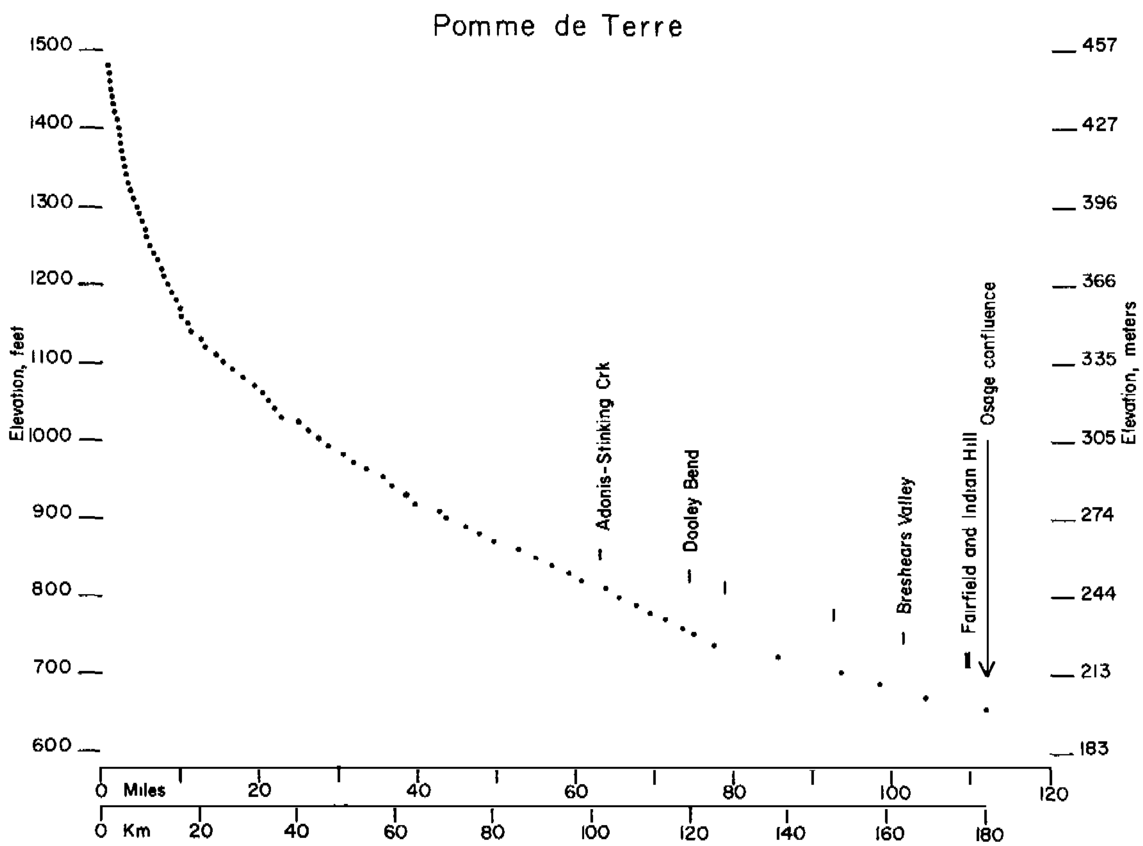

Figure 21. *Plot of the Pomme de Terre River and the gradient of the T2 - Breshears Valley terrace of Brackenridge (1981) and Haynes (1985). These sites were identified and elevations were determined by topographic map interpretation. The vertical length of the dash indicates the elevation range of the terrace site. Cutoff meander sites are identified by a name.*

A cut and fill sequence in the Osage Fork Valley truncates the Lambeth terrace surface, the terrace deposits, and the bedrock floor below the terrace deposits. Figure 9 shows a "low terrace or flood plain, or both" separated from the Lambeth terrace by a scarp. Note also the inset cut into the bedrock between drill sites 3 and 4. This is equivalent to the bedrock channel cut below the base of the T2 meander sediments in the Pomme de Terre, as reported by Brackenridge (*1981*) and Haynes (*1985*). The basal part of the Lambeth terrace deposits and the low terrace sediments is gravel, just as in the T2 and younger materials in the Pomme de Terre. The basal gravel of the Lambeth deposits is overlain by silty clays, clays, and clay loams (appendix B). This is a sequence like that reported for Breshears Valley by Haynes (*1985*).

A remarkable similarity exists between the Pomme de Terre and the Osage Fork valleys. Both Brackenridge (*1981*) and Haynes (*1985*) invoke climatic changes as the general cause of the sequence of events in the Pomme de Terre. The proximity of the Osage Fork suggests that it would be subject to similar climatic conditions and would respond the same way as the Pomme de Terre. To extrapolate the numerical dating of events in the Pomme de Terre to the similar situation in the Osage Fork is reasonable.

Age of the Drew erosion surface

If the assumption is made that the T2 terrace in the Pomme de Terre is equivalent to the Lambeth terrace in the Osage Fork, then alluviation of the Lambeth terrace began more than 160,000 years before present (BP) date. The Drew erosion surface grades to the Lambeth terrace, therefore, Drew erosion began more than 160,000 years BP. Deposition of T2 sediments in the Pomme de Terre ended about 50,000 years BP, therefore, deposition of Lambeth terrace sediments ended at this same time. This was the end of the Drew erosion cycle and the surface dates from this time. Drew erosion began, as previously noted, during the latter part of the Illinoian glacial, continued through the Sangamon Interglacial into early Wisconsin and possibly into middle Wisconsin (*Haynes, 1985* and *Hallberg, 1986*).

Continuing the assumption of parallelism of events in the two rivers, erosion of the Lambeth terrace and abandonment of the cutoff meanders began 49-45,000 years BP, the middle Wisconsin of Hallberg (*1986*). This was the beginning of a complex of cut and fill cycles that has continued into the Holocene. The erosional elements of this sequence were included, without separation, in the Nebo surface of this study. The depositional elements were included in the Drynob complex. All surfaces shown to be older than the Drew by geomorphic relations are older than 160,000 years. This includes the Success surface, the Lebanon surface, the Jacksonville surface, and the Falcon surface. It is not known how much older they are.

The meander cutoffs

Eleven meander cutoffs have been identified in the Gasconade drainage, including the Osage Fork and Big Piney rivers. There are three on the Osage Fork, four on the Big Piney and four on the Gasconade. All of these cutoffs are on the Lambeth terrace gradient. This is illustrated in figures 17 and 19 for the Osage Fork and Big Piney drainages and the Gasconade River between the Osage Fork and Big Piney. Further study of the Gasconade (not illustrated) found one cutoff above the Osage Fork and two between the Big Piney and the Missouri Rivers. As indicated, these plotted on the established Lambeth terrace gradient.

Four cutoffs are on the Pomme de Terre, as previously discussed. This is a total of 15 cutoffs identified in this terrace study. These were classified as either chute or neck cutoffs after Collinson (*1978*). In the Gasconade drainage (including the Osage Fork and Big Piney), there are eight neck cutoffs and three chute cutoffs. In the Pomme de Terre drainage, there are two neck and two chute cutoffs. The predominant neck cutoffs all have a meander core, and, apparently the cutoff was through or across bedrock. The five chute cutoffs all appear to be through alluvial deposits.

The occurrence of these cutoffs in the Gasconade drainage on the Lambeth terrace gradient suggests a close relationship between cutoffs and the terrace. The cutoffs further suggests that meander abandonment and terrace incision were contemporaneous throughout the Gasconade drainage, similar to the Pomme de Terre. The preponderance of neck cutoffs, through bedrock necks, can be interpreted as suggesting a catastrophic event or a series of closely spaced events that isolated the meanders, cleaned out most of the Lambeth terrace fill, and cut a bedrock channel below the bedrock base of the Lambeth terrace (fig. 9).

Correlation of Surfaces With Previous Work

Early Ozarks studies

Hershey (*1895*) recognized erosion surfaces in the Ozarks. He wrote about a "Jura-Cretaceous peneplain," an "eroded plain" that cut across many strata. He recognized erosional outliers or remnants which he described as "small hills and short ridges which rise . . . above the level of the peneplain."

His recognition of valleys with "duplex form" is of interest because similar valley forms are recognized in this present study. He describes them as ". . . compound, consisting of a small trough excavated in the bottom of a much larger trough or valley." This describes the valley of Little Cobb Creek (fig. 3A), where, in this study, the larger and higher "trough" is a scoop-shaped pediment. Figure 8 illustrates this "duplex form" with a series of topographic profiles. The Jacksonville (Ja) surface is equivalent to Hershey's "larger trough or valley" and the Drew (Dr) surface is the valley slope of his "small trough." It appears that Hershey recognized a sequence of at least three erosion surfaces; the oldest being a "Jura-Cretaceous peneplain;" next is his "larger trough" which he thought to be Tertiary, and youngest is his "small trough" which he concluded was Quaternary in age.

Marbut (*1896*) apparently thought in terms of two erosion cycles in the Ozarks region, the present cycle and an older cycle of the uplands. He considered "the upland as a whole" to be "a peneplain of a former cycle of erosion; not necessarily a perfectly base-leveled plain, but a graded surface." He recognized that this surface "beveled the edges of many strata." He stated that there was no evidence of more than one cycle in the upland. He said, "the peneplain represented in the general upland is the only one, and in it the valleys and lowland belts were developed during the present cycle." He thought that no sharply incised valley existed at the close of the old erosion cycle. Marbut cites uplift of the Ozark Dome as the general cause of the incision of the peneplain that has produced the present steep-walled valleys.

Marbut (*1896*) noted two phases of development in the valleys of the Ozark region, the Trough phase and the Canyon phase. The Trough phase referred to the "wide, open shallow troughs" of the upper parts of a valley. The Canyon phase was described as prevailing "where there are perennial streams of considerable size. The wide open parts gradually become deeper and narrower down-stream, passing by insensible gradations into canyons." This seems similar to Hershey's (*1895*) duplex valley form and to the incised scoop-shaped pediment of the Little Cobb Creek drainage in this study.

A comparison can be made between the concepts of this study in Texas County and the ideas presented by Marbut (*1896*) for the same area. On plate VI, pp 56-57, Marbut identifies an area four miles south of Licking, in Texas County, as the "Salem Plain," the "peneplain of a former cycle of erosion." This area is on the Licking 7.5 minute quadrangle (not illustrated), which is the next quadrangle north of the east half (Raymondville Quadrangle) of figure 12.

Reconnaissance geomorphic mapping of the area along the Big Piney - Current divide was carried north into the Licking Quadrangle. The area on the divide, 4 miles south of Licking was identified as the Lebanon (Lb) surface. In this case, Marbut's "Salem Plain" and the Lebanon surface are, apparently, the same thing. However, the Salem Plain may have included the Jacksonville (Ja) surface tentatively identified in some of the drainage heads to the east of this area. Thus, Marbut's peneplain surface may be composed of two of the erosion surfaces identified in this study.

Eight years later Marbut (*1904*) may have recognized a surface, younger than the Salem Plain (Lebanon), that was possibly equivalent to the Jacksonville surface. He mentions briefly "the existence of a peneplain lying at a lower level than that of the so-called Cretaceous peneplain . . . ."

A more recent study

Bretz (*1965*) presented a synthesis of the geomorphic history of the Ozarks that covered the entire region. The following comments are an attempt to relate specific areas of this present study to Bretz's interpretations of these same areas. The discussion will deal primarily with the

Texas County study area because the older geomorphic surfaces are more extensive there.

The two study areas in Laclede and Texas Counties, lie within the Salem Plateau as defined by Bretz (*1965*). The Ozark peneplain, a dissected plain, lies within the Salem Plateau. Bretz seems to use Salem and Ozark interchangeably in his discussions. He recognized that a sequence of erosion surfaces exists and that the Ozark peneplain was not flat. He noted, "minor interfluves that lead off the main divides into today's larger valleys repeatedly carry a profile surviving with little alteration from the slopes of such major valleys on the peneplain itself. They were shallow, wide open, and broad bottomed valleys." Bretz comments further about "steeply walled river valleys and their vigorously headward eroding ravines" that are incised into the peneplain surface. This all implies a recognition of erosion cycles and he calls upon uplift of the Ozark dome as the major driving force. He finds evidence of three times of uplift.

Bretz (*1965* pp 33-36) discusses the Licking, Raymondville, and Houston 7.5 minute topographic quadrangle area. The geomorphic surfaces recognized and mapped in this study are shown in figure 12 which is composed of the Houston and Raymondville quadrangles. Bretz (*1965*) in his figure 9 equates the Ozark peneplain to areas enclosed by the 1,300-foot (396 m) contour line. Areas enclosed by the 1,400-foot (427 m) contour line are called "monadnock elevations," that are probably related to or are remnants of a higher and older surface.

Two surfaces were mapped on the Bretz Ozark peneplain in this study area. The higher, smoother, flatter parts with widely spaced contour lines were delineated as the Lebanon (Lb) surface. The somewhat steeper slopes that have more closely spaced lines marking the better defined slopes grading to the upper reaches of the drainageways were mapped as the Jacksonville (Ja) surface. In this study the Lebanon surface is terminated by the Grovespring scarp that rises to the higher and older Success surface which equates to Bretz's "monadnock elevations." His steep river valley walls and headward eroding ravines are equivalent to the Drew (Dr) and Nebo (Ne) surfaces of this study. These relationships are summarized in table 3.

Table 3. *Relationship of Bretz (*1965*) terminology to the geomorphic surfaces in this study.*

Bretz (*1965*)	This study
Steep walled valleys	Nebo Drew
Ozark peneplain	Jacksonville Lebanon
	Grovespring scarp
Monadnock elevations (Springfield)	Success surface, Texas County

Terrace studies

Relatively little study of the terrace systems in the Ozarks, especially in the river valleys, relates to the Laclede and Texas County study areas. Todd (*1896*) mentions inconspicuous remnants of terraces along the Osage River, and less clearly along the Gasconade where they "are met with sometimes." Brackenridge (*1981*) and Haynes (*1985*) worked out an alluvial sequence in the Pomme de Terre Valley that has been useful to this study. Their alluvial chronology has been extrapolated into the Osage Fork Valley, as discussed in the section of this report titled, "Dating of Geomorphic Surfaces."

Other recent studies of river terraces have been a part of archaeological investigations of scenic rivers conducted by the National Park Service. Saucier (*1987*) described the active floodplain and three discrete terrace levels in the Current River (fig. 1). The floodplain was divided into two units, TO and Tl and included hummocky to undulating surfaces lying generally within 10 feet (3 m) of low water river level, but as high as 20 feet (6 m) above. The lowest discrete terrace level, T2, is defined as lying 10 to 20 feet (3 to 6 m) above low water level. T3 is the next higher level, standing 20 to 40 feet (6 to 12 m) above low water level.

Saucier (*1987*) notes that even the T3 level is subject to flooding with a return frequency of less than 50 years. None of these levels are terraces by the criteria of Howard (*1959*) and Ruhe (*1975*) because they are subject to flooding under the present stream regimen. They are, instead, floodplain steps. They would fit into the Drynob (Dy) complex geomorphic surface unit of the Laclede-Texas County study.

The third discrete terrace level, T4, identified by Saucier (*1987*) stands 60 feet (18 m) above low water level of the Current River. It is of limited extent and was identified at only a few localities in the middle reaches of the river. There was no further discussion of the T4 level. Considering the elevation range of the T3 level, its flooding frequency, and a photograph showing a typical example, it seems probable that T3 is not equivalent to the Lambeth terrace. The T4 level appears most likely to be similar to the Lambeth.

Recent soil survey reports recognize terraces in the Ozark river valleys. Wolf (*1989*) delineated two map units, 14B and 14C, correlated as Claiborne silt loam, 2 to 5 and 5 to 9 percent slopes, on remnants of a terrace in the Big Piney Valley in Pulaski County. Pulaski County is located just north of Texas County. Comparisons between the 1:24,000 scale soil maps and the topographic quadrangles used in the terrace study show that the two map units were consistently on Lambeth terrace sites. The slope classes used for these map units confirm the generally eroded character of the Lambeth terrace remnants.

Structure — Geomorphic Surface Relations

The Jacksonville fault in the Drew Quadrangle

The Jacksonville fault crosses the topographic profile shown in figure 4 between miles 11 and 12. The trend of this fault across the Drew Quadrangle and its intersection with the divide axis is shown in figs. 2 and 3A. The throw or vertical displacement of this fault is estimated to be about 75 feet (23 m) based on information derived from the Drew geology map (*Missouri Department of Natural Resources, 1984*). The downdropped block is to the northeast side of the fault line.

During the course of the study, the question arose as to what was the effect, if any, of this fault on the geomorphic surfaces mapped in the area. Both the Lebanon surface and the Falcon surface have remnants on the south side of the fault. Four of the Lebanon surface sites are on the north or downdropped side (fig. 4). Lebanon site 5 is on the south or upthrown side. The specific question was, "Did Lebanon site 5 show any evidence of the 75-foot (23 m) vertical displacement associated with this fault?"

Linear regression analysis appeared to be a means of answering this by using the elevations of the four downdropped sites to develop a regression equation to predict the elevation of the upthrown site. Elevations were known as ranges, estimated from the topographic map, and they are given in table 1. In considering the ranges, there was a choice of one of three elevations to use, the upper limit, the midpoint, or the lower limit. Graphical analysis of residuals, as defined and described in chapter 4 of Neter and others *(1983)*, was used to determine which site elevation to use. This approach showed that the variance or error in the midpoint elevations was excessive and tended to increase toward the south or upgradient. It also showed that the lower limit elevations were the probable source of the error for the midpoint elevations and also were not useable. The upper limit elevations were the best because the residuals fell within a horizontal band centered around zero, displaying no systematic tendencies to be positive or negative (*Neter and others, 1983*). These upper limit elevations were taken from actual spot elevations shown on the topographic map in at least half the cases. Consequently, they are more accurate than the lower limit ones which were based on map interpretation only.

The linear regression equation of the upper limit of the elevation range (Y) on distance (X) in miles from the Osage Fork-Gasconade confluence along the divide for the four Lebanon sites on the downthrown side of the fault (fig. 4) is Y = 5.5X + 1,212. The correlation coefficient r is 0.987, significant at the 95 percent level. This indicates that sites 1 through 4 are probably related and are on an established grade rising toward the south (fig. 4). The elevation of Lebanon site 5 on the up block south of the fault was predicted using the regression equation. The calculated upper limit elevation for Lebanon site 5 is 1,309 feet (399 m). The actual spot elevation for this site as shown on the topographic map is 1,314 feet (400.6 m). This close agreement indicates that Lebanon site 5 has not been affected by the 75 feet (23 m) of vertical movement. All five sites are on the same gradient. This is confirmed when all five Lebanon sites are used in a regression and the resulting correlation coefficient is 0.990, significant at the 99 percent level. The calculated gradient for this surface is shown on figure 4. The conclusion drawn is that the Lebanon erosion surface truncates or cuts across the Jacksonville fault and is, thus, younger than the fault. There has been no movement of this fault in this area since the cutting of the erosion surface.

The southernmost mapped remnant of the Falcon surface is 2.6 miles (4.2 km) south of the Jacksonville fault along the divide axis on the upthrown block. This is Fa site 13 on figure 3A (location 4) and figure 4, and is on the line between section 36, T. 33 N., R. 14 W. and section 31, T. 33 N., R. 13 W. This raises again the question of the relationship between this fault and the geomorphic surfaces mapped on both sides of it. As noted before, the vertical displacement is about 75 feet (23 m).

Linear regression analysis, following the procedures outlined for the Lebanon surface, was used to evaluate the possible effect of fault movement on this particular site. A regression equation (Y = 3.5X + 1,190) based on seven Falcon sites (6, 7, 8, 9, 10, 11, 12) lying on or near the divide (figs. 3A, 3B, and 4) had a correlation coefficient, r, of 0.853, significant at the 95 percent level. Solving this equation, for the upper limit elevation of the Falcon surface at site 13, gave a value of 1,259 feet (384 m). The actual spot elevation from the topographic map is 1,258 feet (383.5 m). This indicates that no movement of the fault has occured since the Falcon surface was formed. Furthermore, when all eight sites are included in a regression analysis, a correlation coefficient of 0.904, significant at the 99 percent level is obtained. This confirms that the Falcon sites are on a definite gradient and that movement has not affected site 13. The fault is, thus, concluded to be older than the Falcon surface. This calculated gradient of the Falcon surface is shown on figure 4.

The Grovespring scarp

The Grovespring scarp is an erosional feature recognized on a topographic map by a sequence of relatively closely-spaced contour lines showing a slope to a higher or lower elevation along an interfluve. The scarp separates older and younger geomorphic surfaces and exists as a step in a sequence of erosion surfaces. The Grovespring scarp was observed on major interfluves across the Gasconade drainage basin at six sites (fig. 22) for a distance of 43 miles (69 km). The sites are listed on the next page by divide and numbered from west to east.

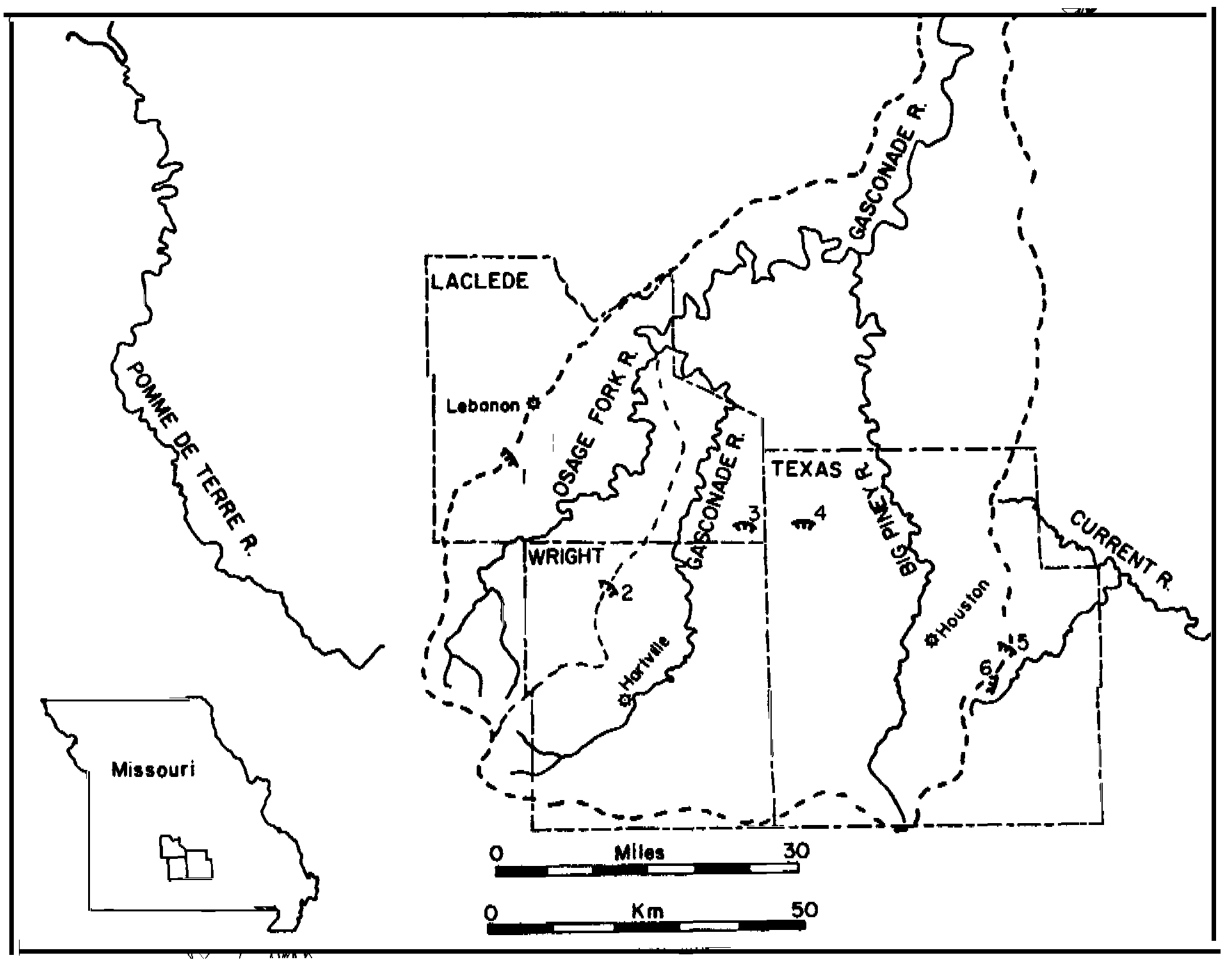

Figure 22. Locations of Grovespring scarp sites: (1) Osage River - Osage Fork River divide, near Brush Creek; (2) Osage Fork - Gasconade divide, near Grovespring; (3) Gasconade - Roubidoux Creek divide, at Lynchburg; (4) Roubidoux Creek - Rock Creek divide, between Plato and Roby; (5) Big Piney - Current divide, near Raymondville; (6) Eastern limit, near Yukon.

1. Osage River - Osage Fork River, near Brush creek on the Brush Creek 7.5 minute quadrangle (NW1/4, SE1/4 sec. 3, T. 33 N., R. 16 W.) toe elevation = 1,330 feet (405 m), Roubidoux Formation.

2. Osage Fork River - Gasconade River, near Grovespring on the Grovespring 7.5 minute quadrangle (SW1/4 sec 1, T. 31 N., R. 15 W.), coincides with the Smittle fault, toe elevation = 1,320 feet (402 m). In this study, the scarp was first recognized at this site.

3. Gasconade River - Roubidoux Creek, at Lynchburg on the north end of the Manes 7.5 minute quadrangle (NE1/4 sec.7, T. 32 N., R 12 W), toe elevation = 1,350 feet (412 m), Jefferson City Formation. The view toward the north from the front porch of the old Lynchburg store is down the scarp.

4. Roubidoux Creek - Rock Creek, between Plato and Roby, south end of the Roby 7.5 minute quadrangle (NE corner sec 7, T. 32 N., R. 11 W.), toe elevation = 1,360 feet (415 m), Jefferson City Formation. There may be obscure remnants in the vicinity of Evening Shade (east side of Roby quadrangle) on the Big Piney River - Roubidoux Creek divide. In this area, it has been essentially destroyed by the headward erosion of minor drainages on both sides of the divide. The divide is, thus, narrow and rough.

5. Big Piney River - Current River at Raymondville on the Raymondville 7.5 minute quadrangle (NE1/4 sec 8, T. 30 N., R. 8 W.), toe elevation = 1,370 feet (418 m), Jefferson City Formation (fig. 12).

6. Eastern Limit - appears to be at the headwaters of the Current River, in particular, Big Creek and its tributaries. The Grovespring scarp has been mapped as remnants on minor interfluves along the east side of the Big Piney River-Current River divide to the south of the Raymondville site where Big Creek and its tributaries head in the divide (fig. 12, location 2). The toe elevation rises southward to 1,390 feet (424 m) west of Yukon. Raymondville 7.5 minute quadrangle (SE1/4 sec 25, T. 30 N., R. 9 W. and SW1/4 sec. 30, T. 30 N., R. 8 W.), Jefferson City Formation.

The reconnaissance geomorphic map of the vicinity of the scarp sites on the Osage River - Osage Fork divide (fig. 22: site 1), the Osage Fork - Gasconade River divide (fig. 22: site 2), and the Roubidoux Creek - Rock Creek divide (fig. 22: site 4) suggests that the Grovespring scarp is the upper limit of the Lebanon surface on these divides. For example, the relatively flat area around Lebanon, MO, (elevation 1,300 to 1,320 ft., 396-402 m) on the Osage River - Osage Fork divide, grades to the toe (elevation 1,330 feet, 405 m) of the Grovespring scarp at figure 22: site 1, figure 23: site 1. This surface at Lebanon is considered to be the same surface as the highest ridgetop surface in the Drew Quadrangle, named Lebanon. According to Bretz (*1965*), the Salem Plateau (Ozark peneplain) is terminated by and lies to the east and northeast of the Eureka Springs Escarpment. This scarp on the Osage River - Osage Fork divide has a toe elevation of 1,560 to 1,580 feet (476 to 482 m) and is located about 17 airline miles (27.4 km) southwest of the Grovespring scarp. The apparent termination of the Lebanon surface at the Grovespring scarp suggests that the Lebanon surface is inset below and, consequently, is younger than the Ozark peneplain (Salem Plateau) rather than equivalent to it. This suggests that the Ozark peneplain of Bretz is in reality a sequence of erosion surfaces.

Detailed mapping on the Big Piney River - Current River divide (fig. 12) shows clearly that the Grovespring scarp is the upper limit of the Lebanon surface. It separates the Lebanon surface from remnants of a higher, older surface that occupies the ridgetop above the scarp. This is illustrated by the topographic profile (fig. 23: site 5). On the Texas County geomorphic map (fig. 12) this older, higher ridgetop surface is called the Success (Ss) surface.

The sequence of topographic profiles in figure 23 shows that the toe elevation of the scarp rises from west to east across the Gasconade drainage. Based on the available geologic mapping, the scarp occurs on both the Roubidoux and Jefferson City Formations. For the reasons noted in the preceding discussion, the Grovespring scarp is thought to be of significance in the geomorphic history of the Ozarks, but more work is needed to develop a better understanding of this significance.

The Smittle fault

The Grovespring scarp coincides with the Smittle fault (*Thompson, 1981*) on the Osage Fork - Gasconade divide near Grovespring (figs. 22, 23: site 2) . This raises a question about the relationship between this scarp and faulting at this and the other locations. Examination of the available geologic map (Missouri open file maps and published 1° x 2° quadrangle maps) shows that there is no fault associated with this scarp at any of the other sites on the other interfluves. Coincidence with a fault is an isolated occurrence.

The Smittle fault has a throw of 260 to 300 feet (79 to 91 meters) based on the elevations of formation contacts derived from the geologic map of Thompson (*1981*) and Easson (*1984*). The upthrown block is on the up-divide or south side of the fault and scarp (fig. 23: site 2). This has raised the Roubidoux Formation, which is said to be primarily sandstones (*Thompson, 1981*), so that these more resistant rocks now form a significant part of the Grovespring scarp slope on this particular divide profile. The 260 to 300 feet (79 to 91 m) of throw on this fault is enough to suggest that this may have had some effect on the gradient of the streams that cut across it.

Stream gradient profiles were constructed along Steins Creek, which crosses the fault to the northwest of the divide, and along Scotts Branch, which crosses to the southeast of the divide. Throws at each of these sites were estimated to be about 300 feet (91 m). Both arithmetic and semilogarithmic plots were made. Neither stream profile shows any evidence of the fault. Semilogarithmic plots (*Hack, 1957*) of the stream gradients show a sequence of straight line segments that relate directly to the bedrock unit outcropping in each segment (fig. 24). Linear regression analysis of each of the three segments confirms the linear character. The fault is coincident with the Gasconade-Jefferson City contact. The character of the bedrock units exerts the primary control on the stream gradient rather than the vertical displacement resulting from the faulting. This suggests that the Smittle fault is old relative to the development of the present drainage system and related erosion surfaces. It seems probable that the erosional processes associated with the development of the Lebanon surface simply exploited the fault and the uplifted Roubidoux sandstones to produce the Grovespring scarp as it now exists on this divide.

In general, the scarp is an erosional feature representing the maximum encroachment of an erosion surface on an older landscape. This erosion surface (the Lebanon surface) is one in a sequence of multiple stepped erosion surfaces such as is discussed by Ruhe (*1975*, pp. 136-140.)

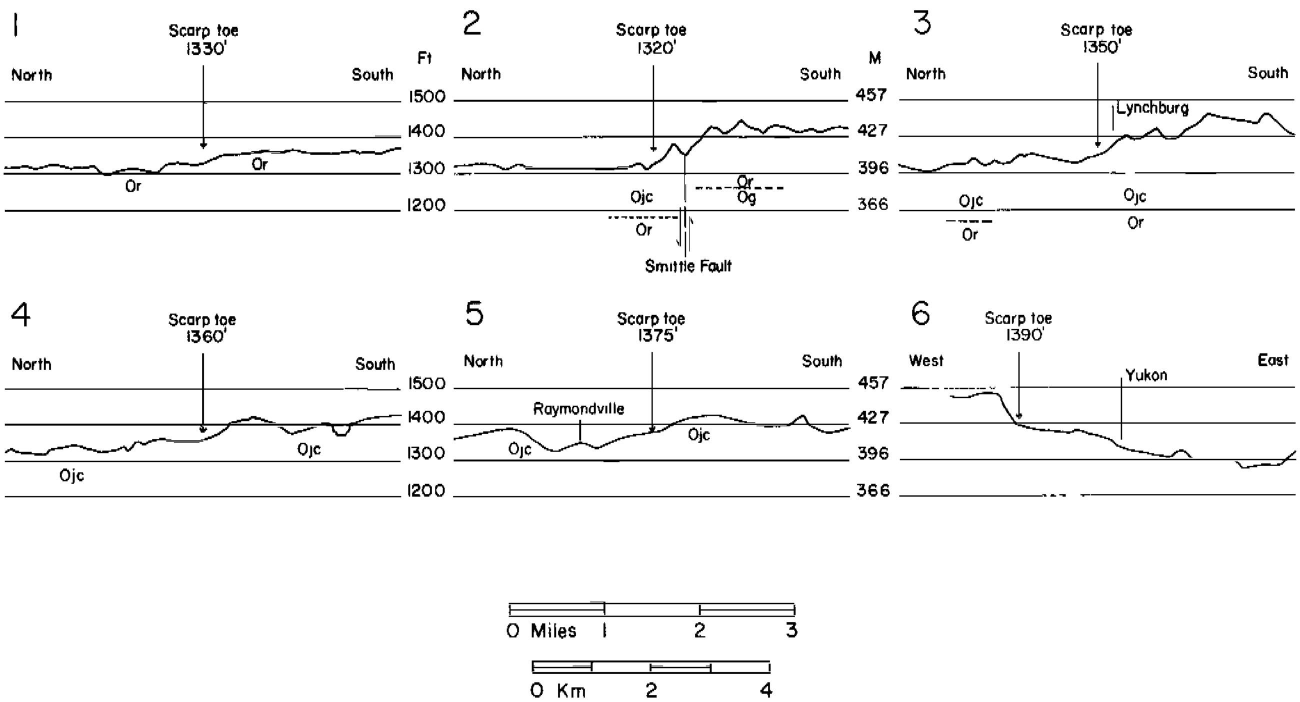

Figure 23. *Topographic profiles across the Grovespring scarp at the six sites identified in figure 22. Geology interpreted from various Missouri Department of Natural Resources open file maps. Ojc = Jefferson City Fm., Or = Roubidoux Fm., Og = Gasconade Fm. Vertical exaggeration is 20X.*

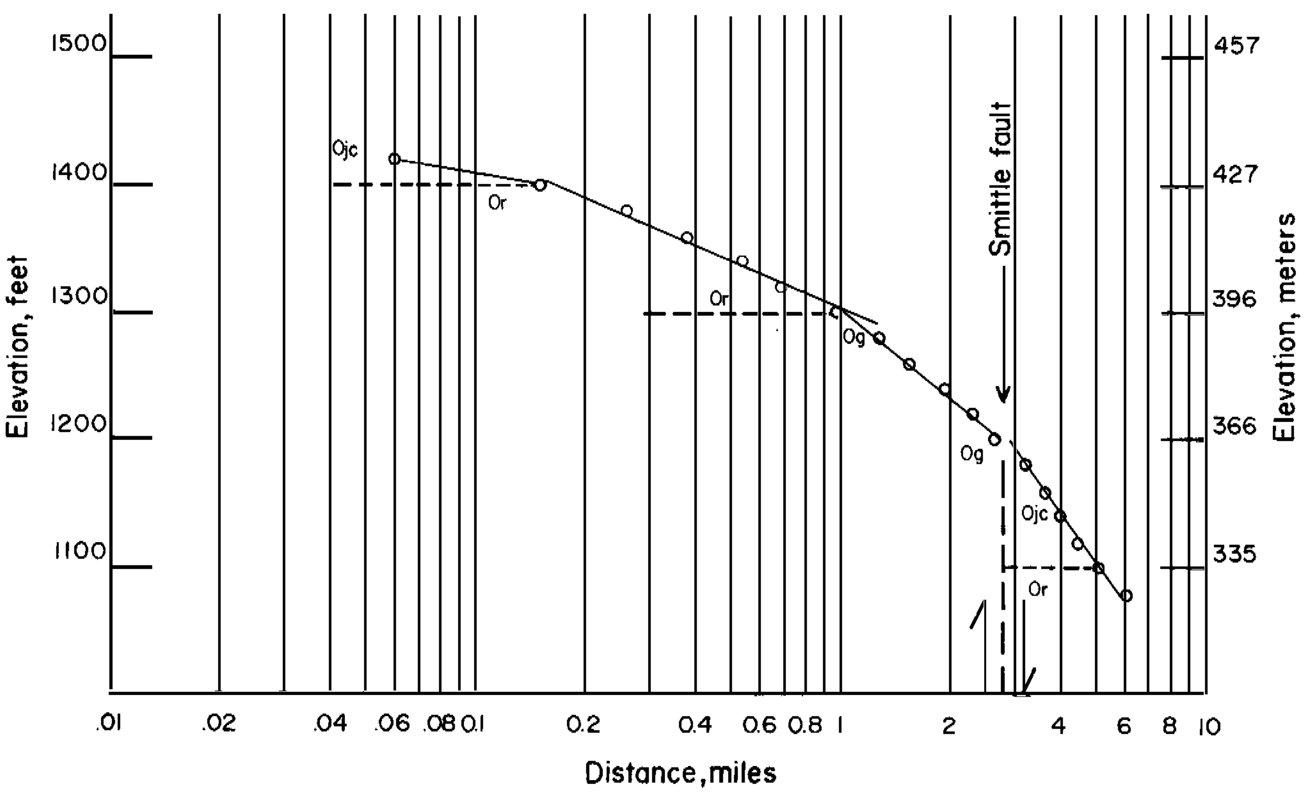

Figure 24. *Semilogarithmic plot of the longitudinal profile of Scotts Branch crossing of the Smittle fault. Site is in the SE1/4, section 18, T31N, R14W, Grovespring Quadrangle. Or = Roubidoux Fm., Og = Gasconade Fm., Ojc = Jefferson City Fm. Geology from Thompson (1981) and Easson (1984).*

Geomorphic Surface — Soil Relations

Site selection for soil characterization

During this study in Laclede County, eight pedons were sampled in the Drew Quadrangle for research and characterization purposes. Sites were selected following the completion of the soil map, the geomorphic surface map, and the power auger surficial stratigraphic study. Geomorphic and stratigraphic control, as well as a soil map were, thus, available as aids in site selection. The use of such control makes evaluating and comparing sites possible in terms of what surface they are on, their relative age, and parent material differences. Examination of the laboratory data indicates that there are two groups of soils. Those on the Lebanon, Falcon, and Jacksonville (Lb, Fa, Ja) surfaces have common characteristics, and those on the Drew (Dr) surface are significantly different. There will be much discussion based on these two geomorphic groups in the following sections. The material to follow was originally presented in a summary report on the Missouri Ozarks soil-geomorphic study given limited distribution in 1982 (*Gamble and Mausbach, 1982*). This summary report has been used as a basis for the following, with omissions and modifications of interpretations dictated by new information obtained since 1982.

Sample site locations are shown in figures 25A and B. Sample site-surface relations are summarized in table 4. Pedon data and descriptions are presented in appendix E. Soils data is normally reported and discussed in metric units. For this reason, English-metric conversions of the soils data will not be used in the following discussions.

Surficial stratigraphy and particle size distributions

Bedrock, residuum and other deposits

The major bedrock unit in the study area is the Ordovician Jefferson City Dolomite. All pedon sampling sites were within this unit. The underlying Roubidoux Formation does outcrop in the bottom of the deeper valleys such as Big Sleepy Hollow and Flagmire Hollow (fig. 25A). The top of the Roubidoux is at about 1,080 feet (329 m) (*R. Ward, Missouri D.N.R., Div. of Geology and Land Survey, personal communication, 1980*), more than 100 feet (30 m) below the lowest sampling site (005) elevation of 1,195 feet (364 m).

A second unit important in the soil-landscape-geology relations is the residuum derived from the dissolution of the cherty dolomites of this general area. Insoluble residue studies (*Grohskopf and*

Table 4. *Soil sample sites and geomorphic surfaces*

Pedon ID No.*	Pedon classification	Mapped surface	Comments
001	Aquic Fragiudalf	Falcon	Good Falcon surface
002	Typic Fragiudalf	Lebanon	Narrow ridgetop remnant on the main divide, may be transitional to Drew
003	Typic Fragiudalf	Drew	Narrow spur ridge top, may be Jacksonville remnant
004	Typic Paleudalf	Drew	In sequence downslope from 003
005	Typic Paleudult	Drew	Ultisol, in sequence downslope from 004
006	Typic Fragiudalf	Lebanon	Good Lebanon surface on spur ridge off main divide
007	Typic Fragiudalf	Lebanon	Bordering on Jacksonville surface, downslope from 006
008	Typic Fragiudalf	Drew	Upper edge of Drew surface in a headslope position

*Brackets indicate a sampling traverse downslope across a sequence of geomorphic surfaces.

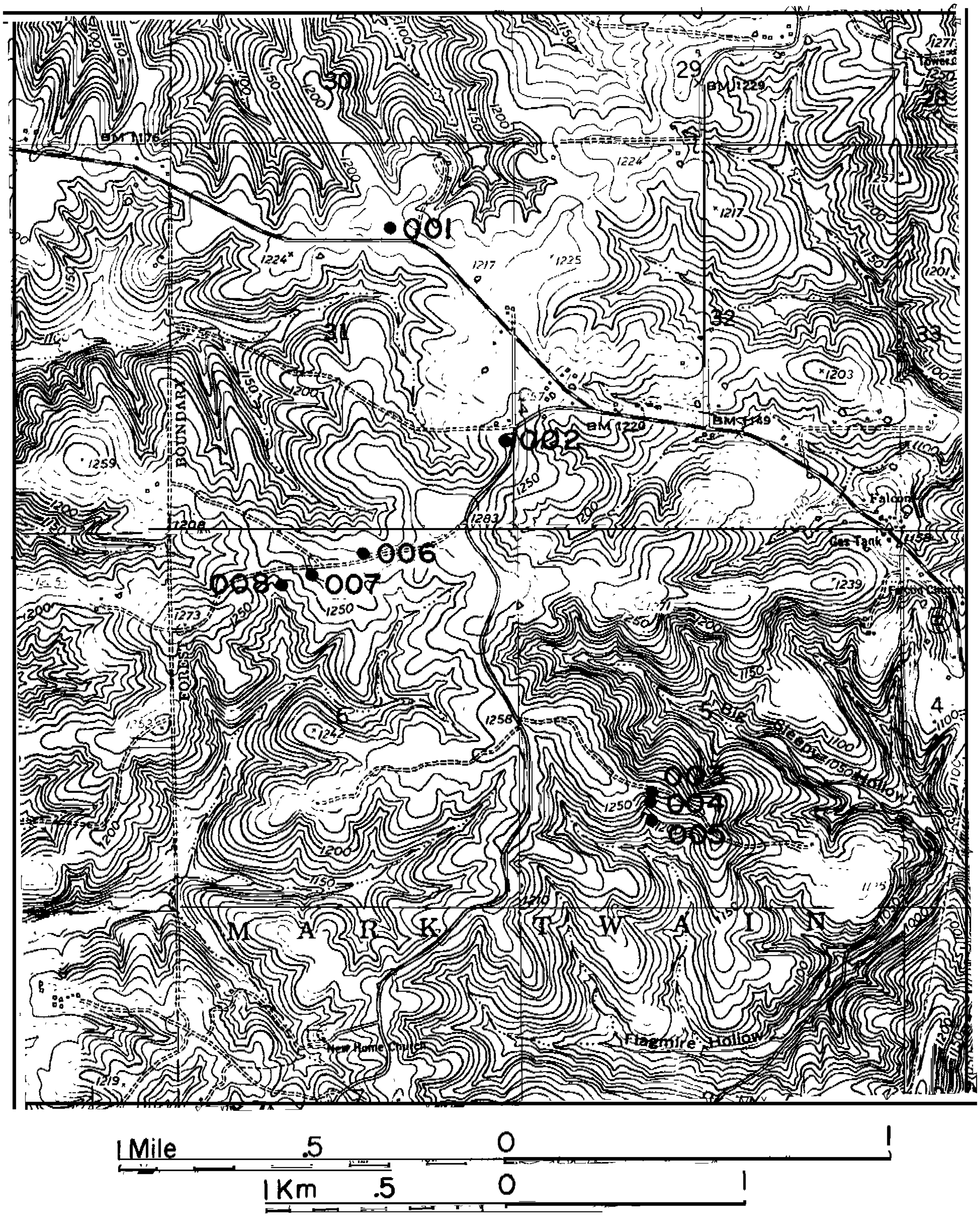

Figure 25A. *Sample site locations in the northeastern corner of the Drew Quadrangle, relative to topography. Contour interval is 10 feet (3m).*

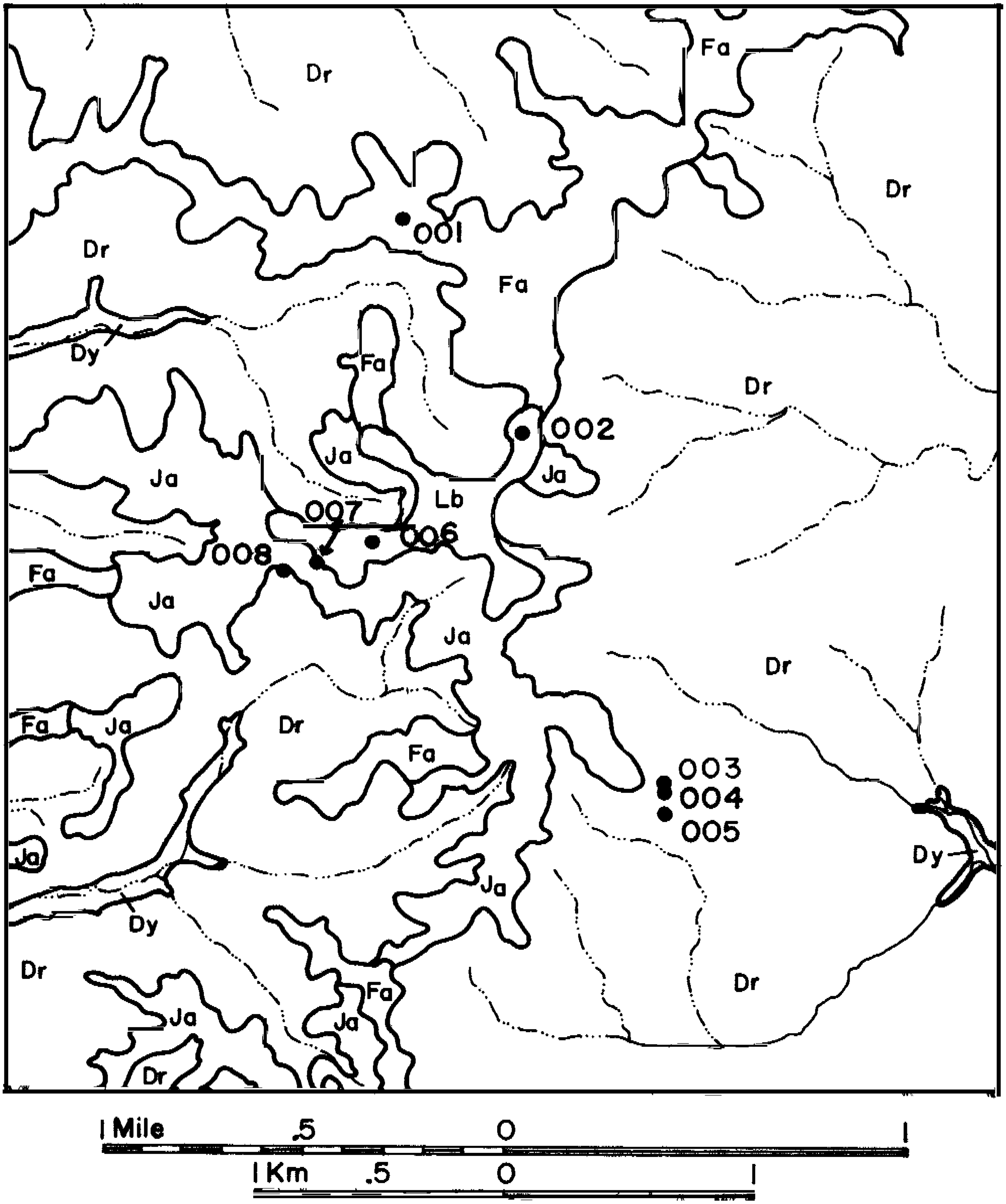

Figure 25B. *Sample site locations in the northeastern corner of the Drew Quadrangle relative to geomorphic surfaces. Lb = Lebanon, Fa = Falcon, Ja = Jacksonville, Dr = Drew, Dy = Drynob.*

McCracken, 1949) indicate that the Jefferson City Formation contains about 25 percent insoluble residue that has smooth oolitic chert as a major component. Thus, sufficient siliceous material is in the dolomite to leave an appreciable residue. Examination of roadcuts and quarries cut in the dolomite shows that the chert is present in essentially horizontal beds or layers. Chert may be in the form of rounded, nodular masses from several inches to a foot or more in length or discontinuous beds ranging from a fraction of an inch to a few inches thick. Deep pits in the clayey residuum reveal the presence of beds of chert that can be traced all around the pit. The attitude of these chert layers ranges from essentially horizontal (as in the unweathered dolomite) to steeply inclined. Where the chert layers are horizontal and there has been little or no disturbance of the original bedding, the dolomite has weathered on a nearly volume-for-volume basis. The illuvial replacement of dissolved carbonates by translocated clay, especially fine clay, may be, in part, responsible for the preservation of the bedding (*Frolking and others, 1983*). Scrivner (*1960*) notes that clay films in cracks and pores descending to the dolomite indicate clay movement throughout the residuum. Where the beds are inclined or otherwise distorted, one would suspect collapse and other disturbances during or following the weathering of the dolomite.

Particle size analysis shows that Jefferson City residuum, as sampled in the study area, is a clay with a large fine clay component. Figure 26 shows the distribution of total clay and fine clay with depth in pedon 002 (fig. 25A). This is also drill hole No. 2 (appendix A) which was sampled to a depth of 31.5 feet (9.6 m). Note the two fine clay bulges and the high proportion of fine clay down to a considerable depth. Total clay content is as high as 81 percent in the drill hole portion of this plot. This drill hole had a total depth of 47.5 feet (14.5 m) but samples were not obtained from these greater depths. The hole was stopped by a chert bed at 47.5 feet (14.5 m). Dolomite was not reached.

"Tripolitic chert" is fairly common in the residuum in the sample pits dug in this area. "Tripolitic chert" is light and relatively porous in appearance in contrast to hard and dense chert. It was found in five of the eight pits. It occurred in beds and layers that were parallel to the hard, dense, nodular layers and other evidences of a relict bedding.

Drilling on the traverse from the Lebanon surface to the lower lying Falcon surface along the main divide showed that the residuum was 30 to 45 feet (9 to 14 m) thick on the higher ridgetops of the study area (fig. 5). The soil sampling pits on the steeper sideslopes (fig. 25B, Drew surface, Pedons 003, 004, 005) indicated residuum to a depth of at least 10 feet (3 m).

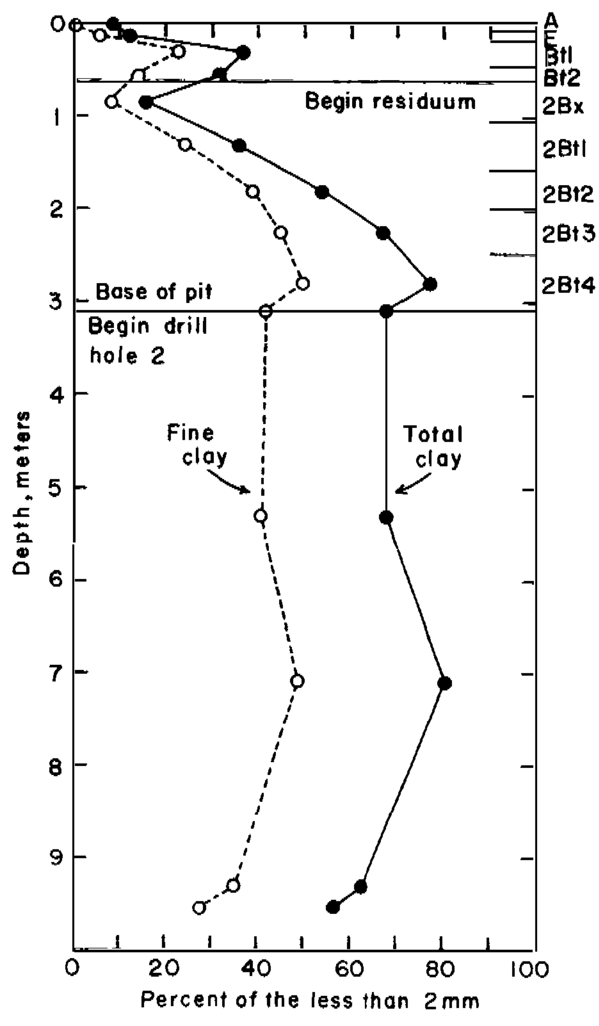

Figure 26. *Pedon 002, fine clay and total clay. Drill hole 2 was in one corner of the sampling pit. This site is a part of profile FF', figures 3A and 5.*

Simon (*1981*) made a study of regolith (residuum) thickness in two parts of the Dry Hollow watershed (N 1/2 Section 14, T34N, R14E), located in the Drynob quadrangle about 2 miles north of the Drew Quadrangle. The geomorphic map shows the area to be Drew surface (fig. 3B). Simon found that regolith thickness on divide summits and shoulders had a mean of 14 feet (4.3 m) that had a standard deviation of 6 feet (1.8 m). Sideslope and other related positions had an average thickness of 3.6 feet (1.1 m). The Jefferson City is the bedrock formation in Simon's study area. Residuum thickness appears to be variable from area to area. Within an area according to Simon, residuum varies according to landscape position.

A third stratigraphic unit of undetermined extent is the fluvial terrace deposit of the Falcon surface. Drill hole data indicated the presence of a unit overlying residuum and containing rounded quartzite pebbles and chert fragments with detectably rounded edges. A 15-ft.-deep (4.5 m) soil sampling pit (001) confirmed the presence of this unit (fig. 5). No attempt was made to map this deposit. Thus, its continuity under the Falcon surface is not known. High level fluvial deposits have been noted in other places in the Ozarks (*Bretz, 1965*).

The uppermost unit in the sequence in this area is a silty mantle believed by many workers to be loess (*Simon, 1981; Thorp and Smith, 1952; Scrivner, 1960*). This mantle covers essentially all parts of the landscape except possibly the low terrace or floodplain steps, or both, along the streams. On the uplands, it covers the old surfaces marked by a lag concentrate of coarse fragments (*Scrivner, 1960; Simon, 1981*) and there has been relatively little mixing of the silt and coarse fragments. This would include the Lebanon, Falcon and Jacksonville surfaces. The loess fell on the steeper parts of the landscape as well, specifically the Drew surface, however, there has been considerable mixing of the silt with the coarse concentrate (*Simon, 1981*) on this surface.

The coarse lag concentrate zone mentioned above is related to the residuum in that it has been in part derived from material contained in the residuum. Examination of the coarse material (2-75 mm) shows it to be mostly chert. The coarse fragments have been concentrated by the removal of finer material and the zone is considered to mark an erosion surface (*Ruhe, 1975,* p. 127). Further, the material laying above the base of the zone and below the loess can be considered pedisediment, namely, material in transit across an erosion surface.

Discontinuities and geomorphic surfaces

Discontinuities were observed and described in all eight of the sampling pits. There were always at least two different materials, and in one instance (fig. 5: pedon 001) there were four. The field-observed discontinuities in each pedon were verified and supported by cumulative curves (not shown) plotted for the silt plus sand fraction for each horizon and by the coarse fragment (2.0-75.0 mm) data. Coarse fragment data from pedon 006 is used as an example (table 5). Three different

Table 5. *Coarse fragment data for Pedon 006. Note the three distinct units.*

Horizon	Depth cm	2 - 75 mm as percent of whole soil	
A	0-13	13	silty (loess) overlay
Bt1	13-27	19	
2Bt2	27-43	76	chert lag concentrate (pedisediment) zone
2Bx	43-68	68	
3Bt1	68-83	29	Residuum with chert layers
3Bt2	83-127	15	
3Bt3	127-178	7	
3Bt4	178-257	14	
3Bt4	257-334	46	

materials are indicated: the silty surface (loess); the coarse fragment or chert concentration (pedisediment) zone; and the residuum. Figure 6 is the field sketch of one wall of the sampling pit with the three stratigraphic units delineated.

Some generalities based on the geomorphic map, the sample sites, and other field observations can be made about the sequence of materials and relations with geomorphic surfaces. The sequence under the Lebanon and Jacksonville surfaces is usually silt (loess) at the surface over the chert lag zone (pedisediment) over residuum as described in the preceding paragraph. The Falcon surface sequence is similar except for the occurrence of the fluvial terrace deposit between the chert lag zone and the residuum. Pedons 001, 006, and 007 are in this Lebanon-Falcon-Jacksonville group. The surficial silt unit has a small admix of coarse fragments averaging 17 percent. This coarse material was derived from the underlying pedisediment unit, which averages 64 percent coarse fragments. Residuum immediately under the pedisediment averages about 50 percent coarse fragments. Some concentration of coarse material has occurred in the pedisediment. The chert lag concentrate zone is clearly not at the surface and is buried or covered by the silty overlay. Its development predates loess deposition and, consequently, it must represent the upper part of the preloess soil profile.

The Drew surface has a significantly different sequence of materials. At all sites examined that were clearly on this surface, there was only one stratigraphic unit over the residuum (pedons 004, 005, 008). This was described as cherty silt loam or silty clay loam in the soil descriptions and as mixed loess (or silty material) and pedisediment in the geologic notes. The high coarse fragment content of the surficial unit (average 60 percent for the three pedons) compared to the immediate underlying material (26 percent) shows that the surficial unit on the Drew surface is a lag concentrate zone. Its development would appear to postdate loess deposition because of the degree to which the silty material is mixed with the coarse fragments.

Silt forms a significant proportion of the upper 30 cm of both the Lebanon-Falcon-Jacksonville and the Drew group. On a whole soil basis, Drew has a relatively low silt content because of the dilution effect of the coarse fragments. Comparison of the silt content of the two groups on a less than 2 mm basis shows them to have essentially the same amount; the Lebanon-Falcon-Jacksonville group has an average of 74 percent and the Drew group has 72 percent. This similarity suggests that these two sets of surfaces probably received the same silt increment. The high coarse fragment content of the Drew material suggests considerable mixing during or following, or both, silt deposition. Mixing of silty material with the cherty lag concentrate on the steeper slopes has been verified by Simon (1981) in his study area.

Clay distributions and geomorphic surfaces

Two different types of clay (less than 0.002 mm) distributions that occur with depth are related to geomorphic surfaces. One type consists of two maxima separated by a distinct minimum. This distribution is characteristic of the older surfaces, Lebanon, Falcon and Jacksonville. Pedons 001, 002, 006, and 007 exhibit this double bulge. This type of clay distribution was also described by Scrivner (*1960*) for Lebanon silt loam in Laclede County. The second distribution has only a single maximum, and it occurs on the younger Drew slopes. Pedons 003, 004, 005, and 008 have this distribution.

A double bulge distribution is illustrated by pedon 006 (fig. 27). The upper maximum occurs either in the silty overlay (pedon 002, fig. 26) or just below in the upper part of the pedisediment as shown in figure 27. The minimum occurs in all cases in what was described as the Bx horizon, either in pedisediment (fig. 27) or in the upper part of the residuum (fig. 26). The second, or lower clay maximum, occurs in the residuum except in pedon 001 where it occurs in the fluvial unit.

In figure 27, the upper clay maximum is in the pedisediment-chert concentration unit (see table 4). The increase in fine clay, as percent of the total clay, suggests that it is an illuvial feature developed in what may have been a former surface horizon. The clay minimum and the low fine clay to clay ratio in the 2Bx horizon suggests it can be interpreted as an eluvial (E) horizon. The decrease in the proportion of fine clay in this horizon is evidence of eluviation. Two of the other three double bulge pedons show the same significant decrease in fine clay in the Bx horizon.

A single bulge distribution is illustrated by pedon 004 (fig. 28). The clay content increases abruptly from 11 to 31 percent in the top of the residuum. Note that the plot of the total clay content shows no clear evidence of this eluvial zone (fig. 28). In all four of the Drew pedons, the total clay content is remarkably constant with depth through the mixed loess and pedisediment (lag concentrate) to the contact with the residuum. This, coupled with the variable behavior of the fine clay, suggests that on this surface little illuviation of clay has occurred in the loess-pedisediment unit. Alternatively, downslope movement and mixing in this material may have been sufficient to obliterate any clear evidence of clay movement.

Mineralogy of the clay-sized fraction

The mineralogy of the clay-sized fraction was interpreted from plots of relative amounts of the various minerals with depth. Relative amounts are reported in the clay mineralogy tier in the primary characterization data for each pedon. Figure 29 shows the plot for pedon 006. In addition, pH (1:1 water) and the percent kaolinite by differential thermal analysis (DTA) were evaluated.

Kaolinite

Kaolinite is a major component of the surface horizons at all sites. It has some tendency to diminish in relative amount toward the surface as vermiculite and montmorillonite increase.

Kaolinite content tends to be at a minimum in the field identified Bx horizons on the Lebanon, Falcon and Jacksonville surfaces (See the DTA plot, fig.

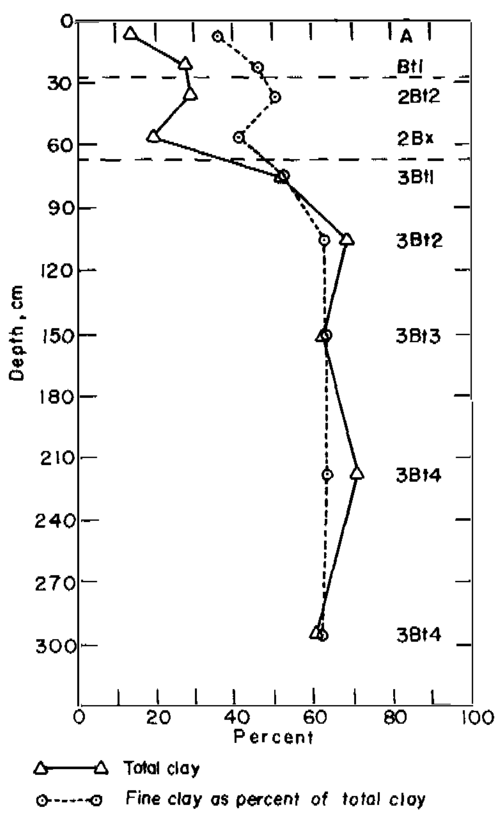

Figure 27. *Pedon 006, total clay and fine clay as percent of total clay, illustrating a double clay maximum.*

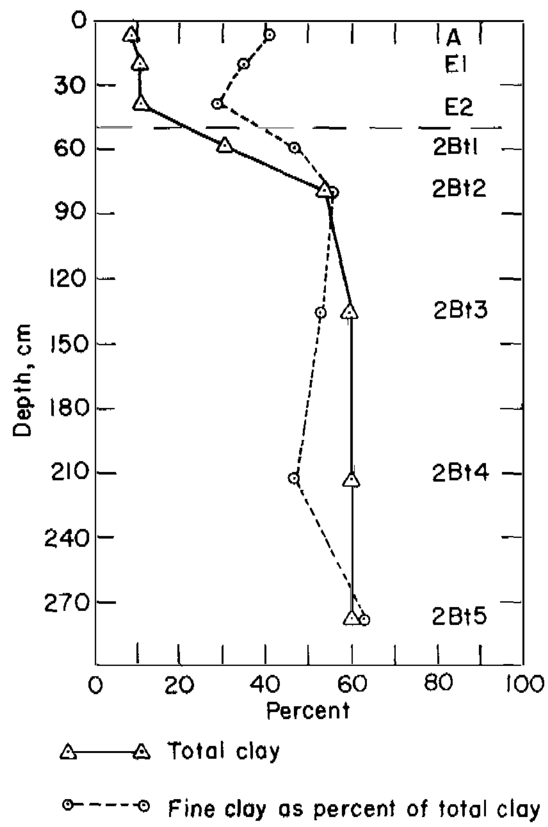

Figure 28. *Pedon 004, total clay and fine clay as percent of total clay, illustrating a single clay maximum.*

29). The Bx horizon is also the horizon of high (50-80 percent) aluminum saturation (fig. 30). On the Drew surface, at sites where there was no field identified Bx horizon (pedons 004, 005), kaolinite content tends to be at a minimum in the A and E horizons (fig. 31). These are also the horizons of high (> 60 percent) aluminum saturation. Kaolinite tends to increase from the E or Bx minimum to a maximum in the residuum, and it is the major clay mineral in the residuum in all pedons. The other significant components are mica and quartz. At the pedon 001 site where the alluvial terrace deposit overlies the residuum, kaolinite is the major constituent of the alluvial unit with mica as the secondary component.

Vermiculite

Vermiculite is also a major component of all surface horizons, usually at the expense of mica (*Douglas, 1989*). It is at a maximum and nearly equal in amount to kaolinite in the surface horizon of all Drew sites (pedons 003, 004, 005, and 008). In the surface of three of the four Lebanon-Falcon-Jacksonville sites (pedons 002, 006, and 007), vermiculite appears to be the major constituent. In pedon 001 on the Falcon surface, kaolinite is the major component and vermiculite, mica, and quartz are nearly equal secondary components. High vermiculite contents often coincide with aluminum saturation maxima in either the surface horizon or the Bx horizon. This suggests the presence of hydroxy aluminum interlayered vermiculite (*Douglas, 1989*). There also appears to be a general relation between pH (1:1 water) and vermiculite. At pH greater than 5.0, vermiculite tends to disappear. Scrivner (*1960*) and Lynn (*personal communication, W. Lynn, National Soil Survey Laboratory*) suggest that the vermiculite may be interstratified with montmorillonite.

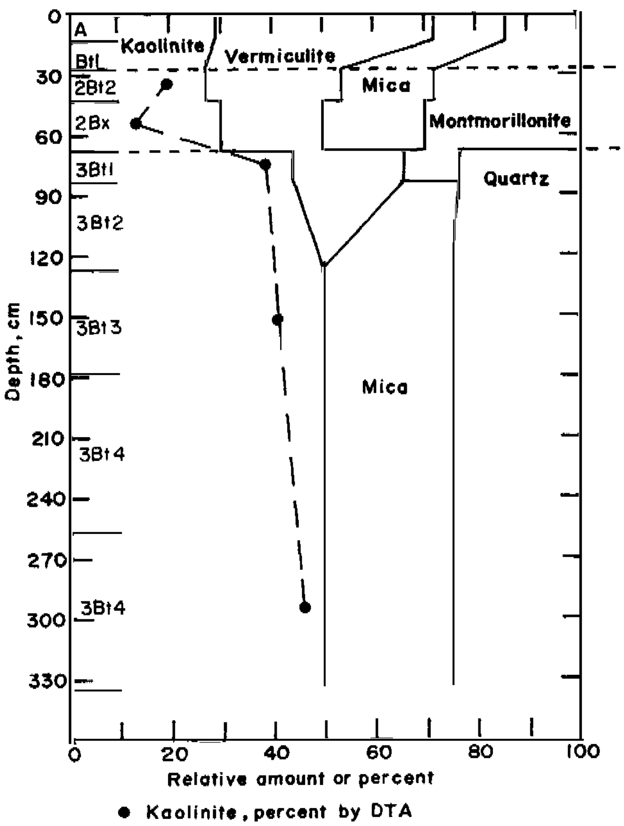

Figure 29. *Pedon 006, on the Lebanon surface, relative amounts of clay minerals by x-ray, and kaolinite percent by differential thermal analysis (DTA) as reported in appendix E.*

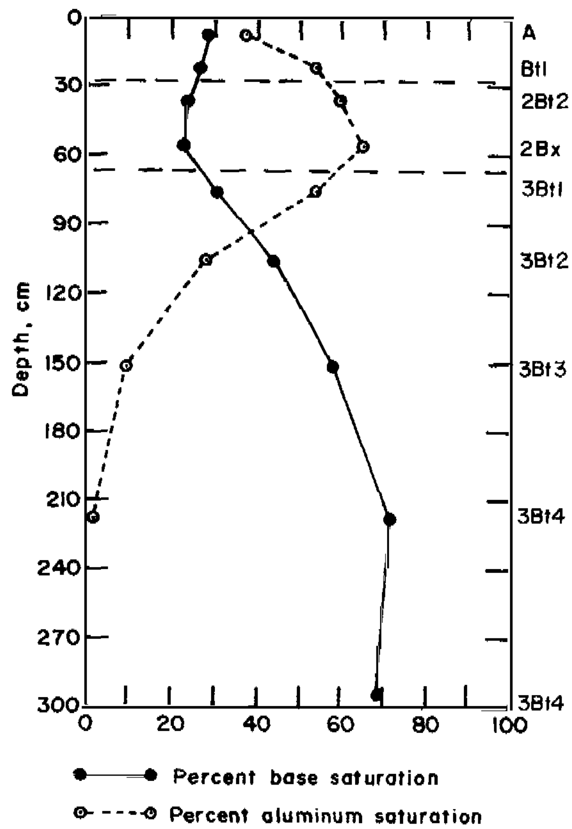

Figure 30. *Pedon 006, base saturation by sum of cations and aluminum saturation as a function of depth.*

An apparent relation is present between geomorphic surface and the depth distribution of vermiculite. It is present to a greater depth in the solum (average 175 cm) on the older surfaces than on the younger Drew surface. It occurs in the pedisediment and the upper part of the residuum (fig. 29). On the Drew surface, vermiculite content decreases to a trace (fig. 31) or disappears at a depth of about 82 cm. This is essentially at the pedisediment-residuum contact. The depth distribution of vermiculite suggests a significantly longer period of weathering for the soils on the Lebanon-Falcon-Jacksonville group of surfaces. This is to be expected when the relative ages of each of these two groups of surfaces are compared.

Mica

For most pedons, mica is at a minimum in the surface horizon and it increases with depth as vermiculite and montmorillonite diminish. Presumably, mica is the precursor of these two minerals as they develop in the low pH and intense leaching environment (*Douglas, 1989*) of the upper part of the solum. Mica is a significant component of the residuum in all pedons, but kaolinite is the major component (figs. 29 and 31). Mica is also the secondary component in the alluvial terrace deposit of the Falcon surface (pedon 001). According to Scrivner (*1960*), the mica is probably illite and is derived from dissolution of the dolomite bedrock. He found it to be "the clay mineral in the dolomite residue."

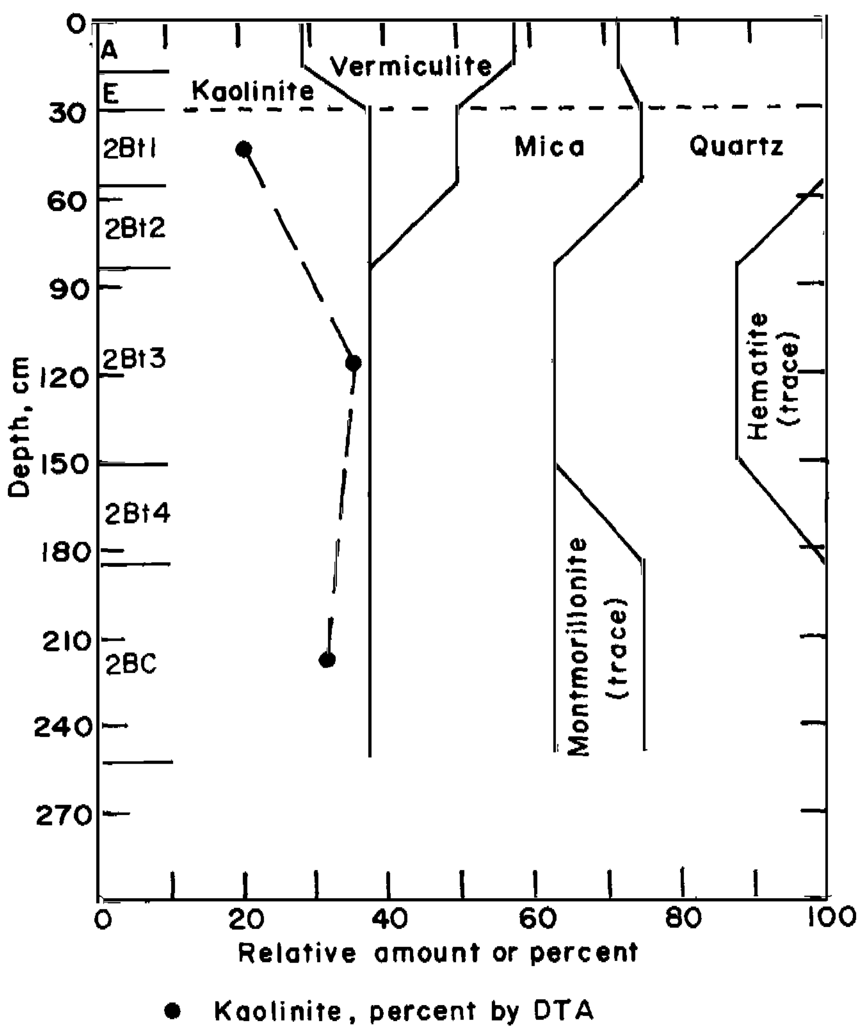

Figure 31. Pedon 005 on the Drew surface, relative amounts of clay minerals by x-ray, and kaolinite percent by differential thermal analysis (DTA) as reported in appendix E.

Montmorillonite

A clear relationship exists between geomorphic surfaces and the occurrence of montmorillonite (smectite) in the pedons sampled in this study. It is reported as a major component in the upper B horizon of all sites (001, 002, 006, 007) in the Lebanon-Falcon-Jacksonville group of surfaces. These are also the double bulge clay distribution sites.

Montmorillonite is not indicated in the upper B horizon of any of the Drew surface sites (003, 004, 005, 008) with their characteristic single bulge clay distribution. It does occur as a trace amount in the lower part of the B horizon of pedon 005. This particular pedon in the Drew surface group clearly classifies as an Ultisol; the others on the Drew surface classify as Alfisols or are on the transition (004) between Alfisol and Ultisol.

Where present in the upper B horizon, montmorillonite tends to be at a maximum in the Bx horizon, the horizon of minimum clay content. Pedon 001 is an exception where the high montmorillonite content occurs in the upper clay maximum in the horizon immediate overlying the Bx. Maximum montmorillonite amounts appear to be related to aluminum saturation percentages of 55 to 82 percent and to a pH in water of 4.5 to 4.7. It does not appear to be related to the presence or absence of any lithologic discontinuity. The montmorillonite is interstratified with vermiculite, as discussed in the vermiculite section of this report.

Quartz

Quartz is a significant component of the clay-sized fraction in most of the pedons sampled. The presence of quartz in more than trace amounts, especially beneath the loess, appears to be related to the presence of what was called "tripolitic chert" in the residuum. Some of the quartz may be derived from the thin sandstone beds interspersed throughout the dolomite bedrock.

Scanning electron micrographs of a tripoli sample from the southwestern Missouri - northeastern Oklahoma area show it to be composed of clay-sized and larger euhedral quartz crystals. Further, in southwestern Missouri, transitions from soft powdery tripoli to dense, hard chert were seen. This can occur in a nodular mass 20 inches (0.5 m) in diameter or as a transition along a horizontal bed. Based on these observations, the relatively soft, light tripolitic chert is, in part, composed of well-shaped, clay-sized quartz crystals. The tripolitic chert is probably the source of some of the observed quartz in the clay-sized faction.

Exchange properties

Base saturation

The depth distribution of the base saturation is related to geomorphic surface. Most of the pedons have a base saturation of less than 30 percent in the upper 50 cm. The two exceptions are pedon 001 where base saturation is 68 percent in the Ap from agricultural liming, and 002 where it is 52 percent in the O horizon, possibly from calcareous road dust. Below about 50 cm on the Lebanon-Falcon-Jacksonville surfaces, pedons 001, 002, 006, and 007 have a generally similar base saturation increase with depth below an inflection point in the Bx horizon. These pedons are also characterized by the double bulge clay distribution and the presence of a fragipan. Figure 30 shows a typical saturation curve for this group. All pedons on these geomorphic surfaces appear to have this smooth regular increase to 65 to 75 percent at about 225 cm depth. Scrivner (*1960*) reported this same base saturation distribution for a similar soil (Lebanon) on what may well be the same geomorphic surface.

Base saturation data from pedon 002 (appendix E) combined with data from drill hole 2 shows that the high base status persists to a considerable depth in the residuum (fig. 32). The apparent discontinuity in the two curves arises from differences in sampling method. The drill hole samples were taken from power auger flights, and the others were taken from a pit using standard procedures (*Soil Survey Staff, 1984*). The pit was dug with the drill hole in one corner. The combined curves do not show a base saturation bulge in the residuum that can be attributed to recharge of bases from the thin loess overlay. The thin loess may not have contained enough bases to be detectable. The high base saturation in the residuum comes about because this material is the residue from the dissolution of dolomite. Calcium and magnesium are, by far, the major cations.

The soils on the younger Drew surface have a base saturation distribution that is not only different from that on the older surfaces, but it appears to change with position on the Drew slope (figs. 25A , 25B, and 33). Figure 34 shows the distribution for pedons 003, 004, and 005 on this slope. These sites do not have the smooth increase in base saturation with depth below 50 cm that is on the older surfaces. Note that 003 and 004 have a definite bulge followed by a decrease in base saturation. Note that the decrease is much greater in 004,

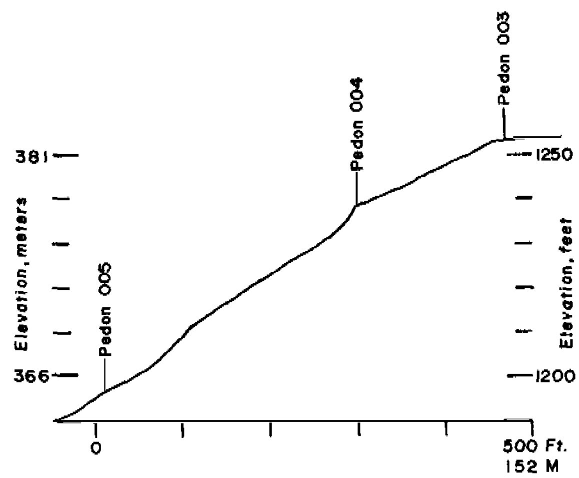

Figure 33. *Sample site locations on the Drew surface slope profile. Elevations and distances determined by transit survey. Vertical exaggeration is 5X.*

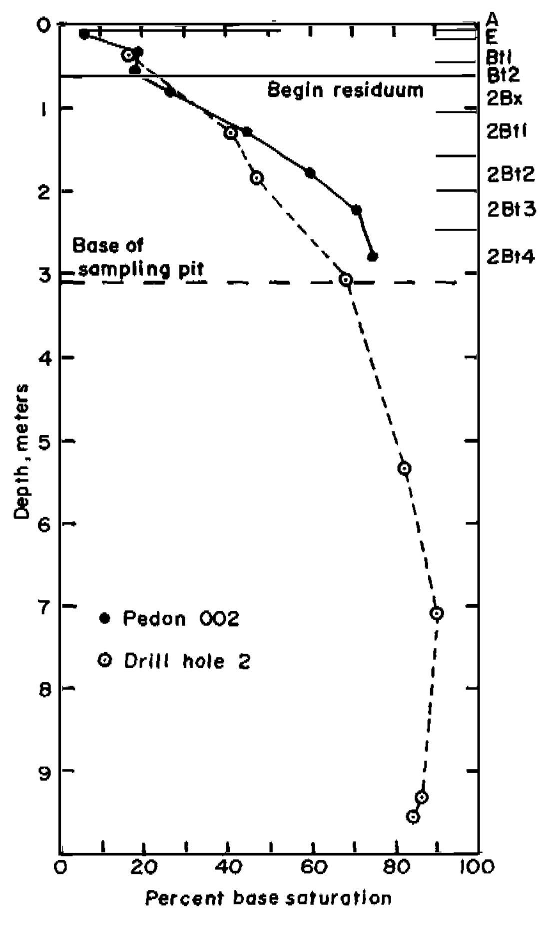

Figure 32. *Percent base saturation by sum of cations for drill hole 2 and pedon 002 sampled at the site of drill hole 2.*

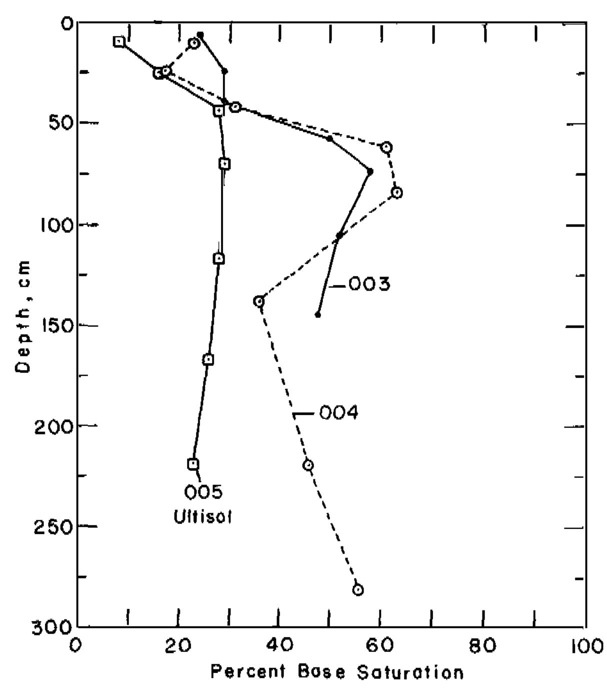

Figure 34. *Base saturation by sum of cations for pedons 003, 004, and 005 on the Drew surface slope shown on figure 33.*

which is farther down the slope. Finally, note that pedon 005, the lowest on the slope, does not have the pronounced bulge and has values consistently less than 30 percent. Pedon 005 classifies as an Ultisol and 003 is an Alfisol. Pedon 004 is transitional from Alfisol to Ultisol with a base saturation of 36 percent.

Aluminum saturation

The amount of exchangeable aluminum present on the exchange complex of a soil is a good indicator of the degree of soil weathering (*Buol and others, 1980*). The higher the aluminum saturation, the more weathered the soil. In addition, aluminum saturation values above 60 percent are likely to result in levels of aluminum in the soil solution that are toxic to plants (*Buol and others, 1980*). For these reasons, some importance is attached to the aluminum saturation data available for the pedons.

Aluminum saturation and base saturation depth distribution curves are mirror images when plotted together. Low base saturation equates with high aluminum saturation. Figure 30 illustrates this point. There is a relation between aluminum saturation and geomorphic surfaces similar to that for base saturation. The Lebanon-Falcon-Jacksonville group of surfaces tend to have an aluminum saturation depth distribution characterized by a maximum value in the Bx horizon that exceeds 60 percent. This is true for pedons 001, 006, and 007. Pedon 002 is an exception in that aluminum saturation is highest in the surface (E) horizon. Pedon 007 also has high aluminum saturation in the surface horizon but does show an increase in the subsurface Bx horizon. Pedons 001, 006, and 007 are double clay bulge profiles, and the Bx horizon is a subsurface clay minimum in terms of total clay and fine clay. The high aluminum saturation and low clay content suggest that the Bx horizon is an E (eluviated) horizon that has been subjected to rather intense weathering. Note that this E horizon occurs beneath the loess increment on these geomorphic surfaces. This raises the possibility that it might be the buried preloess surface. Scrivner (*1960*) has interpreted it as "the compacted former A horizon of a buried soil . . . ." He further comments that it now contains some illuviated materials derived from the overlying loess.

At depths of 2 to 3 meters into the residuum, the aluminum saturation on the older surfaces diminishes to insignificant values as the base saturation increases.

On the Drew surface (pedons 003, 004, and 005), the high aluminum concentrations are in the surface horizons, usually in the upper 30 to 40 cm. Most pedons have 60 percent or more aluminum saturation. Such levels of exchangeable aluminum suggest the possibility of aluminum toxicity as a factor inhibiting plant growth on all the geomorphic surfaces considered in this study. Toxic levels are possible in the Bx horizon of the soils on the Lebanon-Falcon-Jacksonville surfaces, and in the surface horizons of the soils on the Drew surface.

Aluminum saturation values for the Drew slope pedons 003, 004, and 005 are plotted in figure 35. There is a definite trend toward higher aluminum saturation downslope, both in the surface horizons and at the 1 to 2 meter depths. The surface horizons with the high aluminum saturation are also the cherty lag concentrate zone that overlies the residuum on this slope.

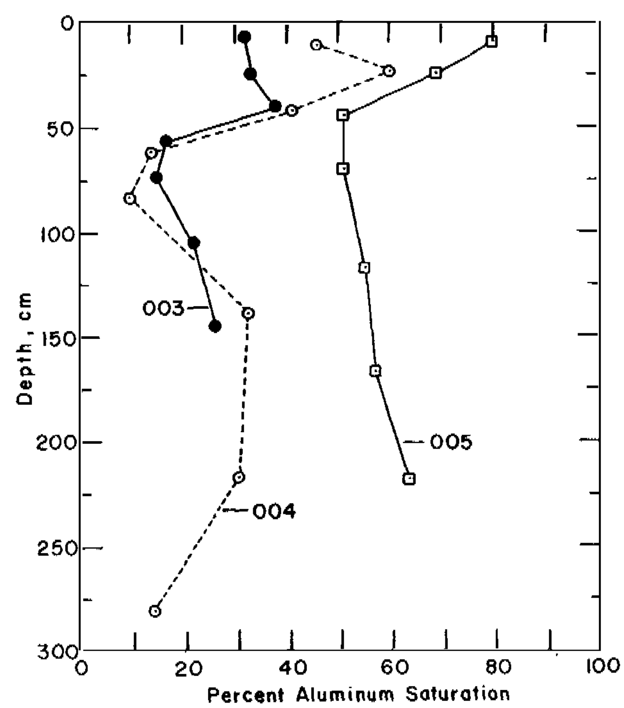

Figure 35. *Aluminum saturation for pedons 003, 004, and 005 on the Drew surface slope shown on figure 33.*

Alfisol-Ultisol problem

A problem of long standing in the study and mapping of soils in some parts of the Ozarks is the anomalous occurrence of Ultisols that have a relatively low base status on the younger geomorphic surface (Drew). The more weathered and leached soils are on the older parts of the landscape, such as the Lebanon, Falcon, and Jacksonville surfaces. Ultisols have been mapped on the steeper slopes that have been shown by this study to be one of the youngest erosion surfaces in the area. This problem was in part recognized as long ago as 1967 in a report from R. B. Grossman, then head of the Lincoln laboratory, to L. T. Alexander, chief, Soil Survey Laboratories, Beltsville, MD. The geomorphic aspects were not investigated nor fully appreciated at that time. The question arises as to why Ultisols occur on this part of the landscape. The experience of soil survey parties indicates that it may, in part, be related to the geologic formation involved. Ultisols in general are thought to be related to thicker more permeable siliceous residuum which is characteristic of the Roubidoux Formation. Alfisols are thought to be related to the Jefferson City Formation where residuum is thinner and dolomite closer to the surface. The insoluble residue content (*Grohskopf and McCracken, 1949*) of the Roubidoux (50 percent) is about twice that of the Jefferson City (23 percent). Observations in the Miller County soil survey area tend to verify the residuum thickness-formation relationship.

Other factors or mechanisms, however, must be operating in the genesis of Ultisols on the steeper younger slopes. In the Laclede County detailed study area, all sample sites, all drill holes, and the major part of the geomorphic surfaces are on the Jefferson City Dolomite. Drill holes indicate that the residuum in this area is unusually thick for this formation. Even so, Alfisols occur under the older Lebanon-Falcon-Jacksonville surfaces and Ultisols are on the Drew slopes. Thus, formation or residuum thickness are not the entire explanation.

During the course of this study, two short-lived hypotheses were developed to explain the anomalous occurrence of the Ultisols. The first proposed the presence on the slopes of relatively thick highly weathered valley-side alluvium or colluvium derived from the older erosion surfaces higher in the landscape. The Ultisols would be developed in this material and would have low base status because of the previously weathered character of the deposit. Work by Simon (*1981*) showed that the thick valley side alluvial-colluvial deposits did not occur. Furthermore, the sequence of three pedons (003, 004, and 005, fig. 33) on the Drew slope in this study showed a progressive downslope thinning of the pedisediment or valley-side alluvium from 66 cm (pedon 003) to 54 cm (004) to 30 cm (005). An additional small pit further downslope from 005 showed only thin (30 cm) material over the residuum. Thus, there was no field evidence of thick alluvial-colluvial deposits on the valley slopes and, consequently, no relation with the occurrence of Ultisols.

The second idea was that the Ultisols were related to the outcrop of highly siliceous beds within the Jefferson City Formation. Examination of the soil map indicated that this was highly unlikely. The Jefferson City is essentially horizontally bedded in a local area. If a bed or zone were responsible, Ultisols should occur on opposite sides of a narrow ridge at the same elevation. This is not the case because, frequently, Alfisols and Ultisols are mapped on opposite sides of a ridge at the same elevation. However, base saturation data are not available to confirm all of these delineations.

Some possible clues to the genesis of the Ultisols can be derived from the exchange properties discussed in previous paragraphs. Base saturation and aluminum saturation (figs. 34 and 35) confirm the existence of Ultisols on the Drew slope. All of these measurements show a downslope increase in apparent intensity or degree of leaching from pedon 003 to pedon 005. These measurements also indicate more leaching has occurred in the residuum under the Drew surface than in that under the Lebanon-Falcon-Jacksonville surfaces.

As leaching is commonly related to the movement of water through the solum, these differences led to speculation about differences in water movement within the soils of these two surface groups that might provide a mechanism for enhanced leaching on the Drew slope. The Lebanon-Falcon-Jacksonville group soils are characterized by the presence of a fragipan. Soils on the Drew surface generally lack a fragipan. Field observations indicate that a perched water table or zone of saturation related to the fragipan is a common occurrence on the older surfaces. A wet or moist zone was observed above the fragipan in the cross section (fig. 36). Material below the pan was always relatively dry. This suggests that vertical movement of water through the solum is inhibited, and, consequently, base saturation at the critical depth remains high (figs. 30 and 32).

Field observation of seepage areas at the edge of the older surfaces and at the top of the Drew slope suggests movement of perched water laterally across the fragipan (*Miller and others, 1971; Palkovics and Petersen, 1977*) on the ridgetops to the upper edge of the Drew slope where it can come to the surface. The water can then re-enter the soil and move downslope as subsurface flow, leaching as it goes. This water would augment the normal infiltration from the surface which is not inhibited by the presence of a fragipan. Base status at the critical depth would be lowered by the more freely moving water. Figure 37 is an illustration of this proposed water movement model (*Gamble and Mausbach, 1982*).

The occurrence of a subsurface flow zone on the slope would probably depend on the amount of moisture fed to it by the ridgetop surface. This in turn would depend on the geometry of the ridgetop and the restrictive layer, as well as the size of the collection area. Other factors, such as relative permeability of the residuum, collapse induced dip of the relict bedding, and discontinuities related to pedisediment and valley-side alluvium will affect the occurrence and path of the subsurface flow. It also seems likely that the flow path will go deeper and deeper down the slope until it reaches some other restrictive layer in the residuum or the bedrock-residuum interface.

Recent work in Camden County, Missouri, tends to verify this model. Burk (*1988*) studied the hydrology of two hillslopes in terrain similar to that in the Laclede County area. Piezometer,

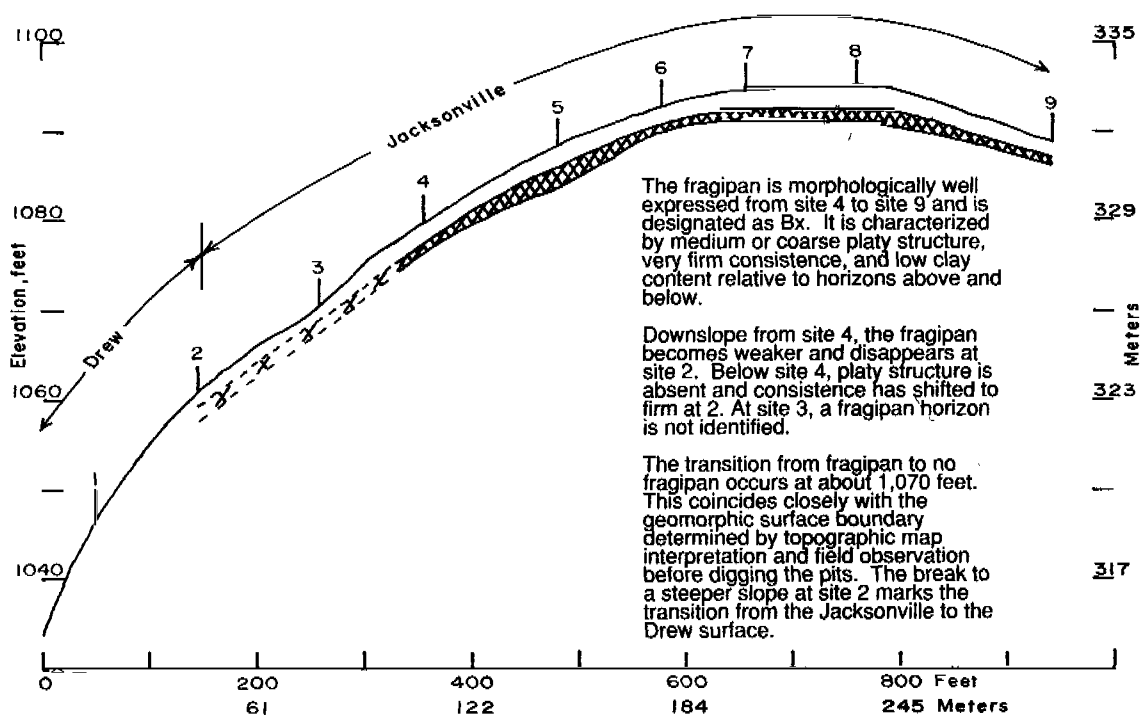

Figure 36. *Fragipan occurrence across a Pulaski County ridgetop. Morphological observations were made in a series of backhoe pits. Elevation and distance were determined by transit survey. Vertical exaggeration is 10X.*

saturated hydraulic conductivity, bulk density, and chemical data were evaluated by Burk. He concluded that when a fragipan is present in the upper landscape (summit) positions, water movement appears to be lateral over the top of the more dense pan and vertical leaching is inhibited. When a fragipan is not present, the flow paths are more vertical. On "mid-slopes", without a fragipan, below the summit, "the flow vector becomes more vertical while the velocity and, thus, the leaching, increases" (*Burk, 1988*). This increased leaching leads to the development of Ultisols on the younger geomorphic surfaces.

Fragipans

Distribution of fragipans as related to geomorphic surface

Fragipan horizons are characteristic of the Lebanon, Falcon, and Jacksonville surfaces. Horizon thickness for this group averages 46 cm and ranges from 25 to 58 cm. Based on the pedons sampled, the Bx horizon may be in either residuum or the pedisediment. In either case, the horizon has a relatively high coarse fragment content. Fragipans related to these surfaces tend to thin and disappear at the transition to the steeper slopes of the Drew surface. This is illustrated in figure 36, a scale drawing of a transect across a ridgetop in Pulaski County. The

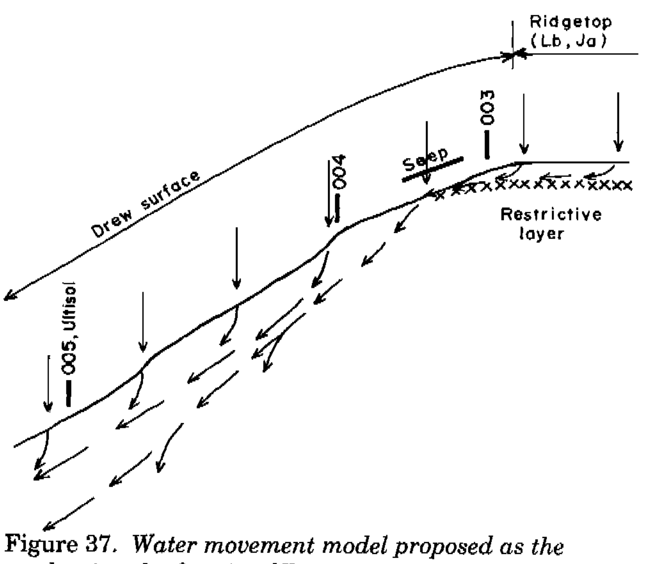

Figure 37. *Water movement model proposed as the mechanism for forming Ultisols on the Drew surface slopes. Pedon locations and slope profile are as in figure 33, 003 is an Alfisol, 004 is transitional, and 005 is the Ultisol.*

section is based on a sequence of eight deep backhoe pits. Soils were described in detail and the various stratigraphic units noted.

Soils that have fragipans can occur as inclusions in the mapped extent of the Drew surface. Pedons 003, 004, and 005 (figs. 25A and 25B, 33) are in a sequence from a narrow, rounded ridgetop down across part of a steep slope. The ridgetop at the site of pedon 003 is mapped as Drew surface rather than Jacksonville surface because it is so narrow. But the sampling pit revealed the presence of a fragipan (2Bx) horizon at this site. The fragipan horizon is only 5 1/2 inches (14 cm) thick, significantly less than the 18 inches (46 cm) average thickness for the Lebanon-Falcon-Jacksonville group of surfaces. The fragipan horizon does not occur in either of the pedons located farther down the slope.

Four of the eight pedons sampled were on the Drew surface (fig. 25B, pedons 003, 004, 005, 008). Two of the four (003 and 008) had a thin Bx horizon, 5 1/2 and 8 1/4 inches (14 and 21 cm), respectively. Both of these pedons were close to the boundary with an older surface and probably represent a point in the fragipan thinning sequence across the boundary. The other two pedons (004 and 005) are down the slope well away from the boundary. These two pedons have no fragipan.

Bulk density and fragipans

A matter of some interest in the Ozarks area is the occurrence of fragipan horizons and their relation-ship with a concentration of chert. These horizons have large coarse fragment (2.0-75.0 mm) contents of 40 to 84 percent. They are exceedingly difficult to dig through because of the close packing of the chert fragments. Field observations indicate that they may inhibit water movement, a well-established characteristic of a fragipan.

The horizons designated as Bx might not qualify as a fragipan in terms of bulk density and brittleness. The so-called "fragic character" could be an artifact of the close packing of the chert fragments. The brittleness of the < 2 mm matrix is difficult to assess because pieces large enough to crush are nearly impossible to obtain. The apparent high density observed in the field could result from the high density of chert coupled with the large amount of chert relative to matrix.

Other characteristics of this horizon are its low clay content, high aluminum saturation, low pH, and low base saturation. These are all evidence of a highly leached and weathered horizon and indicate considerable movement of water through it at some point in its development. Field observations suggest the Bx horizon may perch water, and the Burk (*1988*) study indicates that it inhibits the vertical movement of water. If water perches within the horizon and moves laterally by subsurface flow, then the leached character could be explained as a result of this flow. Pore volume measurements, made as a part of the bulk density determination show that the Bx horizon has a few percent less pore space than the overlying and underlying horizons. This suggests that water probably perches on top of the Bx and, according to Burk (*1988*), moves laterally on top of this horizon. If water perches on top of the horizon and does not readily move into and through it, then other explanations for its leached and weathered character must be found. There is evidence, such as lithologic discontinuities (fig. 6), that this horizon might have been a surface horizon before loess deposition. It would have been subject to eluviation and leaching processes and would have developed its weathered characteristics before being buried by the loess increment. These features might be relics that have not been obliterated by later pedogenic development following loess deposition. The fragipan might better be referred to as an Eb, a buried E horizon.

Brittle consistence (*Grossman and Carlisle, 1969, and Soil Survey Staff, 1975*) and bulk density are probably the two principal defining characteristics of a fragipan. Because of difficulty in observing the presence or absence of the brittle character, emphasis is placed on bulk density in this study. Bulk density data were analyzed by means of regression analyses and "t" tests of the significance of differences between the means of appropriate groupings (*Snedecor, 1956*). Preliminary trials suggested that a separation should be made between samples that contained the less dense "tripolitic chert" and those containing the ordinary "dense chert." Two kinds of bulk density were considered. One was the corrected bulk density reported in the standard lab data sheet. This value represents the density of the matrix with the effect of the coarse material (> 2.0 mm) removed. The other was the uncorrected bulk density, namely, the whole soil or original clod density that has the coarse material present and not corrected for (*Soil Survey Staff, 1984*).

Unfortunately, a statistically significant conclusion was not indicated. Within the dense chert group (effect of low density tripolitic chert removed), horizons called Bx in the field showed a trend towards having a corrected bulk density (mean = 1.56) slightly higher other horizons (mean = 1.38). The "t" test indicated that this was not a significant difference. A second "t" test on this group indicated that field identified Bx horizons have a higher coarse fragment content (mean = 59 percent) than the other horizons (mean = 31 percent). This was not a highly significant difference but is indicative of a trend.

Regression analysis of uncorrected bulk density on the weight percent of coarse fragments in the actual clods showed uncorrected density to be related to coarse fragment content (fig. 38), dense chert clods and dense chert clods plus Bx clods). This, of course, is not an unexpected relation. However, note that in the "Bx clods only" regression although the densities are generally higher, the correlation coefficient is low. This suggests that in these Bx samples, coarse fragment content is only a partial contributor to the higher bulk density. The other factor would appear to be the < 2 mm matrix material which has been shown in the preceding paragraph to have a higher average bulk density.

A recent study of Ozarks fragipans (*Adewunmi, 1987*) indicates that the < 2 mm matrix material in a cherty lag concentrate fragipan horizon has probably been compressed, to some extent, by the loess overlay. This has resulted in a close packing of the matrix, which would explain its higher bulk density. The chert content of the Bx horizon only enhances the density qualities of the matrix material. The overall result is the dense and difficult-to-dig material. The identified Bx horizons probably do qualify as fragipans on the basis of bulk density because they do tend to be more dense than other horizons.

Geomorphic surfaces were identified and mapped in

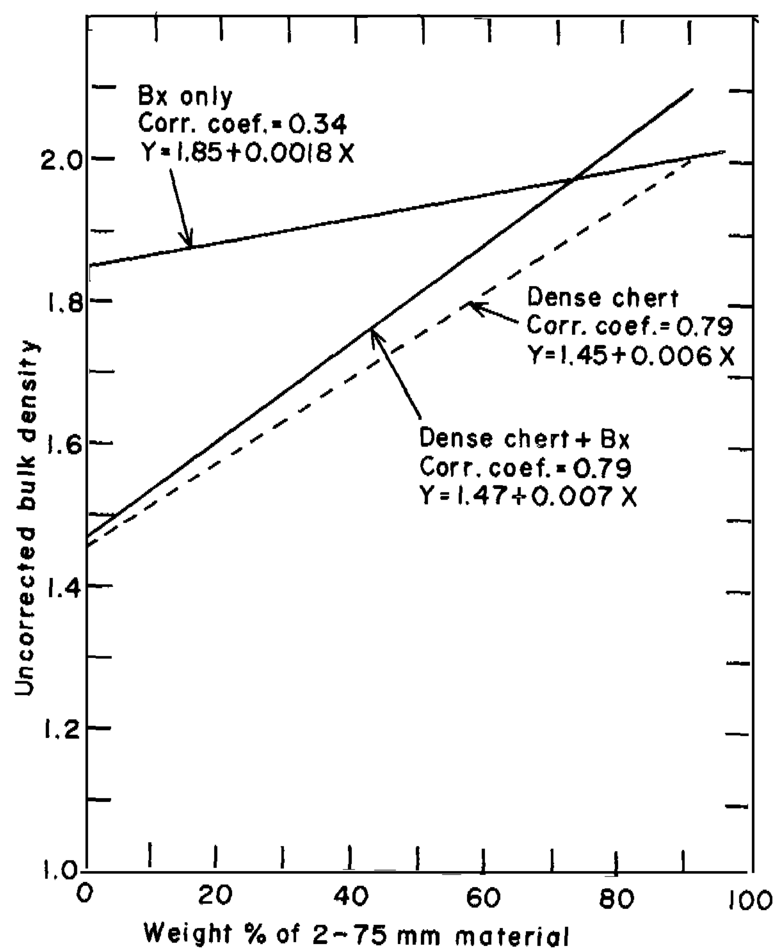

Figure 38. *Regressions of uncorrected bulk density on weight percent of coarse fragments (2-75 mm) in the clods.*

Summary

selected 7.5 minute topographic quadrangles in Laclede and Texas Counties, in the central Missouri Ozarks. In Laclede County, detailed mapping in the Drew Quadrangle revealed the following sequence of surfaces, given in the order of their relative age from oldest to youngest:

1. Lebanon (Lb) is a summit or ridgetop surface. It is the oldest because it is the highest remaining surface in the landscape.
2. Falcon (Fa) is a ridgetop surface of possible fluvial origin. It is inset below the Lebanon and separated from the Lebanon by a scarp and is, therefore, younger than the Lebanon.
3. Jacksonville (Ja) is a valley slope erosion surface that has moderate slopes. It rises to and truncates the ridgetop Lebanon and Falcon surfaces.
4. Drew (Dr) is a valley slope erosion surface with relatively steep slopes. It truncates and lies below the Lebanon, Falcon, and Jacksonville surfaces and, consequently, is younger. The Drew surface grades to or descends to remnants of the Lambeth terrace. Therefore, the Drew surface and the Lambeth terrace surface are the same age.
5. Nebo (Ne) is the youngest valley slope erosion surface. It has steeper slopes than Drew and truncates and lies below Drew. The Nebo surface grades to some part or parts of the Drynob (Dy), an erosional and depositional complex of surfaces and floodplain deposits in the valley bottoms.

A similar sequence of geomorphic surfaces was established and mapped in the Houston and Raymondville Quadrangles in Texas County. These surfaces, from oldest to youngest, are named Success (Ss), Lebanon (Lb), Falcon (Fa), Jacksonville (Ja), Drew (Dr) with the related Lambeth terrace, and Nebo with the related Drynob (Dy) complex. These surfaces, with the exception of the Success, are correlated with the surface of the same name in Laclede County. The Success surface in Texas County is a ridgetop surface of limited extent, standing above the Lebanon. Therefore, it is older than the Lebanon. The Success surface is not present in the Drew Quadrangle in Laclede County.

The Lambeth terrace was traced from its type location on the Osage Fork River in the Drew Quadrangle to the Houston Quadrangle in Texas County via the Gasconade and Big Piney Rivers. This regional extent of the Lambeth terrace establishes the regional extent of the Drew surface which grades to it, and indicates that other geomorphic surfaces in the sequence, of which Drew is a part, are also regional and correlative. The Lambeth terrace in the Osage Fork was dated by extrapolation of dates from the adjacent Pomme de Terre River. Accumulation of the terrace deposits began more than 160,000 years BP and ended about 50,000 years BP. The Drew erosion surface developed during this period. The Jacksonville, Falcon, Lebanon and Success surfaces are older than this interval.

Some significant geomorphic surface-soil relations were observed in the Drew Quadrangle study area in Laclede County. The soils on the old surfaces (Lebanon, Falcon, and Jacksonville) classify as Alfisols because their base saturation is high enough at the required depth. They are characterized by two clay maxima, one of which is a Bt horizon developed in the thin loess overlying a paleosol developed in residuum. The second clay maximum is the Bt horizon of the paleosol. A "fragipan" is in the upper part of the paleosol, just beneath the loess, in a horizon having low base saturation, high aluminum saturation, low pH, and low fine clay content. These properties suggest that this is an Eb horizon.

Soils on the younger Drew surface have only a single clay maximum, no fragipan, and classify as Ultisols because of low base saturation at the required depth. Differences in soil water movement are proposed to explain this anomalous occurrence of Ultisols on the younger surface. The presence of the fragipan, with a higher bulk density, tends to inhibit the vertical movement of water on the older surfaces and consequently leaching is less.

Suggested further study

Many questions that warrant further investigation arose during the course of this study. A few of them are listed in the following. They are not necessarily in order of importance.

1. Geomorphic studies in other areas of the Missouri Ozarks to confirm the sequence of surfaces established in Laclede and Texas Counties by this study.
2. Further investigations of relations among geomorphic surfaces, insoluble residue content of bedrock units, and residuum thickness.
3. Loess thickness distributions in the Ozarks with particular attention to transects toward the assumed Missouri River Valley source.
4. Lambeth terrace studies in other Ozarks river systems and a search for materials suitable for dating this terrace.
5. Further studies of the Falcon surface or terrace to confirm its fluvial origin and to trace the probable course of the related river system.
6. Study of the Nebo-Drynob complex of cut-and-fill cycles to understand the more recent erosional history of the Ozarks and how this history may be related to climatic changes and similar happenings elsewhere

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Appendix A

Drill hole notes, Lebanon-Falcon traverse

Profile FF',
Sections 31 & 32, T. 34 N., R. 13 W,
Drew 7.5' quadrangle
Laclede County, Missouri

October 22-26, 1979

Lb-Fa Traverse, Hole 1

Date: 10-22-79

Approximate elevation: 1,290 feet

Depth, feet	*Description*
0-0.5	Brown (10YR 4/3) silt loam, 20 percent coarse fragments.
0.5-1.0	Red (2.5YR 4/6) silty clay loam, 5 percent coarse fragments.
1.0-2.5	Red (10R 4/6) clay with common medium, prominent, yellowish brown (10YR 5/4) mottles, 5 percent coarse fragments.
2.5-5.0	Red (2.5YR 4/6) clay, 5 percent coarse fragments.
5.0-6.7	Red (2.5YR 4/8) clay, 5 percent coarse fragments.
6.7-7.0	Chert lens, 75 percent coarse fragments.
7.0-9.5	Red (10R 4/6) clay, 5 percent coarse fragments.
9.5-13.0	Red (2.5YR 5/8) silty clay, 5 percent coarse fragments, very dry.
13.0-17.0	Red (2.5YR 5/8) clay, 15 percent coarse fragments.
	Hole terminated by chert. Moved 10 feet to the east.
17.0-20.0	Red (2.5YR 5/8) chert layer, 75 percent coarse fragments.
20.0-30.0	Red (2.5YR 4/6) clay, 10 percent coarse fragments.
30.0-33.0	Yellowish red (5YR 4/6) and pale brown (10YR 6/3) silty clay loam, 10 percent coarse fragments.
33.0	Dolomite Base of hole 33 feet

Lb-Fa Traverse, Hole 2.

Date: 10-23-79

Approximate elevation: 1,275 feet

Depth, feet	*Description*
0-0.3	Brown (10YR 4/3) silt loam.
0.3-0.6	Light yellowish brown (10YR 6/4) heavy silt loam.
0.6-0.9	Strong brown (7.5YR 5/6) silty clay loam.
0.9-1.5	Yellowish red (5YR 4/6) silty clay.
1.5-2.5	Strong brown (7.5YR 5/6) and pale brown (10YR 6/3) light silty clay, 60 percent chert.
2.5-5.0	Yellowish red (5YR 5/8) silty clay, chert gravel layer, rounded chert.
5.0-5.5	Red (2.5YR 4/8) very cherty gravel, 2 cm diameter.
5.5-6.5	Strong brown (7.5YR 4/6) clay, few to common angular chert chips.
6.5-8.0	Dark red (2.5YR 3/6) clay, few to common chert fragments.
8.0-14.5	Red (2.5YR 4/6) clay, few angular fragments and chert chips 2 to 3 cm diameter, evidence of clay flow, slickensides. Abrupt contact.
14.5-16.5	Chert layer, upper part weathered, most chert is broken chips, black (5Y 2/2) color. Abrupt contact.
16.5-25.0	Red (2.5YR 4/8) clay, with few to common, fine, red (2.5YR 5/8) mottles, occasional chert fragments. Chert layer at 18.5-19 feet. Continues on down as red (2.5YR 3/6) clay with slickensided surfaces. Occasional black manganese coatings. Occasional very pale brown (10YR 8/3) mottles, apparently thin chert layers throughout. Grades to—
25.0-30.0	Smooth drilling, yellowish red (5YR 4/6) clay, somewhat moist. Gradational contact to—
30.0-34.0	Yellow (10YR 7/8) silty clay matrix with red (2.5YR 4/8) clay shot through the matrix as irregular shaped "injections". These clay "injections" are common and seem to be like horizontal plates. Occasional black manganese coating. There is a gross alternating yellow (10YR 7/8) and red (2.5YR 4/8) pattern. Some thin cherty layers from 32.5-34 feet.
34.0-35.0	Chert layer.
35.0-37.5	Several thin chert layers, probably intercalated with clay.
37.5-39.5	Smooth clay.
39.5-40.0	Chert layer.
40.0-45.0	Chert layers, clay, intercalated.
45.0-47.0	Clay, color has graded to pale brown (10YR 6/3). Abrupt contact.
47.5	A hard, thick chert layer, "Ozark Refusal".
	Base of hole 47.5 feet.
	There may be more residuum beneath this chert layer but we don't know. Hole is wet in lower 4-5 feet. Everything is noncalcareous.

Lb-Fa Traverse, Hole 3

Date: 10-24-79

Approximate elevation: 1,257 feet

Depth, feet	*Description*
0-2.0	Chert gravel layer, probably road gravel.
2.0-5.5	Yellowish red (2.5YR 4/8) clay with common yellow (10YR 8/6) mottles, many white mottles. Thin chert layer at 5.5feet.
5.5-10.0	Red (2.5YR 4/8) clay, occasional thin chert layer, grades to (2.5YR 4/6) red at 10 feet. Gradational contact.
10.0-19.5	Light yellowish brown (2.5Y 6/4) tough drilling clay. Abrupt contact.
19.5-20.5	Chert (black) layer. Stopped the drill.
	Base of hole 20.5 feet. Appears to be residuum from 2 to 20.5 feet.

Lb-Fa Traverse, Hole 4

Date: 10-24-79

Approximate elevation: 1,233 feet

Depth, feet	*Description*
0-1.0	Brown (10YR 4/3) silt loam with common angular chert gravel up to 3 cm diameter. Gradual boundary.
1.0-3.0	Yellowish brown (10YR 5/4) silty clay loam with many chert pebbles to 2 cm diameter.
	Base of possible fluvial gravel.
3.0-7.5	Reddish brown (2.5YR 4/3) clay with common, angular chert fragments up to 2 cm diameter.
	Hole stopped by in-place chert slabs at 5, 5, and 7.5 feet—three different holes. We interpret residuum with in-place chert slabs below 3 feet. Three feet is the base of a possible fluvial gravel deposit.

Lb-Fa Traverse, Hole 5, on Falcon surface

Date: 10-24-79

Approximate elevation: 1,222 feet

Depth, feet	*Description*
0-0.5	Brown (10YR 4/3) silt loam.
0.5-1.5	Yellowish brown (10YR 5/4) silty clay loam.
1.5-2.0	Grayish brown (2.5Y 5/2) fragipan with yellowish brown (10YR 5/6) mottles, silty clay loam.
2.0-3.5	Dark red (2.5YR 3/6) clay with grayish brown (2.5Y 5/2) mottles, common, angular chert up to 3 cm diameter, one somewhat rounded quartzite pebble that suggests detrital material.
3.5-5.5	Red (10R 4/8) clay, common, angular to subrounded chert pebbles to about 2 cm diameter, and rare quartzite (subrounded) to 3 cm. Gradational boundary.
5.5-11.5	Red (10R 4/8) clay with common, brownish yellow (10YR 6/6) very fine sandy loam mottles—from sandstones. Common, dark gray (10YR 4/1) sandy mottles are also present. Few to common, subrounded, chert pebbles up to 4 cm long occur throughout. The gravel seems to be more concentrated at the base of the unit.
	Base of surficial fluvial unit. The occurrence of subrounded chert pebbles, essentially throughout, suggest water deposition.
11.5-15.0	Yellowish red (5YR 5/6) stiff clay with common yellowish brown (10YR 5/8) mottles, few to common quartz sandstone laminea, and some sandstone pebbles apparently from the laminea.
15.0-17.5	Partly calcareous, yellowish red (5YR 5/8) and yellowish brown (10YR 5/8) stiff clay with thin intercalated sandy layers—from sandstone. We actually cored one sandstone layer about three-fourths inch thick. A few angular chert fragments up to 3 cm diameter occur in the clayey material. Abrupt contact.
17.5-19.0	Yellowish brown (10YR 5/8) soapy feeling clay with common, yellowish red (5YR 5/8), and a few fine light yellowish brown (10YR 6/4) mottles. Common, fine, black manganese coatings, somewhat horizontal or semiplaty structure. Pressure faces occur on the plate surfaces. Noncalcareous.
19.0-25.0	Apparently clay, with chert layers from 21 to 25 feet.
25.0-30.0	Apparently clay as above with minor chert layers.
	Base of hole 30 feet.

Lb-Fa Traverse, Hole 6

Date: 10-24-79

Approximate elevation: 1,217 feet

Depth, feet	*Description*
0-1.0	Dark grayish brown (10YR 4/2) silty clay, few to common chert pebbles up to 2 cm diameter.
1.0-2.0	Brown (7.5YR 5/4) light silty clay loam with common chert pebbles up to 3 cm diameter.
2.0-4.0	Yellowish red (5YR 5/6) silty clay loam, few to common chert pebbles up to 1 cm diameter.
4.0-5.0	Dark red (2.5YR 3/6) clay with few angular chert pebbles up to 2 cm diameter. Gradational boundary.
5.0-12.5	Dark red (10R 3/6) clay with common light brownish gray (2.5Y 6/2) mottles, few angular chert pebbles, very few subrounded sandstone pebbles to 2 cm diameter.
12.5-15.0	Red (2.5YR 4/6) clay with many subangular and angular chert pebbles, up to 4 cm diameter.
	Probable base of surficial fluvial sediment. Determined on the basis of the chert pebbles in the 12.5 to 15 foot zone.
15.0-25.0	Dark red (2.5YR 3/6), strong brown (7.5YR 5/8) and gray (10YR 7/2) stiff clay with black manganese streaks in the lower 5 feet. Several thin chert layers in the lower 5 feet. These were identified by fresh chert chips on the augers imbedded in the clays. Calcareous at least in the lower one foot. Definite residuum.
	Base of hole 25 feet.

Appendix B

Drill hole notes, Lambeth terrace traverse

Drew surface to the Lambeth terrace on the Osage Fork River
NW1/4 Sec. 16, T. 33 N., R. 14 W,
Drew 7.5' quadrangle,
Laclede County, Missouri

October 22-26, 1979

Lambeth Terrace Traverse, Hole 1

Date: 10-25-79

Approximate elevation: 997 feet

Depth, feet	*Description*
0-1.0	Grayish brown (10YR 5/2) silty clay loam.
1.0-2.0	Grayish brown (10YR 5/2) clay with strong brown (7.5YR 5/6) mottles, smooth and tough.
2.0-7.5	Light brownish gray (10YR 6/2) silty clay loam with yellowish brown (10YR 5/6) and yellowish red (5YR 4/6) mottles. There are occasional black manganese concretions and very rare chert pebbles. Gradational boundary.
7.5-10.0	Brown (7.5YR 4/4) silty clay loam with few light gray (10YR 6/1) streaks and yellowish red (5YR 5/6) sandy streaks. More clayey than horizon above—nearly a clay. Gradual boundary.
10.0-12.5	Light brownish gray (10YR 6/2) clay to silty clay with yellowish brown (10YR 5/6) and light olive brown (2.5YR 5/4) mottles. The chert pebble content increases with depth. There are common 2 to 10 mm grits at 12.5 feet. There are few angular chert pebbles up to 2.5 cm diameter. These are all embedded in the clay—silty clay matrix. Abrupt contact.
12.5-16.5	Brown (7.5YR 4/4) gravel plus clay. The pebbles are mostly subangular and up to 2.5 cm diameter. There are rare, rounded ones. The gravel is nearly all chert and it apparently becomes coarser with depth according to the rig reaction.
	Abrupt contact. Probable base of terrace deposit.
16.5-17.5	Dolomite and chert layers, good effervescence with hydrochloric acid.
	Base of hole 17.5 feet.

Lambeth Terrace Traverse, Hole 2

Date: 10-25-79

Approximate elevation: 992 feet

Depth, feet	*Description*
0-0.8	Ap, dark brown (10YR 3/3) silty clay loam to silt loam.
0.8-2.0	B21, reddish brown (5YR 4/4) silty clay loam. One weathered, rotten chert pebble 2.5 cm diameter at 23 inches.
2.0-2.8	Dark red (5YR 3/4-2.5YR 3/6) silty clay loam with common, black manganese coatings in the lower part. Rare chert pebbles.
2.8-3.4	B23, yellowish red (5YR 4/6) heavy silty clay with common brown (7.5YR 4/4) mottles. Rare 1 cm diameter pebbles—rounded. Abrupt contact.
3.4-4.3	Gravelly zone. Yellowish red (5YR 4/6) silty clay with brown (7.5YR 5/4) mottles. Common, rotten chert up to 2.5 cm diameter, and also sandstone.
4.3-7.5	Strong brown (7.5YR 5/6) silty clay loam with few to common brown (10YR 5/3) mottles. Occasional black manganese stains. Abrupt contact.
7.5-12.5	Dark reddish brown (5YR 3/4) gravelly clay with many 2 to 10 mm grits, and common, angular to subrounded chert pebbles to 3 cm diameter.
12.5-15.0	Brown (7.5YR 4/4) and (7.5YR 5/2) clay loam with fine sand. Common subrounded chert pebbles 3 cm diameter with a brown patina. Gradational contact.
15.0-20.0	Brown (7.5YR 4/4) sticky clay with many chert pebbles to about 3 cm diameter. Shapes range from angular to moderately well rounded. Most have the brown patina. Gradational boundary.
20.0-25.0	Probably as above. Essentially gravel plus a bit of clay. "Ozark Refusal" at 25 feet, interpreted as bedrock underlying 25 feet of terrace deposit.
	Base of hole 25 feet.

Lambeth Terrace Traverse, Hole 3

Date: 10-25-79

Approximate elevation: 980 feet

Depth, feet	*Description*
0-2.0	Strong brown (7.5YR 5/6) silt loam, almost a silty clay loam.
2.0-5.0	Dark yellowish brown (10YR 4/4) silty clay loam with light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles, few dark brown manganese stains. Sparse, fine gravel or grits up to 5 mm diameter. Gradational boundary.
5.0-8.0	Brown (7.5YR 4/4) silty clay loam, somewhat less clayey than above with light brownish gray (10YR 6/2) mottles. A few subrounded to well rounded chert pebbles up to 2.5 cm diameter.
8.0-11.5	Brown (7.5YR 4/4) gravel plus silty clay loam. Many chert pebbles up to about 4 cm diameter. Shapes range from angular to rounded. Abrupt contact.
11.5	Dolomite.
	Base of hole 11.5 feet.

Lambeth Terrace Traverse, Hole 4

Date 10-25-79

Approximate elevation: 968 feet

Depth, feet	*Description*
0-4.0	Very dark grayish brown (10YR 3/2) silt loam. Probably alluvium.
4.0-5.0	Very dark grayish brown (10YR 3/2) silty clay loam with few to common, angular to subrounded chert pebbles up to 2.5 cm diameter with the characteristic brown patina. Probable base of silty alluvium. Gradational boundary.
5.0-12.0	Very gravelly, sandy loam. Chert gravel up to 4 to 5 cm diameter but most ranges from 0.5 to 1 cm diameter. Shapes range from angular to well rounded. Many have the brown patina. Abrupt contact.
12.0-12.5	Dolomite.
	Base of hole 12.5 feet.

Lambeth Terrace Traverse, Hole 5

Date: 10-25-79

Approximate elevation: 1,001 feet

Depth, feet	*Description*
0-1.0	Brown (10YR 4/3) silt loam.
1.0-2.5	Dark yellowish brown (10YR 4/4) clay loam with strong brown (7.5YR 4/6) and light brownish gray (10YR 6/2) mottles. Rare chert pebbles to 1 cm diameter.
2.5-5.5	Brown (7.5YR 4/4) heavy clay loam with very few reddish gray (5YR 5/2) mottles. Common chert gravel, in the upper part, up to 5 mm diameter, a few to about 2 cm. Gradational boundary.
5.5-7.5	Brown (7.5YR 4/4) silt loam to clay loam, few (7.5YR 5/2) mottles. Few to common chert and quartzite or sandstone pebbles throughout. There is a pebble concentration in the upper part at 5.5 feet. Gradational boundary.
7.5-12.0	Brown (7.5YR 4/4) silty clay loam with few pinkish gray (7.5YR 6/2) mottles. There are a few angular chert pebbles.
12.0-14.0	Brown (7.5YR 4/4) clay loam with common, angular chert pebbles to 3 cm diameter.
14.0-15.0	Strong brown (7.5YR 4/6) gravel and coarse sand plus clay. Angular chert pebbles up to 4 to 5 cm diameter.
15.0-20.0	Light brown (7.5YR 6/4) clay plus gravel. Common, angular and subrounded pebbles up to 6 cm diameter. Some have the brown patina. Abrupt contact.
20.0	Chert slabs and some dolomite. Effervescense observed.
	Base of hole 20 feet.

Lambeth Terrace Traverse, Hole 6

Date: 10-25-79

Approximate elevation: 1,021 feet

Depth, feet	*Description*
0-0.8	Dark brown (10YR 3/3) silt loam with few angular chert pebbles.
0.8-2.5	Brown (7.5YR 4/4) silty clay loam with few angular chert pebbles to 2 cm diameter.
2.5-4.0	Brown (7.5YR 4/4) silty clay loam with common angular and subrounded chert pebbles. Gradational boundary.
4.0-5.0	Brown (7.5YR 4/4) silty clay loam with common angular chert pebbles to 2.5 cm diameter. Some appear to have a slight patina. Gradational boundary.
5.0-7.5	Brown (7.5YR 4/4) silty clay loam with common to many angular chert pebbles up to 2.5 cm diameter. Gradational boundary.
7.5-9.0	Gravelly, sandy material. Many chert pebbles 2.5 cm diameter. Abrupt contact.
9.0-10.0	"Ozark Refusal". Probably chert layers. No effervescense—brought up many fresh chert chips and sand.
	Base of hole 10 feet.

Appendix C

Locations of cutoff meander sites related to the Lambeth terrace

Osage Fork River

Pease-Smith Branch - SW corner sec. 13, NW corner sec. 24, T. 32 N., R. 16 W., Rader quadrangle.

Murrell Hollow - SW1/4 sec. 26, SE1/4 sec. 27, T. 35 N., R. 14 W., Drynob quadrangle.

Prairie Creek - SW1/4, SE1/4 sec. 23, T. 35 N., R. 14 W., Drynob quadrangle.

Big Piney River

Lost Hill - NE1/4 sec. 25, T. 36 N., R. 11 W., Devils Elbow quadrangle.

Strawstack Hollow - NE1/4, NE1/4 sec. 4, T. 35 N., R. 10 W., Devils Elbow quadrangle.

Baldridge Creek - NW1/4, SE1/4 sec. 18, T. 34 N., R. 20 W., Big Piney quadrangle.

Harmon Valley School - SW1/4, SW1/4 sec. 35, T. 33 N., R. 20 W., Slabtown Spring quadrangle.

Gasconade River

Above Osage Fork

Clark Creek - Whetstone Creek — SE1/4 sec. 24, T. 30 N., R. 14 W., Fuson quadrangle.

Osage Fork to Big Piney

Hazelgreen — SW1/4 sec. 13 and SE1/4 sec. 14, T. 35 N., R. 14 W., Richland quadrangle.

Big Piney to Missouri River

Rich Fountain — SW corner of the Linn 7.5 minute quadrangle.

Turkey Creek — Section 28, T. 44 N., R. 6 W., Pershing quadrangle.

Pomme de Terre River

Adonis-Stinking Creek - SE1/4 sec. 9 and NE1/4 sec. 16, T. 35 N., R. 22 W., Sentinel quadrangle.

Dooley Bend - NW1/4 sec. 10, T. 36 N., R. 22 W., Hermitage 7.5 and 15 minute quadrangles.

Breshears Valley (Spring Br. Church) - Section 4, T. 38 N., R. 22 W., Fristoe 7.5 and 15 minute quadrangles.

Fairfield-Indian Hill - N1/2 sec. 13, T. 33 N., R. 23 W., Warsaw West quadrangle.

Appendix D

Texas County

Falcon surface backhoe pit, location 3. 4/3/86

NW corner, NW1/4, NW1/4 sec. 31, T. 31 N., R. 9 W., Houston 7.5' quadrangle.

Depth, inches	*Description*
0-20	Silty clay loam with an occasional rounded pebble or small cobble. Gradual boundary to --
20-42	Clay grading down to silty clay. Common chert granules (2-4 mm) and pebbles (4-64 mm) throughout. There are a few well rounded chert cobbles up to 75 mm long. Grade to --
42-72	Sandy clay with increasing content of chert and quartzite pebbles and cobbles with depth. Red and gray more or less horizontally oriented mottles. Appears well weathered. Rounding of pebbles and cobbles ranges from angular with rounded edges to well rounded. Base of gravel layer was not determined in this pit.

Appendix E

Laclede County
NSSL Project CP81-M0028

Characterization data and descriptions

Classification of pedons[1]

Pedon S80MO-105-001—SND - Fine-loamy, siliceous, mesic Aquic Fragiudalf

Ped n S80MO-105-002—Wilderness - Loamy-skeletal, siliceous, mesic Typic Fragiudalf

Pedon S80MO-105-003—Wilderness - Loamy-skeletal, siliceous, mesic Typic Fragiudalf

Pedon S80MO-105-004—SND - Fine, mixed, mesic Typic Paleudalf

Ped n S80MO-105-005—Doniphan - Clayey, mixed, mesic Typic Paleudult

Pedon S80MO-105-006—Wilderness - Loamy-skeletal, siliceous, mesic Typic Fragiudalf

Pedon S80MO-105-007—Wilderness - Loamy-skeletal, siliceous, mesic Typic Fragiudalf

Pedon S80MO-105-008—Wilderness - Loamy-skeletal, siliceous, mesic Typic Fragiudalf

[1]These classifications were reviewed by Dennis K. Potter, Soil Specialist, SCS, Columbia, MO.

Pedon No.: **S80MO-105-001** **Date: 4/82**
Sampled as: SND; Fine, mixed, mesic Aquic Fragiudalf
Revised to: Fine-loamy, silicous, mesic Aquic Fragiudalf
Latitude: N37 Deg. 37 Min. 02 Sec. Longitude: W092 Deg. 24 Min. 07 Sec.
Location: LACLEDE CO. IN THE CORNER, SEC. 31, T. 34 N., R. 13 W
MLRA: 116 Ozark
Physiography: Upland ridge in level to undulating uplands
Geomorphic position: On the crest
Slope and aspect: 1 pct S plane
Elevation: 370 m M.S.L
Microrelief: None
Air Temp. 13 C Summer: 24 C Winter: 1 C
Precipitation: 101 cm Udic moisture regime.
Water table: Not observed
Drainage: Moderately well drained
Permeability:
Stoniness:
Land Use: Grassland or grazing land
Erosion or deposition:
Parent material: strongly weathered alluvium
Described by:

This pit was located at the site of drill hole 6, appendix A.

SAMP NOS 81P150 160.

Ap 0 - 10 cm Dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; about 5 percent chert gravel; abrupt smooth boundary.

BE 10 - 28 cm Brown to dark brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; common dark brown (10YR 3/3) organic coats on faces of peds; about 10 percent chert gravel; clear smooth boundary.

Bt 28 - 53 cm Dark grayish brown (10YR 4/2) silty clay; a few fine faint dark yellowish brown (10YR 4/4) and few fine faint dark yellowish brown (10YR 4/6) mottles; moderate fine to medium subangular blocky structure; firm; common thin discontinuous clay skins on faces of peds; about 12 percent chert gravel; abrupt smooth boundary.

2Bx 53 - 86 cm Pale brown (10YR 6/3) very gravelly silt loam, white (10YR 8/1) when dry; few distinct yellowish brown (10YR 5/6) mottles; weak fine to medium platy structure; firm, hard, brittle; about 40 percent chert gravel; clear smooth boundary.

2Bt1 86 - 111 cm Brown (7.5YR 5/4) and strong brown (7.5YR 5/6) gravelly silty clay loam; common fine distinct brown (10YR 5/3) mottles; weak fine subangular blocky structure parting to weak very fine subangular blocky; extremely firm, somewhat hard; common thin discontinuous clay skins on faces of peds; about 20 percent chert gravel; gradual smooth boundary.

3Bt2 111 - 131 cm Yellowish red (5YR 5/6) and red (2.5YR 4/6) silty clay loam; very few fine faint brown (7.5YR 5/4) mottles; weak fine subangular blocky structure parting to weak very fine subangular blocky; firm, hard; common thin discontinuous clay skins on faces of peds; about 10 percent chert gravel; clear smooth boundary.

3Bt3 131 - 170 cm Yellowish red (5YR 5/6) and red (2.5YR 4/6) silty clay loam; common fine faint brown (7.5YR 5/2) mottles; moderate fine subangular blocky structure; firm, hard; common thin discontinuous yellowish brown (10YR 5/4) clay skins on faces of peds; about 13 percent chert gravel; gradual smooth boundary.

3Bt4 170 - 203 cm Dark red (2.5YR 3/6) and yellowish red (5YR 5/6) gravelly silty clay loam; weak fine subangular blocky structure; firm, hard; common thin discontinuous clay skins on faces of peds; about 20 percent chert gravel; gradual smooth boundary.

3Bt5 203 - 249 cm Dark red (2.5YR 3/6) gravelly silty clay; weak fine subangular blocky structure; firm, hard; common thin discontinuous clay skins on faces of peds; about 20 percent chert gravel; gradual smooth boundary.

3Bt6 249 - 400 cm Yellowish red (5YR 5/6) and dark red (2.5YR 3/6) gravelly silty clay loam; weak fine subangular blocky structure; firm, hard; common thin discontinuous clay skins on faces of peds; about 20 percent chert gravel; clear irregular boundary.

*** P R I M A R Y   C H A R A C T E R I Z A T I O N   D A T A ***

(LACLEDE COUNTY, MISSOURI)

S80MO-105-001

PRINT DATE 02/26/91

SAMPLED AS : SND ; FINE, MIXED, MESIC AQUIC FRAGIUDALF

REVISED TO : ; FINE-LOAMY, SILICEOUS, MESIC AQUIC FRAGIUDALF

NSSL - PROJECT 81P 10, GEOMORPHOLOGY STUDY-LAKE OF THE OZARKS SSA
- PEDON 81P 25, SAMPLES 81P 150- 160
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

-1-- -2-- -3-- -4-- -5-- -6-- -7-- -8-- -9-- -10- -11- -12- -13- -14- -15- -16- -17- -18- -19- -20-

SAMPLE NO.	DEPTH (CM)	HORIZON	TOTAL CLAY LT .002	TOTAL SILT .002 -.05	TOTAL SAND .05 -2	CLAY FINE LT .0002	CLAY CO3 LT .002	SILT FINE .002 -.02	SILT COARSE .02 -.05	SAND VF .05 -.10	SAND F .10 -.25	SAND M .25 -.50	SAND C .5 -1	SAND VC 1 -2	COARSE FRACTIONS(MM) WEIGHT 2 -5	WEIGHT 5 -20	WEIGHT 20 -75	WEIGHT .1- 75	(>2MM) WT PCT OF WHOLE SOIL
			<- PCT OF <2MM (3A1)											->	<- PCT OF <75MM(3B1)			->	
81P 150S	0- 10	Ap	16.1	76.1	7.8	7.0		55.4	20.7	0.6	1.6	1.6	1.9	2.1	2	1	2V	12	5
81P 151S	10- 28	BE	22.3	70.4	7.3	9.5		49.5	20.9	0.5	2.1	1.3	1.6	1.8	3	4	4V	17	11
81P 152S	28- 53	Bt	37.3	55.1	7.6	22.6		38.2	16.9	0.8	2.5	1.7	1.0	1.6	5	12	3V	25	20
81P 153S	53- 86	2Bx	18.2	63.7	18.1	9.3		42.0	21.7	1.1	3.0	1.8	2.5	9.7	15	20	16	59	52
81P 154S	86-111	2Bt1	35.3	53.5	11.2	20.7		34.9	18.6	1.3	2.7	1.6	2.0	3.6	9	12	9	37	31
81P 155S	111-131	3Bt2	39.9	49.7	10.4	27.7		32.6	17.1	1.4	3.1	1.9	1.8	2.2	3	3	8V	22	14
81P 156S	131-170	3Bt3	30.4	55.3	14.3	20.7		36.1	19.2	1.9	4.7	2.9	2.6	2.2	4	6	8V	28	18
81P 157S	170-203	3Bt4	25.1	53.3	21.6	17.0		31.2	22.1	2.7	7.3	4.3	2.8	4.5	7	13	8V	42	28
81P 158S	203-249	3Bt5	26.3	53.6	20.1	14.2		31.6	22.0	2.9	7.4	3.8	2.8	3.2	6	10	9V	38	25
81P 159S	249-400	3Bt6	28.0	54.6	17.4	18.6		35.6	19.0	2.5	6.0	3.4	2.1	3.4	6	9	8V	34	23
81P 160S	400-428	4Bt7	27.6	42.5	29.9	18.7		26.8	15.7	2.5	6.4	4.4	4.7	11.9	10	19	39	77	72

DEPTH (CM)	ORGN C 6A1c PCT	TOTAL N 6B3a <2MM	EXTR P 6S3 PPM	TOTAL S 6R3a	DITH-CIT EXTRACTABLE FE 6C2b	DITH-CIT EXTRACTABLE AL 6G7a	DITH-CIT EXTRACTABLE MN 6D2a	(RATIO/CLAY) CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	ATTERBERG LIMITS LL 4F1	ATTERBERG LIMITS PI 4F	BULK DENSITY FIELD MOIST 4A3a	BULK DENSITY 1/3 BAR 4A1d	BULK DENSITY OVEN DRY 4A1h	COLE WHOLE SOIL 4D1	WATER CONTENT FIELD MOIST 4B4	WATER CONTENT 1/10 BAR 4B1c	WATER CONTENT 1/3 BAR 4B1c	WATER CONTENT 15 BAR 4B2a	WRD WHOLE SOIL 4C1
				<- PERCENT OF <2MM -->						PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
0- 10	1.15	0.098			1.4		0.2	0.66	0.40				1.45	1.49	0.009			24.2	6.5	0.25
10- 28	0.63	0.065			1.1		0.1	0.51	0.36				1.40						8.1	
28- 53	0.32	0.041			1.1		TR	0.57	0.38	43	21		1.40	1.53	0.026			23.3	14.2	0.11
53- 86	0.09	0.014			1.0		--	0.46	0.37	26	8		1.64	1.66	0.002			18.8	6.8	0.12
86-111	0.06				1.7		TR	0.34	0.33				1.52	1.61	0.015			22.6	11.8	0.13
111-131	0.06				2.1		TR	0.35	0.36				1.50						14.2	
131-170	0.05				1.9		TR	0.34	0.38	37	19		1.54	1.58	0.008			22.5	11.5	0.15
170-203	0.04				1.7		TR	0.34	0.40				1.50						10.0	
203-249	0.04				1.6		--	0.32	0.40				1.52	1.62	0.018			23.8	10.5	0.17
249-400	0.04				1.5		TR	0.35	0.42				1.50						11.8	
400-428	0.06				1.6		TR	0.35	0.39	37	22		1.22	1.27	0.006			31.8	10.8	0.11

AVERAGES, DEPTH 10- 53: PCT CLAY 31 PCT .1-75MM 22

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-001 PRINT DATE 02/26/91
SAMPLED AS : SND ; FINE, MIXED, MESIC AQUIC FRAGIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 25, SAMPLE 81P 150- 160

	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	(- NH4OAC EXTRACTABLE BASES -)					ACID-	EXTR	(- - - -CEC - - -)			AL	-BASE SAT-		CO3 AS	RES.		COND.		(- - - -PH - - -)	
DEPTH (CM)	CA 5B5a 6N2e	MG 5B5a 6O2d	NA 5B5a 6P2b	K 5B5a 6Q2b	SUM BASES	ITY 6H5a	AL 6G9a	SUM CATS 5A3a	NH4- OAC 5A8b	BASES + AL 5A3b	SAT 5G1	SUM 5C3	NH4 OAC 5C1	CACO3 <2MM 6E1g	OHMS /CM 8E1		MMHOS /CM 8I		CACL2 .01M 8C1f 1:2	H2O 8C1f 1:1
	<- - - - - - - - - - - - -MEQ / 100 G - - - - - - - - - - - - ->										<- - - - - -PCT - - - - ->									
0- 10	7.5	0.9	TR	0.2	8.6	4.1		12.7	10.7			68	80						5.7	5.9
10- 28	4.4	1.5	TR	0.2	6.1	6.5	1.5	12.6	11.3	7.6	20	48	54						4.5	5.1
28- 53	3.8	3.2	0.1	0.3	7.4	16.8	9.2	24.2	21.2	16.6	55	31	35						3.9	4.7
53- 86	1.0	1.1	0.1	0.1	2.3	6.7	3.9	9.0	8.3	6.2	63	26	28						3.9	4.7
86-111	1.6	2.4	0.2	0.2	4.4	8.9	4.5	13.3	12.0	8.9	51	33	37		15000				3.7	4.7
111-131	2.4	3.6	0.3	0.2	6.5	9.8	3.6	16.3	14.0	10.1	36	40	46						3.7	4.7
131-170	2.4	3.1	0.2	0.1	5.8	6.2	1.7	12.0	10.4	7.5	23	48	56						3.9	4.7
170-203	2.6	2.8	0.3	0.2	5.9	4.1	0.7	10.0	8.6	6.6	11	59	69						4.3	5.0
203-249	3.2	2.9	0.3	0.2	6.6	3.3	0.3	9.9	8.4	6.9	4	67	79						4.7	5.5
249-400	4.3	3.6	0.5	0.3	8.7	2.6		11.3	9.7			77	90						5.2	6.0
400-428	4.0	3.8	0.5	0.3	8.6	2.6		11.2	9.6			77	90						5.8	6.4

ESTIMATED BULK DENSITY FOR LAYER 2, 6, 8, 10,

ANALYSES: S= ALL ON SIEVED <2MM BASIS V= 75-20MM FROM VOLUME ESTIMATES

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-001 PRINT DATE 02/26/91
SAMPLED AS : SND ; FINE, MIXED, MESIC AQUIC FRAGIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 25, SAMPLE 81P 150- 160

CLAY MINERALOGY (<.002mm)

FRACTION; X-RAY (7A2i, peak size); THERMAL (DTA 7A6, TGA 7A4b, Percent); ELEMENTAL (SiO2, AL2O3, Fe2O3, MgO, CaO, K2O, Na2O; 7C3, Percent); EGME RETN (7D2, mg/g); INTERPRETATION

SAMPLE NUMBER	-1- FRACTION	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11- SIO2	-12- AL2O3	-13- Fe2O3	-14- MgO	-15- CaO	-16- K2O	-17- Na2O	-18-	-19- EGME RETN	-20- INTERPRETATION
81P 150	TCLY	KK 3	VR 2	MI 2	QZ 2	MT 1														
81P 152	TCLY	MT 3	KK 3	VR 2	MI 2	QZ 1	KK24						8.1			1.3				
81P 153	TCLY	VR 3	MT 2	MI 2	KK 2	QZ 1	KK 4						6.9			1.2				
81P 154	TCLY	KK 3	VR 3	MI 2	MT 2	QZ 1	KK29						8.3			1.3				
81P 156	TCLY	KK 3	VR 2	MI 2	MT 1	QZ 1	KK29						8.6			1.2				
81P 158	TCLY	KK 3	MI 2	MT 1	QZ 1		KK33						9.0			1.3				
81P 160	TCLY	KK 3	MI 2	MT 1	QZ 1		KK26						8.0			1.4				

SAND - SILT MINERALOGY (2.0-0.002mm)

FRACTION; X-RAY (7A2i, Peak Size); THERMAL (DTA 7A3b, TGA 7A4b, Percent); TOT RE; OPTICAL GRAIN COUNT (7B1a, Percent); INTERPRETATION

SAMPLE NUMBER	-1- FRACTION	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10- TOT RE	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20- INTERPRETATION
81P 151	VFS									94	QZ67	FK 5	QI17	PO 1	OP 9	MS 1				
81P 151	VFS										ZRtr	EPtr	HNtr	BT 1						
81P 153	VFS									98	QZ79	FK 1	OP 3	QI 3	BTtr	MStr				
81P 153	VFS										HNtr	POtr	CD13	CBtr	ZRtr					

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm VFS Very Fine Sand, 0.05-0.10mm

MINERAL INTERPRETATION:

KK kaolinite	VR vermiculite	MI mica	QZ quartz	MT montmorill	FK potas-feld
QI fe-coat qz	PO plant opal	OP opaques	MS muscovite	ZR zircon	EP epidote
HN hornblende	BT biotite	CD chalcedony	CB carb-aggreg		

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

*** SUPPLEMENTARY CHARACTERIZATION DATA ***

S80MO-105-001 PRINT DATE 02/26/91
SAMPLED AS : SND ; FINE, MIXED, MESIC AQUIC FRAGIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 25, SAMPLE 81P 150- 160

DEPTH (IN.)	(V O L U M E F R A C T I O N S) ----W H O L E S O I L (MM) A T 1/3 B A R--- <----PCT OF WHOLE SOIL---->													(C/) (/N)	(R A T I O S TO C L A Y) --------<2 MM FRACTION--------					(LINEAR EXTENSIBILITY) WHOLE SOIL <-1/3 BAR TO		--<2 MM-- (PCT)--->		(W R D) <--IN/IN->	
	>2	250 -UP	250 -75	75 -2	75 -20	20 -5	5 -2	<2	2- .05	.05- .002	LT .002	PORES D	PORES F	RAT -IO	FINE CLAY	---C E C-- SUM CATS	NH4- OAC	15 BAR H2O	LE 1/3 BAR	15 BAR	OVEN -DRY	15 BAR	OVEN -DRY	WHOLE SOIL	<2 MM
	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
0- 4	3	--	--	3	1	1	1	97	4	40	8	10	34	12	0.43	0.79	0.66	0.40	0.056	0.7	0.9	0.7	0.9	0.25	0.26
4- 11	6	--	--	6	2	2	2	94	4	35	11	44		10	0.43	0.57	0.51	0.36							
11- 21	12	--	--	12	2	7	3	88	4	26	17	12	29	8	0.61	0.65	0.57	0.38	0.080	1.1	2.5	1.4	3.0	0.11	0.13
21- 34	39	--	1	39	12	15	12	61	7	24	7	5	18	6	0.51	0.49	0.46	0.37	0.022	0.2	0.2	0.2	0.4	0.12	0.20
34- 44	20	--	1	19	6	8	5	80	5	25	16	6	28		0.59	0.38	0.34	0.33	0.054	0.8	1.5	1.1	1.9	0.13	0.16
44- 51	9	--	--	9	5	2	2	91	5	26	21	40			0.69	0.41	0.35	0.36							
51- 67	11	--	--	11	5	4	3	89	7	29	16	7	30		0.68	0.39	0.34	0.38	0.030	0.4	0.6	0.4	0.9	0.15	0.17
67- 80	18	--	--	18	5	8	4	82	10	25	12	35			0.68	0.40	0.34	0.40							
80- 98	16	--	--	16	6	7	4	84	10	26	13	[illegible]	31		0.54	0.38	0.32	0.40	0.080	1.0	1.7	1.3	2.1	0.17	0.20
98-157	14	--	--	14	5	6	4	86	8	26	14	37			0.66	0.40	0.35	0.42							
157-168	54	--	10	45	26	13	7	46	6	9	6	6	18		0.68	0.41	0.35	0.39	0.047	0.5	0.7	0.8	1.3	0.12	0.26

DEPTH (IN.)	(W E I G H T F R A C T I O N S - C L A Y F R E E) --W H O L E S O I L-- PCT OF >2MM+SAND+SILT>						---<2 MM F R A C T I O N---- -------SANDS------- (------PCT OF SAND+SILT------)					SILTS			(-TEXTURE--) (DETERMINED (--<2 MM-)		(--P S D A(MM)---) (--PCT OF .2MM-)			(PH) (- - - - <2 MM- - - -)	(-ELECTRICAL)		(CUMULT. AMOUNTS) IN. OF H2O 1/3 BAR TO (WHL SOIL)	
	>2	75 -2	20 -2	2- .05	.05- .002	LT .002	VC	C	M	F	VF	C	F	CL AY	IN FIELD	BY PSDA	SAND 2- .05	SILT .05- .002	CLAY LT .002	CA- CL2 .01M	RES- IST. OHMS	CON- DUCT. MMHOS	SALT MG/ KG	15BAR	AIRDRY
	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
0- 4	6	6	4	9	85	18	3	2	2	2	1	25	66	19	SIL	SIL	7.8	76.1	16.1	5.7					
4- 11	14	14	9	8	78	25	2	2	2	3	1	27	64	29	SICL	SIL	7.3	70.4	22.3	4.5					
11- 21	28	28	24	9	63	43	3	2	3	4	1	27	61	59	SIC	SICL	7.6	55.1	37.3	3.9					
21- 34	56	55	38	10	34	10	12	3	2	4	1	27	51	22	SIL	SIL	18.1	63.7	18.2	3.9					
34- 44	40	37	27	10	50	33	6	3	2	4	2	29	54	55	SICL	SICL	11.2	53.5	35.3	3.7	15000				
44- 51	21	21	9	14	65	52	4	3	3	5	2	28	54	66	SICL	SICL	10.4	49.7	39.9	3.7					
51- 67	24	24	13	16	60	33	3	4	4	7	3	28	52	44	SICL	SICL	14.3	55.3	30.4	3.9					
67- 80	34	34	24	19	47	22	6	4	6	10	4	30	42	34	SICL	SIL	21.6	53.3	25.1	4.3					
80- 98	31	31	20	19	50	25	4	4	5	10	4	30	43	36	SIC	SIL	20.1	53.6	26.3	4.7					
98-157	29	29	19	17	54	27	5	3	5	8	3	26	49	39	SICL	SICL	17.4	54.6	28.0	5.2					
157-168	78	64	28	9	13	8	16	6	6	9	3	22	37	38	C	CL	29.9	42.5	27.6	5.8					

S80MO-105-001

*** SUPPLEMENTARY CHARACTERIZATION DATA ***
(LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : SND ; FINE, MIXED, MESIC AQUIC FRAGIUDALF
REVISED TO : ; FINE-LOAMY, SILICEOUS, MESIC AQUIC FRAGIUDALF

NSSL - PROJECT 81P 10,
- PEDON 81P 25, SAMPLES 81P 150- 160
- GENERAL METHODS (ENGINEERING FRACTIONS ARE CALCULATED FROM USDA FRACTION SIZES)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (IN.)	HORIZON	ENGINEERING PERCENTAGE PASSING 3 (INCHES)	2	3/2	1	3/4	3/8	4 (NUMBER)	10	40	200	PSDA SIEVE 20 (MICRONS)	5	2	CUMULATIVE CURVE FRACTIONS(<76MM) USDA LESS THAN 1. (MM)	.5	.25	.10	.05	DIAMETERS(MM) AT 60 (PERCENTILE)	50	10	ATTERBERG LL (PCT)	PI	GRADATION UNIFMTY CU	CURVTUR CC
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
81P 150S	0- 4	Ap	100	99	99	98	98	98	97	95	91	88	68	36	15	93	91	90	88	88	0.01	0.009	0.001			15.7	1.1
81P 151S	4- 11	BE	100	99	98	97	96	94	92	89	86	83	64	37	20	87	86	85	83	83	0.02	0.010	0.001			25.6	1.1
81P 152S	11- 21	BE	100	99	99	98	97	91	85	80	78	74	60	42	30	79	78	77	75	74	0.02	0.009	--	43	21	44.9	0.5
81P 153S	21- 34	2Bx	100	95	92	87	84	74	64	49	43	40	29	17	9	44	43	42	41	40	3.74	2.117	0.002	26	8	>100	0.1
81P 154S	34- 44	2Bt1	100	97	96	93	91	85	79	71	67	64	50	35	25	68	67	66	64	63	0.04	0.020	0.001			80.7	0.5
81P 155S	44- 51	3Bt2	100	98	96	94	92	91	89	86	82	78	62	45	34	84	83	81	78	77	0.02	0.007	--			42.1	0.3
81P 156S	51- 67	3Bt3	100	98	96	94	92	89	86	82	77	71	55	37	25	80	78	76	72	70	0.03	0.014	0.001	37	19	54.6	0.6
81P 157S	67- 80	3Bt4	100	98	96	94	92	86	79	72	66	58	41	27	18	69	67	64	58	56	0.13	0.035	0.001			>100	0.5
81P 158S	80- 98	3Bt5	100	97	96	93	91	86	81	75	70	61	43	29	20	73	70	68	62	60	0.05	0.029	0.001			79.7	0.9
81P 159S	98-157	3Bt6	100	98	96	94	92	88	83	77	72	65	49	32	22	74	73	70	66	64	0.04	0.021	0.001			68.6	0.7
81P 160S	157-168	4Bt7	100	89	81	69	61	52	42	32	26	23	17	12	9	28	27	25	23	22	17.65	8.463	0.003	37	22	>100	40.0

DEPTH (IN.)	(WEIGHT FRACTIONS) WHOLE SOIL (MM) >2 (PCT OF WHOLE SOIL)	250-UP	250-75	75-2	75-20	20-5	5-2	<2	<75 MM FRACTION 75-2 (PCT OF <75 MM)	75-20	20-5	5-2	<2		(WEIGHT PER UNIT VOLUME G/CC) WHOLE SOIL SOIL SURVEY 1/3 BAR	OVEN-DRY	ENGINEERING MOIST	SATURATED	<2 MM FRACTION SOIL SURVEY 1/3 BAR	15 BAR	OVEN-DRY	ENGINEERING MOIST	SATURATED	(VOID RATIOS AT 1/3 BAR) WHOLE SOIL	<2 MM
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
0- 4	5	--	--	5	2	1	2	95	5	2	1	2	95		1.48	1.52	1.82	1.92	1.45	1.48	1.49	1.80	1.90	0.79	0.83
4- 11	11	--	--	11	4	4	3	89	11	4	4	3	89		1.48										
11- 21	20	--	--	20	3	12	5	80	20	3	12	5	80		1.55	1.67	1.84	1.97	1.40	1.46	1.53	1.73	1.87	0.71	0.89
21- 34	51	--	1	50	16	20	15	49	51	16	20	15	49		2.04	2.05	2.22	2.27	1.64	1.65	1.66	1.95	2.02	0.30	0.62
34- 44	30	--	2	28	9	12	8	70	29	9	12	8	71		1.74	1.82	2.02	2.08	1.52	1.57	1.61	1.86	1.95	0.52	0.74
44- 51	14	--	--	14	8	3	3	86	14	8	3	3	86		1.60										
51- 67	18	--	--	18	8	6	4	82	18	8	6	4	82		1.67	1.70	1.97	2.04	1.54	1.56	1.58	1.89	1.96	0.59	0.72
67- 80	28	--	--	28	8	13	7	72	28	8	13	7	72		1.71										
80- 98	25	--	--	25	9	10	6	75	25	9	10	6	75		1.70	1.79	2.01	2.06	1.52	1.58	1.62	1.88	1.95	0.56	0.74
98-157	23	--	--	23	8	9	6	77	23	8	9	6	77		1.67										
157-168	72	--	13	59	34	17	9	28	68	39	19	10	32		2.01	2.05	2.19	2.25	1.22	1.25	1.27	1.61	1.76	0.32	1.17

Pedon No.: **S80MO-105-002** **Date: 4/82**

Sampled as: LEBANON; Fine, mixed, mesic Typic Fragiudalf
Revised to: WILDERNESS; Loamy-skeletal, siliceous, mesic Typic Fragiudalf
Latitude: N37 Deg. 36 Min. 31 Sec. Longitude: W092 Deg. 23 Min. 48 Sec.
Location: LACLEDE CO. IN THE CORNER, SEC. 31, T. 34 N., R. 13 W
MLRA: 116 Ozark
Physiography: Upland ridge in level to undulating uplands
Geomorphic position: On the crest noseslope
Slope and aspect: 3 pct N convex
Elevation: 389 m M.S.L
Microrelief: None
Air Temp. 13 C Summer: 24 C Winter: 1 C
Precipitation: 101 cm Udic moisture regime.
Water table: Not observed
Drainage: Well drained Permeability:
Stoniness:
Land use:
Erosion or deposition:
Parent material: strongly weathered, residual material from Jefferson City dolomite
Described by:

This pit was located at the site of drill hole 2, appendix A.

SAMP NOS 81P161 169

A 0 - 7 cm Black (10YR 2/1) fresh material; many fine roots; clear smooth boundary.

E 7 - 18 cm Brown (10YR 5/3) silt loam; weak fine granular structure; friable; many fine roots; about 10 percent chert gravel; clear smooth boundary.

Bt1 18 - 46 cm Brown (7.5YR 4/4) very gravelly silty clay loam; moderate fine subangular blocky structure; firm; many fine roots; common thin discontinuous clay skins on faces of peds; about 40 percent chert gravel; clear wavy boundary.

Bt2 46 - 62 cm Grayish brown (10YR 5/2) very gravelly silty clay loam; common fine faint strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; many very fine roots; common thin discontinuous yellowish brown (10YR 5/6) clay skins on faces of peds; about 50 percent chert gravel; abrupt smooth boundary.

2Bx 62 - 104 cm Pale brown (10YR 6/3) very gravelly silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak very coarse platy structure; hard; about 50 percent chert gravel; clear wavy boundary.

2Bt1 104 - 157 cm Brown to dark brown (7.5YR 4/4) very gravelly silty clay loam; moderate fine subangular blocky structure; very firm, very hard; a few thin discontinuous dark reddish brown (2.5YR 3/4) clay skins on faces of peds; about 50 percent chert gravel; gradual wavy boundary.

2Bt2 157 - 199 cm Dark red (2.5YR 3/6) gravelly silty clay; common medium distinct brown to dark brown (7.5YR 4/4) and common medium distinct light yellowish brown (10YR 6/4) mottles; weak fine to medium subangular blocky structure; very firm, very hard; common thin discontinuous clay skins on faces of peds; about 25 percent chert gravel; gradual wavy boundary.

2Bt3 199 - 247 cm Dark red (10R 3/6) very gravelly silty clay; many red (2.5YR 4/8) and common medium distinct dark reddish gray (5YR 4/2) mottles; weak fine subangular blocky parting to weak fine angular blocky structure; very firm, very hard; common thin discontinuous clay skins on faces of peds; about 60 percent chert gravel; gradual wavy boundary.

2Bt4 247 - 309 cm Dark red (10R 3/6) extremely gravelly silty clay; common medium grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; very firm, very hard; about 70 percent chert gravel; common thin discontinuous clay skins.

*** P R I M A R Y   C H A R A C T E R I Z A T I O N   D A T A ***

S80MO-105-002 (LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : LEBANON ; FINE, MIXED, MESIC TYPIC FRAGIUDALF
REVISED TO : WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF

NSSL - PROJECT 81P 10, GEOMORPHOLOGY STUDY-LAKE OF THE OZARKS SSA
- PEDON 81P 26, SAMPLES 81P 161- 169
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	-4-- (- - -TOTAL CLAY LT .002	-5-- SILT .002 -.05	-6-- SAND .05 -2 - - -)	-7-- (- -CLAY- FINE LT .0002	-8-- CO3 LT .002 -)	-9-- (- -SILT- FINE .002 -.02	-10- COARSE .02 -.05 -)	-11- (- - - SAND- VF .05 -.10	-12- F .10 -.25	-13- M .25 -.50	-14- C .5 -1	-15- VC 1 -2 - -)	-16- (-COARSE FRACTIONS(MM)-) WEIGHT 2 -5	-17- 5 -20	-18- 20 -75	-19- .1- 75	-20- (>2MM) WT PCT OF WHOLE SOIL
			<- - - -	- - - -	- - - -	- - - -	- PCT OF <2MM	(3A1) - -	- - - -	- - - -	- - - -	- - - -	- - ->	<- PCT OF	<75MM(3B1)->			SOIL
81P 161S	0- 7	A	8.7	76.5	14.8	0.5		43.1	33.4	1.7	1.8	2.1	2.0	7.2	1	1	--	15	2
81P 162S	7- 18	E	12.3	79.0	8.7	5.7		50.7	28.3	1.1	2.2	2.2	1.9	1.3	2	3	11V	22	16
81P 163S	18- 46	Bt1	37.5	51.5	11.0	23.1		35.5	16.0	1.1	1.5	1.3	1.4	5.7	8	18	25V	56	51
81P 164S	46- 62	Bt2	22.4	65.5	12.1	14.7		43.6	21.9	1.8	2.2	1.2	1.2	5.7	10	20	29	63	62
81P 165S	62-104	2Bx	16.2	65.6	18.2	8.5		42.4	23.2	2.5	2.3	1.7	2.8	8.9	13	16	28	64	63
81P 166S	104-157	2Bt1	36.2	48.9	14.9	24.4		29.3	19.6	4.6	2.9	1.6	2.1	3.7	18	7	30	60	58
81P 167S	157-199	2Bt2	54.4	29.9	15.7	38.9		17.6	12.3	4.1	2.6	1.8	2.7	4.5	1	17	18V	43	41
81P 168S	199-247	2Bt3	67.5	20.6	11.9	45.0		13.9	6.7	3.2	2.2	1.8	2.5	2.2	27	28	14V	72	71
81P 169S	247-309	2Bt4	78.2	14.2	7.6	49.6		10.2	4.0	1.5	1.4	1.4	1.5	1.8	31	39	7V	78	79

DEPTH (CM)	-1-- ORGN C 6A1c PCT	-2-- TOTAL N 6B3a <2MM	-3-- EXTR P 6S3 PPM	-4-- TOTAL S 6R3a <- PERCENT	-5-- (- - DITH-CIT EXTRACTABLE FE 6C2b	-6-- AL 6G7a OF	-7-- MN 6D2a <2MM --> - -)	-8-- (RATIO/CLAY) CEC 8D1	-9-- 15 BAR 8D1	-10- (ATTERBERG - LIMITS - LL 4F1 PCT	-11- PI 4F <0.4MM)	-12- (- BULK DENSITY -) FIELD MOIST 4A3a <- -	-13- 1/3 BAR 4A1d G/CC -	-14- OVEN DRY 4A1h - ->	-15- COLE WHOLE SOIL 4D1 CM/CM	-16- (- - -WATER CONTENT FIELD MOIST 4B4 <- -	-17- 1/10 BAR 4B1c -PCT OF	-18- 1/3 BAR 4B1c <2MM	-19- 15 BAR 4B2a - -> - -)	-20- WRD WHOLE SOIL 4C1 CM/CM
0- 7	10.9	0.685			0.7		0.3	4.33	2.80				0.70						24.4	
7- 18	0.92	0.050			1.1		TR	0.59	0.41	23	2		1.10						5.1	
18- 46	0.48	0.050			1.4		TR	0.56	0.41				1.15	1.25	0.019			29.3	15.2	0.11
46- 62	0.22	0.027			0.9		TR	0.59	0.43	31	11		1.20						9.7	
62-104	0.07				0.8		TR	0.48	0.40	23	4		1.44	1.44	--			22.0	6.5	0.12
104-157	0.08				1.8		TR	0.35	0.35				1.20						12.8	
157-199	0.14				2.8		TR	0.33	0.37				1.23	1.30	0.014			31.1	20.2	0.10
199-247	0.17				3.1		TR	0.26	0.33				1.20						22.5	
247-309	0.18				3.4		TR	0.23	0.32	71	43		1.07	1.31	0.026			47.7	24.8	0.10

AVERAGES, DEPTH 18- 62: PCT CLAY 32 PCT .1-75MM 58

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-002 PRINT DATE 02/26/91

SAMPLED AS : LEBANON ; FINE, MIXED, MESIC TYPIC FRAGIUDALF

NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 26, SAMPLE 81P 161- 169

	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	(- NH4OAC EXTRACTABLE BASES -)					ACID-	EXTR	(- - - -CEC - - -)			AL	-BASE SAT-		CO3 AS	RES.		COND.	(- - - -PH - - -)		
	CA	MG	NA	K	SUM	ITY	AL	SUM	NH4-	BASES	SAT	SUM	NH4	CACO3	OHMS		MMHOS		CACL2	H2O
DEPTH	5B5a	5B5a	5B5a	5B5a	BASES			CATS	OAC	+ AL			OAC	<2MM	/CM		/CM		.01M	
(CM)	6N2e	6O2d	6P2b	6Q2b		6H5a	6G9a	5A3a	5A8b	5A3b	5G1	5C3	5C1	6E1g	8E1		8I		8C1f	8C1f
	<- - - - - - - - - - - - -				-MEQ /	100 G - - - - - - - - - - - - ->					<- - - - -PCT - - - ->								1:2	1:1
0- 7	21.2	3.5	--	1.0	25.7	24.2		49.9	37.7			52	68							
7- 18	0.2	0.3	--	0.1	0.6	8.3	3.8	8.9	7.3	4.4	86	7	8						4.0	4.4
18- 46	0.7	3.1	TR	0.3	4.1	17.6	11.6	21.7	21.0	15.7	74	19	20						3.9	4.6
46- 62	0.3	2.1	0.1	0.2	2.7	12.1	7.5	14.8	13.2	10.2	74	18	20						3.9	4.5
62-104	0.7	1.3	0.1	0.1	2.2	6.0	3.7	8.2	7.8	5.9	63	27	28		22000				3.8	4.6
104-157	2.9	2.9	0.5	0.2	6.5	7.8	3.0	14.3	12.6	9.5	32	45	52						3.8	4.4
157-199	6.1	5.3	1.3	0.3	13.0	8.7	1.7	21.7	18.1	14.7	12	60	72						4.0	4.1
199-247	7.7	5.8	1.6	0.4	15.5	6.3	0.6	21.8	17.8	16.1	4	71	87						4.7	4.7
247-309	8.6	5.9	1.8	0.5	16.8	5.7	0.2	22.5	18.0	17.0	1	75	93						5.0	5.0

ESTIMATED BULK DENSITY FOR LAYER 1, 2, 4, 6, 8,

ANALYSES: S= ALL ON SIEVED <2MM BASIS V= 75-20MM FROM VOLUME ESTIMATES

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-002 PRINT DATE 02/26/91
SAMPLED AS : LEBANON ; FINE, MIXED, MESIC TYPIC FRAGIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 26, SAMPLE 81P 161- 169

CLAY MINERALOGY (<.002mm)

SAMPLE NUMBER	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	FRACTION	X-RAY 7A2i peak size					THERMAL DTA 7A6 Percent		THERMAL TGA 7A4b Percent		ELEMENTAL 7C3 Percent SiO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O		EGME RETN 7D2 mg/g	INTERPRETATION
81P 162	TCLY	VR 3	KK 2	MI 2	QZ 2	MT 1														
81P 164	TCLY	VR 3	MT 3	KK 3	MI 2	QZ 1	KK17						7.9			1.2				
81P 165	TCLY	VR 3	MT 3	KK 2	MI 2	QZ 1	KK 8						7.0			1.4				
81P 167	TCLY	KK 4	VR 2	QZ 2	MI 1	MT 1	KK34						9.0			1.1				
81P 169	TCLY	KK 4	MI 2	QZ 2	MT 1		KK38						8.0			1.2				

SAND - SILT MINERALOGY (2.0-0.002mm)

SAMPLE NUMBER	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	FRACTION	X-RAY 7A2i Peak Size				THERMAL DTA 7A3b Percent		THERMAL TGA 7A4b Percent		TOT RE	OPTICAL GRAIN COUNT 7B1a Percent									INTERPRETATION
81P 163	VFS									97	QZ53	FK 2	OP 1	QI18	CD33	CBtr				
81P 163	VFS										MStr	HNtr								
81P 165	VFS									98	QZ45	QI31	FK 1	CD22						

FRACTION INTERPRETA.: ON:

TCLY Total Clay, <0.002mm VFS Very Fine Sand, 0.05-0.10mm

MINERAL INTERPRETATION:

VR	vermiculite	KK	kaolinite	MI	mica	QZ	quartz	MT	montmorill	FK	potas-feld
OP	opaques	QI	fe-coat qz	CD	chalcedony	CB	carb-aggreg	MS	muscovite	HN	hornblende

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

*** SUPPLEMENTARY CHARACTERIZATION DATA ***

S80MO-105-002 (LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : LEBANON ; FINE, MIXED, MESIC TYPIC FRAGIUDALF
REVISED TO : WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF

NSSL - PROJECT 81P 10,
- PEDON 81P 26, SAMPLES 81P 161- 169
- GENERAL METHODS (ENGINEERING FRACTIONS ARE CALCULATED FROM USDA FRACTION SIZES)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (IN.)	HORIZON	ENGINEERING PERCENTAGE PASSING SIEVE: 3 in. (1)	2 in. (2)	3/2 in. (3)	1 in. (4)	3/4 in. (5)	3/8 in. (6)	No. 4 (7)	No. 10 (8)	No. 40 (9)	No. 200 (10)	PSDA: 20 microns (11)	5 microns (12)	2 microns (13)	CUMULATIVE CURVE FRACTIONS(<76MM) USDA LESS THAN: 1. mm (14)	.5 mm (15)	.25 mm (16)	.10 mm (17)	.05 mm (18)	DIAMETERS(MM) AT PERCENTILE: 60 (19)	50 (20)	10 (21)	ATTERBERG LL PCT (22)	PI PCT (23)	GRADATION UNIFMTY CU (24)	CURVTUR CC (25)
81P 161S	0- 3	A	100	100	100	100	100	100	99	98	88	84	51	25	9	91	89	87	85	83	0.03	0.019	0.002			12.0	0.7
81P 162S	3- 7	E	100	97	95	91	89	88	86	84	81	77	53	27	10	83	81	79	78	77	0.03	0.017	0.002	23	2	14.1	0.7
81P 163S	7- 18	Bt1	100	93	88	80	75	66	57	49	45	44	36	25	18	46	46	45	44	44	5.93	2.225	0.001			>100	--
81P 164S	18- 24	Bt2	100	92	86	77	71	61	51	41	38	36	27	16	9	39	38	38	37	36	8.81	4.315	0.002	31	11	>100	--
81P 165S	24- 41	2Bx	100	92	86	78	72	64	56	43	38	36	25	14	7	39	38	37	36	35	6.66	3.168	0.003	23	4	>100	--
81P 166S	41- 62	2Bt1	100	91	85	76	70	67	63	45	42	39	29	22	16	43	42	42	40	38	4.08	2.536	0.001			>100	0.1
81P 167S	62- 78	2Bt2	100	95	91	86	82	74	65	64	59	55	46	39	35	61	59	58	57	54	0.64	0.032	--			>100	--
81P 168S	78- 97	2Bt3	100	96	93	89	86	72	58	31	29	28	25	23	21	30	30	29	28	27	5.19	3.649	0.001			>100	>100
81P 169S	97-121	2Bt4	100	98	97	94	93	74	54	23	22	21	20	19	18	23	22	22	22	21	5.83	4.209	0.001	71	43	>100	>100

DEPTH (IN.)	WEIGHT FRACTIONS, WHOLE SOIL (MM), PCT OF WHOLE SOIL: >2 (26)	250-UP (27)	250-75 (28)	75-2 (29)	75-20 (30)	20-5 (31)	5-2 (32)	<2 (33)	<75 MM FRACTION, PCT OF <75 MM: 75-2 (34)	75-20 (35)	20-5 (36)	5-2 (37)	<2 (38)	(39)	WEIGHT PER UNIT VOLUME G/CC, WHOLE SOIL: SOIL SURVEY 1/3 BAR (40)	SOIL SURVEY OVEN-DRY (41)	ENGINEERING MOIST (42)	ENGINEERING SATURATED (43)	<2 MM FRACTION: SOIL SURVEY 1/3 BAR (44)	SOIL SURVEY 15 BAR (45)	SOIL SURVEY OVEN-DRY (46)	ENGINEERING MOIST (47)	ENGINEERING SATURATED (48)	VOID RATIOS AT 1/3 BAR: WHOLE SOIL (49)	<2 MM (50)
0- 3	2	--	--	2	--	1	1	98	2	--	1	1	98		0.71										
3- 7	16	--	--	16	11	3	2	84	16	11	3	2	84		1.21										
7- 18	51	--	--	51	25	18	8	49	51	25	18	8	49		1.60	1.70	1.82	2.00	1.15	1.20	1.25	1.49	1.72	0.66	1.30
18- 24	62	--	7	55	27	19	9	38	59	29	20	10	41		1.83										
24- 41	63	--	13	50	24	14	11	37	57	28	16	13	43		2.01	2.01	2.17	2.25	1.44	1.44	1.44	1.76	1.90	0.32	0.84
41- 62	59	--	8	51	28	6	17	41	55	30	7	18	45		1.76										
62- 78	41	--	8	33	17	16	1	59	36	18	17	1	64		1.59	1.65	1.88	1.99	1.23	1.26	1.30	1.61	1.77	0.67	1.15
78- 97	71	--	7	64	13	26	25	29	69	14	28	27	31		1.98										
97-121	79	--	7	72	7	36	29	21	77	7	39	31	23		2.02	2.18	2.22	2.26	1.07	1.19	1.31	1.58	1.67	0.31	1.48

*** SUPPLEMENTARY CHARACTERIZATION DATA ***

S80MO-105-002 PRINT DATE 02/26/91

CLASSIFICATION: WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF

NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 26, SAMPLE 81P 161- 169

DEPTH (IN.)	VOLUME FRACTIONS WHOLE SOIL (MM) >2	250 -UP	250 -75	75 -2	75 -20	20 -5	5 -2	<2	AT 1/3 BAR 2- .05	.05- .002	LT .002	PORES D	PORES F	(C/N) RAT -IO	RATIOS TO CLAY FINE CLAY	<2 MM FRACTION CEC SUM CATS	CEC NH4-OAC	15 BAR H2O	LE 1/3 BAR	LINEAR EXTENSIBILITY WHOLE SOIL <-1/3 BAR TO 15 BAR	WHOLE SOIL OVEN -DRY	<2 MM (PCT) 15 BAR	<2 MM OVEN -DRY	W R D WHOLE SOIL (IN/IN)	W R D <2 MM (IN/IN)
	<---PCT OF WHOLE SOIL												--->												
	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
0- 3	1	--	--	1	--	1	1	99	4	20	2	73		16	0.06	5.74	4.33	2.80							
3- 7	7	--	--	7	5	1	1	93	3	31	5	54		18	0.46	0.72	0.59	0.41							
7- 18	31	--	--	31	15	11	5	69	3	16	11	18	22	10	0.62	0.58	0.56	0.41	0.075	1.0	2.0	1.4	2.8	0.11	0.16
18- 24	43	--	5	38	19	13	6	57	3	17	6	31		8	0.66	0.66	0.59	0.43							
24- 41	49	--	10	39	18	11	8	51	5	19	5	8	16		0.52	0.51	0.48	0.40						0.11	0.22
41- 62	39	--	5	34	19	4	11	61	4	14	10	34			0.67	0.40	0.35	0.35							
62- 78	25	--	5	20	10	10	1	75	5	10	19	11	29		0.72	0.40	0.33	0.37	0.035	0.4	1.2	0.8	1.9	0.10	0.13
78- 97	54	--	5	48	10	20	19	46	3	4	14	25			0.67	0.32	0.26	0.33							
97-121	60	--	5	54	5	27	22	40	1	2	13	4	20		0.63	0.29	0.23	0.32	0.090	1.3	2.6	3.6	7.0	0.10	0.25

DEPTH (IN.)	WEIGHT FRACTIONS - CLAY FREE WHOLE SOIL >2	75 -2	20 -2	2- .05	.05- .002	LT .002	<2 MM FRACTION SANDS VC	C	M	F	VF	SILTS C	F	CL AY	TEXTURE (DETERMINED) IN FIELD	BY PSDA	PSDA(MM) SAND 2- .05	SILT .05- .002	CLAY LT .002	PH CA- CL2 .01M	ELECTRICAL RES- IST. OHMS	CON- DUCT. MMHOS	SALT MG/ KG	CUMULT. AMOUNTS IN. OF H2O 1/3 BAR TO 15BAR	AIRDRY
	PCT	OF	>2MM+SAND+SILT>				(------PCT OF SAND+SILT------)								(--<2 MM-)		(--PCT OF .2MM-)			(- - - - <2 MM- - - -)				(WHL SOIL)	
	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
0- 3	2	2	2	16	82	9	8	2	2	2	2	37	47	10		SIL	14.8	76.5	8.7						
3- 7	18	18	6	8	74	12	1	2	3	3	1	32	58	14	SIL	SIL	8.7	79.0	12.3	4.0					
7- 18	62	62	32	7	31	23	9	2	2	2	2	26	57	60	SICL	SICL	11.0	51.5	37.5	3.9					
18- 24	68	60	31	5	27	9	7	2	2	3	2	28	56	29	SICL	SIL	12.1	65.5	22.4	3.9					
24- 41	67	53	27	7	26	6	11	3	2	3	3	28	51	19	SIL	SIL	18.2	65.6	16.2	3.8	22000				
41- 62	69	60	27	7	24	17	6	3	3	5	7	31	46	57	SICL	SICL	14.9	48.9	36.2	3.8					
62- 78	60	49	25	14	26	47	10	6	4	6	9	27	39	119	SIC	C	15.7	29.9	54.4	4.0					
78- 97	88	80	63	4	7	24	7	8	6	7	10	21	43	208	SIC	C	11.9	20.6	67.5	4.7					
97-121	94	86	78	2	4	20	8	7	6	6	7	18	47	359	SIC	C	7.6	14.2	78.2	5.0					

Pedon No.: **S80MO-105-003** **Date: 5/82**

Sampled as: SND; Fine-loamy, mixed, mesic Typic Paleudult
Revised to: WILDERNESS; Loamy-skeletal, siliceous, mesic Typic Fragiudalf
Latitude: N37 Deg. 35 Min. 43 Sec. Longitude: W092 Deg. 23 Min. 15 Sec.
Location: LACLEDE CO. IN THE CORNER, SEC. 5, T. 33 N., R. 13 W.
MLRA: 116 Ozark
Physiography: Upland ridge in level to undulating uplands
Geomorphic position: On slope & crest interfluve summit
Slope and aspect: 6 pct S convex Elevation: 381 m M.S.L.
Microrelief: None
Air temp. 13 C Summer: 24 C Winter: 1 C
Precipitation: 101 cm Udic moisture regime.
Water Table: Not observed
Drainage: Well drained Permeability:
Stoniness:
Land use:
Erosion or deposition:
Parent material: strongly weathered, residual material from Jefferson City dolomite
Described by:

SAMP NOS 81P170 176.

A1 0 - 14 cm Brown (10YR 4/3) gravelly silt loam; weak fine granular structure; friable; many very fine roots and many fine roots; about 16 percent chert gravel; clear smooth boundary.

BE 14 - 33 cm Dark yellowish brown (10YR 4/4) gravelly silt loam; weak very fine subangular blocky structure; friable; common thin discontinuous clay skins on faces of peds; many very fine roots and many fine roots; about 16 percent chert gravel; clear smooth boundary.

Bt1 33 - 47 cm Yellowish brown (10YR 5/4) extremely gravelly silty clay loam; weak fine subangular blocky structure; friable; common fine roots; common thin discontinuous clay skins on faces of peds; about 65 percent chert gravel; clear smooth boundary.

Bt2 47 - 66 cm Yellowish brown (10YR 5/4) very gravelly silty clay loam; weak fine subangular blocky structure; friable; common thin discontinuous clay skins on faces of peds; about 60 percent chert gravel; clear smooth boundary.

2Bx 66 - 80 cm Reddish brown (5YR 4/4) extremely gravelly silty clay loam; common fine faint reddish brown (5YR 5/3) mottles; massive; very firm, extremely hard, brittle; about 70 percent chert gravel; clear smooth boundary.

2Bt1 80 - 130 cm Reddish yellow (7.5YR 6/6) extremely gravelly silty clay loam; common fine distinct dark red (2.5YR 3/6) mottles; weak medium subangular blocky structure; very firm, very hard; common thin discontinuous clay skins on faces of peds; about 70 percent chert gravel; gradual smooth boundary.

2Bt2 130 - 160 cm Dark red (2.5YR 3/6) extremely gravelly silty clay; common fine faint red (2.5YR 4/8) mottles; weak medium subangular blocky structure; very firm, very hard; common thin discontinuous clay skins on faces of peds; about 70 percent chert gravel.

S80MO-105-003 *** PRIMARY CHARACTERIZATION DATA ***
(LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : SND ; FINE-LOAMY, MIXED, MESIC TYPIC PALEUDULT
REVISED TO : WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF

NSSL - PROJECT 81P 10, GEOMORPHOLOGY STUDY-LAKE OF THE OZARKS SSA
- PEDON 81P 27, SAMPLES 81P 170- 176
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
			(- - -TOTAL	- - -)		(- -CLAY- -)		(- -SILT- -)		(- - - - -	- -SAND-	- - -	- - -	-)	(-COARSE FRACTIONS(MM)-)				(>2MM)
			CLAY	SILT	SAND	FINE	CO3	FINE	COARSE	VF	F	M	C	VC	- - - - - WEIGHT			- - - -	WT
SAMPLE	DEPTH	HORIZON	LT	.002	.05	LT	LT	.002	.02	.05	.10	.25	.5	1	2	5	20	.1-	PCT OF
NO.	(CM)		.002	-.05	-2	.0002	.002	-.02	-.05	-.10	-.25	-.50	-1	-2	-5	-20	-75	75	WHOLE
			<- - - - -	- - - - -	- - - - -	PCT OF <2MM	(3A1)	- - -	- - -	- - -	- - -	- - -	- - -	->	<- PCT OF	<75MM(3B1)		->	SOIL
81P 170S	0- 14	A1	11.3	75.8	12.9	3.8		52.2	23.6	1.7	3.4	2.3	2.1	3.4	7	8	10V	33	25
81P 171S	14- 33	BE	11.4	74.6	14.0	2.4		52.9	21.7	1.6	3.6	2.6	2.1	4.1	6	13	8V	36	27
81P 172S	33- 47	Bt1	12.1	60.9	27.0	2.0		44.9	16.0	1.7	4.1	3.1	3.6	14.5	10	26	35	78	73
81P 173S	47- 66	Bt2	16.1	59.1	24.8	6.8		41.8	17.3	2.1	3.2	2.4	4.3	12.8	10	18	35	71	65
81P 174S	66- 80	2Bx	23.0	60.0	17.0	10.1		40.4	19.6	3.3	4.0	2.2	3.0	4.5	19	28	33	83	81
81P 175S	80-130	2Bt1	54.4	38.6	7.0	29.9		27.8	10.9	2.5	1.7	0.8	0.9	1.1	31	45	6V	83	82
81P 176S	130-160	2Bt2	63.1	20.6	16.3	44.7		14.3	6.3	2.4	7.6	2.6	1.6	2.1	27	40	14	84	81

	ORGN	TOTAL	EXTR	TOTAL	(- - DITH-CIT	- -)		(RATIO/CLAY)		(ATTERBERG	)	(- BULK DENSITY	-)		COLE	(- - -WATER CONTENT	- -)			WRD
	C	N	P	S	EXTRACTABLE				15	- LIMITS -		FIELD	1/3	OVEN	WHOLE	FIELD	1/10	1/3	15	WHOLE
DEPTH					FE	AL	MN	CEC	BAR	LL	PI	MOIST	BAR	DRY	SOIL	MOIST	BAR	BAR	BAR	SOIL
(CM)	6A1c	6B3a	6S3	6R3a	6C2b	6G7a	6D2a	8D1	8D1	4F1	4F	4A3a	4A1d	4A1h	4D1	4B4	4B1c	4B1c	4B2a	4C1
	PCT	<2MM	PPM	<- PERCENT	OF	<2MM -->				PCT	<0.4MM	<- -	G/CC -	- ->	CM/CM	<- -	-PCT OF	<2MM	- ->	CM/CM
0- 14	1.89	0.117			0.6		0.1	0.75	0.47	29	3		1.20						5.3	
14- 33	0.57	0.048			0.6		0.1	0.35	0.32				1.41	1.41	--			20.8	3.7	0.20
33- 47	0.16	0.031			0.9		TR	0.28	0.31	20	3		1.40						3.7	
47- 66	0.10	0.018			0.8		TR	0.30	0.34	24	6		1.40						5.4	
66- 80	0.13				1.1		--	0.33	0.35				1.48	1.57	0.006			27.6	8.1	0.09
80-130	0.17				2.1		--	0.28	0.32				1.15	1.21	0.006			35.4	17.2	0.07
130-160	0.12				2.9		--	0.28	0.37	63	35		1.20						23.2	

AVERAGES, DEPTH 47- 66: PCT CLAY 16 PCT .1-75MM 72

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-003 PRINT DATE 02/26/91
SAMPLED AS : SND ; FINE-LOAMY, MIXED, MESIC TYPIC PALEUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 27, SAMPLE 81P 170- 176

DEPTH (CM)	-1-- (- NH4OAC EXTRACTABLE BASES -) CA 5B5a 6N2e	-2-- MG 5B5a 6O2d	-3-- NA 5B5a 6P2b	-4-- K 5B5a 6Q2b	-5-- SUM BASES	-6-- ACID-ITY 6H5a	-7-- EXTR AL 6G9a	-8-- (- - - -CEC SUM CATS 5A3a	-9-- NH4-OAC 5A8b	-10- BASES + AL 5A3b - - -)	-11- AL SAT 5G1	-12- -BASE SUM 5C3	-13- SAT- NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1g	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18-	-19- (- - - -PH CACL2 .01M 8C1f 1:2	-20- - - -) H2O 8C1f 1:1
	<- - -	- - -	- - -	- - -	-MEQ /	100 G -	- - -	- - -	- - -	- ->	<- - -	- - -PCT	- - -	- ->						
0- 14	1.7	0.7	TR	0.3	2.7	8.5	1.3	11.2	8.5	4.0	32	24	32						4.3	4.8
14- 33	0.9	0.5	--	0.2	1.6	3.9	0.8	5.5	4.0	2.4	33	29	40						4.5	4.9
33- 47	0.8	0.4	--	0.1	1.3	3.2	0.8	4.5	3.4	2.1	38	29	38						4.3	5.0
47- 66	1.6	1.1	0.1	0.2	3.0	3.0	0.6	6.0	4.9	3.6	17	50	61						4.4	5.1
66- 80	2.6	1.9	0.3	0.2	5.0	3.6	0.9	8.6	7.7	5.9	15	58	65						4.1	4.7
80-130	4.7	3.7	TR	0.3	8.7	8.0	2.5	16.7	15.2	11.2	22	52	57		11000				4.2	4.7
130-160	5.0	4.2	TR	0.3	9.5	10.1	3.4	19.6	17.8	12.9	26	48	53						4.0	4.5

ESTIMATED BULK DENSITY FOR LAYER 1, 3, 4, 7,

ANALYSES: S= ALL ON SIEVED <2MM BASIS V= 75-20MM FROM VOLUME ESTIMATES

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-003 PRINT DATE 02/26/91
SAMPLED AS : SND ; FINE-LOAMY, MIXED, MESIC TYPIC PALEUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 27, SAMPLE 81P 170- 176

< - CLAY MINERALOGY (<.002mm) - >
FRACT < - - - - - - X-RAY - - - - - - ->< - - - THERMAL - - - ->< - - - - - - - - ELEMENTAL - - - - - - - - ->< - -> EGME INTER
SAMPLE ION < >< - DTA - ->< - TGA - -> SiO2 AL2O3 Fe2O3 MgO CaO K2O Na2O < > RETN PRETA
< - - - - - - 7A2I - - - - - - ->< - 7A6 - >< - 7A4b - >< - - - - - - - - - - 7C3 - - - - - - - - - ->< > 7D2 TION
NUMBER <- - >< - - - - - peak size - - - - - - ->< - - - Percent - - - ->< - - - - - - - - - Percent - - - - - - - - ->< - -><mg/g>< - ->

SAMPLE NUMBER	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
81P 170	TCLY	KK 2	VR 2	QZ 2	MI 1															
81P 172	TCLY	KK 2	MI 2	QZ 2	VR 1		KK 3						5.9			1.7				
81P 173	TCLY	KK 3	MI 2	QZ 2	VR 1	MI 1	KK11						7.0			1.7				
81P 175	TCLY	KK 3	MI 2	QZ 2	VR 2	MT 1	KK28						7.4			1.4				
81P 175	TCLY	HE 1																		

< - SAND - SILT MINERALOGY (2.0-0.002mm) - >
FRACT < - - - - - - X-RAY - - ->< - - - THERMAL - - - ->< - - - - - - - - OPTICAL - - - - - - - - - >< > INTER
SAMPLE ION < >< - DTA - ->< - TGA - ->TOT RE< - - - - - - GRAIN COUNT - - - - - - ->< > PRETA
< - - - - - 7A2I - - - - - >< - 7A3b - >< - 7A4b - >< - - - - - - - - - 7B1a - - - - - - - - - ->< > TION
NUMBER < - ->< - - - - Peak Size - - ->< - - - Percent - - - ->< - - - - - - - - - Percent - - - - - - - - ->< - - - - - - - - - - ->< - ->

SAMPLE NUMBER	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
81P 171	VFS									98	QZ57	FK 2	CD30	QI 9	OP 2	PGtr				
81P 171	VFS										BTtr									
81P 173	VFS									98	QZ55	FK 1	CD36	QI 6	OP 1	HNtr				
81P 173	VFS										POtr									
81P 175	VFS									100	QZ24	CD74	FKtr	BTtr	POtr	QI 1				
81P 175	VFS										OP 1	DItr								

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm VFS Very Fine Sand, 0.05-0.10mm

MINERAL INTERPRETATION:

KK	kaolinite	VR	vermiculite	QZ	quartz	MI	mica	FK	potas-feld	CD	chalcedony
QI	fe-coat qz	OP	opaques	PO	plant opal	BT	biotite	MT	montmorill	HN	hornblende
HE	hematite	DI	diatoms								

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

*****   S U P P L E M E N T A R Y   C H A R A C T E R I Z A T I O N   D A T A   *****

S80MO-105-003 (LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : SND ; FINE-LOAMY, MIXED, MESIC TYPIC PALEUDALF
REVISED TO : WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF

NSSL - PROJECT 81P 10,
- PEDON 81P 27, SAMPLES 81P 170- 176
- GENERAL METHODS (ENGINEERING FRACTIONS ARE CALCULATED FROM USDA FRACTION SIZES)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (IN.)	HORIZON	E N G I N E E R I N G — P E R C E N T A G E — <-----I N C H E S-----> 3	2	3/2	1	3/4	3/8	P A S S I N G <-N U M B E R-> 4	10	40	200	P S D A — S I E V E <-MICRONS-> 20	5	2	CUMULATIVE CURVE FRACTIONS(<76MM) — USDA LESS THAN <---MM---> 1.	.5	.25	.10	.05	DIAMETERS(MM) AT <--PERCENTILE--> 60	50	10	ATTER-BERG <-PCT> LL	PI	GRADATION UNI-FMTY CU	CUR-VTUR CC
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
81P 170S	0- 6	A1	100	97	95	92	90	86	82	75	70	66	48	24	8	72	71	69	67	65	0.04	0.023	0.002	29	3	17.3	0.6
81P 171S	6- 13	BE	100	98	96	94	92	86	79	73	68	63	47	24	8	70	68	67	64	63	0.04	0.024	0.002			19.3	0.6
81P 172S	13- 18	Bt1	100	90	83	72	65	52	39	29	24	21	17	9	4	25	24	23	22	21	14.52	8.487	0.006	20	3	>100	51.8
81P 173S	18- 26	Bt2	100	90	83	72	65	56	47	37	30	28	21	12	6	32	31	30	29	28	12.89	5.932	0.004	24	6	>100	1.9
81P 174S	26- 31	2Bx	100	90	84	74	67	54	40	21	19	18	13	8	5	20	19	19	18	17	13.23	7.885	0.008			>100	83.5
81P 175S	31- 51	2Bt1	100	98	97	95	94	72	49	18	18	17	15	12	10	18	18	17	17	17	6.61	4.848	0.002			>100	>100
81P 176S	51- 63	2Bt2	100	96	93	89	86	66	46	19	18	16	15	13	12	19	18	18	16	16	7.66	5.405	0.001	63	35	>100	>100

DEPTH (IN.)	(W E I G H T F R A C T I O N S) ---W H O L E S O I L (MM)- <------PCT OF WHOLE SOIL-----> >2	250 -UP	250 -75	75 -2	75 -20	20 -5	5 -2	<2	--<75 MM FRACTION-- <--PCT OF <75 MM-> 75 -2	75 -20	20 -5	5 -2	<2		(W E I G H T P E R U N I T V O L U M E G/CC) ------WHOLE SOIL------ SOIL SURVEY 1/3 BAR	OVEN -DRY	ENGINEERING MOIST	SATUR -ATED	-------<2 MM FRACTION------- --SOIL SURVEY-- 1/3 BAR	15 BAR	OVEN -DRY	ENGINEERING MOIST	SATUR -ATED	(VOID) --RATIOS-- AT 1/3 BAR WHOLE SOIL	<2 MM
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
0- 6	25	--	--	25	10	8	7	75	25	10	8	7	75		1.39										
6- 13	27	--	--	27	8	13	6	73	27	8	13	6	73		1.61	1.61	1.85	2.00	1.41	1.41	1.41	1.70	1.88	0.65	0.88
13- 18	73	--	6	67	33	24	9	27	71	35	26	10	29		2.12										
18- 26	66	--	7	59	33	17	9	34	63	35	18	10	37		2.03										
26- 31	80	--	6	74	31	25	18	20	79	33	27	19	21		2.29	2.33	2.43	2.43	1.48	1.55	1.57	1.89	1.92	0.16	0.79
31- 51	82	--	--	82	6	45	31	18	82	6	45	31	18		2.15	2.18	2.28	2.34	1.15	1.18	1.21	1.56	1.72	0.23	1.30
51- 63	81	--	--	81	14	40	27	19	81	14	40	27	19		2.16										

*** SUPPLEMENTARY CHARACTERIZATION DATA ***

S80MO-105-003 PRINT DATE 02/26/91

CLASSIFICATION: WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF

NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 27, SAMPLE 81P 170- 176

DEPTH (IN.)	VOLUME FRACTIONS — WHOLE SOIL (MM) AT 1/3 BAR: >2	250-UP	250-75	75-2	75-20	20-5	5-2	<2	2-.05	.05-.002	LT .002	PORES D	PORES F	(C/N) RAT -10	RATIOS TO CLAY, <2 MM FRACTION: FINE CLAY	CEC SUM CATS	CEC NH4-OAC	15 BAR H2O	LE 1/3 BAR	LINEAR EXTENSIBILITY WHOLE SOIL <-1/3 BAR TO 15 BAR	WHOLE SOIL OVEN-DRY	<2 MM (PCT) 15 BAR	<2 MM OVEN-DRY	WRD WHOLE SOIL	WRD <2 MM
	<----PCT OF WHOLE SOIL												---->											<--IN/IN	-->
	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
0- 6	13	--	--	13	5	4	4	87	5	30	4	48		16	0.34	0.99	0.75	0.47							
6- 13	16	--.	--	16	5	8	4	84	6	33	5	15	24	12	0.21	0.48	0.35	0.32						0.20	0.24
13- 18	59	--	5	54	27	19	7	41	6	14	3	20		5	0.17	0.37	0.28	0.31							
18- 26	51	--	5	45	25	13	7	49	7	16	4	23		5	0.42	0.37	0.30	0.34							
26- 31	69	--	5	63	27	21	15	31	3	10	4		14		0.44	0.37	0.33	0.35	0.087	0.4	0.6	1.6	2.0	0.09	0.29
31- 51	66	--	--	66	5	36	25	34	1	6	8	6	13		0.55	0.31	0.28	0.32	0.031	0.3	0.5	0.9	1.7	0.07	0.21
51- 63	65	--	--	65	11	32	22	35	2	3	10	18			0.71	0.31	0.28	0.37							

DEPTH (IN.)	WEIGHT FRACTIONS - CLAY FREE — WHOLE SOIL: >2 PCT	75-2 PCT OF	20-2	2-.05	.05-.002	LT .002	<2 MM FRACTION SANDS: VC	C	M	F	VF	SILTS C	SILTS F	CLAY	TEXTURE DETERMINED IN FIELD	TEXTURE BY PSDA	PSDA (MM) SAND 2-.05	SILT .05-.002	CLAY LT .002	PH CACL2 .01M	ELECTRICAL RES-IST. OHMS	CON-DUCT. MMHOS	SALT MG/KG	CUMULT. AMOUNTS IN. OF H2O 1/3 BAR TO 15BAR	AIRDRY
			>2MM+SAND+SILT>				(------PCT OF SAND+SILT							------)	(--<2 MM-)		(--PCT OF .2MM-)			(- - - - <2 MM- - - -)				(WHL SOIL)	
	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
0- 6	27	27	16	11	62	9	4	2	3	4	2	27	59	13	SIL	SIL	12.9	75.8	11.3	4.3					
6- 13	29	29	21	11	59	9	5	2	3	4	2	24	60	13	SIL	SIL	14.0	74.6	11.4	4.5					
13- 18	75	69	34	8	17	3	16	4	4	5	2	18	51	14	SICL	SIL	27.0	60.9	12.1	4.3					
18- 26	70	62	28	9	21	6	15	5	3	4	3	21	50	19	SICL	SIL	24.8	59.1	16.1	4.4					
26- 31	84	78	45	4	13	5	6	4	3	5	4	25	52	30	SICL	SIL	17.0	60.0	23.0	4.1					
31- 51	91	91	84	1	8	11	2	2	2	4	5	24	61	119	SICL	C	7.0	38.6	54.4	4.2	11000				
51- 63	92	92	76	4	4	14	6	4	7	21	7	17	39	171	SIC	C	16.3	20.6	63.1	4.0					

Pedon No.: **S80MO-105-004** **Date: 5/82**

Sampled as: DONIPHAN; Clayey, mixed, mesic Typic Paleudult
Revised to: SND; Fine, mixed, mesic Typic Paleudalf
Latitude: N37 Deg. 35 Min. 41 Sec. Longitude: W092 Deg. 23 Min. 15 Sec.
Location: LACLEDE CO. IN THE CORNER, SEC. 5, T. 33 N., R. 13 W.
MLRA: 116 Ozark
Physiography: Upland ridge in level to undulating uplands
Geomorphic position: On upper third interfluve
Slope and aspect: 12 pct S convex Elevation: 367 m M.S.L.
Microrelief: None
Air temp. 13 C Summer: 24 C Winter: 1 C
Precipitation: 101 cm Udic moisture regime.
Water table: Not observed
Drainage: Permeability:
Stoniness:
Land use:
Erosion or deposition:
Parent material: strongly weathered, residual material from Jefferson City dolomite
Described by:

SAMP NOS 81P177 185.

Oi 4 - 0 cm fresh leaves and twigs.

A 0 - 13 cm Brown (10YR 4/3) very gravelly silt loam; weak fine granular structure; friable; about 40 percent chert gravel; clear smooth boundary.

E1 13 - 26 cm Light yellowish brown (10YR 6/4) very gravelly silt loam; weak fine platy structure; friable; about 40 percent chert gravel; clear smooth boundary.

E2 26 - 50 cm Light yellowish brown (10YR 6/4) very gravelly silt loam; few fine reddish brown (5YR 4/4) mottles; weak medium granular structure; friable; about 40 percent chert gravel; clear wavy boundary.

2Bt1 50 - 66 cm Yellowish red (5YR 4/6) gravelly silty clay loam; few fine faint light brown (7.5YR 6/4) mottles; weak fine subangular blocky structure; firm, hard; common thin discontinuous clay skins on faces of peds; about 20 percent chert gravel; clear wavy boundary.

2Bt2 66 - 92 cm Yellowish red (5YR 4/6) silty clay; few fine distinct light brown (7.5YR 6/4) mottles; moderate fine to medium subangular blocky structure; firm, hard; common thin discontinuous dark red (2.5YR 3/6) clay skins on faces of peds; few fine chert gravel; gradual smooth boundary.

2Bt3 92 - 177 cm Dark red (2.5YR 3/6) extremely gravelly silty clay; moderate medium subangular blocky structure; firm, hard; common thin discontinuous yellowish red (5YR 4/6) clay skins on faces of peds; about 70 percent chert gravel; gradual irregular boundary.

2Bt4 177 - 250 cm Dark red (2.5YR 3/6) extremely gravelly silty clay; moderate medium to coarse angular blocky structure; firm, hard; common thin discontinuous clay skins on faces of peds; about 70 percent chert gravel; gradual wavy boundary.

2Bt5 250 - 305 cm Red (10R 4/6) very gravelly silty clay; moderate medium to coarse angular blocky structure; firm, hard; common thin discontinuous skeletans over cutans on faces of peds and common thin discontinuous black stains on faces of peds; about 65 percent chert gravel; clear wavy boundary.

CR 305 - 315 cm Soft bedrock.

*** S U P P L E M E N T A R Y   C H A R A C T E R I Z A T I O N   D A T A ***

S80HO-105-004 PRINT. DATE 02/26/91
CLASSIFICATION: SND ; FINE, MIXED, MESIC TYPIC PALEUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 28, SAMPLE 81P 177- 185

DEPTH (IN.)	VOLUME FRACTIONS — WHOLE SOIL (MM) AT 1/3 BAR: >2 (PCT OF WHOLE SOIL)	250-UP	250-75	75-2	75-20	20-5	5-2	<2	2-.05	.05-.002	LT .002	PORES D	PORES F	(C/N) RAT -10	RATIOS TO CLAY (<2 MM FRACTION): FINE CLAY	CEC SUM CATS	CEC NH4-OAC	15 BAR H2O	LE 1/3 BAR	LINEAR EXTENSIBILITY WHOLE SOIL <-1/3 BAR TO 15 BAR	WHOLE SOIL OVEN-DRY	<2 MM (PCT) 15 BAR	<2 MM OVEN-DRY	W R D WHOLE SOIL <--IN/IN->	W R D <2 MM
	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
0- 5	33	--	--	33	16	11	5	67	6	26	3	31		10	0.41	0.63	0.52	0.41							
5- 10	41	--	--	41	18	18	5	59	6	23	4	7	18	11	0.35	0.31	0.24	0.30						0.15	0.25
10- 20	58	--	--	58	19	25	14	42	7	14	3	18		8	0.29	0.29	0.25	0.38							
20- 26	18	--	--	18	5	10	3	82	5	28	15	8	26	6	0.47	0.25	0.24	0.34	0.061	0.8	1.5	1.1	1.9	0.13	0.15
26- 36	3	--	--	3	2	1	1	97	3	21	28	46			0.56	0.23	0.21	0.30							
36- 70	65	--	5	60	3	33	25	35	2	6	11	17			0.53	0.34	0.25	0.35							
70- 98	72	--	--	72	2	48	22	28		6	9	13			0.47	0.23	0.21	0.39							
98-120	61	--	--	61	5	33	23	39	6	2	11	6	13		0.63	0.26	0.22	0.33	0.028	0.2	0.6	0.2	1.7	0.02	0.06
120-124	--	--	--	--	--	--	--	100	1	27	27	45			0.30			0.38							

DEPTH (IN.)	WEIGHT FRACTIONS - CLAY FREE — WHOLE SOIL: >2 (PCT OF >2MM+SAND+SILT)	75-2	20-2	2-.05	.05-.002	LT .002	<2 MM FRACTION SANDS (PCT OF SAND+SILT): VC	C	M	F	VF	SILTS C	SILTS F	CLAY	TEXTURE DETERMINED IN FIELD (<2 MM)	BY PSDA	P S D A (MM): SAND 2-.05 (PCT OF <2MM)	SILT .05-.002	CLAY LT .002	(PH) CACL2 .01M	ELECTRICAL RES-IST. OHMS (<2 MM)	CON-DUCT. MMHOS	SALT MG/KG	CUMULT. AMOUNTS IN. OF H2O 1/3 BAR TO 15BAR (WHL SOIL)	AIRDRY
	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
0- 5	50	50	25	10	40	5	5	4	4	6	2	28	52	10	SIL	SIL	18.2	72.8	9.0	4.4					
5- 10	58	58	33	9	33	5	6	3	3	5	2	26	54	13	SIL	SIL	18.3	70.4	11.3	4.3					
10- 20	73	73	50	9	18	3	19	4	3	4	2	19	49	12	SIL	SIL	28.7	60.4	10.9	4.3					
20- 26	35	35	25	10	55	30	3	2	2	5	2	26	58	45	SICL	SICL	10.5	58.3	31.2	4.4					
26- 36	12	12	4	10	77	102	2	1	2	4	3	24	64	116	SIC	SIC	5.5	40.7	53.8	4.6					
36- 70	89	82	80	3	8	16	9	5	4	4	3	19	55	147	SIC	C	10.6	29.9	59.5	4.2	19000				
70- 98	92	92	90	TR	8	12	1	1	1	1	1	14	80	153	SIC	C	2.2	37.4	60.4	4.4					
98-120	89	89	82	8	3	17	6	9	30	25	3	8	19	149	SIC	C	29.2	10.9	59.9	4.3					
120-124				3	97	96	TR	TR	TR	1	1	6	90	96		SIC	1.7	49.4	48.9						

*** SUPPLEMENTARY CHARACTERIZATION DATA ***

S88MO-105-004 (LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : DONIPHAN ; CLAYEY, MIXED, MESIC TYPIC PALEUDULT
REVISED TO : SND ; FINE, MIXED, MESIC TYPIC PALEUDALF

NSSL - PROJECT 81P 10,
- PEDON 81P 28, SAMPLES 81P 177- 185
- GENERAL METHODS (ENGINEERING FRACTIONS ARE CALCULATED FROM USDA FRACTION SIZES)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (IN.)	HORIZON	ENGINEERING PERCENTAGE PASSING: 3 INCHES (1)	2 INCHES (2)	3/2 INCHES (3)	1 INCHES (4)	3/4 INCHES (5)	3/8 INCHES (6)	4 NUMBER (7)	10 NUMBER (8)	40 NUMBER (9)	200 NUMBER (10)	PSDA SIEVE: 20 MICRONS (11)	5 MICRONS (12)	2 MICRONS (13)
81P 177S	0- 5	A	100	93	88	81	76	68	60	52	47	43	29	15	5
81P 178S	7- 10	E1	100	93	88	81	76	64	52	45	41	37	27	14	5
81P 179S	10- 20	E2	100	93	89	82	77	62	46	29	23	21	16	8	3
81P 180S	20- 26	2Bt1	100	98	96	94	92	85	77	73	70	66	52	34	23
81P 181S	26- 36	2Bt2	100	99	98	97	96	96	95	94	92	89	78	62	51
81P 182S	36- 70	2Bt3	100	99	99	98	97	77	56	24	23	22	20	16	14
81P 183S	70- 98	2Bt4	100	99	99	98	98	71	43	18	18	18	17	13	11
81P 184S	98-120	2Bt5	100	98	97	95	94	74	53	24	22	17	16	15	14
81P 185G	120-124	CR	100	100	100	100	100	100	100	100	100	99	95	67	49

SAMPLE NO.	CUMULATIVE CURVE FRACTIONS(<76MM) USDA LESS THAN (MM): 1. (14)	.5 (15)	.25 (16)	.10 (17)	.05 (18)	DIAMETERS(MM) AT PERCENTILE: 60 (19)	50 (20)	10 (21)	ATTERBERG LL (PCT) (22)	PI (PCT) (23)	GRADATION UNIFMTY CU (24)	CURVTUR CC (25)
81P 177S	50	48	46	44	43	4.70	1.044	0.003			>100	--
81P 178S	42	41	40	38	37	7.49	3.682	0.003		NP	>100	--
81P 179S	24	23	22	21	21	8.83	5.628	0.007			>100	71.9
81P 180S	71	70	69	67	65	0.03	0.017	0.001	36	17	63.0	0.7
81P 181S	93	93	92	90	89	--	0.002	--			13.8	0.4
81P 182S	23	23	22	22	21	5.39	4.004	0.001			>100	>100
81P 183S	18	18	18	18	18	7.24	5.614	0.002	70	41	>100	>100
81P 184S	23	23	20	17	17	5.97	4.302	0.001			>100	>100
81P 185G	100	100	99	99	98	--	0.002	--			10.9	0.6

DEPTH (IN.)	WEIGHT FRACTIONS, WHOLE SOIL (MM), PCT OF WHOLE SOIL: >2 (26)	250 -UP (27)	250 -75 (28)	75 -2 (29)	75 -20 (30)	20 -5 (31)	5 -2 (32)	<2 (33)	<75 MM FRACTION, PCT OF <75 MM: 75 -2 (34)	75 -20 (35)	20 -5 (36)	5 -2 (37)	<2 (38)	(39)
0- 5	48	--	--	48	24	16	8	52	48	24	16	8	52	
5- 10	55	--	--	55	24	24	7	45	55	24	24	7	45	
10- 20	71	--	--	71	23	31	17	29	71	23	31	17	29	
20- 26	27	--	--	27	8	15	4	73	27	8	15	4	73	
26- 36	6	--	--	6	4	1	1	94	6	4	1	1	94	
36- 70	77	--	6	71	3	39	30	23	76	3	41	32	24	
70- 98	82	--	--	82	2	55	25	18	82	2	55	25	18	
98-120	76	--	--	76	6	41	29	24	76	6	41	29	24	
120-124	--	--	--	--	--	--	--	100	--	--	--	--	100	

DEPTH (IN.)	WEIGHT PER UNIT VOLUME G/CC, WHOLE SOIL, SOIL SURVEY: 1/3 BAR (40)	OVEN-DRY (41)	ENGINEERING: MOIST (42)	SATUR-ATED (43)	<2 MM FRACTION, SOIL SURVEY: 1/3 BAR (44)	15 BAR (45)	OVEN-DRY (46)	ENGINEERING: MOIST (47)	SATUR-ATED (48)	VOID RATIOS AT 1/3 BAR: WHOLE SOIL (49)	<2 MM (50)
0- 5	1.82										
5- 10	1.99	1.99	2.17	2.24	1.52	1.52	1.52	1.82	1.95	0.33	0.74
10- 20	2.17										
20- 26	1.75	1.83	2.01	2.09	1.56	1.61	1.65	1.88	1.97	0.51	0.70
26- 36	1.44										
36- 70	2.20										
70- 98	2.30										
98-120	2.15	2.19	2.28	2.34	1.34	1.35	1.41	1.66	1.83	0.23	0.98
120-124	1.45										

*** P R I M A R Y   C H A R A C T E R I Z A T I O N   D A T A ***

S80MO-105-004 PRINT DATE 02/26/91
SAMPLED AS : DONIPHAN ; CLAYEY, MIXED, MESIC TYPIC PALEUDULT
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 28, SAMPLE 81P 177- 185

CLAY MINERALOGY (<.002mm)

FRACTION (col. 1) · X-RAY 7A2i, peak size (cols. 2–6) · THERMAL: DTA 7A6, TGA 7A4b, Percent (cols. 7–10) · ELEMENTAL 7C3, Percent: SiO2, AL2O3, Fe2O3, MgO, CaO, K2O, Na2O (cols. 11–17) · EGME RETN 7D2, mg/g (col. 19) · INTERPRETATION (col. 20)

SAMPLE NUMBER	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	FRACTION	X-RAY 7A2i					THERMAL DTA 7A6		TGA 7A4b		SiO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O		EGME RETN 7D2	INTERPRETATION
		peak size					Percent				Percent								mg/g	
81P 178	TCLY	KK 2	VR 2	QZ 2	MI 1															
81P 180	TCLY	KK 3	MI 2	QZ 2	VR 1		KK25						7.0			1.6				
81P 182	TCLY	KK 3	MI 3	QZ 2	VR 1		KK24						7.0			1.9				
81P 185	TCLY	KK 3	MI 2	QZ 2	VR 1		KK14						4.7			1.9				

SAND - SILT MINERALOGY (2.0-0.002mm)

FRACTION (col. 1) · X-RAY 7A2i, Peak Size · THERMAL: DTA 7A3b, TGA 7A4b, Percent · OPTICAL: TOT RE, GRAIN COUNT 7B1a, Percent · INTERPRETATION

SAMPLE NUMBER	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	FRACTION	X-RAY 7A2i			THERMAL DTA 7A3b		TGA 7A4b			TOT RE	OPTICAL GRAIN COUNT 7B1a									INTERPRETATION
		Peak Size			Percent						Percent									
81P 176	VFS									97	QZ53	CD35	FK 2	QI 6	PO 1	MStr				
81P 178	VFS										HNtr	OP 2								
81P 180	VFS									98	QZ58	CD37	QI10	FK 1	OP 1	HNtr				
81P 180	VFS										EPtr	BTtr								
81P 185	VFS									97	QZ40	CD27	FK 2	OP22	QI 8	EPtr				
81P 185	VFS										BTtr	HN 1								

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm   VFS Very Fine Sand, 0.05-0.10mm

MINERAL INTERPRETATION:

KK	kaolinite	VR	vermiculite	QZ	quartz	MI	mica	CD	chalcedony	FK	potas-feld
QI	fe-coat qz	PO	plant opal	MS	muscovite	HN	hornblende	OP	opaques	EP	epidote
BT	biotite										

RELATIVE PEAK SIZE: 5 Very Large   4 Large   3 Medium   2 Small   1 Very Small   6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-004 PRINT DATE 02/26/91
SAMPLED AS : DONIPHAN ; CLAYEY, MIXED, MESIC TYPIC PALEUDULT
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 28, SAMPLE 81P 177- 185

	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	(- NH4OAC EXTRACTABLE BASES -)					ACID-	EXTR	(- - - -CEC - - -)			AL	-BASE SAT-		CO3 AS	RES.		COND.		(- - - -PH - - -)	
	CA	MG	NA	K	SUM	ITY	AL	SUM	NH4-	BASES	SAT	SUM	NH4	CACO3	OHMS		MMHOS		CACL2	H2O
DEPTH	5B5a	5B5a	5B5a	5B5a	BASES			CATS	OAC	+ AL			OAC	<2MM	/CM		/CM		.01M	
(CM)	6N2e	6O2d	6P2b	6Q2b		6H5a	6G9a	5A3a	5A8b	5A3b	5G1	5C3	5C1	6E1g	8E1		8I		8C1f	8C1f
	<- - - - - - - - - - - - -MEQ / 100 G - - - - - - - - - - - - ->										<- - - - - -PCT - - - - ->								1:2	1:1
0- 13	0.7	0.4	--	0.2	1.3	4.4	1.1	5.7	4.7	2.4	46	23	28						4.4	4.6
13- 26	0.2	0.2	0.1	0.1	0.6	2.9	0.9	3.5	2.7	1.5	60	17	22						4.3	4.9
26- 50	0.4	0.4	0.1	0.1	1.0	2.2	0.7	3.2	2.7	1.7	41	31	37						4.3	5.1
50- 66	2.5	2.0	--	0.3	4.8	3.1	0.8	7.9	7.5	5.6	14	61	64						4.4	5.1
66- 92	4.1	3.5	TR	0.4	8.0	4.6	0.9	12.6	11.3	8.9	10	63	71						4.6	5.2
92-177	3.2	3.5	0.2	0.4	7.3	12.9	3.4	20.2	14.7	10.7	32	36	50		19000				4.2	4.8
177-250	2.4	3.7	TR	0.3	6.4	7.5	2.8	13.9	12.9	9.2	30	46	50						4.4	4.6
250-305	3.6	4.8	TR	0.3	8.7	6.8	1.4	15.5	13.4	10.1	14	56	65						4.3	4.8
305-315							0.5			0.5	100									

ESTIMATED BULK DENSITY FOR LAYER 1, 3, 5, 6, 7,

ANALYSES: S= ALL ON SIEVED <2MM BASIS G= <2MM ON GROUND <75MM BASIS P= FABRIC ON <75MM FRACTION
V= 75-20MM FROM VOLUME ESTIMATES

S80MO-105-004

*** P R I M A R Y   C H A R A C T E R I Z A T I O N   D A T A ***
(LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : DONIPHAN ; CLAYEY, MIXED, MESIC TYPIC PALEUDULT
REVISED TO : SND ; FINE, MIXED, MESIC TYPIC PALEUDALF

NSSL - PROJECT 81P 10, GEOMORPHOLOGY STUDY-LAKE OF THE OZARKS SSA
- PEDON 81P 28, SAMPLES 81P 177- 185
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

-1-- -2-- -3-- -4-- -5-- -6-- -7-- -8-- -9-- -10- -11- -12- -13- -14- -15- -16- -17- -18- -19- -20-

SAMPLE NO.	DEPTH (CM)	HORIZON	(- - -TOTAL - - -) CLAY LT .002	SILT .002 -.05	SAND .05 -2	(- -CLAY- -) FINE LT .0002	CO3 LT .002	(- -SILT- -) FINE .002 -.02	COARSE .02 -.05	(- - - - - -SAND- - - - - - -) VF .05 -.10	F .10 -.25	M .25 -.50	C .5 -1	VC 1 -2	(-COARSE FRACTIONS(MM)-) - - - - WEIGHT - - - - 2 -5	5 -20	20 -75	.1- 75	(>2MM) WT PCT OF WHOLE SOIL
			<- - - - -	- - - - -	- - - -	- - - -	PCT OF <2MM	(3A1) - - -	- - - -	- - -	- - -	- - -	- - -	- - ->	<- PCT OF	<75MM(3B1)	->		SOIL
81P 177S	0- 13	A	9.0	72.8	18.2	3.7		47.6	25.2	1.9	5.2	3.2	3.8	4.1	8	16	24	56	48
81P 178S	13- 26	E1	11.3	70.4	18.3	4.0		47.6	22.8	1.8	4.8	3.1	2.9	5.7	7	24	24	62	55
81P 179S	26- 50	E2	10.9	60.4	28.7	3.2		43.5	16.9	1.6	3.9	2.7	3.8	16.7	17	31	23	79	71
81P 180S	50- 66	2Bt1	31.2	58.3	10.5	14.6		40.1	18.2	1.6	3.3	1.7	1.6	2.3	4	15	8V	33	27
81P 181S	66- 92	2Bt2	53.8	40.7	5.5	30.2		29.7	11.0	1.2	2.0	0.9	0.5	0.9	1	1	4V	10	6
81P 182S	92-177	2Bt3	59.5	29.9	10.6	31.8		22.4	7.5	1.4	1.8	1.6	2.1	3.7	32	41	3V	78	77
81P 183S	177-250	2Bt4	60.4	37.4	2.2	28.6		31.8	5.6	0.5	0.5	0.4	0.4	0.4	25	55	2V	82	82
81P 184S	250-305	2Bt5	59.9	10.9	29.2	37.9		7.7	3.2	1.1	10.0	12.0	3.8	2.3	29	41	6V	83	76
81P 185G	305-315	CR	48.9	49.4	1.7	14.6		46.1	3.3	0.5	0.7	0.2	0.2	0.1	--	--	--	1	--P

DEPTH (CM)	ORGN C 6A1c PCT	TOTAL N 6B3a <2MM	EXTR P 6S3 PPM	TOTAL S 6R3a <- PERCENT	(- - DITH-CIT - -) EXTRACTABLE FE 6C2b	AL 6G7a OF	MN 6D2a <2MM -->	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG) - LIMITS - LL 4F1 PCT	PI 4F <0.4MM	(- BULK DENSITY -) FIELD MOIST 4A3a <- -	1/3 BAR 4A1d G/CC	OVEN DRY 4A1h - - ->	COLE WHOLE SOIL 4D1 CM/CM	(- - -WATER CONTENT - -) FIELD MOIST 4B4 <- -	1/10 BAR 4B1c -PCT OF	1/3 BAR 4B1c <2MM	15 BAR 4B2a - ->	WRD WHOLE SOIL 4C1 CM/CM
0- 13	1.24	0.067			0.7		TR	0.52	0.41				1.40						3.7	
13- 26	0.25	0.022			0.7		TR	0.24	0.30		NP		1.52	1.52	--			19.9	3.4	0.15
26- 50	0.14	0.017			0.9		TR	0.25	0.38				1.50						4.1	
54- 66	0.12	0.021			1.6		TR	0.24	0.34	36	17		1.56	1.65	0.015			20.5	10.6	0.13
66- 92	0.11				2.3		--	0.21	0.30				1.40						16.2	
92-177	0.17				2.4		--	0.25	0.35				1.40						21.0	
177-250	0.14				2.2		TR	0.21	0.39	70	41		1.40						23.5	
250-305	0.06				2.8		TR	0.22	0.33				1.34	1.41	0.006			24.0	19.7	0.02
305-315					1.5		0.1		0.38										18.6	

AVERAGES, DEPTH 54-104: PCT CLAY 47 PCT .1-75MM 28

S80MO-105-004

*** PRIMARY CHARACTERIZATION DATA ***
(LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

CLASSIFICATION: SND ; FINE, MIXED, MESIC TYPIC PALEUDALF

NSSL - PROJECT 81P 10, GEOMORPHOLOGY STUDY-LAKE OF THE OZARKS SSA
- PEDON 81P 28, SAMPLES 81P 177- 185
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	HZ NO	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
		ACID OXALATE	EXTRACTION			PHOSPHOUS		KCL	TOTAL	(- -WATER	CONTENT- -		)	(- - - - WATER DISPERSIBLE					- - - -)	MIN	AGGRT
		OPT DEN	FE	SI	AL	RET	CIT- ACID	MN	C	0.06 BAR	1- BAR	2- BAR	15 BAR	<- - PIPETTE CLAY	SILT	SAND - - >	< - HYDROMETER CLAY	SILT	SAND - >	SOIL CONT	STABL <5mm
		8J	6C9a	6V2	6G12	6S4	6S5	6D3	6A2d	4B1c	4B1a	4B1a	4B2b	<- - -	3A1c	- - ->	<- - -	SML	- - ->	8F1	4G1
			<- P C T o f < 2 m m ->			<- P P M ->			< - - - - - - - - - - P E R C E N T					o f < 2 m m					- - - - - - - - - - - >		< PCT>
81P 177	1																				
81P 178	2																				
81P 179	3																				
81P 180	4																				
81P 181	5																				
81P 182	6							0.0													
81P 183	7																				
81P 184	8																				
81P 185	9																				

Pedon No.: **S80MO-105-005** **Date: 4/82**

Sampled as: DONIPHAN; Clayey, mixed, mesic Typic Paleudult
Revised to: DONIPHAN; Clayey, mixed, mesic Typic Paleudult
Latitude: N37 Deg. 35 Min. 39 Sec. Longitude: W092 Deg. 23 Min. 15 Sec.
Location: LACLEDE CO. 7 4M E OF THE SW CORNER, SEC. 5, T. 33 N., R. 13 W.
MLRA: 116 Ozark
Physiography: Upland ridge in level to undulating uplands
Geomorphic position: On lower third interfluve
Slope and aspect: 21 pct SW plane Elevation: 367 m M.S.L.
Microrelief: None
Air temp. 13 C Summer: 24 C Winter: 1 C
Precipitation: 101 cm Udic moisture regime.
Water table: Not observed
Drainage: Well drained Permeability:
Stoniness:
Land use:
Erosion or deposition:
Parent material: strongly weathered, residual material from Jefferson City dolomite
Described by:
+
SAMP NOS 81P186 192.

A 0 - 17 cm Brown (10YR 5/3) very gravelly silt loam; weak fine granular structure; friable; many medium roots; about 55 percent chert gravel; clear smooth boundary.

E 17 - 31 cm Light yellowish brown (10YR 6/4) very gravelly silt loam; weak fine granular structure; friable; many medium roots; about 60 percent chert gravel; clear smooth boundary.

2Bt1 31 - 55 cm Reddish brown (5YR 4/4) and dark red (2.5YR 3/6) gravelly silty clay loam; weak fine subangular blocky structure; friable; common fine roots; common thin discontinuous clay skins on faces of peds; about 30 percent chert gravel; clear smooth boundary.

2Bt2 55 - 83 cm Dark red (2.5YR 3/6) and red (2.5YR 4/6) gravelly silty clay; weak fine subangular blocky structure; firm, hard; few fine roots; common thin discontinuous clay skins on faces of peds; about 30 percent chert gravel; gradual smooth boundary.

2Bt3 83 - 151 cm Dark red (2.5YR 3/6) and reddish brown (5YR 5/4) gravelly silty clay; common fine distinct light reddish brown (5YR 6/4) mottles; weak fine subangular blocky structure; firm, hard; few fine roots; common discontinuous clay skins; about 25 percent chert gravel; gradual wavy boundary.

2Bt4 151 - 184 cm Red (2.5YR 4/6) very gravelly silty clay; common fine faint yellowish red (5YR 5/6) mottles; weak medium subangular blocky structure; firm, hard; common thin discontinuous clay skins on faces of peds; about 36 percent chert gravel; gradual smooth boundary.

2BC 184 - 252 cm Dark red (2.5YR 3/6) very gravelly silty clay; massive structure; firm, hard; common thin discontinuous clay skins on vertical faces of peds; about 36 percent chert gravel.

*** P R I M A R Y   C H A R A C T E R I Z A T I O N   D A T A ***

S80MO-105-005

(LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : DONIPHAN ; CLAYEY, MIXED, MESIC TYPIC PALEUDULT
REVISED TO : DONIPHAN ; CLAYEY, MIXED, MESIC TYPIC PALEUDULT

NSSL - PROJECT 81P 10, GEOMORPHOLOGY STUDY-LAKE OF THE OZARKS SSA
- PEDON 81P 29, SAMPLES 81P 186- 192
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO. (-1--)	DEPTH (CM) (-2--)	HORIZON (-3--)	-4-- TOTAL CLAY LT .002	-5-- TOTAL SILT .002 -.05	-6-- TOTAL SAND .05 -2	-7-- CLAY FINE LT .0002	-8-- CLAY CO3 LT .002	-9-- SILT FINE .002 -.02	-10- SILT COARSE .02 -.05	-11- SAND VF .05 -.10	-12- SAND F .10 -.25	-13- SAND M .25 -.50	-14- SAND C .5 -1	-15- SAND VC 1 -2	-16- COARSE FRACTIONS (MM) WEIGHT 2 -5	-17- WEIGHT 5 -20	-18- WEIGHT 20 -75	-19- WEIGHT .1- 75	-20- (>2MM) WT PCT OF WHOLE SOIL
			<- - - - - - - - - - - - -	PCT OF <2MM	(3A1)	- - - - - - - -							->	<- PCT OF	<75MM(3B1)->			
81P 186S	0- 17	A	9.8	74.9	15.3	0.8		49.5	25.4	2.2	4.5	3.2	2.2	3.2	4	15	45	69	66
81P 187S	17- 31	E	10.5	72.7	16.8	3.2		49.2	23.5	2.0	4.2	3.2	2.3	5.1	5	21	44	74	72
81P 188S	31- 55	2Bt1	30.4	59.8	9.8	13.4		42.2	17.6	1.9	2.9	2.1	1.4	1.5	6	7	20	38	38
81P 189S	55- 83	2Bt2	42.2	46.9	10.9	24.4		33.3	13.6	1.7	2.4	2.2	2.7	1.9	3	7	19	36	34
81P 190S	83-151	2Bt3	54.8	24.9	20.3	31.7		18.3	6.6	1.5	2.4	3.4	5.1	7.9	5	2	17V	38	30
81P 191S	151-184	2Bt4	69.5	17.8	12.7	42.1		13.1	4.7	1.7	1.5	2.1	2.8	4.5	4	8	34	52	51
81P 192S	184-252	2BC	65.1	21.9	13.0	33.8		14.7	7.2	3.1	2.4	1.8	1.9	3.8	7	13	28	53	52

DEPTH (CM)	ORGN C 6A1c PCT	TOTAL N 6B3a <2MM	EXTR P 6S3 PPM	TOTAL S 6R3a <- PERCENT	DITH-CIT EXTRACTABLE FE 6C2b OF	DITH-CIT EXTRACTABLE AL 6G7a <2MM	DITH-CIT EXTRACTABLE MN 6D2a -->	(RATIO/CLAY) CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	(ATTERBERG LIMITS) LL 4F1 PCT	(ATTERBERG LIMITS) PI 4F <0.4MM	(BULK DENSITY) FIELD MOIST 4A3a <- -	(BULK DENSITY) 1/3 BAR 4A1d G/CC	(BULK DENSITY) OVEN DRY 4A1h - - ->	COLE WHOLE SOIL 4D1 CM/CM	(WATER CONTENT) FIELD MOIST 4B4 <- -	(WATER CONTENT) 1/10 BAR 4B1c -PCT OF	(WATER CONTENT) 1/3 BAR 4B1c <2MM	(WATER CONTENT) 15 BAR 4B2a - ->	WRD WHOLE SOIL 4C1 CM/CM
0- 17	1.17	0.067			0.5		TR	0.48	0.42				1.40						4.1	
17- 31	0.30	0.023			0.7		TR	0.27	0.30				1.50						3.2	
31- 55	0.19	0.023			1.2		--	0.20	0.29				1.64	1.67	0.004			18.7	8.9	0.12
55- 83	0.15	0.021			1.9		--	0.21	0.29				1.50						12.3	
83-151	0.11				2.8		--	0.23	0.30				1.46	1.51	0.009			22.7	16.5	0.07
151-184	0.11				3.2		TR	0.23	0.33				1.09	1.26	0.034			45.0	23.2	0.17
184-252	0.07				2.7		TR	0.21	0.35				1.10						22.7	

AVERAGES, DEPTH 31- 81: PCT CLAY 37 PCT .1-75MM 36

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-005
SAMPLED AS : DONIPHAN ; CLAYEY, MIXED, MESIC TYPIC PALEUDULT
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 29, SAMPLE 81P 186- 192

PRINT DATE 02/26/91

DEPTH (CM)	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	(- NH4OAC EXTRACTABLE BASES -)					ACID-	EXTR	(- - - -CEC - - -)			AL	-BASE SAT-		CO3 AS	RES.		COND.	(- - - -PH - - -)		
	CA	MG	NA	K	SUM BASES	ITY	AL	SUM CATS	NH4-OAC	BASES + AL	SAT	SUM	NH4 OAC	CACO3 <2MM	OHMS /CM		MMHOS /CM		CACL2 .01M	H2O
	5B5a 6N2e	5B5a 6O2d	5B5a 6P2b	5B5a 6Q2b		6H5a	6G9a	5A3a	5A8b	5A3b	5G1	5C3	5C1	6E1g	8E1		8I		8C1f 1:2	8C1f 1:1
	<- - - - - - - - - - - - - -MEQ / 100 G - - - - - - - - - - - - ->										<- - - - - -PCT - - - - ->									
0- 17	0.2	0.2	--	0.1	0.5	5.4	2.0	5.9	4.7	2.5	80	8	11						4.1	4.2
17- 31	0.1	0.3	--	0.1	0.5	2.6	1.1	3.1	2.8	1.6	69	16	18						4.3	4.8
31- 55	0.7	1.3	TR	0.2	2.2	5.6	2.3	7.8	6.2	4.5	51	28	35						4.2	4.8
55- 83	1.1	1.8	--	0.3	3.2	7.9	3.3	11.1	8.8	6.5	51	29	36						4.2	4.9
83-151	1.3	2.3	TR	0.4	4.0	10.4	4.9	14.4	12.4	8.7	55	28	32						4.2	4.8
151-184	1.3	3.2	TR	0.5	5.0	14.0	6.5	19.0	16.0	11.5	57	26	31						4.2	4.9
184-252	0.9	2.6	TR	0.3	3.8	12.5	6.4	16.3	13.8	10.2	63	23	28						4.3	4.7

ESTIMATED BULK DENSITY FOR LAYER 1, 2, 4, 7,

ANALYSES: S= ALL ON SIEVED <2MM BASIS V= 75-20MM FROM VOLUME ESTIMATES

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-005 PRINT DATE 02/26/91
SAMPLED AS : DONIPHAN ; CLAYEY, MIXED, MESIC TYPIC PALEUDULT
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 29, SAMPLE 81P 186- 192

CLAY MINERALOGY (<.002mm)

SAMPLE NUMBER	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	FRACT ION	X-RAY 7A2I peak size					THERMAL DTA 7A6 Percent		THERMAL TGA 7A4b Percent		SIO2 (ELEMENTAL 7C3 Percent)	AL203	Fe203	MgO	CaO	K20	Na20		EGME RETN 7D2 <mg/g>	INTER PRETA TION
81P 186	TCLY	KK 2	VR 2	QZ 2	MI 1															
81P 188	TCLY	KK 3	MI 2	QZ 2	VR 1		KK21						7.1			1.4				
81P 190	TCLY	KK 3	MI 2	QZ 2	HE 1		KK36						8.4			1.6				
81P 192	TCLY	KK 3	MI 2	QZ 2	MT 1		KK32						7.0			1.6				

SAND - SILT MINERALOGY (2.0-0.002mm)

SAMPLE NUMBER	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	FRACT ION	X-RAY 7A2I Peak Size				THERMAL DTA 7A3b Percent		THERMAL TGA 7A4b Percent		TOT RE	OPTICAL GRAIN COUNT 7B1a Percent									INTER PRETA TION
81P 187	VFS									98	QZ47	CD41	QI 8	OP 1	PO 1	FK 3				
81P 188	VFS									98	QZ43	CD44	QI 8	OP 1	FK 3	PO 2				

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm VFS Very Fine Sand, 0.05-0.10mm

MINERAL INTERPRETATION:

KK kaolinite VR vermiculite QZ quartz MI mica CD chalcedony QI fe-coat qz
OP opaques PO plant opal FK potas-feld HE hematite MT montmorill

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

S80MO-105-005

*** S U P P L E M E N T A R Y   C H A R A C T E R I Z A T I O N   D A T A ***
(LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : DONIPHAN ; CLAYEY, MIXED, MESIC TYPIC PALEUDULT
REVISED TO : DONIPHAN ; CLAYEY, MIXED, MESIC TYPIC PALEUDULT

NSSL - PROJECT 81P 10,
- PEDON 81P 29, SAMPLES 81P 186- 192
- GENERAL METHODS (ENGINEERING FRACTIONS ARE CALCULATED FROM USDA FRACTION SIZES)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (IN.)	HORIZON	ENGINEERING PERCENTAGE PASSING <-INCHES-> 3	2	3/2	1	3/4	3/8	<-NUMBER-> 4	10	40	200	PSDA SIEVE <-MICRONS-> 20	5	2	CUMULATIVE CURVE FRACTIONS(<76MM) USDA LESS THAN <-MM-> 1.	.5	.25	.10	.05	DIAMETERS(MM) AT <-PERCENTILE-> 60	50	10	ATTERBERG <-PCT> LL	PI	GRADATION UNIFMTY CU	CURVTUR CC
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
81P 186S	0- 7	A	100	87	78	64	55	48	40	36	34	31	21	11	4	35	34	33	31	30	22.13	11.927	0.005			>100	--
81P 187S	7- 12	E	100	87	78	65	56	46	35	31	28	26	19	9	3	29	29	28	26	26	21.53	12.747	0.006			>100	14.0
81P 188S	12- 22	2Bt1	100	94	90	84	80	77	73	67	65	61	49	32	20	66	65	64	62	60	0.05	0.022	0.001			78.0	0.6
81P 189S	22- 33	2Bt2	100	94	91	85	81	78	74	71	67	64	54	39	30	70	68	66	64	63	0.04	0.014	--			85.1	0.3
81P 190S	33- 59	2Bt3	100	95	92	87	83	82	81	76	65	61	56	47	42	70	66	64	62	61	0.05	0.008	--			>100	0.1
81P 191S	59- 72	2Bt4	100	90	83	73	66	62	58	54	50	48	45	40	38	52	50	49	48	47	6.66	0.483	--			>100	--
81P 192S	72- 99	2BC	100	92	86	78	72	66	59	52	49	46	41	37	34	50	49	48	47	45	5.23	0.983	--			>100	--

DEPTH (IN.)	WEIGHT FRACTIONS: WHOLE SOIL (MM) <-PCT OF WHOLE SOIL-> >2	250 -UP	250 -75	75 -2	75 -20	20 -5	5 -2	<2	<75 MM FRACTION <-PCT OF <75 MM-> 75 -2	75 -20	20 -5	5 -2	<2		WEIGHT PER UNIT VOLUME G/CC: WHOLE SOIL, SOIL SURVEY 1/3 BAR	OVEN -DRY	ENGINEERING MOIST	SATUR -ATED	<2 MM FRACTION, SOIL SURVEY 1/3 BAR	15 BAR	OVEN -DRY	ENGINEERING MOIST	SATUR -ATED	VOID RATIOS AT 1/3 BAR WHOLE SOIL	<2 MM
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
0- 7	67	--	7	60	42	14	4	33	64	45	15	4	36		2.03										
7- 12	71	--	6	65	41	20	4	29	69	44	21	4	31		2.17										
12- 22	38	--	7	31	19	7	6	62	33	20	7	6	67		1.91	1.93	2.14	2.19	1.64	1.66	1.67	1.95	2.02	0.39	0.62
22- 33	35	--	8	27	17	6	3	65	29	19	7	3	71		1.76										
33- 59	30	--	8	22	16	2	5	70	24	17	2	5	76		1.69	1.73	1.96	2.05	1.46	1.47	1.51	1.79	1.91	0.57	0.82
59- 72	51	--	8	42	31	7	4	49	46	34	8	4	54		1.56	1.72	1.90	1.97	1.09	1.18	1.26	1.58	1.68	0.70	1.43
72- 99	52	--	8	44	26	12	6	48	48	28	13	7	52		1 57										

*** SUPPLEMENTARY CHARACTERIZATION DATA ***

S80MO-105-005
CLASSIFICATION: DONIPHAN ; CLAYEY, MIXED, MESIC TYPIC PALEUDULT
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 29, SAMPLE 81P 186- 192

PRINT DATE 02/26/91

DEPTH (IN.)	VOLUME FRACTIONS AT 1/3 BAR — WHOLE SOIL (MM) >2	250 -UP	250 -75	75 -2	75 -20	20 -5	5 -2	<2	2- .05	.05- .002	LT .002	PORES D	PORES F	(C/) (/N) RAT -10	RATIOS TO CLAY <2 MM FRACTION FINE CLAY	CEC SUM CATS	CEC NH4-OAC	15 BAR H2O	LE 1/3 BAR	LINEAR EXTENSIBILITY WHOLE SOIL <-1/3 BAR TO 15 BAR	WHOLE SOIL OVEN -DRY	<2 MM (PCT) 15 BAR	<2 MM OVEN -DRY	W R D WHOLE SOIL	W R D <2 MM
	<---PCT OF WHOLE SOIL--->																							<--IN/IN->	
	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
0- 7	52	--	5	46	32	11	3	48	4	20	3	23		17	0.08	0.60	0.48	0.42							
7- 12	58	--	5	53	34	16	3	42	4	17	3	18		13	0.30	0.30	0.27	0.30							
12- 22	28	--	5	23	14	5	4	72	4	27	14	5	23	8	0.44	0.26	0.20	0.29	0.020	0.2	0.3	0.4	0.6	0.12	0.16
22- 33	23	--	5	18	11	4	2	77	5	20	18	34		7	0.58	0.26	0.21	0.29							
33- 59	19	--	5	14	10	1	3	81	9	11	25	9	27		0.58	0.26	0.23	0.30	0.020	0.2	0.8	0.2	1.1	0.07	0.09
59- 72	30	--	5	25	18	4	2	70	4	5	20	7	34		0.61	0.27	0.23	0.33	0.072	1.7	3.3	2.7	5.0	0.17	0.24
72- 99	31	--	5	26	15	7	4	69	4	6	19	41			0.52	0.25	0.21	0.35							

DEPTH (IN.)	WEIGHT FRACTIONS - CLAY FREE — WHOLE SOIL >2 PCT	75 -2 OF	20 -2 >2MM+SAND+SILT	2- .05	.05- .002	LT .002	<2 MM FRACTION SANDS VC	C	M	F	VF	SILTS C	F	CL AY	TEXTURE (DETERMINED IN FIELD	BY PSDA)	PSDA (MM) SAND 2- .05	SILT .05- .002	CLAY LT .002	(PH) CA- CL2 .01M	ELECTRICAL RES- IST. OHMS	CON- DUCT. MMHOS	SALT MG/ KG	CUMULT. AMOUNTS IN. OF H2O 1/3 BAR TO 15BAR	AIRDRY (WHL SOIL)
							(------PCT OF SAND+SILT------)								(--<2 MM-)		(--PCT OF .2MM-)			(- - - - <2 MM- - - -)					
	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
0- 7	69	62	19	5	26	3	4	2	4	5	2	28	55	11	SIL	SIL	15.3	74.9	9.8	4.1					
7- 12	73	67	25	5	22	3	6	3	4	5	2	26	55	12	SIL	SIL	16.8	72.7	10.5	4.3					
12- 22	47	38	16	7	46	23	2	2	3	4	3	25	61	44	SICL	SICL	9.8	59.8	30.4	4.2					
22- 33	48	37	12	10	42	38	3	5	4	4	3	24	58	73	SIC	SIC	10.9	46.9	42.2	4.2					
33- 59	49	36	11	23	28	62	17	11	8	5	3	15	40	121	SIC	C	20.3	24.9	54.8	4.2					
59- 72	77	64	17	9	13	52	15	9	7	5	6	15	43	228	SIC	C	12.7	17.8	69.5	4.2					
72- 99	76	64	26	9	15	45	11	5	5	7	9	21	42	187	SIC	C	13.0	21.9	65.1	4.3					

Pedon No.: **S80MO-105-006** **Date: 4/82**

Sampled as: LEBANON; Fine, mixed, mesic Typic Fragiudalf
Revised to: WILDERNESS; Loamy-skeletal, siliceous, mesic Typic Fragiudalf
Latitude: N37 Deg. 36 Min. 16 Sec. Longitude: W092 Deg. 24 Min. 12 Sec.
Location: LACLEDE CO. IN THE CORNER, SEC. 6, T. 33 N., R. 13 W.
MLRA: 116 Ozark
Physiography: Upland ridge in level to undulating uplands
Geomorphic position: On the crest interfluve
Slope and aspect: 1 pct S convex Elevation: 385 m M.S.L.
Microrelief: None
Air temp. 13 C Summer: 24 C Winter: 1 C
Precipitation: 101 cm Udic moisture regime.
Water table: Not observed
Drainage: Well drained Permeability:
Stoniness:
Land use:
Erosion or deposition:
Parent material: strongly weathered residuum from Jefferson City dolomite
Described by:

SAMP NOS 81P193 201.

A 0 - 13 cm Very dark gray (10YR 3/1) silt loam; common fine faint yellowish brown (10YR 5/6) mottles; friable; many medium roots; about 10 percent chert gravel; clear smooth boundary.

Bt1 13 - 27 cm Strong brown (7.5YR 5/6) gravelly silty clay loam; few fine faint brown (7.5YR 5/4) mottles; weak fine subangular blocky structure parting to weak very fine subangular blocky ; friable; common medium roots; common thin discontinuous clay skins on faces of peds; about 16 percent chert gravel; clear smooth boundary.

2Bt2 27 - 43 cm Brown (7.5YR 5/4) extremely gravelly silty clay loam; common fine to medium faint light yellowish brown (10YR 6/4) mottles; weak very fine subangular blocky structure; firm, hard; common medium roots; common thin discontinuous clay skins on faces of peds; about 65 percent chert gravel; clear smooth boundary.

2Bx 43 - 68 cm Brown to dark brown (7.5YR 4/4) very gravelly silty clay loam; very few fine distinct light brownish gray (10YR 6/2) mottles; very firm, very hard, brittle; few fine roots; about 60 percent chert gravel; gradual smooth boundary. .

3Bt1 68 - 83 cm Dark red (2.5YR 3/6) gravelly clay; few fine distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; firm, hard; common thin discontinuous clay skins on faces of peds; about 20 percent chert gravel; gradual smooth boundary.

3Bt2 83 - 127 cm Dark red (2.5YR 3/6) clay; few fine faint yellowish red (5YR 5/6) mottles; moderate fine subangular blocky structure; firm, hard; common thin discontinuous clay skinson faces of peds; about 10 percent chert gravel; diffuse smooth boundary.

3Bt3 127 - 178 cm Dark red (10R 3/6) clay; very few medium to coarse prominent light gray (10YR 7/1) mottles; moderate medium subangular blocky structure; firm, hard; common thin discontinuous clay skins on faces of peds; about 5 percent chert gravel; diffuse smooth boundary.

3Bt4 178 - 334 cm Dark red (10R 3/6) and red (10R 4/6) gravelly clay; very few coarse prominent light gray to gray (N 6/0) and very few light gray (10YR 7/1) mottles; weak fine subangular blocky structure; firm, hard; common thin discontinuous clay skins on faces of peds; about 25 percent chert gravel.
SPLIT FOR SAMPLING 178-257 CM AND 257-334 CM.

S80MO-105-006

*** P R I M A R Y   C H A R A C T E R I Z A T I O N   D A T A ***

(LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : LEBANON ; FINE, MIXED, MESIC TYPIC FRAGUIDALF
REVISED TO : WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF

NSSL - PROJECT 81P 10, GEOMORPHOLOGY STUDY-LAKE OF THE OZARKS SSA
- PEDON 81P 30, SAMPLES 81P 193- 201
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	-1-- (- - -TOTAL - - -) CLAY LT .002	-2-- SILT .002 -.05	-3-- SAND .05 -2	-4-- (- -CLAY- -) FINE LT .0002	-5-- CO3 LT .002	-6-- (- -SILT- -) FINE .002 -.02	-7-- COARSE .02 -.05	-8-- (- - -SAND- - -) VF .05 -.10	-9-- F .10 -.25	-10- M .25 -.50	-11- C .5 -1	-12- VC 1 -2	-13- (-COARSE FRACTIONS(MM)-) WEIGHT 2 -5	-14- 5 -20	-15- 20 -75	-16- .1- 75	-17- (>2MM) WT PCT OF WHOLE SOIL
			<- - - PCT OF <2MM (3A1)											- - ->	<- PCT OF <75MM(3B1)->				
81P 193S	0- 13	A	13.5	77.3	9.2	4.9		48.3	29.0	1.4	2.6	2.3	1.8	1.1	2	2	9V	20	13
81P 194S	13- 27	Bt1	27.5	64.7	7.8	12.7		46.4	18.3	0.9	1.6	1.5	1.3	2.5	4	6	9V	25	19
81P 195S	27- 43	2Bt2	29.1	55.6	15.3	14.8		38.2	17.4	1.5	2.5	2.0	2.3	7.0	9	22	42	77	76
81P 196S	43- 68	2Bx	19.4	61.7	18.9	8.1		39.3	22.4	2.8	3.5	2.2	4.1	6.3	4	15	45	70	68
81P 197S	68- 83	3Bt1	51.9	41.4	6.7	27.4		28.2	13.2	2.1	1.6	1.1	0.9	1.0	2	3	10V	19	29
81P 198S	83-127	3Bt2	68.6	24.3	7.1	43.2		17.7	6.6	2.0	1.4	1.3	1.3	1.1	3	2	10V	19	15
81P 199S	127-178	3Bt3	62.7	30.0	7.3	39.8		21.3	8.7	3.0	1.3	0.9	0.8	1.3	2	1	4V	11	7
81P 200S	178-257	3Bt4	70.7	20.0	9.3	44.8		14.8	5.2	2.8	1.8	1.3	1.6	1.8	3	1	10V	20	14
81P 201S	257-334	3Bt4	60.6	27.0	12.4	37.7		17.6	9.4	5.2	1.9	1.2	1.9	2.2	6	7	20	38	46

Column number labels as printed above the table: -1-- -2-- -3-- -4-- -5-- -6-- -7-- -8-- -9-- -10- -11- -12- -13- -14- -15- -16- -17- -18- -19- -20-

DEPTH (CM)	ORGN C 6A1c PCT	TOTAL N 6B3a <2MM	EXTR P 6S3 PPM	TOTAL S 6R3a	(- - DITH-CIT - -) EXTRACTABLE FE 6C2b	AL 6G7a	MN 6D2a	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG - LIMITS -) LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3a	1/3 BAR 4A1d	OVEN DRY 4A1h	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1c	1/3 BAR 4B1c	15 BAR 4B2a	WRD WHOLE SOIL 4C1
				<- PERCENT OF <2MM -->						PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
0- 13	0.81	0.068			0.9		0.1	0.56	0.41				1.44	1.45	0.002			21.7	5.5	0.22
13- 27	0.53	0.059			1.3		TR	0.48	0.37				1.40						10.1	
27- 43	0.42	0.052			1.2		TR	0.50	0.40				1.40						11.6	
43- 68	0.11	0.015			0.8		--	0.44	0.36				1.71	1.73	0.002			11.5	6.9	0.03
68- 83	0.09				2.7		TR	0.27	0.28				1.40						14.4	
83-127	0.09				4.0		--	0.27	0.33				1.30						22.3	
127-178	0.11				3.2		--	0.25	0.35				1.30						21.9	
178-257	0.14				3.2		--	0.23	0.35				1.22	1.36	0.034			36.2	24.8	0.13
257-334	0.08				2.7		--	0.23	0.38				0.97	0.99	0.005			47.6	22.8	0.18

AVERAGES, DEPTH 13- 43: PCT CLAY 28 PCT .1-75MM 52

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-006 PRINT DATE 02/26/91

SAMPLED AS : LEBANON ; FINE, MIXED, MESIC TYPIC FRAGUIDALF

NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 30, SAMPLE 81P 193- 201

	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	(- NH4OAC EXTRACTABLE BASES -)					ACID-	EXTR	(- - - -CEC - - -)			AL	-BASE SAT-		CO3 AS	RES.		COND.		(- - - -PH - - -)	
	CA	MG	NA	K	SUM	ITY	AL	SUM	NH4-	BASES	SAT	SUM	NH4	CACO3	OHMS		MMHOS		CACL2	H2O
DEPTH	5B5a	5B5a	5B5a	5B5a	BASES			CATS	OAC	+ AL			OAC	<2MM	/CM		/CM		.01M	
(CM)	6N2e	602d	6P2b	6Q2b		6H5a	6G9a	5A3a	5A8b	5A3b	5G1	5C3	5C1	6E1g	8E1		8I		8C1f	8C1f
	<- - - - - - - - - - - -MEQ / 100 G - - - - - - - - - - - ->										<- - - - -PCT - - - ->								1:2	1:1
0- 13	1.8	0.8	--	0.1	2.7	6.7	1.6	9.4	7.5	4.3	37	29	36						4.4	4.8
13- 27	2.4	1.6	TR	0.2	4.2	11.2	5.0	15.4	13.2	9.2	54	27	32						4.0	4.7
27- 43	1.9	2.0	TR	0.2	4.1	12.9	6.2	17.0	14.5	10.3	60	24	28						4.0	4.8
43- 68	0.9	1.3	TR	0.1	2.3	7.8	4.2	10.1	8.6	6.5	65	23	27						3.9	4.7
68- 83	2.1	2.5	0.2	0.1	4.9	11.1	5.7	16.0	14.1	10.6	54	31	35						3.9	4.8
83-127	4.8	4.5	0.3	0.2	9.8	12.1	3.9	21.9	18.6	13.7	28	45	53						4.0	4.8
127-178	5.7	4.7	0.4	0.3	11.1	7.6	1.3	18.7	15.7	12.4	10	59	71						4.4	5.1
178-257	7.3	5.5	0.5	0.4	13.7	5.3	0.3	19.0	16.4	14.0	2	72	84						5.1	5.5
257-334	6.7	4.3	0.5	0.4	11.9	5.4		17.3	14.1			69	84						5.6	5.7

ESTIMATED BULK DENSITY FOR LAYER 2, 3, 5, 6, 7,

ANALYSES: S= ALL ON SIEVED <2MM BASIS V= 75-20MM FROM VOLUME ESTIMATES

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-006 PRINT DATE 02/26/91
SAMPLED AS : LEBANON ; FINE, MIXED, MESIC TYPIC FRAGUIDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 30, SAMPLE 81P 193- 201

CLAY MINERALOGY (<.002mm)

SAMPLE NUMBER	-1- FRACT ION	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
		X-RAY 7A2i peak size					THERMAL DTA 7A6 Percent		TGA 7A4b	SiO2 ELEMENTAL 7C3 Percent	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O			EGME RETN 7D2 mg/g	INTER PRETA TION
81P 193	TCLY	VR 3	KK 2	MI 1	MT 1	QZ 1														
81P 195	TCLY	VR 3	MT 3	KK 3	MI 2	QZ 2	KK20						8.0			1.3				
81P 196	TCLY	MT 3	KK 3	VR 2	MI 2	QZ 2	KK14						7.6			1.3				
81P 197	TCLY	KK 4	VR 2	QZ 2	MT 1	MI 1	KK39						9.3			1.1				
81P 197	TCLY	HE 1																		
81P 199	TCLY	KK 4	MI 2	QZ 2			KK41						8.9			1.1				
81P 201	TCLY	KK 4	MI 2	QZ 2			KK46						7.7			1.3				

SAND - SILT MINERALOGY (2.0-0.002mm)

SAMPLE NUMBER	-1- FRACT ION	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
		X-RAY 7A2i Peak Size				THERMAL DTA 7A3b Percent		TGA 7A4b		TOT FE	OPTICAL GRAIN COUNT 7B1a Percent									INTER PRETA TION
81P 194	VFS									98	QZ69	CD20	QI 6	FK 2	OP 3					
81P 196	VFS									98	QZ58	CD30	QI 9	FK 1	OP 1	HNtr				
81P 197	VFS									100	QZ48	CD43	QI 6	FKtr	OP 3					
81P 199	VFS									100	QZ30	CD62	QI 7	OP 1	FKtr					

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm VFS Very Fine Sand, 0.05-0.10mm

MINERAL INTERPRETATION:

VR vermiculite KK kaolinite MI mica MT montmorill QZ quartz CD chalcedony
QI fe-coat qz FK potas-feld OP opaques HN hornblende HE hematite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

S80MO-105-006

*** SUPPLEMENTARY CHARACTERIZATION DATA ***
(LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : LEBANON ; FINE, MIXED, MESIC TYPIC FRAGUIDALF
REVISED TO : WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF

NSSL - PROJECT 81P 10,
- PEDON 81P 30, SAMPLES 81P 193- 201
- GENERAL METHODS (ENGINEERING FRACTIONS ARE CALCULATED FROM USDA FRACTION SIZES)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (IN.)	HORIZON	ENGINEERING PERCENTAGE PASSING: 3 in.	2 in.	3/2 in.	1 in.	3/4 in.	3/8 in.	No. 4	No. 10	No. 40	No. 200	PSDA SIEVE: 20 microns	5 microns	2 microns	CUMULATIVE CURVE USDA LESS THAN: 1. mm	.5 mm	.25 mm	.10 mm	.05 mm	FRACTIONS(<76MM) DIAMETERS(MM) AT PERCENTILE: 60	50	10	ATTERBERG LL (PCT)	PI (PCT)	GRADATION UNIFMTY CU	CURVTUR CC
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
81P 193S	0- 5	A	100	97	96	93	91	91	90	88	85	81	54	29	12	87	85	83	81	80	0.02	0.016	0.001			17.6	0.8
81P 194S	5- 11	Bt1	100	97	96	93	91	88	85	81	78	75	60	37	22	79	78	77	75	75	0.02	0.011	0.001			35.9	0.9
81P 195S	11- 17	2Bt2	100	88	79	67	58	47	36	27	24	23	18	12	8	25	24	24	23	23	20.28	11.433	0.003			>100	>100
81P 196S	17- 27	2Bx	100	87	78	64	55	48	40	36	32	30	21	13	7	34	32	31	30	29	22.13	11.927	0.003			>100	0.1
81P 197S	27- 33	3Bt1	100	97	95	92	90	89	87	85	83	80	68	54	44	84	83	82	81	79	0.01	0.004	--			27.3	0.3
81P 198S	33- 50	3Bt2	100	97	96	93	91	90	89	86	84	81	74	65	59	85	84	83	82	80	--	0.001	--			7.9	0.6
81P 199S	50- 70	3Bt3	100	99	98	97	96	96	95	93	91	88	78	66	58	92	91	90	89	86	--	0.001	--			8.2	0.6
81P 200S	70-101	3Bt4	100	97	95	92	90	90	89	86	83	79	74	66	61	84	83	82	80	78	--	0.001	--			6.6	0.7
81P 201S	101-131	3Bt4	100	94	90	84	80	77	73	67	64	61	52	45	41	66	64	63	62	59	0.06	0.013	--			>100	0.1

DEPTH (IN.)	WEIGHT FRACTIONS, WHOLE SOIL (MM), PCT OF WHOLE SOIL: >2	250-UP	250-75	75-2	75-20	20-5	5-2	<2	<75 MM FRACTION, PCT OF <75 MM: 75-2	75-20	20-5	5-2	<2		WEIGHT PER UNIT VOLUME G/CC, WHOLE SOIL: SOIL SURVEY 1/3 BAR	SOIL SURVEY OVEN-DRY	ENGINEERING MOIST	ENGINEERING SATURATED	<2 MM FRACTION: SOIL SURVEY 1/3 BAR	SOIL SURVEY 15 BAR	SOIL SURVEY OVEN-DRY	ENGINEERING MOIST	ENGINEERING SATURATED	VOID RATIOS AT 1/3 BAR: WHOLE SOIL	<2 MM
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
0- 5	12	--	--	12	9	1	2	88	12	9	1	2	88		1.52	1.53	1.81	1.95	1.44	1.45	1.45	1.75	1.90	0.74	0.84
5- 11	19	--	--	19	9	6	4	81	19	9	6	4	81		1.54										
11- 17	76	--	12	64	37	19	8	24	73	42	22	9	27		2.18										
17- 27	68	--	12	56	40	13	4	32	64	45	15	4	36		2.25	2.26	2.34	2.40	1.71	1.72	1.73	1.91	2.06	0.18	0.55
27- 33	29	--	16	13	8	3	2	71	15	10	3	2	85		1.62										
33- 50	14	--	--	14	9	2	3	86	14	9	2	3	86		1.40										
50- 70	7	--	--	7	4	1	2	93	7	4	1	2	93		1.35										
70-101	14	--	--	14	10	1	3	86	14	10	1	3	86		1.32	1.46	1.73	1.82	1.22	1.27	1.36	1.66	1.76	1.01	1.17
101-131	46	--	19	27	16	6	5	54	33	20	7	6	67		1.37	1.39	1.73	1.85	0.97	0.98	9.99	1.43	1.60	0.93	1.73

*** S U P P L E M E N T A R Y   C H A R A C T E R I Z A T I O N   D A T A ***

S80MO-105-006 PRINT DATE 02/26/91
CLASSIFICATION: WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 30, SAMPLE 81P 193- 201

DEPTH (IN.)	VOLUME FRACTIONS AT 1/3 BAR, WHOLE SOIL (MM), PCT OF WHOLE SOIL: >2	250-UP	250-75	75-2	75-20	20-5	5-2	<2	2-.05	.05-.002	LT .002	PORES D	PORES F	(C/)(/N) RAT -10	RATIOS TO CLAY, <2 MM FRACTION: FINE CLAY	CEC SUM CATS	CEC NH4-OAC	15 BAR H2O	LE 1/3 BAR	LINEAR EXTENSIBILITY, WHOLE SOIL <-1/3 BAR TO: 15 BAR	WHOLE SOIL OVEN-DRY	<2 MM (PCT): 15 BAR	<2 MM OVEN-DRY	W R D WHOLE SOIL <--IN/IN->	W R D <2 MM
	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
0- 5	7	--	--	7	5	1	1	93	5	39	7	14	29	12	0.36	0.70	0.56	0.41	0.015	0.2	0.2	0.2	0.2	0.22	0.23
5- 11	11	--	--	11	5	3	2	89	4	30	13	42		9	0.46	0.56	0.48	0.37							
11- 17	62	--	10	53	30	16	7	38	3	11	6	18		8	0.51	0.58	0.50	0.40							
17- 27	57	--	10	47	34	11	3	43	5	17	5	6	9	7	0.42	0.52	0.44	0.36	0.021		0.1	0.2	0.4	0.03	0.08
27- 33	18	--	10	8	5	2	1	82	3	18	22	39			0.53	0.31	0.27	0.28							
33- 50	7	--	--	7	5	1	2	93	3	11	31	47			0.63	0.32	0.27	0.33							
50- 70	4	--	--	4	2	1	1	96	3	14	29	49			0.63	0.30	0.25	0.35							
70-101	7	--	--	7	5	1	1	93	4	9	30	9	41		0.63	0.27	0.23	0.35	0.052	1.2	3.4	1.3	3.7	0.13	0.14
101-131	24	--	10	14	8	3	3	76	3	8	17	12	36		0.62	0.29	0.23	0.38	0.012	0.2	0.5	0.3	0.7	0.18	0.24

DEPTH (IN.)	WEIGHT FRACTIONS - CLAY FREE, WHOLE SOIL: >2 PCT	75-2	20-2 PCT OF >2MM+SAND+SILT	2-.05	.05-.002	LT .002	<2 MM FRACTION, PCT OF SAND+SILT, SANDS: VC	C	M	F	VF	SILTS C	SILTS F	CLAY	TEXTURE DETERMINED IN FIELD (<2 MM)	TEXTURE DETERMINED BY PSDA	PSDA (MM) PCT OF <2MM: SAND 2-.05	SILT .05-.002	CLAY LT .002	PH CACL2 .01M	ELECTRICAL, <2 MM: RES-IST. OHMS	CON-DUCT. MMHOS	SALT MG/KG	CUMULT. AMOUNTS IN. OF H2O 1/3 BAR TO 15BAR (WHL SOIL)	1/3 BAR TO AIRDRY (WHL SOIL)
	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
0- 5	14	14	3	9	77	13	1	2	3	3	2	34	56	16	SIL	SIL	9.2	77.3	13.5	4.4					
5- 11	24	24	13	8	67	29	3	2	2	2	1	25	64	38	SICL	SICL	7.8	64.7	27.5	4.0					
11- 17	82	69	.9	4	14	8	10	3	3	4	2	25	54	41	SICL	SICL	15.3	55.6	29.1	4.0					
17- 27	72	60	18	6	21	7	8	5	3	4	3	28	49	24	SICL	SIL	18.9	61.7	19.4	3.9					
27- 33	46	21	8	8	47	58	2	2	2	3	4	27	59	108	C	SIC	6.7	41.4	51.9	3.9					
33- 50	34	34	12	15	51	144	4	4	4	4	6	21	56	218	C	C	7.1	24.3	68.6	4.0					
50- 70	17	17	7	16	67	140	3	2	2	3	8	23	57	168	C	C	7.3	30.0	62.7	4.4					
70-101	36	36	10	20	44	155	6	5	4	6	10	18	51	241	C	C	9.3	20.0	70.7	5.1					
101-131	68	40	16	10	22	49	6	5	3	5	13	24	45	154	C	C	12.4	27.0	60.6	5.6					

Pedon No.: **S80MO-105-007** **Date: 4/82**

Sampled as: VIRATON; Fine-loamy, siliceous, mesic Typic Fragiudalf
Revised to: WILDERNESS; Loamy-skeletal, siliceous, mesic TypicFragiudalf
Latitude: N37 Deg. 36 Min. 13 Sec. Longitude: W092 Deg. 24 Min. 21 Sec.
Location: LACLEDE CO. IN THE CORNER, SEC. 6, T. 33 N., R. 13 W.
MLRA: 116 Ozark
Physiography: Upland ridge in level to undulating uplands
Geomorphic position: On upper third interfluve
Slope andaspect: 6 pct SW convex Elevation: 385 m M.S.L.
Microrelief: None
Air temp. 13 C Summer: 24 C Winter: 1 C
Precipitation: 101 cm Udic moisture regime.
Water table: Not observed
Drainage: Well drained Permeability:
Stoniness:
Land use:
Erosion or Deposition:
Parent material: weathered residuum from dolomite
Described by:
SAMP NOS 81P202 210.

A 0 - 16 cm Yellowish brown (10YR 5/4) silt loam; weak very fine granular structure; friable; many medium roots; about 10 percent chert gravel; clear smooth boundary.

Bt1 16 - 29 cm Reddish brown (5YR 5/4) silt loam; weak fine subangular blocky structure; friable; common thin discontinuous clay skins on faces of peds; about 20 percent chert gravel; common medium roots; clear smooth boundary.

2Bt2 29 - 48 cm Reddish brown (5YR 4/4) and brown (7.5YR 5/4) very gravelly silty clay loam; weak fine subangular blocky structure; friable; common medium roots; common thin discontinuous clay skins on faces of peds; about 60 percent chert gravel; gradual smooth boundary.

2Bt3 48 - 67 cm Dark red (2.5YR 3/6) and light reddish brown (5YR 6/3) extremely gravelly silty clay loam; weak fine subangular blocky structure; firm, hard; common fine roots; common thin discontinuous clay skins on faces of peds; about 65 percent chert gravel; clear wavy boundary.

2Bx1 67 - 91 cm Dark gray (5YR 4/1) extremely gravelly silt loam; common fine distinct reddish yellow (7.5YR 6/6) and common fine distinct strong brown (7.5YR 5/8) mottles; massive; very firm, extremely hard, brittle; about 70 percent chert gravel; clear smooth boundary.

2Bx2 91 - 125 cm Light gray (5YR 7/1) very gravelly silt loam; common fine distinct reddish yellow (7.5YR 6/6) and common fine distinct red (7.5R 5/8) mottles; massive; very firm, extremely hard, brittle; about 40 percent chert gravel; clear smooth boundary.

3Bt1 125 - 166 cm Red (2.5YR 4/6) silty clay; many medium prominent light gray to gray (5YR 6/1) mottles; weak medium subangular blocky structure; firm, hard; common thin discontinuous clay skins on faces of peds; about 5 percent chert gravel; gradual smooth boundary.

3Bt2 166 - 335 cm Light gray (5YR 7/1) and dark red (10R 3/6) clay; common fine faint yellowish red (5YR 5/8) and common fine faint dark red (2.5YR 3/6) mottles; moderate very coarse subangular blocky structure parting to moderate coarse subangular blocky; firm, hard; common thin discontinuous clay skins on faces of peds; few chert gravel. SPLIT FOR SAMPLING 266-252 CM AND 252-335 CM.

S80MO-105-007

*** PRIMARY CHARACTERIZATION DATA ***
(LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : VIRATON ; FINE-LOAMY, SILICEOUS, MESIC TYPIC FRAGUIDALF
REVISED TO : WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF

NSSL - PROJECT 81P 10, GEOMORPHOLOGY STUDY-LAKE OF THE OZARKS SSA
- PEDON 81P 31, SAMPLES 81P 202- 210
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM) -1--	HORIZON -2--	-3--	CLAY LT .002 -4--	SILT .002 -.05 -5--	SAND .05 -2 -6--	FINE CLAY LT .0002 -7--	CO3 CLAY LT .002 -8--	FINE SILT .002 -.02 -9--	COARSE SILT .02 -.05 -10-	VF SAND .05 -.10 -11-	F SAND .10 -.25 -12-	M SAND .25 -.50 -13-	C SAND .5 -1 -14-	VC SAND 1 -2 -15-	WEIGHT 2 -5 -16-	WEIGHT 5 -20 -17-	WEIGHT 20 -75 -18-	WEIGHT .1- 75 -19-	(>2MM) WT PCT OF WHOLE SOIL -20-
				(- - -TOTAL - - -)(- -CLAY- -)(- -SILT- -)(- - - - - -SAND- - - - - - -) <- - - - - - - - - - - - - PCT OF <2MM (3A1) - - - - - - - - - - - - - - ->												(-COARSE FRACTIONS(MM)-) <- PCT OF <75MM(3B1)->				
81P 202S	0- 16	A		12.0	75.2	12.8	2.1		49.2	26.0	2.2	3.4	2.6	2.2	2.4	4	3	4V	20	11
81P 203S	16- 29	Bt1		13.4	75.3	11.3	2.9		49.7	25.6	2.0	3.1	2.3	1.4	2.5	4	10	9V	30	23
81P 204S	29- 48	2Bt2		18.7	70.2	11.1	6.9		50.1	20.1	1.7	2.4	1.7	1.9	3.4	5	30	34	72	69
81P 205S	48- 67	2Bt3		27.0	61.0	12.0	12.7		44.2	16.8	1.8	2.1	1.4	1.8	4.9	4	19	49	75	75
81P 206S	67- 91	2Bx1		22.8	48.7	28.5	11.0		31.7	17.0	3.3	4.3	4.1	5.7	11.1	5	25	48	84	84
81P 207S	91-125	2Bx2		26.7	59.0	14.3	12.2		37.7	21.3	3.9	3.1	1.8	2.2	3.3	4	5	20V	36	49
81P 208S	125-166	3Bt1		70.5	25.3	4.2	36.9		18.9	6.4	1.5	1.1	0.6	0.6	0.4	1	2	9V	14	12
81P 209S	166-252	3Bt2		64.6	29.1	6.3	37.9		22.2	6.9	2.1	3.1	0.8	0.2	0.1	TR	2	4V	10	6
81P 210S	252-335	3Bt2		75.8	14.1	10.1	48.7		12.4	1.7	1.4	4.0	3.6	0.6	0.5	TR	1	4V	13	5

DEPTH (CM)	ORGN C 6A1c PCT	TOTAL N 6B3a <2MM	EXTR P 6S3 PPM	TOTAL S 6R3a	DITH-CIT EXTRACTABLE FE 6C2b	DITH-CIT EXTRACTABLE AL 6G7a	DITH-CIT EXTRACTABLE MN 6D2a	(RATIO/CLAY) CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	(ATTERBERG - LIMITS -) LL 4F1	(ATTERBERG - LIMITS -) PI 4F	BULK DENSITY FIELD MOIST 4A3a	BULK DENSITY 1/3 BAR 4A1d	BULK DENSITY OVEN DRY 4A1h	COLE WHOLE SOIL 4D1	WATER CONTENT FIELD MOIST 4B4	WATER CONTENT 1/10 BAR 4B1c	WATER CONTENT 1/3 BAR 4B1c	WATER CONTENT 15 BAR 4B2a	WRD WHOLE SOIL 4C1
				<- PERCENT OF <2MM -->						PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
0- 16	1.47	0.093			0.8		TR	0.63	0.43				1.40						5.2	
16- 29	0.55	0.045			0.7		TR	0.48	0.38	24	4		1.40						5.1	
29- 48	0.42	0.036			1.0		--	0.44	0.35				1.40						6.6	
48- 67	0.33	0.036			1.1		--	0.48	0.40	34	13		1.40						10.8	
67- 91	0.15				1.1		--	0.48	0.40				0.88	0.95	0.009			41.4	9.2	0.11
91-125	0.13				1.1		--	0.32	0.33				1.44	1.49	0.007			22.6	8.7	0.13
125-166	0.12				3.2		--	0.27	0.33	66	38		1.37	1.69	0.067			30.6	23.0	0.10
166-252	0.12				2.5		--	0.28	0.38				1.31	1.65	0.077			33.3	24.5	0.11
252-335	0.10				3.2		--	0.29	0.37				1.16	1.48	0.082			38.6	28.4	0.12

AVERAGES, DEPTH 29- 67: PCT CLAY 23 PCT .1-75MM 73

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-007 PRINT DATE 02/26/91

SAMPLED AS : VIRATON ; FINE-LOAMY, SILICEOUS, MESIC TYPIC FRAGUIDALF

NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 31, SAMPLE 81P 202- 210

DEPTH (CM)	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	(- NH4OAC EXTRACTABLE BASES -)					ACID-	EXTR	(- - - -CEC - - - -)			AL	-BASE SAT-		CO3 AS	RES.		COND.	(- - - -PH - - - -)		
	CA 5B5a 6N2e	MG 5B5a 6O2d	NA 5B5a 6P2b	K 5B5a 6Q2b	SUM BASES	ITY 6H5a	AL 6G9a	SUM CATS 5A3a	NH4- OAC 5A8b	BASES + AL 5A3b	SAT 5G1	SUM 5C3	NH4 OAC 5C1	CACO3 <2MM 6E1g	OHMS /CM 8E1		MMHOS /CM 8I		CACL2 .01M 8C1f 1:2	H2O 8C1f 1:1
	<- - - - - - - - - - - - -MEQ / 100 G - - - - - - - - - - - - ->										<- - - - -PCT - - - ->									
0- 16	0.3	0.5	--	0.2	1.0	8.6	3.2	9.6	7.6	4.2	76	10	13						4.1	4.2
16- 29	0.1	0.5	--	0.2	0.8	6.4	3.1	7.2	6.4	3.9	79	11	13						4.1	4.5
29- 48	0.1	0.9	--	0.2	1.2	8.1	4.3	9.3	8.2	5.5	78	13	15						4.1	4.6
48- 67	0.2	1.7	TR	0.2	2.1	13.1	8.0	15.2	13.0	10.1	79	14	16						4.0	4.6
67- 91	0.1	1.3	TR	0.2	1.6	10.4	7.1	12.0	11.0	8.7	82	13	15						3.9	4.5
91-125	0.5	1.0	0.1	0.1	1.7	8.9	5.2	10.6	8.6	6.9	75	16	20		24000				3.9	4.6
125-166	4.5	3.7	0.5	0.3	9.0	12.2	4.7	21.2	18.9	13.7	34	42	48						4.1	4.8
166-252	6.1	4.9	0.9	0.4	12.3	9.5	2.4	21.8	18.4	14.7	16	56	67						4.0	4.1
252-335	9.3	5.6	1.3	0.6	17.8	8.7	0.7	26.5	21.8	18.5	4	67	82						4.7	4.7

ESTIMATED BULK DENSITY FOR LAYER 1, 2, 3, 4.

ANALYSES: S= ALL ON SIEVED <2MM BASIS V= 75-20MM FROM VOLUME ESTIMATES

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-007 PRINT DATE 02/26/91
SAMPLED AS : VIRATON ; FINE-LOAMY, SILICEOUS, MESIC TYPIC FRAGUIDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 31, SAMPLE 81P 202- 210

CLAY MINERALOGY (<.002mm)

SAMPLE NUMBER	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	FRACTION	X-RAY					THERMAL				ELEMENTAL								EGME RETN	INTERPRETATION
							DTA		TGA		SiO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O			
		7A2i					7A6		7A4b		7C3								7D2	
		peak size					Percent				Percent								mg/g	
81P 202	TCLY	VR 3	KK 2	MI 1	QZ 1															
81P 205	TCLY	VR 3	MT 3	KK 3	MI 2	QZ 1	KK15						8.6			1.2				
81P 206	TCLY	VR 3	MT 3	KK 3	MI 2	QZ 1	KK17						8.7			1.3				
81P 208	TCLY	KK 4	MI 2	VR 1	QZ 1	GE 1	KK36						7.6			1.4				
81P 208	TCLY	HL 1																		
81P 210	TCLY	KK 4	MI 3	QZ 2	VR 1	HE 1	KK39						8.6			1.6				

SAND - SILT MINERALOGY (2.0-0.002mm)

SAMPLE NUMBER	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	FRACTION	X-RAY				THERMAL				TOT RE	OPTICAL									INTERPRETATION
						DTA		TGA			GRAIN COUNT									
		7A2i				7A3b		7A4b			7B1a									
		Peak Size				Percent					Percent									
81P 203	VFS									99	QZ54	CD38	QI 6	FK 1	OPtr	PO 1				
81P 205	VFS									99	QZ44	CD44	QI11	FK 1	OPtr	POtr				
81P 206	VFS									100	QZ38	CD55	QI 7	FKtr	OPtr					

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm VFS Very Fine Sand, 0.05-0.10mm

MINERAL INTERPRETATION:

VR vermiculite	KK kaolinite	MI mica	QZ quartz	CD chalcedony	QI fe-coat qz
FK potas-feld	OP opaques	PO plant opal	MT montmorill	GE goethite	HE hematite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

S80MO-105-007

*** SUPPLEMENTARY CHARACTERIZATION DATA ***
(LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : VIRATON ; FINE-LOAMY, SILICEOUS, MESIC TYPIC FRAGUIDALF
REVISED TO : WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF

NSSL - PROJECT 81P 10,
- PEDON 81P 31, SAMPLES 81P 202- 210
- GENERAL METHODS (ENGINEERING FRACTIONS ARE CALCULATED FROM USDA FRACTION SIZES)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (IN.)	HORIZON	ENGINEERING PERCENTAGE PASSING, INCHES: 3	2	3/2	1	3/4	3/8	NUMBER: 4	10	40	200	PSDA SIEVE, MICRONS: 20	5	2	CUMULATIVE CURVE FRACTIONS(<76MM), USDA LESS THAN, MM: 1.	.5	.25	.10	.05	DIAMETERS(MM) AT PERCENTILE: 60	50	10	ATTERBERG, PCT: LL	PI	GRADATION UNIFMTY CU	CURVTUR CC
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
81P 202S	0- 6	A	100	99	98	97	96	95	93	89	84	79	54	28	11	87	85	83	80	78	0.02	0.016	0.002			14.4	0.7
81P 203S	6- 11	Bt1	100	97	96	93	91	86	81	77	74	69	49	26	10	75	74	72	70	68	0.03	0.021	0.002	24	4	18.2	0.7
81P 204S	11- 19	2Bt2	100	90	83	73	66	51	36	31	29	28	21	12	6	30	29	29	28	28	14.37	9.020	0.004			>100	20.0
81P 205S	19- 26	2Bt3	100	86	76	61	51	42	32	28	26	25	20	12	8	27	26	26	25	25	24.45	17.653	0.003	34	13	>100	>100
81P 206S	26- 36	2Bx1	100	86	76	62	52	40	27	22	18	16	12	8	5	20	18	17	16	16	23.89	16.991	0.010			>100	>100
81P 207S	36- 49	2Bx2	100	94	90	84	80	78	75	71	67	62	46	30	19	69	67	66	64	61	0.05	0.026	0.001			70.5	0.8
81P 208S	49- 65	3Bt1	100	97	96	93	91	90	89	88	87	85	79	69	62	88	87	87	86	84	--	0.001	--	66	38	6.4	0.7
81P 209S	65- 99	3Bt2	100	99	98	97	96	95	94	94	94	89	82	69	61	94	94	93	90	88	--	0.001	--			6.7	0.7
81P 210S	99-132	3Bt2	100	99	98	97	96	96	95	95	93	86	84	77	72	95	94	91	87	85	--	0.001	--			4.9	0.7

DEPTH (IN.)	WEIGHT FRACTIONS, WHOLE SOIL (MM), PCT OF WHOLE SOIL: >2	250 -UP	250 -75	75 -2	75 -20	20 -5	5 -2	<2	<75 MM FRACTION, PCT OF <75 MM: 75 -2	75 -20	20 -5	5 -2	<2		WEIGHT PER UNIT VOLUME G/CC, WHOLE SOIL: SOIL SURVEY 1/3 BAR	OVEN -DRY	ENGINEERING MOIST	SATUR -ATED	<2 MM FRACTION: SOIL SURVEY 1/3 BAR	15 BAR	OVEN -DRY	ENGINEERING MOIST	SATUR -ATED	VOID RATIOS AT 1/3 BAR: WHOLE SOIL	<2 MM
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
0- 6	11	--	--	11	4	3	4	89	11	4	3	4	89		1.48										
6- 11	23	--	--	23	9	10	4	77	23	9	10	4	77		1.56										
11- 19	69	--	--	69	34	30	5	31	69	34	30	5	31		2.06										
19- 26	75	--	12	63	43	17	4	25	72	49	19	4	28		2.17										
26- 36	84	--	27	57	35	18	4	16	78	48	25	5	22		1.97	2.03	2.11	2.23	0.88	0.94	0.95	1.24	1.55	0.35	2.01
36- 49	50	--	28	21	14	4	3	50	29	20	5	4	71		1.86	1.90	2.06	2.16	1.44	1.47	1.49	1.77	1.90	0.42	0.84
49- 65	12	--	--	12	9	2	1	88	12	9	2	1	88		1.45	1.77	1.84	1.90	1.37	1.45	1.69	1.79	1.85	0.83	0.93
65- 99	6	--	--	6	4	2	TR	94	6	4	2	TR	94		1.35	1.69	1.77	1.84	1.31	1.40	1.65	1.75	1.82	0.96	1.02
99-132	5	--	--	5	4	1	TR	95	5	4	1	TR	95		1.20	1.52	1.64	1.75	1.16	1.25	1.48	1.61	1.72	1.21	1.28

*** SUPPLEMENTARY CHARACTERIZATION DATA ***

S80MO-105-007 PRINT DATE 02/26/91
CLASSIFICATION: WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 31, SAMPLE 81P 202- 210

DEPTH (IN.)	VOLUME FRACTIONS, WHOLE SOIL (MM) AT 1/3 BAR: >2	250-UP	250-75	75-2	75-20	20-5	5-2	<2	2-.05	.05-.002	LT .002	PORES D	PORES F	(C/)(/N) RAT -10	RATIOS TO CLAY: FINE CLAY	CEC SUM CATS	CEC NH4-OAC	15 BAR H2O	LE 1/3 BAR	LINEAR EXTENSIBILITY WHOLE SOIL <-1/3 BAR TO 15 BAR	WHOLE SOIL OVEN-DRY	<2 MM (PCT) 15 BAR	<2 MM OVEN-DRY	W R D WHOLE SOIL (IN/IN)	W R D <2 MM (IN/IN)
	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
0- 6	6	--	--	6	2	2	2	94	6	37	6	44		16	0.18	0.80	0.63	0.43							
6- 11	14	--	--	14	5	6	2	86	5	35	6	41		12	0.22	0.54	0.48	0.38							
11- 19	53	--	--	53	26	23	4	47	3	17	5	22		12	0.37	0.50	0.44	0.35							
19- 26	62	--	10	52	35	14	3	38	3	13	6	18		9	0.47	0.56	0.48	0.48							
26- 36	63	--	20	43	26	14	3	37	4	6	3	12	14		0.48	0.53	0.48	0.40	0.114	0.8	1.0	2.2	2.6	0.10	0.28
36- 49	35	--	20	15	10	3	2	65	5	21	10	10	20		0.46	0.40	0.32	0.33	0.041	0.5	0.7	0.7	1.1	0.13	0.20
49- 65	7	--	--	7	5	1	1	93	2	12	34	6	39		0.52	0.30	0.27	0.33	0.102	1.8	6.9	1.9	7.2	0.10	0.10
65- 99	3	--	--	3	2	1	TR	97	3	14	31	7	42		0.59	0.34	0.28	0.38	0.124	2.4	7.8	2.2	8.0	0.11	0.12
99-132	2	--	--	2	2	1	TR	98	4	6	32	11	44		0.64	0.35	0.29	0.37	0.112	2.4	8.2	2.5	8.5	0.12	0.12

DEPTH (IN.)	WEIGHT FRACTIONS - CLAY FREE, WHOLE SOIL: >2 PCT	75-2 PCT OF	20-2	2-.05	.05-.002	LT .002	<2 MM FRACTION SANDS: VC	C	M	F	VF	SILTS C	SILTS F	CLAY	TEXTURE DETERMINED IN FIELD	TEXTURE BY PSDA	PSDA SAND 2-.05	SILT .05-.002	CLAY LT .002	PH CACL2 .01M	ELECTRICAL RESIST. OHMS	CONDUCT. MMHOS	SALT MG/KG	CUMULT. AMOUNTS IN. OF H2O 1/3 BAR TO 15BAR	AIRDRY
	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
0- 6	12	12	8	13	75	12	3	2	3	4	2	30	56	14	SIL	SIL	12.8	75.2	12.0	4.1					
6- 11	26	26	16	10	65	12	3	2	3	4	2	30	57	15	SIL	SIL	11.3	75.3	13.4	4.1					
11- 19	73	73	37	4	23	6	4	2	2	3	2	25	62	23	SICL	SIL	11.1	70.2	18.7	4.1					
19- 26	80	68	23	3	16	7	7	2	2	3	2	23	61	37	SICL	SICL	12.0	61.0	27.0	4.0					
26- 36	87	59	23	5	8	4	14	7	5	6	4	22	41	30	SIL	L	28.5	48.7	22.8	3.9					
36- 49	58	24	8	8	34	15	5	3	2	4	5	29	51	36	SIL	SIL	14.3	59.0	26.7	3.9	24000				
49- 65	32	32	8	10	59	163	1	2	2	4	5	22	64	239	SIC	C	4.2	25.3	70.5	4.1					
65- 99	15	15	5	15	70	155	TR	1	2	9	6	19	63	182	C	C	6.3	29.1	64.6	4.0					
99-132	18	18	4	34	48	257	2	2	15	17	6	7	51	313	C	C	10.1	[illegible]	75.0	4.7					

Pedon No.: **S80MO-105-008** **Date: 4/82**

Sampled as: VIRATON; Fine-loamy, siliceous, mesic Typic Fragiudalf
Revised to: WILDERNESS; Loamy-skeletal, siliceous, mesic Typic Fragiudalf
Latitude: N37 Deg. 36 Min. 12 Sec. Longitude: W092 Deg. 24 Min. 27 Sec.
Location: LACLEDE CO. IN THE CORNER, SEC. 6, T. 33 N., R. 13 W.
MLRA: 116 Ozark
Physiography: Upland ridge in level to undulating uplands
Geomorphic position: On middle third interfluve
Slope and aspect: 7 pct SW convex Elevation: 376 m M.S.L.
Microrelief: None
Air temp. 13 C Summer: 24C Winter: 1 C
Precipitation: 101 cm Udic moisture regime.
Water Table: Not observed
Drainage: Well drained Permeability:
Stoniness:
Land use:
Erosion or deposition:
Parent Material: strongly weathered, residual material from `Jefferson City dolomite
Described by:
SAMP NOS 81P211 217.

A 0 - 9 cm Brown (10YR 5/3) gravelly silt loam; weak fine granular structure; friable; many medium roots; about 35 percent chert gravel; clear smooth boundary.

BE 9 - 24 cm Gray (N 5/0) very gravelly silt loam; weak very fine subangular blocky structure; friable; many medium roots; about 50 percent chert gravel; clear smooth boundary.

Bt1 24 - 43 cm Yellowish brown (10YR 5/4) very gravelly silt loam; weak very fine subangular blocky structure; friable; common thin discontinuous clay skins on faces of peds; common medium roots; about 45 percent chert gravel; clear smooth boundary.

Bt2 43 - 66 cm Strong brown (7.5YR 5/6) and light yellowish brown (10YR 6/4) very gravelly silty clay loam; weak fine subangular blocky structure; friable; common medium roots; common thin discontinuous clay skins on faces of peds; about 45 percent chert graavel; clear smooth boundary.

2Bx 66 - 87 cm Very pale brown (10YR 7/4) gravelly silty clay loam; few fine distinct strong brown (7.5YR 5/6) and few fine distinct strong brown (7.5YR 5/8) mottles; massive; very firm, extremely hard, brittle; about 30 percent chert gravel; gradual smooth boundary.

2Bt1 87 - 135 cm Light gray (5YR 7/1) and light reddish brown (5YR 6/4) silty clay; reddish yellow (5YR 6/6, rubbed); moderate fine to medium subangular blocky structure; firm, hard; common thin discontinuous clay skins on faces of peds; about 5 percent chert gravel; gradual smooth boundary.

2Bt2 135 - 228 cm Dark red (2.5YR 3/6) gravelly silty clay; massive; firm, hard; common thin discontinuous clay skins on faces of peds; about 20 percent chert gravel.

S80MO-105-008

*** PRIMARY CHARACTERIZATION DATA ***

(LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : VIRATON ; FINE-LOAMY, SILICEOUS, MESIC TYPIC FRAGIUDALF
REVISED TO : WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF

NSSL - PROJECT 81P 10, GEOMORPHOLOGY STUDY-LAKE OF THE OZARKS SSA
- PEDON 81P 32, SAMPLES 81P 211- 217
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	-4-- (- - -TOTAL - - -) CLAY LT .002	-5-- SILT .002 -.05	-6-- SAND .05 -2	-7-- (- -CLAY- -) FINE LT .0002	-8-- CO3 LT .002	-9-- (- -SILT- -) FINE .002 -.02	-10- COARSE .02 -.05	-11- (- - - SAND- - -) VF .05 -.10	-12- F .10 -.25	-13- M .25 -.50	-14- C .5 -1	-15- VC 1 -2	-16- (-COARSE FRACTIONS(MM)-) WEIGHT 2 -5	-17- 5 -20	-18- 20 -75	-19- .1- 75	-20- (>2MM) WT PCT OF WHOLE SOIL
			<- - - - - - - - - - - - - -	PCT OF <2MM	(3A1)								- - - - - - ->	<- PCT OF	<75MM(3B1)->				
81P 211S	0- 9	A	10.4	69.9	19.7	2.5		47.0	22.9	1.6	4.3	2.6	4.8	6.4	7	13	25	55	45
81P 212S	9- 24	BE	11.0	68.3	20.7	--		44.7	23.6	1.7	3.9	3.5	3.2	8.4	8	33	25	72	66
81P 213S	24- 43	Bt1	10.9	65.2	23.9	2.4		43.6	21.6	2.0	3.5	3.2	3.9	11.3	11	25	24	69	60
81P 214S	43- 66	Bt2	18.6	66.7	14.7	4.9		44.5	22.2	3.0	4.2	2.5	2.2	2.8	4	13	39	61	62
81P 215S	66- 87	2Bx	25.0	65.6	9.4	7.3		42.8	22.8	2.7	2.3	1.3	1.1	2.0	3	11	22V	40	40
81P 216S	87-135	2Bt1	57.1	37.2	5.7	27.4		25.7	11.5	1.9	1.2	0.6	0.9	1.1	2	1	4V	11	11
81P 217S	135-228	2Bt2	61.9	24.3	13.8	38.5		18.8	5.5	3.4	3.6	2.1	1.8	2.9	16	4	4V	32	31

DEPTH (CM)	ORGN C 6A1c PCT	TOTAL N 6B3a <2MM	EXTR P 6S3 PPM	TOTAL S 6R3a	(- - DITH-CIT - -) EXTRACTABLE FE 6C2b	AL 6G7a	MN 6D2a	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG - LIMITS -) LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3a	1/3 BAR 4A1d	OVEN DRY 4A1h	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1c	1/3 BAR 4B1c	15 BAR 4B2a	WRD WHOLE SOIL 4C1
				<- PERCENT	OF	<2MM -->				PCT <0.4MM		<- - G/CC	- - ->		CM/CM	<- - -PCT OF	<2MM - ->			CM/CM
0- 9	1.67	0.106			0.7		0.1	0.65	0.49				1.30						5.1	
9- 24	0.51	0.048			0.7		TR	0.37	0.35				1.30						3.9	
24- 43	0.22	0.024			0.8		--	0.35	0.34				1.32	1.35	0.004			25.8	3.7	0.17
43- 66	0.18	0.025			0.7		--	0.32	0.34				1.40						6.3	
66- 87	0.07				0.8		--	0.24	0.27				1.67	1.72	0.007			17.3	6.8	0.12
87-135	0.07				2.3		--	0.23	0.32				1.20						18.2	
135-228	0.12				2.6		--	0.20	0.41				1.18	1.32	0.031			40.6	25.5	0.15

AVERAGES, DEPTH 24- 66: PCT CLAY 15 PCT .1-75MM 64

*** P R I M A R Y   C H A R A C T E R I Z A T I O N   D A T A ***

S80MO-105-008 PRINT DATE 02/26/91
SAMPLED AS : VIRATON ; FINE-LOAMY, SILICEOUS, MESIC TYPIC FRAGIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 32, SAMPLE 81P 211- 217

DEPTH (CM)	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
	(- NH4OAC EXTRACTABLE BASES -)					ACID-	EXTR	(- - - -CEC - - -)			AL	-BASE SAT-		CO3 AS	RES.		COND.		(- - - -PH - - -)	
	CA	MG	NA	K	SUM	ITY	AL	SUM	NH4-	BASES	SAT	SUM	NH4	CACO3	OHMS		MMHOS		CACL2	H2O
	5B5a	5B5a	5B5a	5B5a	BASES			CATS	OAC	+ AL			OAC	<2MM	/CM		/CM		.01M	
	6N2e	6O2d	6P2b	6Q2b		6H5a	6G9a	5A3a	5A8b	5A3b	5G1	5C3	5C1	6E1g	8E1		8I		8C1f	8C1f
	<- - - - - - - - - - - -MEQ / 100 G - - - - - - - - - - - ->										<- - - - -PCT - - - ->								1:2	1:1
0- 9	1.5	0.7	0.1	0.3	2.6	7.3	1.2	9.9	6.8	3.8	32	26	38						4.4	4.6
9- 24	0.6	0.5	--	0.2	1.3	3.9	1.1	5.2	4.1	2.4	46	25	32						4.5	4.9
24- 43	0.5	0.6	--	0.1	1.2	3.1	1.0	4.3	3.8	2.2	45	28	32						4.3	5.0
43- 66	0.7	1.0	0.1	0.1	1.9	4.9	2.7	6.8	5.9	4.6	59	28	32						4.1	4.8
66- 87	0.4	0.9	--	0.1	1.4	6.0	3.6	7.4	6.1	5.0	72	19	23						4.1	4.7
87-135	1.6	2.8	TR	0.2	4.6	10.9	5.5	15.5	13.4	10.1	54	30	34						4.0	4.7
135-228	2.8	4.9	0.1	0.2	8.0	11.4	4.1	19.4	17.1	12.1	34	41	47						3.9	4.1

ESTIMATED BULK DENSITY FOR LAYER 1, 2, 4, 6,

ANALYSES: S= ALL ON SIEVED <2MM BASIS V= 75-20MM FROM VOLUME ESTIMATES

*** PRIMARY CHARACTERIZATION DATA ***

S80MO-105-008 PRINT DATE 02/26/91
SAMPLED AS : VIRATON ; FINE-LOAMY, SILICEOUS, MESIC TYPIC FRAGIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 32, SAMPLE 81P 211- 217

CLAY MINERALOGY (<.002mm)

SAMPLE NUMBER	-1- FRACTION	-2- X-RAY 7A2i peak size	-3-	-4-	-5-	-6- THERMAL DTA 7A6 Percent	-7-	-8-	-9- TGA 7A4b	-10-	-11- SIO2 (ELEMENTAL 7C3 Percent)	-12- AL2O3	-13- Fe2O3	-14- MgO	-15- CaO	-16- K2O	-17- Na2O	-18-	-19- EGME RETN 7D2 mg/g	-20- INTERPRETATION
81P 212	TCLY	VR 2	KK 2	MI 1									6.0			6.9				
81P 214	TCLY	KK 3	VR 2	MI 2	QZ 1		KK11						8.6			1.3				
81P 215	TCLY	KK 3	VR 3	MI 2	QZ 1		KK20						7.7			1.4				
81P 216	TCLY	KK 3	MI 3	QZ 2			KK25						6.4			1.9				
81P 217	TCLY	KK 3	MI 3	QZ 2			KK34						6.7			1.9				

SAND - SILT MINERALOGY (2.0-0.002mm)

SAMPLE NUMBER	-1- FRACTION	-2- X-RAY 7A2i Peak Size	-3-	-4-	-5- THERMAL	-6- DTA 7A3b Percent	-7- TGA 7A4b	-8-	-9-	-10- TOT RE	-11- OPTICAL GRAIN COUNT 7B1a Percent	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20- INTERPRETATION
81P 212	VFS									97	QZ50	CD38	QI 8	FK 3	OP 1					
81P 214	VFS									101	QZ50	CD43	QI 7	FK 1	OP 1					
81P 215	VFS									99	QZ42	CD50	QI 7	FK 1	OPtr					

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm VFS Very Fine Sand, 0.05-0.10mm

MINERAL INTERPRETATION:

VR vermiculite KK kaolinite MI mica QZ quartz CD chalcedony QI fe-coat qz
FK potas-feld OP opaques

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

S80MO-105-008

*** SUPPLEMENTARY CHARACTERIZATION DATA ***

(LACLEDE COUNTY, MISSOURI)

PRINT DATE 02/26/91

SAMPLED AS : VIRATON ; FINE-LOAMY, SILICEOUS, MESIC TYPIC FRAGIUDALF
REVISED TO : WILDERNESS ; LOAMY-SKELETAL, SILICEOUS, MESIC TYPIC FRAGIUDALF

NSSL - PROJECT 81P 10,
- PEDON 81P 32, SAMPLES 81P 211- 217
- GENERAL METHODS (ENGINEERING FRACTIONS ARE CALCULATED FROM USDA FRACTION SIZES)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (IN.)	HORIZON	ENGINEERING PERCENTAGE PASSING SIEVE: INCHES 3	2	3/2	1	3/4	3/8	NUMBER 4	10	40	200	PSDA: MICRONS 20	5	2
			1	2	3	4	5	6	7	8	9	10	11	12	13
81P 211S	0- 4	A	100	93	88	80	75	69	62	55	48	45	32	16	6
81P 212S	4- 9	B	100	93	88	81	76	60	43	35	31	28	19	10	4
81P 213S	9- 17	Bt1	100	93	88	81	76	64	51	40	34	31	22	11	4
81P 214S	17- 26	Bt2	100	89	81	69	61	55	48	44	42	38	28	16	8
81P 215S	26- 34	2Bx	100	94	89	83	78	73	67	64	62	59	43	27	16
81P 216S	34- 53	2Bt1	100	99	98	97	96	96	95	93	91	89	77	63	53
81P 217S	53- 90	2Bt2	100	99	98	97	96	94	92	76	72	67	61	53	47

SAMPLE NO.	CUMULATIVE CURVE FRACTIONS(<76MM) USDA LESS THAN (MM) 1.	.5	.25	.10	.05	DIAMETERS(MM) AT PERCENTILE 60	50	10	ATTERBERG (PCT) LL	PI	GRADATION UNIFMTY CU	CURVTUR CC
	14	15	16	17	18	19	20	21	22	23	24	25
81P 211S	51	49	47	45	44	3.68	0.678	0.003			>100	--
81P 212S	32	31	30	28	28	9.65	6.321	0.005			>100	1.8
81P 213S	35	34	33	31	30	7.77	4.349	0.004			>100	0.1
81P 214S	43	42	41	39	38	17.06	5.827	0.002			>100	--
81P 215S	63	62	61	60	58	0.12	0.030	0.001			>100	0.4
81P 216S	92	91	91	89	88	--	0.002	--			12.6	0.5
81P 217S	74	72	71	68	66	0.02	0.003	--			49.5	0.1

DEPTH (IN.)	WEIGHT FRACTIONS: WHOLE SOIL (MM), PCT OF WHOLE SOIL >2	250-UP	250-75	75-2	75-20	20-5	5-2	<2	<75 MM FRACTION, PCT OF <75 MM 75-2	75-20	20-5	5-2	<2		WEIGHT PER UNIT VOLUME G/CC: WHOLE SOIL, SOIL SURVEY 1/3 BAR	OVEN-DRY	ENGINEERING MOIST	SATURATED	<2 MM FRACTION, SOIL SURVEY 1/3 BAR	15 BAR	OVEN-DRY	ENGINEERING MOIST	SATURATED	VOID RATIOS AT 1/3 BAR WHOLE SOIL	<2 MM
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
0- 4	45	--	--	45	25	13	7	55	45	25	13	7	55		1.69										
4- 9	65	--	--	65	24	33	8	35	65	24	33	8	35		1.94										
9- 17	60	--	--	60	24	25	11	40	60	24	25	11	40		1.89	1.91	2.08	2.18	1.32	1.35	1.35	1.66	1.82	0.40	1.01
17- 26	62	--	13	49	34	11	3	38	56	39	13	4	44		1.98										
26- 34	40	--	7	33	20	10	3	60	36	22	11	3	64		1.96	2.00	2.16	2.22	1.67	1.70	1.72	1.96	2.04	0.35	0.59
34- 53	11	--	4	7	4	1	2	89	7	4	1	2	93		1.28										
53- 90	31	--	9	22	4	4	15	69	24	4	4	16	76		1.43	1.56	1.83	1.89	1.18	1.23	1.32	1.66	1.73	0.85	1.25

*** SUPPLEMENTARY CHARACTERIZATION DATA ***

S80MO-105-008 PRINT DATE 02/26/91

SAMPLED AS : VIRATON ; FINE-LOAMY, SILICEOUS, MESIC TYPIC FRAGIUDALF

NATIONAL SOIL SURVEY LABORATORY ; PEDON 81P 32, SAMPLE 81P 211- 217

DEPTH (IN.)	VOLUME FRACTIONS AT 1/3 BAR: WHOLE SOIL (MM) >2 (PCT OF WHOLE SOIL) 51	250-UP 52	250-75 53	75-2 54	75-20 55	20-5 56	5-2 57	<2 58	2-.05 59	.05-.002 60	LT .002 61	PORES D 62	PORES F 63	(C/N) RAT -10 64	RATIOS TO CLAY (<2 MM FRACTION) FINE CLAY 65	CEC SUM CATS 66	CEC NH4-OAC 67	15 BAR H2O 68	LE 1/3 BAR 69	LINEAR EXTENSIBILITY WHOLE SOIL <-1/3 BAR TO 15 BAR 70	WHOLE SOIL OVEN-DRY 71	<2 MM (PCT) 15 BAR 72	<2 MM OVEN-DRY 73	WRD WHOLE SOIL (IN/IN) 74	WRD <2 MM (IN/IN) 75
0- 4	29	--	--	29	16	8	4	71	7	25	4	36		16	0.24	0.95	0.65	0.49							
4- 9	47	--	--	47	17	24	6	53	5	17	3	27		11		0.47	0.37	0.35							
9- 17	43	--	--	43	17	18	8	57	7	18	3	10	19	9	0.22	0.39	0.35	0.34	0.073	0.4	0.4	0.8	0.8	0.17	0.29
17- 26	47	--	10	37	26	8	2	53	4	19	5	25		7	0.26	0.37	0.32	0.34							
26- 34	30	--	5	24	15	7	2	70	4	29	11	6	20		0.29	0.30	0.24	0.27	0.040	0.5	0.7	0.6	1.0	0.12	0.18
34- 53	5	--	2	3	2	1	1	95	2	16	24	52			0.48	0.27	0.23	0.32							
53- 90	17	--	5	12	2	2	8	83	5	9	23	6	40		0.62	0.31	0.28	0.41	0.061	1.2	2.9	1.4	3.8	0.15	0.18

DEPTH (IN.)	WEIGHT FRACTIONS - CLAY FREE: WHOLE SOIL >2 PCT 76	75-2 PCT OF >2MM+SAND+SILT 77	20-2 78	2-.05 79	.05-.002 80	LT .002 81	<2 MM FRACTION SANDS VC (PCT OF SAND+SILT) 82	C 83	M 84	F 85	VF 86	SILTS C 87	SILTS F 88	CLAY 89	TEXTURE (<2 MM) DETERMINED IN FIELD 90	BY PSDA 91	PSDA (MM) SAND 2-.05 (PCT OF <2MM) 92	SILT .05-.002 93	CLAY LT .002 94	(PH) CACL2 .01M 95	ELECTRICAL (<2 MM) RESIST. OHMS 96	CONDUCT. MMHOS 97	SALT MG/KG 98	CUMULT. AMOUNTS IN. OF H2O 1/3 BAR TO 15BAR (WHL SOIL) 99	AIRDRY 100
0- 4	48	48	21	11	41	6	7	5	3	5	2	26	52	12	SIL	SIL	19.7	69.9	10.4	4.4					
4- 9	68	68	43	8	25	4	9	4	4	4	2	27	50	12	SIL	SIL	20.7	68.3	11.0	4.5					
9- 17	63	63	38	10	27	5	13	4	4	4	2	24	49	12	SIL	SIL	23.9	65.2	10.9	4.3					
17- 26	67	53	15	6	27	8	3	3	3	5	4	27	55	23	SICL	SIL	14.7	66.7	18.6	4.1					
26- 34	47	39	15	7	46	18	3	1	2	3	4	30	57	33	SICL	SIL	9.4	65.6	25.0	4.1					
34- 53	22	14	6	10	67	103	3	2	1	3	4	27	60	133	SIC	C	5.7	37.2	57.1	4.0					
53- 90	54	38	33	17	29	75	8	5	6	9	9	14	49	162	SIC	C	13.8	24.3	61.9	3.9					