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Causes of Differences in Soil Series of the Missouri River Bottomlands of Monona County [1]

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The current soil survey of Monona County has revealed many differences in the alluvial deposits occurring in the Missouri River bottomlands. As a consequence the soils developed from these different deposits show numerous dissimilarities. It is the purpose of this paper to describe and explain the causes of the differences encountered.

The principal factors in soil formation are climate, organisms, topography, parent material and time. In the Missouri River bottomlands of Monona County it can be assumed that climate and organisms are not important causes of soil differences. In general, differences in topography are closely related to differences in parent material. Thus parent material or time of deposition or both, must be the principal cause or causes of soil differences.

The soils found on the Missouri River bottomlands are, for the most part, formed from alluvial materials. Some coarser alluvium may have been resorted by wind action subsequent to deposition but areas showing evidence of wind action are not extensive. The principal source of alluvium is the Missouri River; next, the tributary rivers and streams; and, of least importance, the steep bluffs that form the sides of the valley.

In figure 1 the principal soil series mapped on the Missouri River bottomlands have been grouped. These groups, while based on soil morphology, reflect the probable origin and relative age of the deposits. Some of the characteristics of each group of soils are shown in table 1. The Kennebec and Salix groups of soils have adequate surface drainage and desirable profile properties for the most part. They are predominantly silt loam to silty clay loam in texture. For these reasons they constitute much of the better agricultural land in the Missouri River valley.

The Missouri River meanders through a flat valley in Monona County, the valley varying up to 17 miles in width. At the present

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Table 1

Characteristics of the Soil Groups of the Missouri River Bottomlands of Monona County

Soil Group	Textural Range	Surface Color	Source of Alluvium	Depth to Carbonates
Undifferentiated	sand to silty clay	light olive brown	Missouri River	calcareous throughout
Albaton	loamy fine sand to clay	dark greyish brown	Missouri River	at or near surface
Luton-Albaton transition	mainly silty clay to clay	very dark brown with olive cast	Missouri River	in subsurface only
Salix	silt loam to silty clay	very dark brown	Missouri River	absent
Luton	silty clay to clay	very dark grey to black	Missouri River	usually absent to 30 inches
Kennebec	silt loam to silty clay	very dark brown	tributary rivers and streams and bluffs	absent

time the river is somewhat stabilized in its course by human agencies, but in places it is still actively cutting its banks. The soils of the area that is most frequently flooded in Monona County are shown in figure 1 as the undifferentiated group of soils. During periods of high water the banks along the first bottom are not high enough to contain the river at many points. Consequently the second and higher level bottoms of the undifferentiated group are subject to frequent flooding unless adequate dykes are constructed.

The Missouri River, especially when it rises to the flood stage, carries a heavy load. When the river overflows its banks the current of the overflow is reduced principally due to the frictional drag caused by vegetation. The reduction in the velocity of the current causes much of the load of the overflow to be deposited in the undifferentiated soil group area. The type of deposit apparently is determined by the current of the water at the point of deposition. In sheltered places where the current is markedly reduced accumulations of over four inches of silty clay deposits have been observed to occur in one year. Where the current of the overflow is swift such as at a break in a dyke or where vegetation is sparse, quite extensive areas have been covered with several feet of medium to fine sand. The coarse deposits are subject to some wind erosion

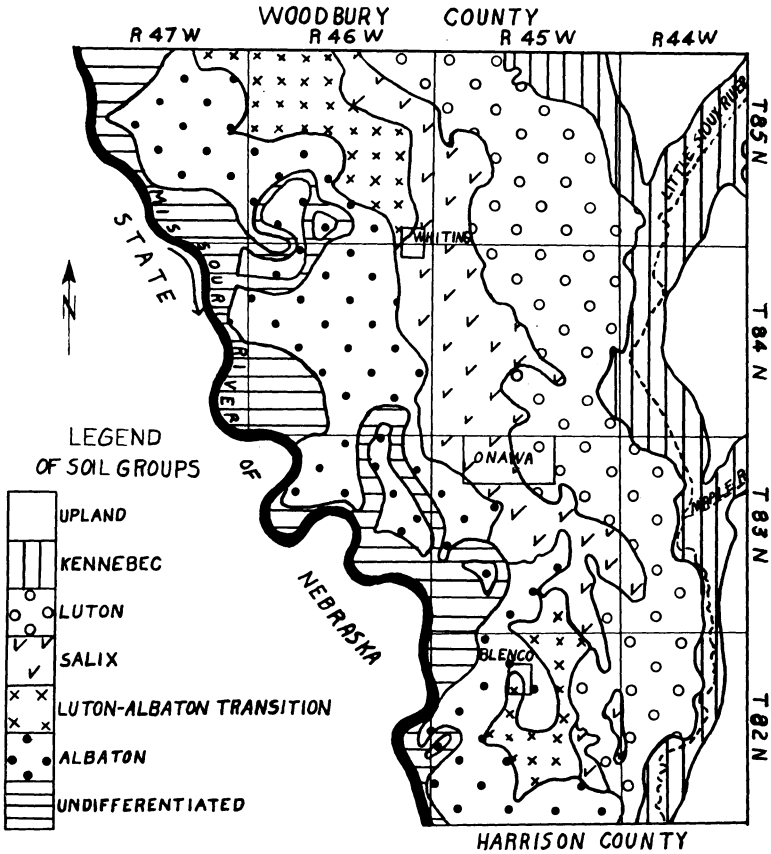

FIGURE I

SOIL GROUPS OF THE MISSOURI RIVER BOTTOMLANDS OF MONONA COUNTY

until vegetation stabilizes them. It is not unusual to find numerous layers of sediments of different textures covering any area in the undifferentiated group of soils. Most of the soils with sandy layers at or near the surface are found close to the river or adjacent to an old oxbow. It seems probable that when the river becomes high enough to flood onto the higher level bottoms most of the sand is deposited before the point of overflow is reached.

The soils found in the Albaton and Luton-Albaton transition groups of soils are less frequently flooded. These soils are only flooded during periods of extremely high water. Natural levees occur frequently in these areas. A diagram of a section of a natural levee is presented in figure 2 showing changes in the composition

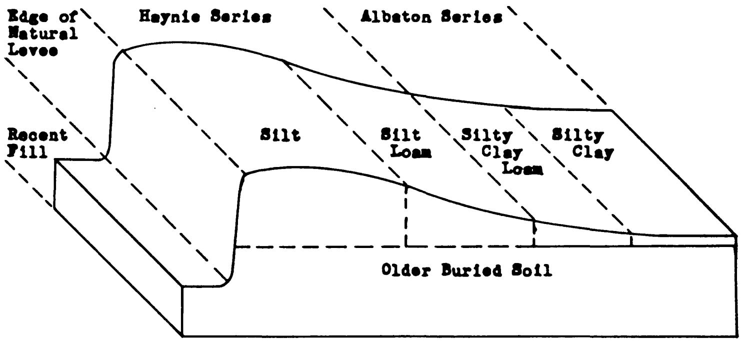

FIGURE 2

A SECTION OF A NATURAL LEVEE OF THE MISSOURI RIVER SHOWING CHANGES IN MECHANICAL COMPOSITION

of the sediments comprising the levee with increasing distance from the source of the overflow. It has been observed that the sediments become finer textured and shallower in depth as the distance from the point of apparent overflow increases. Likely the Missouri River has coursed over most, or all of the valley floor at some time in the past but it has gradually tended to move towards the western edge of the valley in more recent times. Remnants of old natural levees have been encountered in most parts of the bottomlands.

The Salix group of soils are formed from materials which seem to be old natural levees. The soils of the Salix group are dark and vary in texture from silt loam to silty clay loam. They are usually naturally well drained and fertile. They do not appear to have been flooded by the Missouri River in very recent times.

The Luton group of soils occupies a very shallow trough between the Salix and Kennebec groups. The Luton group is, for the most part, composed of dark, poorly drained, clay soils. They appear to be of the same age as the Salix group of soils. Presumably in the past the Missouri River was stabilized just west of the Salix group of soils and the Luton soils represent the finer textured alluvium that was deposited during floods. As the Kennebec and Salix soils occur at slightly higher elevations than the Luton soils natural drainage is to the south. The slope gradient is only about one foot per mile to the south and many depressional areas occur. The inadequate surface drainage together with the clayey nature of the deposits forming the Luton soils result in very restricted drainage.

The tributary rivers entering the Missouri River valley in Monona County are the Little Sioux and Maple Rivers. Both of these rivers, before entering the Misouri River bottomlands, have quite wide valleys. They meander along the eastern edge of the bottomlands before they enter the Missouri River. Both the Little Sioux and Maple Rivers have rather shallow banks and undoubtedly frequently overflowed in the past as they would do at the present time if they were not controlled. The soils along their bottoms before they enter the Missouri River valley are mainly silt loams in texture but some small areas of silty clay loam and silty clay soils do occur. As they approach the Missouri River valley the soils in their valleys become finer textured. Whether this finer material came from their watersheds or from the Missouri River of both is not apparent. Along most of their courses in the bottomlands they have built up narrow natural levees. The rather inextensive nature of these levees appears to indicate that these rivers have not been major factors in the deposition of alluvium on the Missouri River bottomlands.

The steep bluffs along the edges of the Missouri River Bottomlands have been the source of a narrow band of alluvial soils parallel to the faces of the bluffs. Where short drainage channels enter the valley small alluvial fans protrude onto the valley floor. Where the bluffs directly overlook the bottomlands the bluffs invariably have a narrow band of mixed colluvium and alluvium near their bases. This alluvial-colluvial deposit flattens out into an alluvial, silt loam soil which seldom exceeds two hundred yards in width before the level valley floor is reached. As the texture of the surface soils on the bluffs and the alluvial and colluvial soils are about the same, it seems unlikely that the bluffs could have been an important source of alluvium for the finer textured bottomland soils.

In figure 3 the nitrogen of profiles of several bottomland soil series* is shown graphically. These profiles were selected as being representative of the different groups of soils of the bottomlands of Monona County. Most of the nitrogen in the two profiles representing the Albaton group of soils (Albaton silty clay, P-142 and Haynie silt loam, P-148) is in the top eight inches. In the Haynie

*P-148 Haynie silt loam — 41′ W of SE corner of SW¼ of NE¼ of NW¼ of Sec. 34, T 85N, R 46W, Monona County.
P-142 Albaton silty clay — 400′ N and 35′ E of SW corner of Sec. 3, T 83N, R 46W, Monona County.
P-153 Salix silt loam — 150′ S of NE corner of SE¼ of Sec. 24, T 85N, R 45W, Monona County.
P-141 Luton clay — 100′ S of NE corner of NW¼ of sec. 12, T 83N, R 45W, Monona County.
P-150 Kennebec silt loam — 200 yards E of Maple River on road W of Castana, near top of S½ Sec. 24, T 84N, R 44W, Monona County.

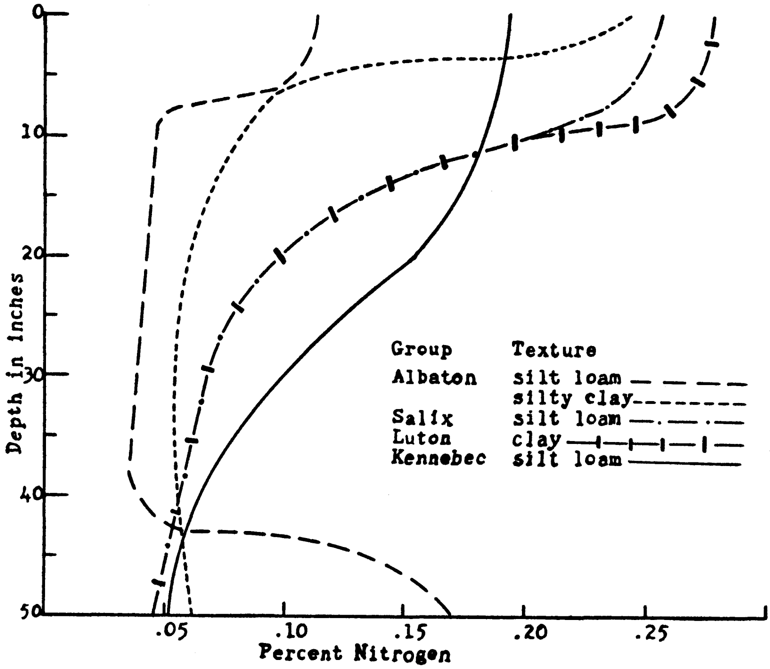

Figure 3
THE NITROGEN CONTENT OF FIVE PROFILES SELECTED AS BEING REPRESENTATIVE OF THE BOTTOMLAND SOILS OF MONONA COUNTY

silt loam profile (P-148) a buried profile occurs below forty inches. The profiles representing the Salix, Luton and Kennebec groups of soils (Salix silt loam, P-153, Luton clay, P-141, and Kennebec silt loam, P-150, respectively) have thicker accumulations of nitrogen. The greater accumulation of nitrogen in these three profiles together with the absence of carbonates in their solums indicates that soil formation has been progressing for a considerable period of time without significant deposition of new materials. The Albaton soils, by the same reasoning, must have developed on alluvium that was deposited relatively recently. It is known that parts of the area occupied by the Albaton group of soils have been recently flooded.

It seems apparent that differences between soils in the Missouri River bottomlands can be attributed to geological processes related to stream action. The soil textures are related to the depositional patterns of the river flood waters that spread out over the valley floor. The length of time that the soils do not receive new depositions is dependent upon the ability of the river to build natural levees or cut deeper channels so that flood waters are retained within an area close to the river.