Glacial Lake Patoka: A Geomorphic Reinterpretation Using Soil Survey

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Abstract

Soil maps were used to examine the relationship between the Illinoian age lacustrine facies of the Atherton Formation in northwestern Dubois County (Glacial Lake Patoka) and the Prospect Formation in the upper Patoka River basin. Most of the areas mapped Prospect Formation are remnants of two distinct topographic surfaces. One, at 550 feet, correlates with a possibly pre-Illinoian stage of Glacial Lake Patoka and the other, at 500 feet, correlates with the Illinoian stage of Glacial Lake Patoka. The 550 foot lake stage has not previously been recognized in the geologic literature. Late Illinoian terraces below the 500 foot lake stage exist along the Patoka River in the vicinity of Jasper in Dubois County. The Sangamon paleosol is formed on all three terrace surfaces, thus the present topography of the lake plain was shaped well before the end of Sangamon time.

Caution is necessary when using soil maps for geological interpretation because soils do not always reflect correctly the underlying parent material. When this limitation is recognized, soil survey can be a valuable aid in reconstructing the Quaternary history of an area.

Introduction

The genesis and morphology of Indiana's soils are closely related to the geological and climatic events surrounding the advance and retreat of continental ice sheets during the Pleistocene. With the exception of residual soils, all soil series in the State can be correlated with one or more of the Pleistocene formations recognized by geologists (2). As a consequence, a detailed soil map can be a valuable tool in reconstructing the Quaternary history of a region. This paper presents the results of using soil survey for this purpose in the upper Patoka River basin in southern Indiana and discusses some of the limitations inherent in relying on published soil maps for geological interpretation. The lacustrine facies of the Atherton Formation and the Prospect Formation were a special focus of this study because the relationship between these two formations is not well understood.

Geomorphic Background

Geologists working in southwestern Indiana around the turn of the century concluded that the flat plain that exists at an average elevation of about 490 feet in the northeastern corner of Pike County and the northwest quarter of Dubois County was created by ponding of the Patoka River at the margin of the Illinoian ice sheet (3,7). The ice sheet also deflected three important tributaries of the East Fork of the White River, which, in combination with a minor tributary of the Wabash River, became integrated into the present Patoka drainage basin. All subsequent discussions of the geomorphology of the Patoka River basin have accepted this interpretation (5,8,10).

The sediments deposited in Glacial Lake Patoka have been mapped as the lacustrine facies of the Atherton Formation on the Geologic

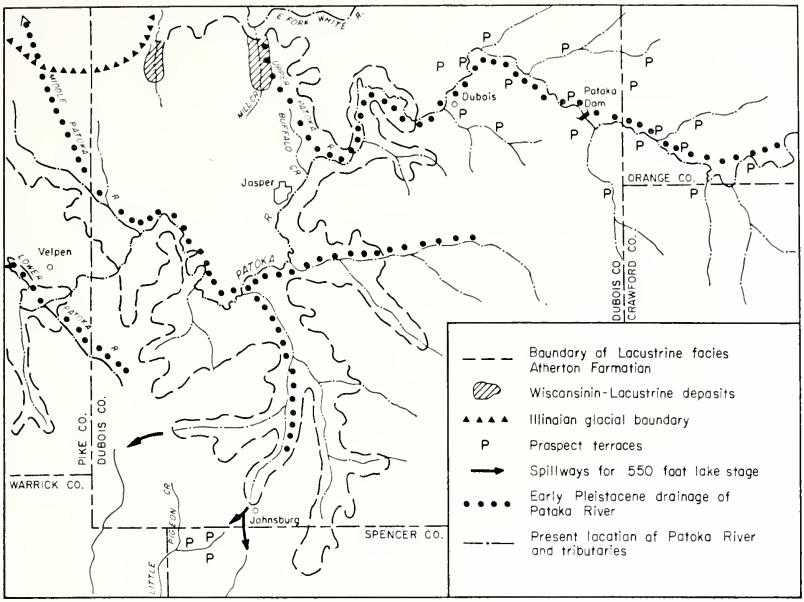

Figure 1. Pleistocene geology of Glacial Lake Patoka, southwestern Indiana.

Figure 1. *Pleistocene geology of Glacial Lake Patoka, southwestern Indiana.*

Map of the Vincennes Quadrangle (6). This map unit also includes small areas of Wisconsinan lacustrine slackwater clays that lie at a lower terrace level (about 450 feet at Mill Creek) along the East Fork of the White River (1,10). Illinoian glacial till (Jessup Formation) lies at the northwestern margin of Glacial Lake Patoka. Terraces along the upper reaches of the Patoka River, beginning at the town of Dubois in Dubois County and extending well into Orange County, are mapped Prospect Formation (Fig. 1). The Prospect Formation consists of silts, sands and gravels and is found throughout the unglaciated uplands of southern Indiana capping eroded terraces 20 to 50 feet above the present floodplain (12). The relationship of this formation to other unconsolidated deposits is poorly understood because it is rarely well exposed. In the Patoka River basin it predates the deposits of Illinoian Glacial Lake Patoka (5), but the dividing line between the Prospect terraces and the lacustrine Atherton terraces is not clearly defined (Henry Gray, personal communication, October 1976).

Study Methods

Several sources of soils and geologic information were used in this study:

1. Direct field observations during the course of mapping soils in Dubois and Orange Counties.

2. Field sheets completed by other soil scientists working in the

two counties (Robert Wingard and John Bernard, Soil Conservation Service, and Jack Coulter and Gary Hudson, Department of Natural Resources).

3. Published soil and geologic maps of the area (3,4,9,11).

4. Copies of the 7½ minute field sheets for the Geologic Map of the Vincennes Quadrangle (6).

Soil series from the different sources were correlated with the different Pleistocene formations in the study area (Table 1). The relationship of the lacustrine and river terraces in the vicinity of Jasper in Dubois County and upstream into Orange County was examined by transferring areas mapped as terrace soils from soil field sheets to 7½ minute topographic maps. Maximum elevations of individual terraces as determined on the topographic map were plotted on a longitudinal transect of the Patoka River upstream from Jasper (Fig. 2).

Certain limitations should be recognized before making geologic interpretations from soil maps. Soils may not reflect correctly the underlying parent material. This is particularly true of soils with similar taxonomic classification. For example, Otwell (lacustrine), Pekin (river terrace), Tilsit and Zanesville (residual) all appear similar in the field and where terrace material is thin over bedrock or has colluvial material mixed in, it is often difficult to judge whether a soil is formed in terrace material or bedrock residuum. Such errors are not critical in most uses of soil maps because similar soils have similar interpretations for management, but they can be misleading to a geologist trying to interpret the nature of the underlying material.

Soils that would be of great interest to the geologist may not be included in the published soil map of a county because they are of minor extent. A small area of glacial till exists in northwestern Dubois County, but acreages of the applicable soil series are so small that they have been mapped as inclusions with deep loess soils.

Correlations between soil series and tthe Pleistocene formations in Indiana may not always be accurate because similar soil profiles can sometimes develop from differing geologic processes. In Monroe County, for example, Markland, A Wisconsinan lacustrine soil which has carbonates near the surface has been mapped on Illinoian lacustrine materials where the normally leached surface material has been stripped off by erosion (Henry Gray, personal communication, October 1976).

Results

In the vicinity of Jasper there are three distinct terrace levels. The highest terrace exists as eroded remnants ranging in elevation from 500 to 580 feet and is recognized on the basis of soil properties, such as course textures and stratification in the substratum, rather than as a topographic surface. Most occurrences of this terrace are below the 550 foot level, but two remnants at 570 and 580 feet stand within a mile of each other on both sides of Bison Branch of Buffalo Creek, which was the pre-Illinoian outlet of the Upper Patoka River into the White River. This terrace has not previously been recognized

TABLE 1. *Correlations of soil series to Pleistocene Formations in the area of Glacial Lake Patoka.*

Soil Survey	Atherton Formation Illinoian	(lacustrine facies) Wisconsinan	Prospect Formation	Jessup Formation
Dubois County				
Current Survey	Otwell Dubois, Peoga, Pike, Parke, Negley	Montgomery, McGary	Pekin, Bartle, Peoga	[1]
1937 Survey	Haubstadt, Dubois, Robinson, Harbison, Bainbridge	Markland, McGary	Huabstadt, Dubois	Alford, Iva[2]
Pike County				
1938 Survey	Haubstadt, Dubois, Otwell, Robinson, Bainbridge, Calhoun	Markland, McGary, Montgomery	----------	Alford, Muren, Iva, Ee[3]

[1] Deep loess soils over till are not differentiated from deep loess soils over other material.
[2] Mapped only over Illinoian till.
[3] Deep loess soils over Illinoian till are differentiated from deep loess soils over bedrock by a boundary.

in the geologic literature. The second, intermediate, terrace ranges between 480 and 500 feet and corresponds to the deposits of Glacial Lake Patoka mapped by Fuller and Ashley (3). It is at an elevation of about 500 feet near the White River and slopes gradually to 480 feet at the Patoka River near Jasper. A third terrace lies below the intermediate lake plain and about ten feet above the present flood plain of the Patoka River. Several miles south of Jasper this terrace is about 460 feet in elevation.

All three terraces can be traced along the Patoka River upstream from Jasper (Fig. 2). Only a few remnants of the high terrace exist between Jasper and the Orange County line. Part of the town of Dubois, near Polson Creek, is built on remnants of this terrace which has a maximum elevation of about 550 feet. Another remnant with the same elevation is near the spillway of the Patoka Dam. Terrace elevations range between 540 and 560 feet for about 25 river miles into Orange County about which point the gradient slopes abruptly upward to a gradient of about 10 feet per mile.

The 500 foot terrace is the most extensively developed terrace between Jasper and the Patoka Dam. The maximum elevation of individual terrace remnants is consistently between 500 and 510 feet for a distance of about 30 miles where the lacustrine plain merges with the present floodplain somewhere around the Orange County line. The low terrace seems to follow the gradient of the Patoka River and merges with the 500 foot terrace somewhere in the vicinity of the town of Dubois.

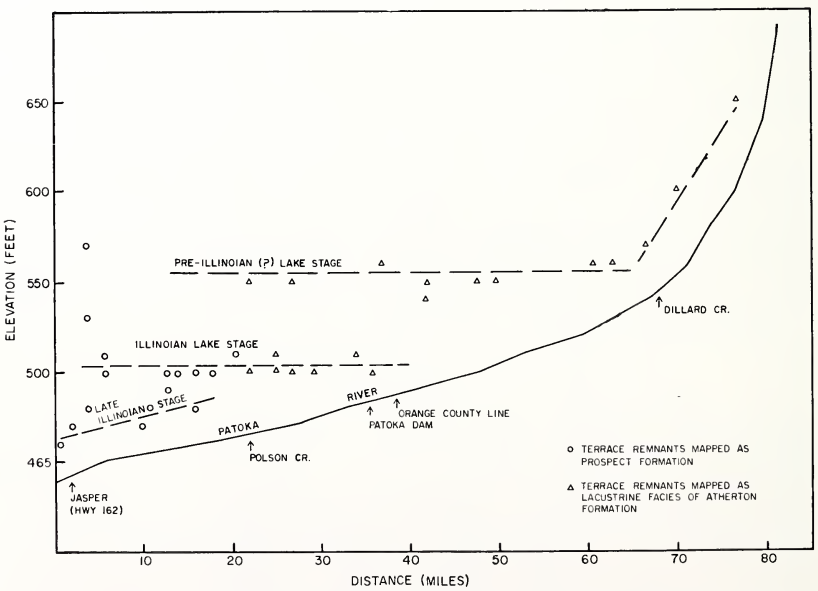

FIGURE 2. *Maximum elevations of terraces along the mainstem Patoka River upstream of Jasper, Dubois County, Indiana.*

The Sangamon paleosol is a ubiquitous feature throughout the lake plain. It is most easily recognized in the well drained lacustrine soils (Pike, Parke and Negley) where a clay loam or sandy clay loam B horizon with hues of 5 or 2.5 YR is covered by a few inches to four or more feet of Peoria loess. The paleosol is developed on all three terrace levels, and seems to follow the present topography of the lake plain very closely. Thus the present topography of the lake plain was shaped well before the end of Sangamon time. The relief of this surface is at least 130 feet in the vicinity of Jasper.

The existence of a lake stage at 550 feet or higher raises the possibility that Glacial Lake Patoka drained through one or more outlets before, or in addition to, the spillway at Velpen that joined the Middle and Lower Patoka Rivers. The hills that surround the lake plains mostly exceed 550 feet in elevation with one notable exception. About a mile southwest of the town of Johnsburg in Dubois County is a drainage divide at an elevation of 510 feet. Several other drainage divides in the same area lie between 540 and 550 feet (Fig. 1).

Interpretation

Most of the areas mapped as Prospect Formation in the Upper Patoka River basin seem to be remnants of two distinct topographic surfaces that are related to two major stages of Glacial Lake Patoka. Thus most of the Prospect terraces along the Patoka River correlate with the lacustrine deposits of the Glacial Lake. More detailed field work needs to be done, but I would like to tentatively propose the following interpretation that I believe fits the presently available data:

1. The high terrace of Glacial Lake Patoka is the result of damming of the early Pleistocene Upper and Middle Patoka River by a pre-Illinoian ice sheet. Maximum elevation of the lake was at least 580 feet, but a relatively stable lake level probably existed at 550 feet. The lake probably had a number of outlets, but the major ones were south into the Ohio River through Little Pigeon Creek and possibly west into the Lower Patoka River near Velpen. The Prospect terraces mapped in the upper reaches of Little Pigeon Creek may be related to this event. The 550 foot Prospect terrace in the Upper Patoka River was either deposited at this time and/or eroded to this level from material deposited during an earlier high base level. If more detailed investigations should prove that the lacustrine soils mapped above 500 feet are not actually water laid, another explanation will have to be found for the 550 foot Prospect terrace.

2. The intermediate terrace of Glacial Lake Patoka is the Illinoian lake stage. The 500 foot Prospect terrace near the Patoka Dam is probably the result of lateral planation of the pre-Illinoian terrace because there is stratigraphic evidence that the material of these terrace remnants is the same age as the 550 foot terrace remnants in the same area (Henry Gray, personal communication, October 1976). Some of the terrace remnants downstream may be depositional rather than erosional.

3. The low terrace is probably related to a late Illinoian stabilization of base level, perhaps due to a readvance of the ice sheet.

Conclusions

The possibility of a pre-Illinoian glacial lake and additional derangement of the Patoka River raises as many questions as it answers. The geomorphic history of the Patoka River is certainly more complex than previously recognized. Careful use of soil maps combined with geological information should increase our understanding of the Patoka's Pleistocene history when more of the River basin is mapped in the course of Indiana's accelerated soil survey program.

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