Identification and Analysis of a Buried Prairie Soil at the Ernie Bank Archaeological Site, Vernon County, Wisconsin

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ABSTRACT

This project evaluated a buried soil at the Ernie Bank site, a Late Woodland occupation (A.D. 800 –A.D. 1050), in Vernon County Wisconsin. The site was analyzed for any cultural evidence, and to determine if the soil formed under prairie conditions. I conducted a particle size analysis, soil pH, total carbon (LOI), and percent organic carbon analysis to determine if this soil formed under prairie vegetation. Stratigraphic column, and soil profile samples were examined for micro-artifacts by screening the samples through a 1/4 inch screen and #10 sieve. By using soil color and texture I determined the soil horizon sequence as A_b, B_t, B_g. The upper 10 centimeters of the stratigraphic column represent historic slope wash. The information from the particle size, soil pH, total carbon (LOI), and percent organic carbon, shows a stable surface from 100-120centimeters, a period of flood deposition, and another stable surface at 160 centimeters. A combination of field research and laboratory analysis indicated that the buried soil containing artifacts was formed under prairie conditions.

INTRODUCTION

Soil study, or pedology, is important to the study of archaeology for numerous reasons. Geoscientists see artifacts, and thus archaeology, as just another part of the deposit, which can be modified by the same processes which affect the rest of the deposit. Archaeologists also use the concept of the deposit as seen in their use of stratigraphy in excavations (Stein 1987). Rapp and Hill suggest, "An understanding of the steps involved in the formation of sedimentary deposits gives an insight into the events that contribute to accumulations of artifacts" (Rapp and Hill 1998:18). "The concept of the deposit has been used for many purposes: to establish human antiquity, to provide relative dates, to reconstruct the environment, and to analyze site formation processes" (Stein 1987:337).

The use of soil as an environmental and chronologic indicator has been well documented. Birkeland states, "They [soils] can be used to indicate the ages of certain layers, past moisture conditions, or perhaps past vegetation" (Birkeland 1984:344). Ferring, in discussing alluvial paleoenvironments, states: "[alluvial soils] are valuable in the study of prehistoric occupations. In too many cases, unfortunately, direct evidence for paleoenvironments, such as pollen, snails or plant macrofossils, is poorly preserved in alluvial settings. Under these circumstances, soils are especially important evidence for past environments" (Ferring 1992:15). Thus it is important for the archaeologist to have someone with knowledge of soils on the crew to identify the diagnostic factors.

Lastly, archaeological sites in alluvial settings are subject to various processes which may skew data if not recognized. Ferring discusses three reasons why alluvial pedology (soils) is important to archaeologists. Briefly these are 1) the concentration of sites in river valleys, 2) the complexity of geologic records (stratigraphy) in alluvial settings, and 3) the scales at which soils can be applied, within sites, among sites, and regional scope (Ferring 1992). The concentration of archaeological sites in alluvial settings, according to Waters, is due to the use of such settings for hunting and gathering, and later for farming (Waters 1992).

Alluvial settings can cause problems in interpretation for the archaeologist who is ignorant of the dynamics of these settings. Artifacts in alluvial settings act like and are acted upon like any other sedimentary particle. "Artifacts in these [alluvial] sites may be eroded, transported, and redeposited as sedimentary particles" (Rapp and Hill 1998:18). This could have profound effects on context, as the artifacts may have been deposited in one location then transported to a secondary location and redeposited, buried, then later excavated. Thus it is important to keep in mind that "Alluvium [including artifacts] is in temporary storage; when conditions that prompted its sedimentation are reached again, re-entertainment of sediment [and artifacts] will occur" (Gladfelter 1985:41).

I think that the reasons given above are enough to justify the use of soils in archaeology. With an understanding of soils the archaeologist can make more valid inferences. When soils are used with other techniques fairly definitive paleoenvironmental assumptions can be made, and soils can be used, in the absence of other factors, to determine environmental conditions. By recognizing alluvial sites for the dynamic settings that they are the archaeologist will be able to avoid erroneous inferences.

SITE SUMMARY

I investigated the Ernie Bank site (also known as Tollackson 6, 47Ve1011) located in Vernon County, Wisconsin, on the North Fork of the Bad Axe River (Figure 1-2), on the Tollackson farm complex (owned by Bryce Tollackson).

The Bad Axe drainage is located in the Driftless Area of southwest Wisconsin, and drains an area of 492 km^2, with the north fork draining 210 km^2. Excavations were conducted by the Mississippi Valley Archaeology Center during the 1993 through the 1996 field seasons. The excavations yielded cord roughened, grit tempered pottery, with diagnostic shoulder and rim decorations. These sherds proved to be Madison Cord Impressed pottery, identifying an Eastman phase occupation, A.D.800-A.D.1050, of the Late Woodland culture as a relative time period. The cultural material was found below 50 cm of historic alluvium, and under another 50 cm of a buried A horizon (Theler and Boszhardt 2000). Also at the Tollackson complex is an Effigy Mound group consisting of 14 birds and quadrupeds, further evidence of Late Woodland occupation. The

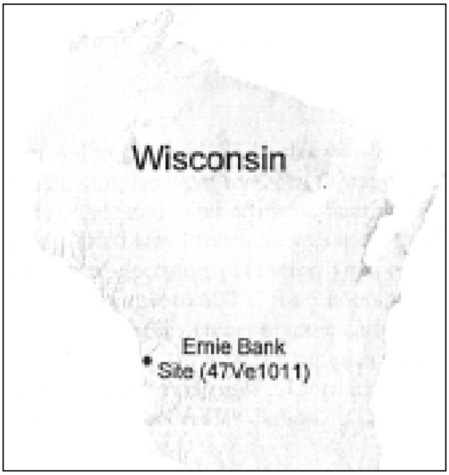


Figure 1. Location in Driftless Area

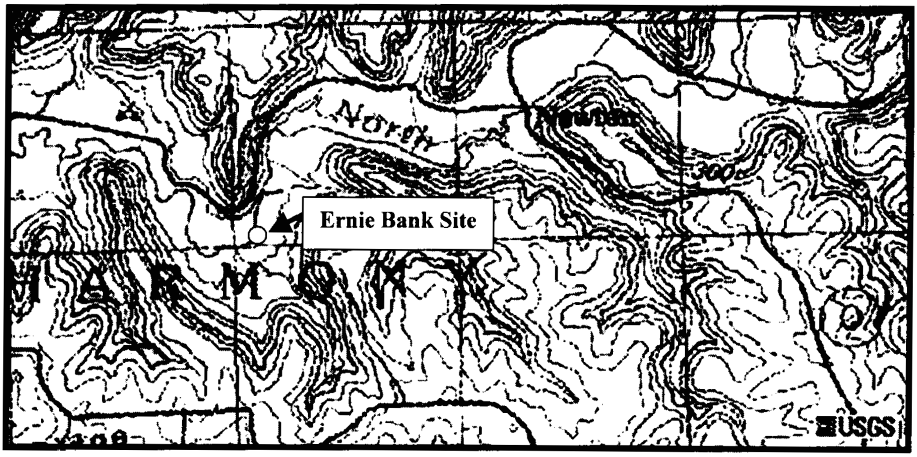


Figure 2. Topographic Location on the North Fork of the Bad Axe River in Harmony Township

faunal assemblage from these excavations produced small mammal remains, with pocket gopher (*Geomys bursarius*) suggesting prairie or mixed prairie woodland for the prehistoric habitat. By A.D. 1050-1150 the people had left this area possibly due to over population/exploitation of the area. The location of my stratigraphic column/soil profile was on a cut-bank of Tollackson 6 adjacent to the Bad Axe River, near the 1993 excavations. The goal of this project was to investigate the soils at the Ernie Bank site to determine if the buried soil represents a former prairie surface.

METHODS

Sediments from a stratigraphic column, and five samples from the soil profile horizons, from the Ernie Bank site, were examined in the field (Figure 3). Laboratory methods included particle size analysis (Gee and Bauder 1979), soil pH (Janitzky 1986a), total carbon loss on ignition (Storer 1983), and percent organic carbon (Janitzky 1986b).

The stratigraphic column was collected in arbitrary 5cm levels, with zero datum at 80 centimeters below ground surface, omitting the historic alluvium, which I did not study. A total of 24 stratigraphic sediment samples and 5 soil horizon samples were collected for laboratory analysis. Lower boundary depths for the individual soil horizons and boundary characteristics were determined in the field. Soil color was determined using a Munsell soil color chart with moist soil. The samples were screened through a ?" mesh screen and a 2 millimeter sieve to recover lithic debris and other artifacts. Samples were oven dried at 105° C. For the particle size analysis a simplified Day Procedure was used, based on hydrometer readings. Soil pH was measured using an electronic pH meter. Total carbon, (LOI, loss on ignition), was determined by heating a 2 gram sample to 600°C for 6 hours, and then comparing the post-combustion weight for total carbon loss. The percent organic carbon was measured using the Walkley-Black method, which involves titrating the samples with ferrous sulfate. The percent organic carbon is then calculated using a mathematical formula based on the amount of potassium dichromate necessary to oxidize the organic carbon.

RESULTS

Soil color and texture differentiated individual soil horizons (See Appendix). An Ab horizon occurs between 0 and 30 cmbd (centimeters below datum), there is a diffuse smooth boundary to an argillic Bt horizon extending down to 80 cmbd, seen as an increase in percent clay in the particle size analysis (Figure 4). There is another diffuse smooth boundary between the Bt and Bg horizons, which is a transitional horizon identified by the presence of gleying.

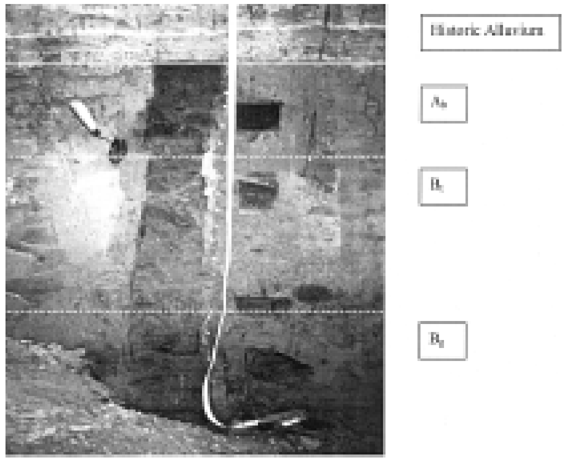


Figure 3. View of the Stratigraphic Column and Soil Profile

The artifacts recovered were micro-artifacts, most being less than ?" in size. The artifacts include 13 lithics (flakes and chunks/shatter), 5 small bone fragments, and some charcoal/plant remains, one of which conforms favorably to wild rice (*Zizanin aquatica*). The largest concentration of artifacts was at the 29-60 cmbd range, with the 6 lithics concentrated at the 30-40 cmbd range (Figure 5). The number of sediment particles larger than 2 millimeter decreased with depth and then increased again at around the 91-112 cmbd depth (Figure 6).

The results from the particle size analysis and soil pH measurements (Figure 7) show three definite periods of deposition and stability. There is a former stable surface at around 80 cmbd, with a period of flood deposits of increasing silt to about 40 cmbd. The 0-10

Figure 4. Particle Size Analysis

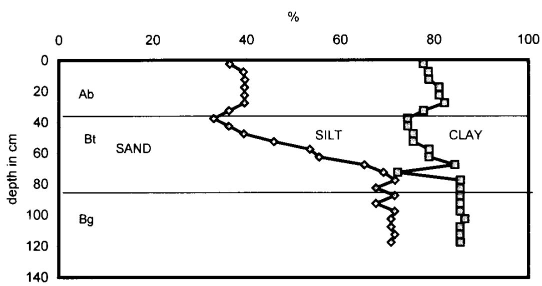
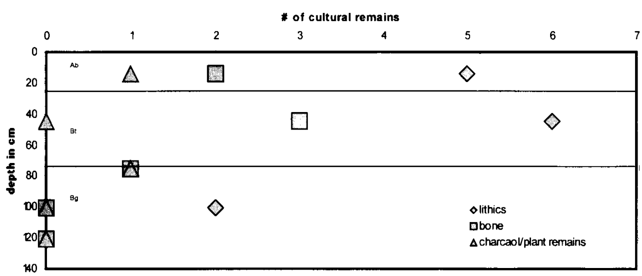


Figure 5. Artifact Concentration



cmbd depth contains upland sediment as a result of runoff from the slopes in historic times. The thickness, approximately 40 centimeters, as well as the dark color (10YR2-2, 7.5YR2.5-2) and texture of the A-horizon are indicative of a well-developed prairie soil. The total carbon shows the same trends as particle size, with 0-10 cmbd being historic runoff, a stable surface at 20-40 cmbd, and another possible stable surface at about 90 cmbd (Figure 8).

There is an increase of organic carbon at about 15 cmbd, and a second increase at 80 cmbd (Figure 9). The total carbon, and organic carbon analysis show a high amount of carbon in the soil, with the majority of it being organically derived. There is up to 10% total carbon at 20 cmbd, 7% of which is organic carbon. These carbon measurements are what would be expected for a well-developed prairie soil.

Figure 6. # Particles >2mm by Soil Profile

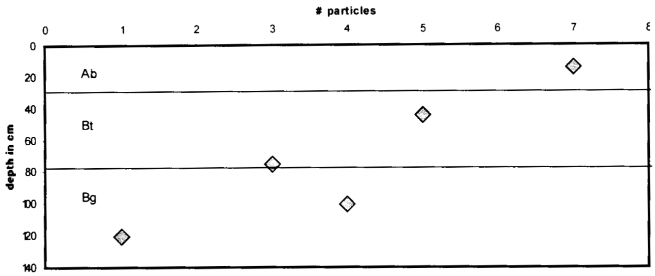


Figure 7. Mean pH

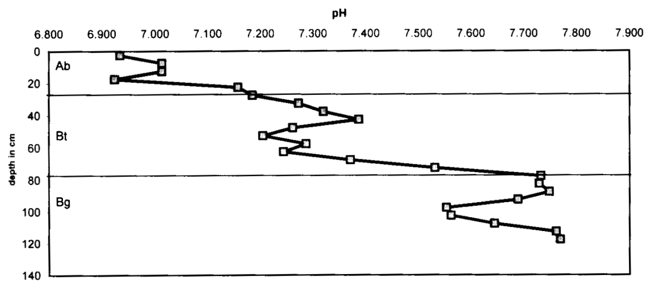


Figure 8. % Total Carbon Loss on Ignition

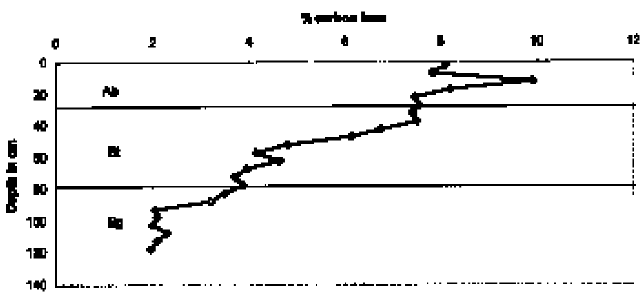
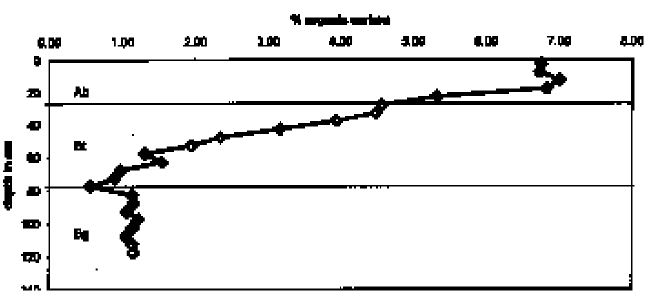


Figure 9. Organic Carbon



DISCUSSION

There have been several climatic shifts during the Holocene. These shifts cause vegetation changes from boreal forest to prairie, with the drying of the climate. Southwest Wisconsin is part of a transitional ecotone with mixed hardwood forests to the north and prairie to the south (Knox 1972). The prairies are a result of the drier “westerlies” which begin to be an important factor during the Holocene. This forest/prairie ecotone is very climatically sensitive due to the location at the border of the arctic and pacific (tropical) air masses (Knox 1972). Lake levels around southern Wisconsin were at their lowest between 6,000 to 3,000 years ago, suggesting a “drought” climate. Pollen samples also show a drier climate as seen in the expansion of the prairie/savanna into southwestern Wisconsin (Baker, et al. 1992).

Xeric oak forests dominated Wisconsin’s Driftless area during middle to late Holocene time (Baker et al. 1992). These forests were adapted to the drier climate and tended to be sparse groupings of Bur Oak with prairie/savanna dispersed between them. In McDowell’s (1982) study of the Brush Creek Valley, in Vernon and Monroe counties, she determined that the Driftless area was covered by lowland hardwood forests and wet prairies on the valley floors, before the land was cleared for agriculture.

Studies in the Driftless area as well as surrounding areas (Knox 1972, McDowell 1982, 1983, Baker et al. 1992) have yielded buried paleosols. I focused on the paleosols that were formed in alluvial settings. These tend to be in a sequence with a well-developed paleosol over a silty clay series, then buried under a silt loam (historic alluvium) (Knox 1972). McDowell’s (1982) research showed the texture to be silty clay loam to sandy loam at the Brush Creek units. Also important was McDowell’s discussion of the formation of the B_t horizon in certain units at Brush Creek. By investigating other work in the Midwest she was able to determine the length of time for Bt horizon formation as less than 2300 years but more than 700 years. This fits with the information from Birkeland (1984), who says that the B_t horizon can form in as few as 100 years, but takes nearly 10,000 years to reach a steady state. He also states that A horizons can form in just a few years, and reach a steady state in about 100 years (Birkeland 1984). I can only date the soil relatively as having formed between A.D. 1000 and A.D. 1850, giving it roughly 800 years to develop the close to 30centimeters of the A_b horizon, and to form a B_t horizon.

Based on my research I believe that the thick A_b horizon in the profile I took, formed under prairie vegetation. The age of the soil that I worked on is younger than those of McDowell (1982) and Baker et al (1992), based on the artifact correlation from MVAC’s excavations in 1993. The soil I worked on also was loam/clay loam over sandy loam; also there seem to be a smaller percentage of silt at the Ernie Bank site than at these other sites.

The thickness of the A-horizon is indicative of a well-developed prairie soil; this is due to the decomposition of surface litter, as well as sub-surface root decay. Forest soils tend to be thinner because only the litter-fall adds to the thickness of the A-horizon (Birkeland 1984). The particle size data I collected shows a fairly stable amount of silt, around 35% until 40cmbd. From 40cmbd the silt declines as the sand increases, and again at around 80cmbd the silt stays at a relatively stable 20%.

The total carbon, and percent organic carbon show a fairly high carbon content in the A_b horizon, which steadily drops with depth. This high carbon percentage combined with the thickness, is indicative of a well-developed prairie soil (Birkeland 1984) The organic carbon also increases a little around 80-85cmbd. I think that this increase, as well as the stability in the particle size, and total carbon data at this level indicates another former stable surface.

Artifacts are found at this depth, but it is possible that they were washed in during a flood episode. I did not find any diagnostic artifacts, as most were micro-artifacts, and I found no ceramics. Snails were noted but did not survive the processes intact. I do think that the evidence supports my hypothesis that this buried soil was a prairie soil.

CONCLUSIONS

In summary the soil that I analyzed consisted of a dark buried horizon, covering a lighter horizon with an increase in clay, which overrides a horizon with some gleying. I determined these horizons as Ab,Bt,and Bg. The thickness, dark color (10YR2-2, 7.5YR2.5-2), and organic carbon content of the Ab horizon indicate its formation under prairie conditions. The increase in clay content in the upper portion of the B-horizon gives it the argillic designation. The Bg horizon, based on the presence of gleying, represents a second former stable surface. The procedures that I conducted support these conclusions. This is important to archaeologists because the prairie soil is an environmental indicator, i.e. warmer, drier climate. Also the identification of the thick buried A-horizon in the Bad Axe River valley can allow correlation of dates in the valley where radiocarbon dating is not possible.

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APPENDIX

Table 1. Stratigraphic Profile Depth, Color and Texture.

Depth in cm	Color	Texture
0-5cm strat. Column	10YR3-1 very dark gray	loam
5-10cm strat. Column	10YR3-1 very dark gray	loam
10-15cm strat. Column	10YR3-2 very dark grayish brown	loam
15-20cm strat. Column	10YR2-2 very dark brown	loam
20-25cm strat. Column	10YR2-2 very dark brown	loam
25-30cm strat. Column	7.5YR2.5-2 very dark brown	loam
30-35cm strat. Column	10YR2-2 very dark brown	loam
35-40cm strat. Column	7.5YR3-2 dark brown	loam to clay loam
40-45cm strat. Column	7.5YR3-3 dark brown	loam to clay loam
45-50cm strat. Column	7.5YR3-3 dark brown	loam
50-55cm strat. Column	7.5YR3-3 dark brown	loam
55-60cm strat. Column	7.5YR3-3 dark brown	sandy clay loam
60-65cm strat. Column	10YR3-3 dark brown	sandy clay loam
65-70cm strat. Column	10YR3-3 dark brown	sandy loam
70-75cm strat. Column	7.5YR3-4 dark brown	sandy loam
75-80cm strat. Column	10YR3-3 dark brown	sandy loam
80-85cm strat. Column	7.5YR3-4 dark brown	sandy loam
85-90cm strat. Column	7.5YR3-3 dark brown	sandy loam
90-95cm strat. Column	7.5YR3-3 dark brown	sandy loam
95-100cm strat. Column	7.5YR3-3 dark brown	sandy loam
100-105cm strat. Column	7.5YR3-3 dark brown	sandy loam
105-110cm strat. Column	7.5YR3-3 dark brown	sandy loam
110-115cm strat. Column	10YR3-3 dark brown	sandy loam
115-120cm strat. Column	10YR3-4 dark brown	sandy loam

Table 2. Soil Profile Depth, Color and Texture.

0-29cm soil profile	10YR3-2 very dark grayish brown	loam
29-91cm(upper) soil profile	10YR3-2 very dark grayish brown	loam to clay loam
29-91cm(lower) soil profile	7.5YR3-3 dark brown	sandy loam
91-112cm soil profile	7.5YR3-3 dark brown	sandy loam
112cm+ soil profile	7.5YR4-3 brown	sandy loam to sandy clay loam