Sedimentology and Geochronology of Holocene Paleochannel Features in the Lower Ohio River Valley, Indiana

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Abstract

Rivers condition human settlement strategy by determining both the location of aquatic resources and the stability of the landscape. Therefore, understanding where the river was and how quickly it migrated in the past aids in predicting buried site potential. This study investigates the sedimentology and geochronology of paleochannel deposits along the Lower Ohio River floodplain. A series of low, wide swales are prominent features in a series of bottoms in a ~40 km section of the river valley downstream from the Falls of the Ohio. Previous studies in Knob Creek Bottom indicate that one of these paleochannel swales was active during the early Holocene, roughly 10K to 7.4K rcybp. The positioning of the others suggest that they are the remains of a single channel that flowed on the west side of the river valley during the early Holocene. To test this proposition, cores were collected in several locations within and adjacent to prominent swales. The channel is characterized by laminated point bar deposits overlain by overbank sediment containing a heavily weathered Alfisol, Mollisol, or Inceptisol soil with prominent redox mottles. The sediment ranges from silt to silt loam. In some reaches, alluvial fan sediments interfinger with the point bar deposits. Datable organic carbon was found in both point bar and overbank contexts. This study compares the sedimentology, weathering, and age of these channel segments to determine their geomorphic relationship.

Methods

Fieldwork

We extracted 3 cores from paleochannel swales (Figure 1) using a truck or track mounted Geoprobe. The cores were collected in ~1-1.3 meter sections in 7 cm diameter tubes. In most cases, the probe refused at underlying Pleistocene outwash deposits.

Core descriptions

In the laboratory, magnetic susceptibility readings were taken for each core at 20 cm intervals using a Bartington Magnetic Susceptibility Meter with a core logging sensor. Cores were then split and described for wet Munsell color, texture, mottling, structure, and effervescence using standard USDA terminology (Soil Survey Staff, 1993). Dateable organic carbon was removed and bagged. Two samples were submitted to Beta Analytic, Inc. for AMS dating. Sediment samples were extracted for grainsize analysis at 20-40 cm intervals or at finer intervals in transition points.

Grainsize analysis

Sediment samples were crushed and soaked overnight in a .5% sodium hexametaphosphate solution to break up clay nodules. They were then wet sieved at 250 µm. The grainsize distribution of the fine fraction was counted for 60 seconds using a CILAS 1064 laser particle size analyzer. The sample was sonicated for 60 seconds prior to each measurement and two tests were run to ensure consistency. Grainsize distributions were combined with the coarse fraction and the percentage of sand, silt, and clay in the samples was calculated.

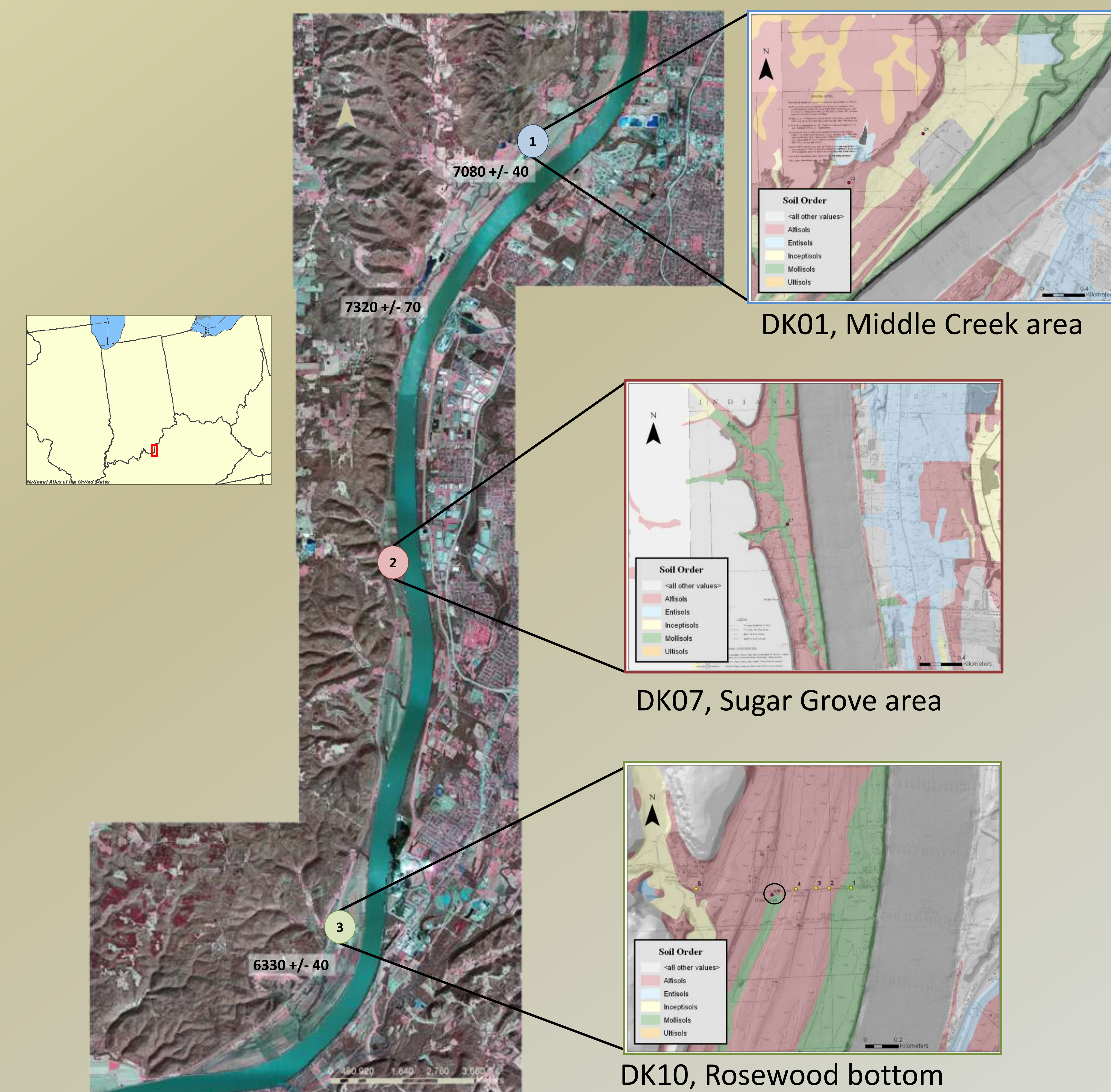

Figure 1 2005 infrared aerial photograph with core locations and dated swales. Inset maps show topography and soil order for individual coring sites. (Photograph is from the Indiana Spatial Data Portal; soil data was downloaded from NCRS SSURGO; topographic data is from USGS... Carbon dates (presented as rcybp) were analyzed by Beta Analytic, Inc. as part of this research and other geoarchaeology projects in the region (Stafford, 2004; Scholl, 2008)).

Study Site—The Lower Ohio River (Harrison County, IN)

A distinctive set of paleochannel features extends roughly 40 km from the Falls of the Ohio near Louisville, KY on the Ohio River's western floodplain (on the Indiana side). Here, the Lower Ohio is constrained by a narrow bedrock valley and is divided into several bottoms. Gray (1984) suggests that while it does not have an extensive flood basin like other rivers, the same processes that form it are expressed in a different ways. Interpreting ridges and swales here is not straightforward because they tend grow in a downstream direction instead of laterally along the floodplain. The paleochannel lay at roughly 130 m amsl, up to 4 m lower than the surrounding floodplain. It is flanked to the west by a low terrace (~134 m amsl) dating to the Early Holocene (Stafford, 2004) and to the east by ridge-and-swale topography that extends to the current Ohio channel. The swale currently acts as a floodbasin and in some bottoms holds tributary stream channels.

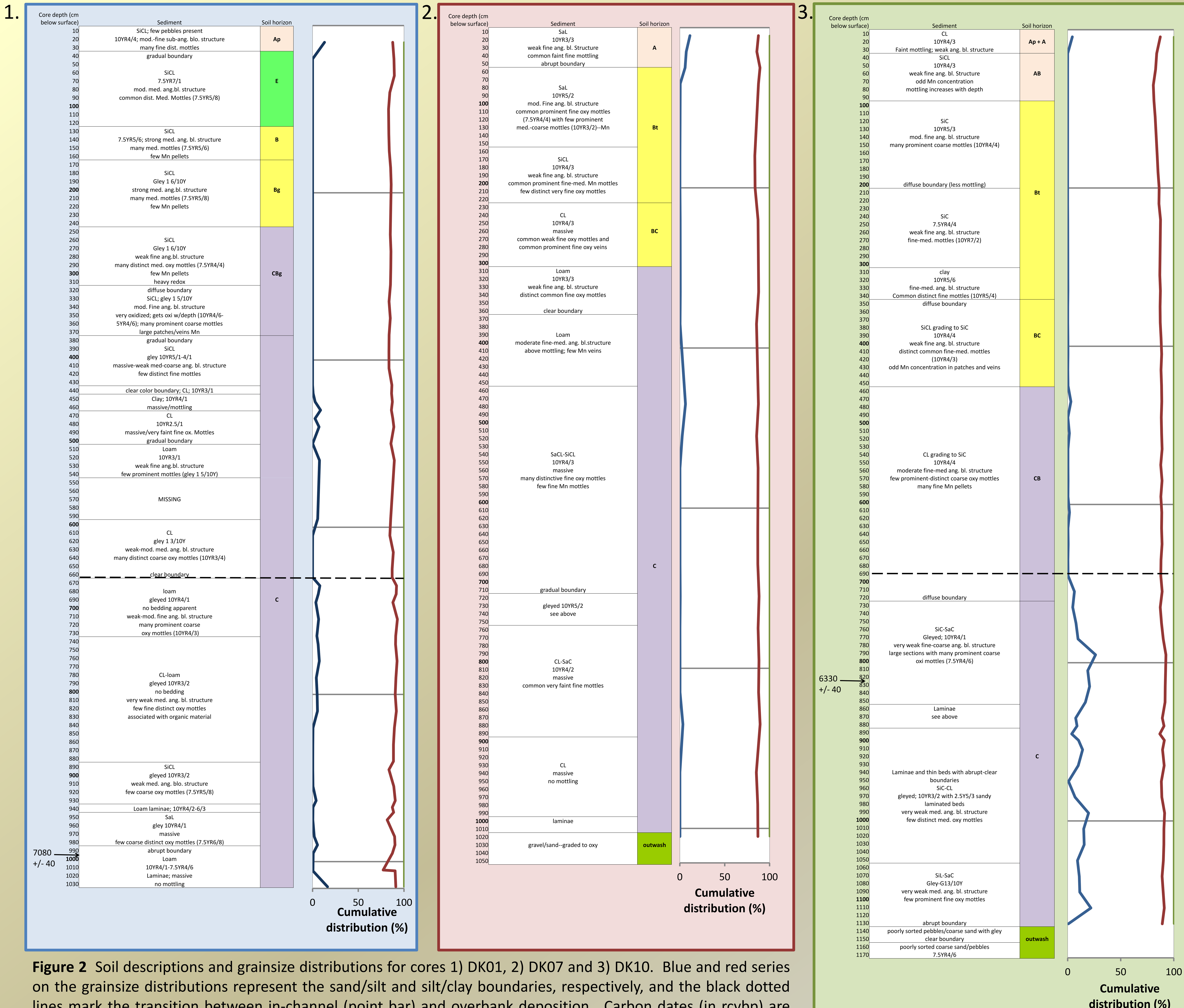

Figure 2 Soil descriptions and grainsize distributions for cores 1) DK01, 2) DK07 and 3) DK10. Blue and red series on the grainsize distributions represent the sand/silt and silt/clay boundaries, respectively, and the black dotted lines mark the transition between in-channel (point bar) and overbank deposition. Carbon dates (in rcybp) are labeled at the depth at which they were recovered.

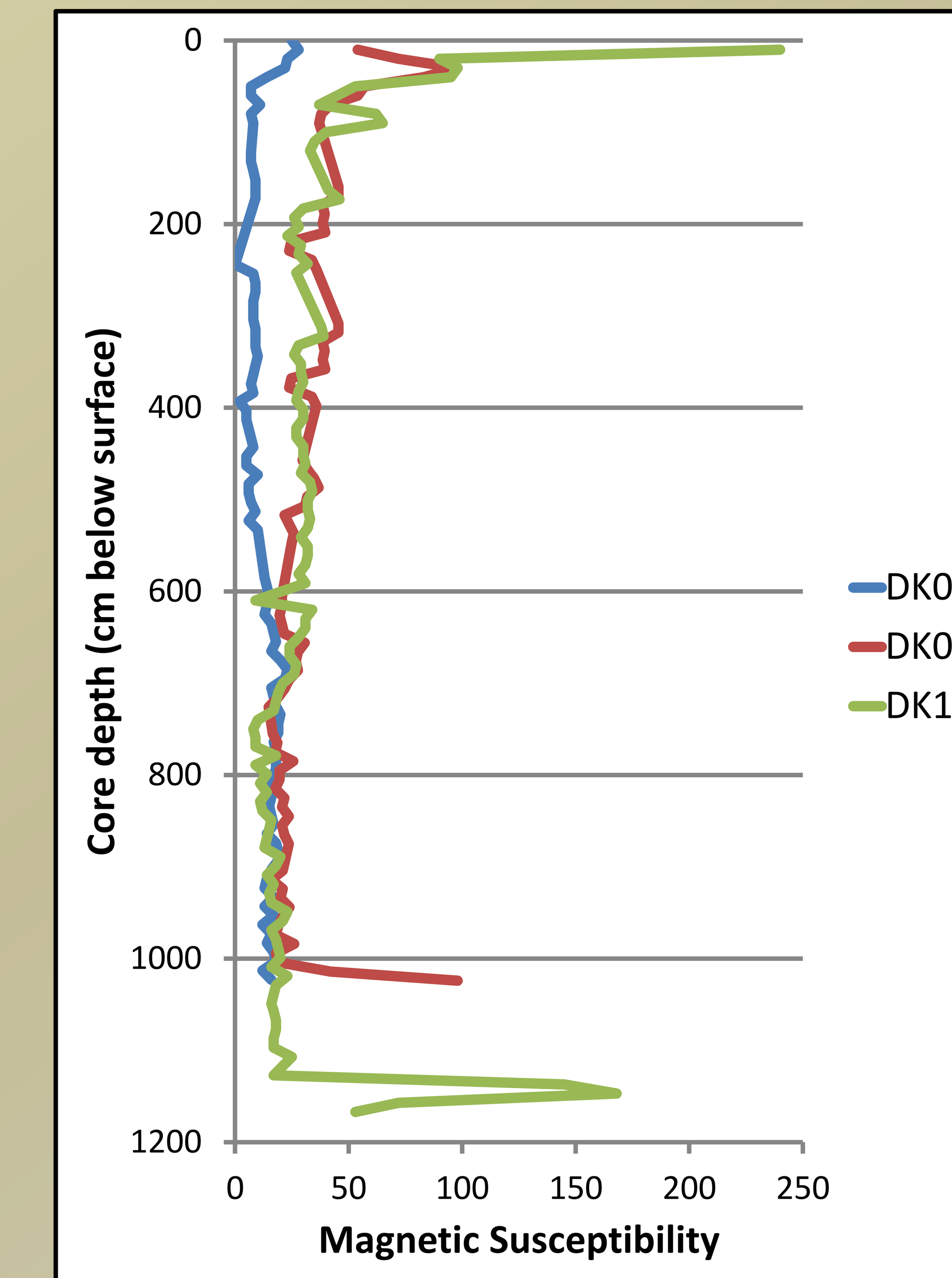

Figure 3 Magnetic susceptibility (unit). Susceptibility appears high in the A horizon and in outwash. The increase at ~700 cmbs in core DK01 may indicate a buried soil.

Discussion

This pilot study characterizes paleochannel swale deposits as part of a larger geomorphic model of the Lower Ohio River valley. The swales exhibit unique soil and sediment profiles, reflecting the localized geologic conditions in each bottom. The swale in the Middle Creek section (Figure 2.1) is overlain by the distal end of an alluvial fan, which may have buried a developing soil (Figure 3). In the Sugar Grove area, a tributary stream flows within the paleochannel, explaining its less developed soil (Figure 2.2). Interestingly, there are no point bar features apparent, which might suggest either that they were eroded away by the tributary stream or that the swale represents only a portion of the former Ohio River channel. The paleochannel at Rosewood bottom (Figure 2.3) displays a prominent point bar overlain by relatively homogenous fine-grain overbank sediment. These swales are all surrounded by highly-weathered Alfisol soils dating to the Early Holocene (Stafford, 2004), suggesting that they formed during similar time-frames. However, the carbon dates (Figure 1) show that the channels were abandoned at different times, indicating that the Ohio River migrated independently within each bottom.

Acknowledgements

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References

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