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## **CHANGING HOLOCENE ENVIRONMENTS AT THE KOSTER SITE: A GEO-ARCHAEOLOGICAL PERSPECTIVE**

Karl W. Butzer

*Geomorphologic and sediment-stratigraphic study of the Koster site has been carried out in the broader context of the lower Illinois Valley. Accumulation of reworked loess in an overdeepened tributary valley began at Koster shortly after 10,000 B.P., and continued through Holocene times with major sedimentary breaks. The Illinois floodplain began to stabilize ca. 5000 B.P. after rapid aggradation, but remained a dynamic environment that developed its present patterns after 2500 B.P. Valley-margin hillside vegetation was considerably more xeric during the periods 1200-950 B.P., 2100-1900 B.P., and ca. 9700-5000 B.P., with hillside woodland reduced to hill prairie or parkland ca. 8500-7700 B.P. These dramatic Holocene environmental changes suggest that interpretative archaeological models for cultural adaptations through time must consider the environment as a critical variable, rather than as a constant.*

The Koster archaeological complex is stratified within a thick suite of Holocene deposits in a minor tributary valley of the lower Illinois River. The locality is at the contact between two macroenvironments—limestone bluffs and upland loess or till plains to the east and the Illinois floodplain to the west. It is also situated within a mosaic of mesoenvironments on the sloping

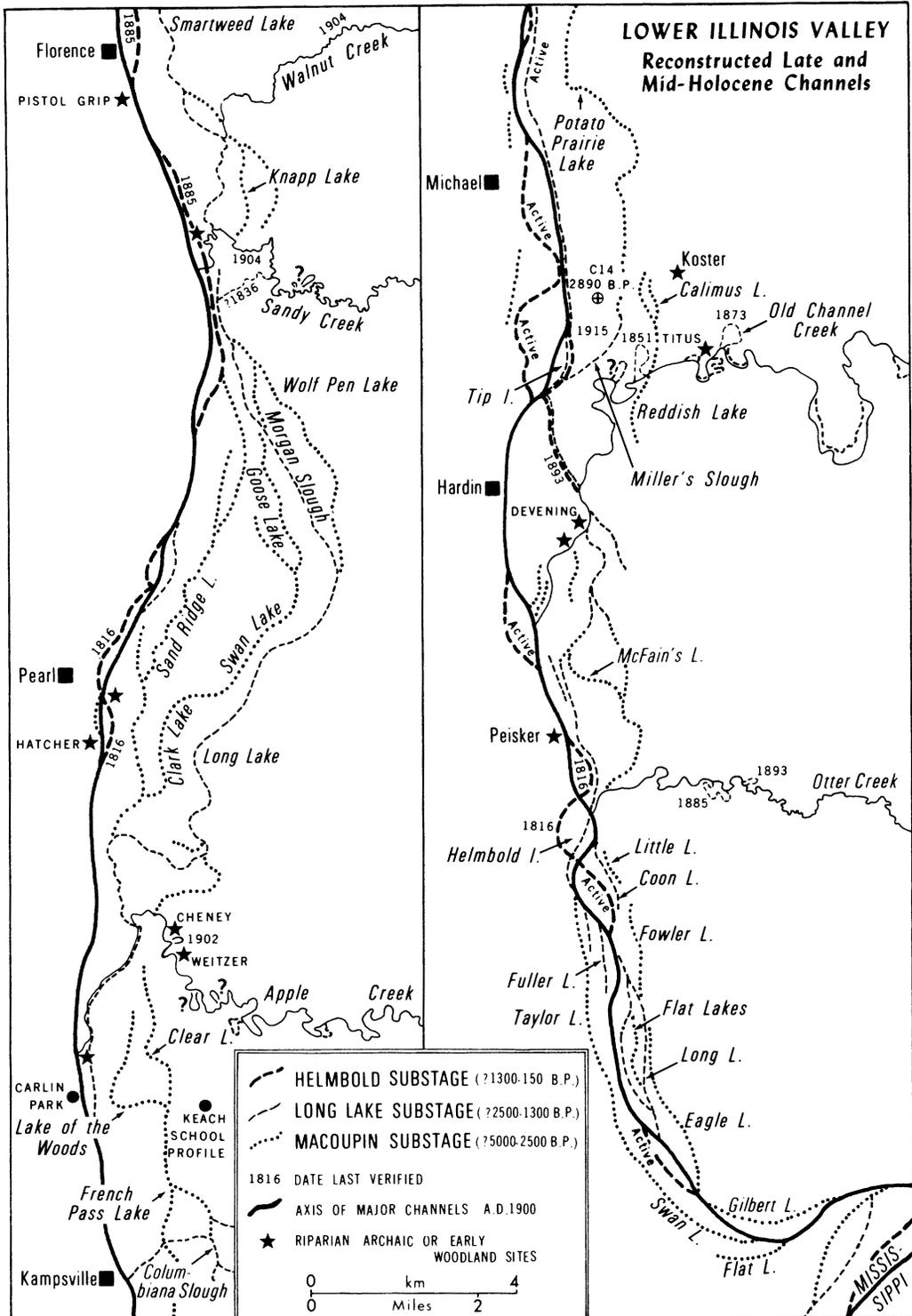


Figure 1. Reconstructed mid-to-late Holocene channels of the lower Illinois floodplain.

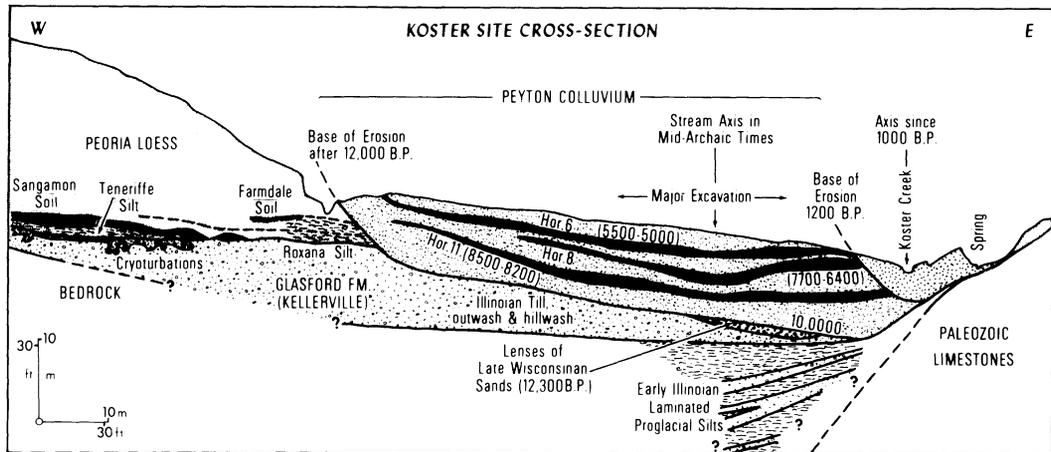


Figure 2. Simplified geological cross-section of the Koster Site.

margin of a minor creek that emerges from the fretted uplands onto an alluvial fan that, in turn, grades down to the valley bottoms. Except for the Illinois floodplain, soils are developed on Pleistocene or reworked eolian sediments, mainly loess. Holocene geomorphic activity on and immediately below the uplands has been characterized by repeated erosion and redeposition of loessic materials that were and remain deceptively similar. Within the Illinois floodplain there are extensive tracts of residual Pleistocene surfaces as well as Holocene flood basins and multiple abandoned channels of the Illinois River, its former branches, and its major tributaries.

The present investigation was begun in 1970 in order to explain the geo-archaeological context of the Koster site and to elucidate the Holocene history of the Illinois floodplain. A program of site-specific and regional microstratigraphic work was combined with geomorphic mapping of a 70 km stretch of the Illinois valley and laboratory study of almost 350 sediment and soil samples. Even these categories of analysis and inference were inadequate to explain all the problems of the record, since information on Holocene processes in the Midwest continues to be fragmentary, and the post-Pleistocene alluvial history of the Illinois and of most other midwestern rivers remains *terra incognita*. It consequently proved necessary to examine the nature of historical soil erosion around Koster since AD 1820 and to evaluate the "sand ridges" and other features of the floodplain in the context of late Pleistocene events and in relation to the still inadequate archaeological surveys of the bottomlands. A final ingredient essential to interpretation of the data was the availability of C-14 dates from the successive horizons at Koster. The first usable suite of radiometric markers became available in 1973, a fuller set of such isotopic assays was accessible only in 1976.

A first attempt to present the Holocene context of Koster from a geomorphological perspective was published in the Illinois State Museum *Reports on Investigations* (Butzer 1977). It is only as good as the available archaeological information and as refined as the technological resources will allow. It has also been handicapped by the absence of geo-archaeological perspectives in the research strategy underlying excavation and surveying in the lower Illinois Valley. Consequently, the present summation does not claim to be definitive. But it does bring together a sampling of a large body of data that provides some surprising new insights into the dynamic and unstable Holocene ecosystem of the lower Illinois Valley.

#### THE FLOODPLAIN

The major features of the Illinois floodplain that are of archaeological interest are the "sand ridges" and the abandoned channel traces.

Most of the sand ridges are extensive, low, sandy terraces which seldom rise more than 3 m above the flood basins. Even where surmounted by lines of elongated hummocks, their elevation is

only 1.5-2.5 m above the highest modern levees but below the level of modern 1-in-100 year floods. Study of these features, designated as the Keach School Terrace, indicates that they consist of coarse sands, in part gravelly or cross-bedded; they are commonly overlain by fine alluvium, coarser than modern flood silts, or by dark, cracking vertisols. The Keach School Terrace represents the youngest outwash terrace of the lower Illinois River, and is younger than the higher and more prominent Deer Plain Terrace, found near the Illinois-Mississippi confluence. Accumulation of the Keach School Terrace probably terminated by ca. 11,000 B.P., and Early Archaic to Mississippian sites are frequently found on its surface or within overlying, superficial deposits.

A major period of river downcutting followed upon abandonment of the Keach School floodplain, and during the first millennia of the Holocene the Illinois flowed over a valley floor a minimum of 12 m below the present flood basins. Details of this interval, critical to a proper evaluation of Early to Middle Archaic occupance of the valley, remain almost inaccessible. The earliest sites located with respect to identifiable surface channel traces of the modern floodplain are late Middle Archaic (Helton phase, ca. 5500-5000 B.P.), but primary riverbank sites are rare until Woodland times (after 2500 B.P.). It appears that prior to 5000 B.P. the river was sandier than today, lacking backswamps. Thereafter, as the river stabilized near its present level, the key stages of its channel evolution can be approximated as follows (see Figure 1):

*Macoupin Substage.* High-sinuosity river with multiple channels, in part closer to the eastern bluffs than today; some alluviation (slightly coarser than today) above modern levee level by intermittent, very high floods. Probable age, ca. 5000-2100 B.P.

*Long Lake Substage.* Higher sinuosity than today, with some major alternative channels, now abandoned; flood silt and basin regime much the same as at present. Probable age, ca. 2000-1000 B.P.

*Helmbold Substage.* River and major tributaries with higher sinuosity than today; some active secondary channels, abandoned as a result of channel-shortening during nineteenth century. Age, ca. 950 B.P. to recent.

#### THE KOSTER WATERSHED

Some 10 m or so of net sediment accumulation took place on the floor of the Koster Valley, adjacent to the site, during the 10 millennia of Holocene time. This sediment includes some channel beds but is dominated by hillwash (Peyton Colluvium) laid down on the gently inclined footslope of a hillside composed of late Pleistocene loess. This complex body of Holocene colluvium fills in a valley that was overdeepened by stream cutting at the close of the Pleistocene, beginning about or shortly after 12,300 B.P. (Figure 2). Extrapolation of C-14-determined sedimentation rates within the site sequence suggests that Holocene aggradation began ca. 9700 B.P. or a few centuries earlier.

The Holocene sedimentary sequence indicates periodic soil erosion upslope, with redistribution of this sediment downslope. Until ca. 8500 B.P., net sediment accretion on the Koster site probably averaged 20-25 cm per century, then increased to 25-50 cm per century ca. 8500-7700 B.P. Slope erosion was reduced ca. 7700-5500 B.P., when accretion rates declined to 9 cm per century, increasing again to 18 cm per century from 5500-5000 B.P. These rates are generally well in excess of erosion and deposition in the wake of intensive Anglo-American land use and disturbance. They also represent a major departure from a predictable model of dynamic slope equilibrium under the mesic hillside forests that mantled the Koster watershed during the early nineteenth century (Figure 3). Opening up of the hillslope vegetation must be postulated in order to allow for persistent, vigorous erosion. It is probable that a thin soil mantle of regosols and lithosols, as well as a scruffy, xeric vegetation of hill prairie and parkland, characterized the hillsides at the peak of geomorphic dynamism ca. 8500-7700 B.P. (Figure 4). A generally reduced rainfall, with dry winters, appears to be a reasonable interpretation, giving an overall moisture balance similar to that of western Iowa today.

Following upon an erosional break ca. 5000 B.P., slope erosion rapidly diminished and a Mollisol paleosol developed on the Koster site. At this time, the hillsides were probably forested,

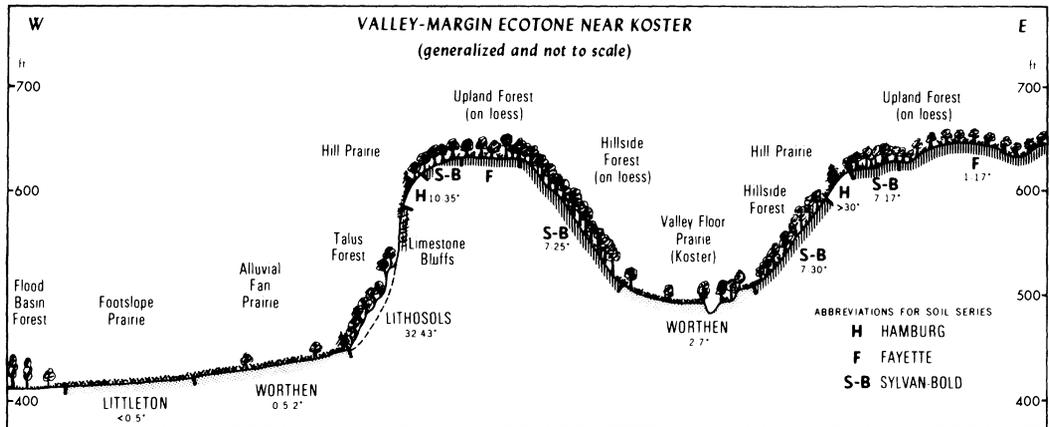


Figure 3. Valley-margin ecotone of the Koster watershed, generalized.

with parkland on the valley floor, much as they were during the early nineteenth century. This pattern of equilibrium was disrupted ca. 2100-1900 B.P. and again 1200-950 B.P. in response to brief dry spells and reduced vegetation that favored gullying or slope stripping upstream and fan alluviation along the margins of the Illinois Valley.

ARCHAEOLOGICAL IMPLICATIONS

A number of parallel studies during the last decade have indicated significant Holocene climatic variation in the upper Midwest and Missouri. The present investigation demonstrates major environmental shifts in Illinois, specifically affecting both the valley-margin forests and the floodplain proper of the Illinois River. Despite broad similarities with geomorphic events elsewhere, external correlations are not simple, and caution must be exercised to prevent premature climato-stratigraphic deductions between Koster and other key sites. But the dramatic Holocene environmental changes recorded at Koster serve to enhance our understanding of the midwestern biomes and their dynamics. They also show that interpretative archaeological models for cultural adaptations through time must consider the environment as a critical variable, rather than as a constant. A few, brief points can be made in this connection:

1. Floodplains are generally dynamic; they tend to progressive change and continual readjustment; they also respond to periodic and aperiodic fluctuations of discharge and sediment loads by

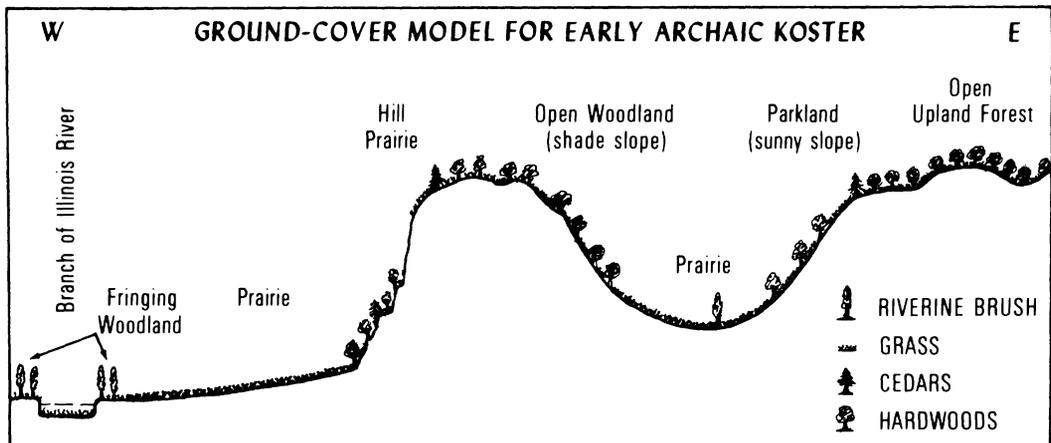


Figure 4. Ground-cover model for Early Archaic Koster, as inferred from geomorphic data.

changing their channel geometry and floodplain regime. Subsistence-settlement systems in the lower Illinois Valley cannot therefore be formulated with respect to a mosaic of environmental resources and specific terrain locations as reconstructed for the nineteenth century. This would be particularly inappropriate for the Archaic, when some of the modern biotopes probably did not exist, and it is inadvisable for the Early Woodland as well.

2. The valley-margin forests of the talus zone, hillsides, and upland fringe clearly have not been persistent and stable, even if their floristic components have remained much the same. Early to Middle Archaic occupation and adaptation in this area can be interpreted only within such a context, in relation to a radically different floodplain; a local creek sometimes flowing clear and sometimes deteriorating to a vegetated draw with little sustained flow; hillsides liable to major soil erosion after each rainstorm; and talus-upland forests replaced by parkland or hill prairie, but then reverting to forest during the Late Archaic. Given such a perspective, it is evident that Archaic subsistence-settlement systems can be properly reconstructed only with due attention to the full range of ecological components.

3. At a higher level of generalization, the present evidence for major ecological shifts cautions against any attempt to explicate Archaic change through time by a paradigm that excludes the environment from the roster of crucial variables.

4. The incisive environmental events in the lower Illinois Valley ca. 2000 B.P. and after 1200 B.P. remain to be investigated in terms of their potential interaction with the subsistence-settlement shifts apparent between the Early and Middle Woodland and again between the Middle and Late Woodland. In particular, a substantial, if relative, reduction of woodland food resources would affect human carrying capacities as well as the ratio of site-size to site-catchment radius.

5. Finally, the Koster geomorphic evidence provides some suggestions that Archaic occupation may have temporarily accelerated prevalent geomorphic trends. This is particularly the case in Koster Horizon 6 (Helton phase) and possibly so in Horizon 11 (Early Archaic). The potential role of Archaic disturbance of the vegetation cover and soil mantle during the course of food and fuel procurement, as well as on-site manipulation and habitation activities, remains to be objectively reassessed.

*Acknowledgment.* This research was supported, in part, by the Foundation for Illinois Archeology and by the University of Chicago Departments of Anthropology and Geography.

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## CHERT SOURCES AND TRACE-ELEMENT ANALYSIS

Barbara E. Luedtke

*Neutron activation analysis of a large number of samples of midwestern cherts shows systematic variation of trace-element proportions within several chert formations. This chemical variation parallels variation in physical properties of the cherts and can also be found between different outcrops of the same chert. Surface alterations of artifacts after they have been deposited in soils also appear to change the chemical properties of the materials to some degree. All of these factors will complicate attempts to characterize chert sources and assign artifacts to them on the basis of their trace-element compositions. Nevertheless, adequate sampling and analysis of cherts should allow discrimination of sources in most areas, since the patterning of variation between cherts appears to be meaningful.*