ILLINOIS STATE GEOLOGICAL SURVEY
Prairie Research Institute
University of Illinois at Urbana-Champaign

Illinois Map 17
2012

Elevation of the Basal Sand and Gravel of the Middle Illinois River Valley

Bureau, LaSalle, Marshall, Peoria, Putnam, and Woodford Counties, Illinois

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2012

Basal Sand Elevation
(feet above mean sea level)

Wisconsin Episode and Holocene on terraces — Young Sand	Wisconsin and Illinois Episodes — Old Sand (mostly buried)
	640
620	620
600	600
580	580
560	560
540	540
520	520
500	500
480	480
460	460
440	440
	420
	400
	380
	360
	340

No basal sand (bedrock upland)

Data Type

543 Stratigraphic test boring or water well log

507 Outcrop of basal sand

1 OSL site with dated samples

Geophysical profile transect

Boring labels indicate elevation of the basal sand in feet above mean sea level. Well and boring records are on file at the ISGS Geological Records Unit and are available from the ISGS Web site.

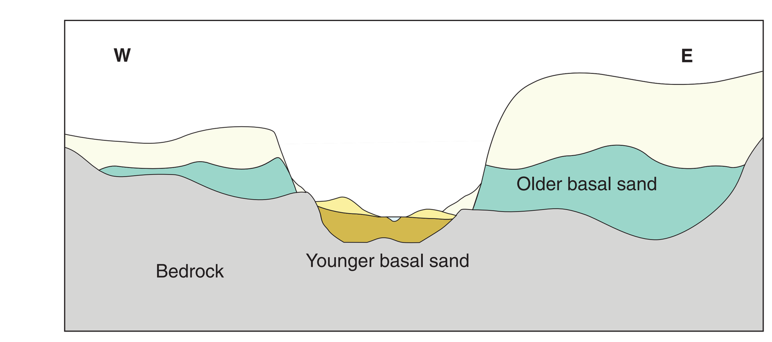

Figure 1 Schematic of the younger sand adjacent to the modern Illinois River, in relation to the older buried sand within the bedrock valley.

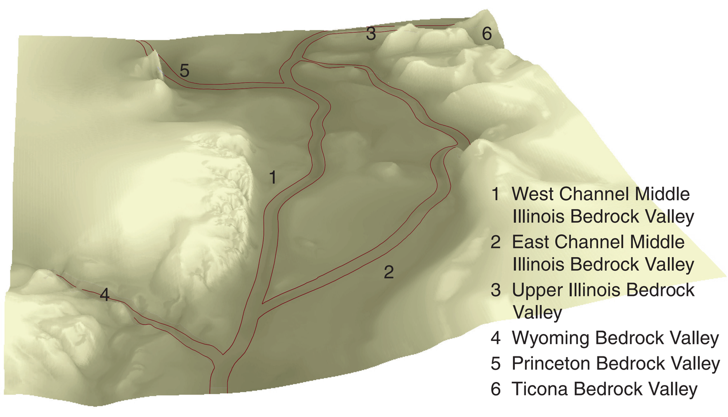

Figure 2 Major bedrock valleys of the Middle Illinois Valley.

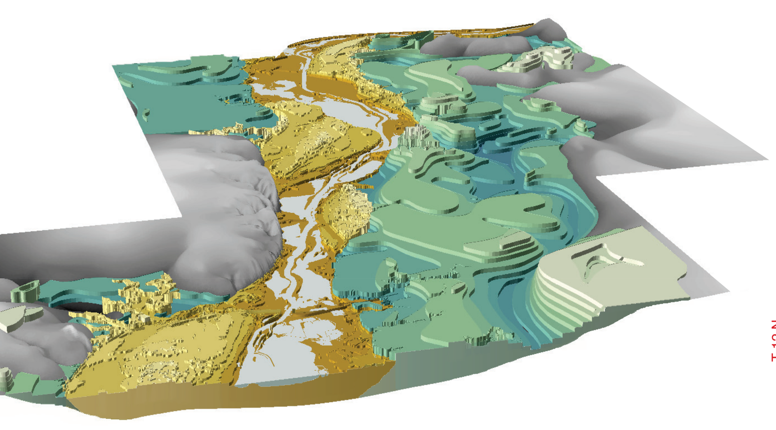

Figure 3 Three-dimensional depiction of the top of the basal sand.

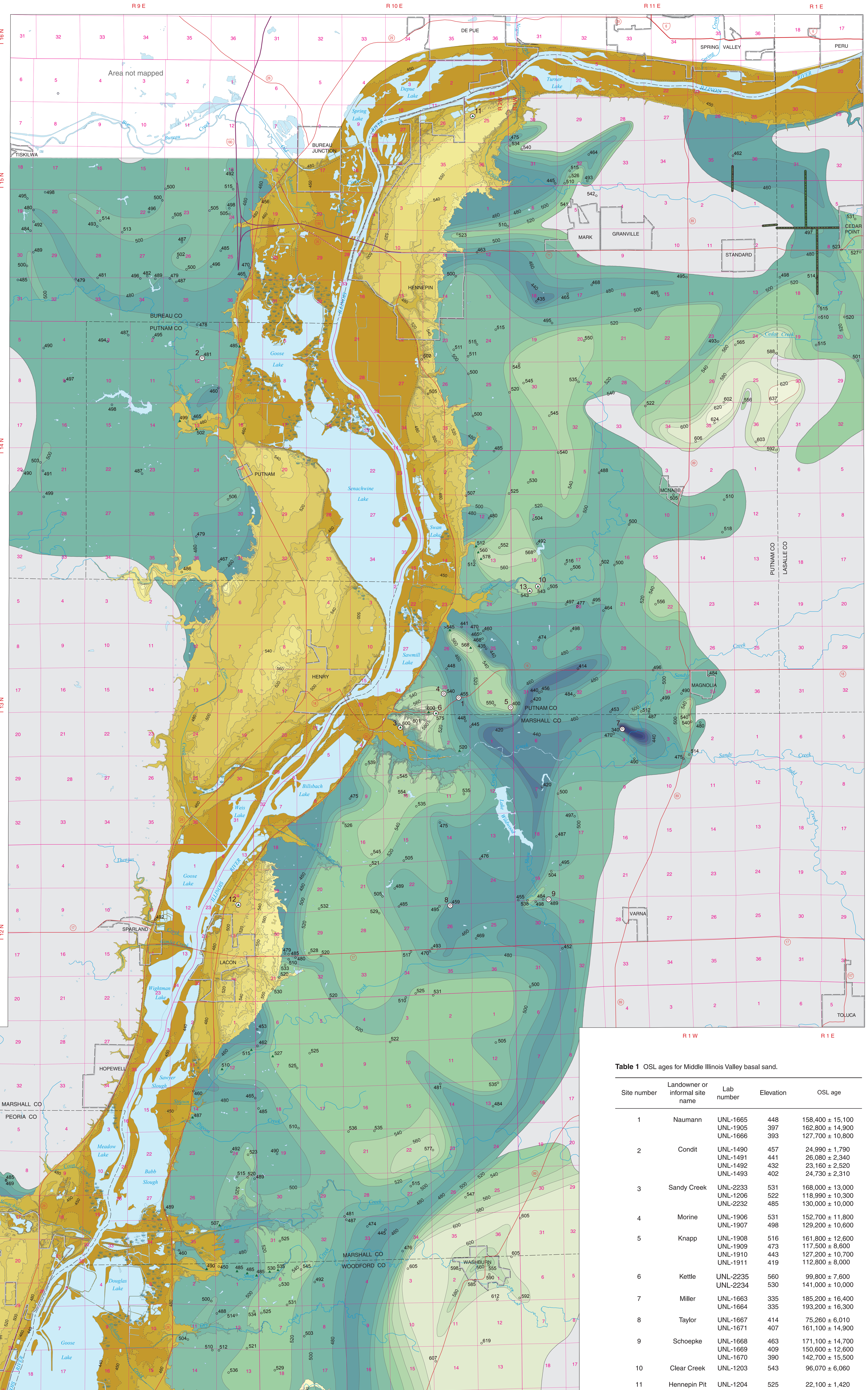

Table 1 OSL ages for Middle Illinois Valley basal sand.

Site number	Landowner or informal site name	Lab number	Elevation	OSL age
1	Naumann	UNL-1665	448	158,400 ± 15,100
		UNL-1905	397	162,800 ± 14,900
		UNL-1666	393	127,700 ± 10,800
2	Condit	UNL-1490	457	24,990 ± 1,790
		UNL-1491	441	26,080 ± 2,340
		UNL-1492	432	23,160 ± 2,520
		UNL-1493	402	24,730 ± 2,310
3	Sandy Creek	UNL-2233	531	168,000 ± 13,000
		UNL-1206	522	118,990 ± 10,300
		UNL-2232	485	130,000 ± 10,000
4	Morine	UNL-1906	531	152,700 ± 11,800
		UNL-1907	498	129,200 ± 10,600
5	Knapp	UNL-1908	516	161,800 ± 12,600
		UNL-1909	473	117,500 ± 8,600
		UNL-1910	443	127,200 ± 10,700
		UNL-1911	419	112,800 ± 8,000
6	Kettle	UNL-2235	560	99,800 ± 7,600
		UNL-2234	530	141,000 ± 10,000
7	Miller	UNL-1663	335	185,200 ± 16,400
		UNL-1664	335	193,200 ± 16,300
8	Taylor	UNL-1667	414	75,260 ± 6,010
		UNL-1671	407	161,100 ± 14,900
9	Schoepke	UNL-1668	463	171,100 ± 14,700
		UNL-1669	409	150,600 ± 12,600
		UNL-1670	390	142,700 ± 15,500
10	Clear Creek	UNL-1203	543	96,070 ± 6,060
11	Hennepin Pit	UNL-1204	525	22,100 ± 1,420
12	Lacon Pit	UNL-1205	490	19,450 ± 1,450
13	Friday 3	UNL-1202	543	93,000 ± 8,800

Base map compiled by Illinois State Geological Survey from digital and paper data provided by the United States Geological Survey.

North American Datum of 1983 (NAD 83)
Projection: Transverse Mercator

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SCALE 1:62,500

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 KILOMETERS

Geology based on field work by E. Donald McKay III and Richard C. Berg, 2001–2011.

Digital cartography by Barbara J. Stiff, Illinois State Geological Survey.

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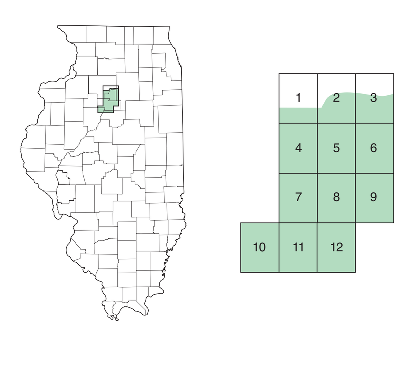

QUADRANGLES
1 Princeton South
2 DePue
3 Spring Valley
4 Putnam
5 Florid
6 McNabb
7 Lacon
8 Henry
9 Varna
10 Rome
11 Chillicothe
12 Washburn

2°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2012

Road Classification

Interstate Route

U.S. Route

State Route

Figure 4 Basal sand and gravel exposed at Site 3 on the map (looking to the north). Note southeasterly dipping beds near the bottom of the slope.

Introduction

The top elevation of the basal sand and gravel is depicted for the middle Illinois River region from east of the "Big Bend" of the river near Hennepin to south of Chillicothe. This sand and gravel resides directly above the bedrock surface, is often greater than 100 feet thick, and constitutes a major drinking water resource for the region. This map provides insight into the erosional and depositional history of the ancient Mississippi River (AMR), the ancient Illinois River, and the modern Illinois River. The topography of the sand and gravel deposit reflects numerous periods of sand and gravel deposition and erosion associated with glacial advances and retreats across the region and associated glacial-fluvial and modern fluvial events. This map is an essential precursor to an aquifer sensitivity map for the region, which will be based on the depth to and thickness of this basal deposit.

This map covers over 500 square miles and includes nine 1:24,000-scale U.S. Geological Survey 7.5-minute quadrangles—Putnam, Florid, McNabb, Lacon, Henry, Varna, Rome, Chillicothe, and Washburn—and the southern half of three quadrangles—Princeton South, DePue, and Spring Valley. Detailed mapping of the basal sand and gravel in this region was an outgrowth of geologic mapping for a proposed highway improvement project along Illinois Route 29, funded by the Illinois Department of Transportation, on the west side of the Illinois River north of Chillicothe (Berg et al. 2002, 2003). This map is part of a series that includes surficial geology (McKay et al. 2010), bedrock topography (Berg et al. 2009), and drift thickness (in preparation) maps of the same region along the middle Illinois River valley (MIV).

Methodology

The basal sand and gravel is divided into two categories (fig. 1):

1. Sand and gravel is exposed at land surface on terraces and on the floodplain along the modern Illinois River and its major tributaries.

2. Older sand and gravel, buried by younger glacial deposits (diamictons, silts and clays, other thinner sands and gravels, and paleosols), occur east of the main Illinois River valley beneath uplands and also above the Princeton Bedrock Valley, Ticona Bedrock Valley, Wyoming Bedrock Valley, and the east channel of the Middle Illinois Bedrock Valley (fig. 2).

The elevation of the younger sand and gravel was determined from land surface contours depicted on topographic maps. The areal extent is bounded by the scarp of the modern Illinois River valley and the walls surrounding the mouths of the major tributaries. Figure 1 shows the relationship of this younger sand and gravel to the older buried sand and gravel within the bedrock valley. Figure 3 is a three-dimensional depiction of the surface of the basal sand and gravel within its bedrock valley.

For the older surface, the top elevation of the buried basal sand and gravel was determined by evaluating logs of borings and by seismic profiling. A total of 1,497 logs of water wells, engineering borings, and coal test borings as well as 23 ISGS exploratory borings and some field-described outcrops were evaluated to determine the top of this basal sand and gravel. These data are on file in the Illinois State Geological Survey (ISGS) Geological Records Unit. In the northeastern portion of the map, seismic reflection profiles, recorded along 5.15 miles of roads, were used to determine the top of the basal sand and gravel within the Ticona Bedrock Valley (Murphey 2005). Logs of nearby water wells were used as a basis for estimating seismic velocities of glacial-fluvial deposits, and travel times measured at selected points (~100 feet apart) along the transect were used to estimate the top of the basal sand and gravel.

The approximate age of the deposit, including the sand on the younger terraces, was determined for 28 samples using optically stimulated luminescence (OSL) of fluvial quartz sand (McKay and Berg 2008) obtained at the 13 sites shown on the map. Sites consisted of outcrops and cores of ISGS test borings (table 1).

To supplement borehole and seismic information, numerous cross sections were constructed to best visualize the continuity of the basal sand and gravel between logs throughout this large MIV region. The elevation of the buried surface was hand-contoured to conform with borehole data. The elevation contours of the buried sand and gravel surface were clipped along the scarp of the modern Illinois River valley and merged with the elevation contours of the younger sand and gravel deposit to produce the surface elevation contours for all MIV sand and gravel deposits.

Observations

Recent geologic mapping and OSL determinations along the MIV have provided new data to better characterize Wisconsin Episode and older sediments associated with glacial and meltwater events that affected the valley several times during the last several hundred thousand years. The AMR reoccupied the valley after each glacial retreat until the river was blocked and diverted by a glacier to its present Mississippi River course at 24,770 ± 250 calendar years BP (McKay et al. 2008). This date was derived from a ^{14}C sample at the top of lake sediment from a core on the east side of the river (site 1 on map). Burial of the AMR valley, first by the basal sand and gravel, followed by Illinois and Wisconsin Episode glacial and glacial-fluvial sediments, and then by postglacial sand and gravel, silt, and clay reflects the complexity of erosion and sedimentation associated with these events. Particularly, the buried topographic expression of the basal sand and gravel provides a first glimpse of the morphology of a patchwork of different aged surfaces.

These different aged surfaces include the following:

1. A prominent buried "terrace" resides at 480–500 feet in the northwestern portion of the map area, west of the Illinois River and above the Princeton Bedrock Valley. Four OSL determinations of the buried basal sand and gravel from an ISGS test drilling site (site 2) reveal dates with a mean weighted average of 24,800 ± 1,100 years BP, which almost perfectly matches the ^{14}C date of AMR diversion from site 1 east of the river. This surface is the floodplain of the AMR just prior to its diversion and subsequent burial by Wisconsin Episode deposits. The surface may have some expression above the Wyoming Bedrock Valley in the southwestern portion of the map and also just east of the main Illinois River valley in the southern portion of the map. However, there are no confirmatory OSL ages for these regions.

2. A prominent buried sand and gravel upland is above an elevation of 500 feet east of the Illinois River. This upland, intersected by channels, extends north-south for about 25 miles and is roughly 1 to 8 miles wide. In the central portion of the map area, the upland is commonly more than 540 feet in elevation and rises, perhaps reflective of a "high terrace remnant," to more than 600 feet at site 3 on the north side of present-day Sandy Creek. Eleven OSL determinations from sites 3, 4, 5, and 6 suggest that this surface is a combination of late Illinois Episode (OSL determination of 141,000 ± 10,000 years BP from a lower sample at site 6) and early Sangamon Episode ages. The latter is perhaps reflective of an interglacial AMR with basal sand and gravel ages of 118,990 ± 10,300 to 130,000 ± 10,000 years BP at site 3, 152,700 ± 11,800 years BP at site 4, 112,800 ± 8,000 to 161,800 ± 12,600 years BP at site 5, and 99,800 ± 7,600 years BP at site 6. The OSL dates at sites 10 and 13 of 96,070 ± 6,060 years BP and 93,000 ± 8,800 years BP, respectively, also suggests a Sangamon age. Some of the uppermost samples at these sites revealed older ages and are inconclusive. The Sangamon Geosol appears to be pervasive over this surface.

3. A 600-foot "high terrace remnant" is observed elsewhere on the map: (a) in the northeast portion about 5 miles south-southwest of the buried Ticona Bedrock Valley, (b) in the extreme southeastern corner, and (c) in the southwestern corner of the map as two small (<1 mi^2) remnants. The relationship of these surfaces to one another is unknown as no OSL ages have been determined. Also data are sparse, and thin diamicton may underlie the basal sand and gravel in some portions of these regions.

4. A channel cut into the buried basal sand and gravel upland surface at an elevation of less than 480 feet is observable east of the river. The channel has continuity from north to south. However, at its northern end, the channel seems to be possibly filled with younger deposits constituting the eventual 500+-foot "terrace" as described in the second item of this list. Ten OSL determinations from sites 1, 7, 8, and 9 suggest that the deposit is early Illinois Episode. At site 1, the uppermost sand has an OSL age of 158,400 ± 15,100 years BP. At site 7, two OSL ages are 185,200 ± 16,400 years BP and 193,200 ± 16,300 years BP. These are the oldest ages for sand that have been dated in the MIV, suggesting that the AMR first occupied this portion of the valley before it began a migration westward. At site 8, an uppermost OSL age on fine sand of 75,260 ± 6,010 years BP suggests a Sangamon Episode alluvial fill succession overlying older sands dated at 161,100 ± 14,900 years BP. The OSL ages at site 9 are 142,700 ± 15,500, 150,600 ± 12,600, and 171,100 ± 14,700 years BP.

Unexplainable are lower elevation portions of the channel, particularly at site 7 where an ISGS test hole revealed the top of the basal sand and gravel at an elevation of 335 feet, overlain by thick Illinois Episode diamictons. Channel scour below an elevation of 460 feet is observable throughout its northern and southern portions. The northwest to southeast channel trend in the northern portion and its alignment with the main AMR channel west of the river above the Princeton Bedrock Valley suggest that the AMR flowed on this eastern side of the valley and could be responsible for the scouring. Southeasterly, steeply dipping, and cemented beds of sand and gravel near the base of site 3 (fig. 4) north of Sandy Creek also suggest major river flow toward the southeast. The southern portion of the buried basal sand and gravel channel directly overlies a channel carved into the bedrock surface (Berg et al. 2009), suggesting that a channel has existed for a long time or perhaps re-occupied itself on the east side of the valley.

Secondary channels are also observable incised into the buried basal sand and gravel surface. The distribution of basal sand and gravel and a channel in the northern portion of the map suggest that there was flow from the Ticona River to the AMR. Two miles southeast of site 8 is a subtle channel below an elevation of 520 feet that perhaps drained the main channel westward.

5. Following the diversion of the AMR to its present Mississippi River course, the modern Illinois River was established as it drained lands from the north and east within the mapped area. Terraces up to elevations of 560 feet were constructed, and the modern floodplain is at an elevation of 450 feet. Two OSL determinations were made on terrace sands from sites 11 and 12. Sand from site 11 at the Hennepin pit had an OSL age of 22,100 ± 1,420 years BP, whereas that from the Lacon Pit at site 12 had an OSL age of 19,450 ± 1,450 years BP. Both are reflective of maximum Wisconsin Episode meltwater flowing down the Illinois River.

Acknowledgments

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