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Holocene loess in Illinois revealed by OSL dating: Implications for stratigraphy and geoarchaeology of the Midwest United States

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ABSTRACT

Most uplands in Illinois are blanketed by late-Wisconsinan Peoria Loess, and the conventional wisdom is that little or no dust accumulation occurred during the Holocene (11.7 ka to present). In a recent effort to investigate if Illinois Holocene loess was deposited and preserved, we applied optically stimulated luminescence (OSL) dating to seven locations where loess is thick. These include four sites along the Mississippi River in westernmost Illinois, and three loess bluffs south of the Illinois River in central Illinois. Our results suggest that Holocene-aged loess is preserved along the Mississippi River in the state of Illinois; in contrast, no Holocene loess was found south of the Illinois River in the central portion of the state. In addition to its spatially limited distribution, Holocene loess thicknesses range only up to 1 m. Nevertheless, loess stratigraphy and OSL dating results provide the first Holocene loess reported east of the Missouri River. Our new finding also resolves the long-time archeological puzzle that a number of artifacts of several thousand years old were buried by upland loess along the Mississippi River.

1. Introduction

Loess is eolian sediment dominated by silt-sized particles. Extensive deposits of loess are present in the Midwest and Great Plains of the United States, and serve as a generally well-studied record of paleoclimate and paleoenvironmental change in these areas and beyond. With the exception of loess in Alaska (Muhs et al., 2003), most loess deposits are located to the immediate south of the area that was occupied by the Laurentide and Cordilleran Ice Sheets (Ruhe, 1983; Leigh and Knox, 1993; Leigh, 1994; Follmer, 1996; Bettis et al., 2003; Grimley et al., 2003; Muhs and Bettis, 2003; Jacobs et al., 2011; Muhs et al., 2018). Many of these loess deposits are interpreted to be periglacial loess, which formed from silt-sized particles that were produced primarily by glacial grinding of crystalline and sedimentary rocks that was transported by glaciers. These particles were subsequently reworked by glaciofluvial processes as outwash along major drainage systems, and finally entrained, transported, and deposited by wind commonly on bluffs along river valleys. Loess in the Central Lowland of the United States has primarily been interpreted as periglacial loess. On the other hand, non-glacial loess, also called desert or hot loess (Smalley, 1995; Wright, 2001), is also present in the Great Plains, where silt-sized particles were generated in and derived from arid or semiarid regions that were not glaciated (Mason, 2001; Aleinikoff et al., 2008; Muhs et al., 2008). Loess of the Chinese Loess Plateau is also typical non-glacial loess (Liu et al., 1985), while Sun (2002) suggests that the loess of the on the High Mountain Regions of Northwestern China may have ultimate glacial component.

In the State of Illinois, loess is typically derived from river valleys that drained from continental glaciers to the north (Smith, 1942; Willman and Frye, 1970). The thickest loess is found along the eastern sides of the Mississippi and Illinois River valleys (Fehrenbacher et al., 1986; Fig. 1). The most common loess deposits are, from youngest to oldest, Peoria, Roxana and Loveland Loess. Older loess units can be found in the non-glaciated southwest

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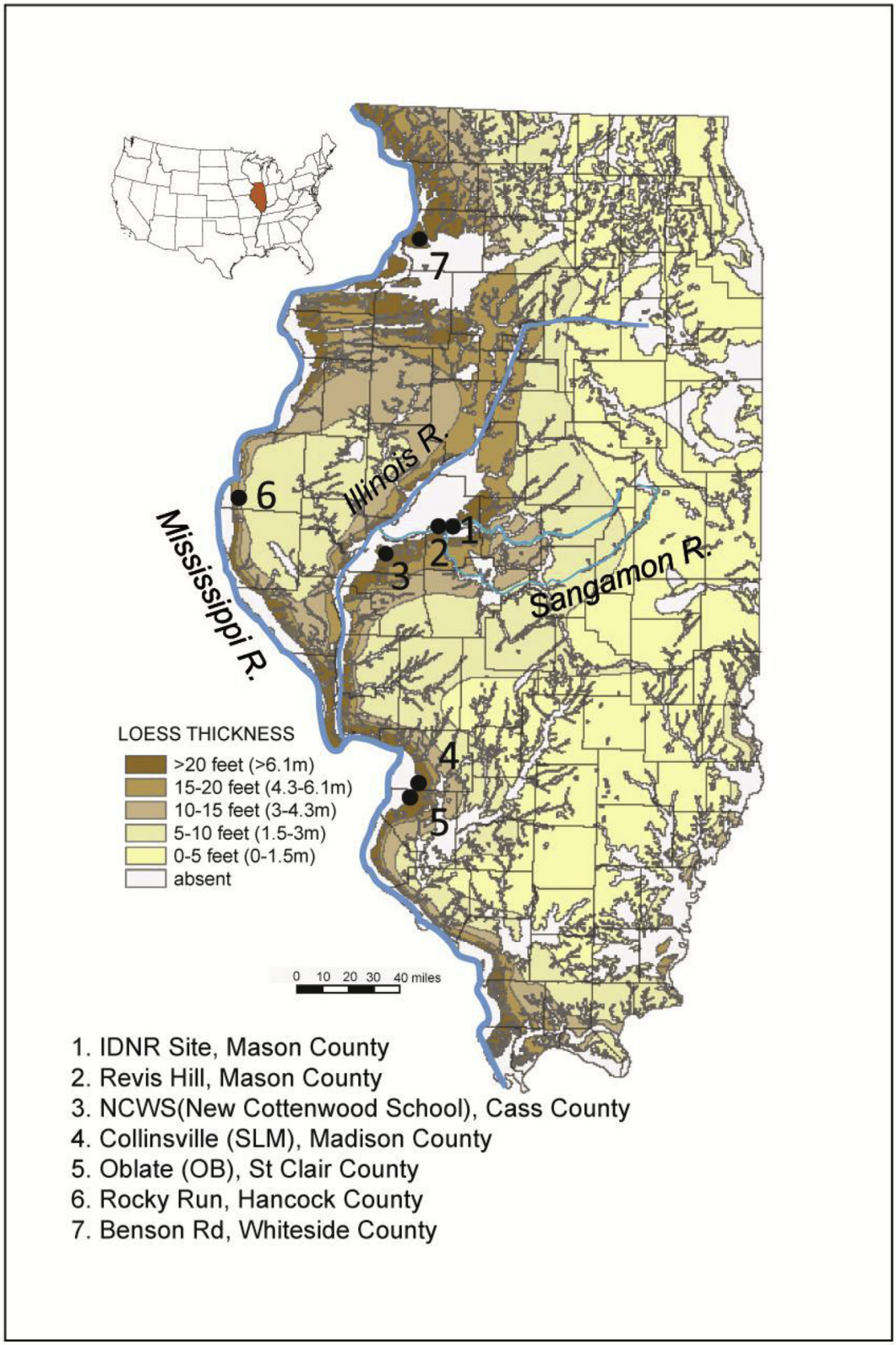

Fig. 1. Study sites in Illinois on the total loess thickness map.

corner of Illinois in the Mississippi River valley including Crowley's Ridge and Marianna Loess (Wang et al., 2009). Peoria loess is a widespread unit that blankets landscapes and constitutes 67% of soil parent material in Illinois (Fehrenbacher et al., 1986; Fig. 1). Radiocarbon dating on soil organic carbon from Peoria Loess yielded ages from 25 to 10 ka (Snowden and Priddy, 1968; McKay, 1979; Ruhe, 1983; Follmer, 1996; Wang et al., 2000; Muhs et al., 2018). Most Peoria Loess was deposited in Illinois prior to 12,500