



# Thin, pedoturbated, and locally sourced loess in the western Upper Peninsula of Michigan



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## ABSTRACT

Soil surveys document thin but discontinuous loess deposits across large tracts of Michigan's western Upper Peninsula (UP), which we informally call the Peshekee loess. Our study is the first to examine the distribution, thickness and textural characteristics of these loess deposits, and speculate as to their origins. Peshekee loess is typically 20–70 cm thick and underlain by sandy glacial deposits. At most sites, pedoturbation has mixed some of the lower materials into the loess, resulting in a particle size mode within the 25–75  $\mu\text{m}$  fraction (from the loess), but also a secondary mode in the 250–500  $\mu\text{m}$  fraction (from the pedoturbated sand). We introduce a method by which the mixed sand data are removed, or “filtered out,” of the original particle size data, to better reflect the original textural characteristics of the loess. Our data – from 237 upland sites – show that the textural and thickness attributes of the loess change markedly across the region, pointing to the influence of many localized loess sources, and suggesting that this loess was transported mainly over short distances. The Peshekee loess deposits were mainly derived locally from moraines, outwash plains, and floodplains of small meltwater streams – interspersed within the region and at its periphery. We identify and name four main loess “core” regions, each of which has distinct characteristics that set it apart, and describe each of these as a unique “type” of loess with one or more local source areas. Loess from each core area overlaps with neighboring loess deposits.

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## 1. Introduction

Loess is found across China, Central Asia, Europe, New Zealand, South America, Alaska, and on both the Great Plains and Central Lowlands of North America, particularly in and near the Mississippi Valley (Smalley, 1975; Follmer, 1996; Mason et al., 1999; Bettis et al., 2003; Roberts et al., 2003) (Fig. 1). Many – although certainly not all – North American loess deposits are associated with glacial episodes, thereby providing a record of environmental change during and after the last glacial phase (Muhs and Bettis, 2003). Interpretation of this record of environmental change requires accurately linking loess stratigraphic sequences to their source areas, along with understanding the spatial characteristics of the loess itself (Mason et al., 1999; Muhs et al., 1999, 2008; Sun, 2002; Schaetzl and Hook, 2008; Aleinikoff et al., 2008; Stanley and Schaetzl, 2011).

In the Midwestern United States, loess can exceed tens of meters in thickness, especially near major meltwater valleys (e.g., Smith, 1942; Olson and Ruhe, 1979; Fehrenbacher et al., 1986; Roberts et al., 2003). The loess deposits generally become thinner

away from these valleys, until, at the margins, these deposits become discontinuous and where present, thin and variously mixed into the underlying sediment (Stanley and Schaetzl, 2011; Scull and Schaetzl, 2011; Schaetzl and Luehmann, 2013). Justifiably, the majority of traditional loess research has focused on the thick loess deposits near large river valleys (Smith, 1942; Wascher et al., 1947; Frazee et al., 1970; Olson and Ruhe, 1979; Fehrenbacher et al., 1986; Leigh, 1994; Pye, 1995; Rutledge et al., 1996; Bettis et al., 2003). The relatively thin and discontinuous loess deposits that blanket much of the Great Lakes region have been, until very recently, inadequately mapped and largely unstudied.

On a small-scale map that is sometimes referred to as the “first best loess map” of the USA, Thorp and Smith (1952) identified major loess deposits near the large meltwater valleys in the Midwest, but failed to show some of the smaller, thinner and disjunct deposits farther from them. One such loess deposit that they did identify extends as a narrow finger from northeastern Wisconsin into Iron County, MI (Fig. 1). Later, between 1980 and 2007, independent work performed by Natural Resource Conservation Service (NRCS) personnel, as part of their county-level soil survey operations, confirmed this loess but also identified loess of considerably wider extent in the western Upper Peninsula (UP) (Berndt, 1988; Linsemier, 1997; Schwenner, 2007) (Fig. 2). Many soil series here were defined as having been formed in loess or in a “modified eolian

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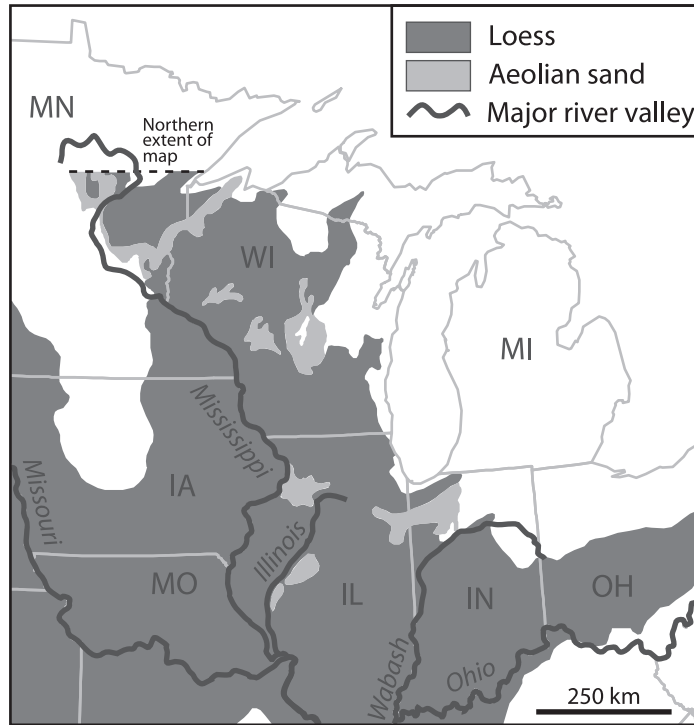


Fig. 1. Extent of loess and aeolian sand deposits in the Midwestern USA, redrawn from Thorp and Smith (1952).

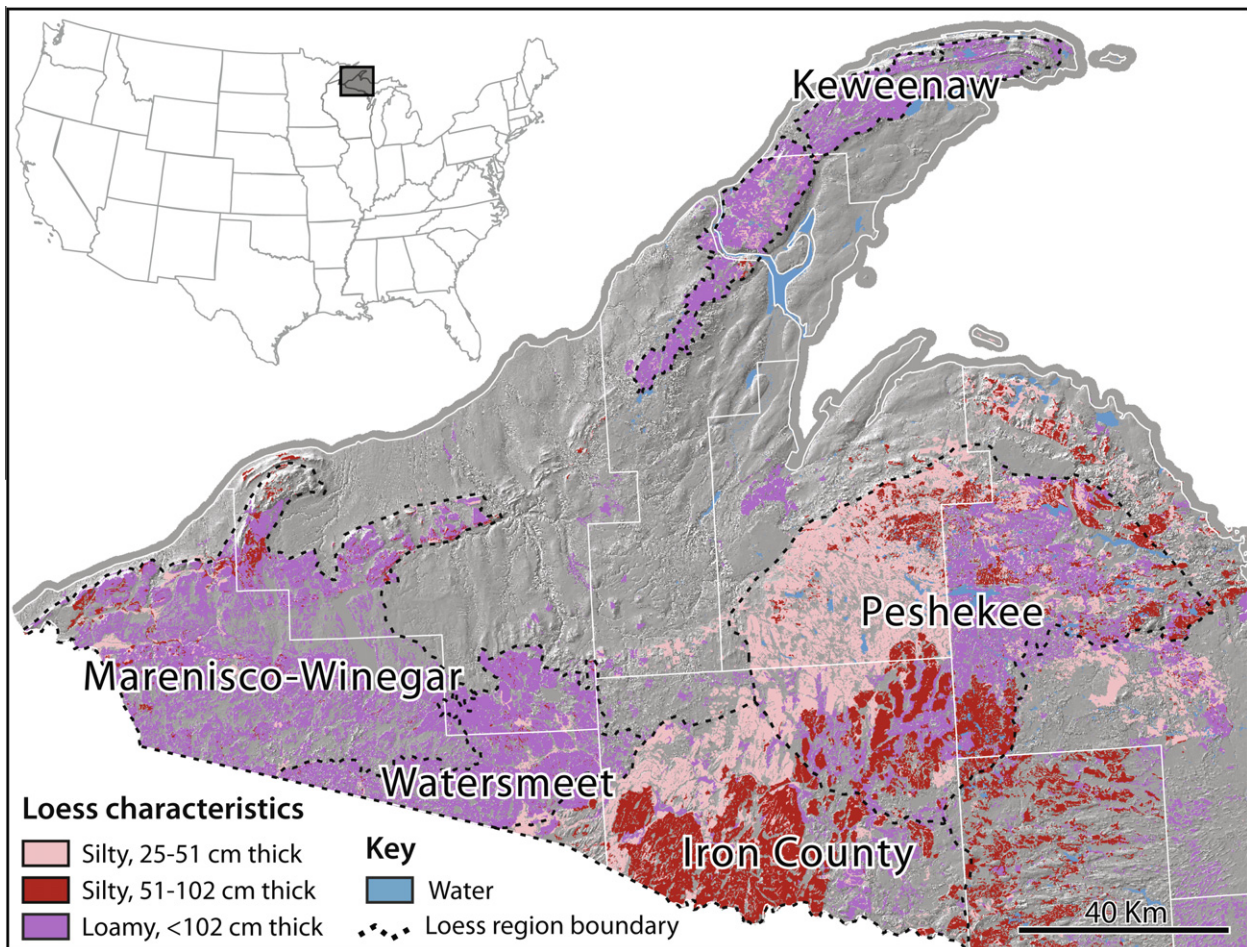


Fig. 2. Loess regions identified within the western Upper Peninsula of Michigan, as indicated on NRCS soil survey maps and as interpreted from Scull and Schaeztl (2011).

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