LOESS SPATIAL CHARACTERISTICS ESTIMATE PALEOWIND PATTERNS DURING AND AFTER LATE GLACIAL MAXIMUM IN WISCONSIN, USA

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ABSTRACT

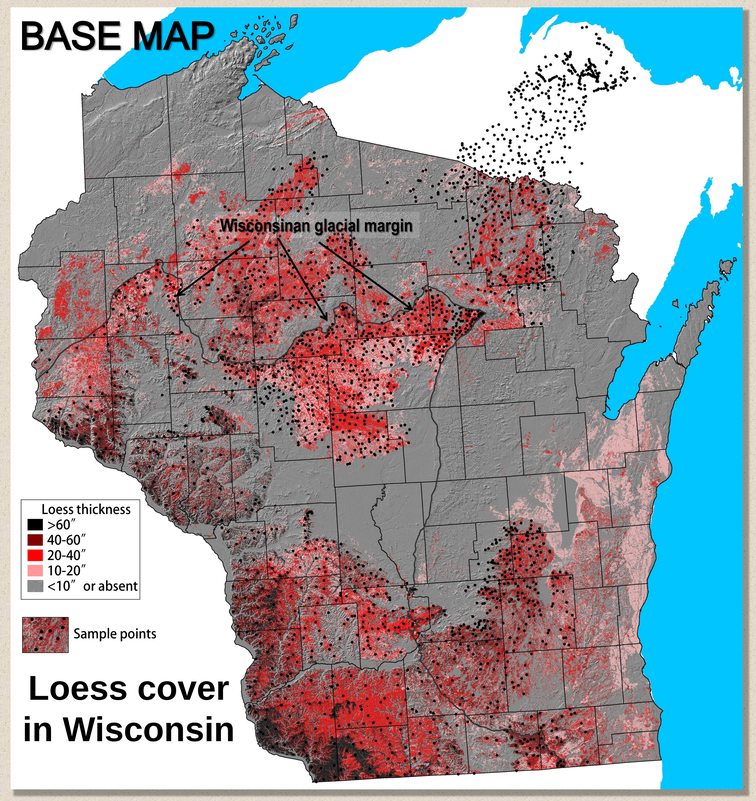
Loess distribution patterns in the midwestern US have long been used to infer paleowind directions during and after the Late Glacial Maximum (LGM). Landscapes east of north-south trending rivers such as the Mississippi, Wabash and Illinois all have thick loess deposits, pointing to loess transport mainly on westerly winds. Most of these sites, however, are considerable distances from the ice front, and were even farther away in the post-LGM period, when loess generation may have been maximal. Thus, they provide only a limited picture of paleowinds.

The general distribution of MIS-2 aged loess deposits in Wisconsin has long been known. To these data we add thickness and texture information derived from 2279 loess samples from uplands across the state, providing an unparalleled opportunity to add insight into loess distribution and transport systems during and shortly after the LGM.

Wisconsin's thickest loess is found on its western margins; loess here was mainly derived from the Mississippi River valley train and other western sources. This loess thins and fines rapidly to the east. Many interior areas, e.g., outwash and glaciolacustrine plains, are usually loess-free, as are areas that remained geomorphically unstable long after loess deposition had stopped, such as hummocky moraines. Other areas in Wisconsin, far from the Mississippi River, also have thick loess. Generally, this loess is associated with "interior" source areas such as glaciolacustrine plains, outwash plains, and hummocky moraines. Loess near these source areas almost always thins and gets finer to the southeast, suggesting that depositional systems were driven by northwesterly winds. With the exception of areas immediately near the ice front, which may have been influenced by katabatic winds, most loess in Wisconsin at and after the LGM was deposited on northwesterly winds. This poster highlights several examples in support of this conclusion.

METHODS

At 2279 upland sites across Wisconsin and the western Upper Peninsula of Michigan, my students and I have sampled loess. Our goal was to obtain samples that are representative of the entire loess column, down to the end of a standard 5' bucket auger or to the underlying sediment, whichever is shallower. Loess thickness is also recorded at each site. All samples have been analyzed for texture using laser diffraction. Entering the data into an ArcGIS shapefile enabled us to examine spatial patterns, which may shed light on possible source areas and paleowinds. Results are provided based on two components of the data that usually attain high values near source areas – thickness and very fine sand content.



Acknowledgements

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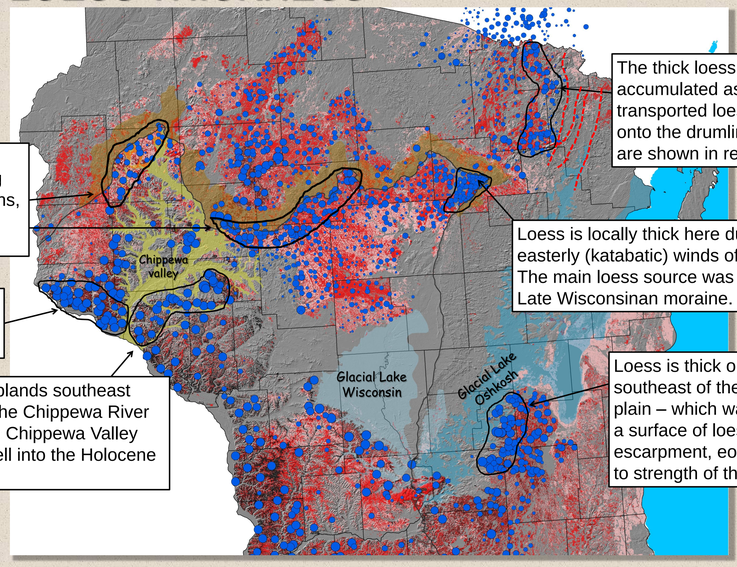
LOESS THICKNESS



Loess is thickest just southeast of the Late Wisconsinan end moraine, pointing to strong northwesterly winds. Silt-rich, ice-walled lake plains, which dominate these two parts of the moraine, are likely loess sources.

Westerly winds led to very thick loess on uplands just east of Mississippi River valley

Loess is thickest on uplands southeast of the valley trains of the Chippewa River and its tributaries. The Chippewa Valley was a loess source well into the Holocene (Schaetzl et al. 2014).

The thick loess here, on drumlin tops, accumulated as easterly (katabatic) winds transported loess from outwash plains onto the drumlins. Former ice-margins are shown in red.

Loess is locally thick here due to easterly (katabatic) winds off the ice sheet. The main loess source was the hummocky Late Wisconsinan moraine.

Loess is thick on the bedrock uplands southeast of the the Glacial Lake Oshkosh plain – which was a loess source and/or a surface of loess transport. Near the edge of the escarpment, eolian sands overlie loess, attesting to strength of the northwesterly winds.

VERY FINE SAND CONTENT

The loess here is sandiest on the eastern margin of the drumlin field. This pattern suggests that the easterly (katabatic) winds that transported this loess from outwash plains were stronger than any westerlies that also may have been present. Former ice-margins are shown in red.

Westerly winds led to loess that is rich in very fine sand on uplands just east of Mississippi River valley

Loess in the southeastern corner of the Antigo Flats is very sandy, pointing to strong easterly (katabatic) winds in this re-entrant area, transporting sands off the moraine.

Loess near edge of Oneota Escarpment is rich in very fine sand. Eolian sands even overlie the loess near the escarpment edge, attesting to strength of the northwesterly winds.

High contents of very fine sand in loess on uplands east and southeast of the valley trains of the Chippewa River and its tributaries point to the valley as a loess source, and to strong northwesterly winds.

Eolian sediment here is sandy because of transport across this low-relief surface. The abrupt change to silty (low-sand, small circles) loess to the east occurs at a major river valley, which sands canot easily cross. In sum, this area shows dominant west-to-east eolian transport.

DISCUSSION AND CONCLUSIONS

Data suggest that much of the loess in Wisconsin was transported on westerly or northwesterly winds. Additionally, easterly and northeasterly winds were strong loess transportation agents near the ice front, as in parts of northeastern Wisconsin (Schaetzl and Attig 2013). Data from spits in Glacial Lake Algonquin, ca. 11,000 BP, in the northern Great Lakes region also point to easterly winds, but only within ≈150-200 km from the ice margin. Most sites in Wisconsin would have been at least that far or farther from the ice, during their loess deposition interval. Thus, the data above point to most loess being transported on winds from the west and northwest, as suggested by loess textural and thickness patterns farther south (Muhs and Bettis 2000, Bettis et al. 2003).

LITERATURE CITED

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