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Letter to the Editor

Mississippi Valley Regional Source of Loess on the Southern Green Bay Lobe Land Surface, Wisconsin—Comment to the paper published by Jacobs et al., Quaternary Research 75 (3), 574–583, 2011

In this article, Jacobs et al. (2011) discuss the possible origins of a thin (75–125 cm) loess mantle on a bedrock upland in southeastern Wisconsin, last glaciated by the Green Bay Lobe (GBL) of the Wisconsin glacier (Fig. 1A). They argue that the ultimate source of this loess was Mississippi River Valley (MRV) glacial outwash—a long-established source for loess elsewhere—and suggest that northwesterly winds carried loess from the valley, assisted by low-relief surfaces of transport, onto the abandoned Glacial Lake Wisconsin (GLW) plain (Fig. 1A). Later, this sediment was remobilized within sand sheets and dunes (Fig. 1B) and subsequently deposited onto the upland because the Oneota escarpment, which forms the sharp northern margin of this upland, blocked further dune migration. Their work supports the loess generation model of Mason et al. (1999), in which topographic barriers to migrating sand (and entrained silt) foster loess deposition on uplands immediately downwind (Sweeney et al., 2005, 2007; Schaetzl and Loope, 2008).

Although the processes described by Jacobs et al. (2011) are plausible, the geography of loess production–sedimentation in this region, and their choice of sample sites, introduces doubt to their interpretations and conclusions. Furthermore, the complex scenario they suggested ignores a more straightforward explanation, which I describe below.

Geography matters

Although loess is silt-dominated, silt mineralogy data obtained by Jacobs et al. (2011) for the GBL loess were not useful in determining a possible source. Therefore, their argument rested mostly on clay mineral similarities between loess from Driftless Area (DA) sites and loess from their GBL study area. They assumed that DA loess was largely sourced from the MRV, and I agree. However, interpretations based on these clay mineral data may be compromised because of issues related to sample selection.

For example, given prevailing winds, loess transported from the MRV to the GLW plain would have mainly derived from sites to the west-northwest of the GLW plain. Only three of the 12 DA loess samples acquired by Jacobs et al. (2011) met this criterion (Fig. 1B). The other 12 DA loess samples are from sites farther south, which have different textures and, likely, different source areas and mineralogical suites (Figs. 1C, D; Mason et al., 1994).

Similarly, some GBL loess samples used in mineralogical analysis were collected from far outside the study area. Indeed, four of these samples are from Rock Prairie, which lies off the GBL surface (Fig. 1B). Additionally, two samples came from a lowland within Lake Scuppernong; these samples could represent silty lake sediment, colluvium, or reworked loess, rather than primary loess. In sum, it is difficult to have confidence in precise mineralogical matches (or mismatches) among samples that have such varying depositional histories and differing geographies.

Lastly, Jacobs et al. (2011) rely on the assumption that MRV loess was transported to GLW plain and then remobilized by migrating dunes. Although dunes exist on the GLW plain (Rawling et al., 2008), most of the lake plain is flat, wet, and lacks obvious dune fields (Fig. 1B). Indeed, the nearest dune field is ≈75 km northwest of the GBL study area. Contrary to what was asserted by Jacobs et al. (2011), between GLW and the Oneota escarpment, few dunes—and no dune fields—occur that could have transported eolian sediment to the base of the cuesta. Additionally, NRCS soils data show that the few sandy areas that occupy the lowlands northwest of (upwind from) the Oneota escarpment are composed of outwash and/or silty-sandy lake sediment, not eolian sand. Furthermore, low *uplands* within this "intervening" landscape lack loess.

Alternative explanation

I suggest that the loess in question was most likely sourced from Glacial Lake Oshkosh (GLO), which was situated proximally upwind to the upland study area. In this scenario, silty-sandy lacustrine sediment intermittently exposed during drawdown events could have been deflated by strong northwesterly winds, onto the neighboring upland (Fig. 1A).

Although Jacobs et al. (2011) used clay mineral data to rule out GLO as a loess source, the GLO samples used are questionable. GLO samples were not taken from surficial lacustrine sediment; instead, samples were taken from three core samples, recovered from between 5 and 81 m depth (Fig. 1B). Vastly different redox environments, vis-à-vis the loess, may have impacted the clay minerals in these subsurface samples.

Regional loess trends

Spatial trends in loess attributes from samples I have collected from upland sites in southern Wisconsin may more accurately illustrate the likely source area for this loess. Using textural data from these samples, I created kriged maps—an established method of determining source areas for loess (Scull and Schaetzl, 2011; Stanley and Schaetzl, 2011). Textural fining of loess from the MRV to sites farther inland confirms that the MRV was a loess source for the western DA (Fig. 1C; Scull and Schaetzl, 2011). For example, transect 1A shows that 25–50 μm (medium and coarse silt) contents decrease towards the southeast from 35% to 24%—across a distance of only 57 km (Fig. 1C). Similarly, 25–50 μm contents decrease south and east of the Oneota escarpment along transects 2 and 3—all clearly suggestive of textural fining away from a loess source area.

Importantly, the loess along transect 1B coarsens markedly as it approaches the GLW plain (Fig. 1C) and fine silt contents (12–25 μ) decrease dramatically toward the GLW plain (Fig. 1D), which suggests that the GLW plain was a loess source area, and may have even contributed loess to the bedrock upland. Counter to the scenario

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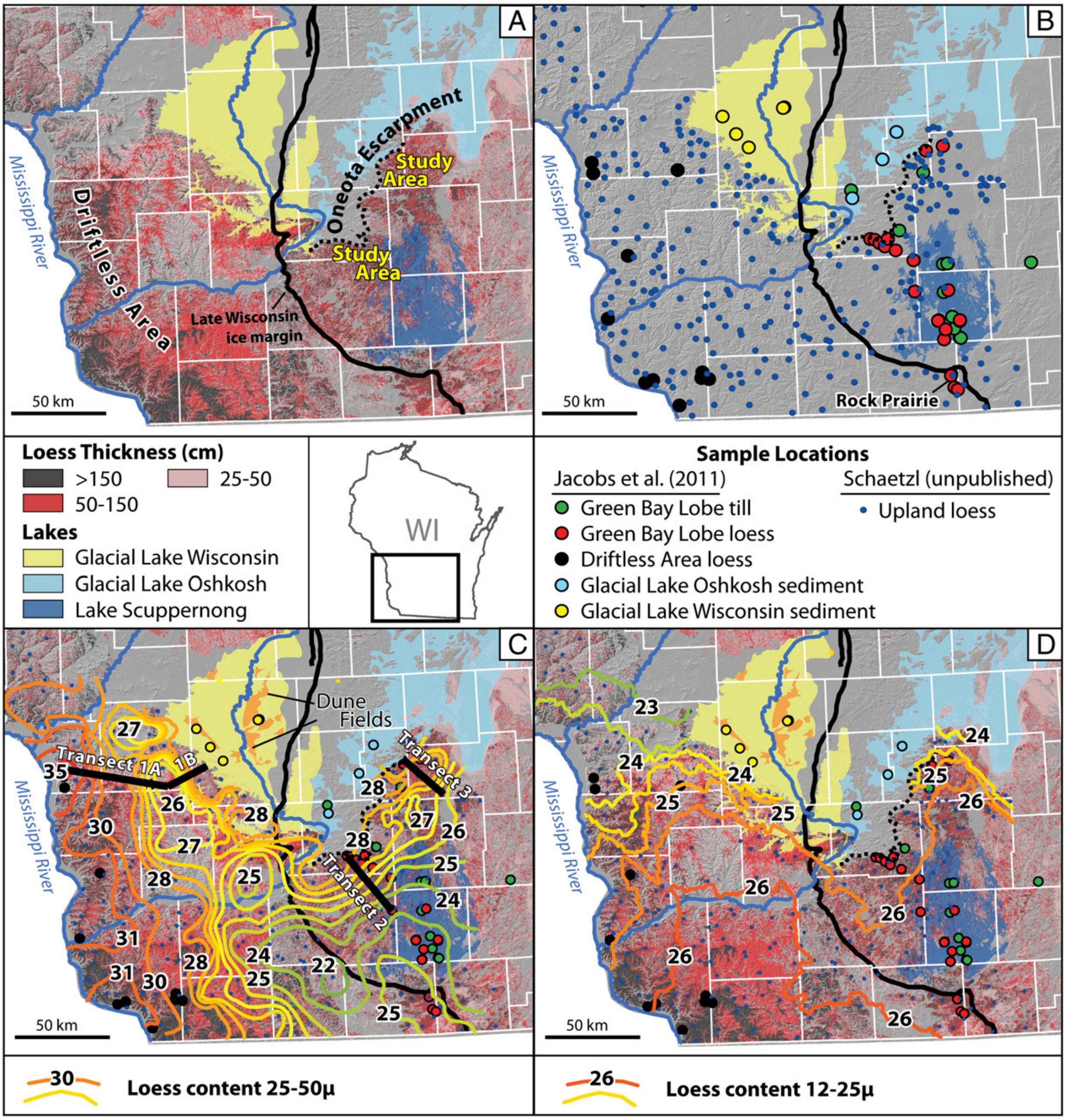

Figure 1. Various maps of southern Wisconsin. A. Map showing loess thicknesses (where present) in various shades of red and black, based on published NRCS soil survey data, e.g., Stanley and Schaetzl (2011). Also shown are the extents of Glacial Lakes Wisconsin (Clayton and Attig, 1989) and Oshkosh (Hooyer, 2007), Lake Scuppernong (Clayton, 1986), the Oneota escarpment, the maximum extent of the Late Wisconsin ice advance (black line), and some major rivers. B. Map showing sample locations and types. Sample locations for Jacobs et al. (2011) are based on supplementary data provided in (linked through) the original article. Because of the scale of this map, overlapping symbols may show as one symbol, but represent several samples. C. Map showing isolines of medium plus coarse silt (25–50 μ) content of loess, using unpublished data from upland sites (blue dots). The map was created using ordinary kriging in ArcGIS 10.0 (© ESRI, Redlands, CA). Isoline values were rounded to the nearest whole percent. The default isoline intervals in ArcGIS have been used in the map. Transects discussed in the text are labeled. Locations of dune fields within Glacial Lake Wisconsin are shown. Loess thickness and other symbology as in panel B. D. Map showing isolines of fine silt (12–25 μ) content of loess. Loess thickness and other symbology as in panel B.

proposed by Jacobs et al. (2011), textural data (Figs. 1C, D) clearly suggest that this loess was not secondary sediment, rich in fine silts, blown in from the MRV and then remobilized. Rather, loess deflated from the GLW plain was coarse and thus, primary sediment, i.e., coming directly off the silty-sandy sediments of the lake plain.

In short, loess on the bedrock uplands south of the Oneota escarpment is considerably coarser than what would have been falling onto the GLW plain, sourced from the MRV (Fig. 1C). Indeed, fine silt contents of the loess in their study area actually *decrease* toward the GLW plain (Fig. 1D), a spatial trend that would not exist if the lake plain were a loess source rich in fine silts. I would also argue that, by the time MRV loess had reached the GLW plain, too little would have been available for deflation—too little to have resulted in >1 m of loess in a study area over 90 km away. Geography simply does not support their model.

Conclusions

Although I support the loess generation model originally presented by Mason et al. (1999), its application in this case is not warranted. Instead, a more parsimonious explanation using Occam's Razor would suggest that most of the thick, coarse loess south of the Oneota escarpment was likely deflated from the lacustrine plain of Glacial Lake Oshkosh, located only ≈5–20 km upwind, to the northwest. This straightforward model of short-distance loess deflation and transport must be disproven before a more complex one can be adopted for this area.

The original article by Jacobs et al. (2011), when combined with this letter and their response to it, shows that more data on loess texture, thickness and mineralogy must be gathered and analyzed before we can know with certainty the nature of loess generation, transportation, and deposition on post-glacial landscapes. I hope that this dialogue has taken the academic community closer to that goal.

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