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Letter to the Editor

Mississippi Valley regional source of loess on the Southern Green Bay Lobe land surface, Wisconsin—Response to comments by Randall Schaetzl, page 574-583

Dear Editor,

We have carefully considered each of the issues raised by Randy Schaetzl (this issue). We appreciate the opportunity to explain our conceptual model more adequately, but in the end we see no need to change our conclusions.

We proposed that loess on the southern Green Bay Lobe (GBL) was derived from the Mississippi Valley region, in part because we could find no other plausible source to explain its smectitic clay mineralogy. One well-established loess source in that region is the late Pleistocene Mississippi floodplain, but as Schaetzl suggests, loess could also have been transported eastward across the Mississippi from sources farther west (Mason et al., 1994). All available data indicate that both of these sources produced loess with high smectite content. For example, Ruhe (1984) and Frye et al. (1962) both characterize loess from the Mississippi Valley as smectitic. The same is true of the loess studied by Mason et al. (1994) from sources west of the Mississippi (Mason, 1992; unpublished data of the authors). All of our Wisconsin Driftless Area samples share this smectitic mineralogy, with no evidence of a spatial trend. Currently, we are investigating geochemical evidence which, like the smectitic clay mineralogy, appears to link loess on the GBL and along the Mississippi River to similar glacial sediment and/or bedrock sources.

Schaetzl suggests that our Driftless Area samples inadequately represent loess from farther north along the Mississippi but presents no evidence that such loess is less smectitic. In any case, our three northern Driftless Area samples (as smectitic as all the others) and the study area of Mason et al. (1994) are directly west of the Central Sand Plain of Wisconsin. Westerly to northwesterly winds would have carried smectite-rich loess from the Mississippi Valley in that area across the sand plain (probably with repeated deposition and re-entrainment) and ultimately southeastward onto the GBL.

Contrary to Schaetzl, no samples of GBL loess were collected “far from the study area”. The four Rock Prairie samples were from loess overlying GBL outwash, within sight of the GBL moraine. We assume outwash and moraine surfaces were exposed to loess deposition from the same regional sources at about the same time. Two sites are said to be within a lowland containing Lake Scuppernong sediment, but we interpreted these as loess rather than lacustrine sediment, using field evidence rather than a generalized map of the extent of Lake Scuppernong. It matters little if we were wrong, however, since those two samples fall within a well-defined cluster of the other 17 loess samples, all of which have smectitic clay mineralogy distinctly different from GBL glacial till and outwash or Glacial Lake Oshkosh sediment.

Eolian sand in the basin of Glacial Lake Wisconsin (GLW) and along the entire transport path from the Mississippi Valley is indeed critical to our model. The largest dunes in the GLW basin were studied by Rawling et al. (2008), but much of the surface of the lake plain consists of gently undulating sands that have been interpreted as eolian, as we described and supported with references cited in the paper. Large parts of the lake plain are wet today, but the occurrence of dunes within those wetlands indicates a lower water table allowing past eolian activity.

Likely or clearly identifiable eolian sands also occur across the landscape between the GLW plain and the Oneota cuesta where the loess ultimately accumulated, contrary to Schaetzl's comments. Large parabolic dunes are clearly visible in soil surveys of Columbia and Green Lake counties, and we have confirmed their morphology and grain-size characteristics in the field. These are among many areas of eolian sand shown in the maps in our paper, and the presence of which is noted in the soil survey reports for Columbia County (Mitchell, 1978, p. 148) and Green Lake County (Anderson and Gundlach, 1977, p. 125). At the northwestern edge of the thick loess, a thin mantle of eolian sand locally overlies loess, also noted in the soil surveys and confirmed in the field.

Schaetzl favors the sediment of Glacial Lake Oshkosh (GLO) as the major loess source, arguing that this is a more parsimonious explanation. In fact, the simplest interpretation is that GLO sediments contain abundant illite and kaolinite because they were derived from GBL glacial sediment with similar mineralogy, and therefore they could not have been the main source of the smectitic loess. Schaetzl suggests the core samples from GLO that we analyzed do not represent shallower sediment that became loess, because of some unspecified effect of the redox environment on clay mineralogy; however, this is implausible and certainly not parsimonious. Illitization of detrital smectite would require much greater depths of burial and higher temperatures, and would beg the question of where the smectite came from to begin with. Formation of smectite through weathering of illite in oxidized upper layers is conceivable as a long-term process, but not one that could have happened quickly enough to allow abundant smectite to be dispersed with the loess soon after the lake drained in the late Pleistocene.

We are happy to see the grain-size patterns mapped by Schaetzl, because they add support to our conceptual model. His data show that the loess on the GBL is relatively coarse along its northwestern edge atop the Oneota escarpment and fines southeastward from there, consistent with data we reported. This is exactly the pattern predicted by our model. Loess from the Mississippi Valley was conveyed east and southeast across a surface of transport (*sensu* Mason et al., 1999), including the Central Sand Plain of Wisconsin and the glacial landscape between the sand plain and the escarpment. Because the loess deposited on the surface of transport was largely re-entrained (leaving a virtually loess-free landscape today), there was only minor depletion of coarse silt along the transport path. Thus, the GBL loess at its proximal edge is almost as coarse as that near the Mississippi.

Schaetzl places great emphasis on grain-size trends in loess on the bedrock uplands southwest of the GLW plain (his transect 1B). He is probably correct in positing an immediate source northeast of this transect, but fails to see that it could have been the surface of transport envisioned in our model. That surface would have been located

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just northeast of transect 1B, and in our model would have been the location of frequent dust re-entrainment. Occasional northerly or northeasterly winds or even the lateral spreading of a southeastward moving dust cloud would have dropped relatively coarse loess on the northeast end of transect 1B. Overall, our conceptual model remains a straightforward interpretation of the available grain-size and mineralogical data.

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