Geophysical Research Abstracts
Vol. 13, EGU2011-3951, 2011
EGU General Assembly 2011

Evidence for Eolian Remobilization of Loess in the Central Great Plains, USA, and Implications for Paleoclimatic Interpretation of the Loess Record

Joseph Mason (1), Mark Sweeney (2), and Paul Hanson (3)

(1) Department of Geography, University of Wisconsin-Madison, Madison, Wisconsin, USA (mason@geography.wisc.edu), (2) Earth Sciences Department, University of South Dakota, Vermilion, South Dakota, USA (Mark.Sweeney@usd.edu), (3) School of Natural Resources, University of Nebraska-Lincoln, Lincoln, Nebraska, USA (phanson2@unlnotes.unl.edu)

During Oxygen Isotope Stage 2 (OIS 2), Peoria Loess up to 50 m thick accumulated on the central Great Plains of North America. The huge volume of Peoria Loess on the Great Plains implies extraordinary rates of atmospheric dust production and transport during OIS 2, with potential impacts far downwind. These considerations have motivated extensive optically stimulated luminescence (OSL) dating of Peoria Loess in Nebraska (Roberts et al., 2003, Quaternary Research 59:411-419 and OSL ages from our research). While OSL ages indicate large variations in accumulation rate, it is difficult to correlate episodes of rapid accumulation or even the beginning and end of Peoria Loess accumulation between sections.

Large uncertainties in the ages clearly contribute to this problem, but here we propose a geomorphic explanation: Widespread eolian remobilization of the loess after initial deposition. Large linear troughs, scarps, and streamlined ridges, aligned northwest to southeast and up to 20 km long, occur in thick Peoria Loess from eastern Colorado to northeastern Nebraska. Similar features occur locally in Peoria Loess of the midwestern U.S. and other loess regions. Abrupt changes in loess thickness are associated with at least some of these features. For example, a trough in western Nebraska cuts through the entire ∼30 m thickness of Peoria Loess, exposing older sediment on the trough floor.

We are testing the hypothesis that these striking landforms were produced by large-scale wind erosion of loess after deposition, and our results to date support that interpretation. Particle-size data from cores in western Nebraska indicate that the upper several meters of loess has been remobilized locally, with winnowing of fine particles to the point that the remaining sediment approaches eolian sand in grain size; this coarse zone is absent at sites only a few km away. The ground surface above the remobilized loess has a distinctive sand sheet-like topography, which appears to form a northwest-southeast band paralleling nearby troughs. We suggest this band represents an initial stage of trough formation. Experiments with the Portable In-Situ Wind Erosion Laboratory (PI-SWERL) confirm that coarse Peoria Loess in the same area can be directly entrained from a bare, uncrusted surface, with winnowing of the fines and movement of coarser grains in saltation.

Local large-scale remobilization and deflation of loess could produce a complex spatial pattern of OSL ages, grain size, and accumulation rates. Where deflation has occurred, the uppermost remaining Peoria Loess could yield a relatively old OSL age, while redeposition of eroded loess would produce very high rates of accumulation and a younger range of ages nearby. Abrupt coarsening in a particular loess section might represent local remobilization, not a regional climatic event. Widespread eolian remobilization may also help resolve a modeling problem: Numerical modeling of dust transport with plausible wind conditions fails to reproduce the persistence of coarse-grained Peoria Loess far downwind across the central Great Plains; however, this may be expected if the coarse grains can be re-entrained and redeposited several times. This research emphasizes the importance of a landscape-scale approach to paleoclimatic reconstruction from the loess record. If our hypothesis of extensive, large-scale wind erosion during OIS 2 is correct, this in itself may be one of the most important paleoclimatic messages. This could not have occurred without much sparser vegetation than would be inferred from most paleoclimatic reconstructions of the last glaciation in this region. Furthermore, remobilization and associated winnowing could have increased fine dust flux downwind from the Great Plains.