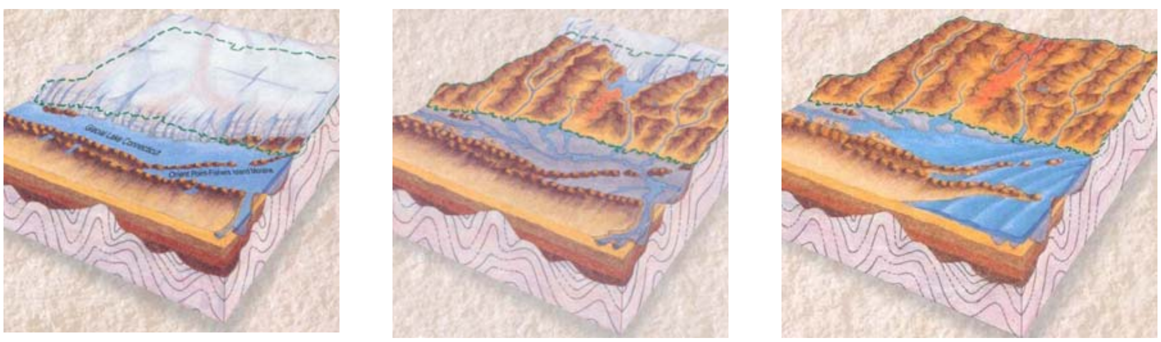
Age of Loess on Long Island

Vesna Kundić, Gilbert N. Hanson and Daniel M. Davis
Department of Geosciences
Stony Brook University
Stony Brook, NY 11794-2100

Loess is unconsolidated, wind deposited sediment composed largely of silt-sized particles with the modal diameter between 15-50 µm. Loess is very homogeneous and shows little or no stratification. Loess deposits on Long Island range from a few centimeters to several meters in thickness. Provenance of Long Island loess was previously studied by Zhong (Zhong, 2000) using single mica grain Ar/Ar ages. Her mica ages fell within the age range of the Connecticut bedrock and she concluded that most loess on Long Island was derived from basement rocks typical of Connecticut.

Our working hypothesis is that Long Island loess is derived from the glacial sediments deposited on the bottom of the present day Long Island Sound. As the ice sheet retreated from Long Island a proglacial lake formed in the Long Island Sound basin between the ice and the Harbor Hill Moraine. This lake was trapping the sediment produced by the glacial grinding. Around 15.5 ka proglacial Lake Connecticut was completely drained and its bottom was exposed. Strong catabatic winds were blowing down from the ice sheet whose margin was then at the Connecticut-Massachusetts border. The lake bottom sediments were entrained by the wind and deposited on Long Island. By 12.4 ka the sea level raised enough to completely cover the bottom of the sound and the lake bottom was no longer available as the loess source (Lewis and Stone, 1991).



17,500 years ago 15,500 years ago 15,000-5,000 years ago

Figure 1 (Lewis and Quellette,) Block diagram showing the history of Long Island Sound

Assuming that topographic lows would serve as traps for dust suspended in the overflowing air (Pye, 1987) we looked at kettle holes expecting to find thick loess deposits at their bottoms. The assumption was that kettle holes were already topographic lows at the time of deposition.

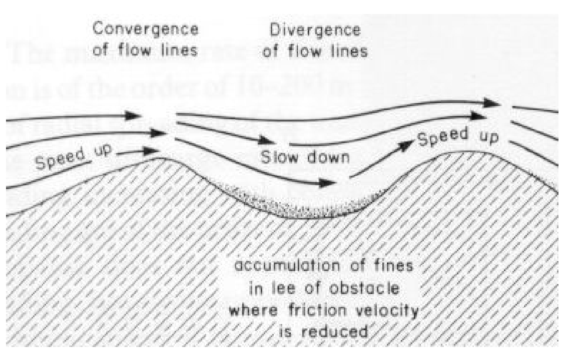


Figure 2 (from Pye, 1987) The particles suspended in wind are deposited when wind slows down and its carrying capacity is reduced.

We further assumed that bigger kettle holes would contain thicker loess deposits. The first site we examined was a large kettle hole near Pt Jefferson, which is about 30 m deep and 300 m wide. We drilled a 186 cm deep core at the bottom of the kettle but found only 15-20 cm of silt.

We hypothesize that at the time of loess deposition the ice was still buried under the sediment and the kettle was not yet formed. Since this kettle is at the edge of the outwash fan it is possible that the ice was covered with a relatively thick layer of sediments, permafrost was keeping material at depth frozen, and it thus took a long time for the large block of ice to melt to make a kettle hole.

The next site we examined was a midsize kettle in Wildwood State Park (Fig. 3), which is only 10 m deep. We used Ground Penetrating Radar (GPR), and resistivity to distinguish the loess Fig. 4. We collected several auger samples and two vibra-core samples through the 2.7 meters of loess.

Figure 3 Topographic map of the Wildwood state park. Arrow points to the kettle hole.

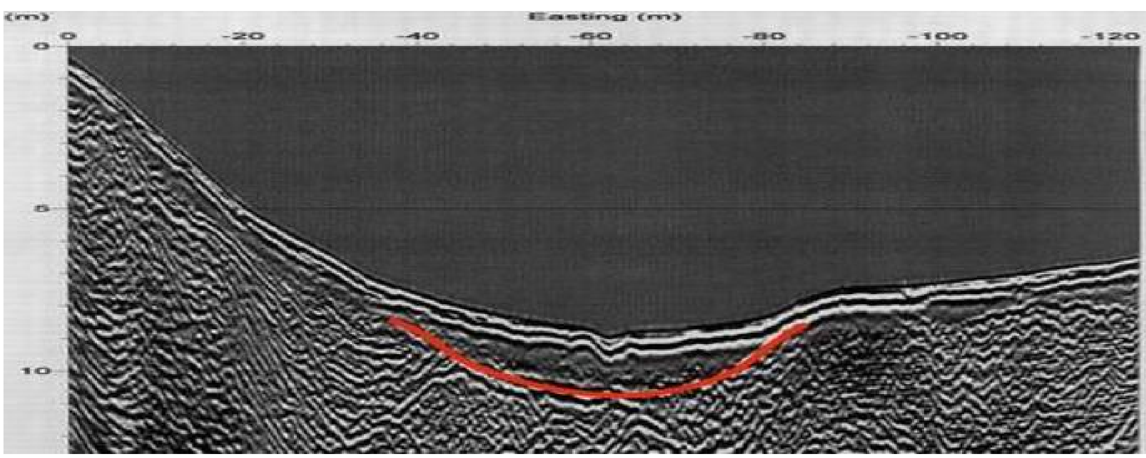


Figure 4. GPR line along the bottom of the kettle shows loess lens below the surface.

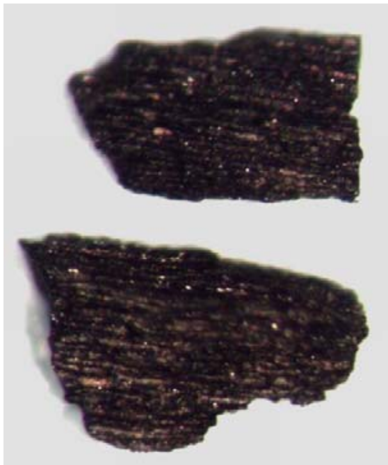
To date the samples we used Optically Stimulated Luminescence (OSL) dating, which measures the time since the sediment was last exposed to light. It is therefore necessary to collect samples for OSL dating without exposing them to light. This was done using vibra-core samples, which were obtained with the help from Marine Science Department at SUNSB. These samples are encased in aluminum pipes that prevent any light from reaching the sample.

Figure 5. Vibra-coring in Wildwood State Park kettle hole.

Three samples were sent for OSL dating to Steve Forman's lab at the University of Illinois at Chicago: one from the bottom of the core, one from the middle and one from just below the soil line. The ages were 13,780 ±1,100 years for the bottom of the deposit and 13, 400±1,250 years for the middle. These ages are consistent with the hypothesis that loess was deposited after 15.5 ka and before 12.4 ka. The third age, just below the soil line, was 7,730±690 years. Forman (written communication, 2002) believes that the age dates the time of colluviation of the loess during a colder period at that time when the vegetation may have been less dense and atmosphere dryer and dustier. This cooling episode in Holocene is better known as 8,200 ka event and it is observed elsewhere in North America. (Barber et al., 1999; Beierle and Smith, 1998; Dean et al., 2002; Yu and Wright, 2001)

The cores we have also contain charcoal grains some of which have been submitted to the University of Arizona Accelerator Mass Spectrometer Laboratory for ^{14}C dating. (Fig.6)

Figure 6. Circled in red is charcoal grain as seen while splitting the core.



Charcoal grains under the microscope. Grains are approximately 1 mm long

BIBLIOGRAPHY

Barber, D.C., Dyke, A., Hillaire-Marcel, C., Jennings, A.E., Andrews, J.T., Kerwin, M.W., Bilodeau, G., McNeely, R., Southon, J., Morehead, M.D., and Gagnon, J.M., 1999, Forcing of the cold event of 8,200 years ago by catastrophic drainage of Laurentide lakes: Nature, v. 400, p. 344-348.

Beierle, B., and Smith, D.G., 1998, Severe drought in the early Holocene (10,000-6800 BP) interpreted from lake sediment cores, southwestern Alberta, Canada: Palaeogeography Palaeoclimatology Palaeoecology, v. 140, p. 75-83.

Dean, W.E., Forester, R.M., and Bradbury, J.P., 2002, Early Holocene change in atmospheric circulation in the Northern Great Plains: an upstream view of the 8.2 ka cold event: Quaternary Science Reviews, v. 21, p. 1763-1775.

Lewis, and Quellette, Geology of Long Island Sound, Connecticut Department of Environmental Protection, Long Island Sound Licence Plate Program.

Lewis, R.S., and Stone, J.R., 1991, Late Quaternary stratigraphy and depositional history of the Long Island Sound basin: Connecticut and New York: Quaternary geology of Long Island Sound and adjacent coastal areas: Journal of Coastal Research, p. Walter Newman Memorial volume, Special Issue No. 11; p. 1-23.

Pye, K., 1987, Aeolian dust and dust deposits, London ; Orlando : Academic Press, 1987., 334 p.

Yu, Z.C., and Wright, H.E., 2001, Response of interior North America to abrupt climate oscillations in the North Atlantic region during the last deglaciation: Earth-Science Reviews, v. 52, p. 333-369.

Zhong, J., 2000, Grain Size Analysis and Provenance of Long Island Loess.