Sedimentary Environments Associated with Episodic Failure of Glacial Moraine Dams in Central Illinois
A Student Field Project

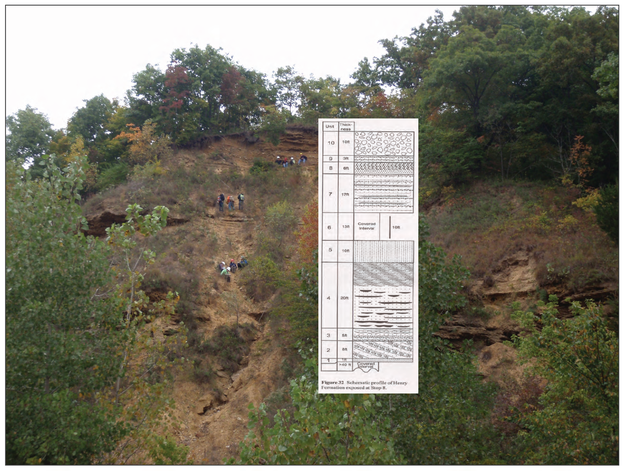
Lisa Tranel, Illinois State University, ltranel@ilstu.edu

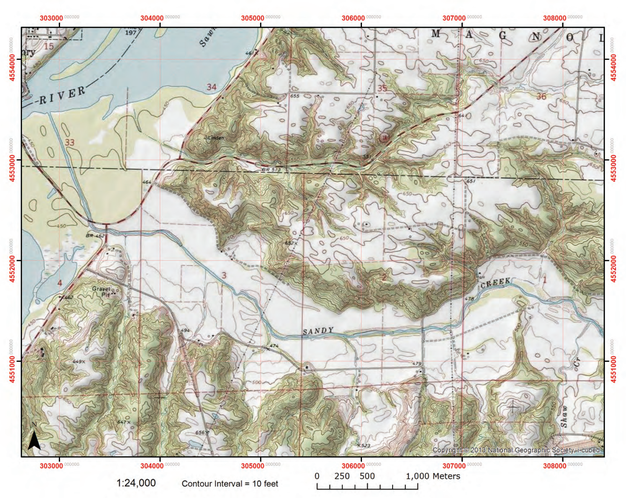
Overview

Students make observations, collect samples, and analyze sediment sizes to evaluate three possible hypotheses on the origin, transport history, and depositional environments of sediment layers. This project is currently used in a sophomore level class geared toward teaching students how to make geologic observations.

Field Site

- Old gravel quarry in Central Illinois along the floodplain of Sandy Creek, a tributary to the Illinois River
- Ancestral Mississippi River Valley flowed across this region before glaciation.
- Gravels likely represent torrent related to release of glacial lake waters following a moraine dam failure. Water would have flowed down ancestral Illinois River valley (Frankie et al., 2002).
- Sediments coarsen upward
  - o Gravel crossbeds at base
  - o Sand and gravel interbedded layers
  - o Preserved flute casts and climbing ripples in lower sandy beds
  - o Silt and clay loess deposits near the top of the outcrop





Goals

- ***Skills:***
  - o Collect a sediment sample
  - o Describe and measure stratigraphy
  - o Sieve sediment and create a cumulative sediment size curve
- ***Field Experiences***
  - o Observe changes in sediment size in an outcrop indicating changing depositional conditions
  - o Measure dip direction of crossbeds
  - o Observe sedimentary structures
  - o Observe various degrees of lithification
- ***Interpretation:***
  - o Students use their observations to determine the velocity of water flow.
  - o Students consider the direction of flow and possible sources of sediment.
  - o Students interpret possible depositional environments from grain size

Student Workflow

- Students work in groups on different sections of the outcrops to complete descriptions and sample collection.
- Students work in groups in the lab to sieve sediments and complete graphs and calculations
- As a class, we compile data from the different sections of the outcrop
- Students read the field guide for the area
- Students write individual reports with their interpretations from their data and observations compared to the observations and interpretations presented in the field guide.

Field

Layer Descriptions
- o How thick are layers?
- o What are the grain sizes in each layer?
- o How does sediment size in one layer compare to other layers?
- o Are the layers horizontal or dipping? If dipping, what angle?
- o Are there any unique sedimentary structures?
- o Include a sketch

Collect a sample

Lab

Lab Work and Calculations
- o Each group will sieve 1 sample.
- o Calculate percent weight for each size fraction
- o Calculate cumulative weight percent
- o Create a cumulative size frequency plot
- o What is the median (D50), D84 and D16 grain size?
- o Calculate the mean grain size
- o Use the Hjulstrom diagram to determine water velocity to transport/deposit mean grain size

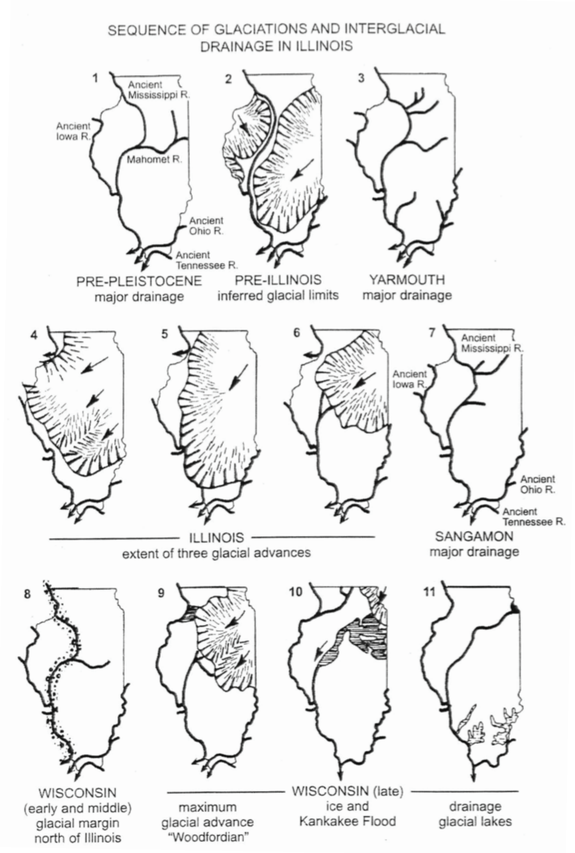
Compilation & Discussion

Reference: Frankie, W.T., Jacobson, R.J., Hansel, A.K., Killey, M.M., Nelson, R.S., Malone, D.H., Shields, W.E., Corbet, R.G. 2002. Guide to the Geology of the Hennepin Area, Putnam, Bureau, and Marshall Counties, Illinois, Illinois State Geological Survey Field Trip Guidebook 2002A.

Student Paper

Hypotheses

- Ancestral Mississippi River deposits
- Glacial outwash down ancestral Illinois River valley
- Modern sediments deposited by Sandy Creek



Discussion Questions

- Do you think that the water velocity was the same over time, or did it change? Explain why or why not.
- Were your sediments deposited during fast or slow discharge? Explain?
- Describe how conditions might have changed in the environment where these sediments were deposited.
- Why were the layers formed?
- What was the depositional and climatic setting?
- Why were there changes between different beds in the outcrop?
- What are the similarities and differences in the transport and depositional processes in this area?
- How did sediment sizes change as you move from bottom to top of the outcrop?