POLAR TREC
Learning Resources

Details

Completion Time: About 2 class periods
Permission: Download

What Can We Learn from Sediments?

Overview

In this activity students learn about varves, annual sediment layers found in lakes. Students will analyze authentic varve data from New England in order to correlate data from three different geographic locations .

Objectives

Students will analyze authentic varve sediment data and create a graph of varve thickness. Students will use their results to make inferences about the climatic conditions of the times.

Lesson Preparation

Introduction & Background Information:
Varves are annual sediment layers usually found in lakes, and result from the transport of sediments due to the seasonal changes in the weather and climate. Glacial lakes usually have pristine varve records since there are fewer burrowing animals found in glacial environments that could displace the sediment record. In glacial environments there is a melting season and a non-melting season. During the melting season there is usually a heavy influx of sediments caused by the melting and movement of the glacial snow and ice, and sediments tend to be coarser and the quantity greater than in the non-melting season. During the non-melting season the only sediment being deposited on the lake floor is from the melting of any ice on the base of the glacier or from the settling of fine clay sediments that had previously been suspended in the lake, therefore the layers tend to be thinner and the color a bit darker. The varve layers deposited during the melting season are called the summer layers whereas the varve layers deposited during the non-melting season are called the winter layers.

Varve chronology is created by matching patterns in varve thickness of varve sequences from around a

Materials

- Graph paper or Excel
- 1 set of a laminated varve sequences created with adding machine paper and the data provided
- Internet access
- Google Earth, Topographic or geologic maps of the New England region in the study (see Resources section for more information)

region. The sequences are effective time stamps for region given the fact that there is yearly deposition of varve layers; therefore one summer/winter layer is equal to one year. A regional chronology can paint a greater picture once the sequences are correlated from one location to the next in a region. It is the custom when acquiring and labeling varve sequences to number the layers in the order in which they were deposited with the oldest having the lowest number and the youngest having the highest number.

Varve sequences from one location to another within a region are correlated by locating a distinctive varve layer that matches across sequences, and using this as a marker of time. If dates are established through radio-dating methods for the sequences then years can be ascribed to the varve layers. The power of using varve chronology is that they can be correlated to the time of deglaciation for a region, and with other proxy climate indicators such as ice cores, paleoclimate records can be reconstructed for a region.

References:
Ridge, J.C., 2008, "The North American Glacial Varve Project": (http://ase.tufts.edu/geology/varves), sponsored by The National Science Foundation and The Geology Department of Tufts University, Medford, Massachusetts (http://ase.tufts.edu/geology/varves/default.asp).

Procedure
1. Using a map source such as those listed in the Resources section, analyze the topography of the region from which the varves were extracted.
2. Using the datasets provided create a multiline graph of the varve thicknesses from the three locations. Be sure to label the horizontal axis with the varve number (NEVC year, NEVC = New England Varve Chronology), and the vertical axis with thickness in centimeters.
3. Complete attached Analysis Worksheet using information from the North American Glacial Varve Project for assistance.

Tips:
This is a great activity that brings the Polar Regions closer to home as the students realize that a vast portion of the United States was covered with ice not too long ago.
• Before using this activity visit the North American Glacial Varve Project website for extensive background information (http://www.ase.tufts.edu/geology/varves/Geology/deglaciation.asp)
• Before starting this activity students should have knowledge of the last period of glaciation in North America including the extent of the glaciation as well as the scale of a glacier.
• These varve sequences date back to approximately 12.6 kyr ago using C-14 calibration.
• The varves are numbered in the order in which they were deposited from oldest (lowest number) to youngest (highest number). Although the numbers are called "years" they do not refer to the years as related today. They should be considered reference years.
• Varves have been correlated to the climate of the region using the calibrated dates compared to the dates from the Greenland Ice Cores.

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Extension
If your students are more advanced have them select and download their own data from the website.

Resources
Google Earth, Topographic or geologic maps of the New England region in the study
http://terraserver-usa.com/
http://topomaps.usgs.gov/
http://geology.com/state-map/new-hampshire.shtml
http://www.anr.state.vt.us/DEC/geo/SurfMap.htm
http://gos2.geodata.gov/wps/portal/gos

Datasets provided but also available at these links:

Lower Connecticut Valley
LCB57-63.TXT 5713-6277, Conn. Valley, NH and VT, VT 14-15 and VT-NH 16-17 plots of Antevs (1922)
http://ase.tufts.edu/geology/varves/Data/NEVCmasterData/LCB57-63.TXT

Ashuelot Valley
ASH58-59.TXT 5804-5879, Ashuelot Valley, Keene, NH, NH 15 plot of Antevs (1922)
http://ase.tufts.edu/geology/varves/Data/NEVCmasterData/ASH58-59.TXT

Merrimack Valley
MER57-64.TXT 5709-5749, 5771-6352, Merrimack Valley, NH, NH 14-15 and NH-VT 16-17 plots of Antevs (1922)
http://ase.tufts.edu/geology/varves/Data/NEVCmasterData/MER57-64.TXT

Assessment
Students will complete the Analysis Worksheet.

Credits
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Learning Resources

National Science Education Standards (NSES):

Content Standards, Grades 9-12

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

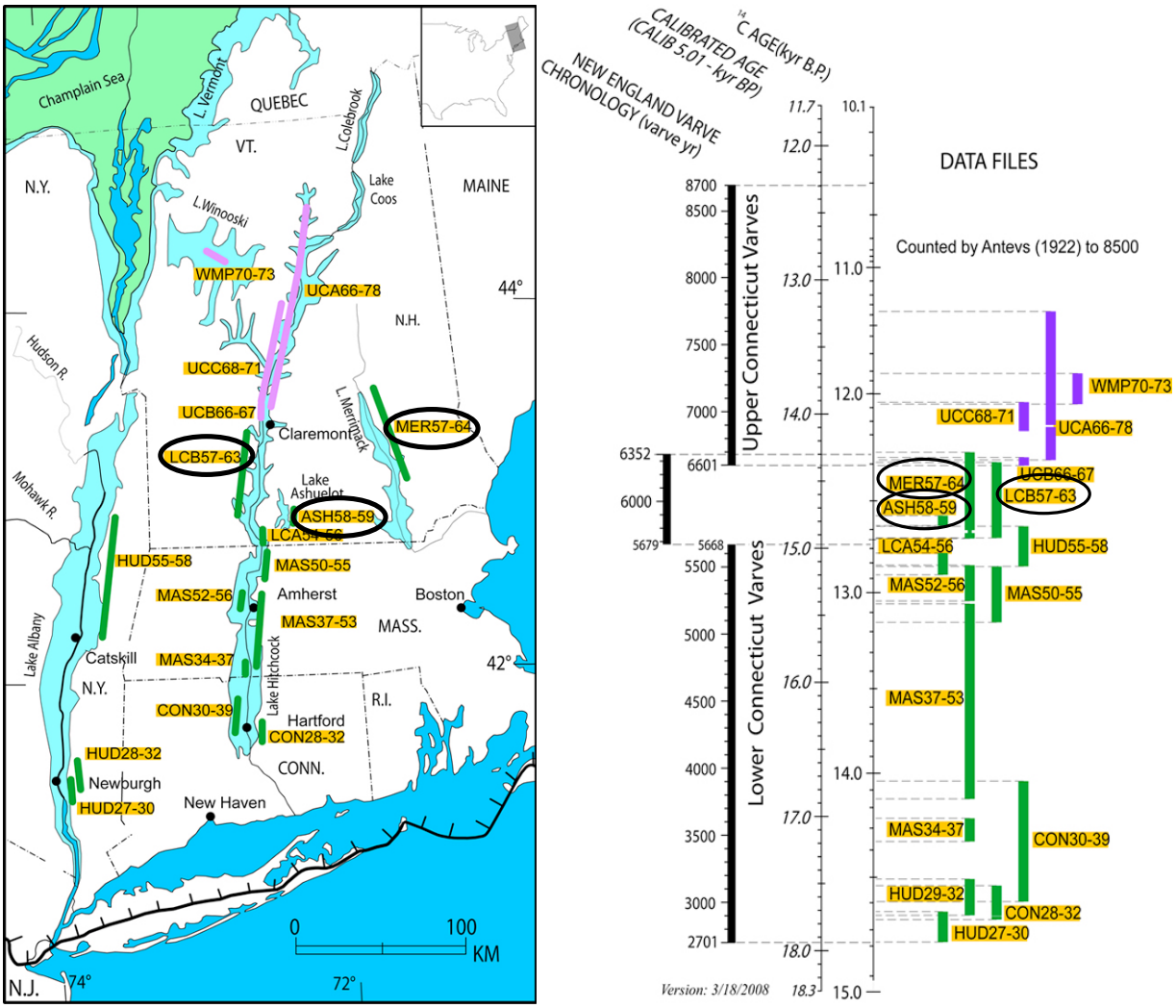
Content Standard D: Earth and Space Science
b. Geochemical cycles

Content Standard E: Science and Technology
b. Understandings about science and technology

Content Standard F: Science In Personal and Social Perspectives
f. Science and technology in local, national, and global challenges

Content Standard G: History and Nature of Science
a. Science as a human endeavor
b. Nature of scientific knowledge
c. Historical perspectives

Other Standards:
N/A



Locations where the varve sequences where retrieved and varve chronology with other area varve sequences. Images from the North American Glacial Varve Project
http://ase.tufts.edu/geology/varves/default.asp

What Can We Learn From Sediments?
Analysis Worksheet

Complete this worksheet using information from the North American Glacial Varve Project for assistance.

1. What are varves?

2. How do they form?

3. Generally speaking why are there variations in thicknesses from season to season and year to year? Site 3 reasons in your answer.

1.

2.

3.

4. Describe the topography of each of the 3 locations:

LCB57-63:

ASH58-59:

MER57-64:

5. What do you think this region looked like 15,000 years ago? Why do you think this?

6. How many years are represented in this dataset? _____

7. Analyze your graph and list 5 specific observations within one set of data or among the 3 sets of data.

1.

2.

3.

4.

5.

8. Look at the first 20 yrs of data. Make an inference about what could cause the data to look the way it does.

9. Look at NEVC years 5855 to 5880. Account for your observations of this area of the graph.

10. Using your observations and inferences in this activity, create a paragraph that recreates the climate of this region 12,000 years ago. After writing this paragraph, create a second paragraph that describes the limitations of this mini-study, and suggest methods to enhance it.