

Equipment for Environmental Research and Education in Surface Processes

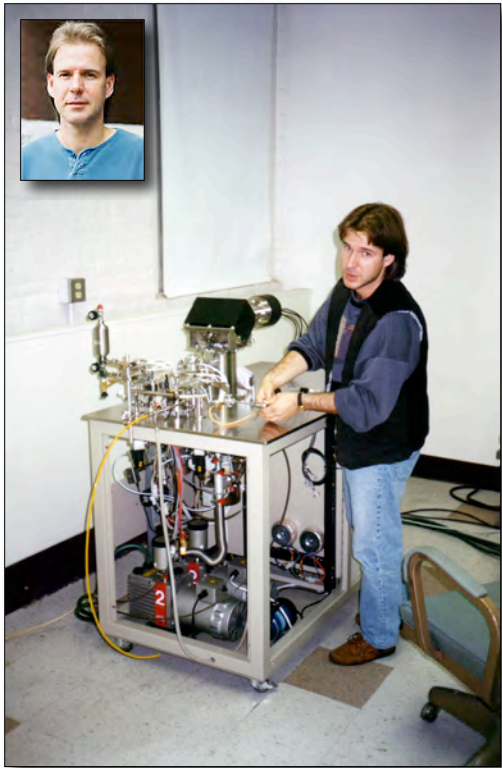


Paul Bierman, Professor

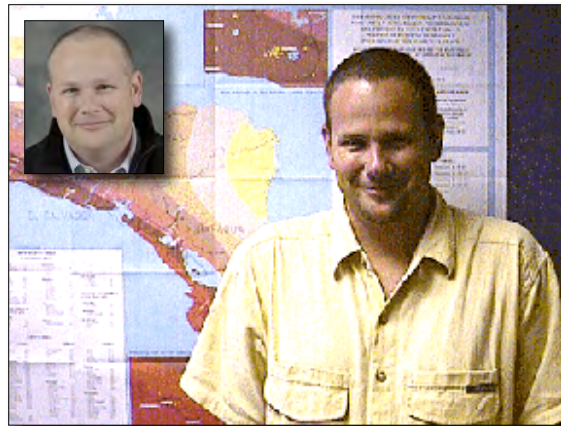
Context....

- 1997
- Three junior faculty, all research active
- Old building, no equipment
- Some shared projects
- Many MS students involved
- Some undergrads involved





Andrea Lini
UVM 1994-present



Rob Young
UVM 1994-1996



Paul Bierman,
UVM 1993-present

We asked for...

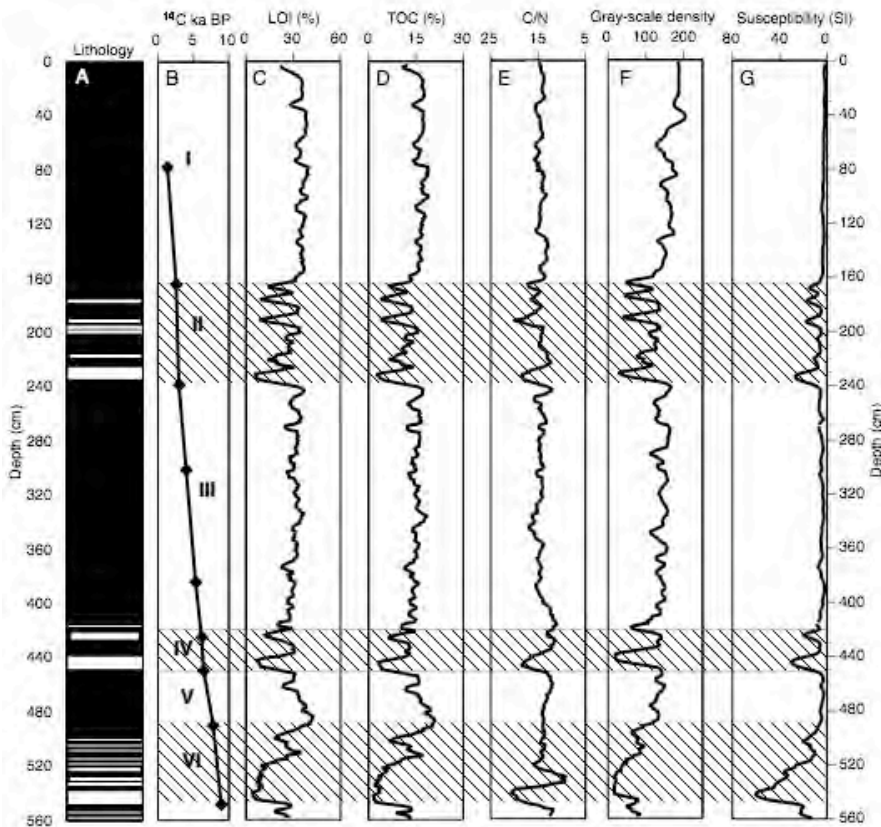
- 1. Global Positioning System Survey Equipment. We seek to acquire up-to date, satellite-based surveying equipment capable of determining the position of any site on Earth's surface with centimeter to sub-meter precision.
- 2. Carbon Nitrogen Analyzer We seek to acquire an automated C/N analyzer that will allow rapid and accurate measurement of carbon and nitrogen abundance in sediment samples
- 3. Core Logging System We seek to acquire an automated core analysis system that will rapidly and reproducibly collect magnetic susceptibility data from the lake, pond, and wetland cores we collect.
- 4. Sedigraph grain size analyzer We seek a sedigraph for rapid and accurate analysis of fine sediment grain size for use in paleo-environmental studies of lakes, ponds and wetlands.

We got funding for...\$164,165 including \$57,999 UVM match

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C:N analyzer

- Used in numerous lake studies



10 000 yr record of extreme hydrologic events

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ABSTRACT
 Well-dated lacustrine sediments provide a hydrologic record indicating that the frequency and magnitude of runoff events, and by inference, storms, have varied over the past 10 k.y. in northern New England. We used five sediment cores and radiocarbon dating to develop a chronology of Holocene hydrologic events for the Hittabuck Pond basin, northern Vermont. Chronological and physical hydrologic events for the Hittabuck Pond basin, northern Vermont. Chronological and physical hydrologic events for the Hittabuck Pond basin, northern Vermont. Chronological and physical hydrologic events for the Hittabuck Pond basin, northern Vermont. Chronological and physical hydrologic events for the Hittabuck Pond basin, northern Vermont.

INTRODUCTION
 Quantitative measures of extreme hydrologic events, in the form of precipitation intensity and duration records, exist for little more than 100 yr in New England's history (Ludlum, 1958). Nevertheless, these records define the magnitude of extreme events and provide the data that permit us to reconstruct New England's hydrologic history around the world high-magnitude hydrologic events in the back as late as 1500 AD (Page, 1990). These records preserve a record of surface effects of past climates and hydrologic events (Cronin, 1999; Edger and Page, 1992; Rowell et al., 1999). In particular, stratigraphically derived, organic layers in otherwise organically derived, sedimentation events. In one northern Vermont water body, Hittabuck Pond, we find 52 radiocarbon dates of which are considered reliable for which we have at least relative times uncertainty. This new record of extreme hydrologic events suggests that New England is undersampled for the magnitude and time distribution potential of future events. Our approach provides a complementary alternative to the paleoflood methods developed for rivers (e.g., Koebel and Baker, 1982; Hout, 1993) and estimates (Lin and Page, 1993) and its more applicable in regions where base levels have changed systematically since deglaciation (1994; Wengle et al., 1997).

METHODS
 Hittabuck Pond, a small periglacial lake, is located in the Green Mountains of northern Vermont; its level is controlled by a shallow bedrock spillway (Fig. 1). Several centimeters of glacial till and soil. We recovered 3.4 m³ of Two overlapping cores were recovered previously with a Livingston corer (Lin et al., 1995). In order to characterize the location, source and provenance of sediment deposited in the pond, some dated cores were located in the deeper part of the pond and two were taken from the spillway. These cores were located in sand and silt deposited just after deglaciation. We used 10 analytical techniques to characterize the sediment, in particular, the degree of organic enrichment (Brown, 1999). Each core was analyzed as continuous intervals for inorganic carbon (C), organic carbon (TOC), and X-ray radiographic density (Fig. 2). Lithology, bulk density, grain-size, carbon nitrogen ratio (C/N), stable carbon isotope, and charcoal analyses focused on determining the origin, sedimentology, and depositional processes of individual inorganic layers. We developed a detailed record of $\delta^{13}C$ from the cores of the pond as an example of a record of data for the four other cores were provided in Brown (1999) and Lin et al. (1995) from each core were submitted to accelerator mass spectrometry (AMS) radiocarbon dating (Lin and Southon, 1993) and used to constrain the inorganic carbon accumulation rates (Table 1). These radiocarbon dates provide age control on individual depositional events and the interval of increased inorganic

Key words: hydrology; storms; lake cover; floods.

FIGURE 1. Hittabuck Pond watershed. Elevation (m), 800 m; maximum depth, 19.8 m. Shaded area indicates core location. Dashed line is watershed boundary. Bathymetric contour interval 9 m. Contour interval 10 m. Adapted from U.S. Geological Survey, quadrangle maps: 819 A, Hittabuck Pond, 6E, Big Muddy Pond.

FIGURE 2. Lithology, bulk density, grain-size, carbon nitrogen ratio (C/N), stable carbon isotope, and charcoal analyses focused on determining the origin, sedimentology, and depositional processes of individual inorganic layers. We developed a detailed record of $\delta^{13}C$ from the cores of the pond as an example of a record of data for the four other cores were provided in Brown (1999) and Lin et al. (1995) from each core were submitted to accelerator mass spectrometry (AMS) radiocarbon dating (Lin and Southon, 1993) and used to constrain the inorganic carbon accumulation rates (Table 1). These radiocarbon dates provide age control on individual depositional events and the interval of increased inorganic

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High-level GPS

Used for topographic control around the world.

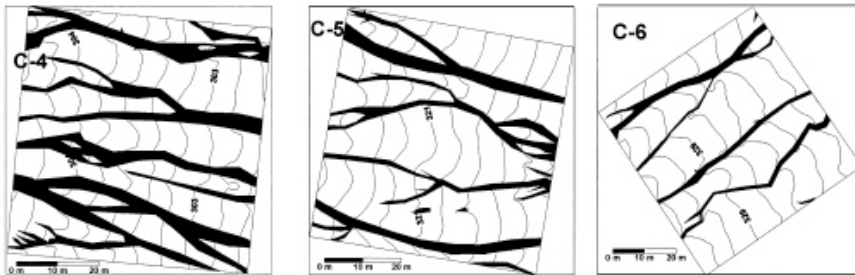


Figure 5. Maps of all control plots. Scale bar and direction are in C-6. Contour interval = 0.2 m. Elevations in maps are precise to ± 1 cm, but real elevations are ± 30 m, due to systematic GPS inaccuracy.



Rapid Late Pleistocene Incision of Atlantic Passive-Margin River Gorges
 Luke J. Reusser,^{1*} Paul R. Bierman,¹ Milan J. Pavich,² E-an Zan,³ Jennifer Larsen,¹ Robert Finkel¹

The direct and secondary effects of rapidly changing climate caused large rivers draining the Atlantic passive margin to incise quickly into bedrock beginning about 35,000 years ago. Measured in samples from bedrock river terraces, 10-Beryllium shows that both the Susquehanna and Potomac rivers during the last glacial cycle. This short-lived pulse of unusually rapid downcutting ended by 13,000 to 14,000 years ago. The timing and rate of Potomac rivers, indicating that regional changes, not simply glacial melt-water, initiated incision.

A fundamental control on the development of landscapes is the rate at which rivers cut through rock. River incision into bedrock transfers the effects of climate and becomes through drainage networks, thus controlling rates of landscape evolution. In this report, we use 59 measured 10-Beryllium (¹⁰Be) concentrations (and 52) to quantify the rate and timing of bedrock incision along two of the largest rivers draining the Atlantic passive margin, the Susquehanna (70,200 km²) and the Potomac (29,700 km²) (Fig. 1).

Over millions of years, large rivers drain- ing the Atlantic passive margin have carved broad valleys into rocks of the Appalachian Piedmont where river profiles are conver- (6–8). Long-term gradual lowering of the Susquehanna and Potomac Valleys (–10.0 m 102 meters per thousand years [mky]) into the Pleistocene uplands reflects a combination of slow fluvial uplift of the Atlantic margin from offshore sediment loading, isostatic re- sponse to denudation, and protracted into Ca-

lifornia sea-level fall (7–9), which a- deepens in the lower reaches, passing through a series of bedrock gorges. How- ever, the largest gorge is about 5 km long, 1 km wide, and incised into a broad valley level; this gorge contains three distinct soil as well as weathered high points repre- senting northern half of the Susquehanna Basin has been glaciated repeatedly (7,9); this asacial meltwater and sediment passed down the Susquehanna channel and then 100 m below the splashed into a broad outer valley. The river drops nearly 20 m as it passes over Great Falls and through 3-km-long Matter Gorge. The gorge is 75 to 125 m wide (7, 2) and rounded, outlines standing decimeter to meters above the bedrock surface. The Potomac Basin remained glacier-free during the Pleistocene (7).

We sampled fluvially eroded bedrock surfaces exposed as these rivers incised toward younger and lower levels. Most out- crops preserved distinct fluvial forms, sug- gesting little erosion since abandonment. The ages are not substantially affected by floodwater absorption of cosmic rays (25), and no sediment covers the outcrops today. Rapid incision and the low ¹⁰Be content of samples collected from the modern bank of the Potomac River (7, 4) allow us to match these concentrations directly as terrace abandonment ages.

Supporting Online Material
 www.sciencemag.org/cgi/content/full/305/5716/499
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 Includes the following text
 Page 51 to 54

499

Core Track

Used for initial lake core processing.

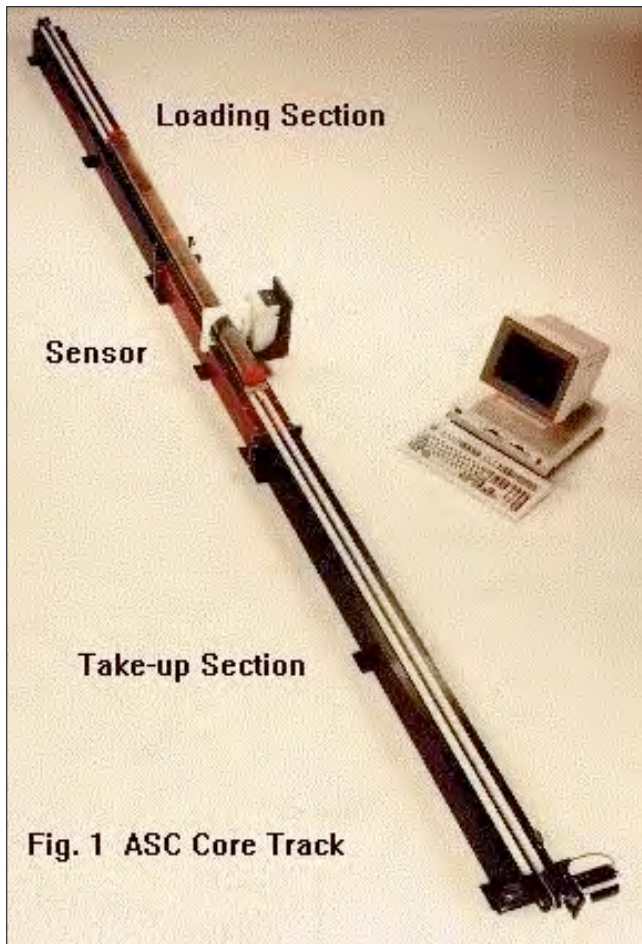


Fig. 1 ASC Core Track

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Reconstructing lake and drainage basin history using terrestrial sediment layers: analysis of cores from a post-glacial lake in New England, USA

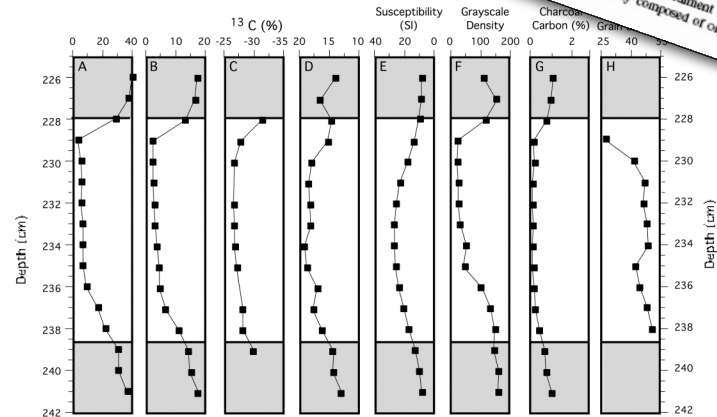
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Key words: Event sedimentation, Holocene, Radiocarbon-based chronology, Storms, Watershed erosion

Abstract
 Four sediment cores and twenty-five ¹⁴C ages from Ritterbush Pond in northern Vermont provide a detailed and continuous temporal record of Holocene lake and watershed dynamics. Using visual logs, carbon content, magnetic susceptibility, stable isotope signatures, and X-radiography, all measured at 1-cm scale, we identify and date discrete layers of terrestrially-derived sediment in the organic-rich, lacustrine gyttja. These inorganic layers range in thickness from <1 mm to >10 cm and range in grain size and sorting from homogeneous silt to graded sand. AMS radiocarbon ages both from macrofossils within the thickest layers, and gyttja bracketing these layers, provide the basis for correlation among the cores, the dating of 52 basin-wide sedimentation events, and development of a detailed sedimentation chronology for the Holocene.
 Physical, chemical, and isotopic analyses suggest the inorganic layers are terrestrially derived and result from hydrologic events large enough to erode and transport sediment from the watershed into the pond. The temporal dynamics since deglaciation over 12,000 years ago. Specifically, for intervals lasting 400 to 1000 years, during the early (>8000 cal yBP), middle (6400 to 6800 cal yBP) and late Holocene (1800 to 2500 cal yBP), the Ritterbush Pond watershed eroded more rapidly than at other times and terrestrially derived material poured into the pond. Analysis of Ritterbush Pond sediments demonstrates the potential for North American lakes to preserve a record of drainage basin dynamics.

Introduction
 The deposition of terrestrially-derived sediment in mountain lakes, and its significance to the reconstruction of lake histories and the interpretation of watershed dynamics, has received little attention in New England. Most lake research in the northeastern North America has focused on constructing vegetative histories from pollen data (Davis and Jacobson 1985; Jackson and Whitehead 1991; Spear et al. 1994; Spear 1989). These pollen chronologies have been used to characterize general changes in temperature and moisture in New England since deglaciation. With the exception of lake research related to the Younger Dryas climate oscillation (Thompson et al. 1995), deposits of inorganic sediment within lacustrine cores from the New England area have been treated as anomalous, basin-specific events (Davis 1969, 1999). To demonstrate the importance of understanding the terrestrial sediment influx to mountain lakes, we have developed a radiocarbon-based chronology of Holocene sedimentation events for Ritterbush Pond, located in the north-central Green Mountains of Vermont (Figure 1.2). The events are recorded as discrete layers of inorganic sediment (sand and silt) within a core primarily composed of organic-rich gyttja (Fig.



Take home messages

- Funded on first request
- Team of young research active faculty
- Proposal listed specific projects
- Catalyzed departmental change
- Many publications resulted
- Most equipment still in use

Uh, Luke, did Trimble really toss in the walk on water module?

