Equipment for Environmental Research and Education in Surface Processes

Paul Bierman, Professor

COLLEGE OF ARTS AND SCIENCES
Department of Geology

The University of Vermont

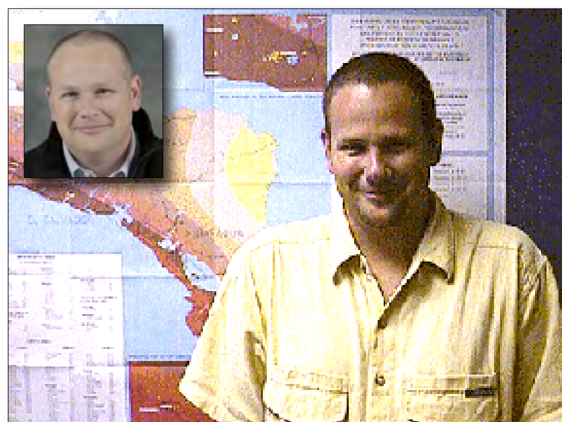
The Rubenstein School of Environment and Natural Resources

Context….

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

Paul Bierman,
UVM 1993-present

Andrea Lini
UVM 1994-present



Rob Young
UVM 1994-1996

We asked for…

- 1. <u>Global Positioning System Survey Equipment.</u> 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. <u>Carbon Nitrogen Analyzer</u> 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. <u>Core Logging System</u> We seek to acquire an automated core analysis system that will rapidly and reproducibly collect magnetic susceptibly data from the lake, pond, and wetland cores we collect.

- 4. <u>Sedigraph grain size analyzer</u> 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

- 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.
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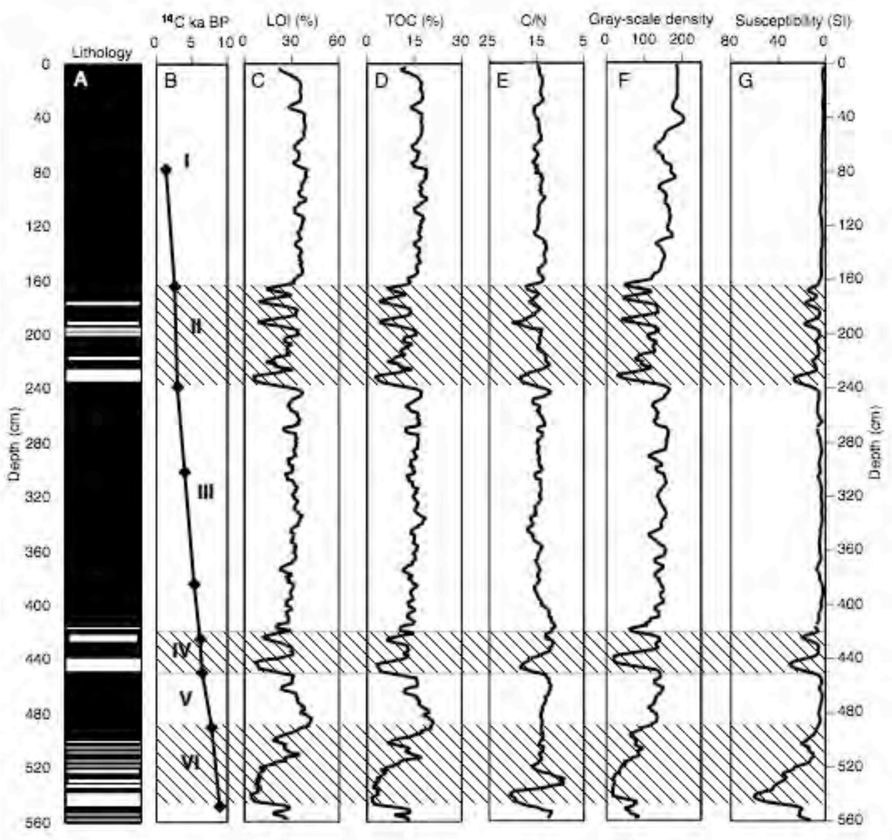
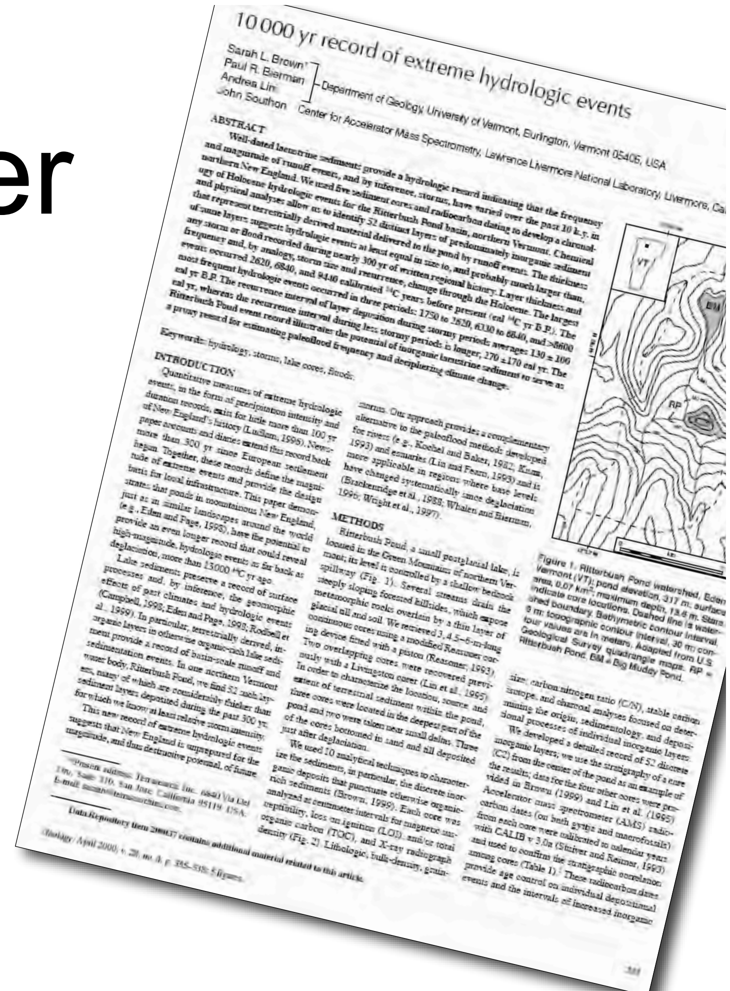
C:N analyzer

- Used in numerous lake studies





10 000 yr record of extreme hydrologic events

Sarah L. Brown*, Paul R. Bierman, Andrea Lini — Department of Geology, University of Vermont, Burlington, Vermont 05405, USA

John Southon — Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratory, Livermore, Ca

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 Ritterbush Pond basin, northern Vermont. Chemical and physical analyses allow us to identify 52 distinct layers of predominately inorganic sediment that represent terrestrially derived material delivered to the pond by runoff events. The thickness of some layers suggests hydrologic events at least equal in size to, and probably much larger than, any storm or flood recorded during nearly 300 yr of written regional history.

High-level GPS

Used for topographic control around the world.

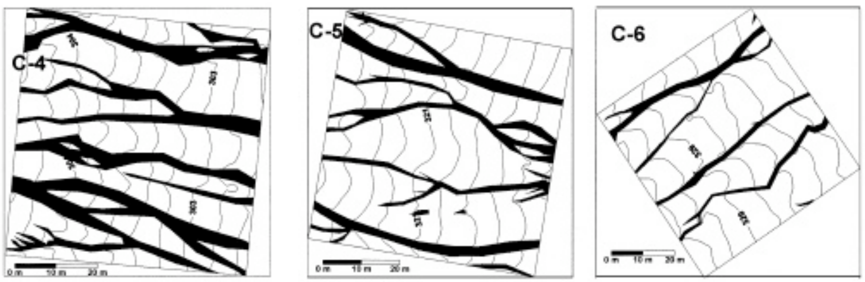


Figure 5. Maps of all control plots. Scale bar and direction are in C-6. Contour interval = 0.2 m. Elevations in maps are precise to ± 1 cm, but real elevations are ± 30 m, due to systematic GPS inaccuracy.

Rapid Late Pleistocene Incision of Atlantic Passive-Margin River Gorges

Luke J. Reusser,[1*] Paul R. Bierman,[1] Milan J. Pavich,[2] E-an Zen,[3] Jennifer Larsen,[1] Robert Finkel[4]

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 fluvial terraces, 10-beryllium shows that both the Susquehanna and Potomac Rivers incised 10- to 20-meter-deep gorges along steep, convex lower reaches 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 downcutting are similar on the glaciated Susquehanna and unglaciated Potomac Rivers, indicating that regional changes, not simply glacial meltwater, initiated incision.

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Core Track

Used for initial lake core processing.

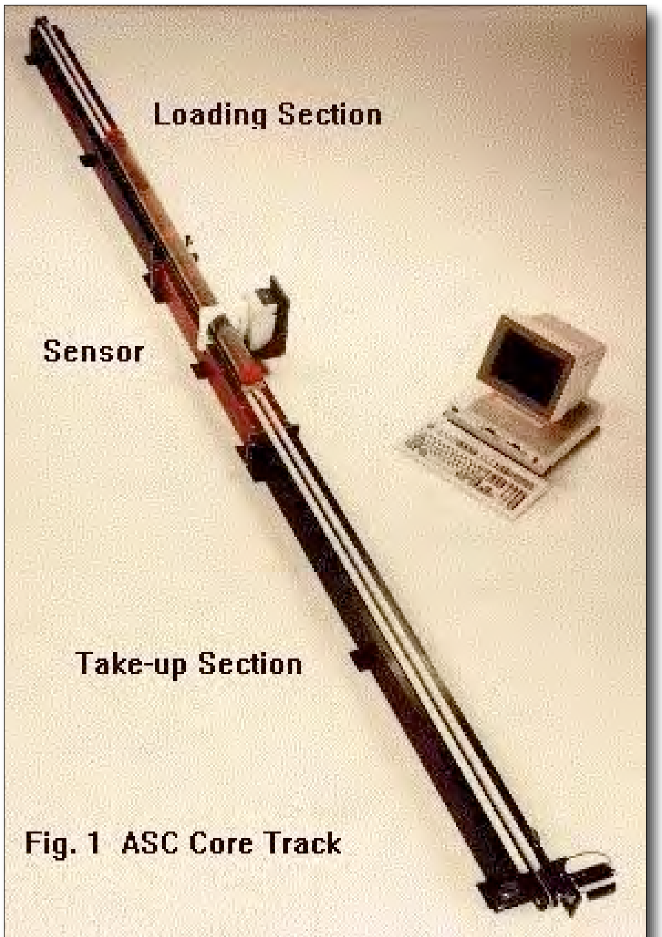

Fig. 1 ASC Core Track

Journal of Paleolimnology 28: 219–236, 2002.

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

Sarah Brown[1,4,*], Paul Bierman[1], Andrea Lini[1], P. Thompson Davis[2] and John Southon[3]
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Key words: Event sedimentation, Holocene, Radiocarbon-based chronology, Storms, Watershed erosion

Abstract

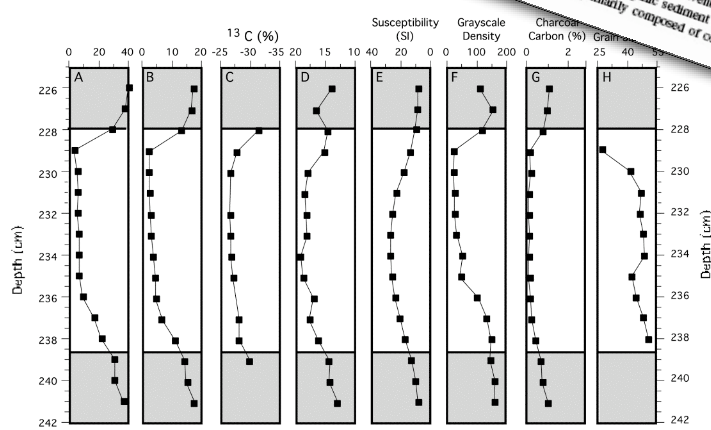
Four sediment cores and twenty-five ^{14}C ages from Ritterbush Pond in northern Vermont provide a detailed and continuous temporal record of Holocene lake and watershed dynamics. Using visual logs, carbon content, magnetic susceptibility, stable isotope signatures, and X-radiography, all measured at 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 the 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 and spatial distribution of the inorganic layers suggests changing basin-wide sedimentation and thus erosion dynamics since deglaciation over 12,000 years ago. Specifically, for intervals lasting 400 to 1000 years, during the early (>8600 cal yBP), middle (6400 to 6800 cal yBP) and late Holocene (1800 to 2600 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. 1996), 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?