

## PROJECT SUMMARY- CAREER PROPOSAL

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### Holocene Geologic Records of Episodic Sedimentation -- Characterizing the Timing and Distribution of Hillslope Erosion and Extreme Hydrologic Events

The densely populated northeastern United States is subject to extreme hydrologic events that impact the landscape. Some of these events are meteorological; nor'easters, hurricanes, and convective thunderstorms generate rainfall of sufficiently high intensity and duration to cause property damage, ecologic disturbance, and erosion. Other events are human-induced; a century ago, the region was almost completely cleared of forest, increasing rates of runoff and erosion. The history of deforestation and reforestation is well documented; yet, 200 years of data are insufficient to characterize the spatial and temporal distribution of the largest storms, those having the greatest recurrence intervals, those capable of the greatest damage, and those causing the most significant, episodic landscape change. Research by myself and my students suggests that a >10,000-year record of datable landscape response to extreme hydrologic events, those capable of causing significant erosion and sediment transport, is preserved in two, decipherable geologic archives: lacustrine sediments and alluvial fans. This *Career* proposal seeks funding for an in-depth study of these archives, a study involving numerous students, collaborators, and a variety of analytical techniques.

Over the past three years, I have supervised five theses that explored the Holocene sedimentary record of Vermont. Data collected by these theses suggests that: 1) significant hydrologic events are represented in some New England ponds by episodic inputs of terrestrial debris, both organic and inorganic and 2) small ( $\approx 10^3 \text{ m}^3$ ) alluvial fans, which occur throughout the Appalachians, provide a means by which to quantify directly the timing and magnitude of hillslope erosion. Within the confidence of the limited dating we have done so far, it appears that many depositional events are synchronous between ponds and fans separated by >75 km.

It is our working hypothesis that in the well-forested Northeast, where infiltration rates are typically high, lacustrine and alluvial fan sedimentation occurs primarily during very intense and/or long duration storms when soil pore pressure increases sufficiently to trigger landslides and saturation overland flow. Our data indicate that sedimentation can also be triggered by deforestation, such as occurred during colonial land clearance; yet, pollen, charcoal, and macrofossil data indicate that New England has been clothed in forest continuously since 11,000 years ago. Although local erosion and sedimentation events could be triggered by tree die back, fire, or localized storms, large-scale storms seem the most reasonable explanation for regionally synchronous sedimentation events.

To further my long-term goals, understanding rates of landscape change and using research-based inquiry as a teaching tool, this proposal seeks funds to collect, analyze, date and compare 30-40 Holocene sedimentary records from the Northeast (New England and New York). By comparing the ages of sedimentation events at wide-spread sites, we will determine the percentage and timing of depositional events that are regionally synchronous. To establish the timing of lacustrine sedimentation events, we will collect, date, and analyze cores from 15-20 "hydrologically sensitive" ponds, those with large, steep, drainage basins. To constrain ages of terrestrial sedimentation events, we will trench, describe and date deposits in 15-20 alluvial fans. We will use both data sets to map (for the past 10,000 years) the temporal and spatial distribution of sedimentation events and by analogy, the paleo-distribution of storm events capable of causing significant hillslope erosion. Not only will we publish our data through conventional channels, but we will create a dynamic Web site and interactive exhibit in the heavily used Perkins Geology Museum at UVM. The Web site will be both a data repository updated as the project progresses and a teaching tool for Earth Science education from the pre-college through the University level.

This *Career* proposal integrates my own field and laboratory research with the research and training of both my undergraduate and graduate students; it furthers my educational philosophy of active student involvement at all levels and is designed to provide discreet, achievable research projects for every student involved. Our initial data, particularly those related