INFORMATION ABOUT PRINCIPAL INVESTIGATORS/PROJECT DIRECTORS(PI/PD) and co-PRINCIPAL INVESTIGATORS/co-PROJECT DIRECTORS

Submit only ONE copy of this form **for each PI/PD and co-PI/PD** identified on the proposal. The form(s) should be attached to the original proposal as specified in GPG Section II.B. Submission of this information is voluntary and is not a precondition of award. This information will not be disclosed to external peer reviewers. ***DO NOT INCLUDE THIS FORM WITH ANY OF THE OTHER COPIES OF YOUR PROPOSAL AS THIS MAY COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION.***

PI/PD Name: Paul R Bierman

Gender: ☒ Male ☐ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☒ Not Hispanic or Latino

Race: (Select one or more)
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☒ White

Disability Status: (Select one or more)
- ☐ Hearing Impairment
- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
- ☐ Other
- ☒ None

Citizenship: (Choose one) ☒ U.S. Citizen ☐ Permanent Resident ☐ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☒

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project ☒

Ethnicity Definition:
Hispanic or Latino. A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.

Race Definitions:
American Indian or Alaska Native. A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.
Asian. A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.
Black or African American. A person having origins in any of the black racial groups of Africa.
Native Hawaiian or Other Pacific Islander. A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.
White. A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

WHY THIS INFORMATION IS BEING REQUESTED:

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on gender, race, ethnicity, or disability of its proposed PIs/PDs. To gather information needed for this important task, the proposer should submit a single copy of this form for each identified PI/PD with each proposal. Submission of the requested information is voluntary and will not affect the organization's eligibility for an award. However, information not submitted will seriously undermine the statistical validity, and therefore the usefulness, of information recieved from others. Any individual not wishing to submit some or all the information should check the box provided for this purpose. (The exceptions are the PI/PD name and the information about prior Federal support, the last question above.)

Collection of this information is authorized by the NSF Act of 1950, as amended, 42 U.S.C. 1861, et seq. Demographic data allows NSF to gauge whether our programs and other opportunities in science and technology are fairly reaching and benefiting everyone regardless of demographic category; to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational oppurtunities; and to assess involvement of international investigators in work supported by NSF. The information may be disclosed to government contractors, experts, volunteers and researchers to complete assigned work; and to other government agencies in order to coordinate and assess programs. The information may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records", 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records", 63 Federal Register 268 (January 5, 1998).

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PI/PD Name: Christine A Massey

Gender: ☐ Male ☒ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☒ Not Hispanic or Latino

Race: (Select one or more)
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

Disability Status: (Select one or more)
- ☐ Hearing Impairment
- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
- ☐ Other
- ☒ None

Citizenship: (Choose one) ☒ U.S. Citizen ☐ Permanent Resident ☐ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☒

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project ☐

Ethnicity Definition:
Hispanic or Latino. A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.

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Black or African American. A person having origins in any of the black racial groups of Africa.
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COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 01-2

NSF 01-42 **04/17/01**

FOR NSF USE ONLY

NSF PROPOSAL NUMBER

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)

GEO - GEOSCIENCE EDUCATION

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SHOW PREVIOUS AWARD NO. IF THIS IS
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☐ AN ACCOMPLISHMENT-BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYMS(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

University of Vermont & State Agricultural College

AWARDEE ORGANIZATION CODE (IF KNOWN)

0036962000

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE

University of Vermont & State Agricultural College
Burlington, VT. 05405

NAME OF PERFORMING ORGANIZATION, IF DIFFERENT FROM ABOVE

PERFORMING ORGANIZATION CODE (IF KNOWN)

ADDRESS OF PERFORMING ORGANIZATION, IF DIFFERENT, INCLUDING 9 DIGIT ZIP CODE

IS AWARDEE ORGANIZATION (Check All That Apply)
(See GPG II.C For Definitions) ☐ FOR-PROFIT ORGANIZATION ☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ WOMAN-OWNED BUSINESS

TITLE OF PROPOSED PROJECT **Looking Forward -- Scaling Up The Digital Image Archive of Landscape Change**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PREPROPOSAL NO., IF APPLICABLE
$ **99,649**	**24** months	**09/01/01**	

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG I.A)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.B, II.C.6)
☐ NATIONAL ENVIRONMENTAL POLICY ACT (GPG II.C.9)
☐ HISTORIC PLACES (GPG II.C.9)
☐ SMALL GRANT FOR EXPLOR. RESEARCH (SGER) (GPG II.C.11)
☐ VERTEBRATE ANIMALS (GPG II.C.11) IACUC App. Date _____
☐ HUMAN SUBJECTS (GPG II.C.11)
Exemption Subsection _____ or IRB App. Date _____
☐ INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES INVOLVED _____
☐ HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.E.1)

PI/PD DEPARTMENT
Department of Geology

PI/PD FAX NUMBER
802-656-0045

PI/PD POSTAL ADDRESS
Perkins Geology Hall

Burlington, VT 05405
United States

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Electronic Mail Address
PI/PD NAME **Paul R Bierman**	**PhD**	**1993**	**802-656-4411**	**pbierman@zoo.uvm.edu**
CO-PI/PD **Christine A Massey**	**MS**	**1995**	**802-656-1344**	**cmassey@zoo.uvm.edu**
CO-PI/PD				
CO-PI/PD				
CO-PI/PD				

CERTIFICATION PAGE

Certification for Principal Investigators and Co-Principal Investigators:

I certify to the best of my knowledge that:

(1) the statements herein (excluding scientific hypotheses and scientific opinions) are true and complete, and
(2) the text and graphics herein as well as any accompanying publications or other documents, unless otherwise indicated, are the original work of the signatories or individuals working under their supervision. I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if an award is made as a result of this proposal.

I understand that the willful provision of false information or concealing a material fact in this proposal or any other communication submitted to NSF is a criminal offense (U.S.Code, Title 18, Section 1001).

Name (Typed)	Signature	Social Security No.*	Date
PI/PD **Paul R Bierman**			
Co-PI/PD **Christine A Massey**			
Co-PI/PD			
Co-PI/PD			
Co-PI/PD			

SSN's are confidential and are not displayed *ON FASTLANE SUBMISSIONS*

Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the individual applicant or the authorized official of the applicant institution is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding debarment and suspension, drug-free workplace, and lobbying activities (see below), as set forth in Grant Proposal Guide (GPG), NSF 01-2. Willful provision of false information in this application and its supporting documents or in reports required under an ensuring award is a criminal offense (U. S. Code, Title 18, Section 1001).

In addition, if the applicant institution employs more than fifty persons, the authorized official of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of Grant Policy Manual Section 510; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflict which cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF.

Debarment Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, ''Disclosure Form to Report Lobbying,'' in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME/TITLE (TYPED) **Regina H.White, Director, OSP**		**04/13/01**

TELEPHONE NUMBER	ELECTRONIC MAIL ADDRESS	FAX NUMBER
802-656-3360	**jfrench@zoo.uvm.edu**	**802-656-1326**

*SUBMISSION OF SOCIAL SECURITY NUMBERS IS VOLUNTARY AND WILL NOT AFFECT THE ORGANIZATION'S ELIGIBILITY FOR AN AWARD. HOWEVER, THEY ARE AN INTEGRAL PART OF THE INFORMATION SYSTEM AND ASSIST IN PROCESSING THE PROPOSAL. SSN SOLICITED UNDER NSF ACT OF 1950, AS AMENDED.

PROJECT SUMMARY

Looking Forward -- Scaling Up The Digital Image Archive of Landscape Change

The New England landscape has changed dramatically over the past 250 years. Only 100 years ago, much of now-forested New England was cleared of trees as agriculture and development drove the rapid conversion of forest to farmland. The bare hills of post-colonial Vermont eroded rapidly and sediment surged down hillslopes, choking the region's rivers. Just as importantly, landscape response to natural events, including floods and windstorms, affected post-colonial settlers and their livelihood. Currently, geologic archives of landscape response to climate change and human impact (pond and alluvial fan sediments) are being read by NSF CAREER-funded faculty and students pursuing a variety of landscape oriented research projects at the University of Vermont (http://geology.uvm.edu/morphwww/career).

Using an initial AFGE award, we have begun to bring high school students into this project as active researchers collecting and analyzing pairs of historic and contemporary images of landscape change. The web-based photo archive (www.geology.uvm.edu/landscape) they have helped to create preserves evidence of landscape change induced by or affecting humans. The first phase of our work has demonstrated the feasibility of the project, a high level of interest in the high school community, and the value of the resulting image bank to a variety of constituencies.

We seek support for a second phase of prototyping so that we may increase the efficiency of image collection and expand our efforts to a broader informal science constituency in preparation for regionalizing our effort. Our next phase has four parts. First, we will iteratively develop and test a web-based interface for the submission of photographs and interpretive text followed by the automatic generation of DLESE-compliant, template-based web pages. Such an interface will increase the efficiency of image submission and web page creation, prerequisite to cost-effectively expanding our geographic coverage and the size of our image collection. Second, we will expand participation in our program to include an informal science constituency that has shown great interest in our work during the first phase. Such expansion will allow us, and our associated high school students, to team directly with interested individuals in museums, libraries, historical societies, and town offices. Third, we will develop, deliver, and refine program training for participants in two formats -- a one day intensive workshop delivered at different sites for different groups of teachers and informal science participants and an on-line training module for those who cannot attend regional trainings. Lastly, we will develop a learning module for students based not on collecting images (as is our current curriculum) but on the interpretation of the existing image bank in terms of geologic and human-induced change.

In this second phase, we will team students and high school teachers with informal science constituencies in the their towns (museums, libraries, town offices, and historical societies). Townspeople will work with each student to find at least two historic photographs clearly showing human/landscape interaction and assist the students as they attempt to relocate the place from which each photo was taken. We will continue to supply digital cameras, GPS equipment, computers and scanners as needed to the class rooms and offices involved in the project. As each town is completed, students and townspeople will submit their work to us over the web using templates developed under this funding request. The impact will be long-lasting in terms of both formal and informal science education. Our long-term goal is for our archive to include photographs from all of New England. Our efforts are already being supported by the University of Vermont (see cost share) and a local foundation interested in education reform.

Phase 2 of our pilot project continues to bridge gaps both between University research and high-school education and between history and science. Our program will involve high-school students and teachers, University of Vermont faculty, staff, and students, museum curators, town officials and librarians, and the Education Specialist for the Perkins Geology Museum at the University of Vermont. Teachers, students, and participating townspeople will continually share their findings on the web and in a University-sponsored culminating conference of high school teachers, students, townspeople, and University scientists.

TABLE OF CONTENTS

For font size and page formatting specifications, see GPG section II.C.

*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

Results of Prior NSF Support

Current Experience AFGE, NSF – EAR9907724 --In Fall, 1999, Bierman and Massey were awarded an initial AFGE grant to develop a digital archive of human-induced landscape change in Vermont. The archive is made up of image pairs (one historic, one contemporary) accompanied by narrative, written by high school students, describing the landscape change documented by the photographs. The images come from a variety of sources including personal collections, libraries, and historical societies. The project and the materials it has created are linked to the Vermont State standards for education (http://geology.uvm.edu/landscape/pdf/standardschart.pdf).

In January 2000, we hired an Outreach Coordinator, Ms. Laura Mallard, and began the Landscape Change project. A Master Teacher, Ms. Shelly Snyder, worked with us for the first year, piloting the project in her own classroom and assisting in the development of standards-centered teacher and student manuals. These and all other project-funded products are available as PDF files from http://geology.uvm.edu/landscape/pdfdownloads.html).

Over the past year, the project has been extremely successful. It has catalyzed the creation of the web-based archive (Figures 1, 2 and 3), involved several hundred students in grades 8 to 12, and been the impetus for development of standards-based units for participating teachers and students. The four sets of equipment purchased with NSF funding (iMacs, scanners, printers, GPS units and digital cameras) have been in nearly constant use by schools around Vermont. We will have worked with 14 Vermont High Schools before the project concludes with a large student-centered conference (http://geology.uvm.edu/landscape/conference.html).

At the core of the landscape change project is the student experience. Over the past 12 months, University of Vermont staff and faculty have worked with 25 to 80 students and their teachers -- contact with over 300 students. In each of these classrooms, students were introduced to the project over several days by the Outreach Coordinator. The introduction included hands-on activities with historic photographs of landscape change, geologic materials, and technology, including computers, scanners, GPS, and digital cameras.

For several weeks after the introduction, the students work on their own and with their teacher. Each student finds at least one and sometimes several historic images showing human-impacted landscapes in their town. Images are found in their homes, in the homes of their relatives, in the local library or the local historical society. Images range from 25 to 125 years old and show landscape change including gully erosion, clearcutting, landslides, storm damage, shifting river channels, dam construction and abandonment, building addition and removal, and mining activities.

The students bring the photographs to school and scan them before heading into the community to learn more about their images and relocate the sites from which the images were taken. We found that the students were working with the town clerks, local historians, and older members of their community in order to locate the sites. After the sites had been located, their coordinates were measured by the students using GPS and the location recorded on a data sheet. At the same time, the students rephotographed the site(s) using a digital camera.

The students searched for information to caption their images. Data collection starts with field work, walking over the site looking for evidence of the impact noted in the photograph. We ask the students to pose such questions as: What does the soil look and feel like? Is there evidence of clear-cutting and or regrowth of forests? Are gullies or landslides still visible? Site visits sometimes lead to interviews with landowners. Most Vermont towns have been incorporated for almost 200 years. A strong tradition of locally-based government means that land records are unusually complete and accessible to the public. Historic photographs have proven easy to find; yet, linking students to the people who know about these photos has proven more difficult. Thus, we seek now to bring in town clerks, historical society, library and museum personnel as integral players in the Landscape Change Project.

The archive has grown to over 600 images at http://geology.uvm.edu/landscape. We have more requests from schools for our assistance than we have resources available; thus we seek to streamline and make more efficient the process of image submittal and web page creation. We have acquired at least one image for over 30% of the towns in Vermont (Figure 3). The project supported two students during the summer of 2000, a high school senior and a UVM undergraduate, Lyman Persico, both of whom worked intensively with Outreach Coordinator, Mallard for two months. Persico's work resulted in a first authored GSA National meeting abstract for a poster he presented in Reno regarding the geomorphic implications of the Landscape Change Archive (Persico et al., 2000). Mallard and Massey presented the project's educational component at the same meeting (Mallard et al., 2000 and Massey et al., 2000). The following publications have already resulted from this grant:

Persico, L. P., Mallard, L. D., Bierman, P. R., and Massey, C. A., 2000, Forest to farmland and back again: a changing Vermont landscape: **Geological Society of America Abstracts with Programs**, 32 (7), A-24. (National)

Mallard, L.D., Massey, C.A., and Bierman, P.R., 2000, Vermont students gather digital images of human-induced landscape change, **Geological Society of America Abstracts with Programs**, 31 (7), A-421. (National)

Massey, C. A., Mallard, L. D., Bierman, P. R.., 2000, Digital archive of human-induced landscape change with K-16 students in Vermont, **Geological Society of America Abstracts with Programs**, 32 (7), A-204. (National)

CAREER award, NSF – EAR-9702643 -- Bierman is currently supported by a four-year CAREER award from NSF Hydrologic Sciences. This grant integrates research, research training, and education for Masters level and undergraduate students. The research identifies major hydrologic events during the Holocene, in particular, defining the spatial and temporal distributions of large storms over the last 10,000 years through the trenching of alluvial fans and the coring of lakes. In 3 years, the grant has supported the research of 5 Masters candidates, provided impetus for an Advanced Geomorphology Field Class, and resulted in the 16 abstracts, 4 completed MS theses, 3 theses in progress, and the following 5 refereed publications:

Brown, S. L., Bierman, P.R., Lini, A., Davis, P.T., and Southon, J., (in review) Lake cores as archives of Holocene watershed events, **Journal of Paleo Limnology.**

Brown, S. L., Bierman, P.R., Lini, A., and Southon, J., (2000), A 10,000 year record of extreme hydrologic events, **Geology**, 28, 335-338.

Bierman, P.R. (2000) Henry's Land, in **The Earth Around Us: Maintaining A Livable Planet**, J. Schniederman, ed., Freeman, p. 47-56.

Gran, S. Nichols, K., and Bierman, P. R., (1999), Teaching winter hydrology using frozen lakes and snowy mountains, **Journal of Geoscience Education,** v. 47, p. 420-427.

Bierman, P., Lini, A., Davis, P.T., Southon, J., Baldwin, L., Church, A. and Zehfuss, P. (1997). Post-glacial ponds and alluvial fans: recorders of Holocene landscape history, **GSA Today**. 7 (10) p. 1-8.

Support for Bierman's Cosmogenic Laboratory -- In addition to the CAREER grant, Bierman has received NSF funding for a variety of projects related to the measurement and interpretation of cosmogenic nuclide abundance in rock and sediment. These grants have supported several hundred isotopic analyses, a laboratory technician, student research, and research training of Masters students. They have resulted in the preparation and publication of 41 abstracts and 28 refereed papers and book chapters by Bierman and his students. A sample of recent refereed publications by Bierman and his students which have resulted from this funding are listed below:

Mitchell (Gran), S., Matmon, A S., Bierman, P.R., Rizzo, D., Enzel, Y., Caffee, M., and Rizzo, D.. (2001), Displacement history of a limestone normal fault scarp northern Israel from cosmogenic ^{36}Cl,. **Journal of Geophysical Research.** Vol. 106 , No. B3 , p. 4247-4265.

Clapp, E., Bierman, P.R., Pavich, M., and Caffee, M. (2001) Rates of sediment supply to arroyos from uplands determined using in situ produced cosmogenic ^{10}Be and ^{26}Al in sediments. **Quaternary Research.** v. 55, n. 2. P. 235-245.

Zehfuss, P. H, Bierman, P.R., Gillespie, A. R., Burke, R. M., Caffee, M.W. (2001) Slip rates on the Fish Springs fault, Owens Valley, California deduced from cosmogenic ^{10}Be and ^{26}Al and relative weathering of fan surfaces. **Geological Society of America Bulletin**. v. 113 (2), p. 241-255.

Marsella, K., Bierman, P. R., Davis, T., and Caffee, M. (2000) Deglacial dynamics and timing, Pangnirtung Fjord and Kolik Valley, Baffin Island, Canada. **Geological Society of America Bulletin**, v.112, p. 1296-1312.

Clapp, E. M., Bierman, P.R., Schick, A. P. Lekach, J., Enzel, Y., and Caffee, M., (2000), Differing rates of sediment production and sediment yield, **Geology**, 28, p. 995-998.

Bierman, P. R., Marsella, K. A., Davis, P. T., Patterson, C. and Caffee, M., (1999), Mid-Pleistocene cosmogenic minimum-age limits for pre-Wisconsinan glacial surfaces in southwestern Minnesota and southern Baffin Island -- a multiple nuclide approach. **Geomorphology**, 27, n 1 / 2, p. 25-40 and subsequent comment and reply **Geomorphology** (in press)**.**

Support for Perkins Geology Museum Programs -- Massey directs several externally funded science education programs at the Perkins Museum of Geology, including programs for high school, middle school, and elementary school students, as well as elementary educators. The NSF provided funding for her programs for elementary educators (pre-service and in-service) and elementary students through Vermont's State Systemic Initiative (SSI) grant. The Vermont Institute for Science, Math, and Technology (VISMT) administers the SSI program in Vermont and funded Science in Vermont--Environmental Science & Technology for Elementary Educators and the associated Grades 1-6 Environmental Science Day Camp. NSF-VISMT funding has resulted in the following abstracts:

Massey, C. A., (1997). Environmental Science and Technology Institute for Elementary Teachers and Education Majors in Vermont. **Geological Society of America--1997 National Meeting Abstracts with Programs**, 29, 6, A-301.

Massey, C. A., (1996). Thrust faults, plankton tows, wastewater, and SEMs: Vermont Earth and Environmental Science for K-12 students and teachers. Geological Society of America**--1996 National Meeting Abstracts with Programs**, 28, 7, A-476.

Goals Specific to this Grant Application

We seek NSF support to complete project prototyping. Initial support was sufficient to demonstrate both that sufficient images and student/teacher interest exist; however, the first year of project work clearly demonstrated that in order for our project to service all those who are interested, we need a broader, more efficient approach to participant training and image organization. Specifically, we seek support to accomplish four discreet goals, each of which is prerequisite to expanding and regionalizing our efforts in the future. We look at these goals as catalysts which will ensure future success and fundability of our work.

1. We will iteratively develop and test a web-based interface for the submission of photographs and interpretive text followed by the automatic generation of DLESE-compliant, template-based web pages. Such an interface will increase the efficiency of image submission and web page creation, prerequisite to cost-effectively expanding our geographic coverage and the size of our image collection.
2. We will expand participation in our program to include the informal science constituency (museums, libraries, and historical societies) that has shown great interest in our work during the first phase. Such expansion will allow us and our associated high school students to team directly with interested individuals outside of academia.
3. We will develop, deliver, and refine program training for participants in two formats -- a one day intensive workshop for teachers and informal science participants and an on-line training module for those who cannot attend regional trainings.
4. We will develop an additional learning module for students based not on collecting images (as is our current curriculum) but on the interpretation of the existing image bank in terms of geologic-and human-induced change.

Long-term, Overarching Project Goals

The overall goal of the Digital Image Archive of Landscape Change is simple. We pursue deep involvement of students in the creation of a digital archive that collects and interprets images of landscape change. The project has several highly inter-related goals that in their entirety will involve students at different levels directly in active research and research training, advance the state of geologic knowledge, and contribute, in the state of Vermont, both to systemic change in science education (e.g., Rutherford and Ahlgren, 1990) and to the enrichment of the entire community through opportunities for informal science learning.

As the Landscape Change Archive project continues, we will:

- continue to involve directly high school students and teachers in an extension of on-going, NSF-funded research that is gathering geologic and historic data to determine the effect of both humans and extremely large storms on the New England landscape. This research is particularly germane to the

management of resources in New England as pressures to develop land and exploit timber resources increase (Zehfuss, 1996; Bierman et al., 1997; Bierman, 2000; Brown et al., 2000).

- continue to expand (using newly developed web-based submission protocols) the unique, digital library of images (geology.uvm.edu/landscape) created by Vermont students that documents landscape change,
- train students, teachers, and the informal science community (museums, historical societies, libraries, town officers) in the use of modern technology to acquire and store images,
- provide a link between science and history at the local level, directly involving the students, their families, and communities,
- form a research and learning partnership between active University researchers (undergraduate students, graduate students, and faculty), high school students, and officials in their towns such as town managers, librarians, and historical society personnel,
- catalyze awareness, through individual student discovery of historical images, that by understanding the past we can better predict the future, and
- provide the opportunity for students to learn for themselves that human actions have distinct and significant environmental consequences.

Relevance to Program Announcement

Our proposed project is directly relevant to the program announcement NSF–01-42. Specifically, our proposal involves graduate training (2 students), secondary education (200 to 300 students), education outside the classroom, teacher training, and undergraduate research training (1 student). It includes the following activities called out in the RFP and follows from ideas laid out in NSF 97-171, Geoscience Education: A Recommended Strategy:

- bringing cutting edge research to the classroom and public,
- implementation of National Science Education Standards (Project 2061, 1993; National Research Council, 1996),
- development of web-based pedagogy,
- opportunities for teachers to work with scientists,
- initiation of state-based alliances of Geoscience researchers, educators, and practitioners,
- partnering for initiation of museum exhibits, and
- workshops to organize precollege data collection programs.

Relationship to On-Going and Proposed Projects

NSF CAREER Grant - -With support from the NSF Hydrologic Sciences and EPSCoR programs, Bierman has been funded over four years to study the geologic record of New England landscape change. This CAREER grant specifically integrates graduate and undergraduate researchers and their research into the undergraduate curriculum with both strong field and web-based components. As part of this research, Bierman and his students collect lake sediments and trench alluvial fans

and river terraces with backhoes (Brown, 1999; Li, 1996, Zehfuss, 1996, Brown et al., 1997, 1998, 2000, in review). The grant is in its fourth year and its web page has matured (http://geology.uvm.edu/morphwww/career). The landscape change photo archive has enhanced the CAREER-based research by providing primary data. Conversely, students and faculty involved in CAREER-funded research bring their expertise to the high-school outreach program. CAREER funds have purchased computers used as public web terminals in the Perkins Geology Museum.

Perkins Geology Museum Outreach -- Science educational programming at the Perkins Geology Museum compliments the efforts of statewide systemic change by offering science and technology content and methods skills to students, teachers and the general public. In addition, students, teachers, and the general public rely on the Perkins Geology Museum as a resource for general Earth Science information and a source of geologic materials for educational borrowing. The Perkins Geology Museum will act a center of operations for the proposed project, displaying student-made posters, and housing public web terminals that contain the database of images in a permanent exhibit. Participants and the general public have free access to the historical image database on-line at the museum as well as from any web terminal in the world.

Vermont Institute for Science, Math, and Technology (VISMT) -- The Statewide Systemic Initiative organization in Vermont, the Vermont Institute for Science, Math, and Technology (VISMT), provides resources and expertise to promote sustained high-level student performance in science, math, and technology. VISMT also spearheaded the development and use of Vermont's Framework of Standards and Learning Opportunities for science, math, and technology in Vermont schools (Vermont Dept. of Education, 1996 a,b). Phase two of our project furthers Vermont's systemic change goals by increasing the use of standards-based science curricula, addressing both content and process standards (http://geology.uvm.edu/landscape/pdf/standardschart.pdf), creating opportunities for student-led investigations, training teachers to facilitate better student learning in science and technology, and connecting high school science and technology curricula with other disciplines such as history and social studies. VISMT will continue to help us recruit teachers and schools for the proposed project. VISMT coordinates a successful Teacher Associates program and maintains an extensive database on science education in Vermont schools (see support letter).

Geology Department Renovation -- Planning has begun for a complete renovation of the Perkins Geology Building that will include the addition of new facilities as well as complete renovation of existing space. Architectural studies are ongoing for this 6.8 million dollar project with building completion and move in scheduled for August 2003. The Perkins Museum will be entirely renovated and additional display space will be provided in an extensive new atrium. Images from this project will be displayed in the museum primarily on digital monitors that will allow visitors

either to see organized virtual tours or scan the museum collection (including the landscape archive) at their leisure.

Institute of Library and Museum Services -- The Geology Department and Perkins Geology Museum were recently awarded $400,000 to digitize much of the museum collection. Outcomes of the digitization project include a research-quality digital archive, educational modules for both K-12 and undergraduate levels, large screen and video-microscope exhibits in the Perkins Museum, and a web-based user interface. The resulting archive will be listed with the National Digitized Image Registry and the Digital Library for Earth Science Education (DLESE). The Landscape Change Project will provide interpretive images for the Museum Collections Archive.

Lintilhac Foundation Support for Masters in Teaching Student -- On the basis of our accomplishments under current AFGE funding, we were just awarded a $17,000 grant by the Vermont-based Lintilhac Foundation to support a Masters in Teaching (MAT) student. This student will earn a MAT degree in Geology at the University of Vermont over the next three years. The MAT student will catalyze development of an in-depth landscape change web site for the town of Shelburne, Vermont, a Burlington suburb. Working closely with Bierman and Massey, faculty and students at the Vermont Commons School (www.vtcommonsschool.org), and the UVM Education Department, she/he will both earn his degree and organize this unique effort. Along with the Commons School faculty, the MAT student will help to develop and eventually publish a detailed curriculum for such in-depth landscape studies.

Project Management and Responsibilities

Project responsibilities will be shared between the two investigators (Bierman and Massey), one full-time staff person (Outreach Assistant Mallard), an undergraduate, and 2 graduate students. Day to day operation of the project will be directed by the Outreach Assistant. PI Bierman will administer the grant and take responsibility for the geomorphological and technology-related aspects of the project. Co-I Massey will oversee education activities. Table 1 outlines staff responsibilities.

Project Approach and Work Plan

Development of Web-based Submission Form and Recruitment of Participating Communities (Fall 2001)

We will spend the fall laying the groundwork for this last prototyping phase. Working with a web consultant from UVM's computing center, we will design and test the web-based image submission protocol. By the end of the fall, anyone should be able to submit images and

accompanying narrative and georeferencing information on-line. Over the fall, the Outreach Assistant will work to establish four teams of schools, historical societies, and town offices willing to work together and with us to document an area's (the several towns served by the local high school) landscape history. Over the fall, we will begin development of both web-based and workshop-style training materials.

Data Collection and Testing of Web Submission and Workshop Protocols (Winter and Spring 2002)

We (Bierman, Massey, and Mallard) will first test our workshop training materials during the winter of 2002 by travelling to the towns where the project is active. Trainings will involve teachers and local professionals (town officers, librarians, town historians) from each of the four towns with which we will work in the spring. Following the trainings, we will install the equipment in the local schools and begin the collection of historic images. Over the course of the semester, students will first collect the historic images (when the ground is snow covered) and then collect contemporary images (when the snow melts). Over the semester, the web-based submission protocol will be tested by students and revised as necessary. By the end of Spring 2001, 4 schools will have studied intensively 12 to 14 towns.

Database Enrichment, Revision of Training Materials, and Development of Archive-based Curriculum (Summer 2002)

We will use the summer to do a variety of activities including collection of additional historic and contemporary images (undergraduate intern and Mallard), revision and improvement of our workshop materials based on feedback from our first four sets of participants (Massey, Bierman, and Mallard), development of modular curricular materials that utilize the landscape archive (MAT Student, Mallard, Massey). The computers and allied equipment will spend the summer with local historical societies so interested volunteers can capture images for the project.

Concluding Project Activities (Fall 2002)

During the last 4 months of the project, we will serve an additional 4 communities. The Outreach Assistant will alternate between working in schools and uploading data to the web site. During this time, we will continually reassess the program and revise our teaching materials as we learn more from different classes. The web site will continue to grow quickly, covering nearly half the State by of Vermont by December 2002. During the last few months of the project, we will seek additional funding from other sources to complete the Vermont State data base as well as expand our work to the New England Region.

Project Products

Web-based Image Submission Protocol -- The web-based image submission protocol will be developed by a consultant with significant data-base experience. The interface will be similar to

that developed by NSF for Fast Lane but far simpler. The user will be prompted to upload both the historic and contemporary images, the town in which the images were taken, the GPS coordinates of the image, and a narrative describing the geology of the site and the landscape change documented by the photos. There will be additional fields provided so that the submitter can include their name and contact information as well as the source of the historic photograph. The uploaded material will be automatically collated into a web page template which will be checked for content and edited for clarity before being put on line. We have spoken with D. Mogk (DLESE) and will use their metadata fields so that our work can be fully searchable in the DLESE database/catalog.

Training Workshop Materials -- The workshop training materials will be developed in easily transferable electronic formats including Microsoft Word, Microsoft PowerPoint, and Adobe Acrobat/PDF. The materials will include a PowerPoint-based set of presentations as well as a participant work book. The work book will include many of the germane PowerPoint images, exercises that participants will complete during the workshop, and copies of selected resources on the geology and history of Vermont that will be useful to project participants. All workshop materials will be posted to our web site for use by others.

Archive-based Curriculum Modules -- The Masters of Arts in teaching graduate student supported for a summer by this project will lead the development of a curricular module based on the images contained in the archive. Such a module differs significantly from the one which we have already developed, a module focussed on the collection and interpretation of images (download teacher and student manuals at http://geology.uvm.edu/landscape/pdfdownloads.html). The new module will focus on quantifying the types and distribution of landscape change visible in archive photos and in doing so will lead students through both the geologic and cultural history of Vermont.

Digital Image Archive -- This project will add to our existing digital library of more than 600 images. All images will be georeferenced and captioned in detail by students involved in the project. Each photo will be presented along with a modern view of the same location. The database will continue to be freely available on the World Wide Web; the site will be hosted on our NSF-supplied server at the University of Vermont. Figure 3 is an example of the image archive.

Posters -- Students will continue to produce posters as one of the culminating experiences of this project. These posters will include the same information as the digital database and will be submitted to the Perkins Geology Museum for rotating display. The posters will be displayed at the culminating conference and donated to the historical society in the town where photographs were taken at the project's completion.

Benefits of Phase 2 to Participants and the General Public

The project will continue to produce a unique data set of georeferenced, historic, and modern photographs of landscape change (Figure 3). This archive will be produced primarily by students and will be widely accessible through the World Wide Web. Generation of this archive will benefit different groups in different ways having a focused impact on the students and teachers in the program but much broader impact on the community at large. It will benefit:

Researchers -- Images collected by the students will be useful immediately to University of Vermont Geoscience researchers working under CAREER funding to understand better human-induced landscape change. In particular, Adam Parris, a current MS student supported by CAREER funding is focussing his research on human impact on landscapes and communicating his findings to the general public.

Graduate and Undergraduate Students – The MAT and MEd graduate students will benefit from working with each other and their advisors on this project building a curricular module and doing program evaluation, respectively. The undergraduate will benefit by working closely with active University researchers.

High School Students -- The process of collecting images, working within their community, using technology, and interacting with University Scientists will enrich the educational experience and historical perspective for 200 to 300 students.

High School Teachers -- By working with this program, at least 8 teachers (4 in spring 2002, 4 in fall 2002) will incorporate numerous content and skill standards into their curriculum. They will have unique access to technology and University expertise via Bierman, Massey and Mallard. Using the web, any teacher will have access to the standards-based Landscape Change curriculum.

Systemic Reform of Vermont Science Education -- Ours is part of a systemic effort to improve science learning in Vermont and to make higher education science expertise available to Vermont students and teachers. See attached letter of support from A. Stephenson.

Informal Science Education -- Images and information collected by this project will serve the wider public as they are incorporated in Perkins Geology Museum displays and accessed by anyone from our web-based digital image library. The trainings we deliver to museum, library, town, and historical society professionals, as well as the links we establish between schools and these institutions, should long out live the project.

Web Page – On line submission of images and related interpretive text will allow the website to be expanded efficiently. Meta data will allow users to more easily retrieve available materials.

Assessment

We will work with the Department of Education at the University of Vermont to perform a formal assessment of our project's impact on students, teachers, and the informal science community with whom we interact. A Masters student in Earth Science Education (supported for part of a summer by this grant) will evaluate our program under the direct supervision of Professor

Russell Agne of the Department of Education. The student will have taken course work in Research Methods and have demonstrated skills to conduct an evaluation of this project.

The evaluation will determine the effects of our curricular modules based on benchmark criteria exemplified in the NRC and Vermont's Framework of Standards and Learning Opportunities, a standards based guide developed with NSF funds through the systemic science initiative. The evaluation will be based on structured interviews and case studies with a representative sample of participants from the program. UVM Education Professor Correne Glesne will be available for consultation with Agne and the graduate student. She has an international reputation in qualitative methodology and serves on many committees for our students conducting policy research in schools.

The evaluation will be an outcomes-based design, i.e., we intend to report the results that have been attained by interventions used in the project. We will also incorporate formative checkpoints to offer feedback to the project director if mid-stream modifications in project direction seem indicated. More specifically, we will respond iteratively to student and teacher feedback to our web page, training workshops, and manuals on the basis of written evaluations and informal feedback. Impact assessment will continue to be informal yet robust and will evaluate how the digital database is used and how participants perceived the project. We will maintain counters on our pages and a log of contacts.

For the first phase of the project, we used written questionnaires for assessment, asking different questions of students and teachers about both process and content. On the basis of these initial responses, we modified our manuals and approach. Responses were generally positive and useful; although student assessments were occasionally bimodal with the majority of students explaining that the project was extremely interesting to them. A minority suggested that it was too much work to find photographs and refind sites and that they did not have sufficient access to the digital camera. We are addressing these concerns by teaming with historical societies, towns and libraries and by leaving the equipment in schools for longer periods of time.

Institutional Commitment (Cost Sharing)

The University of Vermont is committed to the success of this project. To that end, 5% of Bierman's academic year time will be dedicated to the project. Furthermore, the Provost's Office of the University will again sponsor a culminating student conference (a $4000 cash commitment) in its entirety because such a conference directly addresses the University's commitment to engagement in the broader community (see attached letter of support from J. Burke).

Diversity of Populations Served

Our project will serve socio-economically and culturally diverse populations. Vermont is a rural state with only a few small cities. Much of the state is heavily dependent on agriculture and

tourism; only a few communities are dominated by high technology industry. In many communities, schools include students of widely varying socioeconomic backgrounds. When selecting schools to participate in our project, we have sought and will continue to seek a mixture of venues including schools that represent different parts of the state, different income levels, and different cultures such as the logging-dominated economy of the far north, the agricultural economy of the southwest, and the more urban schools of the Burlington area. VISMT will assist in recruiting a diverse population of participants through their existing network of statewide Teacher Associates (see attached support letter).

Future Plans

We view NSF funding of this continued piloting phase as a means by which to begin what could be another five to ten years of work. Our long-term goal is to compile a digital database that includes historic photographs of every town in Vermont followed by networking and regionalization that would allow our data base to expand at least to neighboring states and eventually all of New England.

AFGE funding, requested in this proposal, will support the development of tools that will allow us to continue our work efficiently, most importantly web-based submission protocols and digital teacher training materials for workshops. Using the results of our first successful year, we have already leveraged funding from the Vermont-based Lintilhac foundation to support a Masters in Teaching student.

Once we have used AFGE support to demonstrate our ability to integrate towns (and thus an expanded informal science component into our project), we will approach the Vermont-based Orton and Freeman Foundations, which are committed to town preservation and education reform, respectively. As the project matures, we anticipate submitting proposals to the Center for Field Studies to support expanded image collection over a summer and to work with the Elderhostel program to offer a module in which participants would collect and analyze images for specific towns. We have met with Wayne Sukow (NSF program manager, ESIE) and have discussed the potential for this project to compete for funding in his teacher enhancement program. In the future, the NSF-REU program could support extensive undergraduate involvement in the project. Whatever level of future funding we acquire, once a web-based submission protocol is in place, Massey and Bierman could continue to work with schools to collect images at a much reduced rate using NSF-provided equipment.

Qualifications of Project Personnel

Bierman and Massey are both geologist-educators with complimentary skills. Bierman is a geomorphologist who supervises graduate and undergraduate research. Massey directs the Perkins

Geology Museum and a variety of K-12 outreach programs. Together, they have the combination of experience and expertise to ensure that the project will succeed.

Bierman is an Associate Professor with eight years of experience studying Vermont landscapes. He and his students integrate research and education in a variety of ways, the most visible being an NSF-CAREER project that is searching for records of mega-storms and human impact in the geologic records of New England ponds and alluvial fans. Bierman has directly supervised 11 graduate students, is currently supervising 4 more, and has overseen 4 undergraduate theses. He and his students have published 27 refereed papers and presented 94 abstracts including several dedicated to the integration of research and teaching. Bierman has extensive experience doing science with high school students. Over the past seven years, Bierman has worked with high school students in an eight day residential science program at the University of Vermont - The Governor's Institute for Science & Technology (http://geology.uvm.edu/geowww/morphwww/giv).

Massey is Museum Education Specialist for the Perkins Geology Museum. She provides Earth and Environmental science expertise to the general public and coordinates K-12 outreach for local teachers and students. Massey oversees museum exhibits and collections, manages museum student workers, and directs summer science programs for elementary, middle, and high school students. In addition to Museum programs, Massey works with science education reform efforts in the State of Vermont. She acts as a higher education representative to science education initiatives in the State of Vermont including working with science educators and VISMT personnel to develop science professional development for teachers. She is a member of the Vermont Science Teachers Association. Massey created standards-based science curricula to accompany exhibits at the Barre Granite Museum in Vermont. Work with students and teachers in science education programs prepares her well for work with students and teachers in the proposed project.

Mallard, the Outreach Assistant, has worked with the project since its inception. She has a MS degree in Geology and, having mapped extensively in Vermont, is an expert in Vermont Geology. Mallard has created the existing web site and is facile with several web-authoring programs as well as Macintosh computers in general. Mallard's teaching experience is broad; she has worked extensively with both high school students and College students at several levels.

Professor Agne advises students in Education graduate programs and is thus able to identify talented students with science education backgrounds to participate in collaborative research projects, such as the proposed program assessment. Agne's background is in quantitative methodology, a compliment to the current programs which have students more actively involved in naturalistic inquiry/case study/qualitative research and evaluation projects. Agne has directed an NSF Teacher Enhancement Project, is a Fellow of the AAAS, has coordinated the Eisenhower Higher Education Program for Vermont, and was the chief education consultant for the Grow Lab curriculum of the National Gardening Association.

Figure 1. Index Page for Digital Archive of Landscape Change. Web address: geology.uvm.edu/landscape.

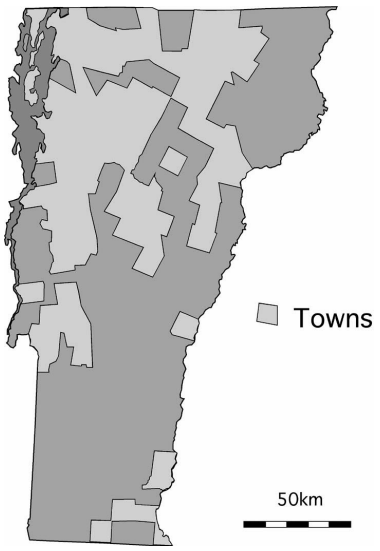

Figure 2. Towns for which we have collected at least one image pair are shown in light gray.

TABLE 1. Phase 2 Staff Responsibilities

Paul Bierman	Christine Massey	Outreach Assistant	Undergraduate Intern	MAT Geology Student	M.Ed. Student and R. Agne
Administer Grant	Assist in development of training materials and perform trainings.	Recruit Teachers with help of Master Teacher, Massey, and VISMT. Recruit informal science professionals. Organize remote training workshops.	Scan and annotate historical images	Develop curricular module based on images in archive	Perform student, teacher, staff and professional interviews for evaluation
Oversee use of technology and computers. Long term web site maintenance.	Oversee development of curricular module by MAT student.	Instruct Teachers and Students in use of technology	Reoccupy and photograph historical sites	Document and test module with students	Collate responses and prepare evaluation
Assist in development of training materials and perform trainings	Organize Culminating Conference	Create and maintain digital database on website	Update digital database	Prepare module for web publication	Post evaluation results and approach to landscape change web site
Organize Culminating Conference		Coordinate student presentations at schools and Perkins Geology Museum Organize Culminating Conference			

RECENT PHOTOGRAPH
latitude: N 44° 38' 35.3"
longitude: W 72° 49' 49.2"
photographer:
Alexandra Crossman
school:
Lamoille Union High School
date: Nov. 2000

OLD PHOTOGRAPH
county: Lamoille
town: Jeffersonville
date: late fall of 1910 or 1911
photo credit: used with permission from the Cambridge Historical
Society. Photo taken by Herold Thomas.
description: This picture was taken on the end of Upper Valley Road on the property of the Hail's on the top of a hill overlooking the town of Jeffersonville.

These photographs were taken atop a hill overlooking the town of Jeffersonville, Vermont. It was originally taken in 1910/1911 and contributed to The Cambridge Historical Society by Wendall Wells, better known as "Stub". The second was taken on November 13, 2000. It was impossible to get an exact location of the first picture because of the reforestation that has taken place there as much of Jeffersonville. So I stood on the foundation of what was once a reservoir (its roof can be seen on the bottom left of the original) that supplied the town's water until 1950 when the water supply was relocated. Where the house next to it now stands was part of the Perkin's Farm used for cattle and haying. In the village the students attended Cambridge Junior High in 1912 until 1920 when it changed to a high school. It was converted into an elementary school when Lamoille Union High School in Hyde Park was built in 1967. An addition was connected to The Cambridge School and the gymnasium was built later. Bert Reynolds Lumberyard had wood stacked nearby, which is no longer in business. The trees have been cleared to the ridge and used for athletic activities. Last year the town purchased the William's property to build new soccer fields. Just out of view of the picture past these fields was Jeffersonville's first "ski area" on Stafford's Hill. It was built in the early 1900's consisting of a single rope tow. This was previous to Smuggler's Notch Resort just four miles up Route 108. The roads have been paved and parking lot instituted on the far side of the school. Two playgrounds on either side of the school were also added in 1990 right after the land was a trailer park. Windridge Tennis Camp (hidden behind the trees beyond the school had been constructed possibly months before the original photograph. There is currently debate about its future use. Housing has increased and continues to develop quite quickly. Homes have also been built along the ridge. Today the only general store in the photo is Hanley's, which, at that time was a tack shop and the general store where The Pocket Full of Poses Shop is now. The landscape has been largely reforested. The ridge has clay deposit where erosion is visible in both pictures. In 1950 there was a landslide. Last year it slid once more causing the house on top to be insecure due to wet weather held in the clay earth. The house had to be burned for safety reasons. These two photographs show that the manmade differences are great but the physical features have changed little.

Figure 3. Example of image pair collected and interpreted by Vermont High School student.

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Research and Teaching Interests

Geomorphology, Isotope and Low-temperature Geochemistry, Geohydrology, Environmental Geology, Glacial Geology, Human Impact on the Landscape

Academic Training

Ph.D., 1993, Geology, University of Washington, Seattle, WA with A. Gillespie
"*Cosmogenic Isotopes and the Evolution of Granitic Landforms*"
MS, 1990, Geology, University of Washington, Seattle, WA with A. Gillespie
"*Accuracy and Precision of Rock Varnish Cation Ratio Dating*"
BA, 1985, Geology and Environmental Studies, Williams College, Williamstown, MA
"*Deglaciation of Northwestern Massachusetts*," (cum laude and senior thesis)

Professional Experience

1998- present Assoc. Professor Univ. of Vermont, Geology and Natural Resources
1993-1998 Assistant Professor Univ. of Vermont
1992-1993 Lecturer University of Washington
1987-1992 Research and Teaching Assistant University of Washington
1985-1987 Hydrogeologist and Project Manager Alliance Tech., Bedford, MA
1985-1987 Instructor Museum of Science, Boston

Honors and Accomplishments

NSF CAREER Award, 1997
NSF Waterman Award nomination, AGI, 1996
Donath Medal for Research by Young Scientist, Geological Society of America, 1996
Presidential Faculty Fellowship nomination, UVM, 1995
Faculty Fellowship, University of Washington, 1992
Fuller Fellowship, University of Washington, 1991
Honorable Mention, NSF Graduate Fellowship, 1987 and 1988

Other Training and Skills

Designed, set-up and manage cosmogenic isotope extraction laboratory and technician
Experienced operator, scanning electron microprobe, AMS, and ICP
Global Positioning Systems, GSA Short Course, 1996
Ground Water Flow and Contaminant Transport, GSA Short Course, 1986
Geology Field Camp, University of Montana, Bozeman, 1983

Professional Service

Associate Editor, GSA Bulletin and GEOLOGY, 1997 and 1999 to present
Panelist, National Science Foundation, *Water and Watersheds* competition, 1995, 1999
Session Chair, Geological Society of America National Meeting, 1994, 1997, 2000
Instructor, Geological Society of America National Meeting, *Cosmogenic Isotopes and Geomorphology* Short-course, 1994, 1995, 1997
Leader and Organizer, Geological Society of America Fieldtrip, Owens Valley, 1991
Leader, NAGT Fieldtrip, Williamstown Glacial Geology, 1986
Manuscript and Book Reviews for *GEOLOGY, Geological Society of America Bulletin, American Antiquity, Quaternary Research, Quaternary International, SCIENCE, GSA Today, Chemical Geology, Nature, Biogeochemical Cycles, Geochimica et Cosmochimica Acta Freeman Press, Earth Surface Processes and Landforms, Geophysical Research Letters, Geomorphology, McGraw Hill, Annals of the Association of American Geographers, Basin Research*

Personal Information

Born October 24, 1961; raised in Baltimore, Maryland; married 1994
Enjoy hiking, running, cross-country skiing, photography, home renovation

Relevant and Important Publications, P. Bierman and his Students

Bierman, P.R. (2000) Henry's Land, in **The Earth Around Us: Maintaining A Livable Planet**, J. Schniederman, ed., Freeman, p. 47-56.

Brown, S. L., Bierman, P.R., Lini, A., and Southon, J., (2000), A 10,000 year record of extreme hydrologic events, **Geology**, 28, 335-338.

Clapp, E. M., Bierman, P.R., Schick, A. P. Lekach, J., Enzel, Y., and Caffee, M., (2000), Differing rates of sediment production and sediment yield, **Geology**, 28, p. 995-998.

Gran, S. Nichols, K., and Bierman, P. R., (1999), Teaching winter using frozen lakes and snowy mountains, **Journal of Geoscience Education,** v. 47, p. 420-427.

Bierman, P. R. (1998), Catastrophic Results of Colonial Clearcutting:, **American Association for the Advancement of Science** National Meeting, Philadelphia. (abs)

Bierman, P., Lini, A., Davis, P.T., Southon, J., Baldwin, L., Church, A. and Zehfuss, P. (1997) Post-glacial ponds and alluvial fans: recorders of Holocene landscape history. **GSA Today**. 7 (10) p. 1-8.

Clapp, E., Bierman, P., Church, A. B., Larsen, P. L., Schuck, R. A. and Hanzas, J. P. (1996). Teaching Geohydrology through analysis of groundwater resources and glacial geology, northwestern Vermont. **Journal of Geoscience Education**. 44, 45-51.

Bierman, P. & Steig, E. (1996). Estimating rates of denudation and sediment transport using cosmogenic isotope abundances in sediment. **Earth Surface Processes and Landforms,** 21, 125-139.

Bierman, P., Gillespie, A., Caffee, M. (1995). Cosmogenic Ages for Earthquake Recurrence Intervals and Debris-Flow Fan Deposition, Owens Valley, CA. **Science**, 270, 447-450.

Bierman, P. (1994). Using in situ cosmogenic isotopes to estimate rates of landscape evolution: A review from the geomorphic perspective. **Journal of Geophysical Research** (special issue on Tectonics and Topography), 99, B-7, 13,885-13,896.

Graduate and Undergraduate Thesis Students

Kyle Nichols, Natural Resources Ph.D., Mojave Desert Piedmonts
Erik Clapp, Natural Resources Ph.D., Models of land surface evolution using ^{10}Be
Adam Parris, Geology MS, Paleostorms in New Hampshire
Lyman Persico, Environmental Science BS w/honors, Mojave gravel transport
Anders Noren, Geology MS, Holocene pond records of hillslope erosion
Karen Jennings, Geology MS, New England Alluvial fans, 2001
Kristine Bryant, Education M.Ed., Development of Vermont Landforms web page,2000
Kyle Nichols, Geology MS, Geomorphic process rates, Patton Camps, Mojave, 2000
Sara Gran, Geology MS, Fault offset rates in the northern Galilee, Israel, 2000
Darrin Santos, Environmental Science BS w/honors, Desert channel initiation, 1999
Sarah Brown, Geology MS, Episodic Holocene sedimentation from extreme storms, 1999
Timothy Whalen, Geology MS, Post-glacial response of the Champlain Basin, 1998
Mike Abbott, Geology MS, Isotopic characterization of Mt. Mansfield groundwater, 1997
Kim Marsella, Geology MS, Deglacial chronology of Baffin Island, 1997
Amy Church, Geology MS, Holocene rates of surface change in northern Vermont, 1997
Lin Li, Geology MS, Vermont Holocene history deduced from lake cores, 1996
Paul Zehfuss, Geology BS, Vermont alluvial fan morphology and stratigraphy, 1996
Patrick Larsen, Geology MS, ^{10}Be and ^{26}Al production rates from moraines, 1995
Kristine Bryant, Geology BS w/honors, Glacial lake levels in the Winooski Basin, 1995

List of Collaborators and Advisors

Alan Gillespie, David Dethier, Douglas Clark, P. Thompson Davis, Minze Stuiver, Bruce Nelson, David Elmore, Marc Caffee, Scott Kuehner, Eric Steig, John Southon, Lou Derry, Mark Johnson, Milan Pavich, Pat Colgan

Christine A. Massey, Museum Education Specialist
Department of Education, University of Vermont, Burlington, VT 05405

Research and Teaching Interests

K-12 Science Education, Introductory Earth and Environmental Science, Glacial Geology, Geology of National Parks, Stable Isotope Geochemistry

Academic Training

MS, 1995, Geology, University of Washington, Seattle, WA (with M. Stuiver)
"Development of Hydrogen Mass Spectrometry Methods for Testing Stable Isotopic Interactions of Water Vapor at the Snowpack-Air Interface, Summit, Greenland"

BA, 1986, Geology with Natural History & German, Carleton College, Northfield, MN
"Sodium Content of Overburden Sediments, Beulah Zap Lignite Formation, North Dakota" (cum laude and senior thesis with C. E. Buchwald)

Professional Experience

1998-present	Museum Education Specialist Perkins Museum, Univ. of Vermont
1995-present	Adjunct Lecturer University of Vermont
1995-present	Director Science & Technology Governor's Institute for Vermont High School Students
1996-1998	K-12 Outreach Coordinator Perkins Museum, University of Vermont
1993-1995	Environmental Consulting Geologist WH&N, Burlington, VT
1989-1993	Research and Teaching Assistant (Geology/Chemistry/Environmental Sciences/Northwest Center for Research on Women) Univ. of WA
1988-1989	Hydrologic Field Assistant U. S. Geological Survey, Menlo Park, CA
1986-1987	Naturalist Intern Foothill Horizons Outdoor Educ. Center, Sonora, CA

Honors and Accomplishments

American Western Universities (AWU) Student Research Fellow--Coal Science Division of the Energy Research Center, University of North Dakota, 1985

Other Training and Skills

Equity Workshop for Educators, South Burlington H. S., So. Burlington, VT, 2000
Communication And Learning Styles Workshop, UVM, Burlington, VT, 1999
Service-Learning Workshop, University of Vermont, Burlington, VT, 1999
Diversity 101 Seminar, University of Vermont, Burlington, VT, 1999
Engaging Middle School Girls in Science and Math, WEEA On-line course, 1999
Lead-Scientist Institute on Systemic Reform of Elementary Science Education, American Physical Society (APS), Washington, DC, 1999
Writing in the Classroom and *Grant Writing Techniques*, University of Vermont, 1998
Educational funding (NSF), Obtaining Educational Materials from the USGS, and *Using GIS in Educational Settings*, GSA Short Courses, 1997
Learning from the Fossil Record, GSA Short Course, 1996
Isotopes in Hydrology, GSA Short Course, 1995
40-Hour OSHA Hazardous Materials & 8-Hour Refresher courses, 1993-1994
Greenland and Antarctica Ice Core Research and Cold Weather Training, 1990-1991
Back-Country Ski Patrol, Pinecrest, CA, 1987-1989
Geology Field Camp, California State University--Bakersfield, Bakersfield, CA, 1987
Carleton Death Valley Field Seminar, 1986
Gemstone, Mining, and Crystallography Research, Sri Lanka, 1984
Languages: English, German, and French

Personal Information

Born: Minneapolis, Minnesota: February 27, 1963.
Lived: Minnesota, Germany, Sri Lanka, California, South Korea, Washington, Greenland, Antarctica, Australia, and Vermont

Professional Service

Organizing Committee Member and Session Chair, "K-16 Education: Earth and Environmental Science," *NE-GSA Meeting*, March 2001, Burlington, Vermont.
Invited Speaker, Burlington Mineral and Gem Club, October, 2000, Burlington, VT
Commissioner, Univ. of Vermont President's Commission on the Status of Women (PCSW), 2000-2002
Invited Delegate, *National Conference on Governor's Schools*, 1999, Stowe, Vermont.
Vice President, *Vermont Geological Society*, 1999-2000
Session Chair, *International Conference and Field Trip on Drainage Basin Dynamics and Morphology*, May, 1999, Jerusalem, Israel
Volunteer Scientist, Science-By-Mail, Boston Museum of Science, 1992-2000
Reviewer, SUGR/FAME student research proposals, University of Vermont, 1998
Curriculum Committee, Barre Granite Museum, Barre, VT, 1997-present
Professional Memberships: *Sigma Xi, American Geophysical Union, Geological Society of America, Association for Women in Science, American Association of University Women, National Association of Geoscience Teachers, Vermont Geological Society, and Vermont Science Teachers Association*
Children's International Summer Village (CISV) Adult leader for U.S. delegation of four eleven year old children to Seoul, South Korea, 1989

Relevant and Important Publications

Massey, C. A., Mallard, L. D., Bierman, P. R., (2000). Digital archive of human-induced landscape change with K-16 students in Vermont, **Geological Society of America—2000 National Meeting Abstracts with Programs**, 32 (7), A-204.
Mallard, L.D., Massey, C.A., and Bierman, P. R., (2000). Vermont students gather digital images of human-induced landscape change, **Geological Society of America—2000 National Meeting Abstracts with Programs**, 31 (7), A-421.
Persico, L. P., Mallard, L. D., Bierman, P. R., and Massey, C. A., (2000). Forest to farmland and back again: a changing Vermont landscape: **Geological Society of America—2000 National Meeting Abstracts with Programs**, 32 (7), A-24.
Massey, C. and Snyder, S., (1999). Geologic field trips sites for teachers in Northwestern Vermont. In Wright, S. F. ed., **New England Intercollegiate Geologic Conference Guidebook**, 91, 159-177.
Massey, C. A., (1998). Earth Science Week. **Connect: Teacher's Innovations in K-8 Science, Math and Technology**, 12, 1, 26.
Massey, C. A., (1998). Learning through inquiry and community service--The Science & Technology Institute for Vermont high school students. **Geological Society of America--1998 National Meeting Abstracts with Programs**, 30, 7, A-350.
Massey, C. A., (1997). Environmental Science and Technology Institute for Elementary Teachers and Education Majors in Vermont. **Geological Society of America--1997 National Meeting Abstracts with Programs**, 29, 6, A-301.
Massey, C. A., (1996). Thrust faults, plankton tows, wastewater, and SEMs: Vermont Earth and Environmental Science for K-12 students and teachers. **Geological Society of America--1996 National Meeting Abstracts with Programs**, 28, 7, A-476.

Undergraduate and High School Student Advisees

Kate Elvin, CVU High School, *Water levels in the Lake Champlain Basin,* 2001
Katherine Meyer, CVU High Sch., *Science Learning for Middle Sch. Girls and Boys,* 1999
Jill Wagner, Env. Studies BA, *Environmental Education at Burlington High School,* 1997

List of Collaborators and Advisors

Russell Agne (UVM Education), Barry Doolan (UVM Geology), Paul Bierman (UVM Geology and Natural Resources), Mike Strauss (UVM Chemistry), Walter Poleman (UVM Field Naturalist Program), Aimee Stephenson (VISMT), Minze Stuiver (UW Quaternary Research Center/Geology), and Pieter Grootes (UW Quaternary Research)

RUSSELL M. AGNE

ADDRESS Department of Education
532B Waterman Building, University of Vermont
Burlington, VT 05405

Voice: (802) 656-3356
Fax: (802) 656-0004
E-mail: ragne@zoo.uvm.edu

EDUCATION

1966-1969 Ph.D. Secondary Education. University of Connecticut.
1962-1963 M.S. Geology/Science Education. Syracuse University.
1958-1962 B.S. Biology, Physics/Secondary Education. Central Connecticut State University.

EXPERIENCE

1977-present: *Professor of Education,* The University of Vermont
1991-1994: *Co-Director,* NSF Teacher Enhancement in Physical Science Grant, University of Vermont.
1984-present: *Director,* Science, Mathematics and Computer Technology Project, UVM.
1979-1984: *Chairman,* Department of Professional Education & Curriculum Development, UVM.
1973-1977: *Associate Professor of Education,* The University of Vermont
1969-1973: *Assistant Professor of Education,* The University of Vermont
1968-1969: *Instructor in Education*, University of Connecticut
1967-1968: *Graduate Teaching Assistant in Education,* University of Connecticut
1964: *Teaching Associate in Field Geology*, Indiana University
1963-1967: *Classroom Teacher of Biology, Physics and General Science*, Wethersfield, Connecticut

PUBLICATIONS

Clarke, J. H., and Agne, R. (1997). *Interdisciplinary High School Teaching: Strategies for Integrated Learning*. Allyn and Bacon, Needham Heights, Mass.

Agne, R., Cohen, H. D., and Hillman, D. F. (1978). "Cognitive Level and College Physics Achievement." *American Journal of.Physics,* 46(10), 1026-1029.

Agne, R., and Ducharme, E. R. (1988). "New Incentives for Pubic School-Higher Education Partnerships. " *Journal of Curriculum and Supervision*, 3(4), 335-343.

Agne, R. (1987). "Teaching Strategies for Presenting Ethical Dilemmas." *Ethics and Social Responsibility in Science Education,* Frazer, M. J. and Komhauser, A., eds., Pergamon Press, Oxford, England, 165-173.

Agne, R. and Ducharme, E. R. (1982). "The Education Professoriate: A Research Based Perspective." *Journal of Teacher Education*, 33(6), 30-36.

Laura Mallard, Landscape Change Project Outreach Coordinator
Department of Geology, University of Vermont, Burlington, VT 05405

Research and Teaching Interest

Origin of mountain belts, Human Impact on the Landscape, K-12 Science Education, Paleontology

Academic Training

MS, 2000, Geology, University of Vermont, Burlington, Vermont, with B. Doolan "*Stratigraphic, structural, and fault history analysis of the Richmond 7.5' Quadrangle, northcentral Vermont"*
BS, 1994, Geology, University of North Carolina, Chapel Hill, North Carolina, with K. Stewart "*Kinematic analysis of a possible suture in the southern Appalachians, Northwestern North Carolina"*

Professional Experience

2000-present Outreach Coordinator, Landscape Change Project University of Vermont
1995-2000 Research and Teaching Assistant University of Vermont
1992-1995 Research Assistant University of North Carolina at Chapel Hill

Other Training and Skills

Designed, set-up and manage the web-based Digital Archive of Human-induced Landscape Change
Editor, UVM Department of Geology Newsletter, 1996
Experienced operator: scanning electron microscope (SEM), magnetometer, gravimeter, rock coring drill, rock thin section preparation equipment, and petrographic microscope
Working knowledge and proficiency of Microsoft Word, Excel and Power Point, Adobe PageMaker, Illustrator, PhotoShop, and PageMill, Canvas, Deltagraph, and Dreamweaver.

Personal Information

Born: Morganton, North Carolina: October 5, 1972
Enjoy kayaking, bicycling, pottery, snowboarding, hiking

Professional Service

Volunteer Scientist, Science-By-Mail, Boston Museum of Science, 1997-2000
Earth Science Week, Geologist in the Park, 2000
Trained volunteers for Lake Champlain Basin Science Center

Relevant Publications

Adams, M.G., Mallard, L.D., Trupe, C.T., and Stewart, K.G., 1995, A technique for compiling and presenting computerized geologic maps on the Macintosh, in Depaor, D.G., editor, **Personal Computers and Structural Geology**, Elsevier Science Ltd., Great Britain.
Mallard, L.D., Adams, M.G., and Stewart, K.G., 1994, Kinematic analysis of a possible suture in the southern Appalachians, northwestern North Carolina: **Geologic Society of America Abstracts with Programs**, v. 26, n.4.
Mallard, L.D., and Rogers, J.J.W, 1995, Relationship of Avalonian terranes and Cadomain terranes to Grenville and Pan-African events: **Geologic Society of America Abstracts with Programs**, v. 27, n.2.
Mallard, L.D., and Rogers, J.J.W., 1997, Relationship of Avalonian terranes and Cadomain terranes to Grenville and Pan-African events: **Journal of Geodynamics**, vol. 23. No. 3/4.
Mallard, Laura D., Massey, Christine A., and Bierman, Paul R., 2000, Vermont students

gather digital images of human-induced landscape change**: Geologic Society of America Abstracts with Programs**, vol. 32, no. 7.

Massey, Christine A., and Mallard, Laura D., 2000, Digital archive of human-induced landscape change: **Geologic Society of America Abstracts with Programs**, vol. 32, no. 7.

Persico, Lyman P., Mallard, Laura D., Bierman, Paul R., and Massey, Christine A., 2000, Forest to Farmland and Back Again: A Changing Vermont Landscape: **Geologic Society of America Abstracts with Programs**, vol. 32, no. 7.

List of Collaborators and Advisors

Barry Doolan (UVM Geology), Kevin Stewart (UNC-CH Geology), Mark Adams(UNC-CH Geology), John J.W. Rogers (UNC-CH Geology), Paul Bierman (UVM Geology), Christine Massey (UVM Geology), Char Mehrtens (UVM Geology), Rolfe Stanley (UVM Geology),

SUMMARY PROPOSAL BUDGET YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Vermont & State Agricultural College

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Paul R Bierman

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Paul R Bierman - Associate Professor**	**0.00**	**0.00**	**0.75**	$ **4,425**	$
2. **Christine A Massey - Education Specialist**	**0.50**	**0.00**	**0.00**	**1,188**	
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.50**	**0.00**	**0.75**	**5,613**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**12.00**	**0.00**	**0.00**	**25,200**	
3. (**2**) GRADUATE STUDENTS				**4,500**	
4. (**1**) UNDERGRADUATE STUDENTS				**2,000**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**1**) OTHER				**500**	
TOTAL SALARIES AND WAGES (A + B)				**37,813**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**10,963**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**48,776**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) **portable computer and projector** $ **7,500**					
TOTAL EQUIPMENT				**7,500**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**1,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**1,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**5,000**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**6,000**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**63,276**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **pub serv (Rate: 27.3000, Base: 55776)**					
TOTAL INDIRECT COSTS (F&A)				**15,227**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**78,503**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **78,503**	$

M. COST SHARING PROPOSED LEVEL $ **4,546** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY
Paul R Bierman		INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked / Date Of Rate Sheet / Initials - ORG

SUMMARY PROPOSAL BUDGET YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Vermont & State Agricultural College

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Paul R Bierman

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Paul R Bierman - Associate Professor**	**0.00**	**0.00**	**0.00**	$ **0**	$
2. **Christine A Massey - Education Specialist**	**0.50**	**0.00**	**0.00**	**1,247**	
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.50**	**0.00**	**0.00**	**1,247**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**0.33**	**0.00**	**0.00**	**8,820**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**10,067**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**3,544**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**13,611**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**2,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**1,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**1,000**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**16,611**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **public serv. (Rate: 27.3000, Base: 16611)**					
TOTAL INDIRECT COSTS (F&A)				**4,535**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**21,146**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **21,146**	$

M. COST SHARING PROPOSED LEVEL $ **9,844** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY
Paul R Bierman		INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked / Date Of Rate Sheet / Initials - ORG

SUMMARY PROPOSAL BUDGET

Cumulative

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Vermont & State Agricultural College

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Paul R Bierman

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Paul R Bierman - Associate Professor**	**0.00**	**0.00**	**0.75**	$ **4,425**	$
2. **Christine A Massey - Education Specialist**	**1.00**	**0.00**	**0.00**	**2,435**	
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)	**1.00**	**0.00**	**0.75**	**6,860**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**2**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**12.33**	**0.00**	**0.00**	**34,020**	
3. (**2**) GRADUATE STUDENTS				**4,500**	
4. (**1**) UNDERGRADUATE STUDENTS				**2,000**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**1**) OTHER				**500**	
TOTAL SALARIES AND WAGES (A + B)				**47,880**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**14,507**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**62,387**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) **$ 7,500**					
TOTAL EQUIPMENT				**7,500**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**3,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**2,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**5,000**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**7,000**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**79,887**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**19,762**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**99,649**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **99,649**	$

M. COST SHARING PROPOSED LEVEL $ **14,390** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY
Paul R Bierman		INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked / Date Of Rate Sheet / Initials - ORG

Looking Forward -- Scaling Up The Digital Image Archive of Landscape Change

Budget for submission to the NSF Geoscience Education Program
From the Departments of Geology and Education, University of Vermont

Start 9/1/01

		YEAR 1 2001-2002	YEAR 2 2002-2003	TOTAL 2000-2003
SALARIES				
Paul Bierman, Associate Professor				
Summer Salary	0.75 month/1 summer@ $5900/mo	4425	0	4425
Outreach assistant	16 months@ $2100/mo	25200	8820	34020
Christine Massey, Education Specialist	0.5 month/yr @ $2376/mo	1188	1247	2435
Russell Agne, Professor of Education	program evaluation	500	0	0
TOTAL SALARIES		31313	10067	40880
STUDENT SUMMER STIPENDS				
1 Undergraduate Student	2 months @ $1000/mo	2000	0	2000
1 Graduate Student, MAT Geology	2.5 months @$1400/mo	3500	0	3500
1 Graduate Student, Med (Earth Science)		1000	0	1000
TOTAL STIPENDS		6500	0	6500
CONSULTANTS				
web submission interface design		5000	0	5000
BENEFITS				
@ 34.5% and 35.2% of salary	Faculty, staff	10803	3544	14347
8% of salary	undergraduate	160	0	0
TOTAL BENEFITS		10963	3544	14347
SUPPLIES				
Poster Supplies		500	500	1000
Zip disks, data storage tapes		300	300	600
Xeroxing, postage		200	200	400
TOTAL SUPPLIES		1000	1000	2000
TRAVEL				
trips to schools, museums and historical societies for class room involvement, student and teacher training miles in van or private car		1000	500	1500
Travel to National Geology Meeting	air fare, registration, per diem	0	1500	1500
TOTAL TRAVEL		1000	2000	3000
EQUIPMENT				
PowerBook and Projector combination		7500	0	7500
				0
TOTAL EQUIPMENT		7500	0	7500

Looking Forward -- Scaling Up The Digital Image Archive of Landscape Change

Budget for submission to the NSF Geoscience Education Program
From the Departments of Geology and Education, University of Vermont

Start 9/1/01

	YEAR 1 2001-2002	YEAR 2 2002-2003	TOTAL 2000-2003
TOTAL DIRECT COSTS	55776	16611	71727
TOTAL EQUIPMENT	7500	0	7500
TOTAL INDIRECT COSTS @27.3%	15227	4535	19762
TOTAL BUDGET	**78503**	**21146**	**99649**

INSTITUTIONAL COMMITMENT -- University of Vermont Cost Sharing

Sponsorship of culminating conference - 300 people			
food (snacks and lunch) @$10/per person	0	3000	3000
mailing	0	100	100
printing	0	400	400
display supplies	0	500	500
TOTAL CONFERENCE COMMITMENT	0	4000	4000
Academic year salary			
Paul Bierman (5%)	2655	2761	5416
fringe benefits on above	916	972	1888
TOTAL COST SHARED DIRECT COSTS	3571	7733	11304
TOTAL COST SHARED INDIRECT COSTS @27.3%	975	2111	3086
TOTAL University of Vermont COST SHARE	**4546**	**9844**	**14390**

BUDGET JUSTIFICATION

Costs associated with this project are primarily for personnel. As a community service project, our activities qualify for an overhead rate of 27.3%.

Salary and Benefits

Most salary costs will support the Outreach Assistant, Laura Mallard, who has experience working with the project and a MS in Geology. The Outreach position has been and will continue to be critical to the project's success as Mallard provides the most direct link between the High School students and the University of Vermont. As PI, Bierman will dedicate three summer weeks to the project primarily developing the on-line training tools, refining the workshop materials, and maintaining the web server. Massey also requests two weeks of salary support each year for her role in developing the training materials and working with the graduate students as they develop curriculum and evaluate the program. Russell Agne, Professor of Education, will supervise the program evaluation process for a $500 fee. University benefits are assigned at standard rates for different personnel.

Student Stipends

Funding requested in this proposal will support three student interns over the summer of 2002, a University of Vermont undergraduate and two graduate students. During this summer, the undergraduate will work with the Outreach Assistant to find and relocate images in Vermont towns where we have no coverage. One graduate student, a candidate for Master of Arts in Teaching Geology, will spend the summer working with Bierman, Massey, and Mallard to create and refine a curriculum based on the image archive itself. He will also assist with the refinement of the training materials. The other graduate student, who will be pursuing a Masters of Science in Education, will work under the supervision of Agne during the summer to evaluate the program's educational impact.

Supplies

We request funding for supplies needed to complete the project. Each school will be provided a kit to make posters that includes pre-cut poster board, glue, and ink jet cartridges for printing photos. Data storage media are needed to transfer information and back up all data. We request funds to prepare copies of the teacher manual, the workshop manuals, the curricular modules, postage, and for copying.

Travel

There is extensive local travel associated with this project. During the school year, the Outreach Assistant will travel to the schools involved in the project. Mallard will use Geology Department vans and her private vehicle.

Travel to national geologic meetings by project staff will allow further dissemination of project results in scientific sessions and approaches in education sessions. Funds requested will cover airfare, registration, and per diem for Mallard, and the graduate and undergraduate geology student (e.g. our last students, see Persico et al., 2000).

Equipment

We request funds for a presentation package including a projector and dedicated portable Macintosh computer. This package will be used for introducing the students to the program, for training workshops, and for presenting our work at professional meetings.

UNIVERSITY OF VERMONT, COST SHARING(TOTAL $14,390)

Culminating Conference-- At the conclusion of the project, participating teachers and their students will come together at the University of Vermont to present their findings in a poster session and attend presentations concerning the Vermont landscape (see http://geology.uvm.edu/landscape/conference.html). University faculty and administrators are invited to attend. The Provost's Office at University of Vermont will sponsor the conference and will be responsible for all associated costs, a cost sharing of $4000 plus indirect.

Staff and Faculty Salary – Bierman will dedicate 5% of his academic year time to this project. This time will be used to develop and deliver the training materials used both on-line and in the training workshops.

Current and Pending Support

(See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: **Paul Bierman**

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Human-Induced Landscape Change -- A Digital Image Archive Created by Students**

Source of Support: **NSF**

Total Award Amount: $ **74,717** Total Award Period Covered: **09/01/99 - 06/30/01**

Location of Project: **Vermont**

Person-Months Per Year Committed to the Project. Cal:**0.45** Acad: **0.45** Sumr: **0.00**

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Understanding rates of change at Earth's surface**

Source of Support: **U.S. Army Research Office, DEPSCoR**

Total Award Amount: $ **225,000** Total Award Period Covered: **09/01/99 - 08/30/02**

Location of Project: **California and Arizona**

Person-Months Per Year Committed to the Project. Cal:**1.00** Acad: **0.00** Sumr: **1.00**

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Extreme hydrologic events (CAREER)**

Source of Support: **NSF Hydrologic Sciences**

Total Award Amount: $ **200,000** Total Award Period Covered: **08/01/98 - 08/01/01**

Location of Project: **New England**

Person-Months Per Year Committed to the Project. Cal:**0.75** Acad: **0.25** Sumr: **0.50**

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Determining Rates and Patterns of Bedrock Incision by Large Rivers**

Source of Support: **NSF Geology**

Total Award Amount: $ **150,000** Total Award Period Covered: **03/01/01 - 02/28/04**

Location of Project: **Maryland, Pennsylvania**

Person-Months Per Year Committed to the Project. Cal:**0.75** Acad: **0.00** Sumr: **0.75**

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Eroding the Appalachians**

Source of Support: **NSF**

Total Award Amount: $ **149,963** Total Award Period Covered: **06/01/01 - 05/30/03**

Location of Project: **Southeastern United States and Vermont**

Person-Months Per Year Committed to the Project. Cal:**0.50** Acad: **0.00** Summ: **0.50**

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*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Infrastructure Available to Support this Project

The Geology Department has the intellectual and physical infrastructure needed to support this project. Funds available through the CAREER grant have been used to acquire several computers including two that are permanently installed as web terminals in the Perkins Geology Museum. Funds from the initial AFGE were used to acquire the web server, iMacs, scanners, digital cameras, and GPS units needed to perform project work. Vans operated by the Geology Department will be used to transport staff, faculty and equipment to and from schools. The University of Vermont Library Special Collections holds many thousands of Vermont images that we may freely access.

The University of Vermont provides a nurturing environment for a project such as we propose. There are close and deeply established ties between the Education and Geology Departments evidenced by the long tradition of the joint Masters in Teaching program. The University is committed to outreach and community engagement as demonstrated by its support of the Perkins Geology Museum, its renovation, and Massey's position as Education Specialist. In comparison o other state Universities, the University of Vermont has long been at the forefront of information technology, particularly web-based pedagogy and distance learning.

VISMT
VERMONT INSTITUTE FOR SCIENCE, MATH & TECHNOLOGY

April 13, 2001

Dr. Paul Bierman
Ms. Christine Massey
University of Vermont
Geology Department
Perkins Building
Burlington, Vermont 05405

Dear Dr. Bierman and Ms. Massey,

It is my pleasure to write this letter of support for your NSF GeoEducation program: "Looking Forward - Scaling Up The Digital Image Archive of Landscape Change." The goals of this project are well aligned with the mission of the Vermont Institute for Science, Math, & Technology (VISMT - Vermont's Statewide Systemic Initiative). Your proposal to scale-up participation, streamline information transfer through the use of technology, improve and refine your teacher training, increase connections to the informal education community, and develop a learning module for students will be considerable additions to an already substantial program.

VISMT will continue to assist you in recruiting participants for the program and help in your regionalization efforts. Your proposal comes at a time when VISMT is scaling up our own efforts to work with high schools. Your program to help schools integrate technology into the science curriculum while participating in real science research projects dovetail's well with our efforts to support the implementation of standards-based science curriculum. We also have a common goal to provide high schools with access to the equipment and technology they need to make sure their science curriculum is engaging and up-to-date. VISMT is always looking for ways to support high quality programs such as yours and we look forward to continuing this collaboration.

Best Wishes,

Aimee E. Stephenson, Ph.D.
Associate Executive Director

Dillingham Hall, 7 West Street, Montpelier, Vermont 05602 • Phone: 802-828-0060 • Fax: 802-828-0076 • Web: www.vismt.org
LOCATED AT VERMONT COLLEGE OF NORWICH UNIVERSITY

The University of Vermont

COLLEGE OF MEDICINE AND COLLEGE OF AGRICULTURE AND LIFE SCIENCES
DEPARTMENT OF MICROBIOLOGY AND MOLECULAR GENETICS
THE MARKEY CENTER FOR MOLECULAR GENETICS
STAFFORD HALL, BURLINGTON, VERMONT 05405-0068
TEL: (802) 656-2164 FAX: (802) 656-8749
WEB SITE: http://salus.med.uvm.edu/mmg/mmg.html

OFFICE OF THE PROVOST

April 13, 2001

Paul Bierman, Associate Professor
University of Vermont
Geology Department and School of Natural Resources
203 Perkins Building

Dear Paul:

I enthusiastically support your Geoscience Education proposal entitled, *Looking Forward -- Scaling Up The Digital Image Archive of Landscape Change*. I believe that the proposal furthers the University goals of active engagement with the local community and emphasizes the continued interaction of active University researchers with high school educators and townspeople throughout our state.

To demonstrate UVM's commitment to your work and this proposal, I commit $4,000 of University funds to sponsor the culminating conference that will bring several hundred Vermont High School students onto campus along with town officers, museum and library staff, and members of historical societies from around Vermont to share their research findings in a public forum. The conference will allow students to interact with each other, with University faculty and staff, and with the general public.

Sincerely,

John M. Burke, Ph.D.
Vice Provost for Research