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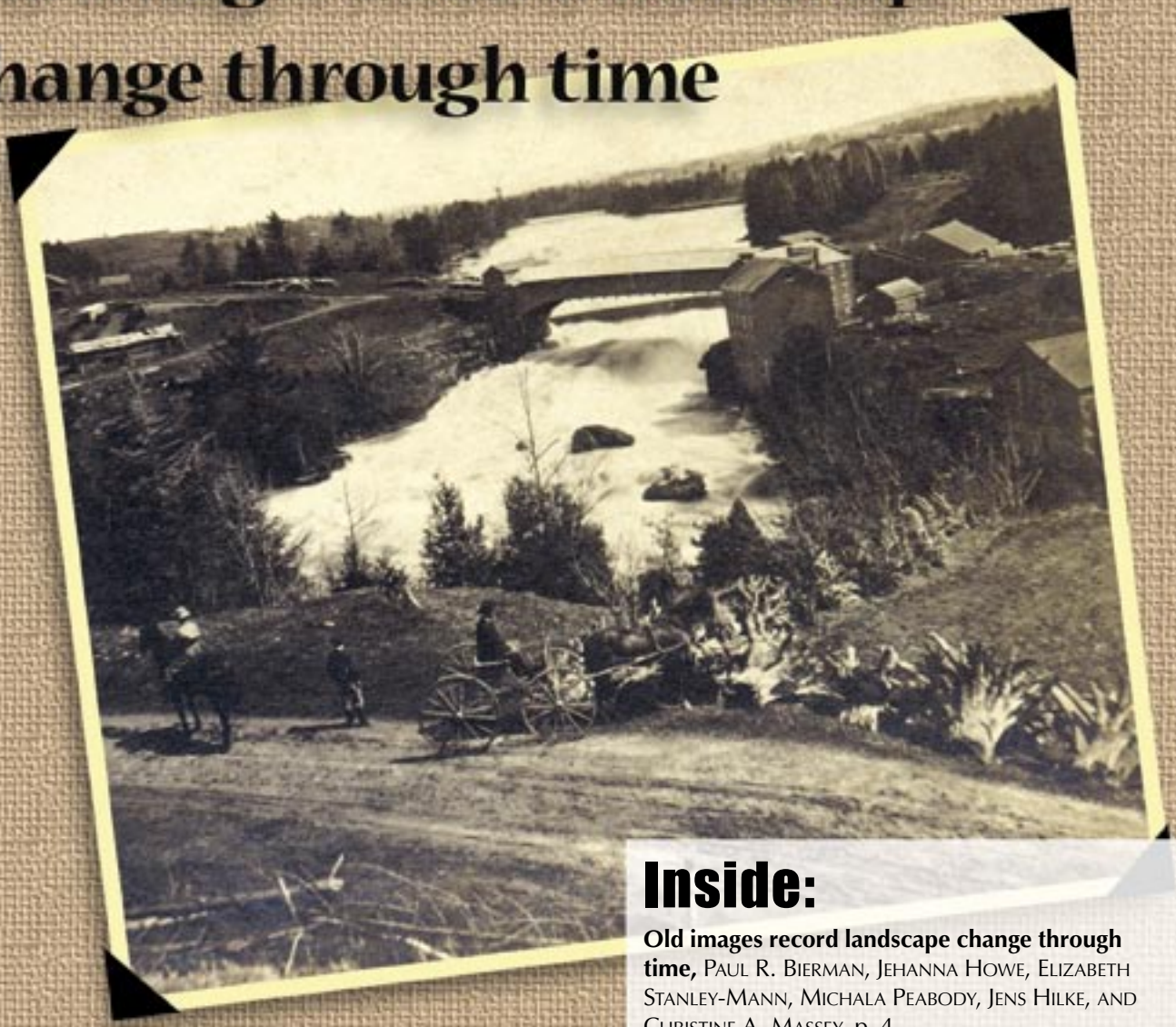
## Old images record landscape change through time



## Inside:

# An Earth Scientist's Periodic Table of the Elements and Their Ions

by L. Bruce Railsback

An Earth Scientist's Periodic Table of the Elements and Their Ions is a new periodic table designed to contextualize trends in geochemistry, mineralogy, aqueous chemistry, and other natural sciences. First published as an insert in the September 2003 issue of *Geology*, this version is updated and supersized—36" by 76"!

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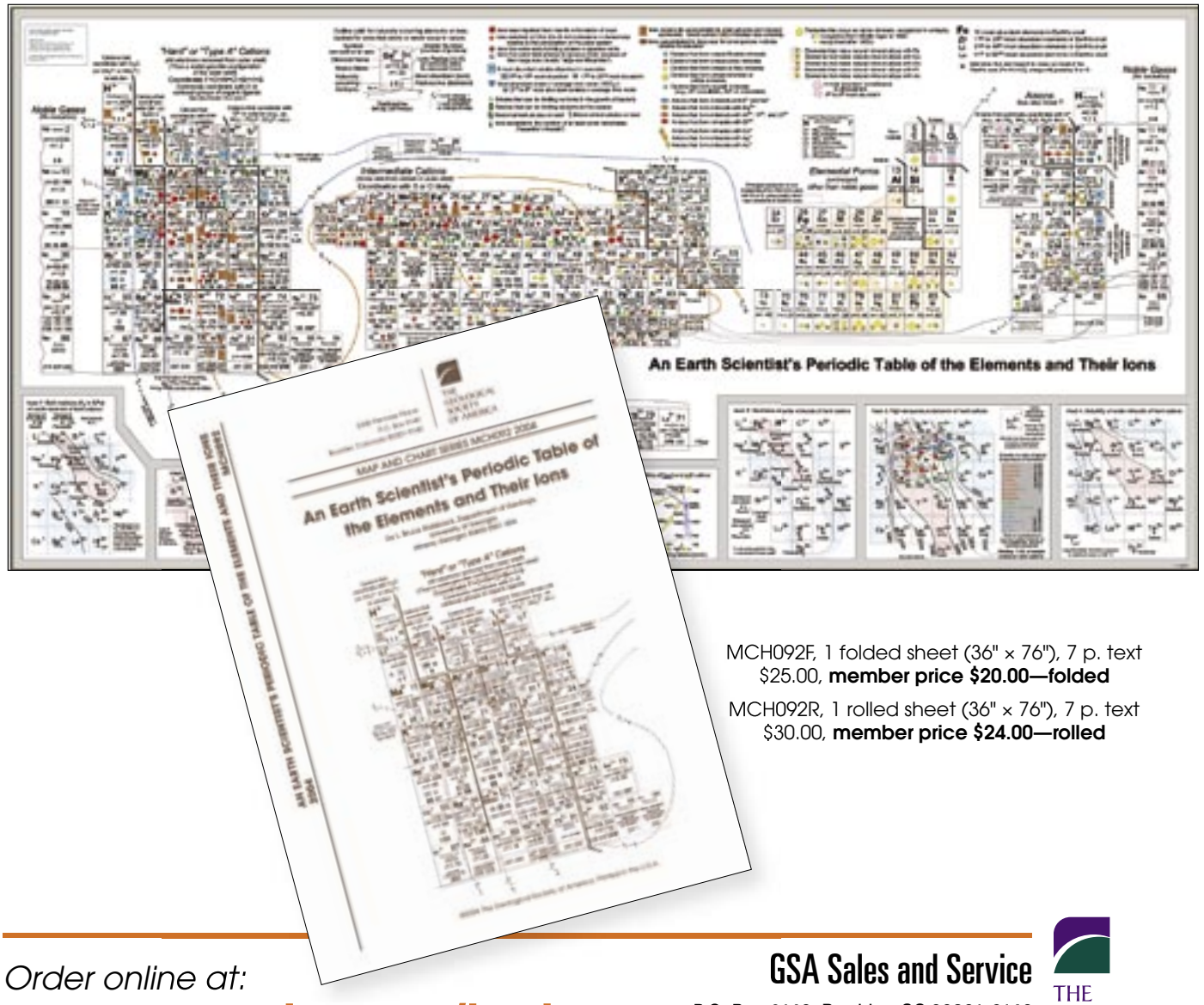


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**Cover:** People change landscapes. The stump fence at the right suggests that tree roots, which once bound the soil, are gone, allowing steep, sandy, rain-soaked slopes to erode in shallow landslides. Stacks of cut lumber and bare hillsides are indicative of nineteenth century deforestation, but the riparian zone is well-forested—an exception for the time. The high river stage, muddy dirt road, and leafless trees suggest it's spring. Image of Highgate Falls on the Missisquoi River, Vermont (http://www.uvm.edu/perkins/landscape/LS_View.php?FileName=LS04684). Image property of University of Vermont, Special Collections, Bailey Howe Library. See "Old images record landscape change through time" by Paul R. Bierman et al., p. 4–10.

## SCIENCE ARTICLE

# Old images record landscape change through time

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## ABSTRACT

Historical photographs are a powerful tool for examining and understanding the distribution of surficial processes, both physical and biological, on the timescale of decades and centuries. Such imagery is particularly valuable for understanding human-landscape interaction. Here, we present several examples of quantitative, image-based, landscape-scale analyses made using hundreds of different images, each taken at a different place. This analysis takes advantage of a large, searchable, Web-based image archive that contains enough images to allow testing of specific hypotheses regarding landscape change over time. For example, analysis of Vermont landscape images dated between 1860 and 1990 demonstrates that erosion is more common in clear-cut areas than in partially or wholly forested sites. We find that the quality of riparian buffers increased slowly over the past 184 years, with a dramatic improvement after 1980. Oblique aerial imagery taken after the 1927 flood of record and recently rephotographed demonstrates the frequency of near-channel land-use change over the past century. Together, these examples show the value of readily searchable image archives in allowing scientists, planners, and land managers to approach problems of significant societal relevance.

**Keywords:** Erosion, landslide, flood, hazard, mapping, historical landscapes.

## INTRODUCTION

For millennia, people have altered the landscapes on which they are born, live, and die. Such alteration began with clearance of valleys and slopes for agriculture at least 9000 years ago and was soon followed by the construction of roads, buildings, and cities (Hooke, 2000). Today, people are the most active geomorphic force on the planet, moving more mass every year than all other natural processes combined (Cronon, 1996; Hooke, 1994).

There is clearly a linkage between human actions and landscape response in areas as diverse as desertification (Zheng and Eltahir, 1997), road building (Wemple et al., 2000), and in the relationship between clear-cutting and mass movements (Montgomery et al., 2000). Such linkages have been made for more than a century. Marsh, writing *Man and Nature* in the 1850s, lamented the clearing of hillslopes and the erosion that followed. Beginning in the 1960s, the environmental movement brought these impacts clearly into the public eye, and debate has raged ever since over logging, road building on wild lands, and the alteration and restoration of river channels in the context of protecting endangered species (Montgomery, 2004).

Geoscientists are key providers of data for environmental management and disaster prevention because they understand relevant deep earth and surficial processes (Schneiderman, 2000). Without denying the value of both physical and mathematical models, much of what we know about Earth is rooted in the mapping of rock and surficial materials (e.g., volcanic mudflow deposits). Such mapping, often coupled with geochronology, lets geologists infer both the spatial and temporal distribution of near-surface geologic processes over millennia.

This paper presents a different way of looking back through time and space to understand both the style and tempo of landscape change. Here, we show that a searchable archive of historical images can be used to understand the distribution of surface processes and landscape characteristics. By examining cultural features and actions, we can infer how societal changes have shaped landscapes as well as how landscapes have shaped societies. Our approach is applicable over much of the past 200 years, providing a bridge between short-term instrumental records and geologic techniques that are often more useful over longer time frames. The approach we lay out could easily be applied to different questions in a wide variety of tectonic and climatic zones.

## THE LANDSCAPE CHANGE PROGRAM VIRTUAL ARCHIVE

The Landscape Change Program is a community archive containing more than 10,000 images of Vermont landscapes from before 1810 to the present. It is freely available at http://uvm.edu/perkins/landscape. Each image in the archive is key-worded, and more than 60% of the holdings are now described in detail, allowing efficient online searching of the archive. More than half the images are dated to the year and >98% are located to the town level. The earliest images are drawings; the first reliably dated photographs are from the 1850s. As of January 2005, the number of dated images in the collection increases exponentially between 1810 and 1910, peaks in the 1920s, and then declines. Nearly 600 images have been rephotographed since the year 2000, providing a contrasting view of earlier landscape imagery. The distribution of images over time reflects both the mid-1800s' popularization of photography and the particular archives from which many of the images were acquired: a collection of stereoviews (late 1800s), the State Agency of Transportation (1910–1970), and the State Division of Tourism (1960–1970).

The Landscape Change collection is particularly rich in images of rural areas, typically underrepresented in many historical archives. Such images typically show subjects of interest to natural scientists. For example, by late 2004, the archive contained >400 images of rivers, >340 images of eroding hillslopes, >660 images of floods and flood damage, >200 images of quarrying and mining, >1000 images of bridges, and >3000 images of roads (Fig. 1).

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Figure 1. Images from the Landscape Change Program archive depicting landscape features, changes, and processes of interest to geoscientists. (A) Photograph of a large landslide that occurred in Burlington, Vermont, in December 1955. Slide is in glacial-lacustrine and glacial-marine silt and clay and was triggered by a leaking drain pipe. LS01781, image property of Bailey Howe Library, Special Collections, University of Vermont. (B) Hand-colored lanternslide of a horse and buggy on a washed-out road in St. Johnsbury, Vermont, 1914. LS06469, image property of Vermont State Archives. (C) Quarrying marble, West Rutland, Vermont. Stereoview shows structure of rock in high wall of quarry. LS05073, image property of Bailey Howe Library, Special Collections, University of Vermont. (D) Photograph showing erosion undercutting railroad tracks in Barton, Vermont, after 1927 flood of record. Slopes above tracks are unvegetated and failing. LS02477, image property of Old Stone House Museum.

Vermont has an exceptionally strong, town-centered governmental system, which favors the preservation of imagery at a local level in town halls and historical societies. Thus, both Vermont and the Landscape Change Program archive have exceptional documentation of major cultural transitions (forest clearance, industrialization, suburbanization, and road building) stretching back two centuries. It is these changes that have shaped both today's landscape and society as we know it. In many ways, Vermont is also physiographically representative of much of the United States, a humid, temperate sample of America where metamorphic, sedimentary, and igneous rocks crop out both in rugged mountains and flat-lying low lands.

## PHOTOGRAPHS AND GEOLOGY

Many kinds of scientific analysis and hypothesis testing can be done by looking back in time using images. Indeed, rephotography is a powerful way by which to study landscape change (Rogers et al., 1984), both physical (Harrison, 1950) and ecological (Hart and Laycock, 1996). Some of the earliest photographic documentation is that of G.K. Gilbert, who set up marked stations to document change in glacier extent over time (Gilbert, 1904). His well-documented sites can still be located and, together with his original images, have been used to show the dramatic shrinkage of small alpine glaciers over the past century (Harrison, 1974).

Some geologic studies use a few historic images. For example, the stripping of trees and consequent landscape response in Colorado is documented and quantified by a series of images taken over a 115-year period (Graf, 1979). These images were used along with hydraulic models to explain the distribution of stream incision over time and space. This and many other previous uses of historic imagery have focused on western North America, often concentrating on important natural areas photographed by early explorers (Griffiths et al., 2004; Meagher and Houston, 1998; Stephens and Shoemaker, 1987; Webb, 1996).

Other studies use many images. Meagher and Houston investigated primarily biologic change in Yellowstone through image comparisons from two or three different time periods, usually the late 1800s, and before and after the 1988 fire. Webb's interest is more geologic, as he investigated a century of change in the Grand Canyon by rephotographing images of the Stanton Expedition a century later. Both Webb (1996) and Meagher and Houston (1998) summarize changes in tabular form, and Meagher and Houston go on to do statistical analysis. The analysis of Griffiths et al. (2004) goes a step further. Analyzing over 1300 paired images of scenes first photographed as early as 1871, they calculate average debris-flow recurrence intervals in the Grand Canyon. Using these data, they develop a regression model suggesting where such flows are most likely to originate.

## USING A DIGITAL IMAGE ARCHIVE TO DO SCIENCE

Widespread adoption of photography in the mid-1800s generated immense numbers of images. Glass plates, negatives, or prints, whether taken of a family picnic by the river or a hotel in the mountains, include far more information and incidental detail than one might suspect, because the resolution of photographic emulsions is so high (Strausz, 2001). For example, images faithfully record in their backgrounds season, vegetation, road types and orientations, stream flows and morphology, and hillslope condition (Fig. 1). Captions and titles can provide even more information, although they may carry the subtle or not-so-subtle biases of the time (Doel and Henson, 2005). Next, we provide three examples of how a searchable Web-based archive can be used to approach scientific and land management questions by analyzing images for the details they contain.

### Erosion—The Tree Connection

Based on contemporary studies (Montgomery et al., 2000) as well as studies of geologic archives (Jennings et al., 2003), we reasoned that more erosion would be recorded in deforested than in forested Vermont landscapes. To test this hypothesis, we searched the Landscape Change Program archive using the keywords *clear-cutting*, *landslide*, and *erosion*. From the search results, we categorized images with respect to date, the amount of tree coverage, the size of the eroded area, and other landscape characteristics, including clear-cut slopes, roads, and farming.

We find an inverse relationship between landscape tree cover and the number of images showing erosion (Fig. 2A), suggesting that relationships determined by modern processes studies hold true over 150 years. Of the 342 images in the Landscape Change Program archive that show erosion, 222 had no trees or almost no trees near the eroded site (65%). Conversely, only nine images showing erosion had complete forest cover near the eroded site (3%). Smaller areas of erosion are always more common than larger areas of erosion, no matter what the tree cover. If we normalize for

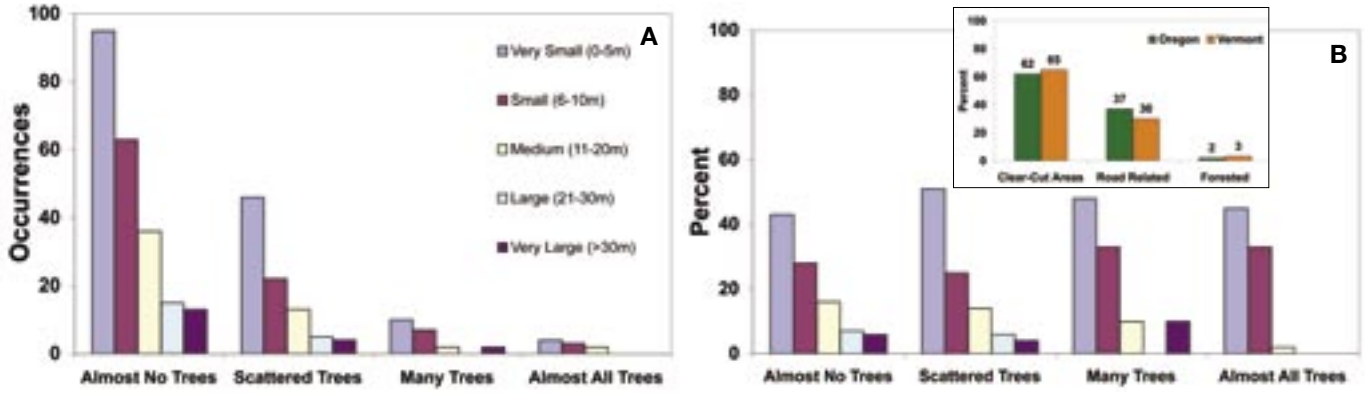


Figure 2. Relationship between tree cover category, erosion, and estimated width of eroded area. (A) Areas of erosion (all width classes) are most common in images with few trees and least common in images with full tree cover. Color key indicates approximate width of eroded area. (B) When normalized for the number of images showing erosion, the size distribution of eroded areas does not depend on the amount of forest cover (i.e., there are fewer large areas of erosion and more small areas of erosion independent of the number of trees on the landscape). Inset compares percentage of images showing erosion classified by land-use/cover classes (Vermont historical image analysis) to percentage distribution of erosion by land-use/cover in Oregon after the intense 1996 storm cycle (Association of Forest Service Employees for Environmental Ethics, 1996). In both studies, the presence of roads and the absence of trees are correlated with erosion.

the frequency of erosion in each tree cover class, the size distributions of erosion areas are similar (Fig. 2B).

From the analysis of these images, we conclude that the removal of woody vegetation from Vermont slopes increased the frequency of erosion. This finding echoes contemporary studies done in the Pacific Northwest (Montgomery et al., 2000) and provides additional support for the suggestion, based on analysis of alluvial fan and lake sediment archives, that New England landscapes eroded rapidly in response to settlement and continued land clearance through the nineteenth century (Bierman et al., 1997; Jennings et al., 2003; Noren et al., 2002). Photographic data from Vermont, spanning nearly 150 years, clearly indicate where, and thus why, such erosion happens (Fig. 2, inset). People catalyze erosion by clearing slopes and building roads (Wemple et al., 2000).

Simple, infinite slope, force-balance models for shallow planar landslides suggest one process by which removal of trees reduces slope stability (Montgomery et al., 2000; Roering et al., 2003). Measurements suggest that tree roots provide 1–12 kPa of effective cohesion (Selby, 1993). Although these values are only a small portion (<1%–30%) of the cohesion (Selby, 1993) of glacial clay (30–70 kPa) or till (150–250 kPa), so common in New England, calculations show that tree roots provide just enough cohesion to hold steep (25–35°), sandy slopes together and thus prevent shallow landsliding during saturated conditions for low cohesion materials such as sand (Fig. 3). Many nineteenth century images show shallow planar landslides on steep, deforested, sandy Vermont hillslopes (e.g., Fig. 4), landsliding we attribute to the loss of effective root cohesion. The process is simple. People clear trees from

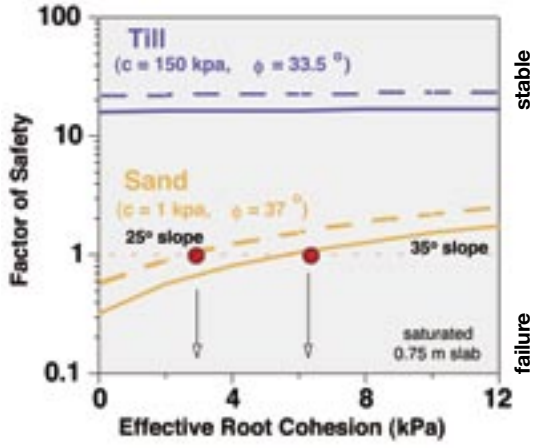


Figure 3. Results of infinite slope stability model. Slopes will fail if factor of safety drops below 1. Till slopes (25° = dashed line and 35° = solid line) have large factors of safety even when saturated and do not fail. Sandy slopes, with little or no cohesion (c), require only the modest effective cohesion provided by tree roots (3–6 kPa) to remain stable when saturated on 25° (dashed line) to 35° slopes (solid line). Red dots represent onset of stable conditions; factor of safety (resisting/driving force) = 1.

Figure 4. View of clear cut area, Champlain Spring, Highgate, Vermont, late 1800s. In the background are landslides on a steep, cleared slope. Field work suggests failures are in silty, fine sand, glacial lake deposits of the Champlain lowland. These shallow planar slides were likely catalyzed by loss of effective root strength after clear-cutting of the slope (see Fig. 3). In the middle ground are many stumps and much slash, the remains of cutting second-growth timber. There is a spring house at the center of the image. Note the tremendous size of the stump on which the man is sitting; it is likely all that remains of the old growth, pre-settlement forest that once covered Vermont lowlands like this. Image property of University of Vermont, Special Collections, Bailey Howe Library (LS03668).

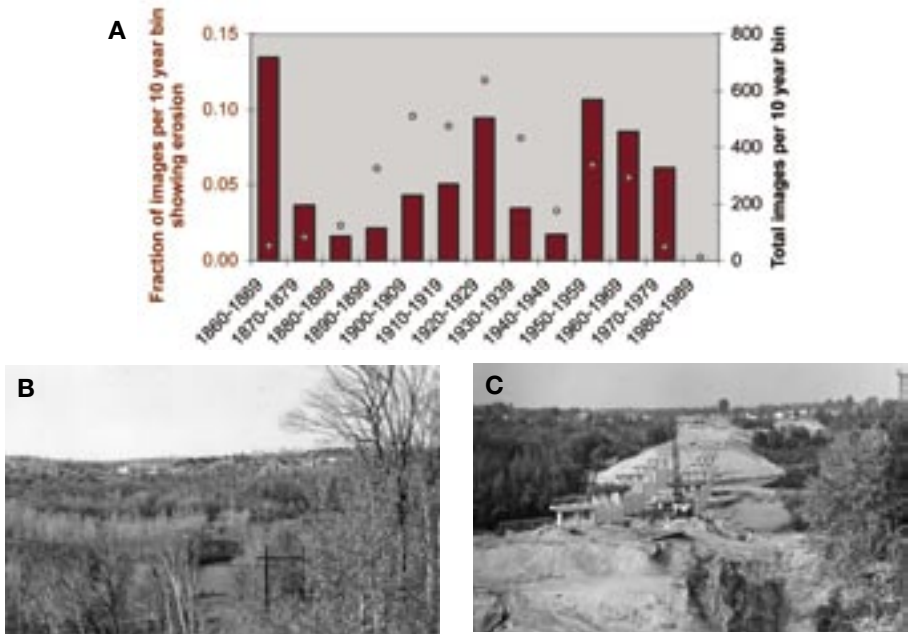


Figure 5. The frequency of images showing erosion has changed over time. (A) Percentage of images in the archive (binned in 10 yr intervals) that show erosion. Open circles show total number of images per bin. (B) Photograph (May 11, 1961) of South Burlington before interstate construction showing wooded slopes above Winooski River. (C) Same view as B but during construction of I-89 (Oct. 10, 1961), showing scale of disturbance and erosion related to road building. Images by D. Wiedenmayer; property of Vermont State Archives.


Figure 6. Examples of riparian zone images used to calculate riparian buffer quality index. (A) Category 1 (score = 1 pt): no riparian buffer. Montpelier, Vermont (LS04060; no date). View across the Winooski River from a farm field. Note large glacial erratics in foreground. Image property of Vermont Historical Society. (B) Category 2 (score = 2 pt): ≤50% riparian buffer. Barton, Vermont (LS03795; no date). Image shows a bend in a river with complete riparian buffer on the left and no buffer on the right. Grazing cows on the cleared bank keep pasture open. Image property of Old Stone House Museum. (C) Category 3 (score = 3 pt): >50% riparian buffer. Bolton, Vermont (LS06204; 1960). Oblique aerial photo shows the construction of I-89 at Bolton flats. Winooski River at right. Farms and fields in the valley bottom with extensive riparian buffer. Image property of Vermont State Archives. (D) Category 4 (score = 4 pt): 100% riparian buffer. Hartford, Vermont (LS01482, 2004). A full riparian buffer is present along both sides of the Connecticut River.

slopes and keep the slopes clear for grazing, preventing regrowth of new trees and new roots. Once the old roots rot or the stumps are pulled, root strength is gone, and the treeless hillslopes are primed for failure, awaiting only a storm large enough to saturate the ground (D'Odorico and Fagherazzi, 2003).

The distribution over time of images depicting erosion reveals relationships to both significant natural and human events and suggests the influence of major cultural transitions. The frequency distribution of erosion images has three peaks (the 1860s, the 1920s, and the 1960s; Fig. 5A). The first peak just predates maximum land clearance in Vermont. The second peak is coincident with the 1927 flood of record, and the third peak occurs during construction of the interstate highway system. Broader cultural changes also influence the timing of erosion maxima. The steady rise in the frequency of erosion images from 1900 to 1930 probably reflects the advent of the automobile and the road building and improvement that followed. Similarly, we suspect that the rapid rise in erosion frequency after 1960 and the slow decline thereafter reflects the massive land disturbance occasioned by building the interstate highways (Fig. 5B and 5C).

## Riparian Buffers—Coming Back

Riparian buffers, the woody vegetation found along streams and rivers, serve a number of important roles, including stabilization of stream banks, moderation of stream flow, provision of habitat, and recruitment sources for large woody debris (Abbe and Montgomery, 1996; Wagner, 1999). Buffers are often destroyed by agriculture and forestry practices (Robbins, 1997) as well as by residential development. Although riparian zones are the focus of extensive protection and restoration efforts (Langston, 2003), there appears to be little documentation of how the extent of buffers has changed over decadal timescales.

We analyzed over 400 photographs of streams and rivers from the Landscape Change Program archive to determine how the continuity of woody riparian buffer vegetation changed over the past 150 years. To quantify change over

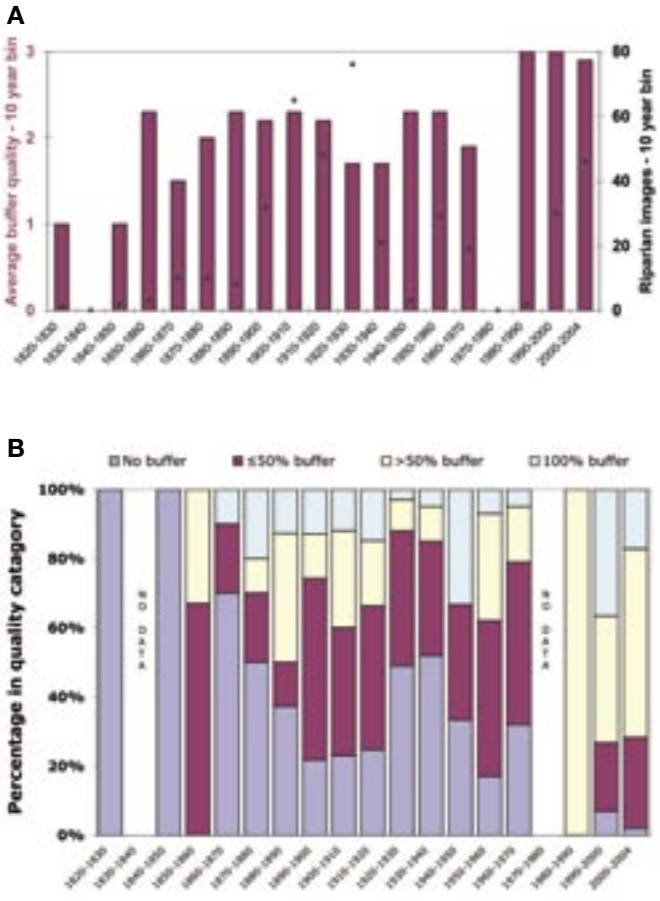


Figure 7. Riparian zone quality has changed over time. (A) Between 1850 and 1970, the average riparian zone quality index (shown by plum bars) varied between 1.5 and 2.3; after 1980, the index rises to ~3. Black circles indicate number of images analyzed per 10 yr bin. Riparian images not available for times with no data. (B) The distribution of riparian zone quality in Vermont has changed through time. The prevalence of river margins with no buffer decreased between 1850 and today. In the past 25 yr, the prevalence of river margins with >50% tree cover has increased.

time, we defined a riparian buffer quality index, in which images showing no buffer (Fig. 6A) were assigned to category 1 (and given a score of 1). Images showing a fully forested buffer along the river or stream banks were assigned a rank and score of 4 (Fig. 6D). Sorting the images by decade, we calculated an average quality index for every 10 yr interval (Fig. 7A).

Dozens of nineteenth century images document riparian zones along Vermont streams with little or no buffering by woody vegetation. Similar impacts on riparian zones from settlement, agriculture, mining, and forestry practices in the 1800s and early 1900s have been noted in the Pacific Northwest (Langston, 2003; Robbins, 1997; Taylor, 1999). The continuity of vegetated, riparian zone buffers along Vermont streams and rivers has improved over time; specifically, the prevalence of river margins with no buffer at all (category 1) decreased over the past 150 years (Fig. 7B). The decrease in completely cleared riparian zones may reflect the move away from wood as both a source of energy and as the dominant structural material for building and fencing (Robbins, 1997).

From 1850 to 1970, the average riparian buffer quality index we defined varied between 1.5 and 2.3 with no trend. After 1980, the average rose and remained at ~3, a substantial increase (Fig. 7A). This step-function increase in the riparian vegetation quality index occurred during the 1980s, ~20 years after community forests were planted, the environmental movement started, and the decline of the Vermont dairy farm began. In the past 25 years, the prevalence of river margins with greater than 50% tree cover has also increased. A similar trend of recently increased riparian vegetation has been identified by analyzing >3000 repeat photography images from the southwestern United States (Webb and Leake, 2005).

The in-stream effects of increasing riparian zone vegetation could be significant. Although it may not be possible to tease apart the effects of changing sediment delivery over time related to reforestation (Trimble, 1999) and watershed development (Wolman and Schick, 1967), the increase in riparian buffer zone continuity over time is likely to affect channel geometry, including width and depth (Hession et al., 2003; Trimble, 1997), as well as improve aquatic ecosystem function (Sweeney et al., 2004).

## Characterizing Flood Effects

In 1927, a November flood, with peak flows typically two times higher than other recorded events, struck Vermont (http://www.uvm.edu/perkins/landscape/1927_flood/flood.htm). The flood destroyed more than 1000 bridges and caused significant channel change and channel bank erosion. October 1927 had been very wet, leaving soils saturated. The storm dropped up to 22 cm of rain in central Vermont, with at least 12.5 cm falling over most of the state (National Weather Service, 2002). Within days of the devastating flood, the U.S. Army flew over Vermont, photographing the damage. Of the 90 images taken, 67 are extant. During the summer of 2004, these 67 historical images were rephotographed to show the changes in riparian corridors, development, and channel characteristics. We also examined hundreds of ground-level images taken both during and after the flood. Many of these images allow identification of flood heights; river stage determined this way is a valuable tool for flood hazard evaluation.

Modern rephotography of flood and post-flood aerial images allows us to quantify changes that have occurred since 1927 (Fig. 8). Examination of the 67 pairs of aerial images shows that between 1927 and 2004, forest cover increased in 70% of the images, new roads were built in almost 60%, development altered the landscape in almost 50%, and vegetation cover in riparian zones increased in over 60% of the images. These changes have differing effects on surface water hydrology, with reforestation tending to reduce peak flows and storm flow volumes, whereas development and road building both tend to increase runoff and storm peaks (Dunne and Leopold, 1978). The increase in riparian zone cover is consistent with the data from ground photos (Fig. 7).

## IMPLICATIONS

The rapid expansion of the World Wide Web, and the consequent ability of anyone to find and analyze large numbers of images, opens up a new way of looking at landscapes over space and time (see GSA Data Repository Item Table

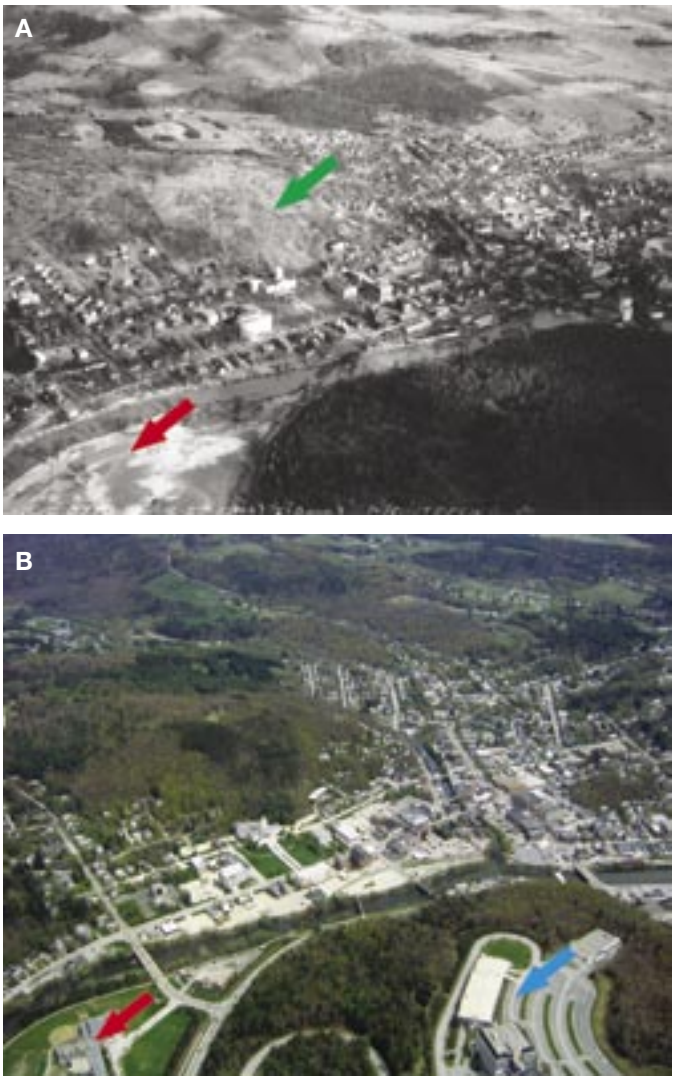


Figure 8. Paired oblique aerial images of Montpelier including the Winooski River. (A) Photograph from several days after the 1927 flood shows overbank deposits alongside the channel and over point bars (red arrow). Much of the hills remain deforested, including the area behind the Vermont State House (green arrow). All bridges over the river have been destroyed. LS01429, image property of Special Collections, Bailey Howe Library, University of Vermont. (B) Similar view photographed in summer 2004. Significant reforestation has covered many slopes with trees. A high school now occupies the point bar (red arrow) and forest cover in the lower right is broken by parking lots and a large office complex (blue arrow). Bridges again cross the river and the riparian zone is better vegetated. (C) Characterization of image pairs (n = 67) showing percentage in which characteristics studied (forest cover, development, riparian cover, and roads) either remained similar (no change) or increased.

DR1[1] for examples of online image archives). In this paper, we present several examples of science that can now be done because such image archives exist. Without the ability to study at least hundreds of relevant images, results such as those we present would have little statistical significance.

As online archives grow in popularity and size, similar types of analyses should be feasible all over the world, with increasing statistical power as sample sizes grow larger. The range of image-based, interdisciplinary research projects that can be undertaken will increase. Images could be used to examine tree species distribution over time in response to landscape disturbance (Cogbill et al., 2002), link landscape disturbance to changing settlement dynamics (Wessels, 1999), and find long-ago-demolished gasoline stations to map the distribution of environmentally hazardous, abandoned underground storage tanks (Vermont Agency of Natural Resources, 2004, personal commun.).

The approach we describe here could be replicated in other physiographic provinces and climatic zones. Research questions would differ in arid, tropical, or subpolar regions, and the length of the photographic record varies from place to place, but much of the world has archives of landscape images. These images, as they move out of attics, onto the Web, and into the hands of natural scientists and others, have many important geologic, environmental management, and ecologic stories to tell. The impact of such research could be very broad, encompassing related disciplines such as historical ecology (Cronon, 1983; Russell, 1998) and the historical evolution of human-landscape interaction over time (Nash, 1967).

## ACKNOWLEDGMENTS

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[1]GSA Data Repository Item 2005065, Table DR1, Examples of online image archives potentially useful for geologic analysis, is available on request from Documents Secretary, GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA, editing@geosociety.org, or at www.geosociety.org/pubs/ft2005.htm.

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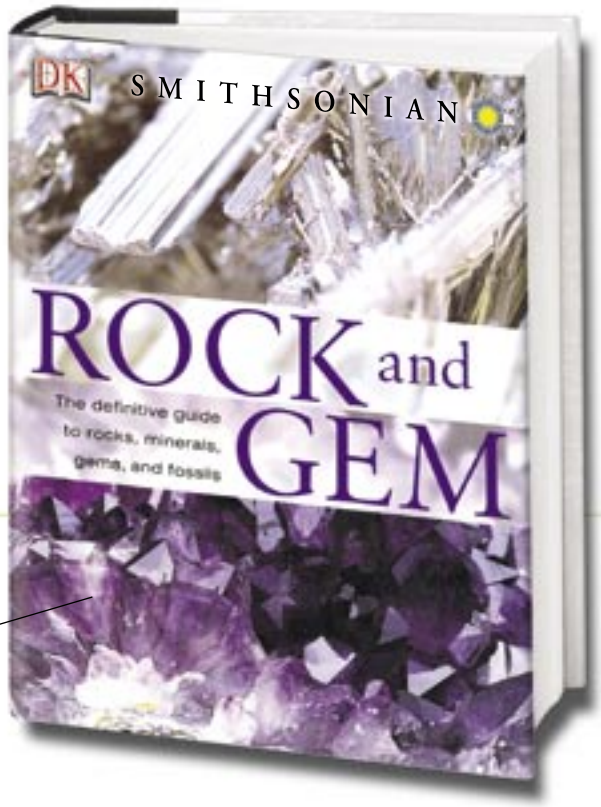


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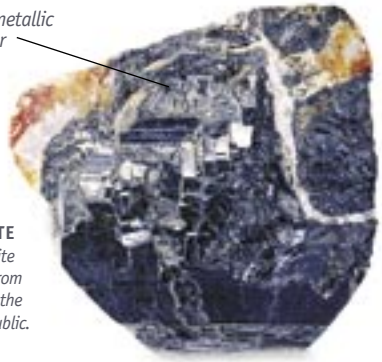

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# Letter

Dear Editor,

In the October issue*, Paul Renne and Igor Villa urge the GSA to abandon what they feel is unofficial (non-SI [Sisteme International]) usage to express "time differences" (millions of years) as opposed to ages (Ma or million anna). They are confusing intervals with points. A physical analogy is mileposts. Each carries a number chosen to identify the post and to coincide with a distance from a chosen point measured in SI units (kilometers). Similarly, anna are not units but designators of points in time (events). For obvious utility, they are chosen to also designate an interval of years from a chosen point, the present. It is meaningless to subtract one point value from another to obtain an interval.

As for the SI definition, the supplementary, widely used English unit is the year, annum being only the Latin equivalent. The year is defined relative to the SI second but also, especially for geological processes, astronomically. Although the astronomical year likely varied over geological time, making the exact link between the present year and those in the distant past imprecise, for most practical purposes this can be ignored.

The traditional bipartite usage thoroughly embedded in the English geological literature suggests that retaining it would minimize confusion and retain the necessary distinction between points and intervals.

Sincerely,
Andrew V. Okulitch, Emeritus Scientist
Geological Survey of Canada

*October 2004 *GSA Today*, v. 14, no. 10, p. 62

Send letters to *GSA Today*, P.O. Box 9140, Boulder, CO 80301-9140, USA, or to kasmus@geosociety.org. Please keep your letter to 300 words or fewer. *GSA Today* reserves the right to edit for length and/or to publish letters online at www.geosociety.org/pubs/.

# STUDENTS—Mark Your Calendars!

**Students:** Plan now to attend a Shlemon Mentor Program and/or a Mann Mentor Program in Applied Hydrogeology at your 2005 Section Meeting to chat one-on-one with practicing geoscientists. These volunteers will answer your questions and share insights on how to get a job after graduation. When programs are scheduled for multiple days, each day's program will offer a different set of mentors.

**FREE LUNCHES** will be served (students only) at the Shlemon Mentor Programs. Students will receive a **FREE LUNCH** ticket, along with their registration badge, to attend each Shlemon Program. However, space is limited. First come, first served.

And, it gets better: **FREE light suppers** will be served (students only) at the Mann Mentor Programs. The **Mann Programs** are specific to careers in hydrogeology; if you're interested in receiving an invitation to attend the Mann Program for a **FREE light supper** after the tech sessions end, contact Karlon Blythe, kblythe@geosociety.org. Be sure to indicate which Section Meeting you plan to attend.

# Mentor Programs for the 2005 Section Meetings

FOR LOCATIONS OF PROGRAMS, ASK AT THE ON-SITE GSA REGISTRATION DESK.

### CORDILLERAN SECTION MEETING

San José, California
SHLEMON MENTOR LUNCHEON PROGRAMS:
Fri. and Sat., April 29–30, 11:30 a.m.–1 p.m.

MANN MENTORS IN APPLIED HYDROGEOLOGY PROGRAM:
(by invitation; contact kblythe@geosociety.org)
Fri., April 29, 5–6:30 p.m.

### NORTH-CENTRAL SECTION MEETING

Minneapolis, Minnesota
SHLEMON MENTOR LUNCHEON PROGRAMS:
Thurs. and Fri., May 19–20, 11:30 a.m.–1 p.m.

MANN MENTORS IN APPLIED HYDROGEOLOGY PROGRAM:
(by invitation; contact kblythe@geosociety.org)
Thurs., May 19, 5–6:30 p.m.

### ROCKY MOUNTAIN SECTION MEETING

Grand Junction, Colorado
SHLEMON MENTOR LUNCHEON PROGRAMS:
Mon. and Tues., May 23–24, 11:30 a.m.–1 p.m.

MANN MENTORS IN APPLIED HYDROGEOLOGY PROGRAM:
(by invitation; contact kblythe@geosociety.org)
Mon., May 23, 5–6:30 p.m.

For more information contact kblythe@geosociety.org

# Call for Nominations: Fourteenth Annual Biggs Award

**for Excellence in Earth Science Teaching for Beginning Professors**

The Biggs Award was established by GSA to reward and encourage teaching excellence in beginning professors of earth science at the college level.

## Eligibility

Earth science instructors and faculty from all academic institutions engaged in undergraduate education who have been teaching full-time for 10 years or fewer. (Part-time teaching is not counted in the 10 years.)

## Award Amount

An award of $750 is made possible as a result of support from the Donald and Carolyn Biggs Fund (maintained by the GSA Foundation), the GSA Geoscience Education Division, and GSA's Education and Outreach Programs. In addition, this award also includes up to $500 in travel funds to attend the award presentation at the GSA annual meeting.

## Deadline and Nomination Information

Nomination forms for the 2005 Biggs Earth Science Teaching Award are posted at www.geosociety.org/aboutus/awards/biggs.htm. Or, contact Diane Lorenz, (303) 357-1028, awards@geosociety.org. Nominations must be received by **May 1, 2005.**

**Mail nomination packets to:**
Diane Lorenz
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# Greetings from Capitol Hill!

## Final Report: 2003–2004 Congressional Science Fellow

*Michèle Koppes*

### Threading Science through the Needle of Politics: Lessons Learned from the Hill

My congressional science fellowship ended this past December with the conclusion of the 108th Congress. Although I am no longer a first-person observer of the political process, the lessons I learned from my time in "the belly of the beast," so to speak, were invaluable. I took this fellowship because I was interested in how science was being used in federal policymaking and to understand how researchers might better communicate their work to lawmakers. These issues had been on my mind for many years owing to my research focus on glacial dynamics and its contribution to understanding global climate change. Thanks to GSA and the U.S. Geological Survey, I am gratified to have seen firsthand the application of science in the policy process, and on several occasions, witnessed scientists effectively communicate the relevance of their work to the political debate.

I spent my fellowship year in the office of Rep. Jay Inslee, who represents the 1st District of Washington State. Congressman Inslee, newly reelected to his fifth term in Congress, is considered on the far left of the political spectrum today. Though his office had never taken on a congressional fellow before, I was drawn to his office by his interest in science and in divorcing data from politics. More importantly, I would have the opportunity to work with him closely on environmental and energy issues pertaining to the House Resources Committee on which he sits. The Resources Committee has oversight over all agencies in the Department of the Interior, including most of the agencies interested in the geosciences such as the U.S. Geological Survey, Bureau of Land Management, U.S. Forest Service, and National Park Service. I looked forward to the opportunity to see the earth sciences applied to debate and decision-making in the committee hearings, as well as the opportunity to question representatives from the various agencies directly about policy proposals and budgets.

Contrary to my expectations, however, many of the issues that came up in relationship to the environment and natural resources during the 108th Congress came through proposed actions and executive orders from the administration rather than through legislation debated by the House Resources Committee. Some examples of these actions include a repeal of the Roadless Rule to require state governors to petition the Forest Service to protect federal forests in their states from new road building, the grounding of long-range tanker planes used by the Forest Service for fighting wildfire from the air, revised National Oceanic and Atmospheric Administration policies for the designation of several species of hatchery salmon as identical to their wild counterparts, revised mitigation strategies for fish passage around federal hydropower dams on the Columbia and Snake Rivers, and plans to open the National Petroleum Reserve in Alaska for development. These quite substantive actions were not debated by Congress or the Resources Committee; rather, they were published with provision for public comment in the Federal Register. In several cases, the proposed actions were opposed by many of the scientists working within the federal agencies that would be subjected to the rule change. In response to these executive orders, members of Congress have the recourse to draft legislation or, like every other citizen, write letters to the administration in support of or opposition to the proposed action. I spent a good part of my time on Capitol Hill composing letters to the White House to express the sentiment of Congressman Inslee regarding these proposed policies.

With the exception of policy driven by executive order, I had the opportunity to sit in on all Resource Committee hearings, briefings, and behind-closed-door negotiations, seeing first-hand both the making of policy and the politics that drive most legislative agendas. One of the most interesting political debates I participated in was the closed-door deliberations over the Wild Sky Wilderness Act, which came up for a hearing in the Resources Committee. Wild Sky is a proposed wilderness area in western Washington whose unique attributes include swaths of low-level temperate forest in the valley floors (i.e., prime timber harvest areas) and proximity to the two million people who reside in Puget Sound. Though the bill had passed the Senate twice in the previous two years and had a groundswell of support in Washington State, it became caught in the political crossfire between the bill's sponsors and the chairman of the Resources Committee over personal interpretations of the 1964 Wilderness Act, in particular over the definition of what constitutes land "untrammeled by man" that could be proposed for wilderness designation (Wild Sky includes many low-lying areas that had been logged at the turn of the century). Congressman Inslee was particularly concerned with including the low-level valley floors in the wilderness area for the protection of aquatic habitat (particularly salmon spawning grounds, the great emblem of the Pacific Northwest), protection of water sources from soil influx due to erosion of logging roads, and protection of old growth forest for wildlife habitat. Arguments for the ecological merits of the region, however, took a back seat to the debate over what constitutes a human legacy in the landscape. Unfortunately, the legislation suffered the additional crossfire of being used as a campaigning tool by both Rep. George Nethercutt and Sen. Patty Murray in the race for the state senate seat and was ultimately not brought to a vote due to its political ramifications in the upcoming election.

In his first term in Congress in 1992, Congressman Inslee represented the 4th district of Washington east of the

Cascades, which encompasses the Hanford Nuclear Reservation, the Department of Energy (DOE) site where the original plutonium atomic bombs were manufactured. As the resident congressional representative, he became heavily involved in issues of nuclear safety, worker safety, and waste clean-up at Hanford, as well as other DOE sites, and has continued to be vocal on nuclear waste issues since. One of my first tasks was to draft amendments and colloquies in opposition to DOE efforts to reclassify high-level nuclear waste as lower level waste for the purposes of expediting required clean-up efforts at federal nuclear sites (and thereby reducing the amount of waste slated to be vitrified and sent to Yucca Mountain). I was also tasked with drafting amendments to prevent the DOE from continuing its practice of dumping low-level and mixed low-level nuclear waste in unlined soil trenches at the Hanford site. Hanford continues to be one of the most contaminated Superfund sites in the country, with the very real danger of a contaminated groundwater plume of high toxicity migrating toward the Columbia River. The clean-up process is so complex, in part due to lack of record-keeping at the dawn of the nuclear era, and due to the numerous parties involved in the clean-up (primarily the DOE, the EPA, and the state of Washington), that continuous and solid oversight remains elusive.

One other reason I was eager to work for Congressman Inslee was his interest in climate change and the potential ramifications of global warming on biodiversity and geopolitics. During my tenure on the Hill, Congressman Inslee helped introduce the Climate Stewardship Act in the House (originally introduced by Senators McCain and Lieberman in the Senate), a bill to cap greenhouse gas emissions at 2000 levels by 2010 through a market-based system of tradable allowances. In working on this issue for the congressman, I was party to strategy sessions among the cosponsors in the House and Senate as well as environmental lobbyists working on emissions issues to promote the legislation in both houses of Congress. The goal was to get a sufficient number of sponsors to sign on to the legislation in order to pique the interest of the appropriate committee chairmen and party leaders to get the bill a hearing in committee and a vote on the floor. While the findings of the Intergovernmental Panel on Climate Change (IPCC) had previously been introduced to the Hill on several occasions, and the administration had developed the Climate Change Science Program (CCSP), whose findings of contemporary change and potential impacts continued to be disseminated in Congress, many members of Congress were reticent to consider any legislation to curb greenhouse gases given the political outcry over the Kyoto Protocol. New strategies to start the discussion included tailoring studies of the regional and local impacts of climate change, the economic impacts and the benefits of early adoption of technologies for the industrial sector, and the impacts of climate change on particularly vulnerable social groups to share with individual members of Congress and their staff.

The one take-home message from my time in Congress is the extent to which science is being politicized on Capitol Hill. Nowhere was this more evident than in the climate change debate, where efforts by scientists to communicate to Congress advances in the understanding of climate change have been obscured by policymakers, lobbyists, and some scientists themselves into two polarized camps: those who claim that current climate change

is insignificant or of non-anthropogenic origin and those who predict a high potential for irreversible, abrupt climate change in the near future and advocate a precautionary approach to anthropogenic contributions. Unfortunately, these perspectives are becoming increasingly entrenched on Capitol Hill, with new research only being disseminated on the Hill to support the argument of one camp or the other. The polarization manifests itself as a battle of competing hearings and briefings for congressional staff, organized on one hand by the Energy & Environment Institute (lobbying for advocates of climate change policy, in particular adopting the Climate Stewardship Act in the House and Senate) and sponsored by Senator McCain and the Congressional Climate Caucus, and on the other hand by the George Marshall Institute and the Cooler Heads Coalition, lobbying for additional research for and a less fatalistic view toward regulated anthropogenic contributions to global warming, supported by Senator Inhofe. The briefings are highly distilled showdowns of the debate occurring in the scientific literature, packaged to promote the personal agenda of the "camp" that sponsored the briefing.

Such polarization reflects the importance of the need for scientific representation in the debate, and more importantly, the policymakers' understanding of the semantics of scientific uncertainty. It is my belief that scientists are one of the most underrepresented groups in Congress. Without a messenger, the scientific data are often lost to those who would be able to use it most in decision-making. Scientists are professionally trained to analyze, not advocate, and are often wary of the fine line to be crossed between the two. Unfortunately, the lack of advocacy for the importance of science in general and for particular findings of social importance manifests itself as decreased federal funds being allocated to the National Science Foundation, the U.S. Geological Survey, and the National Institutes of Health. To prevent such funding shortfalls, there is a need to sell the value of science to both the public and directly to those who set federal budget and scientific priorities. For earth scientists, sometimes this means marketing our assets in the face of large natural and humanitarian disasters, such as the recent tsunami in the Indian Ocean, the earthquake in Iran in 2003, the recent landslides in California, or the floods in the Midwest. These, unfortunately, are the best times to lobby for funding the geosciences at all levels, while the consequences of geologic hazards are in the news and on the radar screen of lawmakers who are poised to take preventive action.

There are many in the federal government who, like Congressman Inslee, see the value in promoting and using science in formulating sound economic and social policies. They need the scientists' help, however, in understanding the data outside of the political lens through which much of the information is transmitted to the Hill. They also need our backing in raising their voices in support of science amidst the constant clamor of the federal government. Although there are a number of professional societies that support congressional science fellows and congressional visits each year, there are yet many more congressional offices whose only link to the scientific community is through the voices of their constituencies.

*This manuscript is submitted for publication by Michèle Koppes, 2003–2004 GSA–U.S. Geological Survey Congressional Science Fellow, with the understanding that the U.S. government is authorized to reproduce and distribute reprints for governmental use. The one-year fellowship is supported by GSA and by the U.S. Geological Survey, Department of the Interior, under Assistance Award No. 02HQGR0141. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. government. Koppes can be reached at koppes@u.washington.edu.*

# 2005 GSA Section Meetings

**CORDILLERAN SECTION**
(*Joint meeting with American Association of Petroleum Geologists*)
April 29–May 1, 2005
Fairmont Hotel, San José, California
**Information:** Jonathan Miller, San José State University, Department of Geology, 1 Washington Square, San José, CA 95192-0102, (408) 924-5015, jsmiller@email.sjsu.edu

**NORTH-CENTRAL SECTION**
May 19–20, 2005
University of Minnesota, Minneapolis, Minnesota
**Information:** Carrie Jennings Patterson, University of Minnesota, Minnesota Geological Survey, 2642 University Ave. W., St. Paul, MN 55114-1032, (612) 627-4780, ext. 220, carrie@umn.edu, or Barbara Lusardi, University of Minnesota, Minnesota Geological Survey, 2642 University Ave. W., St. Paul, MN 55114-1032, (612) 627-4780, ext. 212, lusar001@umn.edu

**ROCKY MOUNTAIN SECTION**
May 23–25, 2005
Mesa State College, Grand Junction, Colorado
**Information:** Rex Cole, Mesa State College, Department of Physical & Environmental Science, 1100 North Ave., Grand Junction, CO 81501-3122, (970) 248-1599, rcole@mesastate.edu

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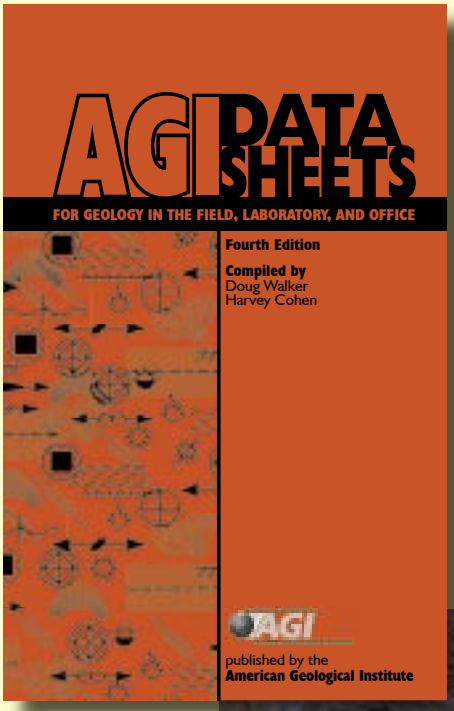


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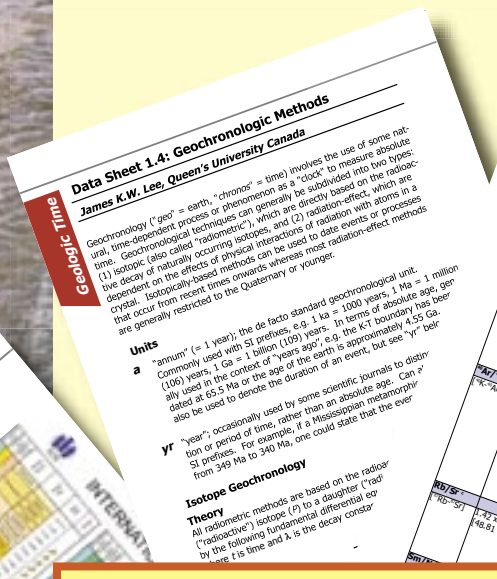


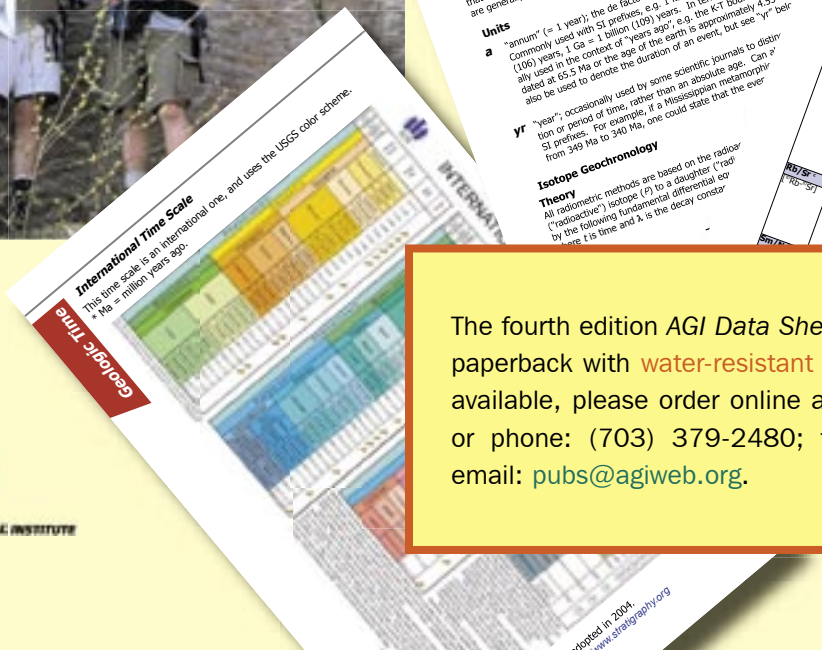


The fourth edition *AGI Data Sheets* will be spiral bound paperback with water-resistant pages, 5" x 8." When available, please order online at www.agiweb.org/pubs or phone: (703) 379-2480; fax: (703) 379-7563; email: pubs@agiweb.org.

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# Field Forum Scheduled

## Rethinking the Assembly and Evolution of Plutons: Field Tests and Perspectives

7–13 October 2005

A field excursion across the Mesozoic Cordilleran batholith from Yosemite to the White Mountains, California


Conveners:

***John M. Bartley,*** *Department of Geology and Geophysics, University of Utah, Salt Lake City, Utah 84112-0111, USA, +1-801-585-1670, jbartley@mines.utah.edu*

***Drew S. Coleman,*** *Department of Geological Sciences, University of North Carolina, Chapel Hill, North Carolina 27599-3315, USA, +1-919-962-0705, dcoleman@unc.edu*

***Allen F. Glazner,*** *Department of Geological Sciences, University of North Carolina, Chapel Hill, North Carolina 27599-3315, USA, +1-919-962-0689, afg@unc.edu*

***Aaron Yoshinobu,*** *Department of Geosciences, Texas Tech University, Lubbock, Texas, 79409-1053, USA, aaron.yoshinobu@ttu.edu*

***Richard D. Law,*** *Department of Geosciences, Virginia Tech., Blacksburg, Virginia 24061, USA, rdlaw@vt.edu*


**Description and Objectives.** The field forum will examine the geologic record of assembly of large Mesozoic granitic plutons in California, focusing on portions of the Sierra Nevada batholith in Yosemite National Park and in the John Muir Wilderness, and more scattered plutons outside of the main batholith in the White Mountains. Particular emphasis will be placed on evaluating the hypothesis that large, superficially homogenous plutons were emplaced in small increments over millions of years rather than as large molten magma bodies. Field examples will be studied in the light of complementary analytical and geophysical data and theoretical considerations, as well as for their broader implications for igneous petrogenesis, the longevity of magmatic systems, and linkage between plutonism and volcanism; for processes by which continental crust is constructed; and for interaction between tectonic and magmatic processes in orogens. The conveners invite participants concerned with all aspects of crustal magmatic processes and their spatial and temporal scales, including but not limited to petrologists, structural geologists, geochronologists, volcanologists, geodesists, seismologists, and geodynamic modelers. Our goal is to consider how better understanding of the growth of plutons can advance general understanding of igneous and tectonic processes and crustal evolution.

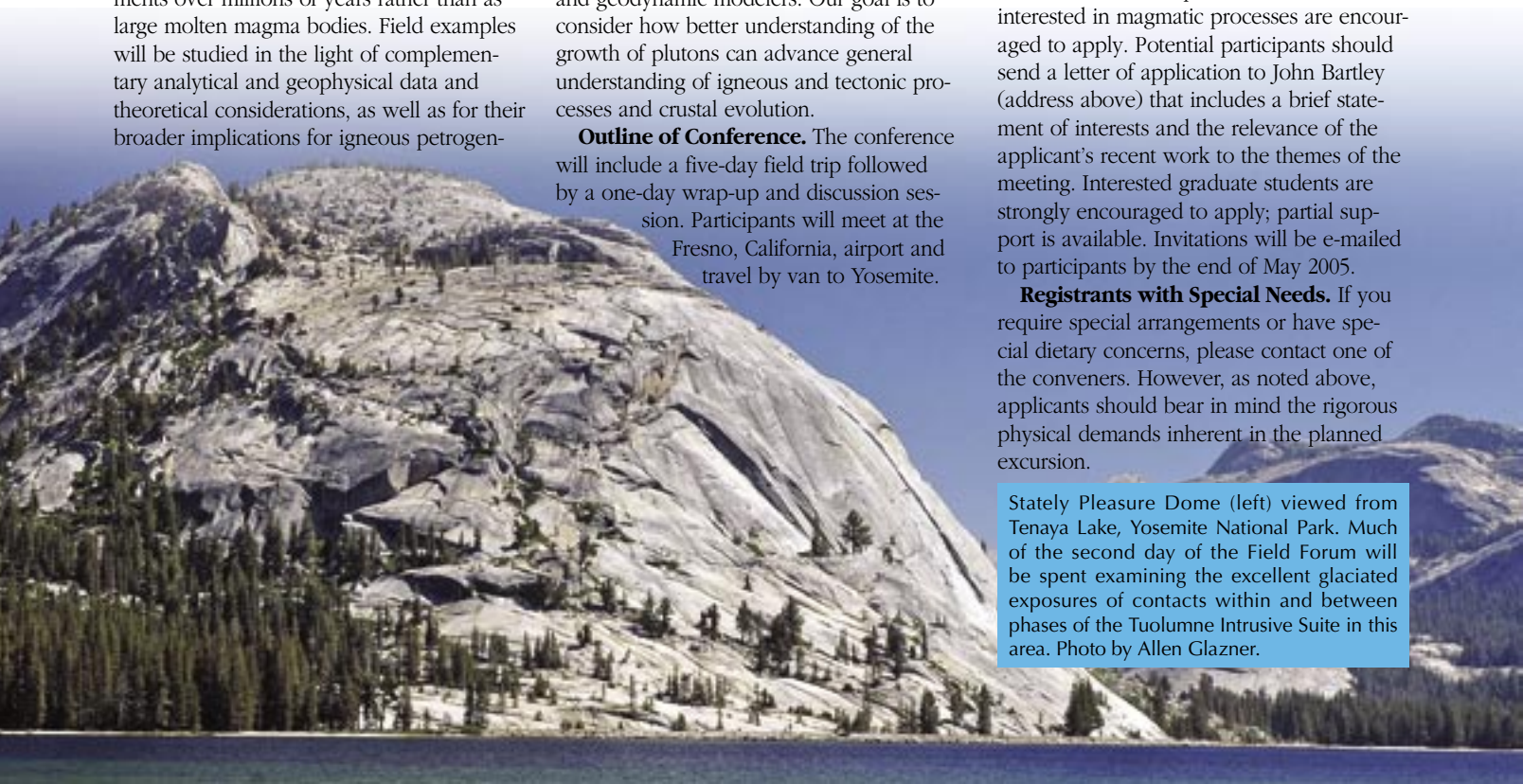
**Outline of Conference.** The conference will include a five-day field trip followed by a one-day wrap-up and discussion session. Participants will meet at the Fresno, California, airport and travel by van to Yosemite. In the first two days, we will examine the Yosemite Valley and Tuolumne intrusive suites. The next two days will be spent on full-day hiking trips to intrusions exposed on the eastern flank of the Sierra Nevada (Bishop and Big Pine creeks), and the last day in the field will be spent on intrusions in the White and Inyo Mountains east of the Sierra Nevada. The wrap-up session will be held at the Crooked Creek Laboratory of the White Mountain Research Station, which is located astride the contact of the Sage Hen Flat pluton at 10,000 ft (3000 m) elevation in the White Mountains.

**Please Note:** Days 3 and 4 of the field forum will involve strenuous trail and off-trail hiking at altitudes ranging above 10,000 ft (3000 m). The first two days will be less vigorous and at somewhat lower elevations (4000–9000 ft; 1200–2750 m), and therefore will aid in the acclimatization of participants who reside at sea level. However, excellent physical fitness that permits participants to travel safely through rugged backcountry areas at high altitude is a prerequisite for participation.

**Venue.** The first two days will be based at Curry Village in Yosemite Valley, and the remainder of the forum will be based at the Owens Valley (Bishop) and Crooked Creek facilities of the White Mountain Research Station of the University of California. The estimated registration fee of US$850 will cover transportation (including to and from the Fresno airport), lodging, meals, and guidebook.

**Application Deadline: May 6, 2005.** Geoscientists of all specializations who are interested in magmatic processes are encouraged to apply. Potential participants should send a letter of application to John Bartley (address above) that includes a brief statement of interests and the relevance of the applicant's recent work to the themes of the meeting. Interested graduate students are strongly encouraged to apply; partial support is available. Invitations will be e-mailed to participants by the end of May 2005.

**Registrants with Special Needs.** If you require special arrangements or have special dietary concerns, please contact one of the conveners. However, as noted above, applicants should bear in mind the rigorous physical demands inherent in the planned excursion.



Stately Pleasure Dome (left) viewed from Tenaya Lake, Yosemite National Park. Much of the second day of the Field Forum will be spent examining the excellent glaciated exposures of contacts within and between phases of the Tuolumne Intrusive Suite in this area. Photo by Allen Glazner.

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# GSA FOUNDATION
# A Quarter of a Century Helping GSA Serve You

**The GSA Foundation will celebrate its 25th anniversary in December 2005.**

The Foundation mission is to solicit support from individuals and institutions for programs and activities of GSA that advance the geosciences, enhance the professional growth of its members, and promote the geosciences in the service of humankind. The Foundation ensures that all gifts are used in ways consistent with donor wishes and wisely manages its resources and assets to maximize their value.

The Foundation can be successful when YOU, the members of the Society, support your professional home base with donations and pledges to the Foundation. The most important resource of the Foundation is our GSA members. Please consider donating to the level you can in this special 25th Anniversary Campaign. Honor your affiliation with this society by supporting the mechanism that helps sustain the growth and successful of GSA—the GSA Foundation.

**Please show your support to your professional GSA home and become a major contributor to the Foundation's 25th Anniversary Campaign.**

Our goal in this 25th Anniversary Campaign is $1,000,000 each year for the next five years through donations and pledges. These funds will be used to support GSA's greatest needs. The current GSA greatest needs list includes:

- Support of the GSA e-journal, *Geosphere*
- GeoCorps™ America
- Education and Outreach Programs
- Student Research Grants
- Congressional Science Fellowship
- Field Forums
- Headquarters building maintenance and remodeling
- International and domestic travel support


*Most memorable early geologic experience:*

Introduction to Arizona geology included rattlesnakes, scorpions, sullen bobcats, curious bears, and ornery mules. Ensuing stories entertained and amused the neighboring crusty but tolerant ranchers.

—Donald Peterson

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# ANNOUNCEMENTS

## MEETINGS CALENDAR

### 2005

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|---|---|
| April 17–20 | 2005 Ground Water Summit, San Antonio, Texas, USA. **Information:** National Ground Water Association, 601 Dempsey Road, Westerville, Ohio 43081-8978, USA. Phone: +1.800.551.7379 or +1.614.898.7791, fax: +1.614.898.7786, customerservice@ngwa.org. |
| April 18–20 | 2005 Digital Library for Earth System Education (DLESE) Data Services Workshop, Breckenridge, Colorado, USA. **Information:** www.dlese.org/people/dataservices/dataservices_2005_workshop.html. |
| April 24–29 | World Geothermal Congress, Antalya, Turkey. Held every fifth year. International Geothermal Association. **Information:** www.WGC2005.org. |
| May 24–28 | 51st Annual Meeting of the Institute on Lake Superior Geology (ILSG), Nipigon, Ontario, Canada. **Information:** www.lakesuperiorgeology.org/nipigon2005; contact e-mail: Nipigon2005@Lakeheadu.ca. |
| May 26–27 | Workshop: "Late Paleozoic of Western Pangea." Grand Junction, Colorado, USA. **Information:** Lynn Soreghan, University of Oklahoma, lsoreg@ou.edu, or Chuck Kluth, Colorado School of Mines, ckluth@mines.edu, +1.303.273.3889. |
| June 11–15 | 42nd Annual Meeting of the Clay Minerals Society, Burlington, Vermont, USA. **Information:** www.middlebury.edu/cms; Chair: Peter Ryan, pryan@middlebury.edu. |
| June 12–16 | National Minerals Education Conference, Tucson, Arizona, USA. **Information:** www.seeuthere.com/MEC2005. Registration deadline: 13 May 2005. |
| July 31–August 5 | Gordon Research Conference on Inorganic Geochemistry: Metals in ore-forming systems: Sources, transport, deposition, Andover, New Hampshire. **Information:** www.grc.uri.edu/programs/2005/inorgeo.htm. |
| August 8–11 | Earth System Processes 2 (ESP2). Cosponsored by GSA and the Geological Society of Canada. Westin Hotel, Calgary, Alberta, Canada. **Information:** www.geosociety.org/meetings/esp2/, or Deborah Nelson, dnelson@geosociety.org, +1.303.357.1014. |
| August 9–12 | 9th International Conference on Diffuse Pollution, Johannesburg, South Africa. **Information:** www.iwa-wisa-2005.com or contact Ralph Heath at ralphh@phd.co.za. |
| September 12–13 | Micro-organisms and Earth Systems: Advances in Geomicrobiology, University of Keele, UK. **Information:** Meetings Office, Society for General Microbiology, Marlborough House, Basingstoke Road, Spencers Wood, Reading RG8 9BE, UK, +44 (0)118.988.1805, fax +44 (0)118.988.5656, www.sgm.ac.uk/meetings. Abstracts deadline: 13 May 2005. |
| September 19–23 | 14th Meeting of the Association of the European Geological Societies, Torino, Italy. **Information:** www.maegs14.com. |

### 2006

| | |
|---|---|
| April 3–7 | Backbone of the Americas—Patagonia to Alaska, Mendoza, Argentina. Co-convened by Asociación Geológica Argentina and GSA. **Information:** www.geosociety.org/meetings/06boa/index.htm or contact Deborah Nelson, dnelson@geosociety.org, +1.303.357.1014. |

**Visit www.geosociety.org/calendar/ for a complete list of upcoming geoscience meetings.**

# About People

GSA Member **Patricia Bobeck** received the inaugural S. Edmund Berger Prize for Excellence in Scientific and Technical Translation from the American Foundation for Translation and Interpretation at the 2004 meeting of the American Translators Association. She received the prize for her English translation of Henry Darcy's 1856 *The Public Fountains of the City of Dijon*. Darcy's account of the planning and construction of Dijon's water distribution system in 1840 includes a detailed description of the experiments that led to the formulation of Darcy's Law.

# The Kerry Kelts Research Awards of the Limnogeology Division

The application process for the Kerry Kelts Research Awards of the Limnogeology Division is now open. These awards are named in honor of Kerry Kelts, a visionary limnogeologist and inspiring teacher. Up to three awards of $300 each for use in research related to limnogeology, limnology, and paleolimnology are available. Application for this award is simple and consists of a summary of the proposed research, its significance, and how the award will be used (five-page maximum). Please send your summary in PDF format along with your name and associated information to the chair of the Limnogeology Division, Thomas C. Johnson, tcj@d.umn.edu. **Application Deadline: August 10, 2005.** Awards will be announced at the Limnogeology Division Business Meeting and Reception at the 2005 GSA Annual Meeting in Salt Lake City in October.

We hope to increase the amount of the awards in succeeding years. If you are interested in supporting this awards program, please send your donations, designated for the Kerry Kelts Research Awards of the Limnogeology Division, to GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA.

# PENROSE CONFERENCE SCHEDULED

## Lessons in Tectonics, Climate, and Eustasy from the Stratigraphic Record in Arc Collision Zones

**October 10–14, 2005**

**Price, Utah**

### Conveners:

***Peter D. Clift,*** *Department of Geology and Petroleum Geology, University of Aberdeen, Aberdeen AB24 3UE, UK, +44.1224.273456; p.clift@abdn.ac.uk*

***Amy E. Draut,*** *University of California–Santa Cruz and U.S. Geological Survey, 400 Natural Bridges Dr., Santa Cruz, California 95060-5755, USA; +1.831.427.4733; adraut@usgs.gov*

Cosponsored by *International Association of Sedimentologists (IAS)* and *British Sedimentological Research Group (BSRG)*

**Description and Objectives.** Sediments and sedimentary rocks are essential to understanding and quantifying tectonic, oceanographic, and climatic processes in subduction zones, especially during arc collision events. The stratigraphic and tectonic record of convergent plate margins is typically dominated not by long periods of steady-state subduction but by collisions between arcs and oceanic topography, as well as with passive continental margins. Arc-continent collisional settings are some of the most dynamic sedimentary settings on Earth, where rapid vertical tectonic motion within sedimentary basins can interact with major exhumation of terranes that form sediment sources, and with local climate that may be highly erosive, to generate complicated, sometimes thick, stratigraphic packages. The collision of seamounts and ridges with active margins can cause major readjustments in the geometry, tectonics, and magmatic character of a subduction zone and appears to be central to governing the flux of material back into the upper mantle. Forearc sedimentary sequences are often the only record of paleo-collision events. In this meeting, we aim to quantify the rates of sedimentation and vertical tectonic motions associated with these events.

Despite the complexities inherent in the stratigraphy of arc collisional settings, recent work on modern examples and ancient accreted arc terranes has advanced our understanding of the processes that control the formation of the sedimentary sequences in such environments. As a result, study of the sedimentary record can now provide a more complete understanding of the tectonic and associated climatic processes that have operated in modern and ancient arc collision zones.

Presentations are requested that describe the processes that form the sedimentary record in arc settings and use that record to document environmental changes, which may include but are not limited to tectonic events, global sea-level variation, and climatic changes. The research and ideas discussed at the meeting are intended to synthesize recent advances in our understanding of these arc environments and stimulate further research in both active modern settings and in their ancient analogues.

**Planning Future Research.** In addition to summarizing what the scientific community knows about sedimentation in arc collisional settings, we will discuss the potential for future research efforts. A GSA Special Paper is planned as an outlet for the meeting results. Future research will be debated with specific recommendations for how it can be advanced within the context of existing, funded programs both in the United States and internationally (e.g., Integrated Ocean Drilling Program [IODP]).

**Proposed Sessions.** The meeting will be arranged as a series of presentations, interspersed with discussion and poster sessions. Key themes to be addressed will include the stratigraphic record and its importance in arc collision environments; tectonic implications to be learned from modern and ancient records; sedimentary studies, including provenance, sediment budgets, and stratigraphic architecture; and development of stratigraphic concepts in modern collision zones.

**Location and Dates.** The meeting will be convened in Price, Utah, immediately before the GSA Annual Meeting in Salt Lake City so that participants can attend both meetings easily and in order to take advantage of the dramatic local geology. Registration costs, estimated at $850, will cover lodging, all meals, and the field trip, but will not cover transportation to and from Price, Utah.

**Field Trip.** A one-day field trip on Thurs., Oct. 13, will highlight some of the classic exposures of sedimentary geology in central Utah. This trip will also provide opportunities for informal discussion in preparation for the final day of presentations and in planning for future research.

**Application Deadline: 15 June 2005**

**To Apply:** Geoscientists interested in the stratigraphic record of arc collision zones and associated processes are encouraged to attend. Potential participants should send a letter of intent to Peter Clift or Amy Draut that includes a brief statement of interests, the relevance of the applicant's recent work to the themes of the meeting, the subject of proposed presentation, and contact information. Interested graduate students are strongly encouraged to apply; partial support is available to student attendees from GSA and the IAS.

**Registrants with Special Needs.** GSA is committed to making Penrose Meetings accessible to all. If you require special arrangements or have special dietary concerns, please contact the meeting coordinator, Edna Collis, at ecollis@geosociety.org.

**To learn more about this Penrose Conference, go to www.abdn.ac.uk/~wpg008/ArcPenroseMeeting.html.**

# GeoVentures™ 2005 Deadlines

Sign up for your trip before time runs out!

**GeoTrip:** Eastern Australia—Students Only!

June 16–June 27, 2005.
Registration deadline: May 1, 2005.

**GeoClass:** Geology of Golden, Colorado, and the Surrounding Area

June 17–20, 2005.
Registration deadline: May 1, 2005.

**GeoHostel:** Geologic Excursions in South-Central Montana

FULL

July 9–14, 2005. Registration deadline: June 1, 2005.

To learn more about these trips and how to sign up, see the February issue of *GSA Today*. For complete details on GeoVentures™ or for full itineraries, contact Edna Collis, program officer, 1-800-472-1988, ext. 1034, fax 303-357-1072, ecollis@geosociety.org, or go to geoventures@geosociety.org.


## 3–7 April 2006 • Mendoza, Argentina

Backbone of the Americas: From Patagonia to Alaska is a GSA special meeting cosponsored with the Asociación Geológica Argentina. The principal themes are ridge collision, shallow subduction, and plateau uplift along the Americas. Field trips are planned to Patagonia before and the Chilean flat-slab or Central Andean Puna plateau after the meeting. Suzanne Kay and Victor Ramos are serving as meeting co-chairs.

*Co-convened by:*

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THE GEOLOGICAL SOCIETY OF AMERICA

**See www.geosociety.org/meetings/06boa/index.htm for details and to sign up for e-news.**

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## Positions Open

**FACULTY POSITION IN ENERGY EXPLORATION**
**WEST VIRGINIA UNIVERSITY**

The Department of Geology and Geography at West Virginia University invites applications for the Marshall S. Miller Energy Professorship in Geology. Appointment will be at the rank of Associate or Full Professor based on qualifications and experience. A Ph.D. degree is required. The successful candidate will focus on energy exploration and development of fossil fuels (oil, gas, coal, coal-bed methane) in both research and teaching. We seek an individual with substantial energy industry experience. Responsibilities will include the recruitment of qualified graduate students, and outreach to energy producers in the Appalachian Basin and beyond in the form of research projects and student placement. The successful applicant will contribute to current Departmental strengths and teaching at both the undergraduate and graduate levels, and will develop a vigorous externally-funded research program. Department strengths include geophysics, structure/tectonics, remote sensing, GIS, sedimentation, stratigraphy, paleontology, petrology, hydrogeology, surficial processes, and environmental geology. The Department is scheduled to move into a renovated building in 2007. Collaborations are encouraged with the National Energy Technology Lab (DOE-NETL), the National Research Center for Coal and Energy (NRCCE), and the West Virginia Geological and Economic Survey, all in Morgantown.

Candidates should send: (1) letter of application detailing teaching area interests, industry and research experience, and research program; (2) curriculum vitae; and (3) names, phone numbers, e-mail and mail addresses of three references to: Energy Professor Search Committee, Department of Geology and Geography, West Virginia University, Morgantown, WV 26506-6300. Questions may be directed to energy@geo.wvu.edu or 304-293-5603. Review of applications will begin August 15, 2005 and continue until the position is filled. The preferred start date is January 1, 2006. Please see www.geo.wvu.edu, www.wvu.edu, and www.morgantown.com. West Virginia University is an Equal Opportunity/Affirmative Action employer. Women and minority candidates are encouraged to apply.

**THE UNIVERSITY OF TEXAS AT AUSTIN**
**DEPARTMENT OF GEOLOGICAL SCIENCES**
**JACKSON SCHOOL OF GEOSCIENCES**
**FACULTY POSITION**
**WATER SCIENCES AND HYDROGEOLOGY**

The Department of Geological Sciences, Jackson School of Geosciences, at The University of Texas at Austin seeks to fill a faculty position in water sciences and hydrogeology. The specific area of research is open, and might include studies in one or more of the following areas: modeling of flow, contaminant transport, and reactions on a variety of scales; groundwater/surface water interactions; theory and applications of geophysical and remote sensing methods; analysis of water resources and related policy; land-atmosphere interactions; and hydrologic impacts of climate variability and climate change. The rank is open, and candidates at all levels, including Chair level, will be considered. The successful candidate will join the Jackson School of Geosciences, which includes the Department of Geological Sciences, the Bureau of Economic Geology, and the Institute for Geophysics. The School has a large and diverse community of geoscientists, with excellent research facilities and support. Through other campus departments in science and engineering and research units, such as the Environmental Science Institute, Center for Space Research, Institute for Computational Engineering and Sciences, and Center for Research in Water Resources, there are opportunities to interact with faculty and scientists from many disciplines. The selected candidate will have demonstrated strong potential for conducting a vigorous externally funded research program, should be an enthusiastic teacher at the undergraduate and graduate levels and well qualified to direct the research of M.S. and Ph.D. students. The anticipated starting date for this position is August 31, 2005, but the position remains open until filled. A PhD in an Earth science or related discipline is required at the time of appointment. Please refer to http://www.geo.utexas.edu for additional information. To apply: please send a curriculum vitae, statement of research and teaching interests, and names and contact information for four references to: Hydrogeology Search, Department of Geological Sciences, The University of Texas at Austin, Austin, Texas 78712-1101. Review of applications will begin March 1, 2005, and will continue until the position is filled. The University of Texas is an Equal Opportunity/Affirmative Action employer.

**SURFACE WATER HYDROLOGIST**
**DESERT RESEARCH INSTITUTE**

Desert Research Institute (DRI), Division of Hydrologic Sciences, Las Vegas, NV, seeks a Surface Water Hydrologist at the Assistant or Associate Research Professor rank. The incumbent will have a Ph.D. with emphasis in hydrology, water resources engineering, or hydraulic engineering; arid land hydrology experience, an engineering background, a strong background in the areas of surface water hydrology and will complement DRI's existing strengths in hydrology, hydraulics, soil science, and sediment engineering. Applicant reviews begin April 15, 2005. For full details visit http://jobs.dri.edu or call 775-673-7332. DRI is an AA/EEO employer.

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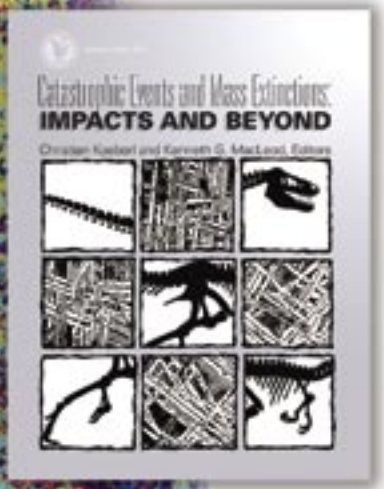


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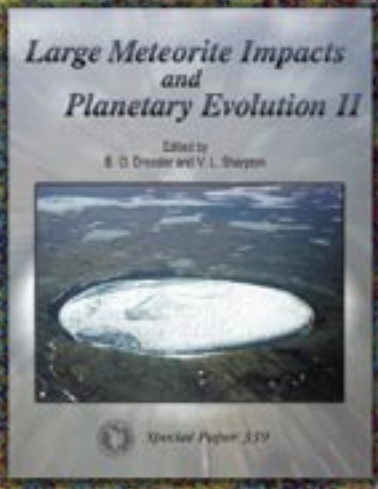



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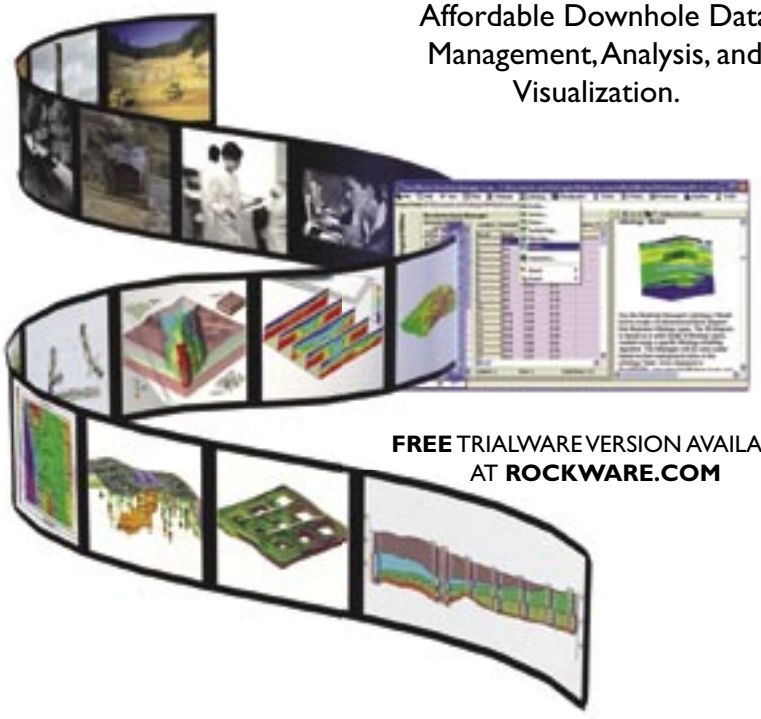

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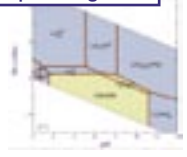

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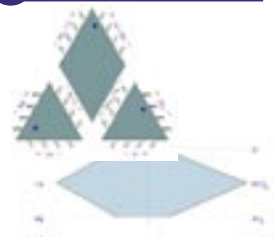

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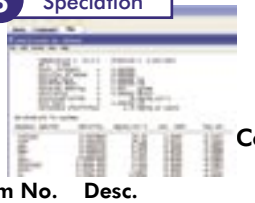

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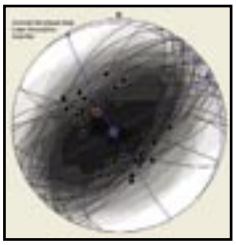

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