

GSA Annual Meeting & Exposition

# GSA TODAY

VOL. 17, No. 6

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JUNE 2007



**2007 EARTH SCIENCES FOR SOCIETY**

**Beginning of the International Year of Planet Earth**

**28-31 October 2007**

Colorado Convention Center, Denver, Colorado, USA

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**Inside:** Penrose Conference Scheduled, p. 60 Groundwork—The Future of Hydrocarbons, p. 69

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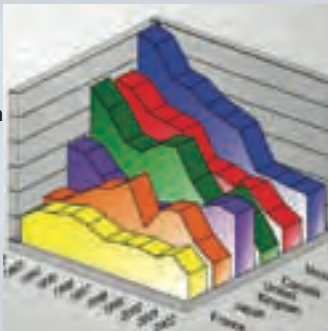
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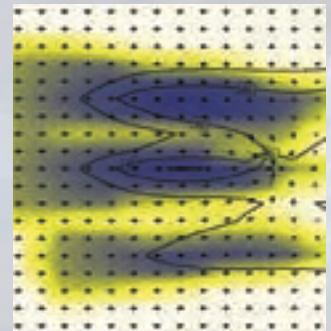
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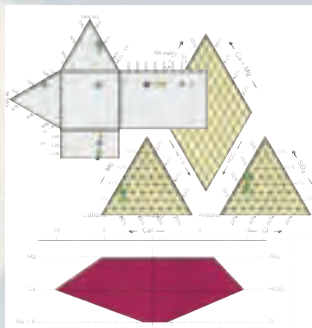
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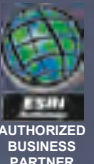
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#### GSA TODAY STAFF:

**Executive Director:** John W. Hess

**Science Editors:** Gerald M. Ross, Kupa'a Farm, Box 458, Kula, HI 96790, USA, lavaboy@hawaiiintel.net; and Stephen T. Johnston, University of Victoria, School of Earth & Ocean Sciences, Victoria, British Columbia V8W 3P6, Canada, stj@uvic.ca.

**Director of Publications:** Jon Olsen

**Managing Editor:** Kristen E. Asmus, kasmus@geosociety.org

**Editorial Staff:** Steven Williams, April Leo

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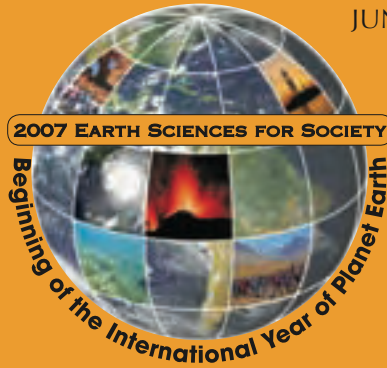
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Hurricane Katrina. Photo used with permission from NASA/Jeff Schmaltz, MODIS Land Rapid Response Team.

## 2007 Earth Sciences for Society—Beginning of the International Year of Planet Earth

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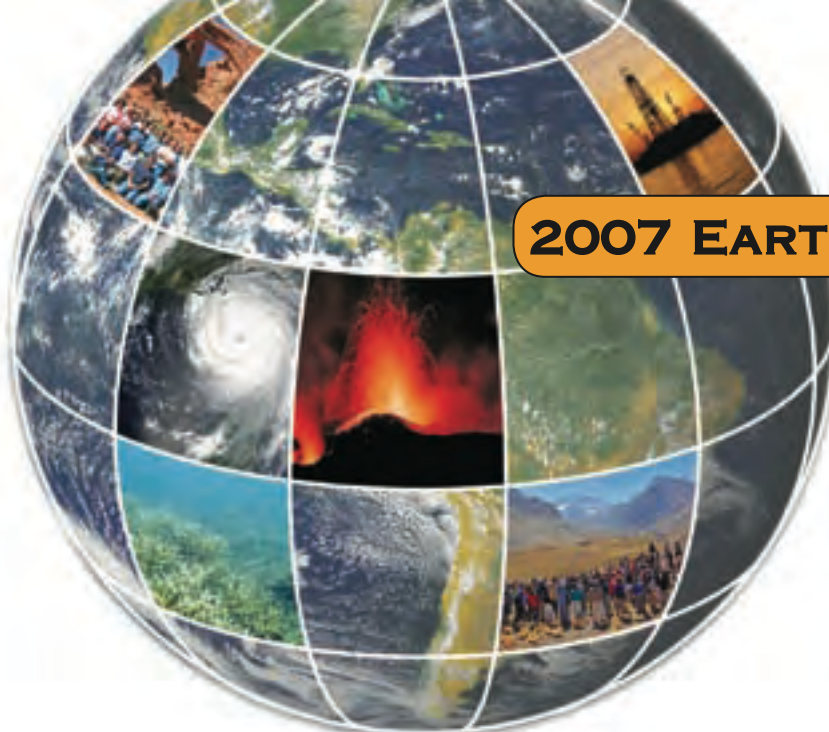
## 2007 EARTH SCIENCES FOR SOCIETY

# Beginning of the International Year of Planet Earth

## Annual Meeting & Exposition

28–31 October 2007  
Colorado Convention Center  
Denver, Colorado, USA

[www.geosociety.org](http://www.geosociety.org)



The GSA Headquarters Staff has come up with our **Top 10 Reasons to attend the GSA Annual Meeting** in Denver on 28–31 October 2007. We invite you to experience Denver and come up with your own Top 10 Reasons!

- 10 Enjoy one of Denver's newest hotels: The Hyatt Regency's geologically influenced architecture is a huge attraction. *Check all rock hammers at the door.*
- 9 Denver is the Napa Valley of beer. There are more local microbrews available at downtown bars than you can count on your fingers and toes!
- 8 Reunite with colleagues, make new connections, and meet face-to-face with

preeminent scientists who in the past may only have been a name in a journal.

- 7 Forensic Geology—see it first-hand at this year's Public Forum.
- 6 Childcare—GSA has teamed up with KiddieCorp to provide assistance to working families attending the meeting.
- 5 Check out the two additions to the already successful Mentor Program: *Women in Geology* and *Geology in Industry*.
- 4 Get your holiday shopping done early when you visit more than 200 exhibitors in our Exhibit Hall.
- 3 Be Green. Use our meeting bulletin board to network and carpool to the meeting. Save some green by find-

ing roommates, too! Another way to be green: use Denver's newly expanded light rail system, which stops right at the Colorado Convention Center.

- 2 The Boulder Flatirons are just a drive away—waiting for you since the Laramide Orogeny. Visit GSA Headquarters while you're in Boulder and check out the other local geology.

The **number one** reason to attend the GSA Annual Meeting in Denver:

- 1 **Science, Science, Science!** Avail yourself of over 3300 speakers, 31 technical field trips, four Hot Topics sessions, 14 Short Courses, and much much more.

### 2007 Organizing Committee

Technical Program Chair  
**David Bush**

University of West Georgia  
dbush@westga.edu

Field Trip Chair  
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Denver Museum of Nature & Science  
denver.basin@dmns.org

Hot Topics Chair  
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berg@isgs.uiuc.edu



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For general meeting questions,  
please contact the GSA Meetings Department at  
[meetings@geosociety.org](mailto:meetings@geosociety.org).

### Important Dates, Events & Deadlines

Registration Opens	Early June
Space Request Deadline	27 June
Abstracts Deadline	10 July
Early Registration Deadline	24 September
Cancellation Deadline	1 October
Premeeting Field Trips	Tues.–Sat., 23–27 Oct.
Short Courses	Fri.–Sun., 26–28 Oct.
Presidential Address & Awards Ceremony	Sat., 27 Oct., 7–9 p.m.
Welcome Reception & Exhibits Opening	Sun., 28 Oct., 5:30–7:30 p.m.
Technical Program	Sun.–Wed., 28–31 Oct.
Pardee Keynote Symposia	Sun.–Wed., 28–31 Oct.
Private Alumni Reception	Mon., 29 Oct., 5:30 p.m.–1 a.m.
Group Alumni Reception	Mon., 29 Oct., 7–9:30 p.m.
Exhibit Hall Hours	Sun., 28 Oct., 5:30–7:30 p.m. Mon.–Tues., 29–30 Oct., 9 a.m.–5:30 p.m. Wed., 31 Oct., 9 a.m.–2 p.m.
Hot Topics	Sun.–Wed., 28–31 Oct., 12:15–1:15 p.m.
Postmeeting Field Trips	Thurs.–Sun., 1–4 Nov.



THE  
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Special Events

## GSA Presidential Address & Awards Ceremony

Sat., 27 Oct., 7–9 p.m.

### Hyatt Regency Hotel at the Colorado Convention Center

Join us Saturday evening when President John M. (Jack) Sharp Jr. gives his Presidential Address and presents the 2007 Awards and Medals. Recipients of the Penrose Medal, the Arthur L. Day Medal, the Young Scientist Award (Donath Medal), the GSA Public Service Award, the GSA Distinguished Service Award, the AGI Medal in Memory of Ian Campbell, and the Subaru Outstanding Woman in Science Award will be honored. The newly elected Honorary Fellows, the GSA Divisions Awards, and the newly elected GSA Fellows will also be honored. A reception will immediately follow the ceremony. You'll find a list of all these awardees and more in the July *GSA Today*.

### Exhibits Opening & Welcome Reception

Sun., 28 Oct., 5:30–7:30 p.m. • Colorado Convention Center

Enjoy a beverage, view the exhibits, and network with colleagues and friends at the 2007 Welcome Reception. The Exhibit Hall opens at 5:30, immediately following the technical sessions.

### Awards Luncheons and Other Ticketed Group Functions

Associated Societies and GSA Divisions invite their members and other interested guests to join them for their annual meeting meal functions, special addresses, and awards ceremonies. Check the registration form or [www.geosociety.org/meetings/2007/](http://www.geosociety.org/meetings/2007/) for exact dates of meal functions. Only a few tickets will be available on-site, so please register early for ticketed functions.

### Alumni Receptions

Mon., 29 Oct.

Monday night is alumni night! Plan to join your fellow alumni for an evening of memories and renewed connections. Make sure your school is a part of the festivities—check the meeting Web site, [www.geosociety.org/meetings/2007/](http://www.geosociety.org/meetings/2007/), to see if your school is listed as part of the Group Alumni Reception, or if it is holding a private reception. If it isn't listed, reserve a spot by filling out a space request form at [https://rock.geosociety.org/Space\\_Request](https://rock.geosociety.org/Space_Request). Contact [spacerequest@geosociety.org](mailto:spacerequest@geosociety.org) for further details.

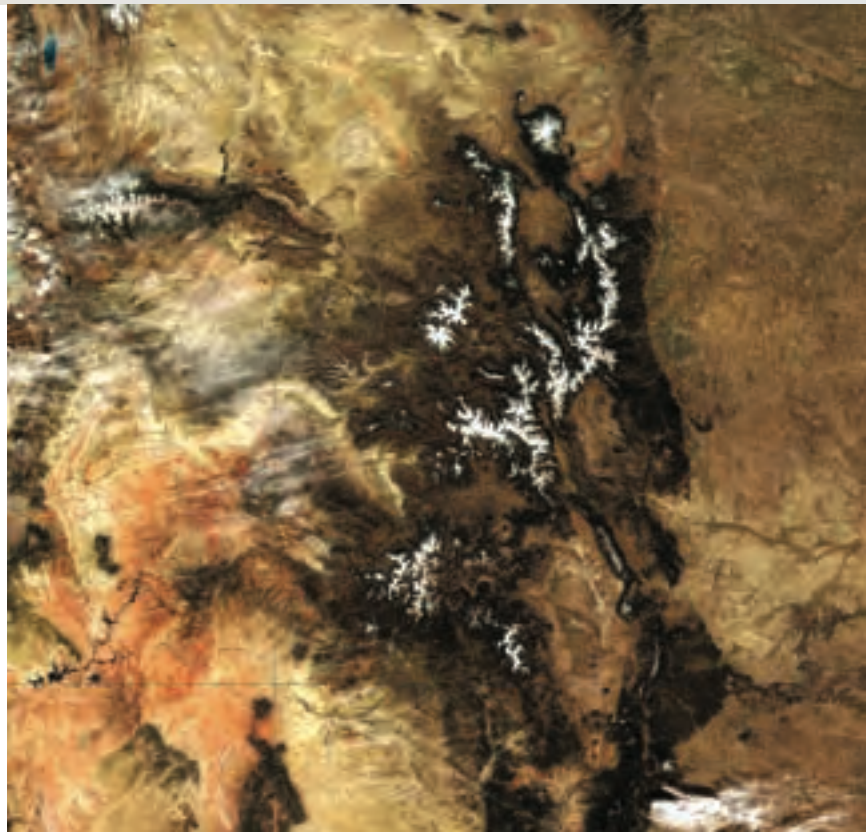
## GSA's 2007 Hall of Fame

Pause in the bustle of the Annual Meeting to visit the Hall of Fame and acknowledge your well-deserving and hard-working colleagues, mentors, students—and maybe even see a banner honoring you!

### This year, the Hall of Fame honors:

- Current and past GSA geoscience award winners;
- Current and past recipients of the AGI Medal in Memory of Ian Campbell;
- Current and past awardees from GSA's Divisions;
- GSA Fellows and Honorary Fellows;
- 50-year and 25-year Members;
- Allied and Associated Society award recipients; and
- Top-ranked graduate student research grant recipients.

True-color moderate resolution imaging spectroradiometer (MODIS) image of Colorado and surrounding states captured 26 October 2001. Courtesy Jacques Descloitres, MODIS Land Rapid Response Team, NASA/GSFC; [http://visibleearth.nasa.gov/view\\_rec.php?id=2302](http://visibleearth.nasa.gov/view_rec.php?id=2302) (Accessed 25 January 2007).





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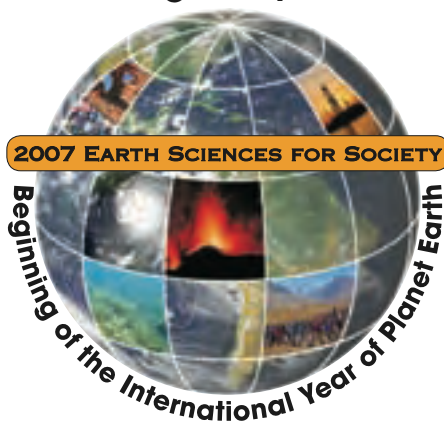


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## GSA Annual Meeting & Exposition



**28-31 October 2007**

Colorado Convention Center  
Denver, Colorado, USA

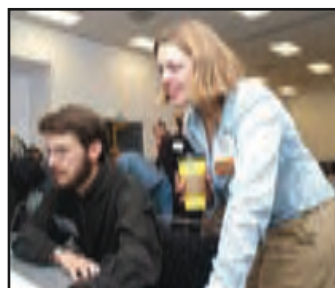
**[www.geosociety.org](http://www.geosociety.org)**

The GSA Annual Meeting & Exposition is the premier event for the world's leading professionals in the geosciences.

## INFORMATION INSPIRATION EXPERIENCE

These are things you bring your students as a  
**GSA CAMPUS REP!**

The GSA network of member-volunteers is over 500 strong—but there are still campuses where students are missing out on learning first-hand from a respected teacher about the advantages of belonging to The Geological Society of America. Volunteer to serve your students and strengthen your Society.



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Visit [www.geosociety.org/members/campus.htm](http://www.geosociety.org/members/campus.htm)  
or contact Christa Stratton, [cstratton@geosociety.org](mailto:cstratton@geosociety.org)

## Nominate Your Next Officers and Councilors!

**Nominations Accepted until 15 July 2007**

The GSA Committee on Nominations requests nominations for officers (vice president and treasurer) and councilors to serve on GSA Council beginning in 2008. Each nomination should be accompanied by basic data and a description of the qualifications of the individual for the position recommended.

**The online nomination form is available at [www.geosociety.org/aboutus/officers/](http://www.geosociety.org/aboutus/officers/), or you may send materials for officer and councilor nominations to Pamela Fistell, GSA, P.O. Box 9140, Boulder, CO 80301-9140, [pfistell@geosociety.org](mailto:pfistell@geosociety.org).**

Join a community of over 6000 geoscientists mingling with exhibitors at the Colorado Convention Center. We have a lot of new and exciting exhibitors this year, so stop by to visit, purchase, inquire, sign up, and catch up!

Exhibitors are listed by category as registered as of press copy deadline. See up-to-the-minute profiles and listings of exhibitors at [www.geosociety.org/meetings/2007/xInfo.htm](http://www.geosociety.org/meetings/2007/xInfo.htm).

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Society of Economic Geologists  
Soil Science Society of America

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Louisiana State University, Dept. of Geology & Geophysics  
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# 2007 Exhibitors

EXHIBITS OPENING & WELCOME RECEPTION

Sun., 28 Oct., 5:30–7:30 p.m.

EXHIBIT HALL HOURS

Mon.–Tues., 29–30 Oct., 9 a.m.–5:30 p.m.

Wed., 31 Oct., 9 a.m.–2 p.m.



### Women in Geology

**Sun., 28 Oct., noon–1:30 p.m.**

This new mentoring program, sponsored by Subaru, will address the issues faced by women in geology. Key women speakers will begin the event, to be followed by a relaxing forum for socializing, sharing ideas, and meeting other women in geology. *Appetizers provided.*



**Registration not required.**

### Geology in Government

*Free lunch for undergraduate and graduate students*

**Mon., 29 Oct., 11:30 a.m.–1:30 p.m.**

This popular annual event features a select panel of mentors representing various government agencies who will invite questions from the students, offer advice about preparing for a career, and comment on the prospects for current and future job opportunities within their agencies. **Registration not required.**

### Geology in Industry

*Free lunch for undergraduate and graduate students*

**Tues., 30 Oct., 11:30 a.m.–1:30 p.m.**

This new mentoring program, cosponsored by ExxonMobil, Foundation Coal Company, and Chevron, brings together a select panel of mentors representing various industries. These mentors will invite questions from students, offer advice about preparing for a career in industry, and comment on the prospects for current and future job opportunities within their agencies.



**Registration not required.**

### John Mann Mentors in Applied Hydrogeology Program

*Distinguished Hydrogeology Division Luncheon  
and Awards Presentation*

**Tues., 30 Oct., noon–3 p.m.**

This program underwrites the cost for up to 25 students to attend the Distinguished Hydrogeology Division Luncheon and Awards Presentation. **Eligible students are those who have: (1) checked the box on their membership application indicating their professional interest in hydrology and/or hydrogeology, AND (2) registered for the GSA Annual Meeting by 24 September 2007.** The lucky recipients of these tickets will have the chance to meet with some of the nation's most distinguished hydrogeologists. Tickets will be awarded to the first 25 students who respond to an **e-mail invitation**, based on the eligibility criteria above. **Registration required.**

View full program descriptions at  
**www.geosociety.org/science/.**

For additional information, contact Jennifer Nocerino,  
jnocerino@geosociety.org, +1-303-357-1036.



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## President's Student Breakfast Reception

Sunday, 28 Oct., 7–8:30 a.m.

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Hosted by GSA

GSA President John M. (Jack) Sharp Jr. invites all students registered for the meeting to attend a free breakfast buffet sponsored by ExxonMobil Corporation. Jack Sharp and members of GSA leadership, along with ExxonMobil staff members, will be on hand to answer questions and address student issues. This will also be a time to recognize the top-ranked graduate student research grant recipients, as well as to acknowledge other student research grant awardees.

Each student registered for the meeting will receive a ticket for the complimentary breakfast buffet. This is one of the most popular events at the meeting for students—with good reason! Make the most of this opportunity to network with fellow students, meet the officers of GSA, and recognize fellow student award recipients.

## Student Travel Fund

GSA is pleased to offer assistance to undergraduate and graduate student Members to cover some of the cost associated with attending the GSA Annual Meeting. A fund has been set up within the GSA Foundation for meeting attendee contributions, and GSA and the Foundation will each contribute US\$1,000 for the 2007 Denver Annual Meeting. The number and amount of awards will be based solely on contributions received, including those from your fellow GSA Members, and 100% of those contributions will go to the student travel fund. For more information on this fund or to apply for assistance, go to [www.geosociety.org/meetings/2007](http://www.geosociety.org/meetings/2007).



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## ATTENTION All Student Members!



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GSA Student Members who are registered for the meeting may apply online for these grants. **Deadline:** 17 September 2007.



## Student Travel Grants from GSA Sections

The GSA Foundation has made US\$4,500 in grants available to each of the six GSA sections. The money, when combined with equal funds from the sections, is used to help GSA undergraduate and graduate Student Members travel to GSA meetings. For information and deadlines, please visit your section Web site or contact your section secretary directly (see [www.geosociety.org/sectdiv/](http://www.geosociety.org/sectdiv/)).

## GSA TRIVIA NIGHT

Tues., 30 Oct., 7–9 p.m.

Come test your knowledge of geoscience trivia at this evening of fun. Over 100 questions have been prepared to rack your brain and test your skills! Come as a team or join a mixed team, meet new people, share your knowledge, and have a great evening in Denver! Winning teams will be awarded fabulous prizes and the prestige of being GSA Trivia Night winners!



**Registration not required.**

## Graduate School Information Forum

### Exhibit Hall

Sun., 28 Oct., 8 a.m.–7:30 p.m.

Mon.–Wed., 29–31 Oct., 8 a.m.–5:30 p.m.

Take full advantage of this opportunity to promote your school to over 1,500 students at the upcoming GSA Annual Meeting and Exposition in Denver, Colorado!

Meet face-to-face with prospective students in a relaxed, informal setting. GSIF booths will be located in the Exhibit Hall between the exhibits and poster sessions. The forum opens Sunday, 28 October, at 8 a.m. and will remain open into the evening (until 7:30 p.m.) so that students at the welcome reception will have a chance to stop by. Monday through Wednesday, GSIF hours run from 8 a.m. to 5:30 p.m.

You may book a booth in the forum for one day or up to all four days. Space is limited: Sunday and Monday will be the first to sell out, so reserve early! Schools reserving multiple days will be assigned first and to the most visible booths.

Reserve your space at

**[www.geosociety.org/meetings/2007/xGSIF.htm](http://www.geosociety.org/meetings/2007/xGSIF.htm)**

Participating schools will be promoted in the September *GSA Today* (pending submittal date of reservation form), the 2007 Annual Meeting Program, and e-mail links on the GSA Web site so prospective students may schedule appointments prior to the Annual Meeting.

For more information, contact Nancy Carlson, +1-303-357-1061, [ncarlson@geosociety.org](mailto:ncarlson@geosociety.org).

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## FREE Research Proposal Writing Workshop

**Graduate Students:** Are you interested in improving your chances of receiving a GSA student research grant or looking for tips to improve your proposal writing for future funding? Then GSA's free proposal-writing workshop is for you!

Led by a member of the GSA Research Grant Committee, this workshop will be based on recent GSA graduate research grant proposals. The workshop will put several examples into hypothesis-driven studies to illustrate the dos and don'ts to the proposal-writing process. The review process of the GSA Research Grant Committee will also be outlined.

Check **[www.geosociety.org/grants](http://www.geosociety.org/grants)** in August for updates on the date, time, and location for this annual workshop.



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Colour cathodoluminescence (CL) image of a part of quartz grain in a granite sample. Late-stage hydrothermal chemical alteration (red) is associated with cracks in the quartz (blue-green) caused by cooling of the granite mass. Width of image is approximately 1.4mm. Image acquired with Gatan's ChromaCL™ live colour CL system mounted on an FEI Quanta scanning electron microscope. Image courtesy of Prof. J. Scheiber, Department of Geological Sciences, Indiana University, Bloomington, IN, USA.



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## ➤ Denver 2007 Field Trips ◀

All trips begin and end at the Colorado Convention Center in Denver, unless otherwise indicated. Details about the precise trip itinerary are provided upon registration or you may contact the field trip leaders directly. Participants are cautioned against scheduling any tight travel connections with field trip return times, as those times are estimates, and delays in the field may occur. For a list of hotels near the airport, contact Eric Nocerino, +1-303-357-1060, enocerino@geosociety.org.

If you register just for a field trip, you must pay a non-registrant fee (see the registration section, p. 36 of this issue) in addition to the field trip fee. This fee may be applied toward meeting registration if you decide to attend the meeting. Trip fees include transportation during the trip and a trip guide. Other services, such as meals and lodging, are noted with each trip by the following: B—breakfast, L—lunch, R—refreshments, D—dinner, ON—overnight lodging.

### PREMEETING

#### **401. Track of the Yellowstone Hot Spot: Young and On-Going Geologic Processes from the Snake River Plain to Yellowstone**

Tues.–Sat., 23–27 Oct. Lisa A. Morgan, U.S. Geological Survey (USGS), Federal Center, P.O. Box 25046, MS 966, Denver, CO 80225, USA, +1-303-273-8646, lmorgan@usgs.gov; Kenneth L. Pierce. Min: 20; max: 44. Cost US\$420 (4ON, B, R).

The 16-Ma Yellowstone hot spot track is one of the few places on Earth where a time-transgressive suite of processes on continental crust can be seen in the volcanic and tectonic (faulting and uplift) record at the rate and direction as predicted by plate motion. Recent interest in young and possible renewed volcanism at Yellowstone along with new discoveries and synthesis of previous studies (i.e., tomographic, deformation, bathymetric, and seismic surveys) are fueling discussion as to Yellowstone's possible plume origin. This field trip will highlight various stages in the evolution of the Snake River Plain–Yellowstone Plateau bimodal volcanic province, also known as the track of the Yellowstone hot spot. Field trip stops will include the young basaltic Craters of the Moon, exposures of 12–4-Ma rhyolites and edges of their collapsed calderas on the Snake River Plain, and faulting progressing with the volcanic fields. An essential stop is Yellowstone National Park, where the last major caldera-forming event occurred 640,000 years ago and now is host to the world's largest hydrothermal field. This 3-day trip will present a quick, intensive overview into volcanism and tectonism in this dynamically active region. We will discuss origin models and examine features that may be reflective of a tilted thermal plume as indicated in recent tomographic studies. Our drive home will pass through Grand Teton National Park, where the Teton Range is currently rising in response to the passage of the North America plate over the Yellowstone hot spot.

#### **402. River Incision Histories of the Black Canyon of the Gunnison and Unaweep Canyon: Interplay between Late Cenozoic Tectonism, Climate Change, and Drainage Integration in the Western Rocky Mountains**

Cosponsored by *GSA Quaternary Geology and Geomorphology Division*

Wed.–Fri., 24–26 Oct. Andres Aslan, Dept. of Physical and Environmental Sciences, Mesa State College, 1100 North Ave., Grand Junction, CO 81501, USA, +1-970-248-1614, aaslan@mesastate.edu; Karl Karlstrom. Min: 12; max: 40. Cost US\$255 (3ON, L, R).

Canyons of the Upper Colorado and Gunnison River systems provide a spectacular backdrop for discussing the interplay between late Cenozoic tectonism, climate change, and base level shifts related to drainage integration. Examination of ancient river gravels, lacustrine deposits, dated volcanic sediments (basalts, Lava Creek B ash), and canyon geometries will be used to discuss rates and patterns of late Cenozoic fluvial incision and the effects of incision on landscape development. Key questions to be addressed include (1) to what degree have glacial-interglacial cycles affected landscape development?; (2) is stream piracy, related to drainage integration, a primary driver of incision?; and (3) are the central Rockies still rising, and if so, what are the neotectonic indications and responses?



Photo by Simon Pattison; see premeeting field trip 404.

#### **403. Cornucopia of Coal and Coalbed Gas in the Powder River Basin: From Mining and Utilization to Methane and Methanogens**

Cosponsored by *GSA Coal Geology Division; GSA Geobiology and Geomicrobiology Division; GSA Hydrology Division*

Thurs.–Fri., 25–26 Oct. Romeo M. Flores, USGS, Box 25046 MS 939, Denver Federal Center, Denver, CO 80225, USA, +1-303-236-7774, rflores@usgs.gov; Jason D. Putnam; Margaret S. Ellis; Michael E. Brownfield; Edward L. Heffern; Gary D. Stricker. Min: 10; max: 25. Cost US\$290 (1ON, L, D).

The Powder River Basin (PRB) in Wyoming and Montana contains abundant, thick subbituminous coals of the Paleocene Fort Union Formation. The coals are surface mined and developed for coalbed methane (CBM). PRB mines make up 35% of the total U.S. coal production, forecast to be 40% by 2030, and supplies fuel to 144 power plants nationwide. The total cumulative gas production from 19,000 CBM wells, projected to be 50,000 wells by 2020, is 2.2 trillion ft<sup>3</sup> (since 1987). This two-day field trip to the PRB highlights exploration, development, distribution, and utilization of this cornucopia of fuel energy. Day one includes tours at the Wyodak coal mine and nearby 330 megawatt Wyodak power plant in east Gillette. Mining in the 100-ft-thick Wyodak coal bed has supplied feed coal to the power plant since 1978. Study of the feed coal provides data useful for characterizing the physical and chemical properties of the combustion products. These data make it possible to predict fly ash properties and modes of occurrence of selected trace elements in the ash. Day two includes tours at CBM facilities. Drilling operations, completed wells, gas compression, and surface water disposal complexes are examined to gain insight about CBM exploration, development, and gas acquisition in the PRB. The CBM production from 6 to 10 coal beds at 200- to 2500-ft depths is >2,000,000 ft<sup>3</sup> per day. A study of the microbial origin of the coalbed gas revealed by methanogens of coproduced water and coal reservoirs is also discussed.

#### **404. Clastic Sedimentology, Sedimentary Architecture, and Sequence Stratigraphy of Fluvio-Deltaic, Shoreface and Shelf Deposits, Book Cliffs, Eastern Utah and Western Colorado**

Cosponsored by *GSA Sedimentary Geology Division; Society for Sedimentary Geology (SEPM)*

Thurs.–Sat., 25–27 Oct. Simon A.J. Pattison, Dept. of Geology, Brandon University, 270 18th St., Brandon, Manitoba R7A 6A9, +1-204-727-7468, pattison@brandonu.ca; Paul Davies; Huw Williams. Min: 5; max: 30. Cost US\$240 (2ON, L, R).

The 300-km-long Book Cliffs of eastern Utah and western Colorado are dissected by numerous side canyons and reentrants providing exceptional three-dimensional (3-D) outcrop control of Campanian strata, both along depositional-dip and depositional-strike. This, combined with the near-horizontal structural configuration, makes the Book Cliffs a world-class field laboratory for studying clastic sedimentology and sequence stratigraphy. It is truly one of the few areas in the world where you can walk and drive out time-equivalent depositional units from their proximal fluvial-coastal plain environments through

the shallow marine shoreface-deltaic environments and onto the shelf. These famous rocks have been used to develop, test, and refine sedimentological and stratigraphic ideas and models over the years, including the principles and concepts of sequence stratigraphy. In addition, the Book Cliffs strata are regularly used as an outcrop analog for fluvial, deltaic, and shoreface-to-shelf hydrocarbon reservoirs worldwide. This field trip will focus on the following themes: (a) sedimentology and 3-D sedimentary architecture of fluvial, coastal plain, river- and wave-dominated deltas, and shoreface-to-shelf depositional systems; (b) stacking patterns in high versus low accommodation settings; (c) distribution of reservoir and non-reservoir facies in a predictive sequence stratigraphic framework; (d) the relationship between relative sea level, shoreline position, and stratigraphic architecture; and (e) applications of outcrop analog data to the exploration and production of hydrocarbons. The trip should be of wide interest to sedimentologists, stratigraphers, oceanographers, and paleontologists in a variety of academic, government, and industry positions. The Book Cliffs arguably represent the best exposed deltaic rocks in the world.

#### **405. Stratigraphy and Sedimentology of the Green River Formation in the Piceance Basin—The Richest Oil Shale Deposits in the World**

Thurs.–Sat., 25–27, Oct. Yuval Bartov, Colorado Energy Research Institute, Colorado School of Mines, 1500 Illinois St., Golden, CO 80401, USA, +1-303-273-3841, ybartov@mines.edu; Rick Sarg. Min: 10; max: 30. Cost US\$310 (2ON, B, L, R).

This field trip will cover the stratigraphy and depositional history of Green River Lake in the Piceance basin, Colorado. We will examine outcrops around the basin that illustrate the evolution of the lake. The lake history is tied to the depositional systems and the oil shale distribution in the basin. We will start from Golden and drive on I-70 toward Rifle, around the eastern part of the basin (Rio Blanco area and Meeker), then we will observe the section in the basin center area and in the western margin (Douglas Pass).

#### **406. Proterozoic Geology and Phanerozoic Reactivation of the Newly Recognized Grizzly Creek Shear Zone, Glenwood Canyon, Colorado**

Cosponsored by *GSA Structural Geology and Tectonics Division*

Fri.–Sat., 26–27 Oct. Joseph L. Allen, Geology and Physical Sciences, Concord University, Campus Box 19, Athens, WV 24712, USA, +1-304-384-5238, allenj@concord.edu; Colin A. Shaw. Min: 10; max: 20. Cost US\$245 (1ON, L, R).

This trip will examine Proterozoic mid-crustal deformation and Phanerozoic brittle reactivation in the newly recognized Grizzly Creek shear zone, central Colorado. Our recent mapping defines the Grizzly Creek shear zone (GCSZ) as a 0.6-km-thick, brittle-plastic deformation system that dips moderately to the north along the southern margin of the White River uplift. Deep canyon incision provides spectacular cross-strike exposures of Proterozoic basement beneath Paleozoic cover strata. In Proterozoic basement, the shear zone consists of a

20-m-thick basal mylonite overlain by highly strained gneisses and megacrystic granitoids, both of which host hundreds of pseudotachylyte fault veins and thin mylonite zones. Locally, part of the shear zone is defined by a strongly foliated, fine-grained granitoid cut by pseudotachylyte and ultramylonite. The presence of mylonitized pseudotachylyte in part of the shear zone suggests that seismogenic faulting and plastic flow occurred cyclically at mid-crustal depths. Kinematic indicators are consistent with top-to-the-south Proterozoic compression. The GCSZ is cut by the Phanerozoic Grizzly Creek fault, an east-west striking, north-dipping reverse fault that coincides with the hinge of a monocline that bounds the southern margin of the Laramide White River uplift. We will discuss applications of our work to understanding earthquake rupture dynamics, Proterozoic tectonics, and the Precambrian ancestry of Phanerozoic structures and fluvial incision in the southern Rockies. The trip will involve a four-mile round-trip trail hike and a steep, off-trail traverse on both days.

#### **407. Coal Geology in the Mesaverde Group along the Eastern Edge of the Greater Green River Basin in Northwestern Colorado and South-Central Wyoming**

Cosponsored by *GSA Coal Geology Division*

Fri.–Sat., 26–27 Oct. Nick Jones, Wyoming State Geological Survey, P.O. Box 1347, Laramie, WY 82073, USA, +1-307-766-2286 ext. 243, njones@uwyo.edu. Min: 5; max: 30. Cost US\$205 (1ON, L, R).

This trip begins in Denver and travels through northwestern Colorado and southwestern Wyoming. We will visit several coal mines (both surface and underground) and observe coal-stratigraphic variability in the Mesaverde Group from outcrops (coal blooms) along the eastern extent of the Greater Green River Basin. At stops during the trip, information regarding the geology will include stratigraphic nomenclature of the Mesaverde Group, depositional environments, peat forming systems, and the resultant coal resources. Other topics of discussion will include coal distribution, utilization, coal conversion technologies, and coalbed natural gas developments along the eastern edge of the Atlantic Rim.

#### **408. Geoarchaeology of the Clary Ranch Paleoindian Sites, Western Nebraska**

Fri., 26 Oct. David W. May, Dept. of Geography, University of Northern Iowa, 205 Innovative Teaching and Technology Center, Cedar Falls, IA 50614, USA, +1-319-273-6059, dave.may@uni.edu; Dave Rapson; Matthew G. Hill. Min: 22; max: 40. Cost US\$105 (L, R).

This trip will visit two late Paleoindian sites in the Ash Hollow drainage, a major tributary to the North Platte River in western Nebraska. These two sites are contemporary and are believed to represent complementary dimensions of a single settlement and subsistence system. One is a bison processing area; the other a camp. Emphasis will be on interdisciplinary research in the basin and at the sites, including geomorphology and early Holocene stratigraphy in the basin, paleoenvironmental reconstruction using several lines of evidence, and Paleoindian archaeology. A visit to a local museum (Ash Hollow Cave) is included as well.

#### **409. From Buttes to Bowls: Repeated Inversions in the Landscape of the Colorado Piedmont**

Cosponsored by *Colorado Geological Survey; Colorado Scientific Society*

Fri., 26 Oct. Matthew Morgan, Colorado Geological Survey, 1313 Sherman St., Suite 715, Denver, CO 80203, USA, +1-303-866-2066, matt.morgan@state.co.us; Vincent Matthews III. Min: 5; max: 20. Cost US\$110 (L, R).

Mesas and buttes of the central Colorado Piedmont are composed of at least two distinct rock types that differ in their cohesiveness and ability to withstand erosion. The lower parts are friable, early to middle Paleogene sandstones of the Dawson Formation. The caprock is composed of one or more resistant formations: Castle Rock Conglomerate, Wall Mountain Tuff, and Larkspur Conglomerate—all of late Paleogene age. These formations were originally deposited in topographic lows. The lower slopes of the buttes are armored with colluvium composed of fragments of the capping units, and commonly form relict faceted slopes. Once the caprock of a butte or mesa has been removed by erosion, the poorly consolidated Dawson Formation quickly erodes out of the center. This leaves the armored lower slopes of the former butte as an erosionally resistant, circular ridge standing as much as 100 m above the surrounding topography. This process produces a topographic low where the peak of the butte once stood. Some buttes have prominent alluvial fans that record the main phase of butte removal and excavation of the central part of the armored slopes. Soil profiles and height above modern streams indicate the oldest preserved gravel deposit is of middle Pleistocene age; the youngest alluvial fans were deposited during the Holocene. This field trip will visit key outcrops between Larkspur and Sedalia, Colorado, that display the anatomy of colluvium rings and armored slopes. We will also discuss their methods of formation, preservation, and rates of erosion.

#### **410. The Beautiful Vail Valley: A Classroom in Geologic Hazards and Mitigation**

Cosponsored by *Colorado Geological Survey*

Sat., 27 Oct. Vincent Matthews III, Colorado Geological Survey, 1313 Sherman Street, Room 715, Denver, CO 80203, USA, +1-303-866-3028, vince.matthews@state.co.us; Jonathan White; Mark A. Gorman II, University of Colorado, 1300 30th St. D5-12, Boulder, CO 80303, USA, +1-303-786-0999, mark.gorman@colorado.edu; Jason Pardo; Bryan Small; Ian Miller. Min: 12; max: 45. Cost US\$75 (L, R).

The beautiful, glaciated Vail Valley has a variety of geological hazards. Land-use decisions relative to mitigation of these hazards are also quite varied. Several excellent examples of the consequences of following recommended mitigations, as well as examples of the consequences of ignoring recommended mitigations, will be pointed out on this trip.

**411. Geology of the Cripple Creek Gold-Telluride Deposit, Colorado**

Cosponsored by *Society of Economic Geologists; International Geological Correlations Program*

Sat., 27 Oct. Paul G. Spry, Geological and Atmospheric Sciences, Iowa State University, 253 Science I, Ames, IA 50011-3212, USA, +1-515-294-9637, pgspry@iastate.edu; Eric P. Jensen. Min: 10; max: 30. Cost US\$85 (L, R).

This trip will focus on the geological setting of one of the largest gold deposits in North America: Cripple Creek and its surrounding environs. The emphasis will be on the host rocks, hydrothermal alteration, and structural relations of the precious metal mineralization. Planned stops include the lodes and attendant hydrothermal alteration in the operating pit at Cripple Creek, and surface exposures of the Cripple Creek Diatreme Intrusive Complex. Participants will see the spatial-genetic relations among gold mineralization, breccias, and alkaline igneous rocks.

**412. Geoarchaeological Context of Paleoindian Sites in Middle Park, Colorado**

Cosponsored by *GSA Archaeological Geology Division*

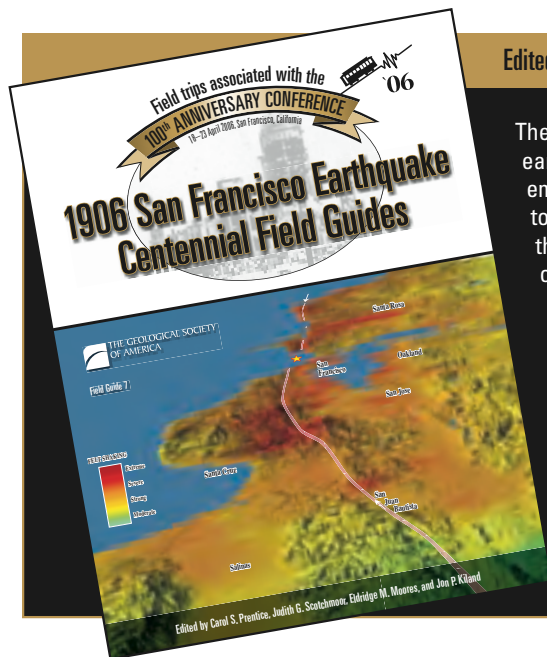
Sat., 27 Oct. James H. Mayer, Dept. of Geosciences, University of Arizona, Gould-Simpson Building #77, 1040 E. Fourth Street, Tucson, AZ 85721, USA, +1-520-400-6470, jhmayer@email.arizona.edu; Todd A. Surovell. Min: 10; max: 40. Cost US\$79 (L, R).

Geoarchaeological investigations have been carried out in Middle Park as part of ongoing research by the University of Wyoming Dept. of Anthropology, with the primary goals of (1)

defining the soil and stratigraphic context of the Paleoindian occupation; (2) determining processes and patterns in Holocene landscape evolution potentially modifying the Paleoindian record; and (3) understanding components of the landscape most likely to yield in situ Paleoindian sites. We will visit two localities subjected to fairly detailed geoarchaeological inquiry: Barger Gulch Locality B, a Folsom campsite, and the Jerry Craig site, a Cody Complex bison kill. Both sites have yielded in situ Paleoindian components associated with buried forest soils in settings currently dominated by sagebrush, thus providing insights into Holocene landscape evolution and paleoenvironmental change. Three to four hours will be spent at Locality B, where the most extensive archaeological and geoarchaeological work has been carried out. Profiles in the upland excavation block, exposure in a low-order tributary gully, and alluvial exposures along Barger Gulch proper will be examined. At Jerry Craig, we will spend one to two hours examining an exposure in the excavation block, as well as a road cut. Discussion at both sites will concentrate on geomorphic histories, with special attention to the soil stratigraphic records. Site records will be compared to other non-archaeological settings examined in Middle Park. Finally, the Middle Park geoarchaeological records will be compared with well-documented glacial, pollen, and fossil insect records from higher elevations in the Colorado Front Range.



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Edited by Carol S. Prentice, Judith G. Scotchmoor, Eldridge M. Moores, and Jon P. Kiland

The twenty field trip guides in this volume represent the work of earthquake professionals from the earth science, engineering, and emergency management communities. The guides were developed to cross the boundaries between these professions, and thus reflect this diversity: trips herein focus on the built environment, the effects of the 1906 earthquake, the San Andreas fault, and other active faults in northern California. Originally developed in conjunction with the 100th Anniversary Earthquake Conference held in San Francisco, California, in April 2006, this book is meant to stand the test of time and prove useful to a wide audience for general interest reading, group trips, or self-guided tours.

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**413. Fish, Turtles, Plants, and Insects within the Morrison Formation: A Walk through a Late Jurassic Ecosystem**

Sat., 27 Oct. Mark A. Gorman II, University of Colorado, 1300 30th St., D5-12, Boulder, CO 80303, USA, +1-303-786-0999, mark.gorman@colorado.edu; Jason Pardo; Bryan Small; Ian Miller. Min: 5; max: 20. Cost US\$110 (L, R).

This will be a four to five hour walk and drive through a lacustrine (lake) Morrison deposit outside Canon City, Colorado. We will be looking at fish, plant, and insect localities excavated over the past four years that allow for a unique look at a Late Jurassic ecosystem. Some additional highlights will be large angular granitic clasts in the basal member of the Morrison and an unconformity located between the Morrison and the crystalline rock below.

**414. Hydrology and Geochemistry of the Boulder Creek Watershed**

Cosponsored by *U.S. Geological Survey; GSA Quaternary Geology and Geomorphology Division*

Sat., 27 Oct. Philip L. Verplank, USGS, Denver Federal Center, P.O. Box 25046, MS 973, Denver, CO 80225, USA, +1-303-236-1902, plv@usgs.gov; John Pitlick; Peter W. Birkeland; Sheila F. Murphy; Larry B. Barber; Travis Schmidt. Min: 12; max: 30. Cost US\$66 with bike rental; US\$45 with own bike (L, R).

This is a bicycle field trip exploring the hydrology and geochemistry of Boulder and South Boulder creeks. Topics include flood frequency and hazards, aqueous geochemistry of the watershed, and potential impacts of invasive species and emerging contaminants on stream ecology. The Boulder Creek watershed is an ideal natural laboratory for integrated research and educational outreach because of natural and land-use gradients and the proximity to research and educational facilities. This sixteen-mile trip at stream gradient will be on rented bicycles primarily using city of Boulder paved trails.

**415. From the Crest of the Front Range to the Depths of the Denver Basin**

Sat., 27 Oct. Shari Kelley, Dept. of Earth and Environmental Science, New Mexico Institute of Mining and Technology, 801 Leroy Place, Socorro, NM 87801, USA, +1-505-661-6171, sakelley@ix.netcom.com; Robert Reynolds. Min: 8; max: 22. Cost US\$89 (L, R).

This one-day trip will travel from the top of Mount Evans to the center of the Denver Basin. Discussion will focus on exhumation of the Front Range, based on low temperature thermochronology, and associated sedimentation in the Denver Basin, based on detrital thermochronology and depositional patterns. We will explore the implications of these results for paleo-reconstructions of past landscapes.

**416. The K-T Boundary and Associated Volcanic Tuffs at West Bijou Creek, Denver Basin**

Cosponsored by *EARTHTIME*

Sat., 27 Oct. Kirk R. Johnson, Denver Museum of Nature & Science, 2001 Colorado Blvd., Denver, CO 80205, USA,

+1-303-370-6448, kirk.johnson@dmns.org; Samuel Bowring. Min: 15; max: 47. Cost US\$70 (L, R).

This one-day trip will visit the West Bijou Creek exposure of the K-T boundary, which is located 40 miles east of Denver in the center of the Denver Basin. This boundary section contains all of the classic indicators of the K-T boundary including Cretaceous and Paleocene plant and vertebrate fossils, evidence of magnetic polarity subchron C29r, anomalous iridium concentrations, shocked minerals, and a negative carbon isotope excursion. In addition, the 40-m section that contains the K-T boundary also contains a number of volcanic tuffs, some that closely bracket the K-T boundary and provide the opportunity to increase the precision on the age of the K-T boundary. This outcrop is under detailed study as part of the ongoing EARTH-TIME initiative. Our trip will allow examination of several different tuffs with a range of outcrop attributes and discussion of their field expression, mineralogy, and geochronology. Trip participants will be able to observe fossils and tuffs in their stratigraphic context and see the results of integrated paleontological, geochemical, and geochronological analyses. Collecting of samples will not be allowed.

DURING THE MEETING

**417. Revisiting the South Cañon Number 1 Coal Mine Fire**

Cosponsored by *GSA Coal Geology Division*

Sun., 28 Oct. Glenn B. Stracher, Div. of Science and Mathematics, East Georgia College, 131 College Circle, Swainsboro, GA 30401, USA, +1-478-289-2073, stracher@ega.edu; Nancy Lindsley-Griffin; Steven Renner; Janet Lynn Stracher. Min: 12; max: 45. Cost US\$75 (L, R).

During this trip, gas vents, ground fissures and subsidence, and forest fires associated with the South Cañon Number 1 Coal Mine fire west of Glenwood Springs, Colorado, are examined and their origin and environmental significance discussed. Field-trip attendees are encouraged to discuss and participate in the following demonstrations: VaporTec passive soil gas sampling, mineral sampling at hot-gas vents, in situ gas analysis using Drager tubes, and gas collection techniques for complete coal-fire gas analysis. The trip involves light hiking, includes snacks and lunch, and culminates in a relaxing dip in Glenwood Spring's "Hot Springs Pool," before returning to Denver.

**418. Old and New Geologic Studies along the Front Range between Golden and Morrison, Including Structural, Volcanic, and Economic Geology and Paleontology (1)**

Cosponsored by *Friends of Dinosaur Ridge; GSA Geoscience Education Division; GSA Sedimentary Geology Division*

Sun., 28 Oct. Chris Carroll, Friends of Dinosaur Ridge, 16831 W. Alameda Pkwy., Morrison, CO 80465, USA, +1-303-697-3466, carroll\_chris@msn.com; T. Caneer; Tim Connors; Norbert Cygan; Harald Drewes. Min: 12; max: 45. Cost US\$85 (L).

This field trip will visit the Laramide uplifted late Paleozoic to early Cenozoic stratigraphic interval exposed between Golden and Morrison, Colorado. Topics to be presented include dinosaur remains of three ages, folds, faults, and two-stage volcanism

associated with the Laramide Orogeny. Economic deposits, past and present, will be observed along the way, including a uranium roll front and oil seeps near Morrison. This field trip provides geologic educators with an opportunity to view excellent field lab sites for geology instruction, including Mesozoic dinosaur tracks and bones of the Dakota Sandstone and Morrison Formation. Field trip stops will include the classic dinosaur track site at Dinosaur Ridge, Triceratops Trail, Red Rocks Park, and North and South Table Mountains.

**419. Kirk Bryan Field Trip: Fluvial-Hydraulic Processes in the Colorado Front Range**

Cosponsored by *GSA Quaternary Geology and Geomorphology Division*

Tues., 30 Oct. John Pitlick, Geography Dept., Box 260, University of Colorado, Boulder, CO 80309-0260, USA, +1-303-492-5906, pitlick@colorado.edu; Ellen Wohl. Min: 20; max: 50. Cost US\$70 (L, R).

On this one-day field trip, attendees will discuss the flood hydrology and geomorphology of Front Range river systems. The main destination for the field trip is the canyon of the Poudre River, west of Fort Collins, Colorado. The trip will involve a 1-hour drive from Denver to Ft. Collins, then up the Poudre River canyon a short distance to the field site. Most of the day will be spent at one or two sites; the group will return to Denver by 6 p.m. Topics to be covered during the field trip will include (1) frequency of major flooding on Front Range rivers; (2) the role of episodic erosion in landscape evolution; (3) fluvial response to fire; and (4) sediment transport and morphodynamics of high-gradient river systems.

**420. Denver's Building Stones**

Tues., 30 Oct. Jack Murphy, Denver Museum of Nature & Science, 2001 Colorado Blvd., Denver, CO 80205, USA, denverbasin@dmns.org; Robert G. Reynolds. Min: 15; max: 30. Cost US\$39 (R).

On this trip, you'll visit a series of buildings in downtown Denver and examine the rock types that were used to construct and decorate the edifices. We will see a wide variety of urban geology, from richly decorative rocks imported from around the world to local material quarried within sight of Denver.

POSTMEETING

**421. Late Quaternary through Holocene Landscape Evolution of the White River Badlands, South Dakota**

Weds.–Sat., 31 Oct.–3 Nov. Patrick Burkhardt, Geography, Geology, and Environment, Slippery Rock University, 335 ATS, Slippery Rock, PA 16057, USA, +1-724-738-2502, patrick.burkhardt@sru.edu; Rachel Benton; Michael Jahn; J. Elmo Rawling III; Jack Livingston. Min: 12; max: 30. Cost US\$410 (3ON, L, R).

Badlands are common arid and semi-arid landscapes long recognized in slope development and erosion rate studies by preeminent geomorphologists, including Gilbert, Davis, and Schumm. This trip will examine in detail Quaternary strata and landscape evolution in arguably the most famous badlands,

the White River Badlands of South Dakota, which were pivotal during the development of vertebrate paleontology in North America. Geologists have collected fossils from the White River Group nearly every field season since the mid-1800s; however, until recently, little work described the extensively exposed Quaternary strata. The White River Badlands are also a proposed dust source for the widespread Peoria Loess of the Central Great Plains. Research highlighted on this trip includes (1) luminescence and radiocarbon ages from late Pleistocene through Holocene eolian sand; (2) radiocarbon ages from Holocene eolian cliff-top deposits; (3) luminescence ages from late Pleistocene fluvial silts; (4) radiocarbon ages of late Holocene fluvial silts; and (5) cosmogenic ages on ventifacts from modern pediments. These new works will facilitate discussions on late Quaternary paleoenvironments, late Quaternary fluvial incision rates, up-wind sediment supply of late Quaternary nonglaciogenic loess, landscape evolution spanning late Pleistocene tableland through late Holocene sod table development, and modern erosion and pedimentation rates.

**422. A GeoMystery Field Trip to the Anton Escarpment**

Cosponsored by *GSA Engineering Geology Division; GSA Quaternary Geology and Geomorphology Division*

Thurs., 1 Nov. David C. Noe, Colorado Geological Survey, 1313 Sherman St., Rm. 715, Denver, CO 80203, USA, +1-303-866-2432, dave.noe@state.co.us. Min: 6; max: 36. Cost US\$85 (L, R).

Everybody loves a mystery. One of Colorado's great mysteries is the origin of the "Anton escarpment" that crosses eastern Colorado's high plains for nearly 100 miles. Was it formed by movement along a fault? If so, what is the timing? Or is this straight-line feature a product of massive, late Pleistocene erosion? The highlight of this field trip will be the examination of new research trenches dug into the slope of the 80-ft-high escarpment. We will look at trench stratigraphy and archeology, and (if present) indicators of seismogenic movement. Because these trenches will be dug later in 2007, even the field trip leaders don't know exactly what we'll see!

**423. Integrated Analysis of Laramide to Holocene Deformation of the Northeastern Front Range Using 3-D Balancing and Comparative Fracture Analysis of Pre- and Post-Laramide Strata**

Cosponsored by *GSA Structural Geology and Tectonics Division*

Thurs., 1 Nov. Eric A. Erslev, Dept. of Geosciences, Colorado State University, Fort Collins, CO 80523, USA, +1-970-491-6375, erslev@warnercnr.colostate.edu; Scott M. Larson. Min: 12; max: 36. Cost US\$79 (L, R).

This field trip will unravel the multistage folding and fracturing of the Rocky Mountains by integrating larger fold and fault geometries with detailed minor fault, joint, and paleomagnetic analyses in a transect just south of the Colorado-Wyoming border. Extensive fault analyses in this area of diverse structural trends show both regional Laramide shortening and local deformation partitioning, which are integrated into a restorable 3-D model of the Laramide deformation. The timing and

mechanisms of extensional fracturing (jointing) are revealed by comparing their orientations to minor faults in the spectacularly folded pre-Laramide strata and to fractures in on-lapping post-Laramide strata. The trip will traverse new open space acquisitions that span the Front Range foothills and include the Lindenmeier archaeological site of the Folsom culture.

**424. Stratal Architecture and Sequence Stratigraphy of the Mount Garfield Formation, Grand Junction Area, Colorado**

Thurs.–Sat., 1–3 Nov. Diane L. Kamola, Geology, University of Kansas, 1475 Jayhawk Blvd., Lawrence, KS 66045, USA, +1-785-864-2724, kamola@ku.edu; Andrew S. Madof; Mustapha Zater. Min: 24; max: 36. Cost US\$270 (2ON, L, R).

This trip will present a depositional and high-resolution sequence stratigraphic analysis for the Upper Cretaceous Mount Garfield Formation, Grand Junction area, Colorado. The Mount Garfield Formation is interpreted as coastal plain to shoreline-nearshore environments, and represents the final regression of the western interior seaway. Nearshore and tidal environments are well exposed. Detailed field study has identified five depositional sequences, each bracketed by a well-documented sequence boundary (regional erosion surface overlain by a basinward shift of facies). The five sequences will be examined in stratigraphic succession, starting with the most proximal (western) exposures and working progressively eastward (i.e., more distally) with each stop. Highstand deposits will be traced along depositional dip, from proximal to distal exposures. These consist primarily of wave-dominated shoreface successions and range from distal offshore siltstones to shoreline sandstones. Parasequence architecture of the highstands will be emphasized, including the regional distribution of component subenvironments. Facies of the lowstand and transgressive systems tracts consisting primarily of incised valley fill deposits will also be emphasized. Incised valley fill strata are complex: some valley fills are characterized by vertically nested fluvial successions, while others contain vertically stacked, tidally influenced sandstones. Many localities contain stacked incised valley fills, which are discernable only through detailed outcrop mapping. A sequence stratigraphic interpretation of the Mount Garfield Formation illustrates the complex stratal geometries associated with higher frequency sequences, as well as the compartmentalization of a formation caused by the depositional response to rapid and successive changes in base level.

**425. Laramide Paleoseismites of the Bighorn Basin**

Thurs.–Sun., 1–4 Nov. Mervin J. Bartholomew, Earth Sciences, University of Memphis, Memphis, TN 38152, USA, +1-901-678-1613, jbrthlm1@memphis.edu; Kevin G. Stewart. Min: 10; max: 30. Cost US\$420 (3ON, L, R).

Paleocene-Eocene faulting along the Beartooth fault in southern Montana and northern Wyoming and earlier faulting in Elk Basin generated numerous large earthquakes. The record of these earthquakes is spectacularly preserved as paleoseismites in synkinematic sediments within the adjacent Bighorn Basin. This field trip will focus on new work by Bartholomew, Stewart, and their graduate students on the nature and distribution

of these paleoseismites and their relationship to the kinematic history of the Beartooth front. Field trip stops will include sites in the basin from Red Lodge, Montana, to near Clark, Wyoming. Most of the exposures are within the Paleocene Fort Union Formation and are easily accessible by vehicle and short hikes. Day 1 of the trip will consist of driving from Denver to Red Lodge, Montana, where we will stay overnight. Days 2 and 3 will be spent examining paleoseismites in the Basin, returning to Red Lodge each night. On Day 4, we will return to Denver.



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**426. Walking with Dinosaurs along Colorado's Front Range**

Thurs., 1 Nov. Joanna Wright, Geography & Environmental Sciences, University of Colorado–Denver, Campus Box 172, P.O. Box 173364, Denver, CO 80217, USA, +1-303-556-6007, jwright@carbon.cudenver.edu. Min: 12; max: 45. Cost US\$70 (L, R).

This will be a one-day trip through late Paleozoic to Mesozoic terrestrial paleoenvironments of the Front Range west of Denver. These sediments comprise a transgressive-regressive sedimentary cycle starting with the uplift of the ancestral Rocky Mountains in the mid to late Paleozoic through the fluvial sediments of the Morrison, the marginal marine and coastal deposits of the Dakota Sandstone, and the fluvial deposits of the latest Cretaceous Laramie Formation. Participants will visit some classic fossil bone and footprint localities, including one of Arthur Lakes' historic quarries and the site of the only known ceratopsian trackways.

**427. Geomorphic Effects of a Catastrophic Forest Fire**

Thurs., 1 Nov. Lee McDonald, U.S. Forest Service, Denver, CO, USA, leemac@cnr.colostate.edu; Robert G. Reynolds. Min: 12; max: 45. Cost US\$69 (L, R).

This trip will visit the area burned by the catastrophic Hayman Fire. We will examine the sedimentary responses to the fire damage and consider the long-term effects of such a major fire in the Colorado Rockies.

**428. Old and New Geologic Studies along the Front Range between Golden and Morrison, Including Structural, Volcanic, and Economic Geology and Paleontology (2)**

Cosponsored by *Friends of Dinosaur Ridge*; *GSA Geoscience Education Division*; *GSA Sedimentary Geology Division*

Thurs., 1 Nov. Chris Carroll, Friends of Dinosaur Ridge, 16831 W. Alameda Pkwy., Morrison, CO 80465, USA, +1-303-697-3466, carroll\_chris@msn.com; Tim Connors; Harald Drewes; T. Caneer; Norb Cygan. Min: 12; max: 45. Cost US\$85 (L).

This field trip will visit the Laramide uplifted late Paleozoic to early Cenozoic stratigraphic interval exposed between Golden and Morrison, Colorado. Topics to be presented include dinosaur remains of three ages, folds, faults, and two-stage volcanism associated with the Laramide Orogeny. Economic deposits, past and present, will be observed along the way, including a uranium roll front and oil seeps near Morrison. This field trip provides geologic educators with an opportunity to view excellent field lab sites for geology instruction, including Mesozoic dinosaur tracks and bones of the Dakota Sandstone and Morrison Formation. Field trip stops will include the classic dinosaur track site at Dinosaur Ridge, Triceratops Trail, Red Rocks Park, and North and South Table Mountains.

**429. Coeval Miocene Magmatism and Crustal Extension in the Colorado River and Death Valley Extensional Terrains**

Thurs.–Sun., 1–4 Nov. J.P. Calzia, USGS, 345 Middlefield Road, Menlo Park, CA 94025, USA, +1-650-329-5538, jcalzia@usgs.gov; O. Tapani Rämö; C.F. Miller. Min: 10; max: 20. Cost US\$430 (3ON, L, R).

Geologic, petrologic, and isotopic studies of Miocene plutonic and volcanic rocks in the Colorado River and Death Valley extensional terrains demonstrate a close temporal and spatial relation between magmatism and crustal extension; the coeval nature of the magmatic rocks and extensional structures suggest a genetic and possibly a dynamic relationship between these geologic processes. This four-day post-meeting trip will begin and end in Las Vegas, Nevada; field evidence and lab data presented during this trip will be summarized into a magmatic-tectonic model that relates magmatism to coeval crustal extension in extensional terrains.

**430. Aquifer Stratigraphy in the Denver Basin**

Fri., 2 Nov. Robert G. Reynolds, Denver Museum of Nature & Science, 2001 Colorado Blvd., Denver, CO 80205-5798, USA, +1-303-370-6047, denverbasin@dmns.org; John Moore; Marieke Dechesne; Steven A. Boand. Min: 8; max: 22. Cost US\$90 (L, R).

Trip participants will visit outcrops of the important bedrock aquifers in the Denver Basin. We will examine a series of detailed subsurface datasets tied to the outcrops and evaluate the volume and character of the groundwater resource that is being rapidly exploited in the Douglas County area. This trip will be of interest to stratigraphers, water-use planners, and residents of the Front Range urban corridor.

**431. New Perspectives and an Update on Continental Accretion—Colorado Style: Island Arcs and Backarcs of the Central Front Range**

Fri., 2 Nov. Thomas R. Fisher, Dept. of Geology and Geological Engineering, Colorado School of Mines, Golden, CO 80401, USA, +1-303-349-2303, tfisher@mines.edu; Lisa Rae Fisher. Min: 10; max: 40. Cost US\$85 (L, R).

This is an all-new update of our popular field trip held during the 2004 Denver Annual Meeting. It is a one-day trip through the Central Front Range of Colorado to examine the ca. 1.7 Ga metamorphosed volcanic and sedimentary sequences formed during the accretion of Colorado onto the North American craton. Island arc, backarc, and sedimentary basin fill sequences that comprise the so-called “Idaho Springs Formation” will be examined. The possible origins and significance of the Coal Creek Quartzite, an amphibolite-grade metasandstone and conglomerate, will be discussed and presented. The trip will feature the original stops plus two new stops to further examine implications of the metamorphic sequences and textures in interpreting the paleogeology and geography of the original protolith. Implications and significance of new geochronology will be discussed and examined. Finally, the trip will attempt to put the Central Front Range accretionary sequences into a more global context by comparison with worldwide events, such as accretionary events of similar age around the West African Craton.

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## ➤ Denver 2007 Short Course Program ⇐

GSA-sponsored professional development short courses will be held immediately before and during the annual meeting and are open to members and nonmembers. If you register *only* for a short course, you must pay the Short Course Only registration fee in addition to the course fee. This fee may be applied toward meeting registration if you decide to attend the meeting. Excepted from this requirement are GSA K–12 Teacher Members, who need only pay the short course fee if not attending the entire meeting.

Early registration is recommended; standard registration (after 24 Sept.) is an additional US\$30. **Cancellation Deadline: 1 Oct. 2007.** See [www.geosociety.org/meetings/2007/cw.htm](http://www.geosociety.org/meetings/2007/cw.htm) or contact Jennifer Nocerino, [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org), for additional information on short courses.

### PROFESSIONAL COURSES

#### **501. Estimating Rates of Groundwater Recharge**

Sat., 27 Oct., 8 a.m.–5 p.m. Rick Healy, U.S. Geological Survey; Bridget Scanlon, Bureau of Economic Geology, The University of Texas at Austin. Limit: 35. Fee: US\$214; includes course materials and lunch. CEU: 0.8.

**Abstract:** Estimates of groundwater recharge are required to accurately assess water resources and evaluate aquifer vulnerability to contamination. This course will review theory, assumptions, uncertainties, advantages, and limitations of different approaches for estimating recharge rates. We will discuss physical, tracer, and numerical modeling techniques based on surface water, unsaturated zone, and saturated zone data. The course content is aimed at practicing hydrologists and advanced hydrology students.

#### **502. Laser Ablation ICP-MS: Fundamentals and Applications to Geological, Environmental, and Biological Problems**

Sun., 28 Oct., 8 a.m.–5 p.m. Alan Koenig, U.S. Geological Survey; Ian Ridley, U.S. Geological Survey. Limit: 30. Fee: US\$262; includes course materials and lunch. CEU: 0.8.

**Abstract:** This course will cover the basics of laser ablation–inductively coupled plasma–mass spectrometry (LA-ICP-MS) as applied to a wide range of geological, environmental, and biological samples. Both fundamentals of the technique and applications to minerals, fluid inclusions, teeth, bones, corals, tree rings, rock and ore powders, among others, will be presented. Instructors will cover these topics by including practical information about how these applications are tackled and what future directions are possible. New directions for LA-ICP-MS, such as isotopic analyses by multi-collector ICP-MS and bulk analysis by large spot capable LA systems will also be covered. The course is intended for those already using laser ablation as well as those just interested in learning more about the technique.

### FACULTY

### AND GRADUATE STUDENT COURSES

#### **503. Three-Dimensional Geologic Mapping for Groundwater Applications**

Sat., 27 Oct., 8 a.m.–5 p.m. Cosponsored by *GSA Geology and Society Division; GSA Hydrogeology Division*. Richard C. Berg, Illinois State Geological Survey; Harvey Thorleifson, Minnesota Geological Survey; Hazen Russell, Geological Survey of Canada. Limit: 55. Fee: US\$61; includes course materials and lunch. CEU: 0.8.

**Abstract:** There is an increasingly pressing need for high quality 3-D geological information about shallow deposits as attention to environmental and land-use issues, as well as evaluation of regional groundwater systems and their long-term sustainability, continue to grow. Demands for this information are becoming increasingly compelling, but there is a continuing lack of high-quality data, maps, and models. This workshop focuses on experimenting with new ways to deal with large data sets, integrating data of variable quality with high-quality data, and developing methods to construct 3-D geologic models that can be used for hydrogeologic modeling.

#### **504. Sequence Stratigraphy for Graduate Students**

Fri.–Sat., 26–27 Oct., 8 a.m.–5 p.m. Cosponsored by *ExxonMobil; BP*. Kirt Campion, ExxonMobil Upstream Research Company; Art Donovan, BP Upstream Technology Directorate. Limit: 55. No fee. Preregistration required. For information or to register, please contact [kirt.m.campion@exxonmobil.com](mailto:kirt.m.campion@exxonmobil.com). CEU: 0.8.

**Abstract:** This free short course is designed to teach graduate students the principles, concepts, and methods of sequence stratigraphy. Sequence stratigraphy is a methodology that uses stratal surfaces to subdivide the stratigraphic record. This methodology allows the identification of coeval facies, documents the time-transgressive nature of classic lithostratigraphic units, and provides geoscientists with an additional way to analyze and subdivide the stratigraphic record. Using exercises that utilize outcrop, core, well-log, and seismic data, the course provides a hands-on experience for learning sequence stratigraphy. The exercises include classic case studies from which many sequence stratigraphic concepts were originally developed.

#### **505. Introduction to the “Learning with Data Workshop”**

Sun., 28 Oct., 8 a.m.–noon. William A. Prothero, Jr., University of California at Santa Barbara; Sabina Thomas, Baldwin Wallace College. Limit: 25. Fee: US\$30; includes course materials and refreshments. CEU: 0.4.

**Abstract:** The “Learning with Data Workshop” (LWD) is a comprehensive resource intended to support learning about Earth using real data. It allows learners to access earth data,

create and annotate data display images, and incorporate them into writing activities, which are also included in the package. It also supports the study of plate tectonics and oceanography. Workshop participants will gain familiarity with the software content and its use, learn how to use it to support effective inquiry/writing activities, and learn how to customize the assignments that are included with LWD. For more information, see <http://lwd.earthednet.org/>.

**506. New Tools for Quantitative Geomorphology: Extraction and Interpretation of Stream Profiles from Digital Topographic Data**

Sun., 28 Oct., 9 a.m.–5 p.m. Cosponsored by NSF *Geomorphology and Land Use Dynamics*; GSA *Quaternary Geology and Geomorphology Division*. Kelin Whipple, Arizona State University; Cameron Wobus, University of Colorado; Eric Kirby, Pennsylvania State University; Benjamin Crosby, Idaho State University. Limit: 20. Fee: US\$30; includes course materials and lunch. CEU: 0.7.

**Abstract:** Empirical data from rivers around the world demonstrate a positive correlation between steepness (gradient normalized to drainage area) and the rate of rock uplift. This short course will teach graduate student, professional, and faculty participants how to utilize a set of integrated global information system (GIS) and numerical analysis tools to exploit this relationship and extract semi-quantitative estimates of rock uplift rates from digital elevation models (DEMs). We will discuss how to obtain and preprocess raw DEM data; how to use our software to create GIS-based maps of river steepness, concavity, and knickpoint locations; and how to interpret these data for tectonic analysis.

**507. Processing and Analysis of GeoEarthscope and Other Community LiDAR Topography Datasets**

Sat., 27 Oct., 9 a.m.–5 p.m. Ramon Arrowsmith, Arizona State University; Chris Crosby, Arizona State University; David Phillips, UNAVCO. Limit: 20. Fee: US\$180; includes course materials and lunch. CEU: 0.7.

**Abstract:** LiDAR (Light, Distance, and Ranging [also, Airborne Laser Swath Mapping; ALSM]) topographic data are of broad interest to earth scientists. Many datasets are or will be available freely to the scientific community, especially for fault systems in the western United States via the GeoEarthscope project. These data have exciting and powerful applications in geomorphology, active tectonics, and geoscience education. Participants in this course will learn about LiDAR technology, access to publicly available datasets, software and hardware considerations for working with the data, data processing (raw or classified point clouds, digital elevation models, other derived products), and approaches for analyzing the data to answer their research questions.

**508. Starting out in Undergraduate Research and Education: A Professional Development Workshop for Young Faculty**

Sat., 27 Oct., 8 a.m.–5 p.m. Cosponsored by *Council on Undergraduate Research*; *National Association of Geoscience Teachers*; GSA *Geoscience Education Division*. Jeffrey G.



Active travertine spring mound issuing on the Tierra Amarilla anticline, near San Ysidro, New Mexico. Photo by Dennis Newell, *GSA Today* cover, v. 15, no. 12.

Ryan, University of South Florida; Lydia K. Fox, University of the Pacific; Jill Singer, Buffalo State College. Limit: 30. Fee: US\$50; includes course materials and refreshments. CEU: 0.8.

**Abstract:** This workshop is focused on developing a successful research program involving undergraduate participants and on inquiry-based courses and teaching practices that are effective in preparing students to pursue research. The course is designed to serve the needs of early-career faculty and others considering academic careers. The workshop facilitators are all current or former officers of the Council on Undergraduate Research and/or the National Association of Geoscience Teachers who have extensive experience in working successfully with undergraduate students in their research enterprises.

**509. Seismic Data Usage for Undergraduates: Options for Both Majors and Non-Majors**

Sat., 27 Oct., 8 a.m.–5 p.m. Cosponsored by GSA *Geoscience Education Division*. Michael Hubenthal, Incorporated Research Institutions for Seismology (IRIS) Consortium; Michael Wyssession, Washington University; John Taber, IRIS Consortium; Jeff Barker, Binghamton University. Limit: 25. Fee: US\$15; includes course materials and lunch. CEU: 0.8.

**Abstract:** This workshop is intended for two-year and four-year college and university faculty who teach earth science courses and are interested in learning more seismology-related content, methods to access seismic data, and methods to incorporate both the content and data in their courses and labs. Seismology content covered during the workshop will include aspects of the following: causes of earthquakes, propagation of seismic waves, statistics of the spatial and temporal distribution of earthquakes, determination of Earth's structure using seismic

data, and earthquake hazards. In addition, the workshop will include one section that is focused on “hot or current topics” of modern seismology.

### **510. Teaching Field Methods in Hydrogeology**

Sat., 27 Oct., 8 a.m.–5 p.m. Cosponsored by *GSA Hydrogeology Division*. Todd Halihan, Oklahoma State University; Shemin Ge, University of Colorado; Ed Harvey, University of Nebraska–Lincoln. Limit: 80. Fee: US\$147; includes course materials and lunch. CEU: 0.8.

**Abstract:** Understanding the use and limits of field equipment is a significant component of hydrogeological science. This short course provides the material and exposure to better train faculty to teach hydrogeology field methods. The course is focused on university or high school faculty who are teaching hydrogeology but may not have training in hydrogeological field techniques. The course will cover field safety and liability, phreatic and vadose equipment, geophysical methods, direct push techniques, and inexpensive methods that cost less than US\$100. The course will be held at a field site near Denver, and equipment will be supplied by GSA vendors.

### **511. Education Research: An In-Depth Look at Qualitative Methods**

Sat., 27 Oct., 1–5 p.m. Julie Sexton, Colorado State University. Limit: 55. Fee: US\$100; includes course materials. CEU: 0.4.

**Abstract:** Participants will learn about qualitative data collection and analysis methods used in geoscience education research. Qualitative research involves the collection and analysis of data from sources such as interviews, classroom observations, and student writings and drawings. It is the building block of and a complement to quantitative education research. Case studies, demonstrations, and hands-on activities will introduce participants to qualitative education research. This workshop is geared for college and K–12 educators, researchers, and students who are conducting or planning education research. Faculty: Julie Sexton, Geoscience Education Doctoral Fellow, National Science Foundation (NSF) Center for Learning and Teaching in the West, Colorado State University; Project Coordinator, NSF Rocky Mountain Middle School Math and Science Partnership, University of Colorado at Denver and Health Sciences Center; ju.sexton@colostate.edu.

### **512. Strategies for Successful Recruitment of Geoscience Majors: Conceptual Framework and Practical Suggestions**

Sat., 27 Oct., 9 a.m.–5 p.m. Cosponsored by *GSA Geoscience Education Division*; *National Association of Geoscience Teachers*. Randall M. Richardson, University of Arizona; Carolyn Eyles, McMaster University. Limit: 35. Fee: US\$50; includes course materials and refreshments. CEU: 0.7.

**Abstract:** Participants in this workshop will identify and discuss successful recruitment strategies for geoscience programs and will have the opportunity to develop an “action plan” to enhance recruitment initiatives in their own department or institution. Panel and other presentations will outline successful recruitment strategies in a variety of contexts (e.g., national-

local, internal-external to the department, in different types of institutions), and include ample time for discussion groups and “brainstorming” sessions.

## K–12 TEACHER COURSES

### **513. Teaching College-Level Earth Science to High-School Students**

Sat., 27 Oct., 8 a.m.–noon. Cosponsored by *National Science Foundation*. Wendy Van Norden, Harvard-Westlake School; Raymond V. Ingersoll, University of California at Los Angeles. Limit: 25. Fee: US\$5; includes course materials and refreshments. CEU: 0.4.

**Abstract:** “College-Level Earth Science for High School Students” is a college-level geoscience course for which high-school students may earn college credit at a collaborating university. The course was designed to attract top science students who would otherwise choose advanced placement courses in other sciences. This short course will introduce high school teachers to the course as it is being taught at Harvard-Westlake School in collaboration with UCLA. Teachers will be introduced to the curriculum, try some of the labs, receive free rock and mineral samples, and discuss the challenges of introducing the course into a school.

### **514. Using GPS Data to Learn about Tectonic Plate Movement, Earthquakes, Volcanoes, and Other Applications: A Workshop for Educators in Secondary Education**

Sun., 28 Oct., 1–5 p.m. Susan C. Eriksson, UNAVCO; Shelley E. Olds, UNAVCO. Limit: 20. Fee: US\$41; includes course materials and refreshments. CEU: 0.4.

**Abstract:** This course is geared toward educators in middle and high schools who teach earth science or a science course in which plate tectonics is a topic. Educators will be introduced to place-based, data-rich educational materials about global positioning system (GPS) and plate tectonics to use in their classrooms, receive an introduction to high-precision GPS, and have the opportunity to discuss pedagogical strategies for classroom implementation. Anticipated topics include faulting along the San Andreas fault, monitoring volcano deformation, and recent advances in researching slow earthquakes in Cascadia. Although individuals with GPS experience are welcome, knowledge of GPS is not required. Participants are encouraged but not required to bring a laptop computer. Materials will be available prior to the course at [www.unavco.org/cws/2007GSA\\_course/](http://www.unavco.org/cws/2007GSA_course/).

## Continuing Education Unit (CEU) Service

All professional development courses and workshops sponsored by GSA offer CEUs. A CEU is made up of 10 contact hours of participation in an organized continuing education experience under responsible sponsorship, capable direction, and qualified instruction. A contact hour is defined as a typical 60-minute classroom instructional session or its equivalent; ten instructional hours are required for one CEU.



## ➤ K-12 Education Events ◀

### GSA Education Share-a-Thon

Share in the success of others!

Sun., 28 Oct., 5:30–7:30 p.m.

Mon.–Tues., 29–30 Oct., 9 a.m.–5:30 p.m.

Wed., 31 Oct., 9 a.m.–2 p.m.

Join us at the Share-a-Thon booth in the Exhibit Hall to meet other educators and learn about their activities. At the same time, pick up FREE education materials and share your favorites!

### K-12 Building Stones of Denver EarthCache Tour

Sun., 28 Oct., 9 a.m.–TBD

K-12 teachers, spouses, and guests are invited to explore the canyons of downtown Denver in search of fossils, rocks, and lesson ideas to enhance their classes. Bring your GPS unit along to help locate these EarthCaches. The trip will be followed by lunch, with opportunities for sharing ideas with colleagues and professional geologists, freebies, and a pass to the GSA Exhibit Hall. We will meet outside Union Station at 9 a.m. on Sunday. For more information, contact [educator@geosociety.org](mailto:educator@geosociety.org).

### EDUCATOR SHORT COURSES

To learn more about these short courses, see page 22–24 of this issue.

#### 505. Introduction to the "Learning with Data Workshop"

Sun., 28 Oct., 8 a.m.–noon.

Limit: 25. Fee: US\$30; includes course materials and refreshments. CEU: 0.4. Information: <http://lwd.earthednet.org/>.

#### 513. Teaching College-Level Earth Science to High-School Students

Sat., 27 Oct., 8 a.m.–noon.

Cosponsored by National Science Foundation. Limit: 25. Fee: US\$5; includes course materials and refreshments. CEU: 0.4.

#### 514. Using GPS Data to Learn about Tectonic Plate Movement, Earthquakes, Volcanoes, and other Applications: A Workshop for Educators in Secondary Education

Sun., 28 Oct., 1–5 p.m.

Limit: 20. Fee: US\$41; includes course materials and refreshments. CEU: 0.4. Materials will be available prior to the course at [www.unavco.org/cws/2007GSA\\_course/](http://www.unavco.org/cws/2007GSA_course/).

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## ➤ Annual GeoScience ◀ Educators' Social Reception

Saturday, 27 Oct., 5–7 p.m.

*Appetizers and cash bar provided.*

**All educators** are invited to this relaxing forum for socializing, sharing ideas, and meeting other geoscience community members interested in education. Come get to know the GSA Education and Outreach staff as well!

*Thanks to our reception cosponsors:* GSA Education Committee, the National Association of Geoscience Teachers (NAGT), the GSA Geoscience Education Division, Cutting Edge, the Digital Library for Earth System Education (DLESE), the Incorporated Research Institutions for Seismology (IRIS) Consortium, the American Geological Institute (AGI), EarthScope, the National Earth Science Teachers Association (NESTA), and UNAVCO. The reception location will be announced in a future issue of *GSA Today*.

## ➤ 2007 Guest Program—Welcome to Denver! ◀

### SPECIAL TOURS

All GSA Annual Meeting attendees and guests are welcome to register for the following guest program tours. The additional cost of formal guest tours includes professional tour guides, roundtrip transportation, admission fees, and gratuities. **Tours may be canceled if minimum attendance is not met, so please register early!**

Guests should check in at the Guest Hospitality Suite and will then be directed to the departure location at the Colorado Convention Center. **Plan to arrive at the departure location 15 minutes before the scheduled departure time to ensure that you don't miss the bus.**

### SUNDAY, 28 OCTOBER

#### **101—Denver City Swing**

9 a.m.—noon

Take a tour through the downtown finance and business areas, as well as the revitalized parts of “old” Denver. See the spectacular Colorado State Capitol Building, and make a picture stop at Coors Field, home of the Colorado Rockies and the “Evolution of the Ball” exhibit. **Cost: US\$37. Minimum: 25.**

#### **102—Cherry Creek Art Walk**

1–4 p.m.

Cherry Creek North is an up-scale shopping district, with boutiques, spas, restaurants, galleries, and other specialty shops. This tour will visit three or four art galleries, each of which showcase a different medium or art technique. **Cost: US\$39. Minimum: 25.**

#### **103—Dinosaurs Rock!**

1–4 p.m.

It took 300 million years to create our first stop—Red Rocks Amphitheater—where two 300-foot-high red sandstone formations flank the stage and seating area. From the top of the seating area, one can view a 200-mile panorama of the Rocky Mountain foothills. This tour includes a look backstage. Next is



a visit to the outdoor classroom of Dinosaur Ridge, where, in 1877, some of the best-known dinosaurs were first discovered. **Cost: US\$53. Minimum: 25.**

### MONDAY, 29 OCTOBER

#### **104—Discover Colorado Springs**

9 a.m.—5 p.m.

The first stop is the United States Air Force Academy, with a visit to the 17-spire Cadet Chapel and the Barry Goldwater Visitors Center. Next, tour the Garden of the Gods, terrain composed of massive slabs of red sandstone rising vertically hundreds of feet from the ground. Last are stops at Old Colorado City and Michael Garman's Magic Town, a 1/6-scale miniaturized city neighborhood. **Cost: US\$63. Minimum: 25.**

#### **105—Foothills Fandango**

12:30–5:30 p.m.

This trip starts at Red Rocks Park and Amphitheater, with its towering, slanting cliffs and slabs of red sandstone rising hundreds of feet into the air, then moves on to a brief picture stop atop Golden's famous Lookout Mountain. Last is a motor coach ride into the town of Golden for a tour of the Coors Brewing Company. **Cost: US\$39. Minimum: 25.**

### TUESDAY, 30 OCTOBER

#### **106—Denver Museum of Nature & Science**

9 a.m.—1 p.m.

The Denver Museum of Nature & Science offers three floors of incredible exhibits about our planet and the creatures that live, or used to live, on it, as well as an IMAX theater. **Cost: US\$53. Minimum: 25.**

#### **107—Back to the Future**

1:30–5:30 p.m.

This tour begins at the Colorado History Museum to view its collection of historic and prehistoric artifacts and documents, then moves on to a vision of Denver's future—the new wing of the Denver Art Museum, designed by architect Daniel Libeskind. **Cost: US\$59. Minimum: 25.**

### WEDNESDAY, 31 OCTOBER

#### **108—Behind the Velvet Curtain**

10 a.m.—12 p.m.

Tour the Denver Performing Arts Complex, the largest theater complex of its kind in the world. **Cost: US\$23. Minimum: 25.**


Red Rocks Park and Amphitheater; courtesy [www.redrocksonline.com/images/media/large/pic10.jpg](http://www.redrocksonline.com/images/media/large/pic10.jpg).



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October 26 and 27, 2007

Friday: **Julie Brigham-Grette** and **David Chapman** on  
*Climate Change*. Panel discussions: *Science and Religion*  
and *Balancing a Geoscience Career and Family Obligations*

Saturday: *Field trip to Glenwood Canyon*  
Details and Registration Forms at [www.awg.org](http://www.awg.org)




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Denver International Airport (DIA) is located 24 miles northeast of downtown Denver and houses easily accessible buses, shuttles, taxis, and car rental companies. **Get up-to-the-minute Airport Information at +1-303-DIA-TIPS ext. 8477 or [www.flydenver.com](http://www.flydenver.com).**

#### Frontier Airlines

[www.frontierairlines.com](http://www.frontierairlines.com)

Receive a 10% discount on all roundtrip tickets purchased for the GSA Annual Meeting by using the meeting code **95LMUW**. The discount is applicable for travel from 24 Oct. 2007 through 3 Nov. 2007 only and is *valid only for reservations made online*. At [www.frontierairlines.com](http://www.frontierairlines.com), click on "More Search Options" and enter the meeting code in the "Meeting ID" box.

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### TRANSPORTATION OPTIONS TO & FROM DENVER INTERNATIONAL AIRPORT

#### TAXIS

Taxis are available both outside the east terminal, exit door 507, or the west terminal, exit door 510. Yellow Cab (+1-303-777-7777) and Metro Taxi (+1-303-336-9127) have wheelchair-accessible vehicles and can provide assistance for limited numbers with prior notice and reservation.

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Shuttles run to and from DIA each day from 4:30 a.m. until midnight and serve all downtown hotels. The cost is US\$19 each way or US\$34 roundtrip (for a special roundtrip rate for the GSA Meeting, please bring the coupon that will be printed in the September *GSA Today*, or print it out from the GSA Meeting Web Site). The SuperShuttle counter is on level 5 in the main terminal. SuperShuttle uses wheelchair-accessible vehicles.

### PUBLIC BUS SERVICE

**RTD**, +1-800-366-7433, +1-303-299-6000, [www.rtd-denver.com/skyRide/](http://www.rtd-denver.com/skyRide/)

**Route AF:** Regional Transportation District (RTD) wheelchair-accessible buses provide service from DIA to downtown Denver at 50 minutes past the hour from 6:50 a.m. to 12:50 a.m. Buses depart DIA from level 5, island 5, on the east side of the main terminal, outside door 511. RTD also has an information booth on level 5 in the main terminal. Route AF takes about 50 minutes and is US\$8 each way.

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**Visit [www.geosociety.org/meetings/2007/](http://www.geosociety.org/meetings/2007/) for detailed information on transportation to and around Denver.**

## CHILDCARE at the GSA Annual Meeting & Exposition

Sat.–Wed., 27–31 October  
Colorado Convention Center



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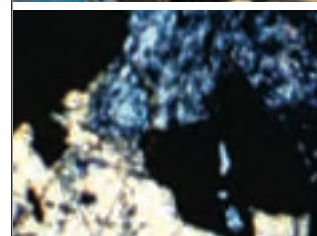
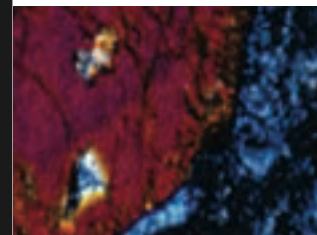
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**For more information**, contact the Meetings Department at [meetings@geosociety.org](mailto:meetings@geosociety.org). *Child care services are a contractual agreement between each individual and the childcare company. GSA assumes no responsibility for the services rendered.*

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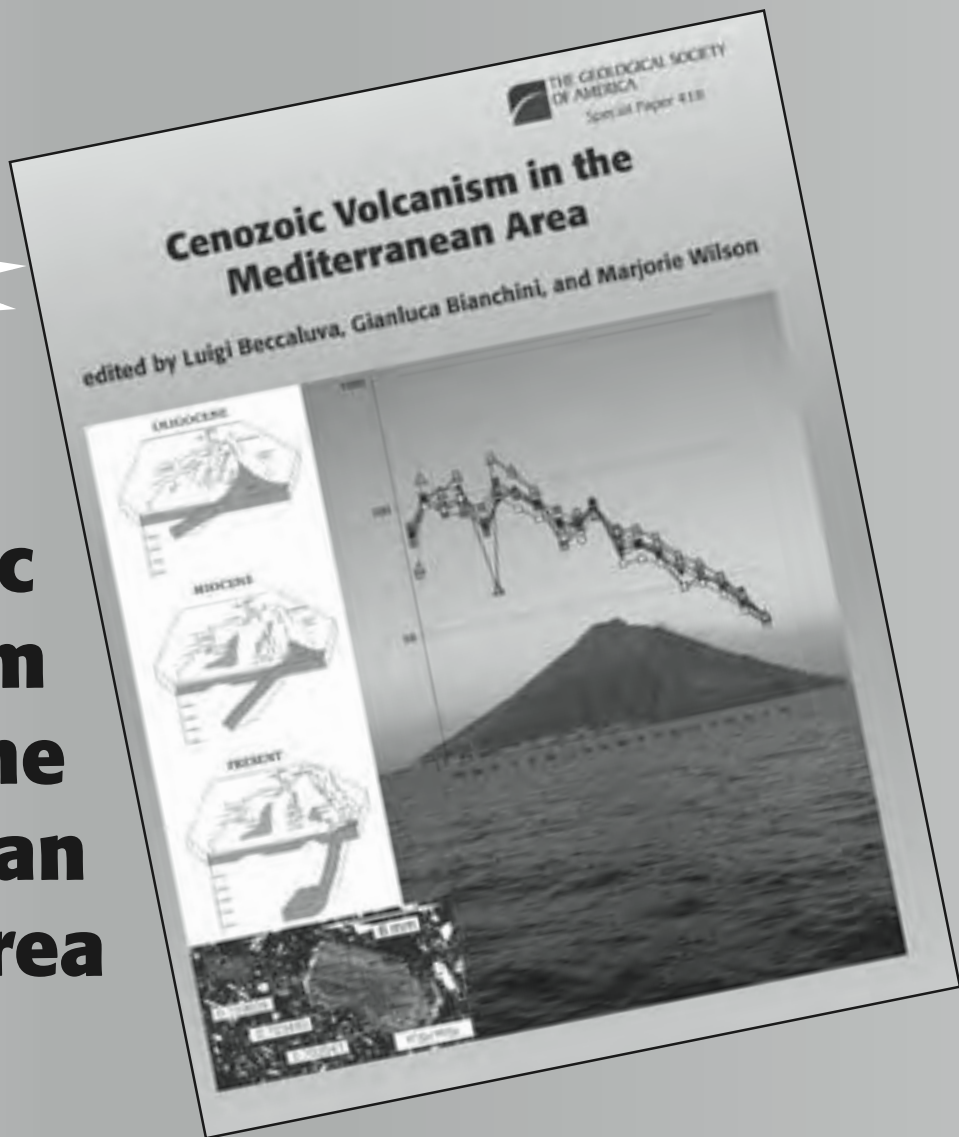
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# **Cenozoic Volcanism in the Mediterranean Area**



**edited by Luigi Beccaluva, Gianluca Bianchini, and Marjorie Wilson**

The widespread volcanism that affected the Mediterranean region during the Cenozoic includes a wide spectrum of magmatic affinities reflecting the complex geodynamic setting of the area. Magmatism is linked to the evolution of a series of subduction zones formed during Africa-Eurasia convergence, including the relative migration of trench-arc systems, opening of interarc basins, and the development of postcollisional, within-plate rifts. Mantle plume activity may also have a significant influence in a number of localities. This collection of papers documents our current understanding of the magmatism in a number of key areas, providing a useful and comprehensive reference for researchers interested in this topic.

Papers summarize results of comprehensive petrological and geochemical studies integrated with available geophysical data (including seismic tomography), allowing characterization of the mantle source of the magmas and magma generation processes. Mantle evolution and dynamics are discussed from an interdisciplinary perspective, providing an improved understanding of the complex tectonomagmatic setting of the Mediterranean region.

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IF FAXING THIS FORM, DO NOT MAIL A DUPLICATE FORM. SUBMIT ONE ROOM REQUEST PER FORM. MAKE ADDITIONAL COPIES IF NEEDED. **Reservations must be received by the Denver Housing Bureau by Friday, 28 September 2007.** Make all changes and cancellations online or contact the Housing Bureau by Friday, 19 October 2007. After Friday, 19 October 2007, you must call your assigned hotel directly. Cancellations made after Friday, 28 September 2007, will incur a charge of US\$25 regardless of when the initial room request was received.

**ONLINE: [www.geosociety.org/meetings/2007/lodging.htm](http://www.geosociety.org/meetings/2007/lodging.htm)**

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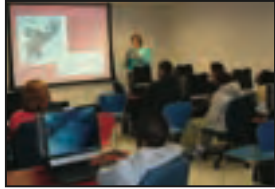
**GSA Annual Meeting & Exposition**  
**28-31 October 2007**  
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## LEADING STUDENTS TO SCIENCE

### Geoscience Days

2007 Annual Meeting in Denver, CO

If you would like to help, contact Deborah Nelson, [dnelson@geosociety.org](mailto:dnelson@geosociety.org)



#### The GSA Minorities and Women in the Geosciences Committee

thanks the following for their generous contributions to Geoscience Days at the 2006 Annual Meeting in Philadelphia:

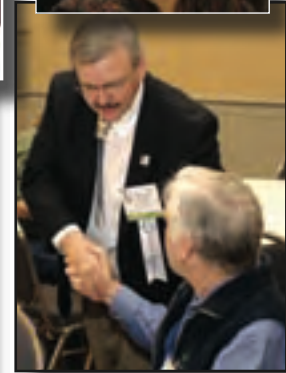
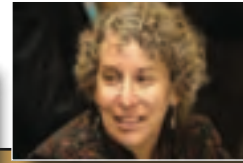
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## Thank you GSA Campus Reps! 2007 Appreciation Breakfast

Monday, 29 October, 7:00–8:30 a.m.  
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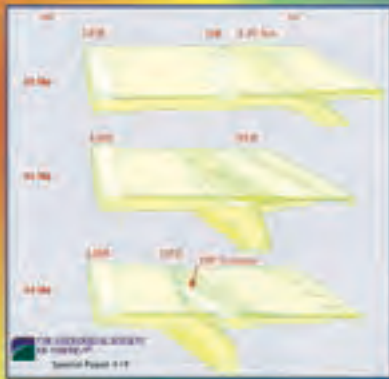
- Network with fellow Campus Reps
- Share your ideas
- Meet GSA staff



Admission is **free**, but seating is limited; please register on the Annual Meeting registration form.

### Convergent Margin Terranes and Associated Regions: A Tribute to W.G. Ernst

edited by M. Cloos, W.D. Carlson, M.C. Gilbert, J.G. Liou, and S.S. Sorensen



## Convergent Margin Terranes and Associated Regions: A Tribute to W.G. Ernst

edited by M. Cloos, W.D. Carlson, M.C. Gilbert, J.G. Liou, and S.S. Sorensen

A symposium titled “Phase Relations, High P–T-ometry, and Plate Pushing” was held at the 2003 Geological Society of America Annual Meeting as a tribute to Professor W. Gary Ernst, whose teaching career at the University of California at Los Angeles (1960–1989) and Stanford University (1989–2004) enriched the lives of thousands of undergraduate students and dozens of graduate students. One hundred and nine presentations in three oral sessions and one poster session were made by Gary’s former students, colleagues, and friends. This volume is a collection of papers that center on the geotectonic themes showcased in the symposium and reflecting the diverse interests and prodigious publications of Gary Ernst; they concern the geologic history of units formed or exposed primarily due to subduction-zone tectonism. Papers are grouped starting with those that focus directly on subduction-zone tectonics, followed by studies of terranes exposed largely because of movements at convergent margins.



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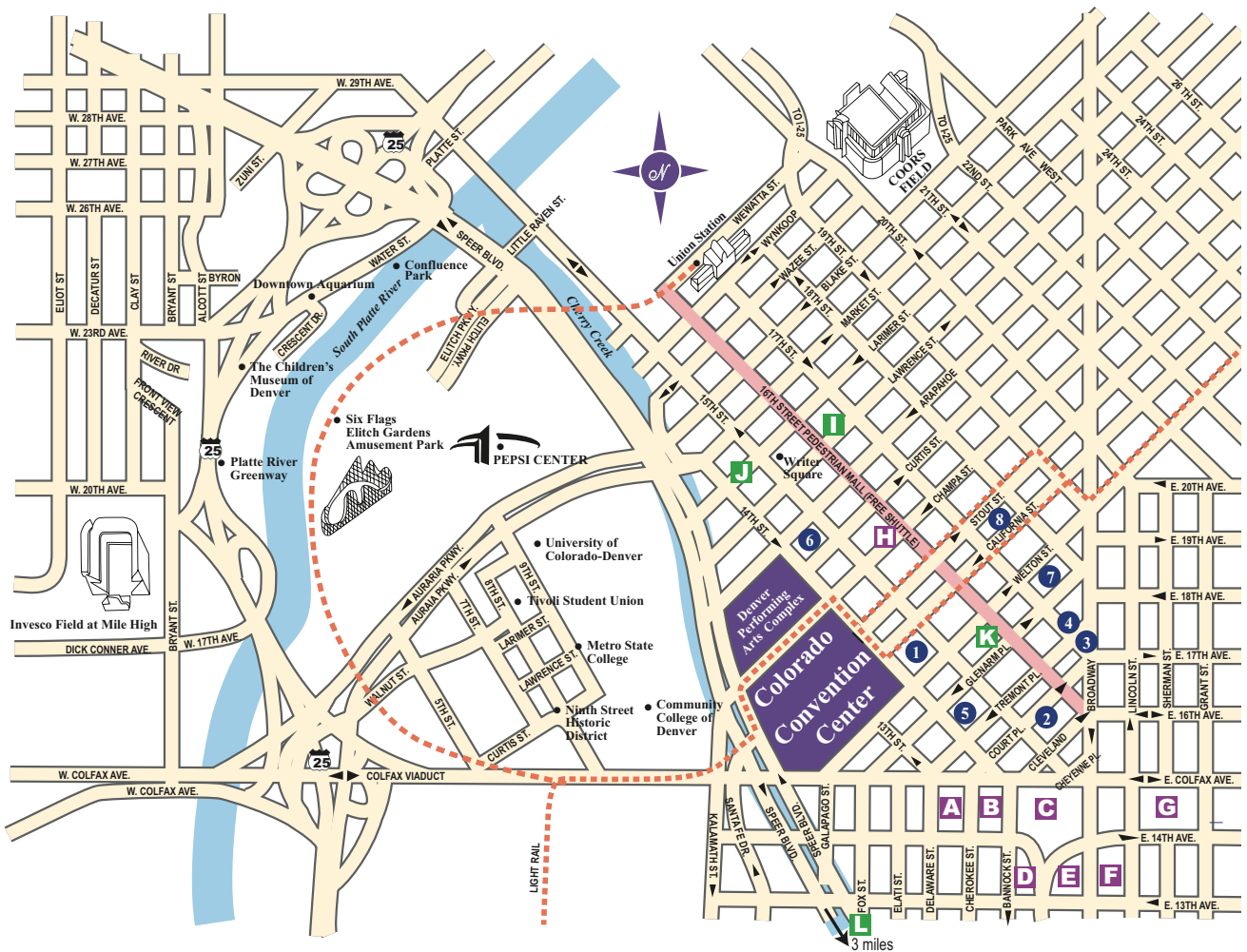
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# ➤ Denver 2007 Hotel and Street Map ◀

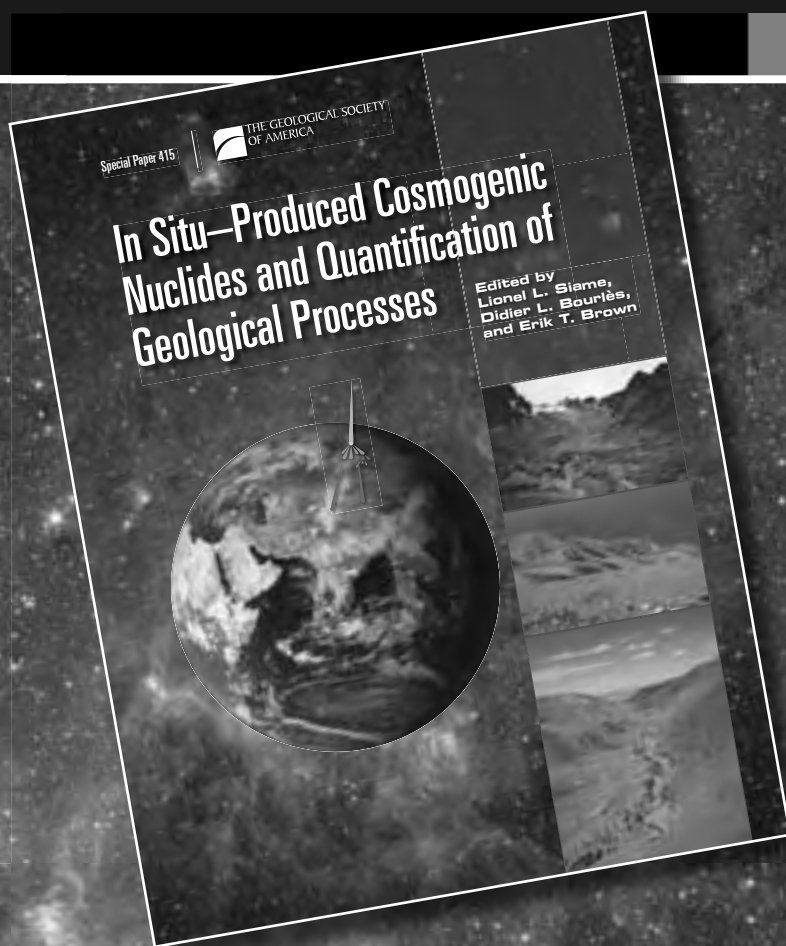
- ① Hyatt Regency (HQ Hotel): US\$175
- ② Adam's Mark: US\$139
- ③ Brown Palace: US\$174
- ④ Comfort Inn: US\$119
- ⑤ Crowne Plaza (formerly Holiday Inn): US\$129
- ⑥ Curtis: US\$124
- ⑦ Grand Hyatt: US\$165
- ⑧ Marriott City Center: US\$169



- |  |                                  |   |                                  |
|--|----------------------------------|---|----------------------------------|
| <b>A</b> U.S. Mint                     | <b>D</b> Denver Art Museum       | <b>G</b> Colorado State Capitol Building  | <b>I</b> Tabor Center Shopping   |
| <b>B</b> Denver City & County Building | <b>E</b> Denver Public Library   | <b>H</b> DMCVB Visitor Information Center | <b>J</b> Larimer Square Shopping |
| <b>C</b> Civic Center Park             | <b>F</b> Colorado History Museum |   | <b>K</b> Pavilions Shopping      |
|  |                                  |   | <b>L</b> Cherry Creek Shopping   |

# In Situ—Produced Cosmogenic Nuclides and Quantification of Geological Processes

Edited by  
**Lionel L. Siame,  
Didier L. Bourlès,  
and Erik T. Brown**



In situ—produced cosmogenic nuclides can provide chronologies of environmental change over the past few thousand to several millions of years and may be used to quantify a wide range of weathering and sediment transport processes. These nuclides are thus now used across a broad spectrum of earth science disciplines, including paleoclimatology, geomorphology, and active tectonics. This book is organized around sections that focus on specific aspects of the utilization of cosmogenic nuclides in earth sciences: (1) development of new methods for application of in situ—produced cosmogenic nuclides (burial dating methods, extending their utilization to carbonate-rich and mafic environments); (2) glacial geology (Laurentide Ice Sheet, northern Alps); (3) active tectonics, focusing on applications to constrain slip rates of active faults in Asia (Tibet and Mongolian Gobi-Altay); and (4) landscape development (quantifying sediment production or erosion rates and processes and application of exposure dating to landslides in Hong Kong).

SPE415, 158 p., ISBN-10 0-8137-2415-5;  
ISBN-13 978-0-8137-2415-7

**\$60.00**  
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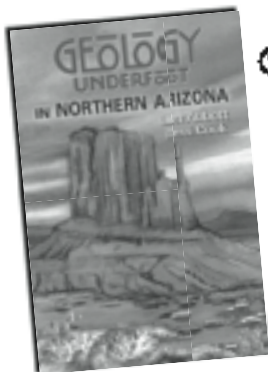
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of LOUISIANA  
SECOND EDITION  
Darwin Spearing

The timeless landscape of Northern Arizona has witnessed colliding volcanic island arcs, the rise and fall of tropical seas and towering mountain ranges, a sand sea filled with giant dunes, and the devastation of meteor impact. At twenty unique sites, with this book in hand, explore evidence of the geologic events that shaped a region.

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Atlantic Coast beaches are full of amazing features formed by the interactions between tides, currents, bedrock, weather, beach critters, and much more. This guide, written for a general audience, uses clear writing, illustrative photographs, and instructive diagrams to answer some curious questions about the beaches from Maine to Florida.

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Author Darwin Spearing explains the geologic forces behind the formation of the delta landscape, shedding light on the human struggle to control a powerful river that breaches its own levees and switches its own deltas. With sections on wetland loss and land subsidence, this is a must-read for understanding the vulnerability of the Mississippi River delta to floods and hurricane.

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September 24-30, 2007 • Hilton El Conquistador Golf and Tennis Resort • Tucson, Arizona

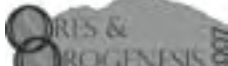
The symposium will bring together members of a diverse international geologic community including specialists in structural geology, sedimentary geology, tectonics, geochemistry, mineral exploration, and mining. It will feature outstanding Technical Programs chaired by leading geoscientists plus other events devoted to tectonics:

- **Plenary Session** - Presentations by W. Dickinson, G. Ernst, D. Bradley, S. Titley, R. Sillitoe
- **Island Arcs and Back-Arc Basins** - Brian Taylor, University of Hawaii, Chair
- **Circum-Pacific Orogenesis I** - Steve Graham, Stanford University, Chair
- **Circum-Pacific Orogenesis II** - Darrel Cowan, University of Washington, Chair
- **NW Pacific Tectonics** - Mark Brandon, Yale University, Chair
- **SW Pacific Tectonics** - David Foster, University of Florida, Gainesville, Chair
- **South American Tectonics** - Susan Beck, University of Arizona, Session Chair
- **North American Tectonics** - George Gehrels, University of Arizona, Session Chair
- **Southwest US** - Northwest Mexico Border Region - Steve Reynolds, Arizona State University, Chair
- **Hot Topics in Tectonics (Special Session)** - George Zandt, University of Arizona, Chair
- **UNESCO IGCP Symposium** - "Palaeoproterozoic Supercontinents and Global Evolution"
- **Tectonics Luncheon** - Speaker: William R. Dickinson - Palm, Sand, and Reef: Tectonics and Island Shorelines in the Tropical Pacific (A Discourse on Scenic Views)
- **Pre- and post-meeting field trips** throughout the circum-Pacific region

Presentation titles and authors can be found on the symposium website: [www.agssymposium.org](http://www.agssymposium.org). Other technical sessions will address ore deposits including porphyry systems, epithermal systems, volcanic-hosted massive-sulfide deposits, and specific deposits found in the circum-Pacific Region.

Don't miss the Reception and Banquet honoring the career of Bill Dickinson, Thursday evening, September 27, 2007

VISIT THE SYMPOSIUM WEBSITE ([www.agssymposium.org](http://www.agssymposium.org)) FOR REGISTRATION FORMS AND INFORMATION



# ➔ Denver 2007 Registration Information ◀

EARLY REGISTRATION DEADLINE: 24 September • CANCELLATION DEADLINE: 1 October

- **Register online at [www.geosociety.org](http://www.geosociety.org)**
- **Register by mail:** 2007 GSA Annual Meeting, P.O. Box 9140, Boulder, Colorado 80301-9140, USA
- **Register by fax:** +1-303-357-1071 or +1-303-357-1072

## REGISTRATION FEES (ALL FEES ARE IN U.S. DOLLARS)

	EARLY (June–24 Sept.)	STANDARD (after 24 Sept.)
Prof. Member—Full Meeting	\$310	\$399
Prof. Member—1 Day	\$205	\$225
Prof. Member >70—Full Meeting	\$255	\$340
Prof. Member >70—1 Day	\$150	\$175
Prof. Nonmember—Full Meeting	\$405	\$499
Prof. Nonmember—1 Day	\$240	\$265
Student Member—Full Meeting	\$99	\$135
Student Member—1 Day	\$70	\$75
Student Nonmember—Full Meeting	\$130	\$165
Student Nonmember—1 Day	\$85	\$90
High School Student	\$40	\$40
K–12 Teacher Member—Full Meeting	\$45	\$50
K–12 Teacher Member—Short Course Only	no fee	no fee
Field Trip or Short Course Only	\$40	\$40
Guest or Spouse	\$85	\$90
Low Income Country*	50% of category fee	50% of category fee

**Guest registration** is available for non-geologist spouses or family members and friends of a professional and/or student registrant and is required for those attending all guest activities, tours, and seminars, and for refreshments in the Guest Hospitality Suite and access to the Exhibit Hall. Formal guest tours are at an additional cost and include professional tour guides, roundtrip transportation, admission fees, and gratuities. The guest registration fee does NOT allow access to technical sessions. However, guests can sign in with the hostess in the Guest Hospitality Suite and get a visitor badge allowing them to attend a specific presentation.

**Badges:** If your registration form is received at GSA by 24 September, your badge will be mailed to you two weeks before the meeting. If you register after 24 September or are located outside the U.S., you may pick up your badge at the GSA Registration Desk, Colorado Convention Center, during the meeting.


**The Abstracts with Programs on CD-ROM** will be provided to each meeting registrant (*Field Trip or Short Course only and Guest and Spouse registrants excluded*). The 2007 Section Meeting Abstracts are also included on the CD.

### Cancellations, Changes, and Refunds

All requests for additions, changes, and cancellations must be made in writing and received by 1 October 2007. Faxes are accepted. **A US\$30 processing fee will be charged for cancellation of a full or one-day professional registration.** No refunds will be made on cancellation notices received after 1 October 2007.

\*GSA is now offering a 50% discount on annual meeting registration fees for individuals who are both residing in and are citizens of low and low-middle income countries as classified by the World Bank.

Member fees apply to members of both GSA Associated and Allied Societies (listed on the registration form). Registrations will not be processed unless full payment is received. Unpaid purchase-orders are NOT accepted as valid registration. The confirmation sent by GSA will be your only receipt. You should receive it within two weeks after your registration is submitted. Badges are needed for access to ALL activities, 8 a.m. Sunday through 5:30 p.m. Wednesday.



## Available at the GSA Bookstore


### Special Paper 417

**Triassic Evolution of the Yangtze Platform in Guizhou Province, People's Republic of China**

by Paul Enos, Daniel J. Lehrmann, Wei Jiayong, Yu Youyi, Xiao Jiafei, Daniel H. Chaikin, Marcello Minzoni, Adrian K. Berry, and Paul Montgomery

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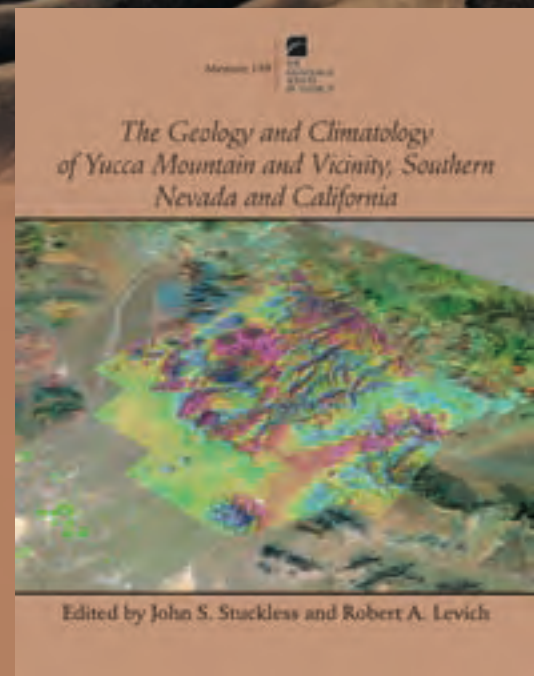
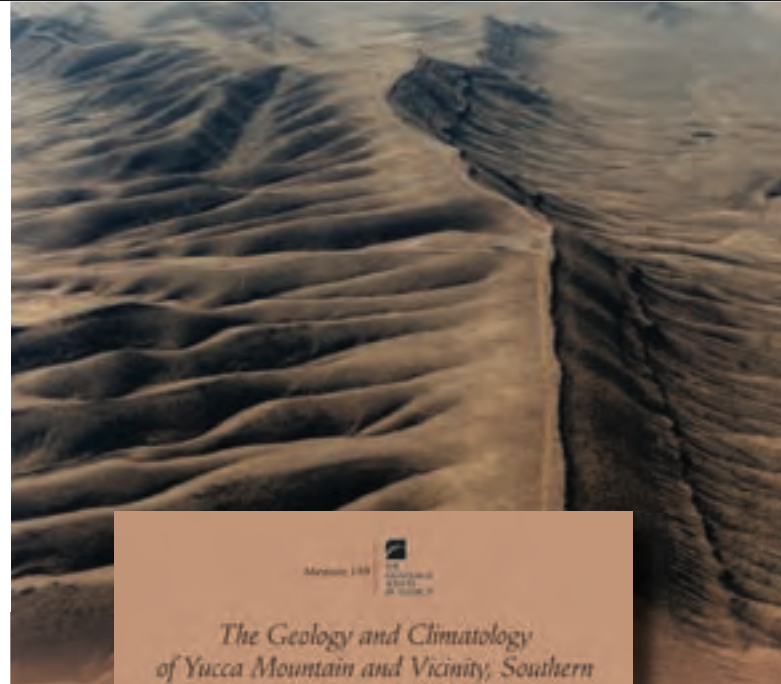
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# *The Geology and Climatology of Yucca Mountain and Vicinity, Southern Nevada and California*

Edited by John S. Stuckless and Robert A. Levich

Yucca Mountain, Nevada, has been approved by Congress as the site for the nation's high-level radioactive waste repository after more than 20 years of intensive geological and environmental study. Yucca Mountain was chosen for its geological capacity to isolate the waste for at least 10,000 years; thus, Yucca Mountain has received more detailed study and hazard analysis than any other comparable feature on the planet. The path to development, however, still faces political, technical, and scientific controversy, in part because Yucca Mountain is within the tectonically active Basin and Range province. This volume explains the reasoning and the history for the selection of Yucca Mountain. It presents important results of the site characterization study, including discussion of the tectonic setting, detailed structural geology and stratigraphy, evaluation of tectonic models that have been proposed, and a study of the climate history and possible climate change that could affect the mountain's ability to isolate radioactive waste.

MWR199, 205 p.,  
ISBN-13 978-0-8137-1199-7  
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➤ Pardee Keynote Symposia ◀

INVITED PAPERS

The Pardee Keynote Symposia are made possible by a grant from the Joseph T. Pardee Memorial Fund.

These Pardee Keynote Symposia are *special events* of broad interest to the geoscience community. The sessions are interdisciplinary, representing issues on the leading edge of a scientific discipline or area of public policy and addressing broad, fundamental issues. Selection was on a competitive basis. This year's eight Pardee Symposia were reviewed and accepted by the Annual Program Committee, and **all speakers are invited**.

**P1. Creating Citizen Scientists: Needs and Opportunities to Engage Students and the Public in the Process of Science**

Cosponsored by *National Association of Geoscience Teachers; U.S. Geological Survey*

Geoscience Education; Geoscience Information/Communication

Anne E. Egger, Stanford University, Stanford, Calif.; Robert W. Ridky, U.S. Geological Survey (USGS) Reston, Va.

Mon., 29 Oct., 1:30 p.m.–5:30 p.m.

The goal of this session is to highlight techniques that allow students and the general public greater access to the process of science, increasing their understanding of socioscientific issues, ideally leading to their participation in society as citizen scientists.

**P2. Identifying America's Most Vulnerable Oceanfront Communities: A Geological Perspective**

Marine/Coastal Science; Public Policy; Geomorphology

Joseph T. Kelley, University of Maine, Orono, Maine; Rob Young, Western Carolina University, Cullowhee, N.C.; Orrin Pilkey, Duke University, Durham, N.C.

Sun., 28 Oct., 1:30 p.m.–5:30 p.m.

Rising sea level and storms threaten shoreline development along America's beaches. This session focuses on 12 beaches at extreme risk of destruction. Speakers address common geologic and historic risk factors and weigh their future options.

**P3. Middle Eastern Water Resources in Times of Crisis**

Cosponsored by *GSA Hydrogeology Division*

Hydrogeology; Public Policy; Geology and Health

Avner Vengosh, Duke University, Durham, N.C.; John W. Lane, USGS, Storrs Mansfield, Conn.

Tues., 30 Oct., 8 a.m.–noon

This session seeks to provide an interdisciplinary overview of water resources in the Middle East that examines current depletion rates, degradation of water quality, and technological solutions within the socio-political context of the region.

**P4. New Data, Models, and Concepts of the San Andreas Fault System**

Cosponsored by *GSA Structural Geology and Tectonics Division*

Tectonics; Geophysics/Tectonophysics/Seismology; Structural Geology

Basil Tikoff, University of Wisconsin, Madison, Wisc.; Mark Zoback, Stanford University, Stanford, Calif.

Tues., 30 Oct., 1:30 p.m.–5:30 p.m.

This session is dedicated to integrating spatial and temporal variations of deformation observed on the San Andreas fault system in central California and will address new results from SAFOD (San Andreas Fault Observatory at Depth) in addition to other ongoing studies.

**P5. New Eyes and Ears on Mars: Recent Advances in Understanding the Red Planet**

Cosponsored by *GSA Planetary Geology Division*

Planetary Geology

Herbert Frey, National Aeronautics and Space Administration–Goddard Space Flight Center, Gambrills, Md.

Mon., 29 Oct., 8 a.m.–noon

A growing armada of spacecraft has steadily increased our ability to explore Mars in more detailed ways through the use of new “eyes” and “ears.” This session will highlight recent discoveries using these new sensors. The latest results will be placed in the ongoing context of both continued global mapping and persistent surface exploration.

**P6. Oxygen, Evolution, and Extinction**

Cosponsored by *Paleontological Society*

Paleontology, Diversity, Extinction, Origination; Paleoclimatology/Paleoceanography; Planetary Geology

Peter Ward, University of Washington, Seattle, Wash.; Robert Berner, Yale University, New Haven, Conn.

Sun., 28 Oct., 8 a.m.–noon

A major discovery of the twenty-first century is that oxygen levels in the past fluctuated more than previously realized, and that major geological and evolutionary events were a consequence. For instance, times of low oxygen can be blamed for at least six major or minor mass extinctions, while times of high oxygen allowed the evolution of giant insects (Carboniferous) and even the conquest of land, which took place in two parts, dictated by oxygen levels. Rates of evolution also appear to be related to oxygen levels, with more “sluggish” evolution during times of high oxygen. Even the major make-up of animal body plans into the various phyla show that adaptations for respiration were a primary driver of anatomy, while it was

an episode of higher oxygen that seems to have stimulated or allowed the first evolution of animals, according to two 2006 studies. Finally, our society must come to grips with episodes of low oxygen and oxygen-free water masses in the oceans and lakes of our planet.

**P7. Pulse of the Earth:  
Geochronology and  
Paleomagnetism of Large Igneous  
Provinces—The Key to  
Reconstructing Precambrian  
Supercontinents**

Cosponsored by *Precambrian [At Large]; International Geological Correlations Program (IGCP509) Paleoproterozoic Supercontinents and Global Evolution*

Precambrian Geology; Tectonics;  
Planetary Geology

David A.D. Evans, Yale University,  
New Haven, Conn.; Joseph G. Meert,  
University of Florida, Gainesville, Fla.

Sun., 28 Oct., 1:30 p.m.–5:30 p.m.

Supercontinents and large igneous provinces (LIPs) relate mantle processes to environmental conditions in deep time. Focused geochronologic and paleomagnetic studies of LIPs can reconstruct pre-Pangean supercontinents and assess relationships with geodynamics, metallogeny, paleoclimate, and life.

**P8. The Cause of Global Warming—  
Are We Facing Global Catastrophe  
in the Coming Century?**

Cosponsored by *GSA Quaternary  
Geology and Geomorphology Division*

Environmental Geoscience;  
Paleoclimatology/Paleoceanography;  
Quaternary Geology

Don Easterbrook, Western Washington  
University, Bellingham, Wash.

Wed., 31 Oct., 8 a.m.–noon

Possible causes of global warming will be discussed by distinguished scientists from geology, astrophysics, climatology, and oceanography. Various kinds of physical evidence for possible causes of climatic warming will be presented.



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**UPCOMING IGWMC SHORT COURSES**

**Coupled Geochemical & Transport Modeling**

**By Chunmiao Zheng, Henning Prommer, and Vincent Post**

Golden CO, USA August 6-10 Fee: \$1495/1695 after 6/23

This course is designed to introduce the participants to the model-based quantification of a wide range of water quality problems from various industries and disciplines. Taking this short course will help ground-water practitioners; understand the basics of coupled geochemical transport modeling, learn how to apply state-of-the-art models to real-world water quality problems, apply the theoretical framework with hands-on experience in the computer lab, and use the modeling tools MODFLOW, MT3DMS, PHREEQC-2 and PHT3D (which couples MT3DMS and PHREEQC-2).

**UCODE 2005 and PEST: Universal Inversion Codes for Automated Calibration**

**By Mary C. Hill and Matthew Tonkin**

Copenhagen, Denmark September 13 - 15 Fee: \$200-\$300 \*

This course is arranged in connection with ModelCARE2007. The course introduces ground-water professionals to inverse modeling concepts and their use via UCODE\_2005 and PEST, relying heavily on hands-on exercises for automatic calibration of ground-water modes to promote understanding and avoid "black-boxing".

\* With ModelCARE2007 Conference registration, the fee for the short course is US\$235 before September 1 and thereafter \$275. Without ModelCARE2007 Conference registration, the fee is \$260 before September 1 and thereafter \$300. For students, the cost of the course is \$200.

**MODFLOW: Introduction to Numerical Modeling**

**By Eileen Poeter**

Golden CO, USA October 25 - 27 Fee: \$1195/1395 after 10/11

If you want to better understand the numerical model results that are presented to you please join us! This course is designed for the hydrogeologist and environmental engineer familiar with ground-water flow concepts, but who have limited or no experience with ground-water flow modeling. The course introduces ground-water professionals to numerical modeling. Basic modeling concepts: conceptual model development, definition of boundary and initial conditions, parameter specification, finite-differencing, gridding, time stepping, and solution control using MODFLOW-2000. Basic modules of MODFLOW are explained and concepts are reinforced with hands-on exercises.

**UCODE: Universal Inversion Code for Automated Calibration**

**By Eileen Poeter**

Golden CO, USA November 1 - 2 Fee: \$895/995 after 10/17

If you want your model to help you decide what field data are needed and convince the responsible party to pay for the data; If you want to report confidence intervals on the predictions you make with your ground-water model; If you would like to spend more time being a hydrologist and less time as a "number tweaker"; If you are tired of trying to decide how much to tweak each number to calibrate your model, PLEASE JOIN US! in the UCODE course. This course is designed for the hydrogeologist and engineer already familiar with ground-water flow modeling who would like to learn to use UCODE to calibrate their models. Participants will benefit most from this short course if they have a working knowledge of ground-water modeling and some knowledge of basic statistics.

**Untangling Multivariate Relationships**

**By Dennis Helsel and Ed Gilroy**

Golden CO, USA November 1 - 2 Fee: \$895/995 after 10/17

Multivariate methods resolve what at first may look like noise into recognizable patterns, providing new insight into the field of study. However, these methods are daunting to many scientists, with acronyms like PCA, CCA or CANOCO, and with unfamiliar terms like varimax rotation and detrended correspondence. The learning curve seems steep, and useful procedures go unused. UMR covers the multivariate methods of primary interest to environmental science, focusing on what each method is designed to do, when to use them, and when not to. Methods for simplifying data are contrasted with those for establishing connections between and among source and response variables. Capabilities of various software packages are reviewed. Example data sets are analyzed by each student in class. By the end, the choice of which method to use, and how to use it, simply makes sense.

For more information on any of these courses, or to register online,  
please visit our course webpage:

<http://www.mines.edu/igwmc/short-course/>

➔ Topical and Discipline Sessions ⇐

ABSTRACTS DEADLINE: 10 JULY

New for 2007! You may present two abstracts—just make one a poster session! Details on page 55.

TOPICAL SESSIONS

Below is a listing of all approved topical sessions. These sessions are topically focused with a mix of invited and volunteered papers. Sessions are designed to promote the exchange of interdisciplinary, state-of-the-art information. Papers can be submitted to a specific topical session, and you may choose up to three scientific categories. After each topical description below, the categories are identified as they appear on the abstract form. Please SUBMIT ONLY IN THE MODE (oral or poster) AND CATEGORIES INDICATED in the description. An abstract submitted in the incorrect mode will be transferred automatically to a discipline session.

Submit your abstract at [www.geosociety.org](http://www.geosociety.org). An abstract submission fee of US\$18 for students and US\$30 for all others will be charged. If you cannot submit the abstract electronically, contact Nancy Carlson, +1-303-357-1061, [ncarlson@geosociety.org](mailto:ncarlson@geosociety.org). **Submission deadline:** 10 July 2007.

DISCIPLINE SESSIONS

From the list on the electronic abstract form (or see page 55 of this issue), you may choose up to three discipline categories into which you feel your abstract would fit best. Joint Technical Program Committee representatives will organize the papers into sessions focused on disciplines (e.g., environmental geoscience, mineralogy).

**T1. Denver Then and Now: From Paleontology to Public Policy on the Front Range Urban Corridor (ORAL)**

Cosponsored by *Paleontological Society; Denver Museum of Nature & Science; GSA Geology and Society Division*

Paleontology; Biogeography/Biostratigraphy; Public Policy; Tectonics

Ian Miller, Denver Museum of Nature & Science, Denver, Colo.; Kirk Johnson, Denver Museum of Nature & Science, Denver, Colo.; Robert Reynolds, Denver Museum of Nature & Science, Denver, Colo.; Beth Ellis, Denver Museum of Nature & Science, Denver, Colo.

**T2. Sourcing Techniques in Archaeology (ORAL)**

Cosponsored by *GSA Archaeological Geology Division*

Archaeological Geology; Geochemistry; Mineralogy/Crystallography

Mostafa Fayek, University of New Mexico, Albuquerque, N.Mex. and University of Manitoba, Winnipeg, Manitoba; Sharon K. Hull, University of Manitoba, Winnipeg, Manitoba

**T3. Alluvial Cycles, Climate, and Human Prehistory (ORAL)**

Cosponsored by *GSA Archaeological Geology Division; Quaternary Geology and Geomorphology Division*

Archaeological Geology; Geomorphology; Hydrogeology  
Gary Huckleberry, Tucson, Ariz.

**T4. From Geoarchaeology and Paleoanthropology to Sedimentary Geology and Geochemistry: A Memorial to Richard L. Hay (ORAL)**

Cosponsored by *GSA Archaeological Geology Division; GSA Limnogeology Division; GSA Sedimentary Geology Division; Mineralogical Society of America*

Archaeological Geology; Limnogeology; Geochemistry  
Gail M. Ashley, Rutgers University, Piscataway, N.J.; Marie Jackson, Northern Arizona University, Flagstaff, Ariz.; Enrique Merino, Indiana University, Bloomington, Ind.; Thure E. Cerling, University of Utah, Salt Lake City, Utah

**T5. Materials Flow in Coal Utilization (ORAL)**

Cosponsored by *GSA Coal Geology Division; GSA Geology and Society Division*

Coal Geology; Environmental Geoscience; Public Policy  
Allan Kolker, USGS, Reston, Va.; James C. Hower, University of Kentucky, Lexington, Ky.; Ronald H. Affolter, USGS, Denver, Colo.

**T6. Microbial Origin of Hydrocarbon Gases in Coal Beds and Sedimentary Basins (ORAL)**

Cosponsored by *GSA Coal Geology Division*

Coal Geology; Geomicrobiology; Hydrogeology  
Donald Klein, Colorado State University, Fort Collins, Colo.; Kevin W. Mandernack, Colorado School of Mines, Golden, Colo.; Romeo M. Flores, USGS, Denver, Colo.

**T7. The Environmental Geology and Geochemistry of Mineral Deposits: Best Practices for Effective Prediction, Mitigation, Closure, and Remediation (ORAL)**

Cosponsored by *Society of Economic Geologists*

Environmental Geoscience; Economic Geology; Geology and Health  
Geoffrey S. Plumlee, USGS, Denver, Colo.; William X. Chávez, New Mexico School of Mines, Socorro, N.Mex.; Mark Logsdon, Geochimica, Aptos, Calif.

**T8. Role of Geology in Planning and Mitigation of Natural Hazards (ORAL)**

Cosponsored by *GSA Engineering Geology Division; Association of Environmental and Engineering Geologists; GSA Geology and Health Division; GSA Geology and Society Division*

Environmental Geoscience; Geology and Health; Public Policy  
Syed E. Hasan, University of Missouri, Kansas City, Mo.



**T9. Identifying America's Most Vulnerable Oceanfront Communities: A Geological Perspective (POSTER)**

Cosponsored by *GSA Geology and Society Division*  
Marine/Coastal Science; Public Policy; Geomorphology  
Joseph T. Kelley, University of Maine, Orono, Maine; Rob Young, Western Carolina University, Cullowhee, N.C.; Orrin Pilkey, Duke University, Durham, N.C.

**T10. Afghanistan Reconstruction—USGS Activities in Afghanistan (ORAL)**

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Geophysics/Tectonophysics/Seismology; Hydrogeology; Economic Geology  
Bruce Franklin Molnia, USGS, Reston, Va.

**T11. Combined Ecological and Geologic Perspectives in Modern Terrestrial Ecosystems (ORAL)**

Cosponsored by *GSA Geobiology and Geomicrobiology Division*  
Environmental Geoscience; Geomicrobiology; Geochemistry  
JoAnn Holloway, USGS, Denver, Colo.; Mark Waldrop, USGS, Menlo Park, Calif.

**T12. The Black Sea–Mediterranean Corridor: Paleoenvironmental and Geoarchaeological Context for the Past 30 k.y. (ORAL)**

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Valentina Yanko-Hombach, Avalon Institute of Applied Science, Winnipeg, Manitoba; Ilya Buynevich, Woods Hole Oceanographic Institution, Woods Hole, Mass.; Olena V. Smyntyna, Odessa I.I. Mechnikov National University, Odessa, Ukraine

**T13. Sources, Transport, Fate, and Toxicology of Trace Elements in the Environment (ORAL)**

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Geochemistry; Environmental Geoscience; Geomicrobiology  
LeeAnn Munk, University of Alaska, Anchorage, Alaska; David Long, Michigan State University, East Lansing, Mich.; Berry Lyons, Ohio State University, Columbus, Ohio

**T14. Innovative Approaches to Uranium Mining and Groundwater Restoration (ORAL)**

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Geochemistry; Environmental Geoscience; Public Policy  
Patricia Beth Moran, Colorado School of Mines, Golden, Colo.; James F. Ranville, Colorado School of Mines, Golden, Colo.

**T15. Perspectives in Redox Geochemistry and Microbial Processes (ORAL)**

Geochemistry; Geomicrobiology; Hydrogeology  
Annette Summers Engel, Louisiana State University, Baton

Rouge, La.; Jennifer A. Roberts, University of Kansas, Lawrence, Kans.

**T16. Geological, Geophysical, Geochemical, and Environmental Studies in Big Bend National Park and the Trans-Pecos Region, Texas (ORAL)**

Cosponsored by *GSA Geophysics Division; International Association of Geochemistry; National Park Service*  
Geochemistry; Petrology, Igneous  
John E. Gray, USGS, Denver, Colo.; Ric Page, USGS, Denver, Colo.

**T17. Management and Restoration of Fluvial Systems with Broad Historical Changes and Human Impacts (ORAL)**

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Geomorphology; Engineering Geology; Environmental Geoscience  
L. Allan James, University of South Carolina, Columbia, S.C.; Sara L. Rathburn, Colorado State University, Fort Collins, Colo.; G. Richard Whittecar, Old Dominion University, Norfolk, Va.

**T18. Hydrogeomorphic Responses of Convulsive Events (ORAL)**

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Geomorphology; Engineering Geology; Sediments, Clastic  
J.J. Major, Cascades Volcano Observatory, Vancouver, Wash.; Christopher S. Magirl, USGS, Tucson, Ariz.

**T19. Geomorphology and Ecology: Interactions and Feedbacks (ORAL)**

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Geomorphology; Environmental Geoscience  
Martha Cary Eppes, University of North Carolina, Charlotte, N.C.

**T20. Landform-Scale Regolith Degradation, Transportation, and Deposition on Annual to Millennial Time Scales (ORAL)**

Geomorphology; Quaternary Geology; Environmental Geoscience  
Jaakko Putkonen, University of Washington, Seattle, Wash.

**T21. Episodic Landscape Change (ORAL)**

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John Ford Shroder, University of Nebraska, Omaha, Neb.; Luke Copland, University of Ottawa, Ottawa, Ontario

### T25. Deformation and the Landscape: Quantitative Approaches to Tectonic Geomorphology (ORAL)

Geomorphology; Tectonics; Neotectonics/Paleoseismology

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### T26. Field-Based Quantitative Studies of Chemical and Physical Weathering (ORAL)

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Geomorphology; Quaternary Geology; Geochemistry

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Michael Fienen, USGS—National Research Council, Middleton, Wisc.; Randall J. Hunt, USGS, Middleton, Wisc.; Chris Muffels, University of Wisconsin, Madison, Wisc.

### T28. Geologic Controls on Chemical Migration in Fractured and Carbonate Aquifers (ORAL)

Hydrogeology; Environmental Geoscience

Allen M. Shapiro, USGS, Reston, Va.; E. Calvin Alexander, University of Minnesota, Minneapolis, Minn.

### T29. Arsenic: From Nature to Human (ORAL)

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Hydrogeology; Environmental Geoscience; Geology and Health

Prosun Bhattacharya, Royal Institute of Technology (KTH), Stockholm, Sweden; Abhijit Mukherjee, University of Texas at Austin, Austin, Tex.; Jochen Bundschuh, Instituto Costarricense de Electricidad (ICE), San José, Costa Rica; Alan H. Welch, Carson City, Nev.

**T30. Ecohydrology of Riparian Zones (ORAL)**

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Steven P. Loheide, University of Wisconsin, Madison, Wisc.; Donald Whittemore, Kansas Geological Survey, Lawrence, Kans.

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Jeffrey M. McKenzie, McGill University, Montreal, Quebec; Laura K. Lautz, SUNY College of Environmental Science and Forestry, Syracuse, N.Y.

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Hydrogeology; Geochemistry; Economic Geology

Martin S. Appold, University of Missouri, Columbia, Mo.; Peter Nabelek, University of Missouri, Columbia, Mo.; Steven Ingebritsen, USGS, Menlo Park, Calif.

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Hydrogeology; Geochemistry; Environmental Geoscience

Ben J. Rostron, University of Alberta, Edmonton, Alberta; Franklin W. Schwartz, The Ohio State University, Columbus, Ohio

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Hydrogeology; Geochemistry; Geomicrobiology

Laura J. Crossey, University of New Mexico, Albuquerque, N.Mex.

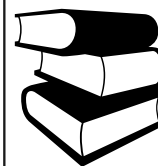
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Shemin Ge, University of Colorado, Boulder, Colo.; Andrew Manning, USGS, Denver, Colo.

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Donald Sweetkind, USGS, Lakewood, Colo.; Mary C. Hill, USGS, Boulder, Colo.; Keith J. Halford, USGS, Sacramento, Calif.; Wayne R. Belcher, USGS, Henderson, Nev.

**T49. Groundwater Mining and Population Growth (ORAL)**

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John Moore, Retired USGS, Denver, Colo.; Philip LaMoreaux, PELA, Tuscaloosa, Ala.

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**T51. The Spatial and Temporal Variability of Groundwater Recharge (ORAL)**

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Matthew Morgan, Colorado Geological Survey, Denver, Colo.

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Quaternary Geology; Geochemistry; Geomorphology

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**T57. Geology of Groundwater-Discharge Deposits in  
Arid Lands (ORAL)**

Quaternary Geology; Paleoclimatology/Paleoceanography;  
Archaeological Geology

Jeffrey Pigati, USGS, Tucson, Ariz.; Jason Rech, Miami  
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**T58. Long Records of Paleoclimate in the Southern  
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Quaternary Geology; Paleoclimatology/Paleoceanography;  
Limnogeology

Marith Reheis, USGS, Denver, Colo.; D.M. Miller, USGS,  
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**T59. Explorations in Sedimentary Geology: Student  
Research (POSTER)**

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Sediments, Carbonates; Sediments, Clastic; Stratigraphy

Daniel Larsen, University of Memphis, Memphis, Tenn.

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Sediments, Clastic; Geomorphology; Marine/Coastal Science

Don Cummings, Geological Survey of Canada, Ottawa,  
Ontario; Hazen A.J. Russell, Geological Survey of Canada,  
Ottawa, Ontario



Aerial view of continental Divide and Front Range.  
Photo by John Karachewski.

**T61. Submarine Landslides: The Importance of Mass  
Movement to the Development of Continental Slopes  
(POSTER)**

Sediments, Clastic; Marine/Coastal Science; Quaternary  
Geology

Mason Dykstra, Colorado School of Mines, Golden, Colo.

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Geoscience Education*

Sediments, Clastic; Stratigraphy; Geoscience Education

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Thomas, St. Paul, Minn.

**T63. Gas Shales of North America (ORAL)**

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Sediments, Clastic; Structural Geology; Stratigraphy

Ibrahim Çemen, Oklahoma State University, Stillwater, Okla.;  
James Puckette, Oklahoma State University, Stillwater, Okla.;  
Darwin Boardman, Oklahoma State University, Stillwater, Okla.

**T64. The Sedimentary Tape Recorder: Characterizing  
and Quantifying the Dynamics of Geomorphic-  
Sedimentologic Coupled Systems (ORAL)**

Sediments, Clastic; Tectonics; Geomorphology

Estelle Mortimer, University of Potsdam, Potsdam, Germany;  
Douglas Paton, Colorado School of Mines, Golden, Colo.;  
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Holly Stein, Colorado State University, Fort Collins, Colo.;  
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Geoscience Information/Communication

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Brent Lewis, Bureau of Land Management, Denver, Colo.

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Barnaby W. Rockwell, USGS, Denver, Colo.

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Cristiana L. Ciobanu, University of Adelaide and South Australian Museum, Adelaide, Australia; Nigel J. Cook, Natural History Museum, University of Oslo, Oslo, Norway; Paul G. Spry, Iowa State University, Ames, Iowa

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Engineering Geology; Coal Geology; Paleontology, Paleocology/Taphonomy

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John Ford Shroder, University of Nebraska, Omaha, Neb.

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Engineering Geology

Abdul Shakoor, Kent State University, Kent, Ohio; Paul M. Santi, Colorado School of Mines, Golden, Colo.

**T75. Tsunamis: Monitoring, Notification, Geology, Modeling, Education, and Outreach: The State of the Art (POSTER)**

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Geophysics/Tectonophysics/Seismology; Geoscience Education; Public Policy

Walter D. Mooney, USGS, Menlo Park, Calif.; Laura Kong, Intergovernmental Oceanographic Commission—International Tsunami Information Center, Honolulu, Hawaii; Annabel Kelly, USGS, Menlo Park, Calif.

**T76. Three-Dimensional Geological Mapping for Engineering and Environmental Geology Applications (ORAL)**

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Engineering Geology; Geoscience Information/Communication

A. Keith Turner, Colorado School of Mines, Golden, Colo.; Carl W. Gable, Los Alamos National Lab, Los Alamos, N.Mex.; Harvey Thorleifson, University of Minnesota, St. Paul, Minn.

**T77. Forensic and Engineering Geology Case Studies: A Tribute to James E. Slosson (ORAL)**

Cosponsored by *GSA Engineering Geology Division; GSA Geology and Society*

Engineering Geology; Public Policy

J. David Rogers, University of Missouri, Rolla, Mo.; David M. Abbott, Consulting Geologist, Denver, Colo.

**T78. Geology and Public Policy: A Tribute to James E. Slosson (ORAL)**

Cosponsored by *GSA Engineering Geology Division; GSA Geology and Society Division*

Engineering Geology; Public Policy

Jeffrey R. Keaton, MACTEC Engineering and Consulting, Los Angeles, Calif.; Susan D. Halsey, Admiral Coastal Consulting, Pine Beach, N.J.; Christopher Mathewson, Texas A&M University, College Station, Tex.

**T79. Landslide Processes, Case Studies, and Issues: A Tribute to James E. Slosson (ORAL)**

Cosponsored by *GSA Engineering Geology Division; GSA Geology and Society*

Engineering Geology; Quaternary Geology; Geomorphology

Jerome DeGraff, USDA Forest Service, Clovis, Calif.; Susan Cannon, USGS, Denver, Colo.; Jerry Higgins, Colorado School of Mines, Golden, Colo.

**T80. Active Faulting, Neotectonics, Paleoseismology: A Tribute to James E. Slosson (ORAL)**

Cosponsored by *GSA Engineering Geology Division; GSA Structural Geology and Tectonics Division*

Engineering Geology; Structural Geology; Neotectonics/Paleoseismology

Wanda Taylor, University of Nevada, Las Vegas, Nev.; Keith Sverdrup, University of Wisconsin, Milwaukee, Wisc.; Vincent S. Cronin, Baylor University, Waco, Tex.

**T81. Diversity in Crustal Fluid Compositions: Geological Origins and Consequences (ORAL)**

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Brian Rusk, USGS, Denver, Colo.; Murray Allan, University of Leeds, West Yorkshire, UK

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**T82. The Structure, Composition, and Evolution of the Lithosphere of Western North America (ORAL)**

Cosponsored by *GSA Geophysics Division; GSA Structure and Tectonics Division*

Geophysics/Tectonophysics/Seismology; Geochemistry; Structural Geology

Walter D. Mooney, USGS, Menlo Park, Calif.; Catherine M. Snelson, University of Nevada, Las Vegas, Nev.; Eugene Humphreys, University of Oregon, Eugene, Oreg.; Richard C. Aster, New Mexico Tech, Socorro, N.Mex.

**T83. Relationship of the Siberian Traps Eruptions to the Mass Extinction(s) at the Close of the Permian: Do We Know Enough to Ascertain Whether a Cause and Effect Relationship Exists? (ORAL)**

Geophysics/Tectonophysics/Seismology; Paleontology, Diversity, Extinction, Origination; Volcanology

Maureen Steiner, University of Wyoming, Laramie, Wyo.

**T84. Active and Ancient Tectonics along the Northern Cordillera Margin—Magmatism, Deformation, Metamorphism, and Basin Development (POSTER)**

Cosponsored by *GSA Structural Geology and Tectonics Division; Geophysics; Sedimentary Geology*

Geophysics/Tectonophysics/Seismology; Stratigraphy; Tectonics

Brian Hampton, Michigan State University, East Lansing, Mich.; Jeffrey M. Trop, Bucknell University, Lewisburg, Pa.; Kenneth D. Ridgway, Purdue University, West Lafayette, Ind.

**T85. Combining Geophysics and Geology to Solve Geoscience Problems (ORAL)**

Cosponsored by *GSA Geophysics Division; GSA Structure and Tectonics Division; GSA Geology and Society Division*

Geophysics/Tectonophysics/Seismology; Structural Geology; Tectonics

Scott Giorgis, SUNY-Geneseo, Geneseo, N.Y.; Eric Horsman, University of California, Berkeley, Calif.; Sarah Titus, Carleton College, Northfield, Minn.

**T86. New Perspectives on the Rio Grande Rift: From Tectonics to Groundwater (ORAL)**

Cosponsored by *GSA Structural Geology and Tectonics Division; GSA Geophysics Division; GSA Hydrogeology Division*

Geophysics/Tectonophysics/Seismology; Tectonics; Hydrogeology

Mark R. Hudson, USGS, Denver, Colo.; V.J.S. Grauch, USGS, Denver, Colo.

**T87. A Retrospective and Prospective Look at Mineralogy, Petrology, and Geochemistry: A Session in Honor of Gordon E. Brown Jr. (ORAL)**

Cosponsored by *Mineralogical Society of America; Geochemical Society*

Mineralogy/Crystallography; Geochemistry; Petrology, Igneous

Michael F. Hochella, Virginia Tech, Blacksburg, Va.; Jerry Gibbs

**T88. Geochemistry of Magmatic and Metamorphic Processes: In Honor of the Contributions of Joseph L. Wooden (ORAL)**

Petrology, Igneous; Petrology, Metamorphic; Tectonics

James Wright, University of Georgia, Athens, Ga.; Drew Coleman, University of North Carolina, Chapel Hill, N.C.; Andrew P. Barth, Indiana University–Purdue University, Indianapolis, Ind.

**T89. Geophysics of the Terrestrial Planets: The G.K. Gilbert Award Session (ORAL)**

Cosponsored by *GSA Planetary Geology Division*

Planetary Geology; Geophysics/Tectonophysics/Seismology

R. Aileen Yingst, University of Wisconsin, Green Bay, Wisc.; Sean Solomon, Carnegie Institution of Washington, Washington D.C.

**T90. Geology of the Northern Plains of Mars: New Tectonic, Petrologic, and Geomorphic Perspectives (ORAL)**

Cosponsored by *GSA Planetary Geology Division*

Planetary Geology; Geomorphology; Tectonics

Joseph Michalski, Jet Propulsion Laboratory, Pasadena, Calif.; Michael Wyatt, Brown University, Providence, R.I.

**T91. Wet Mars: Understanding the Red Planet's Aqueous History through Terrestrial Fieldwork (ORAL)**

Cosponsored by *GSA Planetary Geology Division*

Planetary Geology; Remote Sensing/Geographic Info System

Brian M. Hynek, University of Colorado, Boulder, Colo.; Jennifer L. Heldmann, National Aeronautic and Space Administration–Ames Research Center, Moffett Field, Calif.

**T92. Up Close and Personal: Geology on Mars and Earth at the Handlens Scale (ORAL)**

Cosponsored by *GSA Planetary Geology Division; GSA Sedimentary Geology Division*

Planetary Geology; Sediments, Clastic

R. Aileen Yingst, University of Wisconsin, Green Bay, Wisc.; Juergen Schieber, Indiana University, Bloomington, Ind.

**T93. The First Year of Observations by the Mars Reconnaissance Orbiter (ORAL)**

Cosponsored by *GSA Planetary Geology Division*

Planetary Geology

Laszlo Keszthelyi, USGS, Flagstaff, Ariz.; Roger Phillips, Washington University, St. Louis, Mo.

**T94. Advanced Remote Sensing of the Earth, Moon, and Mars (ORAL)**

Cosponsored by *GSA Planetary Geology Division*

Remote Sensing/Geographic Info System; Planetary Geology; Geoinformatics

William H. Farrand, Space Science Institute, Boulder, Colo.; John C. Mars, USGS, Reston, Va.



**T95. Techniques for Studying the Development of Fields of Small Basaltic Vents on Earth and Mars (ORAL)**

Cosponsored by *GSA Planetary Geology Division*  
Volcanology; Planetary Geology; Geomorphology  
Jacob E. Bleacher, Arizona State University, Tempe, Ariz.

**T96. Ionizing Radiation Sources and Their Impact on Life (ORAL)**

Cosponsored by *Paleontological Society; Society for Sedimentary Geology (SEPM)*  
Paleontology, Diversity, Extinction, Origination;  
Environmental Geoscience; Geochemistry  
Stephen A. Leslie, University of Arkansas, Little Rock, Ark.;  
Bruce Lieberman, University of Kansas, Lawrence, Kans.;  
P. Andrew Karam; Adrian Melott; Brian Fields

**T97. Trace Fossils, Mass Extinctions, and Event Boundaries: Endobenthic and Fossorial Responses to Terrestrial and Extraterrestrial Perturbations (ORAL)**

Cosponsored by *Paleontological Society; GSA Geobiology and Geomicrobiology Division; GSA Sedimentary Geology Division; Society for Sedimentary Geology (SEPM)*  
Paleontology, Diversity, Extinction, Origination;  
Paleontology, Paleoecology/Taphonomy; Paleontology,  
Biogeography/Biostratigraphy  
Stephen T. Hasiotis, University of Kansas, Lawrence, Kans.; Jared R. Morrow, San Diego State University, San Diego, Calif.

**T98. Selectivity of Ancient and Modern Extinctions: Bridging the Gap between Neontological Prediction and Paleontological Observation (ORAL)**

Cosponsored by *Paleontological Society*  
Paleontology, Diversity, Extinction, Origination;  
Paleontology, Paleoecology/Taphonomy  
Jonathan Payne, Stanford University, Stanford, Calif.; Seth Finnegan, Stanford University, Stanford, Calif.

**T99. Environmental Change and Evolution: Micropaleontological Case Studies (ORAL)**

Cosponsored by *Cushman Foundation for Foraminiferal Research*  
Paleontology, Diversity, Extinction, Origination;  
Paleontology, Phylogenetic/Morphological Patterns;  
Paleoclimatology/Paleoceanography  
R. Mark Leckie, University of Massachusetts, Amherst, Mass.;  
B. Huber, Smithsonian Institution, Washington, D.C.

**T100. Whole-Organism Paleoecology and the Relationship of Form, Function, and Ecological Interactions: In Memory of Richard Alexander (ORAL)**

Cosponsored by *Paleontological Society*  
Paleontology, Paleoecology/Taphonomy; Paleontology,  
Phylogenetic/Morphological Patterns; Paleontology,  
Diversity, Extinction, Origination  
Lindsey Leighton, San Diego State University, San Diego, Calif.; Gregory Dietl, Paleontological Research Institution, Ithaca, N.Y.; Patricia H. Kelley, University of North Carolina, Wilmington, N.C.

**T101. Emerging New Methods in Early Earth Studies: Unraveling the Co-Evolution of Earth and Life (ORAL)**

Cosponsored by *GSA Geobiology and Geomicrobiology Division; Paleontological Society*  
Precambrian Geology; Geochemistry; Paleontology,  
Phylogenetic/Morphological Patterns  
Dorothy Oehler, National Aeronautics and Space Administration-Johnson Space Center, Houston, Tex.;  
Carrine E. Blank, Washington University, St. Louis, Mo.; Jack Farmer, Arizona State University, Tempe, Ariz.

**T102. The Solar Stew: The Search for Ingredients of Life and Biomarkers in our Solar System: Past or Present (ORAL)**

Cosponsored by *GSA Geobiology and Geomicrobiology Division; GSA Planetary Geology Division; Paleontological Society*  
Geomicrobiology; Planetary Geology; Paleontology,  
Diversity, Extinction, Origination  
Penny A. Morris, University of Houston-Downtown, Houston, Tex.; Steve Grasby, Geological Survey of Canada, Calgary, Alberta

**T103. Pulse of the Earth: Geochronology and Paleomagnetism of Large Igneous Provinces, the Key to Reconstructing Precambrian Supercontinents (ORAL)**

Cosponsored by *Precambrian [At Large]; International Geological Correlations Program (IGCP509) Paleoproterozoic Supercontinents and Global Evolution*  
Precambrian Geology; Tectonics; Planetary Geology  
David A.D. Evans, Yale University, New Haven, Conn.; Joseph G. Meert, University of Florida, Gainesville, Fla.; Kevin R. Chamberlain, University of Wyoming, Laramie, Wyo.; Stephen S. Harlan, George Mason University, Fairfax, Va.

**T104. Impact Craters and Events: From the Field to the Laboratory (ORAL)**

Cosponsored by *GSA Planetary Geology Division; GSA Sedimentary Geology Division*  
Planetary Geology; Stratigraphy; Geochemistry  
Jared R. Morrow, San Diego State University, San Diego, Calif.; David T. King, Jr., Auburn University, Auburn, Ala.

**T105. The Chesapeake Bay Impact Structure: Results from the 2005–2006 ICDP-USGS Deep Drilling Project (ORAL)**

Cosponsored by *GSA Planetary Geology Division; GSA Structural Geology and Tectonics Division; GSA Geophysics Division; GSA Sedimentary Geology Division; GSA Hydrogeology Division; International Continental Scientific Drilling Program (ICDP)*  
Planetary Geology; Stratigraphy; Geophysics/  
Tectonophysics/Seismology  
Chris Koeberl, University of Vienna, Vienna, Austria; Greg S. Gohn, USGS, Reston, Va.; Wolf Uwe Reimold, Humboldt-Universität zu Berlin, Berlin, Germany; Kenneth Miller, Rutgers University, Piscataway, N.J.

**T106. Geologic Structures, Fluid Flow, and Ore Deposits (ORAL)**

Cosponsored by *GSA Hydrogeology Division; GSA Structure and Tectonics Division; GSA Geophysics Division; Society of Economic Geologists; U.S. Geological Survey; GSA Geology and Society Division*

Structural Geology; Economic Geology; Hydrogeology

Jonathan Saul Caine, USGS, Denver, Colo.; Eric P. Nelson, Colorado School of Mines, Golden, Colo.

**T107. Recognition and Implications of Coseismic Fault-Zone Structures (ORAL)**

Cosponsored by *GSA Structural Geology and Tectonics Division; GSA Geophysics Division*

Structural Geology; Geophysics/Tectonophysics/Seismology; Neotectonics/Paleoseismology

Laurel B. Goodwin, University of Wisconsin, Madison, Wisc.; James P. Evans, Utah State University, Logan, Utah

**T108. Reservoirs to Ruptures: Multidisciplinary Approaches to Studying Fault Rock Distribution and Evolution in the Seismogenic Crust (ORAL)**

Cosponsored by *GSA Structural Geology and Tectonics Division; GSA Geophysics Division*

Structural Geology; Hydrogeology; Geophysics/Tectonophysics/Seismology

Ruth H. Wightman, University of Durham, Durham, UK; Jonathan Imber, University of Durham, Durham, UK; Steven Smith, University of Durham, Durham, UK; Robert E. Holdsworth, University of Durham, Durham, UK; Zoe K. Shipton, University of Glasgow, Glasgow, UK

**T109. Mélanges: Processes of Formation and Societal Significance (ORAL)**

Cosponsored by *GSA International Division; GSA Structural Geology and Tectonics Division; GSA Engineering Geology Division; GSA Sedimentary Geology Division*

Structural Geology; Sediments, Clastic; Engineering Geology

John Wakabayashi, California State University, Fresno, Calif.; Yildirim Dilek, Miami University, Oxford, Ohio

**T110. Combining Kinematics and Mechanics in Understanding Deformation Processes (ORAL)**

Cosponsored by *GSA Structural Geology and Tectonics Division*

Structural Geology; Tectonics; Geophysics/Tectonophysics/Seismology

David Wiltschko, Texas A&M University, College Station, Tex.; John Spang, Texas A&M University, College Station, Tex.

**T111. Understanding Orogenesis through Palealtimetry (ORAL)**

Cosponsored by *Geochemical Society; Mineralogical Society of America*

Tectonics; Geomorphology; Paleoclimatology/Paleoceanography

Matthew Kohn, University of South Carolina, Columbia, S.C.

**T112. A Synoptic Crustal Section from the Cascadia Margin to the Southern Appalachians: Focusing EarthScope Research on Crustal Domains, Their Boundaries, and Fundamental Processes of the U.S. Continent (ORAL)**

Cosponsored by *GSA Structural Geology and Tectonics Division; GSA Geophysics Division*

Tectonics; Geophysics/Tectonophysics/Seismology; Geochemistry

Ben A. van der Pluijm, University of Michigan, Ann Arbor, Mich.; G. Randy Keller, University of Oklahoma, Norman, Okla.; Basil Tikoff, University of Wisconsin, Madison, Wisc.

**T113. Regional Tectonics of Basement-Cored Foreland Shortening: Integrating Geological and Geophysical Insights from Laramide and Analogous Orogens (ORAL)**

Cosponsored by *GSA Structural Geology and Tectonics Division; GSA Geophysics Division*

Tectonics; Geophysics/Tectonophysics/Seismology; Structural Geology

Eric A. Erslev, Colorado State University, Fort Collins, Colo.; Tim F. Wawrzyniec, The University of New Mexico, Albuquerque, N.Mex.

**T114. Mantle Dynamics and Crust-Mantle Interactions in Collisional Orogens (ORAL)**

Cosponsored by *GSA International Division; GSA Structure and Tectonics Division; GSA Geophysics Division; MARGINS Initiative*

Tectonics; Petrology, Igneous; Geophysics/Tectonophysics/Seismology

Yildirim Dilek, Miami University, Oxford, Ohio; Paul T. Robinson, Dalhousie University, Halifax, Nova Scotia

**T115. The Blue Mountains Region of Oregon, Idaho, and Washington: Recent Advances in the Mesozoic and Cenozoic History of an Enigmatic Accretionary Province (ORAL)**

Cosponsored by *GSA Sedimentary Geology Division; GSA Structural Geology and Tectonics Division*

Tectonics; Stratigraphy; Petrology, Igneous

Todd LaMaskin, University of Oregon, Eugene, Oreg.; Joshua Schwartz, University of Wyoming, Laramie, Wyo.; Victor Camp, San Diego State University, San Diego, Calif.

**T116. Evolution of Appalachian-Ouachita Salients and Recesses from Reentrants [Embayments] and Promontories in the Continental Margin: Thirtieth Anniversary Celebration of Advances Derived from Bill Thomas' 1977 American Journal of Science Paper (ORAL)**

Cosponsored by *GSA Structural Geology and Tectonics Division*

Tectonics; Structural Geology; Geophysics/Tectonophysics/Seismology

Allen J. Dennis, University of South Carolina, Aiken, S.C.; Jim Hibbard, North Carolina State University, Raleigh, N.C.

**T117. The Track of the Yellowstone Hot Spot: What Do Neotectonics, Climate Indicators, Volcanism, and Petrogenesis Reveal about Subsurface Processes? (ORAL)**

Cosponsored by *U.S. Geological Survey*

Volcanology; Geophysics/Tectonophysics/Seismology; Quaternary Geology

Lisa A. Morgan, USGS, Denver, Colo.; Kenneth L. Pierce, USGS, Bozeman, Mont.; Henrietta E. Cathey, University of Utah, Salt Lake City, Utah

**T118. Sigma Gamma Epsilon Undergraduate Research (POSTER)**

Cosponsored by *Sigma Gamma Epsilon*

Environmental Geoscience; Stratigraphy; Petrology, Igneous  
Richard L. Ford, Weber State University, Ogden, Utah; Charles Mankin, Oklahoma Geological Survey, Norman, Okla.; Donald Neal, East Carolina University, Greenville, N.C.

**T119. The Impact of Geoinformatics on Geoscience Research and Education (POSTER)**

Cosponsored by *GSA Geoinformatics Division; GSA Geoscience Education Division*

Geoinformatics; Geoscience Education; Geophysics/Tectonophysics/Seismology

Dogan Seber, University of California at San Diego, La Jolla,

Calif.; Krishna Sinha, GSA Geoinformatics Division, Blacksburg, Va.

**T120. Geological and Geophysical Data Preservation Best Practices (ORAL)**

Cosponsored by *U.S. Geological Survey; Association of American State Geologists; GSA Geoinformatics Division; GSA Geology and Society Division; Paleontological Society*

Geoinformatics; Geoscience Information/Communication; Public Policy

Tamara L. Dickinson, USGS, Reston, Va.; John C. Steinmetz, Indiana University, Bloomington, Ind.

**T121. Growing the Cyberinfrastructure for the Geosciences: Contributions from State and Federal Agencies (ORAL)**

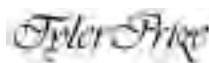
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Linda C. Gundersen, USGS, Reston, Va.; M. Lee Allison, Arizona Geological Survey, Tucson, Ariz.; Tamara L. Dickinson, Reston, Va.

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Gatze Lettinga

Emeritus Professor  
Wageningen University  
Sub-department of Environmental Technology  
Wageningen, The Netherlands



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Gatze Lettinga is recognized for his research and development of an environmentally sound novel process for the treatment of polluted wastewater and its implementation worldwide, especially in developing countries. Web: [www.uasb.org/discover/agsb.htm](http://www.uasb.org/discover/agsb.htm)

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- 2003 Sir Richard Doll, Hans Herren and Yoel Margalith, for Environmental Medicine and Public Health
- 2004 The Barefoot College and Red Latinoamericana de Botánica (RLB), for Environmental Education
- 2005 Charles David Keeling and Lonnie G. Thompson, for Atmospheric Chemistry and Glaciology related to Climate Change
- 2006 David W. Schindler and Igor A. Shiklomanov, for Natural and Human Impacts on Freshwater Resources

**For additional information and nominations contact:**

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**T122. Geoinformatics and Computational Earth Science: New Trends Promoting Data to Knowledge through Shared Resources and Tools toward New Research and Educational Opportunities in Geosciences (ORAL)**

Cosponsored by *GSA Geoinformatics Division*  
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 Hassan Babaie, Georgia State University, Atlanta, Ga.;  
 Krishna Sinha, GSA Geoinformatics Division, Blacksburg,  
 Va.; Walter S. Snyder, Boise State University, Boise, Idaho

**T123. Geoscience Data for Geoinformatics (ORAL)**

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 Kerstin Lehnert, Palisades, N.Y.; G. Randy Keller, University  
 of Oklahoma, Norman, Okla.

**T124. Medical Geology (ORAL)**

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 Geology and Health; Environmental Geoscience;  
 Non-Geoscience  
 Stephen York, Mendham, N.J.

**T125. Climate Change and Human Health: From Subtle Changes to Potential Disasters, Past, Present, and Future (ORAL)**

Cosponsored by *GSA Geology and Health Division; GSA  
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 Geology and Health; Paleoclimatology/Paleoceanography;  
 Public Policy  
 Matthew Huber, Purdue University, West Lafayette, Ind.;  
 Gabriel Filippelli, Indiana University–Purdue University,  
 Indianapolis, Ind.

**T126. Malice and Medical Geology: From Arsenic to Polonium—An Examination of Geological Agents as Poisons (ORAL)**

Cosponsored by *GSA Geology and Health Division; GSA  
 Geology and Society Division*  
 Geology and Health; Public Policy  
 Gabriel Filippelli, Indiana University–Purdue University,  
 Indianapolis, Ind.; Geoffrey Plumlee, USGS, Denver, Colo.

**T127. Positive and Beneficial Aspects of Earth Sciences in Public Health (ORAL)**

Cosponsored by *GSA Geology and Health Division; GSA  
 Geology and Society Division*  
 Geology and Health  
 Ulli Limpitlaw, University of Northern Colorado, Greeley,  
 Colo.; Lynda Williams, Arizona State University, Tempe, Ariz.

**T128. Charting the Future of Geological and Environmental Science Undergraduate Programs (ORAL)**

Cosponsored by *GSA Geoscience Education Division;  
 National Association of Geoscience Teachers*  
 Geoscience Education; Environmental Geoscience;  
 Geoscience Information/Communication  
 Kristen E. St. John, James Madison University, Harrisonburg,  
 Va.; S.A. Hovan, Indiana University of Pennsylvania, Indiana, Pa.

**T129. Teaching Climate Change and Energy Issues in the Classroom: An Imperative for Educated Citizens and Geoscientists (ORAL)**

Cosponsored by *National Association of Geoscience  
 Teachers; GSA Geology and Society Division; GSA Geology  
 and Health Division; GSA Geoscience Education Division*  
 Geoscience Education; Environmental Geoscience;  
 Geoscience Information/Communication  
 George T. Stone, Milwaukee Area Technical College,  
 Milwaukee, Wisc.; Andrew M. Buddington, Spokane  
 Community College, Spokane, Wash.

**T130. Forensic Geoscience: Research and Case Studies (ORAL)**

Cosponsored by *GSA Geology and Society Division;  
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 Environmental Geoscience; Geology and Health; Geochemistry  
 Elisa Bergslien, Buffalo State College, Buffalo, N.Y.; C.E.  
 Nehru, Brooklyn College–CUNY, Brooklyn, N.Y.

**T131. Forensic Geoscience: Innovative Educational Strategies for Attracting Students to the Geosciences (POSTER)**

Cosponsored by *GSA Geoscience Education Division*  
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 Communication; Public Policy  
 Elisa Bergslien, Buffalo State College, Buffalo, N.Y.

**T132. Innovative, Inquiry-Based Approaches That Bring the Field into the Classroom: Moving from Virtual Tour to Virtual Fieldwork (ORAL)**

Cosponsored by *GSA Geoscience Education Division*  
 Geoscience Education; Geoscience Information/  
 Communication; Public Policy  
 Don Duggan-Haas, Colgate University, Hamilton, N.Y.; Robert  
 M. Ross, Paleontological Research Institution, Ithaca, N.Y.

**T133. Innovative Approaches to Injecting Controversial Topics from the History of Geology into Today's Geoscience Education (ORAL)**

Cosponsored by *GSA Geoscience Education Division; GSA  
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 Geoscience Education; History of Geology  
 James H. Wandersee, Louisiana State University, Baton  
 Rouge, La.; Renee M. Clary, Mississippi State University,  
 Mississippi State, Miss.



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**T134. Professional Development for the Professional Developers: Aspects of Effective Teacher Professional Development Programs in the Earth Sciences (ORAL)**

Cosponsored by *GSA Geoscience Education Division; GSA Geology and Society Division*

Geoscience Education; Public Policy; Geoscience Information/Communication

Eric J. Pyle, James Madison University, Harrisonburg, Va.; Don Duggan-Haas, Colgate University, Hamilton, N.Y.

**T135. Early Undergraduate Research Experiences (POSTER)**

Cosponsored by *GSA Geoscience Education Division; Council on Undergraduate Research; National Association of Geoscience Teachers*

Geoscience Education

Laura A. Guertin, Penn State Delaware County, Media, Pa.; Linda Reinen, Pomona College, Claremont, Calif.; Jill Singer, Buffalo State College, Buffalo, N.Y.

**T136. Involving Students with Little Science Background in Authentic Research: Challenges and Victories (ORAL)**

Cosponsored by *GSA Geoscience Education Division; National Association of Geoscience Teachers*

Geoscience Education

Prajukti Bhattacharyya, University of Wisconsin, Whitewater, Wisc.; Joy Branlund, Southwestern Illinois College, Granite City, Ill.

**T137. Involvement in Geological Research: Close Collaboration among the Faculty, Undergraduate, and K–12 Students (POSTER)**

Cosponsored by *GSA Geoscience Education Division*

Environmental Geoscience; Geoscience Education; Geoscience Information/Communication

Nazrul I. Khandaker, York College of CUNY, Jamaica, N.Y.; Stanley Schleifer, York College of CUNY, Jamaica, N.Y.

**T138. Learning in the Field: Effective Strategies for Teaching Undergraduate Geology Outside the Classroom (ORAL)**

Cosponsored by *GSA Geoscience Education Division; National Association of Geoscience Teachers*

Geoscience Education

Jacqueline A. Smith, The College of Saint Rose, Albany, N.Y.; John I. Garver, Union College, Schenectady, N.Y.

**T139. The Future of Geoscience Field Courses (ORAL)**

Cosponsored by *GSA Structural Geology and Tectonics Division; GSA Geoscience Education Division; National Association of Geoscience Teachers; GSA Geophysics Division; GSA Quaternary Geology and Geomorphology Division*

Structural Geology; Geoscience Education; Geomorphology

Steven J. Whitmeyer, James Madison University, Harrisonburg, Va.; L. Scott Eaton, James Madison University, Harrisonburg, Va.; Charles Onasch, Bowling Green State

University, Bowling Green, Ohio; Lee J. Suttner, Indiana University, Bloomington, Ind.

**T140. Geosciences and Web 2.0—Blogs, Wikis, Podcasts, and Web Video (ORAL)**

Geoscience Information/Communication; Geoscience Education; Public Policy

Ronald C. Schott, Fort Hays State University, Hays, Kans.

**T141. Geology in the National Parks: Research, Mapping, and Resource Management (ORAL)**

Cosponsored by *GSA Geology and Society Division*

Geoscience Education

Bruce A. Heise, National Park Service, Lakewood, Colo.

**T142. Geology of Parks and Public Lands: Effective and Innovative Informal Earth Science Education for the Masses (ORAL)**

Cosponsored by *National Park Service; Bureau of Land Management; Association of Earth Science Editors*

Geoscience Information/Communication; Geoscience Education

Marion Malinowski, U.S. Bureau of Land Management, Lakewood, Colo.; Jim F. Wood, National Park Service, Lakewood, Colo.; Melanie V. Ransmeier, National Park Service, Denver, Colo.; Monica Gaiswinkler Easton, Ontario Geological Survey, Sudbury, Ontario

**T143. Geoscience and the Community: An Exploration of Ways to Become Involved (ORAL)**

Cosponsored by *GSA Geology and Society Division; American Geological Institute; GSA Geoscience Education Division; National Association of Geoscience Teachers*

Geoscience Information/Communication; Geoscience Education

Michael A. Phillips, Illinois Valley Community College, Oglesby, Ill.; Linda Rowan, American Geological Institute, Alexandria, Va.

**T144. GeoScience Information: Making the Earth Sciences Accessible for Everyone (ORAL)**

Cosponsored by *Geoscience Information Society*

Geoscience Information/Communication; Public Policy; Geoscience Education

Claudette Cloutier, University of Calgary, Calgary, Alberta

**T145. Challenges in Geoscience Publishing: Perspectives of Communicating Geoscience to Scientists and to the General Public (ORAL)**

Cosponsored by *Association of Earth Science Editors*

Geoscience Information/Communication

Monica Gaiswinkler Easton, Ontario Geological Survey, Sudbury, Ontario

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**T146. Geologic Mapping: Innovations and Interoperability (POSTER)**

Cosponsored by *GSA Engineering Geology Division; GSA Geology and Society Division; GSA Hydrogeology Division; GSA Quaternary Geology and Geomorphology Division; Association of American State Geologists*

Geoscience Information/Communication

Harvey Thorleifson, University of Minnesota, St. Paul, Minn.; David Soller, USGS, Reston, Va.; Richard Berg, GSA Geology and Society Division, Champaign, Ill.; Peter Lyttle, USGS, Reston, Va.; Hazen Russell, Geological Survey of Canada, Ottawa, Ontario

**T147. Exemplars and Exceptions: Using Individual and Group Biography to Understand Critical Issues in the History of Geology (ORAL)**

Cosponsored by *GSA History of Geology Division; GSA Geology and Society Division; History of the Earth Sciences Society*

History of Geology

Julie R. Newell, Southern Polytechnic State University, Marietta, Ga.; Stephen M. Rowland, University of Nevada, Las Vegas, Nev.

**T148. The Science of Groundwater Recharge, Coal Mine Hydrology and Geochemistry, and Stream Restoration and its Application to the Public Good: In Honor of Mary W. Stoertz (ORAL)**

Cosponsored by *GSA Hydrogeology Division*

Hydrogeology

William W. Simpkins, Iowa State University, Ames, Iowa; Joseph J. Donovan, West Virginia University, Morgantown, W.Va.; Kenneth Bradbury, Wisconsin Geological and Natural History Survey, Madison, Wisc.; Maureen Muldoon, University of Wisconsin, Oshkosh, Wisc.; Laura Toran, Temple University, Philadelphia, Pa.; Weston R. Dripps, Furman University, Greenville, S.C.



Treatise on Invertebrate Paleontology

Part H *Revised*

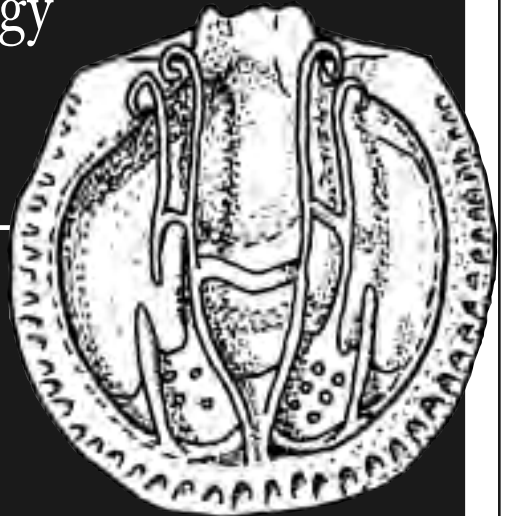
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*Edited by Roger L. Kaesler; coordinating author, Sir Alwyn Williams, leading a team of international specialists, 2006*

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# How To Submit Your Abstract

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## Abstract Fee

Once the abstract is in place, a window to submit payment will appear. The non-refundable submission fee is US\$18 for students; US\$30 for all others.

## Abstract Body

**Please keep the body of the abstract to 2,000 characters or less.** The online abstract system will reject it if it exceeds this limit. You can include a table with your abstract, but understand that the table might reduce the number of words allowed in your abstract. Taken together, the body of the abstract should take up no more space than would be occupied by roughly 2,000 characters alone. For typing and pasting, add an extra line between paragraphs or they will run together when displayed (you can do this before copying, after pasting, or while typing).

Check the spelling of the abstract's body and title using your own word processor. Then read it again and make sure that it is something the whole world should see. (We won't check or edit it for you.) You and your coauthors will be provided (by e-mail) with a record of the abstract identification number and password, and you can access your abstract and revise it as necessary from any Internet connection until 10 July 2007.

## Presentation Modes

Select your preferred mode of presentation: oral, poster, or either (no preference).

**Please note:** Program organizers will do their best to fit you into your preferred mode; however, they will override your original mode selection if they feel your paper would fit well in a particular session with other compatible abstracts. The decision of the program organizers is final.

**Oral Mode.** This is a verbal presentation before a seated audience. The normal length of an oral presentation is 12 minutes, plus three minutes for discussion.

**Poster Mode.** Each poster session presenter is provided with one horizontal, freestanding display board ~8' wide × ~4'

high. Precise measurements will appear in the speaker guide, which will be posted on the GSA Web site in September. Speakers must be at their poster booths for at least two of the four presentation hours.

Papers for discipline sessions may be submitted in either oral or poster mode. Papers for topical sessions are to be submitted *only* in the mode noted in the session description. If a topical abstract is submitted in the incorrect mode, the abstract will be transferred automatically to a discipline session.

**NEW FOR 2007! You may present two volunteered abstracts during the Annual Meeting, as long as one of these abstracts is a poster presentation.** This limitation does not apply to, nor does it include, invited contributions to keynote symposia or topical sessions.

## Speaker Equipment

GSA provides the following equipment in each Technical Session Room at no charge to speaker:

- One desktop PC computer (with Windows 2000 operating system and MS Office XP. All Macintosh or MS PowerPoint XP presentations will work, but must be saved in a PC format).
- One LCD projector
- One screen
- One laser pointer
- One lectern/podium with light and microphone

Overhead projectors and multiple screens are no longer part of the standard set-up; however, these are available for

an additional fee. More information will be included in the speaker guide, to be posted online in August.

## Scientific Categories

Determine if your paper would fit neatly in one of the topical sessions. If it doesn't, please submit your abstract for inclusion in the general discipline sessions. Discipline categories are as follows:

Archaeological Geology  
Coal Geology  
Economic Geology  
Engineering Geology  
Environmental Geoscience  
Geochemistry  
Geochemistry, Organic  
Geoinformatics  
Geology and Health  
Geomicrobiology  
Geomorphology  
Geophysics/Tectonophysics/Seismology  
Geoscience Education  
Geoscience Information/Communication  
History of Geology  
Hydrogeology  
Limnogeology  
Marine/Coastal Science  
Mineralogy/Crystallography  
Neotectonics/Paleoseismology  
Paleoclimatology/Paleoceanography  
Paleontology, Biogeography/Biostratigraphy  
Paleontology, Diversity, Extinction, Origination  
Paleontology, Paleocology/Taphonomy  
Paleontology, Phylogenetic/Morphological Patterns  
Petrology, Experimental  
Petrology, Igneous  
Petrology, Metamorphic  
Planetary Geology  
Precambrian Geology  
Public Policy  
Quaternary Geology  
Remote Sensing/Geographic Info System  
Sediments, Carbonates  
Sediments, Clastic  
Stratigraphy  
Structural Geology  
Tectonics  
Volcanology

## JTPC to Finalize Program in Late July

The Joint Technical Program Committee (JTPC) selects abstracts and determines the final session schedule. All authors will be notified in early August. The JTPC includes representatives from those GSA Associated Societies and Divisions participating in the technical program. GSA Council approved the JTPC technical program chairs.

# GSA Committees: Progress through Service

## The Annual Program Committee

The GSA Annual Program Committee (APC) is a vital committee to GSA and probably directly impacts more members than any other committee. Ever wonder why GSA never has its annual meeting in Honolulu or Newark? Or which sessions get selected to be Pardee Sessions? Or where those crazy and catchy meeting themes come from? These are just part of the job of the Annual Program Committee.

### Planning the Annual Meeting

The fundamental responsibility of the APC is long- and short-range planning for quality science, education, and outreach at the annual meeting and other Society-sponsored meetings. This includes selecting locations for future annual meetings, approving the number and content of technical sessions, selecting leaders for such diverse activities as hot topics, field trips, classes, the public forum, and late-breaking sessions, and setting policies for abstracts. The APC spends a good deal of time evaluating the results of annual membership surveys and meeting surveys to try to understand what was popular and successful and what did not work or needs to be rethought.

A number of financial concerns related to the annual meeting are overseen by the APC. Some obvious ones are the perpetual hot-buttons of registration fees and hotel costs. I doubt many annual meeting attendees, while enjoying the warmth and comfort of the Exhibit Hall or meeting rooms (for sessions, Division and Section meetings, alumni parties, specialty group gatherings, committee meetings, and the like) reflect on the fact that this space is not free.

The annual GSA meeting is a major undertaking. Including GSA's Associated and Allied societies, 6,000 or more geoscientist and guest attendees require space, hospitality, lodging, food services, transportation, and technical support for as long as five or six days.

Only a limited number of cities can accommodate a meeting as large as ours, and in order to reserve space in desirable places at the times we want, contracts and commitments must be made six to seven years in advance. For example, the APC has already planned for GSA to meet in Minneapolis in 2011, and the 125th anniversary meeting will be in Denver in 2013.

### A Creative Endeavor

The APC also tries to be creative within a highly structured system of needs and responsibilities. The 2008 joint meeting in Houston with the "Tri-Societies," comprising the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, is a first for GSA. This meeting presents many challenges as well as opportunities.

The APC also devotes significant time to creative thinking about geoscience discoveries and directions. We continually hear about "AGU-

envy" for everything from meeting locations to quality of science. The APC tries to identify new and emerging areas of earth science that are of interest to large numbers of GSA members. One recent example is the number of topical sessions on wildfire (2001). Following the annual meeting, the APC organized and sponsored a highly successful specialty meeting on wildland fire science in the Denver area in 2002. We are always looking for new ideas, new approaches, and new directions to better serve our members.

GSA meetings are technically strong, healthy, and serve the needs of geoscientists, both young and old. We recently created a subcommittee of young geoscientists, made up of current and former recipients of the Donath Medal and Subaru Outstanding Woman in Science Award, to help broaden our thinking about new directions in earth science.

### An Invitation to Participate

The Annual Program Committee usually meets twice a year and occasionally has conference calls and e-mail discussions. I have served on many GSA committees in my time as a geoscientist, and I feel that the APC has been one of the most interesting from the perspective of breadth of responsibility, impact on GSA, meeting interesting people, and having the opportunity to participate in decisions that really have the chance to improve and advance the geosciences. If these qualities are of interest to you, please let us know, and we would be glad to forward your statement of interest to the Nominating Committee!

**John E. Costa**, U.S. Geological Survey, [jecosta@usgs.gov](mailto:jecosta@usgs.gov)  
*Chair, 2007 GSA Annual Program Committee*





# The Joint Technical Program Committee

Have you ever wondered how the GSA Annual Meeting technical program gets put together? It is a complex fusion of activities performed by headquarters staff and generous volunteers, choreographed each year by a Technical Program Chair working closely with the GSA Meetings staff. At the heart of this process is the Joint Technical Program Committee (JTPC).

## Make-Up of the Committee

Representatives from GSA's seventeen Divisions and from several of GSA's Associated Societies, including the Association of Earth Science Editors, the Geochemical Society, the Geoscience Information Society, the Mineralogical Society of America, the National Association of Geoscience Teachers, the Paleontological Society, and the Society of Economic Geologists, contribute to a significant portion of the technical program every year. Five Representatives-at-Large, covering specialties like environmental geosciences and marine-coastal geology, round out the JTPC.

JTPC representatives serve terms of variable length depending on the bylaws of each organization or Division. All are volunteers.

## The JTPC Process

The Joint Technical Program Committee is involved with most aspects of organizing the Annual Meeting's technical program. The first main task is to review proposed topical sessions. Remember that 9 January 2007 deadline for submitting topical session proposals (*GSA Today*, v. 16, no. 10, p. 32)? Even before that deadline is reached each year, JTPC representatives begin looking at proposals in their respective fields and may review any and all others to look for duplication, poorly defined concepts, and the like. JTPC reps also finalize sponsorship of topical sessions during this time.

Once the list of topical sessions is finalized, by the end of January each year, preparations are made for the Call for Papers, which appears on the GSA Web site and in the April *GSA Today*.

The next major deadline is abstract submittal—this year, it is 10 July. JTPC representatives oversee several topical sessions based on the scientific categories proposed and advocated earlier in the process. The actual organization of each topical session is done by the session advocate, but JTPC reps oversee the process.

Once all topical sessions are filled or withdrawn, abstracts not assigned to a topical session are placed into an abstract pool. This is when the JTPC does its heavy lifting. Representatives select abstracts pertinent to their areas of expertise and organize them into discipline sessions. They may trade abstracts and move abstracts around, trying to generate the best sessions possible. They may even give a session a name if enough abstracts are submitted to give it a discrete focus.

JTPC representatives sometimes contact abstract authors asking them to switch from oral to poster presentation, or vice versa, in order to fit papers into open slots.

Finally, working with the Technical Program Chair, JTPC reps recommend time slots for the various sessions. They are responsible for making sure their sessions do not conflict with Division or Society meetings, special presentations, field trips, and workshops. They also recommend scheduling to the Technical Program Chair to create clusters of similar topics in a given area of the convention center and avoid time conflicts with sessions of similar appeal to attendees.

This is an impossible task, of course, but the JTPC works tirelessly with the Technical Program Chair to make sure there are as few conflicts as possible. Conflicts of time or location will never be totally eliminated, especially if attendees have interests in sessions or papers on widely varying topics. Sessions on geomorphology and igneous petrology, for example, may conflict, and there will always be some folks who are eager to attend both. But considerable regard and effort goes into avoiding or minimizing the most likely conflicts.

By late July, sessions are organized and last-minute changes may be suggested by the Technical Program Chair. The final program goes to the Annual Program Committee for approval in early August and then is posted online, printed in the September *GSA Today*, and listed in the *Annual Program with Abstracts* book and CD.

## An Invitation to Participate

When you next think about the Annual Meeting, think also about those who have given of their time to organize the meeting. Most of the work that goes on behind the scenes would not be possible without the considerable efforts of JTPC volunteers. The hard work is concentrated mostly over short periods of time, including a few days in mid-January and several days in mid- to late July. If you're interested in putting your stamp on the Annual Meeting, you may wish to consider volunteering to serve on the Joint Technical Program Committee. It's an enormously rewarding endeavor and I guarantee you will never again look at the Annual Meeting technical program in the same way.

**David M. Bush**, University of West Georgia, dbush@westga.edu  
2007 GSA Annual Meeting & Exposition Technical Program Chair



# Stimulate Growth and Change

Serve on a GSA Committee!

## 2008–2009 COMMITTEE VACANCIES

Terms begin 1 July 2008 and run for three years (unless otherwise indicated).

GSA is seeking candidates to serve on Society committees and as GSA representatives to other organizations. Contribute to our science by volunteering yourself or nominating others you think should be considered for any of the following openings. Younger members are especially encouraged to become involved in Society activities. (**Graduate Students:** You are eligible to serve on GSA committees as full members, and Council encourages you to volunteer or nominate others for committee service.) If you volunteer or make recommendations, please give serious consideration to the specified qualifications for serving on a particular committee. **Please be sure that your candidates are GSA Members or Fellows and that they fully meet the requested qualifications.**

Volunteer or nominate online! The nomination form and instructions are available at [www.geosociety.org/aboutus/commtees](http://www.geosociety.org/aboutus/commtees). Click on the **Nominate Online for 2008–2009** button to access a secure form. If you prefer, you may download and complete the paper nomination form, also located at this site, and return it to Pamela Fistell, GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA, fax +1-303-357-1070. If you have questions, please contact Pamela Fistell, +1-303-357-1000 ext. 0, 1-800-472-1988 ext. 0, or [pfistell@geosociety.org](mailto:pfistell@geosociety.org).

Nominations received at GSA headquarters by **15 July 2007** on the official one-page form will be forwarded to the Committee on Nominations. Please use one form per candidate. Information provided on the form will assist the committee members with recommendations for the July 2008 committee vacancies. The committee will present at least two nominations for each open position to GSA Council at its fall meeting. Appointees will then be contacted and asked to serve, thus completing the process of bringing new expertise into Society affairs.

### Academic and Applied Geoscience Relations Committee (AM, T/E)

**Three member-at-large vacancies**

Strengthens and expands relations between GSA Members in the academic and applied geosciences. Proactively coordinates the Society's effort to facilitate greater cooperation between academia, industry, and government geoscientists. **Qualifications:** Members from academia,

industry, and government who are committed to developing better integration of applied and academic science in our meetings, publications, short courses, field trips, and education and outreach programs.

### Arthur L. Day Medal (T/E)

**Two member-at-large vacancies**

Selects candidates for the Arthur L. Day Medal. **Qualifications:** knowledge of those who have made "distinct contributions to geologic knowledge through the application of physics and chemistry to the solution of geologic problems."

### Geology and Public Policy (AM, B/E, T/E)

**Two member-at-large vacancies**

Translates knowledge of earth sciences into forms most useful for public discussion and decision making. **Qualifications:** experience in public-policy issues involving the science of geology; ability to develop, disseminate, and translate information from the geologic sciences into useful forms for the general public and for GSA Members; familiarity with appropriate techniques for the dissemination of information.

### GSA Public Service Award (T/E)

**One member-at-large vacancy**

Generates, receives, and evaluates candidate nominations for the GSA Public Service Award and the AGI Outstanding Contribution to the Public Understanding of the Geosciences Award. Each award is given in recognition of outstanding individual contributions to either the public awareness of the earth sciences or the scientific resolution of earth-science problems of significant societal concern. **Qualifications:** knowledge of those whose contributions and accomplishments have enhanced the general public's understanding of earth science.

### Honorary Fellows (T/E)

**Two member-at-large vacancies**

Selects candidates for Honorary Fellows, who are usually non-North Americans. **Qualifications:** knowledge of geologists throughout the world who have distinguished themselves through their contributions to science.

### Membership (B/E)

**Three vacancies: One member-at-large; one member-at-large, government-employment category; one member-at-large, student category**

Evaluates membership benefits and develops recommendations that address the changing needs of the Society's membership, attracts new members, and recommends new GSA Fellows to Council. **Qualifications:** experience in benefit, recruitment, and retention programs is desired.

July 2008 Committee Vacancies: \*Extensive time commitment required AM—Meets at Annual Meeting  
B/E—Meets in Boulder or elsewhere T/E—Communicates by phone or electronically

## Minorities and Women in the Geosciences (AM)

### Three member-at-large vacancies

Stimulates recruitment and promotes positive career development of minorities and women in the geoscience professions. **Qualifications:** familiarity with the education and employment issues of minorities and women; expertise and leadership experience in such areas as human resources and education desired.

## Nominations (B/E, T/E)

### One member-at-large vacancy

Recommends nominees to Council for the positions of GSA Officers and Councilors, Committee members, and Society representatives to other permanent groups. **Qualifications:** familiarity with a broad range of well-known and highly respected geological scientists.

## Penrose Conferences and Field Forums (T/E)

### One member-at-large vacancy

Reviews and approves Penrose Conference proposals and recommends and implements guidelines for the success of the conferences. **Qualifications:** past convener of a Penrose Conference or a Field Forum.

## Penrose Medal (T/E)

### Two member-at-large vacancies

Selects candidates for the Penrose Medal. Emphasis is placed on "eminent research in pure geology, which marks a major advance in the science of geology." **Qualifications:** familiarity with outstanding achievers in the geosciences who are worthy of consideration for the honor.

## Professional Development (T/E)

### Two member-at-large vacancies

Directs, advises, and monitors GSA's professional development program, reviews and approves proposals, recommends and implements guideline changes, and monitors the scientific quality of courses offered. **Qualifications:** familiarity with professional development programs or adult education teaching experience.

## Research Grants\* (B/E)

### Seven member-at-large vacancies

Evaluates student research grant applications and selects grant recipients. **Qualifications:** should have experience in directing research projects and in evaluating research grant applications.

## Treatise on Invertebrate Paleontology Advisory Committee (AM)

### One member-at-large (paleontologist) vacancy

Advises Council, the Committee on Publications, and the *Treatise* editor on matters of policy concerning this publication. **Qualifications:** must be a paleontologist.

## Young Scientist Award (Donath Medal) (T/E)

### Two vacancies: One member-at-large; one councilor/former councilor

Investigates the achievements of young scientists who should be considered for this award and makes recommendations to Council. **Qualifications:** should have knowledge of young scientists with "outstanding achievement(s) in contributing to geologic knowledge through original research which marks a major advance in the earth sciences."

## GSA REPRESENTATIVES TO OTHER ORGANIZATIONS

### GSA-AAAS Consortium of Affiliates for International Programs (CAIP) (AM, B/E)

#### One GSA Representative vacancy (1 Jan. 2009–31 Dec. 2011)

Encourages cooperation on projects with international aspects and facilitates networking in its member societies. Meets twice yearly, providing a forum for scientific societies to discuss their international activities and exchange information on the status of international science.

### AAPG Publication Pipeline Committee (B/E)

#### One GSA Conferee vacancy (1 July 2008–30 June 2011)

Provides the best-possible advice to assist the committee in its efforts to improve the task process and to spread the word of its activities to retired GSA Members or others who wish to dispose of books for donation to overseas libraries.

### North American Commission on Stratigraphic Nomenclature (NACSN) (AM, possibly B/E)

#### One GSA Representative vacancy (Nov. 2008–Nov. 2011)

Develops statements of stratigraphic principles, recommends procedures applicable to classification and nomenclature of stratigraphic and related units, reviews problems in classifying and naming stratigraphic and related units, and formulates expressions of judgment on these matters.



## COMMITTEE, SECTION, AND DIVISION VOLUNTEERS: COUNCIL THANKS YOU!

The GSA Council acknowledges the many Member-volunteers who, over the years, have contributed to the Society and to our science through involvement in the affairs of The Geological Society of America.

July 2008 Committee Vacancies: \*Extensive time commitment required AM—Meets at Annual Meeting  
B/E—Meets in Boulder or elsewhere T/E—Communicates by phone or electronically



# PENROSE CONFERENCE SCHEDULED

## Hothouse, Icehouse, and Impacts: The Late Eocene Earth

Monte Cònero (Ancona), Italy

3–6 October 2007

### Conveners:

**Alessandro Montanari**, Osservatorio Geologico di Coldigioco, I-62020 Frontale di Apiro (MC), Italy; sandro.ogc@fastnet.it

**Christian Koeberl**, Center of Earth Sciences, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria; christian.koeberl@univie.ac.at

**Frits Hilgen**, Institute of Paleoenvironment and Paleoclimate, Budapestlaan 4, 3584 CD Utrecht, The Netherlands; fhilgen@geo.uu.nl

**Rodolfo Coccioni**, Istituto di Geologia e Centro di Geobiologia dell'Università, Campus Scientifico, Località Crocicchia, 61209 Urbino, Italy; cron@info-net.it

### DESCRIPTION AND OBJECTIVES

The late Eocene and the Eocene-Oligocene (E-O) transition mark the most profound oceanographic and climatic changes of the past 50 m.y. of earth history, with cooling beginning in the middle Eocene and culminating in the major earliest Oligocene Oi-1 isotopic event. The late Eocene is characterized by an accelerated global cooling, with a sharp temperature drop of ~2 °C near the Eocene-Oligocene (E-O) boundary, and significant stepwise floral and faunal turnovers. These global climate changes, which are reflected by a gradual increase of marine oxygen isotope values and biotic crises, are commonly attributed to the expansion of the Antarctic ice cap following its gradual isolation from other continental masses. However, multiple bolide impact events, possibly related to a comet shower lasting 2.2 m.y., may have played an important role related to the deterioration of the global climate at the end of the Eocene epoch.

One of the best and most famous exposures of the late Eocene, as well as the site of the Eocene-Oligocene Global Stratotype Section and Point (GSSP), is at Massignano, in the Cònero Riviera near Ancona in east-central Italy.

With the meeting of the International Union of Geological Sciences Subcommittee on Paleogene Stratigraphy (IUGS-SPS)

at Monte Cònero in October 1987 commenced two decades of prolific interdisciplinary stratigraphic research in the abandoned quarry of Massignano, carried out by a number of international research teams, which led to the recognition of this site as a potential GSSP for the Eocene-Oligocene boundary.

The quarry face exposes a 23-m-thick continuous and complete sequence of pelagic marly limestones and calcareous marls, rich in well-preserved benthic and planktonic microfossils and interbedded with several biotite-rich volcano-sedimentary layers spanning the upper Eocene and the lowermost Oligocene. This can be regarded as an ideal situation for the application of an integrated stratigraphic approach aimed at the precise and accurate calibration of the litho-, bio-, magneto-, and chemo-stratigraphic records with direct radio isotopic dating. The Massignano GSSP was formally established by the IUGS Subcommittee on Paleogene Stratigraphy at the 1992 International Geological Congress in Kyoto.

A number of studies further refining the mineralogic, lithostratigraphic, biostratigraphic, paleontologic, magnetostratigraphic, chemostratigraphic, and geochronologic attributes of this section were published in various international journals in the years following the Kyoto meeting. In particular, high-resolution stratigraphic studies led to the discovery, at 5.6 m in the GSSP section, of an impactoclastic layer, possibly of worldwide occurrence, containing an iridium anomaly, shocked quartz, extraterrestrial spinel, altered microkrystites, and a prominent anomaly of <sup>3</sup>He. The <sup>3</sup>He anomaly, which peaks at the impactoclastic layer, extends above and below it, indicating that Earth underwent a 2-m.y.-long cosmic crisis (perhaps a comet shower) throughout the terminal Eocene. These new discoveries encouraged detailed studies on the paleontologic and paleobiologic records of the Massignano GSSP to verify the effects that the inferred cosmic crisis may have had on the terminal Eocene marine biota.

In 1997, the Cònero Regional Park inaugurated the Massignano quarry as a "didactic-scientific site." The reclamation work of the GSSP included consolidation and cleaning of the quarry face, landscaping of the adjacent area, and the installment of geological signage. The Massignano site represents not only the subject of exciting scientific research and cooperative work, but also a concrete example of an ideal GSSP.

The wealth of information about the Massignano-integrated stratigraphy in this pelagic succession across the Eocene-Oligocene boundary has recently prompted further detailed studies on the cyclostratigraphy and climate change during this critical time. These studies, which are based on high-resolution analyses of paleoclimatic proxies throughout the section, such as magnetic susceptibility carried by detrital magnetic grains, cold versus warm dinoflagellate indicators, and combined biogenic CaCO<sub>3</sub>, magnetic susceptibility, and oxygen and carbon stable isotopes analyses, all are revealing a tight control of the orbital cycles of Milankovitch on the stratigraphic record(s) of this particular geologic time of global change. Moreover, these recent cyclostratigraphic studies are leading to the calibration of the time scale via astronomical tuning with unprecedented precision and accuracy.

This conference will provide the opportunity for taking stock and laying out a roadmap for future work at the E-O boundary, taking into account the progress made at Massignano and

at other E-O transitions around the world. The meeting has the goal of assembling the most important researchers on this topic from around the world to take stock of the developments of the past 20 years and the current state of knowledge of the events that marked the late Eocene, as well as chart the course for future work.

### PROPOSED ITINERARY

The conference will be four full days long, with three days of presentations and one day of field excursions. The following three main topics of the conference are a good guideline for what is anticipated in terms of contributions during the oral and poster presentations:

1. Integrated stratigraphy of the late Eocene–early Oligocene transition (biostratigraphy, magnetostratigraphy, chemostratigraphy, cyclostratigraphy, astronomical calibration, and direct radio isotopic geochronology) and reevaluation of the GSSP.
2. Paleoecology and paleoclimate through the critical period of transition from hothouse to icehouse (Oi-1 Glaciation) based on planktonic and benthonic microfossil associations and high-resolution stable isotopes analysis.
3. Impact processes and impact stratigraphy (late Eocene multiple impacts and comet showers recorded at Massignano and elsewhere, and their role in the global paleoecologic-paleoenvironmental change).

One day will be set aside for each of those major themes. Each topic will be represented by three to five keynote speakers and ~10 contributed talks, plus poster presentations. Except for a few long (40 min) keynote presentations, we anticipate 15–20 min talks, all followed by discussion. Abundant discussion time (panel discussions on each of the three major topics) is planned. Poster presentations will be a part of the activities, and at least one, possibly two, time slots for viewing posters (to especially encourage students) will be set aside. The facilities will allow the posters to be up (and viewable) for the duration of the conference.

A fourth day will be devoted to field trips, mainly to view outcrops at Monte Cònero (walking downhill from the hotel toward the base of the mountain—an easy two-hour walk, including stops), and visits to the Massignano Quarry and related outcrops (several locations within a few kilometers of each other). A local Italian bus company will provide transportation for part of the field trips. Outcrops will include the E-O transition, the late Eocene impact layers, K-T boundaries, and rock units in between, of the Umbria-Marche pelagic sequence. Ample discussion time at the outcrops will be allowed. Sampling will be possible at selected locations.

### VENUE

The conference will be held at one of the best and most famous exposures of the late Eocene, as well as the site of the Eocene-Oligocene GSSP: Massignano, on the Cònero Riviera near Ancona, east-central Italy ([www.le-marche.com/Marche/html/ancona.htm](http://www.le-marche.com/Marche/html/ancona.htm)). Participants will stay at the Hotel Monte Cònero ([www.hotelmonteconero.it/](http://www.hotelmonteconero.it/)), 10 km south of the city of Ancona, one of the largest ports on the Adriatic coast of Italy. The location is beautiful, easily accessible, but also somewhat isolated, making it an ideal site for meeting participants to relax

and work together. Here, in fact, is where the first IUGS E-O Boundary ad hoc meeting was held in 1987. The hotel and its facilities are almost completely accessible to the handicapped; the field trips involve walking downhill across easy walking paths, but these paths are not wheelchair accessible.

Ancona can easily be reached from all of Europe by train, car, ferry, and plane. Ancona airport ([www.ancona-airport.com/doc/htm/eng/frameset\\_struttura\\_guida.asp](http://www.ancona-airport.com/doc/htm/eng/frameset_struttura_guida.asp)) has daily connections (in some cases several flights per day) from and to Milan, Rome, Munich, London, and Paris, among other cities.

### ATTENDEES AND ESTIMATED COST

The conference will be limited to about 80 people. Participants will be selected to ensure broad representation by nationality, occupation (i.e., faculty, graduate students, and industry and government scientists), and research interest (e.g., stratigraphy, paleoclimatology, geochemistry, isotope geochronology, sedimentology, geomorphology, impact research). Students, early career professionals, women, and minority participants are particularly encouraged to apply. The registration fee is expected to be ~600 Euros, which will include: accommodation and full board (on the basis of double-occupancy) for four days and five nights, coffee breaks, registration fee, excursion costs, conference materials, and logistics costs. Airfare is not included. We hope to be able to partially subsidize the participation of a number of students.

### APPLICATION DEADLINE: 15 JULY 2007

Interested persons should send a letter of application by e-mail to Sandro Montanari, [sandro.ogc@fastnet.it](mailto:sandro.ogc@fastnet.it). The letter should include a brief statement of the applicant's research interests, relevance of those interests to the focus of the conference, and a potential topic that the applicant might want to present. Please note that we are planning to allow a limited number of oral presentations, but we strongly encourage poster presentations and comment presentations in order to ensure an informal and interactive conference.



The Massignano quarry in 2006.



## IN MEMORIAM

**Robert E. Baker**  
Eureka, Calif.  
1 August 2006

**William P. Brosge**  
Hingham, Mass.  
29 October 2006

**Martin Burkhard**  
Neuchatel, Switzerland  
1 August 2006

**Stanley D. Conrad**  
Arvada, Colo.  
4 November 2006

**Allan M. Gutstadt**  
Bloomington, Ind.  
3 January 2007

**Byron S. Hardie**  
Tucson, Ariz.  
3 May 2006

**N. King Huber**  
Mountain View, Calif.  
24 February 2007

**John A. Logan**  
Carmel, Calif.  
13 December 2006

**Edward M. MacKevett**  
Carson City, Nev.  
29 December 2006

**Ogden W. Nine Jr.**  
Warner Robins, Ga.  
6 April 2006

**John R. Rand**  
Pownal, Maine  
15 March 2007

**Alexander B. Ronov**  
Moscow, Russian Federation  
notified 13 February 2007

**James E. Slosson**  
Simi Valley, Calif.  
28 April 2007

**Fred L. Stricklin Jr.**  
The Woodlands, Tex.  
25 December 2006

**Robert E. Wallace**  
Reno, Nev.  
8 January 2007

**A.L. Washburn**  
Bellevue, Wash.  
1 February 2007

**David C. White**  
Knoxville, Tenn.  
26 October 2006

**Thomas A. Wilson**  
Reno, Nev.  
31 January 2007

**Roger G. Wolff**  
Bluemont, Va.  
1 January 2007



Please contact the GSA Foundation at  
+1-303-357-1054 or [drussell@geosociety.org](mailto:drussell@geosociety.org) for  
information on contributing to the Memorial Fund.

**OF NOTE:** The Groundwork article published in March 2007 *GSA Today* (v. 17, no. 3, p. 28, doi: 10.1130/GSAT01703GW.1) was a condensed version of Henry Pollack's Distinguished Lecture for the Geology and Society Division at the 2005 GSA Annual Meeting.

## About People

Recent award recipients at the Geoscience Information Society (GSIS) annual meeting included a few GSA Fellows: GSA Fellows **Felix M. Gradstein**, **James G. Ogg**, and **Alan G. Smith** received the Mary B. Ansari Best Reference Work Award for their text and wall chart, *A Geologic Time Scale* (2004). GSA Fellows **Scott Southworth** and **William Burton**, along with their collaborators at the U.S. Geological Survey, received the GSIS Best Guidebook Award for *Geology of the National Capital Region* (2004). The GSIS Best Paper Award went to GSA Fellow **Cathy A. Manduca** and colleagues for "Influencing user behavior through digital library design: An example from the geosciences" (2005).

GSA Senior Fellow **William L. Fisher** is the recipient of the 2007 Marcus Milling Legendary Geoscientist Medal. This award was established by the American Geological Institute (AGI) in 1999 to honor geoscientists who have demonstrated a long history of scientific achievement and exceptional service to the geoscience profession.

The William B. Heroy Jr. Award for Distinguished Service to AGI goes to another GSA Senior Fellow, **Thomas D. Barrow**. Recipients of this award are measured against the exemplary career of Heroy, who advanced the use of geophysics in petroleum exploration and in geologic research worldwide and provided outstanding service to AGI and to the geoscience profession as a whole.

## Wandering Editor Makes "Geologic Journey" for Science Channel

*GSA Today's* science co-editor, **Stephen T. Johnston** of the University of Victoria, took time away from his desk last summer to journey along the North American Rocky Mountains, starting from the Columbia Icefield and the Athabasca Glacier in Alberta, heading to the Boulder Flatirons in Colorado. Following along with Johnston was the production crew for "Geologic Journey: The Rockies," part of a Science Channel geology series. A first for Johnston: climbing a Boulder Flatiron, and with cameras and microphones trained on him to boot!

## Future GSA Annual Meetings

2008*	Houston, Texas (5–9 October)
2009	Portland, Oregon (18–21 October)
2010	Denver, Colorado (31 October–3 November)
2011	Minneapolis, Minnesota (9–12 October)

\*Joint meeting with American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America.

# The Kerry Kelts Research Awards of the Limnogeology Division

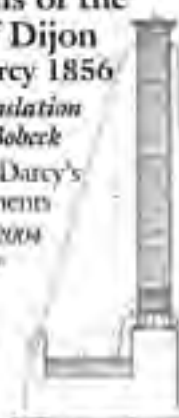
APPLICATION DEADLINE: 10 AUGUST 2007

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 US\$350 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, Kevin M. Bohacs, [kevin.m.bohacs@exxonmobil.com](mailto:kevin.m.bohacs@exxonmobil.com).

Awards will be announced in October at the Limnogeology Division Business Meeting and Reception at the 2007 GSA Annual Meeting in Denver.


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.

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## GEOLOGY Adds New Feature

*GEOLOGY* issues now include a short article highlighting one or two of the research articles published in the same issue. Article authors are selected for their awareness of the field and of the potential broader significance of the highlighted work. This new feature is designed to help a diverse group of readers quickly see the significance of the research problem and how the results of that research contribute to a better understanding of, or provide a solution to, the problem. It is the intention of *GEOLOGY*'s editors that these articles be of value both to professionals, who will be able at a glance to see how the featured article relates to their own work, and to students, who would like to gain entry into the particulars of a current debate within the earth sciences.

# FLOODS, FAULTS, and FIRE

Geological Field Trips in Washington State and  
Southwest British Columbia

Edited by Pete Stelling and David S. Tucker



## FLOODS, FAULTS, AND FIRE: Geological Field Trips in Washington State and Southwest British Columbia

Edited by Pete Stelling and David S. Tucker

The ten geological field guides presented in this volume explore key areas of the geologist's paradise that is Washington State and British Columbia. These trips investigate a wide variety of geologic and geographic terrains, from the dry steppe of the channeled scablands and Columbia River Basalt Group to the east, across the glaciated and forested Cascade arc and Coast Mountains, to the geologically complex islands in the west. This guidebook may be unique in that four of the trips utilize boats to reach remote field areas and are therefore rarely visited by geologists. Although the trips will be guided during the 2007 GSA Cordilleran Section meeting, the guides have been written to ensure that people can easily guide their own trips long after the meeting has ended. The result provides an excellent source of exciting, thought-provoking geologic adventures for years to come.

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## Positions Open

### VISITING ASSISTANT PROFESSOR OF GEOLOGY STATE UNIVERSITY OF NEW YORK AT OSWEGO

The Department of Earth Sciences at the State University of New York at Oswego invites applications for a one-year Visiting Assistant Professor position. We are searching for a field-oriented geologist with broad expertise in soft-rock geology. The position requires teaching courses in oceanography and historical geology, in addition to sedimentation, stratigraphy and invertebrate paleontology. Preference will be given to candidates with prior experience in teaching university-level geology. For complete information about the position and application procedures, visit our Web site at [www.oswego.edu/vacancies](http://www.oswego.edu/vacancies).

Candidates with a Ph.D. are preferred, but candidates that are A.B.D. will be seriously considered. Applications can be mailed or sent by e-mail to Dr. David W. Valentino, Search Committee Chair; Department of Earth Sciences; State University of New York at Oswego; Oswego, New York 13126 ([dvalenti@oswego.edu](mailto:dvalenti@oswego.edu)).

SUNY Oswego is an Affirmative Action Employer.

### PETROLEUM GEOCHEMISTRY THE UNIVERSITY OF TULSA

The Department of Geosciences invites applications for a tenure-track faculty position at the Assistant Professor level to begin August 2007. A Ph.D. degree in geosciences or related field with demonstrated experience in organic geochemistry is required. We seek an individual who shows the potential for outstanding achievement in both research and teaching. The successful candidate will be expected to develop and teach courses at the undergraduate and graduate levels, and will be expected to establish an externally funded research program.

Preference will be given to candidates with experience in petroleum systems science, and/or basin modeling and modeling of rock fluid interaction associated with basin evolution. Interdisciplinary research with existing Petroleum Engineering and environmental science programs is encouraged.

The University of Tulsa is a private, comprehensive university committed to excellence in teaching, creative scholarship, and service to the University and community. Minorities and women are encouraged to apply.

Send a letter of application stating research and teaching interests, curriculum vita, and name and contact information for three references to Dr. Bryan Tapp, Chair, Department of Geosciences, The University of Tulsa, 600 South College Ave., Tulsa, OK 74104-3189. Application review will continue until the position is filled. The University of Tulsa does not discriminate on the basis of personal status or group characteristics including but not limited to the classes protected under federal and state law.

The University of Tulsa is an EEO/AA employer.

### OAK RIDGE NATIONAL LABORATORY, JOB 2356 SIMULATION OF SUBSURFACE PROCESSES

Oak Ridge National Laboratory (ORNL) seeks a highly creative and motivated individual skilled in advanced computational simulation of the coupled processes of geochemistry, microbiology, and hydrology in the subsurface environment using high-performance com-

puters. The simulation effort is part of current research at ORNL that spans from molecular to field scales, aimed at an improved understanding of the behavior of contaminants in soils, sediments, groundwaters, and surface waters. The integration of laboratory, field, and simulation research will be used to inform decisions related to environmental remediation and the long-term stewardship of terrestrial and aquatic systems.

The successful candidate will be expected to focus on the confluence of molecular-scale processes with field-scale behavior. This candidate will interact closely with a team of scientists performing research at multiple scales. Experience in developing and/or using advanced simulation tools in such integrative studies is essential. ORNL is also embarking on new initiatives related to how ecosystems and the carbon cycle respond to various environmental factors and how one can detect and simulate those responses. The integration of above and below-ground systems is an essential component of those research initiatives. The successful candidate will also have the opportunity to work closely with scientists in terrestrial ecology, studying processes at larger spatial domains.

The technical resources available at ORNL are outstanding and the opportunities to participate in multidisciplinary research are exceptional. ORNL manages several field-scale facilities that are used for multi-scale research on coupled hydrological and biogeochemical processes in the subsurface. ORNL currently leads a multi-institutional Field Research Center (FRC) in Oak Ridge. The FRC site hosts field-scale fundamental research in contaminant fate and transport and hydrobiogeochemistry and is used by researchers from around the United States and the World. Field-scale investigations are complemented with laboratory-scale and computational studies to improve the understanding of controlling mechanisms down to molecular scales. The local Walker Branch Watershed with its subsurface weirs and soil blocks coupled with its long-term records of stream-flow chemistry, stand dynamics, and soils is another unique resource. Computing resources at ORNL and within the DOE complex are world-class, offering opportunities to advance computational methods as well as the modeling of biogeochemical processes. Collaboration with modeling groups at other national labs and universities will be expected. ORNL also offers programs of excellence in sensors and sensor networks, nanobiotechnology, and neutron science. Opportunities exist to collaborate with skilled researchers in hydrology, geochemistry, environmental microbiology, and ecology within ORNL, at collaborating Universities and other National Laboratories.

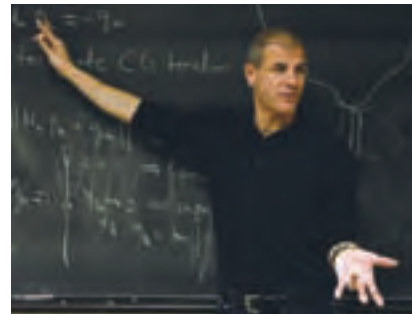
This position requires a Ph.D. in geochemistry, hydrology, geomicrobiology, soil science, computational science or a related discipline. Experienced candidates must have a strong record of successful sponsor interactions and nationally recognized expertise in subsurface science as demonstrated through peer-reviewed publications, oral dissemination of scientific endeavors, and proposal successes. Candidates with less experience are also sought and will be evaluated based on their potential to achieve in these same areas. The candidate must have the ability to work in a team environment and interact effectively with a broad range of colleagues.

This position will remain open for a minimum of three weeks after which it will close when a qualified candidate is identified and/or hired. Questions about the position may be referred to Patricia Neal ([nealap@ornl.gov](mailto:nealap@ornl.gov) or +1-865-574-4441). Additional information about the Oak Ridge National Laboratory is available from [www.ornl.gov](http://www.ornl.gov).

To apply for this position, please visit our Web site: <http://jobs.ornl.gov>. Please submit your resume, references, and publication list in one file. We only accept Microsoft Word documents.

If you have trouble applying for a position, please e-mail [Helpdesk@icims.com](mailto:Helpdesk@icims.com).

ORNL is a multi-program research facility managed by UT-Battelle for the Department of Energy. ORNL is an equal opportunity employer and committed to building and sustaining a culturally diverse workplace.



## NEW HIRES IN GEOSCIENCE EDUCATION

The Jackson School of Geosciences seeks individuals attracted to the challenge of geoscience education at the university level. As leaders in geoscience pedagogy, candidates should excel as teachers and developers of courses set in field, laboratory, and lecture environments. The new hires may also contribute to the Jackson School's commitment to educate the wider community of the public and K-12 pre-college students.

We encourage applications from those with proven records of teaching and related experience at the college level. Candidates are expected to hold a PhD degree in the geosciences or a closely related field. Additional credentials may include experience in securing external funding, and a record of publications related to geoscience education. Opportunities exist for appointments as Lecturer, Senior Lecturer, Adjunct Faculty, or tenure-track Faculty, depending upon credentials and interests. Appointments will be primarily within the Department of Geological Sciences, but may include affiliations with the Jackson School's main research units, the Bureau of Economic Geology or the Institute for Geophysics. The schedule of appointment is negotiable.

Send inquiries and applications (cover letter, CV, publications) to: Office of the Chairman / Department of Geological Sciences / Jackson School of Geosciences, The University of Texas at Austin / 1 University Station C1100 / Austin, TX 78712-0254 or [jobs@jsg.utexas.edu](mailto:jobs@jsg.utexas.edu).

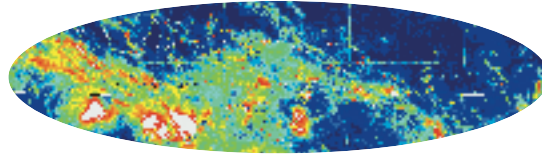
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Positions Open continued on page 68.



### **MULTIPLE HIRES IN CLIMATE SYSTEMS SCIENCE**

The Jackson School is building a premier education and research program in Climate System Science. We seek scientists at the forefront of their disciplines attracted to challenging areas of scholarship that require collaboration across disciplines and programs. We seek the expertise required to address fundamental questions associated with a changing Earth system, including:

- What processes control the rates of change and variability of the climate system, including the atmosphere, ocean, cryosphere, land surface, and biosphere?
- Can we improve our ability to anticipate these changes and determine the potential impacts on society?

Over the next three years, we will hire six or more faculty and scientists who complement our growing strengths. We will hire individuals who will enable us to build a comprehensive climate program and who will make fundamental advances in our understanding of the climate system. These areas include, but are not limited to:

- Improved modeling of the Earth system, specifically including ice sheets, the global carbon cycle, and interaction between the components of the Earth system.
- Enhanced observation of the Earth system, including remote sensing of Earth-surface processes and components.
- Greater capability to utilize geologic archives to understand climate change, including paleoclimatology, paleoceanography, and paleobiology.
- Improved ability to link climate and hydrology, particularly at the basin-to-continent scale.
- Increased strengths in atmospheric dynamics and physical oceanography.
- Increased ability to understand variability and quantify uncertainties, including statistical climatology.
- Greater capability to address societal impacts and vulnerability, including adaptation and mitigation.

We encourage applications from innovative scientists in other areas that are related to climate system science.



### **MULTIPLE HIRES IN ENERGY—SCIENCE, ENVIRONMENT, AND POLICY RESEARCH**

The Jackson School is building a premier education and research program in Energy—Science, Environment and Policy Research. We seek scientists at the forefront of their disciplines attracted to challenging areas of scholarship that require collaboration across disciplines and programs. We seek to address compelling questions within the broad theme of determining how we can create an energy future that is sustainable and environmentally and economically robust. These questions include, but are not limited to:

- How can we integrate classically separated disciplines (geomechanics, geochemistry, tectonics, stratigraphy, petrophysics, geophysical imaging, regional/basin scale studies) to advance interrelationships at the forefront of energy and environmental science?
- How do fluid-rock interactions and the interplay between mechanical and chemical processes influence fluid flow and storage in the subsurface?
- How can we improve identification and recovery of energy resources by comprehensive integration of information at all scales, integrated numerical modeling, and innovative automated and continuous monitoring?
- Can we solve the compelling environmental issues associated with the extraction and use of fossil fuel energy sources, including water and land use, and carbon sequestration?
- Can we develop energy policies founded on solid scientific and engineering information and innovative approaches that will simultaneously promote environmental stewardship and energy security?

Over the next three years we will hire six or more faculty and scientists who complement our existing strengths. We are interested in a wide variety of research areas ranging from rock/fluid systems, subsurface sensing, tectono-stratigraphy, carbon management, energy economics and policy, basin-scale analysis and modeling, and resource and reserve geoinformatics. We also encourage applications from innovative scientists in other areas related to energy—science, environment and policy.

Opportunities exist at any level, can include cluster hires, and can be within or in combination with any Jackson School Unit—the Department of Geological Sciences, the Bureau of Economic Geology, or the Institute for Geophysics. The schedule of appointment is also negotiable. For more information on the school and its hiring program visit us online at [www.jsg.utexas.edu/hiring](http://www.jsg.utexas.edu/hiring).

Send inquiries and applications (cover letter, CV, publications) to: Randal Okumura, Office of the Dean / Jackson School of Geosciences, The University of Texas at Austin / PO Box B, University Station / Austin, TX 78713 or [jobs@jsg.utexas.edu](mailto:jobs@jsg.utexas.edu).

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### **MULTIPLE HIRES IN CRUST, MANTLE, AND CORE DYNAMICS**

The Jackson School is building a premier education and research program in Crust, Mantle, and Core Dynamics. We seek scientists at the forefront of their disciplines attracted to challenging areas of scholarship that require collaboration across disciplines and programs. We particularly seek individuals eager to address the questions encompassing the broad theme of determining how the core, mantle, crust, and surface interact to shape the physical, chemical, and biological evolution of the Earth across a wide range of spatial and temporal scales. These questions include, but are not limited to:

- What controls the style, vigor and time dependence of mantle and core convection?
- How are chemical and physical processes acting in the Earth's interior manifested at the surface and how do surface processes affect Earth's interior?
- What controlling influence do fluids have on geological processes in the Earth's crust and mantle?
- How can knowledge of active tectonic processes and present-day plate motions be utilized to better decipher Earth's history?

Over the next three years, we will hire six or more faculty and scientists who complement our existing strengths. We are interested in a wide variety of research areas ranging from geodynamics, seismology, mineral physics, GPS/remote sensing of active and surface deformation, fluid dynamics, geochronology, geochemistry, rock physics, and computational geosciences focusing on modeling and simulation. We also encourage innovative scientists in other areas related to crust/mantle/core dynamics to apply. Successful applicants will join a strong and diverse group of 125 Ph.D. faculty and scientists, with the facilities and partnerships that will help ensure their success.



### **MULTIPLE HIRES IN EARTH SURFACE AND HYDROLOGIC PROCESSES**

The Jackson School is building a premier education and research program in Earth Surface and Hydrologic Processes. We seek outstanding scientists at the forefront of their disciplines who are attracted to challenging areas of scholarship that require collaboration across disciplines and programs. We seek to address compelling questions in surface and hydrologic processes within the broad theme of determining how surface and hydrologic processes are influenced by their dynamic setting at the interface of the lithosphere, atmosphere, hydrosphere, and biosphere. These questions include:

- How do climate, ice sheets, and tectonics interact to define the distribution and character of sea level change?
- How do coastal zone geology, biology, biogeochemistry, and hydrology respond to surficial processes, particularly to sea level change?
- What are the impacts of climate variability/change and land use change on water, nutrient, and sediment cycles?
- What is the integrated result of the interplay between tectonic deformation, climate change, and biota on the Earth's surface and on the supply, distribution, and storage of sediments?
- What are the physical, chemical, ecological processes and social forces that will determine the sustainability of our water resources?

Over the next three years, we will hire six or more faculty and scientists who complement our existing strengths. We are interested in a range of research areas from quantitative geomorphology to hydrologic-biologic interactions to societal impacts and resource sustainability, and capabilities ranging from modeling landscape dynamics to remote sensing, shallow environmental geophysics, aerogeophysics, and monitoring groundwater and coastal systems. We also encourage innovative scientists in other areas related to surface and hydrologic processes to apply.

Opportunities exist at any level, can include cluster hires, and can be within or in combination with any Jackson School Unit—the Department of Geological Sciences, the Bureau of Economic Geology, or the Institute for Geophysics. The schedule of appointment is also negotiable. For more information on the school and its hiring program visit us online at [www.jsg.utexas.edu/hiring](http://www.jsg.utexas.edu/hiring).

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# PhD Scholarship Projects

## ARC Centre of Excellence in Ore Deposits (CODES)

The ARC Centre of Excellence in Ore Deposits (CODES) is a world-renowned research centre in ore deposits, with major national and international collaborators funded jointly by the Australian Research Council, AMIRA International, the University of Tasmania and the State Government of Tasmania.

CODES undertakes multidisciplinary research in close association with industry on ore deposit LOCATION, FORMATION, DISCOVERY, RECOVERY and TECHNOLOGY and is currently looking for motivated postgraduate students to undertake a variety of projects.

### CODES has PhD projects on ore deposits in:

- Halmahera (Indonesia)
- Zambia (Africa)
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# The future of hydrocarbons: Hubbert's peak or a plateau?

**Eric S. Cheney**, Department of Earth and Space Sciences, Box 351310, University of Washington, Seattle, Washington 98195-1310, USA; [vaalbara@u.washington.edu](mailto:vaalbara@u.washington.edu)

**Marianne W. Hawkes**, 2164 Shadow Brook Court, Carson City, Nevada 89703-7370, USA; [ophirmill@yahoo.com](mailto:ophirmill@yahoo.com)

## INTRODUCTION

Due to economics, science, technology, and the increased manufacturing of hydrocarbons from sources other than oil, the world's production of oil and gas in the twenty-first century will not peak sharply but will plateau or gradually decline. The scenario presented here places us among the optimists.

Data used in this paper come mostly from the Web sites of the U.S. Energy Information Administration and the National Energy Board of Canada and from pre-1977 publications of the former U.S. Bureau of Mines.

Oil is measured in barrels containing 42 U.S. gallons. The heat value of 6000 ft<sup>3</sup> of gas is approximately equivalent to a barrel of oil, so gas is expressed as barrels of oil equivalent (boe). Table 1 uses billions of barrels, Gb, and Gboe.

## HISTORY

The concept that resources are essentially finite may have originated with Thomas Malthus. He concluded in 1798 that the exponential growth of Earth's human population was unsustainable because agricultural production could only increase arithmetically. Since then, mechanized farming, irrigation, refrigeration, chemical fertilizers (from petroleum and other mineral deposits), hybrid grains, genetic modification, and improved transportation systems have blossomed. Now, famine is only caused by political events and by the inability to deliver emergency supplies following natural disasters.

The concept of the inelasticity of oil resources stems from Hubbert's (1956) prediction, based on declining rates of discovery, that the annual production of oil in the 48 contiguous United States would crest in 1970, which it did, at 3.5 Gb. Hubbert's analysis excluded Alaska and the Gulf of Mexico, where oil was discovered in the 1960s and later. Because the contiguous United States is the most explored area in the world and because the worldwide rate of discovery has declined in the past decade, "Hubbert's Peak" is a common model for the world's future production (Deffeyes, 2001). "Peak oil" posits that production will fall as sharply in the twenty-first century as it rose in the twentieth. If so, the economic and political consequences are potentially dire (Urstadt, 2006).

World oil and gas currently have annual production growth rates of 1.9% and 2.3%, respectively. Predicting exhaustion is

not as simple as dividing present reserves by projected production. Estimates of ultimately recoverable oil and gas are qualitative; uncertainties include future prices, geologic models for undiscovered deposits, and future technology. Production is also driven by demand, but significantly higher prices might decrease demand and, hence, affect production.

## ECONOMICS

Higher prices stimulate exploration and production, including from deposits that previously were uneconomic. However, during Hubbert's time (from the 1930s until after 1970) the price of oil was effectively fixed by the Texas Railroad Commission at ≤US\$3/barrel, and after 1938, the U.S. Federal Power Commission fixed the interstate price of natural gas at ≤US\$0.90/kft<sup>3</sup>. The resultant decline of the price of oil in uninflated dollars discouraged exploration, which is documented by a decline in the number of wells drilled, from a high of 57,111 in 1956 to 25,851 wells in 1972. The record was 91,553 wells in 1981, but <25,000 wells were drilled annually from 1992 to 1999, and 33,831 were completed in 2004.

Conventional oil and gas flow from wells. Primary recovery by pumping is typically 20%–30% of the oil present. Secondary recovery can produce the same amount again by injecting gas (including CO<sub>2</sub>), steam, fire, or detergents into reservoir rocks. Higher prices for oil permit more secondary recovery plus the production of oils that are so viscous that primary recovery is minimal.

Higher prices now justify the huge capital investments required for liquefied natural gas (LNG) and gas to liquids (GTL). Intercontinental trade of LNG via cryogenic ships is rapidly expanding. GTL will replace diesel with cleaner fuels. One reason natural gas is in demand is that it generates less CO<sub>2</sub> than oil and only ~40% of the CO<sub>2</sub> from coal of equal heat value. Natural gas was relatively unimportant in Hubbert's time (Table 1) and crested in the United States in 1973 at 3.6 Gboe.

TABLE 1. SELECTED GAS AND OIL STATISTICS FOR THE WORLD AND THE UNITED STATES

World	gas (Gboe)	oil (Gb)	United States	gas (Gboe)	oil (Gb)
<b>2004</b>					
Reserves	~1000	~1200	Reserves	32.1	21.4
Production	~16	26.4	Production	3.2	1.9
			Imports	0.7	4.4
<b>1993</b>					
Reserves		996	Reserves	27.1	23.0
Production	12.7	22.0	Production	3.0	2.5
			Imports	0.4	2.7
<b>1956</b>					
Reserves			Reserves	39.6	30.4
Production	2.0	6.1	Production	1.6	2.6
			Imports	0.2	0.4

Increased production of natural gas will extend conventional production.

Sufficiently higher prices also encourage conservation, which can affect production. Conservation includes smaller and more fuel-efficient cars (including hybrid engines), urban mass-transit systems, energy-efficient (green) buildings, cogeneration of electricity, wearing sweaters indoors, etc.

## GEOSCIENCE

The application of plate tectonics came after 1970, providing the rationale for deep-water drilling on the margins of continents and fostering a better knowledge of other tectonic environments. Additionally, our understanding of petroliferous rocks has changed appreciably as a result of sequence stratigraphy and other geological and geochemical advances.

## TECHNOLOGY

Significant technological advances in finding and producing oil occurred after Hubbert's prediction. These include seismic reflection surveying (especially 3-D seismic imaging), deep-water (off-shore) drilling and production, and horizontal drilling (now up to 10 km).

## SUBSTITUTION

Other forms of energy, non-conventional oil and gas, and conservation will increasingly substitute for conventional oil and gas. Ethanol from biomass (sugar cane, switchgrass, etc.) produces more energy than it consumes in the full cycle of fertilizing, growing, harvesting, transportation, and manufacturing, but much ethanol from corn does not. On a volume basis, ethanol is ~2/3 as efficient a fuel as gasoline.

In 2004, about 21% of the electricity in the United States was generated by 0.3 Gb oil and 1.1 Gboe gas; coal generated 49.8%. The amount of electricity produced by coal, nuclear power, and renewable sources will increase if the relative prices of oil and gas increase.

Canada's oil reserves (now second in the world) experienced a quantum leap in 2005 when the U.S. Securities and Exchange Commission reclassified the tar sands of Alberta as oil. Mining and refining recover 81% to 90% of the oil in the sand as synthetic oil. In 2004, mining and refining complexes were profitable at about US\$30/barrel; the spot price for future oil has exceeded US\$50/barrel since early 2005. Annual production from mines and wells in 2003 was 0.18 Gb; it will be 0.7 Gb by 2015. In 2004, the mineable reserves of Alberta tar sands, 35 Gb, were greater than the United States' reserves of conventional oil (Table 1).

Another nonconventional source of oil is coal, which the United States has in abundance. Germany, during WWII, and South Africa, during the apartheid era, manufactured synthetic oil by reacting coal with water at high temperatures. Most strategies for future "clean coal" envision a similar process, in which pollutants, including CO<sub>2</sub>, will be sequestered, and co-generated steam will produce electricity.

With continued high prices, in-place gasification and/or liquefaction of deep coal or tar sands could be economic. With even higher prices, oil shale and methane ice (clathrates) in sediments on the sea floor might be exploitable. Of course, if such schemes consume more energy than they produce, they are unlikely to be worthwhile.

## THE NEAR FUTURE

In the next few years, world oil production may outstrip demand because of projects planned before the current price increases. To maintain prices, the Organization of the Petroleum Exporting Countries (OPEC) is now considering decreasing production.

Nationally owned companies currently control 90% of the world's production of oil and gas. These companies tend to be secretive and under-capitalized. The major private oil companies have been through boom and bust before. Accordingly, they are focusing on projects that are viable at US\$25 to US\$35/barrel, reducing debt, increasing dividends, and repurchasing their stock. Meanwhile, they fret that too few areas will remain politically attractive for exploration and production.

## CONCLUSIONS

Table 1 and Deffeyes (2001, p. 3) show that U.S. oil production in 2004 was about twice what Hubbert projected (mostly because of production in Alaska and the Gulf of Mexico). Van der Veen (2006) noted that by 2004 cumulative U.S. oil production (exclusive of Alaska and the Gulf of Mexico) totaled 161 Gb and that Hubbert had predicted the ultimately recoverable amount would be 170 Gb. 2004 reserves, exclusive of Alaska and the Gulf of Mexico, were ~13 Gb.

Economics, conservation, substitution, future advances in geoscience and technology, and concerns about global warming imply that the world's combined production of conventional and nonconventional oil and gas will not peak sharply but will plateau or decline gradually in the twenty-first century. The world's per capita production of conventional oil and gas will, of course, decline more steeply.

As for gasoline, it will not run out soon, but it will become progressively more expensive. Presumably, some will always be available at US\$20 to US\$100 (in 2006 dollars) per 3.8 liters, even if it comes from tar sands, cellulose, coal, or oil shale.

Static or gradually declining production would be fairly easy to manage if oil and politics did not mix. Crises will recur due to aggressive or unstable exporting nations and to counterproductive legislation and foreign policies of some of the major consuming nations.

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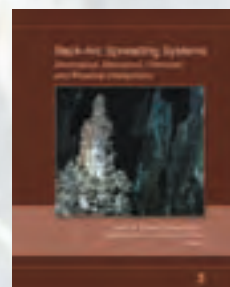
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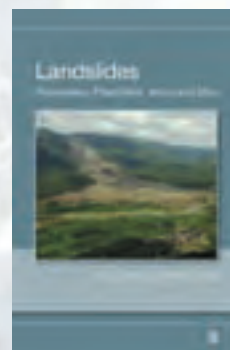
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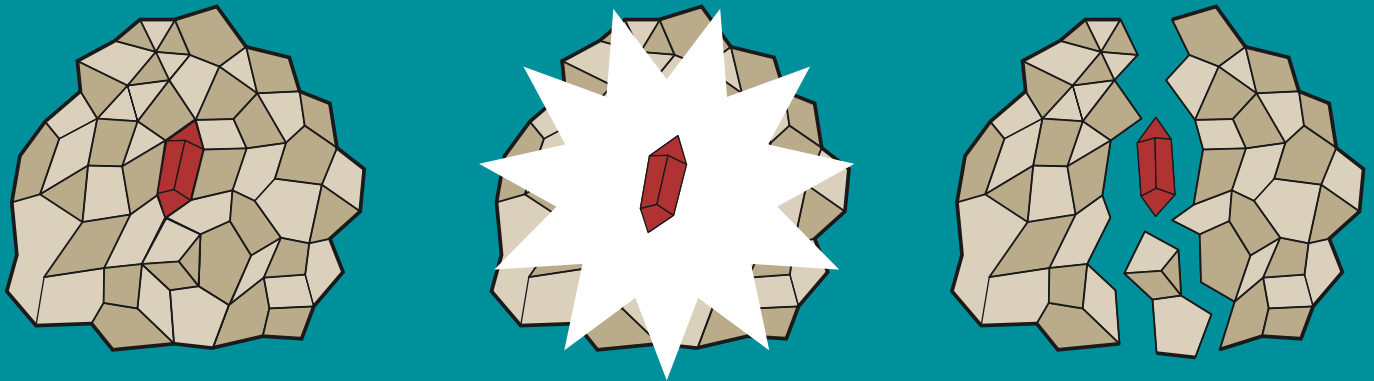


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