

**PPEM**  
 Physical Properties  
 of Earth Materials  
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# Annual Newsletter

November 2012

## A Note From The Chair

~ **Judith Chester** ~  
*Texas A&M University*  
*PPEM Chair*

This has been an action packed year for the PPEM community as witnessed, in part, by several key rock mechanics workshops, the Gordon Conference on Feedback Processes in Rock Deformation, the JFAST drilling project, and new reports from the Alpine Fault drilling program. We have included a brief report on each of these activities in this newsletter and hope that you take the opportunity to talk with the individuals involved to learn more about the science, and to see how you can contribute to these exciting projects in the future.

We express our gratitude to Terry Tullis, who will host one more workshop for our community before the end of the year! That makes four workshops organized by Terry over the last year, all of which were held for the PPEM community, and particularly to promote the next generation of experimentalists. The upcoming event will be held at the Intracontinental Hotel on Saturday and Sunday before AGU (see details on the last page of this newsletter). This workshop will extend discussions initiated at the extremely successful Harvard Workshop held in

August (story on page 7). On Sunday afternoon we hope to hear brief reports on the recent EarthCube workshops held by the Structure/Tectonics and EarthScope communities.

Plans for the 2014 Gordon Conference on Rock Deformation are already underway after the successful completion of the 2012 conference held this past August in New Hampshire. The 2014 conference will focus on "Evolving Structures". Make sure that you put this event on your calendar and broadcast it to your new students. For an overview of the 2012 conference on "Feedback Processes in Rock Deformation", look for Wenlu Zhu's report later in this newsletter.

Don't miss the AGU MRP Reception that will be held on Tuesday evening (12/4) at 6:30-8:30 p.m., in Room Salons 1-7 of the San Francisco Marriott. Chris Marone currently serves as the chair of the MRP committee and would like to see you there. The MRP Outstanding Student Award will be announced at this reception so make sure that you attend and support MRP. Also, don't forget about the Tectonophysics and Seismology Joint Reception

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## PPEM Dinner

The annual PPEM dinner will take place on Monday, December 5th. at Henry's Hunan Restaurant. (Same location as last year!) Festivities will begin with a cash bar at 6:30, followed by dinner at 7:30. The banquet style menu will feature a variety of meat, chicken, seafood and vegetarian dishes showcasing the 3 cuisines of China's Hunan region. The restaurant is a short walk from the Moscone Center, at 110 Natoma Street, San Francisco, CA 94105 in an alley west of 2nd between Howard and Mission. See page 8 for reservation information.

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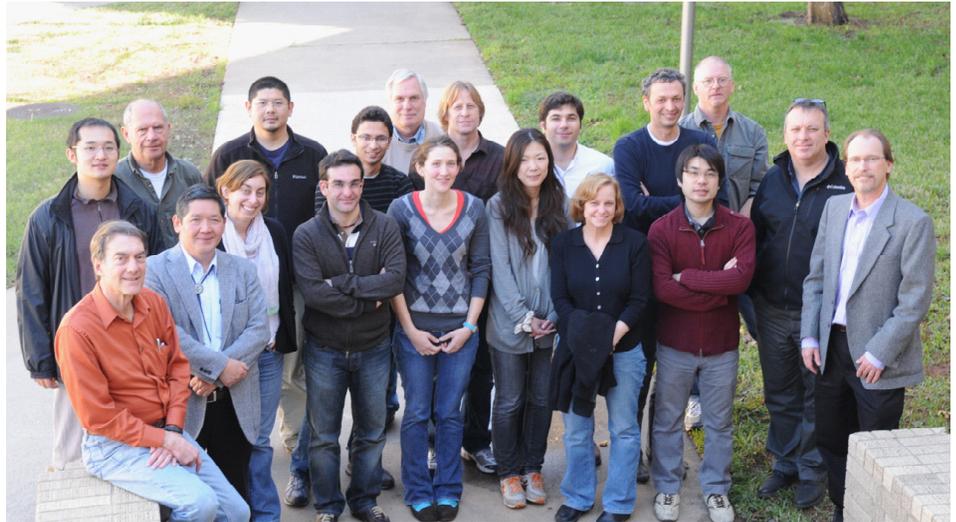
# Design Workshop for a Next-Generation Friction Machine

*Texas A&M University, February 12-15, 2012*

~ **Fred Chester** ~  
*Texas A&M University*

~ **Judith Chester** ~  
*Texas A&M University*

The Department of Geology and Geophysics and the College of Geosciences at Texas A&M University awarded Toshi Shimamoto the Michel T. Halbouty '30 Visiting Chair in recognition of his achievements in experimental rock deformation. He joins a group of accomplished rock mechanists that have been awarded the Chair over the last decade or so, including Jay Melosh, Jon Olson, and Renée Heilbronner. The award provides funds for an extended visit to Texas A&M University to facilitate exchange of knowledge and research techniques. Toshi's visit in February 2012 was action-packed and beneficial to all involved. As part of Toshi's visit, and facilitated by Terry Tullis' enthusiasm to talk about designing a next-generation machine to investigate high-speed friction behavior, we invited members of the rock mechanics community to participate in a Design Workshop. A number of scientists from Asia, America and Europe came to Texas for an enjoyable and productive discussion of existing state-of-the-art friction testing systems, and desired improvements and design goals for advancing these machines. The workshop included presentations by several groups currently operating state-of-the-art-machines, extended discussions of the desirable attributes required in the next generation of friction-measurement appa-



*Back row: Hiroyuki Noda, Ze'ev Reches, Jefferson Chang, Omid Saber, Dave Lockner, Clayton Powell, Charles Choens, Giulio DiToro, Nick Beeler; David Goldsby, Fred Chester. Front Row: Terry Tullis, Toshi Shimamoto, Heather Savage, Nicola De Paola, Melodie French, Hiroko Kitajima, Judi Chester; Wataru Tanikawa*

ratus, critical issues that need to be solved before these apparatus can be designed and built, and potential paths toward solving these issues. This workshop and the 2011 Fall AGU meeting workshop featuring Ivan Getting (very-high pressure gas

machines) began discussions that were continued at the recent NSF-funded "Workshop on Advancing Experimental Rock Deformation Research: Scientific and Technical Needs" that was held August 16-19 at Harvard (see page 7).

## Physical Properties of Earth Materials Annual Newsletter

*The oldest continuously published annual newsletter on experimental rock mechanics and San Francisco fine dining.*

**Brought to you by your PPEM steering committee:**

Judith Chester	Texas A&M	Chair
Phil Skemer	Wash U St. Louis	Newsletter Editor and Chief Correspondent
Heather Savage	LDEO	
Steve Karner	ExxonMobil	
Jessica Warren	Stanford University	
Holger Stunitz	University of Tromsø	
Brian Bonner		Fine Dining Search Team
Steve Blair		Fine Dining Search Team

# Feedback processes in rock deformation: The 9th Gordon Research Conference on Rock Deformation

~ Wenlu Zhu ~

*University of Maryland*

*Chair 2014 Gordon Research  
Conference on Rock Deformation*

The 9th Gordon Conference on Rock Deformation held at Proctor Academy in Andover NH, August 19-24, 2012 was a huge success! Dr. Peter Kelemen was the conference chair who put together a remarkable program on Feedback Processes. Keynote presentations covered a wide range of topics including failure at high confining pressure, fluid assisted slip, reaction-driven cracking, dynamic triggering of earthquakes, localized, reactive fluid transport and deformation, earthquake mechanisms, and subduction zone dynamics and crustal growth. The science program also included 77 poster presentations. More than 120 researchers, many of them graduate students, postdocs and early career scientists attended the conference. As always, GRC provides ideal setting for in-depth discussions and interactions among scientists at all stages of their careers. At the business meeting during the conference, Dr. Francois Renard was elected the Chair for the 11th GRC on Rock Deformation in 2016.

The theme of the 10th GRC on Rock Deformation will be Evolving Structures. Given the excellent facility at Proctor Academy, the impeccable late August weather in New Hampshire, we hope to return to this GRC sit in 2014. Stay tuned!

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



## A Note From The Chair

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that also will be held on Tuesday evening from 6:30-8:30 in Room Golden Gate B of the San Francisco Marriott.

Finally, I want to express my sincere appreciation to Stephen Blair and Brian Bonner, our Fine Dining Search Team, for organizing our PPEM dinner. The dinner will be held at Henry's again this year in response to the overwhelming positive feedback after last year's dinner and Henry's ability to accommodate our growing community. Details on the dinner are provided in the last page of this newsletter. I am looking forward to you joining us for another memorable evening!

This is the third year that I serve as the chair of the PPEM Steering Committee. The steering committee is made up of volunteers that serve three-year terms. Each year at the PPEM dinner meeting we solicit nominations to fill anticipated

vacancies. This year we are seeking three nominations. I will rotate from the chair in Spring 2013. Phil Skemer, our valued newsletter editor and listserv keeper, and Steve Karner are due to rotate from the committee at the end of 2013. Anyone interested in nominating new committee members, or in volunteering to serve the PPEM community, is encouraged to contact one of the current steering committee members before, during, or after the PPEM dinner. Note that the PPEM Steering Committee will meet at the AGU meeting on December 4. Please let us know how we can help increase the visibility of our community and foster activities to advance our young scientists. It has been a great honor to serve the PPEM community over the past three years!

*Best regards,  
Judith*

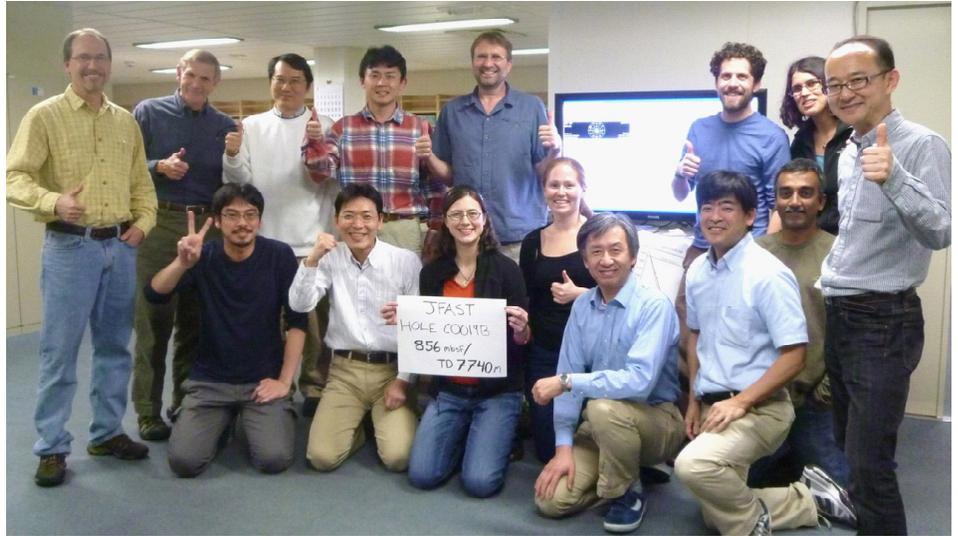
# Update on the Japan Trench Fast Drilling Project

~ Fred Chester ~

Texas A&M University

Over the years many members of PPEM have worked on the problem of determining the absolute strength of plate-boundary faults. Most lines of evidence lead to the conclusion that these faults are profoundly weak, even for those that slip seismically. Recent experimental studies of the frictional properties of faults at coseismic slip rates support this conclusion. Although direct measures of fault strength during an earthquake are lacking, there is the possibility to make direct measures of stress and address other important questions about earthquakes by drilling into a fault zone within a year or two after an earthquake occurs on the fault.

The 2008 ICDP/SCEC Workshop on Rapid Response Drilling of Faults: Past, Present and Future, organized by Emily Brodsky and Jim Mori, laid the foundation of a scenario drilling plan and identified key measurements that could address fundamental and outstanding questions of the mechanics of faulting, including “What is the absolute strength of a fault during an earthquake?” The workshop fostered the first rapid response drilling expedition of the Integrated Ocean Drilling Program (that began about one year after the March 2011 MW 9.0 Tohoku-oki earthquake and tsunami. The goal of IODP Expedition 343, the Japan Trench Fast Drilling Project (JFAST), was to drill, sam-



*Some of the happy members of the JFAST Science Party after completing the record-setting LWD/MWD hole that penetrated the plate boundary décollement in the region that experienced large coseismic slip during the March 2011 (Mw 9.0) Tohoku-oki earthquake. Standing, from left to right, Fred Chester, Casey Moore, Tsuyoshi Ishikawa, Kohtaro Ujiie, Jim Sample, Patrick Fulton, Marianne Conin, Sanny Saito. Kneeling from left to right, Jun Kameda, Takehiro Hirose, Christine Regalla, Becky Cook, Weiren Lin, Jim Mori, and Santanu Bose.*



ple and instrument the source region of the Tohoku-oki earthquake. One year is a remarkably short time to design and prepare a scientific drilling expedition, and it was only possible with the hard work and dedication of the scientists and engineers involved, and the support of IODP, Japan, and the various agencies that operate and support the deep water drill ship, Chikyu.

A remarkable and unexpected observation of the Tohoku-oki earthquake was that the seismic rupture propagated up dip along the plate interface all the way to the seafloor at the axis of the Japan Trench, and that the magnitude of coseismic slip at the trench was about 50 m. It was the large slip at shallow depths

near the trench that generated such a devastating tsunami. The large magnitude of coseismic slip at shallow depths below the sedimentary prism is at odds with the conventional view that friction of the shallow thrust is rate-strengthening and slip is aseismic.

The goals of the JFAST expedition were to 1) drill through the sedimentary prism and penetrate the top of the subducting Pacific Plate, and use logging while drilling (LWD) and measurement while drilling (MWD) technology to locate the plate-interface fault that ruptured during the Tohoku-oki earthquake, 2) drill a coring hole to acquire samples of the prism and of the fault zone, and 3) install pressure and temperature observatories in the bore holes. The top priority was to place a temperature observatory, consisting of more

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# Update on the Deep Fault Drilling Program

## *Alpine Fault, New Zealand*



~ **Virginia Toy** ~  
*University of Otago*

~ **Rupert Sutherland** ~  
*GNS Science*

~ **John Townend** ~  
*Victoria University*

The c. 120m of core recovered from DFDP-1A and DFDP-1B are now in cold storage at the University of Otago. Samples have been scanned using a Geotek (obtaining measurements of core diameter, natural gamma density, p-wave velocity with varying success due to the high attenuation properties of the fractured core), high-resolution 180° composite images of core surfaces have been made, and medical-grade CT scans of the entire core have been collected. We have also documented the lithological and structural features of the

entire core. These are summarized in a series of logs available to registered collaborators in the private workspace of <http://wiki.gns.cri.nz/DFDP>.

Subsampling was undertaken following a review and assessment of requests from collaborators. Most sample requests were able to be met, and all subsamples should now have been sent to collaborators. We are undertaking numerous analyses on principal slip zone gouges, leaving little archival material.

Wireline data from the two DFDP-1 boreholes have been analysed in conjunction with core observations and are now being prepared for publication. The analysis to date has focussed on characterizing and distinguishing the fault rock lithologies in terms of petrophysical parameters (e.g. seismic wavespeed, natural gamma, density and porosity, and

fracture populations) and investigating the implications of variations in these parameters with proximity to the principal slip zone for models of earthquake rupture and fault zone evolution.

The downhole observatory has now been running for 18 months, measuring fluid pressures, temperature, and seismicity. A 2 Hz downhole seismometer (“GCSZ”, Gaunt Creek Borehole) and a strong-motion sensor installed at the wellhead (“WHAS”, Gaunt Creek) are now providing continuous and triggered data respectively to GeoNet; these data can be freely downloaded from the GeoNet website (<http://www.geonet.org.nz>). Jennifer Eccles at IESE, University of Auckland, is presently working with these data.

The first results from drilling and immediately post-drilling observations have been summarized by Sutherland et al. in a paper to be published in the December 2012 issue of *Geology: Drilling reveals fluid control on architecture and rupture of the Alpine Fault, New Zealand*, doi:10.1130/G33614.1.

A series of other manuscripts are in advanced stages of preparation:

1. An outline of the lithological variations in the core, including qualitative geochemical data, which defines a series of eight major lithological units visible in the core (Toy et al.);

2. An analysis of the wireline dataset describing the petrophysical characteristics of the different fault rock lithologies, variations in petrophysical properties with proximity to the principal slip zone, and the overall architecture of the fault zone

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# J-FAST

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than 50 autonomous miniature temperature loggers, that when recovered, would provide a time series of densely spaced temperature measurements spanning the fault. These data are critical to quantify the amount of heat generated during the earthquake and to determine the coseismic frictional strength of the slipped fault. The LWD data and core samples will help define the mechanical, thermal and fluid flow properties of the fault and surrounding sediments, and determine the post earthquake in situ stress at the fault.

As Emily Brodsky mentioned in last year's PPEM newsletter, this expedition pushed the limits in scientific ocean drilling. Not only was the water depth extreme (6.9 km), but the boreholes had to be re-entered in order to install the observatories, which required the use of an underwater television camera to provide real-time images of the well head and drill pipe, and dynamic positioning capability of the drill ship. As expected, a number of challenges were encountered and equipment failures occurred, but in the end all three objectives were accomplished. Much of the data collected and analyzed during and just after the expedition will be reported at the 2012 Fall AGU meeting, and the temperature recording string is scheduled to be retrieved from the borehole in February of 2013. Additional results from laboratory studies including friction and geotechnical experimental testing, modeling work, and continued analysis of core samples are expected over the next several years.

## PPEM Used Equipment Database

Are you using a pressure vessel as a doorstop? Are university administrators threatening to convert your lab to a performance art space and coffee shop?

If you have have equipment that is no longer used or needed, early career members of the PPEM community would love to take it off your hands. PPEM has created a new database that we hope will facilitate the transfer of deformation apparatus and smaller equipment to growing labs and new PIs

To donate equipment, large or small, simply visit the website below and answer a few questions. The information will be provided to early career scientists upon request. Please contact Phil Skemer ([pskemer@wustl.edu](mailto:pskemer@wustl.edu)) for more details.

<http://tinyurl.com/9dbz36p>

## Deep Fault Drilling Program

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(Townend et al.);

3. A report on experiments designed to investigate the permeability and sonic wave speeds of DFDP-1 material over a range of effective stresses in order to explore the permeability structure near the fault and to compare laboratory and borehole measurements of sonic wave speed (Carpenter et al.)

The results of the studies mentioned above, along with other emerging data from the project and aligned research, will be presented as part of the following session at the Fall AGU Meeting in San Francisco, 2–7 December 2012:

T31C. Theory and Practice in Studies of the Earthquake Cycle

The poster sessions are on the morning of Wednesday 5 December, and there are two oral sessions that afternoon.

On the Wednesday evening follow-

ing the T31C session we will organize a joint dinner to which we invite anyone presently involved in DFDP-1, or interested in becoming involved in DFDP-2 and beyond. If you would like to attend please email [virginia.toy@otago.ac.nz](mailto:virginia.toy@otago.ac.nz) to register your interest and be advised of updates. There is likely to be a cost for participants.

We have been funded by the Royal Society of New Zealand's Marsden Fund and the International Continental Drilling Program (ICDP) to drill a second borehole, DFDP-2, which has a target depth of 1500 m. We hope to core a 500 m section around the principal slip zone, perform hydraulic tests, collect wireline logs, and install an observatory. We plan to drill from the start of 2014. Interested parties are encouraged to read the project information online at <http://wiki.gns.cri.nz/DFDP>, and to contact the authors of this article if they wish to become involved.

# Workshop Report: Scientific and Technical Needs of the Rock Deformation Community

~ Phil Skemer ~

Washington University in St. Louis

On August 16-19th a workshop was convened at Harvard University to discuss the scientific and technical needs of the rock deformation community. This meeting, which was supported by NSF, DOE, and SCEC, brought together 100+ scientists, including both practicing experimentalists and those who use experimental data in their research.

The first objective of this workshop was to discuss the important scientific questions to be addressed by our community over the next 5-10 years. A second objective was to determine the technical and organizational needs that will be required to achieve these scientific goals.

The workshop kicked off with keynote presentations highlighting both recent accomplishments and future directions for rock mechanics. Topics covered included everything from the seismogenic zone through the upper mantle. These presentations were accompanied by lively discussion of the technical needs for the community. While the focus was mainly on the needs of the US community, colleagues from Europe and Asia graciously attended to provide their input. Plena-

ry talks were followed by breakout sessions, where smaller groups discussed in more detail the scientific needs of the community, from both the practitioners' and users' perspectives. Additional breakout groups discussed early career issues, technical support needs, shared instrumentation, and data archiving.

Throughout the workshop it became clear that there is a pressing need for a consortium, similar to COMPRES, to serve the rock deformation community in the US. It is envisioned that this consortium will serve as an advocate for the commu-

nity both to colleagues and funding agencies. With a longer outlook, this consortium may be able to support centralized facilities with embedded technical support, to better serve the scientific and technical needs of the community. Building a larger community of labs in the US is necessary to achieve the critical mass of students and early career scientists that is clearly present in Europe and Asia. An organizational meeting for this consortium (presently known as DEFORM), is planned for the weekend before AGU (see contribution by Terry Tullis, this page).

## Organizational Meeting for DEFORM

~ Terry Tullis ~

Brown University

As many of you may already know, on Dec 1-2 just before AGU we will be holding an organizational meeting of the Experimental Rock Deformation Community to set up an organization similar to COMPRES. Based on an overwhelming plurality of responses to a poll sent to much of the community, this organization will be called DEFORM for "Experimental Rock DEFORMation Consortium."

This organizational meeting is primarily intended for practitio-

ners from the USA, but those from abroad and users are welcome. The meeting will be 9 AM - 5 PM on both Saturday and Sunday and will be held on the fourth floor of the InterContinental Hotel, adjacent to Moscone West. Hopefully we will meet in the Laurel Hill room both days – if it is not available for Saturday, we will meet in a nearby room that day and signs will redirect us.

No registration is required and if you have already responded to a poll I emailed on October 6th to many PPEM subscribers, you do not need to do anything. Your poll response will be used to ensure enough chairs in the meeting room and enough food for coffee breaks. If you got that email and didn't respond to the poll, please do so ASAP. If you did not get the email about the poll and are interested in attending, please email me at Terry\_Tullis@brown.edu so I will know how many are coming. If you do email me, tell me which days you can come.

Update your bookmarks! PPEM has a new website:

[sites.agu.org/ppem/](http://sites.agu.org/ppem/)

The screenshot shows the PPEM website interface. At the top, there is a navigation bar with the AGU logo and the text "PPEM Physical Properties of Earth Materials". Below this, there is a main content area with a "Home" link, a "PPEM Dinner" link, and a "Steering Committee" link. The "AGU Fall Meeting 2011" link is also visible. The main content area includes a "Welcome to the Physical Properties of Earth Materials website" section and a "About PPEM" section. The "About PPEM" section states: "PPEM is made up of geoscientists and materials scientists who use experiments, theory and observation to study the properties of Earth's materials. These properties are expressed as constitutive laws that link driving forces and reactions at geodynamic scales. The nature of macroscopic properties and the forma-

# 2012 PPEM Dinner Reservation Form

Reservations must be made and payments received before 27 Nov 2012.  
Send this form or reasonable facsimile by e-mail to: [sclair@sbcglobal.net](mailto:sclair@sbcglobal.net) or make a hardcopy and send by posted mail to the address below.

Please reserve:

\_\_\_\_\_ places at \$35.00 each

\_\_\_\_\_ student places at \$25.00 each

Payment: (due 27 Nov. 2012)

\_\_\_\_\_ I am mailing a check made out to "PPEM"  
(Please do not make checks out to Steve Blair)

Mail check to: Dr. Stephen Blair  
3700 Lakeshore Ave  
Oakland, CA 94610  
USA

\_\_\_\_\_ I will pay using PayPal

Recipient's Email: [sclair@sbcglobal.net](mailto:sclair@sbcglobal.net)

Subject: 2012 PPEM dinner

Note: Please include your name on the paypal message  
(Since PPEM does not have a business account, we can NOT  
accept credit card payment. You must establish your own  
PayPal cash account)

\_\_\_\_\_ I will pay Steve Blair at the AGU meeting BEFORE the dinner  
(please: non-U.S. residents only)

Name: \_\_\_\_\_

Affiliation: \_\_\_\_\_

Other information, comments, special dietary requests, etc:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_