PPEM
Physical Properties
of Earth Materials
sites.agu.org/ppem/

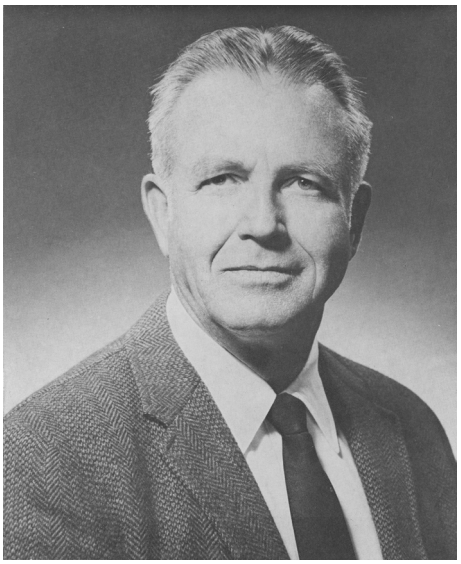
Annual Newsletter

November 2011

A Note From The Chair

~ Judith Chester ~
Texas A&M University
PPEM Chair

This year's Fall AGU Meeting will host several special events important to the PPEM community. The meeting will open Sunday, December 4th with a workshop organized by Ivan Getting and Terry Tullis on Technology for Research at Elevated Pressure (see announcement on page 6). In addition, AGU will host several science-focused, special sessions that honor the memory of David Griggs on the 100th anniversary of his birth (see calender on page 3). Griggs was a pioneering experimentalist with a special talent for designing and operating innovative apparatus to study the mechanical properties of rock at high temperatures and pressures. He was a member of the American Academy of Arts and Sciences and the National Academy of Sciences, and was recipient of the Walter H. Bucher Medal of the American Geophysical Union (1970) and the Arthur L. Day Medal of the Geological Society of America (1973). Join your colleagues at AGU and celebrate the life of David Griggs and his influential contributions to solid-earth geophysics.



David Tressel Griggs (1911-1974)

Recently, we launched a new PPEM website that can be found at sites.agu.org/ppem/. The site is under construction so if you have suggestions for content, please let us know. Photos of the PPEM dinner activities, the high-pressure workshop, and special sessions honoring David Griggs would be excellent additions to this site, so keep your phones charged!

We had several nice contributions to this year's newsletter illustrating that 2011 has been an exciting year for fault zone drilling. Virginia

- Continued on Page 2 -

PPEM Dinner

The annual PPEM dinner will take place on Monday, December 5th. at Henry's Hunan Restaurant. Festivities will begin with a cash bar at 6:00, 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.

Inside:

A Note From The Chair

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Toy, Rupert Sutherland, and John Townend give an excellent summary of the Alpine Fault Deep - Drilling Project, and Emily Brodsky makes a call to the PPEM community to contribute efforts to the Japan Trench Fast Drilling Project (JFAST). Renee Heilbronner and Holger Stunitz describe the international workshop on crystallographic textures (TTT-Texture Topics in Tromso) that they organized and held in October of this year, and announce plans for a similar workshop to be held in 2012. Now is also the time to make plans to attend the 9th Gordon Research Conference on Rock Deformation, Feedback Processes in Rock Deformation, from August 19-24, 2012. See Peter Kelemen's summary in this newsletter and visit the GRC website for further details.

Please join me in congratulating Zhicheng Jing and Dan King, the 2011 Mineral and Rock Physics Graduate Student Research Award recipients, and Ernie Rutter, the 2011 recipient of the Louis Néel Medal of the EGU. Donald J. Weidner and Yehuda Ben-Zion have been recognized as 2011 AGU Fellows. If you know of other award winners that I have missed, please toast them at the PPEM dinner.

Remember, PPEM is a subcommittee of the Mineral and Rock Physics (MRP) AGU Focus Group. Each year, the MRP Focus Group recognizes outstanding contributions by young scientists who are engaged in experimental and/or theoretical studies of Earth materials with The Mineral and Rock Physics Graduate Research Award. The MRP Focus Group also organizes the Outstanding Student Paper Award (OSPA) in Mineral and Rock Physics for the Fall AGU meeting. Please help us recognize the excellent scientific contributions of our students by nominating an outstanding young scientist for the MRP Graduate Research Award next year, and volunteering to be an OSPA judge during this year's Fall AGU. You can pre-register to be a judge using the following link: http://sites.agu.org/fallmeeting/judge-registration/ or contact Dan Shim at SHDShim@gmail.com. If you are not a member of MRP, please consider joining. The current members of the MRP Executive Committee are C. Marone (Chair), C. Agee, R. Caracas, J. Chester, R. Cohen, R. Cooper, A. Dillman, J. Lin, E. Ohtani, W. Panero, H. Savage, A. Schubnel, D. Shim, P. Skemer, S. Vinciguerra, H. Watson, and W. Zhu.

Please plan to attend the Annual PPEM Dinner on Monday, November 5. This year, we will dine at Henry's Hunan, located at 110 Natoma Street, near the Moscone Center. A cash bar will open at 6:00 pm and dinner will begin at 7:30 pm. Make sure that you stop by Brian Bonner's and Steve Blair's table and thank them for organizing another evening of fun and good cheer!

I hope to see you in San Francisco!

Best regards,

Judith

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
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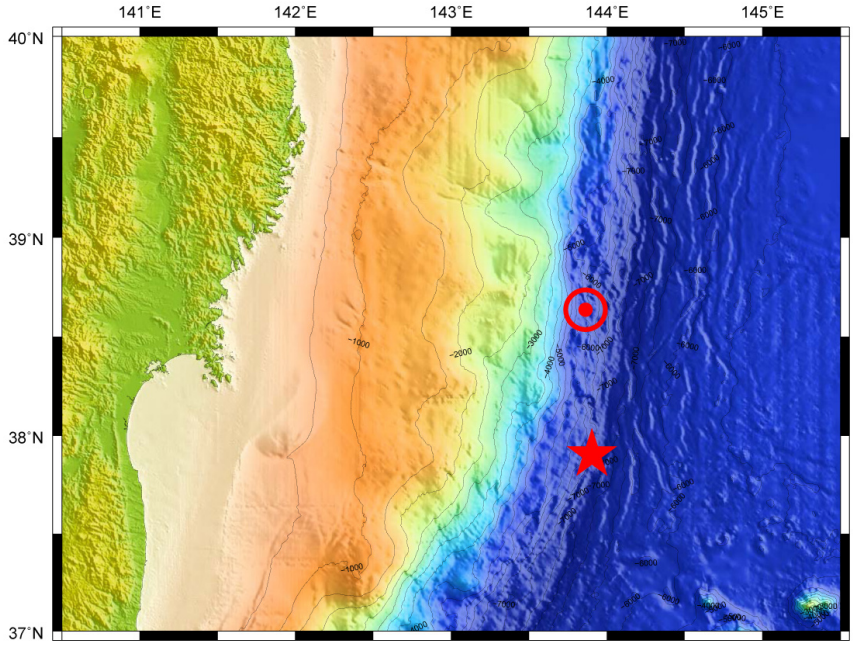
David Goldsby	Brown University	
Steve Karner	ExxonMobil	
Jessica Warren	Stanford University	
Holger Stunitz	University of Tromsø	
Brian Bonner		Fine Dining Search Team
Steve Blair		Fine Dining Search Team

Japan Fast Trench Drilling Project (J-FAST)



Location of the Japan Fast Drilling Project site (star) just South of the the epicenter of the Tohoku earthquake (bullseye).

~ Emily Brodsky ~
UC Santa Cruz

The March 2011 Tohoku earthquake surprised both the geophysical community and the general public with its unprecedented slip, rupture to the seafloor, and resultant devastating tsunami. The earthquake defied some fault mechanics predictions and generated other new problems altogether.

Some of these problems can be addressed through direct sampling of the fault zone. The International Ocean Drilling Program (IODP) is undertaking the J-FAST expedition to drill into the fault zone in April - May 2012. The major goals of the project will be to measure temperature in order to constrain fault friction and to recover a sample of the fault in order to analyze the geological signature of the giant slip event.

Like all IODP projects, J-FAST is an open project and applications for participating scientists are due Nov. 18 for European participants (including Canada), Nov. 20. for US participants and Dec. 1 for Japanese participants. Some countries (including the US) generally provide salary support for participating scientists during the drilling operations.

The J-FAST project has a number of attempted firsts. It is the first attempt to drill rapidly after a subduction earthquake. It is the first attempt to secure a sample known to have slipped 10's of meters in a single earthquake. It is the first attempt to drill a substantive hole in greater than 7000 m water depth. It is the deepest seafloor observatory installation ever attempted. Successfully accomplishing these goals will require that the IODP engineering team is accompanied by a skilled scientific team with a particular emphasis on rock physics and fault mechanics. These scientists need to be able to analyze the data and adapt the project as necessary on the ship. Readers of PPEM, please apply!

For more information:
http://iodp.org/index.php?option=com_content&task=view&id=601&Itemid=1287

2011 Fall AGU Griggs Special Session Wallet Calender

	Monday	Tuesday	Wednesday	Thursday	Friday
Morning (8:00-10:00)	MR11B. Rheology of Geological Materials: From the Concepts to the Field I Posters --- DI11A. Mantle Convection and Mantle Rheology I Posters --- MR11A. Exploratory Deformation of Rocks and Minerals at Extreme Conditions I Posters	DI21B. Mantle Convection and Mantle Rheology II Room 3022			
Morning (10:20-12:20)		T22A. Creep and Faulting in Nature, the Lab, and Theory: Mineral Reaction-Related Instabilities II Room 2016			T52B. Deformation Processes: Microstructure, Rheology, and the Effects of Fluids II Room 2016
Afternoon (1:40-3:40)	T13A. Creep and Faulting in Nature, the Lab, and Theory I Posters	T23G. Creep and Faulting in Nature, the Lab, and Theory: Frictional Instabilities and Ductile Flow III Room 2016		T43C. Deformation Processes: Microstructure, Rheology, and the Effects of Fluids I Posters	T53B. Deformation Processes: Microstructure, Rheology, and the Effects of Fluids III Room 2016 --- MR53A. Exploratory Deformation of Rocks and Minerals at Extreme Conditions II Room 3022
Afternoon (4:00-6:00)		T24B. Creep and Faulting in Nature, the Lab, and Theory: Roles of Water in Failure Mode, Creep Laws, and Deformation Mechanisms IV; Room 2016 --- MR24A. Rheology of Geological Materials: From the Concepts to the Field II Room 3022			T54A. Deformation Processes: Microstructure, Rheology, and the Effects of Fluids IV Room 2016

Alpine Fault - Deep Drilling Project (DFDP-2)

Whataroa, South Westland, New Zealand

Members of the DFDP-1 team displaying the first core to intercept the principal slip zone of New Zealand's Alpine Fault

~ Virginia Toy ~
University of Otago

~ Rupert Sutherland ~
GNS Science

~ John Townend ~
Victoria University

What are the physical conditions in the mid-crust under which large, active continental fault zones evolve and generate earthquakes? The over-arching goal of the "Deep Fault Drilling Project, Alpine Fault" (DFDP) is to address this question through staged drilling into New Zealand's active, locked, dextral reverse Alpine Fault, to observe and sample at progressively greater depths (see Townend et al., 2009, Scientific Drilling, v. 8, doi 10.2204/iodp.sd.8.12.2009 for further details).

The first phase of the Deep Fault Drilling Project (DFDP-1) was carried out in January and February 2011 at Gaunt Creek, South Westland, New Zealand. Two boreholes, DFDP-1A and DFDP-1B, were drilled to depths of 101 m and 151 m respectively. Both boreholes cored hangingwall mylonite sequences containing cataclasite zones that increase in frequency downward to >5 cm thick principal slip surfaces of ultracatalasite and gouge at 90 and 128 m respectively. A footwall sequence of glacial gravel and bedrock was penetrated to a total depth of 151 m in DFDP-1B. A broad suite of downhole geophysical logs was collected and a fault zone observatory comprising seismometers, fluid sampling tubes, piezometers and temperature sensors was established.

The second phase of the Deep Fault Drilling Project (DFDP-2), will commence in early 2013. The initial stage of drilling will not involve coring; coring is expected to commence in ~March 2013. We aim to intercept the fault principal slip zone at approximately 1200 m and to achieve a total borehole depth of 1500 m. Downhole geophysical logs similar to those obtained in DFDP-1 (televiewer; electric; full-wave sonic; density; dipmeter; and EM flowmeter) will be collected and observatory instrumentation installed.

We welcome further collaborative participation in this project from the Earth materials community in two ways:

(1) Additional analysis of materials recovered by DFDP-1, to obtain maximum science benefit from existing material.

(2) Participation of experienced scientists onsite at DFDP-2 in March-May 2013 to assist with core recovery, processing, wireline logging, hydraulic experiments, and observatory construction.

For more information...

For further information about the project in general please refer to https://wiki.gns.cri.nz/DFDP. If you are interested in working with core recovered from the first phase of drilling, please refer to instructions on how to request samples at https://wiki.gns.cri.nz/DFDP/DFDP-1_Gaunt_Ck/DFDP-1_core. If you would like to be involved with DFDP-2, please contact Dr. Rupert Sutherland (r.sutherland@gns.cri.nz), Assoc. Prof. John Townend (John.Townend@vuw.ac.nz) or Dr. Virginia Toy (virginia.toy@otago.ac.nz).

2011 MRP Graduate Student Research Awards

Two members of the PPEM community have been recognized with a 2011 MRP Graduate Student Research Award.

Zhicheng Jing, completed a Ph.D. thesis on the *Equation of State of Silicate Liquids* at Yale University under the supervision of Professor Shun-ichiro Karato. Zhicheng has made the first systematic experimental study on the density of hydrous silicate melts to the pressure of 15 GPa and has developed a new theory of the equation of state to explain a large number of unique and enigmatic observations on silicate melts. These observations include uniformly low bulk moduli and the positive pressure derivative of the Grüneisen parameter. Both of which are totally different from the behavior of the solid counterpart. Most previous models of compression of silicate liquids were based on the analogy with the behavior of solids, but our compilation of the published data shows that such a model is not consistent with the observations. Consequently, we have developed an entirely new model starting from the equation of state of a gas using the analogy with the van der Waals model where the interaction of molecules is due partly to the geometrical effect (exclusive volume effect). In this theory, a large portion of the change in free energy of silicate liquids is caused by the change in configurational entropy not by the change in the internal energy (in solids, a large portion of free energy change is the change in the internal energy). Zhicheng developed such a model for a multi-component liquids (melts). In this model, if one knows the composition, then one can calculate the density of the liquid for any pressure and temperature (with certain limits). In this way, his work forms a basis for the universal equation of state of silicate liquids (melts)."

Top: Zhicheng Jing Bottom: Dan King

Dan King was recognized for his doctoral dissertation research on *Stress-driven melt segregation and reactive melt infiltration in partially molten rocks deformed in torsion with applications to melt extraction from Earth's mantle.* Dan received his Ph.D. at the University of Minnesota under the supervision of Prof. David Kohlstedt and Dr. Ben Holtzman. Dan focused on laboratory experiments to investigate the formation of melt-rich channels during shear deformation of partially molten rocks. Although recent geochemical and geophysical constraints reveal that magma is transported very quickly from depths of over 100 km to Earth's surface, relatively little is understood about the paths or mechanisms that permit rapid transport of magma through a mostly solid rock. In this framework, Dan investigated stress-driven formation of melt-enriched, high-permeability channels in high-temperature, high-pressure torsional shear experiments. Dan demonstrated that, as observed in ophiolites, melt segregation and strain localization are intimately coupled. In addition, Dan investigated the dynamic interaction between melt-enriched channels formed by deformation and those produced by reactive infiltration. These experiments yielded some spectacular results that revealed the importance of deformation on enhancing the rate of melt transport in a reacting system with a simple conclusion: the interplay between deformation-driven and reaction-enhanced melt segregation strongly increases the melt migration rates relative to that of either process alone. This study raises many interesting questions about the nature and importance of non-equilibrium melt-rock systems in the Earth – in melt extraction, transport and emplacement processes. Dan demonstrated a truly exceptional level of intellectual curiosity and sophistication. He is an absolutely first-class experimentalist with a strong background in field studies, thus providing a critical link between laboratory and field studies.

-Shun-ichiro Karato, David Kohlstedt, & Ben Holtzman, nominators

Feedback processes in rock deformation:

The 9th Gordon Research Conference on Rock Deformation

~ Peter Kelemen ~
Columbia University
Chair 2012 Gordon Research Conference on Rock Deformation

The 9th Gordon Research Conference on Rock Deformation will take place from August 19-24, 2012, at the Proctor Academy in Andover, New Hampshire. Chaired by Peter Kelemen and vice-chaired by Wenlu Zhu, the theme for this meeting is "Feedback processes in rock deformation.

Feedback processes are vitally important in controlling the rates and mechanisms of rock deformation. Positive feedbacks lead to accelerating rates, and commonly to spatial focusing. Localization and acceleration of creep is often associated with stress and/or strain rate dependent grain size reduction, frictional heating, or viscous shear heating. The presence of melt may help to localize and accelerate deformation, and in turn deformation may help to localize melt transport. Volume changes during retrograde metamorphic reactions may, under some circumstances, lead to fractures that maintain or increase permeability and reactive surface area, which in turn accelerates reaction rates. Hydraulic fracture often triggers a widening cascade of frictional failures on adjacent fracture systems. Feedbacks that form or reactivate closely-spaced fractures in the upper crust have relevance for, e.g., geological storage of CO2, enhanced geothermal power systems, and shale gas extraction. Clustering of earthquakes involves feedbacks in stress distribution on different faults, or segments of fault zones, that focus deformation in both time and space. Negative feedbacks can modulate or prevent accelerating strain. Gravitational instabilities, such as "delamination", "relamination", and diapirism, are affected by both positive and negative feedbacks when material undergoes phase transformations driven by changing pressure and temperature. Changes in pore pressure due to metamorphic reactions and/or shear heating can modulate earthquake behavior. There is increasing understanding of the mechanisms that limit earthquake rupture zones, and cause slow slip rather than seismic events. Crystallization in pore space can randomize previously focused fluid flow, reduce permeability, and bring metamorphic reactions to a halt. All of these feedbacks are related in a rich interplay of geodynamic processes.

www.grc.org

Seminar/Discussion on Technology for Research at Elevated Pressure

December 4, 2011, 9:00 AM - 5:00 PM
San Francisco Marriott Marquis, 55 4th Street, Room 230

This one-day meeting is intended to bring together younger generation scientists with more senior technologically oriented experimentalists. The purpose is to explore what we can learn from one another about how to envision possibilities for the future of experimental research. The hope is that those who want to be able to do new deformation or hydrostatic experiments can learn from those who have been around the block a few times. The exact discussion content will depend on the interests of those attending. Subjects that may be discussed in more or less detail include design and construction of pressure vessels, pressure seals, and loading frames, safety, steels, internal heaters, closed loop servo control, and measurement of temperature, pressure and force; multianvil systems will not be a focus.

The seminar will be lead by Ivan Getting and Terry Tullis. The proceedings will be videotaped. We hope that out of the discussion some younger individuals might discover that they would like to help design as well as use the next generation of equipment.

Anyone intending to attend please email *Terry_Tullis@brown.edu* as soon as possible so we will know how many people to plan for. Please say if your attendance is definite or uncertain.

Workshop participants, from left to right:

Pritam Nasipuri, Tromsø, N
Luca Menegon, Tromsø, N
Luís Gustavo Viegas, São Paulo, B
Livia Nardini, Tromsø, N
Deta Gasser, NGU, N
Håvard Smeplass, NGU, N
Andrea Bistacchi, Milano, I
Thomas Scheiber, Bern, CH
Steven Smith, Rome, I
Marianne Negrini, Tromsø, N
Barbara Kleine, Stockholm, S
Renée Heilbronner, Basel, CH
Phil Skemer, NOT from Montana, USA
Holger Stünitz, Tromsø, N
Gill Pennock, Utrecht, NL
Martyn Drury, Utrecht, NL
Rüdiger Kilian, Basel, CH
Espen Torgersen, NGU, N

not on picture:
Reia Chmielowski, Luleå, S
Kjetil indreavær, Tromsø, N

TTT - Texture Topics in Tromsø

~ Renee Heilbronner ~
Basel University

~ Holger Stunitz ~
University of Tromsø

From Oct. 10th to 14th, an international workshop on crystallographic texture of geologic materials was held at the University of Tromsø, Northern Norway. Just before the beginning of winter, many PhD students and professionals came from many different parts of the world to the tip of Europe at 70°North to watch the days grow shorter (by 1 hour during the workshop) and discuss aspects of texture interpretation and orientation imaging.

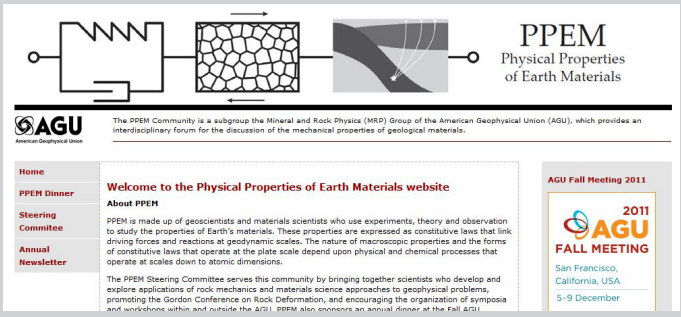
The workshop started with a two day hands-on introduction to the CIP method, followed by a three-day expert meeting aimed at geologists who want to use textures to analyze physical properties or processes. It turned out to be quite a success and a fruitful learning experience for everybody involved, lecturers and audience alike. The format was rather open, with presentations and ample discussion time for questions and problems. The lecturers included Renee Heilbronner, Gill Pennock, Martyn Drury, Phil Skemer, and Holger Stunitz. The focus was on orientation imaging (CIP and EBSD), texture development, misorientation analysis, and how these aspects are used in the interpretation of textures. Not surprisingly, discussing textures immediately involved aspects of deformation mechanisms, rheology, deformation microstructures, recrystallization, and many other processes in rock deformation of crustal and mantle materials.

It is planned to offer the workshop next year again at approximately the same time period, most likely with some emphasis on ice textures.

For more information:
http://pages.unibas.ch/earth/micro/workshops/TEXcourse2011/

Update your bookmarks! PPEM has a new website:

sites.agu.org/ppem/



2011 PPEM Dinner Reservation Form

Reservations must be made and payments received before November 28th 2011.

Send this form or reasonable facsimile by e-mail to: scblair@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 28 Nov. 2011)

_____ 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: scblair@sbcglobal.net
Subject: 2011 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, which takes about two weeks)

_____ 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:

_____
_____
_____