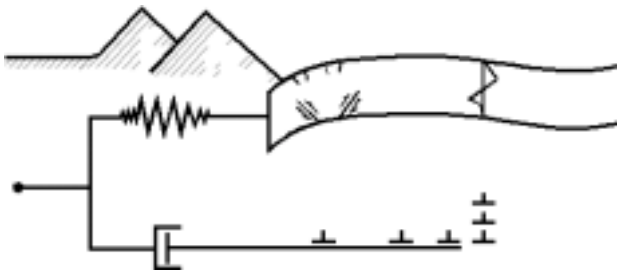

Physical Properties of Earth Materials *Newsletter*

October, 2000

A Note from the Chair

Teng-fong Wong
SUNY at Stony Brook

This is the second year that I serve as the chair of the PPEM committee. This year the steering committee consists of Nick Beeler, (USGS Menlo Park), Brian Bonner (LLNL), Steve Brown (New England Research), Georg Dresen (GFZ Potsdam), Dave Olgaard (Exxon), Linda Reinen (Pomona), Dave Rubie (Bayerisches Geoinstitut), Ernie Rutter (Manchester University) and Charlie Sammis (USC).

I would like to thank Andreas Kronenberg who has continued to maintain and improve our web page. It remains the most comprehensive and informative source of information on PPEM. If you have not visited it yet, I would urge you to do so on a regular basis at http://geoweb.tamu.edu/tectono/ppem

We are grateful to Bill Durham and Brian Bonner, our Fine Dining Search Team for organizing yet another PPEM dinner, that promises to be as good as, if not better than the previous PPEM dinners. Details on the dinner are provided in the last page of this newsletter. Because of the special scheduling for the AGU meeting this year, the dinner will be held on Friday (12/15). **The MRP and Nonlinear Geophysics Joint Reception will be held on Saturday (12/16) at 6:30-8:30 pm., in Room 270, Moscone Center.** Dave Kohlstedt chairs the MRP committee this year, and during the reception the MRP Outstanding Student Award will be announced.

I would also invite all of you to congratulate Jim Dieterich who will receive the Bucher Medal, as well as Michael Brown, Shun-ichiro Karato and Bruce Moskowitz who are recognized as AGU fellows.

Many individuals in the PPEM community have proposed and organized special AGU sessions. In particular a special session in honor of Jim Byerlee, was organized by Dave Lockner and Malcolm Johnston.

Each year, three members of the committee rotate off and we need your input to identify new recruits. The new members will be selected at the PPEM committee meeting that will be held on Thursday in the Marriott Hotel (in meeting room 218 at 4:00 pm).

PPEM 2000 Dinner

Bill Durham
Brian Bonner
Lawrence Livermore National Laboratory

The millenium dinner will be at the fabulous Maharani Restaurant on **Friday evening, 15 December 2000** (note this is on the *first* full day of the meeting not the second, as has been our tradition). For years the Maharani has been known as being among the finest Indian dining places in town. It is located on 1122 Post St. (between Polk and Van Ness, about 7 blocks north of the Civic Center) in San Francisco. The cash bar will start 6:30 pm and dinner at 7:30 pm. Join us and meet colleagues from all over the globe for a relaxing and joyful evening.

(continued page 8, column 3)

Marginal Behavior: Theoretical and Experimental Institute on "Rheology and Deformation of the Lithosphere at Continental Margins"

Brian Evans
MIT

The first Margins Theoretical and Experimental Institute, "Rheology & Deformation of the

Lithosphere at Continental Margins", was convened at Snowbird, UT, on January 22-26, 2000, by G. Karner (LDEO, NY.), D. Kohlstedt (U. Minn.), N. Driscoll (WHOI, MA.), and B. Taylor (U. Hawaii) with substantial help from A. Aichinger (U. Hawaii). About 100 scientists, mostly from the United States, but also from Europe, Canada, Mexico, and New Zealand, attended the four-day TEI. Fifteen oral lectures and several dozen posters were presented. A two-day workshop, "Rupturing Continental Lithosphere and Birth of an Ocean", followed. The main goal of the Short Course was to educate research workers in rheology and deformation processes and to concentrate on aspects of tectonic theory that observations can test. The institute was specifically designed to discuss the scaling problems associated with the comparison of physical experiments and natural systems.

The NSF Margins Program, of which the TEI was a part, was formulated to investigate the complex interplay of processes that govern the genesis and evolution of continent-ocean margins. The program emphasizes a process-oriented methodology and a broad interdisciplinary approach, including theory, modeling, simulations, and a new class of major experiments.

To foster stronger interactions between observationalists, experimentalists, and theoreticians, the Margins Steering committee organized three workshops and two theoretical and experimental institutes. The second of the two TEI, "Inside the Subduction Factory", will be convened by Terry Plank and Marc Hirschmann, this August, at Eugene, Oregon. More information on the Margins Initiative and the TEI's may be found at http://www.soest.hawaii.edu/margins/.

The topic for this short course was particularly important because continental margins are the loci for tectonic processes, including earthquakes, landslides, and volcanic activity. They are the sites of hydrocarbon and metal deposits. Yet, quantitative knowledge of the forces, processes, and mechanisms of their formation is deficient.
(continued page 6, column 1)

Nonuniform Compaction of Porous Rock:
Field and Laboratory Evidence, Theory, and Applications
A Summary of the 1999 AGU Fall Meeting special session

Bezalel Haimson
University of Wisconsin
Bill Olsson
Sandia National Laboratory

A special session was convened at the 1999 Fall AGU Meeting to discuss a recently discovered rock deformation process, namely that of inhomogeneous volume reduction in high-porosity granular rocks leading to tabular structures called compaction bands. Compaction bands are potentially very important with regard to permeability in porous rock, and for the possible formation of barriers to fluid flow.

The session brought together key investigators who are studying these little understood rock structures in order to share their results and ideas. The thirteen papers presented (abstracts can be found in EOS, Trans. AGU, vol. 80, No. 46, p. F1066-F1068) dealt with field observations, laboratory replications, theoretical confirmations, numerical simulations, and the apparent strong correlation between borehole breakouts and compaction bands.

Compaction bands are thin planar zones of the order of a few centimeters that occur in sandstones with large grain sizes and high porosities (typically in excess of 20%). They are oriented perpendicular to the largest compressive stress, and exhibit normal closure, but no shear offset. Experiments on laboratory-scale porous sandstone subjected to triaxial deformation show evidence of compaction band development and propagation. The shear localization theory has been found to admit solutions for compaction bands in the range of parameters representative of porous rock.

It has also been observed that laboratory borehole drilling under high stress conditions in Berea sandstone of greater than 20% porosity often induces fracture-like tabular breakouts. Counterintuitively, these fractures are orthogonal to the major far-field principal stress. Microscopic examination reveals that stress concentration ahead of the tips of these breakouts appears to induce a compaction band, which debonds the grains and facilitates their continuous removal by the circulating

drilling fluid. This phenomenon could be a source of sand production in oil fields. Numerical simulations of a set of laboratory borehole breakouts in porous sandstone provide added evidence of the newly discovered mechanism of failure in rock in which cracks are of mode I, but they extend perpendicular to maximum compression, i.e. the tip mechanism is compaction and appears to originate from a compaction band.

It is important to emphasize that compaction bands have not been universally observed in all porous rocks. Recent triaxial experiments on porous limestones and other porous sandstones have not yielded compaction bands. Thus, the specific conditions of deformation that can lead to compaction banding, and which rock types are susceptible, remain important subjects for study.

Relationships between Damage and Localization:
A Euroconference on Rock Mechanics and Rock Physics

Gary Couples
Heriot-Watt University
Ian Main
University of Edinburgh
Philip Meredith
University College London

The mechanical behaviour and physical properties of porous/cracked rocks are of fundamental importance to several crucial problems, including those associated with the environment and energy resources. Knowledge of the state of deformation is needed to build better simulations of fluid movements in almost every type of subsurface investigation, ranging from efforts to mitigate pollution to those associated with enhancing oil recovery. Because of this importance, a series of Euroconferences has been organised to bring together researchers from universities and industry. The first of these, which focused on pore pressure and scale effects, took place in November of 1998 in the French Alps (BOUTÉCA and GUÉGUEN, 1999a,b).

This report concerns the second conference, which took place in Edinburgh in November of 1999. The third conference, on "Thermo-Hydro-Mechanical Coupling in Fractured Rock", will take place in Bonn, in November of 2000.

At the four-day Edinburgh conference, recent advances in rock mechanics and rock physics were presented and discussed, together with major problems that industry is facing in these fields.

The conference participants considered the implications and significance of field data, laboratory data, and theoretical models concerning the way that distributed deformation becomes localized into discrete shears. About 65 attendees listened to, and challenged, the presentations of invited speakers, as well as those talks and posters contributed by other participants. Lively discussions ensued in each session, highlighted by the diverse viewpoints brought to the conference by researchers from Industry and Academia.

The first day concentrated on natural examples. J. WALSH (Liverpool) reviewed a large body of work concerning the scaling relationships of faults and fractures. He emphasized that the presence of lithological layering can significantly impact the distributions of discontinuities. A power-law scaling relationship typifies cases where layering is not important, or where the scale is such that the mechanical stratigraphy is so thick that layering is not the primary control.

In other situations, the layering becomes effective, and the sizes, intensities, and orientations of discontinuities are not scalable in the same way. C. CACAS (IFP) focused on the need to develop different statistical methods for faults and fractures, and for differing generations. G. MASSONNAT (Elf) continued this theme by describing multi-scale up-scaling concepts necessary for building appropriate flow simulators.
(continued page 7, column 3)

From Fracturing to Faulting: Laboratory, Borehole and Field Studies:
European Geophysical Society: Meeting April 2000 Nice, France

Arno Zang
GeoForschungsZentrum
Potsdam
Philippe Pezard
Aix en Provence

The session was dedicated to the fracture process zone in rock at different scales. The fracture process zone is defined as the region affected by microcracking and frictional slip surrounding the tip of a propagating macrocrack or fault under stress.

At field scale fracture distributions are mapped geologically around faults in Nubian sandstone (Suez Rift), in the Dead Sea Rift using ground penetrating radar and in the Precordillerian fault system (Chile) by combining magnetotelluric and structural geology observations.

Highlight at the wellbore scale were two presentations dealing with the investigation of the Nojima fault zone. The Geological Survey of Japan drilled one year after the Kobe earthquake a 747 m deep hole into the slipped portion of the fault activated by the quake. The fault core was intersected at a depth of 623 m and had a fault normal thickness of 0.3 m. It was characterized by a greater intensity of brittle deformation and hydrothermal alteration than typical host granodiorites.

At laboratory scale two papers about the fracture process zone in triaxially compressed granite cores were presented. The width of the process zone was quantified with acoustic emission hypocenters and crack densities from microscopic analysis of deformed core. The width of zone not only scales with the grain size, but also depends on the crack velocity. Faster faults are surrounded by broader process zones than slower ones. In total twelve oral and six poster presentations were given.

Gordon Research Conference on Rock Deformation, May/June 2002.

Ernie Rutter
University of Manchester

The next Gordon conference on Rock Deformation will take place in Spring 2002. It has been moved on one year to get it out of sync with the European rock deformation conference. We have applied for the venue to be at the Gordon conference site in Italy (Il Ciocco, Tuscany). This will hopefully allow for a wider international participation, and admit a range of exciting post-conference field excursions which will sit well with the conference theme.

The focus will be in transitions in modes an mechanisms of rock deformation, such as the 'brittle-ductile transition'. This topic should prove attractive both to experimentalists, theoreticians and field geologists.

The preferred dates that have been requested are 2-7 June, 19-24 May and 26-31 May, in that order. The exact dates and confirmation of venue will be passed on as soon as the information becomes available.

Deformation Mechanisms, Rheology and Tectonics
2 - 4 April, 2001 Noordwijkerhout, Netherlands

Siese de Mer, Martyn Drury, Gill Pennock, Pat Trimby, Magda Martens, Jaap Liezenber
Utrecht University

In 1976, Prof. H. J. (Henk) Zwart brought together geo-scientists devoted to the study of the deformation and rheological behaviour of rocks at a highly successful conference held near Leiden, in the Netherlands. The "Leiden Meeting", as it became known, started a tradition which has become expressed in meetings hosted every two years by different European Universities. This tradition remains as strong as ever, as illustrated by the high quality of the last meeting held at Neustadt an der Weinstrasse. The next meeting will be organised by a team at Utrecht University. As announced in the first circular, on the 25th anniversary of the Leiden meeting, the Deformation mechanisms, Rheology and Tectonics (DRT) 2001 conference will be held at the original venue in Noordwijkerhout, near Leiden.

The meeting will be held on 2 - 4 April, 2001. Two post-conference workshops (5-6 April 2001) will be held at Utrecht University.

DRT 2001 will cover a wide range of topics, with particular emphasis on the progress made in the past 25 years and the direction our research should take as we enter the new millennium. It is our intention to maintain the same objective held by both the original meeting in 1976 and the two most recent meetings (Neustadt in 1999 and Basel in 1997), namely to encourage dialogue between researchers working on all scales of field, experimental and theoretical studies.

Conference Topics include:

1. Mechanistic Controls on Lithospheric Tectonics
2. Deformation Processes under High Pressure Conditions
3. Fault Zones and Large Strain Deformation Processes
4. New Developments in Microstructural Interpretation - What will they tell us?

5. The Effects of Fluids and Melts on Deformation.

6. The Geophysical Signature of Deformation Processes in the Crust and Mantle

Workshop A: The rheology of crust and upper mantle.

Workshop B: Theoretical studies on microstructures.

More information on the meeting can be obtained from: http://www.geo.uu.nl/~drt2001/drthome.html

Rheology and properties of the lithosphere, rocks and faults:
Physical properties of rocks and other geomaterials: a special session to honour Prof. H. Kern (SE4.03)
EGS XXVI General Assembly, Nice, France, 26-30 March 2001

David Mainprice
Universite Montpellier II
Till Popp
Universität Kiel

In recent years significant advances have been made in the characterisation and understanding of physical properties of rocks. The major stimuli for these studies has come from applied studies (petroleum industry, geothermal energy, water resources and environment) and major academic projects (deep bore holes of Kola and KTB; deep crustal reflection programmes BIRPS, COCORPS, ECORS, DEKORP etc.). Over more than 30 years Prof. H. Kern (Kiel) has made an important contribution to laboratory measurements using his unique cubic high temperature and pressure apparatus for the measurement of seismic wave velocities, attenuation and mechanical properties. The main emphasis of his work is the high quality measurement of properties at temperature and pressure and the physical understanding of rock behaviour in the context of anisotropy and microstructure. Just before his retirement this symposium honours his scientific activities.

The scope of the symposium is to reveal the current state of research on physical (elastic, magnetic, electric and thermal) and mechanical rock properties. We invite contributions representing the complete range of physical rock properties measured in the laboratory and applications to geophysical measurements.

Other EGS Solid Earth (Geophysical Properties of Geomaterials) Sessions at Nice:

SE4.01 Rheology and properties of the lithosphere, rocks and faults: Analysis of lithospheric deformation: integration of rheological, numerical and analogue models
Convener: Faccenna, C.; Co-Convener(s): Ranalli, G.

SE4.02 Rheology and properties of the lithosphere, rocks and faults: Open session on physical properties of geomaterials
Convener: Petford, N.; Co-Convener(s): Huenges, E.

SE4.04 Rheology and properties of the lithosphere, rocks and faults: Intergranular pressure solution (IPS)
Convener: Leroy, Y.M.; Co-Convener(s): den Brok, S.W.J., Schutjens, P.M.

SE4.05 Rheology and properties of the lithosphere, rocks and faults: Petrophysical properties of crystalline rocks
Convener: Pezard, P.A.; Co-Convener(s): Hurter, S., Petrov, V.A.

SE4.06 Rheology and properties of the lithosphere, rocks and faults: Micro-to-macro behaviour of rock transport properties
Convener: Glover, P.W.; Co-Convener(s): Clavaud, J.-B., Holt, R.M., Zimmermann, G.

SE4.07 Rheology and properties of the lithosphere, rocks and faults: Fractured and faulted rocks: characteristics, formation processes and implications for geological and hydrogeological phenomena
Convener: Bertotti, G.; Co-Convener(s): Storti, F.

The deadline for receipt of abstracts is 1 December 2000. Abstracts should be sent directly to the convenors. Further information on abstract style and student financial support can be obtained from: http://www.copernicus.org/EGS/egsga/nice01/nice01.htm

The Specialist Group in Tectonics and Structural Geology Field Conference
Ulverstone, Tasmania
February 12-16, 2001

Ron Berry
University of Tasmania

The Specialist Group in Tectonics and Structural Geology under the auspices of the Geological Society of Australia, will hold their next conference at

Ulverstone, northwest Tasmania, from Sunday 11 February to Friday 16 February, 2001. Ulverstone's position on the northwest coast, amongst magnificently exposed high-strain allochthonous Cambrian metamorphic rocks which have been complexly faulted into the underlying autochthonous Neoproterozoic, provides the perfect location for the field conference.

The conference will focus in part on the correlation between Tasmania and mainland Australia, as well as reviewing past and present developments in tectonics and structural geology. It will include three-and-a-half days of presentations and reviews, including keynote speeches from internationally recognised structural geologists.

Two mid-week field excursions are on offer, and the conference is complemented by pre- and post-conference excursions from Bridport in the northeast of the state to Zeehan in the west, reviewing the tectonic history of this often overlooked corner of the Lachlan fold belt.

Marginal Behavior:
Theoretical and Experimental Institute on "Rheology and Deformation of the Lithosphere at Continental Margins"

(continued from page 2)

Because our observations are based on surface geology or remote geophysical observations, it is problematic to ascertain the exact processes occurring over the entire crust and lithosphere. Using theoretical and numerical modeling, R. Buck (LDEO, N.Y.) constrained the mechanisms of rifting by matching predictions and observations of rift width, fault patterns, and post-rift subsidence. Differences in pre-rift geometry of the continental crust can result in substantial variations in the margin that is formed.

Ascertaining the relationship between the patterns of faults in the continental crust and the pattern of flow in the underlying creeping material is a challenging problem, as the correlation may not be unique (J. Jackson, Cambridge, UK). Indeed, fault patterns in the Aegean Sea and Asia Minor may be understood two different modes of crustal deformation, both accomodating a common, deep, flow pattern.

The accommodation of strain in extensional basins by faults that now dip at low angles also presents a mechanical conundrum. Although some fault orientations may be explained by rolling hinge models that would reduce the apparent dip-angle, other structures seem to have been formed and slipped at low angles (G. Axen, Univ. Cal., Los Angeles). Explanations for the apparent low strength call on rotations of the stress field or on the reduction of friction by abnormally high fluid pressure or by anisotropic fabrics.

Estimates of the amount of extension during rifting have been independently determined from faulting, crustal thickness, and post-rift subsidence. The estimates derived from faulting are consistently less than those estimated for total crustal extension, indicating that depth-dependent stretching occurs during early sea-floor spreading (N. Kusznir, Liverpool, U.K.).

Other heterogeneity of structure can be handled with finite element techniques and is useful in understanding rifting access jumps, rift asymmetry, and the effect of the crustal toughness (D. Sawyer, Rice, Louisiana).

By casting the deformation as a non-linear viscous flow, the deformation along a convergent margin may also be modeled using FEM (S. Willett, Univ. Wash.). Solutions indicate that the style of deformation can indicate the underlying deformation mechanisms. For example if horizontal extension occurs within a portion of an overall convergent orogen, Coulomb behavior is unlikely to be an important deformation mechanism.

Faulting, seismicity and fault structures are important sources of information in understanding continental rifting and margin formation. The extent and limits of the seismogenic zone (L. Ruff, Michigan) provide first-hand information on the depth of unstable faulting. However, uncertainty exists, particularly regarding the effects of fluids and the magnitude dependence of the seismogenic depth limit. Subducting margins seem to have both up-dip and down-dip aseismic limits (R. Hyndman, Victoria, B.C.). The down-dip limit may be associated with changes in mineralogy that occur at about 350° C.

Field structural observations suggest that faults evolve from joints or fractures to tabular zones of fractured or brecciated rocks containing narrower zones of concentrated slip that evolve as the slip distances increase (F. Chester, Texas A&M). It may be that strength evolves as well,

particularly if the elevated pore fluid pressure can be generated and maintained.

Such elevated pore fluid pressures have been mooted as a mechanism to maintain abnormally low strengths along mature faults, including the San Andreas. C. Scholz (LDEO, New York) questioned the foundations of the weak fault assumption, particularly the interpretation of heat flow results. He posited that the stress measurements around the San Andreas are actually consistent with friction coefficients ~0.6. Apart from the question of the value of the static coefficient of friction, even small changes in the friction coefficient owing to changes in slip velocity are important in understanding fault stability.

Recent laboratory measurements are qualitatively consistent with upper and lower aseismic limits (C. Marone, Mass. Inst. Tech.) and also require that a constitutive law for frictional behavior must include enough complexity to produce repetitive failure, time dependent strengthening, fault healing, and the transition from stable to unstable slip.

Laboratory experiments have also increased our knowledge of the complexity of deformation of rocks at higher temperatures. The current state of knowledge is moving from accurate descriptions mechanical behavior of monophase aggregates to include deformation of multiphase aggregates, minerals undergoing phase changes, and phases involved in metamorphic reactions (J. Tullis, Brown, Rhode Island). And now, information involving phase stability, reaction kinetics, and diffusion rates may be incorporated into more realistic descriptions of mechanical behavior.

Similarly, the effect of melt content and water fugacity on rock strength is being vigorously investigated (D. Kohlstedt/M. Zimmerman, U. Minnesota). Both water fugacity and melt content have profound influence on the strength of mantle rocks: strength and water concentration are related inversely in both the diffusion and dislocation creep regime, and the effect of melt in undrained experiments is even larger.

As fluid content affects strength, deformation also has profound effect on the transport properties (B. Evans, Mass. Inst. Tech.). Experiments on partially molten peridotite with a variety of melts show that compaction can be limited by melt viscosity, even when length scales are small. Fluid transport and mechanical behavior are also linked when metamorphic dehydration occurs (T.-F. Wong, State Univ. New York, Stony Brook). Reaction progress and mechanical strength are linked through the effective pressure to cause episodic fluid production and embrittlement.

It seemed clear from the workshop that consistent, and sometimes, spectacular progress in obtaining quantitative knowledge of tectonic processes has been made in the last 20 years. This optimistic assessment is arguable for all areas: geologic and geophysical observations, theory, computations, and experiments. In short, the potential for success for the Margins program seems quite high. Contributions from scientists studying physical properties can continue to play a substantial role, particularly if an open dialogue is maintained with other groups. An earlier article on the TEI was published by the steering committee in *EOS, American Geophysical Union, Vol. 79.* No. 11, 1999.

Relationships between Damage and Localization:

A Euroconference on Rock Mechanics and Rock Physics

(continued from page 3)

The second day was focused on laboratory observations. J. DESRUES (Grenoble) presented a summary of localization experiments in a variety of geomaterials. A particular highlight was a video, and the analysis of displacements displayed in the experiments that were recorded in that visual record. This work reveals that the material properties within a shear zone quickly evolve to be in a “critical state”, while the bulk of the medium remains little changed from its initial condition. At a different scale, G. DRESEN (GFZ) described fracture-zone propagation processes in cleverly-designed granite specimens. Even in the “pre-cursor” stage, the evolving microcracks develop in clusters, indicating a spatial ordering. P. MEREDITH (UCL) continued with the theme of spatial organisation in describing contrasting experiments with directional and isotropic gradients. These differences are reflected in the spatial patterns of the evolving transport properties (principally permeability and electrical conductivity). J. FREDRICH (Sandia) continued the theme to smaller scales. She described pore-scale maps that illustrated crack propagation as well as pore

collapse in the transition through the critical void ratio. The experimental observations were complemented with numerical simulations of the micro-mechanics processes.

On day three, we concentrated on theoretical approaches. J. RICE (Harvard) focused on frictional sliding. He emphasized the remarkable confluence between what experiments reveal about the non-classical features of frictional constitutive laws, and what is needed mathematically to make well-posed formulations of problems involving sliding of elastic bodies. This first-principles treatment was contrasted with the practical, engineering approaches collected together by N. BICANIC (Glasgow). He gave a broad overview of the wide range of computational methods that can be applied to the simulation of deformation in fractured and discontinuous media. There seemed to be a general sense of surprise at the scope of the numerical methods that are available to us.

On the final day, we were treated to two presentations that illustrated the Industrial end-use for the results of research. C. TOWNSEND (Statoil) gave an overview of how faulting can be treated in petroleum reservoir simulations. He illustrated both explicit treatments for larger faults, and up-scaling approaches for smaller faults. An important point was the way that uncertainty in properties and effects can be included. K. HEFFER (Heriot-Watt) emphasized the need to consider both natural and induced length scales in the process(es) of deriving appropriate hydraulic properties for use in simulations. He gave particular attention to the way that rock-framework stresses interact with fluid pressures to alter the dominant length scales during the production of reservoirs.

In addition to the keynote presentations, every poster, and every contributed talk, revealed something new and sparked a train of discussion. Insights were gained through discussion and debate, and a number of personal relationships were initiated or strengthened. Tours of the rock mechanics and rock physics labs at Heriot-Watt were widely appreciated, as was the evening dinner at a castle in the Scottish Borders, where we participated in a Sherlock Holmes murder mystery (a number of surprising talents were revealed!). The intimacy of the Euroconference format is ideal for fostering step-changes in the research culture of a community such as the one involved here.

The meeting seems to have been successful at highlighting evolving concepts that are important to researchers in different specialist areas. Natural examples indicate that discontinuities (representing both damage, and localization) are strongly influenced by the layering, in addition to the structural setting. Even the distributed nature of damage is somehow clustered and shows an element of localization. This pre-cursory development of spatial patterns is also present in the laboratory, and there are increasing hints of it in numerical experiments. It is beginning to seem that, although probability distributions can be defined for damage processes, the distribution of damage is anything but random. This appreciation should open an abundance of new research avenues.

The conference was partially supported by the European Commission (Euroconferences), to whom we express our thanks. We also thank all participants who made the event such a pleasant and productive one.

Physical Properties of Earth Materials 2000 Fall AGU Meeting Dinner

(continued from page 1)

PLACE:

Maharani Restaurant
1122 Post St. (between Polk and Van Ness, about 7 blocks north of the Civic Center) San Francisco

TIME:

Friday evening, 15 December 2000
6:30 pm cash bar
7:30 pm dinner

MENU:

appetizers,spices,and condiments

Entrees:
Lamb Madras (non-vegetarian)... a dry lamb stew, typical South Indian Spices

Bangan Bharta... eggplant, finely chopped with spices

Murgh Makhni (non-vegetarian)... tandori chicken finished in a rich cream sauce

Saag Paneer... Indian farmer's cheese and spinach

Malai Kofta ... dumplings in a savory cream sauce (a bit unusual; home cooking)
rice and breads

Dessert:

Kulfi Anarkali...pistachio ice cream with nuts and a touch of saffron

Gulab Jamun ... **sheer ambrosia, defies description**
tea, coffee
white and red table wine

COST:

$45 people / $25 students; includes dinner, wine, tip, and tax.

Payment requested before 27 November 2000
See reservation form below.

Payment: Checks payable to "PPEM" or web-based payment

Non-U.S. participants unable to pay by check may reserve now, and pay Bill Durham at the AGU meeting

Experimental Geophysics and Geochemistry Faculty Position

The Department of Earth, Atmospheric, and Planetary Sciences at MIT seeks an outstanding scientist in the area of experimental geophysics and geochemistry who studies the physics and chemistry of Earth materials. The successful candidate will have a strong record of research and potential to be an excellent teacher. Junior candidates (tenure track) are encouraged to apply.

Areas of interest include, but are not limited to:

1.) Mechanical properties, including the study of multiphase materials or materials undergoing chemical reactions.

2.) Thermal transport, fluid transport, acoustic and/or electrical properties, including flow of granular material, fluid flow through porous materials, transport of magma and flow in the mantle.

3.) High pressure mineralogy, mineral physics and phase transitions in planetary interiors. Candidates should be interested in the relating laboratory and computational experiments, field relations, and tectonic scale processes.

Interested individuals should send curriculum vita and names of three references to Professor Ron Prinn, Department Head, Attention EGG Search, Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139. MIT is an Equal Opportunity/Affirmative Action Employer. MIT is a non-smoking environment.

Editor for the 2000 Newsletter: *Georg Dresen*

2000 PPEM Dinner Reservation Form.

Reservations must be made **before 27 November 2000**. Send this form or reasonable facsimile by e-mail to: **durham1@llnl.gov** or make a hardcopy and send by posted mail to the address below.

Web-based payment using PayPal is being offered on a trial basis for those who want to help us avoid dealing with cash and checks. Thanks for participating in this experiment. If you have alternate suggestions/possibilities for web-based payment, we encourage you to discuss them with Bill Durham.

Please reserve:

_____ places at $45.00 each

_____ student places at $25.00 each

Payment: (due before 27 Nov 00)

_____ I am mailing a check made out to "PPEM"

To: W. B. Durham, L-201
UCLLNL
P.O. Box 808
Livermore, CA 94550
USA

_____ I will pay Bill Durham at the AGU meeting BEFORE the dinner
(please: non-U.S. residents only)

_____ I will pay by PayPal http://www.x.com/
recipient: durham1@llnl.gov
subject: 2000 PPEM dinner
please specify name(s) reserved in the "Note" area

Name: _____

Affiliation: _____

Other information you want to provide:

_____
_____
_____

Special requests, comments, suggestions:

_____
_____
_____